Nano Plus-HP CANopen

PCF NPP-HP

DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS

PCF Plus Common Features

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

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
- Camming, Gearing
- Position, Velocity, Torque

Command Interface

- CANopen
- 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

- CANopen
- 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

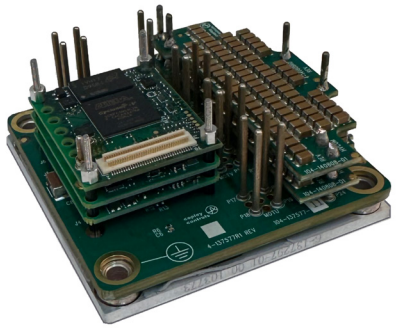
Safe Torque Off (STO)

- SIL 3, Category 3, PL e

Dimensions: in [mm]

- NPP-HP: 1.3 x 2.6 x 2.5 in [33 x 66 x 63.5 mm], 5.8 oz [164 g]
- NPP-HP-Z:1.44 x 2.6 x 2.5 in [36.5 x 66 x 63.5 mm], 7.6 oz [215 g]

CANopen®



NPP-HP

Model	Ic	Ip	Vdc
NPP-090-80-C	80	80	9~90
NPP-090-140-C	140	140	9~90

NPP-HP-Z (Soldered to EZ Board)

Model	Ic	Ip	Vdc
NPP-090-80-C-Z	80	80	9~90
NPP-090-140-C-Z	140	140	9~90

Description

The Nano[Plus] High Power drive provides 100% digital control of brushless servo motors in a compact DC powered, modular package. The NPP-HP models operate as nodes used for transmitting data on a CAN nework. This drive complies with the requirements of the robotics, AGV, industrial machinery, medical/life-sciences and aerospace industries. The Nano has a third party approved STO feature. Opto-isolators provide connections to user wiring and controls.

The NPP-HP drive can be mounted to any of the following:

- directly on the motor or within the robotic joints
- the user PC boards using either connectors
- soldered into the board

An optional interface board provides connectors which simplify the integration into customer applications.

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	NPP-090-80-C NPP-090-80-C-Z	NPP-090-140-C NPP-090-140-C-Z	Units
OUTPUT POWER			
Peak Current	80 (56.6)	140 (99.0)	Adc (Arms, sinusoidal)
Peak Time	N/A	N/A	Sec
Continuous Current	80 (56.6)	140 (99.0)	Adc (Arms, sinusoidal)
Peak Output Power	4.7	8.3	kW
Continuous Output Power	4.7	8.3	kW
*Note: For EZ packages, all Nano Plus HP modules are soldered into the EZ board.			
INPUT POWER			
HVmin to HVmax	+9 to +90	+9 to +90	Vdc, transformer-isolated
+HV Absolute Max.	+95	+95	Vdc, transformer-isolated
Ipeak	50	88	Adc
Icont	50	88	Adc continuous
VLOGIC	+9 to +60	+9 to +60	Vdc, transformer-isolated
VLOGIC Absolute Max.	+60	+60	Vdc, transformer-isolated
VLOGIC Power	4 W with no encoder, 8 W with encoder +5V @ 500 mA, VLOGIC @ 24 VDC output.		
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			
CANOPEN	CANopen: 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 NPP-HP			
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 NPP-HP-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
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.
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 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 (PL e)
Inputs	2 two-terminal: STO_1, STO1_RTN, STO_2, 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 Undervoltage	+HV < +9.0 Vdc ±1 Vdc	Drive outputs turn Off until +HV is > +8.5 Vdc ±0.5 Vdc (90 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	NPP-HP: 1.3 x 2.6 x 2.5 in [33 x 66 x 63.5 mm], 5.8 oz [164 g] NPP-HP-Z: 1.44 x 2.6 x 2.5 in [36.5 x 66 x 63.5 mm], 7.6 oz [215 g]
Ambient Temperature	Operating: 0 to +45 °C, Storage: -40 to +85 °C
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, half 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 Refer to the Copley NANO^{Plus} High Power User Guide, (Part Number: 16-140881).*** For information on any application using the NANO Plus High Power drive STO feature, refer to the Copley NANO^{Plus} High Power User Guide (PN: 16-140881). ***Failure to heed this warning can cause equipment damage, injury, or death.***

CANOPEN COMMUNICATIONS

CANOPEN

CANopen is the communication protocol 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 offers a highly effective combination of data-rate and low costs for the 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

NPP-HP 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).

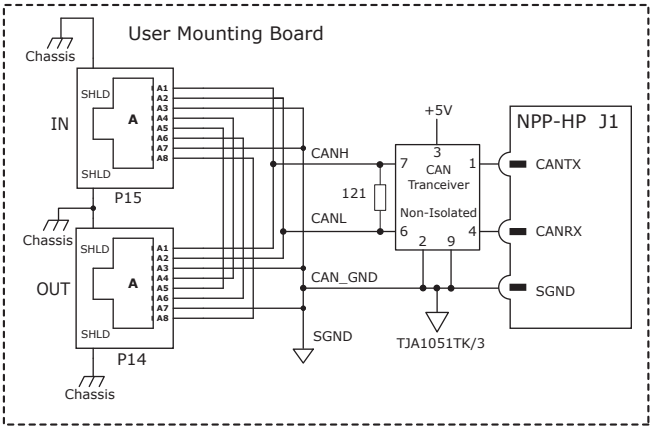
A maximum of 127 CAN nodes are allowed on a single CAN bus. Up to six digital inputs can be used to produce CAN Node-IDs from 1~63, or the Node-ID can be saved to the flash memory in the module. Node-ID 0 is reserved for the CANopen master on the network.

CANOPEN COMMAND INPUTS

In the following diagram, it shows connections between the NPP-HP and RJ45 connectors on the NPP-HP. If the NPP-HP 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 NPP-HP devices on the mounting PCB, then the terminating resistor should be near the NPP-HP that is farthest from the CAN network connection to the PCB. The node Node-ID of the NPP-HP may be set by using digital inputs, or programmed into flash memory in the drive.

Signal	J1 Pins
CANTX	33
CANRX	31
SGND	39,40



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. Use the Copley software to program the setup for the drive configuration or to setup the external equipment to send ASCII commands.

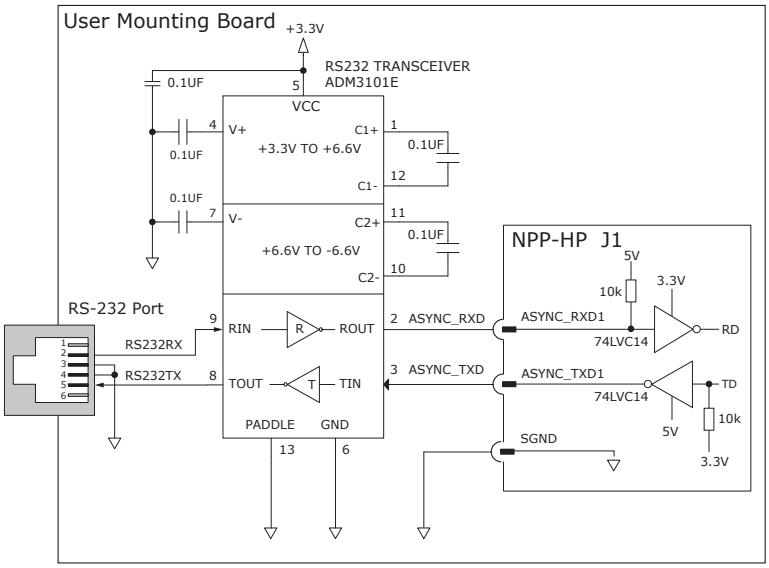
In the following diagram, the circuit shown is used on the -Z boards. It is recommended for the user's PC boards. It converts the single-ended TTL signals levels in the NPP-HP into the ANSI RS-232 levels which are the standard for serial communications and computer COMM ports.

RS-232 PORT

Signal	Pins
RS232RX	2
RS232TX	5
SGND	3,4

DRIVE J1

Signal	Pins
ASYNC_RXD1	28
ASYNC_TXD1	30
SGND	39,40



WARNING

Refer to NANO NPP-HP 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} High Power User Guide, (Part Number: 16-140881).***
	For information on any application using the NANO Plus High Power drive STO feature, refer to the Copley NANO^{Plus} High Power User Guide (PN: 16-140881).
	Failure to heed this warning can cause equipment damage, injury, or death.

STO DISABLE

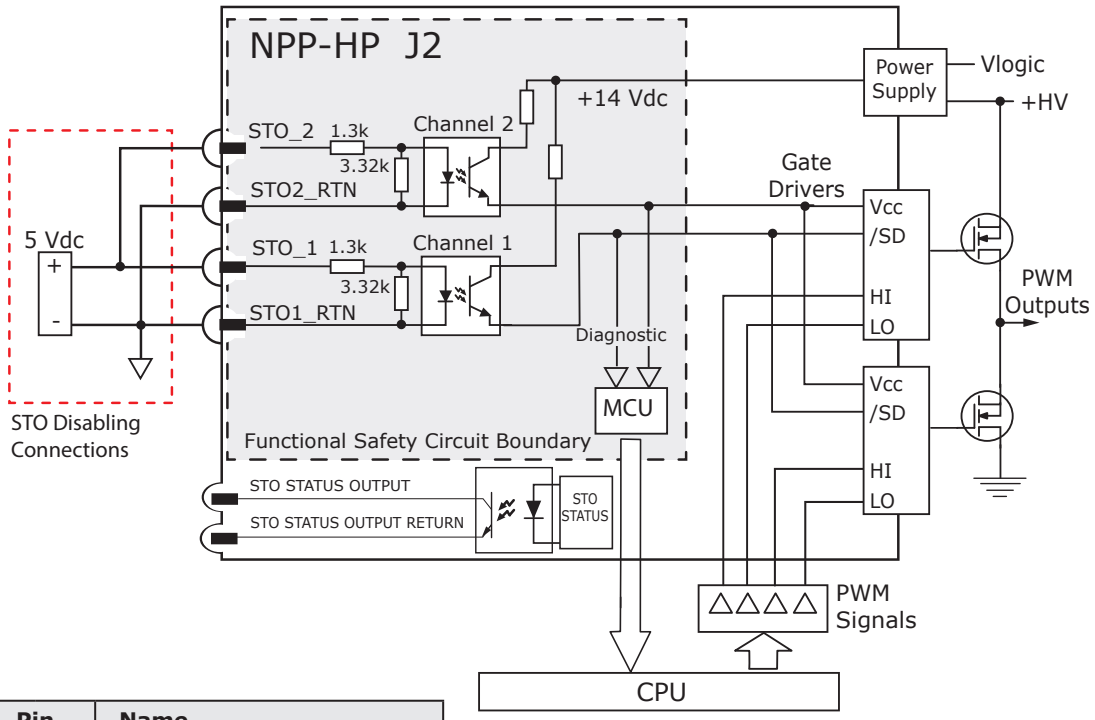
To activate the PWM outputs of the NPP-HP, the current must be flowing through the opto-couplers that are connected to the STO_1 and STO_2 terminals and the drive must be in an ENABLED state. When either of the opto-couplers are Off, the drive is in a Safe Torque Off (STO) state and the PWM outputs cannot be activated by the control core to drive a motor.

In the diagram, it 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
STO_1	1	2	STO1_RTN
STO_2	3	4	STO2_RTN
STO1_STATUS_OUTPUT	5	6	STO1_STATUS_OUTPUT_RTN

STO OPERATION

STO Input Voltage	STO State
STO_1 *AND* STO_2 ≥ 3.0 Vdc	STO Inactive. Drive can be enabled to produce torque.
STO_1 *OR* STO_2 ≤ 0.8 Vdc	STO Active. Drive cannot be enabled to produce torque.
STO_1 *OR* STO_2 Open	

Note: In the above table, the voltages are referenced between a STO_x and a STOx_RTN.
For example, V(STO1) = V(STO_1) - 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

The NPP-HP works with the motion controllers to send output pulses to the 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.

