Matrix-513

Linux ARM9 Industry Box Computer

User Guide

Version 1.0.1

Table of Contents

1. Introduction

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

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

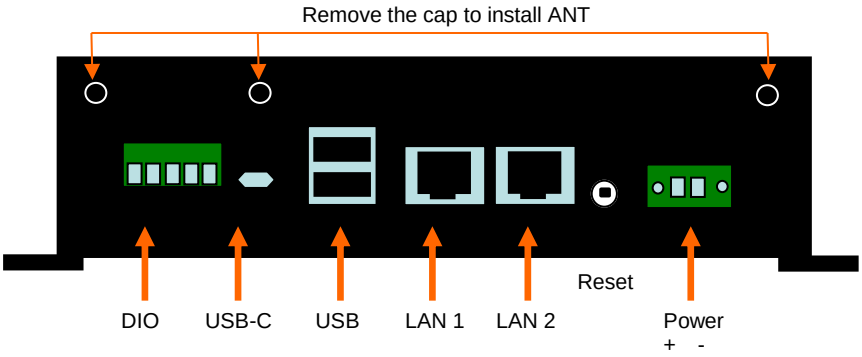
1.1 Packing List

- Matrix-513 Box Computer
- Wall mount bracket

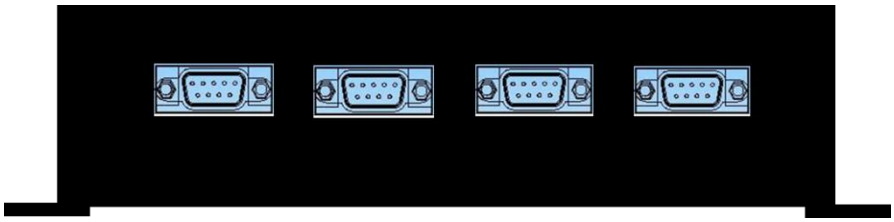
1.2 Optional Accessory

- CBL-F10M9-20 (91-0P9M9-001): Console Cable (10Pin Header to DB9 Male, 20cm)
- DK-35A (36-DK35A-000): DIN RAIL Mounting Kit
- Pigtail-WiFi-1001-20 (91-CST16-001): IPEX to RP-SMA Female Coaxial Cable, 20cm
- Pigtail-3G-1001-20 (91-CST17-001): IPEX to SMA Female Coaxial Cable, 20cm
- Ant-WiFi-1001 (91-CRF38-001): 5dBi External WiFi Antenna
- Ant-3G-1001 (91-CRF37-001): 5dBi External 2G / 3G Antenna
- M-9001 (ZA-CAR00-004): 802.11b/g/n USB Half-size miniPCIe Card, Ralink RT5390U, 1T2R
- M-9011 (CM5000): Full-size miniPCIe 2G / 3G Card, with SIM Socket
- PWR-12V-1A (31-62100-000): 110~240VAC to 12VDC 1A Power Adapter

2. Layout


Remove the cap to install ANT
DIO
USB-C
USB
LAN 1
LAN 2
Reset
Power
+ -


V- V+
9~48VDC
LAN_1
LAN_2
USB Host
Digital Input/Relay Output
Artila
Power
Ready
LAN_1
LAN_2
MATRIX 513
Industrial Linux Computer
RS-232/422/485
P1
RS-232/422/485
P2
RS-232/422/485
P3
RS-232/422/485
P4



3. Pin Assignment and Definition

3.1 Reset Button

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

3.2 Power LED

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

3.3 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.

3.4 Link / Act LED

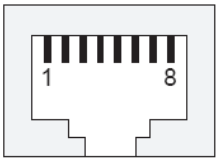
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic is the Ethernet port, this LED will flash.

3.5 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.

3.6 Ethernet Port

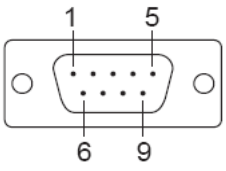
Pin No.	Signal
1	ETx+
2	ETx-
3	ERx+
6	ERx-



3.7 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

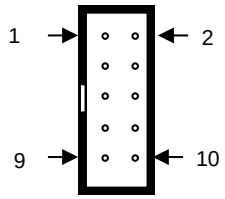


Note: * Port 2 only

3.8 Serial Console Port

Serial console port is located inside the box at CON1. You need to use console cable (91-0P9M9-001) 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

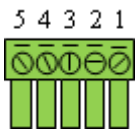
Parity: N

Stop bit: 1

Terminal type: VT100

3.9 Digital I/O Port

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



3.10 Factory Default Settings

LAN 1 IP Address: 192.168.2.127

LAN 2 IP Address: 192.168.3.127

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

3.11 Power on and System Boot up

Once system is correctly power on, it will start boot Linux kernel and mount file system. You can use Ethernet and telnet to login. 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.

