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

MODEL PCI-QUAD-8 and PCI-QUAD-4

Eight and Four Up/Down Counter Quadrature Input PCI Boards

User Manual

File: MPCI-QUAD-8.D1b

Notice

The information in this document is provided for reference only. ACCES does not assume any liability arising out of the application or use of the information or products described herein. This document may contain or reference information and products protected by copyrights or patents and does not convey any license under the patent rights of ACCES, nor the rights of others.

IBM PC, PC/XT, and PC/AT are registered trademarks of the International Business Machines Corporation.

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.

TABLE OF CONTENTS

Chapter 1: Introduction

Features

- Eight or four-Counter quadrature decoder
- Single-ended or differential inputs for up to eight encoders (A, B & Index)
- Programmable clock source (high/low) for digital filtering on inputs
- Programmable active index polarity
- Per Counter software control:
  - corrects reversed A / B wiring
  - selects flag for interrupt source
- Resettable fused 5V output available to power encoders or general purpose
- High-density DB78 male I/O connector with screw locks

Applications

- Automatic Test Systems
- Laboratory Automation
- Robotics
- Machine Control
- Security Systems
- Energy Management

Functional Description

The PCI-QUAD-8 provides counter functions for incremental quadrature encoders for PCI computers.

Type AM26LS232s differential line receivers provide input signal conditioning for each input from a variety of quadrature encoders. Inputs from up to eight quadrature encoders are accepted by LSI/CSI LS7766 Quadrature Counters.

The LSI/CSI LS7766 features per Counter:

- 32-bit quadrature (X1, X2, X4), non-quadrature up/down counters
  - Quadrature frequencies up to 9.6MHz
  - Non-quadrature frequencies up to 40MHz
- Programmable IOs for index and marker flags (carry, borrow, sign & compare)
  - Enable/disable sources generating IRQ's
- Programmable count modes:
  - Normal (free-run) / Modulo-N / Range Limit / Non-Recycle, Binary / BCD

The card is 4.825 inches in length and 3.875 inches seated height.

