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. 64MB 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
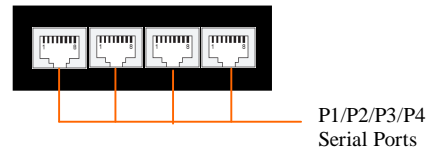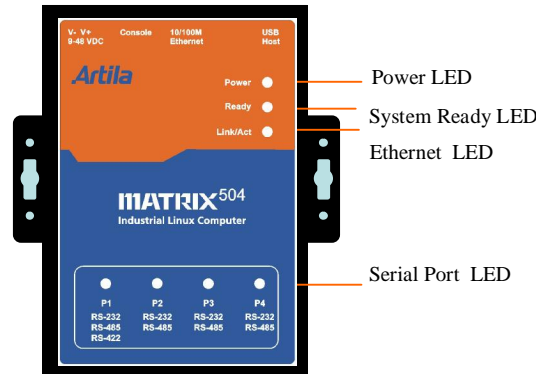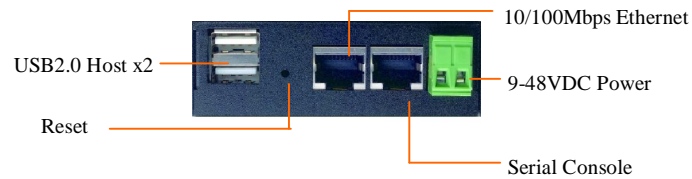12. Optional DIN RAIL mounting adaptor

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

- USB2.0 Host x2
- Reset
- 10/100Mbps Ethernet
- 9-48VDC Power
- Serial Console

- Power LED
- System Ready LED
- Ethernet LED
- Serial Port LED

- P1/P2/P3/P4 Serial Ports

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	---	---
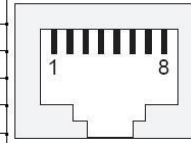
Port 1: RS-232/422/485
    RS-232: RXD,TXD,RTS,CTS,DSR,DTR,DCD,GND
    RS-422: TXD+, TXD-,RXD+,RXD-,GND
    RS-485: DATA+,DATA-,GND
Port 2/3/4:
    RS-232: RXD,TXD,RTS,CTS,GND
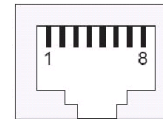   RS-485: DATA+, DATA-, GND

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

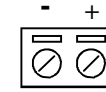| Pin	Definition
1	PIO0
2	TXD
3	GND
4	PIO1
5	PIO2
6	PIO3
7	RXD
8	PIO4

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.
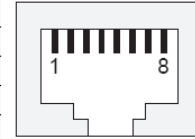
Power Connector

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.

Inittab and Run levels:

Inittab contains information of system initialization. The system initialization script */etc/rcS.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/securetty*)
5.   ftp server (vsftp)
6.   web server (apache2)
7.   Ready LED (debug LED for internal use)

Network Settings

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.

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

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

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
/use/sbin

Please refer to Appendix for the utility collection list

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**

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*

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 packge 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 OS installed as followed:
Fedore 7, ubuntu 7.04, OpenSUSE 10.2, Mandriva 2008, Debian 5.0, Centos (RedHat) 5 and above.
Login as a root user then copy the arm-linux-4.3.2.tar.gz to root directory of PC. Under root directory, type following command to install the Matrix 504 Tool Chain
#tar -xvfj arm-linux-4.3.3.tar.bz2
The tool chain file name are
arm-linux-gnueabi-gcc
arm-linux-gnueabi-g++
arm-linux-gnueabi-strip
Version: gcc 4.3.3, glibc 2.9, binutils 2.18

For Windows user, please download the toolchain from CodeSourcery at
http://www.codesourcery.com/sgpp/lite/arm/portal/package4547/public/arm-none-linux-gnueabi/arm-2009q1-203-arm-none-linux-gnueabi.exe
The tool chain file name are
arm-none-linux-gnueabi-gcc
arm-none-linux-gnueabi-g++
arm-none-linux-gnueabi-strip
Version: gcc 4.3.3, glibc 2.8, binutils 2.19

