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IP-DIGITAL48

&

IP-DUALPIT2

User Manual

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IP-DIGITAL48 & IP-DUALPIT2

High-Density Digital I/O

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Table of Contents

1 PRODUCT DESCRIPTION 5
1.1 I/O Circuit 7
2 TECHNICAL SPECIFICATION 8
3 ID ROM CONTENTS 9
4 IP ADDRESSING 10
4.1 I/O Addressing 10
5 INSTALLATION 12
5.1 Jumper Configuration 12
5.1.1 Interrupts 12
5.1.2 Strobe 13
5.1.3 Jumper Options 14
6 PIN ASSIGNMENT – I/O CONNECTOR 17

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TABLE OF FIGURES

FIGURE 1-1 : BLOCK DIAGRAM 6
FIGURE 1-2 : I/O CIRCUITRY 7
FIGURE 2-1 : TECHNICAL SPECIFICATION 8
FIGURE 3-1 : ID ROM CONTENTS 9
FIGURE 4-1 : ADDRESS MAP 10
FIGURE 4-2 : REGISTER MAP 11
FIGURE 5-1 : INTERRUPT PRIORITY 12
FIGURE 5-2 : INTERRUPT ENABLE/DISABLE SHUNT 12
FIGURE 5-3 : STROBE USAGE 13
FIGURE 5-4 : JUMPER POSITIONS FOR PI/T Y 14
FIGURE 5-5 : JUMPER POSITIONS FOR PI/T X 15
FIGURE 5-6 : JUMPER POSITIONS FOR IP-DIGITAL48 16
FIGURE 5-7 : JUMPER POSITIONS FOR IP-DUALPIT2 16
FIGURE 6-1 : PIN ASSIGNMENT I/O CONNECTOR 18

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1 Product Description

IP-DIGITAL48 and IP-DUALPIT2 are two IndustryPack® compatible modules constructed from the same printed circuit board. Each has its own IDROM and factory configuration. However, by changing solder connections, you may convert from one product to the other, or to one of many intermediate configurations.

The IP-DIGITAL48 and the IP-DUALPIT2 are drop-in replacements for the IP-Digital-48 and the IP-Dual-PIT.

The IP-DIGITAL48 and IP-DUALPIT2 emulate two Motorola MC68230 Programmable Interface/Timer (PI/T) ICs (without DMA). Together with the IDROM and additional logic they are integrated in a Xilinx Spartan II FPGA. The FPGA is configured at power up from a serial configuration PROM which is mounted in a socket.

The IP-DUALPIT2 is configured to take advantage of the more sophisticated features of the PI/Ts. Timer, I/O, interrupts, and hardware mediated double-buffered data transfer are supported. 32 general purpose digital I/O lines are available in several programmable modes.

The IP-DIGITAL48 is configured to maximize the number of digital I/O lines. Multiple modes are available via programming.

Users may reconfigure either IndustryPack to implement desired features, while maximizing the number of available I/O lines.

Each MC68230 provides up to three 8-bit I/O ports, one 24-bit timer and five separate interrupt vectors. Ports may be software configured for bit I/O, unidirectional 8-bit and 16-bit I/O, or bi-directional 8-bit and 16-bit I/O. Port modes include single and double buffering, with strobe and handshake options. Due to pin limitations, not all options are available simultaneously.

The IP-DIGITAL48 and IP-DUALPIT2, like all IndustryPacks, use a 50-pin flat ribbon cable connected to the carrier board for I/O. The IP-DUALPIT2 configuration uses 32 lines for bit I/O, 8-bit or 16-bit (unidirectional, bi-directional, single or double buffered) plus eight lines as programmable handshake lines or timer I/O with alternate ground wires.

IP-DIGITAL48 is configured for 48 general purpose lines of bit I/O. These lines may also be used for 8-bit and 16-bit I/O with handshake lines. Timer I/O is also available. In this configuration 48 of the 50 cable lines are I/O, with two ground lines. In this configuration, user provided cabling with additional grounds may be required for high speed operation. Interrupts are unavailable if all 48 lines are used for I/O.

IP-DIGITAL48 and IP-DUALPIT2 connect user I/O lines to the Spartan2 inputs and outputs via 47 ohm serial resistors. They are TTL compatible (output voltage 3.3V, 5V tolerant). Source and sink current is 2mA and leakage current is 10 μA.

