

Introduction:

Matrix 513 is an ARM9-based Linux ready industrial computer. The key features are as follow:

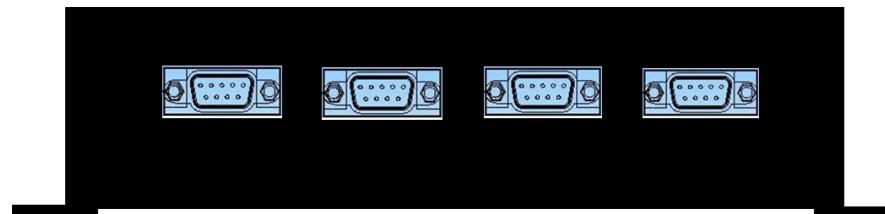
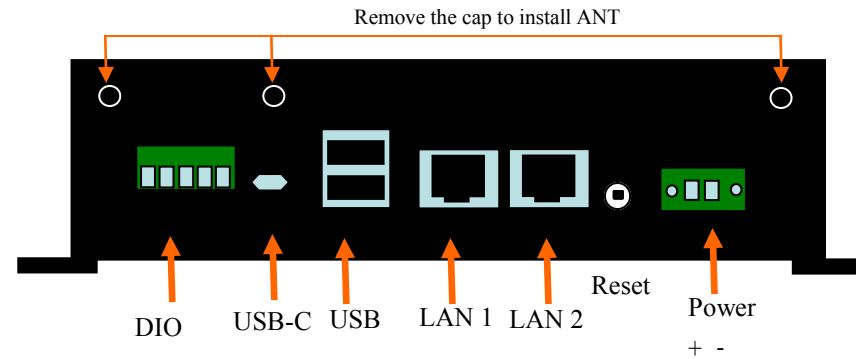
1. Atmel AT91SAM9G45 400MHz w/MMU
2. 32-KByte Data Cache and 32-KByte Instruction Cache
3. 128MB DDR2 RAM, 256MB NAND Flash on board
4. Two 10/100 Mbps Ethernet
5. Two USB 2.0 high speed (480 Mbps) Host ports, one USB device port
6. Multimedia Card Interface for Micro SD memory card
7. Four RS-232/422/485 ports
8. One full size and one half size miniPCIe card socket (USB bus only)
9. Two isolated (2500 Vrms) digital input
10. One relay (30VDC @1A) form A or B output (jumper select)
11. Ready for wireless LAN and 3G miniPCIe module (USB bus)
12. 9 to 48VDC power input
13. Pre-installed Standard Linux 2.6.38 kernel and file system
14. GNU tool chain available in Artila CD
15. Optional DIN RAIL mounting adaptor

Packing List

1. Matrix 513 Box Computer
2. Wall mount bracket
3. Artila CD includes Tool Chain (C/C++), user guide and utility software and device driver.

Optional Accessory:

1. CBL-F10M9-20: Serial Console Cable
2. DK-35A: DIN RAIL Mounting Kit
3. External antenna cable
4. External antenna
5. wireless LAN miniPCIe card
1. 3G miniPCIe card
2. PWR-12V-1A: 110~240VAC to 12 VDC 1A Power adaptor

Matrix 513Layout

Pin Assignment and Definition

Reset Button

Press the “Reset” button to activate the hardware reset. You should only use this function if the software does not function properly.

Power LED

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

Ready LED

The Ready LED will show solid green if Matrix 513 complete system boot up. If Ready LED is off during system boot up, please check if power input is correct. Turn off the power and restart Matrix 513 again. If Ready LED is still off, please contact the manufacture for technical support.

Link/Act LED

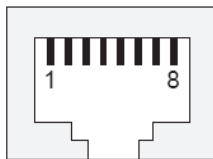
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic in the Ethernet port, this LED will flash

Serial Port LED

These eight 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.

