Xenus PLUS 2-Axis MACRO

Rev 01 **XM2**

DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

CONTROL MODES
- Indexer, Point-to-Point, PVT
- Camming, Gearing
- Position, Velocity, Torque

COMMAND INTERFACE
- MACRO
- ASCII and discrete I/O
- Stepper commands
- ±10V position/velocity/torque (2 inputs)
- PWM velocity/torque command
- Master encoder (Gearing/Camming)

COMMUNICATIONS
- MACRO
- RS-232

FEEDBACK

Incremental
- Digital quad A/B encoder
- Analog sin/cos encoder
- Panasonic Incremental A
- Aux. encoder / encoder out

Absolute
- SSI
- EnDat 2.1 & 2.2
- Absolute A
- Tamagawa Absolute A
- Panasonic Absolute A Format
- BiSS (B&C)

Other
- Digital Halls

I/O DIGITAL
- 12 High-speed inputs
- 2 Motor over-temp inputs
- 8 Opto-isolated inputs
- 5 Opto-isolated outputs
- 2 Opto-isolated motor brake outputs

I/O ANALOG
- 2 Reference inputs, 14-bit

SAFE TORQUE OFF (STO)
- SIL 3, Category 3, PL d

DIMENSIONS: IN [MM]
- 9.24 x 5.42 x 3.59 [234.7 x 137.6 x 91.1]

Model	Vac	Ic	Ip
XM2-230-20	100~240	10	20

DESCRIPTION

The *XM2 Xenus Plus 2-Axis MACRO* is a high-performance, AC powered drive for torque and velocity control of brushless and brush motors via MACRO (Motion And Control Ring Optical). MACRO is a high bandwidth, nonproprietary fiber optic or wired field bus protocol for machine control networks. Connections to a MACRO ring are via SC-type fiber optic connectors. MACRO address selection is via two rotary switches for Master and Node addresses.

The *XM2 Xenus Plus 2-Axis MACRO* set new levels of performance, connectivity, and flexibility via the MACRO interface. A wide range of absolute interfaces are built-in including EnDat, SSI, BiSS, and Absolute A.

High resolution A/D converters ensure optimal current loop performance. Both isolated and high-speed non-isolated I/O are provided. For safety critical applications, redundant power stage enable inputs (STO) can be employed. In addition to the MACRO interface, torque and velocity control is also supported via an analog input with a ±10 Vdc range.

GENERAL SPECIFICATIONS

Test conditions: Wye connected load: 2 mH line-line. Ambient temperature = 40° C

MODEL	XM2-230-20	
OUTPUT CURRENT (Each Axis)		0~40 C Ambient
Peak Current	20 (14)	Adc (Arms, sinusoidal)
Peak time	1	s
Continuous current	10 (7)	Adc (Arms, sinusoidal)
INPUT POWER		
Mains voltage, frequency	100~240	Vac, 50/60 Hz
Mains current	18	Arms, 1 Ø
	14	Arms, 3 Ø
Inrush current	20 Apeak @ 120 Vac, 40 Apeak @ 240 Vac, 40 ms	All models
Control power	+24 Vdc, ±10%	Required for operation
	10 W (Typ, no load on encoder +5V outputs), ≤ 28 W, (Max, all four encoder +5V @ 500 mA)	

DIGITAL CONTROL		
Digital Control Loops	Current, velocity, position. 100% digital loop control	
Sampling rate (time)	Current loop: 16 kHz (62.5 µs), Velocity & position loops: 4 kHz (250 µs)	
Bus voltage compensation	Changes in bus or mains voltage do not affect bandwidth	
Minimum load inductance	200 µH line-line	
COMMAND INPUTS (NOTE: DIGITAL INPUT FUNCTIONS ARE PROGRAMMABLE)		
Distributed Control Modes		
MACRO	Velocity, Torque	
Stand-alone mode		
Analog torque, velocity, position reference	±10 Vdc, 14 bit resolution	Dedicated differential analog input
Digital position reference	Pulse/Direction, CW/CCW	Stepper commands (2 MHz maximum rate)
	Quad A/B Encoder	2 M line/sec, 8 Mcount/sec (after quadrature)
Digital torque & velocity reference	PWM , Polarity	PWM = 0% - 100%, Polarity = 1/0
	PWM 50%	PWM = 50% ±50%, no polarity signal required
	PWM frequency range	1 kHz minimum, 100 kHz maximum
	PWM minimum pulse width	220 ns
Indexing	Up to 32 sequences can be launched from inputs or ASCII commands.	
Camming	Up to 10 CAM tables can be stored in flash memory	
ASCII	RS-232, 9600~115,200 Baud, 3-wire, RJ-12 connector	

DIGITAL INPUTS	
Number	22
[IN1,11]	Digital, Schmitt trigger, 1.5 µs RC filter, 24 Vdc compatible, 15kΩ programmable pull-up/down to +5 Vdc/ground, Vt+ = 2.5~3.5 Vdc, VT- = 1.3~2.2 Vdc, VH = 0.7~1.5 Vdc
[IN21, 22]	Same specs as IN1 & IN11, but with fixed 15 kΩ pull-up to +5 Vdc
[IN2~5,12~15]	Programmable as single-ended or differential pairs, 100 ns RC filter, 5 Vdc max, 10 kΩ programmable pull-up/down per input to +5 Vdc/ground, SE: Vin-LO ≤ 2.3 Vdc, Vin-HI ≥ 2.7 Vdc, VH = 45 mV typ, DIFF: Vin-LO ≤ 200 mVdc, Vin-HI ≥ 200 mVdc, VH = 45 mV typ,
[IN6~9,16~19]	Opto-isolated, single-ended, ±15~30 Vdc compatible, bi-polar, 2 groups of 4 with common return for each group Rated impulse ≥ 800 V, Vin-LO ≤ 6.0 Vdc, Vin-HI ≥ 10.0 Vdc, Input current ±3.6 mA @ ±24 Vdc, typical
[IN10,20]	Motor overtemp signals on feedback connectors, , Schmitt trigger, 24 Vdc compatible 330 µs RC filter, 4.99k pullup to +5 Vdc, Vt+ = 2.5~3.5 Vdc, VT- = 1.3~2.2 Vdc, VH = 0.7~1.5 Vdc
ANALOG INPUTS	
Number	2
[AIN1~2]	Differential, ±10 Vdc, 5 kΩ input impedance, 14-bit resolution
SAFE TORQUE OFF (STO)	
Function	PWM outputs are inactive and current to the motor will not be possible when the STO function is asserted
Standard	Designed to IEC-61508-1, IEC-61508-2, IEC-61800-5-2, ISO-13849-1
Safety Integrity Level	SIL 3, Category 3, Performance level d
Inputs	2 two-terminal: STO-IN1+,STO-IN1-, STO-IN2+, STO-IN2-
Type	Opto-isolators, 24V compatible, Vin-LO ≤ 6.0 Vdc or open, Vin-HI ≥ 15.0 Vdc,
Input current (typical)	STO-IN1: 9.0 mA, STO-IN2: 4.5 mA
Response time	2 ms from Vin ≤6.0 Vdc to interruption of energy supplied to motor
Reference	***Complete information and specifications are in the Xenus Plus 2-Axis STO Manual***
RS-232 PORT	
Signals	RxD, TxD, Gnd in 6-position, 4-contact RJ-11 style modular connector
Mode	Full-duplex, DTE serial communication port for drive setup and control, 9,600 to 115,200 baud
Protocol	Binary and ASCII formats
DIGITAL OUTPUTS	
Number	7
[OUT1~5]	Opto-isolated SSR, two-terminal, 300 mA max, 24 V tolerant, Rated impulse ≥ 800 V, series 20 Ω resistor
[OUT6~7]	Motor brake control: opto-isolated, current-sinking with flyback diode to +24 Vdc, 1 Adc max
ETHERCAT PORTS	
Format	Dual RJ-45 receptacles, 100BASE-TX
Protocol	EtherCAT, CAN application layer over EtherCAT (CoE)
STATUS INDICATOR LEDS	
Drive Status	Bicolor LED, drive status indicated by color, and blinking or non-blinking condition
CAN Status	Bicolor LED, status of CAN bus indicated by color and blink codes to CAN Indicator Specification 303-3
5V OUTPUT	
Number	4, two on the feedback connectors (J10, J11), two on the control connector (J12) for the A and B multi-mode ports
Ratings	+5 Vdc @ 500 mA, thermal and overload protected, each output. 2000 mA total for all four outputs

GENERAL SPECIFICATIONS

REGENERATION		
Operation	Internal solid-state switch drives external regen resistor (see Ordering Guide for types)	
Cut-In Voltage	+HV > 390 Vdc	Regen output is on, (optional external) regen resistor is dissipating energy
Drop-Out Voltage	+HV < 380 Vdc	Regen output is off, (optional external) regen resistor not dissipating energy
Tolerance	±2 Vdc	For either Cut-In or Drop-Out voltage
PROTECTIONS		
HV Overvoltage	+HV > 400 Vdc	Drive PWM outputs turn off until +HV is less than overvoltage
HV Undervoltage	+HV < 60 Vdc	Drive PWM outputs turn off until +HV is greater than undervoltage
Drive over temperature	IGBT > 80 °C ±3 °C	Drive PWM outputs turn off until IGBT temperature is below threshold
Short circuits	Output to output, output to ground, internal PWM bridge faults	
I^2T Current limiting	Programmable: continuous current, peak current, peak time	
Motor over temperature	Programmable input to disable drive when voltage is above or below a set point 0~5 Vdc	
Feedback power loss	Fault occurs if feedback is removed or +5 V is <85% of normal	
MECHANICAL & ENVIRONMENTAL		
Size	9.24 x 5.42 x 3.59 [234.7 x 137.6 x 91.1] in[mm]	
Weight	4.19 lb [1.90kg]	
Ambient temperature	0 to +40 °C operating, -40 to +85 °C storage	
Humidity	0% to 95%, non-condensing	
Contaminants	Pollution degree 2	
Vibration	2 *g* peak, 10~500 Hz (sine), IEC60068-2-6	
Shock	10 *g*, 10 ms, half-sine pulse, IEC60068-2-27	
Environment	IEC68-2: 1990	

AGENCY STANDARDS CONFORMANCE

Approvals

UL and cUL recognized component to UL 61800-5-1 (file no. E168959)
TÜV SÜD Functional Safety to IEC 61508 and ISO 13849 <pending>

Functional Safety

IEC 61508-1, IEC 61508-2, EN (ISO) 13849-1, EN (ISO) 13849-2, IEC 61800-5-2
(see The Xenus Plus Dual-Axis STO Manual for further detail)

Electrical Safety

Directive 2006/95/EC – Low Voltage: IEC 61800-5-1:2007
UL 61800-5-1-2012

EMC

Directive 2004/108/EC – EMC:
IEC 61800-3:2004+A1:2011

16-01419 Document Revision History

Revision	Date	Remarks
A	October 21, 2015	Initial released version

SAFE TORQUE OFF (STO)		
Inputs	2 two-terminal: [ENH+], [ENH-], [ENL+], [ENL-]	
Type	Opto-isolators, 24V compatible	
Output	1 two-terminal: [LED+], [LED-]	
	24V compatible	

GENERAL SPECIFICATIONS

FEEDBACK

Incremental:

Digital Incremental Encoder — Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required)
5 MHz maximum line frequency (20 M counts/sec)
MAX3097 differential line receiver with 121 Ω terminating resistor between complementary inputs

Analog Incremental Encoder — Sin/cos format (sin+, sin-, cos+, cos-), differential, 1 Vpeak-peak,
ServoTube motor compatible, BW > 300 kHz, 121 Ω terminating resistor between complementary inputs

Analog Index signal — Differential, 121 Ω terminating resistor between complementary inputs, 1 Vpeak-peak zero-crossing detect

Absolute:

SSI — Clock (X, /X), Data (S, /S) signals, 4-wire, clock output from XM2, data returned from encoder

EnDAT — Clock (X, /X), Data (S, /S), sin/cos (sin+, sin-, cos+, cos-) signals

Absolute A, Tamagawa Absolute A, Panasonic Absolute A Format
SD+, SD- (S, /S) signals, 2.5 or 4 MHz, 2-wire half-duplex communication
position feedback: 13-bit resolution per rev, 16 bit revolution counter (29 bit absolute position data)
status data for encoder operating conditions and errors

BiSS (B&C) — MA+, MA- (X, /X), SL+, SL- (S, /S) signals, 4-wire, clock output from XM2, data returned from encoder

DIGITAL HALLS

Type — Digital, single-ended, 120° electrical phase difference between U-V-W signals,
Schmitt trigger, 1 µs RC filter, 24 Vdc compatible, programmable pull-up/down to +5 Vdc/ground,
Vt+ = 2.5~3.5 Vdc, VT- = 1.3~2.2 Vdc, VH = 0.7~1.5 Vdc

Inputs — 10 kΩ pullups to +5 Vdc, 1 µs RC filter to Schmitt trigger inverters

MULTI-MODE ENCODER PORT

As Input — Digital quadrature encoder (A, /A, B, /B, X, /X), 121 Ω terminating resistors between A & /A, B & /B inputs
18 M-counts/sec, post-quadrature (4.5 M-lines/sec)
Digital absolute encoder (Clk, /Clk, Dat, /Dat) half or full-duplex operation, 121 Ω terminating resistors

As Emulated Output — Quadrature encoder emulation with programmable resolution to 4096 lines (65,536 counts) per rev
from analog sin/cos encoders
A, /A, B, /B, outputs from MAX3032 differential line driver, X, /X, S, /S outputs from MAC3362 drivers

As Buffered Output — Digital encoder feedback signals from primary digital encoder are buffered by MAX3032 line driver

ENCODER POWER SUPPLIES

Number — 4, two on the feedback connectors (J10, J11), two on the control connector (J12)
for the A and B multi-mode ports

Ratings — +5 Vdc @ 500 mA, thermal and overload protected, each output. 2000 mA total for all four outputs)

OPTIONS

XTL-FA-01 Edge Filter — One used for each motor output. A passive R-L-C filter that reduces capacitive coupling of PWM outputs
to adjacent cabling by lengthening the rise/fall times and providing common-mode filtering of the
PWM outputs. Typically used in systems that have servo drives operating near other cables
carrying low-amplitude sensor or video signals.
Further details on the XTL-RA-04 can be found in the *Xenus Regeneration Guide* on the Copley Controls web-site
http://www.copleycontrols.com/Motion/pdf/Xenus_regen_guide-03-04.pdf

XTL-RA-04 Regen Resistor — Used when the regenerative energy from a moving load is greater than the absorption
capacity of the internal regen resistor. 15 Ω, 65 W default continuous power, 400 W max continuous power
10 kW peak power, 1000 ms peak power time.
Further details on the XTL-FA-01 can be found in the *XTL-FA-01 Edge Filter for Xenus User Guide* on the
Copley Controls web-site: http://www.copleycontrols.com/Motion/pdf/Xenus-Filter.pdf

Note!
When you see this marker, it's for hot tips or best practices that will
help you get the best results when using Copley Controls products.

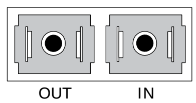
MACRO COMMUNICATIONS

MACRO (Motion And Control Ring Optical) is a non-proprietary communications network that uses optical fibre or copper cabling and supports bit-rates up to 125 Mb/sec. The Xenus Plus MACRO (XM2) uses the optical fibre interface and operates typically as a torque drive. Velocity drive mode is also supported.
More information on MACRO can be found on the organization web-site: http://www.macro.org/index.html

MACRO CONNECTIONS

Dual SC sockets accept standard optical fiber. The IN port connects to a master, or to the OUT port of a device that is 'upstream', between the XM2 and the master. The OUT port connects to 'downstream' nodes. If XM2 is the last node on a network, only the IN port is used. No terminator is required on the OUT port.

J7: MACRO PORT
Duplex type SC
optical fiber connector



MACRO ADDRESS

A PMAC card can hold up to four MACRO IC's each of which is a master on a MACRO ring. Each master IC can address 16 stations (nodes, slaves) enabling the addressing of up to 64 devices on a ring. Of these, 32 can be motion devices such as XM2.

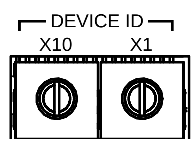
A node address is an 8-bit value with bits 7~4 addressing the master IC and bits 3~0 addressing the slave. Switch S1 is set to select the master IC to which the Xenus will be linked. The four possible values for this setting are 0,1,2, and 3.

As a MACRO station or node the XM2 has eight available addresses as a motion control device. These are 0,1,4,5,8,9,12, & 13. Addresses 2,3,6,7,10, & 11 are for I/O stations and addresses 14 & 15 are reserved. The table shows the available selections for S2. Boxes greyed-out are invalid selections and have no function.
The switch positions are numbered in hexadecimal. The chart shows these positions with the slave address shown in decimal.

Example: Configure the XM2 as node 36 (0x24)

The XM2 will be node 4 controlled by master IC 2 on the PMAC
S1 = 2 (Master IC 2)
S2 = 4 (Slave address)

The S1 settings are in multiples of 16 (2^4), so 2 X 16 = 32.
The S2 settings are read directly equal 4.
This produces the node address of 2 x 16 + 4 = 36.



