

Control Modes

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

Command Interface

- CANopen/DeviceNet
- ASCII and discrete I/O
- Stepper commands
- $\pm 10V$ position/velocity/torque command
- PWM velocity/torque command
- Master encoder (Gearing/Camming)

Communications

- CANopen/DeviceNet
- RS232

Feedback

- Digital Quad A/B encoder
- Secondary encoder
- Digital Halls
- Resolver (-R option)

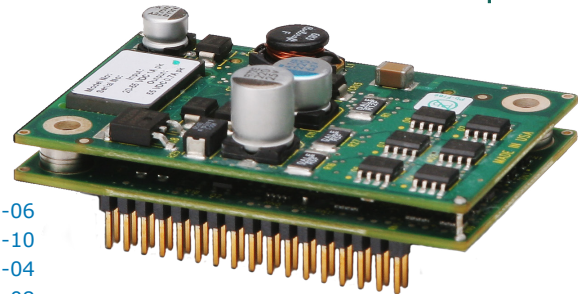
I/O - Digital

- 10 inputs, 3 outputs

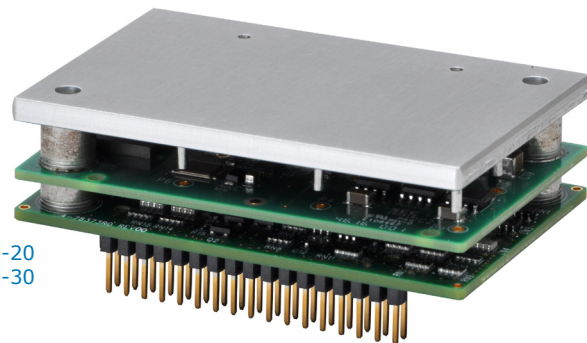
Dimensions: mm [in]

- 63.5 x 40.6 x 21.1 [2.50 x 1.60 x 0.83]

CANopen



ACK-055-06
ACK-055-10
ACK-090-04
ACK-090-08



ACK-090-20
ACK-090-30

MODEL	I _c	I _p	V _{dc}
ACK-055-06	3	6	14~55
ACK-055-10	5	10	20~55
ACK-090-04	2	4	14~90
ACK-090-08	4	8	20~90
ACK-090-20	10	20	14~90
ACK-090-30	15	30	14~90

DESCRIPTION

Accelnet Micro Module is a digital servodrive that combines CANopen networking with 100% digital control of brush or brushless motors in a PC board mounting package with power options to 15 A_{dc} continuous and 30 A_{dc} peak from 14 to 90 V_{dc} power supplies.

Accelnet Micro Module operates as a Motion Control Device using the DSP-402 protocol under the CANopen DS-301 V4.01 (EN 50325-4) application layer. DSP-402 modes supported include Interpolated Position (PVT), Profile Position, Profile Velocity, Profile Torque, and Homing.

There are ten logic inputs. One is dedicated to the Amp Enable function, the other nine are programmable. There are three logic outputs rated to +30 V_{dc}.

Used as a stand-alone drive, Accelnet Micro Module can operate using incremental position commands from step-motor controllers in Pulse/Direction or CU/CD format, as well as A/B quadrature commands from a master-encoder. Torque or velocity control can be from digital PWM signals, or analog $\pm 10 V$.

Drive commissioning is facilitated by CME 2™ software operating under Windows® communicating with Accelnet Micro Module via CAN or an RS-232 link.

Auto-tuning algorithms in CME 2™ slash set up times for fast system commissioning by automating motor phasing, and current-loop tuning.

A powerful oscilloscope and waveform generator displays drive performance for fine tuning. Drive configurations are saved in non-volatile flash memory. OEM's can inventory one part, and configure drives on-site to each axis in a machine.

Space-vector modulation delivers higher motor speeds and lower motor power dissipation than conventional sine-PWM modulation. Carrier-cancellation modulation all but eliminates motor ripple current and dissipation at a standstill. Current-loop sampling is at 15 kHz, position and velocity loops at 3 kHz and PWM ripple at 30 kHz. All drive circuits are DC coupled and operate from unregulated transformer-isolated linear DC power supplies, or regulated switching power supplies.

The PC-board mounting package is suitable for high-density, multi-axis installations in equipment where space is at a premium, and wiring must be minimized.

GENERAL SPECIFICATIONS

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

MODEL	ACK-055-06	ACK-055-10	ACK-090-04	ACK-090-08	ACK-090-20	ACK-090-30	
OUTPUT POWER							
Peak Current	6 (4.2)	10 (7.1)	4 (2.8)	8 (5.7)	20 (14.1)	30 (21.2)	Adc (Arms, sinusoidal)
Peak time	1	1	1	1	1	1	Sec
Continuous current	3 (2.1)	5 (3.5)	2 (1.4)	4 (2.8)	10 (7.07)	15 (10.6)	Adc (Arms, sinusoidal)
Peak Output Power	0.33	0.50	0.36	0.72	1.8	2.7	kW
Continuous Output Power	0.15	0.18	0.18	0.36	0.9	1.35	kW

INPUT POWER							
HVmin to HVmax	+14 to +55	+20 to +55	+14 to +90	+20 to +90	+14 to +90	+14 to +90	Vdc, transformer-isolated
Ipeak	6.6	11	4.4	8.8	22	33	Adc (1 sec) peak
Icont	3.3	5.5	2.3	4.4	11	16.5	Adc continuous
Aux HV	+14 to HVmax	2.5 W	Optional keep-alive power input when +HV is removed				

PWM OUTPUTS							
Type	MOSFET 3-phase inverter, 15 kHz center-weighted PWM carrier, space-vector modulation						
PWM ripple frequency	V _{r+}		30 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	15 kHz (66.7 μs)						
Position & Velocity loop update rate	3 kHz (333 μs)						

REFERENCE INPUTS							
CANopen bus	Homing, Profile Position, Profile Velocity, Profile Torque and Interpolated Position modes						
Digital position reference	Pls/Dir, CW/CCW		Stepper commands (2 MHz maximum rate)				
Analog torque, velocity & position reference	Quad A/B Encoder		2 Mline/sec, (8 Mcount/sec after quadrature)				
Digital torque & velocity reference (Note 1)	±10 Vdc, 5 kΩ differential input impedance						
	PWM , Polarity		PWM = 0~100%, Polarity = 1/0				
	PWM		PWM = 50% +/-50%, no polarity signal required				
	PWM frequency range		1 kHz minimum, 100 kHz maximum				
	PWM minimum pulse width		220 ns				

DIGITAL INPUTS (NOTE 1)							
Number	10						
All inputs	74HC14 Schmitt trigger with RC filter on input, 10 kΩ pull-up to +5 Vdc RC time-constants assume active drive on inputs and do not include 10 kΩ pull-ups.						
Logic levels	V _{cc} = 5.0 Vdc, V _{r+} = 1.83~3.5 Vdc, V _{r-} = 1.00~2.2 Vdc, V _h = 0.53~1.53, Maximum input voltage = +10 Vdc						
Enable [IN1]	1 dedicated input for drive enable, active level programmable, 33 μs RC filter						
GP [IN2,3,4,5]	4 General Purpose inputs with 33 μs (22 μs for [IN5]) RC filter, programmable functions						
HS [IN6,7,8,9,10]	5 High-Speed Inputs inputs with 100 ns RC filter, programmable functions						

DIGITAL OUTPUTS							
Number	3						
Type	Current-sinking MOSFET open-drain output with 1 kΩ pullup to +5 Vdc through diode 300 mAdc sink max, +30 Vdc max						
Functions	Programmable with CME 2™						
Active Level	Programmable to either HI (off, pull-up to +5 Vdc) or LO (on, current-sinking) when output is active						

RS-232 COMMUNICATION PORT							
Signals	RxD, TxD, Gnd						
Mode	Full-duplex, DTE serial communication port for drive setup and control, 9,600 to 115,200 baud						
Protocol	ASCII or Binary format						
Multi-drop	ASCII interface from single RS-232 port to control multiple drives (Xenus, Accelnet, Stepnet) Drive with serial connection acts as master for bi-directional data flow to other drives using CAN connections in daisy-chain from drive to drive						

CANOPEN COMMUNICATION PORT							
Signals	CANH, CANL, CAN_GND; 1Mbit/sec maximum.						
Protocol	CANopen Application Layer DS-301 V4.01						
Device	DSP-402 Device Profile for Drives and Motion Control						

FEEDBACK							
Digital Incremental Encoder	Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required) 5 MHz maximum line frequency (20 M counts/sec) 26LS32 differential line receiver with 121 Ω terminating resistor between complementary inputs +5 Vdc @ 250 mAdc max (L-C filter required between Stepnet and encoder) (see specifications on opposite page)						
Encoder power							
Resolver							

NOTES
1. [IN1] is not programmable and always works as drive Enable. Other digital inputs are programmable.

DC POWER OUTPUT

+5 Vdc 250 mA maximum. Directly connects to drive internal circuits.
 L-C filter required to isolate drive and external circuits

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
 Encoder (primary) Quadrature, differential (A, /A, B, /B, X, /X), 5 Mlines/sec (20 Mcount/sec after quadrature)
 Encoder (secondary) Quadrature, active single-ended (A, B, X),
 2 MHz maximum line frequency (8 Mcounts/sec after quadrature)
 Halls Hall signals (U,V,W)
 Motemp Motor temperature sensor or switch

PROTECTIONS

HV Overvoltage	+HV > +56 Vdc	Drive outputs turn off until +HV is < overvoltage (-06, -10 models)
	+HV > +91 Vdc	Drive outputs turn off until +HV is < overvoltage (-04, -08, -20, -30 models)
HV Undervoltage	+HV < +14 Vdc	Drive outputs turn off until +HV >= +14 Vdc (for -04, -06, -20, -30 models)
	+HV < +20 Vdc	Drive outputs turn off until +HV >= +20 Vdc (for -08, -10 models)
Drive over temperature	PC Board > 90 °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
Latching / Non-Latching		Programmable response to errors

MECHANICAL & ENVIRONMENTAL

Size	2.50 in (63.5 mm) X 1.60 in (40.6 mm) X 0.83 in (21.1 mm) for -04 & -06 models 2.50 in (63.5 mm) X 1.60 in (40.6 mm) X 0.71 in (18.0 mm) for -08 & -10 models 2.50 in (63.5 mm) X 1.60 in (40.6 mm) X 0.81 in (20.6 mm) for ACK-090-30 & ACK-090-20 models
Weight	1.3 oz (37 g) for all models except ACK-090-30 2.5 oz (70 g) for ACK-090-30 & ACK-090-20 without heatsink
Ambient temperature	0 to +45°C operating, -40 to +85°C storage
Humidity	0 to 95%, non-condensing
Vibration	2 g peak, 10~500 Hz (sine), IEC60068-2-6
Shock	10 g, 10 ms, half-sine pulse, IEC60068-2-27
Contaminants	Pollution degree 2
Environment	IEC68-2: 1990
Cooling	Forced air cooling required for continuous power output

AGENCY STANDARDS CONFORMANCE

In accordance with EC Directive 2004/108/EC (EMC Directive)

EN 55011: 2007	CISPR 11:2003/A2:2006 Industrial, Scientific, and Medical (ISM) Radio Frequency Equipment – Electromagnetic Disturbance Characteristics – Limits and Methods of Measurement Group 1, Class A
EN 61000-6-1: 2001	Electromagnetic Compatibility (EMC) – Part 6-1: Generic Standards – Immunity for residential, Commercial and Light-industrial Environments

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

IEC 61010-1:2001	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
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Underwriters Laboratory Standards

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

SPECIFICATIONS FOR RESOLVER FEEDBACK OPTION

RESOLVER

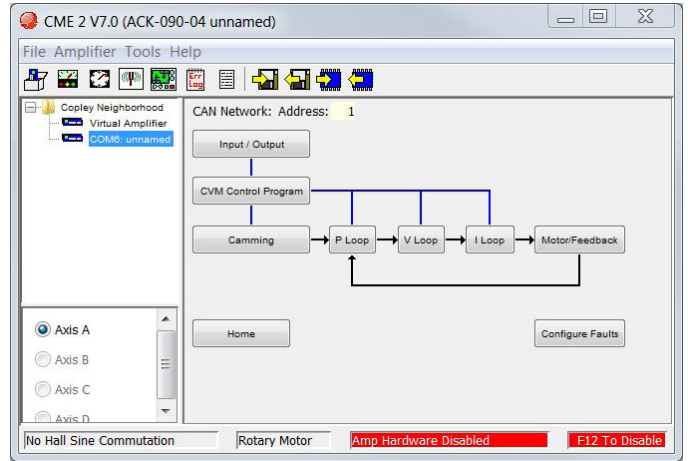
Type	Brushless, single-speed, 1:1 to 2:1 programmable transformation ratio
Resolution	14 bits (equivalent to a 4096 line quadrature encoder)
Reference frequency	7.5 kHz
Reference voltage	2.8 Vrms, auto-adjustable by the drive to maximize feedback
Reference maximum current	100 mA
Maximum RPM	10,000

ENCODER EMULATION

Resolution	Programmable to 65,536 counts/rev (4096 line encoder equivalent)
Buffered encoder outputs	26C31 differential line driver

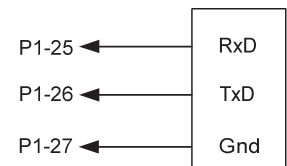
CME 2™ SOFTWARE

Drive setup is fast and easy using CME 2™ software. All of the operations needed to configure the drive are accessible through this powerful and intuitive program which communicates with the drive over CAN or an RS-232 link. Motor data can be saved as .ccm files. Drive data is saved as .ccx files that contain all drive settings plus motor data. This eases system management as files can be cross-referenced to amplifiers. Once a drive configuration has been completed systems can be replicated easily with the same setup and performance.



