

Matrix-510

Linux ARM9 Industry Box Computer

User Guide

Version 1.0



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1. Introduction

Matrix-510 is an ARM9-based Linux ready industrial computer. The key features are as follow:

- ARM920T ARM Thumb Processor with 200MIPS at 180MHz, Memory Management Unit
- 16-KByte Data Cache and 16-KByte Instruction Cache
- 64MB SDRAM, 16MB Flash on board
- Two 10/100Mbps Ethernet
- Two USB 2.0 full speed (12Mbps) Host Ports
- Multimedia Card Interface for SD memory card
- Five 3-in-1 RS-232/422/485 ports and three RS-232 ports
- 21 programmable Digital I/O port
- Audio Output
- 9 to 40VDC power input
- Pre-installed Standard Linux 2.6 OS
- GNU tool chain available on Artila FTP
- Optional DIN RAIL mounting adaptor

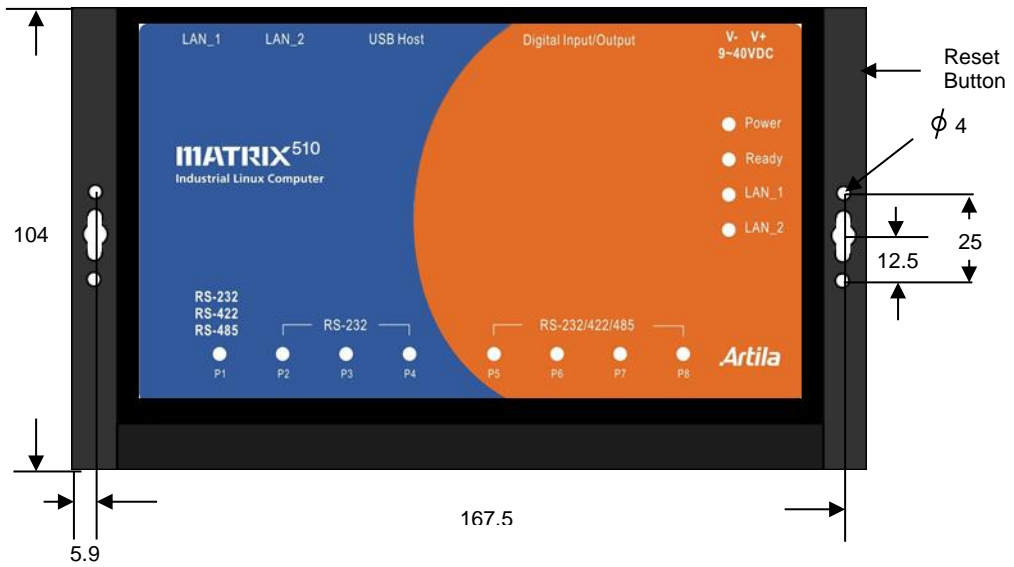
1.1 Packing List

- Matrix-510 Box Computer
- Wall mount bracket

1.2 Optional Accessory

- CB-RJ45F9-150 (91-R45F9-150): Serial Cable (RJ45 to DB9 Female, 150cm)
- CB-RJ2CON-100 (91-RJCON-100): Console Cable (RJ45 to DB9 Female, 100cm)
- DK-35A (36-DK35A-000): DIN RAIL Mounting Kit

2. Layout



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-510 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-510 again. If Ready LED is still off, please contact the manufacture for technical support.

3.4 Link / Act LED

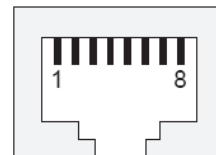
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic is the Ethernet port, this LED will flash.

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-



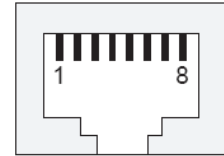
3.7 Serial Port

- **Port 1, 5, 6, 7, 8:** 3-in-1 RS-232 / 422 / 485
- **Port 2, 5, 6, 7, 8:** RS-232 with full modem control

Note

RS-232 / 422 / 485 is software selection.

