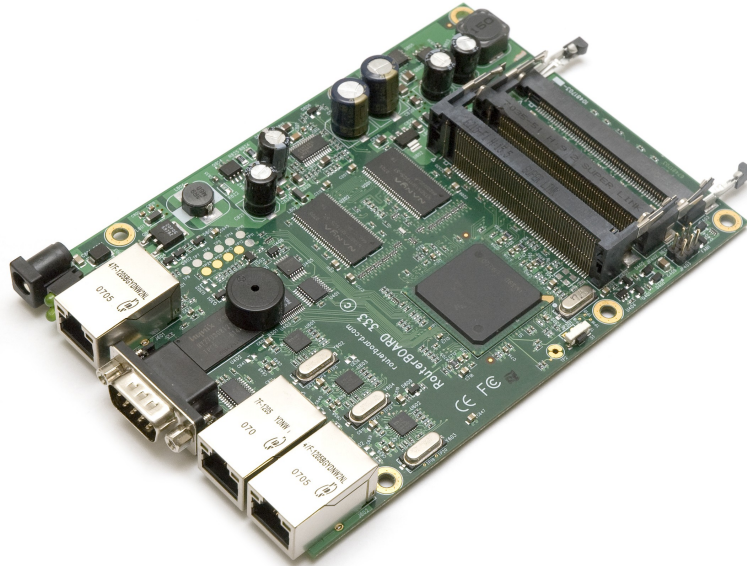


# RouterBOARD 333 Series

## User's Manual

Rev. B (27-Aug-2007)



### Copyright

Copyright © 2003-2007 MikroTiks SIA. This manual contains information protected by copyright law. No part of it may be reproduced or transmitted in any form without prior written permission from the copyright holder.

### Trademarks

RouterBOARD, RouterOS, RouterBOOT and MikroTik are trademarks of MikroTiks SIA. All trademarks and registered trademarks appearing in this manual are the property of their respective holders.

### Limited Warranty

**Hardware.** MikroTiks SIA warrants all RouterBOARD 333 series equipment for the term of one year from the shipping date to be free of defects in materials and workmanship under normal use and service. All parts will be repaired or replaced with similar or functionally equivalent parts by MikroTiks SIA during the warranty term, except in case the returned parts have mechanical, electrical or other accidental or intended damages caused by improper use or due to wind, rain, fire or other acts of nature.

Parts (or systems) must be shipped pre-paid to our facility in Riga, Latvia. All items must have a Return Material Authorization (RMA) which you can get by contacting us via email, telephone or fax. RMA must be printed, signed, and enclosed with the shipment, also the RMA number must be written on the package itself. Parts sent without following the proper procedure will be treated as those not to be repaired or replaced due to the above mentioned conditions. Items proved to be free of defects in our lab will be returned to the customer at the customer's expense. Those that do meet the warranty repair requirements will be repaired or replaced, and returned to the customer's location at our expense, extending the warranty term for the time the items are being shipped to and from our facility and replaced or repaired.

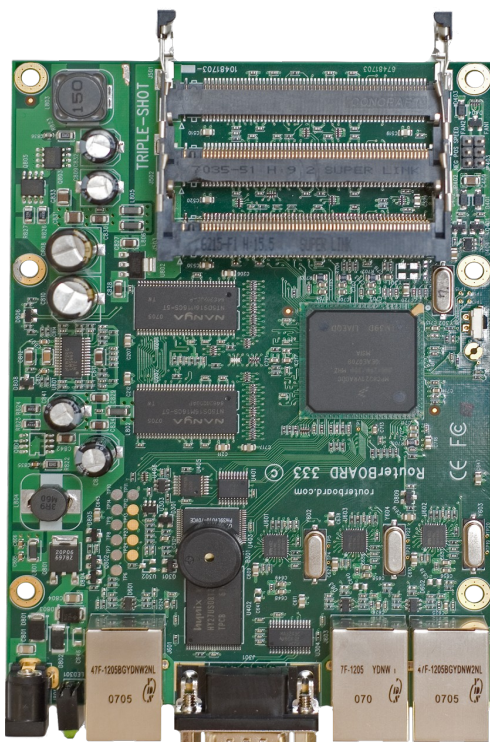
**Manual.** This manual is provided "as is" without a warranty of any kind, expressed or implied, including, but not limited to, the implied warranty of merchantability and fitness for a particular purpose. The manufacturer has made every effort to ensure the accuracy of the contents of this manual, however, it is possible that it may contain technical inaccuracies, typographical or other errors. No liability is assumed for any inaccuracy found in this publication, nor for direct or indirect, incidental, consequential or other damages that may result from such an inaccuracy, including, but not limited to, loss of data or profits. Please report any inaccuracies found to [docs@mikrotik.com](mailto:docs@mikrotik.com).

