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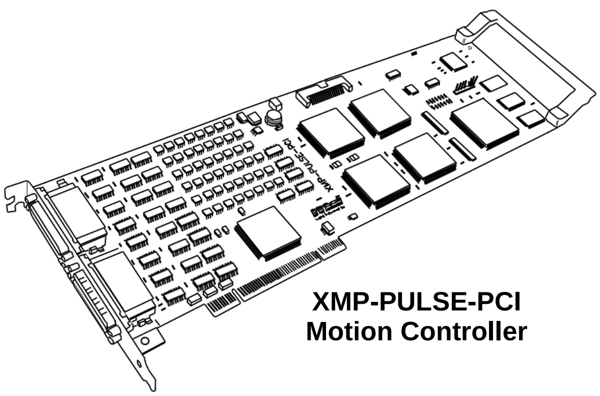
APPLICATION NOTE 218, REV. A

(DCO 1295)

XMP-PULSE-PCI Installation Instructions

Description

This application note provides helpful installation information for XMP-PULSE-PCI motion controllers made by MEI. Similar information may also be found in the *XMP Hardware Installation Manual* and related application notes. A view of the PCI form factor used with this controller is shown below.



Introduction

The XMP-PULSE-PCI motion controller is designed as a cost-effective XMP-series motion controller for pulse (step/direction) control drives having up to 32 axes. Compared with other XMP-series motion controllers made by Motion Engineering, Inc., the XMP-PULSE-PCI behaves similarly via its MPI-MEI software interface; however, its hardware design is specifically suited for pulse (step/direction) hardware only. This application note provides information for those needing to install and run the controllers.

Document Revision History: Application Note 218			
Rev.	Date	Description	DCR No.
A	25JUN2001	Restricted release.	527

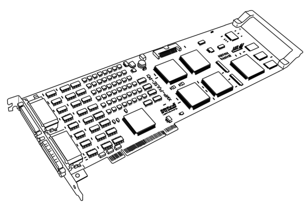
Hardware Requirements and Ratings

Environmental Requirements

Description	***Operating Range***
Temperature	0-50 Deg. C
Humidity	20-80% RH (no condensation)

Power Requirements

Power requirements for the XMP-PULSE-PCI are shown in the chart below.

Controller	***Voltage***[a]	***Current (Typ. amps)***	***Current (Max. amps)***
XMP-PULSE-PCI 	+5 VDC ± 5%	1.50 (main) 1.50 (expansion)	4.00 (main) 4.00 (expansion)

a. Controller voltage required at computer or card cage.

Encoder Power

The XMP-PULSE-PCI may not be used to power encoders. Encoders must be powered externally from separate supplies.

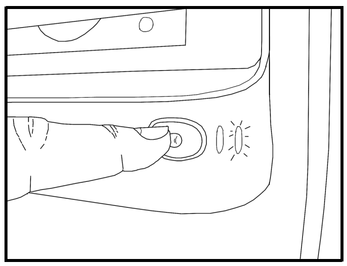
Installing the XMP-PULSE-PCI Controller

During installation, good electrical contact must be ensured at connectors; otherwise, noise and power problems will develop. (Connections should be verified through inspection and testing.)

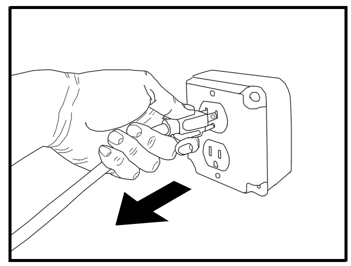
Standard safety rules prevail during installation of any hardware. Some are summarized below for the XMP. For more information, refer to local occupational safety regulations and the manufacturer of your motion drive.

Turn Off All Power Before Installing Equipment

Before installing any motion control equipment, including XMP controllers, power should be switched OFF. Unplug all power plugs from their sources of power.



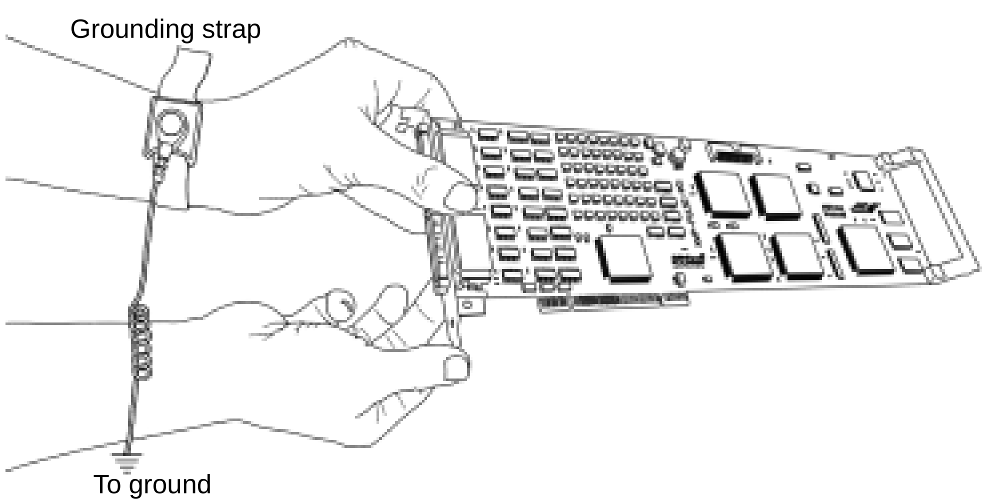
Switch OFF equipment.



Unplug from source of power.

Observe ESD Precautions

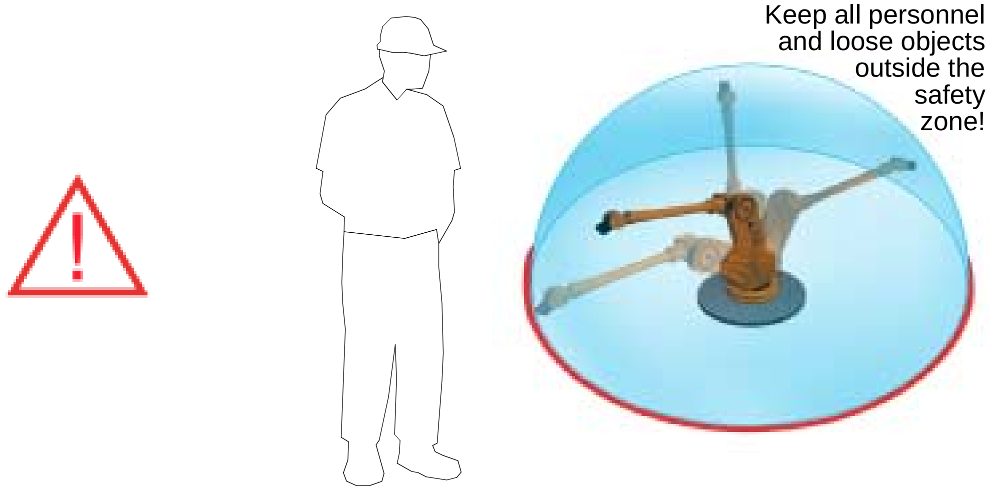
To prevent damage to controller and drive electronics due to electrostatic discharge (ESD), service personnel are cautioned to observe proper grounding during handling of components.



Grounding straps should be worn at all times when handling XMP controller boards and connection hardware.

Define and Clear a Safety Zone!

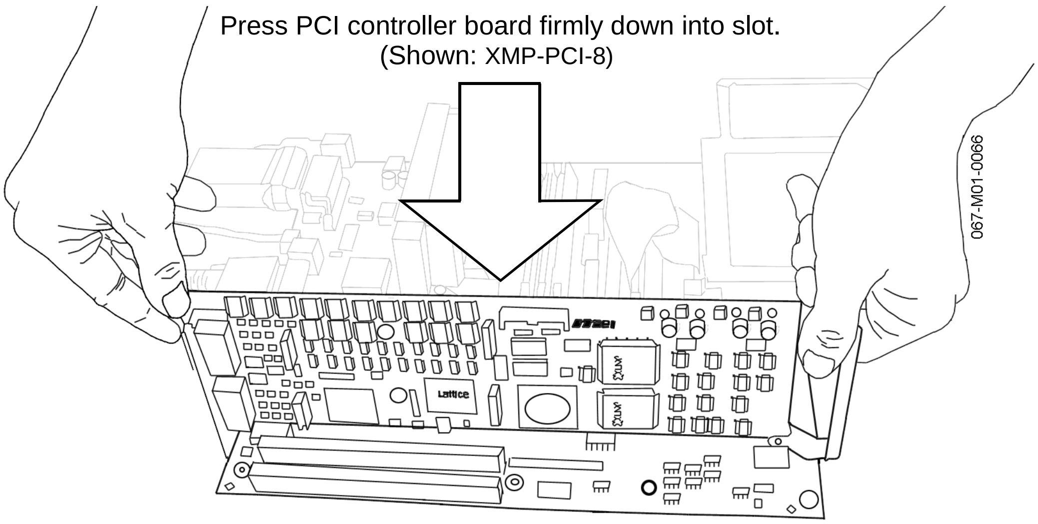
During installation and testing of motion control hardware-software, a safety zone should be defined around moving components and kept clear of personnel, hands, fingers and loose hardware. During repowering of the system, motion control components may behave erratically due to misconnected lines, or wrongly configured software settings. Sudden and unexpected moves by components can cause injury, property damage or even death! Under NO circumstances, should a motion system be tested or operated while personnel are within the safety zone. Additionally, beware of flying debris from unsecured hardware operating at high speeds. The use of safety shielding is highly recommended.



Install Controller

The XMP-PULSE-PCI controller is keyed to fit 3.3 / 5 volt PCI industry buses. When installing and removing controllers, verify that good electrical contact is made between the controller and receptacle.

The XMP-PULSE-PCI controller is installed into the PCI bus of the host computer's mother board in the same manner as all PCI boards. During installation, verify the controller is seated firmly in its assigned PCI slot by pressing firmly downward. The I/O bracket should be screwed securely to the expansion bay chassis.



XMP-PULSE-PCI Bus Connections

XMP-PULSE-PCI Bus Pin-outs

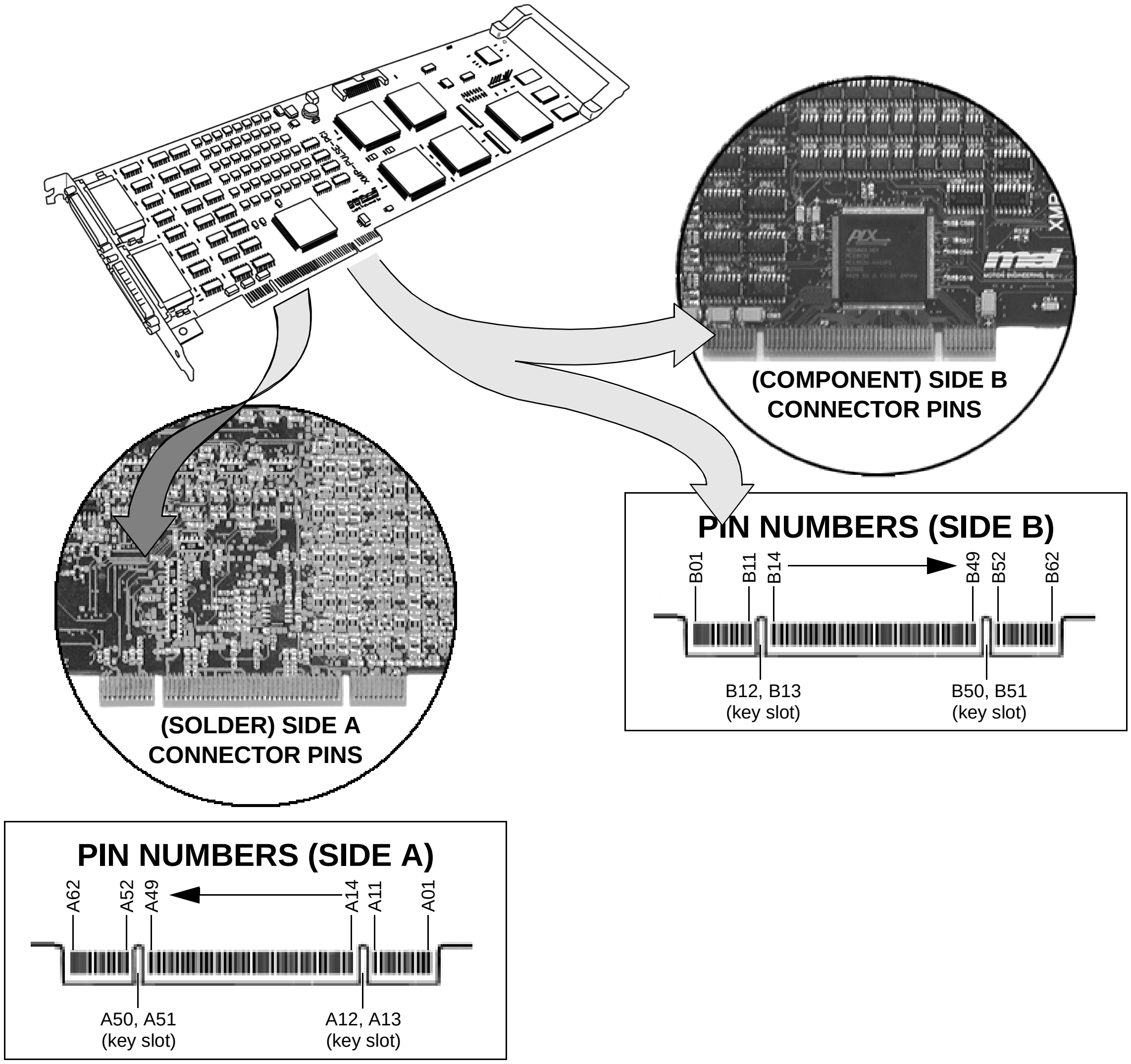


Table 1: XMP-PULSE-PCI Bus Connector Pin-outs

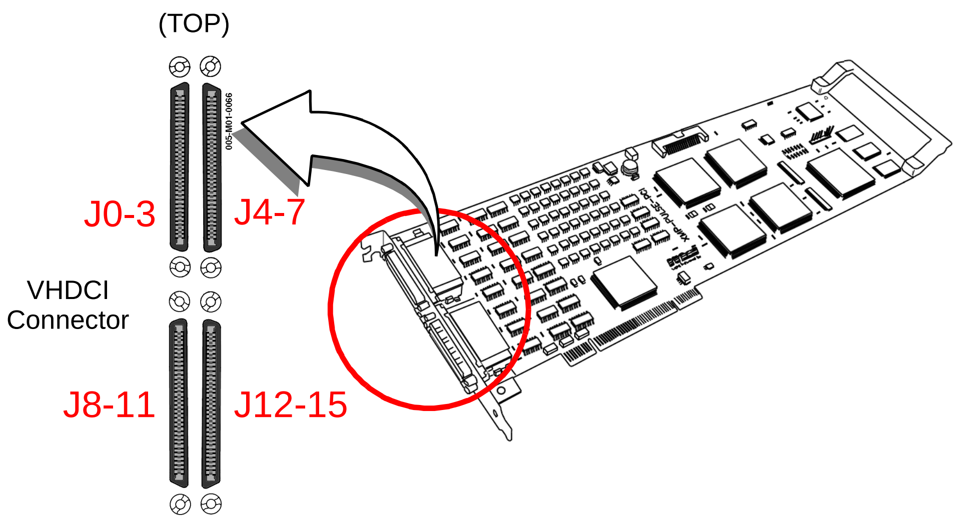
Bus Connector			
Side B		Side A	
Pin	Function	Pin	Function
01B	-12V	01A	TRST#
02B	TCK	02A	+12V
03B	GND	03A	TMS
04B	TDO	04A	TDI
05B	+5V	05A	+5V
06B	+5V	06A	INTA#
07B	INTB#	07A	INTC#
08B	INTD#	08A	+5V
09B	PRSNT1#	09A	Reserved
10B	Reserved	10A	+VI/O
11B	PRSNT2#	11A	Reserved
12B	3.3V KEY SLOT	12A	3.3V KEY SLOT
13B		13A	
14B	Reserved	14A	3.3V Aux
15B	Ground	15A	RST#
16B	CLK	16A	+VI/O
17B	Ground	17A	GNT#
18B	REQ#	18A	Ground
19B	+V (I/O)	19A	PME#
20B	AD[31]	20A	AD[30]
21B	AD[29]	21A	+3.3V
22B	Ground	22A	AD[28]
23B	AD[27]	23A	AD[26]
24B	AD[25]	24A	Ground
25B	+3.3V	25A	AD[24]
26B	C/BE[3]#	26A	IDSEL
27B	AD[23]	27A	+3.3V
28B	Ground	28A	AD[22]
29B	AD[21]	29A	AD[20]
30B	AD[19]	30A	Ground
31B	+3.3V	31A	AD[18]
32B	AD[17]	32A	AD[16]
33B	C/BE[2]#	33A	+3.3V
34B	Ground	34A	FRAME#
35B	IRDY#	35A	Ground
36B	+3.3V	36A	TRDY#
37B	DEVSEL#	37A	Ground
38B	Ground	38A	STOP#
39B	LOCK#	39A	+3.3V
40B	PERR#	40A	RESERVED
41B	+3.3V	41A	RESERVED