3.12 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.*** Linux 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

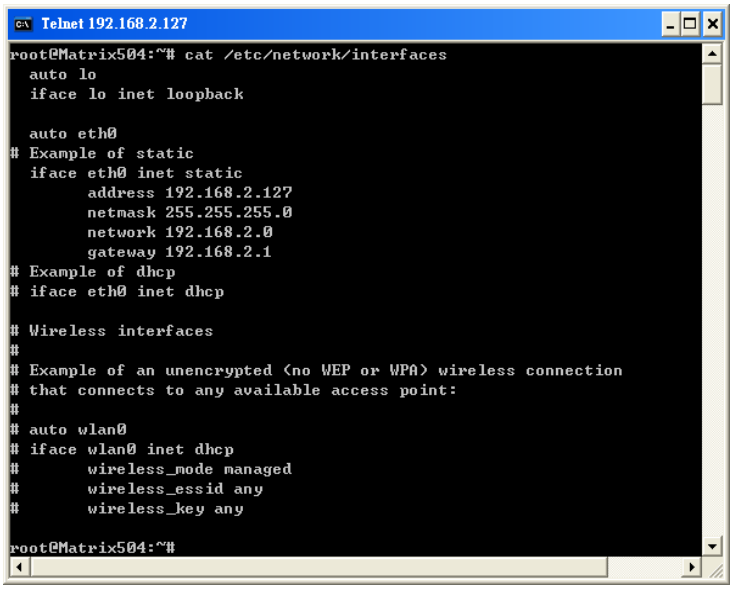
Run level 6 is reboot

Please refer to loader menu section for selection of run level.

3.13 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 (lighttpd)
7. Ready LED (debug LED for internal use)

3.14 Network Settings



Use ***vi*** editing tool to edit the ***/etc/network/interfaces*** for network setting. The Wireless LAN configuration file is located at:

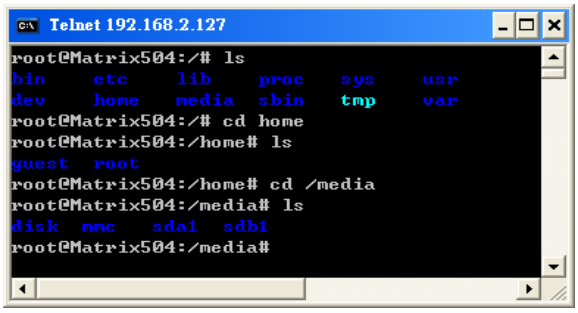
/etc/Wireless/RT5370STA/RT5370STA.dat

Modify the file for the wireless LAN settings. Please refer to the ***RT5370_WIFI_Setup***

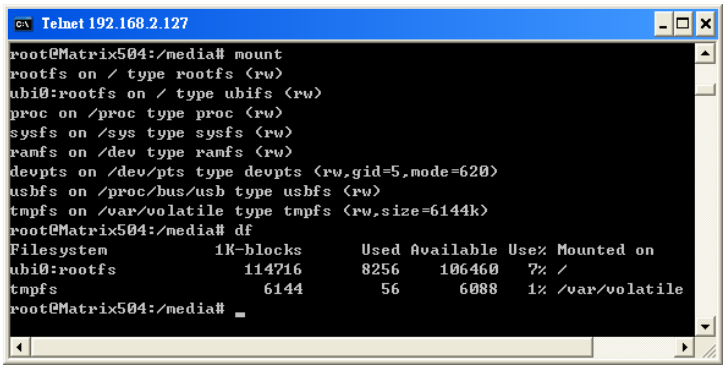
Matrix-513 supports USB WLAN adaptor (Ralink RT2571 and RT5370sta). You can enable the driver module (rt5370sta) by adding ***rt5370sta*** in:

/etc/modules

3.15 File System



The NAND Flash memory of Matrix-513 contains Boot loader (uBoot), Linux Kernel, Root File System and user disk (\home). The file system and disk space are shown as follow:



3.16 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)

3.17 Utility Software

Matrix-513 Linux includes busybox utility collection and Artila utility software and there are placed at:

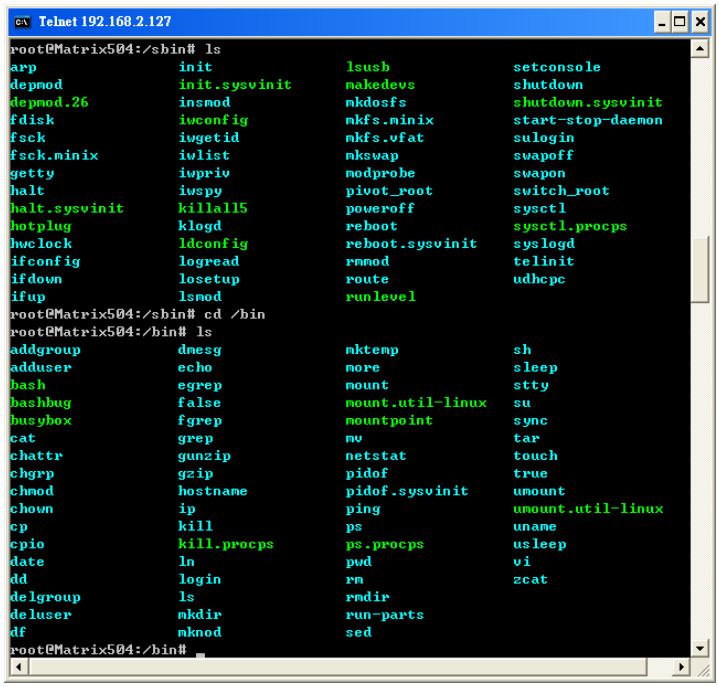
/sbin

/bin

/usr/bin

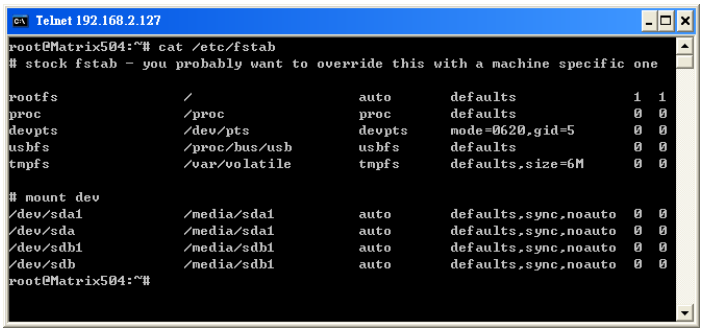
/use/sbin

Please refer to Appendix for the utility collection list.



3.18 Mounting USB Device by udev

Matrix-513 supports udev which can automatically load the device driver when plugging your USB device.



3.19 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.***

3.20 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 on Artila FTP to adjust the RTC time.

ntpclient [time server ip]

3.21 SSH Console

Matrix-513 supports SSH. If you use Linux computer, you can use SSH command to login Matrix-513. The configuration of SSH and key are located at ***/etc/ssh.***

The key generation program is available at ***/usr/bin***.

3.22 Welcome Message

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

3.23 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.

3.24 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-513. Currently user can use ipkg to install the software package from Artila FTP. You can find the configuration at ***ipkg.conf***.

When Matrix-513 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.***

3.25 Install GNU Toolchain

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-513 Toolchain:

#tar -xvfj arm-linux-4.3.3.tar.bz2

The toolchain 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 toolchain 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

3.26 Getting Started with the Hello Program

There are many example programs on Artila FTP. 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-513 user disk (/home/guest) and use

chmod +x file.o

To change it to execution mode and

./file.o

to run the program.

3.27 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

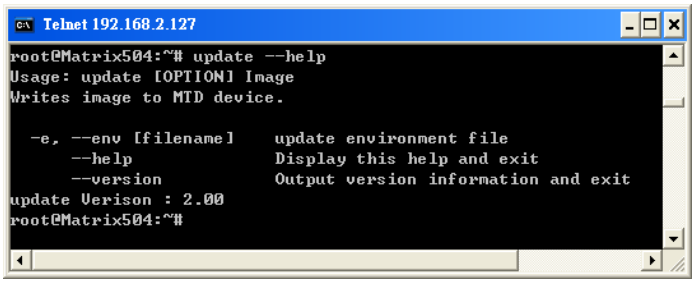
Hello will be executed after system boot up. ***rc.local*** has the similar function as ***/etc/rc*** in Matrix-513.

4. Artila Utility Software

The introduction of Artila utility software as follow:

4.1 update

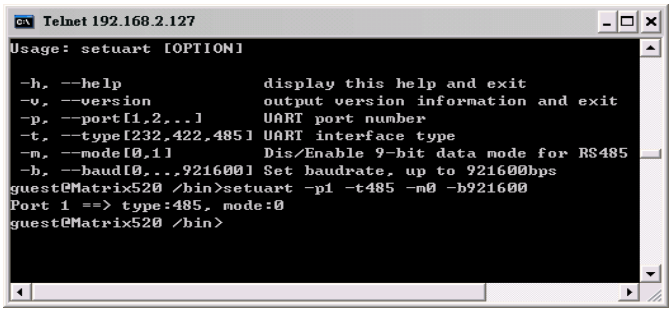
Update loader, environment file and kernel image. Type ***update--help*** to find the command usage.