## Table of Contents

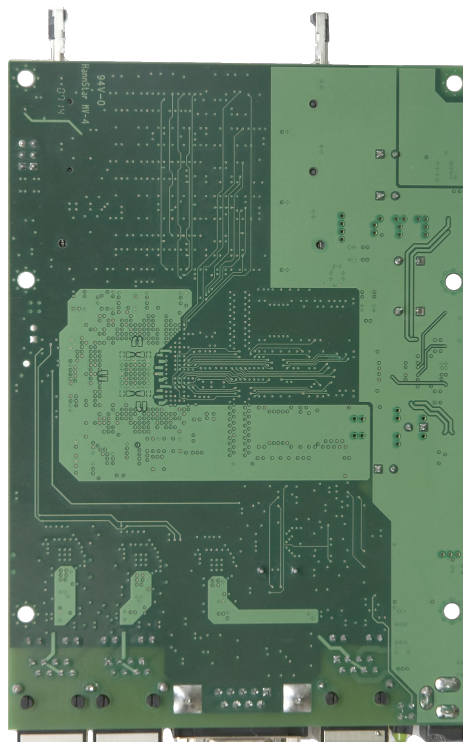
<a href="#">Copyright</a> .....	1
<a href="#">Trademarks</a> .....	1
<a href="#">Limited Warranty</a> .....	1
<a href="#">System Board View</a> .....	3
<a href="#">System Board Layout</a> .....	3
<a href="#">Specifications</a> .....	4
<a href="#">Block Diagram</a> .....	4
<a href="#">Hardware Guide</a> .....	5
<a href="#">Memory and Storage Devices</a> .....	5
<a href="#">Onboard Memory</a> .....	5
<a href="#">Onboard NAND Storage Device</a> .....	5
<a href="#">Extension Slots</a> .....	5
<a href="#">MiniPCI Slots</a> .....	5
<a href="#">Input/Output Ports</a> .....	5
<a href="#">LAN1 Port with PoE</a> .....	5
<a href="#">LAN2 Port</a> .....	5
<a href="#">LAN3 Port</a> .....	5
<a href="#">DB9 Serial Port</a> .....	5
<a href="#">Fan Connectors</a> .....	5
<a href="#">LEDs</a> .....	6
<a href="#">Power LED</a> .....	6
<a href="#">User LED</a> .....	6
<a href="#">User's Guide</a> .....	6
<a href="#">Assembling the Hardware</a> .....	6
<a href="#">Powering</a> .....	6
<a href="#">Booting options</a> .....	6
<a href="#">Onboard NAND Storage Device</a> .....	6
<a href="#">Booting from network</a> .....	7
<a href="#">Operating System Support</a> .....	7
<a href="#">System Architecture</a> .....	7
<a href="#">MikroTik RouterOS</a> .....	7
<a href="#">RouterBOOT</a> .....	7
<a href="#">Boot Loader Configuration</a> .....	7
<a href="#">Configurable Options</a> .....	8
<a href="#">Boot Loader Upgrading</a> .....	8
<a href="#">Primary Boot Loader</a> .....	8
<a href="#">RouterOS on RouterBOARD 333</a> .....	9
<a href="#">Health monitor</a> .....	9
<a href="#">Firmware information</a> .....	9
<a href="#">Firmware Settings</a> .....	9
<a href="#">Software Reset</a> .....	9
<a href="#">Appendix</a> .....	10
<a href="#">Connector Index</a> .....	10
<a href="#">Jumper Index</a> .....	11
<a href="#">Button Index</a> .....	11
<a href="#">Ethernet Cables</a> .....	11
<a href="#">Serial Null-modem (Console) Cable with Loopback</a> .....	11
<a href="#">Board Dimensions</a> .....	12

# System Board View

RB333:

