

DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

Control Modes

- Cyclic Synchronous Position-Velocity-Torque (CSP, CSV, CST)
- Cyclic Synchronous Torque with Commutation Angle (CSTCA)
- Profile Position-Velocity-Torque, Interpolated Position (PT,PVT), Homing
- Indexer, Point-to-Point, CPL
- Camming, Gearing
- Position, Velocity, Torque

Command Interface

- CANopen application protocol over EtherCAT (CoE)
- ASCII, Serial Binary, and discrete I/O
- Stepper or Quad A/B position commands
- PWM Velocity/Torque command
- Master encoder (Gearing/Camming)

Communications

- EtherCAT, Ethernet
- RS-232

Feedback

- Dual Absolute Encoder Ports
 - SSI
 - EnDat 2.1, 2.2
 - Absolute A
 - Tamagawa Absolute A
 - Panasonic , Sanyo Denki Absolute A Format
 - BiSS
- Incremental
 - Digital quad A/B/X encoder
 - Analog Sin/Cos encoder
- Other
 - Digital Halls

I/O

- 7 High-speed digital inputs
- 6 High-speed digital outputs
- 1 Differential analog input

Safe Torque Off (STO)

- SIL 3, Category 3, PL e

Dimensions: in [mm]

- 2.5 x 1.6 x .69 [64 x 41 x 17.6] AEV
- 4.4 x 2.1 x 1.85 [112 x 53.3 x 47] AEZ-090-50
- 5.08 x 3.6 x 2.18 [129 x 91.4 x 55.2] AEZ-090-50-C

DESCRIPTION

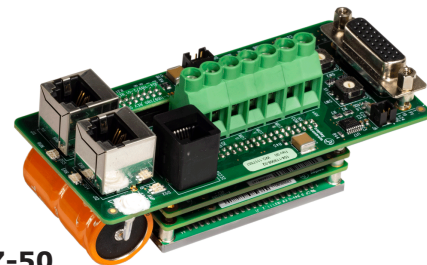
AEV sets new levels of performance, connectivity, and flexibility. CANopen application protocol over EtherCAT (CoE) communication provides a widely used cost-effective industrial bus. A wide range of absolute encoders are supported.

Safe Torque Off (STO) eliminates external contactors and wiring, reducing system cost and complexity. For safety critical applications, redundant STO disable inputs can be employed.



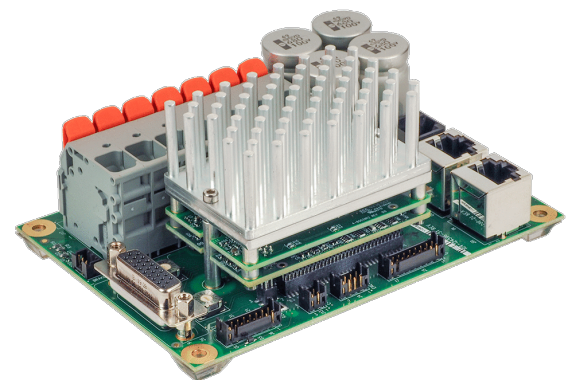
AEV

| MODEL | I _c | I _P | V _{DC} |
|--------------|----------------|----------------|-----------------|
| AEV-090-14 | 7 | 14 | 9~90 |
| AEV-090-30 | 15 | 30 | 9~90 |
| AEV-090-50 | 25 | 50 | 9~90 |
| AEV-090-50-C | 50 | 50 | 9~90 |
| AEV-180-10 | 5 | 10 | 20~180 |
| AEV-180-20 | 10 | 20 | 20~180 |



AEZ-50

| MODEL | I _c | I _P | V _{DC} |
|------------|----------------|----------------|-----------------|
| AEZ-090-50 | 25 | 50 | 9~90 |



AEZ-50-C

| MODEL | I _c | I _P | V _{DC} |
|--------------|----------------|----------------|-----------------|
| AEZ-090-50-C | 50 | 50 | 9~90 |

GENERAL SPECIFICATIONS


Test conditions: Load = Wye connected load: 1 mH + 1Ω line-line. Ambient temperature = 25 °C. +HV = HVmax

| MODEL | AEV-090-14 | AEV-090-30 | AEV-090-50 | AEV-090-50-C | AEZ-090-50 | AEZ-090-50-C | AEV-180-10 | AEV-180-20 | |
|---|--|------------|------------|--------------|------------|--------------|------------|------------|------------|
| OUTPUT POWER | | | | | | | | | |
| Peak Current | 14 (9.9) | 30 (21.2) | *50 (35.4) | *50 (35.4) | 50 (35.4) | 50 (35.4) | 10 (7.1) | 20 (14.2) | Adc (Arms) |
| Peak time | 1 | 1 | 1 | n/a | 1 | n/a | 1 | 1 | Sec |
| Continuous current | 7 (5.0) | 15 (10.6) | *25 (17.7) | *50 (35.4) | 25 (17.7) | 50 (35.4) | 5 (3.5) | 10 (7.1) | Adc (Arms) |
| Peak Output Power | 1.26 | 2.7 | 4.5 | 4.5 | 4.5 | 4.5 | 1.8 | 3.6 | kW |
| Continuous Output Power | 0.63 | 1.35 | 2.25 | 4.5 | 2.25 | 4.5 | 0.9 | 1.8 | kW |
| * AEV-090-50 & AEV-090-50-C must be soldered to a mounting board for these ratings. | | | | | | | | | |
| INPUT POWER | | | | | | | | | |
| HVmin to HVmax | +9~90 | +9~90 | +9~90 | +9~90 | +9~90 | +9~90 | +20~180 | +20~180 | Vdc |
| I _{peak} | 14 | 30 | 50 | 50 | 50 | 50 | 10 | 20 | Adc |
| I _{cont} | 7 | 15 | 25 | 50 | 25 | 50 | 5 | 10 | Adc |
| VLOGIC | +9~60 | +9~60 | +9~60 | +9~60 | +9~60 | +9~60 | +9~60 | +9~60 | Vdc |
| VLOGIC Power | VLOGIC @ 9 Vdc 3.4 W, @ 24 Vdc 3.5 W, @ 60 Vdc 4.2 W with 2 encoders @ +5 V, 500 mA total | | | | | | | | |
| PWM OUTPUTS | | | | | | | | | |
| Type | MOSFET 3-phase inverter, 16 kHz center-weighted PWM carrier, space-vector modulation | | | | | | | | |
| PWM ripple frequency | 32 kHz | | | | | | | | |
| BANDWIDTH | | | | | | | | | |
| Current loop, small signal | 2.5 kHz typical, bandwidth will vary with tuning & load inductance | | | | | | | | |
| HV Compensation | Changes in HV do not affect bandwidth | | | | | | | | |
| Current loop update rate | 16 kHz (62.5 μs) | | | | | | | | |
| Position & Velocity loop update rate | 4 kHz (250 μs) | | | | | | | | |
| COMMAND INPUTS | | | | | | | | | |
| <i>EtherCAT:</i> | CANopen application protocol over EtherCAT (CoE): Cyclic Synchronous Position/Velocity/Torque Profile Position/Velocity/Torque, Interpolated Position (PVT), Homing Cyclic Synchronous Torque with Commutation Angle (CSTCA) | | | | | | | | |
| <i>Stand-alone mode</i> | | | | | | | | | |
| Digital position reference | Pulse/Direction, CW/CCW Stepper commands (2 MHz maximum rate) Quad A/B Encoder 2 M line/sec, 8 Mcount/sec (after quadrature) | | | | | | | | |
| Digital torque & velocity reference | PWM, Polarity PWM = 0% - 100%, Polarity = 1/0 PWM 50% PWM = 50% ±50%, no polarity signal required PWM frequency range 1 kHz minimum, 100 kHz maximum PWM minimum pulse width 220 ns | | | | | | | | |
| Indexing | Up to 32 sequences can be launched from inputs or ASCII commands | | | | | | | | |
| Camming | Up to 10 CAM tables can be stored in flash memory | | | | | | | | |
| ASCII | RS-232, 9600~230,400 Baud, 3-wire | | | | | | | | |
| DIGITAL INPUTS | | | | | | | | | |
| Number | 7 | | | | | | | | |
| All inputs | High-speed Schmitt trigger with 100 ns RC filter, 10 kΩ pull-up to +5 Vdc, max input voltage = +6 Vdc RC time-constants assume active drive on inputs and do not include 10 kΩ pull-ups | | | | | | | | |
| IN1~IN6 | V _{T+} = 1.42~2.38 Vdc, V _{T-} = 0.68~1.6 Vdc, V _H = 0.44~1.26 | | | | | | | | |
| IN7 | V _{T+} = 1.30~2.00 Vdc, V _{T-} = 0.55~1.30 Vdc, V _H = 0.40~0.79 | | | | | | | | |
| ANALOG INPUT | | | | | | | | | |
| Number | 1 | | | | | | | | |
| Type | Differential, ±10 Vdc range, 16 bits, 14 kHz input filter bandwidth, sample-rate 16 kHz | | | | | | | | |
| Function | Torque, velocity, or position command. Or, as general purpose analog input | | | | | | | | |
| DIGITAL OUTPUTS | | | | | | | | | |
| Number | 6 | | | | | | | | |
| OUT1~3 | CMOS HCT inverters, functions programmable, +5 Vcc Source -8 mA @ VOH = 2.4 Vdc, Sink 6 mA @ VOL = 0.5 Vdc | | | | | | | | |
| OUT4~6 | CMOS LVC inverters, functions programmable, for SLI port, +3.3 Vcc Source -24 mA @ VOH = 2.3 Vdc, Sink 24 mA @ VOL = 0.55 Vdc | | | | | | | | |
| RS-232 COMMUNICATION PORT | | | | | | | | | |
| Signals | Rx/D, Tx/D, SGND | | | | | | | | |
| Mode | Full-duplex, DTE serial communication port for drive setup and control, 9,600 to 230,400 Baud | | | | | | | | |
| Protocol | ASCII or Binary format | | | | | | | | |
| Isolation | Non-isolated. Referenced to Signal Ground | | | | | | | | |
| NETWORK PORT | | | | | | | | | |
| Isolation | External magnetics required. Max voltage with respect to grounds: 32 Vdc | | | | | | | | |
| Format | 100BASE-TX | | | | | | | | |
| ETHERCAT | | | | | | | | | |
| Protocol | EtherCAT, CANopen Application Protocol over EtherCAT (CoE) | | | | | | | | |
| ETHERNET | | | | | | | | | |
| Protocol | TCP-IP, UDP, Modbus-TCP | | | | | | | | |

GENERAL SPECIFICATIONS

| | |
|--|---|
| DC POWER OUTPUT | |
| +5 Vdc | 500 mA maximum. Protected for overload or shorts. Shared by dual encoders |
| SAFE TORQUE OFF (STO) | |
| Function | PWM outputs are inactive and current to the motor will not be possible when the STO function is enabled |
| 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 e |
| Inputs | 2 two-terminal: STO-IN1+, STO-IN1-, STO-IN2+, STO-IN2- |
| Type | Opto-isolators, 5 V compatible, Vin-LO ≤ 2.0 Vdc or open, Vin-HI ≥ 3.3 Vdc |
| Input current (typical) | STO-IN1, STO-IN2: 11 mA each |
| Response time | 2 ms from Vin ≤ 2.0 Vdc to interruption of energy supplied to motor |
| Muting | Wiring a shorting plug with jumpers (see page 7) will mute (bypass) the STO function |
| PROTECTIONS | |
| HV Overvoltage | +HV > +95 ±1 Vdc Drive outputs turn off until +HV is < +95 ±1 Vdc (90 V models) +HV > +185 ±1 Vdc Drive outputs turn off until +HV is < +185 ±1 Vdc (180 V models) |
| HV Undervoltage | +HV < +8.5 ±0.5 Vdc Drive outputs turn off until +HV > +8.5 Vdc ±0.5 Vdc (90 V models) +HV < +19.5 ±0.5 Vdc Drive outputs turn off until +HV > +19.5 Vdc ±0.5 Vdc (180 V models) |
| Drive over temperature | PC Board > 90 °C +3/-0 °C Programmable as latching or temporary fault |
| Short circuits | Output to output, output to ground, internal PWM bridge faults |
| I ² T Current limiting | Programmable: continuous current, peak current, peak time for drive and motor |
| Latching / Non-Latching | Programmable response to errors |
| MECHANICAL & ENVIRONMENTAL | |
| Size | AEV: 2.5 x 1.6 x 0.69 in [64 x 41 x 17.6 mm] AEZ-090-50: 4.4 x 2.1 x 1.85 in [112 x 53.3 x 47 mm] AEZ-090-50-C: 5.08 x 3.6 x 2.18 in [129 x 91.4 x 55.2 mm] |
| Weight | AEV: ≤ 0.16 lb (0.073 kg), add 0.106 lb (0.048 kg) for pins heatsink AEZ-090-50: 0.40 lb (0.18 kg) AEZ-090-50-C: 0.72 lb (0.33 kg) |
| Ambient temperature | 0 to +45 °C operating, -40 to +85 °C storage |
| Humidity | 0 to 95%, non-condensing |
| Altitude | ≤ 2000 m (6,500 ft) |
| Vibration | 2 g peak, 10~500 Hz (sine) |
| Shock | 10 g, 10 ms, half-sine pulse |
| Contaminants | Pollution degree 2 |
| Cooling | Forced air cooling required for continuous power output |
| AGENCY STANDARDS CONFORMANCE | |
| <i>Standards and Directives</i> | |
| <i>Functional Safety</i> | |
| IEC 61508-1, IEC 61508-2, IEC 61508-3, IEC 61508-4 (SIL 3) | |
| Directive 2006/42/EC (Machinery) | |
| ISO 13849-1 (Cat 3, PL e) | |
| IEC 61800-5-2 (SIL3) | |
| <i>Product Safety</i> | |
| Directive 2014/35/EU (Low Voltage) | |
| IEC 61800-5-1 | |
| <i>EMC</i> | |
| Directive 2014/30/EU (EMC) | |
| IEC 61800-3 | |
| IEC 61800-5-2 | |
| <i>Approvals</i> | |
| <i>UL and cUL recognized component to:</i> | |
| UL 61800-5-1, UL 61800-5-2 (E168959-20200424A) | |
| IEC 61800-5-1, IEC 61800-5-2 | |



| | |
|--|---|
|  DANGER | Refer to the 16-01687 Accelnet Plus Micro Modules AEV/APV User Guide |
| | <p>The information provided in the 16-01687 Accelnet Plus Micro Modules AEV & APV User Guide must be considered for any application using the AEV drive STO feature.</p> <p>Failure to heed this warning can cause equipment damage, injury, or death.</p> |

GENERAL SPECIFICATIONS

MOTOR CONNECTIONS

| | |
|-------------|--|
| Motor U,V,W | Drive outputs to 3-phase brushless motor, Wye or delta connected For DC brush motor use outputs U & V Minimum inductance: 200 µH line-line |
| Encoder | Digital encoders, incremental and absolute (see FEEDBACK below) Analog Sin/Cos incremental |
| Halls | see <i>Commutation</i> (below) |
| Motemp | Inputs are programmable to disable the drive if motor sensor drives input HI or LO |

FEEDBACK

| | |
|---|--|
| <i>Incremental encoders</i> | |
| Digital Incremental Encoder | Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required) RS-422 line receivers, 5 MHz maximum line frequency (20 M counts/sec) |
| Analog Incremental Encoder | Sin/Cos format (Sin+, Sin-, Cos+, Cos-), differential, 1 Vpeak-peak ±20% BW > 300 kHz, 16-bit resolution, with zero-crossing detection |
| <i>Absolute encoders</i> | |
| EnDat 2.1, 2.2, SSI Absolute A Format | Serial Clock (X, /X), and Data (A, /A) signals SD+, SD- (A, /A) signals, 2.5 or 4 MHz, half-duplex 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) Terminators Commutation Encoder power | MA+, MA- (X, /X), SL+, SL- (A, /A) signals, clock output from drive, data returned from encoder All encoder data inputs and clock outputs are differential and require external terminators Hall signals (U,V,W), 15 kΩ pull-up to +5V, 15 kΩ/100 pF RC to 74LVC3G14 Schmitt trigger at +5 Vcc +5 Vdc ±2% @ 500 mAdc max, shared by dual encoders |

HALLS

| | |
|----------------|--|
| <i>Digital</i> | U, V, W: Single-ended, 120° electrical phase difference between U-V-W signals Schmitt trigger, 1.5 µs RC filter from active HI/LO sources, 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 |
| <i>Analog</i> | U & V: Sin/Cos format (Sin+, Sin-, Cos+, Cos-), differential, 1 Vpeak-peak ±20% BW > 300 kHz, 121 Ω terminating resistors between Sin+ & Sin-, Cos+ & Cos- inputs 16-bit resolution, BW > 300 kHz, with zero-crossing detection |

MULTI-MODE ENCODER PORT

| | |
|---------------------------|--|
| <i>As Input</i> | See Digital Incremental Encoder above for electrical data on A, B, & X channels, or Absolute encoders using X or A channels. External terminators required as shown above |
| <i>As Emulated Output</i> | Quadrature A/B encoder emulation with programmable resolution to 4096 lines (65,536 counts) per rev from analog Sin/Cos encoders or resolvers |
| <i>As Buffered Output</i> | A, /A, B, /B, outputs from MAX3032 differential line driver, X, /X, A, /A from MAX 3362 line drivers Digital A/B/X encoder signals from primary digital encoder are buffered as shown above 5 MHz max, 20 mega count/sec |

5V OUTPUT

| | |
|---------|--|
| Number | 1 |
| Ratings | +5 Vdc @ 500 mA thermal and overload protected |

NOTE:

Inputs and outputs may have more than one function. Data tables now have a Signals column that has the signal names used in the Reference Kits.

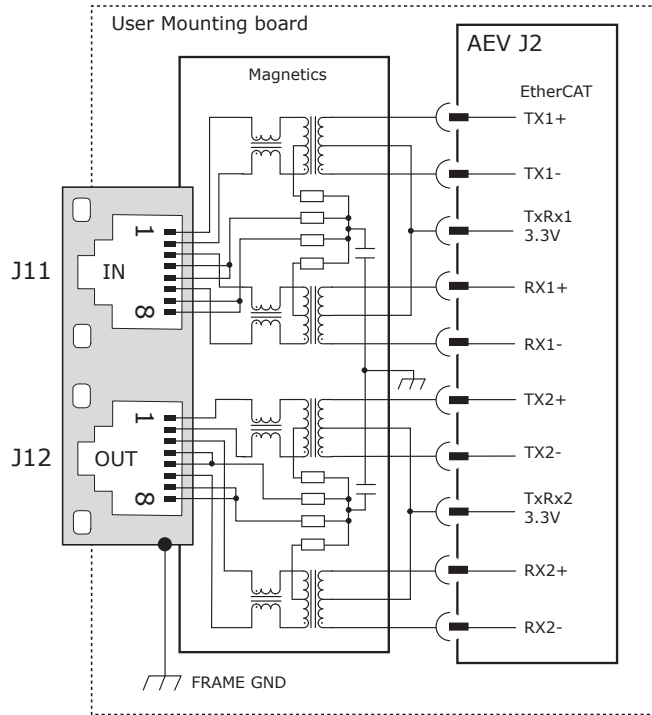
Other columns show the signal names that have been used in the datasheets.

16-01681 Document Revision History

| Revision | Date | Remarks |
|----------|--------------------|--|
| 00~09 | n/a | Developmental revisions |
| 10 | February 26, 2020 | New EZ board and EZ Development Board designs |
| 11 | May 1, 2020 | All models are CE certified, "All of the agency standards are pending at this time" note was removed. A page with information on panel-mounting has been added |
| 12 | August 31, 2020 | Correction of part numbers on pp. 18~19, clarified AEZ-090-50-C heatsink feature |
| 13 | September 25, 2020 | Correction of VLOGIC pins on pp. 16~17, added EZ board signals to data tables |
| 14 | October 21, 2020 | Data tables now have "Signals" columns that contain the labels shown in the Reference Design schematics. Other columns show the labels that have been used in the datasheets and manuals |
| 15 | November 16, 2020 | Add UL file number to Approvals in Agency Standards Conformance, ECAT corrections corrected |

ETHERCAT COMMUNICATIONS

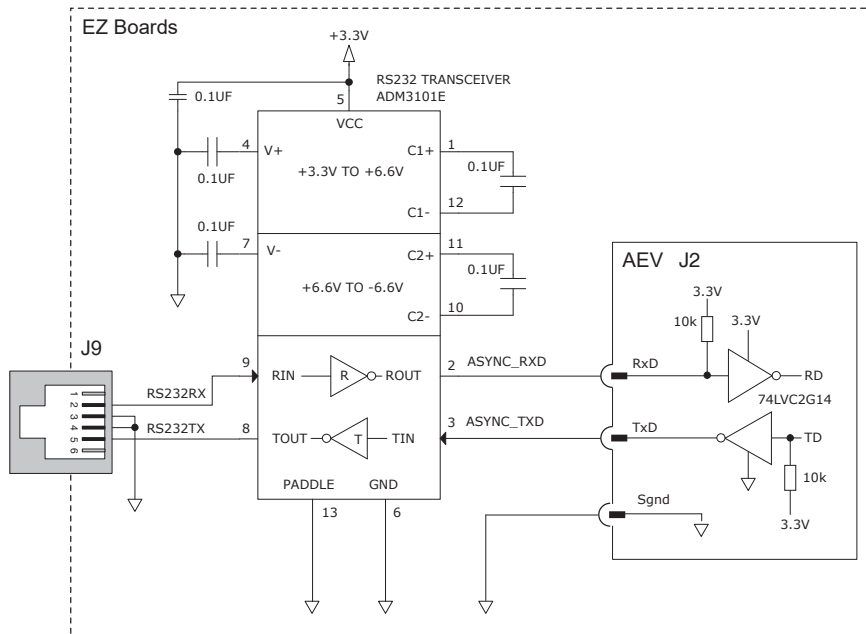
EtherCAT is the open, real-time Ethernet network developed by Beckhoff based on the widely used 100BASE-TX cabling system. EtherCAT enables high-speed control of multiple axes while maintaining tight synchronization of clocks in the nodes. Data protocol is CANopen application protocol over EtherCAT (CoE)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



| ECAT | AEV J2 Pins |
|------------|-------------|
| TX1+ | 27 |
| TX1- | 29 |
| TxRx1 3.3V | |
| RX1+ | 24 |
| RX1- | 26 |
| TX2+ | 23 |
| TX2- | 25 |
| RX2+ | 20 |
| RX2- | 22 |

RS-232 COMMUNICATIONS

RS-232 PORT



The serial port is a full-duplex, three-wire (RxD, TxD, SGND) type that operates from 9,600 to 230,400 Baud. It can be used by CME for drive configuration and setup or by external equipment sending ASCII commands.

The circuit shown here is used on the EZ board and is recommended for user's PC boards. It converts the single-ended TTL signals levels in the AEV into the ANSI RS-232 levels which are the standard for serial communications and computer COMM ports.

| RS-232 | Signal | J2 Pins |
|--------|-----------|---------|
| RxD | ASYNC_RXD | 28 |
| TxD | ASYNC_TXD | 30 |
| SGND | SGND | 32 |

SAFE TORQUE OFF (STO)

The Safe Torque Off (STO) function is defined in IEC 61800-5-2. Two channels are provided which, when de-energized, prevent the upper and lower devices in the PWM outputs from producing torque in the motor.

This provides a positive OFF capability 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 to produce torque in the motor.

INSTALLATION

DANGER

Refer to the 16-01687 Accelnet Plus Micro Modules AEV & APV User Guide

The information provided in the 16-01687 Accelnet Plus Micro Modules AEV & APV User Guide must be considered for any application using the AEV drive STO feature.

FAILURE TO HEED THIS WARNING CAN CAUSE EQUIPMENT DAMAGE, INJURY, OR DEATH.



STO DISABLE

In order for the PWM outputs of the AEV to be activated, current must be flowing through the opto-couplers that are connected to the STO-IN1 and STO-IN2 terminals and the drive must be in an ENABLED state. When either of 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 a +5V source. When this is done the STO feature is disabled and control of the output PWM stage is under control of the digital control core.

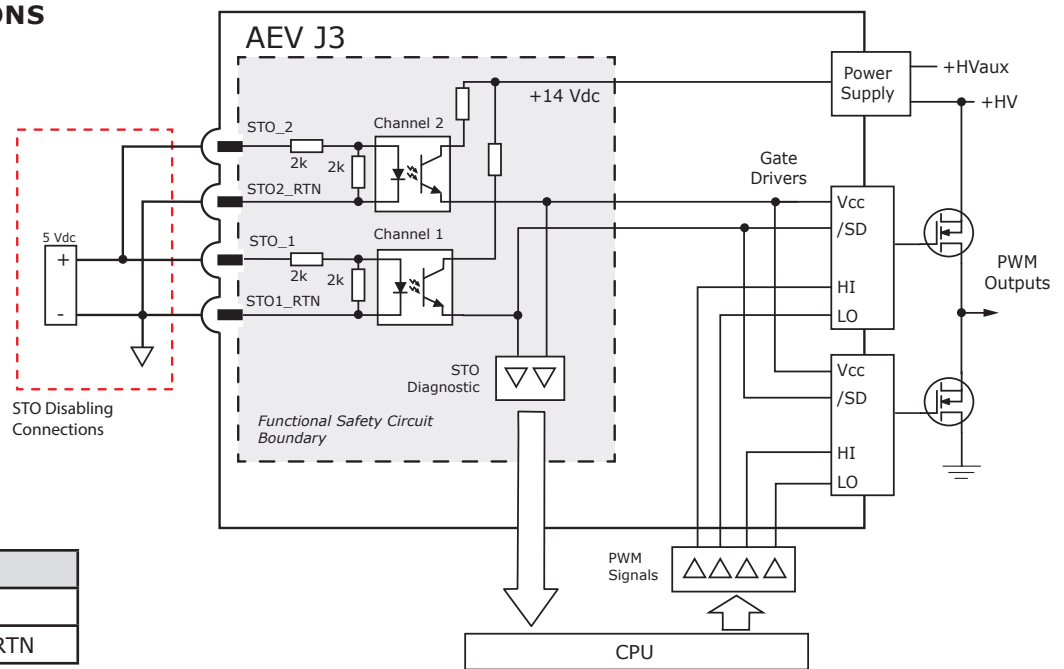
If not using the STO feature, these connections must be made in order for the drive to be enabled.

FUNCTIONAL DIAGRAM

STO DISABLE CONNECTIONS



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



J3 STO

| Signal | Pin | Signal |
|----------|-----|--------|
| STO_1 | 1 | 3 |
| STO1_RTN | 2 | 4 |
| STO_2 | | |
| STO2_RTN | | |

STO OPERATION

| STO Input Voltage | STO State |
|---------------------------|---|
| STO_1 AND STO_2 ≥ 3.3 Vdc | STO Inactive. Drive can be enabled to produce torque |
| STO_1 OR STO_2 ≤ 2.0 Vdc | STO Active. Drive cannot be enabled to produce torque |
| STO_1 OR STO_2 Open | |

Note: Voltages in the table above are referenced between an STO-INx+ and an STO-INx-.
E.g. $V(\text{STO-IN1}) = V(\text{STO-IN1+}) - V(\text{STO-IN1-})$

STO STATUS

A digital output can be programmed to be active when the drive is disabled by the STO function. The active level of the output is programmable to be HI or LO.

Note: STO Status is not part of the STO Safety Function.

DIGITAL COMMAND INPUTS: POSITION

STAND-ALONE MODE DIGITAL POSITION-CONTROL INPUTS

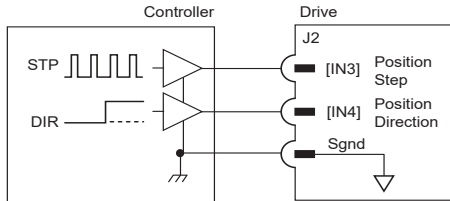
AEV works with motion controllers that output pulses to command position.

