
VXC Cards User's Manual

VXC-112A, VXC-142/142i, VXC-182i

Warranty

All products manufactured by ICP DAS are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

Warning

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1. Introduction

The VXC series multi-port serial card enables user to install additional communication ports on the PC. It's the best choice for time-critical and reliably communications and controls on the industrial environment. For example: Communicates to PLC, FAB machine, meter, console management of devices, laboratory instruments and Modem link, etc. In harsh industrial environments, the onboard surge protection protects the computer and other equipment from being damaged by high potential voltages.

COM-Selector:

The VXC series cards equip a COM-Selector (dip switch) for the COM port number selection (automatically or manually). It's an important and innovative feature of the VXC cards. It has the following advantages:

- Simplifies the COM port number selection without using configuration utility programs.
- Users specify the COM port number exactly what they want, no matter which PCI slot is using.
- Automatically select an available COM port number is supported by setting the COM-Selector (dip switch) to 0 (default).
- Needn't to install configuration utility for different OS, and needn't to study operations of the utility.
- Prevents confusion. Other PnP COM port devices always confusing users by using a dynamic COM port number.
- Replacing an existing card is very easy, just setting the COM-Selector (dip switches) to the same.
- It's great for mass system installation, just setting the COM-Selector (dip switches) to use the same COM port number in systems.

Up To 128KB Software FIFO:

The VXC card driver for Windows features a maximums 128KB software FIFO for each port (default is 4KB). It's practical for large file transmission.

Self-Tuner:

The RS-485 ports of VXC cards equip a "Self-Tuner" chip, which controls the sending/receiving direction, baud rate and data format automatically and reduces the software loading for such controls.

1.1 Features

	VXC-112A	VXC-142	VXC-142i	VXC-182i
Common Features	<ul style="list-style-type: none"> ● 5V PCI Bus add-on card ● COM-Selector ● Provides surge protection ● LED diagnostic indicators ● 16-byte UART FIFO 			
RS-422/485	-	2-Port	2-Isolated	1-Isolated
RS-232	2-Port	-	-	1-Port
Self-tuner	-	Yes	Yes	Yes
Isolated	-	-	3KV	3KV

1.2 Specifications

	VXC-112A	VXC-142	VXC-142i	VXC-182i
Data bit	5, 6, 7, 8			
Stop bit	1, 1.5, 2			
Parity	None, Even, Odd, Mark, Space			
Speed	50~115.2Kbps			
Connectors	2 x DB9 (Male)			
UART	2 x 16C550 Compatible			
Isolation	-	-	3 KV	3 KV (RS-422/485)
Operating Temperature	0~50°C			
Storage Temperature	-20 to 70°C			
Humidity	0~90% non-condensing			
Dimensions (mm)	140 x 95	130 x 105	140 x 95	140 x 95

1.3 Product Check List

In addition to this manual, the package includes the following items:

- One VXC-112A, VXC-142/142i or VXC-182i card
- One ICP DAS floppy diskette or CD
- One copy of the release notes

Before continuing, it is recommended that you read the release notes, which contain the following important information:





1. The location of the software driver & utility
2. How to install the software & utility
3. The location of the diagnostic program

Attention! If any of these items are missing or damaged, contact the dealer from whom you purchased the product. Save all shipping materials and the carton in case you need to ship or store the product in the future.

1.4 Ordering Information

- VXC-112A: 2-port RS-232 Communication Board
- VXC-142: 2-port RS-422/485 Communication Board
- VXC-142i: 2-port Isolated RS-422/485 Communication Board
- VXC-182i: 1-port isolated RS-422/485 and 1-port RS-232 Communication Board

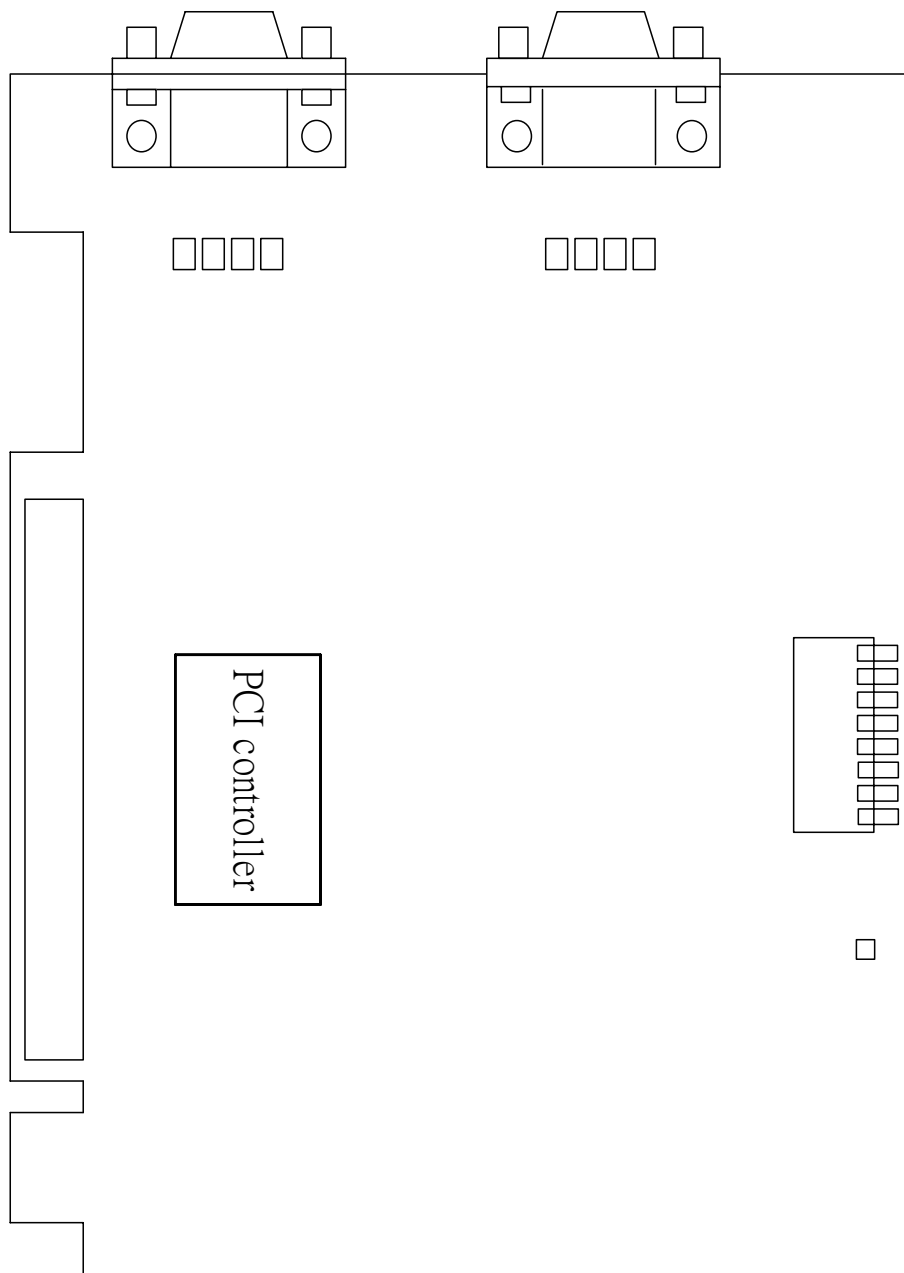
1.5 Options

Item	Description	VXC-112A	VXC-142 VXC-142i	VXC-182i
CA-0903 	9-pin Female D-sub & 5-wire RS-232 cable, 30cm	√	-	√
CA-0910 	9-pin Female D-sub & 3-wire RS-232 cable, 1M	√	-	√
CA-0910F 	9-pin Female-Female D-sub Cable, 1M	√	√	√
DN-09-2F 	I/O Connector Block with DIN-Rail Mounting and two 9-pin Male Header. Includes: CA-0910F x 2 (9-pin Female-Female D-sub Cable, 1M)	√	√	√
CA-090910 	9-pin Female D-sub & (9-wire) RS-422 Cable, 1M	-	√	√
CA-PC09F 	9-pin Female D-sub connector with plastic cover	√	√	√
CA-0915 	9-pin Male-Female D-sub cable, 1.5M	√	√	√

