

## CONTROL MODES

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

## COMMAND INTERFACE

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

## COMMUNICATIONS

- CANopen
- RS-232

## FEEDBACK

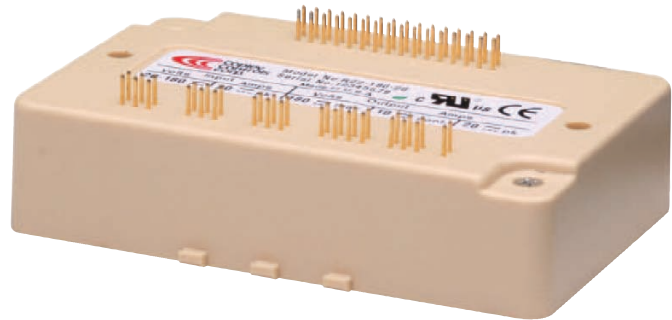
- Digital quad A/B encoder
- Secondary encoder
- Brushless resolver (-R option)
- Digital Halls

## I/O - DIGITAL

- 10 inputs, 2 outputs

## DIMENSIONS: mm [in]

- 102 x 69 x 25 [4.0 x 2.7 x 1.0]



Model *	Vdc	Ic	Ip
R22-055-18	20 - 55	6	18
R22-090-09	20 - 90	3	9
R22-090-24	20 - 90	12	24
R22-090-60	20 - 90	30	60
R22-180-09	20 - 180	3	9
R22-180-18	20 - 180	6	18
R22-180-20	20 - 180	10	20

Add -R to part number for resolver option

## DESCRIPTION

Accelnet R22 is a ruggedized, PC board-mounting digital servo drive that combines CANopen networking with 100% digital control of brush or brushless motors. It 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. A  $\pm 10$  Vdc analog input has been added for position/velocity/torque control. Ten logic inputs are configurable as CAN address bits, enables, limit & home switches, motor temperature switch, stepper/encoder pulses, and reset. Two logic outputs are programmable to report drive status, or to drive a motor brake. As a stand-alone drive Accelnet R22 can operate using incremental position commands from step-motor controllers in Pls/Dir or CW/CCW format, as well as A/B quadrature commands from a master-encoder. Drive commissioning is facilitated by CME 2™ software operating under Windows® communicating with Accelnet R22 via 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 display 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. 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.

## RUGGEDIZED STANDARDS CONFORMANCE

Ambient Temperature	Non-Operating	-50°C to 85°C
	Operating	-40°C to 70°C
Thermal Shock	Operating	-40°C to 70°C in 1 minute
Relative Humidity	Non-Operating	95% non-condensing at 60°C
	Operating	95% non-condensing at 60°C
Vibration	Operating	5 Hz to 500 Hz, up to 3.85 grms
Altitude	Non-Operating	-400 m to 12,200 m
	Operating	-400 m to 5,000 m
Shock	Crash Safety	75 g peak acceleration
	Operating	40 g peak acceleration
MIL-STD specifications	MIL-STD-	461, 704, 810, 1275, 1399
IEC specifications	IEC-	60068, 60079

## GENERAL SPECIFICATIONS

Test conditions: Load = Wye connected load: 1 mH+ 1Ω line-line. Ambient temperature = 25 °C. +HV = HV<sub>max</sub>

MODEL	R22-055-18	R22-090-09	R22-090-24	R22-090-60	R22-180-09	R22-180-18	R22-180-20	
OUTPUT POWER								
Peak Current	18 (12.7)	9 (6.34)	24 (17.0)	60 (42.4)	9 (6.34)	18 (12.7)	20 (14.14)	Adc (Arms)
Peak time	1	1	1	1	1	1	1	Sec
Continuous current	6 (4.24)	3 (2.1)	12 (8.5)	30 (21.2)	3 (2.1)	6 (4.24)	10 (7.1)	Adc (Arms)
Peak Output Power	0.99	0.81	2.16	5.4	1.62	3.24	3.6	kW
Continuous Output Power	0.33	0.27	1.08	2.7	0.54	1.08	1.8	kW
INPUT POWER								
HVmin to HVmax	+20 to +55	+20 to +90	+20 to +90	+20 to +90	+20 to +180	+20 to +180	+20 to +180	Vdc
Ipeak	18	9	24	60	9	18	20	Adc
Icont	6	3	12	30	3	6	10	Adc
Aux HV	+20 to HVmax2.5 W max			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	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	Operating Modes				Profile Position, Profile Velocity, Profile Torque			
Digital position reference	Pls/Dir, CW/CCW Quad A/B Encoder				Interpolated Position (PVT), Homing Stepper commands (2 MHz maximum rate)			
Digital torque & velocity reference (Note 1)	PWM PWM frequency range PWM minimum pulse width				2 Mline/sec, (8 Mcount/sec after quadrature) PWM , Polarity PWM = 0~100%, Polarity = 1/0 PWM = 50% +/-50%, no polarity signal required 1 kHz minimum, 100 kHz maximum 220 ns			
Analog torque/velocity/position	±10 Vdc, 5 kΩ differential input impedance							
DIGITAL INPUTS (NOTE 1)								
Number	10							
All inputs	74HC14 Schmitt trigger operating from +5 Vdc 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	Vin-LO < 1.35 Vdc, Vin-HI >3.65 Vdc, Maximum input voltage = +10 Vdc							
Enable [IN1]	1 dedicated input for drive enable, active level programmable, 330 μs RC filter							
GP [IN2,3,4]	3 General Purpose inputs, 10 kΩ pull-ups, 330 μs RC filter (33 μs for [IN4]), 24 Vdc max							
Motemp [IN5]	1 General Purpose input with, 4.99 kΩ pull-up, 330 μs RC filter, 24 Vdc max							
HS [IN6,7,8,9,10]	5 High-Speed Inputs inputs with 100 ns RC filter, +12 Vdc max							
DIGITAL OUTPUTS (NOTE 1)								
Number	2							
Type	Current-sinking MOSFET open-drain output with 1 kΩ pullup to +5 Vdc through diode 1 Adc 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 Full-duplex, serial communication port for drive setup and control, 9,600 to 115,200 Baud							
CANOPEN COMMUNICATION PORT								
Signals	CANH, CANL, Gnd. 1Mbit/sec maximum.							
Protocol	CANopen Application Layer DS-301 V4.01							
Device	DSP-402 Device Profile for Drives and Motion Control							
MOTOR CONNECTIONS								
Motor U,V,W	Drive outputs to 3-phase brushless motor, Wye or delta connected (DC brush motor use outputs U & V)							
Encoder	Quadrature encoder, differential outputs (A,/A,B,/B,X,/X), 5 Mlines/sec (20 Mcount/sec after quadrature)							
Halls	Hall signals (U,V,W)							
Motemp	Motor temperature sensor or switch							
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+							
PROTECTIONS								
HV Overvoltage	+185, +91, +56 Vdc			Drive outputs turn off until +HV is < overvoltage (for 180, 90, 55 Vdc models)				
HV Undervoltage	+HV < +20 Vdc			Drive outputs turn off until +HV >= +20 Vdc				
Drive over temperature	PC Board > 80 °C.			Drive latches OFF until drive is reset, or powered off-on				
Short circuits				Output to output, output to ground, internal PWM bridge faults				
I²T Current limiting				Programmable: continuous current, peak current, peak time				
Latching / Non-Latching				Programmable				

## NOTES

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

## MECHANICAL & ENVIRONMENTAL

Size	4.05 in (102.7 mm) X 2.62 in (66.5 mm) X 0.92 in (24.9 mm)
Weight	5.7 oz (0.16 kg)
Contaminants	Pollution degree 2
Environment	IEC68-2: 1990
Cooling	Heatsink required for continuous power output

## AGENCY STANDARDS CONFORMANCE

EN 55011 : 2007	CISPR 11 : 2003/A2 : 2006 Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific, and Medical (ISM) Radio Frequency Equipment
EN 61000-6-1 : 2001	Electromagnetic Compatibility Generic Immunity Requirements
Following the provisions of EC Directive 89/336/EEC:	
EN 61010-1 : 2001	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory use Following the provisions of EC Directive 2006/95/EC (Low Voltage Directive)
UL 61010-1 2nd Ed.: RoHS	2004 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use The R22 amplifier models are RoHS, the MDK-180-01 Development Kit is not RoHS

## ACCELNET R22 FEATURES

### CANOPEN NETWORKING

Based on the CAN physical layer, a robust, two-wire communication bus originally designed for automotive use where low-cost and noise-immunity are essential, CANopen adds support for motion-control devices and command synchronization. The result is a highly effective combination of data-rate and low-cost for multi-axis motion control systems. Device synchronization enables multiple axes to coordinate moves as if they were driven from a single control card.

### FIELD-ORIENTED CONTROL

Unlike conventional sinusoidal commutation which controls only the amplitude of the motor phase currents, Field-Oriented Control (FOC) controls the electrical phase in order to maintain the optimum  $\pm 90^\circ$  between the motor magnetic axis and the field produced by the phase currents. The effect is to maximize the efficiency of the motor, and minimize the heating produced by the drive currents. Torque is maintained over a wider range of speeds than with conventional sinusoidal commutation, and space-vector modulation gives higher motor speeds from the same power supply.

### PC BOARD MOUNTING

The small size, and cooling options enable Accelnet R22 to be integrated into machinery with fewer cables and connections, and closer to the motor when required. Optional convection heatsinks provide two choices of cooling capacity. The Accelnet R22 case has tabs molded-in that accept Socket-A compatible chip-coolers which have integral fans to provide even greater cooling capacity.

## RS-232 COMMUNICATION

Accelnet R22 is configured via a three-wire, full-duplex RS-232 port that operates from 9,600 to 115,200 Baud. CME 2™ software provides a graphic user interface (GUI) to set up all of Accelnet R22 features via a computer serial port.

The RS-232 port is used for drive set up and configuration. Once configured, Accelnet R22 can be used in stand-alone mode taking digital position, velocity, or torque commands from a controller, or as a networked drive on a CANopen bus.