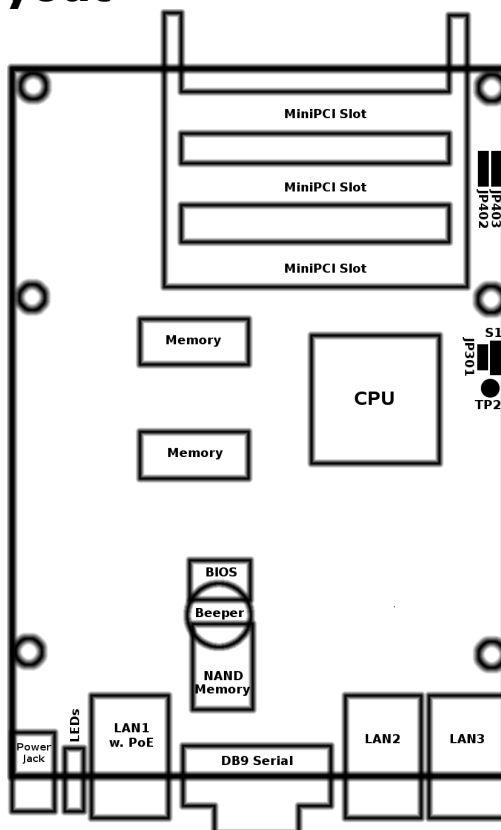


Top view



Bottom view

# System Board Layout

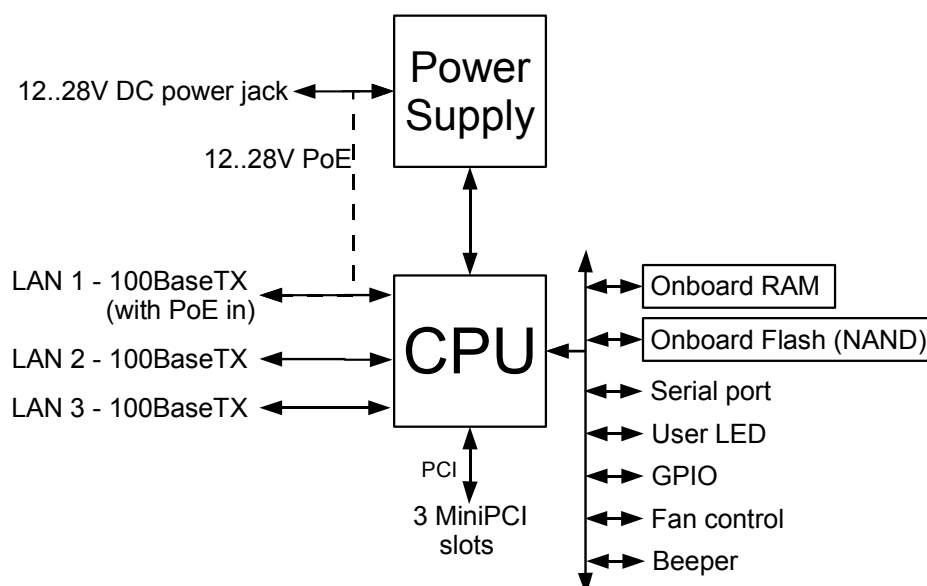


You can download the board dimensions and case design files (PDF and DXF) from [www.routerboard.com](http://www.routerboard.com) .

## Specifications

	<b>RouterBOARD 333</b>
<b>CPU</b>	MPC8321 333MHz network processor
<b>Memory</b>	64MB DDR SDRAM onboard memory
<b>Boot loader</b>	RouterBOOT
<b>Data storage</b>	64MB onboard NAND memory chip
<b>Ethernet</b>	Three 10/100 Mbit/s Fast Ethernet ports supporting Auto-MDI/X
<b>MiniPCI slot</b>	Three MiniPCI Type IIIA/IIIB slots
<b>Serial port</b>	One DB9 RS232C asynchronous serial port
<b>LEDs</b>	Power and User LED
<b>Beeper</b>	Present
<b>Power</b>	Power over Ethernet: 12..28V DC (except power over datalines) Power jack: 12..28V DC Voltage sensor
<b>Fan control</b>	<b>Two</b> DC fan power output headers with rotation sensor and automatic fan switching (maximum output current - 500mA total)
<b>Dimensions</b>	10.5 cm x 15 cm (4.13 in x 5.91 in)
<b>Weight</b>	133 g (4.69 oz)
<b>Temperature</b>	Operational: -20°C to +65°C (-4°F to 149°F)
<b>Humidity</b>	Operational: up to 70% relative humidity (non-condensing)
<b>Power consumption</b>	~3W without extension cards, maximum - 25W (18W output to extension cards)

## Block Diagram



# Hardware Guide

## Memory and Storage Devices

### Onboard Memory

The boards are equipped with 64 MB DDR SDRAM onboard memory.

