Matrix-522

Linux ARM9 Industry Box Computer

User Guide

Version 1.1

Table of Contents

1. Introduction

Matrix-522 is an ARM9-based Linux ready industrial computer. The key features are as follow:

- ARM926EJ-S ARM Thumb Processor 400MHz w/MMU
- 32-KByte Data Cache and 32-KByte Instruction Cache
- 64MB SDRAM, 256MB NAND Flash on board
- Two 10/100 Mbps Ethernet
- Two USB 2.0 full speed (12 Mbps) Host Ports, one USB device port
- Multimedia Card Interface for Micro SD memory card
- Two 3-in-1 RS-232/422/485 ports
- Two 2500 Vrms fully isolated CAN 2.0A/2.0B ports
- 21 programmable Digital I/O port
- 9 to 40VDC power input
- Pre-installed Standard Linux 2.6.29 OS
- GNU tool chain available on Artila FTP
- Support SocketCAN and CANopen Library
- Optional DIN RAIL mounting adaptor

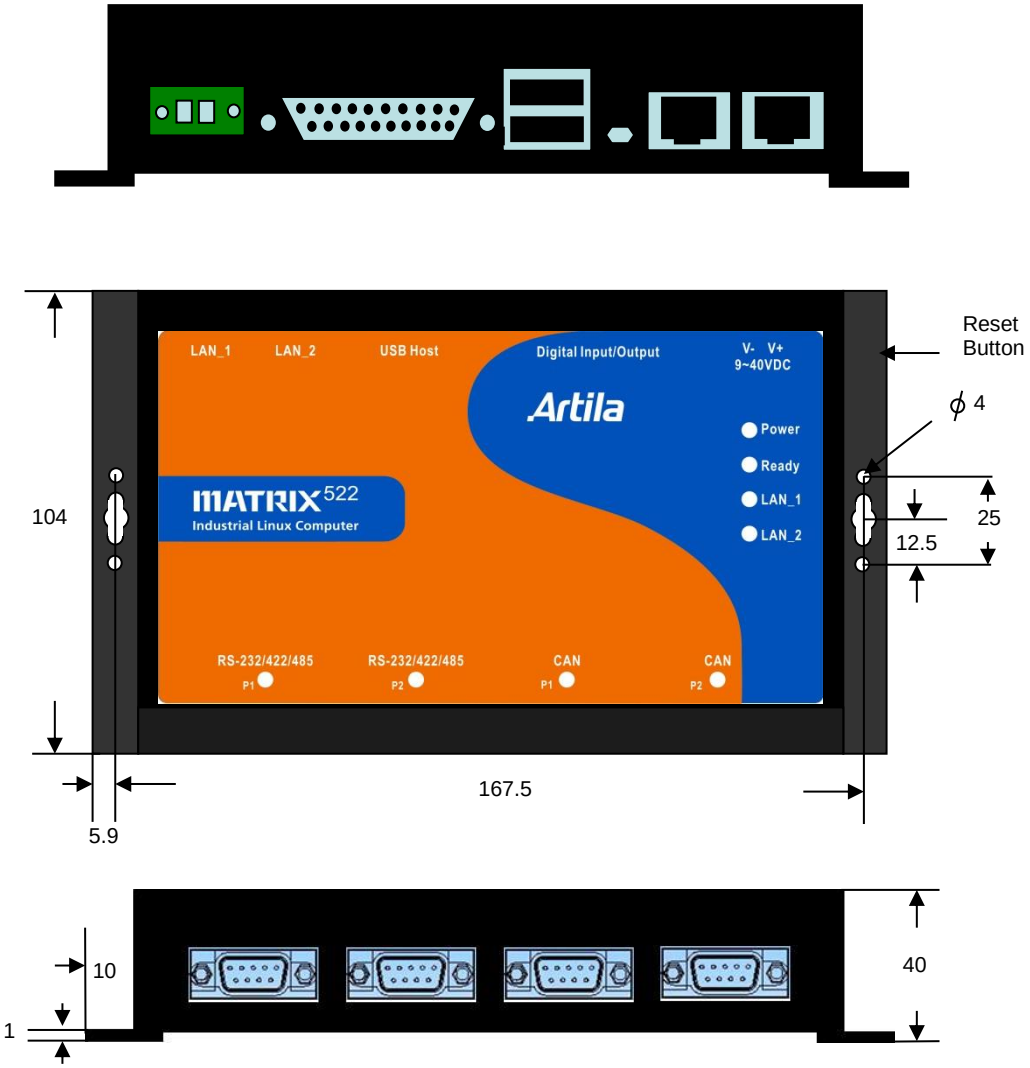
1.1 Packing List

- Matrix-522 Box Computer
- Wall mount bracket

1.2 Optional Accessory

- CBL-F10M9-20 (91-0P9M9-001): Console Cable (10Pin Header to DB9 Male, 20cm)
- DK-35A (36-DK35A-000): DIN RAIL Mounting Kit

2. Layout


LAN_1
LAN_2
USB Host
Digital Input/Output
V- V+
9~40VDC
Artila
Power
Ready
LAN_1
LAN_2
MATRIX 522
Industrial Linux Computer
RS-232/422/485
P1
RS-232/422/485
P2
CAN
P1
CAN
P2
Reset
Button
ϕ 4
104
25
12.5
167.5
5.9
10
1
40

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-522 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-522 again. If Ready LED is still off, please contact the manufacture for technical support.