## REFERENCE INPUTS

As a network drive, the primary command input is the CANopen bus. But, Accelnet R22 can also operate in stand-alone mode, taking position, velocity, or current (torque, force) commands in digital format from a motion controller.

## CANOPEN COMMUNICATION

Accelnet R22 uses the CAN physical layer signals CANH, CANL, and GND for connection, and CANopen protocol for communication.

Before connecting Accelnet R22 to the CAN network, it must be assigned a CAN address. This is done via the RS-232 port, which is also used for general drive setup. The CAN address is a combination of an internal address stored in flash memory, and digital inputs which have been configured to act as CAN address bits. 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.

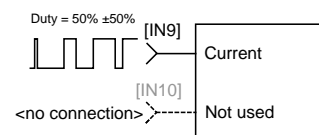
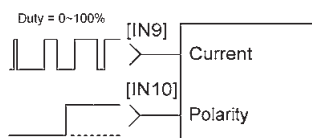
When inputs are used for the CAN address bits, the internal address is added to the binary value that results from the inputs. If all the inputs are used as logic inputs, then the CAN address in flash memory is the drive CAN address.

## DIGITAL REFERENCE INPUTS

Two logic inputs are used as digital reference inputs in the stand-alone mode. These will be assigned automatically to inputs that have the HS filters.

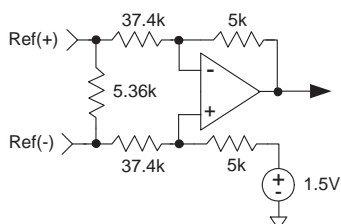
Current (torque, force) mode commands can be in one or two-wire format. In the one-wire format (50% PWM), a single input takes a square waveform that has a 50% duty cycle when the drive output should be zero. Thereafter, increasing the duty cycle to 100% will command an output current that will produce a maximum force or torque in a positive direction of motion, and decreasing the duty cycle to 0% will produce a maximum negative torque or force output.

In two-wire format (PWM/Dir), one input takes a PWM waveform of fixed frequency and variable duty cycle, and the other input takes a DC level that controls the polarity of the output current. The active level of the PWM signal for 0 current output is programmable. The direction of the force or torque produced will depend on the polarity of the DC signal on the direction input.



## ANALOG COMMAND INPUT

An analog input is provided for position/velocity/torque control. When using this input, Ref(+) and Ref(-) must both be connected to the controller. This differential connection is important for two reasons. First, for rejection of noise between controller and drive grounds. Second, because if one Ref input is left open, grounding of the other input will produce a  $\pm 2\%$  of peak-current command, not a 0% command.



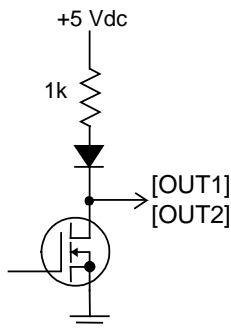
## DIGITAL OUTPUTS

The digital outputs [OUT1], and [OUT2] are open-drain MOSFETs with 1 k $\Omega$  pull-up resistors in series with a diode to +5 Vdc. They can sink up to 1 A dc 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 drive 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 k $\Omega$  resistor to +5 Vdc in the drive. This could turn the PLC input on, giving a false indication of the drive output state.



## DIGITAL INPUTS

There are ten digital inputs to *Accelnet*, 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 cannot be programmed in such a way that, once installed, it could not be shut down by the controller. The other nine inputs can be set to a selection of functions. Two types of RC filters are used: GP (General Purpose), and HS (High-Speed). Input functions such as Pulse/Direction, CW/CCW, Quad A/B typically are wired to inputs having the HS filters, and inputs with the GP filters are used for general purpose logic functions, limit switches, and the motor temperature sensor. Input [IN4] has a 33  $\mu$ s RC filter.

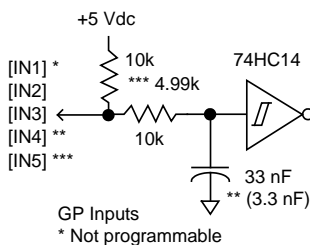
Programmable functions of the I/O inputs are:

- Positive Limit switch
- Negative Limit switch
- Home switch
- Drive Reset
- PWM current or velocity control
- CAN address
- Pls/Dir, or CW/CCW step motor control pulses
- Quad A/B master encoder position commands
- Motor temperature sensor or switch input
- Motion Profile Abort

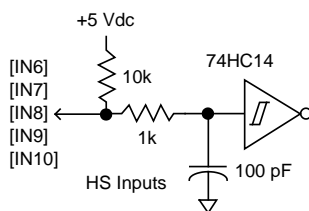
In addition to the selection of functions, the active level for each input is individually programmable.

Drive reset takes 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.

## GENERAL-PURPOSE INPUTS



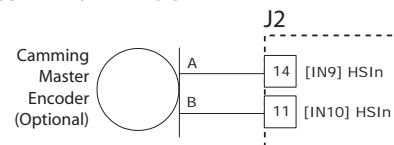
## HIGH-SPEED INPUTS



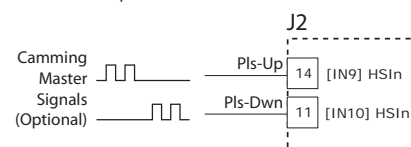
## CAM MASTER

When operating in Camming mode an incremental encoder may be the Master input and connects to [IN9] and [IN10]. Other types of digital signals can be used, too. Pulse & Direction or Pulse-Up/Pulse-Down formats are supported.

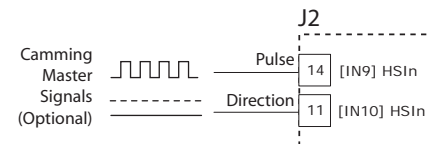
## QUAD A/B ENCODER



## PULSE-UP, PULSE-DOWN



## PULSE-DIRECTION

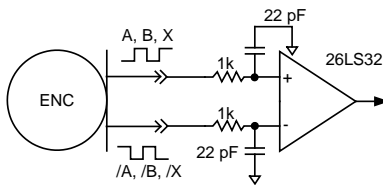


## MOTOR CONNECTIONS

Motor connections are of three types: phase, Halls, and encoder. 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. The encoder signals give incremental position feedback and are used for velocity and position modes, as well as sinusoidal commutation.

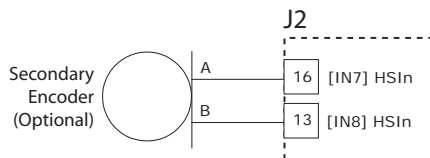
## MOTOR ENCODER

The motor encoder interface is a differential line-receiver with R-C filtering on the inputs. Encoders with differential outputs are preferred because they are less susceptible to noise that can be picked on single-ended outputs. PC board layouts should route the encoder signal-pairs as close to each other as possible for best transmission-line characteristics. If single-ended encoders are used, a pull-up resistor should be installed on the PC board, and the unused input can be left open. If this is done, it is recommended that the inverting input be left open as its' open-circuit voltage of 2.0 Vdc (typical) is closer to TTL and CMOS levels than the non-inverting input which has an open-circuit voltage of 2.9 Vdc (typical). The encoder input circuit is shown below.



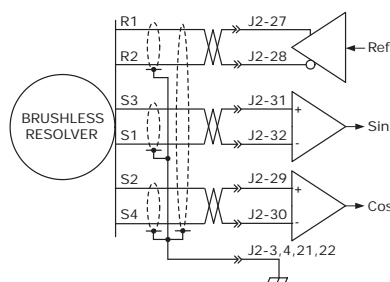
## SECONDARY ENCODER

A secondary incremental encoder can be connected to [IN7] and [IN8] for dual-loop position control. A typical use for this would be a gear-motor driving a leadscrew. An encoder on the leadscrew would give the position of the load while the motor encoder and Halls would be used for velocity control and commutation.



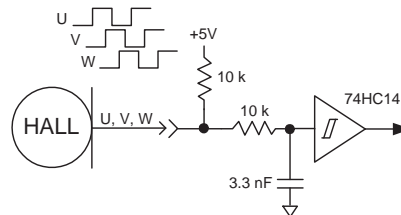
## RESOLVER (-R MODELS)

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



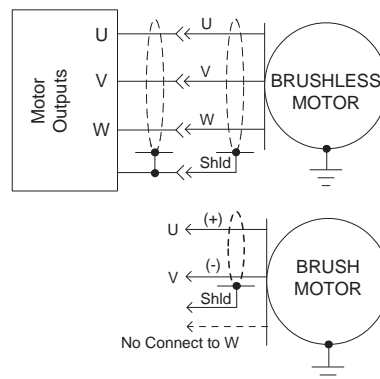
## MOTOR HALL SIGNALS

Hall signals are single-ended signals that provide absolute feedback within one electrical cycle of the motor. There are three of them (U, V, & W) and they may be sourced by magnetic sensors in the motor, or by encoders that have Hall tracks as part of the encoder disc. They typically operate at much lower frequencies than the motor encoder signals, and in *Accelnet* they are used for commutation-initialization after startup, and for checking the motor phasing after the drive has switched to sinusoidal commutation.



## MOTOR PHASE CONNECTIONS

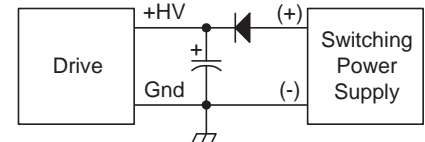
The drive output is a three-phase PWM inverter that converts the DC buss voltage (+HV) into three sinusoidal voltage waveforms that drive the motor phase-coils. The peak voltage between adjacent etches on the PC board is equal to the +HV power, and peak and continuous currents will not be greater than the ratings of the particular drive model. A trace width of 0.175 in, plating thickness of 3 oz copper, and spacing of 0.25 in is adequate for all models of *Accelnet*.



## POWER SUPPLIES

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

Operation from regulated switching power supplies is possible if a diode is placed between the power supply and drive to prevent regenerative energy from reaching the output of the supply. If this is done, there must be external capacitance between the diode and drive. The minimum value required is 330  $\mu$ F per drive.



