Introduction:

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

1. ARM926EJ-S ARM Thumb Processor 400MHz w/MMU
2. 32-KByte Data Cache and 32-KByte Instruction Cache
3. 64MB SDRAM, 128MB NAND Flash on board
4. Two 10/100 Mbps Ethernet
5. Two USB 2.0 full speed (12 Mbps) Host Ports, one USB device port
6. Multimedia Card Interface for Micro SD memory card
7. Two 3-in-1 RS-232/422/485 ports
8. Two 2500 Vrms fully isolated CAN 2.0A/2.0B ports
9. 21 programmable Digital I/O port
10. 9 to 40VDC power input
11. Pre-installed Standard Linux 2.6.29 OS
12. GNU tool chain available in Artila CD
13. Support SocketCAN and CANopen Library
14. Optional DIN RAIL mounting adaptor

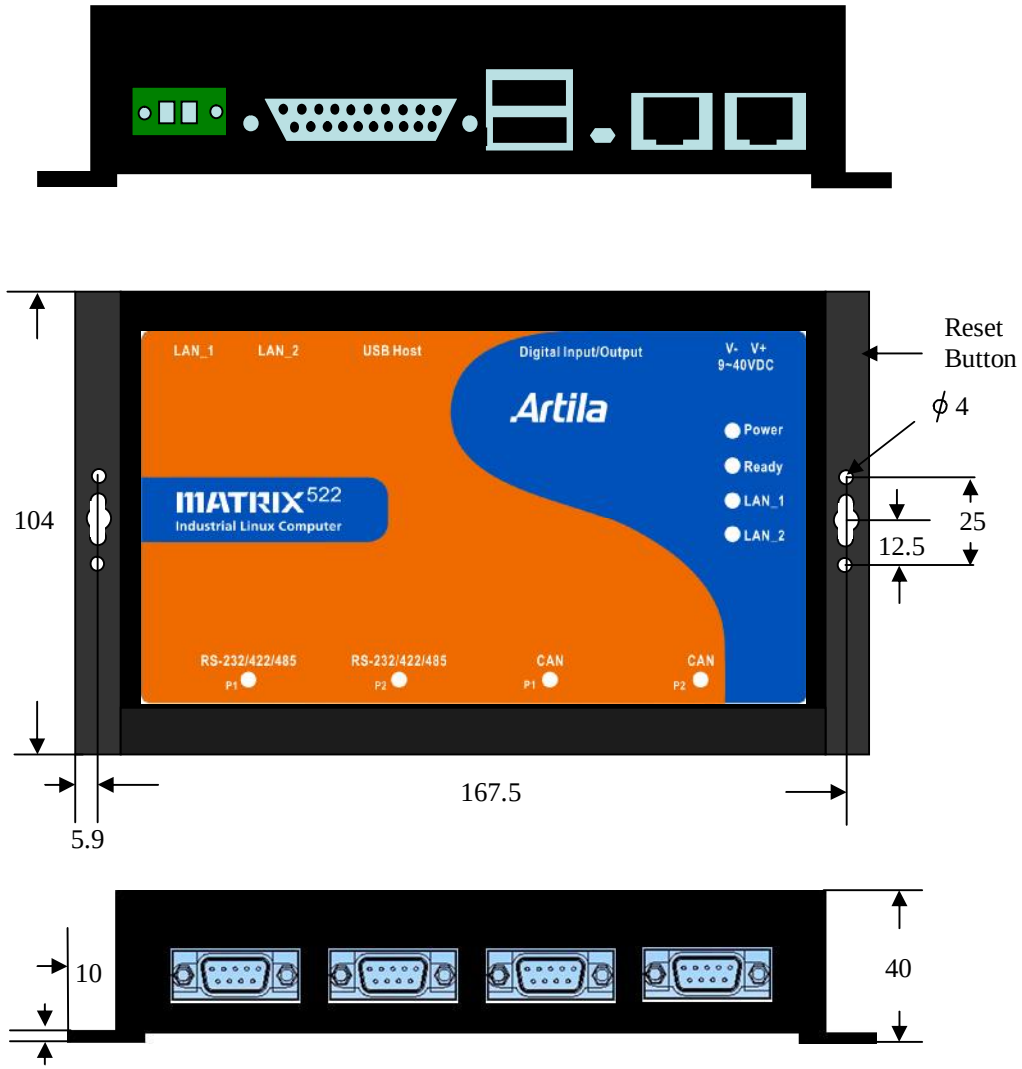
Packing List

1. Matrix 522 Box Computer
2. Wall mount bracket
3. Artila CD

Optional Accessory:

1. Console cable: CB-DB2CON-100
2. Serial cable: CB-DB9FDB9M-100
3. DK-35A: DIN RAIL Mounting Kit

Matrix 522 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 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.

Link/Act LED

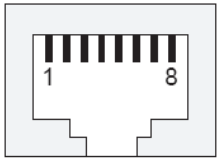
When Ethernet port are connected to the network, Link/ Act will show solid green and if there is traffic in the Ethernet, this LED will flash.