MACRO Node
Address Switches

Switch S1	
Master	
HEX	DEC
0	0
1	1
2	2
3	3

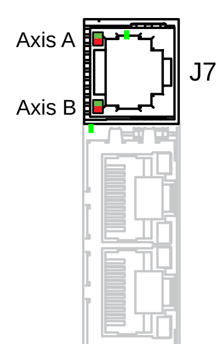
Switch S2	
Slave	
HEX	DEC
0	0
1	1
2	
3	
4	4
5	5
6	
7	
8	8
9	9
A	
B	
C	12
D	13
E	
F	

INDICATORS: DRIVE STATE

AXIS LEDS: DRIVE STATUS

A bi-color LED gives the state of each axis. Colors do not alternate, and can be solid ON or blinking.
When multiple conditions occur, only the top-most condition will be displayed.
When that condition is cleared the next one below will shown.

1) Red/Blinking = Latching fault. Operation will not resume until drive is Reset.
2) Red/Solid = Transient fault condition. Drive will resume operation when the condition causing the fault is removed.
3) Green/Double-Blinking = STO circuit active, drive outputs are Safe-Torque-Off
4) Green/Slow-Blinking = Drive OK but NOT-enabled. Will run when enabled.
5) Green/Fast-Blinking = Positive or Negative limit switch active. Drive will only move in direction not inhibited by limit switch.
7) Green/Solid = Drive OK and enabled. Will run in response to MACRO commands or analog input.



Latching Faults

Default
- Short circuit (Internal or external)
- Drive over-temperature
- Motor over-temperature
- Feedback Error
- Following Error

Optional (programmable)
- Over-voltage
- Under-voltage
- Motor Phasing Error
- Command Input Fault

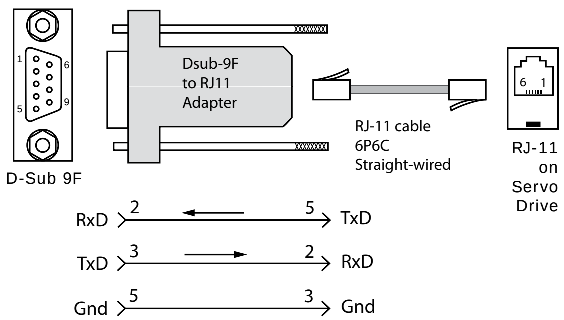
COMMUNICATIONS: RS-232 SERIAL

RS-232 COMMUNICATIONS

XM2 is configured via a three-wire, full-duplex DTE RS-232 port that operates from 9600 to 115,200 Baud, 8 bits, no parity, and one stop bit. Signal format is full-duplex, 3-wire, DTE using RxD, TxD, and Gnd. Connections to the *XM2* RS-232 port are through J7, an RJ-11 connector. The *XM2* Serial Cable Kit (SER-CK) contains a modular cable, and an adapter that connects to a 9-pin, Sub-D serial port connector (COM1, COM2, etc.) on PC's and compatibles.

SER-CK SERIAL CABLE KIT

The SER-CK provides connectivity between a D-Sub 9 male connector and the RJ-11 connector on the XM2. It includes an adapter that plugs into the COM1 (or other) port of a PC and uses common modular cable to connect to the XM2. The connections are shown in the diagram below.



Don't forget to order a Serial Cable Kit SER-CK when placing your order for an XM2!

ASCII COMMUNICATION PROTOCOL

ASCII COMMUNICATIONS

The Copley ASCII Interface is a set of ASCII format commands that can be used to operate these drives over an RS-232 serial connection. For instance, after basic amplifier configuration values have been programmed using CME 2, a control program can use the ASCII Interface to:

- Enable the amplifier in Programmed Position mode.
- Home the axis.
- Issue a series of move commands while monitoring position, velocity, and other run-time variables.

The Baud rate defaults to 9,600 after power-on or reset and is programmable up to 115,200 thereafter.
After power-on, reset, or transmission of a Break character, the Baud rate will be 9,600. Once communication has been established at this speed, the Baud rate can be changed to a higher rate (19,200, 57,600, 115,200).
ASCII parameter 0x90 holds the Baud rate data. To set the rate to 115,200 enter this line from a terminal:

```
s r0x90 115200 <enter>
```

Then, change the Baud rate in the computer/controller to the new number and communicate at that rate.

Additional information can be found in the ASCII Programmers Guide on the Copley website:
http://www.copleycontrols.com/Motion/pdf/ASCII_ProgrammersGuide.pdf

Copley Controls, 20 Dan Road, Canton, MA 02021, USA

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SAFE TORQUE OFF (STO)

DESCRIPTION
The XM2 provides the Safe Torque Off (STO) function as defined in IEC 61800-5-2. Three opto-couplers are provided which, when de-energized, prevent the upper and lower devices in the PWM outputs from being operated by the digital control core. This provides a positive OFF capability that cannot be overridden by the control firmware, or associated hardware components. When the opto-couplers are activated (current is flowing in the input diodes), the control core will be able to control the on/off state of the PWM outputs.

INSTALLATION

DANGER	***Refer to the Xenus Plus Dual-Axis STO User Manual***
	The information provided in the Xenus Plus Dual-Axis STO User Manual must be considered for any application using the XM2 drive's STO feature. ***Failure to heed this warning can cause equipment damage, injury, or death.***

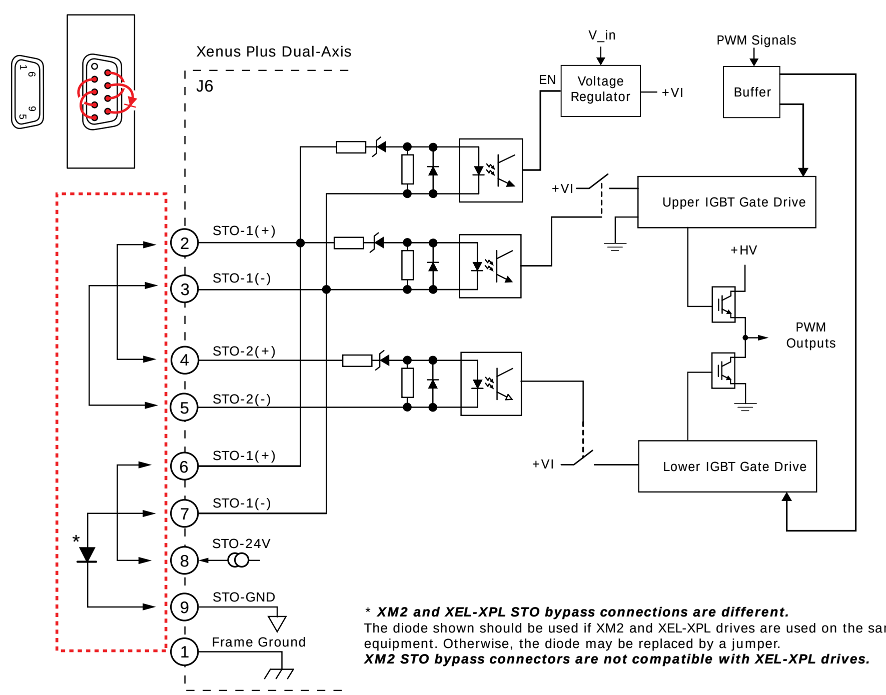
STO BYPASS (MUTING)
In order for the PWM outputs of the XM2 to be activated, current must be flowing through all of the opto-couplers that are connected to the STO-1 and STO-2 terminals of J6, and the drive must be in an ENABLED state. When the opto-couplers are OFF, the drive is in a Safe Torque Off (STO) state and the PWM outputs cannot be activated by the control core to drive a motor. This diagram shows connections that will energize all of the opto-couplers from an internal current-source. When this is done the STO feature is overridden and control of the output PWM stage is under control of the digital control core.
If not using the STO feature, these connections must be made in order for the XM2 to be enabled.

STO MUTING (BYPASS) CONNECTIONS

Note: STO applies to Axis-A AND Axis-B

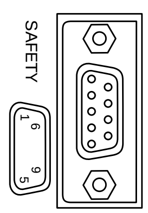
Current must flow through all of the opto-couplers before the XM2 can be enabled

* STO bypass connections on the XM2 and Xenus XEL/XPL/XML models are different. If both drives are installed in the same cabinet, the diode should be wired as shown to prevent damage that could occur if the STO bypass connectors are installed on the wrong drive. The diode is not required for STO bypass on the XM2 and can be replaced by a wire between pins 7 and 9.



**** XM2 and XEL-XPL STO bypass connections are different.***
The diode shown should be used if XM2 and XEL-XPL drives are used on the same equipment. Otherwise, the diode may be replaced by a jumper.
XM2 STO bypass connectors are not compatible with XEL-XPL drives.

SAFETY CONNECTOR J6



J6 SIGNALS

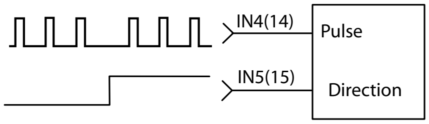
PIN	SIGNAL	PIN	SIGNAL
1	Frame Gnd	6	STO-1(+)
2	STO-1(+)	7	STO-1(-)
3	STO-1(-)	8	STO-24V
4	STO-2(+)	9	STO-GND
5	STO-2(-)		

DIGITAL COMMAND INPUTS: IN2, IN3, IN4, IN5, IN12, IN13, IN14, IN15

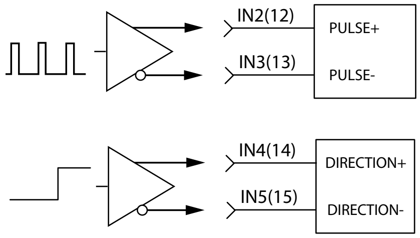
DIGITAL POSITION

Digital position commands can be in either single-ended or differential format. Single-ended signals should be sourced from devices with active pull-up and pull-down to take advantage of the high-speed inputs. Differential inputs have 121 Ω line-terminators.

SINGLE-ENDED PULSE & DIRECTION



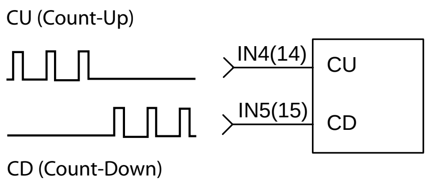
DIFFERENTIAL PULSE & DIRECTION



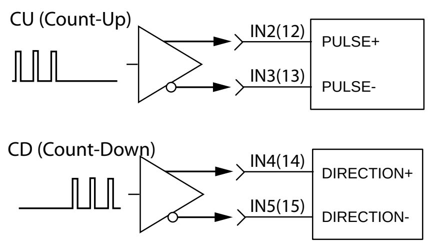
COMMAND SINGLE-ENDED

Signal	Axis A	Axis B
Pls, Enc A	J12-10	J12-15
Dir, Enc B	J12-11	J12-30
Sgnd	J12-6,16,22,31,37,44	
Shld	J12-1	

SINGLE-ENDED CU/CD



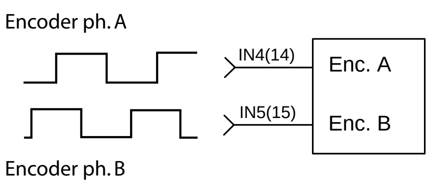
DIFFERENTIAL CU/CD



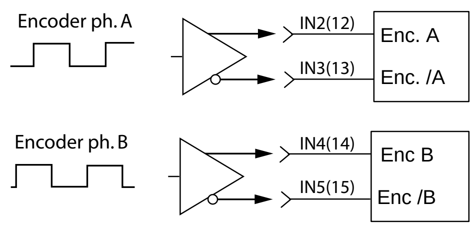
COMMAND DIFFERENTIAL

Signal	Axis A	Axis B
Pls, Enc A	J12-8	J12-13
/Pls, Enc /A	J12-9	J12-14
Dir, Enc B	J12-10	J12-15
/Dir, Enc /B	J12-11	J12-30
Sgnd	J12-6,16,22,31,37,44	
Shld	J12-1	

QUAD A/B ENCODER SINGLE-ENDED



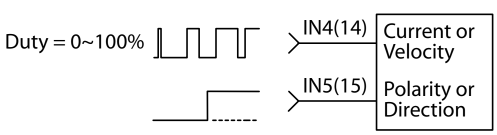
QUAD A/B ENCODER DIFFERENTIAL



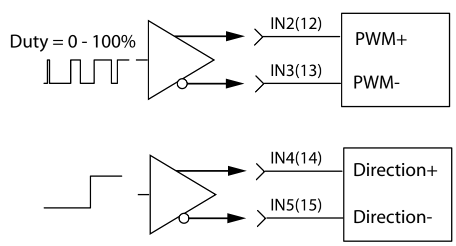
DIGITAL TORQUE, VELOCITY

Digital torque or velocity commands can be in either single-ended or differential format. Single-ended signals must be sourced from devices with active pull-up and pull-down to take advantage of the high-speed inputs.

SINGLE-ENDED PWM & DIRECTION



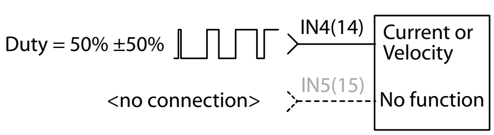
DIFFERENTIAL PWM & DIRECTION



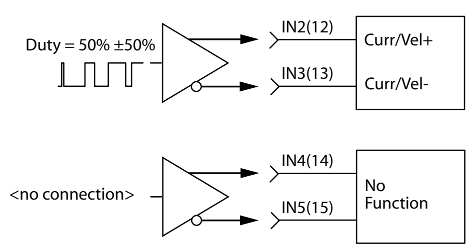
COMMAND SINGLE-ENDED

Signal	Axis A	Axis B
PWM	J12-10	J12-15
Dir	J12-11	J12-30
Sgnd	J12-6,16,22,31,37,44	
Shld	J12-1	

SINGLE-ENDED 50% PWM



DIFFERENTIAL 50% PWM



COMMAND DIFFERENTIAL

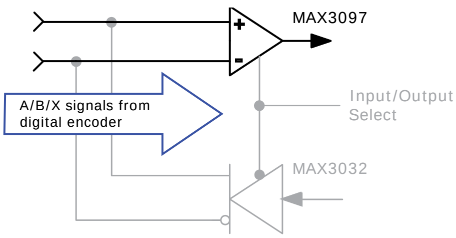
Signal	Axis A	Axis B
PWM	J12-8	J12-13
/PWM	J12-9	J12-14
Dir	J12-10	J12-15
/Dir	J12-11	J12-30
Sgnd	J12-6,16,22,31,37,44	
Shld	J12-1	

MULTI-MODE ENCODER PORT AS AN INPUT

INPUT TYPES

POSITION COMMAND INPUTS: DIFFERENTIAL

- Pulse & Direction
- CW & CCW (Clockwise & Counter-Clockwise)
- Encoder Quad A & B
- Camming Encoder A & B input

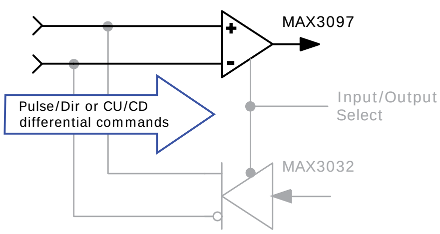


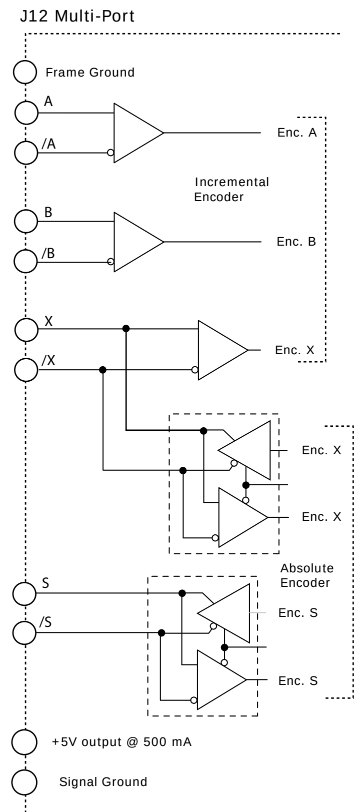
COMMAND INPUT
MULTI-PORT

Signal	Axis A	Axis B
Pls, Enc A	J12-36	J12-42
/Pls, Enc /A	J12-21	J12-27
Dir, Enc B	J12-35	J12-41
/Dir, Enc /B	J12-20	J12-26
Enc X	J12-34	J12-40
Enc /X	J12-19	J12-25
Sgnd	J12-6,16,22,31,37,44	
Shld	J12-1	

CURRENT or VELOCITY COMMAND INPUTS: DIFFERENTIAL

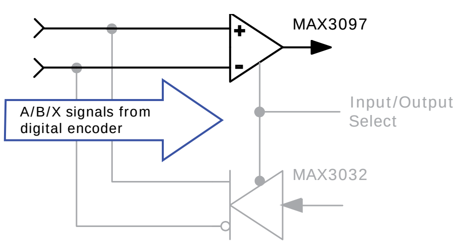
- Current or Velocity & Direction
- Current or Velocity (+) & Current or Velocity (-)





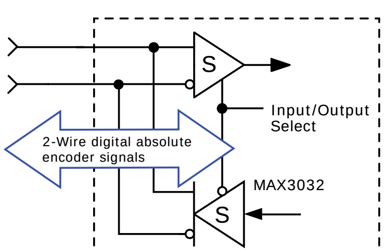
SECONDARY FEEDBACK: INCREMENTAL

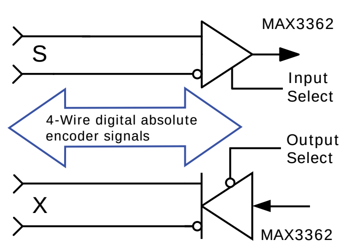
- Quad A/B/X incremental encoder
- Quad A/B emulated encoder from sin/cos encoder



SECONDARY FEEDBACK: ABSOLUTE

- S channel: Absolute A encoders (2-wire)
  The S channel first sends a Clock signal and then receives Data from the encoder in half-duplex mode.
- S & X channels: SSI, BiSS, EnDat encoders (4-wire)
  The X channel sends the Clock signal to the encoder, which initiates data transmission from the encoder on the S-channel in full-duplex mode