These formats are supported:

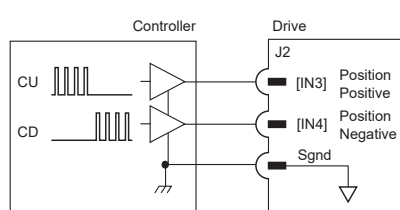
- Step/Direction
- Count-Up/Count-Down (CU/CD)
- A/B Quadrature Encoder

In Step/Direction mode, a pulse-train controls motor position, and the direction is controlled by a DC level at the Direction input. CU/CD (Count-Up/Count-Down) signals command the motor to move CW or CCW depending on which input the pulse-train is directed to. The motor can also be operated in an electronic gearing mode by connecting the inputs to a quadrature encoder on another motor. In all cases the ratio between input pulses and motor revolutions is programmable.

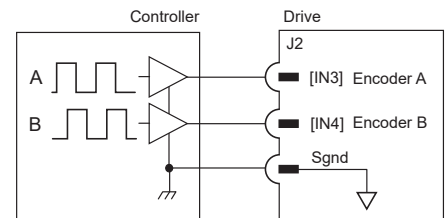
STEP/DIRECTION INPUTS



COUNT-UP/COUNT-DOWN INPUTS



QUAD A/B ENCODER INPUTS



| Command Options | Signal | J2 Pins |
|---|--------|---------|
| Step, Position Positive, Encoder A | IN3 | 7 |
| Direction, Position Negative, Encoder B | IN4 | 8 |

| J2 SGND Pins |
|-----------------------------------|
| 3,4,18,31,32,33,34,42,49,50,59,60 |

DIGITAL COMMAND INPUTS: VELOCITY, TORQUE

STAND-ALONE MODE DIGITAL VELOCITY/TORQUE CONTROL INPUTS

AEV works with motion controllers that output pulses to command velocity and torque (current).

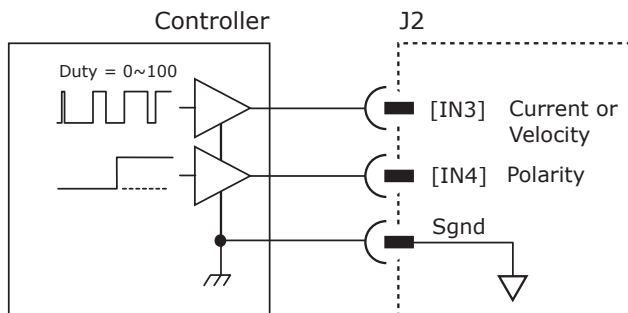
These formats are supported:

- PWM/Direction
- 50% PWM

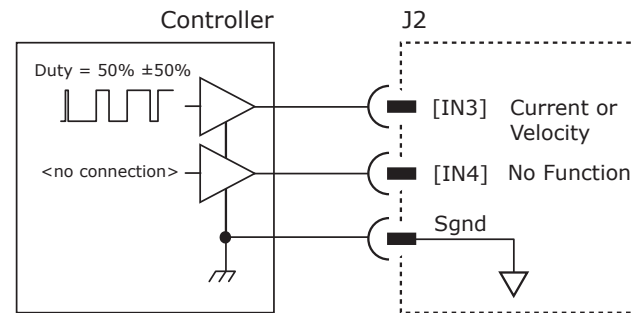
In PWM/Direction mode, a pulse-train with variable duty-cycle controls motor Vel/Trq, and the polarity or direction is controlled by HI/LO levels at the Direction input. With 50% PWM operation there is a single signal.

A 50% duty cycle produces zero output. Increasing the duty cycle to 100% produces a full-scale output in one direction and 0% duty cycle produces a full-scale output in the opposite direction.

PWM / DIRECTION



50% PWM



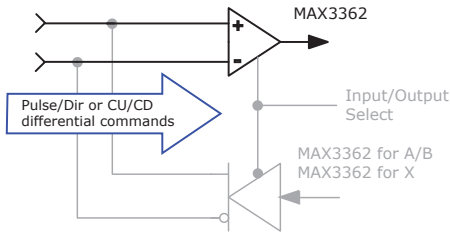
| Command Options | Signal | J2 Pins |
|-----------------------------|--------|---------|
| PWM/Dir Current or Velocity | IN3 | 7 |
| PWM/Dir Polarity | IN4 | 8 |

MULTI-MODE PORT AS AN INPUT

COMMAND INPUT

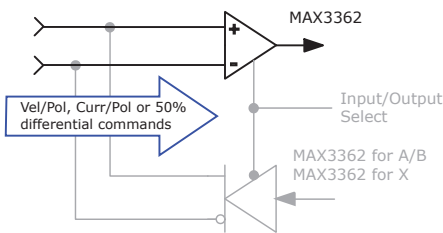
POSITION COMMANDS: DIFFERENTIAL

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



CURRENT or VELOCITY COMMANDS: DIFFERENTIAL

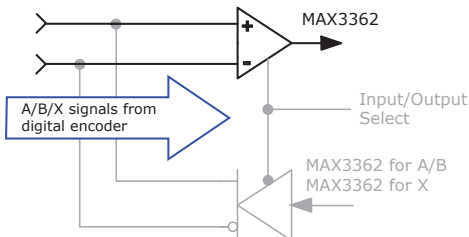
- Current/Velocity Magnitude & Direction
- Current/Velocity 50%



FEEDBACK INPUT: ENCODER 2

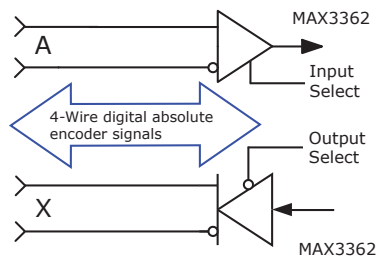
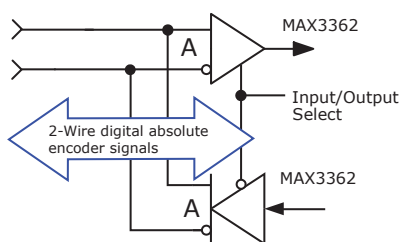
SECONDARY FEEDBACK: INCREMENTAL

- Quad A/B/X incremental encoder



SECONDARY FEEDBACK: ABSOLUTE

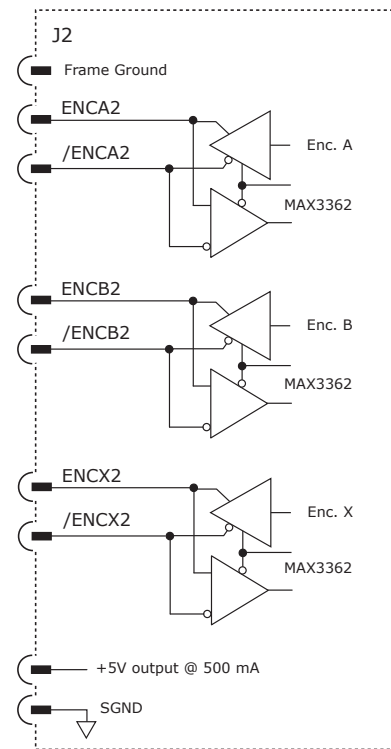
- Half-Duplex: Absolute A encoders (2-wire)
The A channel first transmits a Clock signal and then switches to a receiver to receive data from the encoder
- Full-Duplex: SSI, BiSS, EnDat encoders (4-wire)
The X channel sends the Clock signal to the encoder, which initiates data transmission to the A-channel



| Command Options | J2 Pins |
|--|---------|
| Pulse, CW, Quad Encoder A, Vel-Curr-Magnitude, Vel-Curr-50% | 51 |
| /Pulse, /CW, Quad Encoder /A, /Vel-Curr-Magnitude, /Vel-Curr-50% | 52 |
| Direction, CCW, Quad Encoder B, Vel-Curr-Direction | 53 |
| /Direction, /CCW, Quad Encoder /B, /Vel-Curr-Direction | 54 |

J2 SIGNALS

| Signal | Pin |
|--------|-----|
| ENCA2 | 51 |
| /ENCA2 | 52 |
| ENCB2 | 53 |
| /ENCB2 | 54 |
| ENCX2 | 55 |
| /ENCX2 | 56 |



| Feedback Options | J2 Pins |
|---|---------|
| Quad Encoder A, Half-Duplex CLK-DATA, Full-Duplex DATA | 51 |
| Quad Encoder /A, Half-Duplex /CLK-DATA, Full-Duplex /DATA | 52 |
| Quad Encoder B | 53 |
| Quad Encoder /B | 54 |
| Quad Encoder X, Full-Duplex CLOCK | 55 |
| Quad Encoder /X, Full-Duplex /CLOCK | 56 |

J2 SGND Pins

3,4,18,31,32,33,34,42,49,50,59,60

MULTI-MODE PORT AS AN OUTPUT

OUTPUT TYPES

BUFFERED FEEDBACK OUTPUTS: DIFFERENTIAL

An incremental encoder connected as primary feedback from the motor is internally connected to the multi-port configured as an output. This can then be wired to a motion controller that needs position data without the need for split-wiring cables from the encoder alone.

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

EMULATED FEEDBACK OUTPUTS: DIFFERENTIAL

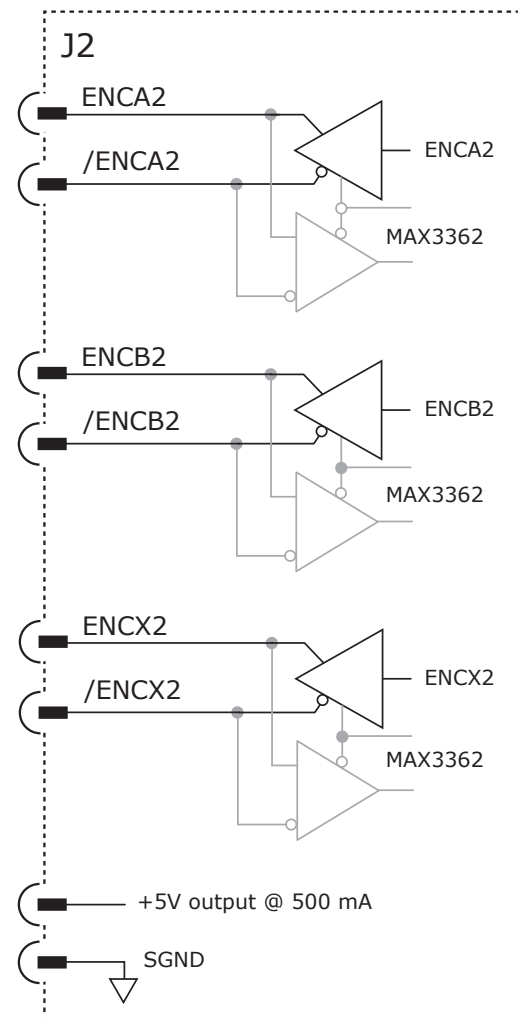
Firmware produces emulated quad A/B signals from feedback data from the following devices:

- Absolute encoders
 - Analog Sin/Cos incremental encoders
- The X channel is not used in this mode

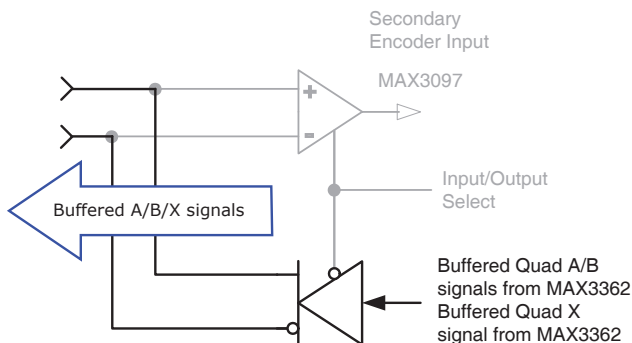
J2 SIGNALS

| Buffered A/B/X | Emulated A/B | Signal | Pin |
|----------------|--------------|--------|-----|
| Buffered A | Quad A | ENCA2 | 51 |
| Buffered /A | Quad /A | /ENCA2 | 52 |
| Buffered B | Quad B | ENCB2 | 53 |
| Buffered /B | Quad /B | /ENCB2 | 54 |
| Buffered X | | ENCX2 | 55 |
| Buffered /X | | /ENCX2 | 56 |

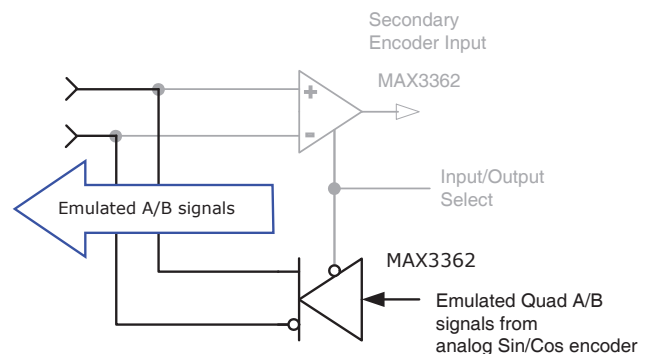
| J2 SGND Pins |
|-----------------------------------|
| 3,4,18,31,32,33,34,42,49,50,59,60 |



BUFFERED QUAD A/B/X OUTPUTS



EMULATED QUAD A/B OUTPUTS



CME DEFAULTS

These tables show the CME default settings. They are user-programmable and the settings can be saved to non-volatile flash memory as CCX or CCD files.

Input / Output > Digital Inputs

| Name | Configuration |
|------|---|
| IN1 | Amp Enable-LO Enables with Clear Faults |
| IN2 | Not Configured |
| IN3 | Not Configured |
| IN4 | Not Configured |
| IN5 | Motor Temp-Hi Disables |
| IN6 | Encoder Fault-Active HI |
| IN7* | SLI MISO (Master Input Slave Output) |

*If not used for an SLI port, this input can be programmed for other functions.

Configure Filters > Filter Settings

| Name | Notes |
|------------------|--|
| Analog Reference | Disabled |
| V Loop Input | Disabled |
| V Loop Output 1 | Low Pass, Butterworth, 2 poles, 200 Hz |
| V Loop Output 2 | Disabled |
| V Loop Output 3 | Disabled |
| I Loop Input 1 | Disabled |
| I Loop Input 2 | Disabled |
| Input Shaping | Disabled, 0.1 Poles |

Home

| | |
|-------------------|----------------------------------|
| Software Limits | Positive, Negative, Deceleration |
| Method | Set Current Position as Home |
| Fast Velocity | RPM |
| Slow Velocity | RPM |
| Accel / Decel | RPS |
| Offset | Counts |
| Homing Adjustment | Counts |

Input / Output > Digital Outputs

| Name | Notes |
|--------|--------------------------------------|
| OUT1 | Fault-Active LO |
| OUT2 | Not Configured |
| OUT3 | Brake-Active Low |
| OUT4* | SLI MOSI (Master Output Slave Input) |
| OUT5* | SLI CLK (Clock) |
| OUT 6* | SLI SS (Slave Select) |

*If not used for an SLI port, these outputs can be programmed for other functions.

Configure Faults > Latched Faults

| Active | Notes |
|--------|---------------------------|
| ✓ | Short Circuit |
| ✓ | Amp Over Temperature |
| ✓ | Motor Over Temp |
| | Over Voltage |
| | Under Voltage |
| ✓ | Feedback Error |
| | Motor Phasing Error |
| ✓ | Following Error |
| | Command Input Lost |
| | Motor Wiring Disconnected |
| | STO Active |

Configure Faults > Optional Faults

| | |
|--|------------------------|
| | Over Current (Latched) |
|--|------------------------|

✓ These are the default settings for Latched Faults. Using CME, these can be checked or unchecked.

HIGH SPEED INPUTS: IN1, IN2, IN3, IN4, IN5, IN6

The six digital inputs to the AEV are programmable to a selection of functions. All have 100 ns RC filters when driven by active sources (CMOS, TTL, etc) and all have 10 kΩ pull-up resistors to +5 Vdc. In addition to the selection of functions, the active level for each input is individually programmable. Input *level* functions have programmable HI or LO to activate the function. Input *transition* functions are programmable to activate on LO -> HI, or HI -> LO transitions.

INPUT LEVEL FUNCTIONS

- Drive Enable, Enable with Clear Faults, Enable with Reset
- PWM Sync
- Positive Limit Switch
- Negative Limit Switch
- Home Switch
- Encoder Fault
- Motor Temperature Sensor Input
- Motion Abort
- High-Resolution Analog Divide

INPUT TRANSITION FUNCTIONS

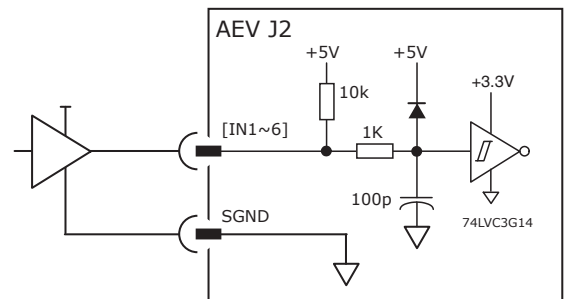
- Clear Faults and Event Latch
- Drive Reset
- PWM Sync Input
- Trajectory Update
- Count Input Edges, Save to Register
- High-Speed Position Capture
- Simulated Absolute Encoder Burst
- Abort Move if > N Counts From Destination in Register

SPECIFICATIONS

| Input | Data | Notes |
|-----------------|-----------------|-------------------------------|
| Input Voltages | HI | $V_{T+} = 1.42 \sim 2.38$ Vdc |
| | LO | $V_{T-} = 0.68 \sim 1.6$ Vdc |
| | Hys | $V_H = 0.44 \sim 1.26$ |
| | Max | +6 Vdc |
| | Min | 0 Vdc |
| Pull-up | R1 | 10 kΩ |
| Low pass filter | R2 | 1 kΩ |
| | C1 | 100 pF |
| | RC ¹ | 0.1 μs |

CONNECTIONS

| Signal | J2 Pins |
|--------|---------|
| IN1 | 5 |
| IN2 | 6 |
| IN3 | 7 |
| IN4 | 8 |
| IN5 | 9 |
| IN6 | 10 |



J2 SGND PINS

3,4,18,31,32,33,34,42,49,50,59,60

HIGH SPEED INPUT: IN7

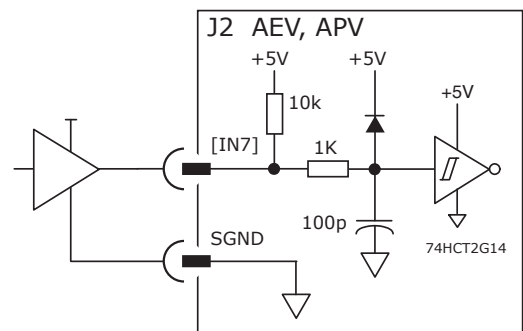
- Digital, non-isolated
- Programmable functions
- MISO Input when SLI port is in use.

SPECIFICATIONS

| Input | Data | Notes |
|-----------------|-----------------|---------------------------------|
| Input Voltages | HI | $V_{T+} \geq 1.3 \sim 2.0$ Vdc |
| | LO | $V_{T-} \leq 0.55 \sim 1.3$ Vdc |
| | Hys | $V_H 0.40 \sim 0.79$ Vdc |
| | Max | +6 Vdc |
| | Min | 0 Vdc |
| Pull-up | R1 | 10 kΩ |
| Low pass filter | R2 | 1 kΩ |
| | C1 | 100 nF |
| | RC ¹ | 0.1 μs |

CONNECTIONS

| Signal | J2 Pins |
|--------|---------|
| IN7 | 11 |



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

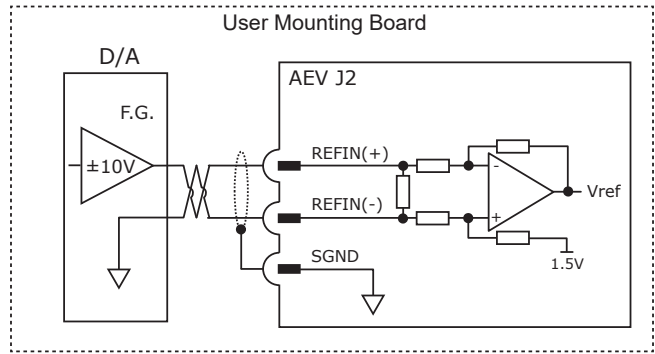
ANALOG INPUT: AIN1

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 | 5.09 kΩ |

| Signal | J2 Pins |
|----------|---------|
| REFIN(+) | 2 |
| REFIN(-) | 1 |

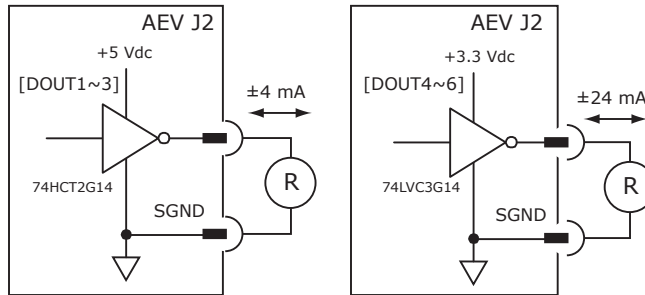


DIGITAL OUTPUTS: OUT1~OUT6

Digital outputs [OUT1~3] are HCT CMOS inverters. They operate from +5V and can source/sink 4 mA. [OUT4~6] are LVC CMOS inverters. They operate from 3.3V and can source/sink 24 mA. The output functions shown below are programmable to turn the output ON (HI) or OFF (LO) when active.

OUTPUT FUNCTIONS

- Fault
- Brake
- Custom event
- PWM Sync
- Custom Trajectory status
- Custom position-triggered output
- Program control



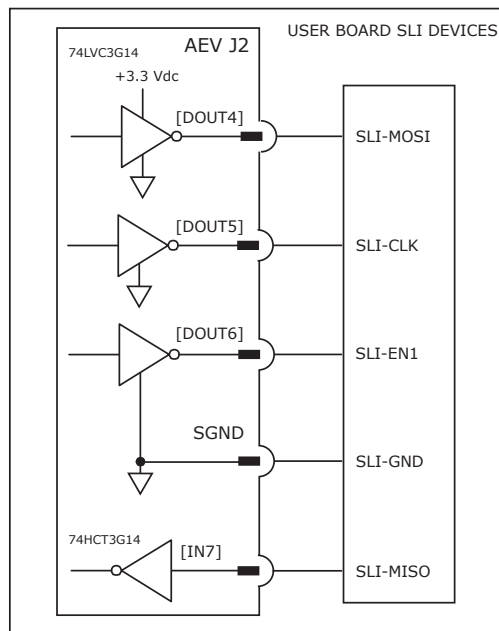
| Signal | J2 Pins |
|--------|---------|
| DOUT1 | 13 |
| DOUT2 | 12 |
| DOUT3 | 15 |
| DOUT4 | 14 |
| DOUT5 | 17 |
| DOUT6 | 16 |

SLI (Switch & LED Interface) PORT

These three outputs and one input operate as an SLI (Switch and LED Interface) port for controlling LEDs and reading the settings the network address switches. The graphic below shows them in SLI mode. If not used for SLI they are programmable for other functions to turn the output ON (HI) or OFF (LO) when active. [IN7] is shown here for completeness as part of the SLI function.

OUTPUT FUNCTIONS

- Fault
- Brake
- Custom event
- PWM Sync
- Custom Trajectory status
- Custom position-triggered output
- Program control

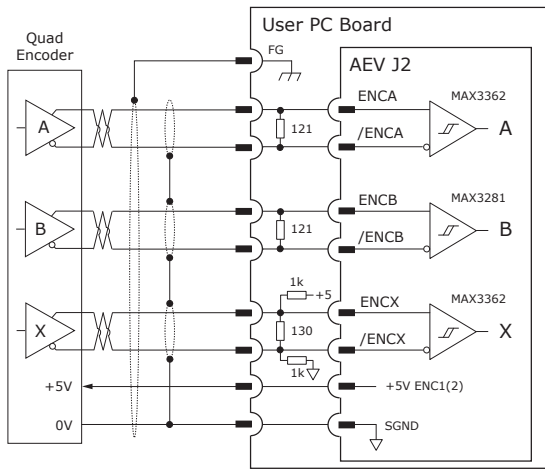


| SLI PORT | Signal | J2 Pins |
|----------|--------|---------|
| SLI-MOSI | DOUT4 | 14 |
| SLI-CLK | DOUT5 | 17 |
| SLI-EN1 | DOUT6 | 16 |
| SLI-GND | SGND | 18 |
| SLI-MISO | IN7 | 11 |

| J2 SGND Pins |
|---------------------------------------|
| 3,4,18,31,32,33, 34,42,49,50,59,60 |

ENCODER 1 (PRIMARY FEEDBACK)

QUAD ENCODER WITH INDEX



A/B/X SIGNALS

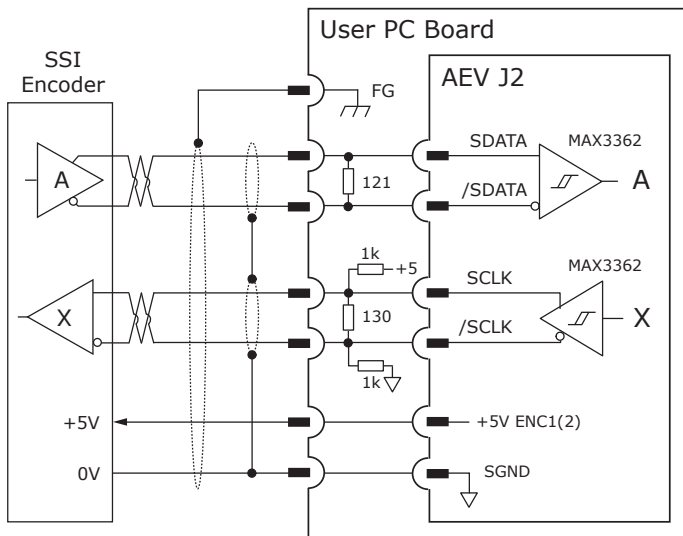
| Signal | J2 Pins |
|--------|---------|
| ENCA1 | 43 |
| /ENCA1 | 44 |
| ENCB1 | 45 |
| /ENCB1 | 46 |
| ENCX1 | 47 |
| /ENCX1 | 48 |
| +5VENC | 57,58 |

J2 SGND Pins

3,4,18,31,32,33,34,42,49,50,59,60

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 AEV 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 number of encoder data bits and counts per motor revolution are programmable. The hardware bus consists of two signals: SCLK and SDATA. The SCLK signal is only active during transfers. Data is clocked in on the falling edge of the clock signal.



SSI, BiSS SIGNALS

| SSI | BiSS | Signal | J2 Pins |
|--------|--------|--------|---------|
| SCLK | MA+ | ENCX1 | 47 |
| /SCLK | MA- | /ENCX1 | 48 |
| SDATA | SL+ | ENCA1 | 43 |
| /SDATA | SL- | /ENCA1 | 44 |
| +5V | +5VENC | | 57,58 |

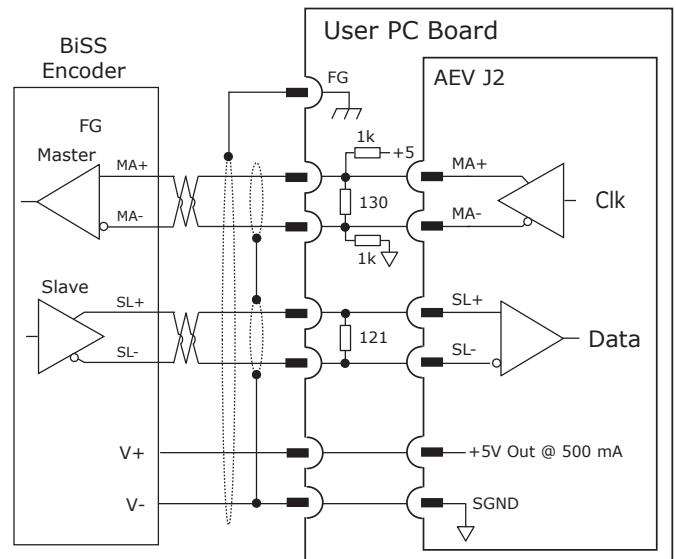
BiSS ABSOLUTE ENCODER

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



Note: Signal (outer) shields should be connected at the drive end. Inner shields are optional for digital encoders and should only be connected to Signal Ground on the drive.

