Accelnet Plus 2-Axis Panel CANopen BP2

DIGITAL SERVO DRIVE
FOR BRUSHLESS/BRUSH MOTORS

CONTROL MODES
- Profile Position-Velocity-Torque, Interpolated Position, Homing
- Camming, Gearing
- Indexer

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

COMMUNICATIONS
- CANopen DS-402
- RS-232

FEEDBACK
Incremental Encoders
- Digital quad A/B
  Analog Sin/Cos
  Panasonic Incremental A Format
- Aux. quad A/B encoder / encoder out

Absolute Encoders
- SSI, EnDat, Absolute A,
  Tamagawa & Panasonic Absolute A
  Sanyo Denki Absolute A, BiSS (B & C)

Resolver (-R option)
- Brushless Resolver

Other
- Digital Halls

I/O DIGITAL
- 10 non-isolated, 8 isolated inputs,
- 5 isolated outputs, 2 non-isolated outputs

ANALOG
- 2, 12-bit inputs

SAFE TORQUE OFF (STO)
- SIL 3, Category 4, PL e

DIMENSIONS: MM [IN]
- 167 x 115.2 x 40.6 [6.58 x 4.54 x 1.60]

Model	Ip	Ic	Vdc
BP2-090-06	6	3	90
BP2-090-14	14	7	90
BP2-090-20	20	10	90

Current ratings are for each axis
Add -R for resolver feedback option

DESCRIPTION

The Accelnet Plus BP2 is a 2-axis, high-performance DC powered drive for position, velocity, and torque control of brushless and brush motors via CANopen. As well as operating on CANopen networks, the BP2 also operates in the following traditional control modes: step/direction, RS-232 ASCII, master encoder for gearing and camming, digital input commands to initiate predetermined motion sequences.

Indexing mode simplifies operation with PLC's using outputs to select and launch indexes and inputs to read back drive status. A single serial port on the PLC can send ASCII data to multiple drives to change motion profiles as machine requirement change.

Drive commissioning is fast and simple using CME 2™ software operating under Windows® and communicating with the BP2 via RS-232 or using the CAN network.

CANopen operation supports Profile Position/Velocity/Torque, Interpolated Position Mode (PVT), and Homing. Up to 127 BP2 drives can operate on a single CAN bus and pairs of drives can be linked via the CAN so that they execute motion profiles together.

Feedback from both incremental and absolute encoders is supported. A multi-mode encoder port functions as an input or output depending on the drive's basic setup. As an input it takes feedback from a secondary encoder to create a dual-loop position control system or as a master encoder for driving a cam table. As an output, it buffers the digital encoder signals from the motor's digital encoder and eliminates split cables that would be needed to send the signals to both drive and control system.

There are ten non-isolated inputs and eight opto-isolated digital inputs that are bipolar types that source or sink current into a common connection that can be tied to ground or +24V. [IN1&10] default to the drive Enable function for axes A & B, and are programmable to other functions. The other inputs are programmable. All inputs have programmable active levels. Five opto-isolated outputs [OUT1~5] have individual collector/emitter connections. Two MOSFET outputs [OUT6~7] are programmable to drive motor brakes or other functions and have internal flyback diodes for driving inductive loads.

Drive power is transformer-isolated DC from regulated or unregulated power supplies. An AuxHV input is provided for "keep-alive" operation permitting the drive power stage to be completely powered down without losing position information, or communications with the control system.

GENERAL SPECIFICATIONS

Test conditions: Load = Wye connected load: 2 mH + 2 Ω line-line. Ambient temperature = 25°C, +HV = HV_{max}

MODEL	BP2-090-06	BP2-090-14	BP2-090-20	
OUTPUT POWER				
Peak Current	6 (4.24)	14 (9.9)	20 (14.4)	Adc (Arms-sine), ±5%
Peak time	1			Sec
Continuous current (Note 1)	3 (2.1)	7 (5)	10 (7.1)	Adc (Arms-sine) per phase
INPUT POWER				
HVmin~HVmax	+14 to +90	+14 to +90	+14 to +90	Vdc Transformer-isolated
Ipeak	6	14	20	Adc (1 sec) peak
Icont	3	7	10	Adc continuous
Aux HV	+14 to +HV Vdc @ 500 mAdc maximum, 2.5 W			Optional, not required for operation

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		
CANopen	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 (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, DTE, 9600~115,200 Baud, 3-wire, RJ-12 connector	

DIGITAL INPUTS	
Number	18
[IN1,2,10,11]	Digital, non-isolated, 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
[IN3,4,12,13]	Digital, non-isolated, programmable as single-ended or differential pairs, 100 ns RC filter, 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,
[IN5~8,14~17]	Digital, 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
[IN9,18]	Default as motor overtemp inputs on feedback connectors, 12 Vdc max, programmable to other functions Other digital inputs are also programmable for the Motemp function 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
Functions	[IN3~18] are programmable, [IN1~2] default to drive axes A & B Enable function and are programmable

SAFE TORQUE OFF (STO)	
Function	PWM outputs active 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 4, Performance level e
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 (IN1, IN2) from Vin ≤6.0 Vdc to interruption of energy supplied to motor

ANALOG INPUTS	
Number	2
[AIN1~2]	Differential, ±10 Vdc, 5 kΩ input impedance, 12-bit resolution

DIGITAL OUTPUTS	
Number	7
[OUT1~5]	Opto-isolated Darlingtons, 20 mA max, 24 V tolerant, Rated impulse ≥ 800 V, series 20 ohm resistor collector & emitter connections on each output, Vce = 1.2 Vdc @ 20 mAdc, typical, output ON, Vce-max 32 Vdc, output OFF, Td-ON = 500 µs max @ 20 mA, Td-OFF = 500 µs max @ 20 mA, times include rise/fall times
[OUT6~7]	Default as motor brake control: current-sinking, 1 Adc max, external flyback diode required when driving inductive loads Programmable for other functions if not used for brake

RS-232 PORT	
Signals	RxD, TxD, Gnd in 6-position, 4-contact RJ-12 style modular connector, non-isolated, common to Signal Ground
Mode	Full-duplex, DTE serial communication port for drive setup and control, 9,600 to 115,200 baud
Protocol	Binary and ASCII formats

CANOPEN PORTS	
Format	Dual RJ-45 receptacles
Protocol	CANopen, DS-402

NOTES:

1) Heatsink or forced-air required for continuous current rating

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 BP2, 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, Sanyo Denki Absolute A SD+, SD- (S, /S) signals, 2.5 or 4 MHz, 2-wire half-duplex communication 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 BP2, 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 on X & S inputs only 5 MHz maximum line frequency (20 M counts/sec), MAX3097 line receiver Digital absolute encoder (Clk, /Clk, Dat, /Dat) half or full-duplex operation, S & X inputs with 121 Ω terminating resistors are used for absolute encoder interface
As Emulated Output	Quadrature encoder emulation with programmable resolution to 4096 lines (65,536 counts) per rev from analog sin/cos encoders or resolvers. A, /A, B, /B, X, /X, from ISL32179 differential line driver
As Buffered Output	Digital encoder feedback signals from primary digital encoder are buffered by ISL32179 line driver
RESOLVER (-R OPTION)	
Type	Brushless, single-speed, 1:1 to 2:1 programmable transformation ratio
Resolution	14 bits (equivalent to a 4096 line quadrature encoder)
Reference frequency	8.0 kHz
Reference voltage	2.8 Vrms, auto-adjustable by the drive to maximize feedback
Reference maximum current	100 mA
Maximum RPM	10,000 typical
Sin/Cos inputs	Differential, 54k ±1% differential impedance, 2.0 Vrms, BW ≥ 300 kHz
DC POWER OUTPUTS	
Number	2
Ratings	+5 Vdc, 500 mA max each output, thermal and short-circuit protected
Connections	Axis A +5V Output: J1-25, J6-17, J6-22; combined current from these pins cannot exceed 500 mA Axis B +5V Output: J1-30, J7-17, J7-22; combined current from these pins cannot exceed 500 mA
RS-232 PORT	
Signals	RxD, TxD, Gnd in 6-position, 4-contact RJ-11 style modular connector, referenced to Signal Ground
Mode	Full-duplex, DTE serial port for drive setup and control, 9,600 to 115,200 Baud Baud rate defaults to 9,600 after power-on or reset and is programmable up to 115,200 thereafter
Protocol	ASCII or Binary format
MOTOR CONNECTIONS	
Phase U, V, W	PWM outputs to 3-phase ungrounded Wye or delta connected brushless motors, or DC brush motors
Hall U, V, W	Digital Hall signals, single-ended
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 ohm inputs
Analog Incremental Encoder	Sin/cos format (sin+, sin-, cos+, cos-), differential, 1 Vpeak-peak, 121 ohm inputs X or S input may be firmware configured to latch position or time
SSI	Serial data and clock signals (DATA, /DATA, CLK, /CLK), differential, 121 ohm inputs
EnDat 2.1,2.2	Serial data and clock signals (DATA, /DATA, CLK, /CLK), differential, 121 ohm inputs Sin/cos signals (Sin+, Sin-, Cos+, Cos-)
Absolute A	Tamagawa Absolute A, Panasonic Absolute A Format, SD+, SD- (S, /S) signals, 121 ohm inputs
BiSS (B&C)	MA+, MA-, SL+, SL, 121 ohm inputs
Hall & encoder power	(See DC POWER OUTPUTS section)
Brake	[OUT6~7] Default to brake function, programmable for other functions.
INDICATORS	
AMP	Bicolor LED, drive status indicated by color, and blinking or non-blinking condition
L/A, RUN, ERR	Yellow & green LED on A & B ports, status of CANopen bus indicated by color and blink codes based on CANopen Indicator Specification V0.91 Green LED: ON = Good Link, Blinking = Activity, OFF = No Link Yellow LED: ON for Full-Duplex, OFF for Half-Duplex

SPECIFICATIONS (CONT'D)

PROTECTIONS

HV Overvoltage	+HV > HV_{max}	Drive outputs turn off until +HV < HV_{max} (See Input Power for HV_{max})
HV Undervoltage	+HV < +14 Vdc	Drive outputs turn off until +HV > +14 Vdc
Drive over temperature	Heat plate > 70°C.	Drive outputs turn off
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	Digital inputs programmable to detect motor temperature switch	
Feedback Loss	Inadequate analog encoder amplitude or missing incremental encoder signals	

MECHANICAL & ENVIRONMENTAL

Size	167 x 115.2 x 40.6 [6.58 x 4.54 x 1.60]
Weight	<tbd>
Ambient temperature	0 to +45°C operating, -40 to +85°C storage
Humidity	0 to 95%, non-condensing
Vibration	2 *g* peak, 10~500 Hz (sine), IEC60068-2-6
Shock	10 *g*, 10 ms, half-sine pulse, IEC60068-2-27
Contaminants	Pollution degree 2
Environment	IEC68-2: 1990
Cooling	Heat sink and/or forced air cooling required for continuous power output

AGENCY STANDARDS CONFORMANCE

Approvals

Underwriters Laboratory (UL) recognized component to UL 61010-1, 2nd Ed.: 2004
Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
UL File Number E249894

TUV Functional Safety to IEC 61508

Functional Safety

IEC 61508-1, IEC 61508-2, EN(ISO) 13849-1, EN(ISO) 13849-2

Electrical Safety

In accordance with EC Directive 2006/95/EC (Low Voltage Directive)

IEC/UL/CSA 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use

IEC 61800-5-1:2007

EMC

IEC 61326-1:2005 (Industrial locations)

IEC 61326-3-1:2008

IEC 55011:2009/A1:2010,Group 1, Class A

IEC 61800-3:2004

Hazardous Substances

Lead-free and RoHS compliant

CANOPEN COMMUNICATION

Accelnet uses the CAN physical layer signals CANH, CANL, and GND for connection, and CANopen protocol for communication. Before installing the drive in a CAN system, it must be assigned a CAN address. A maximum of 127 CAN nodes are allowed on a single CAN bus. The rotary switch on the front panel controls the four lower bits of the seven-bit CAN address. When the number of nodes on a bus is less than sixteen, the CAN address can be set using only the switch.

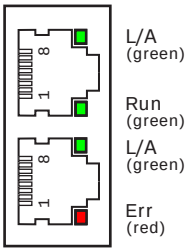
For installations with sixteen or more CAN nodes on a network CME 2 can be used to configure Accelnet to use the rotary switch, or combinations of digital inputs and programmed offset in flash memory to configure the drive with a higher CAN node address. For more information on CANopen communications, download the CANopen Manual from the Copley web-site: http://www.copleycontrols.com/motion/downloads/pdf/CANopenProgrammersManual.pdf

CANOPEN LEDS (ON RJ-45 CONNECTORS)

L/A Green: Shows the state of the physical link and activity on the link.
Off = No Link
On = Port open, no activity
On & Flickering = Port open and activity

RUN Green: Shows the state of the CAN state machine
Off = Init
Blinking = Pre-operational
Single-flash = Stopped
On = Operational

ERR Red: Shows errors such as watchdog timeouts and unsolicited state changes in the BP2 due to local errors.
Off = No errors, communications are working correctly
Blinking = Invalid configuration, general configuration error
Single Flash =Warning limit reached; an error counter of the CAN controller has reached or exceeded the warning level.
Double Flash = A guard event or heartbeat event has occurred
On = Bus off. The CAN controller is bus off.



