Argus PLUS Module EtherCAT

GEM

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 commandf
- Master encoder (Gearing/Camming)

COMMUNICATIONS
- EtherCAT
- RS-232
- RS-422

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
- Resolver (-R model)

I/O DIGITAL
- 6 High-speed inputs
- 1 Motor over-temp input
- 4 Opto-isolated inputs
- 4 High-speed output
- 4 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]
- 3.10 x 2.40 x 0.92 [78.7 x 60.1 x 23.4]

Model	Ic	Ip	Vdc
GEM-055-60	30	60	9~55
GEM-055-60-R	30	60	9~55
GEM-090-60	30	60	14~90
GEM-090-60-R	30	60	14~90

DESCRIPTION

GEM 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.

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

MODEL			GEM-055-60(-R)	GEM-090-60(-R)	
OUTPUT CURRENT					
Peak Current			60 (42.4)	60 (42.4)	Adc (Arms)
Peak time			1	1	Sec
Continuous current			30 (21.2)	30 (21.2)	Adc (Arms)
Peak Output Power			5.4	5.4	kW
Continuous Output Power			2.7	2.7	kW
INPUT POWER					
HVmin to HVmax			+9 to +55	+14 to +90	Vdc
Ipeak			60	60	Adc
Icont			30	30	Adc
Aux HV	+20 to HVmax	2.5 W max	Optional keep-alive power input when +HV is removed		
PWM OUTPUTS					
Type		MOSFET 3-phase inverter, 16 kHz center-weighted PWM carrier, space-vector modulation			
PWM ripple frequency		32 kHz			
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)			
PWM frequency		16 kHz			
Bus voltage compensation		Changes in bus or mains voltage do not affect bandwidth			
Minimum load inductance		500 µH line-line			
Resolution		12-bit capture of U & V phase currents			
COMMAND INPUTS					
EtherCAT:		CAN application protocol over EtherCAT (CoE): Cyclic Synchronous Position/Velocity/Torque, Profile Position/Velocity/Torque, Interpolated Position (PVT), 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					
Number		11			
[IN1,2,3,4,5,6]		Digital, non-isolated, Schmitt trigger, 1 µs RC filter, 7 Vdc compatible, 10k pull-up to +5 Vdc Vt+ = 3.5 Vdc max, Vt- = 1.5 Vdc min, Vh = 0.45 Vdc min, SLI port MISO signal			
[IN7,8,9,10]		Digital, opto-isolated, single-ended, ±15~30 Vdc compatible, bi-polar, with common return Rated impulse ≥ 800 V, Vin-LO ≤ 6.0 Vdc, Vin-HI ≥ 10.0 Vdc, Input current ±3.6 mA @ ±24 Vdc, typical			
[IN11]		Defaults as motor overtemp input on feedback connector, 24 Vdc max, programmable to other functions Other digital inputs are also programmable for the Motemp function 330 µs RC filter, 4.99k pull-up to +5 Vdc, Vt+ = 2.5~3.5 Vdc, VT- = 1.3~2.2 Vdc, VH = 0.7~1.5 Vdc			
Functions		All inputs are programmable, [IN1] defaults to the Enable function and is programmable for other functions.analog input			
ANALOG INPUT					
[AIN±]		Differential, ±10 Vdc, 5 kΩ input impedance, 12-bit resolution Bandwidth (-3 dB) of analog signal path: ≥ 60 kHz, common-mode range -10 to +20 Vdc			
DIGITAL OUTPUTS					
Number		9			
[OUT1~4]		Isolated, two-terminal SSR with 1 Ω series resistor and 36 V Zener diode for driving inductive loads Ton = 5 ms max, @ 300 mA, Toff = 2 ms max @ 300 mA Maximum working voltage with respect to ground: 32 Vdc, rated impulse voltage ≥ 800 Vdc			
[OUT5~8]		High speed, SLI port MOSI, SCLK, & EN1 signals, 74AHCT125 line drivers; +5 Vdc tolerant Output current: ±25 mA max @ ±5 Vdc			
[OUT9 BRAKE]		Isolated, MOSFET, 1 A max, external flyback diode required, Turn-ON & Turn-OFF delay 250 µs max GATE output can drive an external MOSFET for brakes requiring higher current Maximum working voltage with respect to ground: 32 Vdc, rated impulse voltage ≥ 800 Vdc			
Functions		Default functions are shown above, programmable to other functions			
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			
RS-422 PORT					
Signals		A/Y(+), B/X(-), Gnd from ISL32455 tranceiver, optically isolated			
Mode		Half-duplex, RS-422 slave, 9,600 to 230.4 kbps			
Protocol		Binary and ASCII formats			

NOTES:
1. Brake output [OUT9] is programmable as motor brake, or as general purpose digital output.
2. 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

DC OUTPUTS		
Number	1	
Ratings	+5 Vdc @ 500 mA thermal and overload protected	
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-IN1:11.2 mA, STO-IN2: 11.2 mA	
Response time	2 ms from Vin ≤6.0 Vdc to interruption of energy supplied to motor	
Muting	Wiring a shorting plug with jumpers (see page 7) will mute (bypass) the STO function	
Reference	***Copley Argus GEM & GPM STO Manual***	
PROTECTIONS		
HV Overvoltage -055 models	+HV > 55 Vdc	Drive outputs turn off until +HV ≤ 55 Vdc
HV Undervoltage -055 models	+HV < 9 Vdc	Drive outputs turn off until +HV ≥ 9 Vdc
HV Overvoltage -090 models	+HV > 90 Vdc	Drive outputs turn off until +HV ≤ 90 Vdc
HV Undervoltage -090 models	+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 mm [in]	3.10 x 2.40 x 0.92 [78.7 x 60.1 x 23.4]	
Weight	4.2 oz (120 g) without heatsink	
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	
Altitude	≤ 2000 m (6560 ft) per IEC 60068-2-13	

AGENCY STANDARDS CONFORMANCE

Standards and Directives

Functional Safety

IEC 61508-1, IEC 61508-2,
EN (ISO) 13849-1, EN (ISO) 13849-2, IEC 61800-5-2
Reference: Copley Argus GEM & GPM STO Manual

Electrical Safety

Directive 2014/35/EU (Low Voltage)
UL 61800-5-1, IEC 61800-5-1:2007

EMC

Directive 2014/30/EU
IEC 61800-3:2004+A1:2011
EMC and Functional Safety of PDS (IFA publication)
SEMI F47-0706

Restriction of the Use of Certain Hazardous Substances (RoHS)

Directive 2011/65/EU (RoHS II)

Approvals

UL and cUL recognized component to:

UL 61800-5-1:2012

UL Functional Safety Certification to:

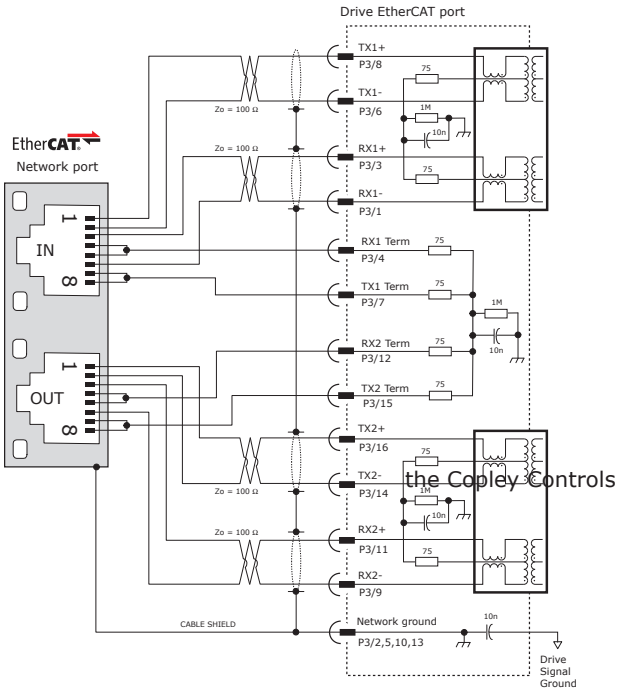
IEC 61508-1:2012, ISO 13849-1/:2015, IEC 61508-5-2:2007

GENERAL SPECIFICATIONS

FEEDBACK		
	Incremental encoders:	
	Digital Incremental Encoder	Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required) MAX3097 differential line receivers for A, B and X, 5 MHz maximum line frequency (20 M counts/sec) Fault detection for open/shorted inputs, or low signal amplitude, selectable for A||B||X or A||B External terminators required for fault detection, 121Ω for A & B channels, 130Ω for X
	Analog Incremental Encoder	Sin/Cos, differential, internal 121Ω terminators between ± inputs, 1.0 Vp-p typical, 1.45 Vp-p maximum, Common-mode voltage 0.25 to 3.75 Vdc, , ±0.25 V, centered about 2.5 Vdc Signals: Sin(+), Sin(-), Cos(+), Cos(-), Frequency: 230 kHz maximum line (cycle) frequency, interpolation 12 bits/cycle (4096 counts/cycle)
	Absolute encoders:	
	Heidenhain EnDat 2.2, SSI	Serial Clock (X, /X), Data (S, /S) signals, differential 4-wire, External 121Ω terminator required for Clock, 221Ω for Data
	Heidenhain EnDat 2.1	Clock (X, /X), Data (S, /S), Sin/Cos (Sin+, Sin-, Cos+, Cos-) signals Internal 121Ω terminators between Sin/Cos inputs, External 121Ω terminator required for Clock, 221Ω for Data
	Absolute A, Tamagawa Absolute A, Panasonic Absolute A Format	SD+, SD- (S, /S) signals, 2.5 or 4 MHz, 2-wire half-duplex, external 221Ω terminator required 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 drive, data returned from encoder External 121Ω terminator required for MA, 221Ω for SL
	Resolver:	
	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+
HALLS		
	Digital:	U, V, W: Single-ended, 120° electrical phase difference between U-V-W signals, Schmitt trigger, 1.5 µs RC filter, 24 Vdc compatible, 15 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. External terminators required 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 resolvers. A, /A, B, /B, outputs from MAX3032 differential line driver, X, /X, S, /S from MAX 3362 line drivers
	As Buffered Output:	Digital A/B/X encoder signals from primary digital encoder are buffered as shown above, 5 MHz max
5V OUTPUT		
	Number	1
	Ratings	+5 Vdc @ 500 mA thermal and overload protected

ETHERCAT COMMUNICATIONS

EtherCAT is the open, real-time Ethernet network developed by Beckhoff based on the widely used 100BASE-TX cabling system. EtherCAT enables high-speed control of multiple axes while maintaining tight synchronization of clocks in the nodes. Data protocol is CAN application protocol over EtherCAT (CoE) based on DSP-402 for motion control devices. More information on EtherCAT can be found on the EtherCAT Technology Group web-site: https://www.ethercat.org/default.htm



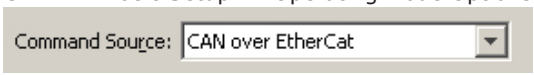
ETHERCAT CONNECTIONS

Page 22 shows guidelines for PC board layout and designing for EtherCAT signals.

Page 25 shows the dual EtherCAT cable connections on the Development Kit.

Magnetics are in the servo drive. External RJ-45 connectors do not require integrated magnetics.

CME2 -> Basic Setup -> Operating Mode Options

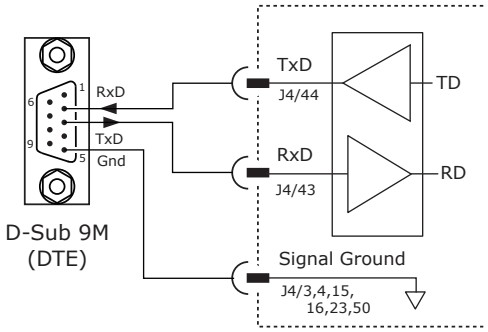


the Copley Controls

RS-232 COMMUNICATIONS

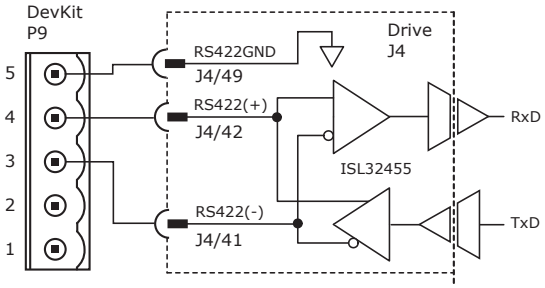
GEM is configured via a three-wire, full-duplex DTE RS-232 port that operates from 9600 to 115,200 Baud, 8 bits, no parity, and one stop bit. Signal format is full-duplex, 3-wire, DTE using RxD, TxD, and Gnd. Connections to the *GEM* RS-232 port are through P4 The graphic below shows the connections between an *GEM* and a computer COM port which is a DTE device.

CME2 -> Tools -> Communications Wizard



RS-422 COMMUNICATIONS

RS-422 is a two-wire differential half-duplex port that operates from 9600 to 230.4 kbps. Connections to the *GEM* RS-232 port are through P4 The graphic below shows the connections between a *GEM* and a computer RS-422 port.



SAFE TORQUE OFF (STO)

DESCRIPTION

The GEM 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

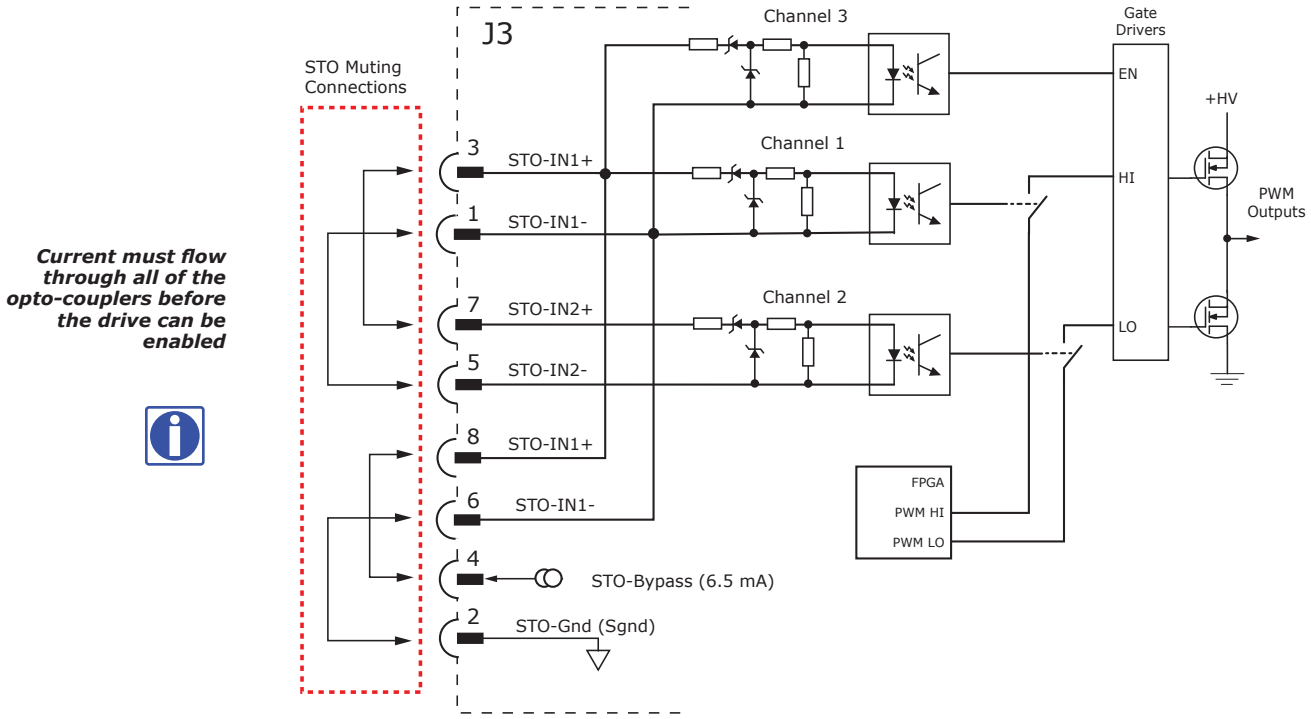
DANGER	***Refer to the Argus Plus Compact STO Manual***
	The information provided in the *Argus Plus Compact STO Manual* must be considered for any application using the GEM drive STO feature. ***Failure to heed this warning can cause equipment damage, injury, or death.***