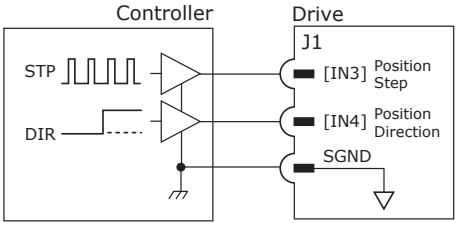
- Count-Up/Count-Down (CU/CD)

  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.

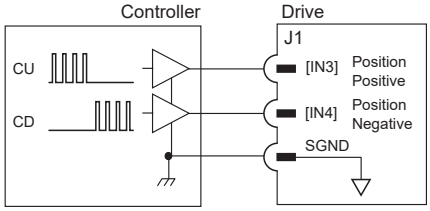
- A/B Quadrature Encoder

  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.

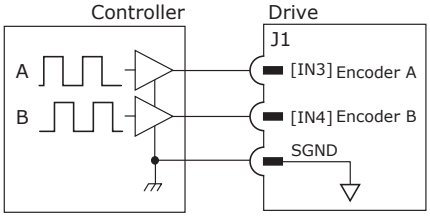
STEP/DIRECTION INPUTS



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

The NPP-HP works with the motion controllers to send output pulses to the command Velocity or Torque. The following formats are supported:

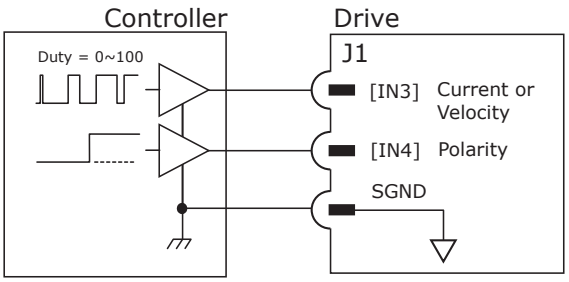
- Pulse/Direction

  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.

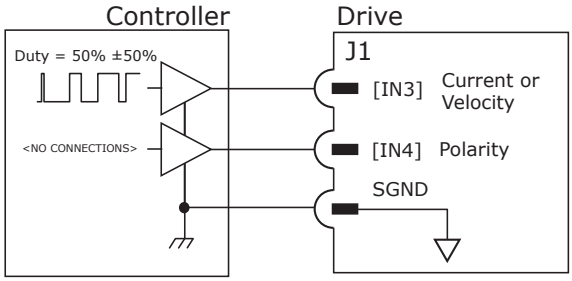
- PWM 50%

  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 seven digital inputs to the NPP-HP 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

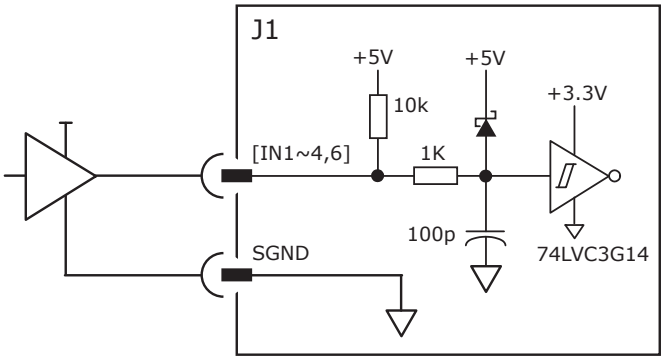
In addition to the selection of functions, the active level for each input is individually programmable. Input level functions have programmable HI or LO to activate the function. Input transition functions are programmable to activate on LO -> HI, or HI -> LO transitions.

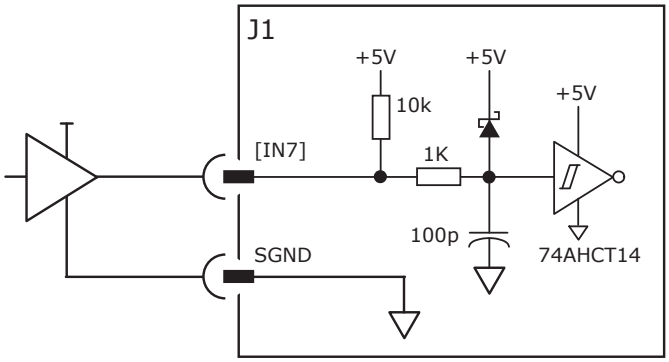
INPUT TRANSITION FUNCTIONS

- 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.

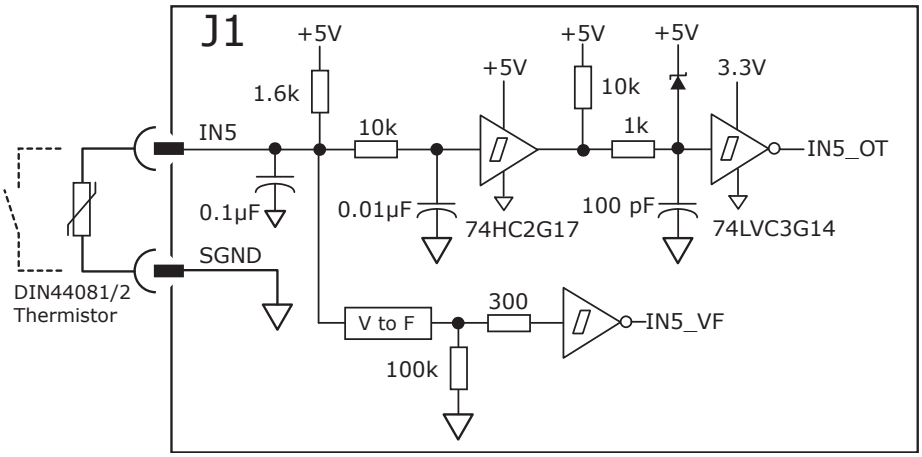
MOTOR OVERTEMP INPUT: IN5

Input IN5 has a 100 microsecond rise time RC filter, with a 1.6 kΩ pull-up 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

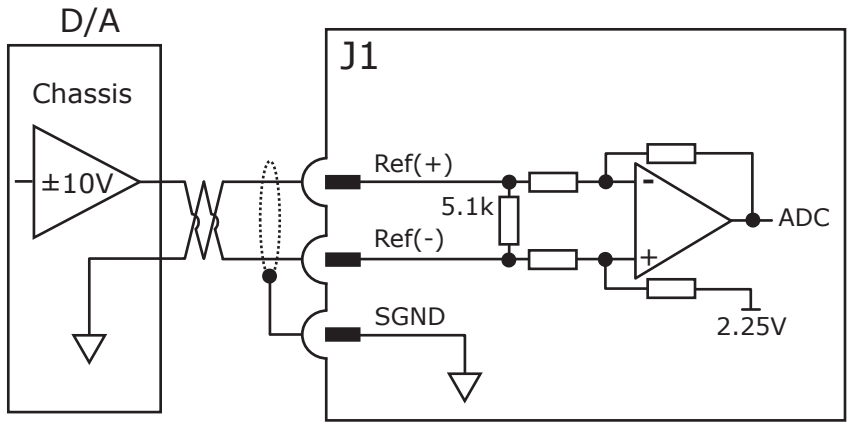
As a reference input, the AIN1 takes Position/Velocity/Torque commands from a controller.

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
AGND	3



DIGITAL OUTPUTS: OUT1~OUT3

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

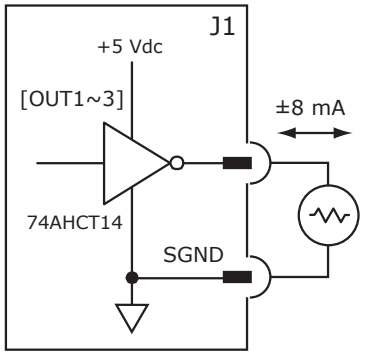
OUTPUT FUNCTIONS

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

Signal	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

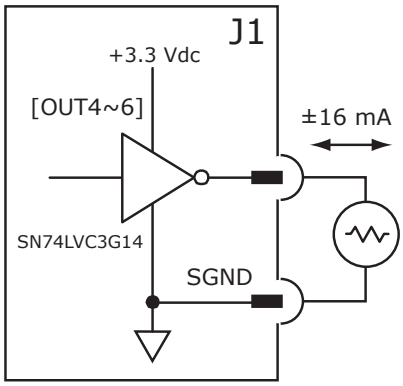
Digital outputs [OUT4~6] are CMOS inverters. They operate +3.3V and can source/sink 16 mAdc.

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.

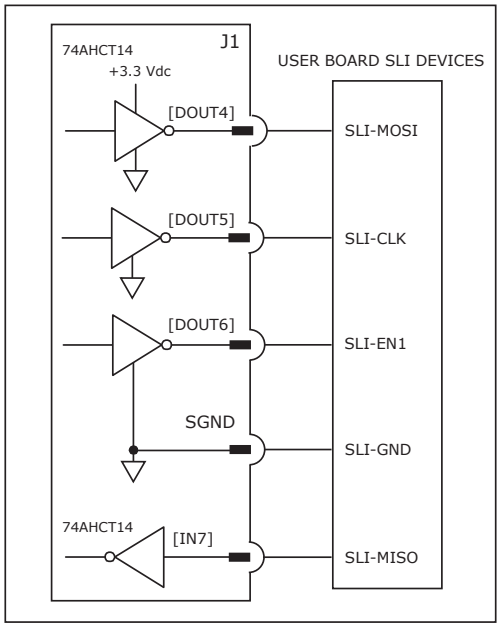
OUTPUT FUNCTIONS

- 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.



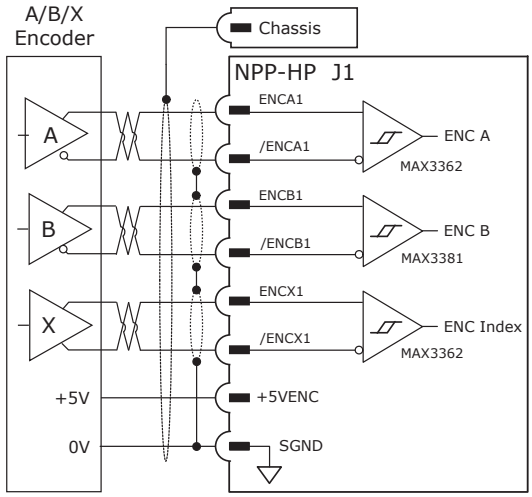
ENCODER 1 (PRIMARY FEEDBACK)

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
SGND	56,57

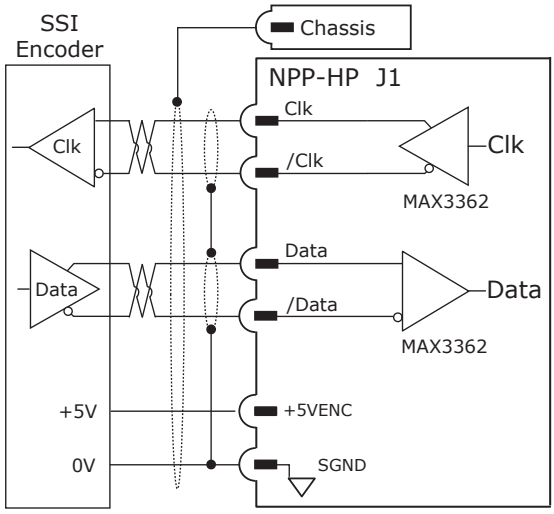
J1 SGND Pins
3,4,18,39,40,44,45,56,57



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 NPP-HP 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.



