Xenus PLUS Compact EtherCAT XEC

DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

CONTROL MODES
- Cyclic Synchronous Position-Velocity-Torque (CSP, CSV, CST)
- Profile Position-Velocity-Torque, Interpolated Position, Homing
- Indexer, Point-to-Point, PVT
- Camming, Gearing
- Position, Velocity, Torque

COMMAND INTERFACE
- CANopen application protocol over EtherCAT (CoE)
- ASCII and discrete I/O
- Stepper commands
- ±10V position/velocity/torque
- PWM velocity/torque command
- Master encoder (Gearing/Camming)

COMMUNICATIONS
- EtherCAT
- 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
- Sanyo Denki Absolute A
- BiSS (B&C)

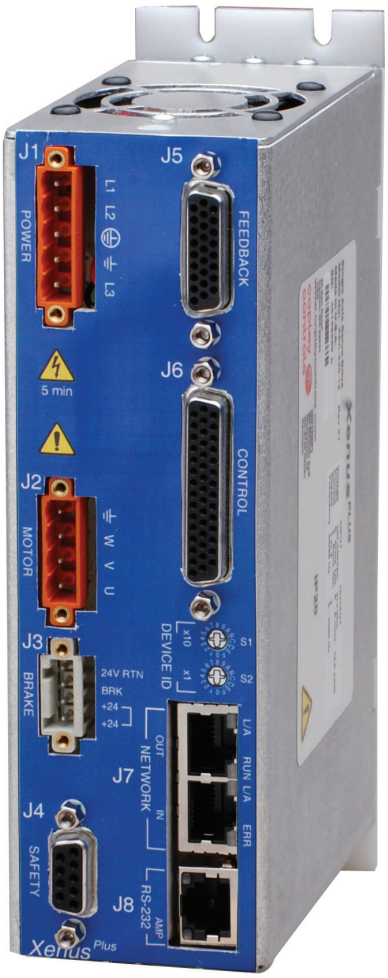
Other
- Digital Halls

I/O DIGITAL
- 6 High-speed inputs
- 1 Motor over-temp input
- 4 Opto-isolated inputs
- 1 High-speed output
- 3 Opto-isolated outputs
- 1 Opto-isolated motor brake output

I/O ANALOG
- 1 Reference input, 12-bit

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

DIMENSIONS: IN [MM]
- 7.54 x 4.55 x 2.13 [191.4 x 115.6 x 54.1]



Model	Ic	Ip	Vac
XEC-230-09	3	9	100~240
XEC-230-12	6	12	100~240
XEC-230-15	7.5	15	100~240

DESCRIPTION

XEC sets new levels of performance, connectivity, and flexibility. CANopen application protocol over EtherCAT (CoE) communication provides a widely used cost-effective industrial bus. A wide range of absolute encoders are supported.

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 can be employed.

GENERAL SPECIFICATIONS

Test conditions: Wye connected load: 2 mH line-line. Ambient temperature = 25 °C. Power input = 230 Vac, 60 Hz, 1 Ø

MODEL	XEC-230-09	XEC-230-12	XEC-230-15	
OUTPUT CURRENT				
Peak Current	9 (6.4)	12 (8.5)	15 (10.6)	Adc (Arms, sinusoidal)
Peak time	1	1	1	s
Continuous current	3 (2.12)	6 (4.24)	7.5 (5.3)	Adc (Arms, sinusoidal)
INPUT POWER				
Mains voltage, phase, frequency	100~240	100~240	100~240	Vac, ±10%, 1Ø or 3Ø, 47~63 Hz
Maximum Mains Current, (Note 2)	4.7	9.4	11.8	Arms 1Ø
	2.6	5.2	6.5	Arms 3Ø
+24 Vdc Control power	+20~32 VdcRequired for operation (Note 3_			
	7.5 W (Typ, no load on +5V outputs), ≤ 18 W, (Max, both +5V outputs @ 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	
Resolution	12-bit capture of U & V phase currents	
COMMAND INPUTS		
CANopen application protocol over EtherCAT	Cyclic synchronous Position-Velocity-Torque, Profile Position-Velocity-Torque, Interpolated position, Homing	
Stand-alone mode		
Analog torque, velocity, position reference	±10 Vdc, 12 bit resolution	Dedicated differential analog input
Digital position reference	Pulse/Direction, CW/CCW	Stepper commands (4 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-11 connector	

DIGITAL INPUTS	
[IN1,2]	Digital, Schmitt trigger, 1.5 µs RC filter, 24 Vdc compatible, 15 kΩ programmable pull-up/downs to +5 Vdc/ground, Vt+ ≥ 3.15 Vdc, VT- ≤ 1.13 Vdc
[IN3,4,5,6]	Programmable as 4 single-ended or 2 differential pairs, 100 ns RC filter, 5 Vdc typical, 12 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,
[IN7,8,9,10]	Opto-isolated, single-ended, ±15~30 Vdc compatible, bi-polar, with common return to +24V or ground Rated impulse ≥ 800 V, Vin-LO ≤ 6.0 Vdc, Vin-HI ≥ 10.0 Vdc, Input current ±3.6 mA @ ±24 Vdc, typical Maximum working voltage with respect to signal ground: 32 Vdc
[IN11]	Motor overtemp signal on feedback connector, Schmitt trigger, 24 Vdc compatible 330 µs RC filter, 4.99k pullup to +5 Vdc, Vt+ ≥ 3.15 Vdc, VT- ≤ 1.13 Vdc Programmable for other functions if not used for Motemp
ANALOG INPUT	
[AIN±]	Differential, ±10 Vdc, 5.06 kΩ input impedance, 12-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	***Xenus Plus Compact STO Manual***
RS-232 PORT	
Signals	RxD, TxD, Gnd in 6-position, 4-contact RJ-11 style modular connector, non-isolated
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	
[OUT1~3]	Opto-isolated SSR, two-terminal, 300 mA max, 24 V tolerant, series 1 Ω resistor, 36 V Zener flyback diode Rated impulse ≥ 800 V
[OUT4]	High-speed CMOS buffer, +5V max, ±8 mA into 560 Ω (minimum)
[OUT5]	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, isolated from signal ground, max working voltage with respect to signal ground: 32 Vdc
Protocol	EtherCAT, CAN application protocol over EtherCAT (CoE)
5V OUTPUTS	
Number	2: +5Vout1 on the feedback connector (J5), +5Vout2 on the control connector (J6) for the multi-mode encoder
Ratings	+5 Vdc @ 500 mA each output, 1000 mA total for both outputs, thermal and overload protected

NOTES:

1. Brake output [OUT5] is programmable as motor brake, or as general purpose digital output.
2. The actual mains current is dependent on the mains voltage, and motor load and operating conditions. The Maximum Mains Currents shown above occur when the drive is operating from the maximum input voltage and is producing the rated peak and continuous output currents at the maximum output voltage.
3. When STO feature is used, the 24V power supply must be a SELV or PELV type with the maximum output voltage limited to 60 Vdc or lower.

GENERAL SPECIFICATIONS

STATUS INDICATORS		
Drive Status	Bicolor LED, drive status indicated by color, and blinking or non-blinking condition	
NET Status	RUN/ERR LEDs, status of EtherCAT bus indicated by color and blink codes to CAN Indicator Specification 303-3	
REGENERATION		
Operation	Solid state switch drives 60 Ω internal regen resistor	
Bus Capacitance	940 µF	
Continuous Power Capability	20 W	
Cut-In Voltage	+HV > 390 Vdc ±2 Vdc	Regen output is on, regen resistor is dissipating energy
Drop-Out Voltage	+HV < 380 Vdc ±2 Vdc	Regen output is off, regen resistor not dissipating energy
PROTECTIONS		
AC Mains Loss	Loss of mains power between L1 & L2 is detected	
HV Overvoltage	+HV > 400 Vdc	Drive PWM outputs turn off until +HV is less than 400 Vdc
HV Undervoltage	+HV < 60 Vdc	Drive PWM outputs turn off until +HV is greater than 60 Vdc
Drive over temperature	IGBT > 85 °C ±3 °C	Drive PWM outputs turn off until IGBT temperature is below 85 ºC
Short circuits	Motor: Output to output, output to ground, output to HV, internal PWM bridge faults Regen: Regen+ to ground, Regen- to HV	
I^2T Current limiting	Programmable: continuous current, peak current, peak time	
Motor over temperature	[IN11] input programmable to disable drive when motor sensor resistance increases	
Feedback loss	Programmable to detect loss of A OR B encoder channels, or loss of A OR B OR X channels	
Command Signal Loss	EtherCAT master stops cyclical updates, network cable is unplugged Programmable as a latching fault	
24V Reversed Polarity	Reversing the +24V connections (J3-4 & J3-1) will not damage the drive	
MECHANICAL & ENVIRONMENTAL		
Size	7.54 x 4.55 x 2.13 [191.4 x 115.6 x 54.1]	
Weight	2.2 lb [1.0 kg]	
Ambient temperature	0 to +45 °C operating, -40 to +85 °C storage	
Altitude	≤ 2000 m (6560 ft)	
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	
Cooling	Internal fan allows operation at rated continuous current to 45 C ambient	

AGENCY STANDARDS CONFORMANCE

Standards and Directives

Functional Safety

IEC 61508-1:2010, IEC 61508-2:2010, IEC 61508-3:2010, IEC 61508-4: 2010 (SIL 3)
Directive 2006/42/EC (Machinery)
ISO 13849-1/Cor. 1:2009 (Cat 3, PL d)
IEC 61800-5-2:2007 (SIL3)
Reference: Xenus Plus Compact STO Manual

Product Safety

Directive 2006/95/EC (Low Voltage)
IEC 61800-5-1:2007

EMC

Directive 2004/108/EC (EMC)
IEC 61800-3:2004/A1:2011

Restriction of the Use of Certain Hazardous Substances (RoHS)

Directive 2011/65/EU (RoHS II)

Approvals

UL and cUL recognized component to:

UL 61800-5-1, 1st Ed.

UL Functional Safety Certification to:

IEC 61508-1:2010, IEC 61508-2:2010, IEC 61508-3:2010, IEC 61508-4: 2010 (SIL 3)
ISO 13849-1/Cor. 1:2009 (Cat 3, PL d)

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 121 Ω terminators between A & /A, B & /B inputs, 130 Ω between X & /X input
	Analog Incremental Encoder	Sin/cos format (Sin+, Sin-, Cos+, Cos-), differential, 1 Vpeak-peak ±20%, ServoTube motor compatible BW > 300 kHz, 121 Ω terminating resistors between Sin+ & Sin-, Cos+ & Cos- inputs 12-bit resolution, BW > 300 kHz, with zero-crossing detection
Absolute:		
	SSI	Clock (X, /X), Data (S, /S) signals, 4-wire, Clock is output from XEC, Data is input from encoder 130 Ω terminatoR between X & /X outputs, 221 Ω between S & /S inputs 1 kΩ pull-ups to +5 Vdc on X & S, 1 kΩ pull-downs to Sgnd on /X & /S
	EnDAT	Clock (X, /X), Data (S, /S), Sin/Cos (Sin+, Sin-, Cos+, Cos-) signals
	Absolute A, Tamagawa Absolute A, Panasonic Absolute A Format, Sanyo Denki Absolute A	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 XEC, Data is input from encoder X & S channels for absolute encoders use ISL3178 bi-directional line driver/receivers
HALLS		
Digital:		
		U, V, W: Single-ended, 120° electrical phase difference between U-V-W signals, Schmitt trigger, 1 µs RC filter, 24 Vdc compatible, 10 kΩ pull-up to +5 Vdc Vt+ = 2.5~3.5 Vdc, VT- = 1.3~2.2 Vdc, VH = 0.7~1.5 Vdc
Analog:		
		U & V: Sin/cos format (Sin+, Sin-, Cos+, Cos-), differential, 1 Vpeak-peak ±20%, ServoTube motor compatible BW > 300 kHz, 121 Ω terminating resistors between Sin+ & Sin-, Cos+ & Cos- inputs 12-bit resolution, BW > 300 kHz, with zero-crossing detection
MULTI-MODE ENCODER PORT		
	As Input	See Digital Incremental Encoder above for electrical data on A, B, & X channels, or Absolute encoders using X or S channels. No terminators on A & B channels, X & S channels as shown above
	As Emulated Output	Quadrature A/B encoder emulation with programmable resolution to 4096 lines (65,536 counts) per rev from analog sin/cos encoders or absolute encoders. A/B outputs use ISL3178 line drivers. A, /A, B, /B, outputs from ISL3178 differential line driver, X, /X, S, /S outputs from ISL3178 driver
	As Buffered Output	Digital A/B/X encoder signals from primary digital encoder are buffered by ISL3178 line drivers, 5 MHz max
5V OUTPUTS		
	Number	2: +5Vout1 on the feedback connector (J5), +5Vout2 on the control connector (J6) for the multi-mode encoder
	Ratings	+5 Vdc @ 500 mA each output, 1000 mA total for both outputs, thermal and overload protected

ETHERCAT COMMUNICATIONS

ETHERCAT CONNECTIONS

Dual RJ-45 sockets accept standard Ethernet cables. The IN port connects to a master, or to the OUT port of a device that is 'upstream', between the XEC and the master. The OUT port connects to 'downstream' nodes. If the XEC is the last node on a network, only the IN port is used. No terminator is required on the OUT port.