2. Hardware configuration

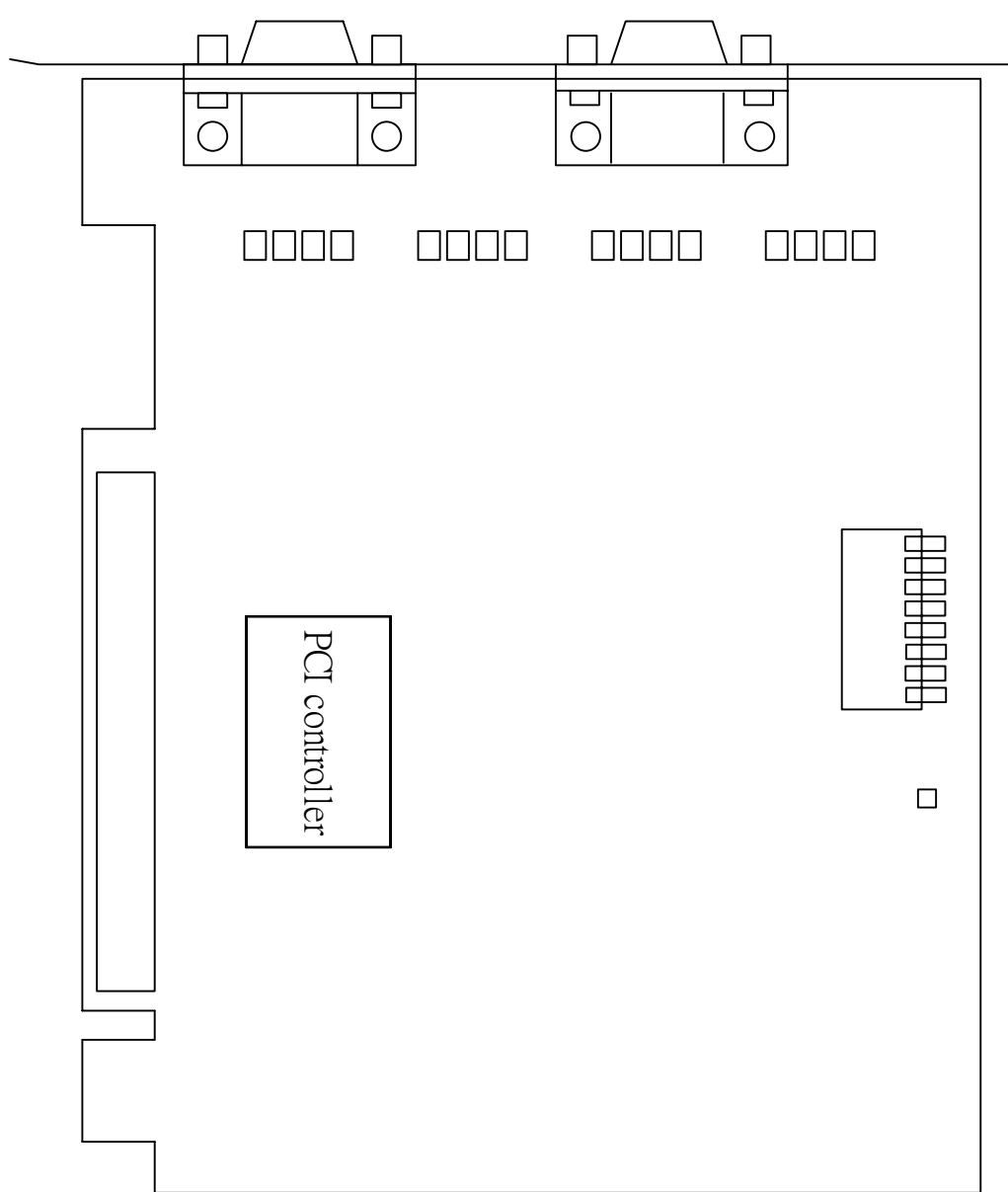
2.1 Board Layout

- Board layout of the VXC-112A



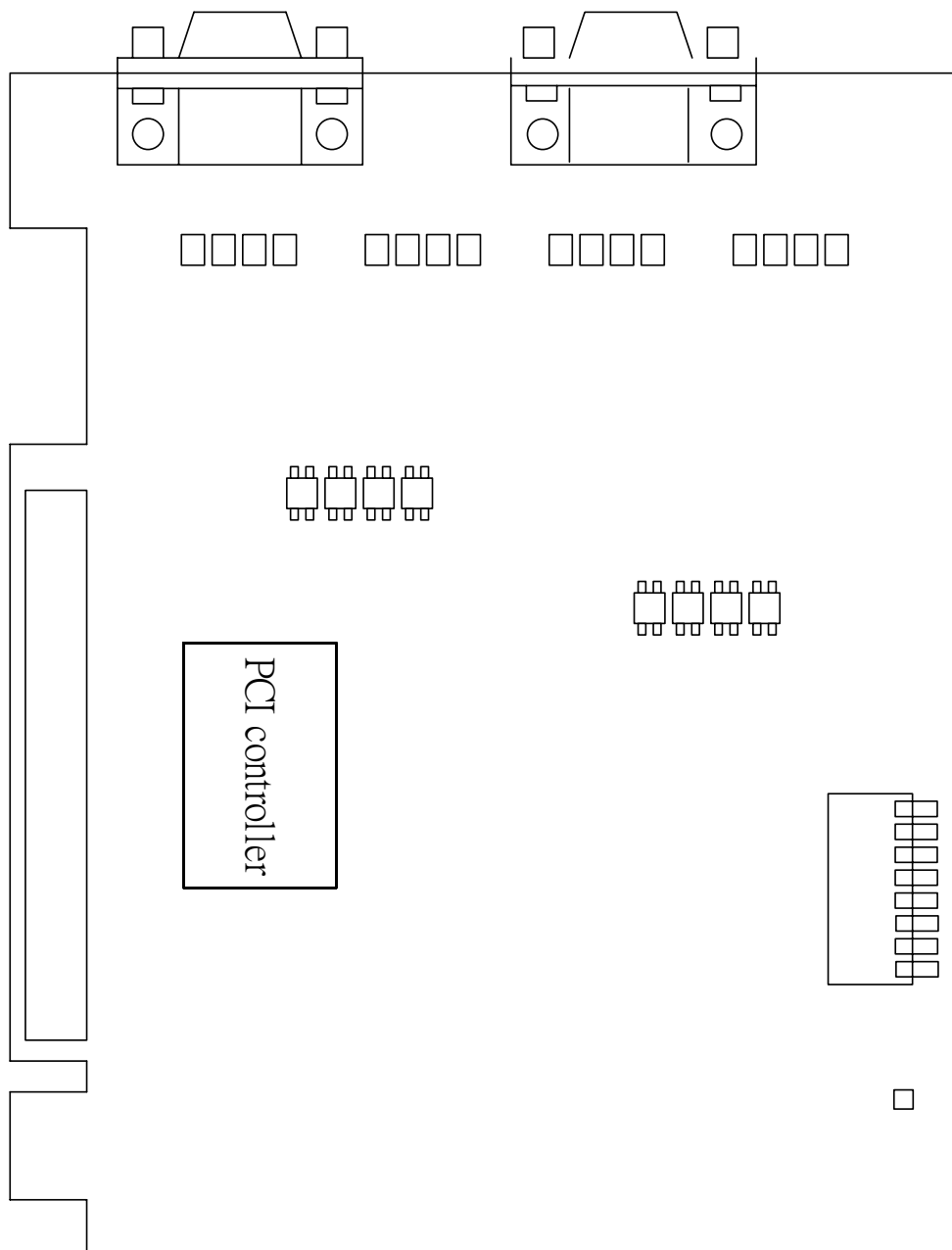
Note: CN1/2 => RS-232 Port

- Board layout of the VXC -142



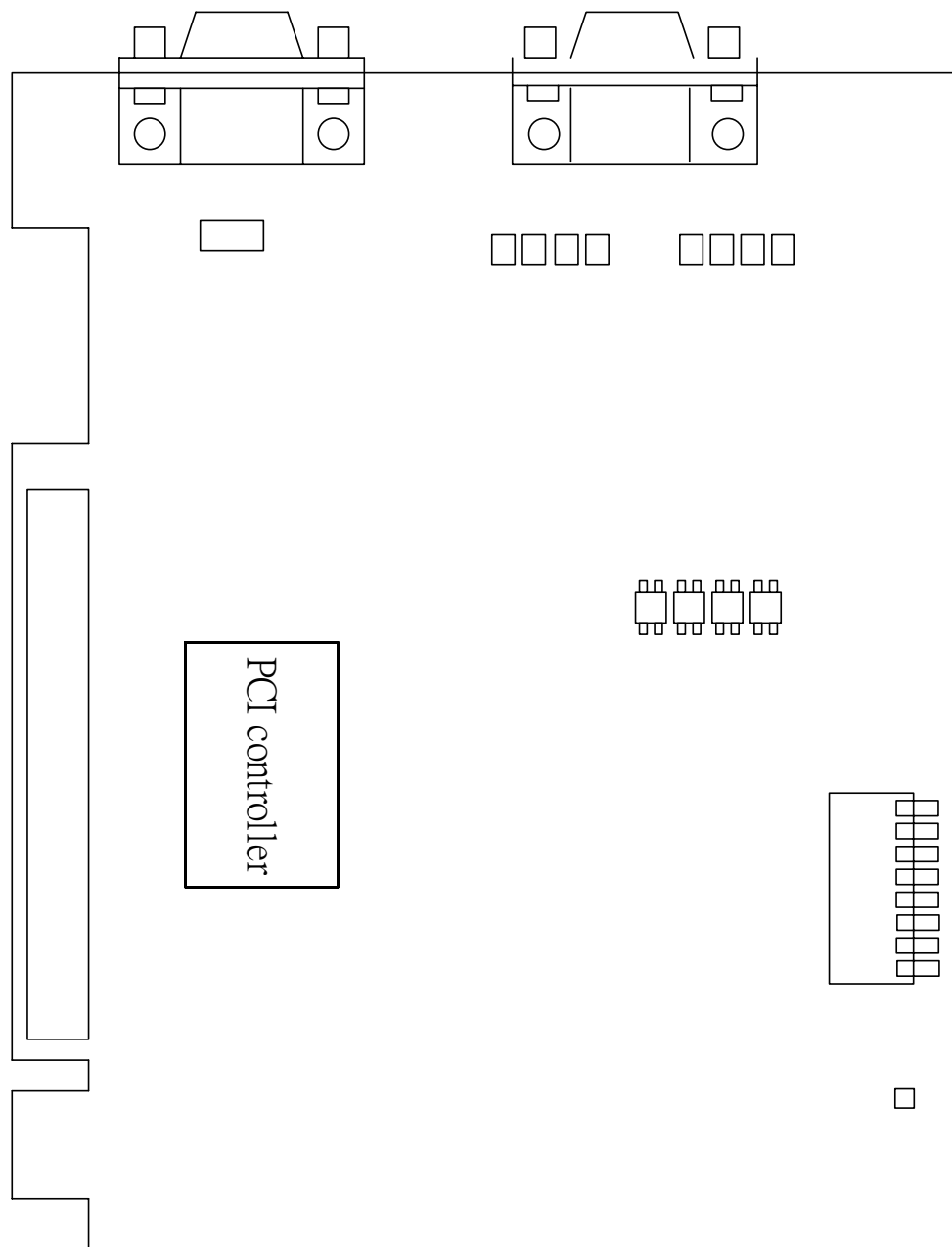
Note: CN1/2 => Non-Isolated RS-422/485 port

-
- Board layout of the VXC-142i



Note: CN1/2 => Isolated RS-422/485 port

-
- Board layout of the VXC-182i



Note: CN1 => Isolated RS-422/485 port
CN2 => RS-232 port

2.2 COM Port Mapping and Board ID

The Board ID and COM port mapping are the same, which is set by the S1 DIP switch. The S1 DIP switch has different functions under different OS.

For **DOS** users, the S1 DIP switch acts as **Board ID**. When there are two or more multi-port serial cards in a single system, it is difficult to identify individual card number. For easier identification, the VXC series card includes a Board ID function.

For **Windows** users, the S1 DIP switch acts as **COM port number selector** and the COM port number is depending on the Board ID. If the Board ID is 0, then the driver finds a valid number for each port. If the Board ID is not 0, then the driver uses the “**Board ID**” to be the first COM port number and uses the “**Board ID +1**” to be the next COM port number and so on.

Note: It's recommended to select a unique COM port number (Board ID) by users. This helps users to identify and fix these cards and ports in a system without confuses.

Warning: The port will not work if the COM port number is conflicted under Windows or Linux system. In that case, users should try other COM port numbers.

Usually, the COM1 and COM2 are reserved by systems. And it's recommended to reserve the COM3 and COM4 if you will have other Plug&Play serial ports in the future. This prevents confliction.

For **Linux** users, it's the same as Windows users but for **TTY device number selector**.

The configuration examples are as follows.

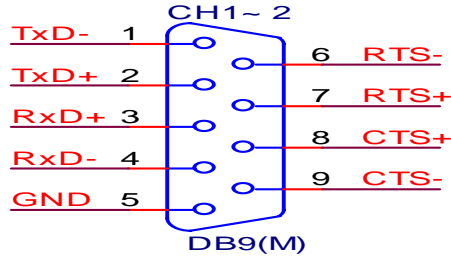
S1



S1 DIP Switch	8	7	6	5	4	3	2	1