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

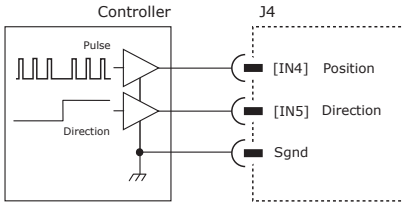


J3 SIGNALS

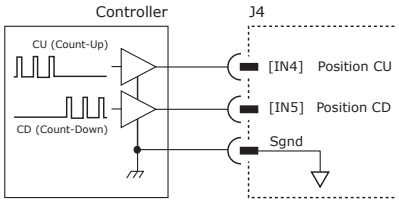
SIGNAL	PIN	PIN	SIGNAL
STO-IN2(-)	1	2	STO-GND
STO-IN2(+)	3	4	STO-24V
STO-IN1(-)	5	6	STO-IN1(-)
STO-IN1(+)	7	8	STO-IN1(+)

DIGITAL COMMAND INPUTS: POSITION

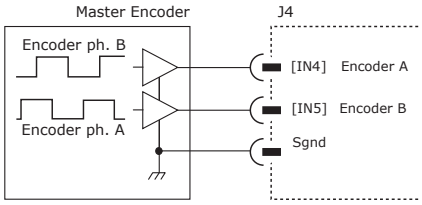
PULSE & DIRECTION



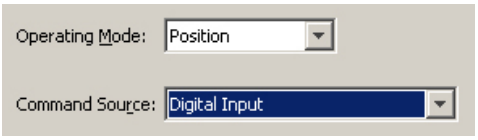
CU/CD



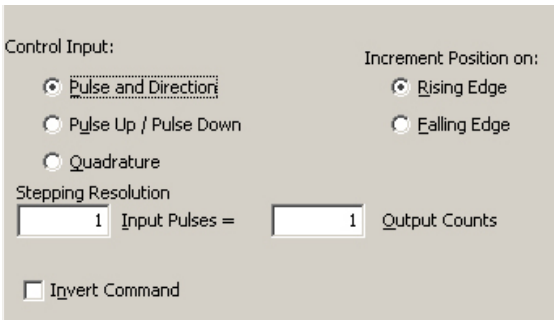
QUAD A/B ENCODER



CME2 -> Basic Setup -> Operating Mode Options

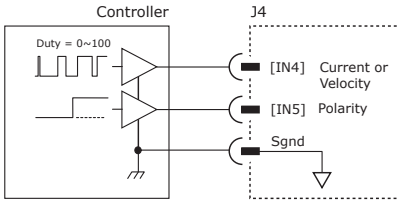


CME2 -> Basic Setup -> Operating Mode Options

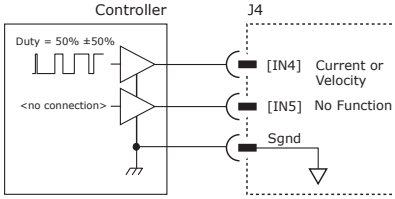


DIGITAL COMMAND INPUTS: VELOCITY, TORQUE

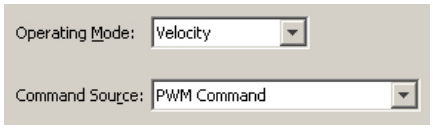
PWM & DIRECTION



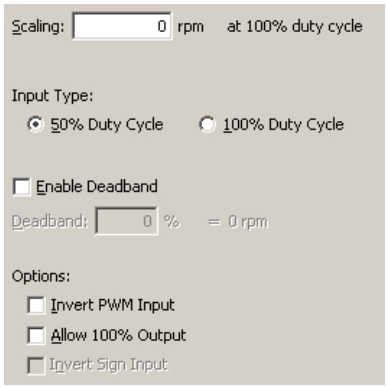
50% PWM



CME2 -> Basic Setup -> Operating Mode Options



CME2 -> Main Page-> PWM Command



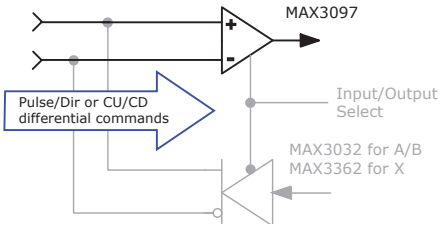
CONNECTIONS

Input	J4 Pins
IN4	19
IN5	22
Sgnd	3,4,15,16,23,50

MULTI-MODE ENCODER PORT AS AN INPUT

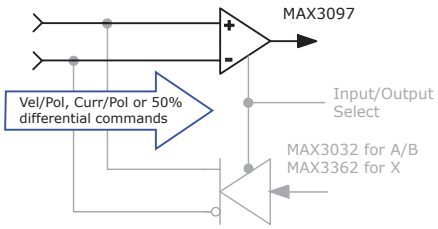
POSITION COMMAND INPUTS: DIFFERENTIAL

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



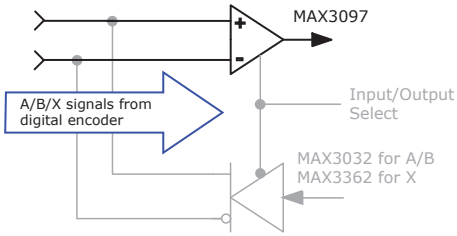
CURRENT or VELOCITY COMMAND INPUTS: DIFFERENTIAL

- Current/Velocity Magnitude & Direction
- Current/Velocity 50%



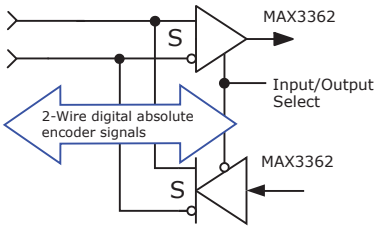
SECONDARY FEEDBACK: INCREMENTAL

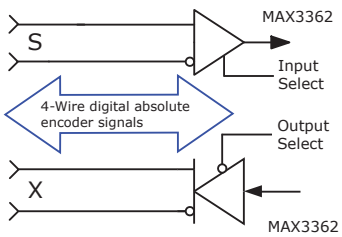
- Quad A/B/X incremental encoder



SECONDARY FEEDBACK: ABSOLUTE

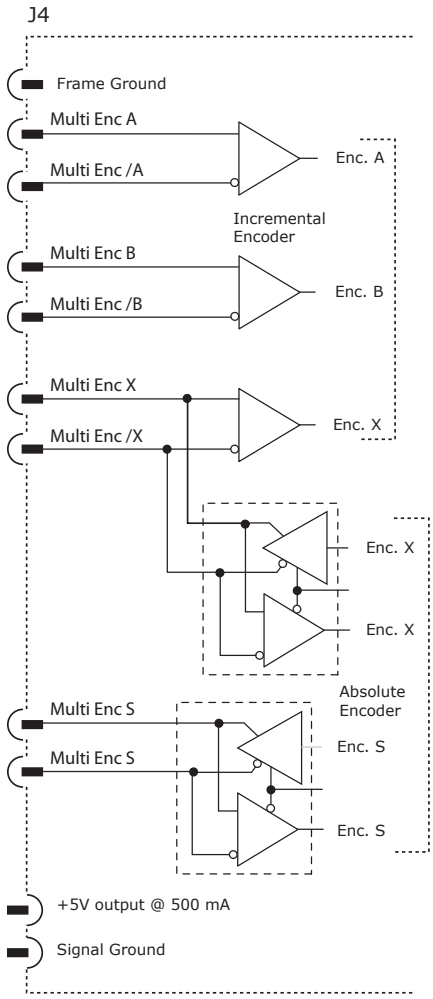
- S channel: Absolute A encoders (2-wire)
  The S channel first sends a Clock signal and then receives Data from the encoder in half-duplex mode.
- S & X channels: SSI, BiSS, EnDat encoders (4-wire)
  The X channel sends the Clock signal to the encoder, which initiates data transmission from the encoder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





SIGNALS & PINS

Signal	J4 Pins
Pulse, CW, Encoder A, Vel-Curr-Mag, Vel-Curr-50%	8
/Pulse, /CW, Encoder /A, /Vel-Curr-Mag, /Vel-Curr-50%	7
Direction, CCW, Encoder B, Vel-Curr-Pol	10
/Direction, /CCW, Encoder /B, /Vel-Curr-Pol	9
Quad Enc X, Absolute Clock	14
Quad Enc /X, /Absolute Clock	13
Enc S, Absolute (Clock) Data	12
Enc /S, / Absolute (Clock) Data	11
Signal Ground	3,4,15,16, 23,50



MULTI-MODE PORT AS AN OUTPUT

OUTPUT TYPES

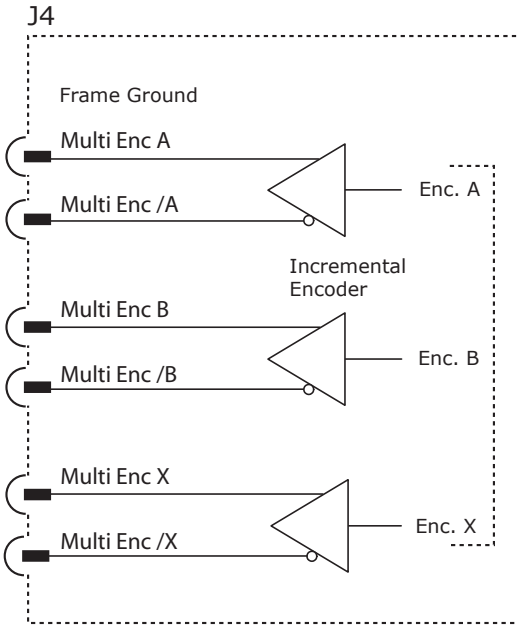
BUFFERED FEEDBACK OUTPUTS: DIFFERENTIAL

- 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:

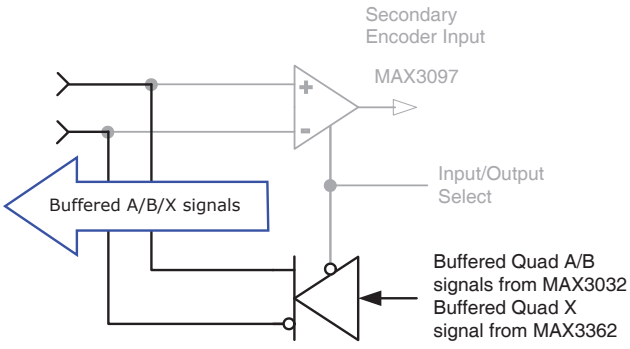
- Absolute encoders
- Analog Sin/Cos incremental encoders



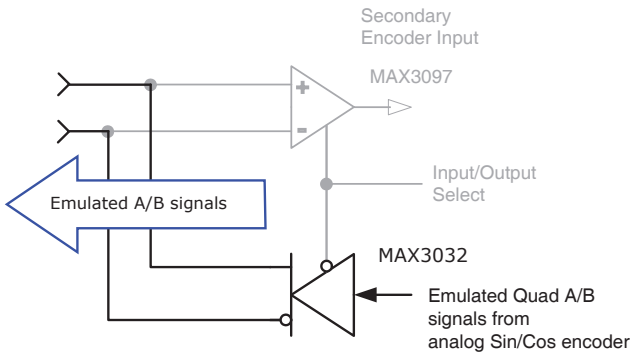
SIGNALS & PINS

Signal	J4 Pins
Encoder A	8
Encoder /A	7
Encoder B	10
Encoder /B	9
Encoder X	14
Encoder /X	13
Signal Ground	3,4,15,16,23,50

BUFFERED QUAD A/B/X OUTPUTS

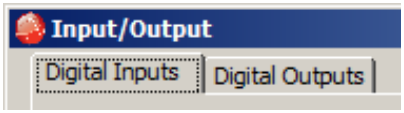


EMULATED QUAD A/B OUTPUTS

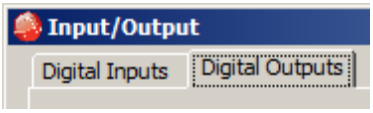


CME2 DEFAULTS

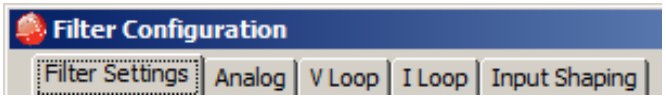
These tables show the CME2 default settings. They are user-programmable and the settings can be saved to non-volatile flash memory.



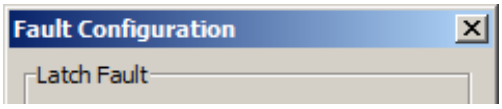
Name	Configuration	PU/PD
IN1	Enable-LO, Clear Faults	+5V PU
IN2	Not Configured	+5V/Gnd
IN3		
IN4		
IN5		
IN6		
IN7	Opto Not Configured	
IN8		
IN9		
IN10		
IN11	Motemp	+5V PU



Name	Notes
OUT1	Isolated Fault Active Off
OUT2	Isolated Not Configured
OUT3	
OUT4	
OUT5	HS Not Configured
OUT 6	HS SPI_MOSI
OUT 7	HS SPI_CLK
OUT 8	HS SPI_EN1
OUT 9	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, IN3, IN4, IN5, IN6

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

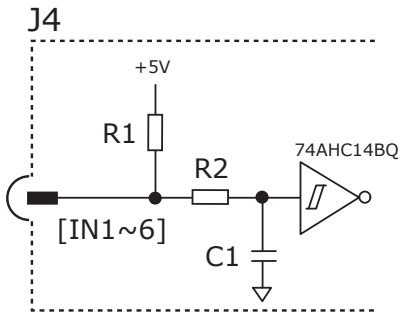
SPECIFICATIONS

Input	Data	Notes
Input Voltages	HI	VT+ ≥ 2.5~3.5Vdc
	LO	VT- ≤ 1.3~2.2 Vdc
	Hys	VH 0.7~1.5 Vdc
	Max	+30 Vdc
	Min	0 Vdc
Pull-up/down	R1	10 kΩ
Low pass filter	R2	1 kΩ
	C1	100 pF
	RC[1]	0.1 µs

Notes:
1) The R2*C2 time constant applies when input is driven by active HI/LO devices

CONNECTIONS

Input	J4 Pins
IN1	18
IN2	17
IN3	20
IN4	19
IN5	22
IN6	21
Sgnd	3,4,15,16, 23,50



MOTOR OVERTEMP INPUT: IN11

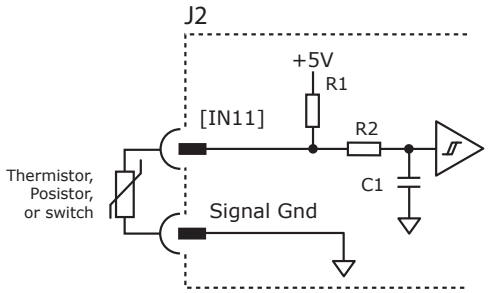
- Digital, non-isolated
- Motor overtemp input
- 24V Compatible
- Programmable functions

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	VT+ ≥ 2.5~3.5Vdc
	LO	VT- ≤ 1.3~2.2 Vdc
	Hys	VH 0.7~1.5 Vdc
	Max	+30 Vdc
	Min	0 Vdc
Pull-up	R1	4.99 kΩ
Low pass filter	R2	10 kΩ
	C1	33 nF
	RC[1]	330 µs



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

CONNECTIONS

Input	J2 Pins
IN11	17
Sgnd	8,18,21,22

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

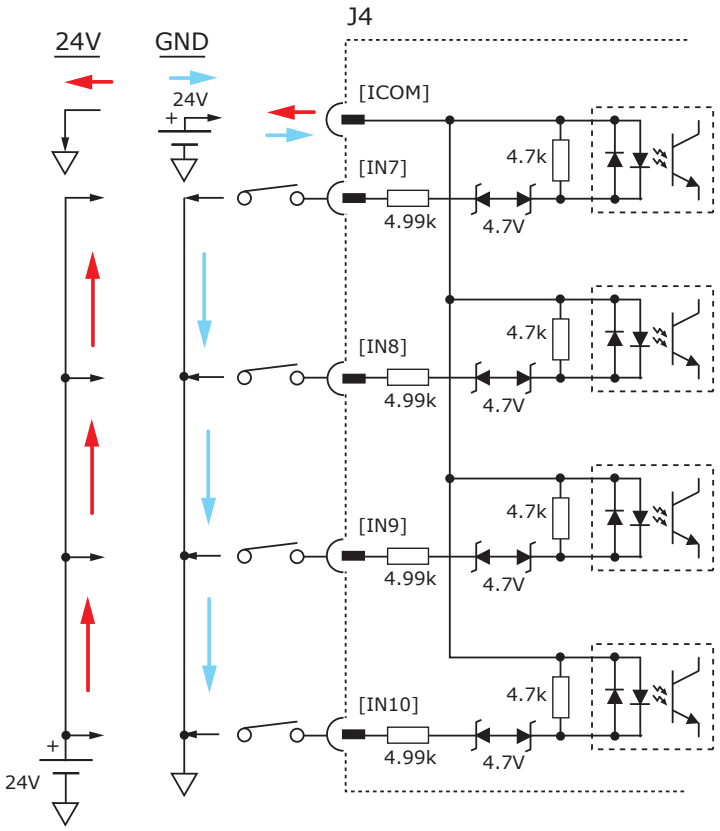
OPTO-ISOLATED INPUTS: IN7, IN8, IN9, IN10

- 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 ≤ ±6.0 Vdc *
	Max	±30 Vdc *
Input Current	±24V	±3.6 mAdc
	0V	0 mAdc

* Vdc Referenced to ICOM terminals.

