

PAC-5070

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	3
3.3	Ready LED.....	3
3.4	LAN1 / LAN2 LED	3
3.5	Serial Port LED	3
3.6	Ethernet Port (LAN1 / LAN2)	3
3.7	Serial Port	3
3.8	Power Input Connector (J3).....	5
3.9	Digital Output Connector.....	5
3.10	Digital Input Connector	6
3.11	Analog Input Connector	6
3.12	Factory Default Settings.....	7
3.13	Login	7
3.14	Network Settings	8
3.15	Wireless LAN Configuration.....	8
3.16	File System	8
3.17	Devices List.....	9
3.18	Utility Software	10
4.	Artila Utility Software	11
4.1	update	11
4.2	setuart	11
4.3	gpiocpl.....	11
4.4	setadc.....	12

4.5	How to Read Analog Input Data	12
4.6	How to Make More Utility Software	12
4.7	Restore to Default Setting	12
4.8	How to Calibrate the Analog Input Channels	13
4.9	Mounting External Storage Memory	13
4.10	Welcome Message	13
4.11	Web Page Directory	13
4.12	Adjust the System Time	13
4.13	SSH Console.....	14
4.14	Manager Utility Software	14
4.15	Install GNU Toolchain	15
4.16	Getting Started the Hello Program.....	15

1. Introduction

PAC-5070 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
- 4 isolated analog inputs
- Input type: mV, V, mA
- Input range: +/- 150mV, +/- 500mV, +/- 1V, +/- 5V, +/- 10V, 0~150mV, 0~500mV, 0~1V, 0~5V, 0~10V, 0~20mA
- 1500Vdc isolation
- 8 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

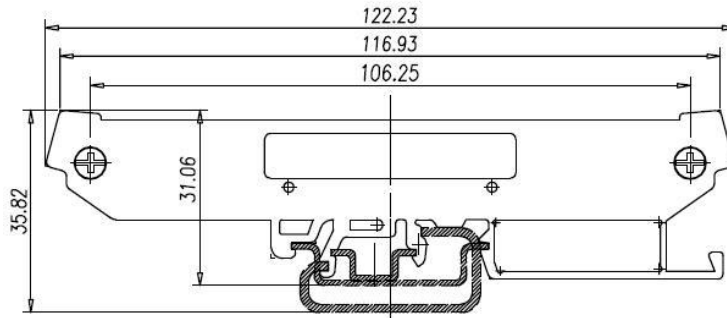
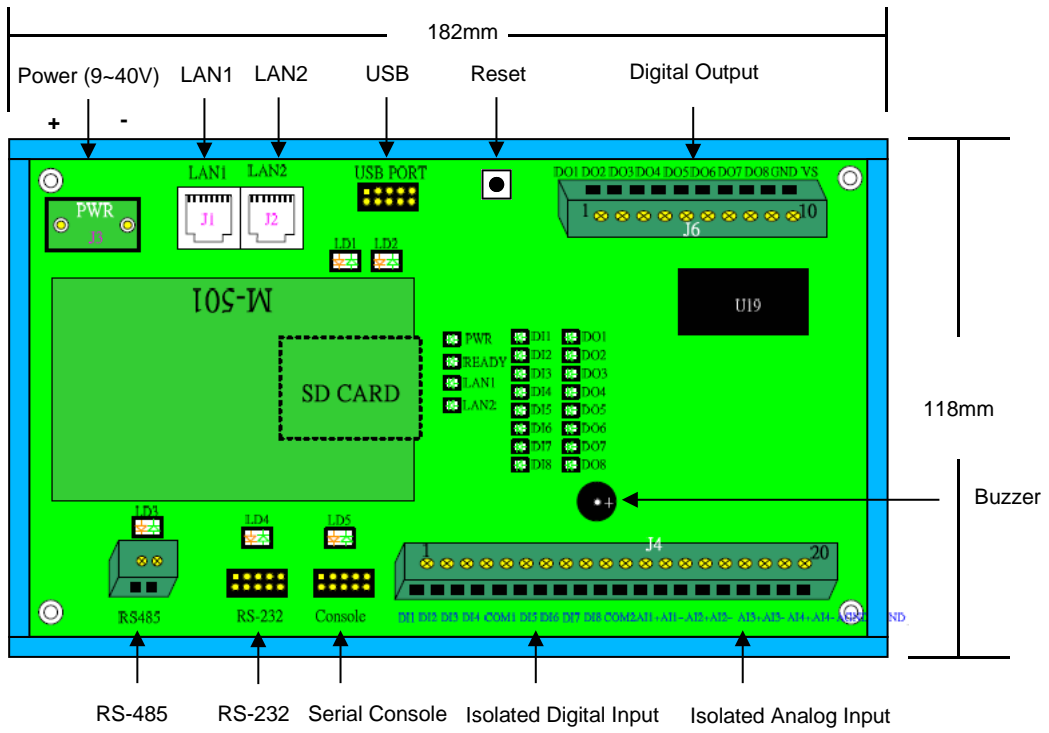
1.2 Packing List

