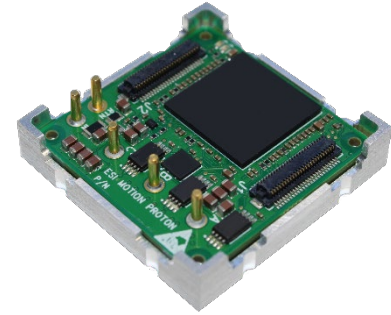


# PROTON

## Single Axis Servo Drive Module

### *Industry-Leading* Ultra-Low Weight & Compact Size



ESI Motion's Proton leads the industry with its *extremely small size and low weight*. The Proton is a high-performance digital servo controller that can source 50 Amps with an 80 VDC bus to drive the most demanding applications.

#### Features:

- Bus Voltage Range: 8 VDC – 80 VDC
- 100 Amps Continuous Motor Current
- 30 Amps Continuous Output Current Without Heatsink
- Max Output power: 3,850 W (80 VDC Bus, Motor Current 50 Amps peak-of-sin)
- Fully Digital High-Performance Drive
- 40 kHz PWM Frequency Offered Standard (Consult factory for PWM frequencies up to 100 kHz)
- Multiple Feedbacks Included
  - Dual Resolver
  - Dual Quadrature Encoder
  - Dual BiSS-C
  - Dual HALL
  - Sensorless
- Communication Interfaces
  - CAN
  - RS-422
- CANOpen and EtherCAT (Coming Soon)
- MIL-STD-883 Temperature/Vibration Acceptance Available
- Torque, Velocity, or Position control
- Configurable, user-friendly GUI with Integrated Oscilloscope
- 5 Digital IO
- Software available for driving Single Motor
- Embedded Motion Controller, Coordinated Motion Axis

#### Specifications:

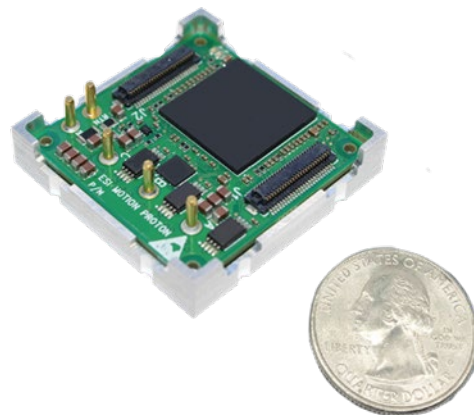
- Wide Operating Temperatures:
  - – 55 °C to 100 °C - Aerospace
  - – 40 °C to 85 °C – Industrial
  - – 30 °C to 60 °C – Commercial
- Size: 37.1 mm x 37.1 mm x 10.4 mm (1.47" x 1.47" x 0.41")
- Weight: 16.72 g (0.59 oz)

#### Compliance:

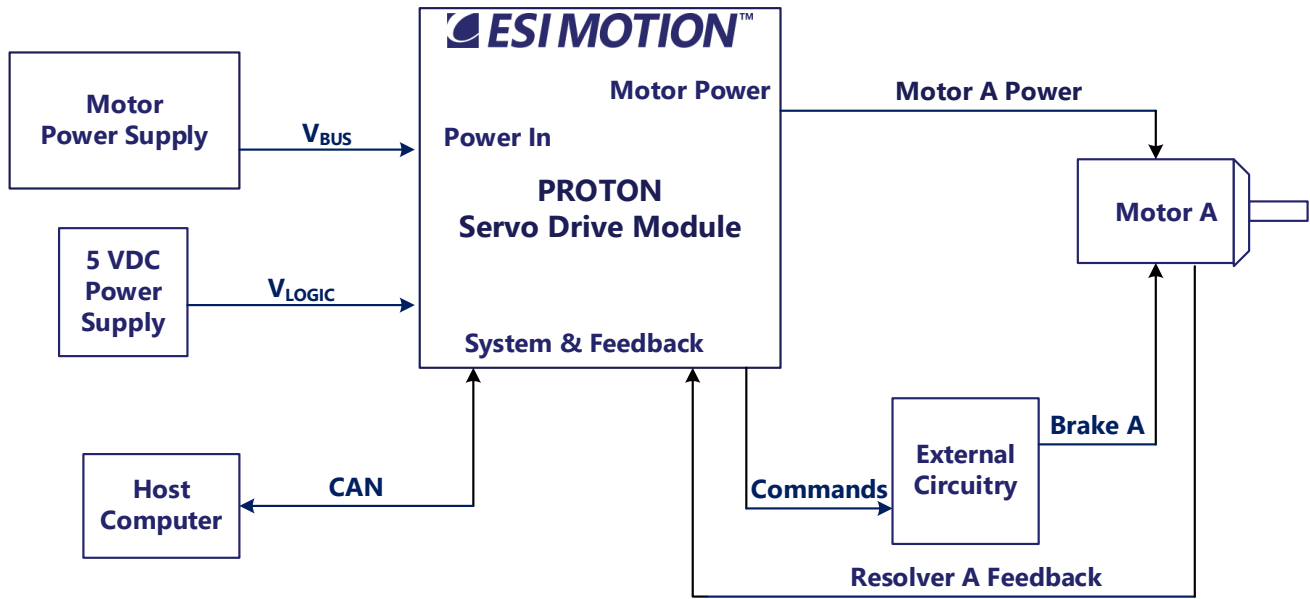
- Compliant to IPC-610 Class II (Class III available)
- Chassis-cooled
- I/O Board available

#### Customization Available

Customizable Solutions (Including Radiation Tolerant)



**Typical Proton Application:**



## Electrical Specifications

### Absolute Maximum Values

The values in the table below should never be exceeded as permanent damage to the controller may result.