J3: CANOPEN PORTS

RJ-45 receptacles, 8 position

PIN	SIGNAL
3	CAN_GND
2	CAN_L
1	CAN_H

CANopen ADDRESS

In the BP2, the node address provided by two 16-position rotary switches with hexadecimal encoding. These can set the address of the drive from 0x01~0xFF (1~255 decimal). The chart shows the decimal values of the hex settings of each switch.

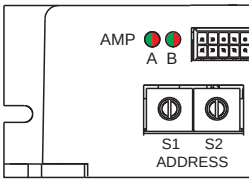
Example 1: Find the switch settings for decimal address 107:

1) Find the highest number under S1 that is less than 107 and set S1 to the hex value in the same row:
   96 < 107 and 112 > 107, so S1 = 96 = Hex 6
2) Subtract 96 from the desired address to get the decimal value of switch S2 and set S2 to the Hex value in the same row:
   S2 = (107 - 96) = 11 = Hex B

CANopen Address Switch Decimal values

Set	S1	S2	Set	S1	S2
Hex	Dec		Hex	Dec	
0	0	0	8	128	8
1	16	1	9	144	9
2	32	2	A	160	10
3	48	3	B	176	11
4	64	4	C	192	12
5	80	5	D	208	13
6	96	6	E	224	14
7	112	7	F	240	15

AMP LEDS & ADDRESS SWITCHES



AMP LEDS

Two bi-color LEDs give the state of each axis of the BP2 drive.
Colors do not alternate, and can be solid ON or blinking:

Green/Solid = Drive OK and enabled. Will run in response to reference inputs, or CANopen commands.

Green/Slow-Blinking = Drive OK but NOT-enabled. Will run when enabled.

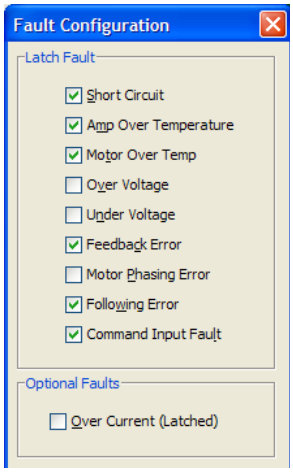
Green/Fast-Blinking = Positive or Negative limit switch active. Drive will only move in direction not inhibited by limit switch.

Red/Solid = Transient fault condition. Drive will resume operation when fault is removed.

Red/Blinking = Latching fault. Operation will not resume until drive is Reset.

The Fault Configuration graphic shows the faults that can be configured as Latching Faults and that would produce a blinking red AMP led condition.
Faults are programmable to be either transient or latching

FAULTS



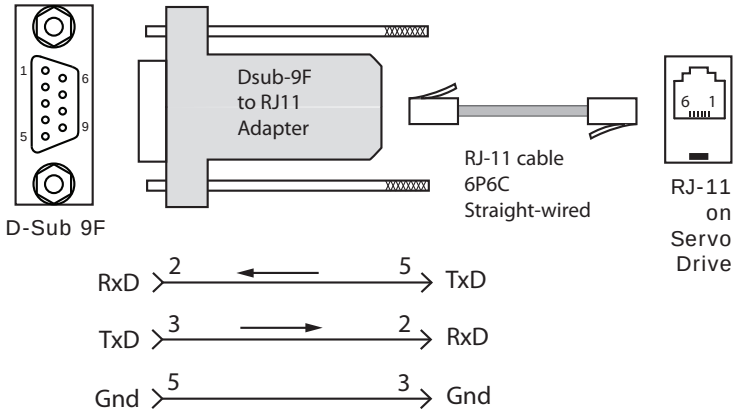
COMMUNICATIONS

RS-232 COMMUNICATIONS

BP2 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 *BP2* RS-232 port are through J4, an RJ-11 connector. The *BP2* 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.
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).

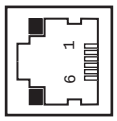
SER-CK SERIAL CABLE KIT

The SER-CK provides connectivity between a D-Sub 9 male connector and the RJ-11 connector on the BP2. It includes an adapter that plugs into the COM1 (or other) port of a PC and uses common modular cable to connect to the BP2. The connections are shown in the diagram below.



J4: RS-232 PORT

RJ-11 receptacle,
6 position, 4 contact



PIN	SIGNAL
2	RxD
3,4	Gnd
5	Txd

Don't forget to order a Serial Cable Kit SER-CK when placing your order for an BP2!

ASCII COMMUNICATIONS

The Copley ASCII Interface is a set of ASCII format commands that can be used to operate and monitor Copley Controls Accelnet, Stepnet, and BP2 series amplifiers 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

Three opto-couplers are provided which, when de-energized, prevent the upper and lower devices in the PWM outputs in both axes from driving current to the motor. This provides a positive OFF capability for both axes that cannot be overridden by the control firmware, or associated hardware components. When the opto-couplers are energized (current is flowing in the input diodes), the control core will be able to control the on/off state of the PWM outputs of each axis individually.

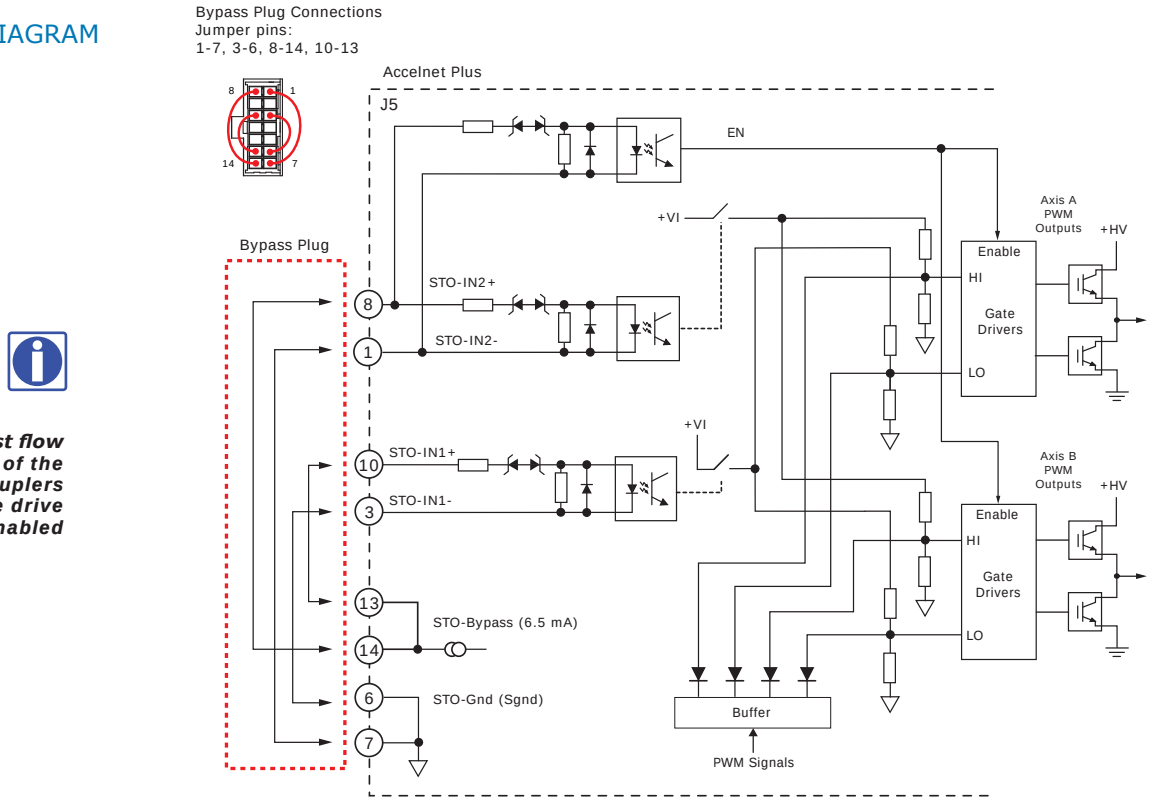
FUNCTIONAL DIAGRAM

In order for the PWM outputs of the BP2 Plus to be activated, current must be flowing through all opto-couplers that are connected to the STO_IN1± and STO_IN2± terminals of J5, and the drive must be in an ENABLED state. When the LED opto-couplers are de-energized, the drive is in a Safe Torque Off state and the PWM outputs cannot be activated to drive a motor.

STO OVERRIDE

The diagram below shows connections that will energize all of the opto-couplers from the internal power source.
When this is done the torque-off feature is defeated 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 as shown in order for the BP2 to be enabled.

FUNCTIONAL DIAGRAM



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

J5 SIGNALS

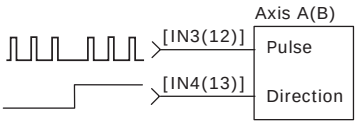
SIGNAL	PIN		SIGNAL
STO_IN2+	8	1	STO_IN2-
n.c.	9	2	n.c.
STO_IN1+	10	3	STO_IN1-
n.c.	11	4	n.c.
n.c.	12	5	n.c.
STO_BYP	13	6	Sgnd
	14	7	Sgnd

COMMAND INPUTS

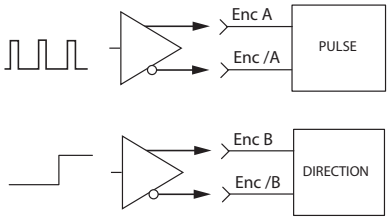
DIGITAL POSITION

Single-ended digital position commands should 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 are used.

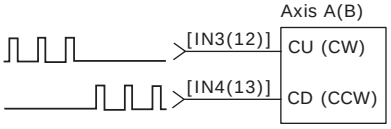
SINGLE-ENDED PULSE & DIRECTION



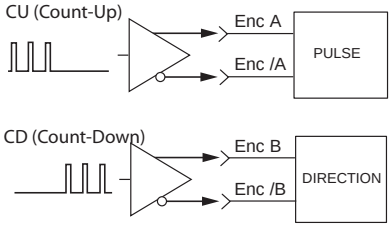
DIFFERENTIAL PULSE & DIRECTION



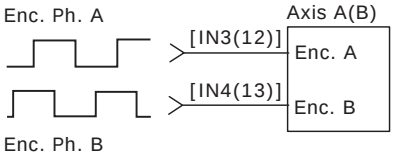
SINGLE-ENDED CU/CD



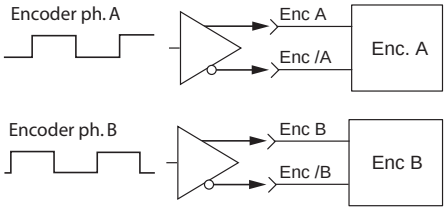
DIFFERENTIAL CU/CD



QUAD A/B ENCODER SINGLE-ENDED



QUAD A/B ENCODER DIFFERENTIAL



SINGLE-ENDED

Signal	Axis A J1	Axis B J1
Pls, Enc A	23	24
Dir, Enc B	5	6
Sgnd	7,12,20	
Shld	17	

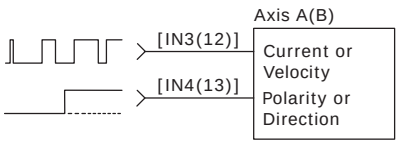
DIFFERENTIAL

Signal	Axis A J1	Axis B J1
Pls, Enc A	26	31
/Pls, Enc /A	8	13
Dir, Enc B	27	32
/Dir, Enc /B	9	14
Sgnd	7,12,20	
Shld	17	

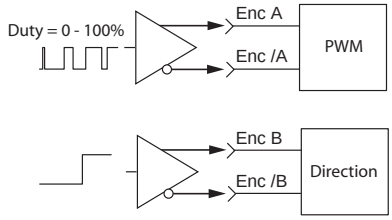
DIGITAL TORQUE, VELOCITY

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

SINGLE-ENDED PWM & DIRECTION



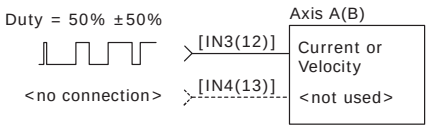
DIFFERENTIAL PWM & DIRECTION



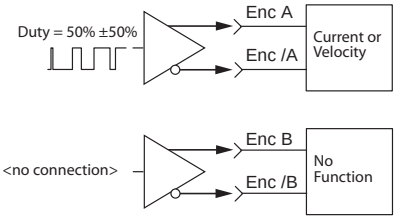
SINGLE-ENDED

Signal	Axis A J1	Axis B J1
PWM	23	24
Dir	5	6
Sgnd	7,12,20	
Shld	17	

SINGLE-ENDED 50% PWM



DIFFERENTIAL 50% PWM



DIFFERENTIAL

Signal	Axis A J1	Axis B J1
PWM	26	31
/PWM	8	13
Dir	27	32
/Dir	9	14
Sgnd	7,12,20	
Shld	17	

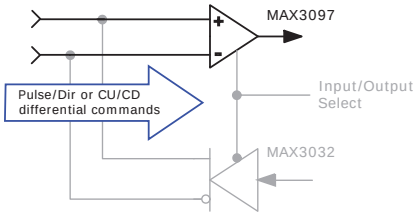
MULTI-MODE ENCODER PORT

This port consists of three differential input/output channels that take their functions from the Basic Setup of the drive. With quad A/B encoder feedback, the port works as an output, buffering the signals from the encoder. With resolver or sin/cos encoder versions, the feedback is converted to “emulated” quad A/B/X signals with programmable resolution. These signals can then be fed back to an external motion controller that closes the position or velocity loops. As an input, the port can take quad A/B signals to produce a dual-loop position control system or use the signals as master-encoder commands in camming mode. In addition, the port can take stepper command signals (CU/CD or Pulse/Direction) in differential format.