ETHERCAT LEDS (ON RJ-45 CONNECTORS)

L/A A green LED indicates the state of the EtherCAT network:

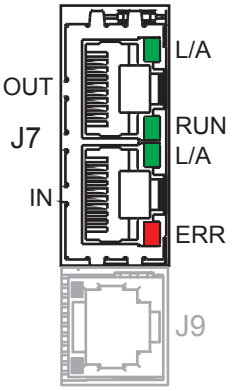
LED	Link	Activity	Condition
ON	Yes	No	Port Open
Flickering	Yes	Yes	Port Open with activity
Off	No	(N/A)	Port Closed

RUN Green: Shows the state of the ESM (EtherCAT State Machine)

Off	=	Init
Blinking	=	Pre-operational
Single-flash	=	Safe-operational
On	=	Operational

ERR Red: Shows errors such as watchdog timeouts and unsolicited state changes in the XEC due to local errors.

Off	=	EtherCAT communications are working correctly
Blinking	=	Invalid configuration, general configuration error
Single Flash	=	Local error, slave has changed EtherCAT state autonomously
Double Flash	=	PDO or EtherCAT watchdog timeout, or an application watchdog timeout has occurred



J7: EtherCAT PORTS

RJ-45 receptacles,
8 position, 4 contact

PIN	SIGNAL
1	TX+
2	TX-
3	RX+
6	RX-

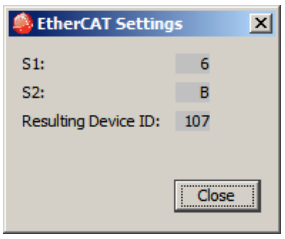
EtherCAT DEVICE ID (STATION ALIAS)

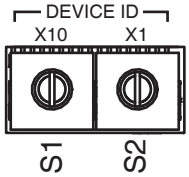
In an EtherCAT network, slaves are automatically assigned consecutive addresses based on their position on the network. But when the device must have a positive identification that is independent of cabling, a Device ID is used. This is provided by two 16-position rotary switches with hexadecimal encoding. These can set the Device ID of the drive from 0x00~0xFF (0~255 decimal). The chart shows the decimal values of the hex settings of each switch.

Example 1: Find the switch settings for decimal Device ID 107:

1) Find the highest number in the X10 column that is less than 107 and set X10 to the hex value in the same row:
   96 < 107 and 112 > 107, so X10 = 96 = Hex 6
2) Subtract 96 from the desired Device ID to get the decimal value for the switch X1 and set it to the Hex value in the same row:
   X1 = (107 - 96) = 11 = Hex B
3) Result: X10 = 6, X1 = B, Alias = 0x6B (107)

CME2 -> Amplifier -> Network Configuration





EtherCAT Device ID Switch Decimal values

Set	x10	x1
Hex	Dec	
0	0	0
1	16	1
2	32	2
3	48	3
4	64	4
5	80	5
6	96	6
7	112	7

Set	x10	x1
Hex	Dec	
8	128	8
9	144	9
A	160	10
B	176	11
C	192	12
D	208	13
E	224	14
F	240	15

INDICATORS: DRIVE STATE

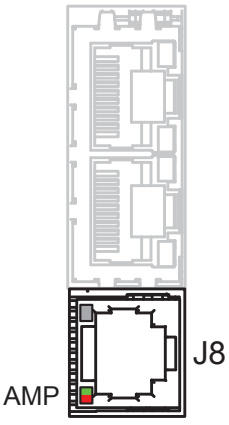
The AMP bi-color LED gives the state of the drive. Colors do not alternate, and can be solid ON or blinking.
When multiple conditions occur, only the top-most condition will be displayed.
When that condition is cleared the next one below will shown.

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 reference inputs or EtherCAT commands.

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 Lost
- Motor Wiring Disconnected
- STO Active
- Over Current (latched)



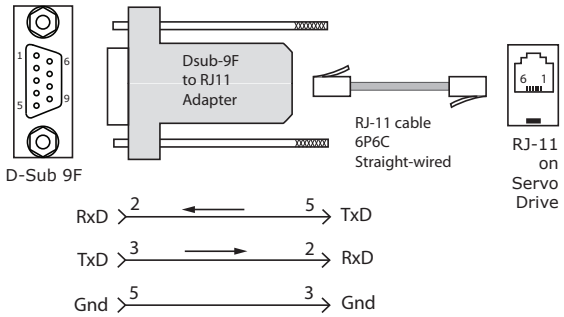
COMMUNICATIONS: RS-232 SERIAL

RS-232 COMMUNICATIONS

XEC 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 *XEC* RS-232 port are through J8, an RJ-11 connector. The *XEC* 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.

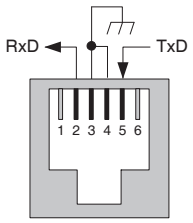
SER-CK SERIAL CABLE KIT

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



J8: RS-232 PORT

RJ-11 receptacle,
6 position, 4 contact



RJ-11
(DTE)

PIN	SIGNAL
2	RxD
3,4	Gnd*
5	Txd

* SIGNAL GROUND

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

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

SAFE TORQUE OFF (STO)

DESCRIPTION

The XEC 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 Compact STO Manual***
	The information provided in the *Xenus Plus Compact STO Manual* must be considered for any application using the XEC drive 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 drive 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 J4, 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.

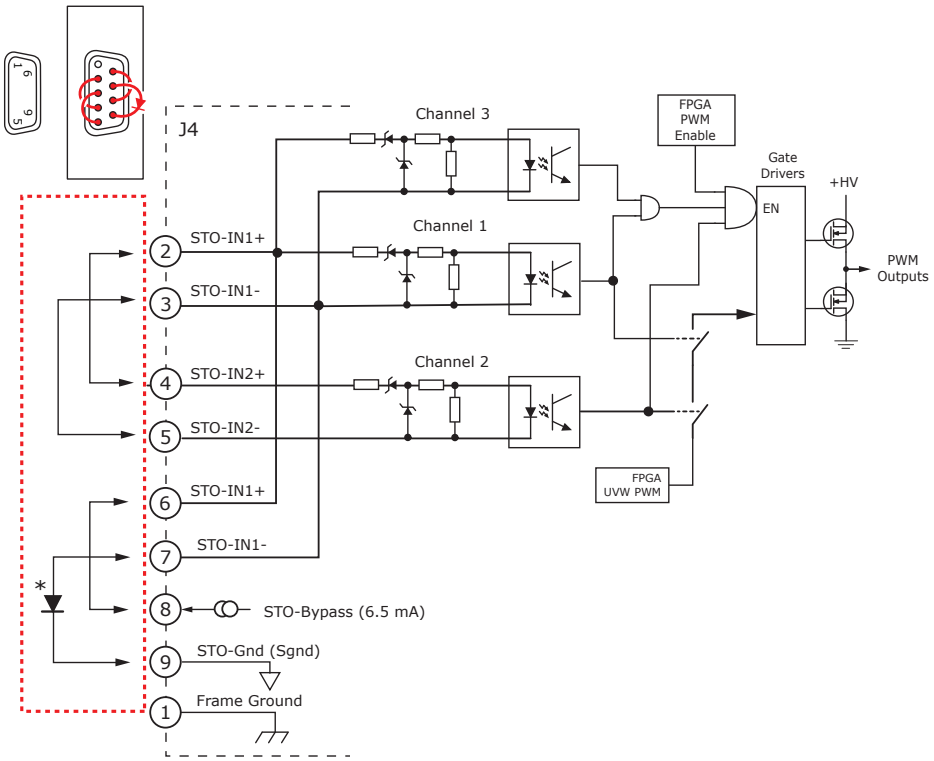
If not using the STO feature, these connections must be made in order for the drive to be enabled.

STO BYPASS CONNECTIONS

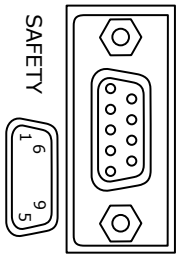
Current must flow through all of the opto-couplers before the drive can be enabled

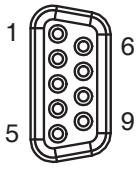
* STO bypass connections on the XPC and Xenus XEL/XPL models are different. If both drives are installed in the same cabinet, the diode should be wired as shown to prevent damage that could occur if the STO bypass connectors are installed on the wrong drive. The diode is not required for STO bypass on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

Bypass Plug Connections
Jumper pins:
2-4, 3-5, 6-8, 7-9 *



STO CONNECTOR





J4 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(-)		

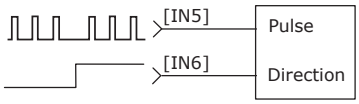
DIGITAL COMMAND INPUTS: POSITION

POSITION COMMAND INPUTS

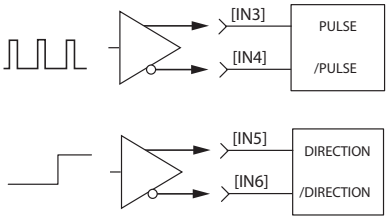
Digital position commands must be sourced from devices with active pull-up and pull-down to take advantage of the high-speed inputs.

For differential commands, the A & B channels of the multi-mode encoder ports may be used.