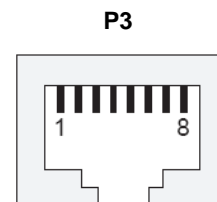
Pin No.	RS-232	RS-422	RS-485
1	DSR	--	-
2	RTS	TXD+	DATA+
3	GND	GND	GND
4	TXD	TXD-	DATA-
5	RXD	RXD+	--
6	DCD	RXD-	-
7	CTS	-	-
8	DTR	-	-



3.8 Serial Console Port

Serial console port share the connector with Serial port 3 but the pin definition as shown as follow:

Pin No.	RS-232
1	
2	TXD
3	GND
4	
5	
6	
7	RXD
8	



The serial console port is disabled as factory default setting. To enable the serial console, you need to use the serial console cable and connect it to port 3. Use any terminal software such as hyper terminal and setting as follow:

Baud Rate: 115200

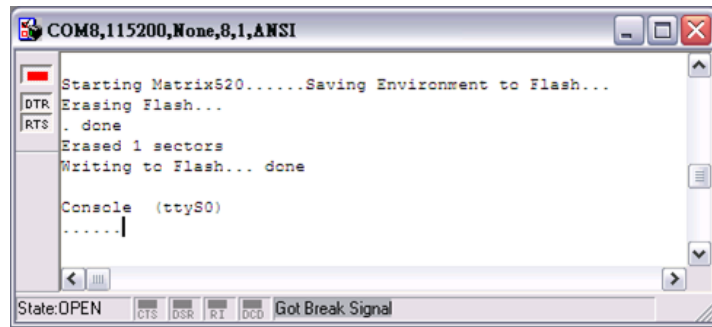
Data bits: 8

Parity: N

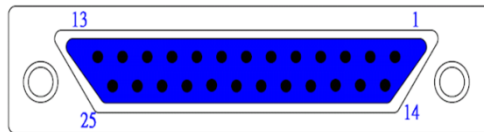
Stop bit: 1

Terminal type: ANSI

Right after powering on the system, keep typing \$ continuously until you see the message as shown in the figure followed. Console (ttyS0) stands for console port ttyS0 is enabled. Repeat this procedure will disable the serial console and Screen will show "Console (null)".



3.9 Digital I/O Port (DB25 Female)



Pin No.	RS-232	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

3.10 Factory Default Settings

LAN 1 IP Address: 192.168.2.127

LAN 2 IP Address: DHCP

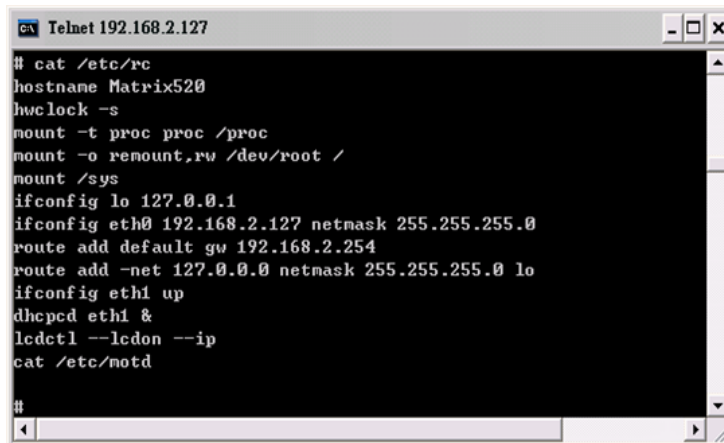
Login: guest

Password: guest

Supervisor: root (ssh supported)

Password: root

3.11 Network Settings



```
cv Telnet 192.168.2.127
# cat /etc/rc
hostname Matrix520
hwclock -s
mount -t proc proc /proc
mount -o remount,rw /dev/root /
mount /sys
ifconfig lo 127.0.0.1
ifconfig eth0 192.168.2.127 netmask 255.255.255.0
route add default gw 192.168.2.254
route add -net 127.0.0.0 netmask 255.255.255.0 lo
ifconfig eth1 up
dhcpcd eth1 &
ledctl --lcdon --ip
cat /etc/motd
#
```

To configure the IP address, Netmask and Gateway setting, please modify /disk/etc/rc as following:

```
ifconfig eth0 192.168.2.127 netmask 255.255.255.0
```

For DHCP setting:

```
dhcpcd eth1 &
```

3.12 Wireless LAN Configuration

Matrix-510 supports wireless LAN by using USB WLAN adaptor which uses Ralink RT2570 (rt2570) /2571 (rt73) controller. Please refer to the website <http://ralink.rapla.net> for the supporting list of the USB WLAN adaptor.