AS COMMAND INPUTS

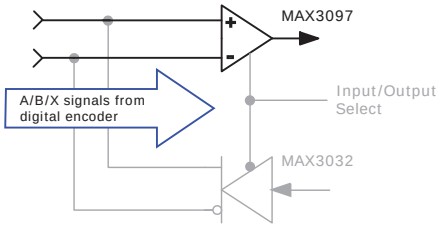
AS DIGITAL COMMAND INPUTS IN PULSE/DIRECTION, PULSE-UP/PULSE-DOWN, OR DIGITAL QUADRATURE ENCODER FORMAT

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.



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.



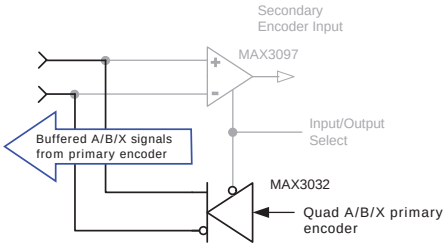
COMMAND INPUT MULTI-PORT

Signal	Axis A J1	Axis B J1
Pls, Enc A	26	31
/Pls, Enc /A	8	13
Dir, Enc B	27	32
/Dir, Enc /B	9	14
Enc X	28	33
Enc /X	10	15
Sgnd	7,12,20	
Shld	17	

AS AN OUTPUT FOR FEEDBACK SIGNALS TO AN EXTERNAL CONTROLLER

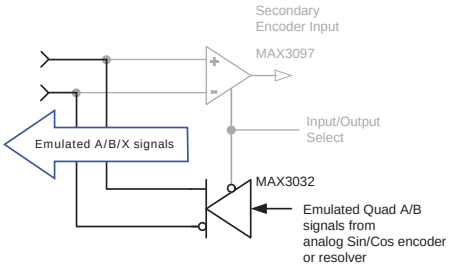
AS BUFFERED OUTPUTS FROM A DIGITAL QUADRATURE PRIMARY ENCODER

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 J8, 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.



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.



EMULATED QUAD A/B/X MULTI-PORT

Signal	Axis A J1	Axis B J1
Enc A	26	31
Enc /A	8	13
Enc B	27	32
Enc /B	9	14
Enc X	28	33
Enc /X	10	15
Sgnd	7,12,20	
Shld	17	

PROGRAMMABLE DIGITAL INPUTS

Use this chart shows as a quick reference to the inputs and their characteristic R/C combinations.

HI/LO DEFINITIONS: INPUTS

Input	State	Condition
IN1,2,10,11 IN9,18	HI	Vin >= 3.5 Vdc
	LO	Vin <= 0.7 Vdc
IN3,4,12,13	HI	Vin >= 2.7 Vdc
	LO	Vin <= 2.3 Vdc
IN5,6,7,8 IN14,15,16,17	HI	Vin >= 10.0 Vdc
	LO	Vin <= 6.0 Vdc

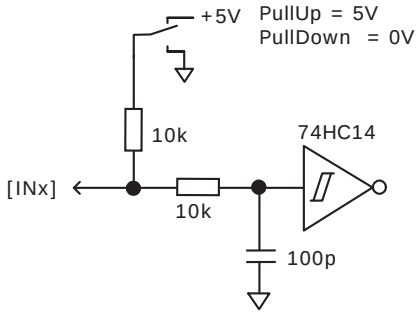
[IN1~18] SIGNALS

Input	Pin	R1	R2	C1
*IN1	J1-21	10k	10k	100p
*IN2	J1-3			
*IN3	J1-23		1k	
*IN4	J1-5			
IN5	J2-11	Opto ±Common is J1-20		
IN6	J2-1			
IN7	J2-12			
IN8	J2-2			
IN9	J6-7	4.99k	10k	33n

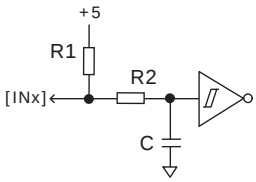
Input	Pin	R1	R2	C1
*IN10	J1-22	10k	10k	100p
*IN11	J1-4			
*IN12	J1-24		1k	
*IN13	J1-6			
IN14	J2-13	Opto ±Common is J1-20		
IN15	J2-3			
IN16	J2-14			
IN17	J2-4			
IN18	J7-7	4.99k	10k	33n

* 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.



INPUT CONFIGURATIONS



Vmax

+24V

+12V

INPUTS WITH PROGRAMMABLE PULL UP/DOWN

Input	Pin	PU/PD
IN1	J1-21	1
IN2	J1-3	2
IN3	J1-23	5
IN4	J1-5	6

Input	Pin	PU/PD
IN10	J1-22	3
IN11	J1-4	4
IN12	J1-24	7
IN13	J1-6	8

SINGLE-ENDED/DIFFERENTIAL DIGITAL INPUTS [IN3~4,12~13]

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):

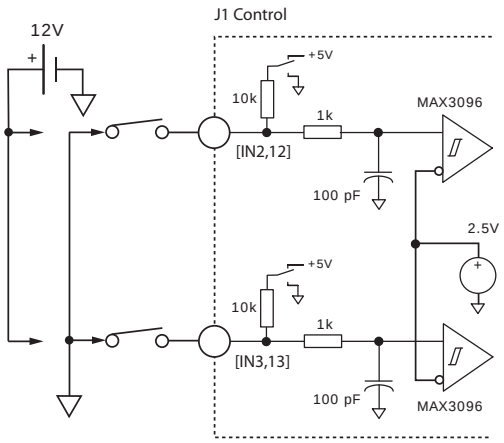
- PWM 50%, PWM & Direction for Velocity or Current modes
- Pulse/Direction, CU/CD, or A/B Quad encoder inputs for Position or Camming modes

[IN3~4,12~13] SIGNALS

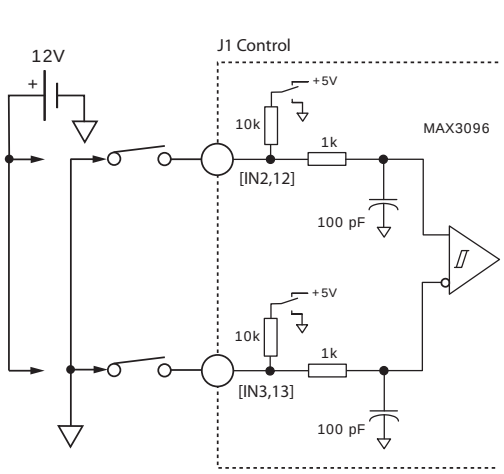
S.E. Input	Diff Input	Pin
IN3	IN2+	J1-23
IN4	IN2-	J1-5

S.E. Input	Diff Input	Pin
IN12	IN12+	J1-24
IN13	IN12-	J1-6

12 Vdc max
SINGLE-ENDED



12 Vdc max
DIFFERENTIAL



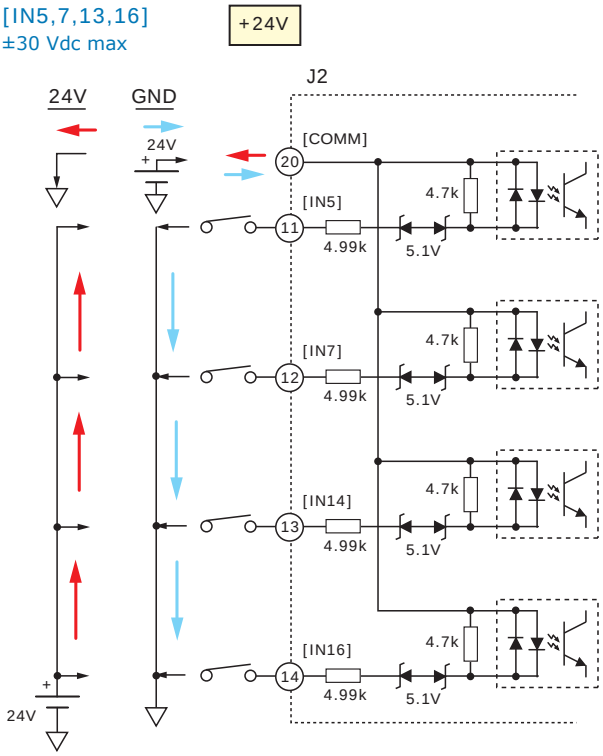
PLC outputs are frequently current-sourcing from 24V for driving grounded loads. PC based digital controllers commonly use NPN or current-sinking outputs. Set the Accelnet inputs to pull-down to ground for current-sourcing connections, and to pull-up to 5V for current-sinking connections.

OPTO-ISOLATED DIGITAL INPUTS

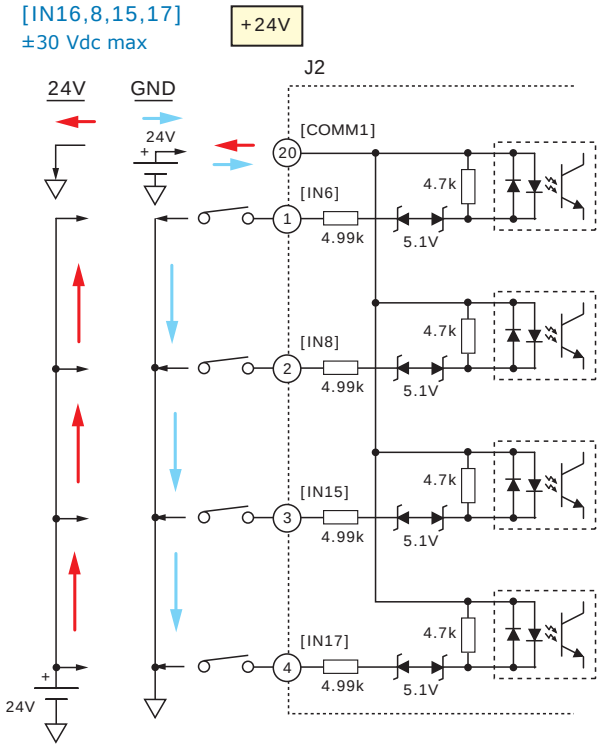
These inputs have all the programmable functions of the GP inputs plus opto-isolation. There are two groups of four inputs, each with its' own common terminal. Grounding the common terminal configures the inputs to work with current-sourcing outputs from controllers like PLC's. When the common terminal is connected to +24V, then 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

[IN5,7,13,16]
±30 Vdc max



[IN16,8,15,17]
±30 Vdc max



These inputs work with current-sourcing OR current-sinking connections. Connect the COMM to controller ground/common for current-sourcing connections and to 15~24V from the controller for current-sinking connections.

Vmax
+24V

[IN5~8,14~17] SIGNALS

Signal	Pins	Signal	Pins
IN5	J2-11	IN6	J2-1
IN7	J2-12	IN8	J2-2
IN14	J2-13	IN15	J2-3
IN16	J2-14	IN17	J2-4
COMM	J2-20		

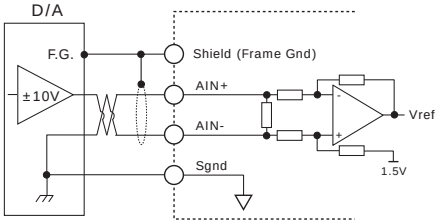
ANALOG INPUTS

The analog inputs have a ±10 Vdc range at 12-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.