Board ID= 0x00 (Default) COM = Auto-defined	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Board ID= 0x03 COM = 3/4	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
Board ID= 0x05 COM = 5/6	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
Board ID= 0x07 COM = 7/8	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
Board ID= 0x09 COM = 9/10	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON
Board ID= 0x14 COM = 20/21	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF
Board ID= 0x1E COM = 30/31	OFF	OFF	OFF	ON	ON	ON	ON	OFF
Board ID= 0x28 COM = 40/41	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF
Board ID= 0x32 COM = 50/51	OFF	OFF	ON	ON	OFF	OFF	ON	OFF
Board ID= 0x3C COM = 60/61	OFF	OFF	ON	ON	ON	ON	OFF	OFF
Board ID= 0x64 COM = 100/101	OFF	ON	ON	OFF	OFF	ON	OFF	OFF
Board ID= 0x96 COM = 150/151	ON	OFF	OFF	ON	OFF	ON	ON	OFF
Board ID= 0xC8 COM = 200/201	ON	ON	OFF	OFF	ON	OFF	OFF	OFF
.								
.								
.								
Board ID= 0xFF COM = 255/256	ON	ON	ON	ON	ON	ON	ON	ON

2.3 Pin Assignment and Cable Wiring

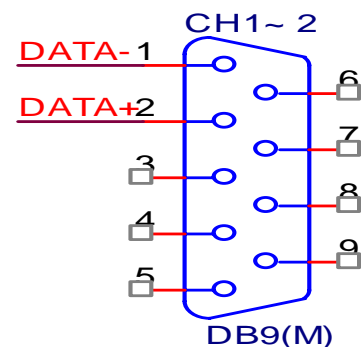
2.3.1 RS-422 Cable Wiring



VXC-142/142i, VXC-182i DTE (MALE DB-9)		Terminal DTE (DB-9)	
PIN	Signal	PIN	Signal
1	TxD-	4	RxD-
2	TxD+	3	RxD+
3	RxD+	2	TxD+
4	RxD-	1	TxD-
5	GND	5	GND
6	RTS-	9	CTS-
7	RTS+	8	CTS+
8	CTS+	7	RTS+
9	CTS-	6	RTS-

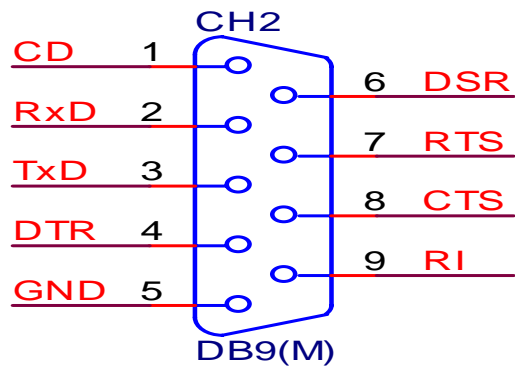
2.3.2 RS-485 Cable Wiring

VXC-142/142i, VXC-182i DTE (MALE DB-9)		Terminal DTE (DB-9)	
PIN	Signal	PIN	Signal
1	DATA -	1	DATA -
2	DATA +	2	DATA +



Warning: The RS-485 bus is a differential (balanced) signal, thus **you cannot wire the Data+ with Data- directly for a single port loop-back test.** It will not work at all!

2.3.3 RS-232 Cable Wiring



VXC-112A, VXC-182i (Male DB-9) Null Modem Cable Wiring

System 1	Pin		Pin	System 2
TX	3	→	2	RX
RX	2	←	3	TX
RTS	7	→	1	DCD
CTS	8		-	
DSR	6	←	4	DTR
DCD	1	←	7	RTS
	-		8	CTS
DTR	4	→	6	DSR

2.4 Hardware Installation

Warning: Static electricity can easily damage computer equipment. Ground yourself by touching the chassis of the computer before touching any boards.