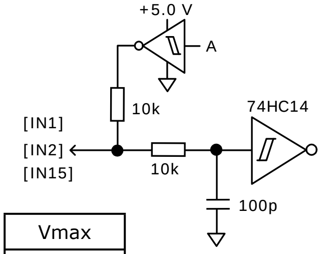


EMULATED QUAD A/B/X
MULTI-PORT

Signal	Axis A	Axis B
Enc A	J12-36	J12-42
Enc /A	J12-21	J12-27
Enc B	J12-35	J12-41
Enc /B	J12-20	J12-26
Enc X	J12-34	J12-40
Enc /X	J12-19	J12-25
Sgnd	J12-6,16,22,31,37,44	
Shld	J12-1	

GENERAL PURPOSE INPUTS

HS Inputs [IN1~2]
24 Vdc max



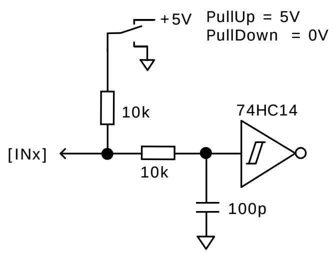
Vmax
+5V
±10
+12V
+24V
±24V

Input	Pin	R1	R2	C1	Vm
*IN1	J12-7	15k	10k	100p	+24
*IN2	J12-8	10k	1k	100p	+12
*IN3	J12-9				
*IN4	J12-10				
*IN5	J12-11				
IN6	J9-2	Opto			±24
IN7	J9-3				
IN8	J9-4				
IN9	J9-5				
ICOM1	J9-6				
IN10	J10-7	4.99k	10k	33n	+24
IN21	J10-24	15k	10k	100p	

Input	Pin	R1	R2	C1	Vm
*IN11	J12-12	15k	10k	100p	+24
*IN12	J12-13	10k	1k	100p	+12
*IN13	J12-14				
*IN14	J12-15				
*IN15	J12-30				
IN16	J9-7	Opto			±24
IN17	J9-8				
IN18	J9-9				
IN19	J9-18				
ICOM2	J9-17				
IN20	J11-7	4.99k	10k	33n	+24
IN22	J11-24	15k	10k	100p	

* PROGRAMMABLE PULL UP/DOWN

The input resistor of these inputs is programmable to pull-up to +5V or pull-down to 0V. Pull-up is the default and works with current-sinking outputs from a controller. Pull-down works with current-sourcing outputs, typically PLC's that drive grounded loads. Six of the inputs have individually settable PU/PD. The other four have PU/PD control for pairs of inputs.



INPUTS WITH PROGRAMMABLE PULL UP/DOWN

Input	Pin	PU/PD
IN1	J12-7	1
IN2	J12-8	2
IN3	J12-9	3
IN4	J12-10	4
IN5	J12-11	

Input	Pin	PU/PD
IN11	J12-12	5
IN12	J12-13	6
IN13	J12-14	7
IN14	J12-15	8
IN15	J12-30	

SINGLE-ENDED/DIFFERENTIAL DIGITAL INPUTS [IN2~5,12~15]

These inputs have all the programmable functions of the GP inputs plus these additional functions which can be configured as single-ended (SE) or differential (DIFF):

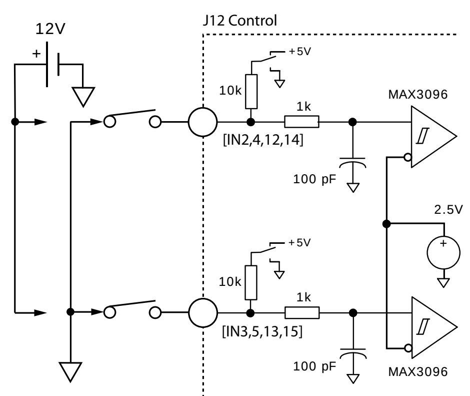
- PWM 50%, PWM & Direction for Velocity or Current modes
- Pulse/Direction, CU/CD, or A/B Quad encoder inputs for Position or Camming modes

[IN2~5,12~15] SIGNALS

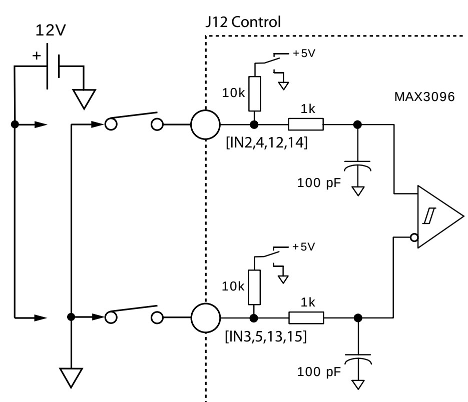
S.E. Input	Diff Input	Pin
IN2	IN2+	J12-8
IN3	IN2-	J12-9
IN4	IN4+	J12-10
IN5	IN4-	J12-11

S.E. Input	Diff Input	Pin
IN12	IN12+	J12-13
IN13	IN12-	J12-14
IN14	IN14+	J12-15
IN15	IN14-	J12-30

SINGLE-ENDED
12 Vdc max



DIFFERENTIAL
12 Vdc max



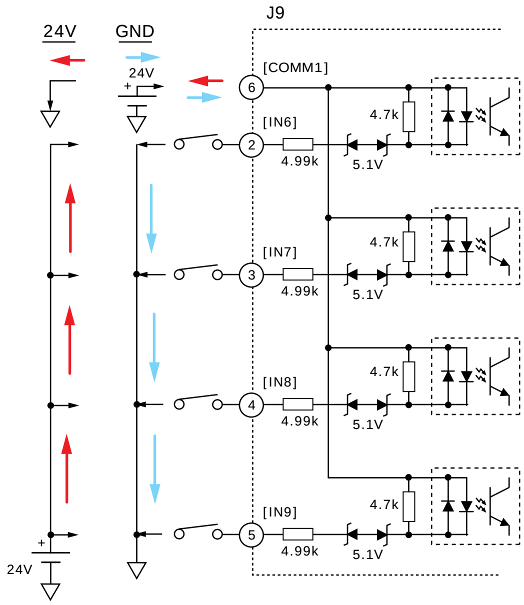
PLC outputs are frequently current-sourcing from 24V for driving grounded loads. PC based digital controllers commonly use NPN or current-sinking outputs. Set the Xenus inputs to pull-down to ground for current-sourcing connections, and to pull-up to 5V for current-sinking connections.

OPTO-ISOLATED INPUTS: IN6, IN7, IN8, IN9, IN16, IN17, IN18, IN19

These inputs have all the programmable functions of the GP inputs plus opto-isolation. There are two groups of four inputs, each with a common terminal. Grounding the common terminal configures the inputs to work with current-sourcing outputs from controllers like PLC's. When the common terminal is connected to +24V, the inputs will be activated by current-sinking devices such as NPN transistors or N-channel MOSFETs. The minimum ON threshold of the inputs is ±15 Vdc.

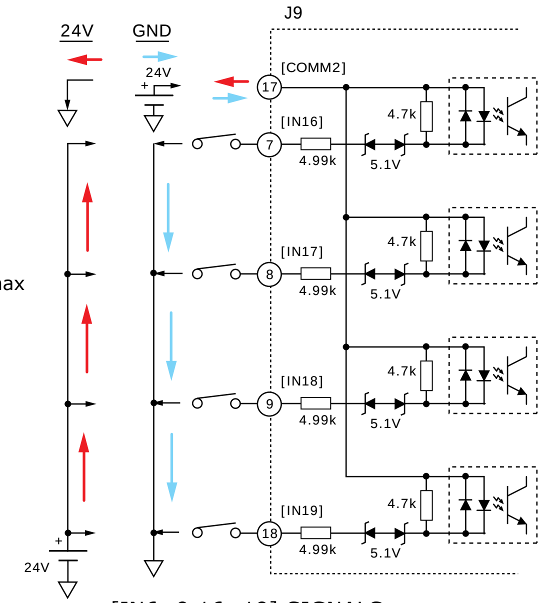
IN THE GRAPHICS BELOW, "24V" IS FOR CONNECTIONS TO CURRENT-SOURCING OUTPUTS AND "GND" IS FOR CURRENT-SINKING OUTPUTS ON THE CONTROL SYSTEM

[IN6~9]
±30 Vdc max



+24V
±24 ±10% Vdc max

[IN16~19]
±30 Vdc max



[IN6~9,16~19] SIGNALS

Signal	Pins	Signal	Pins
IN6	J9-2	IN16	J9-7
IN7	J9-3	IN17	J9-8
IN8	J9-4	IN18	J9-9
IN9	J9-5	IN19	J9-18
COMM1	J9-6	COMM2	J9-17

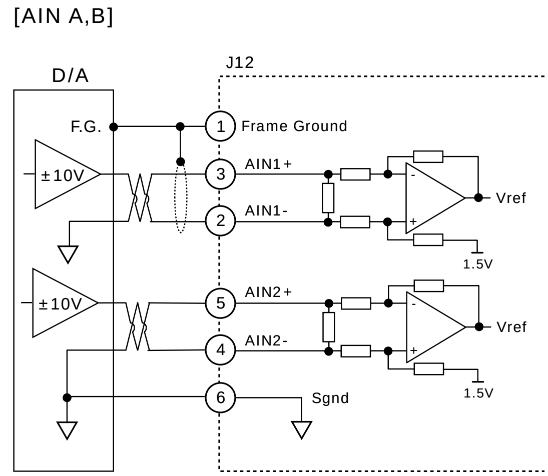
These inputs work with current-sourcing OR current-sinking connections. Connect the COMM to controller ground/common for current-sourcing connections and to +24V for current-sinking connections.
The 24V power shown in these connection diagrams does not have to be connected to the logic power supply for the drive, and is commonly provided in the control system to power relays and other devices.

ANALOG INPUTS

The analog inputs have a ±10 Vdc range at 14-bit resolution
As reference inputs they can take position/velocity/torque commands from a controller. If not used as command inputs, they can be used as general-purpose analog inputs.

[AIN A,B] SIGNALS

Signal	Axis A	Axis B
AIN(+)	J12-3	J12-5
AIN(-)	J12-2	J12-4
Sgnd	J12-6,16,22,31,37,44	
Shield	J12-1	

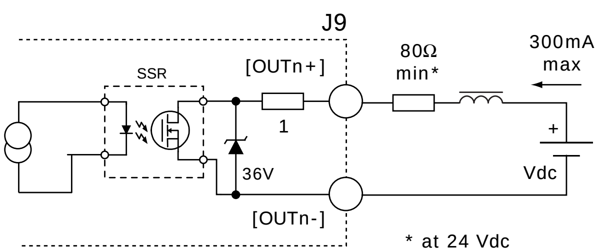


ISOLATED GENERAL PURPOSE OUTPUTS OUT1~5

- Digital, opto-isolated
- SSR, 2-terminal
- Flyback diode for inductive loads
- 24V Compatible
- Programmable functions

[OUT1~5] SIGNALS

Signal	Pins	Signal	Pins
[OUT1+]	J9-19	[OUT1-]	J9-10
[OUT2+]	J9-20	[OUT2-]	J9-11
[OUT3+]	J9-21	[OUT3-]	J9-12
[OUT4+]	J9-22	[OUT4-]	J9-13
[OUT5+]	J9-23	[OUT5-]	J9-14



HI/LO DEFINITIONS: [OUT1~5]

Input	State	Condition
OUT1~5	HI	Output transistor is ON, current flows
	LO	Output transistor is OFF, no current flows

±30Vmax
±24V typical

+24V

30 Vdc max
Zener clamping diodes across outputs allow driving of resistive-inductive (R-L) loads without external flyback diodes.

ISOLATED BRAKE OUTPUTS

- Brake outputs Opto-isolated
- Flyback diodes for inductive loads
- 24V Compatible
- Connection for external 24V power supply
- Programmable functions

SPECIFICATIONS

Output	Data	Notes
Voltage Range	Max	+30 Vdc
Output Current	Ids	1.0 Adc

HI/LO DEFINITIONS: OUTPUTS

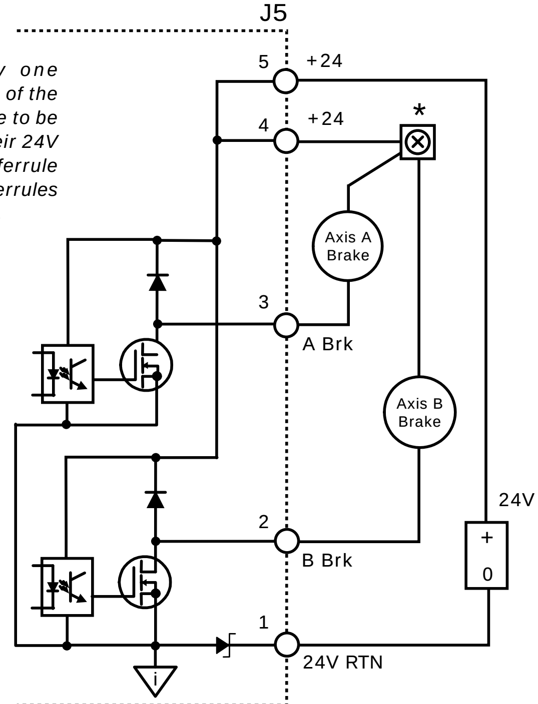
Input	State	Condition
BRK-A,B OUT6,7	HI	Output transistor is OFF Brake is un-powered and locks motor Motor cannot move Brake state is Active
	LO	Output transistor is ON Brake is powered, releasing motor Motor is free to move Brake state is NOT-Active

CME2 Default Setting for Brake Outputs [OUT6,7] is "Brake - Active HI"

Active = Brake is holding motor shaft (i.e. the *Brake is Active*)
Motor cannot move
No current flows in coil of brake
CME2 I/O Line States shows Output 6 or 7 as HI
BRK Output voltage is HI (24V), MOSFET is OFF
Servo drive output current is zero
Servo drive is disabled, PWM outputs are off

Inactive = Brake is not holding motor shaft (i.e. the *Brake is Inactive*)
Motor can move
Current flows in coil of brake
CME2 I/O Line States shows Output 6 or 7 as LO
BRK output voltage is LO (~0V), MOSFET is ON
Servo drive is enabled, PWM outputs are on
Servo drive output current is flowing

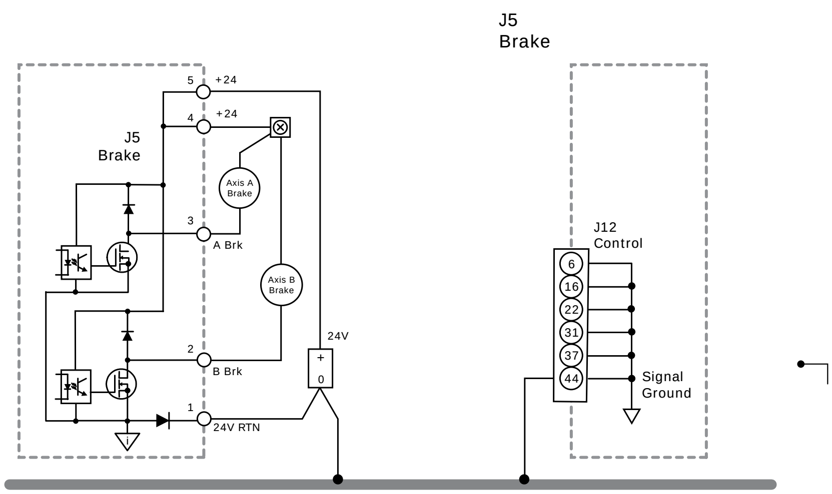
*
There should be only one conductor in each position of the J5 connector. If brakes are to be wired directly to J5 for their 24V power, use a double wire ferrule for J5-4. Information for ferrules can be found on page 27.



The brake circuits are optically isolated from all drive circuits and frame ground.

CONNECTIONS

Pin	Signal
5	+24V
4	+24V
3	A Brk [OUT6]
2	B Brk [OUT7]
1	24V Return



Earthing connections for power supplies should be as close as possible to elimimate potential differences between power supply 0V terminals.

This diagram shows the connections to the drive that share a common ground in the driver. If the brake 24V power supply is separate from the DC supply powering the drive, it is important that it connects to an earth or common grounding point with the HV power supply.

MOTOR CONNECTIONS: ENCODERS

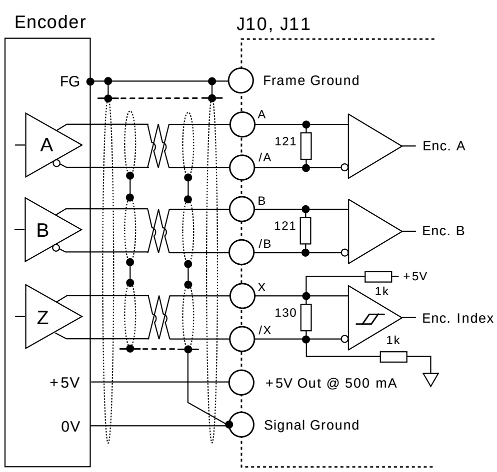
Motor connections are of three types: phase, feedback, and thermal sensor. The phase connections carry the drive output currents that drive the motor to produce motion. A thermal sensor that indicates motor overtemperature is used to shut down the drive to protect the motor. Feedback can be digital quad A/B encoder, analog sin/cos encoder, or digital Halls, depending on the version of the drive.