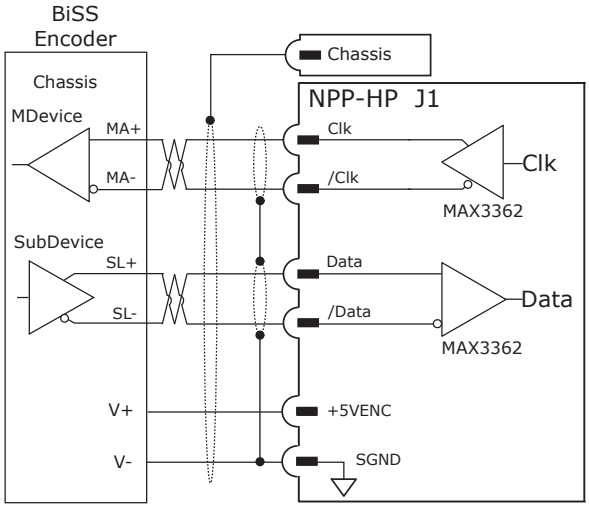
SSI, BiSS SIGNALS

SSI	BiSS	Signal	J1 Pins
Clk	MA+	ENCX1	55
/Clk	MA-	/ENCX1	54
Data	SL+	ENCA1	51
/Data	SL-	/ENCA1	50
+5VENC			64,66
SGND			56,57

BiSS ABSOLUTE ENCODER

BiSS is an Open Source - Digital Interface used for sensors and actuators. BiSS refers to the principles of well known industrial standards for Serial Synchronous Interfaces like SSI, AS-Interface® and Interbus® with the following 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.

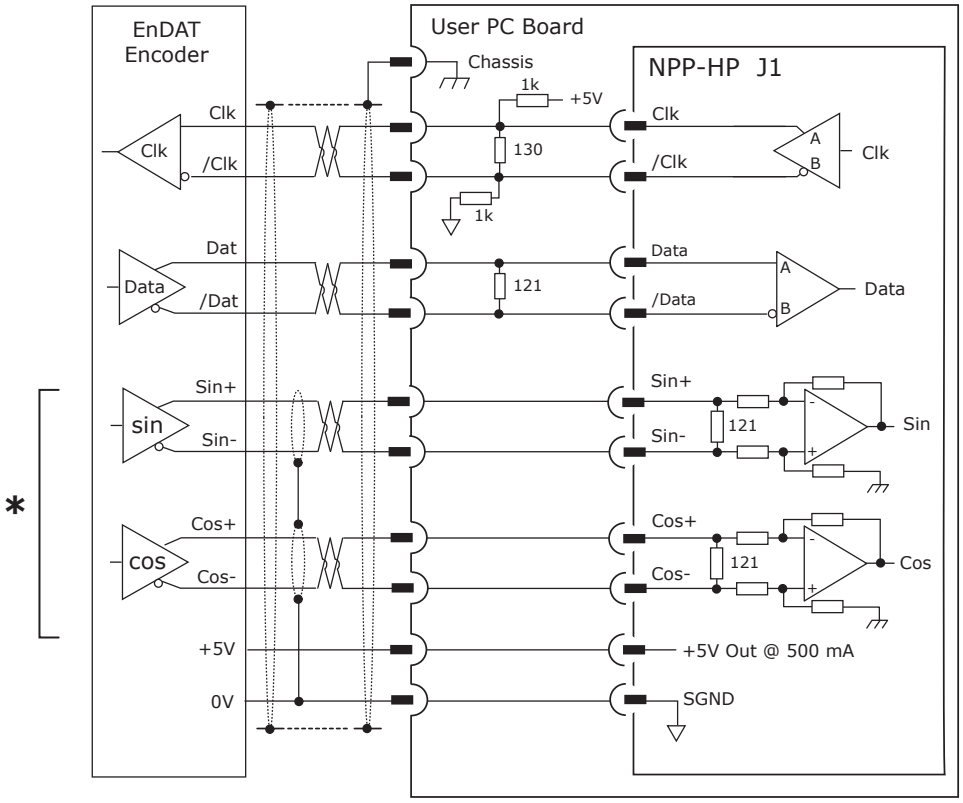
The number of position data bits are programmable and so are the use of Sin/Cos channels. In the EnDat specification, using the Sin/Cos incremental signals is optional.

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

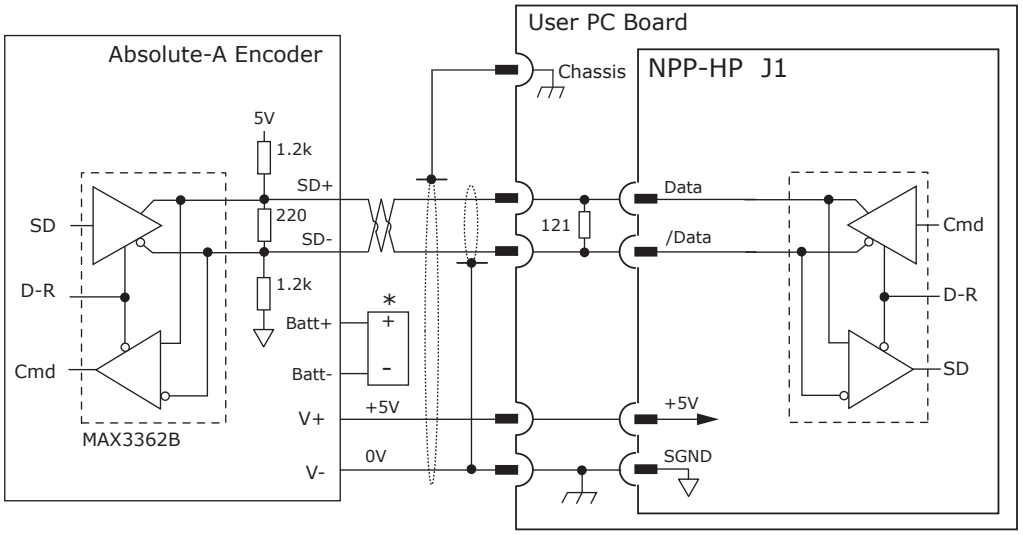
The Absolute A interface is a serial, half-duplex type that is electrically the same as the RS-485.

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
GND	SGND	56,57

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



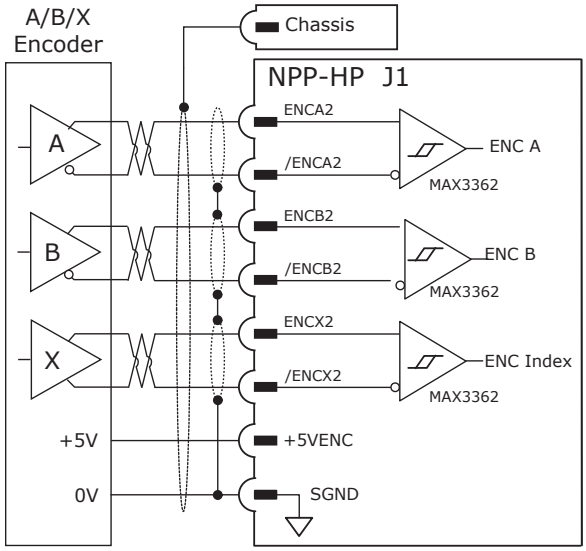
NOTE: Signal (outer) shields should be connected at the drive end. The inner shield is optional for digital encoders and should only be connected to Signal Ground on the drive.

ENCODER 2 (SECONDARY FEEDBACK)

QUAD ENCODER WITH INDEX

In the following diagram, it shows the secondary encoder connections.

The 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

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

ABSOLUTE ENCODERS

Secondary Feedback: Absolute

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

Feedback Options
Quad Encoder A, Half-Duplex CLK-DATA, Full-Duplex DATA
Quad Encoder /A, Half-Duplex /CLK-DATA, Full-Duplex /DATA
Quad Encoder B
Quad Encoder /B
Quad Encoder X, Full-Duplex CLOCK
Quad Encoder /X, Full-Duplex /CLOCK

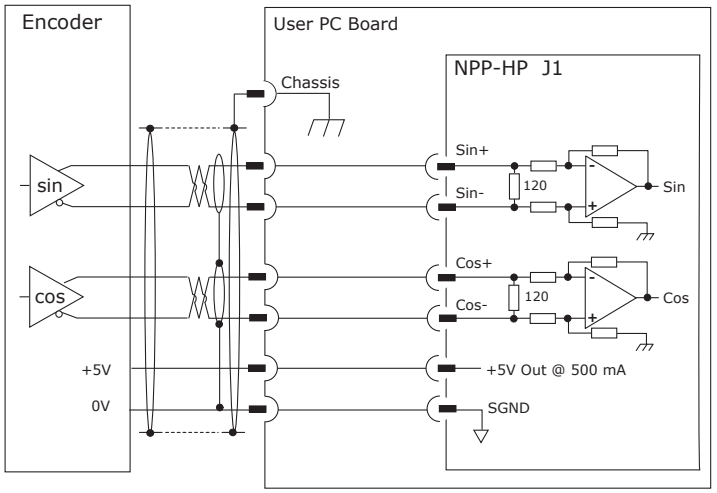
SIN/COS ENCODER

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.

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

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.



OTHER MOTOR CONNECTIONS

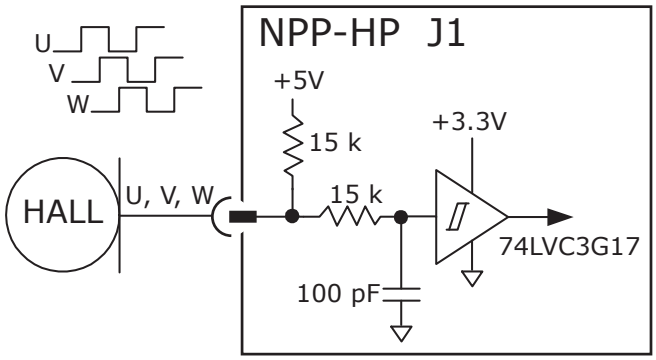
HALLS

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

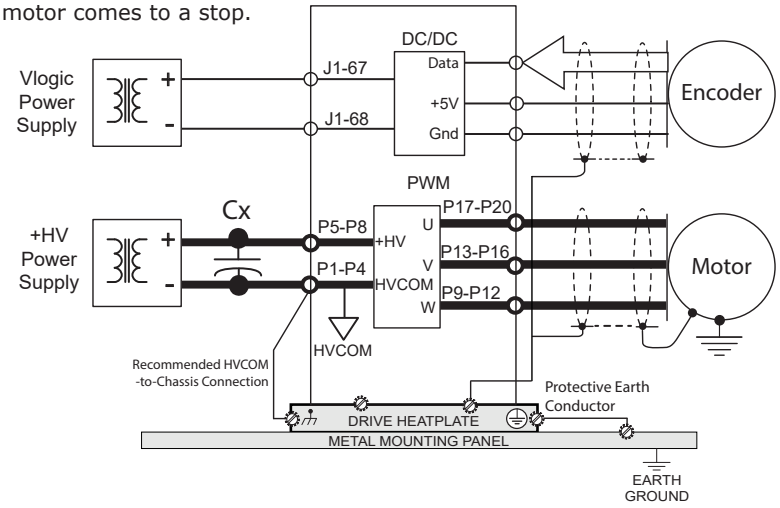


+HV CONNECTIONS

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~P8. 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.



