

PAC-5010

Programmable Automation Controller

User Guide

Version 1.0



Table of Contents

1.	Introduction	1
1.1	Features	1
1.2	Packing List.....	1
1.3	Optional Accessory	1
2.	Layout	2
3.	Pin Assignment and Definition.....	3
3.1	Reset Button	3
3.2	Power LED (D4)	3
3.3	Ready LED (D5).....	3
3.4	LAN1 / LAN2 LED (D6 / D7)	3
3.5	Serial Port LED (LD3 / LD4 / LD5)	3
3.6	User LED (LD1 / LD2).....	3
3.7	Ethernet Port (LAN1 / LAN2)	3
3.8	Serial Port	3
3.9	Power Input Connector (J3)	5
3.10	Digital Output Connector (J5)	5
3.11	Digital Input Connector (J4)	6
3.12	Factory Default Settings.....	6
3.13	Login	7
3.14	Network Settings	7
3.15	Wireless LAN Configuration.....	8
3.16	File System	8
3.17	Devices List.....	8
3.18	Utility Software	9
4.	Artila Utility Software	10
4.1	update	10
4.2	setuart	10
4.3	gpiocpl.....	11
4.4	How to Make More Utility Software.....	11

4.5	Restore to Default Setting	11
4.6	Mounting External Storage Memory	12
4.7	Welcome Message	12
4.8	Web Page Directory	12
4.9	Adjust the System Time	12
4.10	SSH Console.....	13
4.11	Manager Utility Software	13
4.12	Install GNU Toolchain	13
4.13	Getting Started the Hello Program.....	14

1. Introduction

PAC-5010 is an ARM9-based Linux ready industrial Programmable Automation Controller.

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
- Two 10/100Mbps Ethernet
- Two USB 2.0 full speed (12Mbps) Host Ports
- Multimedia Card Interface for SD memory card
- One RS-485, One RS-232 and One serial console port
- 16 opto-isolated digital inputs
- 8 Darlington-pair digital outputs
- 9 to 40VDC power input
- Pre-installed Standard Linux 2.6 OS
- GNU tool chain available on Artilla FTP
- DIN RAIL mounting

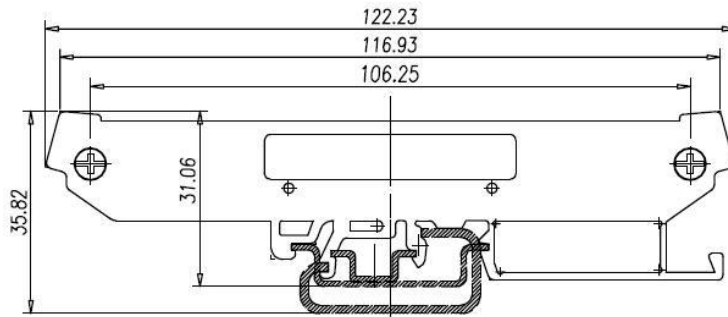
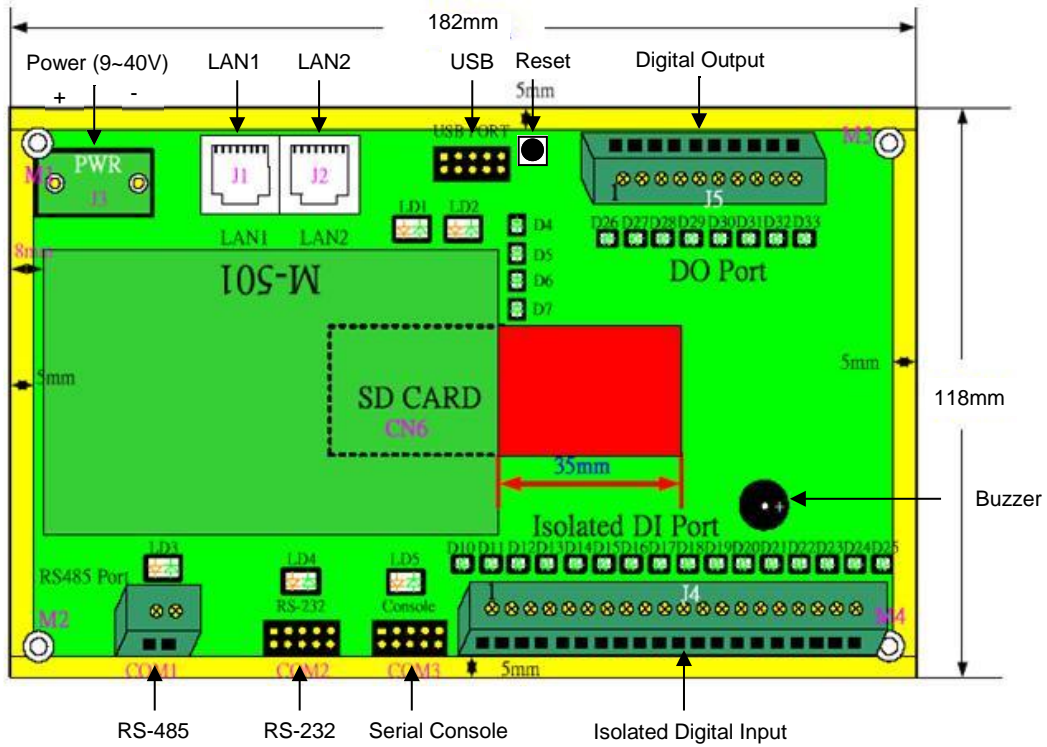
1.2 Packing List

