



LinPAC AM335x Series User Manual

V2.0.4 December 2021



LP-22xx/LP-52xx Series



LP-8x2x Series



LP-9x2x Series

Warranty

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Email: service@icpdas.com

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1. Introduction

This chapter introduces the fundamental concepts for the user with the LinPAC AM335x series.

LinPAC AM335x series is the new generation Linux-based PAC (Programmable Automation Controller) from ICP DAS and is equipped with a Cortex-A8 CPU (1.0 GHz) running a Linux kernel 3.x operation system, multiple communication interfaces and slots for high performance parallel I/O modules and serial I/O modules.

Main advantage of the LinPAC AM335x PAC is its high quality control system, including its stably properties, open source and the standard LinPAC SDK for Windows and Linux using the GNU C language, JAVA and GUI software. The main purpose of LinPAC AM335x PAC is to allow the numerous enthusiastic Linux users to control their own embedded system easily within the Linux environment.

ICP DAS also provides a library file, libi8k.a, custom applications can easily be developed for the LinPAC AM335x PAC using either C or Java and .NET applications will also be supported in the future. The various functions contained in the library are divided into sub-group functions for ease of use within the different applications.

1.1. Features

The LinPAC AM335x PAC offers the most comprehensive configuration and remote system upgrade solutions to meet specific application requirements. The following list shows the hardware and software features designed to simplify installation, configuration and application.

- **Powerful CPU Module**
 - AM335x ARM Cortex-A8 (1.0 GHz)
- **Memory Size**
 - SDRAM (512 MB DDR3)
 - Flash (512 MB)
 - MRAM (128 KB) for LP-8x2x/9x2x
 - EEPROM/FRAM (16 KB for LP-8x2x/9x2x, 64 KB for LP-22xx/52xx)
 - SD Card (support up to 32 GB)
- **Linux OS**
 - Linux kernel 3.2.14
- **Real-Time Capability**
- **64-bit Hardware Serial Number for Software Protection**
- **Rich I/O Expansion Ability**
 - RS-232/RS-485
 - USB
 - FRnet
 - CAN
 - XV-Board for LP-22xx/52xx
- **10/100/1000 Mbit/s Ethernet Port**
- **Redundant Power Input for LP-8x2x/9x2x**
- **GSM/GPS/3G System for LP-5231PM-3GWA**
- **GSM/GPS/3G/4G System**
 - (For LP-5231PM-4GE/LP-5231M-4GC/LP-2241MX-4GE/LP-2241MX-4GC)
- **Operating Temperature: -25 ~ +75°C**

For full details of specifications which can be found at:

LinPAC-22xx series:

<https://www.icpdas.com/en/product/LP-2241M>

<https://www.icpdas.com/en/product/LP-2241MX-4GC>

<https://www.icpdas.com/en/product/LP-2241MX-4GE>

LinPAC-52xx series:

<https://www.icpdas.com/en/product/LP-5231>

<https://www.icpdas.com/en/product/LP-5231M>

<https://www.icpdas.com/en/product/LP-5231PM-3GWA>

<https://www.icpdas.com/en/product/LP-5231PM-4GE>

<https://www.icpdas.com/en/product/LP-5231PM-4GC>

LinPAC-8x2x series:

<https://www.icpdas.com/en/product/LP-8121>

<https://www.icpdas.com/en/product/LP-8421>

<https://www.icpdas.com/en/product/LP-8821>

LinPAC-9x2x series:

<https://www.icpdas.com/en/product/LP-9221>

<https://www.icpdas.com/en/product/LP-9421>

<https://www.icpdas.com/en/product/LP-9821>

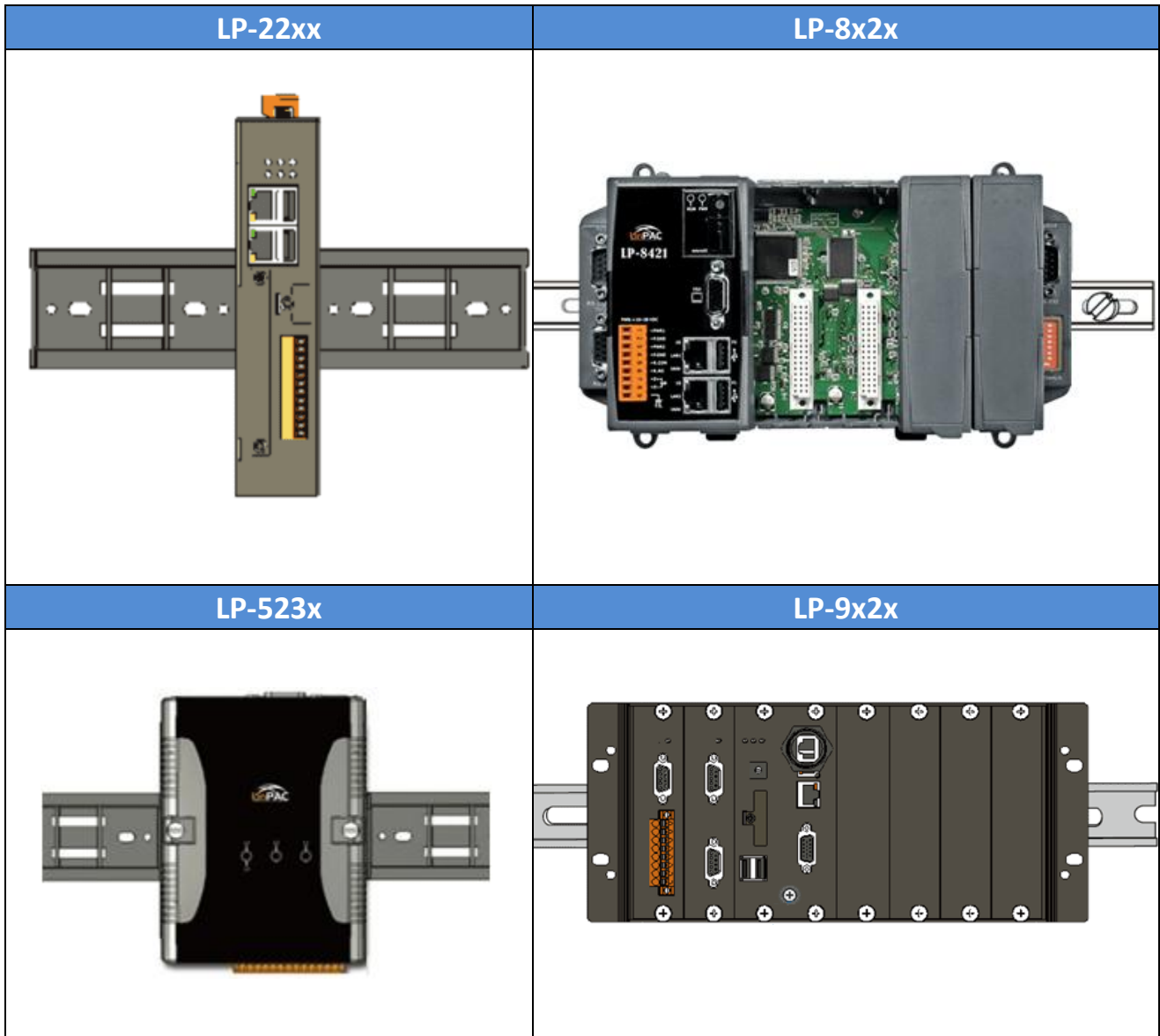
Please note:

- ◆ **The flash and microSD disk have a finite number of program-erase cycles. Important information should always be backed up on other media or storage device for long-term safekeeping.**
- ◆ **The Li-batterie can continually supply power to the 512 KB SRAM to retain the data for 10 years (It is recommended that batteries are changed each 5~7 year.)**

2. LinPAC AM335x Getting Started

This chapter provides a guided tour of the LinPAC AM335x series PAC installation and configuration that describes the steps needed to download, install, configure, and run the basic procedures for the user working with the in LinPAC AM335x PAC for the first time.

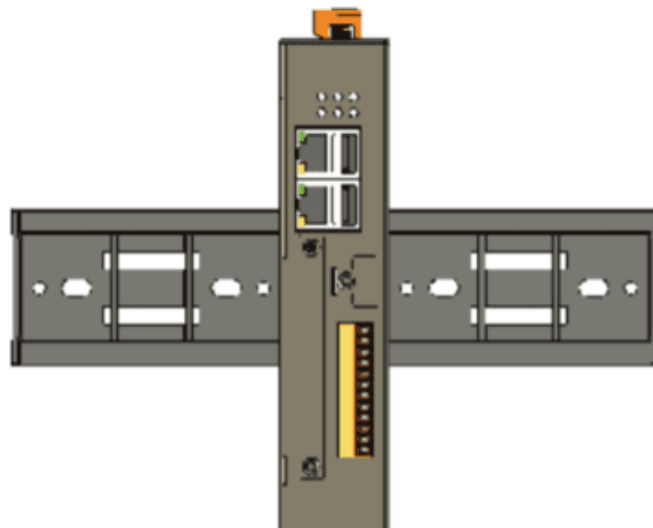
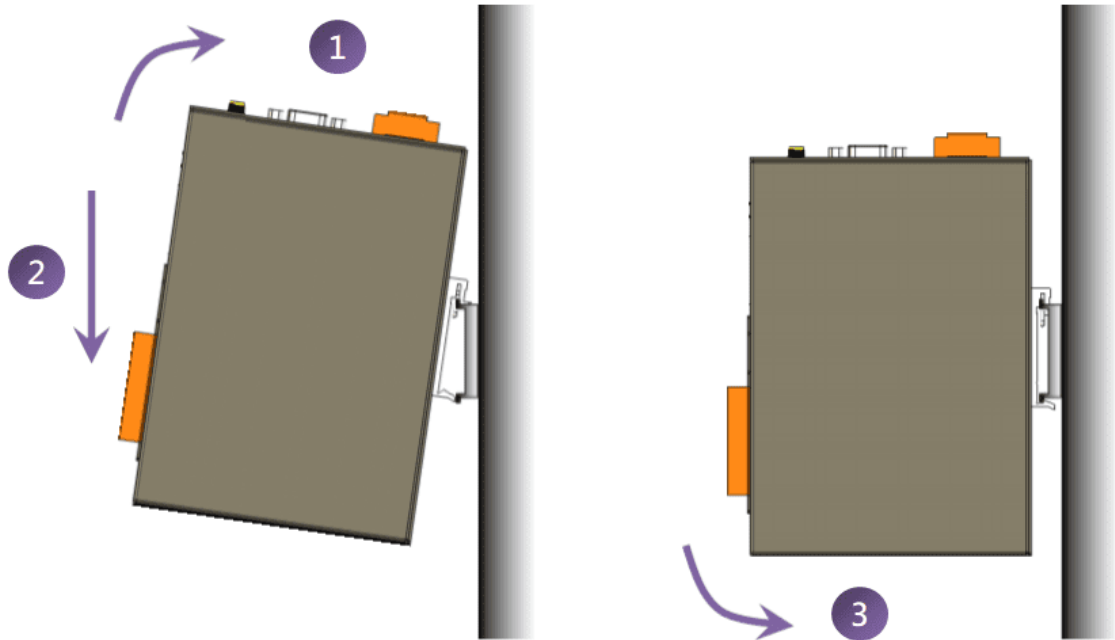
2.1. Mounting the Hardware



2.1.1. Mounting the LP-22xx

DIN-Rail mounting

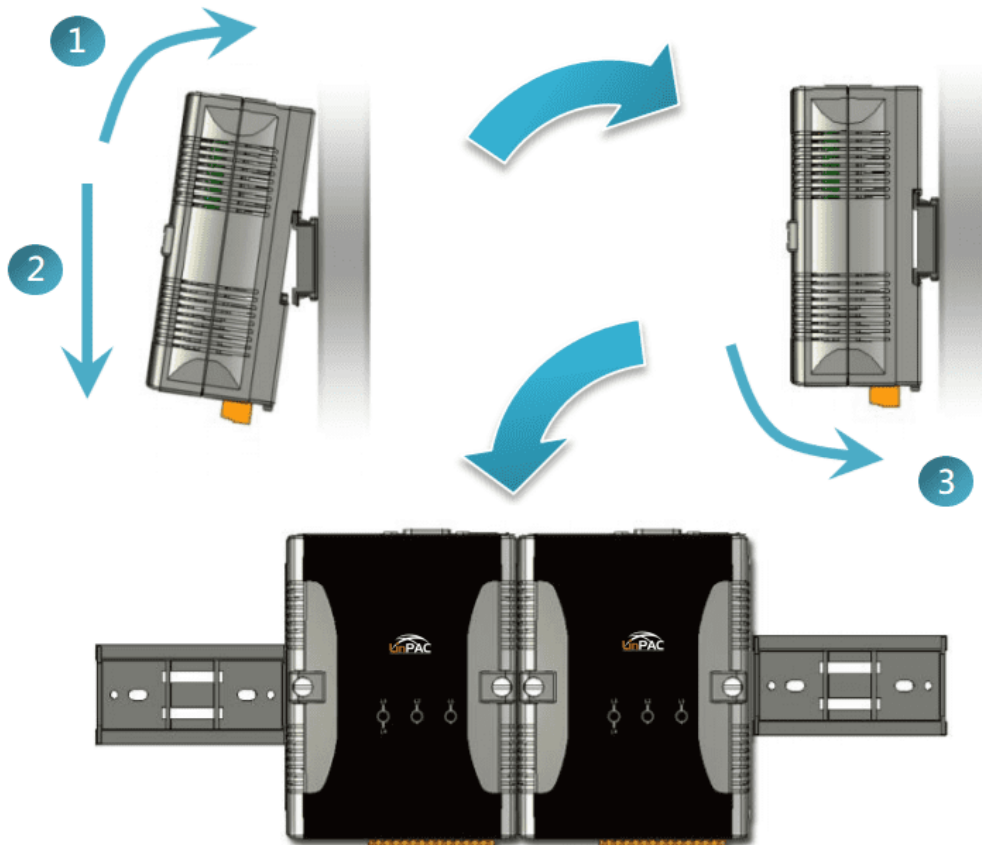
The LP-2241 has simple rail clips for mounting reliably on a standard 35 mm DIN-Rail.



2.1.2. Mounting the LP-52xx

DIN-Rail mounting

The LP-5231 has simple rail clips for mounting reliably on a standard 35 mm DIN-Rail.



Remove the LP-5231 from the DIN-Rail

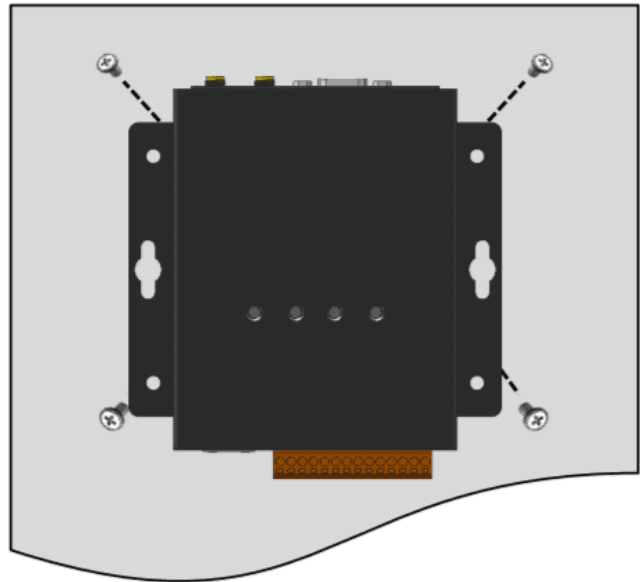


Wall/Panel mounting

The LP-5231M/LP-5231PM-3GWA/LP-5231PM-4GE/LP-5231PM-4GC can be mounted either directly to a wall/panel.

Step 1: Install the four mounting screws into the 4 keyhole mounting holes.

Step 2: Fasten the screws securely.



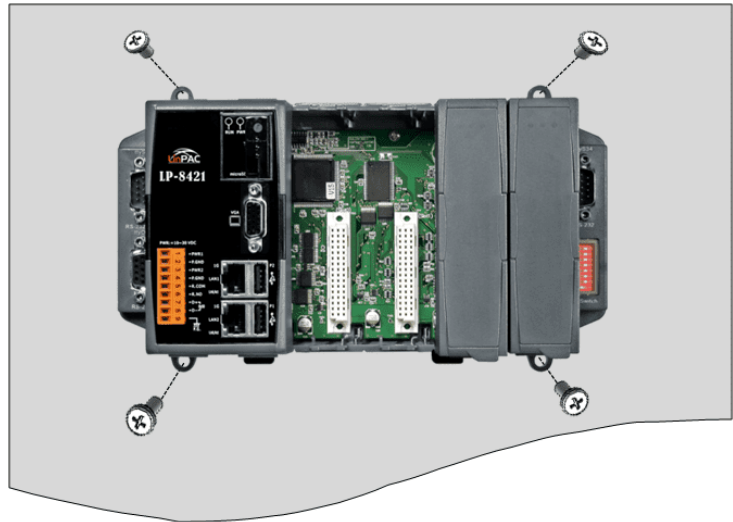
2.1.3. Mounting the LP-8x2x

Wall/Panel mounting

The LP-8x2x can be mounted either directly to a wall/panel or onto a standard 35mm DIN-Rail.

Step 1: Install the four mounting screws into the 4 keyhole mounting holes.

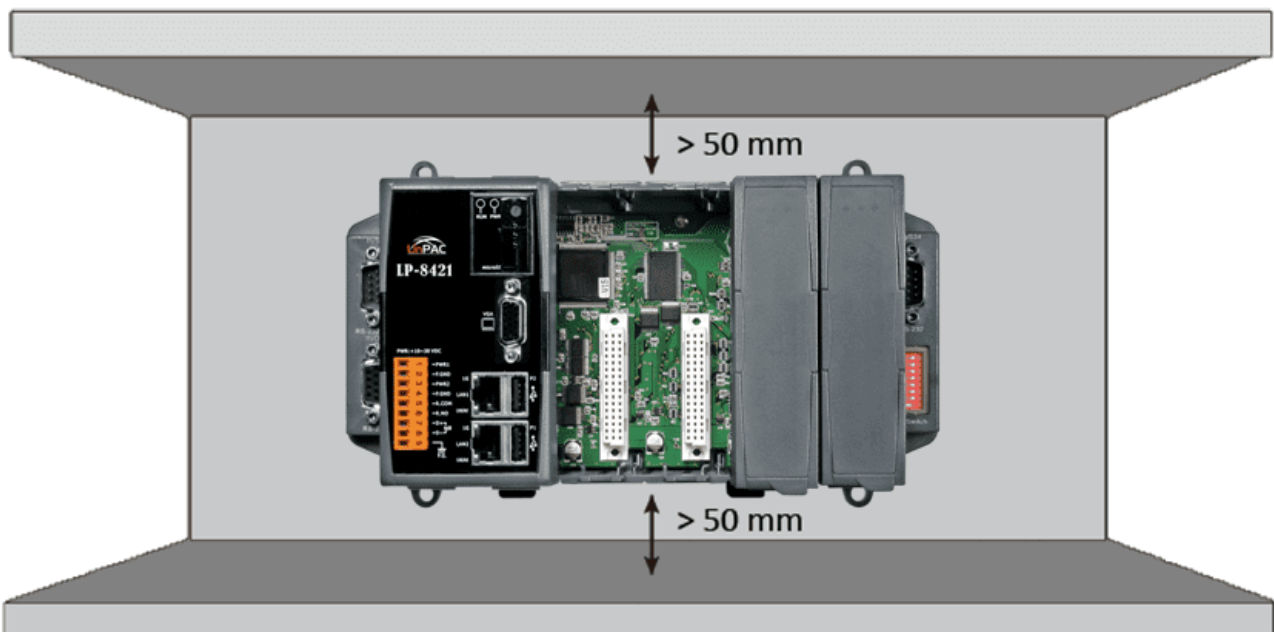
Step 2: Fasten the screws securely.



Tips & Warnings



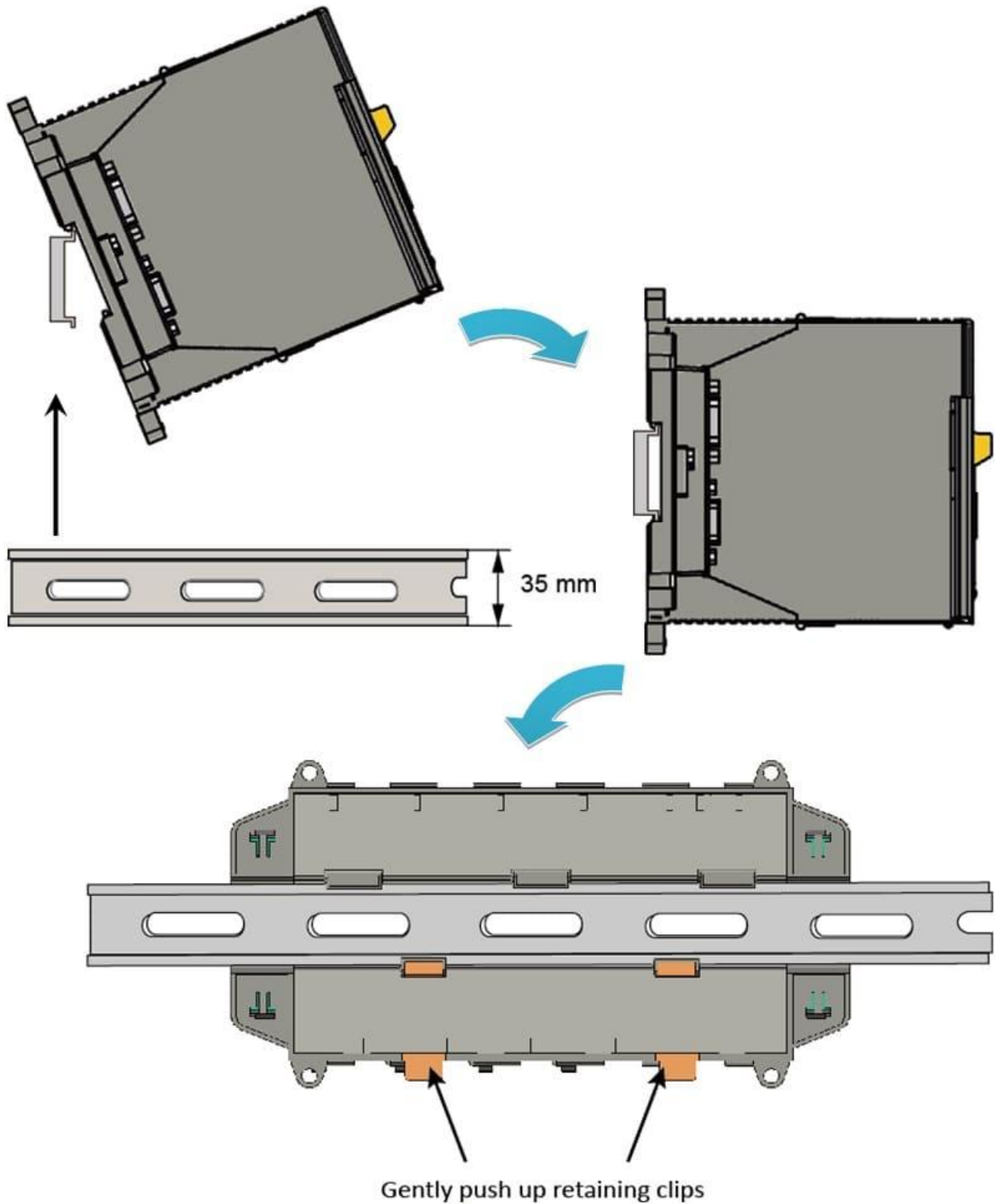
There must be a minimum clearance of 50mm between the LP-8x2x and the top and bottom side of the enclosure panel.



DIN-Rail mounting

Step 1: Hook upper tab over upper flange of DIN-Rail.

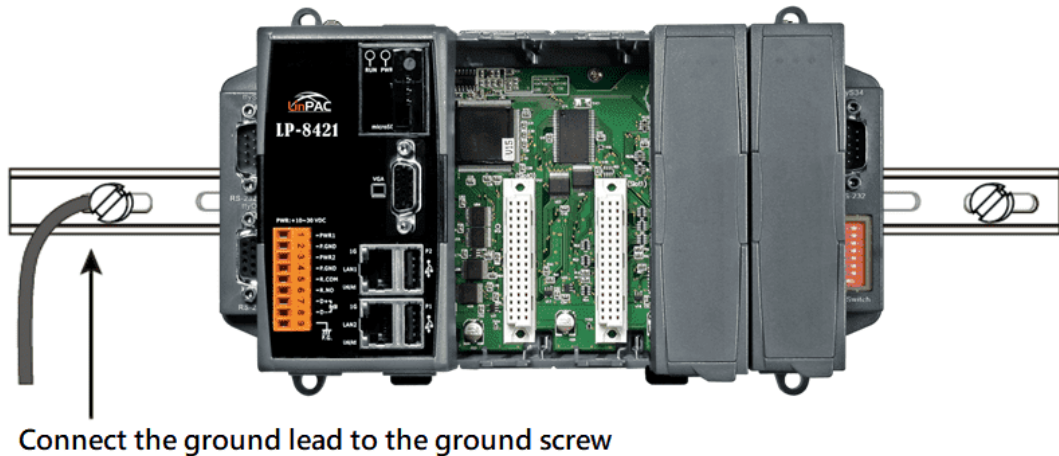
Step 2: Tilt the module toward DIN-Rail until it snaps securely to DIN-Rail.



Tips & Warnings



A good common ground reference (earth ground) is essential for proper operation of the LP-8x2x. One side of all control circuits, power circuits, and the ground lead must be properly connected to earth ground by either installing a ground rod in close proximity to the enclosure or by connecting to the incoming power system ground. There must be a single-point ground (i.e. copper bus bar) for all devices in the enclosure that require an earth ground.

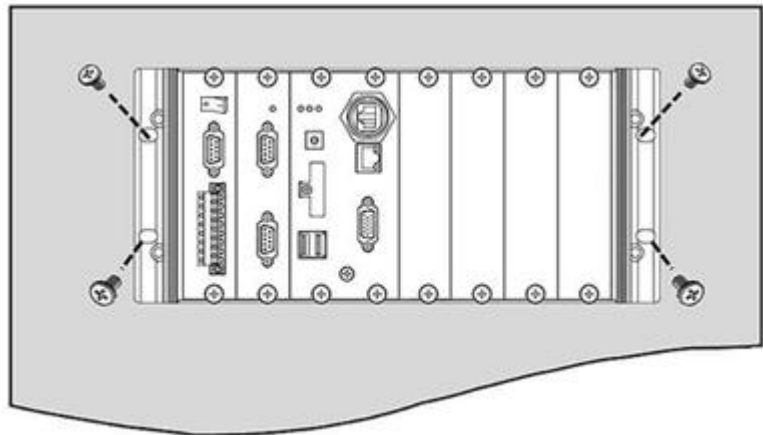


2.1.4. Mounting the LP-9x2x

Wall/Panel mounting

The LP-9x2x can be mounted either directly to a wall/panel, or onto a stainless 35mm DIN-Rail.

Step 1: Install the four mounting screws into the 4 keyhole mounting holes.

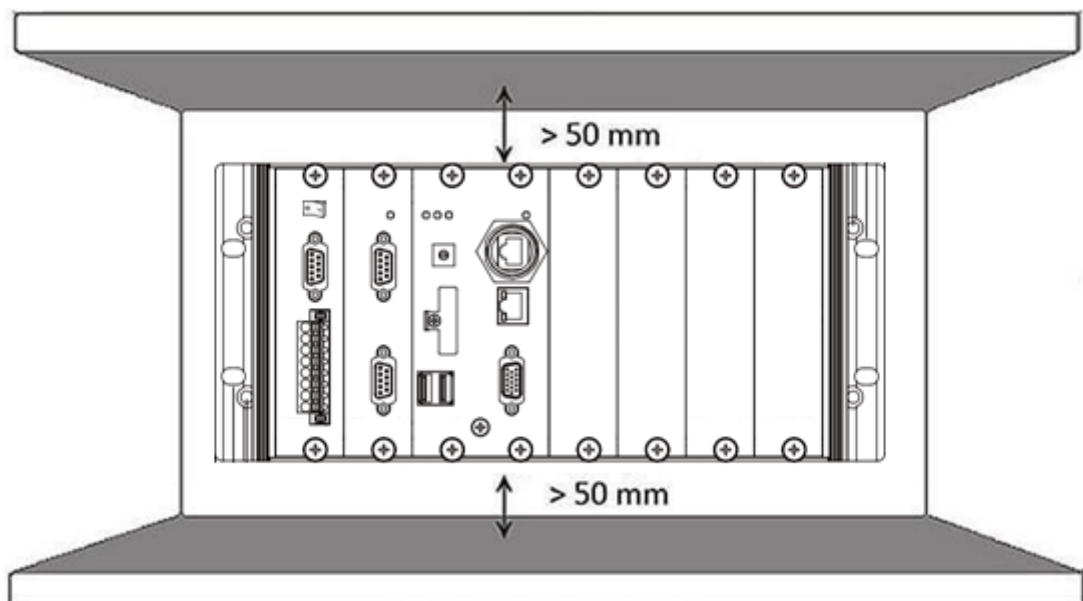


Step 2: Fasten the screws securely.

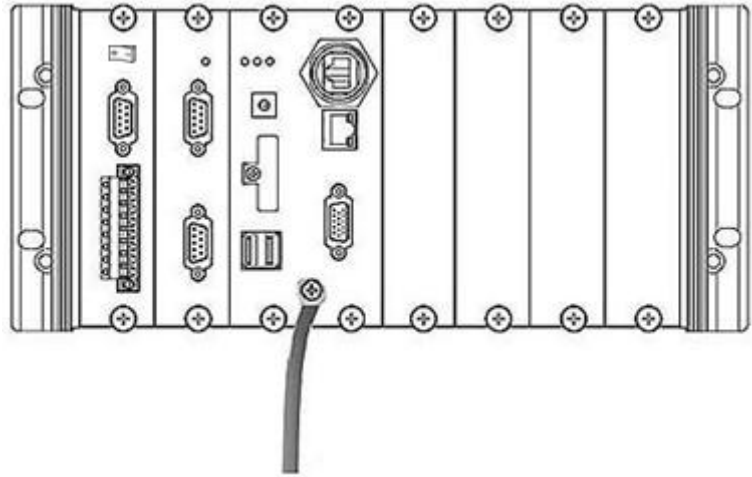
Tips & Warnings



There must be a minimum clearance of 50 mm between the LP-9x2x and the top and bottom side of the enclosure panel.



Step 3: Connect the ground lead to the frame ground point.



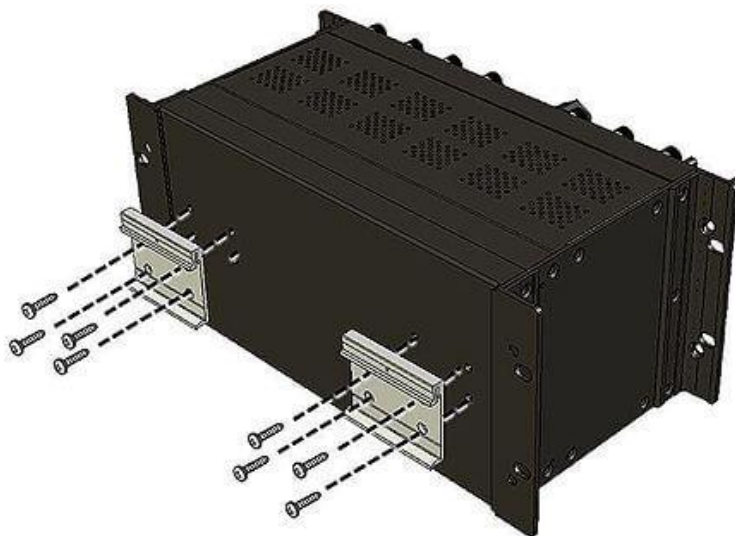
Tips & Warnings



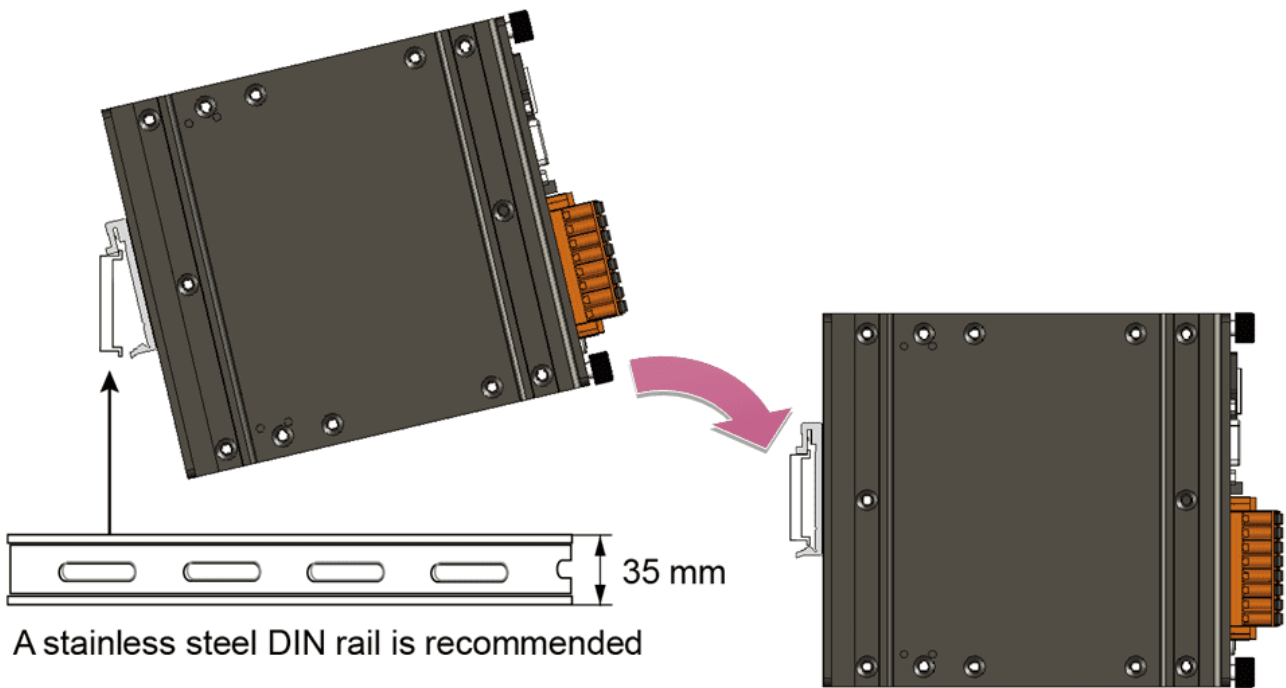
A good common ground reference (earth ground) is essential for proper operation of the LP-9x2x. One side of all control circuits, power circuits, and the ground lead must be properly connected to earth ground by either installing a ground rod in close proximity to the enclosure or by connecting to the incoming power system ground. There must be a single-point ground (i.e. copper bus bar) for all devices in the enclosure that require an earth ground.

DIN-Rail mounting

Step 1: Fasten the DIN-Rail clip to the LP-9x2x.



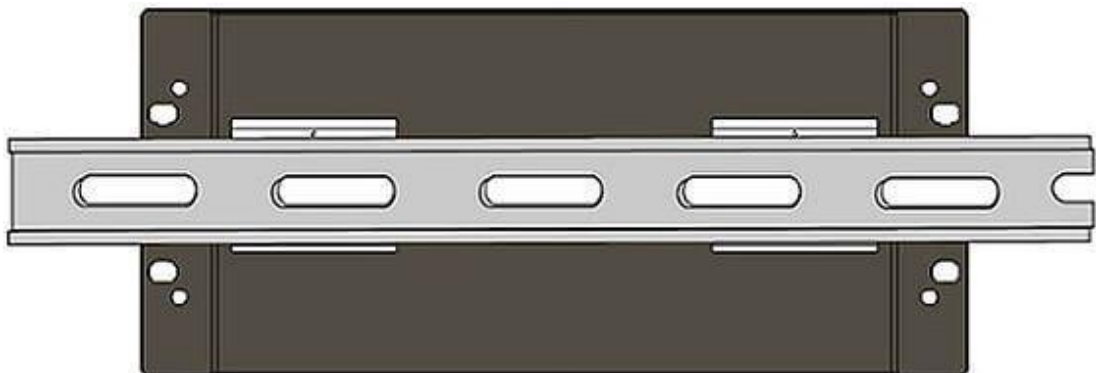
Step 2: Clip the device onto a stainless DIN-Rail.



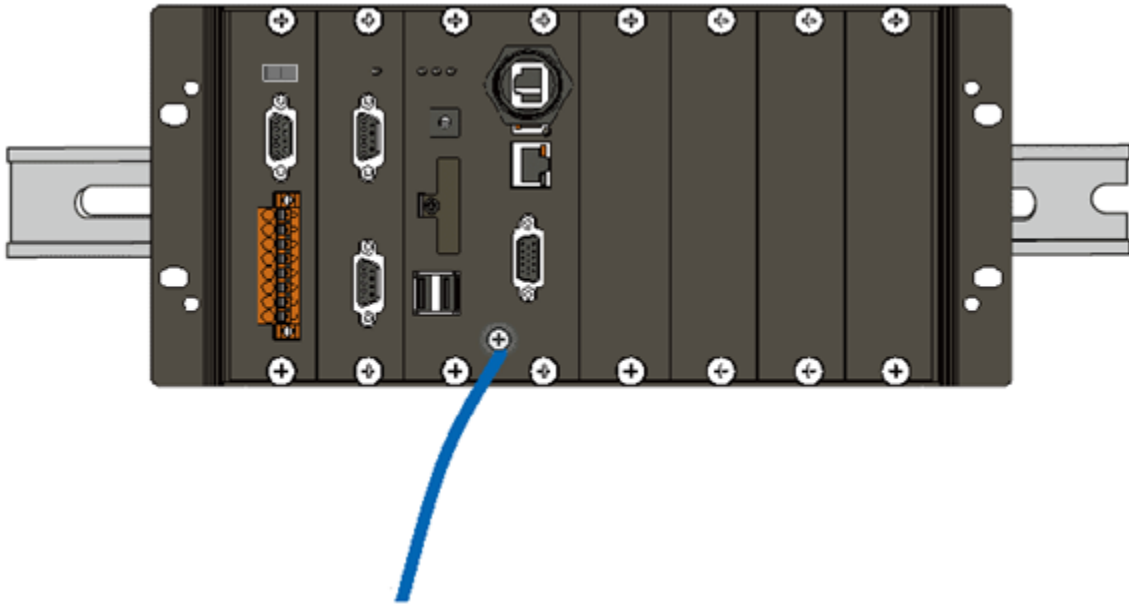
Tips & Warnings



For DIN-Rail mounting, it is strongly recommended that only a stainless steel DIN-Rail be used to support the weight of the LP-9x2x system, providing stability and preventing LP-9x2x from leaning.



Step 3: Connect the ground lead to the frame ground point.



Tips & Warnings

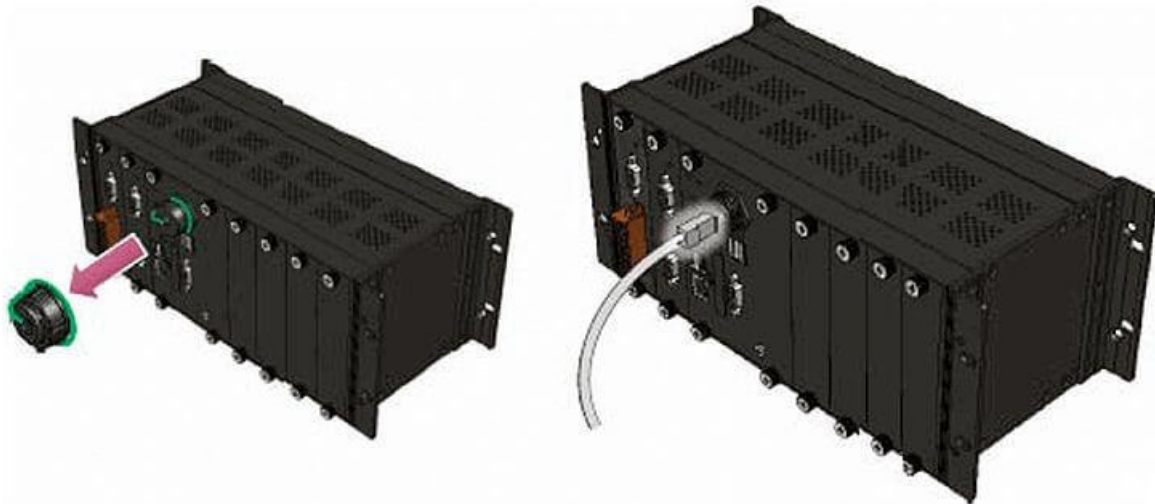


A good common ground reference (earth ground) is essential for proper operation of the LP-9x2x. One side of all control circuits, power circuits, and the ground lead must be properly connected to earth ground by either installing a ground rod in close proximity to the enclosure or by connecting to the incoming power system ground. There must be a single-point ground (i.e. copper bus bar) for all devices in the enclosure that require an earth ground.

