

Matrix 518 User Guide

Introduction:

Matrix 518 is an ARM9-based Linux ready industrial computer. The key features are as follow:

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. Two 10/100 Mbps Ethernet
5. Two USB 2.0 full speed (12 Mbps) Host Ports, one USB device port
6. Multimedia Card Interface for Micro SD memory card
7. Eight 3-in-1 RS-232/422/485 ports
8. 21 programmable Digital I/O port
9. Audio Output
10. 9 to 40VDC power input
11. Pre-installed Standard Linux 2.6 OS
12. GNU tool chain available in Artila CD
13. Optional DIN RAIL mounting adaptor

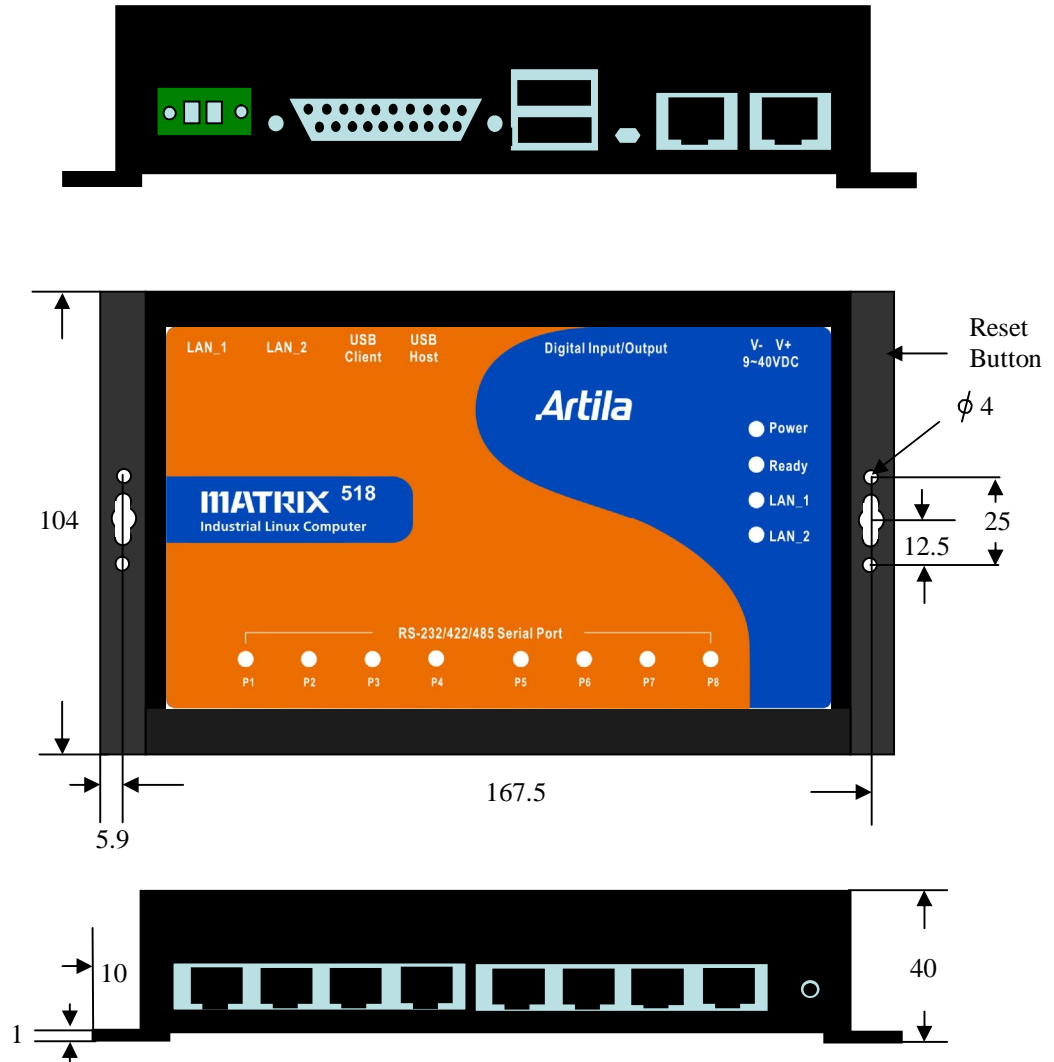
Packing List

1. Matrix 518 Box Computer
2. Wall mount bracket
3. Artila CD

Optional Accessory:

1. CB-RJ45F9-150: RJ45 to DB9 Female Cable
2. CBL-F10M9-20: Serial Console Cable
3. DK-35A: DIN RAIL Mounting Kit

Matrix 518 Layout



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 518 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 518 again. If Ready LED is still off, please contact the manufacture for technical support.