- PAC-5010 Programmable Automation Controller

1.3 Optional Accessory

- CBL-F10M9-20 (91-0P9M9-001): Console Cable (10Pin Header to DB9 Male, 20cm)

2. Layout



3. Pin Assignment and Definition

3.1 Reset Button

Press the "Reset" button to activate the hardware reset. You should only use this function if the software reboot does not function properly.

3.2 Power LED (D4)

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

3.3 Ready LED (D5)

The Ready LED will show solid green if PAC-5010 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 PAC-5010 again. If Ready LED is still off, please contact the manufacture for technical support.

3.4 LAN1 / LAN2 LED (D6 / D7)

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.

3.5 Serial Port LED (LD3 / LD4 / LD5)

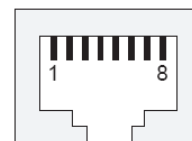
These three dual color LEDs indicate the data traffic at the serial ports. When RXD line is high then RED light is ON and when TXD line is high, GREEN light is ON.

3.6 User LED (LD1 / LD2)

LD1 and LD2 are dual color LED for user application. Please refer to example program for the usage.

3.7 Ethernet Port (LAN1 / LAN2)

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



3.8 Serial Port

- **COM1: RS-485 (Data+, Data-)**

Data+ is pull up to 3.3VDC with 10K Ohm resistor.

Data- is pull low to ground.

Termination resistor is not included. User can add a 120 Ohm resistor shunt with

D+ to D- if necessary.

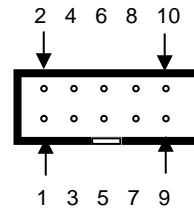
COM1: RS-485

Data+ Data-



- **COM2:** RS-232 with full modem control
- **COM3:** RS-232 with RxD, TxD (Console)

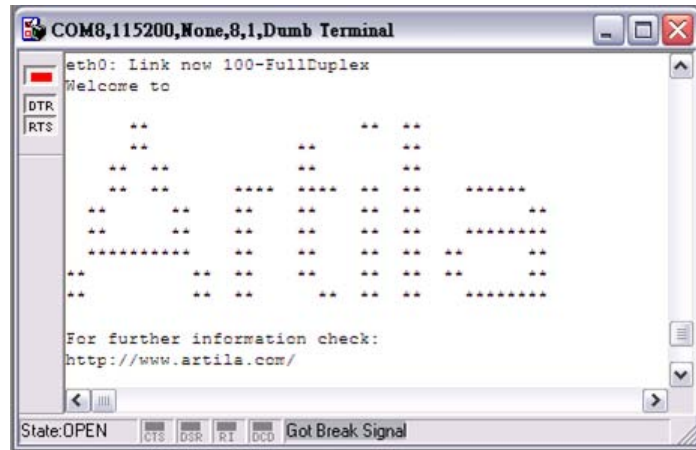
Pin	COM2	COM3
1	DCD	N/C
2	DSR	N/C
3	RXD	RXD
4	RTS	N/C
5	TXD	TXD
6	CTS	N/C
7	DTR	N/C
8	N/C	N/C
9	GND	GND
10	N/C	N/C