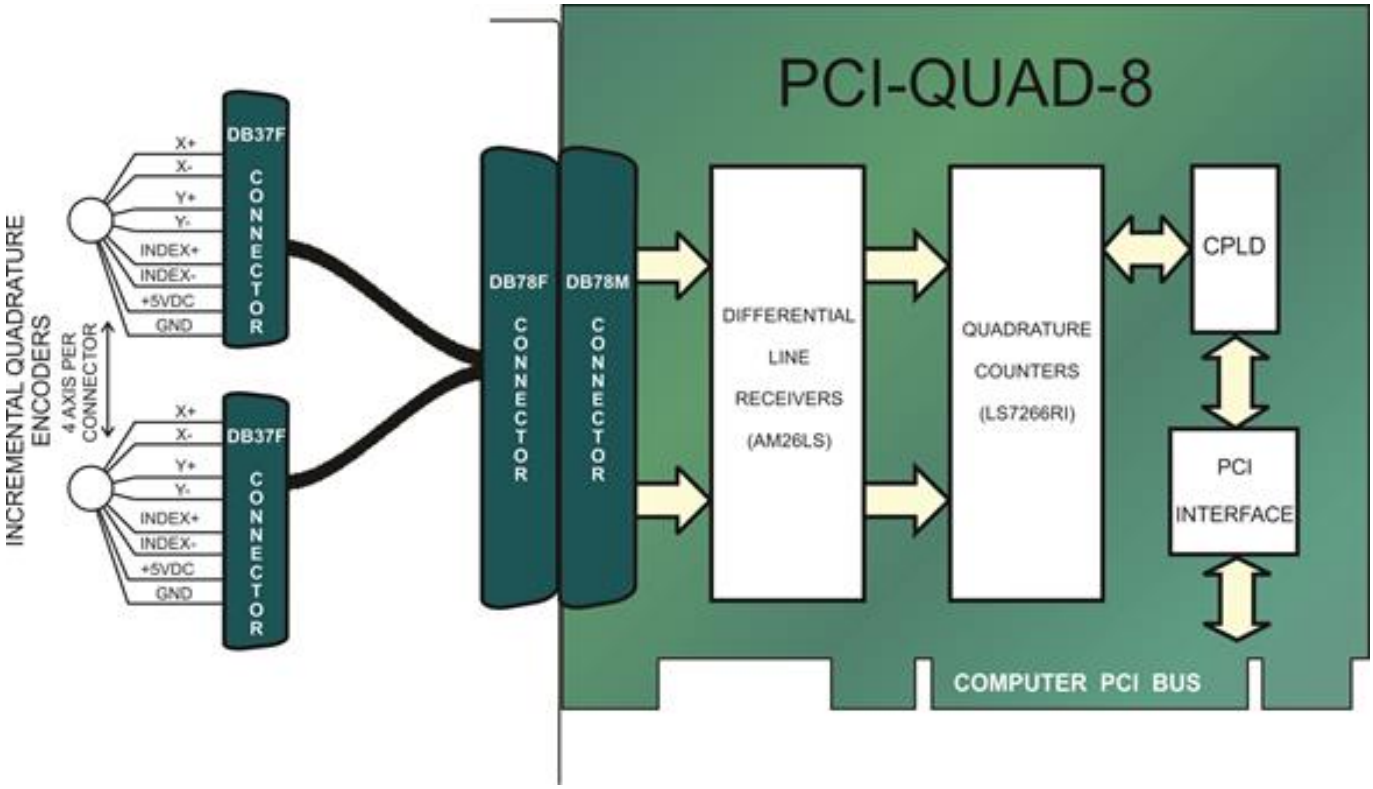

Figure 1-1: Block Diagram

Ordering Guide

PCI-QUAD-8	Eight-Counter quadrature input
PCI-QUAD-4	Four-Counter quadrature input

Model Options

-T	Extended operating temperature of -40˚ to +85˚C
-RoHS	This product is available in a RoHS compliant version. Please call for specific pricing then be sure to add this suffix to the model number on any hard-copy or verbal purchase orders.
-S0x	Special designator for custom Filter Clock rate, etc.

Included with your board

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

PCI quadrature board
Software Master CD (PDF user manual installed with product package)
Printed I/O Quick-Start Guide

Optional Accessories

CAB78F-37/2	6' round-wire "Y" cable, DB78 female terminates in two DB37 female connectors.
CAB78F-37/1	As above, terminates in one DB37 female, use with PCI-QUAD-4.
STB-37/2F Kit	Screw Terminal and Cabling solution mounted on a SNAP-TRACK. Includes two STB-37 screw terminal cards, Y Cable, and 1' SNAP-TRACK.
STB-37/1F Kit	As above, terminates with one STB-37, use with PCI-QUAD-4.
STB-37/2F Kit-CL	Includes four DIN clips to allow mounting the two STB-37's & SNAP-TRACK onto a DIN-RAIL.

Chapter 2: Installation

A printed Quick-Start Guide (QSG) is packed with the board for your convenience. If you've already performed the steps from the QSG, you may find this chapter to be redundant and may skip forward to begin developing your application.

Software CD Installation

The software provided with this board is contained on one CD and ***must be installed onto your hard disk prior to use.*** To do this, perform the following steps as appropriate for your operating system. Substitute the appropriate drive letter for your drive where you see D: in the examples below.

Windows

a. Place the CD into your CD-ROM drive.
b. The install program automatically run. If the install program does not run, click START | RUN and type D:\INSTALL, click OK or press Enter.
c. Follow the on-screen prompts to install the software for this board.

Linux

a. Please refer to linux.htm on the CD for information on installing under Linux.

Hardware Installation

Please install the software package before plugging the hardware into the system.
Refer to the printed I/O Quick Start Guide included with your board which can also be found on the CD, for specific, quick steps, to complete the hardware and software installation.

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.

Hardware Installation

1. Do not install card into the computer until the software has been fully installed.
2. Turn OFF computer power AND unplug AC power from the system.
3. Remove the computer cover.
4. Carefully install the card in an available 5V or 3.3V PCI expansion slot ensuring the card is fully seated into the PCI connector (you may need to remove a backplate first).
5. Inspect for proper fit of the card then tighten mounting bracket screw securely verifying there is a positive chassis ground.
6. Install an I/O cable onto the card's bracket mounted connector.
7. Replace the computer cover and turn ON the computer which should auto-detect the card (depending on the operating system) and automatically finish installing the drivers.
8. Run one of the provided sample programs that was copied to the newly created card directory (from the CD) to test and validate your installation.

Chapter 3: Hardware Details

Option Selection

There are no jumpers or switches to set or configure prior to installing the card into the PCI slot of the PC.