## AUX HV INPUT

*Accelnet* can continue to communicate on a CANopen network under EMO (EMergency Off) conditions if auxiliary DC power is connected to the Aux HV input. This powers the internal DC/DC converter so that motor position and drive communications are preserved while +HV is removed from the PWM inverter stage. The minimum voltage is +20 Vdc, and the maximum is the same as the drive maximum +HV rating. The current requirements will vary with voltage and can be calculated based on an average power consumption of 2.5 W.

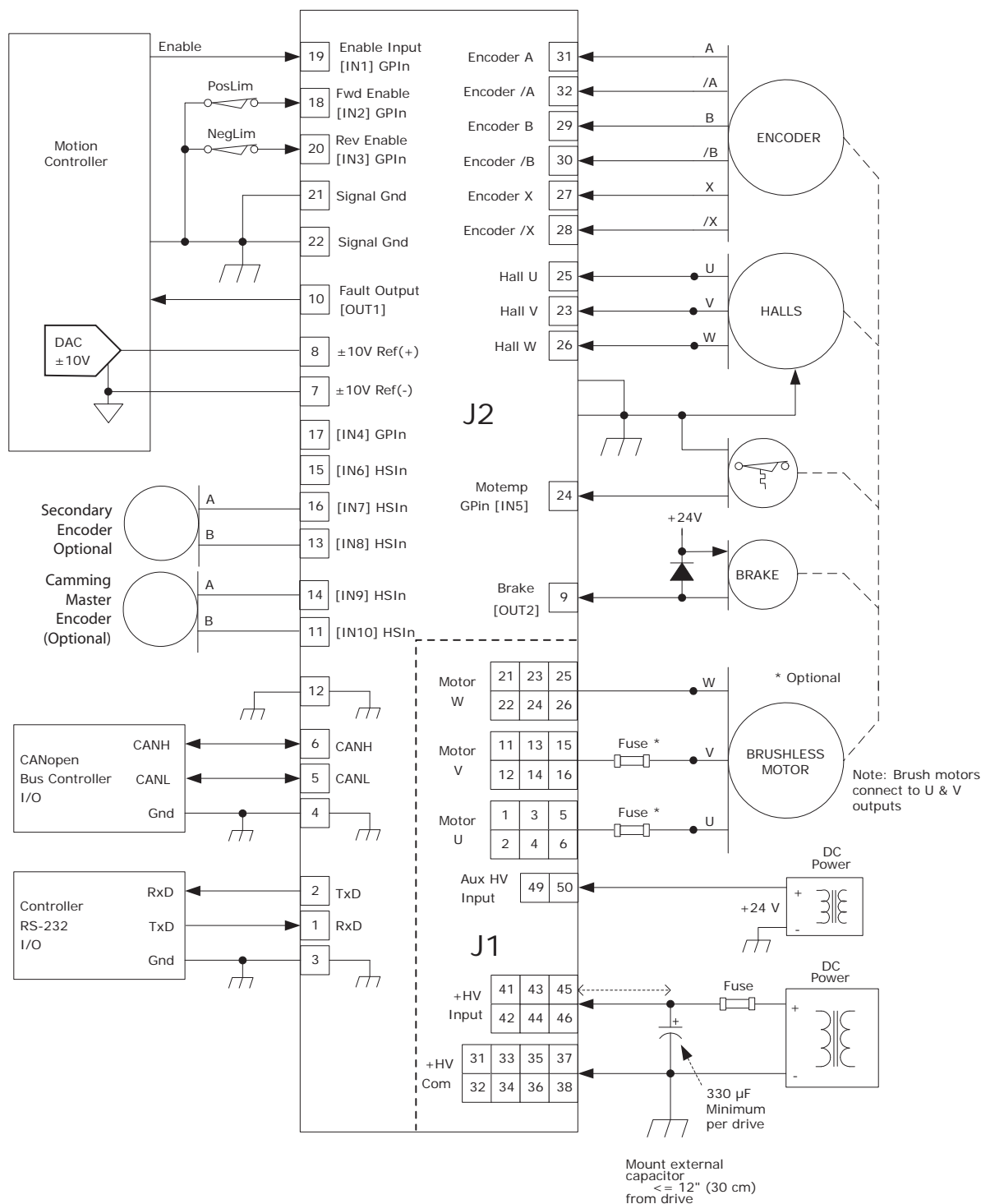
## MOUNTING AND COOLING

*Accelnet* mounts on PC boards using two, dual-row, 0.1 in 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 options are: no heatsink and convection heatsinks.

Convection heatsinks are available from Copley in standard, or low-profile forms.

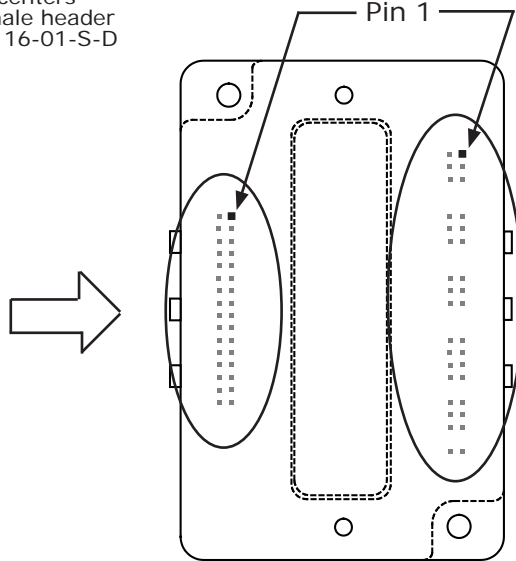


## TYPICAL DRIVE CONNECTIONS



## DRIVE PC BOARD CONNECTORS

J2: Signal  
Dual row, 0.1" centers  
32 position female header  
SAMTEC SSW-116-01-S-D



Drive viewed from above looking down on the pc board on which it is mounted. Pins and housing shapes are shown in phantom view.

J1: +HV, Aux HV, Gnd, & Motor Outputs  
Dual row, 0.1" centers  
Female header  
SAMTEC SSW-125-01-S-D

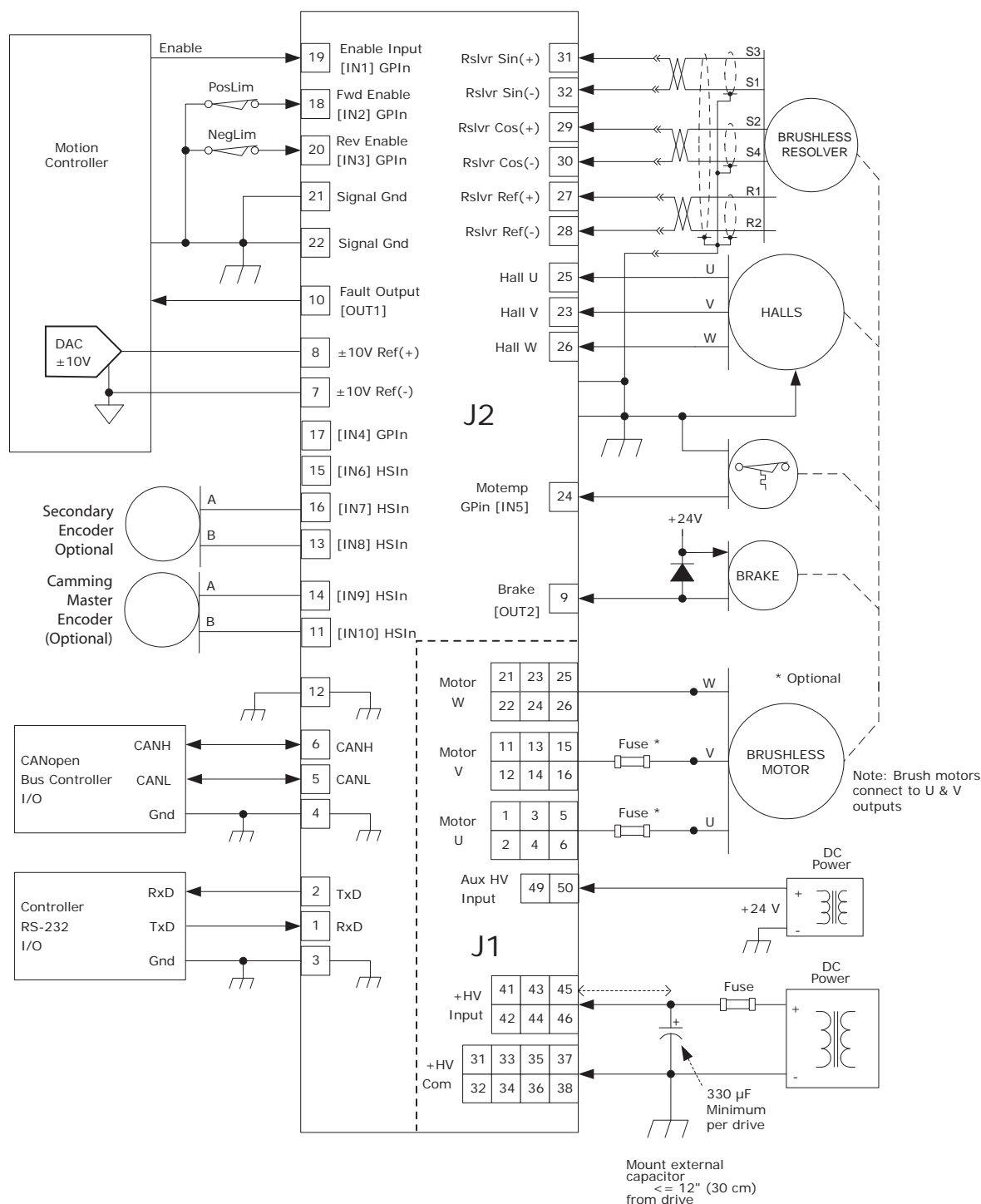
Signal	J2 Pin	Signal
RS-232 TxD	2	1 RS-232 RxD
Signal Ground	4	3 Signal Ground
CANH	6	5 CANL
±10V Ref(+)	8	7 ±10V Ref(-)
Fault [OUT1]	10	9 [OUT2] Brake
Signal Ground	12	11 [IN10] HSInput
HSInput [IN9]	14	13 [IN8] HSInput
HSInput [IN7]	16	15 [IN6] HSInput
GPInput [IN2]	18	17 [IN4] GPInput
GPInput [IN3]	20	19 [IN1] GPInput
Signal Ground	22	21 Signal Ground
GPInput [IN5]	24	23 Hall V
Hall W	26	25 Hall U
Encoder /X	28	27 Encoder X
Encoder /B	30	29 Encoder B
Encoder /A	32	31 Encoder A

### Notes

1. 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.