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

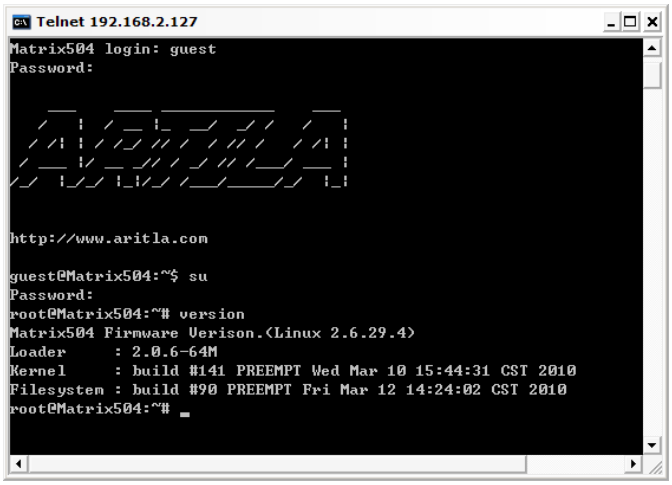
4.2 setuart

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



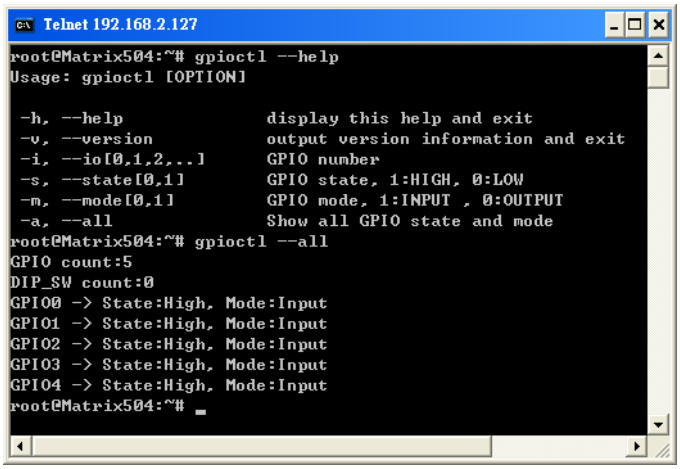
4.3 version

Find out the version of OS.



4.4 gpioctl

The gpio can be configured by ***gpioctl*** and the usage is as shown followed.

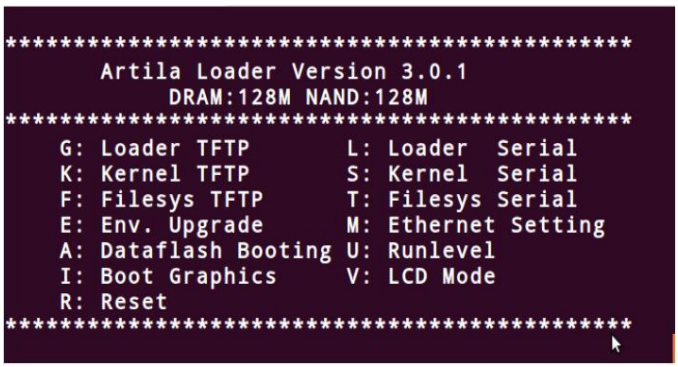


5. Loader Menu

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-513, please repeatedly keying "@" and you will see the loader menu appear as follow:



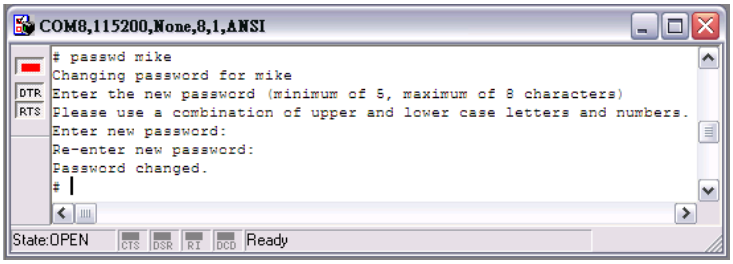
If you miss the timing, please power on again the Matrix-513 and do it again. Select U will prompt the run level selection message. Run level 0 is halt, run level 1 is single user (disable login and service). Run level 2~5 are multiple users and run level 6 is reboot. To view the run level configuration, please check:

/etc/inittab

6. Frequently Asked Question

6.1 Forgot Password

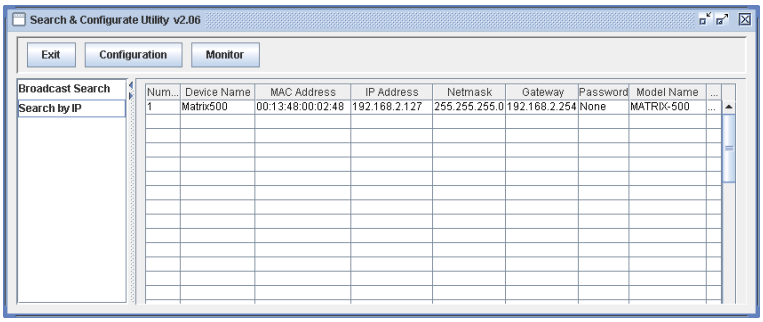
If you forgot the password for login, please use serial console and use run level 1 to boot system. Use passwd to change the password setting.