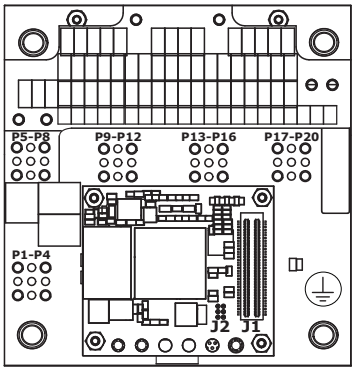
GROUNDING

The P1~P4 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.
The labeled mounting hole provides a PE (Protective Earth) connection as well as a point to ground the motor cable shields.

P1~P20

Signal	Pins
HVCOM	P1~P4
+HV	P5~P8
MOTW	P9~P12
MOTV	P13~P16
MOTU	P17~P20
Chassis	*

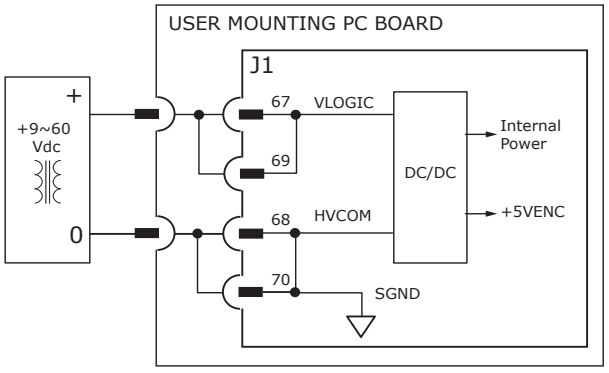
*Note: The mounting holes are connected to one another and to Chassis Ground. The mounting hole marked with the PE symbol is the connection point for the protective earth conductor.



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

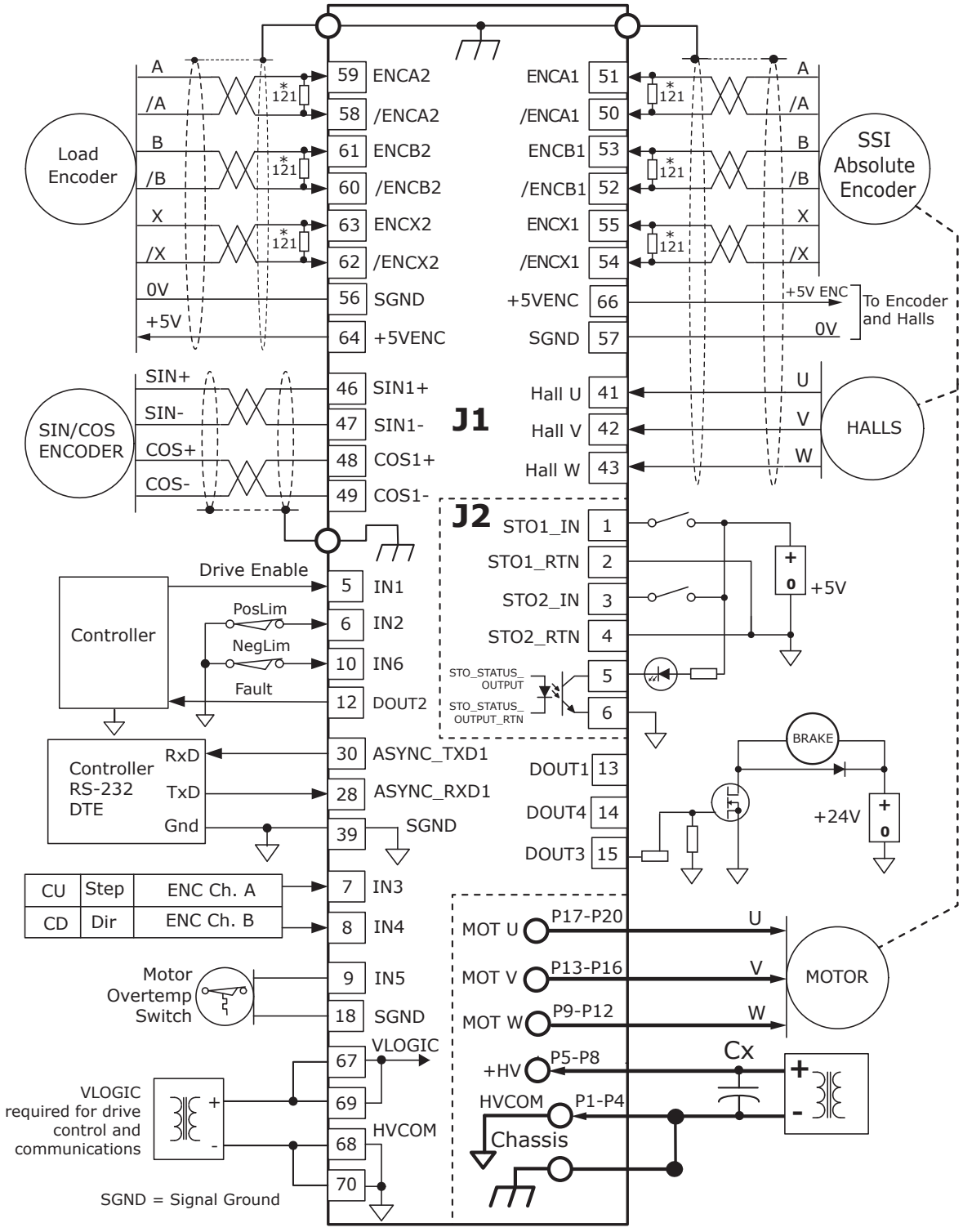
WARNING

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.

NPP-HP TYPICAL CONNECTIONS

The following diagram shows the NPP-HP connections and identifies the pins and signals.



NPP-HP Connections Diagram

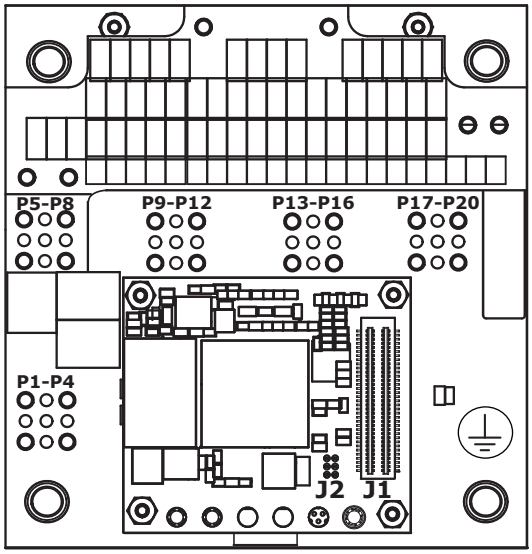
PC BOARD CONNECTIONS

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

P1~P20

Signal	Pins
HVCOM	P1~P4
+HV	P5~P8
MOTW	P9~P12
MOTV	P13~P16
MOTU	P17~P20
Chassis	*

*Note: The mounting holes are connected to one another and to Chassis Ground. The mounting hole marked with the PE symbol is the connection point for the protective earth conductor.



NPP-HP Module Board Connections Diagram

J2 STO

Name	Pin		Name
STO1_RTN	2	1	STO_1
STO2_RTN	4	3	STO_2
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
N.C.	19	20	N.C.
N.C.	21	22	N.C.
N.C.	23	24	N.C.
N.C.	25	26	N.C.
N.C.	27	28	ASYNC_RXD1
N.C.	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

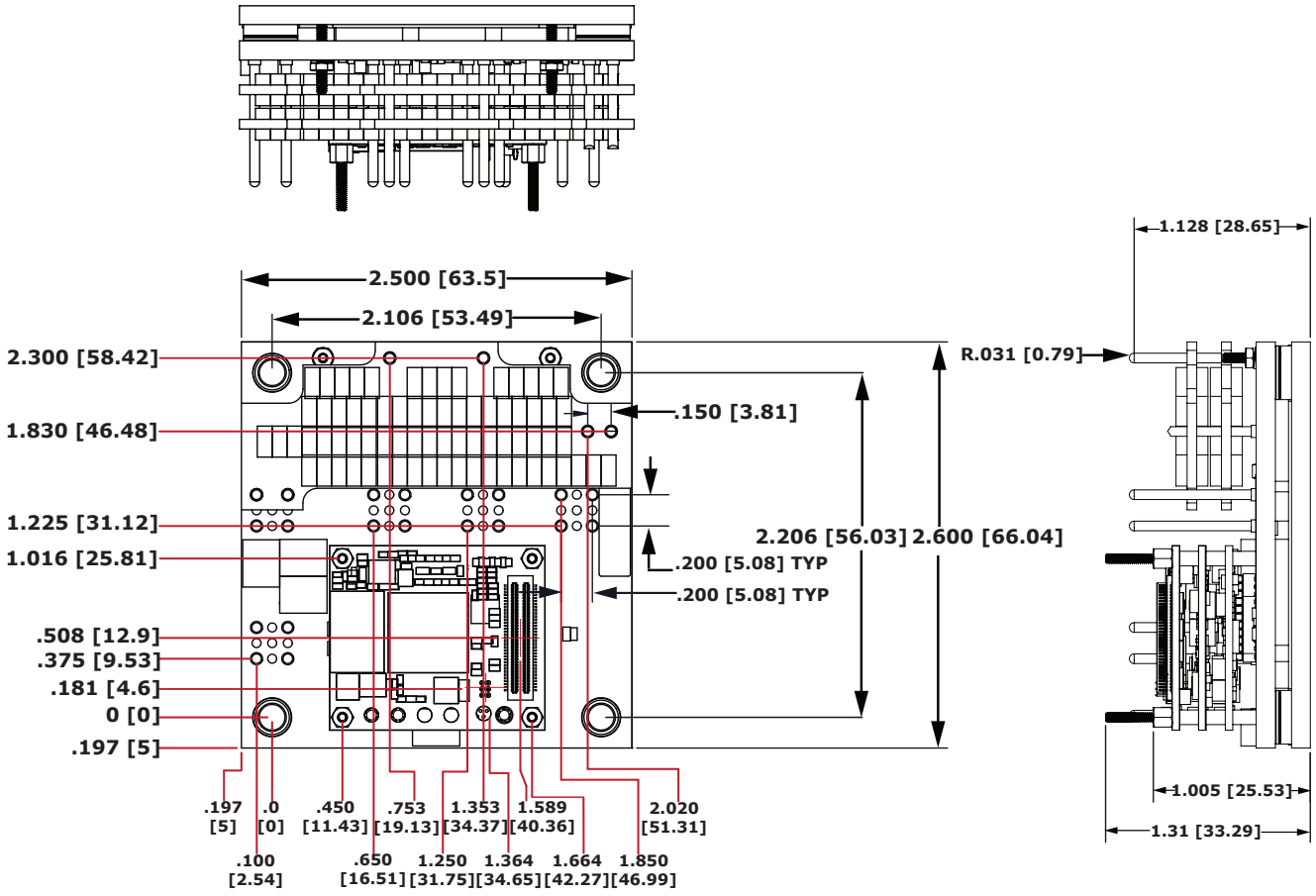
*Note: The Part Number column indicates the parts that require the purchase of reels for those components. Refer to the following vendor to contact for approved value-added partner Action Electronics.
Action Electronics, Inc.
Walpole, MA 02081-2522-US
Phone: (508) 668-5621

DIMENSIONS

NPP-HP MODULE

The following diagram shows the NPP-HP module dimensions.

The dimensions are measured in inches [in] and millimeters [mm].