SINGLE-ENDED PULSE & DIRECTION



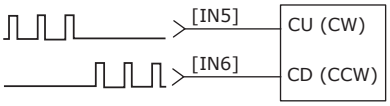
DIFFERENTIAL PULSE & DIRECTION



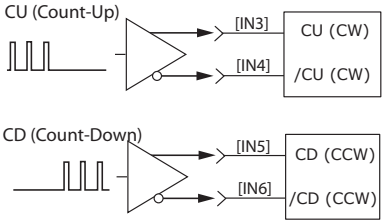
SINGLE-ENDED: IN5, 6

Signal	J6 Pins
[IN5] Pls, CU, Enc A	11
[IN6] Dir, CD, Enc B	12
Signal Ground	6,16,22,31, 37,44
Frame Ground	1

SINGLE-ENDED CU/CD



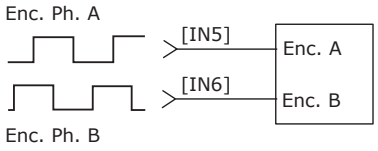
DIFFERENTIAL CU/CD



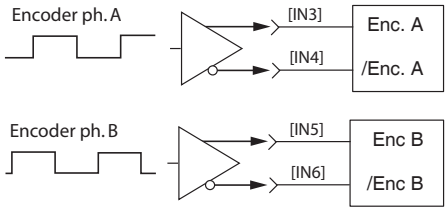
DIFFERENTIAL: IN3,4,5,6

Signal	J6 Pins
[IN3] Pls, CU, Enc A	9
[IN4] /Pls, /CU, Enc /A	10
[IN5] Dir, CD, Enc B	11
[IN6] /Dir, /CD, Enc /B	12
Signal Ground	6,16,22,31, 37,44
Frame Ground	1

QUAD A/B ENCODER SINGLE-ENDED



QUAD A/B ENCODER DIFFERENTIAL

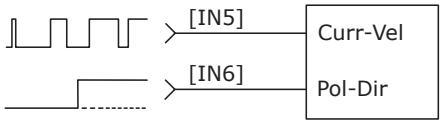


DIGITAL COMMAND INPUTS: VELOCITY, TORQUE

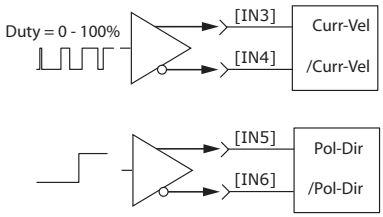
Single-ended digital torque or velocity commands must be sourced from devices with active pull-up and pull-down to take advantage of the high-speed inputs.

For differential commands, the A & B channels of the multi-mode encoder ports may be used.

SINGLE-ENDED PWM & DIRECTION



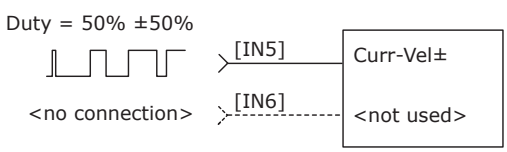
DIFFERENTIAL PWM & DIRECTION



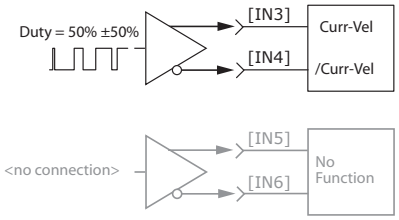
SINGLE-ENDED: IN5,6

Signal	J6 Pins
[IN5] Curr-Vel±	11
[IN6] Pol-Dir	12
Sgnd	6,16,22,31, 37,44
Frame Ground	1

SINGLE-ENDED 50% PWM



DIFFERENTIAL 50% PWM



DIFFERENTIAL: IN3,4,5,6

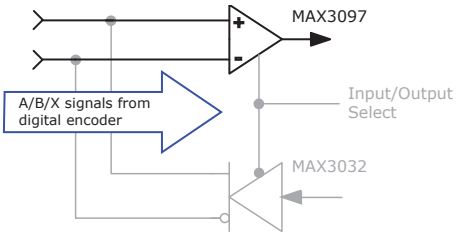
Signal	J6 Pins
[IN3] Curr-Vel±	9
[IN4] / Curr-Vel±	10
[IN5] Pol-Dir	11
[IN6] /Pol-Dir	12
Signal Ground	6,16,22,31, 37,44
Frame Ground	1

MULTI-MODE ENCODER PORT AS AN INPUT

INPUT TYPES

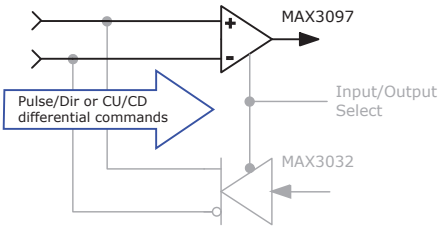
POSITION COMMAND INPUTS: DIFFERENTIAL

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



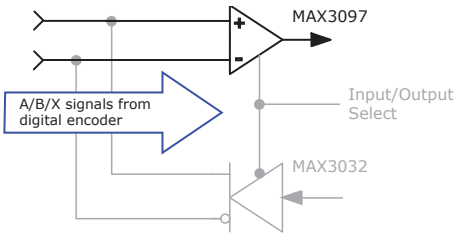
CURRENT or VELOCITY COMMAND INPUTS: DIFFERENTIAL

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



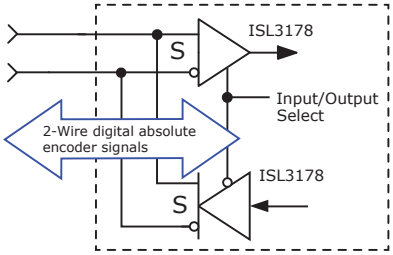
SECONDARY FEEDBACK: INCREMENTAL

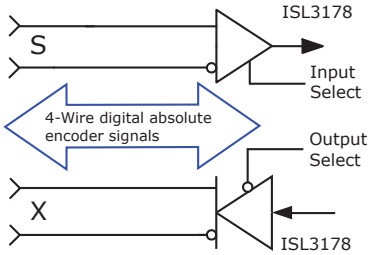
- Quad A/B/X incremental encoder



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

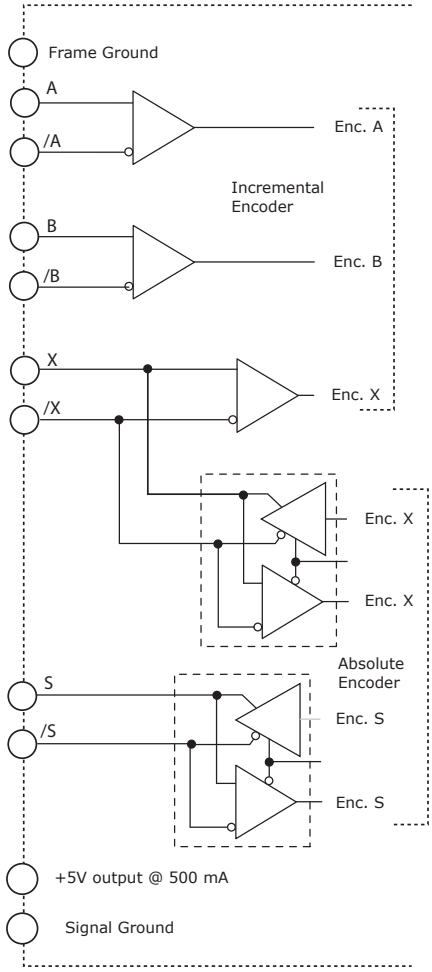




SIGNALS & PINS

Signal	J6
Pulse, CW, Encoder A	36
/Pulse, /CW, Encoder /A	21
Direction, CCW, Encoder B	35
/Direction, /CCW, Encoder /B	20
Quad Enc X, Absolute Clock	34
Quad Enc /X, /Absolute Clock	19
Enc S, Absolute (Clock) Data	33
Enc /S, / Absolute (Clock) Data	18
Signal Ground	6, 16, 22, 31, 37, 44
Frame Ground	1

J6 Control



MULTI-MODE PORT AS AN OUTPUT

OUTPUT TYPES

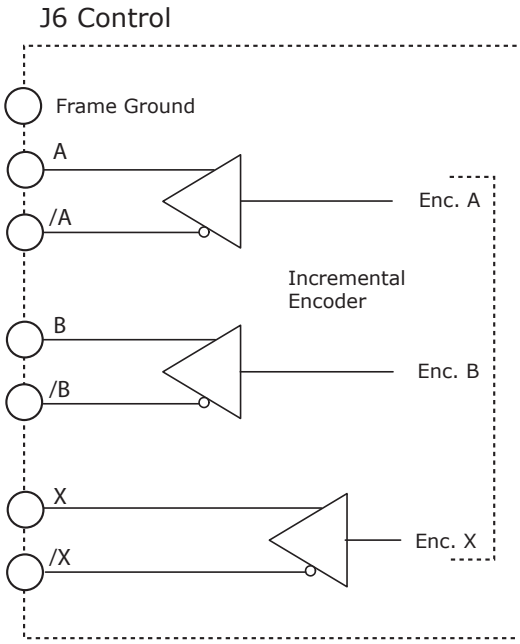
BUFFERED FEEDBACK OUTPUTS: DIFFERENTIAL

- Encoder Quad A, B, X channels
- Direct hardware connection between quad A/B/X encoder feedback and differential line drivers for A/B/X outputs

EMULATED FEEDBACK OUTPUTS: DIFFERENTIAL

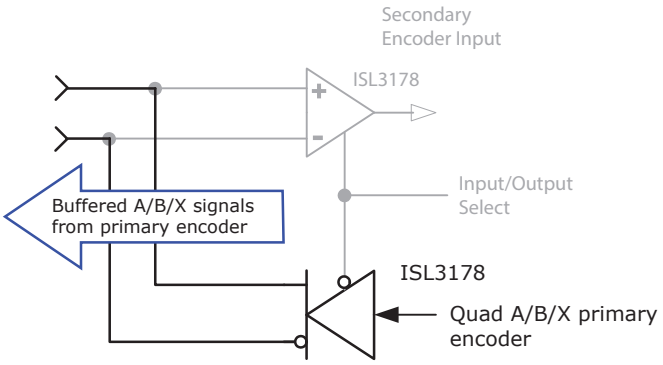
Firmware produces emulated quad A/B signals from feedback data from the following devices:

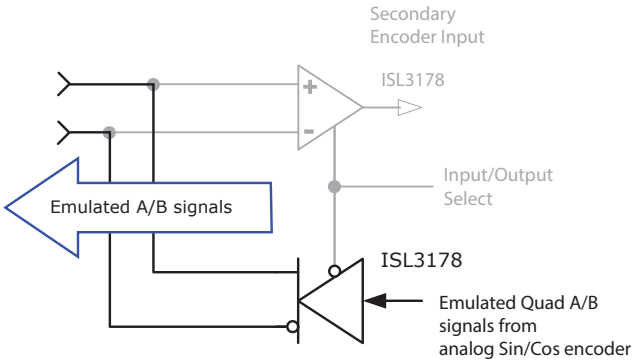
- Absolute encoders
- Analog Sin/Cos incremental encoders



SIGNALS & PINS

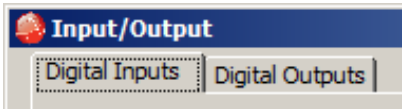
Signal	J6
Encoder A	36
Encoder /A	21
Encoder B	35
Encoder /B	20
Encoder X	34
Encoder /X	19
Encoder S	33
Encoder /S	18
Signal Ground	6, 16, 22, 31, 37, 44
Frame Ground	1



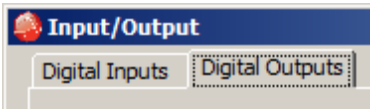


CME2 DEFAULTS

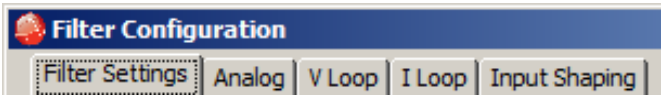
These tables show the CME2 default settings. They are user-programmable and the settings can be saved to non-volatile flash memory.



