PAC-5070

Programmable Automation Controller

User Guide

Version 1.0

Table of Contents

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 Artila FTP
- DIN RAIL mounting

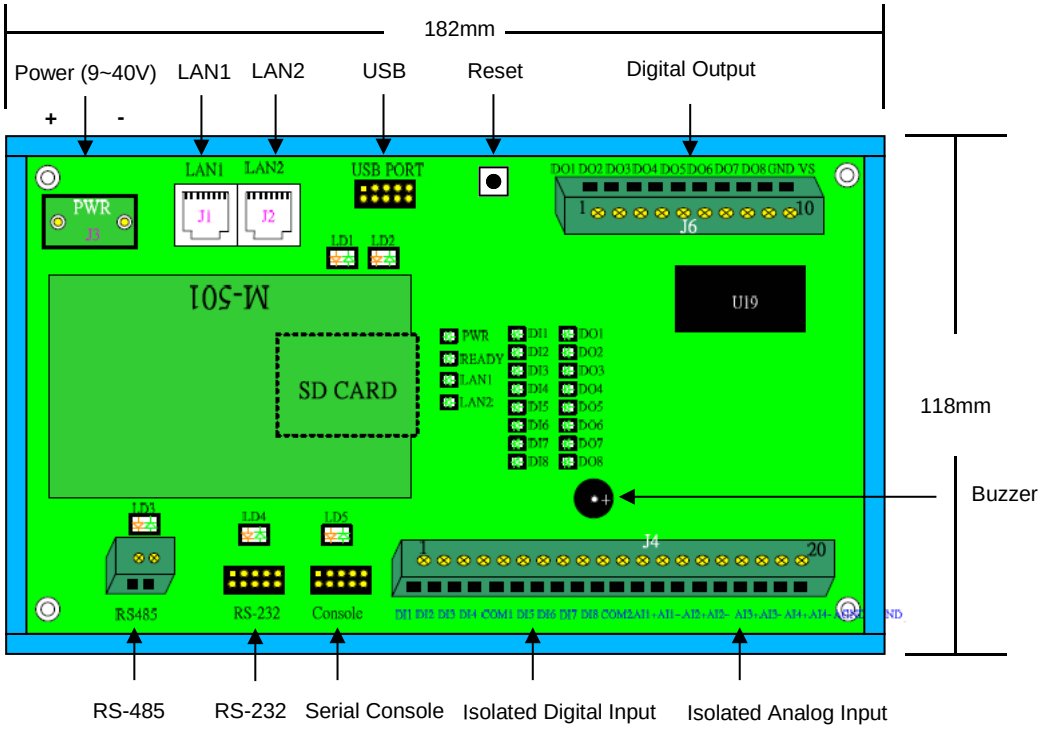
1.2 Packing List

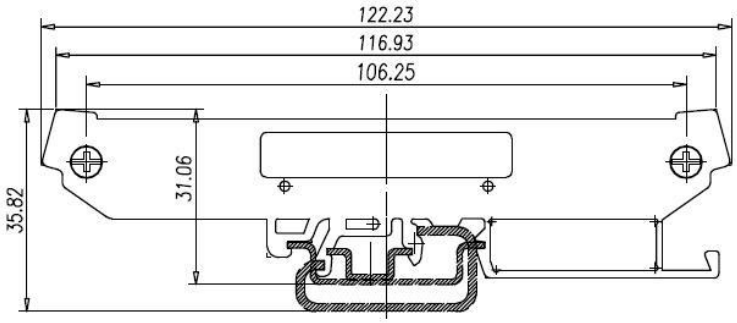
- PAC-5070 Programmable Automation Controller

1.3 Optional Accessory

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

2. Layout


182mm
Power (9~40V)
LAN1
LAN2
USB
Reset
Digital Output
+
-
LAN1
LAN2
USB PORT
PWR
J1
J2
J6
LD1
LD2
M-501
SD CARD
U19
PWR
READY
LAN1
LAN2
118mm
Buzzer
LD3
LD4
LD5
J4
RS485
RS-232
Console
RS-485
RS-232
Serial Console
Isolated Digital Input
Isolated Analog Input


122.23
116.93
106.25
31.06
35.82

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

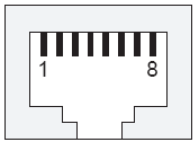
When Ethernet port are connected to the network, Link/Act will show solid green and if there is traffic in the Ethernet, this LED will flash.

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-



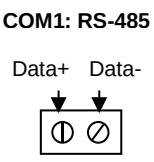
3.7 Serial Port

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

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

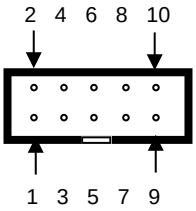
  Data- is pull low to ground.