RS-232 COMMUNICATION

The serial port is a full-duplex, three-wire (RxD, TxD, Gnd) RS-232 type that operates from 9,600 to 115,200 Baud. It can be used by CME2 for drive configuration and setup or by external equipment sending ASCII commands.



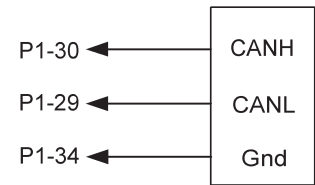
ICL3221
RS-232 Transceiver

CANOPEN COMMUNICATION

Accelnet Micro Module uses the CAN physical layer signals CANH, CANL, and GND for connection, and CANopen protocol for communication. The electrical interface is a TJA1050 high-speed CAN transceiver.

Before connecting Accelnet Micro Module to the CAN network, it must be assigned a CAN address. This can be done via the RS-232 port, or by using logic inputs for the CAN address bits. The CAN address is a combination of an internal address stored in flash memory, and an address derived from the logic inputs. A maximum of 127 CAN devices are allowed on a CAN bus network, so this limits the input pins used for this purpose to a maximum of seven, leaving three inputs available for other purposes. Most installations will use less than the maximum number of CAN devices, in which case the number of inputs used for a CAN address can be less than seven, leaving more inputs available for other functions.

When inputs are used for the CAN address bits, the internal address is added to the binary value that results from the inputs. If all the inputs are used as logic inputs, then the CAN address in flash memory is the drive CAN address.



TJA1050
CAN Transceiver

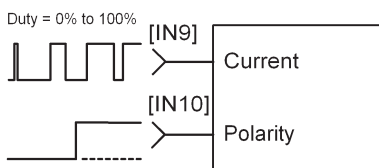
STAND-ALONE OPERATION

Accelnet Micro Module can operate with external motion controllers in torque, velocity, or position mode.

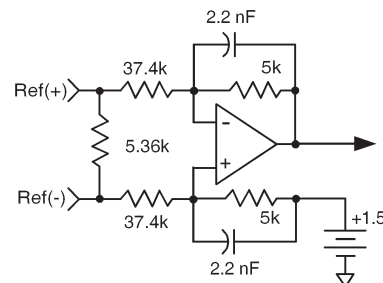
Torque (current, force) and velocity modes accept command inputs in either analog $\pm 10V$ format, or as digital PWM & Direction signals. When operating as a position controller command signals are digital in either Pulse/Direction or CU/CD (Count-UP/Count-Down) format, or analog as $\pm 10V$. Quadrature encoder signals can also be used. In all cases, the ratio of input position commands to motor encoder feedback is programmable to match controller position units to actual motor travel. If using an encoder as position input this feature also enables electronic gearing.

DIGITAL TORQUE & VELOCITY INPUTS

The PWM signal duty-cycle controls magnitude, and the DC signal controls polarity.



ANALOG TORQUE, VELOCITY OR POSITION INPUTS



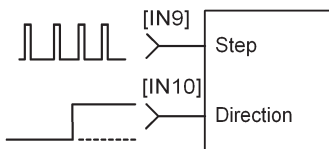
STAND-ALONE MODE DIGITAL POSITION-CONTROL INPUTS

Accelnet Micro Module works with motion controllers that output pulses to command position. These formats are supported:

- Step/Direction
- 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.

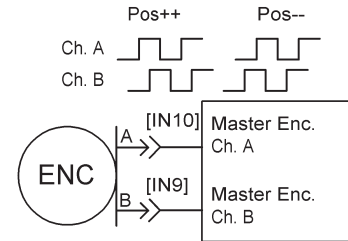
STEP/DIRECTION INPUTS



COUNT-UP/COUNT-DOWN INPUTS



QUAD A/B ENCODER INPUTS

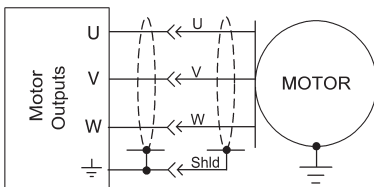


MOTOR CONNECTIONS

Motor connections are of five types: phase, Halls, temperature sensor, encoder and resolver (option). The phase connections carry the drive output currents that drive the motor to produce motion. The Hall signals are three digital signals that give absolute position feedback within an electrical commutation cycle. A temperature sensor can shut down the drive to protect the motor from over-heating. The encoder and resolver signals give incremental position feedback and are used for velocity and position modes, as well as sinusoidal commutation.

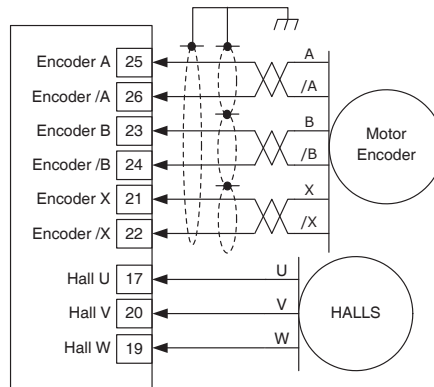
MOTOR PHASE CONNECTIONS

The drive output is a dual H-bridge that converts the DC buss voltage (+HV) into sinusoidal voltage waveforms that drive the motor phases. Cable should be sized for the continuous current rating of the drive. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits.



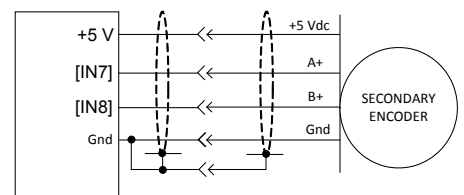
MOTOR ENCODER

Six dedicated inputs accept the encoder A, B, and X (index) signals. Encoders with differential outputs must be used.



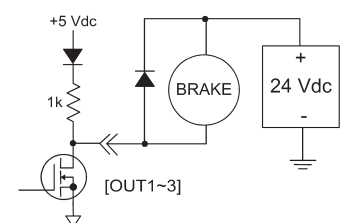
SECONDARY ENCODER

Inputs [IN7] & [IN8] accept the encoder A and B signals. Encoders with single-ended active outputs must be used.



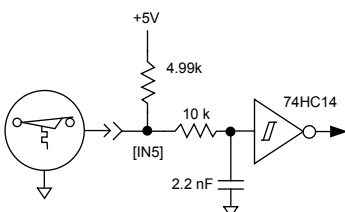
MOTOR BRAKE

Digital outputs [OUT1,2,3] can be programmed to power a motor-mounted brake. These brake the motor when they are in an unpowered state and must have power applied to release. This provides a fail-safe function that prevents motor motion if the system is in an unpowered (uncontrolled) state. Because brakes are inductive loads, an external flyback diode must be used to control the coil voltage when power is removed. The timing of the brake is programmable.



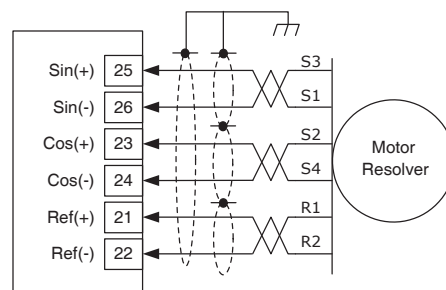
MOTOR TEMPERATURE SENSOR

Digital input [IN5] is programmable for use with a motor overtemperature switch. The input should be programmed as a pull-up to +5 Vdc if the motor switch is grounded.



MOTOR RESOLVER (-R option)

Resolvers use only six connections and do not need +5V.



DIGITAL INPUTS

There are ten digital inputs to *Accelnet Micro Module*, nine of which can be programmed to a selection of functions. The Enable input which controls the on/off state of the PWM outputs is fixed to [IN1] as a safety measure so that a drive cannot be programmed in such a way that, once installed, it could not be shut down by the controller. Two types of RC filters are used: GP (General-purpose) and HS (High Speed). The input time-constants apply when driven by active sources (CMOS, TTL, etc). All inputs except [IN5] have 10 kΩ pull-up resistors to +5 Vdc. The pull-up for [IN5] is 4.99 k for compatibility with Copley linear motors. Input functions such as Step/Direction, CountUp/CountDown, Quad A/B must be wired to inputs having the HS filters, and inputs with the GP filters can be used for general purpose logic functions, limit switches, and the motor temperature sensor. In addition to the selection of functions, the active level for each input is individually programmable.

GP INPUT FUNCTIONS

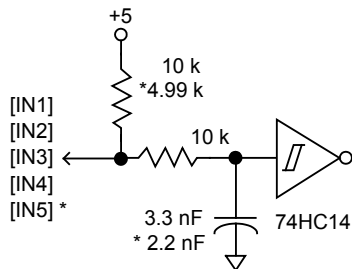
- Drive enable
- CAN address
- Positive Limit switch
- Negative Limit switch
- Home switch
- Drive Reset
- Motor temperature sensor input
- Motion abort

HS INPUT FUNCTIONS

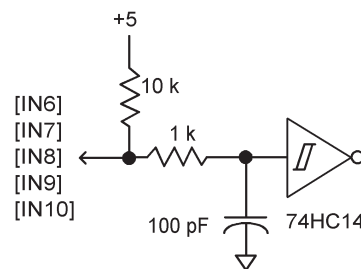
- Step/Direction, or CountUp/CountDown step motor control commands
- Quad A/B master encoder position commands
- Motor-mounted feedback encoder

Drive reset is programmable to take place on transitions of the input and is programmable to 1/0 or 0/1. The motor temp sensor function will disable the drive if a switch in the motor opens or closes when the motor overheats.

GP INPUTS 1,2,3,4,5

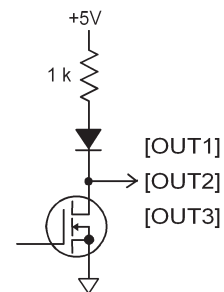


HS INPUTS 6,7,8,9,10



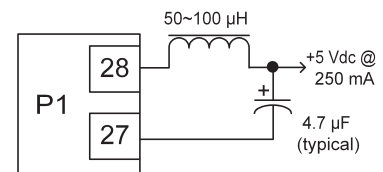
DIGITAL OUTPUTS

Digital outputs [OUT1~3] are open-drain MOSFETs with 1 kΩ pull-up resistors in series with a diode to +5 Vdc. They can sink up to 300 mAdc from external loads operating from power supplies to +30 Vdc. The outputs are typically configured as drive fault and motor brake. Additional functions are programmable. As a drive fault output, the active level is programmable to be HI or LO when a fault occurs. As a brake output, it is programmable to be either HI or LO to release a motor brake when the drive is enabled. When driving inductive loads such as a relay, an external fly-back diode is required. A diode in the output is for driving PLC inputs that are opto-isolated and connected to +24 Vdc. The diode prevents conduction from +24 Vdc through the 1 kΩ resistor to +5 Vdc in the drive. This could turn the PLC input on, giving a false indication of the drive output state.



+5 VDC OUTPUT

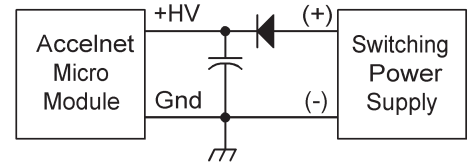
The drive internal +5 Vdc power is made available at P1-28. The output current is 250 mA maximum. This power should be used with care as there is no linear regulator between the drive internal power supply and the external circuits as in other Copley drives with +5 Vdc outputs. When using this power an L-C filter is required. This consists typically of a ferrite-core inductor and an electrolytic capacitor. A typical value for the capacitor would be 4.7 μF. The inductor can be 50~150 μH and should be rated for DC current of 250 mA minimum. The capacitor should have a return path to drive power ground (J1-13,14).



