copley controls Nano PLUS Module EtherCAT PCF NEP

DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

PCF Plus Common Features

- Virtual Multi-Axes with IDC
- Large CVM dRAM 64k
- Large Trace 16k
- Built-in Ethernet

Control Modes

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

Command Interface

- CANopen® Application Protocol over EtherCAT® (CoE)
- ASCII, Serial Binary, and Discrete I/O
- Stepper or Quad A/B Position Commands
- PWM Position-Velocity-Torque Command
- Master Encoder (Gearing/Camming)
- ±10 V Position-Velocity-Torque

Communications

- EtherCAT
- Ethernet
- UDP, TCP-IP, Modbus-TCP, Ethernet/IP
- RS-232

Feedback

- Dual Absolute
  BiSS, SSI, EnDat
  Absolute A
  Panasonic™, Sanyo Denki™, Tamagawa™
- Analog Sin/Cos Encoder
- Digital Quad A/B/X Encoder
- Secondary Encoder/Emulated Output
- Digital Halls

I/O

- 1 Analog Input ±10V, 16-bit
- 7 High-Speed Digital Inputs
- 6 High-Speed Digital Outputs
- High-Speed Pulse-at-Position
- SLI Support: DOUT4~6, IN7
- I/O Expansion

Safe Torque Off (STO)

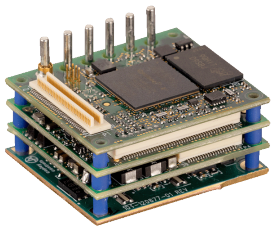
- SIL 3, Category 3, PL e

Dimensions: in [mm]

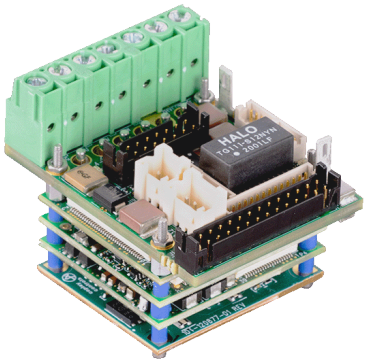
- NEP: 1.38 x 1.18 x 0.86 in [35 x 30 x 21.8 mm], 1.2 oz [0.034 kg]
- NEP-Z:1.85 x 1.38 x 1.32 in [47 x 35 x 33.6 mm], 2.0 oz [0.057 kg]
- NEP-D:3.83 x 6.05 x 1.77 in [97.2 x 153.7 x 45 mm], 11.5 oz [0.326 kg]
  Optional heatsink weight: 0.58 oz [0.016 kg]

EtherCAT®

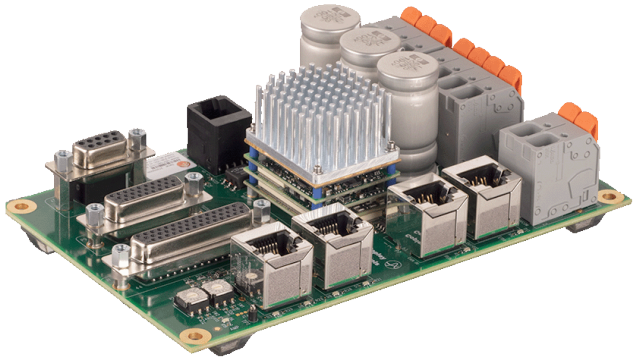
NEP



NEP-Z



NEP-D



Model	Ic	Ip	Vdc
NEP-090-10	5	10	9~90
NEP-090-70	35	70	9~90
NEP-180-10	5	10	20~180
NEP-180-30	15	30	20~180

Note: The -D & -Z models include the same ratings.
Append -D for Module/Dev Board Assy [-D]
Append -Z for Module/OEM Board Assy [-Z]
Note: For NEP-090-70-D and NEP-090-180-30-D assemblies, heatsinks are installed at the factory.

Description

The Nano[Plus] is the smallest servo drive that Copley offers. It can be mounted directly on the motor or within the robotic joints. This drive complies with the requirements of the robotics, AGV, industrial machinery, medical/life-sciences and aerospace industries. It can be mounted to the user PC boards using either connectors, or it can be soldered into the board.

An optional interface board provides connectors which simplify the integration into customer applications. The Nano has a third party approved STO feature. Opto-isolators provide connections to user wiring and controls.

DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

GENERAL SPECIFICATIONS

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

MODEL	NEP-090-10 NEP-090-10-D NEP-090-10-Z	NEP-090-70 NEP-090-70-D NEP-090-70-Z	NEP-180-10 NEP-180-10-D NEP-180-10-Z	NEP-180-30 NEP-180-30-D NEP-180-30-Z	Units
OUTPUT POWER					
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	2.7	kW
	*Note: NEP-090-70 must be soldered to a mounting PCBA to meet this output.				
INPUT POWER					
HVmin to HVmax	+9 to +90	+9 to +90	+20 to +180	+20 to +180	Vdc, transformer-isolated
+HV Absolute Max.	+95	+95	+185	+185	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 Absolute Max.	+60	+60	+60	+60	Vdc, transformer-isolated
VLOGIC Power	4 W with no encoder, 8 W with encoder +5V @ 500 mA.				
PWM OUTPUTS					
Type	MOSFET 3-phase inverter, 16 kHz center-weighted PWM carrier, space-vector modulation				
PWM Ripple Frequency	32 kHz				
Minimum Load Inductance	200 µH				
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					
EtherCAT	CANopen application protocol over EtherCAT (CoE): Cyclic Synchronous Position/Velocity/Torque, Profile Position/Velocity/Torque, Interpolated Position (PVT), Homing, Cyclic Synchronous Torque with Commutation Angle (CSTCA)				
Stand-Alone Mode:					
Digital Position Reference	Pulse/Direction, CW/CCW	Stepper commands (4 MHz maximum rate)			
	Quad A/B Encoder	10 M line/sec, 40 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				
Analog	Current, Velocity, Profile Velocity, Position				
DIGITAL INPUTS NEP					
Number	7				
IN1~4, 6	General purpose inputs High speed LVC CMOS 3.3V Schmitt trigger, 5V compatible, 100 ns RC filter, 10 kΩ pull-up to +5 Vdc, max. voltage = +6 Vdc, 1.42~2.38 Vdc positive-going threshold, 0.70~1.44 Vdc negative-going threshold RC time-constant assumes active drive on inputs and does not include 10 kΩ pull-ups.				
IN5	Motor overtemperature, LV CMOS 5V Schmitt trigger, 100 µs RC filter, 1.6 kΩ pull-up to +5 Vdc, max. voltage = +6 Vdc, 2.53~3.43 Vdc positive-going threshold, 1.25~2.20 Vdc negative-going threshold Also, connected to an ADC channel for continuous signal acquisition.				
IN7	High speed 5V AHCT TTL Schmitt trigger, 100 ns RC filter, 10 kΩ pull-up to +5V, max. voltage = +6 Vdc 2.00 Vdc min. positive-going threshold, 0.55 Vdc max. negative-going threshold Programmable as SLI Function: SLI_MISO				
DIGITAL INPUTS NEP-D					
IN1~2	HC CMOS 5.0V Schmitt trigger, 24V compatible, 1 µs RC filter, 10 kΩ pull-up to +5 Vdc, max. voltage = +30 Vdc, 2.53~3.50 Vdc positive-going threshold, 1.25~2.20 Vdc negative-going threshold				
IN3~4	High speed LVC CMOS 3.3V Schmitt trigger, 5V compatible, 100 ns RC filter, 10 kΩ pull-up to +5 Vdc, max. voltage = +6 Vdc, 1.42~2.38 Vdc positive-going threshold, 0.70~1.44 Vdc negative-going threshold				
IN5	Motor overtemperature, LV CMOS 5V Schmitt trigger, 100 µs RC filter, 1.6 kΩ pull-up to +5 Vdc, max. voltage = +6 Vdc, 2.53~3.43 Vdc positive-going threshold, 1.25~2.20 Vdc negative-going threshold Also connected to an ADC channel for continuous signal acquisition.				
IN6	Not available as an input. It is driven by an IC that checks the states of the ENCA and ENCB encoder signals. If errors are found, IN6 will go TRUE, disabling the drive.				
IN7	High speed 5V AHCT TTL Schmitt trigger, 100 ns RC filter, 10 kΩ pull-up to +5V, max. voltage = +6 Vdc				
DIGITAL INPUTS NEP-Z					
IN1~2	HC CMOS 5.0V Schmitt trigger, 24V compatible, 1 µs RC filter, 10 kΩ pull-up to +5 Vdc, max. voltage = +30 Vdc, 2.53~3.50 Vdc positive-going threshold, 1.25~2.20 Vdc negative-going threshold				
IN3~4	High speed LVC CMOS 3.3V Schmitt trigger, 5V compatible, 100 ns RC filter, 10 kΩ pull-up to +5 Vdc, max. voltage = +6 Vdc, 1.42~2.38 Vdc positive-going threshold, 0.70~1.44 Vdc negative-going threshold				
IN5	Motor overtemperature, LV CMOS 5V Schmitt trigger, 100 µs RC filter, 1.6 kΩ pull-up to +5 Vdc, max. voltage = +6 Vdc, 2.53~3.43 Vdc positive-going threshold, 1.25~2.20 Vdc negative-going threshold Also connected to an ADC channel for continuous signal acquisition.				
IN6	Not available as an input. It is driven by an IC that checks the states of the ENCA and ENCB encoder signals. If errors are found, IN6 will go TRUE, disabling the drive.				
IN7	High speed 5V AHCT TTL Schmitt trigger, 100 ns RC filter, 10 kΩ pull-up to +5V, max. voltage = +6 Vdc				

DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

DIGITAL OUTPUTS	
Number	6
OUT1~3	CMOS +5 Vdc inverters, 4.99 kΩ pull-up to 3.3 Vdc, functions programmable Source -8 mA @ VOH > 3.94 Vdc, Sink 8 mA @ VOL < 0.36 Vdc
OUT3	With NEP-D attached: Firmware controls duty-cycle for PWM braking.
OUT4~6	HS CMOS +3.3 Vdc inverters, functions programmable Source -16 mA @ VOH ≥ 2.4 Vdc, Sink 16 mA @ VOL ≤ 0.4 Vdc General purpose programmable or SLI functions: OUT4 = SLI_MOSI, OUT5 = SLI_CLK, OUT6 = SLI_EN1
ANALOG INPUT	
Number	1
Type	Differential, ±10 Vdc range, 5.1 kΩ input impedance, 16 bits, single-pole, -3 dB @ 1450 Hz input filter
Function	Torque, Velocity, Position command or as general purpose analog input
SERIAL COMMUNICATION PORT	
Signals	RS-232: RxD, TxD, SGND
Mode	Full-duplex, DTE serial communication port for drive setup and control, 9,600 to 230,400 Baud
Protocol	ASCII or Binary format
Isolation	Non-isolated. Referenced to Signal Ground.
ETHERCAT PORT	
Format	100BASE-TX
Protocol	EtherCAT, CANopen Application Protocol over EtherCAT (CoE)
Isolation	External magnetics required for module. NEP-D and NEP-Z have internal magnetics. Max. voltage with respect to grounds: 32 Vdc
MOTOR CONNECTIONS	
Motor U,V,W	Drive outputs to 3-phase brushless motor, Wye or delta connected DC brush motors use outputs U & V. Minimum inductance: 200 µH line-line
Encoder	Digital encoders, incremental and absolute (See FEEDBACK below). Analog Sin/Cos incremental
Halls	Digital U/V/W, 120°
Motemp	Input is programmable to disable the drive if the motor sensor drives input HI or LO.
FEEDBACK	
Incremental Encoders:	
Digital Incremental Encoder	Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required). 5 MHz maximum line frequency (20 Hz counts/sec) 1 kΩ pull-up on (+), 1 kΩ pull-down on (-) input VT+ = 1.2~2.0 Vdc min., VT- = 0.8~1.5 Vdc max., VH = 0.3 ~ 1.2 Vdc
Analog Incremental Encoder	Sin/Cos format (Sin+, Sin-, Cos+, Cos-), differential, 1 Vpeak-peak ±20% BW > 300 kHz, 16-bit resolution, with zero-crossing detection
Absolute Encoders:	
EnDat, SSI, CSR	Serial Clock (X, /X), and Data (A, /A) signals
Absolute A	SD+, SD- (A, /A) signals, 2.5 or 4 MHz, half-duplex, 32 bit
BiSS	MA+, MA- (X, /X), SL+, SL- (A, /A) signals, clock output from drive, data returned from encoder.
Terminators	All encoder data inputs and clock outputs are differential and require external terminators.
Commutation	Hall signals (U,V,W), 15 kΩ pull-up to +5V, 15 kΩ/100 pF RC to 74LVC3G14 Schmitt trigger at +5 Vcc
Encoder Power	+5 Vdc ±2% @ 250 mAdc max., shared by dual encoders.
HALLS	
Digital U-V-W	Single-ended, 120° electrical phase difference Schmitt trigger, 1.5 µs RC filter from active HI/LO sources, 5 Vdc compatible 15 kΩ pull-up to +5 Vdc, 74LVC, 3.3 V thresholds
5V OUTPUT	
Number	2
Ratings	500 mA maximum. Protected for overload or shorts. Shared by dual encoders.

DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

SAFE TORQUE OFF(STO)

Function	PWM outputs are inactive and the current to the motor will not be possible when the STO function is active.
Safety Integrity Level	SIL 3, Category 3, Performance level 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.
STO_STATUS_OUTPUT	STO status feedback, non-functional safety specified.

PROTECTIONS

HV Overvoltage	+HV > +95 ±1 Vdc	Drive outputs turn Off until +HV is < +95 ±1 Vdc (90 V models).
	+HV > +185 ±1 Vdc	Drive outputs turn Off until +HV is < +185 ±1 Vdc (180 V models).
HV Undervoltage	+HV < +9.0 Vdc ±1 Vdc	Drive outputs turn Off until +HV is > +8.5 Vdc ±0.5 Vdc (90 V models).
	+HV < +20 Vdc ±1 Vdc	Drive outputs turn Off until +HV is > +19.5 Vdc ±0.5 Vdc (180 V models).
Drive Over Temperature	PC Board > 90 °C +3/-0 ºC	Programmable as latching or temporary fault.
Short Circuits	Output to output, output to ground, internal PWM bridge faults	
I^2T Current Limiting	Programmable: continuous current, peak current, peak time for drive and motor	
Latching / Non-Latching	Programmable response to errors.	

MECHANICAL & ENVIRONMENTAL

Size, Weight	NEP: 1.38 x 1.18 x 0.86 in [35 x 30 x 21.8 mm], 1.2 oz [0.34 kg] NEP-Z: 1.85 x 1.38 x 1.32 in [47 x 35 x 33.6 mm], 2.0 oz [0.57 kg] NEP-D: 3.83 x 6.05 x 1.77 in [97.2 x 153.7 x 45 mm], 11.5 oz [0.326 kg] *Optional heat sink add: 0.58 oz [0.016 kg]
Ambient Temperature	Operating: 0 to +45 °C, Storage: -40 to +85 °C
Humidity	0 to 95%, non-condensing
Altitude	≤ 2000 m (6,500 ft)
Vibration	2 *g* peak, 10~500 Hz (Sine)
Shock	10 *g*, 10 ms, ½ Sine pulse
Contaminants	Pollution Degree 2

AGENCY STANDARDS CONFORMANCE

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

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

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

Restriction of the Use of Certain Hazardous Substances (RoHS)
- Directive 2011/65/EU and its amendments 2015/863/EU

Approvals
- UL 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

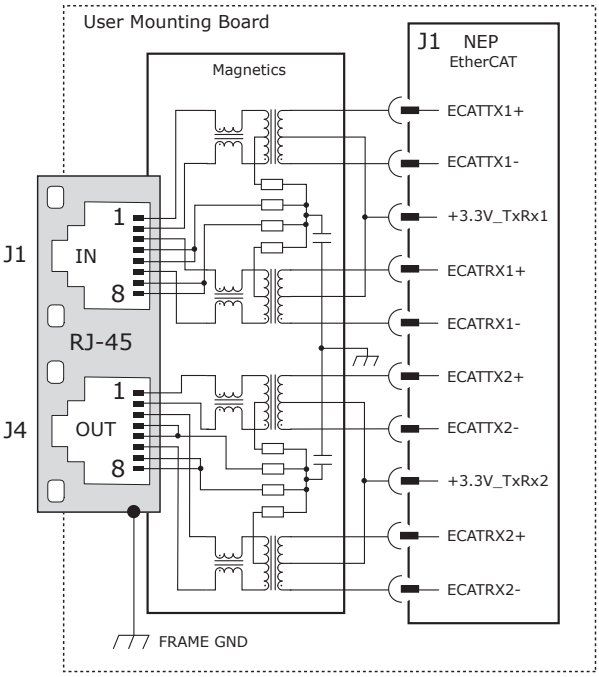
RoHS Directive 2011/65/EU is now part of the CE marking procedure.

DANGER	***Refer to the Copley NANO^{Plus} User Guide for NANO Family, (Part Number: 16-138296).***
	For information on any application using the NANO drive STO feature, refer to the ***Copley NANO^{Plus} User Guide for NANO Family*** *(PN: 16-138296)*. ***Failure to heed this warning can cause equipment damage, injury, or death.***

ETHERCAT COMMUNICATIONS

EtherCAT is the open, real-time Ethernet network developed by Beckhoff based on the widely used 100BASE-TX cabling system. EtherCAT enables high-speed control of multiple axes while maintaining tight synchronization of clocks in the nodes.

Data protocol is CANopen application protocol over EtherCAT (CoE) based on CiA 402 for motion control devices. More information on EtherCAT can be found on this web-site: *https://ethercat.org.*



NETWORK RJ-45

IN Name	Pin	OUT Name
ECATTX1+	1	ECATTX2+
ECATTX1-	2	ECATTX2-
ECATRX1+	3	ECATRX2+
R/C	4	R/C
	5	
ECATRX1-	6	ECATRX2-
R/C	7	R/C
	8	

DRIVE J1

Signal	Pin
ECATTX1+	27
ECATTX1-	29
+3.3V_TXRX1	19
ECATRX1+	24
ECATRX1-	26
ECATTX2+	23
ECATTX2-	25
+3.3V_TXRX2	21
ECATRX2+	20
ECATRX2-	22

RS-232 COMMUNICATIONS

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

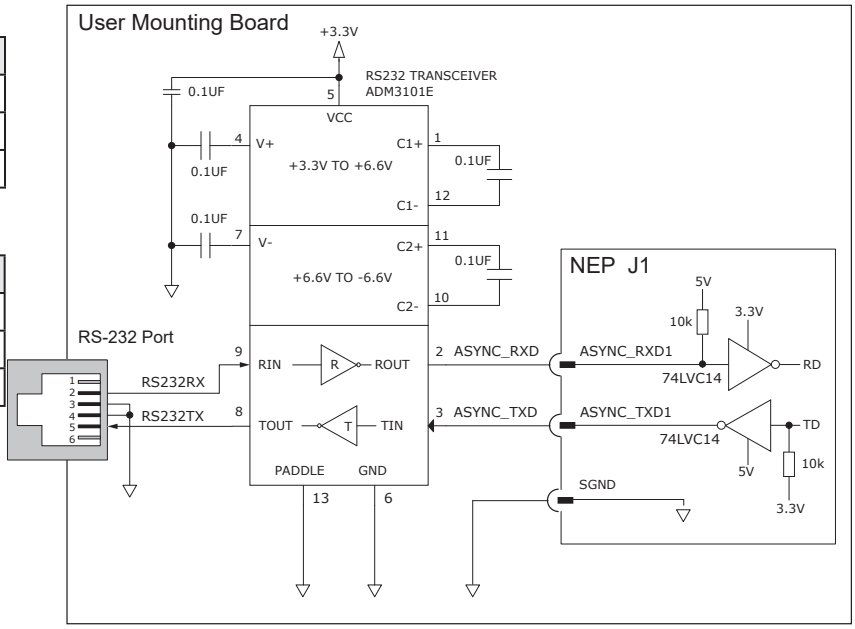
In the following diagram, the circuit shown is used on the NEP-D and it is recommended for the user's PC boards. It converts the single-ended TTL signals levels in the NEP into the ANSI RS-232 levels which are the standard for serial communications and computer COMM ports.

RS-232 PORT

Signal	Pins
RS232RX	2
RS232TX	5
SGND	3,4

DRIVE J1

Signal	Pins
ASYNC_RXD1	28
ASYNC_TXD1	30
SGND	40



WARNING

Refer to NANO NEP/NPP Reference Designs & Drawings.

Do not use 5V RS232 logic with module 3.3V logic RxD and TxD. Use ANSI RS232 Transceiver logic RS232RX and RS232TX.

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 (for example, the current is flowing in the input diodes), the control core is enabled to control the ON/OFF state of the PWM outputs to produce torque in the motor.

