MODELS
USB-DIO48DO24
USB-DIO24DO12
USB-DO24

USB 48 CHANNEL DIGITAL INPUT/OUTPUT
24 CHANNEL FET OUTPUT MODULE

USER MANUAL

File: USB-DIO48DO24.A1g

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WARNING!!
ALWAYS CONNECT AND DISCONNECT YOUR FIELD CABLING WITH THE COMPUTER POWER OFF. ALWAYS TURN COMPUTER POWER OFF BEFORE INSTALLING A BOARD. CONNECTING AND DISCONNECTING CABLES, OR INSTALLING BOARDS INTO A SYSTEM WITH THE COMPUTER OR FIELD POWER ON MAY CAUSE DAMAGE TO THE I/O BOARD AND WILL VOID ALL WARRANTIES, IMPLIED OR EXPRESSED.

Warranty

Prior to shipment, ACCES equipment is thoroughly inspected and tested to applicable specifications. However, should equipment failure occur, ACCES assures its customers that prompt service and support will be available. All equipment originally manufactured by ACCES which is found to be defective will be repaired or replaced subject to the following considerations:

Terms and Conditions

If a unit is suspected of failure, contact ACCES' Customer Service department. Be prepared to give the unit model number, serial number, and a description of the failure symptom(s). We may suggest some simple tests to confirm the failure. We will assign a Return Material Authorization (RMA) number which must appear on the outer label of the return package. All units/components should be properly packed for handling and returned with freight prepaid to the ACCES designated Service Center, and will be returned to the customer's/user's site freight prepaid and invoiced.

Coverage

First Three Years: Returned unit/part will be repaired and/or replaced at ACCES option with no charge for labor or parts not excluded by warranty. Warranty commences with equipment shipment.

Following Years: Throughout your equipment's lifetime, ACCES stands ready to provide on-site or in-plant service at reasonable rates similar to those of other manufacturers in the industry.

Equipment Not Manufactured by ACCES

Equipment provided but not manufactured by ACCES is warranted and will be repaired according to the terms and conditions of the respective equipment manufacturer's warranty.

General

Under this Warranty, liability of ACCES is limited to replacing, repairing, or issuing credit (at ACCES' discretion) for any products which are proved to be defective during the warranty period.   In no case is ACCES liable for consequential or special damage arriving from use or misuse of our product. The customer is responsible for all charges caused by modifications or additions to ACCES equipment not approved in writing by ACCES or, if in ACCES opinion the equipment has been subjected to abnormal use.   "Abnormal use" for purposes of this warranty is defined as any use to which the equipment is exposed other than that use specified or intended as evidenced by purchase or sales representation. Other than the above, no other warranty, expressed or implied, shall apply to any and all such equipment furnished or sold by ACCES.

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Chapter 1: Introduction

This USB board is an ideal solution for adding portable, easy-to-install digital I/O capabilities and solid state switch outputs to any computer with a USB port. The board is a high speed device, offering the fastest speed available with the USB 2.0 bus. It is fully compatible with both USB 1.1 and USB 3.0 ports. The unit is plug-and-play allowing quick connect / disconnect whenever you need additional I/O on a USB port.

Model Versions

USB-DIO48DO24 48 digital I/O's and 24 FET solid state outputs
USB-DIO24DO12 24 Digital I/O's and 12 FET solid state outputs
USB-DO24   24 FET solid state outputs

This manual primarily describes the USB-DIO48DO24. Wherever references occur to the number of inputs and number of outputs, substitute the number of inputs and outputs with the quantity specific to the model you are considering, or have purchased.