Link/Act LED

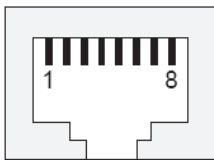
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic is the Ethernet, this LED will flash

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-

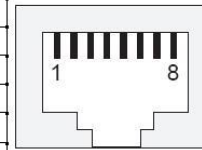


Serial Ports:

Port 1~8: 3-in-1 Software Configurable
RS-232/422/485

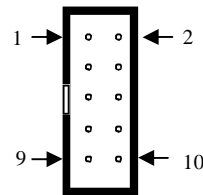
NOTE: Only Port 2,5,6,7,8 have full modem signals DSR,DTR, DCD

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	---	---



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

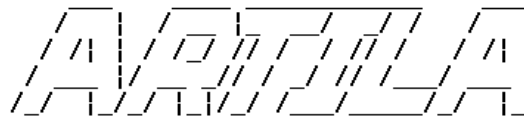


Serial Console RS-232			
1	N/C	2	N/C
3	RXD	4	N/C
5	TXD	6	N/C
7	N/C	8	N/C
9	GND	10	N/C

To use the serial console port, you need to open the metal case of Matrix-518 and the CON1 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

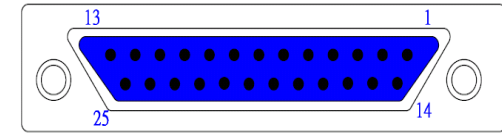
Matrix518 login: root
Password:



<http://www.artila.com>

root@Matrix518:~# _

Digital I/O Port (DB25 Female)



Pin No.	Function	Pin No.	Function
1	DIO0	14	DIO13
2	DIO1	15	DIO14
3	DIO2	16	DIO15
4	DIO3	17	DIO16
5	DIO4	18	DIO17
6	DIO5	19	DIO18
7	DIO6	20	DIO19
8	DIO7	21	DIO20
9	DIO8	22	GND
10	DIO9	23	GND
11	DIO10	24	VCC3
12	DIO11	25	VCC5
13	DIO12		

Note:

1. VCC3: 3.3 VDC output
2. VCC5: 5 VDC output
3. GND: Digital Ground

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

Power on and System boot up

Once Matrix-518 is correctly power on, it will start boot Linux kernel and mount file system. You can use Ethernet and telnet and login Matrix-518. 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-518.



```
CA Telnet 192.168.2.127
Matrix504 login: guest
Password:

http://www.aritla.com

guest@Matrix504:~$
```

Inittab and Run levels:

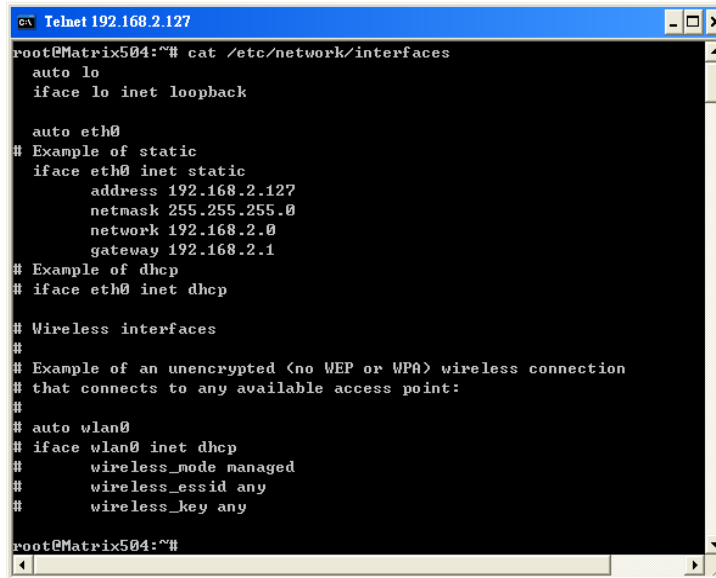
Inittab contains information of system initialization. The system initialization script */etc/rcS.d* runs first then the run level 5 */etc/rc5.d* Matrix-518 uses run level for system setup and the default run level is number 5. Please refer to introduction to linux (<http://tille.garrels.be/training/tldp/>) 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



```
CA 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

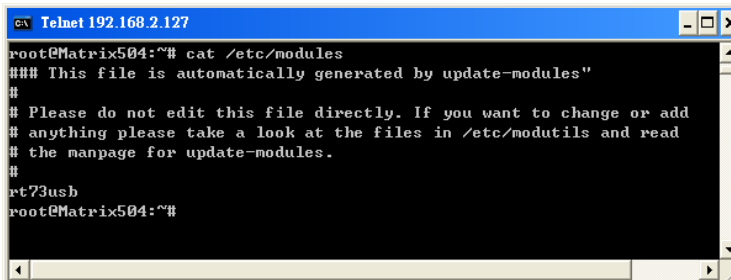
root@Matrix504:~#
```