2.1.4.1. Installing the RJ-45 waterproof connector assembly

The LP-9x2x series is equipped with an RJ-45 waterproof connector to withstand contaminant in the dusty environment.

The RJ-45 waterproof connector is optional for use with LAN1 port. If you do not need the RJ-45 waterproof connector, you can remove the cap and just plug in a regular Ethernet cable.



If you want to use the RJ-45 waterproof connector for protecting the connection, follow the instructions below.

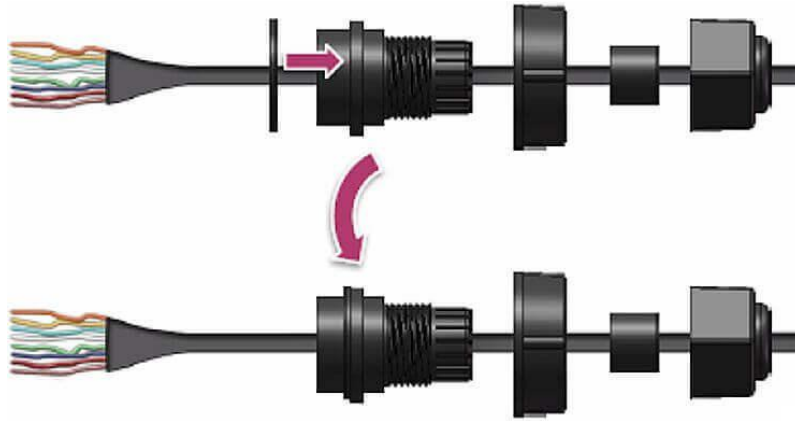
Step 1: Remove the RJ-45 connector from the RJ-45 cable.



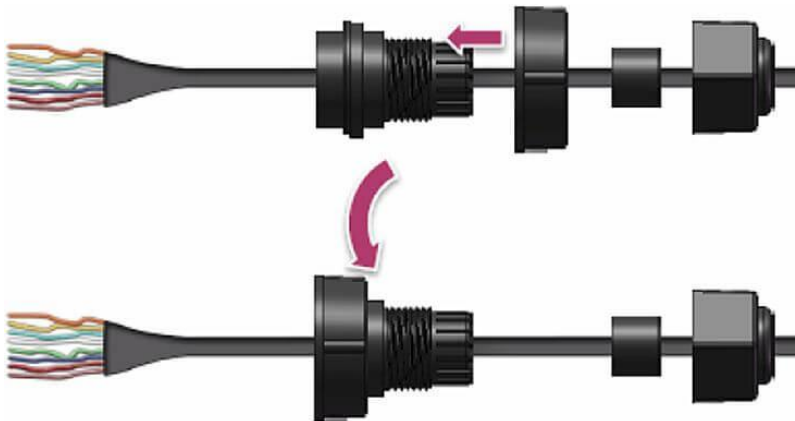
Step 2: Feed the end of the RJ-45 cable through the (A) sealing nut, (B) rubber sealing insert, (C) clamping ring, (D) cable gland base and (E) panel gasket.



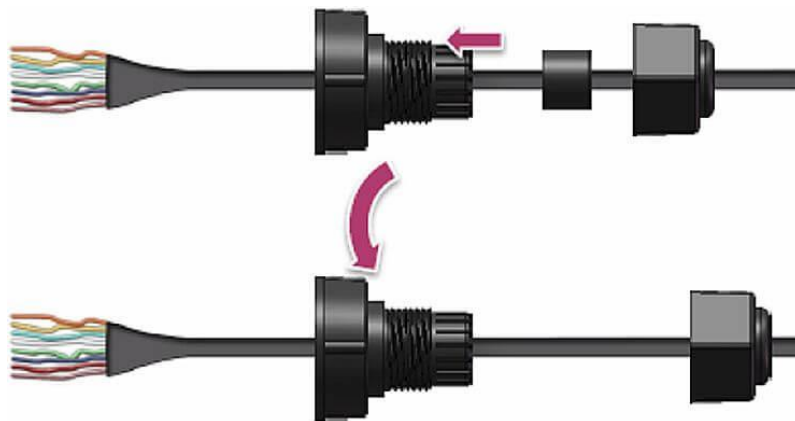
Step 3: Wrap the (E) panel gasket base around the (D) cable gland base.



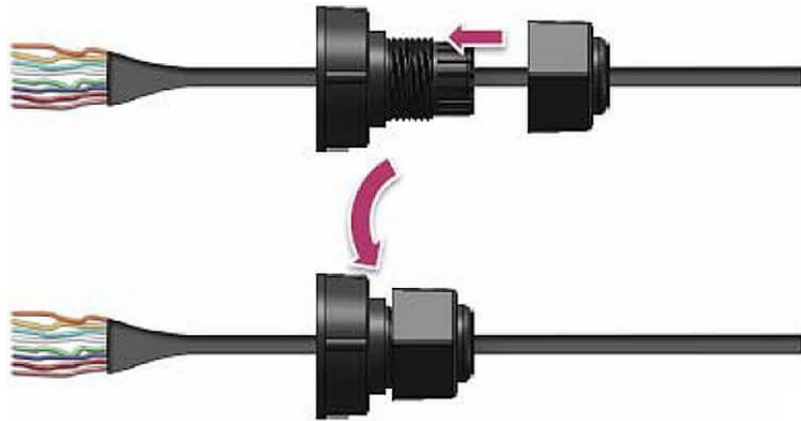
Step 4: Wrap the (C) clamping ring around the (D) cable gland base.



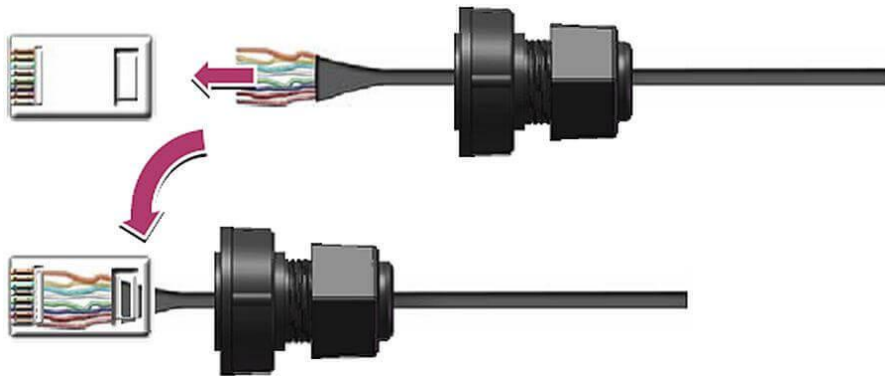
Step 5: Insert the (B) rubber sealing insert into the (D) cable gland base.



Step 6: Push the (A) sealing nut forward and Hand-tighten it to seal the assembly.



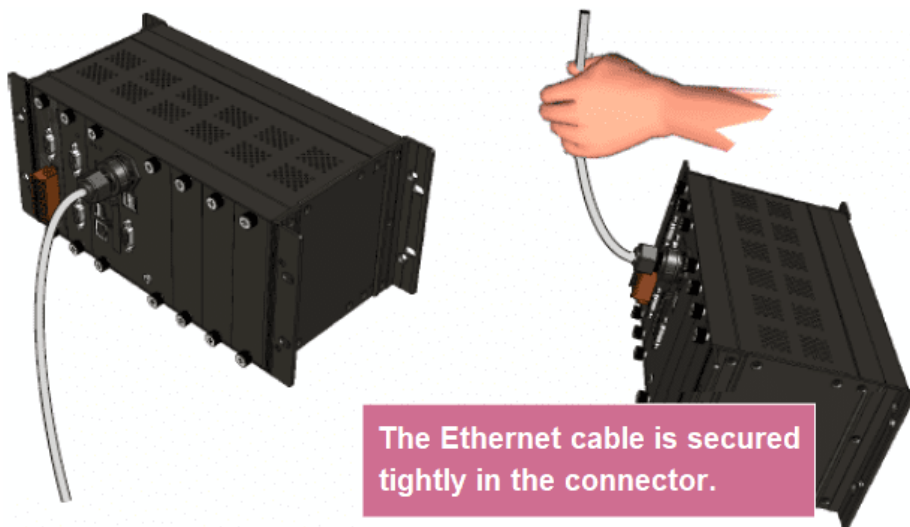
Step 7: Insert the RJ-45 cable into the RJ-45 connector.



Step 8: Push the RJ-45 waterproof connector assembly forward.



Step 9: Insert the Ethernet cable and screw the RJ-45 waterproof into the receptacle.



2.2. Deploying a Basic System

The LinPAC AM335x series PAC provides a variety of communication interface to suit a range of application. Here is a simple application for using the LP-22xx/52xx/8x2x/9x2x.

Tips & Warnings



1. The input range of power supply is **+10 V_{DC} to +30 V_{DC}** for **LP-8x2x/9x2x** and **+12 V_{DC} to +48 V_{DC}** for **LP-22xx/52xx**.
 2. The LP-8x2x/9x2x have two power inputs that can be connected simultaneously to the two independent power sources. If one power source fails, the other source takes over automatically. Redundant power input help assure non-stop operation of the LP-8x2x/9x2x.
-

2.2.1. Installation for LP-22xx

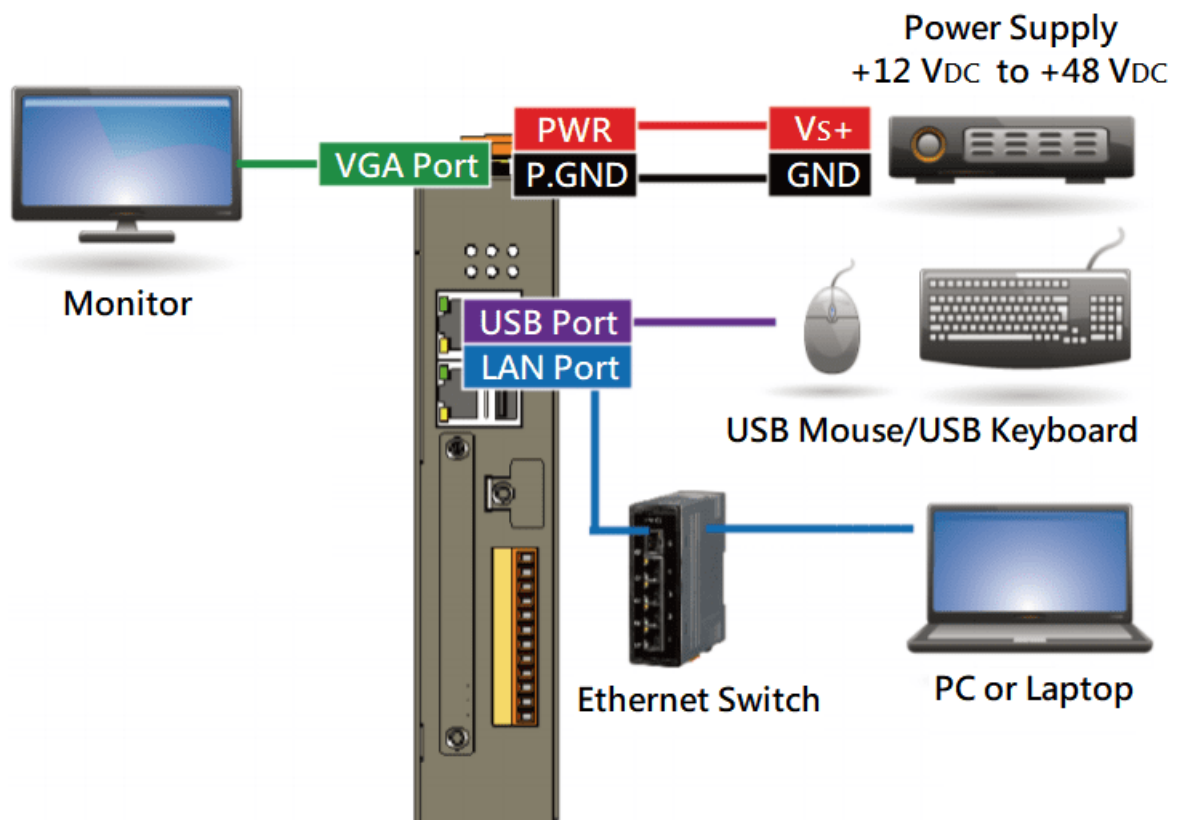
Connecting to a PC, the USB device, and the power supply.

Step 1: Connect the positive terminal (+) of the power supply to the terminal **PWR** and the negative terminal (-) of the power supply to the **P.GND**.

Step 2: Connect the USB mouse or the USB keyboard to the USB port.

Step 3: Connect the monitor to the VGA port.

Step 4: Connect to PC or the laptop to the LAN port via an Ethernet switch.



Interface	LAN1 (eth0)	LAN2 (eth1)
IP (Default)	192.168.0.1	192.168.0.2
Netmask	255.255.255.0	255.255.255.0
User ID	root	
Password	icpdas	

2.2.2. Installation for LP-52xx

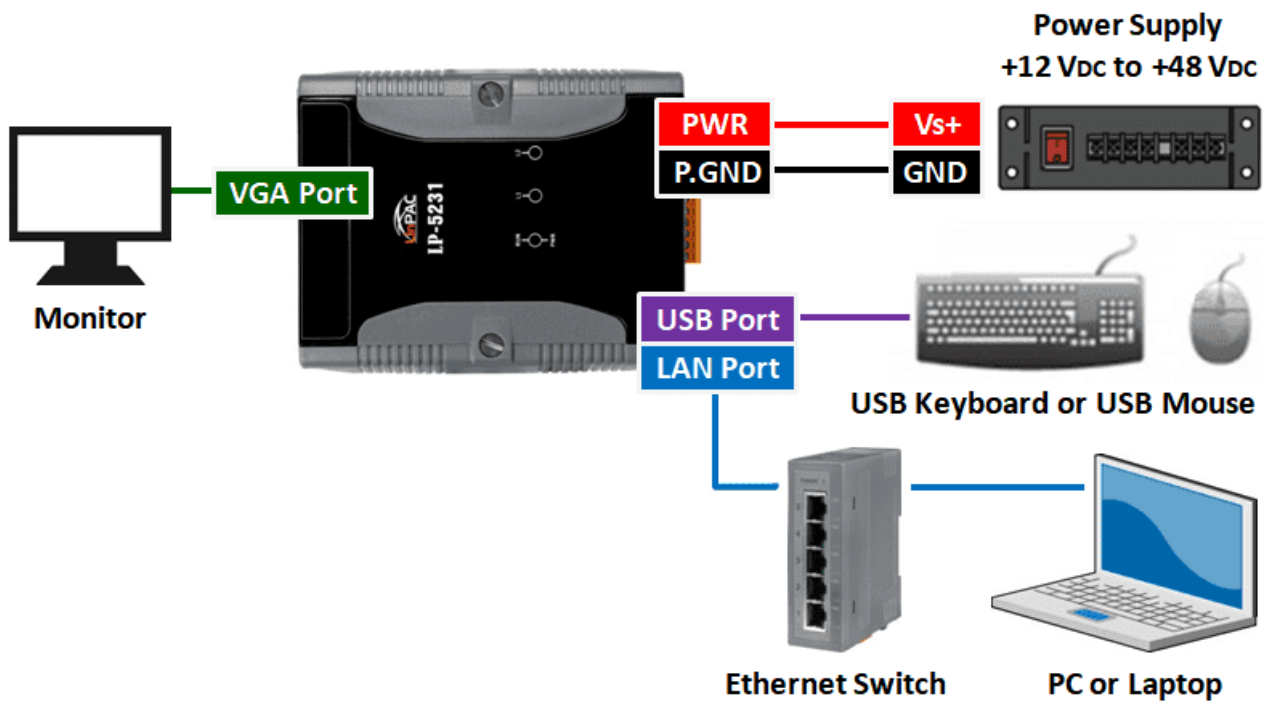
Connecting to a PC, the USB device, and the power supply.

Step 1: Connect the positive terminal (+) of the power supply to the terminal **PWR** and the negative terminal (-) of the power supply to the **P.GND**.

Step 2: Connect the USB mouse or the USB keyboard to the USB port.

Step 3: Connect the monitor to the VGA port.

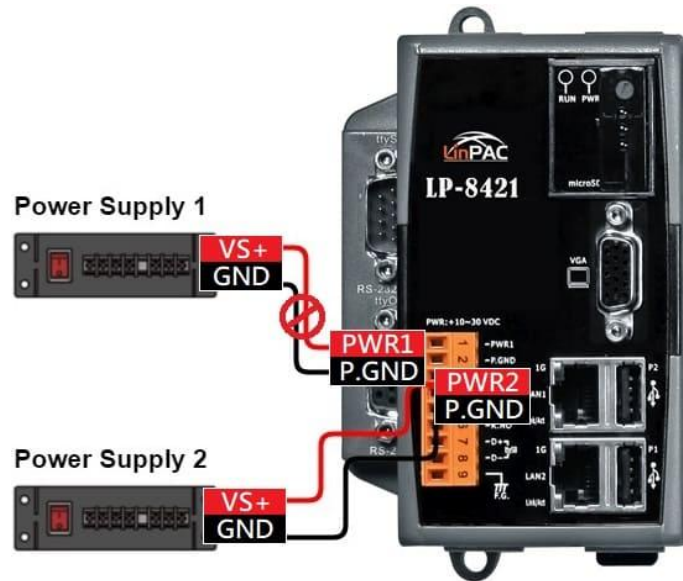
Step 4: Connect to PC or the laptop to the LAN port via an Ethernet switch.



2.2.3. Installation for LP-8x2x

Connecting to a PC, the USB device, and the power supply.

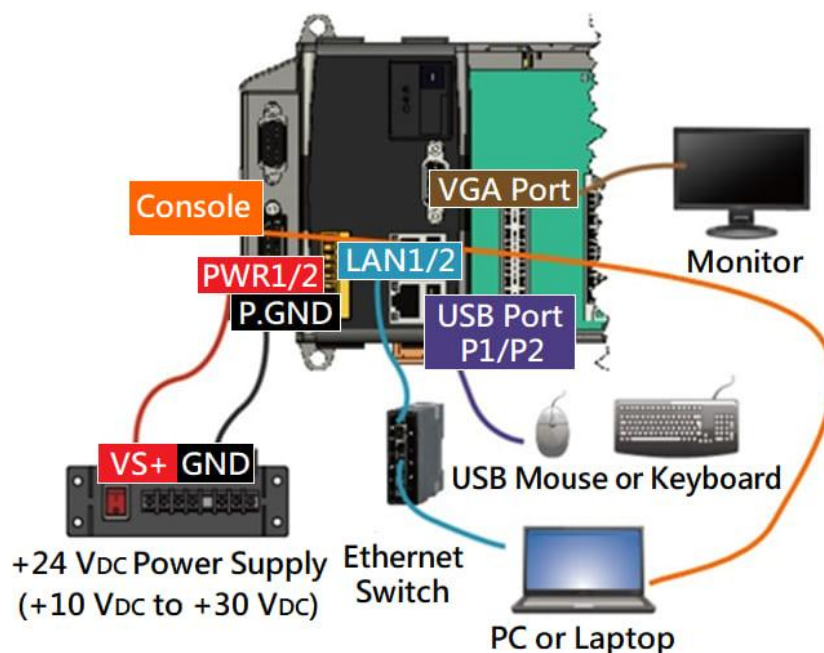
Step 1: Connect the positive terminal (+) of the power supply to the terminal PWR1/2 and the negative terminal (-) of the power supply to the P.GND.



Step 2: Connect the USB mouse or the USB keyboard to the USB port.

Step 3: Connect the monitor to the VGA port.

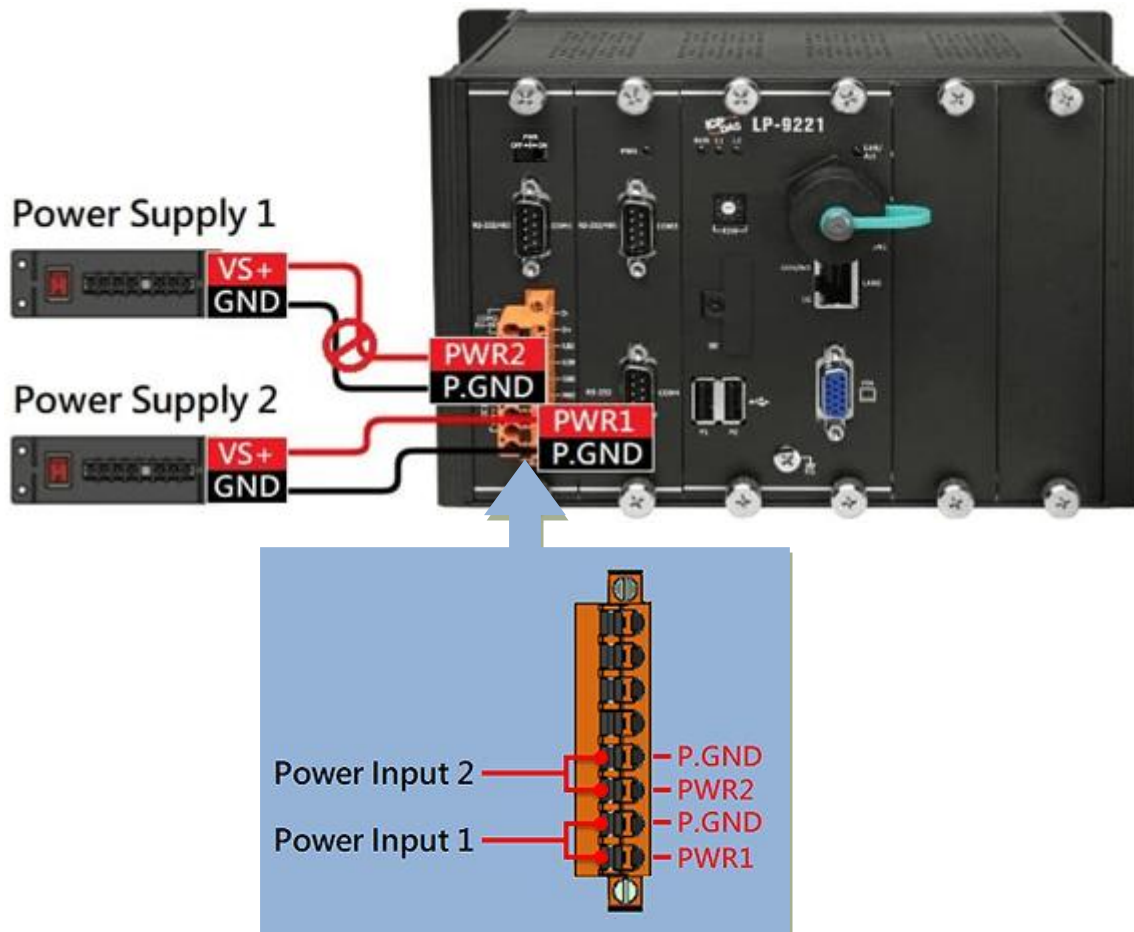
Step 4: Connect to PC or the laptop to the LAN port via an Ethernet switch.



2.2.4. Installation for LP-9x2x

Connecting to a PC, the USB device, and the power supply.

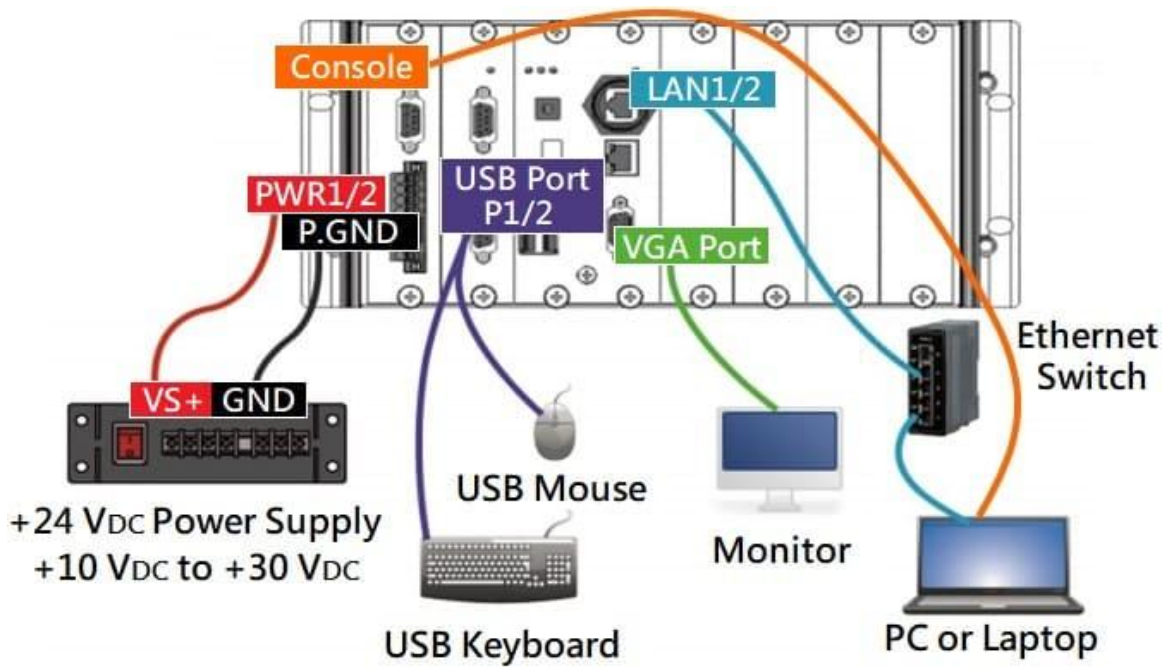
Step 1: Connect the positive terminal (+) of the power supply to the terminal PWR1/2 and the negative terminal (-) of the power supply to the P.GND.



Step 2: Connect the USB mouse or the USB keyboard to the USB port.

Step 3: Connect the monitor to the VGA port.

Step 4: Connect to PC or the laptop to the LAN port via an Ethernet switch.



2.3. Inserting the I/O Modules

LinPAC controller is equipped with rich I/O expansion ability, all kinds of I/O modules as described in the following:

Type	Number of RS-232 and 485 ports	Number of slots	I-7K	I-8K and I-87K	I-9K and I-97K	XV-board
LP-22xx	3	1	√	-	-	√
LP-52xx	3	1	√	-	-	√
LP-8x2x	2 or 3	1 or 4 or 8	√	√	-	-
LP-9x2x	4	2 or 4 or 8	√	-	√	-

Note: '√': Support ; '-': Not Support

Before choosing the right I/O modules, you first need to know the I/O expansion capacities in order to choose the best expansion module for achieving maximal efficiency. For more information about the I/O expansion modules that are compatible with the LinPAC AM335x series PAC, please refer to the following website links:

LP-22xx/52xx series:

https://www.icpdas.com/en/product/guide+Remote_I_O_Module_and_Unit+PAC+%EF%BC%86amp;+Local_I_O_Modules+XV-board

LP-8x2x series:

[https://www.icpdas.com/en/product/guide+Remote_I_O_Module_and_Unit+PAC+%EF%BC%86amp;+Local_I_O_Modules+I-8K_I-87K_Series_\(High_Profile\)](https://www.icpdas.com/en/product/guide+Remote_I_O_Module_and_Unit+PAC+%EF%BC%86amp;+Local_I_O_Modules+I-8K_I-87K_Series_(High_Profile))

LP-9x2x series:

https://www.icpdas.com/en/product/guide+Remote_I_O_Module_and_Unit+PAC+%EF%BC%86amp;+Local_I_O_Modules+I-9K_I-97K_Series

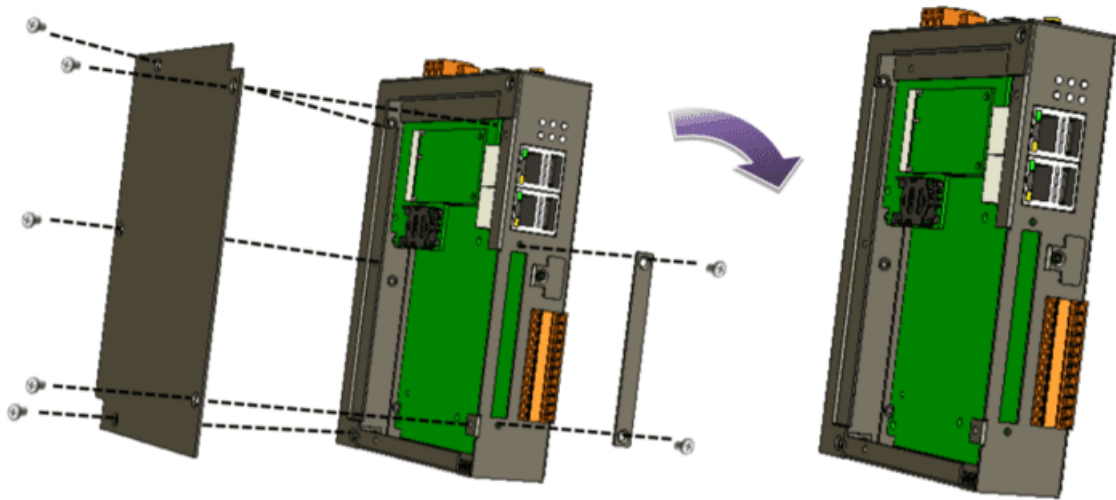
2.3.1. Adding an I/O Device for LP-22xx

2.3.1.1. Installing the XV-Board

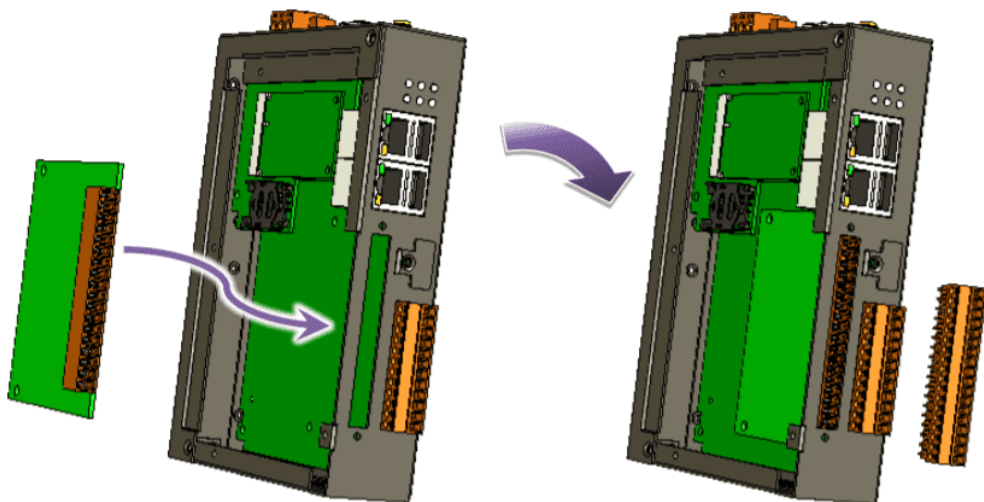
LP-22xx has one expansion I/O slots to expand the functions. For more information about the I/O expansion modules that are compatible with the LP-22xx, please refer to:

http://www.icpdas.com/root/product/solutions/hmi_touch_monitor/touchpad/xv-board_selection.html

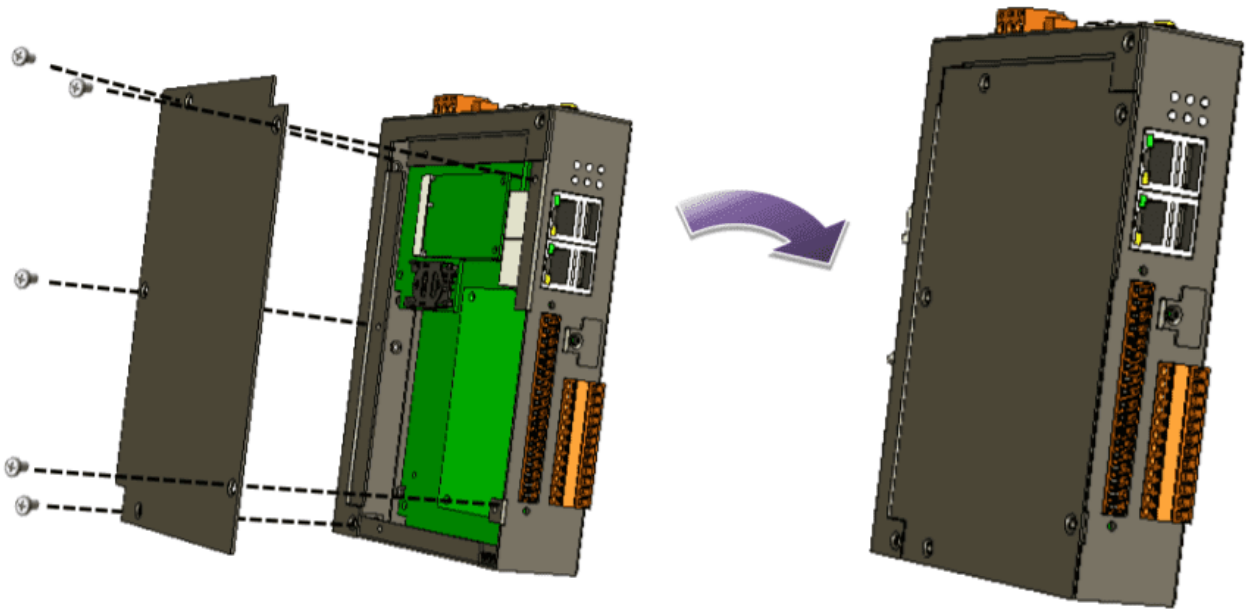
Step 1: Remove stripped screws and then remove the cover.



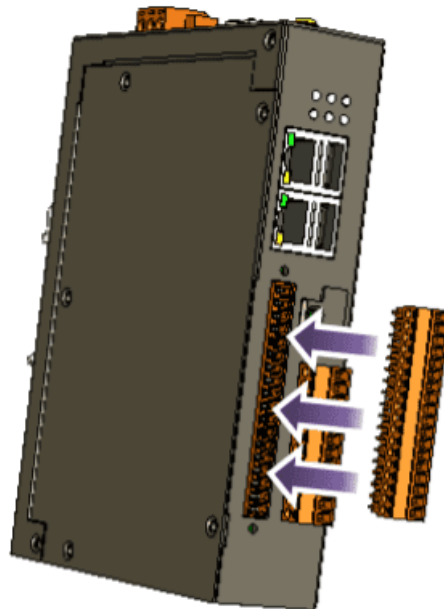
Step 2: Hold the XV-board vertically and align the socket, and then carefully press the XV-board onto the socket.



Step 3: Close the cover and then fasten the screws.



Step 4: Insert the I/O terminal and then stick the I/O sticker.



2.3.2. Adding an I/O Device for LP-52xx

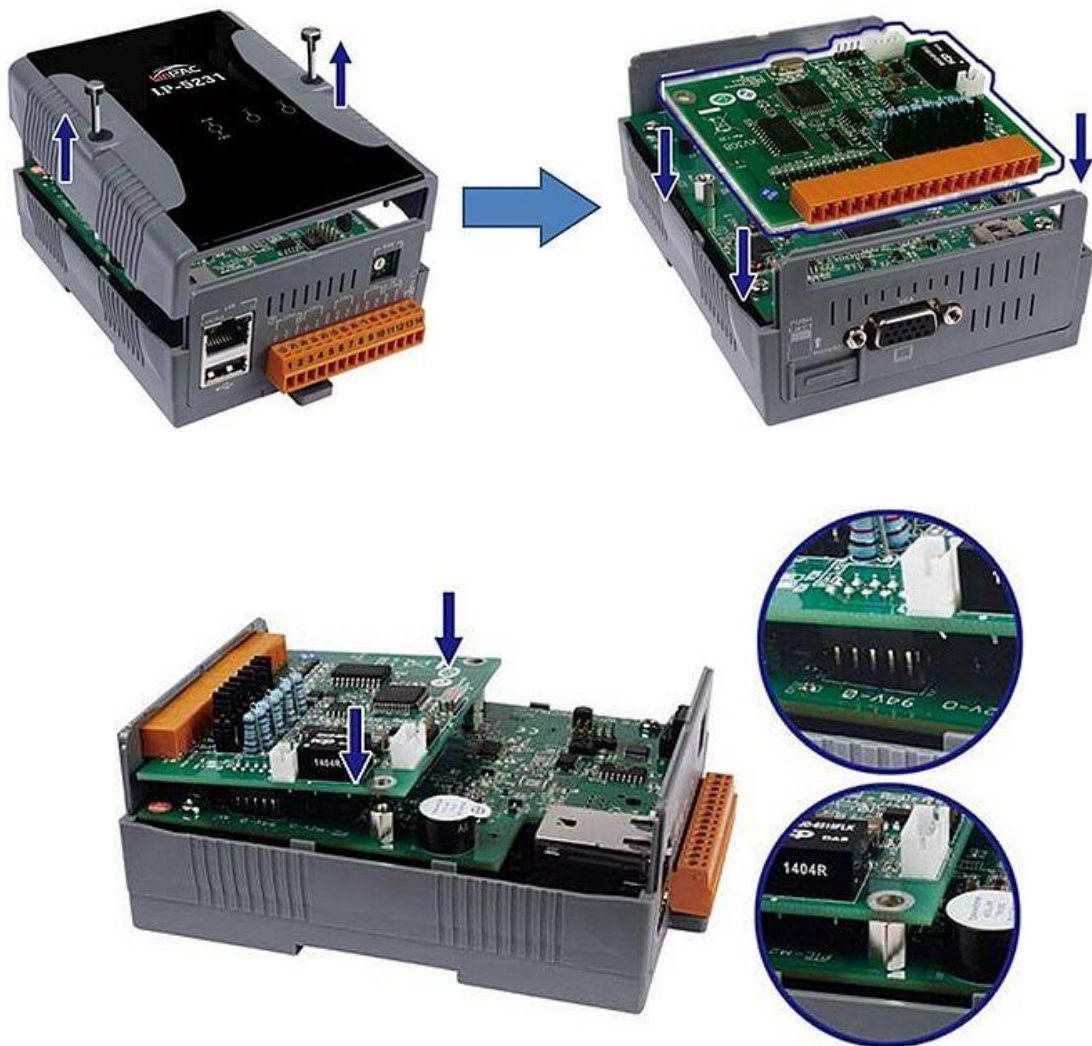
2.3.2.1. Installing the XV-Board

LP-52xx has one expansion I/O slots to expand the functions. For more information about the I/O expansion modules that are compatible with the LP-52xx, please refer to:

http://www.icpdas.com/root/product/solutions/hmi_touch_monitor/touchpad/xv-board_selection.html

Step 1: Remove stripped screws and then remove the cover.

Step 2: Hold the XV-board vertically and align the socket, and then carefully press the XV-board onto the socket.



Step 3: Close the cover and then fasten the screws.



Step 4: Insert the I/O terminal and then stick the I/O sticker.



2.3.2.2. Inserting the SIM card

The SIM card tray is located on the top side of the module. The eject button is on the right side of the tray door.

Step 1: Push the ejection button until the SIM card tray pops out.



Step 2: Pull out the tray completely and set it on a flat surface.

Step 3: Put the SIM card in the tray, and then push the tray back into the socket.

Tips & Warnings



Make sure to turn the LP-5231PM-3GWA/LP-5231PM-4GE/LP-5231PM-4GC off before inserting or removing the SIM card. Do not bend or scratch the SIM card.

2.3.2.3. Installing the antenna

The LP-5231PM-3GWA/LP-5231PM-4GE/LP-5231PM-4GC has 2 antenna connectors that can be used to connect the 3G/4G antenna. To install the antenna, just screw the antenna tightly into the connector, and put the antenna in the purpose place.



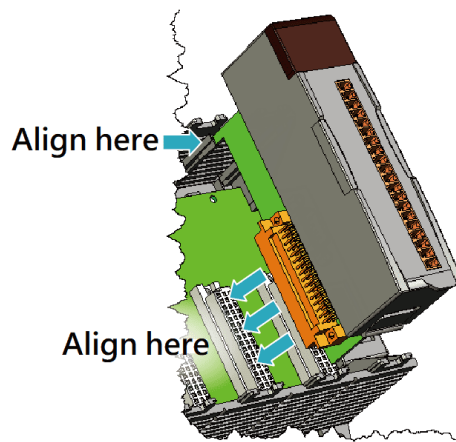
2.3.3. Adding an I/O Device for LP-8x2x

All I/O Web Page include the I/O module specifications, pin assignments and wiring connections.

For example, Pin Assignments and Wiring connections for the I-87054W module are as follows:

http://www.icpdas.com/root/product/solutions/remote_io/rs-485/i-8k_i-87k/i-87054w.html

Step 1: Align circuit card with slot and press firmly to seat module into connector.

