

Introduction:

Matrix 510/520 are ARM9-based Linux ready industrial computer. The key features are as follow:

1. ARM920T ARM Thumb Processor with 200MIPS at 180MHz, Memory Management Unit
2. 16-KByte Data Cache and 16-KByte Instruction Cache
3. 32MB SDRAM, 16MB Flash on board
4. Two 10/100 Mbps Ethernet
5. Two USB 2.0 full speed (12 Mbps) Host Ports
6. Multimedia Card Interface for SD memory card
7. Five 3-in-1 RS-232/422/485 ports and three RS-232 ports
8. 21 programmable Digital I/O port
9. LCM Display (2x18 character mode) with backlight (Matrix 520 only)
10. Audio Output
11. 9 to 40VDC power input
12. Pre-installed Standard Linux 2.6 OS
13. GNU tool chain available in Artila CD
14. Optional DIN RAIL mounting adaptor

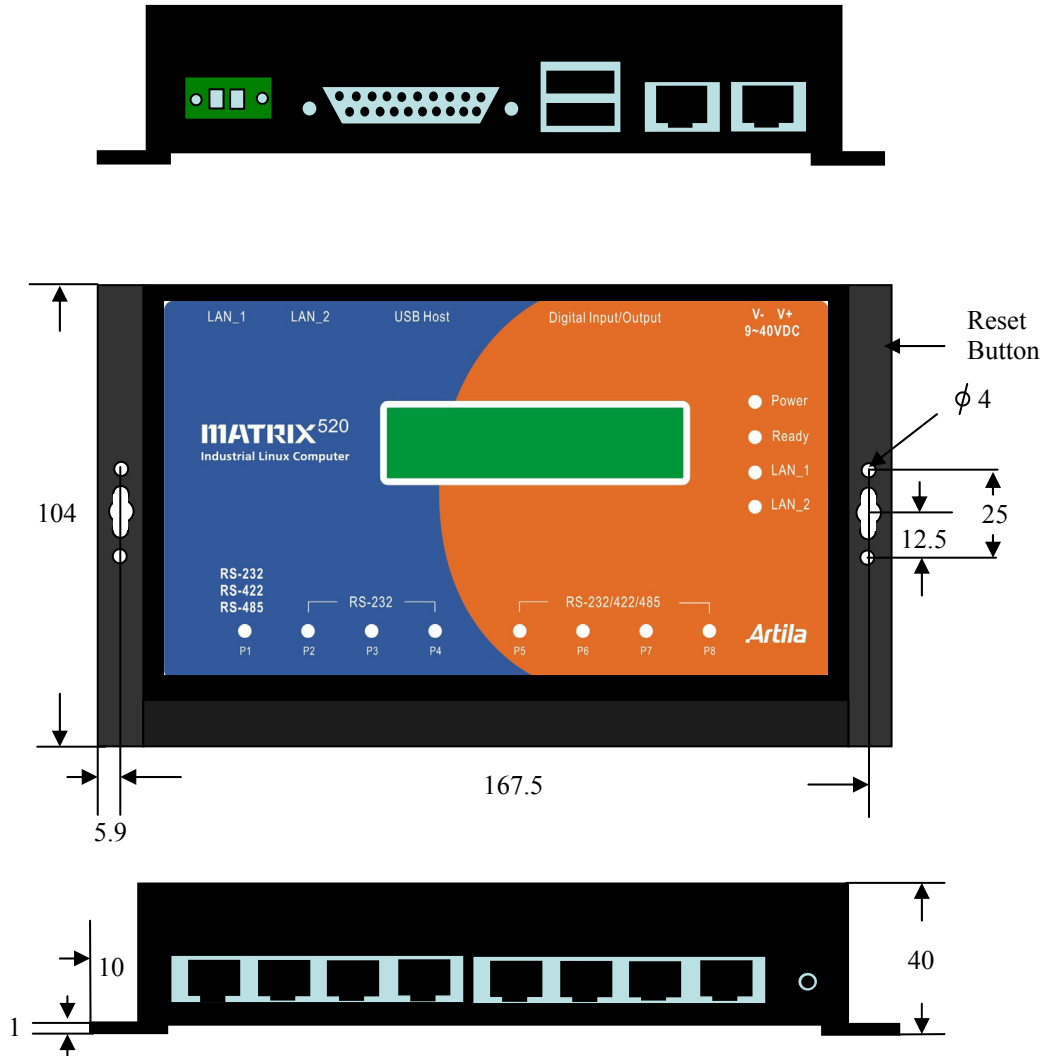
Packing List

1. Matrix 520 Box Computer
2. Wall mount bracket
3. Artila CD

Optional Accessory:

1. CB-RJ45F9-150: RJ45 to DB9 Female Cable
2. CB-RJ2CON-100: Serial Console Cable
3. DK-35A: DIN RAIL Mounting Kit

Matrix 520 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 520 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 520 again. If Ready LED is still off, please contact the manufacture for technical support.

Link/Act

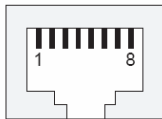
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic is the Ethernet, this LED will flash

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-

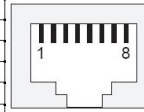


Serial Ports:

Port 1,5,6,7 and 8: 3-in-1 RS-232/422/485
 Port 2: RS-232 with full modem control
 Port 3, 4: RS-232 with hardware flow control

Note: RS-232/422/485 is software selection

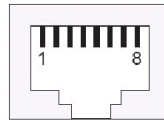
Pin	RS-232	RS-422	RS-485
1	DSR	---	---
2	RTS	TXD+	Data+
3	GND	GND	GND
4	TXD	TXD-	Data-
5	RXD	RXD+	---
6	DCD	RXD-	---
7	CTS	---	---
8	DTR	---	---



Serial Console Port:

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

P3



Pin	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

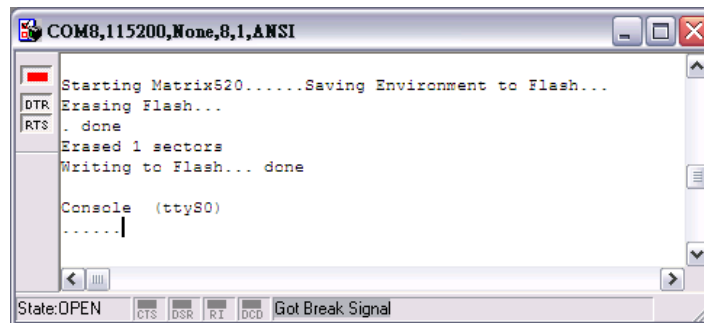
Data bits: 8

Parity: N

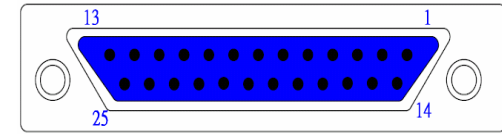
Stop bit: 1

Terminal type: ANSI

Once system is power on, you will see “Starting Matrix520...”, Keep typing \$\$\$\$ to turn on the serial console function. If the serial console is enabled, you will see “Console (ttyS0)” as follow. Repeat this procedure will disable the serial console and Screen will show “Console (null)”



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: DHCP
Login: guest
Password: guest
Supervisor: root (ssh supported)
Password: root

Network Settings

```
guest@Matrix520 /dev>ls
console mem mtdblock4 pty8 sde ttyACM0
cua0 midi00 mtdr0 pty9 sequencer ttyACM1
cua1 mixer mtdr1 ram0 sndstat ttyS0
dsp mmc mtdr2 ram1 spi0 ttyS1
flash mmc0 mtdr3 ram2 spii ttyS2
gpio mmc1 mtdr4 ram3 tty ttyS3
hda hda mmc2 null random tty0 ttyS4
hda1 mtd0 ppp rtc tty1 ttyS5
hda2 mtd1 pty0 sda tty2 ttyS6
hda3 mtd2 pty1 sda1 tty3 ttyS7
hda4 mtd3 pty2 sda2 tty4 ttyS8
ipsec mtd4 pty3 sda3 tty5 ttyUSB0
knem mtdblock0 pty4 sda4 tty6 ttyUSB1
lcd mtdblock1 pty5 sdb tty7 tty0
ledman mtdblock2 pty6 sdc tty8 tty1
log mtdblock3 pty7 sdd tty9 tty2
guest@Matrix520 /dev>
```

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 &
```

Wireless LAN Configuration

Matrix 520 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 YYYYYYYY mode MMMM
```

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

For Ad-Hoc mode mode XXXX is the Matrix 500 device name and YYYYYYYY is the encryption key MMMM should be **adhoc**.