Features

- High-speed USB 2.0 device, USB 3.0 and 1.1 compatible
- 48 lines of digital I/O
  - Six (6) 8-bit ports independently selectable for inputs or outputs
  - Buffered with 32mA source, 64mA sink capabilities
  - Buffers can be enabled or tri-stated under program control
  - Jumper selectable, pulled up to 5V (via 10kΩ), down to ground or floating
  - Compatible with Industry-Standard I/O Racks such as OPTO22
- 24 fully protected high-side FETs
  - 2A outputs
  - Common switched 5-34VDC
- Type B USB connector features industrial strength high retention design
- Alternate micro-fit embedded USB connector for stacking and embedded applications
- Resettable fused +5VDC output per I/O connector
- Standard 50-pin IDC-type shrouded connectors with key
- -OEM version (board only) features PC/104 module size (3.550 by 3.775 in.) and mounting capabilities
- Small (4" x 4" x 1.7"), rugged, industrial, steel enclosure
- Internal removable spring / screw terminal board for simplified wiring

Applications

- Kiosks
- Automatic Test Systems
- Laboratory Automation
- Robotics & Machine Control
- Security Systems, Energy Management
- Relay Monitoring and Control
- Sensing Switch Closures or TTL, DTL, CMOS Logic
- Control of Indicator Lights or Recorders
- Industrial ON/OFF control

Functional Description

TTL I/O

The board features 48 bits of TTL-compatible digital I/O with high-current capabilities. Digital I/O lines are programmed to accept inputs or to drive outputs in six 8-bit ports. All I/O lines are buffered by a type 74ABT543A tristate buffer transceiver capable of sourcing 32mA or sinking 64mA.

Jumper options permit user configuration of each 8-bit port for pull-up (to +5 VDC), pull-down (to ground), or floating, depending on the application requirement. Pull-ups are useful for contact monitoring and pull-downs ensure that there are no erroneous outputs at power-up until the board is initialized by system software.

Power is supplied to the board via the USB cable, or for higher source current capabilities, an external power option may be ordered (-PR option).

FET Outputs

The solid state outputs are comprised of 24 fully protected high-side power MOSFET switches. The FETs have built in current limiting and are protected against short-circuit, over-temperature, over-voltage, reverse polarity, ESD and inductive load transients. The current limitation is activated until the thermal protection acts.

The outputs are de-energized at power-up to prevent an unintended control output signal.

Each output shares a common switched voltage of 5-34VDC and is capable of driving up to 2A each. There is a cumulative total of 10A that this board can handle on the VBB line or terminal connections.

When powering the unit over the USB cable, if the USB cable becomes disconnected during control operations the FETs will turn off immediately. With application power connected to the FETs, there is no "sneak-path" to keep the USB module powered on when the USB cable is disconnected.

