

LinPAC AM335x Series User Manual

V2.0.0 Jan 2019



LP-22xx/LP-52xx Series



LP-8x2x Series



LP-9x2x Series

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Contents

1. Introduction			7
1.1. Feature	S		8
2. LinPAC AM335	x Getting Started		10
2.1. Mounti	ng the Hardware		10
2.1.1. N	Nounting the LP-22xx		10
2.1.2. N	Nounting the LP-52xx		11
2.1.3. N	Nounting the LP-8x2x		13
2.1.4. N	Nounting the LP-9x2x		16
2.2. Deployi	ng a Basic System		23
2.2.1.	nstallation for LP-22xx		24
2.2.2.1	nstallation for LP-52xx		25
2.2.3.1	nstallation for LP-8x2x		26
2.2.4.1	nstallation for LP-9x2x		27
2.3. Insertin	g the I/O Modules		28
2.3.1. <i>F</i>	dding an I/O Device for LP	9-22xx	29
2.3.2. A	dding an I/O Device for LP	9-52xx	31
2.3.3. A	dding an I/O Device for LP	9-8x2x	34
2.3.4. <i>F</i>	dding an I/O Device for LP	9-9x2x	35
2.4. Console	Port Connection		37
2.5. LAN1/L	AN2 Network Configuratio	n	
2.6. LAN1/L	AN2 Network Connection .		
2.7. Overvie	w of the Serial Ports		40
2.7.1.	ntroduction to Serial port f	for LP-22xx	40
2.7.2.1	ntroduction to Serial port	for LP-52xx	41
2.7.3.1	ntroduction to Serial port f	for LP-8x2x	42
2.7.4.1	ntroduction to Serial port f	for LP-9x2x	43
2.7.5. A	Accessing the common seri	al ports	44
2.7.6. 9	erial Port configuration		52
3. Instructions fo	r LinPAC AM335x PAC		53
3.1. Basic Li	านx Command		53
3.1.1. k	s: lists the file information	(Equivalent DOS Command: di	r)53
3.1.2. c	d directory: Changes direc	tory (Equivalent DOS Comman	d: cd)53
3.1.3. r	nkdir: creates a subdirecto	ry (Equivalent DOS Command:	md)54
AM335X-PAC Series	s User Manual	version 2.0.0	Page: 3

	3.1.4. rmdir: deletes the subdirectory which	must be empty	
	(Equivalent DOS Command: rd)	5	54
	3.1.5. rm: deletes (removes) the file or direct	ory (Equivalent DOS Command: delete)5	54
	3.1.6. cp: copies one or more files (Equivalen	t DOS Command: copy)5	54
	3.1.7. mv: moves or renames a file or directo	ry (Equivalent DOS Command: move)5	54
	3.1.8. pwd: displays the full path of the curre	nt working directory5	54
	3.1.9. who: displays a list of the users current	t logged on5	54
	3.1.10. chmod: changes the access permissio	ns for a file5	55
	3.1.11. uname: displays the Linux version info	ormation5	55
	3.1.12. ps: displays a list of the currently activ	ve procedures5	55
	3.1.13. ftp: transfers a file using the file trans	fer protocol (FTP)5	55
	3.1.14. telnet: establishes a connection to an	other PC via Telnet terminal	55
	3.1.15. date: prints or sets the system date a	nd time5	55
	3.1.16. hwclock: queries and sets the hardwa	re clock (RTC)5	6
	3.1.17. netstat: displays the current state of t	the network5	6
	3.1.18. ifconfig: displays the ip and network r	mask information	
	(Equivalent DOS Command: ipconfig)	5	6
	3.1.19. ping: used to test whether the host in	a network is reachable5	6
	3.1.20. clear: clears the screen	5	6
	3.1.21. passwd: used to change the password	15	56
	3.1.22. reboot: reboots the LinPAC (or use 'sl	nutdown –r now')5	56
	3.1.23. wget: get the file from the web link	5	56
	3.1.24. update-rc.d : install and remove Syste	em-V style init script links5	57
3.2. i	-Talk Utility	5	58
4. Getting	started with the LinPAC AM335x SDK	6	51
4.1. I	ntroduction of the LinPAC AM335x SDK	6	52
	4.1.1. Introduction to Cygwin	ε	52
	4.1.2. Introduction to Cross-Compilation	ε	53
	4.1.3. Download the LinPAC AM335x SDK	ε	53
4.2.0	Quick Installation of the LinPAC AM335x SDK.	ε	54
	4.2.1. Download/Install LinPAC AM335x SDK	on Linux6	54
	4.2.2. Download/Install LinPAC AM335x SDK	on Windows6	57
	4.2.3. Integrating LinPAC AM335x SDK with C	ode::Blocks IDE7	0
4.3. \	/our First Program		13
	4.3.1. A simple example- helloworld.c	7	<i>'</i> 4
	4.3.2. Compile Demo- helloworld.c		<i>'</i> 5
AM335X-PA	C Series User Manual	version 2.0.0 Page:	4