QUAD A/B ENCODER WITH FAULT PROTECTION

Encoders with differential line-driver outputs are required (single-ended encoders are not supported) and provide incremental position feedback via the A/B signals and the optional index signal (X) gives a once per revolution position mark. The MAX3097 receiver has differential inputs with fault protections for the following conditions:

Short-circuits line-line:	This produces a near-zero voltage between A & /A which is below the differential fault threshold.
Open-circuit condition:	The 121Ω terminator resistor will pull the inputs together if either side (or both) is open. This will produce the same fault condition as a short-circuit across the inputs.
Low differential voltage detection:	This is possible with very long cable runs and a fault will occur if the differential input voltage is < 200mV.
±15kV ESD protection:	The 3097E has protection against high-voltage discharges using the Human Body Model.
Extended common-mode range:	A fault occurs if the input common-mode voltage is outside of the range of -10V to +13.2V

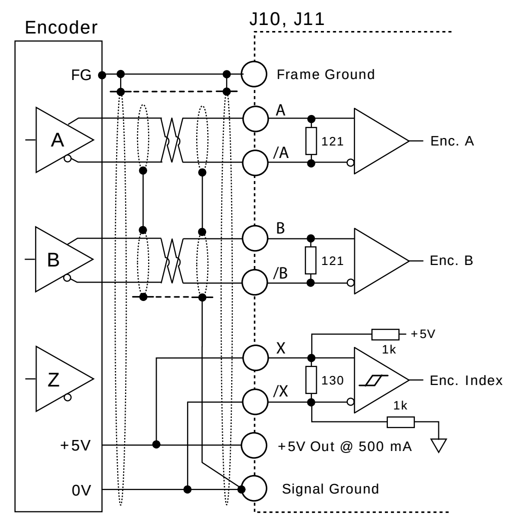
CONNECTIONS WITH A/B/X ENCODER



A/B/X SIGNALS

Signal	J10,J11 Pin
Enc A	13
Enc /A	12
Enc B	11
Enc /B	10
Enc X	9
Enc /X	8
+5V	6
Sgnd	5
Shld	1

CONNECTIONS WITH NO INDEX SIGNAL

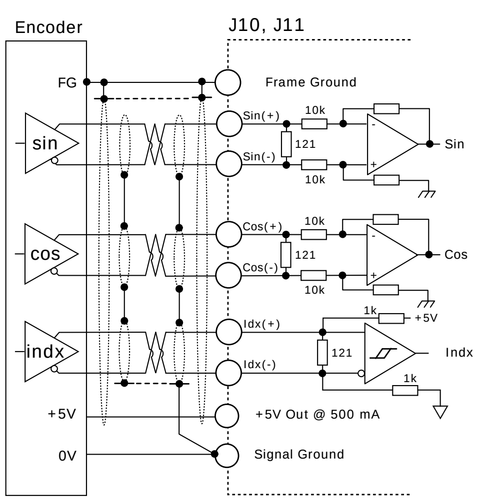


SHIELDED CABLE CONNECTIONS

Double-shielded cable is recommended for analog sin/cos encoders. The outer shield connects to the motor and drive frames. The inner shield(s) should only connect to the Signal Ground at the drive. The inner shields shown here are for individually shielded twisted-pair cables. If the inner shield is a single one, it connects to Signal Ground at the drive.
The inner shield should have no connection at the motor, or the the outer shield. Double-shielding is used less frequently for digital encoders, but the connections are shown here and on following pages for completeness.

ANALOG SIN/COS INCREMENTAL ENCODER

The sin/cos/idx inputs are differential with 121 Ω terminating resistors and accept 1 Vp-p signals in the format used by incremental encoders with analog outputs, or with ServoTube motors.



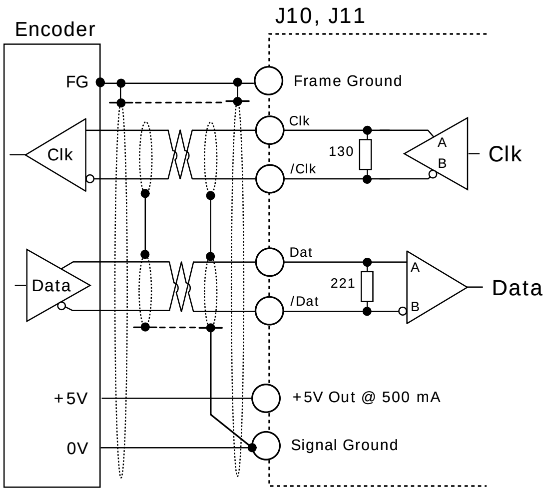
SIN/COS SIGNALS

Signal	J10,J11 Pin
Sin(+)	19
Sin(-)	18
Cos(+)	21
Cos(-)	20
Idx(+)	23
Idx(-)	22
+5V	17
Sgnd	16
Shld	1

MOTOR CONNECTIONS: ABSOLUTE ENCODERS

SSI ABSOLUTE ENCODER

The SSI (Synchronous Serial Interface) is an interface used to connect an absolute position encoder to a motion controller or control system. The XEL drive provides a train of clock signals in differential format to the encoder which initiates the transmission of the position data on the subsequent clock pulses. The polling of the encoder data occurs at the current loop frequency (16 kHz). The number of encoder data bits and counts per motor revolution are programmable. The hardware bus consists of two signals: SCLK and SDATA. Data is sent in 8 bit bytes, LSB first. The SCLK signal is only active during transfers. Data is clocked out on the falling edge and clock in on the rising edge of the Master.



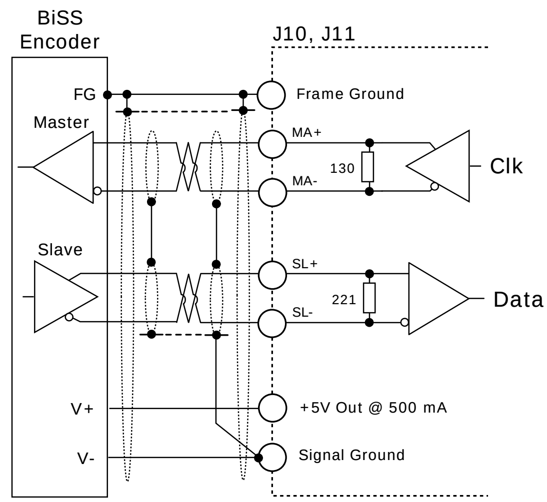
BiSS ABSOLUTE ENCODER

BiSS is an - Open Source - digital interface for sensors and actuators. BiSS refers to principles of well known industrial standards for Serial Synchronous Interfaces like SSI, AS-Interface® and Interbus® with additional options.

- Serial Synchronous Data Communication
- Cyclic at high speed
- 2 unidirectional lines Clock and Data
  - Line delay compensation for high speed data transfer
  - Request for data generation at slaves
  - Safety capable: CRC, Errors, Warnings
  - Bus capability incl. actuators
- Bidirectional
  - BiSS B-protocol: Mode choice at each cycle start
  - BiSS C-protocol: Continuous mode

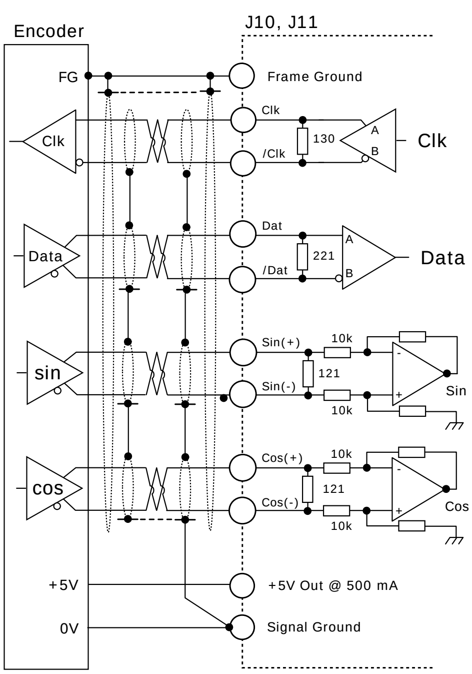
SSI,BiSS SIGNALS

Signal	J10,J11 Pin
Clk	9
/Clk	8
Data	15
/Data	14
+5V	6,17
Sgnd	5,16
Shld	1



ENDAT ABSOLUTE ENCODER

The EnDat interface is a Heidenhain interface that is similar to SSI in the use of clock and data signals, but which also supports analog sin/cos channels from the same encoder. The number of position data bits is programmable as is the use of sin/cos channels. Use of sin/cos incremental signals is optional in the EnDat specification.

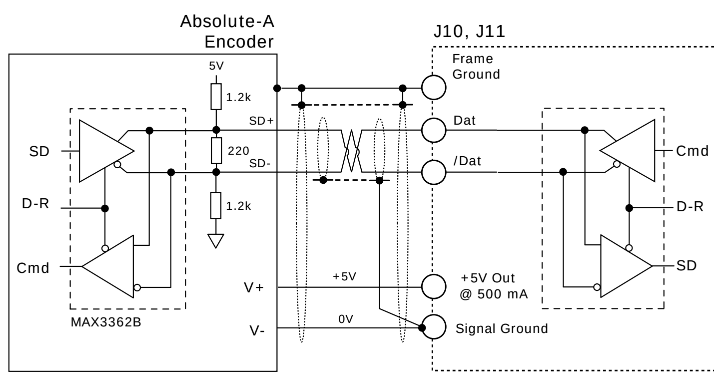


ENDAT SIGNALS

Signal	J10,J11 Pin
Clk	9
/Clk	8
Data	15
/Data	14
Sin(+)	19
Sin(-)	18
Cos(+)	21
Cos(-)	20
+5V	6,17
Sgnd	5,16
Shld	1

ABSOLUTE-A ENCODER & INCREMENTAL A

The interface is a serial, half-duplex type that is electrically the same as RS-485.



ABSOLUTE ENCODERS

Absolute-A
Tamagawa Absolute-A
Panasonic Absolute A Format
Sanyo Denki Absolute-A

INCREMENTAL ENCODERS

Panasonic Incremental A

ABSOLUTE-A SIGNALS

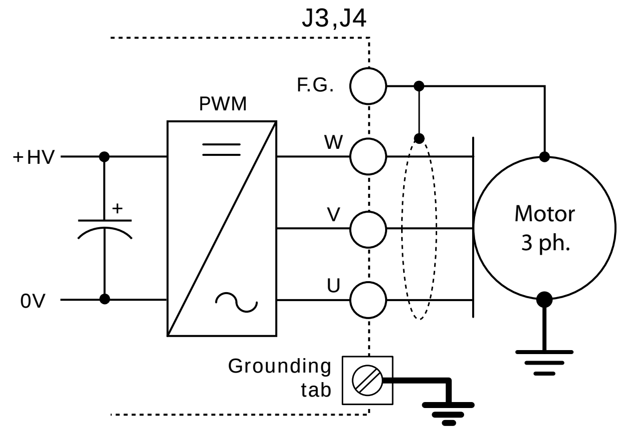
Signal	J10,J11 Pin
Data	15
/Data	14
+5V	6,17
Sgnd	5,16
Shld	1

MOTOR PHASE CONNECTIONS

The drive output is a three-phase PWM inverter that converts the DC buss voltage (+HV) into three sinusoidal voltage waveforms that drive the motor phase-coils. Cable should be sized for the continuous current rating of the motor. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shield should connect to motor frame and the drive frame ground terminal (J3,J4-1) for best results.

MOTOR SIGNALS

Signal	J3,J4 Pin
Mot U	4
Mot V	3
Mot W	2
Shield	1

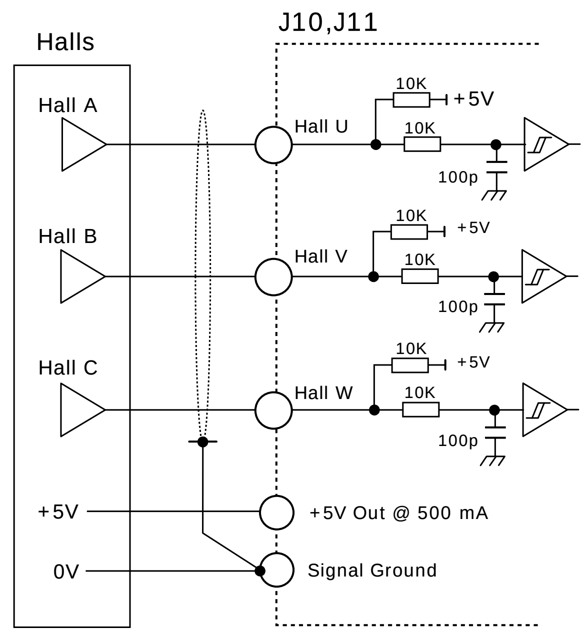


DIGITAL HALL SIGNALS

Hall signals are single-ended signals that provide absolute feedback within one electrical cycle of the motor. There are three of them (U, V, & W) and they may be sourced by magnetic sensors in the motor, or by encoders that have Hall tracks as part of the encoder disc. They typically operate at much lower frequencies than the motor encoder signals, and are used for commutation-initialization after startup, and for checking the motor phasing after the amplifier has switched to sinusoidal commutation.

HALL SIGNALS

Signal	J10,J11 Pin
Hall U	2
Hall V	3
Hall W	4
+5V	6,17
Sgnd	5,16 25,26



MOTEMP SIGNALS

Signal	Pin
Motemp A	J10-7
Motemp B	J11-7
Sgnd	J10,J11 -5,16,25,26

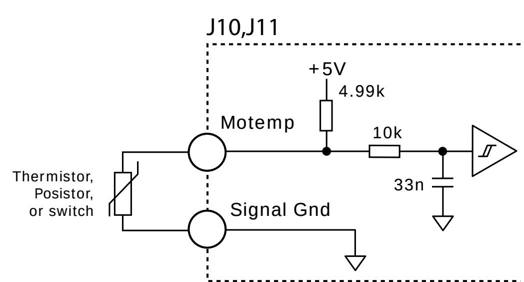
+30Vmax
+24V typical

+24V

Property	Ohms
Resistance in the temperature range 20°C to +70°C	60~750
Resistance at 85°C	≤1650
Resistance at 95°C	≥3990
Resistance at 105°C	≥12000

MOTOR OVER TEMP INPUT

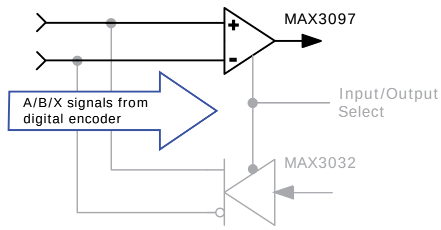
The 4.99k pull-up resistor works with PTC (positive temperature coefficient) thermistors that conform to BS 4999:Part 111:1987 (table below), or switches that open/close indicating a motor over-temperature condition. The active level is programmable.



The multi-mode port can operate as primary or secondary feedback from digital quad A/B/X or absolute encoders.

FEEDBACK FROM DIGITAL QUADRATURE ENCODER

When operating in position mode the multi-mode port can accept digital command signals from external encoders. These can be used to drive cam tables, or as master-encoder signals when operating in a master/slave configuration.

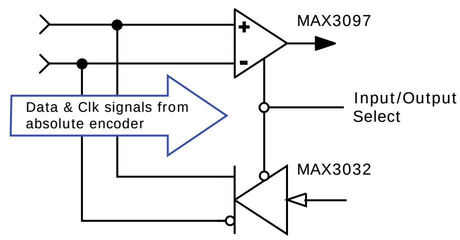


EMULATED QUAD A/B/X MULTI-PORT

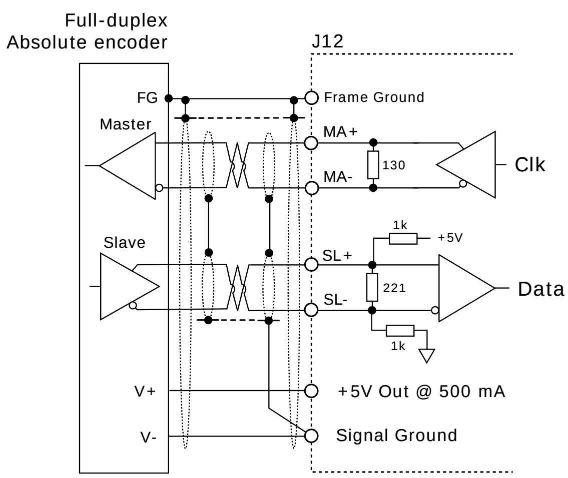
Signal	Axis A Pin	Axis B Pin
Enc A	J12-36	J12-42
Enc /A	J12-21	J12-27
Enc B	J12-35	J12-41
Enc /B	J12-20	J12-26
Enc X	J12-34	J12-40
Enc /X	J12-19	J12-25
+5V	32,17	J12-38,23
Sgnd	J12-31,16	J12-37,22
Shld	J12-1	

FEEDBACK FROM ABSOLUTE ENCODERS

Digital absolute encoder feedback as motor or load encoder can come from absolute encoders, too. Analog sin/cos and index signals are not supported by the multi-port. The graphic to the right shows half-duplex format but both full and half-duplex operation are supported by the multi-port (see below)



ABSOLUTE ENCODER, FULL-DUPLEX MODE



FULL-DUPLEX ENCODERS

SSI
BiSS
EnDat

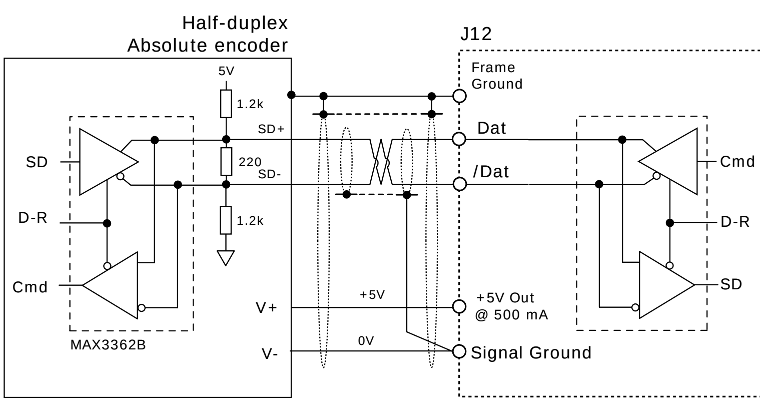
HALF-DUPLEX ENCODERS

Absolute-A
Sanyo Denki Absolute-A
Tamagawa Absolute-A

FULL-DUPLEX SIGNALS

Signal	Axis A Pin	Axis B Pin
Clk, MA+	J12-34	J12-40
/Clk, MA-	J12-19	J12-25
Dat, SL+	J12-33	J12-39
/Dat, SL-	J12-18	J12-24
+5V	J12-32,17	J12-38,23
Sgnd	J12-31,16	J12-37,22
Shld	J12-1	

ABSOLUTE ENCODER, HALF-DUPLEX MODE



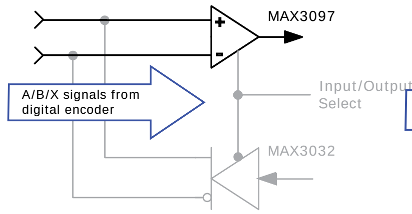
HALF-DUPLEX SIGNALS

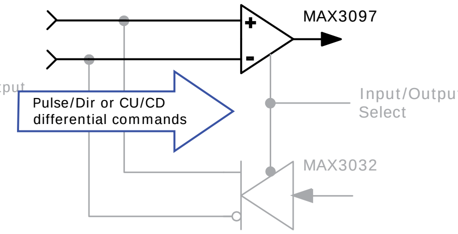
Signal	Axis A Pin	Axis B Pin
Dat	J12-33	J12-39
/Dat	J12-18	J12-24
+5V	J12-32,17	J12-38,23
Sgnd	J12-31,16	J12-37,22
Shld	J12-1	

MULTI-MODE ENCODER PORT: COMMAND INPUTS

AS A MASTER OR CAMMING ENCODER INPUT FROM A DIGITAL QUADRATURE ENCODER

When operating in position mode the multi-mode port can accept digital command signals from external encoders. These can be used to drive cam tables, or as master-encoder signals when operating in a master/slave configuration.