INSTALLATION

DANGER	***Refer to the Copley NANO^{Plus} User Guide for NANO Family, (Part Number: 16-138296).***
	For information on any application using the NANO drive STO feature, refer to the ***Copley NANO^{Plus} User Guide for NANO Family*** *(PN: 16-138296)*. ***Failure to heed this warning can cause equipment damage, injury, or death.***

STO DISABLE

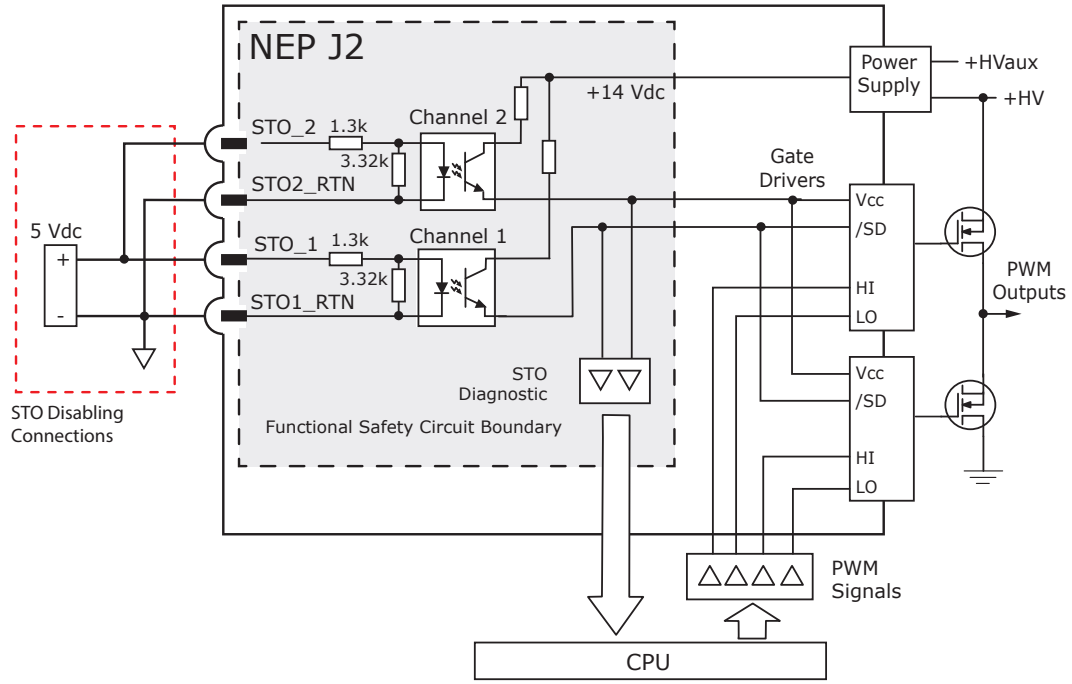
In order for the PWM outputs of the NEP to be activated, the current must be flowing through the opto-couplers that are connected to the STO1_IN and STO2_IN terminals and the drive must be in an ENABLED state. When either of the opto-couplers are OFF, the drive is in a Safe Torque OFF (STO) state and 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 the STO feature is not used, these connections must be made in order for the drive to be enabled.

STO DISABLE CONNECTIONS

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

FUNCTIONAL DIAGRAM



J2 STO

Name	Pin		Name
STO1_IN	1	2	STO1_RTN
STO2_IN	3	4	STO2_RTN
STO1_STATUS_OUTPUT	5	6	STO1_STATUS_OUTPUT_RTN

STO OPERATION

STO Input Voltage	STO State
STO1_IN *AND* STO2_IN ≥ 3.0 Vdc	STO Inactive. Drive can be enabled to produce torque.
STO1_IN *OR* STO2_IN ≤ 0.8 Vdc	STO Active. Drive cannot be enabled to produce torque.
STO1_IN *OR* STO2_IN Open	

NOTE: In the above table, the voltages are referenced between a STOx_IN and a STOx_RTN.
For example, V(STO1) = V(STO1_IN) - V(STO1_RTN)
The maximum voltage allowed for the STO inputs are 7.0 VDC.

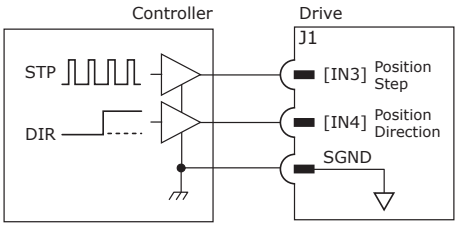
DIGITAL COMMAND INPUTS: POSITION

STAND-ALONE MODE DIGITAL POSITION-CONTROL INPUTS

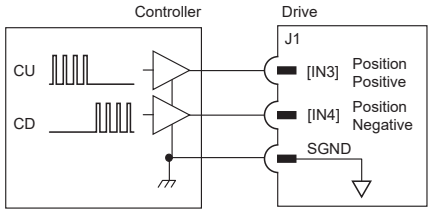
NEP works with motion controllers that output pulses to command position. The following formats are supported:

- Step/Direction
  In Step/Direction mode, a pulse-train controls motor position, and the direction is controlled by a DC level at the Direction input.
- Count-Up/Count-Down (CU/CD)
  CU/CD (Count-Up/Count-Down) signals command the motor to move CW or CCW depending on to which input the pulse-train is directed.
- A/B Quadrature Encoder
  In the A/B Quadrature Encoder mode, the motor can 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.

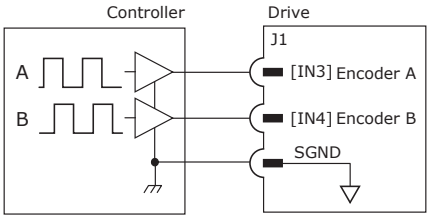
STEP/DIRECTION INPUTS



COUNT-UP/COUNT-DOWN INPUTS



QUAD A/B ENCODER INPUTS



Command Options	Name	J1 Pins
Step, Count Up, Encoder A	IN3	7
Direction, Count Down, Encoder B	IN4	8

J1 SGND Pins
3,4,18,39,40,44,45,56,57

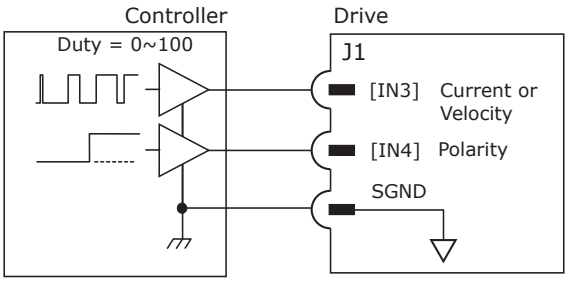
DIGITAL COMMAND INPUTS: VELOCITY, TORQUE

STAND-ALONE MODE DIGITAL VELOCITY-TORQUE INPUTS

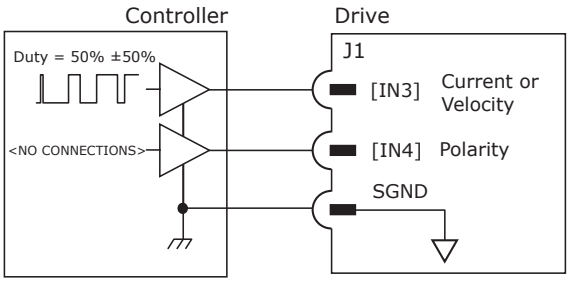
NEP works with the motion controllers that output pulses to the command Velocity or Torque. The following formats are supported:

- Pulse/Direction
  In Pulse/Direction mode, a pulse-train with variable duty cycle on IN3 controls Velocity or Torque from 0~100%.
  -IN4 HI or LO controls the direction of the Velocity or polarity of the Torque.
- PWM 50%
  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	J1 Pins
PWM Vel/Trq, PWM Vel/Trq & Direction	IN3	7
PWM/Dir Polarity, (none)	IN4	8

HIGH SPEED INPUTS: IN1, IN2, IN3, IN4, IN6, IN7

The six digital inputs to the NEP can be programmed to a selection of functions. All inputs include the following:

- 100 ns RC filters when they are driven by the active sources (CMOS, TTL, etc.).
- 10 kΩ pull-up resistors to +5 Vdc.

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

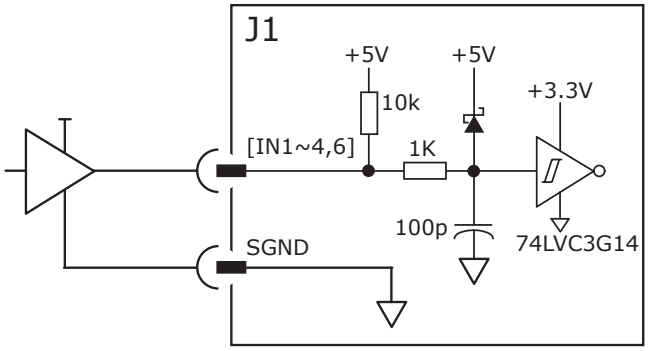
In addition to the selection of functions, the active level for each input is individually programmable. Input level functions have programmable HI or LO to activate the function. Input transition functions are programmable to activate on LO -> HI, or HI -> LO transitions.

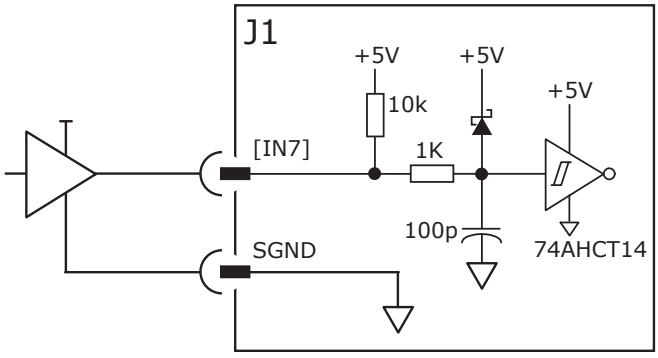
INPUT TRANSITION FUNCTIONS

- 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

Inputs IN1~4, and IN6 have 100 nanosecond rise time RC filters, each input with a 10 kΩ pull-up resistor to +5 VDC.

IN7 has the same input network, but the interface IC is a 74AHCT14BQ powered with 5.0 Vdc.





SPECIFICATIONS

Input	Data	Notes
Input Voltages IN1~4,6	HI	V_T+ ≥ 1.42~2.38 Vdc
	LO	V_T- ≤ 0.70~1.44 Vdc
	Max	+6 Vdc
	Min	0 Vdc
Input Voltage IN7	HI	V_T+ ≥ 2.00 Vdc
	LO	V_T- ≤ 0.55 Vdc
	Max	+6 Vdc
	Min	0 Vdc
Pull-up	R1	10 kΩ
Low Pass Filter	R2	1 kΩ
	C1	100 pF
	RC	100 ns

CONNECTIONS

Name	J1 Pins
IN1	5
IN2	6
IN3	7
IN4	8
IN6	10
IN7	11

J1 SGND Pins
3,4,18,39,40,44,45,56,57

WARNING	***For information on Adapting 24V logic to 5V logic, consult the Factory.***
	5V logic. Do not exceed 6V. Do not connect a 24V logic to this input. Refer to page 24 that shows the circuit for 24V inputs.

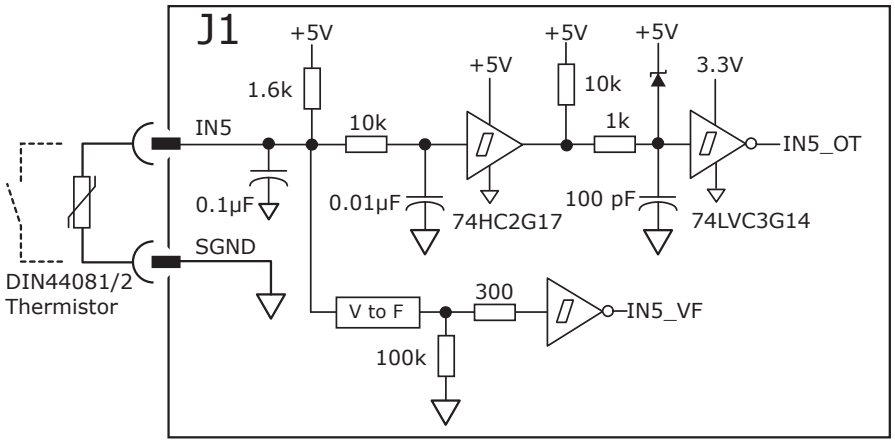
MOTOR OVERTEMP INPUT: IN5

Input IN5 has a 100 microsecond rise time RC filter, with a 1.6 kΩ pullup resistor to +5 VDC. If it is not used for the Motemp function, IN5 can be re-programmed for other input functions. The input network is the default used for a DIN44081/2 type PTC thermistor mounted in a motor.

IN5_VF has a voltage-to-frequency [V to F] converter. It connects to the FPGA where the frequency decodes to a voltage. By using this converter, it can be configured to work with thermistors to protect motors and/or loads. Use the Copley software to select the input to be used for the motor overtemp protection.

CONNECTIONS

Signal	J1 Pins
IN5	9



ANALOG INPUT: AIN1

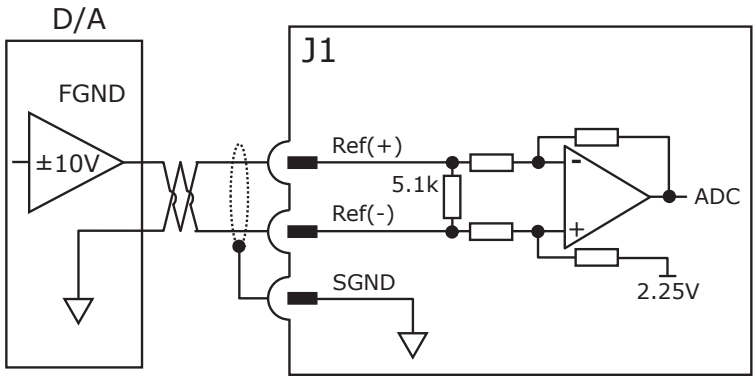
As a reference input, the AIN1 takes Position/Velocity/Torque commands from a controller.

If it is not used as a command input, it can be used as general-purpose analog input.

SPECIFICATIONS

Specifications	Data	Notes
Input Voltage	Vref	±10 Vdc
Input Resistance	Rin	5.1 kΩ

Signal	J1 Pins
Ref(+)	2
Ref(-)	1



DIGITAL OUTPUTS: OUT1~OUT3

Digital outputs [OUT1~3] are CMOS inverters. They operate from +5V and can source/sink 8 mAdc.

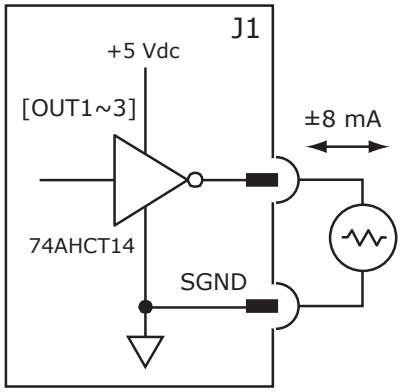
OUTPUT FUNCTIONS

- Fault
- Custom Event
- PWM Sync
- Custom Trajectory Status
- Custom Position-Triggered Output
- Program Control
- Brake Control

Name	J1 Pins
OUT1	13
OUT2	12
OUT3	15

J1 SGND Pins
3,4,18,39,40,44,45,56,57

In the following diagram, the output functions shown are programmable to turn the output On (HI) or Off (LO) when they are active.



DIGITAL OUTPUTS: OUT4~OUT6

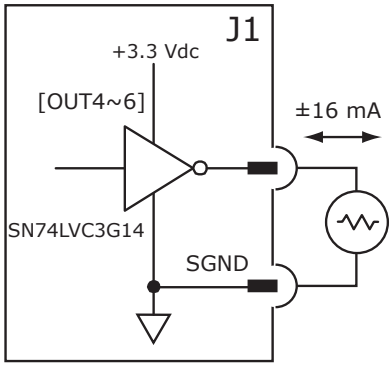
Digital outputs [OUT4~6] are CMOS inverters. They operate +3.3V and can source/sink 16 mAdc.

OUTPUT FUNCTIONS

- Fault
- Custom Event
- PWM Sync
- Custom Trajectory Status
- Custom Position-Triggered Output
- Program Control

Name	J1 Pins
OUT4	14
OUT5	17
OUT6	16

In the following diagram, the output functions shown are programmable to turn the output On (HI) or Off (LO) when it is active.



SLI: DOUT4, DOUT5, DOUT6, IN7

The three outputs and one input operate as an SLI (Switch and LED Interface) port for controlling LEDs and reading the settings of the network address switches. In the following diagram, it shows the outputs/input in the SLI mode.

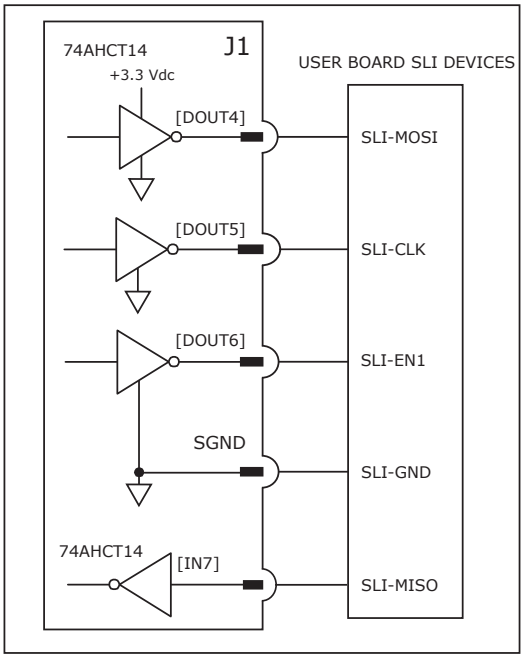
OUTPUT FUNCTIONS

- Fault
- Brake
- Custom Event
- PWM Sync
- Custom Trajectory Status
- Custom Position-Triggered Output
- Program Control

J1 SGND Pins
3,4,18,39,40,44,45,56,57

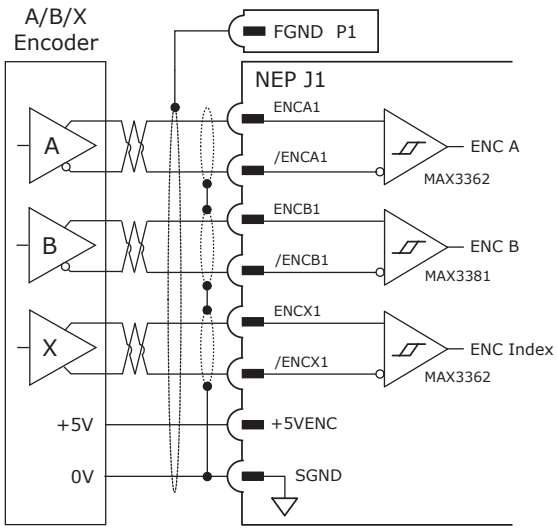
SLI Port	Signal	J1 Pins
SLI-MOSI	DOUT4	14
SLI-CLK	DOUT5	17
SLI-EN1	DOUT6	16
SLI-GND	SGND	18
SLI-MISO	IN7	11

If they are not used for SLI, they are programmable for other functions to turn the output On (HI) or Off (LO) when they are active. [IN7] is shown in the diagram as part of the SLI function.



ENCODER 1 (PRIMARY FEEDBACK)

QUAD ENCODER WITH INDEX



A/B/X SIGNALS

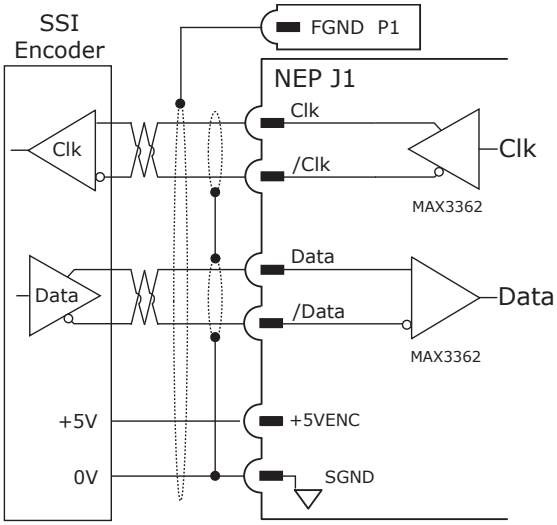
Signal	J1 Pins
ENCA1	51
/ENCA1	50
ENCB1	53
/ENCB1	52
ENCX1	55
/ENCX1	54
+5VENC	64, 66

FRAME GROUND
P1

J1 SGND Pins
3,4,18,39,40,44,45,56,57

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 NEP drive provides a train of clock signals in differential format that are sent to the encoder which initiates the transmission of the position data on the subsequent clock pulses. The number of encoder data bits and counts per motor revolution are programmable. The hardware bus consists of two signals: SCLK and SDATA. The SCLK signal is only active during transfers. Data is clocked in on the falling edge of the clock signal.



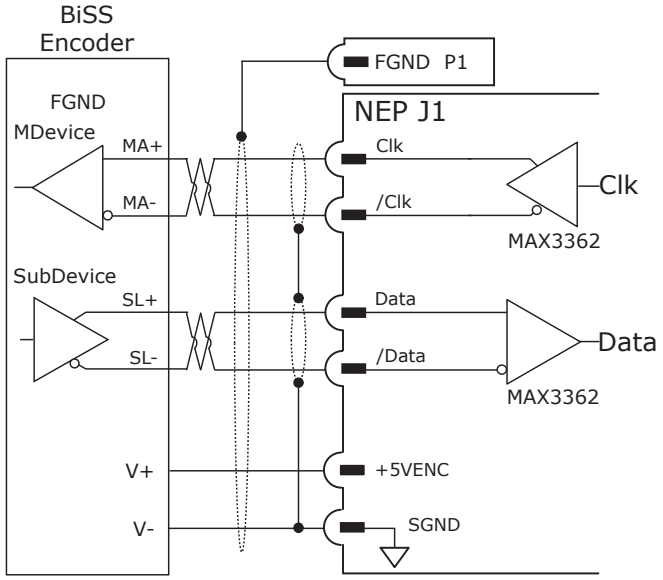
SSI, BiSS SIGNALS

SSI	BiSS	Signal	J1 Pins
Clk	MA+	ENCX1	55
/Clk	MA-	/ENCX1	54
Data	SL+	ENCA1	51
/Data	SL-	/ENCA1	50
+5VENC			64,66

BiSS ABSOLUTE ENCODER

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

- Serial Synchronous Data Communication
- Cyclic at high speed
- 2 Unidirectional Lines Clock and Data
  - -Line delay compensation for high speed data transfer
  - -Request for data generation at slaves
  - -Safety capable: CRC, Errors, Warnings
  - -Bus capability including actuators
- Bidirectional
  - -BiSS C-protocol: Continuous mode



NOTE: Connect Single (outer) shields at the drive end. Connect Inner (shields to the Signal Ground on the drive.