ENCODER 1 (PRIMARY FEEDBACK)

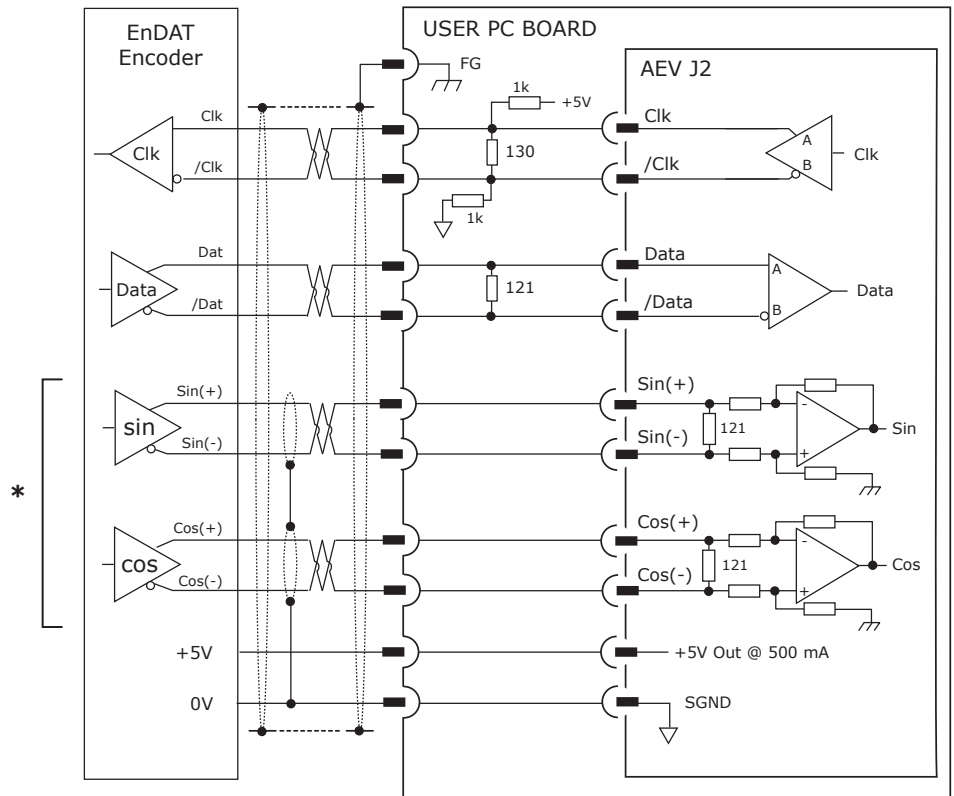
ENDAT ABSOLUTE ENCODER

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

| EnDAT | Signal | J2 Pins |
|--------|--------|---------|
| Clk | ENCX1 | 47 |
| /Clk | /ENCX1 | 48 |
| Data | ENCA1 | 43 |
| /Data | /ENCA1 | 44 |
| Sin(+) | SIN1+ | 36 |
| Sin(-) | SIN1- | 35 |
| Cos(+) | COS1+ | 38 |
| Cos(-) | COS1- | 37 |
| +5V | +5ENC | 57,58 |

* Sin/Cos optional with EnDat 2.2 or any 1 Mbit or faster EnDat
Sin/Cos required if EnDat 2.1 < 1 Mbit



J2 Signal Ground Pins

3,4,18,31,32,33,34,42,49,50,59,60

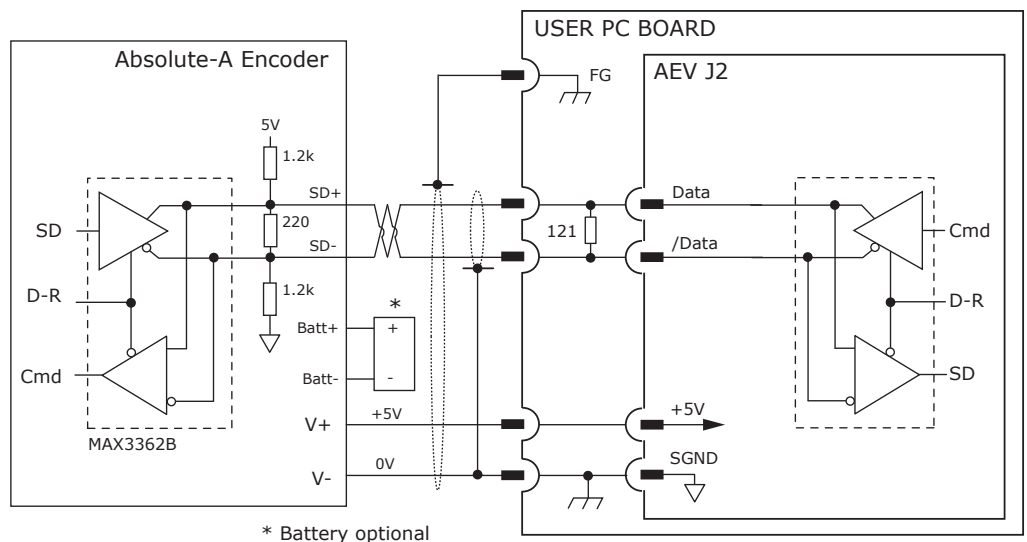
ABSOLUTE-A ENCODER

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 SIGNALS

| ABS-A | Signal | J2 Pins |
|-------|--------|---------|
| Data | ENCA1 | 43 |
| /Data | /ENCA1 | 44 |
| +5V | +5ENC | 57,58 |

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



* Battery optional

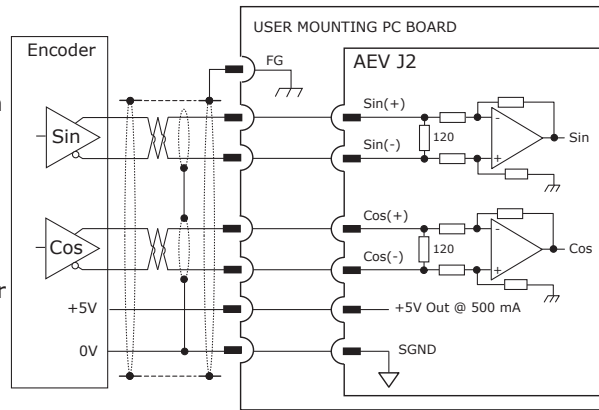
Note: Signal (outer) shields should be connected at the drive end. The inner shield is optional for digital encoders and should only be connected to Signal Ground on the drive.

ANALOG ENCODER

SIN/COS ENCODERS

Sin/Cos sensors in linear brushless motors are produced from the magnetic field in the rod and provide commutation feedback as well as higher resolution position feedback by interpolating of the signals.

Incremental rotary encoders are also available with Sin/Cos outputs. Programmable interpolation enables the number of counts per revolution or linear movement to be programmed.

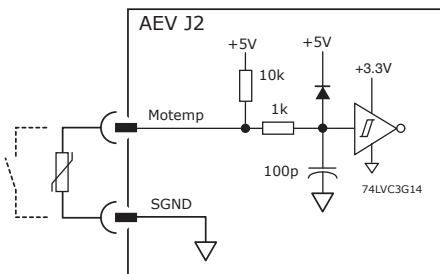


| Encoder | Signal | J2 Pins |
|---------|--------|---------|
| Sin(+) | SIN1+ | 36 |
| Sin(-) | SIN1- | 35 |
| Cos(+) | COS1+ | 38 |
| Cos(-) | COS1- | 37 |
| +5V | +5VENC | 57,58 |

OTHER MOTOR CONNECTIONS

MOTOR TEMPERATURE SENSOR

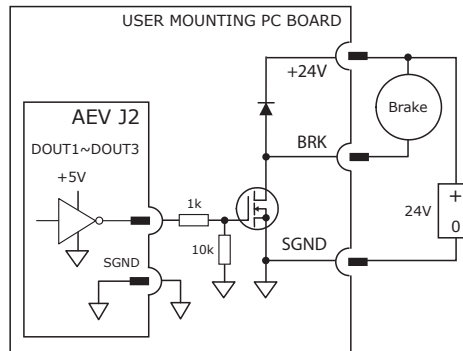
Any digital input is programmable for use with a motor overtemperature switch. Either a HI or LO input level is programmable to signal an over-temp condition.



| Input | Signal | J2 Pins |
|--------|--------|---------|
| Motemp | IN5 | 9 |
| SGND | SGND | 3 |

MOTOR BRAKE

OUT1~OUT3 have +5V outputs that can control a MOSFET. When programmed for brake control with an active HI level, the output will turn on the MOSFET, releasing the brake and allowing the motor to move.

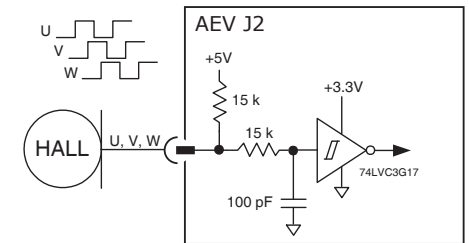


| Brake | Signal | J2 Pins |
|--------|--------|---------|
| OUT1 | DOUT1 | 13 |
| OUT2 | DOUT2 | 12 |
| OUT3 * | DOUT3 | 15 |

* OUT3 is brake default

HALLS

Hall sensors in a brushless motor are produced from the magnetic field in the motor and provide commutation feedback without an encoder. When used with incremental encoders, they enable the motor to operate without a phase-finding cycle.



| Input | Signal | J2 Pins |
|--------|--------|---------|
| Hall U | HALLU | 39 |
| Hall V | HALLV | 40 |
| Hall W | HALLW | 41 |

J2 Signal Ground Pins

3,4,18,31,32,33,34,42,49,50,59,60

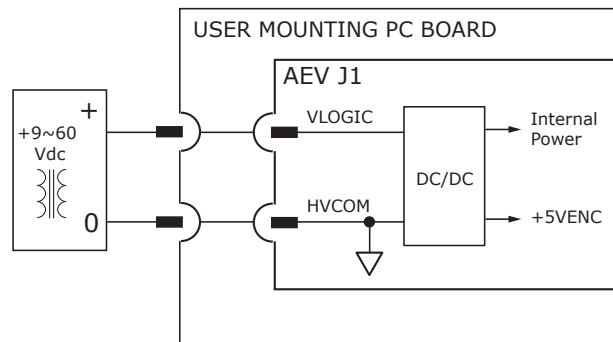
VLOGIC

DESCRIPTION

Powers the internal logic and control circuits in the drive.

When using the STO feature, it must be produced by power supplies with transformer isolation from the mains and PELV or SELV ratings and a maximum output voltage of 60 Vdc.

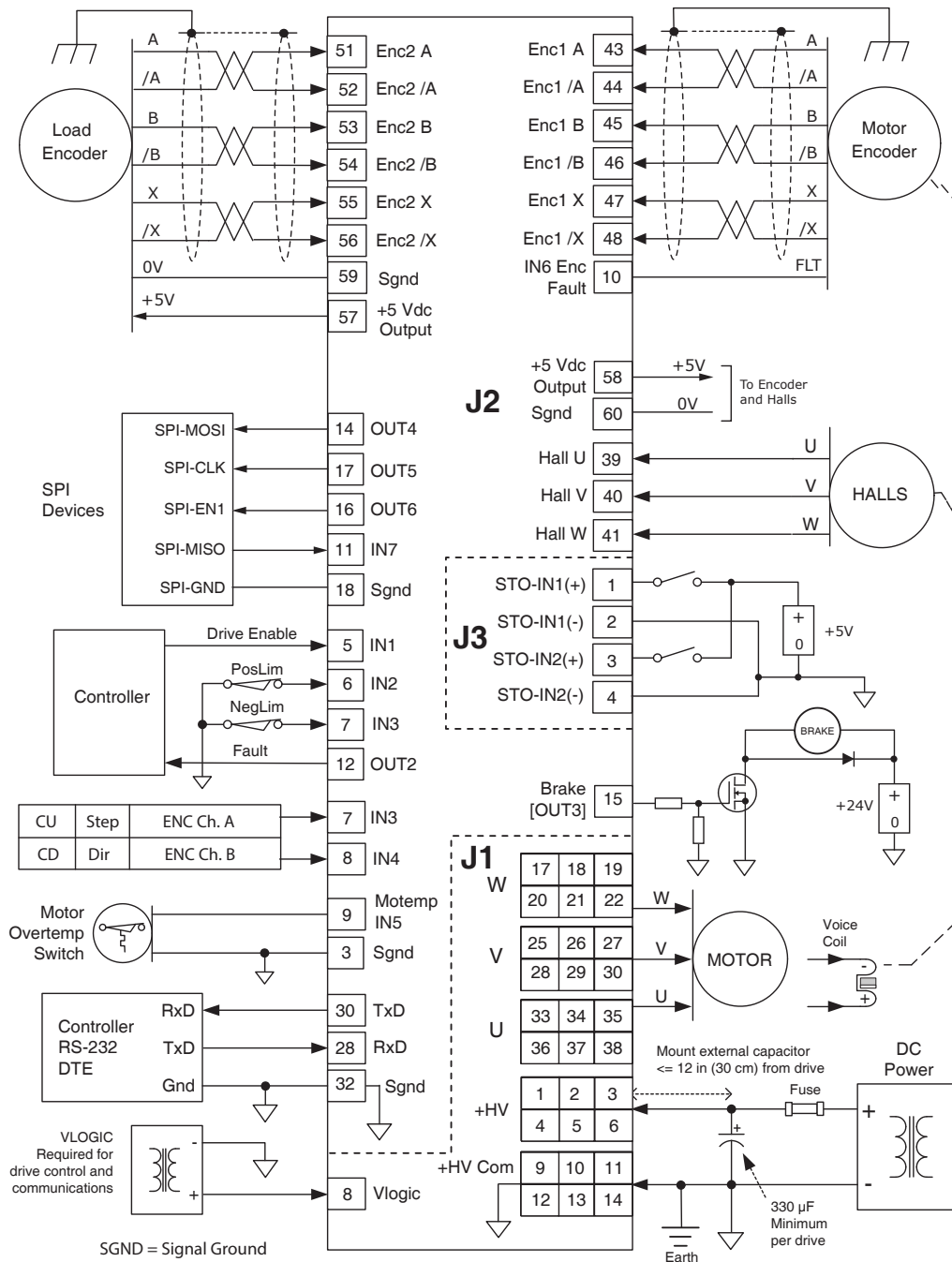
If the motor can operate from voltages of 60 Vdc or less, the +HV and VLOGIC can be driven from a single power supply.



| Signal | J1 Pins |
|--------|------------------|
| VLOGIC | 8 |
| HVCOM | 9,10,11,12,13,14 |

TYPICAL CONNECTIONS

This graphic shows the functional connections between AEV connectors and various devices. User mounting board connections are not shown.

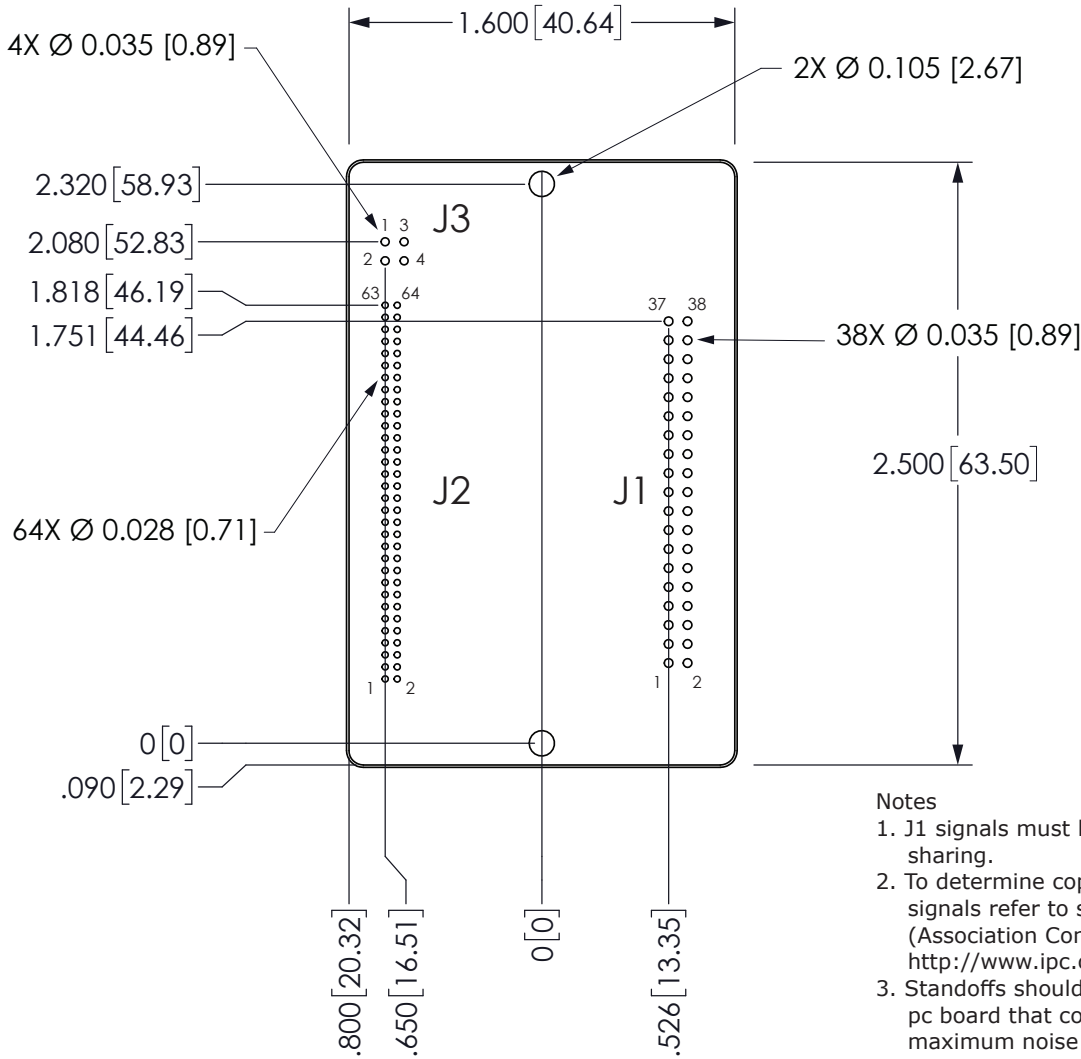


NOTES

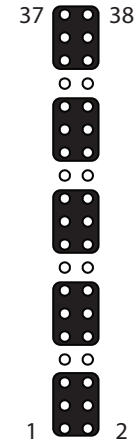
- [IN1] is shown as Drive Enable and [IN2] and [IN3] are shown with some typical functions. [IN3] and [IN4] are shown as digital command inputs. [IN3] is shown twice. If SLI function is used, it will not be available for other functions. All inputs are programmable.
- [OUT2] is shown as a Fault signal to the controller and [OUT3] is shown as control for a motor brake. All outputs are programmable.
- Encoder connections are shown for incremental types, but absolute encoders are supported on both primary and load encoder inputs.

PC BOARD MOUNTING & DRILLING DIMENSIONS

Top view looking down on mounting PC board



J1 Signal Grouping for current-sharing



Notes

1. J1 signals must be connected for current-sharing.
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 should be connected to etches on pc board that connect to frame ground for maximum noise suppression and immunity. They also provide the PE (Protective Earth) connection between the heatplate and ground.

Dimensions are in inches [mm]

For Sockets on User PC Board:

| Qty | Description | Mfgr | Part Number | Ref Des | Remarks |
|-----|--------------|-----------------------------------|----------------------|---------|---------------------------|
| 1 | Socket Strip | Samtec | SQT-119-01-G-D | J1 | 0.0787 in (2.00 mm) pitch |
| 1 | Socket Strip | Samtec | FLE-132-01-G-DV-K-TR | J2 | 0.050 in (1.27 mm) pitch |
| 1 | Socket Strip | Samtec | TLE-102-01-G-DV-TR | J3 | 0.0787 in (2.00 mm) pitch |
| 2 | Standoff | hex, 20.5 mm long, M2.5 mm thread | | | |

For Soldering to User PC Board:

| Qty | Description | Mfgr | Part Number | Ref Des | Remarks |
|-----|---|----------------------------------|-------------|---------|---------|
| 1 | For J1, refer to this document: http://suddendocs.samtec.com/processing/through-hole-printing.pdf | | | | |
| 2 | Standoff | hex, 15 mm long, M 2.5 mm thread | | | |

PC BOARD SIGNALS

J3 SAFETY

| SIGNAL | PIN | PIN | SIGNAL |
|----------|-----|-----|----------|
| STO_1 | 1 | 3 | STO_2 |
| STO1_RTN | 2 | 4 | STO2_RTN |

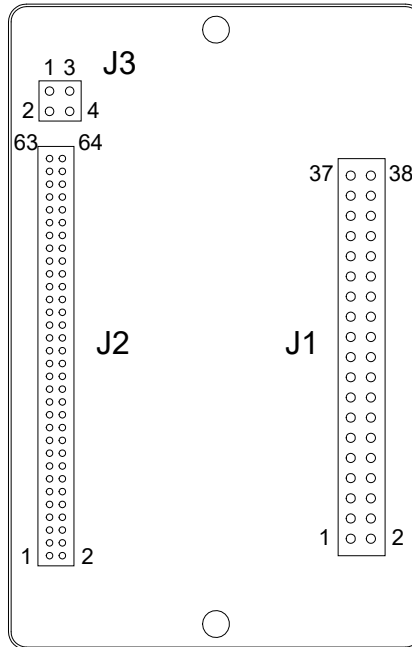
J2 FEEDBACK

| Signal | P3 Pin | Signal |
|-----------------|--------|--------|
| * | 63 | 64 |
| * | 61 | 62 |
| SGND | 59 | 60 |
| +5VENC | 57 | 58 |
| ENCX2 | 55 | 56 |
| ENCB2 | 53 | 54 |
| ENCA2 | 51 | 52 |
| SGND | 49 | 50 |
| ENCX1 | 47 | 48 |
| ENCB1 | 45 | 46 |
| ENCA1 | 43 | 44 |
| HALLW | 41 | 42 |
| HALLU | 39 | 40 |
| COS1- | 37 | 38 |
| SIN1- | 35 | 36 |
| SGND | 33 | 34 |
| SGND | 31 | 32 |
| ECATTX1- | 29 | 30 |
| ECATTX1+ | 27 | 28 |
| ECATTX2- | 25 | 26 |
| ECATTX2+ | 23 | 24 |
| +3.3V_TXR2 | 21 | 22 |
| +3.3V_TXR1 | 19 | 20 |
| (SLI-CLK) DOUT5 | 17 | 18 |
| (BRAKE) DOUT3 | 15 | 16 |
| DOUT1 | 13 | 14 |
| (SLI-MISO) IN7 | 11 | 12 |
| IN5 | 9 | 10 |
| IN3 | 7 | 8 |
| (Enable) IN1 | 5 | 6 |
| SGND | 3 | 4 |
| REFIN(-) | 1 | 2 |

* Do NOT CONNECT TO THESE PINS

TOP VIEW

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



Connector part numbers for socket mounting.

- J1: HV & Motor
Dual row, 2 mm centers
38 position female header
Samtec: SQT-119-01-G-D
- J2: Feedback
Dual row, 0.050 inch centers
64 position female header
Samtec: FLE-132-01-G-DV-K-TR
- J3: Safety
Dual row, 2 mm centers
4 position female header
Samtec: TLE-102-01-G-DV-TR

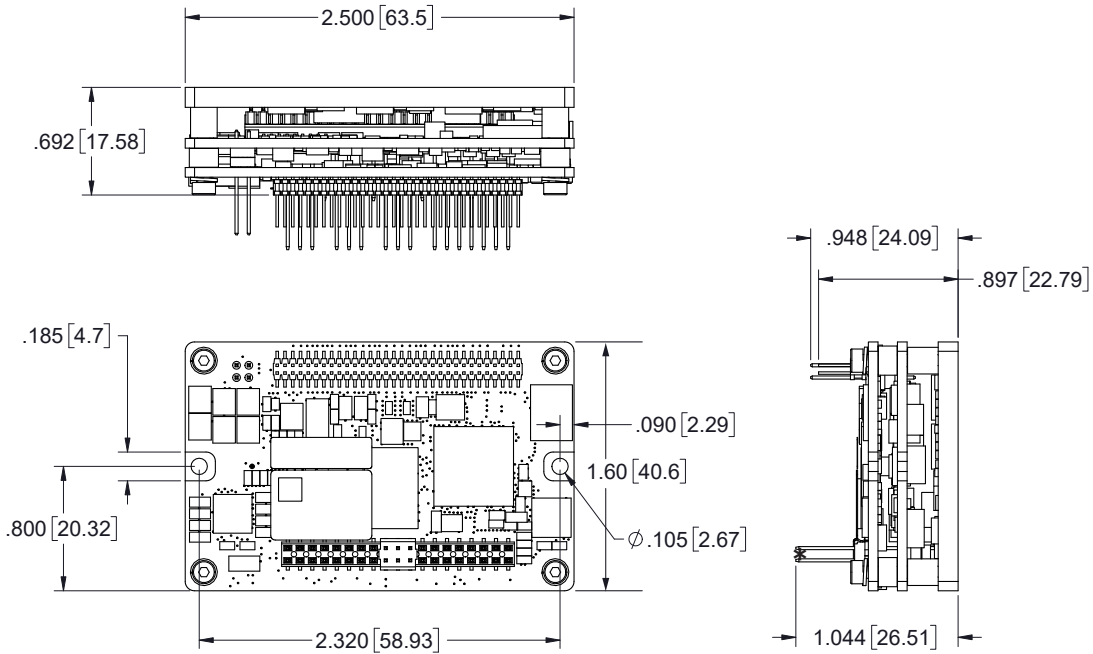
J1 POWER & MOTOR

| Signal | J1 Pin | Signal |
|--------|--------|--------|
| MOTU | 37 | 38 |
| | 35 | 36 |
| | 33 | 34 |
| * | 31 | 32 |
| MOTV | 29 | 30 |
| | 27 | 28 |
| | 25 | 26 |
| * | 23 | 24 |
| MOTW | 21 | 22 |
| | 19 | 20 |
| | 17 | 18 |
| * | 15 | 16 |
| HVCOM | 13 | 14 |
| | 11 | 12 |
| | 9 | 10 |
| * | 7 | 8 |
| +HV | 5 | 6 |
| | 3 | 4 |
| | 1 | 2 |

* Do NOT CONNECT TO THESE PINS

DIMENSIONS

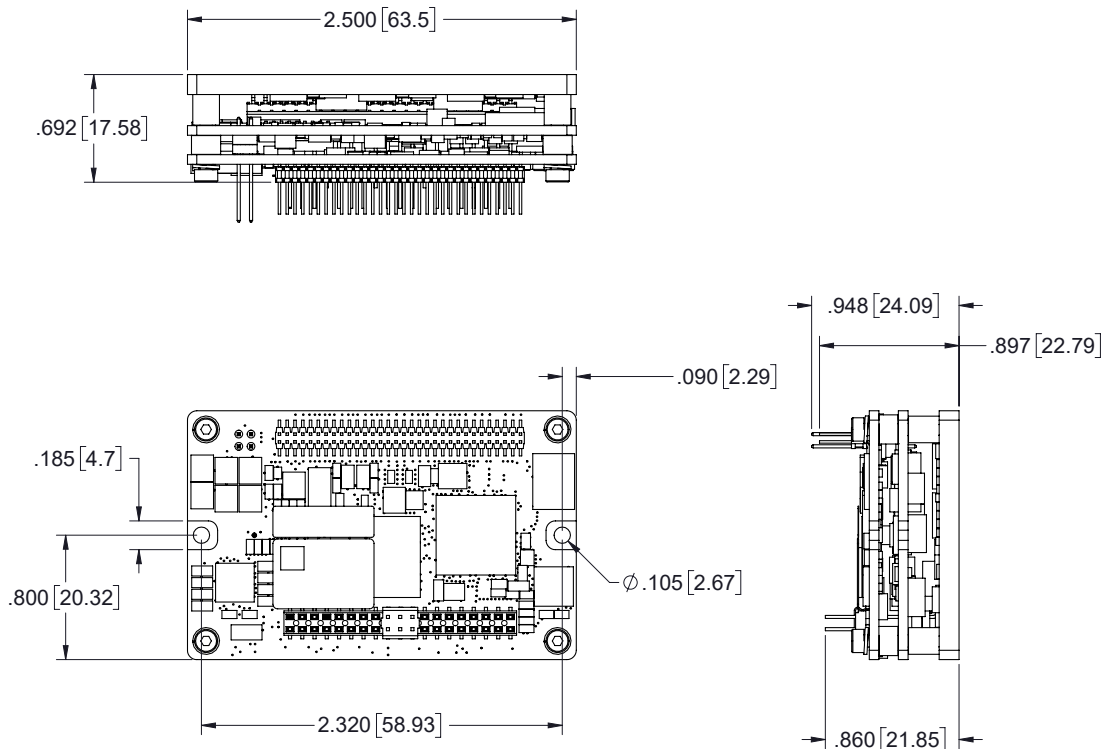
AEV-090-50, AEV-090-50-C



Dimensions are in inches [mm].