Bus Connector			
Side B		***Side A***	
Pin	***Function***	***Pin***	***Function***
42B	SERR#	42A	Ground
43B	+3.3V	43A	PAR
44B	C/BE[1]#	44A	AD[15]
45B	AD[14]	45A	+3.3V
46B	Ground	46A	AD[13]
47B	AD[12]	47A	AD[11]
48B	AD[10]	48A	Ground
49B	M66EN	49A	AD[09]
50B	5v KEY SLOT	50A	5v KEY SLOT
51B		51A	
52B	AD[08]	52A	C/BE[0]#
53B	AD[07]	53A	+3.3V
54B	+3.3V	54A	AD[06]
55B	AD[05]	55A	AD[04]
56B	AD[03]	56A	Ground
57B	Ground	57A	AD[02]
58B	AD[01]	58A	AD[00]
59B	+VI/O	59A	+VI/O
60B	ACK64#	60A	REQ64#
61B	+5V	61A	+5V
62B	+5V	62A	+5V

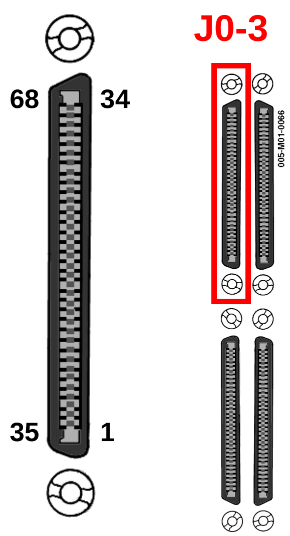
Stepper Drive Input/Output (I/O)

VHDCI Connectors

Stepper motor drives communicate with the XMP-PULSE-PCI controller via two dual-stacked, 68-pin VHDCI connectors (AMP 787962-1). Connectors comply with the SCSI-4 (ultra SCSI) VHDCI standard for high-density SCSI applications (0.8mm). These VHDCI connectors and cables are also available from Molex, Berg, and Honda.

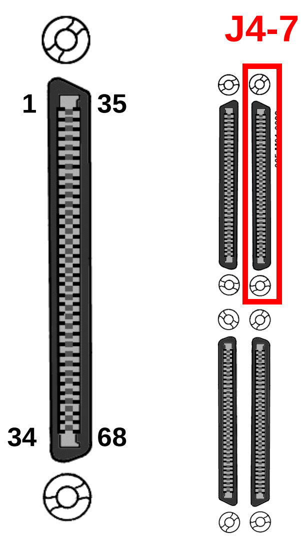


XMP-PULSE-PCI VHDCI Pin-outs for J0-3 (Motor Blocks 0-3)



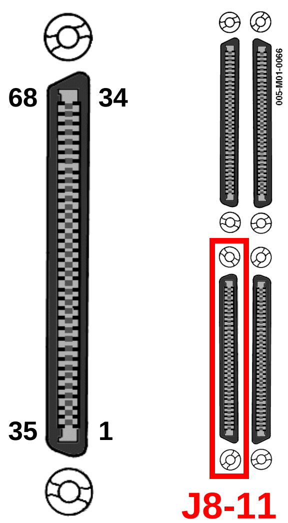
J0-3 (Motor Blocks 0-3)			
Pin #	**Signal**	**Signal**	**Pin #**
1	XCVR0D+	XCVR0D-	35
2	XCVR0E+	XCVR0E-	36
3	GND	GND	37
4	OPTO0A+	OPTO0A-	38
5	OPTO0B+	OPTO0B-	39
6	OPTO0C+	OPTO0C-	40
7	XCVR0A+	XCVR0A-	41
8	XCVR0B+	XCVR0B-	42
9	OPTO0D+ or XCVR0C+	OPTO0D- or XCVR0C-	43
10	XCVR1D+	XCVR1D-	44
11	XCVR1E+	XCVR1E-	45
12	OPTO1A+	OPTO1A-	46
13	OPTO1B+	OPTO1B-	47
14	OPTO1C+	OPTO1C-	48
15	XCVR1A+	XCVR1A-	49
16	XCVR1B+	XCVR1B-	50
17	OPTO1D+ or XCVR1C+	OPTO1D- or XCVR1C-	51
18	OPTO2A+	OPTO2A-	52
19	OPTO2B+	OPTO2B-	53
20	OPTO2C+	OPTO2C-	54
21	XCVR2A+	XCVR2A-	55
22	XCVR2B+	XCVR2B-	56
23	OPTO2D+ or XCVR2C+	OPTO2D- or XCVR2C-	57
24	XCVR2D+	XCVR2D-	58
25	XCVR2E+	XCVR2E-	59
26	OPTO3A+	OPTO3A-	60
27	OPTO3B+	OPTO3B-	61
28	GND	GND	62
29	OPTO3C+	OPTO3C-	63
30	OPTO3D+ or XCVR3C+	OPTO3D- or XCVR3C-	64
31	XCVR3A+	XCVR3A-	65
32	XCVR3B+	XCVR3B-	66
33	XCVR3D+	XCVR3D-	67
34	XCVR3E+	XCVR3E-	68

XMP-PULSE-PCI VHDCI Pin-outs for J4-7 (Motor Blocks 4-7)



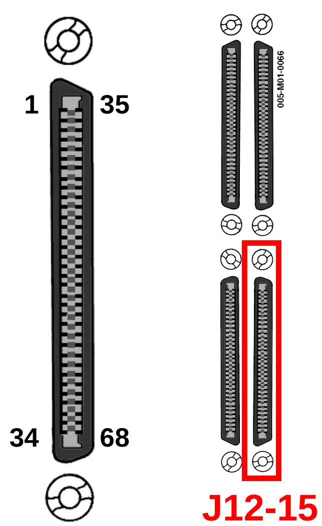
J4-7 (Motor Blocks 4-7)			
Pin #	Signal	Signal	Pin #
1	XCVR4D+	XCVR4D-	35
2	XCVR4E+	XCVR4E-	36
3	GND	GND	37
4	OPTO4A+	OPTO4A-	38
5	OPTO4B+	OPTO4B-	39
6	OPTO4C+	OPTO4C-	40
7	XCVR4A+	XCVR4A-	41
8	XCVR4B+	XCVR4B-	42
9	OPTO4D+ or XCVR4C+	OPTO4D- or XCVR4C-	43
10	XCVR5D+	XCVR5D-	44
11	XCVR5E+	XCVR5E-	45
12	OPTO5A+	OPTO5A-	46
13	OPTO5B+	OPTO5B-	47
14	OPTO5C+	OPTO5C-	48
15	XCVR5A+	XCVR5A-	49
16	XCVR5B+	XCVR5B-	50
17	OPTO5D+ or XCVR5C+	OPTO5D- or XCVR5C-	51
18	OPTO6A+	OPTO6A-	52
19	OPTO6B+	OPTO6B-	53
20	OPTO6C+	OPTO6C-	54
21	XCVR6A+	XCVR6A-	55
22	XCVR6B+	XCVR6B-	56
23	OPTO6D+ or XCVR6C+	OPTO6D- or XCVR6C-	57
24	XCVR6D+	XCVR6D-	58
25	XCVR6E+	XCVR6E-	59
26	OPTO7A+	OPTO7A-	60
27	OPTO7B+	OPTO7B-	61
28	GND	GND	62
29	OPTO7C+	OPTO7C-	63
30	OPTO7D+ or XCVR7C+	OPTO7D- or XCVR7C-	64
31	XCVR7A+	XCVR7A-	65
32	XCVR7B+	XCVR7B-	66
33	XCVR7D+	XCVR7D-	67
34	XCVR7E+	XCVR7E-	68

XMP-PULSE-PCI VHDCI Pin-outs for J8-11 (Motor Blocks 8-11)



J8-11 (Motor Blocks 8-11)			
Pin #	**Signal**	**Signal**	**Pin #**
1	XCVR8D+	XCVR8D-	35
2	XCVR8E+	XCVR8E-	36
3	GND	GND	37
4	OPTO8A+	OPTO8A-	38
5	OPTO8B+	OPTO8B-	39
6	OPTO8C+	OPTO8C-	40
7	XCVR8A+	XCVR8A-	41
8	XCVR8B+	XCVR8B-	42
9	OPTO8D+ or XCVR8C+	OPTO8D- or XCVR8C-	43
10	XCVR9D+	XCVR9D-	44
11	XCVR9E+	XCVR9E-	45
12	OPTO9A+	OPTO9A-	46
13	OPTO9B+	OPTO9B-	47
14	OPTO9C+	OPTO9C-	48
15	XCVR9A+	XCVR9A-	49
16	XCVR9B+	XCVR9B-	50
17	OPTO9D+ or XCVR9C+	OPTO9D- or XCVR9C-	51
18	OPTO10A+	OPTO10A-	52
19	OPTO10B+	OPTO10B-	53
20	OPTO10C+	OPTO10C-	54
21	XCVR10A+	XCVR10A-	55
22	XCVR102B+	XCVR10B-	56
23	OPTO10D+ or XCVR10C+	OPTO10D- or XCVR10C-	57
24	XCVR10D+	XCVR10D-	58
25	XCVR10E+	XCVR10E-	59
26	OPTO11A+	OPTO11A-	60
27	OPTO11B+	OPTO11B-	61
28	GND	GND	62
29	OPTO11C+	OPTO11C-	63
30	OPTO11D+ or XCVR11C+	OPTO11D- or XCVR11C-	64
31	XCVR11A+	XCVR11A-	65
32	XCVR11B+	XCVR11B-	66
33	XCVR11D+	XCVR11D-	67
34	XCVR11E+	XCVR11E-	68

XMP-PULSE-PCI VHDCI Pin-outs for J12-15 (Motor Blocks 12-15)



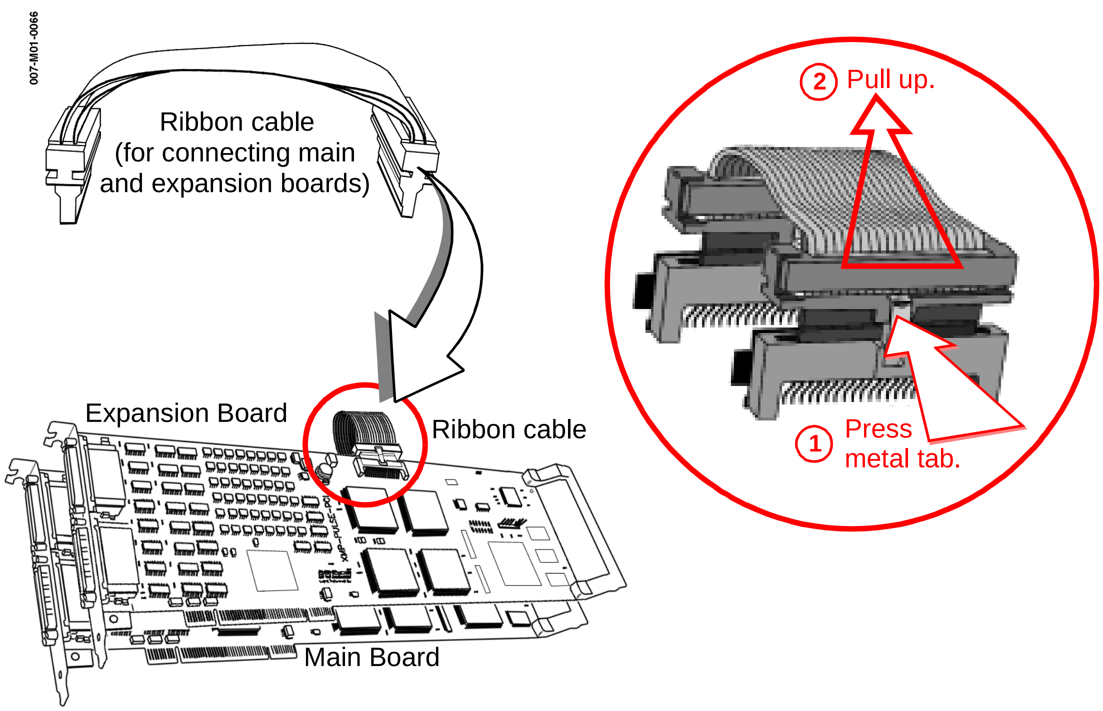
J12-15 (Motor Blocks 12-15)			
Pin #	Signal	Signal	Pin #
1	XCVR12D+	XCVR12D-	35
2	XCVR12E+	XCVR12E-	36
3	GND	GND	37
4	OPTO12A+	OPTO12A-	38
5	OPTO12B+	OPTO12B-	39
6	OPTO12C+	OPTO12C-	40
7	XCVR12A+	XCVR12A-	41
8	XCVR12B+	XCVR12B-	42
9	OPTO12D+ or XCVR12C+	OPTO12D- or XCVR12C-	43
10	XCVR13D+	XCVR13D-	44
11	XCVR13E+	XCVR13E-	45
12	OPTO13A+	OPTO13A-	46
13	OPTO13B+	OPTO13B-	47
14	OPTO13C+	OPTO13C-	48
15	XCVR13A+	XCVR13A-	49
16	XCVR13B+	XCVR13B-	50
17	OPTO13D+ or XCVR13C+	OPTO13D- or XCVR13C-	51
18	OPTO14A+	OPTO14A-	52
19	OPTO14B+	OPTO14B-	53
20	OPTO14C+	OPTO14C-	54
21	XCVR14A+	XCVR14A-	55
22	XCVR14B+	XCVR14B-	56
23	OPTO14D+ or XCVR14C+	OPTO14D- or XCVR14C-	57
24	XCVR14D+	XCVR14D-	58
25	XCVR14E+	XCVR14E-	59
26	OPTO15A+	OPTO15A-	60
27	OPTO15B+	OPTO15B-	61
28	GND	GND	62
29	OPTO15C+	OPTO15C-	63
30	OPTO15D+ or XCVR15C+	OPTO15D- or XCVR15C-	64
31	XCVR15A+	XCVR15A-	65
32	XCVR15B+	XCVR15B-	66
33	XCVR15D+	XCVR15D-	67
34	XCVR15E+	XCVR15E-	68

Configuring the XMP-PULSE-PCI Controller

XMP-PULSE-PCI controllers consist of either one or two boards: "main" boards which contain DSPs, or an optional "expansion" boards, which do not have DSPs. All controllers must include a main board, either singly or connected to an expansion board. NOTE: expansion boards can consist of XMP-PULSE types, or other XMP-series types such as those supporting servo motors.