When the unit is externally powered (-PR option) and the USB cable is disconnected, the FETs will remain in their last commanded state.
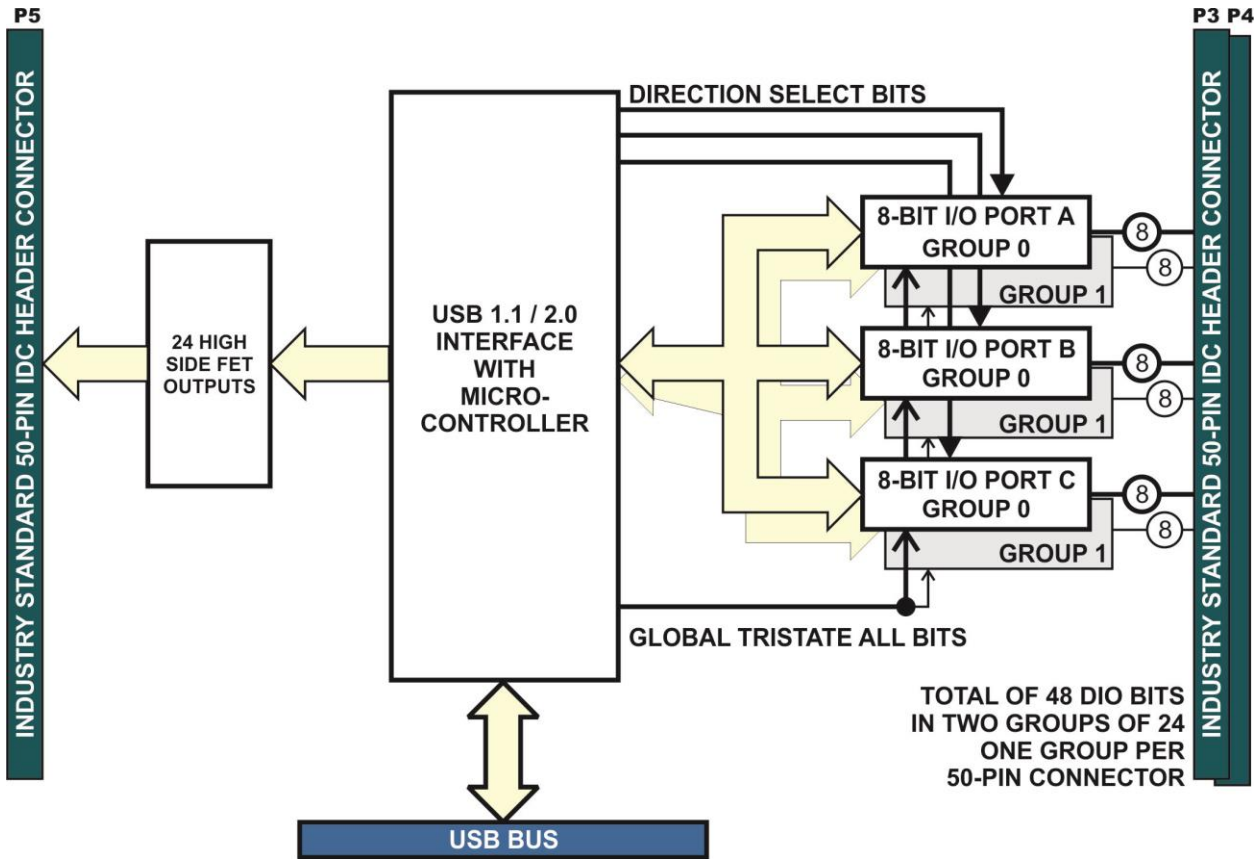
Figure 1-1: Block Diagram
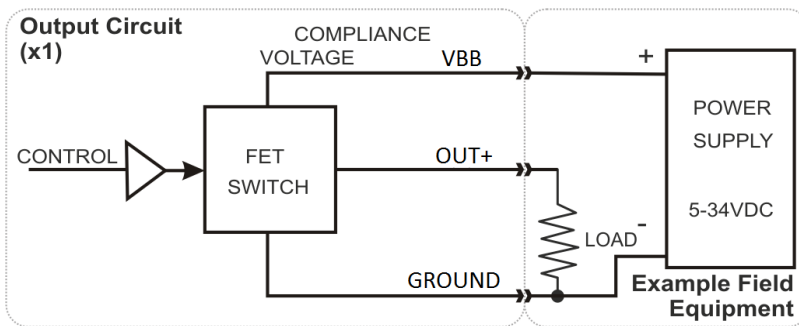
Figure 1-2: Example of One Output Circuit

Ordering Guide

USB-DIO48DO24   48 digital I/O's and 24 FET solid state outputs in a rugged steel enclosure with internal terminal board

USB-DIO24DO12   24 Digital I/O's and 12 FET solid state outputs in a rugged steel enclosure with internal terminal board

USB-DO24   24 FET solid state outputs in a rugged steel enclosure with internal terminal board

Model Options

-PR	Adds power DC jack and AC/DC regulated +5V adapter
-OEM	Board only (no enclosure or terminal board)
-RoHS	RoHS Compliant board
-T	Extended operating temperature -40˚C to +85˚C
-E	Economy model (in enclosure but no terminal board)
-VBB	Adds DC power input for connecting power to FET VBB lines for switched outputs

Included with your board

The following components are included with your shipment depending on options ordered. Please take time now to ensure that no items are damaged or missing.