6.2 Forgot the IP Address

If you forgot the Matrix-513 IP address, you can use the Java Manager available on Artila FTP to search the IP address of Matrix-513.

Or use serial console port to find out the IP address by ***#ifconfig.***

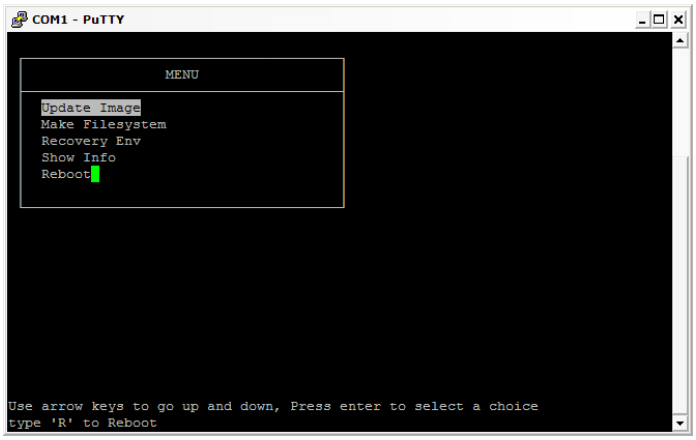


6.3 System Fail to Boot

If you mess up the root file system and make the system fail to boot, Matrix-513 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.

7. 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:



7.1 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 on Artila FTP. Please prepare an USB disk with vFAT file system and copy the image files to it before choosing this option.

7.2 Make Filesystem

This option is used to create customized file system. Before using this function, you need to copy the folder of ***mkimage*** on the Artila FTP 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-513.

7.3 Recovery Env.

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

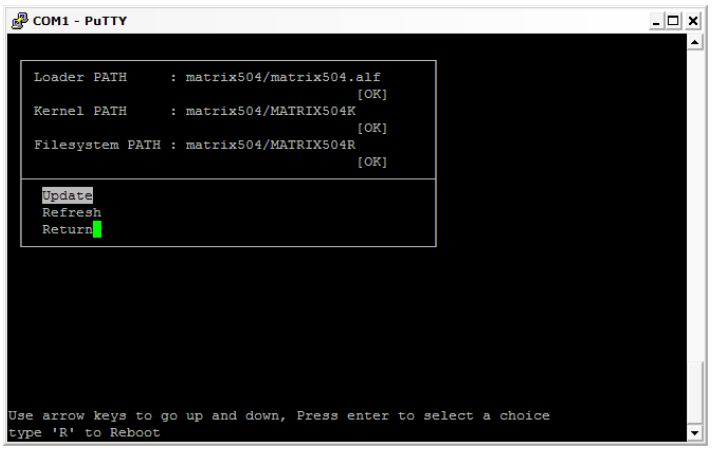
7.4 Show Info

Show the version information of Matrix-513.

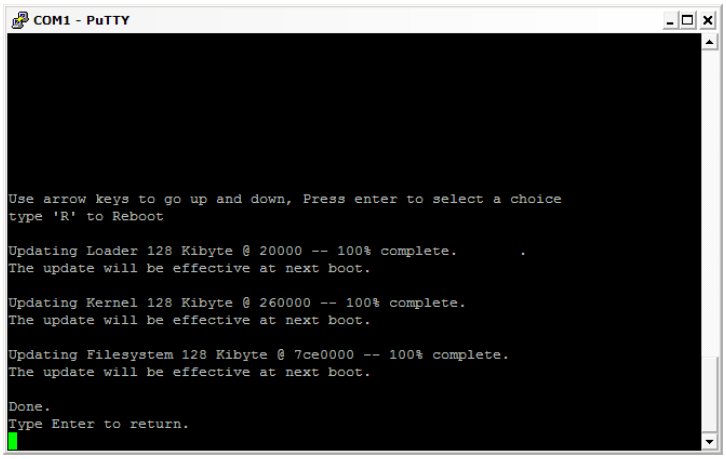
7.5 Reboot

Reboot the NAND flash file system.