To install your VXC series cards, complete the following steps:

1. Turn off your computer
2. Remove all covers from the computer
3. Select an unused PCI slot
4. Remove the PCI slot cover from the PC
5. Carefully insert your VXC card into the PCI slot, and attach the cable to the connector
6. Replace the PC cover
7. Turn on your PC and refer to Chapter 3 for information regarding software installation

3. Software Installation

ICP DAS provides following device drivers for most operation systems such as MS-DOS, Windows NT 4.0 and Windows 2000/XP/2003. These Windows drivers provide full interrupt-driven, buffered I/O for each COM ports. And also supports the Plug & Play mechanism for easy installation.

VxCard DOS Lib: Programming library files and sample programs for DOS.

VxCard Driver NT: COM port driver for Windows NT 4.0.

VxCard Driver 2K: COM port driver for Windows 2000/XP/2003.

VxCard Driver Linux: tty driver for Linux.

Note: VxCard Driver 2K also supports Windows XP and Windows Server 2003.

For Windows users to access COM ports, please refer to the “**Serial Communications in Win32**” article for programming information. Which can be found by searching on the <http://msdn.microsoft.com>.

This chapter shows you the detail steps to install these drivers.

Note: For more information about COM port number selection, please refer to **Section 2.2 “COM Port Mapping & Board ID”**.

3.1 DOS Lib

Microsoft provides standard Win32 APIs for Windows 9x/NT/2K/XP/2003 users to access the COM ports. But DOS did not have such standard APIs, thus ICP DAS provides library functions under DOS for the VXC cards. Which provides easy programming interfaces and sample programs (include source code) that written in Turbo C.

These sample programs (include source code) show you ...

1. To find out all VXC cards.
2. To get the I/O address and IRQ number of the card.
3. To get the Board ID of the card.
4. To Send/receive data to/from the COM ports.
5. To control the LED On/Off of the card.

3.1.1 Installation

Please refer to the “**Release Note**” paper that shows you the location of the software on the CD. Run the “**install.bat**” batch file to install the software into your c: disk.

If you like to install the software into a different location, you can specify the parameter after the “**install.bat**” file. For example:

Install d:MyProj <Enter>

Or, you can copy the folder into your project directory manually.

3.2 Windows NT 4.0

3.2.1 Installation

Please refer to the “**Release Note**” paper to see the software location and refer to the following steps to complete it.

Note: It's recommended to install the software first, and then the hardware. This reduces the reboot times of your computer.

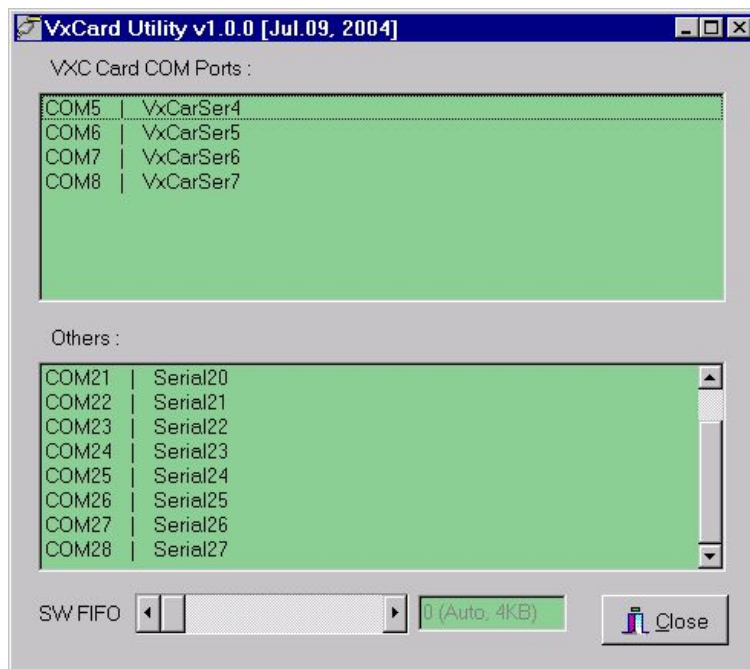
1. Launch the “**VxCardNT.exe**” setup program, and then click the “**Next >**” button.
2. When prompted, click the “**Next >**” button to start installation. Or click the “**Change...**” button to select a new folder first for the installation.
3. After the driver is installed, click the “**Finish**” button.
4. When prompted, select the “**Yes, I want to restart my computer now.**” option, and then click the “**Finish**” button to reboot the computer.

Note: After the installation is completed, users must restart the computer to start the driver.

3.2.2 Verification

ICP DAS provides a “**VxCard Utility**” program (VxCardUtil.exe) for users to see all the COM ports on the system. It shows COM ports in two groups, one for VXC Card and one for others. So, users can check if any conflict occurred between COM ports.

To launch the utility, just double-click on the “**VxCard Utility**” short-cut on your desktop.



Note: When the hardware and software are well installed, the driver turns off the LED on the card. If there is something error, such as driver not work or COM port number conflicted, the LED keeps lighting.

3.2.3 Configuration

If need, users can change the input buffer size (default is 4KB for each port, up to 128KB) by setting the "SW FIFO" scroll-bar on the VxCard Utility.

To change the COM port mappings, users should restart the driver by rebooting the computer, or launch a DOS box and run ...

"**Net Stop VxCarSer**" command to stop the driver, then run
"**Net Start VxCarSer**" command to start the driver again.

3.2.4 Uninstallation

1. Select the "**Start / Settings / Control Panel**" and double-click the "**Add/Remove Programs**" icon.
2. Select the "**VxCard Driver NT**" and click the "**Add/Remove**" button.

3.3 Windows 2000

3.3.1 Installation

Note: It's recommended to install the software first, and then the hardware. This reduces the configuration procedures.

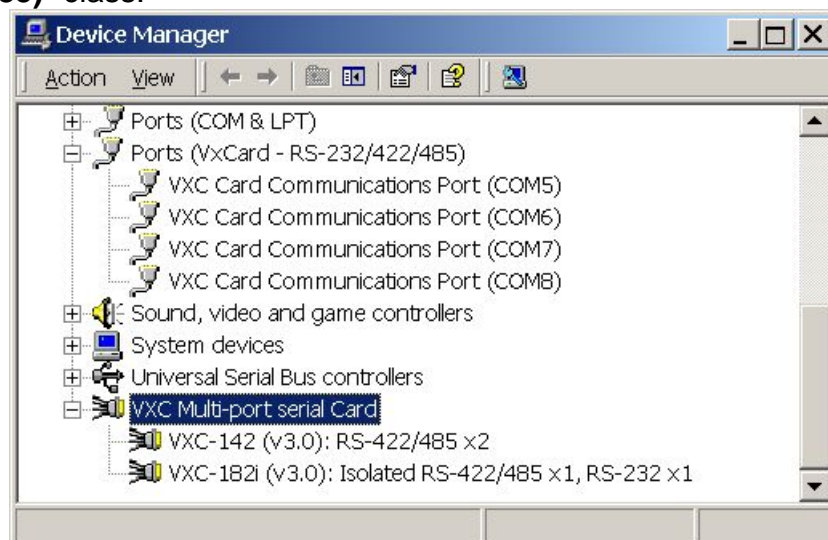
1. Launch the VxCard2K.exe to install the driver and register the related information onto the system.
2. Power off the computer and install the VxCard into the PC.
3. Power on your computer, Windows 2000 should find the new card and load the driver automatically. (Sometimes Win2K pops up few confirm dialog box, just click "next" or "OK" to finish it.)

3.3.2 Verification

To verify the installation, please complete the following steps:

1. Select "**Start/Settings/Control Panel**" and double-click the "**System**" icon.
2. Click the "**Hardware**" tab and then click the "**Device Manager**" button.

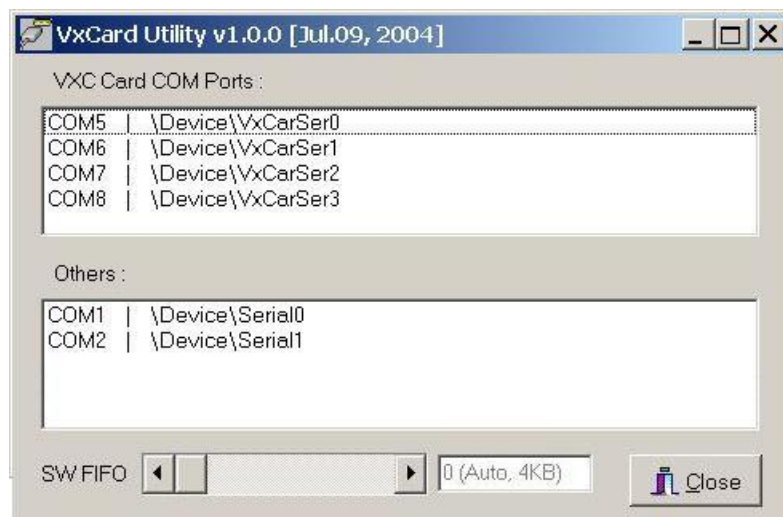
The VXC Card is listed under the "**VXC Multi-port serial Card**" class, and each Communications Port is listed under the "**Ports (VxCard – RS-232/422/485)**" class.



