

Matrix-512

Linux ARM9 Industry Box Computer

User Guide

Version 1.0



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1. Introduction

Matrix-512 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
- Four 3-in-1 RS-232/422/485 ports
- RS-485 supports auto data direction control
- 21 programmable Digital I/O
- 9 to 40VDC power input
- Pre-installed Standard Linux 2.6 OS
- Optional DIN RAIL mounting adaptor

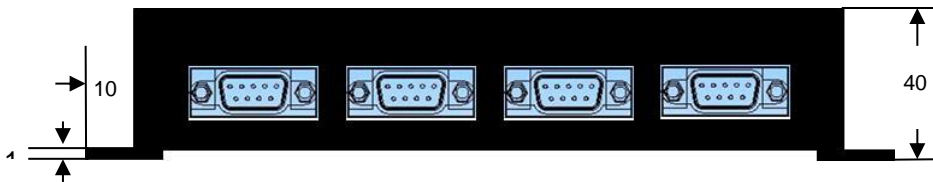
1.1 Packing List

- Matrix-512 Box Computer
- Wall mount bracket

1.2 Optional Accessory

- CB-DBCON-100 (91-DBCON-100): Console Cable (DB9 Female 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-512 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-512 again. If Ready LED is still off, please contact the manufacture for technical support.

3.4 Link / Act LED

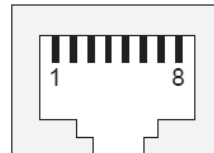
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic is the Ethernet port, this LED will flash.

3.5 Serial Port LED

These four dual color LEDs indicate the data traffic at the serial ports. When Rx/D line is high then Green light is ON and when Tx/D line is high, Yellow light is ON.

3.6 Ethernet Port

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



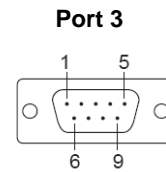
3.7 Serial Port

The four serial ports are 3-in-one RS-232/422/485 ports and the interface is configured in by software. Please refer to example program to configure the serial or use “*setuart*” utility to configure serial port setting. RS-485 hardware supports data direction control. Therefore it is software compatible with a RS-232 interface.

3.8 Serial Console Port: (P3)

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

Pin No.	RS-232
1	--
2	--
3	--
4	--
5	GND
6	--
7	TXD
8	RXD
9	--



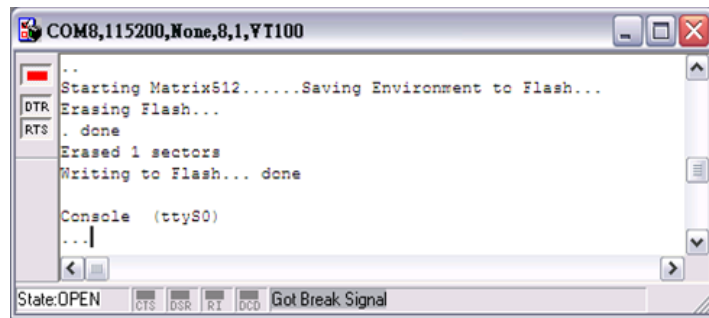
Baud Rate: 115200
 Data bits: 8
 Parity: N
 Stop bit: 1
 Terminal type: ANSI

The console cable can be ordered and its part number is 91-DBCON-100. Its configuration can be found at document Matrix-512 console cable.

3.9 Enable / Disable Serial Console Port

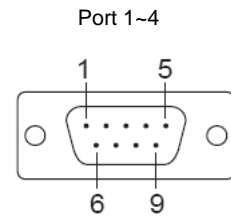
The serial console port is disabled as factory default setting. To enable the serial console, you need to purchase or prepare a serial console cable and connect it to port 3. Right after powering on the system, keep typing \$ continuously until you see the message as shown in the figure followed.

Console (ttyS0) stands for console port ttyS0 is enabled. Repeat this procedure will disable the serial console and Screen will show "Console (null)".