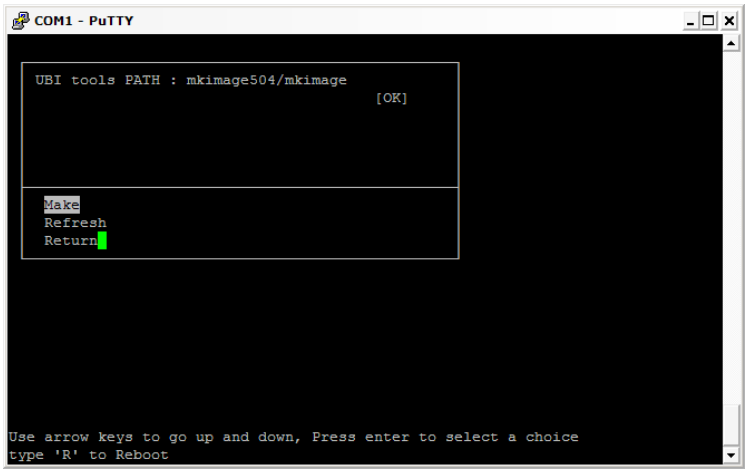
7.6 Update Image Starts



7.7 Update Image Completes



7.8 Make Files System Starts



☞ 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-513 power on.

8. Appendix

8.1 Utility Collection

- busybox: tiny utility collection
- sysvinit: standard Linux initialization
- util-linux-mount/umount: support long file name
- ssh: support sftp server
- usbutils: USB id program
- lighttpd: web server
- wget: used in ipkg software
- iptables: IP routing
- ipkg: software package management
- procps: support webmin process management
- vsftpd: ftp server
- bash: GNU shell
- wireless tools: wireless LAN utility
- ppp: ppp dial up utility
- psmics: procps supplement
- artila utility: handy utility added by Artila

You can find more utility on Artila FTP and use ipkg to install the utility.

8.2 ipkg Software Package Management

Matrix-513 uses ***ipkg*** to manage the software installation, upgrade and removal. Artila will continuously add the kernel module and utility on Artila FTP, user can install these software from Artila FTP. In addition user can also setup your FTP server to update the software you want.

How to setup ipkg via internet

enable DHCP

$ udhcpc eth0

make sure your network environment can access internet

$ ping www.artila.com

modify **/etc/ipkg.conf**

add the following two lines

src/gz arm http://www.artila.com/download/ipkgs/9G45/utility/

src/gz kernel http://www.artila.com/download/ipkgs/9G45/modules/

comment out other package source

save and quit

execute ipkg update

*$ ipkg **update***

examples of package installation

*$ ipkg **install** pythoncore*

*$ ipkg **install** pythonpyserial*

How to setup ipkg via USB disk

You can also copy the Utility and module folder from Artila FTP 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

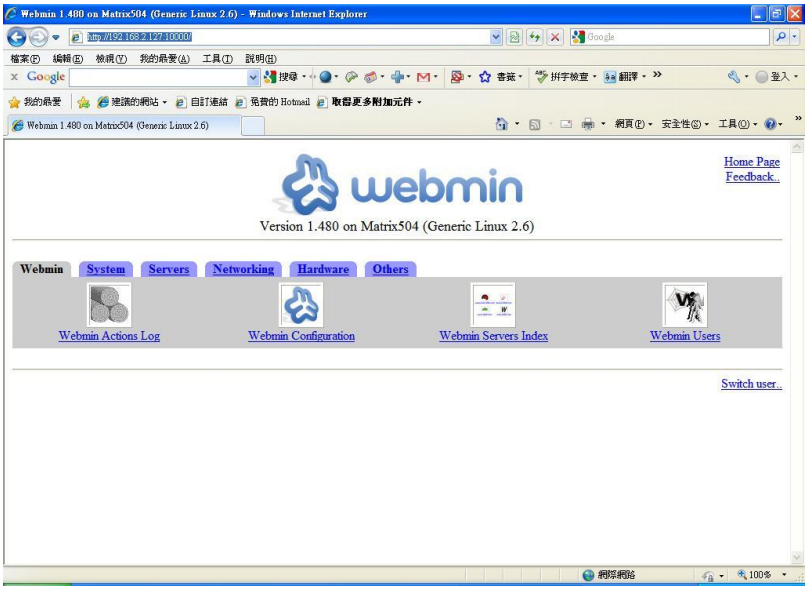
To install webmin. Webmin is a web-based interface to system administration.

To start webmin, go to ***/etc/webmin*** and type

start webmin

Then you can use browser to visit Matrix-513 port 10000.

http: //192.168.2.127 : 10000



The webmin for Matrix-513 provides following modules:

- Webmin: webmin configuration
- System: system boot, process and log management
- Server: lighttpd and SSH server configuration
- Network: network configuration
- Hardware: RTC setting
- 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.