PARAMETER	ABSOLUTE MAXIMUM	UNIT	
V_BUS (Motor Power)	90	VDC	
V_LOGIC (Logic Power)	6	V	
±10 Volt Analog Inputs	±22	V	
±3 Volt Analog Inputs (Resolver Inputs)	±22	V	
Single Ended Analog Input	±22	V	
Open Collector Inputs (Hall Inputs)	±22	V	
CAN Network (CAN+ and CAN-)	Differential (CAN+ – CAN-)	±27	V
	Common-Mode	±27	V
RS-422 Inputs	±14	V	
Differential Digital Inputs (Encoder and BiSS-C Inputs)	Differential (Assumes 50% Duty Cycle)	7.6	V
	Common-mode	±7.0	V
Digital Input	+4.6	V	
Temperature Sensor Input	-3 to +6	V	
Storage Temperature	-55 to +100	°C	

### Motor Currents

PARAMETER	Model	MAX	UNIT
Transient Output Current <sup>(1)(2)</sup>	50A	50	Amps
Continuous Output Current <sup>(1)</sup>	50A	50	Amps
Transient Output Current <sup>(1)(2)</sup>	25A	50	Amps
Continuous Output Current <sup>(1)</sup>	25A	25	Amps
Transient Output Current <sup>(1)(2)</sup>	12A	24	Amps
Continuous Output Current <sup>(1)</sup>	12A	12	Amps
Transient Output Current <sup>(1)(2)</sup>	5A	10	Amps
Continuous Output Current <sup>(1)</sup>	5A	5	Amps

Notes:

1. Peak Sine Wave
2. Transient Output Current Duration: 3 Seconds

## Recommended Operating Conditions

POWER SUPPLY INPUT CHARACTERISTICS			
SIGNAL	MIN	MAX	UNIT
V_BUS (Motor Power) Operating Voltage	8	80	VDC
Recommended External Bus Capacitance			
V_LOGIC Operating Voltage	4.5	5.5	VDC
V_LOGIC Operating Current		450	mA

I/O CHARACTERISTICS				
PARAMETER	MIN	NOM	MAX	UNIT
<b>±10 Volt Analog Inputs</b> ANALOG_IN_1, ANALOG_IN_2				
Input Range	-10		+10	V
Common Mode Input Range	-8.0	0	+10.0	V
Impedance		20.0		KΩ
Input Bandwidth		100		kHz
<b>ANALOG_IN_7</b>				
Input Voltage Range	-5		8	V
Input Impedance		10.0		kOhm
<b>Analog Output</b> ANALOG_OUT_1, ANALOG_OUT_2				
Output Range	-3		+3	V
Analog Test Point Output Impedance		50		Ω
Update Rate		2X		PWM Frequency
<b>CAN Signals</b> CAN+, CAN-				
Voltage Levels	Compliant to ISO 11898-2			
Standard Bit Rates	100, 250, 500, and 1,000			Kbps
<b>Digital I/O</b>				
Input Voltage Range	-0.3		3.6	
High Level Input Voltage	2.0			V
Low Level Input Voltage			0.8	V
Output Current			4.0	mA
High-Level Output Voltage			2.4	V
Low-Level Output Voltage	0.6			V
<b>Encoder and BiSS-C Signals</b> A+MA, A-MA, B+MA, B-MA, I+MA, I-MA, A+MB, A-MB, B+MB, B-MB, I+MB, I-MB				

I/O CHARACTERISTICS					
PARAMETER		MIN	NOM	MAX	UNIT
Voltage Levels		Compliant to EIA-422-B			
Differential Input Impedance			120		Ohms
Input Frequency				25	MHz
<b>Logic Power</b> V_LOGIC					
Input Range		4.5	5.0	5.5	VDC
Operating Current			450		mA
<b>Motor Power</b> V_BUS					
Input Range		0		80	V
Internal Bus Capacitance <sup>(1)</sup>			80 42 13		uF
			V_BUS = 0 Volts V_BUS = 30 Volts V_BUS = 80 Volts		
Output Voltage		3.19	3.3	3.39	V
Output Current		0		50	mA
Motor Inductance (line-to-line)		25			uH
<b>Motor Temperature</b> MOTOR_TEMP+, MOTOR_TEMP-					
Thermistor Resistance at 25°C		1	5	10	KΩ
Recommended Thermistor		TDK/Epcos PN B57540G502F			
Excitation Voltage			3.0		V
Excitation Impedance			2.0		kOhm
Input Bandwidth			1.6		kHz
<b>Open Collector Inputs (HALL Inputs)</b> HALL_A_MA, HALL_B_MA, HALL_C_MA, HALL_A_MB, HALL_B_MB, HALL_C_MB					
Input Voltage		0		10	V
Internal Pull Up Voltage		4.5	5.0	5.5	V
Internal Pull Up Impedance			1.0		kOhm
Logic High Voltage			1.95		V
Logic Low Voltage			1.07		V
Input Hysteresis			0.88		V
<b>Resolver Excitation</b> EXE+MA, EXE-MA, EXE+MB, EXE-MB					
Output Voltage		3.8	4	4.2	V <sub>RMS</sub>
Resolver Excitation Output Frequency <sup>(2)</sup>			5.0		kHz
<b>Resolver SIN, COS (ANALOG_IN_2 – ANALOG_IN_6)</b> SIN+MA, SIN-MA, COS+MA, COS-MA, SIN+MB, SIN-MB, COS+MB, COS-MB					

