

RouterBOARD 450/G Series

User's Manual

(21-Aug-2012)

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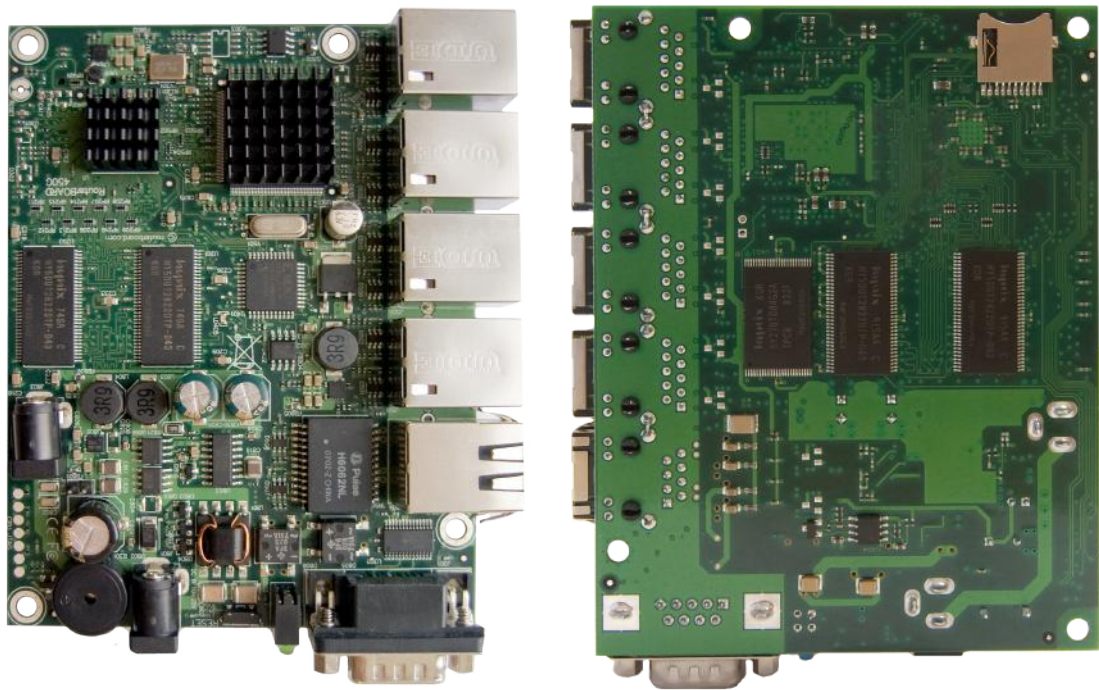
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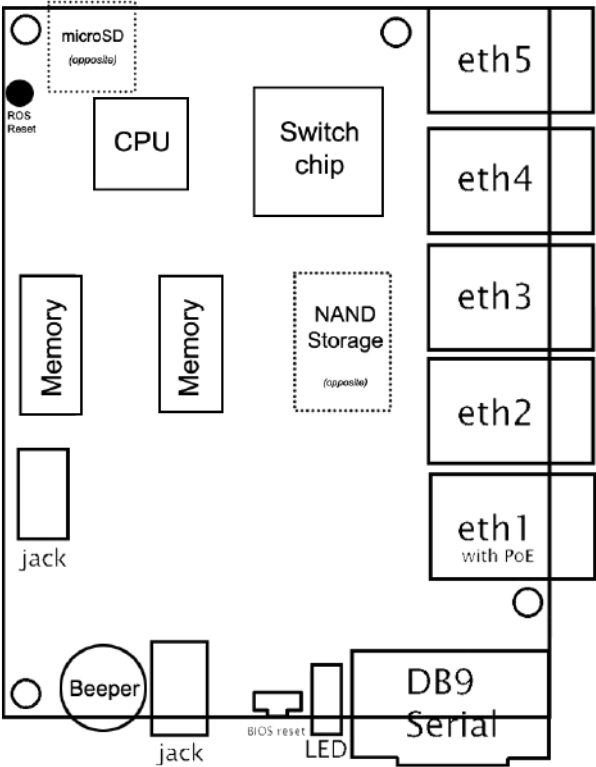
System Board View



RB450G Top

RB450G Bottom

System Board Layout



	RouterBOARD 450	RouterBOARD 450G
CPU	AR7131 300MHz	AR7161 680MHz
Memory	32MB DDR RAM	256MB DDR SDRAM onboard memory
Boot loader	RouterBOOT	
Data storage	onboard NAND memory chip	onboard NAND memory chip, microSD card slot (on reverse)
Ethernet	Five 10/100 Ethernet ports supporting Auto-MDI/X	Five 10/100/1000 Mbit/s Gigabit Ethernet ports supporting Auto-MDI/X
MiniPCI slot	none	
Serial port	One DB9 RS232C asynchronous serial port	
LEDs	Power and User LED	
Beeper	Present	
Power	Power over Ethernet: 14..28V DC (except power over datalines) Power jack: 10..28V DC	
Fan control	none	
Dimensions	90 mm x 115 mm (3.5 in x 4.5 in)	
Weight	95 g	
Temperature	Operational: -45°C to +70°C	
Humidity	Operational: up to 70% relative humidity (non-condensing)	
Power consumption	6.4W at maximum load	

Hardware Guide

Memory and Storage Devices

Onboard Memory

The RB450G equipped with 256 DDR SDRAM onboard memory, RB450 has 32MB DDR SDRAM onboard memory.