CME2 -> Basic Setup -> Operating Mode Options

[AIN A,B] SIGNALS

Signal	J1 Pins	
	Axis A	Axis B
AIN(+)	18	19
AIN(-)	1	2
Sgnd	7,12,20	
Shield	17	

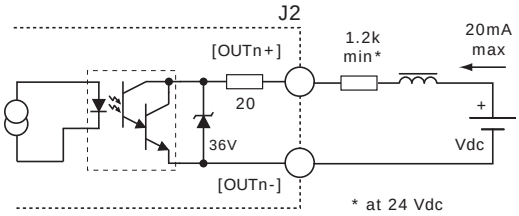


OUTPUTS

OPTO-ISOLATED OUTPUTS [OUT1~5]

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

[OUT1~5]

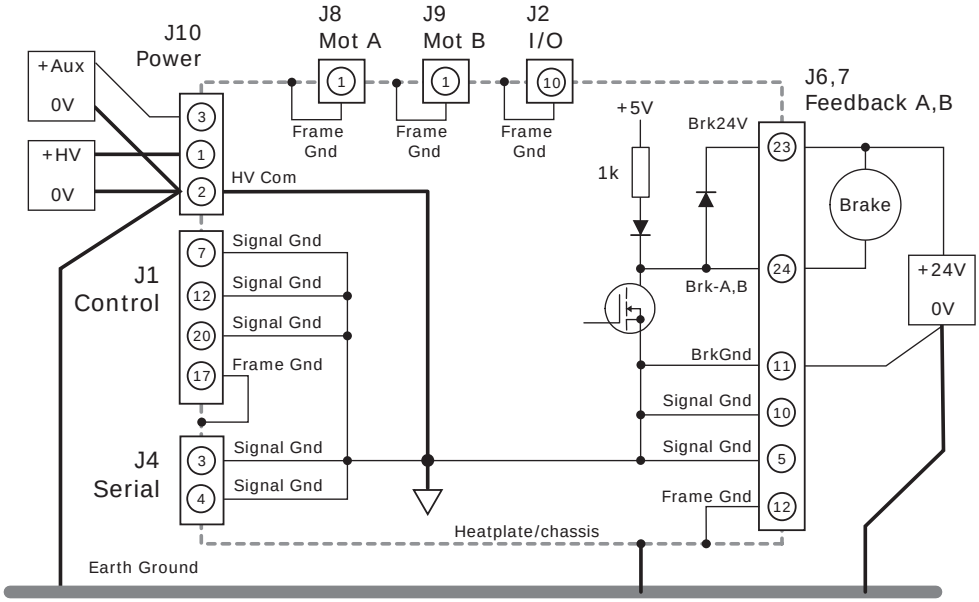


[OUT1~5] SIGNALS

Signal	Pins	Signal	Pins
[OUT1+]	J2-15	[OUT1-]	J2-5
[OUT2+]	J2-16	[OUT2-]	J2-6
[OUT3+]	J2-17	[OUT3-]	J2-7
[OUT4+]	J2-18	[OUT4-]	J2-8
[OUT5+]	J2-19	[OUT5-]	J2-9
[COMM]	J2-20		

BRAKE OUTPUTS [OUT6,7]

These outputs are open-drain MOSFETs with internal flyback diodes for driving inductive loads. Each can sink up to 1A from a motor brake connected to the +24 Vdc supply. The operation of the brake is programmable with *CME 2*. They can also be programmed as a general-purpose digital outputs.



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.

BRAKE SIGNALS

Signal	Axis A	Axis B
Brk24V	J6-23	J7-23
BRK-A,B	J6-24	J7-24
BrkGnd	J6-11	J7-11

HI/LO DEFINITIONS: OUTPUTS

Input	State	Condition
OUT1~5	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

MOTOR CONNECTIONS

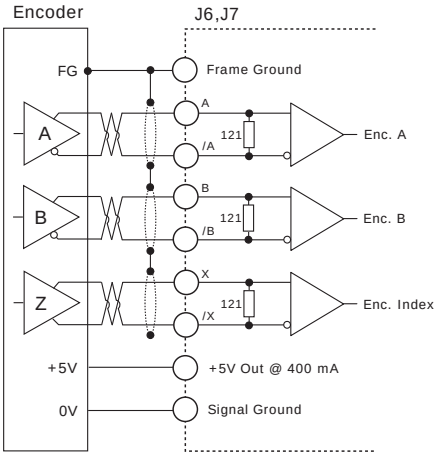
Motor connections are of three types: phase, feedback, and thermal sensor. The phase connections carry the drive output currents that drive the motor to produce motion. A thermal sensor that indicates motor overtemperature is used to shut down the drive to protect the motor. Feedback can be digital quad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

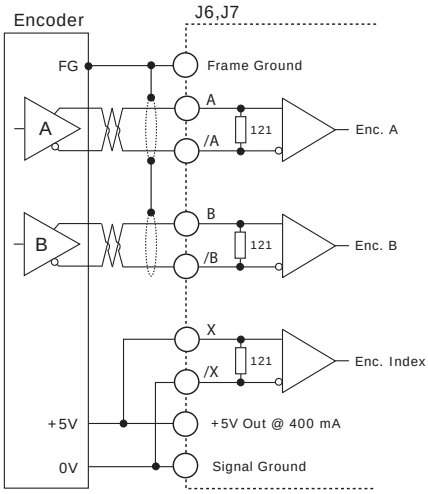
CONNECTIONS WITH A/B/X ENCODER



A/B/X SIGNALS

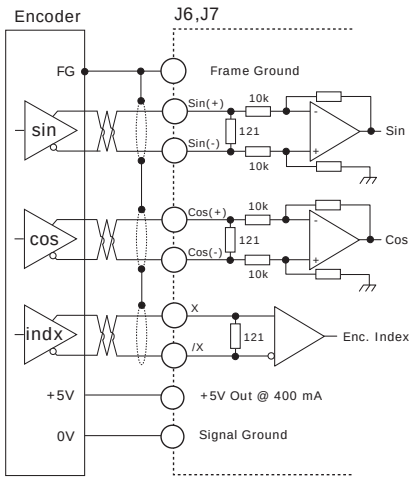
Signal	J6,J7 Pin
Enc A	13
Enc /A	1
Enc B	14
Enc /B	2
Enc X	15
Enc /X	3
+5V	17,22
Sgnd	5,10,11,23
Frame Gnd	12

CONNECTIONS WITH NO INDEX SIGNAL



ANALOG SIN/COS INCREMENTAL ENCODER

The sin/cos/index 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.

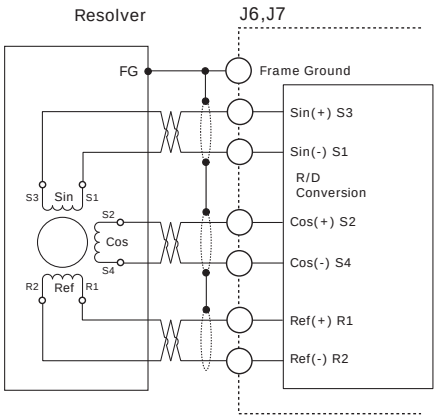


SIN/COS SIGNALS

Signal	J6,J7 Pin
Sin(+)	20
Sin(-)	8
Cos(+)	21
Cos(-)	9
X	15
/X	3
+5V	17,22
Sgnd	5,10,11,23
Frame Gnd	12

RESOLVER (-R MODELS)

Connections to the resolver should be made with shielded cable that uses three twisted-pairs. Once connected, resolver set up, motor phasing, and other commissioning adjustments are made with CME 2 software. There are no hardware adjustments.



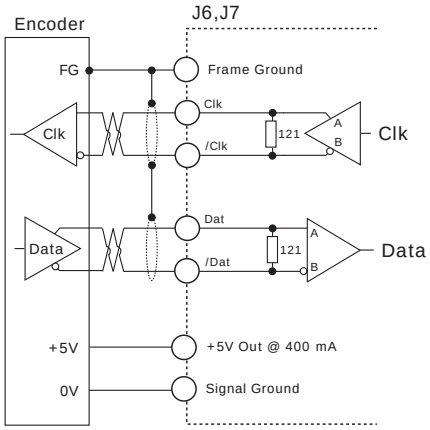
RESOLVER SIGNALS

Signal	J6,J7 Pin
Sin(+) S3	20
Sin(-) S1	8
Cos(+) S2	21
Cos(-) S4	9
Ref(+) R1	15
Ref(-) R2	3
Frame Gnd	12

MOTOR CONNECTIONS (CONT'D)

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.



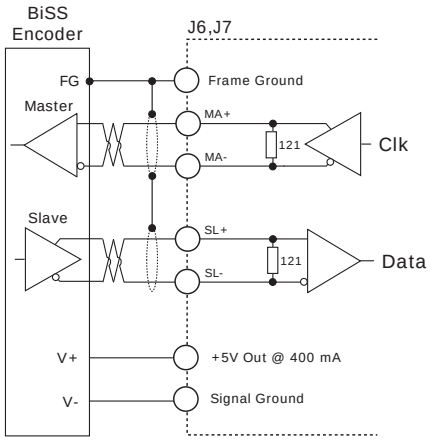
SSI,BiSS SIGNALS

SSI	BiSS	J6,J7 Pin
Clk	MA+	15
/Clk	MA-	3
Data	SL+	16
/Data	SL-	4
+5V		17,22
Sgnd		5,10
Frame Gnd		12

BiSS ABSOLUTE ENCODER

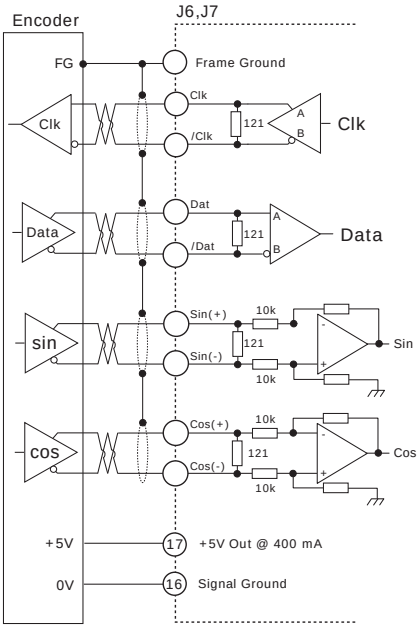
BiSS is an - Open Source - digital interface for sensors and actuators. BiSS refers to principles of well known industrial standards for Serial Synchronous Interfaces like SSI, AS-Interface® and Interbus® with additional options.

- 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.

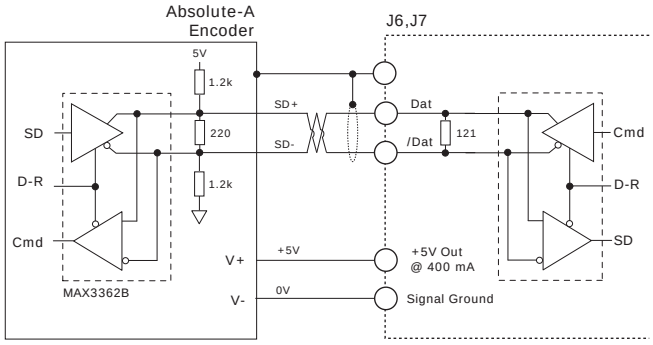


ENDAT SIGNALS

Signal	J6,J7 Pin
Clk	15
/Clk	3
Data	16
/Data	4
Sin(+)	20
Sin(-)	8
Cos(+)	21
Cos(-)	9
+5V	17,22
Sgnd	5,10
Frame Gnd	12

ABSOLUTE-A ENCODER

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



ABSOLUTE-A SIGNALS

Signal	J6,J7 Pin
Data	16
/Data	4
+5V	17,22
Sgnd	5,10
Frame Gnd	12

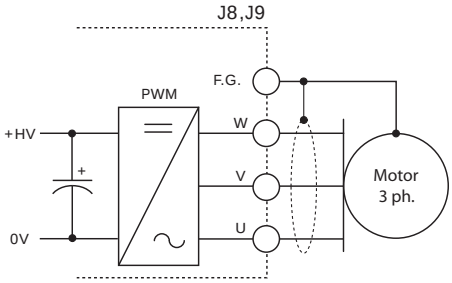
MOTOR CONNECTIONS (CONT'D)

MOTOR PHASE CONNECTIONS

The drive outputs are three-phase PWM inverters that convert 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 (J8,J9-1) for best results.

MOTOR SIGNALS

Signal	J8,J9 Pin
Mot U	4
Mot V	3
Mot W	2
Frame Gnd	1

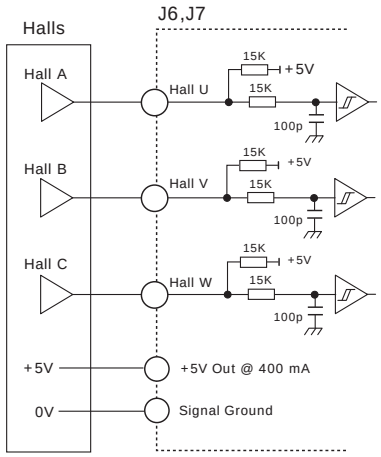


DIGITAL HALL SIGNALS

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.