Each of the two MC68230s has a 24-bit programmable timer. Timer clock source is a 250 KHz internal clock or a user provided external clock. Using the internal clock, a resolution of 4 μs with a maximum time of 64 seconds is available. The timer may be used as a counter, watchdog, or square wave generator. It may generate single or periodic interrupts. An external gate signal as well as an external timer output is available. In general, it is easier to use the timers starting from an IP-DIGITAL48 configuration than from an IP-DUALPIT2 configuration.

All communication between the IndustryPack and the carrier board is performed byte-wide.

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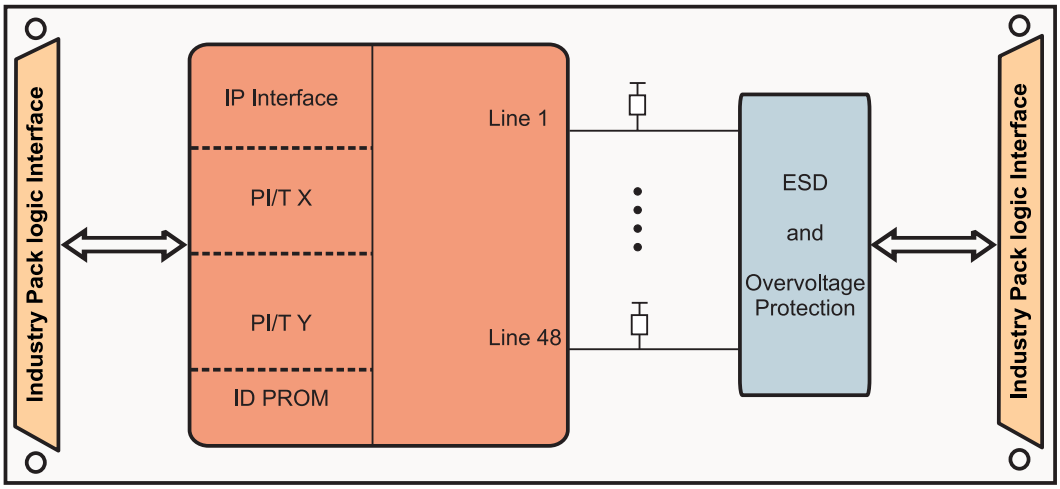


Figure 1-1 : Block Diagram

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1.1 I/O Circuit

The I/O lines are realized with an Input / Output register built in the XILINX FPGA and a few external passive devices.

Please note that the length of flat cables connected to the module should be kept very short to prevent large cross talk.

In the following figure only one I/O line is shown.