Serial/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.

Ethernet Port

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



Serial Ports:

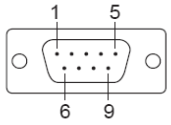
Port 1~2: 3-in-1 Software Configurable
RS-232/422/485

NOTE: Only Port 2 has full modem signals DSR,DTR, DCD

Serial Port (DB9 Male)

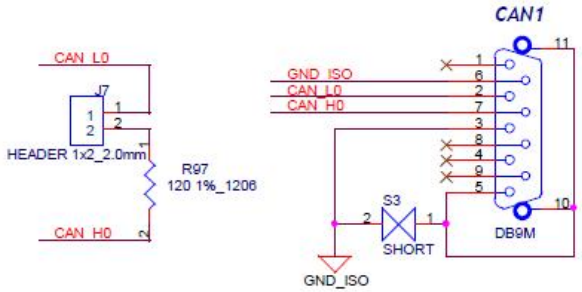
Pin No.	RS-232	RS-422	RS-485
1	DCD*	TXD-	—
2	RXD	TXD+	—
3	TXD	RXD+	DATA+
4	DTR*	RXD-	DATA-
5	GND	GND	GND
6	DSR*	—	—
7	RTS	—	—
8	CTS	—	—
9	---	—	—

Port 1~2



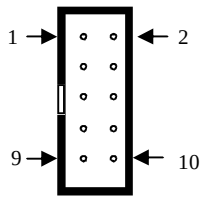
CAN Port (DB9 Male)

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.



Serial Console Port:

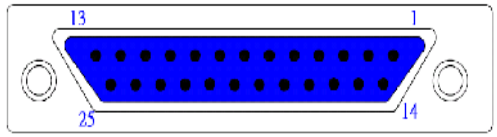
Serial console port is located inside the box at CON1. You need to use console cable (CBL-F10M9-20) to access it



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.

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: 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

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.

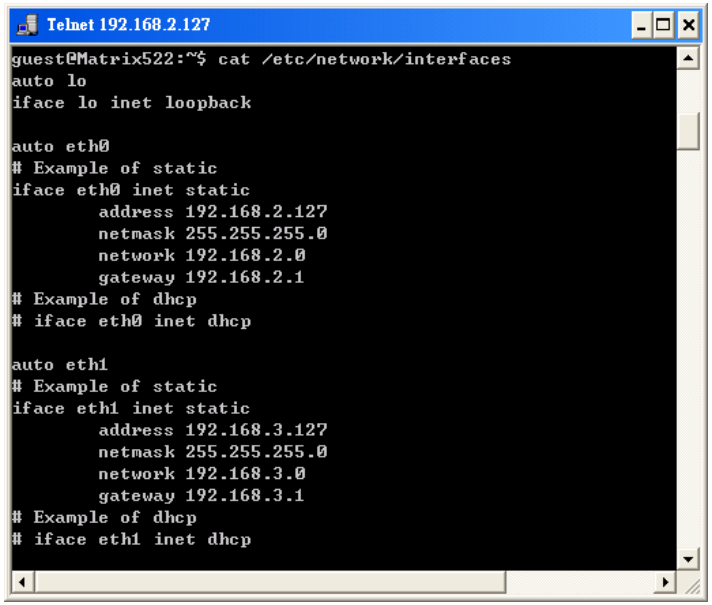
Inittab and Run levels:

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

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)

Network Settings

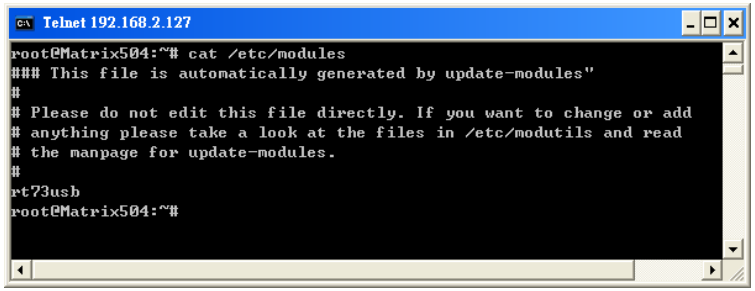


Insert kernel module

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

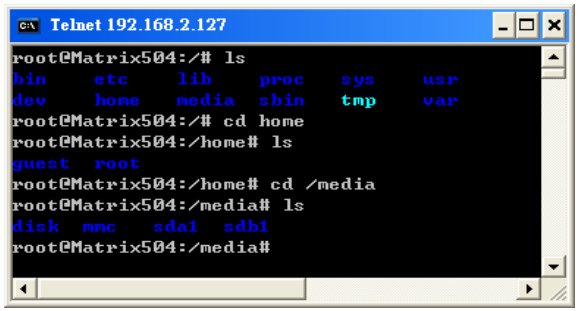
rt73usb

To load the USB WLAN adaptor.

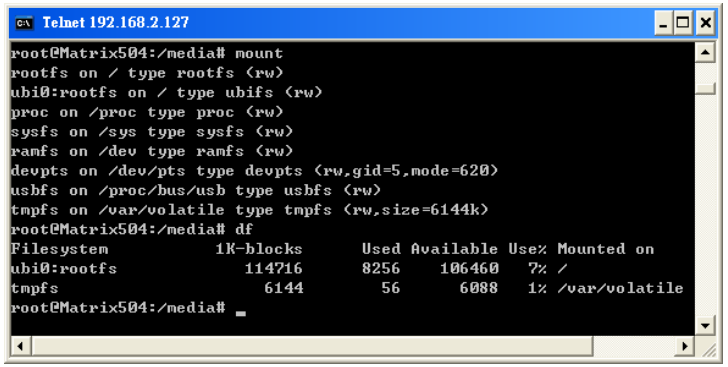


Use ***vi*** editing tool to edit the ***/etc/network/interfaces*** for network setting. The default setting is static IP 192.168.2.127. Matrix-522 also supports Wireless LAN. Use
wireless_essid XXX
wireless_key YYY
To add SSID and WEP key if necessary. XXX is SSID and YYY is WEP Key
Matrix-522 supports popular USB WLAN adaptor. Please contact Artila for the most update driver support.

