

RouterBOARD 800 Series

User's Manual

Rev. A (08-Jan-2010)

Limited Warranty

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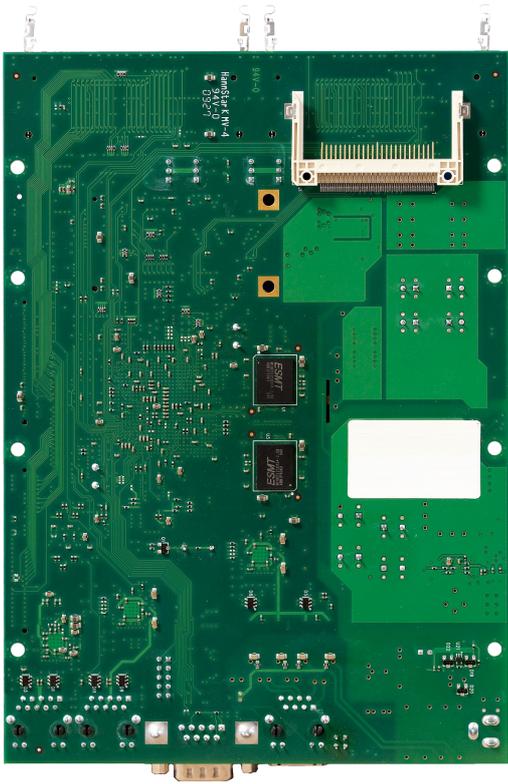
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System Board View

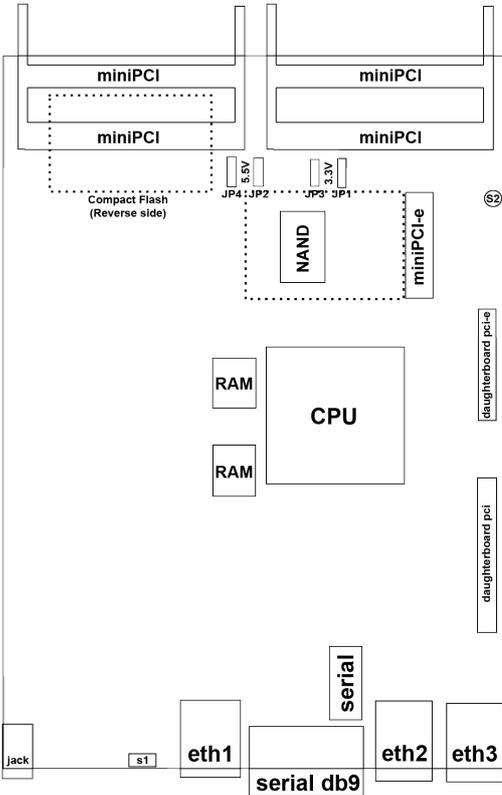


Top view



Bottom view

System Board Layout

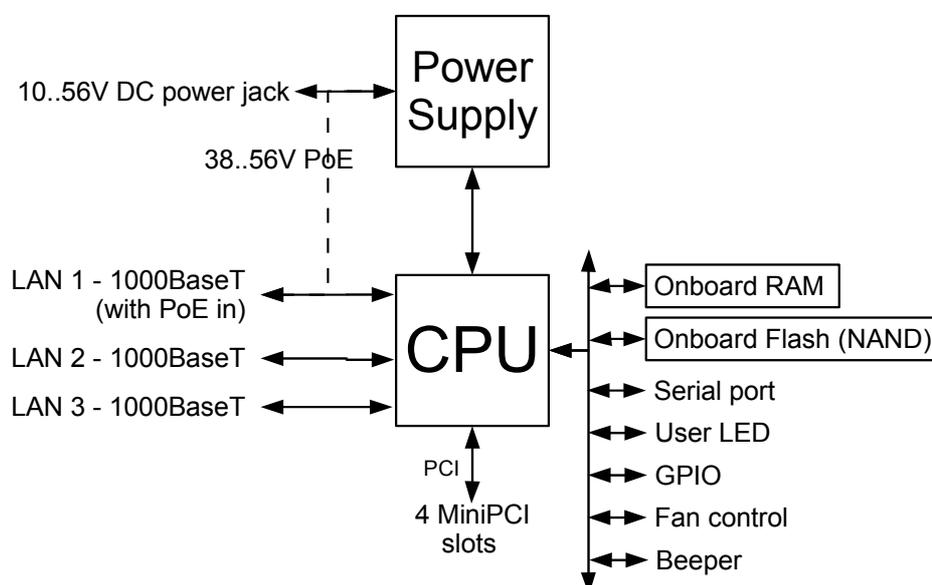


You can download the board dimensions and case design files (PDF and DXF) from www.routerboard.com .