POWER SUPPLIES

Accelnet Micro Module operates typically from transformer-isolated, unregulated DC power supplies. These should be sized such that the maximum output voltage under high-line and no-load conditions does not exceed the drive maximum voltage rating. Power supply rating depends on the power delivered to the load by the drive.

Operation from regulated switching power supplies is possible if a diode is placed between the power supply and drive to prevent regenerative energy from reaching the output of the supply. If this is done, there must be external capacitance between the diode and drive. The minimum value required is 330 μF per drive mounted no more than 12 inches from the drive.



AUX HV (OPTIONAL)

CANopen communications can be maintained when +HV is turned off by using the Aux HV input. The voltage has the same range as +HV, and can be greater or less than +HV.

In operation, the Aux HV keeps the drive logic and control circuits active so it is always visible as a node on a CAN bus. The current-position data is maintained making 'homing' unnecessary after system power is re-enabled. If Accelnet Micro Module is operating as a stand-alone drive, Aux HV is not necessary but can be useful if the controller is monitoring drive digital outputs.

GROUNDING CONSIDERATIONS

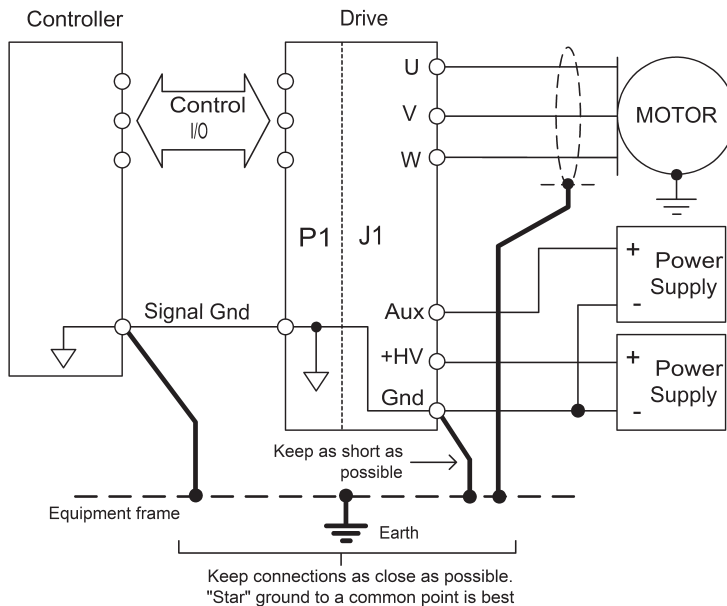
Power and control circuits share a common circuit-ground (P1-3, 4, 27, 33, 34, and J1-13, 14). Input logic circuits are referenced to Signal Ground, as are power GND, digital outputs, and encoder. For this reason, drive Gnd terminals should connect to the users' common ground system so that signals between drive and controller are at the same common potential, and to minimize noise. The system ground should, in turn, connect to an earthing conductor at some point so that the whole system is referenced to "earth".

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

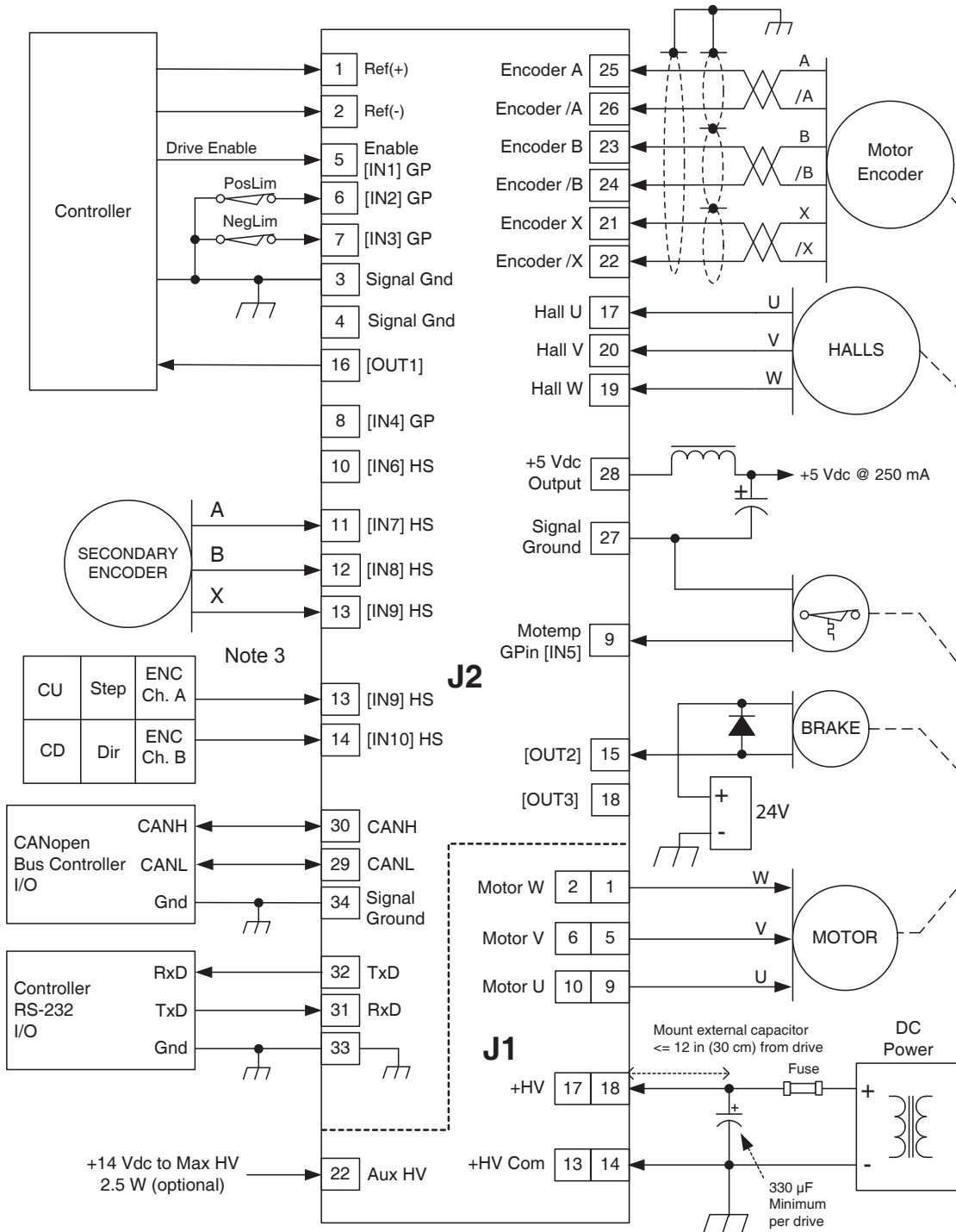
For CE compliance drive cables should be shielded. Motor phase currents are balanced, but currents can flow between the PWM outputs, and the motor cable shield.

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

First, the power supply currents flowing into and out of the drive at the +HV and Gnd pins on J1. Second, the drive outputs current into and out of the motor phases, and motor shield currents circulating between the U, V, and W outputs and HV common. And, lastly, logic and signal currents connected to the drive control inputs and outputs. For CE compliance drive cables should be shielded. Motor phase currents are balanced, but currents can flow between the PWM outputs, and the motor cable shield.



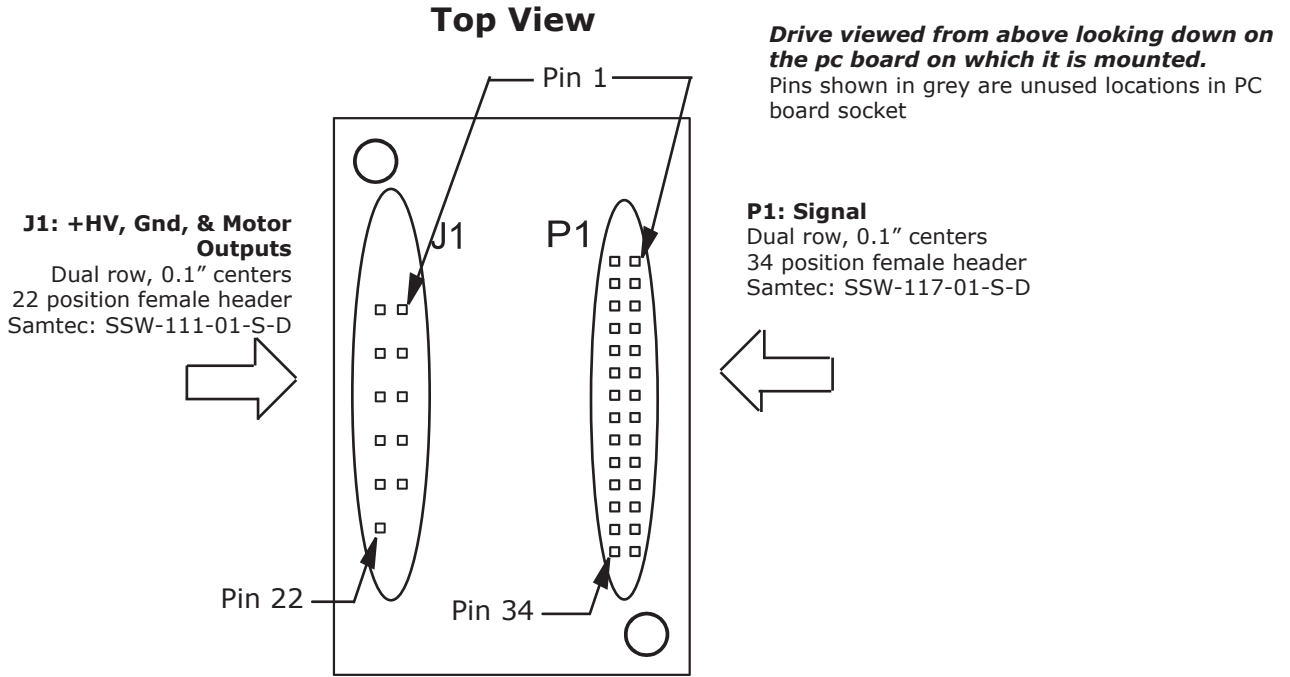
TYPICAL DRIVE CONNECTIONS (STANDARD, ENCODER MODELS)



NOTES

- [IN1] always functions as Drive Enable with programmable active level
[IN2]~[IN10] have programmable functions and active level
- HS inputs [IN6,7,8,9,10] are for high-speed signals and have 100 ns RC filters.
GP inputs [IN1,2,3, & 4] have 33 µs filters, [IN5] has a 22 µs filter.
RC filter time constants apply when inputs are driven by active sources and do not include the 10 kΩ pull-up resistors.
- [IN9] is programmable as an encoder index (X) input if it is not used as an input for digital commands.