3.4 Link / Act LED

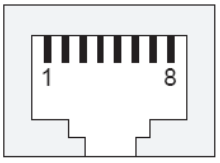
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic is the Ethernet port, this LED will flash.

3.5 Serial / CAN Port LED

The dual color LEDs indicate the data traffic at the serial bus and CAN bus. 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 Ports

Port 1~2: 3-in-1 Software Configurable
RS-232/422/485

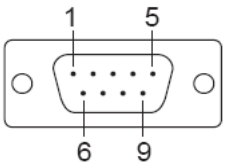
☞ **Note**

- Only Port 2 has full modem signals DSR, DTR, DCD.

3.8 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	-	-	-

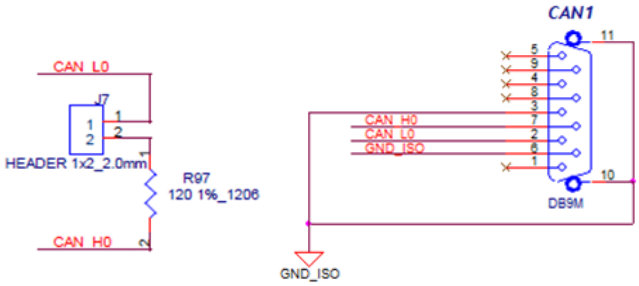
Port 1~2



Note: * Port 2 only

3.9 CAN Port (DB9 Male)

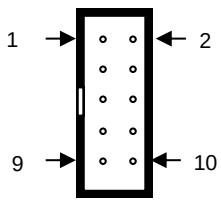
Matrix-522 features two 2500 Vrms fully isolated CAN ports. A 120 Ohm terminator is applied between CAN_H and CAN_ L that can be disabled by removing jumper J7 and J8. A shielding ground is available at Pin 3 of the DB9 connector.



3.10 Serial Console Port

Serial console port is located inside the box at CON1. You need to use console cable (91-0P9M9-001) to access it.

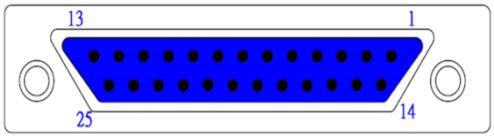
Serial Console RS-232			
1	N/C	2	N/C
3	RXD	4	N/C
5	TXD	6	N/C
7	N/C	8	N/C
9	GND	10	N/C



To use the serial console port, you need to open the metal case of Matrix-522 and the CON1 connector is near the reset button and LEDs. User can also redirect the serial console port to any one of the serial port by command ***/setconsole.*** Please use setconsole —help for the usage.

3.11 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

3.12 Factory Default Settings

LAN 1 IP Address: 192.168.2.127

LAN 2 IP Address: 192.168.3.127

Login: root or guest (telnet guest only)

Password: root or guest (telnet guest only)

Serial Console Port:

Baud rate: 115200

Data format: 8 Bits, No Parity, 1 Stop bit (N,8,1)

Flow Control: None

Terminal type: VT100

3.13 Power on and System Boot up

Once Matrix-522 is correctly power on, it will start boot Linux kernel and mount file system. You can use Ethernet and telnet and login Matrix-522. Once kernel loaded, it will find ***/sbin/init*** and execute it. The initialization configuration is at ***/etc/inittab***. Once boot up, you can use telnet to login Matrix-522.

3.14 Inittab and Run Levels

Inittab contains information of system initialization. The system initialization script ***/etc/rcS.d*** runs first then the run level 5 ***/etc/rc5.d***. Matrix-522 uses run level for system setup and the default run level is number 5. Please refer to introduction to linux (http://tille.garrels.be/training/tldp/) for information about run level.

Following is the run levels setting:

Run level 0: halt

Run level 1 is single user (login and service are disabled)

Run level 2~5 are multiple users

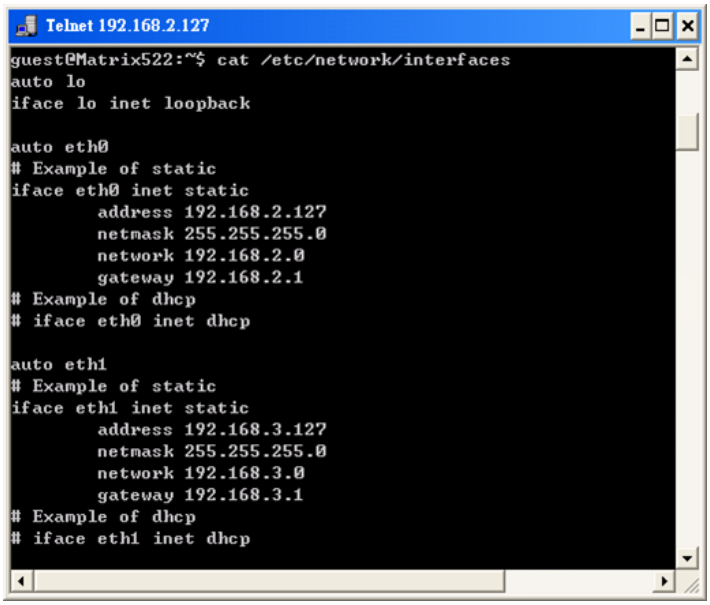
Run level 6 is reboot

Please refer to loader menu section for selection of run level.