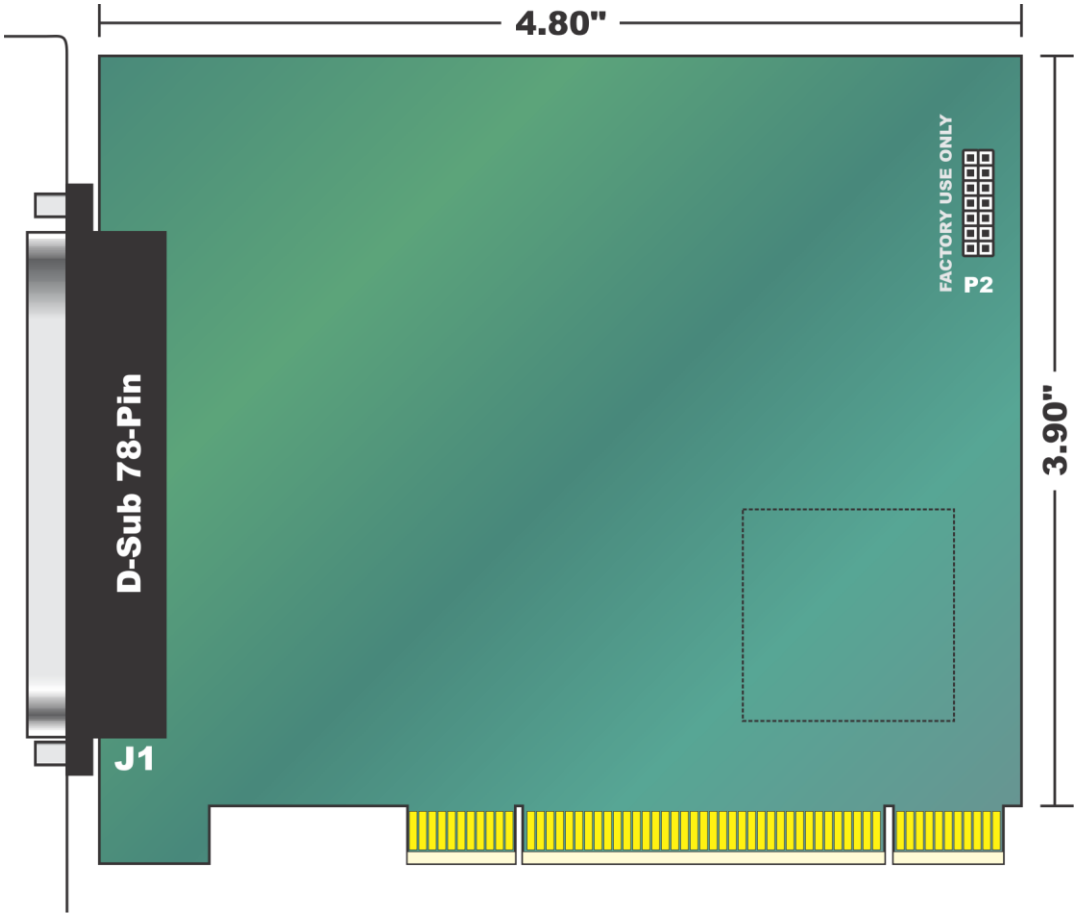

Figure 3-1: Card Image

Chapter 4: Address Selection

The Vendor ID for this card is 0x494F. (ASCII for "IO")
The Device ID for the PCI-QUAD-8 is 0x2230.
The Device ID for the PCI-QUAD-4 is 0x2231.

This card uses I/O addresses offset from the Offset assigned by the PCI bus. The address spaces are defined in the programming section of this manual.

PCI architecture is Plug-and-Play. This means that the BIOS or Operating System determines the resources assigned to PCI cards rather than the user selecting those resources with switches or jumpers. As a result, you cannot set or change the card's Offset or IRQ level. You can only determine what the system has assigned.

The following information is for advanced users only:

The PCI bus supports 64K of I/O address space, so your card's addresses may be located anywhere in the 0000h to FFFFh range.

The card uses more resources than you usually need be concerned with.

