Douloi Motion Server Signals and Connectors

Description

Cabling to Motion Server is performed through flat ribbon cables terminated with IDC connectors.

Axis Group Connectors

There are (4) 60 pin connectors for axis information called "Axis Group" connectors. Each 60 pin ribbon cable supports (4) axis of signals. The 60 pin ribbon cable can be split apart into (4) identical 15 pin axis sub-cables. The signals have been chosen in a very regular pattern so that all of the 15 pin sub-cables are identical in layout.

I/O Connector

There is (1) 50 pin connector containing 48 bits of configurable I/O. Signals are configured as input or output in 4 bit groups.

E-Stop Connector

There is (1) 6 pin header used to configure E-Stop with a jumper or to cable to EStop. The jumper can be used to disable E-Stop, connect I/O signal 1 to be E-Stop, or can serve as a cable connector for an external E-Stop cable assembly.

External Bus Connector

There is (1) 26 pin connector which supports an external 8 bit bus allowing Motion Server to control additional hardware elements.

Douloi Automation, Inc. 740 Camden Avenue Suite B, Campbell, CA 95008 (408) 374-6322 Fax (408) 374-6355

Axis Signal Descriptions

Encoder A+, A-, B+, B-, I+, I-

Functional Description

Encoder signals provide position feedback from a rotary or linear encoder. In general these signals are provided in a "quadrature" format indicating both position and direction change. Encoders are necessary for servo motors and optional for stepper motors. Differential signals are desirable demonstrating improved noise immunity, however single-ended encoders may also be used. When using a single ended encoders connect the signals to the "+" inputs. The "-" inputs have a "pull-center" resistors connecting the "-" inputs to the differential receivers to a 2 volt reference. This provides a default "-" signal level in the absence of the actual signal. In certain rare cases it may be necessary to change this default reference value. This can be done by removing or switching an resistor network which is socketed on the board. Consult Douloi Automation before attempting any change.

The "I" signal is the index pulse for an optical encoder. This signal can be used for higher speed, more repeatable homing, or for encoder-drift detection.

Electrical Description

Encoder signals go into a 3486-style differential receiver. The receivers are rated for a maximum differential mode voltage of +/- 25 volts and common mode voltage of +/- 15 volts. In most cases the encoder signals are 5 volt signals.

Amp Enable High, Amp Enable Low

Functional Description

The amplifier enable signal is a digital output which allows the motor amplifier to apply power. If the amplifier is not enabled, the amplifier will not produce motor current regardless of the level of the motor command voltage. Different amplifiers have different conventions for what "enable" means. Some apply power if the signal is a high logic level. Some apply power on a low logic level. To accommodate these differences both a high and a low level signal are provided. Review amplifier documentation to learn which level is required. Douloi Automation recommends setting the amplifier (if the option is available) to be inactive until a deliberate amp enable signal is provided by the controller. Providing both a high and low level signal places the decision of amplifier enable sense into the machine wiring harness, not an on-controller jumper which could be misconfigured.

Electrical Description

The amplifier enable signals are driven by a 74LS07 with open collector outputs.

Position Capture

Functional Description

The Position Capture input can be used for high-speed registration applications. The position of the encoder is recorded in hardware in response to a position capture signal. Most often the signal is used as a homing input. Even without an encoder, the level of the signal can be monitored in software with the CaptureBit command.

Electrical Description

The Position Capture signal is the "+" side of a 3486 differential receiver. The "-" side of the receiver goes to a 2 volt reference. Standard TTL level can be used and voltage up to 24 volts maximum can be tolerated. There is no on-board pullup resistor for this input. If the sensor being used is an open-collector style drive, a 4.7k pullup resistor to +5 volts (available on the axis connector) should be used.

Position Compare

Functional Description

Position Compare is an output signal that is set when the encoder hardware detects a specific encoder position. The output can also be used as a general purpose output.

Electrical Description

Position Compare is a TTL level output with a 12 ma sink and approximately no source capability. This signal is the most "exposed" signal on the axis connector set coming directly from a FPGA device on the board with no additional buffering or protection.

