

**Introduction:**

Matrix 512 is an ARM9-based Linux ready industrial computer. The key features are as follow:

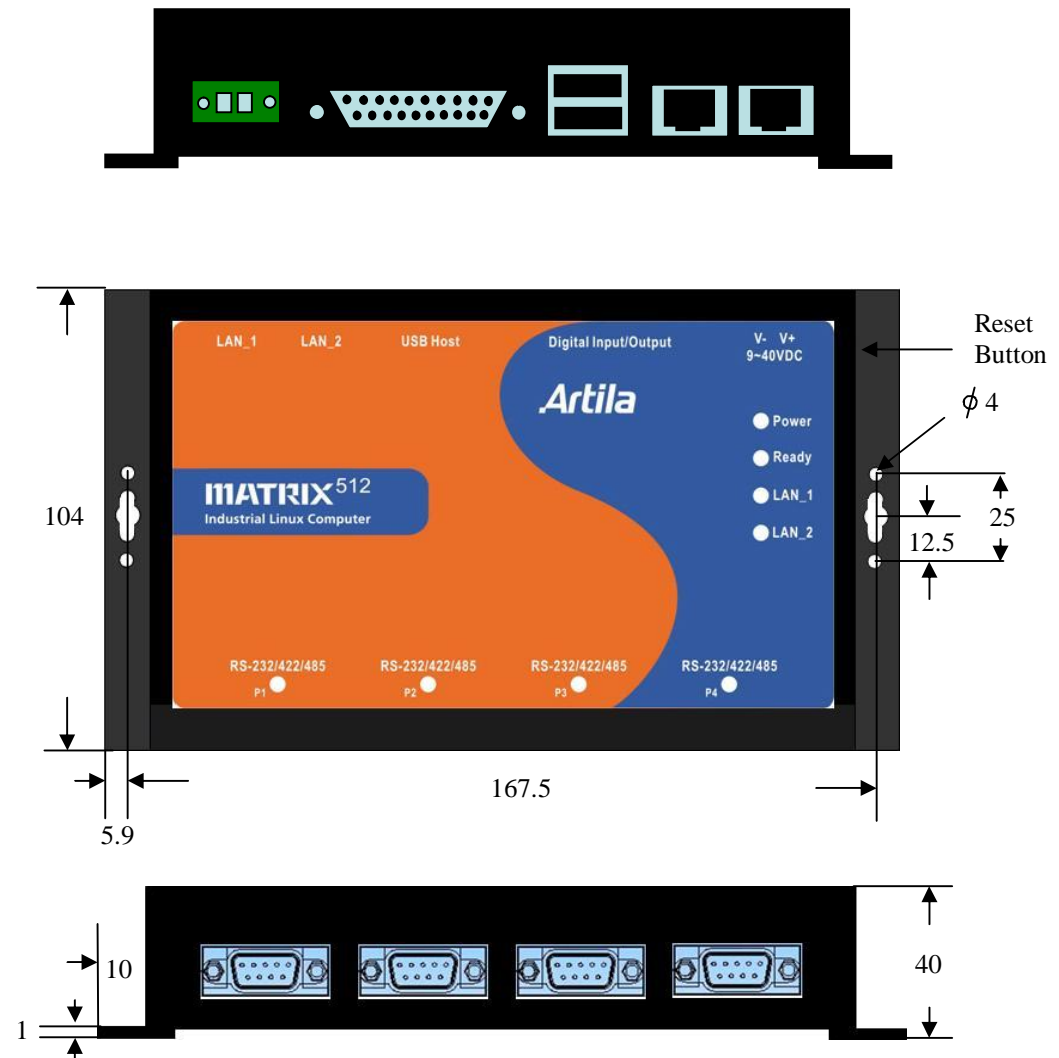
1. ARM920T ARM Thumb Processor with 200MIPS at 180MHz, Memory Management Unit
2. 16-KByte Data Cache and 16-KByte Instruction Cache
3. 64MB SDRAM, 16MB Flash on board
4. Two 10/100 Mbps Ethernet
5. Two USB 2.0 full speed (12 Mbps) Host Ports
6. Multimedia Card Interface for SD memory card
7. Four 3-in-1 RS-232/422/485 ports
8. RS-485 supports auto data direction control
9. 21 programmable Digital I/O
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 512 Box Computer
2. Wall mount bracket
3. Artila CD