For those who require it, be aware of the following:
BAR[0]: memory mapped PEX8311
BAR[1]: I/O mapped PEX8311
BAR[2]: I/O mapped card registers (←all most software needs)

Register Offset	Port Assignment	Operation	Device
+0	Counter 0 MCR0	Read/Write	First LS7766
+1	Counter 0 MCR1	Read/Write	
+2	Counter 0 IDR0	Read/Write	
+3	Counter 0 IDR1	Read/Write	
+4	Counter 0 IDR2	Read/Write	
+5	Counter 0 IDR3	Read/Write	
+6	Counter 0 STR/TCR	Read/Write	
+7	Counter 0 CPLD	Read/Write	
+8 - F	Counter 1	“	
+10 - 17	Counter 2	“	Second LS7766
+18 – 1F	Counter 3	“	
+20 - 27	Counter 4	“	Third LS7766 (8 Counter only)
+28 – 2F	Counter 5	“	
+30 – 37	Counter 6	“	Fourth LS7766 (8 Counter only)
+38 – 3F	Counter 7	“	

Table 5-1: Register Map

Offset +0 - 6 (Read/Write) 32 Bit Quadrature Counter

To write application software, in conjunction with this user manual and provided sample programs, please refer to pages 3 and 4 of the LS7766 spec sheet (located on the ACCES CD in “ChipDocs”) for register descriptions.

CS/	RS2	RS1	RS0	RD/	WR/	SELECTED REGISTER	DATABUS REGISTER MAP	OPERATION
1	x	x	x	x	x	none	none	none
0	0	0	0	0	1	MCR0	DBL	READ
0	0	0	1	0	1	MCR1	DBL	READ
0	0	1	0	0	1	ODR0	DBL	READ
0	0	1	1	0	1	ODR1	DBL	READ
0	1	0	0	0	1	ODR2	DBL	READ
0	1	0	1	0	1	ODR3	DBL	READ
0	1	1	0	0	1	STR	DBL	READ
0	0	0	0	1	0	MCR0	DBL	WRITE
0	0	0	1	1	0	MCR1	DBL	WRITE
0	0	1	0	1	0	IDR0	DBL	WRITE
0	0	1	1	1	0	IDR1	DBL	WRITE
0	1	0	0	1	0	IDR2	DBL	WRITE
0	1	0	1	1	0	IDR3	DBL	WRITE
0	1	1	0	1	0	TCR	DBL	WRITE

Table 5-2: Octal Bus Register Configuration

Offset +7 (Read/Write) CPLD Global and Counter 0 Specific Control

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Global IRQ Status	always 0	Global Z inputs polarity	Global PCK frequency	Ctr 0 Interrupt Status	Ctr 0 Flag-b Interrupt Enable	Ctr 0 Flag-a Interrupt Enable	Ctr 0 A/B Wiring Position

Offset +F (Read/Write) CPLD Global and Counter 1 Specific Control

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Global IRQ Status	always 0	Global Z inputs polarity	Global PCK frequency	Ctr 1 Interrupt Status	Ctr 1 Flag-b Interrupt Enable	Ctr 1 Flag-a Interrupt Enable	Ctr 1 A/B Wiring Position

Offset +17 (Read/Write) CPLD Global and Counter 2 Specific Control

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Global IRQ Status	always 0	Global Z inputs polarity	Global PCK frequency	Ctr 2 Interrupt Status	Ctr 2 Flag-b Interrupt Enable	Ctr 2 Flag-a Interrupt Enable	Ctr 2 A/B Wiring Position

Offset +1F (Read/Write) CPLD Global and Counter 3 Specific Control

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Global IRQ Status	always 0	Global Z inputs polarity	Global PCK frequency	Ctr 3 Interrupt Status	Ctr 3 Flag-b Interrupt Enable	Ctr 3 Flag-a Interrupt Enable	Ctr 3 A/B Wiring Position

Offset +27 (Read/Write) CPLD Global and Counter 4 Specific Control

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Global IRQ Status	always 0	Global Z inputs polarity	Global PCK frequency	Ctr 4 Interrupt Status	Ctr 4 Flag-b Interrupt Enable	Ctr 4 Flag-a Interrupt Enable	Ctr 4 A/B Wiring Position

Offset +2F (Read/Write) CPLD Global and Counter 5 Specific Control

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Global IRQ Status	always 0	Global Z inputs polarity	Global PCK frequency	Ctr 5 Interrupt Status	Ctr 5 Flag-b Interrupt Enable	Ctr 5 Flag-a Interrupt Enable	Ctr 5 A/B Wiring Position

Offset +37 (Read/Write) CPLD Global and Counter 6 Specific Control

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Global IRQ Status	always 0	Global Z inputs polarity	Global PCK frequency	Ctr 6 Interrupt Status	Ctr 6 Flag-b Interrupt Enable	Ctr 6 Flag-a Interrupt Enable	Ctr 6 A/B Wiring Position