To configure the IP address use command

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

File System

```
guest@Matrix520 ~>mount
/dev/ram0 on / type ext2 (rw,nogrp)
/dev/mtdblock4 on /mnt/disk type jffs2 (rw,noatime)
/proc on /proc type proc (rw,nodiratime)
/dev/sys on /sys type sysfs (rw)
guest@Matrix520 ~>df
Filesystem      1k-blocks      Used Available Use% Mounted on
/dev/ram0         8059          6777      873   89% /
/dev/mtdblock4  11648          532    11116    5% /mnt/disk
guest@Matrix520 ~>
```

Matrix 520 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 !!!

```
guest@Matrix520 />ls
bin      disk      lib       proc      tmp
default  etc       lost+found /sbin     usr
dev      home     mnt       sys       var
guest@Matrix520 />
```

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 (fdt_sio.ko)
6. rtc: Real Time Clock
7. gpio: General Purpose digital I/O
8. ttyACM0 and ttyACM1: USB Modem (CDC compliant)

```
guest@Matrix520 /dev>ls
console mem mtdblock4 pty8 sde ttyACM0
cua0 midi00 mtdr0 pty9 sequencer ttyACM1
cua1 mixer mtdr1 ram0 sndstat ttyS0
dsp mmc mtdr2 ram1 spi0 ttyS1
flash mmc0 mtdr3 ram2 spii ttyS2
gpio mmc1 mtdr4 ram3 tty ttyS3
hda hda mmc2 null random tty0 ttyS4
hda1 mtd0 ppp rtc tty1 ttyS5
hda2 mtd1 pty0 sda tty2 ttyS6
hda3 mtd2 pty1 sda1 tty3 ttyS7
hda4 mtd3 pty2 sda2 tty4 ttyS8
ipsec mtd4 pty3 sda3 tty5 ttyUSB0
knem mtdblock0 pty4 sda4 tty6 ttyUSB1
lcd mtdblock1 pty5 sdb tty7 tty0
ledman mtdblock2 pty6 sdc tty8 tty1
log mtdblock3 pty7 sdd tty9 tty2
guest@Matrix520 /dev>
```

Utility Software:

Matrix 520 includes busybox utility collection and Artila utility software as follow:

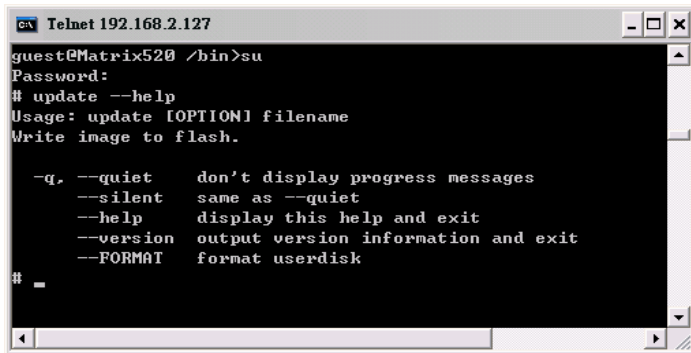
```
guest@Matrix520 /bin>ls
addgroup echo ln setuart
adduser egrep login sh
angrd false ls sleep
bash fgrep mkdir sshd
boa ftpd nke2fs stty
busybox gpiotcl mkfs.jffs2 su
cat grep mknod sync
chat gunzip nktemp tar
chgrp gzip more telnetd
chmod hostname mount tip
chown inetd np3play tone
cp init nv touch
cpu iptables netstat true
date iptables-restore pidof umount
delgroup iptables-save ping update
deluser iwconfig pppd usleep
df iwlist ps version
dhcpcd iwpriv pwd vi
discard kill rm vplay
dmesg lcdctl rndir zcat
guest@Matrix520 /bin>
```