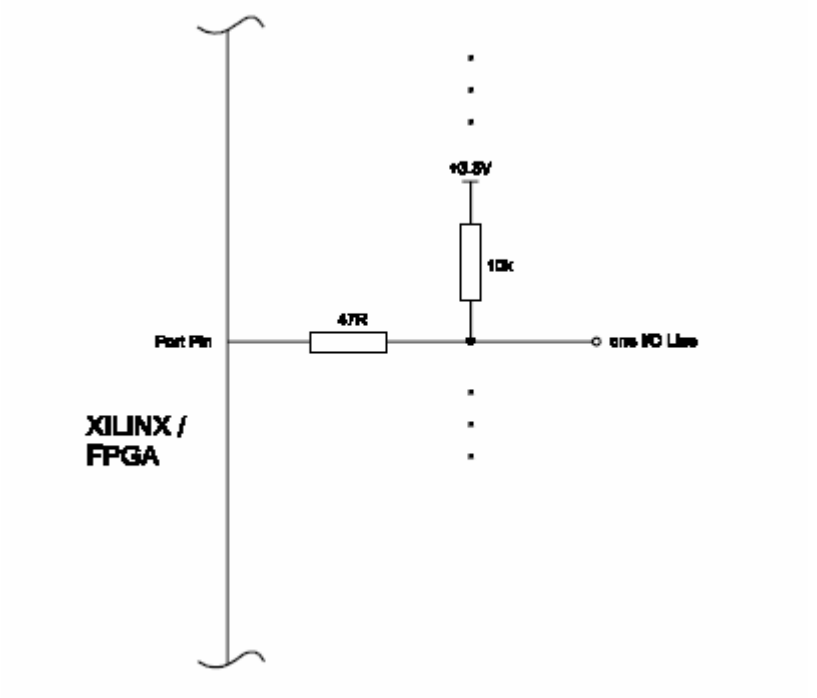


Figure 1-2 : I/O Circuitry

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2 Technical Specification

IP Interface		
Interface	Single Size IndustryPack® Logic Interface compliant to ANSI/VITA 4-1995	
ID ROM Data	Format I	
I/O Space	Used	
Memory Space	Not used	
Interrupts	Int1 / Int2 used	
DMA	Not supported	
Clock Rate	8MHz	
Module Type	Type I	
Wait States	ID reads: 0 wait states I/O reads and writes: 1 wait state Interrupt cycles: 1 wait state	
I/O Interface		
Interface Connector	50-conductor flat cable	
Termination	10kohms resistor as pull up to 3.3V for each I/O line of port A and B, H2, H4, PIRQ#, TIRQ#	
Input Voltage Range	-0.5V to +5.5V	
Output 'High' Voltage	+3.3V	
Output 'Low' Current	-2mA on port A and B, H2, H4 and port C (line 0-2,4,6,7) -8mA on port C (line 3 and 5)	
Output 'High' Current	+2mA on port A and B, H2, H4 and port C (line 0-2,4,6,7) +8mA on port C (line 3 and 5)	
Physical Data		
Power Requirements	100mA typical @ +5V DC, all lines are inputs	
Temperature Range	Operating Storage	-40°C to +85°C -65°C to +150°C
MTBF	854000h	
Humidity	5% – 95 % non-condensing	

Figure 2-1 : Technical Specification

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3 ID ROM Contents

Address	Function	Contents
0x01	ASCII 'I'	0x49
0x03	ASCII 'P'	0x50
0x05	ASCII 'A'	0x41
0x07	ASCII 'C'	0x43
0x09	Manufacturer ID	0xF0
0x0B	Model Number IP-DUALPIT2 Model Number IP-DIGITAL48	0x23 0x24
0x0D	Revision	0xA2
0x0F	Reserved	0x00
0x11	Driver-ID Low - Byte	0x00
0x13	Driver-ID High - Byte	0x00
0x15	Number of bytes used	0x0C
0x17	CRC IP-DUALPIT2 CRC IP-DIGITAL48	0x4D 0x09

Figure 3-1 : ID ROM Contents

The content of the ID ROM can be configured by an additional zero ohm resistor, labeled as R50, between "IP-DIGITAL48" and "IP-DUALPIT2" (see chapter "Jumper Configuration").

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4 IP Addressing

4.1 I/O Addressing

The complete register set of the IP is accessible in the I/O space of the module.

IP-DIGITAL48 and IP-DUALPIT2 are implemented by emulating two Motorola MC68230 chips. These two chips are referenced as X and Y in this manual.

Each 68230 has 23 directly addressable internal registers. IP address lines A1 through A5 are used to select the register. Address line A6 selects either the X or Y 68230. All host accesses to the IP are byte-wide, using the low (D7..D0) byte of the 16-bit data bus. Thus all accesses use an odd address, which is standard for 68000 family peripheral chips. The next figure shows the base address of the X and Y 68230.

Address	68230
base + 0x00	X 68230
base + 0x40	Y 68230

Note: All accesses are byte wide, using odd address.

Figure 4-1 : Address Map

Complete register addresses consist of the sum of the carrier board's base address, any offset due to the module location on the carrier board, the X or Y offset, and the register address. Register addresses are shown in the following figure. More information on programming the 68230 is given in the MC68230 Parallel Interface / Timer Data Sheet from Motorola.

Address	68230	Register (byte access)
0x01	X	Port General Control Register
0x03	X	Port Service Request Register
0x05	X	Port A Data Direction Register
0x07	X	Port B Data Direction Register
0x09	X	Port C Data Direction Register
0x0B	X	Port Interrupt Vector Register
0x0D	X	Port A Control Register
0x0F	X	Port B Control Register
0x11	X	Port A Data Register
0x13	X	Port B Data Register
0x15	X	Port A Alternate Register
0x17	X	Port B Alternate Register
0x19	X	Port C Data Register
0x1B	X	Port Status Register
0x21	X	Timer Control Register
0x23	X	Timer Interrupt Vector Register
0x27	X	Counter Preload Register (High)
0x29	X	Counter Preload Register (Med)
0x2B	X	Counter Preload Register (Low)