File System



The 128MB 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



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

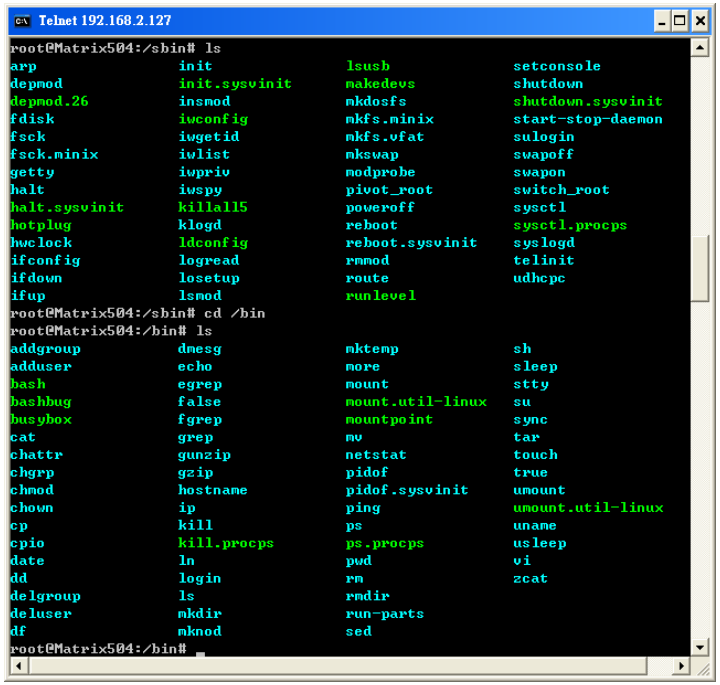
Note: can0 and can1 are network devices under SocketCAN

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



Mounting External Storage Memory

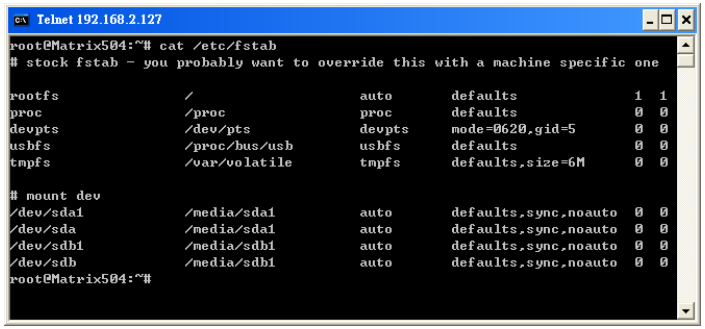
To find out the device name of the external memory device which plug into Matrix 522, you can use the command

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***



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 ***/usr/www*** and the ***/etc/lighttpd.conf*** contains the lighttpd 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 Artila CD to adjust the RTC time.

ntpclient [time server ip]

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*

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

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***

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
in Artila CD for the SocketCAN API.

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

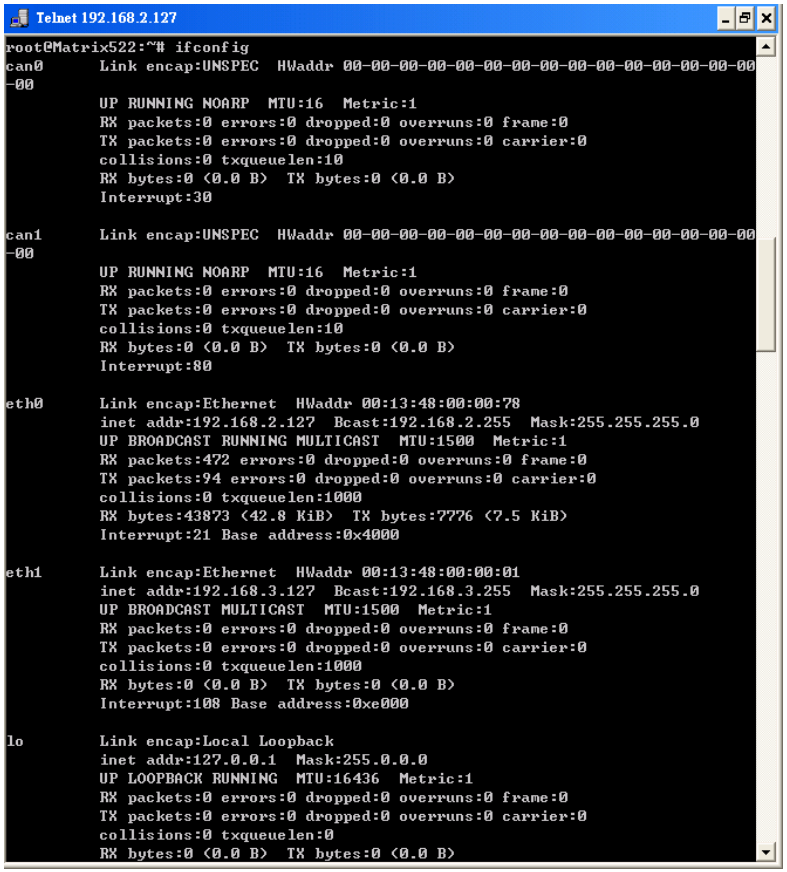
Configure CAN:

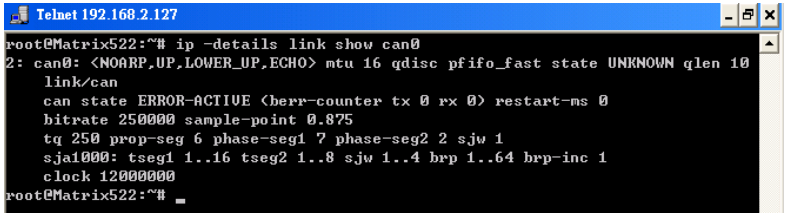
To configure CAN device, you can use utility programs:
/canconfig
/candump
/canecho
/cansend
/cansequnce
User can also use ***ip*** command to configure CAN e.g.
/ip link set can0 down
/ip link set can0 type can bitrate 250000
/ip link set can0 up
/ip –details link show can0

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

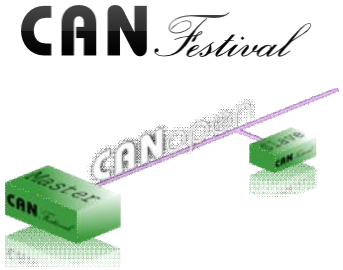




CANOpen:

The Artila CD also includes CanFestival 3 open source for CANOpen. Please refer to
\example\CanBus\canfestival

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



Install GNU Tool Chain

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 Tool Chain

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

The tool chain 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 tool chain 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

Getting started with the Hello program

There are many example programs in Artila CD. 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 504 user disk (/home/guest) and use

chmod +x file.o

To change it to execution mode and

./file.o

to run the program

Auto start program on boot:

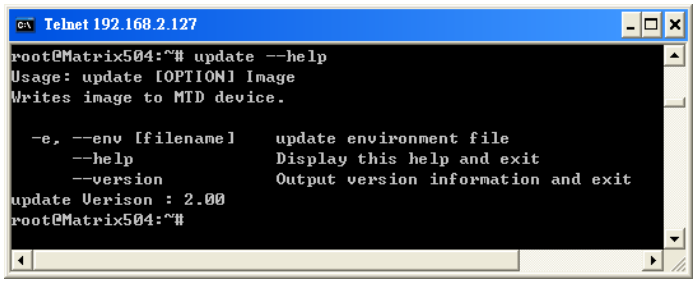
To start a program on boot, you can use ***/etc/rc.local***
For example to use ***vi*** to edit ***rc.local***

hello &
exit 0

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

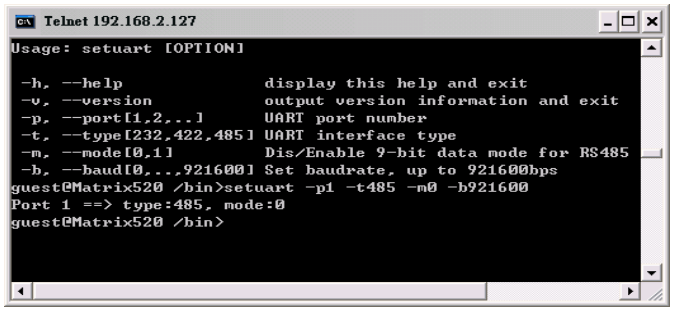
Artila Utility Software:

The introduction of Artila utility software as follow:
1. ***update*** : update loader, environment file and kernel image. Type *update—help* to find the command usage

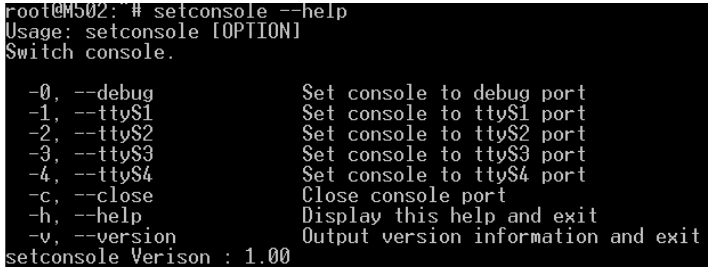


Update can only operated under supervisor mode (password : root). Please use command ***su*** and login as root

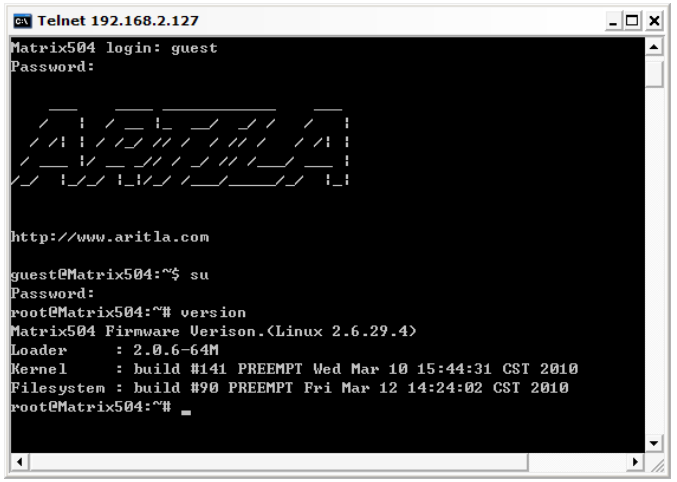
2. ***setuart:*** configure serial port setting. An example show as followed to configure port 1 as RS-485 interface with baud rate 921600.



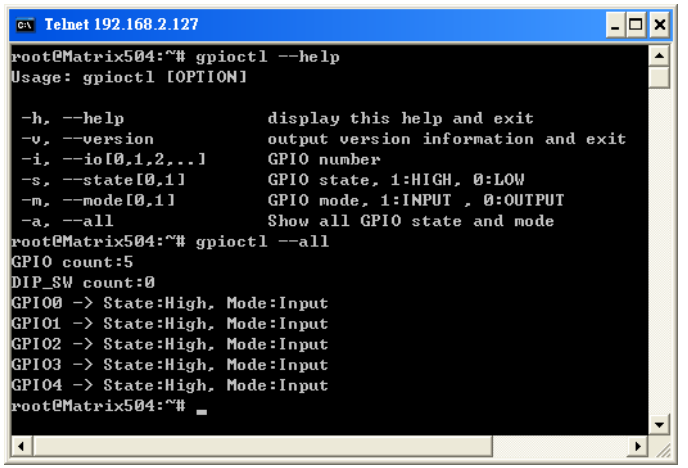
3. ***setconsole:*** Unlike Matrix-510 which shares the serial console port with the serial port 3, Matrix-522 uses dedicated pins for serial console (debug port). ***setconsole*** command allows user to redirect the serial console port to any one of the four serial port of Matrix-522. Therefore user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



3. ***version:*** find out the version of OS.