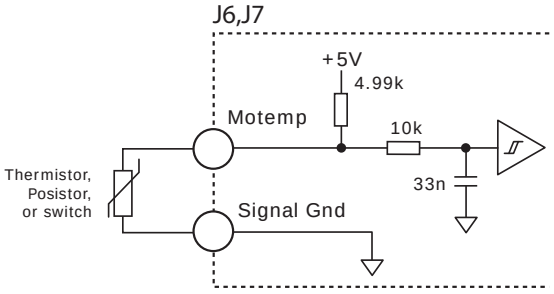
HALL SIGNALS

Signal	J6,J7 Pin
Hall U	18
Hall V	6
Hall W	19
+5V	17,22
Sgnd	5,10
Frame Gnd	12



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.
These inputs are programmable for other functions if not used as Motemp inputs. And, other inputs are programmable for the Motemp function.



MOTEMP SIGNALS

Signal	Pin
Motemp A	J6-7
Motemp B	J7-7
J6,J7 Sgnd	5,10
Frame Gnd	12

BS 4999 SENSOR

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

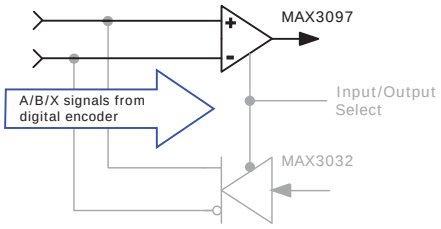
MOTOR CONNECTIONS (CONT'D)

MULTI-MODE ENCODER PORT

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.

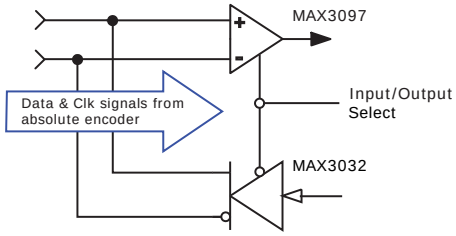


QUAD A/B/X SIGNALS

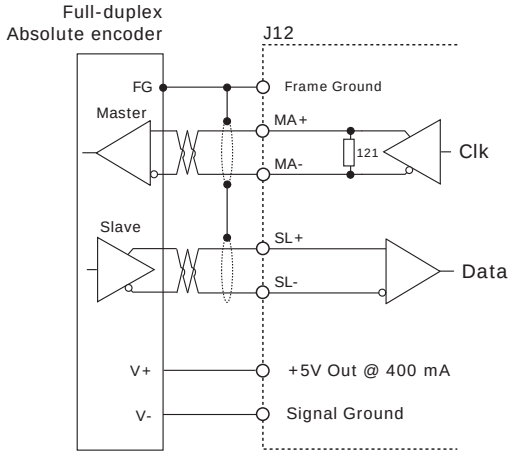
Signal J1	Axis A	Axis B
Enc A	26	31
Enc /A	8	13
Enc B	27	32
Enc /B	9	14
Enc X	28	33
Enc /X	10	15
+5V Output	25	30
Sgnd	7,12,20	
Frame Gnd	17	

FEEDBACK FROM ABSOLUTE ENCODERS

Digital absolute encoder feedback as motor or load encoder can come from absolute encoders, too. Analog sin/cos 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

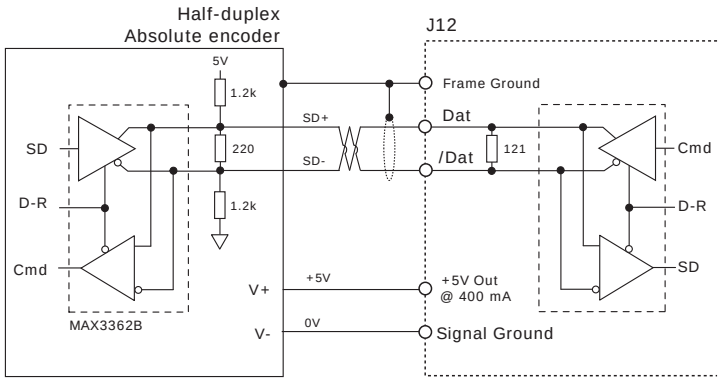
HALF-DUPLEX ENCODERS

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

FULL-DUPLEX SIGNALS

Signal J1	Axis A	Axis B
Clk	28	33
/Clk	10	15
Dat	29	34
/Dat	11	16
+5V Output	25	30
Sgnd	7,12,20	
Frame Gnd	17	

ABSOLUTE ENCODER, HALF-DUPLEX MODE

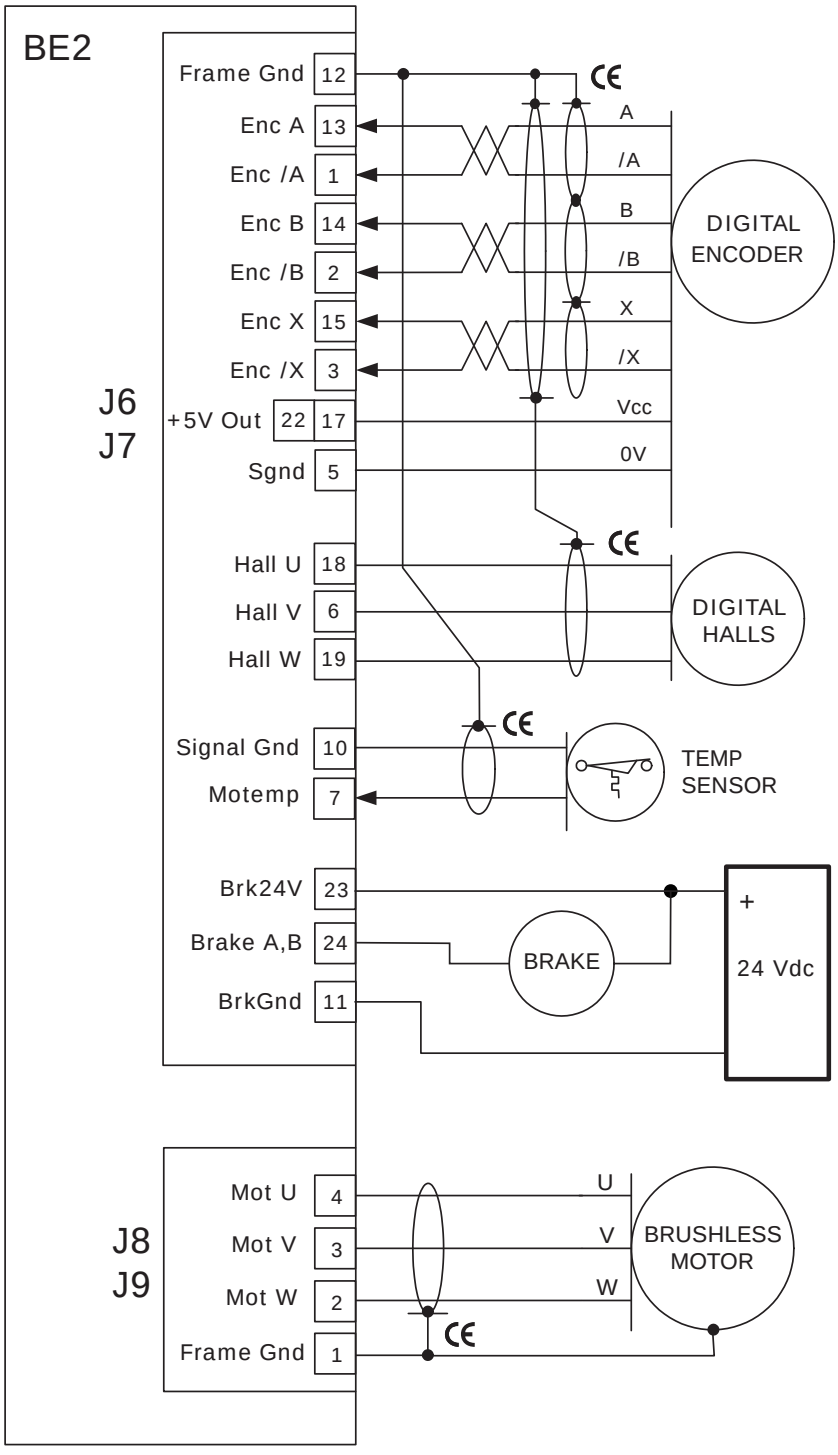


HALF-DUPLEX SIGNALS

Signal J1	Axis A	Axis B
Dat	29	34
/Dat	11	16
+5V Output	25	30
Sgnd	7,12,20	
Frame Gnd	17	