Serial console port (COM3) is very helpful to perform system configuration and debug. When you forgot password or network IP address, serial console provide an easy way to access PAC-5010. To access serial console port, you can use 91-0P9M9-001 to convert 10-pin header to RS-232 DB9 male connector and use a null modem adaptor for PC RS-232 interface. Use any terminal software such as hyper terminal and setting as follow:

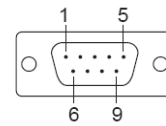
- Baud Rate: 115200
- Data bits: 8
- Parity: N
- Stop bit: 1
- Terminal type: ANSI

Once you power up PAC-5010, you will see the console message appears.



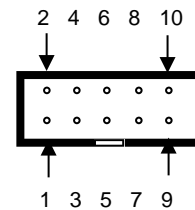
Pin	RS-232
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	N/C

RS-232 DB9 Male Connector



Pin	USB
1	Vcc1
2	Vcc2
3	Data1-
4	Data2-
5	Data1+
6	Data2+
7	GND
8	GND
9	N/C
10	N/C

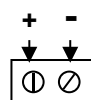
USB Port



Vcc1, Vcc2: +5Vdc
GND: Ground

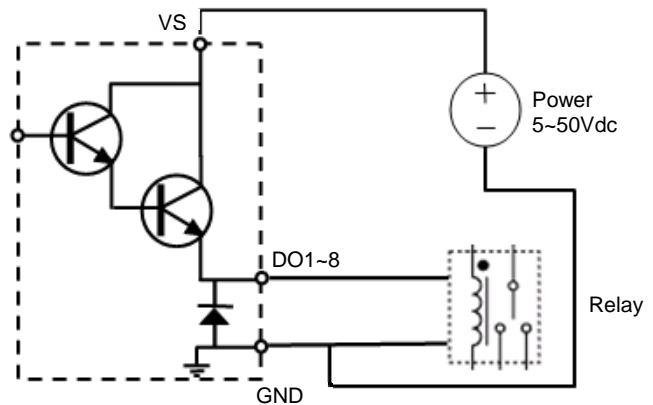
3.9 Power Input Connector (J3)

PAC-5010 uses +9VDC to 40VDC power and input from J3 connector. Auto-polarity and surge protection are included in power input circuitry of PAC-5010 to provide power protection to PAC-5010.



3.10 Digital Output Connector (J5)

The digital output are equipped with 8 darlington pair transistors (Allegro UDN2981A) to switch the external relay or solenoid. The internal transient-suppression diodes permit the drive to be used with inductive load. The source voltage of the drive is from 5Vdc to 50Vdc and the maximum driving current is 500mA.



3.11 Digital Input Connector (J4)

The 16 channel isolated input are equipped with 2500Vrms photo coupler isolator. Four of the channels form a group and share the same common ground. The specification of the isolated input channels are:

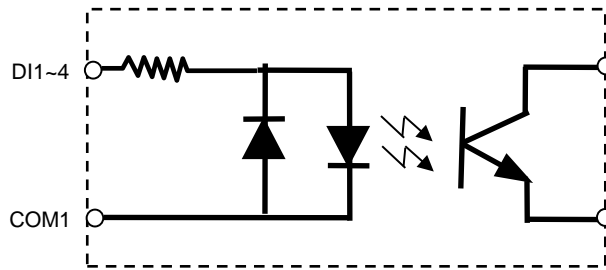
Logical High: 5~24Vdc

Logical Low: 0~1.5Vdc

Input resistance: 1.2KOhms @0.5W

Response time: 20μs

Isolation: 2500Vrms



J4				J5	
1	DI1	11	DI9	1	DO1
2	DI2	12	DI10	2	DO2
3	DI3	13	DI11	3	DO3
4	DI4	14	DI12	4	DO4
5	COM1	15	COM3	5	DO5
6	DI5	16	DI13	6	DO6
7	DI6	17	DI14	7	DO7
8	DI7	18	DI15	8	DO8
9	DI8	19	DI16	9	GND
10	COM2	20	COM4	10	VS