Offset +3F (Read/Write) CPLD Global and Counter 7 Specific Control

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Global IRQ Status	always 0	Global Z inputs polarity	Global PCK frequency	Ctr 7 Interrupt Status	Ctr 7 Flag-b Interrupt Enable	Ctr 7 Flag-a Interrupt Enable	Ctr 7 A/B Wiring Position

Bit	Logic 1	Logic 0 (default)
0	Sensor wiring “reversed” B leads A	Sensor wiring “normal” A leads B
1	Enable IRQ generation when Flag-a set (true)	Disabled
2	Enable IRQ generation when Flag-b set (true)	Disabled
3 (Read Only)	Counter generated an IRQ*	No Counter IRQ pending
4	PCK Input 16MHz	PCK Input 4MHz
5	Z input is active when low	Z input is active when high
7 (Read Only)	PCI Bus IRQ active*	No Board IRQ pending

*When a PCI bus IRQ is generated by this card here’s how it is cleared:
For each Counter with interrupts enabled, read offset +7, and when bit 3=1
clear it by writing to that Counter offset +6 with bit 3=1.
If this is the only Counter with an interrupt pending, the card’s global interrupt pin will be cleared.

Quoted from LS7766 datasheet:

```
Counter n TCR (write only)
Bit3 = 0: Nop
Bit3 = 1: Reset STR
Affects status bits for carry, borrow, compare and index.
Status bits corresponding to count_enable, direction and sign are not
affected.
```

Chapter 6: Connector Pin Assignments

Digital I/O signals are connected to the card via a male 78-pin D type connector that extends through the back of the computer case. The mating connector is an AMPLIMITE 1658685-1 or equivalent. We optionally provide a breakout cable that divides the 78-pin I/O connector down to two female 37-pin D type connectors. See the following pages for information about termination solutions.

Pin	Name	Pin	Name	Pin	Name	Pin	Name
1	GND	21	GND	40	GND	60	GND
2	VCC1	22	VCC1	41	VCC2	61	VCC2
3	VCC1	23	INHI_Z3	42	VCC2	62	INHI_Z7
4	INHI_Z1	24	INLO_Z3	43	INHI_Z5	63	INLO_Z7
5	INLO_Z1	25	INHI_B3	44	INLO_Z5	64	INHI_B7
6	INHI_B1	26	INLO_B3	45	INHI_B5	65	INLO_B7
7	INLO_B1	27	INHI_A3	46	INLO_B5	66	INHI_A7
8	INHI_A1	28	INLO_A3	47	INHI_A5	67	INLO_A7
9	INLO_A1	29	GND	48	INLO_A5	68	GND
10	GND	30	GND	49	GND	69	GND
11	GND	31	VCC1	50	GND	70	VCC2
12	VCC1	32	VCC1	51	VCC2	71	VCC2
13	VCC1	33	INHI_Z2	52	VCC2	72	INHI_Z6
14	INHI_Z0	34	INLO_Z2	53	INHI_Z4	73	INLO_Z6
15	INLO_Z0	35	INHI_B2	54	INLO_Z4	74	INHI_B6
16	INHI_B0	36	INLO_B2	55	INHI_B4	75	INLO_B6
17	INLO_B0	37	INHI_A2	56	INLO_B4	76	INHI_A6
18	INHI_A0	38	INLO_A2	57	INHI_A4	77	INLO_A6
19	INLO_A0	39	GND	58	INLO_A4	78	GND
20	GND			59	GND		

Table 6-1: DB78M Pin Assignments

Notes:

1. When using single-ended Encoders leave the Negative Input open and connect the Encoder (A, B, Index) output lead to the corresponding Positive Input pin.

2. Both single-ended and differential Encoders require a ground connection between the Encoder and the PCI-QUAD board to eliminate the adverse effects of exceeding the common mode range.

Signal Name	I/O	Signal Description Name
INLO_Ax	In	Quadrature A Negative Input (GND for Single Ended Encoders)
INHI_Ax	In	Quadrature A Positive Input
INLO_Bx	In	Quadrature B Negative Input (GND for Single Ended Encoders)
INHI_Bx	In	Quadrature B Positive Input
INLO_Zx	In	Index Negative Input (GND for Single Ended Encoders)
INHI_Zx	In	Index Positive Input
VCC1	Out	Fused +5V Source for Encoder Power (F1)
VCC2	Out	Fused +5V Source for Encoder Power (F2)
GND	Out	Ground Reference Connection / +5V Return

Table 6-2: I/O Connector Signal Names, Directions and Descriptions

Figure 6-1: DB78 Connector

Termination Solutions

The breakout solution involves a “Y” cable that terminates into two identically pinned out DB37F connectors. As part of a kit, these connectors plug into the STB-37 screw terminal cards, which easily mount into a length of SNAPTRACK. The “Y” cable is six (6) feet long on each leg.