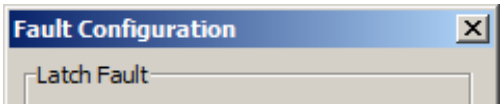
Name	Configuration	PU/PD
IN1	Enable-LO, Clear Faults	+5V PU
IN2	Not Configured	+5V/Gnd
IN3		
IN4		
IN5		
IN6		
IN7	Opto Not Configured	
IN8		
IN9		
IN10		
IN11	Motemp	+5V PU



Name	Notes
OUT1	Fault Active Off
OUT2	Isolated Not Configured
OUT3	
OUT4	HS Output Not Configured
OUT5	Brake Active-HI



Name	Notes
Analog: Reference Filter	Disabled
Vloop: Input Filter	Disabled
Vloop: Output Filter 1	Low Pass, Butterworth, 2-pole, 200 Hz
Vloop: Output Filter 2	Disabled
Vloop: Output Filter 3	Disabled
Iloop: Input Filter 1	Disabled
Iloop: Input Filter 2	Disabled
Input Shaping	Disabled



Active	Notes
√	Short Circuit
√	Amp Over Temperature
√	Motor Over Temp
	Over Voltage
	Under Voltage
√	Feedback Error
	Motor Phasing Error
√	Following Error
	Command Input Fault
	Motor Wiring Disconnected
	STO Active

OPTIONAL FAULTS

	Over Current (Latched)

Option	Notes
Method	Set Current Position as Home

HIGH SPEED INPUTS: IN1, IN2

- Digital, non-isolated, high-speed
- Progammable pull-up/pull-down
- 24V Compatible
- Programmable functions

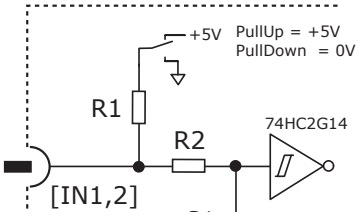
SPECIFICATIONS

Input	Data	Notes
Input Voltages	HI	VT+ = 2.5~3.5 Vdc
	LO	VT- = 1.3~2.2 Vdc
	VH[1]	VH = ±0.7~1.5 Vdc
	Max	+30 Vdc
	Min	0 Vdc
Pull-up/down	R1	15 kΩ
Low pass filter	R2	15 kΩ
	C1	100 pF
Input Current	24V	1.3 mAdc
	0V	-0.33 mAdc
Time constant	RC[2]	1.5 µs

CONNECTIONS

Input	Pin
IN1	J6-7
IN2	J6-8
Sgnd	J6-6, 16, 22, 31, 37, 44

FEEDBACK CONNECTOR



Notes:
1) VH is hysteresis voltage (VT+) - (VT-)
2) The R2*C2 time constant applies when input is driven by active HI/LO devices

SINGLE-ENDED/DIFFERENTIAL INPUTS: IN3, IN4, IN5, IN6

- Digital, non-isolated, high-speed
- Progammable pull-up/pull-down
- 12V Compatible
- Single-ended or Differential
- Programmable functions

SPECIFICATIONS

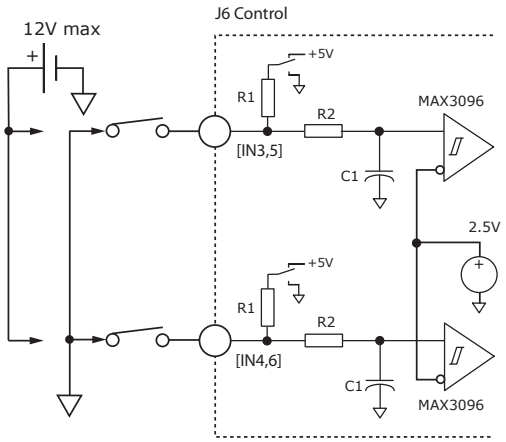
Input	Data	Notes
Input Voltages Single-ended	HI	Vin ≥ 2.7 Vdc
	LO	Vin ≤ 2.3 Vdc
	VH[1]	45 mVdc typ
Input Voltages Differential[3]	HI	Vdiff ≥ +200 mVdc
	LO	Vdiff ≤ -200 mVdc
	VH	±45 mVdc typ
Common mode	Vcm	0 to +12 Vdc
Pull-up/down	R1	10 kΩ
Low pass filter	R2	1 kΩ
	C1	100 pF
Time constant	RC[2]	100 ns

Notes:
1) VH is hysteresis voltage IN2 - IN3 or IN12 - IN13
2) The R2*C2 time constant applies when input is driven by active HI/LO devices)
3) Vdiff = AINn(+) - AINn(-) n = 1 for Axis A, 2 for Axis B

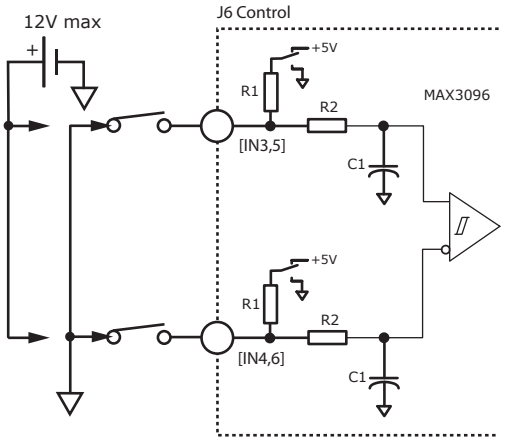
CONNECTIONS

S.E.	DIFF	Pin
IN3	IN3+	J6-9
IN4	IN4-	J6-10
IN5	IN5+	J6-11
IN6	IN6-	J6-12
Sgnd		J6-6, 16, 22, 31, 37 , 44

SINGLE-ENDED



DIFFERENTIAL



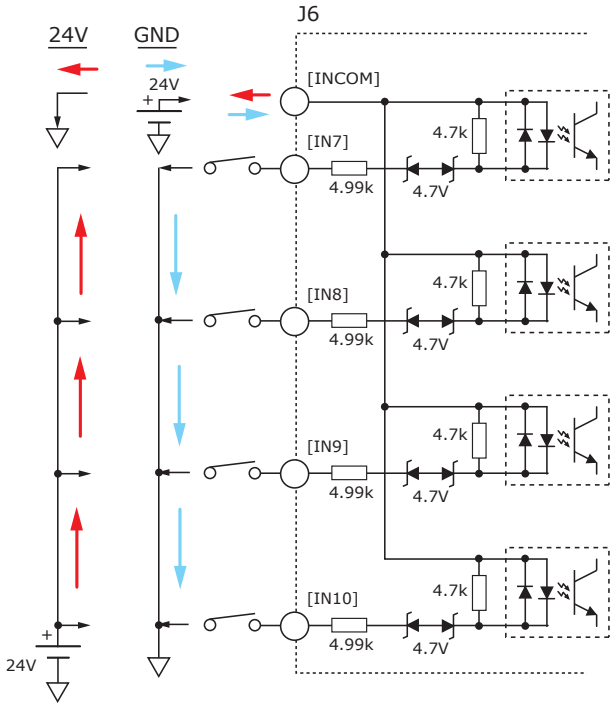
OPTO-ISOLATED INPUTS: IN7, IN8, IN9, IN10

- Digital, opto-isolated
- A group of four, with a common terminal
- Works with current sourcing or sinking drivers
- 24V Compatible
- Programmable functions

SPECIFICATIONS		
Input	Data	Notes
Input Voltages	HI	Vin ≥ ±10.0 Vdc *
	LO	Vin ≤ ±6 Vdc *
	Max	±30 Vdc *
Input Current	±24V	±2 mAdc
	0V	0 mAdc

* Vdc Referenced to ICOM terminals.

CONNECTIONS	
Signal	J6 Pin
IN7	13
IN8	14
IN9	15
IN10	30
ICOM	28



MOTOR OVERTEMP INPUT: IN11

- Digital, non-isolated
- Motor overtemp input
- 24V Compatible
- Programmable functions

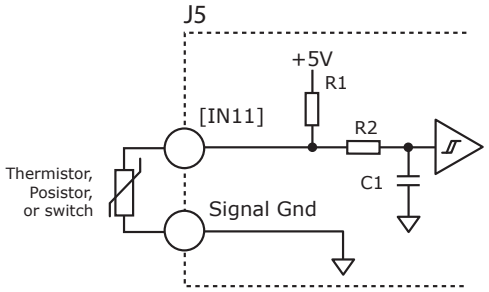
MOTOR OVER TEMP INPUT

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

SPECIFICATIONS

Input	Data	Notes
Input Voltages	HI	Vin ≥ 3.5 Vdc
	LO	Vin ≤ 0.7 Vdc
	Max	+24 Vdc
	Min	0 Vdc
Pull-up	R1	4.99 kΩ
Input Current	24V	5.7 mAdc
	0V	-1.0 mAdc
Low pass filter	R2	10 kΩ
	C1	33 nF
Time constant	Te	330 µs *

* RC time constant applies when input is driven by active high/low device



CONNECTIONS

Input	Pin
IN11	J5-7
Sgnd	J5-5, 16, 25, 26

BS 4999:Part 111:1987

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

ANALOG INPUT: AIN1

- ±10 Vdc, differential
- 12-bit resolution
- Programmable functions

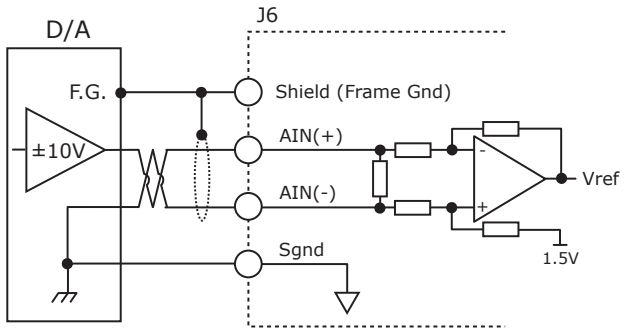
As a reference input it takes position/velocity/torque commands from a controller. If not used as a command input, it can be used as general-purpose analog input.

SPECIFICATIONS

Spec	Data	Notes
Input Voltage	Vref	±10 Vdc
Input Resistance	Rin	5.05 kΩ

CONNECTIONS

Signal	Pins
AIN(+)	J6-3
AIN(-)	J6-2
Sgnd	J6-6, 16, 22, 31, 37, 44



OPTO-ISOLATED OUTPUTS: OUT1, OUT2, OUT3

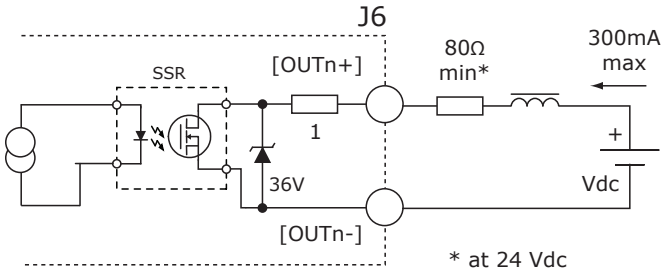
- Digital, opto-isolated
- MOSFET output SSR, 2-terminal
- Flyback diode for inductive loads
- 24V Compatible
- Programmable functions

SPECIFICATIONS

Output	Data	Notes
ON Voltage OUT(+) - OUT(-)	Vdc	0.85V @ 300 mAdc
Output Current	Iout	300 mAdc max

CONNECTIONS

Signal	(+)	(-)
OUT1	J6-42	J6-27
OUT2	J6-41	J6-26
OUT3	J6-40	J6-25

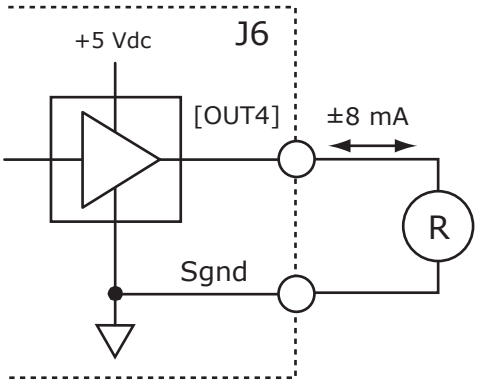


HI/LO DEFINITIONS: OUTPUTS

Input	State	Condition
OUT1~3	HI	Output SSR is ON, current flows
	LO	Output SSR is OFF, no current flows