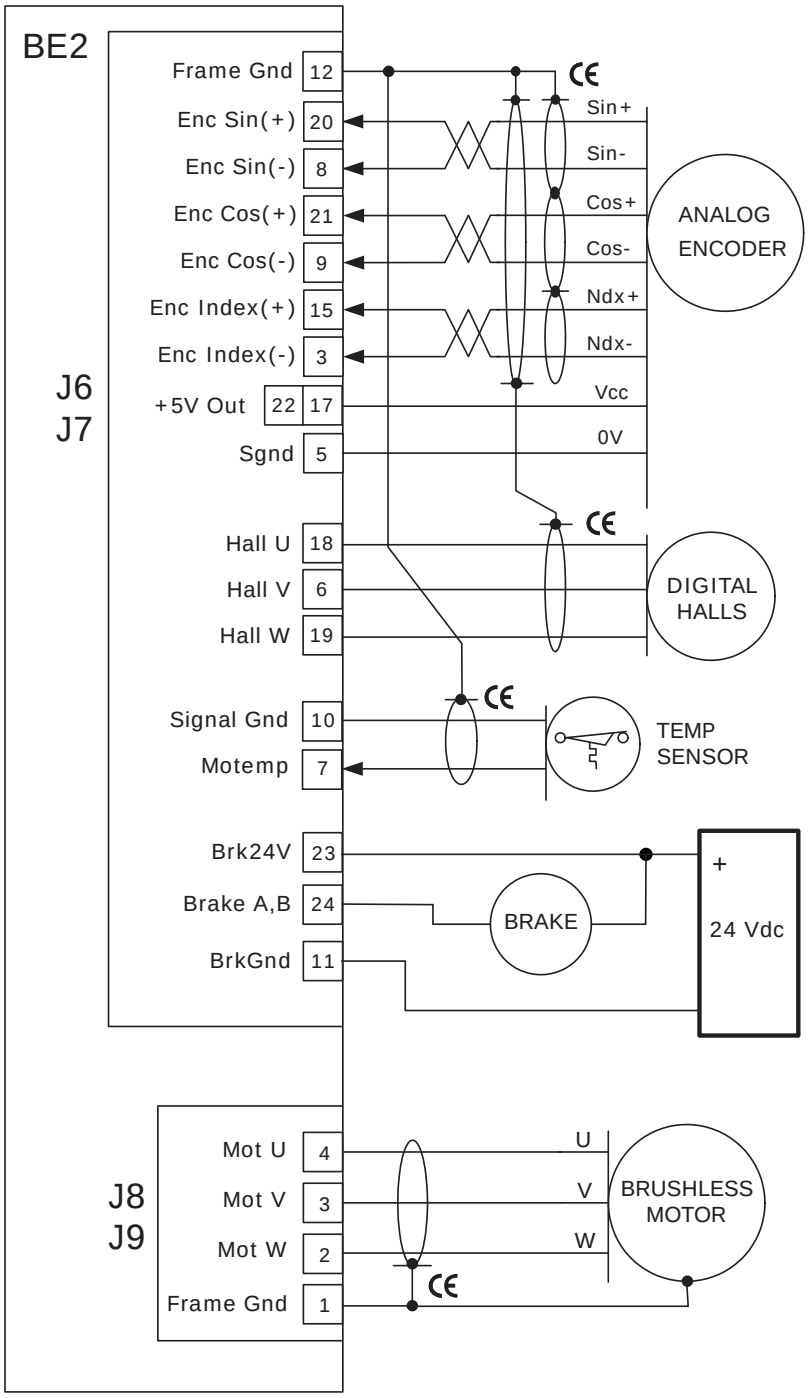
MOTOR CONNECTIONS FOR INCREMENTAL DIGITAL ENCODERS

The connections shown may not be used in all installations



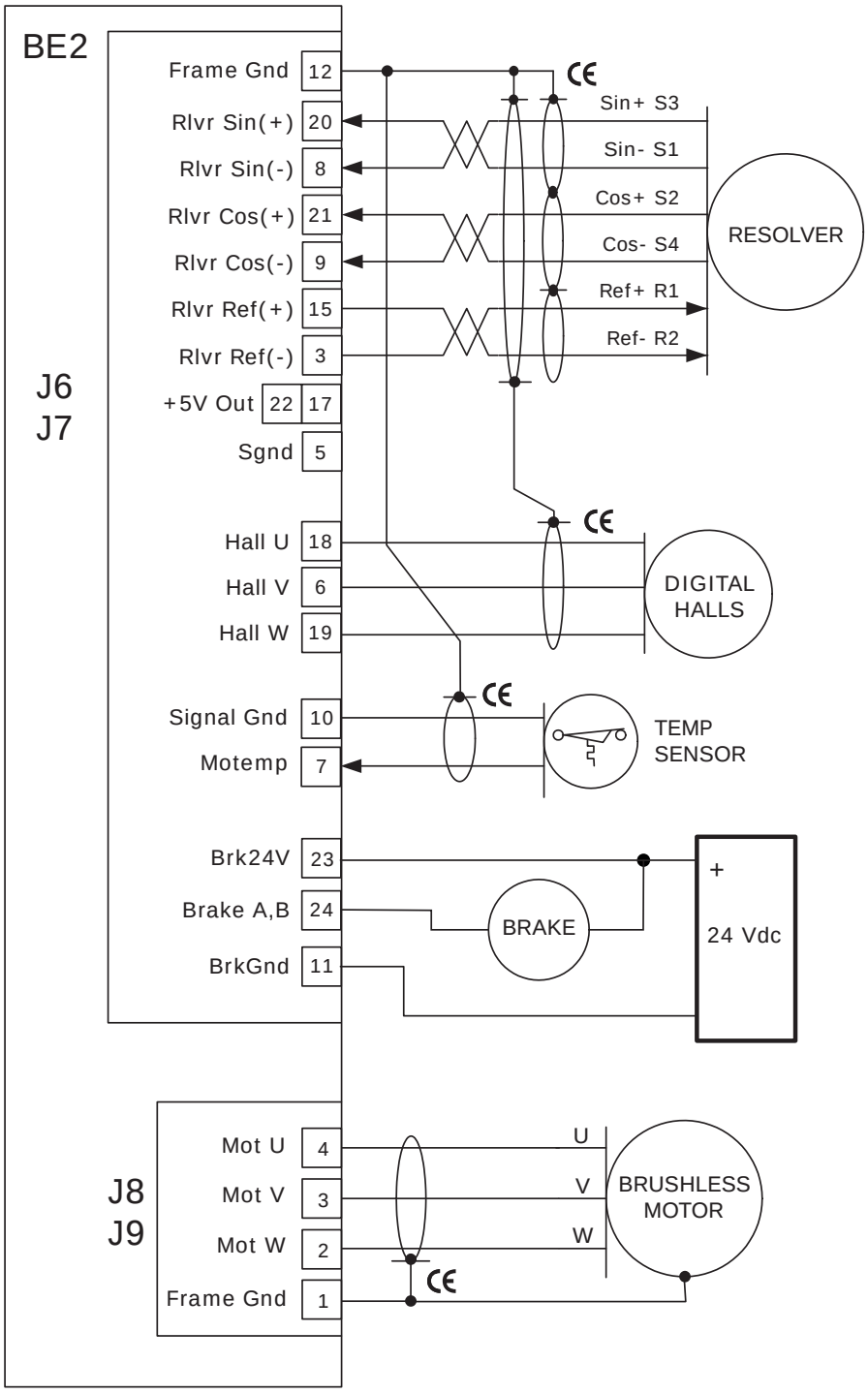
MOTOR CONNECTIONS FOR INCREMENTAL ANALOG (SIN/COS) ENCODERS

The connections shown may not be used in all installations



MOTOR CONNECTIONS FOR RESOLVERS

The connections shown may not be used in all installations.
Hall signals are not generally used with resolver feedback but are shown here because they function if needed for resolver operation.



CONNECTORS & SIGNALS

J2: I/O

Signal	Pin		Signal
ISO Input [IN5]	11	1	ISO Input [IN6]
ISO Input [IN7]	12	2	ISO Input [IN8]
ISO Input [IN14]	13	3	ISO Input [IN15]
ISO Input [IN16]	14	4	ISO Input [IN17]
ISO Output [OUT1+]	15	5	ISO Output [OUT1-]
ISO Output [OUT2+]	16	6	ISO Output [OUT2-]
ISO Output [OUT3+]	17	7	ISO Output [OUT3-]
ISO Output [OUT4+]	18	8	ISO Output [OUT4-]
ISO Output [OUT5+]	19	9	ISO Output [OUT5-]
ISO COMM [ICOM]	20	10	Frame Ground

J2 I/O Connector:
20-position shrouded cable header, keyed polarization
Samtec IPL1-110-01-L-D-RA-K

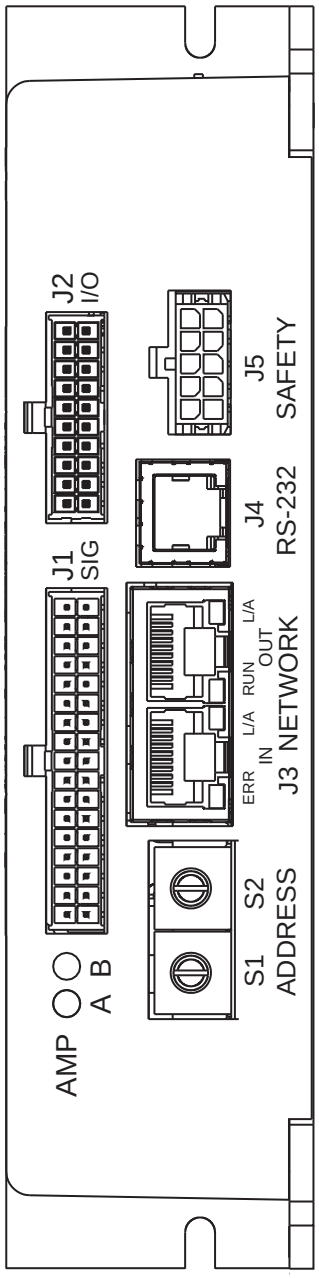
J2 Cable Connector:
Samtec IPD1-10-D-K
Contacts: CC79L-2024-L (AWG 20~24)

J1: CONTROL

Signal	Pin		Signal
Axis A Analog Ref(+)	18	1	Axis A Analog Ref(-)
Axis B Analog Ref(+)	19	2	Axis B Analog Ref(-)
Signal Ground	20	3	GP Input [IN2]
GP Enable Input [IN1]	21	4	GP Input [IN11]
GP Input [IN10]	22	5	HS Input [IN4]
HS Input [IN3]	23	6	HS Input [IN13]
HS Input [IN12]	24	7	Signal Ground
Axis A +5 Vdc Output	25	8	Axis A Multi-Mode Enc /A
Axis A Multi-Mode Enc A	26	9	Axis A Multi-Mode Enc /B
Axis A Multi-Mode Enc B	27	10	Axis A Multi-Mode Enc /X
Axis A Multi-Mode Enc X	28	11	Axis A Multi-Mode Enc /S
Axis A Multi-Mode Enc S	29	12	Signal Ground
Axis B +5 Vdc Output	30	13	Axis B Multi-Mode Enc /A
Axis B Multi-Mode Enc A	31	14	Axis B Multi-Mode Enc /B
Axis B Multi-Mode Enc B	32	15	Axis B Multi-Mode Enc /X
Axis B Multi-Mode Enc X	33	16	Axis B Multi-Mode Enc /S
Axis B Multi-Mode Enc S	34	17	Frame Ground

J1 Control Connector:
34-position shrouded cable header, keyed polarization
Samtec: IPL1-117-01-L-D-RA-K

J1 Cable Connector:
34-position connector housing, keyed polarization
Samtec IPD1-17-D-K
Contacts: CC79L-2024-L (AWG 20~24)



J5 Safety Connector:
14-position shrouded cable header, keyed polarization
Samtec IPL1-107-01-L-D-RA-K

J5 Cable Connector:
Samtec IPD1-07-D-K
Contacts: CC79L-2024-L (AWG 20~24)

J5: SAFETY

Signal	Pin		Signal
STO_IN2+	8	1	STO_IN2-
n.c.	9	2	n.c.
STO_IN1+	10	3	STO_IN1-
n.c.	11	4	n.c.
n.c.	12	5	n.c.
STO_BYP	13	6	Sgnd
	14	7	Sgnd

J4: SERIAL

Pin	Signal
6	n.c.
5	TxD
4	Sgnd
3	Sgnd
2	RxD
1	n.c.

J4 RS-232 Connector:
RJ-11 modular receptacle
6-position, 4 used

J3: CANOPEN

Pin	Signal
8	TX1 Term
7	TX1 Term
6	RX1-
5	RX1 Term
4	RX1 Term
3	RX1+
2	TX1-
1	TX1+

J3 CANopen Connector:
RJ-45 dual receptacle

Samtec Connector Tools:
Crimping tool: CAT-HT-179-2024-11
Contact Extractor: CAT-EX-179-01
Contact lance reset tool: CAT-RE-169-01

Notes on Tools:
Connector tools are available from manufacturers and are not sold by Copley Controls.

CONNECTORS & SIGNALS

J7: AXIS B FEEDBACK

Signal	Pin		Signal
Axis B Enc A	13	1	Axis B Enc /A
Axis B Enc B	14	2	Axis B Enc /B
Axis B Enc X	15	3	Axis B Enc /X
Axis B Enc S	16	4	Axis B Enc /S
Axis B +5 Vdc Output	17	5	Signal Ground
Axis B Hall U	18	6	Axis B Hall V
Axis B Hall W	19	7	Axis B Motemp [IN18]
Axis B Sin(+)	20	8	Axis B Sin(-)
Axis B Cos(+)	21	9	Axis B Cos(-)
Axis B +5 Vdc Output	22	10	Signal Ground
Axis B Brake +24V	23	11	Brake Ground 0V
Axis B Brake [OUT7]	24	12	Frame Ground

J6: AXIS A FEEDBACK

Signal	Pin		Signal
Axis A Enc A	13	1	Axis A Enc /A
Axis A Enc B	14	2	Axis A Enc /B
Axis A Enc X	15	3	Axis A Enc /X
Axis A Enc S	16	4	Axis A Enc /S
Axis A +5 Vdc Output	17	5	Signal Ground
Axis A Hall U	18	6	Axis A Hall V
Axis A Hall W	19	7	Axis A Motemp [IN9]
Axis A Sin(+)	20	8	Axis A Sin(-)
Axis A Cos(+)	21	9	Axis A Cos(-)
Axis A +5 Vdc Output	22	10	Signal Ground
Axis A Brake +24V	23	11	Brake Ground 0V
Axis A Brake [OUT6]	24	12	Frame Ground

J6,J7 Feedback Connectors:
24-position shrouded cable headers, keyed polarization
Samtec IPL1-112-01-L-D-RA-K

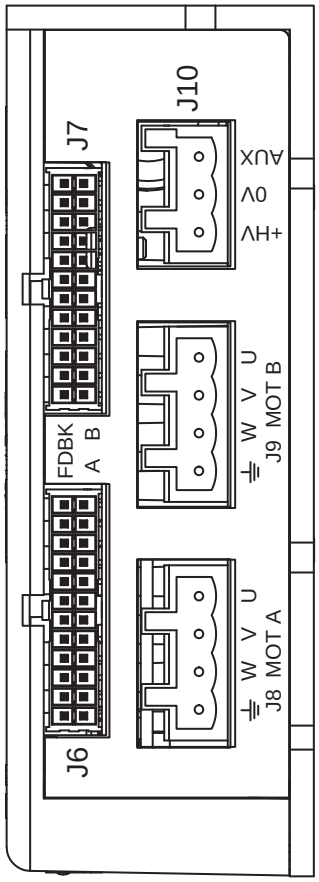
J6,J7 Cable Connectors:
34-position connector housing, keyed polarization
Samtec IPD1-12-D-K
Contacts: CC79L-2024-L (AWG 20~24)

Samtec Connector Tools:
Crimping tool: CAT-HT-179-2024-11
Contact Extractor: CAT-EX-179-01
Contact lance reset tool: CAT-RE-169-01

Notes on Tools:
Connector tools are available from manufacturers and are not sold by Copley Controls.