I/O CHARACTERISTICS					
PARAMETER		MIN	NOM	MAX	UNIT
Differential Range		2		4.2	V <sub>RMS</sub>
Differential Impedance			20		KΩ
Input Bandwidth			70		kHz
<b>RS422 Signals</b> RS422_TX, RS422_RX					
Voltage Levels		Compliant to EIA-422-B			
Standard Bit Rates		115.2, 230.4, 460.8, 921.6, 1000		Kbps	
<b>Thermal Information</b>					
Core to Ambient Thermal Resistance			TBD <sup>(3)</sup>		°C/W
Core to Sink Thermal Resistance	Module		0.8 <sup>(3)</sup>		°C/W
Maximum Core Temperature	-A			100	°C
	-I			85	
	-C			60	

Notes:

1. Ceramic capacitors exhibit a negative voltage coefficient.
2. Default Resolver Frequency is 5 kHz. Contact Factory for custom frequencies.
3. Preliminary

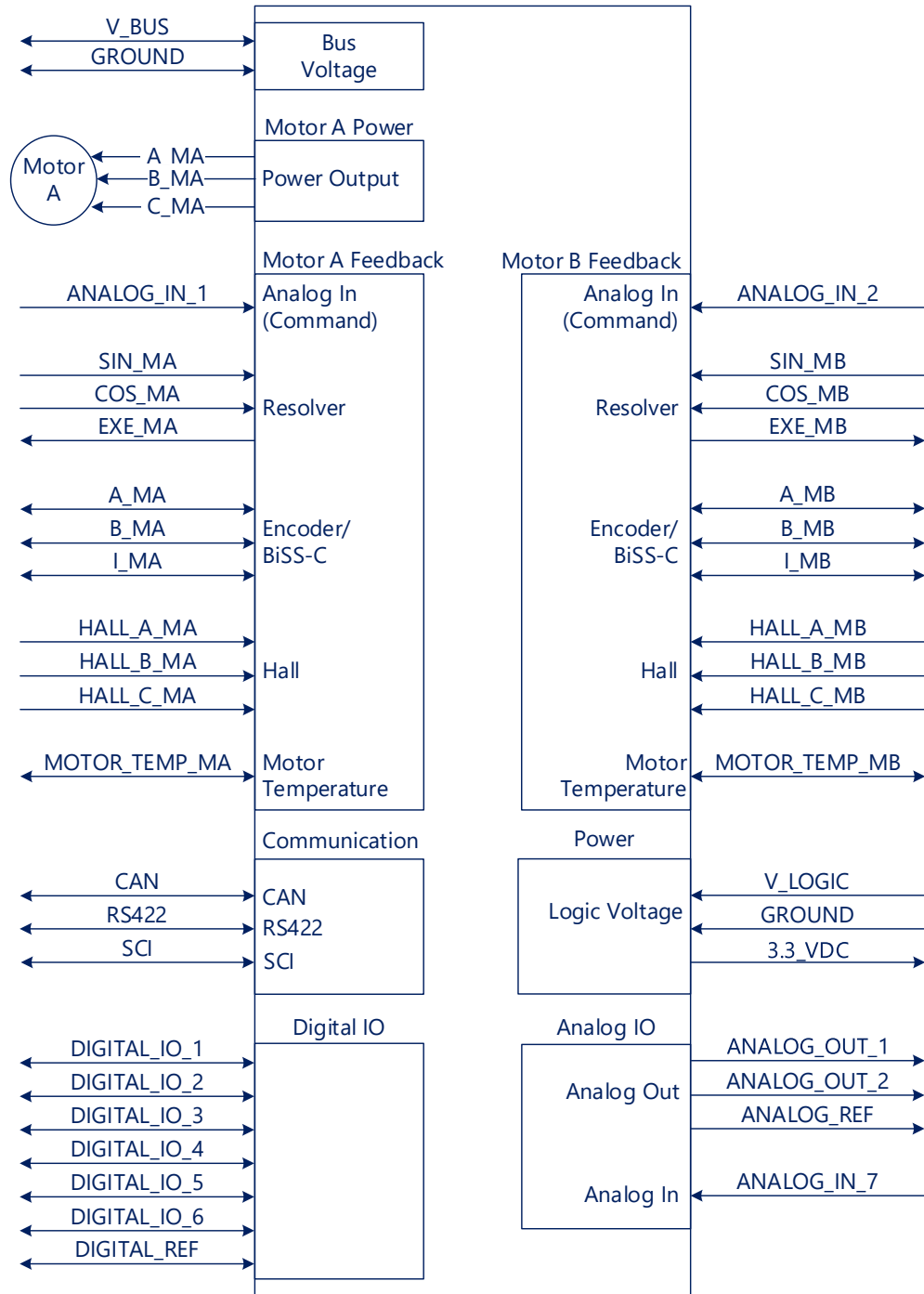
## Mechanical Specifications

Mechanical Specifications		
PARAMETER	Value	UNIT
Weight	16.72 (0.59)	gm (oz)
Size	37.1 x 37.1 x 10.4 (1.47 x 1.47 x 0.41)	mm (in)

## Connector Information

Connector Information				
Ref. No.	Name	Layout, Pitch	Proton CONNECTOR (CONTACTS)	MATING CONNECTOR (CONTACTS)
J1	System 1	2 x 25 0.5mm pitch	Amphenol ICC 10132798-051100LF Plug	Amphenol ICC 10132797-051100LF Receptacle
J2	System 2	2 x 25 pins 0.5mm pitch	Amphenol ICC 10132798-051100LF Plug	Amphenol ICC 10132797-051100LF Receptacle
J3	Motor A Phase A	Single Pin	1.52 mm (0.06") Nail Nin	Use plated hole when maximum current capability is desired  Use pin receptacles when ease of assembly is desired Mill Max PN: 9372-0-15-15-23-27-10-0 Receptacle
J4	Motor A Phase B	Single Pin		
J5	Motor A Phase C	Single Pin		
J9	V <sub>BUS</sub> VDC Input Power	Single Pin		
J11	VBUS VDC Return	Single Pin		

## Interconnect Diagram





## Interfaces Description

### Power Input

V<sub>BUS</sub> Voltage is the high current input used for motor power. V<sub>BUS</sub> shares a common return with V<sub>LOGIC</sub>.