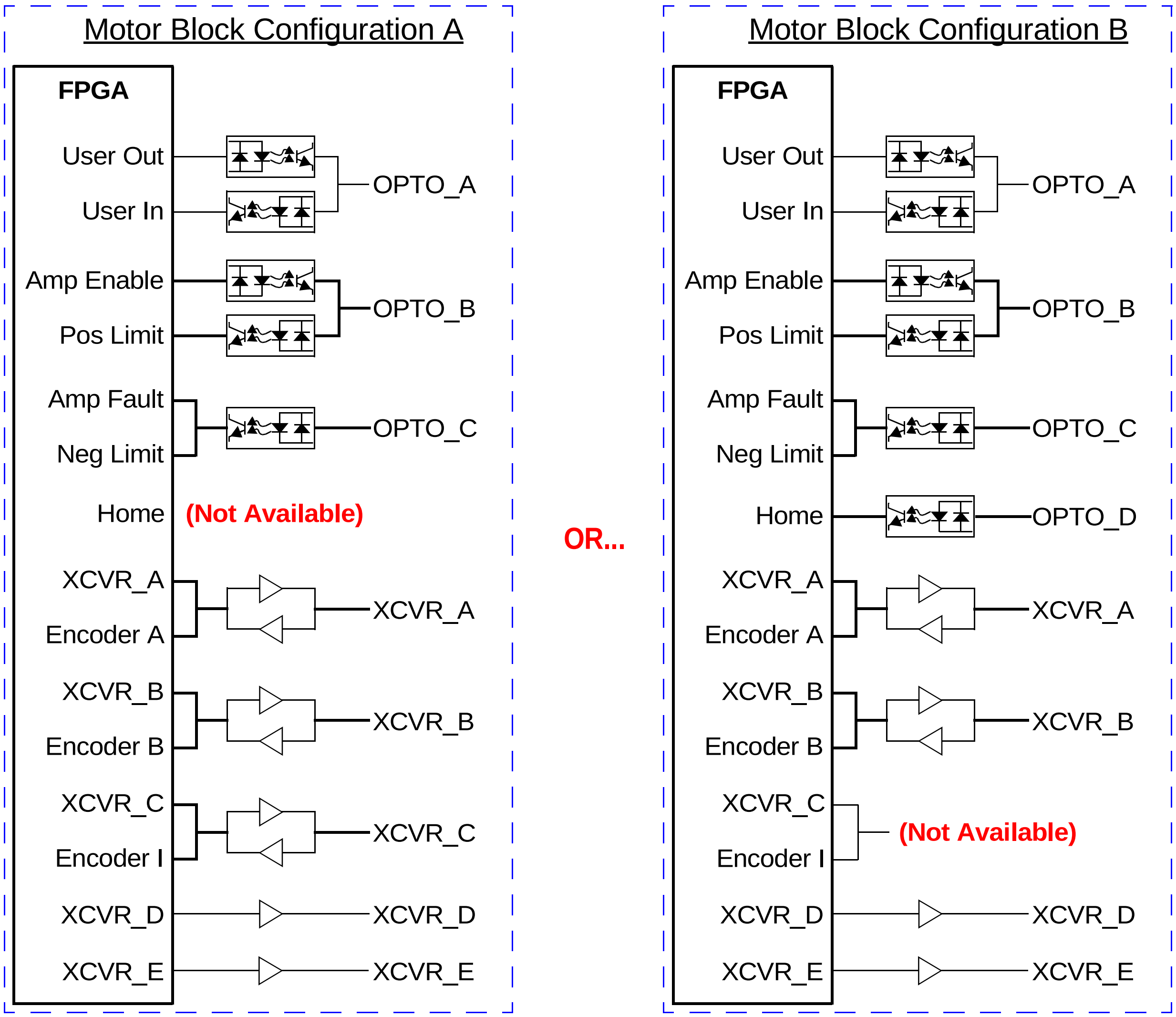
“Main” versus “Expansion” Boards

XMP-PULSE-PCI controllers may be extended for more axes by adding an expansion board. Up to 32 axes are controlled by a single “main” controller board. Expansion boards consist of separate electronics, very similar in appearance and function to main boards. Typically, an expansion board is located on the bus or backplane immediately adjacent to a main board. Both boards (main and expansion) are connected via a short ribbon cable. When connected together, one main and one expansion board constitute a single, unified “controller.”

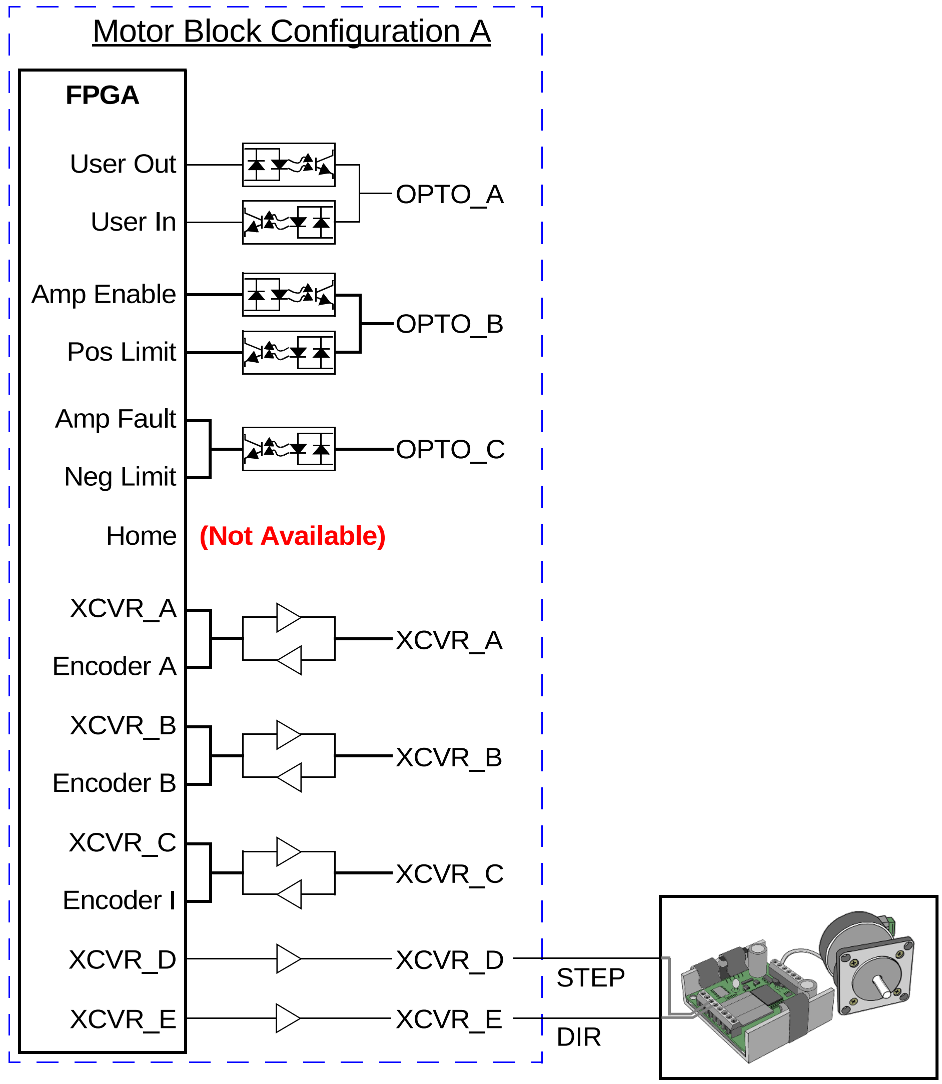


Factory Options

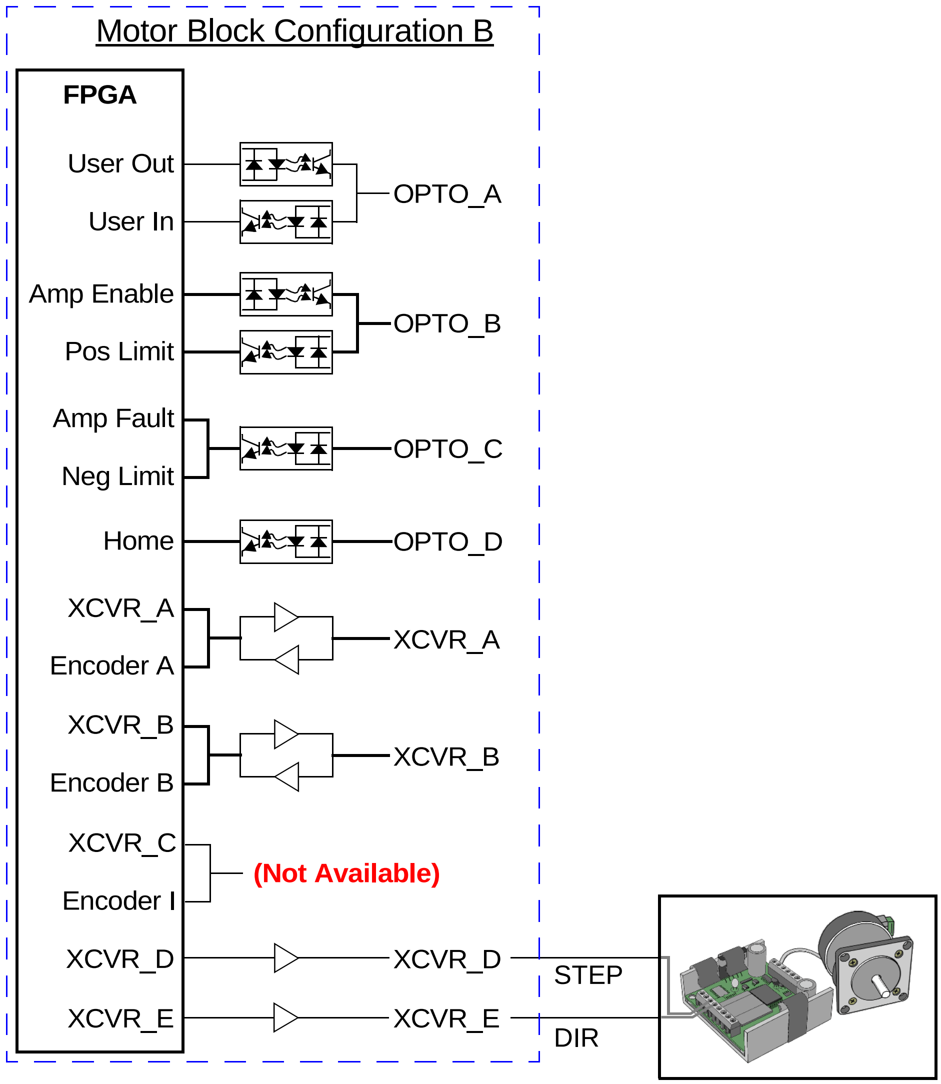
XMP-PULSE-PCI controllers are divided into four (4) *motion blocks*, each of which contains four (4) *motor blocks*. Each motor block is comprised of transceivers and opto-isolators configured at the factory in either Configuration A or Configuration B as shown below.



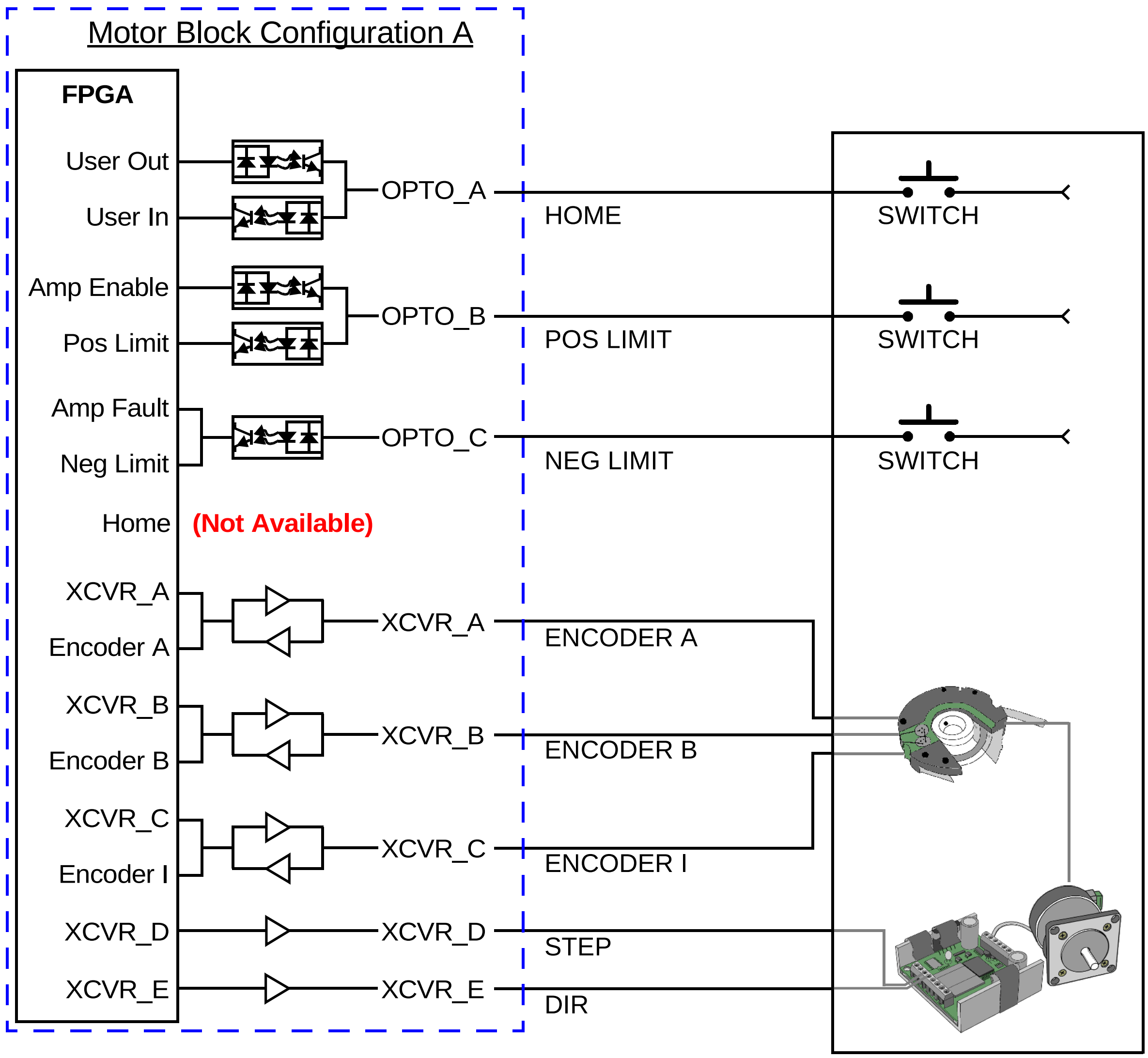
1 Motor; No Encoder Feedback; No Limits
Motor Block Configuration A