Note: When the hardware and software are well installed, the driver turns off the LED on the card. If there is something error, such as driver not work or COM port number conflicted, the LED keeps lighting.

3.3.3 Configuration

If need, users can change the input buffer size (default is 4KB for each port, up to 128KB) by setting the “SW FIFO” scroll-bar on the VxCard Utility. The utility’s short cut is placed on the desktop after installation.



To change the COM port mappings, users should restart the driver by rebooting the computer, or re-install the “**VXC Card**” hardware in the “**Device Manager**” by un-install card and then scan new hardware.

3.3.4 Uninstallation

Before removing the card from your computer, it’s recommended to uninstall the device from the “**Device Manager**”. This removes unused hardware information from the database (registry) of Windows.

3.4 Windows XP/2003

3.4.1 Installation

Note: It's recommended to install the software first, and then the hardware. This reduces the configuration procedures.

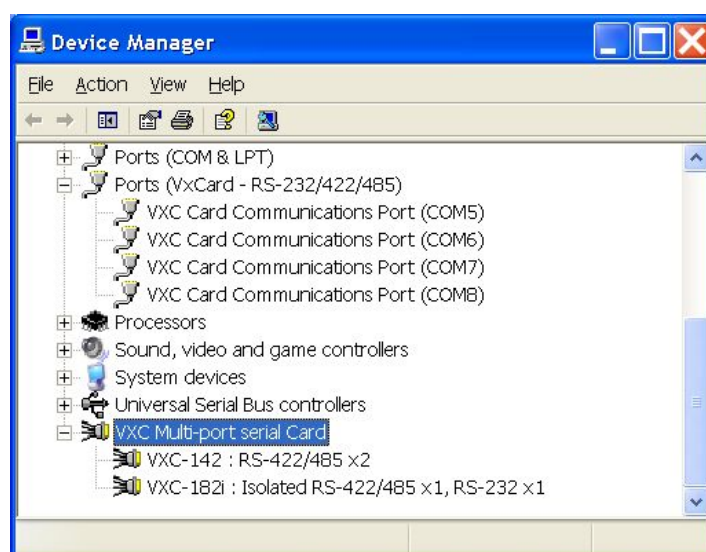
1. Launch the VxCard2K.exe to install the driver and register the related information onto the system. (Win2K driver also works on XP/Server 2003.)
2. Power off the computer and install the VxCard into the PC.
3. Power on your computer, Windows XP/2003 should find the new card and load the driver automatically. (WinXP/2003 may pop up few confirm dialog box, just click "next" or "OK" to finish it.)

3.4.2 Verification

To verify the installation, please complete the following steps:

1. Select "**Start/Settings/Control Panel**" and double-click the "**System**" icon.
2. Click the "**Hardware**" tab and then click the "**Device Manager**" button.

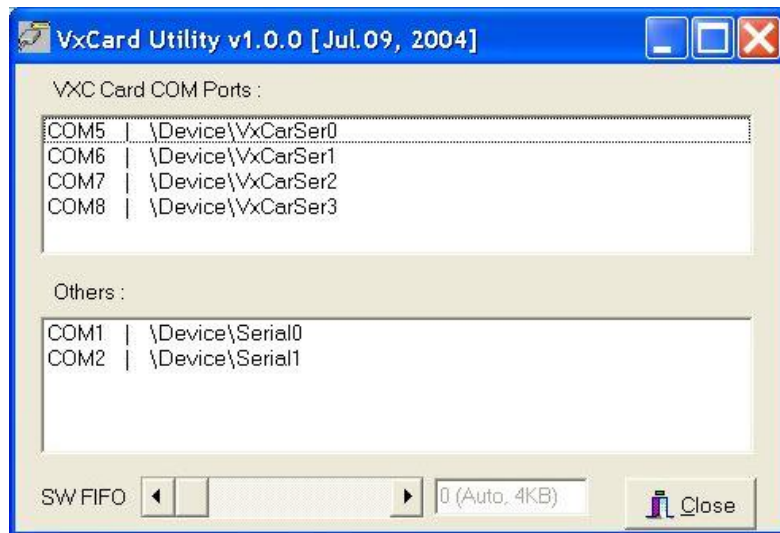
The VXC Card is listed under the "**VXC Multi-port serial Card**" class, and each Communications Port is listed under the "**Ports (VxCard – RS-232/422/485)**" class.



Note: When the hardware and software are well installed, the driver turns off the LED on the card. If there is something error, such as driver not work or COM port number conflicted, the LED keeps lighting.

3.4.3 Configuration

If need, users can change the input buffer size (default is 4KB for each port, up to 128KB) by setting the “SW FIFO” scroll-bar on the VxCard Utility. The utility’s short cut is placed on the desktop after installation.



To change the COM port mappings, users should restart the driver by rebooting the computer, or re-install the “**VXC Card**” hardware in the “**Device Manager**” by un-install card and then scan new hardware.

3.4.4 Uninstallation

Before removing the card from your computer, it’s recommended to uninstall the device from the “**Device Manager**”. This removes unused hardware information from the database (registry) of Windows.

3.5 Linux

This section describes VXC Card Linux driver's features and how to compile and install into a general Linux system. The VXC Card Linux driver is modified from Linux kernel source and supports most of popular PC-based Linux distributions.

3.5.1 Driver Features

- Device file.
 - Dynamic device allocation.
 - Dynamic major number.
 - One major number for multiple devices.
 - Use the GNU configure and build system.
-

3.5.2 Installation

Please refer to the following steps to complete it.

1. Download or copy the **IxCOM** package to a directory that you have access to.
2. Extract the package.

For example, the package's file name is "**ixcom-0.05.0.tar.gz**" and its path related to your current working directory is `../pkg`, then the extraction command would be

```
gunzip -c ../pkg/ixcom-0.05.0.tar.gz | tar xvf -
```

or

```
tar -zxvf ../pkg/ixcom-0.05.0.tar.gz
```

An `ixcom-0.05.0` directory is created after extraction.

3. For convenient access, it is a good idea to put a symbol-link on it.
ln -s ixcom-0.05.0 ixcom
 4. Change to the **ixcom** working directory you just made, type
./configure to create proper Makefiles.
-

5. Once the configuring has done successfully, type “**make**” to build all.

Note: If you like to install files to system directory, the make install will do it for you. However, install files to system directory is not necessary for further operation. You will need the root privilege for that.

Script “**./ixcom.inst**” loads modules automatically. Script “**./ixcom.remove**” removes the loaded modules. The root privilege is required when installing or removing these kernel modules.

3.5.3 Access To VXC Serial Port

Script “**ixcom.inst**” will establish unused device major number dynamically and create correspond device node for access VXC serial port.

```
# ./ixcom.inst
IxCOM Installer 0.4.0
Check kernel version... 2.4
Use proc-file /proc/icpdas/ixcom
Load module ixcom
```

Use “**dmesg**” command to inspect the driver output message.

```
dmesg
.....
.....
ICPDAS VXC multi-serial card Serial driver version 5.05c
(2001-07-08) with HUB-6 MANY_PORTS MULTIPORT
SHARE_IRQ SERIAL_PCI enabled
vxc major = 254
vxc aux_major = 253
PCI: Found IRQ 5 for device 00:13.0
ttySV0 at port 0xe0c0 (irq = 5) is a 16550A
ttySV1 at port 0xe0e0 (irq = 5) is a 16550A
```

The script “**ixcom.inst**” had loaded module into kernel and find a VXC card that have two serial port, ttySV0 and ttySV1.

The “**ixcom.inst**” script will use major number 254 to create correspond device on the /dev.

```
# ls -la /dev/ttySV?  
crw-rw-rw- 1 root root 254, 64 Jul 14 10:13 /dev/ttySV0  
crw-rw-rw- 1 root root 254, 65 Jul 14 10:13 /dev/ttySV1  
crw-rw-rw- 1 root root 254, 66 Jul 14 10:13 /dev/ttySV2  
crw-rw-rw- 1 root root 254, 67 Jul 14 10:13 /dev/ttySV3  
crw-rw-rw- 1 root root 254, 68 Jul 14 10:13 /dev/ttySV4  
crw-rw-rw- 1 root root 254, 69 Jul 14 10:13 /dev/ttySV5  
crw-rw-rw- 1 root root 254, 70 Jul 14 10:13 /dev/ttySV6  
crw-rw-rw- 1 root root 254, 71 Jul 14 10:13 /dev/ttySV7  
crw-rw-rw- 1 root root 254, 72 Jul 14 10:13 /dev/ttySV8  
crw-rw-rw- 1 root root 254, 73 Jul 14 10:13 /dev/ttySV9
```

To remove VXC driver from system use script “**./ixcom.remove**” to removes the loaded modules.