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



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 M-518, 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
**********************************************
```

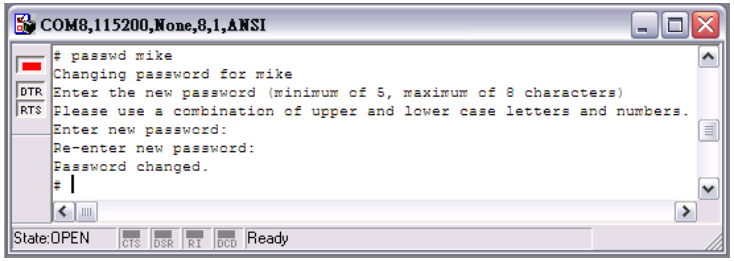
If you miss the timing, please power on again the Matrix-522 and do it again. Select U will prompt the run level selection message. Run level 0 is halt, run level 1 is single user (disable login and service). Run level 2~5 are multiple users and run level 6 is reboot. To view the run level configuration,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

/etc/inittab

Frequently Asked Question

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.

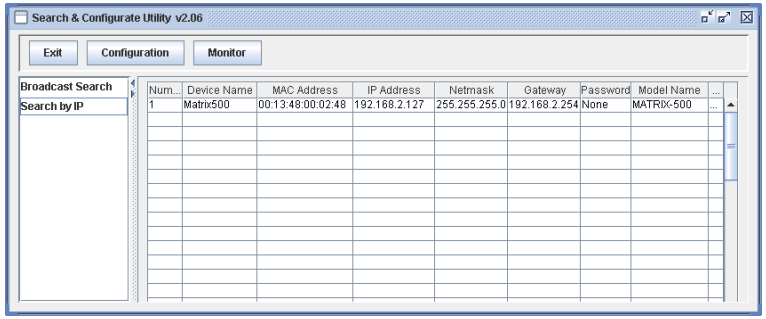


2. *Forgot the IP address*

If you forgot the Matrix-522 IP address, you can use the Java Manager available in Artila CD to search the IP address of Matrix-522

Or use serial console port to find out the IP address by

#ifconfig

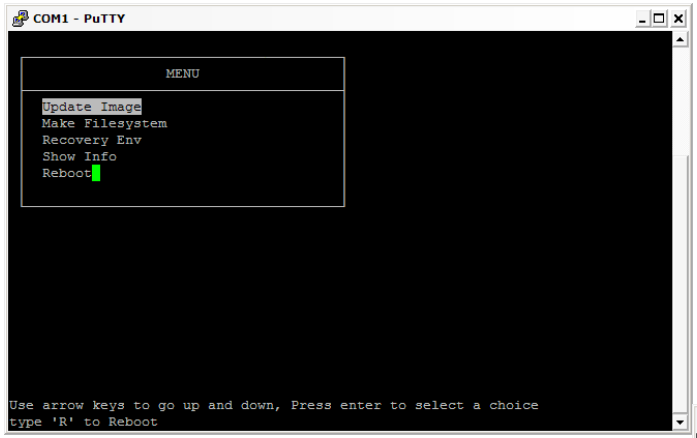


3. *System fail to boot*

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.

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:



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 in Artila CD. Please prepare an USB disk and copy the image files to it before choosng this option.

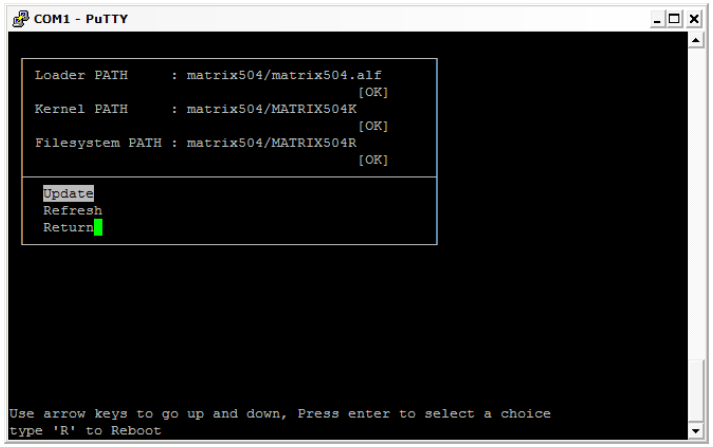
2. Make Filesystem: this option is used to create customized file system. Before using this function, you need to copy the folder of ***mkimage522*** in the Artila CD to an USB disk. This function will create a new file system image for users and they can use it to duplicate the customized file system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