4.3.3. Execute Demo- helloworld.exe		75
4.3.4. Execute the application on LinF	PAC AM335x PAC at boot time	80
5. Application for LinPAC AM335x PAC		81
5.1. Package management with APT		81
5.2. SFTP(secure file transfer program)		82
5.3. LAMP Server		83
5.4. XFCE(secure file transfer program) GL	II Desktop	84
5.5. SysVinit Support		85
5.6. Network Support		86
5.6.1. 2G/3G/4G		86
5.6.2. SMS(Short Message Service)		87
6. LinPAC AM335x PAC System Settings		94
6.1. Using a microSD Card		94
6.1.1. Mounting a microSD Card		95
6.1.2. Unmounting the microSD Card		96
6.1.3. Scanning and repairing a micro	SD Card	97
6.2. Using a USB Storage Device		98
6.2.1. Mounting a USB Storage Device	2	99
6.2.2. Unmounting the USB Storage D	Device	99
6.3. WDT		
6.3.1. WDT for LP-8x2x and LP-9x2x		
6.3.2. WDT for LP-22xx and LP-52xx		
6.4. EEPROM		
6.5. LED		
6.5.1. LED Indicators for LP-22xx serie	es	
6.5.2. LED Indicators for LP-52xx serie	es	
6.5.3. LED Indicators for LP-8x2x serie	25	
6.5.4. LED Indicators for LP-9x2x serie	es	
7. Additional Support		
7.1. Support for N-Port Modules		
7.1.1. Application for N-Port Module		
7.2. Configuration of multiple spanning tre	e protocol interface setting with	dual LAN116
7.3. Building a sample MQTT application u	sing LinPAC	
7.4. Power-on Value Settings		
Appendix		127
A. I-8K Modules and I-87K Modules		
AM335X-PAC Series User Manual	version 2.0.0	Page: 5

B. I-9K Modules and I-97K Modules	128
C. XV-Board Modules	129
D. Revision History	

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 (16 KB for LP-22xx/8x2x/9x2x, 64 KB for LP-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
- Operating Temperature: -25 ~ +75°C

For full details of specifications which can be found at:

LinPAC-22xx series:

http://ftp.icpdas.com.tw/pub/cd/linpac/napdos/lp-2000/lp-2x41/lp-2241/document/data_sheet/ LinPAC-52xx series:

http://ftp.icpdas.com.tw/pub/cd/linpac/napdos/lp-5000/lp-52xx/lp-5231/document/data_sheet/

LinPAC-8x2x series:

http://ftp.icpdas.com.tw/pub/cd/linpac/napdos/lp-8x2x/document/data_sheet/

LinPAC-9x2x series:

http://ftp.icpdas.com.tw/pub/cd/linpac/napdos/lp-9x2x/document/data_sheet/

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.



version 2.0.0



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.



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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.



AM335X-PAC Series User Manual	version 200
AM325Y_DAC Series User Manual	version 20

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 2: Fasten the screws securely.

holes.

Tips & Warnings



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



AM335X-PAC Series User Manual

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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.



Connect the ground lead to the ground screw

AM335X-PAC Series User Manual

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.



AM335X-PAC Series User Manual

version 2.0.0

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.

AM335X-PAC Series User Manual

version 2.0.0

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.



AM335X-PAC Series User Manual

version 2.0.0

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.



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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.



AM335X-PAC Series User Manual version 2.0.0

Page: 21

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.



AM335X-PAC Series User Manual

version 2.0.0

Page: 22

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.
- 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 <u>PWR</u> and the negative terminal (-) of the power supply to the <u>P.GND</u>.
- 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.



2.2.2. 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 <u>PWR</u> and the negative terminal (-) of the power supply to the <u>P.GND</u>.
- 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 <u>PWR1/2</u> and the negative terminal (-) of the power supply to the <u>P.GND</u>.



- 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 <u>PWR1/2</u> and the negative terminal (-) of the power supply to the <u>P.GND</u>.



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:

Туре	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	\checkmark	-	-	✓
LP-52xx	3	1	\checkmark	-	-	✓
LP-8x2x	2 or 3	1 or 4 or 8	√	✓	-	-
LP-9x2x	4	2 or 4 or 8	\checkmark	-	\checkmark	-

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:

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

LP-8x2x/9x2x series:

http://www.icpdas.com/root/product/solutions/remote io/remote io products.php

AM335X-PAC Series User Manual

version 2.0.0

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.



AM335X-PAC Series User Manual

version 2.0.0



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

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



AM335X-PAC Series User Manual

version 2.0.0

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.





AM335X-PAC Series User Manual

version 2.0.0

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



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



version 2.0.0

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.



AM335X-PAC Series User Manual

version 2.0.0

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

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 wring 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.



AM335X-PAC Series User Manual

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:

http://www.icpdas.com/root/product/solutions/remote io/i-9k i-97k/i-9k i-97k selection.html

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.



AM335X-PAC Series User Manual
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.

ategory:				
Session	Basic optio	ns for your PuTTY session		
Logging Terminal	Specify the destination Serial line	you want to connect to <u>Speed</u>		
- Keyboard	COM1	115200		
Features	Connection type:	Connection type:		
- Appearance - Behaviour - Translation	Load, save or delete a Sav <u>e</u> d Sessions	stored session		
- Selection - Colours	Default Settings	Load		
 Connection Data 		Sa <u>v</u> e		
- Proxy - Telnet		Delete		
Rlogin ⊞-SSH	Close window on e <u>x</u> it Always Nev	ver Only on clean exit		
oenai				

(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)



Figure 2.5-1. Network configuration

Step 3: After user save the file and use 'reboot' command to reset the device, 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)



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

	🕵 PuTTY Configu	? ×	
	Category:		
	Session	Basic options for your PuTTY ses Specify the destination you want to connect to	sion
Step 2: User can use SSH client	Keyboard Bell	Host <u>N</u> ame (or IP address)	Port 22
software (Putty or others)	Window	Connection type: Raw Telnet Rlogin SSH	Serial
to connect the LinPAC.	Behaviour	Load, save or delete a stored session	
(Refer to the Figure 2.6-2)	- Translation - Selection	Sav <u>e</u> d Sessions	
	Connection	Default Settings	Load
	Telnet Rlogin		Delete
	SSH Serial	Close window on e <u>x</u> it Always Never Only on cle	an exit

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

Help

AM335X-PAC Series User Manual	version 2.0.0	Page: 39
		0

About

Cancel

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:

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

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

AM335X-PAC Series User Manual

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

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AM335X-PAC Series User Manual version 2.0.0
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Page: 43



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: <u>http://www.icpdas.com/root/product/solutions/remote_io/rs-485/i-8k_i-87k/i-8k_i-87k_dio.html</u>
 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 <u>3.2. i-Talk Utility</u>.