* These pins are longer for soldering to the user PC board.

AEV-090-14, AEV-090-30, AEV-180-10, AEV-180-20

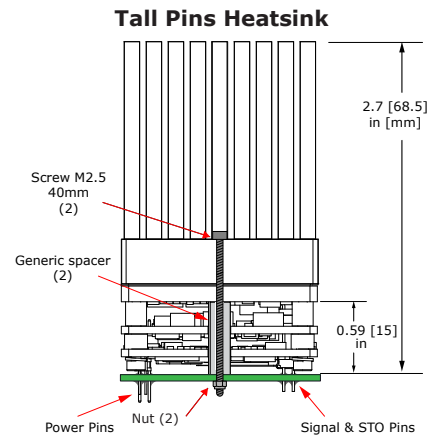
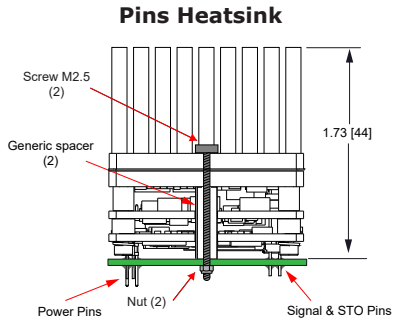


MOUNTING: SOLDERED INTO USER PC BOARD

AEV-090-50, AEV-090-50-C

Kits are not available for this configuration. Here are the parts required:

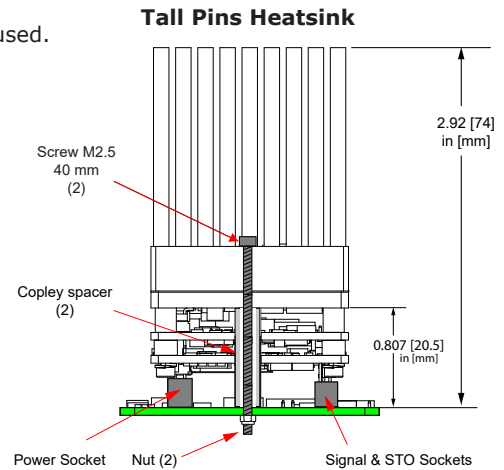
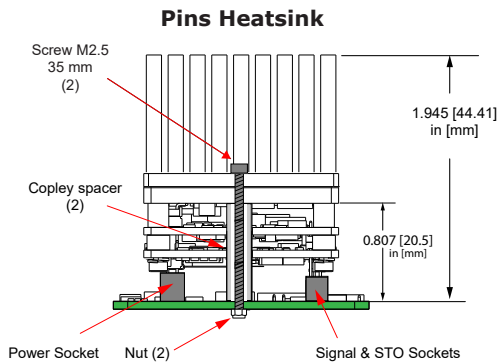
- Standoffs: 15 mm, diameter 4.5 mm, hollow, aluminum, RAF M0514-25, qty 2
- Thermal pad: Copley CC 6-83985-01, qty 1
- Pins Heatsink: Copley CC 21-126260-01, qty 1
- Screws: M2.5, Length dependent on assembly, qty 2
- Nuts: M2.5, Dependent on assembly, qty 2



MOUNTING: SOCKETED INTO USER PC BOARD

AEV-090-14, AEV-090-30, AEV-180-10, AEV-180-20

All connections shown socketed. With the pins heatsink the 30 mm screws are used. With the long pins heatsink the 40 mm screws are used.



PINS HEATSINK KIT: AEV-HK

| Part | Part Number | Qty |
|------------------|---------------------------------------|-----|
| Screw | M2.5-0.45 x 35 mm slotted cheese head | 2 |
| Nut | M2.5-0.45 DIN nylon lock nut | 2 |
| Thermal material | Copley | 1 |
| Spacer | Copley non-threaded spacer 20.5 mm, | 2 |
| Heatsink | Pins Heatsink, 1 inch tall | 1 |

TALL PINS HEATSINK KIT: AEV-THK

| Part | Part Number | Qty |
|------------------|---------------------------------------|-----|
| Screw | M2.5-0.45 x 40 mm slotted cheese head | 2 |
| Nut | M2.5-0.45 DIN nylon lock nut | 2 |
| Thermal material | Copley | 1 |
| Spacer | Copley non-threaded spacer 20.5 mm, | 2 |
| Heatsink | Tall Pins Heatsink, 2 inch tall | 1 |

CONNECTORS FOR SOCKETING

| Part | Mfgr | Part Number | Qty |
|---------------|--------|----------------------|-----|
| Signal Socket | Samtec | FLE-132-01-G-DV-K-TR | 1 |
| Power Socket | Samtec | SQT-119-01-G-D | 1 |
| STO Socket | Samtec | TLE-102-01-G-DV-TR | 1 |

For the half-soldered configuration the dimensions, spacers, screws, and nuts are the same.

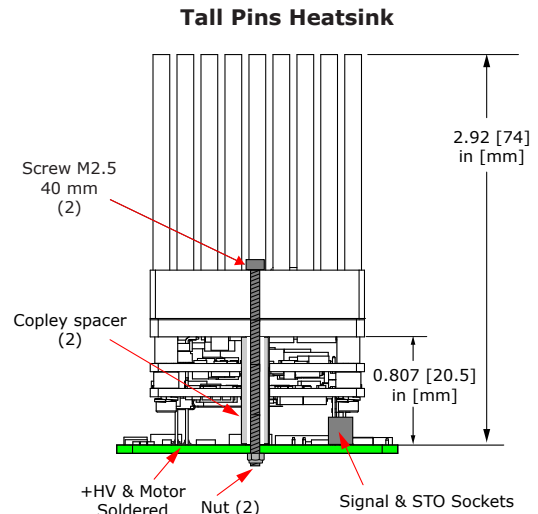
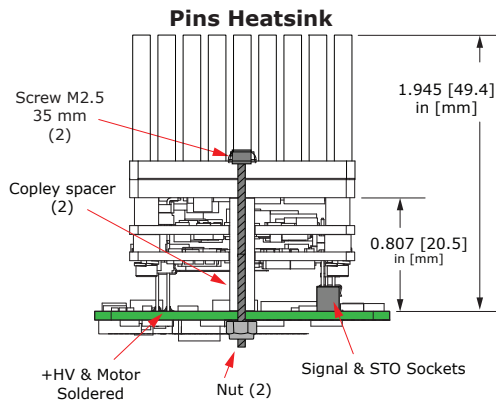
MOUNTING: HALF-SOCKETED INTO USER PC BOARD

APV-090-14, APV-090-30, APV-180-10, APV-180-20

Signal J2 and STO J3 are socketed. Power & motor J1 are soldered. With the pins heatsink 35 mm screws are used. With the long pins heatsink 40 mm screws are used.

CONNECTORS FOR HALF-SOCKETING

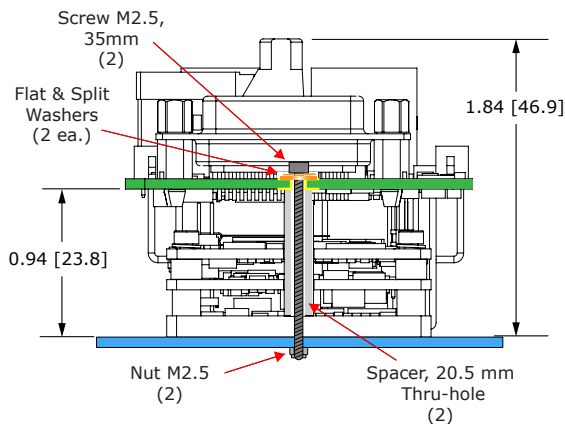
| Part | Mfgr | Part Number | Qty |
|------------------|--------|----------------------|-----|
| Signal Socket J2 | Samtec | FLE-132-01-G-DV-K-TR | 1 |
| STO Socket J3 | Samtec | TLE-102-01-G-DV-TR | 1 |



PANEL MOUNTING: AEV & EZ BOARD

AEV-090-14, AEV-090-30, AEV-180-10, AEV-180-20

These models are shown below socketed into an EZ Board. Screws pass through the EZ Board and standoffs to nuts that hold the drive to the panel. Tapping a hole in the panel to accept the M2.5-0.45 screw allows the drive to be mounted and removed from one side of the panel. User-designed mounting boards should have the same conductive etch rings around the screw holes to provide PE grounding for their circuits.



PANEL MOUNTING PARTS

| Part | Part Number | Qty |
|-------------------|---------------------------------------|-----|
| Screw | M2.5-0.45 x 35 mm slotted cheese head | 2 |
| Nut | M2.5-0.45 DIN nylon lock nut | 2 |
| Thermal material | Copley | 1 |
| Spacer | Copley non-threaded spacer 20.5 mm | 2 |
| Flat Washer | Metric, M2.5, flat | 2 |
| Split Lock Washer | Metric, M2.5, lock | 2 |

AEZ-090-50

This model has the motor, +HV, and grounding pins soldered to the EZ board. The signal and STO pins are socketed. The dimensions and mounting to a panel are the same as the AEV models.

IMPORTANT

The example shown here using the EZ Board to mount to a panel does not apply to panel mounting of the AEV-090-50 and AEV-090-50-C models. These models are incompatible with the EZ Board.

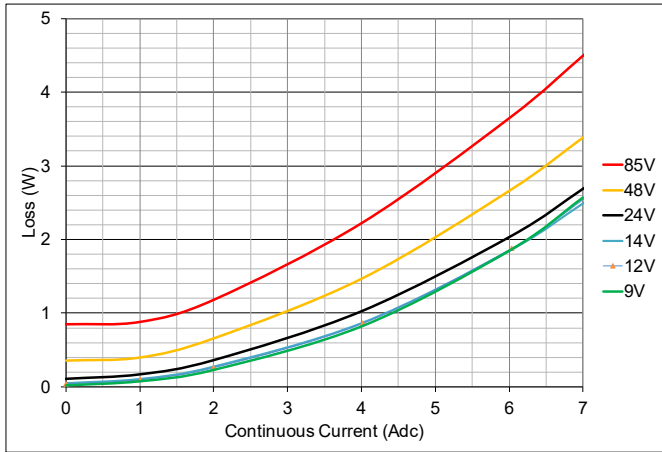
IMPORTANT

Standoffs must be metal, preferably brass. The EZ Board has conductive etch rings on each side of the screw holes which connect via etch through the holes. The screws then provide a path from the PE circuits on the drive through the standoffs and drive heatplate to the mounting panel which should be earthed. The etch on the bottom of the holes connects to the standoffs and drive heatplate, providing a PE ground for the heatplate. The thermal material between the mounting board and heatplate of the drive is non-conductive so effective grounding of the heatplate is provided by through the standoffs.

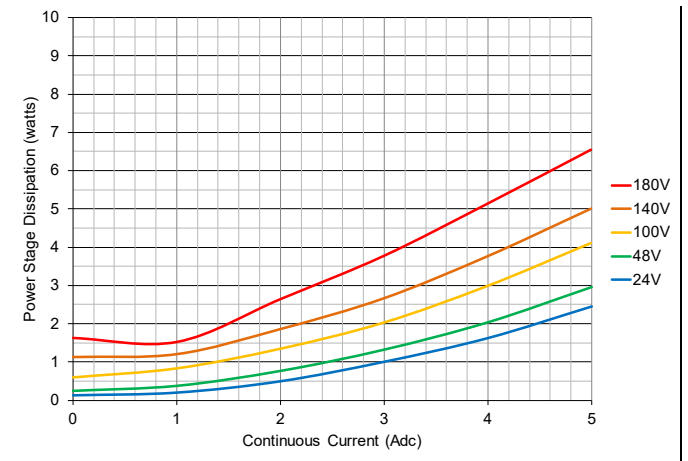
THERMALS: PWM OUTPUTS DISSIPATION

These charts show power dissipation in the drive when the PWM outputs are driving a motor. The following page shows the dissipation in the VLOGIC circuits that power the drives control circuits and external encoders. Adding the PWM dissipation to the VLOGIC dissipation will yield the total dissipation in Watts for the drive. The dotted lines in the AEV-090-30 chart show a dissipation of 9.5 W. at a continuous current of 13 Adc and +HV = 85 Vdc.

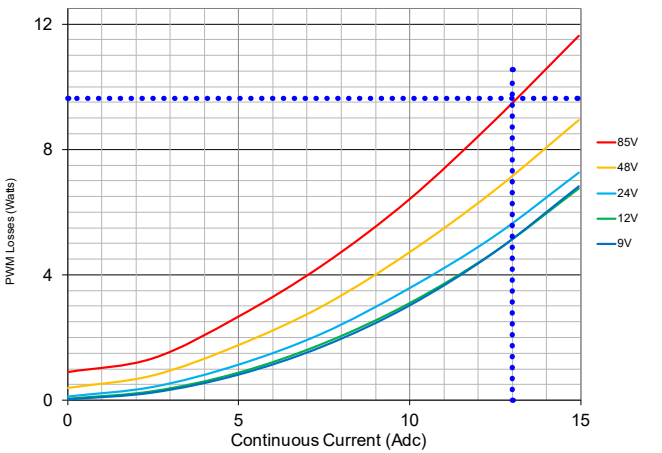
AEV-090-14



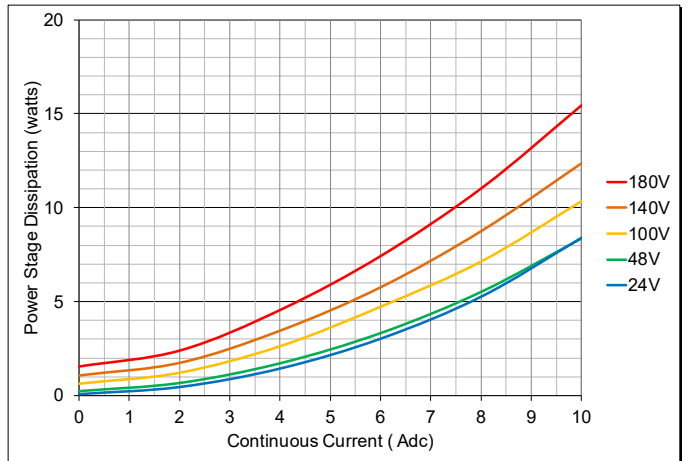
AEV-180-10



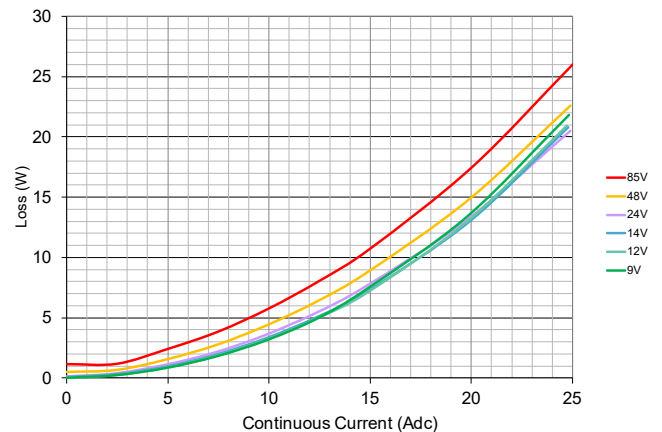
AEV-090-30



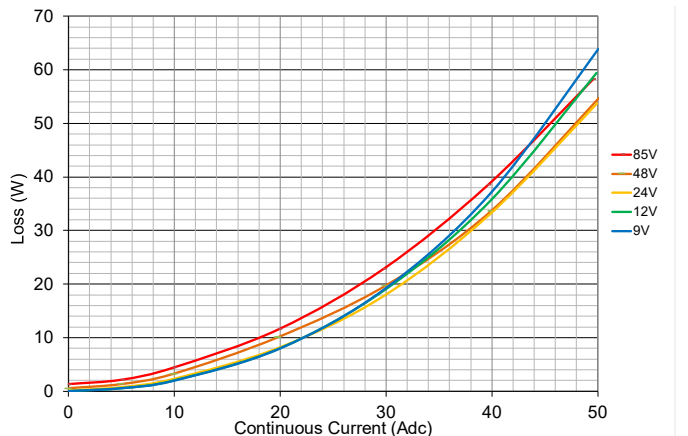
AEV-180-20



AEV-090-50

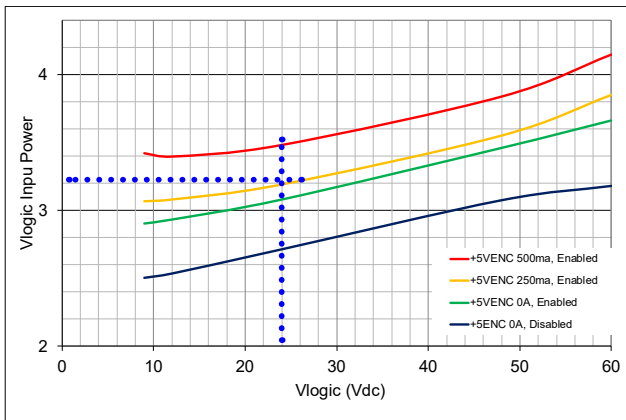


AEV-090-50-C



THERMALS: VLOGIC & ENCODER +5V OUTPUT DISSIPATION

AEV All Models



This chart shows the power dissipation in the VLOGIC circuits that power the drives control circuits and external encoders. Adding the PWM dissipation to the VLOGIC dissipation will yield the total dissipation in Watts for the drive. The dotted lines in the chart show a dissipation of 3.2 W. at VLOGIC = 24 Vdc when the drive is in an Enabled state and outputting 250 mA for an encoder.

THERMAL RESISTANCE

Thermal resistance Rth is a measure of the way the drive resists the flow of heat produced internally to the environment. The lower the resistance the more freely the heat can be dissipated. Thermal resistance Rth is in units of degrees-Centigrade per Watt (C/W). Lowering Rth can be done with heatsinks that increase the area that is exposed to the environment and by moving air over the surfaces with fans. The flow of fan forced air is measured in Linear-Feet-per-Minute (LFM).

No Heatsink

| | | | | |
|-----|-----|-----|-----|-----|
| LFM | 0 | 100 | 200 | 300 |
| Rth | 8.5 | 6.5 | 5.5 | 4.0 |

Pins Heatsink A-Airflow

| | | | | |
|-----|---|-----|-----|-----|
| LFM | 0 | 100 | 200 | 300 |
| Rth | - | 2.9 | 1.8 | 1.4 |

Pins Heatsink B-Airflow

| | | | | |
|-----|---|-----|-----|-----|
| LFM | 0 | 100 | 200 | 300 |
| Rth | - | 4.2 | 2.6 | 1.9 |

Tall Pins Heatsink A-Airflow

| | | | | |
|-----|---|-----|-----|-----|
| LFM | 0 | 100 | 200 | 300 |
| Rth | - | 1.3 | 0.9 | 0.7 |

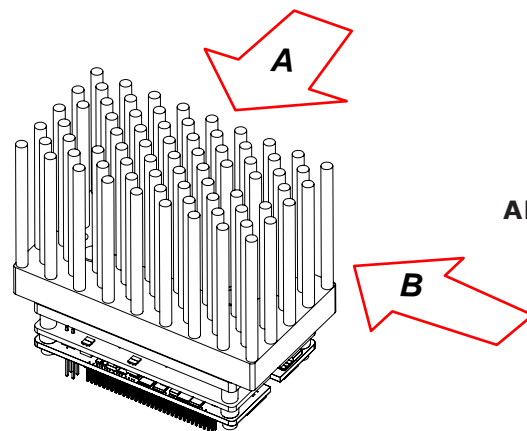
Tall Pins Heatsink B-Airflow

| | | | | |
|-----|---|-----|-----|-----|
| LFM | 0 | 100 | 200 | 300 |
| Rth | - | 2.2 | 1.4 | 1.1 |

AEV



AEV + AEV-HK



Note: The Tall Pins Heatsink is not shown here.

THERMAL CALCULATIONS

THERMAL CALCULATIONS EXAMPLE: AEV-090-30, +HV = 85 V, IO_{UT} = 13 A, AMBIENT TEMP 32 °C

FIND THE COOLING MEANS REQUIRED WHEN DISSIPATION AND AMBIENT TEMP ARE KNOWN

Given: $T_{amb} = 32\text{ °C}$ (89.6 °F), +HV dissipation = 9.5 W, VLOGIC dissipation = 3.2 W
 $T_{max} = 90\text{ °C}$ (drive shut-down temperature)

Find: Thermal resistance R_{th} :
 $\Delta-T = T_{max} - T_{amb} = 90 - 32 = 58\text{ °C}$
 Total dissipation = 9.5 + 3.2 = 12.7 W
 $R_{th} = \Delta-T / \text{dissipation} = \text{°C} / \text{Watt} = 58 / 12.7 = 4.57\text{ °C/W}$

From the tables above, there are three configurations that provide R_{th} less than 4.57 °C/W:
 No heat sink, forced air at 300 LFM
 With short pins heat sink, forced air at A or B direction, 100 LFM or greater
 With long pins heat sink, convection with forced air not required

FIND THE MAX AMBIENT TEMP WHEN DRIVE CONFIGURATION IS KNOWN

Given: AEV-090-30 with pins heatsink, forced-air at 200 LFM, A direction, dissipation is 12.7 W
 $R_{th} = 1.8\text{ °C/W}$
 $T_{max} = 90\text{ °C}$ (drive shut-down temperature)

Find: Max ambient operating temperature
 $\Delta-T = 12.7\text{ W} \times 1.8\text{ °C/W} = 22.9\text{ °C}$
 $\text{Max } T_{amb} = T_{max} - \Delta-T = 90 - 22.9 = 67.1\text{ °C}$
 Max ambient operating temperature is 45 °C so it can operate up to this temperature

BEST PRACTICES FOR THERMAL MANAGEMENT

- All of the variables in an installation are usually not known
- Calculations like those above are done with values that may be estimates, not exact values
- Movement of air is very important. Even when enclosures have no openings, internal fans circulate the air to move heat from drives to the enclosure walls and to prevent hot-spotting
- A heat sink cuts the AEV thermal resistance significantly with forced air
 Overheating can shut down drive but over-cooling is not possible
 Measurement of the drive temperature with CME is easy and is the best indicator of the need for a heatsink. It shows the combined effect of all the variables:
 Thermal dissipation, ambient temperature, cooling means, the environment, etc

EZ BOARD

DESCRIPTION

The EZ Boards provide connectivity to these AEV models so they can be mounted directly to equipment surfaces.

The AEV-EZ-090 EZ Board accepts these models as plug-ins:

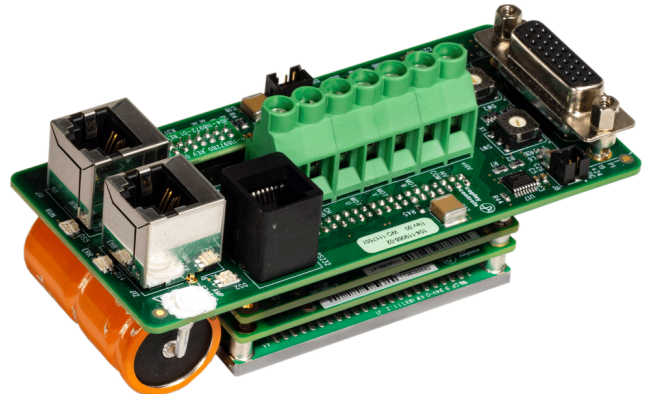
- AEV-090-14
- AEV-090-30

The AEV-EZ-180 EZ Board accepts these models as plug-ins:

- AEV-180-10
- AEV-180-20

Important: The AEV-EZ-090 EZ Board is not compatible with the AEV-090-50 and AEV-090-50-C models.

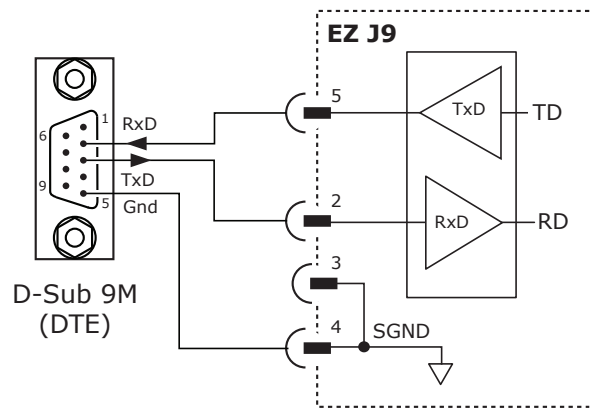
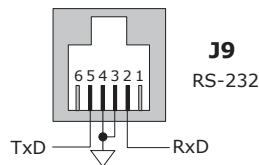
For higher current, the AEZ-090-50 is an AEV-090-50 soldered to the EZ Board at the factory as a single assembly.



RS-232 CONNECTION

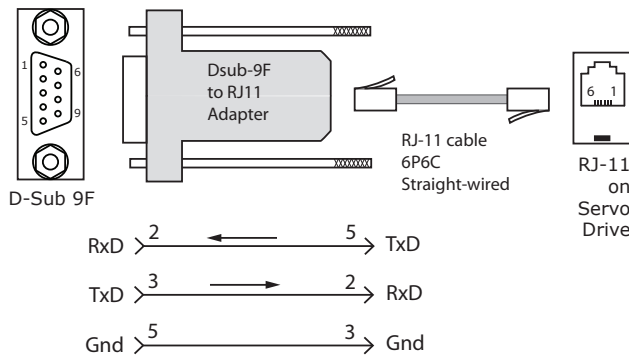
The RS-232 port is used to configure the drive for stand-alone applications, or for configuration before it is installed into an EtherCAT network. CME software communicates with the drive over this link and is then used for complete drive setup. The EtherCAT Device ID that is set by the rotary switches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

The RS-232 connector, J9, 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 J9 on the EZ board. It includes an adapter that plugs into the COM1 (or other) port of a PC and uses a straight-through modular cable to connect to the AEV. The connections are shown in the diagram below.



Don't forget to order a Serial Cable Kit SER-CK or SER-USB-RJ11 when placing your order for an AEZ drive, or an EZ board.

EZ BOARD ETHERCAT INDICATORS & ADDRESS SWITCHES

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 AEV and the master. The OUT port connects to 'downstream' nodes. If the AEV is the last node on a network, only the IN port is used. No terminator is required on the OUT port.