### Onboard NAND Storage Device

The boards are equipped with one 64MB NAND nonvolatile memory chip.

## Extension Slots

### MiniPCI Slots

The board has three MiniPCI Type IIIA slots with 3.3V only power signaling. They also accept MiniPCI Type IIIB standard cards. The board has been tested to operate with 3 Ubiquity SR2 high power cards if ambient temperature and adequate cooling is ensured.

Supplied power for the extension cards (excluding CPU and onboard Ethernet ports):

+3.3V: 5.5A max

## Input/Output Ports

### LAN1 Port with PoE

This Fast Ethernet port is recognized as the first LAN interface. It is compatible with passive (non-standard) Power over Ethernet. The board accepts voltage input from 12 to 28 V DC. It is suggested to use the higher voltage for power over long cables because of better efficiency (less power is lost in the cable itself and power supply is more efficient).

See **Connector Index** for pinout of the standard cable required for PoE. All cables made to EIA/TIA 568A/B cable specifications will work correctly with PoE. Note that this port supports automatic cross/straight cable correction (Auto MDI/X), so you can use either straight or cross-over cable for connecting to other network devices.

### LAN2 Port

This Fast Ethernet port is recognized as the second LAN interface. This port does not support Power over Ethernet.

All cables made to EIA/TIA 568A/B cable specifications will work correctly (see **Connector Index** for pinout). Note that this port supports automatic cross/straight cable correction (Auto MDI/X), so you can use either straight or cross-over cable for connecting to other network devices.

### LAN3 Port

This Fast Ethernet port is recognized as the third LAN interface. This port does not support Power over Ethernet.

All cables made to EIA/TIA 568A/B cable specifications will work correctly (see **Connector Index** for pinout). Note that this port supports automatic cross/straight cable correction (Auto MDI/X), so you can use either straight or cross-over cable for connecting to other network devices.

### DB9 Serial Port

The RS232C standard male DB9 asynchronous serial port may be used for initial configuration, or for attaching a modem or any other RS232 serial device. TxD (pin 3) of this port has -5V DC power when idle. Some signals are not connected, so this implementation may not be considered to support full hardware flow-control, so software flow-control (XON/XOFF) or none at all should be used.

### Fan Connectors

You can connect up to two fans to the RouterBOARD, but only one of them will work at a time. They will receive the same voltage as the board itself (**CAUTION**: you may damage the fans if the input voltage of

the board is out of the fans' operating range). The board supports fan speed feedback signaling. RouterOS can be configured to change the active fan, if the current active one is not rotating (note that if a fan does not have rotation sensor, it will be considered failed).

## LEDs

### Power LED

Power LED is on when the board is powered.

### User LED

User LED may be programmed at user's option. It is lit by default when the board starts up, then it is turned off when the bootloader runs kernel.

## User's Guide

### Assembling the Hardware

First to use the board:

- Insert MiniPCI cards;
- Install the board in a case and connect antenna wires, if needed;
- Connect other peripherals and cables.

You can also order a pre-assembled system with RouterBOARD and extension cards of your choice already installed in a case.

### Powering

Power options:

- **J9** power jack:  
12..28V DC (cut-off voltage - 30V)
- Power over Ethernet (PoE) on the **J601** LAN1 Ethernet port:  
12..28V DC (18..28 V suggested; cut-off voltage - 30V) non-standard PoE powering support

The board has a direct-input power jack **J801** (5.5mm outside and 2mm inside diameter, female, pin positive plug) and can as well be powered with PoE. All power inputs are always active, but only one should be used at the same time.

RouterBOARD 333 series boards are equipped with a reliable 25W onboard power supply with overvoltage protection. 12..28 V DC input voltages are accepted, but when powered over long cables, it is suggested to use at least 18V. The system is tested with 24V solar/wind/RV systems with 27.6 charge voltage. Overvoltage protection starts from about 30V (up to 60V), so the board will not be damaged if connected to a 48 or 60 V power line.