DRIVE PC BOARD CONNECTORS



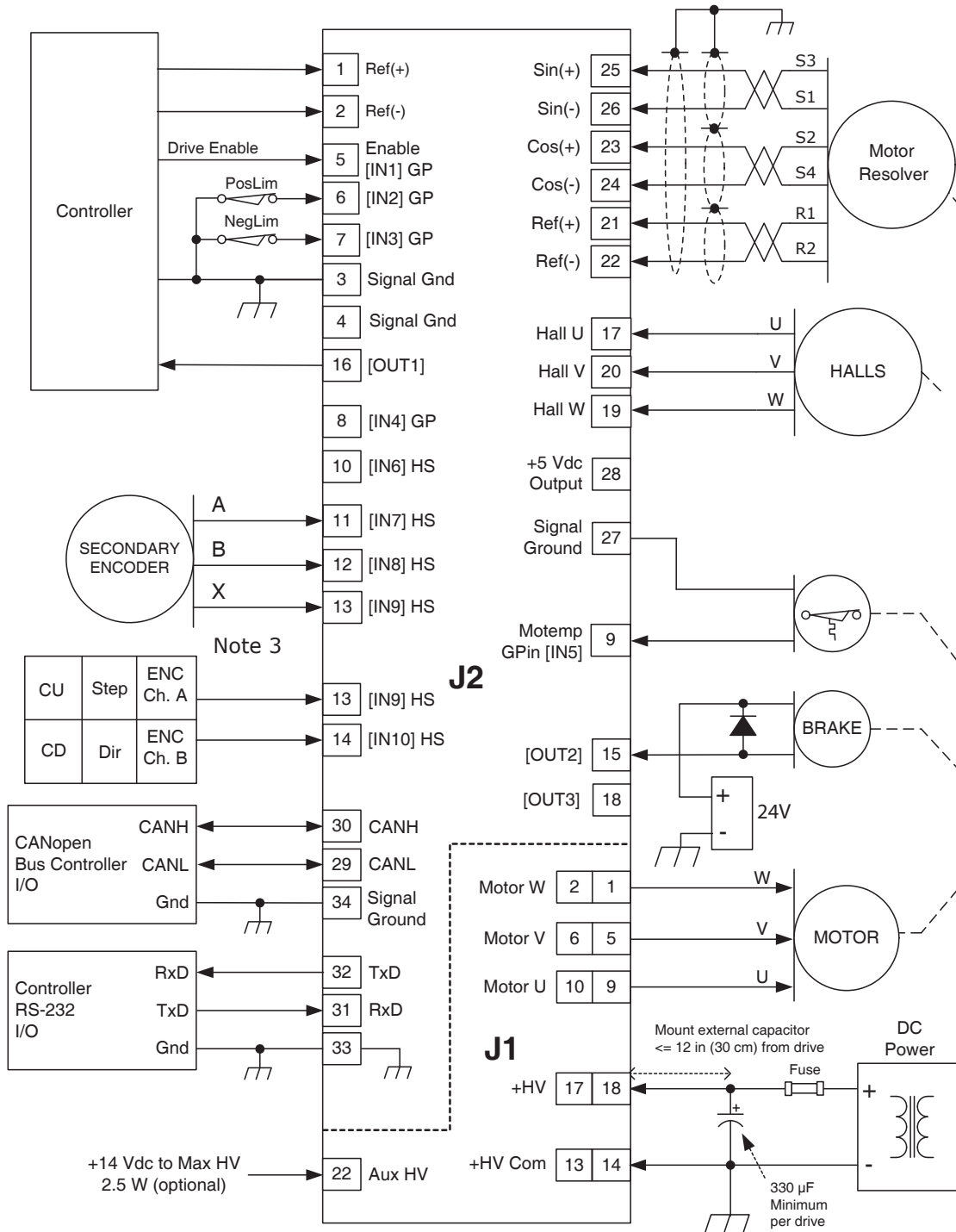
Signal	J1 Pin	Signal
Motor W	2 1	Motor W
	4 3	
Motor V	6 5	Motor V
	8 7	
Motor U	10 9	Motor U
	12 11	
HV common	14 13	HV common
	16 15	
+HV	18 17	+HV
	20 19	

SIGNALS	P1 Pin		SIGNALS
Ref (-)	2	1	Ref (+)
Signal ground	4	3	Signal ground
[IN2]	6	5	[IN1]
[IN4]	8	7	[IN3]
[IN6]	10	9	[IN5]
[IN8]	12	11	[IN7]
[IN10]	14	13	[IN9]
[OUT1]	16	15	[OUT2]
[OUT3]	18	17	Hall U
Hall V	20	19	Hall W
Encoder /X	22	21	Encoder X
Encoder /B	24	23	Encoder B
Encoder /A	26	25	Encoder A
+5 Vdc @ 250 mA	28	27	Signal Ground
CANH	30	29	CANL
TxD	32	31	RxD
Signal ground	34	33	Signal Ground

NOTES

1. Grey-shaded signal are N.C. (No Connection)
2. Signals are grouped for current-sharing on the power connector. When laying out pc board art-works, all pins in groups having the same signal name must be connected.

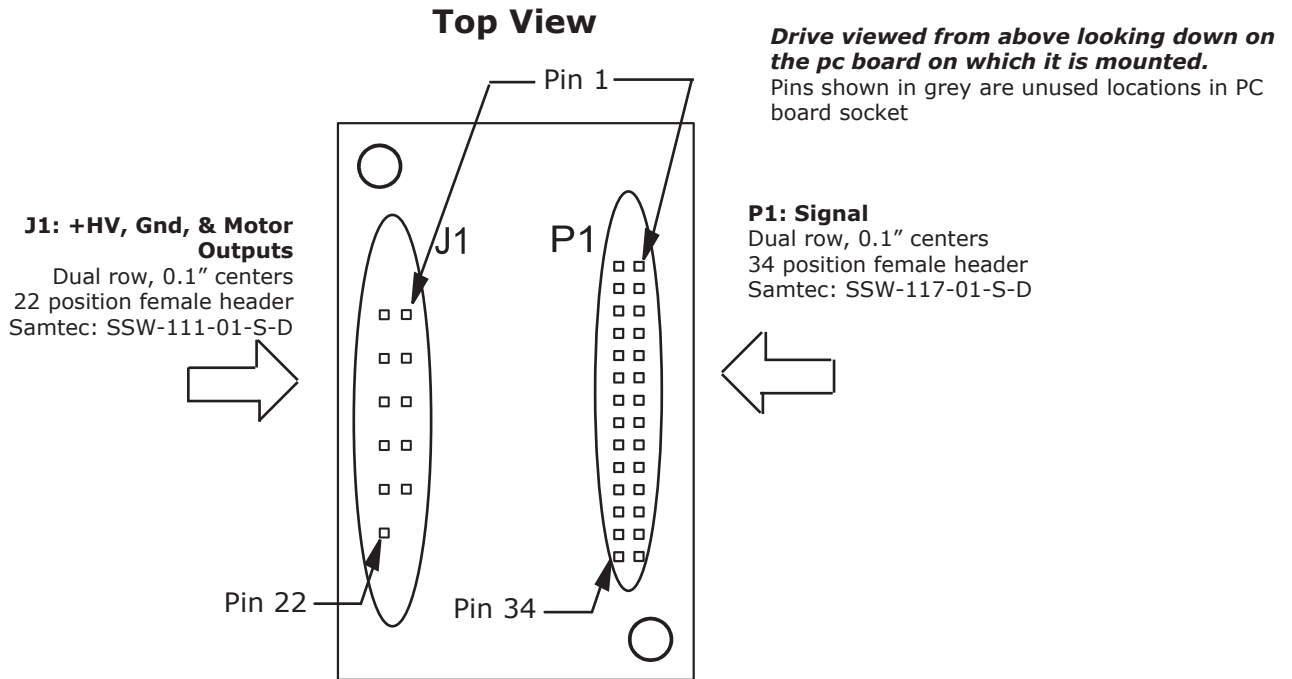
TYPICAL DRIVE CONNECTIONS (RESOLVER OPTION)



NOTES

- [IN1] always functions as Drive Enable with programmable active level
[IN2]~[IN10] have programmable functions and active level
- HS inputs [IN6,7,8,9,10] are for high-speed signals and have 100 ns RC filters.
GP inputs [IN1,2,3, & 4] have 33 μ s filters, [IN5] has a 22 μ s filter.
RC filter time constants apply when inputs are driven by active sources and do not include the 10 k Ω pull-up resistors.
- [IN9] is programmable as an encoder index (X) input if it is not used as an input for digital commands.

DRIVE PC BOARD CONNECTORS



Signal	J1 Pin	Signal
Motor W	2 1	Motor W
	4 3	
Motor V	6 5	Motor V
	8 7	
Motor U	10 9	Motor U
	12 11	
HV common	14 13	HV common
	16 15	
+HV	18 17	+HV
	20 19	
+HV Aux	22 21	

Signal	P1 Pin	Signal
Ref(-)	2 1	Ref(+)
Sgnd	4 3	Sgnd
[IN2]	6 5	[IN1]
[IN4]	8 7	[IN3]
[IN6]	10 9	[IN5]
[IN8]	12 11	[IN7]
[IN10]	14 13	[IN9]
[OUT1]	16 15	[OUT2]
[OUT3]	18 17	Hall U
Hall V	20 19	Hall W
R2 Ref(-)	22 21	R1 Ref(+)
S4 Cos(-)	24 23	S2 Cos(+)
S1 Sin(-)	26 25	S3 Sin(+)
+5 Vdc @ 250 mA	28 27	Sgnd
CANH	30 29	CANL
RS-232 TxD	32 31	RS-232 RxD
Sgnd	34 33	Sgnd

NOTES

1. Grey-shaded signal are N.C. (No Connection)
2. Signals are grouped for current-sharing on the power connector. When laying out pc board artworks, all pins in groups having the same signal name must be connected.

PC BOARD MOUNTING FOOTPRINT

MOUNTING AND COOLING

Accelnet Micro Module mounts on PC boards using two, dual-row, 0.1" female headers. These permit easy installation and removal of the drive without soldering. Threaded standoffs swaged into the PC board provide positive retention of the drive and permit mounting in any orientation. Cooling is by convection, or external fan-supplied forced air.

NOTES

1. J1 pins with the same signal name 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.

PC BOARD DESIGN

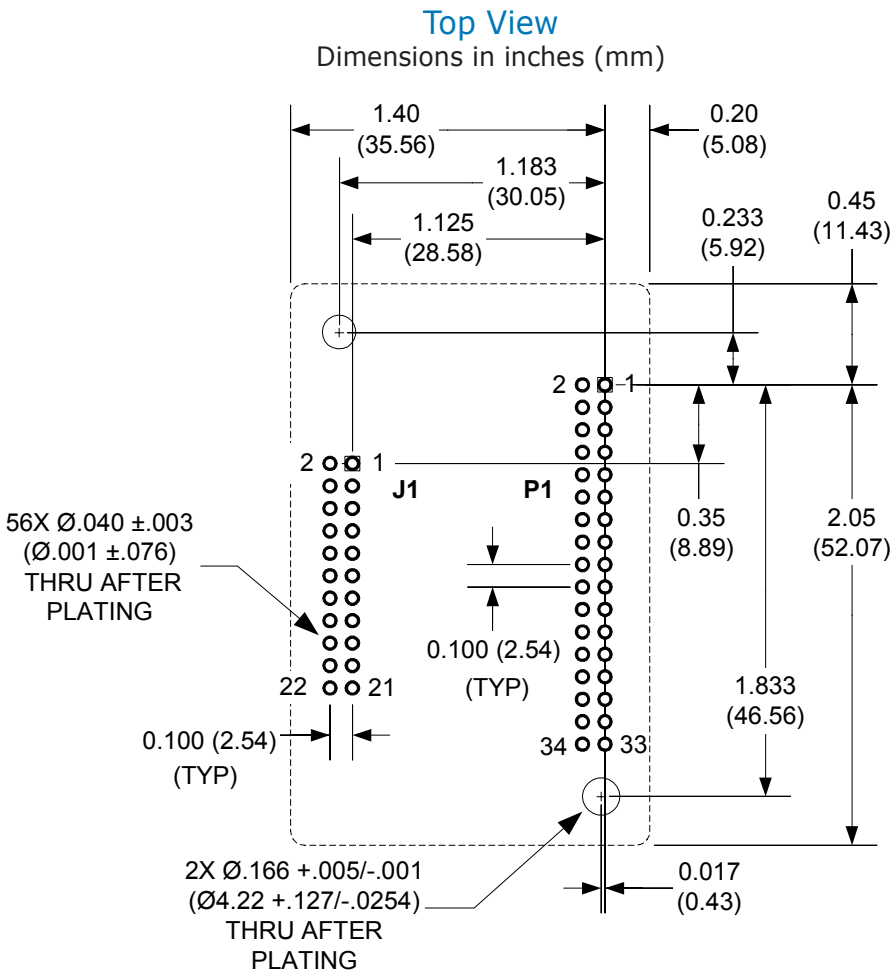
The peak voltage between adjacent traces will be equal to +HV. Trace width and copper plating thickness should support the drive peak and continuous output current ratings.

Printed circuit board layouts for Accelnet Micro Module drives should follow some simple rules:

1. Install a low-ESR electrolytic capacitor not more than 12 inches from the drive. PWM drives produce ripple currents in their DC supply conductors. Accelnet Micro Module drives do not use internal electrolytic capacitors as these can be easily supplied by the printed circuit board. In order to provide a good, low-impedance path for these currents a low-ESR capacitor should be mounted as close to the drive as possible. 330 µF is a minimum value, with a voltage rating appropriate to the drive model and power supply.

2. Connect J1 signals (U, V, & W outputs, +HV, and +HV Common) in pin-groups for current-sharing. The signals on J1 are all higher-current types. To carry these currents (up to 6 Adc peak) the pins of J1 must be used in multiples to divide the current and keep the current carrying capacity of the connectors within specification. The diagram on page 9 shows the pin groups that must be inter-connected to act as a single connection point for pc board traces.

3. Minimum trace width, and copper plating thickness should follow industry-standards (IPC-2221). The width and plating should depend on the model of drive used, the maximum voltage, and maximum current expected to be used for that model. Power supply traces (+HV, +HV Common) should be routed close to each other to minimize the area of the loop enclosed by the drive DC power. Noise emission or effects on nearby circuitry are proportional to the area of this loop, so minimizing it is good layout practice. Motor signals should also be routed close together. Phase outputs (U, V, & W) should be routed as closely as possible to form a balanced transmission path. Keeping these traces as closely placed as possible will again minimize noise radiation due to motor phase currents. Accelnet Micro Module circuit grounds are electrically common, and connect internally. However, the J1 signals carry high currents while the grounds on P1 (signal ground) carry low currents. So, P1 signals should be routed away from, and never parallel to the signals on J1.