CONNECTIONS	
Signal	J4 Pins
IN7	27
IN8	25
IN9	26
IN10	24
ICOM	28



ANALOG INPUT: AIN1

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

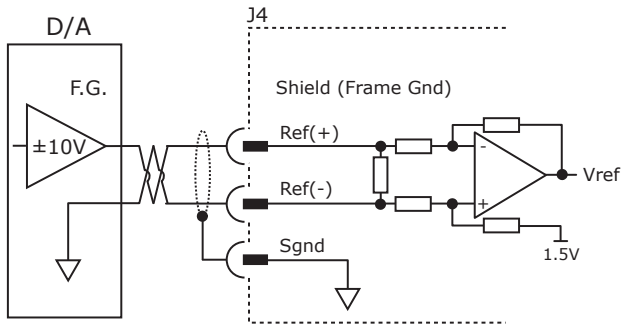
As a reference input it takes position/velocity/torque commands from a controller. If not used as a command input, it can be used as general-purpose analog input.

SPECIFICATIONS

Spec	Data	Notes
Input Voltage	Vref	±10 Vdc
Input Resistance	Rin	5 kΩ

CONNECTIONS

Signal	J4 Pins
AIN(+)	2
AIN(-)	1
Sgnd	3,4,15,16,23,50

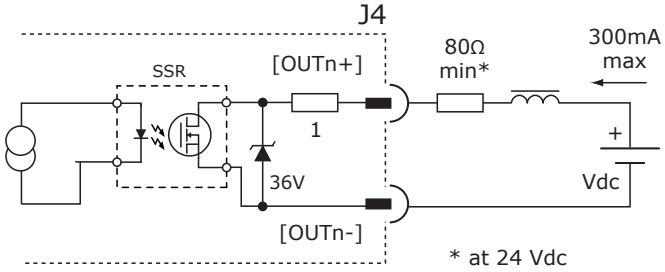


OPTO-ISOLATED OUTPUTS: OUT1, OUT2, OUT3, OUT4

- 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	0.5V @ 300 mAdc
Output Current	Iout	300 mAdc max



CONNECTIONS: J4 PINS

Signal	(+)	(-)
OUT1	30	29
OUT2	32	31
OUT3	34	33
OUT4	36	35

HI/LO DEFINITIONS: OUTPUTS

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

HIGH-SPEED OUTPUT: OUT5, OUT6, OUT7, OUT8

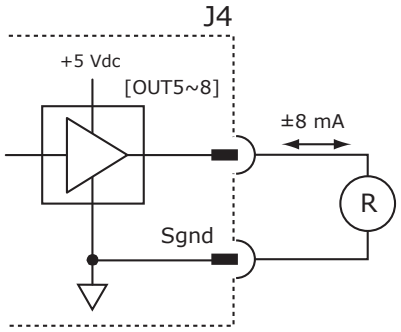
- CMOS buffer
- 74AHCT1G125
- Programmable functions

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

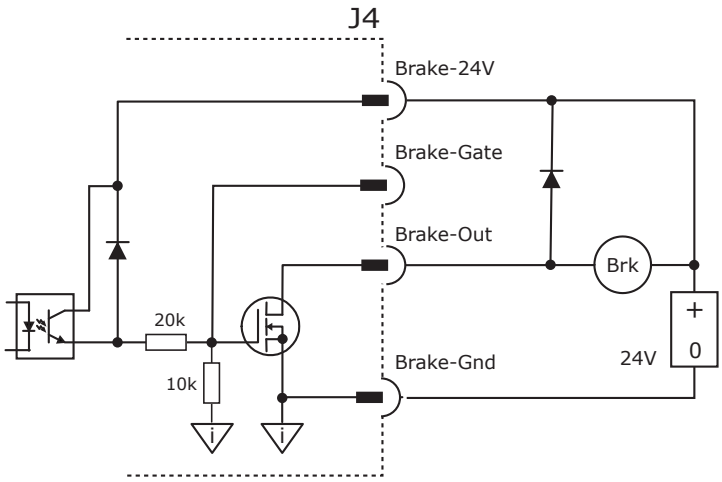
CONNECTIONS

Signal	J4 Pins
OUT 5	38
OUT 6	37
OUT 7	40
OUT 8	39
Sgnd	3,4,15,16,23,50



OPTO-ISOLATED MOTOR BRAKE OUTPUT: OUT9

- Brake output [OUT9]
- Opto-isolated
- 24V Compatible
- Programmable functions
- Gate output to drive external MOSFET



SPECIFICATIONS

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

HI/LO DEFINITIONS: OUTPUTS

Input	State	Condition
BRAKE [OUT9]	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

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

J4 CONNECTIONS

Pin	Signal
45	Brake-24V
48	Brake-Gate
47	Brake-Out
46	Brake Gnd

CME2 Default Setting for Brake Output [OUT9] 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 [OUT9] 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 [OUT9] 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

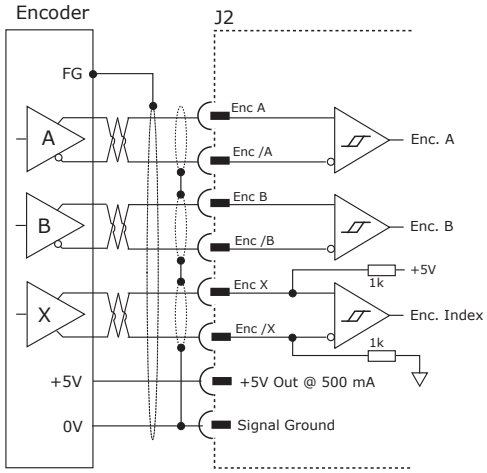
FEEDBACK CONNECTIONS

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



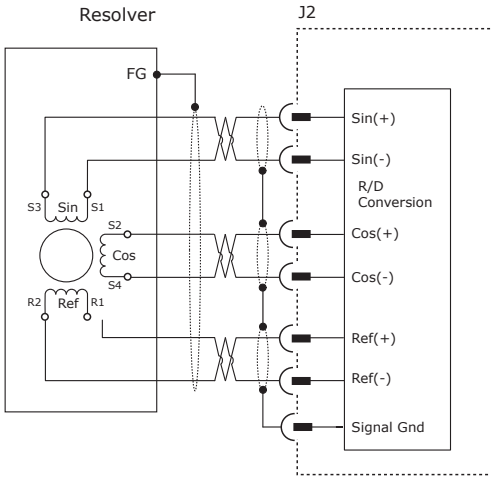
A/B/X SIGNALS

Signal	J2 Pins
Enc A	10
Enc /A	9
Enc B	12
Enc /B	11
Enc X	16
Enc /X	15
+5V	19,20
Sgnd	8,18,21,22

Sgnd = Signal Ground

RESOLVER

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.

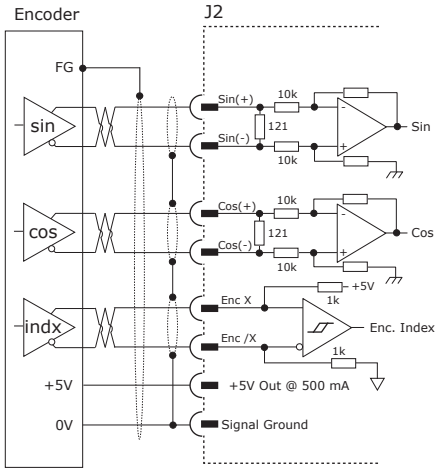


RESOLVER SIGNALS

Signal	J2 Pins
Sin(+)	2
Sin(-)	1
Cos(+)	4
Cos(-)	3
Ref(+)	24
Ref(-)	23
Sgnd	8,18,21,22

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

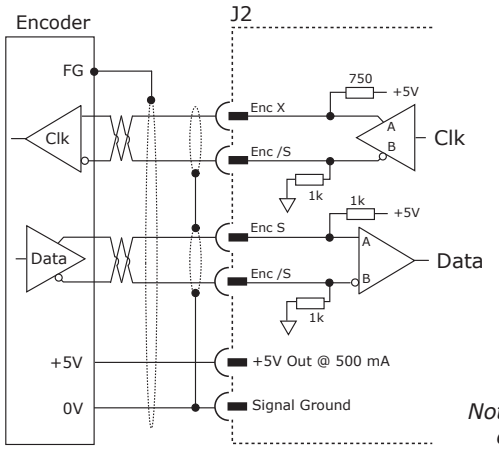
Signal	J2 Pins
Sin(+)	2
Sin(-)	1
Cos(+)	4
Cos(-)	3
X	16
/X	15
+5V	19,20
Sgnd	8,18,21,22

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 GEM 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

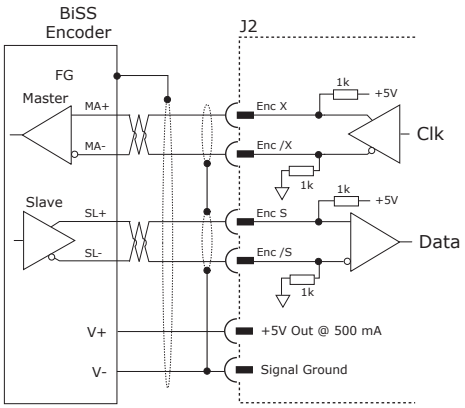
SSI	BiSS	J2 Pins
Clk	MA+	14
/Clk	MA-	13
Data	SL+	12
/Data	SL-	11
+5V		19,20
Sgnd		8,18,21,22

Note: Single (outer) shields should be connected at the controller end. Inner shields should only be connected to Signal Ground on the drive.

BiSS ABSOLUTE ENCODER

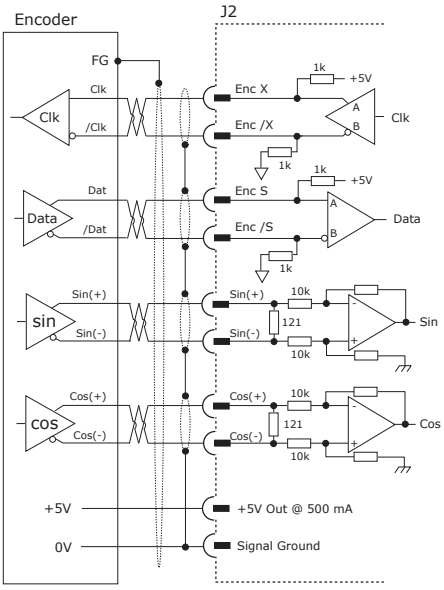
BiSS is an - Open Source - digital interface for sensors and actuators. BiSS refers to principles of well known industrial standards for Serial Synchronous Interfaces like SSI, AS-Interface® and Interbus® with additional options.

- 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.



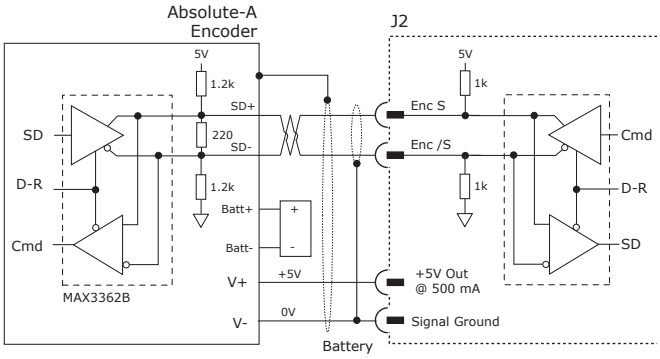
ENDAT SIGNALS

Signal	J2 Pins
Clk	16
/Clk	15
Data	14
/Data	13
Sin(+)	2
Sin(-)	1
Cos(+)	4
Cos(-)	3
+5V	19,20
Sgnd	8,18,21,22

Sgnd = Signal Ground

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	J2 Pins
Data	14
/Data	13
+5V	19,20
Sgnd	8,18,21,22

Sgnd = Signal Ground

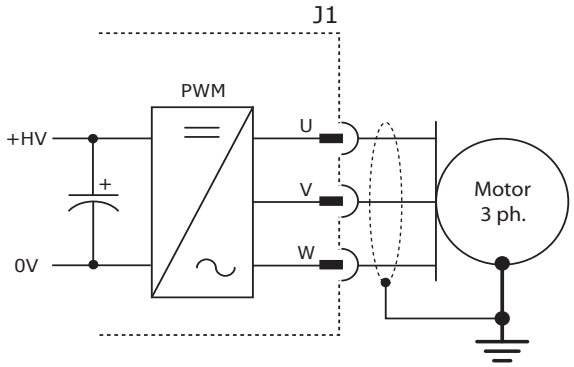
MOTOR CONNECTIONS

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 ground for best results.

MOTOR SIGNALS

Signal	J1 Pin
Mot U	41~46
Mot V	31~36
Mot W	21~26

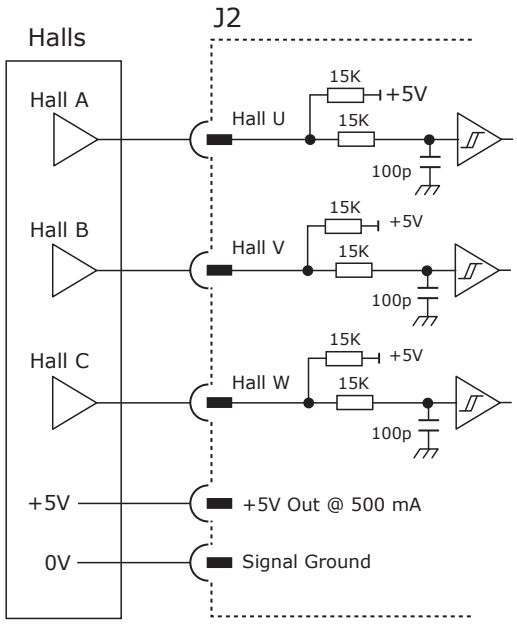


DIGITAL HALL SIGNALS

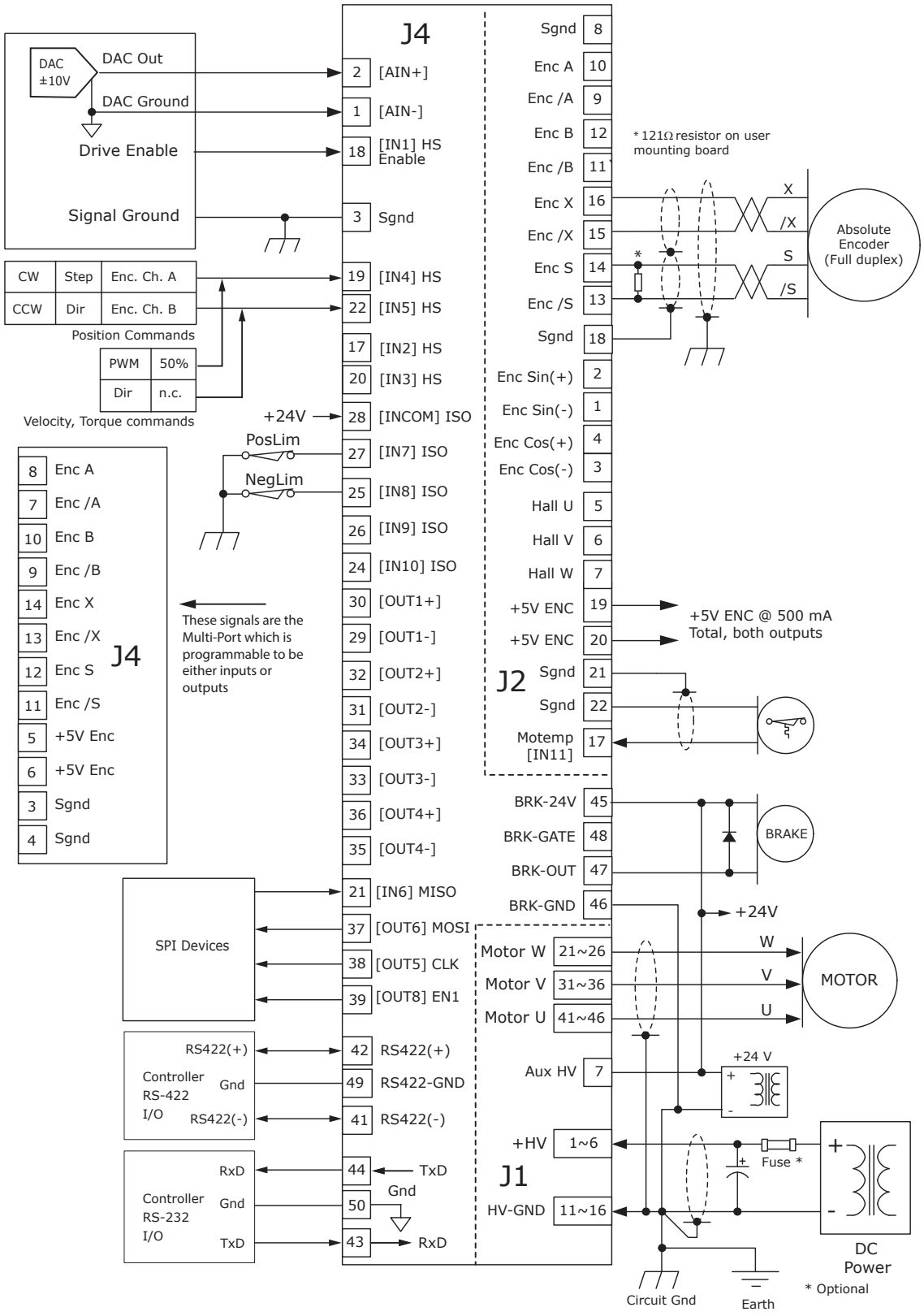
Hall signals are single-ended signals that provide absolute feedback within one electrical cycle of the motor. There are three of them (U, V, & W) and they may be sourced by magnetic sensors in the motor, or by encoders that have Hall tracks as part of the encoder disc. They typically operate at much 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	J2 Pins
Hall U	5
Hall V	6
Hall W	7
+5V	19,20
Sgnd	8,18,21,22