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

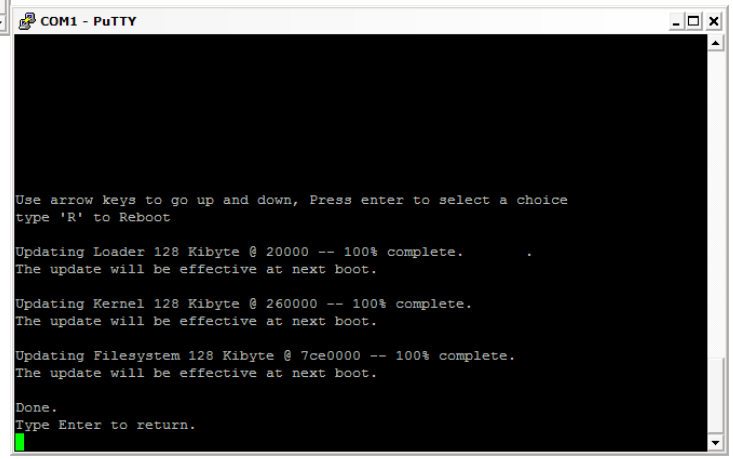
4. Show Info: Show the version information of Matix-522

5. Reboot: Reboot the NAND flash file system.

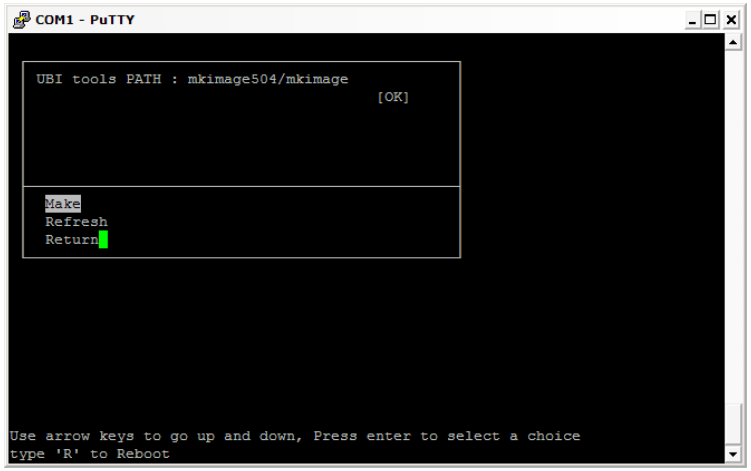
Update Image Starts



Update Image Completes



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.

Appendix

Utility Collection

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

You can find more utility at Artila Matrix-504 CD and use ipkg to install the utility.

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 at our ftp server, user can install these software from Artila's ftp server. In addition user can also setup your ftp server to update the software you want. To install the utility from Artila ftp, please use ***vi*** to edit the ***/etc/ipkg.conf***

src/gz arm ftp://ftp:ftp@ftp.artila.com/AT9G20/Artila-CD/Linux/Utility
src/gz kernel ftp://ftp:ftp@ftp.artila.com/AT9G20/Artila-CD/Linux/modules

You can also copy the Utility and module folder from Artila CD 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

The webmin for Matrix-522 provides following modules:

1. Webmin: webmin configuration
2. System: system boot, process and log management
3. Server: Apache and SSH server configuration
4. Network: network configuration
5. Hardware: RTC setting
6. 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.

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