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 gpioctl ........................................................................................................................................... 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 Artila 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

![Layout Diagram]

- Power (9~40V)
- LAN1
- LAN2
- USB
- Reset
- Digital Output
- Isolated Digital Input
- Serial Console
- RS-232
- RS-485
- Buzzer
- SD CARD
- DO Port
- Isolated DI Port

Dimensions:
- 118mm x 182mm
- 35mm
- 5mm
- 122.23mm
- 116.93mm
- 106.25mm
- 37.06mm
- 35.82mm
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)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ETx+</td>
</tr>
<tr>
<td>2</td>
<td>ETx-</td>
</tr>
<tr>
<td>3</td>
<td>ERx+</td>
</tr>
<tr>
<td>6</td>
<td>ERx-</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Pin</th>
<th>COM2</th>
<th>COM3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DCD</td>
<td>N/C</td>
</tr>
<tr>
<td>2</td>
<td>DSR</td>
<td>N/C</td>
</tr>
<tr>
<td>3</td>
<td>RXD</td>
<td>RXD</td>
</tr>
<tr>
<td>4</td>
<td>RTS</td>
<td>N/C</td>
</tr>
<tr>
<td>5</td>
<td>TXD</td>
<td>TXD</td>
</tr>
<tr>
<td>6</td>
<td>CTS</td>
<td>N/C</td>
</tr>
<tr>
<td>7</td>
<td>DTR</td>
<td>N/C</td>
</tr>
<tr>
<td>8</td>
<td>N/C</td>
<td>N/C</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>10</td>
<td>N/C</td>
<td>N/C</td>
</tr>
</tbody>
</table>

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.
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: 1.2KΩms @0.5W
- Response time: 20µs
- Isolation: 2500Vrms

![Digital Input Connector Diagram]

<table>
<thead>
<tr>
<th>J4</th>
<th>J5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DI1</td>
</tr>
<tr>
<td>2</td>
<td>DI2</td>
</tr>
<tr>
<td>3</td>
<td>DI3</td>
</tr>
<tr>
<td>4</td>
<td>DI4</td>
</tr>
<tr>
<td>5</td>
<td>COM1</td>
</tr>
<tr>
<td>6</td>
<td>DI5</td>
</tr>
<tr>
<td>7</td>
<td>DI6</td>
</tr>
<tr>
<td>8</td>
<td>DI7</td>
</tr>
<tr>
<td>9</td>
<td>DI8</td>
</tr>
<tr>
<td>10</td>
<td>COM2</td>
</tr>
</tbody>
</table>

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
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-5010.

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:

```
dhcpd eth1 &
```
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 YYYYYYY mode MMMM
```

For infrastructure mode XXXX is the access point name and YYYYYYY is the encryption key and MMMM should be managed.

For Ad-Hoc mode mode XXXX is the PAC-5010 device name and YYYYYYY 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.

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. ttyACM0 and ttyACM1: USB Modem (CDC compliant)

3.18 Utility Software
PAC-5010 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 gpioclt

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

```
>gpioclt --help
```

To find out the usage of this command.

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 *ntpcient, 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
```

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 Artila 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.

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:

\textit{make}

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

\textit{ftp 192.168.2.127}

And bin command to set transfer mode to binary

\textit{ftp>bin}

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

\textit{chmod +x file.o}

To change it to execution mode and

\textit{./file.o}

to run the file.