Onboard NAND Storage Device

The boards are equipped with one built in NAND nonvolatile memory chip.

Extension Slots

MiniPCI Slots

The board has no miniPCI slots or other expansion abilities

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 10 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.

LAN2-5 Port

These Fast Gigabit Ethernet ports are recognized as the second-fifth LAN interface. These ports do 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.

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:

- Connect ethernet cables
- Connect power cable

You can also order a pre-assembled system with RouterBOARD already installed in a case.

Powering

Power options:

- **J9** power jack:
10..28V DC (cut-off voltage - 30V)
- Power over Ethernet (PoE) on the **J601** LAN1 Ethernet port:
14..28V DC (18..28 V suggested; cut-off voltage - 30V) non-standard PoE powering support

The board has two direct-input power jacks **J801** and **J803** for use with different cases (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 450 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 27.8V-29V (depends on some part physical options, works up to 60V), so the board will not be damaged if connected to a 48 or 60 V power line.

RouterBOARD 450 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 450 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 450 series embedded boards are fully compatible with the standard e300 architecture with PCI bus.

CPU. RouterBOARD 450 series has Atheros MIPSBE architecture based embedded processor. RB450G has a Atheros AR7161 680MHz CPU.

Ethernet. RouterBOARD 450G has five onboard 10/100/1000 Gigabit Ethernet ports RB450 has 10/100 Mbit Ethernet ports.

MikroTik RouterOS

MikroTik RouterOS, starting from version 3.0, is fully compatible with RouterBOARD 450 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 450

CPU frequency: 680 MHz

Memory size: 256 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 (680MHz and 800MHz. 680MHz default, 800MHz – overclock. use with caution).

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.

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

Backup Bootloader

There are two boot loaders present on the NOR flash memory chip. The main one, that is executed by default, and the Backup, which is built-in failsafe. In case something goes wrong in the upgrade process, or you have set some incorrect settings that render it unusable, you can load the Backup boot loader by holding the Software Reset 1 button (**S301**) connecting the power, and then releasing the button/jumper. The Backup boot loader uses Default settings, which can not be changed. It is also not possible to upgrade it. In case the Main Bootloader is damaged, RouterOS v3.23 supports Permanently setting the Backup Boot Loader as Main (thus avoiding the need to hold the button).

RouterOS on RouterBOARD 450

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: "450"
    serial-number: "154201C1DD3C"
    current-firmware: "2.16"
    upgrade-firmware: "2.16"
[admin@MikroTik] >
```

The firmware version can be upgraded using **"/system routerboard upgrade"** command, if a new firmware file has been uploaded to the RouterOS "Files" menu. Also new firmware is present in the routerboard.npk package, which is usually installed by default. In this case new firmware becomes available after a software upgrade. Availability of new BootLoader versions is displayed in "upgrade-firmware"

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: 680MHz
    boot-protocol: bootp
    enable-jumper-reset: yes
[admin@MikroTik] >
```

The Software Reset jumper (**RESET**) 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 short-circuiting the reset-hole during the power-up (see ROS reset in layout diagram). 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	
	1	Connected together
	4	
	6	
	2	RxD (Receive Data)
	3	TxD (Transmit Data)
	5	GND
	7	Connected together
	8	
J505	RJ45 Fast Ethernet 100Base-TX port LAN1 with passive PoE extension (next to serial connector)	
J501-J504	RJ45 Fast Ethernet 100Base-TX port LAN3 (no PoE)	
J801/J803	Power jack (12..28 V DC, positive contact is the central pin)	

Button Index

S301	Bootloader Reset button. Loads the Backup boot loader
------	---

Jumper Index

RESET	Software Reset jumper hole. Resets RouterOS settings.
-------	---

Ethernet Cables

Note: When using the MikroTik Gigabit PoE injector, PoE is passed on pins 4,5 (+) and 7,8 (-). When using other PoE injectors, power can be passed on any other pins, depending on PoE injector model.

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
2	RxD	3	2
3	TxD	2	3
5	GND	5	7
7 + 8	RTS + CTS	N/C	N/C
N/C	RTS + CTS	7 + 8	4 + 5

N/C – not connected.