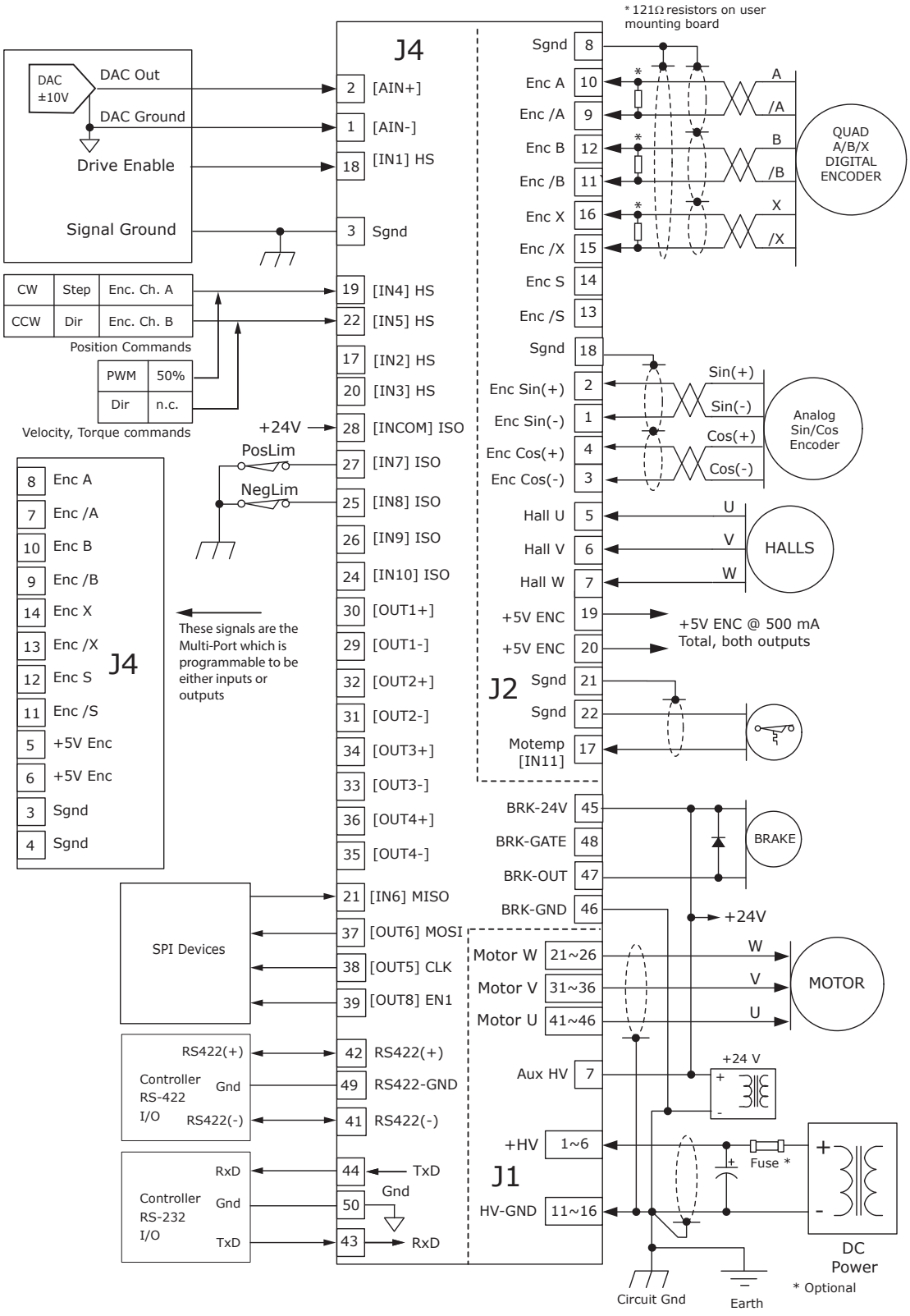


CONNECTIONS FOR ABSOLUTE ENCODER WITH DUPLEX CLOCK/DATA



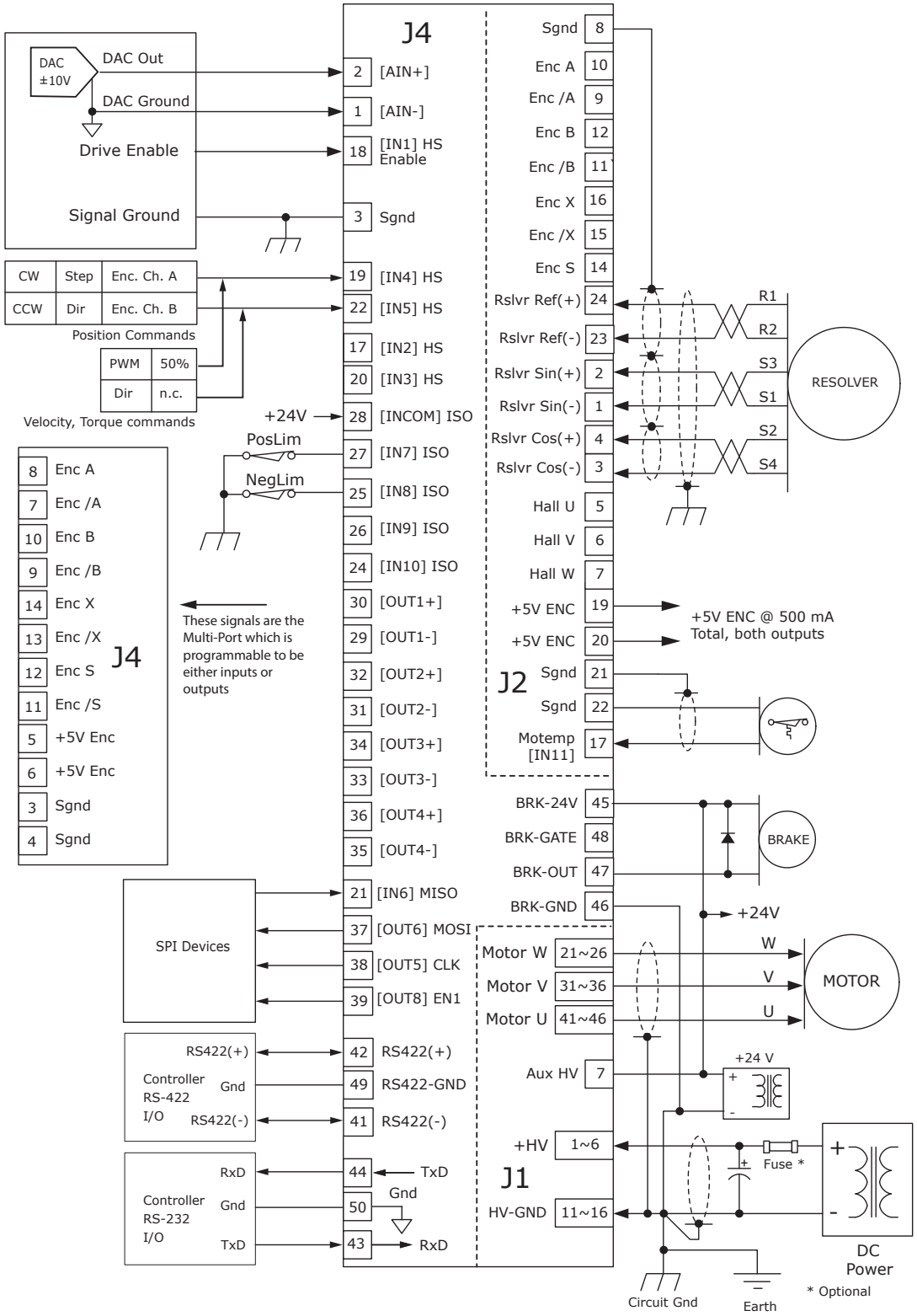
CONNECTORS & SIGNALS

CONNECTIONS FOR INCREMENTAL DIGITAL OR ANALOG ENCODERS



CONNECTORS & SIGNALS

CONNECTIONS FOR RESOLVERS (-R OPTION)



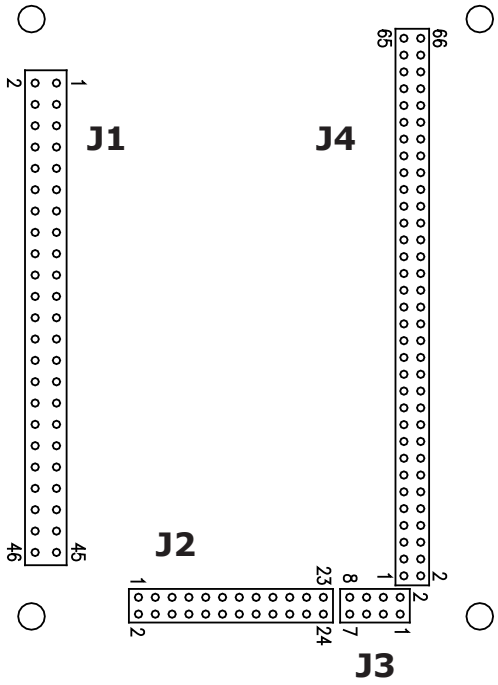
DIMENSIONS IN[MM]

J1 POWER & MOTOR

Signal	J1 Pin		Signal
+HV	2	1	+HV
	4	3	
	6	5	
N/C	8	7	HV Aux
	10	9	N/C
HV Gnd	12	11	HV Gnd
	14	13	
	16	15	
N/C	18	17	N/C
	20	19	
Mot W	22	21	Mot W
	24	23	
	26	25	
N/C	28	27	N/C
	30	29	
Mot V	32	31	Mot V
	34	33	
	36	35	
N/C	38	37	N/C
	40	39	
Mot U	42	41	Mot U
	44	43	
	46	45	

TOP VIEW

Viewed from above looking down on the connectors or PC board footprint to which the module is mounted



J1: HV & Motor
Dual row, 2 mm- centers
46 position female header
SAMTEC SSQ-123-01-L-D

J2: Feedback
Dual row, 2 mm- centers
24 position female header
SAMTEC SQT-112-01-L-D

J3: Safety
Dual row, 2 mm- centers
8 position female header
SAMTEC SQT-104-01-L-D

J4: Control
Dual row, 2 mm- centers
66 position female header
SAMTEC SQT-133-01-L-D

J2 FEEDBACK

Signal	P3 Pin		Signal
RES-REF-	23	24	RES-REF+
Sgnd	21	22	Sgnd
+5V ENC	19	20	+5V ENC
[IN11]	17	18	Sgnd
ENC /X	15	16	ENC X
ENC /S	13	14	ENC S
ENC /B	11	12	ENC B
ENC /A	9	10	ENC A
HALL W	7	8	Sgnd
HALL U	5	6	HALL V
COS-	3	4	COS+
SIN-	1	2	SIN+

J4 CONTROL

Signal	P1 Pin		Signal
TX2TERM	65	66	TX2+
ECAT-SHLD	63	64	TX2-
RX2+	61	62	RX2TERM
RX2-	59	60	ECAT-SHLD
TX1TERM	57	58	TX1+
ECAT-SHLD	55	56	TX1-
RX1+	53	54	RX1TERM
RX1-	51	52	CAN_GND
RS422-GND	49	50	Sgnd
Brake-Out	47	48	Brk-Gate
Brake-24V	45	46	Brake-Gnd
RS232 RxD	43	44	RS232 TxD
RS422(-)	41	42	RS422(+)
HS [OUT8] SPI-EN1	39	40	[OUT7] HS
HS [OUT6] SPI-MOSI	37	38	[OUT5] HS SPI-CLK
[OUT4-] ISO	35	36	ISO [OUT4+]
[OUT3-] ISO	33	34	ISO [OUT3+]
[OUT2-] ISO	31	32	ISO [OUT2+]
[OUT1-] ISO	29	30	ISO [OUT1+]
[IN7] ISO	27	28	ISO [INCOM]
[IN8] ISO	25	26	ISO [IN9]
Sgnd	23	24	ISO [IN10]
[IN6] HS SPI-MISO	21	22	HS [IN5]
[IN4] HS	19	20	HS [IN3]
[IN2] HS	17	18	HS [IN1]
Sgnd	15	16	Sgnd
Enc /X	13	14	Enc X
Enc /S	11	12	Enc S
Enc /B	9	10	Enc B
Enc /A	7	8	Enc A
+5V ENC	5	6	+5V ENC
Sgnd	3	4	Sgnd
[AREF-]	1	2	[AREF+]

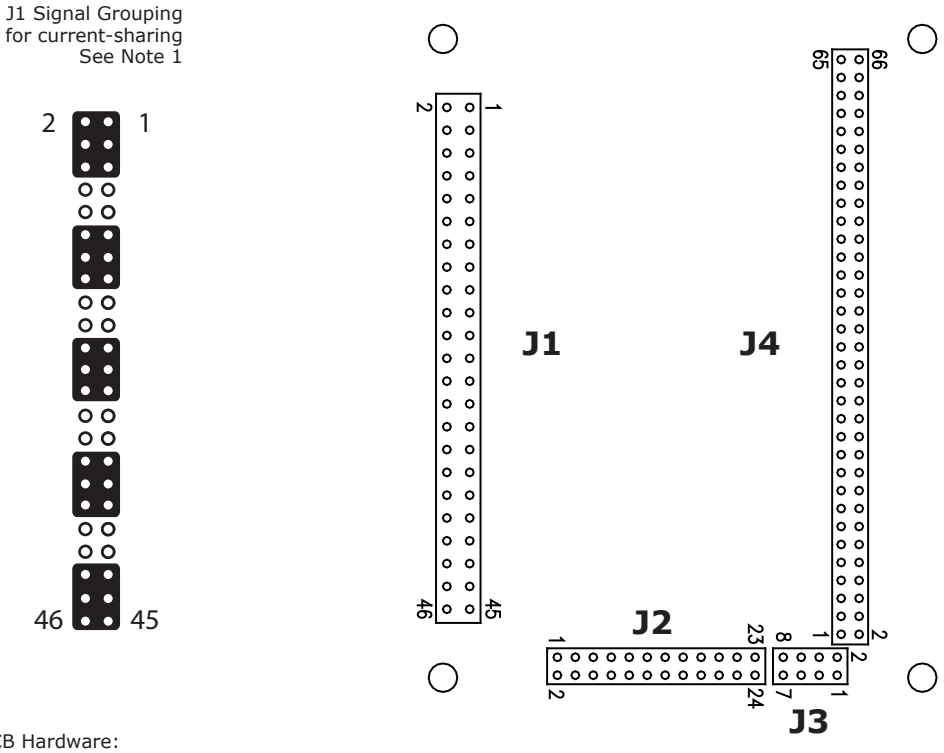
J3 SAFETY

Signal	P4 Pin		Signal
STO-GND	2	1	STO-IN2-
STO-OVR	4	3	STO-IN2+
STO-IN1-	6	5	STO-IN1-
STO-IN1+	8	7	STO-IN1+

PRINTED CIRCUIT BOARD FOOTPRINT

TOP VIEW

Viewed from above looking down on the connectors or PC board footprint to which the module is mounted



PCB Hardware:

Qty	Description	Mfgr	Part Number	Remarks
1	Socket Strip	Samtec	SSQ-123-01-L-D	J1 HV & Motor
1	Socket Strip	Samtec	SQT-112-01-L-D	J2 Feedback
1	Socket Strip	Samtec	SQT-104-01-L-D	J3 Safety
1	Socket Strip	Samtec	SQT-133-01-L-D	J4 Control
2	Standoff	PEM	KFE-4/40-8ET	#4/40 X 1/4"

Additional Hardware (not shown above)

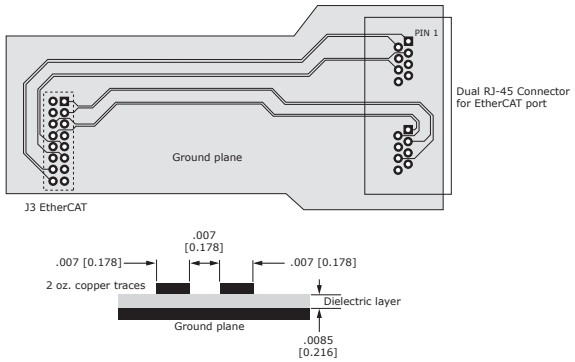
2 Screw, #4-40 x 1.25" Phillips Pan Head External Tooth Lockwasher SEMS, Stainless, or steel with nickel plating, Torque to 3~5 lb-in (0.34~0.57 N·m)

Notes

1. J1 signals of the same name must be connected for current-sharing (see graphic above).
2. To determine copper width and thickness for J1 signals refer to specification IPC-2221. (Association Connecting Electronic Industries, http://www.ipc.org)
3. Standoffs or mounting screws should connect to etch on pc board that connect to frame ground for maximum noise suppression and immunity.

