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1. Introduction

The CRD155B is part of Winford Engineering's *Portal* line of I/O cards; it plugs into a computer's ISA bus and allows the user to perform input and output routines with their computer. With this card, the computer can be used for communications and control applications. It allows the computer to be interfaced to external circuitry.

The CRD155B utilizes the popular 8255 I/O chip and provides 24 digital I/O lines. This card has various modes of operation, making it suitable for a variety of applications.

Package Contents

The package you received should contain 3 items:
1. This manual
2. The CRD155B card
3. Floppy disk with drivers, sample code, and documentation

Disclaimer

The CRD155B is not intended or designed for military, medical, or other life-critical applications. Winford Engineering shall not be held responsible or liable for damages or injury that occur as a result of the use this product. The following words of wisdom are applicable for just about any situation:

1.) You can't be too careful.
2.) A little common sense goes a long ways.

EMC Conformance Statement

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio / TV technician for help.

2. Warranty

Winford Engineering provides a 1-year warranty for the CRD155B card. This warranty does not cover the misuse or abuse of this product. In the event of product failure, Winford Engineering should be contacted for information regarding the return and replacement of the product.

3. Technical Support

   If you find yourself in need of technical assistance beyond what is covered in this manual, there are several ways to contact Winford Engineering. If your problem is not urgent, we would prefer that you use e-mail. Please provide us with your preferred e-mail address, as well as a phone number where you wish to be reached. This will help us get back to you in a timely fashion.

                         Technical Support Contacts

                         Phone: 1-989-671-2941
                         FAX: 1-989-671-2941
                         E-mail: support@winford.com

                         Winford Engineering
                         Technical Support
                         4169 Four Mile Road
                         Bay City, MI 48706

4. Specifications

Absolute Maximum Ratings:
      Operating Temperature Rating: 0 deg. C to 70 deg. C
      Voltage on any pin with respect to GND: -0.5V to +7.0V
      Drive current on any output pin: 2.5mA *
      ISA Bus Clock Frequency: 8.0 MHz

      * Outputs are not internally current-limited

DC Characteristics:

I/O Voltage Limits

Parameter	Min	Max	Unit
Input Low Voltage	-0.5	0.8	V
Input High Voltage	2.0	5.0	V
Output Low Voltage	0	0.45	V
Output High Voltage	2.4	5.0	V

5. Quick Start

For those who are anxious to run the CRD155B through some paces without reading through the manual, follow these steps to get started quickly:

1. Set the base address and install the CRD155B in an open ISA slot. Putting all DIP switches down (address 384) works in most computers.
2. Install the Portal API (page 9)
3. Run the CRD155BTest program included on the product disk to test basic operations of the I/O ports. For basic usage of the test program, see the troubleshooting tips on page 25.

6. Configuring and Installing the CRD155B

The DIP switches on the board control where the board is mapped into the computer's I/O address space. Each I/O device on the ISA bus requires a unique address or group of addresses so that I/O devices do not interfere with each other.

The CRD155B occupies four consecutive I/O ports in the PC address space. The first (lowest) address is referred to as the base address. A DIP switch allows the user to select one of sixteen possible base addresses. The DIP switch settings for each possible base address are shown in the following chart. In order for the board to work properly, the selected base address and the following three addresses must not be taken by any other device. Generally, the address range supported by the CRD155B will not conflict with other devices (unless you have a rare and unusual device installed). Note that if you install multiple CRD155B cards in a single computer, *each card must have a unique base address.* Simply select a different table entry for each card installed.