ENCODER 1 (PRIMARY FEEDBACK)

ENDAT ABSOLUTE ENCODER

The EnDat interface is a Heidenhain interface that functions similar to SSI in the use of clock and data signals. In addition, it supports analog Sin/Cos channels from the same encoder.

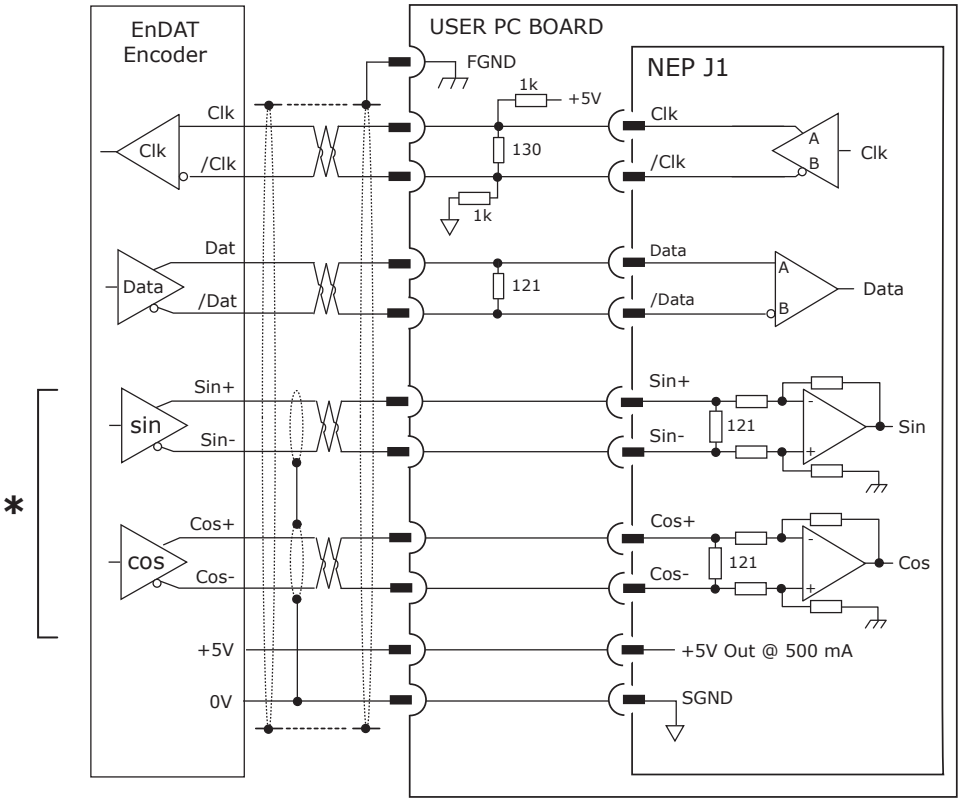
The number of position data bits are programmable and so are the use of Sin/Cos channels. In the EnDat specification, using the Sin/Cos incremental signals is optional.

ENDAT SIGNALS

EnDAT	Signal	J1 Pins
Clk	ENCX1	55
/Clk	/ENCX1	54
Data	ENCA1	51
/Data	/ENCA1	50
Sin+*	SIN1+	46
Sin-*	SIN1-	47
Cos+*	COS1+	48
Cos-*	COS1-	49
+5V	+5ENC	64,66

*Note: In the EnDAT column, the Sin/Cos is optional with EnDat 2.2 or any 1 Mbit or faster.
If EnDat 2.1 < 1 Mbit, EnDat Sin/Cos is required.

J1 Signal Ground Pins
3,4,18,39,40,44,45,56,57



ABSOLUTE-A ENCODER

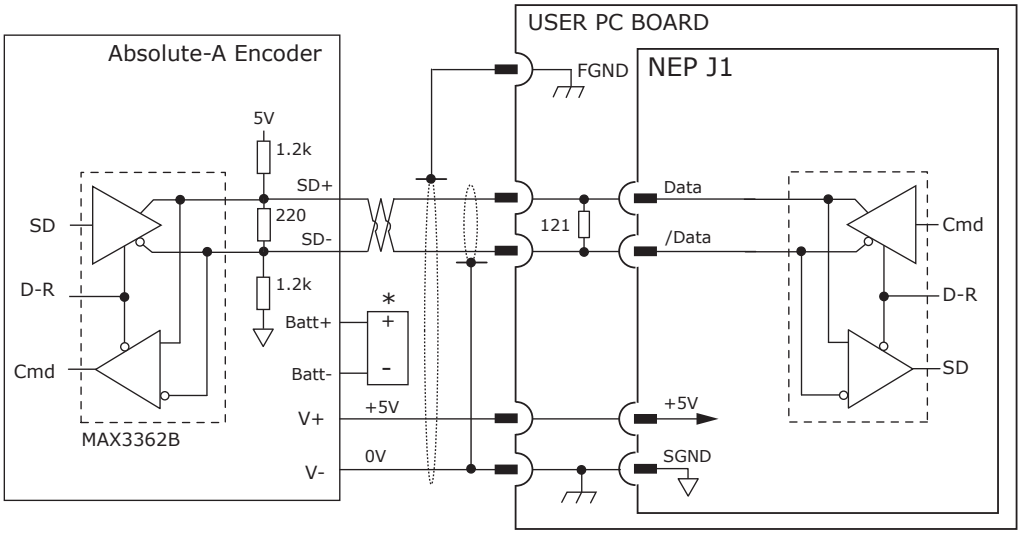
The Absolute A interface is a serial, half-duplex type that is electrically the same as the RS-485.

Note the battery which must be connected. Without the battery, the encoder will produce a fault condition.

ABSOLUTE-A SIGNALS

ABS-A	Signal	J1 Pins
Data	ENCA1	51
/Data	/ENCA1	50
+5V	+5ENC	64,66

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

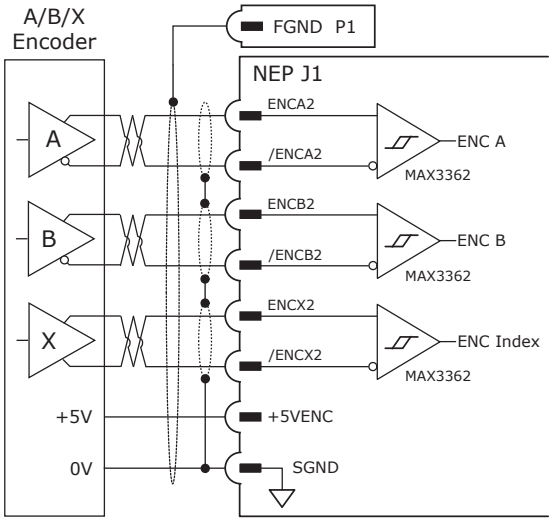


Note: Signal (outer) shields should be connected at the drive end. The inner shield is optional for digital encoders and should only be connected to Signal Ground on the drive.

ENCODER 2 (SECONDARY FEEDBACK)

QUAD ENCODER WITH INDEX

In the following diagram, it shows the secondary encoder connections. The secondary encoder only supports A/B/X incremental encoders.



The tables identify the signals and pins.

A/B/X SIGNALS

Signal	J1 Pins
ENCA2	59
/ENCA2	58
ENCB2	61
/ENCB2	60
ENCX2	63
/ENCX2	62
+5VENC	64, 66

FRAME GROUND
P1

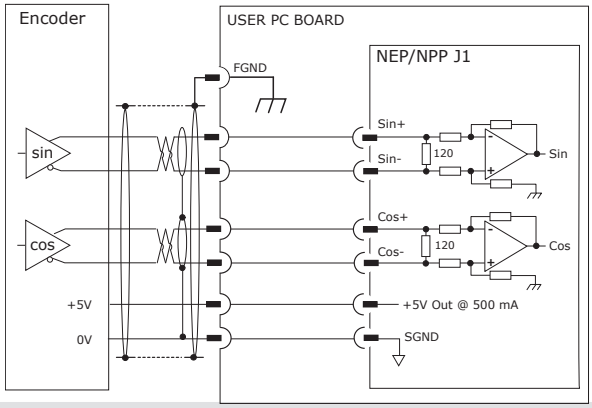
J1 SGND Pins
3,4,18,39,40,44,45,56,57

SIN/COS ENCODER

SIN/COS ENCODER

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

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

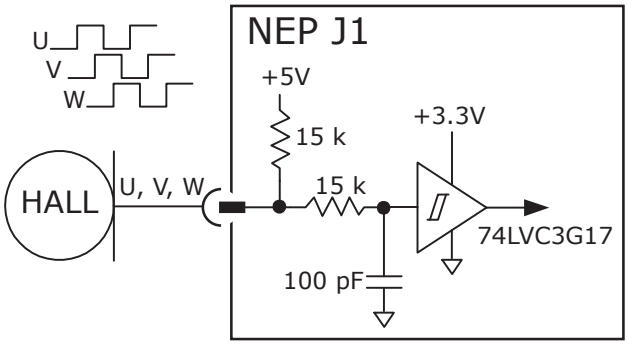


SIGNAL	J1 PINS
SIN1+	46
SIN1-	47
COS1+	48
COS1-	49
+5VENC	64, 66
SGND	56, 57

OTHER MOTOR CONNECTIONS

HALLS

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



HALL SIGNALS

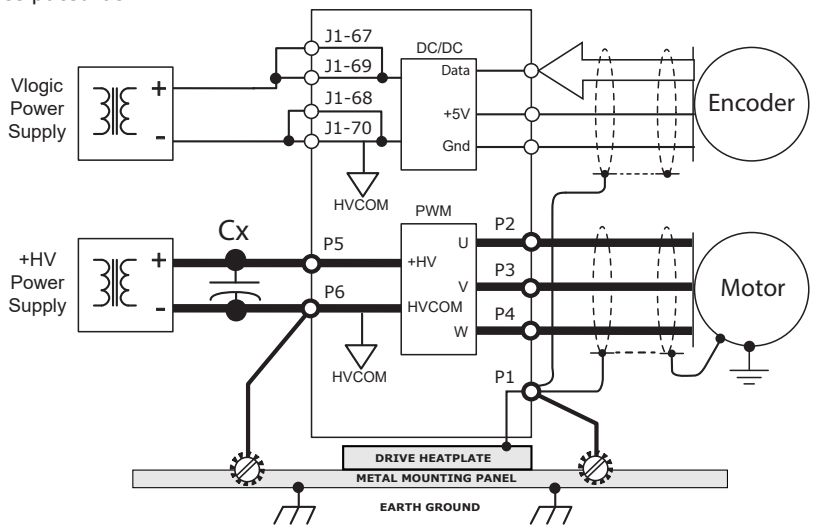
Signal	J1 Pins
HALLU	41
HALLV	42
HALLW	43

+HV CONNECTIONS

POWER SUPPLIES

The drive main power, +HV is typically supplied by unregulated DC power supplies. These power supplies must be isolated from the mains, and all circuits should be grounded from earth wired to HVCOM at the drive. The +HV power 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. It 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 HVCOM terminals.

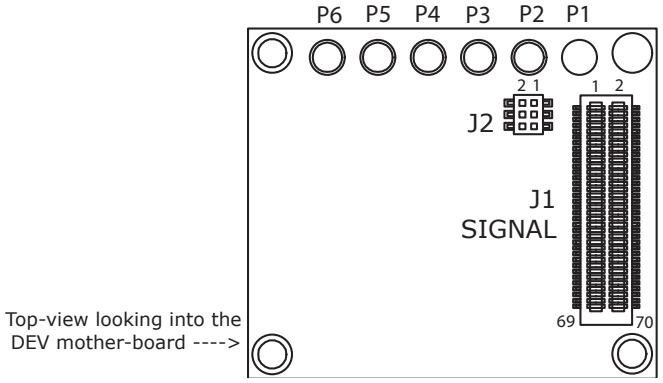


GROUNDING

The 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

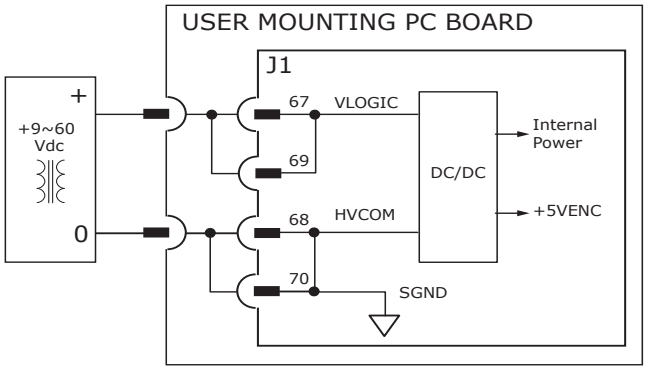
Signal	Pins
FGND	P1
MOTU	P2
MOTV	P3
MOTW	P4
+HV	P5
HVCOM	P6



VLOGIC CONNECTIONS

DESCRIPTION

VLOGIC is required for the operation of the drive. It powers the internal logic and the control circuits. Encoder +5V is derived from VLOGIC.
When the STO feature is used, 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.



J1 VLOGIC

Name	Pin		Name
VLOGIC	67	68	HVCOM
VLOGIC	69	70	HVCOM

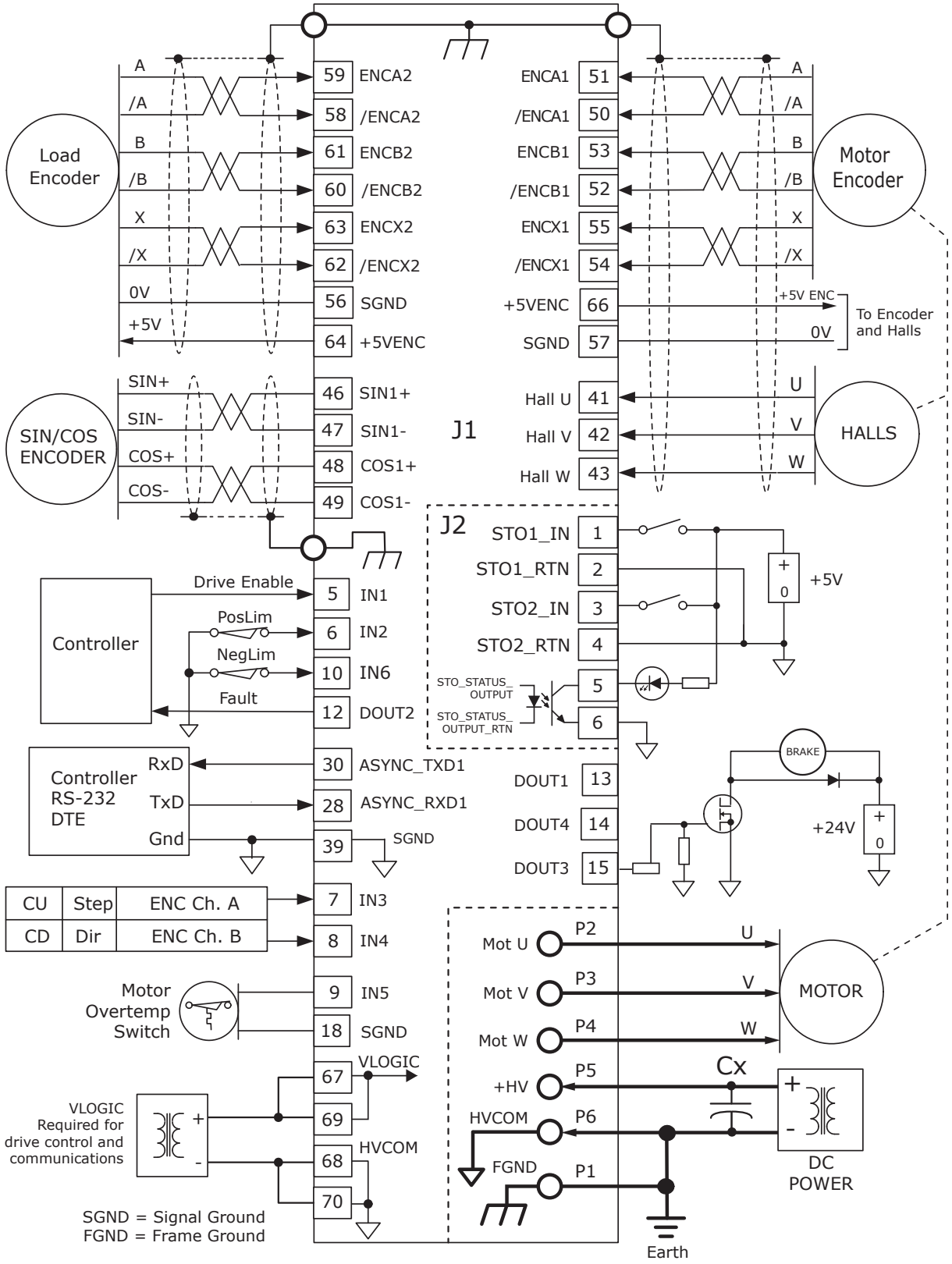
WARNING

Refer to the AN136 Accelnet External Regen Application Note, Part Number 16-125661.

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

NEP TYPICAL CONNECTIONS

The following diagram shows the NEP connections and identifies the pins and signals.

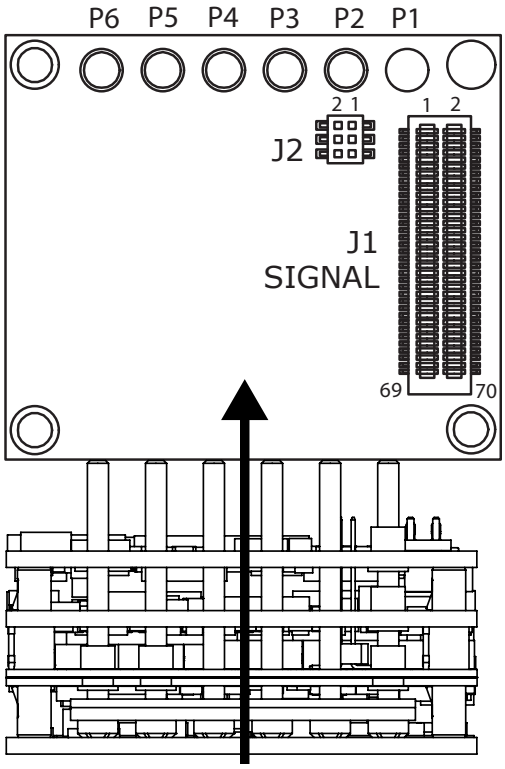


NEP Connections Diagram

PC BOARD CONNECTIONS

The following diagram shows the topside view of the pins and signals pointed downwards towards the PC user mounting board.

Signal	Pin
FGND	1
MOTU	2
MOTV	3
MOTW	4
+HV	5
HVCOM	6



Board Connections Diagram

J2 STO

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

J1 SIGNAL

Signal	Pin		Signal
REFIN1-	1	2	REFIN1+
SGND	3	4	SGND
[ENABLE] IN1	5	6	IN2
IN3	7	8	IN4
IN5	9	10	IN6
IN7	11	12	DOUT2
DOUT1	13	14	DOUT4
DOUT3	15	16	DOUT6
DOUT5	17	18	SGND
+3.3V_TXRX1	19	20	ECATRX2+
+3.3V_TXRX2	21	22	ECATRX2-
ECATTX2+	23	24	ECATRX1+
ECATTX2-	25	26	ECATRX1-
ECATTX1+	27	28	ASYNC_RXD1
ECATTX1-	29	30	ASYNC_TXD1
CAN_RX	31	32	ASYNC_RXD2
CAN_TX	33	34	ASYNC_TXD2
*HSTL_0P	35	36	HSTL_1P*
*HSTL_0N	37	38	HSTL_1N*
SGND	39	40	SGND
HALLU	41	42	HALLV
HALLW	43	44	SGND
SGND	45	46	SIN1+
SIN1-	47	48	COS1+
COS1-	49	50	/ENCA1
ENCA1	51	52	/ENCB1
ENCB1	53	54	/ENCX1
ENCX1	55	56	SGND
SGND	57	58	/ENCA2
ENCA2	59	60	/ENCB2
ENCB2	61	62	/ENCX2
ENCX2	63	64	+5VENC
N.C.	65	66	+5VENC
VLOGIC	67	68	HVCOM
VLOGIC	69	70	HVCOM

*NOTE: In the Signal column, the asterisk indicates do not connect to these pins. Consult the factory for AN146: IDC Inter-Drive Communication.