To configure the wireless LAN setting, please use command:

```
modprobe rt73 or modprobe rt2570
```

```
ifconfig wlan0 up
```

```
iwconfig wlan0 essid XXXX key YYYYYYYYY mode MMMM
```

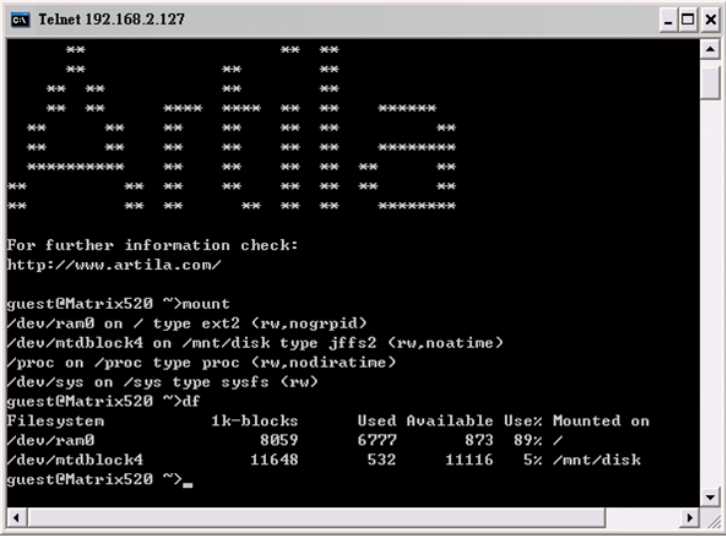
For infrastructure mode XXXX is the access point name and YYYYYYYYY is the encryption key and MMMM should be *managed*.

For Ad-Hoc mode mode XXXX is the Matrix-510 device name and YYYYYYYYY is the encryption key MMMM should be *ad-hoc*.

To configure the IP address use command

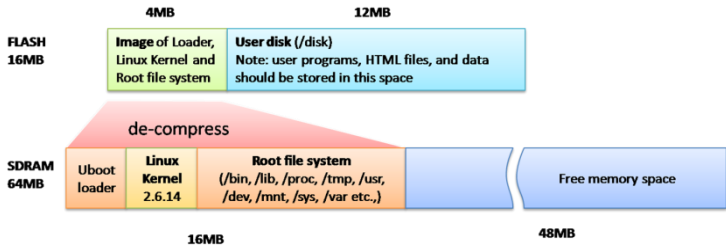
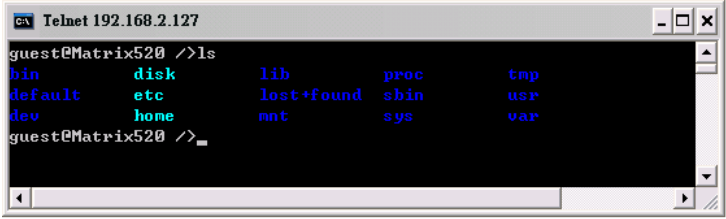
```
dhcpcd wlan0 & or ifconfig wlan0 192.168.2.127 netmask 255.255.255.0
```

3.13 File System



Matrix-510 configures the root file system as RAMDISK and the user disk (/disk) which includes /home and /etc directory are configured as Flash Disk. To find out the file system information, please use command /mount as show as above. In addition, use command /df to find out the disk space of the disk. The RAMDISK uses 8MB memory space to store the root file system and the user disk is about 11MB for user’s program storage.