- PAC-5070 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

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

3.3 Ready LED

The Ready LED will show solid green if PAC-5070 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-5070 again. If Ready LED is still off, please contact the manufacture for technical support.

3.4 LAN1 / LAN2 LED

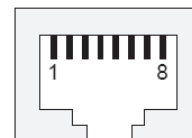
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic in the Ethernet, this LED will flash.

3.5 Serial Port LED

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 Ethernet Port (LAN1 / LAN2)

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



3.7 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.

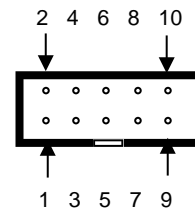
COM1: RS-485

Data+ Data-



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

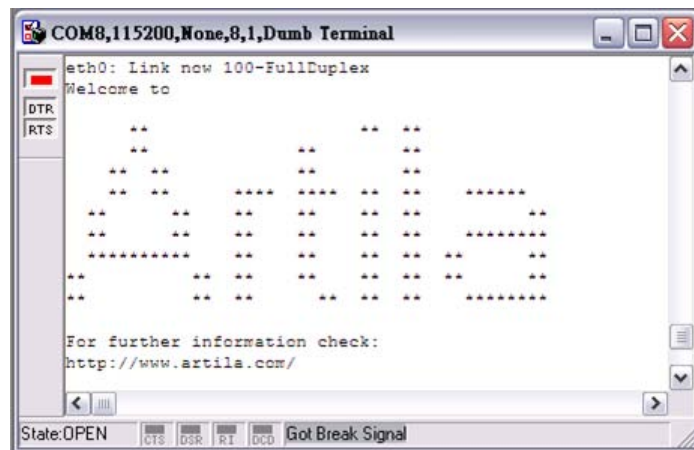
Pin	COM2	COM3
1	DCD	N/C
2	DSR	N/C
3	RXD	RXD
4	RTS	N/C
5	TXD	TXD
6	CTS	N/C
7	DTR	N/C
8	N/C	N/C
9	GND	GND
10	N/C	N/C



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-5070. 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:

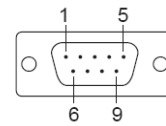
- Baud Rate: 115200
- Data bits: 8
- Parity: N
- Stop bit: 1
- Terminal type: ANSI

Once you power up PAC-5070, you will see the console message appears.



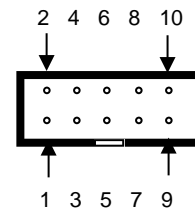
Pin	RS-232
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	N/C

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

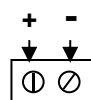
USB Port



Vcc1, Vcc2: +5Vdc
GND: Ground

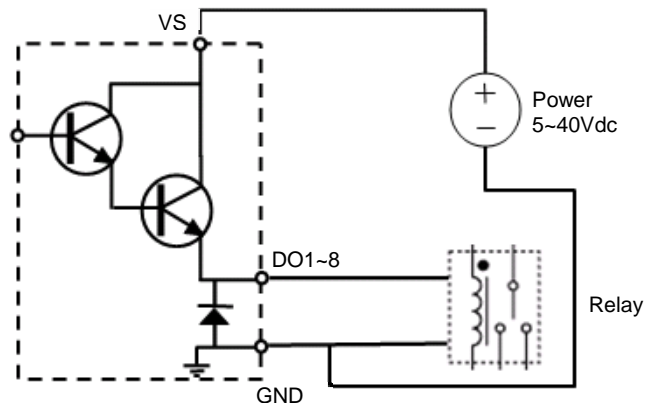
3.8 Power Input Connector (J3)

PAC-5070 uses +9VDC to 40VDC power and input from J3 connector. Auto-polarity and surge protection are included in power input circuitry of PAC-5070 to provide power protection to PAC-5070.