Getting started with the Hello program

There are many example programs in Artila CD. To compile the sample you can use the Make file and type
make
To compile and link the library. Once done, use ftp command
ftp 192.168.2.127
Then login with password. Use 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*
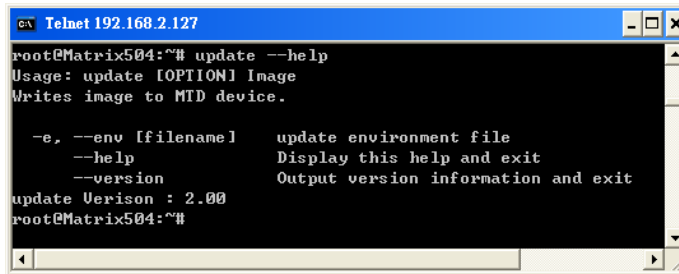For example to use *vi* to edit *rc.local*
hello &
exit 0
Hello will be executed after system boot up. *rc.local* has the similar function as */etc/rc* in Matrix-500

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

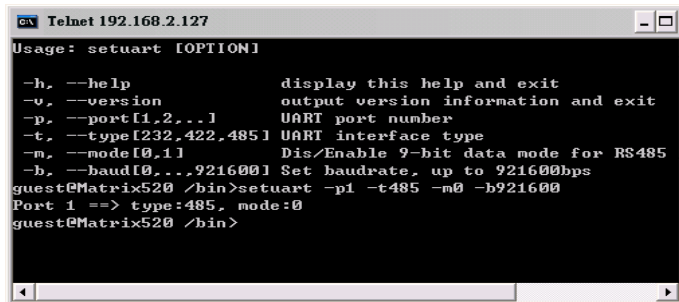Update can only operated under supervisor mode (password : root). Please use command *su* and login as root

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

3. *version:* find out the version of OS.
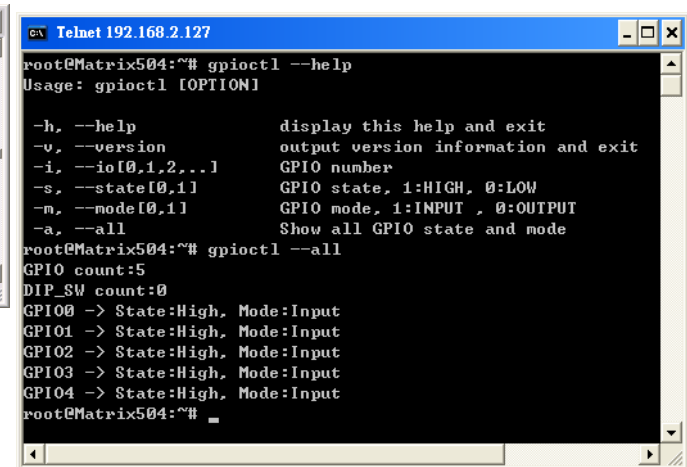
4. *gpioctl:* The gpio can be configured by *gpioctl* and the usage is as shown followed. The default setting is digital input with 75K ohm pull up resistor.

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.
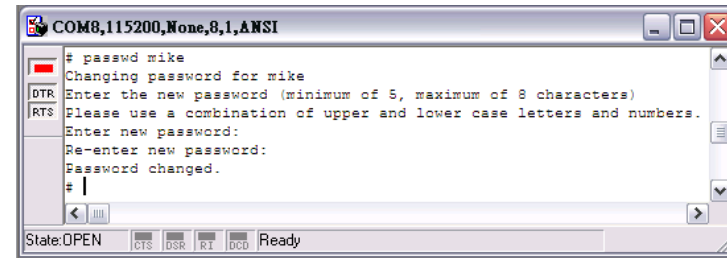
2. *Forgot the IP address*

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
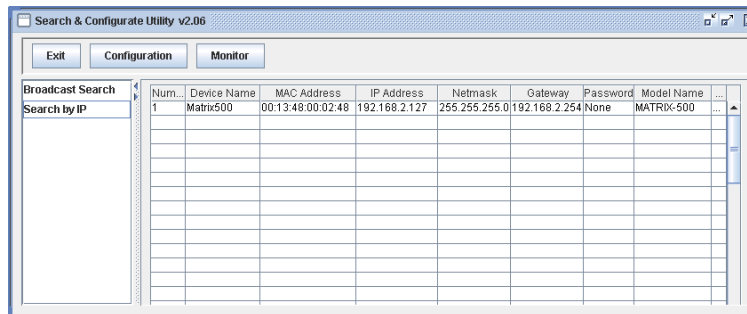
3. *System fail to boot*

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 and a console menu will show up at console port to help user perform system recovery. **System Recovery Section** will tell you how to recover the system.