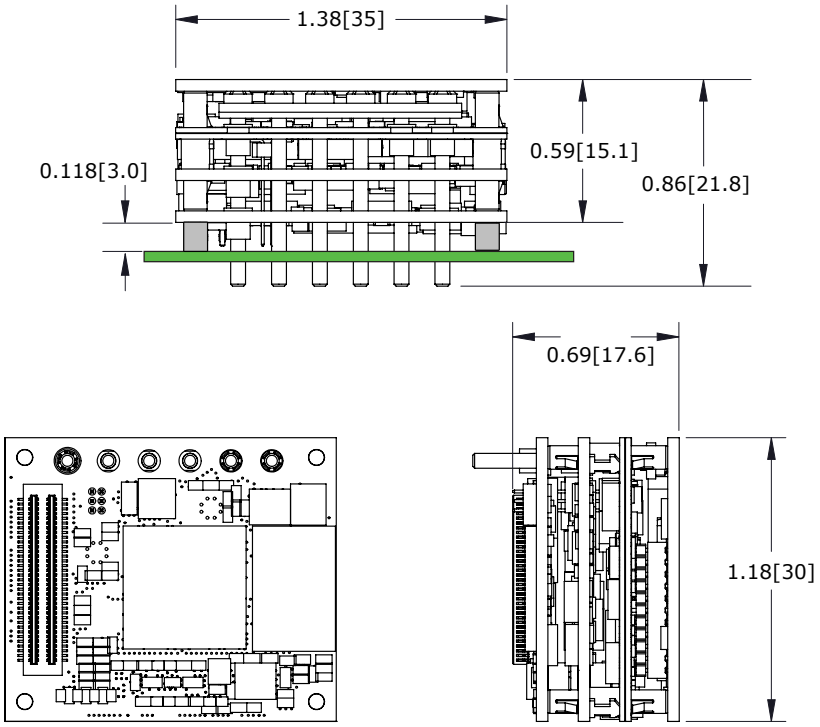
Ref Des	Label	Mfgr	Part Number *	Description	Qty
J1	Signal	WCON	3620-S070-022G3R02	Header, 70 pos, 0.5 mm pitch	1
J2	STO	WCON	2521-203MG3CUNR1	Header, 6 pos, 1 mm pitch	1
P1~P6	+HV, Motor	WINPIN	WP-WJ018G3R1	RCPTL Outer Sleeve Crown Spring	6

*NOTE: The Part Number column indicates the parts that require the purchase of reels for those components. Refer to the following vendor to contact for approved value-added partner Action Electronics.
Action Electronics, Inc.
Walpole, MA 02081-2522-US
Phone: (508) 668-5621

DIMENSIONS

NEP MODULE

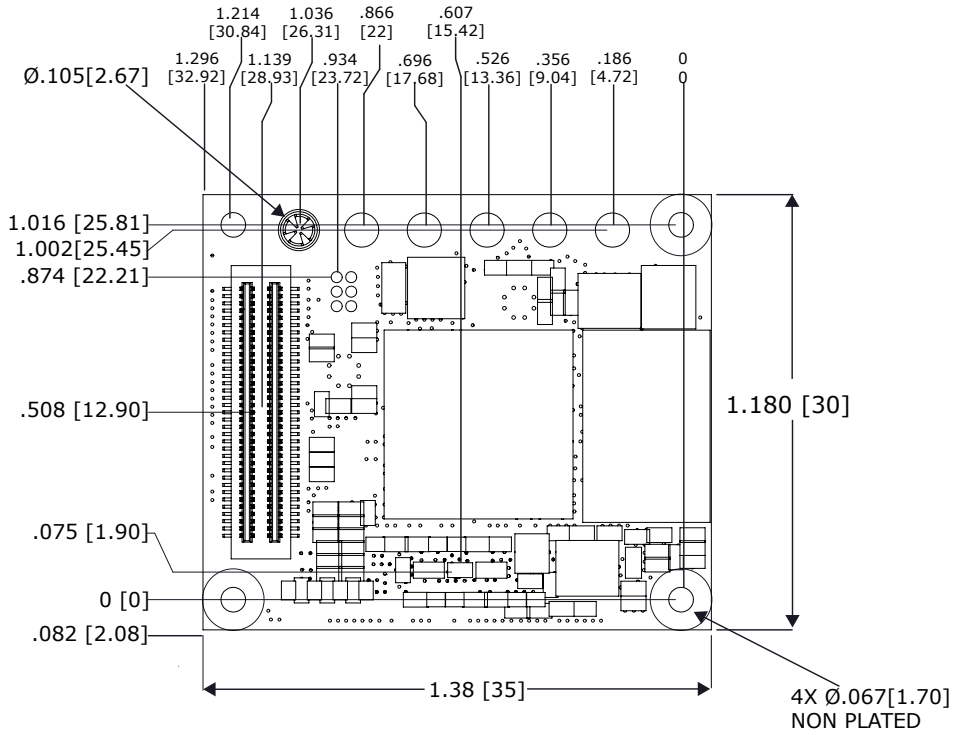
The following diagram shows the NEP module dimensions.



NEP Module Dimensions Diagram

PC BOARD MOUNTING DIMENSIONS

The following diagram shows the bottom surface dimensions on the PC user mounting board.



PC User Mounting Board Dimensions (Bottom View)

NEP-D BOARD

The NEP-D Board diagram shows the connections and board layout. The tables identify the signals and pins for each connector.

J4 +HV

Signal	Pin
PE	1
HVCOM	2
+HV	3

J5 MOTOR

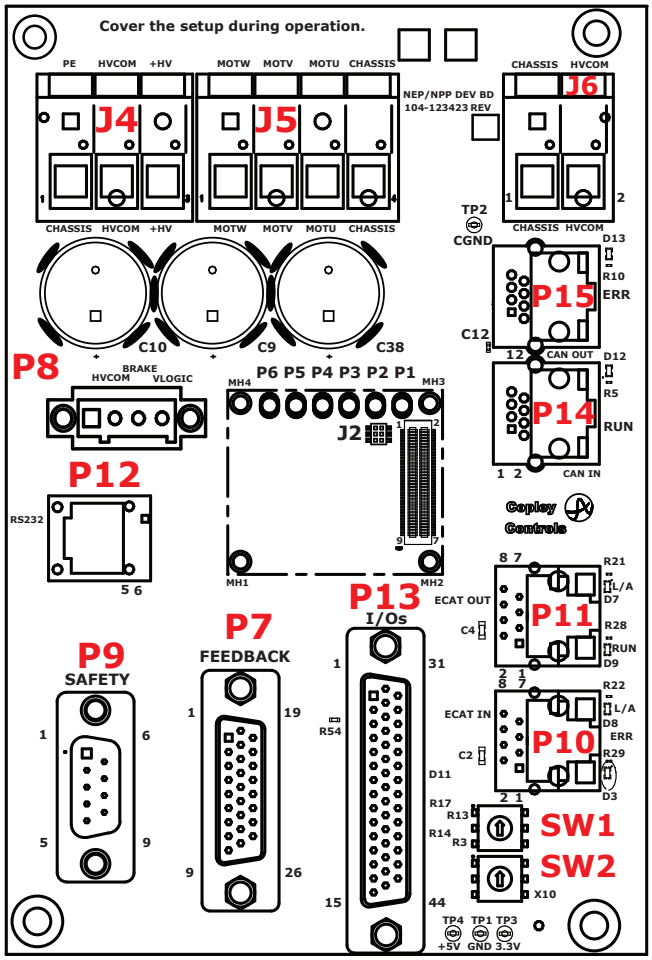
Signal	Pin
MOTW	1
MOTV	2
MOTU	3
FGND	4

P8 BRAKE

Signal	Pin
HVCOM	1
BRAKE	2
VLOGIC	3
VLOGIC	4

P12 RS-232

Signal	Pin
N.C.	6
RS232TX1	5
SGND	4
SGND	3
RX232RX1	2
N.C.	1



NEP-D Board Connections Diagram

J6 HVCOM

Pin	Signal
1	FGND
2	HVCOM

NOTE: P14 & P15 are used for CANopen and cannot be used in the NEP.

P10 ECAT IN

Pin	ECAT
1	TX1+
2	TX1-
3	RX1+
4	N.C.
5	N.C.
6	RX1-
7	N.C.
8	N.C.

P11 ECAT OUT

Pin	ECAT
1	TX2+
2	TX2-
3	RX2+
4	N.C.
5	N.C.
6	RX2-
7	N.C.
8	N.C.

P9 STO

Signal	Pin		Signal
FGND	1	6	STO_STATUS_OUTPUT
STO1_24V_IN	2	7	STO_STATUS_OUTPUT_RTN
STO1_RTN	3	8	SGND
STO2_24V_IN	4	9	VLOGIC +24V
STO2_RTN	5		

P7 MOTOR FEEDBACK

Pin	Signal	Pin	Signal	Pin	Signal
1	FGND	10	/ENCB1	19	SIN1+
2	HALLU	11	ENCB1	20	COS1-
3	HALLV	12	/ENCA1	21	COS1+
4	HALLW	13	ENCA1	22	/ENCX1
5	SGND	14	/ENCS1	23	ENCX1
6	+5VENC	15	ENCS1	24	N.C.
7	IN5	16	SGND	25	SGND
8	/ENCX1	17	+5VENC	26	SGND
9	ENCX1	18	SIN1-		

P13 I/O & ENCODER 2

Pin	Signal	Pin	Signal	Pin	Signal
1	REFIN1-	16	SGND	31	DOUT1
2	REFIN1+	17	SGND	32	DOUT2
3	IN1_24V	18	SGND	33	DOUT3
4	IN2_24V	19	SGND	34	N.C.
5	IN3	20	SGND	35	DOUT4
6	IN4	21	SGND	36	DOUT5
7	IN5	22	SGND	37	DOUT6
8	IN6	23	SGND	38	N.C.
9	IN7	24	SGND	39	N.C.
10	ENCA2	25	SGND	40	/ENCA2
11	ENCB2	26	SGND	41	/ENCB2
12	ENCX2	27	SGND	42	/ENCX2
13	SGND	28	+5VENC	43	+5VENC
*14	*HSTL_1N	*29	*HSTL_1P	*44	*HSTL_0P
15	FGND	*30	*HSTL_0N		

*NOTE: In the table, the asterisk indicates do not connect to these pins. Consult the factory for AN146: IDC Inter-Drive Communication.

NEP-D ETHERCAT CONNECTORS

ETHERCAT CONNECTORS

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

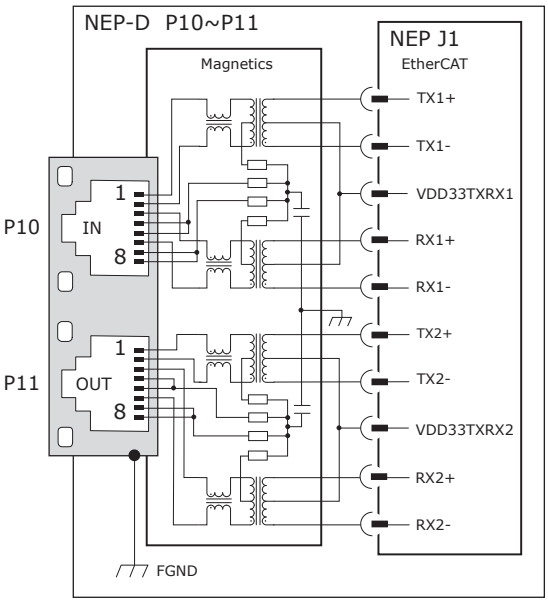
P10 ECAT-IN

Pin	ECAT
1	TX1+
2	TX1-
3	RX1+
4	N.C.
5	N.C. *
6	RX1-
7	N.C.
8	N.C.

P11 ECAT-OUT

Pin	ECAT
1	TX2+
2	TX1-
3	RX2+
4	N.C.
5	N.C. *
6	RX2-
7	N.C.
8	N.C.

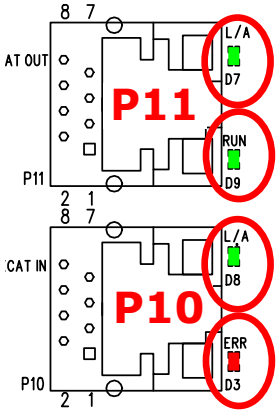
*Note: In the Signal column, the asterisk indicates the corresponding pin connects to the R/C that is inside the ECAT connector.



Dual RJ-45 sockets accept standard Ethernet cables. The IN port connects to a master, or it connects to the OUT port of a device that is 'upstream' between the NEP and the master.

The OUT port connects to 'downstream' nodes. If the NEP is the last node on a network, only the IN port is used. A terminator is not required on the OUT port.

RUN Green shows the EtherCAT State Machine.		**ERR** Red shows error conditions.	
Off	= Init State	Blinking	= Invalid Configuration
Blinking	= Pre-operational	Single Flash	= Unsolicited State Change
Single Flash	= Safe-Operational	Double Flash	= Application Watchdog Timeout
On	= Operational		



L/A (LINK/ACT)

Green indicates the state of the EtherCAT network.

LED	Link	Activity	Condition
On	Yes	No	= Port Open
Flickering	Yes	Yes	= Port Open with activity
Off	No	(N/A)	= Port Closed

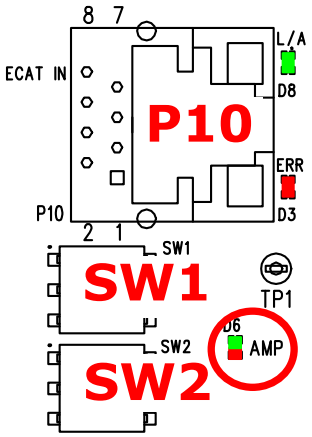
P10~11 EtherCAT PORTS

RJ-45 receptacles, 8 position

DRIVE STATUS LED (AMP)

A bi-color LED displays the state of the drive. Colors do not alternate and can be solid On or Blinking. If multiple conditions occur, only the top-level condition will be displayed. When that condition is cleared, the next condition in the table is shown.

LED	Condition Description
Red/Blinking	Latching fault. Operation cannot resume until the drive is Reset.
Red/Solid	Transient fault condition. Drive can resume the 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 the direction not inhibited by the limit switch.
Green/Solid	Drive OK and enabled. Can run in response to reference inputs or EtherCAT commands.



NEP-D ETHERCAT ADDRESS

EtherCAT DEVICE ID

In an EtherCAT network, slaves are automatically assigned fixed addresses based on their position on the bus. When a device requires a positive identification that is independent of cabling, a Device ID is needed. In the NEP-D, the Device ID is assigned two, 16-position rotary switches with hexadecimal encoding. These switches can set the Device ID of the drive from 0x01~0xFF (1~255 decimal). In the table, the Decimel column includes the decimal values and the HEX column includes the corresponding hex settings for each switch (SW1 and SW2).

For Example 1: To find the switch settings for the Decimal Device ID 107, refer to the table to calculate the following:

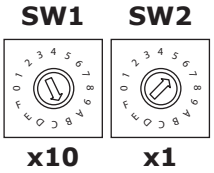
1)In the table SW1 column, find the highest number that is less than 107, (96).

Refer to the SW1 column and set SW1, (96) to the corresponding hex value that appears in the HEX column, (6).

96 < 107 and 112 > 107, so SW1 = 96 = Hex 6

2)Subtract (96) from the desired Device ID (107) to get the decimal value of switch SW2, (11). Refer to the SW2 column and set SW2, (11) to the corresponding hex value that appears in the HEX column, (B).

SW2 = (107 - 96) = 11 = Hex B



EtherCAT Device ID Switch Decimel Values

HEX	SW1 Decimel	SW2 Decimel
0	0	0
1	16	1
2	32	2
3	48	3
4	64	4
5	80	5
6	96	6
7	112	7
8	128	8
9	144	9
A	160	10
B	176	11
C	192	12
D	208	13
E	224	14
F	240	15

NEP-D RS-232 CONNECTIONS

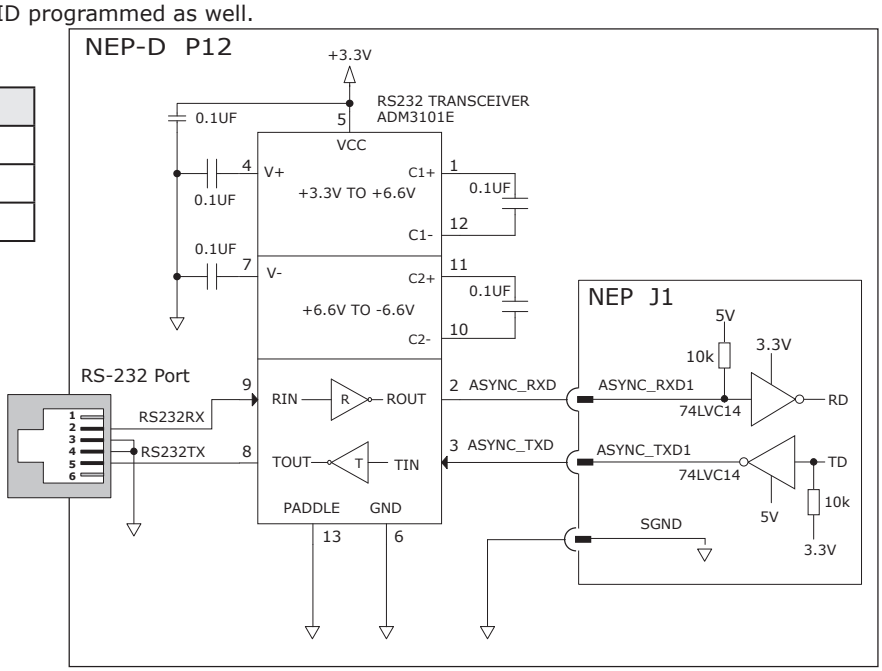
RS-232 CONNECTION

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

The RS-232 connector, 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-USB-RJ11) that includes the modular cable.

P12 DEV RS-232

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



SER-USB-RJ11

The SER-USB-RJ11 device provides connectivity between a USB connector and the RJ-11 connector P12 on the NEP-D board.

NOTE: The Serial Interface Cable USB to RJ11 (SER-USB-RJ11) can be used to plug-in to either a customer-designed board with an RJ11 or a Copley NEP drive with the NEP-D. When you order either type of board, the Manufacturer recommends you order the Serial Interface Cable USB to RJ11 (SER-USB-RJ11).

NEP-D SAFE TORQUE (STO)

DESCRIPTION

In the following diagram, it shows the use of external 24V to energize the STO inputs. Both STO inputs must be energized in order to enable the drive.

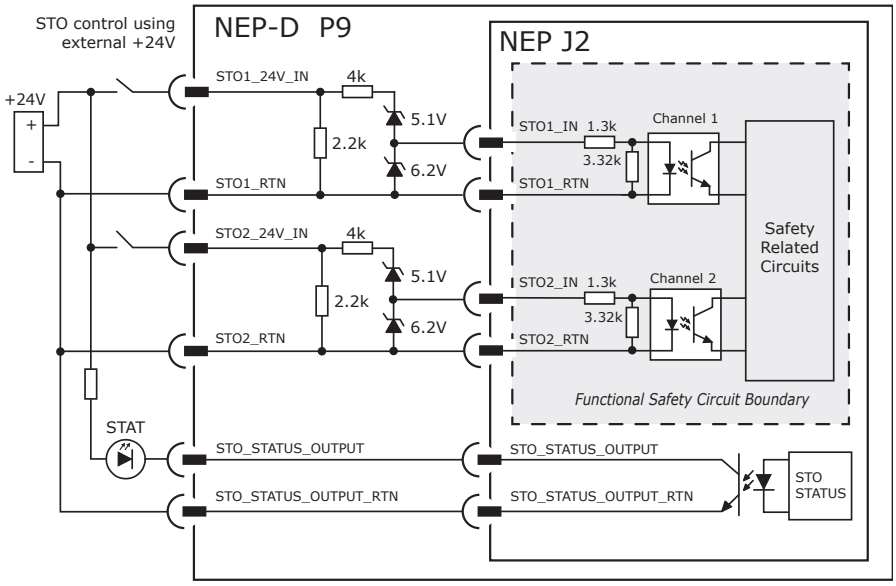
IN1 is the hardware Enable input. It is used with an immediate contact relay to bring the motor to a stop before a delayed contact relay de-energizes the STO inputs and prevents torque production in the motor.

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	6	STO_STATUS_OUTPUT
STO1_24V_IN	2	7	STO_STATUS_OUTPUT_RTN
STO1_RTN	3	8	SGND
STO2_24V_IN	4	9	VLOGIC
STO2_RTN	5		



In the STAT_OUT Operation table, the following describes the values.

- STO1 & STO2 rows, 1 = 24V are 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_24V_IN *AND* STO2_24V_IN ≥ 16 Vdc	STO Inactive. Drive can be enabled to produce torque.
STO1_24V_IN *OR* STO2_24V_IN < 5.9 Vdc	STO Active. Drive cannot be enabled to produce torque.
STO1_24V_IN *OR* STO2_24V_IN Open	STO Active. Drive cannot be enabled to produce torque.

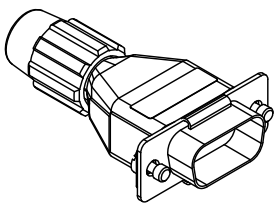
Note: In the above table, the Voltages are referenced between a STOx_24V_IN and a STOx_RTN in P9. For example, V(STO1) = V(STO1_24V_IN) - V(STO1_RTN)

NEP-D SAFE TORQUE OFF (STO) BYPASS

The Bypassing function is used when the user does not require the STO function. The STO-CK-04 has jumpers that use the VLOGIC to energize the STO inputs.

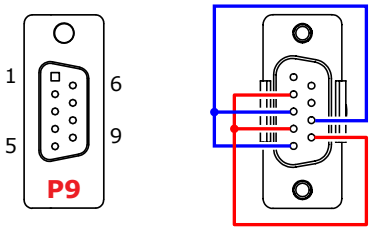
This disables the STO function, allowing the drive to be enabled from hardware inputs or a network. When STO-CK-04 is used, VLOGIC shall use 24 Vdc.