3.9 Digital Output Connector

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 40Vdc and the maximum driving current is 500mA.



DOx: Voltage output channels

GND: Ground

VS: Voltage source input

3.10 Digital Input Connector

The 8 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:

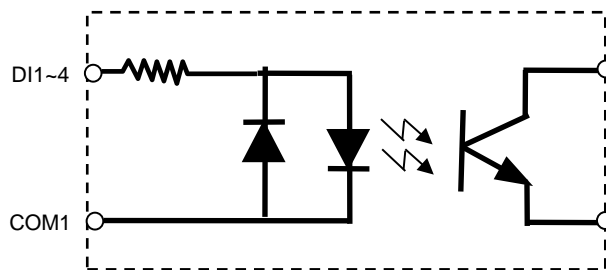
Logical High: 5~24Vdc

Logical Low: 0~1.5Vdc

Input resistance: 1.2KOhms @0.5W

Response time: 20 μ s

Isolation: 2500Vrms



DIx: Isolated digital input channels

COMx: common ground of four DIx

3.11 Analog Input Connector

Each of the 4 channels isolated analog input can be configured as various input range and the common features are show as follow:

Effective Resolution: 16-bit

Channels: four differential input channels

Input Type: mV, V, mA

Input Range: Uni-polar: 0~150mV, 0~500mV, 0~1V, 0~5V, 0~10V

Bi-polar: +/-150mV, +/-500mV, +/-1V, +/-5V, +/-10V

Current: 0~20mA

Sampling rate: 10~100 samples /sec

Input Impedance: 20M Ohm

Accuracy: +/-0.1%

CMR: 50/60Hz 100dB

Isolation: 1500Vrms (Three-way)

The analog input channels provide 1500Vrms isolation. Therefore, to measure a floating signal such as a battery and single-ended source, simply connect the positive signal to AI+ and negative (ground) signal to AI- to perform a differential measurement.

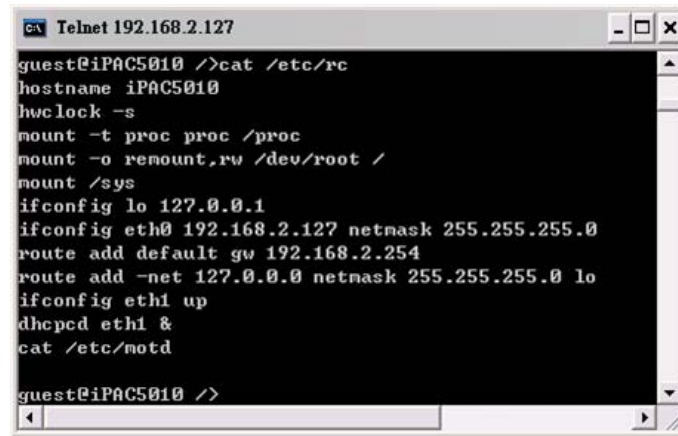
3.14 Network Settings

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 &
```



```
Telnet 192.168.2.127
guest@iPAC5010 />cat /etc/rc
hostname iPAC5010
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 &
cat /etc/motd
guest@iPAC5010 />
```

3.15 Wireless LAN Configuration

PAC-5070 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 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 PAC-5070 device name and YYYYYYYYY is the encryption key MMMM should be *ad-hoc*.

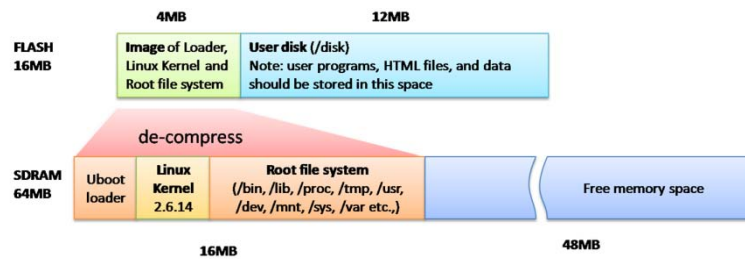
To configure the IP address use command:

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

3.16 File System

PAC-5070 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.



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. adc0~3: analog input channels
10. ttyACM0 and ttyACM1: USB Modem (CDC compliant)

