

**CIO-DO24DD
&
CIO-DO48DD**

User's Manual



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1.0 INTRODUCTION

CIO-DO24DD and CIO-DD48DD are designed for switching circuits of higher voltage and current than standard TTL type components are capable of. They provide 24 and 48 outputs respectively.

The 'DD' designation indicates that these boards are capable of 'Direct Drive.' The current specification that earns the direct drive designation is a switching capacity of up to 500 mA.

Throughout this manual the part number CIO-DO24DD is used for both products since most of information applies to both. Where necessary, the appropriate part number is noted.

Both the CIO-DO24DD and the CIO-DD48DD are supported by the Universal Library programming library for DOS and Windows available from Measurement Computing.

1.1 DIRECT DRIVE

The CIO-DO24DD is similar to a set of non-isolated solid state relays. The digital lines of the DD are capable of completing a circuit to ground thereby allowing current to flow in the circuit. Because there is a small amount of OFF current flowing in the circuit, like a solid state relay, the circuits on a DD board are not ideal for switching low level signals. If you have a circuit that is suitable for solid state relays and does not need isolation, the DD board can be substituted.

1.2 DARLINGTON TRANSISTORS

Each output is an NPN Darlington pair. All outputs are open collector and incorporate clamping diodes for transient suppression. The ability to withstand transients, connect directly to voltages up to 50V and sink as much as 500 mA make these outputs ideally suited for controlling lamps, relays, printer hammers and similar loads.

1.3 CLAMPING VOLTAGE

The clamping voltage is that voltage which, when exceeded, is clamped to prevent damage to the circuit. The clamping voltage of each 8-bit port can be set independently and must be supplied externally. In addition, the open collector points of each 8-bit port can be pulled to a common voltage by connecting an eight-resistor SIP.

2.0 SOFTWARE INSTALLATION

On the disk labeled InstaCal there is an installation program. Please run this program and accept the defaults. Refer to the *Extended Software Installation Manual* for complete instructions. If you have purchased the Universal Library for programming language support, use that disk to install both InstaCal and the Universal Library.

InstaCal will guide you through switch and jumper settings you may need to make before installing your board. Detailed information on hardware settings is also provided below.

3.0 HARDWARE INSTALLATION

3.1 BASE ADDRESS

The boards are setup at the factory with the base address set to 300h (768 decimal). If there are no other devices installed in your computer that are using addresses 300h through 304h (or 308h if using the CIO-DO48DD), do not change the base address.

The CIO-DO24DD employs the PC bus for power, communications and data transfer. As such it draws power from the PC, monitors the address lines and control signals and responds to it's I/O address, and places data on the eight data lines.

The BASE address is the only user selectable bus related feature of the CIO-DO24DD. The base address identifies the registers that software writes to when communicating with the CIO-DO24DD.

A block of eight (or seven) DIP switches are used for setting the base address. Each switch position corresponds to one of the PC bus address lines. Placing a switch down asserts that address bit.

A complete address is constructed by calculating the HEX or decimal number which corresponds to all the address bits the board has been instructed to respond to. For example, in Figure 3-1, (for CIO-DO24DD) address switches 9 and 8 for are DOWN, all others UP. See Figure 3-2 for the address select switches for the CIO-DO48DD. Address 9 = 200h (512D) and address 8 = 100h (256 decimal), when added together they equal 300h (768 decimal).

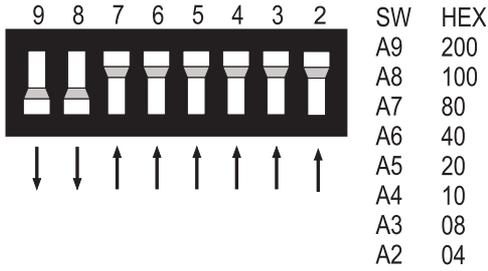
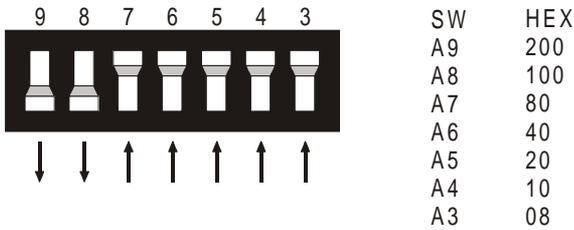


Figure 3-1. CIO-DO24DD Address Select Switches

NOTE

DISREGARD THE NUMBERS PRINTED ON THE SWITCH. REFER TO THE NUMBERS PRINTED IN WHITE ON THE BOARD!



