

# Matrix 504 Quick Installation Guide

## Overview

Matrix 504 is a Linux ready, ARM9-based embedded computer. Its lower power and robust design concept makes it an ideal industrial computer platform for harsh environment. The Linux OS and file system are pre-installed in the on-board Flash memory and the GNU tool chain CD coming with Matrix 504 is ready for your application development.

## Features

1. ARM926EJ-S ARM Thumb Processor 400MHz w/MMU
2. 32-KByte Data Cache and 32-KByte Instruction Cache
3. 128MB SDRAM, 128MB NAND Flash on board
4. One 10/100 Mbps Ethernet
5. Two USB 2.0 full speed (12 Mbps) Host Ports
6. One software configurable RS-232/422/485 port and three RS-232/485 ports
7. One serial console port
8. 5 programmable GPIO
9. 9 to 48VDC power input
10. Pre-installed Linux 2.6.29 kernel and file system
11. GNU tool chain available in Artila CD
12. Optional DIN RAIL mounting adaptor

## Packing List

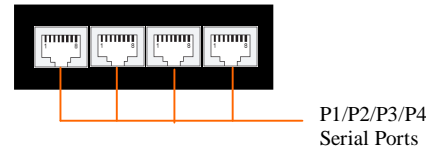
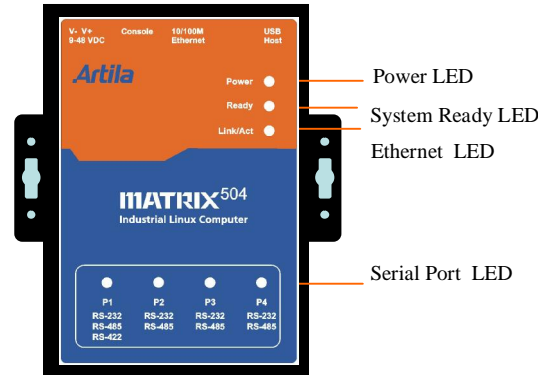
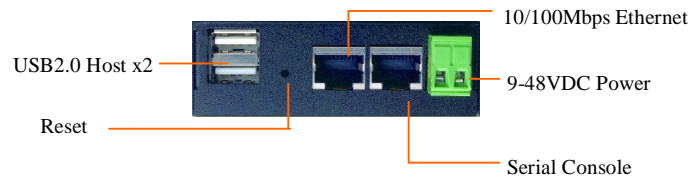
Matrix 504 is shipped with following items

1. Matrix 504
2. Artila CD includes Tool Chain, Installation guide and Utility software and device driver and example programs

## Optional Accessory

1. CB-RJ45F9-150: RJ45 to DB9 Female Cable
2. CB-RJ2CON-100: Serial Console Cable
3. DK-35A: DIN RAIL Mounting Kit
4. PWR-12V-1A: 110~240VAC to 12VDC 1A Power Adaptor

## Matrix 504 Layout



## USB Port

The USB port is an USB2.0 high speed host port. It can be used to expand the hardware function of Matrix 504 and exchange file and data between PC and Matrix 504 using an USB flash disk. Currently the hardware support by Matrix 504 USB is shown as follow:

1. USB Storage Device
2. USB to Wireless LAN Adaptor (Ralink RT73)
3. USB to Serial Adaptor (fdti usb to UART)
4. USB to Modem (CDC compliant)
5. USB Camera

The USB client port is reserved for production purpose only. Contact Artila if you find your hardware is not shown on the list.

## Reset Button

Press the “Reset” button to activate the hardware reset. Please always use “reboot” command to reset Matrix 504. You should only use this function if the software reboot does not function properly.

## Power LED

The Power LED will show solid green if power is properly applied

### Ready LED

After Power ON, Matrix 504 starts booting. Once system is boot up, the Ready LED will show solid green. The Ready LED will be turned off after Matrix 504 received “halt” command.

### Link/Act LED

When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic in the Ethernet, this LED will flash

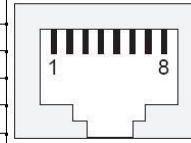
### Serial Port LED

These four dual color LEDs indicate the data traffic at the serial ports. When RXD line is high then Green light is ON and when TXD line is high, Yellow light is ON.

### Serial Port

The four serial ports can be configured as RS-232, RS-422 or RS-485 by software. They use RJ45 connector and the pin assignment are shown as following table.