8.3 Loading wireless driver process

Modify /etc/modules

```
root@Matrix513:~# vi /etc/modules
```

As below information were wireless driver doesn't enable.

```
###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.
#
### update-modules: start processing /etc/modutils/hidp
#hidp
### update-modules: end processing /etc/modutils/hidp
### update-modules: start processing /etc/modutils/rfcomm
#rfcomm
### update-modules: end processing /etc/modutils/rfcomm
#ohci-hcd
ehci-hcd
```

Add the message "**rt5370sta**" in "modules" files.

```
### 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.
#
### update-modules: start processing /etc/modutils/hidp
#hidp
```

```
### update-modules: end processing /etc/modutils/hidp

### update-modules: start processing /etc/modutils/rfcomm
#rfcomm
rt5370sta
### update-modules: end processing /etc/modutils/rfcomm
#ohci-hcd
ehci-hcd
```

8.4 Set WiFi Client to connect to the MobilePhone

2. As below are example of mobilephone's wifi share，set wifi Client to connect to the mobilephone

Modify /etc/network/interface

```
root@Matrix513:~# vi /etc/network/interfaces
```

Delete the"#" in front of the command.

#auto wlan0

#iface wlan0 inet dhcp

Before edit:

```
# Wireless interfaces
#
# auto wlan0
# iface wlan0 inet dhcp
#
# Example of an unencrypted (no WEP or WPA) wireless connection
```

After edit:

```
# Wireless interfaces
#
 auto wlan0
 iface wlan0 inet dhcp
#
# Example of an unencrypted (no WEP or WPA) wireless connection
```

Search the wifi Access Point can be used, and enable the wifi mode.

```
root@Matrix513:~# ifup wlan0up
root@Matrix513:~# iwlist wlan0 scan
```

```
wlan0        Scan completed :
```

```
Cell 10 - Address: F2:DC:E2:3F:68:8C
                    Protocol:802.11g
                    ESSID:"Artila"
                    Mode:Managed
                    Frequency:2.412 GHz (Channel 1)
                    Quality=18/100  Signal level=-83 dBm  Noise level=-78 dBm
                    Encryption key:on
                    Bit Rates:54 Mb/s
                    IE: IEEE 802.11i/WPA2 Version 1
                        Group Cipher : CCMP
                        Pairwise Ciphers (1) : CCMP
                        Authentication Suites (1) : PSK
```

Find the wifi Access Point essid, and input the SSID, Network Type, AuthMode, Encryp Type and WPAPSK.

Modify /etc/Wireless/RT5370STA/RT5370STA.dat

```
root@Matrix513:~# vi /etc/Wireless/RT5370STA/RT5370STA.dat
```

```
Default
SSID=Artila
NetworkType=Infra
AuthMode=WPA2PSK
EncrypType=TKIP
WPAPSK=12345asd
```

Input the wpa-essid and wpa-psk./ wep-essid and wep-psk

Modify /etc/network/interfaces

```
root@Matrix513:~# vi /etc/network/interfaces
```

```
#Exmaple of WPA
        wpa-mode managed
        wpa-essid Artila
        wpa-psk 12345asd
```

```
#Exmaple of WEP
        wireless-mode managed
        wireless-essid Artila
        wireless-psk 12345asd
```

Enable wifi mode

```
root@Matrix513:~# ifdown wlan0
root@Matrix513:~# ifup wlan0
```

Check wifi Network interface connection success or not.

```
root@Matrix513:~# ifconfig
```

```
wlan0     Link encap:Ethernet  HWaddr 6C:71:D9:4D:A4:05
          inet addr:172.20.10.6  Bcast:0.0.0.0  Mask:255.255.255.240
          inet6 addr: fe80::6e71:d9ff:fe4d:a405/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1947393 (1.8 MiB)  TX bytes:10860 (10.6 KiB)
```

8.5 Set 3G mode connection

Please add on SIM card into 3G module.

Modify /etc/network/interfaces

```
root@Matrix513:~# vi /etc/network/interfaces
```

Delete the"#" in front of the command.

auto 3g

iface 3g inet ppp

provider 3g

Before edit:

```
# 3G PPP interface
#
# Example of a 3G ppp connection
#
# auto 3g
# iface 3g inet ppp
# provider 3g
```

After edit:

```
# 3G PPP interface
#
# Example of a 3G ppp connection
#
auto 3g
iface 3g inet ppp
```

```
provider 3g
```

Enable ppp0 mode

```
root@Matrix513:~# Ifdown 3g
root@Matrix513:~# ifup 3g
```

Check the ppp0 Network interface

```
root@Matrix513:~# Ifconfig
```

```
ppp0      Link encap:Point-to-Point Protocol
          inet addr:10.76.8.9  P-t-P:10.76.8.9  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:5 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:68 (68.0 B)  TX bytes:141 (141.0 B)
```

