

**DIGITAL SERVO DRIVE FOR BRUSH & BRUSHLESS MOTORS**

**[AFS] Advanced Feature Set**

- 32-bit Floating Point Filters
- Multiple Advanced Filters
- Frequency Analysis Tools

**Control Modes**

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

**Command Interface**

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

**Communications**

- EtherCAT®
- RS-232

**Feedback**

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

**I/O**

- 1 Analog Input ±10V, 12-bit
- 5 High-speed Digital Inputs
- 1 Motor Overtemp Input
- 4 High-speed Digital Outputs

**Safe Torque Off**

- SIL 3, Category 3, PL e

**Dimensions, Weight**

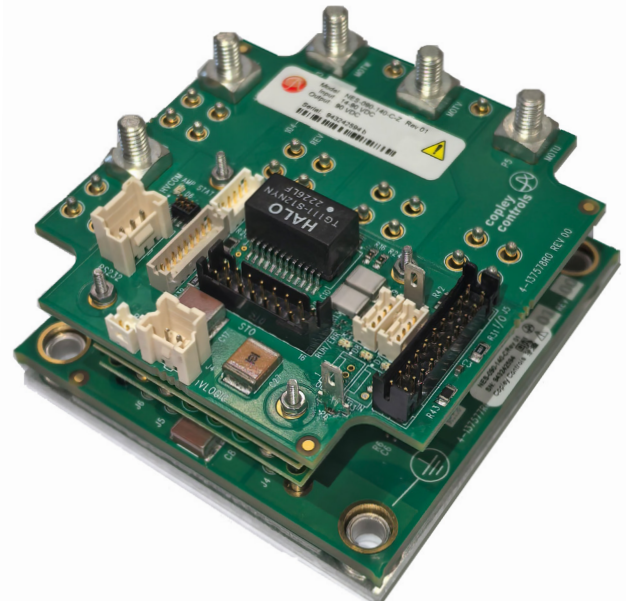
- NES-HP: 1.3 x 2.6 x 2.5 in [31.7 x 66 x 63.5 mm], 5.64oz [160g]
- NES-Z-HP: 1.44 x 2.6 x 2.5 in [36.5 x 66 x 63.5 mm], 6.38oz [181g]

**DESCRIPTION**

Copley's NES-HP is the High Power Series of the Nano Standard servo drive product line. Due to its size, it can be mounted directly on the motor or within robotic joints. In addition, Nano Standard High Power complies with the requirements of the robotics, AGV, industrial machinery, medical/life-sciences and aerospace industries.

The NES-HP module may be implemented in a customer application using only connectors, or it can be used when the power pins may be soldered for high load current applications.

The NES-Z-HP is a small form factor available for immediate integration into a customer application. It is used with the industry standard connectors and a heat plate mounted to the frame.



**NES-Z-HP**

MODEL	Ic	Ip	Vdc
NES-090-140-C	140	140	9~90
NES-090-80-C	80	80	9~90
NES-090-140-C-Z	140	140	9~90
NES-090-80-C-Z	80	80	9~90