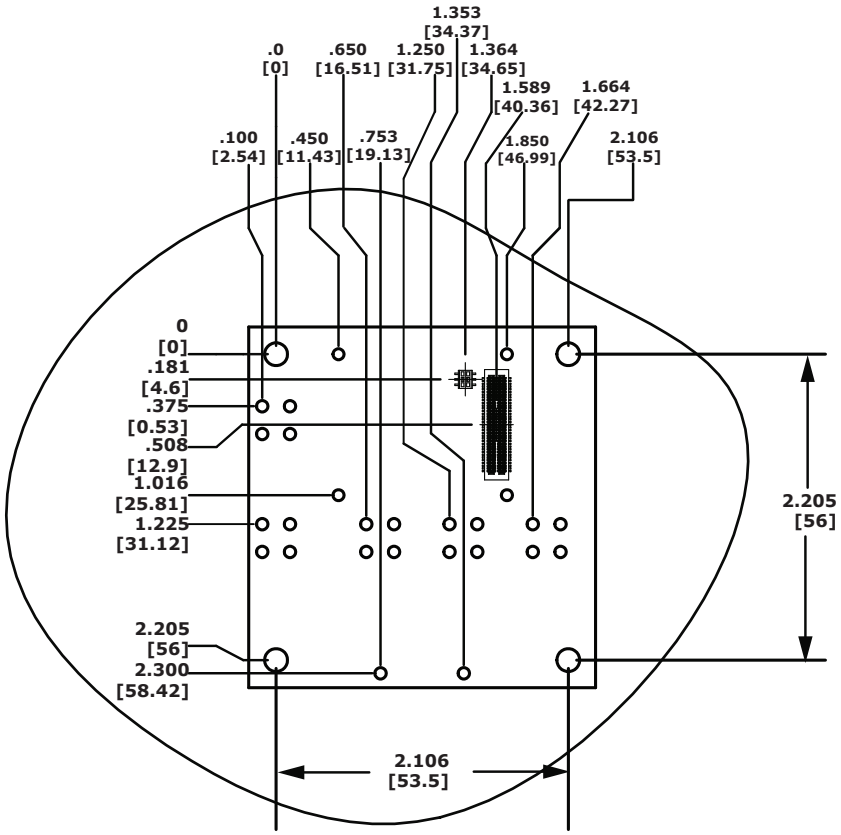
NPP-HP Module Dimensions Diagram

DIMENSIONS

PC BOARD MOUNTING DIMENSIONS

The following diagram shows the topside view of the user mounting PC board for the drive.

The STO (J2) connector is mounted on the underside of the PC board. The topside view shows the clearance holes for the STO connector mating pins.



PC User Mounting Board Dimensions (Bottom View)

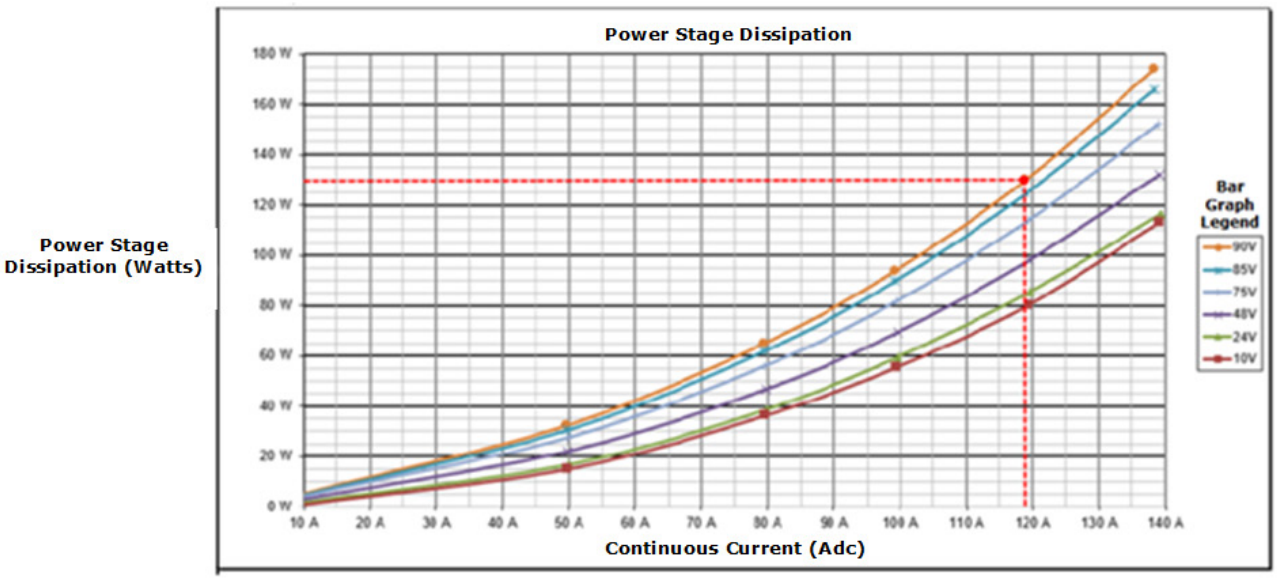
NOTES:

1. The J2 Connector is not shown in the above diagram, because it is located on the far side of the PCB. The CL dimension for the connector body is shown with the 6 access holes used for the header pins so that they can pass through the customer board. Then, mate to the connector.
2. To determine the copper width and thickness for P1~P20 signals, refer to specification IPC-2221. (Association Connecting Electronic Industries, https://www.ipc.org)
3. For maximum noise suppression and immunity, connect the standoffs to etches on the PC board that connects to the chassis.
4. The Nano Plus High Power Module drives do not emit noise above 70 dB(A) when they are mounted and operating.

THERMALS: PWM OUTPUTS DISSIPATION

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 show a power dissipation of 130 W at a continuous current of 119 Adc and +HV = 90 VDC.

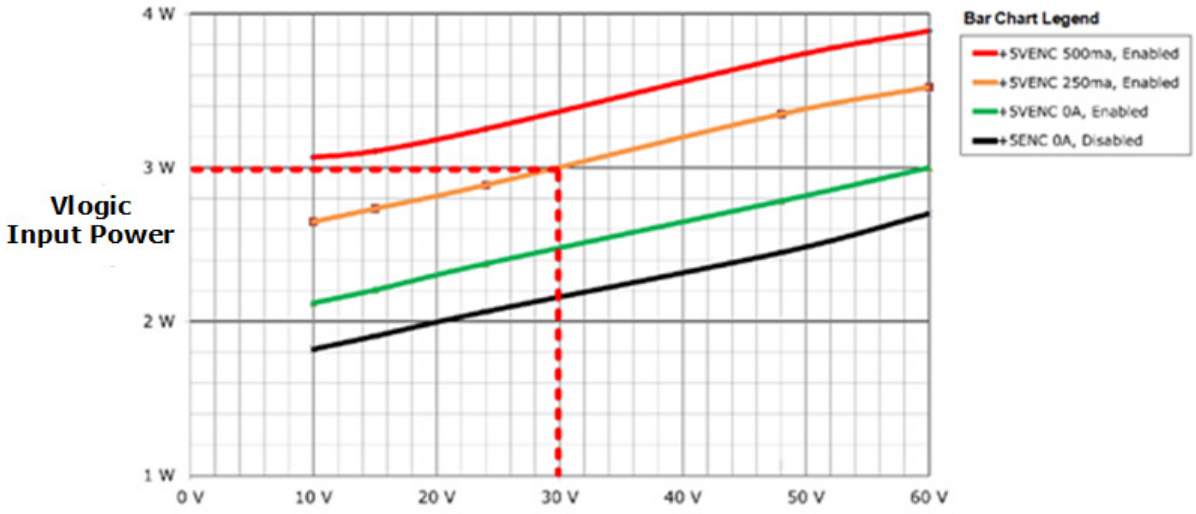


Power Stage Dissipation Chart

VLOGIC/VOLTAGE

In the chart below, it shows the power dissipation in the Vlogic circuits that power the drive's control circuits and the external encoders. Adding the PWM dissipation to the Vlogic dissipation will yield the total dissipation in Watts for the drive.

In the chart, the dotted lines 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.



Vlogic Voltage Chart

NPP-HP-Z

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

MODELS

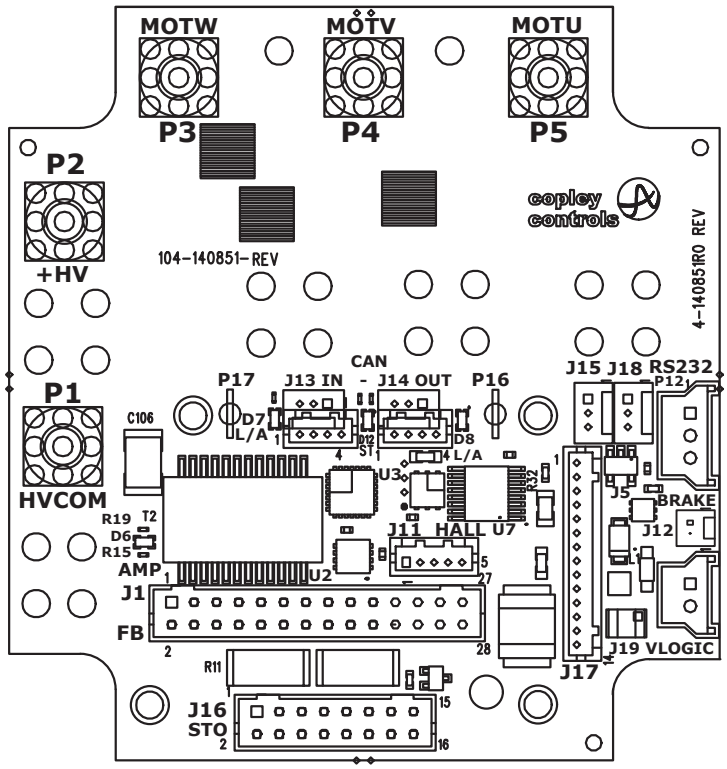
NPP-090-80-C-Z
NPP-090-140-C-Z

P1-P5

Signal	Pin
HVCOM	P1
+HV	P2
MOTW	P3
MOTV	P4
MOTU	P5

J11 HALLS

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



NPP-HP-Z Connections Diagram

P16 SHIELD P17 SHIELD

Signal	Pin	Signal	Pin
SHLD	1	SHLD	1

J13 CAN J14 CAN

IN	Pin	OUT	Pin
CANH	1	CANH	1
CANL	2	CANL	2
SGND	3	SGND	3

P12 RS-232

Signal	Pin
RX232TX1	3
RS232RX1	2
SGND	1

J12 BRAKE

Signal	Pin
VLOGIC	2
BRAKE	1

J19 VLOGIC

Signal	Pin
VLOGIC	2
HVCOM	1

J16 STO

Signal	Pin		Signal
STO1_24V_IN	2	1	STO1_RTN
STO_1	4	3	STO1_RTN
N.C.	6	5	N.C.
STO2_24V_IN	8	7	STO2_RTN
STO_2	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	Chassis
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

NPP-HP-Z: P12 RS-232

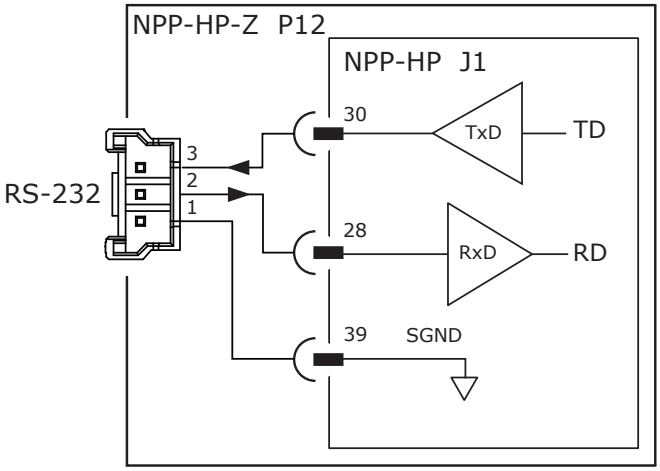
RS-232 CONNECTION

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

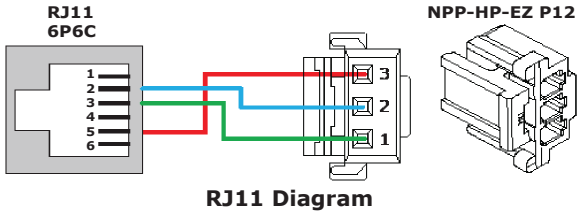
P12 RS-232

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 CAN Device ID is set via RS-232 along with other operating functions.