RouterBOARD 333 series boards are compatible with non-standard (passive) Power over Ethernet injectors (except power over datalines) and accept powering over up to 100m (330 ft) long Ethernet cable connected to the Ethernet port (**J8**). The board **does not** work with IEEE802.3af compliant 48V power injectors.

The maximum output of the power supply to the extension cards is normally at about 5.5A.

### Booting options

First, RouterBOOT loader is started. It displays some useful information on the onboard RS232C asynchronous serial port, which is set to 115200bit/s, 8 data bits, 1 stop bit, no parity by default. The loader may be configured to boot the system from the onboard NAND module or from Ethernet network. See the respective section of this manual for how to configure booting sequence and other boot loader parameters.

### Onboard NAND Storage Device

The RouterBOARD may be started from the onboard NAND storage chip. As there is no partition table on the device, the boot loader assumes the first 4MiB form a YAFFS filesystem, and executes the file called "kernel" stored in the root directory on that partition. It is possible to partition the rest of the medium by patching the kernel source.

## Booting from network

Network boot works similarly to PXE or EtherBoot protocol, and allows you to boot a RouterBOARD 333 series computer from an executable image stored on a TFTP server. It uses BOOTP or DHCP (configurable in boot loader) protocol to get a valid IP address, and TFTP protocol to download an executable (ELF) kernel image combined with the initial RAM disk (inserted as an ELF section) to boot from (the TFTP server's IP address and the image name must be sent by the BOOTP/DHCP server).

To boot the RouterBOARD computer from Ethernet network you need the following:

- An ELF kernel image for the loader to boot from (you can embed the kernel parameters and `initrd` image as ELF sections called `kernparm` and `initrd` respectively)
- A TFTP server which to download the image from
- A BOOTP/DHCP server (may be installed on the same machine as the TFTP server) to give an IP address, TFTP server address and boot image name

See the RouterBOOT section on how to configure loader to boot from network.

Note that you must connect the RouterBOARD you want to boot, and the BOOTP/DHCP and TFTP servers to the same broadcast domain (i.e., there must not be any routers between them).

## Operating System Support

### System Architecture

RouterBOARD 333 series embedded boards are fully compatible with the standard e300 architecture with PCI bus.

**CPU.** RouterBOARD 333 series has Freescale MPC8321 PowerQUICC II Pro based embedded processor using e300c2 core. The core includes Memory Management Units and does not include Float Point Unit (so it is optimized for integer operations).

**Ethernet.** RouterBOARD 333 series has three onboard Ethernet ports controlled by the QUICC Engine.

### MikroTik RouterOS

MikroTik RouterOS, starting from version 3.0rc1 (RouterBOARD 333 series edition), is fully compatible with RouterBOARD 333 series embedded boards.

## RouterBOOT

The RouterBOOT firmware (also referred as boot loader here) provides minimal functionality to boot an Operating System. It supports serial console via the onboard serial port at the boot time. The loader supports booting from the onboard NAND device and from a network server (see the respective section for details on this protocol).

### Boot Loader Configuration

Loader parameters may be configured through the onboard RS232C DB9 asynchronous serial interface. To connect to it, use a standard null-modem cable. By default, the port is set to 115200bit/s, 8 data bits, 1 stop bit, no parity. **Note** that the device does not fully implement the hardware (RTS/CTS) flow control, so it is suggested to try to disable hardware flow control in the terminal emulation program in case the serial console does not work as expected, and if it does not help, make a new cable using the pinout given in the Appendix.

To enter the loader configuration screen, press any key (or only [Delete] key (or [Backspace] key – see the note for the respective configurable option), depending on the actual configuration) just after the boot loader is asking for it:

```
RouterBOOT booter 2.9
```

```
RouterBoard 333
```

```
CPU frequency: 333 MHz
Memory size: 64 MB
```

```
Press any key within 2 seconds to enter setup
```

```
RouterBOOT-2.9
What do you want to configure?
  d - boot delay
  k - boot key
  s - serial console
  o - boot device
  f - cpu frequency
  r - reset configuration
  e - format nand
  g - upgrade firmware
  i - board info
  p - boot protocol
  t - do memory testing
  x - exit setup
your choice:
```

To select a menu point, press the key written at the beginning of this line. Pressing [Enter] selects the option marked with '\*'.