Signal	J1 Pin		Signal
Motor U	2	1	Motor U
	4	3	
	6	5	
No Connection	8	7	No Connection
	10	9	
Motor V	12	11	Motor V
	14	13	
	16	15	
No Connection	18	17	No Connection
	20	19	
Motor W	22	21	Motor W
	24	23	
	26	25	
No Connection	28	27	No Connection
	30	29	
HV COM (Ground)	32	31	HV COM (Ground)
	34	33	
	36	35	
	38	37	
No Connection	40	39	No Connection
+HV	42	41	+HV
	44	43	
	46	45	
No Connection	48	47	No Connection
Aux HV	50	49	Aux HV

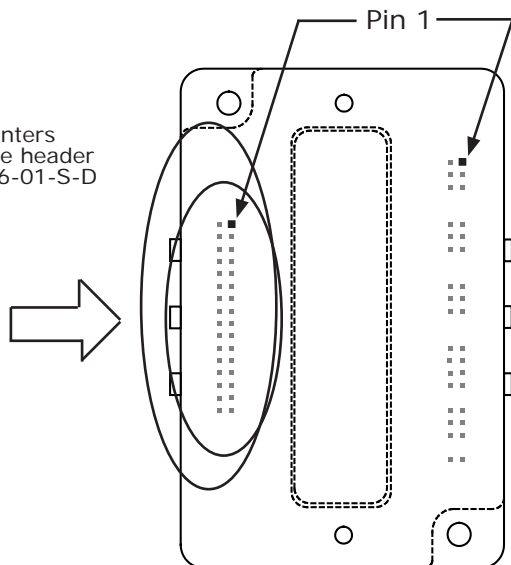
## TYPICAL DRIVE CONNECTIONS





## DRIVE PC BOARD CONNECTORS

J2: Signal  
Dual row, 0.1" centers  
32 position female header  
SAMTEC SSW-116-01-S-D



Drive viewed from above looking down on the pc board on which it is mounted. Pins and housing shapes are shown in phantom view.

J1: +HV, Aux HV, Gnd, & Motor Outputs  
Dual row, 0.1" centers  
Female header  
SAMTEC SSW-125-01-S-D

Signal	J2 PIN	SIGNAL
RS-232 TxD	2	1 RS-232 RxD
Signal Ground	4	3 Signal Ground
CAN_H	6	5 CAN_L
±10V Ref(+)	8	7 ±10V Ref(-)
Fault [OUT1]	10	9 [OUT2] Brake
Signal Ground	12	11 [IN10] HSInput
HSInput [IN9]	14	13 [IN8] HSInput
HSInput [IN7]	16	15 [IN6] HSInput
GPInput [IN2]	18	17 [IN4] HSInput
GPInput [IN3]	20	19 [IN1] HSInput
Signal Ground	22	21 Signal Ground
GPInput [IN5]	24	23 Hall V
Hall W	26	25 Hall U
Ref(-) Output R2	28	27 Ref(+) Output R1
Cos(-) Input S4	30	29 Cos(+) Input S2
Sin(-) Input S1	32	31 Sin(+) Input S3

Signal	J1 Pin		Signal
Motor U	2	1	Motor U
	4	3	
	6	5	
No Connection	8	7	No Connection
	10	9	
Motor V	12	11	Motor V
	14	13	
	16	15	
No Connection	18	17	No Connection
	20	19	
Motor W	22	21	Motor W
	24	23	
	26	25	
No Connection	28	27	No Connection
	30	29	
HV COM (Ground)	32	31	HV COM (Ground)
	34	33	
	36	35	
	38	37	
No Connection	40	39	No Connection
+HV	42	41	+HV
	44	43	
	46	45	
No Connection	48	47	No Connection
Aux HV	50	49	Aux HV

### Notes

1. 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 DESIGN

Printed circuit board layouts for Accelnet R22 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 R22 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  $\mu$ F 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 high-current types (with the exception of the +24 Vdc Aux HV supply). To carry

these high currents (up to 20 A dc 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 8 shows the pin groups that must be inter-connected to act as a single connection point for pc board traces.

3. Follow IPC-2221 rules for conductor thickness and minimum trace width of J1 signals. 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.

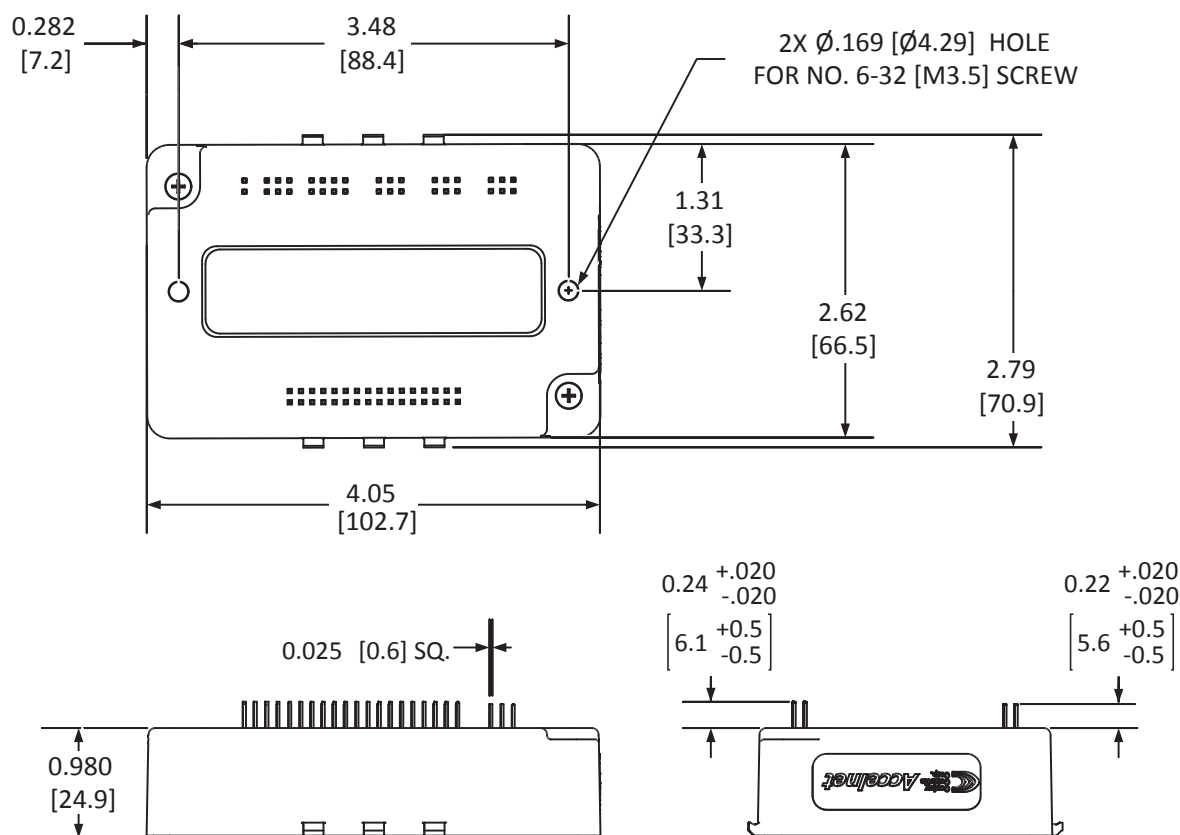
Motor signals (U,V,W) should also be routed close together. All the motor currents sum

to zero, and while the instantaneous value in a given phase will change, the sum of currents will be zero. So, keeping these traces as closely placed as possible will again minimize noise radiation due to motor phase currents.

Accelnet R22 circuit grounds are electrically common, and connect internally. However, the J1 signals carry high currents while the grounds on J2 (signal ground) carry low currents. So, J2 signals should be routed away from, and never parallel to the signals on J1. Encoder signal pairs (A, /A, B, /B, and X, /X) should be routed close together for good transmission-line effect to reduce reflections and noise.

The drive heatplate is electrically isolated from all drive circuits. For best noise-immunity it is recommended to connect the standoffs to frame ground and to use metal mounting screws to maintain continuity between heatplate and standoffs.