3.15 Default Started Service

1. amgrd (Artila broadcast search daemon)
2. ssh (secured shell) with sftp
3. syslog/klogd (system and kernel log)
4. telnet server (disable root with ***/etc/securetty***)
5. ftp server (vsftp)
6. web server (lighttpd)
7. Ready LED (debug LED for internal use)

3.16 Network Settings

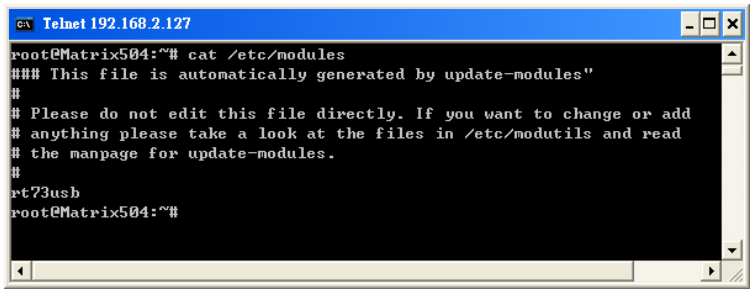


3.17 Insert Kernel Module

To insert kernel module while system boot up, please use ***vi*** to edit ***/etc/modules*** to add module to load e.g.

rt73usb

To load the USB WLAN adaptor.



Use ***vi*** editing tool to edit the ***/etc/network/interfaces*** for network setting. The default setting is static IP 192.168.2.127. Matrix-522 also supports Wireless LAN. Use

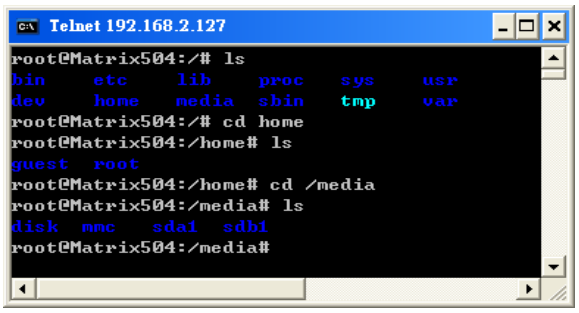
wireless_essid XXX

wireless_key YYY

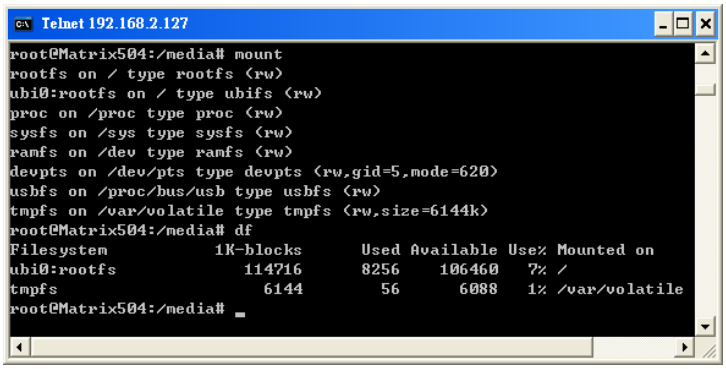
To add SSID and WEP key if necessary. XXX is SSID and YYY is WEP Key.

Matrix-522 supports popular USB WLAN adaptor. Please contact Artila for the most update driver support.

3.18 File System



The 256MB NAND Flash memory of Matrix-522 contains Boot loader (uBoot), Linux Kernel, Root File System and user disk (\home). The file system and disk space are shown as follow:



3.19 Devices List

The supported devices are shown at /dev directory. Following list are most popular ones:

1. ttyS0: serial console port
2. ttyS1 to ttyS2: serial port 1 to port 2
3. sda to sdb: USB flash disk
4. ttyUSB0 to ttyUSB1: USB RS-232 adaptor (fdti_sio.ko)
5. rtc: Real Time Clock
6. gpio: General Purpose digital I/O
7. ttyACM0 and ttyACM1: USB Modem (CDC compliant)
8. mmc: SD driver

> ☞ **Note**
>
> ▪ can0 and can1 are network devices under SocketCAN.

3.20 Utility Software

Matrix-522 includes busybox utility collection and Artila utility software and there are placed at:

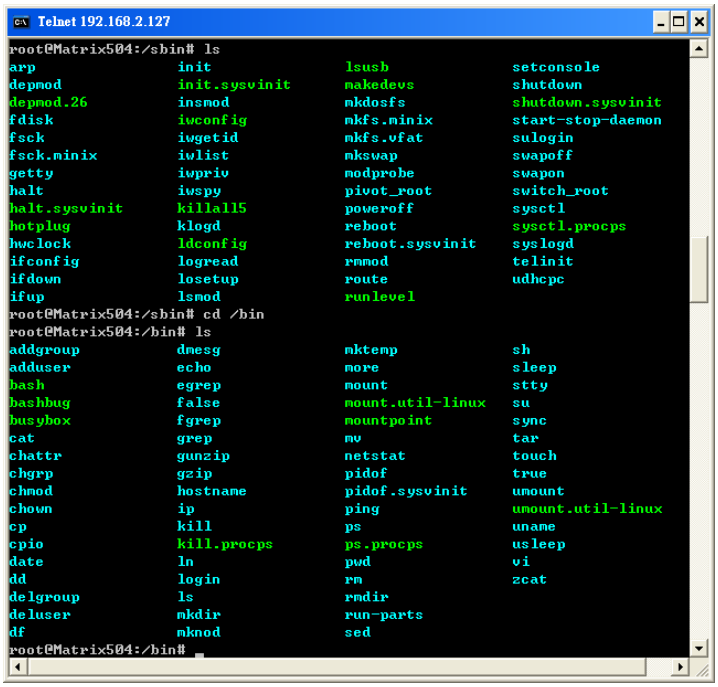
/sbin

/bin

/usr/bin

/use/sbin

Please refer to Appendix for the utility collection list.