Logic power is supplied to the controller on the V<sub>LOGIC</sub> pin. This pin accepts +5VDC and can be powered independent of V<sub>BUS</sub> without damage. ESI recommends that all digital encoders (i.e., BiSS-C, Quadrature Encoder, etc) are powered from the same logic supply as the Proton.

### Motor Power Output

Dedicated motor power pins are provided for Motor A.

The Power Input and Motor Power Output pins can be soldered to a carrier printed circuit board for high current applications. They also can be connected with a standard mill-max PCB pin receptacle for easy assembly and removal in less current demanding applications.

### Motor Feedback

The Proton Servo Drive Module supports the following motor feedback devices:

- Resolver
- Quadrature Encoder
- Hall
- BiSS-C
- Sensorless

Feedback selection is software configurable. ESI recommends that digital feedback devices (i.e., Quadrature Encoder and BiSS-C) are powered from the same 5VDC V<sub>LOGIC</sub> supply used to power the Proton.

Multiple motor feedbacks can be connected simultaneously – i.e., a user can use a resolver and a BiSS-C encoder for feedback in two loops. BiSS-C and the Quadrature Encoder share connector pins, thus cannot be run at the same time.

### Temperature Sensor Input

The temperature inputs accept a Negative Temperature Coefficient (NTC) thermistor. The software linearizes the NTC output. The sensor linearization is configurable through entry of a polynomial. If the polynomial is not updated, the servo drive assumes the temperature is the TDK/Epcos PN B57540G502F.

### Communication Interface

ESI recommends using either CAN or RS-422 interfaces for control where possible. The digital interface eliminates system grounding issues resulting in a lower noise floor when compared to the legacy analog interface. The legacy analog commands are a viable alternative when a digital interface is not available. It is recommended that all analog voltages used for control loops are wired as shielded differential pairs. Single-ended analog signals are susceptible to system noise.

The user must provide external termination resistors on the CAN network - the Proton drive does not include an internal termination resistor.

### Analog Inputs

The Proton includes 7 analog inputs of the following types and quantities:

- ±10 Volt Differential x Two Inputs
- ±5 Volt Differential x Four Inputs
- -5 to 8 Volt Single Ended x One Input

These inputs can be scaled and mapped to the current command, velocity command, or position command. They can also be used to enable or disable the drive. This analog input is provided to support legacy analog systems – ESI recommends CAN or RS-422 if the system allows.

The ±3 volt differential inputs can be used for either resolver feedback or for general purpose analog inputs.

## Digital IO

Digital IOs are also provided. They can be mapped to several functions via software. A list of possible mappings include:

- Brake Control
- Inrush Control
- Bus Pre-charge Control
- Regen Control
- Discharge Control
- Drive Enable

## Analog Outputs

Two Analog Outputs are provided for legacy support. These outputs can be bound to any internal variable through software. These signals can be used as an analog command for slave devices. The controller updates the output at 2X the selected PWM frequency, making these signals suitable for real-time bandwidth measurements with an analog Frequency Response Analyzer. While these outputs are very flexible and powerful, ESI recommends capturing data with either CAN or RS-422 if the system allows. The analog output impedance is 50 Ohms. If driven into a 50 Ohm load, the signal will be attenuated by a factor of 2.

## Reserved Functions

The hardware includes several functions reserved for future upgrades. These interfaces are present in hardware but are not exercised by software. Please contact ESI if your application would benefit from these functions. The reserved hardware interfaces include:

- I2C
- SPI
- PWM (4 Channels)

## Heatsink

The Proton module has an integrated aluminum heat sink. The controller can drive a large current without an additional heatsink. A secondary heatsink can be mounted to the Proton if additional cooling is desired. See the thermal information for determination if an application requires additional cooling.

## Proton I/O Board Option

The Proton Servo Drive Module is designed to mount to a printed circuit board. ESI offers an off-the-shelf IO board (see the ESI web site). This IO board provides connector access to the Proton signals. Depending on model, the IO board also includes a +5VDC power supply and additional bus capacitance.

## Built-In Protection

The Proton Servo Drive Module includes numerous protections. For details, please refer to the Software User's Manual. A partial list of the built-in protection follows:

- Over Current
- Over Voltage
- Under Voltage
- Controller Over Temperature
- Motor Over Temperature
- Over Speed
- Loss of Feedback

### ESI Motion’s HiDS Application

The Host Interface for Drive/Servo Controller (HiDS) is ESI Motion’s servo motor controller software configuration tool.

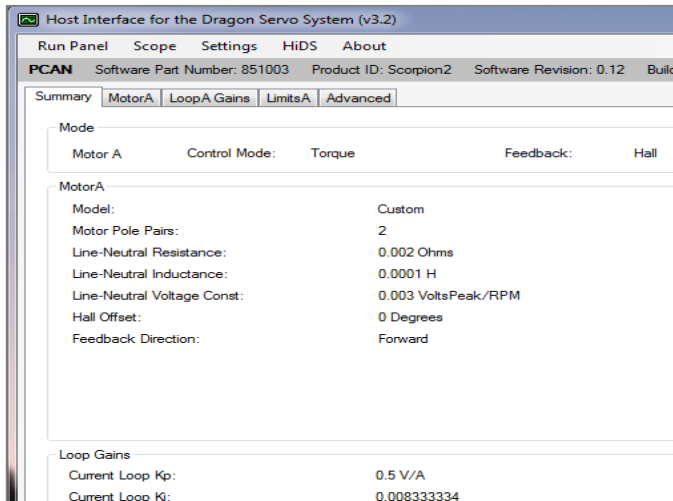
This innovative application allows users to configure a servo motor control system quickly, and with a great deal of flexibility. It’s based upon a configurable, user-friendly GUI, with an integrated oscilloscope feature. Extensive data collection and control allows system tuning and troubleshooting.