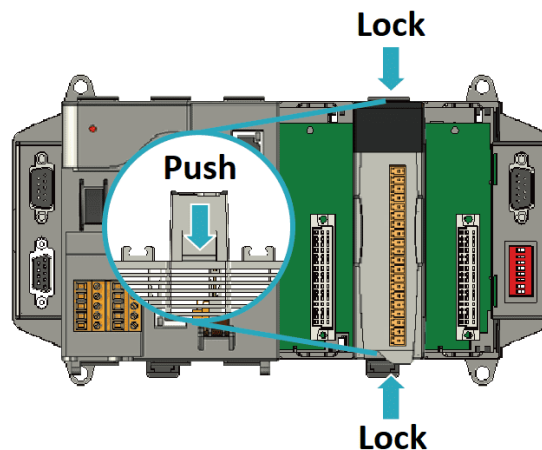


Tips & Warnings

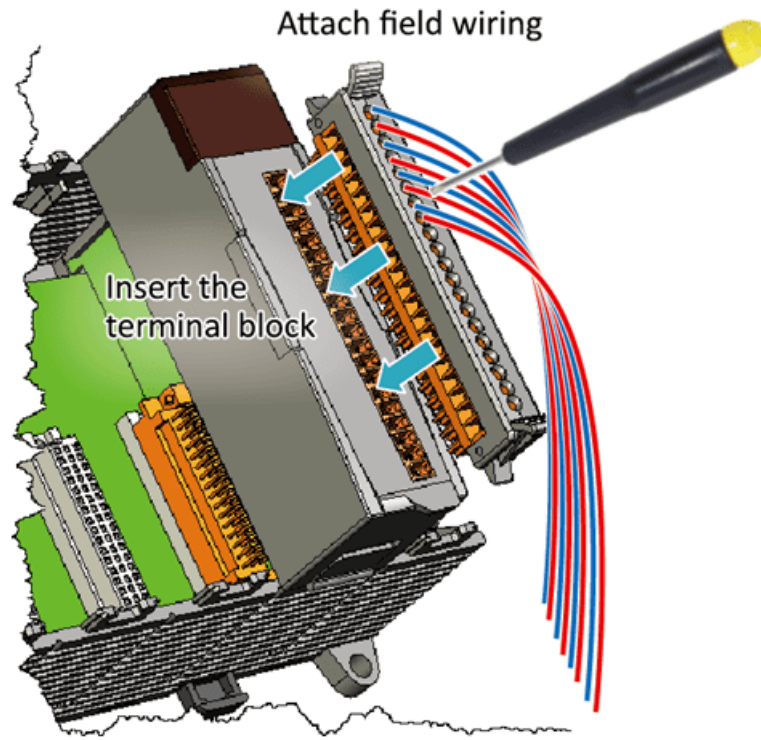


It is recommended that the power to the LP-8x2x is switched off when wiring the I/O module which are plugging in the LP-8x2x slots.

Step 2: Pull top and bottom locking tabs toward module face. Click indicates lock is engaged.



Step 3: Attach field wiring using the terminal block, and then insert the terminal block.



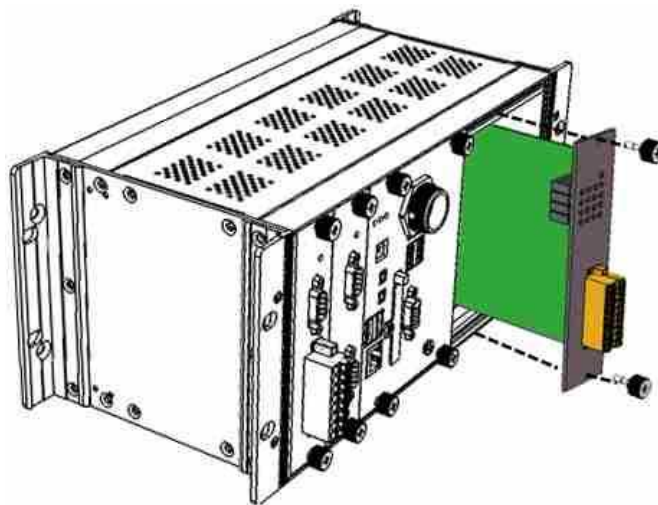
2.3.4. Adding an I/O Device for LP-9x2x

LP-9000 has 2/4/8 I/O expansion slots to support I-9K and I-97K series I/O modules. Before choosing the right I/O modules, you first need to know the I/O expansion capacities in order to choose the best expansion module for achieving maximal efficiency.

For more information about the I/O expansion modules that are compatible with the LP-9000, please refer to:

[https://www.icpdas.com/en/product/guide+Remote I O Module and Unit+PAC %EF%BC %86+ Local I O Modules+I-9K I-97K Series](https://www.icpdas.com/en/product/guide+Remote+I+O+Module+and+Unit+PAC+%EF%BC%86+Local+I+O+Modules+I-9K+I-97K+Series)

Step 1: Insert the I/O module.



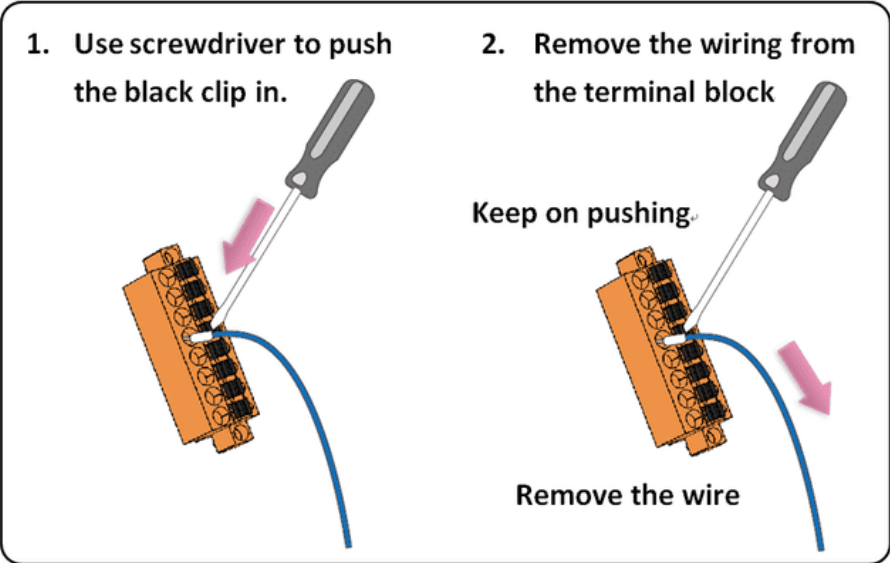
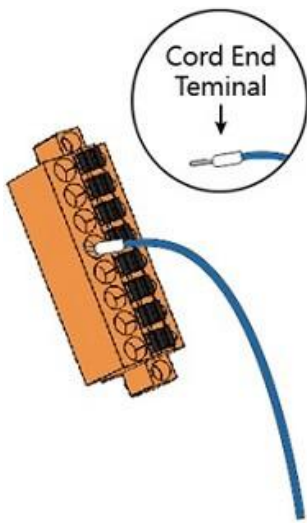
Tips & Warnings



If you do not expand the I/O module full, please keep the top case of the unused slot to protect the backplane from dirt, dust and damage from foreign objects.

Step 2: Wiring connection.

The metal part of the cord end terminal on the wire can be direct wired to the terminal of LP-9x2x.



2.4. Console Port Connection

The LinPAC AM335x PAC support remote connection from the 'Console' port. The user can follow below steps to connect to the LinPAC AM335x PAC.

Step 1: User can choose the software (Putty or others) through the 'Console' to connect the LinPAC AM335x PAC.

Step 2: If user chose the 'Console', user can set the baud rate '115200' to connect the device. (Refer to the Figure 2.4-1)

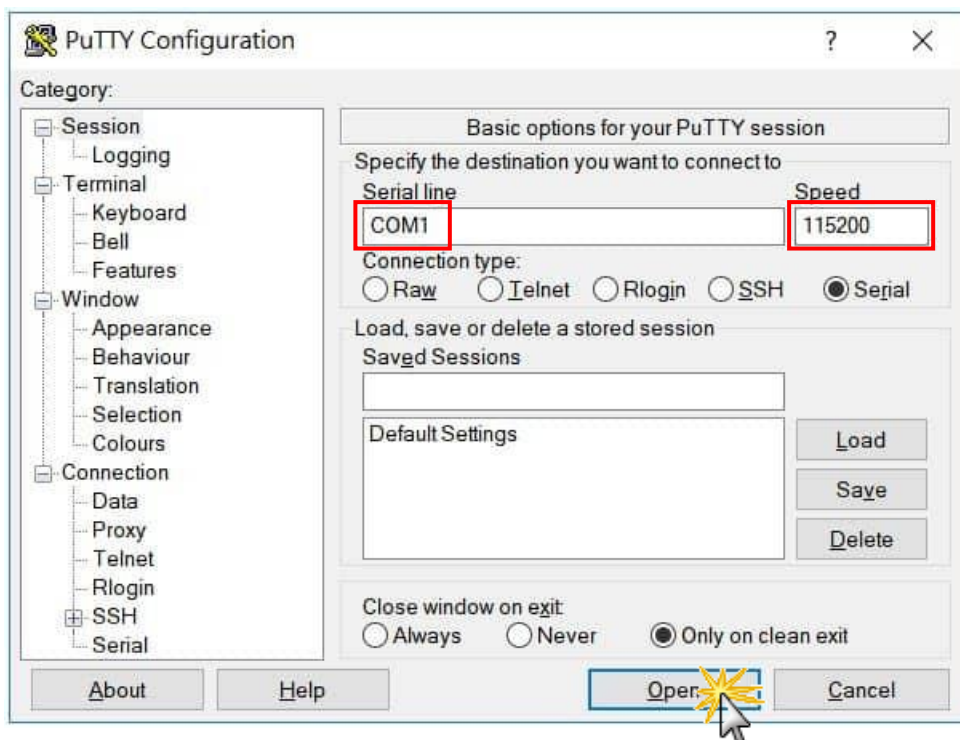


Figure 2.4-1. Console connection

Step 3: After user connect to the LinPAC AM335x PAC from the 'Console' port, user can input default ID 'root' and password 'icpdas' to login.

2.5. LAN1/LAN2 Network Configuration

After logging into the LinPAC AM335x PAC successfully, the user can use `'ifconfig'` command to get the IP address of LAN1/LAN2. The LAN 1/2 of factory setting use DHCP. If user would prefer to setup the IP address for static mode, the following steps for reference:

Step 1: Using the Linux command `'vi'` to modify the file `'/etc/network/interfaces'`.

Step 2: Using the `'#'` to mark the default configuration.

Remove the `'#'` comment from each line in the static IP block and comment out the DHCP block by adding `'#'` to each entry. Entry the relevant IP, Netmask and Gateway details in the respective Assign IP block entries. (Refer to the Figure 2.5-1)

```
#auto lo
#iface lo inet loopback
auto eth0 eth1
# Enable dhcp on eth0
#iface eth0 inet dhcp
#iface eth1 inet dhcp
#iface wlan0 inet dhcp
#iface ppp0 inet dhcp

# Or unmark following lines and modify the ip configuration to enable ethernet
iface eth0 inet static
    address 10.1.0.75
    netmask 255.255.255.0
    gateway 10.1.0.254
iface eth1 inet static
    address 10.1.0.62
    netmask 255.255.255.0
    gateway 10.1.0.254
```

Using '#' to mark the eth0/eth1's factory setting "dhcp"

Figure 2.5-1. Network configuration

Step 3: Restart networking in LinPAC.

After user save the file and use `'reboot'` command to reset the device or type the command `"/etc/init.d/networking restart"`, user can use the new network configuration on LinPAC AM335x PAC.

2.6. LAN1/LAN2 Network Connection

The user can use 'ifconfig' command to get the IP address of LAN1/LAN2 and the SSH client software (Putty or others) to connect the LinPAC AM335x PAC.

Step 1: Using 'ifconfig' command to check the IP address of LAN1/2. (Refer to the Figure 2.6-1)

```
root@icpdas:~# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0d:e0:6e:08:16
          inet addr:10.1.0.75  Bcast:10.1.255.255  Mask:255.255.0.0
          inet6 addr: fe80::20d:e0ff:fe6e:816/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:593929 errors:0 dropped:0 overruns:0 frame:0
          TX packets:8928 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:39831066 (39.8 MB)  TX bytes:5713563 (5.7 MB)
          Interrupt:17 Memory:febe0000-fec00000
eth1      Link encap:Ethernet  HWaddr 00:0d:e0:b0:97:0b
          inet addr:10.1.0.62  Bcast:10.1.255.255  Mask:255.255.0.0
          inet6 addr: fe80::20d:e0ff:feb0:970b/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:587861 errors:0 dropped:1 overruns:0 frame:0
          TX packets:36 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:28616065 (28.6 MB)  TX bytes:7795 (7.7 KB)
```

Figure 2.6-1. Typing 'ifconfig' command to check the IP address

Step 2: User can use SSH client software (Putty or others) to connect the LinPAC. (Refer to the Figure 2.6-2)

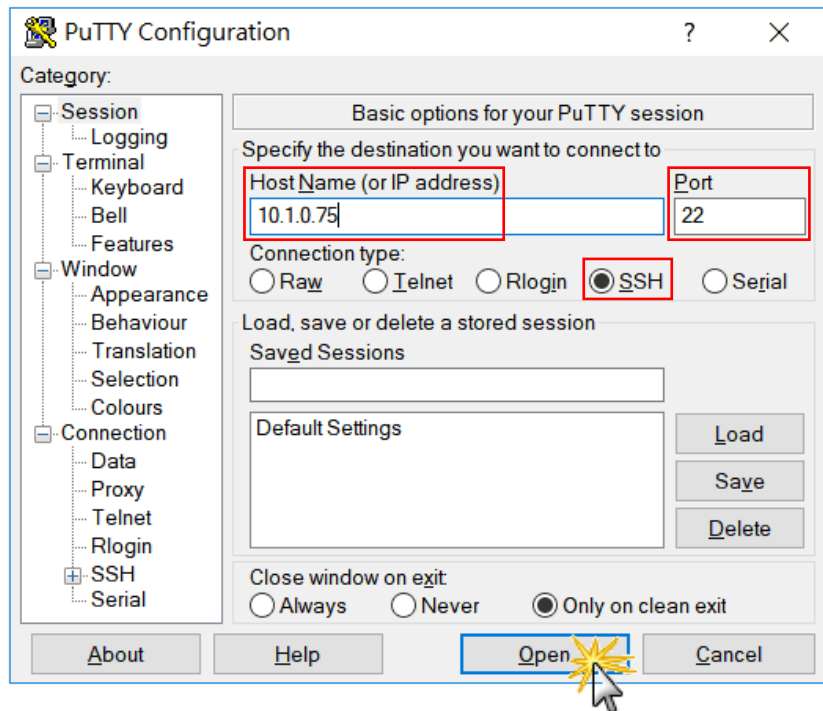


Figure 2.6-2. Using 'Putty' utility to connect the LinPAC

2.7. Overview of the Serial Ports

The following is a description of the functionality for the three serial ports contained in the LinPAC AM335x series embedded controller, and are based on the RS-232 or RS-485 interfaces.

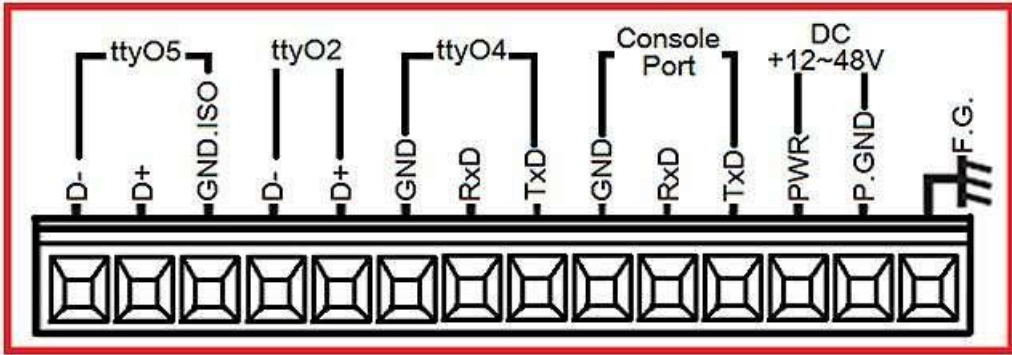
2.7.1. Introduction to Serial port for LP-22xx

The following illustrates the ports contained on the LP-22xx. The information is organized as follows table:

Device name	Definition in LP-22xx SDK	Description	Default Baud rate
-	<code>/dev/ttyO1</code> or COM1	Internal communication with the XV-board modules	115200
-	Console port	RS-232 (RxD, TxD and GND); Non-isolated	115200
ttyO4	<code>/dev/ttyO4</code> or COM4	RS-232 (RxD, TxD and GND); Non-isolated	9600
ttyO2	<code>/dev/ttyO2</code> or COM2	RS-485 (Data+, Data-); Non-isolated	9600
ttyO5	<code>/dev/ttyO5</code> or COM5	RS-485 (Data+, Data-); 2500 VDC isolated	9600

2.7.2. Introduction to Serial port for LP-52xx

The following illustrates the ports contained on the LP-52xx. The information is organized as follows table:



Device name	Definition in LP-52xx SDK	Description	Default Baud rate
-	<code>/dev/ttyO1</code> or COM1	Internal communication with the XV-board modules	115200
-	Console port	RS-232 (RxD, TxD and GND); Non-isolated	115200
ttyO4	<code>/dev/ttyO4</code> or COM4	RS-232 (RxD, TxD and GND); Non-isolated	9600
ttyO2	<code>/dev/ttyO2</code> or COM2	RS-485 (Data+, Data-); Non-isolated	9600
ttyO5	<code>/dev/ttyO5</code> or COM5	RS-485 (Data+, Data-); 2500 VDC isolated	9600

2.7.3. Introduction to Serial port for LP-8x2x

Figure 2.7.3-1 illustrates the ports contained on the LP-8821 and Figure 2.7.3-2 illustrates those on the LP-8121. The information is organized as follows:

- ttyO4– Internal communication with the I-87KW modules in slots
- ttyO5 – RS-232 (RxD, TxD and GND); Non-isolation; Console
- ttyS0 – RS-485 (D2+, D2-; self-tuner ASIC inside)
- ttyS1 – RS-232/RS-485
(RXD, TXD, CTS, RTS and GND for RS-232, Data+ and Data- for RS-485)
- ttyS34 – RS-232 (RXD, TXD, CTS, RTS, DSR, DTR, CD, RI and GND)

Device name	Definition in LP-8x21 SDK	Default baudrate
ttyO4	COM1	115200
ttyO5 (RS-232/console)	None	115200
ttyS0 (RS-485)	COM2	9600
ttyS1 (RS-232/485)	COM3 (LP-8421/8821 only)	9600
ttyS34 (RS-232)	COM36 (LP-8421/8821 only)	9600

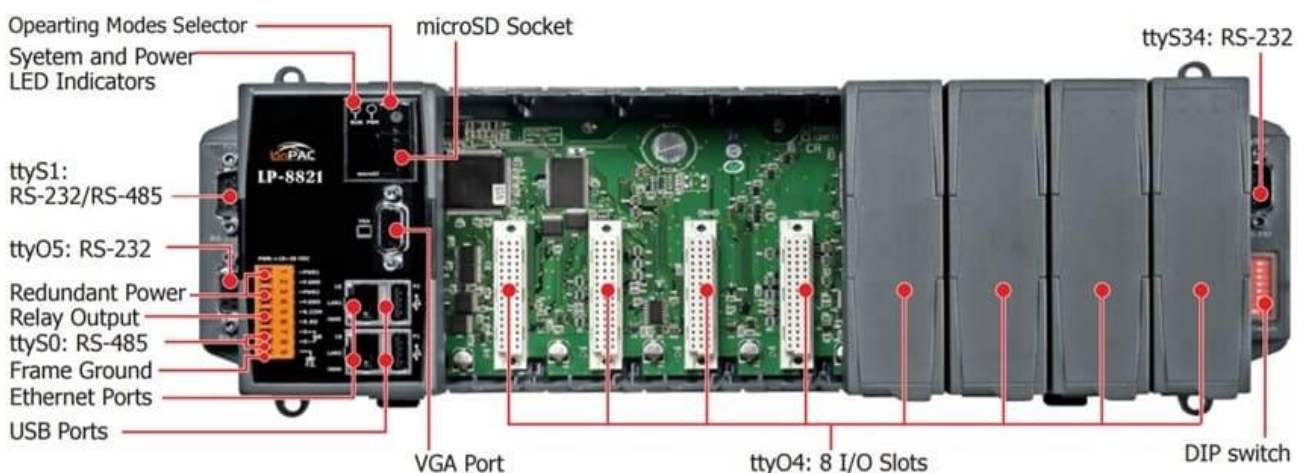


Figure 2.7.3-1. Serial port mapping on the LP-8821

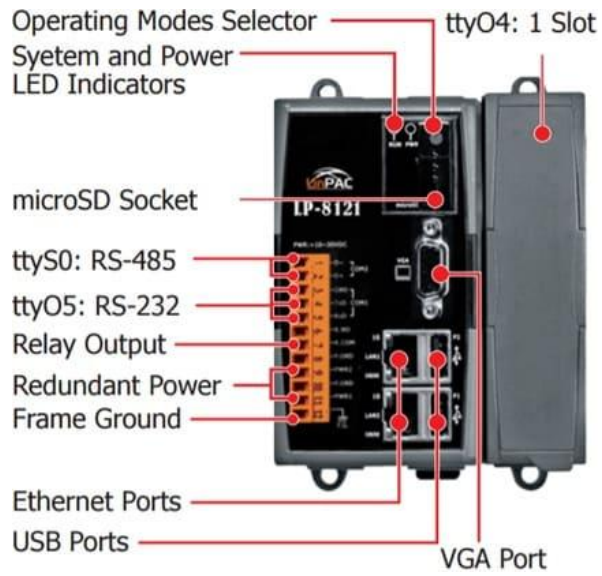


Figure 2.7.3-2. Serial port mapping on the LP-8121

2.7.4. Introduction to Serial port for LP-9x2x

Figure 2.7.4-1 illustrates the ports contained on the LP-9821. The information is organized as follows:

- ttyO4– Internal communication with the I-97KW modules in slots
- ttyO5 – RS-232/RS-485; Non-isolation; Console
- ttyS0 – RS-485 (D2+, D2-; self-tuner ASIC inside)
- ttyS1 – RS-232/RS-485
(RXD, TXD, CTS, RTS and GND for RS-232, Data+ and Data- for RS-485)
- ttyS34 – RS-232 (RXD, TXD, CTS, RTS, DSR, DTR, CD, RI and GND)

Device name	Definition in LP-9x21 SDK	Default baudrate
ttyO4	COM1	115200
ttyO5 (RS-232/485/console)	None	115200
ttyS0 (RS-485)	COM2	9600
ttyS1 (RS-232/485)	COM3 (LP-9421/9821 only)	9600
ttyS34 (RS-232)	COM36 (LP-9421/9821 only)	9600

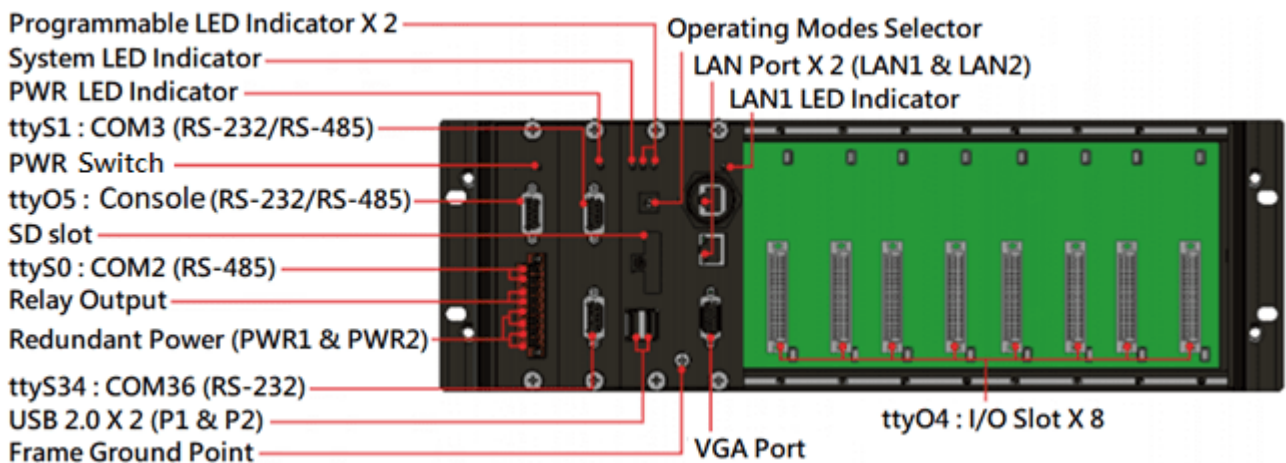


Figure 2.7.4-1. Serial port mapping on the LP-9821

2.7.5. Accessing the common serial ports

2.7.5.1. Internal communication for COM1 port

The COM1 port is an internal I/O expansion port on the LinPAC and is used to connect to the series module inserted into the LinPAC embedded controller. The I-87K, I-97K and XV-board series is based on a serial interface, which is provided for combining a variety of I/O function within the LP-8x2x, LP-9x2x and LP-22xx/52xx controllers. The differences between the three series are listed as follows:

- ❑ I-87K series can used with LP-8x2x, visit to this website:
http://www.icpdas.com/root/product/solutions/remote_io/rs-485/i-8k_i-87k/i-8k_i-87k_dio.html
- ❑ I-97K series can used with LP-9x2x, visit to this website:
http://www.icpdas.com/root/product/solutions/remote_io/i-9k_i-97k/i-9k_i-97k_aio.html
- ❑ XV-board series can used with LP-22xx/52xx, visit to this website:
http://www.icpdas.com/root/product/solutions/hmi_touch_monitor/touchpad/xv-board_selection.html

A serial command must be used to control the I-87KW/97K series module. For more information about serial command usage, see the chapter [3.2. i-Talk Utility](#).

To control the series module, the Com port parameters and call the **Open_Com()** function to open the COM1 port based on the appropriate settings. Finally, call the **ChangeToSlot(slot)** function to specify which slot will be controlled, the **I-87KW/97K** series could be necessary.

This is like the serial address, meaning that control commands can be sent to an I/O module that is inserted in the specified slot. Consequently, **the serial address for the slot that contains the module is 0**. A detailed example is provided below:

For Example:

```
int slot=1; char data=8, parity=0, stopbit=1 ;  
unsigned char port=1; // for all modules in COM1 port of LP-8x21
```



```

DWORD baudrate=115200;
Open_Slot(slot);
Open_Com(port, baudrate, data, parity, stopbit);
ChangeSlotToI-87k(slot);
// send command...
Close_Com(port);
Close_Slot(slot);

```

2.7.5.2. RS-232 port

The following is RS-232 serial port for the LP-22xx, LP-52xx, LP-8x2x and LP-9x2x, as illustrated in Figures 2.7.5.2-1, 2.7.5.2-2 and 2.7.5.2-3 below.

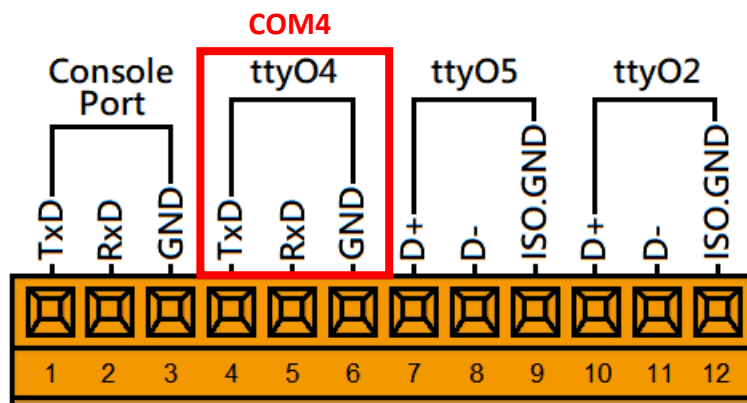


Figure 2.7.5.2-1. COM4 serial port for the LP-22xx

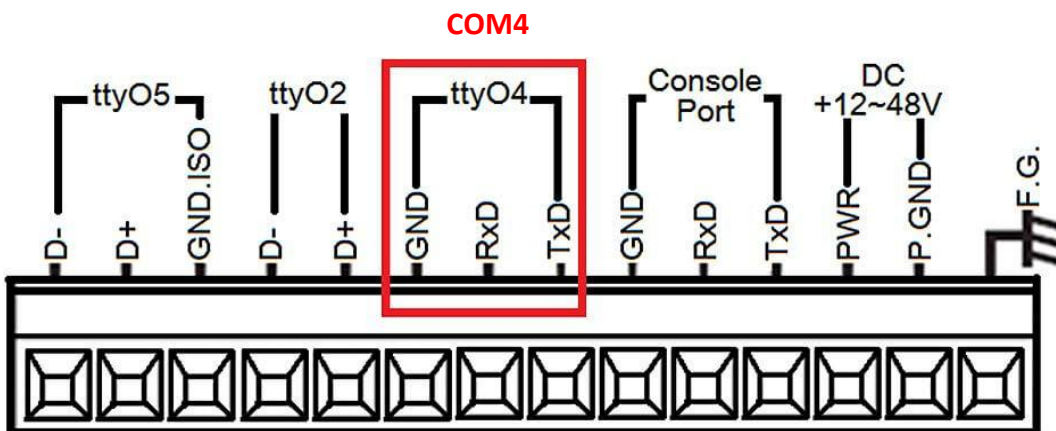


Figure 2.7.5.2-2. COM4 serial port for the LP-52xx

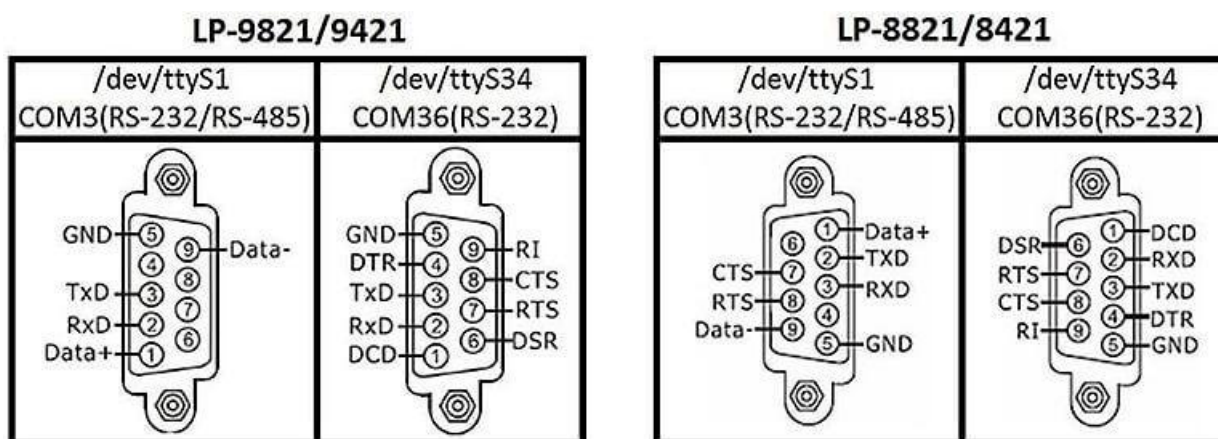


Figure 2.7.5.2-3. COM3 and COM36 serial port for the LP-8x2x/9x2x

This `/dev/ttyS1`, `/dev/ttyS34` or `/dev/ttyO4` port is located on the right-upper corner on the LP-22xx, LP-52xx, LP-8x2x and LP-9x2x and is a standard **RS-232** serial port that provides TxD, RxD, RTS, CTS, GND, non-isolated and a maximum speed of 115200 bps.

The RS-232 port can also be used to connect to an I-7520 module in order to provide general RS-485 communication functionality, and also can be used to connect to a wireless modem so that the module controlled from a remote device. The application example and code is demonstrated below:

➤ Test using C language:

```

unsigned char port=3;
DWORD baudrate=9600;
char data=8;
char parity=0;
char stopbit=1;
Open_Com(port, baudrate, data, parity, stopbit);
// Send a command...
Close_Com(port);

```

➤ Test using the command line interface: (PC connected to `/dev/ttyS1` on the LP-8x21- see Figure 2.7.5.2-4)

(A) Open 'Hyper Terminal' on the Host PC to monitor the test process. The default settings for COM3 port are 9600, 8, N, 1

(B) Send data via /dev/ttyS1 port:

On the LP-8x21:

Type the command: `echo send-232 >/dev/ttyS1`

Check that the word 'send-232' is displayed on the 'Hyper Terminal' screen on the PC

(C) Receive data via the /dev/ttyS1 port:

On the LP-8x21:

Type the command: `cat /dev/ttyS1`

On the PC:

Enter some text in the 'Hyper Terminal' screen on the PC

Check that the some words on the LP-8x21.

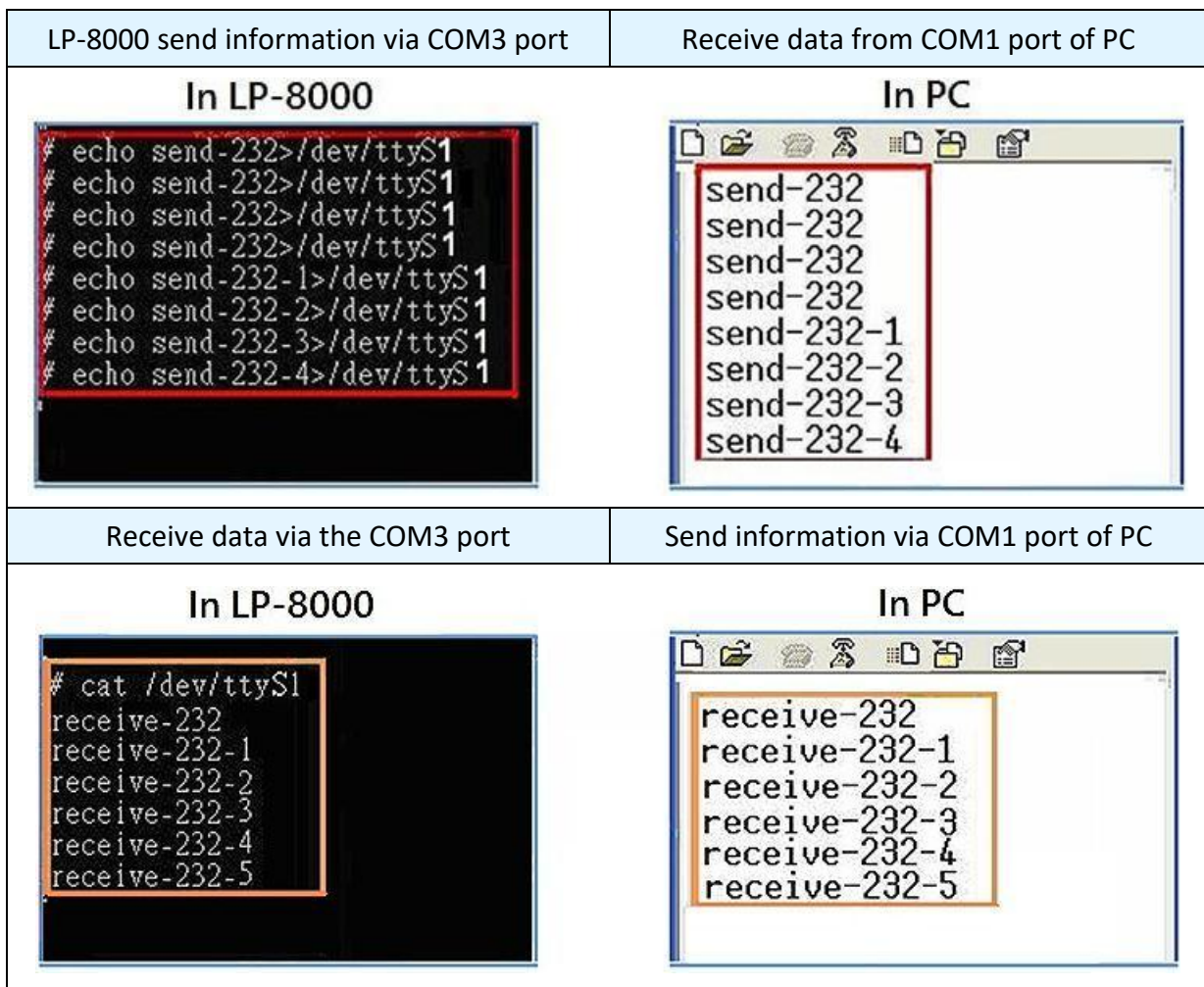


Figure 2.7.5.2-4. Using the command line to test

2.7.5.3. RS-485 port

The following is 2-wire RS-485 serial port for the LP-22xx, LP-52xx, LP-8x2x and LP-9x2x, as illustrated in Figures 2.7.5.3-1, 2.7.5.3-2 and 2.7.5.3-4 below.

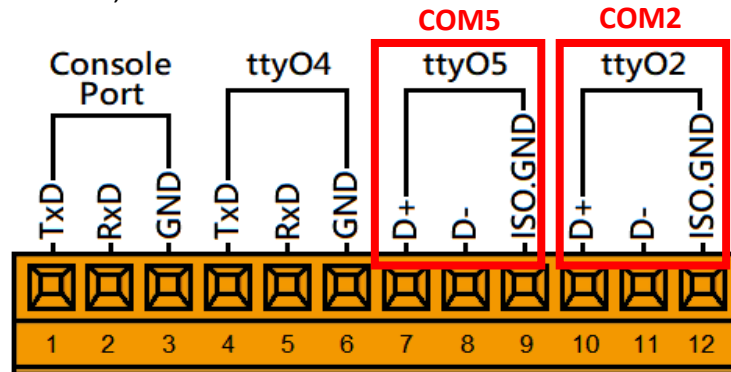


Figure 2.7.5.3-1. RS-485 connections of COM2 and COM5 for LP-22xx

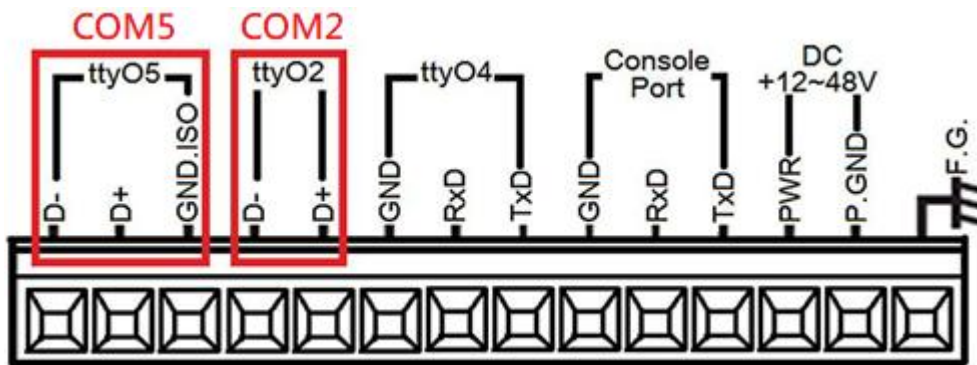


Figure 2.7.5.3-2. RS-485 connections of COM2 and COM5 for LP-52xx

Use the 'setexdo' command to set digital output value to a serial module. (Refer to Figure 2.7.5.3-3)

```

root@LP-5231
root@LP-5231:~# ./getsendreceive 0 2 1 '$01M' 115200
1017060 root@LP-5231:~#
root@LP-5231:~# chmod 777 setexdo
root@LP-5231:~# ./setexdo
ICPDAS iTalk utility v15
function : setexdo
Set digital output value to a module
Usage: setexdo slot 1 data
      setexdo slot comport data baudrate address
Example 1:setexdo 2 1 55
Set the dec digital output value to the module at slot 2
Example 2:setexdo 0 3 55 9600 2
Set the dec digital output value to the module at COM3
root@LP-5231:~# ./setexdo 0 2 2 115200 1
root@LP-5231:~# ./setexdo 0 2 1 115200 1
root@LP-5231:~#
  
```

Figure 2.7.5.3-3. Using the command line to test on LP-5231

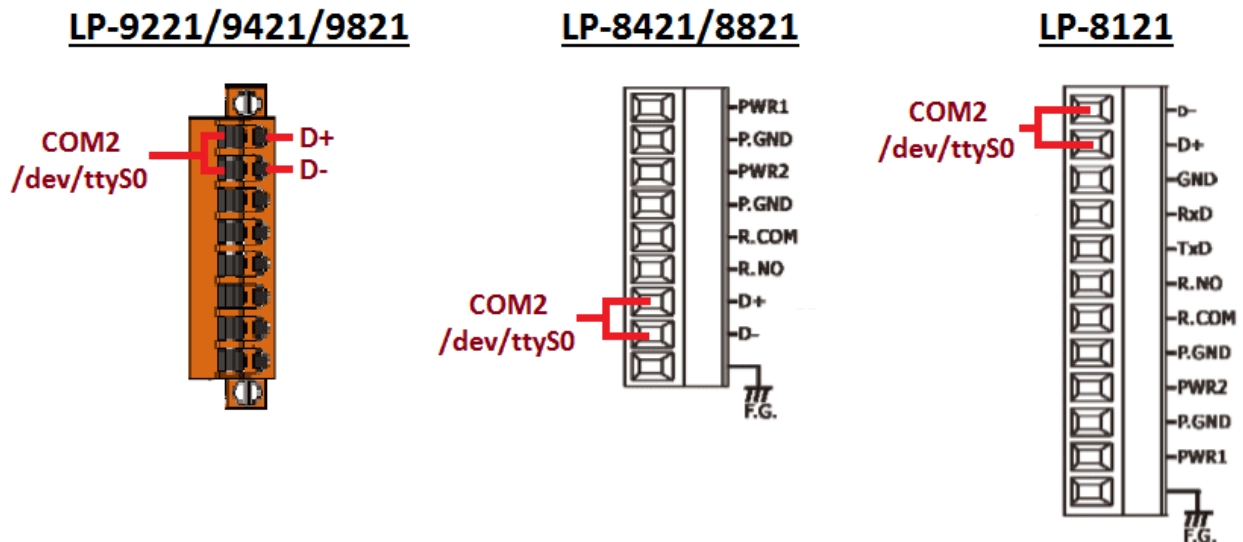


Figure 2.7.5.3-4. RS-485 connections of COM2 for LP-8x2x/9x2x

This port provides **RS-485** serial communication functionality (DATA+ and DATA-) and is located on the bottom-right corner on the LP-22xx, LP-52xx, LP-8x2x and LP-9x2x. This port allows a connection to be made to modules that contain an RS-485 interface such as the I-7000 serial modules (DCON Module), meaning that ICP DAS I/O series modules can be directly controlled via this port with any converter. ICP DAS provides a very easy to use library of functions (libi8k.a) that can use to easily communicate with I-7000, I-8000, I-9000, I-87k and I-97k series modules. Below is an application example of the program code demo.