AS DIGITAL COMMAND INPUTS IN PULSE/ DIRECTION, PULSE-UP/PULSE-DOWN, OR DIGITAL QUADRATURE ENCODER FORMAT

The multi-mode port can also be used when digital command signals are in a differential format. These are the signals that typically go to single-ended inputs. But, at higher frequencies these are likely to be differential signals in which case the multi-mode port can be used.

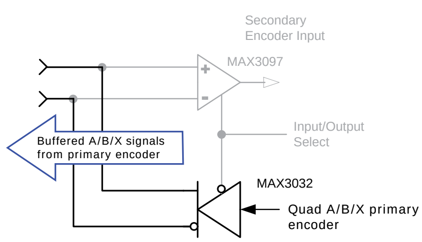
COMMAND INPUTS MULTI-PORT

Signal			Axis A Pin	Axis B Pin
Enc A	Pulse	CW	J12-36	J12-42
Enc /A	/Pulse	/CW	J12-21	J12-27
Enc B	Dir	CCW	J12-35	J12-41
Enc /B	/Dir	/CCW	J12-20	J12-26
Enc X			J12-34	J12-40
Enc /X			J12-19	J12-25
+5V			32,17	J12-38,23
Sgnd			J12-31,16	J12-37,22
Frame Gnd			J12-1	

MULTI-MODE ENCODER PORT: FEEDBACK OUTPUTS

AS BUFFERED OUTPUTS FROM A DIGITAL QUADRATURE PRIMARY ENCODER

When using a digital quadrature feedback encoder, the A/B/X signals drive the multi-mode port output buffers directly. This is useful in systems that use external controllers that also need the motor feedback encoder signals because these now come from J12, the Control connector. In addition to eliminating "Y" cabling where the motor feedback cable has to split to connect to both controller and motor, the buffered outputs reduce loading on the feedback cable that could occur if the motor encoder had to drive two differential inputs in parallel, each with it's own 121 ohm terminating resistor.

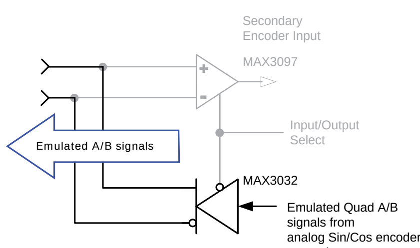


BUFFERED OUTPUTS MULTI-PORT

Signal	Axis A Pin	Axis B Pin
Enc A	J12-36	J12-42
Enc /A	J12-21	J12-27
Enc B	J12-35	J12-41
Enc /B	J12-20	J12-26
Enc X	J12-34	J12-40
Enc /X	J12-19	J12-25
+5V	32,17	J12-38,23
Sgnd	J12-31,16	J12-37,22
F.G.	J12-1	

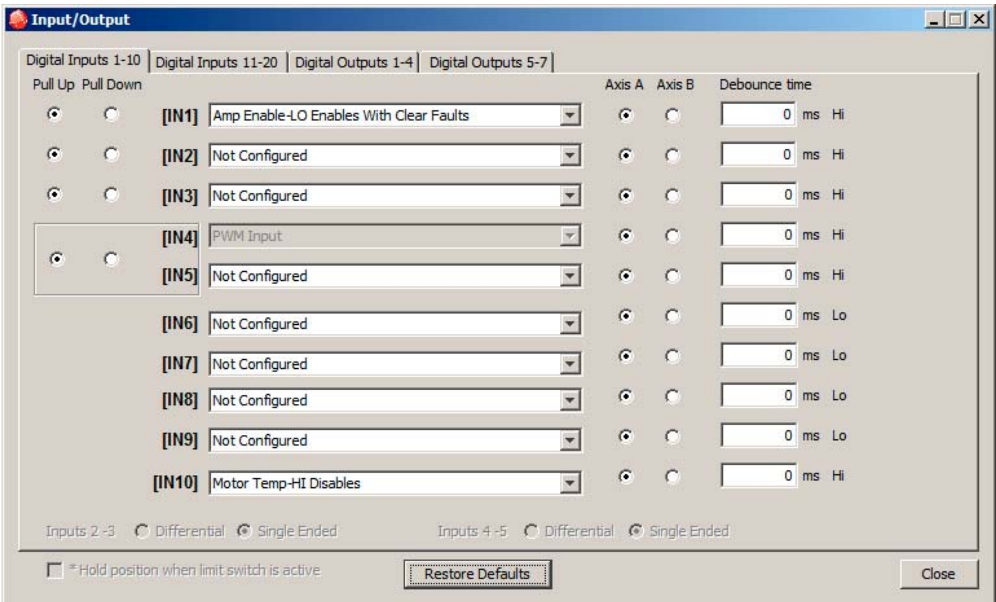
AS EMULATED QUAD A/B/X ENCODER OUTPUTS FROM AN ANALOG SIN/COS FEEDBACK ENCODER

Analog sin/cos signals are interpolated in the drive with programmable resolution. The incremental position data is then converted back into digital quadrature format which drives the multi-mode port output buffers. Some analog encoders also produce a digital index pulse which is connected directly to the port's output buffer. The result is digital quadrature A/B/X signals that can be used as feedback to an external control system.



CME2 & AXIS A I/O CONNECTIONS

CME2 SCREEN FOR INPUTS [IN1~IN10]



INPUT DATA

Input	Pin	R1	R2	C1
IN1	J12-7	10k	10k	100p
IN2	J12-8	10k	1k	100p
IN3	J12-9			
IN4	J12-10			
IN5	J12-11			
IN6	J10-2	Opto		
IN7	J10-3			
IN8	J10-4			
IN9	J10-5			
ICOM1	J10-6			
IN10	J11-7	4.99k	10k	33n
IN21	J11-24	10k	10k	100p

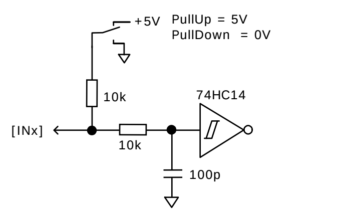
+30Vmax
+24V typical

+24V

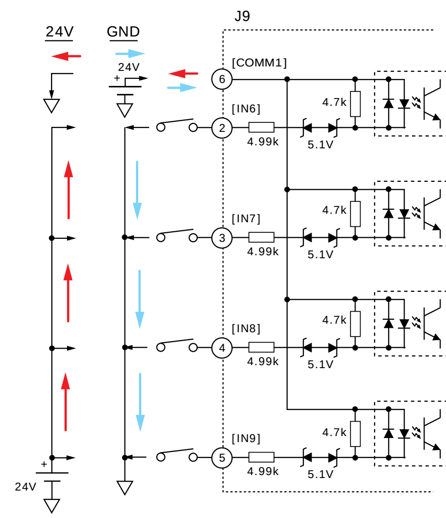
Vmax

+5V

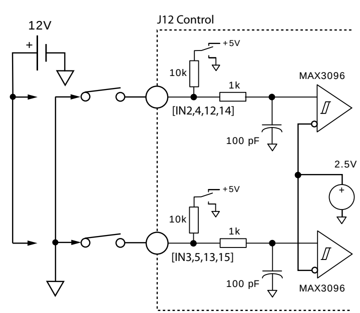
[IN1]



[IN6~9]



[IN2~5]



HI/LO DEFINITIONS: INPUTS

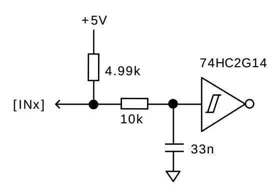
Input	State	Condition
IN1,10,21	HI	Vin >= 2.5 Vdc
	LO	Vin <= 1.3 Vdc
IN2~5	HI	Vin > 2.5 Vdc
	LO	Vin < 2.5 Vdc
IN6~9	HI	Input diode ON
	LO	Input diode OFF

IN6~9 are optically isolated and work from positive or negative input voltages. When voltage is applied to an input and current flows through the input diode of the opto-coupler the diode condition is ON. When no voltage is applied to an input and no current flows through the input diode it is OFF.

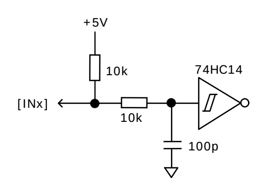
INPUTS WITH PROGRAMMABLE PULL UP/DOWN

Input	Pin	PU/PD
IN1	J12-7	1
IN2	J12-8	2
IN3	J12-9	3
IN4	J12-10	4
IN5	J12-11	

[IN10]

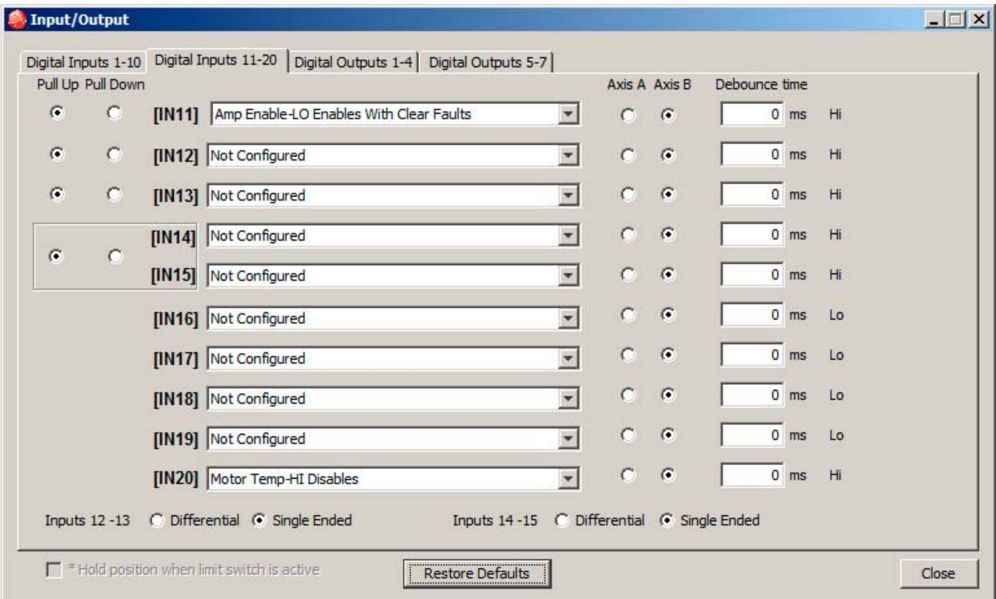


[IN21]



CME2 & AXIS B I/O CONNECTIONS

CME2 SCREEN FOR INPUTS [IN11~IN20]



INPUT DATA

Input	Pin	R1	R2	C1
IN11	J12-12	10k	10k	100p
IN12	J12-13	10k	1k	100p
IN13	J12-14			
IN14	J12-15			
IN15	J12-30			
IN16	J9-7	Opto		
IN17	J9-8			
IN18	J9-9			
IN19	J9-18			
ICOM2	J9-17			
IN20	J11-7	4.99k	10k	33n
IN22	J11-24	10k	10k	100p

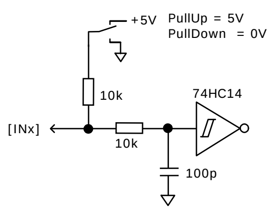
+30Vmax
+24V typical

+24V

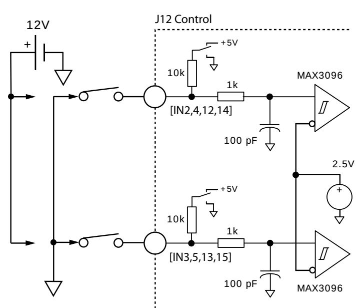
Vmax

+5V

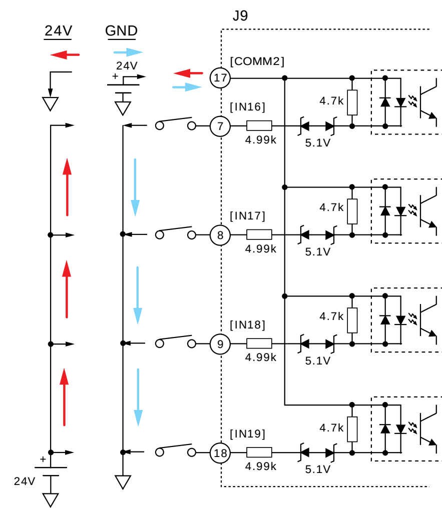
[IN11]



[IN12~15]



[IN16~19]



HI/LO DEFINITIONS: INPUTS

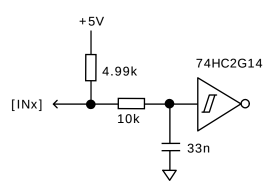
Input	State	Condition
IN11,20,22	HI	Vin >= 2.5 Vdc
	LO	Vin <= 1.3 Vdc
IN12~15	HI	Vin > 2.5 Vdc
	LO	Vin < 2.5 Vdc
IN16~19	HI	Input diode ON
	LO	Input diode OFF

IN16~19 are optically isolated and work from positive or negative input voltages. When voltage is applied to an input and current flows through the input diode of the opto-coupler the diode condition is ON. When no voltage is applied to an input and no current flows through the input diode it is OFF.