Ethernet Port

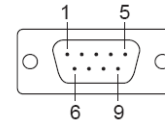
| Pin | Signal |
|-----|--------|
| 1 | ETx+ |
| 2 | ETx- |
| 3 | ERx+ |
| 6 | ERx- |



Serial Port (DB9 Male)

| Pin No. | RS-232 | RS-422 | RS-485 |
|---------|--------|--------|--------|
| 1 | DCD* | TXD- | — |
| 2 | RXD | TXD+ | — |
| 3 | TXD | RXD+ | DATA+ |
| 4 | DTR* | RXD- | DATA- |
| 5 | GND | GND | GND |
| 6 | DSR* | — | — |
| 7 | RTS | — | — |
| 8 | CTS | — | — |
| 9 | --- | — | — |

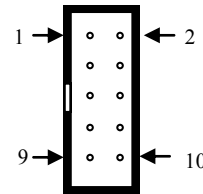
Port 1~4



Note: * Port 2 only

Serial Console Port:

Serial console port is located inside the box at CON1. You need to use console cable (CBL-F10M9-20) to access it

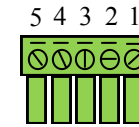


| Serial Console RS-232 | | | |
|-----------------------|-----|----|-----|
| 1 | N/C | 2 | N/C |
| 3 | RXD | 4 | N/C |
| 5 | TXD | 6 | N/C |
| 7 | N/C | 8 | N/C |
| 9 | GND | 10 | N/C |

To use the serial console port, you need to open the metal case of Matrix-513 and the console connector is near the reset button and LEDs. Use any terminal software such as hyper terminal and configure the setting as follow:

Baud Rate: 115200
Data bits: 8
Parity: N
Stop bit: 1
Terminal type: VT100

Digital I/O Port



| | |
|---|--------|
| 1 | DO Out |
| 2 | DO Com |
| 3 | DI 1 |
| 4 | DI 2 |
| 5 | DI Com |

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 (usbserial.ko)
5. gpio: General Purpose digital I/O
6. ttyACM0 and ttyACM1: USB Modem (CDC compliant)
7. spi0, spi1: SPI bus controller
8. mmc : SD driver
9. rtc0: m41t81 real time clock device (default)
10. rtc1: rs5c372a real time clock device (M-501 compatible)

Utility Software:

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

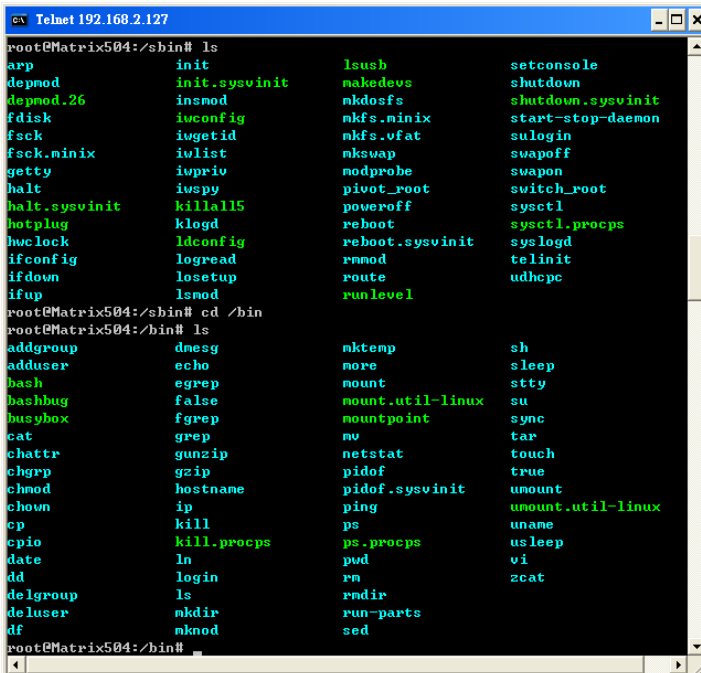
/sbin

/bin

/usr/bin

/use/sbin

Please refer to Appendix for the utility collection list



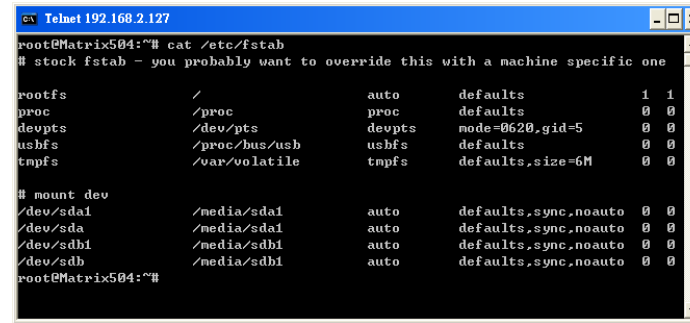
```

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        iulist            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             udhcpc
ifup             lsmod            runlevel

root@Matrix504:/sbin# cd /bin
root@Matrix504:/bin# ls
addgroup          dmesg             mktemp            sh
adduser          echo              more              sleep
bash             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                usleep
cpio             kill.procps     ps.procps        vi
date             ln               pwd              zcat
dd               login            rn
de lgroup        ls               rndir
deluser          mkdir            run-parts
df              mkmod            sed
```

Mounting USB device by udev

Matrix supports udev which can automatically load the device driver when plugging your USB device.



```

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:~#
```

Web Page Directory

The web pages are placed at /usr/www and the /etc/lighttpd.conf contains the lighttpd 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.