HiDS functions require connection to the CAN network. The HiDS tool and the Software User’s Manual can be downloaded from ESI Motion’s website at:

<https://www.esimotion.com/support/downloads/>

The user can set the drive mode to either current, velocity, or position control. Each of these control loops utilizes a Proportional, Integral, and Derivative (PID) filter. The Software User’s Manual includes a procedure for tuning each loop.

The Software User’s Manual walks you through the steps to set up limits, enter motor parameters, and feedback types. An excerpt from the HiDS tool is shown below.

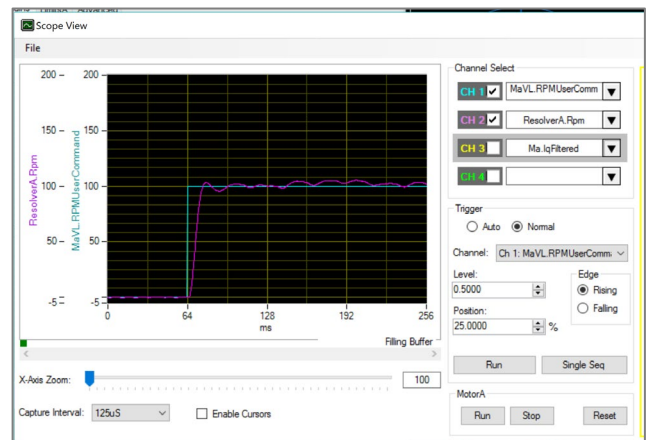


HiDS allows extreme flexibility via simply changing parameters, without the need to reload custom software.

The HiDS Run Panel facilitates control commands and monitoring of parameters such as motor speed and current.

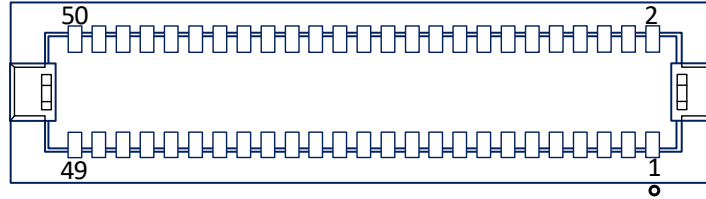


A typical velocity-loop step response, displayed on the built-in oscilloscope function, is shown below.



The Proton Servo Control Module and HiDS tool allow for tremendous flexibility in motor control and monitoring. This capability ensures success of the most challenging motion control applications.

## J1 and J2 Pinout Assignments



**Figure 1 - J1 and J2 Connector Pinout (Facing into Connector)**

Connectors J1 and J2 provide the system interface signals on two 50-contact connectors. See diagram in Figure 1 for pinout numbering.

J1 PIN	NAME	I/O	DESCRIPTION	TYPE
1	ANALOG_IN_1+ (CMD+MA)	IN	Analog In 1 (+), can be used as Command Positive Motor A	±10 Volt Analog Input
2	ANALOG_IN_1- (CMD-MA)	IN	Analog In 1 (-), can be used as Command Negative Motor A	±10 Volt Analog Input
3	SIN+MA (ANALOG_IN_3+)	IN	Resolver SIN positive motor A, can be used as ANALOG_IN_3+	Resolver Input ±3 Volt Analog Input
4	SIN-MA (ANALOG_IN_3-)	IN	Resolver SIN negative motor A, can be used as ANALOG_IN_3-	Resolver Input ±3 Volt Analog Input
5	COS+MA (ANALOG_IN_4+)	IN	Resolver COS positive motor A, can be used as ANALOG_IN_4+	Resolver Input ±3 Volt Analog Input
6	COS-MA (ANALOG_IN_4-)	IN	Resolver COS negative motor A, can be used as ANALOG_IN_4-	Resolver Input ±3 Volt Analog Input
7	EXE+MA	OUT	Resolver excitation output positive motor A	Resolver Output
8	EXE-MA	OUT	Resolver excitation output negative motor A	Resolver Output
9	A+MA (BISS_CLK+MA)	IN OUT	Quadrature encoder A positive BiSS-C clock positive motor A	Differential Digital Input Differential Digital Output
10	A-MA (BISS_CLK-MA)	IN OUT	Quadrature encoder A negative BiSS-C clock negative motor A	Differential Digital Input Differential Digital Output
11	B+ MA	IN	Quadrature encoder B positive motor A	Differential Digital Input
12	B- MA	IN	Quadrature encoder B negative motor A	Differential Digital Input
13	I+MA (BISS_DATA+MA)	IN	Quadrature encoder I positive BiSS-C data positive motor A	Differential Digital Input
14	I-MA (BISS_DATA-MA)	IN	Quadrature encoder I negative BiSS-C data negative motor A	Differential Digital Input
15	HALL_A_MA (DIGIAL_IN_1)	IN	Hall A motor A DIGIAL_IN_1	Open Collector Input
16	HALL_B_MA (DIGIAL_IN_2)	IN	Hall B motor A DIGIAL_IN_2	Open Collector Input
17	HALL_C_MA (DIGIAL_IN_3)	IN	Hall C motor A DIGIAL_IN_3	Open Collector Input
18	DIGITAL_REF	---	Digital ground	Ground
19	MOTOR_TEMP+MA	IN	Temperature positive motor A	Temperature Sensor Input
20	MOTOR_TEMP-MA	IN	Temperature negative motor A	Temperature Sensor Input
21	V_LOGIC+	IN	Logic Voltage (V <sub>LOGIC</sub> )	Logic Power Input
22	GROUND	--	System Ground	Logic Power Ground
23	RS422_TX+	OUT	RS422 transmit positive	RS-422 Digital Output
24	RS422_TX-	OUT	RS422 transmit negative	RS-422 Digital Output
25	RS422_RX+	IN	RS422 receive positive	RS-422 Digital Input