```
# ls
adc0      lcd      mtd8      mtdr7      random    tty0      ttyS7
adc1      ledman   mtd9      mtdr8      rtc       tty1      ttyS8
adc2      log      mtdblock0 mtdr9      sda       tty2      ttyUSB0
adc3      loop0    mtdblock1 null        sda1      tty3      ttyUSB1
adc4      mem      mtdblock2 ppp         sda2      tty4      tty00
adc5      midi00   mtdblock3 pty00      sda3      tty5      tty01
console   mixer    mtdblock4 pty01      sda4      tty6      tty02
cua0      mmc      mtdblock5 pty02      sdb       tty7      tty03
cua1      mmc0     mtdblock6 pty03      sdb1      tty8      tty04
dsp       mmc1     mtdblock7 pty04      sdc       tty9      tty05
flash     mmc2     mtdblock8 pty05      sdc1      ttyACM0   tty06
gpio      mtd0     mtdblock9 pty06      sdd       ttyACM1   tty07
hda       mtd1     mtdr0     pty07      sdd1      ttyS0     tty08
hda1      mtd2     mtdr1     pty08      sde       ttyS1     tty09
hda2      mtd3     mtdr2     pty09      sequencer ttyS2     urandom
hda3      mtd4     mtdr3     ram0        sndstat   ttyS3     video0
hda4      mtd5     mtdr4     ram1        spi0      ttyS4     video1
lpsec     mtd6     mtdr5     ram2        spi1      ttyS5     watchdog
kmem     mtd7     mtdr6     ram3        tty       ttyS6     zero
# _
```

3.18 Utility Software

PAC-5070 includes busybox utility collection and Artilla utility software as follow:

```
# ls
addgroup      delgroup      gpioc1       ls            ps            tar
adduser       deluser       grep          mkdir         pod           telnetd
amgrd         df            gunzip        mke2fs        rm            tip
bash          dhcpcd        gzip          mkfs.jffs2   rmdir         touch
boa           dhrystone    hostname      mknod        scp           true
boa_indexer   discard       inetd         mktemp       setadc       umount
busybox       dmesg        init          more          setuart      update
cat           echo          iptables     mount         sh            usleep
chgrp         egrep         iwconfig     nv            sleep        version
chmod         erase         iwlist       netstat       snmpd        vi
chown         false        iwpriv       ntpdate      schd         zcat
cp            fgrep        kill          pidof         stty
cpu           ftp          ln            ping          su
date          ftpd         login         pppd          sync
# _
```

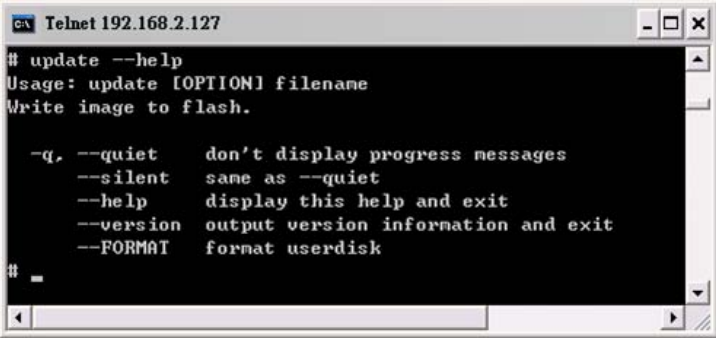
4. Artila Utility Software

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.

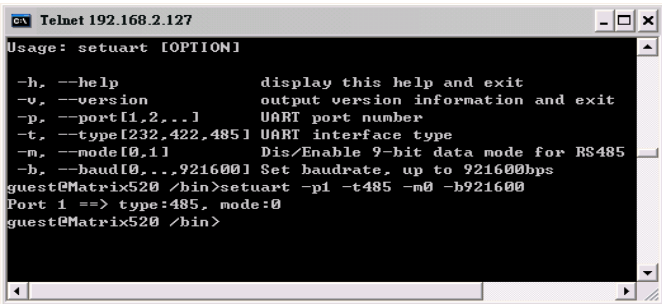
-q, --quiet      don't display progress messages
--silent        same as --quiet
--help          display this help and exit
--version       output version information and exit
--FORMAT        format userdisk

#
  
```

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 gpioc1

gpioc1 can use to control the digital input and output of PAC-5070. Use:

>gpioc1 --help

To find out the usage of this command.



```

# gpioc1 -h
Usage: gpioc1 [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

#
  
```

4.4 setadc

setadc is used to configure the analog input channels.