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.

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);
ChangeSlotTol-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)

ual	I	al
-----	---	----

- (A) Open 'Hyper Terminal' on the Host PC to monitor the test process. The <u>default settings</u> 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)



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 <u>I-7000 serial</u> <u>modules</u> (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 <u>/dev/ttyS0 port are 9600, 8, N, 1</u>
 - (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.



AM335X-PAC Series User Manual

version 2.0.0

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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:

-F /dev/ttyS1 ispeed 115200 ospeed 11520
--

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 armv71)
 * 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

AM335X-PAC	Series	User	Manual
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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.

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

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

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

AM335X-PAC Series User Manual

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	mkdir -p directory
	directories as needed	

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	rmdir -p directory
	each parent directory component with the same path name	

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
-1	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

AM335X-PAC Series User Manual

3.1.10. chmod: changes the access permissions for a file

Syntax: chmod ??? file \rightarrow ??? means owner: group: all users For example: chmod 754 test.exe

> $754 \rightarrow 111$ (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 IPAdress (Example: ftp 192.168.0.200 \rightarrow 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
	(Forexample: 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

AM335X-PAC Series User Manual

Parameter	Description	Examp	le
-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

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

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

AM335X-PAC Series User Manual

version 2.0.0

Page: 56

```
proot@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	<pre>setdo {slot} {data} setdo 3 3 Sets channels 1 and 2 on the I-8055W module to ON</pre>
getdi	<i>getdi {slot} {type}</i> <i>getdi 3 8</i> Reads the 8-bit Digital Input value from the I-8055W module
setport	setport {slot} {offset} {data}setport1020Set the dec value 20 to offset 0 of slot 1
getport	getport {slot} {offset}getport 1 0Get the dec value from offset 0 of slot 1
getsendreceive	getsendreceive {slot} {1} {timeout} {command}getsendreceive 2 1 1 '\$00M'Send command \$00M to the module at slot 2 and wait responsegetsendreceive {slot} {comport} {timeout} {command} {baudrate}getsendreceive 0 3 1 '\$01M' 9600Send command \$01M to the module at COM3 and wait response
getreceive	getreceive {slot} {comport} {timeout} {baudrate} {format}getreceive02596008n1Get 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
Lad	Set LED (L1~L2) for LP-52xx
Lea	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
 - Download/Install LinPAC_AM335x SDK on Linux
- Windows
 - Download/Install LinPAC_AM335x SDK on Windows
 - 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:

- 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.
- 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-gnueabihf-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.)**

LinPAC	Download Path
LP-22xx/52xx	ftp://ftp.icpdas.com/pub/cd/linpac/napdos/lp-5000/lp-52xx/lp-5231/sdk/lp52xx am335x sdk f
	<u>or windows.exe</u>
LP-8x2x/9x2x	ftp://ftp.icpdas.com/pub/cd/linpac/napdos/lp-9x2x/sdk/linpac_am335x_sdk_for_windows.exe

□ For Linux systems: (Extract the .bz2 file into to the root (/) directory.)

LinPAC	Download Path
LP-22xx/52xx	ftp://ftp.icpdas.com/pub/cd/linpac/napdos/lp-5000/lp-52xx/lp-5231/sdk/lp52xx_am335x_sdk_f
LP-8x2x/9x2x	ftp://ftp.icpdas.com/pub/cd/linpac/napdos/lp-9x2x/sdk/linpac_am335x_sdk_for_linux.tar.bz2

Note: We recommend user to change user ID to become root by 'sudo' or 'su' command.

4.2. Quick Installation of the LinPAC AM335x SDK

4.2.1. Download/Install LinPAC AM335x SDK on Linux

 To create a 'icpdas' folder in root directory, maybe you need to change the root user by 'sudo' or 'su' command. (Refer to Figure 4.2.1-1)



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

Insert the installation CD into your CD-ROM driver. (Refer to Figures 4.2.1-2 and 4.2.1-3)
 Locate the 'linpac_am335x_sdk_for_linux.tar.bz2' file in the \napdos\lp-9x2x\SDK\ folder or visit the ICP DAS website to download the latest version of the LinPAC_AM335x SDK.



Figure 4.2.1-2.

Figure 4.2.1-3.

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

tar jxvf linpac_am335x_sdk_for_linux.tar.bz2

🖨 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/qcc/		
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/qcc/arm-linux-qnueabihf/4.7.3/crtbeqinS.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 (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/bin:/icpdas/linpac_am335x_sdk# ls