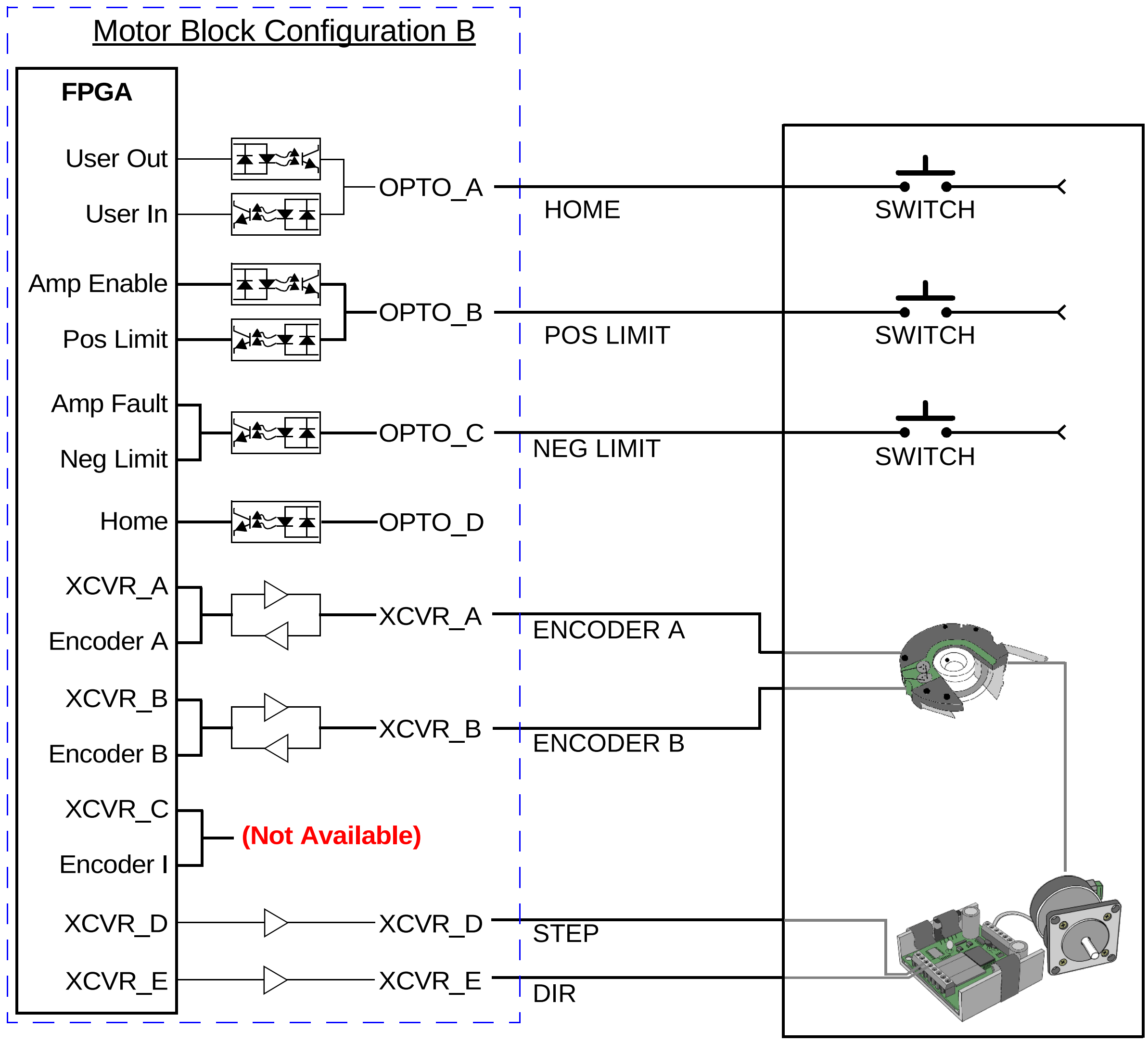
1 Motor; No Encoder Feedback; No Limits
Motor Block Configuration B



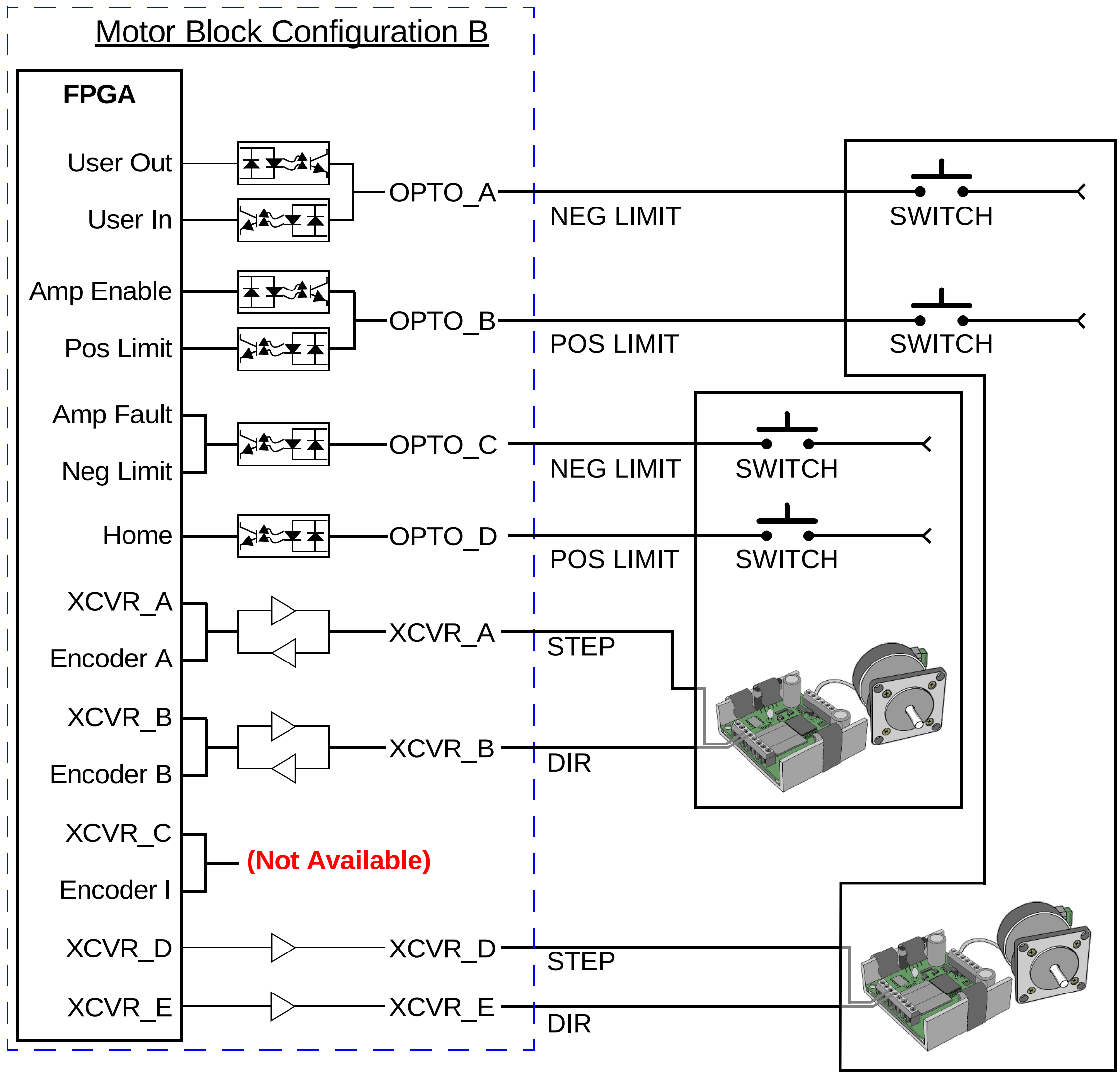
1 Motor; Encoder Feedback with Limits
Motor Block Configuration A



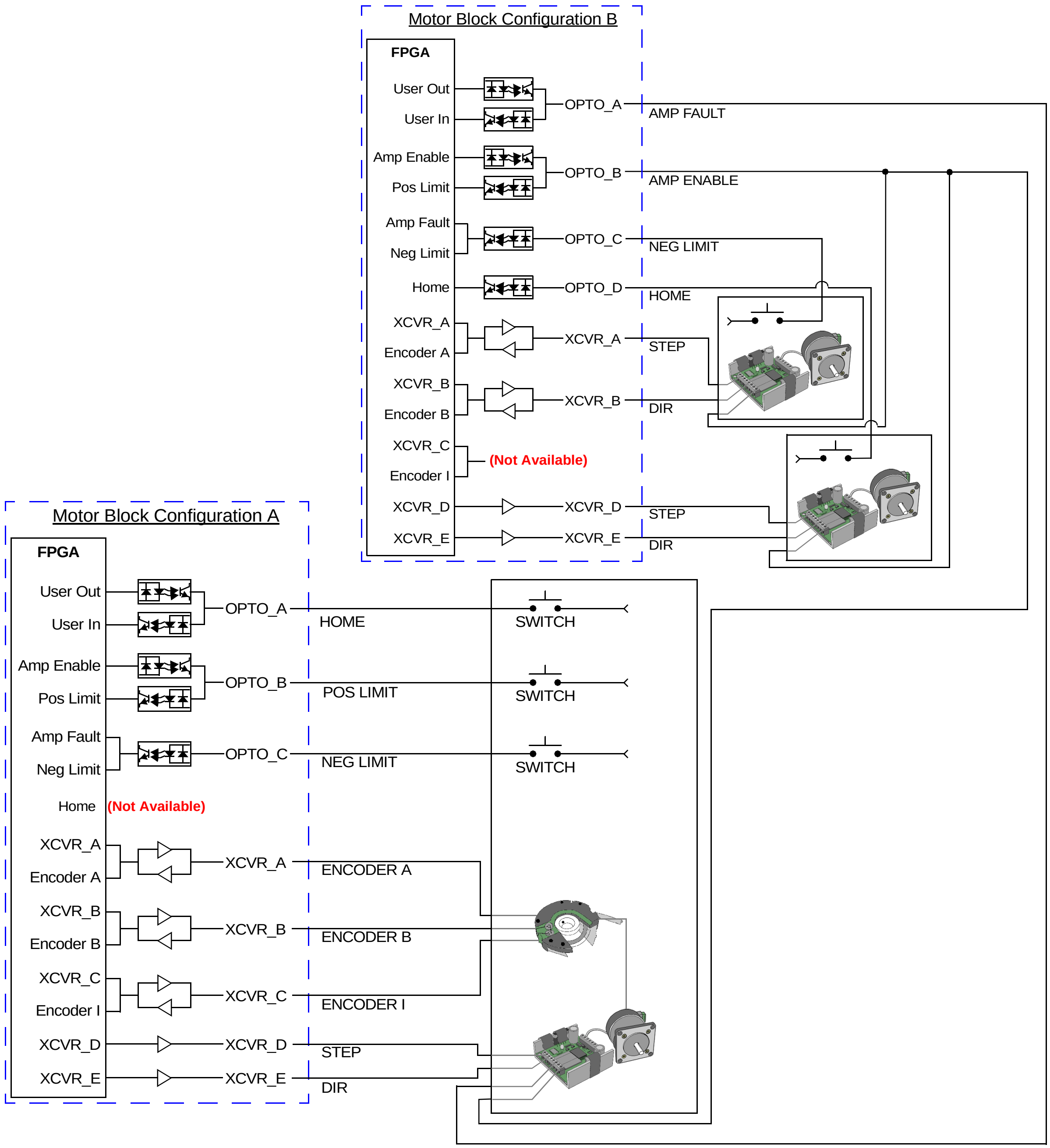
1 Motor; Encoder Feedback with Limits
Motor Block Configuration B



2 Motors; No Encoder Feedback
Motor Block Configuration B



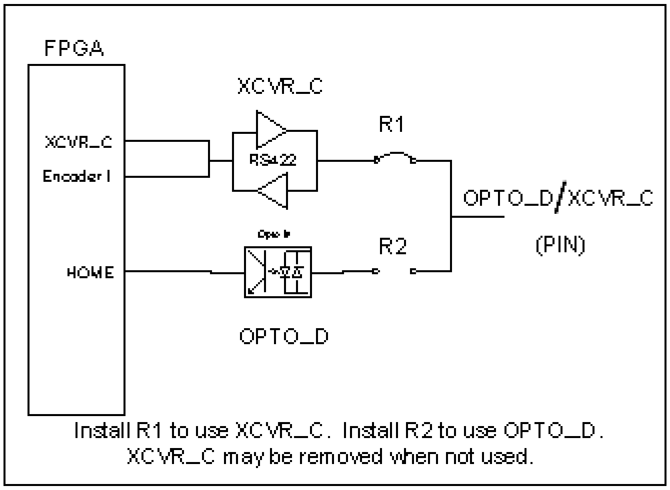
3 Motors: Encoder Feedback on 1 Motor with Limits
Motor Block Configurations A and B (combined)



SPECIAL NOTE: XCVR_C and OPTO_D

XCVR_C and OPTO_D on each axis are mutually exclusive. Notice that in Configuration A above, Opto-isolator D (OPTO_D) is not available, and Transceiver C (XCVR_C) is available. In Configuration B above, Transceiver C (XCVR_C) is not available, and Opto-isolator D (OPTO_D) is available. In each motor block one of these two configurations prevails, depending upon factory assembly (see figure below).

Figure 1. Placement of resistor to configure XCVR_C versus OPTO_D.



The selection of which configuration to use for each motor block depends upon the user's I/O design requirements, which should be discussed with MEI beforehand. Standard versions of the XMP-PULSE-PCI-MAIN-16 main board (Part No. A040-0011) and XMP-PULSE-PCI-EXP-16 expansion boards (Part No. A041-0011) have XCVR_C installed on Motor Block 0, and OPTO_D installed on Motor Blocks 1-3 of each motion block as shown below.

Motor Block 0	Configuration A
Motor Block 1	Configuration B
Motor Block 2	Configuration B
Motor Block 3	Configuration B

Other motor block configurations are possible. For more information, please contact MEI's Sales department.

Opto-Isolators

Table 2: Dedicated Opto Input Specifications

Active Input Guaranteed	$I_{IN} > 2mA$ (See discussion below for V_{IN} @ I_{IN} = 2mA)
Inactive Input Guaranteed	$I_{IN} < 0.1mA$
Propagation Delay	$T_P < 20us$
Absolute Maximums[a]	$V_{ISOLATION} < 40V$ (See discussion below for maximum V_{IN} and I_{IN})

a. Exceeding absolute maximums may damage components.

Table 3: Dedicated Opto Output Specifications

Active Output Guaranteed	$V_{OUT} < 0.3V$ @ $I_{OUT} < 2mA$ $V_{OUT} < 1.1V$ @ $I_{OUT} < 10mA$
Inactive Output Guaranteed	$I_{OUT} < 0.01mA$
Propagation Delay	$T_P < 100us$ (load < 10K ohm)
Absolute Maximums[a]	$I_{OUT} < 50mA$ $V_{OUT} < 40V$ $I_{REVERSE} < 100mA$ @ $V_{REVERSE}$ 0.4V (protection diode) $V_{ISOLATION} < 40V$

a. Exceeding absolute maximums may damage components.

Table 4: Bi-directional Opto Input Specifications

Active Input Guaranteed	I_{IN} > 2mA V_{IN} < 1.7V @ I_{IN} = 2mA
Inactive Input Guaranteed	I_{IN} < 0 .1mA
Propagation Delay	T_P < 20us
Absolute Maximums[a]	I_{IN} < 50mA $V_{REVERSE}$ < 30V $V_{ISOLATION}$ < 40V

a. Exceeding absolute maximums may damage components.

Table 5: Bi-directional Opto Output Specifications

Active Output Guaranteed	V_{OUT} < 0.3V @ I_{OUT} < 2mA V_{OUT} < 1.1V @ I_{OUT} < 10mA
Inactive Output Guaranteed	I_{OUT} < 0.01mA
Propagation Delay	T_P < 100us (load < 10K ohm)
Absolute Maximums[a]	I_{OUT} < 50mA V_{OUT} <40V $I_{REVERSE}$ <50mA @ $V_{REVERSE}$ 1.7 V (input circuit) $V_{ISOLATION}$ < 40V

a. Exceeding absolute maximums may damage components.