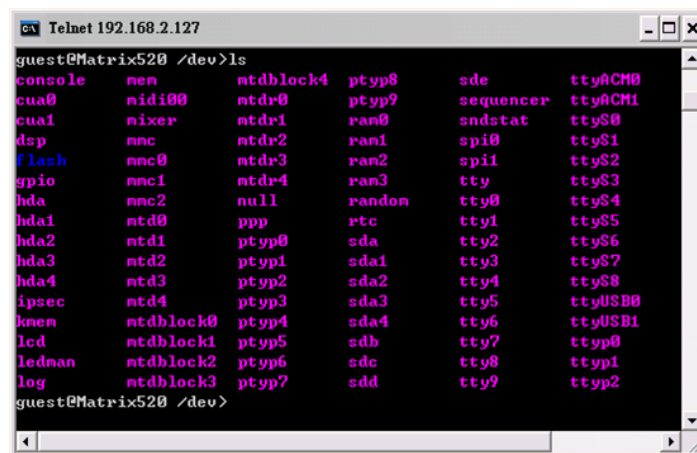
Therefore, user’s program and utility software must be saved in the user disk space (/disk). Files saved to other directory will be loss after power off.



3.14 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. mmc to mmc2: SD memory card
4. sda to sde: USB flash disk
5. ttyUSB0 to ttyUSB1: USB RS-232 adaptor (ftdi_sio.ko)
6. rtc: Real Time Clock
7. gpio: General Purpose digital I/O
8. ttyACM0 and ttyACM1: USB Modem (CDC compliant)



```

cx Telnet 192.168.2.127
guest@Matrix520 /dev>ls
console      mem          mtdblock4   ptypp8      sde          ttyACM0
cua0         midi00      mtdr0       ptypp9      sequencer   ttyACM1
cua1         mixer       mtdr1       ram0        sndstat     ttyS0
dsp          mmc         mtdr2       ram1        spi0        ttyS1
flash        mmc0        mtdr3       ram2        spi1        ttyS2
gpio         mmc1        mtdr4       ram3        tty         ttyS3
hda          mmc2        null        random      tty0        ttyS4
hda1         mtd0        ppp         rtc         tty1        ttyS5
hda2         mtd1        ptypp0      sda         tty2        ttyS6
hda3         mtd2        ptypp1      sda1        tty3        ttyS7
hda4         mtd3        ptypp2      sda2        tty4        ttyS8
ipsec        mtd4        ptypp3      sda3        tty5        ttyUSB0
kmen         mtdblock0   ptypp4      sda4        tty6        ttyUSB1
lcd          mtdblock1   ptypp5      sdb         tty7        ttypp0
ledman       mtdblock2   ptypp6      sdc         tty8        ttypp1
log          mtdblock3   ptypp7      sdd         tty9        ttypp2
guest@Matrix520 /dev>

```

3.15 Utility Software

Matrix-510 includes busybox utility collection and Artila utility software as follow:



```

cx Telnet 192.168.2.127
guest@Matrix520 /bin>ls
addgroup     echo         ln           setuart
adduser      egrep        login        sh
amgrd        false       ls           sleep
bash         fgrep        mkdir        sshd
boa          ftpd         mke2fs       stty
busybox      gpioc1      mkfs.jffs2  su
cat          grep         mknod        sync
chat         gunzip       mktemp       tar
chgrp        gzip         more         telnetd
chmod        hostname    mount        tip
chown        inetd        mp3play     tone
cp           init         mv           touch
cpu          iptables    netstat     true
date         iptables-restore pidof        umount
delgroup     iptables-save ping         update
deluser      iuconfig    pppd        usleep
df           iwlist      ps           version
dhepcd      iupriv     pwd          vi
discard      kill        rm           vplay
dmesg        lcdctl     rmdir       zcat
guest@Matrix520 /bin>