➤ Test using C language:

```
unsigned char port=36;
DWORD baudrate=9600;
char data=8, parity=0, stopbit=1;
Open_Com(port, baudrate, data, char parity, stopbit);
// send command...
```

➤ Test using command line: (PC <--> i-7520 <--> /dev/ttyS on the LP-8x21 - see Figure 2.7.5.3-5)

(A) Open '**Hyper Terminal**' on the Host PC to monitor the test process. The default settings for the /dev/ttyS0 port are 9600, 8, N, 1

(B) Send data via /dev/ttyS0 port:

On the LP-8x21:

Type command: **echo send-485 >/dev/ttyS0**

Check that the word 'send-485' is displayed on the 'Hyper Terminal' screen on the PC.

(C) Receive data via the /dev/ttyS0 port:

On the LP-8x21:

Type the command: **cat /dev/ttyS0**

On the PC:

Enter some words in the 'Hyper Terminal' screen on the PC

Check that the same text displayed on the LP-8x21.

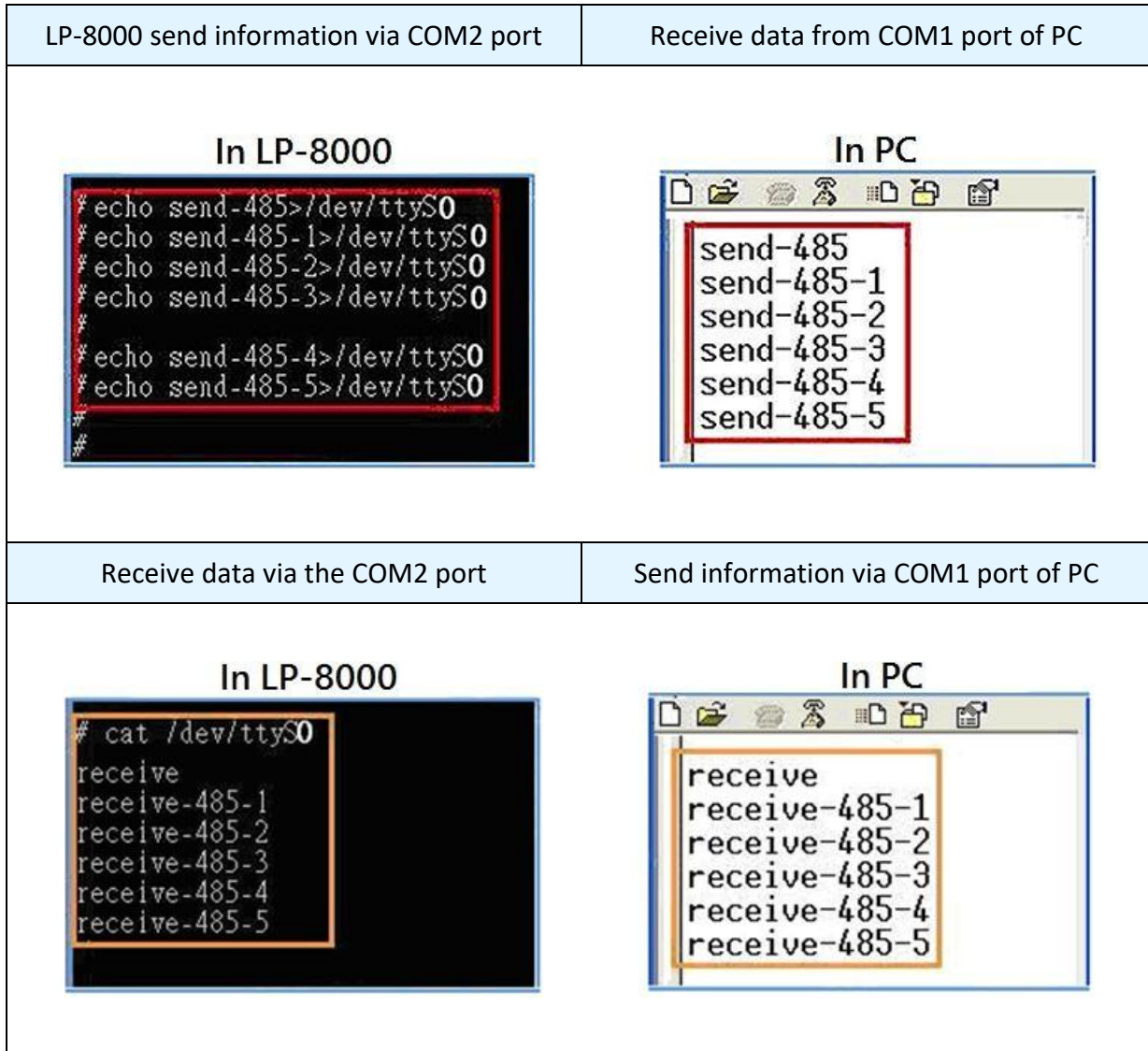


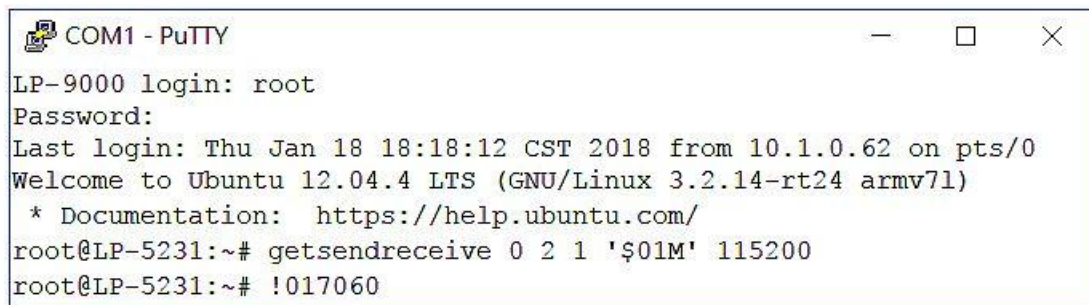
Figure 2.7.5.3-5. Using the command line to test

2.7.6. Serial Port configuration

Use the **'stty'** command to query or configure the COM port. For example, to modify the baud rate 9600 to 115200 bps via **/dev/ttyS1** port:

```
# stty -F /dev/ttyS1 ispeed 115200 ospeed 115200
```

Use the **'getsendreceive'** command to query or configure the COM port. (Refer to Figure 2.7.6-1) For example, the I-7060 module is connected with COM2 port of the LP-9x2x, and sending the command **'\$01M'** to query the module name which baud rate is 115200 bps connect with **/dev/ttyS0** port, it will get a response: **'!017060'**.



```
COM1 - PuTTY
LP-9000 login: root
Password:
Last login: Thu Jan 18 18:18:12 CST 2018 from 10.1.0.62 on pts/0
Welcome to Ubuntu 12.04.4 LTS (GNU/Linux 3.2.14-rt24 armv7l)
 * Documentation:  https://help.ubuntu.com/
root@LP-5231:~# getsendreceive 0 2 1 '$01M' 115200
root@LP-5231:~# !017060
```

Figure 2.7.6-1. Use the **'getsendreceive'** command to query or configure the COM port

3. Instructions for LinPAC AM335x PAC

This chapter provides a brief introduction of the LinPAC AM335x PAC service tools and its benefits. There are several tools and utilities built-in and designed for use with LinPAC AM335x PAC. Some of these are pre-installed on LinPAC AM335x PAC and can work directly on LinPAC AM335x PAC, and some of these are supporting tools and can help you to manage the LinPAC AM335x PAC remotely on a PC.

3.1. Basic Linux Command

The Linux basic command can be used to set Linux OS or get system information in the LinPAC AM335x PAC. This section provides an introduction to some of the more commonly used Linux instructions. These Linux instructions are similar to those used in DOS and are generally expressed in lower case letters.

3.1.1. ls: lists the file information (Equivalent DOS Command: dir)

Parameter	Description	Example
-l	Lists detailed information related to the files	ls -l
-a	Lists all files, including hidden files	ls -a
-t	Lists the files arranged in date/time order	ls -t

3.1.2. cd directory: Changes directory (Equivalent DOS Command: cd)

Parameter	Description	Example
..	Move to the parent directory	cd ..
~	Move back to the root directory	cd ~
/	Path component separator	cd /root/i8k

3.1.3. mkdir: creates a subdirectory (Equivalent DOS Command: md)

Parameter	Description	Example
-p	No error if the subdirectory exists, and creates the parent directories as needed	mkdir -p directory

3.1.4. rmdir: deletes the subdirectory which must be empty (Equivalent DOS Command: rd)

Parameter	Description	Example
-p	Removes the specified DIRECTORY, then attempts to remove each parent directory component with the same path name	rmdir -p directory

3.1.5. rm: deletes (removes) the file or directory (Equivalent DOS Command: delete)

Parameter	Description	Example
-i	Displays a warning message before deleting	rm -i test.exe
-r	Deletes the directory even if it isn't empty	rm -r test.exe
-f	No warning message displayed when deleting	rm -f test.exe

3.1.6. cp: copies one or more files (Equivalent DOS Command: copy)

Parameter	Description	Example
-R	Performs a recursive copy	cp -R test bak
-i	Displays a confirmation prompt before overwriting	cp -i test bak
-l	Links the files instead of copying them	cp -l test bak

3.1.7. mv: moves or renames a file or directory (Equivalent DOS Command: move)

Parameter	Description	Example
-f	Does not display a confirmation prompt before overwriting	cp -f sour des
-i	Displays a confirmation prompt before overwriting	cp -i /sour /des

3.1.8. pwd: displays the full path of the current working directory

3.1.9. who: displays a list of the users current logged on

3.1.10. chmod: changes the access permissions for a file

Syntax: chmod ??? file → ??? means owner: group: all users

For example: chmod 754 test.exe

7 5 4 → 111 (read, write, execute)

101 (read, write, execute)

100 (read, write, execute)

The first number 7: the **owner** can read and write and execute files

The second number 5: the **group** can only read and execute files

The third number 4: **all users** can only read files

3.1.11. uname: displays the Linux version information

3.1.12. ps: displays a list of the currently active procedures

3.1.13. ftp: transfers a file using the file transfer protocol (FTP)

Syntax: ftp IPAddress (Example: ftp 192.168.0.200 → connect to ftp server)

Syntax	Description
!	temporarily exits the FTP
exit	back to the ftp
bin	transfers files in 'binary' mode
get	downloads a file from the LinPAC to the Host (For example: get /mnt/hda/test.exe c:/test.exe)
put	uploads a file from the host to the LinPAC (For example: put c:/test.exe /mnt/hda/test.exe)
bye	exits FTP

3.1.14. telnet: establishes a connection to another PC via Telnet terminal

Syntax: telnet IPAddress

For example telnet 192.168.0.200 (will allow remote control of the LinPAC AM335x PAC)

3.1.15. date: prints or sets the system date and time

3.1.16. hwclock: queries and sets the hardware clock (RTC)

Parameter	Description	Example
-r	Reads the hardware clock and prints the time on a standard output.	hwclock -r
-w	Sets the hardware clock to the current system time	hwclock -w

3.1.17. netstat: displays the current state of the network

Parameters: [-a]: list all states (For example: netstat -a)

3.1.18. ifconfig: displays the ip and network mask information (Equivalent DOS Command: ipconfig)

3.1.19. ping: used to test whether the host in a network is reachable

Syntax: ping IPAddress

For example ping 192.168.0.1

3.1.20. clear: clears the screen

3.1.21. passwd: used to change the password

3.1.22. reboot: reboots the LinPAC (or use 'shutdown -r now')

3.1.23. wget: get the file from the web link

Syntax: wget [option] [URL]

For example:

wget http://ftp.icpdas.com/pub/cd/linpac/napdos/lx-series/sdk/linpac_x86_sdk.tgz

Note: Using static IP address may have to be configured in the '/etc/resolv.conf' file.

At the Command Prompt, edit the [/etc/resolv.conf](#) file by modifying the settings.

For example:

nameserver 10.0.0.3

nameserver 10.0.0.9

search icpdas.com

```
root@LP-9000: ~
# Dynamic resolv.conf(5) file for glibc resolver(3) generated by resolvconf(8)
#     DO NOT EDIT THIS FILE BY HAND -- YOUR CHANGES WILL BE OVERWRITTEN
nameserver 10.0.0.3
nameserver 10.0.0.9
search icpdas.com
~
~
"/etc/resolv.conf" 5 lines, 209 characters
```

3.1.24. update-rc.d: install and remove System-V style init script links

update-rc.d [-n] name defaults (Example: update-rc.d hello defaults)

update-rc.d [-n] [-f] name remove (Example: update-rc.d -f hello remove)

3.2. i-Talk Utility

The **i-Talk utility** can make the convenient for users to access the modules and hardware in the LinPAC AM335x PAC and can be found in the path `/usr/sbin/iTalk`. An overview of the i-Talk utility functions is given below:

■ LP-8x2x/9x2x

Instruction	Description
getlist	Lists the names of all modules inserted in the LP-8x2x/9x2x
setdo	Sets the Digital Output value for I-8K modules
getdi	Reads the Digital Input value for I-8K/9K modules
setport	Sets the Port offset value for the module
getport	Reads the Port offset value for the module
getsendreceive	Send ASCII command and wait response from a serial
getreceive	Get ASCII response from a serial module
getmrtu	Send a Modbus/RTU command and wait for a response from a serial module
getmtcp	Send a Modbus/TCP command and wait for a response from a serial module
getmasc	Send a Modbus/ASC command and wait for a response from a serial module
getpactype	List the FPGA version (Shown as '0x82' on the LP-8x21, and '0x93' on the LP-9x21)
wdt	Set the WatchDog Timer (WDT) for the LP-8x2x/9x2x

Below table lists the demos that show how to use the I-talk utility. In the demo, the I-8024W (**AO Module**), I-8017HW (**AI Module**) and I-8055W (**DIO Module**) are all used and they are plugged into the slots 1, 2 and 3 of the LinPAC separately. Typing the name of the instruction will display usage details for the instruction.

Instruction	Example
getlist	<i>getlist</i> Lists the names of all modules inserted in the LinPAC-8x2x/9x2x
setdo	<i>setdo {slot} {data}</i> setdo 3 3 Sets channels 1 and 2 on the I-8055W module to ON
getdi	<i>getdi {slot} {type}</i> getdi 3 8 Reads the 8-bit Digital Input value from the I-8055W module
setport	<i>setport {slot} {offset} {data}</i> setport 1 0 20 Set the dec value 20 to offset 0 of slot 1
getport	<i>getport {slot} {offset}</i> getport 1 0 Get the dec value from offset 0 of slot 1
getsendreceive	<i>getsendreceive {slot} {1} {timeout} {command}</i> getsendreceive 2 1 1 '\$00M' Send command \$00M to the module at slot 2 and wait response <i>getsendreceive {slot} {comport} {timeout} {command} {baudrate}</i> getsendreceive 0 3 1 '\$01M' 9600 Send command \$01M to the module at COM3 and wait response
getreceive	<i>getreceive {slot} {comport} {timeout} {baudrate} {format}</i> getreceive 0 2 5 9600 8n1 Get response from the module at COM2 with 8n1 format in 0.5s

■ LP-22xx/52xx

Instruction	Description
setxvdo	Set digital output value to XV-Board
setxvao	Set analog output value to XV-Board
getxvdi	Get digital input value from XV-Board
getxvai	Get analog input value from XV-Board
getxvdo	Get digital output value from XV-Board
getxvao	Get analog output value from XV-Board
setmodbus	Set a Modbus command to modbus device
getmodbus	Get the status of modbus device
Rsw	Get the rotary switch ID
Led	Set LED (L1~L2) for LP-52xx Set LED (L1~L3) for LP-22xx

4. Getting started with the LinPAC AM335x SDK

The 'LinPAC_AM335x SDK' is a development toolkit provided by ICP DAS, which can be used to easily develop custom applications for the LP-22xx/52xx/8x2x/9x2x embedded controller platform.

The toolkit consists of the following items:

- ❑ LinPAC_AM335x SDK (Linaro GCC toolchain, Libraries, header, examples files, etc.)
- ❑ Code:: Blocks project file (Windows platform only)
- ❑ Basic Linux commands (Windows platform only)

The topic provides LinPAC_AM335x SDK installation instructions for the following platforms:

- ❑ Linux (running a **32-bit** operating system)
 - ◆ Download/Install LinPAC_AM335x SDK on [Linux PC](#)
- ❑ Windows
 - ◆ Download/Install LinPAC_AM335x SDK on [Windows PC](#)
 - ◆ Integrating LinPAC_AM335x SDK with Code:: Blocks IDE

4.1. Introduction of the LinPAC AM335x SDK

This section will discuss some of the techniques that are adopted in the LinPAC_AM335x SDK, including detailed explanations that describe how to easily use the LinPAC_AM335x SDK. The LinPAC_AM335x SDK is based on Cygwin and is also a Linux-like environment for Microsoft Windows systems, and provides a powerful GCC cross-compiler and an IDE (Integrated Development Environment) that enables LinPAC_AM335x SDK applications to be quickly developed. Therefore, once an application has been created, the LinPAC_AM335x SDK can be used to compile it into an executable file that can be run on the LinPAC_AM335x SDK embedded controller.

Note:

1. The latest Linux AM335x SDK is integrate AM335x series SDK. Select the appropriate software for your controller.
2. The names of all the I/O module's API functions must begin with the prefix 'I8K'.
3. The I-8K and I-9K I/O modules using the same API function and examples.
4. More detailed information, user can refer to **readme.txt** file here:
C:\cygwin\LinPAC_am335x_SDK\examples\readme.txt file
or root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk/i8k/examples/readme.txt

4.1.1. Introduction to Cygwin

Cygwin is a collection of free software tools originally developed by Cygnus Solutions to allow various versions of Microsoft Windows to act somewhat like a UNIX system. Cygwin is a Linux-like environment for Windows consisting of two parts:

- (1) A DLL (cygwin1.dll) which acts as a Linux emulation layer providing substantial Linux API functionality.
- (2) A collection of tools that provide users with the Linux look and feel.

4.1.2. Introduction to Cross-Compilation

Generally, program compilation is performed by running a compiler on the build platform. The compiled program will then run on the target platform. Usually, these two processes are intended for use on the same platform. However, if the intended platform is different, the process is called **cross compilation**, where source code on one platform can be compiled into executable files to be used on other platforms. For example, if the 'arm-linux-gnueabi-gcc' cross-compiler is used on an x86 windows platform, the source code can be compiled into an executable file that can run on an arm-linux platform.

So why use cross compilation? In fact, cross compilation is sometimes more complicated than normal compilation, and errors are easier to make. Therefore, this method is often only employed if the program cannot be compiled on the target system, or if the program being compiled is so large that it requires more resources than the target system can provide. For many embedded systems, cross compilation is the only possible approach.

4.1.3. Download the LinPAC AM335x SDK

- For Windows systems:** Extract the .exe file into to the **C:\ driver**.
- For Linux systems:** Extract the .bz2 file into to the **root (/) directory**.

LinPAC	Download Path
LP-22xx/52xx	https://www.icpdas.com/en/download/show.php?num=1195&model=LP-5231M
LP-8x2x/9x2x	https://www.icpdas.com/en/download/show.php?num=915&model=LP-9821

Note:

- 1) We recommend user to change user ID to become **root** by 'sudo' or 'su' command.
- 2) Linux 64-bit operating system lacks 32-bit support libraries. If your Linux PC is 64-bit OS, you must install 32-bit libraries on your system before you run the 32-bit version of the LinPAC SDK (Linux version).

4.2. Quick Installation of the LinPAC AM335x SDK

4.2.1. Download/Install LinPAC AM335x SDK on Linux

1. To create a 'icpdas' folder in root directory, change the **root** user by 'sudo' or 'su' command.

(Refer to Figure 4.2.1-1)

```
root@LinuxPC-ICPDAS: /icpdas
root@LinuxPC-ICPDAS:/# pwd
/
root@LinuxPC-ICPDAS:/# mkdir icpdas
root@LinuxPC-ICPDAS:/# cd icpdas
root@LinuxPC-ICPDAS:/icpdas# ls
linpac_am335x_sdk_for_linux.tar.bz2
root@LinuxPC-ICPDAS:/icpdas#
```

Figure 4.2.1-1. Create a directory named 'icpdas'

2. Visit the ICP DAS website to download the latest version of the LinPAC_AM335x SDK, file name is 'linpac_am335x_sdk_for_linux.tar.bz2' (Refer to Figures 4.2.1-2 and 4.2.1-3).

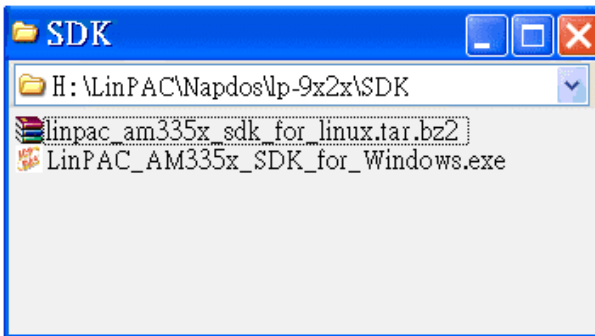


Figure 4.2.1-2.



Figure 4.2.1-3.

3. Try the 'tar' command to decompress file. (Refer to Figure 4.2.1-4)

```
root@LinuxPC-ICPDAS: /icpdas
root@LinuxPC-ICPDAS:/icpdas# tar jxvf linpac_am335x_sdk_for_linux.tar.bz2
linpac_am335x_sdk/
linpac_am335x_sdk/linpac_am335x.sh
linpac_am335x_sdk/tools/
linpac_am335x_sdk/tools/lib/
linpac_am335x_sdk/tools/lib/gcc/
linpac_am335x_sdk/tools/lib/gcc/arm-linux-gnueabihf/
linpac_am335x_sdk/tools/lib/gcc/arm-linux-gnueabihf/4.7.3/
linpac_am335x_sdk/tools/lib/gcc/arm-linux-gnueabihf/4.7.3/crtbeginS.o
linpac_am335x_sdk/tools/lib/gcc/arm-linux-gnueabihf/4.7.3/libgcc.a
```

Figure 4.2.1-4. Decompress 'tar.bz2' file

- Before compiling the program, you need to **set LinPAC_AM335x SDK path in environment variables**: using the provided environment variable script, which is called `linpac_am335x.sh` -- LP-8x2x and LP-9x2x for example (Refer to Figure 4.2.1-5).

```

root@LinuxPC-ICPDAS: /icpdas/linpac_am335x_sdk
root@LinuxPC-ICPDAS:/icpdas#
root@LinuxPC-ICPDAS:/icpdas# cd linpac_am335x_sdk
root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk# ls
i8k  linpac_am335x.sh  tools
root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk# . linpac_am335x.sh
root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk# export | grep PATH
declare -x PATH="/icpdas/linpac_am335x_sdk/tools/bin:/icpdas/linpac_am335x_sdk/tools/sbin:/usr/local/nosweb:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games"
root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk# ls i8k/
ChangeLog  examples  include  lib  opt
root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk#

```

Figure 4.2.1-5. Setting environment variables for LinPAC_AM335x SDK

- Type `'make'` on the command line it will execute the compile command according to the Makefile. (Refer to Figure 4.2.1-6)

```

root@LinuxPC-ICPDAS: /icpdas/linpac_am335x_sdk/i8k/examples
root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk/i8k/examples# make
arm-linux-gnueabi-gcc -I. -I../include -c -o xvboard/getxvai.o xvboard/getxvai.c
arm-linux-gnueabi-gcc -I. -I../include -o ./xvboard/getxvai ./xvboard/getxvai.o ../lib/libi8k.a -lm
rm -f ./xvboard/getxvai.o
arm-linux-gnueabi-gcc -I. -I../include -c -o xvboard/getxvao.o xvboard/getxvao.c
arm-linux-gnueabi-gcc -I. -I../include -o ./xvboard/getxvao ./xvboard/getxvao.o ../lib/libi8k.a -lm
rm -f ./xvboard/getxvao.o
arm-linux-gnueabi-gcc -I. -I../include -c -o xvboard/getxvdi.o xvboard/getxvdi.c
arm-linux-gnueabi-gcc -I. -I../include -o ./xvboard/getxvdi ./xvboard/getxvdi.o ../lib/libi8k.a -lm
rm -f ./xvboard/getxvdi.o
arm-linux-gnueabi-gcc -I. -I../include -c -o xvboard/getxvdo.o xvboard/getxvdo.c
arm-linux-gnueabi-gcc -I. -I../include -o ./xvboard/getxvdo ./xvboard/getxvdo.o ../lib/libi8k.a -lm
rm -f ./xvboard/getxvdo.o
arm-linux-gnueabi-gcc -I. -I../include
arm-linux-gnueabi-gcc -I. -I../inc
k.a -lm

```

Figure 4.2.1-6. Compiling demo code according to the Makefile

4.2.2. Download/Install LinPAC AM335x SDK on Windows

The LinPAC_AM335x_SDK_for_Windows.exe provides compilers, library, header, examples, and IDE workspace file (for Code::Blocks project).

- ❑ Open the SDK folder and double-click the icon for the 'LinPAC_AM335x_SDK_for_Windows.exe' file, when the Setup Wizard is displayed, click the 'Next>' button to continue, refer to Figures 4.2.2-1 and 4.2.2-2.

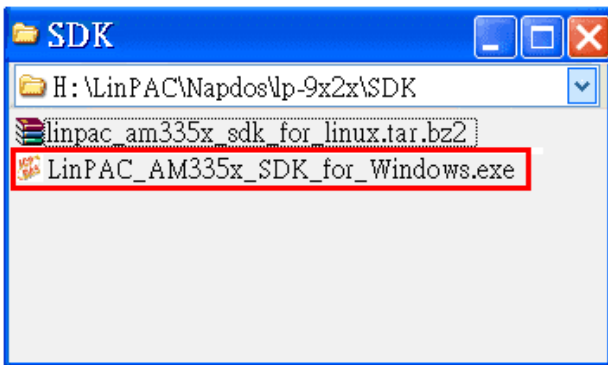


Figure 4.2.2-1.

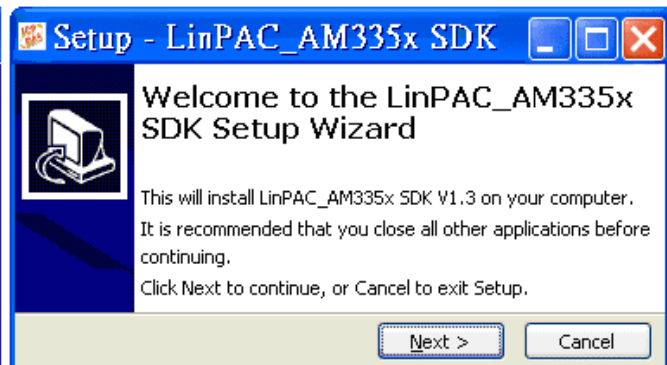


Figure 4.2.2-2.

- ❑ Click the 'I accept the agreement' option and then click the 'Next' button (refer to Figure 4.2.2-3), and select Start Menu Folder option and then click the 'Next' button, refer to Figure 4.2.2-4.

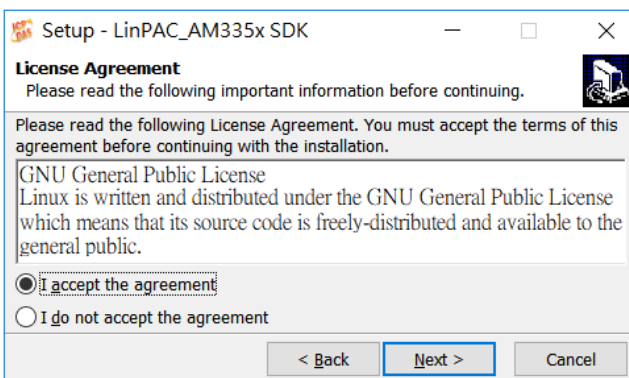


Figure 4.2.2-3.

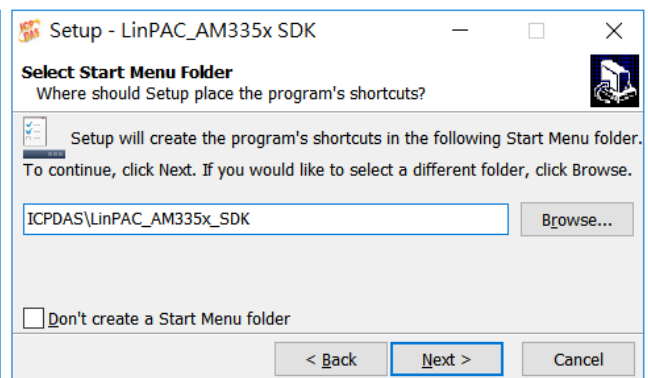


Figure 4.2.2-4.

- ❑ The LinPAC_AM335x SDK files will be extracted and installed and a progress bar will be displayed to indicate the status, refer to Figure 4.2.2-5.

- ❑ Once the software has been successfully installed, click the 'Finish' button to complete the development toolkit installation, refer to Figure 4.2.2-6.

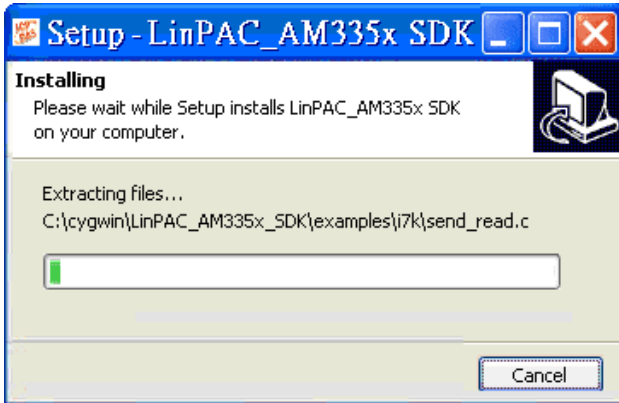


Figure 4.2.2-5.

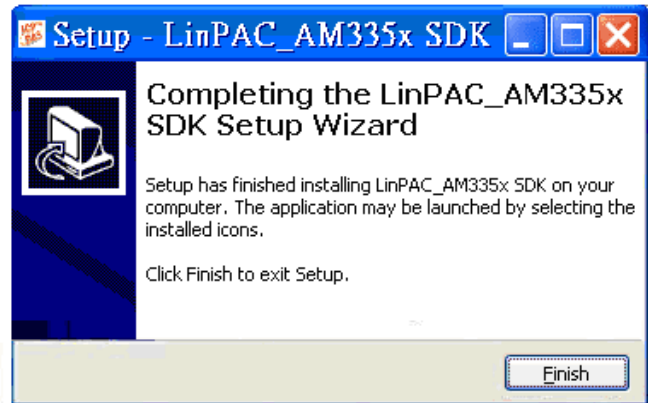


Figure 4.2.2-6.

- ❑ Open the LinPAC_AM335x SDK installation directory, the default data directory location is 'C:\cygwin\', the user can see the contents of the folder. Refer to Figures 4.2.2-7 and 4.2.2-8.



Figure 4.2.2-7.

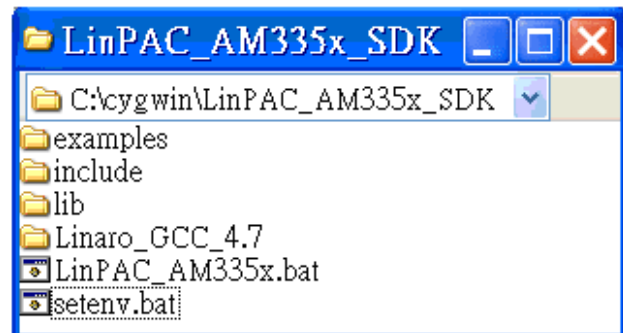


Figure 4.2.2-8.

- ❑ From the desktop, double-click the shortcut icon for the 'LinPAC_AM335x Build Environment' or click the 'Start' > 'Programs' > 'ICPDAS' > 'LinPAC_AM335x_SDK' > 'LinPAC_AM335x Build Environment'.

A Command Prompt window will then be displayed that allows applications for the LinPAC_AM335x to be compiled. Refer to Figures 4.2.2-9 and 4.2.2-10.

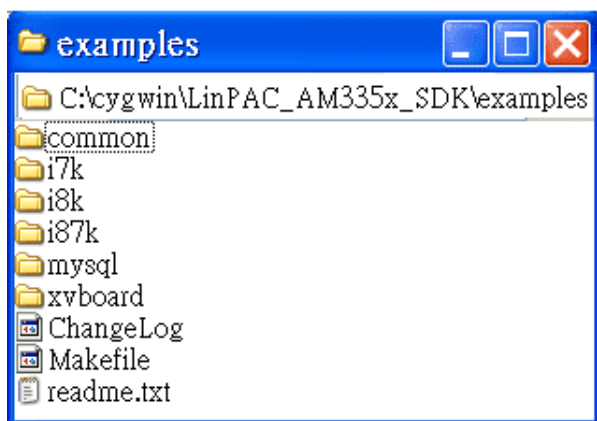


Figure 4.2.2-9.

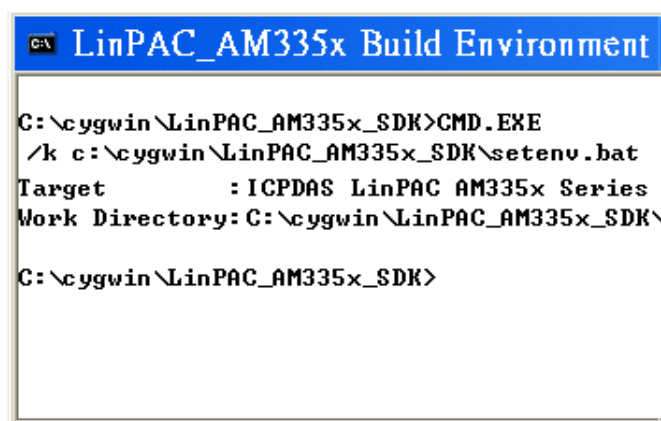


Figure 4.2.2-10.

- ❑ Type 'make'. A Command Prompt window will then be displayed that allows applications for the LinPAC_AM335x to be compiled. Refer to Figure 4.2.2-11.

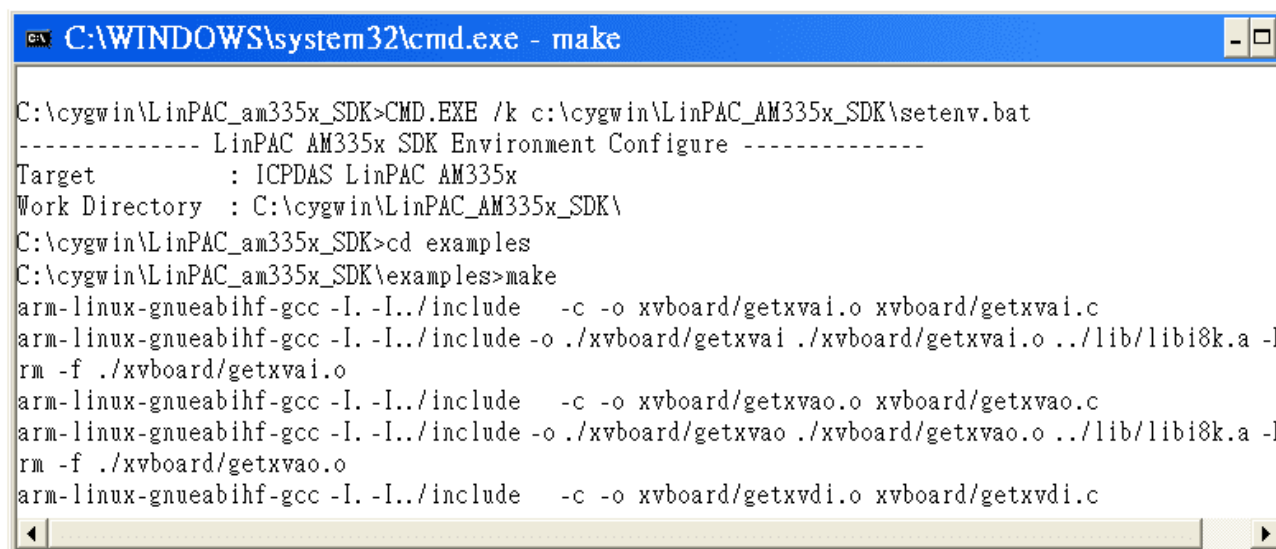


Figure 4.2.2-11. Compiling demo code according to the Makefile

4.2.3. Integrating LinPAC AM335x SDK with Code::Blocks IDE

This tutorial gives you easy-to-follow instructions, with screenshots, for setting up a compiler (the Linaro GCC compiler), a tool that will let you turn the code that you write into programs, and Code::Blocks IDE, a free development environment. This tutorial explains how to integrate LinPAC AM335x SDK with Code::Blocks IDE on Windows platform.

Step 1: Download Code::Blocks IDE.

- Go to this website: <http://www.codeblocks.org/downloads/binaries>
- Go to the Windows 2000/XP/Vista/7 section, and download Windows version.

Step 2: Install Code::Block IDE.

- The default install location is the C:\Program Files\CodeBlocks folder.
- A complete manual for Code::Blocks is available here:
<http://www.codeblocks.org/user-manual>

Step 3: Running in Code::Block IDE.