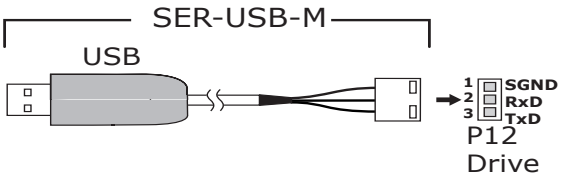


The RJ-11 socket (6P6C) is compatible with the existing serial-data cables. It can be done using an RJ-11 socket (6P6C) wired with a compatible serial-data cable as shown in the RJ11 Diagram. Molex: 42410-6170 Modular Jack, 6 terminals, size 6



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 NPP-HP-Z serial port.



CANOPEN CONNECTIONS

CANOPEN 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 Ω CAN terminator should be placed in the last drive in the chain.

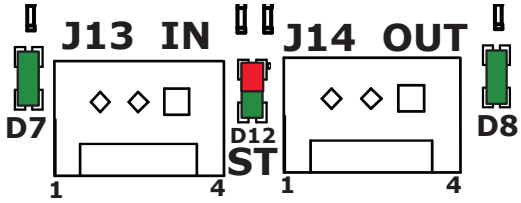
J13-J14 CAN CONNECTORS

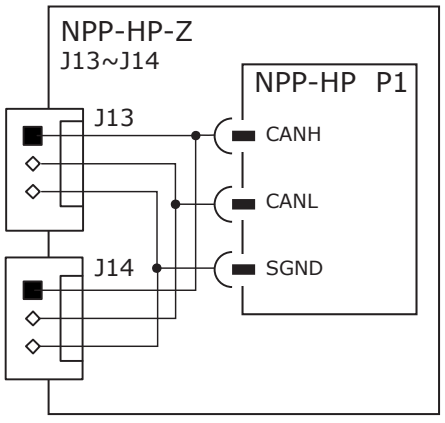
J13 CAN

Signal	Pin
CANH	1
CANL	2
SGND	3

J14 CAN

Signal	Pin
CANH	1
CANL	2
SGND	3





NPP-HP-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 CANopen commands.

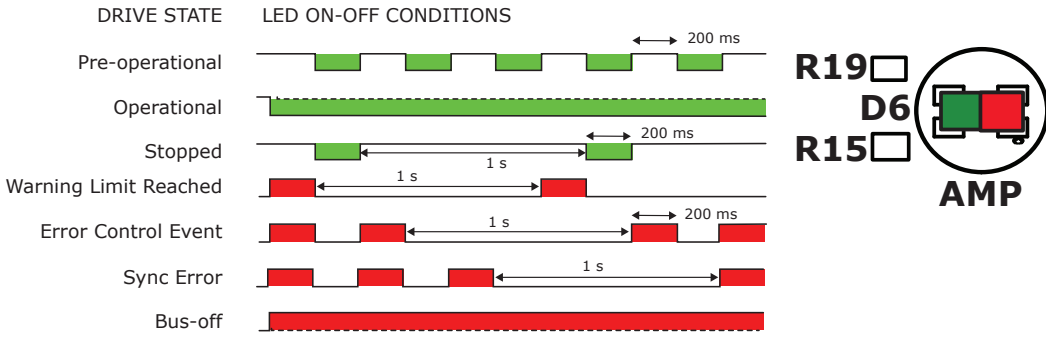
LATCHING FAULTS

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
	Over Current (Latched)

CAN STATUS LED

In the following LED On-Off Conditions diagram, 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

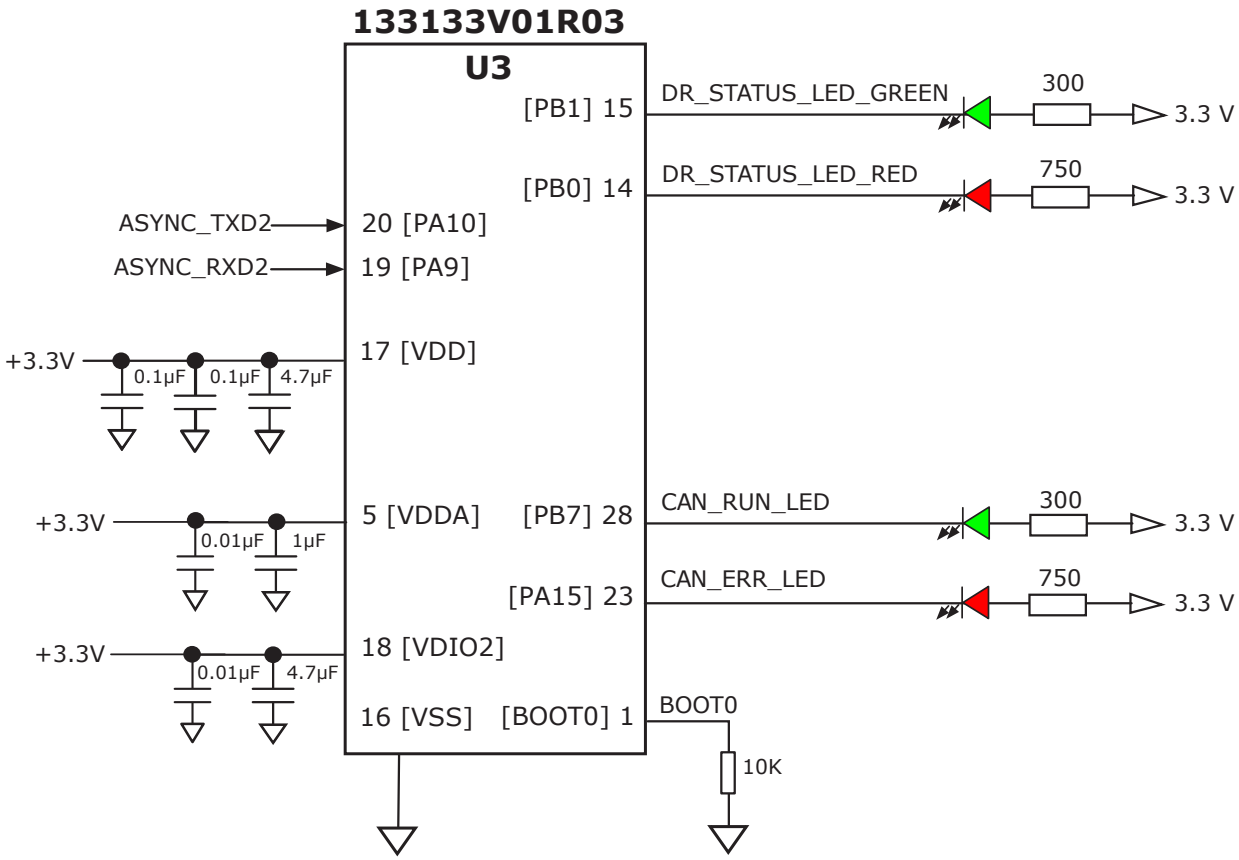
LED On-Off Conditions Diagram

NPP-HP-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.
- CAN_XXX_LED show the network status of the drive communication.

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



NPP-HP-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.

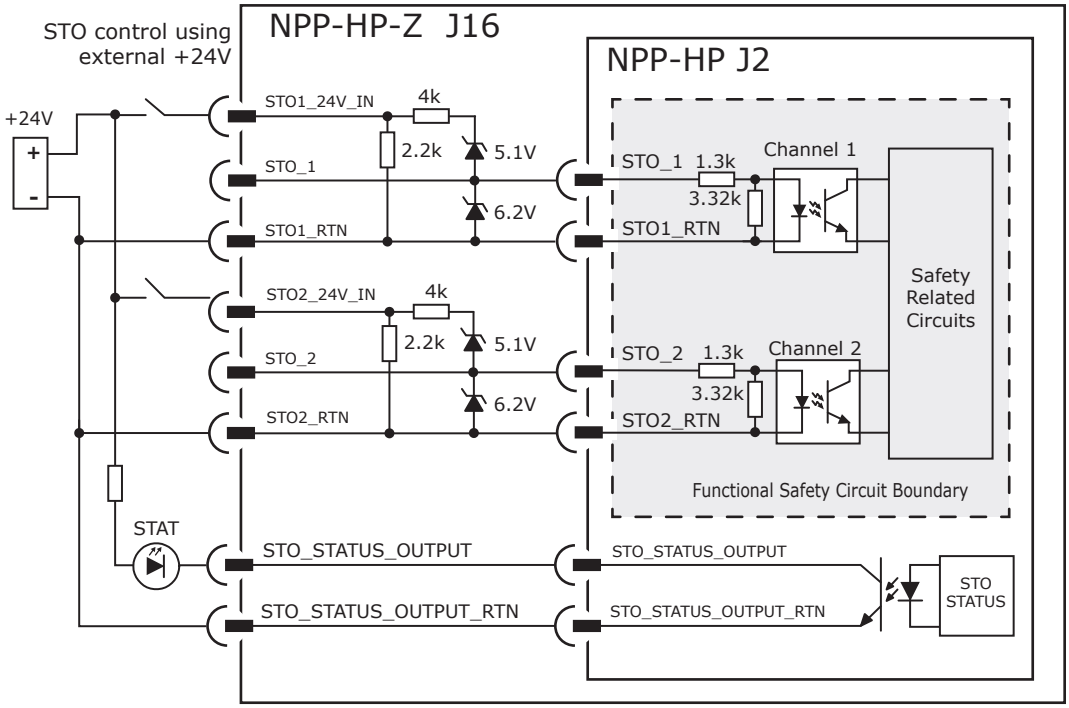
Part Number	Supplier	Description
133133V01R03	Arrow Electronics	Pre-programmed uC for Drive and Network Status LEDs.
NOTE: For information on the STM32F042G4U6TR electrical, pinout and package details, refer to the product: STM32F042G4U6TR Datasheet. The datasheet is posted on the ST Microelectronics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

NPP-HP-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.



NPP-HP-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 STO_x maximum voltage limits are +7.0 Vdc.

STO_STATUS_OUTPUT

STO1	0	1	0	1
STO2	0	0	1	1
STAT	0	1	1	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	STO_1
N.C.	5	6	N.C.
STO2_RTN	7	8	STO2_24V_IN
STO2_RTN	9	10	STO_2
N.C.	11	12	N.C.
SGND	13	14	STO_STATUS_OUTPUT_RTN
STO_STATUS_OUTPUT	15	16	+5V

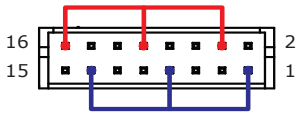
STO OPERATION

STO Input Voltage	STO State
STO1_24V_IN *AND* STO2_24V_IN ≥ 15 Vdc	STO Inactive. Drive can be enabled to produce torque.
STO_1 *AND* STO_2 ≥ 3.0 Vdc	
STO1_24V_IN *OR* STO2_24V_IN < 5.0 Vdc	STO Active. Drive cannot be enabled to produce torque.
STO_1 *OR* STO_2 ≤ 0.8 Vdc	
STO_1 *OR* STO_2 Open	

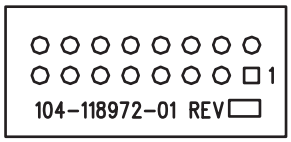
Note: In the above table, the voltages are referenced between a STO_x and a STOx_RTN in J16
For example, V(STO1) = V(STO1_24V_IN) - V(STO1_RTN)

NPP-HP-Z: J16 SAFE TORQUE OFF (STO) BYPASS

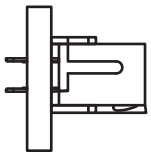
The Bypassing function is used when the user does not require the STO function. The STO-Bypass has jumpers that use the +5VENC to energize the STO inputs. This disables the STO function, allowing the drive to be enabled from hardware inputs or a network. The following diagrams show the STO-Bypass top and bottom views.