ivs/local/noweb:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games"
root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk# ls
ivs/local/noweb:/icpdas/linpac_am335x_sdk# ls
ivs/local/noweb:/icpda

Figure 4.2.1-5. Setting environment variables for LinPAC_AM335x SDK

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

Proot@LinuxPC-ICPDAS: /icpdas/linpac_am335x_sdk/i8k/examples
root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk/i8k/examples# make
arm-linux-gnueabihf-gcc -II/include -c -o xvboard/getxvai.o xvboard/getxvai.c
arm-llnux-ynueablnf-ycc -11/lncluue -0 ./xvbbaru/yelxval ./xvbbaru/yelxval.0/ lib/libi8k a -1m
rm -f ./xvboard/getxvai.o
arm-linux-gnueabihf-gcc -II/include -c -o xvboard/getxvao.o xvboard/getxvao.c
arm-linux-gnueabihf-gcc -II/include -o ./xvboard/getxvao ./xvboard/getxvao.o/
lib/libi8k.a -lm
rm -f ./xvboard/getxvao.o
arm-linux-gnueabinf-gcc -ll/include -c -o xvboard/getxvd1.o xvboard/getxvd1.c
arm-linux-gnueadin+-gcc -11/include -0 ./xvdoard/getxvdl ./xvdoard/getxvdl.o/ lib/libi9k a _1m
rm -f /xuboard/netxudi o
arm-linux-onueabihf-occ -II/include -c -o xvboard/oetxvdo.o xvboard/oetxvdo.c
arm-linux-qnueabihf-qcc -II/include -o ./xvboard/qetxvdo ./xvboard/qetxvdo.o/
lib/libi8k.a -lm
rm -f ./xvboard/getxvdo.o
arm-linux-gnueabihf-gcc -II/include
linux-gnueabint-gcc -11/inc

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).

- □ Insert the installation CD into your CD-ROM driver.
- □ Open the \napdos\LP-9x21\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 4.2.2-2.

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 4.2.2-6.

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.

🗅 cygwin 📃 🗆 🔀	🗅 LinPAC_AM335x_SDK 🔳 🗖 🔀
🗀 C:\cygwin 🛛 🖌	🗀 C:\cygwin\LinPAC_AM335x_SDK 🐱
CodeBlock LinPAC_AM335x_SDK opt unins000.dat Sunins000.exe	≧examples ≧include ≧lib ≧Linaro_GCC_4.7 ▼LinPAC_AM335x.bat ▼Isetenv.bat

Figure 4.2.2-7.



AM335X-PAC Series User Manual

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.

🖻 examples 📃 🗖 🔀	LinPAC_AM335x Build Environment
C:\cygwin\LinPAC_AM335x_SDK\examples common i7k i8k i8k i87k mysql Xvboard ChangeLog Makefile readme.txt	C:\cygwin\LinPAC_AM335x_SDK>CMD.EXE /k c:\cygwin\LinPAC_AM335x_SDK\setenv.bat Target :ICPDAS LinPAC AM335x Series Work Directory:C:\cygwin\LinPAC_AM335x_SDK\ C:\cygwin\LinPAC_AM335x_SDK>

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 LinPCA AM335x SDK with Code::Blocks IDE on Windows platform.

Step 1: Download Code::Blocks IDE.

- Go to this website: <u>http://www.codeblocks.org/downloads/binaries</u>
- 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: <u>http://www.codeblocks.org/user-manual</u>

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):

LINPAC_am335x_SDK\examples\common\getexd1.c [LinPAC_AM335x_SDK] - Code::Blocks 1	0.05 🗗 🔀
<u>File E</u> dit <u>V</u> iew Search <u>Project Build Debug</u> wxSmith Tools Plugins <u>S</u> ettings <u>H</u> elp	
ji 😳 🕨 🗞 🌚 🛛 Build target: all 🔤 🛐	
Wanagement Projects Symbols Resources Impact Sources Impact Sour	slot 2\n");

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):

Compiler and	l debugger settings		
	Glob	oal compiler settings	
Global compiler settings Batch builds	Selected compiler GNU ARM GCC Compiler Set as default Linker settings Search dir Compiler's installation dir C:\cygwin\LinPAC_AM: NOTE: All programs bel Program Files Additiona C compiler: C++ compiler: Linker for dynamic libs:	Copy Rename Delete Reset ectory 335x_SDK\Linaro_GCC_4.7\bin Auto ow, must exist either in the "bin" sub-direc arm-linux-gnueabihf-gcc.exe arm-linux-gnueabihf-g++.exe	defaults s <>>
Debugger settings	Linker for static libs: Debugger: Resource compiler:	arm-linux-gnueabihf-ar.exe arm-linux-gnueabihf-gdb.exe	
		OK C	iancel

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)

🖡 LinPAC_am335x_SDK\examples\common\getexdi.c [LinPAC_AM335x_SDK] - Code::Blocks 10.05 👘 💽 🔀		
<u>File Edit View</u> Search Pro	ject Build Debug wxSmith Tools Plugins Settings Help	
🕴 🏟 🂊 🐼 🛛 Build target: all		
Management	LinPAC_am335x_SDK\examples\common\getexdi.c ×	
Projects Symbols Resources Workspace LinPAC_AM335x_SDK Sources LinPAC_am335x_SDK Common Sources Common Common	<pre>183 printf("function : getexdi\n"); 184 printf("Get digital input value from a serial module\n"); 185 printf("Usage: getexdi slot 1\n"); 186 printf(" getexdi slot comport baudrate address\n"); 187 printf("Example 1:getexdi 2 1\n"); 188 printf("Get the dec digital input value from the module at slot 2\n"); 189 printf("Example 2:getexdi 0 3 9600 2\n"); </pre>	
⊕ 187k ⊕ ≥ i8k ⊕ ≥ mysql ⊕ ≥ xvboard	Code::Blocks Search results Suild log X Pauld messages Debugger rm -f ./i8k/demo8014W/8014W_magic_Blk.o arm-linux-gnueabihf-gcc -II./include -c -o i8k/demo8014W/8014W_magic_isr.o i8k/demo8014W/8014W_magic_isr.c arm-linux-gnueabihf-gcc -II./include -o ./i8k/demo8014W/8014W_magic_isr ./i8k/demo8014W/8014W_magic_isr.o ./lib/libi8k.a -lm rm -f ./i8k/demo8014W/8014W_magic_isr.o Process terminated with status 0 (9 minutes, 27 seconds) 0 errors, 0 warnings	

Figure 4.2.3-4. Compiling a C program