**Optional Accessory:**

1. DK-35A: DIN RAIL Mounting Kit
2. Console cable CB-DB2CON-100
3. Serial cable: CB9FDB9F-100

***Matrix 512 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 reboot 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 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 520 again. If Ready LED is still off, please contact the manufacture for technical support.

### Link/Act

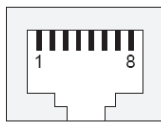
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic in the Ethernet, this LED will flash

### 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

### Ethernet Port

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



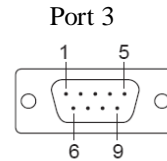
### Serial Ports:

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.

### Serial Console Port: (P3)

Serial console port shares 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	—

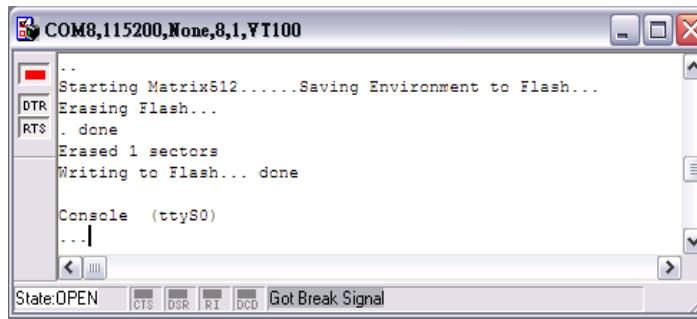


Baud Rate: 115200  
Data bits: 8  
Parity: N  
Stop bit: 1  
Terminal type: ANSI

The console cable can be ordered and its part number is CB-DB9FDB9F-100. Its configuration can be found at document Matrix 512 console cable

### Enable/Disable Serial Console Port

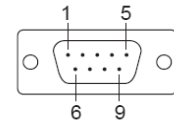
The serial console port is disabled as factory default setting. To enable the serial console, you need to purchase or prepare a serial console cable and connect it to port 3. Right after powering on the system, keep typing \$ continuously until you see the message as shown in the figure followed. Console (ttyS0) stands for console port ttyS0 is enabled. Repeat this procedure will disable the serial console and Screen will show “Console (null)”



### Serial Port (DB9 Male)

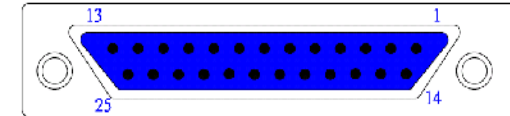
Pin No.	RS-232	RS-422	RS-485
1	DCD*	TXD-	—
2	RXD	TXD+	—
3	TXD	RXD+	DATA+
4	DTR*	RXD-	DATA-
5	GND	GND	GND
6	DSR*	—	—
7	RTS	—	—
8	CTS	—	—
9	---	—	—

### **Port 1~4**



**Note: \* Port 2 only**

### 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

```
LAN 1 IP Address: 192.168.2.127
LAN 2 IP Address: DHCP
Login: guest
Password: guest
Supervisor: root (ssh supported)
Password: root
```

```

# 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 &
lcdctl --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 &*

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 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 Matrix512, the device name and YYYYYYYY 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
```