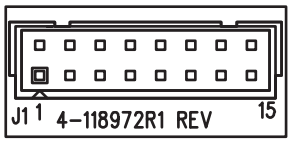


Top View



Top View





Bottom View

NPP-HP-Z: +HV & MOTOR CONNECTIONS

+HV

The +HV power supply outputs connect to terminal P2. HVCOM connects to terminal P1. An overall cable shield for the +HV/HVCOM pair is necessary to meet EMC requirements. As shown, this shield connects to the chassis ground at the power supply end and to chassis ground at the drive end. To minimize electrical noise, Copley recommends that the user connect the negative (-, HVCOM) terminal of the power supply with a short, direct path to the drive chassis ground located close to the drive.

MOTOR

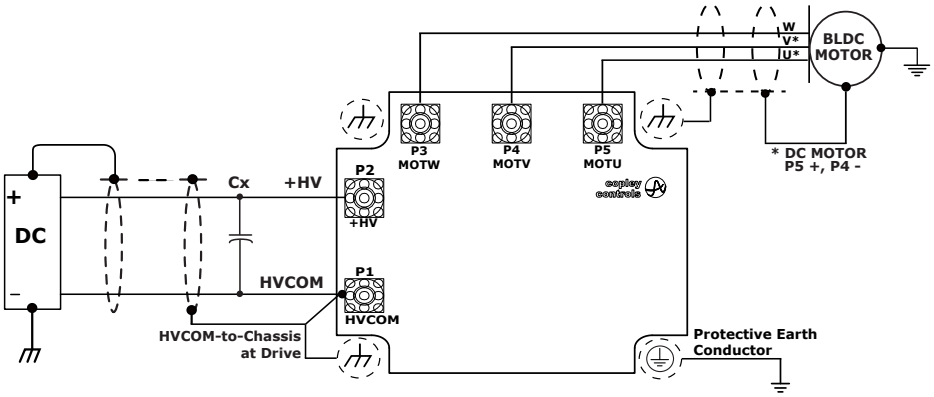
P5, P4 and P3 are used for the motor windings U, V and W respectively. Motor cables typically have one wire for each of the three phases and a fourth wire for connecting the motor housing to protective earth. The protective earth conductor wire color is commonly GREEN with a YELLOW stripe. This user must connect this protective earthing conductor to a suitable protective earth connection point which is most often found on the frame of the machine into which the drive and motor are mounted

Protective Earth

The Nano Plus High Power drives are Protective Class I equipment relating to protection against electric shock. Accordingly, the drives have both basic insulation between circuits and accessible conductive parts and offer a method of connecting a protective earthing conductor to prevent accessible conductive parts (the heatplate for example) from becoming 'hazardous live' in the event of a failure of the basic insulation. The PE symbol appears next to one of the four corner mounting holes on the module and identifies it as the connection point for the protective earthing conductor.

Chassis Ground Connections

The mounting holes other than the one specified as the Protective Earth connection point, are suitable connection points for connecting cable shields to Chassis Ground and for connecting the negative (-, HVCOM) power supply terminal to Chassis Ground.



NPP-HP-Z +HV & Motor Connections Diagram

Pin	Signal
P1	HVCOM
P2	+HV

Pin	Signal
P3	Motor W
P4	Motor V
P5	Motor U

Description	Data
Recommended Wire	2~4 AWG, 600 V, shielded cable required for CE compliance.
Recommended	#10 Ring Terminal, 4AWG Wire, Insulated

NPP-HP-Z: J12 BRAKE

J12 BRAKE:

The EZ board has components that can actuate a brake using pulse-width modulation, controlled by DOUT3.

The behavior is based on the following parameters, which can be set using the Copley software.

Parameter	Description
Initial Voltage (V)	Applied to the brake by duty cycling OUT3 to the brake's rated voltage.
Time at Inital Voltage (ms)	Sufficient time to open the brake after which, it switches to Holding Voltage.
Holding Voltage (V)	A lower duty-cycled voltage that is adequate to hold the brake open without overheating.
PWM Frequency (Hz)	16 KHz is the default and it is programmable.

SPECIFICATIONS

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

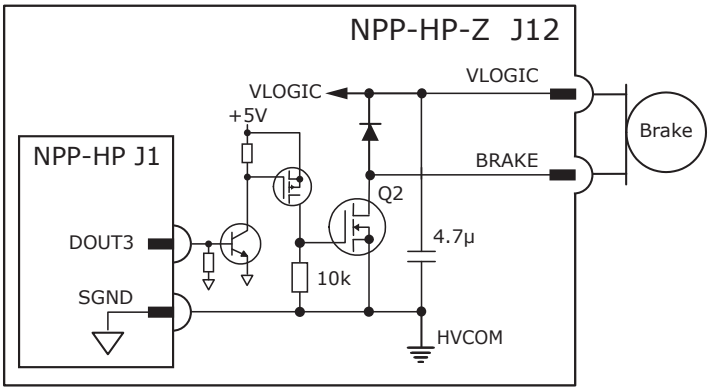
J12 BRAKE

Pin	Signal
2	VLOGIC
1	BRAKE

Copley software default setting for Brake Output [DOUT3] is "Custom Brake Output."

"Active = Brake is holding motor shaft (i.e. the *Brake is Active*).
Motor cannot move.
No current flows in coil of brake.
Copley software 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.
Copley software 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.



NPP-HP-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.

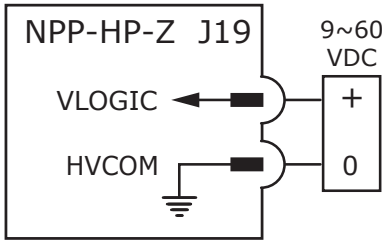
SPECIFICATIONS

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.

NPP-HP-Z: J1 INPUTS & OUTPUTS

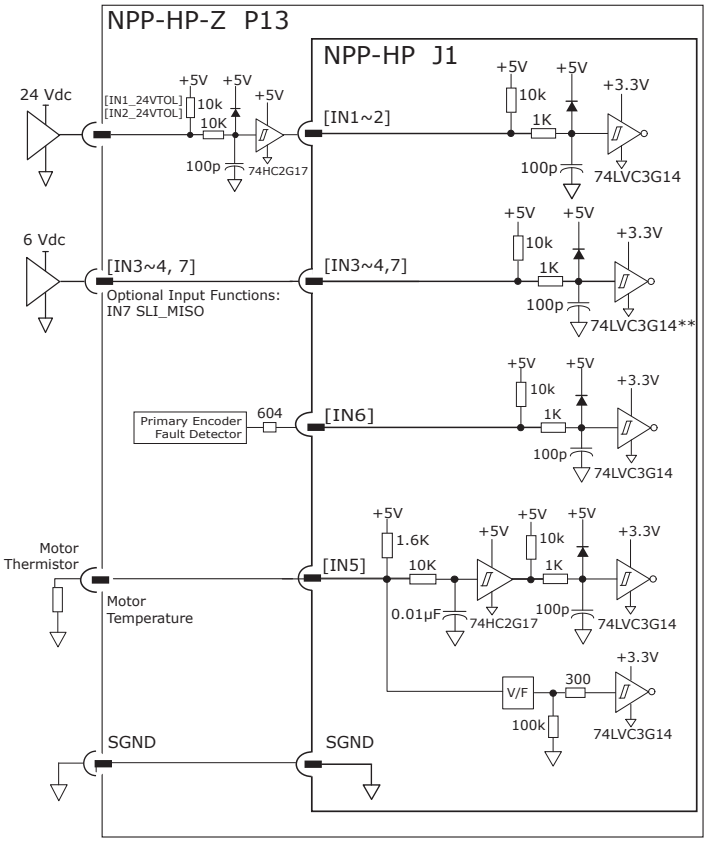
J1 has the following inputs and outputs:
- Digital Inputs 1~7
- Digital Outputs 1~6
- Analog Differential Input
- Secondary Quad A/B/X Encoder Input

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
+5 V	5,7
SGND	3,13,20,23

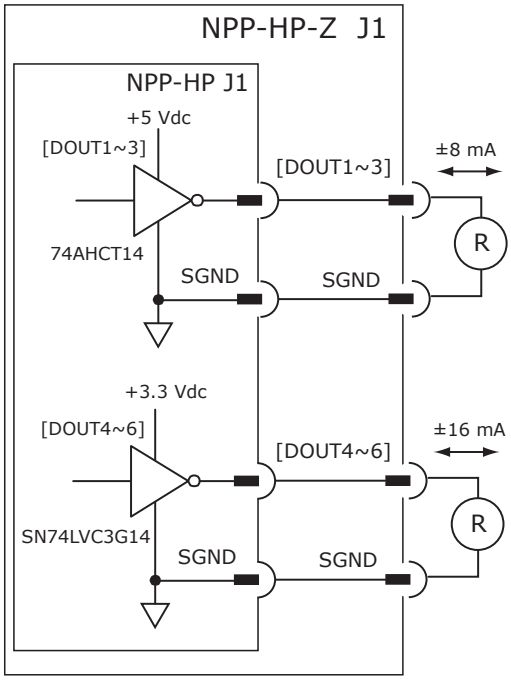
Notes:
1) For information on IN5, refer to page 9:Motor Overtemp Input IN5.
2) The gate on IN7 is 74AHCT14BQ powered with 5.0 Vdc.



NPP-HP-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



NPP-HP-Z: J1 ANALOG INPUT

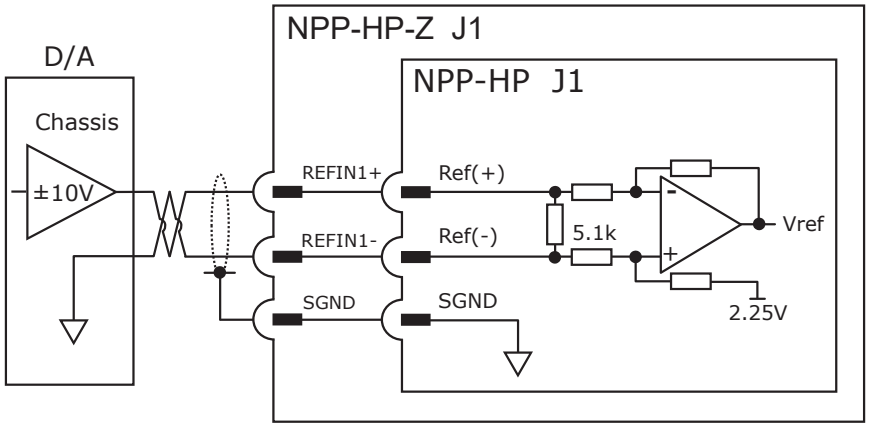
As a reference input, the J1 analog input takes Position/Velocity/Torque commands from a controller.