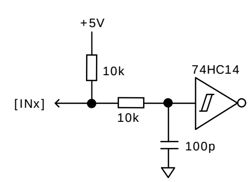
INPUTS WITH PROGRAMMABLE PULL UP/DOWN

Input	Pin	PU/PD
IN11	J12-12	5
IN12	J12-13	6
IN13	J12-14	7
IN14	J12-15	8
IN15	J12v-30	

[IN20]

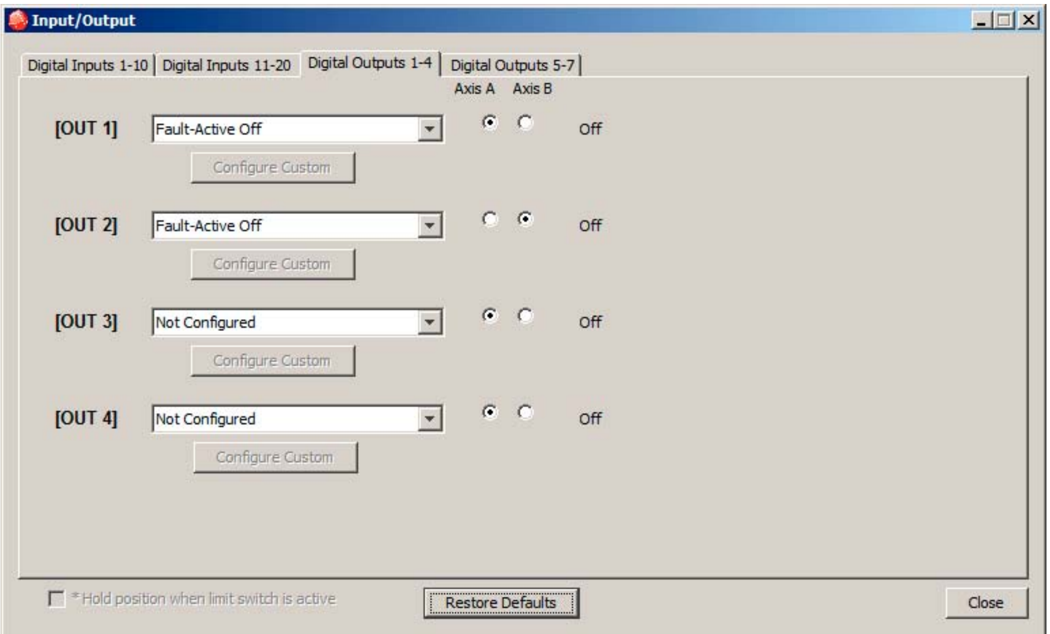


[IN22]



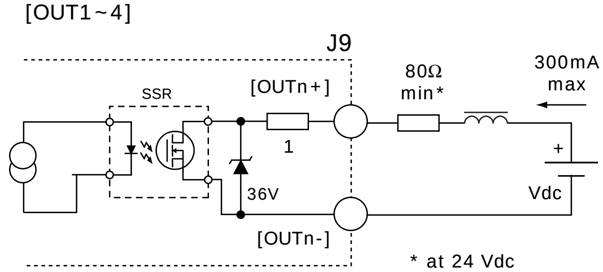
OUTPUT CONNECTIONS

CME2 SCREEN FOR OUTPUTS [OUT1~4]



OUTPUT DATA

[OUT1~4]



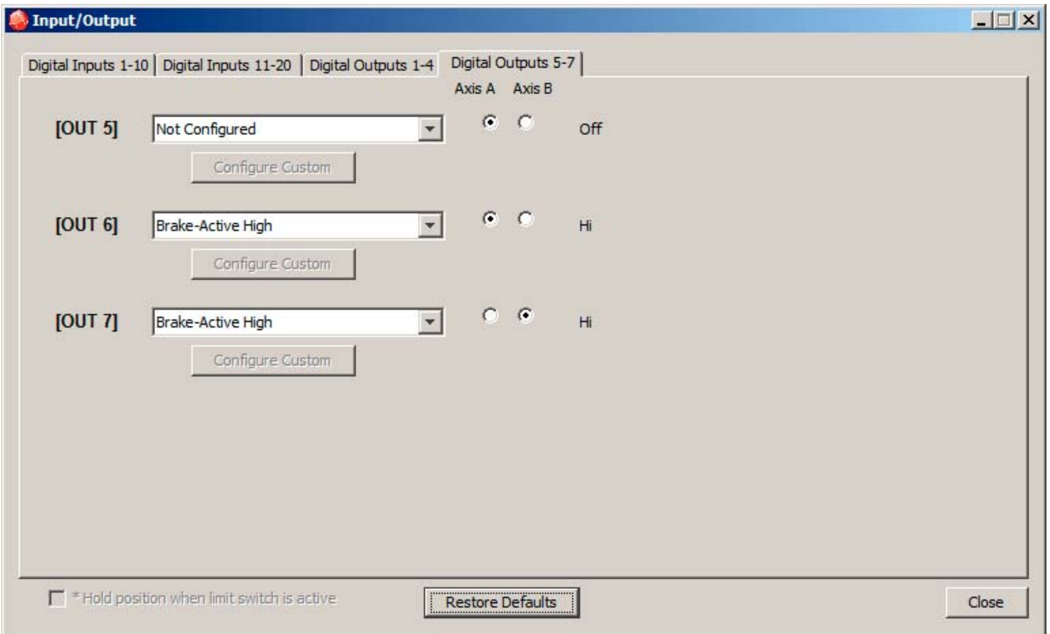
[OUT1~4] SIGNALS

Signal	Pins	Signal	Pins
[OUT1+]	J9-19	[OUT1-]	J9-10
[OUT2+]	J9-20	[OUT2-]	J9-11
[OUT3+]	J9-21	[OUT3-]	J9-12
[OUT4+]	J9-22	[OUT4-]	J9-13

HI/LO DEFINITIONS: OUTPUTS

Input	State	Condition
OUT1~4	HI	Output transistor is ON, current flows
	LO	Output transistor is OFF, no current flow

CME2 SCREEN FOR OUTPUTS [OUT5~7]



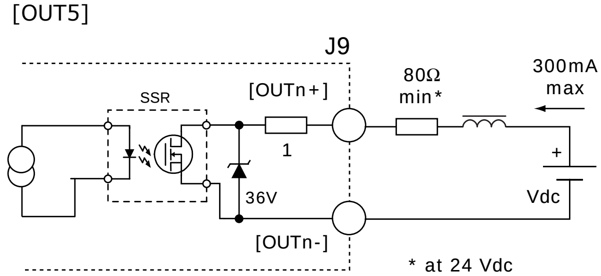
OUTPUT DATA

[OUT5~7] SIGNALS

Signal	Pins
[OUT5+]	J9-23
[OUT5-]	J9-14
[OUT6]	J5-3
[OUT7]	J5-2

+30Vmax
+24V typical
+24V

[OUT5]



HI/LO DEFINITIONS: OUTPUTS

Input	State	Condition
OUT5	HI	Output transistor is ON, current flows
	LO	Output transistor is OFF, no current flows
BRK-A,B OUT6,7	HI	Output transistor is OFF Brake is un-powered and locks motor shaft Motor cannot move Brake state is Active
	LO	Output transistor is ON Brake is powered, releasing motor shaft Motor is free to move Brake state is NOT-Active

CME2 Default Setting for Brake Outputs [OUT6,7] is “Brake - Active HI”

Active = Brake is holding motor shaft (i.e. the *Brake is Active*)
Motor cannot move
No current flows in coil of brake
CME2 I/O Line States shows Output 6 or 7 as HI
BRK Output voltage is HI (24V), MOSFET is OFF
Servo drive output current is zero
Servo drive is disabled, PWM outputs are off

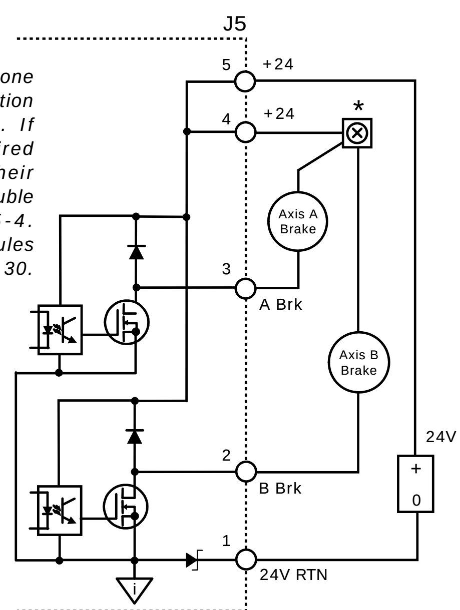
Inactive = Brake is not holding motor shaft (i.e. the *Brake is Inactive*)
Motor can move
Current flows in coil of brake
CME2 I/O Line States shows Output 6 or 7 as LO
BRK output voltage is LO (~0V), MOSFET is ON
Servo drive is enabled, PWM outputs are on
Servo drive output current is flowing

* *There should be only one conductor in each position of the J5 connector. If brakes are to be wired directly to J5 for their 24V power, use a double wire ferrule for J5-4. Information for ferrules can be found on page 30.*

[BRK-A,B]

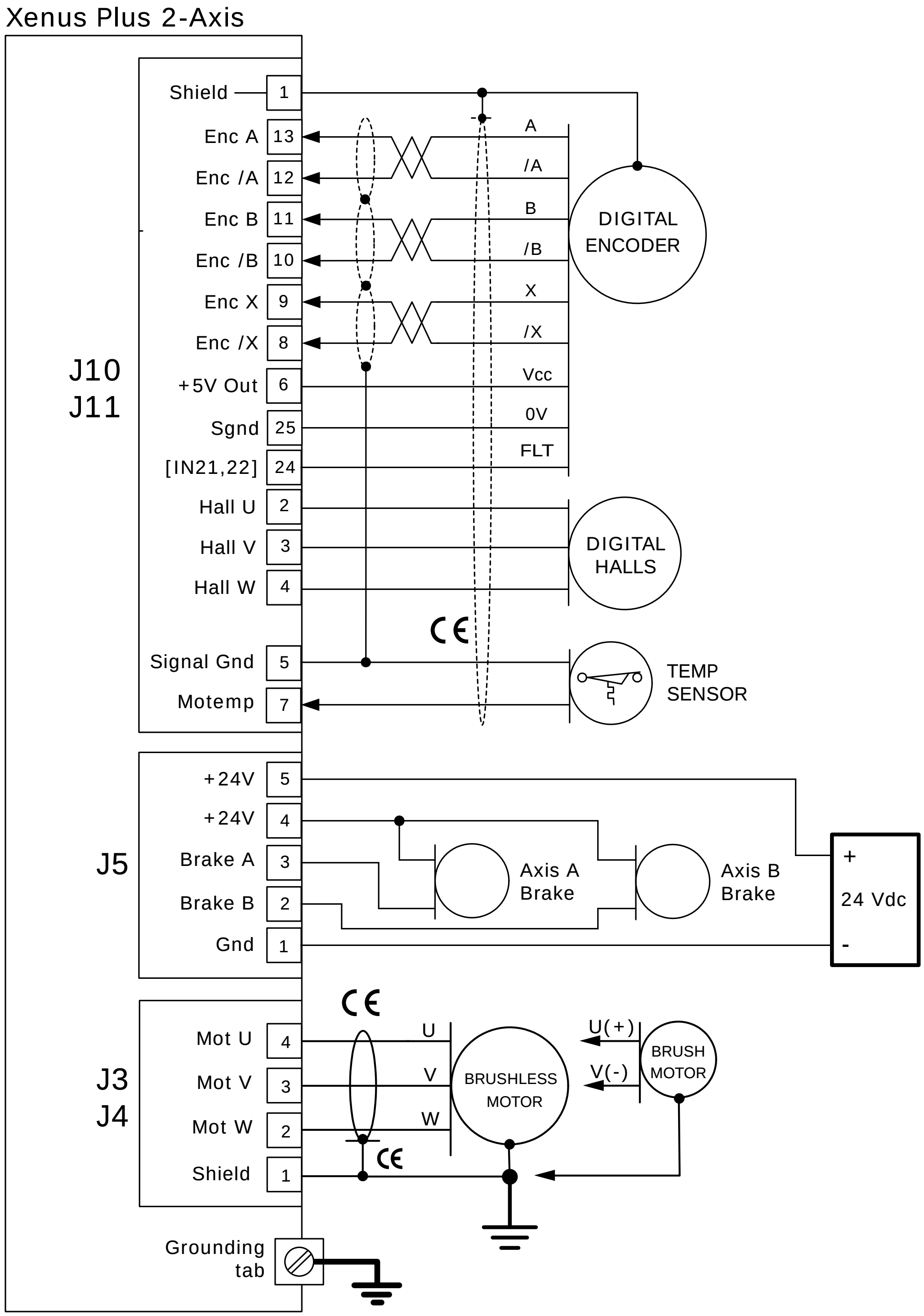
[OUT6~7]

Signal	Pins
Brake A	J5-3
Brake B	J5-2



MOTOR CONNECTIONS FOR DIGITAL INCREMENTAL ENCODERS

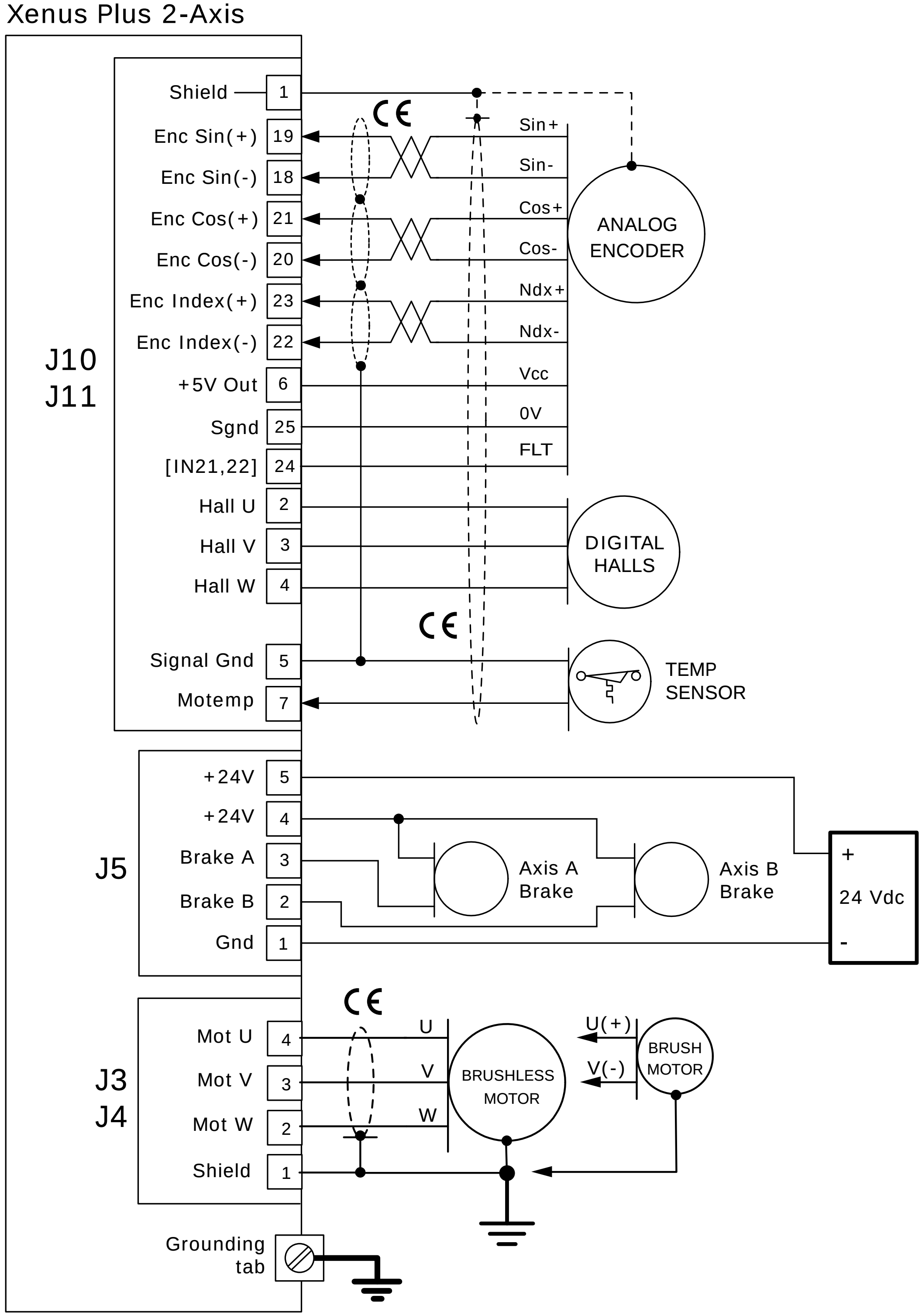
The connections shown may not be used in all installations



NOTES:
1) +5V Out on J10 & J11 are independent power supplies and each is rated for 500 mA
2) CE symbols indicate connections required for CE compliance.

MOTOR CONNECTIONS FOR ANALOG INCREMENTAL ENCODERS

The connections shown may not be used in all installations



NOTES:

1) +5V Out on J10 & J11 are independent power supplies and each is rated for 500 mA
2) CE symbols indicate connections required for CE compliance.

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MOTOR CONNECTIONS FOR DIGITAL & ANALOG INCREMENTAL & ABSOLUTE ENCODERS

WARNING: Hazardous voltages exist on connections to J1, J2, J3 & J4 when power is applied, and for up to 5 minutes after power is removed.