ETHERCAT LEDS

RUN

Green shows the EtherCAT State Machine:

- Off = Init state
- Blinking = Pre-operational
- Single Flash = Safe-operational
- On = Operational

ERR

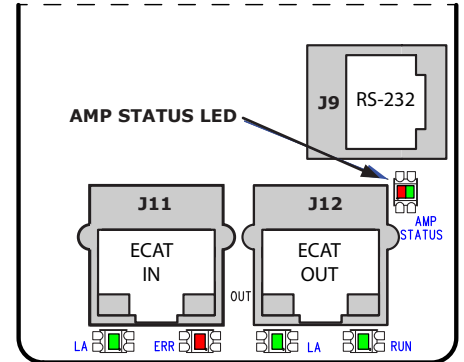
Red shows error conditions:

- Blinking = Invalid configuration
- Single Flash = Unsolicited state change
- Double Flash = Application watchdog timeout

L/A (LINK/ACT)

Green 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 |



EtherCAT LEDS

AMP STATUS LED

A bi-color LED gives the state of the drive. Colors do not alternate, and can be solid ON or blinking.

If multiple conditions occur, only the top-most condition will be displayed. When that condition is cleared the next one below will shown.

- Red/Blinking = Latching fault. Operation can not resume until drive is Reset.
- Red/Solid = Transient fault condition. Drive can resume operation when the condition causing the fault is removed.
- Green/Slow-Blinking = Drive OK but NOT-enabled. Can run when enabled.
- Green/Fast-Blinking = Positive or Negative limit switch active. Drive can only move in direction not inhibited by limit switch.
- Green/Solid = Drive OK and enabled. Can run in response to reference inputs or EtherCAT commands.

LATCHING FAULTS

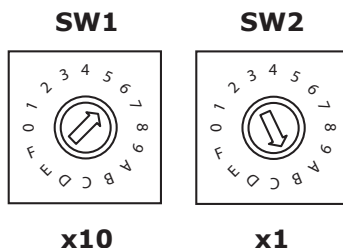
- | | |
|--------------------------------------|---------------------------|
| Default | Optional (programmable) |
| Short circuit (Internal or external) | Over-voltage |
| Drive over-temperature | Under-voltage |
| Motor over-temperature | Motor Phasing Error |
| Feedback Error | Command Input Lost |
| Following Error | Motor Wiring Disconnected |
| | Over Current (latched) |

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 EZ board 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:

- Find the highest number under SW1 that is less than 107 and set SW1 to the hex value in the same row: 96 < 107 and 112 > 107, so SW1 = 96 = Hex 6
- Subtract 96 from the desired Device ID to get the decimal value of switch SW2 and set SW2 to the Hex value in the same row: SW2 = (107 - 96) = 11 = Hex B



EtherCAT Device ID Switch Decimal values

| | SW1 | SW2 |
|-----|-----|-----|
| 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 |

EZ BOARD ETHERCAT CONNECTORS

ETHERCAT CONNECTORS

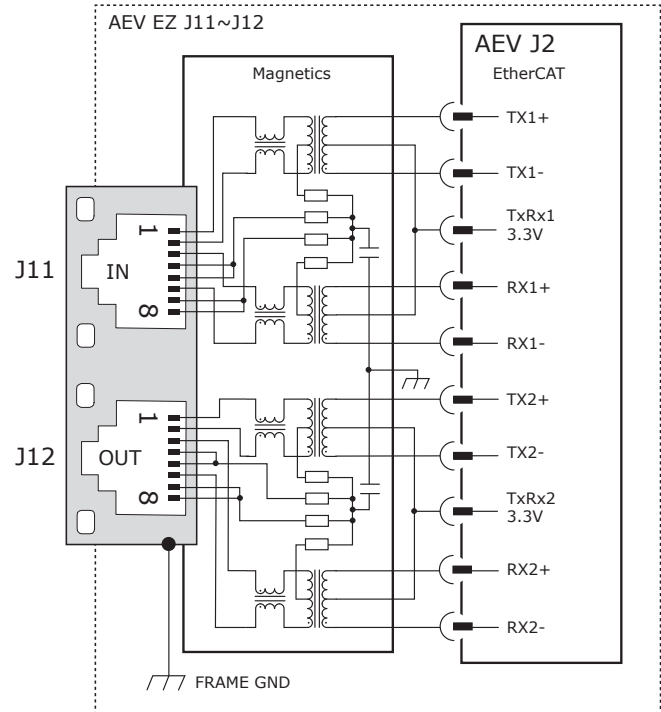
Dual RJ-45 connectors that accept standard Ethernet CAT-5 cables are provided for EtherCAT connectivity.

J11 ECAT-IN

| Pin | ECAT |
|-----|------|
| 1 | TX1+ |
| 2 | TX1- |
| 3 | RX1+ |
| 4 | n.c. |
| 5 | n.c. |
| 6 | RX1- |
| 7 | n.c. |
| 8 | FGND |

J12 ECAT-OUT

| Pin | ECAT |
|-----|------|
| 1 | TX2+ |
| 2 | TX2- |
| 3 | RX2+ |
| 4 | n.c. |
| 5 | n.c. |
| 6 | RX2- |
| 7 | n.c. |
| 8 | FGND |



EZ BOARD SAFE TORQUE OFF (STO)

DESCRIPTION

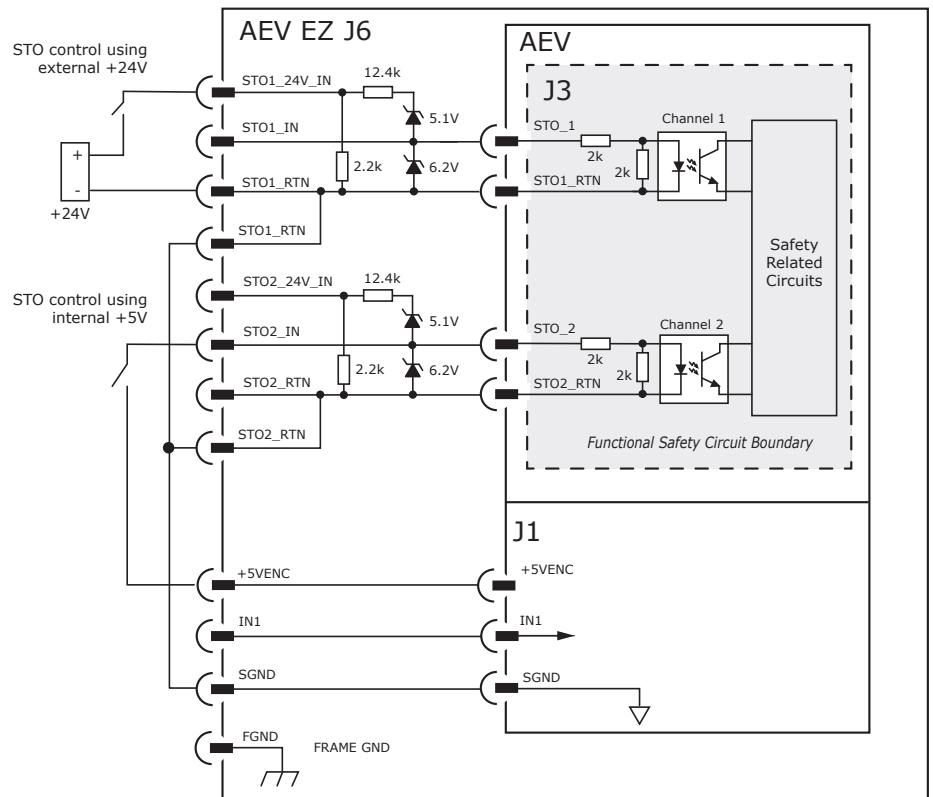
This shows the use of the internal +5V or external 24V to energize the STO inputs.

Both STO inputs must be energized in order to enable the drive. IN1, the hardware Enable input is for use with an immediate contact relay to bring the motor to a stop before a delayed contact relay de-energizes the STO inputs and prevents torque production in the motor.

J6 STO

| Signal | Pin | Signal | |
|----------|-----|--------|-------------|
| STO1_RTN | 1 | 2 | STO1_24V_IN |
| STO1_RTN | 3 | 4 | STO1_IN |
| n.c. | 5 | 6 | n.c. |
| STO2_RTN | 7 | 8 | STO2_24V_IN |
| STO2_RTN | 9 | 10 | STO2_IN |
| n.c. | 11 | 12 | n.c. |
| SGND | 13 | 14 | FGND |
| IN1 | 15 | 16 | +5VENC |

n.c. = No connection



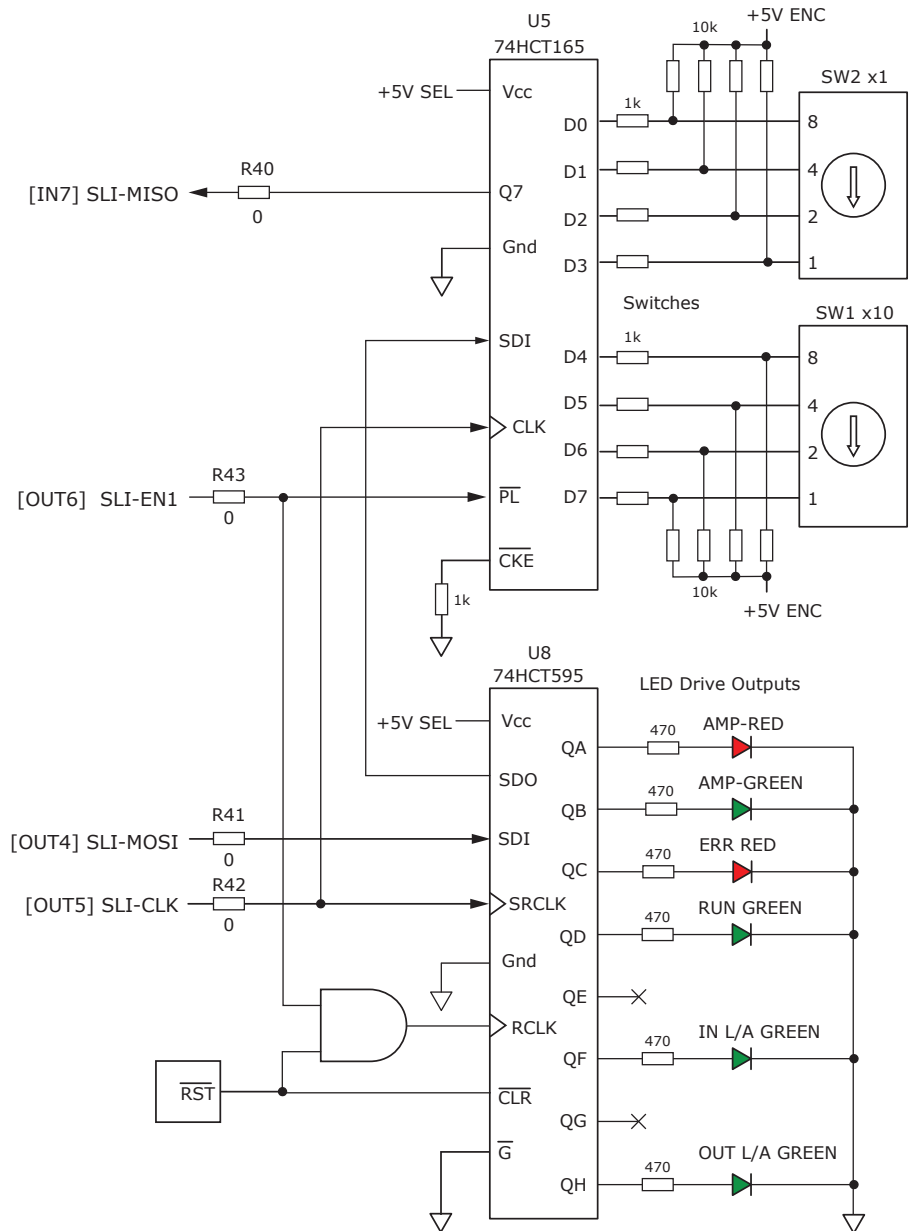
EZ BOARD SLI PORT SWITCHES & LEDs

ETHERCAT DEVICE ID (STATION ALIAS) SWITCH CONNECTIONS

The graphic below shows the connections to the EtherCAT Device ID switches and status LEDs. The switches 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 [OUT4,5,6] and input [IN7] operate as an SLI port which reads the settings on the EtherCAT Device ID switches, and controls the Amp and EtherCAT status LEDs.

NOTE:

R40, R41, R42, R43 may be removed by the user if IN7, OUT4, OUT5, OUT6 are needed for other functions. This will disable the address switches and LEDs.



SLI PORT

| SLI-Port | Signal | Pin |
|-----------------|--------|-----|
| SLI-MISO (IN7) | IN7 | 11 |
| SLI-EN1 (OUT6) | DOUT6 | 16 |
| SLI-MOSI (OUT4) | DOUT4 | 14 |
| SLI-CLK (OUT5) | DOUT5 | 17 |

Note:
The SLI-xxxx naming appears as SPI-xxxx in the Reference Design schematic.
The SPI interface is not supported in the AEV.

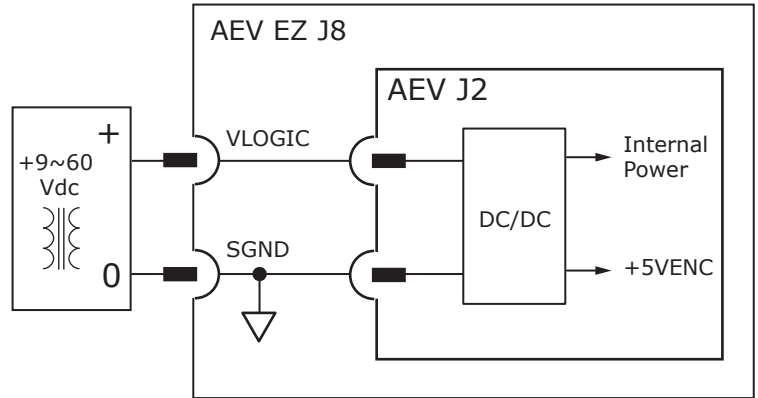
EZ BOARD VLOGIC

DESCRIPTION

Powers the internal logic and control circuits in the drive. When using the STO feature, it must be produced by power supplies with transformer isolation from the mains and PELV or SELV ratings and a maximum output voltage of 60 Vdc. If the motor can operate from voltages of 60 Vdc or less, the +HV and VLOGIC can be driven from a single power supply.

J8 VLOGIC

| Pin | EZ-Board | Signal |
|-----|----------|-------------|
| 1 | VLOGIC | +24V_VLOGIC |
| 2 | SGND | SGND |

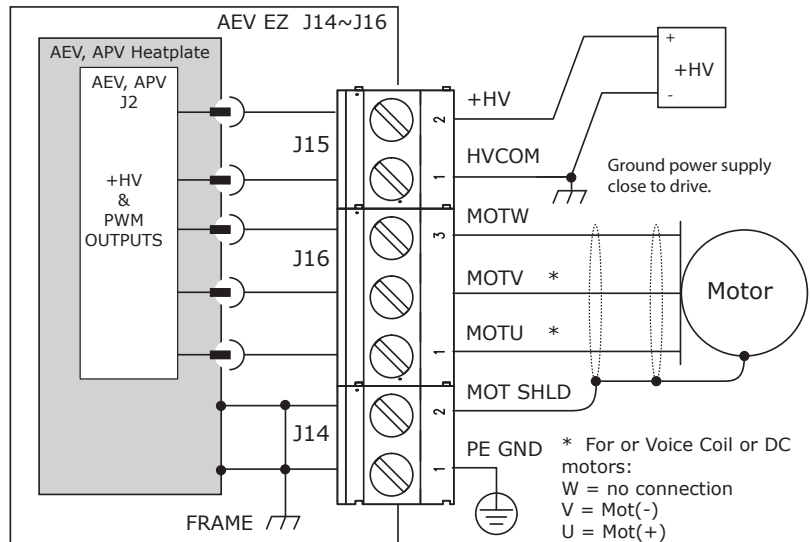


EZ BOARD +HV & MOTOR CONNECTIONS

DESCRIPTION

J15 provides connection to the DC power supply. J16 carries three conductors for brushless motors. J14-1 provides a connection for a shielded cable connecting the motor housing to chassis ground. The PE (Protective Earth) terminal provides a single connection to earth for bonding of the AEV to an earth-ground point.

| J# | Pins | EZ-Board | Signal |
|-----|------|----------|---------|
| J15 | 2 | +HV | +HV |
| | 1 | HVCOM | HVCOM |
| J16 | 3 | MOT W | MOTW |
| | 2 | MOT V * | MOTV |
| | 1 | MOT U * | MOTU |
| J14 | 2 | FGND | CHASSIS |
| | 1 | PE | PE |



EZ BOARD I/O CONNECTORS

LOGIC INPUTS

| EZ-Board | Signal | J5 Pins |
|-------------------|--------|------------|
| IN1 Enable | IN1 | 4 |
| IN2 | IN2 | 3 |
| IN3 | IN3 | 6 |
| IN4 | IN4 | 5 |
| IN5 | IN5 | 8 |
| IN6 Encoder Fault | IN6 | 7 |
| IN7 SLI MISO | IN7 | 10 |
| SGND | SGND | 15, 17, 18 |

Logic inputs max input voltage is +6 Vdc.

IN5 is connected to P1, the primary encoder Motemp input. If it is not used for that function then IN5 is available as a logic input.

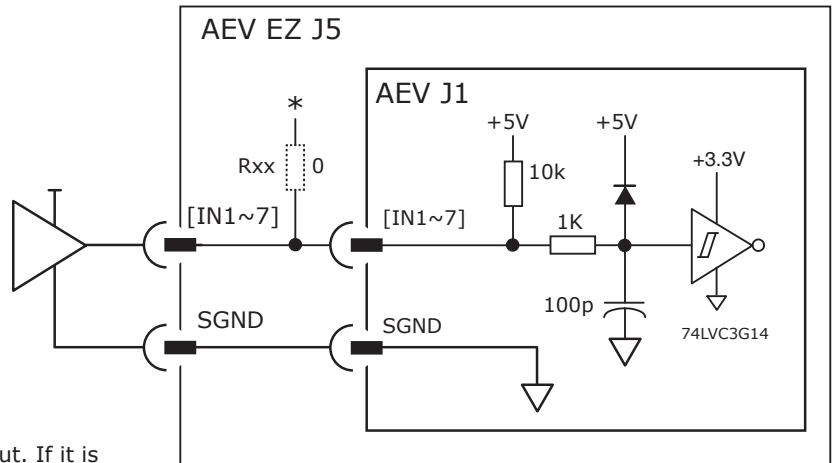
* Rxx shows the locations of 0 Ω resistors that are in place by default as R44 and R40.

R44 connects the Encoder Fault signal to IN6.

R40 connects the SLI-MISO signal to IN7 which is used by the SLI port that controls the LEDs and reads the address switches.

If neither of these functions are needed then R40 and/or R44 can be removed making

IN6 & IN7 available as logic inputs



LOGIC OUTPUTS

| EZ-Board | Signal | J5 Pins |
|------------------|--------|------------|
| DOUT1 | DOUT1 | 12 |
| DOUT2 | DOUT2 | 9 |
| DOUT3 (Brake) | DOUT3 | 14 |
| DOUT4 (SLI-MOSI) | DOUT4 | 11 |
| DOUT5 (SLI-CLK) | DOUT5 | 16 |
| DOUT6 (SLI-EN1) | DOUT6 | 13 |
| SGND | SGND | 15, 17, 18 |

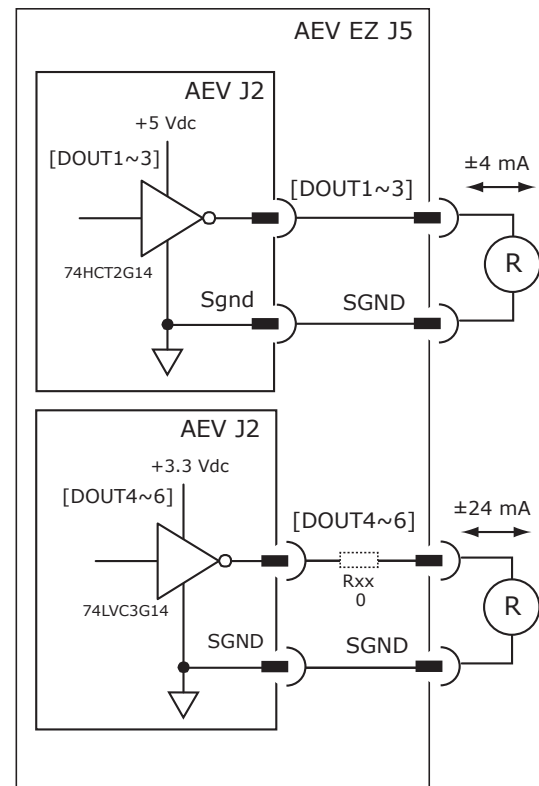
OUT3 is connected by default to the MOSFET that is the Brake output on J10. OUT1~2 are available as logic outputs.

OUT4~6 connect to the SLI circuit that drives the displays and reads the address switches. If the SLI function is not needed then these outputs can be used as logic outputs by removing the Rxx as follows:

OUT4: R41

OUT5: R42

OUT6: R43



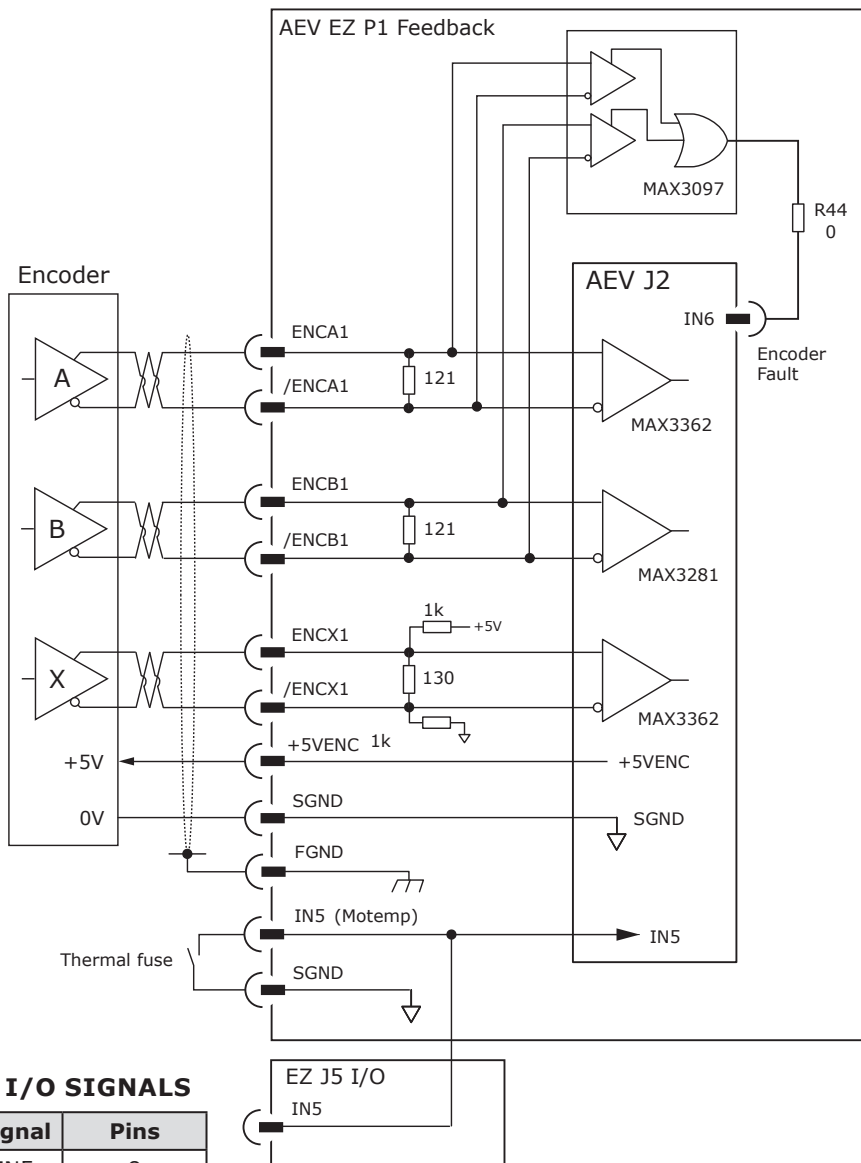
EZ BOARD PRIMARY FEEDBACK CONNECTOR P1

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. 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 or B & /B 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 3097 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

FAULT DETECTION



J5 I/O SIGNALS

| Signal | Pins |
|--------|------------|
| IN5 | 8 |
| IN6 | 7 |
| SGND | 15, 17, 18 |

NOTE:

IN5 on the feedback connector is connected to the drive IN5.

P1 ENCODER SIGNALS

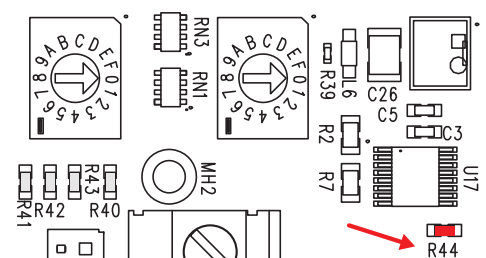
| EZ-Board | Signal | Pins |
|--------------|--------|-------------|
| Enc1 A | ENCA1 | 13 |
| Enc1 /A | /ENCA1 | 12 |
| Enc1 B | ENCB1 | 11 |
| Enc1 /B | /ENCB1 | 10 |
| Enc1 X | ENCX1 | 9, 23 |
| Enc1 /X | /ENCX1 | 8, 22 |
| +5V ENC | +5VENC | 6, 17 |
| [IN5] Motemp | IN5 | 7 |
| FGND | FGND | * |
| SGND | SGND | 5,16, 25,26 |

* FGND on P1 is the metal shell.

IN5 MOTEMP SIGNALS

| Connector | Signal | Pins |
|-----------|--------|---------------|
| EZ P1 | IN5 | 7 |
| | SGND | 5, 16, 25, 26 |
| EZ J5 | IN5 | 8 |
| | SGND | 15, 17, 18 |

R44 LOCATION

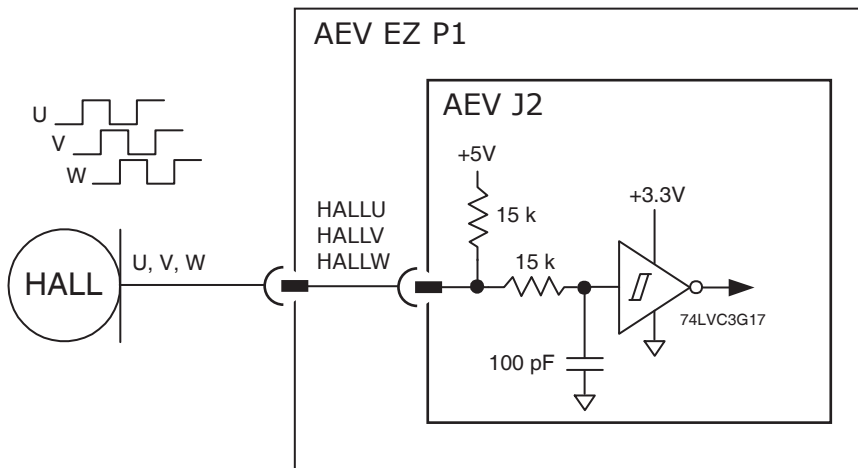


NOTE:

R44 connects IN6 to the encoder fault detection by default. If this feature is not used, then removing R44 allows IN6 to be programmed for user's function.