  Termination resistor is not included. User can add a 120 Ohm resistor shunt with D+ to D- if necessary.



- **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

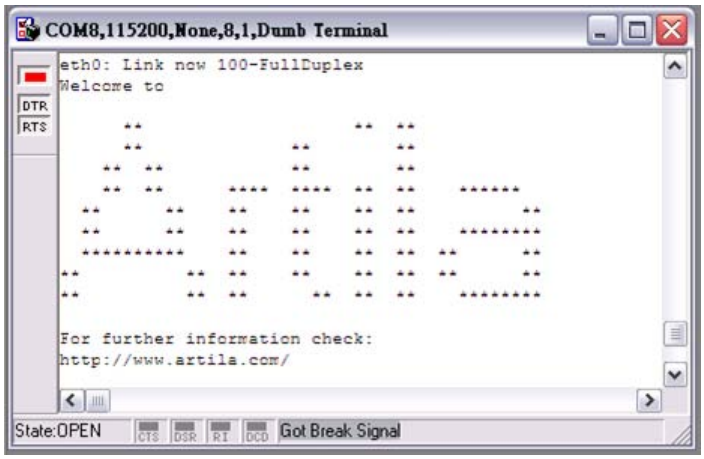
Data bits: 8

Parity: N

Stop bit: 1

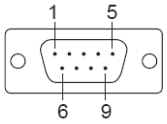
Terminal type: ANSI

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



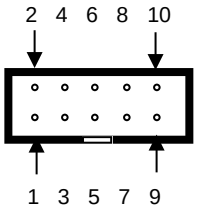
Pin	RS-232
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	N/C

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

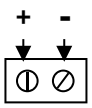
USB Port



Vcc1, Vcc2: +5Vdc
GND: Ground

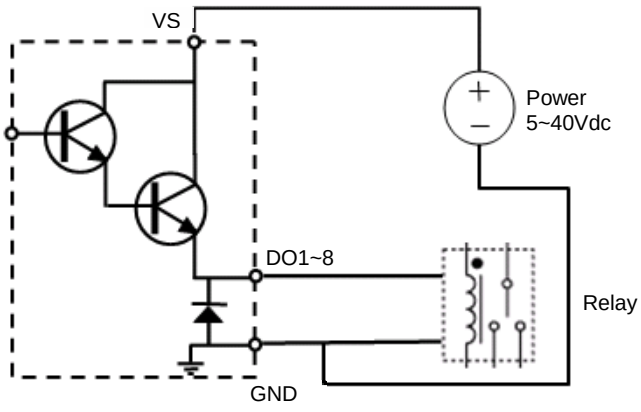
3.8 Power Input Connector (J3)

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:

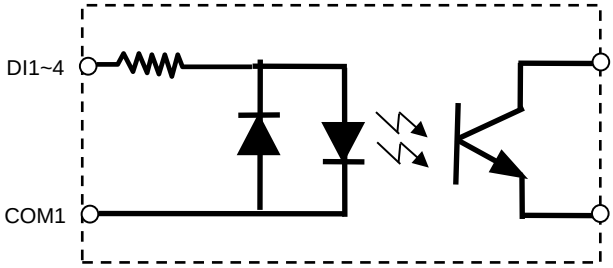
Logical High: 5~24Vdc

Logical Low: 0~1.5Vdc

Input resistance: 1.2KOhms @0.5W

Response time: 20μs

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%

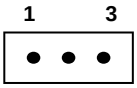
CMR: 50/60Hz 100dB

Isolation: 1500Vrms (Three-way)

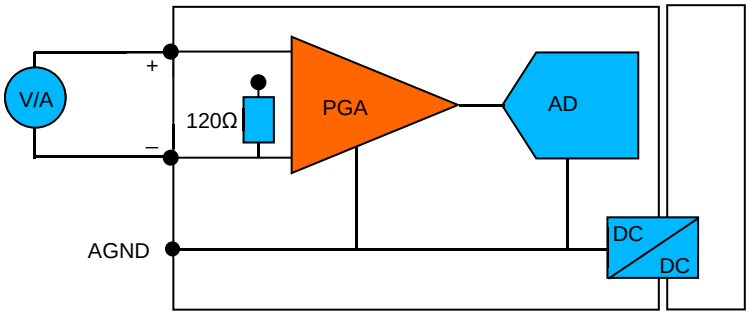
The analog input channels provide 1500Vrms isolation. Therefore, to measure a floating signal such as a battery and single-ended source, simply connect the positive signal to AI+ and negative (ground) signal to AI- to perform a differential measurement.

To measure current input, please set the jumper (JP1~JP4) to position 2-3 to shunt the 120 ohm resistor on board for current measurement.