3.5.4 Access to VXC Auxiliary Serial Port

Each port of the VXC card has a corresponding auxiliary device named cuaV. The auxiliary device cuaV behave is very similar to serial device ttySV except DCD signal identify.

A serial port will fails to open when the DCD signal is OFF and closing automatically when DCD signal is OFF. But the auxiliary serial device will not to check the status of DCD signal if ON when open serial port and not closing serial port automatically when DCD signal is OFF. The auxiliary serial device will be useful with dialing-out modem that fails to assert DCD signal when there is no one called into it and there is no carrier. The cuaV device was once used for dialing-out and ttySV used for dialing-in purpose traditionally.

Each ttySV device of VXC serial card has a corresponding auxiliary device cuaV with the same minor number but different major number that create by script ixcom.inst automatically.

```
# ls -la /dev/cuaV?  
crw-rw-rw- 1 root root 253, 64 Jul 14 10:13 /dev/cuaV0  
crw-rw-rw- 1 root root 253, 65 Jul 14 10:13 /dev/cuaV1  
crw-rw-rw- 1 root root 253, 66 Jul 14 10:13 /dev/cuaV2  
crw-rw-rw- 1 root root 253, 67 Jul 14 10:13 /dev/cuaV3  
crw-rw-rw- 1 root root 253, 68 Jul 14 10:13 /dev/cuaV4  
crw-rw-rw- 1 root root 253, 69 Jul 14 10:13 /dev/cuaV5  
crw-rw-rw- 1 root root 253, 70 Jul 14 10:13 /dev/cuaV6  
crw-rw-rw- 1 root root 253, 71 Jul 14 10:13 /dev/cuaV7  
crw-rw-rw- 1 root root 253, 72 Jul 14 10:13 /dev/cuaV8  
crw-rw-rw- 1 root root 253, 73 Jul 14 10:13 /dev/cuaV9
```

4. Programming Reference

4.1 Determining the I/O Address

The plug & play BIOS will assign the correct I/O address to each VXC series card during the power-up process. The fixed IDs of each VXC series card is as follows:

Item	Vendor ID	Device ID	Sub-Vendor ID	Sub-Device ID	Sub-Aux ID
VXC-112A	0xe159	0x0001	0x1D61	0x0000	0x00
VXC-142	0xe159	0x0001	0x0061	0x0000	0x00
VXC-142i	0xe159	0x0001	0x0161	0x0002	0x00
VXC-182i	0xe159	0x0001	0x0161	0x0001	0x00

All necessary functions are provided as follows:

1. PIO_DriverInit(&wBoard, wSubVendor, wSubDevice, wSubAux)
2. PIO_GetConfigAddressSpace(wBoardNo, *wBase, *wIrq, *wSubVendor, *wSubDevice, *wSubAux, *wSlotBus, *wSlotDevice)
3. Show_PIO_PISO(wSubVendor, wSubDevice, wSubAux)

All functions are defined in PIO.H. The important driver information is as follows:

1. Resource-allocated information:

- wBase : BASE address mapping in the PC
- wIrq: The IRQ channel number allocated in the PC

2. VXC identification information:

- wSubVendor: The subVendor ID of the board
- wSubDevice: The subDevice ID of the board
- wSubAux: The subAux ID of the board

3. PC's physical slot information:

- wSlotBus: The slot position of hardware slot ID1 in the PC
- wSlotDevice: The slot position of hardware slot ID2 in the PC

The **PIO_PISO.EXE** utility program will detect and display all VXC cards installed in the PC.

4.1.1 PIO_DriverInit

PIO_DriverInit(&wBoards, wSubVendor, wSubDevice, wSubAux)

- wBoards →[OUT] number of boards found in this PC
- wSubVendor →[IN] Sub-vendor ID of the board to be determined
- wSubDevice →[IN] Sub-device ID of the board to be determined
- wSubAux →[IN] Sub-aux ID of the board to be determined

Note: The “[IN]” symbolic indicates that the parameter should assign a value by users, while the “[OUT]” symbolic indicates that the parameter will return a value after calling the function.

The **PIO_DriverInit** function detects all VXC series cards in the system, and is implemented based on the PCI plug & play mechanism. All VXC series cards installed in this system will be detected and the resources will be saved in the library.

Sample program 1:

Determine the resources for all VXC-142 cards in the PC

```
wSubVendor=0x61; wSubDevice=0x00; wSubAux=0x00; /* for VXC-142 */

wRetVal=PIO_DriverInit(&wBoards, wSubVendor,wSubDevice,wSubAux);
printf("There are %d VXC-142 card(s) in this PC\n",wBoards);

/* Step 2: save the resources of all cards installed in the PC */
for (i=0; i<wBoards; i++)
{ PIO_GetConfigAddressSpace(i,&wBase,&wlrq,&wID1,&wID2,&wID3,
                           &wID4,&wID5);

  printf("\nCard_ %d: wBase=%x, wlrq=%x", i,wBase,wlrq);
  wConfigSpace[i][0]=wBaseAddress; /* save all resources of this card */
  wConfigSpace[i][1]=wlrq;         /* save all resources of this card */
}
```

Sample program 2:

Identify all VXC cards in the PC

```
wRetVal=PIO_DriverInit(&wBoards,0xff,0xff,0xff); /* identify all VXC cards */
printf("\nThere are %d VXC Cards in this PC",wBoards);
if (wBoards==0 ) exit(0);

printf("\n-----");
for(i=0; i<wBoards; i++)
{
    PIO_GetConfigAddressSpace(i,&wBase,&wIrq,&wSubVendor,
        &wSubDevice,&wSubAux,&wSlotBus,&wSlotDevice);

    printf("\nCard_%d:wBase=%x,wIrq=%x,subID=[%x,%x,%x],
        SlotID=[%x,%x]",i,wBase,wIrq,wSubVendor,wSubDevice,
        wSubAux,wSlotBus,wSlotDevice);
    printf(" --> ");
    ShowPioPiso(wSubVendor,wSubDevice,wSubAux);
}
```

4.1.2 PIO_GetConfigAddressSpace

**PIO_GetConfigAddressSpace(wBoardNo,*wBase,*wIrq, *wSubVendor,
*wSubDevice,*wSubAux,*wSlotBus, *wSlotDevice)**

- wBoardNo →[IN] Board index number which between 0 and total boards -1.
- wBase →[OUT] The base address of this board.
- wIrq →[OUT] The IRQ channel number allocated to this board.
- wSubVendor →[OUT] The sub-vendor ID for this board.
- wSubDevice →[OUT] The sub-device ID for this board.
- wSubAux →[OUT] The sub-aux ID for this board.
- wSlotBus →[OUT] The hardware slot ID1 for this board.
- wSlotDevice →[OUT] The hardware slot ID2 for this board.

The **PIO_GetConfigAddressSpace** function can be used to save the resource information for all VXC cards installed in the system. The application program can then directly control the functions of each VXC series card.

A sample program source is as follows:

```

/* Step 1: detect all VXC-142 cards */
wSubVendor=0x61; wSubDevice=0x00; wSubAux=0x00; /* for VXC-142 */
wRetVal=PIO_DriverInit(&wBoards, wSubVendor,wSubDevice,wSubAux);
printf("There are %d VXC-142 cards in this PC\n",wBoards);

/* Step 2: save the resources for each VXC-142 card installed in the PC */
for (i=0; i<wBoards; i++)
{ PIO_GetConfigAddressSpace(i,&wBase,&wlrq,&t1,&t2,&t3,&t4,&t5);
  printf("\nCard_%d: wBase=%x, wlrq=%x", i,wBase,wlrq);
  wConfigSpace[i][0]=wBaseAddress; /* save all resources for this card */
  wConfigSpace[i][1]=wlrq;          /* save all resources for this card */
}

/* Step 3: directly control the VXC-142 */
wBase=wConfigSpace[0][0]; /* get the base address of card_0 */
outport(wBase,1);          /* enable all D/I/O operations for card_0 */
wBase=wConfigSpace[1][0]; /* get the base address of card_1 */
outport(wBase,1);          /* enable all D/I/O operations for card_1 */

```

4.1.3 Show_PIO_PISO

Show_PIO_PISO(wSubVendor,wSubDevice,wSubAux)