EZ BOARD PRIMARY FEEDBACK CONNECTOR P1

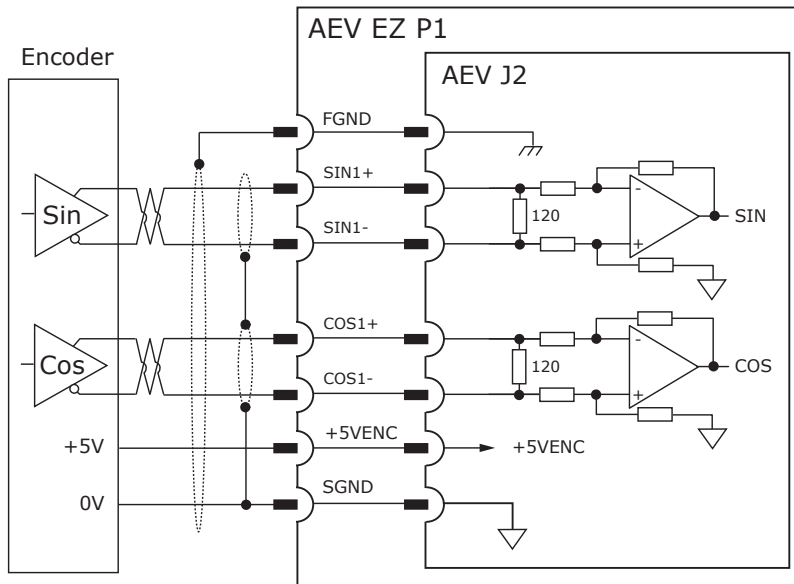
HALLS



P1 HALL SIGNALS

| HALLS | Signal | Pins |
|--------|--------|------|
| Hall U | HALLU | 2 |
| Hall V | HALLV | 3 |
| Hall W | HALLW | 4 |

SIN/COS ENCODERS



P1 SIN/COS SIGNALS

| Sin/Cos | Signal | Pins |
|---------|--------|------|
| Sin(+) | SIN1+ | 19 |
| Sin(-) | SIN1- | 18 |
| Cos(+) | COS1+ | 21 |
| Cos(-) | COS1- | 20 |

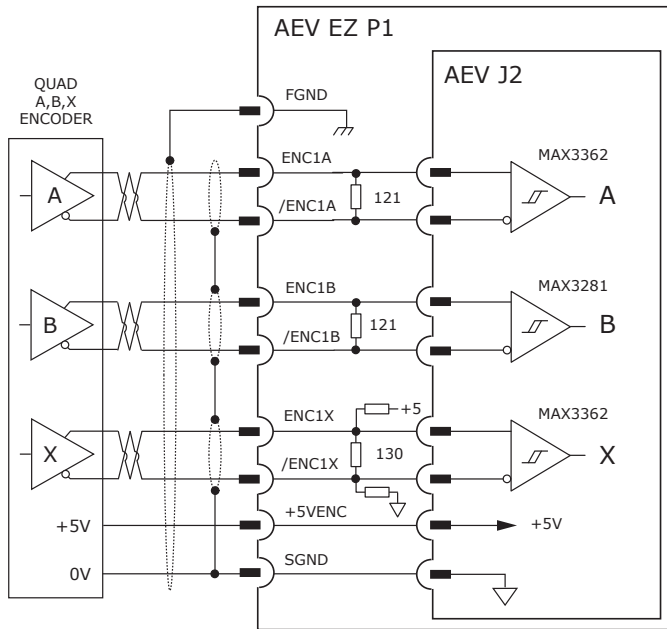
P1 +5V & SGND

| Signal | Pins |
|--------|---------------|
| +5VENC | 6, 17 |
| SGND | 5, 16, 25, 26 |

Note that double-shielded cable is used for the Sin/Cos signals that are analog and more susceptible to noise. Two inner shields are used providing one for each twisted-pair and these connect to SGND. The outer shield connects to Frame Ground on the drive end is it not connected to the motor frame on the other. With the cable for the PWM outputs to the motor connected to Frame Ground on the drive end and the motor casing on the other there is a return path for currents produced by the capacitance between the UVW output wires and the motor cable shield.

EZ BOARD PRIMARY FEEDBACK CONNECTOR P1

QUAD ENCODER WITH INDEX



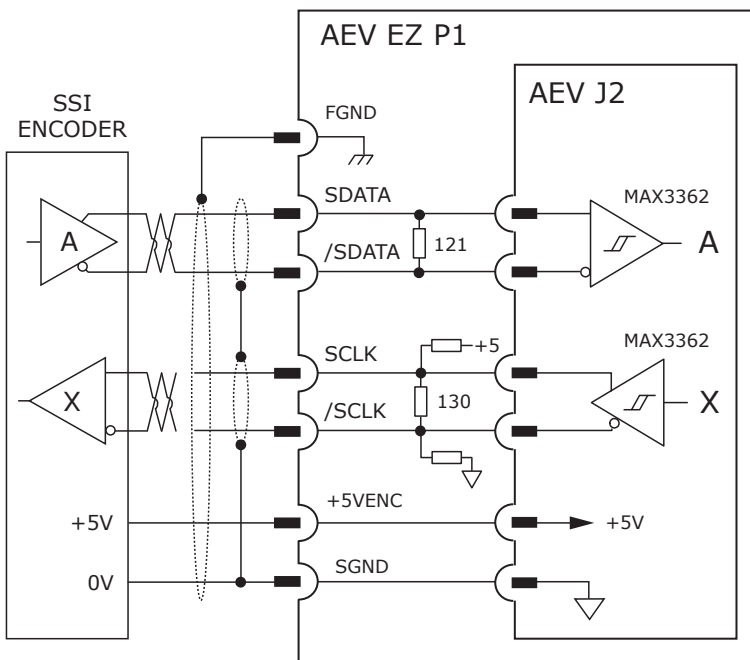
A/B/X SIGNALS

| QUAD | Signal | P1 Pins |
|---------|--------|------------|
| Enc1 A | ENCA1 | 13 |
| Enc1 /A | /ENCA1 | 12 |
| Enc1 B | ENCB1 | 11 |
| Enc1 /B | /ENCB1 | 10 |
| Enc1 X | ENCX1 | 9 |
| Enc1 /X | /ENCX1 | 8 |
| +5V ENC | +5VENC | 6,17 |
| SGND | SGND | 5,16,25,26 |
| FGND | FGND * | 27, 28 |

* FGND on P1 is the metal shell of the connector. This makes contact with the feedback cable backshell which then makes contact with the motor feedback cable's shielding. It is shown as a pins 27 & 28 which is how it appears in the EZ board schematic.

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 AEV 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 number of encoder data bits and counts per motor revolution are programmable. The hardware bus consists of two signals: SCLK and SDATA. The SCLK signal is only active during transfers. Data is clocked in on the falling edge of the clock signal.



BiSS ABSOLUTE ENCODER

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

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

SSI, BiSS SIGNALS

| SSI | BiSS | Signal | P1 Pins |
|--------|------|--------|---------|
| SDATA | MA+ | ENCA1 | 13 |
| /SDATA | MA- | /ENCA1 | 12 |
| SCLK | SL+ | ENCX1 | 9 |
| /SCLK | SL- | /ENCX1 | 8 |
| +5V | | +5VENC | 6,17 |

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

EZ BOARD PRIMARY FEEDBACK CONNECTOR P1

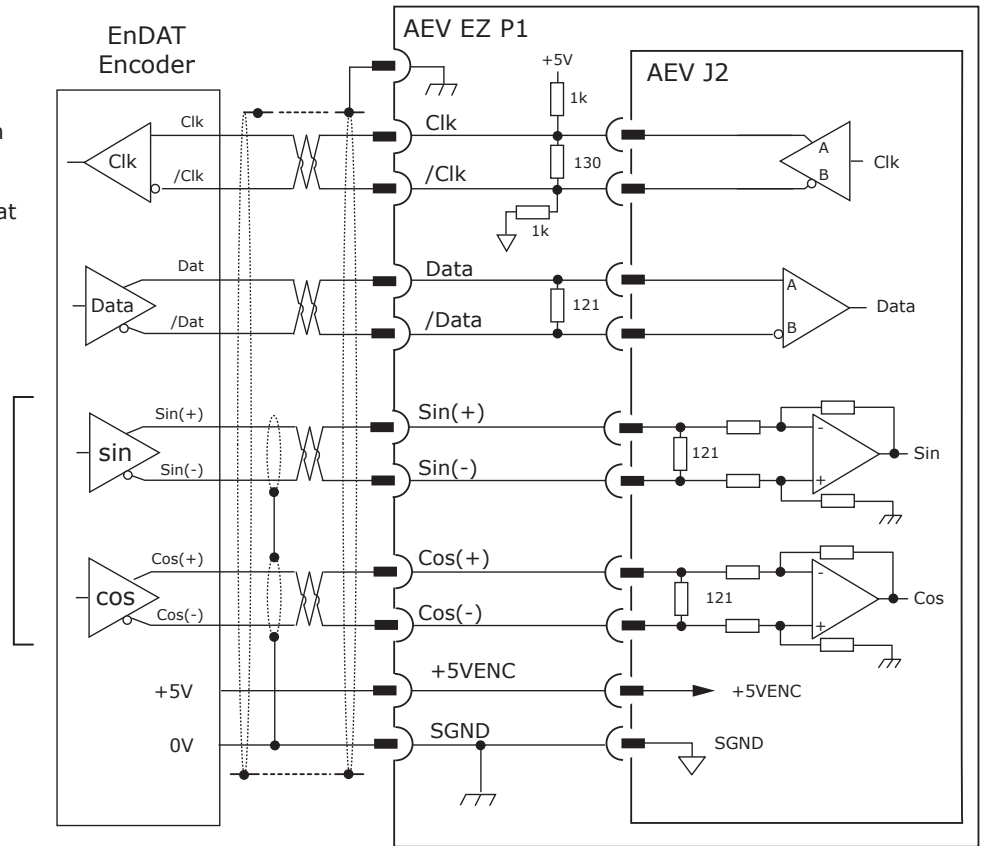
ENDAT ABSOLUTE ENCODER

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

| EnDAT | Signal | P1 Pins |
|---------|--------|----------------|
| Clk | ENCX1 | 9 |
| /Clk | /ENCX1 | 8 |
| Data | ENCA1 | 13 |
| /Data | /ENCA1 | 12 |
| Sin(+)* | SIN1+ | 19 |
| Sin(-)* | SIN1- | 18 |
| Cos(+)* | COS1+ | 21 |
| Cos(-)* | COS1- | 20 |
| +5V | +5VENC | 6,17 |
| 0V | SGND | 5, 16 25,26 |

* Sin/Cos optional with EnDat 2.2 or any 1 Mbit or faster Endat
Sin/Cos required if EnDat 2.1 < 1 Mbit



ABSOLUTE-A ENCODER

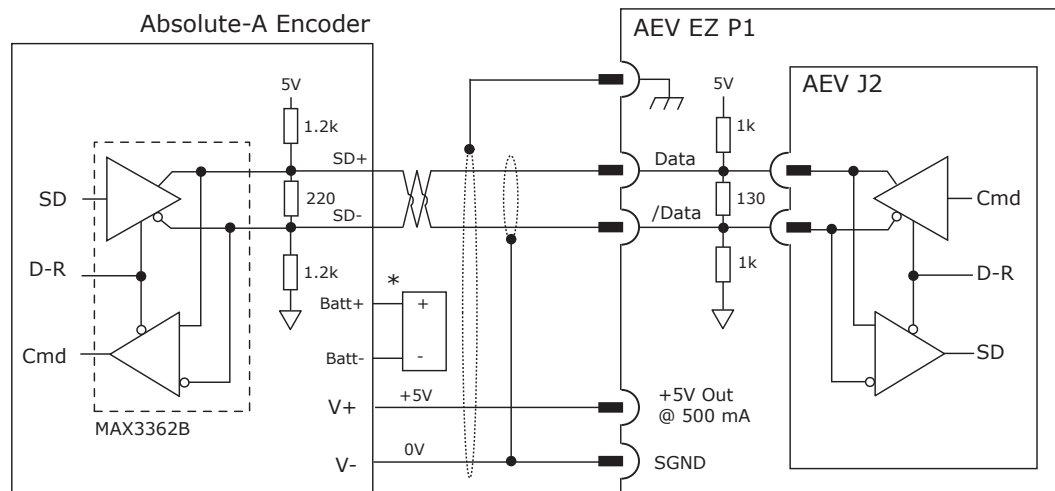
The Absolute A interface is a serial, half-duplex type that is electrically the same as RS-485. Note the battery which must be connected. Without it, the encoder will produce a fault condition.

ABSOLUTE-A SIGNALS

| ABS-A | Signal | J2 Pins |
|-------|--------|---------|
| Data | ENCA1 | 13 |
| /Data | /ENCA1 | 12 |
| +5V | +5VENC | 6, 17 |

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

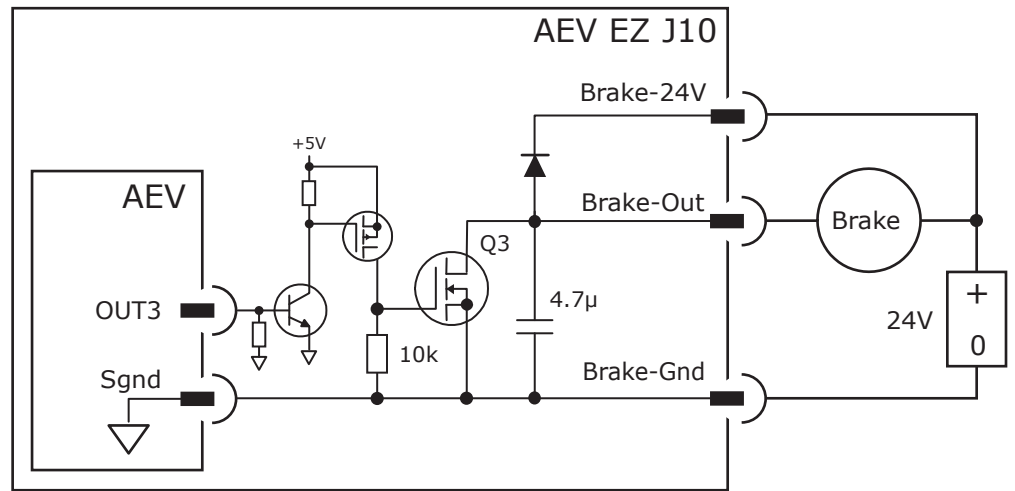
* Battery optional



EZ BOARD BRAKE OUTPUT

The brake circuit on the EZ board is a MOSFET driven by OUT3 of the AEV.

- Brake output [OUT3]
- 24V Compatible
- Programmable functions



Specifications

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

The EZ brake circuit is referenced to SGND in the AEV.

HI/LO definitions: outputs

| Input | State | Condition |
|--------------|-------|---|
| BRAKE [OUT3] | LO | Output MOSFET Q3 is OFF Brake is un-powered and locks motor Motor cannot move Brake state is Active |
| | HI | Output MOSFET Q3 is ON Brake is powered, releasing motor Motor is free to move Brake state is NOT-Active |

J10 BRAKE SIGNALS

| Pin | Brake | Signal |
|-----|-----------|------------|
| 1 | Brake-24V | +24V_IN |
| 2 | Brake-Out | BRAKE |
| 3 | Brake-Gnd | 24V_GND_IN |

CME Default Setting for Brake Output [OUT3] is "Brake - Active Low"

Active = Brake is holding motor shaft (i.e. the *Brake is Active*)

Motor cannot move

No current flows in coil of brake

CME I/O Line States shows [OUT3] as LO

BRK Output voltage is HI (24V), MOSFET Q3 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

CME I/O Line States shows [OUT3] as HI

BRK output voltage is LO (~0V), MOSFET Q3 is ON

Servo drive is enabled, PWM outputs are on

Servo drive output current is flowing

EZ BOARD CONNECTORS

P1 ENCODER 1

| Pin | EZ Board | Pin | EZ Board | Pin | EZ Board |
|-----|----------|-----|----------|-----|--------------|
| 26 | SGND | 18 | Sin(-) | 9 | Enc1 X |
| 25 | SGND | 17 | +5V ENC | 8 | Enc1 /X |
| 24 | N.C. | 16 | SGND | 7 | [IN5] Motemp |
| 23 | N.C. | 15 | Enc1 S | 6 | +5V ENC |
| 22 | N.C. | 14 | Enc1 /S | 5 | SGND |
| 21 | Cos(+) | 13 | Enc1 A | 4 | Hall W |
| 20 | Cos(-) | 12 | Enc1 /A | 3 | Hall V |
| 19 | Sin(+) | 11 | Enc1 B | 2 | Hall U |
| | | 10 | Enc1 /B | 1 | Frame Gnd |

J10 BRAKE

| Pin | EZ Board |
|-----|--------------|
| 3 | HVCOM |
| 2 | Brake output |
| 1 | +24V Input |

J8 V-LOGIC

| Pin | EZ Board |
|-----|----------|
| 1 | VLOGIC |
| 2 | SGND |

J15 DC-POWER

| Pin | EZ Board |
|-----|----------|
| 2 | +HV |
| 1 | HV COM |

J16 MOTOR

| Pin | EZ Board |
|-----|----------|
| 3 | Mot W |
| 2 | Mot V |
| 1 | Mot U |

J14 GROUNDS

| Pin | EZ Board |
|-----|----------|
| 2 | FGND |
| 1 | PE |

J9 RS-232

| Pin | EZ Board |
|-----|----------|
| 1 | N.C. |
| 2 | RxD |
| 3 | SGND |
| 4 | SGND |
| 5 | TxD |
| 6 | N.C. |

J5 I/O

| EZ Board | Pin | Pin | EZ Board |
|----------------|-----|-----|------------------|
| Aref(-) | 2 | 1 | Aref(+) |
| Enable IN1 | 4 | 3 | IN2 |
| IN3 | 6 | 5 | IN4 |
| Motemp IN5 | 8 | 7 | IN6 Enc-Fault ** |
| * SLI-MISO IN7 | 10 | 9 | OUT2 |
| OUT1 | 12 | 11 | OUT4 SLI-MOSI * |
| * Brake OUT3 | 14 | 13 | OUT6 SLI-EN1 * |
| * SLI-CLK OUT5 | 16 | 15 | SGND |
| SGND | 18 | 17 | SGND |

J4 ENCODER 2

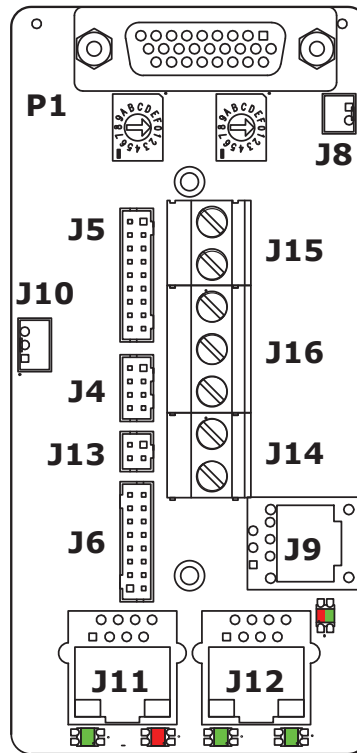
| EZ Board | Pin | Pin | EZ Board |
|----------|-----|-----|----------|
| Enc2 A | 2 | 1 | Enc2 /A |
| Enc2 B | 4 | 3 | Enc2 /B |
| Enc2 X | 6 | 5 | Enc2 /X |
| SGND | 8 | 7 | +5V ENC |

J13

| EZ Board | Pin | Pin | EZ Board |
|----------|-----|-----|----------|
| *** | 2 | 1 | *** |
| *** | 4 | 3 | *** |

J6 STO

| EZ Board | Pin | Pin | EZ Board |
|------------|-----|-----|------------|
| IN1 | 15 | 16 | +5V ENC |
| SGND | 13 | 14 | FGND |
| n.c. | 11 | 12 | n.c. |
| STO-IN2(-) | 9 | 10 | STO-IN2(+) |
| STO-IN2(-) | 7 | 8 | STO-IN2(+) |
| n.c. | 5 | 6 | n.c. |
| STO-IN1(-) | 3 | 4 | STO-IN1(+) |
| STO-IN1(-) | 1 | 2 | STO-IN1(+) |



* These signals are wired for the functions shown. They can be programmed for other functions but the default functions will no longer function.

** This input can be programmed for other functions by removing the resistor R44 that connects the input to the encoder 1 fault-detection circuit.

*** No connections

J11 ECAT-IN

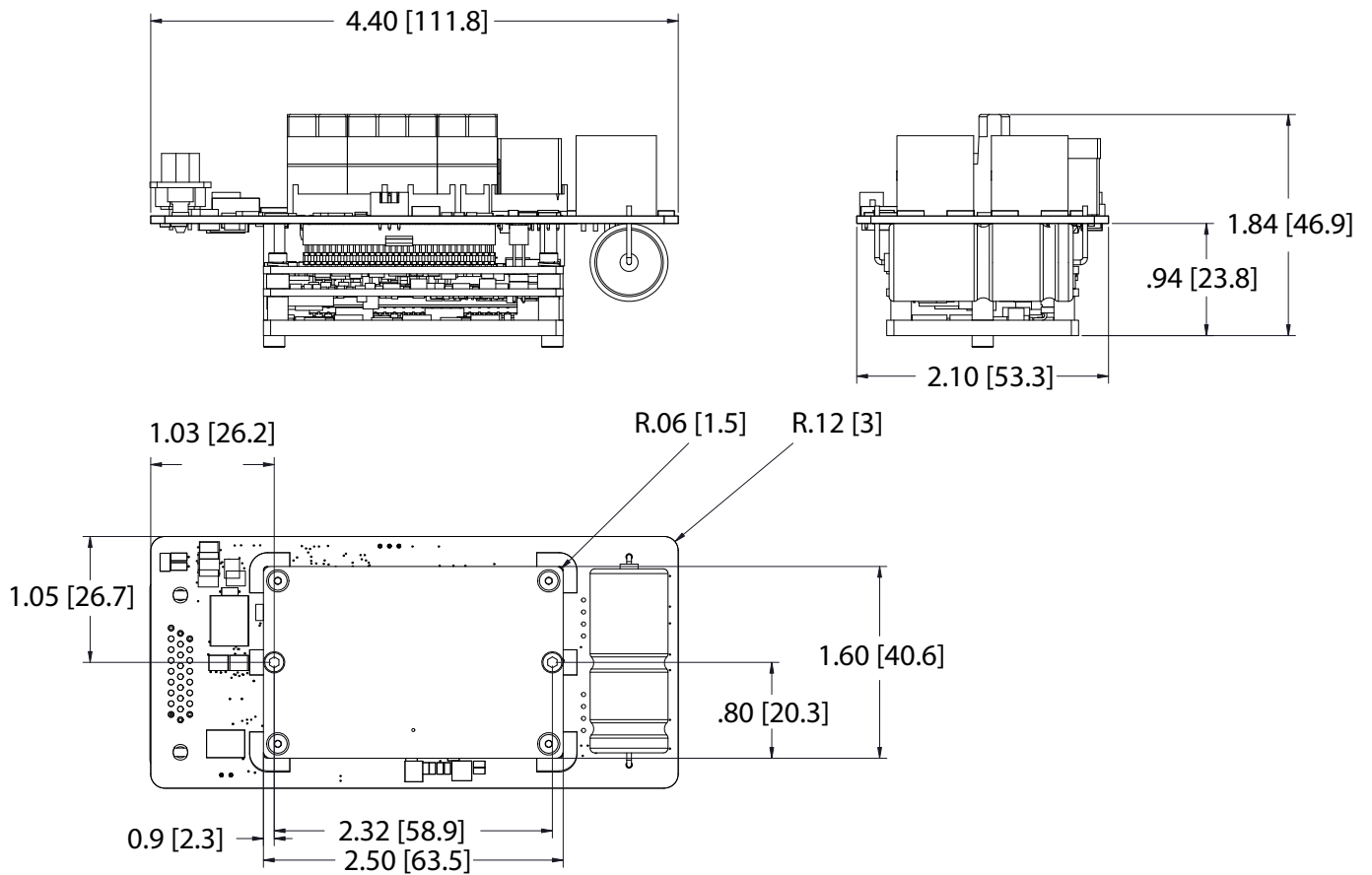
| Pin | EZ Board |
|-----|----------|
| 1 | TX1+ |
| 2 | TX1- |
| 3 | RX1+ |
| 4 | n.c. |
| 5 | n.c. |
| 6 | RX1- |
| 7 | n.c. |
| 8 | FGND |

J12 ECAT-OUT

| Pin | EZ Board |
|-----|----------|
| 1 | TX2+ |
| 2 | TX2- |
| 3 | RX2+ |
| 4 | n.c. |
| 5 | n.c. |
| 6 | RX2- |
| 7 | n.c. |
| 8 | FGND |

EZ BOARD DIMENSIONS

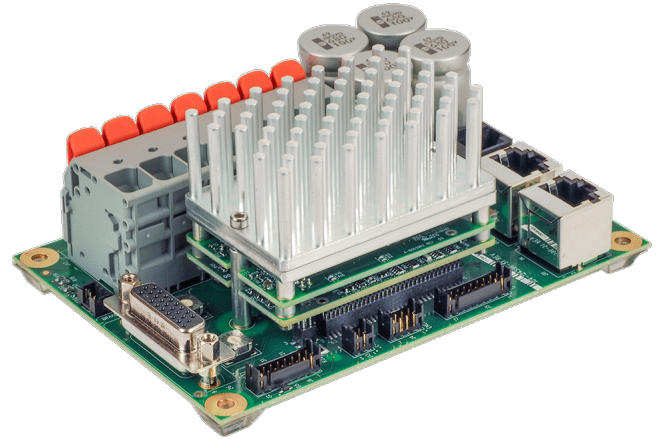
The dimensions shown here are for an AEV drive socketed into an EZ Board



EZ DEVELOPMENT BOARD

DESCRIPTION

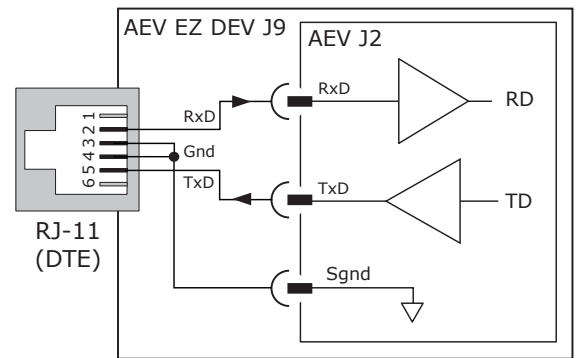
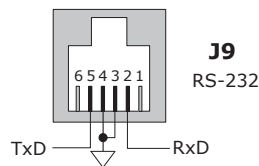
The AEZ-090-50-C is an AEV-090-50-C drive with the motor and +HV pins soldered to a Development Kit to support the 50 Adc peak and continuous current rating. The heatsink shown here is included.



RS-232 CONNECTION

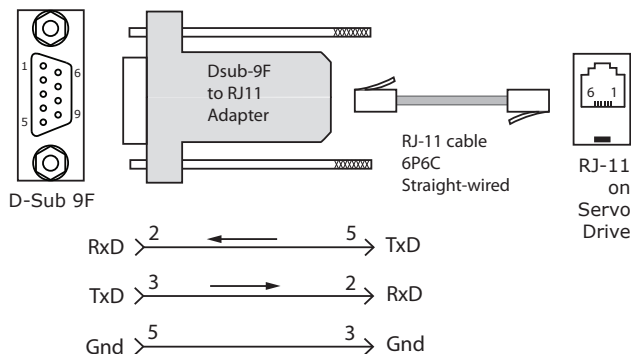
The RS-232 port is used to configure the drive for stand-alone applications, or for configuration before it is installed into an EtherCAT network. CME software communicates with the drive over this link and is then used for complete drive setup. The EtherCAT Device ID that is set by the rotary switches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

The RS-232 connector, J9, 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 J9 on the EZ Development Board. It includes an adapter that plugs into the COM1 (or other) port of a PC and uses a straight-through modular cable to connect to the AEV. 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 AEZ drive, or an EZ board.

EZ DEVELOPMENT BOARD ETHERCAT INDICATORS & ADDRESS SWITCHES

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 AEV and the master. The OUT port connects to 'downstream' nodes. If the AEV is the last node on a network, only the IN port is used. No terminator is required on the OUT port.

ETHERCAT LEDS

RUN

Green shows the EtherCAT State Machine:

- Off = Init state
- Blinking = Pre-operational
- Single Flash = Safe-operational
- On = Operational

ERR

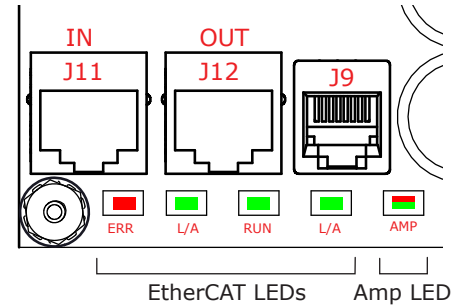
Red shows error conditions:

- Blinking = Invalid configuration
- Single Flash = Unsolicited state change
- Double Flash = Application watchdog timeout

L/A (LINK/ACT)

Green 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.

