

Matrix-500

Linux ARM9 Industry Box Computer

User Guide

Version 2.2



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1. Introduction

Matrix-500 features four serial ports, 10/100Mbps Ethernet, USB port and SD socket for flash disk expansion. The pre-install Linux OS and GNU tool chain make Matrix-500 ready for your application development.

1.1 Features

- 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
- One 10/100Mbps Ethernet
- Two USB 2.0 full speed (12Mbps) Host Ports
- Multimedia Card Interface for SD memory card
- One 3-in-1 RS-232/422/485 ports and three RS-232 ports
- 16 General Purpose DIO inside box
- 9 to 48VDC power input
- Pre-installed Standard Linux 2.6.14 OS
- GNU toolchain available on Artila FTP
- Optional DIN RAIL mounting adaptor

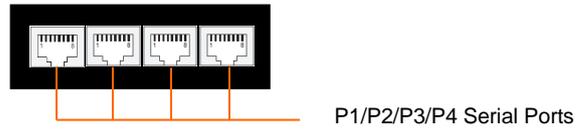
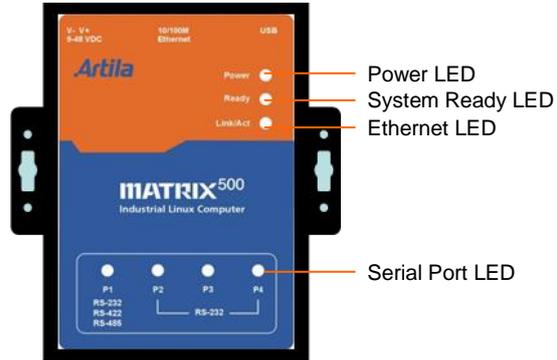
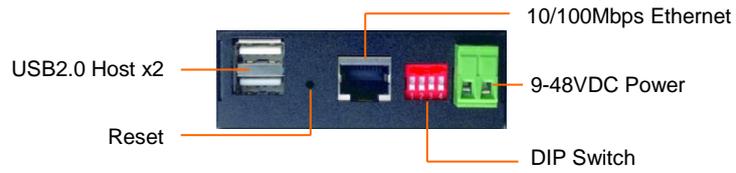
1.2 Packing List

- Matrix-500

1.3 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
- PWR-12V-1A (31-62100-000): 110~240VAC to 12VDC 1A Power Adaptor

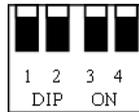
2. Layout



3. Pin Assignment and Definition

3.1 DIP Switch

The four keys DIP switch is used to configure serial port interface and user application. Key 1 and 2 are used to configure the RS-232/422/485 mode of serial port P1 and Key3 and Key 4 are connected to GPIO and they are reserved for user's application.



Pin	RS-232	RS-422	RS-485
1	ON	OFF	OFF
2	ON	ON	OFF
3	--	--	--
4	--	--	--

3.2 USB Port

The USB port is a USB2.0 high speed host port. It can be used to expand the hardware function of Matrix-500 and exchange file and data between PC and Matrix-500 using an USB flash disk.

Currently the hardware support by Matrix-500 USB is shown as follow:

1. USB Storage Device
2. USB to Wireless LAN Adaptor (Ralink RT2571)
3. USB to Serial Adaptor (fdt usb to UART)
4. USB to Modem (CDC compliant)
5. USB Camera

Contact Artila if you find your hardware is not shown on the list.

3.3 Reset Button

Press the "Reset" button to activate the hardware reset. Please always use "reboot" command to reset Matrix-500. You should only use this function if the software reboot does not function properly.

3.4 Power LED

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

3.5 Ready LED

After Power ON, Matrix-500 will decompress the kernel and root file system to RAMDISK. Once system is boot up, the Ready LED will show solid green. The Ready LED will be turned off after Matrix-500 received "halt" command.

3.6 Link / Act LED

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

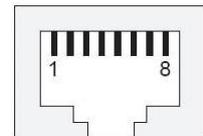
3.7 Serial Port LED

These four 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.

3.8 Serial Port

The four serial ports use RJ45 connector and the pin assignment are shown as following table.