[Note] If you observer 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)





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

C:\cygwin\LinPAC_AM335x_SDK>CMD.EXE /k c:\cygwin\LinPAC_AM335x_SDK\setenv.bat Target :ICPDAS LinPAC AM335x Series Work Directory:C:\cygwin\LinPAC_AM335x_SDK\ C:\cygwin\LinPAC_AM335x_SDK> chcp 65001	LinPAC_AM335x Build Environment	LinPAC_AM335x Build Environment
	C:\cygwin\LinPAC_AM335x_SDK>CMD.EXE /k c:\cygwin\LinPAC_AM335x_SDK\setenv.bat Target :ICPDAS LinPAC AM335x Series Work Directory:C:\cygwin\LinPAC_AM335x_SDK\ C:\cygwin\LinPAC_AM335x_SDK> chcp 65001	Active code page: 65001 C:\cygwin\LinPAC_AM335x_SDK>

Figure 4.2.3-6.

Figure 4.2.3-7.

AM335X-PAC Series User Manual

version 2.0.0

Page: 72
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.



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.

🛤 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 C:\cygwin\LinPAC	C:\cygwin\LinPAC_AM335x_SDK> cd examples\common C:\cygwin\LinPAC_AM335x_SDK\examples\common> ls						
back_plane_id	getexai	getsendrece ive	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

AM335X-PAC Series User Manual	version 2.0.0	Page: 74
		- 0 -

4.3.2. Compile Demo- helloworld.c

Type the command '**arm-linux-gnueabihf-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	C:\cygwin\LinPAC_AM335x_SDK\examples\common>ls						
back_plane_id	getexai	getsendreceive	nran	setexdo			
back_plane_id.c	getexai.c	getsendreceive.c	mran.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	<pre>slot_count.c</pre>			
eeprom	getport	led_8×2×	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, <u>ftp 192.168.0.200</u> 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.

AM335X-PAC Series User Manual

- (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)

LinPAC_AM335x Build Environment
C:\cygwin\LinPAC_AM335x_SDK\examples\common> ftp 192.168.0.200 Connected to 192.168.0.200 220 (weFTPd 2 3 5)
User (192.168.0.200:(none)): root 331 Please specify the password.
Password: 230 Login successful.
ftp> bin 200 Switching to Binarv mode.
Itp> 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.\ourwin\LinDAC_AM225: SDE\ourminlog\common>
c. (cygwin (Lmr AC_AND))x_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)

🖬 root@192.168.0.200- FileZilla						
<u>F</u> ile <u>E</u> dit	<u>V</u> iew Iransfer <u>S</u> erver <u>B</u> ookmarks <u>H</u> elp					
Host: 192.168	3.0.200 <u>U</u> sername: root Pass <u>w</u> ord: **** <u>Port:</u> 21 <u>Quickconnect</u>					
Response:	226 Directory send OK.					
Status:	Calculating timezone offset of server					
Command:	MDTM 8017DEMO.C					
Response:	213 20170602071439					
Status:	Timezone offsets: Server: O seconds. Local: 28800 seconds. Difference: 28800 seconds.					
Status:	Directory listing successful					



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

🔁 root @ 192.168.0	.200 - FileZilla				
<u>File E</u> dit <u>V</u> iew]	Transfer <u>S</u> erver <u>B</u> oo	okmarks <u>H</u>	elp <u>N</u> ew version a	vailable!	
Host: 192.168.0.200	Username: root	Pass <u>w</u> o	ord: *****	Port: Quickco	nnect
Local site: \cygwin\LinPA(_AM335x_SDK\examples\	common\ 🔽	Remote site: /root		~
On PC	On PC common i7k On LinPAC				
Filename A getsendreceive_bin getsendreceive_bin.	F 5 c	ilesize	Filename 🔺	Filesize	Fil 🔨
helloworld.c helloworld.c led_52xx	↑ Upload ↑ Add files to queue		Documents Downloads mstpd_am335x		*
Selected 1 file. Total size: 5,86:	<u>O</u> pen <u>E</u> dit		9 files and 9 directories. To) otal size: 98,044 bytes	>
Server/Local file	<u>C</u> reate directory Refresh	e		Size Priority	S
<	<u>D</u> elete <u>R</u> ename				>

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.

🔁 root @ 192.168.0.200 -	FileZilla				
<u>File E</u> dit <u>V</u> iew <u>T</u> ransfer	<u>S</u> erver <u>B</u> ookmark	s <u>H</u> e	elp <u>N</u> ew version	available!	
Host: 192.168.0.200 Usern	ame: root	Pass <u>w</u> o	ord: *****	Port: Quickco	nnect
Local site: \cygwin\LinPAC_AM335	5x_SDK\examples\commor	11 💌	Remote site: /root		*
On PC	on	<	□ ⑦ / I cot	On LinPAC	
Filename 🔺	Filesize	^	Filename 🔺	Filesize	Fil 🔨
i getsendreceive_bin	52,184		Deelsten		
belloworld eve	5,100 5,861		Deskiop		
Chelloworld.c	280		Downloads		
🖬 led_52xx	12,095		helloworld.exe	Download	
Cled 52xx c	1 309	_	🗐 install log	Add files to queue	
<u> </u>		2	K	View/Edit	
Selected 1 file. Total size: 5,861 bytes			Selected 1 file. Total size	Create directory	
Server/Local file	Direction Remote fi	le		Create new file	
L root@192.168.0.200				Refresh	
C:\cygwin\LinPAC>> /root/helloworld.exe					
Rename					
<u>[S]</u>	Ш.			Copy URL(s) to clip	board
				File permissions	

Figure 4.3.3-4. Modify the permissions of files

Remote site /root	~	
■ @ / ■ D root On LinPAC		Change file attributes 🛛 🔀
 install.log ✓ Download ✓ Add files to queue ✓ View/Edit ✓ Selected 1 file. Total size: ✓ Create directory Create new file Refresh Delete Rename Copy URL(s) to clipboard File permissions 		Please select the new attributes for the file "helloworld.exe". Owner permissions



Use SSH to access LinPAC and execute program

- (1) Putty the free PuTTY is an SSH and telnet client. Download PuTTY tool: <u>http://www.putty.org/</u>