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Address	68230	Register (byte access)
0x2F	X	Count Register (High)
0x31	X	Count Register (Med)
0x33	X	Count Register (Low)
0x35	X	Timer Status Register
0x41	Y	Port General Control Register
0x43	Y	Port Service Request Register
0x45	Y	Port A Data Direction Register
0x47	Y	Port B Data Direction Register
0x49	Y	Port C Data Direction Register
0x4B	Y	Port Interrupt Vector Register
0x4D	Y	Port A Control Register
0x4F	Y	Port B Control Register
0x51	Y	Port A Data Register
0x53	Y	Port B Data Register
0x55	Y	Port A Alternate Register
0x57	Y	Port B Alternate Register
0x59	Y	Port C Data Register
0x5B	Y	Port Status Register
0x61	Y	Timer Control Register
0x63	Y	Timer Interrupt Vector Register
0x67	Y	Counter Preload Register (High)
0x69	Y	Counter Preload Register (Med)
0x6B	Y	Counter Preload Register (Low)
0x6F	Y	Count Register (High)
0x71	Y	Count Register (Med)
0x73	Y	Count Register (Low)
0x75	Y	Timer Status Register

Figure 4-2 : Register Map

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5 Installation

5.1 Jumper Configuration

Four shunts and 16 solder connections are used to set certain non-programmable configuration options. These options are discussed in this section.

Shunts are labeled E1 through E4 on the board and zero ohm resistors are labeled E5 through E12 and E13 through E20.

For removing zero ohm resistors, work on a grounded, static free work surface.

5.1.1 Interrupts

Each IndustryPack can generate up to two interrupt requests: IRQ0 and IRQ1. The carrier board maps these IP interrupt requests into the available interrupt levels on the host bus. See your carrier board user manual for more information.

The X 68230 uses the IRQ0 line. The Y 68230 uses the IRQ1 line. Two shunts are used to assist in interrupt configuration. The interrupt vector and most interrupt options are programmed in the 68230s.

In each 68230, the data transfer section (the "interface" portion) is distinct from the timer section. Shunt E1 determines which of these two sections has priority if both are requesting service. Note that the two sections typically have distinct vectors, but share an interrupt level. See figure below.

Timer highest priority	E1 IN	**Default**
Interface highest priority	E1 OUT	

Figure 5-1 : Interrupt Priority

Interrupts may be disabled entirely by removing shunt E2. See figure below.

Interrupts Disabled	E2 OUT	
Interrupts Enabled	E2 IN	**Default**

Figure 5-2 : Interrupt Enable/Disable Shunt

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5.1.2 Strobe

The IndustryPack logic specification defines a pin on the interface called Strobe (pin 46). The strobe line is used to input or output special clocks. Some carrier boards provide for shunt or programmable strobe functions.

The IP-DIGITAL48 and IP-DUALPIT2 may use the strobe as clock input or output. The timer in the X 68230 is used for strobe functions. See figure below for configuration options. TIN is Timer IN. TOUT is Timer OUT. See jumper options, later in this section for E19 and E20 usage.

Shunts	Function	Default
E3-1 to E3-2	X–PC3/TOUT to E19	Default
E3-2 to E3-3	Strobe to X–TOUT	
E4-1 to E4-2	X–PC2/TIN to E20	Default
E4-2 to E4-3	Strobe to X–TIN	

Figure 5-3 : Strobe Usage

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5.1.3 Jumper Options

The shunts E5 to E20 of the IP-DIGITAL48 / IP-DUALPIT2 are zero ohm resistors which can be assembled in two positions. The pads of the zero ohm resistors allow making a direct solder connection between the pads at one of the two positions, after removing the zero ohm resistors. Note that the IP-DUALPIT2 connects position 1 for all solder bridges and the IP-DIGITAL48 connects position 2.

The content of the ID ROM can be configured by an additional zero ohm resistor, labeled as R50, between "IP-DIGITAL48" and "IP-DUALPIT2".