STO-CK-04 Connector



Wiring Diagram

Red (VLOGIC): 2,4,9
Blue (SGND): 3,5,8

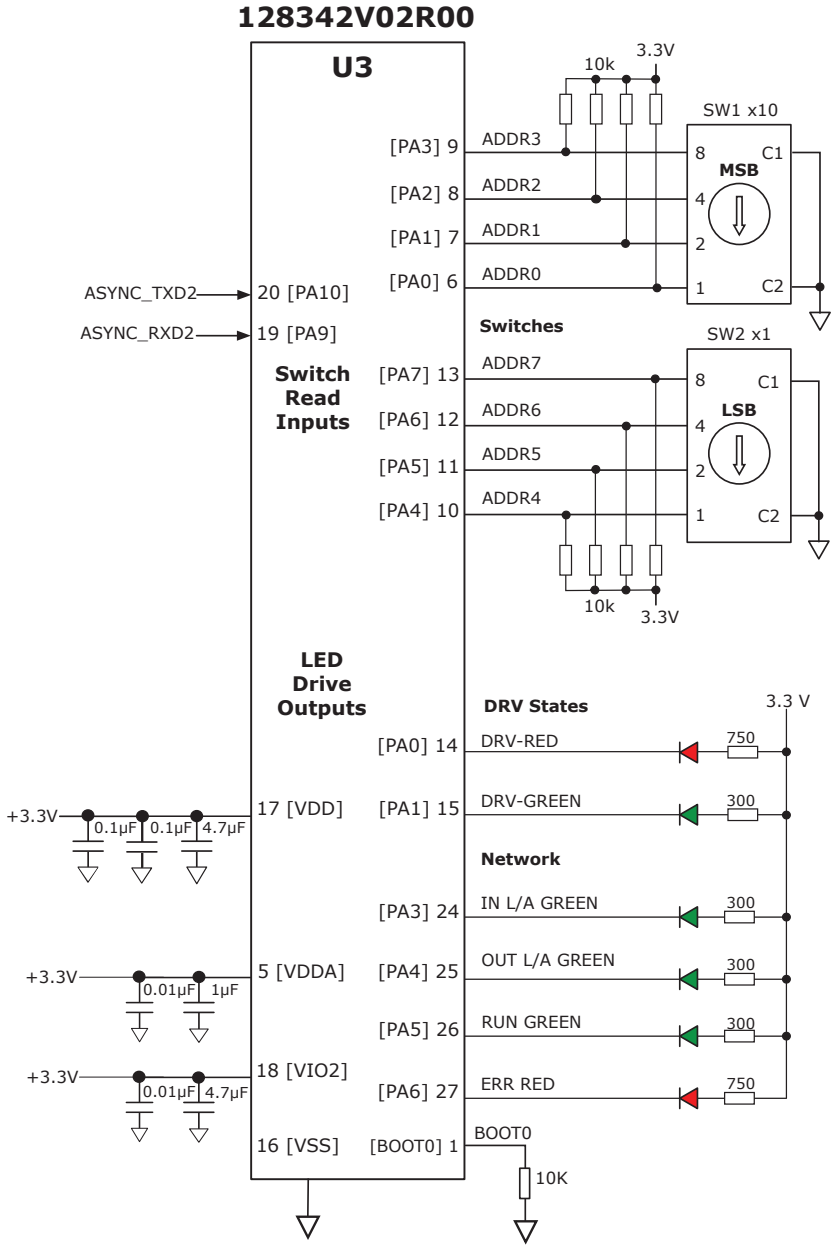


NEP-D SWITCHES & LEDS

ETHERCAT DEVICE ID (STATION ALIAS) SWITCH CONNECTIONS & LEDS

The following diagram shows the connections to the EtherCAT Device ID switches and status LEDs. The switches are read after the drive is reset or powered-On.

When changing the settings of the switches, be sure to either reset the drive or power the drive Off-On.



NEP-D Switches & LEDs Diagram

Ordering Information: U3

In the above diagram, U3 can be purchased through the Copley approved supplier, Arrow Electronics.

Contact Information:
Arrow Electronics
4 Technology Drive
Peabody, MA 01960
Phone: (978) 538-8500

Refer to the table below for more details.

Part Number	Supplier	Description
128342V02R00	Arrow Electronics	Pre-programmed uC for Address Switch and LED
Note: For information on the STM32F042G4U6TR electrical, pinout and package details, refer to the product: STM32F042G4U6TR Datasheet. The datasheet is posted on the ST Microelectronics™ website: https://www.st.com.		

NEP-D +HV, VLOGIC, & MOTOR CONNECTIONS

J4 +HV

The +HV power supply connects to J4 pins 2 & 3. In the following diagram, the shield shown is optional and is primarily used for the reduction of RF emissions originating from the drive. As shown, it connects to the case of the power supply. Note that the minus terminal is not grounded externally. The reason is that 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 used for the motor windings. Pin 4 is used for a cable shield. It connects to the drive heatplate on one end and should connect to the motor frame on the other end. 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 it to equipment, without the shield connections the PWM shield, the current could flow into external devices.

P8 VLOGIC

P8 powers the internal logic and control circuits in the drive. When it is used with 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 and motor connections. If the STO jumper is used, then 24Vdc shall power the Vlogic P8.

GROUNDING

PE and CHASSIS are Protective Earth grounds which are the zero-volt reference for the voltages used in the drive. In addition, they are used as the connection points for fault currents that might flow from any failures in the drive that could expose a user to an electric shock.

All of these items connect to the drive heatplate and they have no connections to any circuits in the drive. HVCOM, High-Voltage-Common is the 0V or 'ground' circuit for the high voltage circuits that drive the motor.

J4 +HV

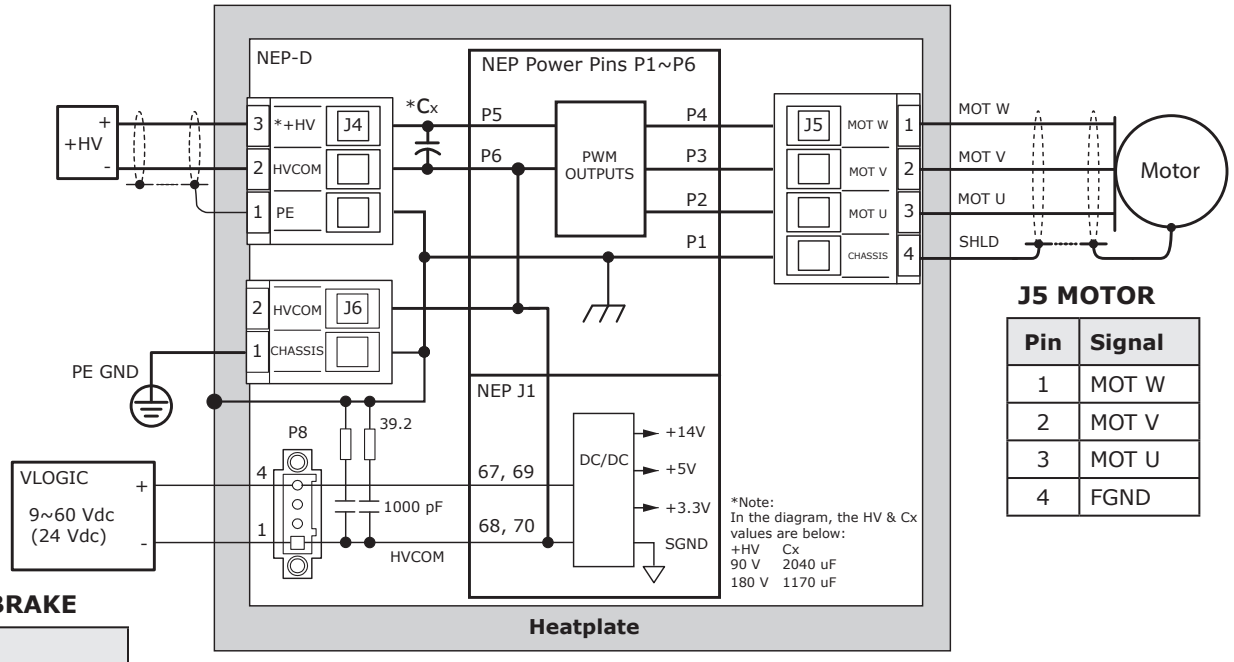
Pin	Signal
3	+HV
2	HVCOM
1	FGND

J6 GROUNDS

Pin	Signal
2	HVCOM
1	FGND

P8 VLOGIC & BRAKE

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



NEP-D Connections Diagram

J5 MOTOR

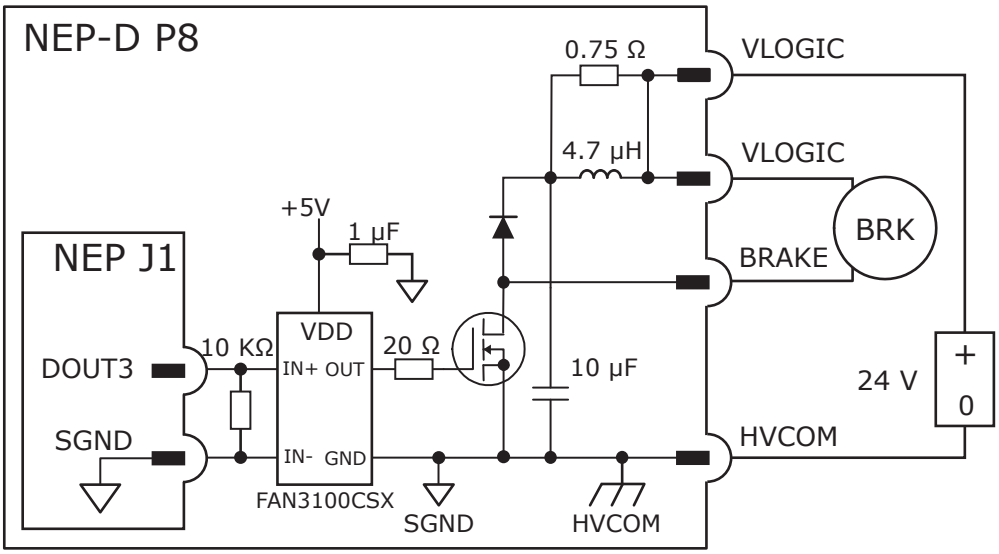
Pin	Signal
1	MOT W
2	MOT V
3	MOT U
4	FGND

WARNING	***Refer to the AN136 Accelnet External Regen Application Note, Part Number 16-125661.***
	VLOGIC +9~60. 24V power is recommended. If common to HV do not exceed 60V, use REGEN protection, and diode isolation from HV.

NEP-D VLOGIC & BRAKE CONNECTIONS

In the following diagram, it shows the NEP-D Vlogic and brake connections.

The brake circuit on the NEP-D is MOSFET driven by OUT3 of the NEP.



NEP-D VLOGIC & Brake Diagram

SPECIFICATIONS

Output	Data	Notes
Voltage Range	Max	+9~60 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 [DOUT3]	LO	Output MOSFET is OFF. Brake is un-powered and locks motor. Motor cannot move. Brake state is Active.
	HI	Output MOSFET is ON. Brake is powered, releasing motor. Motor is free to move. Brake state is NOT-Active.

CME Default Setting for the Brake Output [DOUT3] is "Brake - Active Low."

Active = Brake is holding motor shaft (for example, the *Brake is Active*).
Motor cannot move.
No current flows in coil of brake.
CME I/O Line States shows [DOUT3] as LO.
BRK Output voltage is HI (24V), MOSFET is OFF.
Servo drive output current is zero.
Servo drive is disabled, PWM outputs are OFF.

Inactive = Brake is not holding motor shaft (for example, the *Brake is NOT-Active*).
Motor can move.
Current flows in coil of brake.
CME I/O Line States shows [OUT3] as HI.
BRK output voltage is LO (~0V), MOSFET is ON.
Servo drive is enabled, PWM outputs are ON.
Servo drive output current is flowing.

WARNING	***Refer to the AN136 Accelnet External Regen Application Note, Part Number 16-125661.***
	Vlogic +9~60. 24V power is recommended. If using a 24V Brake, 24V is required. If common to HV do not exceed 60V, use REGEN protection and diode isolation from HV.

NEP-D INPUTS & OUTPUTS

INPUTS 1~7

The inputs are described below:

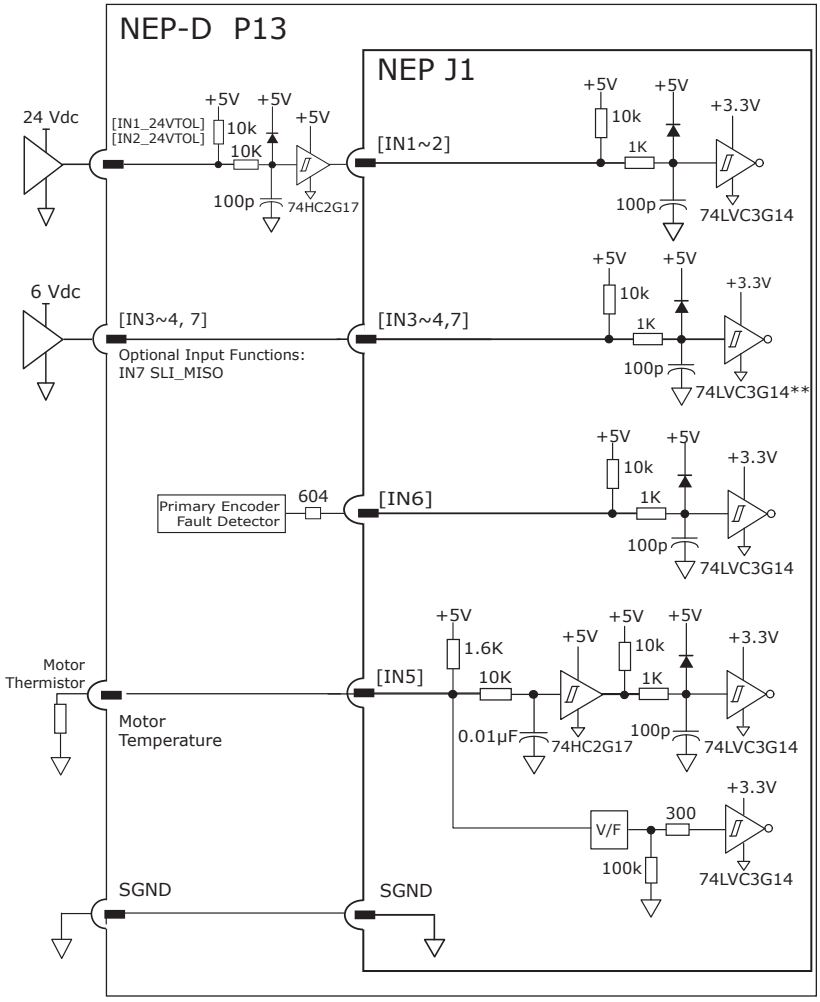
- IN1~2, 24V can tolerate +24 Vdc.
- IN3~4, IN7 can tolerate +6 Vdc.
- IN5 is used to interface a DIN44081/2 thermistor in a motor winding.
- IN6 is for the motor encoder fault.

P13 INPUTS

Signal	Pins
IN1_24V	3
IN2_24V	4
IN3	5
IN4	6
IN5[1]	7
IN6	8
IN7[2]	9

NOTES:

1) For information on IN5, refer to page 9:Motor Overtemp Input IN5.
2) The gate on IN7 is 74AHCT14BQ powered with 5.0 Vdc.

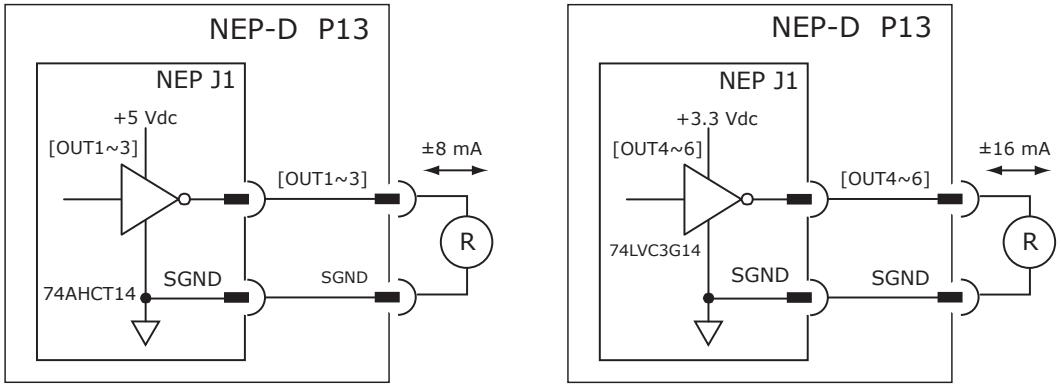


NEP-D Inputs & Outputs Diagram

OUTPUTS 1~6

P13 OUTPUTS

Signal	Pins
DOUT1	31
DOUT2	32
DOUT3	33
DOUT4	35
DOUT5	36
DOUT6	37



NEP-D P13 Outputs Diagram

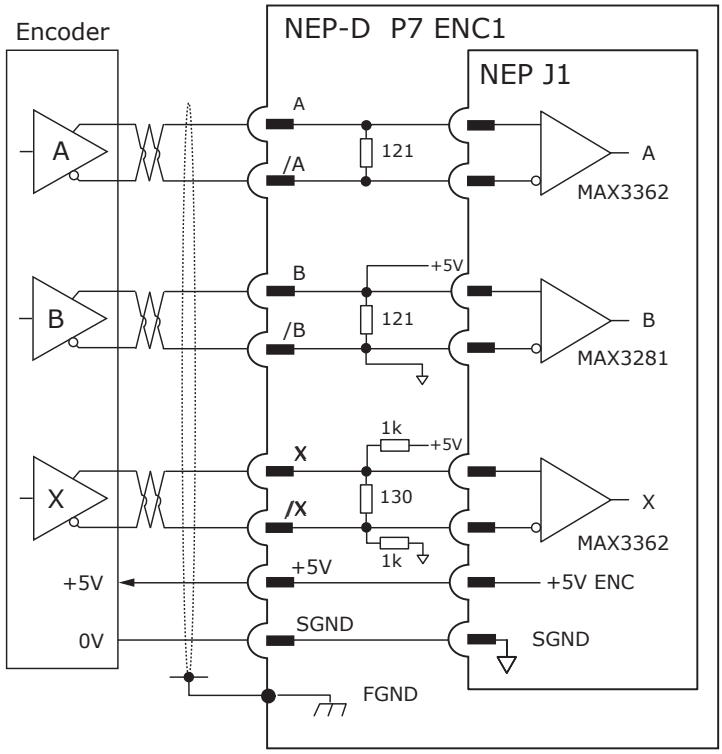
NEP-D PRIMARY FEEDBACK ENCODER

ENC1 is the Motor encoder. It is used in single-encoder applications. In Dual-encoder applications, it can be assigned as Primary or Secondary using the Copley software.

FGND connects to the connector shells which connect to the etch areas surrounding the four mounting holes of the NEP-D. The mounting screws and metal standoffs provide a connection to the equipment chassis which has a connection to earth.

P7 INPUTS

Signal	Pins
ENCA1	13
/ENCA1	12
ENCB1	11
/ENCB1	10
ENCX1	9
/ENCX1	8
+5VENC	6
SGND	5,16, 25,26
FGND	1



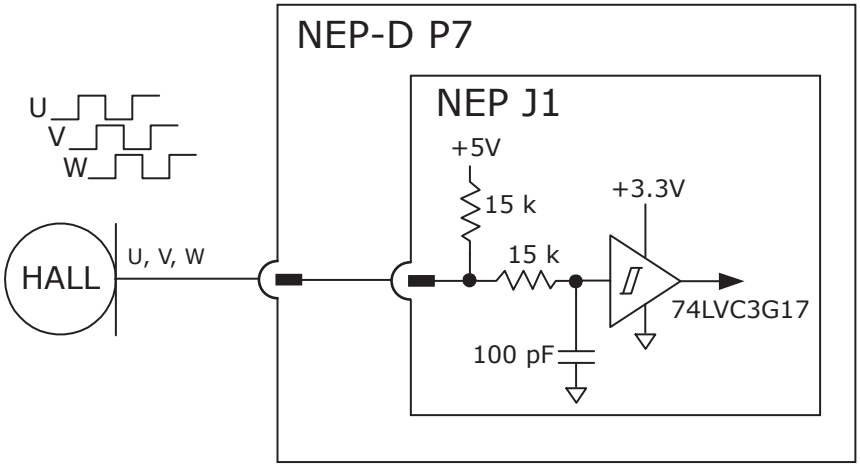
NEP-D HALLS

In the following diagram, it shows the NEP-D Halls connections.

The table identifies the signals and pins for the P9 Hall inputs.

P7 HALL INPUTS

Signal	Pins
Hall U	2
Hall V	3
Hall W	4



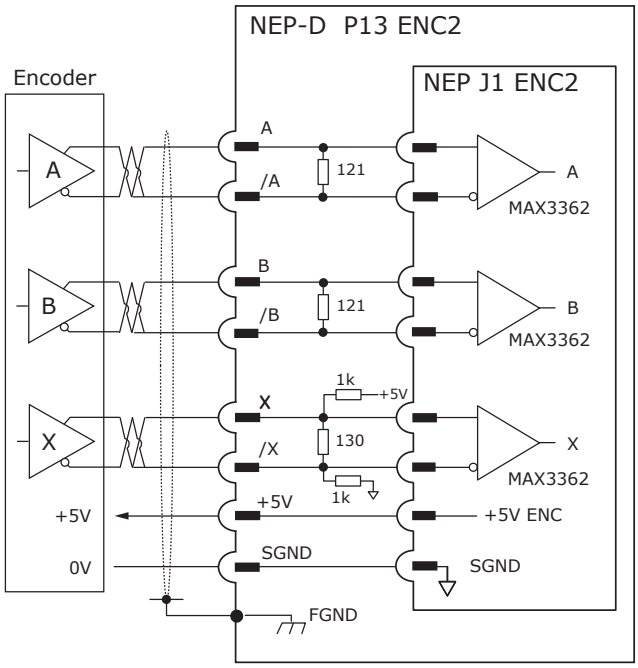
NEP-D SECONDARY FEEDBACK

ENC2 is the Load encoder. Typically, it provides the feedback from a load driven by the motor. It is used in dual-encoder applications as well.

In dual-encoder applications, it can be assigned as Primary or Secondary using the Copley software.