J1 PIN	NAME	I/O	DESCRIPTION	TYPE
26	RS422_RX-	IN	RS422 receive negative	RS-422 Digital Input
27	CAN+	I/O	CAN Bus positive	CAN Network
28	CAN-	I/O	CAN Bus negative	CAN Network
29	Reserved		Reserved	Do Not Connect
30	Reserved		Reserved	Do Not Connect
31	ANALOG_REF	---	Analog ground	Analog Ground
32	DIG_IO	I/O	Digital input/output	Digital I/O
33	SPI_CLK	OUT	Reserved SPI Clock Output for future upgrades	Digital Output
34	Reserved		Reserved	Do Not Connect
35	Reserved		Reserved	Do Not Connect
36	Reserved		Reserved	Do Not Connect
37	SPI_SIMO	OUT	Reserved SPI Data Output for future upgrades	Digital Output
38	SPI_SOMI	IN	Reserved SPI Data Input for future upgrades	Digital Input
39	ANALOG_OUT_1	OUT	Analog Output 1 can be bound to any internal variable	Analog Output
40	ANALOG_OUT_2	OUT	Analog Output 2 can be bound to any internal variable	Analog Output
41	Reserved		Reserved	Do Not Connect
42	SDA	I/O	Reserved I2C for future upgrades	Do Not Connect
43	Reserved		Reserved	Do Not Connect
44	SCL	OUT	Reserved I2C for future upgrades	Do Not Connect
45	Reserved		Reserved	Do Not Connect
46	Reserved		Reserved	Do Not Connect
47	Reserved		Reserved	Do Not Connect
48	Reserved		Reserved	Do Not Connect
49	Reserved		Reserved	Do Not Connect
50	BOOT_CAN	IN	Boot to CAN	Digital Input

J2 PIN	NAME	I/O	DESCRIPTION	TYPE
1	ANALOG_IN_2+ (CMD+MB)	IN	Analog In 2 (+), <i>can be used as Command Positive Spare</i>	Analog Input ±10 volt
2	ANALOG_IN_2- (CMD-MB)	IN	Analog In 2 (-), <i>can be used as Command Negative Spare</i>	Analog Input ±10 volt
3	SIN+MB (ANALOG_IN_5+)	IN	Resolver SIN positive motor B, <i>can be used as ANALOG_IN_5+</i>	Resolver Input ±3 volt
4	SIN-MB (ANALOG_IN_5-)	IN	Resolver SIN negative motor B, <i>can be used as ANALOG_IN_5-</i>	Resolver Input ±3 volt
5	COS+MB (ANALOG_IN_6+)	IN	Resolver COS positive motor B, <i>can be used as ANALOG_IN_6+</i>	Resolver Input ±3 volt
6	COS-MB (ANALOG_IN_6-)	IN	Resolver COS negative motor B, <i>can be used as ANALOG_IN_6-</i>	Resolver Input ±3 volt
7	EXE+MB	OUT	Resolver excitation positive motor B	Resolver Output
8	EXE-MB	OUT	Resolver excitation negative motor B	Resolver Output
9	A+MB (BISS_CLK+MB)	IN OUT	Quadrature encoder A positive BiSS-C clock positive motor B	Differential Digital In Differential Digital Out
10	A-MB (BISS_CLK-MB)	I/O	Quadrature encoder A negative BiSS-C clock negative motor B	Differential Digital In Differential Digital Out
11	B+MB	IN	Quadrature encoder B positive motor B	Differential Digital Input
12	B-MB	IN	Quadrature encoder B negative motor B	Differential Digital Input
13	I+MB (BISS_DATA+MB)	IN	Quadrature encoder I positive BiSS-C data positive motor B	Differential Digital Input
14	I-MB (BISS_DATA-MB)	IN	Quadrature encoder I negative BiSS-C data negative motor B	Differential Digital Input
15	HALL_A_MB (DIGIAL_IN_4)	IN	Hall A motor B DIGIAL_IN_4	Open Collector Input
16	HALL_B_MB (DIGIAL_IN_5)	IN	Hall B motor B DIGIAL_IN_5	Open Collector Input
17	HALL_C_MB (DIGIAL_IN_6)	IN	Hall C motor B DIGIAL_IN_6	Open Collector Input
18	DIGITAL_REF	IN	Low current ground reference (connected to System Ground internally)	Ground
19	MOTOR_TEMP+MB	IN	Temperature positive motor B	Temperature Sensor Input
20	MOTOR_TEMP-MB	IN	Temperature negative motor B	Temperature Sensor Input
21	V_LOGIC	IN	Logic Voltage (V <sub>LOGIC</sub> )	Logic Power Input
22	GROUND	--	Logic Voltage Return	Logic Power Ground
23	Reserved		Reserved	Do Not Connect
24	Reserved		Reserved	Do Not Connect
25	Reserved		Reserved	Do Not Connect
26	Reserved		Reserved	Do Not Connect
27	Reserved		Reserved	Do Not Connect
28	Reserved		Reserved	Do Not Connect
29	Reserved		Reserved	Do Not Connect
30	3.3_VDC	OUT	3.3 VDC Output (max: 50 mA)	Voltage Output
31	DIGITAL_IO_6	I/O	User Configurable Digital IO	Digital Input or Output
32	DIGITAL_IO_5	I/O	User Configurable Digital IO	Digital Input or Output
33	DIGITAL_IO_4	I/O	User Configurable Digital IO	Digital Input or Output
34	DIGITAL_IO_2	I/O	User Configurable Digital IO	Digital Input or Output
35	DIGITAL_IO_3	I/O	User Configurable Digital IO	Digital Input or Output
36	ANALOG_IN_7	IN	Single Ended Analog Input	Analog Input 0 to 5 volts
37	SCI_TX	OUT	Serial Communication Interface (SCI) Transmit	Digital Output
38	SCI_RX	IN	Serial Communication Interface (SCI) Receive	Digital Input
39	BOOT_USB	IN	Boot to USB	Digital Input