BASE ADDRESS SWITCH - Address 300H shown here

Figure 3-2. CIO-DO48DD Address Select Switches

Certain addresses are used by the PC, others are free and can be used by the CIO-DO24DD and other expansion boards. Refer to Table 3-1 for PC register addressing. We recommend BASE = 300h (768 decimal) be tried first.

Table 3-1. PC I/O Addresses

HEX RANGE	FUNCTION	HEX RANGE	FUNCTION
000-00F	8237 DMA #1	2C0-2CF	EGA
020-021	8259 PIC #1	2D0-2DF	EGA
040-043	8253 TIMER	2E0-2E7	GPIB (AT)
060-063	8255 PPI (XT)	2E8-2EF	SERIAL PORT
060-064	8742 CONTROLLER (AT)	2F8-2FF	SERIAL PORT
070-071	CMOS RAM & NMI MASK (AT)	300-30F	PROTOTYPE CARD
080-08F	DMA PAGE REGISTERS	310-31F	PROTOTYPE CARD
0A0-0A1	8259 PIC #2 (AT)	320-32F	HARD DISK (XT)
0A0-0AF	NMI MASK (XT)	378-37F	PARALLEL PRINTER
0C0-0DF	8237 #2 (AT)	380-38F	SDLC
0F0-0FF	80287 NUMERIC CO-P (AT)	3A0-3AF	SDLC
1F0-1FF	HARD DISK (AT)	3B0-3BB	MDA
200-20F	GAME CONTROL	3BC-3BF	PARALLEL PRINTER
210-21F	EXPANSION UNIT (XT)	3C0-3CF	EGA
238-23B	BUS MOUSE	3D0-3DF	CGA
23C-23F	ALT BUS MOUSE	3E8-3EF	SERIAL PORT
270-27F	PARALLEL PRINTER	3F0-3F7	FLOPPY DISK
2B0-2BF	EGA	3F8-3FF	SERIAL PORT

The CIO-DO24DD BASE switch can be set for address in the range of 000-3FC so it should not be hard to find a free address area for CIO-DO24DD. Once again, if you are not using IBM prototyping cards or some other board which occupies these addresses, then 300-31F HEX are free to use.

Addresses not specifically listed, such as 390-39F, are not reserved and may be available. Check your computer for other boards which may use I/O addresses.

3.2 INSTALLING IN THE COMPUTER

1. Turn the power off.
2. Remove the cover of your computer. Please be careful not to dislodge any of the cables installed on the boards in your computer as you slide the cover off.
3. Locate an empty expansion slot in your computer.
4. Push the board firmly down into the expansion bus connector. If it is not seated fully it may fail to work and could short circuit the PC bus power onto a PC bus signal. This could damage the motherboard in your PC as well as the CIO-DO24DD.

4.0 INTERFACING

4.1 CONNECTOR DIAGRAMS

The output connector(s) is a 50-pin header type connector accessible from the rear of the PC through the expansion back plate (Figure 4-1). The output signals are direct connections to the Darlington output transistor.