1.   USB Board with internal terminal board installed in labeled enclosure
2.   6' USB cable

Optional Accessories

IIB-24	24-input channel optical isolator board
CAB50-6	6' flat ribbon cable female to edge connector
MP104-DIN	DIN rail mounting provision
CUSB-EMB-6	6' USB Cable with Type A to mini connector
CUSB-LOCK	6' USB Cable w/positive retention screw locked type B connector

Additional accessories are available, please contact the factory.

Terminal Accessory Board

An STB-DIO48DO24 terminal board is included with the unit, except for the -E and -OEM versions. The board provides access to all I/O signals via spring cage terminals and allows external power to connect via screw terminals. The terminal board plugs directly onto the I/O board.
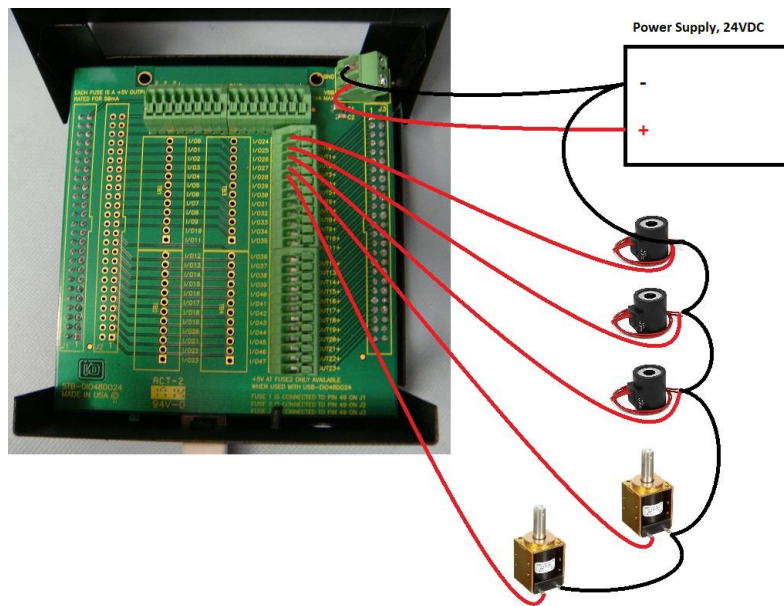
Figure 1-3: Terminal Accessory Board

Chapter 2: Installation

Software Installation

The software provided with this board is available to download via the product page for free and must be installed onto your hard disk prior to use.

Installing from Downloaded Installer

Download the software package here (https://accesio.com/files/packages/USB-DIO48DO24%20Install.exe) or from the Downloads tab on the product page.

Linux

Please refer to linux.htm, and visit https://github.com/accesio for more.

> ***Caution! * ESD A single static discharge can damage your card and cause premature failure! Please follow all reasonable precautions to prevent a static discharge such as grounding yourself by touching any grounded surface*** *prior to touching the card.*

Configure Board Options via Jumper Selection

Before connecting the board to your USB port, carefully read Chapter 3: Hardware Details of this manual, then configure the board according to your requirements. Our Windows based setings program can be used in conjunction with Chapter 3 to assist in configuring jumpers on the board, as well as provide additional descriptions for usage of the various board options.

Hardware Installation

The board can be installed in any USB 2.0, USB 1.1, or USB 3.0 port. Please refer to the USB I/O Quick Start Guide which can be found on the CD, for specific, quick steps to complete the hardware and software installation.

Chapter 3: Hardware Details

Refer to the settings program installed with the software package. Also, refer to the Block Diagram and the Option Selection Map when reading this section of the manual.