The silk-screened labels on the printed circuit board identify each DIP switch as D, C, B, or A. Switch 'D' is the MSB (Most-Significant-Bit), while Switch 'A' is the LSB (Least Significant Bit). The switch labels directly correspond to the table below. Also notice the '0' and '1' labels just to the right of the DIP switch. These labels indicate which position the switch is in. When a switch is DOWN (toward the bottom of the card), it is in the '0' position. When a switch is UP (toward the top of the card), it is in the '1' position. The '0' and '1' positions directly correspond to the values shown in the table. To configure the base address of the CRD155B, simply set the DIP switches to match the table entries for the desired base address.
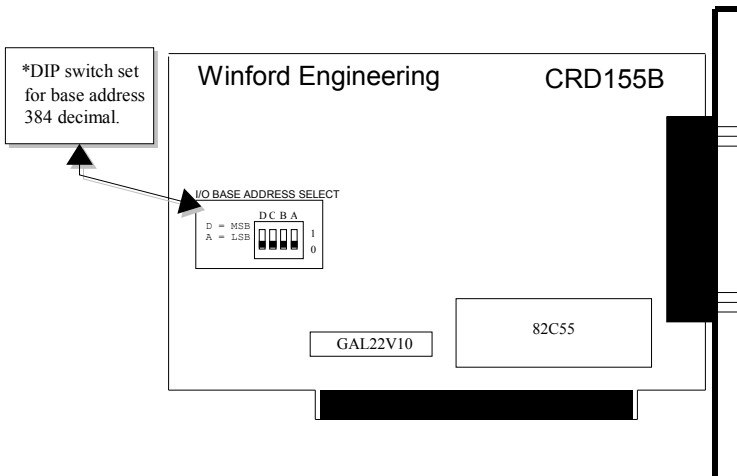
DIP SWITCHES				RESULTING BASE ADDRESS	
D	*C*	*B*	*A*	*Base Addr. (dec)*	*Base Addr. (hex)*
0	0	0	0	384	0x180
0	0	0	1	388	0x184
0	0	1	0	392	0x188
0	0	1	1	396	0x18C
0	1	0	0	400	0x190
0	1	0	1	404	0x194
0	1	1	0	408	0x198
0	1	1	1	412	0x19C
1	0	0	0	416	0x1A0
1	0	0	1	420	0x1A4
1	0	1	0	424	0x1A8
1	0	1	1	428	0x1AC
1	1	0	0	432	0x1B0
1	1	0	1	436	0x1B4
1	1	1	0	440	0x1B8
1	1	1	1	444	0x1BC

In most cases, there will be no conflicts with other devices at the lowest base address (384 decimal).

After you have selected a base address using the DIP switches, remove your computer's case and install the CRD155B into an open ISA slot.

7. Portal API

The Portal API driver and library included with the CRD155B is the recommended tool for accessing and controlling your I/O card. It consists of a device driver (system-level software that allows programs to access hardware) and a library (a DLL on Windows) that makes the use of the driver simple and straightforward. While the CRD155B can also be programmed manually using low-level port I/O (as described on page 13), the Portal API provides an easier method that automatically takes care of many of the details necessary for using the card.

7.1. Installation

The Portal driver and library must be installed on any computer that will run your applications or any of the Portal sample applications included on the disk, including the `CRD155BTest` program.

Windows
The driver/library installation procedure is very similar on all versions of Windows except Windows NT. The driver is installed using the "Add Hardware" option of the Control Panel. Since the CRD155B will not be detected automatically by Windows, the Portal driver will need to be installed by manually selecting a driver.   Use the "Have Disk" button to point Windows to the "`win\driver`" directory of the Portal API (for example "`A:\portalapi\win\driver`" on your product disk). More detailed instructions for each operating system are described below.

Windows XP
1. Open the Control Panel.
2. Open the "Add Hardware" wizard. If you are using Windows XP's default "Category View" for the Control Panel, this is done by clicking on "Printers and Other Hardware" and under "See Also" on the left, click "Add Hardware".
3. The wizard typically displays a screen explaining what it is used for. Click Next to continue.
4. The wizard may automatically scan for new hardware. The scanning will not detect any Portal I/O cards.
5. You may be asked "Have you already connected this hardware to your computer?" Regardless of whether you have installed any cards yet, click Yes.
6. You will be shown a list of the hardware already installed in your computer. Scroll all the way down and select "Add a new hardware device"
7. You will be asked whether Windows should search for the new hardware. Select "Install the hardware that I manually select from a list"
8. A list of hardware categories will be shown. Select "Show All Devices" (On some versions of Windows this may be called "Other")

9. Click the "Have Disk" button and point Windows to the "`win\driver`" directory of the Portal distribution ("`A:\portalapi\win\driver`" on your product disk).
10. A list of drivers found in the directory you specified will be shown. Select the "Portal I/O Cards" item and click Next.
11. Click Next again to "start installing your new hardware."
12. The files will be copied and installed. Click Finish to complete. You do not need to restart your computer.