```

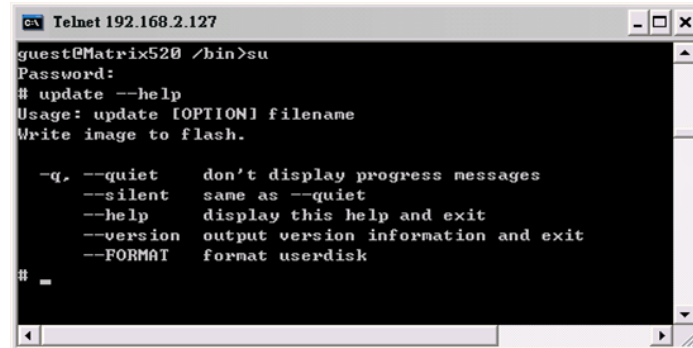
4. Artila Utility Software

The introduction of Artila utility software as follow:

4.1 update

Update loader, kernel or root file system image. Also use **update—FORMAT** to format user disk.

Type **update—help** to find the command usage.



```

c:\ Telnet 192.168.2.127
guest@Matrix520 /bin>su
Password:
# update --help
Usage: update [OPTION] filename
Write image to flash.

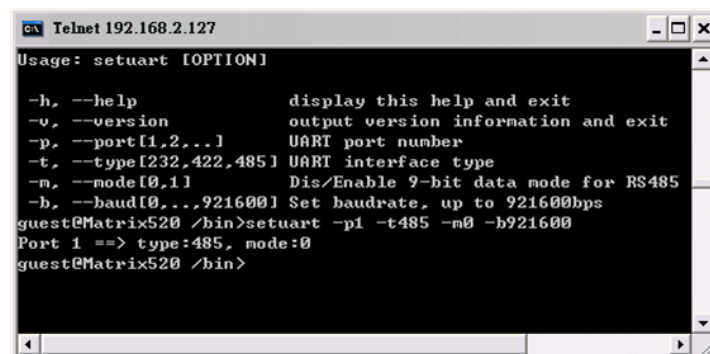
  -q, --quiet      don't display progress messages
  --silent        same as --quiet
  --help          display this help and exit
  --version       output version information and exit
  --FORMAT        format userdisk
#

```

Update can only operated under supervisor mode (password: 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. Please note only port 1 support 9-bit data at RS-485.



```

c:\ Telnet 192.168.2.127
Usage: setuart [OPTION]

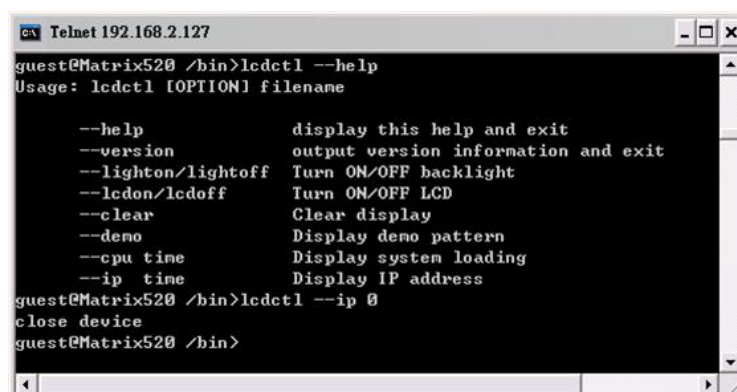
  -h, --help          display this help and exit
  -v, --version       output version information and exit
  -p, --port[1,2,..] UART port number
  -t, --type[232,422,485] UART interface type
  -n, --mode[0,1]     Dis/Enable 9-bit data mode for RS485
  -b, --baud[0,..,921600] Set baudrate, up to 921600bps
guest@Matrix520 /bin>setuart -p1 -t485 -n0 -b921600
Port 1 ==> type:485, mode:0
guest@Matrix520 /bin>

```

4.3 lcdctl

Lcdctl is used to control the LCD display. Use lcdctl to display user message, please prepare 2x18 text message and save it as a file. Then use lcdctl filename to display the message on the LCD screen.