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### GENERAL SPECIFICATIONS

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

MODEL	NES-090-140-C NES-090-140-C-Z	NES-090-80-C NES-090-80-C-Z	UNITS
<b>OUTPUT POWER</b>			
Peak Current	140(99)	80 (57)	ADC (Arms, sinusoidal)
Peak Time	NA	NA	Sec
Continuous Current	140(99)	80 (57)	ADC (Arms, sinusoidal)
Peak Output Power	12.6	7.2	kW
Continuous Output Power	12.6	7.2	kW
*Note: NES-090-140-C must be soldered to a mounting PCBA to meet this output.			
<b>INPUT POWER</b>			
HVmin to HVmax	+9 to +90	+9 to +90	Vdc, transformer-isolated
Ipeak	140	80	ADC (1 sec) peak
Icont	140	80	ADC continuous
VLogic	+9 to +60	+9 to +60	Vdc, transformer-isolated
VLogic Power	3 W with no encoder, 6 W with encoder +5V @ 500 mA, VLogic @ 24 Vdc		
<b>PWM OUTPUTS</b>			
Type	MOSFET 3-phase inverter, 16 kHz center-weighted PWM carrier, space-vector modulation		
PWM Ripple Frequency	32 kHz		
<b>BANDWIDTH</b>			
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)		
<b>COMMAND INPUTS</b>			
EtherCAT	EtherCAT® (CoE) CANopen® over Ethernet Cyclic Synchronous Position/Velocity/Torque Profile Position/Velocity/Torque, Interpolated Position (PVT), Homing Cyclic Synchronous Torque with Commutation Angle (CSTCA)		
Signals	RX1+, RX1-, TX1+, TX1-, RX2+, RX2-, TX2+, TX2-		
Stand-Alone Mode			
Digital Position Reference	Pulse/Direction, CW/CCW	Stepper Commands (2 MHz maximum rate)	
	Quad A/B Encoder	2 M line/sec, 8 Mcount/sec (after quadrature)	
Digital Torque & Velocity Reference	PWM, Polarity	PWM = 0% - 100%, Polarity = 1/0	
	PWM 50%	PWM = 50% ±50%, no polarity signal required.	
	PWM Frequency Range:	1 kHz minimum, 100 kHz maximum	
	PWM minimum pulse width:	220 ns	
Indexing	Up to 32 sequences can be launched from inputs or ASCII commands.		
Camming	Up to 10 CAM tables can be stored in flash memory.		
ASCII	RS-232, 9600~230,400 Baud, 3-wire		
<b>DIGITAL INPUTS MODULE</b>			
Number	6		
IN1~5	General purpose inputs LV CMOS 3.3V Schmitt trigger, 100 ns RC filter, max. input voltage = +12 Vdc, 10 kΩ pull-up to +5 Vdc, 2.2 Vdc min. positive threshold, 0.6 Vdc max. negative threshold RC time-constant assumes active drive on inputs and does not include 10 kΩ pull-ups.		
IN6	Motor over-temperature, LV CMOS 3.3V Schmitt trigger, 33 μs RC filter, max. input voltage = +12 Vdc 4.99 kΩ pull-up to +5 Vdc, 2.2 Vdc min. positive threshold, 0.6 Vdc max. negative threshold		
<b>DIGITAL INPUTS NES-Z-HP</b>			
IN1~3	24 V tolerant, HC CMOS 5.0V Schmitt trigger, 330 μs RC filter, 0~24 Vdc compatible, 10 kΩ pull-up to +5Vdc 2.2 Vdc min. positive threshold, +0.6 Vdc max. negative threshold		
IN4~5	LV CMOS 3.3V Schmitt trigger, 100 ns RC filter, max. input voltage = +12 Vdc, 10 kΩ pull-up to +5 Vdc, 2.2 Vdc min. positive threshold, 0.6 Vdc max. negative threshold		
IN6	Motor over-temperature, HC CMOS 5.0V Schmitt trigger, 330 μs RC filter, max. input voltage = +12 Vdc 1.6 kΩ pull-up to +5 Vdc, 2.2 Vdc min. positive threshold, 0.6 Vdc max. negative threshold		
<b>DIGITAL OUTPUTS MODULE</b>			
Number	4		
OUT1~4	74HCT14 5 V CMOS Schmitt trigger, functions programmable, +5 Vcc Source -4 mA @ VOH = 4.18 Vdc, Sink 4 mA @ VOL = 0.26 Vdc		
<b>DIGITAL OUTPUTS NES-Z-HP</b>			
Number	4		
OUT1~4	74HCT14 5 V CMOS Schmitt trigger, functions programmable, +5 Vcc Source -4 mA @ VOH = 4.18 Vdc, Sink 4 mA @ VOL = 0.26 Vdc		
OUT4 (NES-Z-HP)	Brake control, programmable release time followed by programmable PWM duty-cycle for holding current.		