Windows 2000
1. Open the Control Panel.
2. Open the "Add/Remove Hardware" wizard.
3. The wizard typically displays a screen explaining what it is used for. Click Next to continue.
4. You will be asked whether to Add or Uninstall a device. Select "Add/Troubleshoot a device" and click Next.
5. The wizard may automatically scan for new hardware. The scanning will not detect any Portal I/O cards.
6. You will be shown a list of the hardware already installed in your computer. Select "Add a new device" and click Next.
7. You will be asked whether Windows should search for the new hardware. Select "No, I want to select the hardware from a list"
8. A list of hardware categories will be shown. Select "Other devices"
9. Click the "Have Disk" button and point Windows to the "`win\driver`" directory of the Portal distribution ("`A:\portalapi\win\driver`" on your product disk).
10. A list of drivers found in the directory you specified will be shown. Select the "Portal I/O Cards" item and click Next.
11. You will be informed that "Windows will use default settings to install the software for this hardware device." Simply click Next to begin installation.
12. The files will be copied and installed. Click Finish to complete. You do not need to restart your computer.

Windows 98/Me
1. Open the Control Panel.
2. Open the "Add New Hardware" wizard. (You may have to click "view all Control Panel options" for this to be displayed.)
3. The wizard typically displays a screen explaining what it is used for. Click Next to continue.
4. You will be told that the wizard will scan for new Plug and Play devices. Click Next to continue. The scan will not find any Portal I/O cards. If the wizard displays a list of devices that were found, select "No, the device isn't in the list".
5. You will be asked if Windows should search for non Plug and Play hardware. Select "No, I want to select the hardware from a list".

6. A list of hardware categories will be shown. Select "Other devices" and click Next.
7. Click the "Have Disk" button and point Windows to the "win\driver" directory of the Portal distribution ("A:\portalapi\win\driver" on your product disk).
8. A list of drivers found in the directory you specified will be shown. Select the "Portal I/O Cards" item and click Next.
9. One last page will be shown stating "Windows can continue installing your hardware now." Simply click Finish to perform the installation. You do not need to restart your computer.

Windows 95
1. Open the Control Panel.
2. Open the "Add New Hardware" wizard
3. The wizard typically displays a screen explaining what it is used for. Click Next to continue.
4. You will be asked if Windows should search for your new hardware. Select "No".
5. A list of hardware categories will be shown. Select "Other devices"
6. Click the "Have Disk" button and point Windows to the "win\driver" directory of the Portal distribution ("A:\portalapi\win\driver" on your product disk).
7. A list of drivers found in the directory you specified will be shown. Select the "Portal I/O Cards" item and click Next.
8. One last page will be shown stating "Windows can continue installing your hardware now." Simply click Finish to perform the installation. You do not need to restart your computer.

Windows NT
1. Run the NTinstall.exe program, located in the "A:\portalapi\win\driver" directory of your product disk.
2. A message box will be shown explaining that the driver will be installed. Click Yes to continue.
3. A message box will be shown confirming that the driver was installed. Click OK to complete. You do not need to restart your computer.

Linux
The Linux version of the Portal API uses the device file /dev/port to perform port I/O and communicate with the I/O cards. Therefore, no driver installation is necessary. The only thing you must do is ensure that your applications are executed with root-level privileges. This is due to the fact that port I/O is a privileged operation and is not available to non-root users. Other than that, just be sure to link your program with wecrd.a as described in the Portal API documentation.

7.2. Documentation

Complete documentation for the Portal API is included on the product disk in HTML format. Start by viewing
`"portalapi\documentation\index.html"` in your web browser. The documentation starts with the basics of using the API and then moves on to using the API in programming languages, detailed reference information on every function of the API, installing the API on your computer, and more.

7.3. Sample Applications

Several sample applications, in both executable and source code forms, are also included in the `portalapi` directory. These samples serve to demonstrate how to use the Portal API in your own applications. Samples are included for Visual Basic on Windows as well as C on both Windows and Linux platforms.