System Recovery

If NAND Flash file system does fail, DataFlash file system will automatically boot up and a Console Menu at console port will appear as follow:

```
COM1 - PuTTY                                          _ □ ×

  ┌─────────────────────────────┐
  │           MENU              │
  ├─────────────────────────────┤
  │ Update Image                │
  │ Make Filesystem             │
  │ Recovery Env                │
  │ Show Info                   │
  │ Reboot                      │
  └─────────────────────────────┘




Use arrow keys to go up and down, Press enter to select a choice
type 'R' to Reboot
```

1. Update Image: this option can recover the loader, kernel and file system by using an USB disk. The USB disk contains the images files with the path as follow:

   Loader: ***matrix504/matrix504.alf***
   Kernel: ***matrix504/matrix504K***
   File system: ***matrix504/matrix504R***

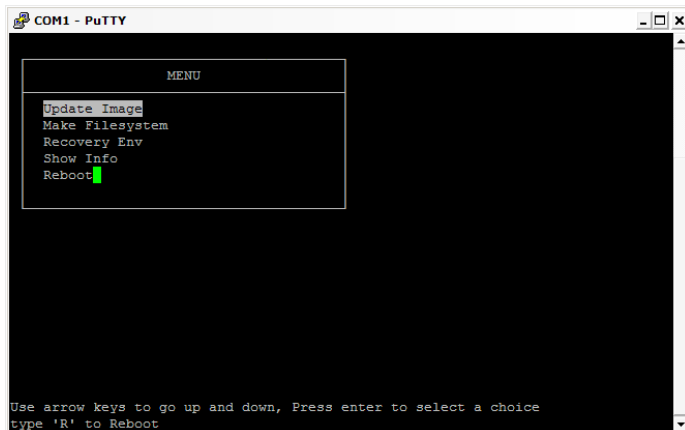The files are available in Artila CD. Please prepare an USB disk and copy the image files to it before choosng this option.
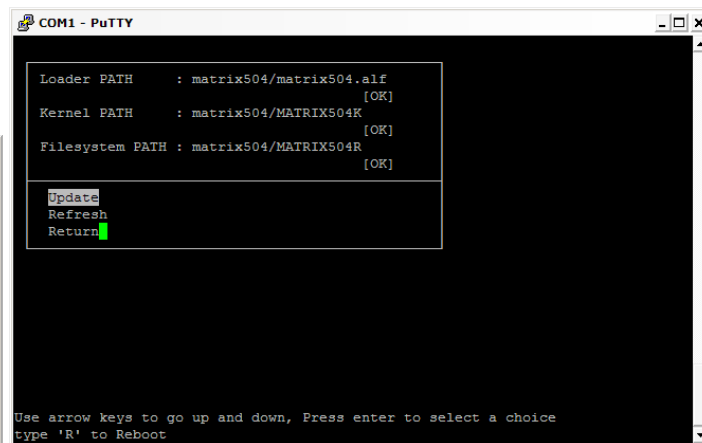
2. Make Filesystem: this option is used to create customized file system.   Before using this function, you need to copy the folder of ***mkimage504*** in the Artila CD to an USB disk. This function will create a new file system image for users and they can use it to duplicate the customized file system to other Matrix-504.

3. Recovery Env.: The option will recover the environment files as default setting.   Use this function only when the NAND file system crash.