ISOLATED CIRCUIT

J1 MAINS CONNECTIONS

Signal	Pin
Mains Input L3	5
Frame Ground	4
PE Ground	3
Mains Input L2	2
Mains Input L1	1

J2 REGEN RESISTOR

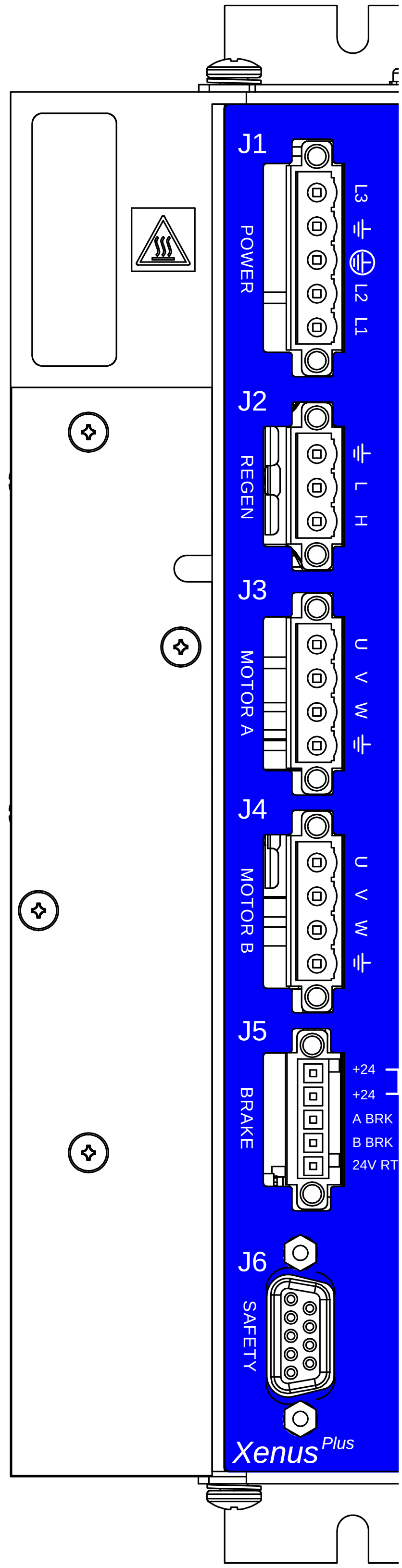
Signal	Pin
Frame Ground	3
Regen -	2
Regen +	1

J3 &J4 MOTOR OUTPUTS

Signal	Pin
Motor Phase U	4
Motor Phase V	3
Motor Phase W	2
Frame Ground	1

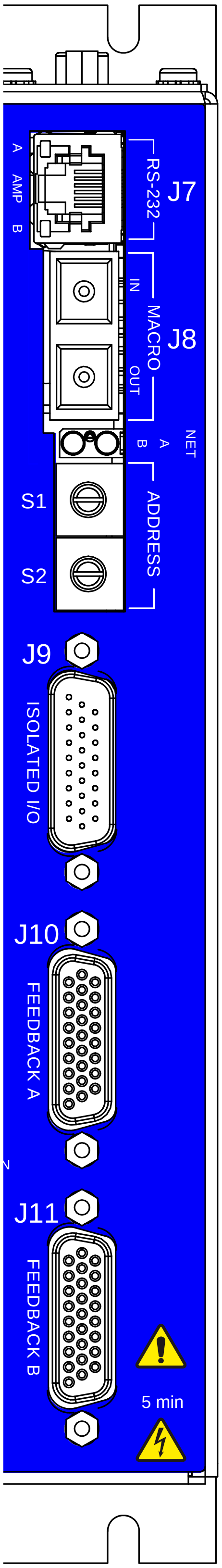
J5 +24 VDC & BRAKE

Signal	Pin
24V Input	5
Brake 24V Output	4
A Brake	3
B Brake	2
24V Return	1



J5 STO

PIN	SIGNAL	PIN	SIGNAL
1	Frame Gnd	6	STO-1(+)
2	STO-1(+)	7	STO-1(-)
3	STO-1(-)	8	STO-24V
4	STO-2(+)	9	STO-GND
5	STO-1(-)		



J12 CONTROL (ON END PANEL)

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
1	Frame Gnd	16	Signal Gnd	31	Signal Gnd
2	Ref1(-)	17	5V Out3	32	5V Out3
3	Ref1(+)	18	A-MultiEnc /S	33	A-MultiEnc S
4	Ref2(-)	19	A-MultiEnc /X	34	A-MultiEnc X
5	Ref2(+)	20	A-MultiEnc /B	35	A-MultiEnc B
6	Signal Gnd	21	A-MultiEnc /A	36	A-MultiEnc A
7	[IN1] GP	22	Signal Gnd	37	Signal Gnd
8	[IN2] GP	23	5V Out4	38	5V Out4
9	[IN3] GP	24	B-MultiEnc /S	39	B-MultiEnc S
10	[IN4] GP	25	B-MultiEnc /X	40	B-MultiEnc X
11	[IN5] HS	26	B-MultiEnc /B	41	B-MultiEnc B
12	[IN11] HS	27	B-MultiEnc /A	42	B-MultiEnc A
13	[IN12] HS	28	n.c.	43	n.c.
14	[IN13] HS	29	n.c.	44	Signal Gnd
15	[IN14] HS	30	[IN15]		

J9 ISOLATED I/O

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
9	[IN18] GPI	18	[IN19] GPI	26	n.c.
8	[IN17] GPI	17	[IN16~19] COMM	25	n.c.
7	[IN16] GPI	16	n.c.	24	n.c.
6	[IN6~9] COMM	15	n.c.	23	[OUT5+]
5	[IN9] GPI	14	[OUT5-]	22	[OUT4+]
4	[IN8] GPI	13	[OUT4-]	21	[OUT3+]
3	[IN7] GPI	12	[OUT3-]	20	[OUT2+]
2	[IN6] GPI	11	[OUT2-]	19	[OUT1+]
1	Frame Ground	10	[OUT1-]		

J10, J11 FEEDBACK

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
1	Frame Gnd	10	Enc /B	19	Sin1(+)
2	Hall U	11	Enc B	20	Cos1(-)
3	Hall V	12	Enc /A	21	Cos1(+)
4	Hall W	13	Enc A	22	Indx(-)
5	Signal Gnd	14	Enc /S	23	Indx(+)
6	+5V Out1(2)	15	Enc S	24	IN21(22)
7	Motemp IN10(20)	16	Signal Gnd	25	Signal Gnd
8	Enc /X	17	+5V Out1(2)	26	Signal Gnd
9	Enc X	18	Sin1(-)		

Note: Signals unique to axis A or axis B are shown as "Xxx A(B)"

All other signals are common to both axes A & B

WIRING

AC POWER, REGEN, AND MOTOR OUTPUTS: J1~J4

Wago MCS-MIDI Classic: 231-305/107-000 (J1) 231-303/107-000 (J2), 231-304/107-000 (J3, J4), female connector; with screw flange; 3-pole; pin spacing 5.08 mm / 0.2 in

Conductor capacity

Bare stranded:	AWG 28~14 [0.08~2.5 mm2]
Insulated ferrule:	AWG 24~16 [0.25~1.5 mm2]
Stripping length:	8~9 mm
Operating Tool:	Wago MCS-MIDI Classic: 231-159

J1

J2

J3, J4

Tool

FERRULE PART NUMBERS: SINGLE WIRE INSULATED

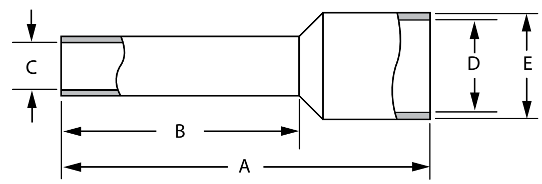
AWG	mm²	Color	Mfgr	PNUM	A	B	C	D	E	SL
14	2.5	Blue	Wago	216-206	15.0 (0.59)	8.0 (0.31)	2.05 (.08)	4.2 (0.17)	4.8 (0.19)	10 (0.39)
16	1.5	Black	Wago	216-204	14.0 (0.59	8.0 (0.31)	1.7 (.07)	3.5 (0.14)	4.0 (0.16)	10 (0.39)
18	1.0	Red	Wago	216-223	12.0 (.47)	6.0 (.24)	1.4 (.055)	3.0 (.12)	3.5 (.14)	8 (.31)
20	0.75	Gray	Wago	216-222	12.0 (.47)	6.0 (.24)	1.2 (.047)	2.8 (.11)	3.3 (.13)	8 (.31)
22	0.5	White	Wago	216-221	12.0 (.47)	6.0 (.24)	1.0 (.039)	2.6 (.10)	3.1 (.12)	7.5 (.30)

NOTES

PNUM = Part Number

SL = Stripping length

Dimensions: mm (in)



24V & BRAKE: J5

Wago MCS-MINI: 734-105/107-000, female connector; with screw flange, 5-pole; pin spacing 3.5 mm / 0.138 in

Conductor capacity

Bare stranded:	AWG 28~16 [0.08~1.5 mm2]
Insulated ferrule:	AWG 24~16 [0.25~1.5 mm2]
Stripping length:	0.24~0.28 in[6~7 mm]
Operating tool:	Wago MCS-MINI: 734-231

J5

Tool

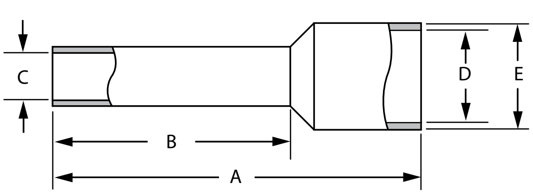
FERRULE PART NUMBERS: SINGLE WIRE INSULATED

AWG	mm²	Color	Mfgr	PNUM	A	B	C	D	E	SL
18	1.0	Red	Wago	216-223	12.0 (.47)	6.0 (.24)	1.4 (.06)	3.0 (.12)	3.5 (.14)	8 (.31)
20	0.75	Gray	Wago	216-222	12.0 (.47)	6.0 (.24)	1.2 (.05)	2.8 (.11)	3.3 (.13)	8 (.31)
22	0.5	White	Wago	216-221	12.0 (.47)	6.0 (.24)	1.0 (.04)	2.6 (.10)	3.1 (.12)	7.5 (.30)

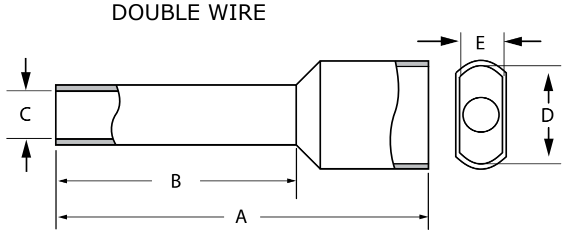
FERRULE PART NUMBERS: DOUBLE WIRE INSULATED

AWG	mm²	Color	Mfgr	PNUM	A	B	C	D	E	SL
2 x 18	2 x 1.0	Red	Altech	2776.0	15.4 (.61)	8.2 [.32]	2.4 (.09)	3.2 (.13)	5.8 (.23)	11.0 (.43)
2 x 18	2 x 1.0	Gray	Altech	2775.0	14.6 (.57)	8.2 (.32)	2.0 (.08)	3.0 (.12)	5.5 (.22)	11.0 (.43)
2 x 20	2 x 0.75	White	Altech	2794.0	14.6 (.57)	8.2 (.32)	1.7 (.07)	3.0 (.12)	5.0 (.20)	11.0 (.43)
2 x 20	2 x 0.75	Gray	TE	966144-2	15.0 (.59)	8.0 (.31)	1.70 (.07)	2.8 (.11)	5.0 (.20)	10 (.39)
2 x 22	2 x 0.50	White	TE	966144-1	15.0 (.59)	8.0 (.31)	1.40 (.06)	2.5 (.10)	4.7 (.19)	10 (.39)

SINGLE WIRE



DOUBLE WIRE



DRIVE POWER SOURCES

An external +24 Vdc power supply is required, and powers an internal DC/DC converter that supplies all the control voltages for drive operation. Use of an external supply enables MACRO communication with the drive when the mains power has been removed.

Power distribution in *XM2* is divided into three sections: +24 Vdc, signal, and high-voltage. Each is isolated from the other and all are isolated from the chassis.

EXTERNAL +24 VDC

The primary side of the DC/DC converter operates directly from the external +24 Vdc supply and is isolated from other drive power sections. The Brake outputs operate in this section and are referenced to the +24 Vdc return (0V). They sink current from an external load connected to the external +24 Vdc power source.

INTERNAL SIGNAL POWER

The signal power section supplies power for the control circuits as well as logic inputs and outputs. Motor feedback signals such as Halls, encoder, and temperature sensor operate from this power source. All signal circuits are referenced to signal ground. This ground should connect to the control system circuit ground or common so that drive and controller inputs and output voltage levels work properly with each other.

MAINS POWER

Mains power drives the high-voltage section. It is rectified and capacitor-filtered to produce +HV which the PWM stages convert into voltages that drive either three phase brushless or DC brush motors. An internal solid-state switch together with an external power resistor provides dissipation during regeneration when the mechanical energy of the motors is converted back into electrical energy that must be dissipated before it charges the internal capacitors to an overvoltage condition. All the circuits in this section are "hot", that is, they connect directly to the mains and must be considered high-voltages and a shock hazard requiring proper insulation techniques during installation.

GROUNDING

A grounding system has three primary functions: safety, voltage-reference, and shielding. As a safety measure, the primary ground at J1-3 will carry fault-currents from the mains in the case of an internal failure or short-circuit of electronic components. Wiring to this is typically done with the green conductor with yellow stripe using the same gauge wire as that used for the mains. The pin on the drive at J1-3 is longer than the other pins on J1 giving it a first-make, last-break action so that the drive chassis is never ungrounded when the mains power is connected. This wire is a 'bonding' conductor that should connect to an earthed ground point and must not pass through any circuit interrupting devices.

All of the circuits on J1, J2, J3, and J4 are mains-connected and must never be grounded. The frame ground terminals at J1-3, J2-3, J3-1, J4-1, J6-1, J9-1, J10-1, J11-1, and J12-1 all connect to the drive chassis and are isolated from all drive internal circuits.

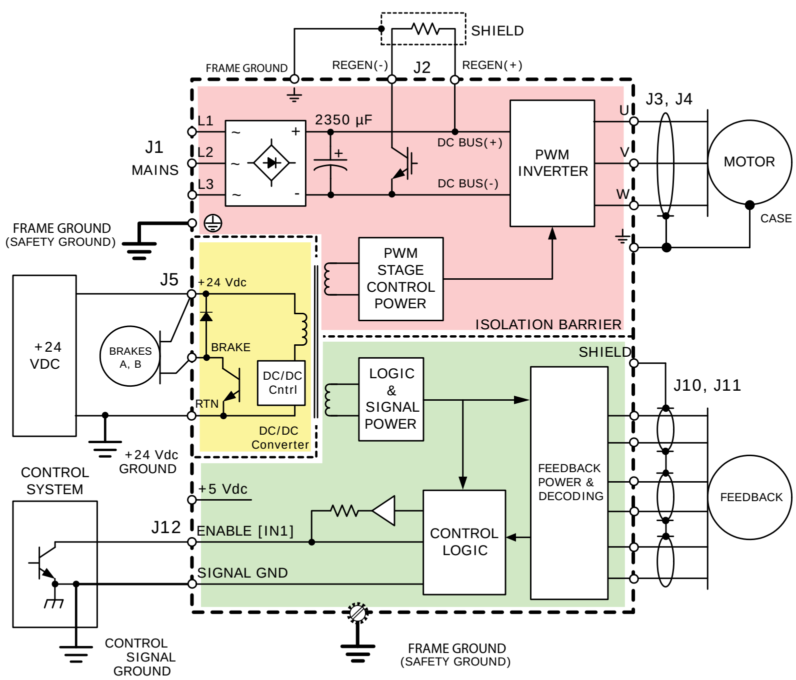
Signal grounding references the drive control circuits to those of the control system. These controls circuits typically have their own earth connection at some point. To eliminate ground-loops it is recommended that the drive signal ground be connected to the control system circuit ground. When this is done the drive signal voltages will be referenced to the same 0 V level as the circuits in the control system. Small currents flow between controller and drive when inputs and outputs interact. The signal ground is the path for these currents to return to their power sources in both controller and drive.

Shields on cables reduce emissions from the drive for CE compliance and protect internal circuits from interference due to external sources of electrical noise. Because of their smaller wire gauge, these should not be used as part of a safety-ground system. Motor cases can be safety-grounded either at the motor, by earthing the frame, or by grounding conductors in the motor cables that connect to J3-1 & J4-1. These cables should be of the same gauge as the other motor phase cables.

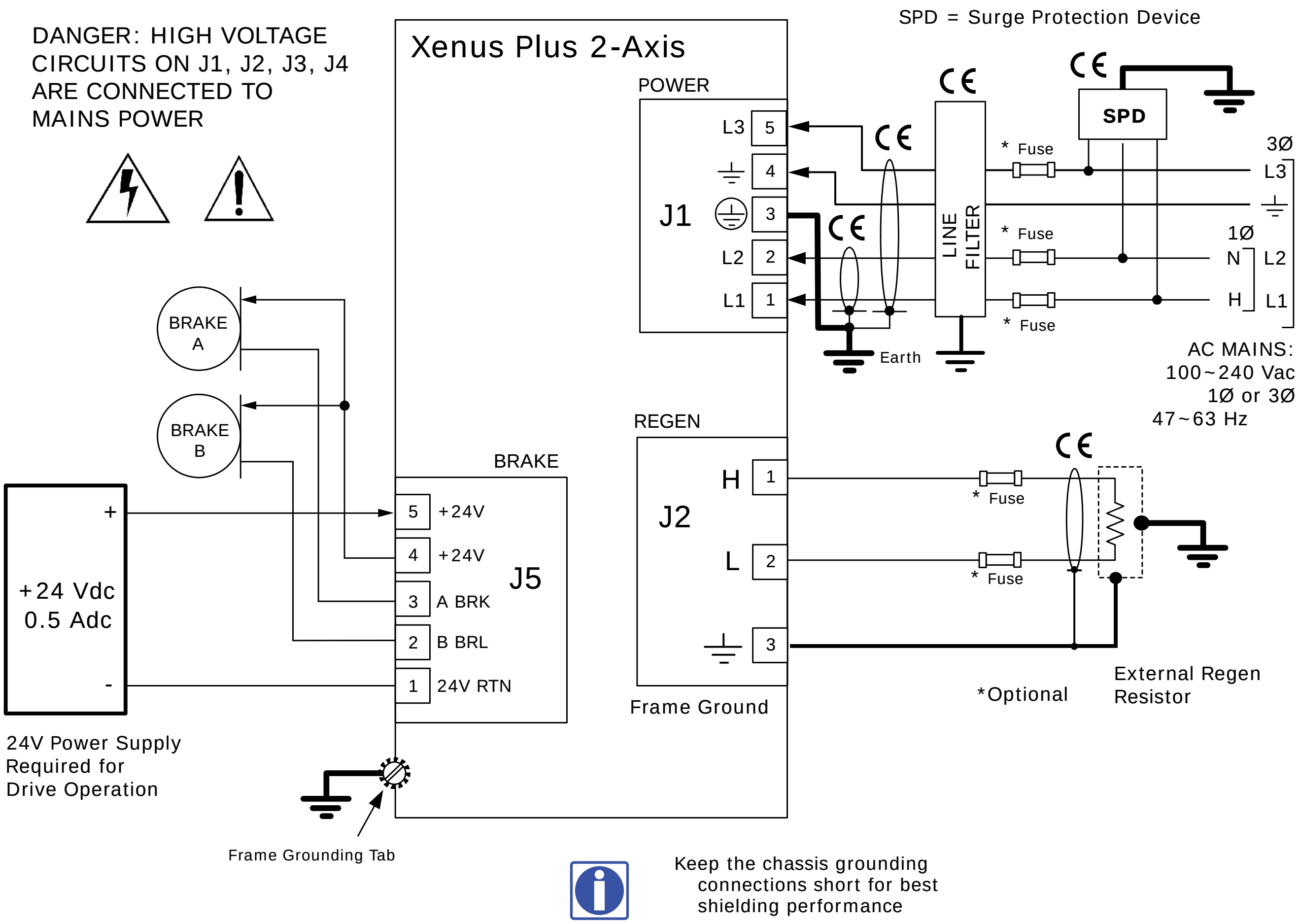
For CE compliance and operator safety, the drive heatplate should be earthed to the equipment frame. An unplated tab is provided on the heatplate (near to J1) for this connection.