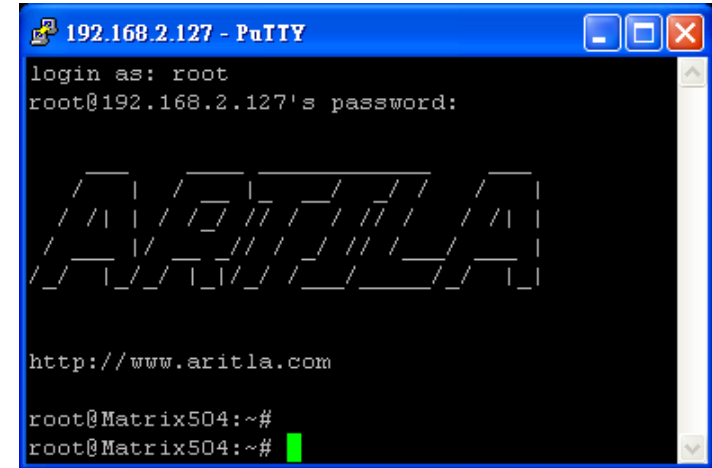
ntpclient [time server ip]

SSH Console

Matrix supports SSH. If you use Linux computer, you can use SSH command to login Matrix. 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:
Matrix504
http://www.artila.com
root@Matrix504:~#
root@Matrix504:~#
```

Welcome Message

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

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

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. Currently user can use ipkg to install the software package from Artila FTP. You can find the configuration at *ipkg.conf* When Matrix 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 Tool Chain

```
#tar -xvzf 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 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
```

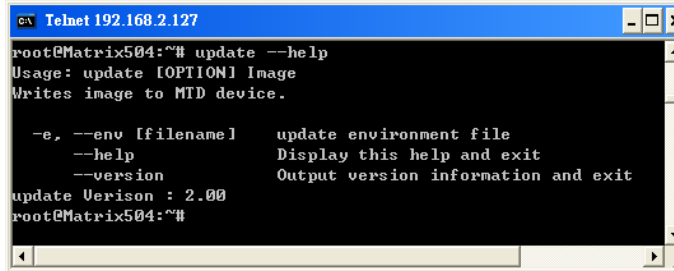
Hello will be executed after system boot up. **rc.local** has the similar function as **/etc/rc** in Matrix

Artila Utility Software:

The introduction of Artila utility software as follow:

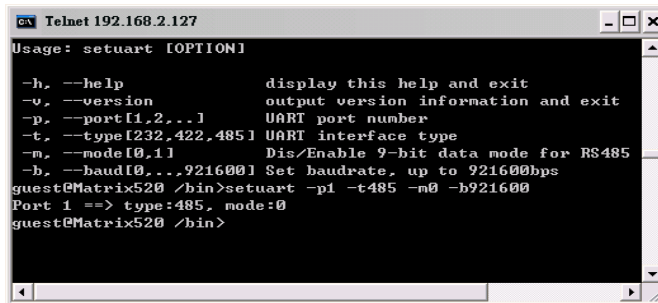
1. **update** : update loader, environment file and kernel image.

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

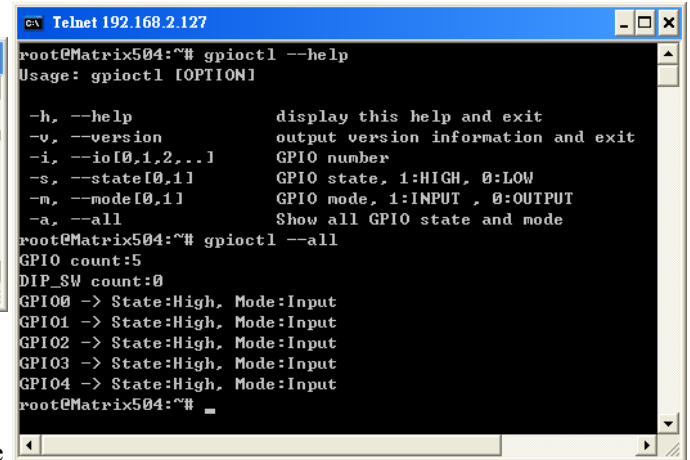
2. **setuart**: configure serial port setting. An example show as followed to configure port 1 as RS-485 interface with baud rate 921600.



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



4. **gpiocli**: The gpio can be configured by **gpiocli** and the usage is as shown followed.



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, please repeatedly keying “@” and you will see the loader menu appear as follow:

```
*****
Artila Loader Version 3.0.1
DRAM:128M NAND:128M
*****
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
I: Boot Graphics  V: LCD Mode
R: Reset
*****
```

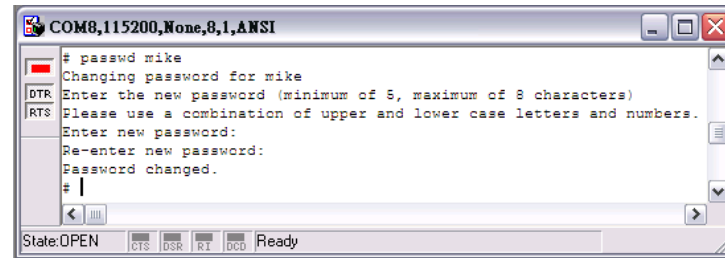
If you miss the timing, please power on again the Matrix and do it again. Select U will prompt the run level selection message. Run level 0 is halt, run level 1 is single user (disable login and service). Run level 2~5 are multiple users and run level 6 is reboot. To view the run level configuration,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

/etc/inittab

Frequently Asked Question

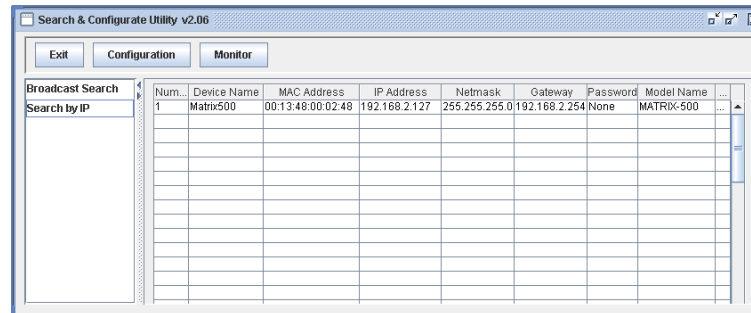
1. Forgot password:

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 IP address, you can use the Java Manager available in Artila CD to search the IP address of Matrix Or use serial console port to find out the IP address by *#ifconfig*

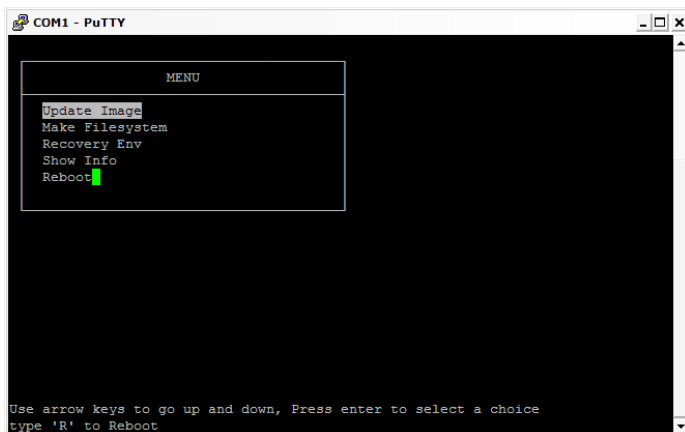


3. System fail to boot

If you mess up the root file system and make the system fail to boot, Matrix 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: **M9G45A/m9g45a.alf**
Kernel: **M9G45A/M9G45-K**
File system: **M9G45A/M9G45-R**

The files are available in Artila CD. Please prepare an USB disk with vFAT file system and copy the image files to it before choosing this option.

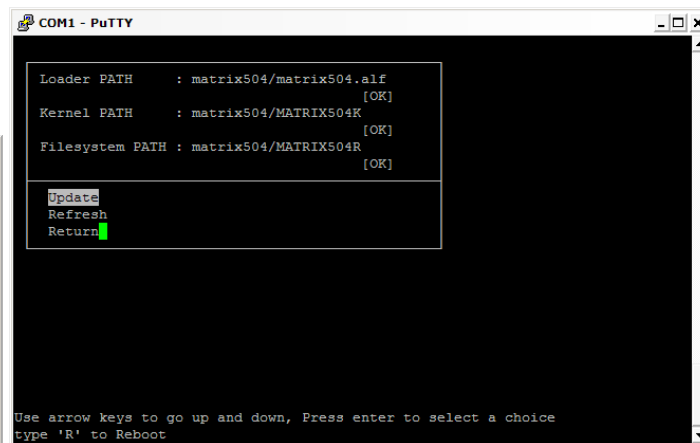
2. Make Filesystem: this option is used to create customized file system. Before using this function, you need to copy the folder of **mkimage** in the Artila CD to an USB disk. This function will create a new file system image for users and they can use it to duplicate the customized file system to other Matrix.