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

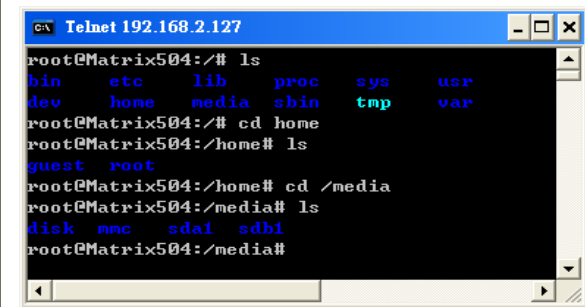
To load the USB WLAN adaptor.



```
CA 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:~#
```

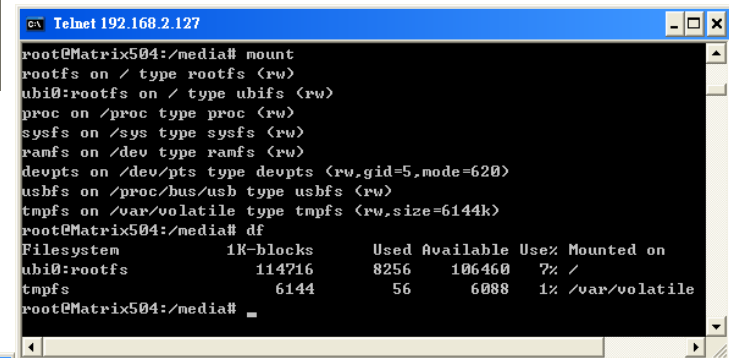
Use *vi* editing tool to edit the */etc/network/interfaces* for network setting. The default setting is static IP 192.168.2.127. Matrix-518 also supports Wireless LAN. Use *wireless_essid XXX* *wireless_key YYY* To add SSID and WEP key if necessary. XXX is SSID and YYY is WEP Key Matrix-504 supports USB WLAN adaptor (Ralink RT2571). You can enable the driver module (*rt73usb*) by adding *rt73usb* in */etc/modules*

File System



```
CA 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-518 contains Boot loader (uBoot), Linux Kernel, Root File System and user disk (\home). The file system and disk space are shown as follow



```
CA 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)
devpts on /dev/pts type devpts (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 ttyS8: serial port 1 to port 8
3. sda to sdb: USB flash disk
4. ttyUSB0 to ttyUSB1: USB RS-232 adaptor (fdt_i2c.ko)
5. rtc: Real Time Clock
6. gpio: General Purpose digital I/O
7. ttyACM0 and ttyACM1: USB Modem (CDC compliant)
8. mmc : SD driver

Utility Software:

Matrix 518 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  iwlist        mkswap       swapoff
getty        iwpriv        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         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           uname
cpio        kill.procps  ps.procps    usleep
date        ln           pwd          vi
dd          login        rm           zcat
delgroup   ls           rmdir       zcat
deluser    ls           rmdir
df          mkdir        run-parts
           mknod       sed

```

Mounting External Storage Memory

To find out the device name of the external memory device which plug into Matrix 518, you can use the command

dmesg | grep sd

dmesg | grep mmc

To find out the device type (sda , sdb or mmc)

And use

mount /dev/sda1

mount /dev/mmc

to mount the USB disk or SD card and folder is local at **media/sda1** or **/mnt/sda1**

```

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/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 518 supports SSH. If you use Linux computer, you can use SSH command to login Matrix 518. 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-518

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-518. Currently user can use ipkg to install the software package from Artila FTP. You can find the configuration at **ipkg.conf**

