

## DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

### [AFS] Advanced Feature Set

- 32-bit floating point filters
- Multiple advanced filters
- Frequency analysis tools

### Control Modes

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

### Command Interface

- CANopen
- ASCII, Serial Binary, and discrete I/O
- Stepper or Quad A/B position commands
- PWM Velocity-Torque command
- Master encoder (Gearing, Camming)
- ±10 V Position-Velocity-Torque

### Communications

- CANopen
- RS-232

### Feedback

- Primary Absolute
  - BiSS-C Unidirectional
  - SSI Absolute or Incremental
- Secondary Incremental
  - Differential Quad A/B/X
- Dual Feedback
- Digital Halls

### I/O

- 1 Analog input ±10V, 12-bit
- 5 High-speed digital inputs
- 1 Motor overtemp input
- 4 High-speed digital outputs

### Safe Torque Off (Pending)

- SIL 3, Category 3, PL e

### Dimensions

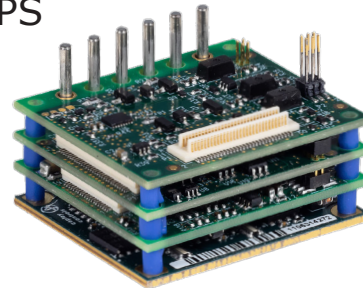
- NPS: 35 x 30 x 23.4 mm [1.38 x 1.18 x 0.92 in], 29 g [1.0 oz]
  - NPS-EZ: 35 x 47 x 33.6 mm [1.38 x 1.85 x 1.32], 57 g [2.0 oz]
  - NPS-DEV: 97.2 x 112.4 x 45 mm [3.82 x 4.42 x 1.77 in], 221 g [7.8 oz]\*
- \*optional heatsink weight: 16.5 g [0.58 oz]

MODEL	I <sub>c</sub>	I <sub>p</sub>	V <sub>DC</sub>
NPS-090-10	5	10	9~90
NPS-090-70	35	70	9~90
NPS-180-10	5	10	20~180
NPS-180-30	15	30	20~180

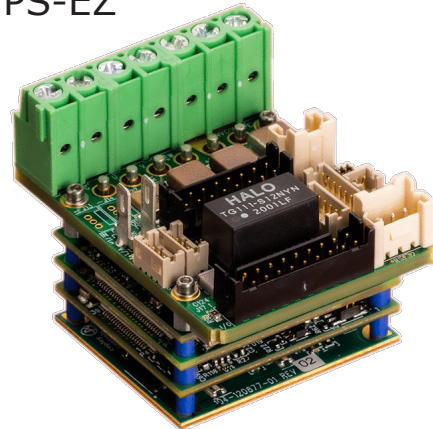
### **-EZ and -DEV have these ratings**

Nano is the smallest servo drive that Copley offers and can be mounted directly on the motor or within robotic joints. It can satisfy requirements of the robotics, AGV, industrial machinery, medical/life-sciences and aerospace industries.

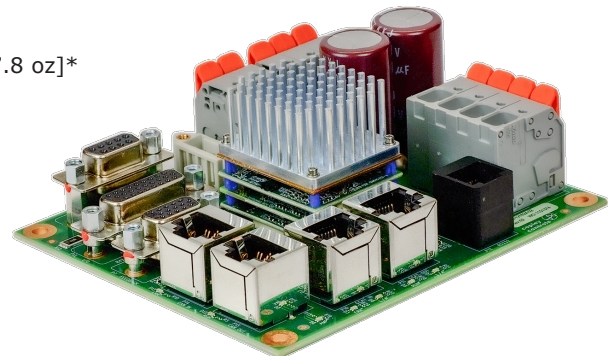
NPS



NPS-EZ



NPS-DEV



The NPS module may be implemented in a customer application using connectors only, or the power pins may be soldered for high load current applications. The NPS-EZ is a small form factor available for immediate integration into a customer application with industry standard connectors.

## DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

### GENERAL SPECIFICATIONS

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

MODEL	NPS-090-10 NPS-090-10-D NPS-090-10-Z	NPS-090-70 NPS-090-70-D NPS-090-70-Z	NPS-180-10 NPS-180-10-D NPS-180-10-Z	NPS-180-30 NPS-180-30-D NPS-180-30-Z	-D = -DEV -Z = -EZ
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### OUTPUT POWER...

	NPS-090-10	NPS-090-70	NPS-180-10	NPS-180-30	
Peak Current	10 (7.07)	70 (49.5)	10 (7.07)	30 (21.2)	Adc (Arms, sinusoidal)
Peak time	1	1	1	1	Sec
Continuous current	5 (3.54)	35 (24.8)	5 (3.54)	15 (10.6)	Adc (Arms, sinusoidal)
Peak Output Power	0.9	6.3	1.8	5.4	kW
Continuous Output Power	0.45	3.15	0.9	1.8	kW

\* NPS-090-70 must be soldered to a mounting PCBA to meet this output

### INPUT POWER

	NPS-090-10	NPS-090-70	NPS-180-10	NPS-180-30	
HVmin to HVmax	+9 to +90	+9 to +90	+20 to +180	+20 to +180	Vdc, transformer-isolated
Ipeak	10	70	10	30	Adc (1 sec) peak
Icont	5	35	5	15	Adc continuous
VLOGIC	+9 to +60	+9 to +60	+9 to +60	+9 to +60	Vdc, transformer-isolated
VLOGIC Power	3 W with no encoder, 6 W with encoder +5V @ 500 mA, VLOGIC @ 24 Vdc				

### PWM OUTPUTS

Type	MOSFET 3-phase inverter, 16 kHz center-weighted PWM carrier, space-vector modulation
PWM ripple frequency	32 kHz

### BANDWIDTH

Current loop, small signal	2.5 kHz typical, bandwidth will vary with tuning & load inductance
HV Compensation	Changes in HV do not affect bandwidth
Current loop update rate	16 kHz (62.5 μs)
Position & Velocity loop update rate	4 kHz (250 μs)

### COMMAND INPUTS

CANopen	CAN TJA1051 transceiver, ISO 11898-2:2016 and SAE J2284-1 to SAE J2284-5 compliant	
Signals	CAN_H, CAN_L, CAN_GND, 1 mBit/sec maximum	
Data protocol	CANopen Device Profile DSP-402 over CANopen (CoE)	
Stand-alone mode		
Digital position reference	Pulse/Direction, CW/CCW	Stepper commands (2 MHz maximum rate)
	Quad A/B Encoder	2 M line/sec, 8 Mcount/sec (after quadrature)
Digital torque & velocity reference	PWM, Polarity	PWM = 0% - 100%, Polarity = 1/0
	PWM 50%	PWM = 50% ±50%, no polarity signal required
	PWM frequency range	1 kHz minimum, 100 kHz maximum
	PWM minimum pulse width	220 ns
Indexing	Up to 32 sequences can be launched from inputs or ASCII commands.	
Camming	Up to 10 CAM tables can be stored in flash memory	
ASCII	RS-232, 9600~230,400 Baud, 3-wire	

### DIGITAL INPUTS MODULE

Number	6
IN1~5	General purpose inputs LV CMOS 3.3V Schmitt trigger, 100 ns RC filter, max input voltage = +12 Vdc, 10 kΩ pull-up to +5 Vdc 2.2 Vdc max positive threshold, 0.6 Vdc min negative threshold RC time-constant assumes active drive on inputs and does not include 10 kΩ pull-ups
IN6	Motor overtemperature, LV CMOS 3.3V Schmitt trigger, 33 μS RC filter, max input voltage = +12 Vdc 4.9 kΩ pull-up to +5 Vdc, 2.2 Vdc max positive threshold, 0.6 Vdc min negative threshold

### DIGITAL INPUTS NPS-DEV, NPS-EZ

IN1~3	24 V tolerant, HC CMOS 5.0V Schmitt trigger, 330 μs RC filter, 0~24 Vdc compatible, 10 kΩ pull-up to +5 Vdc 2.2 Vdc min positive threshold, +0.6 Vdc max negative threshold
IN4~5	LV CMOS 3.3V Schmitt trigger, 100 ns RC filter, max input voltage = +12 Vdc, 10 kΩ pull-up to +5 Vdc 2.2 Vdc min positive threshold, 0.6 Vdc max negative threshold
IN6	Motor overtemperature, HC CMOS 5.0V Schmitt trigger, 330 μs RC filter, max input voltage = +12 Vdc 1.6 kΩ pull-up to +5 Vdc, 2.2 Vdc min positive threshold, 0.6 Vdc max negative threshold

### DIGITAL OUTPUTS MODULE

Number	4
OUT1~4	74HCT14 5 V CMOS Schmitt trigger, functions programmable, +5 Vcc Source -4 mA @ VOH = 4.18 Vdc, Sink 4 mA @ VOL = 0.26 Vdc

### DIGITAL OUTPUTS NPS-DEV, NPS-EZ

Number	4
OUT1~4	74HCT14 5 V CMOS Schmitt trigger, functions programmable, +5 Vcc Source -4 mA @ VOH = 4.18 Vdc, Sink 4 mA @ VOL = 0.26 Vdc
OUT4 (NPS-DEV)	Brake control, programmable release time followed by programmable PWM duty-cycle for holding current

## DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

### ANALOG INPUT

Number	1
Type	Differential, $\pm 10$ Vdc range, 5.0 k $\Omega$ input impedance to a 12 bit ADC, single-pole low pass filter with a 1934 Hz -3dB bandwidth
Function	Torque, Velocity, or Position command. Or, as general purpose analog input

### SERIAL COMMUNICATION PORT

Signals	RxD, TxD, SGND RxD input is 74LVC14 3.3 V Schmitt trigger with 10 k $\Omega$ pull-up to +5V TxD output is 74HCT14 5 V Schmitt trigger
Mode	Full-duplex, DTE serial communication port for drive setup and control, 9,600 to 230,400 bit/second
Protocol	ASCII or Binary format
Isolation	Non-isolated. Referenced to Signal Ground

### SERIAL COMMUNICATION PORT, NPS-DEV, NPS-EZ

An ADM3101E transceiver provides standard RS-232 signal levels. An RJ11 connector accepts commonly used cable connectors

Signals	RxD, TxD, SGND
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### CANOPEN PORT

Format	CAN_H, CAN_L, CAN_GND, 1 Mbit/sec maximum
Protocol	CANopen, CiA 402
Isolation	Galvanically isolated from drive 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 Minimum inductance: 200 $\mu$ H line-line
Encoder	Digital encoders, incremental and absolute (see FEEDBACK below)
Halls	Digital U/V/W
Motemp	Input is programmable to disable the drive if motor sensor drives input HI or LO

### FEEDBACK

<i>Incremental encoders:</i>	
Digital Incremental Encoder	Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required) RS-422 line receivers, 5 MHz maximum line frequency (20 M counts/sec), 74HCT thresholds
<i>Absolute encoders:</i>	
BiSS-C Unidirectional, SSI	MA+, MA- (X, /X), SL+, SL- (A, /A) signals, clock output from drive, data returned from encoder
<i>Terminators</i>	All encoder data inputs and clock outputs are differential and require external terminators
<i>Commutation:</i>	Hall signals (U,V,W), 15 k $\Omega$ pull-up to +5V, 15 k $\Omega$ /100 pF RC to 74LVC3G14 Schmitt trigger at +5 Vcc

### HALLS

U, V, W:	Single-ended, 120° electrical phase difference Schmitt trigger, 1.0 $\mu$ s RC filter from active HI/LO sources, 5 Vdc compatible 15 k $\Omega$ pull-up to +5 Vdc, 74LVC, 3.3 V thresholds
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### +5V OUTPUT

Number	1
Rating	150 mA maximum. Protected for overload or shorts. Available for optional peripherals immediately adjacent to the module

### +3.3V OUTPUT

Number	3
Rating	150 mA maximum. Protected for overload or shorts.
Available for optional microcontroller, RS-232 Transceiver, CANopen Transceiver, LEDs, and Address Switches	

### +5VENC OUTPUT

Number	2
Rating	500 mA maximum. Protected for overload or shorts.

## DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

### SAFE TORQUE OFF (STO)

Function	PWM outputs are inactive and current to the motor will not be possible when the STO function is active
Safety Integrity Level	SIL 3, Category 3, Performance Level e (PL e)
Inputs	2 two-terminal: STO1_IN, STO1_RTN, STO2_IN, STO2_RTN
Type	Opto-isolators, 5V compatible
Disabling	Connecting both STO inputs to +5V will deactivate the STO function

### PROTECTIONS

HV Overvoltage	+HV > +95 ±1 Vdc	Drive outputs turn off until +HV is < +95 ±1 Vdc (90 V model)
	+HV > +185 ±1 Vdc	Drive outputs turn off until +HV is < +185 ±1 Vdc (180 V models)
HV Undervoltage	+HV < +8.5 ±0.5 Vdc	Drive outputs turn off until +HV > +8.5 Vdc ±0.5 Vdc (90 V models)
	+HV < +19.5 ±0.5 Vdc	Drive outputs turn off until +HV > +19.5 Vdc ±0.5 Vdc (180 V models)
Drive over temperature	PC Board > 90 °C +3/-0 °C	Programmable as latching or temporary fault
Short circuits	Output to output, output to ground, internal PWM bridge faults	
I <sup>2</sup> T Current limiting	Programmable: continuous current, peak current, peak time for drive and motor	
Latching / Non-Latching	Programmable response to errors	

### MECHANICAL & ENVIRONMENTAL

Size, Weight	NPS: 35 x 30 x 21.6 mm [1.38 x 1.18 x 0.85 in], 1.0 oz [29 g] NPS-EZ: 54.62 x 35 mm [2.25 x 1.378 in], 2.0 oz [57 g] NPS-DEV: 112.4 X 97.2 X 36.86 mm [4.42 X 3.82 X 1.45 in], 7.8 oz [221 g]* *add 0.58 oz [0.0165 kg] for optional heatsink
Weight	0.8 oz [0.023 kg]
Ambient temperature	0 to +45 °C operating, -40 to +85 °C storage
Humidity	0 to 95%, non-condensing
Altitude	≤ 2000 m (6,562 ft)
Vibration	2 g peak, 10~500 Hz (Sine)
Shock	10 g, 10 ms, ½ Sine pulse
Contaminants	Pollution degree 2

### AGENCY STANDARDS CONFORMANCE

*Standards and Directives*

*Functional Safety*

IEC 61508-1, IEC 61508-2, IEC 61508-3, IEC 61508-4 (SIL 3)  
Directive 2006/42/EC (Machinery)  
ISO 13849-1 (Cat 3, PL e)  
IEC 61800-5-2 (SIL3)

*Product Safety*

Directive 2014/35/EU (Low Voltage)  
IEC 61800-5-1

*EMC*

Directive 2014/30/EU (EMC)  
IEC 61800-3  
IEC 61800-5-2

*Restriction of the Use of Certain Hazardous Substances (RoHS)*

Directive 2011/65/EU and its amendments 2015/863/EU

*Approvals*

*UL and cUL recognized component to:*


UL 61800-5-1, UL 61800-5-2  
IEC 61800-5-1, IEC 61800-5-2

**FUNCTIONAL SAFETY**



ISO 13849-1  
Up to PL e (Cat.3)  
IEC 61800-5-2  
Up to SIL 3

*All of the agency standards are pending at this time.*

 <b>DANGER</b>	<p><b>Refer to the 16-121699 Copley User Guide for NANO Family</b></p>
	<p>The information provided in the 16-121699 <b>Copley User Guide for NANO Family</b> must be considered for any application using the NANO drive STO feature.</p> <p><b>Failure to heed this warning can cause equipment damage, injury, or death.</b></p>

## CANOPEN COMMUNICATIONS

### CANOPEN

Based on the CAN V2.0b 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.

### CANOPEN COMMUNICATION

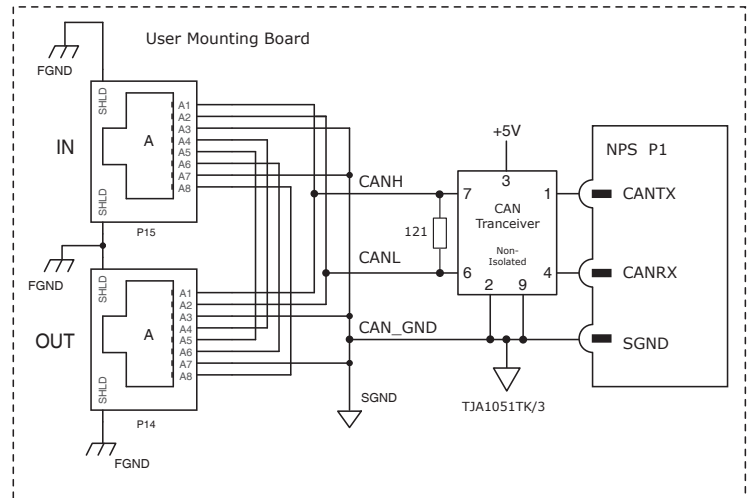
NPS uses the CAN physical layer signals CANH, CANL, and CAN\_GND for connection, and CANopen protocol for communication. Before installing the drive in a CAN system, it must be assigned a CAN Node-ID (address). A maximum of 127 CAN nodes are allowed on a single CAN bus. Up to six digital inputs can be used to produce CAN Node-IDs from 1~63, or the Node-ID can be saved to flash memory in the module. Node-ID 0 is reserved for the CANopen master on the network.

### CANOPEN COMMAND INPUTS

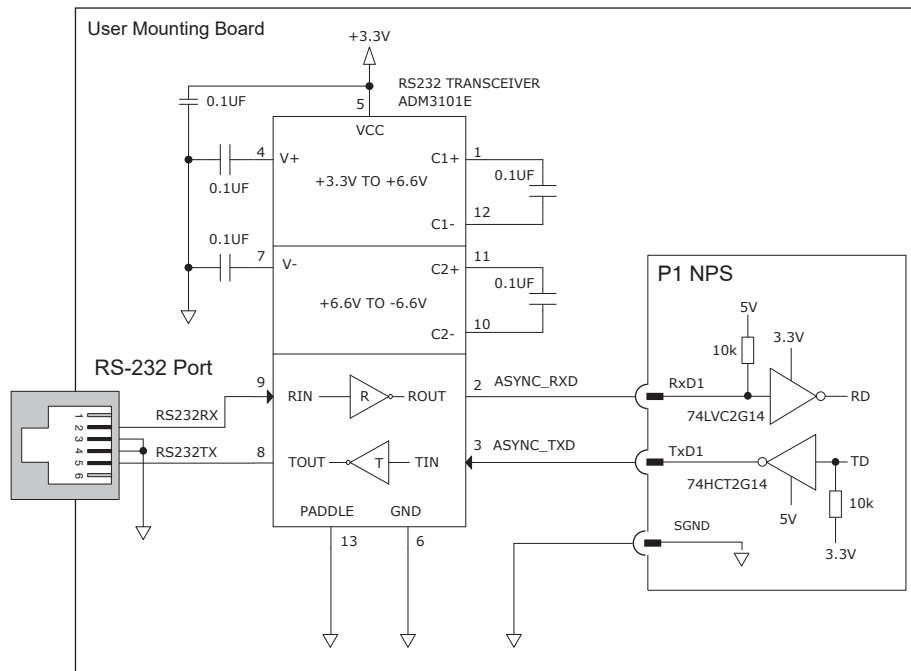
The graphic shows connections between the NPS and RJ-45 connectors on the user mounting board. If the NPS is the last node on a CAN bus, the internal terminator resistor can be used by adding a connection on the PC board as shown. If there are multiple NPS on the mounting PCB then the terminating resistor should be near the NPS that is farthest from the CAN network connection to the PCB. The node Node-ID of the NPS may be set by using digital inputs, or programmed into flash memory in the drive.

**Drive P1**

Signal	Pins
CANTX	36
CANRX	38
SGND	34



## RS-232 COMMUNICATIONS



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

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

**RS-232 Port**

Signal	Pins
RS232RX	2
RS232TX	5
SGND	3,4

**Drive P1**

Signal	Pins
RxD1	30
TxD1	32
SGND	34

## SAFE TORQUE OFF (STO)

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

This provides a positive OFF capability that cannot be overridden by the control firmware, or associated hardware components. When the opto-couplers are energized (current is flowing in the input diodes), the control core will be able to control the on/off state of the PWM outputs to produce torque in the motor.

### INSTALLATION



**Refer to the 16-121699 Copley User Guide for NANO Family**

The information provided in the 16-121699 Copley User Guide for NANO Family must be considered for any application using the drive's STO feature.

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



### STO DISABLE

In order for the PWM outputs of the NPS to be activated, current must be flowing through the opto-couplers that are connected to the STO-IN1 and STO-IN2 terminals and the drive must be in an ENABLED state. When either of the opto-couplers are OFF, the drive is in a Safe Torque Off (STO) state and the PWM outputs cannot be activated by the control core to drive a motor.

This diagram shows connections that will energize both opto-couplers from a +5V source. When this is done the STO feature is disabled and control of the output PWM stage is under control of the digital control core.