POWER SECTIONS

The graphic below shows the different power sections of the Xenus Plus drive and the isolation barriers between them. Only one motor is shown but all motor PWM drivers are in the mains-connected section.



POWER, REGEN, & BRAKE CONNECTIONS



Notes:

1) Items marked with CE are required for standards conformance.
2) In the end product installation, a UL RC (Recognized Component) SPD (Surge Protective Device) type 1CA, 2CA, 3CA or a UL Listed (VZCA) SPD type 1, 2, or 3 rated 2500 V, with a minimum SCCR of 5 kA, 240 Vac, and surge voltage monitoring needs to be provided if the over-voltage category of the installation is greater than Category II. When this occurs, the purpose of the SPD is to establish an over-voltage CAT II environment for the drives.
3) The line filter used in CE conformance testing was a Filter Concepts 3F15.
4) Fuses and/or circuit breakers are optional and can be selected by the user to meet local codes and/or machine construction requirements.
5) The internal regen resistor of the XM2 must be unplugged when using an external regen resistor. Only one regen resistor can be connected to the Regen connector J2.

Grounding for Safety

The protective earth (PE) ground at J1-3 (for both single and dual axis drives), is the electrical safety ground and is intended to carry the fault currents from the mains in the case of an internal failure or short-circuit of electronic components. Wiring to this ground should be done using the same gauge wire as that used for the mains. This wire is a "protective bonding" conductor that should be connected to an earthed ground point and must not pass through any circuit interrupting devices. The PE ground also connects to the drive heatplate (Frame Ground, FG). Connections of the regen and motor cable shields to the FG points (J2-1, J3-1) is done to prevent the motor or regen resistor housing from becoming hazardous in the event of an insulation failure. Protective earth connections for the motor and regen resistor housings are subject to local electrical codes and must be reviewed for compliance with those codes. It is the responsibility of the end user to ensure compliance with local electrical codes and any other applicable standards. It is strongly recommended that motor and regen resistor housings also be connected to protective earth connection points located as close to the motor and regen resistor as possible. In many applications, the machine frame is used as a primary or supplemental protective earth connection point for the motor and regen resistor housings

Grounding and Shielding for CE Compliance

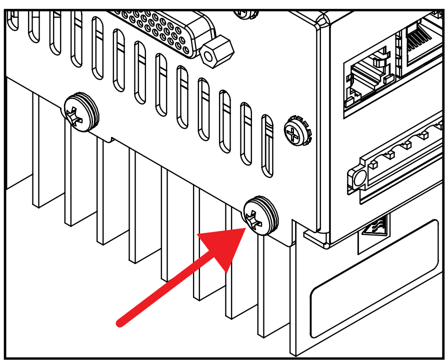
These connections are the means of controlling the emission of radio frequency energy from the drive so that it does not interfere with other electronic equipment. The use of shielded cables to connect the drive to motors and feedback devices is a way of extending the chassis of the drive out to these devices so that the conductors carrying noise generated by the drive are completely enclosed by a conductive shield. The FG ground terminals provide cable shield connection points for the motor, feedback, and regen resistor cables. By connecting the shields for these devices at the drive and at the device, the connection is continuous and provides a return path for radio-frequency energy to the drive.

To further minimize electrical noise it is important to keep the connection between the drive heatplate and earth/equipment frame as short as possible. A Heatplate Grounding Screw is provided for making this connection.

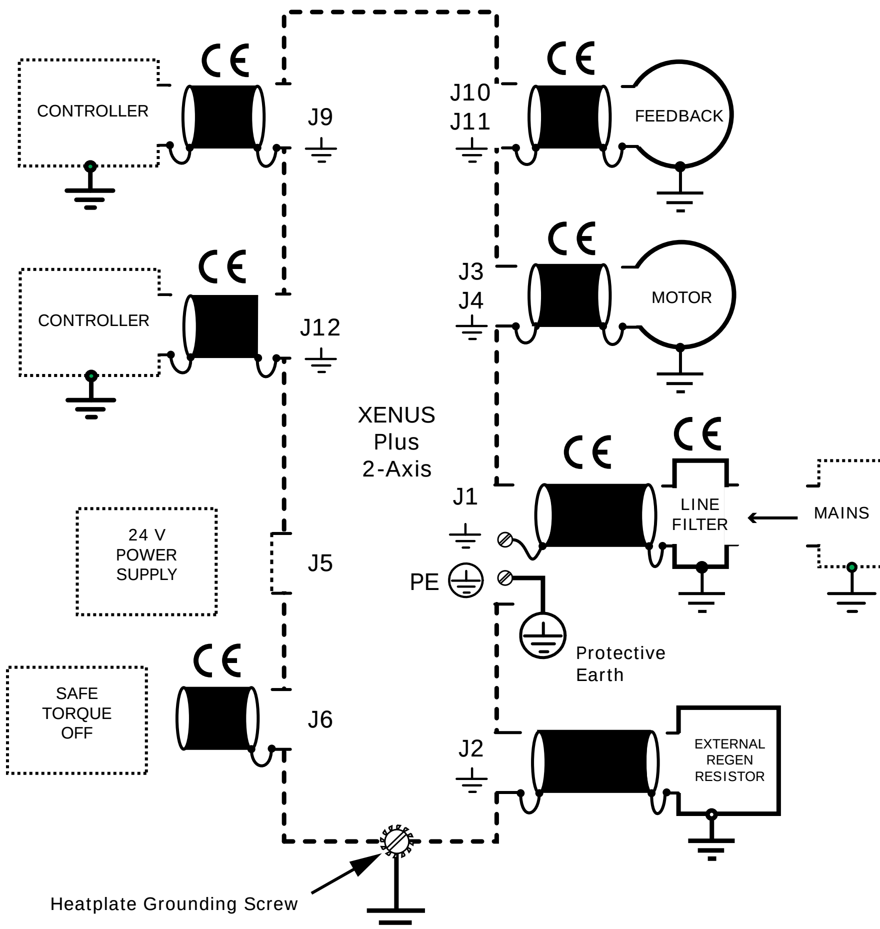
Grounding for Leakage Current Requirements

The connection to the Heatplate Grounding Screw also provides a second protective earthing conductor to address the touch current requirements of IEC 61800-5-1. ***Further information on this topic can be found in the Xenus Plus User Guide.***

HEATPLATE GROUNDING SCREW



Keep the chassis grounding connections short for best shielding performance



Notes:
1) Shielded cables required for CE are shown in the diagram above.
2) Line filter required for CE

REGENERATION

The drive has has an internal regen resistor which can handle regenerative energy that exceeds the absorption capacity of the internal bus capacitance. The internal regen resistor will be switched on when the energy shown in the table has been absorbed and the bus voltage driven up to 390 Vdc at which point the internal regen resistor will be switched to absorb the kinetic energy of the load.

ABSORPTION

Vac	*E*
100	155
120	145
200	85
240	43

Absorption is the energy that can be transferred to the internal capacitors during deceleration. This table shows the energy absorption in W·s for a drive operating at some typical mains voltages. The capacitor bank is 2350 uF and the energy absorption is shared with both axes.
If the deceleration energy is less than the absorption capacity of the drive, then a regeneration resistor will not be used because the bus voltage will not rise enough to hit the over-voltage level that would disable the PWM outputs.

Terms:

E	Energy	Joules, Watt·seconds
J	Rotary Moment of Inertia	$kg \cdot m^2$
P	Power	Watts

CALCULATING THE REGEN REPETITION FREQUENCY

Step 1: Find the energy of motion for a rotating load, for this example let it be 75 Joules:

$$E = \frac{J * RPM^2}{182} = 75\ J$$

Joules; $kg \cdot m^2$, RPM

Step 2: Subtract the absorption at your mains voltage to get the energy that must be dissipated in the regen resistor. Use 240 Vac:

75J - 43J = 32 J   Joules; Joules

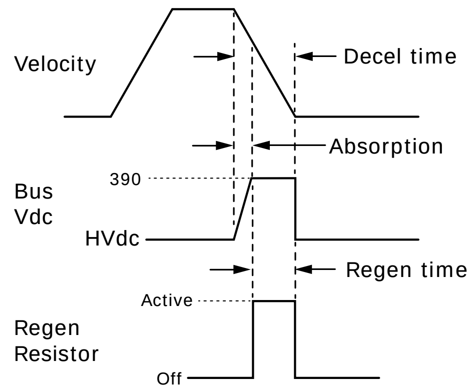
Step 3: Divide the regen energy by the continuous power rating of 20 Watts to get the dwell time that can dissipate the regen energy in the resistor:

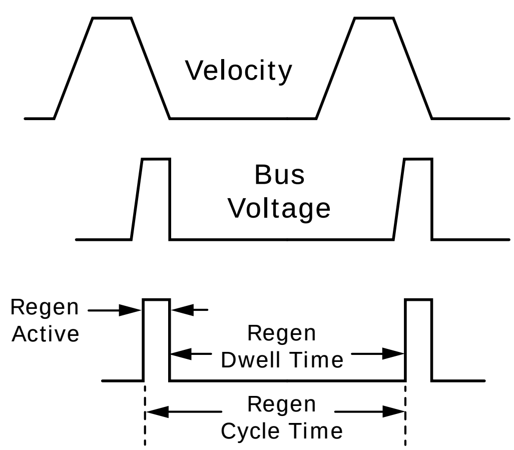
$$\text{Dwell Time} = \frac{32\ \text{Joules}}{20\ \text{Watts}} = 1.6\ \text{sec}$$

Seconds; Joules, Watts

Step 4: Find the total regen cycle time by adding the deceleration time to the dwell time:

Decel Time = 1.25 sec
Dwell Time = 1.60 sec
Cycle Time = 2.85 sec



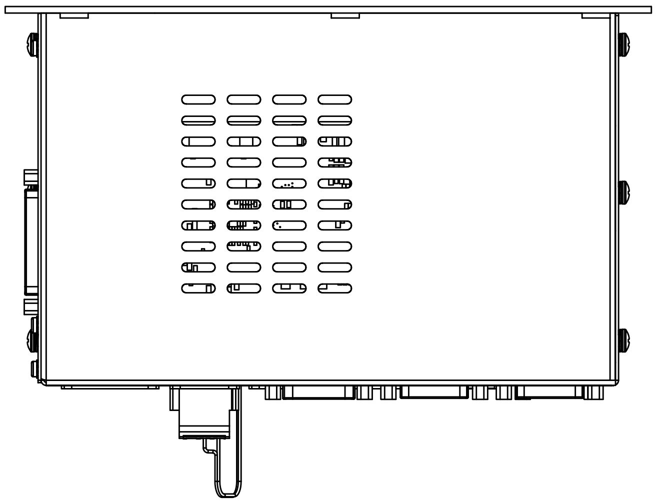


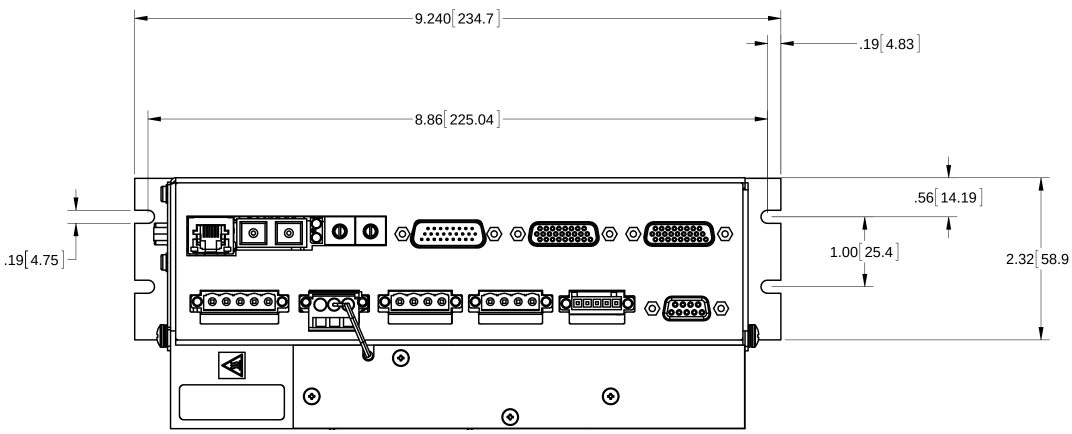
INTERNAL REGEN RESISTOR

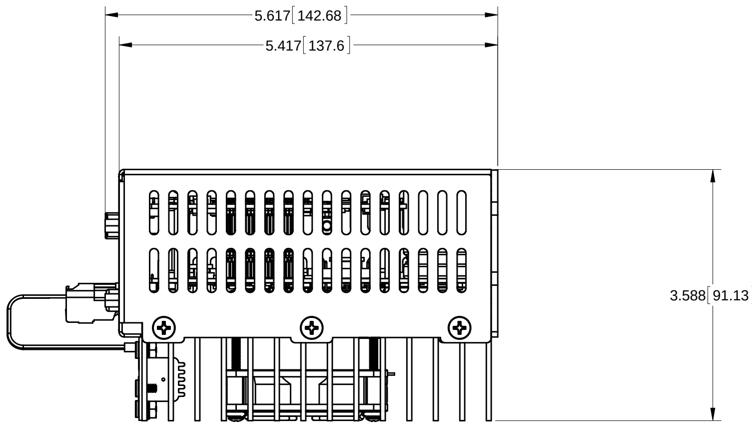
Max Energy	100 W·s (J)
Resistance	18 W
Power, continuous	20 W
Power, peak	70 W
Time	2000 ms

DIMENSIONS

Units: in [mm]







Weight:
4.19 lb [1.90kg]

ORDERING INFORMATION

XM2-230-20	*XM2* Servo Drive 10/20 Adc, Encoder feedback

MACRO Motion And Control Ring Optical

Example: Order one *Xenus Plus XM2* drive, solder-cup connector Kit, serial cable kit:

Qty	Item	Remarks
1	XM2-230-20-R	*Xenus Plus XM2* servo drive
1	XM2-CK	Connector Kit
1	SER-CK	Serial Cable Kit

ACCESSORIES

	Qty	Ref	Name	Description	Manufacturer P/N
XM2-CK Connector Kit	1	J1	AC Pwr	Plug, 4 position, 5.08 mm, female	Wago: 231-305/107-000 (Note 1)
	1	J2	Regen	Plug, 3 position, 5.08 mm, female	Wago: 231-303/107-000 (Note 1)
	2	J3,J4	Motor	Plug, 4 position, 5.08 mm, female	Wago: 231-304/107-000 (Note 1)
	1	J5	Brake	Plug, 5 position, 3.5 mm, female	Wago: 734-105/107-000 (Note 1)
	1	J5	Tool	Tool, wire insertion & extraction, 734 series	Wago: 734-231
	4	J1, J2, J3, J4	Tool	Tool, wire insertion & extraction, 231 series	Wago: 231-159
	1	J6 Note 2	Safety	Connector, DE-9M, 9-position, standard, male	AMP/Tyco: 205204-4
	9			AMPLIMITE HDP-20 Crimp-Snap contacts, 24-20AWG, sel AU/NI	AMP/Tyco: 66506-9
	1			Backshell, DE-9, RoHS, metallized, for J6	Norcomp: 979-009-020R121
	1	J12	Control	Connector, high-density DB-44M, 44 position, male, solder cup	Norcomp: 180-044-103L001
	1			Backshell, DB-44, 44 Pin, RoHS, metallized	Norcomp: 979-025-020R121
	1	J9	I/O	Connector, high-density DA-26F, 26 position, female, solder cup	Norcomp: 180-026-203L001
	2	J10~11	Feed-back	Connector, high-density DA-26M, 26 position, male, solder cup	Norcomp: 180-026-103L001
	3	J9~11		Backshell, DA-26, RoHS, metallized	Norcomp: 979-015-020R121
SER-CK	1	J7	RS-232	Serial Cable Kit	

Note 1: For RoHS compliance, append "/RN01-0000" to the Wago part numbers listed above

Note 2: Insertion/extraction tool for J6 contacts is AMP/Tyco 91067-2 (not included in XM2-CK)

REGENERATION RESISTOR (OPTIONAL)

XTL-RA-04	1	J2		Regeneration resistor assembly, 15 Ω

EDGE FILTER (OPTIONAL, ONE REQUIRED FOR EACH AXIS. QUANTITIES BELOW ARE FOR ONE FILTER AND ONE CONNECTOR KIT)

XTL-FA-01	1	J3~4	Edge filter	
Edge Filter Connector Kit XTL-FK	1		Plug, 4 position, 5.0 mm, female	Wago: 721-104/026-047 (Note 1)
	1		Plug, 5 position, 5.0 mm, male	Wago: 721-605/000-044 (Note 1)
	2		Tool, wire insertion & extraction	Wago: 231-131

Note: Specifications are subject to change without notice

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