J2 PIN	NAME	I/O	DESCRIPTION	TYPE
40	RESET_IN	IN	This active low reset input includes an internal 50 kOhm pull-up resistor to 3.3 VDC.	Digital Input
41	DIGITAL_IO_3	I/O	User Configurable Digital IO	Digital Input or Output
42	PWM_1	OUT	Reserved PWM output for future upgrades	Do Not Connect
43	Reserved		Reserved	Do Not Connect
44	PWM_2	OUT	Reserved PWM output for future upgrades	Do Not Connect
45	Reserved		Reserved	Do Not Connect
46	PWM_3	OUT	Reserved PWM output for future upgrades	Do Not Connect
47	Reserved		Reserved	Do Not Connect
48	PWM_4	OUT	Reserved PWM output for future upgrades	Do Not Connect
49	LED	OUT	Heartbeat LED Output	Digital Output
50	Reserved		Reserved	Do Not Connect

### Motor Phase Pin Assignments

Motor A Power Output Phases A, B & C are provided by nail pin connections.

Conn	NAME	I/O	DESCRIPTION	TYPE
J3	A_MA	OUT	Motor A Phase A	Motor Power Output
J4	B_MA	OUT	Motor A Phase B	Motor Power Output
J5	C_MA	OUT	Motor A Phase C	Motor Power Output

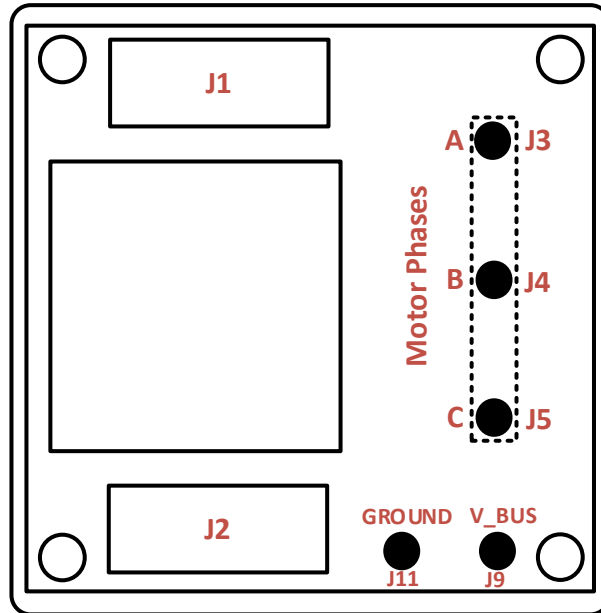
### Motor Power Pin Assignments

Motor Power is provided by two pairs of nail pin connections.

Conn	NAME	I/O	DESCRIPTION	TYPE
J9	V_BUS	IN	Bus Voltage Input	DC Bus Voltage Input
J11	GROUND	IN	Bus Voltage Return (System Ground)	DC Bus Return

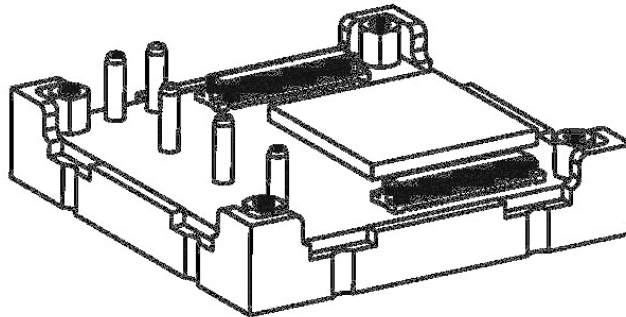
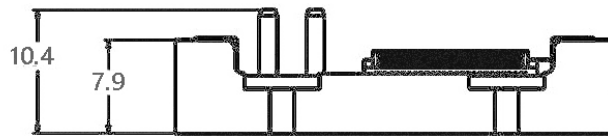
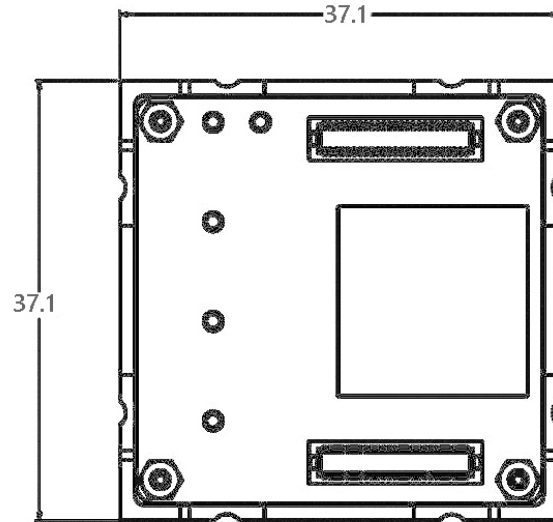
### Connector Locations

This diagram shows connection reference designators when viewing the Proton from the bottom. Pin 1 of J1 and J2 are indicated by the dot next to each connector.