If multiple conditions occur, only the top-most condition will be displayed. When that condition is cleared the next one below will shown.

- Red/Blinking = Latching fault. Operation can not resume until drive is Reset.
- Red/Solid = Transient fault condition. Drive can resume operation when the condition causing the fault is removed.
- Green/Slow-Blinking = Drive OK but NOT-enabled. Can run when enabled.
- Green/Fast-Blinking = Positive or Negative limit switch active. Drive can only move in direction not inhibited by limit switch.
- Green/Solid = Drive OK and enabled. Can run in response to reference inputs or EtherCAT commands.

LATCHING FAULTS

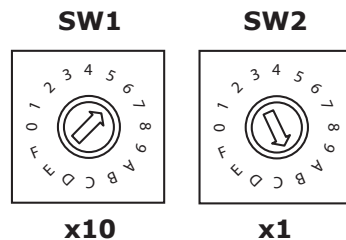
| | |
|--------------------------------------|---------------------------|
| Default | Optional (programmable) |
| Short circuit (Internal or external) | Over-voltage |
| Drive over-temperature | Under-voltage |
| Motor over-temperature | Motor Phasing Error |
| Feedback Error | Command Input Lost |
| Following Error | Motor Wiring Disconnected |
| | Over Current (latched) |

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 EZ Development Board 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 SW1 that is less than 107 and set SW1 to the hex value in the same row: 96 < 107 and 112 > 107, so SW1 = 96 = Hex 6
- 2) Subtract 96 from the desired Device ID to get the decimal value of switch SW2 and set SW2 to the Hex value in the same row: SW2 = (107 - 96) = 11 = Hex B



EtherCAT Device ID Switch Decimal values

| HEX | SW1 | SW2 |
|-----|-----|-----|
| | 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 |

EZ DEVELOPMENT BOARD ETHERCAT CONNECTORS

ETHERCAT CONNECTORS

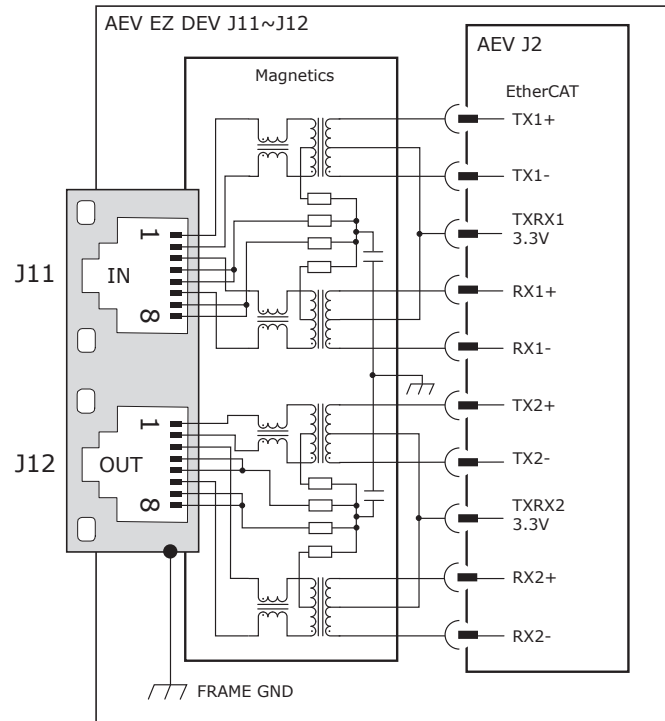
Dual RJ-45 connectors that accept standard Ethernet CAT-5 cables are provided for EtherCAT connectivity.

J11 ECAT-IN

| Pin | ECAT |
|-----|------|
| 1 | TX1+ |
| 2 | TX1- |
| 3 | RX1+ |
| 4 | n.c. |
| 5 | n.c. |
| 6 | RX1- |
| 7 | n.c. |
| 8 | FGND |

J12 ECAT-OUT

| Pin | ECAT |
|-----|------|
| 1 | TX2+ |
| 2 | TX2- |
| 3 | RX2+ |
| 4 | n.c. |
| 5 | n.c. |
| 6 | RX2- |
| 7 | n.c. |
| 8 | FGND |



EZ DEVELOPMENT BOARD SAFE TORQUE OFF (STO)

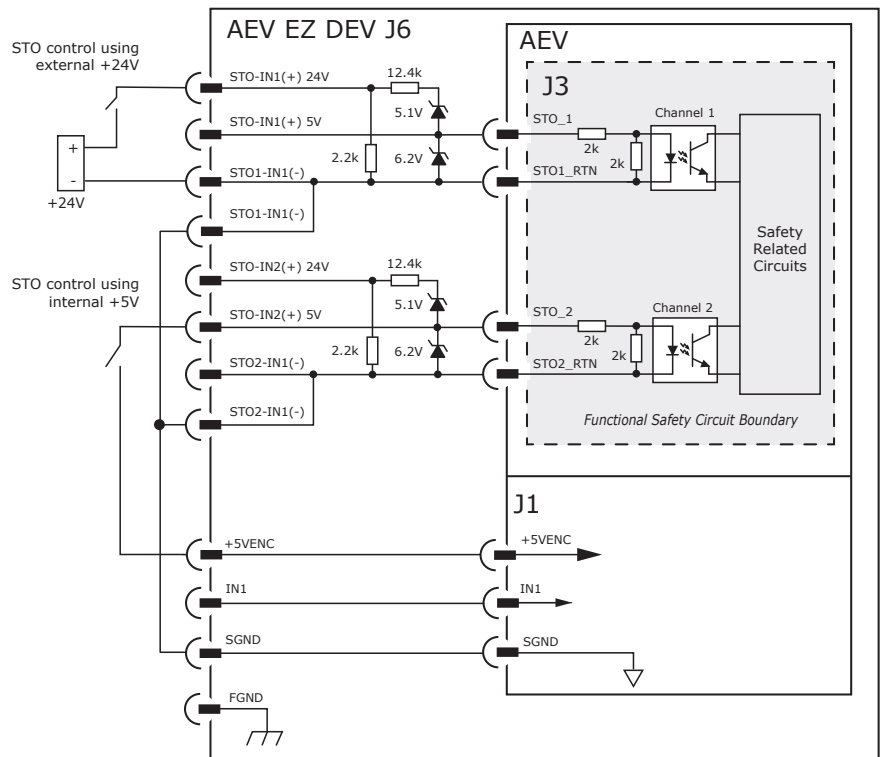
DESCRIPTION

This shows the use of the internal 5V and external 24V to energize the STO inputs.

Both STO inputs must be energized in order to enable the drive. IN1, the hardware Enable input is for use with an immediate contact relay to bring the motor to a stop before a delayed contact relay de-energizes the STO inputs and prevents torque production in the motor.

J6 STO

| EZ-Dev | Pin | EZ-Dev |
|------------|-----|--------|
| STO-IN1(-) | 1 | 2 |
| STO-IN1(+) | 3 | 4 |
| n.c. | 5 | 6 |
| STO-IN2(-) | 7 | 8 |
| STO-IN2(+) | 9 | 10 |
| n.c. | 11 | 12 |
| SGND | 13 | 14 |
| IN1 | 15 | 16 |



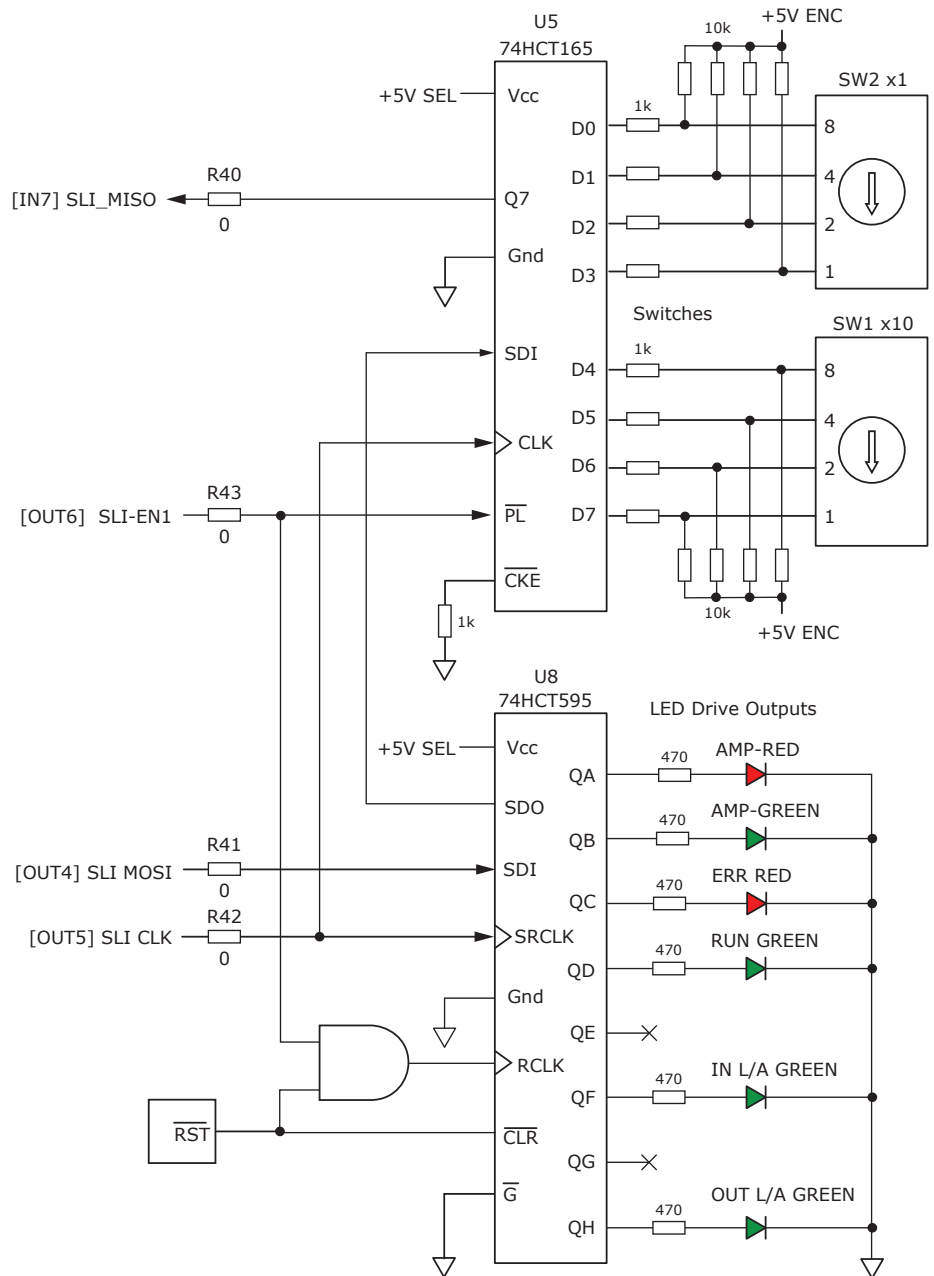
EZ DEVELOPMENT BOARD SLI PORT SWITCHES & LEDs

ETHERCAT DEVICE ID (STATION ALIAS) SWITCH CONNECTIONS

The graphic below shows the connections to the EtherCAT Device ID switches and status LEDs. The switches 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 [OUT4,5,6] and input [IN7] operate as an SLI port which reads the settings on the EtherCAT Device ID switches, and controls the Amp and EtherCAT status LEDs.

NOTE:

R40, R41, R42, R43 may be removed by the user if IN7, OUT4, OUT5, OUT6 are needed for other functions. This will disable the address switches and LEDs.



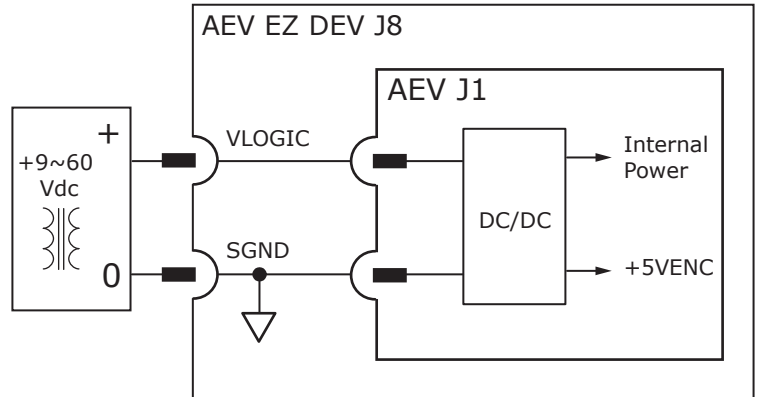
EZ DEVELOPMENT BOARD VLOGIC

DESCRIPTION

Powers the internal logic and control circuits in the drive. When using the STO feature, it must be produced by power supplies with transformer isolation from the mains and PELV or SELV ratings with a maximum output voltage of 60 Vdc. If the motor can operate from voltages of 60 Vdc or less, the +HV and VLOGIC can be driven from a single power supply.

J8 VLOGIC

| Pins | EZ-Dev | Signal |
|------|--------|-------------|
| 1 | VLOGIC | +24V_VLOGIC |
| 2 | SGND | SGND |



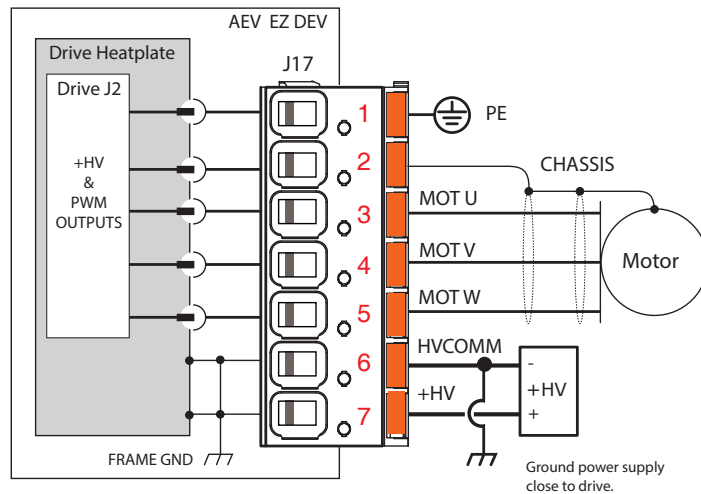
EZ DEVELOPMENT BOARD POWER, MOTOR, & GROUNDING CONNECTIONS

DESCRIPTION

J17 provides connection to the DC power supply, PWM outputs, and grounds. There are three conductors for brushless motors that provide and connection for a shielded cable connecting the motor housing to frame ground. The PE (Protective Earth) terminal provides a single connection to earth for bonding of the AEV frame ground to an earth-ground point.

J17 +HV, MOTOR, GNDS

| Pins | EZ-Dev | Signal |
|------|--------|---------|
| 1 | PE | PE |
| 2 | FGND | CHASSIS |
| 3 | MOT U | MOTU |
| 4 | MOT V | MOTV |
| 5 | MOT W | MOTW |
| 6 | HVCOM | HVCOMM |
| 7 | +HV | +HV |



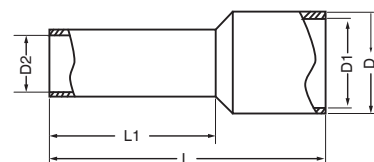
| CONDUCTOR TYPE | MM ² | AWG |
|---|-----------------|--------|
| Solid | 0.75 ~ 16 | 18 ~ 4 |
| Fine stranded | 0.75 ~ 25 | 18 ~ 4 |
| Fine stranded with ferrule with plastic collar | 0.75 ~ 16 | N/A |
| Fine stranded with ferrule without plastic collar | 0.75 ~ 16 | |
| Fine stranded with twin ferrule | 0.75 ~ 6 | |

| INSULATION STRIPPING | MM | INCH |
|----------------------|---------|-------------|
| Strip length | 18 ~ 20 | 0.71 ~ 0.79 |

| FERRULES | | |
|-----------------|-----|----------|
| MM ² | AWG | WAGO P/N |
| 16 | 6 | 216-210 |
| 10 | 8 | 216-289 |
| 6 | 10 | 216-288 |
| 4 | 12 | 216-287 |
| 2.5 | 14 | 216-286 |
| 1.5 | 16 | 216-284 |

Wago ferrules shown are electro-tin plated, electrolytic copper, gastight crimped, according to DIN 46228, Part 4/09.90. Wago part numbers are shown but other ferrule types with comparable specifications may be used.

216-210 Dimensions
 L = 28 mm
 L1 = 18 mm
 D = 9.6 mm
 D1 = 8.8 mm
 D2 = 5.8 mm



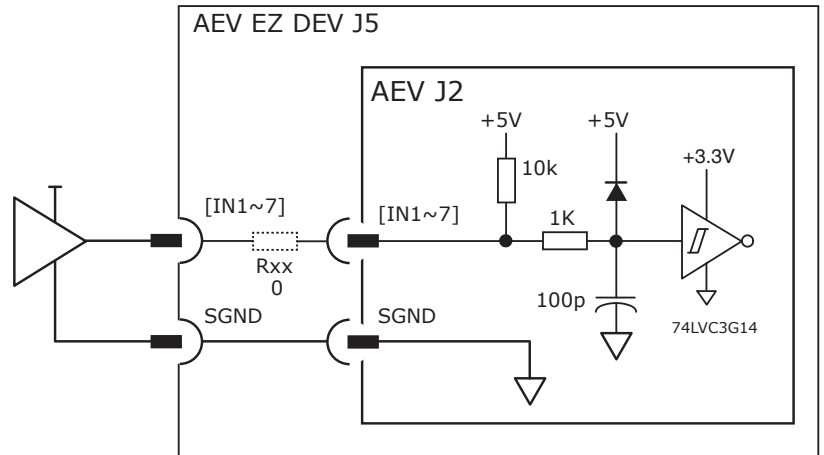
216-210

EZ DEVELOPMENT BOARD I/O CONNECTORS

LOGIC INPUTS

| EZ-Dev | Signal | J5 Pins |
|-------------------|--------|------------|
| IN1 Enable | IN1 | 4 |
| IN2 | IN2 | 3 |
| IN3 | IN3 | 6 |
| IN4 | IN4 | 5 |
| IN5 | IN5 | 8 |
| IN6 Encoder Fault | IN6 | 7 |
| IN7 SLI MISO | IN7 | 10 |
| SGND | SGND | 15, 17, 18 |

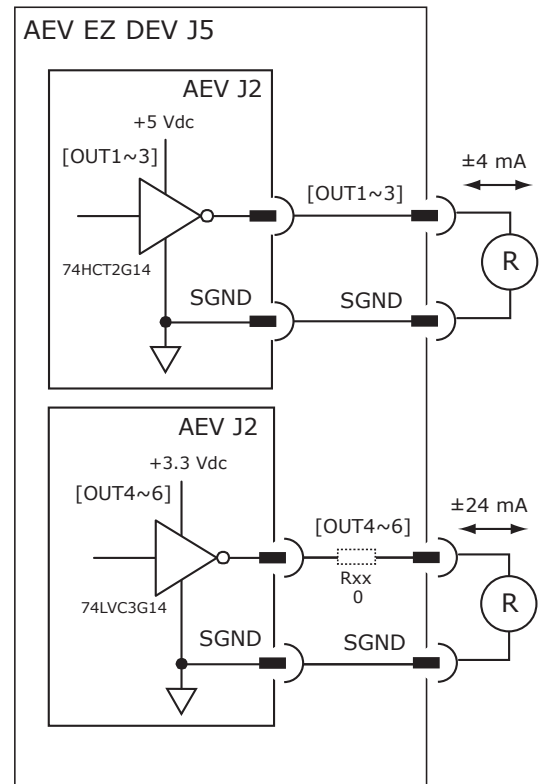
Logic inputs max input voltage is +6 Vdc.
 Rxx shows the location of 0 Ω resistors that are in place by default as R40 and R44.
 R40 connects the SLI-MISO signal to IN7 which is used by the SLI port that controls the LEDs and reads the address switches.
 R44 connects the Encoder Fault signal to IN6.
 If neither of these functions are needed then R40 and/or R44 can be removed making IN6 & IN7 available as logic inputs



LOGIC OUTPUTS

| EZ-Dev | Signal | J5 Pins |
|---------------|--------|------------|
| OUT1 | DOUT1 | 12 |
| OUT2 | DOUT2 | 9 |
| OUT3 Brake | DOUT3 | 14 |
| OUT4 SLI-MOSI | DOUT4 | 11 |
| OUT5 SLI-CLK | DOUT5 | 16 |
| OUT6 SLI-EN1 | DOUT6 | 13 |
| SGND | SGND | 15, 17, 18 |

OUT3 is connected by default to the MOSFET that is the Brake output on J10. OUT1~2 are available as logic outputs.
 OUT4~6 connect to the SLI circuit that drives the displays and reads the address switches. If the SLI function is not needed then these outputs can be used as logic outputs by removing the Rxx as follows:
 OUT4: R41
 OUT5: R42
 OUT6: R43



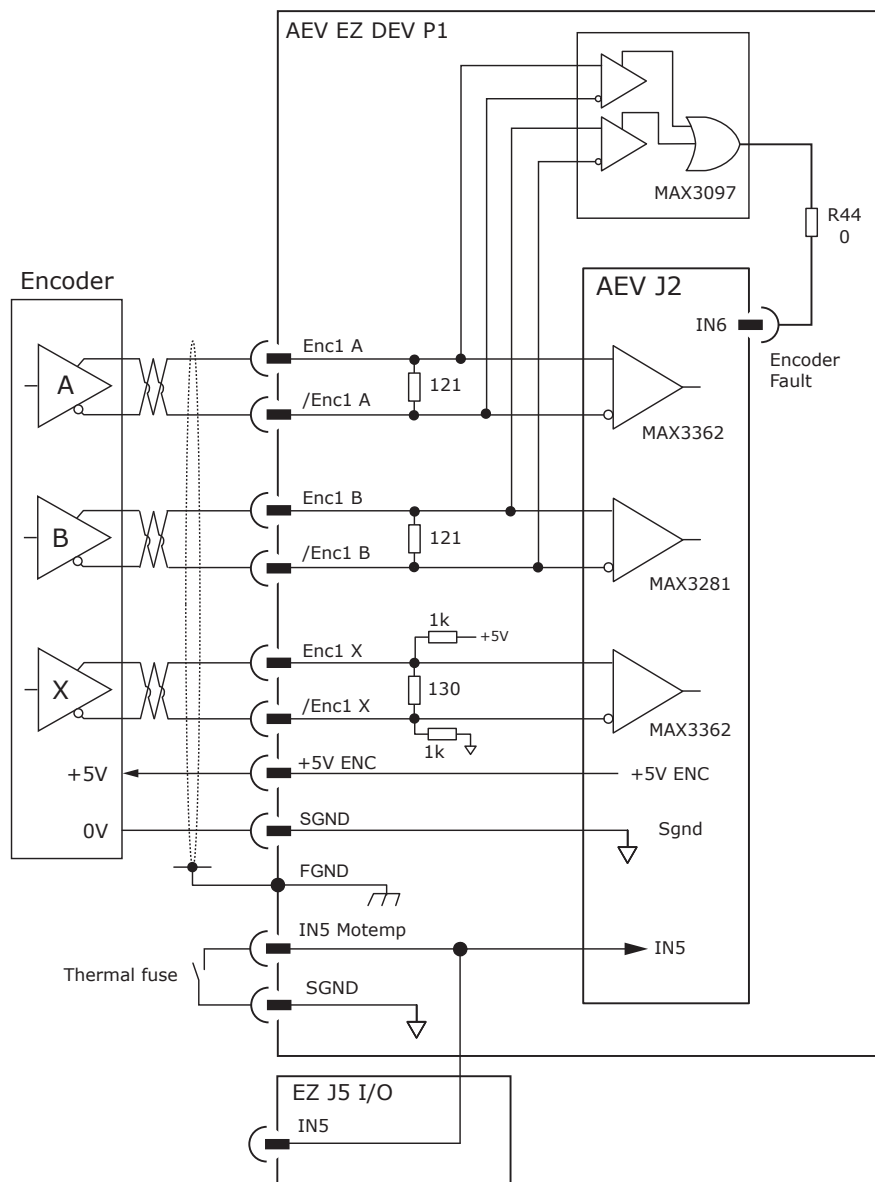
EZ DEVELOPMENT BOARD PRIMARY FEEDBACK CONNECTOR P1

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. 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 or B & /B 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 3097 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

FAULT DETECTION



P1 ENCODER 1 SIGNALS

| EZ-Dev | Signal | Pins |
|------------|--------|-------------|
| Enc1 A | Enc A | 13 |
| Enc1 /A | Enc /A | 12 |
| Enc1 B | Enc B | 11 |
| Enc1 /B | Enc /B | 10 |
| Enc1 X | Enc X | 9 |
| Enc1 /X | Enc /X | 8 |
| +5V ENC | +5V | 6, 17 |
| IN5 Motemp | IN5 | 7 |
| SGND | SGND | 5,16, 25,26 |

SGND = Signal Ground

NOTE:

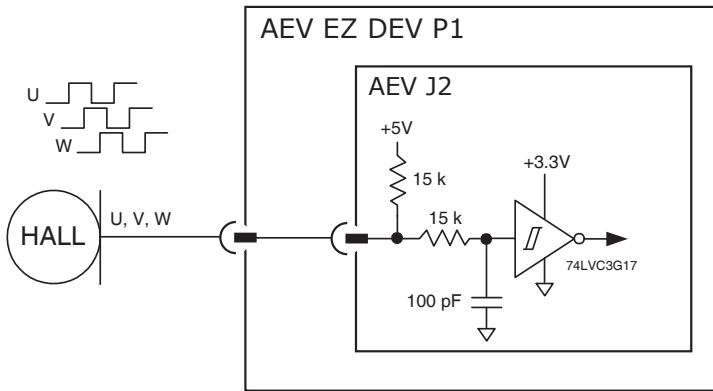
IN5 on the feedback connector is connected to the drive IN5.