Option Selection
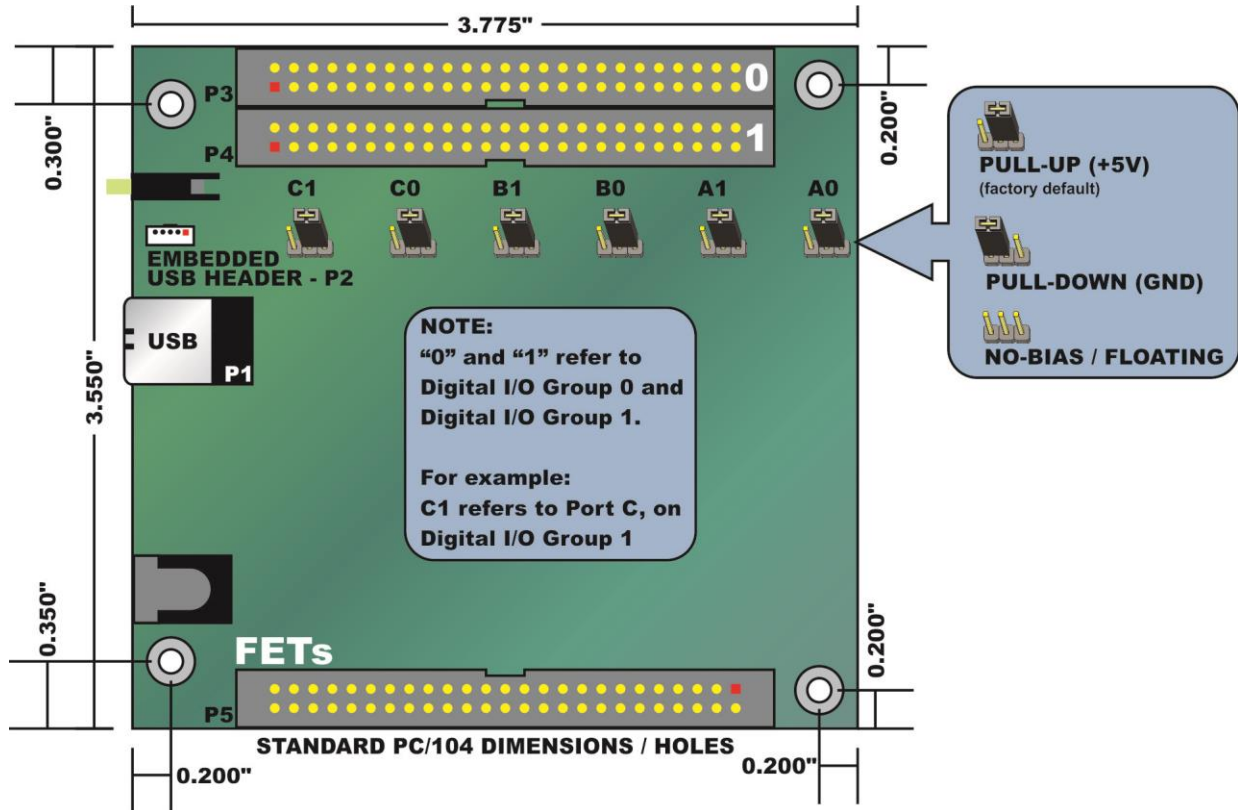
Figure 3-1: Option Selection Map

Pull-Up / Pull-Down Configuration Jumpers

One configuration jumper controls each 8-bit group of I/O that can be pulled up to +5V via 10kΩ (for dry-contact monitoring) or pulled down (pull-downs ensure that there are no erroneous outputs at power-up until the board is initialized by system software). When no jumpers are installed, the lines are left floating.

Due to the 10kΩ resistor packs any unused input will not have suppressed cross-talk.

- For pull-ups (most common), install these jumpers in the +5V position (factory default).
- For pull-downs, install these jumpers in the GND position.
- For neither, remove these jumpers.

USB Connector (P1)

The primary USB connector is a Type B high-retention connector and mates with the cable provided. The USB port provides communication signals along with +5 VDC power. The board can be powered from the USB port or, an external power supply can optionally be used if desired. Simply specify the "-PR" option when ordering, which includes the on-board DC power jack and circuitry and an external power supply adapter.