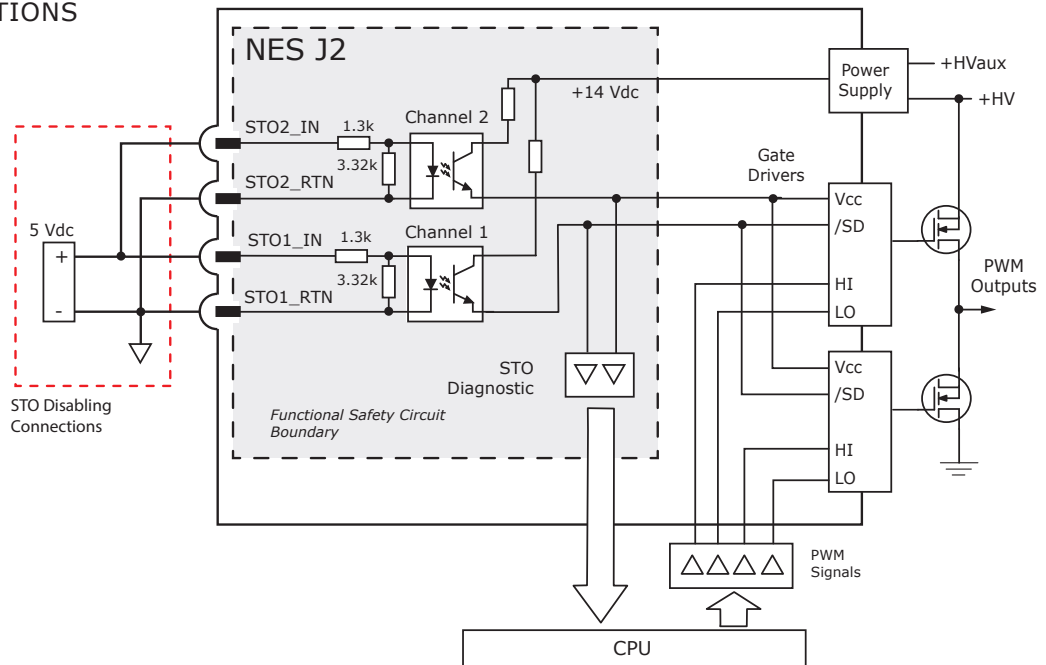
**If not using the STO feature, these connections must be made in order for the drive to be enabled.**

### FUNCTIONAL DIAGRAM

#### STO DISABLE CONNECTIONS



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



#### J2 STO

Name	Pin	Name	
STO_STATUS_OUTPUT	6	5	STO_STATUS_OUTPUT_RTN
STO2_IN	4	3	STO2_RTN
STO1_IN	2	1	STO1_RTN

### STO OPERATION

STO Input Voltage	STO State
STO-IN1 AND STO-IN2 $\geq$ 3.3 Vdc	STO Inactive. Drive can be enabled to produce torque
STO-IN1 OR STO-IN2 $\leq$ 2.0 Vdc	STO Active. Drive cannot be enabled to produce torque
STO-IN1 OR STO-IN2 Open	

Note: Voltages in the table above are referenced between an STOx-IN and an STOx-RTN in J2  
 E.g.  $V(\text{STO1-IN}) = V(\text{STO1-IN1}) - V(\text{STO1-RTN})$

## DIGITAL COMMAND INPUTS: POSITION

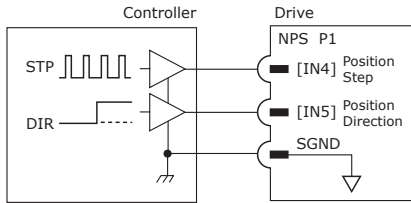
### STAND-ALONE MODE DIGITAL POSITION-CONTROL INPUTS

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

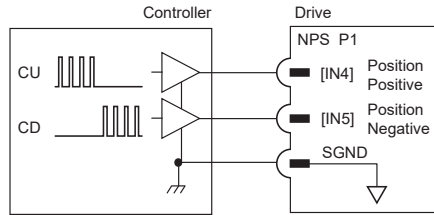
- Step/Direction
- Count-Up/Count-Down (CU/CD)
- A/B Quadrature Encoder

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

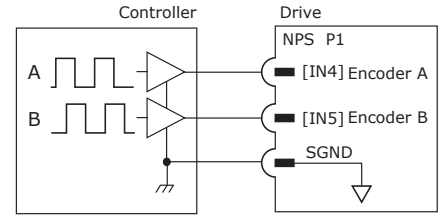
#### STEP/DIRECTION INPUTS



#### COUNT-UP/COUNT-DOWN INPUTS



#### QUAD A/B ENCODER INPUTS



Command Options	Name	P1 Pins
Step, Count Up, Encoder A	IN4	8
Direction, Count Down, Encoder B	IN5	9

P1 SGND Pins
3,4,11,12,33,34,49,50

## DIGITAL COMMAND INPUTS: VELOCITY, TORQUE

### STAND-ALONE MODE DIGITAL VELOCITY-TORQUE INPUTS

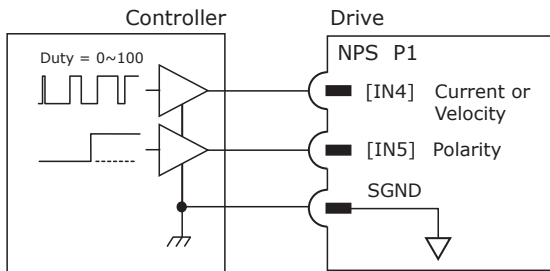
NPS works with motion controllers that output pulses to command Velocity or Torque. These formats are supported:

- Pulse/Direction
- PWM 50%

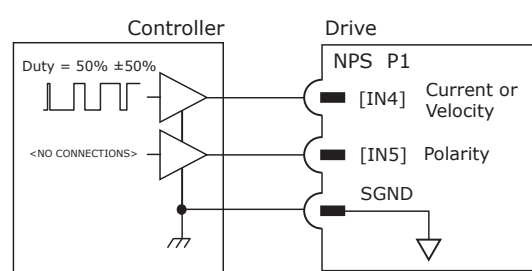
In Pulse/Direction mode, a pulse-train with variable duty cycle on IN4 controls Velocity or Torque from 0~100%. IN5 HI or LO controls the direction of the Velocity or polarity of the Torque.

In 50% PWM mode, a single signal of 50% duty cycle commands 0% Velocity/Torque. Increasing the duty cycle to 100% commands positive Velocity/Torque. Decreasing the duty cycle to 0% commands negative Velocity/Torque.

#### PWM & DIRECTION



#### 50% PWM



Command Options	Name	P1 Pins
PWM Vel/Trk, PWM Vel/Trk & Direction	IN4	8
PWM/Dir Polarity, (none)	IN5	9

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

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

### INPUT LEVEL FUNCTIONS

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

### INPUT TRANSITION FUNCTIONS

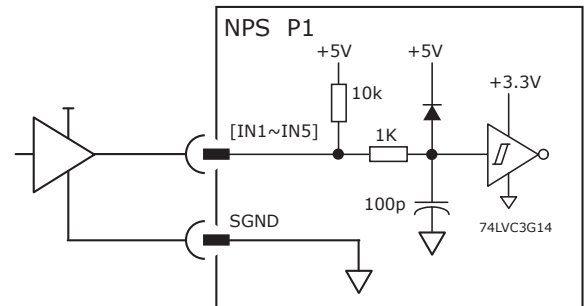
- Clear Faults and Event Latch
- Drive Reset
- PWM Sync Input
- Trajectory Update
- Count Input Edges, Save to Register
- High-Speed Position Capture
- Simulated Absolute Encoder Burst
- Abort Move if > N Counts From Destination in Register

### SPECIFICATIONS

Input	Data	Notes
Input Voltages	HI	$V_{T+} = 1.42 \sim 2.38$ Vdc
	LO	$V_{T-} = 0.68 \sim 1.6$ Vdc
	Hys	$V_H = 0.44 \sim 1.26$
	Max	+12 Vdc
	Min	0 Vdc
Pull-up	R1	10 kΩ
	R2	1 kΩ
Low pass filter	C1	100 pF
	RC	IN1~5: 0.1 μs
		IN6: 33 us

### CONNECTIONS

Signal	P1 Pins
IN1	5
IN2	6
IN3	7
IN4	8
IN5	9



P1 SGND Pins
3,4,11,12,33,34,49,50

**Consult Factory for Adapting 24V logic to 5V logic**

5V logic. Do not exceed 6V. Do not connect a 24V logic to this input.

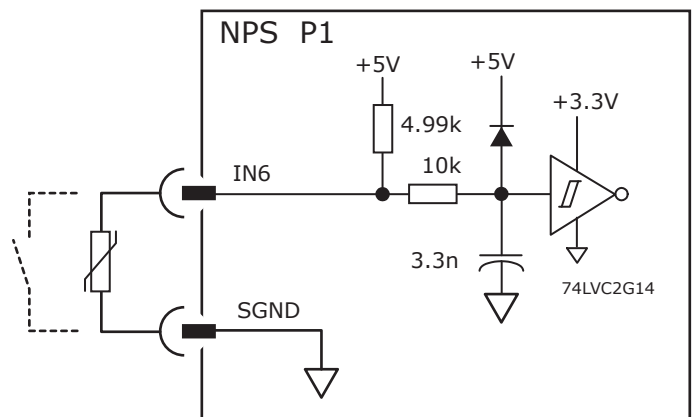
**WARNING**

## MOTOR OVERTEMP INPUT: IN6

Input IN6 has a 33 microsecond rise time RC filter when driven by active sources (CMOS, TTL, etc), with a 4.99 kΩ pullup resistor to +5 VDC. Input IN6 is designed to interface with an industry standard PTC thermistor IAW BS 49990111(1987) for built-in thermal protection of the motor as a default. If not used for the Motemp function, IN6 can be re-programmed for other input functions.

### CONNECTIONS

Signal	P1 Pins
IN6	10



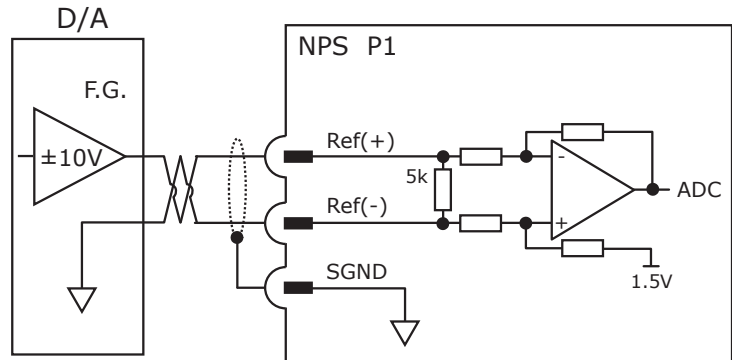
## ANALOG INPUT: AIN1

As a reference input it takes Position/Velocity/Torque commands from a controller. If not used as a command input, it can be used as general-purpose analog input.

### SPECIFICATIONS

Spec	Data	Notes
Input Voltage	Vref	±10 Vdc
Input Resistance	Rin	5.0 kΩ

Signal	P1 Pins
Ref(+)	2
Ref(-)	1



## DIGITAL OUTPUTS: OUT1~OUT4

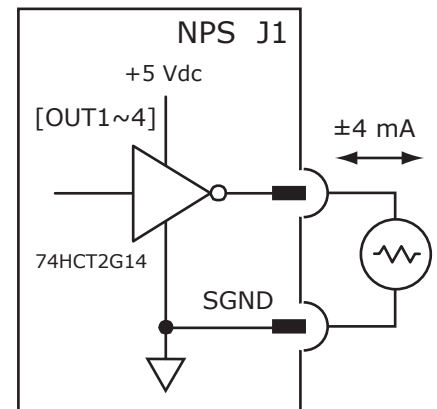
Digital outputs [OUT1~4] are CMOS inverters. They operate from +5V and can source/sink ±4 mA. The output functions shown below are programmable to turn the output ON (HI) or OFF (LO) when active.

### OUTPUT FUNCTIONS

- Fault
- Custom event
- PWM Sync
- Custom Trajectory status
- Custom position-triggered output
- Program control
- Brake control (see below)

Signal	P1 Pins
OUT1	13
OUT2	14
OUT3	15
OUT4	16

P1 SGND Pins
3,4,11,12,33,34,49,50



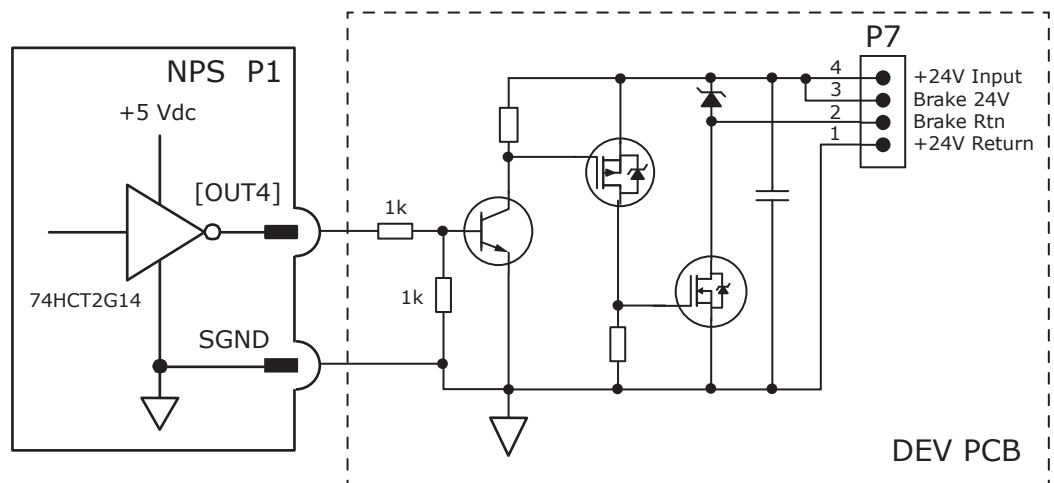
## BRAKE OUTPUT: OUT4

The default function of OUT4 is control of a motor holding brake using the NPS-D board that has components to sink the higher current of the brake. If not used for brake control it can be programmed as a logic output.

### OUTPUT FUNCTION

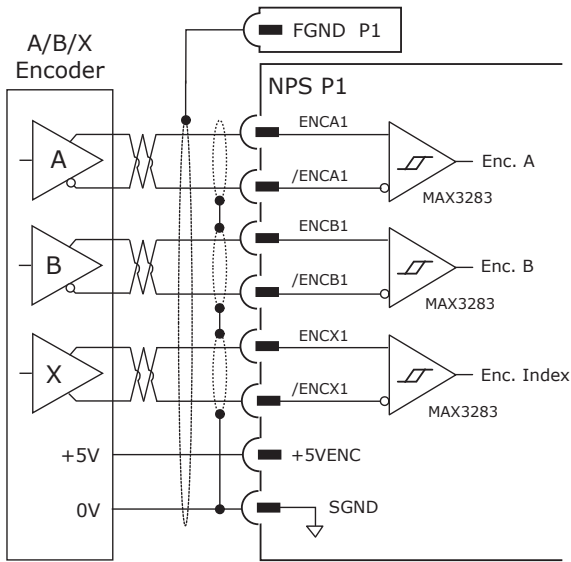
- Motor holding brake when NPS is mounted to an DEV PCB.
- Same functions as OUT1~OUT3 if drive is used without DEV PCB

Signal	P1 Pins
OUT4	16



## ENCODER 1 (PRIMARY FEEDBACK)

### QUAD ENCODER WITH INDEX



### A/B/X SIGNALS

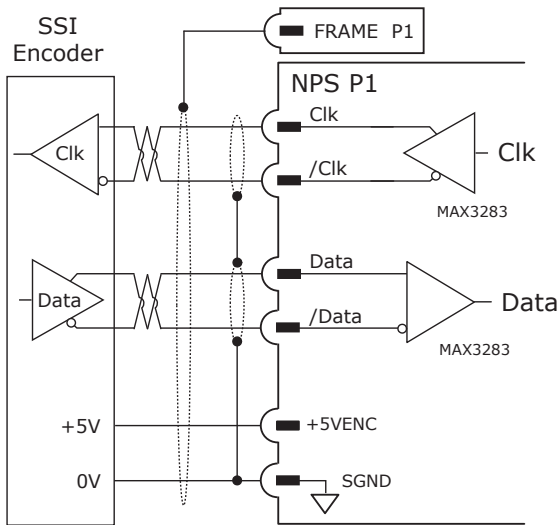
Signal	P1 Pins
ENCA1	43
/ENCA1	44
ENCB1	45
/ENCB1	46
ENCX1	47
/ENCX1	48
+5VENC	57,59

FRAME GROUND
P1

P1 SGND Pins
3,4,11,12,33,34,49,50

### SSI ABSOLUTE ENCODER

The SSI (Synchronous Serial Interface) is an interface used to connect an absolute position encoder to a motion controller or control system. The NPS drive provides a train of clock signals in differential format to the encoder which initiates the transmission of the position data on the subsequent clock pulses. The number of encoder data bits and counts per motor revolution are programmable. The hardware bus consists of two signals: SCLK and SDATA. The SCLK signal is only active during transfers. Data is clocked in on the falling edge of the clock signal.



### BiSS-C ABSOLUTE ENCODER

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

Serial Synchronous Data Communication

Cyclic at high speed

2 unidirectional lines Clock and Data

Line delay compensation for high speed data transfer

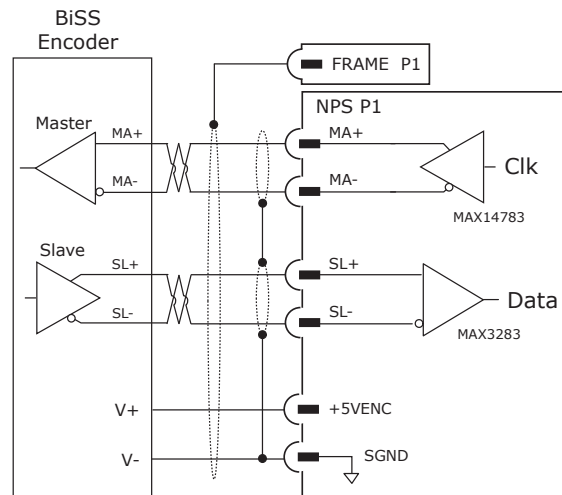
Request for data generation at slaves

Safety capable: CRC, Errors, Warnings

Bus capability incl. actuators

Bidirectional

BiSS C-protocol: Continuous mode



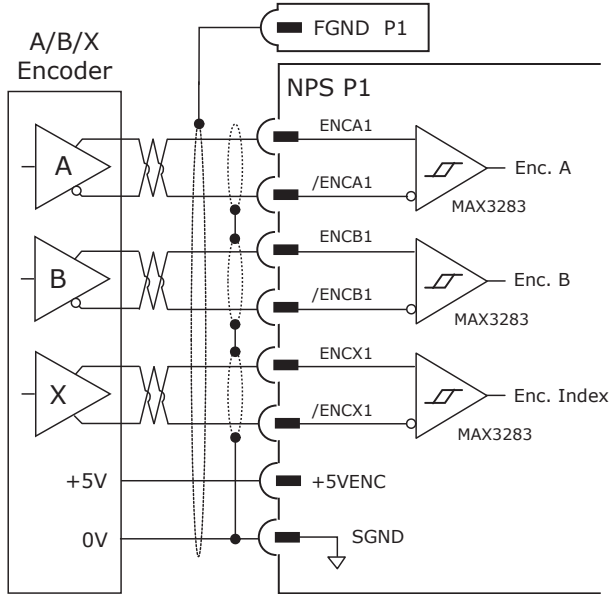
### SSI, BiSS SIGNALS

SSI	BiSS	P1 Pins
Clk	MA+	47
/Clk	MA-	48
Data	SL+	43
/Data	SL-	44
+5V		57,58

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

## ENCODER 2: SECONDARY FEEDBACK

### QUAD ENCODER WITH INDEX



### A/B/X SIGNALS

Signal	P1 Pins
ENCA2	51
/ENCA2	52
ENCB2	53
/ENCB2	54
ENCX2	55
/ENCX2	56
+5VENC	57,59

### FRAME GROUND

P1

### P1 SGND Pins

3,4,11,12,33,34,49,50

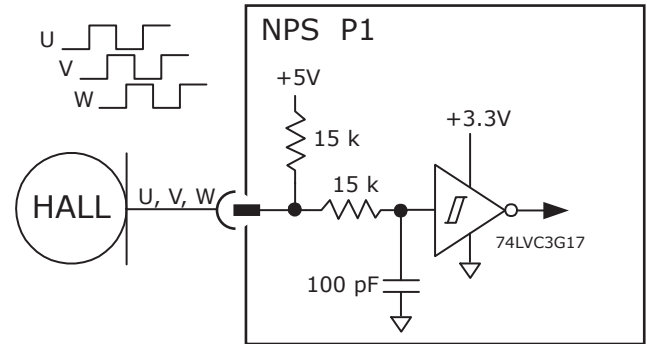
## OTHER MOTOR CONNECTIONS

### HALLS

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

### HALL SIGNALS

Signal	P1 Pins
HALLU	39
HALLV	40
HALLW	41



## DC OUTPUT VOLTAGES

### +5VENC

This voltage is for encoders and has internal fault protection. The maximum current output is 500 mA shared between encoders. Current limiting occurs at 600 mA minimum, 1.0 A maximum

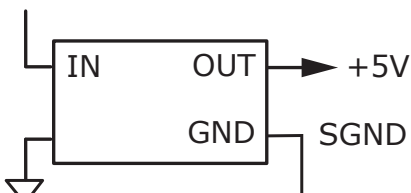
### +5V

This voltage is for optional peripherals immediately adjacent to the module and has internal fault protection. The maximum current output is 150 mA.

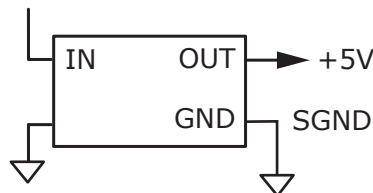
### +3.3 VDC

For connections immediately adjacent to the module: Microcontroller, RS-232 Transceiver, CAN Transceiver, LEDs, and Address Switches. 150 mA maximum. Protected for overload or shorts.

