RouterBOARD 493/AH/G

User's Manual

(1-Sep-2011)

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3. Out-of-warranty devices and devices not covered by warranty sent to Mikrotik will be returned to the sender at sender's cost.
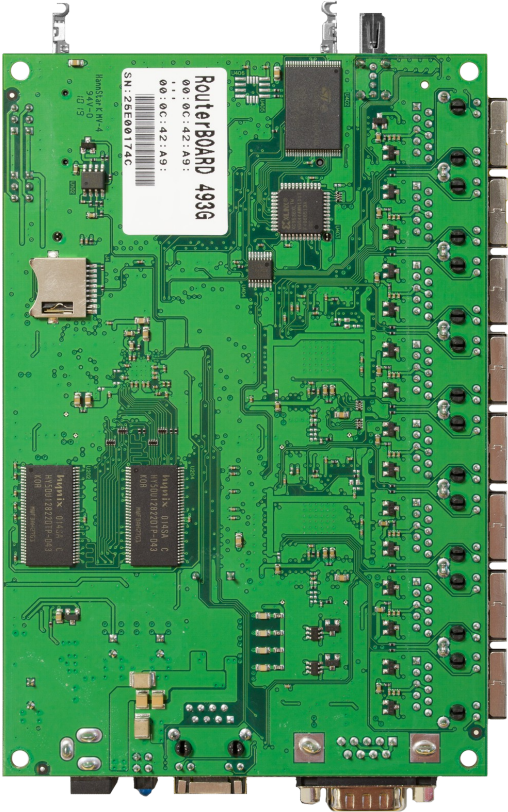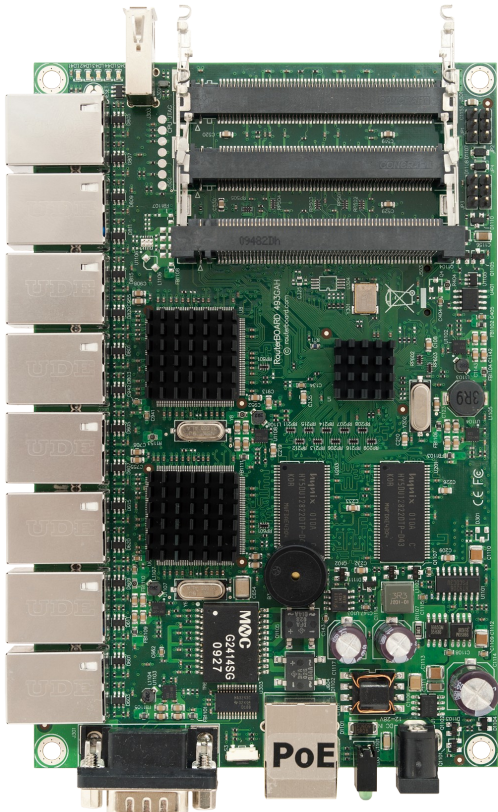
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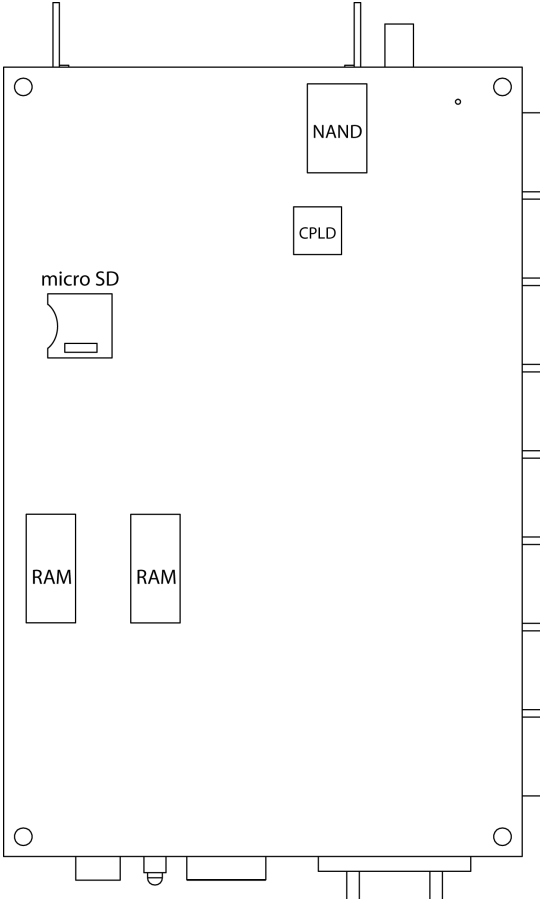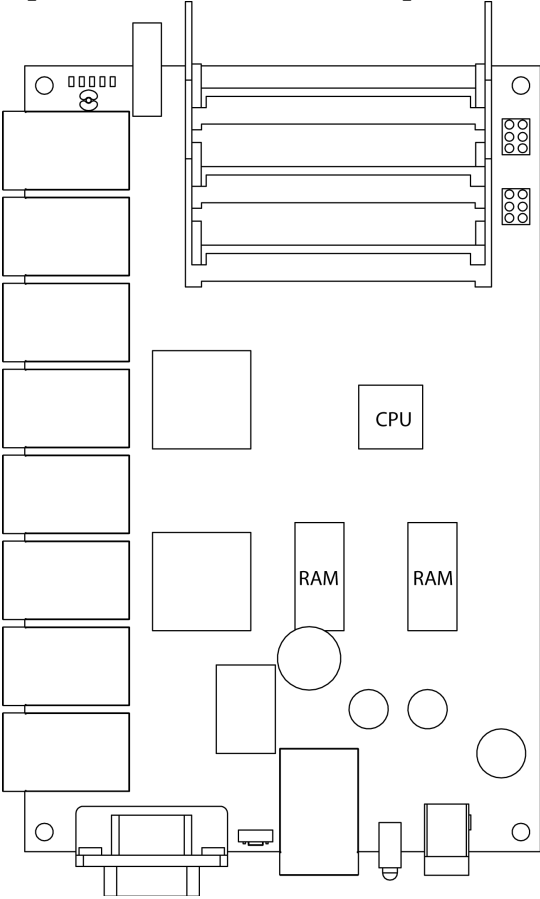
Table of Contents