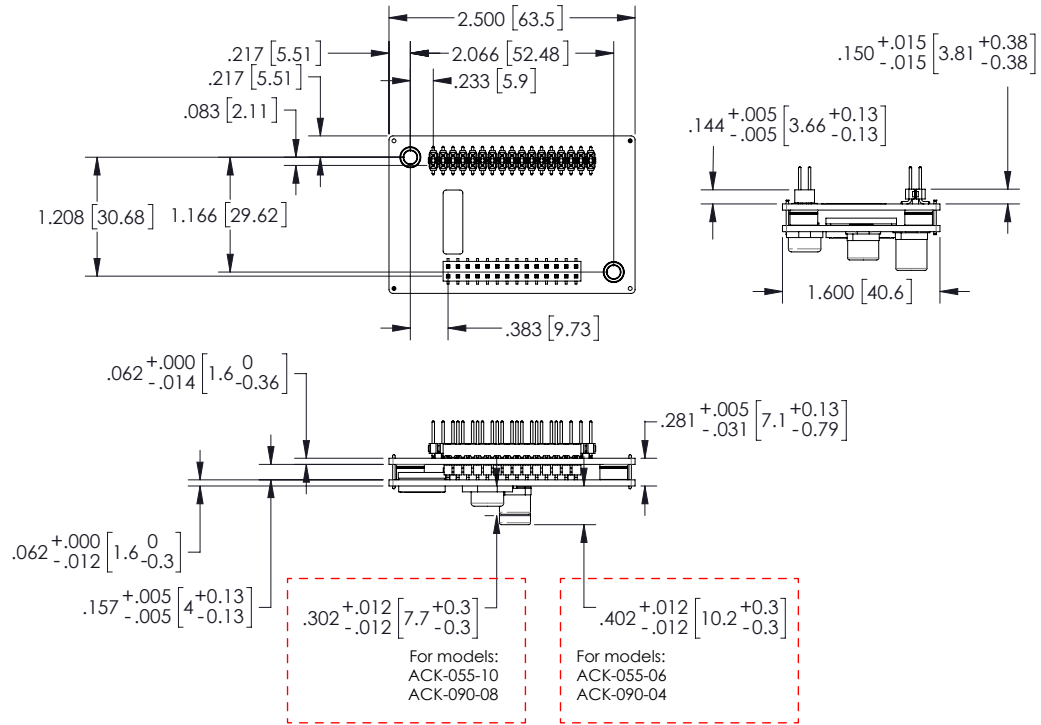


Mounting Hardware:

Qty	Description	Mfgr	Part Number	Remarks
1	Socket Strip	Samtec	SSW-111-01-S-D	J1
1	Socket Strip	Samtec	SSW-117-01-S-D	P1
2	Standoff 4-40 X 3/8"	PEM	KFE-440-12-ET	

DIMENSIONS

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES, WITH MILLIMETERS IN BRACKETS FOR REFERENCE ONLY.
TOLERANCES ARE: .XX= ±.01; .XXX= ±.005; ANGLES= ±1.0°



COOLING REQUIREMENTS

From charts below, find power dissipation based on drive model, HV, and output current. With ambient temperature known, calculate required thermal resistance. Select cooling method that gives a thermal resistance that is equal to, or lower than the calculated value.

Example:

ACK-055-06, HV = 55 Vdc, Iout = 3A

Power dissipation is 3.9 W

Drive thermal shutdown is at 90 °C, ambient is 50 °C

Thermal resistance required = (90 - 50) / 3.9 = 10.26

Convection cooling gives 11.4 °C/W, so forced-air is required.

Thermal Resistance (°C/W)	
Convection	11.4
Forced Air, 300 LFM	3.7

ACK-055-06 Dissipation (W)			
Iout (A dc)	HV (Vdc)		
	15	35	55
0	2.37	2.31	2.42
1	2.49	2.45	2.63
2	2.89	2.85	3.13
3	3.58	3.52	3.86

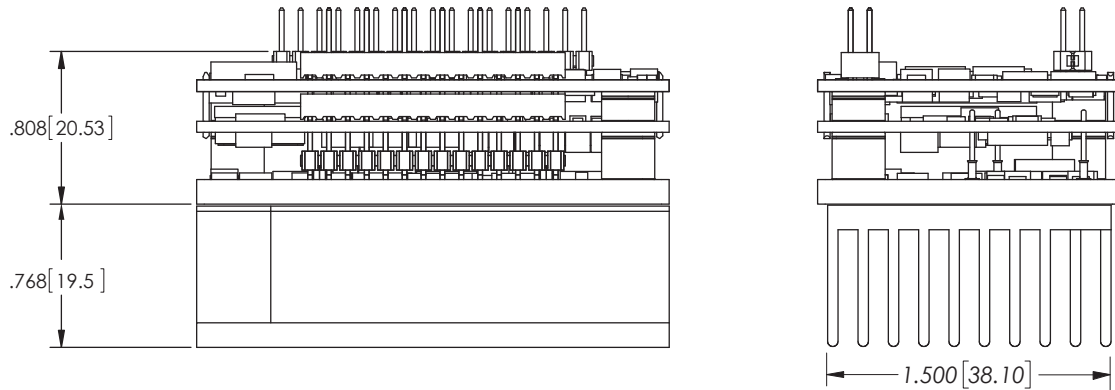
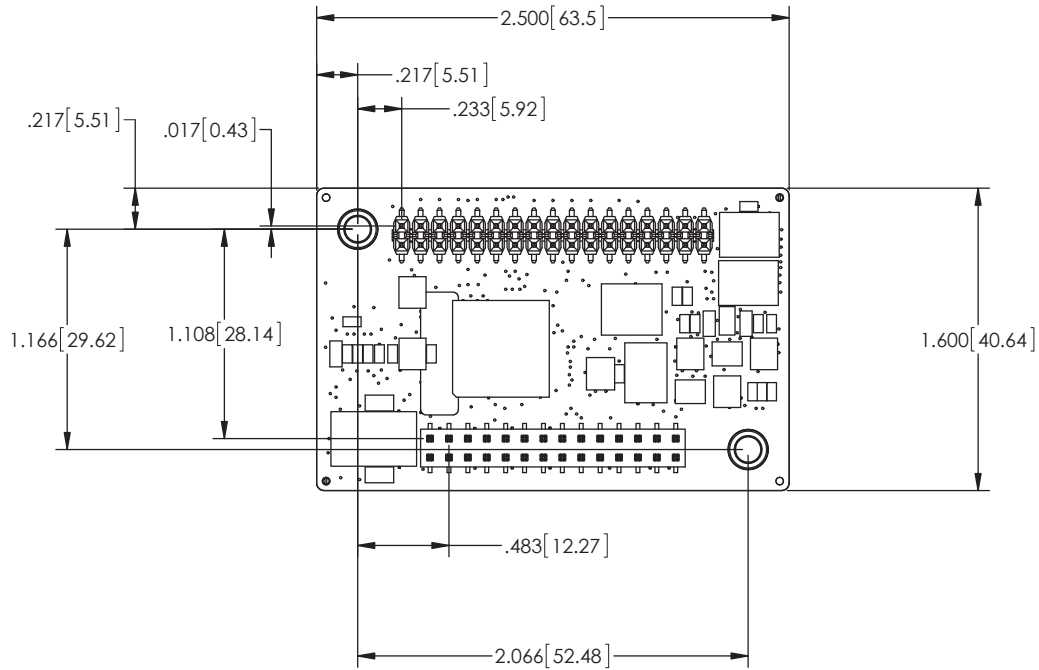
ACK-090-04 Dissipation (W)			
Iout (A dc)	HV (Vdc)		
	30	60	90
0	2.28	2.44	2.70
1	2.45	2.69	3.05
2	2.95	3.25	3.74

ACK-055-10 Dissipation (W)			
Iout (A dc)	HV (Vdc)		
	15	35	55
0	2.32	2.29	2.45
1	2.34	2.37	2.58
2	2.59	2.66	2.99
3	3.05	3.10	3.53
4	3.52	3.64	4.19
5	4.23	4.39	5.02

ACK-090-08 Dissipation (W)			
Iout (A dc)	HV (Vdc)		
	25	55	85
0	2.23	2.42	2.74
1	2.34	2.56	2.93
2	2.56	2.84	3.35
3	3.01	3.36	3.98
4	3.65	4.01	4.75

DIMENSIONS

ACK-090-20
 ACK-090-30



NOTES

1. DIMENSIONS ARE IN INCHES, WITH MILLIMETERS IN BRACKETS FOR REFERENCE ONLY.
 TOLERANCES ARE: .XX= ±.01; .XXX= ±.005; ANGLES= ±1.0°.

DESCRIPTION

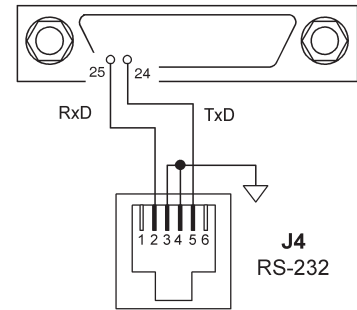
The Development Kit provides mounting and connectivity for a Accelnet Micro Module drive. Solderless jumpers ease configuration of inputs and outputs to support their programmable functions. Switches can be jumpered to connect to digital inputs 1~5 so that these can be toggled to simulate equipment operation. Three LED's provide status indication for the digital outputs. To simplify cabling to external controllers, the encoder signals from the motor are connected to pins on the signal connector J3. Dual CAN bus connectors make daisy-chain connections possible so that other CANopen devices such as Copley's Stepnet or Xenus drives can easily be connected to build mixed stepper and servo multi-axis systems.



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 a CANopen network. CME 2™ software communicates with the drive over this link and is then used for complete drive setup. The CAN address that is set by the rotary switch can be monitored, and an address offset programmed as well. This will add to the switch address to produce a working CAN address that can be from 1 to 127.

The RS-232 connector, J4, is a modular 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.



CAN CONNECTIONS

Connectors J6 & J7 are Sub-D male and female 9-position types that conform to the CAN DS-102 Physical Layer specification. The male-female configuration supports a single cable type with male and female connectors that can be daisy-chained from device to device along a CANopen network.

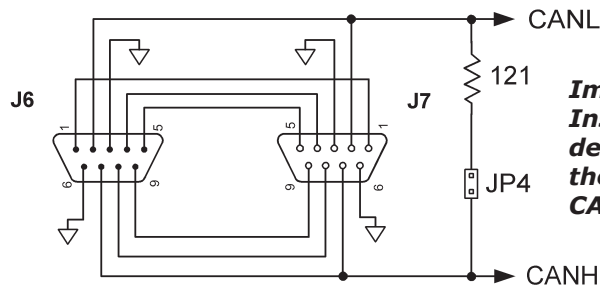
Only the CAN_H, CAN_L, and CAN_GND signals are used. The CAN_GND is connected to the circuit ground on the development kit. This ground is also shared by the drive power supply, accessory +5V (for encoders), and the RS-232 link. Other DS-102 signals are wired-through for use by products that support them.

The table below lists the signals and pins on J6 & J7. Signals in () are those that have no connection on the development kit and which are connected pin-to-pin between J6 & J7.

CAN Bus Connector Signals

* These signals connect through from J6 to J7 with no connection to Development Kit PC board.

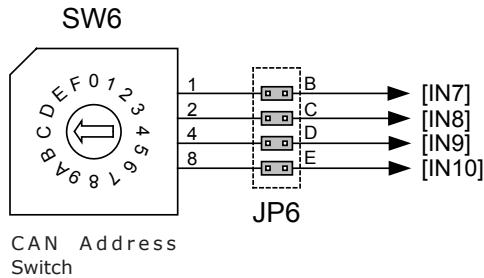
PIN	SIGNALS
* 1	(Reserved)
2	CAN_L
3	CAN_GND
* 4	(Reserved)
5	(CAN_SHLD)
6	Signal ground
7	CAN_H
* 8	(Reserved)
* 9	(Reserved)



Important!
Install JP4 ONLY if development kit is the LAST node on a CAN bus

CAN ADDRESS SELECTION

Rotary switch SW6, labeled "CAN ADDR" connects to IN7, IN8, IN9, and IN10 of the drive. These are programmable inputs which default to CAN address bits. The switch will select CAN addresses 0x01~0x0F (dec 1~15). Address 0 is reserved for network management devices. The CAN standard permits up to 127 devices, so if the drive must have an address beyond 0x0F(dec 15), this is done by programming an address offset into the drive before it is installed into a CAN environment or by programming logic inputs as CAN address bits.