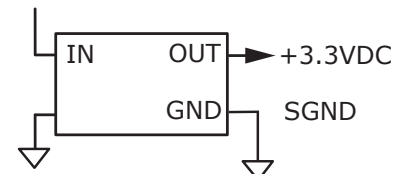
### VLOGIC



### VLOGIC



### VLOGIC



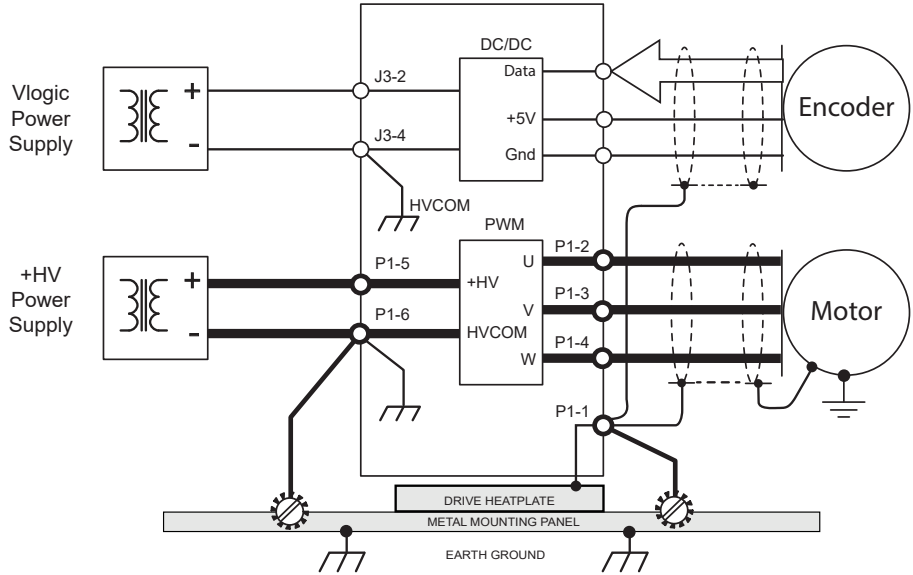
## +HV CONNECTIONS

### 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 P5 and P6. 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.

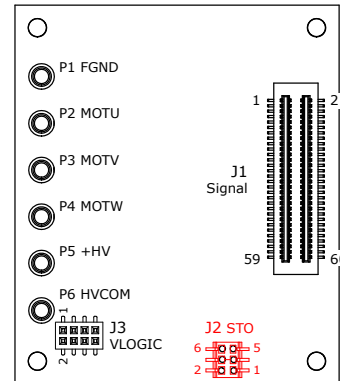
### GROUNDING

A P6 connection to ground keeps the +HV power source stable at the drive while the voltage at the power supply (-) varies due to the cable resistance and the +HV current. Grounding at P1 provides a PE (Protective Earth) connection as well as a point to ground the motor cable shields.



### P1~P6

Signal	Pins
FGND	P1
MOTU	P2
MOTV	P3
MOTW	P4
+HV	P5
HVCOM	P6



Top-view looking into the DEV mother-board ---->

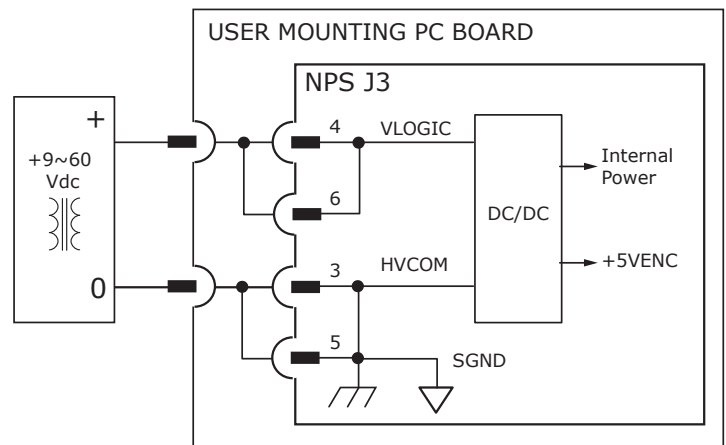
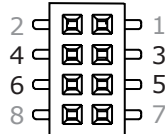
## VLOGIC CONNECTIONS

### DESCRIPTION

VLOGIC is required for operation of the drive. It powers the internal logic and control circuits. Encoder +5V is derived from VLOGIC. When using the STO feature, VLOGIC must be produced by power supplies with transformer isolation from the mains and PELV or SELV ratings and a maximum output voltage of 60 Vdc. If the motor can operate from voltages of 60 Vdc or less, the +HV and VLOGIC can be driven from a single power supply.

### J3 VLOGIC

Name	Pin	Name
n.c.	2	1 n.c.
VLOGIC	4	3 HVCOM
VLOGIC	6	5 HVCOM
n.c.	8	7 n.c.

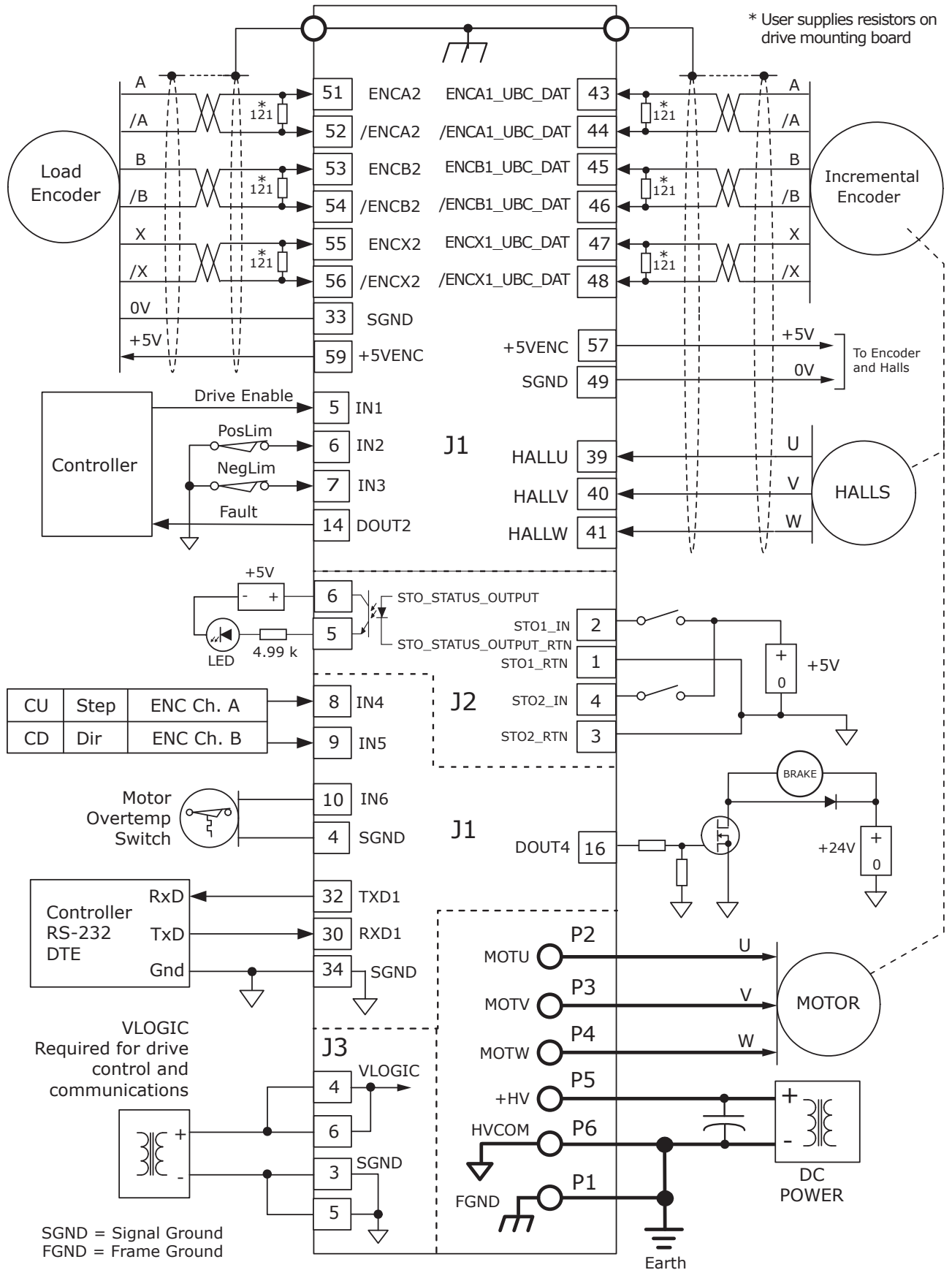


**WARNING**

**Refer to the 16-125661 AN136 Accelnet External Regen Application Note**

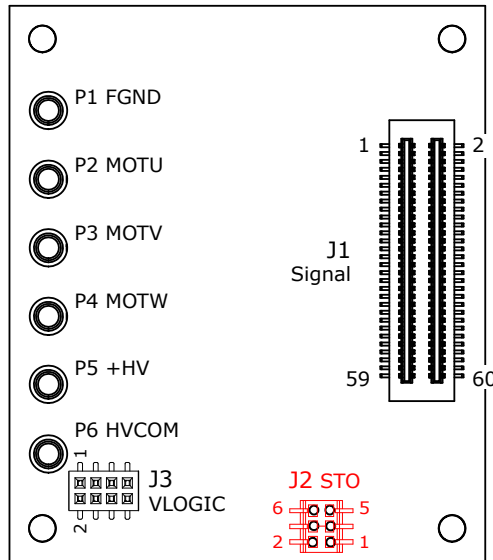
VLOGIC +9~60. 24V power is recommended. 24V required if using 24V BRAKE. If common to HV do not exceed 60V, use REGEN protection, and diode isolation from HV.

## NPS TYPICAL CONNECTIONS

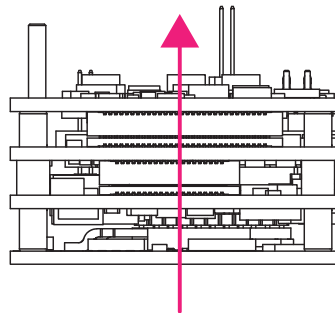


## PC BOARD CONNECTIONS

Name	Pin
FGND	P1
Mot U	P2
Mot V	P3
Mot W	P4
+HV	P5
HVCOM	P6



This page shows the pins and signals looking down on a user PC board.



### J3 VLOGIC

Name	Pin	Name
N.C.	2	1
VLOGIC	4	3
	6	5
N.C.	8	7

### J2 STO

Name	Pin	Name
STO_STATUS_OUTPUT	6	5
STO2_IN	4	3
STO1_IN	2	1

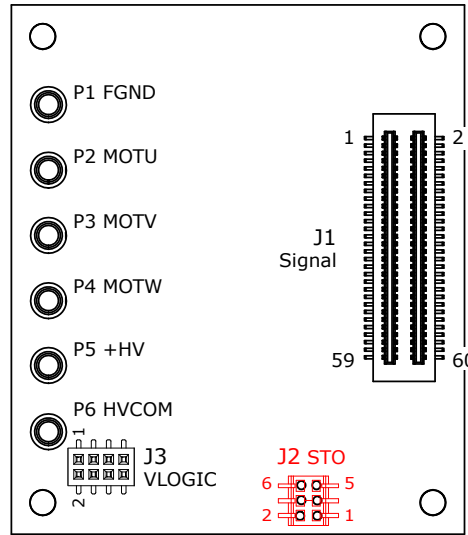
### J1 SIGNAL

Name	Pin	Name
REFIN1-	1	2
N.C.	3	4
[ENABLE] IN1	5	6
IN3	7	8
IN5	9	10
SGND	11	12
DOUT1	13	14
DOUT3	15	16
SGND	17	18
N.C.	19	20
N.C.	21	22
N.C.	23	24
N.C.	25	26
N.C.	27	28
N.C.	29	30
SGND	31	32
SGND	33	34
ASYNC_RXD2	35	36
ASYNC_TXD2	37	38
HALLU	39	40
HALLW	41	42
ENCA1_UBC_DAT	43	44
ENCB1	45	46
ENCX1_UBC_CLK	47	48
SGND	49	50
ENCA2	51	52
ENCB2	53	54
ENCX2	55	56
+5VENC	57	58
+5VENC	59	60

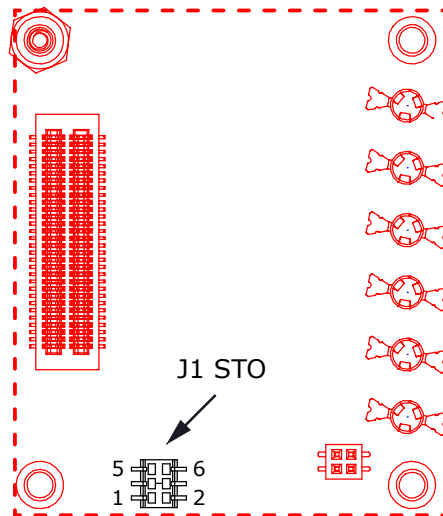
N.C. = No Connection

NOTE:  
THE STO CONNECTOR J2  
IS MOUNTED ON THE BOTTOM  
SIDE OF THE PCB

## PC BOARD CONNECTORS



Module  
PC Board  
TOP VIEW



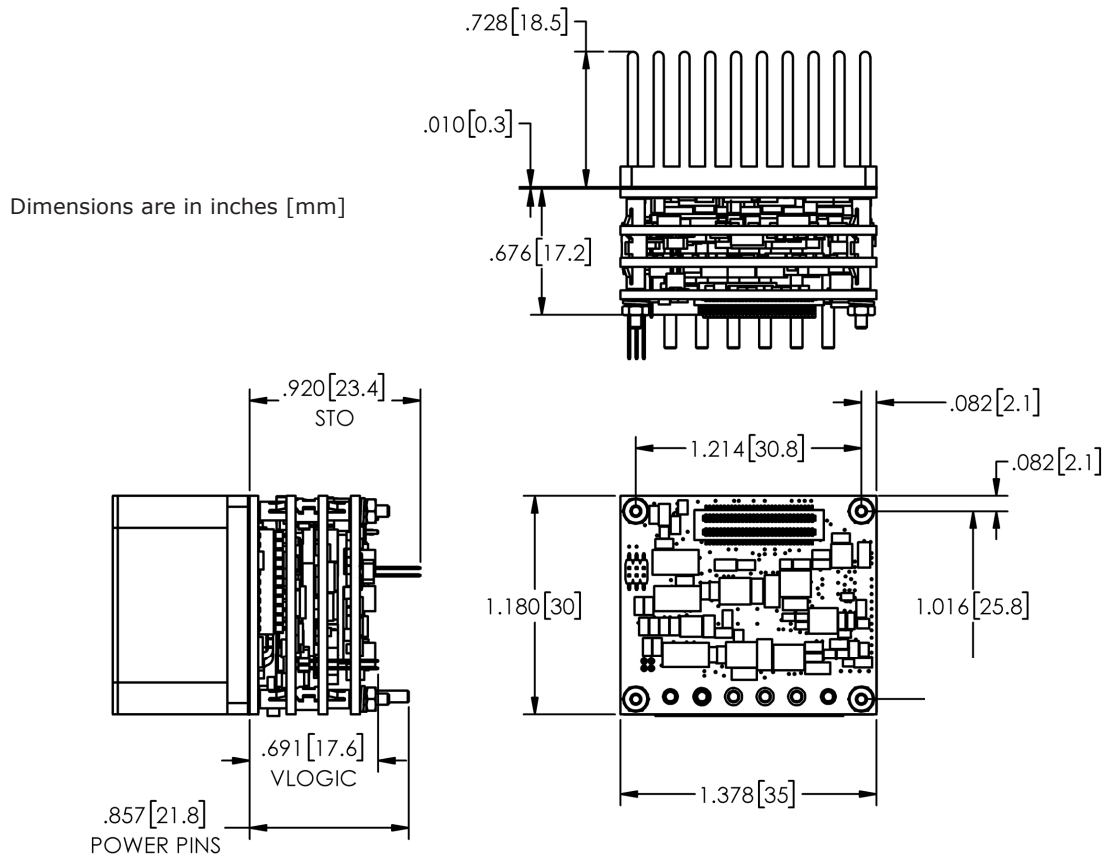
Module  
PC Board  
BOTTOM VIEW

Ref Des	Label	Mfgr	Part Number *	Description	Qty
P1	Signal	WCON	3620-S060-022G3R02	Header, 60 pos, 0.5 mm pitch	1
J2	STO	Samtec	CLM-103-02-L-D-BE	Header, 6 pos, 1 mm pitch	1
J3	VLOGIC	WCON	2521-202MG3CUNR1	Header, 4 pos, 1 mm pitch	1
P1~P6	+HV, Motor	WINPIN	WP-WJ018G3R1	RCPTL Outer Sleeve Crown Spring	6

\* To purchase reels of these components please contact approved value-added partner Action Electronics.

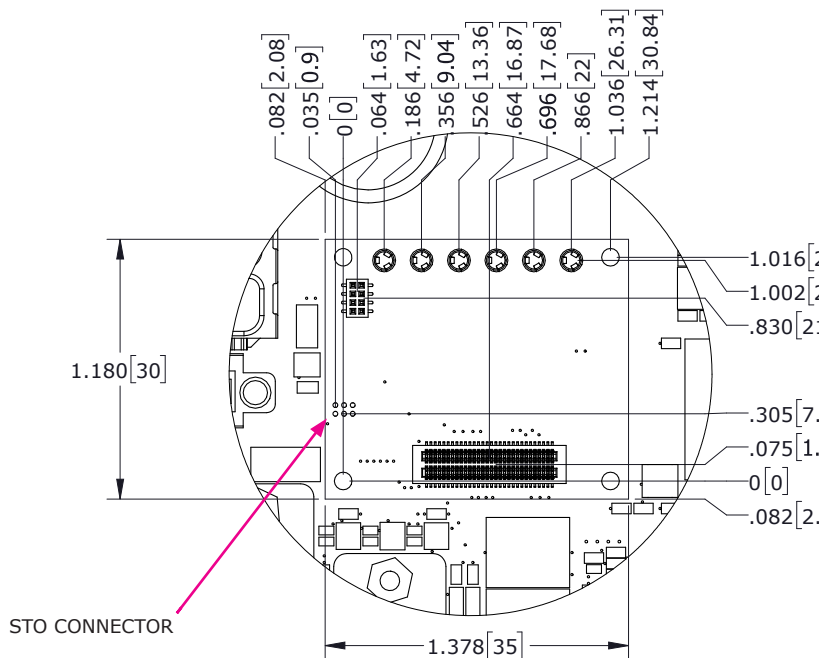
Action Electronics, Inc.  
Walpole, MA 02081-2522-US  
Phone: (508) 668-5621

**DIMENSIONS**



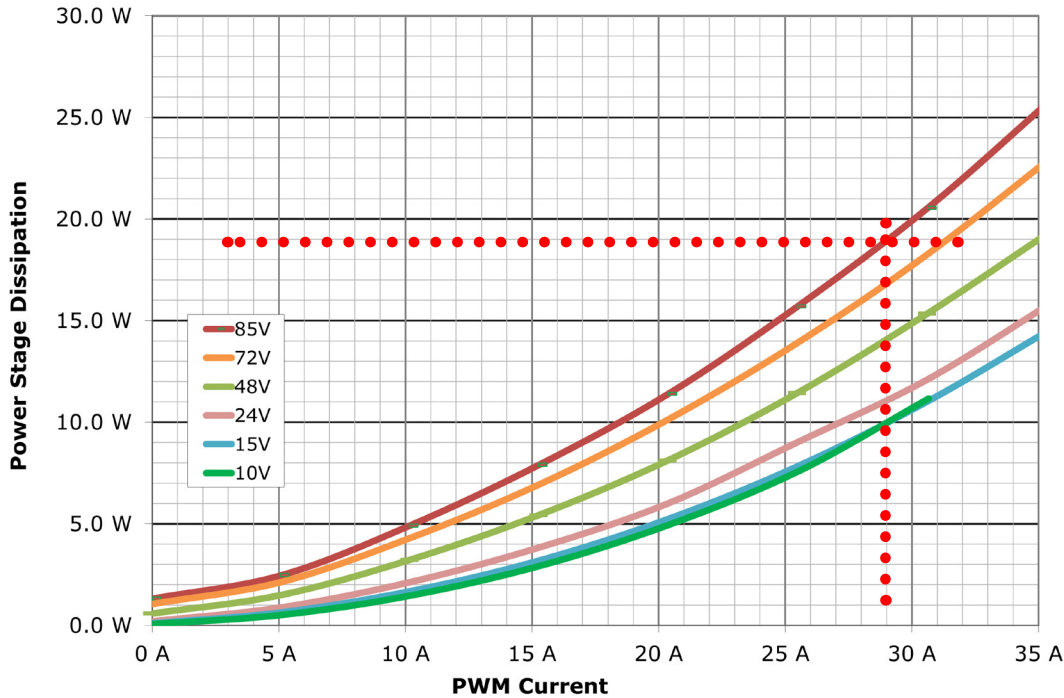
**PC BOARD MOUNTING DIMENSIONS**

Looking down on the mounting PC board for the drive. The STO connector is mounted on the underside of the PC board.