Use **lcdctl—ip 0** to display the ip address of the network setting on the LCD screen. The parameter *time* is the refresh rate in second and use **lcdctl—cpu 0** to display the system loading information.



```

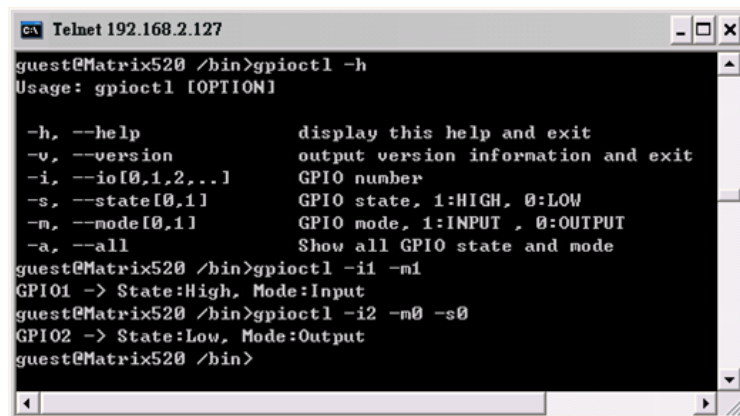
c:\ Telnet 192.168.2.127
guest@Matrix520 /bin>lcdctl --help
Usage: lcdctl [OPTION] filename

  --help          display this help and exit
  --version       output version information and exit
  --lighton/lightoff Turn ON/OFF backlight
  --lcdon/lcdoff   Turn ON/OFF LCD
  --clear         Clear display
  --demo          Display demo pattern
  --cpu time      Display system loading
  --ip time       Display IP address
guest@Matrix520 /bin>lcdctl --ip 0
close device
guest@Matrix520 /bin>

```

4.4 gpioc1

gpioc1 is used to control the programmable digital I/O port located on the DB25 connector. Following example is to configure DIO1 as digital input and DIO2 as digital output with low output state.

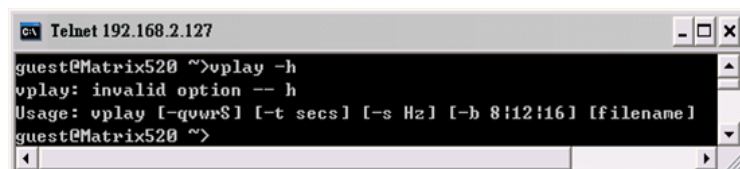


```
Telnet 192.168.2.127
guest@Matrix520 /bin>gpioc1 -h
Usage: gpioc1 [OPTION]

-h, --help          display this help and exit
-v, --version       output version information and exit
-i, --io[0,1,2,...] GPIO number
-s, --state[0,1]    GPIO state, 1:HIGH, 0:LOW
-m, --mode[0,1]     GPIO mode, 1:INPUT , 0:OUTPUT
-a, --all           Show all GPIO state and mode
guest@Matrix520 /bin>gpioc1 -i1 -m1
GPIO1 -> State:High, Mode:Input
guest@Matrix520 /bin>gpioc1 -i2 -m0 -s0
GPIO2 -> State:Low, Mode:Output
guest@Matrix520 /bin>
```

4.5 vplay

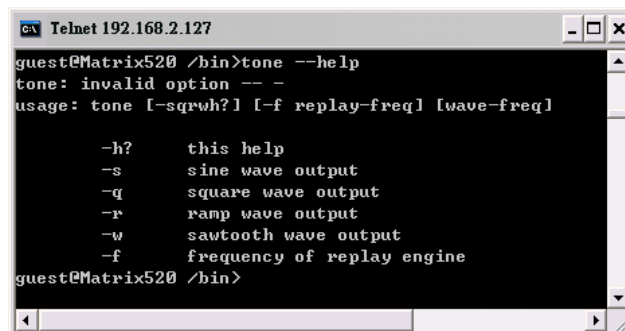
vplay is used to play audio file in wave format.



```
Telnet 192.168.2.127
guest@Matrix520 ~>vplay -h
vplay: invalid option -- h
Usage: vplay [-qwr$] [-t secs] [-s Hz] [-b 8:12:16] [filename]
guest@Matrix520 ~>
```

4.6 Tone

Audio output test program.