Jumper Position	I/O Connection	68230	Default
E5 – 1	Pin 49 to Y–H4	Y	IP-DUALPIT2
E5 – 2	Pin 49 to Y-PC7	Y	IP-DIGITAL48
E6 – 1	Pin 47 to Y–H3	Y	IP-DUALPIT2
E6 – 2	Pin 47 to Y–PC6	Y	IP-DIGITAL48
E7 – 1	Pin 45 to Y–H2	Y	IP-DUALPIT2
E7 – 2	Pin 45 to Y-PC5	Y	IP-DIGITAL48
E8 – 1	Pin 43 to Y–H1	Y	IP-DUALPIT2
E8 – 2	Pin 43 to Y–PC4	Y	IP-DIGITAL48
E9 – 1	Pin 48 to GND	Y	IP-DUALPIT2
E9 – 2	Pin 48 to Y–PC3/TOUT	Y	IP-DIGITAL48
E10 – 1	Pin 46 to GND	Y	IP-DUALPIT2
E10 – 2	Pin 46 to Y–PC2/TIN	Y	IP-DIGITAL48
E11 – 1	Pin 44 to GND	Y	IP-DUALPIT2
E11 – 2	Pin 44 to Y-PC1	Y	IP-DIGITAL48
E12 – 1	Pin 42 to GND	Y	IP-DUALPIT2
E12 – 2	Pin 42 to Y–PC0	Y	IP-DIGITAL48

Figure 5-4 : Jumper positions for PI/T Y

Caution: Never make simultaneous connections on position 1 and 2 of one jumper. Serious damage of the module is possible.

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Jumper Position	I/O Connection	68230	Default
E13-1	Pin 24 to X–H4	X	IP-DUALPIT2
E13-2	Pin 24 to X-PC7	X	IP-DIGITAL48
E14-1	Pin 22 to X–H3	X	IP-DUALPIT2
E14-2	Pin 22 to X–PC6	X	IP-DIGITAL48
E15-1	Pin 20 to X–H2	X	IP-DUALPIT2
E15-2	Pin 20 to X-PC5	X	IP-DIGITAL48
E16-1	Pin 18 to X–H1	X	IP-DUALPIT2
E16-2	Pin 18 to X–PC4	X	IP-DIGITAL48
E17-1	Pin 19 to GND	X	IP-DUALPIT2
E17-2	Pin 19 to X–PC1	X	IP-DIGITAL48
E18-1	Pin 17 to GND	X	IP-DUALPIT2
E18-2	Pin 17 to X–PC0	X	IP-DIGITAL48
E19-1	Pin 23 to GND	X	IP-DUALPIT2
E19-2	Pin 23 to E3	X	IP-DIGITAL48
E20-1	Pin 21 to GND	X	IP-DUALPIT2
E20-2	Pin 21 to E4	X	IP-DIGITAL48

Figure 5-5 : Jumper positions for PI/T X

Caution: Never make simultaneous connections on position 1 and 2 of one jumper. Serious damage of the module is possible.

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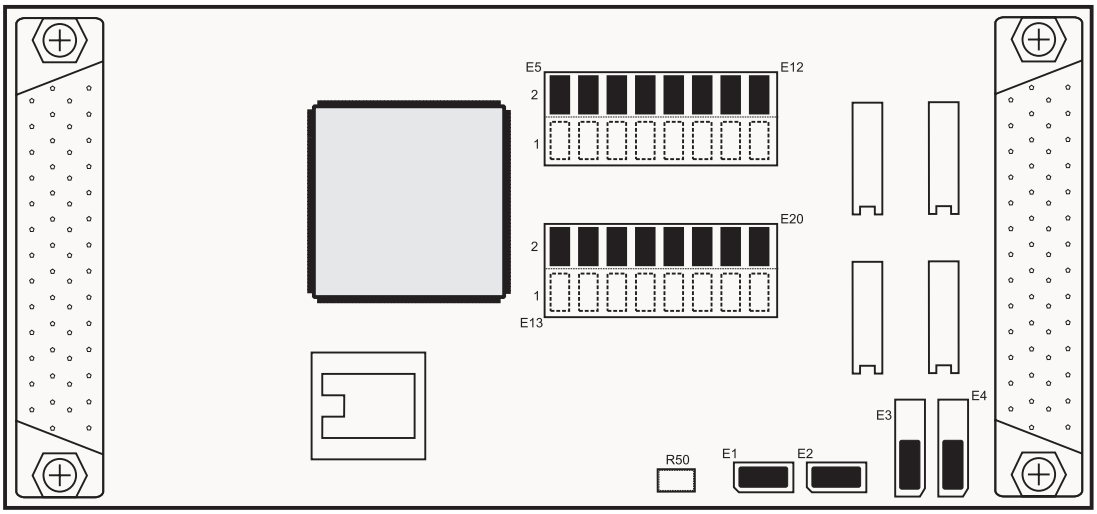