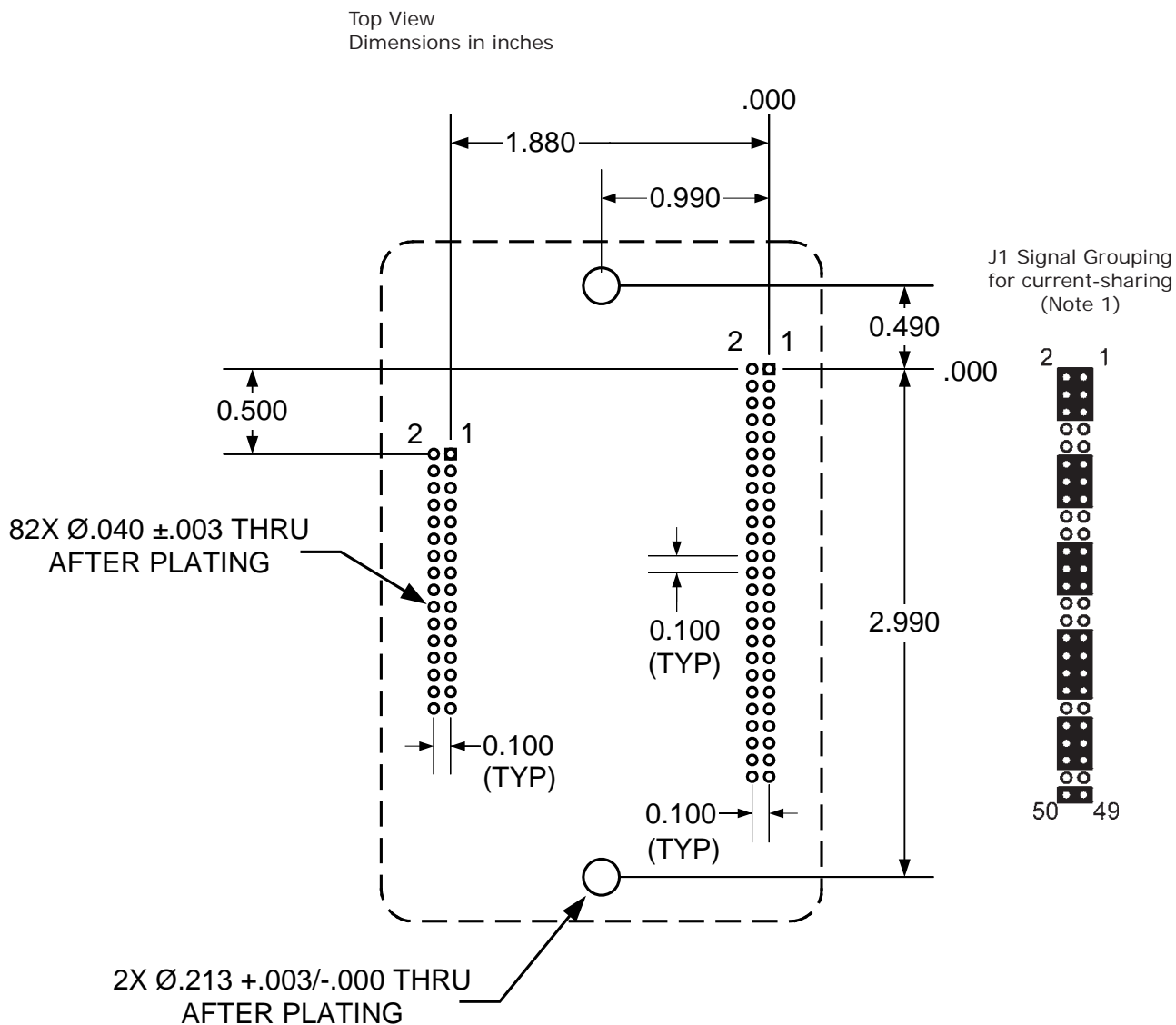
## DIMENSIONS



### Notes

1. Dimensions shown in inches [mm].

## PC BOARD MOUNTING FOOTPRINT



### Accelnet R22 Mounting Hardware:

Qty	Description	Mfgr	Part Number	Remarks
1	Socket Strip	Samtec	SSW-116-01-S-D J2	
1	Socket Strip	Samtec	SSW-125-01-S-D J1	
2	Standoff 6-32 X 3/8"	PEM	KFE-632-12-ET	

### 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.

## Development Kit

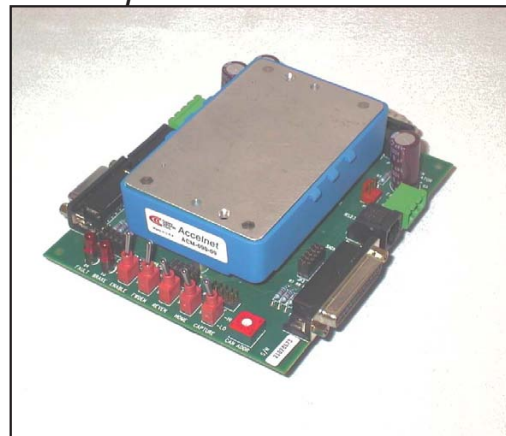
### DESCRIPTION

There two types of Development Kits:

MDK-180-01 for models with current ratings of 9, 18, 20, & 24 Adc.

RDK-090-01 for models with current ratings of 60 Adc.

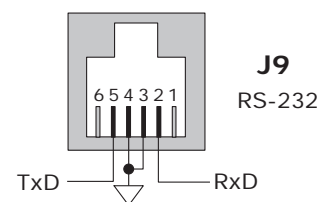
The Development Kits provide mounting and connectivity for one R22 drive. Solderless jumpers ease configuration of inputs and outputs to support their programmable functions. Switches can be jumpered to connect to digital inputs so that these can be toggled to simulate equipment operation. LED's provide status indication for the digital outputs. Dual CANopen connectors make daisy-chain connections possible so that other CANopen devices can easily be connected.



### RS-232 CONNECTION

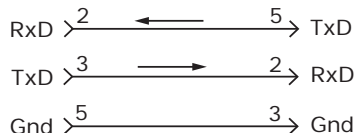
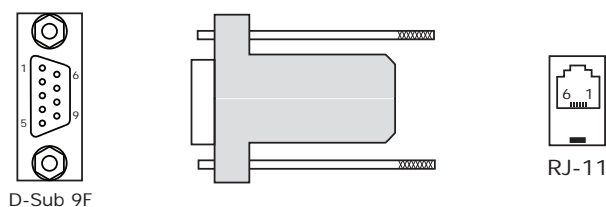
The RS-232 port is used to configure the drive for stand-alone applications, or for configuration before it is installed into an CANopen network. CME 2™ software communicates with the drive over this link and is used for complete drive setup. The CANopen node address that is set by the rotary switch can be monitored, and an address offset 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 Development Kit. It includes an adapter that plugs into the COM1 (or other) port of a PC and uses common modular cable to connect to the R22. 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 AEM Development Kit!

## CAN CONNECTORS

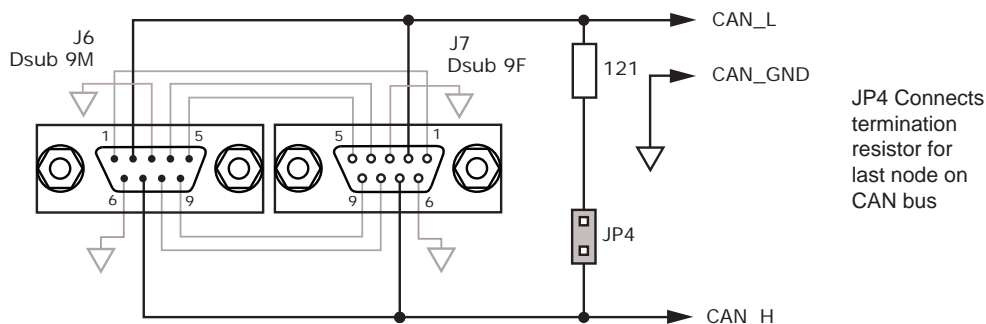
Connectors J6 & J7 are Sub-D male and female 9-position types that conform to the CAN DS-102 Physical Layer specification. The male-female configuration supports a single cable type with male and female connectors that can be daisy-chained from device to device along a CANopen network.

Accelnet uses only the CAN\_H, CAN\_L, and CAN\_GND signals. The CAN\_GND is connected to the circuit ground on the development kit. This ground is also shared by the amplifier power supply, accessory +5 Vdc (for encoders), and the RS-232 link. Other DS-102 signals are wired-through for use by products that might 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

PIN	SIGNAL
1	(Reserved)
2	CAN_L
3	CAN_GND
4	(Reserved)
5	(CAN_SHLD)
6	No connection
7	CAN_H
8	(Reserved)
9	(Reserved)

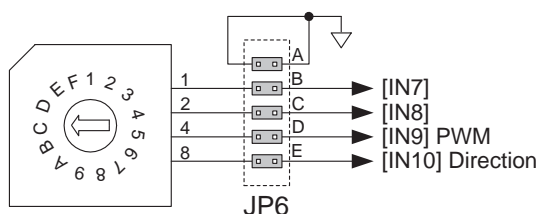


**Important!**  
Install JP4 ONLY if development kit is the LAST node on a CAN bus

## CAN ADDRESS SELECTION

Rotary switch SW6, labeled "CAN ADDR" connects to logic inputs 7, 8, 9, and 10 of the R22. These are programmable inputs which default to CAN address bits. The switch will select CAN addresses 0x00 through 0x0F (0~15 decimal). Address 0x00 is reserved for network management devices so amplifiers should use addresses 0x01~0x0F. The CAN standard permits up to 127 devices, so if the amplifier must have a address of 0x10 (decimal 16) or higher, this is done by programming an address offset into the amplifier before it is installed into the CAN bus. When this is done, the switch setting is added to the CAN offset in the amplifier to produce the actual CAN address.

CAN Address  
Switch



R22  
Logic  
Inputs

Note: To use inputs 7,8,9, or 10 as logic inputs remove jumpers on JP6.  
Connections can then be made via the pins on JP6.  
Inputs [IN9,10] are digital reference inputs for use when amplifier is used in stand-alone mode.

## ENCODER CONNECTIONS

The development kit has 10 k $\Omega$  pull-up resistors on the A,B, and X encoder signal inputs (J2-8, 7, 6). There are no pull-up resistors on the /A, /B, and /X inputs (J2-15,14,13). Jumpers JP1-A,B,C connect 121  $\Omega$  terminating resistors between the A-/A, B-/B, and X-/X signal pairs for use with differential-output encoders.

If single-ended encoders are used, these should be connected to the A,B, & X inputs and jumpers JP1-A,B, C must be removed to take the terminating resistors out of circuit. For motors which use encoders with differential outputs, jumpers JP1-A,B,C should be installed to eliminate reflections that degrade signal quality. For longer distances between motor and amplifier, and to offset the effects of cable capacitance, wiring should be twisted-pair, preferably with a shield for each pair.