Transceivers

The XMP-PULSE-PCI controller features up to 20 transceiver pairs, each of which may be configured for either one motor or one encoder. All transceiver and user I/O are part of the “Motor” software object.

Table 6: RS422 receiver specifications.

Description	Specification
Input High Threshold	$V_{DIFF} > 0.2V$
Input Low Threshold	$V_{DIFF} < -0.2V$
Input Current	$I_{IN} < 1.0mA$ @ $V_{IN} = 12V$ $I_{IN} < -0.8mA$ @ $V_{IN} = -7V$
Propagation Delay	$T_p < 200$ ns
Absolute Maximums[a]	ESD Protection ± 15kV $-8V < V_{IN} < +12.8V$ (input to GND)

a. Exceeding absolute maximums may damage components.

RS422 receiver specification apply to XCVRs A, B and C (when installed) on each motor block. These specifications are identical to those on the XMP.

Table 7: RS422 transmitter specifications.

Description	Specification
Differential Output Voltage	$V_{DIFF} < 5V$ @ $I = 0mA$ $V_{DIFF} > 2V$ @ $I = 20mA$
Common Mode Output Voltage	V_{OUT} (common mode) < 3V (100Ω load)
Propagation Delay	$T_p < 60ns$
Absolute Maximums[a]	$I_{OUT} < 50mA$

a. Exceeding absolute maximums may damage components.

Tables below show various functions that each of the transceiver pins can provide. Please note that when encoders are used, the correlating FPGA XCVR function needs to be set as an input.

Table 8: XCVR A Functions

MOTOR 0 XCVR_A Functions[a] (Connector signal pair XCVR_0A+ and XCVR_0A-)		
Function	**Signal Direction**	**Comments**
OUTPUT	OUTPUT	General purpose output
COMPARE	OUTPUT	Compare output signal for MOTOR 0
STEP0	OUTPUT	STEP signal for MOTOR 0 stepper
DIR0	OUTPUT	DIRECTION signal for MOTOR 0 stepper
CW0	OUTPUT	CLOCKWISE signal for MOTOR 0 stepper
CCW0	OUTPUT	COUNTER-CLOCKWISE signal for MOTOR 0 stepper
QUADA0	OUTPUT	QUADRATURE A signal for MOTOR 0 stepper
QUADB0	OUTPUT	QUADRATURE B signal for MOTOR 0 stepper
STEP1	OUTPUT	STEP signal for MOTOR 1 stepper
DIR1	OUTPUT	DIRECTION signal for MOTOR 1 stepper
CW1	OUTPUT	CLOCKWISE signal for MOTOR 1 stepper
CCW1	OUTPUT	COUNTER-CLOCKWISE signal for MOTOR 1 stepper
QUADA1	OUTPUT	QUADRATURE A signal for MOTOR 1 stepper
QUADB1	OUTPUT	QUADRATURE B signal for MOTOR 1 stepper
INPUT	INPUT	General purpose input *or...* To CAPTURE EVENT 0 input lookup table
ENCODER A	INPUT	ENCODERA input

a. Use of XCVR_D and XCVR_E for the Motor 0 outputs is recommended.

Table 9: XCVR B Functions

MOTOR 0 XCVR_B Functions[a] (Connector signal pair XCVR_0B+ and XCVR_0B-)		
Function	**Signal Direction**	**Comments**
OUTPUT	OUTPUT	General purpose output
COMPARE	OUTPUT	Compare output signal for MOTOR 0
STEP0	OUTPUT	STEP signal for MOTOR 0 stepper
DIR0	OUTPUT	DIRECTION signal for MOTOR 0 stepper
CW0	OUTPUT	CLOCKWISE signal for MOTOR 0 stepper
CCW0	OUTPUT	COUNTER-CLOCKWISE signal for MOTOR 0 stepper
QUADA0	OUTPUT	QUADRATURE A signal for MOTOR 0 stepper
QUADB0	OUTPUT	QUADRATURE B signal for MOTOR 0 stepper
STEP1	OUTPUT	STEP signal for MOTOR 1 stepper
DIR1	OUTPUT	DIRECTION signal for MOTOR 1 stepper
CW1	OUTPUT	CLOCKWISE signal for MOTOR 1 stepper
CCW1	OUTPUT	COUNTER-CLOCKWISE signal for MOTOR 1 stepper
QUADA1	OUTPUT	QUADRATURE A signal for MOTOR 1 stepper
QUADB1	OUTPUT	QUADRATURE B signal for MOTOR 1 stepper
INPUT	INPUT	General purpose input -or- To CAPTURE EVENT 0 input lookup table
ENCODERB	INPUT	ENCODERB input

a. Use of XCVR_D and XCVR_E for the Motor 0 outputs is recommended.

Table 10: XCVR C Functions

MOTOR 0 XCVR_C Functions[a] (Connector signal pair XCVR_0C+ and XCVR_0C-)		
Function	**Signal Direction**	**Comments**
OUTPUT	OUTPUT	General purpose output
COMPARE	OUTPUT	Compare output signal for MOTOR 0
INPUT	INPUT	General purpose input *or...* To CAPTURE EVENT 0 input lookup table
ENCODERI	INPUT	ENCODERI input

a. May not be installed in all axes.

Table 11: XCVR D Functions

MOTOR 0 XCVR D Functions (Connector signal pair XCVR0D+ and XCVR0D-)		
Function	**Signal Direction**	**Comments**
OUTPUT	OUTPUT	General purpose output
STEP0	OUTPUT	STEP signal for MOTOR 0 stepper
DIR0	OUTPUT	DIRECTION signal for MOTOR 0 stepper
CW0	OUTPUT	CLOCKWISE signal for MOTOR 0 stepper
CCW0	OUTPUT	COUNTER-CLOCKWISE signal for MOTOR 0 stepper
QUADA0	OUTPUT	QUADRATURE A signal for MOTOR 0 stepper
QUADB0	OUTPUT	QUADRATURE B signal for MOTOR 0 stepper
INPUT	INPUT	General purpose input

Table 12: XCVR E Functions

MOTOR 0 XCVR E Functions (Connector signal pair XCVR0E+ and XCVR0E-)		
Function	**Signal Direction**	**Comments**
OUTPUT	OUTPUT	General purpose output
STEP0	OUTPUT	STEP signal for MOTOR 0 stepper
DIR0	OUTPUT	DIRECTION signal for MOTOR 0 stepper
CW0	OUTPUT	CLOCKWISE signal for MOTOR 0 stepper
CCW0	OUTPUT	COUNTER-CLOCKWISE signal for MOTOR 0 stepper
QUADA0	OUTPUT	QUADRATURE A signal for MOTOR 0 stepper
QUADB0	OUTPUT	QUADRATURE B signal for MOTOR 0 stepper
INPUT	INPUT	General purpose input

Transceiver Notes

Each hardware axis has five (5) transceivers dedicated to it, labeled XCVR_A, XCVR_B, and XCVR_C, XCVR_D and XCVR_E. The XCVR_A, XCVR_B, XCVR_C, XCVR_D and XCVR_E transceivers support:

Table 13: All three transceivers support input/output, normal/inverted.

Transceiver	*Input or Output?*	*Normal or Inverted?*
XCVR_A	Both	Both
XCVR_B	Both	Both
XCVR_C	Both	Both
XCVR_D	Output	Both
XCVR_E	Output	Both

Step and Direction (Dir) configurations must accord. For example, if XCVR_D is configured for *Step*, then XCVR_E should be configured for *Dir*. If XCVR_D is configured for *Dir*, then XCVR_E should be configured for *Step*. Refer to the next table.

Table 14: Sample transceiver configurations that are supported.

XCVR_D	*XCVR_E*
Step	Dir
Dir	Step
CW	CCW
CCW	CW
QuadA	QuadB
QuadB	QuadA

Step/Dir & CW/CCW Specifications

Table 15: Step/dir and CW/CCW specifications.

Pulse width range for Step, CW & CCW	25 nsec to 25.5 microsec
Maximum step output rate	5 MHz

The maximum separation between the Dir edge and the rising Step edge depends upon the sample rate and the commanded motion. A rule of thumb is that the Dir edge occurs at the start of the DSP's trajectory calculator (when the command velocity is non-zero), and the first Step occurs when the command position increments the first whole count. The time separation can be estimated from the commanded acceleration (Accel):

$$Time = \sqrt{\frac{2}{Accel}}$$

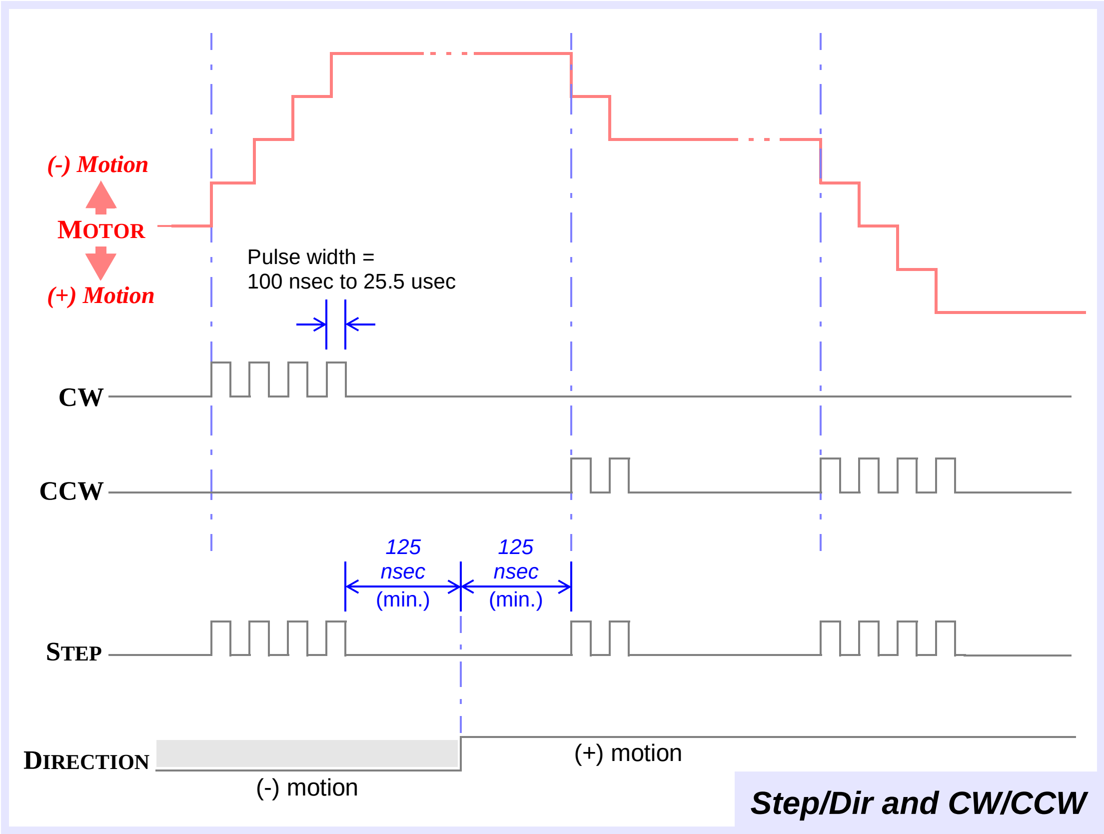
For example, if acceleration is 100,000 cts/sec^2, then the separation between the Dir edge and the first Step edge is

$$Time = \sqrt{\frac{2}{100,000}}$$

which computes to Time = 4.5 milliseconds

The minimum separation between the Dir edge and the first Step edge is 125 nanoseconds. Note that the XMP-PULSE increments its counter on each *rising edge* of the Step or CW signal.

Figure 2. Step/Dir, CW/CCW, and motor motion.



Stepper Loopback

When the *Loopback* feature is enabled, the Step/Dir (or CW/CCW) logic is routed back into the encoder inputs. Note that the DSP doesn't use the feedback for control. There are two to three samples of latency between when the DSP's command position is updated and when the actual position (loopback) is updated. Also, loopback is not affected by "inverted" configurations.

The position error limit is still valid for loopback operations. If Loopback is not enabled, you can connect the encoder inputs to actual encoders.

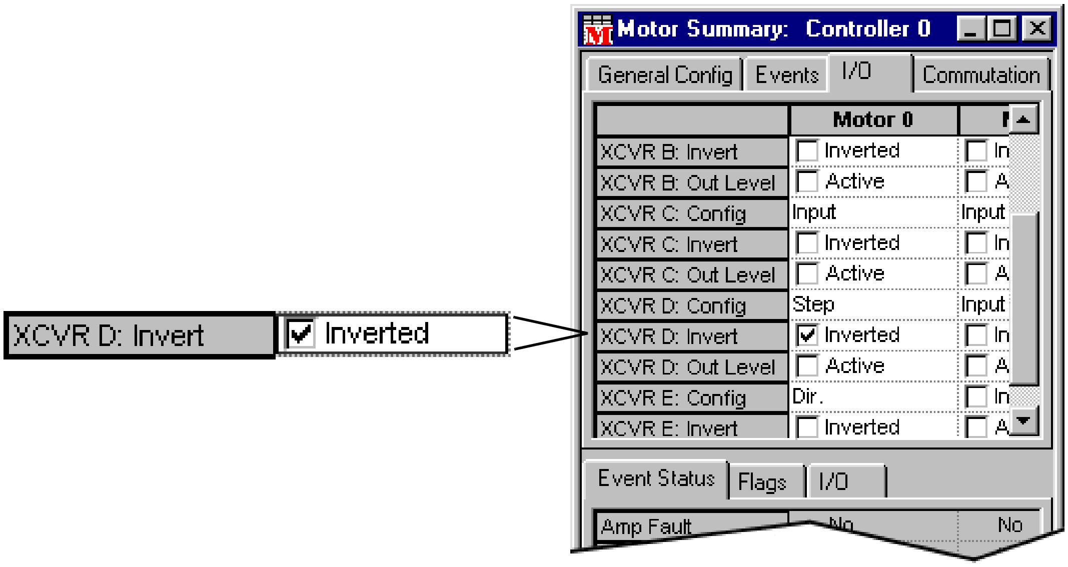
HELPFUL TIP: Stepper loopback is very useful for motor simulation. When real servo motors are not available, the controller's stepper motor and loopback configurations make it possible to develop software.

NOTE: When a motor block has two motors connected to it, only one of the motors may use this stepper loopback function.

Open-loop Steppers

XMP-PULSE controllers can control stepper motors in open-loop (no feedback) configurations. The XMP can also be configured for STEP LOOPBACK. When this is enabled, the motor Position Error Limit and Axis Settling will depend on the output steps being read back into the actual position register. If STEP LOOPBACK is disabled, an external feedback device (e.g. encoder) will be needed for determining position error limits and axis settling. In either case, the output is generated regardless of actual position.

For stepper drives that trigger on the falling edge, invert the step output transceiver. This can be done from Motion Console by enabling the **XCVR D: Invert** (or **XCVR E: Invert**, etc.) parameter in the **Motor Summary / I/O** page.



NOTE: to determine whether your drive triggers on the rising or falling step edge, consult the drive manufacturer's manual.

Closed Loop Steppers

Currently, there is no explicit support for closed loop stepper configurations. But, it is possible to correct the final position based on the actual position via application software, since the encoder inputs are valid with Step/Dir and CW/CCW configurations.