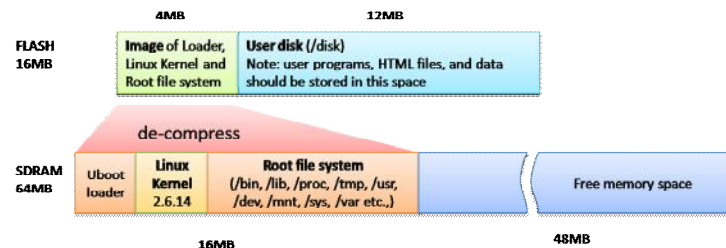
```
Telnet 192.168.2.127

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

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

guest@Matrix520 ~$mount
/dev/ram0 on / type ext2 (rw,nogrpuid)
/dev/mtddb0k4 on /mnt/disk type jffs2 (rw,noatime)
/proc on /proc type proc (rw,nodiratime)
/dev/sys on /sys type sysfs (rw)
guest@Matrix520 ~$df
Filesystem      1k-blocks      Used Available Use% Mounted on
/dev/ram0              8059        6777       873   89% /
/dev/mtddb0k4        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 !!!



```

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

```

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\_i2c.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   ptyp8        sde          ttyACM0
cua0         midi00      mtdr0       ptyp9        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        ptyp0       sda          tty2         ttyS6
hda3         mtd2        ptyp1       sda1         tty3         ttyS7
hda4         mtd3        ptyp2       sda2         tty4         ttyS8
ipsec        mtd4        ptyp3       sda3         tty5         ttyUSB0
kmem         mtdblock0   ptyp4       sda4         tty6         ttyUSB1
lcd          mtdblock1   ptyp5       sdb          tty7         tty0
ledman       mtdblock2   ptyp6       sdc          tty8         tty1
log          mtdblock3   ptyp7       sdd          tty9         tty2

```

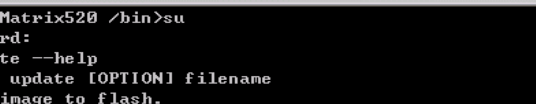
Matrix 512 includes busybox utility collection and Artila utility software as follow:

```

Telnet 192.168.2.127
guest@Matrix520 ~/bin>ls
addgroup          echo              ln                setuaurt
adduser           egrep            login            sh
amgrd             false           ls               sleep
hash             fgrep           mkdir            sshd
boa              ftpd            mke2fs           stty
busybox          gpioctl         mkfs.jffs2       su
cat              grep            mknod            sync
chat             gunzip          nktemp           tar
chgrp            gzip            more             telnetd
chmod            hostname        mount            tip
chown            inet            mp3play          tone
cp              init            mv               touch
cpu             iptables        netstat          true
date            iptables-restore pidof            ount
delgroup         iptables-save   ping             update
deluser          iwconfig        pppd             usleep
df              iulist         ps               version
dheped          iwpriv          pwd              vi
discard          kill            rm               vplay
dmesg           ledctl         rmdir            zcat
guest@Matrix520 ~/bin>

```

The introduction of Artila utility software as follow:



The screenshot shows a Telnet window titled 'Telnet 192.168.2.127'. The user is logged in as 'guest@Matrix520' in the '/bin' directory. They enter the 'su' command, followed by 'Password:'. Then they enter '# update --help', which displays the usage information for the 'update' command. The usage text indicates that the command takes an optional filename and writes the image to flash. A list of options is provided: '-q' for quiet, '--silent' for silent, '--help' for help, '--version' for version information, and '--FORMAT' for formatting the userdisk. The prompt returns to '# \_'.

```
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

# _
```

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

```

CN 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>

```

```

guest@Matrix520 /bin>gpioctl -h
Usage: gpioctl [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>gpioctl -i1 -m1
GPIO1 -> State:High, Mode:Input
guest@Matrix520 /bin>gpioctl -i2 -m0 -s0
GPIO2 -> State:Low, Mode:Output
guest@Matrix520 /bin>

```

You might also find utility software available on Artila CD 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 Tool Chain to make the utility by yourself.

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
```

```

# 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
#

```

```
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 512 Tool Chain

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

## Getting started the Hello program

There are many example programs in Artila 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 512 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>
```

### Frequently Asked Question

1. *Forgot password:*

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

## 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.

### 3. *Forgot the IP address*

If you forgot the Matrix 512 IP address, you can use the Java Manager available in Artila CD to search the IP address of Matrix 512