Motor Command

Functional Description

The Motor Command signal is a +/- 10 volt signal most often used to specify requested current from a servo motor amplifier. The signal can also represent requested voltage or velocity depending on the amplifier mode selected. In most cases torque mode is most suitable

Electrical Description

The Motor Command signal is +/- 10 volts with 3 ma drive. Many amplifiers have differential receivers. In this case, use the motor command signal on the "+" side of the receiver and ground (from the axis cable set) on the negative side. Providing Motor Command and ground in a twisted pair can improve noise immunity.

Step Pulse, Direction

Functional Description

Step Pulse and Direction signals are used for controlling stepper motors. Standard firmware supports narrow (1 microsecond) step pulses. Alternate firmware for 4-axis controllers is available for supporting wide step pulses (30 microseconds) if the stepper driver is unable to respond to narrow pulses.

Electrical Description

Step Pulse and Direction signals are open collector outputs driven by a 74LS07.

+5 Volts, Ground

Description

+5 Volts and Ground are available for providing encoder power, sensor power, and pull-up references. These signals come directly from the PC's power supply.

Pin Numbering Conventions

There are two different connector styles most often used with the Motion Server Controller. The first is "2-row IDC" style connectors, which are the style commonly used with computer disk-drive cabling etc. In this convention, the pin number corresponds to the wire number, counting sequentially from the end of the wire. This produces a "back and forth" counting pattern on the IDC connector.

The other connector often used is a D subminiature style. This connector has a pin definition which can often be read on the connector itself. Small, inscribed numbers next to the pins indicate that the pin numbering is sequential along the length of the connector, and then resumes at the beginning of the next row. This is quite different from the "back and forth" convention of the 2 row IDC connector. It is most convenient to use D connectors by "splitting apart" the 60 pin IDC cable and then crimping IDC style D connectors. NOTE THAT THE PIN NUMBERING CONVENTION FOR D-CONNECTORS ATTACHED TO THE RIBBON CABLE IS DIFFERENT THAN THE IDC 2-ROW CONVENTION FOR THE CABLE ITSELF. Please refer to the proper table when preparing to wire to the controller.

Axis Group Connector Definitions, 2-Row IDC

The following Table defines the connectors for the axis groups. These connectors are designated "Axis 1-4", "Axis 5-8", "Axis 9-12", and "Axis 13-16" on the printed circuit board silk screen. The signal definitions is a regular pattern both along the connector, and from one connector to the next. For example, Pin 3 is always an Encoder B+ signal with the axis defined by which connector the pin is on. Each pin in any particular connector has 3 other counterparts spaced a multiple of 15 away. For example, pin 18 (pin 3 + 15) is also an Encoder B+ signal as well as pin 33 (pin 3 +30) and pin 48 (pin 3 + 45)

Pin Number	Description	Axis 1-4	Axis 5-8	Axis 9-12	Axis 13-16
1	Encoder A+	Axis 1	Axis 5	Axis 9	Axis 13
2	Encoder A-	Axis 1	Axis 5	Axis 9	Axis 13
3	Encoder B+	Axis 1	Axis 5	Axis 9	Axis 13
4	Encoder B-	Axis 1	Axis 5	Axis 9	Axis 13
5	Encoder I+	Axis 1	Axis 5	Axis 9	Axis 13
6	Encoder I-	Axis 1	Axis 5	Axis 9	Axis 13
7	Amp Enable High	Axis 1	Axis 5	Axis 9	Axis 13
8	Amp Enable Low	Axis 1	Axis 5	Axis 9	Axis 13
9	Position Capture	Axis 1	Axis 5	Axis 9	Axis 13
10	Position Compare	Axis 1	Axis 5	Axis 9	Axis 13
11	Motor Command	Axis 1	Axis 5	Axis 9	Axis 13
12	Step Pulse	Axis 1	Axis 5	Axis 9	Axis 13
13	Direction	Axis 1	Axis 5	Axis 9	Axis 13
14	+5 Volts	Axis 1	Axis 5	Axis 9	Axis 13
15	Ground	Axis 1	Axis 5	Axis 9	Axis 13
16	Encoder A+	Axis 2	Axis 6	Axis 10	Axis 14
17	Encoder A-	Axis 2	Axis 6	Axis 10	Axis 14
18	Encoder B+	Axis 2	Axis 6	Axis 10	Axis 14
19	Encoder B-	Axis 2	Axis 6	Axis 10	Axis 14
20	Encoder I+	Axis 2	Axis 6	Axis 10	Axis 14
21	Encoder I-	Axis 2	Axis 6	Axis 10	Axis 14
22	Amp Enable High	Axis 2	Axis 6	Axis 10	Axis 14
23	Amp Enable Low	Axis 2	Axis 6	Axis 10	Axis 14
24	Position Capture	Axis 2	Axis 6	Axis 10	Axis 14
25	Position Compare	Axis 2	Axis 6	Axis 10	Axis 14
26	Motor Command	Axis 2	Axis 6	Axis 10	Axis 14
27	Step Pulse	Axis 2	Axis 6	Axis 10	Axis 14
28	Direction	Axis 2	Axis 6	Axis 10	Axis 14
29	+5 Volts	Axis 2	Axis 6	Axis 10	Axis 14
30	Ground	Axis 2	Axis 6	Axis 10	Axis 14