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	--	--



Port 1: RS-232/422/485 (switch selection)

RS-232: RXD, TXD, RTS, CTS, GND

RS-422: TXD+, TXD-, RXD+, RXD-, GND

RS-485: DATA+, DATA-, GND

Port 2:

RS-232: RXD, TXD, RTS, CTS, DSR, DTR, DCD, GND

Port 3:

RS-232: RXD, TXD, RTS, CTS, GND

Port 4:

RS-232: RXD, TXD, RTS, CTS, GND

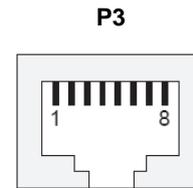
3.9 Serial Console Port

Serial console port is used for local access Matrix-500 system using RS-232 port. At factory, serial console port is disabled because serial console port shares the P3 connector with Serial port 3 and the pin definition as shown as follow:

Port 0:

RS-232: RXD, TXD, GND

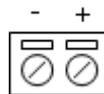
Pin	RS-232
1	
2	TXD
3	GND
4	
5	
6	
7	RXD
8	



Therefore you need to prepare or purchase the serial console cable (91-RJCON-100) in order to use the serial console port. See Enable serial console port for information to use serial console.

3.10 Power Connector

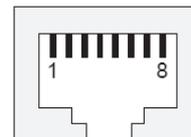
Connect the 9 to 48VDC power line to Matrix-500. If the power is properly supply, the power LED will show a solid green color.



3.11 Ethernet Port

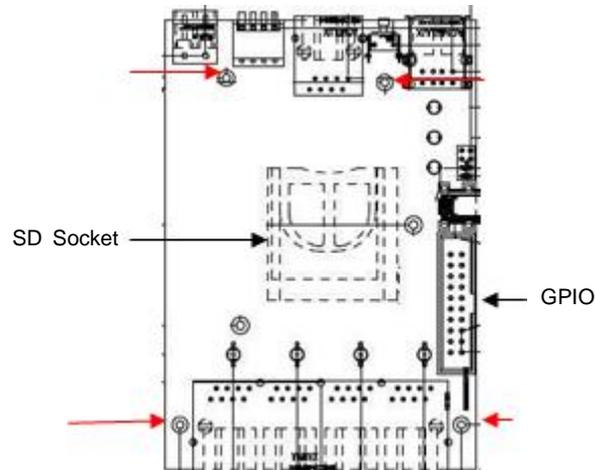
The Ethernet Port use RJ45 connector.

Pin	Signal
1	ETx+
2	ETx-
3	ERx+
6	ERx-



3.12 SD Socket

The SD socket is compatible with SD memory card specification version 1.0. The SD Socket is located in the back panel of the PCB. To install the SD memory card, please use the screw driver to open the metal case of Matrix-500 and unscrew Screw 1 to 4 as following:



3.13 General Purpose IO (GPIO)

CN7 is a 20-pin box connector which is used for 16 channels GPIO. The pin definition is as shown following:

+3.3V	20	19	+5V
GND	18	17	GND
DI15	16	15	DI14
DI13	14	13	DI12
DI11	12	11	DI10
DI9	10	9	DI8
DI7	8	7	DI6
DI5	6	5	DI4
DI3	4	3	DI2
DI1	2	1	DI0

The signal level of GPIO is CMOS/TTL compatible and pitch of the pin header is 2.54 mm. Each of the DIO pin can be programmed as digital input or digital output.

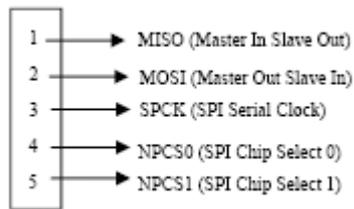
3.14 JTAG Header

CN1 is a JTAG header and the pin definition is shown as follow:

VCC3 (3.3V)	←	1	2	→	NTRST
GND	←	3	4	→	TDI
TDO	←	5	6	→	TMS
VCC3_PWROK	←	7	8	→	TCK

3.15 SPI Header

CN6 is a SPI header and its pin definition is shown as follow:



3.16 Boot Manager Selection

JP1 is boot selection jumper. Set to position 2-3 always. Change the setting will cause incorrectly boot up.