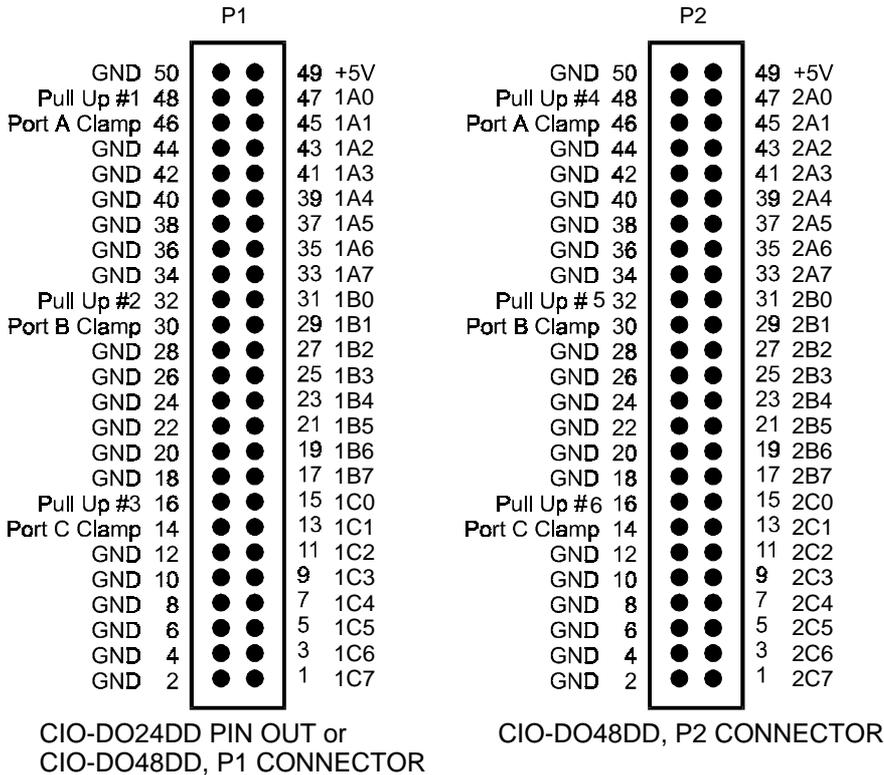


Figure 4-1. Connector Pin Outs

The connectors accepts female 50-pin header type connectors, such as those on the C50FF-2, a 2-foot cable with female connectors.

If frequent changes to signal connections or signal conditioning is required, please refer to the information on the CIO-TERM100, CIO-SPADE50 and CIO-MINI50 screw terminal boards.

4.2 CABLING TO THE CONNECTOR

The CIO-DO24DD connector is accessible through the PC/AT expansion bracket. The connector is a standard 50-pin header connector. A cable with mating connectors (C50FF-##) can be purchased from Measurement Computing Corp. The second output connector for the CIO-DO48DD is on the end of the card opposite the expansion bracket.

4.3 CONNECTOR PIN ASSIGNMENTS

The connector is arranged so that there is generally a ground return for each control line, and each 8 lines of a port are together on the cable.

The signal Pull Up# is the input to the pull-up resistor SIP associated with a port. Applying a voltage to that pin will pull up all lines of a port to that voltage through the user-installed SIP resistor when the circuit is open.

The signal Port n Clamp is the clamping voltage input for that port. For example, if the circuit you are switching at port A is a 24 volt circuit but is subject to 100V spikes, connect 24V to the Port A Clamp input and any signal over 24V will be clamped to 24V.

4.4 THE OUTPUT CIRCUIT

The heart of the CIO-DO24DD is a Darlington pair of transistors. It is composed of a ULN2803 and a few passive components. It works much the same as a solid state relay. A simplified schematic of the circuit is shown in figure 4-2.

The load device is wired to the Output Pin so that your device is energized ON when a path to ground is completed. If desired, a clamping voltage can be supplied to the Port N Clamp input.

The circuit is switched by the PC setting a register bit. When a 1 is written to a bit in the register for a particular port, the Darlington transistors associated with that bit are turned on and your circuit is completed via a path from the output pin to PC Ground.

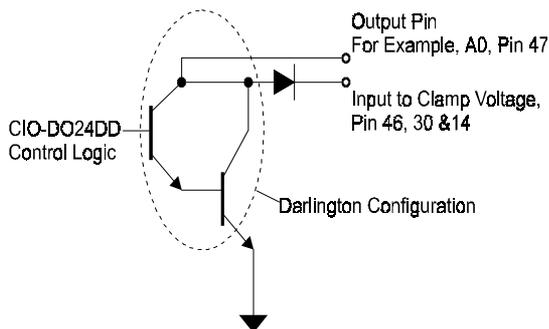


Figure 4-2. Darlington Output Circuit

All outputs share a common ground on the board so all your circuits must use the common ground. Also, as with any transistor circuit, there is a small amount of OFF current.

4.5 PULL-UP RESISTORS

There are locations for pull-up resistors on the board. They are marked RN1 through RN3 (through RN6 on the CIO-DO48DD).

These locations are designed to accept 9 pin SIP resistors configured as eight individual resistors with one end in common. Each resistor in the SIP package makes a connection between one of the Darlington collectors and the pin labeled “Pull Up #” for the port associated with that particular Darlington transistor.

For example, installing a 9 pin SIP resistor into the location marked “RN1” places a resistor between all of the Darlington collectors for Port A1 and the pin labeled “Pull Up 1”. A voltage applied to this pin becomes the supply voltage for all eight of the Darlington transistors in Port A1.