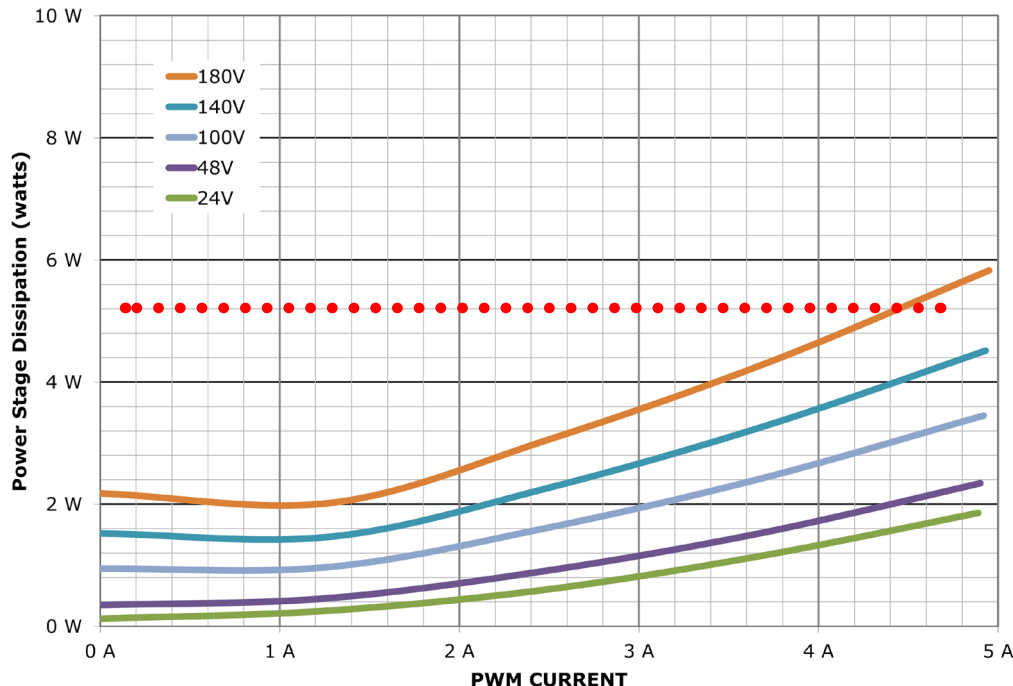


**THERMALS: PWM OUTPUTS DISSIPATION**

**NPS-090-70** This chart shows the power dissipation in the drive when the PWM outputs are driving a motor. Adding the PWM dissipation to the Vlogic dissipation will yield the total dissipation in Watts for the drive. The dotted lines in the chart show a dissipation of 18 W. at a continuous current of 28 Adc and +HV = 85 Vdc.

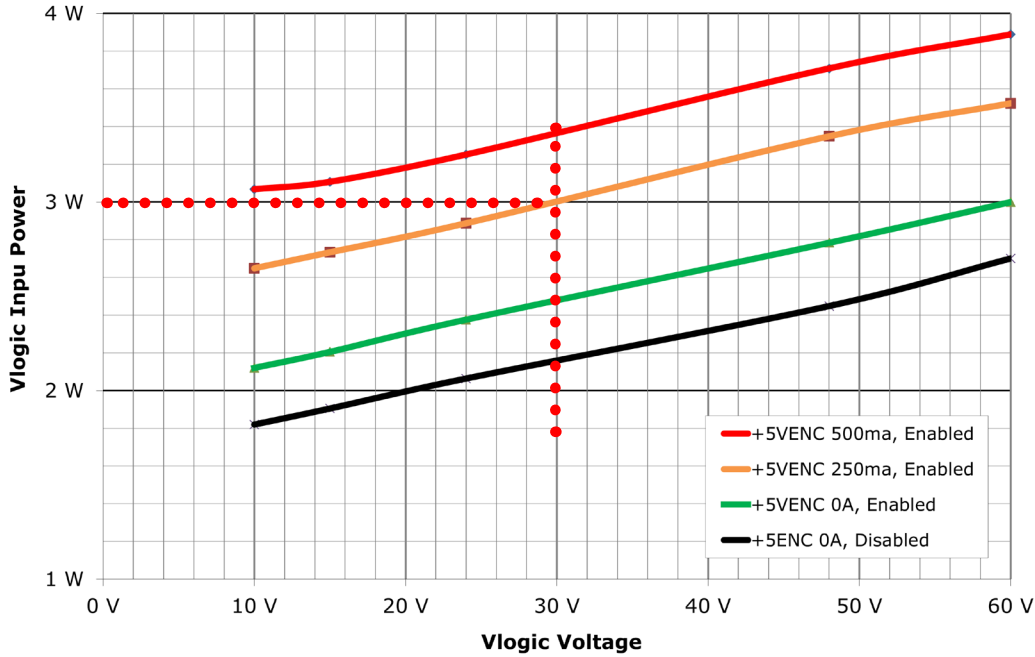


**NES-180-10** This chart shows the power dissipation in the drive when the PWM outputs are driving a motor. Adding the PWM dissipation to the Vlogic dissipation will yield the total dissipation in Watts for the drive. The dotted lines in the chart show a dissipation of 5.2 W. at a continuous current of 4.4 Adc and +HV = 180 Vdc.



## THERMALS: VLOGIC & ENCODER +5V OUTPUT DISSIPATION

**NPS All Models** This chart shows the power dissipation in the Vlogic circuits that power the drives control circuits and external encoders. Adding the PWM dissipation to the Vlogic dissipation will yield the total dissipation in Watts for the drive. The dotted lines in the chart show a dissipation of 3.0 W. at Vlogic = 30 Vdc when the drive is in an Enabled state and outputting 250 mA for an encoder.



**THERMAL RESISTANCE**

These tables show the thermal resistance Rth in degrees-C per Watt (C/W) for typical mounting and cooling configurations. The drive has the standard "pins" heatsink mounted with a sheet of thermal material between drive and heatsink. LFM is Linear Feet per Minute, the velocity of air flow produced by a fan directed in line with the heatsink fins.

**HEATSINK**

LFM	0	100	200	300	400
Rth	5.3	3	2.5	1.6	1.3

**FIND COOLING MEANS WITH DISSIPATION AND AMBIENT TEMPERATURE KNOWN**

Given: Tamb = 32 °C (89.6 °F), PWM dissipation = 18 W, VLOGIC dissipation = 3 W  
 Tmax = 80 °C (drive shut-down temperature)

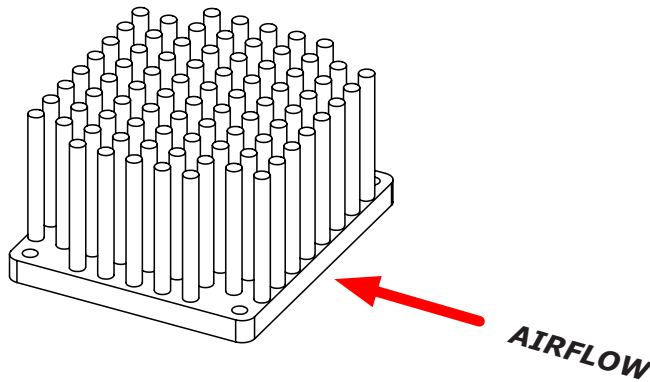
Find: Thermal resistance Rth:  
 Delta-T = Tmax - Tamb = 80 - 32 = 48 °C  
 Total dissipation = 18 + 3 = 21 W  
 Rth = Delta-T / dissipation = °C / Watt = 48 / 21 = 2.3 °C/W

From the tables above, there are two configurations that provide Rth less than 2.3 °C/W:  
 With heat sink, forced air at 300, 400 LFM

**FIND MAX AMBIENT TEMP WHEN DRIVE CONFIGURATION IS KNOWN**

Given: Heatsink, forced-air at 300 LFM, dissipation is 26.5 W  
 Rth = 1.6 °C/W  
 Tmax = 80 °C (drive shut-down temperature)

Find: Max ambient operating temperature  
 Delta-T = 26.5 W x 0.9 °C/W = 23.9 °C  
 Max Tamb = Tmax - Delta-T = 80 - 23.9 = 56.1 °C  
 Max ambient operating temperature is 45 °C so it can operate up to this temperature



**NPS-DEV**

MODEL	Ic	Ip	Vdc
NPS-090-10-D	5	10	9~90
NPS-090-70-D	35	70	9~90
NPS-180-10-D	5	10	20~180
NPS-180-30-D	15	30	20~180

**J4 +HV**

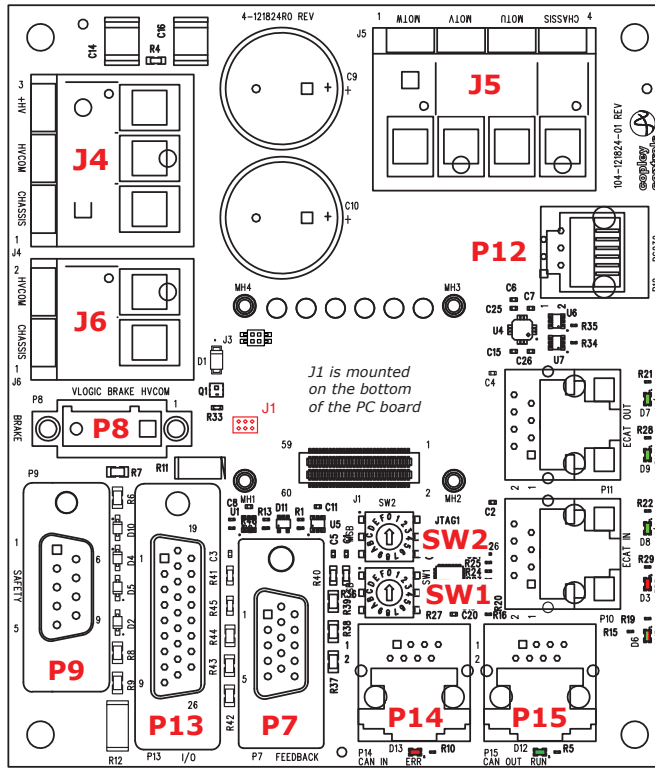
Signal	Pin
+HV	3
HVCOM	2
FGND	1

**J6 GROUNDS**

Signal	Pin
HVCOM	2
FGND	1

**P8 BRAKE**

Signal	Pin
24V_GND_IN	1
BRAKE	2
VLOGIC	3
VLOGIC	4



**J5 MOTOR**

Pin	Signal
1	MOTW
2	MOTV
3	MOTU
4	FGND

**P12 RS-232**

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

**P14 CAN**

Pin	Signal
1	CANH
2	CANL
3	SGND
4	*
5	*
6	*
7	SGND
8	*

**P15 CAN**

Pin	Signal
1	CANH
2	CANL
3	SGND
4	*
5	*
6	*
7	SGND
8	*

\* These pins are feed-through between P14 & P15. They have no internal connections.

**P9 STO**

Signal	Pin	Signal
FGND	1	6
STO1_24V_IN	2	7
STO1_RTN	3	8
STO2_24V_IN	4	9
STO2_RTN	5	

**P13 I/O & ENCODER 2**

Pin	Signal	Pin	Signal	Pin	Signal
1	FGND	10	IN5	19	SGND
2	REFIN1-	11	n.c.	20	+5VENC
3	REFIN1+	12	n.c.	21	/ENCX2
4	IN1_24VTOL	13	n.c.	22	ENCX2
5	IN2_24VTOL	14	n.c.	23	/ENCB2
6	IN3_24VTOL	15	SGND	24	ENCB2
7	IN4	16	DOUT1	25	/ENCA2
8	n.c.	17	DOUT2	26	ENCA2
9	n.c.	18	DOUT3		

**P7 ENCODER 1**

Pin	Signal	Pin	Signal	Pin	Signal
1	FGND	6	HALLV	11	/ENCB1
2	+5VENC	7	/ENCX1_UBC_CLK	12	ENCB1
3	HALLU	8	ENCX1_UBC_CLK	13	/ENCA1_UBC_DAT
4	+5VENC	9	HALLW	14	ENCA1_UBC_DAT
5	SGND	10	OVERTEMP_IN	15	SGND

## NPS-DEV CAN CONNECTORS

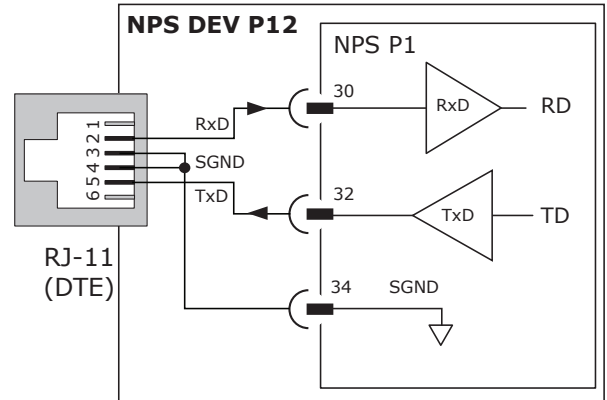
### CANOPEN CONNECTORS

Dual RJ-45 connectors that accept standard Ethernet cables are provided for CAN bus connectivity. Pins are wired-through so that drives can be daisy-chained and controlled with a single connection to the user's CAN interface. A 120 Ω CAN terminator should be placed in the last drive in the chain. The XTL-NT is a 121 ohm resistor in a male modular connector. This provides an easy way to terminate the last drive in a CAN network.

### P14-P15 CAN CONNECTORS

P14 CAN		P15 CAN	
Pin	Signal	Pin	Signal
1	CANH	1	CANH
2	CANL	2	CANL
3	CANGND	3	CANGND
4	*	4	*
5	*	5	*
6	*	6	*
7	*	7	*
8	*	8	*

\* These pins have no internal connections and feed-through for each pin.



### RS-232 CONNECTION

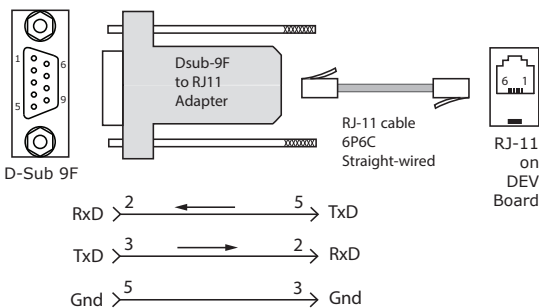
The RS-232 port is used to configure the drive for stand-alone applications, or for configuration before it is installed into an CANOpen network. CME software communicates with the drive over this link and is then used for complete drive setup. The CANOpen Device ID that is set by the rotary switches can be monitored, and a Device ID programmed as well. The RS-232 connector, P12, 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.

### P12 DEV RS-232

Pin	Signal
2	RS232RX1 [RxD]
3,4	SGND
5	RS232TX1 [TxD]

### SER-CK SERIAL CABLE KIT

The SER-CK provides connectivity between a D-Sub 9 male connector and the RJ-11 connector P12 on the NPS-D. It includes an adaptor that plugs into the COM1 (or other) port of a PC and uses a straight-through modular cable to connect to the NPS. The connections are shown in the diagram below.



### SER-USB-RJ11

This provides connectivity between a USB connector and the RJ-11 connector P12 on the NPS-D.



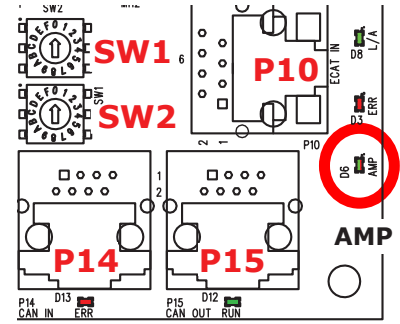
Don't forget to order a SER-USB-RJ11 when placing your order for an NPS drive with the NPS-D.

## NPS-DEV

### AMP STATUS LED

A bi-color LED "AMP" gives the state of the drive. Colors do not alternate, and can be solid ON or blinking. If multiple conditions occur, only the top-most condition will be displayed. When that condition is cleared the next one below will shown.

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



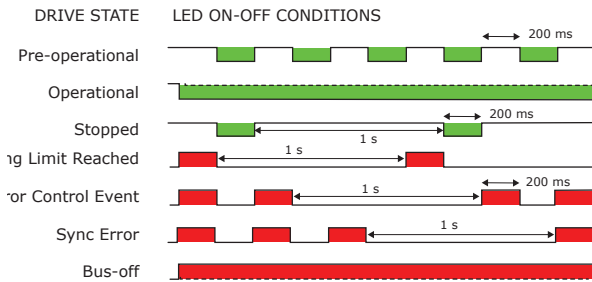
### LATCHING FAULTS

DEFAULT	OPTIONAL (PROGRAMMABLE)
Short circuit (Internal or external)	Over-voltage
Drive over-temperature	Under-voltage
Motor over-temperature	Motor Phasing Error
Feedback Error	Command Input Lost
Following Error	Motor Wiring Disconnected
STO Active	Over Current (latched)

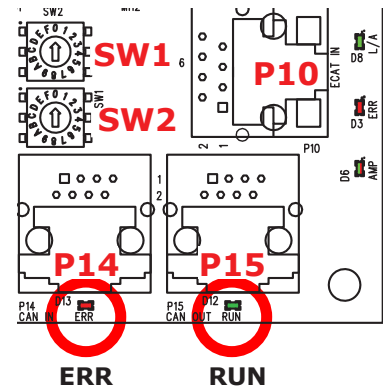
## CAN BUS COMMUNICATIONS

### CAN LEDS

The green LED "RUN" shows the state of the CAN state machine. The red LED "ERR" shows the status of the CAN physical layer and errors due to missing messages.



Green = RUN, Red = ERR

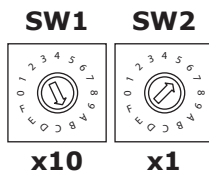


### CAN DEVICE ID

Drives operating on a CANopen system must have a Device ID set either through programming or through inputs or switches located on the Dev board. In the NPS-D this is provided by two 16-position rotary switches with hexadecimal encoding. These can set the Device ID of the drive from 0x01~0x7F (1~127 decimal). The chart shows the decimal values of the hex settings of each switch.

Example 1: Find the switch settings for decimal Device ID 107:

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



CAN Device ID Switch Decimal values

HEX	SW1	SW2
	DEC	
0	0	0
1	16	1
2	32	2
3	48	3
4	64	4
5	80	5
6	96	6
7	112	7
8		8
9		9
A		10
B		11
C		12
D		13
E		14
F		15

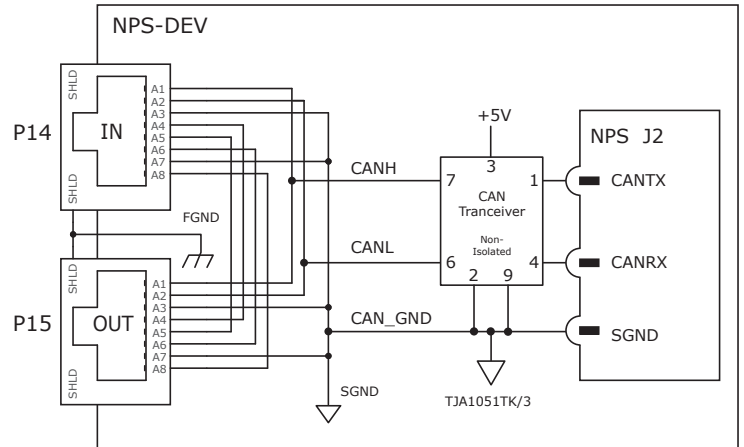
NPS-DEV CANOPEN CONNECTORS

CAN CONNECTORS

Dual RJ-45 connectors that accept standard Ethernet CAT-5 cables are provided for CANopen connectivity. If there are multiple NPS drives with NPS-D in the system. The 121 ohm terminator should only be placed on the last drive in the chain.

P14 CAN-IN		P15 CAN-OUT	
Pin	Signal	Pin	Signal
A1	CANH	A1	CANH
A2	CANL	A2	CANL
A3	SGND	A3	SGND
A4	*	A4	*
A5	*	A5	*
A6	*	A6	*
A7	SGND	A7	SGND
A8	*	A8	*

\* These pins are feed-through between P14 & P15. They have no internal connections.



NPS-DEV SAFE TORQUE OFF (STO)

DESCRIPTION

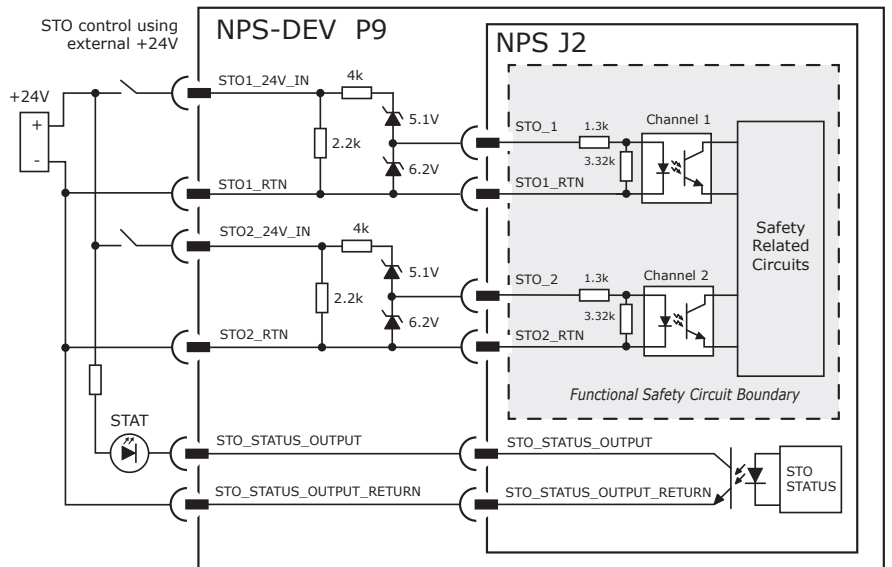
This shows the use of external 24V to energize the STO inputs. Both STO inputs must be energized in order to enable the drive. IN1, the hardware Enable input is for use with an immediate contact relay to bring the motor to a stop before a delayed contact relay de-energizes the STO inputs and prevents torque production in the motor.

STAT-OUT Operation

STO1	0	1	0	1
STO2	0	0	1	1
STAT	0	0	0	1

P9 STO

Signal	Pin	Signal
FGND	1	STO_STATUS_OUTPUT
STO1_24V_IN	2	STO_STATUS_OUTPUT_RETURN
STO1_RTN	3	SGND
STO2_24V_IN	4	VLOGIC
STO2-RTN	5	



In this table, STO1 & STO2 rows, 1 = 24V has been applied between the IN-24V and RTN. 0 = open-circuit.