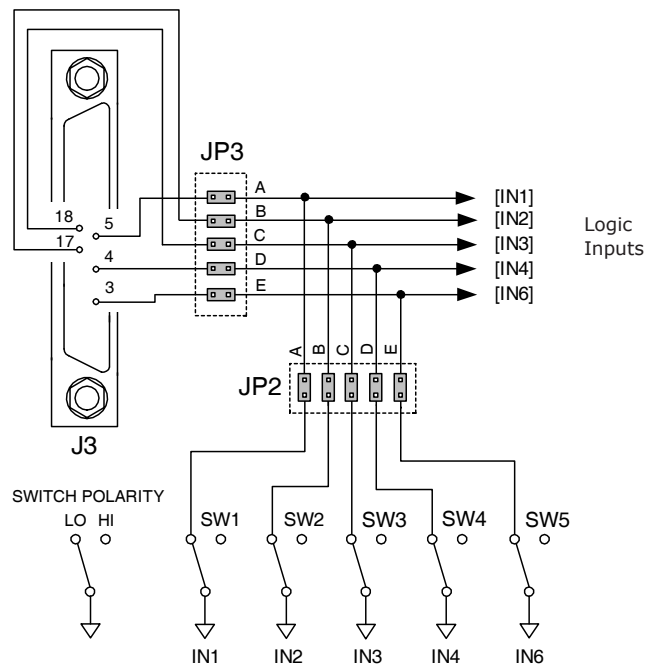
Note: To use inputs 7,8,9, or 10 as logic inputs remove jumpers shown at left to disconnect SW6 from logic inputs.

LOGIC INPUTS

There are 10 logic inputs. [IN1] is dedicated to the drive enable function, the other inputs are programmable.

The development kit is equipped with switches that can be used to control logic inputs 1~5. To use these switches jumpers JP2-A, B, C, D, and E must be installed.

If connecting these logic inputs to external equipment, the same jumpers must be removed so that the switches cannot short input signals to ground.

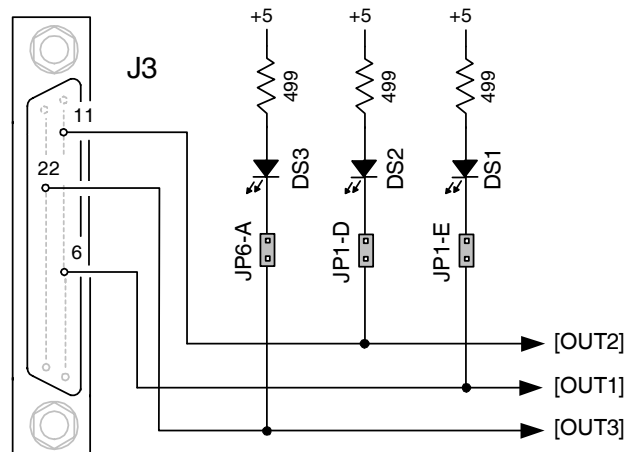


LOGIC OUTPUTS

There are three logic outputs that can drive controller logic inputs or relays. If relays are driven, then flyback diodes must be connected across their terminals to clamp overvoltages that occur when the inductance of the relay coil is suddenly turned off.

As delivered, these outputs drive three LED's. Jumpers JP6-A, and JP1-D, & E connect these LED's to logic outputs. These are N-channel MOSFET's which sink current from loads connected to positive voltages. When the outputs are ON (Active Low), they ground the cathode of the led's which then turn on as they are connected to the +5Vdc supply via current-limiting resistors.

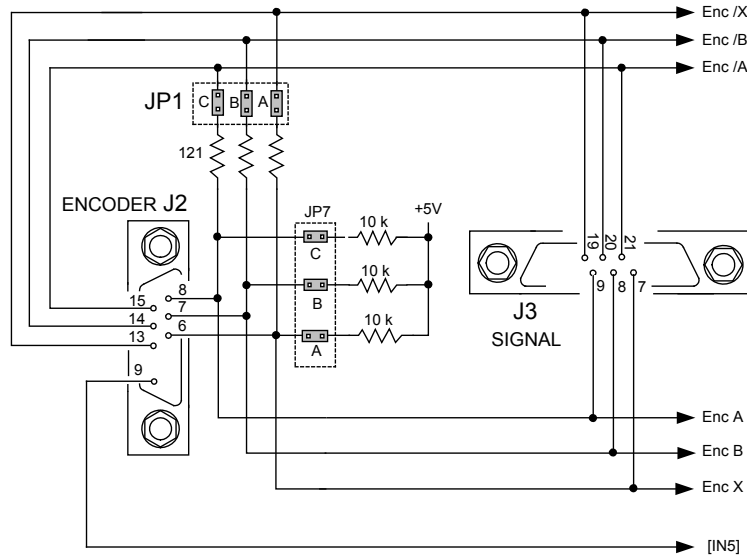
The logic outputs also connect to signal connector J3. If they are used to drive external loads > +5Vdc, the LED jumpers must be removed.



ENCODER CONNECTIONS

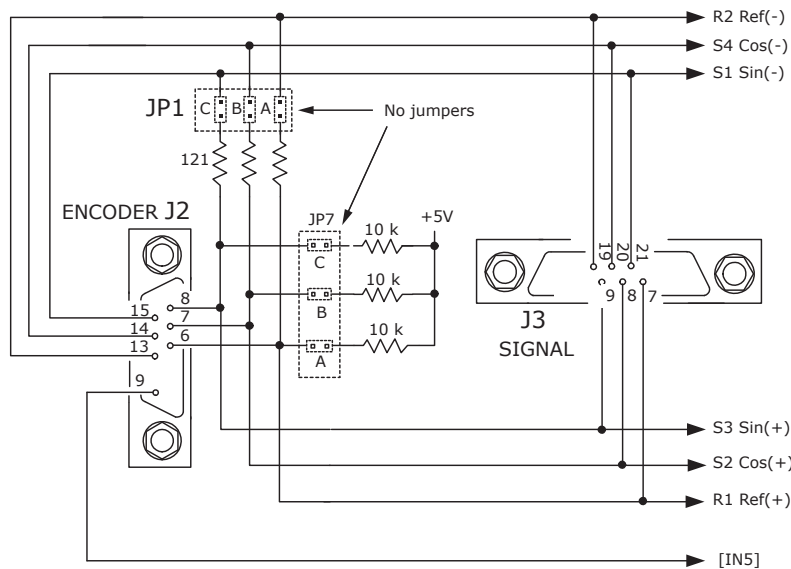
The development kit has a 26C32 differential line receiver for the motor encoder inputs. Differential-output encoders are preferred for best signal quality and noise rejection. Wiring should be twisted-pairs, preferably with a shield for each pair. To eliminate noise on the encoder signals caused by reflections on the cables, it is good practice to terminate signal-pairs with a resistor that matches the characteristic impedance of the cable. On the development kit, 121Ω resistors are provided for this purpose. Jumpers at JP9-A, B, and C connect these termination resistors across the differential signals when installed.

If single-ended encoders are used, they must have active (not open-collector) outputs. They should be connected to the A, B, and X pins leaving the /A, /B, and /X pins open. Jumpers at JP1-A, B, and C must be removed.



RESOLVER CONNECTIONS

With resolver feedback, termination resistors across complementary signals cannot be used. Jumpers at JP9-A, B, and C connect these termination resistors when using encoders, but must be removed when using resolvers. The pull-up resistors for single-ended encoders are also not used. Removing JP7-A,B, & C will take these out of circuit.

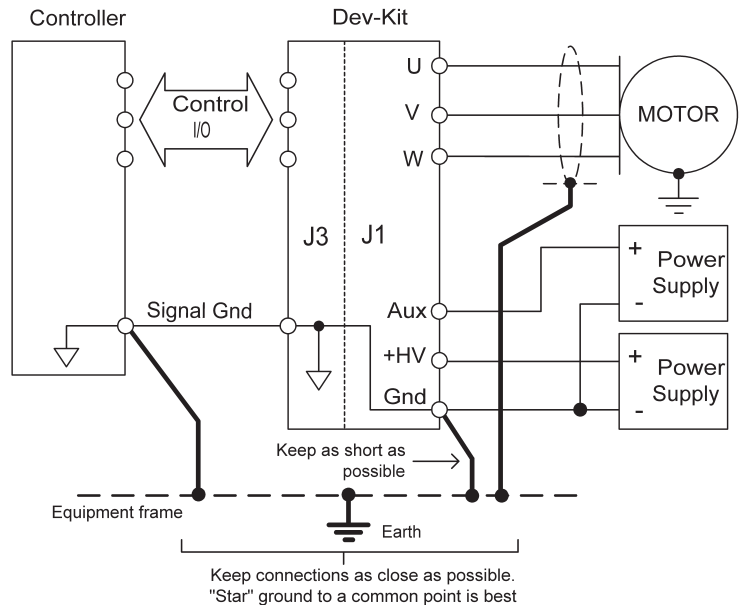


POWER SUPPLIES

The drive main power, +HV, is typically supplied by unregulated DC power supplies. These must be isolated from the mains, and all circuits should be grounded to earth at some point. The +HV supply connects to J1. For good wiring practice, the +HV wires should be twisted together for noise suppression, and the power supply should not be grounded. Doing this ensures that the higher currents flowing in these conductors will not flow through any circuit grounds where they might induce noise. During deceleration, mechanical energy in the motor and load is converted back into electrical energy that must be dissipated as the motor comes to a stop. While some of this is converted to heat in the motor windings, the rest of it will flow through the drive into the power supply. An external storage capacitor should be used if the load has appreciable inertia, and this should be sized such that adding the undissipated energy from the motor will not raise the voltage beyond the point at which the drive shuts down. When this is not possible, an external 'dumper', or regenerative energy dissipater must be used which acts as a shunt regulator across the +HV and Gnd terminals.

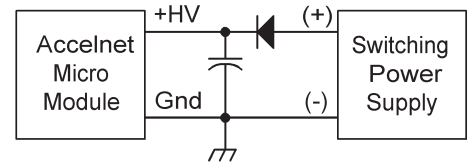
GROUNDING

An earthing ground connection can be made via a second conductor to J1-2 that connects to the equipment frame ground.



SWITCHING POWER SUPPLIES

Switching power supplies can also be used for +HV power. Unlike unregulated supplies, these cannot accept reverse energy flow, so an isolating diode must be placed between the power supply and J1-1 to block current flow back into the power supply. When this is done, an external storage capacitor must be used across J1-1 & J1-2 because the capacitor on the Development Kit board is only for ripple-current control, and cannot store enough energy to handle regeneration.