## Configurable Options

**boot delay** – how much time to wait for a key stroke while booting (1..9 seconds; **2 second** by default).

**boot key** – which key will cause the loader to enter configuration mode during **boot delay** (any key | <Delete> key only; **any key** by default). Note that in some serial terminal programs, it is impossible to use the [Delete] key to enter the setup – in this case it might be possible to do this with the [Backspace] key.

**serial console** – to configure initial serial console bitrate (1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200; **115200** bps by default).

**cpu-frequency** – CPU frequency (266MHz | 333MHz; **333MHz** by default).

**boot device** – initial boot device (boot over Ethernet | boot from NAND | boot Ethernet once, then NAND; **boot from NAND** by default). You can also select **boot chosen device** option to boot from the device selected immediately, without saving the setting.

**reset configuration** – whether to reset all the boot loader settings to their respective default values (yes | no; **no** by default).

**format nand** – perform a low-level NAND format. During this operation, all previously marked bad sectors are retested to find out if they are faulty indeed.

**upgrade firmware** – receive a new boot loader image using XModem protocol over serial line or using DHCP/BOOTP and TFTP protocols through the Ethernet network (upgrade firmware over ethernet | upgrade firmware over serial port).

**board info** – prints the serial number, boot loader version, CPU frequency, memory size and MAC addresses of the onboard Ethernet ports

**boot protocol** – network booting protocol (bootp protocol | dhcp protocol; **bootp protocol** by default).

**do memory testing** – performs a full memory test.

## Boot Loader Upgrading

The boot loader is needed to initialize all the hardware and boot the system up. Newer loader versions might have support for more hardware, so it's generally a good idea to upgrade the loader once a newer version is available. You can upgrade the loader through the onboard serial port using XModem protocol (programs available for all major OSs). For example, you can use HyperTerminal for Windows or Minicom for Linux to upload the boot loader. Alternatively if you have a DHCP/BOOTP and TFTP servers available, you can specify the loader image as a boot image and choose the **bios upgrade over ethernet** option in the boot loader configuration menu. The loader will get the image from the TFTP server and upgrade itself. The most current loader image is available for download on [www.routerboard.com](http://www.routerboard.com).

The boot loader upgrading is supported also from MikroTik RouterOS. The procedure is described in the MikroTik RouterOS manual.

## Primary Boot Loader

There are two boot loaders present on the NOR flash memory chip. Secondary is the main one, that is executed by default. This is the one that can be upgraded. In case something goes wrong in the upgrade

process, or you have set some incorrect settings that render it unusable, you can load the Primary boot loader by holding the Software Reset 1 button (**S1**) or jumper (**JP301**), connecting the power, and then releasing the button/jumper. The Primary boot loader has the default settings, which can not be changed. It is also not possible to upgrade it.

## RouterOS on RouterBOARD 333

### Health monitor

This menu shows the current input voltage and fan status.

```
[admin@MikroTik] > system health print
fan-mode: manual
use-fan: main
active-fan: main
voltage: 18.8
[admin@MikroTik] >
```

**fan-mode** – whether to use automatic fan failover (auto | manual; **manual** by default).

**use-fan** – which fan to use in manual mode (main | auxiliary; **main** by default).

### Firmware information

This menu displays RouterBOARD model number, serial number, the current boot loader version and the version available in the current software packages installed.

```
[admin@MikroTik] > system routerboard print
routerboard: yes
model: "333"
serial-number: "154201C1DD3C"
current-firmware: "2.9"
upgrade-firmware: "2.9"
[admin@MikroTik] >
```

The firmware version can be upgraded using `"/system routerboard upgrade"` command.

### Firmware Settings

Boot loader settings are also accessible through this menu.

```
[admin@MikroTik] > system routerboard settings print
baud-rate: 115200
boot-delay: 2s
boot-device: nand-if-fail-then-ethernet
enter-setup-on: any-key
cpu-frequency: 333MHz
boot-protocol: bootp
enable-jumper-reset: yes
[admin@MikroTik] >
```

The Software Reset 2 button (**TP2**) button, which resets both boot loader settings and RouterOS setting by default, can be disabled in this menu (it will still reset the boot loader settings).

### Software Reset

It is possible to reset all software configuration by holding the Software Reset 2 button (**TP2**) during the power-up. No confirmation or passwords will be asked, so use with caution. This feature can be disabled in the `"system routerboard settings"` menu by switching the `"enable-jumper-reset"` parameter to `"no"`.