In the STAT row, 1 = the optocoupler is ON, 0 = the optocoupler is OFF.

STAT output is ON (True) when both STO1 & STO2 are energized, allowing the drive to be enabled and to produce torque.

STO OPERATION

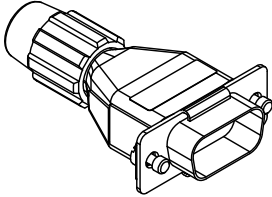
STO Input Voltage	STO State
STO1-IN-24V AND STO2-IN-24V ≥ 16 Vdc	STO Inactive. Drive can be enabled to produce torque
STO1-IN-24V OR STO2-IN-24V < 16 Vdc	STO Active. Drive cannot be enabled to produce torque
STO1-IN OR STO2-IN Open	

Note: Voltages in the table above are referenced between an STOx-IN and an STOx-RTN in P2  
 E.g.  $V(\text{STO1-IN}) = V(\text{STO1-24V-IN1}) - V(\text{STO1-RTN})$

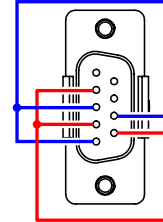
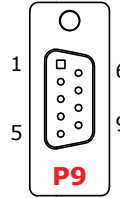
## NPS-DEV SAFE TORQUE OFF (STO) BYPASS

Bypassing is for users who don't want to use the STO function. The STO-CK-04 has jumpers that use the VLOGIC to energize the STO inputs. This disables the STO function, allowing the drive to be enabled from hardware inputs or a network.

### STO-CK-04



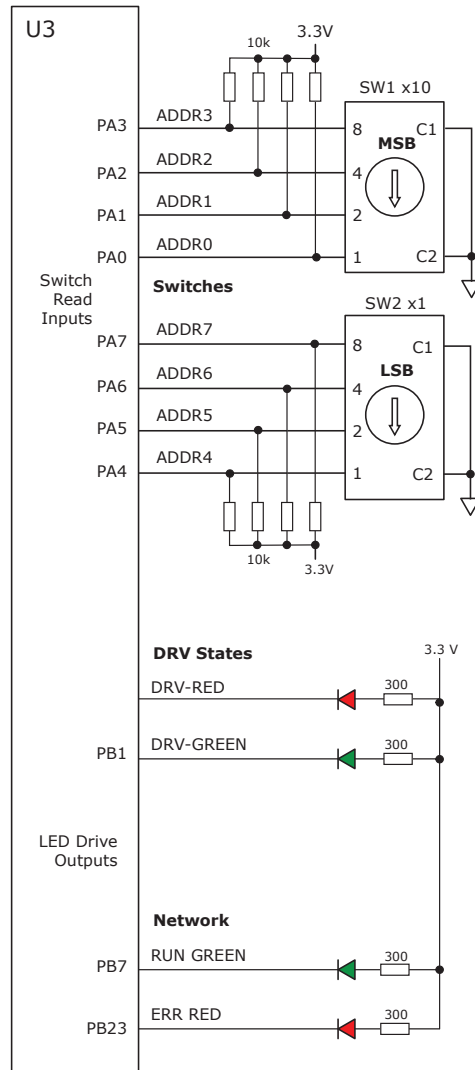
**WIRING**  
 Red (VLOGIC): 2,4,9  
 Blu (SGND): 3,5,8



## NPS-DEV SWITCHES & LEDS

### CAN DEVICE ID SWITCH CONNECTIONS & LEDS

The graphic below shows the connections to the CAN Device ID switches and status LEDs. The switches are read after the drive is reset, or powered-on. When changing the settings of the switches, be sure to either reset the drive, or to power it off-on.



## NPS-DEV +HV, VLOGIC, & MOTOR CONNECTIONS

### J4 +HV

The +HV power supply connects to J4 pins 2 & 3. The shield shown is optional and is primarily for reduction of RF emissions from the drive. As shown it connects to the case of the power supply. Note that the minus terminal is not grounded externally. This is because currents in the cables produce voltage drops. Grounding the supply at the drive ensures that such voltage drops do not appear in the drive circuits.

### J5 MOTOR

Pins 1~3 are for the motor windings. Pin 4 is for a cable shield. It connects to the drive heatplate on one end and should connect to the motor frame on the other. This provides a return path for currents produced by the PWM outputs and the capacitance between the cable conductors, motor windings, and motor frame. While the frame is commonly grounded by mounting to equipment, without the shield connections the PWM shield current could flow into external devices.

### P8 VLOGIC

Powers the internal logic and control circuits in the drive. When using the STO feature, it must be produced by power supplies with transformer isolation from the mains and PELV or SELV ratings and a maximum output voltage of 60 Vdc. If the motor can operate from voltages of 60 Vdc or less, the +HV and VLOGIC can be driven from a single power supply. P8 also is the connection point for a motor holding brake. These connect to pins 2 & 3 and is not shown here because it is not part of the power & motor connections.

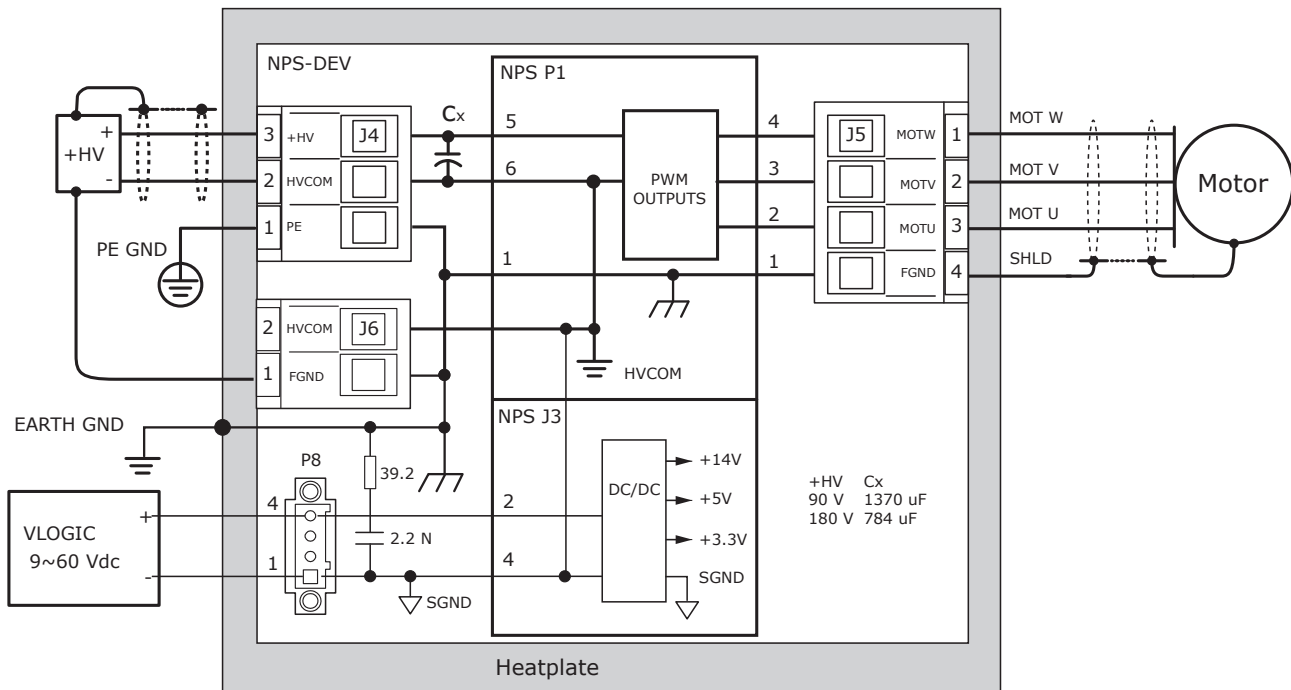
### GROUNDING

PE GND is a Protective Earth ground which is the zero-volt reference for voltages used in the drive and is also the connection point for fault currents that might flow from any failures in the drive that could expose a user to an electric shock.

FGND, Frame Ground is referenced to the drive heatplate and has no connections to any circuits in the drive. Internal connections from the heatplate to J4, J5, and J6 enable cabling for grounding and shielding.

HVCOM, High-Voltage-Common is the 0V or 'ground' circuit for the high voltage circuits that drive the motor.

SGND, Signal Ground is the 0V circuit for low power control and interface circuits. It is connected to HVCOM internally so that all internal circuits have a common "0V" connection.



#### J4 +HV

Pin	Signal
3	+HV
2	HVCOM
1	FGND

#### J6 GROUNDS

Pin	Signal
2	HVCOM
1	FGND

#### P8 VLOGIC & BRAKE

Pin	Signal
4	VLOGIC input
3	VLOGIC to brake
2	Brake
1	HVCOM

#### J5 MOTOR

Pin	Signal
1	MOTW
2	MOTV
3	MOTU
4	FGND



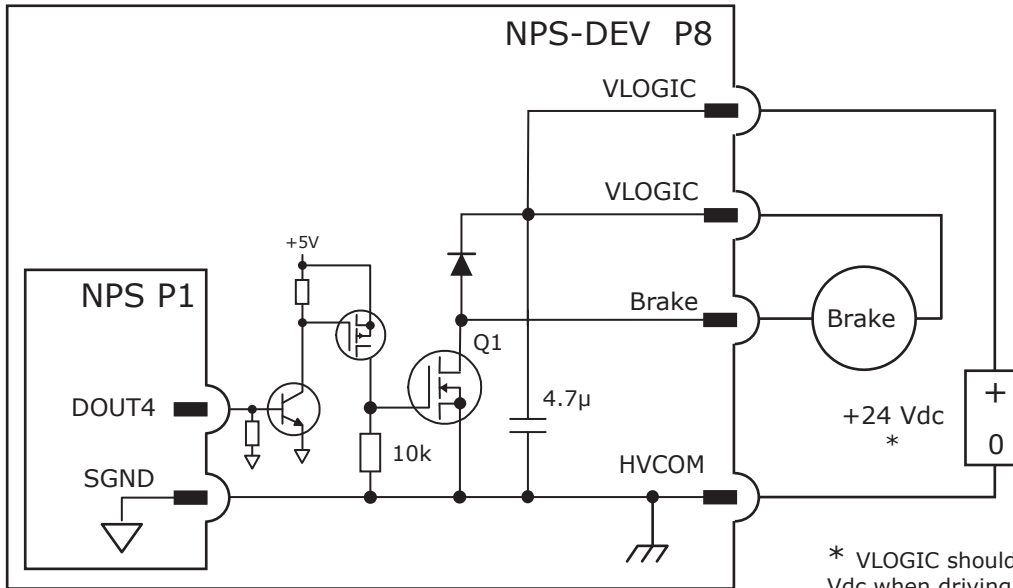
**WARNING**

**Refer to the 16-125661 AN136 Accelnet External Regen Application Note**

VLOGIC +9~60. 24V power is recommended. 24V required if using 24V BRAKE.  
If common to +HV does not exceed 60V, use REGEN protection, and diode isolation from HV.

NPS-DEV VLOGIC & BRAKE

The brake circuit on the NPS-D board is a MOSFET driven by OUT4 of the NPS.



\* VLOGIC should be 24 Vdc when driving a brake because CME assumes this for controlling the brake.

Specifications

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

P8 BRAKE

Signal	Pins
Input VLOGIC	4
Brake VLOGIC	3
Brake	2
HVCOM	1

HI/LO definitions: outputs

Input	State	Condition
BRAKE [OUT4]	LO	Output MOSFET Q1 is OFF Brake is un-powered and locks motor Motor cannot move Brake state is Active
	HI	Output MOSFET Q1 is ON Brake is powered, releasing motor Motor is free to move Brake state is NOT-Active

CME Default Setting for Brake Output [OUT4] is "Brake - Active Low"

Active = Brake is holding motor shaft (i.e. the Brake is Active)  
 Motor cannot move  
 No current flows in coil of brake  
 CME I/O Line States shows [OUT4] as LO  
 BRK Output voltage is HI (24V), MOSFET Q1 is OFF  
 Servo drive output current is zero  
 Servo drive is disabled, PWM outputs are off

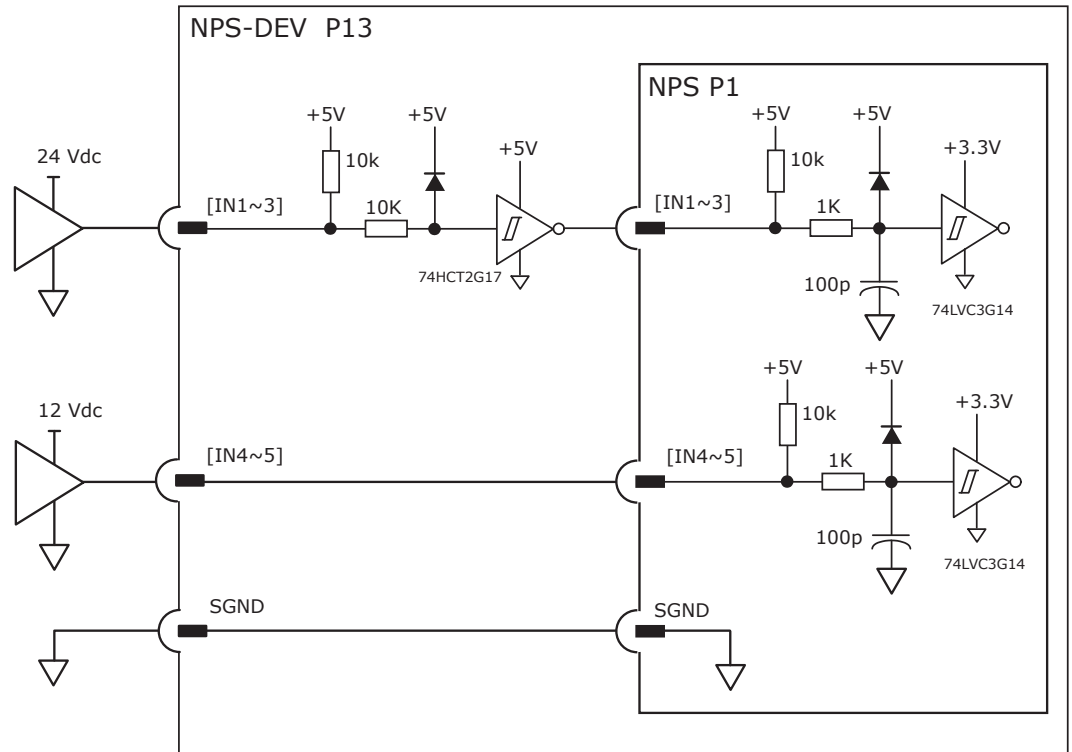
Inactive = Brake is not holding motor shaft (i.e. the Brake is NOT-Active)  
 Motor can move  
 Current flows in coil of brake  
 CME I/O Line States shows [OUT4] as HI  
 BRK output voltage is LO (~0V), MOSFET Q1 is ON  
 Servo drive is enabled, PWM outputs are on  
 Servo drive output current is flowing

**NPS-DEV INPUTS & OUTPUTS**

**P13 LOGIC INPUTS**

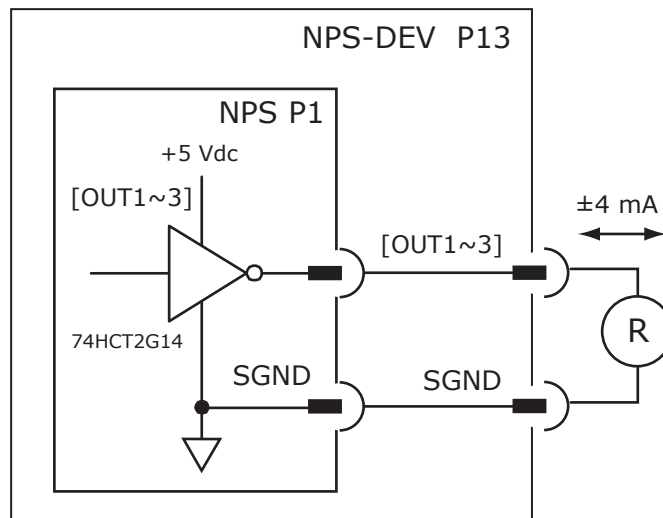
Signal	Pins
IN1_24VTOL [IN1]	4
IN2_24VTOL [IN2]	5
IN3_24VTOL [IN3]	6
IN4	7
IN5	10
SGND	15,19

IN1~3 on the NPS-D are 24V compatible.  
IN4~5 are 12V tolerant.



**P13 LOGIC OUTPUTS**

Signal	Pins
DOUT1 [OUT1]	16
DOUT2 [OUT2]	17
DOUT3 [OUT3]	18
SGND	15,19

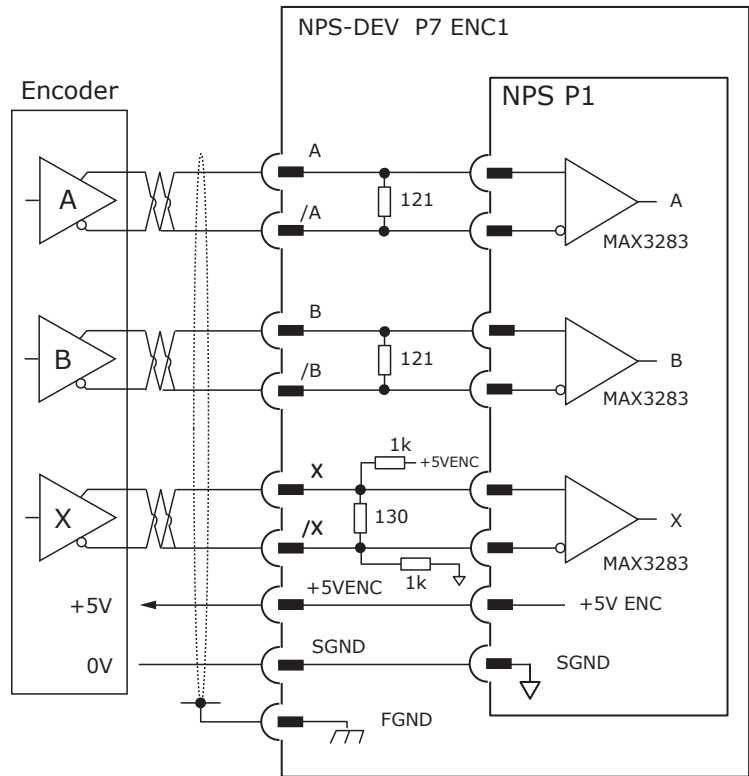


NPS-DEV PRIMARY FEEDBACK ENCODER

P7 ENC1 INPUTS

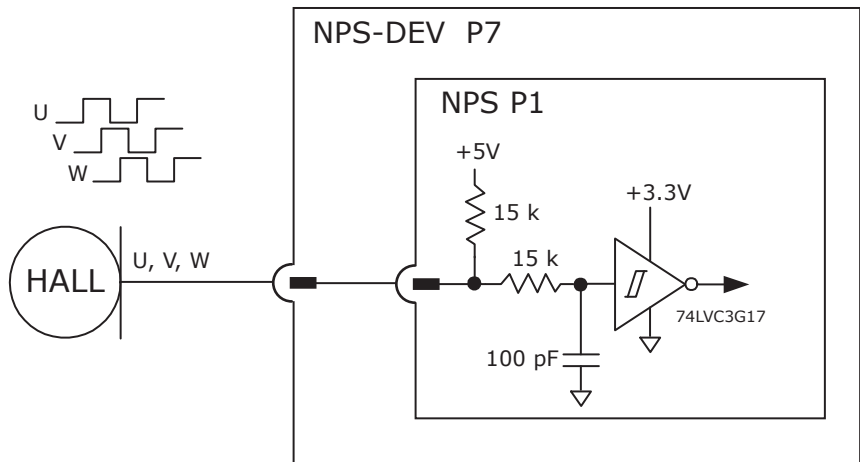
Signal	Pins
ENCA1_UBC_DAT [A]	14
/ENCA1_UBC_DAT [/A]	13
ENCB1 [B]	12
/ENCB1 [/B]	11
ENCX1_UBC_CLK [X]	8
/ENCX1_UBC_CLK [/X]	7
OVERTEMP_IN [IN6]	10
+5VENC	2,4
SGND	5,15

ENC1 is the Motor encoder and should be used in single-encoder applications. In dual-encoder applications, it can be assigned as Primary or Secondary using CME.



P7 HALL INPUTS

Signal	Pins
HALLU	3
HALLV	6
HALLW	9
SGND	5,15

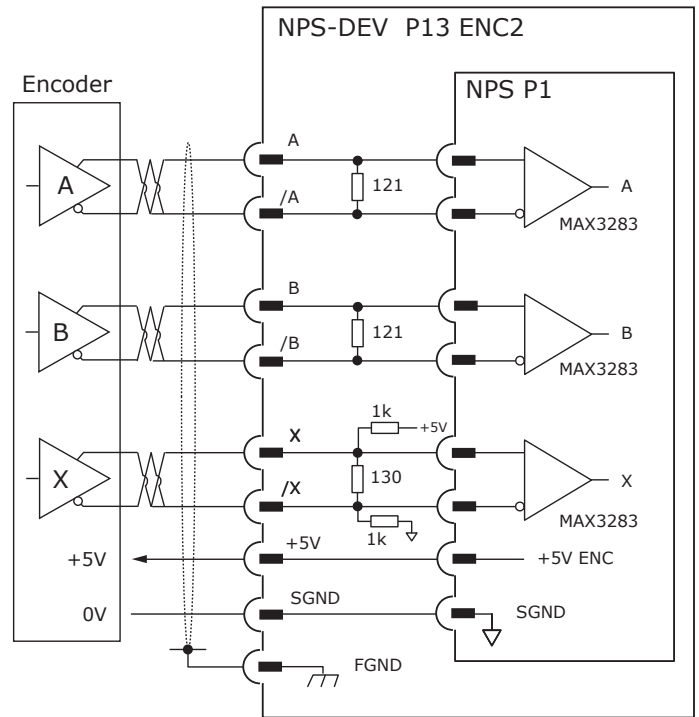


NPS-DEV SECONDARY FEEDBACK ENCODER

P13 ENC2 INPUTS

Signal	Pins
ENCA2 [A]	26
/ENCA2 [/A]	25
ENCB2 [B]	24
/ENCB2 [/B]	23
ENCX2 [X]	22
/ENCX2 [/X]	21
IN5 [Fault]	10
+5VENC	20
SGND	15,19
FGND	1

ENC2 is the Load encoder and typically is feedback from a load driven by the motor and is used in dual-encoder applications. In dual-encoder applications, it can be assigned as Primary or Secondary using CME.