Pin	RS-232	RS-422	RS-485
1	DSR	---	---
2	RTS	TXD+	Data+
3	GND	GND	GND
4	TXD	TXD-	Data-
5	RXD	RXD+	---
6	DCD	RXD-	---
7	CTS	---	---
8	DTR	---	---



Port 1: RS-232/422/485

RS-232: RXD, TXD, RTS, CTS, DSR, DTR, DCD, GND

RS-422: TXD+, TXD-, RXD+, RXD-, GND

RS-485: DATA+, DATA-, GND

Port 2/3/4:

RS-232: RXD, TXD, RTS, CTS, GND

RS-485: DATA+, DATA-, GND

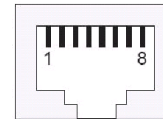
### Serial Console Port:

Serial console port is used for locally accessing Matrix 504 system using RS-232 port. The console port uses RJ45 connector and is next to Ethernet port. Therefore please be careful to plug in the right connector

Port 0: RS-232:RXD, TXD, GND

Pin	Definition
1	PIO0
2	TXD
3	GND
4	PIO1
5	PIO2
6	PIO3
7	RXD
8	PIO4

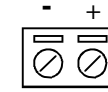
### **Console**



Therefore you need to prepare or purchase the serial console cable (CB-RJ2CON-100) in order to use the serial console port . In addition to the serial console signal, the console RJ45 port also provides GPIO ( programmable I/O signal) function. The GPIO port is CMOS I/O and can be programmed as digital input or output. Power up setting is digital input mode with 75K ohm pull up resistor.

### Power Connector

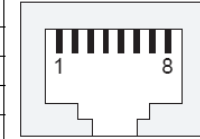
Connect the 9 to 48VDC power line to Matrix 504. If the power is properly supply, the power LED will show a solid green color.



### Ethernet Port

The Ethernet Port use RJ45 connector

Pin	Signal
1	ETx+
2	ETx-
3	ERx+
6	ERx-

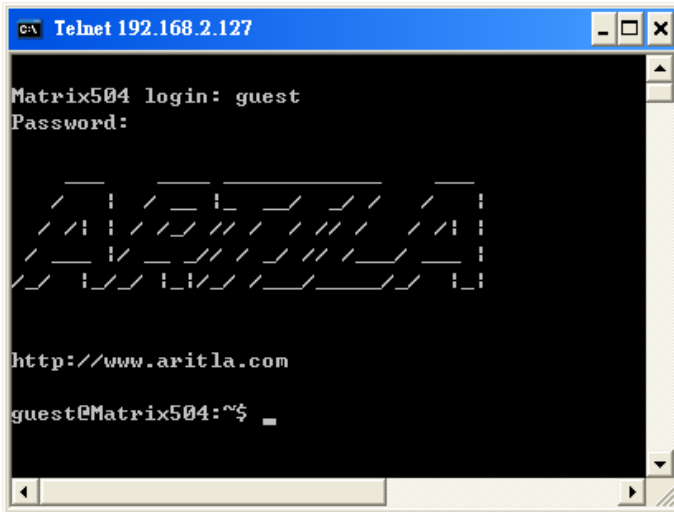


### Factory Default Settings

LAN 1 IP Address: 192.168.2.127  
Login: root or guest ( telnet guest only)  
Password: root or guest ( telnet guest only)  
Serial Console Port:  
    Baud rate: 115200  
    Data format: 8 Bits, No Parity, 1 Stop bit (N,8,1)  
    Flow Control: None  
    Terminal type: VT100

### Power on and System boot up

Once Matrix-504 is correctly power on, it will start boot Linux kernel and mount file system. You can use Ethernet and telnet and login Matrix-504. Once kernel loaded, it will find */sbin/init* and execute it. The initialization configuration is at */etc/inittab*. Once boot up, you can use telnet to login Matrix-504.



```
GA Telnet 192.168.2.127
Matrix504 login: guest
Password:
http://www.aritla.com
guest@Matrix504:~$
```

### Inittab and Run levels:

Inittab contains information of system initialization. The system initialization script */etc/rc.S.d* runs first then the run level 5 */etc/rc5.d* Matrix-504 uses run level for system setup and the default run level is number 5. Please refer to introduction to linux (<http://tille.garrels.be/training/tldp/>) for information about run level. Following is the run levels setting:

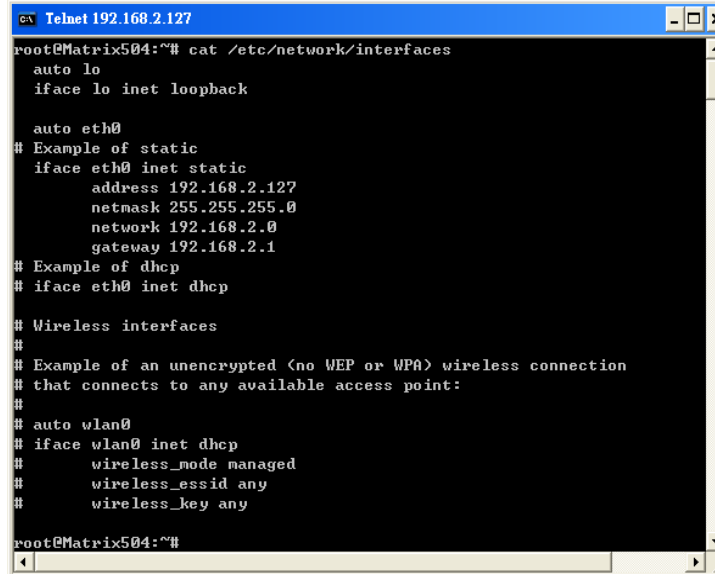
- Run level 0: halt
- Run level 1 is single user ( login and service are disabled )
- Run level 2~5 are multiple users
- Run level 6 is reboot.

Please refer to loader menu section for selection of run level

### Default started service

1. amgrd (Artila broadcast search daemon)
2. ssh (secured shell) with sftp
3. syslog/klogd (system and kernel log)
4. telnet server (disable root with */etc/security*)
5. ftp server (vsftp)
6. web server (apache2)
7. Ready LED (debug LED for internal use)

### Network Settings



```
GA Telnet 192.168.2.127
root@Matrix504:~# cat /etc/network/interfaces
auto lo
iface lo inet loopback

auto eth0
# Example of static
iface eth0 inet static
address 192.168.2.127
netmask 255.255.255.0
network 192.168.2.0
gateway 192.168.2.1

# Example of dhcp
# iface eth0 inet dhcp

# Wireless interfaces
#
# Example of an unencrypted (no WEP or WPA) wireless connection
# that connects to any available access point:
#
# auto wlan0
# iface wlan0 inet dhcp
# wireless_mode managed
# wireless_essid any
# wireless_key any

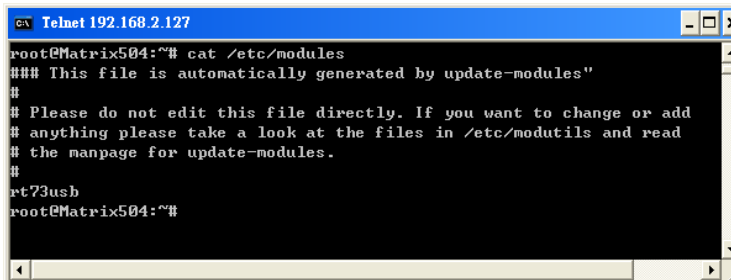
root@Matrix504:~#
```

### Insert kernel module

To insert kernel module while system boot up, please use *vi* to edit */etc/modules* to add module to load e.g.

#### *rt73usb*

To load the USB WLAN adaptor.



```
GA Telnet 192.168.2.127
root@Matrix504:~# cat /etc/modules
### This file is automatically generated by update-modules"
#
# Please do not edit this file directly. If you want to change or add
# anything please take a look at the files in /etc/modutils and read
# the manpage for update-modules.
#
rt73usb
root@Matrix504:~#
```

Use *vi* editing tool to edit the */etc/network/interfaces* for network setting. The default setting is static IP 192.168.2.127. Matrix-504 also supports Wireless LAN. Use

*wireless\_essid XXX*

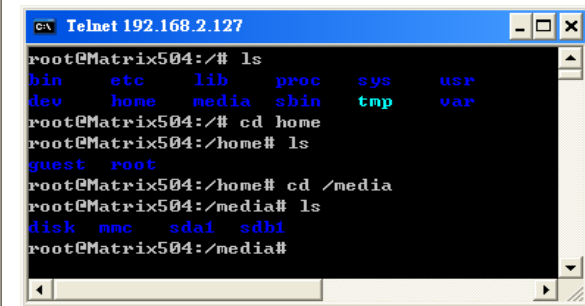
*wireless\_key YYY*

To add SSID and WEP key if necessary. XXX is SSID and YYY is WEP Key

Matrix-504 supports USB WLAN adaptor (Ralink RT2571).