## Appendix

### Connector Index

J301	RS232C male DB9 serial port	
	2	RxD (Receive Data)
	3	TxD (Transmit Data)
	5	GND
	7	RTS (Request to Send)
	8	CTS (Clear to Send)
J501	MiniPCI Type type IIIA/B connector 1 (lowest)	
J502	MiniPCI Type type IIIA/B connector 2 (middle)	
J503	MiniPCI Type type IIIA/B connector 3 (top)	
J601	RJ45 Fast Ethernet 100Base-TX port LAN1 with passive PoE extension	
	1	Data TX+
	2	Data TX-
	3	Data RX+
	4	PoE power +
	5	PoE power +
	6	Data RX-
	7	PoE power -
J602	RJ45 Fast Ethernet 100Base-TX port LAN3 (no PoE)	
	1	Data TX+
	2	Data TX-
	3	Data RX+
J603	RJ45 Fast Ethernet 100Base-TX port LAN2 (no PoE)	
	1	Data TX+
	2	Data TX-
	3	Data RX+
J801	Power jack (12..28 V DC, positive contact is the central pin)	
	6	Data RX-
	JP402	
	DC Fan 2 connector	
JP402	1	GND
	2	+12..+28 V DC (same as input voltage)
	3	Rotation speed feedback
JP403	DC Fan 1 connector	
	1	GND
	2	+12..+28 V DC (same as input voltage)
	3	Rotation speed feedback

## Jumper Index

JP301	Software Reset 1 jumper. Loads the Primary boot loader
-------	--

## Button Index

S1	Software Reset 1 button. Loads the Primary boot loader
TP2	Software Reset 2 button. Resets boot loader and RouterOS settings

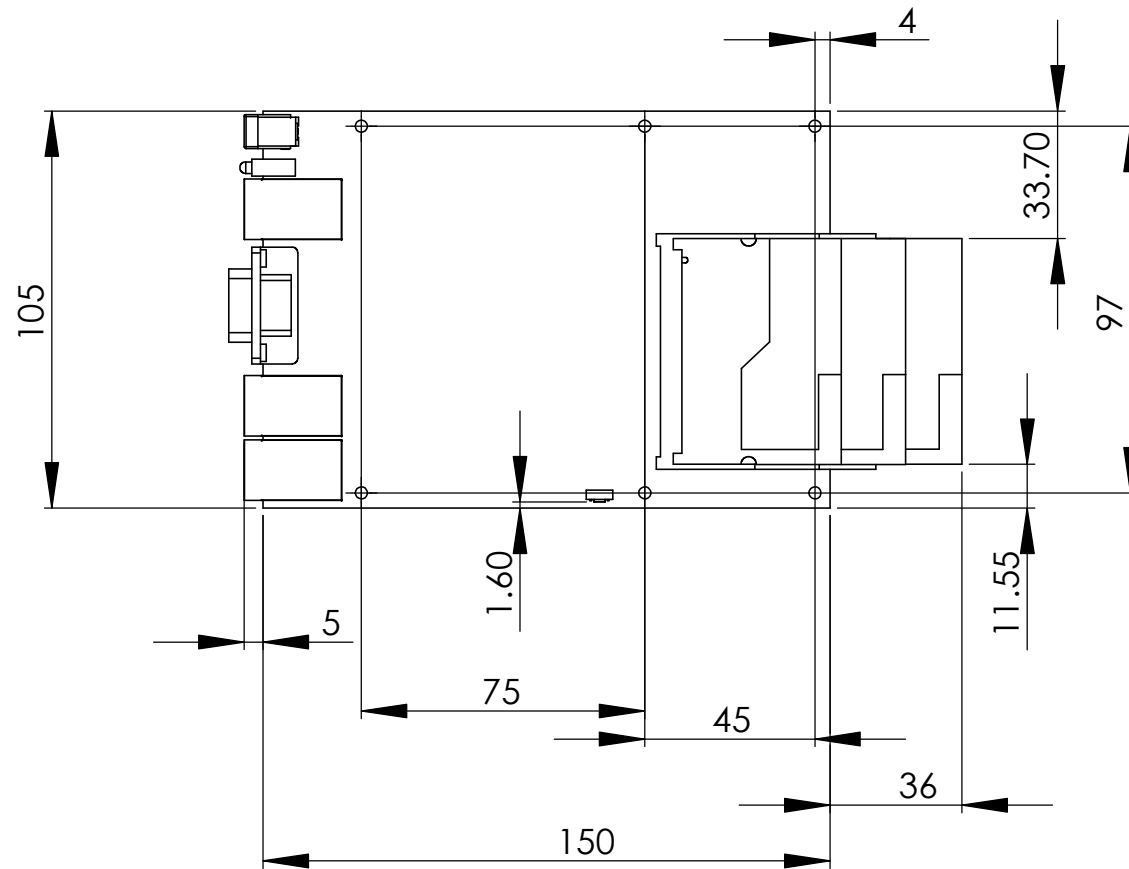
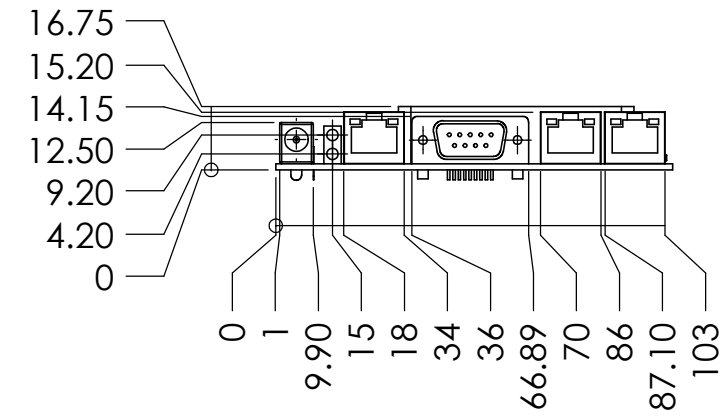
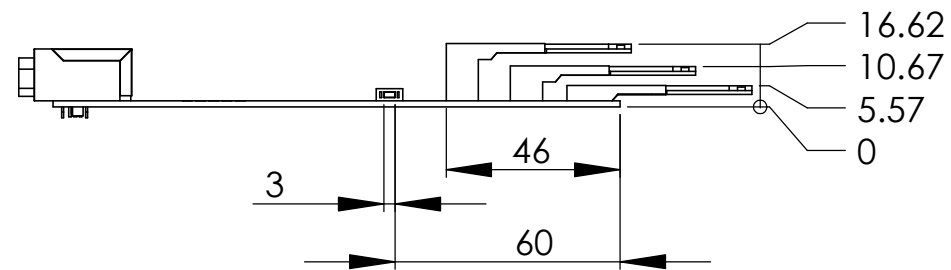
## Ethernet Cables