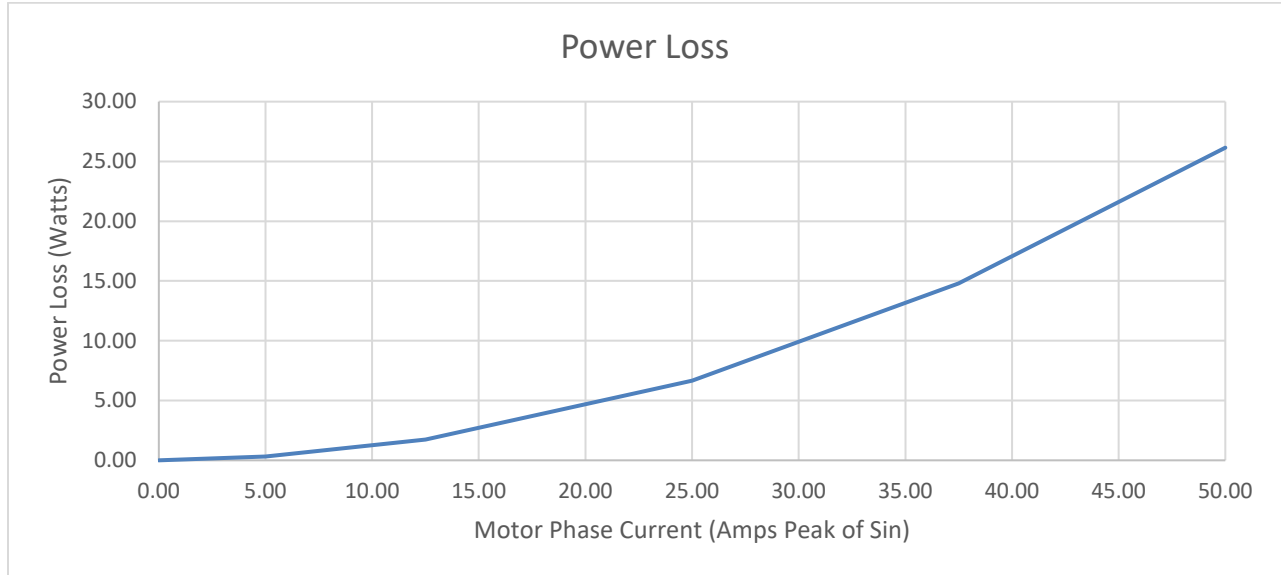


## Dimensions

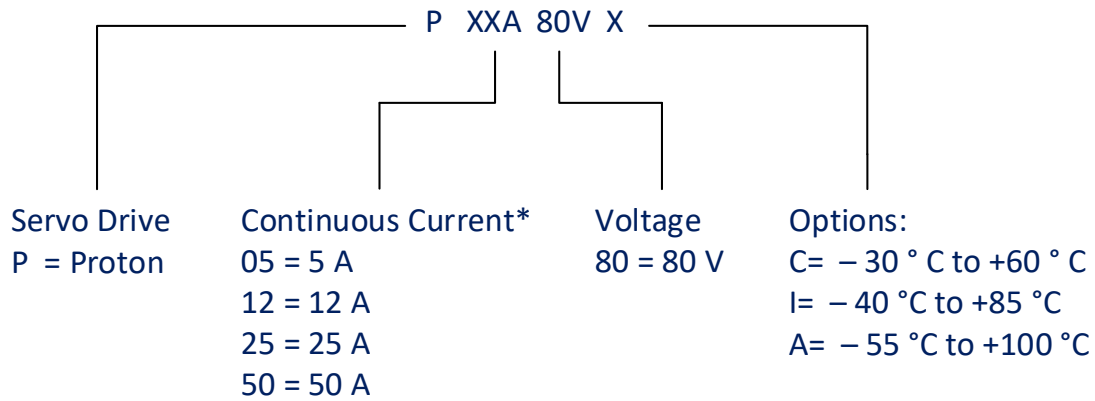


### Thermal Information

The typical power loss curves are shown below. The curves assume the controller is running hot.



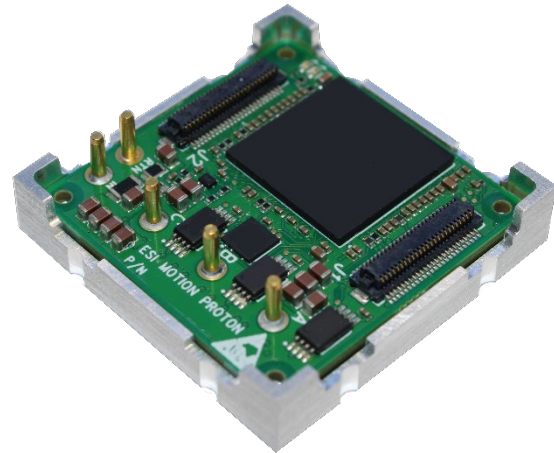
**Ordering Information**



\* Peak Sine Wave, per module

**Example**

Part Number: P50A80VA  
 Servo Drive: Proton  
 Continuous Current: 50 Amp  
 Max Bus Voltage: 80 V  
 Temperature Range: -55 °C to 100 °C



**Accessories**

PART NUMBER	MANUFACTURER	DESCRIPTION
600375-00	ESI Motion	Proton IO Board – Converts the Proton into a stand-alone unit.
500208-00	ESI Motion	Connector Kit – Mating Connectors for Single Motor
IPEH-002021	Peak Systems	USB-to-CAN Adapter (Required for PC Interface)
GC-CAN-TERM-GC	GRID CONNECT	DB9 CAN Termination