A type B USB connector is used on all ACCES USB/104 products which features a high retention design that complies with the class 1, Div II minimum withdrawal requirement of over 3 pounds of force (15 Newtons). This connector has an orange color-coded insulator to quickly differentiate it from standard USB connectors.

For higher retention requirements, the CUSB-LOCK provides a positive retention screw lock connection when used in conjunction with our steel enclosure.

Embedded USB Connector (P2)

The board includes an alternate USB connector. The connector is a Molex Pico Blade Connector series 53047 5-pin header. The mating connector is a Molex 51021-050. This connector is perfect for space constrained embedded applications and provides a reduced footprint, avoiding the rigid, bulky USB cables commonly used today.

LED (L1)

The LED on the front of the enclosure is used to indicate power and data transmissions. When the LED is in an illuminated steady green state, this signifies that the board is successfully connected to the computer and has been detected and configured by the operating system. When the LED flashes, this signifies that there is data being transmitted over the USB bus.

50 Pin Box Headers (P3, P4, and P5)

The 50 pin shrouded headers have standard 0.100" spacing between pins and are keyed to prevent improper connections. It can be used with standard IDC type ribbon cables.

5V Resettable Fused Outputs (F1, F2, and F3)

A resettable fuse (50mA hold, 150mA trip current) feeds each I/O connector at pin 49 used to power external module racks or relay boards. If an over-current persists on a circuit protected by a resettable fuse, it will open, interrupting power to the circuit. Response time depends on over-current level and ambient temperature, humidity, etc. The fuse will remain open until the bi-metal elements cool sufficiently, at which time the circuit will be restored.

DC Power Jack (DC1 - Optional)

Order this option when current sourced on outputs is anticipated to be more than a USB port can provide (typically 500 mA). The DC jack has a 2.00mm post and is designed to be used with the AC/DC regulated 5V external power supply shipped with this option.

Chapter 4: USB Plug and Play Information

Use the provided driver to access the USB board. This driver will allow you to determine how many supported USB devices are currently installed, and each device's type. This information is returned as a Vendor ID (VID) and Product ID (PID).

The board's VID is "0x1605", and the PID for each model is listed below:

PID	Model #
803C	USB-DIO48DO24
803D	USB-DIO24DO12
803E	USB-DO24

Table 4-1: Product ID by Model

Chapter 5: Programming

The software provided includes a DLL compatible with any Windows programming language. Samples provided in C#, Delphi, Visual Basic, and Visual C++ demonstrate the use of the driver and board. Full source code is always provided. Check the linux.html file for details regarding Linux support.

The following is a list of the most useful function calls provided for this board by the driver.

For a complete list of available functions and details on how to use them refer to the USB Software Reference Manual located in the installation path for this board.

unsigned long DIO_Configure(DeviceIndex, bTristate, pOutMask, pData)

 unsigned long **DIO_Configure**(
  unsigned long DeviceIndex - number from 0-31 of the device you want to configure
  unsigned char bTristate - boolean value. TRUE causes all bits on the device to enter tristate (high-impedance) mode. FALSE removes the tristate. The tristate is changed **after** the remainder of the configuration has occurred. All devices with this feature power-on in the "tristate" mode at this time.
  void *pOutMask - a pointer to the first element of an array of bytes; one byte per 8 ports or fraction. Each "1" bit in the array indicates that the corresponding port of the device is Output.
  void *pData - a pointer to the first element of an array of bytes. Each byte is copied to the digital output ports on the device before the ports are taken out of tristate. Any bytes in the array associated with ports configured as input are ignored.
)

The size of the out mask and data is as follows:

Out Mask	1 bytes
Data	9 bytes

unsigned long DIO_WriteAll(DeviceIndex,pData)
unsigned long DIO_ReadAll(DeviceIndex,pData)

 unsigned long DIO_WriteAll(
 or
 unsigned long DIO_ReadAll(
  unsigned long DeviceIndex - number from 0-31 of the device you wish to write/read all output bits on
  void *pData - pointer to the first element of an array of bytes. DIO_WriteAll copies each byte to the corresponding output port; bytes written to ports configured as inputs are ignored. DIO_ReadAll reads each port, and the reading stored in the corresponding byte in the array.
)
 Note that the size of "all" is the same as the size of the data given under DIO_Configure.