8. Low-level Port I/O Programming

   While using the Portal API is typically the easiest method for programming the CRD155B, it may also be controlled manually through low-level port I/O if your application requires finer-grained control or utilization of the advanced modes of the 8255 chip. In this method, port I/O commands are used directly to configure the card and read or write data. This is basically a 4-step process.

1.) Determine which operation mode you will use.
2.) Construct the control byte required to program the 8255 chip (the main chip on the CRD155B I/O card) for the operation mode you have chosen.
3.) Write the control byte to the 8255 control register.
4.) Read from / write to the data ports as needed.

Example:
   As a simple example, suppose we want to connect 8 LEDs to an output port and turn them on and off with a computer program. We also want to connect 3 switches to an input port and monitor the status of those switches from our program. We will go through the four steps listed above.

1.) We want 1 output port and 1 input port. The various possible operation modes will be covered in depth in a later section; for now, assume we will use Port A as a simple output port and Port B as a simple input port. Port C will not be used.
2.) Looking at the Configuration Control Byte diagram on page 19, we see that the required control byte is 10001011 binary, or 139 decimal.
3.) Now we need to write this control byte to the 8255 control register. Assuming that the card is at base address 384 decimal, we write the value 139 to the port 387 (the address of the control port). Here is how this would look in several common programming languages.

```
BASIC: OUT 387, 139

DOS C compiler : outportb(387, 139);

Assembly: MOV DX, 387d
          MOV AX, 139d
          OUT DX, AX

Winford's PortIO32: OutByte(387, 139);
```

4.) We may now write to Port A (address 384 decimal) to turn on LEDs or read from Port B (address 385 decimal) to monitor switches.

8.1. PortIO32

While most DOS-based languages include provision for low-level port I/O, Windows programs need a driver and library to provide port I/O functionality. Winford Engineering has provided PortIO32 for this purpose. The structure, installation procedures, and methods for using PortIO32 are very similar to the Portal API. PortIO32 is a completely general purpose tool -- it can be used to read or write any I/O ports in your computer and it has no functionality specifically for the CRD155B card.

Please see the documentation for the PortIO32 API in the `"portio32\documentation"` directory on your product disk for information on installation, using PortIO32 in your programming languages, and information on each function available for your use.

9. Configuring the 8255 Chip

Most of the information in this section is not necessary when using the Portal API to access and control the CRD155B. This information will be most valuable to those using low-level port I/O for controlling the CRD155B or those who are interested in the architecture of the card.

The CRD155B card utilizes the popular 8255 I/O chip to implement the data ports. This chip contains four 8-bit ports, and consequently occupies four addresses in the computer's address space. Three of the ports are used for I/O purposes while the fourth port is used for configuring the 8255. The following chart shows the port designations.

Address	*Port*	*Designated Use*
Base Address + 0	Port A	I/O
Base Address + 1	Port B	I/O
Base Address + 2	Port C	I/O and Handshaking
Base Address + 3	Control	Configuring the 8255

When the computer is first powered up or reset, the 8255 is reset to its initial default condition. This causes all the I/O lines to be configured as inputs in order to eliminate the possibility of a data conflict. In general, the 8255 will need to be configured before it can be used in a project. The 8255 is configured by sending the appropriate control byte to the Control Port. The I/O Ports can be configured for input or output, with hand-shaking or without, and unidirectional or bidirectional data transfer.

9.1. Modes of the 8255 Chip

The configuration of a port is determined by which operating mode is selected, as shown below. Not all modes are available for all three ports.

> Mode 0:
> • Provides basic input or basic output without handshaking. This is the simplest mode, and it is probably used more than any other mode. For beginners, this is the place to start.
> • This mode is available for Ports A, B, and C.
> • When a value is written to an output port, that value is latched, and it will remain on the port pins until another value is written.
> • When a port is in input mode, values placed on the port data lines are *not* latched. The values present on the lines will be the values read when the command is issued to read the port.
>
> Mode 1:
> • Provides strobed input or strobed output with handshaking signals.
> • This mode is available for Ports A and B.
> • Port C is used for handshaking signals.
> • Port C bits that are not used for handshaking may be used for I/O.
>
> Mode 2:
> • Provides strobed bidirectional bus operation.
> • This mode is available for Port A only.
> • Port B can still be configured for Mode 0 or Mode 1.
> • Five bits of Port C are used for handshaking for Port A.
> • Three bits of Port C are used for I/O or for handshaking for Port B.