3.21 Mounting External Storage Memory

To find out the device name of the external memory device which plug into Matrix-522, you can use the command:

dmesg | grep sd

dmesg | grep mmc

To find out the device type (sda, sdb or mmc).

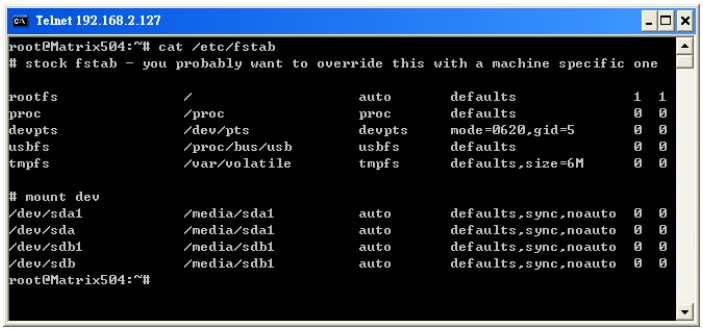
And use

mount/dev/sda1

mount/dev/mmc

to mount the USB disk or SD card and folder is local at

media/sda1* or *mnt/sda1



3.22 Welcome Message

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

3.23 Web Page Directory

The web pages are placed at ***/usr/www*** and the ***/etc/lighttpd.conf*** contains the lighttpd web server settings. The home page name should be *index.html.*

3.24 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]

3.25 SSH Console

Matrix-522 supports SSH. If you use Linux computer, you can use SSH command to login Matrix-522.

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

The key generation program is available at ***/usr/bin***.

3.26 Putty Console Software

For Windows user, you can download the putty software at http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html to use SSH to login Matrix-522.

3.27 ipkg Package Software Management

ipkg is a light software package utility. It can be used to install, upgrade and remove the software package for Matrix-522. Currently user can use ipkg to install the software package from Artila FTP. You can find the configuration at ***ipkg.conf***.

When Matrix-522 is connected to network and issue command:

ipkg update

To update the package list and use

ipkg install

To install software package and

ipkg remove

To remove software

ipkg list

To list available software

ipkg list_installed

To list software installed

Please refer to Appendix for more about ***ipkg.***

3.28 SocketCAN

Matrix-522 supports SocketCAN which implements a standard network interface for CAN protocols for Linux. Unlike other CAN implementation for Linux based on character devices, SocketCAN uses Berkeley socket API, the Linux network stack and implements CAN device drivers as network interfaces.

The CAN socket API has been designed as similar as possible to the TCP/IP protocols to allow programmers, familiar with network programming, to easily learn how to use CAN sockets.

Please refer to the document:
Example\CanBus\socketcan\socketCAN.txt on Artila FTP for the SocketCAN API.

3.29 libsocketcan

The libsocketcan library allows you to control some basic functions in socketcan from userspace.

Please refer to:
Example\CanBus\libsocketcan for the examples program for libsocketcan.

3.30 Configure CAN

To configure CAN device, you can use utility programs:

/canconfig

/candump

/canecho

/cansend

/cansequnce

User can also use ***ip*** command to configure CAN e.g.

/ip link set can0 down

/ip link set can0 type can bitrate 250000

/ip link set can0 up

/ip –details link show can0

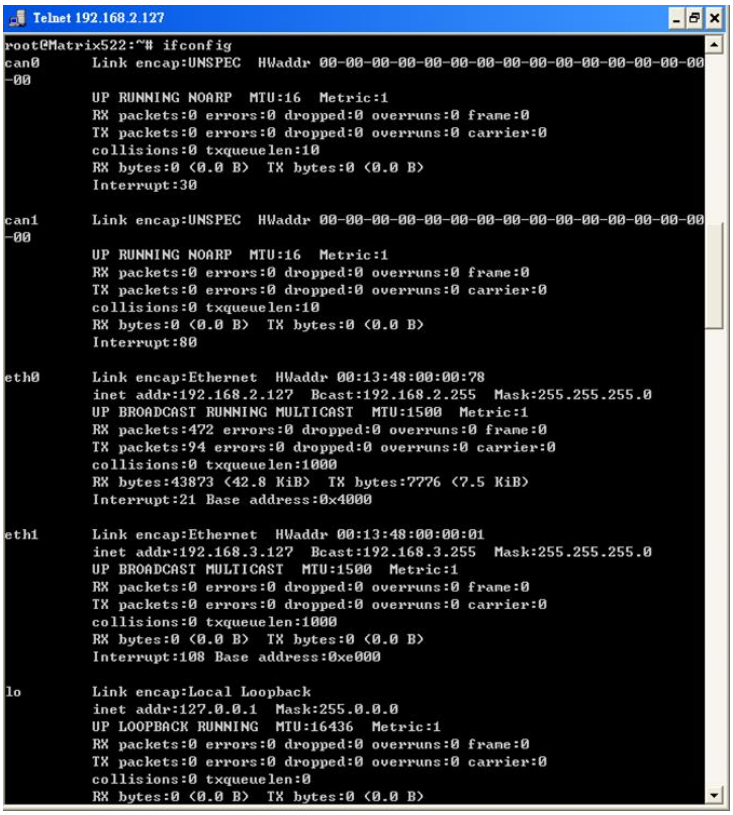
The boot up CAN bit rate setting is at ***/etc/can_config***