The base model has 9 bytes of data, arranged in the byte array as shown:

Data Array	Index 0	Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	Index 7	Index 8
Contains	TTL DIO 0-7	TTL DIO 8-15	TTL DIO 16-23	TTL DIO 24-31	TTL DIO 32-39	TTL DIO 40-47	FET 0-7	FET 8-15	FET 16-23

The position of each data does not change for versions of the board with fewer data bits. For example, the 24-TTL bit board with 12 FETs has the following data array structure:

Data Array	Index 0	Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	Index 7	Index 8
Contains	TTL DIO 0-7	TTL DIO 8-15	TTL DIO 16-23	unused	unused	unused	FET 0-7	FET 8-11	unused

Sample Programs

Sample programs are useful to check out initial operation of the board as well as aiding in the understanding of the programming techniques used (sample source code provided).

ACCES recommends Delphi, a modern, high performance, easy to use, CASE (Computer Aided Software Engineering) language created initially by Borland. Our Delphi language samples do not require runtime installations so can operate even on computers without .NET or MSVC runtimes installed.

Chapter 6: Connector Pin Assignments

Two 50-pin male headers are provided for I/O connections designated as P3 and P4, which are also referred to as Groups 0 and 1 respectively.

IDC 50-Pin Header Male
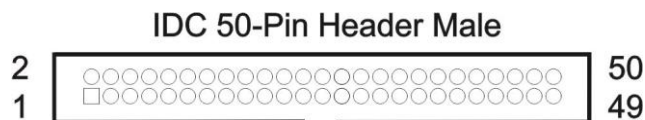
PIN	P3	P4	PIN	FUNCTION
1	I/O 23	I/O 47	2	GND
3	I/O 22	I/O 46	4	GND
5	I/O 21	I/O 45	6	GND
7	I/O 20	I/O 44	8	GND
9	I/O 19	I/O 43	10	GND
11	I/O 18	I/O 42	12	GND
13	I/O 17	I/O 41	14	GND
15	I/O 16	I/O 40	16	GND
17	I/O 15	I/O 39	18	GND
19	I/O 14	I/O 38	20	GND
21	I/O 13	I/O 37	22	GND
23	I/O 12	I/O 36	24	GND
25	I/O 11	I/O 35	26	GND
27	I/O 10	I/O 34	28	GND
29	I/O 09	I/O 33	30	GND
31	I/O 08	I/O 32	32	GND
33	I/O 07	I/O 31	34	GND
35	I/O 06	I/O 30	36	GND
37	I/O 05	I/O 29	38	GND
39	I/O 04	I/O 28	40	GND
41	I/O 03	I/O 27	42	GND
43	I/O 02	I/O 26	44	GND
45	I/O 01	I/O 25	46	GND
47	I/O 00	I/O 24	48	GND
49	+5VDC	+5VDC	50	GND

Table 6-1: DIO 50-Pin Connector Pin Assignments

Name	I/O	Description
I/O xx	I/O	Input, Output, or Tristated, pulled up or down via 10kΩ, or floating
+5VDC	O	Via resettable fuse (50mA hold, 150mA trip)
GND	N/A	Ground (Power Supply Return)

Table 6-2: DIO Detailed Pin Descriptions

FET outputs are connected to the board via a 50-pin header type connector named P5. The mating connector is an IDC type with 0.1 inch centers or equivalent. Normally, a terminal accessory (STB-DIO48DO24) is included and installed directly on to the board headers.