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**ANALOG INPUT**

Number	1
Type	Differential, ±10 Vdc range, 5.0 kΩ input impedance to a 12 bit ADC, single-pole low pass filter with a 14.5 kHz -3dB bandwidth
Function	Torque, Velocity, or Position command, or functions as a general purpose analog input.

**SERIAL COMMUNICATION PORT**

Signals	RxD, TxD, SGND RxD input is 74LVCM14 3.3 V Schmitt trigger with 10 kΩ pull-up to +5V TxD output is 74HCT14 5 V Schmitt trigger
Mode	Full-duplex, DTE serial communication port for drive setup and control, 9,600 to 230,400 bits/second
Protocol	ASCII or Binary format
Isolation	Non-isolated. Referenced to Signal Ground

**SERIAL COMMUNICATION PORT, NES-Z-HP**

Serial Communication Port	An ADM3101E transceiver provides standard RS-232 signal levels. NES-Z-HP requires an SER-USB-M or cable terminated to Molex 3 Pin to connect to the Serial port.
Signals	RxD, TxD, SGND

**ETHERCAT PORT**

Format	100BASE-TX
Protocol	EtherCAT® (CoE) CANopen® over Ethernet
Isolation	External magnetics required for module. NES-HP and NES-Z-HP 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 for DC brush motor use outputs U & V. Minimum inductance: 200 μH line-line
Encoder	Digital encoders, incremental and absolute (See FEEDBACK below).
Halls	Digital U/V/W
Motemp	Input is programmable to disable the drive if motor sensor drives input HI or LO.

**FEEDBACK**

Incremental Encoders	
Digital Incremental Encoder	Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required). RS-422 line receivers, 5 MHz maximum line frequency (20 M counts/sec), 74HCT thresholds
Absolute Encoders	BISS-C Unidirectional, SSI MA+, MA- (X, /X), SL+, SL- (A, /A) signals, clock output from drive, data returned from the 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

**HALLS**

U, V, W	Single-ended, 120° electrical phase difference Schmitt trigger, 1.0 μs RC filter from active HI/LO sources, 5 Vdc compatible 15 kΩ pull-up to +5 Vdc, 74LVC, 3.3 V thresholds
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**+5V OUTPUT**

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

**+3.3V OUTPUT**

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

**+5VENC OUTPUT**

Number	2
Rating	250 mA nominal, 500 mA maximum. Protected for overload and shorts. Note: The maximum total current for both outputs combined is 500 mA.

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**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: STO1_IN, STO1_RTN, STO2_IN, STO2_RTN
Type	Opto-isolators, 5V compatible
Disabling	Connecting both STO inputs to +5V will deactivate the STO function.

**PROTECTIONS**

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

**MECHANICAL & ENVIRONMENTAL**

Size, Weight	NES-HP: 1.3 x 2.6 x 2.5 in [31.7 x 66 x 63.5 mm], 5.64oz [160g] NES-Z-HP-Z: 1.44 x 2.6 x 2.5 in [36.5 x 66 x 63.5 mm], 6.38oz [181g]
Ambient Temperature	Operating: 0 to +50 °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, ½ Sine pulse
Contaminants	Pollution Degree 2

**AGENCY STANDARDS CONFORMANCE**

*Standards and Directives*

*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
- IEC 61800-5-2

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

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

*Approvals*

*UL Recognized Component to:*


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

**FUNCTIONAL SAFETY**



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

*All the Agency standards are pending at this time.*

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

**REVISION HISTORY**

**16-138164 Document Revision History**

Revision	Date	Remarks
AA	April 12, 2024	Pre-production revision.
AB	April 30, 2024	Add new NES-Z-HP photo.
AC	November 4, 2024	Add NES-090-80-C & NES-090-80-C-Z. Update photos, dimensions, weight, output/input power and specifications.