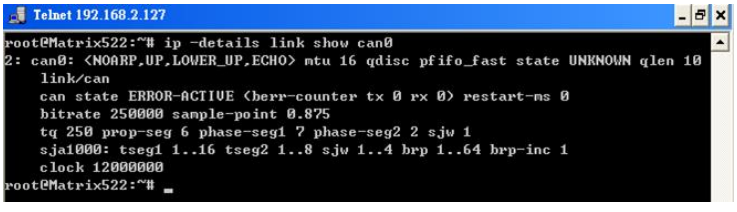
Format: [can port]: [bit rate]

0:250000

1:250000

Bit rate: 10K~ 1M





3.31 CANOpen

The Artila FTP also includes CanFestival 3 open source for CANOpen.

Please refer to:

\example\CanBus\canfestival

and http://www.canfestival.org for Canfestival.

3.32 Install GNU Toolchain

Find a PC with Linux OS installed as followed:

Fedore 7, ubuntu 7.04, OpenSUSE 10.2, Mandriva 2008, Debian 5.0, Centos (RedHat) 5 and above.

Login as a root user then copy the arm-linux-4.3.2.tar.gz to root directory of PC. Under root directory, type following command to install the Matrix-522 Toolchain:

#tar -xvfj arm-linux-4.3.3.tar.bz2

The toolchain file name are:

arm-linux-gnueabi-gcc

arm-linux-gnueabi-g++

arm-linux-gnueabi-strip

Version: gcc 4.3.3, glibc 2.9, binutils 2.18

For Windows user, please download the toolchain from CodeSourcery at http://www.codesourcery.com/sgpp/lite/arm/portal/package4547/public/arm-none-linux-gnueabi/arm-2009q1-203-arm-none-linux-gnueabi.exe

The toolchain file name are:

arm-none-linux-gnueabi-gcc

arm-none-linux-gnueabi-g++

arm-none-linux-gnueabi-strip

Version: gcc 4.3.3, glibc 2.8, binutils 2.19

3.33 Getting Started with the Hello Program

There are many example programs on Artila 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

Then login with password. Use bin command to set transfer mode to binary

ftp>bin

To transfer the execution file to Matrix-522 user disk (/home/guest) and use

chmod +x file.o

To change it to execution mode and

./file.o

to run the program.

3.34 Auto Start Program on Boot

To start a program on boot, you can use ***/etc/rc.local.***

For example to use ***vi*** to edit ***rc.local***

hello &

exit 0

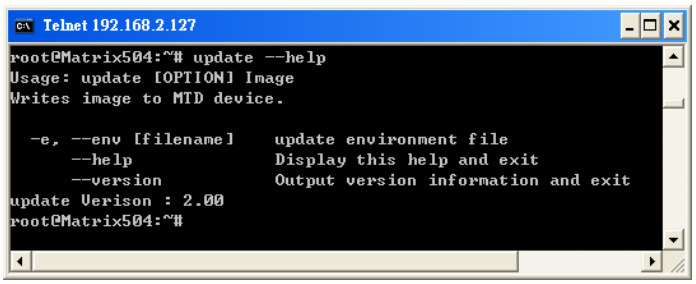
Hello will be executed after system boot up. ***rc.local*** has the similar function as ***/etc/rc*** in Matrix-522.

4. Artila Utility Software

The introduction of Artila utility software as follow:

4.1 update

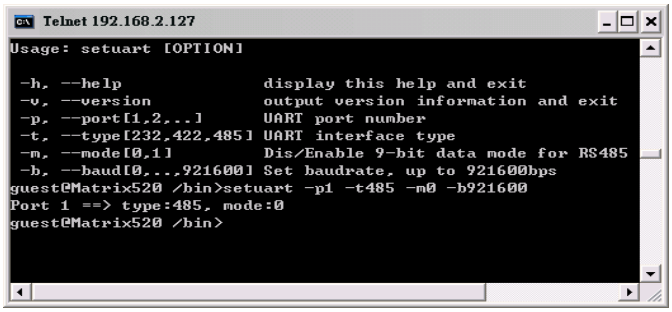
Update loader, environment file and kernel image. Type ***update--help*** to find the command usage.



Update can only operate under supervisor mode (password: root). Please use command ***su*** and login as root.

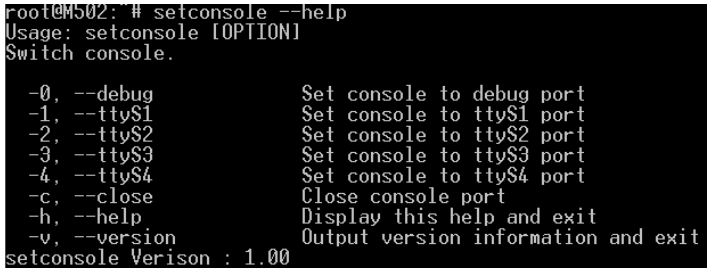
4.2 setuart

Configure serial port setting. An example show as followed to configure port 1 as RS-485 interface with baud rate 921600.