Connections to Stepper Motors

Opto-isolated, Bi-directional

There are four (4) bi-directional I/Os per 4-axis motion block, and each I/O is individually configurable as an input or output. In Figures 4 and 5 below, lines "A" and "B" are configured as shown here:

A	B
OPTO_A	OPTO_A RTN
OPTO_B	OPTO_B RTN

Figure 3. Connect I/O input to pull-up logic.

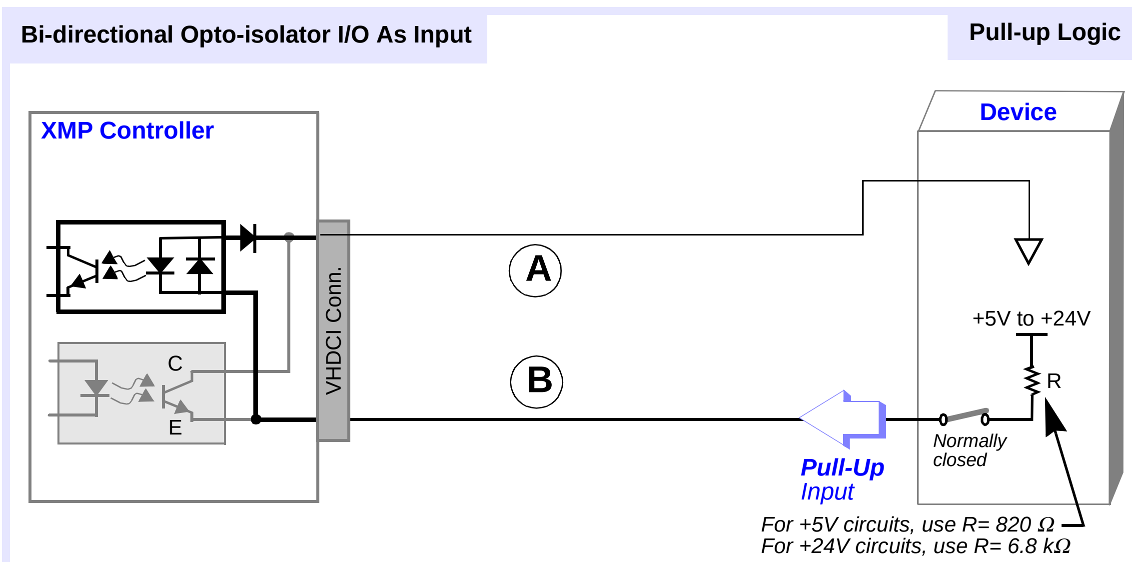
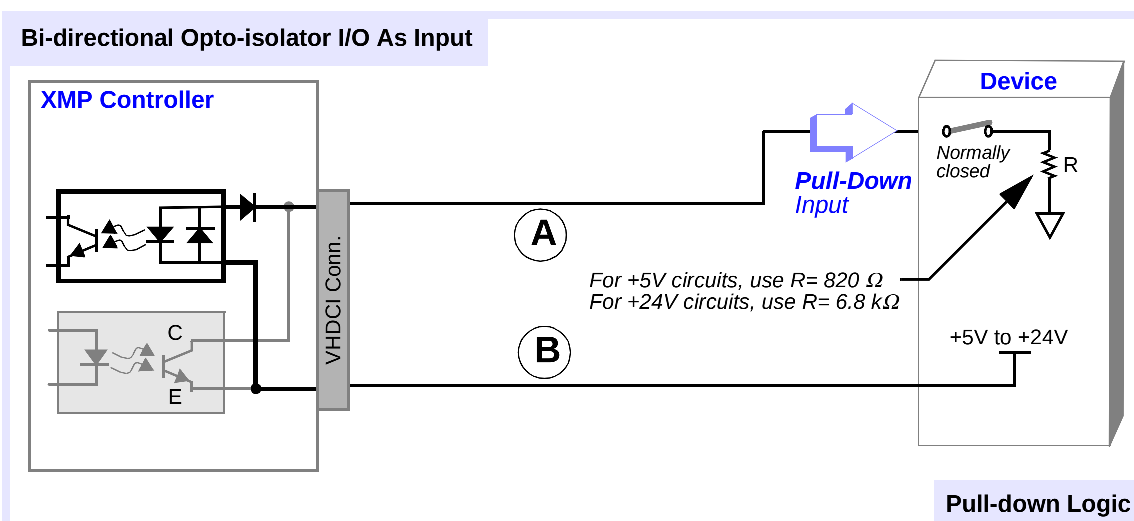


Figure 4. Connect I/O input to pull-down logic.



As Opto-isolator I/O Outputs

In figures 6 and 7 below, lines "A" and "B" are configured as follows:

A	B
OPTO_A	OPTO_A RTN
OPTO_B	OPTO_B RTN

Figure 5. Connect I/O as outputs to pull-up logic.

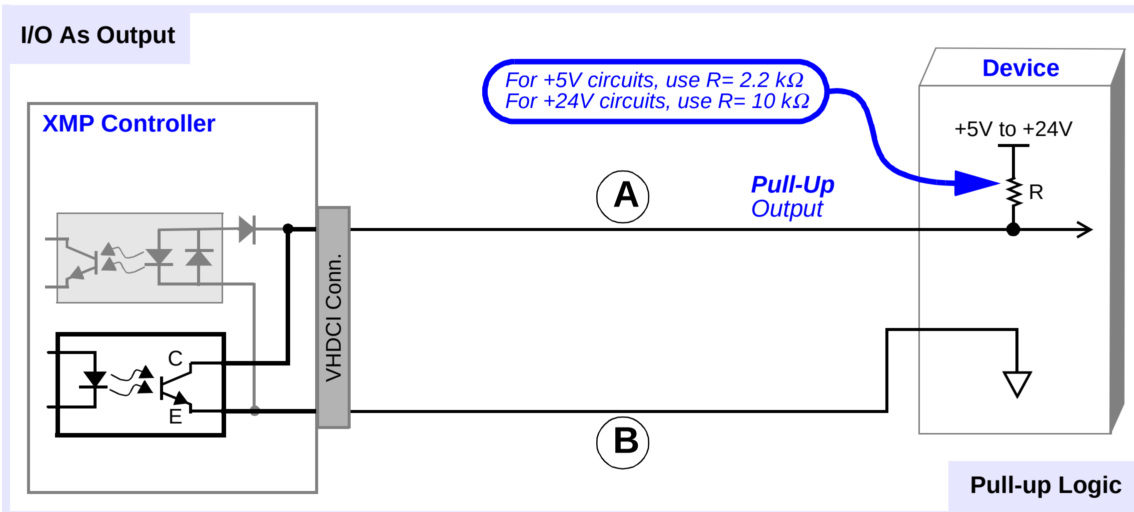
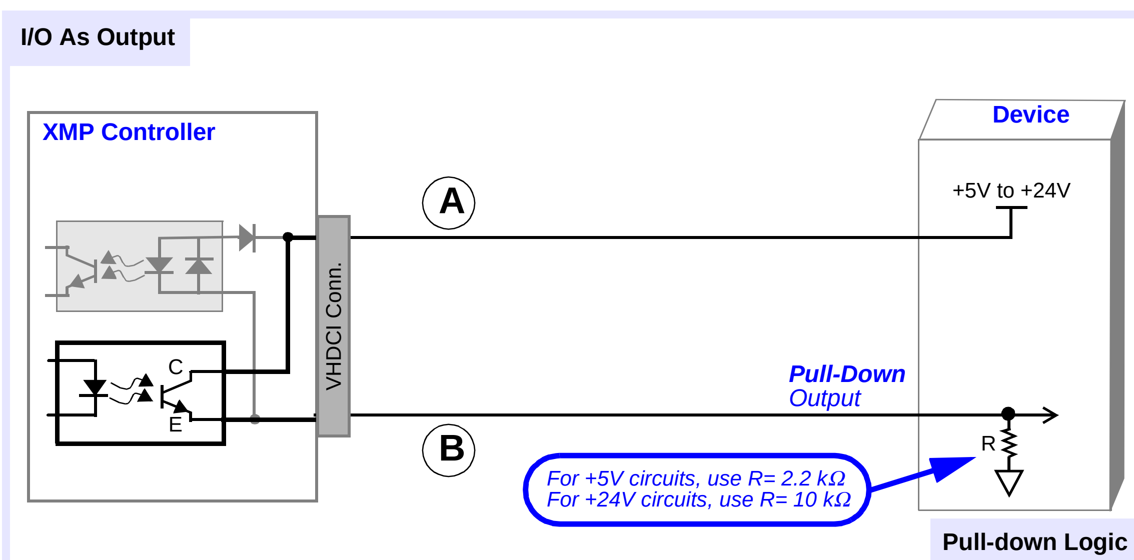


Figure 6. Connect I/O as outputs to pull-down logic.

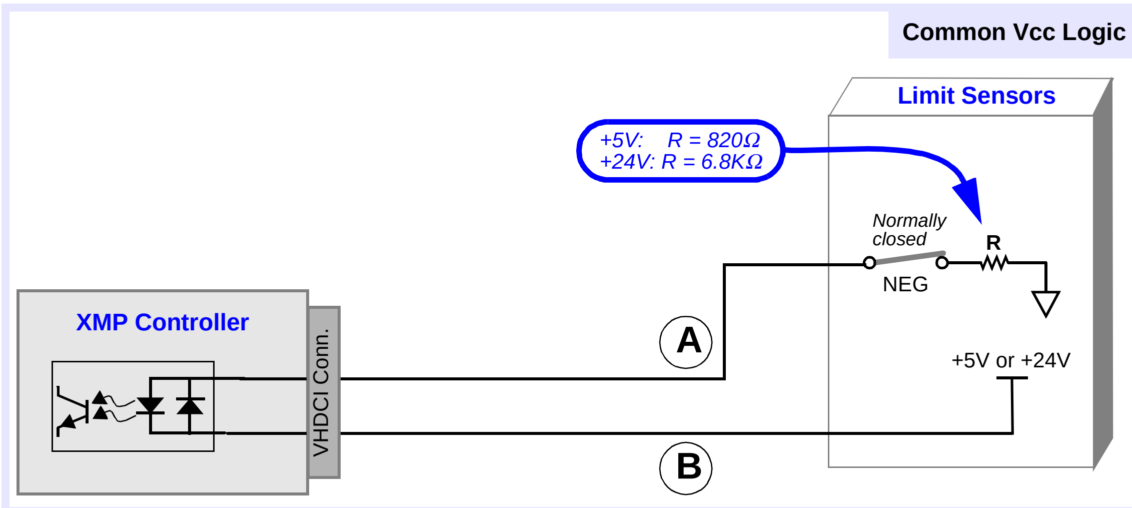


Common Vcc Logic

In Figure 8 below, lines "A" and "B" are configured as follows:

A	B
OPTO_C	OPTO_C RTN
OPTO_D	OPTO_D RTN

Figure 7. Connect opto-isolated inputs (common Vcc logic).



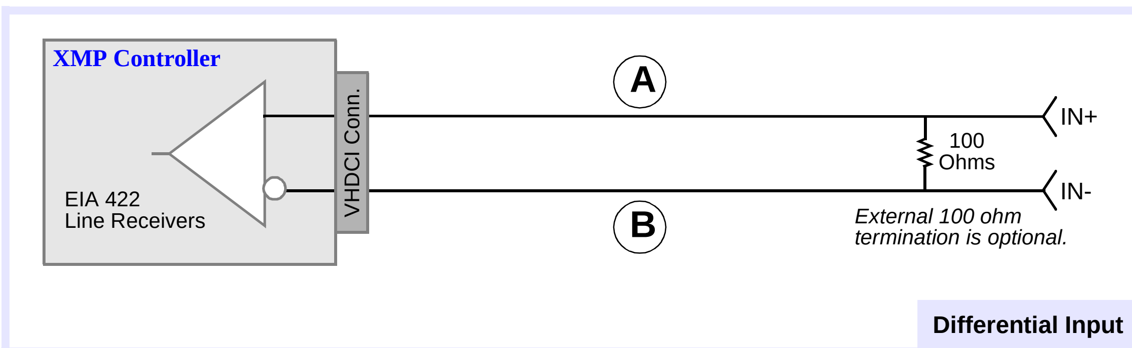
Connecting XMP Transceiver I/O as an Input

There are I/Os for each 4-axis motion block: 8-12 bi-directional XCVRs and 8 dedicated outputs.In Figure 9 and 10 below, lines "A" and "B" are configured as follows:

A	B
OPTO_A-	OPTO_A+
OPTO_B-	OPTO_B+
OPTO_C-	OPTO_C+

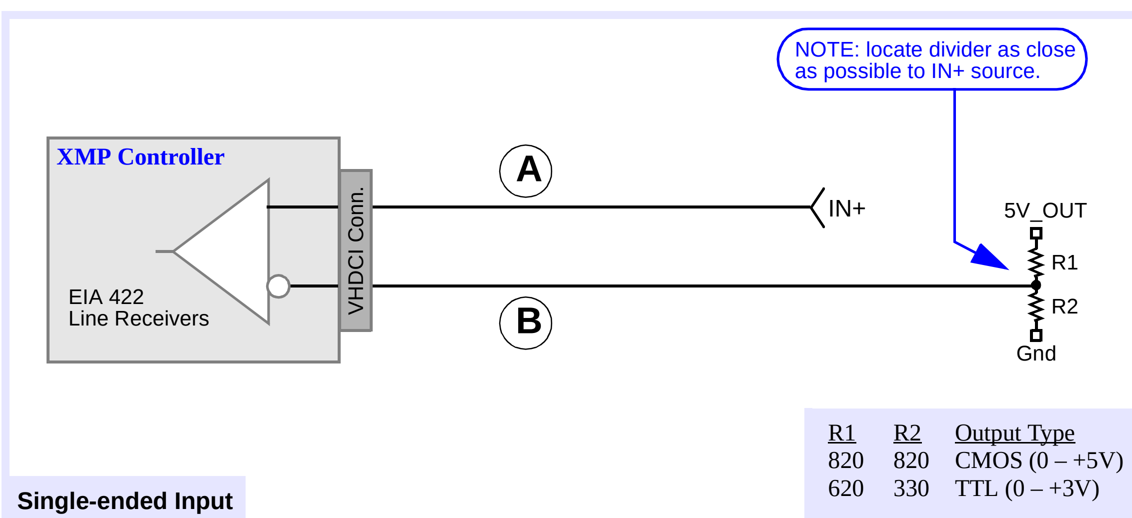
Connect Transceiver as Differential Input

Figure 8. Connect transceiver as differential input.



Connect Transceiver as Single-ended Input

Figure 9. Connect transceiver as single-ended input.



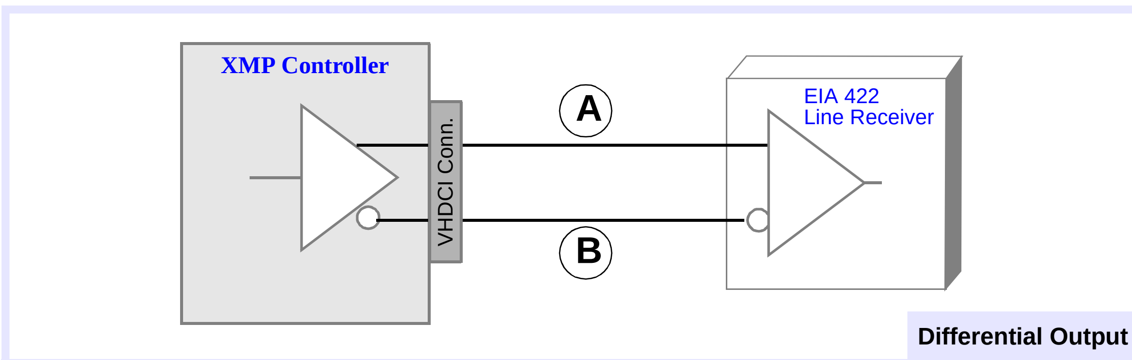
Transceiver as an Output

Connect Transceiver as Differential Output

There are I/Os for each 4-axis motion block: 8-12 bi-directional XCVRs and 8 dedicated outputs.In Figure 9 and 10 below, lines "A" and "B" are configured as follows:

A	B
XCVR_1A+	XCVR_1A-
XCVR_1B+	XCVR_1B-
XCVR_1C+	XCVR_1C-
XCVR_1D+	XCVR_1D-

Figure 10. Connect transceiver as differential output.