RJ45 Pin	Color	Function	RJ45 pin for Straight cable (MDI, EIA/TIA568A)	RJ45 pin for Crossover cable (MDI-X, EIA/TIA568B)
1	Green	TX+ Data	1	3
2	Green/White	TX- Data	2	6
3	Orange	RX+ Data	3	1
4	Blue	-	4	4
5	Blue/White	-	5	5
6	Orange/White	RX- Data	6	2
7	Brown	-	7	7
8	Brown/White	-	8	8

## Serial Null-modem (Console) Cable with Loopback

DB9f	Function	DB9f	DB25f
1 + 4 + 6	CD + DTR + DSR	N/C	N/C
N/C	CD + DTR + DSR	1 + 4 + 6	6 + 8 + 20
2	RxD	3	2
3	TxD	2	3
5	GND	5	7
7 + 8	RTS + CTS	7 + 8	4 + 5

N/C – not connected.



1. Unspecified R  $\leq 1$   
 2. Unspecified tolerances: DIN7168/FINE  
 except p.3:

Tolerance		
Nominal	External:	Internal:
>	-IT12	+IT12
≤	Others: $\pm IT12/2$	
6	0.1	
30	0.2	
120	0.3	
315	0.4	
1000	0.6	
2000	1.0	

3. Hole coordinates with unspecified tolerances  
 Hole pattern  $\phi \phi 0,3$  for all coordinative dim-s;  
 countersunks -  $\phi \phi 0,1$

Do not scale drawing			Finish:	Scale 1:2	Mass:
				Material:	
		Date	Name	Description:	
		Drawn. 20.04.07	Veiders	RB333 dimensions	
		Check:			
		Approv:			
				Drawing code:	A3
				RB333	sheet 1 of 1
Printed: 22.08.07					