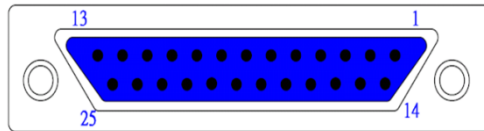
3.10 Serial Port (DB9 Male)

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	-	-	-



Note: * Port 2 only

3.11 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

3.12 Factory Default Settings

LAN 1 IP Address: 192.168.2.127

LAN 2 IP Address: DHCP

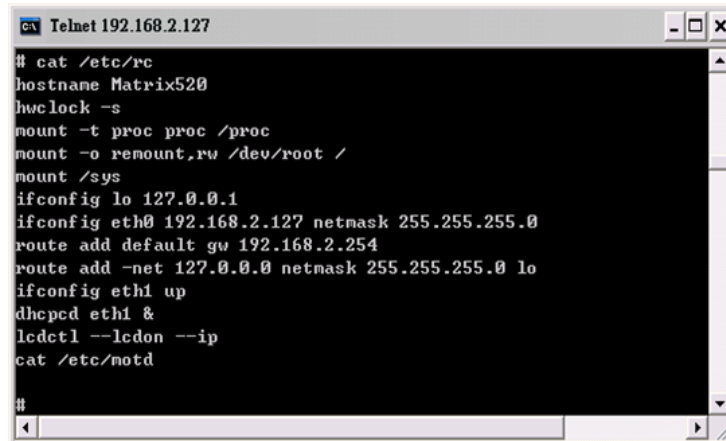
Login: guest

Password: guest

Supervisor: root (ssh supported)

Password: root

3.13 Network Settings

A screenshot of a Telnet terminal window titled 'Telnet 192.168.2.127'. The terminal shows a series of commands and their outputs for configuring the system. The commands include: '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 --ledon --ip', and 'cat /etc/notd'. The prompt '#' is visible at the end of each line.

```
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 --ledon --ip
cat /etc/notd
#
```

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 &
```

3.14 Wireless LAN Configuration

Matrix-512 supports wireless LAN by using USB WLAN adaptor which uses Ralink RT2571 (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:

```
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 Matrix-512, the device name and YYYYYYYYY is the encryption key and 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
```

3.15 File System

```

Telnet 192.168.2.127

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

For further information check:
http://www.artila.com/

guest@Matrix520 ~>nmount
/dev/ram0 on / type ext2 (rw,nogrpид)
/dev/ntdblock4 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/ntdblock4       11648          532      11116    5% /mnt/disk
guest@Matrix520 ~>_
  
```

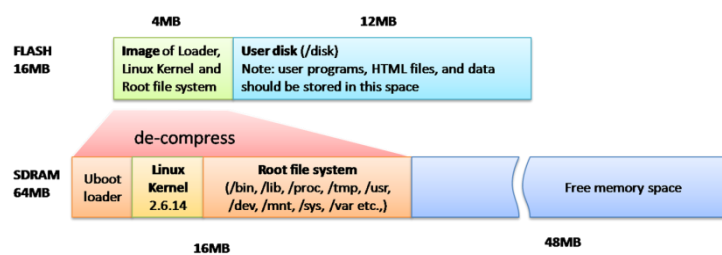
Matrix-512 configures the root file system as RAMDISK and the user disk (/disk) which includes /home and /etc directory are configured as Flash Disk. To find out the file system information, please use command /mount as show as above. In addition, use command /df to find out the disk space of the disk. 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.

```

Telnet 192.168.2.127

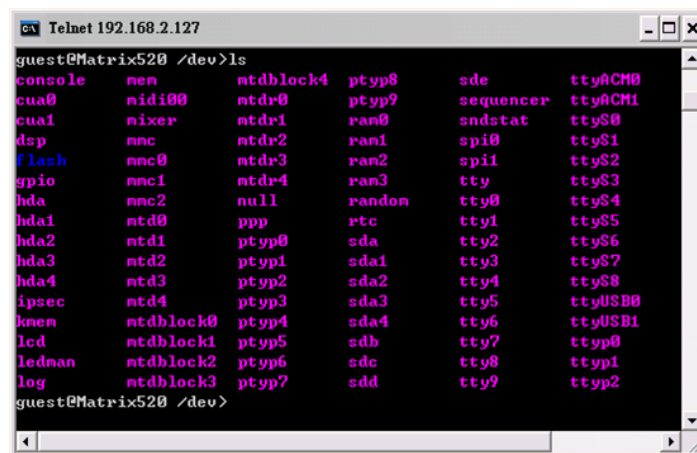
guest@Matrix520 />ls
bin           disk          lib           proc          tmp
default      etc           lost+found  /sbin         usr
dev           home          mnt          sys           var
guest@Matrix520 />_
  
```



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. 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>