System Board View

System Board Layout

	RouterBOARD 493	**RB493AH**	**RB493G**
CPU	**AR7130** 300MHz	**AR7161** 680MHz	**AR7161** 680MHz
Memory	64MB DDR SDRAM	128MB DDR SDRAM	256MB DDR SDRAM
Ethernet	Nine 10/100 Mbit/s Fast Ethernet ports supporting Auto-MDI/X	Nine 10/100 Mbit/s Fast Ethernet ports supporting Auto-MDI/X	Nine 10/100/1000 Mbit/s **Gigabit** Ethernet ports supporting Auto-MDI/X
Switch chip	ICPlus178C	ICPlus178C	2x AR8316
MiniPCI slot	Three MiniPCI Type IIIA/IIIB slots	Three MiniPCI Type IIIA/IIIB slots	Three MiniPCI Type IIIA/IIIB slots
Serial port	One DB9 RS232C asynchronous serial port	One DB9 RS232C asynchronous serial port	One DB9 RS232C asynchronous serial port
USB	-	-	1x USB 2.0 non powered, injector required
LEDs	Power and User LED	Power and User LED	Power and User LED
Beeper	Yes	Yes	Yes
	-	-	1x microSD
Power	Power over Ethernet: 10..28V DC (except power over datalines) Power jack: 10..28V DC	Power over Ethernet: 10..28V DC (except power over datalines) Power jack: 10..28V DC	Power over Ethernet: 10..28V DC (except power over datalines) Power jack: 10..28V DC
Fan control	**Two** DC fan power output headers with rotation sensor and automatic fan switching (maximum output current - 500mA total)	**Two** DC fan power output headers with rotation sensor and automatic fan switching (maximum output current - 500mA total)	**Two** DC fan power output headers with rotation sensor and automatic fan switching (maximum output current - 500mA total)
Dimensions	105 mm x 160 mm	105 mm x 160 mm	105 mm x 160 mm
Weight	140 g	140 g	160 g
Temperature	Operational: -20°C to +65°C (-4°F to 149°F)	Operational: -20°C to +65°C (-4°F to 149°F)	Operational: -20°C to +65°C (-4°F to 149°F)
Humidity	Operational: up to 70% relative humidity (non-condensing)	Operational: up to 70% relative humidity (non-condensing)	Operational: up to 70% relative humidity (non-condensing)
Power consumption	~3W without extension cards, maximum – 25W (18W output to extension cards)	~3W without extension cards, maximum – 25W (18W output to extension cards)	~3W without extension cards, maximum – 25W (18W output to extension cards)

Hardware Guide

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.

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 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).

A Gigabit PoE injector is required to power **RB493G**.

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.

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.

Cooling Fan Connectors

You can connect up to four fans to the RouterBOARD RB493, but only two of them will work at a time.

JP1,JP2 are 3,3V. JP3,JP4 is the same voltage as received by the power jack. You can only use one pair of fans (ie. JP1 + JP2 or JP3 + JP4). It is recommended to use a 12V PSU for the RB device, and JP3,JP4 headers with 12V cooling fans.

USB

RB493G features one USB 2.0 port. This port is not powered, this means that all connected devices require a USB power injector to be used. For example: http://www.routerboard.com/index.php?showProduct=99

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.

It is recommended to connect all the antenna cables to the miniPCI cards before powering the device.

Powering

Power options:

- Power jack:
  10..28V DC (cut-off voltage - 30V)

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

The board has a direct-input power jack (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 493 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 28.1V-29V ±delta (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 493 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.

If using PoE, RB493G should be powered only with a special Gigabit power injector.

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 493 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

MikroTik RouterOS

MikroTik RouterOS, starting from v4.13, is fully compatible with RouterBOARD 493 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 493

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 on RB493. On RB493AH/G also available 680MHz and 800MHz. 680MHz 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.

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 493

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).

Firware 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: "493"
     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 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 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

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)
MiniPCI Type type IIIA/B connector 1 (lowest)	
MiniPCI Type type IIIA/B connector 2 (middle)	
MiniPCI Type type IIIA/B connector 3 (top)	
RJ45 Fast Ethernet 100Base-TX port LAN1 with passive PoE extension	
RJ45 Fast Ethernet 100Base-TX port LAN2-9 (no PoE)	
Power jack (10..28 V DC, positive contact is the central pin)	
Two DC Fan 3.3V connectors (alternating)	
1	GND
2	+3.3 V DC
3	Rotation speed feedback
Two DC Fan Line connectors (alternating)	
1	GND
2	+12/+24 V DC (same as input voltage)
3	Rotation speed feedback
One USB 2.0 (RB493G only)	

Button Index

S3	Software Reset 1 button. Loads the Primary boot loader
RESET	Software Reset 2 jumper. 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	7 + 8	4 + 5

N/C – not connected.