4.6 SIGNAL CONNECTION

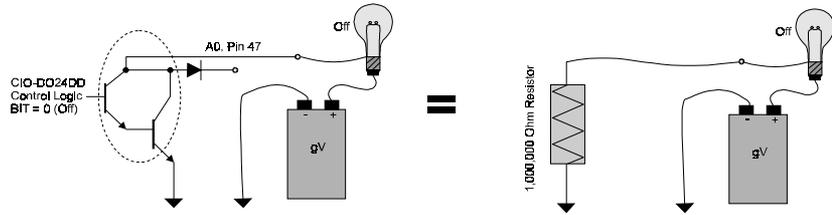
The output circuits are capable of completing a circuit of up to 50 volts and having a current of up to 500 mA.

1. The voltage specification applies only when the transistor is off. The transistor can block up to 50V.

- The current specification applies only when the transistor is on. The transistor can pass up to 500 mA.

Figure 4-3 is an example of a simple circuit. It shows a lamp with a 9 volt battery. The positive battery terminal is connected to a contact of the lamp. The other lamp connection is tied to the Darlington output. The negative side of the battery is connected to GND (pin 44). When you write a 1 to the A0 bit, the Darlington turns on by completing the circuit and the lamp lights.

CIRCUIT OFF



CIRCUIT ON

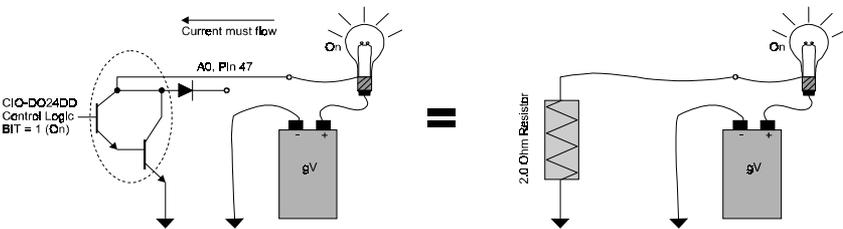


Figure 4-3. Darlington Explained

Notice in Figure 4-3 above, that an equivalent, simplified circuit based on a resistor is shown to the right of the Darlington circuit. The Darlington transistors act like a switch which alternates between two resistors, one of great resistance and one of minimal resistance. Notice that when the Darlington is OFF, there is some leakage current flowing. Notice also that when the transistors are ON, there is a small voltage drop across the Darlington. Both these aspects of the switch should be considered in the design of your overall circuit.

The current can only flow from the pins labeled A#, B#, and C# to ground, and the PC must share a common ground with your circuit.

For specifications of the leakage current and ON voltage of the Darlington, please see the specifications in the back of this manual.

4.7 CLAMPING VOLTAGE INPUT

The output transistors can be set to clamp voltage spikes and prevent them from damaging your circuit. For example, if you are switching a 9V circuit, connect the 9V to the clamp input as well. This will hold transient voltages to less than 11V (9V + 2V max forward voltage across the clamping diode at 350mA).

4.8 TEST CONNECTIONS

The CIO-DO24DD is a digital switching device. To test the installation and the board you will need a known working circuit to switch, such as a lamp bulb and battery described previously.

After you have the circuit connected, the TEST option of the *InstaCal* program can be used to produce an alternating on/off signal at the switch.

5.0 CONTROL & DATA REGISTERS

5.1 INTRODUCTION

CIO-DO24DD is a direct drive, 24-line digital switching board built up of logic chips. There are no configuration registers as such. There are only four (or eight) buffer registers for holding the output values. The output circuits are capable of switching up to 500 mA at up to 50V.

Each board is composed of parallel output chips. Each address contains one latch and one buffer controlling 8 output pins. The ports are arranged in sets of 3, with an intervening unused address. This scheme allows partial compatibility with applications written to control 82C55 based boards in which the 82C55 is used for output only. On those boards every fourth address contains a configuration register. The *partial* compatibility arises from the lack of a read back of the output buffers on the CIO-DO24DD or CIO-DO48DD.

To write control data to an output register, the individual bits must be set to 0 or 1 then combined to form a byte.

Table 5-1 has the register assignments for the CIO-DO24DD and CIO-DO48DD. Note that the last four registers (Base + 4 to +7) apply only to the CIO-DO48DD.