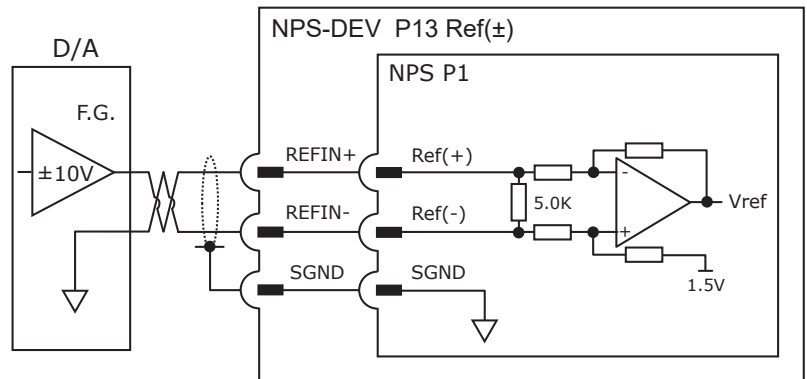
NPS-DEV ANALOG INPUT: AIN1

As a reference input it takes Position/Velocity/Torque commands from a controller. If not used as a command input, it can be used as general-purpose analog input.

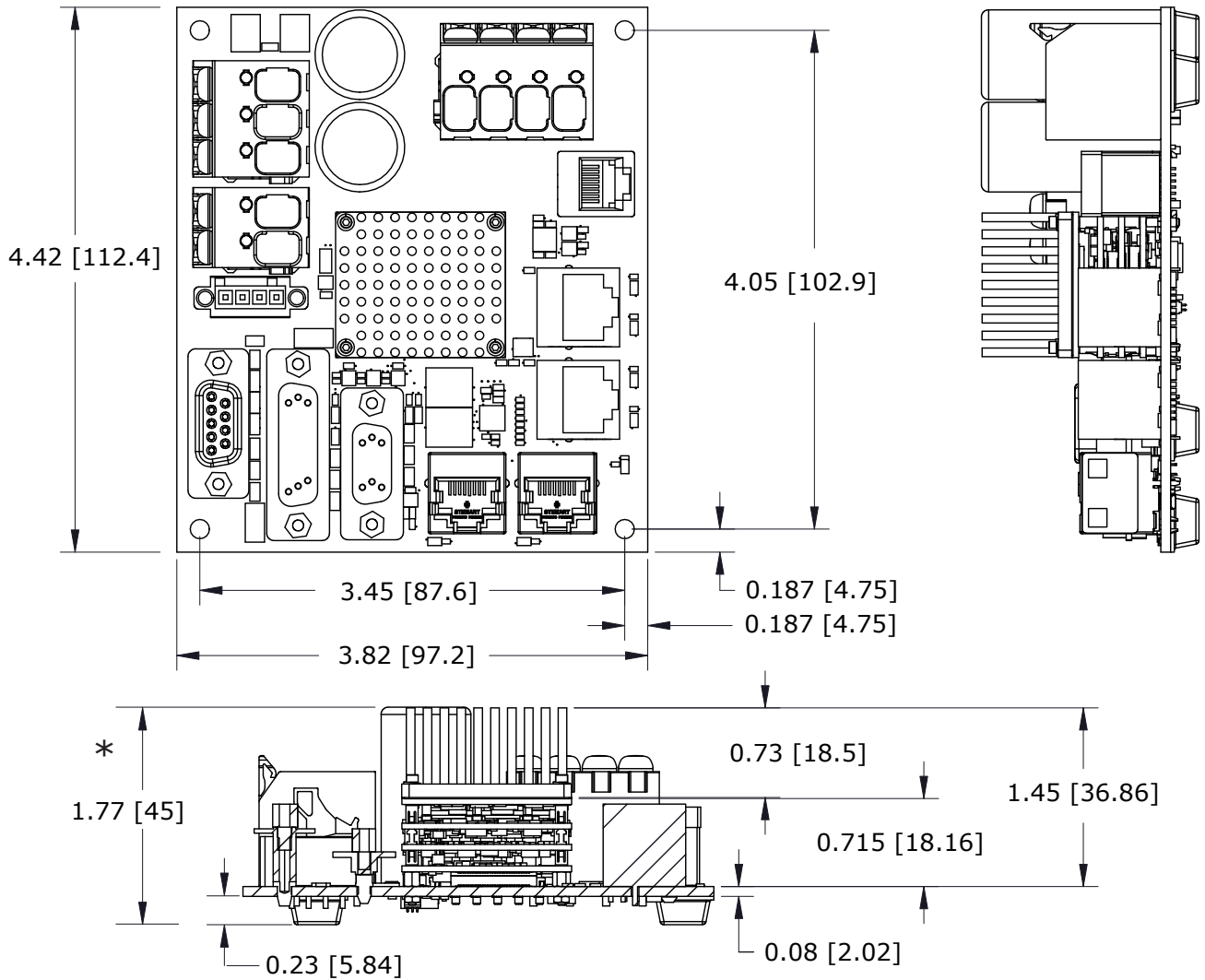
SPECIFICATIONS

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

Signal	J2 Pins
REFIN+ [Ref(+)]	3
REFIN- [Ref(-)]	2
Sgnd	15, 19



**NPS-DEV DIMENSIONS**

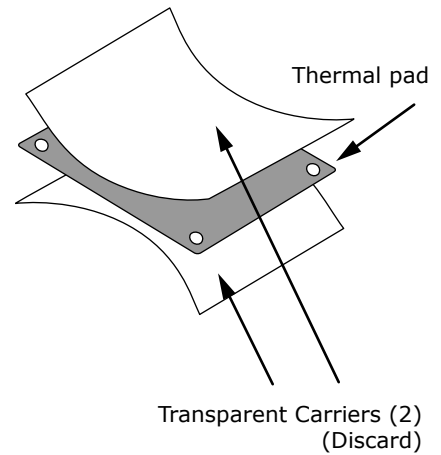
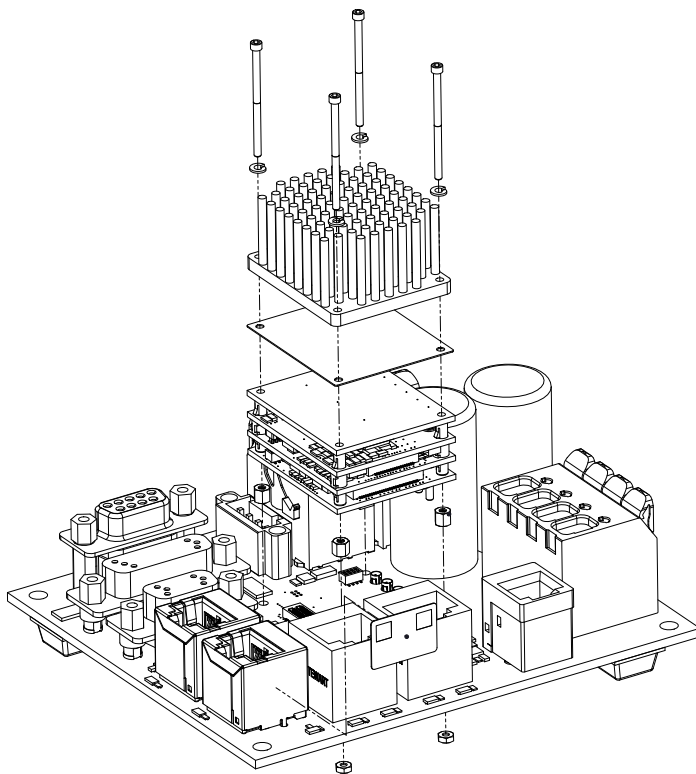


\* The height of the NPS-D is the same with or without the heatsink.

**NPS-DEV HEATSINK MOUNTING**

A thermal pad is used in place of heatsink grease. The pad is die-cut to shape and has holes for the heat sink mounting screws. There are two protective sheets, blue on one side and clear on the other. Both must be removed when the interface pad is installed.

- 1: Remove the blue protective sheet from one side of the pad.
- 2: Place the interface pad on the drive, taking care to center the pad holes over the heatplate mounting holes.
- 3 Remove the clear protective sheet from the pad.
- 4 Mount the heatsink onto the drive taking care to see that the holes in the heatsink, interface pad, and drive all line up.
- 5 Torque the \_#0-80 mounting screws to 1 in-lb, 16 in-oz, 0.113 Nm.

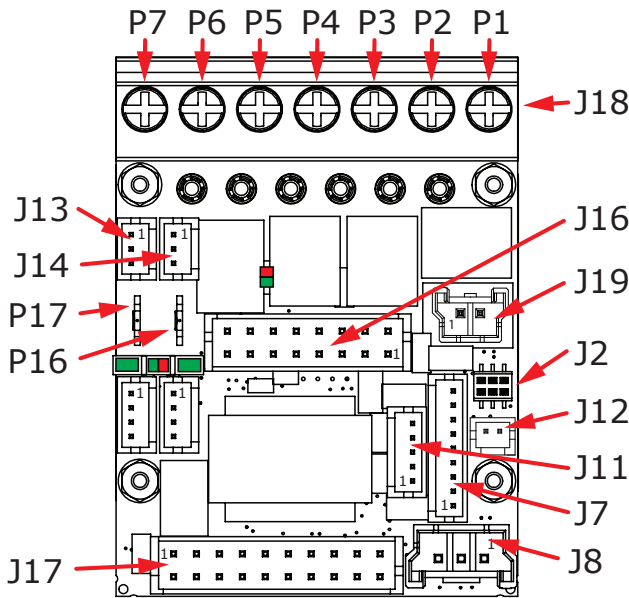


N-HK Heatsink Kit

Item	Description	Quantity
1	Screw, #0-80, hex, socket cap screw, 1 in [25.4 mm], stainless steel	4
2	Heatsink, 0.728 [18.49] tall, pins	1
3	Thermal pad	1
4	Spacer, hex, 0.125 in [3.18 mm], 0-80 UNC 2B thread, 0.120 in [3.05 mm] tall, AL	4
6	Washer, medium split lock, #0, 18-8, stainless steel	4
7	Nut, #0-80, fine thread, stainless steel	4
5	Ifixit Opening Tool	1

## NPS-EZ: BOARD

NPS-090-70-Z
NPS-180-30-Z
NPS-180-10-Z
NPS-090-10-Z



J13 CAN		J14 CAN	
IN	Pin	OUT	Pin
CANH	1	CANH	1
CANL	2	CANL	2
SGND	3	SGND	3

P17 SHIELD		P16 SHIELD	
Signal	Pin	Signal	Pin
SHLD	1	SHLD	1

J18	
PIN	Signal
1	PE
2	HVCOM
3	+HV
4	MOTW
5	MOTV
6	MOTU
7	FGND

J19 VLOGIC	
Signal	Pin
HVCOM	1
VLOGIC	2

**J17 I/O**

Signal	PIN	Signal
/ENCA2	2	REFIN1-
ENCA2	4	REFIN1+
IN1_24VTOL	6	/ENCX2
IN2_24VTOL	8	ENCX2
IN3_24V_TOL	10	+5VENC
DOUT1	12	SGND
DOUT2	14	/ENCB2
DOUT3	16	ENCB2
IN4	18	SGND
IN5	20	FGND

**J16 STO**

Signal	PIN	Signal
STO1_24V_IN	2	STO1_RTN
STO1_IN	4	STO1_RTN
n.c.	6	n.c.
STO2_24V_IN	8	STO2_RTN
STO2_IN	10	STO2_RTN
n.c.	12	n.c.
STO_STATUS_OUTPUT_RTN	14	SGND
+5V	16	STO_STATUS_OUTPUT

**J12 BRAKE**

Signal	Pin
VLOGIC	2
BRAKE	1

**J7 ENCODER 1**

Signal	Pin
OVERTEMP_IN	9
ENCX1_UBC_CLK	8
/ENCX1_UBC_CLK	7
ENCB1	6
/ENCB1	5
ENCA1_UBC_DAT	4
/ENCA1_UBC_DAT	3
+5VENC	2
SGND	1

**J11 HALLS**

Signal	Pin
HALLU	5
HALLV	4
HALLW	3
+5VENC	2
SGND	1

**J8 RS-232**

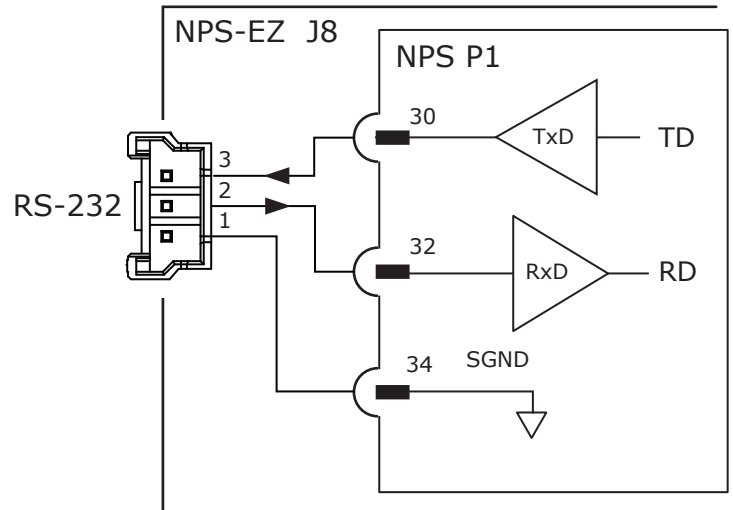
Signal	Pin
RX232TX1	3
RS232RX1	2
SGND	1

## NPS-EZ: RS-232

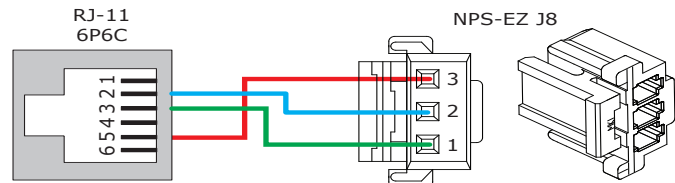
### RS-232 CONNECTION

The RS-232 port is used to configure the drive for stand-alone applications, or for configuration before it is installed into an CAN network. CME software communicates with the drive over this link and is then used for complete drive setup. The CAN Device ID is set via RS-232 along with other operating functions.

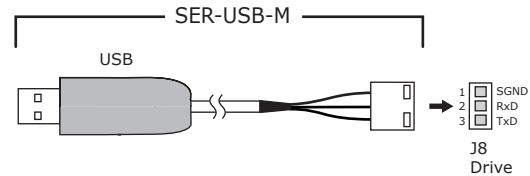
J8 RS-232	
Signal	Pin
RX232TX1	3
RS232RX1	2
SGND	1



Compatibility with existing serial-data cables can be done with an RJ-11 socket (6P6C) wired as shown here. Molex: 42410-6170 Modular Jack, 6 terminals, size 6



Copley will soon offer a SER-USB-M serial port adapter. This serial port is a full-duplex, three-wire (RxD, TxD, SGND) type that operates from 9,600 to 230,400. The SER-USB-M cable has output levels that are compatible with NPS-Z serial port.



## NPS-EZ: AMP STATUS LED

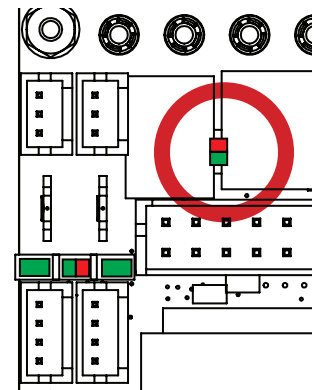
### DRIVE STATUS LED (AMP)

A bi-color LED gives the state of the drive. Colors do not alternate, and can be solid ON or blinking. If multiple conditions occur, only the top-most condition will be displayed. When that condition is cleared the next one below will shown.

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

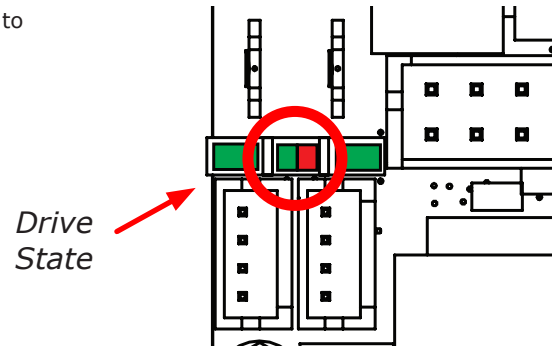
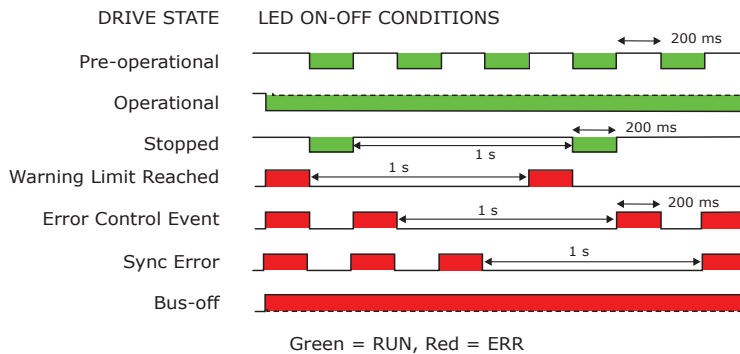
### LATCHING FAULTS

- |                                      |                                |
|--------------------------------------|--------------------------------|
| <b>DEFAULT</b>                       | <b>OPTIONAL (PROGRAMMABLE)</b> |
| Short circuit (Internal or external) | Over-voltage                   |
| Drive over-temperature               | Under-voltage                  |
| Motor over-temperature               | Motor Phasing Error            |
| Feedback Error                       | Command Input Lost             |
| Following Error                      | Motor Wiring Disconnected      |
| STO Active                           | Over Current (latched)         |



## NPS-EZ: CAN STATUS LED

The green LED "RUN" shows the state of the CAN state machine.  
The red LED "ERR" shows the status of the CAN physical layer and errors due to missing messages.



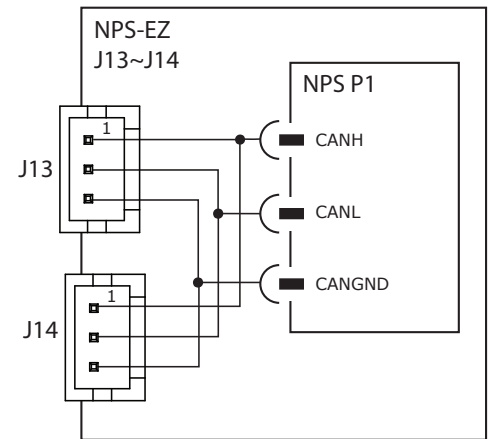
## NPS-EZ: J13-J14 CAN

### CAN CONNECTORS

Dual connectors are provided for CAN bus connectivity. Pins are wired-through so that drives can be daisy-chained and controlled with a single connection to the user's CAN interface. A 120 ohm CAN terminator should be placed in the last drive in the chain.