Software

The XMP-PULSE-PCI controller responds to the same MPI/MEI software library used with all XMP-series controllers. The controller's configurable motor blocks, however, require matching software configurations, which are described in this section.

Settings

Although two stepper motors can be assigned to a single motor block, only one stepper motor is allocated per motor block as a default. If there are more motors than motor blocks present, the extra motors will not have valid software configurations. It is up to the user to:

- Set up where the Step Command is sent out.
- Set up where the FeedBack comes from.
- Configure the appropriate transceivers (XCVRs).
- Remap the Motor Events/Limits sources and actions.

To remap a motor's Feedback and Step Command to another motor block, the user sets the ResourceNumber (located in the MEIMotorStepper in MEIMotorConfig) to the appropriate Motor Block number.

Transceivers

If two motors are assigned to a single motor block, step pulses will come from XCVR_D and XCVR_E for the first stepper motor and from XCVR_A and XCVR_B for the second. If only one stepper is present, step commands can be assigned to either set of transceivers, although XCVR_D and XCVR_E are recommended.

If there are two stepper motors assigned to a single motor block there is no encoder feedback available for either motor. An internal “Loopback” feedback is available to one motor per motor block .

Step Command and Feedback

The following example is a typical 32 stepper motor setup (NOTE: if the maximum number of motors are present (32) this configuration will *not* vary). When the Motor objects are created, their Resource Numbers are identical to their Motor->numbers. Motors that do not have hardware (motor blocks) associated with them must change their Resource Number to the number of the motor whose motor block they are sharing. In this example, motors 0-15 have valid motor blocks, and motors 16-31 share their resources; this is reflected in their Resource Number.

Table 16: Configuration for 32 Stepper Motors

Motor #	Resource #	Command	Feedback
0	0	PosCmd 0: StepCmd 0_0	PosStatus 0: Encoder 0
1	1	PosCmd 0: StepCmd 0_1	PosStatus 0: Encoder 1
2	2	PosCmd 0: StepCmd 0_2	Not Available
3	3	PosCmd 0: StepCmd 0_3	Not Available
4	4	PosCmd 1: StepCmd 0_0	PosStatus 1: Encoder 0
5	5	PosCmd 1: StepCmd 0_1	PosStatus 1: Encoder 1
6	6	PosCmd 1: StepCmd 0_2	PosStatus 1: Encoder 2
7	7	PosCmd 1: StepCmd 0_3	Not Available
8	8	PosCmd 2: StepCmd 0_0	PosStatus 2: Encoder 0
9	9	PosCmd 2: StepCmd 0_1	PosStatus 2: Encoder 1
10	10	PosCmd 2: StepCmd 0_2	PosStatus 2: Encoder 2
11	11	PosCmd 2: StepCmd 0_3	Not Available
12	12	PosCmd 3: StepCmd 0_0	Not Available
13	13	PosCmd 3: StepCmd 0_1	Not Available
14	14	PosCmd 3: StepCmd 0_2	Not Available
15	15	PosCmd 3: StepCmd 0_3	PosStatus 3: Encoder 3
16	0	PosCmd 0: StepCmd 1_0	Not Available
17	1	PosCmd 0: StepCmd 1_1	Not Available
18	2	PosCmd 0: StepCmd 1_2	PosStatus 0: Encoder 2
19	3	PosCmd 0: StepCmd 1_3	PosStatus 0: Encoder 3
20	4	PosCmd 1: StepCmd 1_0	Not Available
21	5	PosCmd 1: StepCmd 1_1	Not Available
22	6	PosCmd 1: StepCmd 1_2	Not Available
23	7	PosCmd 1: StepCmd 1_3	PosStatus 1: Encoder 3
24	8	PosCmd 2: StepCmd 1_0	Not Available
25	9	PosCmd 2: StepCmd 1_1	Not Available
26	10	PosCmd 2: StepCmd 1_2	Not Available
27	11	PosCmd 2: StepCmd 1_3	PosStatus 2: Encoder 3
28	12	PosCmd 3: StepCmd 1_0	PosStatus 3: Encoder 0
29	13	PosCmd 3: StepCmd 1_1	PosStatus 3: Encoder 1
30	14	PosCmd 3: StepCmd 1_2	PosStatus 3: Encoder 2
31	15	PosCmd 3: StepCmd 1_3	Not Available

Alternate Setups

The XMP-PULSE has a multitude of different possible configurations. The Resource Number is what determines where the feedback and step commands come from and this number is determined by the hardware setup. The user must know how the motor numbers are allocated and which motors are sharing a single motor block. Generally, a motor will never-have a Resource Number that is larger than its motor number.

The XMP-PULSE board does not have the capability to control servo motors. However, if a servo-configured expansion board is used with an XMP-PULSE main board, servo motors may be run alongside stepper motors. The maximum number of motors is always 32, regardless of the setup. Please contact MEI's Sales department to discuss possible main/expansion controller board configurations.

A sample setup using an XMP-PULSE in conjunction with an XMP expansion board is as follows:

- Number of Stepper Motors: 22. Motor->number, 0-13, 22-31 (XMP-PULSE-PCI)
- Number of Servo Motors: 8. Motor->numbers 14-21 (XMP-PCI)

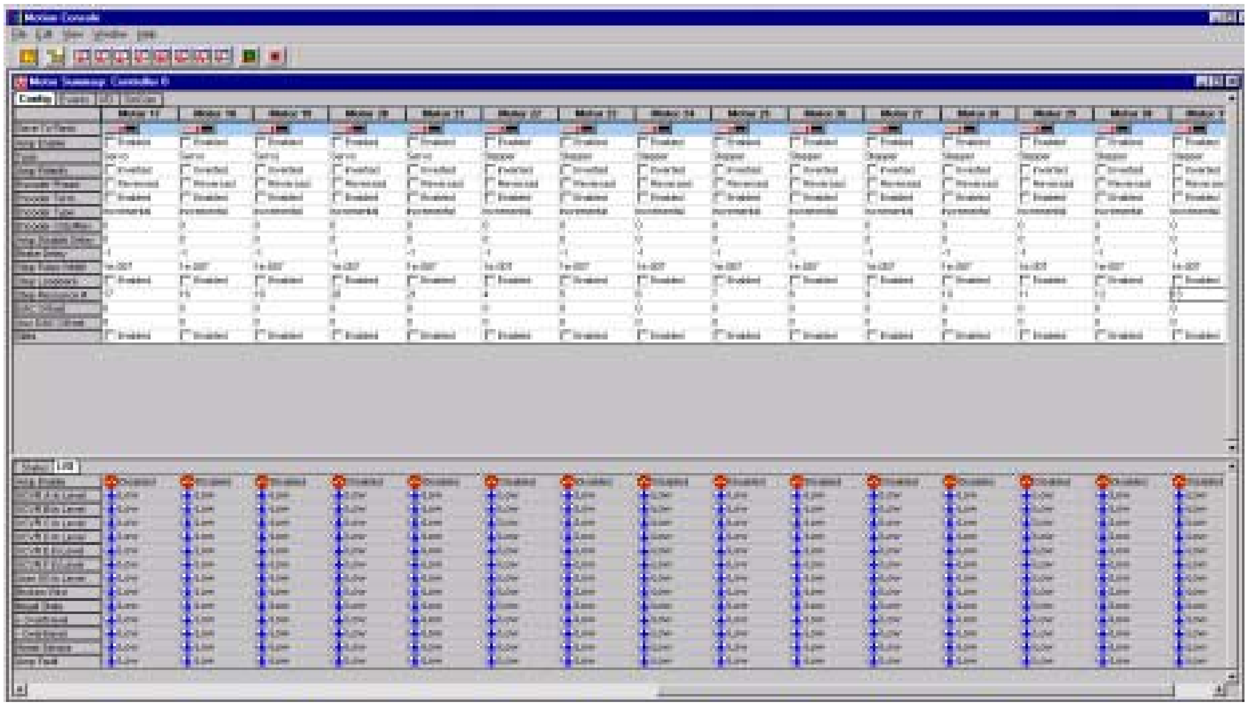
.

Table 17: Alternative Configuration

Motor #	Resource #	Command	Feedback
0	0	PosCmd 0: StepCmd 0_0	PosStatus 0: Encoder 0
1	1	PosCmd 0: StepCmd 0_1	PosStatus 0: Encoder 1
2	2	PosCmd 0: StepCmd 0_2	Not Available
3	3	PosCmd 0: StepCmd 0_3	Not Available
4	4	PosCmd 1: StepCmd 0_0	PosStatus 1: Encoder 0
5	5	PosCmd 1: StepCmd 0_1	PosStatus 1: Encoder 1
6	6	PosCmd 1: StepCmd 0_2	PosStatus 1: Encoder 2
7	7	PosCmd 1: StepCmd 0_3	Not Available
8	8	PosCmd 2: StepCmd 0_0	PosStatus 2: Encoder 0
9	9	PosCmd 2: StepCmd 0_1	PosStatus 2: Encoder 1
10	10	PosCmd 2: StepCmd 0_2	PosStatus 2: Encoder 2
11	11	PosCmd 2: StepCmd 0_3	Not Available
12	12	PosCmd 3: StepCmd 0_0	Not Available
13	13	PosCmd 3: StepCmd 0_1	Not Available*
14	NA	PosCmd 4: DAC 0	PosStatus 4: Encoder 0
15	NA	PosCmd 4: DAC 1	PosStatus 4: Encoder 1
16	NA	PosCmd 4: DAC 2	PosStatus 4: Encoder 2
17	NA	PosCmd 4: DAC 3	PosStatus 4: Encoder 1
18	NA	PosCmd 5: DAC 0	PosStatus 5: Encoder 0
19	NA	PosCmd 5: DAC 1	PosStatus 5: Encoder 1
20	NA	PosCmd 5: DAC 2	PosStatus 5: Encoder 2
21	NA	PosCmd 5: DAC 3	PosStatus 5: Encoder 3
22	4	PosCmd 1: StepCmd 1_0	Not Available*
23	5	PosCmd 1: StepCmd 1_1	Not Available*
24	6	PosCmd 1: StepCmd 1_2	Not Available*
25	7	PosCmd 1: StepCmd 1_3	PosStatus 1: Encoder 3
26	8	PosCmd 2: StepCmd 1_0	Not Available*
27	9	PosCmd 2: StepCmd 1_1	Not Available*
28	10	PosCmd 2: StepCmd 1_2	Not Available*
29	11	PosCmd 2: StepCmd 1_3	PosStatus 2: Encoder 3
30	12	PosCmd 3: StepCmd 1_0	PosStatus 3: Encoder 0
31	13	PosCmd 3: StepCmd 1_1	PosSatus 3: Encoder 1

*****Not Available – Position Loopback already being used by another Motor.

The **Motor Summary** screen below demonstrates how the alternative settings in Table 17 appear within the Motion Console utility. Motors 17 through 31 are displayed.



Motor Events and Limits

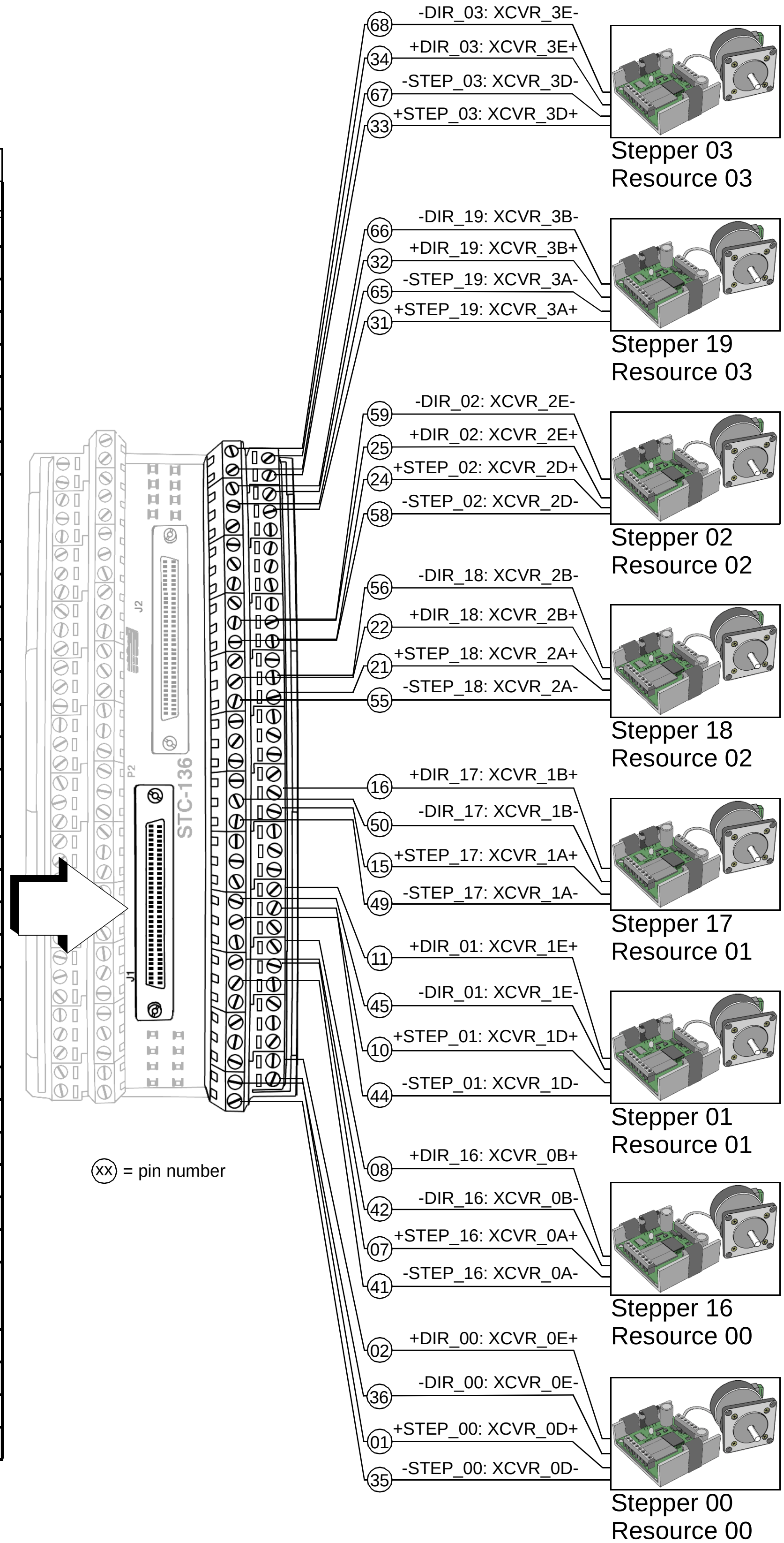
XMP Pulse has the ability to control two stepper motors with one motor block. This limits the available motor I/O. To expand the available I/O, the user is given the option of sharing opto-isolators among motors.

The software interface is simple. For a given Motor Event (i.e., Home, Amp Fault, +/- Overtravel) the User needs to set MEIMotorEventConfig.Condition[].SourceAddress and MEIMotorEventConfig.Condition[].Mask.