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



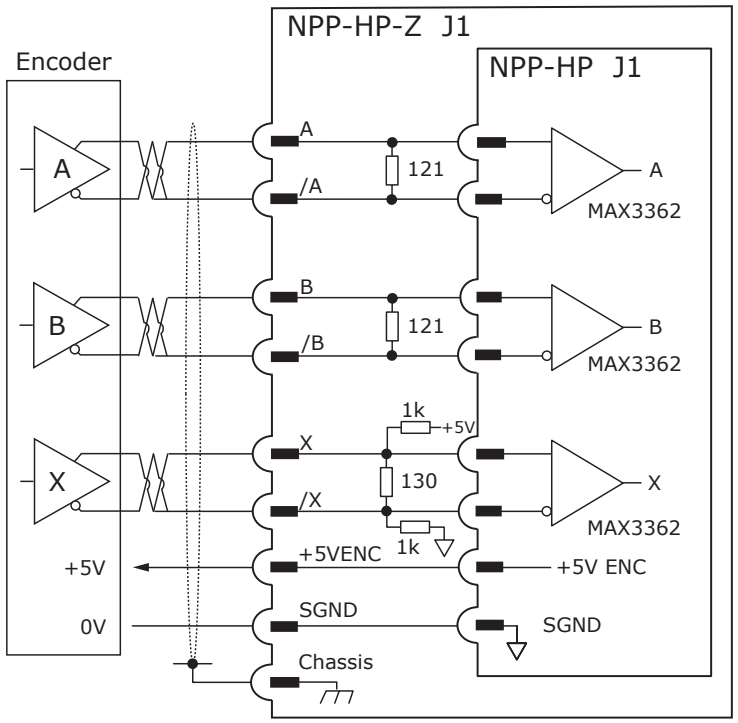
NPP-HP-Z: J1 SECONDARY ENCODER

In the following diagram, it shows the NPP-HP-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
Chassis	1



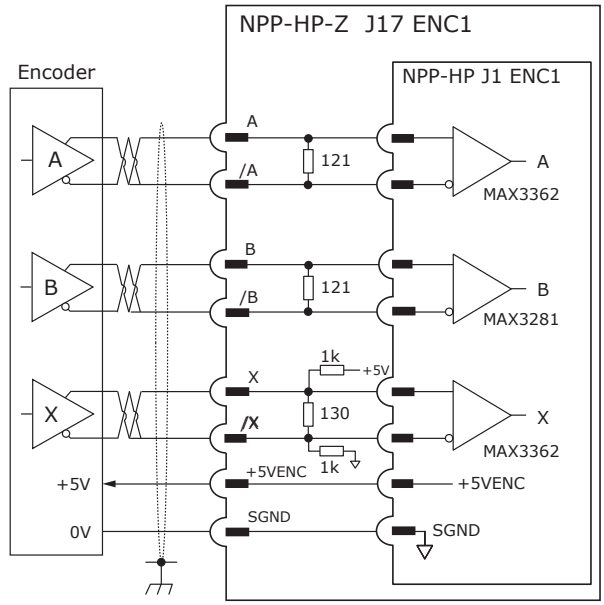
NPP-HP-Z: J7 PRIMARY ENCODER

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



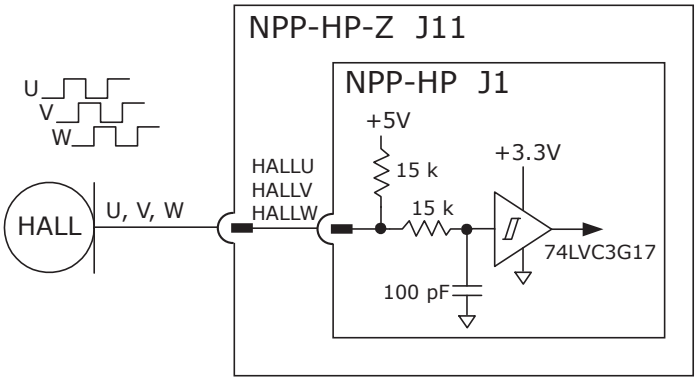
NPP-HP-Z: J11 HALLS

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

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

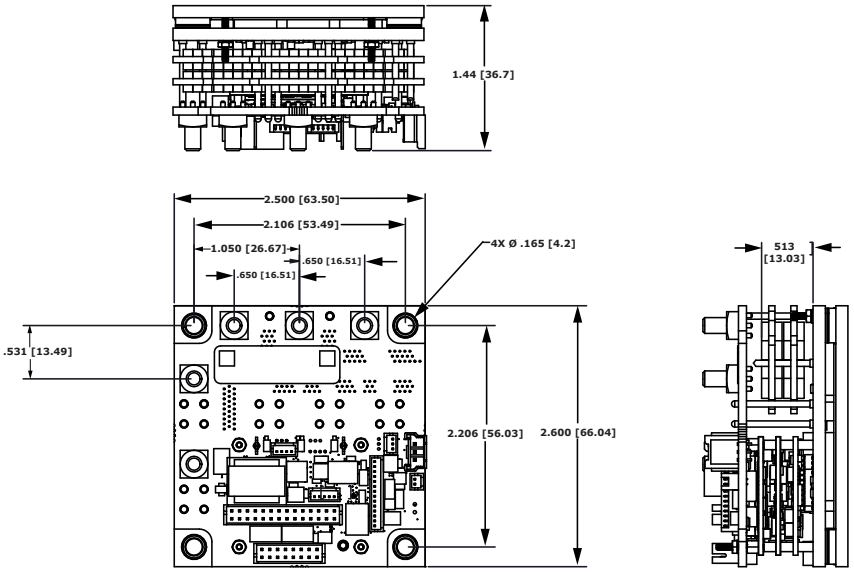
J11 HALL INPUTS

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



NPP-HP-Z: MECHANICALS

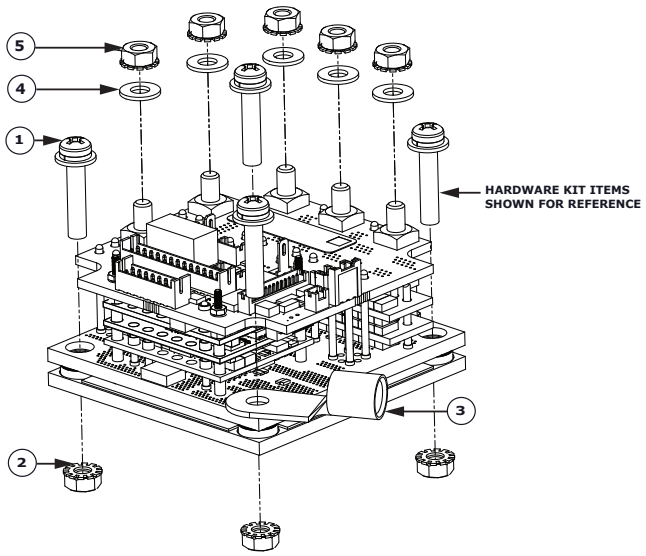
In the NPP-HP-Z Dimensions diagram, it shows the dimensions for the NPP-HP-Z module components.



NPP-HP-Z Dimensions Diagram

In the NPP-HP-Z Components Assembly diagram, it shows the location of the hardware parts on the drive. Use the screws to connect the nuts and washers to secure the parts together.

For information on the hardware kit components, type, size, manufacturer, part number and description, refer to the tables below.



NPP-HP-Z Mounting Assembly Diagram

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

N-HP-Z-MK: Nano and Nano Plus HP EZ Customer Assembly Hardware Kit

#	Item	Qty	Mfgr	Part Number	Description
1	Screw	4	Arnold Industries	1923NK	M4 SEMS screw, 20mm long, Phillips Pan Head
2	Nut	4	Arnold Industries	BN1364M4NK	M4 KEP Nut
3	Terminal Lug	6	Panduit Corporation	P4-10R-T	#10 Ring Terminal, 4AWG Wire, Non-Insulated

N-HP-Z-MK: Nano and Nano Plus HP EZ Customer Assembly Hardware Kit

#	Item	Qty	Mfgr	Part Number	Description
4	Washer	5	Bossard International	1215930	M4 Flat Washer, Brass Nickel
5	Nut	5	Arnold Industries	BN1364M4NK	M4 KEP Nut
NOTE: The items (4 & 5-nuts and washers) are assembled with the product. Use the assembly items 4 & 5 for the customer wire attachment connecting to the Power-In and Motor-Out terminals. If the customer requires additional parts, refer to the information for items 4 & 5.					

ORDERING GUIDE

NPP-HP

Part Number	Description
NPP-090-80-C*	Nano[Plus] High Power Module CANopen NPP-HP servo drive, 80/80 A, 90 Vdc
NPP-090-80-C-Z	Nano[Plus] High Power Module soldered to EZ board CANopen, NPP-HP-Z servo drive, 80/80 A, 90 Vdc
NPP-090-140-C*	Nano[Plus] High Power Module CANopen NPP-HP servo drive, 140/140 A, 90 Vdc
NPP-090-140-C-Z	Nano[Plus] High Power Module soldered to EZ board CANopen, NPP-HP-Z servo drive, 140/140 A, 90 Vdc

*Note: The NPP-HP units must be soldered directly to a mounting PCBA.

ACCESSORIES FOR NPP-HP

Part Number	Description
N-HP-MK	Hardware Kit, Nano and Nano Plus HP MOD Customer Assembly

ACCESSORIES FOR NPP-HP-Z

Part Number	Description
NP-Z-CK	Connector Kit for Nano Plus HP
N-HP-Z-MK	Hardware Kit, Nano and Nano Plus HP EZ Customer Assembly
SER-USB-M	USB to 3-Pin Molex Adapter Cable

CONNECTOR KIT FOR NANO PLUS HP

	Qty	Ref	Name	Description	MFGR Part Number
NP-Z-CK Connector Kit	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	J17	Primary Feedback	CONN WIRE-MT HSG SKT 1X14P 1.25MM LKG NYL BEIGE	Hirose: DF13-14S-1.25C
	29	J9,J10,J11, J12,J13, J14,J17	DF13 pins	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	J1	Secondary Feed-back, I/O	CONN WIRE-MT HSG RCPT 2X14P 2X2MM LKG NYL BLK	Hirose: DF11-28DS-2C
	44		DF11 pins	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	P12	RS-232	CONN WIRE-MT HSG RCPT 1X3P 2MM LKG POLYEST NAT	Molex: 35507-0300
	2	P16, P17	Cable Shields	FASTON RCPT .110X.020 26-22GA UNINSUL POSI-TIVE-LOCK PHBRZ/SN	TE: 353249-2
	4		DF13 Wires, Black	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD BLK AU 12IN	Hirose:H4BBG-10112-B6
	17		DF13 Wires, White	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD WHT AU 12IN	Hirose:H4BBG-10112-W6
	20		DF11 Wires, White	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD WHT AU 12IN	Hirose:H3BBG-10112-W6
	3		DF11 Wires, Red	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD RED AU 12IN	Hirose:H3BBG-10112-R6
	3		DF13 Wires, Red	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD RED AU 12IN	Hirose:H4BBG-10112-R6
	1		J19, HVCOM Wire, Black	CBL ASSY SKT CONTC TO FREE END 1COND 24GA 7STRD BLK SN 12IN	Molex:0502128000-12-B4
	1		J19, +VLOGIC Wire, Red	CBL ASSY SKT CONTC TO FREE END 1COND 24GA 7STRD RED SN 12IN	Molex:0502128000-12-R4
	3		DF11 Wires, Black	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD BLK AU 12IN	Hirose:H3BBG-10112-B6
	1		DF13 Brake Wire, Blue	CBL ASSY SKT CONTC TO SKT CONTC 1COND 26GA 7STRD BLU AU 12IN	Hirose:H4BBG-10112-L6
	1		STO-Bypass PCB	BD ASSY, STO BYPASS BOARD	Copley: 104-118972-01

REVISION HISTORY

16-140918 Document Revision History

Revision	Date	Remarks
00	July 15, 2025	Initial Release for Production