When Matrix-518 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
```

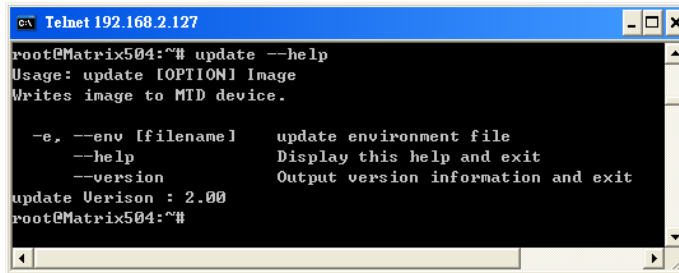
Hello will be executed after system boot up. *rc.local* has the similar function as */etc/rc* in Matrix-504

Artila Utility Software:

The introduction of Artila utility software as follow:

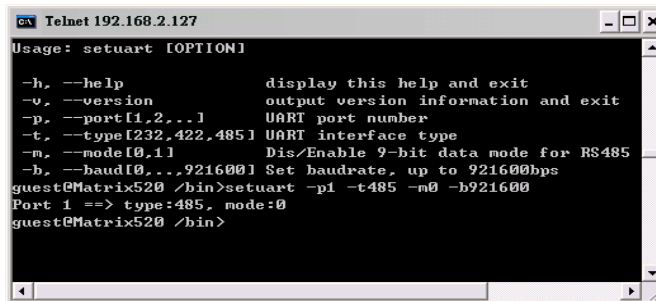
1. **update** : update loader, environment file and kernel image.

Type *update--help* to find the command usage

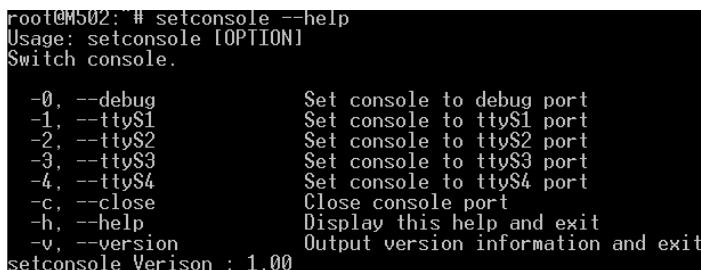


Update can only operated under supervisor mode (password : root). Please use command *su* and login as root


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



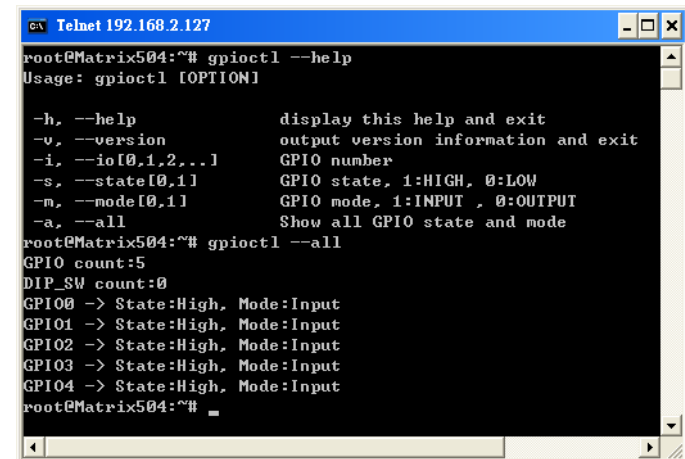
3. **setconsole**: Unlike Matrix-510 which shares the serial console port with the serial port 3, Matrix-518 uses dedicated pins for serial console (debug port). *setconsole* command allows user to redirect the serial console port to any one of the four serial port of M-518. Therefore user can avoid opening the metal case to access the serial console.



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



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



5. audio command:

```
madplay - play mp3 file
```

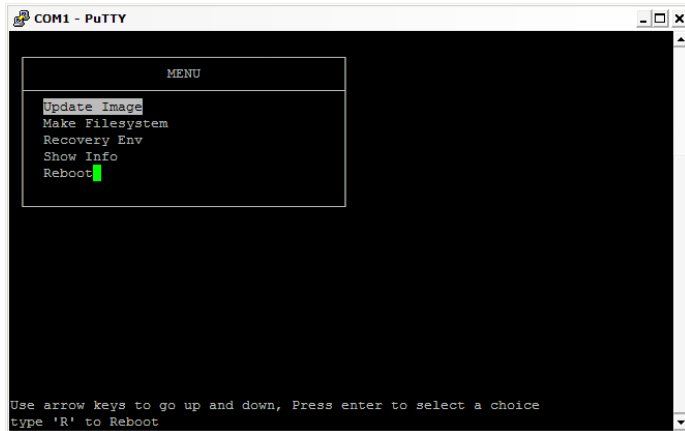
```
aplay - play wav file
```