- All files and settings that are included in a LinPAC_AM335x_SDK workspace file.
- Open the **C:\cygwin\CodeBlock** folder, and double click the '**LinPAC_AM335x_SDK**' as below (Refer to Figure 4.2.3-1):

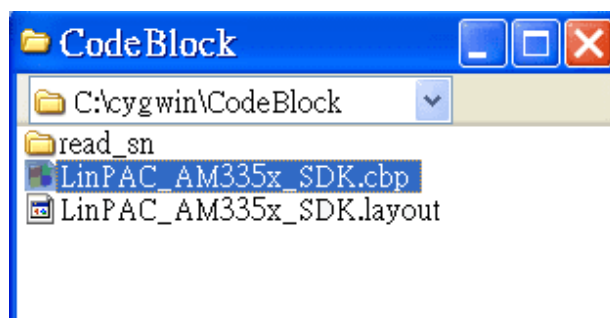


Figure 4.2.3-1. Startup the LinPAC AM335x SDK

- ❑ Following window will come up (Refer to Figure 4.2.3-2):

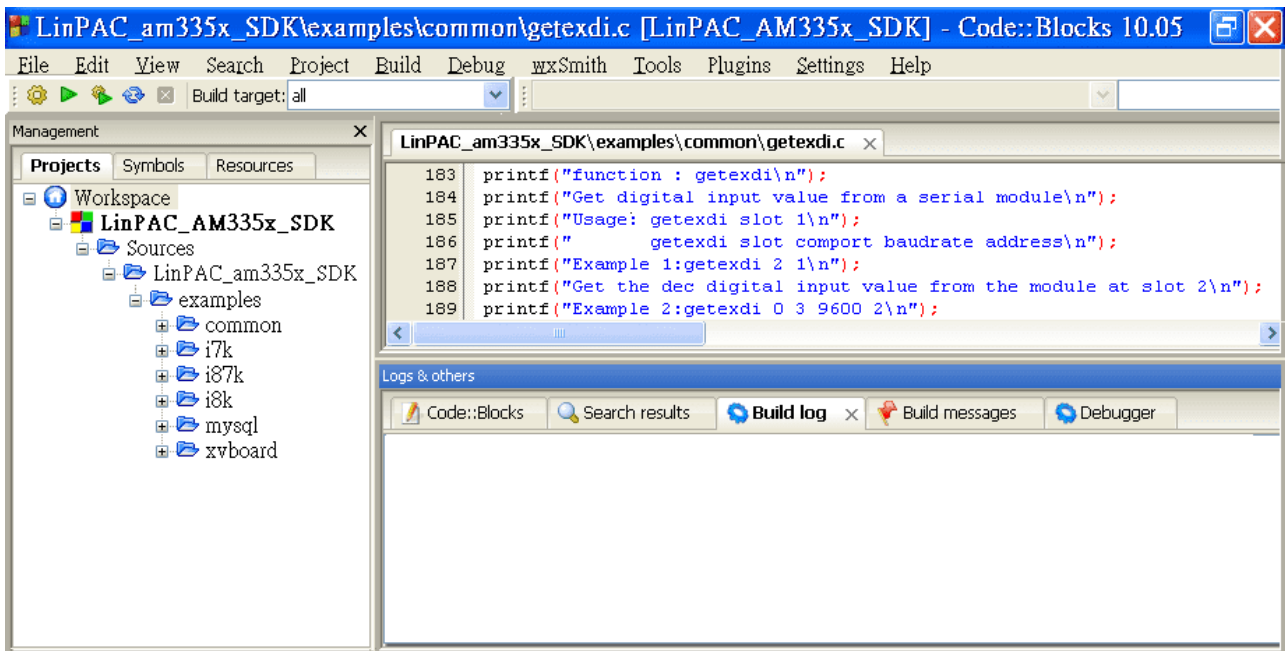


Figure 4.2.3-2. Startup the LinPAC AM335x SDK

- ❑ Check compiler settings for Linaro GCC cross compiler: Click 'Settings' > 'Compiler' > 'Toolchain executables tab' (Refer to Figure 4.2.3-3):

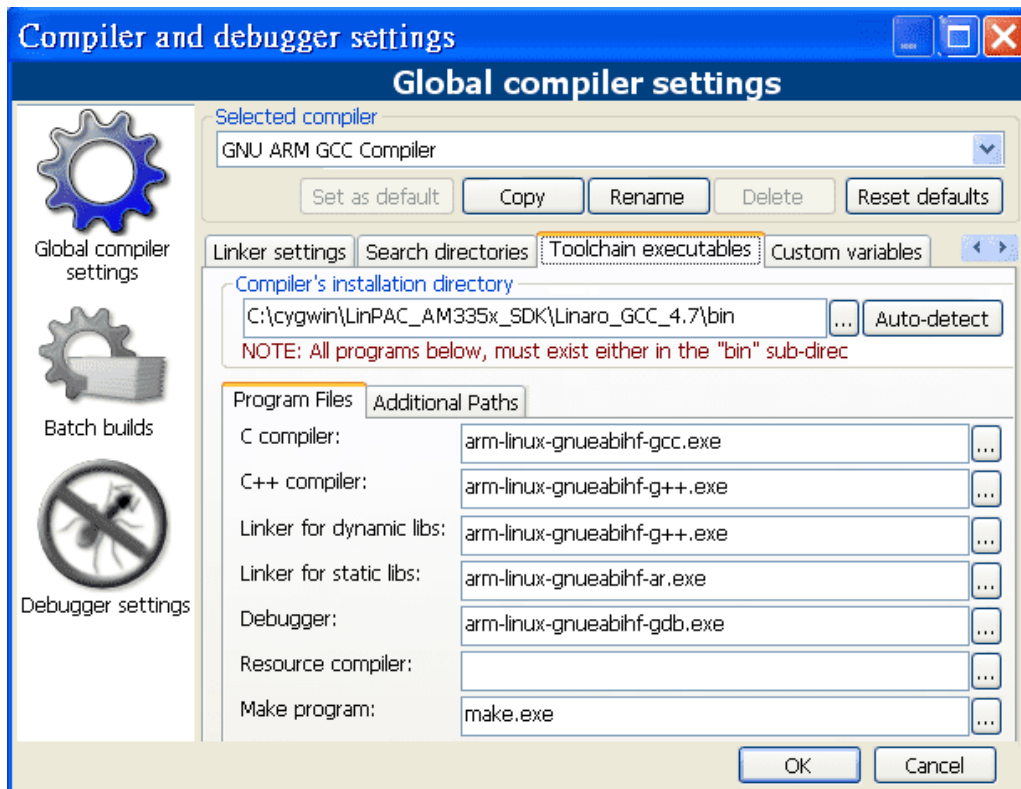


Figure 4.2.3-3. Check compiler settings

- ❑ Click **Build** options, and it will compile the LinPAC_AM335x project completely. (Refer to Figure 4.2.3-4)

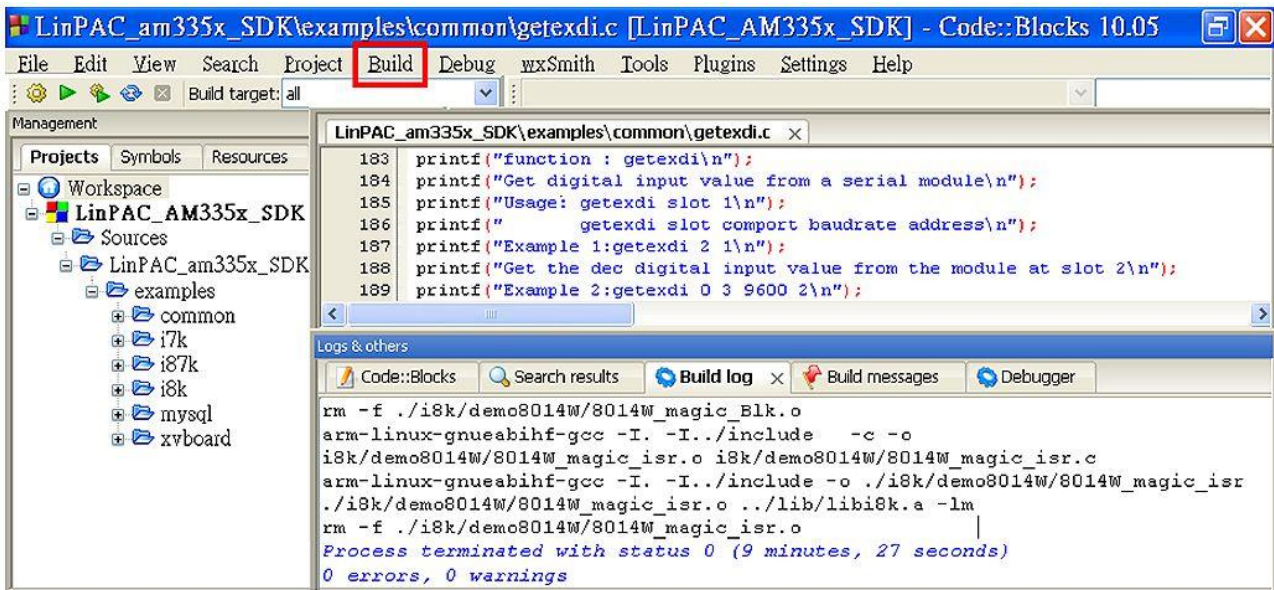


Figure 4.2.3-4. Compiling a C program

[Note] If you observe some characters may not display properly in cmd.exe, change the code page for the console only, do the following:

- ❑ Double-click the shortcut icon for the 'LinPAC_AM335x Build Environment'. (Refer to Figure 4.2.3-5)

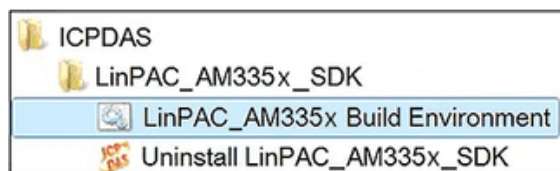


Figure 4.2.3-5. Click the 'LinPAC_AM335x Build Environment'

- ❑ Type command: **chcp 65001**. (Refer to Figures 4.2.3-6 and 4.2.3-7)

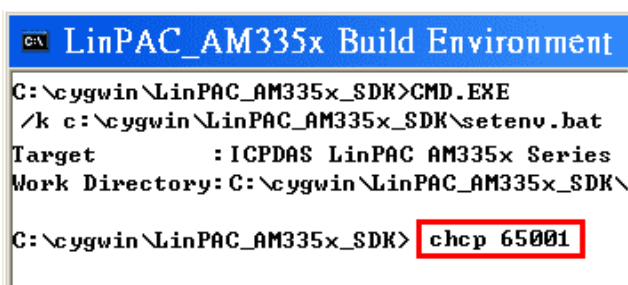


Figure 4.2.3-6.

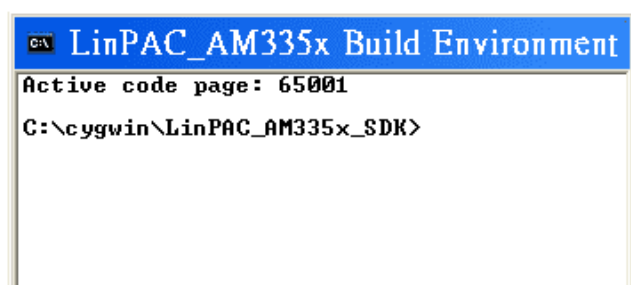


Figure 4.2.3-7.

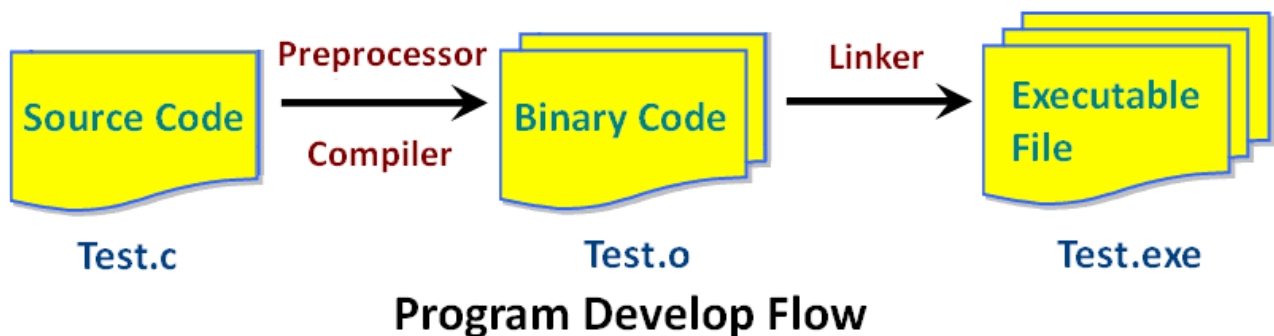
4.3. Your First Program



In this section, we will introduce how to compile the helloworld.c file to helloworld **executable file** and executes this on the LinPAC AM335x PAC. In this example, no ICP DAS modules are used. To create a demo program with C language that includes the following main steps:

1. Find demo 'helloworld.c' in SDK
2. Compile the demo on Windows/Linux PC using SDK
3. Upload and execute the demo on LinPAC AM335x PAC
4. Execute the application on LinPAC AM335x PAC at boot time

All main steps will be described in the following subsection.

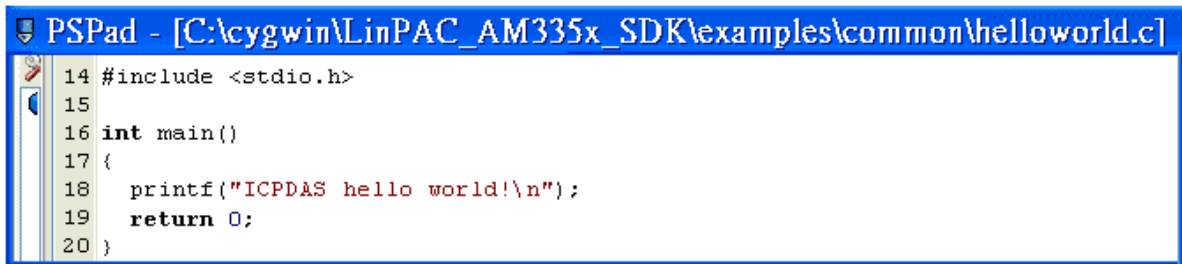


4.3.1. A simple example- helloworld.c

There are three choices available to you:

1. Coding a helloworld.c file
2. To modify/create demo 'helloworld.c'

Using a programmer's editor, such as PSPad. Create a demo - helloworld.c file. Note that the code is case-sensitive. Refer to Figure 4.3.1-1 for more details.



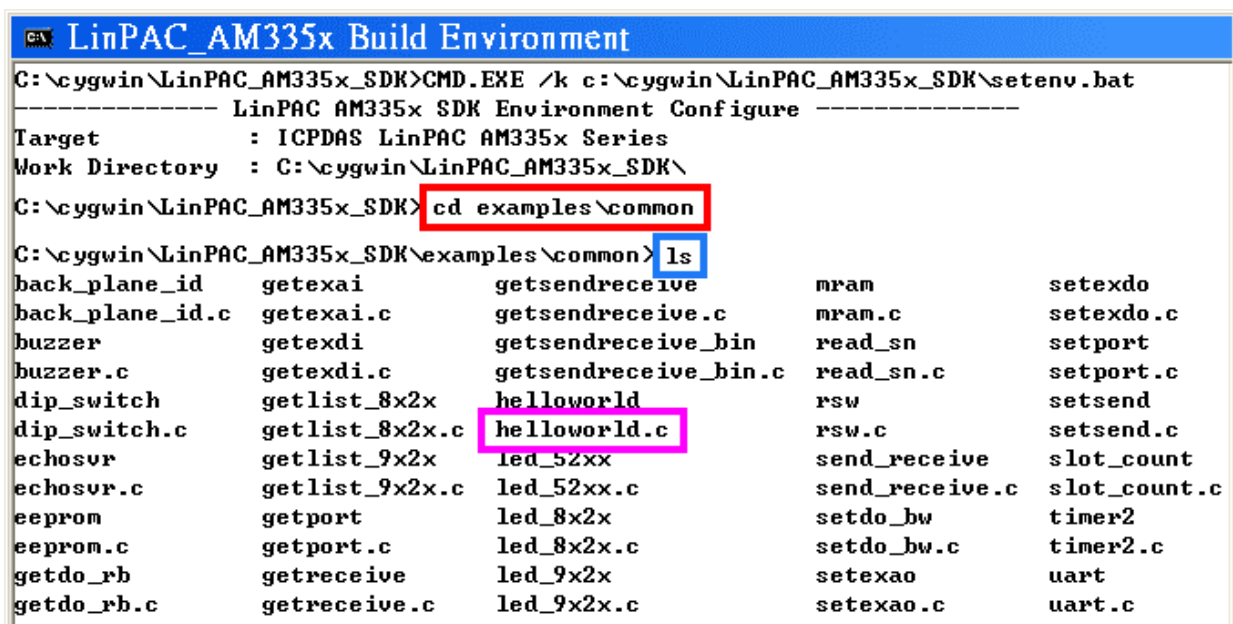
```
PSPad - [C:\cygwin\LinPAC_AM335x_SDK\examples\common\helloworld.c]
14 #include <stdio.h>
15
16 int main()
17 {
18     printf("ICPDAS hello world!\n");
19     return 0;
20 }
```

Figure 4.3.1-1. Creating helloworld.c

3. Find the demo in SDK

The process can be divided into two steps, which are described below:

- ◆ Open the LinPAC_AM335x SDK and then type 'cd examples/common' to change the path to C:/cygwin/LinPAC_AM335x_SDK/examples/common.
- ◆ Type 'dir/w' or 'ls' command and to display the contents of the directory and confirm that the helloworld.c file is present. Refer to Figure 4.3.1-2 for more details.

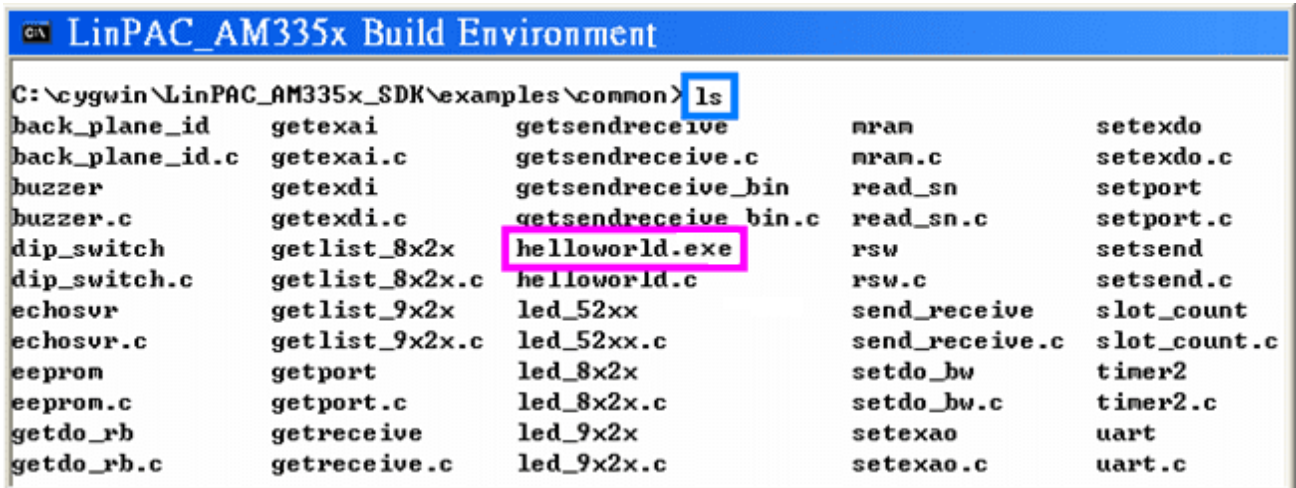


```
C:\> LinPAC_AM335x Build Environment
C:\cygwin\LinPAC_AM335x_SDK>CMD.EXE /k c:\cygwin\LinPAC_AM335x_SDK\setenv.bat
----- LinPAC AM335x SDK Environment Configure -----
Target       : ICPDAS LinPAC AM335x Series
Work Directory : C:\cygwin\LinPAC_AM335x_SDK\
C:\cygwin\LinPAC_AM335x_SDK> cd examples\common
C:\cygwin\LinPAC_AM335x_SDK\examples\common> ls
back_plane_id      getexai            getsendreceive     mram               setexdo
back_plane_id.c    getexai.c          getsendreceive.c   mram.c             setexdo.c
buzzer             getexdi            getsendreceive_bin read_sn             setport
buzzer.c           getexdi.c          getsendreceive_bin.c read_sn.c           setport.c
dip_switch         getlist_8x2x       helloworld         rsw                setsend
dip_switch.c       getlist_8x2x.c    helloworld.c       rsw.c              setsend.c
echosvr            getlist_9x2x       led_52xx           send_receive       slot_count
echosvr.c          getlist_9x2x.c    led_52xx.c         send_receive.c     slot_count.c
eeprom             getport            led_8x2x           setdo_bw           timer2
eeprom.c           getport.c          led_8x2x.c         setdo_bw.c         timer2.c
getdo_rb           getreceive         led_9x2x           setexao            uart
getdo_rb.c        getreceive.c       led_9x2x.c         setexao.c          uart.c
```

Figure 4.3.1-2. Display and confirm the contents of the common directory

4.3.2. Compile Demo- helloworld.c

Type the command 'arm-linux-gnueabi-gcc -o helloworld.exe helloworld.c' to compile helloworld.c into helloworld.exe, then type 'dir/w' or 'ls' command to display the contents of the directory and confirm that the helloworld.exe file has been created. (Refer to Figure 4.3.2-1)



```
LinPAC_AM335x Build Environment
C:\cygwin\LinPAC_AM335x_SDK\examples\common> ls
back_plane_id      getexai            getsendreceive     nram               setexdo
back_plane_id.c    getexai.c         getsendreceive.c   nram.c            setexdo.c
buzzer             getexdi           getsendreceive_bin read_sn            setport
buzzer.c           getexdi.c         getsendreceive_bin.c read_sn.c          setport.c
dip_switch         getlist_8x2x      helloworld.exe     rsw               setsend
dip_switch.c       getlist_8x2x.c    helloworld.c       rsw.c            setsend.c
echosvr            getlist_9x2x      led_52xx           send_receive      slot_count
echosvr.c          getlist_9x2x.c    led_52xx.c         send_receive.c    slot_count.c
eeprom             getport           led_8x2x           setdo_bw          timer2
eeprom.c           getport.c         led_8x2x.c         setdo_bw.c        timer2.c
getdo_rb           getreceive        led_9x2x           setexao           uart
getdo_rb.c        getreceive.c      led_9x2x.c         setexao.c         uart.c
```

Figure 4.3.2-1. Executable file - helloworld.exe

4.3.3. Execute Demo- helloworld.exe

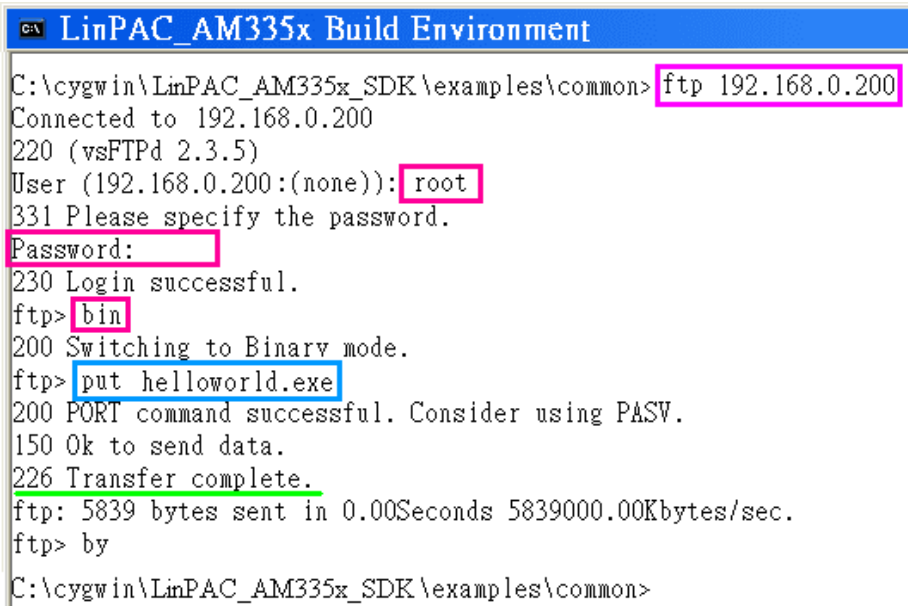
The user can refer to below steps to transfer and execute helloworld.exe.

Use 'Dos Command Prompt' and 'FTP' tools to transfer program

Two methods can be used to transfer files to the LinPAC AM335x PAC, with LP-8x21 as an example:

< Method one > Using the 'DOS Command Prompt'

- (1) Open a 'DOS Command Prompt' or double-click the shortcut icon for the '[LinPAC_AM335x Build Environment](#)' and type the ftp IP Address of the LP-8x21 for example, **ftp 192.168.0.200** to establish a connection to the FTP Server on the LP-8x21. When prompted, type the **User_Name (default value is 'root')** and **Password (default value is 'icpdas')** to establish a connection to the LP-8x21.
- (2) Before transferring the files to the LP-8x21, type the 'bin' command to ensure that the file is transferred to the LP-8x21 in **binary mode**.
- (3) Type the command '**put helloworld.exe**' to transfer the helloworld.exe file to the LP-8x21.
- (4) Once the message '**Transfer complete**' is displayed, then transfer process has been completed. To disconnect from the LP-8x21, type the '**bye**' command to return to the PC console. (Refer to Figure 4.3.3-1)



```
C:\> LinPAC_AM335x Build Environment
C:\cygwin\LinPAC_AM335x_SDK\examples\common> ftp 192.168.0.200
Connected to 192.168.0.200
220 (vsFTPd 2.3.5)
User (192.168.0.200:(none)): root
331 Please specify the password.
Password:
230 Login successful.
ftp> bin
200 Switching to Binary mode.
ftp> put helloworld.exe
200 PORT command successful. Consider using PASV.
150 Ok to send data.
226 Transfer complete.
ftp: 5839 bytes sent in 0.00Seconds 5839000.00Kbytes/sec.
ftp> by
C:\cygwin\LinPAC_AM335x_SDK\examples\common>
```

Figure 4.3.3-1. Transfer the helloworld.exe file to the LP-8x21

< Method two > Using an FTP Client:

- (1) Open the FTP Software and add an FTP Host to the LP-8x2x. (for example, FileZilla - The free FTP solution for both client and server, <https://filezilla-project.org/>)
- (2) Type the User_Name (default value is 'root') and Password (default value is 'icpdas'). Then click the 'Quickconnect Connect' button to establish a connection to the ftp server on the LP-8x2x. (refer to Figure 4.3.3-2)

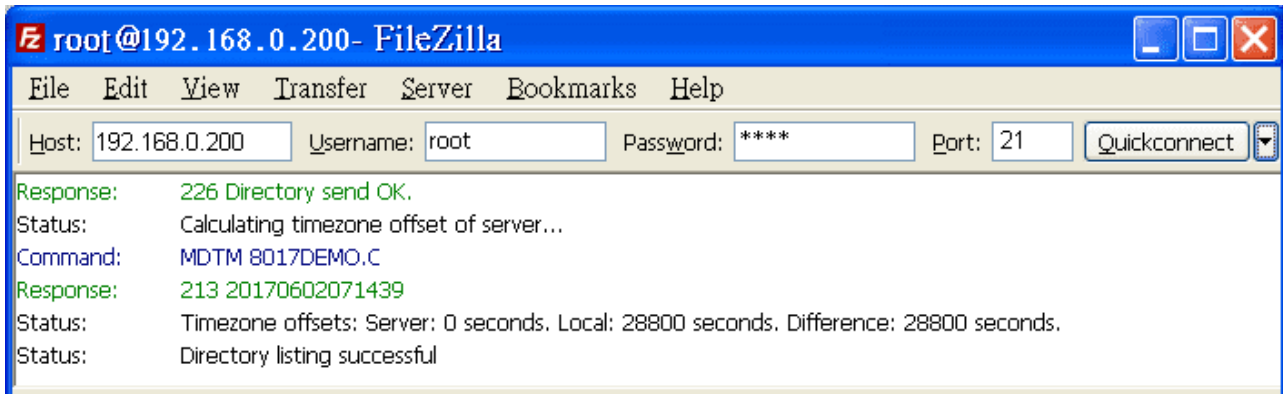


Figure 4.3.3-2. Establish a connection to the ftp server on the LP-8x21

- (3) Upload the 'Helloworld.exe' file to the LP-8x21. (Refer to Figure 4.3.3-3)

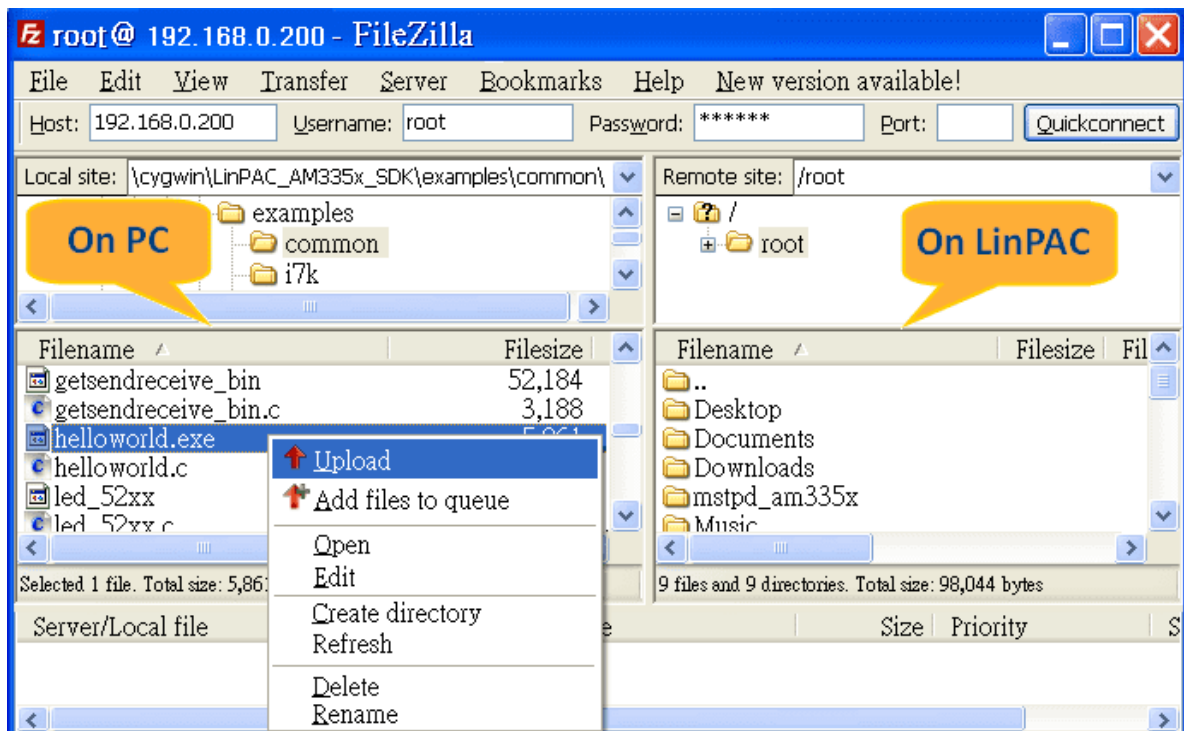


Figure 4.3.3-3. Upload file to the LinPAC

- (4) Click the helloworld.exe file in the LP-8x21 to select it and then right-click the file icon and click the 'File Permissions' option. In the Properties dialog box, type 777 into the Numeric textbox, and then click the OK button. Refer to Figures 4.3.3-4 and 4.3.3-5 for more details.

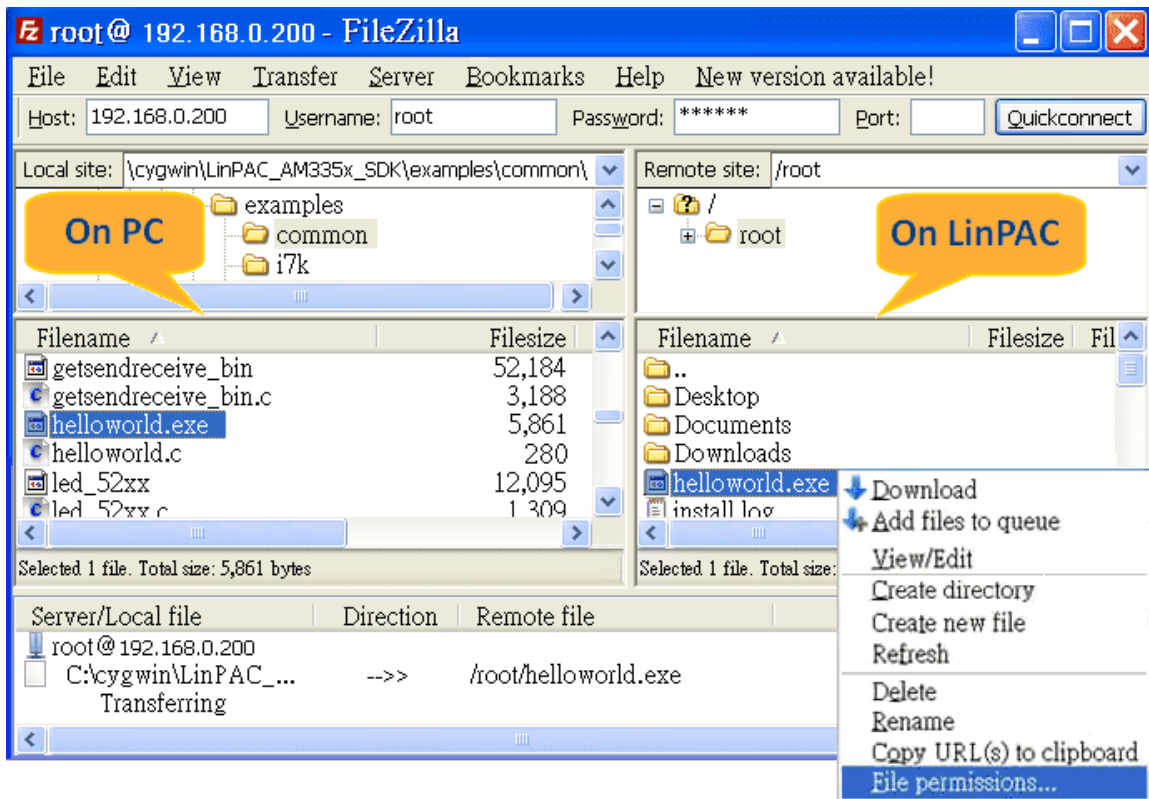


Figure 4.3.3-4. Modify the permissions of files

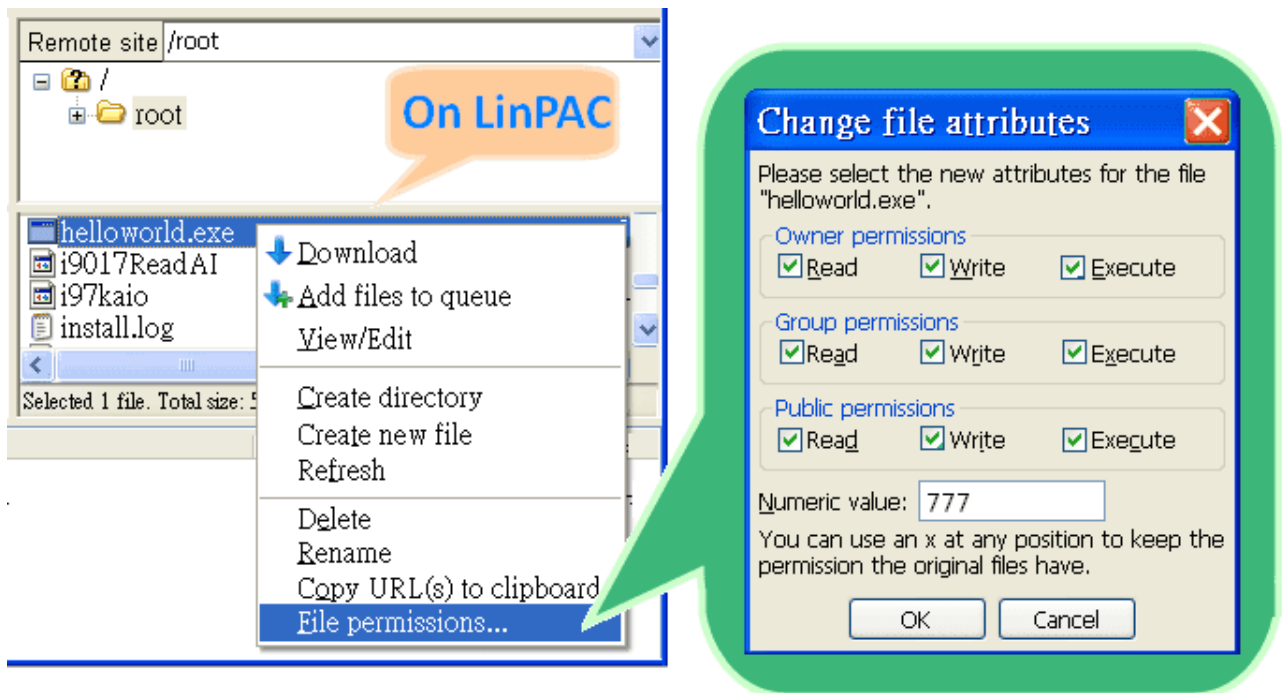


Figure 4.3.3-5. Modify the permissions of files

Use SSH to access LinPAC and execute program

(1) Putty – the free PuTTY is an SSH and telnet client. Download PuTTY tool:

<http://www.putty.org/>

(2) Open a 'Putty Prompt' and type the IP Address of the LinPAC, and the connection type is set to SSH. When prompted, type the User_Name and Password to establish a connection to the LP-8x2x. If the '#' prompt character is displayed, it signifies that a connection to the telnet server on the LP-8x2x has been successfully established. (refer to Figure 4.3.3-6)

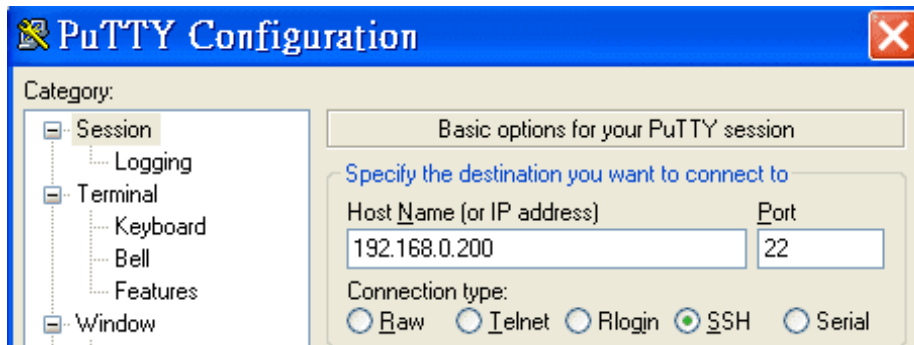


Figure 4.3.3-6. Establish a connection to the telnet server

(3) Type the '**chmod 777 helloworld.exe**' command to change the permissions for the helloworld.exe file. Type the '**ls -l**' command again to list all the files in the /root directory and verify the permissions assigned to the 'helloworld.exe' file. This means that the file is executable. Execute the './helloworld.exe' file by typing and the message 'ICPDAS hello world!' will be displayed.

The compile, transfer and execution processes are now complete. (refer to Figure 4.3.3-7)

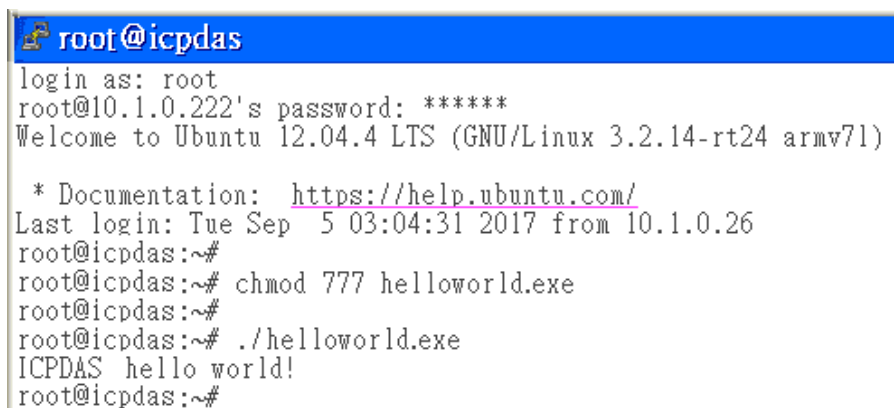


Figure 4.3.3-7. Modify the permissions of files

4.3.4. Execute the application on LinPAC AM335x PAC at boot time

User can refer to below steps to auto-execute demo 'helloworld' at boot time in LinPAC AM335x PAC.

1. Copy SDK demo 'examples/common/helloworld' to '/usr/sbin' directory
2. Create script file in '/etc/init.d' directory. Check the '/etc/init.d/pppon' or '/etc/init.d/single' file for an example.

User can use 'vi' command to create the script file in '/etc/init.d' directory and add below script language to the file.

```
root@ LinPAC-AM335x:~# vi /etc/init.d/hello
```

```
#!/bin/sh

### BEGIN INIT INFO
# Provides: ICP DAS
# Required-Start:
# Required-Stop:
# Should-Start:
# Should-Stop:
# Default-Start: 2 3 4 5
# Default-Stop: 0 1 6
# Short-Description: Start and stop hello
# Description: hello
### END INIT INFO

helloworld > /tmp/test.log
```

3. Type 'chmod 755 /etc/init.d/hello' command to change the access permissions for the file.
4. Use 'update-rc.d' command to add the script 'hello' automatically.

```
root@ LinPAC-AM335x:~# chmod +x /etc/init.d/hello
root@ LinPAC-AM335x:~# update-rc.d hello defaults
```

5. Reboot the LinPAC. After setting the file, the LP-22xx/52xx/8x2x/9x2x will execute binary 'helloworld' at boot time.

5. Application for LinPAC AM335x PAC

In this chapter, ICP DAS provides extra module supported and instructions to enhance LinPAC AM335x PAC functionality and affinity.

5.1. Package management with APT

The 'apt-get' utility is the Ubuntu package manager used to download and install software packages from local package repositories or ones located on the Internet. Package management via apt-get runs hand-in-hand with the /etc/apt/sources.list file. This page describes how to handle the packages on LinPAC AM335x PAC using apt-get and related commands.