Table 5-1. Register Assignments

ADDRESS	READ FUNCTION	WRITE FUNCTION
BASE + 0	ID Code	Port 1A Outputs (24 & 48 bit models)
BASE + 1	None	Port 1B Outputs (24 & 48 bit models)
BASE + 2	None	Port 1C Outputs (24 & 48 bit models)
BASE + 3	None	None
BASE + 4	None	Port 2A Outputs (48 bit model only)
BASE + 5	None	Port 2B Outputs (48 bit model only)
BASE + 6	None	Port 2C Outputs (48 bit model only)
BASE + 7	None	None

Notice that the register layout is very similar to that of a standard 82C55 based digital I/O board and the other high drive digital output boards. The alignment of ports A, B & C are identical and the position normally occupied by the configuration register is left empty. This is so your existing digital board software will work without modification.

5.2 REGISTER FORMATS - BOTH 24- AND 48-BIT VERSIONS

PORT 1A DATA

BASE ADDRESS + 0

7	6	5	4	3	2	1	0
1A7	1A6	1A5	1A4	1A3	1A2	1A1	1A0

PORT 1B DATA

BASE ADDRESS + 1

7	6	5	4	3	2	1	0
1B7	1B6	1B5	1B4	1B3	1B2	1B1	1B0

PORT 1C DATA

BASE ADDRESS + 2

7	6	5	4	3	2	1	0
1C7	1C6	1C5	1C4	1C3	1C2	1C1	1C0

5.3 REGISTER FORMAT-CIO-DO48DD, CONNECTOR P2 ONLY

PORT 2A DATA

BASE ADDRESS + 4

7	6	5	4	3	2	1	0
2A7	2A6	2A5	2A4	2A3	2A2	2A1	2A0

PORT 2B DATA

BASE ADDRESS + 5

7	6	5	4	3	2	1	0
2B7	2B6	2B5	2B4	2B3	2B2	2B1	2B0

PORT 2C DATA

BASE ADDRESS + 6

7	6	5	4	3	2	1	0
2C7	2C6	2C5	2C4	2C3	2C2	2C1	2C0

6.0 SPECIFICATIONS

Power consumption

+5V

CIO-DO24DD
CIO-DO48DD

275mA typical, 345mA max
425mA typical, 535mA max

Digital Output

Digital Type

ULN2803 Darlington (open collector)

Configuration

CIO-DO24DD
CIO-DO48DD

3 banks of 8 outputs each
6 banks of 8 outputs each

Number of channels

CIO-DO24DD
CIO-DO48DD

24
48

Maximum output voltage, V_{CE}

50V

Maximum continuous current, I_C

500mA

Output leakage current

$V_O = 50V, T_a = +70\text{ }^\circ\text{C}$
 $V_O = 50V, T_a = +25\text{ }^\circ\text{C}$

100 μA max
50 μA max

Collector-Emitter saturation voltage

$i_C = 350\text{mA}, i_B = 500\mu\text{A}$
 $i_C = 200\text{mA}, i_B = 350\mu\text{A}$
 $i_C = 100\text{mA}, i_B = 250\mu\text{A}$

1.1V typ, 1.6Vmax
0.95V typ, 1.3Vmax
0.85V typ, 1.1Vmax

Clamp diode reverse leakage current

$V_R = 50V, T_a = +25\text{ }^\circ\text{C}$

50 μA max

Clamp diode forward voltage

Diode current = 350mA

1.5V typ, 2.0V max

Environmental

Operating temperature range

0 to 50°C

Storage temperature range

-20 to 70°C

Humidity

0 to 90% non-condensing

For your notes.

For your notes.

EC Declaration of Conformity

We, Measurement Computing Corporation, declare under sole responsibility that the product:

CIO-DO24DD & CURRENT OUTPUT BOARD
CIO-DO48DD

Part Number	Description
-------------	-------------

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other normative documents:

EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.

EU 55022 Class B: Limits and methods of measurements of radio interference characteristics of information technology equipment.

EN 50082-1: EC generic immunity requirements.

IEC 801-2: Electrostatic discharge requirements for industrial process measurement and control equipment.

IEC 801-3: Radiated electromagnetic field requirements for industrial process measurements and control equipment.

IEC 801-4: Electrically fast transients for industrial process measurement and control equipment.

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