There is an enum (MEIMotorEventOpto) that can be used to set the Mask. The SourceAddress can be set by calling **meiMotorDedicated[In/Out]AddrGet()**, which returns the Dedicated I/O Source Address.

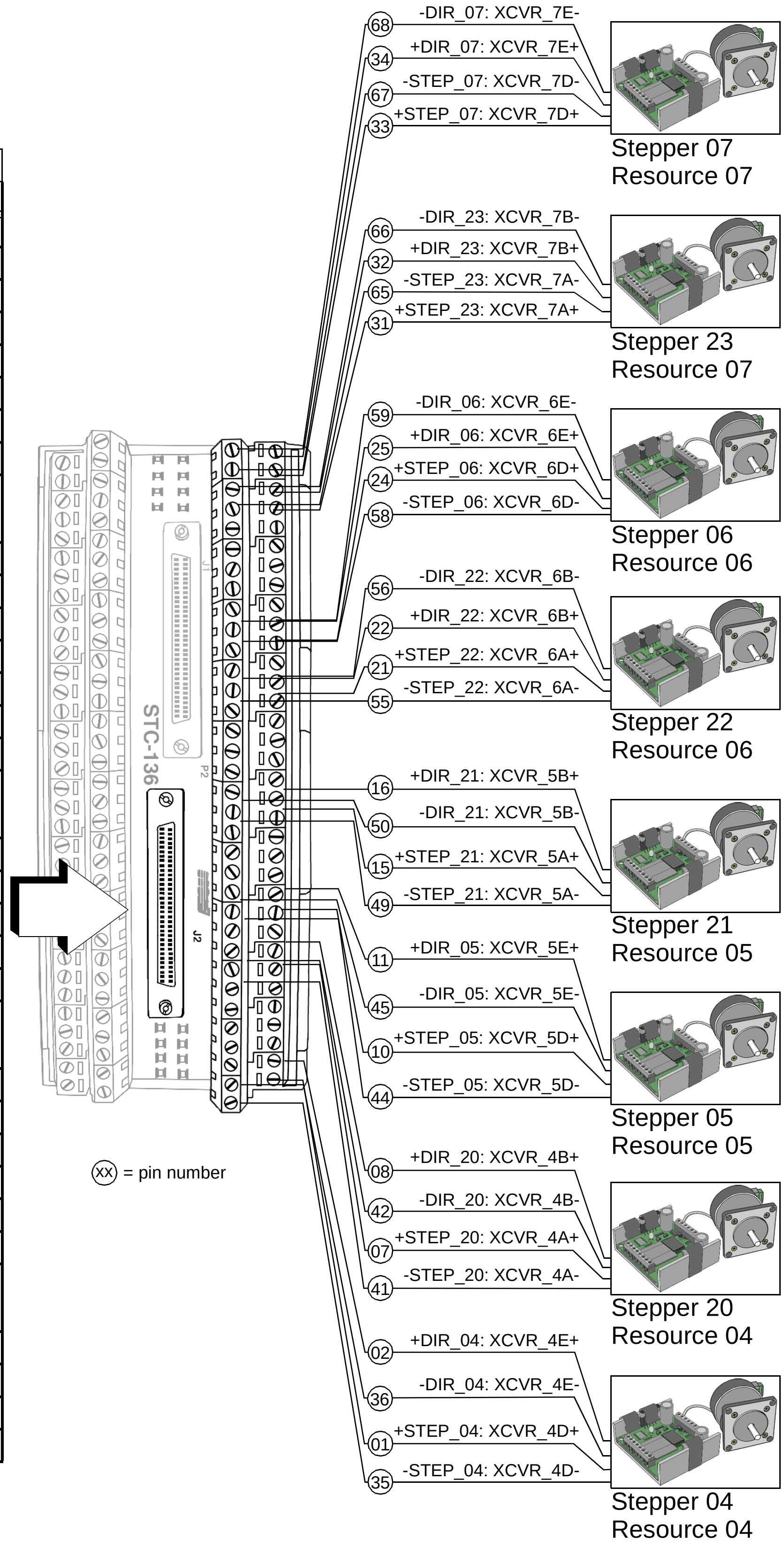
Software-Hardware Configuration: Axes 0-3, 16-19

J0-3 (Motor Blocks 0-3)			
Pin	Signal	Signal	Pin
1	XCVR0D+	XCVR0D-	35
2	XCVR0E+	XCVR0E-	36
3	GND	GND	37
4	OPTO0A+	OPTO0A-	38
5	OPTO0B+	OPTO0B-	39
6	OPTO0C+	OPTO0C-	40
7	XCVR0A+	XCVR0A-	41
8	XCVR0B+	XCVR0B-	42
9	OPTO0D+ or XCVR0C+	OPTO0D- or XCVR0C-	43
10	XCVR1D+	XCVR1D-	44
11	XCVR1E+	XCVR1E-	45
12	OPTO1A+	OPTO1A-	46
13	OPTO1B+	OPTO1B-	47
14	OPTO1C+	OPTO1C-	48
15	XCVR1A+	XCVR1A-	49
16	XCVR1B+	XCVR1B-	50
17	OPTO1D+ or XCVR1C+	OPTO1D+ or XCVR1C-	51
18	OPTO2A+	OPTO2A-	52
19	OPTO2B+	OPTO2B-	53
20	OPTO2C+	OPTO2C-	54
21	XCVR2A+	XCVR2A-	55
22	XCVR2B+	XCVR2B-	56
23	OPTO2D+ or XCVR2C+	OPTO2D- or XCVR2C-	57
24	XCVR2D+	XCVR2D-	58
25	XCVR2E+	XCVR2E-	59
26	OPTO3A+	OPTO3A-	60
27	OPTO3B+	OPTO3B-	61
28	GND	GND	62
29	OPTO3C+	OPTO3C-	63
30	OPTO3D+ or XCVR3C+	OPTO3D+ or XCVR3C-	64
31	XCVR3A+	XCVR3A-	65
32	XCVR3B+	XCVR3B-	66
33	XCVR3D+	XCVR3D-	67
34	XCVR3E+	XCVR3E-	68



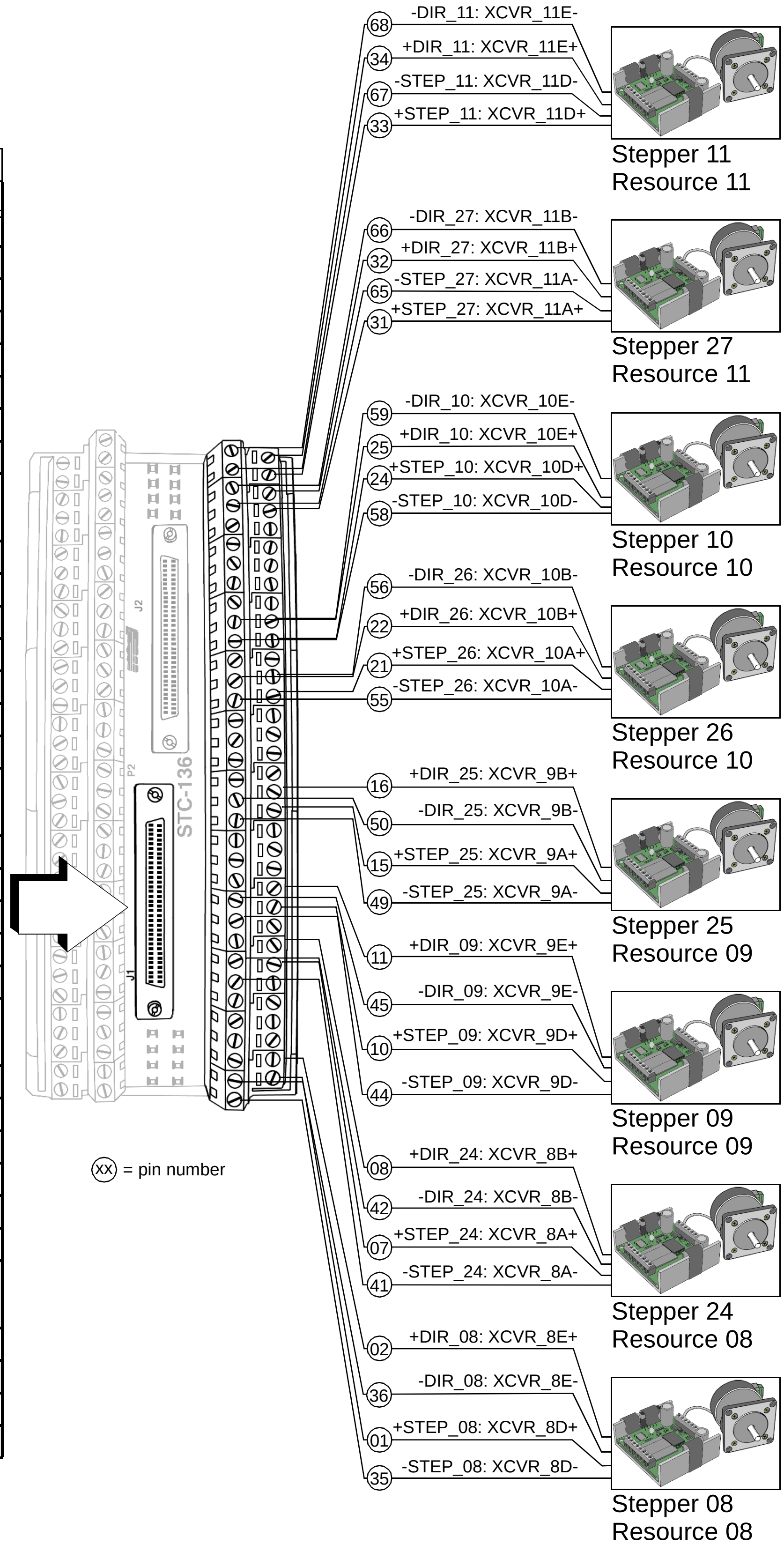
Software-Hardware Configuration: Axes 4-7, 20-23

J4-7 (Motor Blocks 4-7)			
Pin	Signal	Signal	Pin
1	XCVR4D+	XCVR4D-	35
2	XCVR4E+	XCVR4E-	36
3	GND	GND	37
4	OPTO4A+	OPTO4A-	38
5	OPTO4B+	OPTO4B-	39
6	OPTO4C+	OPTO4C-	40
7	XCVR4A+	XCVR4A-	41
8	XCVR4B+	XCVR4B-	42
9	OPTO4D+ or XCVR4C+	OPTO4D- or XCVR4C-	43
10	XCVR5D+	XCVR5D-	44
11	XCVR5E+	XCVR5E-	45
12	OPTO5A+	OPTO5A-	46
13	OPTO5B+	OPTO5B-	47
14	OPTO5C+	OPTO5C-	48
15	XCVR5A+	XCVR5A-	49
16	XCVR5B+	XCVR5B-	50
17	OPTO5D+ or XCVR5C+	OPTO5D+ or XCVR5C-	51
18	OPTO6A+	OPTO6A-	52
19	OPTO6B+	OPTO6B-	53
20	OPTO6C+	OPTO6C-	54
21	XCVR6A+	XCVR6A-	55
22	XCVR6B+	XCVR6B-	56
23	OPTO6D+ or XCVR6C+	OPTO6D- or XCVR6C-	57
24	XCVR6D+	XCVR6D-	58
25	XCVR6E+	XCVR6E-	59
26	OPTO7A+	OPTO7A-	60
27	OPTO7B+	OPTO7B-	61
28	GND	GND	62
29	OPTO7C+	OPTO7C-	63
30	OPTO7D+ or XCVR7C+	OPTO7D+ or XCVR7C-	64
31	XCVR7A+	XCVR7A-	65
32	XCVR7B+	XCVR7B-	66
33	XCVR7D+	XCVR7D-	67
34	XCVR7E+	XCVR7E-	68



Software-Hardware Configuration: Axes 8-11, 24-27

J8-11 (Motor Blocks 8-11)			
Pin	Signal	Signal	Pin
1	XCVR8D+	XCVR8D-	35
2	XCVR8E+	XCVR8E-	36
3	GND	GND	37
4	OPTO8A+	OPTO8A-	38
5	OPTO8B+	OPTO8B-	39
6	OPTO8C+	OPTO8C-	40
7	XCVR8A+	XCVR8A-	41
8	XCVR8B+	XCVR8B-	42
9	OPTO8D+ or XCVR8C+	OPTO8D- or XCVR8C-	43
10	XCVR9D+	XCVR9D-	44
11	XCVR9E+	XCVR9E-	45
12	OPTO9A+	OPTO9A-	46
13	OPTO9B+	OPTO9B-	47
14	OPTO9C+	OPTO9C-	48
15	XCVR9A+	XCVR9A-	49
16	XCVR9B+	XCVR9B-	50
17	OPTO9D+ or XCVR9C+	OPTO9D+ or XCVR9C-	51
18	OPTO10A+	OPTO10A-	52
19	OPTO10B+	OPTO10B-	53
20	OPTO10C+	OPTO10C-	54
21	XCVR10A+	XCVR10A-	55
22	XCVR10B+	XCVR10B-	56
23	OPTO10D+ or XCVR10C+	OPTO10D- or XCVR10C-	57
24	XCVR10D+	XCVR10D-	58
25	XCVR10E+	XCVR10E-	59
26	OPTO11A+	OPTO11A-	60
27	OPTO11B+	OPTO11B-	61
28	GND	GND	62
29	OPTO11C+	OPTO11C-	63
30	OPTO11D+ or XCVR11C+	OPTO11D+ or XCVR11C-	64
31	XCVR11A+	XCVR11A-	65
32	XCVR11B+	XCVR11B-	66
33	XCVR11D+	XCVR11D-	67
34	XCVR11E+	XCVR11E-	68



Software-Hardware Configuration: Axes 12-15, 28-31

J12-15 (Motor Blocks 12-15)			
Pin	Signal	Signal	Pin
1	XCVR12D+	XCVR12D-	35
2	XCVR12E+	XCVR12E-	36
3	GND	GND	37
4	OPTO12A+	OPTO12A-	38
5	OPTO12B+	OPTO12B-	39
6	OPTO12C+	OPTO12C-	40
7	XCVR12A+	XCVR12A-	41
8	XCVR12B+	XCVR12B-	42
9	OPTO12D+ or XCVR12C+	OPTO12D- or XCVR12C-	43
10	XCVR13D+	XCVR13D-	44
11	XCVR13E+	XCVR13E-	45
12	OPTO13A+	OPTO13A-	46
13	OPTO13B+	OPTO13B-	47
14	OPTO13C+	OPTO13C-	48
15	XCVR13A+	XCVR13A-	49
16	XCVR13B+	XCVR13B-	50
17	OPTO13D+ or XCVR13C+	OPTO13D+ or XCVR13C-	51
18	OPTO14A+	OPTO14A-	52
19	OPTO14B+	OPTO14B-	53
20	OPTO14C+	OPTO14C-	54
21	XCVR14A+	XCVR14A-	55
22	XCVR14B+	XCVR14B-	56
23	OPTO14D+ or XCVR14C+	OPTO14D- or XCVR14C-	57
24	XCVR14D+	XCVR14D-	58
25	XCVR14E+	XCVR14E-	59
26	OPTO15A+	OPTO15A-	60
27	OPTO15B+	OPTO15B-	61
28	GND	GND	62
29	OPTO15C+	OPTO15C-	63
30	OPTO15D+ or XCVR15C+	OPTO15D+ or XCVR15C-	64
31	XCVR15A+	XCVR15A-	65
32	XCVR15B+	XCVR15B-	66
33	XCVR15D+	XCVR15D-	67
34	XCVR7E+	XCVR7E-	68