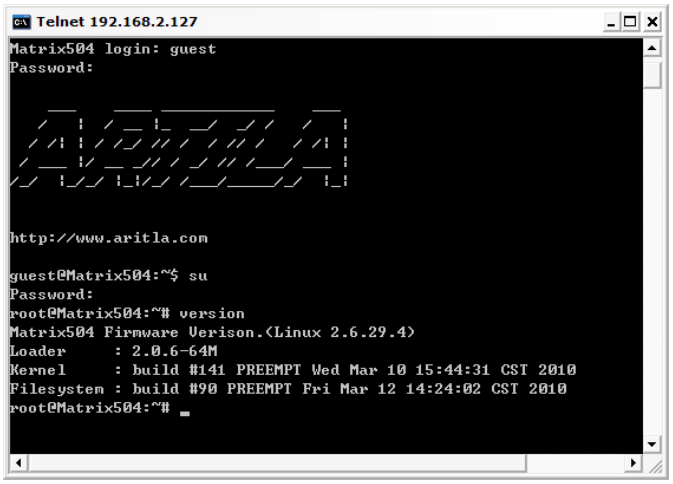
4.3 setconsole

Unlike Matrix-510 which shares the serial console port with the serial port 3, Matrix-522 uses dedicated pins for serial console (debug port). ***setconsole*** command allows user to redirect the serial console port to any one of the four serial port of Matrix-522. Therefore user can avoid opening the metal case to access the serial console.



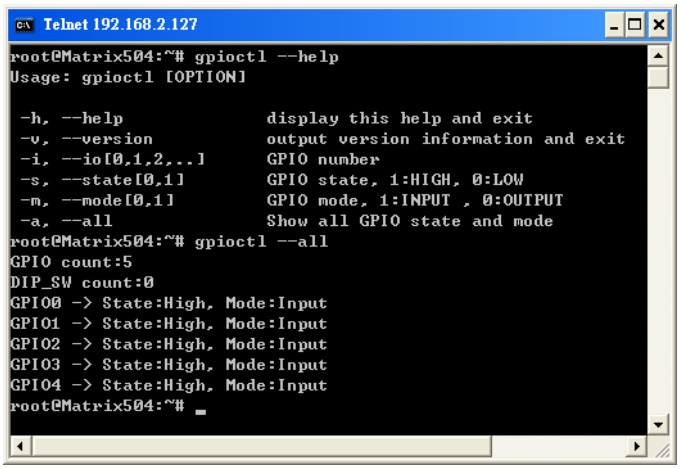
4.4 version

Find out the version of OS.



4.5 gpioctl

The gpio can be configured by ***gpioctl*** and the usage is as shown followed.



5. Loader Menu

Loader menu helps user to select the run level of system boot up. User need to use serial console to enter loader menu. Please configure the serial port of terminal as follow:

Baud Rate: 115200
Data bits: 8
Parity: N
Stop bit: 1
Flow Control: None
Terminal type: VT100

Once power up Matrix-522, please repeatedly keying "@" and you will see the loader menu appear as follow:

```
Starting M502.........
***********************************************
       Artila Loader Version 2.0.9
            DRAM:64M NAND:128M
***********************************************
    G: Loader TFTP       L: Loader  Serial
    K: Kernel TFTP       S: Kernel  Serial
    F: Filesys TFTP      T: Filesys Serial
    E: Env. Upgrade      M: Ethernet Setting
    A: Dataflash Booting U: Runlevel
    C: Switch Console    R: Reset
***********************************************
```

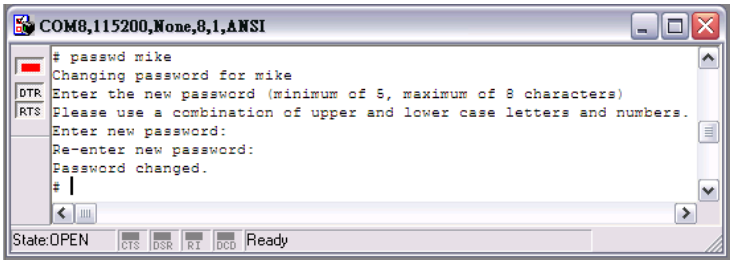
If you miss the timing, please power on again the Matrix-522 and do it again. Select U will prompt the run level selection message. Run level 0 is halt, run level 1 is single user (disable login and service). Run level 2~5 are multiple users and run level 6 is reboot. To view the run level configuration, please check:

/etc/inittab

6. Frequently Asked Question

6.1 Forgot Password

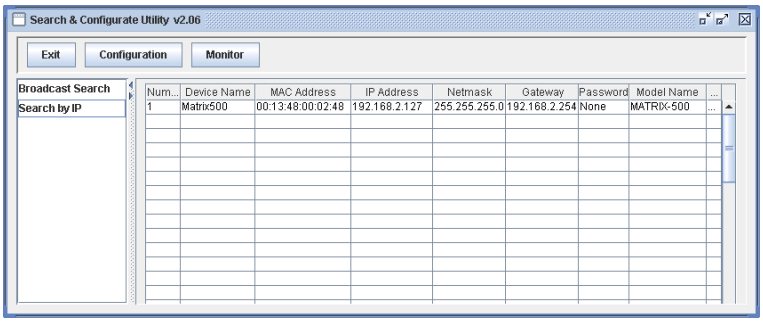
If you forgot the password for login, please use serial console and use run level 1 to boot system. Use passwd to change the password setting.