- To install a package run the following commands:

```
# apt-get update
# apt-get install <package>
```

- To remove a package run the following commands:

```
# apt-get remove --purge <package>           // Remove the package
# apt-get autoremove --purge <package>       // Remove the dependencies packages
```

- To search available package run the following commands:

```
# apt-cache search <package name>
```

5.2. SFTP (secure file transfer program)

The LinPAC AM335x series PAC had supported SFTP(or SCP), user can transfer the file from Windows(or Linux). For examples, using Windows Program 'WinSCP' to access the device over network, please follow below steps:

1. Choosing the 'SFTP' or 'SCP' protocol and type IP address, default ID(root) and password(icpdas) to login. (Refer to Figure 5.2-1)

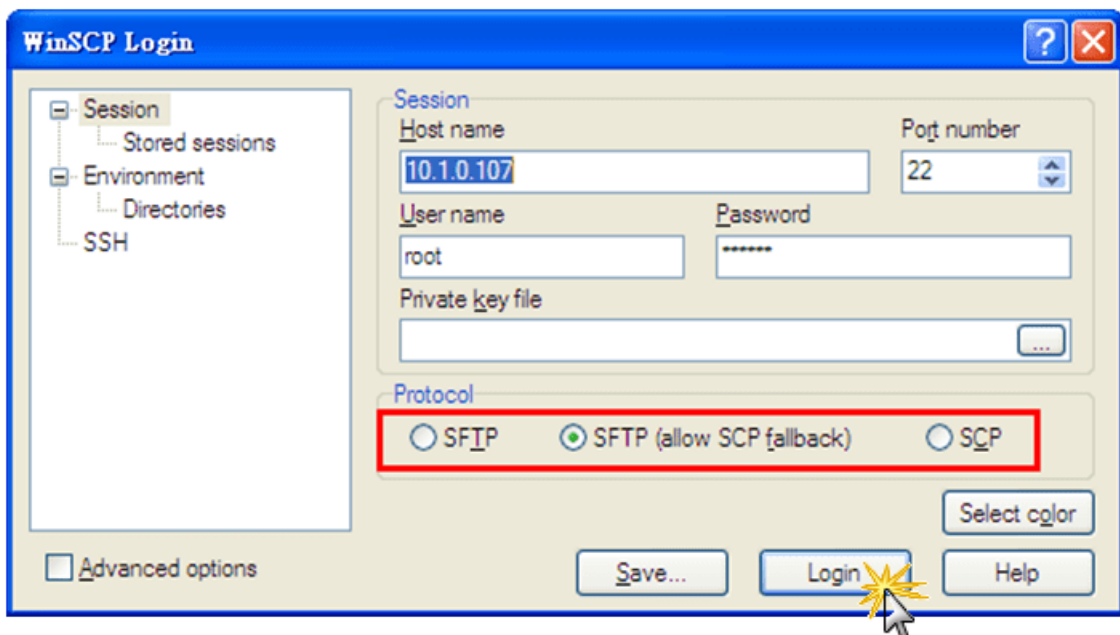


Figure 5.2-1. Using Windows Program 'WinSCP' to access the device over network

2. Drag and drop file. (Refer to Figure 5.2-2)

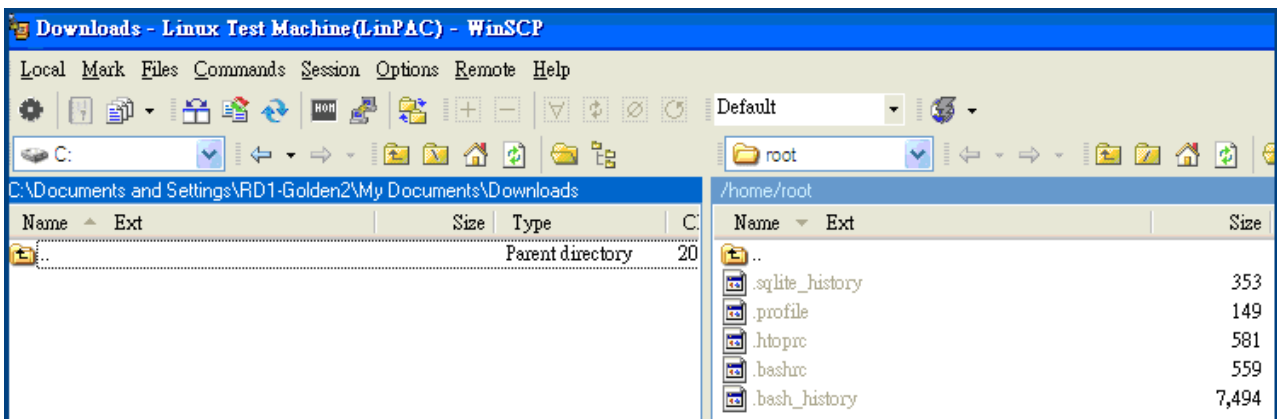
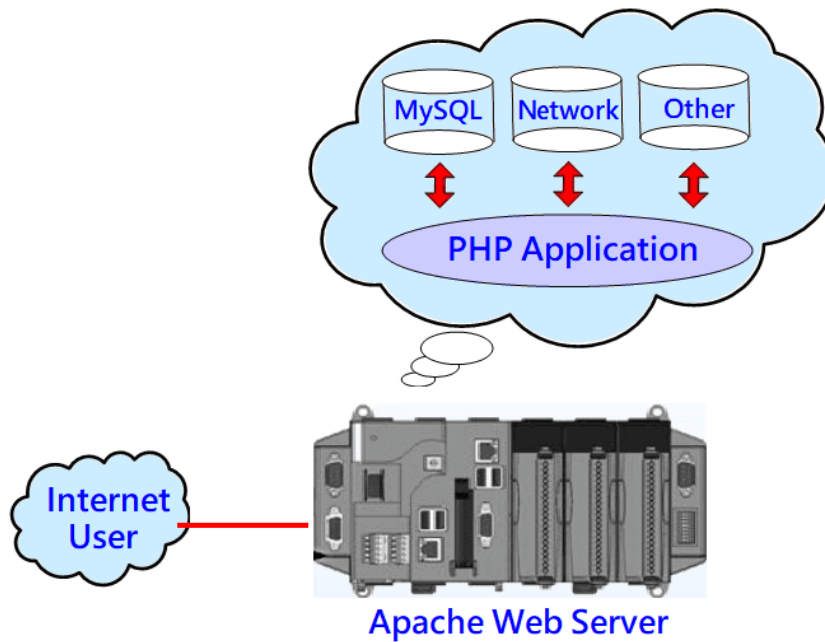



Figure 5.2-2. Drag and drop file

5.3. LAMP Server

The LAMP (Apache2 + PHP5 + MySQL) server has been built in the LinPAC AM335x PAC and it will be started automatically at boot time. As a solution stack, LAMP is suitable for building dynamic web sites and web applications. The default path of web page in the `'/var/www'` directory. If user want to change the web page's path, user can use command 'vi' to modify the configuration file `'/etc/apache2/sites-enabled/000-default'` of daemon 'apache2'. User can use the web browser and input the device IP to connect to default index page 'index.php' to get detail information.

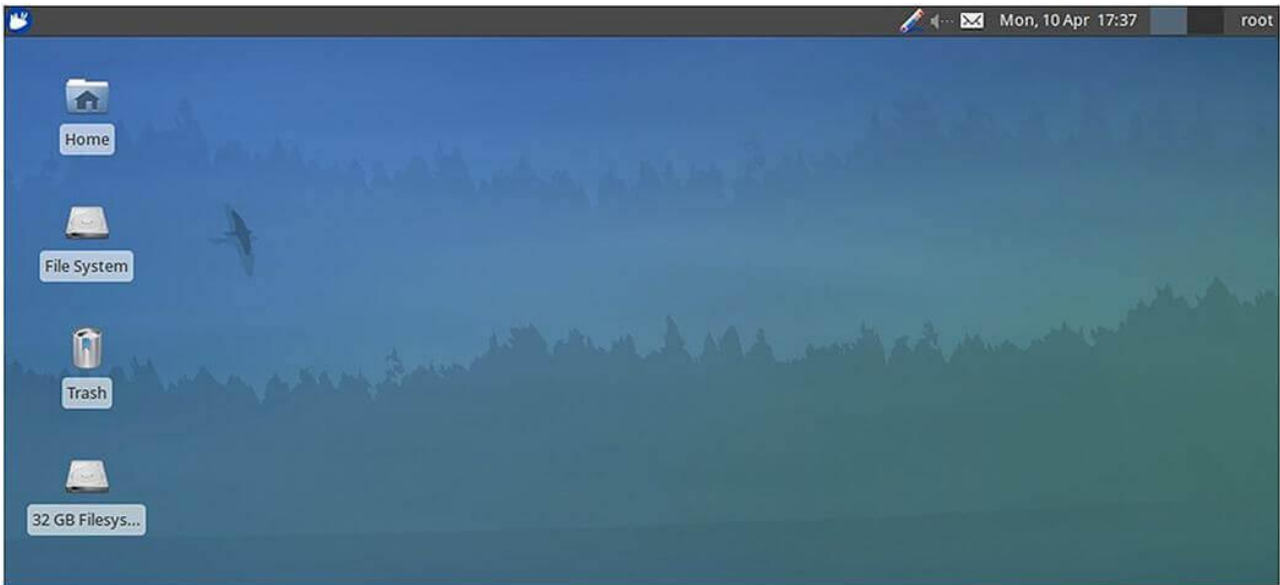


PHP Version 5.3.10-1ubuntu3.25 

System	Linux LP-5231 3.2.14-rt24 #86 PREEMPT RT Tue Jun 6 09:26:29 CST 2017 armv7l
Build Date	Oct 3 2016 16:40:05
Server API	Apache 2.0 Handler
Virtual Directory Support	disabled
Configuration File (php.ini) Path	/etc/php5/apache2
Loaded Configuration File	/etc/php5/apache2/php.ini
Scan this dir for additional .ini files	/etc/php5/apache2/conf.d
Additional .ini files parsed	/etc/php5/apache2/conf.d/pdo.ini
PHP API	20090626
PHP Extension	20090626

5.4. XFCE(secure file transfer program) GUI Desktop

XFCE is a lightweight desktop environment for UNIX-like operating systems. It aims to be fast and low on system resources, while still being visually appealing and user friendly. Now the LinPAC AM335x series Linux provides the XFCE package, after user type 'root' and password 'icpdas' to login, the local terminal would execute the XFCE Desktop.



5.4.1. Disable login prompt

To disable login prompt, user should to edit `/etc/init/tty1.conf` file first, and add "`--autologin root`" for automatically log in the specified user without asking for a username or password.

Finally, reboot the LinPAC.

```
root@icpdas: /etc/init
tty1 - getty
#
# This service maintains a getty on tty1 from the point the system is
# started until it is shut down again.
start on stopped rc RUNLEVEL=[2345] and (
    not-container or
    container CONTAINER=lxc or
    container CONTAINER=lxc-libvirt)
stop on runlevel [!2345]
respawn
exec /sbin/getty -8 38400 --autologin root tty1
#exec /sbin/getty -8 38400 tty1
```

5.4.2. Disable screensaver and make the monitor sleep

To disable screensaver and make the monitor sleep using **xset**, follow the command described below.

```
# export DISPLAY=:0.0
# xset s noblank
# xset s 0 0
# xset dpms 0 0 0
# xset -dpms // turn off DPMS
# xset q // query current settings
```

User can type '**xset q**' command to confirm the setup status, which is show the information on the current settings, as illustrated in Figure 5.4.2-1.

```
root@icpdas:~# xset q
Keyboard Control:
auto repeat: on      key click percent: 0      LED mask: 00000000
XKB indicators:
 00: Caps Lock: off   01: Num Lock: off   02: Scroll Lock: off
 03: Compose: off   04: Kana: off   05: Sleep: off
 06: Suspend: off   07: Mute: off   08: Misc: off
 09: Mail: off   10: Charging: off   11: Shift Lock: off
 12: Group 2: off   13: Mouse Keys: off
auto repeat delay: 660      repeat rate: 25
auto repeating keys: 00ffffffdffffbbf
                    fadffffefffedffff
                    9fffffffffffffff
                    fff7ffffffffffffff
bell percent: 50      bell pitch: 400      bell duration: 100
Pointer Control:
acceleration: 2/1      threshold: 4
Screen Saver:
prefer blanking: no      allow exposures: yes
timeout: 0      cycle: 0
Colors:
default colormap: 0x20      BlackPixel: 0      WhitePixel: 65535
Font Path:
/usr/share/fonts/X11/misc,/usr/share/fonts/X11/Type1,built-ins
DPMS (Energy Star):
Standby: 0      Suspend: 0      Off: 0
DPMS is Disabled
```

Disable Screen Saver

Disable DPMS

Figure 5.4.2-1 current settings

5.5. SysVinit Support

SysVinit is a system and service manager for Linux operating systems. User can start/stop/enable /disable software service by using Linux command 'service' and 'update-rc.d'. Refer to Figure 5.5-1 and 5.5-2 for more details.

```
root@LP-5231:~# service ssh start Start software service
ssh start/running, process 1940
root@LP-5231:~#
root@LP-5231:~# service ssh stop Stop software service
ssh stop/waiting
```

Figure 5.5-1. Start/stop software

```
root@LP-5231:~# update-rc.d -f apache2 remove Removig service at boot time
Removing any system startup links for /etc/init.d/apache2 ...
/etc/rc0.d/K09apache2
/etc/rc1.d/K09apache2
/etc/rc2.d/S91apache2
/etc/rc3.d/S91apache2
/etc/rc4.d/S91apache2
/etc/rc5.d/S91apache2
/etc/rc6.d/K09apache2
root@LP-5231:~#
root@LP-5231:~# update-rc.d apache2 defaults Adding service at boot time
Adding system startup for /etc/init.d/apache2 ...
/etc/rc0.d/K20apache2 -> ../init.d/apache2
/etc/rc1.d/K20apache2 -> ../init.d/apache2
/etc/rc6.d/K20apache2 -> ../init.d/apache2
/etc/rc2.d/S20apache2 -> ../init.d/apache2
/etc/rc3.d/S20apache2 -> ../init.d/apache2
/etc/rc4.d/S20apache2 -> ../init.d/apache2
/etc/rc5.d/S20apache2 -> ../init.d/apache2
root@LP-5231:~# █
```

Figure 5.5-2. Enable/Disable software

5.6. Network Support

The LinPAC embedded controller already includes a variety of network functions. Following is an overview of the network functions supported in the LinPAC AM335x PAC.

5.6.1. 2G/3G/4G

LP-5231PM-3GWM support the 2G/3G system and LP-2241MX-4GE/ LP-2241MX-4GC/ LP-5231PM-4GE/LP-5231PM-4GC support the 2G/3G/4G system. User can use the command '**service pppon start**' to start 2G/3G/4G or the command '**service pppon stop**' to stop 2G/3G/4G. After checking for an IP address from the network provider, look for whether the '**ppp0**' network interface is active. The following is an example of operation in the LP-5231PM-3GWM. (Refer to Figure 5.6.1-1)

```
root@LP-5231:~# service pppon start
$Starting pppd:  ...done.
root@LP-5231:~#
root@LP-5231:~# ifconfig ppp0
ppp0      Link encap:Point-to-Point Protocol
          inet addr:100.84.200.69  P-t-P:10.64.64.64  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:10 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:345 (345.0 B)  TX bytes:369 (369.0 B)

root@LP-5231:~#
root@LP-5231:~# service pppon stop
$Stopping pppd:  ...done.
root@LP-5231:~#
```

Using 2G/3G/4G network

Stopping 2G/3G/4G network

Figure 5.6.1-1. pppon service

5.6.2. SMS(Short Message Service)

The LP-5231PM-3GWA and LP-2241MX-4GE / LP-2241MX-4GC / LP-5231PM-4GE / LP-5231PM-4GC module are equipped with a 3G/4G connection application, meaning that users can download and install software for the purpose of sending short messages via a 2G, 3G, or 4G network. Four SMS tools are available for installation that allows SMS (Short Message Service) applications to be implemented on the LP-5231PM-3GWA and LP-2241MX-4GE / LP-2241MX-4GC / LP-5231PM-4GE / LP-5231PM-4GC module, each of which will be described in more detail below.

However, it is recommended that only one SMS tool be installed on the system at any one time so as to avoid software dependencies. You should ensure that any existing tools have been completely removed from the system before installing another SMS tool.

By default, the name of the 3G device is `/dev/ttyUSB3`, as illustrated in Figure 5.6.2-1.

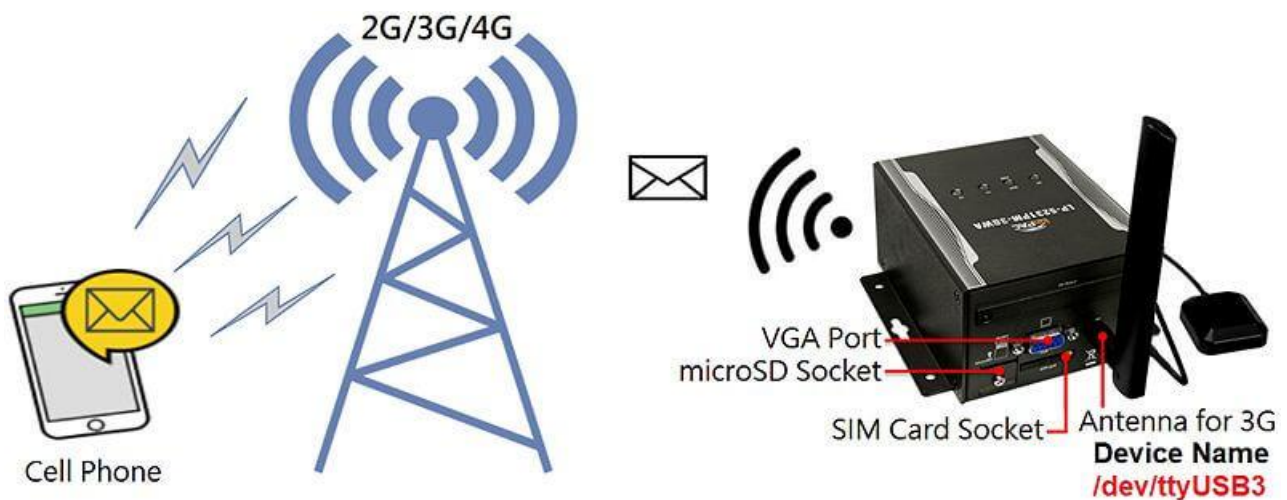


Figure 5.6.2-1. LP-5231PM-3GWA 3G device name

The following is a brief introduction to the four SMS tools available. Any one of which can be installed to send SMS messages, and they are organized as follows:

5.6.2.1. Message in English

Sending an English message, users can try the following SMS tools.

(a) gsm-utils

The gsm-utils binary package provides some simple command line programs that can be used to access a GSM mobile phone via GSM modem. To send an SMS message, using the gsm-utils package, follow the procedure described below.

Step 1: Use the `'apt-get install gsm-utils'` command to install the gsm-utils package.

Step 2: Use the following command to send an SMS message.

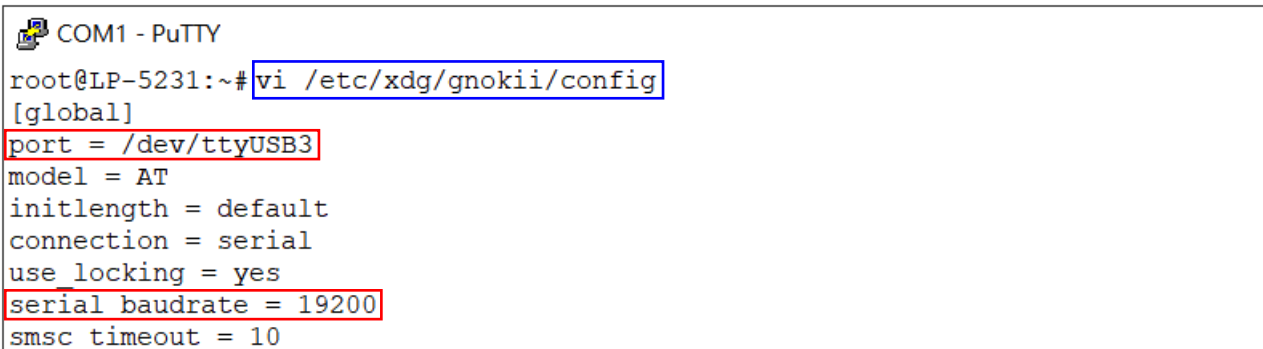
```
# gsmutils -d /dev/ttyUSB3 +8869XXXXXXX "gsm : test"
```

(b) Gnokii

Gnokii is a suite of programs for communicating with mobile phones that can be used for reading, writing, sending and receiving SMS messages. To send an SMS message, using Gnokii, follow the procedure described below.

Step 1: Use the `'apt-get install gnokii-cli'` command to install the Gnokii package.

Step 2: Open the configuration file found in the `'/etc/xdg/gnokii/'` folder and adjust the values for the `'port'` and `'serial_baudrate'` parameters, as illustrated in Figure 5.6.2.1-1.

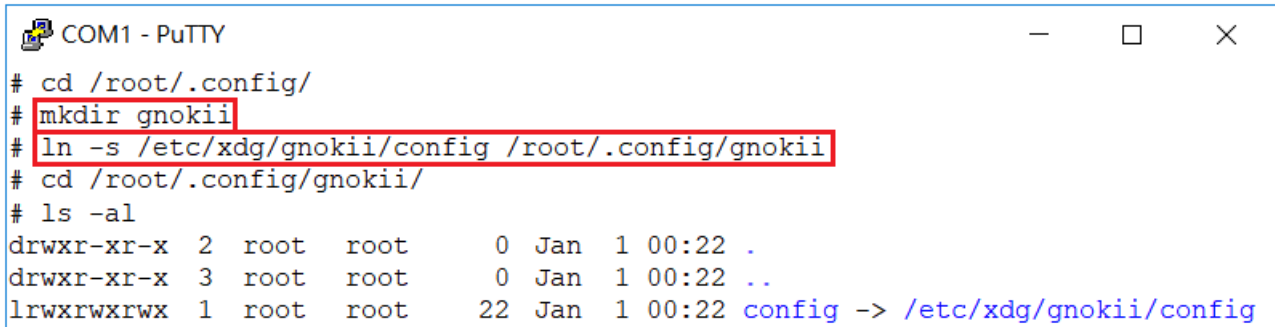


```
COM1 - PuTTY
root@LP-5231:~# vi /etc/xdg/gnokii/config
[global]
port = /dev/ttyUSB3
model = AT
initlength = default
connection = serial
use_locking = yes
serial_baudrate = 19200
smc_timeout = 10
```

Figure 5.6.2.1-1. Modifying the Gnokii configuration file

Step 3: Use the `mkdir gnokii` command to create a folder in the path `/root/.config/`, as illustrated in Figure 5.6.2.1-2.

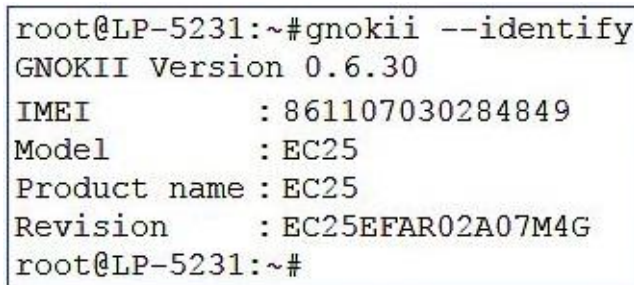
Step 4: Use the `ln -s /etc/xdg/gnokii/config /root/.config/gnokii` command to create a symbolic link in the `/root/.config/gnokii/` folder, as illustrated in Figure 5.6.2.1-2.



```
COM1 - PuTTY
# cd /root/.config/
# mkdir gnokii
# ln -s /etc/xdg/gnokii/config /root/.config/gnokii
# cd /root/.config/gnokii/
# ls -al
drwxr-xr-x 2 root root 0 Jan 1 00:22 .
drwxr-xr-x 3 root root 0 Jan 1 00:22 ..
lrwxrwxrwx 1 root root 22 Jan 1 00:22 config -> /etc/xdg/gnokii/config
```

Figure 5.6.2.1-2. Creating the directory and file links

Step 5: Use the `gnokii --identify` command to verify that the configuration functions as expected, as illustrated in Figure 5.6.2.1-3.

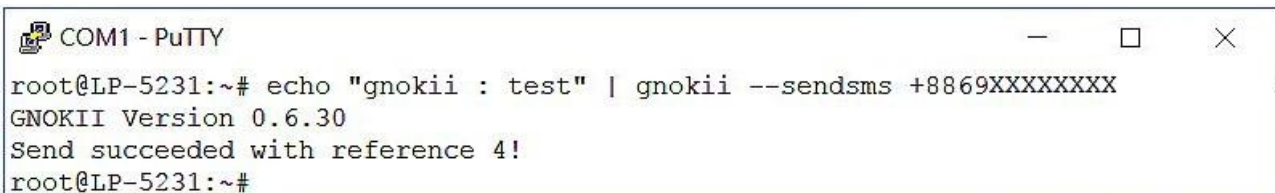


```
root@LP-5231:~#gnokii --identify
GNOKII Version 0.6.30
IMEI      : 861107030284849
Model     : EC25
Product name : EC25
Revision  : EC25EFAR02A07M4G
root@LP-5231:~#
```

Figure 5.6.2.1-3.

Step 6: Use the following command to send an SMS message, as illustrated in Figure 5.6.2.1-4.

```
# echo "gnokii : test" | gnokii --sendsms +8869XXXXXXXXX
```



```
COM1 - PuTTY
root@LP-5231:~# echo "gnokii : test" | gnokii --sendsms +8869XXXXXXXXX
GNOKII Version 0.6.30
Send succeeded with reference 4!
root@LP-5231:~#
```

Figure 5.6.2.1-4. Sending an SMS message using Gnokii

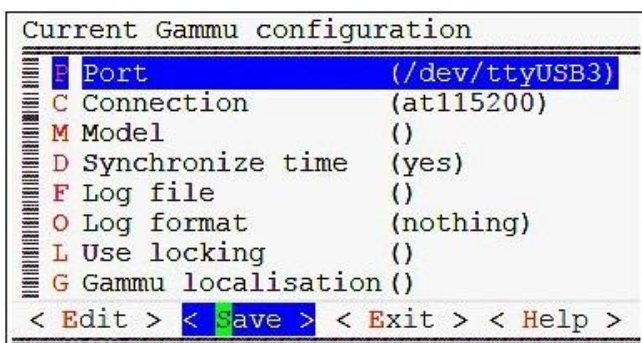
(c) Gammu

Gammu is a command line utility that can be used for reading, writing, sending and receiving SMS messages. To send an SMS message using Gammu, follow the procedure described below.

Step 1: Use the `'apt-get install gammu'` command to install the Gammu package.

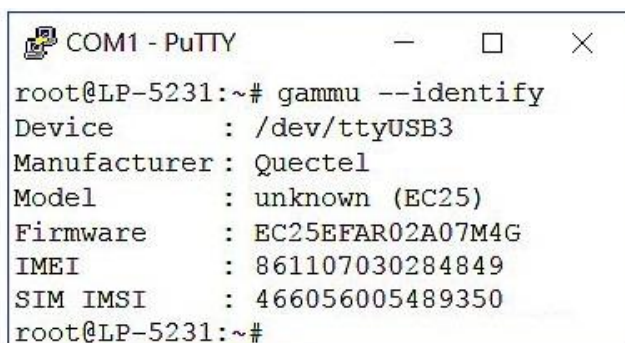
Step 2: Use the `'gammu-config'` command to modify the configuration file.

The Gammu package includes an easy to use tool `gammu-config`, which allows the user to create and configure the most important options in the Gammu configuration file, as illustrated in Figure 5.6.2.1-5.



```
Current Gammu configuration
Port (/dev/ttyUSB3)
Connection (at115200)
Model ()
Synchronize time (yes)
Log file ()
Log format (nothing)
Use locking ()
Gammu localisation ()
< Edit > < Save > < Exit > < Help >
```

Figure 5.6.2.1-5.



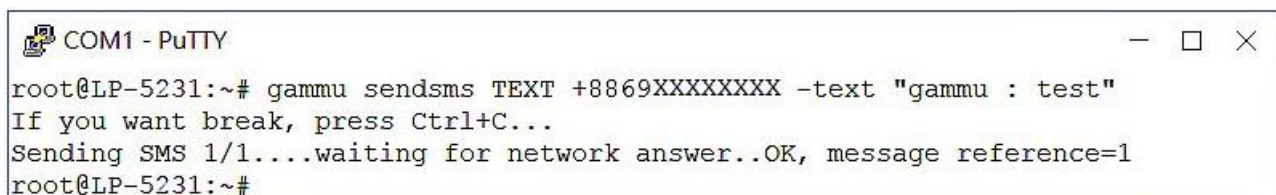
```
COM1 - PuTTY
root@LP-5231:~# gammu --identify
Device      : /dev/ttyUSB3
Manufacturer: Quectel
Model       : unknown (EC25)
Firmware    : EC25EFAR02A07M4G
IMEI        : 861107030284849
SIM IMSI    : 466056005489350
root@LP-5231:~#
```

Figure 5.6.2.1-6.

Step 3: Use the `'gammu -identify'` command to verify that the configuration is functioning as expected, as illustrated in Figure 5.6.2.1-6.

Step 4: Use the following command to send an SMS message, as illustrated in Figure 5.6.2.1-7.

```
# gammu sendsms TEXT +8869XXXXXXXX -text "gammu : test"
```



```
COM1 - PuTTY
root@LP-5231:~# gammu sendsms TEXT +8869XXXXXXXX -text "gammu : test"
If you want break, press Ctrl+C...
Sending SMS 1/1...waiting for network answer..OK, message reference=1
root@LP-5231:~#
```

Figure 5.6.2.1-7. Sending an SMS message using Gammu

(d) SMS Server Tools

The SMS Server tools package is an SMS Gateway application which can be used to send and receive SMS messages via GSM modems and mobile phones. To send an SMS message via the SMS Server, follow the procedure described below.

Step 1: Download the SMS Server Tools package.

The latest version of the SMS Server Tools package can be downloaded from:

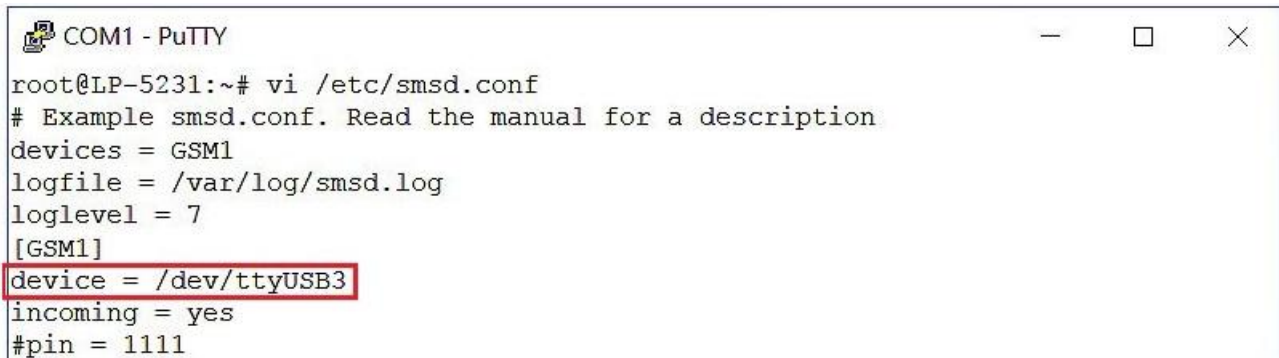
<http://smstools3.kekekasvi.com/index.php?p=packages>

Step 2: Compile and install the SMS Server tools package.

Refer to the following website for detailed information about how to compile and install the SMS Server tools package:

<http://smstools3.kekekasvi.com/index.php?p=compiling>

Step 3: Use the Linux 'vi' command to modify the '/etc/smsd.conf' file and change the 'device' parameters, as illustrated in Figure 5.6.2.1-8.



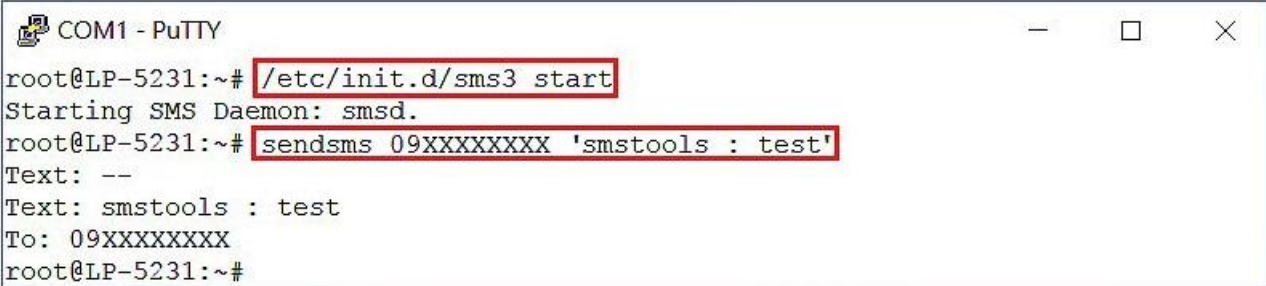
```
COM1 - PuTTY
root@LP-5231:~# vi /etc/smsd.conf
# Example smsd.conf. Read the manual for a description
devices = GSM1
logfile = /var/log/smsd.log
loglevel = 7
[GSM1]
device = /dev/ttyUSB3
incoming = yes
#pin = 1111
```

Figure 5.6.2.1-8. Modifying the smsd configuration file

Step 4: Use the `‘/etc/init.d/sms3 start’` command to start the SMSD service in the background, as illustrated in Figure 5.6.2.1-9.

Step 5: Use the following command to send an SMS message, as illustrated in Figure 5.6.2.1-9.

```
# sendsms 09XXXXXXXX 'smstools : test'
```



```
COM1 - PuTTY
root@LP-5231:~# /etc/init.d/sms3 start
Starting SMS Daemon: smsd.
root@LP-5231:~# sendsms 09XXXXXXXX 'smstools : test'
Text: --
Text: smstools : test
To: 09XXXXXXXX
root@LP-5231:~#
```

Figure 5.6.2.1-9. Sending an SMS message using SMS Server tools

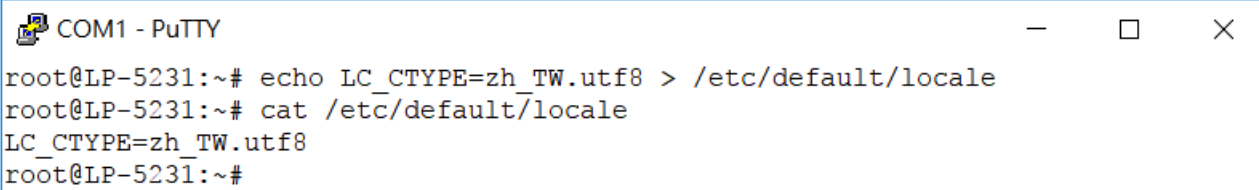
5.6.2.2. Messages in Traditional Chinese

To send a message in Traditional Chinese, first install the ‘SMS Server tools’ package. For more detailed information regarding the installation of this package, refer to Section (d) of Chapter 5.6.2.1. Before you can send a message in Traditional Chinese the locale configuration for the system must be changed to **UTF-8** encoding. Refer to the procedure described below for details of how to accomplish this.

Step 1: Use the following command to create a new system locale and write the ‘LC_CTYPE=zh_TW.utf8’ environment variables to the ‘/etc/default/locale’ file, as illustrated in Figure 5.6.2.2-1.

(Note: ‘zh_TW.utf8’ is the UTF-8 code for Traditional Chinese.)

```
# echo LC_CTYPE=zh_TW.utf8 > /etc/default/locale
```



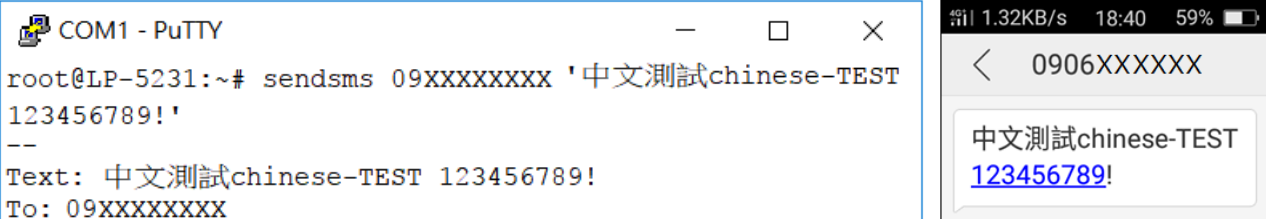
```
COM1 - PuTTY
root@LP-5231:~# echo LC_CTYPE=zh_TW.utf8 > /etc/default/locale
root@LP-5231:~# cat /etc/default/locale
LC_CTYPE=zh_TW.utf8
root@LP-5231:~#
```

Figure 5.6.2.2-1. Setting the system locale

Step 2: To apply the new configuration, type the ‘reboot’ command to restart the LinPAC.

Step 3: Use the ‘/etc/init.d/sms3 start’ command to start the SMSD service in the background.

Step 4: Send a message to a mobile device using Traditional Chinese. The results of the execution are as illustrated in Figure 5.6.2.2-2.



```
COM1 - PuTTY
root@LP-5231:~# sendsms 09XXXXXXXX '中文測試chinese-TEST
123456789!'
--
Text: 中文測試chinese-TEST 123456789!
To: 09XXXXXXXX
```

Mobile phone screenshot showing received SMS: 中文測試chinese-TEST 123456789!

Figure 5.6.2.2-2. Sending an SMS message using Traditional Chinese

6. LinPAC AM335x PAC System Settings

The following is a guide to easily configuration the LinPAC AM335x PAC.

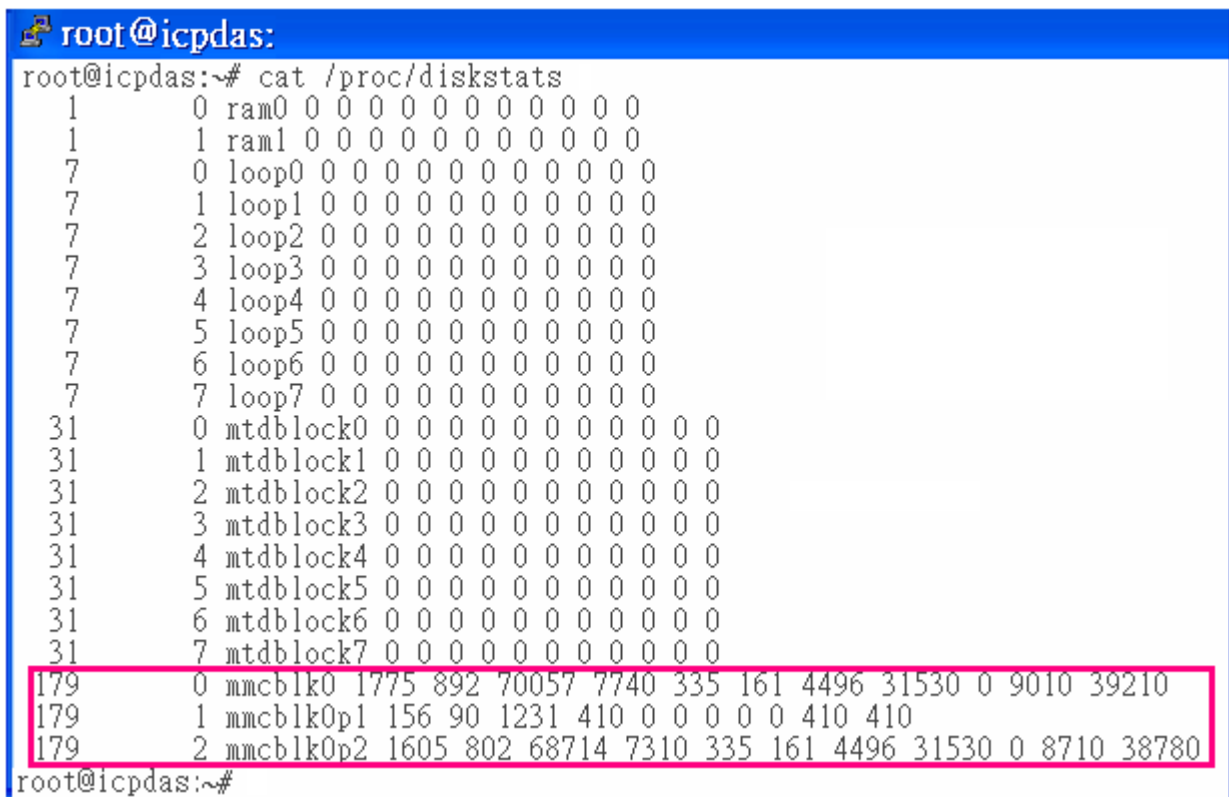
6.1. Using a microSD Card

When using a microSD card, be sure to pay attention to the following items:

1. Unmount the microSD card before removing it.
2. Do not power off or reboot the LinPAC AM335x PAC while data is being written to or read from the microSD card.
3. The microSD card must be formatted with the VFAT/EXT2/EXT3 file system.

