RouterBOARD 433 Series

User's Manual

(09-Jun-2009)

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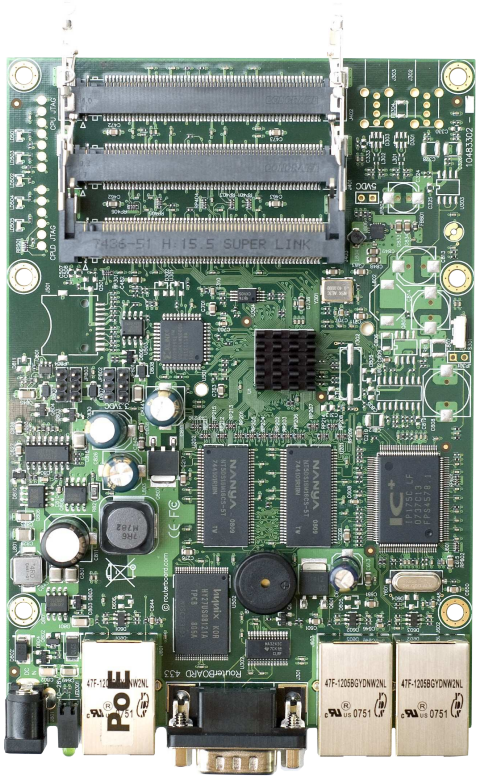
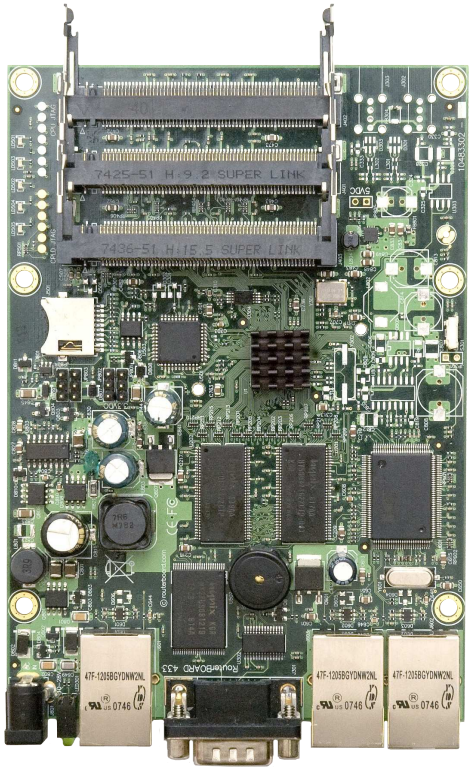
System Board View

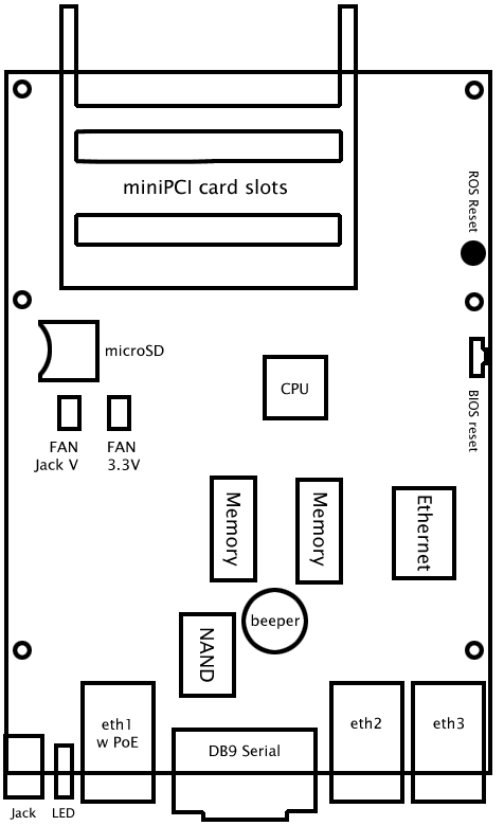


RB433



RB433AH

System Board Layout



	RouterBOARD 433/433AH
CPU	Atheros **AR7130** 300MHz / **AR7161** 680MHz
Memory	64/128MB DDR SDRAM onboard memory
Boot loader	RouterBOOT
Data storage	64MB onboard NAND memory chip
Ethernet	Three 10/100 Mbit/s Fast Ethernet ports supporting Auto-MDI/X
MiniPCI slot	Three MiniPCI Type IIIA/IIIB slots
Serial port	One DB9 RS232C asynchronous serial port
LEDs	Power and User LED
Beeper	Present
Power	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)
Dimensions	105 mm x 150 mm (4.13 in x 5.91 in)
Weight	140 g
Temperature	Operational: -20°C to +65°C (-4°F to 149°F)
Humidity	Operational: up to 70% relative humidity (non-condensing)
Power consumption	~3W without extension cards, maximum – 25W (18W output to extension cards)

Hardware Guide

Memory and Storage Devices

Onboard Memory

The RB433 is equipped with 64 MB DDR SDRAM onboard memory. RB433AH boards are equipped with 128 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.

NOTE: that RB400 series currently does not support Senao 8602 cards, Atheros AR5211 or older chipset and Prism chipset based cards. Wireless compression is not supported on RB400 series devices.

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).

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:
  10..28V DC (cut-off voltage - 30V)
- Power over Ethernet (PoE) on the **J601** 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 **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 433 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 433 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 433 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 433 series embedded boards are fully compatible with the standard e300 architecture with PCI bus.

CPU. RouterBOARD 433 series has Atheros MIPSBE architecture based embedded processor. RB433 has a Atheros AR7130 300MHz CPU and the RB433AH has a Atheros AR7161 680MHz CPU.

Ethernet. RouterBOARD 433 series has three onboard 10/100 Ethernet ports.

MikroTik RouterOS

MikroTik RouterOS, starting from version 3.0rc1, is fully compatible with RouterBOARD 433 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 433

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 RB433. On RB433AH 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 433

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: "433"
     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

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)
J403	MiniPCI Type type IIIA/B connector 1 (lowest)	
J401	MiniPCI Type type IIIA/B connector 2 (middle)	
J402	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 -
	8	PoE power -
J602	RJ45 Fast Ethernet 100Base-TX port LAN3 (no PoE)	
	1	Data TX+
	2	Data TX-
	3	Data RX+
	6	Data RX-
J603	RJ45 Fast Ethernet 100Base-TX port LAN2 (no PoE)	
	1	Data TX+
	2	Data TX-
	3	Data RX+
	6	Data RX-
J801	Power jack (12..28 V DC, positive contact is the central pin)	
JP801 JP802	Two DC Fan 3.3V connectors (alternating)	
	1	GND
	2	+3.3 V DC
	3	Rotation speed feedback
JP803 JP804	Two DC Fan Line connectors (alternating)	
	1	GND
	2	+12/+24 V DC (same as input voltage)
	3	Rotation speed feedback

Jumper Index

JP301	Software Reset 1 jumper. Loads the Primary boot loader

Button Index

S301	Software Reset 1 button. Loads the Primary boot loader
RESET	Software Reset 2 jumper. Resets 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.