6.2 Forgot the IP Address

If you forgot the Matrix-522 IP address, you can use the Java Manager available on Artila FTP to search the IP address of Matrix-522.

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

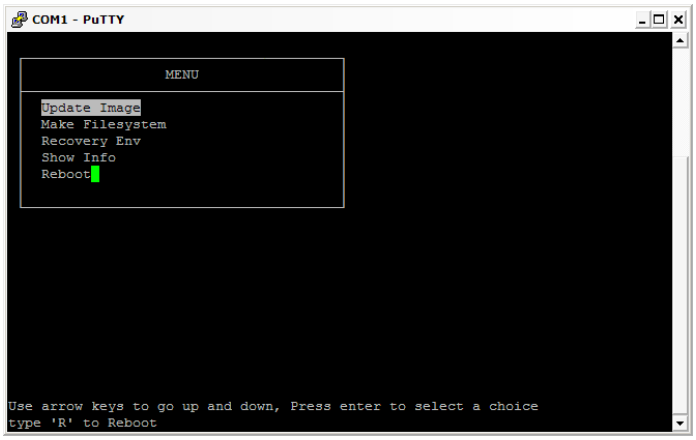


6.3 System Fail to Boot

If you mess up the root file system and make the system fail to boot, Matrix-522 will automatically switch to boot from Dataflash file system and a console menu will show up at console port to help user perform system recovery. ***System Recovery Section*** will tell you how to recover the system.

7. System Recovery

If NAND Flash file system does fail, DataFlash file system will automatically boot up and a Console Menu at console port will appear as follow:



7.1 Update Image

This option can recover the loader, kernel and file system by using an USB disk. The USB disk contains the images files with the path as follow:

Loader: ***m522/m522.alf***

Kernel: ***m522/m522K***

File system: ***m522/m522R***

The files are available on Artila FTP. Please prepare an USB disk and copy the image files to it before choosing this option.

7.2 Make Filesystem

This option is used to create customized file system. Before using this function, you need to copy the folder of ***mkimage522*** on Artila FTP to an USB disk. This function will create a new file system image for users and they can use it to duplicate the customized file system to other Matrix-522.

7.3 Recovery Env.

The option will recover the environment files as default setting. Use this function only when the NAND file system crash.

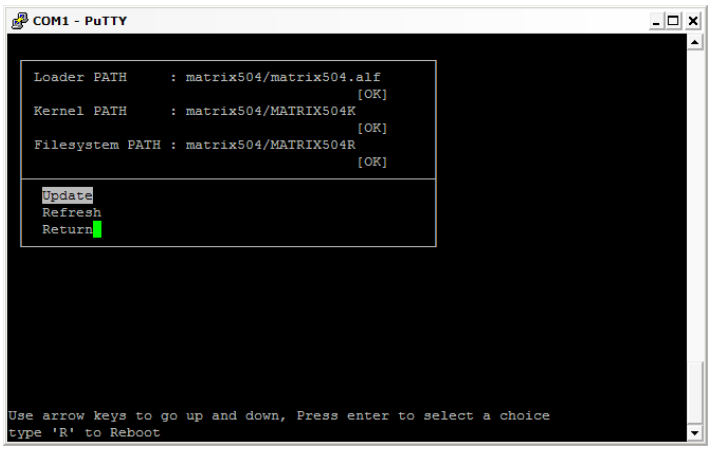
7.4 Show Info

Show the version information of Matrix-522.

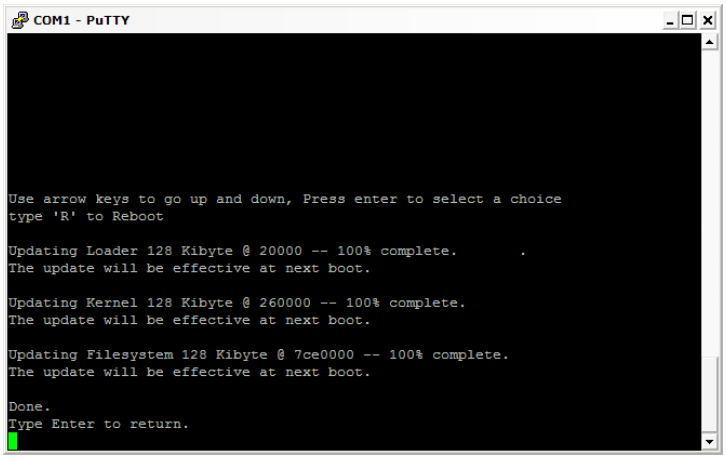
7.5 Reboot

Reboot the NAND flash file system.