Pin Number	Description	Axis 1-4	Axis 5-8	Axis 9-12	Axis 13-16
31	Encoder A+	Axis 3	Axis 7	Axis 11	Axis 15
32	Encoder A-	Axis 3	Axis 7	Axis 1	Axis 15
33	Encoder B+	Axis 3	Axis 7	Axis 11	Axis 15
34	Encoder B-	Axis 3	Axis 7	Axis 11	Axis 15
35	Encoder I+	Axis 3	Axis 7	Axis 11	Axis 15
36	Encoder I-	Axis 3	Axis 7	Axis 11	Axis 15
37	Amp Enable High	Axis 3	Axis 7	Axis 11	Axis 15
38	Amp Enable Low	Axis 3	Axis 7	Axis 11	Axis 15
39	Position Capture	Axis 3	Axis 7	Axis 11	Axis 15
40	Position Compare	Axis 3	Axis 7	Axis 11	Axis 15
41	Motor Command	Axis 3	Axis 7	Axis 11	Axis 15
42	Step Pulse	Axis 3	Axis 7	Axis 11	Axis 15
43	Direction	Axis 3	Axis 7	Axis 11	Axis 15
44	+5 Volts	Axis 3	Axis 7	Axis 11	Axis 15
45	Ground	Axis 3	Axis 7	Axis 11	Axis 15
46	Encoder A+	Axis 4	Axis 8	Axis 12	Axis 16
47	Encoder A-	Axis 4	Axis 8	Axis 12	Axis 16
48	Encoder B+	Axis 4	Axis 8	Axis 12	Axis 16
49	Encoder B-	Axis 4	Axis 8	Axis 12	Axis 16
50	Encoder I+	Axis 4	Axis 8	Axis 12	Axis 16
51	Encoder I-	Axis 4	Axis 8	Axis 12	Axis 16
52	Amp Enable High	Axis 4	Axis 8	Axis 12	Axis 16
53	Amp Enable Low	Axis 4	Axis 8	Axis 12	Axis 16
54	Position Capture	Axis 4	Axis 8	Axis 12	Axis 16
55	Position Compare	Axis 4	Axis 8	Axis 12	Axis 16
56	Motor Command	Axis 4	Axis 8	Axis 12	Axis 16
57	Step Pulse	Axis 4	Axis 8	Axis 12	Axis 16
58	Direction	Axis 4	Axis 8	Axis 12	Axis 16
59	+5 Volts	Axis 4	Axis 8	Axis 12	Axis 16
60	Ground	Axis 4	Axis 8	Axis 12	Axis 16

Axis Group Connector Definitions, D-Style

If the 60 pin axis cable is split into (4) 15 pin groups, it is possible to attach 15 pin IDC style connectors for a simple cable assembly. However the D connector pin numbering convention does not correspond to the wire number sequentially across. When using IDC D connectors please refer to the following table:

D Pin Number	Description
1	Encoder A+
2	Encoder B+
3	Encoder I+
4	Amp Enable High
5	Position Capture
6	Motor Command
7	Direction
8	Ground
9	Encoder A-
10	Encoder B-
11	Encoder I-
12	Amp Enable Low
13	Position Compare
14	Step Pulse
15	+5 Volts

I/O Connector Definition

The 50 pin connector provides TTL level inputs and outputs. Outputs sink 12 ma. The pin number is the I/O number with the exception of 49 (+5) and 50 (ground). Input or output sense is configured in 4 bit groups. The groups are defined by "splitting" the connector into (2) 1x50 strips, and then slicing those strips into (12) groups of (4) bits each. This partitioning was chosen so that the even-pin strip could be configured as inputs allowing a standard OPTO-22 cable to plug into the connector without contention between the cable grounds (located on all the even pins) and signals normally available on those pins.