3.17 Factory Default Settings

LAN 1 IP Address: 192.168.2.127

Login: guest

Password: guest

Supervisor: root (use ssh to login)

Password: root

Serial Console: Disabled

3.18 Network Settings

```

c:\ Telnet 192.168.2.127
# cat rc
hostname Matrix500
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
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 &
```

3.19 Wireless LAN Configuration

Matrix-500 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:

```
modprobe rt73
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-500 host 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
```

3.20 File System



```
Telnet 192.168.2.127
# ls
bin      disk    lib     proc    tmp
default  etc     lost+found  /sbin  usr
dev      home   mnt     sys     var
#
```

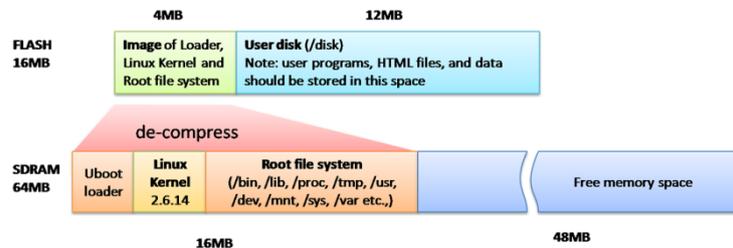
Matrix-500 configures the root file system as RAMDISK and the user disk (/disk) which includes /home and /etc directory are configured as Flash Disk. To find out the file system information, please use command /mount as shown as below. In addition, use command /df to find out the disk space of the disk. The RAMDISK uses 8MB SDRAM space to store the root file system and 8MB for uboot loader and Linux Kernel Therefore it is about 64MB free SDRAM for user application software. The image of Linux kernel and root file system is stored in the flash memory and it uses about 4MB flash memory space and the rest of 12MB flash memory is designed for user flash disk to store user's program.

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

```

c:\ Telnet 192.168.2.127
# mount
/dev/ram0 on / type ext2 (rw,nogrpid)
/dev/ntdblock3 on /mnt/disk type jffs2 (rw,noatime)
/proc on /proc type proc (rw,nodiratime)
/dev/sys on /sys type sysfs (rw)
# df
Filesystem          1k-blocks      Used Available Use% Mounted on
/dev/ram0            8059          6172    1478   81% /
/dev/ntdblock3      12288          532    11756    4% /mnt/disk
#

```



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

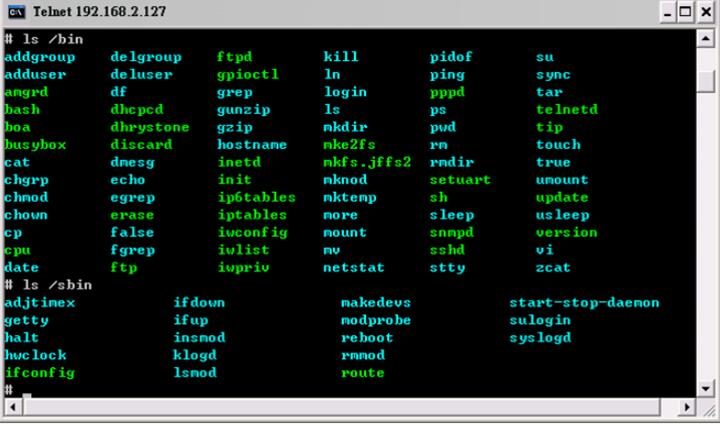
```

c:\ Telnet 192.168.2.127
# cd /dev
# ls
console  mem          mtdblock4  ptyp8      sde         ttyACM0     ttyp3
cua0     midi00      mtdr0      ptyp9      sequencer  ttyACM1     ttyp4
cua1     mixer      mtdr1      ran0       sndstat    ttyS0       ttyp5
dsp      mmc        mtdr2      ran1       spi0       ttyS1       ttyp6
flash    mmc0       mtdr3      ran2       spii       ttyS2       ttyp7
gpio     mmc1       mtdr4      ran3       tty        ttyS3       ttyp8
hda      mmc2       null       random     tty0       ttyS4       ttyp9
hda1     mtd0       ppp        rtc        tty1       ttyS5       urandom
hda2     mtd1       ptyp0      sda        tty2       ttyS6       video0
hda3     mtd2       ptyp1      sda1       tty3       ttyS7       video1
hda4     mtd3       ptyp2      sda2       tty4       ttyS8       watchdog
ipsec    mtd4       ptyp3      sda3       tty5       ttyUSB0     zero
kmem     mtdblock0  ptyp4      sda4       tty6       ttyUSB1
lcd      mtdblock1  ptyp5      sdb        tty?       ttyp0
ledman   mtdblock2  ptyp6      sdc        tty8       ttyp1
log      mtdblock3  ptyp7      sdd        tty9       ttyp2
#