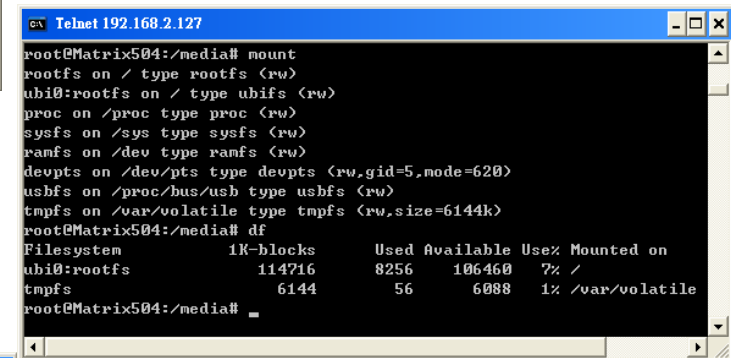
You can enable the driver module (*rt73usb*) by adding *rt73usb* in */etc/modules*

### File System



```
GA Telnet 192.168.2.127
root@Matrix504:~# ls
bin  etc  lib  proc  sys  usr
dev  home  media  sbin  tmp  var
root@Matrix504:~# cd home
root@Matrix504:/home# ls
guest  root
root@Matrix504:/home# cd /media
root@Matrix504:/media# ls
disk  mmc  sda1  sdb1
root@Matrix504:/media#
```

The 128MB NAND Flash memory of Matrix-504 contains Boot loader (uBoot), Linux Kernel, Root File System and user disk (/home). The file system and disk space are shown as follow



```
GA Telnet 192.168.2.127
root@Matrix504:/media# mount
rootfs on / type rootfs (rw)
ubi0:rootfs on / type ubifs (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
ramfs on /dev type ramfs (rw)
depts on /dev/pts type depts (rw,gid=5,mode=620)
usbfs on /proc/bus/usb type usbfs (rw)
tmpfs on /var/volatile type tmpfs (rw,size=6144k)
root@Matrix504:/media# df
Filesystem            1K-blocks      Used Available Use% Mounted on
ubi0:rootfs            114716         8256   106460    7% /
tmpfs                  6144            56     6088    1% /var/volatile
root@Matrix504:/media#
```

## Devices list

The supported devices are shown at /dev directory. Following list are most popular ones:

1. ttyS0: serial console port
2. ttyS1 to ttyS4: serial port 1 to port 4
3. sda to sdb: USB flash disk
4. ttyUSB0 to ttyUSB1: USB RS-232 adaptor (fdti\_sio.ko)
5. rtc: Real Time Clock
6. gpio: General Purpose digital I/O
7. ttyACM0 and ttyACM1: USB Modem (CDC compliant)

## Utility Software:

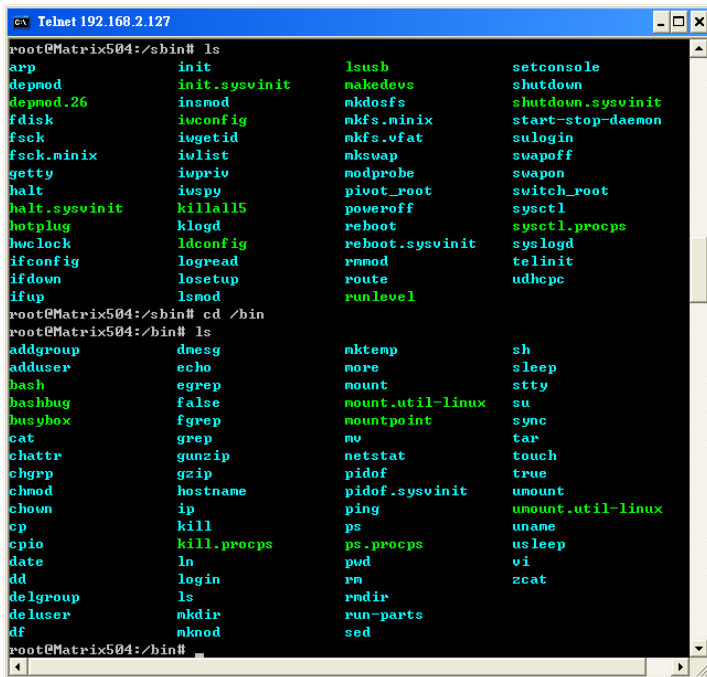
Matrix 504 includes busybox utility collection and Artila utility software and there are placed at :