Specifications

	RouterBOARD 800
CPU	MPC8544 800MHz network processor
Memory	256MB DDR2 SDRAM onboard memory
Boot loader	RouterBOOT
Data storage	64MB onboard NAND memory chip
Ethernet	Three 10/100/1000 Mbit/s Gigabit Ethernet ports supporting Auto-MDI/X
MiniPCI slot	Four MiniPCI Type IIIA/IIIB slots
Expansion	1x RouterBOARD-PCI Daughterboard connector 1x RouterBOARD-PCIe Daughterboard connector
CompactFlash slots	One CompactFlash slot on reverse (True IDE Microdrive supported)
Serial port	One DB9 RS232C asynchronous serial port One IDC10 serial connector
LEDs	Power and User LED
Beeper	Yes
Power	Power over Ethernet: 38..56V DC (supports power over datalines) Power jack: 10..56V DC
Fan control	Two 5.5V DC fan power output headers Two 3.3V DC fan power output headers with rotation sensor and automatic fan switching (maximum output current - 300mA total)
Dimensions	14 cm x 20 cm (5.51 in x 7.87 in)
Weight	227 g (8 oz)
Temperature	Operational: -75°C to +65°C Startup: boots at warmer than -50°C
Humidity	Operational: up to 70% relative humidity (non-condensing)
Power consumption	~9W without extension cards, maximum - 35+ W (25+ W output to extension cards)
Monitoring	Has Voltage and Temperature monitoring sensors

Block Diagram



Hardware Guide

Memory and Storage Devices

Onboard Memory

The boards are equipped with 256 MB DDR2 SDRAM onboard memory.

Onboard NAND Storage Device

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

CompactFlash Slots

The board has one CompactFlash slot that supports Compact Flash Type I or II cards and True IDE Microdrive storage devices. The CF slot is bootable. Warning! The RouterBOARD 800 series boards do not support hot insert of CompactFlash/Microdrive devices.

Extension Slots

MiniPCI Slots

The board has four 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 5 Ubiquity SR series 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: 7.5A typical

Daughterboard Connector

Additional Ethernet and/or MiniPCI slots may be connected to the board using the daughterboard connectors. Two connectors are provided, the longer connector (J4) is routerboard-pci type, same as used on RB600 and RB500 series devices. The shorter connector (J10) is routerboard-pcie type.

Input/Output Ports

LAN1 Port with PoE

This Gigabit Ethernet port is recognized as the first LAN interface. It is compatible with most Power over Ethernet injectors. The board accepts voltage input from 38 to 56 V DC. It is suggested to use 48V 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 Gigabit 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 Gigabit Ethernet port is recognized as the third LAN interface. This port does not support Power over Ethernet.

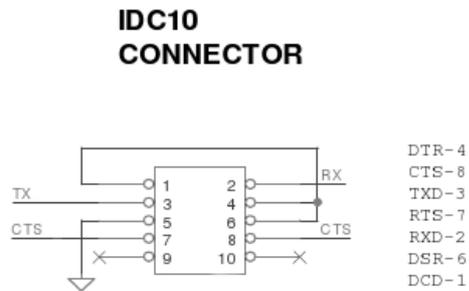
All cables made to EIA/TIA 568A/B cable specifications will work correctly (see **Connector Index** for pinout). Note that this port supports automatic cross/straight cable correction (Auto MDI/X), so you can use either straight or cross-over cable for connecting to other network devices.

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.

IDC10 Serial connector

This connector can be used to add another serial port to the RB800. It's pinout is as follows:



Fan Connectors

You can connect up to four fans to the RouterBOARD, but only one pair of them will work at a time. They will receive either 3.3V or 5.5V DC power. 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).

JP1 and JP3 are 3.3V connectors, only one of them will power a cooling fan at the same time, other one will be started when the first stops.

JP2 and JP4 are 5.5V connectors, only one of them will power a cooling fan at the same time, other one will be started when the first stops.

To enable rotation of two fans simultaneously, simply connect one 3.3V fan to JP1 and a 5.5V fan to JP4 (outside of the pair).

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:

- In most cases you do not need to use any additional boot devices, as you can boot the RouterBOARD from the onboard NAND memory. You can also install one CompactFlash module or Microdrive hard drive, which you can use as an alternative boot device for non-RouterOS operating systems, or for additional storage media;
- Insert MiniPCI cards on the board itself, and on the daughterboard if you have one;
- Install the board in a case, connect and secure the daughterboard 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.

Please do not power on the system with installed miniPCI cards if they have no antennas connected, powering miniPCI wireless cards with no antenna can damage them. Disabled (in RouterOS) miniPCI wireless cards can be used with no antenna.

Powering

Power options:

- **J14** power jack:
10..56V DC
- Power over Ethernet (PoE) on the **J12** LAN1 Ethernet port:
38..56V DC Power over Ethernet

The board has a direct-input power jack **J14** (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 800 series boards are equipped with a reliable 35+ Watt onboard power supply. 10..56 V DC input voltages are accepted through the **J14** power jack. The system is tested with 24V solar/wind/RV systems with 27.6 charge voltage.