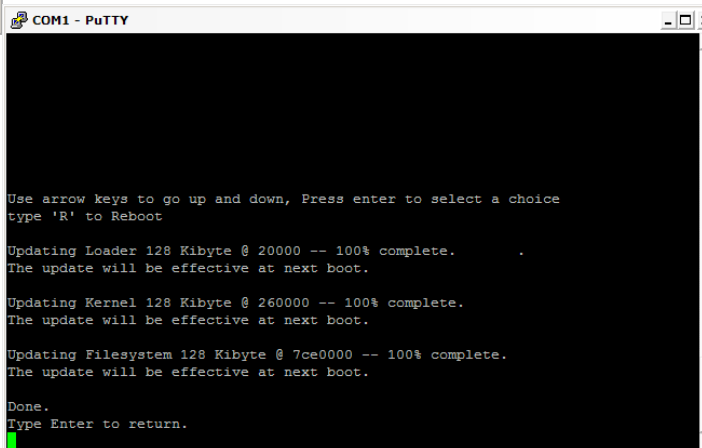4. Show Info: Show the version information of Matrix-504

5. Reboot: Reboot the NAND flash file system.
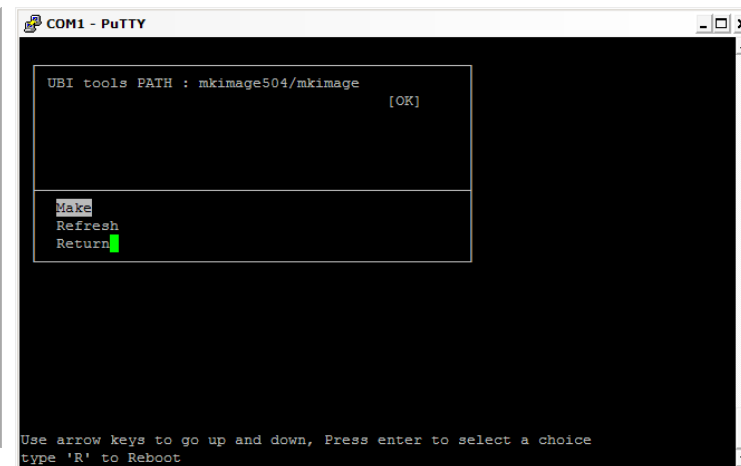
Update Image Starts

```
COM1 - PuTTY                                          _ □ ×

  ┌─────────────────────────────────────────────────┐
  │ Loader PATH      : matrix504/matrix504.alf        │
  │                                         [OK]      │
  │ Kernel PATH      : matrix504/MATRIX504K           │
  │                                         [OK]      │
  │ Filesystem PATH : matrix504/MATRIX504R            │
  │                                         [OK]      │
  │                                                   │
  │ Update                                            │
  │ Refresh                                           │
  │ Return                                            │
  └─────────────────────────────────────────────────┘




Use arrow keys to go up and down, Press enter to select a choice
type 'R' to Reboot
```

Update Image Completes

```
COM1 - PuTTY                                          _ □ ×




Use arrow keys to go up and down, Press enter to select a choice
type 'R' to Reboot

Updating Loader 128 Kibyte @ 20000 -- 100% complete.          .
The update will be effective at next boot.

Updating Kernel 128 Kibyte @ 260000 -- 100% complete.
The update will be effective at next boot.

Updating Filesystem 128 Kibyte @ 7ce0000 -- 100% complete.
The update will be effective at next boot.

Done.
Type Enter to return.
```

Make Files System Starts

```
COM1 - PuTTY                                          _ □ ×

  ┌─────────────────────────────────────────────────┐
  │ UBI tools PATH : mkimage504/mkimage               │
  │                                         [OK]      │
  │                                                   │
  │                                                   │
  │                                                   │
  │ Make                                              │
  │ Refresh                                           │
  │ Return                                            │
  └─────────────────────────────────────────────────┘



Use arrow keys to go up and down, Press enter to select a choice
type 'R' to Reboot
```

Note:

1.   Use Arrow keys up and down to selection the functions
2.   Use Arrow keys left and right to go to higher or lower levels of menu screen
3.   To force system go into DataFlash booting, repeatedly keying "!" (Shift +1) right after Matrix-504 power on.

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 Artila's ftp server. 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/Matrix504/Linux/Utility
src/gz kernel ftp://ftp:ftp@ftp.artila.com/Matrix504/Linux/modules

You can also copy the Utility and module folder from 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 USB disk is correctly mounted, 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.