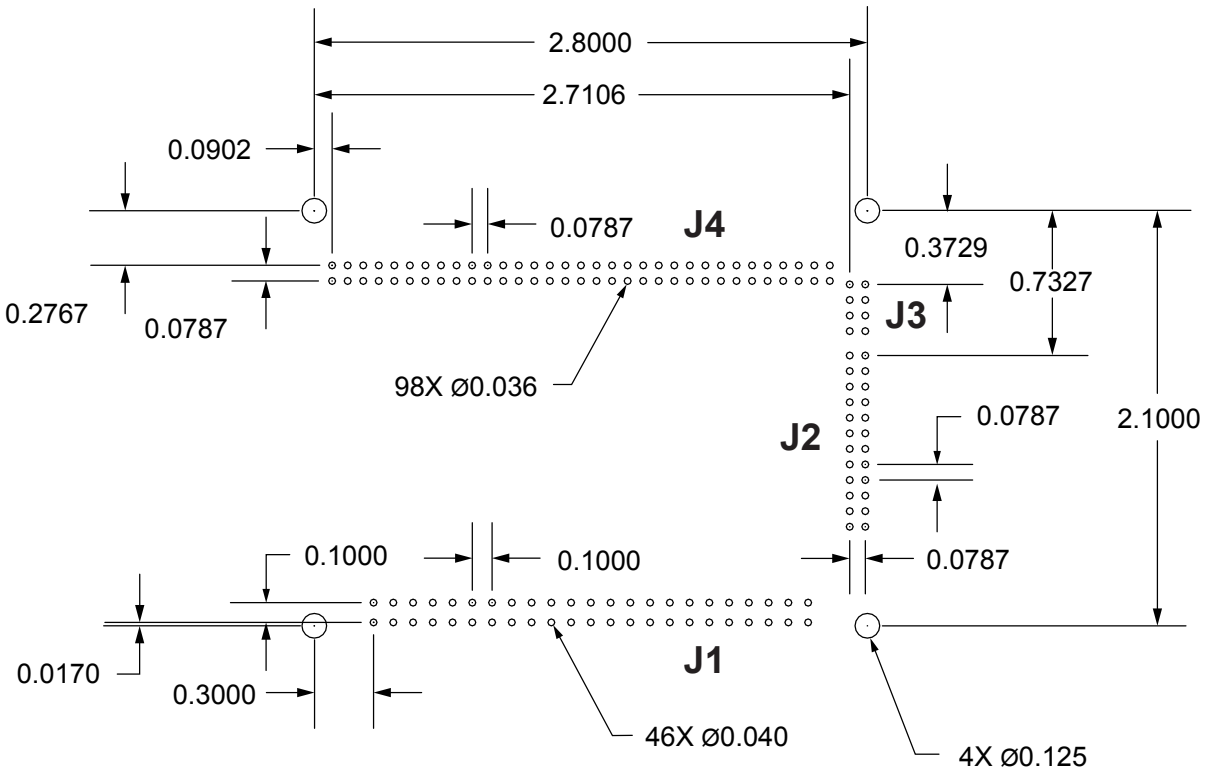
PRINTED CIRCUIT BOARD DESIGN FOR ETHERCAT SIGNALS

EtherCAT signal routing must produce a controlled impedance to maintain signal quality. This graphic shows some principles of PC board design that should be followed. Traces for differential signals must have controlled spacing trace-trace, trace thickness, and spacing above a ground plane. All these things and the properties of the dielectric between ground plane and signals affect the impedance of the traces. The dimensions shown here are typical.
The graphic on p. 5 detailing the EtherCAT connections shows resistors and a capacitor in the drive for terminating the unused conductors. As an alternative to adding traces back to the drive connector J4 for these signals, the same parts can be placed on the board at the RJ-45 connector, leaving only the differential EtherCAT signals to be routed with controlled impedance.



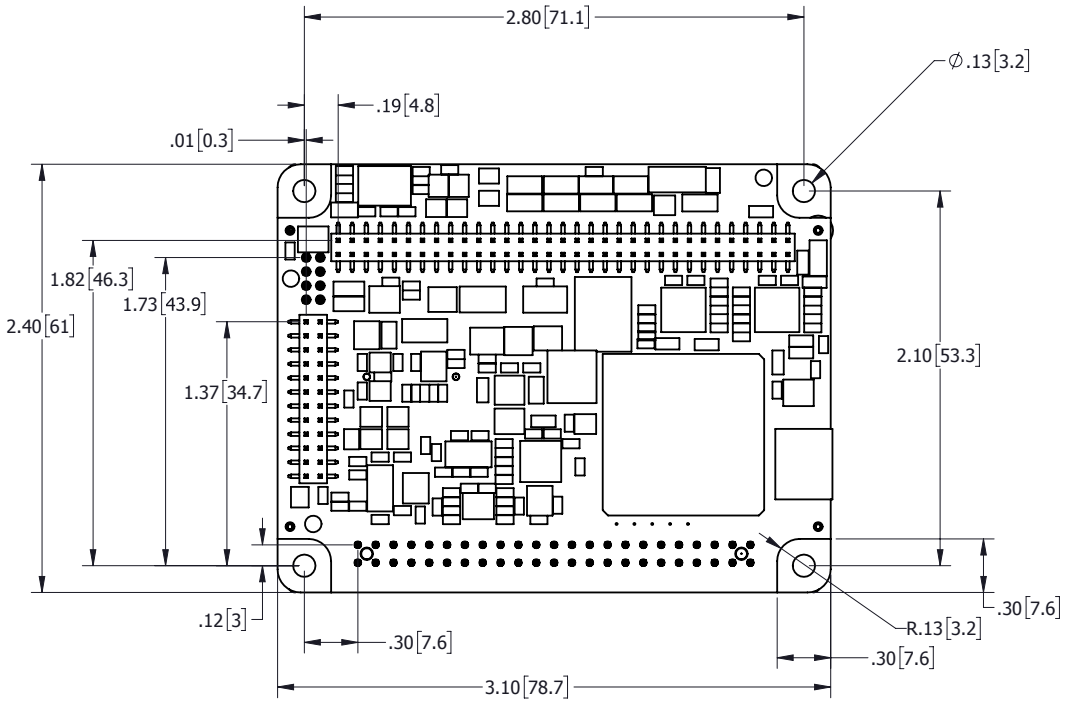
PRINTED CIRCUIT DRILLING DIMENSIONS

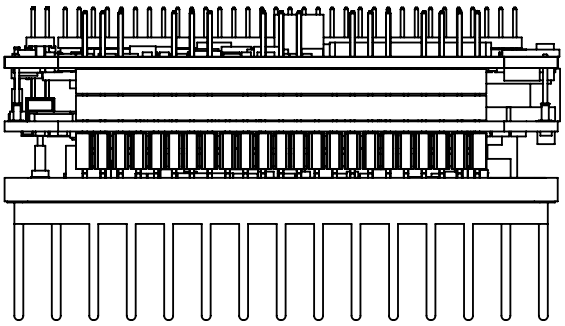
Notes:
1. This shows the drilling dimensions looking down on the mounting surface of the PC board.

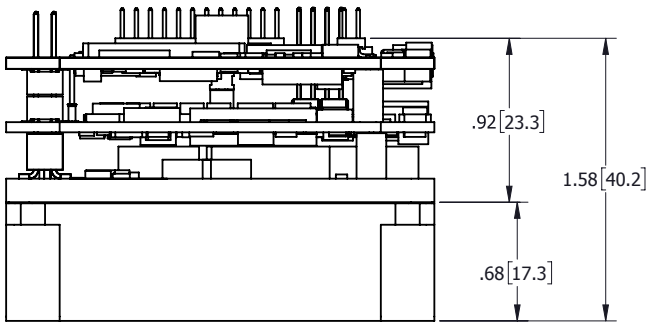


Dimensions are in inches

DIMENSIONS





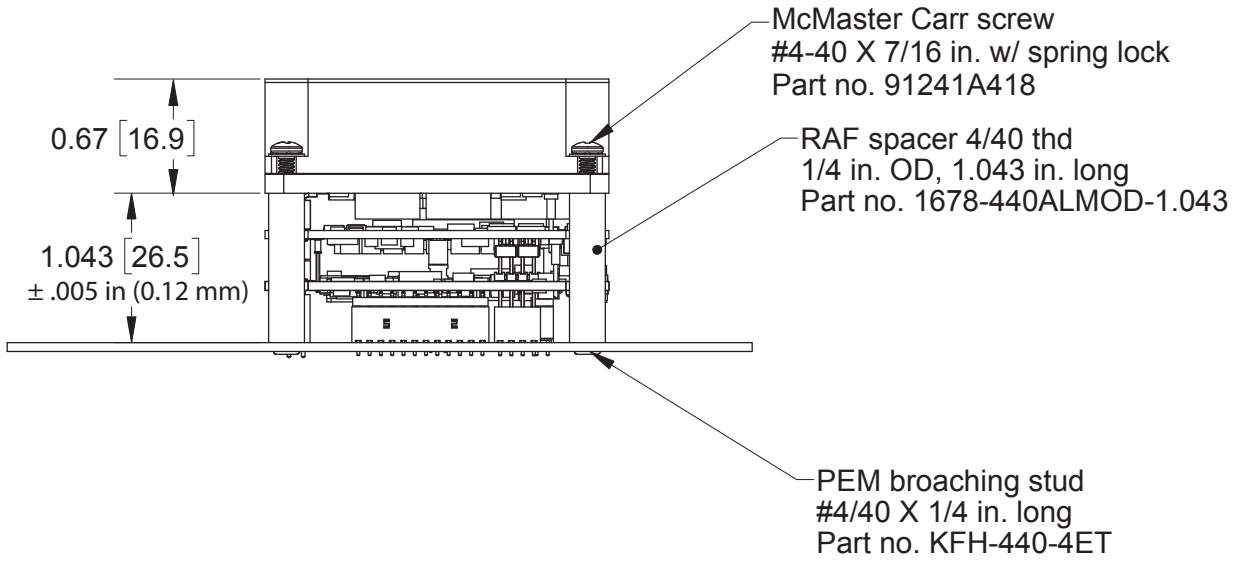


Dimensions are in inches[mm]

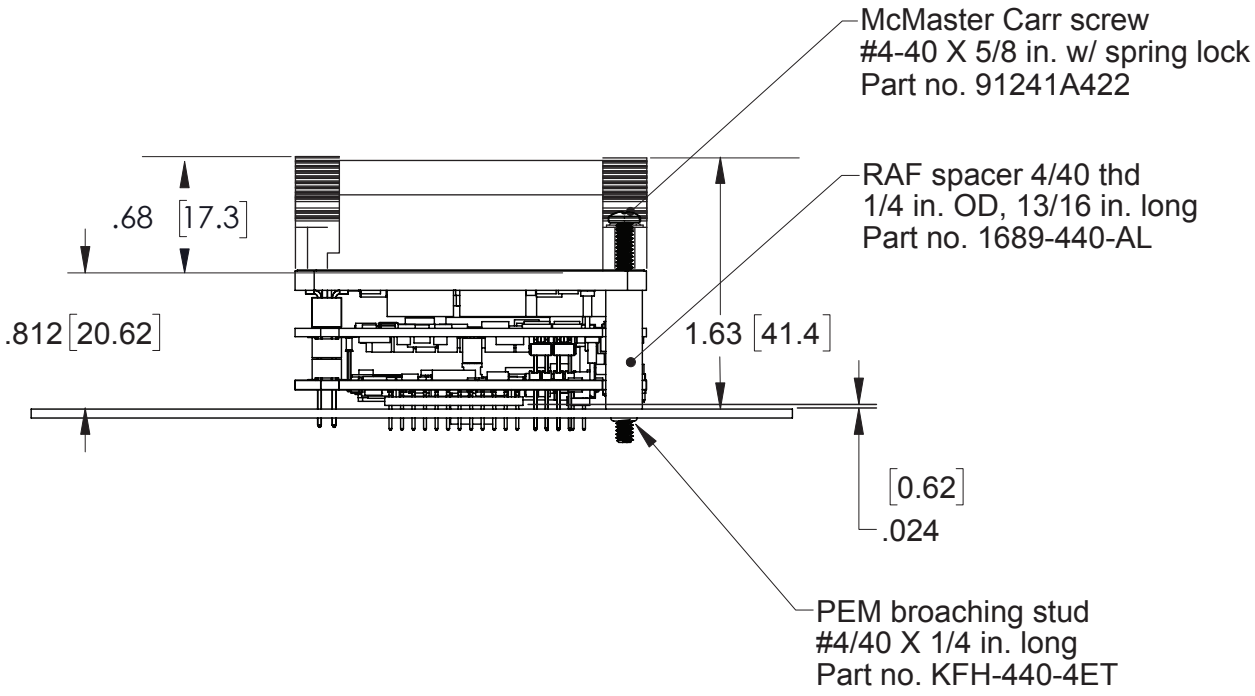
MOUNTING

MOUNTING WITH CONNECTORS ON PC BOARD

See page 22 for part numbers of connectors.



MOUNTING SOLDERED TO PC BOARD



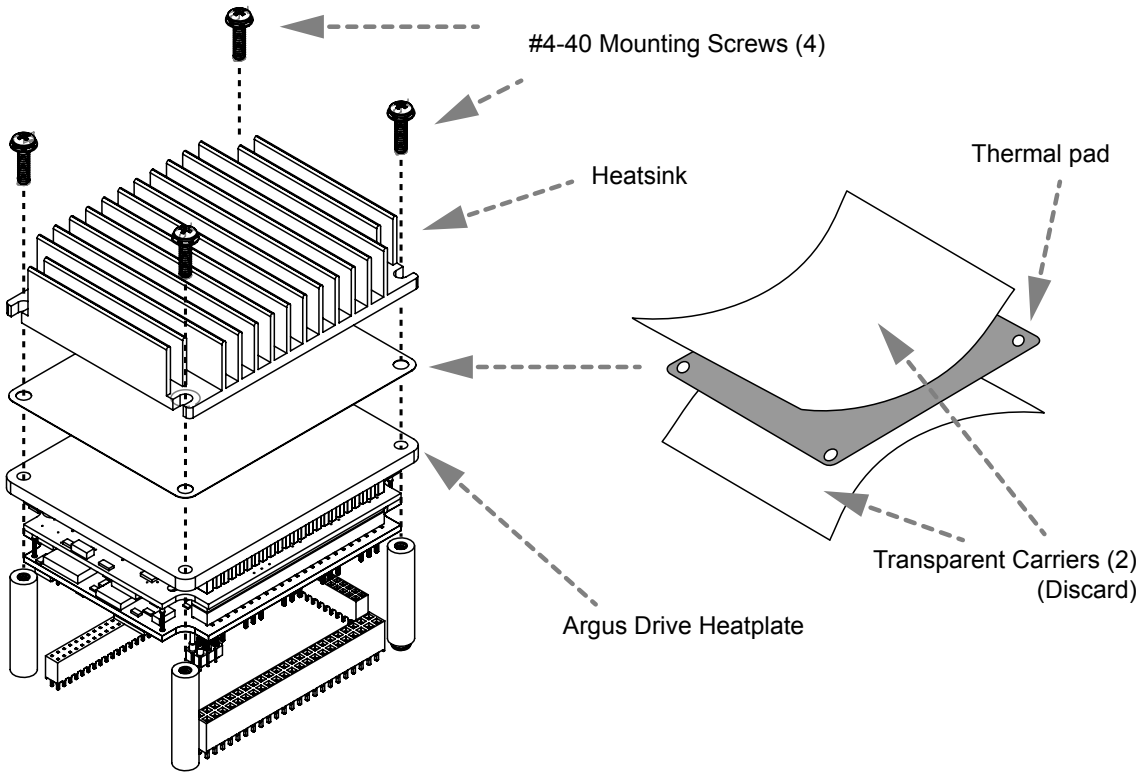
HEATSINK MOUNTING

HEATSINK INSTALLATION USING THE GEM-HK HEATSINK KIT

An AOS Micro Faze thermal pad is used in place of thermal grease. This material comes in sheet form and changes from solid to liquid form as the drive warms up. This forms an excellent thermal path from drive heatplate to heatsink for optimum heat transfer.