```

3.17 Utility Software

Matrix-512 includes busybox utility collection and Artilla 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>

```

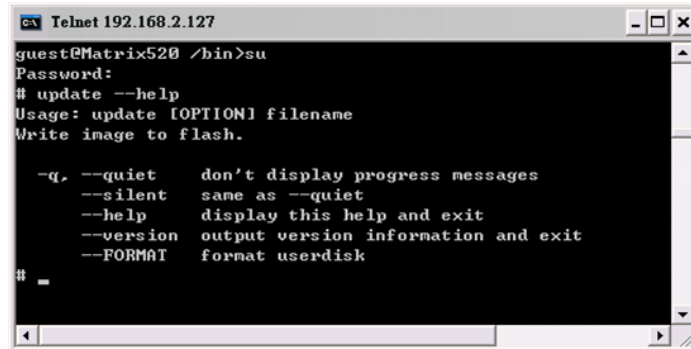
4. Artila Utility Software

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.



```

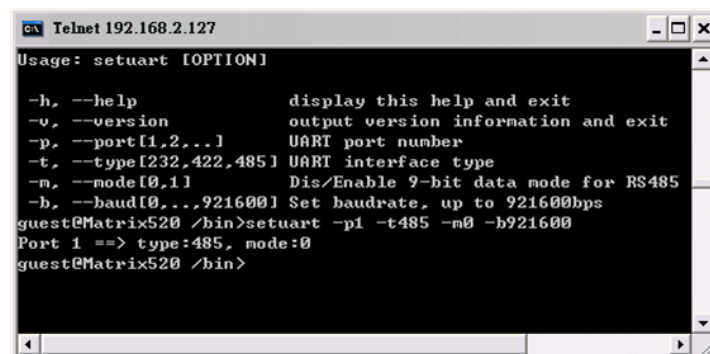
c:\ Telnet 192.168.2.127
guest@Matrix520 /bin>su
Password:
# update --help
Usage: update [OPTION] filename
Write image to flash.

  -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.



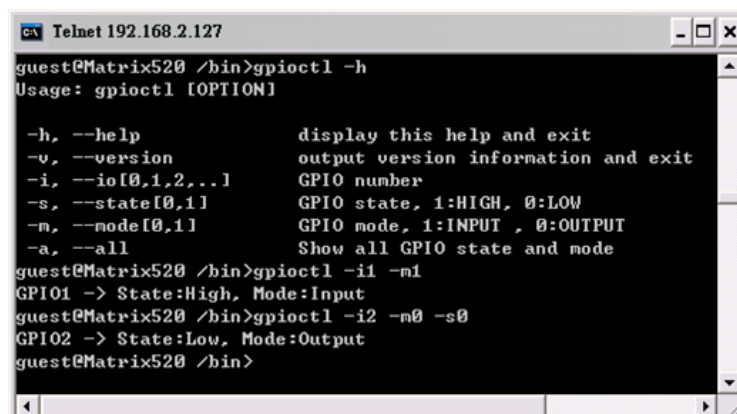
```

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

4.3 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.