Input Type Selection Jumper JP1~JP3



Voltage Input: 1-2 (default)
Current Input: 2-3



3.12 Factory Default Settings

LAN 1 IP Address: 192.168.2.127

LAN 2 IP Address: DHCP

Login: guest

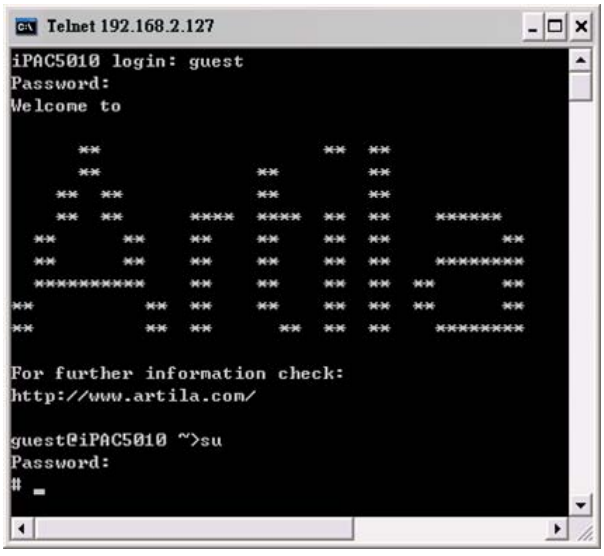
Password: guest

Supervisor: root (ssh only)

Password: root

3.13 Login

After power on, wait about 30 seconds for system boot up. Using Telnet and guest or ssh and root to login in PAC-5070.



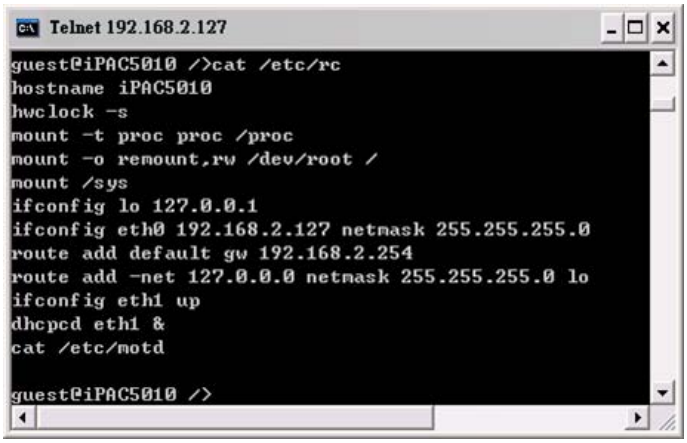
3.14 Network Settings

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 &



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

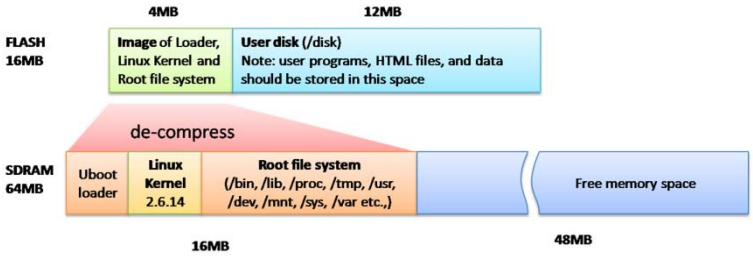
To configure the IP address use command:

dhcpcd wlan0 & or ifconfig wlan0 192.168.2.127 netmask 255.255.255.0

3.16 File System

PAC-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 (fdti_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)

3.18 Utility Software

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

4. Artila Utility Software

The introduction of Artila utility software as follow:

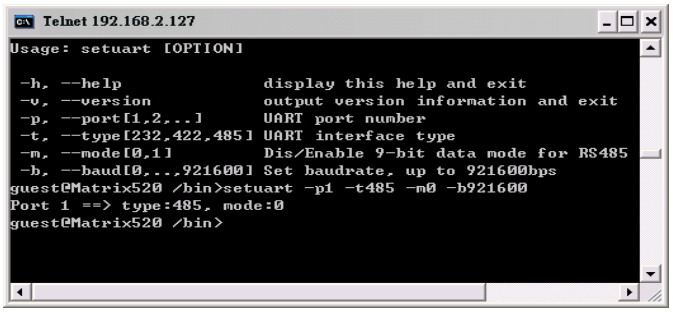
4.1 update

Update loader, kernel or root file system image. Also use ***update —FORMAT*** to format user disk. Type ***update—help*** to find the command usage.

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.

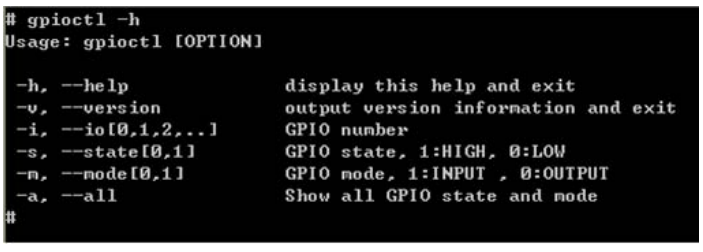


4.3 gpioctl

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

>gpioctl --help

To find out the usage of this command.