Artila Utility Software:

The introduction of Artila utility software as follow:

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

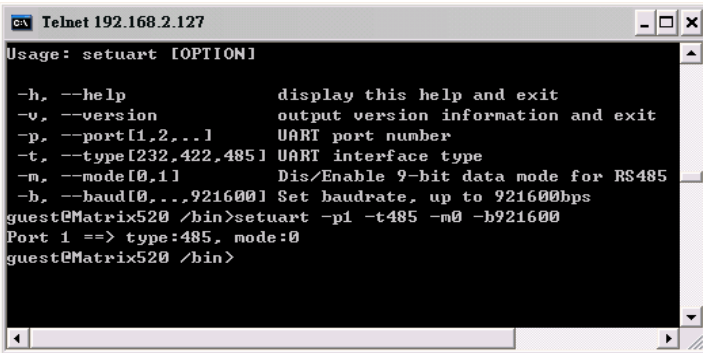


```
Telnet 192.168.2.127
guest@Matrix520 /bin>su
Password:
# update --help
Usage: update [OPTION] filename
Write image to flash.

-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)

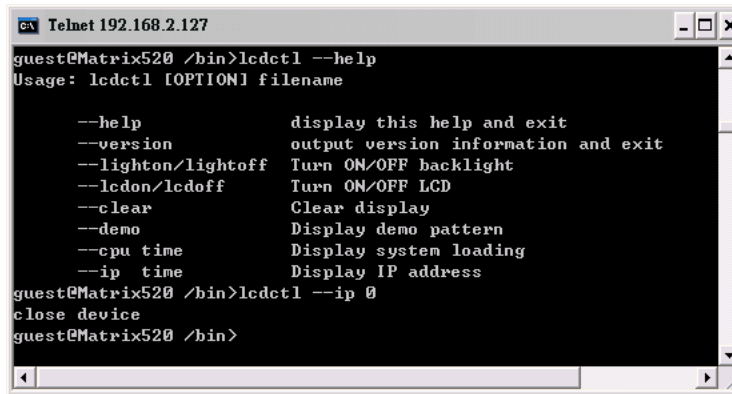
2. *setuart*: configure serial port setting. An example show as followed to configure port 1 as RS-485 interface with baud rate 921600. Please note only port 1 support 9-bit data at RS-485



```
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
-m, --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 -m0 -b921600
Port 1 ==> type:485, mode:0
guest@Matrix520 /bin>
```

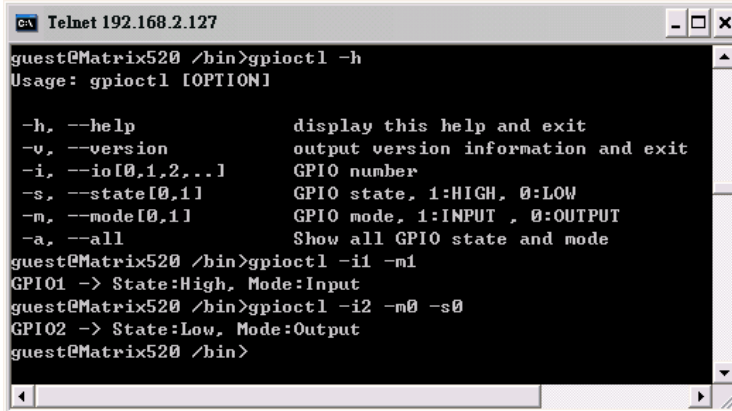
3. *lcdctl*: lcdctl is used to control the LCD display. Use lcdctl to display user message, please prepare 2x18 text message and save it as a file. Then use lcdctl filename to display the message on the LCD screen. Use *lcdctl —ip 0* to display the ip address of the network setting on the LCD screen. The parameter *time* is the refresh rate in second and use *lcdctl —cpu 0* to display the system loading information