/sbin

/bin

/usr/bin

Please refer to Appendix for the utility collection list



```
ex Telnet 192.168.2.127
root@Matrix504:/sbin# ls
arp                init               lsusb              setconsole
depmod             init.sysvinit     makedevs          shutdown
depmod.26         insmod            mkdosfs           shutdown.sysvinit
fdisk              iwconfig          mkfs.minix        start-stop-daemon
fsck              iwgetid           mkfs.vfat         sulogin
fsck.minix        iwlist            mkswap            swapoff
getty             iupriv           modprobe          swapon
halt              iwspy            pivot_root        switch_root
halt.sysvinit     killall5          poweroff          sysctl
hotplug           klogd            reboot            sysctl.procps
hwclock           ldconfig          reboot.sysvinit   syslogd
ifconfig          logread           rmmod             telinit
ifdown            losetup           route             udhcp
ifup              lsmod            runlevel

root@Matrix504:/sbin# cd /bin
root@Matrix504:/bin# ls
addgroup           dmesg              nktmp             sh
adduser           echo               nore              sleep
hash              egrep              mount             stty
bashbug           false             mount.util-linux su
busybox           fgrep              mountpoint        sync
cat               grep              mv                tar
chattr            gunzip             netstat           touch
chgrp             gzip              pidof             true
chmod             hostname          pidof.sysvinit   umount
chown             ip                ping              umount.util-linux
cp               kill              ps                uname
cpio              kill.procps       ps.procps         usleep
date              ln                pwd               vi
dd               login             rm                zcat
delgroup          ls                rmdir
deluser           mkdir             run-parts
df               mkmod             sed
```

## Mounting External Storage Memory

To find out the device name of the external memory device which plug into Matrix 504, you can use the command

```
/dmesg | grep sd
```

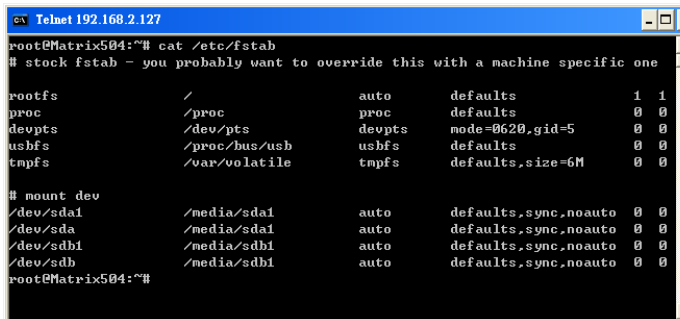
To find out the device type (sda or sdb)

And use

```
mount /dev/sda1
```

to mount the USB disk and folder is local at

```
/media/sda1 or /mnt/sda1
```



```
ex Telnet 192.168.2.127
root@Matrix504:~# cat /etc/fstab
# stock fstab - you probably want to override this with a machine specific one

rootfs                /                    auto                defaults            1 1
proc                  /proc               proc                defaults            0 0
devpts                /dev/pts            devpts             mode=0620,gid=5    0 0
usbfs                 /proc/bus/usb       usbfs              defaults            0 0
tmpfs                 /var/volatile       tmpfs              defaults,size=6M   0 0

# mount dev
/dev/sda1              /media/sda1         auto                defaults,sync,noauto 0 0
/dev/sda               /media/sda1         auto                defaults,sync,noauto 0 0
/dev/sdb1              /media/sdb1         auto                defaults,sync,noauto 0 0
/dev/sdb               /media/sdb1         auto                defaults,sync,noauto 0 0
root@Matrix504:~#
```

## Welcome Message

To modify the welcome message, user can use text edit to modify the /etc/motd.

## Web Page Directory

The web pages are placed at /usr/share/apache2 and the /etc/apache2/httpd.conf contains the apache web server settings.