- (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)

🛚 PuTTY Configuration 🛛 🔀					
Category:					
Session	Basic options for your PuTTY session				
Logging	Specify the destination you want to connect to-				
Erminal	Host Name (or IP address) Port				
Bell	192.168.0.200 22				
- Features ⊡- Window	Connection type: ○ <u>R</u> aw ○ <u>T</u> elnet ○ Rlogin ⊙ <u>S</u> SH ○ S	Serial			

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)

🖨 root@icpdas
login as: root root@10.1.0.222's password: ****** Welcome to Ubuntu 12.04.4 LTS (GNU/Linux 3.2.14-rt24 armv71)
* Documentation: <u>https://help.ubuntu.com/</u> Last login: Tue Sep 5 03:04:31 2017 from 10.1.0.26 root@icpdas:~# root@icpdas:~# chmod 777 helloworld.exe root@icpdas:~# root@icpdas:~# ./helloworld.exe ICPDAS hello world! root@icpdas:~#

Figure 4.3.3-7. Modify the permissions of files

AM335X-PAC Series User Manual

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.

AM335X-PAC Series User Manual

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></package>

To remove a package run the following commands:

#	apt-get	removepurge <package></package>	<pre>// Remove the package</pre>
#	apt-get	autoremovepurge <package></package>	<pre>// Rmove the dependencies packages</pre>

To search available package run the following commands:

|--|

AM335X-PAC Series User Manual

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)

WinSCP Login		? 🛛
Session Stored sessions Environment Directories SSH	Session Host name 10.1.0.107 User name Password root Private key file Protocol O SFTP ● SFTP (allow SCP failback	Poţt number 22
Advanced options	Save	

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)

a Downloads - Linux Test Machine(LinPAC) - WinSCP						
Local Mark Files Commands Session Options Remote Help						
🏟 🛛 🗹 🖂 🖼 🚱 🔤 🎥 🥵 🖽 🖃 🖾 🖉	Default - 🐼 -					
🖙 C: 💽 🔄 🗢 🔹 🖻 🔽 🚮 😰 🚰 🏗	📄 🗁 root 🛛 💽 🔄 🗢 🗸 😥 🤤					
C:\Documents and Settings\RD1-Golden2\My Documents\Downloads	/home/root					
Name – Ext Size Type C.	Name – Ext Size					
🖻 Parent directory 20	🖻					
	🖬 .sqlite_history 353					
	🖬 .profile 149					
	🖬 .htopre 581					
	🖬 .bashrc 559					
	.bash_history 7,494					

Figure 5.2-2. Drag and drop file

AM335X-PAC Series User Manual	version 2.0.0	Page: 82
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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			

AM335X-PAC Series User Manual

version 2.0.0

Page: 83

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E-mail: service@icpdas.com

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.



5.5. 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.



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
<pre>/etc/rc0.d/K20apache2 ->/init.d/apache2</pre>
<pre>/etc/rc1.d/K20apache2 ->/init.d/apache2</pre>
<pre>/etc/rc6.d/K20apache2 ->/init.d/apache2</pre>
<pre>/etc/rc2.d/S20apache2 ->/init.d/apache2</pre>
<pre>/etc/rc3.d/S20apache2 ->/init.d/apache2</pre>
<pre>/etc/rc4.d/S20apache2 ->/init.d/apache2</pre>
<pre>/etc/rc5.d/S20apache2 ->/init.d/apache2</pre>
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-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:~#	Using 2G/3G/4G network
root@LP-5231:~# ifconfig ppp0	
ppp0 Link encap:Point-to-Point inet addr:100.84.200.69 H UP POINTOPOINT RUNNING NOW RX packets:10 errors:0 dro TX packets:10 errors:0 dro collisions:0 txqueuelen:3 RX bytes:345 (345.0 B) TX	Protocol P-t-P:10.64.64.64 Mask:255.255.255.255 ARP MULTICAST MTU:1500 Metric:1 opped:0 overruns:0 frame:0 opped:0 overruns:0 carrier:0 K bytes:369 (369.0 B)
root@LP-5231:~# root@LP-5231:~# service pppon stop \$Stopping pppd:done. root@LP-5231:~#	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-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-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.
---------------------------	----------------	-------------	----------

gsmsendsms -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

smsc 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 'In -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.

Putty	- 🗆 X
# cd /root/.config/	
# mkdir gnokii	
<pre># ln -s /etc/xdg/gnokii/config /root/</pre>	.config/gnokii
<pre># cd /root/.config/gnokii/</pre>	
# 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	:~#gnokiiidentify
GNOKII Versi	on 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 +8869XXXXXXXX





(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 configu	Iration	🛃 COM1 - Ри	ALLA			X
<pre>Port C Connection M Model D Synchronize time F Log file O Log format L Use locking G Gammu localisatio < Edit > < Save > <</pre>	<pre>(/dev/ttyUSB3) (at115200) () (yes) () (nothing) () n() Exit > < Help ></pre>	root@LP-52: Device Manufacture Model Firmware IMEI SIM IMSI root@LP-52:	31:~# gammu : /dev/tt er: Quectel : unknown : EC25EFA : 8611070 : 4660560 31:~#	ide .yUSB3 . (EC2) .R02A0	5) 7M4G 849 350	



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"
---	-------	---------	------	---------------	-------	----------------



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'
#	senusins	υσλαλαλα	3111310013.1231

	×
-	- 0

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:~#
```