8.6 Update and build-up GCC environment

- modify ipkg configure file

```
root@Matrix513:~# vi /etc/ipkg.conf
```

Add on three command as below.

```
# ftp example
src/gz arm http://www.artila.com/download/ipkgs/9G45/utility
src/gz kernel http://www.artila.com/download/ipkgs/9G45/modules
src/gz utilities http://www.artila.com/download/ipkgs/9G45/utility_gcc
```

- update ipkg list

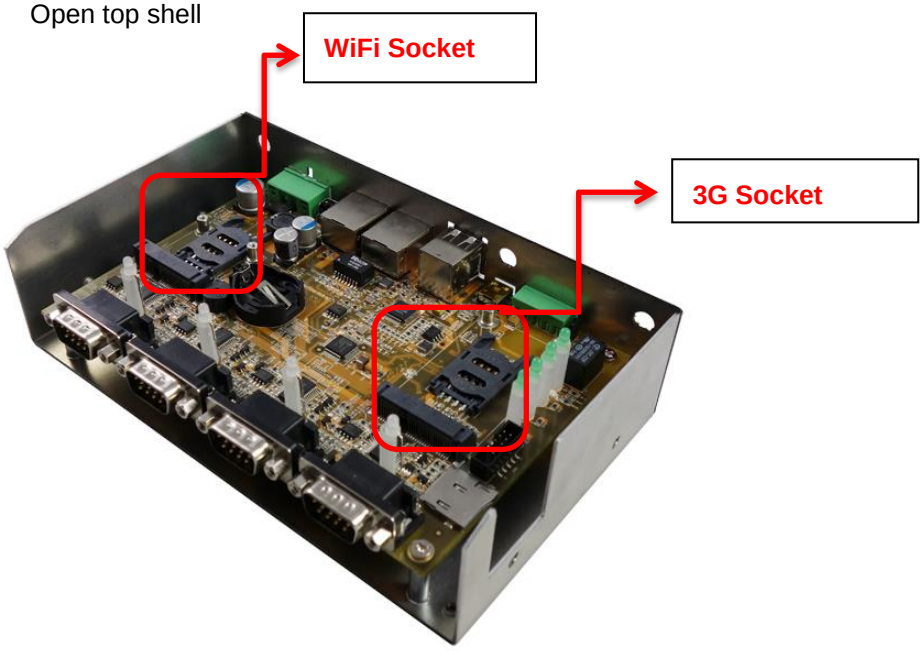
```
root@Matrix513:~#ipkg update
```

- install gcc packages

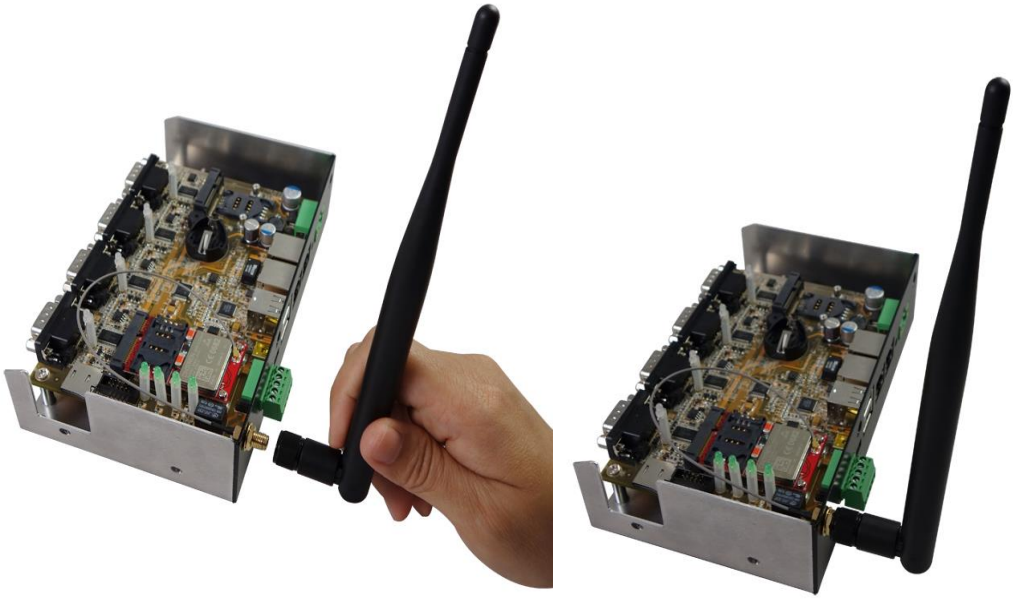
```
root@Matrix513:~#ipkg install gcc make libgcc-dev gcc-symlinks libgcc-dev cpp cpp-symlinks binutils
```

8.7 WiFi and 3G Assembling

8.7.1 Open top shell



8.7.2 Add on 3G module and antenna



8.7.3 Finish 3G and WiFi module assembling.