HIGH-SPEED OUTPUT: OUT4

- CMOS buffer
- 74AHCT1G125
- Programmable functions

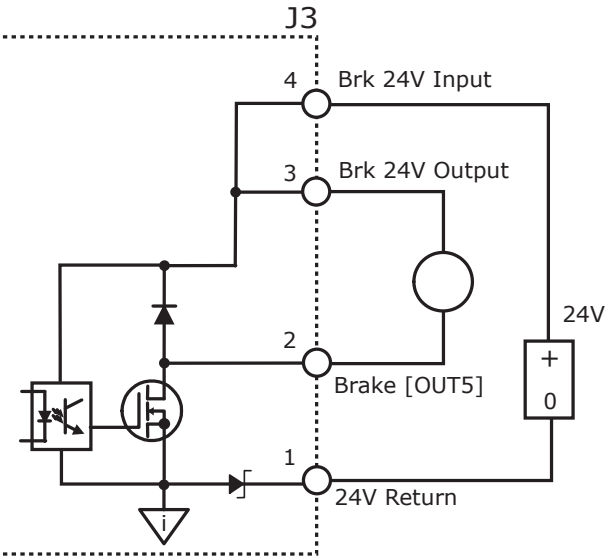


SPECIFICATIONS

Output HI	Data	Notes
Vout HI	Voh	4.4 Vdc
Iout HI	Ioh	-8.0 mAdc
Vout LO	Vol	0.40 Vdc
Iout LO	Iol	8.0 mAdc

OPTO-ISOLATED MOTOR BRAKE OUTPUT: OUT5

- Brake output
- Opto-isolated
- Flyback diode for inductive load
- 24V Compatible
- Protected from 24V reverse-connections to J3-1 & J3-4
- Programmable functions for [OUT5]



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

SPECIFICATIONS

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

HI/LO DEFINITIONS: OUTPUTS

Input	State	Condition
BRAKE [OUT5]	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 Output [OUT5] 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 4 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 5 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

J3 CONNECTIONS

Pin	Signal
4	Brk 24V Input
3	Brk 24V Output
2	Brake [OUT5]
1	24V Return

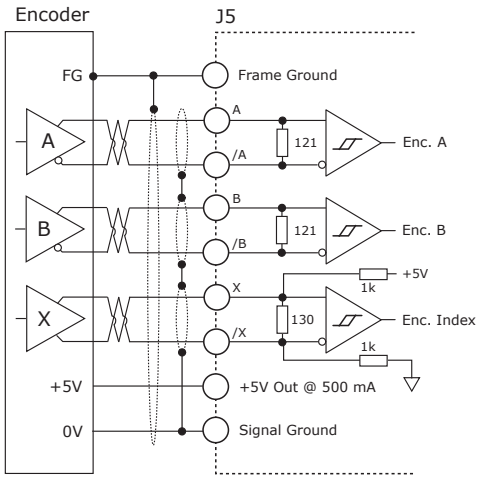
FEEDBACK CONNECTIONS

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

QUAD ENCODER WITH INDEX

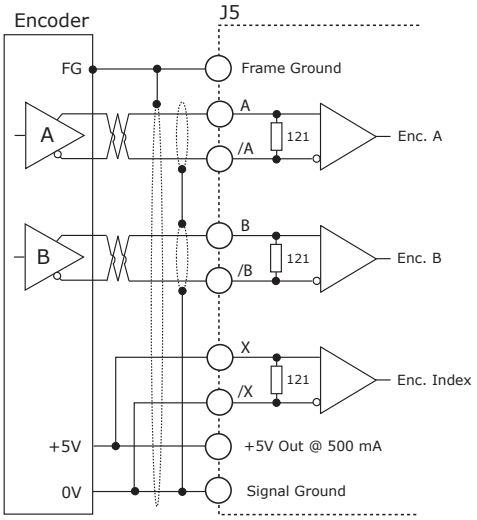


A/B/X SIGNALS

Signal	J5 Pins
Enc A	13
Enc /A	12
Enc B	11
Enc /B	10
Enc X	9
Enc /X	8
+5V	6, 17
Sgnd	5, 16, 25, 26
F.G.	1

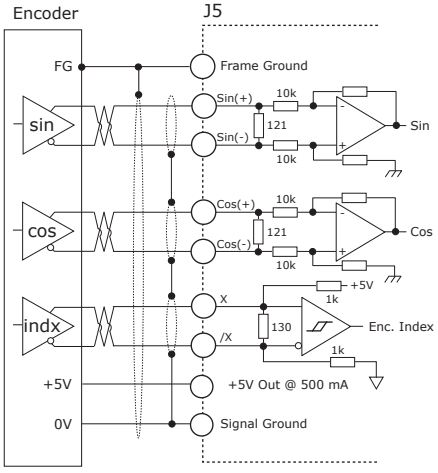
Sgnd = Signal Ground
F.G. = Frame Gnd

QUAD ENCODER WITH NO INDEX



ANALOG SIN/COS INCREMENTAL ENCODER

The sin/cos inputs are analog 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. The index input is digital, differential.



SIN/COS SIGNALS

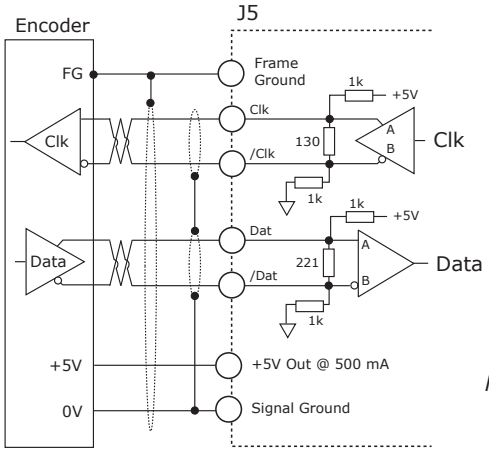
Signal	J5 Pins
Sin(+)	19
Sin(-)	18
Cos(+)	21
Cos(-)	20
X	9
/X	8
+5V	6, 17
Sgnd	5, 16, 25, 26
F.G.	1

Sgnd = Signal Ground
F.G. = Frame Gnd

FEEDBACK CONNECTIONS

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 XEC 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.



SSI,BiSS SIGNALS

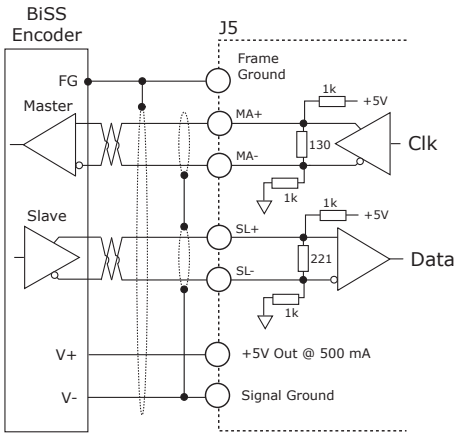
SSI	BiSS	J5 Pins
Clk	MA+	9
/Clk	MA-	8
Data	SL+	15
/Data	SL-	14
+5V		6, 17
Signal Ground		5, 16, 25, 26
Frame Gnd		1

Note: Single (outer) shields should be connected at both ends (motor and drive frame grounds). Inner shields should only be connected to Signal Ground on the drive.

BiSS ABSOLUTE ENCODER

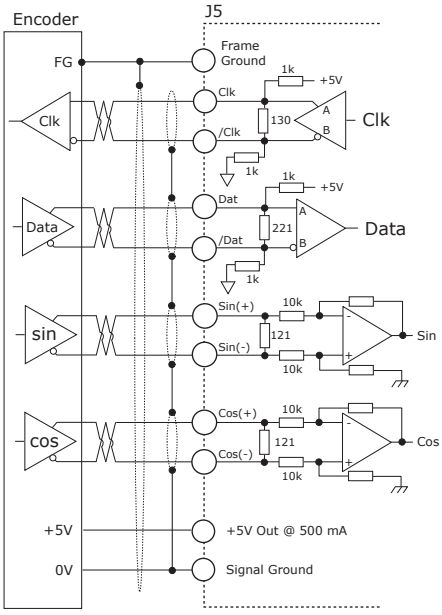
BiSS is an - Open Source - digital interface for sensors and actuators. BiSS refers to principles of well known industrial standards for Serial Synchronous Interfaces like SSI, AS-Interface® and Interbus® with additional options.

- 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



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.



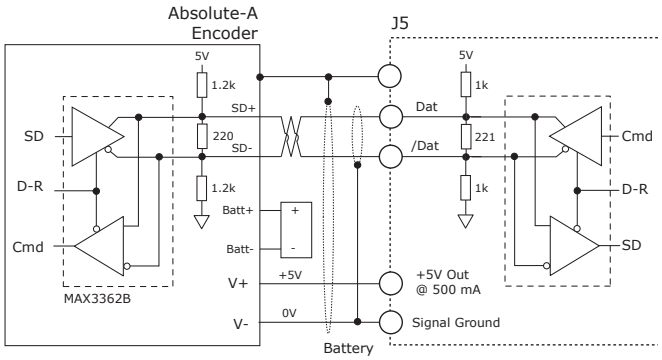
ENDAT SIGNALS

Signal	J5 Pins
Clk	9
/Clk	8
Data	15
/Data	14
Sin(+)	19
Sin(-)	18
Cos(+)	21
Cos(-)	20
+5V	6, 17
Sgnd	5, 16, 25, 26
F.G.	1

Sgnd = Signal Ground
F.G. = Frame Gnd

ABSOLUTE-A ENCODER

The Absolute A interface is a serial, half-duplex type that is electrically the same as RS-485. Note the battery which must be connected. Without it, the encoder will produce a fault condition.



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

ABSOLUTE-A SIGNALS

Signal	J5 Pins
Data	15
/Data	14
+5V	6, 17
Sgnd	5, 16, 25, 26
F.G.	1

Sgnd = Signal Ground
F.G. = Frame Gnd

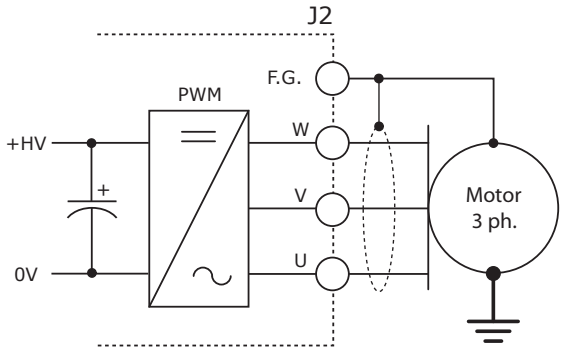
MOTOR CONNECTIONS

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 (J2-1) for best results.

MOTOR SIGNALS

Signal	J2 Pin
Mot U	4
Mot V	3
Mot W	2
Frame Gnd	1

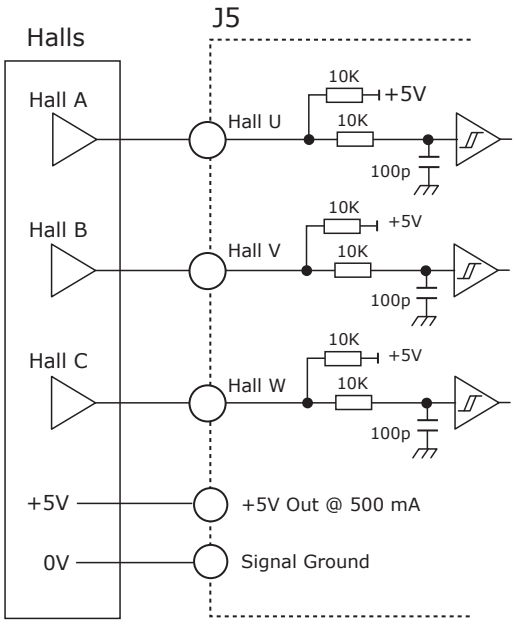


DIGITAL HALL SIGNALS

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.