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.



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

AM335X-PAC Series User Manual version 2.0.0

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:
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
7 1 loop1 0 0 0 0 0 0 0 0 0 0
7 2 loop2 0 0 0 0 0 0 0 0 0 0 0
7 3 loop3 0 0 0 0 0 0 0 0 0 0
$\frac{7}{4}$ 4 loop4 0 0 0 0 0 0 0 0 0 0 0 0
<u>7</u> 5 100p5 0 0 0 0 0 0 0 0 0 0 0
31 2 mtdblock2 0 0 0 0 0 0 0 0 0 0 0
31 = 4 mtdblock4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
31 $5 mtdblock5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0$
31 7 mtdblock7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
179 0 www.chib0 1775 802 70057 7740 335 161 4406 31530 0 0010 30210
179 0 mmc01k0 1775 092 70057 7740 555 101 4490 51550 0 9010 59210 179 1 mmcb1b0p1 156 90 1231 $410 - 0 - 0 - 0 410 410$
179 2 mmcblk0p1 150 50 1251 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/had**' to create a directory named '**had**'. (Refer to Figure 6.1-2)

AM335X-PAC Series User Manual

(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# Is
hda nfs
root@icpdas:/mnt#_mount /dev/mmcblkUp2_/mnt/hda_
root@1cpdas:/mnt# mount
/dev/root on / type ext4 (rw,noatime,errors=remount-ro,user_xattr,barrier=1,data=ordered)
devimpis on /dev type devimpis (iw,relatime,size=255590k,nr_inodes=65549,mode=755)
none on /nev/pts type devpts (iw,nosuld,noexec,leiatime,mode=000)
none on /svs type svsfs (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/mmcblkUpl on /boot/uboot type viat (rw,noatime,fmask=UU22,dmask=UU22,codepage=cp43
7,1ocharset=1so8859-1,shortname=m1xed,errors=remount-ro)
rpc_pipeis on /run/rpc_pipeis type rpc_pipeis (rw,relatime)
nisa on /proc/is/nisa type nisa (rw.relatime) /dem/mmeblb0n2 en /mmt/bde type est4 (rm. neletime enneme-nement ne unen wette benniew-
vdev/mmcbikupz on /mmt/nda type ext4 (iw,ieiatime,eriois=remount-ro,user_xatti,barrier= 1 dete=ordered)
root@icndag:/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:
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 /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 tvpe tmpfs (rw.nosuid.nodev.relatime) /dev/mmcblkOp1 on /boot/uboot type vfat (rw,noatime,fmask=0022,dmask=0022,codepage=cp437,iocha rset=iso8859–1,shortname=mixed,errors=remount-ro)
rpc_pipets on /run/rpc_pipets type rpc_pipets (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

AM335X-PAC Series User Manual

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:				
<pre>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 /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#</pre>				
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
report	print a report for device	blockdevreport /dev/mmcblk0p1
-v getra getbz	get readhead and blocksize	blockdev -vgetra –getbz /dev/mmcblk0p1

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

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

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

Parameter	Description	Example
-a	automatically repair the file system	fsck.vfat -a /dev/mmcblk0p1
-1	list path names of files being processed	fsck.vfat -l /dev/mmcblk0p1

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

Parameter	Description	Example
-t	specifies the type of file system to be built	mkfs -t vfat /dev/mmcblk0p1
-0	check the device for bad blocks before	mkfs -c vfat /dev/mmcblk0p1
	building the file system	

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E-mail: service@icpdas.com

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

Parameter	Description	Example
	create a Linux MINIX file-system	mkfs.minix /dev/mmcblk0p1
-c	check the device for bad blocks before building the file system	mkfs.minix -c /dev/mmcblk0p1

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/mmcblk0p1
-V	verbose execution	mkfs.vfat -v /dev/mmcblk0p1

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)

🛃 I	oot@icpdas:
root	@icndas:/wnt#_cat/proc/diskstats
1	
1	1 ram 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1	
- 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
- 7	4 loop4 0 0 0 0 0 0 0 0 0 0 0
$\dot{7}$	
- 51	U mtdblockU U U U U U U U U U U U
31	1 mtdblock1 0 0 0 0 0 0 0 0 0 0 0
31	2 mtdblock2 0 0 0 0 0 0 0 0 0 0 0
31	3 mtdblock3 0 0 0 0 0 0 0 0 0 0 0
31	4 m+dblock 4 0 0 0 0 0 0 0 0 0 0 0 0
21	5 wtdblock = 0.0000000000000000000000000000000000
21	
16	
31	7 mtdblock7 U U U U U U U U U U U
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/sdal on /mnt/usb type vfat (rw,relatime,fmask=0022,dmask=0022,codepage=cp437,io
charset=iso8859–1,shortname=mixed,errors=remount-ro)
root@icpdas:/mnt#
root@icpdas:/mnt# ls /mnt/usb
lp8k_9k_1.0.tgz
                                                interfaces.txt
                                                                     rootfs.ubi ulmage
                                 boot
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.