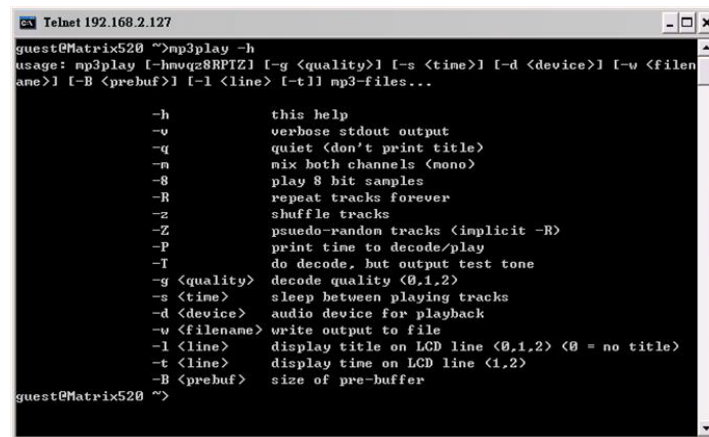


```
Telnet 192.168.2.127
guest@Matrix520 /bin>tone --help
tone: invalid option -- -
usage: tone [-sqwrh?] [-f replay-freq] [wave-freq]

-h?    this help
-s     sine wave output
-q     square wave output
-r     ramp wave output
-w     sawtooth wave output
-f     frequency of replay engine
guest@Matrix520 /bin>
```

4.7 mp3play

mp3play is used to play MP3 format audio files.



```

Tsh Telnet 192.168.2.127
guest@Matrix520 ~$ mp3play -h
usage: mp3play [-hmvqz8RPTZ] [-g <quality>] [-s <time>] [-d <device>] [-w <filename>] [-B <prebuf>] [-l <line>] [-t] mp3-files...

-h          this help
-v          verbose stdout output
-q          quiet (don't print title)
-m          mix both channels (mono)
-8          play 8 bit samples
-R          repeat tracks forever
-z          shuffle tracks
-Z          psuedo-random tracks (implicit -R)
-P          print time to decode/play
-T          do decode, but output test tone
-g <quality> decode quality (0,1,2)
-s <time>   sleep between playing tracks
-d <device> audio device for playback
-w <filename> write output to file
-l <line>   display title on LCD line (0,1,2) (0 = no title)
-t <line>   display time on LCD line (1,2)
-B <prebuf> size of pre-buffer
guest@Matrix520 ~$

```

4.8 How to Make More Utility Software

You might also find utility software available on Artila FTP under /Matrix 510/utility such as *ntpcient*, *ssh*, *scp*, *bluez* and *ssh-keygen*. If you want, you can ftp or copy the utility software to Matrix-510 user disk (/disk). Also you can use find the source code and use the GNU Toolchain to make the utility by yourself.

4.9 Mounting External Storage Memory

To find out the device name of the external memory device which plug into Matrix-510, you can use the command

```
/dmesg | grep sd
```

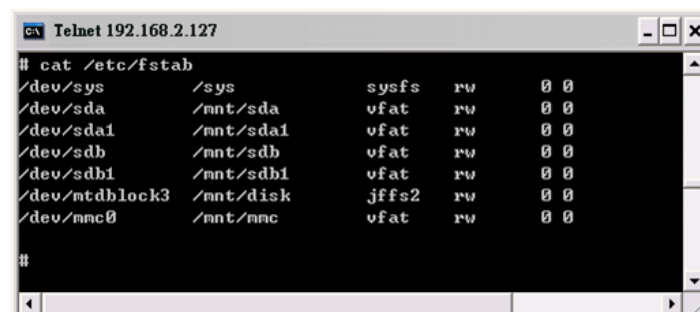
or

```
/dmesg | grep mmc
```

Type

```
mount /dev/sda1 to mount the USB disk and
```

```
mount /dev/mmc0 to mount SD card
```



```

Tsh Telnet 192.168.2.127
# cat /etc/fstab
/dev/sys      /sys         sysfs       rw      0 0
/dev/sda      /mnt/sda     vfat        rw      0 0
/dev/sda1     /mnt/sda1    vfat        rw      0 0
/dev/sdb      /mnt/sdb     vfat        rw      0 0
/dev/sdb1     /mnt/sdb1    vfat        rw      0 0
/dev/mtdblock3 /mnt/disk    jffs2       rw      0 0
/dev/mmc0     /mnt/mmc     vfat        rw      0 0
#

```

4.10 Welcome Message

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

4.11 Web Page Directory

The web pages are placed at /home/httpd and the boa.conf contains the boa web server settings. The home page name should be *index.html*.