- wSubVendor →[IN] the subVendor ID of the board to be determined
- wSubDevice →[IN] the subDevice ID of the board to be determined
- wSubAux →[IN] the subAux ID of the board to be determined

The **Show_PIO_PISO** function will display a text string to identify the special subIDs. The text string is the same as that defined in PIO.H

A demo program is as follows:

```
wRetVal=PIO_DriverInit(&wBoards,0xff,0xff,0xff); /*find all VXC*/
printf("\nThere are %d VXC Cards in this PC",wBoards);
if (wBoards==0 ) exit(0);

printf("\n-----");

for(i=0; i<wBoards; i++)
{
PIO_GetConfigAddressSpace(i,&wBase,&wIrq,&wSubVendor,
&wSubDevice,&wSubAux,&wSlotBus,&wSlotDevice);

printf("\nCard_ %d:wBase=%x,wIrq=%x,subID=[%x,%x,%x],
SlotID=[%x,%x]",i,wBase,wIrq,wSubVendor,wSubDevice,
wSubAux,wSlotBus,wSlotDevice);
printf(" --> ");
ShowPioPiso(wSubVendor,wSubDevice,wSubAux);
}
```

4.2 I/O Address Mapping

The I/O address of the VXC series card is automatically assigned by the main-board ROM BIOS. The I/O address can also be re-assigned by the user. **It is strongly recommended that user does not change the I/O address. The plug & play BIOS will assign the correct I/O address to each VXC series card.**

The table below indicates the I/O address of the VXC-112A, VXC-142/142i and VXC-182i series cards:

Address	Read	Write
wBase+0	-	RESET control register
wBase+2	-	Aux control register
wBase+3	-	Aux data register
wBase+5	-	INT mask control register
wBase+7	Aux pin status register	-
wBase+0x2a	-	INT polarity control register
wBase+0xc0	Read Data from Port 1	Write Data to Port 1
wBase+0xe0	Read Data from Port 2	Write Data to Port 2
wBase+0xdc	-	High/low speed mode of Port 1
wBase+0xfc	-	High/low speed mode of Port 2

Note. Refer to Sec. 4.1 for more information regarding wBase.

4.2.1 RESET\ Control Register

(Read/Write): wBase+0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	-	RESET\

Note. Refer to Sec. 4.1 for more information regarding wBase.

When the PC is first powered-on, the RESET\ signal is in the Low state. **This will disable all D/I/O operations.** The user must set the RESET\ signal to the High state before sending any D/I/O commands.

```
outportb(wBase,1);    /* RESET\ = High → all D/I/O are now enabled */
outportb(wBase,0);    /* RESET\ = Low → all D/I/O are now disabled */
```

4.2.2 AUX Control Register

(Read/Write): wBase+2

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Aux7	Aux6	Aux5	Aux4	Aux3	Aux2	Aux1	Aux0

Note. Refer to Sec. 4.1 for more information regarding wBase.

Aux n=0 → the Aux is used as an input.

Aux n=1 → the Aux is used as an output. n=0~7

When the PC is first powered-on, all Aux n signals are in the Low state. Each Aux n is designed as an input for all VXC series cards.

4.2.3 AUX data Register

(Read/Write): wBase+3

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Aux7	Aux6	Aux5	Aux4	Aux3	Aux2	Aux1	Aux0

Note. Refer to Sec. 4.1 for more information regarding wBase.

This register is designed for LED controls. Before controlling LED state, users have to configure the related Aux? to be an output.

Aux5: For VXC-112A LED controls.

Aux7: For VXC-142/142i and VXC-182i LED controls.

```
outputb(wbase+2,0x80); /* Set Aux7 is used as an output*/
outputb(wBase+3,0); /* turns the LED off */
outputb(wBase+3,0x80); /* turns the LED on */
```

4.2.4 INT Mask Control Register

(Read/Write): wBase+5

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	EN3	EN2	EN1	EN0

Note. Refer to Sec. 4.1 for more information regarding wBase.

EN0~EN1 (INT_CH0 ~ INT_CH1): (CH0 offset = 0)

For VXC-142/142i and VXC-182i Interrupt Mask.

EN2~EN3 (INT_CH0 ~ INT_CH1): (CH0 offset = 2)

For VXC-112A Interrupt Mask.

EN? =0→ disables INT_CHAN_? as an interrupt signal (default)

EN? =1→ enables INT_CHAN_? as an interrupt signal

```

outportb(wBase+5, 0);      /* disables all interrupts */
outportb(wBase+5,0x03);   /* enables INT ch0 and ch1 for VXC-142 */
outportb(wBase+5,0x0B);   /* enables INT ch0 and ch1 for VXC-112A */

```

4.2.5 Aux Status Register

(Read/Write): wBase+7

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Aux7	Aux6	Aux5	Aux4	Aux3	Aux2	Aux1	Aux0

Note. Refer to Sec. 4.1 for more information regarding wBase.

Aux0=INT_CHAN_0, Aux1=INT_CHAN_1:

For VXC-142/142i and VXC-182i card.

Aux2=INT_CHAN_0, Aux3=INT_CHAN_1:

For VXC-112A card.

Aux0~3 are used as interrupt sources. The interrupt service routine must read this register to perform interrupt source identification.

4.2.6 Interrupt Polarity Control Register

(Read/Write): wBase+0x2A

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	INV3	INV2	INV1	INV0

Note. Refer to Sec. 4.1 for more information regarding wBase.

INV0~INV1: For VXC-142/142i and VXC-182i card.

INV2~INV3: For VXC-112A card.

INV? =0→ selects the inverted signal from INT_CHAN_?
 INV? =1→ selects the non-inverted signal from INT_CHAN_?

```

outputb(wBase+0x2a,0);    /* selects the inverted input from all 8 channels */
outputb(wBase+0x2a,0xFF); /* selects the non-inverted input from all 8 channels */

```

// For VXC-142/142i and VXC-182i

```

outputb(wBase+0x2a,0x2); /* selects the inverted input of INT_CHAN_0 */
                          /* selects the non-inverted input of INT_CHAN_1 */

```

// For VXC-112A

```

outputb(wBase+0x2a,0x8); /* selects the inverted input of INT_CHAN_0 */
                          /* selects the non-inverted input of INT_CHAN_1 */

```

4.2.7 Speed selection

(Read/Write): wBase+0xdc/0xfc

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	Speed	-

Mode	Clock Rate	Baud Rate	Remark
Low Speed (0)	1,843,200Hz	50 bps ~ 115.2K bps	(Default)
High Speed (2)	14,745,600Hz	400 bps ~ 921.6K bps	

**Note. Refer to Sec. 4.1 for more information regarding wBase.
 Refer to Sec. 5.2 for “Programmable Baud Rate”.**

```

outputb(wAddr+0xdc, 0); /* low speed mode for port 1 */
outputb(wAddr+0xfc, 0); /* low speed mode for port 2 */

```

```

outputb(wAddr+0xdc, 2); /* high speed mode for port 1 */
outputb(wAddr+0xfc, 2); /* high speed mode for port 2 */

```

4.3 Interrupt Operation

There are two interrupt sources in the VXC cards. They are named as INT0 and INT1. Their signal sources are as follows:

INT0: UART 0 interrupt output

INT1: UART 1 interrupt output

If only one interrupt signal source is used, the interrupt service routine doesn't need to identify the interrupt source.

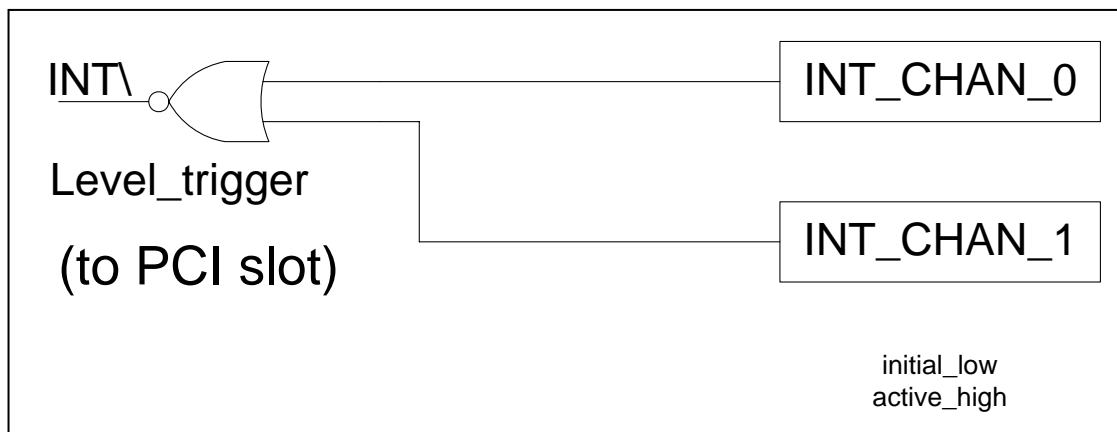
If there is more than one interrupt source, the interrupt service routine needs to identify the active signals by:

1. Reading the new status of all interrupt signal sources
2. Servicing it if INT0 is active
3. Servicing it if INT1 is active

Note:

If the interrupt signal is too short, the interrupt service routine cannot identify which interrupt source is active. Therefore, the interrupt signal must be in the hold_active state long enough for the interrupt service routine to be executed. The hold_time is different for different Operating Systems. The hold_time can be as short as a microsecond or as long as a whole second. In general, 20mS is a long enough to for successful execution under any OS.