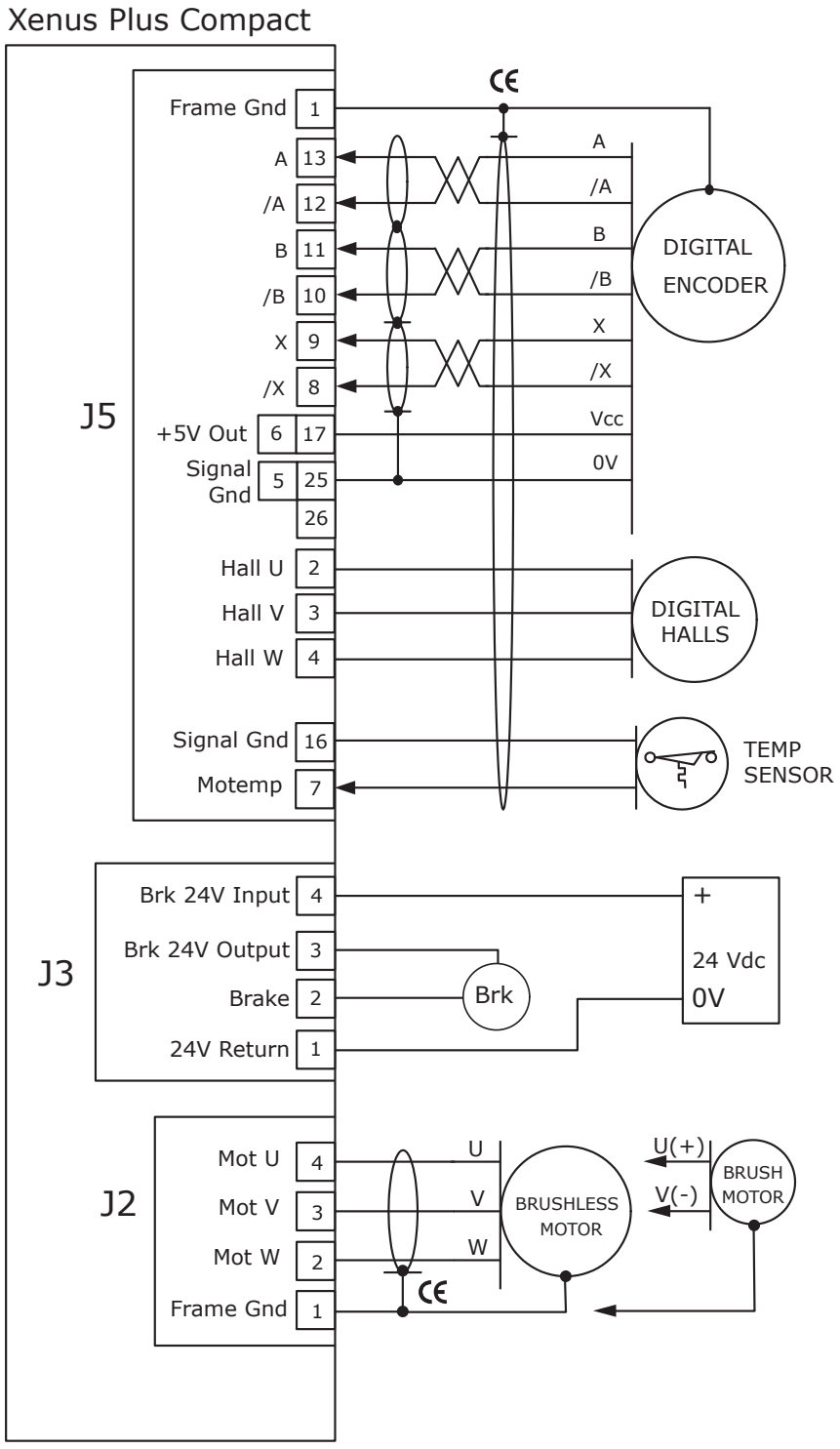
HALL SIGNALS

Signal	J5 Pins
Hall U	2
Hall V	3
Hall W	4
+5V	6, 17
Sgnd	5, 16, 25, 26
Frame Gnd	1



MOTOR CONNECTIONS: DIGITAL QUAD A/B ENCODERS

The connections shown may not be used in all installations

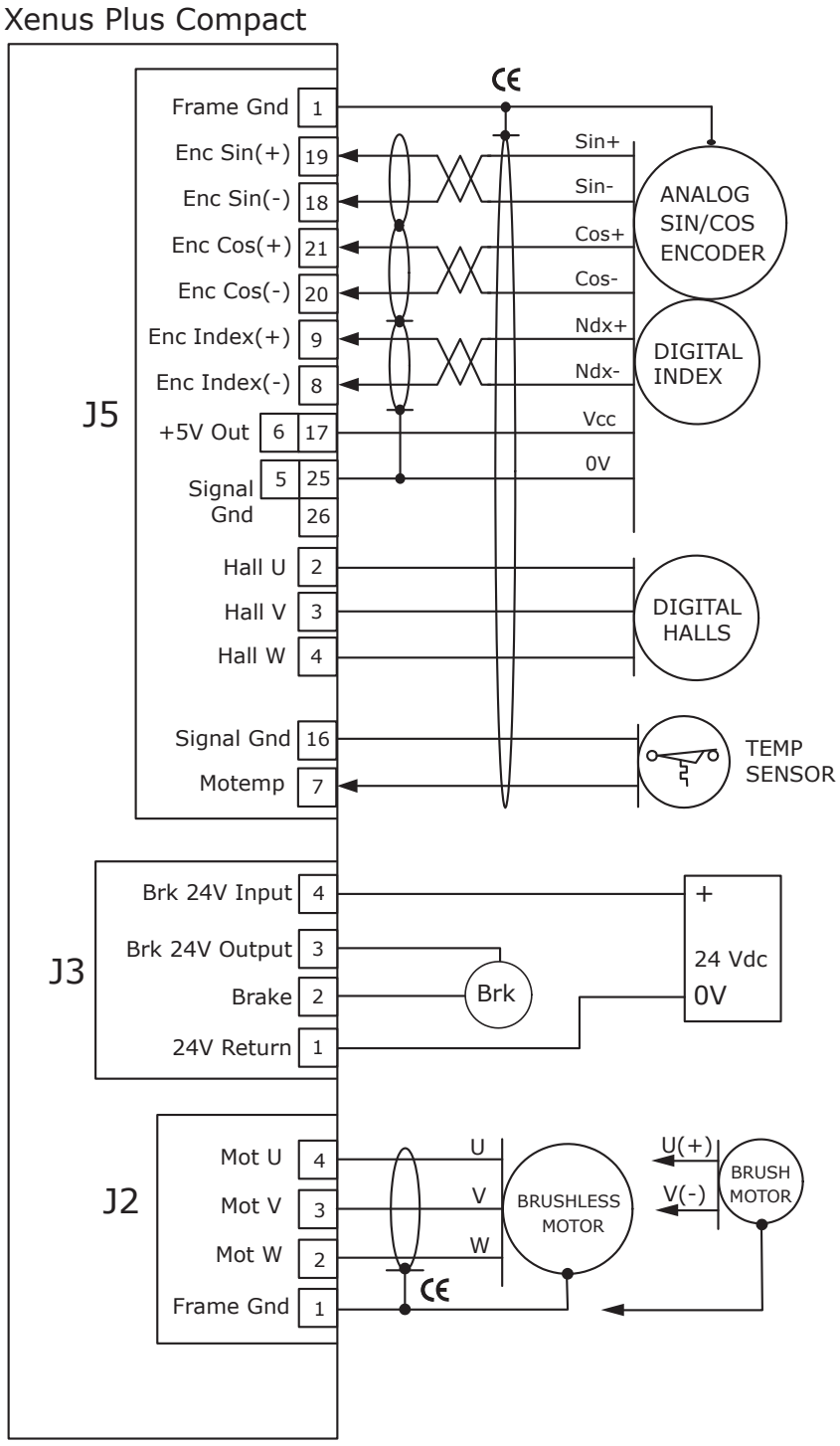


NOTES:

1) CE symbols indicate connections required for CE compliance.
2) When STO feature is used, the 24V power supply must be SELV or PELV with output voltage limited to 60 Vdc.

MOTOR CONNECTIONS: ANALOG SIN/COS INCREMENTAL ENCODERS

The connections shown may not be used in all installations



NOTES:

1) CE symbols indicate connections required for CE compliance.
2) When STO feature is used, the 24V power supply must be SELV or PELV with output voltage limited to 60 Vdc.

CONNECTORS & SIGNALS

WARNING: Hazardous voltages exist on connections to J1, & J2 when power is applied, and for up to 4 minutes after power is removed.

ISOLATED CIRCUIT

J1 MAINS CONNECTIONS

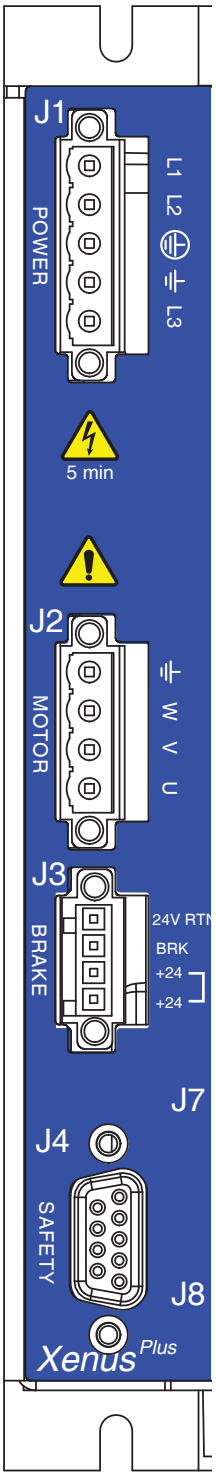
Signal	Pin
Mains Input L1	1
Mains Input L2	2
PE Ground	3
Frame Ground	4
Mains Input L3	5

J2 MOTOR OUTPUT

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

J3 +24 VDC & BRAKE

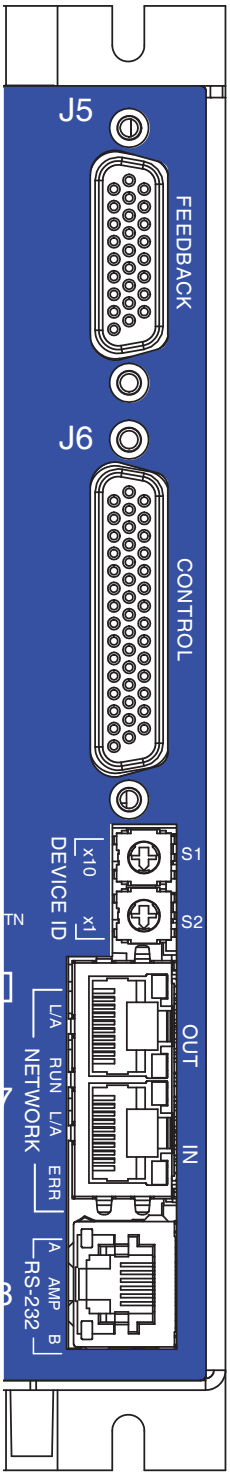
Signal	Pin
+24V Return	1
Brake	2
+24V to Brake	3
+24V	4



J4 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-2(-)		

CONNECTORS & SIGNALS



J5 FEEDBACK

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
1	Frame Gnd	10	Enc /B	19	Sin1(+) S3
2	Hall U	11	Enc B	20	Cos1(-) S4
3	Hall V	12	Enc /A	21	Cos1(+) S2
4	Hall W	13	Enc A	22	n/c
5	Signal Gnd	14	Enc /S	23	n/c
6	+5V Out1	15	Enc S	24	n/c
7	Motemp IN11	16	Signal Gnd	25	Signal Gnd
8	Enc /X	17	+5V Out1	26	Signal Gnd
9	Enc X	18	Sin1(-) S1		

Notes:
1) The total current drawn from +5V Out1 on J5 cannot exceed 500 mA.