```
amixer - volume control
```

```
alsamixer - graph control
```


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: *m518/m518.alf*
Kernel: *m518/m518K*
File system: *m518/m518R*

The files are available in Artila CD. Please prepare an USB disk and copy the image files to it before choosng this option.

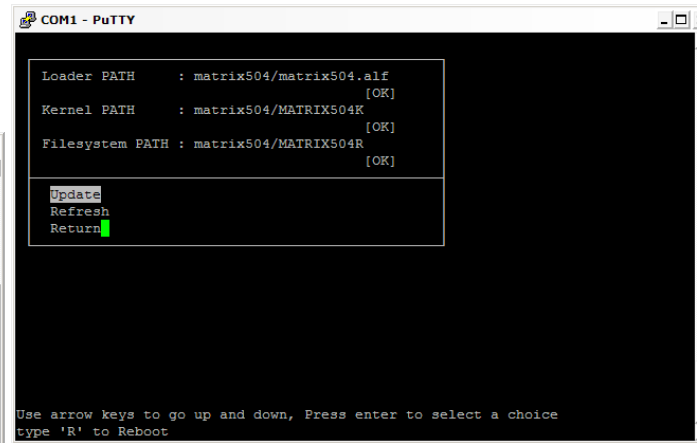
2. Make Filesystem: this option is used to create customized file system. Before using this function, you need to copy the folder of *mkimage518* in the Artila CD to an USB disk. This function will create a new file system image for users and they can use it to duplicate the customized file system to other Matrix-518.

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 Matix-518

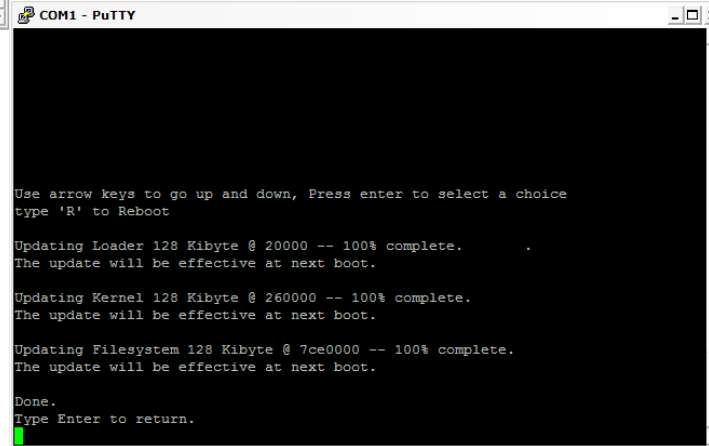
5. Reboot: Reboot the NAND flash file system.

Update Image Starts



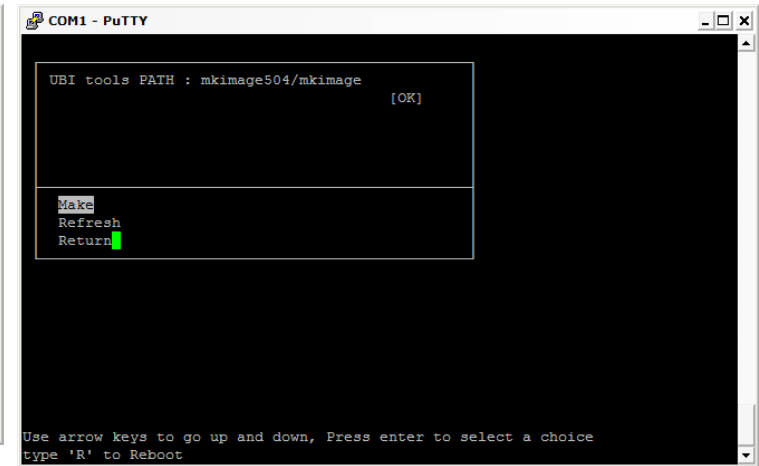
```
COM1 - PuTTY
Loader PATH : matrix504/matrix504.alf [OK]
Kernel PATH : matrix504/MATRIX504K [OK]
Filesystem PATH : matrix504/MATRIX504R [OK]
Update
Refresh
Return
Use arrow keys to go up and down, Press enter to select a choice
type 'R' to Reboot
```

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-518 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. lighttpd v 1.7-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-518 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/Matrix518/Linux/Utility
src/gz kernel ftp://ftp:ftp@ftp.artila.com/Matrix518/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-518 port 10000
http://192.168.2.127:10000

The webmin for Matrix-518 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.