### J13-J14 CAN CONNECTORS

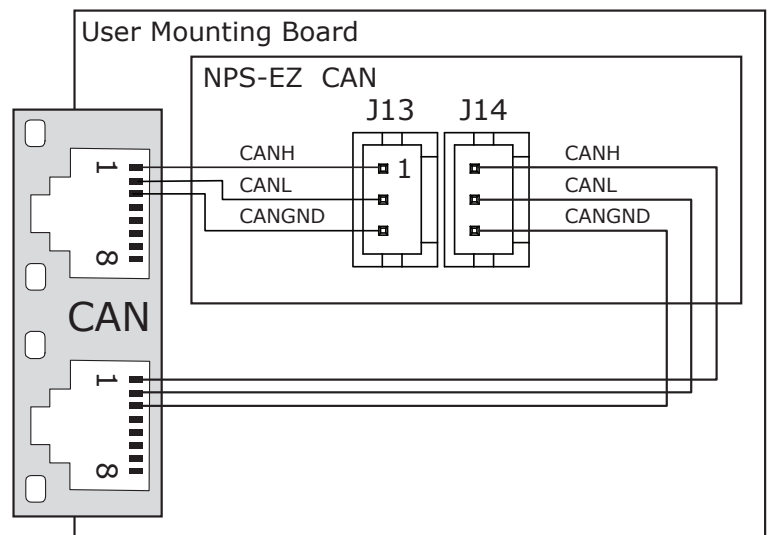
J13 CAN		J14 CAN	
Signal	Pin	Signal	Pin
CANH	1	CANH	1
CANL	2	CANL	2
SGND	3	SGND	3



### CAN CABLE CONNECTORS

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

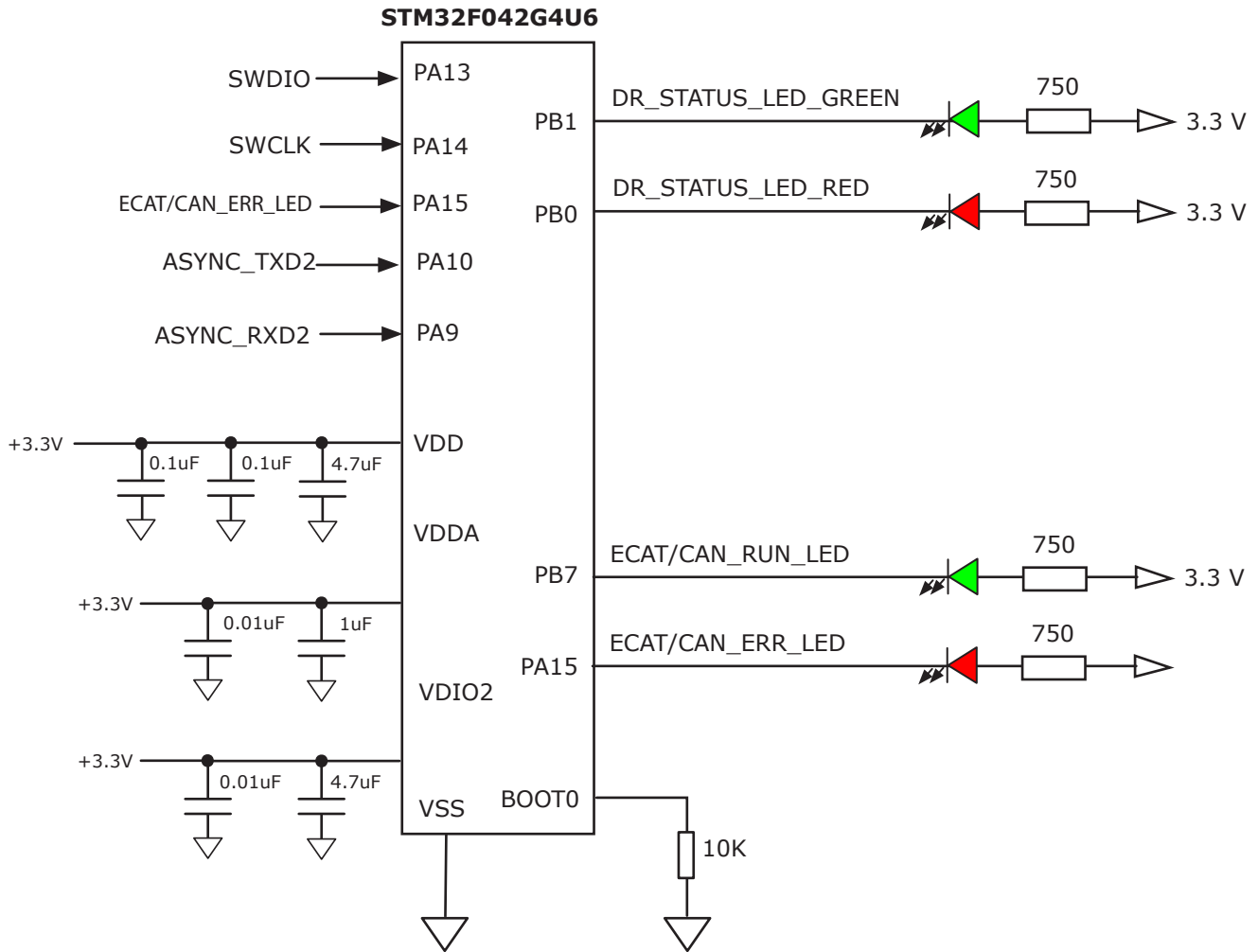
RJ-45 CAN	
Pin	Signal
1	CANH
2	CANL
3	CANGND
4	*
5	*
6	*
7	*
8	*



\* These pins are pass-through and have no connections to the drive circuits.

**NPS-EZ: DRIVE AND NETWORK STATUS LEDs**

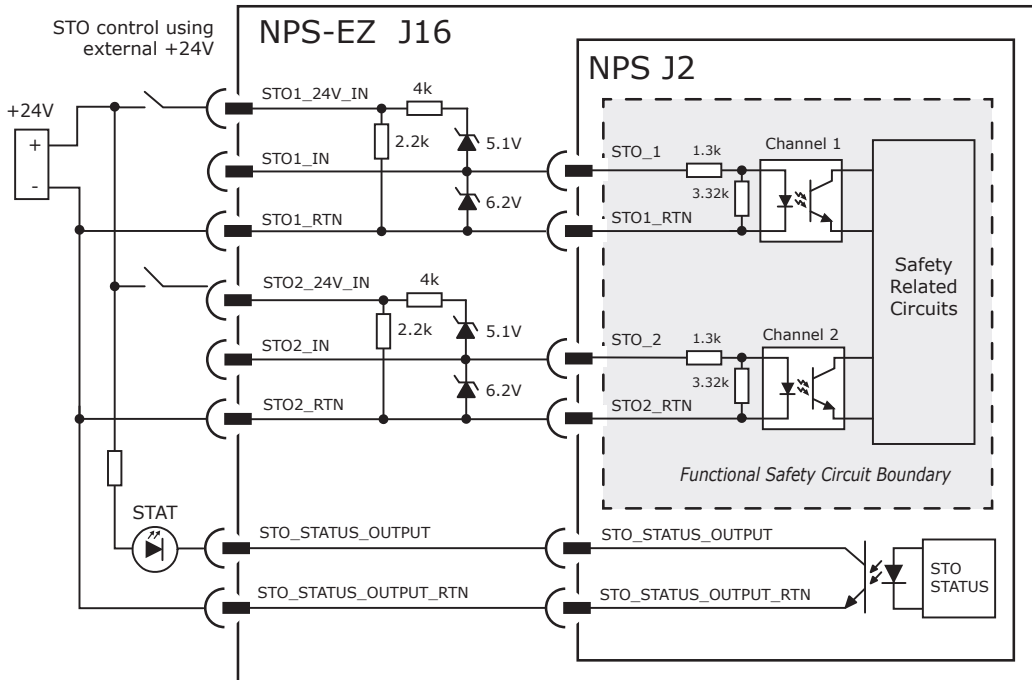
The "STM" chip uses the serial data from ASYNC\_TXD2 to drive LEDs. DR\_STATUS\_LED\_X signals drive the AMP STATUS LED (detail on page 2). CAN\_XXX\_LED show the network status of the drive communication.



## NPS-EZ: J16 SAFE TORQUE OFF [STO]

### DESCRIPTION

This shows the use of external 24V to energize the STO inputs. Both STO inputs must be energized in order to enable the drive.



*NOTE that the +24V shown in the graphic can be driven from the VLOGIC power supply. The STOx\_24V\_IN circuits can tolerate the +60V limit of the VLOGIC input. The STOx\_IN maximum voltage limits are +7.0 Vdc*

### STO\_STATUS\_OUTPUT

STO1	0	1	0	1
STO2	0	0	1	1
STAT	0	0	0	1

In this table, STO1 & STO2 rows, 1 = 24V has been applied between the IN-24V and RTN. 0 = open-circuit. In the STAT row, 1 = the optocoupler is ON, 0 = the optocoupler is OFF. STAT output is ON (True) when both STO1 & STO2 are energized, allowing the drive to be enabled and to produce torque.

### J16 STO

Signal	Pin	Signal
STO1_RTN	1	2
STO1_RTN	3	4
n.c.	5	6
STO2_RTN	7	8
STO2_RTN	9	10
n.c.	11	12
SGND	13	14
STO_STATUS_OUTPUT	15	16

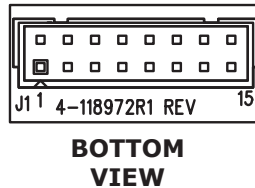
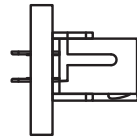
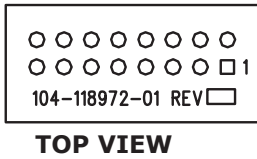
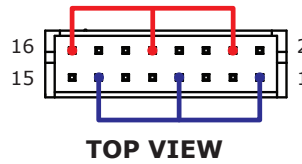
### STO OPERATION

STO Input Voltage	STO State
STO1_24V_IN AND STO2-IN-24V $\geq$ 16 Vdc STO1_IN AND STO2_IN $\geq$ 3.0 Vdc	STO Inactive. Drive can be enabled to produce torque
STO1-IN-24V OR STO2-IN-24V $<$ 16 Vdc STO1_IN OR STO2_IN $\leq$ 2.0 Vdc STO1-IN OR STO2-IN Open	STO Active. Drive cannot be enabled to produce torque

Note: Voltages in the table above are referenced between an STOx-IN and an STOx-RTN in J16  
E.g.  $V(\text{STO1-IN}) = V(\text{STO1-24V-IN1}) - V(\text{STO1-RTN})$

## NPS-EZ: J16 SAFE TORQUE OFF (STO) BYPASS

Bypassing is for users who do not use the STO function. The NS-Z-STO has jumpers that use the VLOGIC to energize the STO inputs. This disables the STO function, allowing the drive to be enabled from hardware inputs or a network. The graphic shows the wiring of the NS-Z-STO



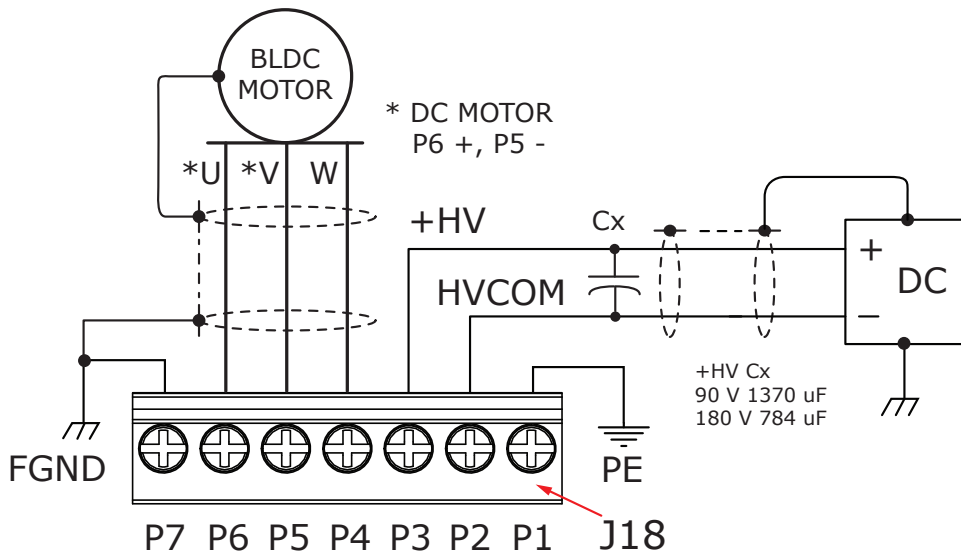
## NPS-EZ: BOARD J18 +HV & MOTOR CONNECTIONS

### J18 +HV: P2, P3

The +HV power supply connects to J18 pins P2 & P3. The shield shown is optional and is primarily for reduction of RF emissions from the drive. As shown it connects to the case of the power supply. Note that the minus terminal is not grounded externally. This is because currents in the cables produce voltage drops. Grounding the supply at the drive ensures that such voltage drops do not appear in the drive circuits. Bulk capacitance Cx is required from +HV to HVCOM as shown. Cx must be adjacent to the EZ-OEM.

### J18 MOTOR: P4~P7

Pins P4~P6 are for the motor windings. Pin P7 is for the cable shield. It connects to FGND on one end and should connect to the motor frame on the other. This provides a return path for currents produced by the PWM outputs and the capacitance between the cable conductors, motor windings, and motor frame. While the frame is commonly grounded by mounting to equipment, without the shield connections the PWM shield current could flow into external devices.



### J18

Pin	Signal
P1	PE
P2	HVCOM
P3	+HV
P4	MOTW
P5	MOTV
P6	MOTU
P7	FGND

\*For DC brush motors connect to P6 & P5

 <b>WARNING</b>	<p><b>Refer to the 16-125661 AN136 Accelnet External Regen Application Note</b></p>
	<p>VLOGIC +9~60. 24V power is recommended. 24V required if using 24V BRAKE. If common to HV does not exceed 60V, use REGEN protection, and diode isolation from HV.</p>

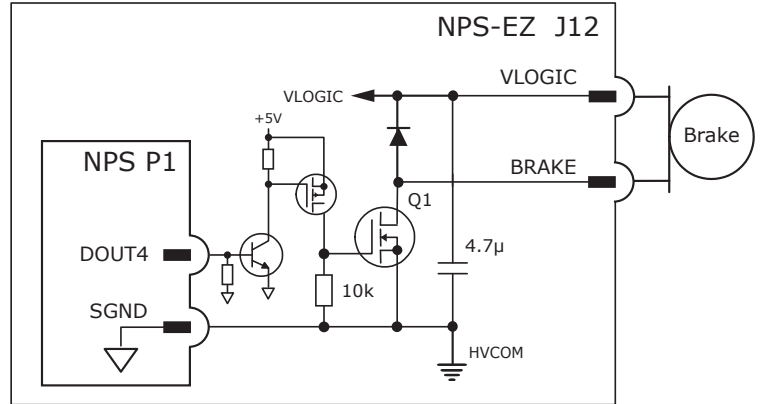
**NPS-EZ: J12 BRAKE**

**J12 BRAKE:**

The EZ board has components that can actuate a brake when controlled by DOUT4. If not used for the brake, DOUT4 is programmable for other functions. Use CME for Custom Brake Configuration. This has settings for VLOGIC, Initial Voltage, Time at Initial Voltage, Holding Voltage, and PWM Period.

**HI/LO definitions: outputs**

Input	State	Condition
BRAKE [DOUT4]	LO	Output MOSFET Q1 is OFF Brake is un-powered and locks motor Motor cannot move Brake state is Active
	HI	Output MOSFET Q1 is ON Brake is powered, releasing motor Motor is free to move Brake state is NOT-Active



CME Default Setting for Brake Output [OUT4] is "Brake - Active Low"

Active = Brake is holding motor shaft (i.e. the *Brake is Active*)  
 Motor cannot move  
 No current flows in coil of brake  
 CME I/O Line States shows [OUT4] as LO  
 BRK Output voltage is HI (24V), MOSFET Q1 is OFF  
 Servo drive output current is zero  
 Servo drive is disabled, PWM outputs are off

Inactive = Brake is not holding motor shaft (i.e. the *Brake is NOT-Active*)  
 Motor can move  
 Current flows in coil of brake  
 CME I/O Line States shows [OUT4] as HI  
 BRK output voltage is LO (~0V), MOSFET Q1 is ON  
 Servo drive is enabled, PWM outputs are on  
 Servo drive output current is flowing

**J12 BRAKE**

Pin	Signal
2	VLOGIC
1	BRAKE

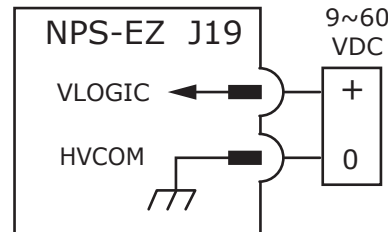
**Specifications**

Input	Data	Notes
Voltage Range	Max	+6~60 Vdc
Output Current	Ids	1.0 Adc

**NPS-EZ: J19 VLOGIC**

**J19 VLOGIC:**

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



**Specifications**

Input	Data	Notes
Voltage Range	Max	+6~60 Vdc
Input Power	Typ	4 W
	Max	8 W

Typical input power is no load on encoder +5V.  
 Maximum input power is with two encoders @ 250 mA each, and +5V at maximum.

**J19 VLOGIC**

Pin	Signal
2	VLOGIC
1	HVCOM



**Refer to the 16-125661 AN136 Accelnet External Regen Application Note**

VLOGIC +9~60. 24V power is recommended. 24V required if using 24V BRAKE. If common to +HV does not exceed 60V, use REGEN protection, and diode isolation from HV.

NPS-EZ: J17 INPUTS & OUTPUTS

J17 has the following connections:

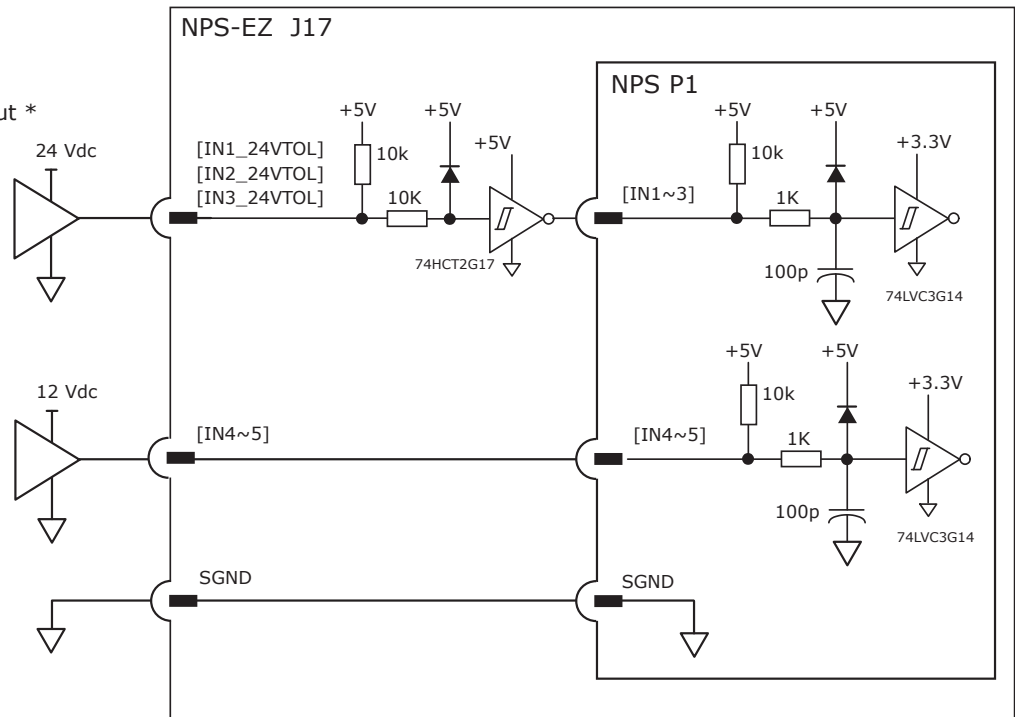
- Digital inputs 1~5
- Digital outputs 1~3
- Analog differential input \*
- Secondary quad A/B/X encoder input \*

\* See page 39

IN1~3 are 24V compatible  
IN4~5 are 12V tolerant

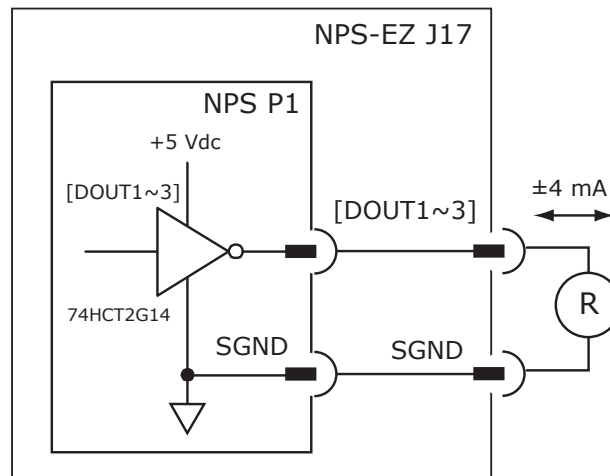
J17 LOGIC INPUTS

Signal	Pins
IN1_24VTOL	6
IN2_24VTOL	8
IN3_24VTOL	10
IN4	18
IN5	20
SGND	11,17



J17 LOGIC OUTPUTS

Signal	Pins
DOUT1 [OUT1]	12
DOUT2 [OUT2]	14
DOUT3 [OUT3]	16
SGND	11,17



J17 I/O

Signal	Pins	Signal	
/ENCA2	2	1	REFIN-
ENCA2	4	3	REFIN+
IN1_24VTOL	6	5	/ENCX2
IN2_24VTOL	8	7	ENCX2
IN3_24VTOL	10	9	+5VENC
DOUT1	12	11	SGND
DOUT2	14	13	/ENCB2
DOUT3	16	15	ENCB2
IN4	18	17	SGND
IN5	20	19	FGND

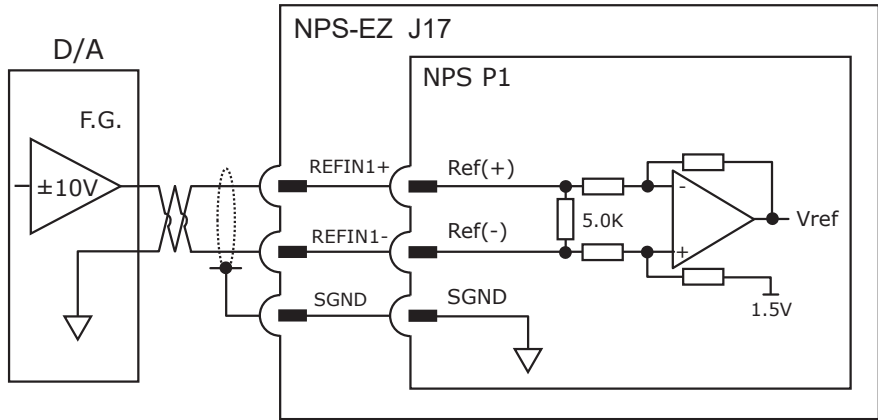
NPS-EZ: J17 ANALOG INPUT

As a reference input it takes Position/Velocity/Torque commands from a controller. If not used as a command input, it can be used as general-purpose analog input.

