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System Board View

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

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](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 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).
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: "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

<table>
<thead>
<tr>
<th>Connector Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS232C male DB9 serial port</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RxD (Receive Data)</td>
</tr>
<tr>
<td>3</td>
<td>TxD (Transmit Data)</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
</tr>
<tr>
<td>7</td>
<td>RTS (Request to Send)</td>
</tr>
<tr>
<td>8</td>
<td>CTS (Clear to Send)</td>
</tr>
<tr>
<td>MiniPCI Type IIIA/B connector 1 (lowest)</td>
<td></td>
</tr>
<tr>
<td>MiniPCI Type IIIA/B connector 2 (middle)</td>
<td></td>
</tr>
<tr>
<td>MiniPCI Type IIIA/B connector 3 (top)</td>
<td></td>
</tr>
<tr>
<td>RJ45 Fast Ethernet 100Base-TX port LAN1 with passive PoE extension</td>
<td></td>
</tr>
<tr>
<td>RJ45 Fast Ethernet 100Base-TX port LAN2-9 (no PoE)</td>
<td></td>
</tr>
<tr>
<td>Power jack (10..28 V DC, positive contact is the central pin)</td>
<td></td>
</tr>
<tr>
<td>Two DC Fan 3.3V connectors (alternating)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>GND</td>
</tr>
<tr>
<td>2</td>
<td>+3.3 V DC</td>
</tr>
<tr>
<td>3</td>
<td>Rotation speed feedback</td>
</tr>
<tr>
<td>Two DC Fan Line connectors (alternating)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>GND</td>
</tr>
<tr>
<td>2</td>
<td>+12/+24 V DC (same as input voltage)</td>
</tr>
<tr>
<td>3</td>
<td>Rotation speed feedback</td>
</tr>
<tr>
<td>One USB 2.0 (RB493G only)</td>
<td></td>
</tr>
</tbody>
</table>

Button Index

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3</td>
<td>Software Reset 1 button. Loads the Primary boot loader</td>
</tr>
<tr>
<td>RESET</td>
<td>Software Reset 2 jumper. Resets RouterOS settings</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>RJ45 Pin</th>
<th>Color</th>
<th>Function (100Mbit)</th>
<th>Function (1Gbit)</th>
<th>RJ45 pin for Straight cable (MDI, EIA/TIA568A)</th>
<th>RJ45 pin for Crossover cable (MDI-X, EIA/TIA568B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Green</td>
<td>TX+ Data</td>
<td>Data A+</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Green/White</td>
<td>TX- Data</td>
<td>Data A-</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Orange</td>
<td>RX+ Data</td>
<td>Data B+</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Blue</td>
<td>-</td>
<td>Data C+</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Blue/White</td>
<td>-</td>
<td>Data C-</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Orange/White</td>
<td>RX- Data</td>
<td>Data B-</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Brown</td>
<td>-</td>
<td>Data D+</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Brown/White</td>
<td>-</td>
<td>Data D-</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
Serial Null-modem (Console) Cable with Loopback

<table>
<thead>
<tr>
<th>DB9f</th>
<th>Function</th>
<th>DB9f</th>
<th>DB25f</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 + 4 + 6</td>
<td>CD + DTR + DSR</td>
<td>N/C</td>
<td>N/C</td>
</tr>
<tr>
<td>N/C</td>
<td>CD + DTR + DSR</td>
<td>1 + 4 + 6</td>
<td>6 + 8 + 20</td>
</tr>
<tr>
<td>2</td>
<td>RxD</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>TxD</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>7 + 8</td>
<td>RTS + CTS</td>
<td>7 + 8</td>
<td>4 + 5</td>
</tr>
</tbody>
</table>

N/C – not connected.