RouterBOARD 800 series boards are compatible with most standard and non-standard (passive) Power over Ethernet injectors and accept powering over up to 100m (330 ft) long Ethernet cable connected to the Ethernet port (**J12**). The minimum turn on voltage is about 38V DC and it has undervoltage protection turning the board off when the input voltage drops lower than 32V.

The maximum output of the power supply to the extension cards is normally at about 25W (7.5A at 3.3V), however with appropriate cooling, the onboard power supply is capable to provide higher power output to the extension cards.

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.

Internal Storage Device

The RouterBOARD may be started from a CompactFlash module or a Microdrive hard drive installed in the CompactFlash slot (**J1**). At least two partitions must exist on the device, first of which being the ELF image the board is to be booted from (normally, it is a Linux kernel, appended with the kernparm ELF section that specifies the root partition name and, optionally, other kernel parameters of your choice).

Booting from network

Network boot works similarly to PXE or EtherBoot protocol, and allows you to boot a RouterBOARD 800 series boards 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

CPU. RouterBOARD 800 series uses the MPC8544 800MHz PPC architecture embedded processor.

Ethernet. RouterBOARD 800 series has two onboard Gigabit Ethernet ports (**J12 ETH1** and **J13 ETH2**) controlled by the CPU and one additional onboard Gigabit Ethernet port (**J1, ETH3**) controlled by Atheros AR8131 Gigabit Ethernet Controller.

MikroTik RouterOS

MikroTik RouterOS, starting from version 4.0, is fully compatible with RouterBOARD 800 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 2.21
```

```
RouterBOARD 800
```

```
CPU frequency: 800 MHz
Memory size: 256 MB
```

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

```
RouterBOOT-2.21
```

```
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).

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

cpu-frequency – CPU frequency (**800MHz** by default).

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.

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**), 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 800

Health monitor

This menu shows the current fan status.

```
[admin@MikroTik] > system health print
  fan-mode: manual
  use-fan: main
  active-fan: main
[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: "rb800"
  serial-number: "154201C1DD3C"
  current-firmware: "2.21"
  upgrade-firmware: "2.21"
[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
  boot-protocol: bootp
  enable-jumper-reset: yes
[admin@MikroTik] >
```

The Software Reset 2 jumper (S2), 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 jumper (**S2**) 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"**.

To use it, simply shorten it with a screwdriver, and power up the device, until RouterOS loads.

JP5 DIS POE Jumper

This jumper will disable the 802.11af compatible smart PoE, and also lower the undervoltage protection threshold to approx 10V, allowing to use this device with passive PoE in 24V Solar power installations.

Appendix

Connector Index

J1	CompactFlash slot	
J11	RJ45 Gigabit Ethernet 1000Base-T port LAN3 (no PoE)	
J4	Daughterboard PCI connector	
J10	Daughterboard PCIe connector	
J5	MiniPCI Type type IIIA/B connector 1	
J6	MiniPCI Type type IIIA/B connector 2	
J7	MiniPCI Type type IIIA/B connector 3	
J8	MiniPCI Type type IIIA/B connector 4	
J2	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)
J12	RJ45 Gigabit Ethernet 1000Base-T port LAN1 with PoE extension	
J13	RJ45 Gigabit Ethernet 1000Base-T port LAN2 (no PoE)	
J14	Power jack (10..56 V DC, positive contact is the central pin)	
JP1	DC Fan 1 connector	
	1	GND
	2	+3.3 V DC
	3	Rotation speed feedback
JP3	DC Fan 2 connector	
	1	GND
	2	+3.3 V DC
	3	Rotation speed feedback
JP2	DC Fan 2 connector	
	1	GND
	2	+5.5 V DC
	3	Rotation speed feedback
JP4	DC Fan 2 connector	
	1	GND
	2	+5.5 V DC
	3	Rotation speed feedback

Button Index

S1	Software Reset 1 button. Loads the Primary boot loader
S2	Software Reset 2 jumper. Resets boot loader and RouterOS settings

Ethernet Cables

RJ45 Pin	Color	Function (100Mbit)	Function (1Gbit)	RJ45 pin for Straight cable (MDI, EIA/TIA568A)	RJ45 pin for Crossover cable (MDI-X, EIA/TIA568B)
1	Green	TX+ Data	Data A+	1	3
2	Green/White	TX- Data	Data A-	2	6
3	Orange	RX+ Data	Data B+	3	1
4	Blue	-	Data C+	4	4
5	Blue/White	-	Data C-	5	5
6	Orange/White	RX- Data	Data B-	6	2
7	Brown	-	Data D+	7	7
8	Brown/White	-	Data D-	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

DB9f	Function	DB9f	DB25f
2	RxD	3	2
3	TxD	2	3
5	GND	5	7
7 + 8	RTS + CTS	7 + 8	4 + 5

N/C – not connected.