DIx: Isolated digital input channels

COMx: common ground of four DIx

DOx: Voltage output channels

GND: Ground

VS: Voltage source input

3.12 Factory Default Settings

LAN 1 IP Address: 192.168.2.127

LAN 2 IP Address: DHCP

Login: guest

3.15 Wireless LAN Configuration

PAC-5010 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 the PAC-5010 device name and YYYYYYYY is the encryption key MMMM should be *ad-hoc*.

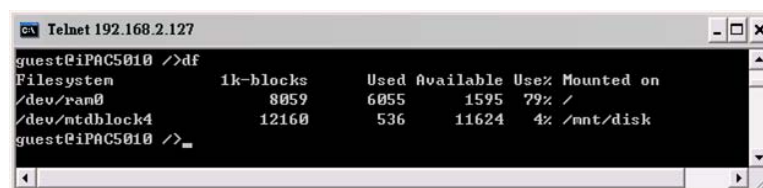
To configure the IP address use command:

```
dhcpcd wlan0 & or ifconfig wlan0 192.168.2.127 netmask 255.255.255.0
```

3.16 File System

PAC-5010 configures the root file system as RAMDISK and the user disk (/disk) which includes /home and /etc directory are configured as Flash Disk. To find out the file system information, please use command /mount as show as above. In addition, use command /df to find out the disk space of the disk. The RAMDISK uses 8MB memory space to store the root file system and the user disk is about 11MB for user's program storage.

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



```

Telnet 192.168.2.127
guest@iPAC5010 />df
Filesystem      1k-blocks    Used Available Use% Mounted on
/dev/ram0        8059         6055    1595    79% /
/dev/mtdblock4  12160         536   11624     4% /mnt/disk
guest@iPAC5010 />_

```

3.17 Devices List

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

1. ttyS0: port 3 serial console port
2. ttyS1: port 1 RS-485
3. ttyS2: port 2 RS-232
4. mmc to mmc2: SD memory card
5. sda to sde: USB flash disk
6. ttyUSB0 to ttyUSB1: USB RS-232 adaptor (ftdi_sio.ko)

7. rtc: Real Time Clock
8. gpio: digital I/O
9. ttyACM0 and ttyACM1: USB Modem (CDC compliant)

```

Telnet 192.168.2.127
guest@iPAC5010 /dev>ls
console mem ntdblock4 ptyp8 sde ttyACM0 tty3
cua0 midi00 ntdr0 ptyp9 sequencer ttyACM1 tty4
cua1 mixer ntdr1 ran0 sndstat ttyS0 tty5
dsp mmc ntdr2 ran1 spi0 ttyS1 tty6
flash mmc0 ntdr3 ran2 spi1 ttyS2 tty7
gpio mnc1 ntdr4 ran3 tty ttyS3 tty8
hda null random tty0 ttyS4 tty9
hda1 ntd0 ppp rtc tty1 ttyS5 urandom
hda2 ntd1 ptyp0 sda tty2 ttyS6 video0
hda3 ntd2 ptyp1 sda1 tty3 ttyS7 video1
hda4 ntd3 ptyp2 sda2 tty4 ttyS8 watchdog
ipsec ntd4 ptyp3 sda3 tty5 ttyUSB0 zero
kmem ntdblock0 ptyp4 sda4 tty6 ttyUSB1
lcd ntdblock1 ptyp5 sdb tty7 tty00
ledman ntdblock2 ptyp6 sdc tty8 tty01
log ntdblock3 ptyp7 sdd tty9 tty02
guest@iPAC5010 /dev>