To mount a microSD storage devices follow the procedure described below:

(1) Type '`cat /proc/diskstats`' to find the device name of microSD card. (Refer to Figure 6.1-1)



```
root@icpdas:~# cat /proc/diskstats
1      0 ram0 0 0 0 0 0 0 0 0 0 0 0 0
1      1 ram1 0 0 0 0 0 0 0 0 0 0 0 0
7      0 loop0 0 0 0 0 0 0 0 0 0 0 0 0
7      1 loop1 0 0 0 0 0 0 0 0 0 0 0 0
7      2 loop2 0 0 0 0 0 0 0 0 0 0 0 0
7      3 loop3 0 0 0 0 0 0 0 0 0 0 0 0
7      4 loop4 0 0 0 0 0 0 0 0 0 0 0 0
7      5 loop5 0 0 0 0 0 0 0 0 0 0 0 0
7      6 loop6 0 0 0 0 0 0 0 0 0 0 0 0
7      7 loop7 0 0 0 0 0 0 0 0 0 0 0 0
31     0 mtddb0 0 0 0 0 0 0 0 0 0 0 0 0
31     1 mtddb1 0 0 0 0 0 0 0 0 0 0 0 0
31     2 mtddb2 0 0 0 0 0 0 0 0 0 0 0 0
31     3 mtddb3 0 0 0 0 0 0 0 0 0 0 0 0
31     4 mtddb4 0 0 0 0 0 0 0 0 0 0 0 0
31     5 mtddb5 0 0 0 0 0 0 0 0 0 0 0 0
31     6 mtddb6 0 0 0 0 0 0 0 0 0 0 0 0
31     7 mtddb7 0 0 0 0 0 0 0 0 0 0 0 0
179    0 mmcblk0 1775 892 70057 7740 335 161 4496 31530 0 9010 39210
179    1 mmcblk0p1 156 90 1231 410 0 0 0 0 0 410 410
179    2 mmcblk0p2 1605 802 68714 7310 335 161 4496 31530 0 8710 38780
root@icpdas:~#
```

Figure 6.1-1. Find the device name of microSD card

(2) Type 'mkdir /mnt/hda' to create a directory named 'hda'. (Refer to Figure 6.1-2)

(3) Files contained on a mounted microSD card can be accessed from the /mnt/hda directory.

(Refer to Figure 6.1-2)

```
root@icpdas:
root@icpdas:/mnt# mkdir hda
root@icpdas:/mnt# ls
hda nfs
root@icpdas:/mnt# mount /dev/mmcblk0p2 /mnt/hda
root@icpdas:/mnt# mount
/dev/root on / type ext4 (rw,noatime,errors=remount-ro,user_xattr,barrier=1,data=ordered)
devtmpfs on /dev type devtmpfs (rw,relatime,size=253396k,nr_inodes=63349,mode=755)
none on /dev/pts type devpts (rw,nosuid,noexec,relatime,mode=600)
none on /proc type proc (rw,nosuid,nodev,noexec,relatime)
none on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw,nosuid,nodev,noexec,relatime)
none on /sys/kernel/debug type debugfs (rw,relatime)
none on /run type tmpfs (rw,nosuid,noexec,relatime,size=50700k,mode=755)
none on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
none on /run/shm type tmpfs (rw,nosuid,nodev,relatime)
/dev/mmcblk0p1 on /boot/uboot type vfat (rw,noatime,fmask=0022,dmask=0022,codepage=cp437,iocharset=iso8859-1,shortname=mixed,errors=remount-ro)
rpc_pipefs on /run/rpc_pipefs type rpc_pipefs (rw,relatime)
nfsd on /proc/fs/nfsd type nfsd (rw,relatime)
/dev/mmcblk0p2 on /mnt/hda type ext4 (rw,relatime,errors=remount-ro,user_xattr,barrier=1,data=ordered)
root@icpdas:/mnt#
```

Figure 6.1-2. Create and mount a directory named 'had'

6.1.1. Mounting a microSD Card

To use a microSD card, insert the microSD card into the socket on the LinPAC AM335x PAC, and it will be automatically mounted when the LinPAC AM335x PAC is booted. The files of SD card can then be accessed from the **/boot/uboot** directory. (Refer to Figure 6.1.1-1)

```
root@icpdas:~# mount
/dev/root on / type ext4 (rw,noatime,errors=remount-ro,user_xattr,barrier=1,data=ordered)
devtmpfs on /dev type devtmpfs (rw,relatime,size=253396k,nr_inodes=63349,mode=755)
none on /dev/pts type devpts (rw,nosuid,noexec,relatime,mode=600)
none on /proc type proc (rw,nosuid,nodev,noexec,relatime)
none on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw,nosuid,nodev,noexec,relatime)
none on /sys/kernel/debug type debugfs (rw,relatime)
none on /run type tmpfs (rw,nosuid,noexec,relatime,size=50700k,mode=755)
none on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
none on /run/shm type tmpfs (rw,nosuid,nodev,relatime)
/dev/mmcblk0p1 on /boot/uboot type vfat (rw,noatime,fmask=0022,dmask=0022,codepage=cp437,ioccharset=iso8859-1,shortname=mixed,errors=remount-ro)
rpc_pipefs on /run/rpc_pipefs type rpc_pipefs (rw,relatime)
nfsd on /proc/fs/nfsd type nfsd (rw,relatime)
root@icpdas:~#
```

Figure 6.1.1-1. The files of SD card can be accessed from the **/boot/uboot** directory

6.1.2. Unmounting the microSD Card

Before removing the microSD card from the LinPAC AM335x PAC, unmount the card by entering the command:

```
# umount /boot/uboot
```

The microSD card can then be safely removed to prevent damage to the card. (Refer to Figure 6.1.2-1)

```
root@icpdas: /etc/rc4.d# mount
/dev/root on / type ext4 (rw,noatime,errors=remount-ro,user_xattr,barrier=1,data=orderd)
devtmpfs on /dev type devtmpfs (rw,relatime,size=253396k,nr_inodes=63349,mode=755)
none on /dev/pts type devpts (rw,nosuid,noexec,relatime,mode=600)
none on /proc type proc (rw,nosuid,nodev,noexec,relatime)
none on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw,nosuid,nodev,noexec,relatime)
none on /sys/kernel/debug type debugfs (rw,relatime)
none on /run type tmpfs (rw,nosuid,noexec,relatime,size=50700k,mode=755)
none on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
none on /run/shm type tmpfs (rw,nosuid,nodev,relatime)
rpc_pipefs on /run/rpc_pipefs type rpc_pipefs (rw,relatime)
nfsd on /proc/fs/nfsd type nfsd (rw,relatime)
root@icpdas:/etc/rc4.d#
root@icpdas:/etc/rc4.d# df
Filesystem      1K-blocks    Used Available Use% Mounted on
rootfs          2820552  866660   1812520  33% /
/dev/root       2820552  866660   1812520  33% /
devtmpfs        253396      4    253392   1% /dev
none            50700      200    50500   1% /run
none            5120       0     5120   0% /run/lock
none           253484     0    253484   0% /run/shm
root@icpdas:/etc/rc4.d#
```

Figure 6.1.2-1. Remove the microSD card

6.1.3. Scanning and repairing a microSD Card

After the LinPAC AM335x PAC is booted, the microSD card will be named `‘/dev/mmcblk0p1’`. It is recommended that the microSD card is unmounted first before attempting to perform a scan or repair.

- ❑ **blockdev:** this command is used to call block device ioctls from the command line.

Parameter	Description	Example
<code>--report</code>	print a report for device	<code>blockdev --report /dev/mmcblk0p1</code>
<code>-v</code> <code>--getra</code> <code>--getbz</code>	get readhead and blocksize	<code>blockdev -v --getra --getbz /dev/mmcblk0p1</code>

- ❑ **fsck.minix:** this command is used to perform a consistency check for the Linux MINIX filesystem.

Parameter	Description	Example
<code>-r</code>	performs interactive repairs	<code>fsck.minix -r /dev/mmcblk0p1</code>
<code>-s</code>	outputs super-block information	<code>fsck.minix -s /dev/mmcblk0p1</code>

- ❑ **fsck.vfat:** this command is used to check and repair MS-DOS file systems.

Parameter	Description	Example
<code>-a</code>	automatically repair the file system	<code>fsck.vfat -a /dev/mmcblk0p1</code>
<code>-l</code>	list path names of files being processed	<code>fsck.vfat -l /dev/mmcblk0p1</code>

- ❑ **mkfs:** this command is used to build a Linux file system on a device, usually a hard disk partition.

Parameter	Description	Example
<code>-t</code>	specifies the type of file system to be built	<code>mkfs -t vfat /dev/mmcblk0p1</code>
<code>-c</code>	check the device for bad blocks before building the file system	<code>mkfs -c vfat /dev/mmcblk0p1</code>

- ❑ **mkfs.minix:** this command is used to make a MINIX filesystem

Parameter	Description	Example
	create a Linux MINIX file-system	mkfs.minix /dev/mmcbk0p1
-c	check the device for bad blocks before building the file system	mkfs.minix -c /dev/mmcbk0p1

- ❑ **mkfs.vfat:** this command is used to make an MS-DOS filesystem

Parameter	Description	Example
-A	use Atari variation of the MS-DOS filesystem	mkfs.vfat -A /dev/mmcbk0p1
-v	verbose execution	mkfs.vfat -v /dev/mmcbk0p1

6.2. Using a USB Storage Device

USB storage devices are not automatically mounted to the LinPAC AM335x PAC, set it must be manually mounted before attempting to access the USB storage device. (Refer to Figure 6.2-1)

```
root@icpdas:
root@icpdas:/mnt# cat /proc/diskstats
 1      0 ram0 0 0 0 0 0 0 0 0 0 0 0 0 0
 1      1 ram1 0 0 0 0 0 0 0 0 0 0 0 0 0
 7      0 loop0 0 0 0 0 0 0 0 0 0 0 0 0 0
 7      1 loop1 0 0 0 0 0 0 0 0 0 0 0 0 0
 7      2 loop2 0 0 0 0 0 0 0 0 0 0 0 0 0
 7      3 loop3 0 0 0 0 0 0 0 0 0 0 0 0 0
 7      4 loop4 0 0 0 0 0 0 0 0 0 0 0 0 0
 7      5 loop5 0 0 0 0 0 0 0 0 0 0 0 0 0
 7      6 loop6 0 0 0 0 0 0 0 0 0 0 0 0 0
 7      7 loop7 0 0 0 0 0 0 0 0 0 0 0 0 0
31     0 mtddblock0 0 0 0 0 0 0 0 0 0 0 0 0 0
31     1 mtddblock1 0 0 0 0 0 0 0 0 0 0 0 0 0
31     2 mtddblock2 0 0 0 0 0 0 0 0 0 0 0 0 0
31     3 mtddblock3 0 0 0 0 0 0 0 0 0 0 0 0 0
31     4 mtddblock4 0 0 0 0 0 0 0 0 0 0 0 0 0
31     5 mtddblock5 0 0 0 0 0 0 0 0 0 0 0 0 0
31     6 mtddblock6 0 0 0 0 0 0 0 0 0 0 0 0 0
31     7 mtddblock7 0 0 0 0 0 0 0 0 0 0 0 0 0
 8      0 sda 303 1489 2401 4200 0 0 0 0 0 4200 4200
 8      1 sda1 283 1489 2241 4150 0 0 0 0 0 4150 4150
root@icpdas:/mnt#
```

Figure 6.2-1. Checking that the USB storage device is on disk

6.2.1. Mounting a USB Storage Device

To mount a USB storage devices follow the procedure described below:

- (1) Type `mkdir /mnt/usb` to create a directory named 'usb'.
- (2) Type `mount /dev/sda1 /mnt/usb` to mount the USB storage device to the usb directory and then type `ls /mnt/usb` to view the contents of the USB storage device. (Refer to Figure 6.2.1-1)

```
root@icpdas:
root@icpdas:/mnt# mkdir /mnt/usb
root@icpdas:/mnt#
root@icpdas:/mnt# cat /proc/diskstats | grep sda*
   8          0 sda 165 563 1337 4060 0 0 0 0 0 4060 4060
   8          1 sda1 145 563 1177 4010 0 0 0 0 0 4010 4010
root@icpdas:/mnt#
root@icpdas:/mnt# mount /dev/sda1 /mnt/usb
root@icpdas:/mnt# mount
ubi0:rootfs on / type ubifs (rw,relatime)
devtmpfs on /dev type devtmpfs (rw,relatime,size=253396k,nr_inodes=63349,mode=755)
none on /dev/pts type devpts (rw,nosuid,noexec,relatime,mode=600)
none on /proc type proc (rw,nosuid,nodev,noexec,relatime)
none on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw,nosuid,nodev,noexec,relatime)
none on /sys/kernel/debug type debugfs (rw,relatime)
tmpfs on /tmp type tmpfs (rw,relatime)
none on /run type tmpfs (rw,nosuid,noexec,relatime,size=50700k,mode=755)
tmpfs on /boot/uboot type tmpfs (rw,relatime)
none on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
none on /run/shm type tmpfs (rw,nosuid,nodev,relatime)
/dev/sda1 on /mnt/usb type vfat (rw,relatime,fmask=0022,dmask=0022,codepage=cp437,iocharset=iso8859-1,shortname=mixed,errors=remount-ro)
root@icpdas:/mnt#
root@icpdas:/mnt# ls /mnt/usb
lp8k_9k_1.0.tgz          boot          interfaces.txt  rootfs.ubi  ulmage
root@icpdas:/mnt#
```

Figure 6.2.1-1. Mounting a USB Storage Device

6.2.2. Unmounting the USB Storage Device

Before removing the USB storage device from the LinPAC AM335x PAC, the device must be unmounted to prevent any damage to the device. To unmount the device, type the `umount/mnt/usb` command and then remove the USB storage device.

6.3. WDT

6.3.1. WDT for LP-8x2x and LP-9x2x

Use the 'wdt' command to enable and configure the WDT. There are three steps to this process, which are described below.

(1) Enable the WDT.

- Enable the WDT. The default response time is 10 seconds.

```
# wdt -e
```

- Enable the WDT and set the response time (the response time ranges between 2 and 510 seconds).

```
# wdt -e -s4 // Set the response time to 4 seconds
```

(2) Refresh the WDT source.

```
# wdt -r
```

(3) Disable the WDT.

```
# wdt -d
```

6.3.2. WDT for LP-22xx and LP-52xx

To Enable WDT working status, there are two steps to this process, which are described below.

(1) Refresh WDT source.

```
# echo timer > /sys/class/leds/beaglebone::wdt/trigger //Refresh WDT
```

(2) Enable WDT.

```
# echo 0 > /proc/hmistat/radiopower //Enable WDT
```

To Disable WDT working status, there are two steps to this process, which are described below.

(1) Disable WDT.

```
# echo 1 > /proc/hmistat/radiopower //Disable WDT
```

(2) Clear WDT refresh source.

```
# echo none > /sys/class/leds/beaglebone::wdt/trigger //Clear WDT Refresh Source
```

6.4. EEPROM/FRAM

To Enable EEPROM/EEPROM working status, there are four steps to this process, which are described below.

(1) Startup GPIO function.

```
# echo 64 > /sys/class/gpio/export
```

(2) The EEPROM/FRAM is write protected by default, the user needs to modify default value.

```
# echo out > /sys/class/gpio/gpio64/direction
```

(3) Change to writable of EEPROM/FRAM.

```
# echo 0 > /sys/class/gpio/gpio64/value
```

(4) To write a data to EEPROM/FRAM.

```
# echo hello > /sys/bus/i2c/devices/1-0050/eeprom
```

More detailed information, please refer to the demo code:

[C:\cygwin\LinPAC_am335x_SDK\examples\common\eeeprom.c](#) or

[root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk/i8k/examples/common/eeeprom.c](#)

6.5. LED

Following is the control method of the LinPAC AM335x series PAC LED indicators.

6.5.1. LED Indicators for LP-22xx series

The LP-22xx series modules have 6 LED indicators, as illustrated in Figure 6.5.1-1.

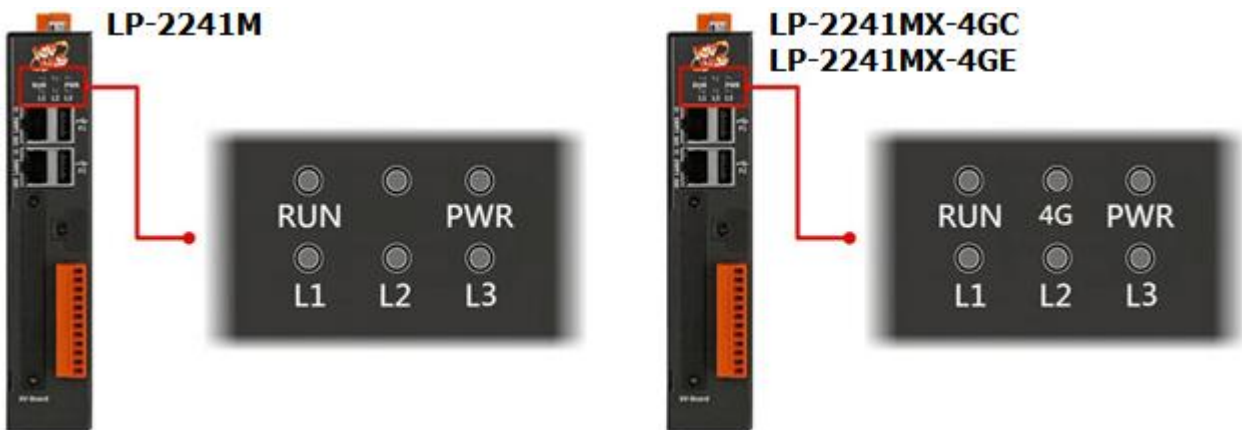


Figure 6.5.1-1. LED indicators for LP-22xx series

LED Indicator	Color	Meaning
4G	Green	The 4G LED indicates that the antenna is connected to 4G network.
PWR	Red	Power is on.
RUN	Green	Power on and OS is running.
L1	Green	User programmable LED indicator.
L2	Orange	
L3	Red	

The user can use 'led' command to control the LP-22xx LED indicator.

Parameter:

LED Indicator	L1		L2		L3	
Status	ON	OFF	ON	OFF	ON	OFF
Parameter	-g1	-g0	-y1	-y0	-r1	-r0

6.5.2. LED Indicators for LP-52xx series

The LP-52xx series modules have 3/4 LED indicators, as illustrated in Figure 6.5.2-1.

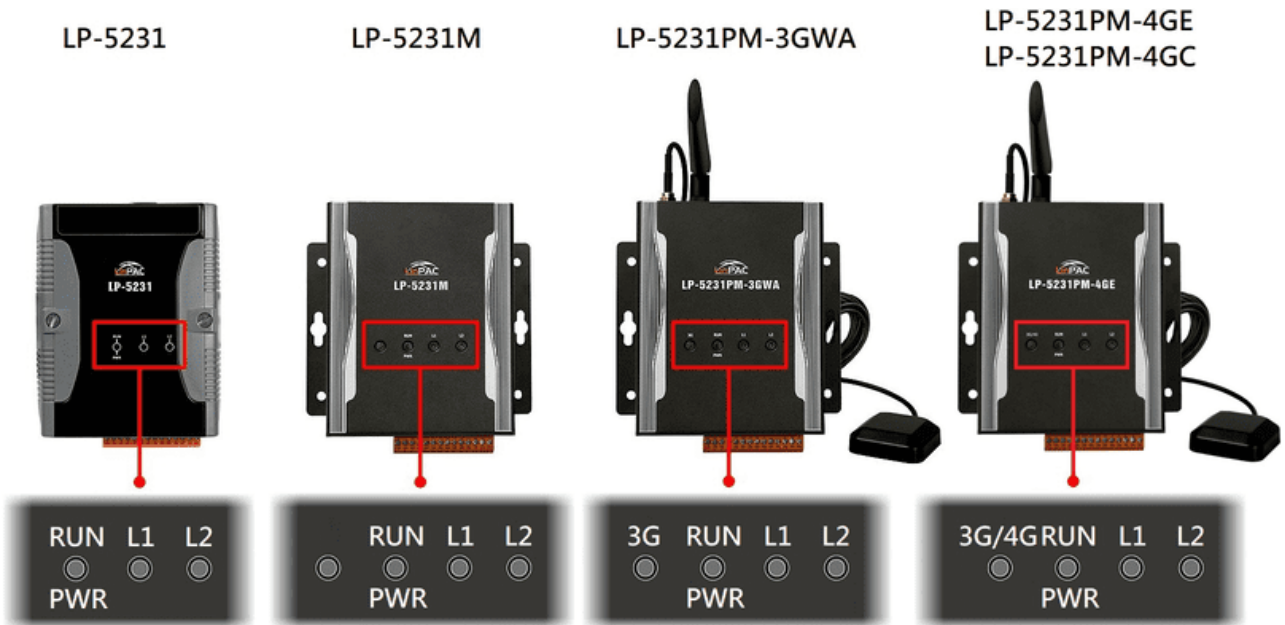


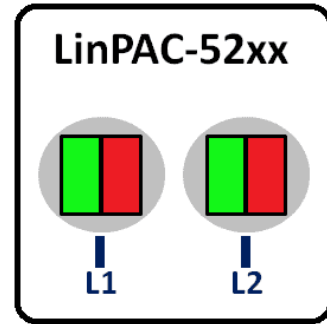
Figure 6.5.2-1. LED indicators for LP-52xx series

LED Indicator	Color	Meaning
3G/4G	Green	The 3G/4G LED indicates that the antenna is connected to 3G/4G network.
PWR	Red	Power is on.
RUN	Green	OS is running.
L1	Green/Red	User programmable LED indicator.
L2	Green/Red	

The led_52xx.c demo program illustrates control method of the LP-52xx LED indicator, user can be found demo code in the path C:\cygwin\LinPAC_am335x_SDK\examples\common\led-52xx.c or root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk/i8k/examples/common/led-52xx.c

Parameter:

LED Indicator		Parameter
L1		-l1
L2		-l2
LED color		Parameter
Green	ON	-g1
	OFF	-g0
Red	ON	-r1
	OFF	-r0



6.5.3. LED Indicators for LP-8x2x series

The LP-8x2x series modules have 2 LED indicators, as illustrated in Figure 6.5.3-1.



Figure 6.5.3-1. LED indicators for LP-8x2x series

LED Indicator	Color	Meaning
PWR	Green	Power 1 is on.
RUN	Red	OS is running.
	Red	User programmable LED indicator.

The led_8x2x.c demo program illustrates control method of the LP-8x2x LED indicator, user can be found demo code in the path C:\cygwin\LinPAC_am335x_SDK\examples\common\led-8x2x.c or root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk/i8k/examples/common/led-8x2x.c

Parameter:

- [RUN LED] **1** : Turn on the RUN LED
- 0** : Turn off the RUN LED

6.5.4. LED Indicators for LP-9x2x series

The LP-9x2x series modules have 5 LED indicators, as illustrated in Figure 6.5.4-1.

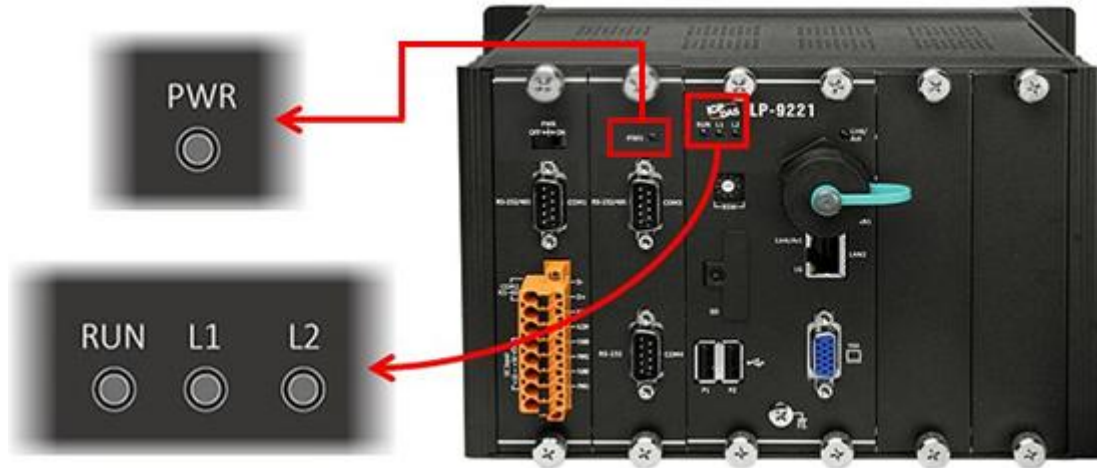


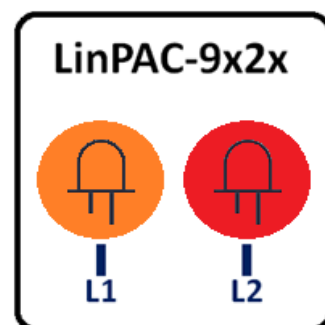
Figure 6.5.4-1. LED indicators for LP-9x2x series

LED Indicator	Color	Meaning
PWR	Red	Power is on.
RUN	Green	OS is running.
L1	Orange	User programmable LED indicator.
L2	Red	

The led_9x2x.c demo program illustrates control method of the LP-9x2x LED indicator, user can be found demo code in the path C:\cygwin\LinPAC_am335x_SDK\examples\common\led-9x2x.c or root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk/i8k/examples/common/led-9x2x.c

Parameter:

Options	LED Status	
	L1	L2
1	ON	OFF
2	OFF	ON
3	ON	ON
4	OFF	OFF



7. Additional Support

This chapter provides additional information related to the modules supported, together with instructions that can be used to enhance the functionality and efficiency of the LinPAC AM335x PAC module.

7.1. Support for N-Port Modules

N-port communication modules provide **two or four serial ports** and can be inserted into the slot of an LP-8x2x/9x2x embedded controller. In this way, additional serial ports can be used on the LP-8x2x/9x2x embedded controller, meaning that the maximum number of serial ports available on the LP-8x2x/9x2x will be expanded to **thirty-four**.

■ LP-8x2x

The LP-8x2x embedded controller is a multi-tasking unit, meaning that all the serial ports can be controlled simultaneously. **The number of each serial port on the I-8114W and I-8112iW modules** are presented in Figures 7.1-1 and 7.1-2. The information illustrated in Figure 7.1-5 is for the LP-8121 only and is **fixed** based on their slot position.

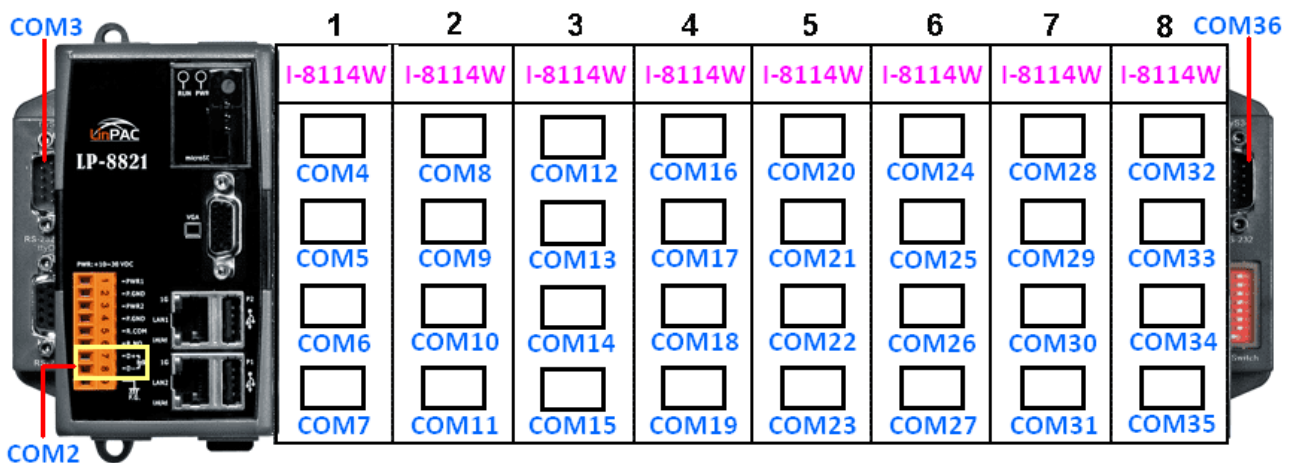


Figure 7.1-1. The number of each serial port on the I-8114W modules are presented

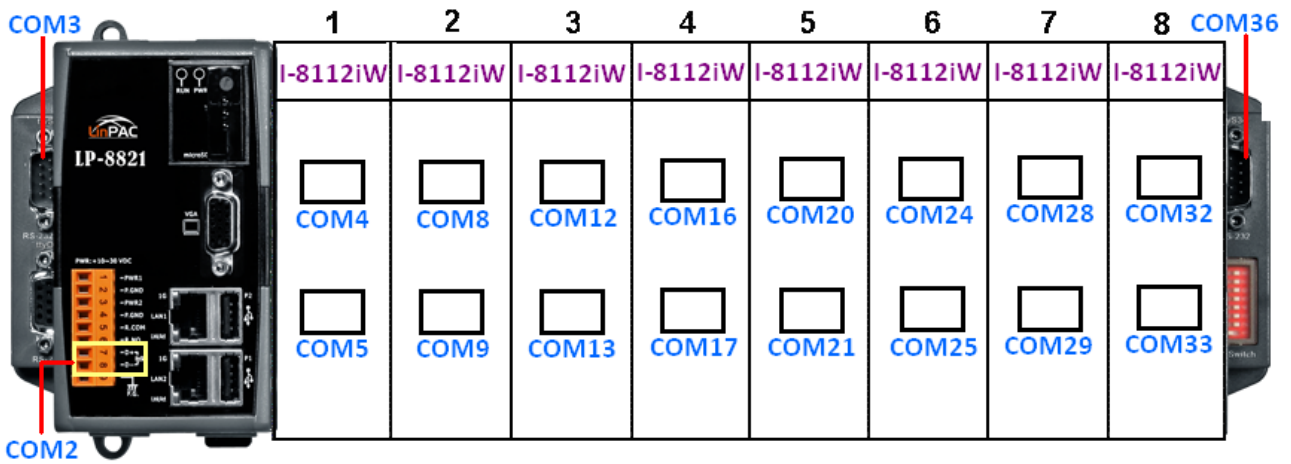


Figure 7.1-2. The number of each serial port on the I-8112iW modules are presented

Figures 7.1-3 and 7.1-4 illustrated the serial port numbers that correspond to the **device name** on the LP-8x2x.

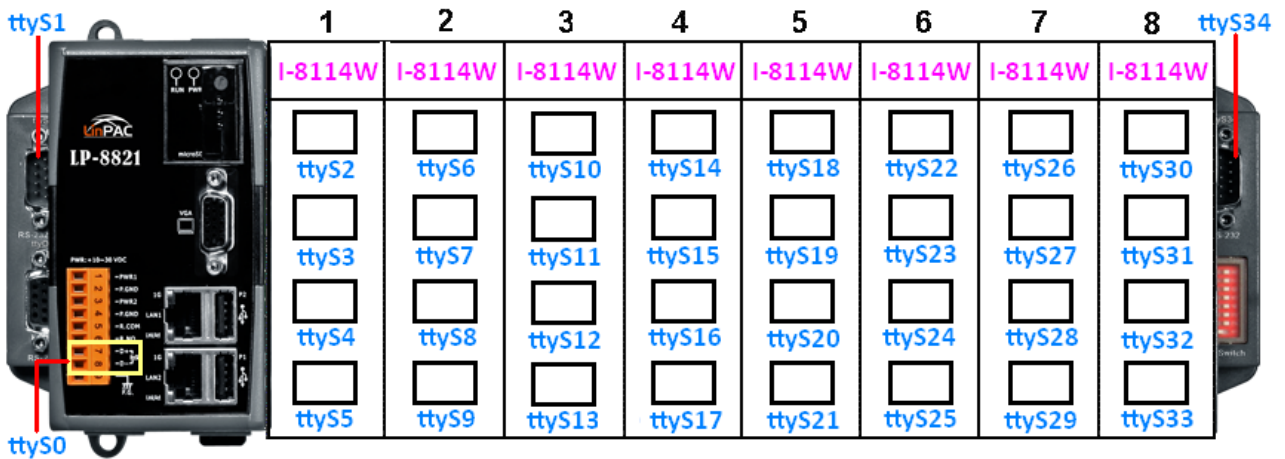


Figure 7.1-3. Device node of I-8114W

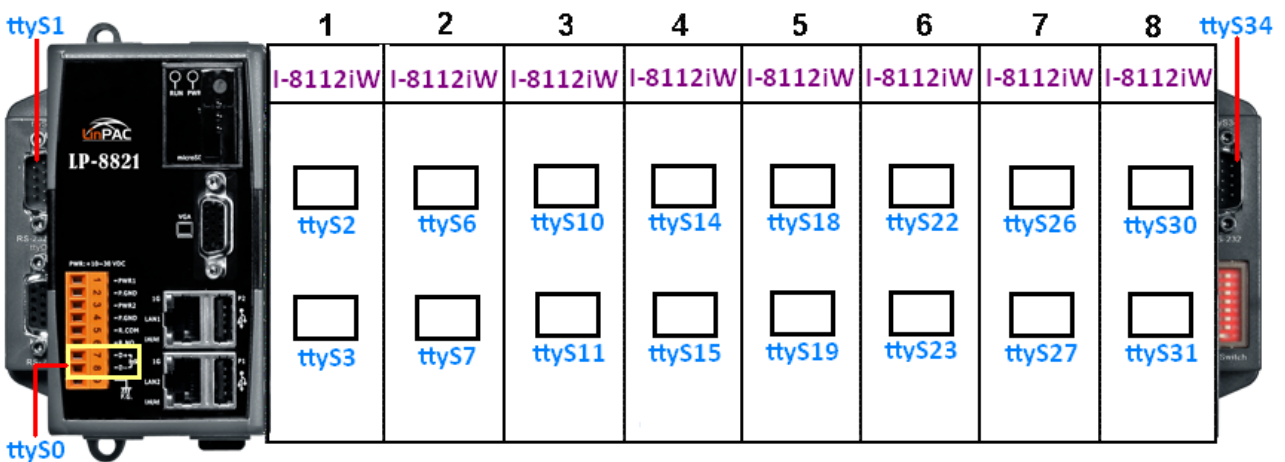


Figure 7.1-4. Device node of I-8112iW

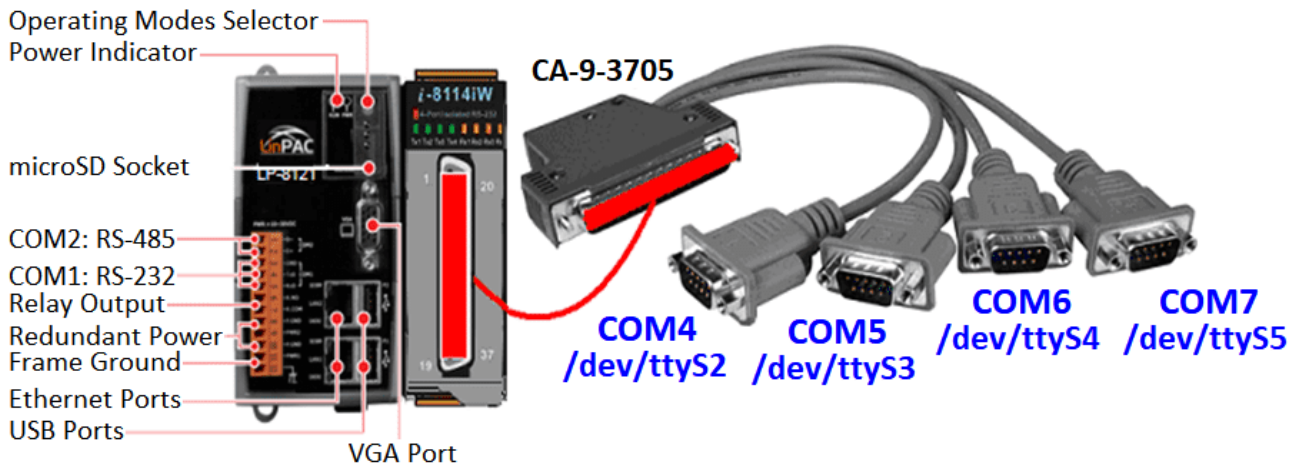


Figure 7.1-5. Device slot information for the LP-8121 only

The user can type 'getlist' to check the module is installed or not, as illustrated in Figure 7.1-6.

```

root@icpdas:~# /usr/sbin/iTalk/getlist
slot 1 ... 8024
slot 2 ... not installed
slot 3 ... 8144
slot 4 ... 8144
root@icpdas:~# cat /etc/version
LP-8x21/9x21(Ubuntu Precise 12.04.4 LTS)
Linux Kernel : 20171222
Linux Rootfs : 20171229
root@icpdas:~#

```

Figure 7.1-6. Lists the names of all modules inserted

Selection guide for High-profile I-8K modules:

Module	Interface	Ports	Max. Channels	Max. Speed (Kbps)	Isolation (V)
I-8112iW	RS-232	2	16	115.2	2500
I-8114W	RS-232	4	32	115.2	–
I-8114iW	RS-232	4	32	115.2	2500
I-8142iW	RS-422/RS-485	2	16	115.2	2500
I-8144iW	RS-422/RS-485	4	32	115.2	2500

For more information relating to these modules, refer to:

http://www.icpdas.com/products/Remote_IO/i-8ke/selection_rs232_i8k.htm

■ LP-9x2x

The LP-9x2x embedded controller is a multi-tasking unit, meaning that all the serial ports can be controlled simultaneously. **The number of each serial port on the I-9114 and I-9144 modules are presented in Figure 7.1-7 and is fixed based on their slot position.**

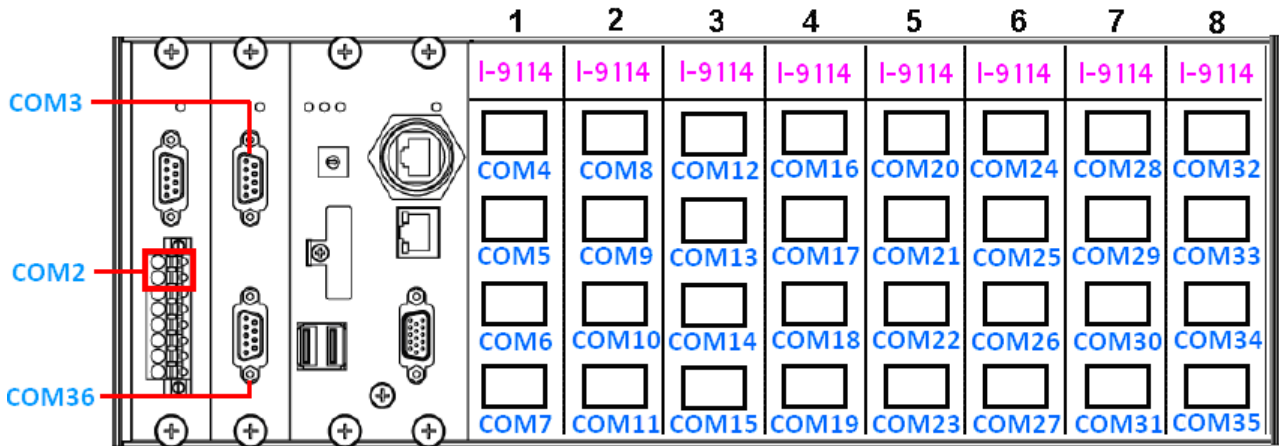


Figure 7.1-7. The number of each serial port on the I-9114 modules are presented

Figure 7.1-8 illustrated the serial port numbers that correspond to the **device name** on the LP-9x2x.