“1 – 39” (QUAD-4 & 8)			
PIN	**NAME**	**PIN**	**NAME**
1	INLO_A0	20	INHI_A0
2	VCC1	21	INHI_B0
3	INLO_B0	22	GND
4	VCC1	23	INHI_Z0
5	INLO_Z0	24	INLO_Z2
6	NC	25	INHI_A2
7	INLO_A2	26	INHI_B2
8	VCC1	27	GND
9	INLO_B2	28	INHI_Z2
10	VCC1	29	INLO_Z3
11	INLO_A3	30	INHI_A3
12	VCC1	31	INHI_B3
13	INLO_B3	32	GND
14	VCC1	33	INHI_Z3
15	INLO_A1	34	INHI_A1
16	VCC1	35	INHI_B1
17	INLO_B1	36	GND
18	VCC1	37	INHI_Z1
19	INLO_Z1		

“40 – 78” (QUAD-8 only)			
PIN	**NAME**	**PIN**	**NAME**
1	INLO_A4	20	INHI_A4
2	VCC2	21	INHI_B4
3	INLO_B4	22	GND
4	VCC2	23	INHI_Z4
5	INLO_Z4	24	INLO_Z6
6	NC	25	INHI_A6
7	INLO_A6	26	INHI_B6
8	VCC2	27	GND
9	INLO_B6	28	INHI_Z6
10	VCC2	29	INLO_Z7
11	INLO_A7	30	INHI_A7
12	VCC2	31	INHI_B7
13	INLO_B7	32	GND
14	VCC2	33	INHI_Z7
15	INLO_A5	34	INHI_A5
16	VCC2	35	INHI_B5
17	INLO_B5	36	GND
18	VCC2	37	INHI_Z5
19	INLO_Z5		

Table 6-3: DB37F x 2 Pin Assignments

Chapter 7: Specification

Input Section

Receiver Type:	AM26LS32
Configuration:	Phase A, B and Index; differential or S.E. inputs
Counters:	8 or 4
Common mode:	+/-7 V maximum
Differential Inputs:	+/-25 V maximum
Input Sensitivity:	+/- 200 mV
Input Hysteresis:	50 mV typical
Input Impedance:	Internal 12kΩ minimum
Input Bias:	Non-inverting 4.7kΩ to Vcc
	Inverting 4.7kΩ to Vcc / 2.35kΩ to Gnd (1.67V)
Absolute max input:	+/- 25 V differential

Counter Section

Counter type:	LS7766 32-bit Dual Axis Quadrature Counter
Quad (A&B) inputs:	9.6MHz maximum
Separation:	26ns minimum
A&B pulse width:	52ns minimum
Index pulse width:	32ns minimum
Non-Quad (A) input:	40MHz maximum
Low/Hi pulse width:	12ns minimum
B input (direction) :	12ns minimum setup time
	10ns minimum hold time
Index pulse width:	32ns minimum
High Filter Clock:	MCR0 bit 7 low = 33MHz
	MCR0 bit 7 high = 16.5MHz
Low Filter Clock:	MCR0 bit 7 low = 8.25MHz
	MCR0 bit 7 high = 4.125MHz

CPLD Controller Section

Interrupt sources:	LS7766 FLGa / FLGb outputs
FLGa sources:	Index, Carry, Borrow, Compare
FLGb sources:	Sign, Up/Down
I/O Address Space:	8-bytes per Counter
	(64-bytes for 8-Counter board)

Environmental

Operating temperature:	0 to 70˚C standard (-40 to +85˚C optional)
Storage temperature:	-50 to +120˚C
Humidity:	Up to 95 % non-condensing
Size:	4.825” length by 3.875” tall
Power Required:	+5V @ 400mA typical (no sensors connected)
	F1 Resettable 0.5A Fuse, feeds VCC1 signal pins
	F2 Resettable 0.5A Fuse, feeds VCC2 signal pins
Connections:	DB78M connector

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