Encoder power is supplied from an external +5 Vdc supply with sufficient current to drive the motor encoder. Typically these will be 250 mA or less. In cases where an encoder uses a separate interpolator module to process the data, current demand may be higher. Consult the motor encoder literature to be sure that the +5 Vdc supply can handle the encoder power requirements.

## POWER SUPPLIES

Amplifier 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. Pin J1-5 is the +HV positive terminal, and pin J1-4 is the power supply negative terminal that connects to circuit ground. 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.

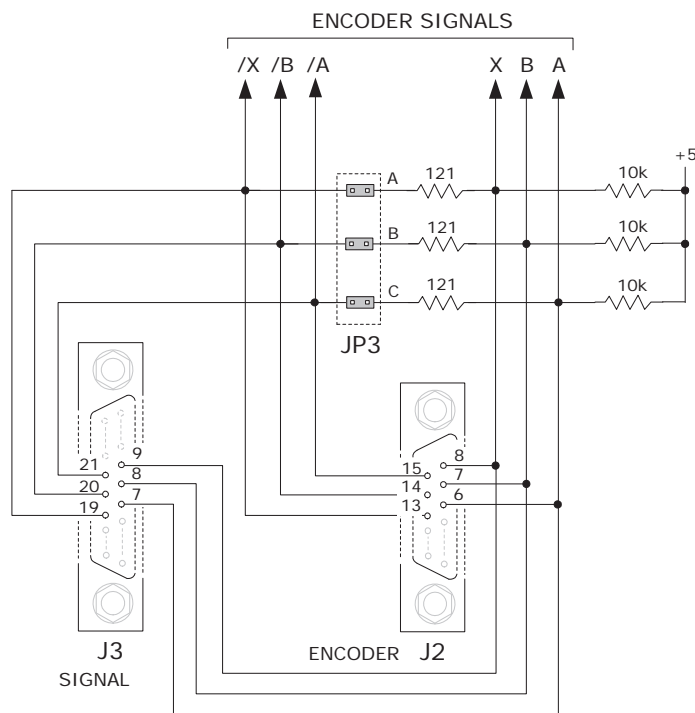
During deceleration, mechanical energy in the motor and load is converted back into electrical energy that must be dissipated as the motor comes to a stop. While some of this is converted to heat in the motor windings, the rest of it will flow through the amplifier into the power supply. An external 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 amplifier 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 terminals.

Switching power supplies can also be used to power *Accelnet*. Unlike unregulated supplies, these cannot accept reverse energy flow, so an isolating diode must be placed between the power supply and J1-5 to block current flow back into the power

supply. When this is done, an external storage capacitor must be used across J1-5 & J1-4 because the capacitor on the Development Kit board is only for ripple-current control, and can't store enough energy to handle regeneration.

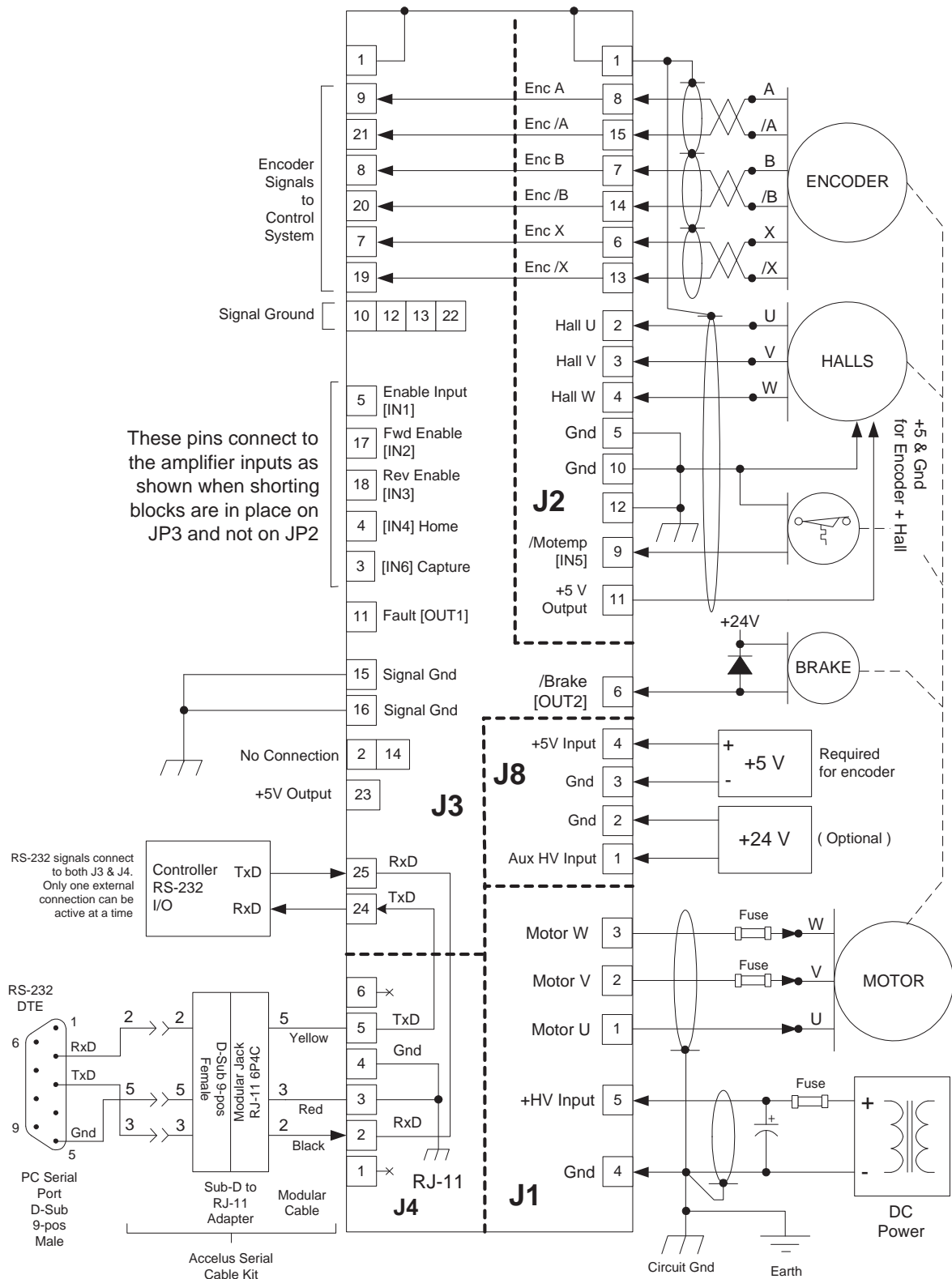
An earthing ground connection can be made via a second conductor to J1-4 that connects to the equipment frame ground.

If desired, an Aux HV supply can also be connected via J8-1 and J8-2. This supply must be greater than the amplifier minimum supply voltage of +20 Vdc. Commonly available +24 Vdc supplies work well for this. Using the Aux HV input enables the amplifier to have the HV supply turned off for equipment safety or EMO (Emergency Off) conditions. At this time, the Aux HV will keep the amplifier 'alive' and able to communicate and monitor position, but not to power the motor.





## CONNECTIONS



## CONNECTOR LAYOUT

### FOR THE MDK-180-01 DEVELOPMENT KIT

Model *	Vdc	Ic	Ip
R22-055-18	20 - 55	6	18
R22-090-09	20 - 90	3	9
R22-090-24	20 - 90	12	24
R22-180-09	20 - 180	3	9
R22-180-18	20 - 180	6	18
R22-180-20	20 - 180	10	20

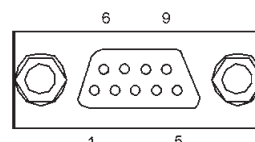
CANopen Signal	Pin
(Reserved)	1
CAN_L	2
CAN_GND	3
(Reserved)	4
(CAN_SHLD)	5

### J7 CABLE CONNECTOR

Dsub-9F

Norcomp: 171-009-203L001

Tyco: 5-747905-2

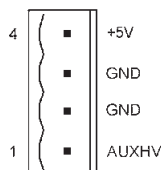


### J8 CABLE CONNECTOR

Amphenol/PCD: ELFP04210

Tyco/Buchanan: 796635-4

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

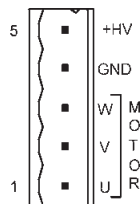


### J1 CABLE CONNECTOR

Amphenol/PCD: ELFP05210

Tyco/Buchanan: 796635-5

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



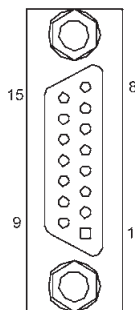
### J2 CABLE CONNECTOR

Dsub-15M

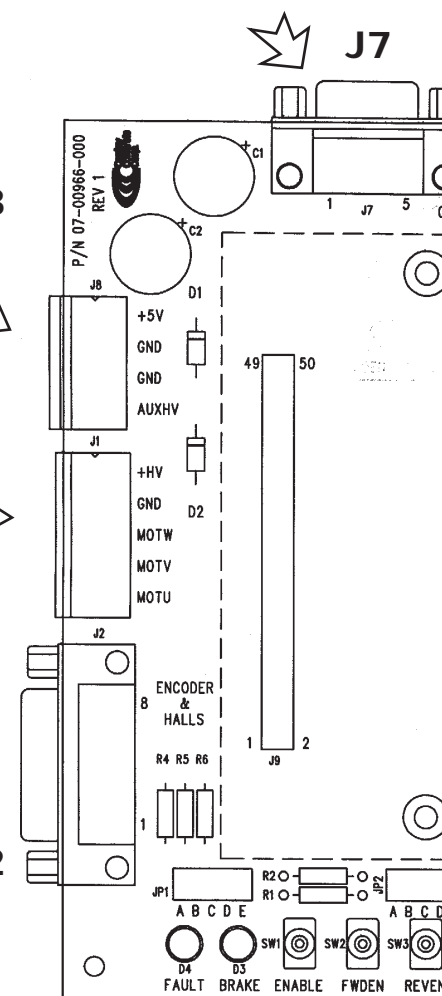
Norcomp: 171-015-103L001

Tyco: 5-747908-2

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



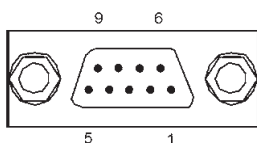
PIN	J2 SIGNAL
8	Encoder A Input
7	Encoder B Input
6	Encoder X Input
5	Signal Ground
4	Hall W Input
3	Hall V Input
2	Hall U Input
1	Chassis Ground