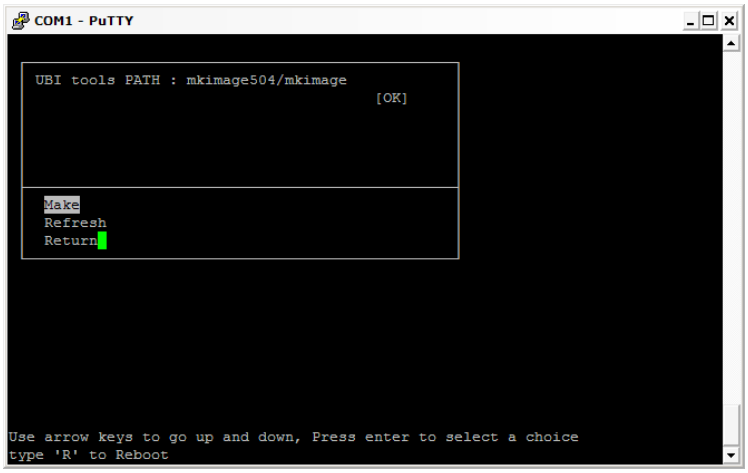
7.6 Update Image Starts



7.7 Update Image Completes



7.8 Make Files System Starts



☞ Note

1. Use Arrow keys up and down to selection the functions.
2. Use Arrow keys left and right to go to higher or lower levels of menu screen.
3. To force system go into DataFlash booting, repeatedly keying “!” (Shift +1) right after Matrix-522 power on.

8. Appendix

8.1 Utility Collection

- busybox v1.14.2: tiny utility collection
- sysvinit v2.86: standard Linux initialization
- util-linux-mount/umount v2.12r: support long file name
- ssh v4.6p1: support sftp server
- usbutils v0.7: USB id program
- lighttpd v 1.7: web server
- wget v1.9.1: used in ipkg software
- iptables v1.3.8: IP routing
- ipkg v.0.99.163: software package management
- procps v3.2.7: support webmin process management
- vsftpd v2.0.5: ftp server
- bash v3.2: GNU shell
- wireless_tools v29: wireless LAN utility
- ppp v2.4.3: ppp dial up utility
- psmics v22.2: procps supplement
- Canutils 4.0.6
- artila utility v.1.1: handy utility added by Artila

You can find more utility on Artila FTP and use ipkg to install the utility.

8.2 ipkg Software Package Management

Matrix-522 uses ***ipkg*** to manage the software installation, upgrade and removal. Artila will continuously add the kernel module and utility on Artila FTP, user can install these software from Artila FTP. In addition user can also setup your FTP server to update the software you want.

How to setup ipkg via internet

enable DHCP

$ udhcpc eth0

make sure your network environment can access internet

$ ping www.artila.com

modify **/etc/ipkg.conf**

add the following two lines

src/gz arm http://www.artila.com/download/ipkgs/9G20/utility/

src/gz kernel http://www.artila.com/download/ipkgs/9G20/modules/

comment out other package source

save and quit

execute ipkg update

*$ ipkg **update***

examples of package installation

*$ ipkg **install** pythoncore*

*$ ipkg **install** pythonpyserial*

How to setup ipkg via USB disk

You can also copy the Utility and module folder from Artila FTP to a USB disk, then use USB disk to install the software by changing the ***ipkg.conf***

src/gz usb_arm ftp://root:root@127.0.0.1/media/sda1/Utility

src/gz usb_kernel ftp://root:root@127.0.0.1/media/sda1/modules

Make sure the USB disk is correctly mounted, now use command:

ipkg update

To update the package list and use

ipkg install webmin

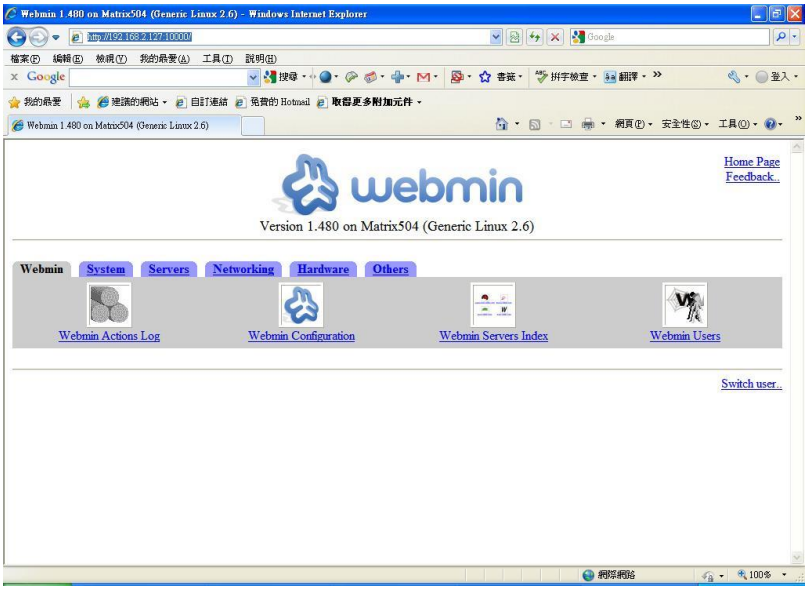
To install webmin. Webmin is a web-based interface to system administration.

To start webmin, go to ***/etc/webmin*** and type

start webmin

Then you can use browser to visit Matrix-522 port 10000.

http: //192.168.2.127 : 10000



The webmin for Matrix-522 provides following modules:

- Webmin: webmin configuration
- System: system boot, process and log management
- Server: Apache and SSH server configuration
- Network: network configuration
- Hardware: RTC setting
- Others: File manager, upload and download

Remember to use command:

depmod –a /lib/modules/2.6.29.4/modules.dep

To update the dependency list if new kernel module were added.