The bits of Port A and Port B are always used for data input/output. However, the way in which the bits of Port C are used depends upon which modes are used for Ports A and B. The following chart lists each mode available for Ports A and B as well as the affected bits of Port C. Bits of Port C that are not used for handshaking may be used for I/O. See the *Information Resources* (page 24) for links to data sheets which contain information on the various modes of the 8255 chip.

Port A configured for Mode 0:

Bit	Designation	Direction
Port A bits 7..0	I/O	Set by user
Port C bits 7..4	I/O	Set by user

Port B configured for Mode 0:

Bit	Designation	Direction
Port B bits 7..0	I/O	Set by user
Port C bits 3..0	I/O	Set by user

Port A configured for Mode 1, input port:

Bit	Designation	Direction
Port A bits 7..0	Data	Inputs
Port C bit 3	INTRa	Output
Port C bit 4	STBa#	Input
Port C bit 5	IBFa	Output
Port C bit 6	I/O	Set by user
Port C bit 7	I/O	Set by user

Port A configured for Mode 1, output port:

Bit	Designation	Direction
Port A bits 7..0	Data	Outputs
Port C bit 3	INTRa	Output
Port C bit 4	I/O	Set by user
Port C bit 5	I/O	Set by user
Port C bit 6	ACKa#	Input
Port C bit 7	OBFa#	Output

Port B configured for Mode 1, input port:

Bit	Designation	Direction
Port B bits 7..0	Data	Inputs
Port C bit 0	INTRb	Output
Port C bit 1	IBFb	Output
Port C bit 2	STBb#	Input

Port B configured for Mode 1, output port:

Bit	Designation	Direction
Port B bits 7..0	Data	Inputs
Port C bit 0	INTRb	Output
Port C bit 1	OBFb#	Output
Port C bit 2	ACKb#	Input

Port A configured for Mode 2, bidirectional port:

Bit	Designation	Direction
Port A bits 7..0	Data	Input/Output
Port C bit 3	INTRa	Output
Port C bit 4	STBa#	Input
Port C bit 5	IBFa	Output
Port C bit 6	ACKa#	Input
Port C bit 7	OBFa#	Output

Port A (PA7..0) and the upper bits of Port C (PC7..4) are designated as Group I. Port B (PB7..0) and the lower bits of Port C (PC3..0) are designated as Group II. The following figure (*Configuration Control Byte*) can be used as a reference for deriving the proper control byte to be used for setting the desired modes. Note that the most significant bit must be "1" to signify that this control byte is for setting the operation mode of the chip.