Figure 5-6 : Jumper positions for IP-DIGITAL48

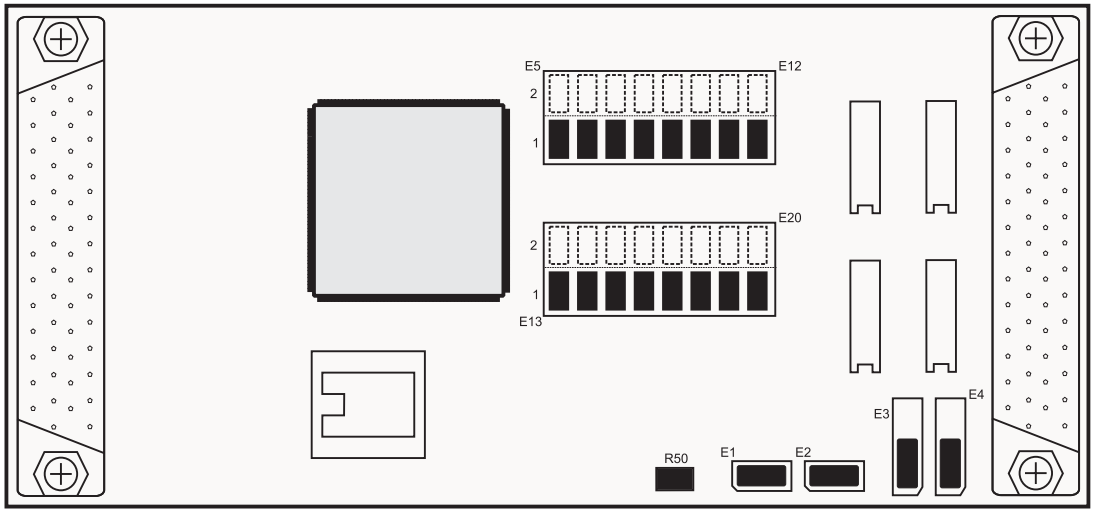


Figure 5-7 : Jumper positions for IP-DUALPIT2

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6 Pin Assignment – I/O Connector

This section gives the pin assignments for the 50 user I/O lines.

The pin numbers shown in the next figure correspond to numbers on the 50-pin IndustryPack I/O connector, to the wires of a 50-conductor flat cable plugged into a standard IP carrier board, and to the screw terminal numbers on the IP terminal block.

Note that the X and Y 68230s are wired nearly symmetrically. That is, the X PI/T uses the first 25 lines of the I/O cable, and the Y PI/T uses the last 25 lines. Within each group of 25 lines the pin usage is almost the same (factory default). The X PI/T has some shunt options involving its timer. See the jumper options section for more details.

Note that special customer configurations may change this default wiring symmetry.

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Pin Number	X or Y 68230	Signal Name IP-DUALPIT2	Signal Name IP-DIGITAL48
1	X	PA0	PA0
2	X	PA1	PA1
3	X	PA2	PA2
4	X	PA3	PA3
5	X	PA4	PA4
6	X	PA5	PA5
7	X	PA6	PA6
8	X	PA7	PA7
9	X	PB0	PB0
10	X	PB1	PB1
11	X	PB2	PB2
12	X	PB3	PB3
13	X	PB4	PB4
14	X	PB5	PB5
15	X	PB6	PB6
16	X	PB7	PB7
17	X	GND	PC0
18	X	H1	PC4
19	X	GND	PC1
20	X	H2	PC5
21	X	GND	PC2/TIN
22	X	H3	PC6
23	X	GND	PC3/TOUT
24	X	H4	PC7
25		GND	GND
26	Y	PA0	PA0
27	Y	PA1	PA1
28	Y	PA2	PA2
29	Y	PA3	PA3
30	Y	PA4	PA4
31	Y	PA5	PA5
32	Y	PA6	PA6
33	Y	PA7	PA7
34	Y	PB0	PB0
35	Y	PB1	PB1
36	Y	PB2	PB2
37	Y	PB3	PB3
38	Y	PB4	PB4
39	Y	PB5	PB5
40	Y	PB6	PB6
41	Y	PB7	PB7
42	Y	GND	PC0
43	Y	H1	PC4
44	Y	GND	PC1
45	Y	H2	PC5
46	Y	GND	PC2/TIN
47	Y	H3	PC6
48	Y	GND	PC3/TOUT
49	Y	H4	PC7
50		GND	GND

Figure 6-1 : Pin Assignment I/O Connector

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