J6 CONTROL & I/O

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
1	Frame Gnd	16	Signal Gnd	31	Signal Gnd
2	Ref1(-)	17	+5V Out2	32	+5V Out2
3	Ref1(+)	18	Multi Enc /S	33	Multi Enc S
4	n/c	19	Multi Enc /X	34	Multi Enc X
5	n/c	20	Multi Enc /B	35	Multi Enc B
6	Signal Gnd	21	Multi Enc /A	36	Multi Enc A
7	[IN1] GP	22	Signal Gnd	37	Signal Gnd
8	[IN2] GP	23	[OUT4] HS	38	n/c
9	[IN3] HS	24	n/c	39	n/c
10	[IN4] HS	25	[OUT3-] ISO	40	[OUT3+] ISO
11	[IN5] HS	26	[OUT2-] ISO	41	[OUT2+] ISO
12	[IN6] HS	27	[OUT1-] ISO	42	[OUT1+] ISO
13	[IN7] ISO	28	[INCOM] ISO	43	n/c
14	[IN8] ISO	29	n/c	44	Signal Gnd
15	[IN9] ISO	30	[IN10] ISO		

J8 RS-232 PORT

PIN	SIGNAL
1	n/c
2	RxD
3	Gnd*
4	Gnd*
5	TxD
6	n/c

RJ-11 receptacle,
6 position, 4 contact

* Signal Ground

J8 CABLE CONNECTOR:

RJ-11 style, male, 6 position
Cable: 6-conductor modular type, straight-through

J8 RS-232 NOTE

1. J8 signals are referenced to Signal Gnd.

WIRING

AC POWER, AND MOTOR OUTPUT: J1, J2

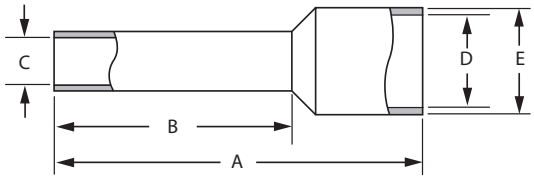
Wago MCS-MIDI Classic: 231-305/107-000, 5-pole (J1), 231-304/107-000, 4-pole(J2), female connectors; with screw flange; pin spacing 5.08 mm / 0.2 in

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

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: J3

Wago MCS-MINI: 734-104/107-000, female connector; with screw flange, 4-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

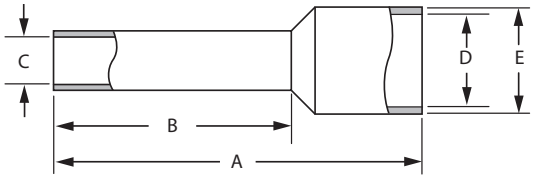
FERRULE PART NUMBERS: SINGLE WIRE INSULATED

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)

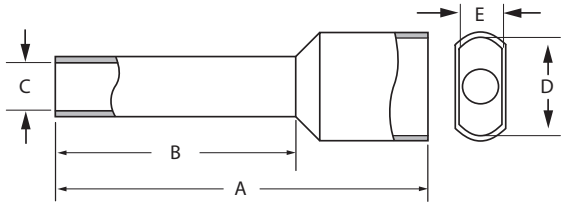
FERRULE PART NUMBERS: DOUBLE WIRE INSULATED

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



DEVICE STRUCTURE & ISOLATION

DRIVE POWER SOURCES

There are four isolation zones in the XEC:

1. +24V, Brake, & STO
2. Control circuits, motor feedback, and RS-232 comms
3. High-voltage inputs & PWM outputs
4. EtherCAT network interface

Each of these is isolated from the others and all are isolated from the chassis.

+24 VDC, BRAKE, & STO

The primary side of the DC/DC converter operates directly from the external +24 Vdc supply and is isolated from other drive power sections. Secondary windings provide power for each isolation zone. The Brake output [OUT6] operates in this section and is referenced to the +24 Vdc return (0V). It sinks current from an external load connected to the external +24 Vdc power source. The STO circuits also operate from the 24V power and the STO-24V supplies current for de-activating (muting) the STO function when it is not used.

SIGNAL & RS-232 CIRCUITS

The signal power section supplies power for the control circuits as well as the RS-232 communications. Motor feedback signals such as Halls, encoder, and temperature sensor operate in this section. 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.

HIGH VOLTAGE, REGEN, & PWM

Mains power drives the high-voltage section. It is rectified and capacitor-filtered to produce internal DC bus which the PWM stage converts into voltages that drive either three phase brushless or DC brush motors. An internal solid-state switch and power resistor provides dissipation during regeneration. 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.

ETHERCAT NETWORK

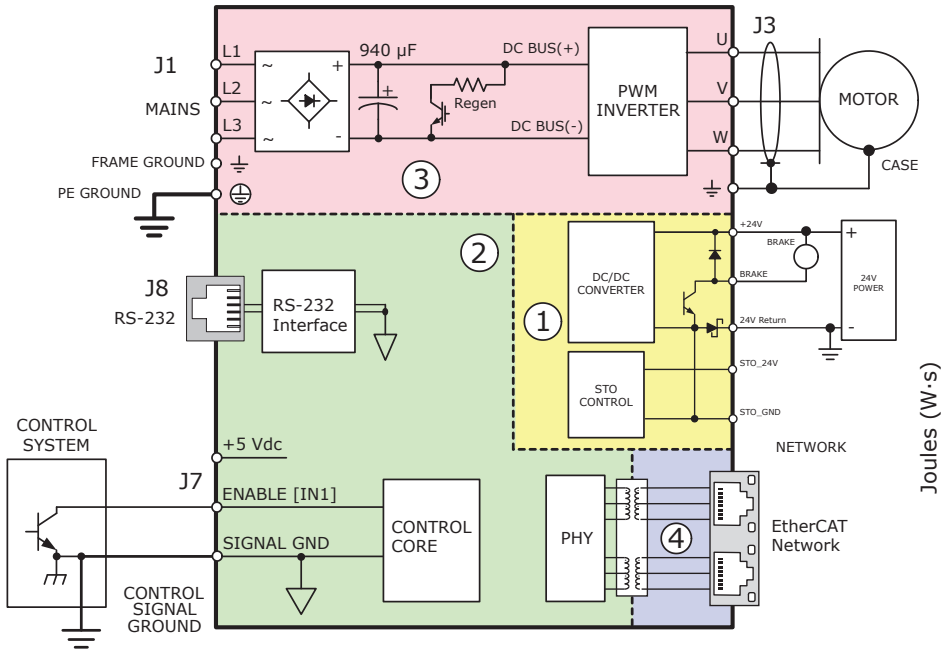
The network connections from the EtherCAT receptacles are magnetically isolated from the PHY (PHYsical interface) logic which converts them into data which is handled by the control core.

GROUNDING

A grounding system has three primary functions: safety, voltage-reference, and shielding. As a safety measure, the PE (Protective Earth) 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. 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, and J2 are mains-connected and must never be grounded.* The frame ground terminals at J1-3, J1-4, J2-1, J4-1, J5-1, and J6-1 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.

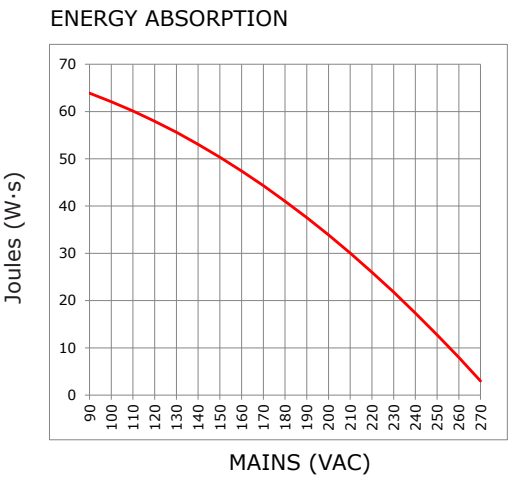
Shields on cables reduce emissions from the drive for CE compliance and protect internal circuits from interference due to external sources of electrical noise. Because of their smaller wire gauge, these should not be used as part of a safety-ground system. Motor cases can be safety-grounded either at the motor, by earthing the frame, or by a grounding conductor in the motor cable that connects to J2-1. This cable should be of the same gauge as the other motor phase cables.



REGENERATION

The chart below shows the energy absorption in W·s for a *XEC* drive operating at some typical mains voltages. When the load mechanical energy is greater than these values an external regen resistor is available as an accessory.

ENERGY ABSORPTION



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	62
120	58
200	34
240	17

Absorption is the energy that can be transferred to the 940 uF internal capacitance during deceleration. This table shows the energy absorption in W·s for a drive operating at some typical mains voltages. If the deceleration energy is less than the absorption capacity of the drive, then the regeneration resistor will not be switched-on 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·m²
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·m², 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:

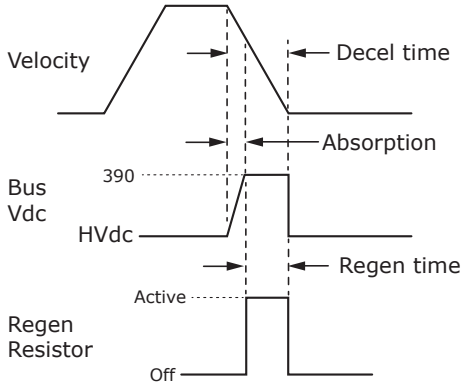
75J - 17J = 58 J

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:

$$\text{Dwell Time} = \frac{58\ \text{Joules}}{20\ \text{Watts}} = 2.9\ \text{sec}$$

Seconds; Joules, Watts

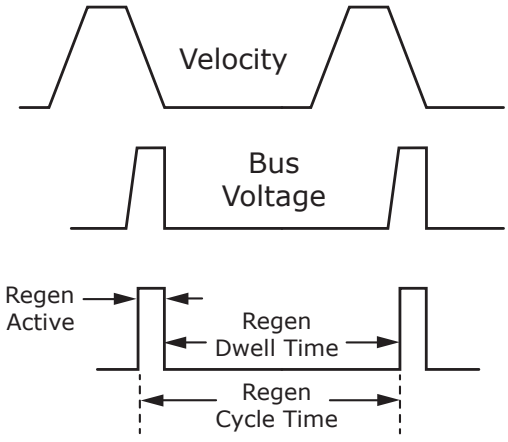


Step 4: Find the total regen cycle time by adding the deceleration time to the dwell time:

Decel Time = 1.25 sec

Dwell Time = 2.90 sec

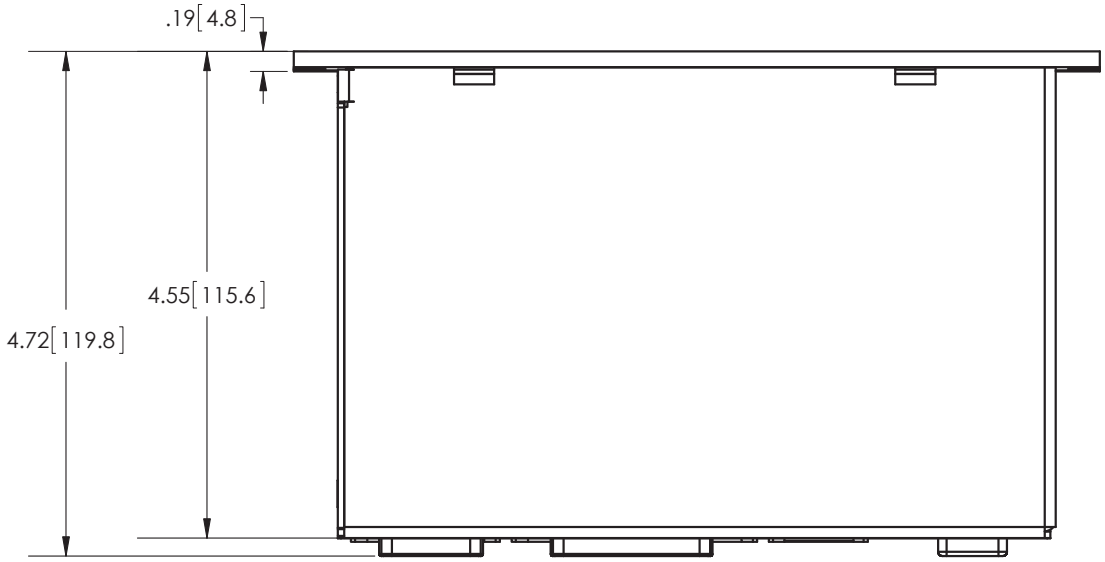
Cycle Time = 4.15 sec

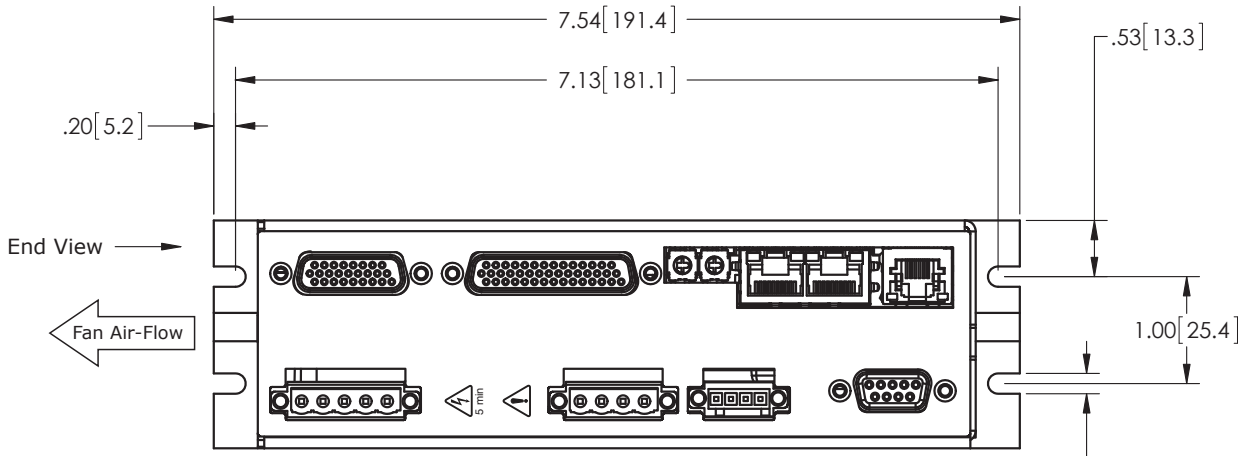


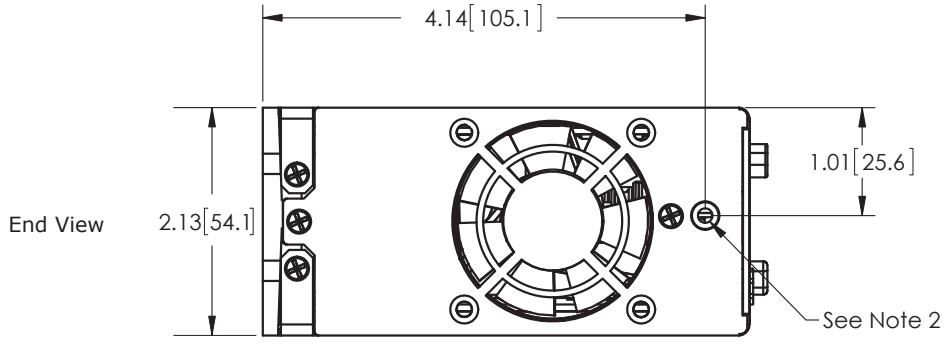
INTERNAL REGEN RESISTOR

Max Energy	248 W·s (J)
Resistance	60 Ω
Power, continuous	20 W
Power, peak	2500 W
Time	100 ms

DIMENSIONS [IN/MM]



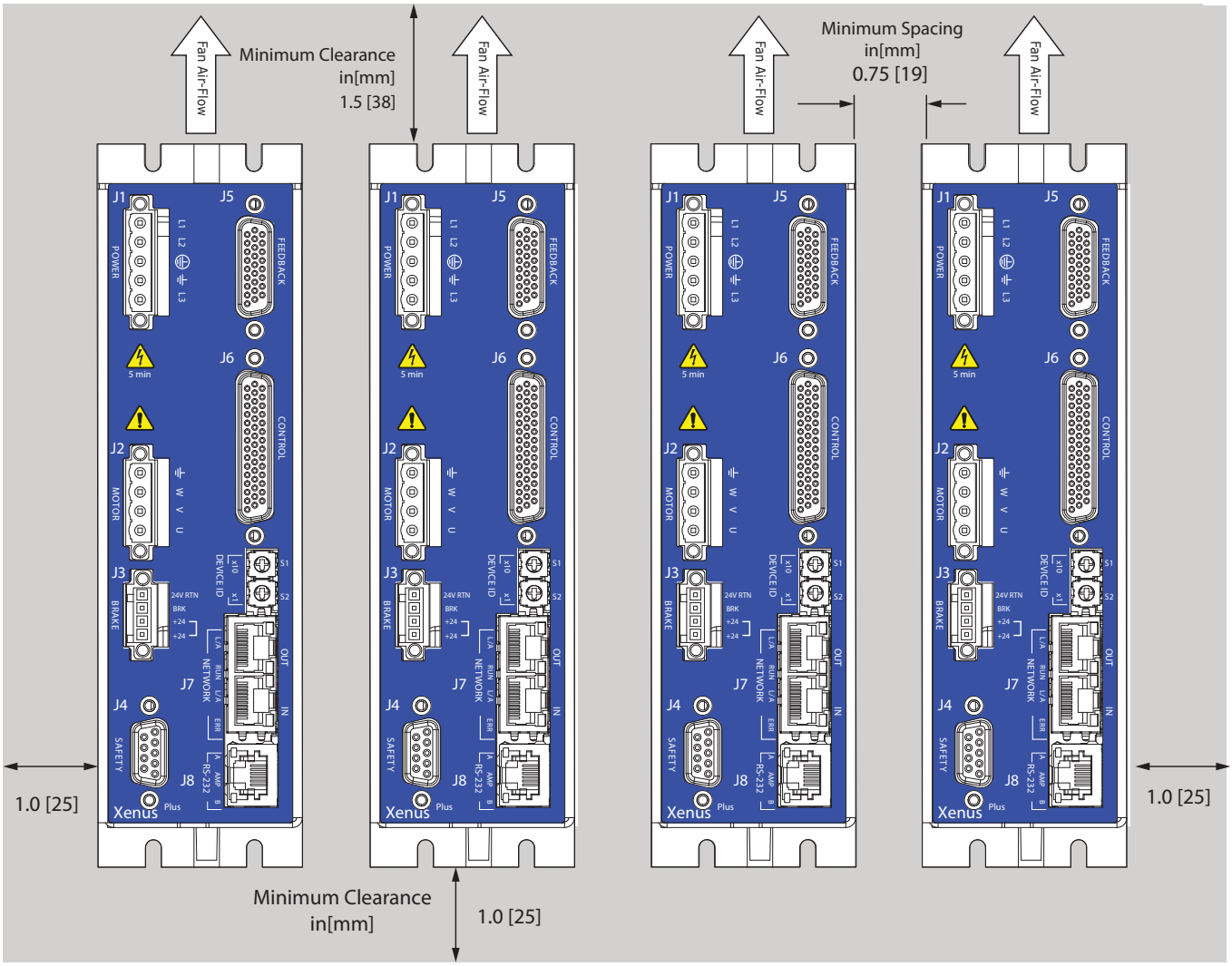




Notes:
1) Recommended screws for mounting slots: #8-32 or M4 external tooth SEMS
2) Cable shield grounding socket: #8-32 external tooth SEMS

INSTALLATION

The graphic below shows the recommended mounting for multiple drives.
The clearances shows are minimums.



ORDERING INFORMATION

ORDERING GUIDE

XEC-230-09	*XEC* Servo Drive, 3/9 Adc
XEC-230-12	*XEC* Servo Drive, 6/12 Adc
XEC-230-15	*XEC* Servo Drive, 7.5/15 Adc

EtherCAT®

Example: Order one *Xenus Plus Compact* drive, 6/12 A with connector Kit, and serial cable kit:

Qty	Item	Remarks
1	XEC-230-12	*Xenus Plus Compact* servo drive
1	XEC-CK	Connector Kit
1	SER-CK	Serial Cable Kit

ACCESSORIES

	Qty	Ref	Name	Description	Manufacturer P/N
XEC-CK Connector Kit	1	J1	AC Pwr	Plug, 5 position, 5.08 mm, female	Wago: 231-305/107-000 (Note 1)
	1			Strain relief, snap-on, 5.08 mm, 5 position, orange	Wago: 232-635
	1	J2	Motor	Plug, 4 position, 5.08 mm, female	Wago: 231-304/107-000 (Note 1)
	1			Strain relief, snap-on, 5.08 mm, 4 position, orange	Wago: 232-634
	1	J1, J2	Tool	Tool, wire insertion & extraction, 231 series	Wago: 231-159
	1	J3	Brake	Plug, 4 position, 3.5 mm, female	Wago: 734-104/107-000 (Note 1)
	1			Strain relief, snap-on, 3.5 mm, 5 position, grey	Wago: 734-604
	1	J5	Tool	Tool, wire insertion & extraction, 734 series	Wago: 734-231
	1	J4 Note 2	Safety	Connector, DB-9M, 9-position, standard, male	TE/AMP: 205204-4
	9			AMPLIMITE HD-20 Crimp-Snap contacts, 24-20AWG, AU flash	TE/AMP: 66506-9
	1			Metal Backshell, DB-9, RoHS	3M: 3357-9209
	4			Jumper, with pins crimped on both ends	Copley: 10-75177-01
	1	J5	Feed-back	Connector, high-density DB-26M, 26 position, male, solder cup	Norcomp: 180-026-103L001
	1			Metal Backshell, DB-15, RoHS	3M: 3357-9215
	1	J6	Control	Connector, high-density DB-44M, 44 position, male, solder cup	Norcomp: 180-044-103L001
	1			Metal Backshell, DB-25, RoHS	3M: 3357-9225
XEC-NC-10	1	J7	Network	EtherCAT® network cable, 10 ft (3 m)	
XEC-NC-01	1			EtherCAT® network cable, 1 ft (0.3 m)	
SER-CK	1	J8	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 XEC-CK)

16-01435 Document Revision History

Revision	Date	Remarks
00	August 30, 2016	Initial released version
01	October 2, 2016	Corrected input currents, 85C shutdown

Note: Specifications subject to change without notice