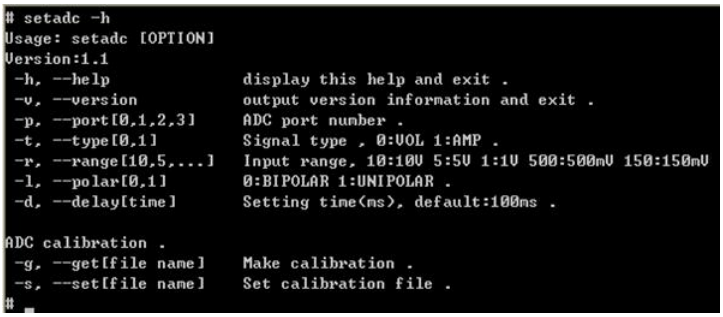


4.4 setadc

setadc is used to configure the analog input channels.

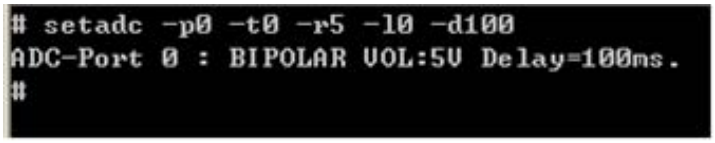
>setadc –h

To find out the usage of this command.



To configure channel one (AI1) with +/-5V with 10 samples/sec sampling rate simply type

>setadc –p0 –t0 –r5 –l0 –d100



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

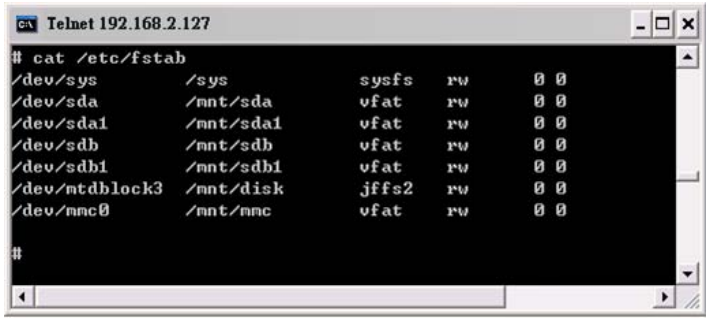
or

/dmesg | grep mmc

Type

mount /dev/sda1 to mount the USB disk and

mount /dev/mmc0 to mount SD card



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.

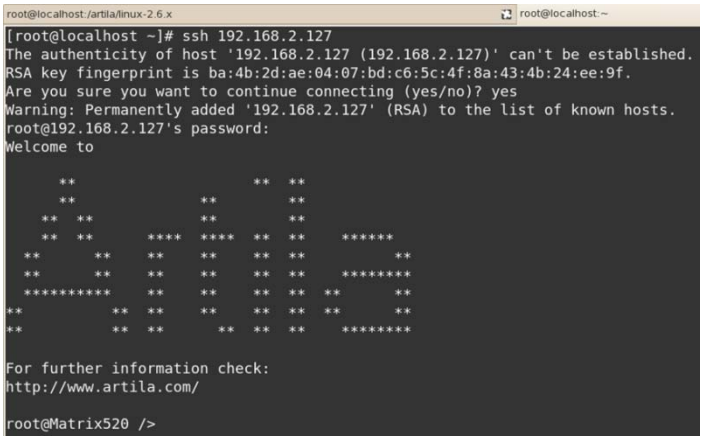
User can also use NTP client utility on Artila FTP to adjust the RTC time.

Intpclient [time server ip]

4.13 SSH Console

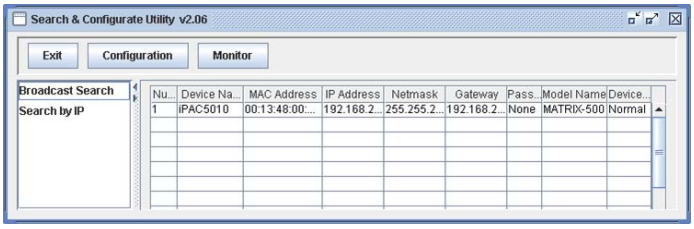
PAC-5070 support SSH. If you use Linux computer, you can use SSH command to login PAC-5070.
The configuration of SSH and key are located at /etc/config/ssh
The key generation program is available on Artila FTP: /matrix 5XX/utility/ssh_keygen

User can copy this program to PAC-5070 to generate the key.



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>
```