J10: Power Connector:
Euro-style 5,0 mm receptacle, 3-position
Wago: 721-463/001-040
Insert/extract lever: Wago: 231-131

J10 Cable Connector:
Wago 721-103/026-047/RN01-0000
Insert/extract lever: Wago: 231-131



J10: HV & AUX POWER

Pin	Signal
3	Aux HV
2	HV Com (Gnd)
1	+HV

J9: AXIS B MOTOR

Pin	Signal
4	Axis B Mot U
3	Axis B Mot V
2	Axis B Mot W
1	Frame Ground

J8: AXIS A MOTOR

Pin	Signal
4	Axis A Mot U
3	Axis A Mot V
2	Axis A Mot W
1	Frame Ground

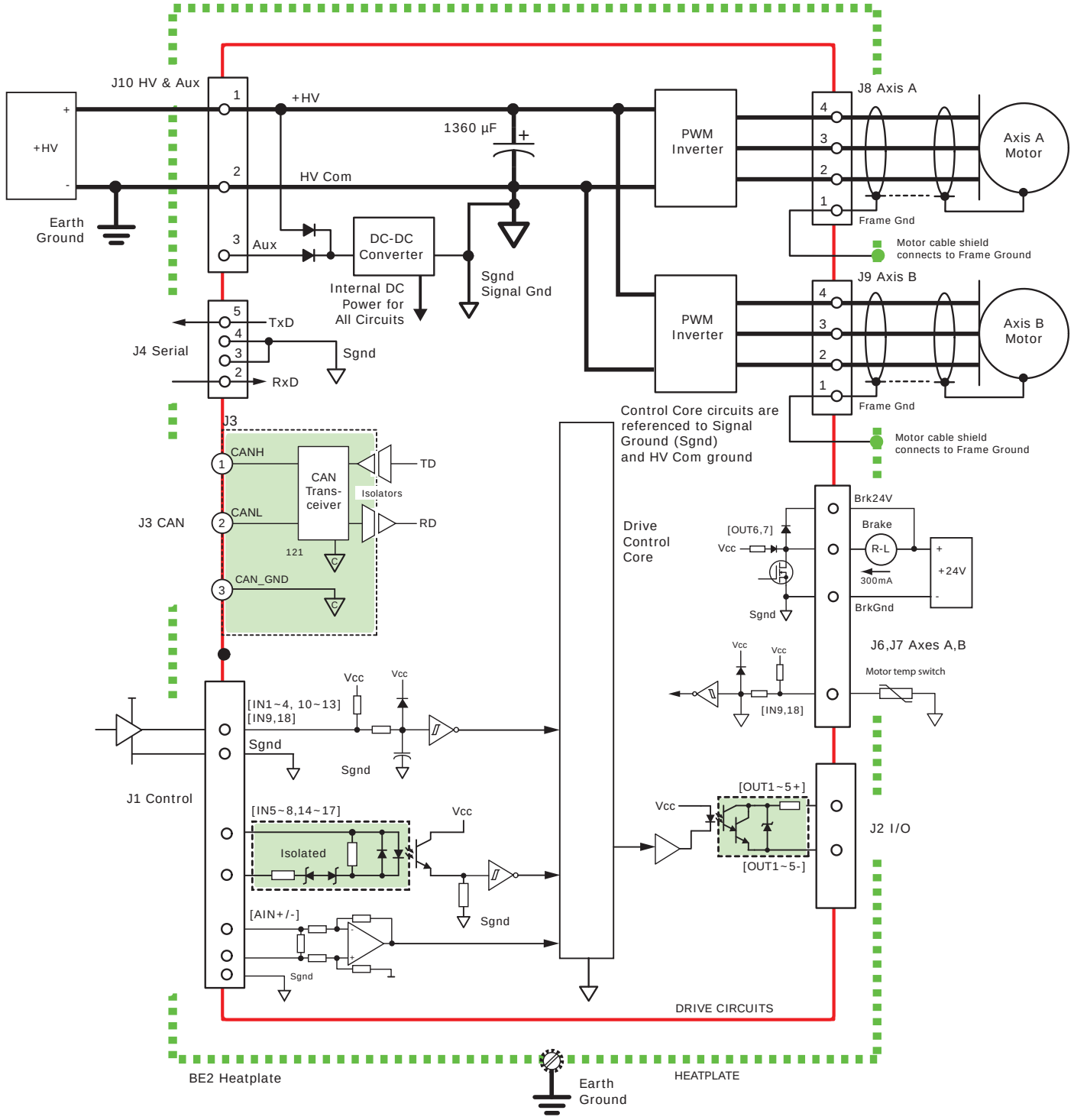
J8,J9: Motor Connectors:
Euro-style 5,0 mm receptacles, 4-position
Wago: 721-464/001-000

J8,J9 Cable Connectors:
Wago 721-104/026-047/RN01-0000
Insert/extract lever: Wago: 231-131

Wago Connector Tool:
Contact opener: 231-131
(included in BP2-CK)

DEVICE STRUCTURE

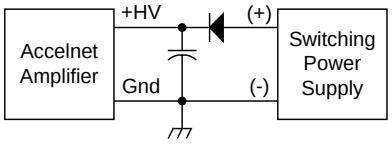
This graphic shows the electrical structure of the drive, detailing the elements that share a common circuit common (Signal Ground, HV Com) and circuits that are isolated and have no connection to internal circuits.
Note that there is no connection between the heatplate (Chassis, Frame Ground) and any drive circuits.



POWER SUPPLIES

Accelnet BP2 operates typically from transformer-isolated, unregulated DC power supplies. These should be sized such that the maximum output voltage under high-line and no-load conditions does not exceed the drives maximum voltage rating. Power supply rating depends on the power delivered to the load by the drive. In many cases, the continuous power output of the drive is considerably higher than the actual power required by an incremental motion application.

Operation from regulated switching power supplies is possible if a diode is placed between the power supply and drive to prevent regenerative energy from reaching the output of the supply. If this is done, there must be external capacitance between the diode and drive.



AUXILIARY HV POWER

Accelnet BP2 has an input for AUX-HV. This is a voltage that can keep the drive communications and feedback circuits active when the PWM output stage has been disabled by removing the main +HV supply. This can occur during EMO (Emergency Off) conditions where the +HV supply must be removed from the drive and powered-down to ensure operator safety. The AUX–HV input operates from any DC voltage that is within the operating voltage range of the drive and powers the DC/DC converter that supplies operating voltages to the drive DSP and control circuits.

When the drive +HV voltage is greater than the AUX-HV voltage it will power the DC/DC converter. Under these conditions the AUX-HV input will draw no current.

GROUNDING CONSIDERATIONS

Power and control circuits in *Stepnet BP2* share a common circuit-ground (See diagram in the Brake section of page 13). Circuits that are referenced to Signal Ground are the analog Reference input, non-isolated digital inputs, buffered encoder outputs, motor encoder and Hall signals, PWM outputs and the RS-232 port. For this reason, drive Signal Gnd terminals should connect to the users' control ground system so that signals between drive and controller are at the same common potential, and to minimize noise. The system ground should, in turn, connect to an earthing conductor at some point so that the whole system is referenced to "earth". The CAN ports are opto-isolated from the drive circuits.

Because current flow through conductors produces voltage-drops across them, it is best to connect the drive HV Return to system earth, or circuit-common through the shortest path, and to leave the power-supply floating. In this way, the power supply (-) terminal connects to ground at the drive HV Return terminals, but the voltage drops across the cables will not appear at the drive ground, but at the power supply negative terminal where they will have less effect.

Motor phase currents are balanced, but currents can flow between the PWM outputs, and the motor cable shield. To minimize the effects of these currents on nearby circuits, the cable shields should connect to Frame Gnd (J6~7-12).

The drive heatplate (Frame Gnd) does not connect to any drive circuits. Connections to the heatplate are provided on connectors J1-17, J2-10, J6~7-12, and J8~9-1. Cables to these connectors must be shielded for CE compliance, and the shields should connect to these terminals. When installed, the drive heatplate should connect to the system chassis. This provides a path to ground for noise currents that may occur in the cable shields.

Signals from controller to drive are referenced to +5 Vdc, and other power supplies in user equipment. These power supplies should also connect to system ground and earth at some point so that they are at same potential as the drive circuits.

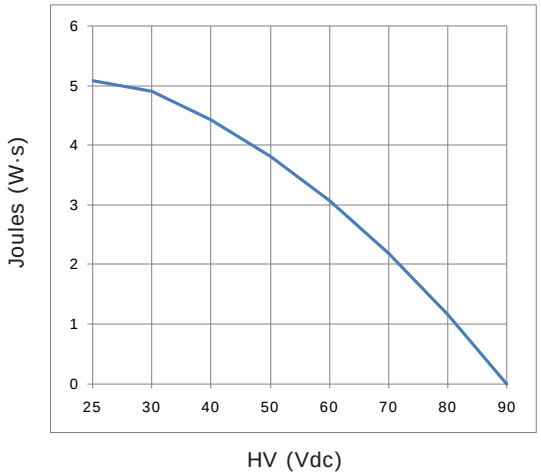
The final configuration should embody three current-carrying loops. First, the power supply currents flowing into and out of the drive at the +HV and HV_COM pins on J10. Second the drive outputs driving currents into and out of the motor phases on J8~9, and motor shield currents circulating between the U, V, and W outputs and Gnd. And, lastly, logic and signal currents connected to the drive control inputs and outputs.

For CE compliance and operator safety, the drive heatplate should be earthed by using external tooth lock washers under the mounting screws. These will make contact with the aluminum chassis through the anodized finish to connect the chassis to the equipment frame ground.

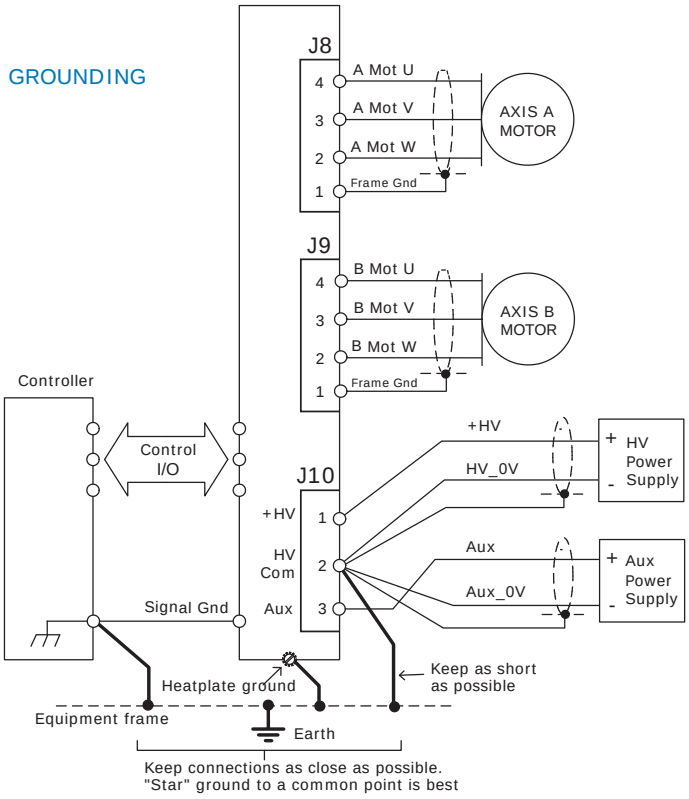
REGENERATION

The chart below shows the energy absorption in W·s for a *BP2* drive operating at some typical DC voltages. When the load mechanical energy is greater than these values an external regenerative energy dissipater is required. The internal capacitor bank is 1360 uF and the energy absorption is shared with both axes.

ENERGY ABSORPTION



GROUNDING

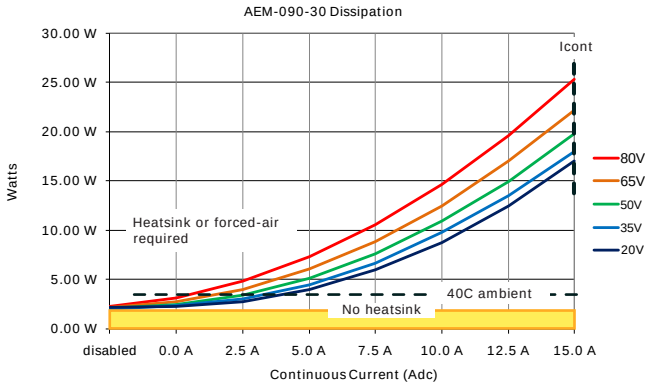


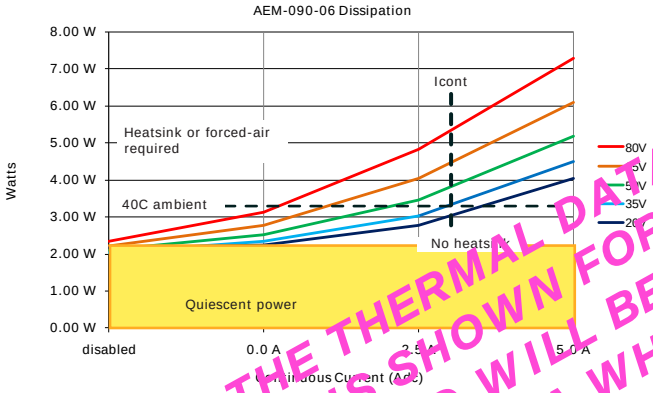
POWER DISSIPATION

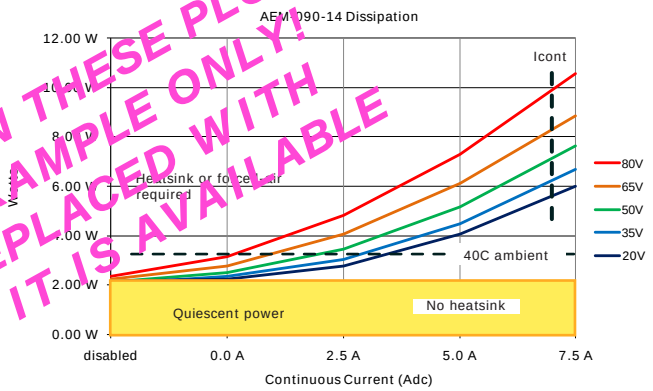
The charts on this page show the internal power dissipation for different models under differing power supply and output current conditions. The values on the chart represent the continuous current that the drive would provide during operation. The +HV values are for the average DC voltage of the drive power supply.