Pin	CANopen Signal
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)



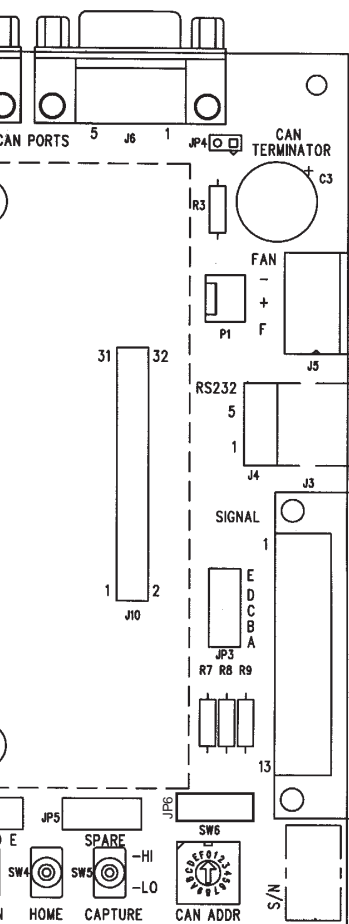
**J6 CABLE CONNECTOR**

Dsub-9M

Norcomp: 171-009-103L001

Tyco: 5-747904-2

**J6**

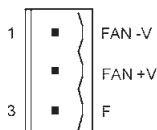


PIN	J5 SIGNAL
1	Fan -V
2	Fan +V
3	F

**J5 CABLE CONNECTOR**

Amphenol/PCD: ELFP03210

Tyco/Buchanan: 796635-3



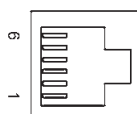
PIN	J4 SIGNAL
6	No Connection
5	TxD Output
4	Ground
3	Ground
2	RxD Input
1	No Connection

**J3 CABLE CONNECTOR**

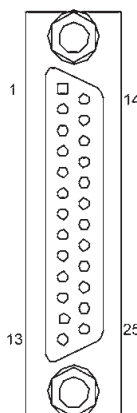
Dsub-25M

Norcomp: 171-025-103L001

Tyco: 5-747912-2



J3 SIGNAL	PIN
Chassis Ground	1
No Connection	2
Capture [IN6]	3
Home [IN4]	4
Enable Input [IN1]	5
Brake Output [OUT2]	6
Encoder X Output	7
Encoder B Output	8
Encoder A Output	9
Signal Ground	10
Fault Output [OUT1]	11
Signal Ground	12
Signal Ground	13



PIN	J3 SIGNAL
14	No Connection
15	Signal Ground
16	Signal Ground
17	[IN2] Forward Enable Input
18	[IN3] Reverse Enable Input
19	Encoder /X Output
20	Encoder /B Output
21	Encoder /A Output
22	Signal Ground
23	+5V Output
24	RS-232 TxD Output
25	RS-232 RxD Input

## CONNECTOR LAYOUT

FOR THE RDK-090-01 DEVELOPMENT KIT

Model *	Vdc	Ic	Ip
R22-090-60	20 - 90	30	60

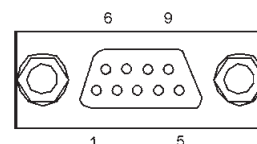
CANopen Signal	Pin
(Reserved)	1
CAN_L	2
CAN_GND	3
(Reserved)	4
(CAN_SHLD)	5

### J7 CABLE CONNECTOR

Dsub-9F

Norcomp: 171-009-203L001

Tyco: 5-747905-2

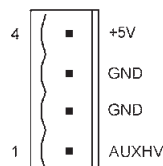


### J8 CABLE CONNECTOR

Amphenol/PCD: ELFP04210

Tyco/Buchanan: 796635-4

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

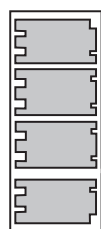


J8

### J1 CABLE CONNECTOR

Phoenix PC 5/5-STCL-7,62

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



J1

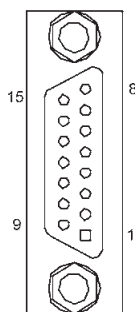
### J2 CABLE CONNECTOR

Dsub-15M

Norcomp: 171-015-103L001

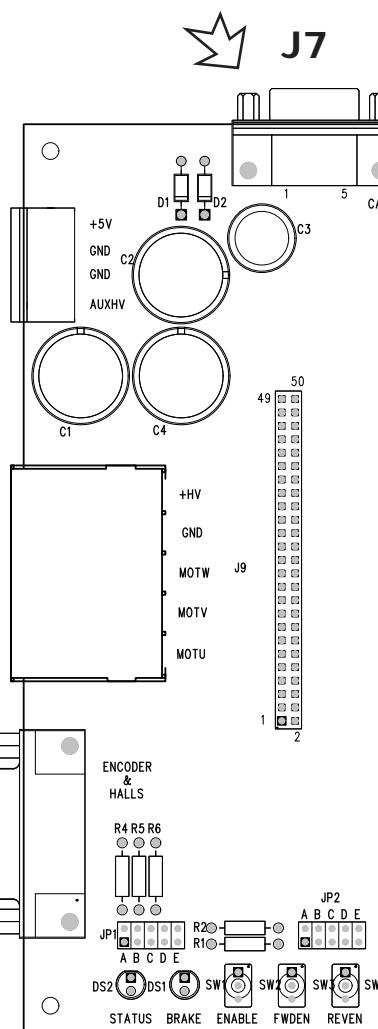
Tyco: 5-747908-2

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



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

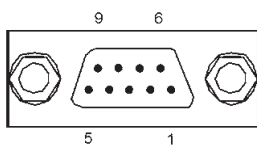
J2



Pin	CANopen Signal
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 (Accel-net signal and power ground)



**J6 CABLE CONNECTOR**

Dsub-9M

Norcomp: 171-009-103L001

Tyco: 5-747904-2

**J6**

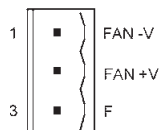


PIN	J5 SIGNAL
1	Fan -V
2	Fan +V
3	F

**J5 CABLE CONNECTOR**

Amphenol/PCD: ELFP03210

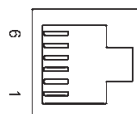
Tyco/Buchanan: 796635-3



**J5**



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



**J4**



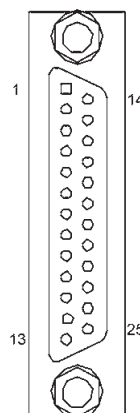
**J3 CABLE CONNECTOR**

Dsub-25M

Norcomp: 171-025-103L001

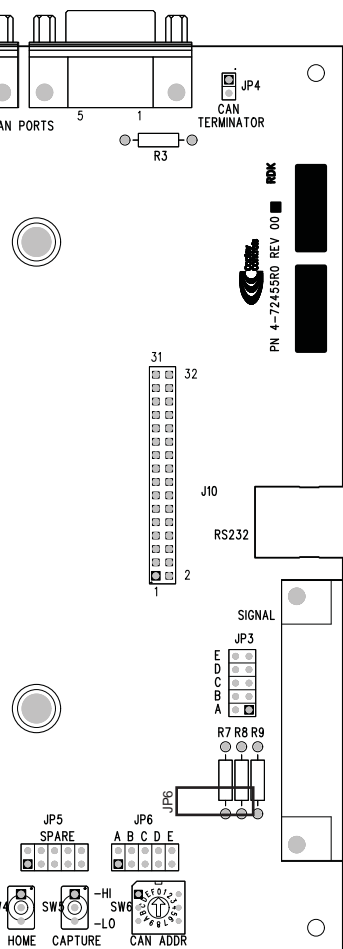
Tyco: 5-747912-2

J3 SIGNAL	PIN
Chassis Ground	1
No Connection	2
Capture [IN6]	3
Home [IN4]	4
Enable Input [IN1]	5
Brake Output [OUT2]	6
Encoder X Output	7
Encoder B Output	8
Encoder A Output	9
Signal Ground	10
Fault Output [OUT1]	11
Signal Ground	12
Signal Ground	13



PIN	J3 SIGNAL
14	No Connection
15	Signal Ground
16	Signal Ground
17	[IN2] Forward Enable Input
18	[IN3] Reverse Enable Input
19	Encoder /X Output
20	Encoder /B Output
21	Encoder /A Output
22	Signal Ground
23	+5V Output
24	RS-232 TxD Output
25	RS-232 RxD Input

**J3**

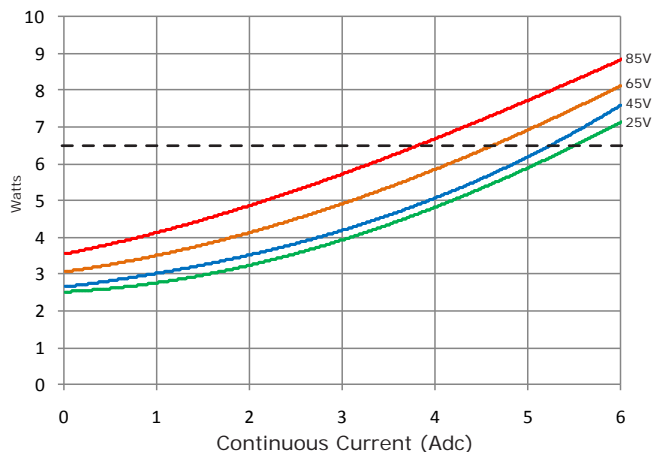


## POWER DISSIPATION

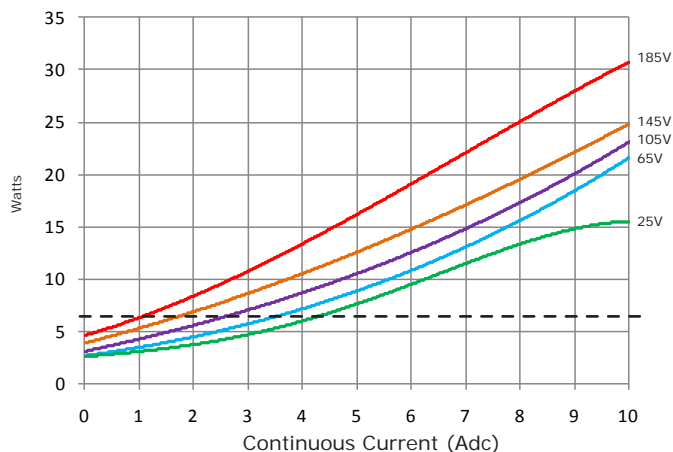
The charts on this page show the drive's internal power dissipation for different models under differing power supply and output current conditions. Drive output current is calculated from the motion profile, motor, and load conditions. The values on the chart represent the continuous current that the drive would provide during operation. The +HV values are for the average DC voltage of the drive power supply.