```
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>
```

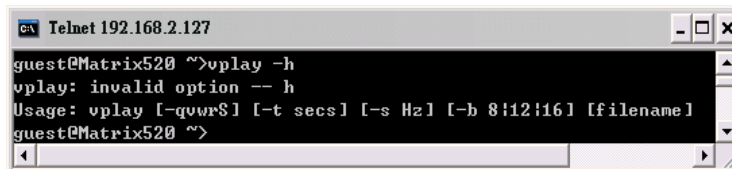
4. *gpioc1*: gpioc1 is used to control the programmable digital I/O port located on the DB25 connector. Following example is to configure DIO1 as digital input and DIO2 as digital output with low output state.



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

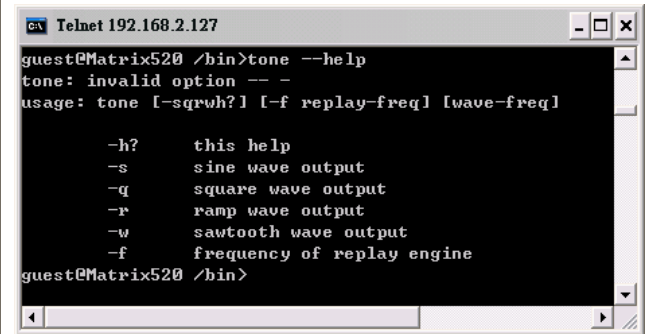
-h, --help          display this help and exit
-v, --version       output version information and exit
-i, --io[0,1,2,..] GPIO number
-s, --state[0,1]    GPIO state, 1:HIGH, 0:LOW
-m, --mode[0,1]    GPIO mode, 1:INPUT, 0:OUTPUT
-a, --all           Show all GPIO state and mode
guest@Matrix520 /bin>gpioc1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

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 ~>
```

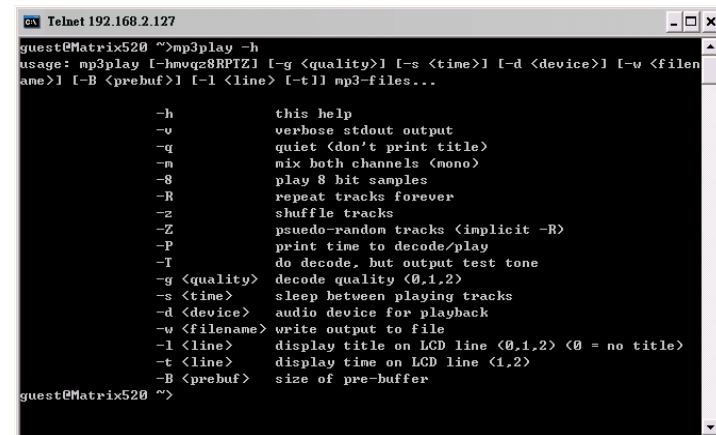
6. *Tone*: Audio output test program



```
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>
```

7. *mp3play*: mp3play is used to play MP3 format audio files



```
Telnet 192.168.2.127
guest@Matrix520 ~>mp3play -h
usage: mp3play [-hwqz8RPTZ] [-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          pseudo-random tracks (implicit -R)
-P          print time to decode/play
-I          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 ~>
```

How to make more utility software

You might also find utility software available on Artila CD under /Matrix 520/utility such as *ntpclient*, *ssh*, *scp*, *bluez* and *ssh-keygen*. If you want, you can ftp or copy the utility software to Matrix 520 user disk (/disk). Also you can use find the source code and use the GNU Tool Chain to make the utility by yourself.

Mounting External Storage Memory

To find out the device name of the external memory device which plug into Matrix 520, 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

```
ca 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
#
```

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 `/home/httpd` and the `boa.conf` contains the `boa` 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 Artilla CD to adjust the RTC time.

`/ntpclient [time server ip]`

SSH Console

Matrix 520 support SSH. If you use Linux computer, you can use SSH command to login Matrix 520. The configuration of SSH and key are located at
`/etc/config/ssh`

The key generation program is available at Artilla CD

`/matrix 520/utility/ssh_keygen`

User can copy this program to Matrix 520 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 />
```

Install GNU Tool Chain

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 520 Tool Chain

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

Getting started the Hello program

There are many example programs in Artilla CD. 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 520 user disk (`/disk`) and use

`chmod +x file.o`

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>
```