IDC 50-Pin Header Male
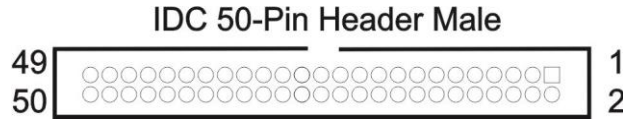
PIN	FUNCTION	PIN	FUNCTION
1	OUT0+	2	VBB
3	OUT1+	4	GND
5	OUT2+	6	VBB
7	OUT3+	8	GND
9	OUT4+	10	VBB
11	OUT5+	12	GND
13	OUT6+	14	VBB
15	OUT7+	16	GND
17	OUT8+	18	VBB
19	OUT9+	20	GND
21	OUT10+	22	VBB
23	OUT11+	24	GND
25	OUT12+	26	VBB
27	OUT13+	28	GND
29	OUT14+	30	VBB
31	OUT15+	32	GND
33	OUT16+	34	VBB
35	OUT17+	36	GND
37	OUT18+	38	VBB
39	OUT19+	40	GND
41	OUT20+	42	VBB
43	OUT21+	44	GND
45	OUT22+	46	VBB
47	OUT23+	48	GND
49	+5VDC	50	GND

Table 6-3: FET 50-Pin Connector Pin Assignments

Name	I/O	Description
VBB	I	FET Supply Voltage (5V to 34VDC)
OUT+	O	Switched (Supply Voltage) Output
GND	N/A	Ground (Power Supply Return)

Table 6-4: FET Detailed Pin Descriptions

The FETs on this product share a common VBB; all VBB signals on this connector are tied together.

WARNING! USE ONLY ONE EXTERNAL POWER SOURCE FOR ALL VBBs.

Chapter 7: Specification

TTL Digital Input / Output Lines
Number of channels: 48 in six 8-bit groups

Inputs:	Logic High:	2.0 VDC min., 5.5 VDC max.
	Logic Low:	-0.5 VDC min., +0.8 VDC max.
Outputs:	Logic High:	2.0 VDC min., source 32 mA
	Logic Low:	0.55 VDC max., sink 64 mA

FET Outputs
Number of outputs: 24 Solid State FETs (off @ power up)

Output Type: High Side Power MOSFET Switch. Protected against short circuit, over-temperature, over-voltage, reverse power, ESD & can drive inductive loads.

Voltage Range: 5-34VDC recommended (customer supplied) for continuous use, 40VDC absolute maximum

Current Rating: 2A maximum
Absolute Max: There is a cumulative total limit of 10A for the VBB current through this board

Turn-on time: 90 uS (typical)

Turn-off time: 110 uS (typical)

Bus Type
USB 2.0 High-speed, USB 3.0 Compatible, USB 1.1 Compatible

Environmental
Operating Temp: 0° to +70°C, optional -40° to +85°C

Storage Temp: -40° to +85°C

Humidity: 5% to 90% RH, non-condensing

Board Dimension: 3.550" x 3.775"

Box Dimension: 4" x 4" x 1.7"

Power
+5VDC: 110mA (All inputs, no load)
5VDC provided via USB cable up to 500mA**

**+5VDC from the USB bus or external power supply depending on user configuration. The USB bus is specified to provide 500 mA to most desktop environments. This gives you 390mA available (500 mA - 110mA = 390 mA). If using more than a total of 500mA, use optional regulated +5VDC external power supply (-PR option) and remove VUSB jumper and place jumper on VEXT. Then plug in external power before plugging into USB port.

Customer Comments

If you experience any problems with this manual or just want to give us some feedback, please email us at: manuals@accesio.com. Please detail any errors you find and include your mailing address so that we can send you any manual updates.

ACCES I/O PRODUCTS, INC.
10623 Roselle Street, San Diego CA 92121
Tel. (858)550-9559   FAX (858)550-7322
www.accesio.com