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

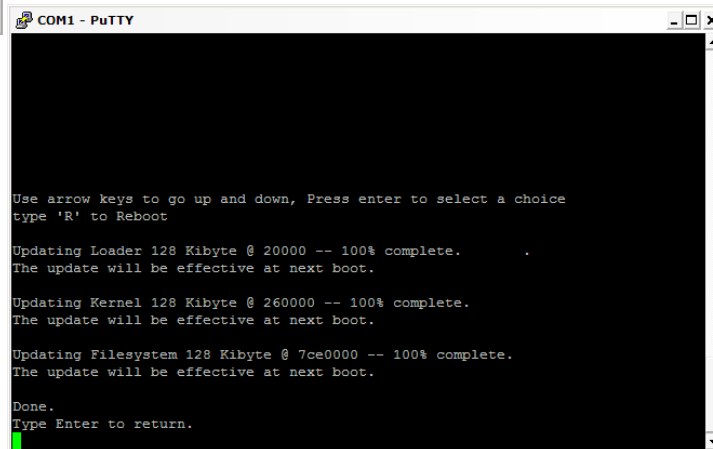
5. Reboot: Reboot the NAND flash file system.

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

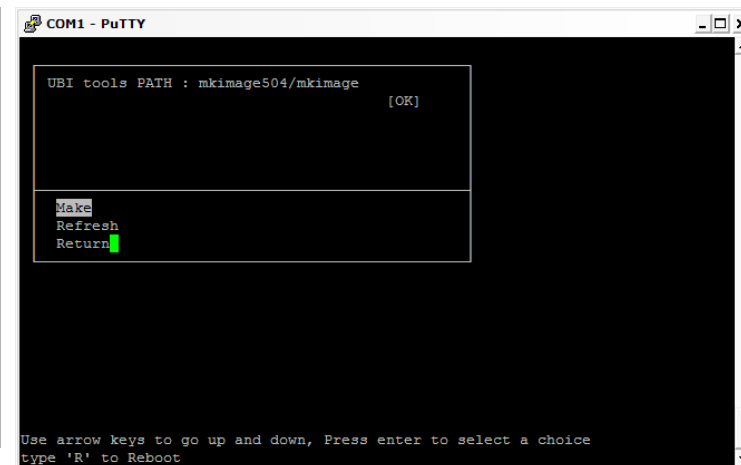
Updating Loader 128 Kibyte @ 20000 -- 100% complete.
The update will be effective at next boot.

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 key-ing “!” (Shift +1) right after Matrix power on.

Appendix

Utility Collection

1. Busybox:-tiny utility collection
2. Sysvinit: -standard Linux initialization
3. util-linux-mount/umount :-support long file name
4. ssh :- support sftp server
5. Usbutils:- USB id program
6. Lighttpd:-web server
7. Wget:- used in ipkg software
8. Iptables:- IP routing
9. Ipkg:- software package management
10. Procps:- support webmin process management
11. Vsftpd:- ftp server
12. Bash:-GNU shell
13. wireless_tools :- wireless LAN utility
14. Ppp:-ppp dial up utility
15. Psmics:- procps supplement
16. artila utility:- handy utility added by Artila

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

ipkg software package management

Matrix 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/AT9G45/Artila-CD/Linux/Utility
src/gz kernel ftp://ftp:ftp@ftp.artila.com/AT9G45/Artila-CD/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 port 10000

The webmin for Matrix provides following modules:

1. Webmin: webmin configuration
2. System: system boot, process and log management
3. Server: lighttpd 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/2.6.38.7/modules.dep

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