IN5 MOTEMP SIGNALS

| EZ-Dev | Signal | Pins |
|--------|--------|---------------|
| P1 | IN5 | 7 |
| | SGND | 5, 16, 25, 26 |
| J5 | IN5 | 8 |
| | SGND | 15, 17, 18 |

EZ DEVELOPMENT BOARD PRIMARY FEEDBACK CONNECTOR P1

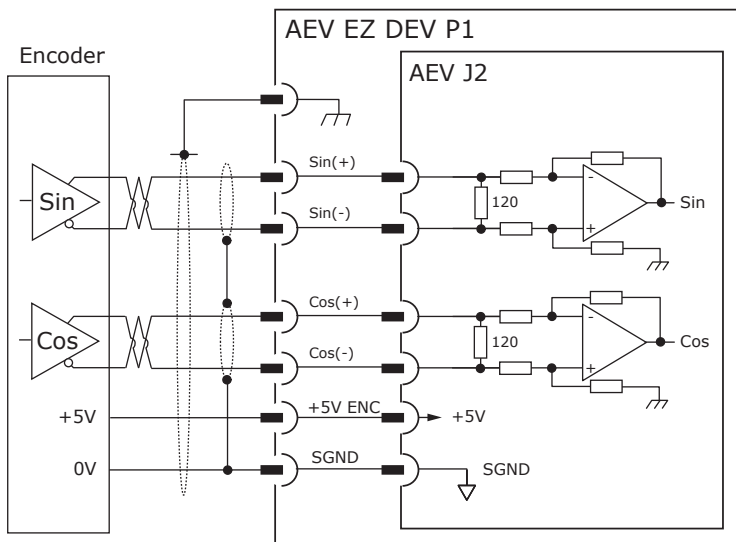
HALLS



P1 HALL SIGNALS

| EZ-Dev | Signal | Pins |
|--------|--------|------|
| Hall U | HALLU | 2 |
| Hall V | HALLV | 3 |
| Hall W | HALLW | 4 |

SIN/COS ENCODERS



P1 SIN/COS SIGNALS

| EZ-Dev | Signal | Pins |
|--------|--------|------|
| Sin(+) | SIN1+ | 19 |
| Sin(-) | SIN1- | 18 |
| Cos(+) | COS1+ | 21 |
| Cos(-) | COS1- | 20 |

P1 +5V & SGND

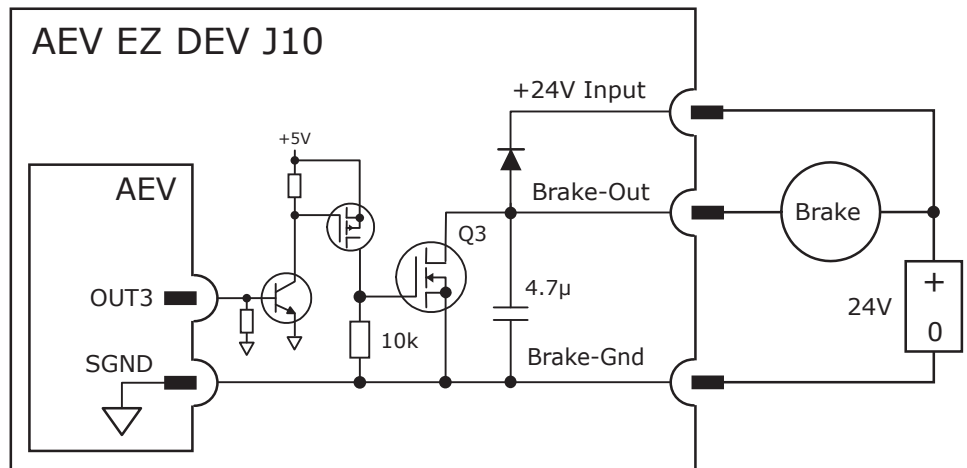
| EZ-Dev | Signal | Pins |
|---------|--------|---------------|
| +5V ENC | +5VENC | 6, 17 |
| SGND | SGND | 5, 16, 25, 26 |

Note that double-shielded cable is used for the Sin/Cos signals that are analog and more susceptible to noise. Two inner shields are used providing one for each twisted-pair and these connect to SGND. The outer shield connects to Frame Ground on the drive end is it not connected to the motor frame on the other. With the cable for the PWM outputs to the motor connected to Frame Ground on the drive end and the motor casing on the other there is a return path for currents produced by the capacitance between the UVW output wires and the motor cable shield.

EZ DEVELOPMENT BOARD BRAKE OUTPUT

The brake circuit on the EZ board is a MOSFET driven by OUT3 of the AEV.

- Brake output [OUT3]
- 24V Compatible
- Programmable functions



Specifications

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

The EZ brake circuit is referenced to SGND in the AEV.

HI/LO definitions: outputs

| Input | State | Condition |
|--------------|-------|---|
| BRAKE [OUT3] | LO | Output MOSFET Q3 is OFF Brake is un-powered and locks motor Motor cannot move Brake state is Active |
| | HI | Output MOSFET Q3 is ON Brake is powered, releasing motor Motor is free to move Brake state is NOT-Active |

J10 BRAKE SIGNALS

| EZ-Dev | Signal | Pin |
|-----------|------------|-----|
| Brake-24V | +24V_IN | 1 |
| Brake-Out | BRAKE | 2 |
| Brake-Gnd | 24V_GND_IN | 3 |

CME Default Setting for Brake Output [OUT3] is "Brake - Active Low"

Active = Brake is holding motor shaft (i.e. the *Brake is Active*)

Motor cannot move

No current flows in coil of brake

CME I/O Line States shows [OUT3] as LO

BRK Output voltage is HI (24V), MOSFET Q3 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

CME I/O Line States shows [OUT3] as HI

BRK output voltage is LO (~0V), MOSFET Q3 is ON

Servo drive is enabled, PWM outputs are on

Servo drive output current is flowing

EZ DEVELOPMENT BOARD CONNECTORS

P1 ENCODER 1

| Pin | Signal | Pin | Signal | Pin | Signal |
|-----|---------|-----|---------|-----|------------|
| 19 | Sin(+) | 10 | Enc1 /B | 1 | FGND |
| 20 | Cos(-) | 11 | Enc1 B | 2 | Hall U |
| 21 | Cos(+) | 12 | Enc1 /A | 3 | Hall V |
| 22 | Enc1 /X | 13 | Enc1 A | 4 | Hall W |
| 23 | Enc X | 14 | Enc1 /S | 5 | SGND |
| 24 | N.C. | 15 | Enc1 S | 6 | +5V ENC |
| 25 | SGND | 16 | SGND | 7 | IN5 Motemp |
| 26 | SGND | 17 | +5V ENC | 8 | Enc1 /X |
| | | 18 | Sin(-) | 9 | Enc1 X |

J10 BRAKE

| Pin | Signal |
|-----|-----------|
| 1 | Brake-24V |
| 2 | Brake-Out |
| 3 | Brake-Gnd |

J6 STO

| Signal | Pin | Signal |
|------------|-----|-------------------|
| IN1 | 15 | +5V ENC |
| SGND | 13 | FGND |
| n.c. | 11 | n.c. |
| STO-IN2(-) | 9 | STO-IN2(+) |
| STO-IN2(-) | 7 | STO-IN2(+) 24V |
| n.c. | 5 | n.c. |
| STO-IN1(-) | 3 | STO-IN1(+) |
| STO-IN1(-) | 1 | STO-IN1(+) 24V |

J13

| Signal | Pin | Signal |
|--------|-----|--------|
| *** | 3 | *** |
| *** | 1 | *** |

*** No connections

J4 ENCODER 2

| Signal | Pin | Signal |
|---------|-----|--------|
| +5V ENC | 7 | SGND |
| Enc2 /X | 5 | Enc2 X |
| Enc2 /B | 3 | Enc2 B |
| Enc2 /A | 1 | Enc2 A |

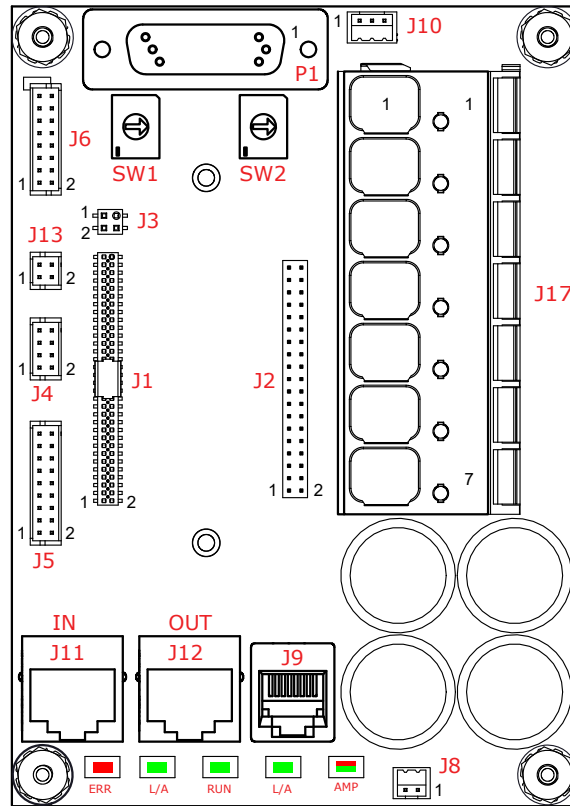
J5 I/O

| Signal | Pin | Signal |
|------------------|-----|----------------|
| SGND | 17 | SGND |
| SGND | 15 | OUT5 SLI-CLK * |
| * SLI-EN1 OUT6 | 13 | OUT3 Brake * |
| * SLI-MOSI OUT4 | 11 | OUT1 |
| OUT2 | 9 | IN7 SLI-MISO * |
| ** Enc-Fault IN6 | 7 | IN5 Motemp |
| IN4 | 5 | IN3 |
| IN2 | 3 | IN1 Enable |
| Aref(+) | 1 | Aref(-) |

* These signals are wired for the functions shown.

They can be programmed for other functions but the default functions will no longer function.

** This input can be programmed for other functions by removing the resistor R44 that connects the input to the encoder 1 fault-detection circuit.



J17 GROUNDS

| Pin | Signal |
|-----|--------|
| 1 | PE |
| 2 | FGND |

J17 MOTOR

| Pin | Signal |
|-----|--------|
| 3 | Mot U |
| 4 | Mot V |
| 5 | Mot W |

J17 DC-POWER

| Pin | Signal |
|-----|--------|
| 6 | HVCOM |
| 7 | +HV |

J8 V-LOGIC

| Pin | Signal |
|-----|--------|
| 1 | VLOGIC |
| 2 | SGND |

J11 ECAT-IN

| Pin | Signal |
|-----|--------|
| 1 | TX1+ |
| 2 | TX1- |
| 3 | RX1+ |
| 4 | n.c. |
| 5 | n.c. |
| 6 | RX1- |
| 7 | n.c. |
| 8 | FGND |

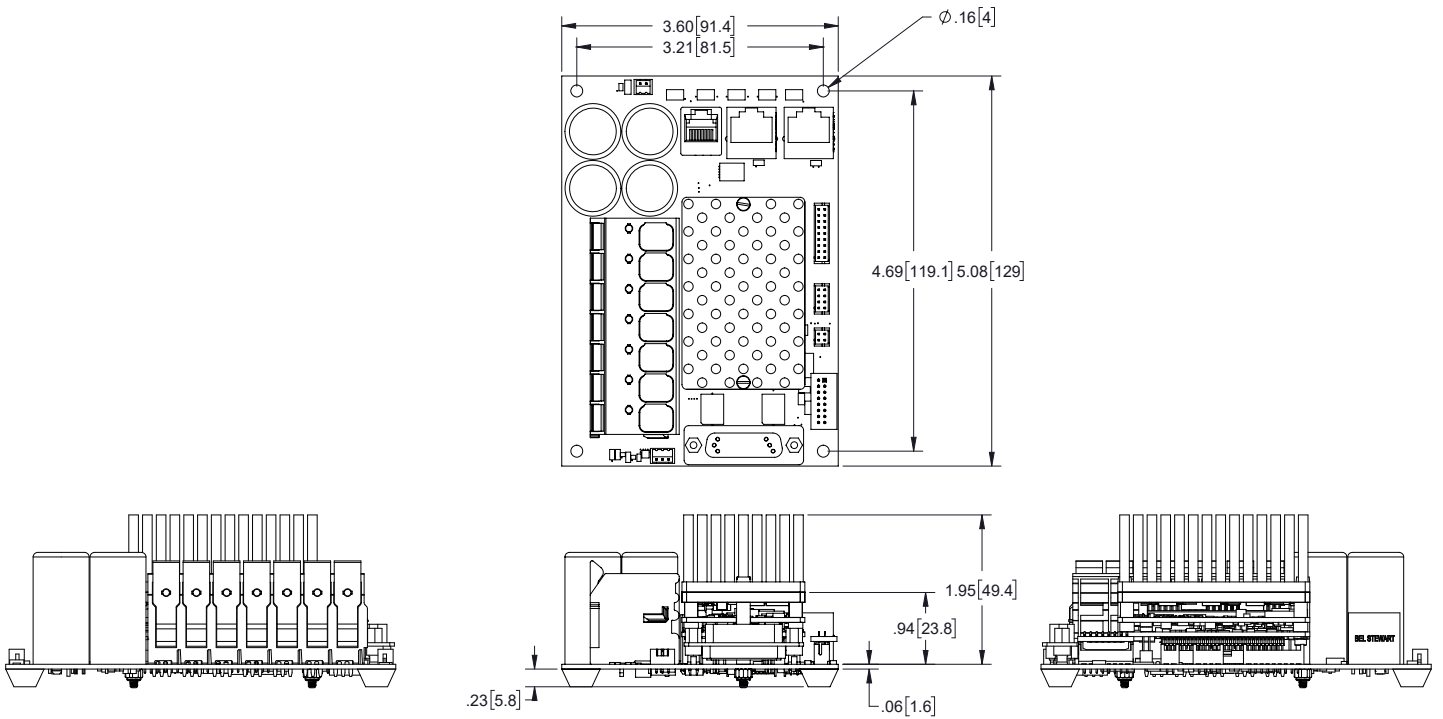
J12 ECAT-OUT

| Pin | Signal |
|-----|--------|
| 1 | TX2+ |
| 2 | TX2- |
| 3 | RX2+ |
| 4 | n.c. |
| 5 | n.c. |
| 6 | RX2- |
| 7 | n.c. |
| 8 | FGND |

J9 RS-232

| Pin | Signal |
|-----|--------|
| 1 | N.C. |
| 2 | RxD |
| 3 | SGND |
| 4 | SGND |
| 5 | TxD |
| 6 | N.C. |

EZ DEVELOPMENT BOARD DIMENSIONS



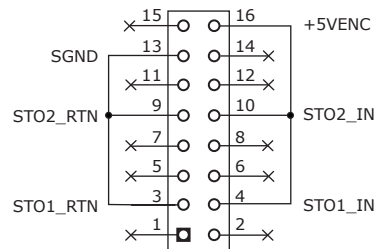
AEV-EZ-STO SAFE TORQUE OFF DISABLING ACCESSORY

J6 STO EZ-Board

| Signal | Pin | Signal |
|------------|-----|---------------------|
| IN1 | 15 | 16 +5V ENC |
| SGND | 13 | 14 FGND |
| n.c. | 11 | 12 n.c. |
| STO-IN2(-) | 9 | 10 STO-IN2(+) |
| STO-IN2(-) | 7 | 8 STO-IN2(+) 24V |
| n.c. | 5 | 6 n.c. |
| STO-IN1(-) | 3 | 4 STO-IN1(+) |
| STO-IN1(-) | 1 | 2 STO-IN1(+) 24V |

The AEV-EZ-STO, when inserted into J6 will disable the STO function, allowing normal operation of the AEV drive when the STO function is not required. As shown below, the STO inputs are energized in parallel using the encoder +5V from the drive.

The AEV-EZ-STO works on the EZ Board and the EZ Development Board.



J6 STO Signals

| Signal | Pin | Signal |
|----------|-----|---------------|
| IN1 | 15 | 16 +5VENC |
| SGND | 13 | 14 FGND |
| n.c. | 11 | 12 n.c. |
| STO2_RTN | 9 | 10 STO2_IN |
| STO2_RTN | 7 | 8 STO2_24V_IN |
| n.c. | 5 | 6 n.c. |
| STO1_RTN | 3 | 4 STO1_IN |
| STO1_RTN | 1 | 2 STO1_24V_IN |

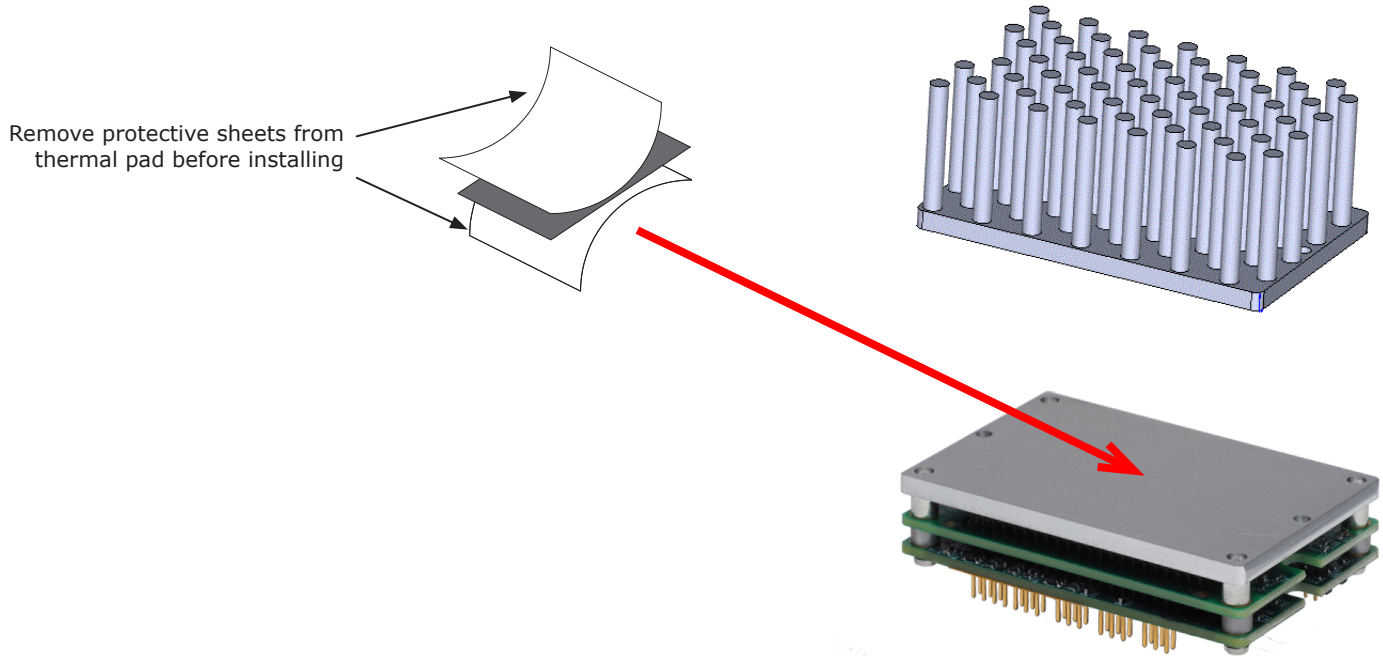
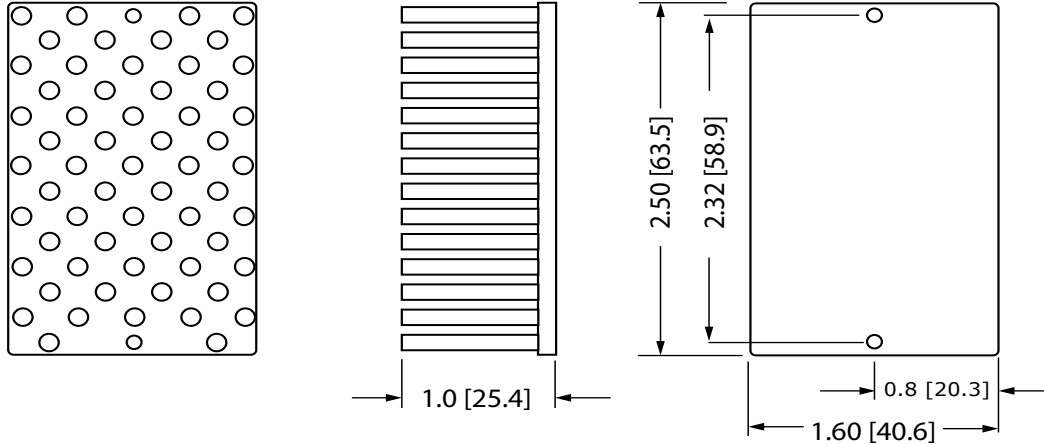


AEV-EZ-STO

ORDERING CONFIGURATIONS

AEV-HK HEATSINK KIT

The AEV-HK kit contains a heatsink, thermal material, and hardware to mount it to the drive and PC board.



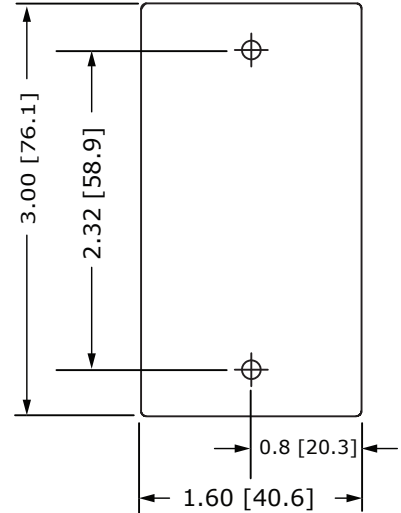
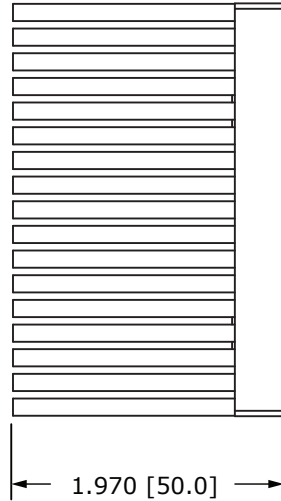
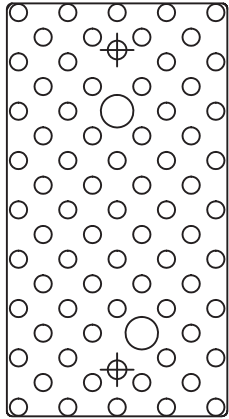
AEV-HK Pins Heatsink Kit

| Qty | Description |
|-----|--|
| 1 | Pins Heatsink, 1 inch tall |
| 1 | Thermal material |
| 2 | Copley non-threaded spacer, 20.5 mm |
| 2 | Screw, M2.5-0.45 x 35 mm slotted drive cheese head |
| 2 | Nut, M2.5x0.45 DIN Zinc Plated Nylon Insert Lock |

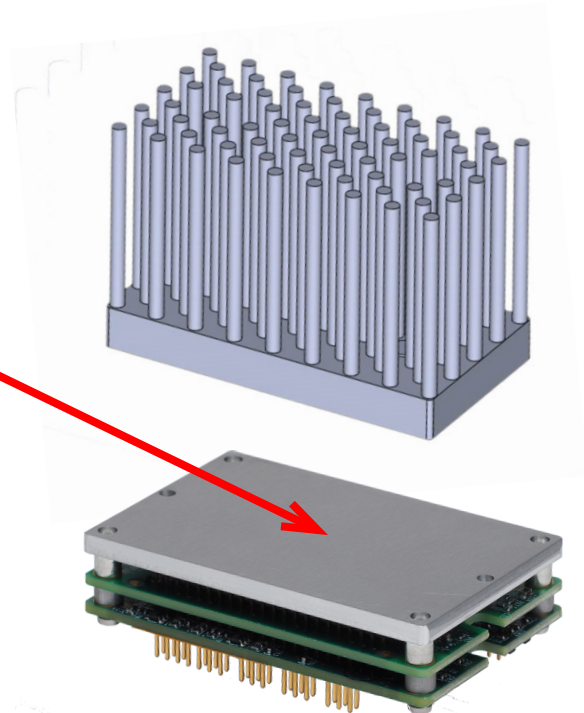
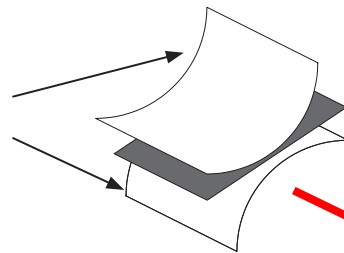
ORDERING CONFIGURATIONS

AEV-THK HEATSINK KIT

The AEV-THK kit contains a heatsink, thermal material, and hardware to mount it to the drive and PC board.



Remove protective sheets from thermal pad before installing



AEV-THK Pins Heatsink Kit

| Qty | Description |
|-----|--|
| 1 | Tall Pins Heatsink, 1.97 inch tall |
| 1 | Thermal material |
| 2 | Copley non-threaded spacer, 20.5 mm |
| 2 | Screw, M2.5-0.45 x 40 mm slotted drive cheese head |
| 2 | Nut, M2.5x0.45 DIN Zinc Plated Nylon Insert Lock |

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ORDERING GUIDE

MICRO MODULES

| | |
|----------------|--|
| AEV-090-14 | Accelnet Plus Micro Module AEV servo drive, 7/14 A, 90 Vdc |
| AEV-090-30 | Accelnet Plus Micro Module AEV servo drive, 15/30 A, 90 Vdc |
| AEV-090-50 * | Accelnet Plus Micro Module AEV servo drive, 25/50 A, 90 Vdc |
| AEV-090-50-C * | Accelnet Plus Micro Module AEV servo drive 50/50 A, 90 Vdc |
| AEV-180-10 | Accelnet Plus Micro Module AEV servo drive, 5/10 A, 180 Vdc |
| AEV-180-20 | Accelnet Plus Micro Module AEV servo drive, 10/20 A, 180 Vdc |

* Not compatible with AEV-EZ-090 board. Use AEZ-090-50 or AEZ-090-50-C if connectorized version is needed.

MICRO MODULES SOLDERED

| | |
|--------------|--|
| AEZ-090-50 | Accelnet Plus Micro Module AEV servo drive, 25/50 A, 90 Vdc, soldered to EZ Board |
| AEZ-090-50-C | Accelnet Plus Micro Module AEV servo drive 50/50 A, 90 Vdc, soldered to EZ Development Board with heatsink installed (see page 39) |

ACCESSORIES FOR MICRO MODULES

| | |
|--------------|---|
| AEV-EZ-090 | EZ Board (Pluggable for 90V AEV modules, <i>Not compatible with AEV-090-50 or AEV-090-50-C</i>) |
| AEV-EZ-180 | EZ Board (Pluggable for 180V AEV modules) |
| AEV-EZ-CK | EZ Board Connector Kit (see below) |
| AEV-HK | Heatsink kit (Pins heatsink, thermal pad, and hardware) |
| AEV-THK | Heatsink kit (Tall Pins heatsink, thermal pad, and hardware) |
| SER-CK | Serial Cable Kit: 9-Pin Dsub receptacle to 6-pin modular adapter, plus modular cable for EZ board |
| SER-USB-RJ11 | Serial Interface Cable: USB to RJ11 |

ORDERING GUIDE: EZ BOARD CONNECTOR KIT WITH SHELLS & CRIMP SOCKETS

CONNECTOR KIT FOR EZ BOARD AND EZ DEVELOPMENT BOARD

| | QTY | REF | NAME | DESCRIPTION | MFGR/PART NUMBER | |
|------------------|----------------------|------------------------------|---|---|--|------------------------|
| AEV-EZ-CK | 1 | J4 | Encoder 2 | Connector, socket, double row, 2.00 mm, 8 pos | Hirose: DF11-8DS-2C | |
| | 1 | J5 | I/O | Connector, socket, double row, 2.00 mm, 18 pos | Hirose: DF11-18DS-2C | |
| | 1 | J6 | STO | Connector, socket, double row, 2.00 mm, 16 pos | Hirose: DF11-16DS-2C | |
| | 1 | J8 | VLOGIC | Connector, socket, single row, 2.00 mm, 2 pos | Hirose: DF3-2S-2C | |
| | 1 | J10 | Brake | Connector, socket, single row, 2.00 mm, 3 pos | Hirose: DF3-3S-2C | |
| | 40 | J4,J5,J6 | Crimp socket, 24~28 AWG, gold | | Hirose: DF11-2428-SCFA | |
| | 5 | J8,J10 | Crimp socket, 24~28 AWG, gold | | Hirose: DF3-2428-SCC | |
| | Connector Kit | 15 | J4,J5,J6 | White Flying Lead with contacts at both ends, 26 AWG, gold, 12" | | Hirose: H3BBG-10112-W6 |
| | | 2 | | Red Flying Lead with socket at both ends, 26 AWG, gold, 12" | | Hirose: H3BBG-10112-R6 |
| | | 3 | | Black Flying Lead with socket at both ends, 26 AWG, gold, 12" | | Hirose: H3BBG-10112-B6 |
| | | 1 | J8,J10 | Blue Flying Lead with socket at both ends, 26 AWG, gold, 12" | | Hirose: H2BBG-10112-L6 |
| | | 1 | | Red Flying Lead with socket at both ends, 26 AWG, gold, 12" | | Hirose: H2BBG-10112-R6 |
| | | 1 | | Black Flying Lead with socket at both ends, 26 AWG, gold, 12" | | Hirose: H2BBG-10112-B6 |
| | | 1 | P1 | Encoder 1 | Connector, high-density DB-26M, 26 pos, male, solder cup | |
| | 1 | Metal Backshell, DB-15, RoHS | | | 3M: 3357-9215 | |
| 1 | J6 | AEV-EZ-STO | EZ board plug-in to J6 for disabling STO function | | | |

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Note: Specifications subject to change without notice