The home page name should be index.html

## Adjust the system time

To adjust the RTC time, you can follow the command

```
/date MMDDhhmmYYYY
```

where

MM=Month (01~12)

DD=Date (01~31)

hh=Hour

mm=minutes

YYYY= Year

```
/hwclock -w
```

To write the date information to RTC

User can also use NTP client utility in Artila CD to adjust the RTC time.

```
/ntpclient [time server ip]
```

## SSH Console

Matrix 504 supports SSH. If you use Linux computer, you can use SSH command to login Matrix 504. The configuration of SSH and key are located at

/etc/ssh

The key generation program is available at /usr/bin



```
192.168.2.127 - PuTTY
login as: root
root@192.168.2.127's password:

Matrix 504

http://www.aritla.com

root@Matrix504:~#
root@Matrix504:~#
```

## Putty Console Software

For Windows user, you can download the putty software at <http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html> to use SSH to login Matrix-504

## ipkg package software management

ipkg is a light software package utility. It can be used to install, upgrade and remove the software package for Matrix-504. Currently user can use ipkg to install the software package from Artila FTP. You can find the configuration at ipkg.conf

When Matrix-504 is connected to network and issue command

**ipkg update**

To update the package list and use

**ipkg install**

to install software package and

**ipkg remove**

to remove software

**ipkg list**

to list available software

**ipkg list installed**

to list software installed

Please refer to Appendix for more about ipkg

### Install GNU Tool Chain

Find a PC with Linux 2.6.X Kernel installed and login as a root user then copy the arm-linux-3.3.2.tar.gz to root directory of PC. Under root directory, type following command to install the Matrix 504 Tool Chain

```
#tar zxvf arm-linux-3.3.2.tar.gz
```

### Getting started with the Hello program

There are many example programs in Artila CD. To compile the sample you can use the Make file to and type `make`

To compile and link the library. Once done, use ftp command `ftp 192.168.2.127`

And bin command to set transfer mode to binary

```
ftp>bin
```

to transfer the execution file to Matrix 504 user disk (/home/guest) and use

```
chmod +x file.o
```

To change it to execution mode and

```
./file.o
```

to run the program

### Auto start program on boot:

To start a program on boot, you can use `/etc/rc.local`

For example to use `vi` to edit `rc.local`

```
/guest/hello &  
exit 0
```

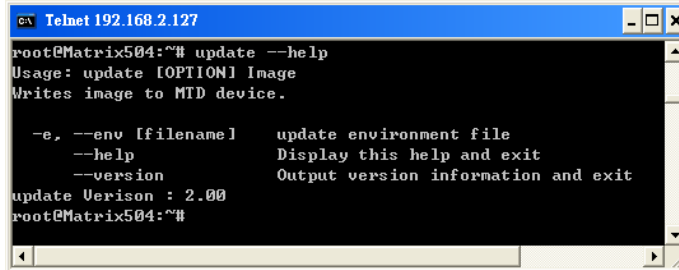
Hello will be executed after system boot up. `rc.local` has the similar function as `/etc/rc` in Matrix-500

### Artila Utility Software:

The introduction of Artila utility software as follow:

1. **update** : update loader, environment file and kernel image.

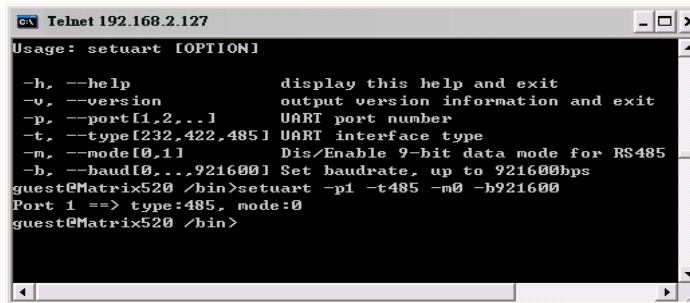
Type `update—help` to find the command usage



```
Telnet 192.168.2.127  
root@Matrix504:~# update --help  
Usage: update [OPTION] Image  
Writes image to MTD device.  
  
-e, --env [filename]  update environment file  
--help                Display this help and exit  
--version             Output version information and exit  
update Version : 2.00  
root@Matrix504:~#
```

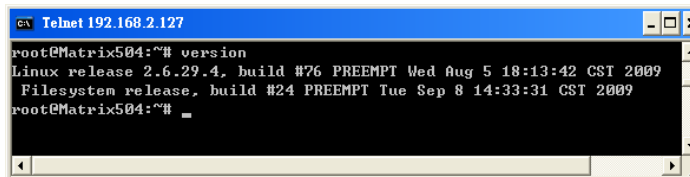
Update can only operated under supervisor mode (password : root)

2. **setuart**: configure serial port setting. An example show as followed to configure port 1 as RS-485 interface with baud rate 921600.