9.2. Configuration Control Byte

D7	D6	D5	D4	D3	D2	D1	D0
1							

Group I

00 = Mode 0
01 = Mode 1
10 = Mode 2
11 = Mode 2

Port A:
0 = Output
1 = Input

Port C (Upper):
0 = Output
1 = Input

Group II

0 = Mode 0
1 = Mode 1

Port B:
0 = Output
1 = Input

Port C (Lower):
0 = Output
1 = Input
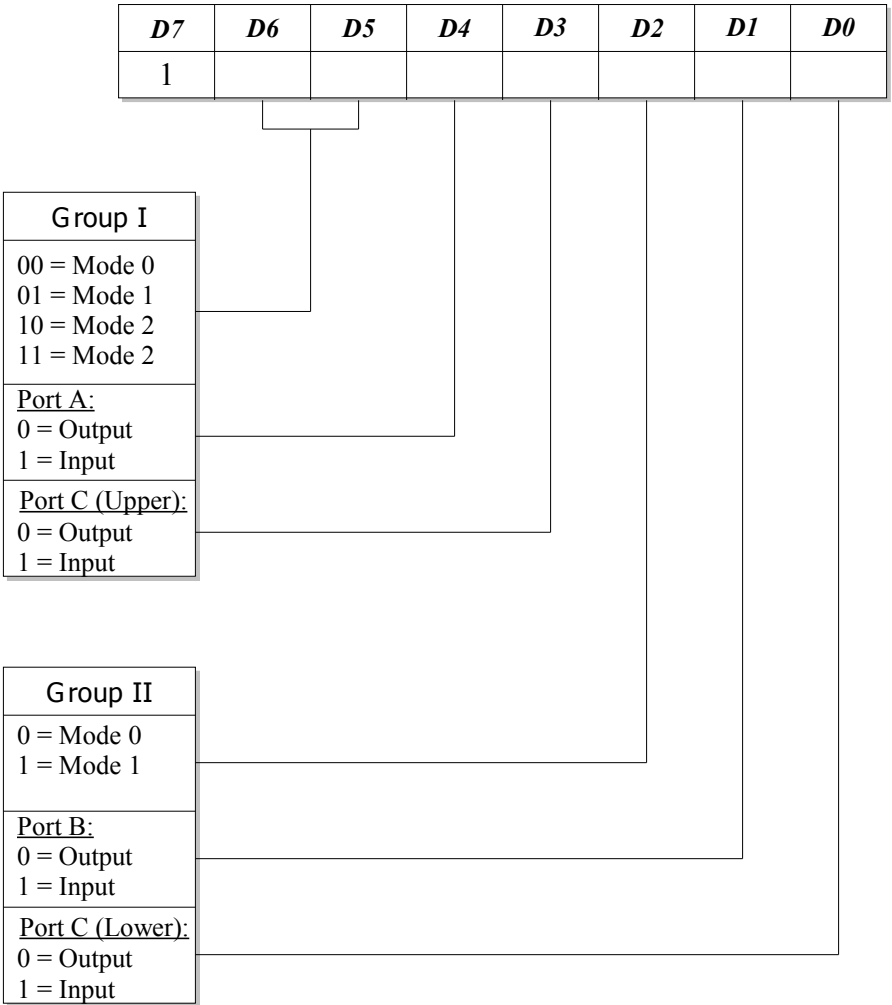
Example:

The following setup is desired for the ports:

Port	Desired Function
A	Output without handshaking (Mode 0)
Upper C	Input
B	Input without handshaking (Mode 0)
Lower C	Output

The control byte can then be determined based upon the above specifications.

Bit	Desired Setting	Bit Value
D7	Set Modes	1
D6	Group I set to Mode 0	0
D5	Group I set to Mode 0	0
D4	Port A used for outputs	0
D3	Upper Port C used for inputs	1
D2	Group II set to Mode 0	0
D1	Port B used for inputs	1
D0	Lower Port C used for output	0

Therefore, the control byte would be 10001010 binary, which is 138 decimal or 8A hexadecimal.
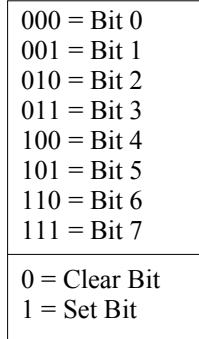
9.3. Bit Set/Reset Control Byte

   A control byte can also be used to set or clear bits of Port C. Typically, this is used when some of the lines for Port C are taken for use as handshaking lines for Port A or Port B. If all Ports are configured for Mode 0, then Port C is just a normal I/O port with all 8 bits available, and this special control byte would probably not be used.
   To signify that this is a Bit Set/Reset Control Byte, and not a Configuration Control Byte, the most significant bit (D7) of the control byte must be "0". The least significant bit (D0) determines whether the bit will be set or cleared. Bits D3, D2, and D1 are used to select the desired bit of Port C. Bits D6, D5, and D4 are not used. This is shown in the following figure.