```

3.22 Utility Software

Matrix-500 includes busybox utility collection and Artila utility software as follow:



```
ex Telnet 192.168.2.127
# ls /bin
addgroup      delgroup      ftpd           kill           pidof         su
adduser       deluser       gpioc1        ln             ping         sync
amrpd         df            grep          login         pppd         tar
bash          dhcpcd       gunzip        ls            ps           telnetd
boa           dhrystone    gzip          mkdir         pwd          tip
busybox       discard      hostname     nke2fs        rm           touch
cat           dnsmg        inetd         mkfs.jffs2    rmdir       true
chgrp         echo          init          mknod         setuart     unmount
chmod         egrep        iptables     mktemp        sh           update
chown         erase         iptables     more          sleep       usleep
cp            false        iwconfig     mount         snmpd       version
cpu           fgrep        iwlist        mv            sshd        vi
date          ftp          iupriv       netstat       stty        zcat

# ls /sbin
adjtimex      ifdown        nakedevs      start-stop-daemon
getty         ifup          nodprobe     sulogin
halt          insmod        reboot        syslogd
hwclock       klogd         rmdir
ifconfig      lsmod         route
```

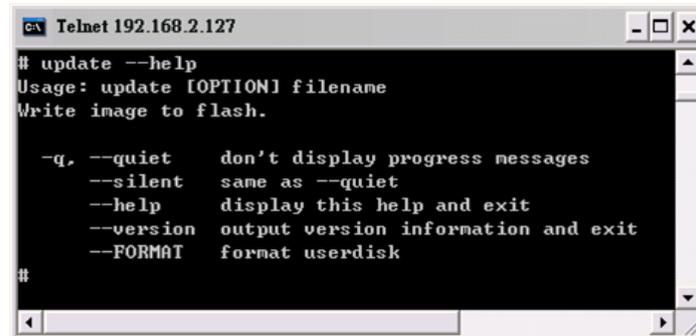
4. Artila Utility Software

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.



```

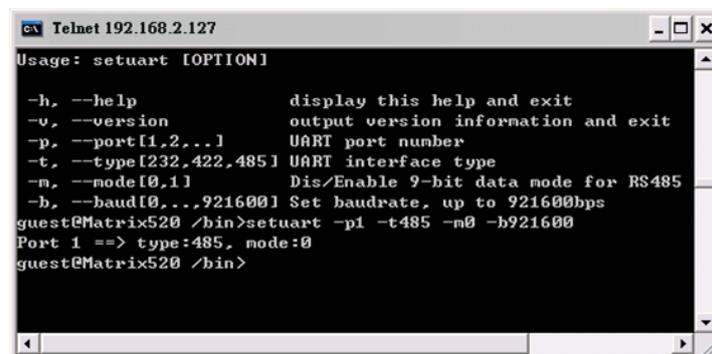
c:\ Telnet 192.168.2.127
# update --help
Usage: update [OPTION] filename
Write image to flash.

  -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 How to Make More Utility Software

You might also find utility software available on Artila FTP under /Matrix 500/utility such as *ntpclient*, *ssh*, *scp*, *bluez* and *ssh-keygen*. If you want, you can ftp or copy the utility software to Matrix-500 user disk (/disk). Also you can use find the source code and use the GNU Toolchain to make the utility by yourself.

4.4 Mounting External Storage Memory

To find out the device name of the external memory device which plug into Matrix-500, you can use the command

```
/dmesg | grep sd
```

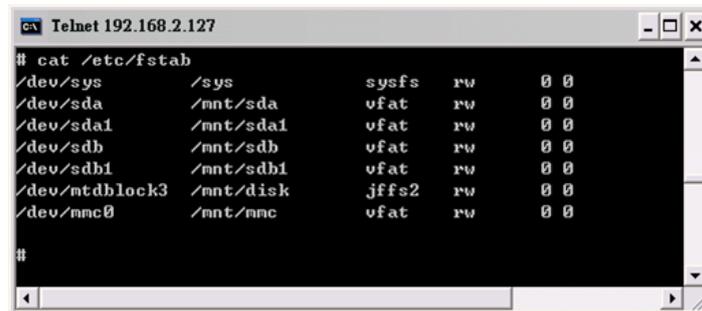
or

```
/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
#
```

4.5 Welcome Message

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

4.6 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`.

4.7 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]
```

4.8 SSH Console

Matrix-500 support SSH. If you use Linux computer, you can use SSH command to login Matrix-500.