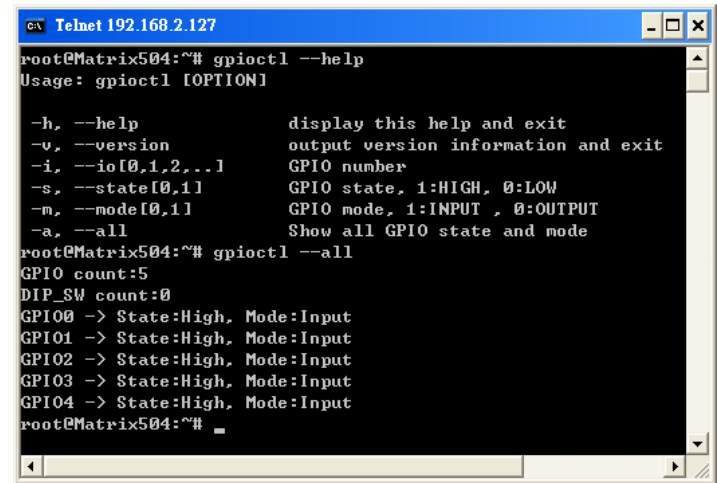
```
Telnet 192.168.2.127  
Usage: setuart [OPTION]  
  
-h, --help            display this help and exit  
-v, --version         output version information and exit  
-p, --port[1,2,..]   UART port number  
-t, --type[232,422,485] UART interface type  
-m, --mode[0,1]      Dis/Enable 9-bit data mode for RS485  
-b, --baud[0,..,921600] Set baudrate, up to 921600bps  
guest@Matrix520 /bin>setuart -p1 -t485 -m0 -b921600  
Port 1 ==> type:485, mode:0  
guest@Matrix520 /bin>
```

3. **version**: find out the version of OS.



```
Telnet 192.168.2.127  
root@Matrix504:~# version  
Linux release 2.6.29.4, build #76 PREEMPT Wed Aug 5 18:13:42 CST 2009  
Filesystem release, build #24 PREEMPT Tue Sep 8 14:33:31 CST 2009  
root@Matrix504:~#
```

4. **gpiocli**: The gpio can be configured by `gpiocli` and the usage is as shown followed. The default setting is digital input with 75K ohm pull up resistor.



```
Telnet 192.168.2.127  
root@Matrix504:~# gpiocli --help  
Usage: gpiocli [OPTION]  
  
-h, --help            display this help and exit  
-v, --version         output version information and exit  
-i, --io[0,1,2,..]   GPIO number  
-s, --state[0,1]     GPIO state, 1:HIGH, 0:LOW  
-m, --mode[0,1]      GPIO mode, 1:INPUT , 0:OUTPUT  
-a, --all             Show all GPIO state and mode  
root@Matrix504:~# gpiocli --all  
GPIO count:5  
DIP_SW count:0  
GPIO0 -> State:High, Mode:Input  
GPIO1 -> State:High, Mode:Input  
GPIO2 -> State:High, Mode:Input  
GPIO3 -> State:High, Mode:Input  
GPIO4 -> State:High, Mode:Input  
root@Matrix504:~#
```



## Loader Menu

Loader menu helps user to select the run level of system boot up. User need to use serial console to enter loader menu. Please configure the serial port of terminal as follow:

Baud Rate: 115200  
Data bits: 8  
Parity: N  
Stop bit: 1  
Flow Control: None  
Terminal type: VT100

Once power up Matrix-504, please repeatedly keying “@” and you will see the loader menu appear as follow:

```
Starting Matrix504.....
*****
      Artila Loader Version 2.0.0
*****
G: Loader TFTP      L: Loader Serial
K: Kernel TFTP     S: Kernel Serial
F: Filesys TFTP    T: Filesys Serial
E: Env. Upgrade    M: Ethernet Setting
A: Dataflash Booting U: Runlevel
R: Reset
*****
```

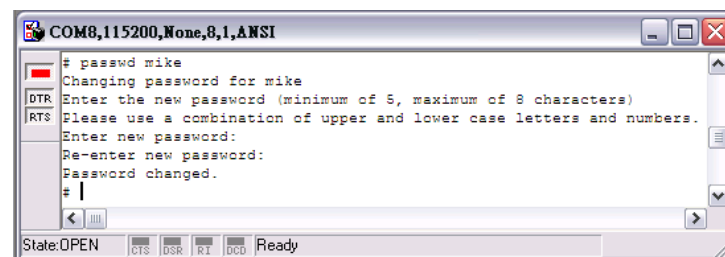
If you miss the timing, please power on again the Matrix-504 and do it again. Select U will prompt the run level selection message. Run level 0 is halt, run level 1 is single user ( disable login and service ). Run level 2~5 are multiple users and run level 6 is reboot. To view the run level configuration, please check

*/etc/inittab*

## Frequently Asked Question

### **1. Forgot password:**

If you forgot the password for login, please use serial console and use run level 1 to boot system. Use passwd to change the password setting.