STEPS TO INSTALL

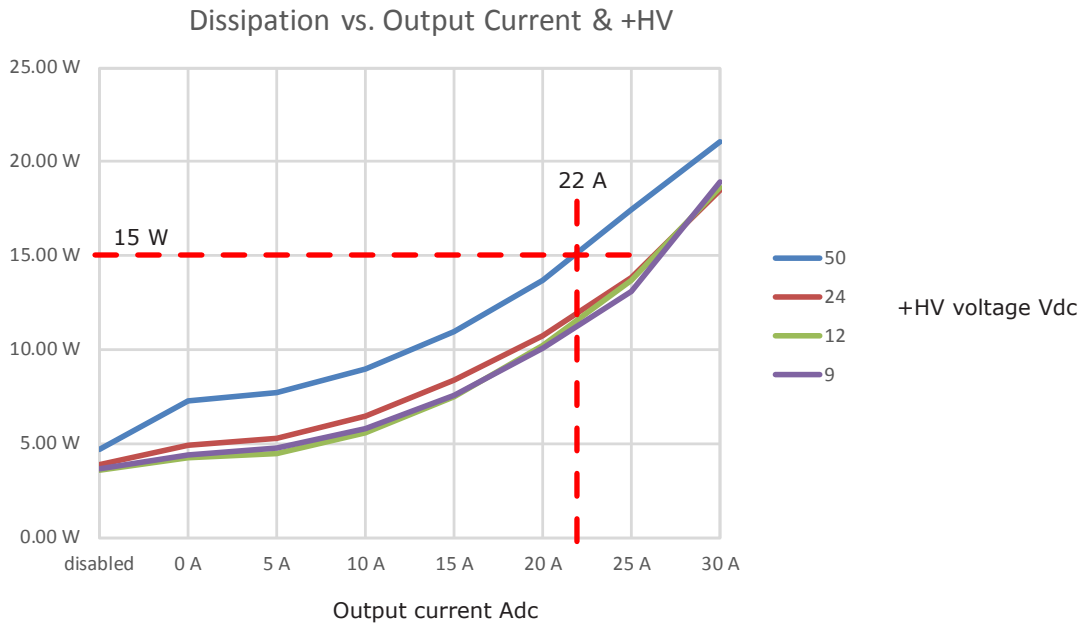
1. Insert the drive into the sockets and press smoothly until the heatplate is resting on the standoffs.
2. Remove one of the clear plastic carriers from the thermal pad.
3. Place the side of the thermal pad without the carrier onto the *Argus* aluminum heatplate taking care to center the thermal pad holes over the holes in the drive heatplate.
4. Remove the second clear plastic carrier from the thermal pad.
5. Place the heatsink onto the thermal pad. Take care to ensure that the holes in the heatsink, thermal pad, and drive all line up.
6. Insert the four #4-40 screws through the heatsink and torque them to 3~5 lb-in (0.34~0.57 N·m). Apply a smaller torque to each screw in rotation until the final torque is reached. This will ensure an even contact between the drive and heatplate for best thermal transfer.



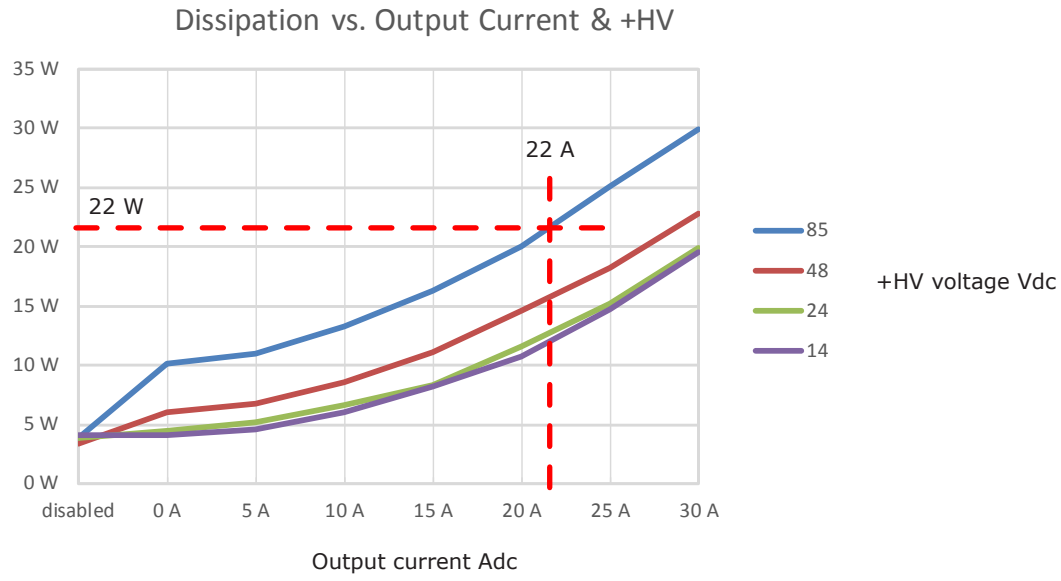
POWER DISSIPATION

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 9º 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.

GEM-055-60

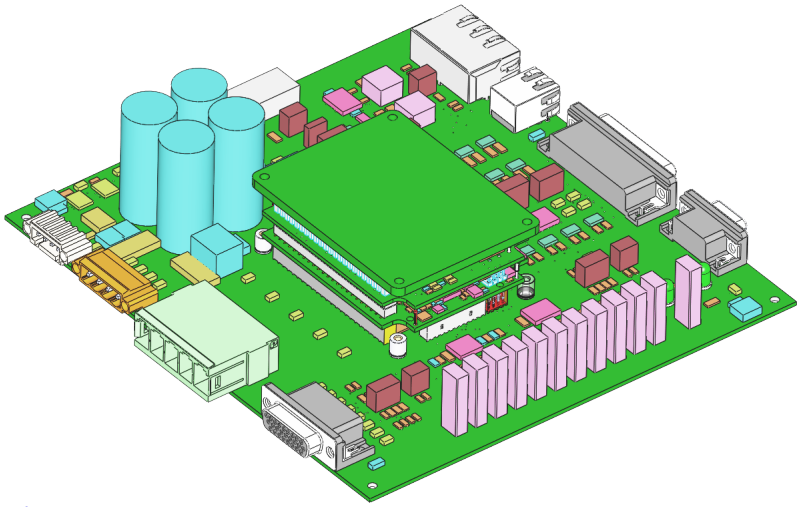


GPM-090-60



DESCRIPTION

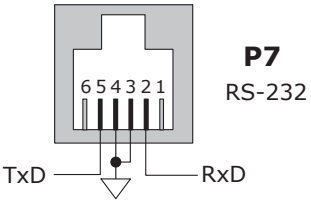
The Development Kit provides mounting and connectivity for one GEM drive. Solderless jumpers ease configuration of inputs and outputs to support their programmable functions. Switches can be jumpered to connect to digital inputs 1~10 so that these can be toggled to simulate equipment operation. Dual EtherCAT connectors make daisy-chain connections possible so that other EtherCAT devices such as Copley's Argus Plus or Xenus Plus Ethercat drives can easily be connected.



RS-232 CONNECTION

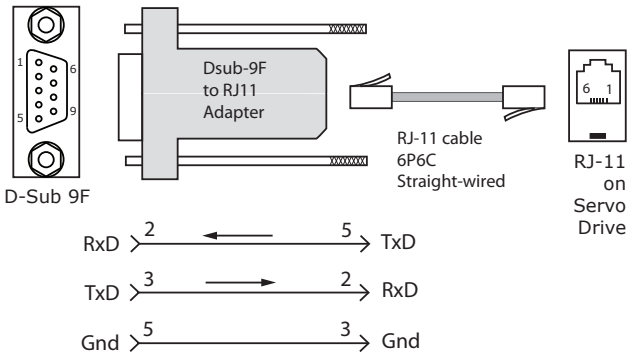
The RS-232 port is used to configure the drive for stand-alone applications, or for configuration before it is installed into an EtherCAT network. CME 2™ software communicates with the drive over this link and is then used for complete drive setup. The EtherCAT Device ID that is set by the rotary switch can be monitored, and a Device ID offset programmed as well.

The RS-232 connector, P7, is a modular RJ-11 type that uses a 6-position plug, four wires of which are used for RS-232. A connector kit is available (SER-CK) that includes the modular cable, and an adaptor to interface this cable with a 9-pin RS-232 port on a computer.



SER-CK SERIAL CABLE KIT

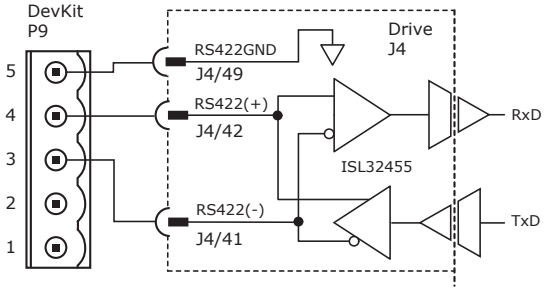
The SER-CK provides connectivity between a D-Sub 9 male connector and the RJ-11 connector P8 on the Development Kit. It includes an adapter that plugs into the COM1 (or other) port of a PC and uses common modular cable to connect to the XEL. The connections are shown in the diagram below.



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

RS-422 COMMUNICATIONS

RS-422 is a two-wire differential half-duplex port that operates from 9600 to 230.4 kbps. Connections to the *RS-422* port are through P9. The graphic below shows the connections between a *GEM* and a computer RS-422 port.



ETHERCAT CONNECTIONS

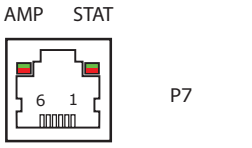
Dual RJ-45 sockets accept standard Ethernet cables. The IN port connects to a master, or to the OUT port of a device that is 'upstream', between the Stepnet and the master. The OUT port connects to 'downstream' nodes. If Stepnet is the last node on a network, only the IN port is used. No terminator is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

ETHERCAT STAT LED

The bi-color STAT LED combines the functions of the RUN and ERR LEDs.
Green and red colors alternate, and each color has a separate meaning:

Green is the "RUN" or EtherCAT State Machine:
Off = INIT state
Blinking = PRE-OPERATIONAL
Single Flash = SAFE-OPERATIONAL
Application watchdog timeout
On = OPERATIONAL

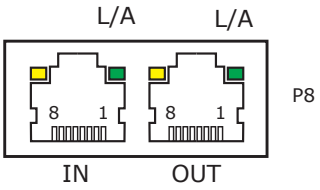
Red is the "ERR" indicator:
Blinking = Invalid configuration
Single Flash = Unsolicited state change
Double Flash =



L/A (LINK/ACT) LED

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



AMP LED

A 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/Slow-Blinking = Drive OK but NOT-enabled. Will run when enabled.
4) Green/Fast-Blinking = Positive or Negative limit switch active. Drive will only move in direction not inhibited by limit switch.
5) Green/Solid = Drive OK and enabled. Will run in response to reference inputs or EtherCAT commands.

Latching Faults

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

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

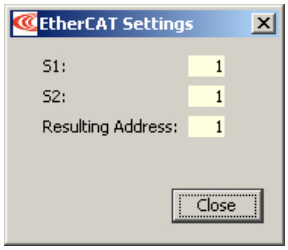
EtherCAT DEVICE ID

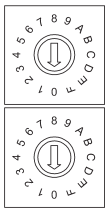
In an EtherCAT network, slaves are automatically assigned fixed addresses based on their position on the bus. When a device must have a positive identification that is independent of cabling, a Device ID is needed. In the GEM DevKit, this is provided by two 16-position rotary switches with hexadecimal encoding. These can set the Device ID 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 Device ID 107:

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

CME2 -> Amplifier -> Network Configuration





CME2 -> Input/Output -> Digital Outputs

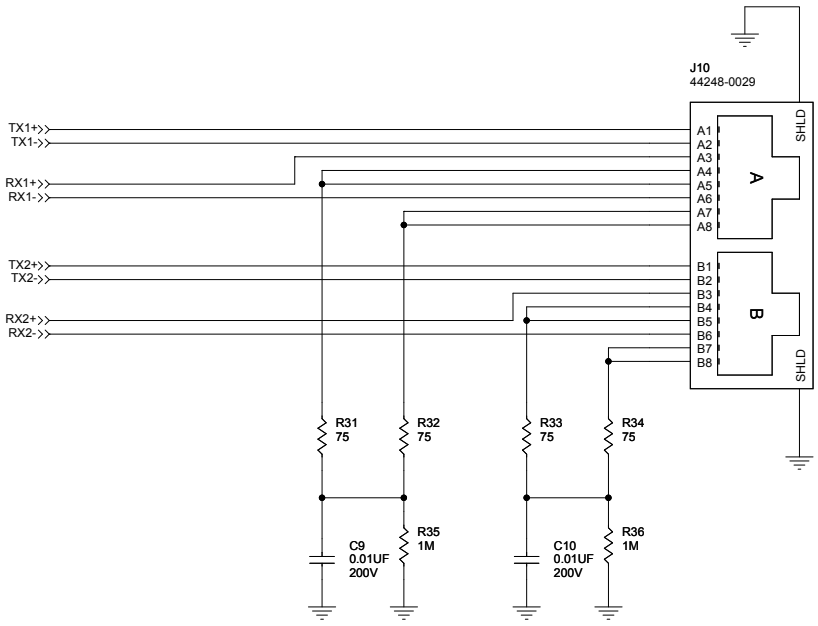
EtherCAT
Device ID Switch
Decimal values

	S2	S1
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
8	128	8
9	144	9
A	160	10
B	176	11
C	192	12
D	208	13
E	224	14
F	240	15

ETHERCAT CONNECTORS

ETHERCAT CONNECTORS

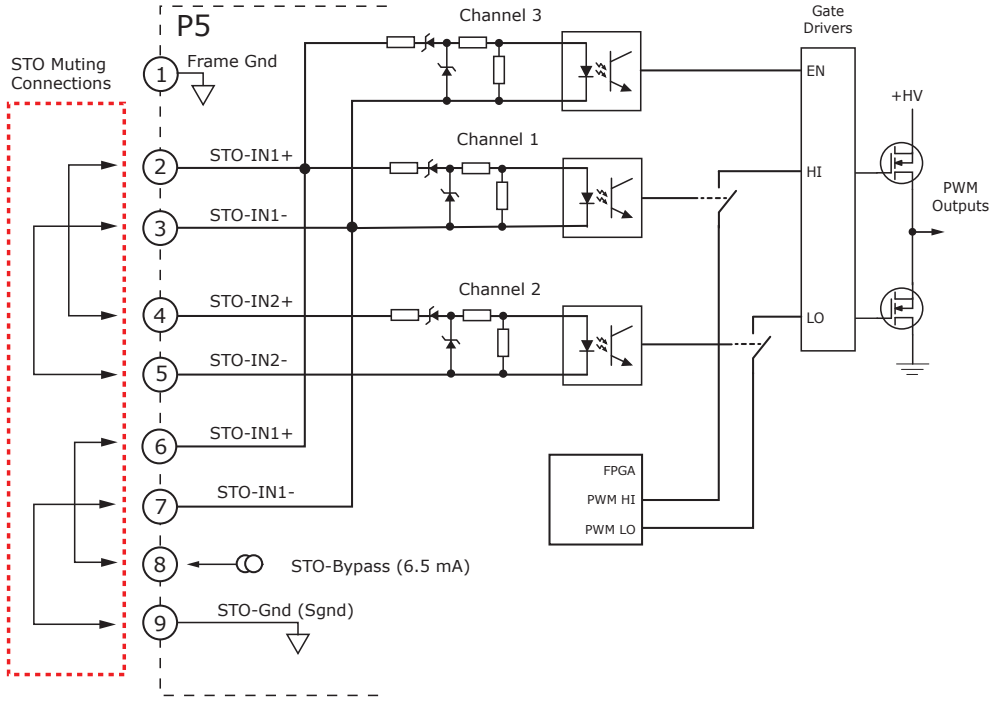
Dual RJ-45 connectors that accept standard Ethernet cables are provided for EtherCAT connectivity.