P13 ENC2 INPUTS

Signal	Pins
ENCA2 [A]	10
/ENCA2 [/A]	40
ENCB2 [B]	11
/ENCB2 [/B]	41
ENCX2 [X]	12
/ENCX2 [/X]	42
IN6 [Fault]	8
+5VENC	28,43
SGND	13,16,17,18,19,20,21, 22,23,24,25,26,27
FGND	15



NEP-D ANALOG INPUT

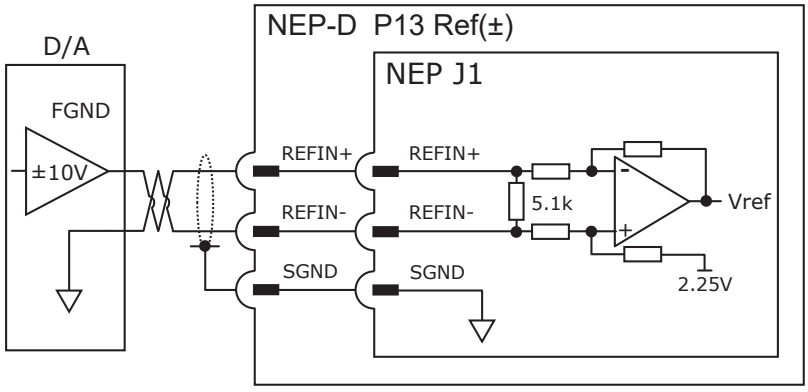
As a reference input, the NEP-D analog input takes Position/ Velocity/Torque commands from a controller.

If it is not used as a command input, it can be used as a general-purpose analog input.

SPECIFICATIONS

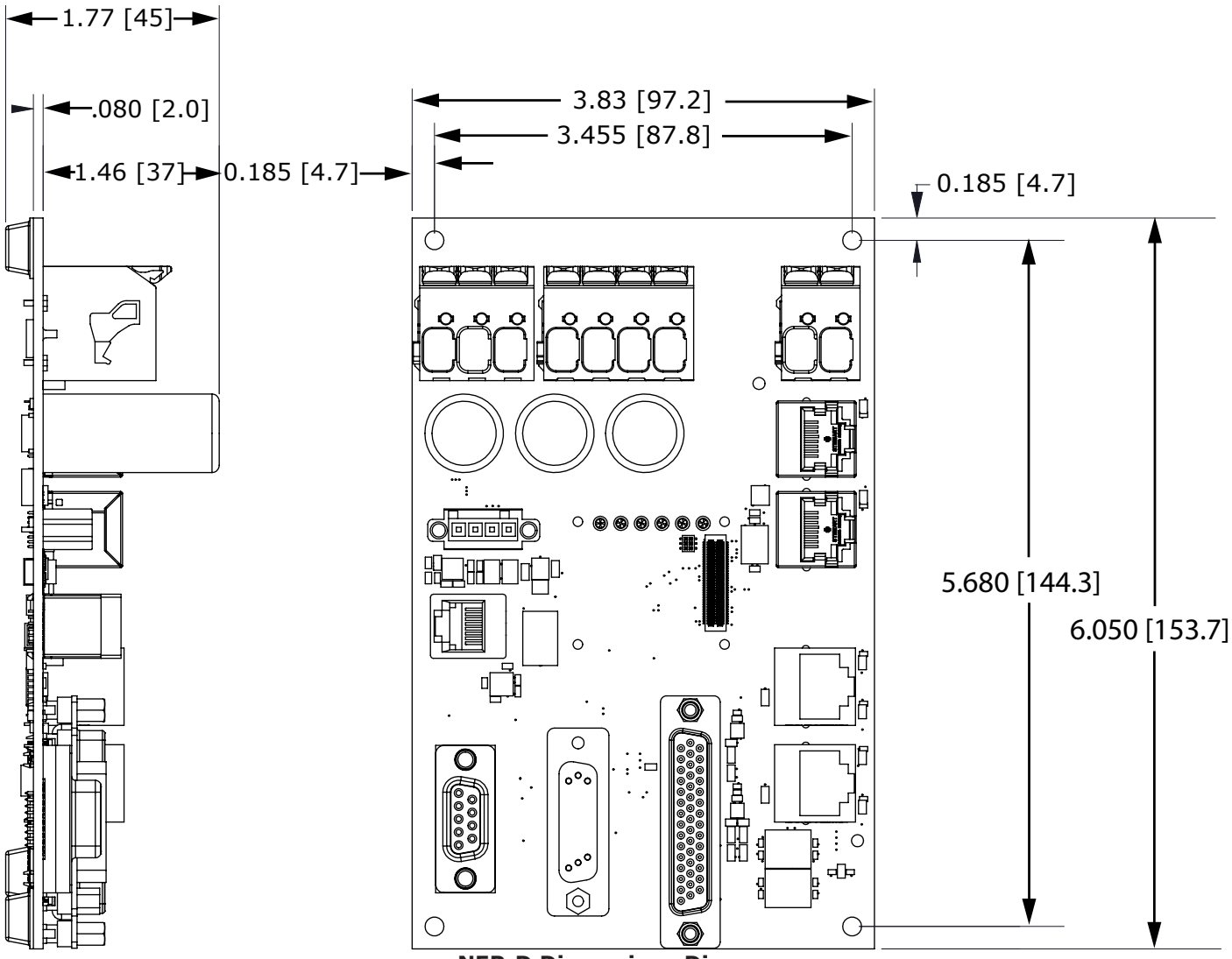
Specifications	Data	Notes
Input Voltage	Vref	±10 Vdc
Input Resistance	Rin	5.1 kΩ

Signal	P13 Pins
REFIN1+ [Ref(+)]	2
REFIN1- [Ref(-)]	1
SGND	13,16,17,18,19,20,21, 22,23,24,25,26,27



NEP-D DIMENSIONS

In the following diagram, it shows the NEP-D dimensions and board layout.



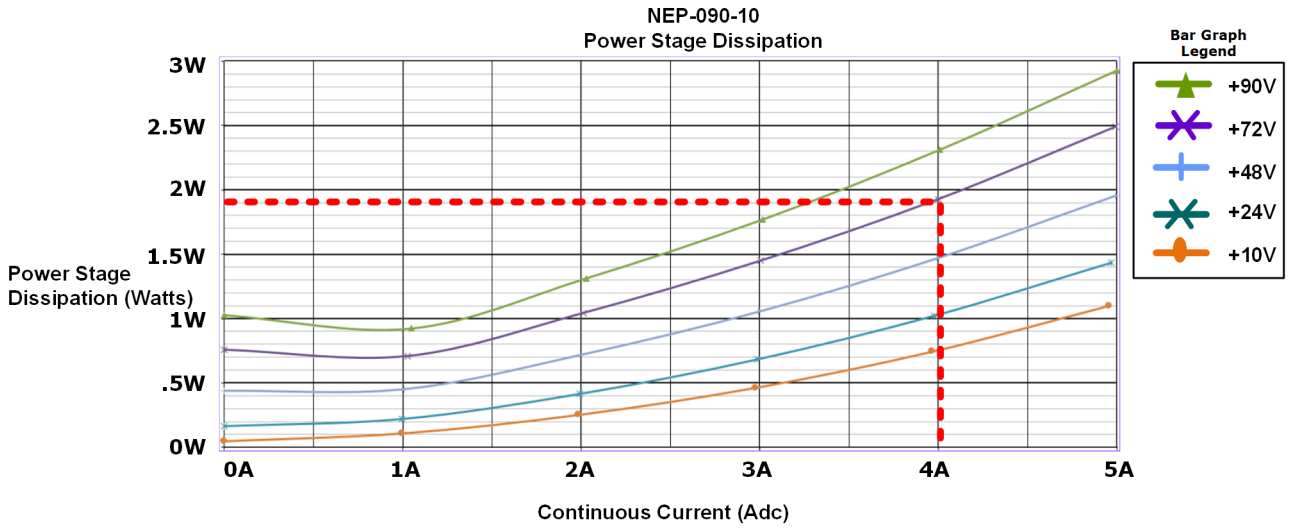
NEP-D Dimensions Diagram

THERMALS: PWM OUTPUTS DISSIPATION

NEP-090-10

The following 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.

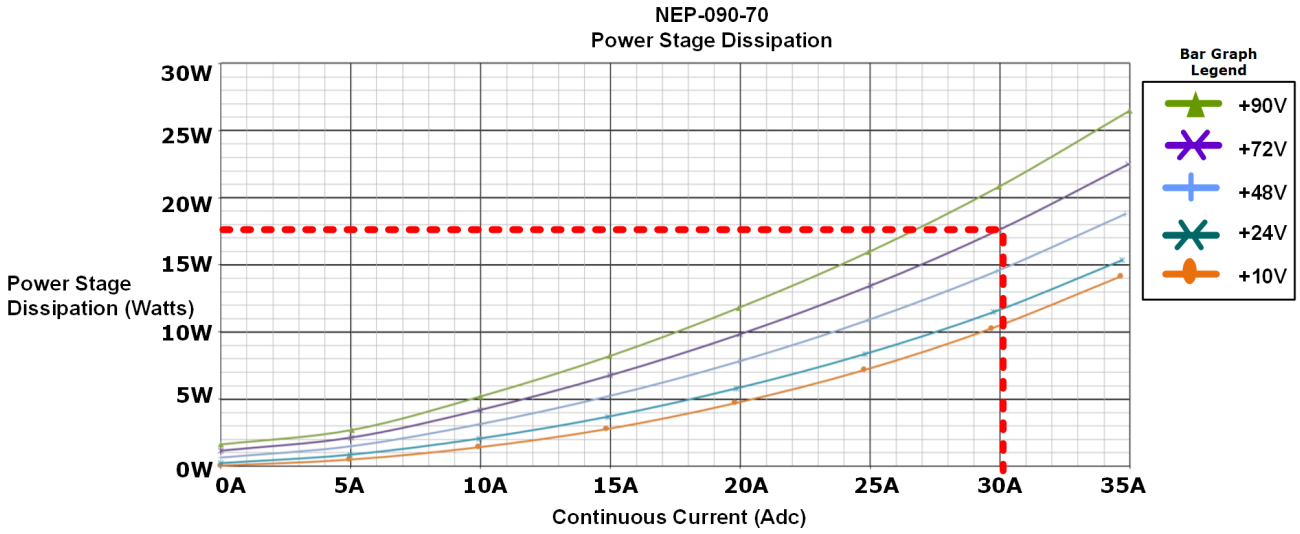
For example in the chart, the red dotted line shows the purple line identifying a dissipation of 1.9W at a continuous current of 4 Adc and +HV = +72V.



NEP-090-70-D

The following 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.

For example in the chart, the red dotted line shows the purple line identifying a dissipation of 17.5W at a continuous current of 30 Adc and +HV = +72V.

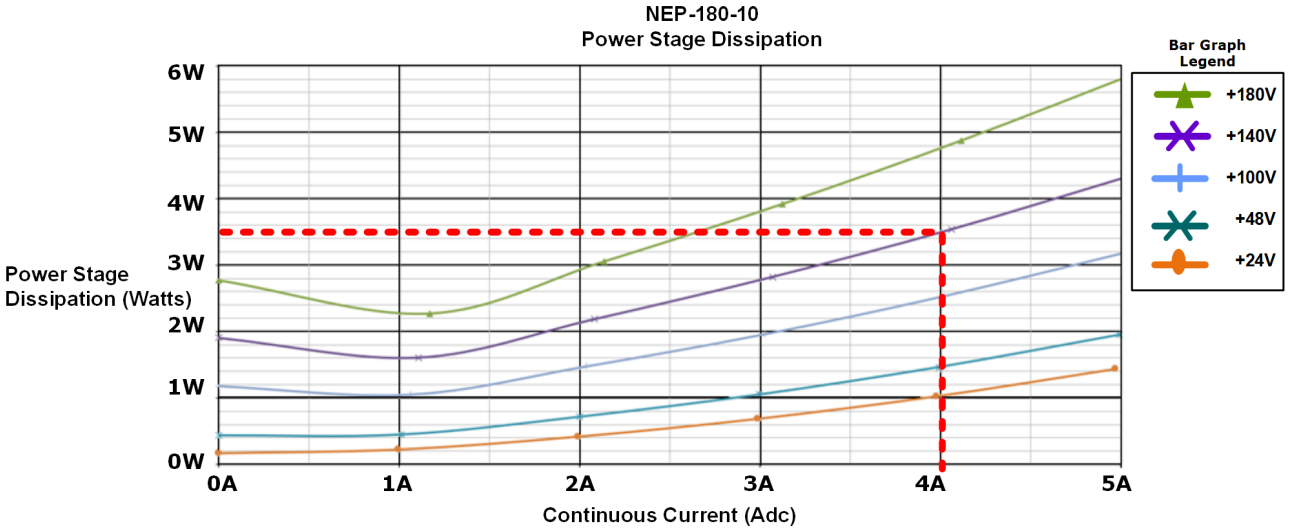


THERMALS: PWM OUTPUTS DISSIPATION

NEP-180-10

The following 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.

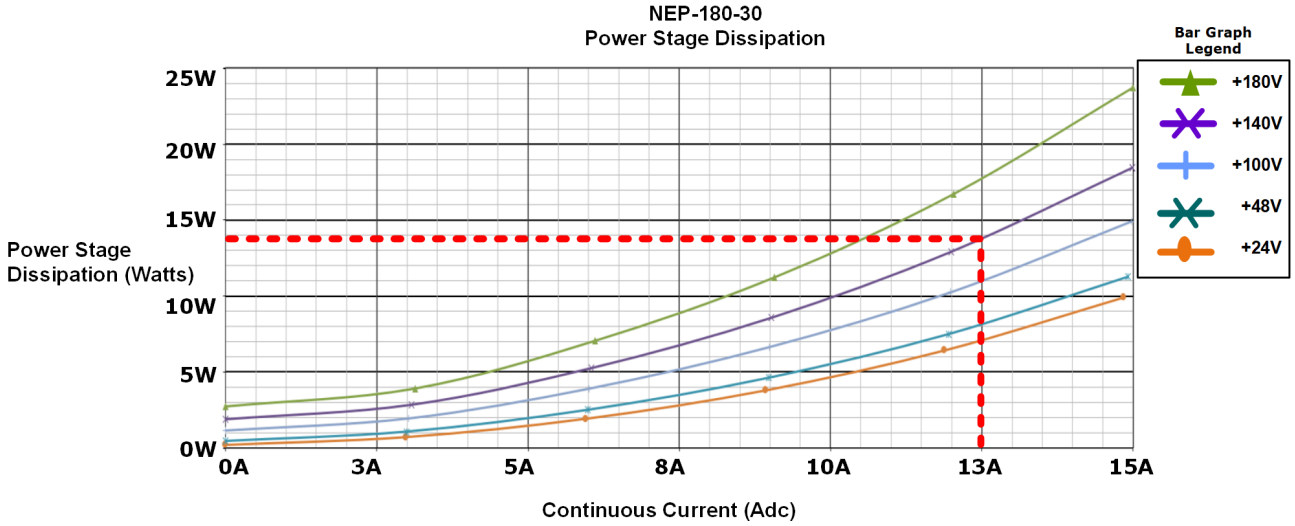
For example in the chart, the red dotted line shows the purple line identifying a dissipation of 3.5W at a continuous current of 4 Adc and +HV = +140V.



NEP-180-30

The following 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.

For example in the chart, the red dotted line shows the purple line identifying a dissipation of 14W at a continuous current of 13 Adc and +HV = +140V.



NEP-Z

The NEP-Z Board diagram shows the connections and board layout. The tables identify the signals and pins for each connector.

J4 +HV/ MOTOR

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

J12 BRAKE

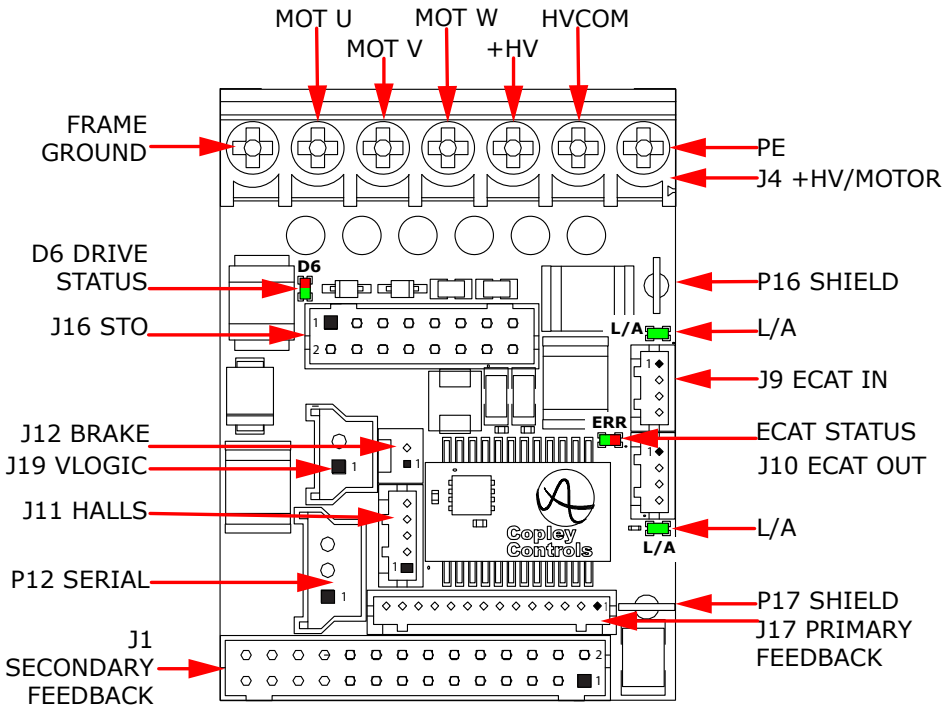
Signal	Pin
VLOGIC	2
BRAKE	1

J19 VLOGIC

Signal	Pin
VLOGIC	2
HVCOM	1

J11 HALLS

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



NEP-Z Connections Diagram

P12 RS-232

Signal	Pin
RX232TX1	3
RS232RX1	2
SGND	1

P16 SHIELD

Signal	Pin
SHLD	1

J9 ECAT

IN	Pin
RX1+	1
RX1-	2
TX1+	3
TX1-	4

J10 ECAT

OUT	Pin
RX2+	1
RX2-	2
TX2+	3
TX2-	4

P17 SHIELD

Signal	Pin
SHLD	1

J16 STO

Signal	Pin		Signal
STO1_24V_IN	2	1	STO1_RTN
STO1_IN	4	3	STO1_RTN
N.C.	6	5	N.C.
STO2_24V_IN	8	7	STO2_RTN
STO2_IN	10	9	STO2_RTN
N.C.	12	11	N.C.
STO_STATUS_ OUTPUT_RTN	14	13	SGND
+5V	16	15	STO_STATUS_ OUTPUT

J1 I/O

Signal	Pin		Signal
/ENCA2	2	1	FGND
ENCA2	4	3	SGND
IN1_24V	6	5	+5VENC
IN2_24V	8	7	+5VENC
IN3	10	9	/ENCB2
IN4	12	11	ENCB2
IN5 (MOTEMP)	14	13	SGND
IN6 (ENC_FAULT)	16	15	/ENCX2
IN7 (SLI_MISO)	18	17	ENCX2
SGND	20	19	REFIN1-
DOUT1	22	21	REFIN1+
DOUT2	24	23	SGND
DOUT3 (BRAKE OFF)	26	25	DOUT6 (SLI_EN1)
DOUT4 (SLI_MOSI)	28	27	DOUT5 (SLI_CLK)

J17 ENCODER 1

Signal	Pin
+5VENC	1
SGND	2
/ENCA1	3
ENCA1	4
/ENCB1	5
ENCB1	6
/ENCX1	7
ENCX1	8
IN5	9
SGND	10
COS1+	11
COS1-	12
SIN1+	13
SIN1-	14

NEP-Z: P12 RS-232

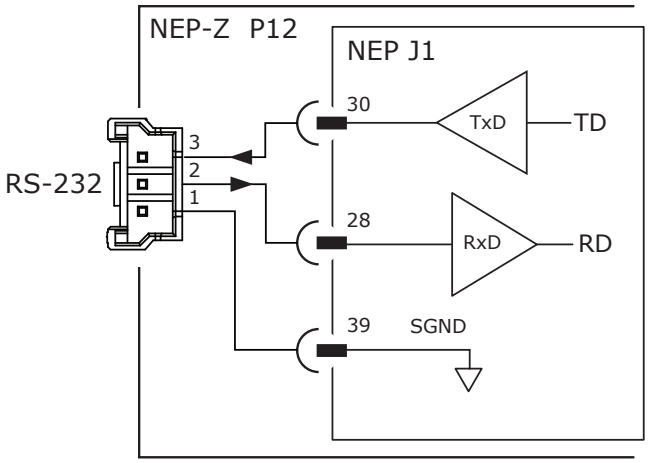
RS-232 CONNECTION

The RS-232 port is used to configure the drive for stand-alone applications, or it can be used for the configuration before it is installed into an EtherCAT network.

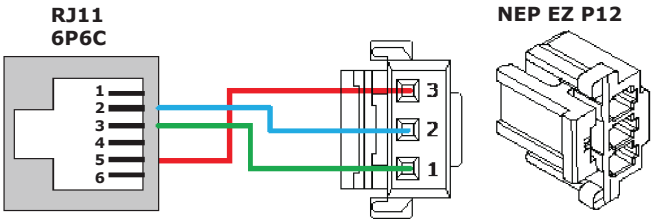
P12 RS-232

Signal	Pin
RX232TX1	3
RS232RX1	2
SGND	1

The Copley software communicates with the drive over this link. It is then used for the complete drive setup. The EtherCAT Device ID is set via RS-232 along with other operating functions.

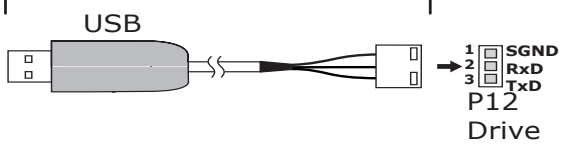


The RJ-11 socket (6P6C) is compatible with the existing serial-data cables. It can be done using an RJ-11 socket (6P6C) wired with a compatible serial-data cable as shown in the RJ11 Diagram. Molex: 42410-6170 Modular Jack, 6 terminals, size 6



RJ11 Diagram

Copley offers 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 NEP-Z serial port.