```

c:\ 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>
  
```

4.4 How to Make More Utility Software

You might also find utility software available on Artilla FTP under /Matrix & iPAC/utility such as *ntpclient*, *ssh*, *scp*, *bluez* and *ssh-keygen*. If you want, you can ftp or copy the utility software to Matrix-512 user disk (/disk). Also you can use find the source code and use the GNU Toolchain to make the utility by yourself.

4.5 Mounting External Storage Memory

To find out the device name of the external memory device which plug into Matrix-512, you can use the command

```
/dmesg | grep sd
```

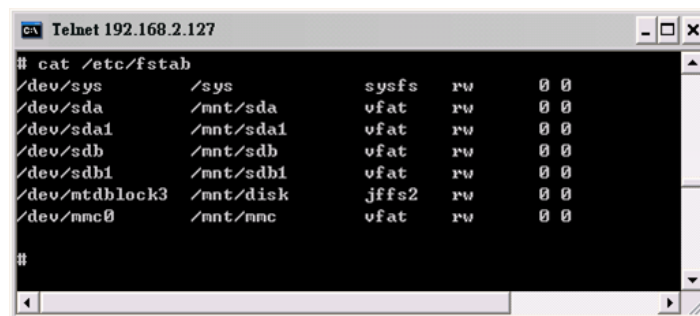
or

```
/dmesg | grep mmc
```

Type

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

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



```

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
#

```

4.6 Welcome Message

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

4.7 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*.

4.8 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]

4.9 SSH Console

Matrix-512 support SSH. If you use Linux computer, you can use SSH command to login Matrix-512.

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

The key generation program is available on Artila FTP: `/matrix and ipac/utility/ssh_keygen`

User can copy this program to Matrix-512 to generate the key.

```

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 />

```

4.10 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-512 toolchain.

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

4.11 Getting Started 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-512 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>
```


5. Frequently Asked Question

5.1 Forgot Password

If you forgot the password for login, please use serial console to modify the password.

5.2 Reset Matrix-512 to Factory Default Setting

The factory default setting is available at `/default` directory. User can copy the default setting to `/etc` and `/home` directories manually or format the user disk to set Matrix-512 to factory default setting.

Performing disk format will erase all the files in user disk. Therefore please backup the files you need in USBDISK first before format the disk. Use command:

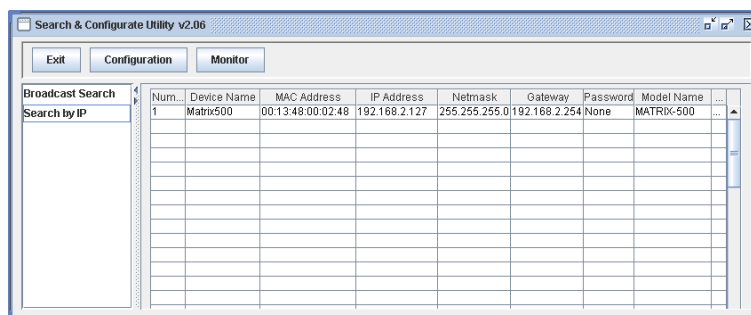
`/update —FORMAT`

To format disk.

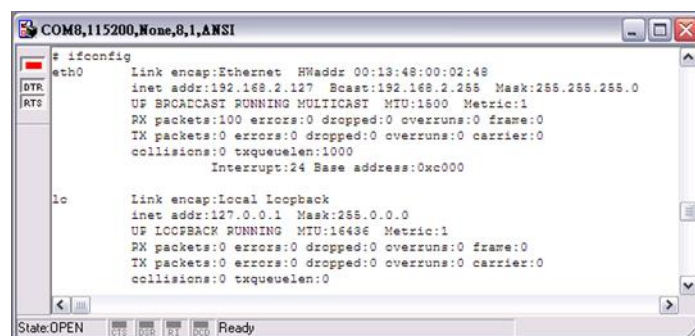
5.3 Forgot the IP Address

If you forgot the Matrix-512 IP address, you can use the Java Manager available on Artila FTP to search the IP address of Matrix-512.

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



Num.	Device Name	MAC Address	IP Address	Netmask	Gateway	Password	Model Name
1	Matrix500	00:13:48:00:02:48	192.168.2.127	255.255.255.0	192.168.2.254	None	MATRIX-500



```
# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:13:48:00:02:48
          inet addr:192.168.2.127  Bcast:192.168.2.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1600  Metric:1
          RX packets:100 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
             Interrupt:24 Base address:0xc000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  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:0
```