4.12 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.

```
Intpclient [time server ip]
```

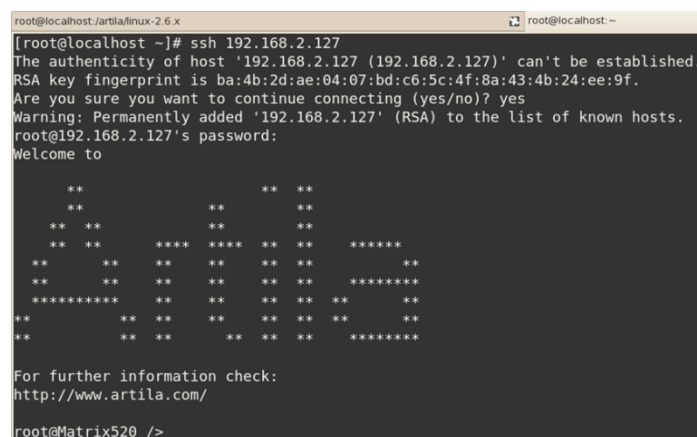
4.13 SSH Console

Matrix-510 support SSH. If you use Linux computer, you can use SSH command to login Matrix-510.

The configuration of SSH and key are located at */etc/config/ssh*

The key generation program is available on Artila FTP: */matrix 510/utility/ssh_keygen*

User can copy this program to Matrix-510 to generate the key.



```

root@localhost:/artila/linux-2.6.x
[root@localhost ~]# ssh 192.168.2.127
The authenticity of host '192.168.2.127 (192.168.2.127)' can't be established.
RSA key fingerprint is ba:4b:2d:ae:04:07:bd:c6:5c:4f:8a:43:4b:24:ee:9f.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.2.127' (RSA) to the list of known hosts.
root@192.168.2.127's password:
Welcome to

  **                **
  **                **
 ** **          **
** **       **** **
** **  **  ** ** ** **
**  **  **  **  ** **
***** ** ** ** **
** ** ** ** ** ** **
**   ** ** ** **
**   ** ** ** **
**   ** ** **
**   ** ** **

For further information check:
http://www.artila.com/
root@Matrix520 />

```


4.14 Install GNU Toolchain

Find a PC with Linux 2.6.X Kernel installed and login as a **root** user then copy the arm-linux-3.3.2.tar.gz to root directory of PC. Under root directory, type following command to install the Matrix-510 toolchain.

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

4.15 Getting Started with the Hello Program

There are many example programs on Artila FTP. To compile the sample you can use the Make file to and type:

```
make
```

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

```
ftp 192.168.2.127
```

And bin command to set transfer mode to binary

```
ftp>bin
```

To transfer the execution file to Matrix-510 user disk (/disk) and use

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

To change it to execution mode and

```
./file.o
```

to run the file.

```
[root@localhost ~]# ftp 192.168.2.127
Connected to 192.168.2.127.
220 Matrix520 FTP server (GNU inetutils 1.4.1) ready.
500 'AUTH GSSAPI': command not understood.
500 'AUTH KERBEROS_V4': command not understood.
KERBEROS_V4 rejected as an authentication type
Name (192.168.2.127:root): root
331 Password required for root.
Password:
230- Welcome to
230-
230-      **          **          **
230-      **          **          **
230-      ** **          **          **
230-      ** **          ****  **** ** **          *****
230-      **      **      **      **      **      **
230-      **      **      **      **      **      **          *****
230-      *****      **      **      **      **      **
230-      **          ** **      **      **      **      **
230-      **          ** **      **      **      **          *****
230-
230- For further information check:
230- http://www.artila.com/
230-
230 User root logged in.
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> bi
200 Type set to I.
ftp>
```