NEP-Z: DRIVE STATUS LED (AMP)

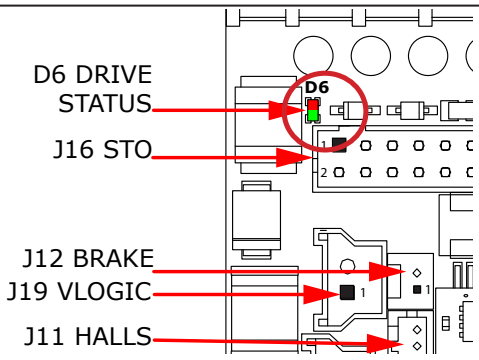
DRIVE STATUS LED (AMP)

A bi-color LED "AMP" displays 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 condition in the table is shown.

LED	Condition Description
Red/Blinking	Latching fault. Operation can not resume until the drive is Reset.
Red/Solid	Transient fault condition. Drive can resume the 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 the direction not inhibited by the limit switch.
Green/Solid	Drive OK and enabled. Can run in response to reference inputs or EtherCAT commands.

LATCHING FAULTS

Default	Optional (Programmable)
Short circuit (Internal or External)	Over-voltage
Drive Over-temperature	Under-voltage
Motor Over-temperature	Motor Phasing Error
Feedback Error	Command Input Fault
Following Error	Motor Wiring Disconnected
	Over Current (Latched)



NEP-Z: J9~J10 ETHERCAT COMMUNICATIONS

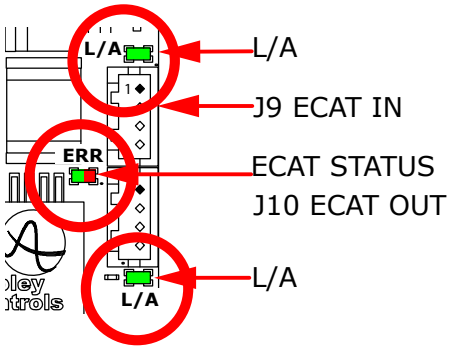
EtherCAT is the open, real-time Ethernet network developed by Beckhoff based on the widely used 100BASE-TX cabling system. EtherCAT enables high-speed control of multiple axes while maintaining tight synchronization of clocks in the nodes.

Data protocol is CANopen application protocol over EtherCAT (CoE) based on DSP-402 for motion control devices. For additional information on EtherCAT, refer to the web-site: https://ethercat.org.

ETHERCAT CONNECTIONS

J9 & J10 accept the Ethernet cables. The IN port connects to a master, or it connects to the OUT port of a device that is 'upstream', between the Nano and the master.

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



ETHERCAT STATUS LED

RUN Green shows the state of the ESM (EtherCAT State Machine).		ERR Red shows errors such as watchdog timeouts and unsolicited state changes in the drive due to local errors.	
Off	= Init State	Off	= EtherCAT communications are working correctly.
Blinking	= Pre-operational	Blinking	= Invalid configuration, general configuration error
Single Flash	= Safe-Operational	Single Flash	= Local error, slave has changed EtherCAT state autonomously
On	= Operational	Double Flash	= PDO or EtherCAT watchdog timeout, or an application watchdog timeout has occurred.

L/A (LINK/ACT)

Green indicates the state of the EtherCAT network.

LED	Link	Activity	Condition
On	Yes	No	= Port Open
Flickering	Yes	Yes	= Port Open with Activity
Off	No	(N/A)	= Port Closed

ETHERCAT DEVICE ID

In an EtherCAT network, slaves are automatically assigned fixed addresses based on their position on the bus. Stations on EtherCAT are automatically addressed by their bus location. The first drive on the network is station address -1. The second drive is station address -2, and so forth.

When a device is required to have a positive identification that is independent of cabling, a Device ID is needed. This Device ID can be set using the digital inputs or set with a programmed value. Use the Copley software to configure both of these modes.

ETHERCAT CONNECTORS

In the following RJ-45 diagram, it shows the connections to the EZ Board that use the standard RJ-45 recepticals for their network connections. The tables identify the pins and signals for each connector.

RJ-45

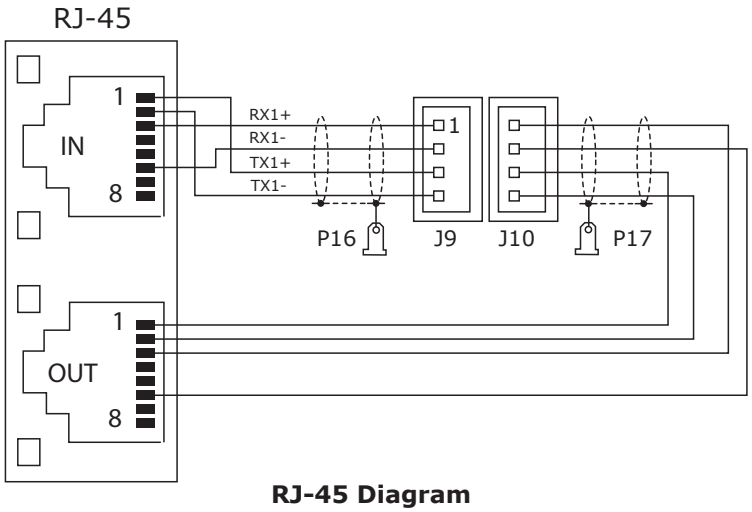
Signal	Pins
TX1+	1
TX1-	2
RX1+	3
N.C.	4
N.C.	5
RX1-	6
N.C.	7
N.C.	8

J10 ECAT-OUT

Pin	Signal
1	RX2+
2	RX2-
3	TX2+
4	TX2-

J9 ECAT-IN

Pin	Signal
1	RX1+
2	RX1-
3	TX1+
4	TX1-



RJ-45 Diagram

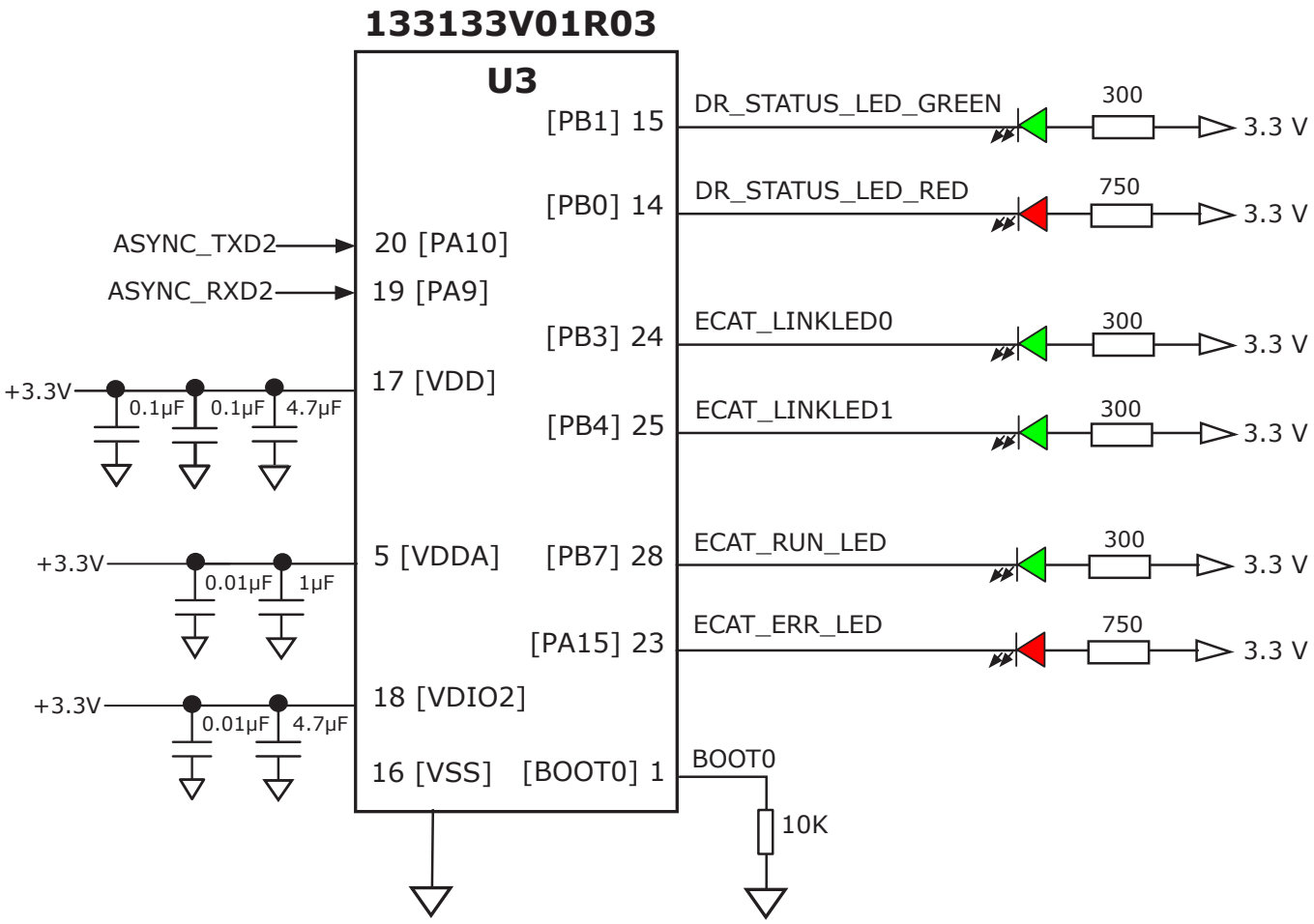
Note: Use the P16 & P17 for shields in the J9 and J10 EtherCAT cables.

NEP-Z: DRIVE AND NETWORK STATUS LEDS

The microprocessor chip uses the serial port with ASYNC_TXD2 and ASYNC_RXD2 to drive LEDs.

- DR_STATUS_LED_X signals drive the AMP STATUS LED.
- ECAT_XXX_LED shows the network status of the drive communication.
- ECAT_LINKLEDx signals show the presence of activity on the ECAT connections.

In the following diagram, it shows the NEP-Z drive and network status LEDs.



NEP-Z Drive and Network Status LEDs Diagram

Ordering Information: U3

In the above diagram, U3 can be purchased through the Copley approved supplier, Arrow Electronics.

Contact Information:
Arrow Electronics
4 Technology Drive
Peabody, MA 01960
Phone: (978) 538-8500

Refer to the table below for more details.

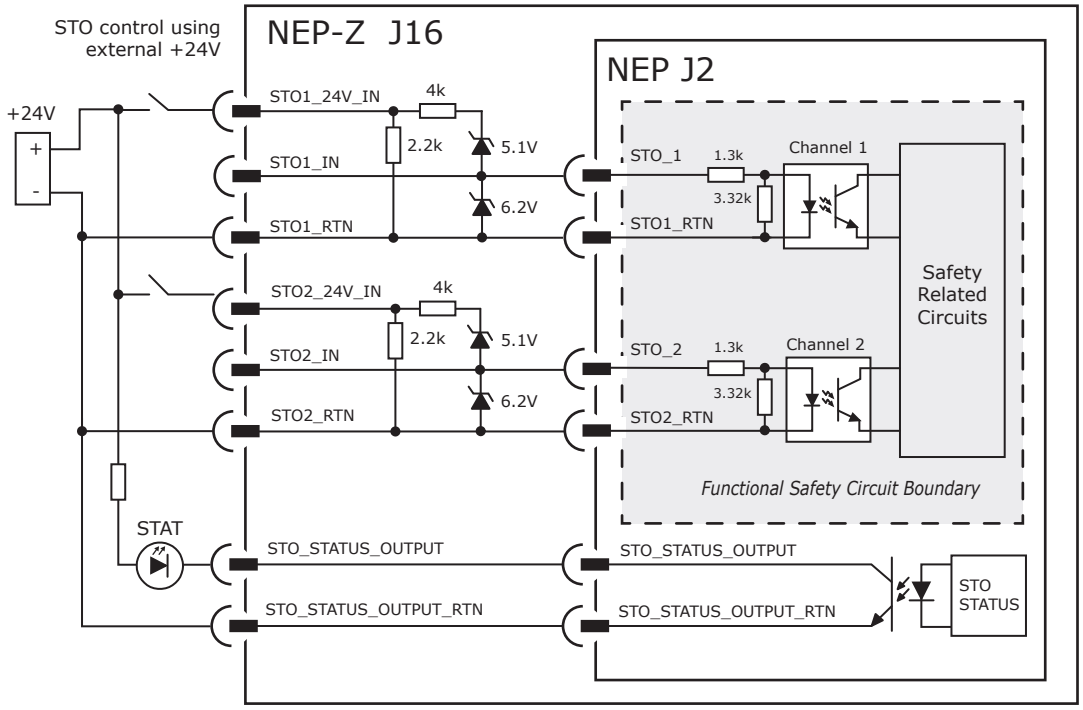
Part Number	Supplier	Description
133133V01R03	Arrow Electronics	Pre-programmed uC for Address Switch and LED
NOTE: For information on the STM32F042G4U6TR electrical, pinout and package details, refer to the product: STM32F042G4U6TR Datasheet. The datasheet is posted on the ST Microelectronics website: https://www.st.com.		

NEP-Z: J16 SAFE TORQUE OFF [STO]

DESCRIPTION

In the following diagram, it shows the use of an external 24V to energize the STO inputs. Both STO inputs must be energized in order to enable the drive.

IN1 is the hardware Enable input. It is used 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.



NEP-Z J16 STO Diagram

NOTE: In the diagram, the +24V shown 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 the STAT-OUT Operation table, the following describes the values.

- STO1 & STO2 rows, 1 = 24V. It is 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_24V_IN
STO1_RTN	3	4	STO1_IN
N.C.	5	6	N.C.
STO2_RTN	7	8	STO2_24V_IN
STO2_RTN	9	10	STO2_IN
N.C.	11	12	N.C.
SGND	13	14	STO_STATUS_OUTPUT_RTN
STO_STATUS_OUTPUT	15	16	+5V

STO OPERATION

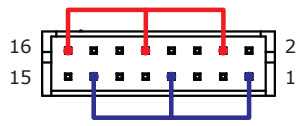
STO Input Voltage	STO State
STO1_24V_IN *AND* STO2_24V_IN ≥ 16 Vdc	STO Inactive. Drive can be enabled to produce torque.
STO1_IN *AND* STO2_IN ≥ 3.0 Vdc	
STO1_24V_IN *OR* STO2_24V_IN < 5.9 Vdc	STO Active. Drive cannot be enabled to produce torque.
STO1_IN *OR* STO2_IN ≤ 0.8 Vdc	
STO1_IN *OR* STO2_IN Open	

NOTE: In the above table, the Voltages are referenced between a STOx_IN and a STOx_RTN in J16
For example, V(STO1) = V(STO1_24V_IN) - V(STO1_RTN)

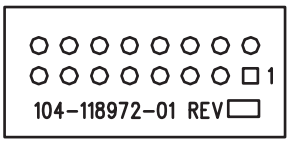
NEP-Z: J16 SAFE TORQUE OFF (STO) BYPASS

The Bypassing function is used when the user does not require the STO function. The NP-Z-STO has jumpers that use the +5VENC to energize the STO inputs.

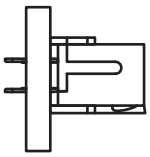
This disables the STO function, allowing the drive to be enabled from hardware inputs or a network. The following diagrams show the NP-Z-STO top and bottom views.

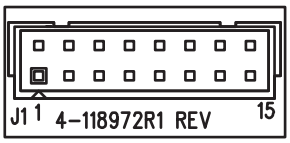


Top View



Top View





Bottom View

NEP-Z: J4 +HV & MOTOR CONNECTIONS

J4 +HV: PIN 2, 3

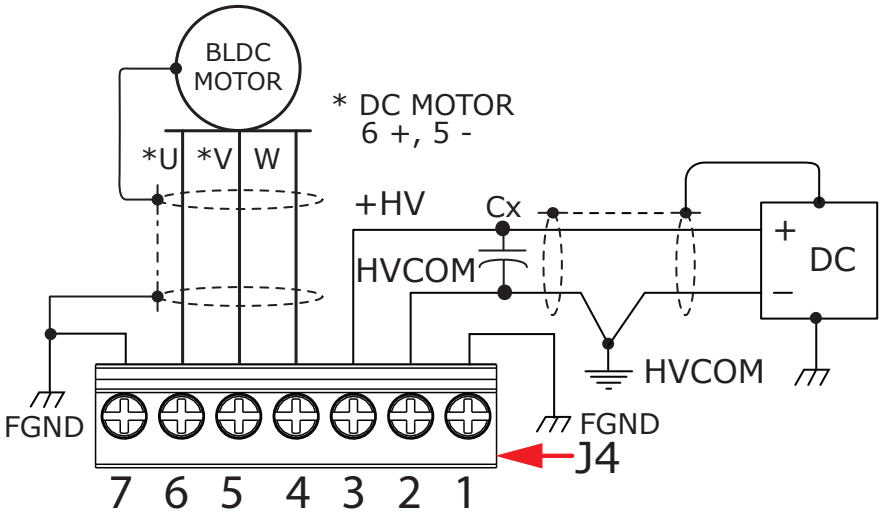
The +HV power supply connects to J4 pins 2 and 3. In the following diagram, it shows the shield. The shield is optional and it is primarily used for the reduction of RF emissions from the drive. As shown, it connects to the case of the power supply. Note that the minus terminal is not grounded externally. 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.

J4 MOTOR: PIN 4~6

Pins 4~6 are used for the motor windings. Pin 7 is used for the cable shield. It connects to FGND on one end and it connects to the motor frame on the other end. 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.

J4 +HV/MOTOR

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



NEP-Z J4 +HV & Motor Connections Diagram

NEP-Z: J12 BRAKE

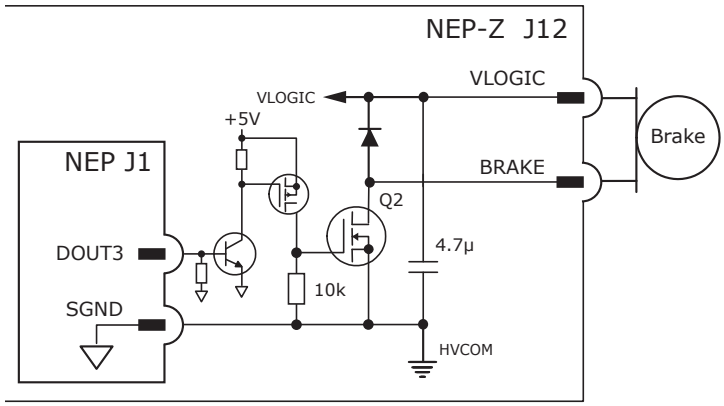
J12 BRAKE:

The EZ board has components that can actuate a brake when it is controlled by DOUT3.

If it is not used for the brake, DOUT3 is programmable for other functions.

HI/LO Definitions: Outputs

Input	State	Condition
BRAKE [DOUT3]	LO	Output MOSFET Q2 is OFF. Brake is un-powered and locks motor. Motor cannot move. Brake state is Active.
	HI	Output MOSFET Q2 is ON. Brake is powered, releasing motor. Motor is free to move. Brake state is NOT-Active.



CME Default Setting for Brake Output [DOUT3] 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 [DOUT3] as LO.
BRK Output voltage is HI (24V), MOSFET Q2 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 [DOUT3] as HI.
BRK output voltage is LO (~0V), MOSFET Q2 is ON.
Servo drive is enabled, PWM outputs are ON.
Servo drive output current is flowing.

SPECIFICATIONS

Input	Data	Notes
Voltage Range	Max	+9~60 Vdc
Output Current	Ids	1.0 Adc

J12 BRAKE

Pin	Signal
2	VLOGIC
1	BRAKE

NEP-Z: J19 VLOGIC

J19 VLOGIC:

The J19 VLogic powers the internal logic and control circuits in the drive. When the STO feature is used, it must be produced by the power supplies with the transformer isolation from the mains, PELV or SELV ratings, and provide 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.

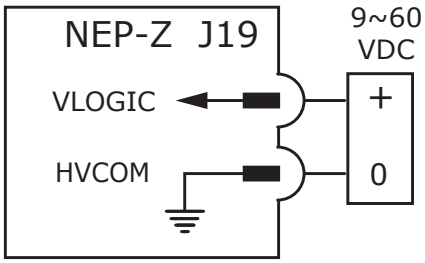
SPECIFICATIONS

Input	Data	Notes
Voltage Range	Max	+9~60 Vdc
Input Power	Typ	4 W
	Max	8 W

NOTE: The following are the input power values:
- Typical input power is no load on encoder +5V.
- Maximum input power is two encoders @ 250 mA each, and +5V at maximum.

J19 VLOGIC

Pin	Signal
2	VLOGIC
1	HVCOM



WARNING	***Refer to the AN136 Accelnet External Regen Application Note, Part Number 16-125661.***
	Vlogic +9~60. 24V power is recommended. If using a 24V Brake, 24V is required. If common to HV do not exceed 60V, use REGEN protection and diode isolation from HV.