Bit Set/Reset Control Byte
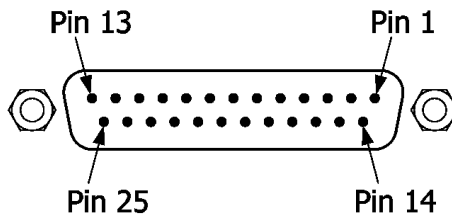
D7	D6	D5	D4	D3	D2	D1	D0
0	x	x	x				

```
000 = Bit 0
001 = Bit 1
010 = Bit 2
011 = Bit 3
100 = Bit 4
101 = Bit 5
110 = Bit 6
111 = Bit 7

0 = Clear Bit
1 = Set Bit
```

10. Hardware Information

10.1. Connector Pinout

Pin	Function	Pin	Function
1	Port A bit 0	14	Port B bit 5
2	Port A bit 1	15	Port B bit 6
3	Port A bit 2	16	Port B bit 7
4	Port A bit 3	17	Port C bit 0
5	Port A bit 4	18	Port C bit 1
6	Port A bit 5	19	Port C bit 2
7	Port A bit 6	20	Port C bit 3
8	Port A bit 7	21	Port C bit 4
9	Port B bit 0	22	Port C bit 5
10	Port B bit 1	23	Port C bit 6
11	Port B bit 2	24	Port C bit 7
12	Port B bit 3	25	Ground
13	Port B bit 4		

Pin 13   Pin 1

Pin 25   Pin 14

*(** looking at connector on the card **)*

10.2. Port Direction

Ports A, B, and C can all be used as inputs or as outputs. However, on the CRD155B, Port A is *optimized* for output. If you need only 1 output port, then it would be a good idea to use Port A. This is because Port A has RC filters on its lines to reduce radiated noise and ringing on the lines. Remember, though, that you *can* use any of the ports for input or output.

10.3. Data Contention

Because the data ports on the CRD155B are programmable as either inputs or outputs, extra care should be taken to prevent data contention. Normally, the *output* of one logic chip should drive the *input* of another chip. Data contention can occur when two or more chip *outputs* are tied together. If the the logic states of the outputs differ, then each output attempts to overpower the other. This can result in unreliable operation and possible damage to the hardware. How does this discussion apply to your CRD155B I/O card? If you build a hardware device that *outputs* data, and you want to interface your computer to the device, then you must connect the device to an I/O port configured as an *input* port. Your device sends out data, and the I/O card reads the data. Just be sure that you don't reconfigure the port as an *output* port while the device is still connected. Note that the CRD155B defaults to input mode on all ports when the computer is turned on or when it undergoes a hard reset. (A hard reset occurs when the mechanical 'Reset' button on the computer case is pressed). A 'soft' reset (for example, restarting your computer from Windows) will typically not reset the card.

10.4. Pull-up and Pull-down Values

The 8255 chip employs internal port-hold circuitry to maintain the state of its I/O pins. Port A has pull-up and pull-down devices, while Port B and Port C have pull-up devices that are only active from power-up or reset until the time a low signal becomes present on a pin (in short, don't depend on pull-ups on ports B and C). These pull-up and pull-down devices have a weak influence on the data pins even when the port is in input mode. The important thing to note is that the circuitry connected to the CRD155B input ports must be capable of sourcing/sinking enough current to overpower the weak pull-up or pull-down force of the port-hold circuitry. Active logic chips work just fine. The potential problem is with your own *external* pull-up/pull-down resistors. If you plan to use these, they must be small enough that they will conduct enough current to overpower the port-hold circuitry. To be on the safe side, use resistors no larger than $3.3\text{k}\Omega$ for both pull-ups and pull-downs. For pull-ups, connect the pull-up resistor to a 5-volt source. If your design does not require pull-up or pull-down resistors, then disregard this information.

11. Information Resources

Here are some links to information which could be useful to you as you use your CRD155B I/O card.

General Information:

Winford Engineering's web site contains a variety of information that could be of use in your projects. Please check our Support area for application notes, sample code, downloads, etc.

8255 Information:

 -Data sheets:
> http://www.winford.com/download/datasheets/intel_82c55a.pdf
> http://www.winford.com/download/datasheets/intersil_82c55a.pdf

 -Q & A:
> http://support.intel.com/design/archives/periphrl/docs/7190.htm

 -Port hold devices:
> http://support.intel.com/design/archives/periphrl/docs/7204.htm
> http://support.intel.com/design/archives/periphrl/docs/7154.htm

12. Troubleshooting

If you experience difficulties with your I/O card and cannot get it to function properly, follow these procedures to isolate the problem. This procedure is geared to the situation where the card does not appear to be functioning at all.