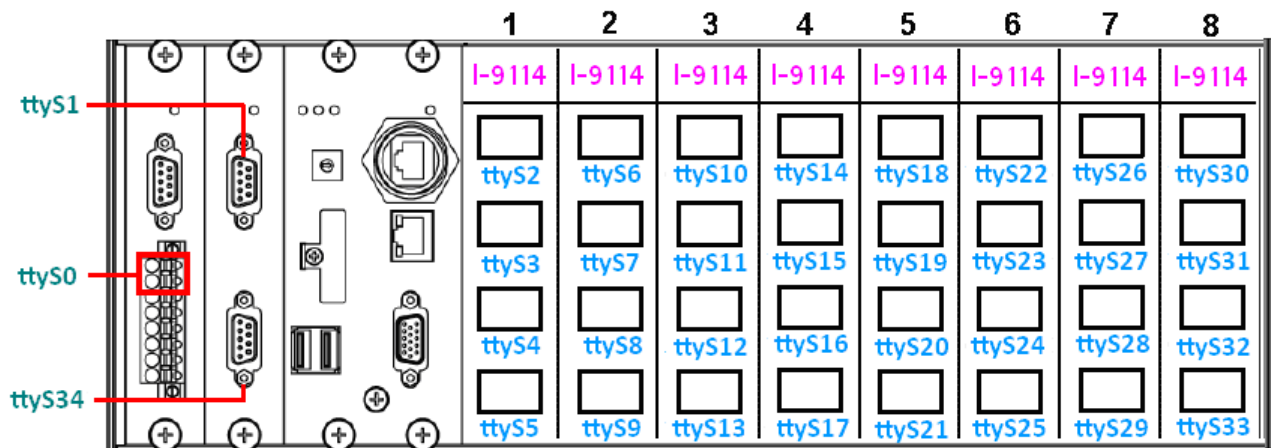


Figure 7.1-8. Device node of I-9114

Check the module is installed or not, and then check the status of the serial port, as illustrated in Figure 7.1-9.

```

root@icpdas
root@icpdas:~# getlist
slot 1 ... 9017
slot 2 ... 9144
slot 3 ... 9114
slot 4 ... 9017
root@icpdas:~#
root@icpdas:~# lsmod
Module                Size  Used by
8250                   41757  0
8250_lp9k              3300  0
slot                   28379  0
irq_ipic               3325  0
joydev                 7254  0
pps_ldisc              1719  0
root@icpdas:~#
root@icpdas:~# dmesg |grep -r 8250*
[ 4.182537] OMAP Watchdog Timer Rev 0x01: initial timeout 60 sec
[ 12.458825] ADDRCONF(NETDEV_UP): eth1: link is not ready
[ 20.274066] Serial: 8250/16550 driver $Revision: 1.90 $ 46 ports, IRQ sharing enabled
[ 20.315189] serial8250.0: ttyS0 at MMIO 0x1009050 (irq = 653) is a XR16850
[ 20.318970] serial8250.0: ttyS1 at MMIO 0x1009060 (irq = 654) is a XR16850
[ 20.328413] serial8250.0: ttyS6 at MMIO 0x1002040 (irq = 641) is a XR16850
[ 20.330306] serial8250.0: ttyS7 at MMIO 0x1002060 (irq = 641) is a XR16850
[ 20.331160] serial8250.0: ttyS8 at MMIO 0x1002080 (irq = 641) is a XR16850
[ 20.335976] serial8250.0: ttyS9 at MMIO 0x10020a0 (irq = 641) is a XR16850
[ 20.338528] serial8250.0: ttyS10 at MMIO 0x1003040 (irq = 642) is a XR16850
[ 20.340388] serial8250.0: ttyS11 at MMIO 0x1003060 (irq = 642) is a XR16850
[ 20.342259] serial8250.0: ttyS12 at MMIO 0x1003080 (irq = 642) is a XR16850
[ 20.344801] serial8250.0: ttyS13 at MMIO 0x10030a0 (irq = 642) is a XR16850
[ 20.384541] serial8250.0: ttyS34 at MMIO 0x1009070 (irq = 655) is a XR16850
root@icpdas:~#

```

Figure 7.1-9. Lists the names of all modules inserted

Selection guide for High-profile I-9K modules:

Module	Interface	Ports	Max. Speed (Kbps)	Isolation (Vrms)
I-9114	RS-232	4	115.2	2500
I-9144	RS-422/RS-485	4	115.2	2500

For more information relating to these modules, refer to:

http://www.icpdas.com/root/product/solutions/remote_io/i-9k_i-97k/i-9k_i-97k_selection.html

7.1.1. Application for N-Port Module

The `i7kdio_8114.c` demo program illustrates how to use an I-8114W module that is inserted into an LP-8x21 embedded controller. In this demo program, the I-7044 module (8 DO and 4 DI channels) is controlled through the second serial port on the I-8114W module that is inserted into the slot 2 on the LP-8x21, which, in turn, is connected to an RS-485 network. The address of the I-7044 module is 02 and the baud rate is 115200 bps. Figure 7.1.1-1 provides an illustration of the control diagram.

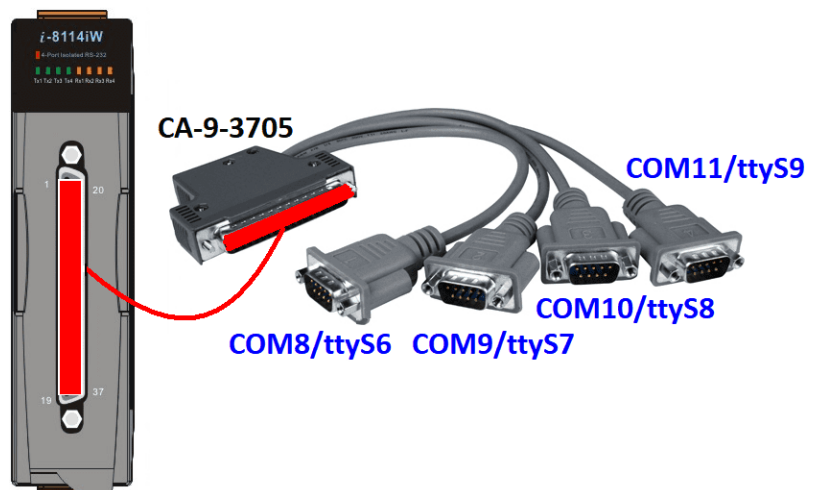


Figure 7.1.1-1. Connection diagram of the device

The result of executing this demo program is that the state of the DO channels can be controlled, and the program returns the state of the DI channels. The source code for the demo program is as follows:

```
#include<stdio.h>
#include<stdlib.h>
#include "msw.h"

char szSend[80], szReceive[80], ans;
WORD wBuf[12];
float fBuf[12];
int main()
{
    int wRetVal, j=0;
    char i[10];
```



```

// Check Open_Com9 on the I-8114W
wRetVal = Open_Com(COM9, 115200, Data8Bit, NonParity, OneStopBit);
if (wRetVal > 0) {
    printf("Failed to open port. \n");
    return (-1);
}

// ***** 7044 DO & DI Parameters *****
wBuf[0] = 9;                // COM Port
wBuf[1] = 0x02;            // Address
wBuf[2] = 0x7044;         // ID
wBuf[3] = 0;              // Checksum disable
wBuf[4] = 100;           // Timeout, 100 milliseconds
wBuf[6] = 0;            // Debug string

while(j!=113) {
    printf("Enter the DO value, or press 'q' to quit -> ");
    scanf("%s",i);
    if (i[0]=='q') {
        wBuf[5] = 0;                // All DO Channels OFF
        wRetVal = DigitalOut(wBuf, fBuf, szSend, szReceive);           // 7044 DO
        break;
    }

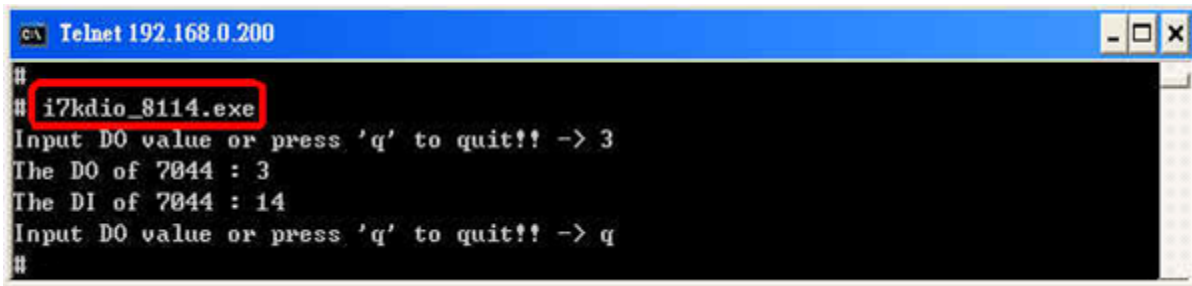
    j=atoi(i);
    if (j>=0 & j<=255)
        wBuf[5] = j;                // DO Channels ON
    else if (j>255)
        wBuf[5] = 255;

    wRetVal = DigitalOut(wBuf, fBuf, szSend, szReceive);
    if (wRetVal)                    // There was an error with the Digital Output on the I-7044
        printf("Digital Output of 7044 is error, Error Code=%d\n", wRetVal);
    else
        printf("The DO value of 7044 is: %u \n", wBuf[5]);

    DigitalIn(wBuf, fBuf, szSend, szReceive);           // 7044 DI
    printf("The DI of 7044 : %u \n", wBuf[5]);
}
Close_Com(COM9);
return 0;
}

```

Figure 7.1.1-2 below illustrates the result of the execution.



```
CA Telnet 192.168.0.200
#
# i7kdio_8114.exe
Input DO value or press 'q' to quit!! -> 3
The DO of 7044 : 3
The DI of 7044 : 14
Input DO value or press 'q' to quit!! -> q
#
```

Figure 7.1.1-2. Results of the demo

7.2. Configuration of multiple spanning tree protocol interface setting with dual LAN

The LP-22xx/8x2x/9x2x series modules include support for the MSTPD daemon, which is the Spanning Tree Protocol (STP) that is always recommended in layer 2 topologies that run on bridges and switches. An extension of STP is the MSTP (Multiple Spanning Tree Protocol), which can be used to prevent loops and broadcast storms on a network, and also provide redundant links for automatic failover if an active link fails. The bridge function allows a virtual interface to be configured so that it can be included in the network. The virtual interface behaves similarly to a physical interface and ensures that LinPAC networking communication is always active, as illustrated in Figure 7.2-1.

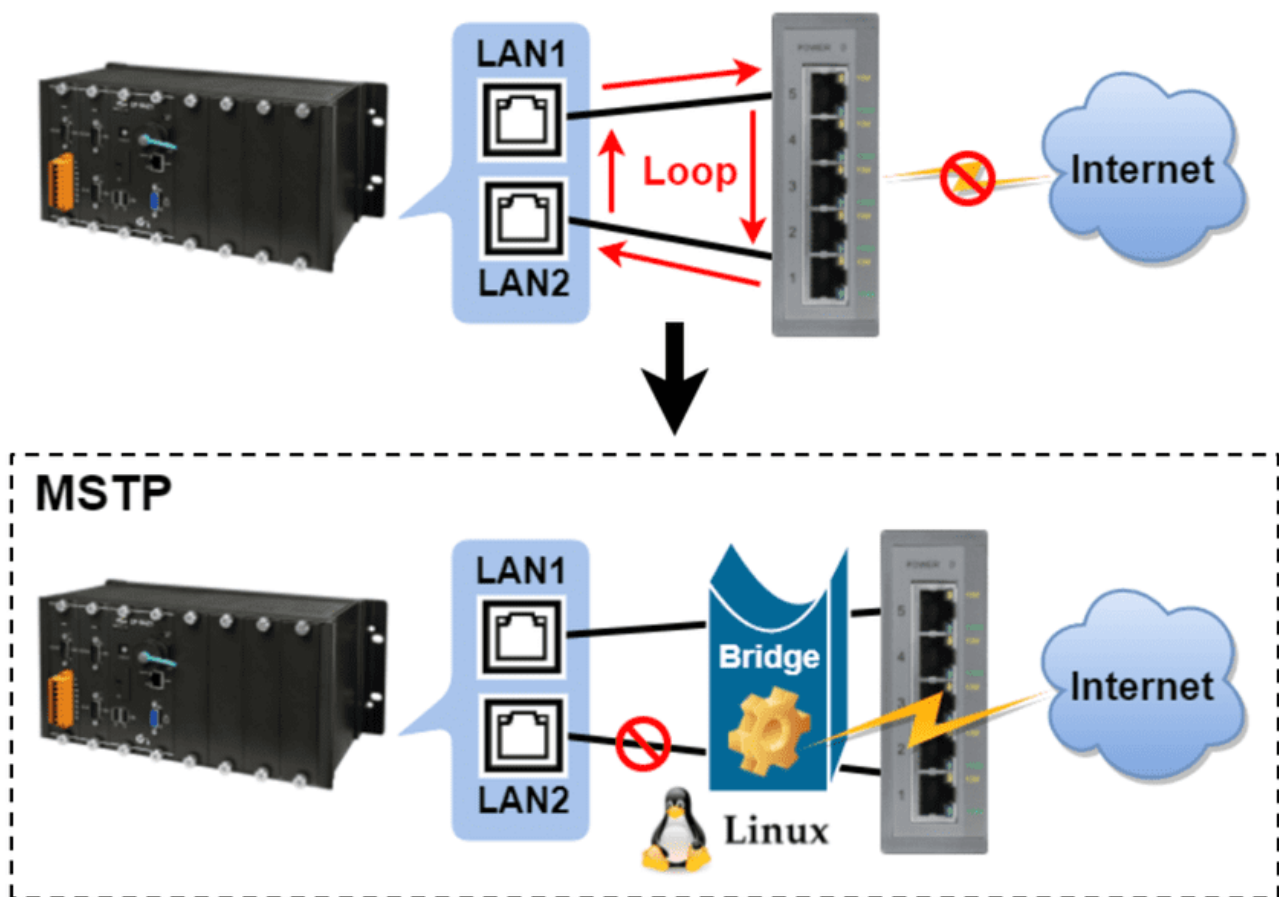


Figure 7.2-1. Using MSTP technology to solve loop problems

The procedure described below will help you to quickly and accurately complete the configuration tasks.

Step 1: Ensure that the bridge-utils package is installed. If not, user can type `'sudo apt-get update'` and `'apt-get install bridge-utils'` command to install bridge-utils package.

Step 2: Before proceeding, back up the interfaces file found in the `'/etc/network/'` directory.

Step 3: Locate the interfaces-mstpd file in the `'/etc/network/'` directory and rename the file as `'interfaces'`.

Step 4: Type `'vi /etc/network/interfaces'` to edit the file, and enable either a DHCP or a Static IP address by configuring the network settings, as illustrated in Figure 7.2-2 below.

DHCP Mode:

```
COM1 - PuTTY
# interfaces(5) file used by ifup(8) and
auto lo
iface lo inet loopback
auto br0
iface eth0 inet manual
iface eth1 inet manual
# DHCP br0
iface br0 inet dhcp
# Static br0
#iface br0 inet static
#address 10.1.0.22
#netmask 255.255.0.0
#gateway 10.1.0.254
bridge_ports eth0 eth1
bridge_stp on
mstpctl_ports eth0 eth1
mstpctl_stp on
mstpctl_forcevers rstp
```

Enable DHCP

Disable Static IP

Static IP Mode:

```
COM1 - PuTTY
# interfaces(5) file used by ifup(8) and
auto lo
iface lo inet loopback
auto br0
iface eth0 inet manual
iface eth1 inet manual
# DHCP br0
#iface br0 inet dhcp
# Static br0
iface br0 inet static
address 10.1.0.22
netmask 255.255.0.0
gateway 10.1.0.254
bridge_ports eth0 eth1
bridge_stp on
mstpctl_ports eth0 eth1
mstpctl_stp on
mstpctl_forcevers rstp
```

Disable DHCP

Assign Static IP

Figure 7.2-2. Configuration for a Dual LAN network

Step 5: Reset the network settings by entering the command `'reboot'` or `'/etc/init.d/networking restart'`.

Step 6: Use the 'ifconfig' command to display the current configuration information for the network interface, as illustrated in Figure 7.2-3.

```
root@icpdas:~# ifconfig
br0    Link encap:Ethernet  HWaddr 68:c9:0b:b4:ba:95
       inet addr:10.1.0.22  Bcast:10.1.255.255  Mask:255.255.0.0
       inet6 addr: fe80::6ac9:bff:feb4:ba95/64 Scope:Link
       UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
       RX packets:129988 errors:0 dropped:0 overruns:0 frame:0
       TX packets:181 errors:0 dropped:0 overruns:0 carrier:0
       collisions:0 txqueuelen:0
       RX bytes:18450942 (18.4 MB)  TX bytes:15518 (15.5 KB)

eth0    Link encap:Ethernet  HWaddr 68:c9:0b:b4:ba:95
       UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
       RX packets:188673 errors:0 dropped:128 overruns:0 frame:0
       TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
       collisions:0 txqueuelen:1000
       RX bytes:36222282 (36.2 MB)  TX bytes:60 (60.0 B)

eth1    Link encap:Ethernet  HWaddr 68:c9:0b:b4:ba:97
       inet6 addr: fe80::6ac9:bff:feb4:ba97/64 Scope:Link
       UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
       RX packets:188330 errors:0 dropped:128 overruns:0 frame:0
       TX packets:365 errors:0 dropped:0 overruns:0 carrier:0
       collisions:0 txqueuelen:1000
       RX bytes:36198068 (36.1 MB)  TX bytes:26692 (26.6 KB)
```

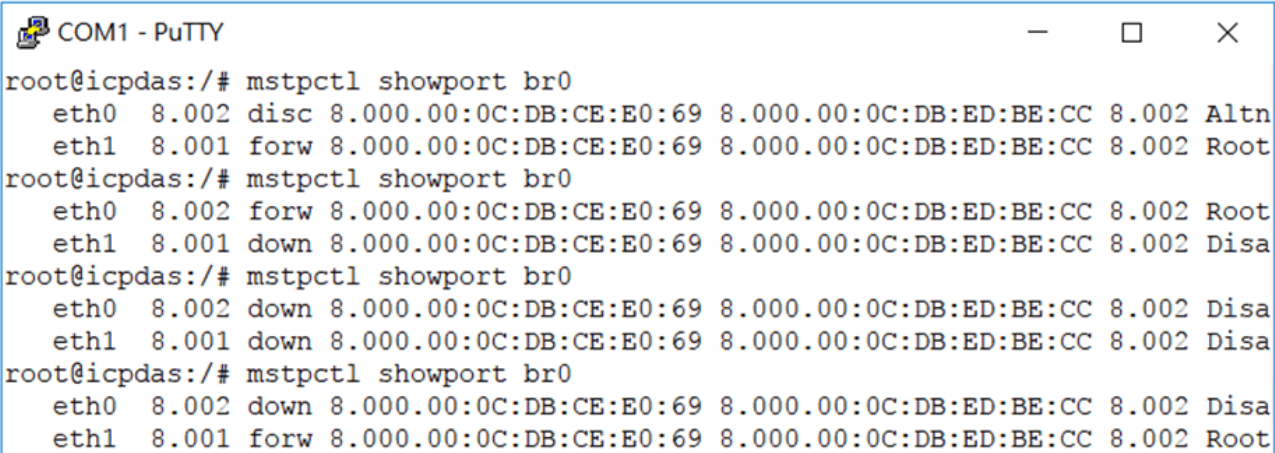
Figure 7.2-3. Checking the IP address that has been assigned to the br0 interface

Step 7: Use the 'mstpcctl showbridge br0' command to verify that the 'force protocol version' is set to RSTP mode, as illustrated in Figure 7.2-4.

```
root@icpdas:~# mstpcctl showbridge br0
br0 CIST info
  enabled          yes
  bridge id        8.000.68:C9:0B:B4:BA:95
  designated root  8.000.00:0C:DB:CE:E0:69
  regional root    8.000.68:C9:0B:B4:BA:95
  root port        eth1 (#1)
  path cost        200019      internal path cost    0
  max age          20          bridge max age        20
  forward delay    15          bridge forward delay  15
  tx hold count    6           max hops               20
  hello time       2           ageing time            300
  force protocol version  rstp
  time since topology change 2084
  topology change count      5
  topology change            no
  topology change port        eth0
  last topology change port    eth1
```

Figure 7.2-4. Check that the MSTPD service is correctly configured

Step 8: Use the '**mstpctl showport br0**' command to check the connection status of the two LANs and monitor any changes in the status when inserting or removing the Ethernet cable, as illustrated in Figure 7.2-5.



```
COM1 - PuTTY
root@icpdas:/# mstpctl showport br0
eth0 8.002 disc 8.000.00:0C:DB:CE:E0:69 8.000.00:0C:DB:ED:BE:CC 8.002 Altn
eth1 8.001 forw 8.000.00:0C:DB:CE:E0:69 8.000.00:0C:DB:ED:BE:CC 8.002 Root
root@icpdas:/# mstpctl showport br0
eth0 8.002 forw 8.000.00:0C:DB:CE:E0:69 8.000.00:0C:DB:ED:BE:CC 8.002 Root
eth1 8.001 down 8.000.00:0C:DB:CE:E0:69 8.000.00:0C:DB:ED:BE:CC 8.002 Disa
root@icpdas:/# mstpctl showport br0
eth0 8.002 down 8.000.00:0C:DB:CE:E0:69 8.000.00:0C:DB:ED:BE:CC 8.002 Disa
eth1 8.001 down 8.000.00:0C:DB:CE:E0:69 8.000.00:0C:DB:ED:BE:CC 8.002 Disa
root@icpdas:/# mstpctl showport br0
eth0 8.002 down 8.000.00:0C:DB:CE:E0:69 8.000.00:0C:DB:ED:BE:CC 8.002 Disa
eth1 8.001 forw 8.000.00:0C:DB:CE:E0:69 8.000.00:0C:DB:ED:BE:CC 8.002 Root
```

Figure 7.2-5. Monitoring the status of the MSTPD bridge port

7.3. Building a sample MQTT application using LinPAC

MQTT (Message Queuing Telemetry Transport) is an ISO standard publish-subscribe based messaging protocol. It is a lightweight connectivity protocol for M2M (machine to machine) communication that works on top of the TCP/IP protocol. The protocol uses a publish-subscribe model for message exchange between machines, based on the efficient distribution of messages to one or many receivers through a broker. It is useful for mobile applications because of its small size, low power usage and minimized data packets.

The LinPAC controller provides message transfer functionality for MQTT applications. Let's look at an example where we wish to communicate between an MQTT client and an MQTT server (broker). The following is a demonstration of the configuration and processes involved, as illustrated in Figure 7.3-1.

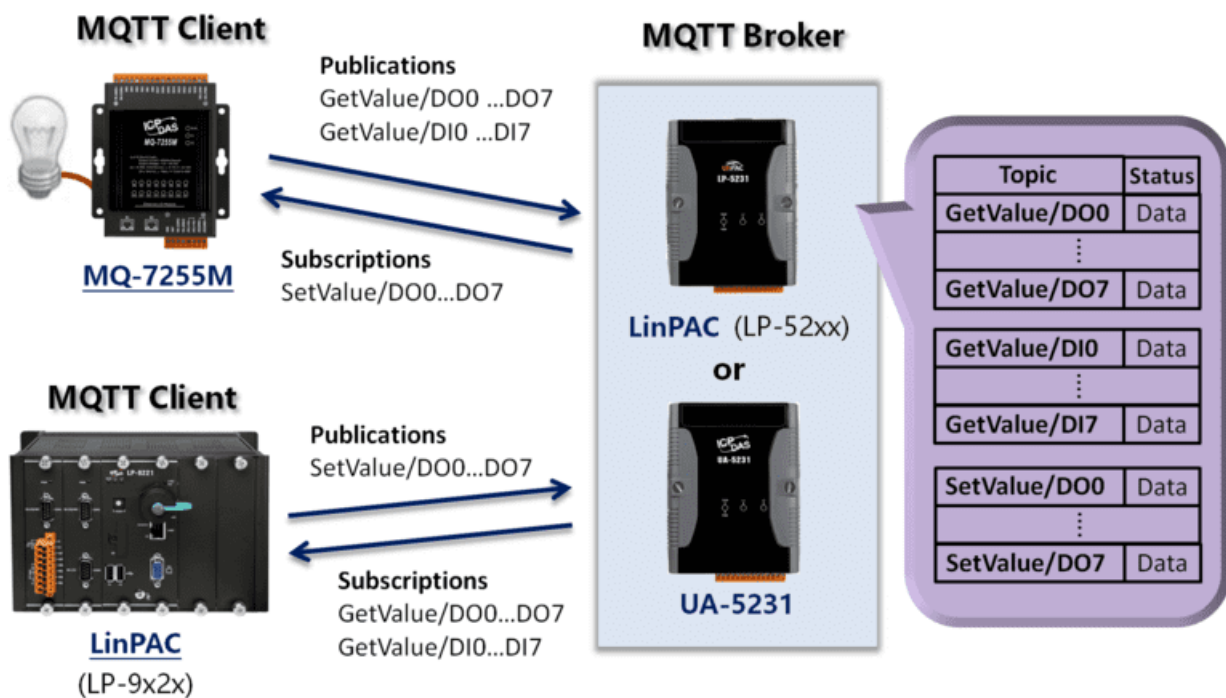


Figure 7.3-1. MQTT architecture for LinPAC

Refer to the following websites for more detailed information.

UA-5200 series:

http://www.icpdas.com/root/product/solutions/industrial_communication/m2m_iiot_server/opc_ua.html

MQ-7200M series:

http://www.icpdas.com/root/product/solutions/remote_io/mqtt_io/mq-7200m_introduction.html

We use LinPAC series devices as both the MQTT client and the MQTT broker, and communicate through the broker to control the MQ-7255M module, as you can see from the architecture diagram in Figure 7.3-1, the LP-9x2x module is used as the MQTT client, and the LP-52xx module is used as the MQTT broker.

You must install the relevant packages discussed below for testing purposes on LinPAC series modules that are either an MQTT broker or an MQTT client. Before installing the packages, it is recommended that you use the command **'sudo apt-get update'** to upgrade the package lists.

<MQTT broker>

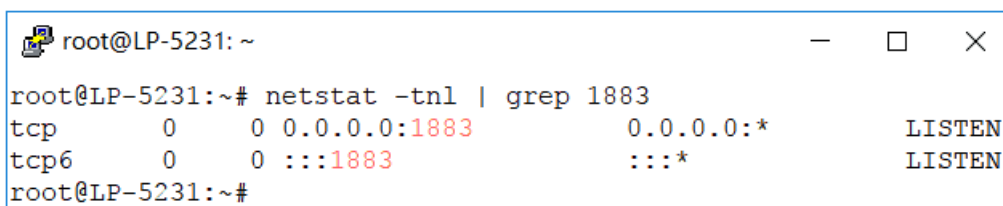
You can deploy the MQTT broker on either a UA-5200 or a LinPAC series module (LP-52xx). If you need to deploy an MQTT broker on a LinPAC series module, follow the procedure described below.

Step 1: Use the following command to install the Mosquitto package on the LP-52xx module.

```
# sudo apt-get install mosquitto
```

Step 2: Use the following command to verify that the MQTT broker/server is active, as illustrated in Figure 7.3-2.

```
# netstat -tnl | grep 1883
```



```
root@LP-5231: ~
root@LP-5231:~# netstat -tnl | grep 1883
tcp        0      0 0.0.0.0:1883          0.0.0.0:*           LISTEN
tcp6       0      0 :::1883              :::*                 LISTEN
root@LP-5231:~#
```

Figure 7.3-2. Confirm that the MQTT broker is listening on Port 1883

<MQTT client>

Use the following command to install the Mosquitto-client package on the LinPAC series module (LP-9x2x).

```
# sudo apt-get install mosquitto-clients
```

As an MQTT client, the MQ-7200M series module is able to publish messages that related to the status of the Digital I/O to a broker and subscribe to topics from a broker that are used to control the DO lines. In a similar way, other MQTT clients can obtain the status information from the Digital I/O by subscribing to a topic from the broker and then publishing messages to the broker that then control the DO lines, as illustrated in Figure 7.3-3. An example application is demonstrated below.

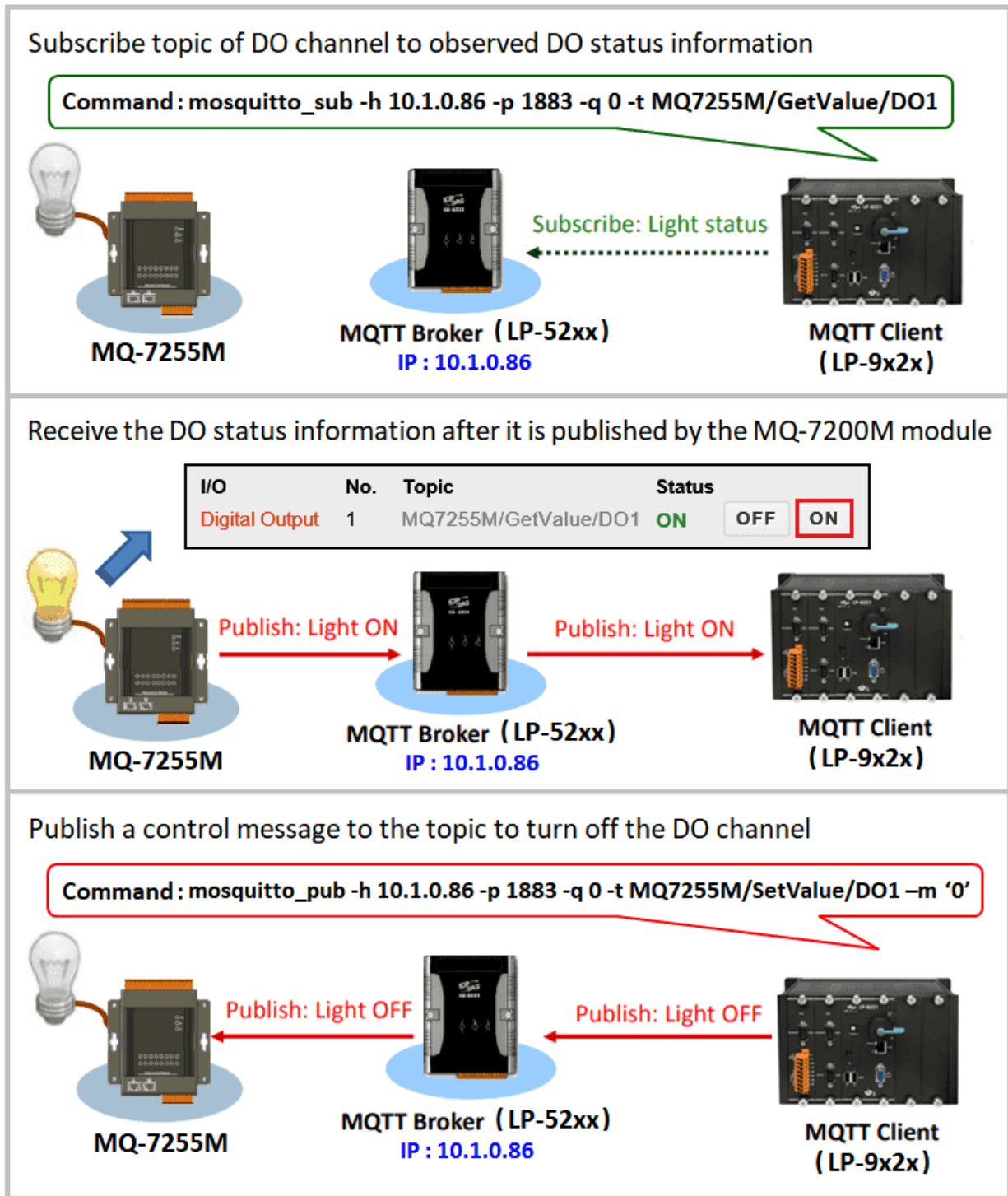


Figure 7.3-3. Controlling the device via the MQTT broker

Step 1: Connecting an MQ-7255M module to a LinPAC MQTT broker.

On the configuration page for the MQ-7255M module, first click the 'MQTT' option. Modify the configuration for the built-in web browser on the MQ-7255M module, as illustrated in Figure 7.3-4.

For more detailed information, refer to Chapter 4.3 of the MQ-7200M user manual, which you can download from:

http://ftp.icpdas.com/pub/cd/mq-7200m/document/mq-7200m_user_manual_english_v100.pdf

Overview	Connectivity	
Configuration	Broker URI	<input type="text" value="10.1.0.86"/> 1883 <small>[e.g. www.mybroker.com or 192.168.255.2]</small>
	Client identifier	<input type="text" value="MQ7255M_652B27"/>
	Alias name	<input type="text" value="MQ7255M"/> <small>[maximum of 30 characters]</small>
	Connection timeout (sec)	<input type="text" value="5"/> <small>[between 3 and 120 seconds]</small>
	Reconnection interval (sec)	<input type="text" value="10"/> <small>[between 5 and 120 seconds]</small>
	Keep alive interval (sec)	<input type="text" value="20"/> <small>[between 10 and 300 seconds]</small>
<input type="button" value="APPLY"/>		

Figure 7.3-4. Connectivity information

Step 2: Managing topics and subscriptions.

On the LP-9x2x module, use the following command to subscribe to a topic from the MQ7255M via the MQTT Broker.

```
# mosquitto_sub -h <broker IP> -p 1883 -q 0 -t MQ7255M/GetValue/DO1
```

In this example, the topic being subscribed to is 'MQ7255M/GetValue/DO1', as illustrated in Figure 7.3-5. The MQ-7255M module will then continuously publish the status information from the DO1 channel to the topic 'MQ7255M/GetValue/DO1'. Messages will also be published in cases where an I/O event causes the status to change, meaning that we can quickly monitor the status of the DO1 channel from the module.


```
root@icpdas: ~
root@icpdas:~# mosquitto_sub -h 10.1.0.86 -p 1883 -q 0 -t MQ7255M/GetValue/DO1
0
0
0
0
0
```

Figure 7.3-5. Subscribing to a topic

Step 3: Managing topics and publishing.

On the LP-9x2x module, use the following command to publish a message from the LP-9x2x module to the MQ-7255M module via the MQTT Broker.

```
# mosquitto_pub -h <broker IP> -p 1883 -q 0 -t MQ7255M/SetValue/DO1 -m '1'
```

In this example, the topic being published is 'MQ7255M/SetValue/DO1'. We can use the command to turn the device OFF or ON by publishing the status value '0' or '1' for the DO1 channel to the topic 'MQ7255M/SetValue/DO1'. In a similar way, we can also publish changes to the I/O value to the relevant topic, which then allows us to control the device.

Step 4: Verify that the value of the subscription topic 'MQ7255M/GetValue/DO1' has changed.

You can determine if there are any variations in the DO1 value by monitoring the changes in the value published to the 'MQ7255M/GetValue/DO1' topic, as illustrated in Figure 7.3-6 below.

```
root@icpdas: ~
root@icpdas:~# mosquitto_sub -h 10.1.0.86 -p 1883 -q 0 -t MQ7255M/GetValue/DO1
0
0
0
0
1
1
1
1
The value has changed after the message was published to topic
"MQ7255M/SetValue/DO1"
```

Figure 7.3-6. Monitor the variation in the DO1 value

7.4. Power-on Value Settings

This section will discuss the Power-on Value functions that are adopted in the Linux PAC. When the Power-on Value function is active, the DO or AO output will be restored to the preconfigured value if the power supply has an on/off switch. The following is an operational example using an I-87024W module inserted in an LP-8x21 controller.

Communicate with the I-87K Series module using the `setexdo.c` and `getsendreceive.c` programs. Sample code can be found in the `C:\cygwin\LinPAC_am335x_SDK\examples\common` or `root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk/i8k/examples/common` folder. The following is the procedure for configuring the Power-on Value:

Step 1: Configure the channel value for the I/O module

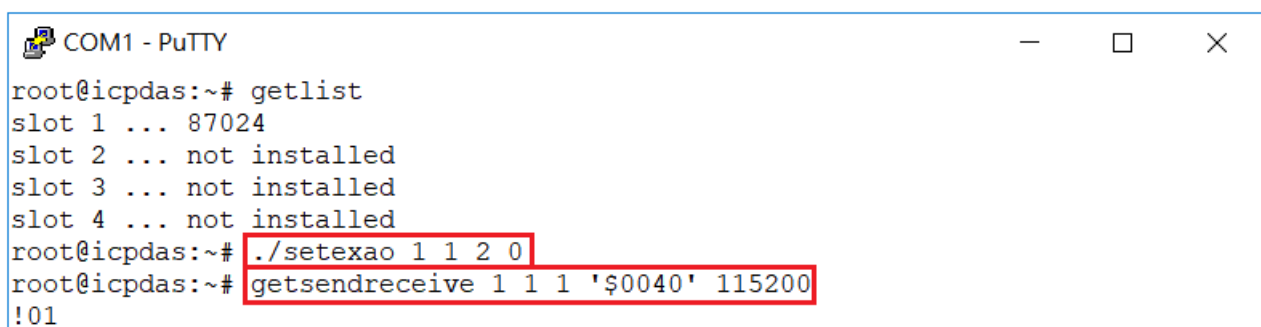
Set the Analog Output value to **2 V** for **channel 0** on the I-87024W module and use a multimeter to measure the output voltage of channel 0, as illustrated in Figure 7.4-1.

```
# ./setexao 1 1 2 0 // Command syntax: setexao <slot> 1 <value> <channel>
```

Step 2: Set the Power-on Value for the specified output channel

Set the Analog Output value for channel 0 to the Power-on Value on the I-87024W module, as illustrated in Figure 7.4-1.

```
# getsendreceive 1 1 1 '$0040' 115200
// DCON command: '$AA4N'. Refer to the Notes below for additional information.
```



```
COM1 - PuTTY
root@icpdas:~# getlist
slot 1 ... 87024
slot 2 ... not installed
slot 3 ... not installed
slot 4 ... not installed
root@icpdas:~# ./setexao 1 1 2 0
root@icpdas:~# getsendreceive 1 1 1 '$0040' 115200
!01
```

Figure 7.4-1. Power-on Value settings

Step 3: Restart the LinPAC

Switch off the LinPAC and then restart it. Channel 0 on the I-87024W module will output 2 V.

Step 4: Confirm that the Power-on Value is functioning correctly

Use the multimeter to measure the channel output voltage on the I-87024W module and verify that the voltage is the same as before the LinPAC was restarted.

Notes:

1. Use the DCON protocol to configure the I-87024W module. For more information about the command set for the I-87024W module, refer to:
http://ftp.icpdas.com/pub/cd/8000cd/napdos/dcon/io_module/87k/aio/87024w_rw/dcon_87k/87024_dcon_87k.htm
2. The **address** and **baudrate** for the LP-8x2x/9x2x are **00** and **115200** respectively. They are fixed-parameters in the library and cannot be modified.

Appendix

A. I-8K Modules and I-87K Modules

This chapter provides a brief overview of the differences between the I-8K and I-87K series modules.

I-8K and I-87K modules provide the option to expand the local I/O to expansion I/O slots and the bus type for the modules can be either parallel (high profile I-8K series) or serial (high profile I-87K series).

The differences between the I-8K and I-87K series modules are as follows.

Item	I-8K Series	I-87K Series
Microprocessor	No	Yes (8051)
Communication Interface	Parallel Bus	Serial Bus
Communication Speed	Fast	Slow
Latched DI Function	No	Yes
Counter Input (for digital input modules)	No	Yes (100 Hz)
Power-on Value	No	Yes
Safe Value	No	Yes
Programmable Slew-Rate for AO modules	No	Yes

For full details of specifications which can be found at:

[https://www.icpdas.com/en/product/guide+Remote_I_O_Module_and_Unit+PAC_%EF%BC%86amp;+Local_I_O_Modules+I-8K_I-87K_Series_\(High_Profile\)](https://www.icpdas.com/en/product/guide+Remote_I_O_Module_and_Unit+PAC_%EF%BC%86amp;+Local_I_O_Modules+I-8K_I-87K_Series_(High_Profile))

B. I-9K Modules and I-97K Modules

This chapter provides a brief overview of the differences between the I-9K and I-97K series modules.

There are two types of I/O modules provided for supporting LP-92xx. One is high communication speed I-9K series modules with parallel interface; the other is I-97K series modules with serial interface. The differences between the two series are listed as follows:

The differences between the I-9K and I-97K series I/O modules are as follows.

Item	I-9K Series	I-97K Series
Communication Interface	Parallel Bus	Serial Bus
Protocol	-	DCON
Communication Speed	Fast	Slow
DI with latched function	-	Y
DI with counter input	-	Y (100 Hz)
Power on value	-	Y
Safe Value	-	Y
Programmable slew-rate for AO module	-	Y

For full details of specifications which can be found at:

https://www.icpdas.com/en/product/guide+Remote_I_O_Module_and_Unit+PAC_%EF%BC%86amp;_Local_I_O_Modules+I-9K_I-97K_Series

C. XV-Board Modules

The XV-board series are for LP-22xx/52xx and WP-2x41/52xx-CE7. One PAC can only plug only one XV-board. The XV-board series have following common specification:

- DI channel is dry contact, sink type.
- DO channel is open collector, sink type.

For more detailed information about these support modules, please refer to

https://www.icpdas.com/en/product/guide+Remote_I_O_Module_and_Unit+PAC_%EF%BC%86amp;+Local_I_O_Modules+XV-board

D. Revision History

This chapter provides revision history information to this document.

The table below shows the revision history.

Revision	Date	Description
V1.0.0	July 2018	Initial issue
V2.0.0	Jan 2019	<ol style="list-style-type: none">1. Add the product introduction for LP-22xx.2. Add the product introduction for LP-5231PM-4GE.3. Add the product introduction for LP-5231PM-4GC.4. Add the Power-on Value Settings.
V2.0.1	Apr 2019	<ol style="list-style-type: none">1. Modify EEPROM/FRAM for LP-22xx
V2.0.2	Dec 2019	<ol style="list-style-type: none">1. Add factory default value of Ethernet for LP-22xx.
V2.0.3	Apr 2021	<ol style="list-style-type: none">1. Add the product introduction for LP-2214MX-4GE.2. Add the product introduction for LP-2241MX-4GC.
V2.0.4	Dec 2021	The original power indicator of LP-9x21 changed to an On/Off switch.