To see if a heatsink is required or not, the next step is to determine the temperature rise the drive will experience when it's installed. For example, if the ambient temperature in the drive enclosure is 40 °C, and the heatplate temperature is to be limited to 80° C or less to avoid shutdown, the maximum rise would be 80C - 40C. or 40° C. Dividing this dissipation by the thermal resistance of 6.2° C/W with no heatsink gives a dissipation of 6.5W. This line is shown in the charts below. For power dissipation below this line, no heatsink is required.

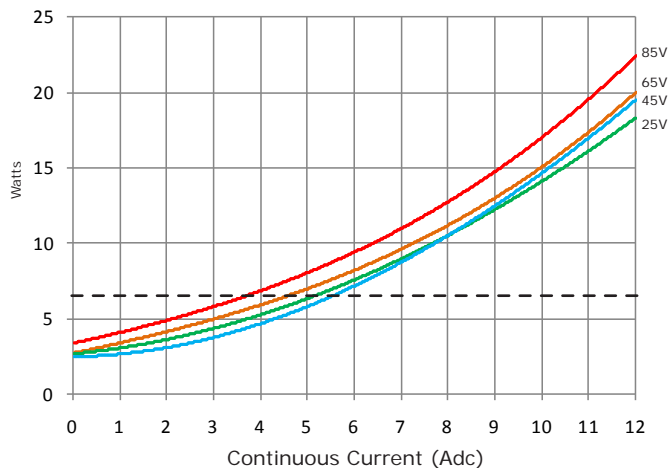
Models: R22-055-18, R22-090-09



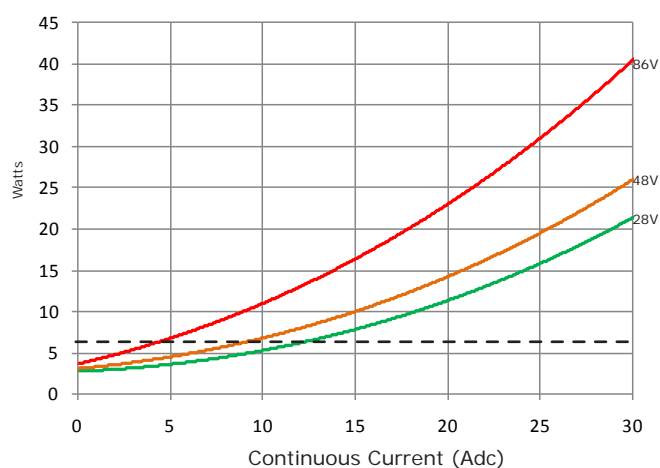
Models: R22-180-18, R22-180-09



Model: R22-090-24



Model: R22-090-60



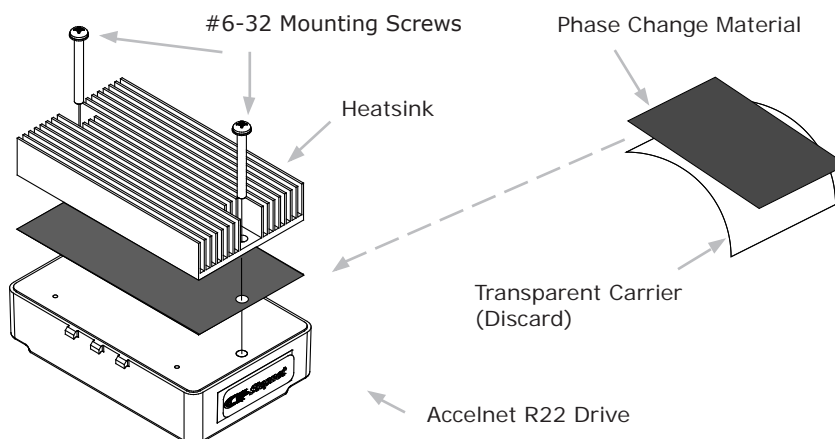


## HEATSINK INSTALLATION

If a heatsink is used it is mounted using the same type of screws used to mount the drive without a heatsink but slightly longer. Phase change material (PSM) is used in place of thermal grease. This material comes in sheet form and changes from solid to liquid form as the drive warms up. This forms an excellent thermal path from drive heatplate to heatsink for optimum heat transfer.

### STEPS TO INSTALL

1. Remove the PSM (Phase Change Material) from the clear plastic carrier.
2. Place the PSM on the Accelnet R22 aluminum heatplate taking care to center the PSM holes over the holes in the drive body.
3. Mount the heatsink onto the PSM again taking care to see that the holes in the heatsink, PSM, and drive all line up.
4. Torque the #6-32 mounting screws to 8~10 lb-in (0.9~1.13 N·m).

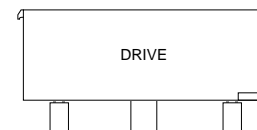
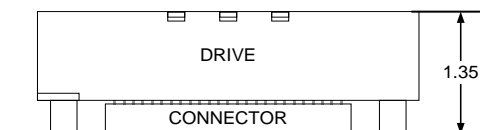


## HEATSINK OPTIONS

Rth expresses the rise in temperature of the drive per Watt of internal power loss. The units of Rth are °C/W, where the °C represent the rise above ambient in degrees Celsius. The data below show thermal resistances under convection, or fan-cooled conditions for the no-heatsink, HL, and HS heatsinks.

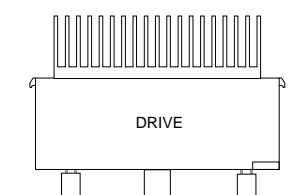
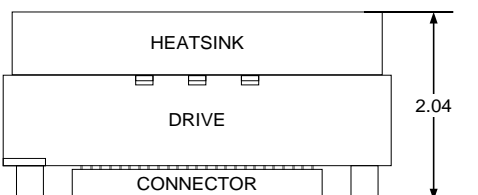
### NO HEATSINK

NO HEATSINK	°C/W
CONVECTION	6.2
FORCE AIR (300 LFM)	2.1



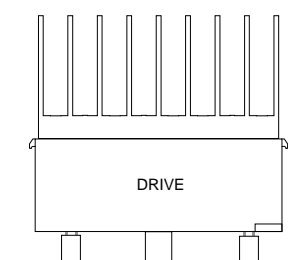
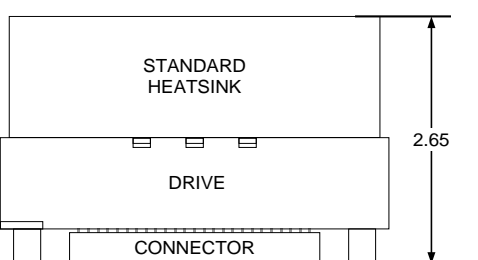
### LOW-PROFILE HEATSINK (R22-HL)

ACM-HL HEATSINK	°C/W
CONVECTION	4.0
FORCE AIR (300 LFM)	0.9



### STANDARD HEATSINK (R22-HS)

ACM-HS HEATSINK	°C/W
CONVECTION	2.2
FORCE AIR (300 LFM)	0.5



## ORDERING GUIDE

PART NUMBER	DESCRIPTION
R22-055-18	R22 servo drive 6/18 Adc @ 55 Vdc
R22-090-09	R22 servo drive 3/9 Adc @ 90 Vdc
R22-090-24	R22 servo drive 12/24 Adc @ 90 Vdc
R22-090-60	R22 servo drive 30/60 Adc @ 90 Vdc
R22-180-09	R22 servo drive 3/9 Adc @ 180 Vdc
R22-180-18	R22 servo drive 6/18 Adc @ 180 Vdc
R22-180-20	R22 servo drive 10/20 Adc @ 180 Vdc
MDK-180-01*	Development Kit for -09, -18-, -20, & -24 models
RDK-090-01	Development Kit for -50 & -60 models
MDK-CK	Development Kit Connector Kit for MDK-180-01
RDK-CK	Development Kit Connector Kit for RDK-090-01
R22-HL	R22 Heatsink Kit, Low profile
R22-HS	R22 Heatsink Kit, Standard
CME2	CME 2 Drive Configuration Software CD-ROM
SER-CK	Serial Cable Kit for Development Kit

*Add -R to part number for resolver option*

\* The R22 drives are RoHS.  
The MDK-180-01 Development Kit is not RoHS

## ORDERING INSTRUCTIONS

Example: Order 1 R22-090-09 drive with  
Standard Heatsink, Development Kit,  
and Development Kit Connector Kit

Qty	Item	Remarks
1	R22-090-09	Accelnet R22 servodrive
1	R22-HS	Standard Heatsink
1	MDK-180-01	Accelnet R22 Development Kit
1	MDK-CK	Connector Kit for Development Kit
1	CME2	CME2™ CD
1	SER-CK	Serial Cable Kit

### Notes

1. Heatsink kits are ordered separately and installed by the customer, not at the factory.