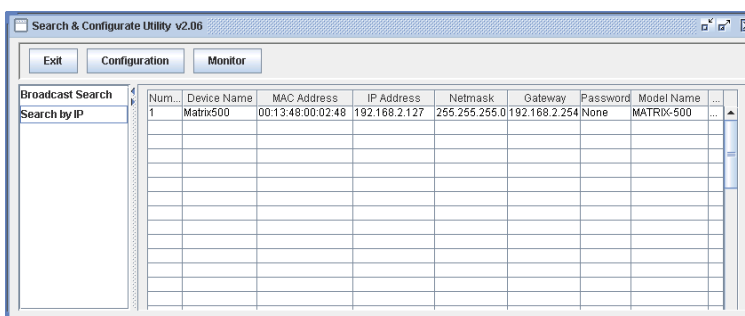


### **2. Forgot the IP address**

If you forgot the Matrix 504 IP address, you can use the Java Manager available in Artila CD to search the IP address of Matrix 504

Or use serial console port to find out the IP address by

*#ifconfig*



### **3. System fail to boot**

If you mess up the root file system and make the system fail to boot, Matrix-504 will automatically switch to boot from Dataflash file system. The Dataflash file system is read only and uses factory default setting. After Dataflash boot, user can organize the NAND file system for system boot.

If system is locked by user program e.g. forgetting to add & at auto start program, user can use Dataflash boot to edit the */etc/rc.local* file.

User can also use loader menu to force Dataflash boot

# Appendix

## Utility Collection

1. busybox v1.14.2-tiny utility collection
2. sysvinit v2.86 -standard Linux initialization
3. util-linux-mount/umount v2.12r-support long file name
4. ssh v4.6p1- support sftp server
5. usbutils v0.7- USB id program
6. Apache2 v2.23-web server
7. wget v1.9.1- used in ipkg software
8. iptables v1.3.8- IP routing
9. ipkg v.0.99.163- software package management
10. procps v3.2.7- support webmin process management
11. vsftpd v2.0.5- ftp server
12. bash v3.2-GNU shell
13. wireless\_tools v29- wireless LAN utility
14. ppp v2.4.3-ppp dial up utility
15. psmics v22.2- procps supplement
16. artila utility v.1.1- handy utility added by Artila

You can find more utility at Artila Matrix-504 CD and use ipkg to install the utility.

## ipkg software package management

Matrix-504 uses **ipkg** to manage the software installation, upgrade and removal. Artila will continuously add the kernel module and utility at our ftp server, user can install these software from internet. In addition user can also setup your ftp server to update the software you want. To install the utility from Artila ftp, please use **vi** to edit the **/etc/ipkg.conf**  
**src/gz arm ftp://ftp:ftp@ftp.artila.com/Matrix5xx/tmp/armv5te**  
**src/gz kernel ftp://ftp:ftp@ftp.artila.com/Matrix5xx/tmp/matrix504**

You can also copy the Utility and module folder to Artila CD to a USB disk, then use USB disk to install the software by changing the **ipkg.conf**  
**src/gz usb\_arm ftp://root:root@127.0.0.1/media/sda1/Utility**  
**src/gz usb\_kernel ftp://root:root@127.0.0.1/media/sda1/modules**

Make sure the internet is connected or USB disk is correctly mount, now use command

### **ipkg update**

to update the package list and use

### **ipkg install webmin**

To install webmin. Webmin is a web-based interface to system administration. To start webmin, go to **/etc/webmin** and type

### **start webmin**

Then you can use browser to visit Matrix-504 port 10000  
http: //192.168.2.127 : 10000

The webmin for Matrix-504 provides following modules:

1. Webmin: webmin configuration
2. System: system boot, process and log management
3. Server: Apache and SSH server configuration
4. Network: network configuration
5. Hardware: RTC setting
6. Others: File manager, upload and download

Remember to use command

**depmod -a /lib/modules/2.6.29.4/modules.dep**

To update the dependency list if new kernel module were added.