AM335X-PAC Series User Manual

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

# \	wdt	-е
-----	-----	----

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

// Set the response time to 4 seconds

(2) Refresh the WDT source.

wdt -r

(3) Disable the WDT.

wdt -d

[#] wdt -e -s4

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)	(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 **<u>Disable WDT</u>** 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

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

(1) Startup EEPROM GPIO function.

echo <mark>64</mark> > /sys/class/gpio/export

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

# echo out > /sys/class/gpio/gpio6	4/direction
------------------------------------	-------------

(3) Change to writable of EEPROM.

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

(4) To write a data to EEPROM.

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\eeprom.c or

root@LinuxPC-ICPDAS:/icpdas/linpac_am335x_sdk/i8k/examples/common/eeprom.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
PWR	Red	Power is on.
RUN	Green	Power on and OS is running.
L1	Green	
L2	Orange	User programmable LED indicator.
L3	Red	

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

Parameter:

LED Indicator	L	1	L	2	L3	
Status	ON	OFF	ON	OFF	ON	OFF
Parameter	-g1	-g0	-y1	-y0	-r1	-r0

AM335X-PAC Series User Manual version 2.0.0

Page: 103

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/ <mark>Red</mark>	Licor programmable LED indicator
L2	Green/ <mark>Red</mark>	oser programmable LED mulcator.

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 Ind	icator	Parameter
L1	L	-11
L2	2	-12
LED c	olor	Parameter
Crean	ON	-g1
Green	OFF	-g0
Ded	ON	-r1
Red	OFF	-r0



AM335X-PAC Series User Manual

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.
DUN	Red	OS is running.
KÜN	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 LED0 : Turn off the RUN LED

AM335X-PAC Series User Manual

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:

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



AM335X-PAC Series User Manual

version 2.0.0

Page: 107

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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 uint, 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

AM335X-PAC Series User Manual
	1	2	3	4	5	6	7	8 COM36
220	I-8112iW							
	COM4	COM8	COM12	COM16	COM20	COM24	COM28	COM32 COM32

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.

ttyS1	1	2	3	4	5	6	7	8 tty	\$34
220	I-8114W								
CARAC 10-8821								55 (.)4	
LF-0021	ttyS2	ttyS6	ttyS10	ttyS14	ttyS18	ttyS22	ttyS26	ttyS30	
PHL-10-31 VK	ttyS3	ttyS7	ttyS11	ttyS15	ttyS19	ttyS23	ttyS27	ttyS31	222
	ttyS4	ttyS8	ttyS12	ttyS16	ttyS20	ttyS24	ttyS28	ttyS32	witch
	ttyS5	ttyS9	ttyS13	ttyS17	ttyS21	ttyS25	ttyS29	ttyS33	

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:
root@icpdas:~# /usr/sbin/iTalk/getlist
slot 1 6024 <u>slot 2 not i</u> nstalled
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 Hight-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

AM335X-PAC Series User Manual

version 2.0.0

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LP-9x2x

The LP-9x2x embedded controller is a multi-tasking uint, 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@icodas:~# getlist
slot 1 9017
slot 2 9144
slot 3 9114
slot 4 9017
root@icodas:~#
rootDicodas:~# 1smod
Module Size Used bu
8250 41757 0
8250 109k 3300 0
slot 28379 0
irg 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 enable
[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 Hight-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:



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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
                                // Timeout, 100 milliseconds
 wBuf[4] = 100;
 wBuf[6] = 0;
                                // Debug string
// 7044 DO
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);
          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]);
```

```
// 7044 DI
DigitalIn(wBuf, fBuf, szSend, szReceive);
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.



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:

Static IP Mode:



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@i	cpdas:~# 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)
ethl	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 'mstpctl showbridge br0' command to verify that the 'force protocol version' is

set to **RSTP** mode, as illustrated in Figure 7.2-4.



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.

Putty 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:C	C 8.002	Altn
eth1 8.001	forw 8.000.00:0C:DB:CE:E0:69	8.000.00:0C:DB:ED:BE:C	C 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:C	C 8.002	Root
eth1 8.001	down 8.000.00:0C:DB:CE:E0:69	8.000.00:0C:DB:ED:BE:C	C 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:C	C 8.002	Disa
eth1 8.001	down 8.000.00:0C:DB:CE:E0:69	8.000.00:0C:DB:ED:BE:C	C 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:C	C 8.002	Disa
eth1 8.001	forw 8.000.00:0C:DB:CE:E0:69	8.000.00:0C:DB:ED:BE:C	C 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/mgtt_io/mg-7200m_introduction.html

AM335X-PAC Series User Manual

version 2.0.0

Page: 120

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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



<MQTT client>

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



AM335X-PAC Series User Manual

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	
	Broker URI	10.1.0.86 [e.g. www.mybroker.com or 192.168.255.2]
I/O Settings	Client identifier	MQ7255M_652B27
MQTT	Alias name	MQ7255M [maximum of 30 characters]
Web HMI	Connection timeout (sec)	5 [between 3 and 120 seconds]
	Reconnection interval (sec)	10 [between 5 and 120 seconds]
	Keep alive interval (sec)	20 [between 10 and 300 seconds]
		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.

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
0
0
0
0
0



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.

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 1 '\$0040' 115200

// DCON command: '\$AA4N'. Refer to the Notes below for additional information.

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		



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:

 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_87 k/87024_dcon_87k.htm

2. The **address** and **baudrate** for the LP-8x2x 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:

http://www.icpdas.com/products/PAC/winpac/io_support_list.htm

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	-	Υ	
Programmable slew-rate for AO module	-	Y	

For full details of specifications which can be found at:

http://www.icpdas.com/root/product/solutions/remote io/i-9k i-97k/i-9k i-97k selection.html

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

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

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	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.