SPECIFICATIONS

Spec	Data	Notes
Input Voltage	Vref	±10 Vdc
Input Resistance	Rin	5.0 kΩ

Name	P1 Pins
Ref(+)	3
Ref(-)	1

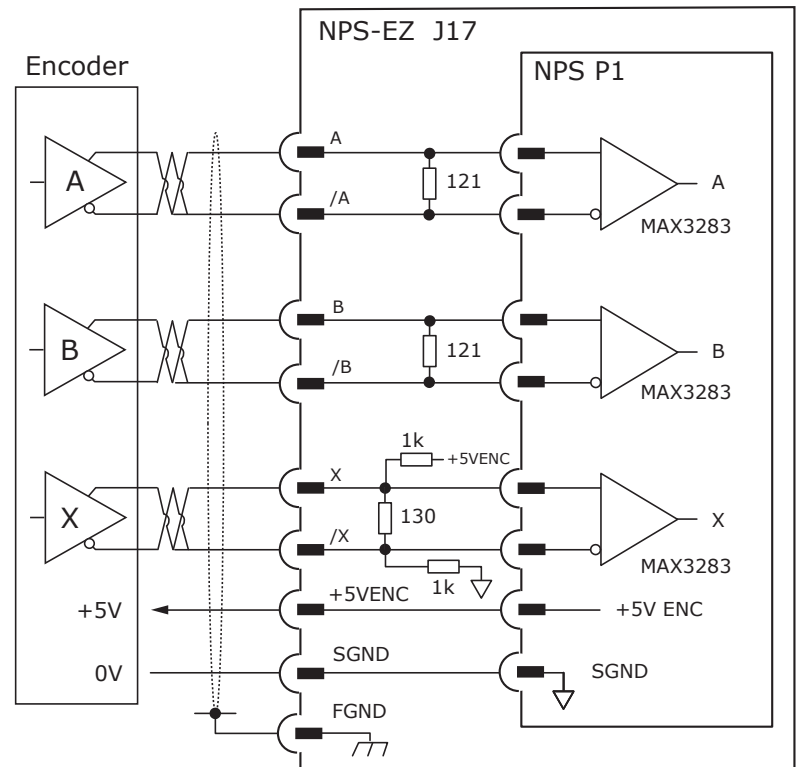


NPS-EZ: J17 SECONDARY ENCODER

The secondary encoder is used when the load is not connected directly to the motor.

J17 ENC2 INPUTS

Signal	Pins
ENCA2 [A]	4
/ENCA2 [/A]	2
ENCB2 [B]	15
/ENCB2 [/B]	13
ENCX2 [X]	7
/ENCX2 [/X]	5
+5VENC	9
SGND	11,17
FGND	19

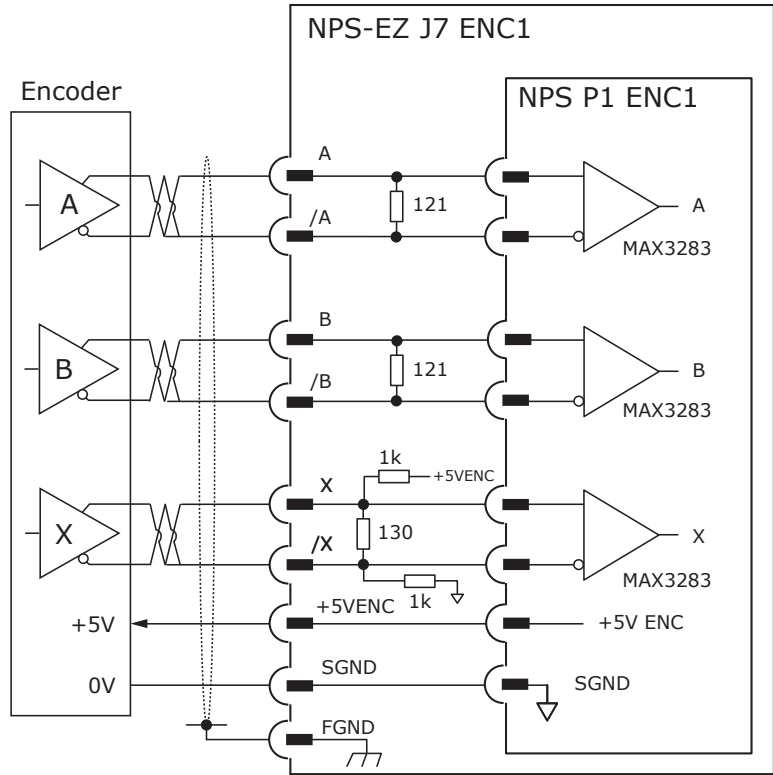


**NPS-EZ: J7 PRIMARY ENCODER**

ENC1 is the Motor encoder and should be used in single-encoder applications. In dual-encoder applications, it can be assigned as Primary or Secondary using CME.

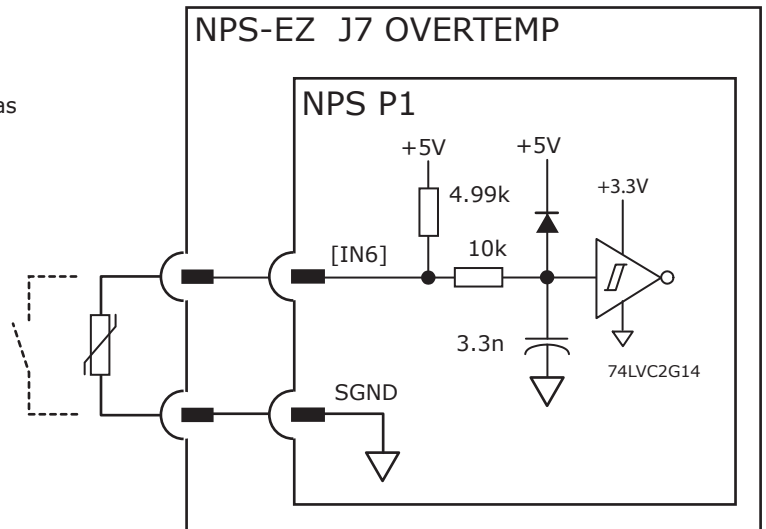
**J7 ENC1 INPUTS**

Signal	Pins
ENCA1_UBC_DAT [A]	4
/ENCA1_UBC_DAT [/A]	3
ENCB1 [B]	6
/ENCB1 [/B]	5
ENCX1_UBC_CLK [X]	8
/ENCX1_UBC_CLK [/X]	7
OVERTEMP_IN [IN6]	9
+5VENC	2
SGND	1



**NPS-EZ: J7 OVERTEMP**

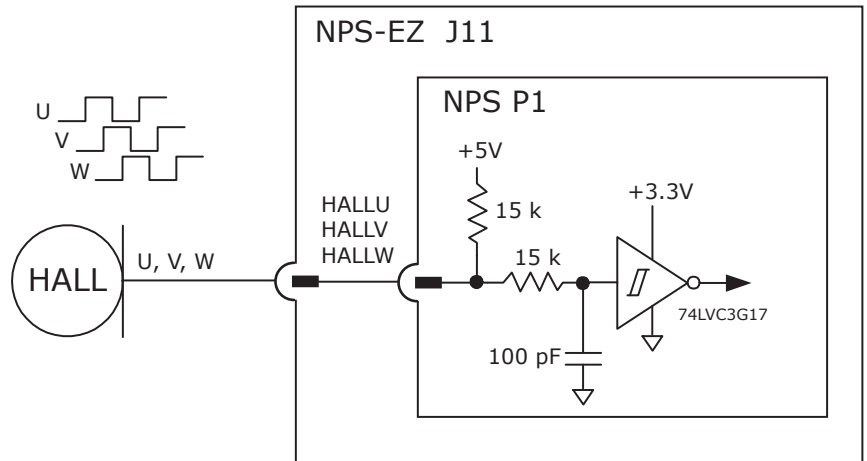
Input IN6 has a 49 microsecond rise time RC filter with a 4.99 kΩ pullup resistor to +5 VDC. Input IN6 is designed to interface with an industry standard PTC thermistor IAW BS 49990111(1987) for built-in thermal protection of the motor as a default. If not used for the Motemp function, IN6 can be re-programmed for other input functions.



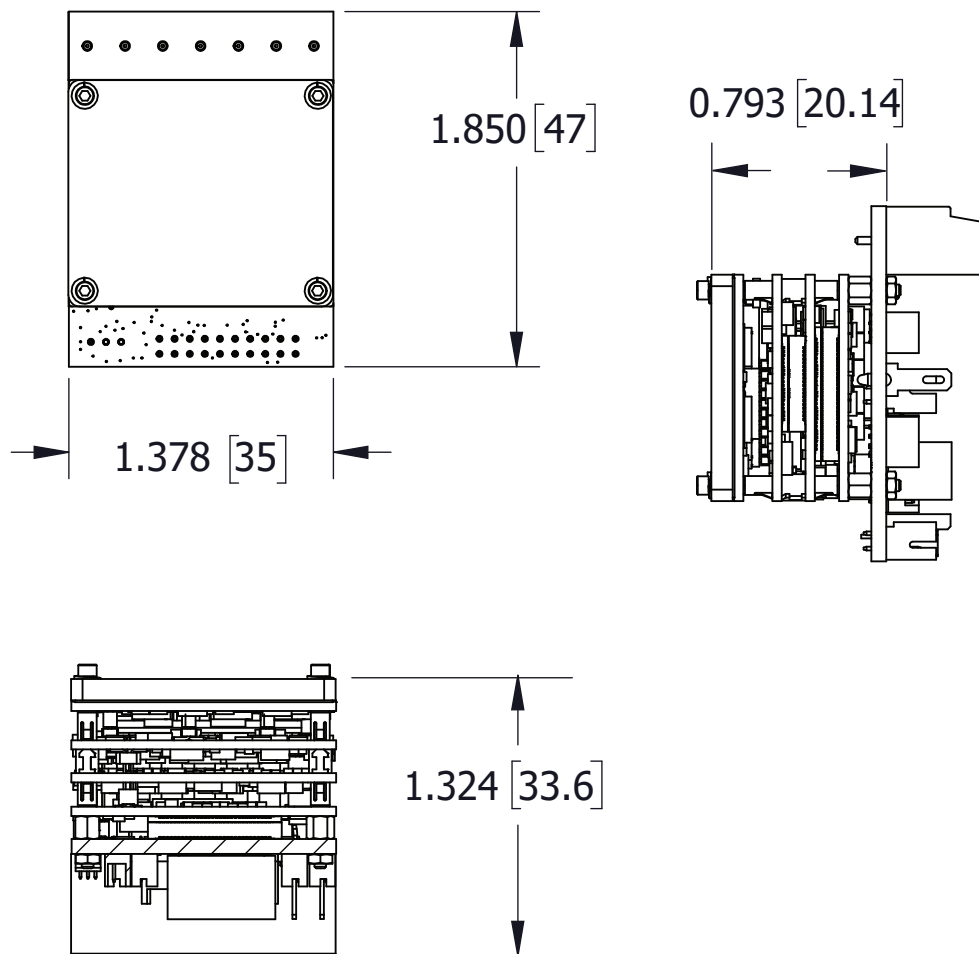
**NPS-EZ: J11 HALLS**

**J11 HALL INPUTS**

Signal	Pins
Hall U	5
Hall V	4
Hall W	3
+5VENC	2
SGND	1

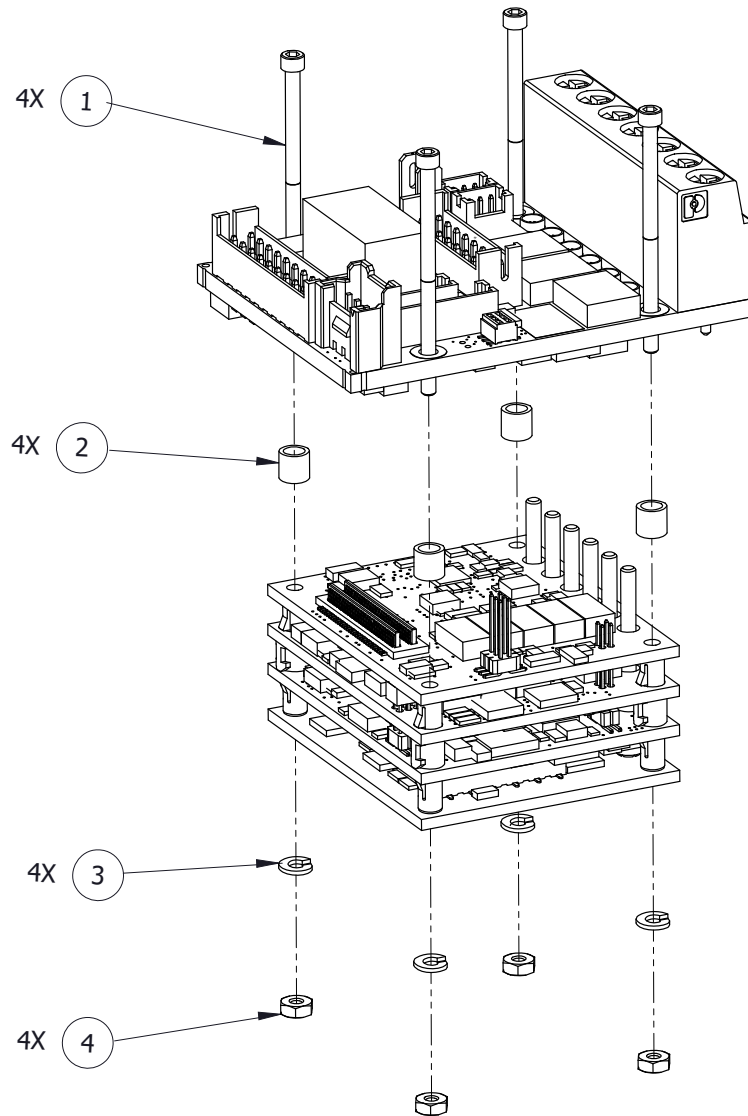


**NPS-EZ: MECHANICALS**



**NPS-Z: MECHANICALS**

NOTE: the parts shown below are the ones in the drive when it is shipped.  
 The screw lengths are 1" to allow the nuts and washers to hold the parts together. When mounting to a panel with nuts on the backside, add the thickness to this number to find the minimum length of the screws required.  
 For a panel with tapped holes the 1" screw should be sufficient.



Item	Qty	Description	Mfgr, Part Number
1	4	Screw, 1", hex, 0-80, 18-8 THD, 80-1 SS	Fastenal: 0171020
2	4	Spacer, 3 mm, 0.090" I.D, 0.125" O.D.	Bivar: 937-3MM
3	4	Washer, split, 0.062 ID, 18-8, 0.137" O.D. SS	Fastenal: 017926
4	4	Nut, 0-80, 1/8", hex, socket, cap 18-8 SS	Fastenal: 0173909

## ORDERING GUIDE

### NANO

NPS-090-10	Nano Micro Module CAN NPS servo drive, 5/10 A, 90 Vdc
NPS-090-70	Nano Micro Module CAN NPS servo drive, 35/70 A, 90 Vdc
NPS-180-10	Nano Micro Module CAN NPS servo drive, 5/10 A, 180 Vdc
NPS-180-30	Nano Micro Module CAN NPS servo drive, 15/30 A, 180 Vdc
NPS-090-10-D	Nano Micro Module CAN NPS with DEV board, not soldered, no heat sink
NPS-090-70-D	Nano Micro Module CAN NPS with DEV board, <b>soldered</b> , with heat sink
NPS-180-10-D	Nano Micro Module CAN NPS with DEV board, not soldered, no heat sink
NPS-180-30-D	Nano Micro Module CAN NPS with DEV board, not soldered, with heat sink
NPS-090-10-Z	Nano Micro Module CAN NPS with EZ board, not soldered, no heat sink
NPS-090-70-Z	Nano Micro Module CAN NPS with EZ board, <b>soldered</b> , no heat sink
NPS-180-10-Z	Nano Micro Module CAN NPS with EZ board, not soldered, no heat sink
NPS-180-30-Z	Nano Micro Module CAN NPS with EZ board, not soldered, no heat sink

### ACCESSORIES FOR NPS-DEV

NS-D-CK	NPS-D Connector Kit
STO-CK-04	NPS-D Bypass Jumper
N-HK	Heat Sink Kit
SER-CK	Serial Cable Kit: 9-Pin Dsub receptacle to 6-pin modular adapter, plus modular cable
SER-USB-RJ11	USB to 6-pin modular adapter
NPS-NC-01	Network cable, 1 ft (0.3 m)
NPS-NC-10	Network cable, 10 ft (3 m)

### CONNECTOR KIT FOR NPS-DEV

	QTY	REF	NAME	DESCRIPTION	MFGR PART NUMB
<b>NS-D-CK</b>  <b>Connector Kit</b>	1	P8	VLOGIC and Brake	Connector, terminal-block, 4-pole, 3.5 mm	Wago: 734-104/107-000
	1			Tool, for P8	Wago: 734-231
	2	P7,P9	I/O	Connector Cover, D-Sub, 9-pin	3M: 3357-9209
	1	P9	Safety	Connector, D-Sub, 9-position, size 1	TE: 205204-4
	9	P9	Safety	Contact, pin, crimp, snap-in, 24~20 AWG	TE: TYC66506-9
	1	P7	I/O	Connector Cover, D-Sub, 15-pin	3M: 3357-9215
	1	P7	Feedback	Connector, D-Sub, 15-pin (HD), male, solder cup	Norcomp: 180-015-103L001
	1	P13	I/O	Connector, D-sub, 26-pin (HD), male, metal shell	Norcomp: 180-026-103L001

**ORDERING GUIDE**

**ACCESSORIES FOR NANO MICRO MODULE NPS-EZ**

NS-Z-CK	NPS-Z Connector Kit
N-HK	Heat Sink Kit
SER-USB-M	USB to 3-Pin Molex adapter cable

**CONNECTOR KIT FOR NPS-Z**

	QTY	REF	NAME	DESCRIPTION	MFGR PART NUMB
<b>NS-Z-CK Connector Kit</b>	1	J12	Brake	CONN WIRE-MT HSG SKT 1X2P 1.25MM LKG NYL BEIGE	Hirose DF13-2S-1.25C
	2	J13, J14	CAN	CONN WIRE-MT HSG SKT 1X3P 1.25MM LKG NYL BEIGE	Hirose DF13-3S-1.25C
	2	J9, J10	EtherCAT	CONN WIRE-MT HSG SKT 1X4P 1.25MM LKG NYL BEIGE	Hirose DF13-4S-1.25C
	1	J11	Halls	CONN WIRE-MT HSG SKT 1X5P 1.25MM LKG NYL BEIGE	Hirose DF13-5S-1.25C
	1	J7	ENC1, Motemp	CONN WIRE-MT HSG SKT 1X9P 1.25MM LKG NYL BEIGE	Hirose DF13-9S-1.25C
	24	J7,J9,J10 J11,J12 J13,J14		CONN CONTC SKT CRMP 30-26GA 1MM MAX INSUL DIA AU	Hirose DF13-2630SCFA
	1	J16	STO	CONN WIRE-MT HSG RCPT 2X8P 2X2MM LKG NYL BLK	Hirose DF11-16DS-2C
	1	J17	IN1~5, DOUT1~3, ENC2, AREF	CONN WIRE-MT HSG RCPT 2X10P 2X2MM LKG NYL BLK MATING 129846	Hirose DF11-20DS-2C
	36			CONN CONTC SKT CRMP 28-24GA 1.45MM MAX INSUL DIA AU	Hirose DF11-2428SCFA(04)
	1	J19	Vlogic	CONN WIRE-MT HSG RCPT 1X2P 2MM LKG POLYEST NAT	Molex 35507-0200
	1	J8	RS-232	CONN WIRE-MT HSG RCPT 1X3P 2MM LKG POLYEST NAT	Molex 35507-0300
	2	P16, P17	Cable Shields	FASTON RCPT .11-.125W .02THK 26-22GA POSTIVE LOCK	TE 353249-2
	3		DF13 Wires	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD BLK AU 12IN	Digi-Key H4BBG-10112-B6-ND
	19		DF13 Prewire	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD WHT AU 12IN	Digi-Key H4BBG-10112-W6-ND
	20		DR11 Wires	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD WHT AU 12IN	Digi-Key H3BBG-10112-W6-ND
	3		DF11 GP	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD RED AU 12IN	Digi-Key H3BBG-10112-R6-ND
	3		DF13 Wire	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD RED AU 12IN	Digi-Key H4BBG-10112-R6-ND
	1		P6, HVCOM	CBL ASSY SKT CONTC TO FREE END 1COND 24GA 7STRD BLK SN 12IN	Digi-Key 0502128000-12-B4
	1		J19, +VLOGIC	CBL ASSY SKT CONTC TO FREE END 1COND 24GA 7STRD RED SN 12IN	Digi-Key 0502128000-12-R4
	3		DF11	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD BLK AU 12IN	Digi-Key H3BBG-10112-B6-ND
	1		Brake Wire	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD BLU AU 12IN	Digi-Key H4BBG-10112-L6-ND
	1	J16	STO Bypass PCB	BD ASSY, STO BYPASS BOARD	Copley: NS-Z-STO

16-121737 Document Revision History

Revision	Date	Remarks
00	November 12, 2019	Initial released version
01	November 22, 2019	NPS-090-10 added
02	December 6, 2019	Deleted EtherCAT references, updated accessories, corrections to diagram on page 15.
03	May 20, 2020	Added thermals, added -D models to table above.
04	February 22, 2021	Deleted NPS-090-10 model, NPS-D only
AA	April 7, 2021	Pre-production revision - Changed revision to pre-production naming convention. Updated signal names to follow NPS-D and added connector kit for NPS-D.
AB	November 1, 2021	Pre-production revision - Changed revision to pre-production naming convention. Added -Z board
05	June 22, 2022	Production revision Updated with 24V recommendations for VLOGIC, updated with 3.3V input, updated with capacitor on +HV input
06	August 8, 2022	Corrected pages 6 and 13 to match STO pinouts on page 14

Note: Specifications subject to change without notice