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

The key generation program is available on Artilla FTP: `/matrix 5XX/utility/ssh_keygen`

User can copy this program to Matrix-500 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 />

```

4.9 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-500 toolchain.

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

4.10 Getting Started with the Hello Program

There are many example programs on Artilla 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
```

And bin command to set transfer mode to binary

```
ftp>bin
```

To transfer the execution file to Matrix-500 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-
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>

```

4.11 Enabled Serial Console Port

The serial console port is disabled as factory default setting. To enable the serial console, you need to use the serial console cable (91-RJCON-100) and connect it to port 3. Use any terminal software such as hyper terminal and setting as follow:

Baud Rate: 115200

Data bits: 8

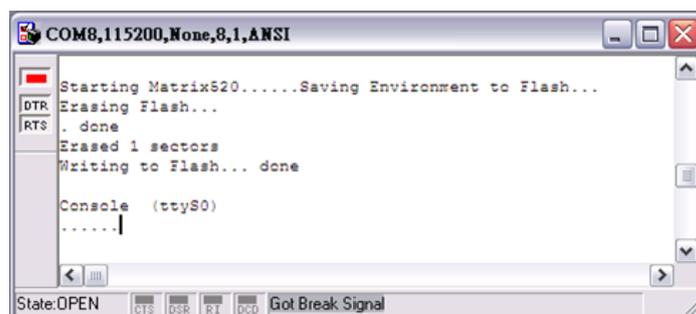
Parity: N

Stop bit: 1

Terminal type: ANSI

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.

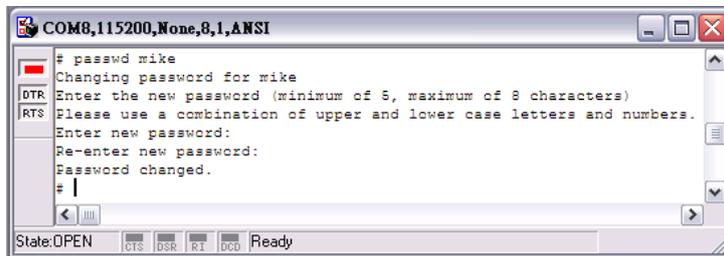
Console (ttyS0) stands for console port ttyS0 is enabled. Repeat this procedure will disable the serial console and Screen will show "Console (null)".



5. Frequently Asked Question

5.1 Forgot Password

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



```

COM8,115200,None,8,1,ANSI
# passwd mike
Changing password for mike
Enter the new password (minimum of 5, maximum of 8 characters)
Please use a combination of upper and lower case letters and numbers.
Enter new password:
Re-enter new password:
Password changed.
#
  
```

5.2 Reset Matrix-500 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-500 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:

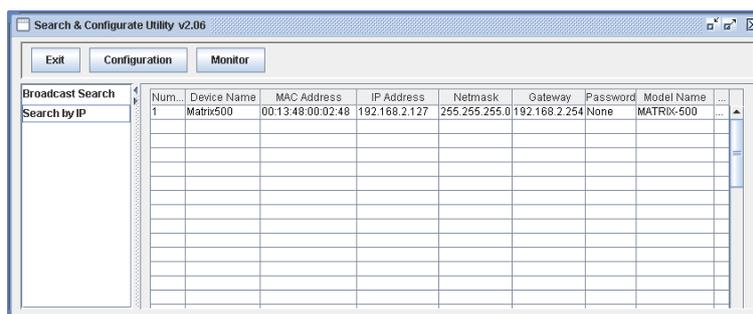
`/update —FORMAT`

To format disk.

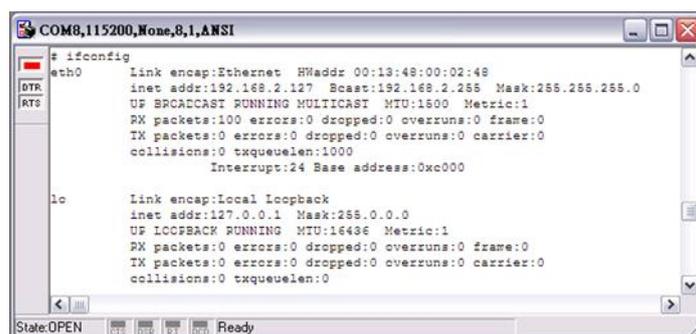
5.3 Forgot the IP Address

If you forgot the Matrix-500 IP address, you can use the Java Manager available on Artila FTP to search the IP address of Matrix-500.

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



```

COM8,115200,None,8,1,ANSI
# 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
  
```