SAFE TORQUE OFF (STO)

DESCRIPTION

If the STO feature will not be used, the STO function can be disabled by adding jumpers to a connector for P5 as shown below.



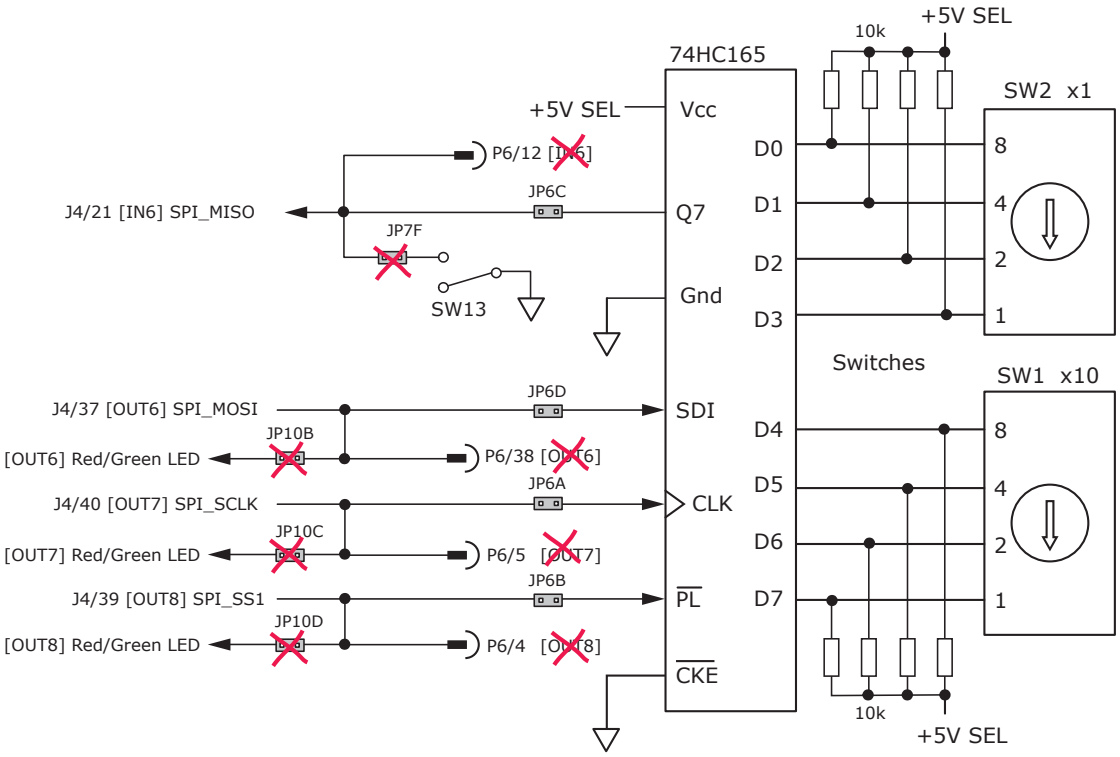
ETHERCAT DEVICE ID SWITCHES

ETHERCAT DEVICE ID (STATION ALIAS) SWITCH CONNECTIONS

The graphic below shows the connections to the EtherCAT Device ID switches. These are read after the drive is reset, or powered-on. When changing the settings of the switches, be sure to either reset the drive, or to power it off-on. Outputs [OUT5,6,8] and input [IN6] operate as an SLI (Switch & LED Interface) port which reads the settings on the EtherCAT Device ID switches, and controls the LEDs on the serial and CAN port connectors. In addition to the SLI function, the port can operate as an SPI interface.

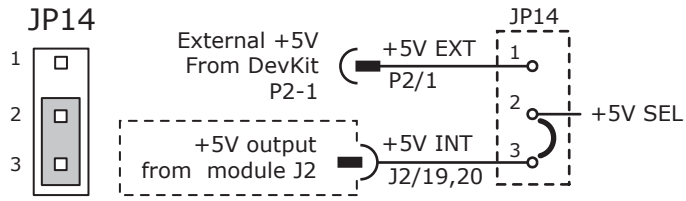
The jumpers marked with red "X" should be removed so that SW13, or external connections to the signals do not interfere with the operation of the SLI port. The "X" on [OUT6] shows that no connections should be made to this by the user when the SLI port is active.

CME2 -> Input/Output -> Digital Outputs



5V POWER SOURCES

Power for circuits on the Development Kit (+5V SEL) can be supplied either from the 5V from the servo drive (+5V ENC), or from an external +5V power supply (+5 EXT). Jumper JP14 selects the source of the +5V SEL from either the drive or from the external source.



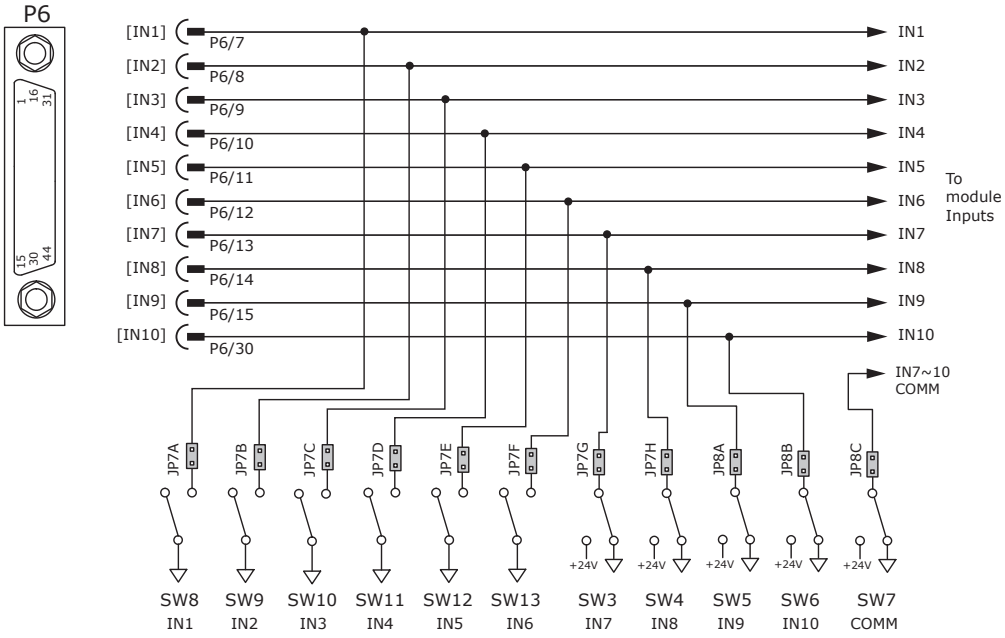
CONNECTORS & SIGNALS

LOGIC INPUTS & SWITCHES

The Development Kit has jumpers that can connect the GEM digital inputs to switches on the kit, or to the Signal connector P8.

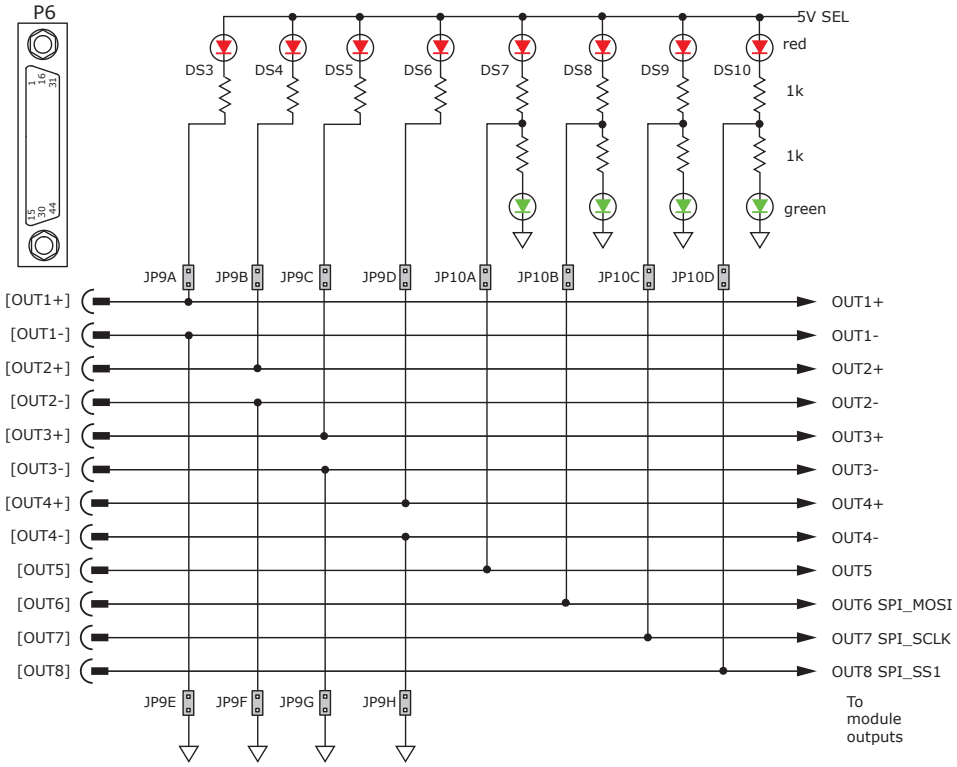
As delivered, all of these jumpers are installed as shown. If connecting to external devices that actively control the level of an input, it is desirable to disconnect the switch which could short the input to ground.

For example, if [IN1] is connected to an external device for the Enable function, then jumper JP7A should be removed to take the switch SW1 out of the circuit. The figure below shows these connections.



LOGIC OUTPUTS

There are logic outputs that can drive controller logic inputs or relays. If relays are driven, then flyback diodes must be connected across their terminals to clamp overvoltages that occur when the inductance of the relay coil is suddenly turned off. Outputs 5,6,7 & 8 are CMOS types that pull up to 5V or down to ground. When these outputs go high it turns on the green LED. When they are low, the red LED is turned on. Outputs 1,2,3, & 4 are two-terminal opto-isiolated types. With the jumpers in place as shown, when the outputs are ON they will drive current through the LEDs DS3~6.



FEEDBACK CONNECTOR & SIGNALS

MOTOR FEEDBACK CONNECTOR P4

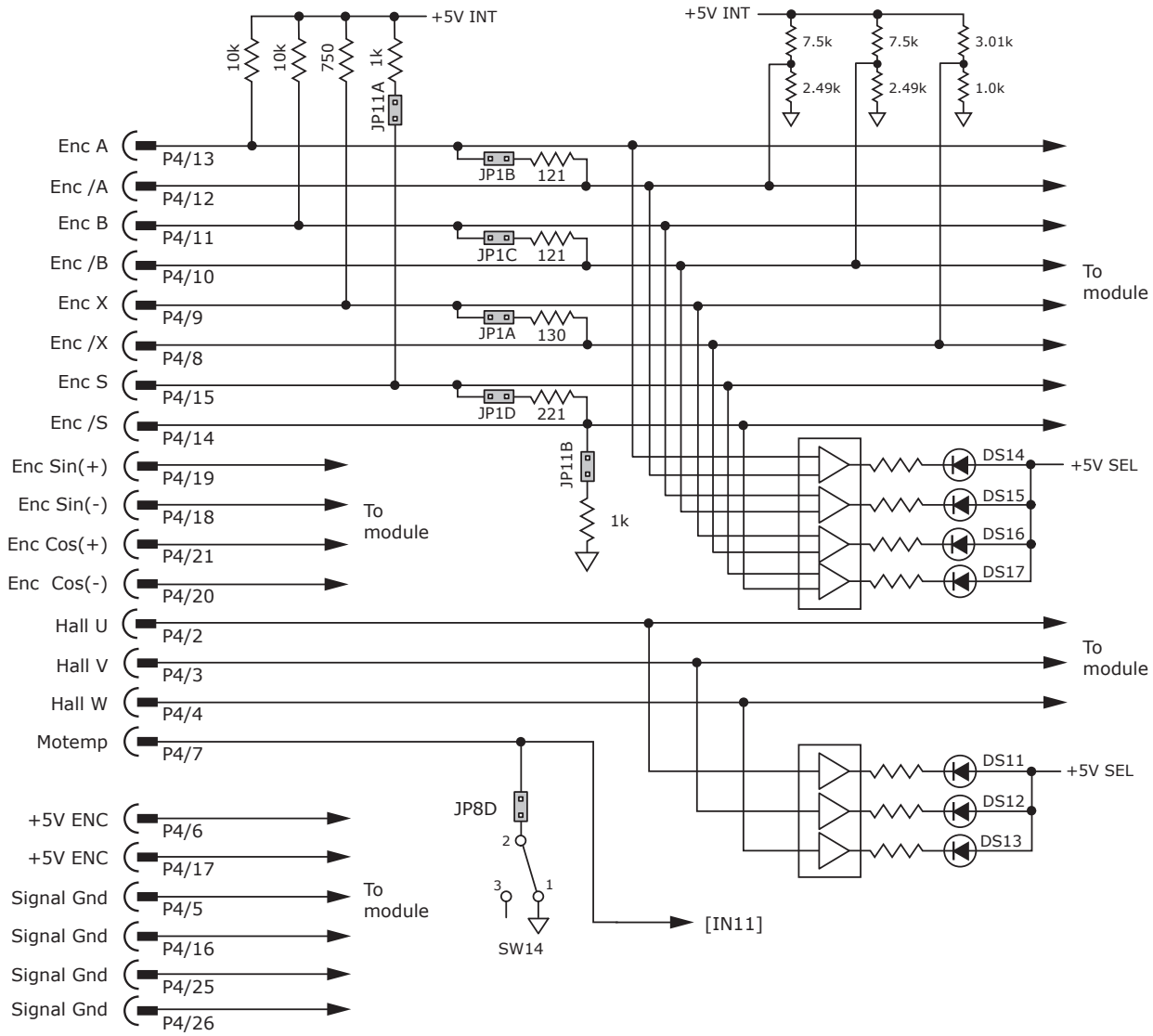
For motors with differential encoders: install jumpers JP1B, JP1C, JP1A to connect terminators across A, B, and X inputs.

For motors with single-ended encoders: remove jumpers JP1B, JP1C, JP1A to disconnect the terminators. Then use the A, B, and X inputs for the encoder. The /A, /B, and /X inputs are then biased by dividers to work with the single-ended encoder signals.

A motor temperature sensor that connects to [IN11] must have jumper JP8D removed to prevent switch SW14 from grounding the Motemp[IN11] signal.

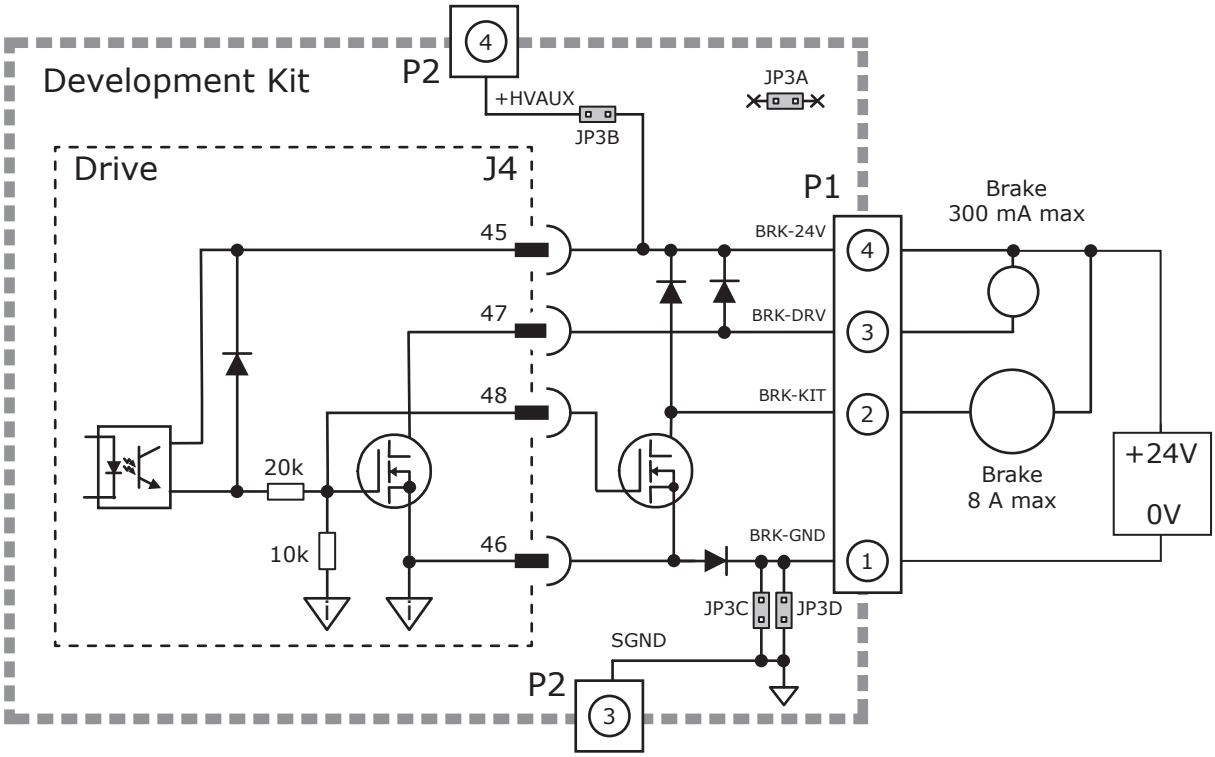
Absolute encoders such as the Nikon A type that use 2-wire bidirectional signals require biasing the lines when they are in a quiescent state. Jumpers JP11A, JP11B, and JP1D must be in place to provide line termination and biasing.