```

3.18 Utility Software

PAC-5010 includes busybox utility collection and Artila utility software as follow:

```

Telnet 192.168.2.127
guest@iPAC5010 /bin>ls
addgroup delgroup gpiotcl ls ps telnetd
adduser deluser grep mkdir pvd tip
angrd df gunzip mke2fs ra touch
bash dhcpd gzip mkfs_ext2 radir true
boa dhrystone hostname mkfs_jffs2 scp unmount
boa_indexer discard inetd mknod setuart update
busybox dmesg init mktemp sh usleep
cat echo iptables more sleep version
chgrp egrep iuconfig mount snmpd vi
chmod erase iulist nv eshd zcat
chown false iupriv netstat stty
cp fgrep kill pidof su
cpu ftp ln ping sync
date ftpd login pppd tar
guest@iPAC5010 /bin>

```

4. Artila Utility Software

The introduction of Artila utility software as follow:

4.1 update

Update loader, kernel or root file system image. Also use **update—FORMAT** to format user disk.

Type **update—help** to find the command usage.



```

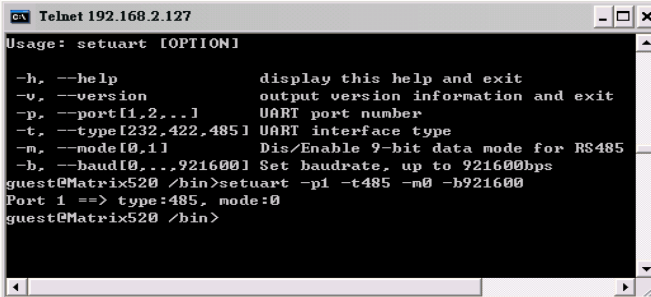
c:\ Telnet 192.168.2.127
# update --help
Usage: update [OPTION] filename
Write image to flash.

-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 be 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
-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>
  
```

4.3 gpiocctl

gpiocctl can use to control the digital input and output of PAC-5010. Use:

```
>gpiocctl --help
```

To find out the usage of this command.



```
guest@iPAC5010 /bin>gpiocctl -a
GPIO count:24
DIP_SW count:0
GPIO0 -> State:Low, Mode:Output
GPIO1 -> State:Low, Mode:Output
GPIO2 -> State:Low, Mode:Output
GPIO3 -> State:Low, Mode:Output
GPIO4 -> State:Low, Mode:Output
GPIO5 -> State:Low, Mode:Output
GPIO6 -> State:Low, Mode:Output
GPIO7 -> State:Low, Mode:Output
GPIO8 -> State:Low, Mode:Input
GPIO9 -> State:Low, Mode:Input
GPIO10 -> State:Low, Mode:Input
GPIO11 -> State:Low, Mode:Input
GPIO12 -> State:Low, Mode:Input
GPIO13 -> State:Low, Mode:Input
GPIO14 -> State:Low, Mode:Input
GPIO15 -> State:Low, Mode:Input
GPIO16 -> State:Low, Mode:Input
GPIO17 -> State:Low, Mode:Input
GPIO18 -> State:Low, Mode:Input
GPIO19 -> State:Low, Mode:Input
GPIO20 -> State:Low, Mode:Input
GPIO21 -> State:Low, Mode:Input
GPIO22 -> State:Low, Mode:Input
GPIO23 -> State:Low, Mode:Input
guest@iPAC5010 /bin>
```

GPIO0~GPIO7 map to digital output DO1~DO8.

GPIO8~GPIO23 map to digital input DI1~DI16.

4.4 How to Make More Utility Software

You might also find utility software available on Artila FTP under /Matrix 5XX/utility such as *ntpclient*, *ssh*, *scp*, *bluez* and *ssh-keygen*. If you want, you can ftp or copy the utility software to PAC-5010 user disk (/disk). Also you can use find the source code and use the GNU Toolchain to make the utility by yourself.

4.5 Restore to Default Setting

The factory default setting is available at /default directory. Copy files in this folder to /disk will restore PAC-5010 to factory default setting.