To see if a heatsink is required or not, the next step is to determine the temperature rise the drive will experience when it's installed. For example, if the ambient temperature in the drive enclosure is 40 °C, and the heatplate temperature is to be limited to 70° C or less to avoid shutdown, the maximum rise would be 70C - 40C. or 30° C. Dividing this dissipation by the thermal resistance of 9° C/W with no heatsink gives a dissipation of 3.33W. This line is shown in the charts. For power dissipation below this line, no heatsink is required. The vertical dashed line shows the continuous current rating for the drive model.

Note: These charts are based on the total power dissipation in the drive which includes quiescent operating power and dissipation in the PWM output section.







THE THERMAL DATA IN THESE PLOTS IS SHOWN FOR EXAMPLE ONLY! AND WILL BE REPLACED WITH BP2 DATA WHEN IT IS AVAILABLE

MOUNTING

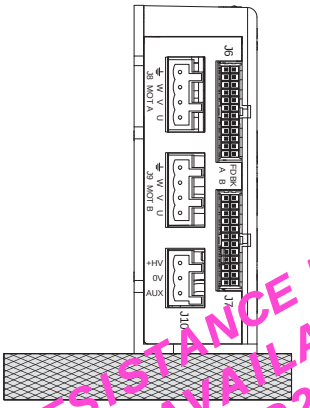
Thermal data for convection-cooling with a heatsink assumes a vertical mounting of the drive on a thermally conducting surface. Heatsink fins run parallel to the long axis of the drive. When fan-cooling is used vertical mounting is not necessary to guarantee thermal performance of the heatsink.

THERMAL RESISTANCE

Thermal resistance is a measure of the temperature rise of the drive heatplate due to power dissipation in the drive. It is expressed in units of °C/W where the degrees are the temperature rise above ambient.

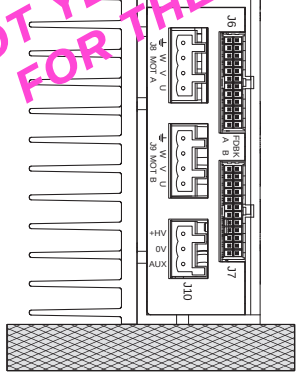
E.g., an drive dissipating 16 W mounted with no heatsink or fan would see a temperature rise of 46 °C above ambient based on the thermal resistance of 2.9 °C/W. Using the drive maximum heatplate temperature of 70 °C and subtracting 46 °C from that would give 24 °C as the maximum ambient temperature the drive in which the drive could operate before going into thermal shutdown. To operate at higher ambient temperatures a heatsink or forced-air would be required.

END VIEWS
VERTICAL MOUNTING

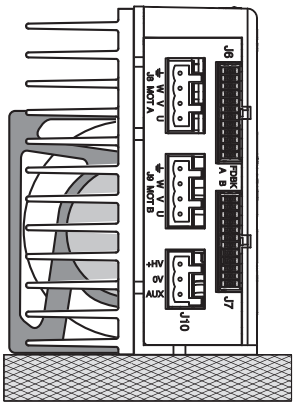


NO HEATSINK, NO FAN	°C/W
CONVECTION	

THERMAL RESISTANCE DATA IS NOT YET AVAILABLE FOR THE BP2



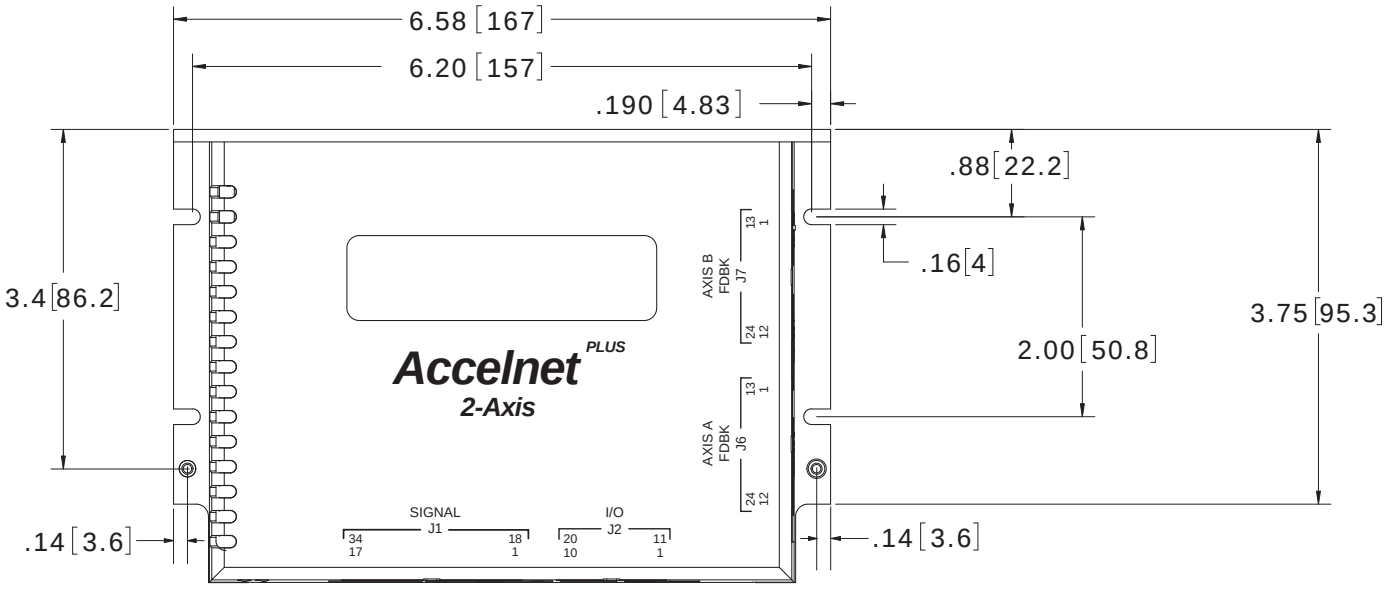
HEATSINK, NO FAN	°C/W
CONVECTION	

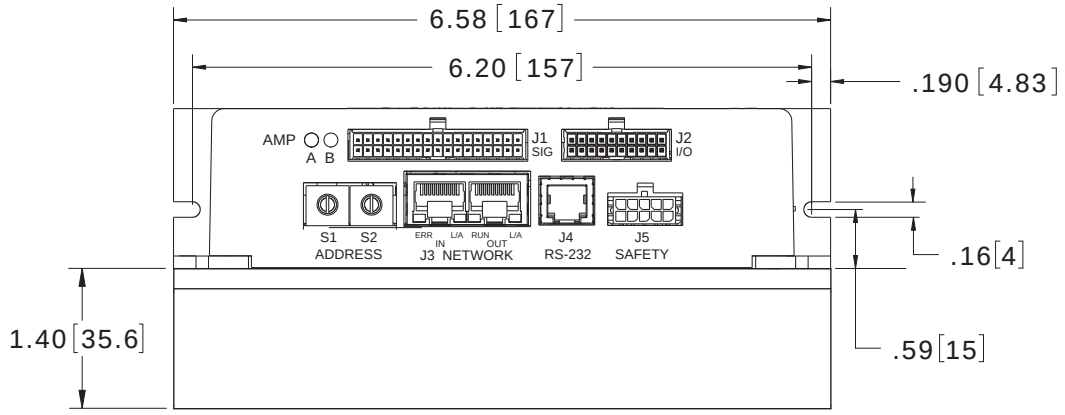


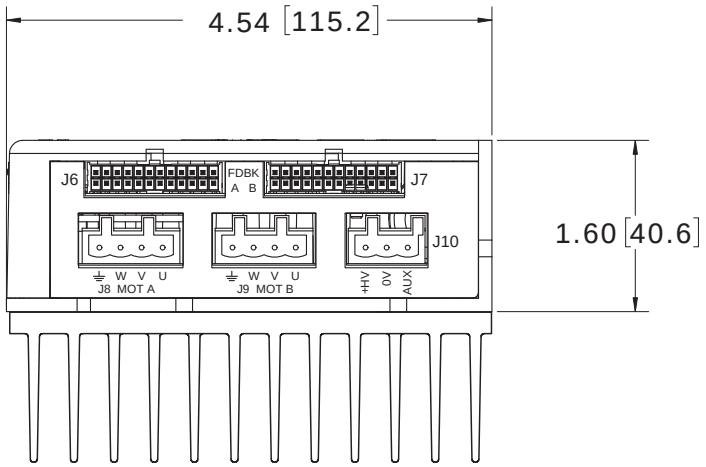
HEATSINK + FAN	°C/W
FORCED-AIR, 300 LFM	

DIMENSIONS

Dimensions: in[mm]







MASTER ORDERING GUIDE

BP2-090-06	*Accelnet Plus 2-Axis Panel* CANopen servo drive, 3/6 A, 90 Vdc
BP2-090-14	*Accelnet Plus 2-Axis Panel* CANopen servo drive, 7/14 A, 90 Vdc
BP2-090-20	*Accelnet Plus 2-Axis Panel* CANopen servo drive, 10/20 A, 90 Vdc

Add -R to model number for resolver feedback option (Example: BP2-090-14-R)
Add -H to model number for factory-installed heatsink

ACCESSORIES

	QTY	REF	DESCRIPTION	MANUFACTURERS PART NUMBER
BP2-CK Connector Kit	1	J1	Connector housing, 34 position, keyed polarization	Samtec: IPD1-17-D-K
	1	J2	Connector housing, 20 position, keyed polarization	Samtec: IPD1-10-D-K
	4	J5	Connector housing, 14 position, keyed polarization	Samtec: IPD1-07-D-K
	2	J6,J7	Connector housing, 24 position, keyed polarization	Samtec: IPD1-12-D-K
	2	J8,J9	Plug, 4 position, 5.0 mm, female	Wago: 721-104/026-047/RN01-0000
	1	J10	Plug, 3 position, 5.0 mm, female	Wago: 721-103/026-047/RN01-0000
	120	->	Contacts for J1, J2, J5, J6, J7	Samtec: CC79L-2024-L
	1	->	Tool, wire insertion & extraction for J8, J9, J10	Wago: 231-131
CME 2			CME 2 Drive Configuration Software (CD-ROM)	
SER-CK		J4	RS-232 Cable Kit: Includes Dsub9 adapter and modular cable	
BP2-NK CANopen Network Kit			Adapter Assy, DB9 Female to RJ45 Jack (BP2-CV)	
			CANopen Network Cable, 10 ft. (BP2-NC-10)	
			CANopen Network Terminator (BP2-NT)	
BP2-NC-10	1	J3	CANopen® network cable, 10 ft (3 m)	
BP2-NC-01	1		CANopen® network cable, 1 ft (0.3 m)	
BP2-CV	1		D-Sub 9F to RJ-45 Adapter	
BP2-NT	1		CAN bus Network Terminator	

Heatsink Kits for Field Installation (Optional)

BP2-HK Heatsink Kit	1	BP2 Heatsink
	1	Heatsink thermal material
	4	Heatsink hardware

Note: The heatsink can be fitted at the factory by adding an "-H" to the drive part number.
The BP2-HK is for field installation by the user. The kit contains the heatsink, mounting hardware, and thermal interface material.

Example: Order one *Accelnet Plus BP2* drive, resolver version, 7/14 A, with connector Kit, *CME 2* CD, serial cable kit, network cable kit, and heatsink fitted at the factory:

Qty	Item	Remarks
1	BP2-090-14-R-H	*Accelnet Plus BP2* 2-axis servo drive with resolver and heatsink
1	BP2-CK	*BP2* Connector Kit
1	CME 2	CME 2 CD
1	SER-CK	Serial Cable Kit
1	BP2-NK	Network Cable Kit

ACCESSORIES (NOT SOLD BY COPLEY)

Hand crimping tool	J1,J2, J6,J7, J5	Samtec: CAT-HT-179-2024-11 (for CC79L-2024 contacts)
Contact extraction tool		Samtec: CAT-EX-179-01
Contact lance reset tool		Samtec: CAT-RE-169-01

Note: Specifications subject to change without notice

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