AUX HV

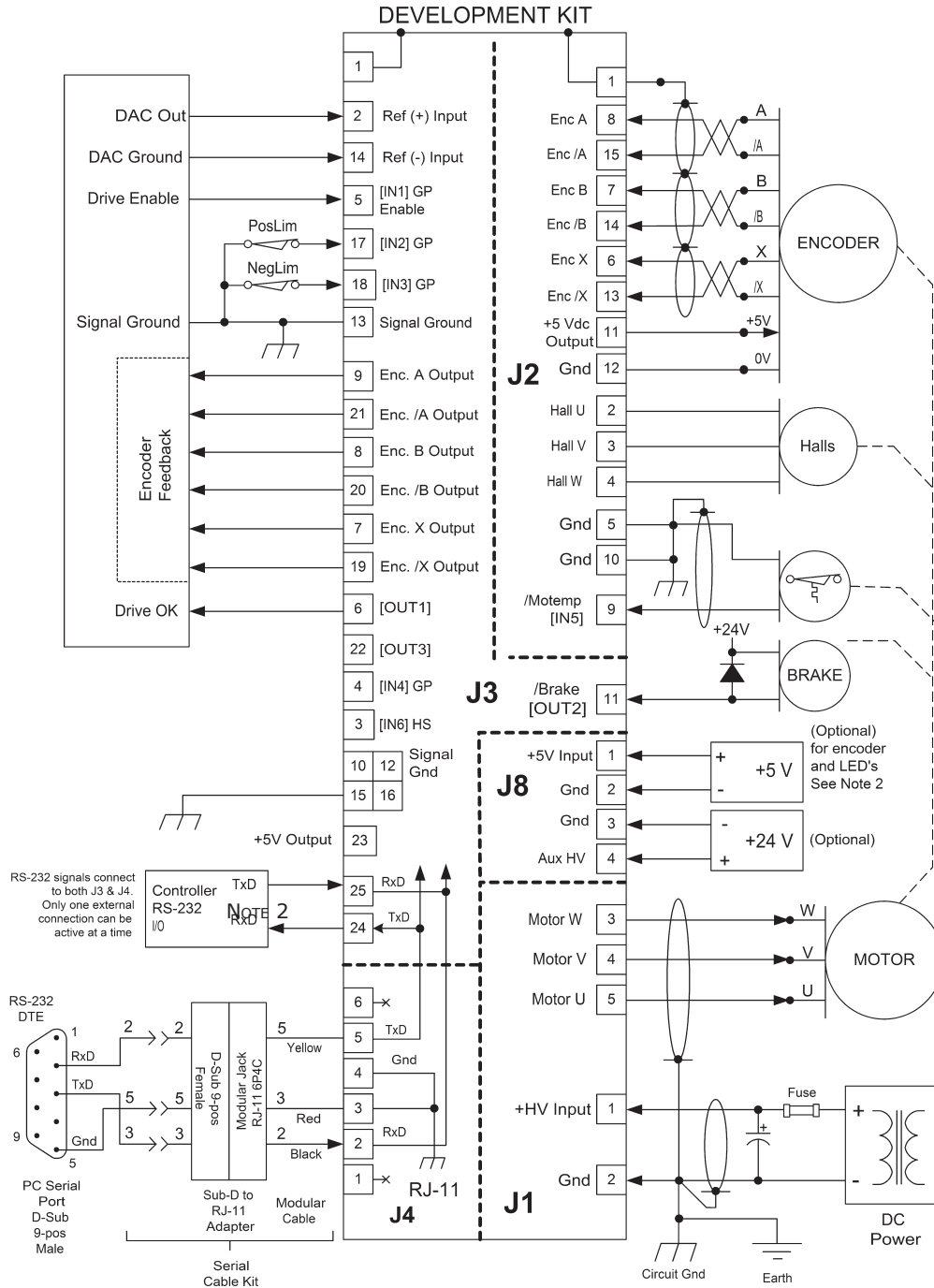
Not required for stand-alone operation, an Aux HV power supply provides power for the drive control circuits so that CAN bus communications with the drive can be maintained when the +HV supply is turned off. This might occur as a result of an Emergency Off condition, or for machine operator intervention. The Aux HV supply does not power the PWM stage that drives the motor, but keeps the drive controller enabled as well as inputs and outputs. The Aux HV supply must be less than the +HV supply voltage and greater than the drive minimum +HV (> 14 Vdc).

ENCODER +5 VDC

Encoder power can be supplied from an external +5 Vdc supply or from the drive. To use drive +5 Vdc @ 250 mA maximum, install jumper JP8. If more than 250 mA is required then this must come from an external +5V source and JP8 must be removed when this is done.

IMPORTANT: REMOVE JP8 BEFORE CONNECTING EXTERNAL +5V POWER TO J8-1. FAILURE TO DO SO WILL DAMAGE DRIVE!!

DEVELOPMENT KIT CONNECTIONS (STANDARD MODELS WITH ENCODER FEEDBACK)



Notes:

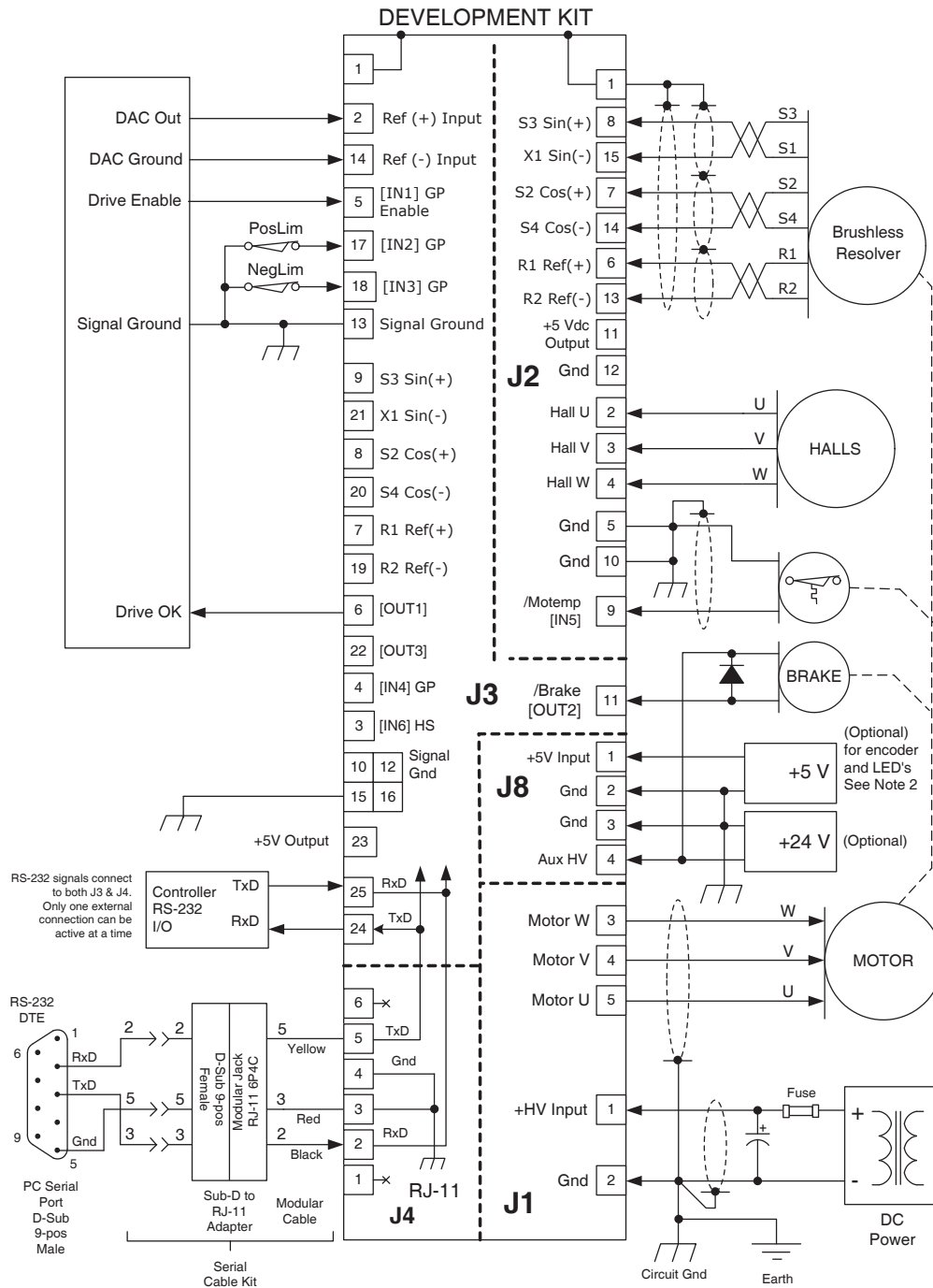
1. CAN connectors J6 & J7 are not shown here. For details see pp. 3,6, & 10.

2. JP8 installed: +5 Vdc @ 250 mA from drive available at J3-23

JP8 removed: +5 Vdc must be supplied from an external power supply connected to J8-1 & 2.

WHEN USING EXTERNAL 5 VDC POWER SUPPLY, JP8 MUST BE REMOVED OR DAMAGE TO DRIVE WILL OCCUR

DEVELOPMENT KIT CONNECTIONS (MODELS WITH -R OPTION FOR RESOLVER FEEDBACK)



Notes:

1. CAN connectors J6 & J7 are not shown here. For details see pp. 3,6, & 10.

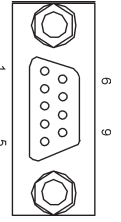
2. JP8 installed: +5 Vdc @ 250 mA from drive available at J3-23

JP8 removed: +5 Vdc must be supplied from an external power supply connected to J8-1 & 2.

WHEN USING EXTERNAL 5 VDC POWER SUPPLY, JP8 MUST BE REMOVED OR DAMAGE TO DRIVE WILL OCCUR

DEVELOPMENT KIT CONNECTIONS (STANDARD MODELS WITH ENCODER FEEDBACK)

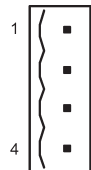
CANopen SIGNALS	PIN
(Reserved)	1
CAN_L	2
CAN_GND	3
(Reserved)	4
(CAN_SHLD)	5



J7

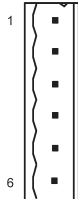
IMPORTANT:
 REMOVE JUMPER JP8 BEFORE CONNECTING EXTERNAL +5 Vdc POWER TO J8-1. FAILURE TO DO SO WILL DAMAGE DRIVE!!

J8 SIGNALS	PIN
+5V Input	1
Gnd	2
Gnd	3
Aux HV Input	4



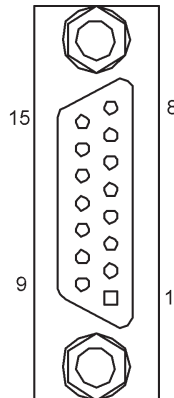
J8

J1 SIGNALS	PIN
+HV Input	1
GND	2
Motor W Output	3
Motor V Output	4
Motor U Output	5



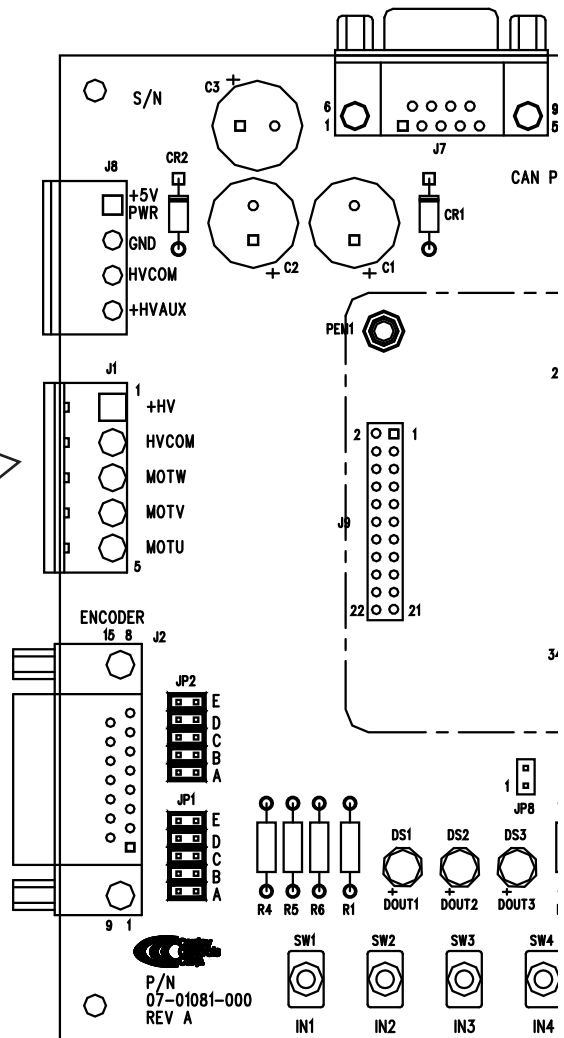
J1

J2 SIGNALS	PIN
Encoder /A Input	15
Encoder /B Input	14
Encoder /X Input	13
Signal Ground	12
+5V Output	11
Signal Ground	10
[IN5]	9

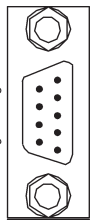


PIN	J2 SIGNALS
8	Encoder A Input
7	Encoder B Input
6	Encoder X Input
5	Signal Ground
4	Hall W
3	Hall V
2	Hall U
1	Chassis Ground

J2



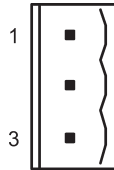
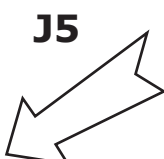
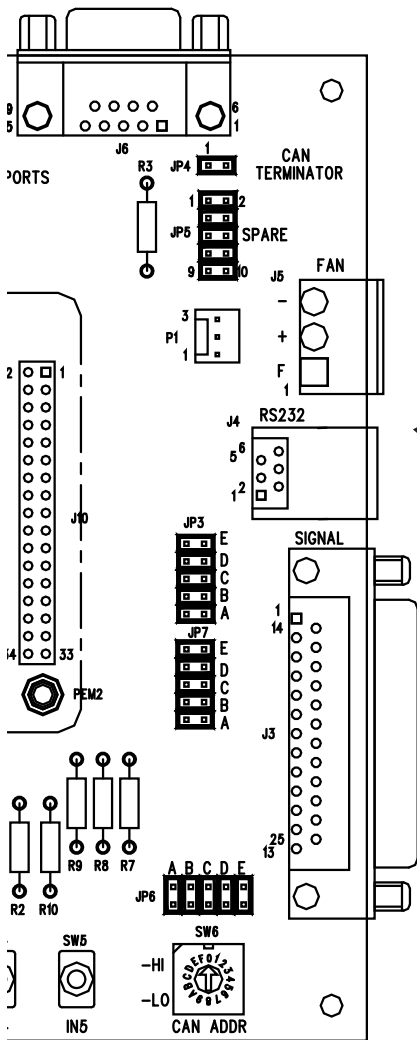
DEVELOPMENT KIT CONNECTIONS (STANDARD MODELS WITH ENCODER FEEDBACK)