4.3.1 VXC Card Interrupt Block Diagram

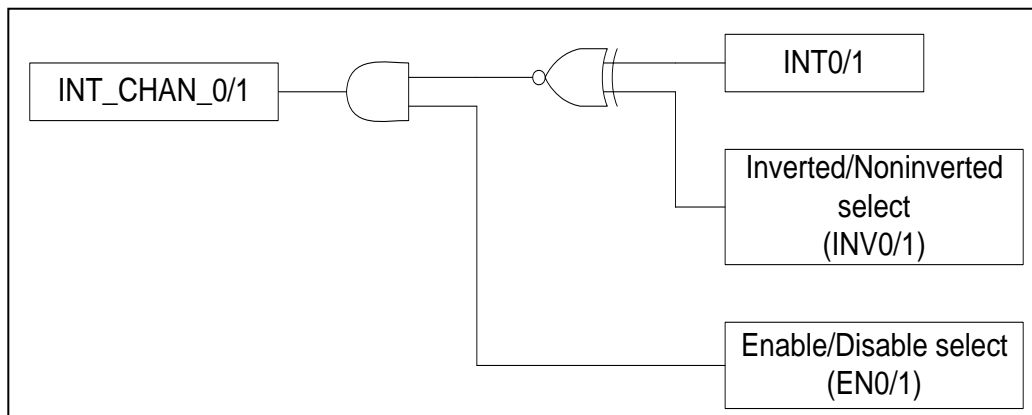


The interrupt output signal of the VXC card, **INT**, is **Level-Trigger and Active_Low**. If INT\ generates a low_pulse, the VXC card will send an interrupt signal to the PC only once. If INT\ is fixed in low_level, the VXC card will send an interrupt signal to the PC continuously. Therefore, **INT_CHAN_0/1 must be controlled as a pulse_type signal, which must normally be fixed in a low_level state and should generate a high_pulse when sending an interrupt signal to the PC.**

The INT_CHAN_0/1 priority is the same as the above. If both signals are active at the same time, then INT\ will activate only once. The interrupt service routine must read the status of all interrupt channels for multi-channel interrupts.

If only one interrupt source is used, the interrupt service routine doesn't need to read the status of the interrupt source.

4.3.2 INT_CHAN_0/1



The INT_CHAN_0 and INT_CHAN_1 architecture is shown in the above figure. The only difference between INT0 and INT1 is that the INT_CHAN_0 signal source comes from the UART 0 interrupt output, and the INT_CHAN_1 signal source comes from the UART 1 interrupt output.

INT_CHAN_0/1 must be fixed in a low level state normally and should generate a high_pulse when sending an interrupt signal to the PC.

The EN0/1 can be used to enable/disable the INT_CHAN_0/1 as follows:
(Refer to Sec.4.2.4) (Note: **VXC-112A using EN2/3.**)

EN0/1 = 0 → INT_CHAN_0/1 = disabled
EN0/1 = 1 → INT_CHAN_0/1 = enabled

INV0/1 can be used to invert/non-invert the INT0/1 as follows:
(Refer to Sec.4.2.6) (Note: **VXC-112A using INV2/3.**)

INV0/1 = 0 → INT_CHAN_0/1 = inverted state of INT0/1
INV0/1 = 1 → INT_CHAN_0/1 = non-inverted state of INT0/1

As mentioned above, if INT \setminus is fixed in a low level state, the VXC card will continuously send interrupt signals to the PC. The interrupt service routine should use INV0/1 to invert/non-invert INT0/1 and so generate a high_pulse. (Note: VXC-112A using INV2/3.)

5. Appendix

5.1 UART Register Mapping

This section describes the UART register mapping for VXC cards. For more information, please refer to the TI 16C550 datasheet.

wBase+0xC0: Port 0 Receiver Buffer Register (RBR)

wBase+0xE0: Port 1 Receiver Buffer Register (RBR)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0

wBase+0xC0: Port 0 Transmitter Holding Register (THR)

wBase+0xE0: Port 1 Transmitter Holding Register (THR)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0

wBase+0xC4: Port 0 Interrupt Enable Register (IER)

wBase+0xE4: Port 1 Interrupt Enable Register (IER)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	Enable Modem Status Interrupt	Enable Receiver Line Status Interrupt	Enable Transmitter Holding Register Empty Interrupt	Enable Received Data Available Interrupt

wBase+0xC8: Port 0 FIFO Control Register (FCR)

wBase+0xE8: Port 1 FIFO Control Register (FCR)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Receiver Trigger (MSB)	Receiver Trigger (LSB)	Reserved	Reserved	DMA Mode Select	Transmitter FIFO Reset	Receiver FIFO Reset	FIFO Enable

wBase+0xCC: Port 0 Line Control Register (LCR)

wBase+0xEC: Port 1 Line Control Register (LCR)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Divisor Latch Access Bit	Break Control	Stick Parity	Even Parity Select	Parity Enable	Number of Stop Bits	Word Length Select Bit 1	Word Length Select Bit 0

wBase+0xD0: Port 0 Modem Control Register (MCR)

wBase+0xF0: Port 1 Modem Control Register (MCR)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	Autoflow Control Enable	Loop	OUT2	OUT1	Request to Send	Data Terminal Ready

wBase+0xD4: Port 0 Line Status Register (LSR)

wBase+0xF4: Port 1 Line Status Register (LSR)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Error in RCVR FIFO	Transmitter Empty	Transmitter Holding Register	Break Interrupt	Framing Error	Parity Error	Overrun Error	Data Ready

wBase+0xD8: Port 0 Modem Status Register (MSR)

wBase+0xF8: Port 1 Modem Status Register (MSR)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data Carrier Detect	Ring Indicator	Data Set Ready	Clear to Send	Delta Data Carrier Detect	Trailing Edge Ring Indicator	Delta Data Set Ready	Delta Clear to Send

wBase+0xDC: Port 0 Scratch Register (SCR)

wBase+0xFC: Port 1 Scratch Register (SCR)

5.2 Programmable Baud Rate

Baud Rates Using a 1.8432-MHz Crystal (Low-Speed Mode in VXC Cards)

DESIRED BAUD RATE	DIVISOR USED TO GENERATE 16× CLOCK	PERCENT (%) ERROR
50	2304	
75	1536	
110	1047	0.026
150	768	
300	384	
600	192	
1200	96	
2400	48	
4800	24	
9600	12	
14400	8	
19200	6	
23040	5	
28800	4	
38400	3	
56000	2	2.86
57600	2	
115200	1	

Baud Rates Using a 14.7456-MHz Crystal (High-Speed Mode in VXC Cards)

DESIRED BAUD RATE	DIVISOR USED TO GENERATE 16× CLOCK	PERCENT (%) ERROR
115200	8	
184320	5	
230400	4	
307200	3	
460800	2	

Warning: The baud rates higher than 115,200 bps are not guaranteed to work.

To generate baud rate 125,000 bps:

$125,000 * 16 * 1 = 2,000,000 = 2\text{MHz crystal}$

$125,000 * 16 * 8 = 16,000,000 = 16\text{MHz crystal}$

So, when you use a 2MHz or 16MHz crystal and selecting the baud rate 115,200 bps in your software setting, the hardware will generate baud rate 125kbps actually.

Warning: The baud rates higher than 115,200 bps are not guaranteed to work.

To generate baud rate 250,000 bps:

$250,000 * 16 * 4 = 16,000,000 = 16\text{MHz crystal}$

(Baud rate * 16x clock * Divisor = Crystal Clock Frequency)

Thus, when you use a 16MHz crystal and selecting the baud rate 230,400 bps in your software setting, the hardware will generate baud rate 250kbps actually.

Note: The multi-port serial cards can have a special baud rate in OEM version. Please contact us for more information regarding the OEM products.