	Description	Pin	Pin	Description	
Group 1	I/O 1	1	2	I/O 2	Group 2
Group 1	I/O 3	3	4	I/O 4	Group 2
Group 1	I/O 5	5	6	I/O 6	Group 2
Group 1	I/O 7	7	8	I/O 8	Group 2
Group 3	I/O 9	9	10	I/O 10	Group 4
Group 3	I/O 11	11	12	I/O 12	Group 4
Group 3	I/O 13	13	14	I/O 14	Group 4
Group 3	I/O 15	15	16	I/O 16	Group 4
Group 5	I/O 17	17	18	I/O 18	Group 6
Group 5	I/O 19	19	20	I/O 20	Group 6
Group 5	I/O 21	21	22	I/O 22	Group 6
Group 5	I/O 23	23	24	I/O 24	Group 6
Group 7	I/O 25	25	26	I/O 26	Group 8
Group 7	I/O 27	27	28	I/O 28	Group 8
Group 7	I/O 29	29	30	I/O 30	Group 8
Group 7	I/O 31	31	32	I/O 32	Group 8
Group 9	I/O 33	33	34	I/O 34	Group 10
Group 9	I/O 35	35	36	I/O 36	Group 10
Group 9	I/O 37	37	38	I/O 38	Group 10
Group 9	I/O 39	39	40	I/O 40	Group 10
Group 11	I/O 41	41	42	I/O 42	Group 12
Group 11	I/O 43	42	44	I/O 44	Group 12
Group 11	I/O 45	45	46	I/O 46	Group 12
Group 11	I/O 47	47	48	I/O 48	Group 12
	+5 Volts	49	50	Ground	

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E-Stop Connector Definition

The EStop connector has 6 pins defined as follows

pin 1	Not Connected (pin 1 is closest to the mounting bracket, rear of PC)
pin 2	Ground
pin 3	E-Stop input
pin 4	I/O 1 from 50 pin connector
pin 5	12 Volt Input for Unlocking Flash Memory
pin 6	12 Volt Source from PC

Placing a jumper between pins 2 and 3 enables the E-Stop (which must be maintained at ground against its 4.7k pullup). This is not recommended if doing anything besides bench testing free spinning motors.

Placing the jumper between pins 3 and 4 redirects the EStop to be from the general I/O connector where an OPTO-22 module rack may be hooked in, or some other IO interconnect that has been chosen for general purpose I/O

A third option is to put a 6 x 1 plug into this header with a cable for pins 2 and 3. A normally closed switch would serve as an E-Stop switch. If the switch disconnected, or the cable was missing, the controller will not enable power to the amplifiers.

The on-board Flash memory chip is used to store application programs. If the board contains a 28F class Flash Memory chip, a 12 volt level must be supplied to the chip to "unlock" the chip and permit alteration of its contents. This level can be provided by turning on switch number 4 on the board itself. In some applications, accessing switch 4 may be inconvenient. In this case, an external switch can be provided that connects pin 5 and pin 6 allowing the memory device to be programmed. Alternately, consult with Douloi Automation regarding a newer 29F class memory chip which does not require the 12 volt level.

External Bus Connector

The remaining 26 pin connector provides a simplified 8-bit bus that can be used to connect to additional hardware. Note that Douloi provides a PC/104 "bridge" accessory that is driven by this connector. The PC/104 format allows the use of many third part cards

Power signals from this connector should only be for signal-level power. If you need any significant current, use a disk-drive connector. Additional details about the use of this bus are available from Douloi Automation on request.

Pin	Description
1	Data 0
2	Data 1
3	Data 2
4	Data 3
5	Data 4
6	Data 5
7	Data 6
8	Data 7
9	Addr 0
10	Addr 1
11	Addr 2
12	Addr 3
13	Addr 4
14	Addr 5
15	Addr 6
16	Select
17	Write/Read
18	Comm_Capture_1
19	Comm_Capture_2
20	Comm_Capture_3
21	Comm_Capture_4
22	Reset
23	+12 Volts
24	-12 Volts
25	+5 Volts
26	Ground