LED's are provided to show the status of the encoder and Hall signals.

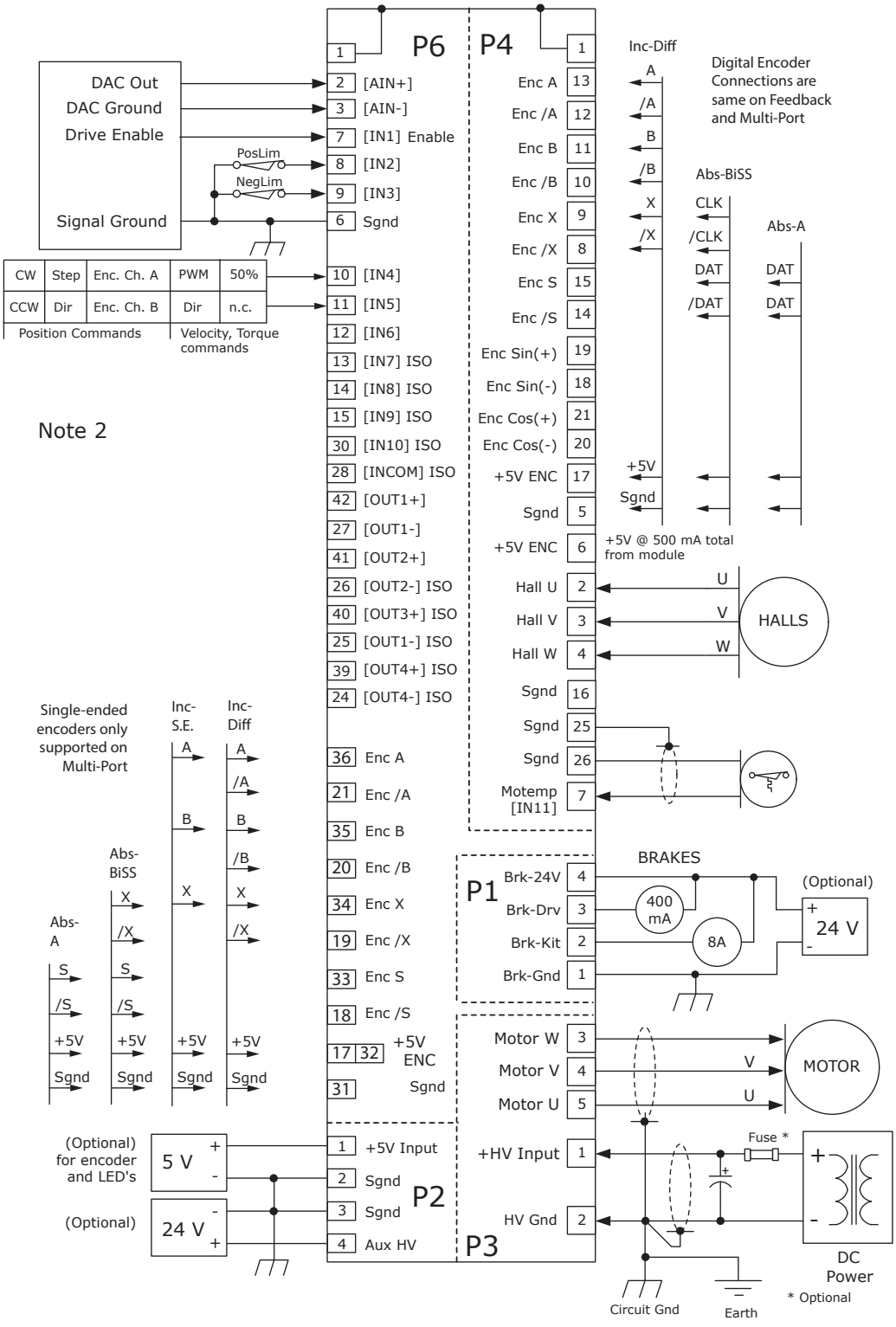


BRAKE CONNECTOR & SIGNALS

The brake circuit in the GEM is optically isolated from the other drive circuits. And the brake circuit in the Development Kit is isolated from other circuits in the kit. Jumpers are provided that connect the kit brake circuits to the +24V (HVAUX) power and +HVCOM (HV power ground and Signal Ground).
With the jumpers in place, supplying +24V to P2-4 and ground to P2-3 will power the brake circuit.
When this is done a low-current brake can be connected to P1-3 and P1-4, or a higher-current brake can be connected between P1-4 and P1-2. The +24V power supply must be able to supply the required current to energize the brake.



DEVELOPMENT KIT CONNECTIONS

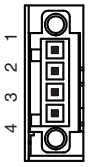


DEVELOPMENT KIT CONNECTORS

P9 (See table on page 33)

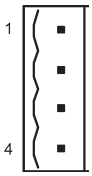
P1 BRAKE

Signal	Pin
BRK-GND	1
BRK-KIT	2
BRK-DRV	3
BRK-24V	4



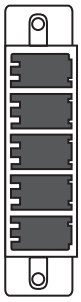
P2 AUX HV & +5V

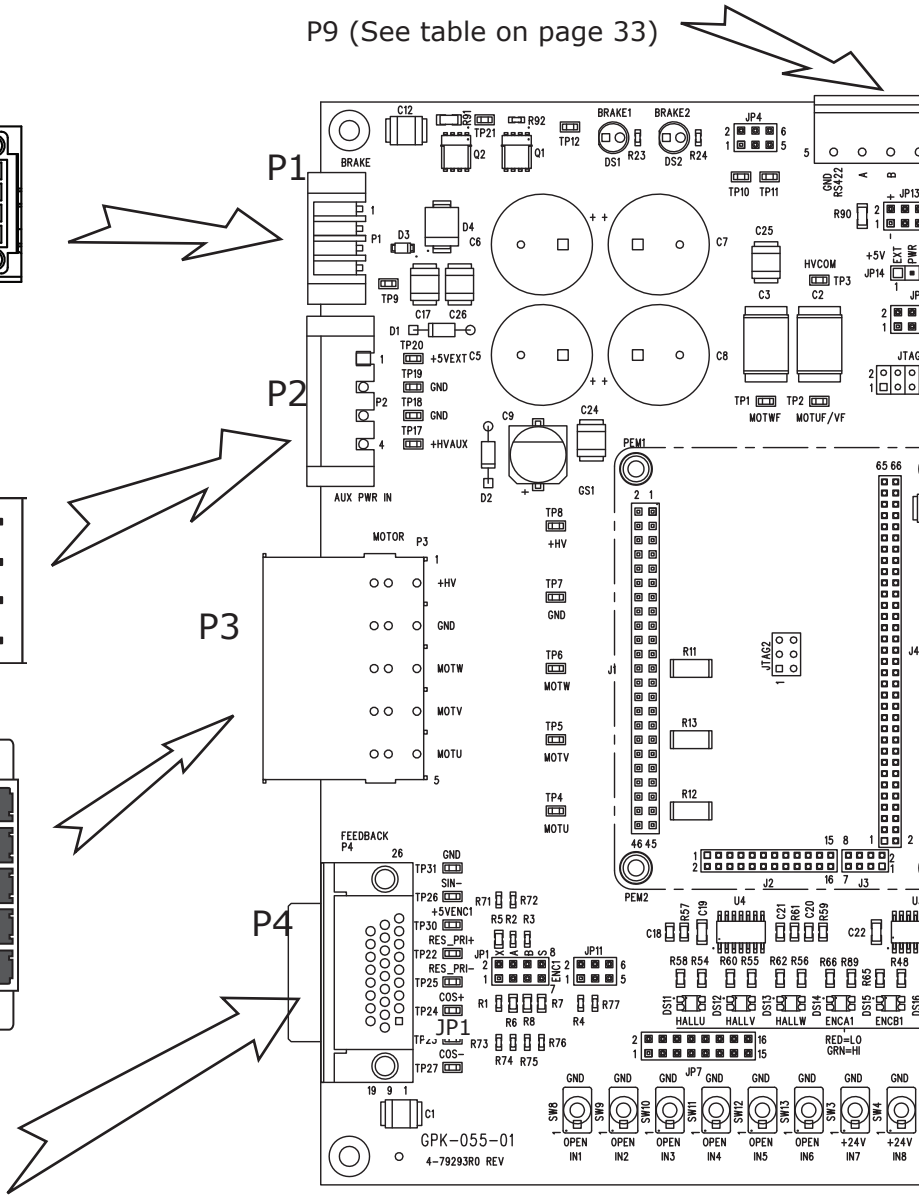
Signal	Pin
+5 Ext	1
Gnd	2
Gnd	3
Aux HV	4



P3 MOTOR & +HV POWER

Signal	Pin
+HV	1
HV Gnd	2
Motor W	3
Motor V	4
Motor U	5





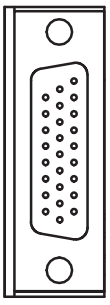
P4 FEEDBACK

PIN	SIGNAL
26	Signal Gnd
25	Signal Gnd
24	N.C.
23	Rslvr Ref(+)
22	Rslvr Ref(-)
21	Cos(+)
20	Cos(-)
19	Sin(+)

PIN	SIGNAL
18	Sin(-)
17	+5V Enc
16	Signal Gnd
15	Enc S
14	Enc /S
13	Enc A
12	Enc /A
11	Enc B
10	Enc /B

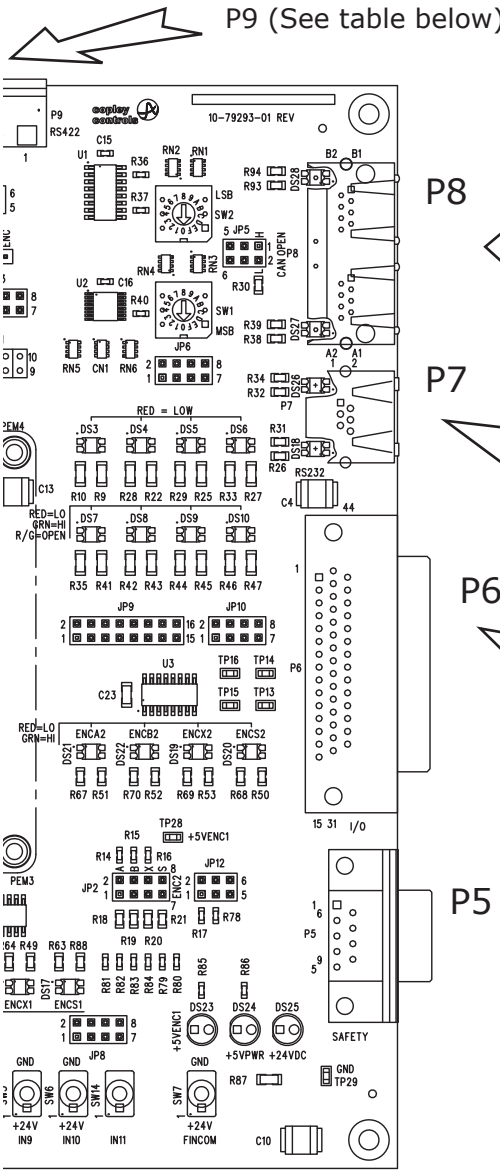
PIN	SIGNAL
9	Enc X
8	Enc /X
7	[IN11] Motemp*
6	+5V ENC
5	Signal Gnd
4	Hall W
3	Hall V
2	Hall U
1	Frame Gnd

INPUT SWITCHES

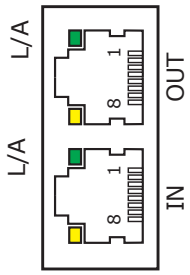


* Signal connections on the PC board are affected by jumper placement

DEVELOPMENT KIT CONNECTORS

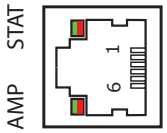


P8 ETHERCAT



See pinouts on page 28

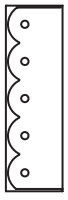
P7 RS-232



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

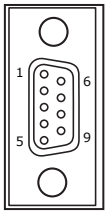
P6 CONTROL

PIN	SIGNAL	PIN	SIGNAL	PIN	SIGNAL
1	Frame Gnd	16	Signal Gnd	31	Signal Gnd
2	[AIN-]	17	+5V ENC	32	+5V ENC
3	[AIN+]	18	/S Multi-Port	33	S Multi-Port
4	[OUT8] SPI-EN1	19	/X Multi-Port	34	X Multi-Port
5	[OUT7] SPI-CLK	20	/B Multi-Port	35	B Multi-Port
6	Signal Gnd	21	/A Multi-Port	36	A Multi-Port
7	[IN1] HS	22	Signal Gnd	37	Signal Gnd
8	[IN2] HS	23	[OUT5] SPI-CLK	38	[OUT6] SPI-MOSI
9	[IN3] HS	24	[OUT4-] ISO	39	[OUT4+] ISO
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		



P9 RS-422

Pin	Signal
1	N.C.
2	N.C.
3	RS422(-)
4	RS422(+)
5	RS422-GND



P5 SAFETY

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(-)		

ORDERING INFORMATION

ORDERING GUIDE

EtherCAT

GEM-055-60	*GEM* Servo Drive, 30/60 Adc, with encoder feedback
GEM-055-60-R	*GEM* Servo Drive, 30/60 Adc, with resolver feedback
GEM-090-60	*GEM* Servo Drive, 30/60 Adc, with encoder feedback
GEM-090-60-R	*GEM* Servo Drive, 30/60 Adc, with resolver feedback

Example: Order one *Argus Plus GEM* drive, 30/60 Adc with resolver feedback, Development Kit, Connector Kit, Serial Cable Kit, and Heatsink Kit

Qty	Item	Remarks
1	GEM-055-60-R	*Argus Plus GEM* servo drive with resolver feedback
1	GEK-090-01	Development Kit
1	GEK-CK	Connector Kit for Development Kit
1	SER-CK	Serial Cable Kit
1	GEM-HK	Heatsink Kit

ACCESSORIES

	Qty	Ref	Name	Description	Manufacturer P/N
GEK-090-01				Development Kit for all GEM models	
GEK-CK Connector Kit for Development Kit	1	P3	HV & Motor	Plug, 5 position, 7.62 mm, female	Phoenix Contact: PC 5/5-STCL-7,62
	1	P1	Brake	Plug, 4 position, 3.5 mm, female	Wago: 734-104/107-000
	1			Strain relief, snap-on, 3.5 mm, 4 position, grey	Wago: 734-604
	1		Tool	Tool, wire insertion & extraction, 734 series	Wago: 734-231
	1	P2	Aux HV	Plug, 4 position, 5.08 mm, female	Wago: 231-304/107-000
	1	P5	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	P4	Feedback	Connector, high-density DB-26M, 26 position, male, solder cup	Norcomp: 180-026-103L001
	1			Metal Backshell, DB-15, RoHS	3M: 3357-9215
	1	P6	Control	Connector, high-density DB-44M, 44 position, male, solder cup	Norcomp: 180-044-103L001
	1			Metal Backshell, DB-25, RoHS	3M: 3357-9225
	1	P9	RS-422	Connector, terminal block, female, 0.20 in, 5-position	TE: 796634-5
SER-CK	1	P7	RS-232	Serial Cable Kit	
GEK-NC-10		P8	Network	EtherCAT network cable, 10 ft (3 m)	
GEK-NC-01				EtherCAT network cable, 1 ft (0.3 m)	
GEM-HK				Heatsink kit	

16-01558 Document Revision History

Revision	Date	Remarks
00	March 27, 2017	Preliminary version
01	April 4, 2017	Initial released version
02	December 6, 2017	Added 90V models, change 90V model min voltage to 14 Vdc, corrected DevKit model number, added thermal data, remove large heatsink, add HS kit to accessories.

Note: Specifications subject to change without notice