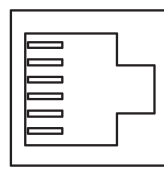
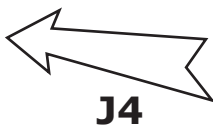
PIN	CANopen SIGNALS
6	CAN_GND
7	CAN_H
8	(Reserved)
9	(CAN_V+)

CANopen Notes:

1. Connector pinouts for J6 & J7 follow CAN standard DS-102.
2. Signals in () are wired-through from J7 to J6 and have no other connections on the pc board.
3. CAN_GND is connected to Gnd on pc board (Accelnet signal and power ground)



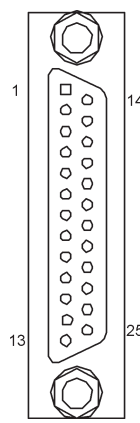
PIN	J5 SIGNALS
1	P1-1
2	P1-2
3	P1-3



PIN	J4 SIGNALS
6	No Connection
5	TxD Output
4	Signal Ground
3	Signal Ground
2	RxD Input
1	No Connection



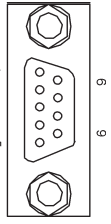
J3 SIGNALS	PIN
Chassis Ground	1
Analog Ref(+)	2
GP Input [IN6]	3
GP Input [IN4]	4
Enable Input [IN1]	5
Output [OUT1]	6
Encoder output X	7
Encoder output B	8
Encoder output A	9
Signal Ground	10
Output [OUT2]	11
Signal Ground	12
Signal Ground	13



PIN	J3 SIGNALS
14	Analog Ref (-)
15	Signal Ground
16	Signal Ground
17	[IN2] POS Limit Switch
18	[IN3] NEG Limit Switch
19	Encoder /X output
20	Encoder /B output
21	Encoder /A output
22	[OUT3] Output
23	+5V Output
24	RS-232 TxD Output
25	RS-232 RxD Input

DEVELOPMENT KIT CONNECTIONS (MODELS WITH -R OPTION FOR RESOLVER FEEDBACK)

CANopen SIGNALS	PIN
(Reserved)	1
CAN_L	2
CAN_GND	3
(Reserved)	4
(CAN_SHLD)	5

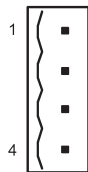


J7



IMPORTANT:
REMOVE JUMPER JP8 BEFORE CONNECTING EXTERNAL +5 Vdc POWER TO J8-1. FAILURE TO DO SO WILL DAMAGE DRIVE!!

J8 SIGNALS	PIN
+5V Input	1
Gnd	2
Gnd	3
Aux HV Input	4

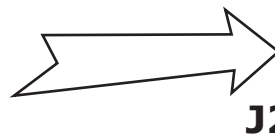


J8

J1 SIGNALS	PIN
+HV Input	1
GND	2
Motor W Output	3
Motor V Output	4
Motor U Output	5

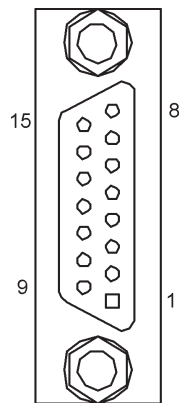


J1

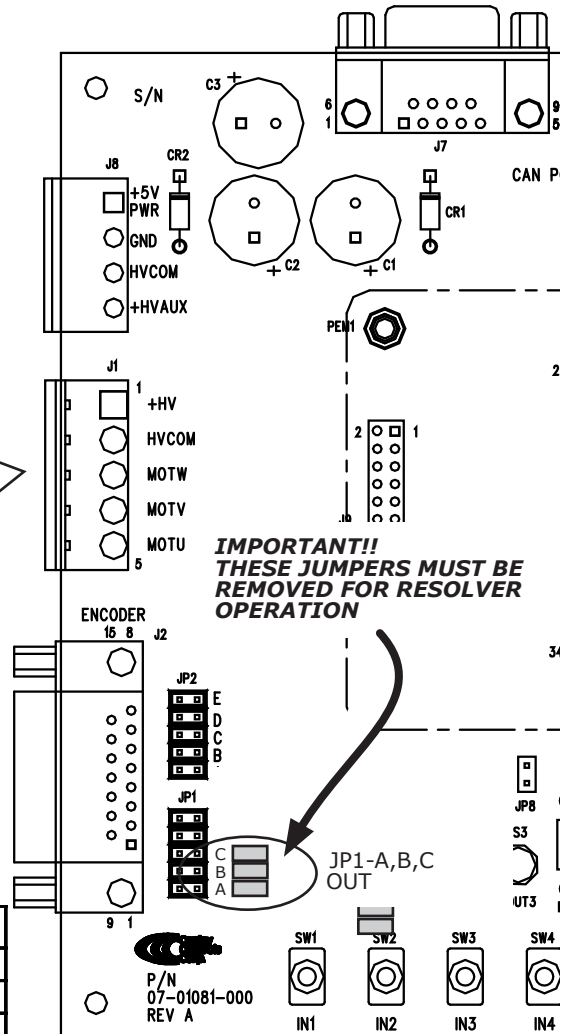


J2

J2 SIGNALS	PIN
S1 Sin(-)	15
S4 Cos(-)	14
R2 Ref(-)	13
Signal Ground	12
+5V Output	11
Signal Ground	10
[IN5]	9

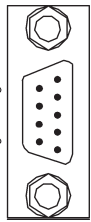


PIN	J2 SIGNALS
8	S3 Sin(+)
7	S2 Cos(+)
6	R1 Ref(+)
5	Signal Ground
4	Hall W
3	Hall V
2	Hall U
1	Chassis Ground



IMPORTANT!!
THESE JUMPERS MUST BE REMOVED FOR RESOLVER OPERATION

DEVELOPMENT KIT CONNECTIONS (MODELS WITH -R OPTION FOR RESOLVER FEEDBACK)

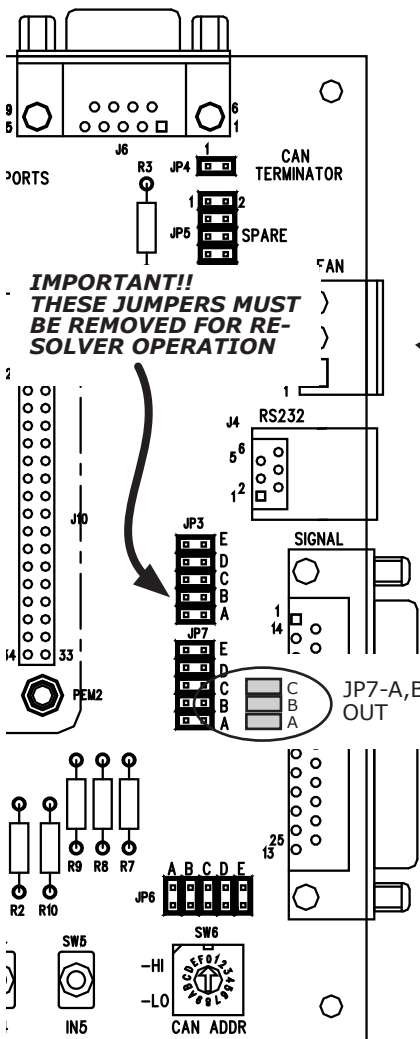


PIN	CANopen SIGNALS
6	CAN_GND
7	CAN_H
8	(Reserved)
9	(CAN_V+)

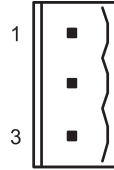
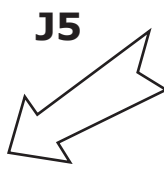


J6 CANopen Notes:

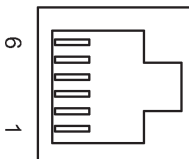
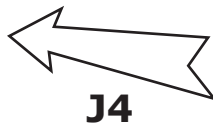
1. Connector pinouts for J6 & J7 follow CAN standard DS-102.
2. Signals in () are wired-through from J7 to J6 and have no other connections on the pc board.
3. CAN_GND is connected to Gnd on pc board (Accelnet signal and power ground)



IMPORTANT!!
THESE JUMPERS MUST BE REMOVED FOR RESOLVER OPERATION



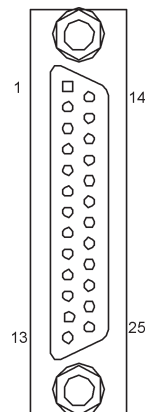
PIN	J5 SIGNALS
1	P1-1
2	P1-2
3	P1-3



PIN	J4 SIGNALS
6	No Connection
5	TxD Output
4	Signal Ground
3	Signal Ground
2	RxD Input
1	No Connection



J3 SIGNALS	PIN
Chassis Ground	1
Analog Ref(+)	2
GP Input [IN6]	3
GP Input [IN4]	4
Enable Input [IN1]	5
Output [OUT1]	6
R1 Ref(+)	7
S2 Cos(+)	8
S3 Sin(+)	9
Signal Ground	10
Output [OUT2]	11
Signal Ground	12
Signal Ground	13



PIN	J3 SIGNALS
14	Analog Ref (-)
15	Signal Ground
16	Signal Ground
17	[IN2] POS Limit Switch
18	[IN3] NEG Limit Switch
19	R2 Ref(-)
20	S4 Cos(-)
21	S1 Sin(-)
22	[OUT3] Output
23	+5V Output
24	RS-232 TxD Output
25	RS-232 RxD Input

ORDERING GUIDE

PART NUMBER	DESCRIPTION
ACK-055-06	Accelnet Micro Module 3/6 Adc @ 55 Vdc
ACK-055-10	Accelnet Micro Module 5/10 Adc @ 55 Vdc
ACK-090-04	Accelnet Micro Module 2/4 Adc @ 90 Vdc
ACK-090-08	Accelnet Micro Module 4/8 Adc @ 90 Vdc
ACK-090-20	Accelnet Micro Module 10/20 Adc @ 90 Vdc
ACK-090-30	Accelnet Micro Module 15/30 Adc @ 90 Vdc
KDK-090-01	Accelnet Micro Module Development Kit
KDK-CK	Accelnet Micro Module Development Kit Connector Kit
SER-CK	Serial cable for Development Kit

FOR RESOLVER OPTION, ADD "-R" TO THE ACCELNET PART NUMBER

ORDERING INSTRUCTIONS

Example: Order 1 ACK-055-06 drive with Development Kit, Development Kit Connector Kit, Serial Cable Kit, and CME 2:

Qty	Item	Remarks
1	ACK-055-06	Accelnet Micro Module drive
1	KDK-090-01	Accelnet Micro Module Development Kit
1	KDK-CK	Connector Kit for Development Kit
1	SER-CK	Serial Cable Kit

ACCESSORIES

	QTY	REF	DESCRIPTION	MANUFACTURER/PART NUMBER
Connector Kit for Development Kit KDK-CK	1	J1	Plug, Euro, 5 Terminal, 0.2 in (5.08 mm)	Tyco: 796635-5
	1	J8	Plug, Euro, 4 Terminal, 0.2 in (5.08 mm)	Tyco: 796635-4
	1	J5	Plug, Euro, 3 Terminal, 0.2 in (5.08 mm)	Tyco: 796635-3
	1	J3	25 Pin Connector, D-Sub, Male, Solder Cup	Norcomp: 171-025-103L001
	1		25 Pin Connector Backshell	Norcomp: 979-025-020R121
	1	J2	15 Pin Connector, D-Sub, Male, Solder Cup	Norcomp: 171-015-103L001
	2		15 Pin Connector Backshell	Norcomp: 979-015-020R121
	1	J6	9 Pin Connector, D-Sub, Female, Solder Cup	Norcomp: 171-009-203L001
	2	J7	9 Pin Connector, D-Sub, Male, Solder Cup	Norcomp: 171-009-103L001
	2	J6,7	15 Pin Connector Backshell	Norcomp: 979-009-020R121
SER-CK	Serial Cable Kit: 9-Pin Dsub receptacle to 6-pin modular adapter, plus modular cable			

16-01646 Document Revision History

Revision	Date	Remarks
00	June 13, 2017	Initial release
01	December 18, 2017	Additional information added to dimensions

Note: Specifications subject to change without notice