4.6 Mounting External Storage Memory

To find out the device name of the external memory device which plug into PAC-5010, you can use the command

```
/dmesg | grep sd
```

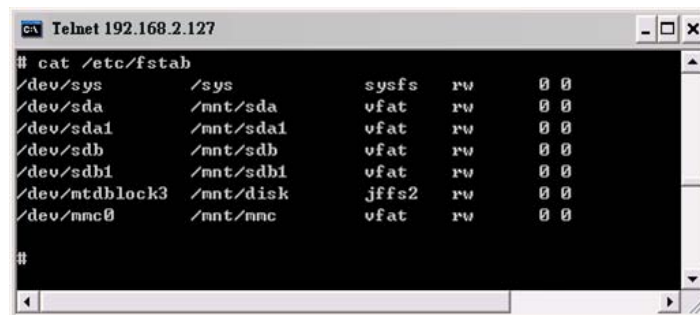
or

```
/dmesg | grep mmc
```

Type

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

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



```

Telnet 192.168.2.127
# cat /etc/fstab
/dev/sys          /sys             sysfs           rw      0 0
/dev/sda          /mnt/sda         vfat            rw      0 0
/dev/sda1         /mnt/sda1       vfat            rw      0 0
/dev/sdb          /mnt/sdb         vfat            rw      0 0
/dev/sdb1         /mnt/sdb1       vfat            rw      0 0
/dev/mtdblock3   /mnt/disk        jffs2           rw      0 0
/dev/mmc0         /mnt/mmc         vfat            rw      0 0
#

```

4.7 Welcome Message

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

4.8 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***.

4.9 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 Artilla FTP to adjust the RTC time.

```
/ntpclient [time server ip]
```


4.10 SSH Console

PAC-5010 support SSH. If you use Linux computer, you can use SSH command to login PAC-5010.

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

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

User can copy this program to PAC-5010 to generate the key.

```

root@localhost:~# ssh 192.168.2.127
The authenticity of host '192.168.2.127 (192.168.2.127)' can't be established.
RSA key fingerprint is ba:4b:2d:ae:04:07:bd:c6:5c:4f:8a:43:4b:24:ee:9f.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.2.127' (RSA) to the list of known hosts.
root@192.168.2.127's password:
Welcome to

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

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

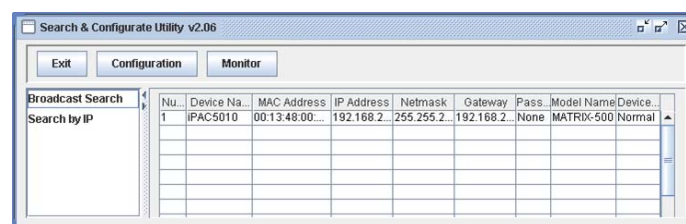
root@Matrix520 />

```

4.11 Manager Utility Software

The Manager Utility software, **manager.jar** is a java program and is used to discovered the PAC-5010 in the network if the IP address is forgotten. It can be run at any OS where java run time is available.

To install the java run time platform at your computer, please visit <http://java.sun.com> and download the Java 2 Standard Edition (J2SE). Once the PAC-5010 is found, you can click the Telnet Console to configure the PAC-5010.



4.12 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 *Gnu Toolchain*.

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

4.13 Getting Started the Hello Program

There are many example programs on Artila FTP. To compile the sample you can use the Make file to and type:

```
make
```

To compile and link the library. Once done, use ftp command

```
ftp 192.168.2.127
```

And bin command to set transfer mode to binary

```
ftp>bin
```

To transfer the execution file to PAC-5010 user disk (/disk) and use

```
chmod +x file.o
```

To change it to execution mode and

```
./file.o
```

to run the file.

```
[root@localhost ~]# ftp 192.168.2.127
Connected to 192.168.2.127.
220 Matrix520 FTP server (GNU inetutils 1.4.1) ready.
500 'AUTH GSSAPI': command not understood.
500 'AUTH KERBEROS_V4': command not understood.
KERBEROS_V4 rejected as an authentication type
Name (192.168.2.127:root): root
331 Password required for root.
Password:
230- Welcome to
230-
230-      **          **          **
230-      **          **          **
230-      ** **      **          **
230-      ** **      ****  ****  ** **  *****
230-      **      ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** **
230-      **      ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** **
230-      ***** ** ** ** ** ** ** ** ** ** ** **
230- **          ** ** ** ** ** ** ** ** ** ** **
230- **          ** ** **          *****
230-
230- For further information check:
230- http://www.artila.com/
230-
230 User root logged in.
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> bi
200 Type set to I.
ftp>
```