>setadc -h

To find out the usage of this command.

```
# setadc -h
Usage: setadc [OPTION]
Version:1.1
-h, --help           display this help and exit .
-v, --version        output version information and exit .
-p, --port[0,1,2,3]  ADC port number .
-t, --type[0,1]      Signal type , 0:UOL 1:AMP .
-r, --range[10,5,...] Input range, 10:10V 5:5V 1:1V 500:500mV 150:150mV
-l, --polar[0,1]     0:BIPOLAR 1:UNIPOLAR .
-d, --delay[time]    Setting time(ms), default:100ms .

ADC calibration .
-g, --get[file name] Make calibration .
-s, --set[file name] Set calibration file .
#
```

To configure channel one (A1) with +/-5V with 10 samples/sec sampling rate simply type

>setadc -p0 -t0 -r5 -l0 -d100

```
# setadc -p0 -t0 -r5 -l0 -d100
ADC-Port 0 : BIPOLAR UOL:5V Delay=100ms.
#
```

4.5 How to Read Analog Input Data

To read the analog data of the input channel, please follow the steps below:

- Set the configuration of the analog channels [adc0~adc3]
- Repeatedly read data from the device [adc0~adc3]

Note

Please set the delay time to be 100ms or longer if you want to perform multiple channels scan. The ADC device driver will delay 100ms for Multiplexer and Programmable Gain Amplifier to be stable before taking the data from ADC.

4.6 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-5070 user disk (/disk). Also you can use find the source code and use the GNU Toolchain to make the utility by yourself.

4.7 Restore to Default Setting

The factory default setting is available at /default directory. Copy files in this folder to /disk will restore PAC-5070 to factory default setting.

4.8 How to Calibrate the Analog Input Channels

The analog input channel are calibrated in factory. We do not recommend user to perform the calibration. If necessary, user can use command:

```
>setadc -p0 -g /etc/adc
```

And follow the instruction prompted to apply calibration source to perform calibration. Once done, you can activate the calibration function by using command:

```
>setadc -s /etc/adc
```

And this command had been included in /etc/rc.

4.9 Mounting External Storage Memory

To find out the device name of the external memory device which plug into PAC-5070, you can use the command

```
/dmesg | grep sd
```

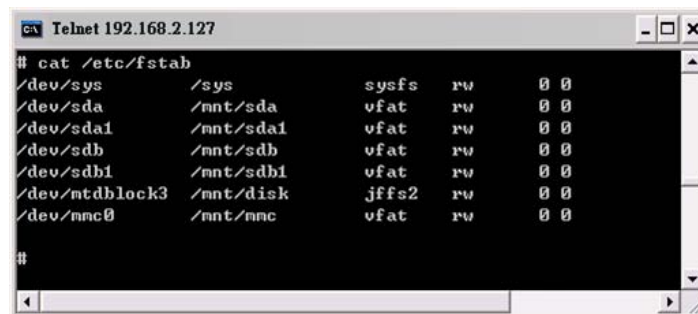
or

```
/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
#

```

4.10 Welcome Message

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

4.11 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*.

4.12 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.

Intpclient [time server ip]

4.13 SSH Console

PAC-5070 support SSH. If you use Linux computer, you can use SSH command to login PAC-5070.

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-5070 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

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

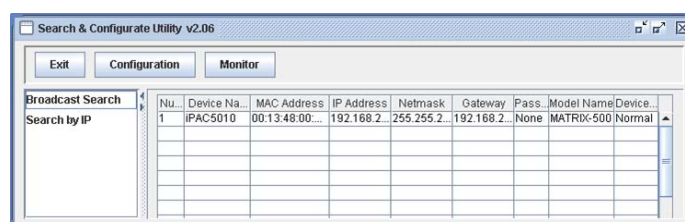
For further information check:
http://www.artila.com/

root@Matrix520 />
    
```

4.14 Manager Utility Software

The Manager Utility software, **manager.jar** is a java program and is used to discovered the PAC-5070 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-5070 is found, you can click the Telnet Console to configure the PAC-5070.



4.15 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
```

4.16 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-5070 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>
```