NEP-Z: J1 INPUTS & OUTPUTS

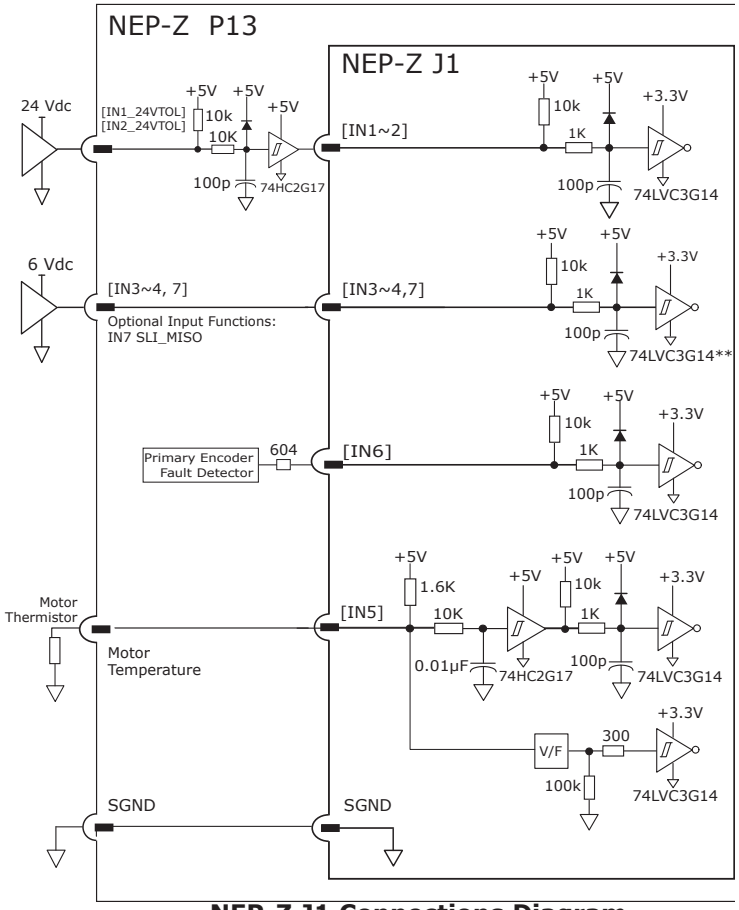
J1 has the following inputs and outputs:
- Digital Inputs 1~7
- Digital Outputs 1~6
- Analog Differential Input
- Secondary Quad A/B/X Encoder Input

The inputs and outputs are described as follows:
- IN1~2 are 24V compatible.
- IN3,4,5,7 are 6V tolerant.
- IN6 is dedicated to primary encoder fault detection.

J1 LOGIC INPUTS

Signal	Pins
IN1_24VTOL	6
IN2_24VTOL	8
IN3	10
IN4	12
IN5[1]	14
IN6	16
IN7[2]	18
SGND	3,13,20,23

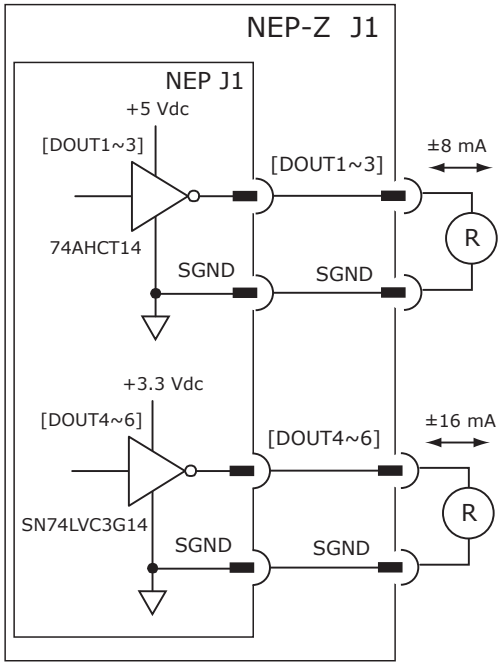
NOTES:
1) For information on IN5, refer to page 9:Motor Overtemp Input IN5.
2) The gate on IN7 is 74AHCT14BQ powered with 5.0 Vdc.



NEP-Z J1 Connections Diagram

J1 LOGIC OUTPUTS

Signal	Pins
DOUT1 [OUT1]	22
DOUT2 [OUT2]	24
DOUT3 [BRAKE_OFF]	26
DOUT4 [SLI_MOSI]	28
DOUT5 [SLI_CLK]	27
DOUT6 [SLI_ENI]	25
SGND	3,13,20,23



NEP-Z: J1 ANALOG INPUT

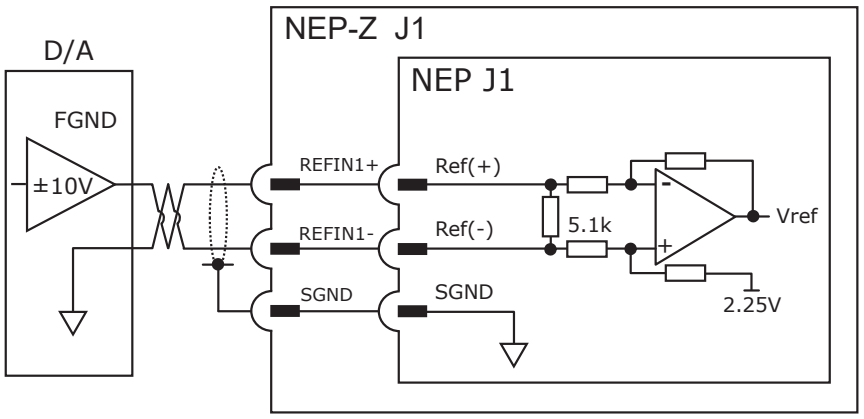
As a reference input, the J1 analog input takes Position/Velocity/Torque commands from a controller.

If it is not used as a command input, it can be used as the general-purpose analog input.

SPECIFICATIONS

Specifications	Data	Notes
Input Voltage	Vref	±10 Vdc
Input Resistance	Rin	5.1 kΩ

Signal	J1 Pins
Ref(+)	21
Ref(-)	19



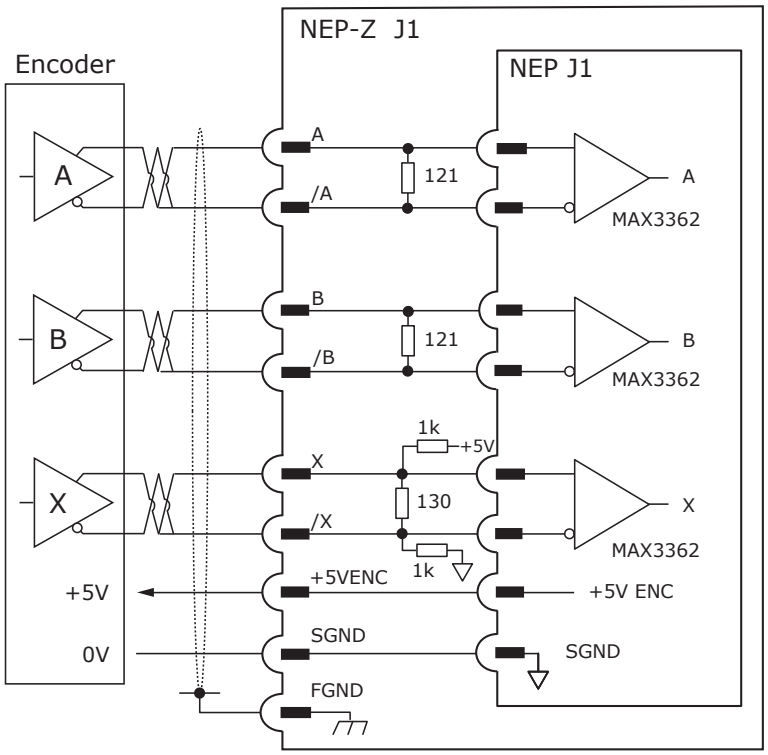
NEP-Z: J1 SECONDARY ENCODER

In the following diagram, it shows the NEP-Z J1 secondary encoder connections. The table identifies the signal and pins for the J1 ENC2 inputs.

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

J1 ENC2 INPUTS

Signal	Pins
ENCA2 [A]	4
/ENCA2 [/A]	2
ENCB2 [B]	11
/ENCB2 [/B]	9
ENCX2 [X]	17
/ENCX2 [/X]	15
+5VENC	5,7
SGND	3,13,20,23
FGND	1



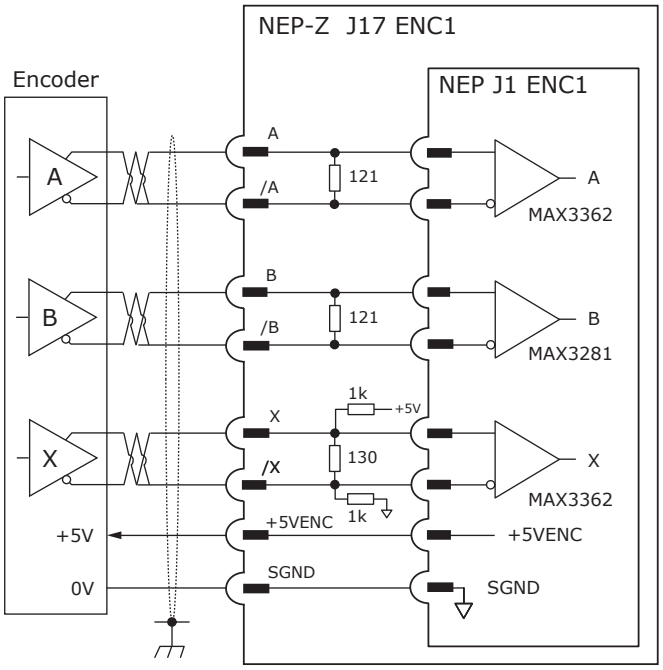
NEP-Z: J17 PRIMARY ENCODER

ENC1 is the Motor encoder. It is used in the single-encoder applications.

In the dual-encoder applications, it can be assigned as Primary or Secondary in the Copley software.

J17 ENC1 INPUTS

Signal	Pins
ENCA1 [A]	4
/ENCA1 [/A]	3
ENCB1 [B]	6
/ENCB1 [/B]	5
ENCX1 [X]	8
/ENCX1 [/X]	7
OVERTEMP_IN [IN5]	9
+5VENC	1
SGND	2,10



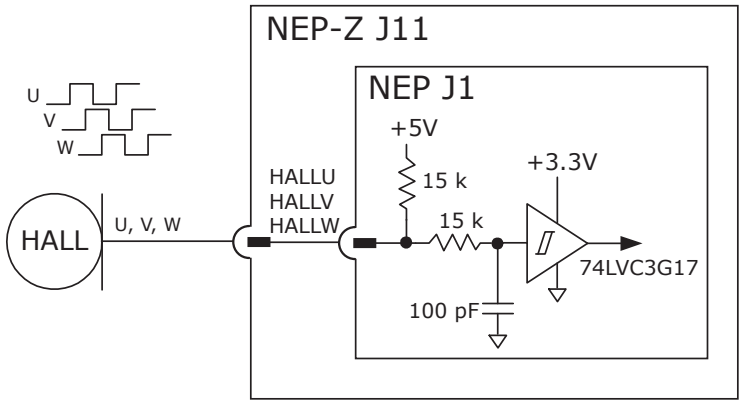
NEP-Z: J11 HALLS

In the NEP-Z, J11 diagram, it shows the Halls connections.

The table identifies the signal and pins for the J11 Hall Inputs.

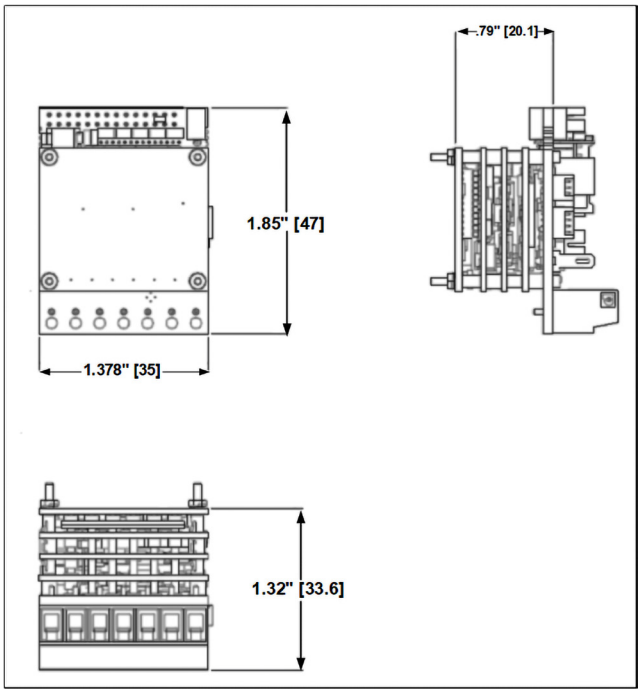
J11 HALL INPUTS

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



NEP-Z: MECHANICALS

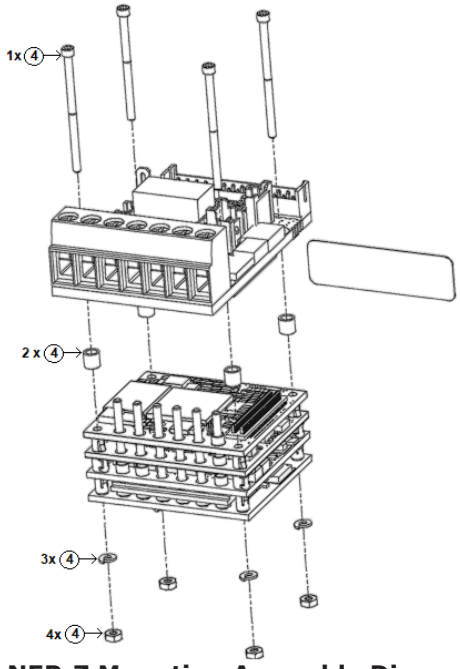
In the NEP-Z Dimensions diagram, it shows the dimensions for the NEP-Z module components.



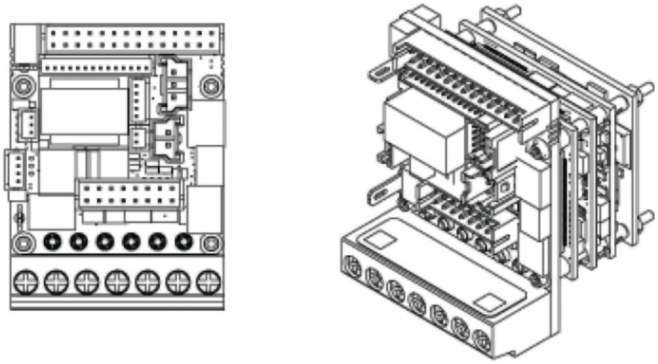
NEP-Z Dimensions Diagram

In the NEP-Z Mounting Assembly diagram, it shows the location of the parts in the drive when it is shipped.
To mount the board to the panel, use screw lengths of 1" [25.4 mm]. Connect the nuts to the washers and secure the parts together. As shown in the diagram, secure the nuts to the underside of the board.

NOTE: To calculate the minimum length of the screws, add the nuts' (depth or width) to this number. For a panel with tapped holes, the 1" [25.4 mm] screw should be sufficient.



NEP-Z Mounting Assembly Diagram



NEP-Z Module Diagram

The following table lists the item, quantity, description and manufacturing part numbers shipped with the drive.

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

Part Number	Description
NEP-090-10	Nano Plus Micro Module EtherCAT NEP Servo Drive, 5/10 A, 90 Vdc
NEP-090-70	Nano Plus Micro Module EtherCAT NEP Servo Drive, 35/70 A, 90 Vdc
NEP-180-10	Nano Plus Micro Module EtherCAT NEP Servo Drive, 5/10 A, 180 Vdc
NEP-180-30	Nano Plus Micro Module EtherCAT NEP Servo Drive, 15/30 A, 180 Vdc
NEP-090-10-D	Nano Plus Micro Module with NEP-D Development Board, not soldered, no Heat Sink
NEP-090-70-D	Nano Plus Micro Module with NEP-D Development Board, **soldered**, with Heat Sink
NEP-180-10-D	Nano Plus Micro Module with NEP-D Development Board, not soldered, no Heat Sink
NEP-180-30-D	Nano Plus Micro Module with NEP-D Development Board, not soldered, with Heat Sink
NEP-090-10-Z	Nano Plus Micro Module with NEP-Z EZ OEM Board, not soldered, no Heat Sink
NEP-090-70-Z	Nano Plus Micro Module with NEP-Z EZ OEM Board, **soldered**, no Heat Sink
NEP-180-10-Z	Nano Plus Micro Module with NEP-Z EZ OEM Board, not soldered, no Heat Sink
NEP-180-30-Z	Nano Plus Micro Module with NEP-Z EZ OEM Board, not soldered, no Heat Sink

ACCESSORIES FOR NANO PLUS MICRO MODULE NEP-D DEVELOPMENT BOARD

Part Number	Description
NP-D-CK	NEP-D Development Board Connector Kit
STO-CK-04	NANO Bypass Jumper for the NEP-D Development Board
N-HK	Heat Sink Kit
SER-USB-RJ11	USB to RJ11 6-pin Modular Adapter

CONNECTOR KIT FOR NEP-D DEVELOPMENT BOARD

	QTY	REF	Name	Description	MFGR Part Number
NP-D-CK Connector Kit	1	P8	VLOGIC and Brake	Connector, Terminal Block, 4-pole, 3.5 mm	WAGO: 734-104/107-000
	1			Tool for Terminal Block	WAGO: 734-231
	1	P9	STO	Backshell, 9 Pin, Metal	3M: 3357-9209
	1	P7	Feedback	Backshell, 15 Pin, Metal	3M: 3357-9215
	1	P13	I/O	Backshell, 25 Pin, Metal	3M: 3357-9225
	1	P9	STO	Connector, 9 Pin Plug, Metal Shell	AMP: 205204-4
	1	P7	Feedback	Connector, D-Sub, 26 Pin HD, Male, Solder Cup	Norcomp: 180-026-103L001
	1	P13	I/O	Connector, D-Sub, 44 Pin HD, Male, Solder Cup	Norcomp: 180-044-103L001
	9	P9	STO	Contact, Pin, Snap-In, 24~20 AWG	AMP: 66506-9
	2	P9	STO	Jumper, Wire Harness for STO Bypass Terminator	Copley: 103-131505-01

ORDERING GUIDE

ACCESSORIES FOR NANO PLUS MICRO MODULE NEP-Z OEM BOARD

Part Number	Description
NP-Z-CK	NEP-Z OEM Board Connector Kit
N-HK	Heat Sink Kit
SER-USB-M	USB to 3-pin Molex Adapter Cable

CONNECTOR KIT FOR NEP-Z OEM BOARD

	Qty	Ref	Name	Description	MFGR Part Number
NP-Z-CK Connector Kit	1	J16	STO Bypass	Board Assembly, STO Bypass Board	Copley: NP-Z-STO
	1	J19	VLOGIC	Connector, Socket, single row, 2.00 mm, 2 pos	Molex: 35507-0200
	1	P12	RS-232	Connector, Socket, single row, 2.00 mm, 3 pos	Molex: 35507-0300
	1	J17	Primary Feedback	Connector, Socket, single row, 1.25 mm, 14 pos	Hirose: DF13-14S-1.25C
	1	J16	STO	Connector, Socket, double row, 2.00 mm, 16 pos	Hirose: DF11-16DS-2C
	1	J12	Brake	Connector, Socket, single row, 1.25 mm, 2 pos	Hirose: DF13-2S-1.25C
	2	J13, J14	CAN	Conn Wire-MT HSG SKT 1x3P, LKG NYL, beige, 1.25 mm	Hirose: DF13-3S-1.25C
	2	J9, J10	ECAT IN, OUT	Connector, Socket, single row, 1.25 mm, 4 pos	Hirose: DF13-4S-1.25C
	1	J11	Halls	Connector, Socket, single row, 1.25 mm, 5 pos	Hirose: DF13-5S-1.25C
	1	J1	Secondary Fdbk, I/O	Connector, Socket, double row, 2.00 mm, 28 pos	Hirose: DF11-28DS-2C
	1	P16, P17	Shields	Connector, positive locking, 26-22 AWG	TE: 353249-2
	5	J19, P12	Molex Crimps	Crimp, Socket 30-24 AWG, 1.4 mm max. Insulation, Tin	Molex: 501212-8000
	1	J19	VLOGIC GND	Black Flying Lead with Socket at one end, 24 AWG, gold, 12”	Molex: 050212-8000-12-B4
	1	J19	VLOGIC	Red Flying Lead with Socket at one end, 24 AWG, gold, 12”	Molex: 050212-8000-12-R4
	29		DF13 Pins	Connector, Contact, Crimp, 30-26 AWG, 1 mm	Hirose: DF13-2630SCFA
	4		DF13 Wires	Black Flying Lead with Sockets at both ends, 26 AWG, gold, 12”	Hirose: H4BBG-10112-B6
	17		DF13 Wires	White Flying Lead with Sockets at both ends, 26 AWG, gold, 12”	Hirose: H4BBG-10112-W6
	1		Brake Wire	Blue Flying Lead with Sockets at both ends, 26 AWG, gold, 12”	Hirose: H4BBG-10112-L6
	3		DF13 Wires	Red Flying Lead with Sockets at both ends, 26 AWG, gold, 12”	Hirose: H4BBG-10112-R6
	3		DF11 Wires	Black Flying Lead with Sockets at both ends, 26 AWG, gold, 12”	Hirose: H3BBG-10112-B6
	3		DF11 Wires	Red Flying Lead with Sockets at both ends, 26 AWG, gold, 12”	Hirose: H3BBG-10112-R6
	20		DF11 Wires	White Flying Lead with Sockets at both ends, 26 AWG, gold, 12”	Hirose: H3BBG-10112-W6
	44	J1, J16	DF11 Pins	Connector, Contact, Crimp 28-24 AWG, 1.45 mm	Hirose: DF11-2428SCA

REVISION HISTORY

16-123146 Document Revision History

Revision	Date	Remarks
AA	November 30, 2021	Evaluation version, pre-release
AB	May 30, 2024	Update digital output & input values and related information. Add Action Electronics part numbers, and replace P1 with J1 (where applicable). Update new NEP assembly drawing.
00	October 16, 2024	Production revision.
01	January 21, 2025	Update NEP-D/Z Switches & LEDs diagrams & add part: STM32F042G4U6TR.