A diagnostic program for the CRD155B has been included on the accompanying disk. You will find it in the `crd155btest` directory of the disk; the program is called `CRD155BTest`. Please note that the `CRD155BTest` program depends on the Portal API and therefore requires that the Portal API be installed on your system. See the installation instructions on page 9 or in the Portal documentation if it has not yet been installed. Linux users, please note that the `crd155btest` program must be run as root.

Before you actually run the diagnostics program, it is important to put the I/O card into a known state. Disconnect any devices which may be connected to the DB25 connector on the back of the card. The data lines should be disconnected and available for testing. Also, be sure all 4 DIP switches are in the 'down' position (the '0' position). This will place the I/O card at address 384 decimal.

Once these preliminary steps have been taken care of, run the `CRD155BTest` program. It is a simple console application with text-based menu choices. Note that you must press `Enter` (Return) to actually enter a menu selection.

First, select menu item: `1 - Open an I/O Card`

Enter `384` when prompted for the base address.

You should get a message saying `"Card was opened successfully."` If instead you get a message saying `"Error -115 occurred when trying to open the card"` then double-check your DIP switch settings and be sure to type in `384` for the base address when prompted. If you continue to receive this error message, then it is possible that there is an I/O conflict between the CRD155B and another device you have installed on your system. Try a different base address by adjusting the DIP switches and then entering the corresponding address into the diagnostics program. A good address to try would be 444 decimal (all the DIP switches in the 'up' position). If you continue to receive the error message even after trying several different base addresses, then the I/O card is probably defective. See the *Technical Support* section (page 4) of the manual for information on how to contact Winford Engineering for assistance or service/warranty information.

If your card was opened successfully, now choose the menu item:

`2 - Configure Card`

When prompted for which port to configure, enter `1`. We want to configure the first port on the card as an output port, so enter `2` when prompted for the port mode.

Next, we will write a value to the port, so choose menu item:

```
3 - Output a value to an output port
```

You will be prompted for a port number to write to. Choose 1 (This is the port we just configured as an output.) You will then be prompted for a value to write to the port. Type 255. This turns on all the bits of the port. With a voltmeter, measure the voltage between Bit 0 (Pin 1 on the DB25 connector) and Ground (Pin 25 on the DB25 connector). You should typically get between 4 and 5 volts. If you do not get this voltage level, measure the voltage between some of the other pins of the port (Pins 2 - 8 on the DB25 connector) and Ground. The voltage between any of these pins and Ground should be roughly 4 - 5 volts. If you are not getting the specified voltage levels on the pins, then your card is defective. It is quite probable that the 8255 chip is bad.   See the *Technical Support* section (page 4) of the manual for information on how to contact Winford Engineering for assistance or service/warranty information.

If your card has been successful up to this point, then the basic operation of the card has been verified. In other words, the card is responding to bus signals and is obeying software commands. If you desire to test one of the other ports, simply repeat the procedure, but type in 2 or 3 when asked for which port to configure and which port to write a value to.

13. Accessories

Winford Engineering carries several accessories and supplies for the CRD155B I/O card. Brief descriptions are provided below. Please see our web site for more complete information and photographs.

www.winford.com

Breakout Board

The BRK25 breakout board is a printed circuit board which plugs into a female DB25 connector and connects each pin to a screw terminal. The screw terminals are arranged in groups which correspond to the I/O ports of the CRD155B, with each screw terminal clearly labeled. Convenient holes and solder rings are also provided if you desire to solder wires directly to the board or mount .1" headers. The card has a male DB25 connector on it, so it can be used to provide convenient access to the pins of any female DB25 connector. Use a DB25 extender cable to connect this breakout board to the CRD155B I/O card.

This breakout board is perfect for experimentation and prototype work, as well for use in the educational laboratory. The screw terminals facilitate quick assembly and disassembly of projects.

Extender Cable

The EXT25-x extender cables are simple straight-through extender cables for DB25 connectors. They have a male DB25 connector on one end and a female connector on the other end. These cables can be used to connect the CRD155B I/O card to the BRK25 breakout board.

Connectors

Winford Engineering also sells DB25 solder-cup style connectors and hoods which are useful for connecting your projects to the CRD155B I/O card.

Notes