ESI MOTION™
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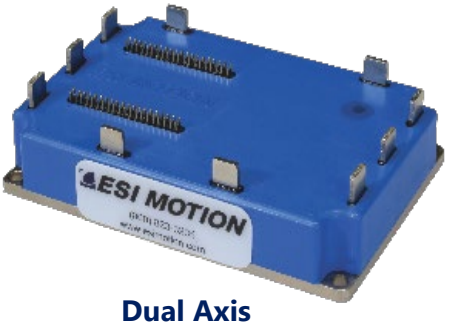
www.esimotion.com Product of USA

MITE
Servo Drive Module

Compact
Lightweight
Versatile
Powerful

Single Axis



Dual Axis

ESI Motion's servo drive modules are designed for precision military, aviation, automotive, robotics, and specialized industrial applications, where size and weight are critical. ESI Motion products are designed and built in our USA facility.

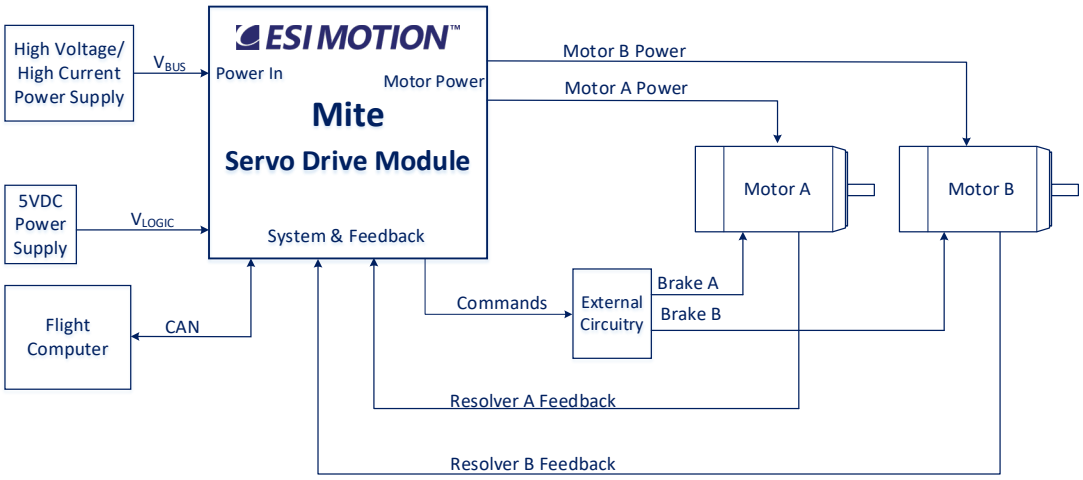
ESI Motion's Mite Servo Module series is available in single, dual or paralleled axis. It is offered in many configurations, to meet a wide spectrum of applications. The Mite incorporates our rugged, high-density DSP controller and power driver, offers many feedback options, and is packaged in a rock-solid potted plastic case. It's ready to be integrated into the heart of your rugged motor control application.

This versatile servo drive module is ideal for high-performance applications operating at high temperatures, in high vibration, or other extreme environmental conditions. It comes with an industry benchmark user interface, allowing the most flexible and precise system integration and control.

Key Features

- Nominal bus voltage range 12V to 170V
- Nominal input current up to 40A (transient: 80A)
- Maximum output power 2 kW
- Operating temperature -40ºC to +71ºC
    - Extended -55°C to 100°C (optional)
- Maximum motor speed 75,000 RPM
- Torque, velocity or position control
- Lightweight and efficient
- Commands: Brakes, Inrush (Precharge), Regeneration, and Voltage Discharge (external circuits required)
- Includes configurable, user-friendly GUI with enhanced data collection capability and integrated oscilloscope feature.
- Chassis-cooled
- Robust potted plastic case with integrated heat sink.

Typical Mite Application:



Specifications and Compliance

- Weight: 1.9 oz (single), 3.7 oz. (dual)
- Size:
  - Single: 2.0″ L x 1.8″ W x 0.8″ H
  - Dual: 2.0″ L x 3.0″ W x 0.6″ H
- Compliant to IPC-610 Class II (Class III and higher also available)
- Designed to ruggedization standards:
  - MIL-STD-810
  - MIL-STD-1275
  - MIL-STD-704
  - MIL-STD-461

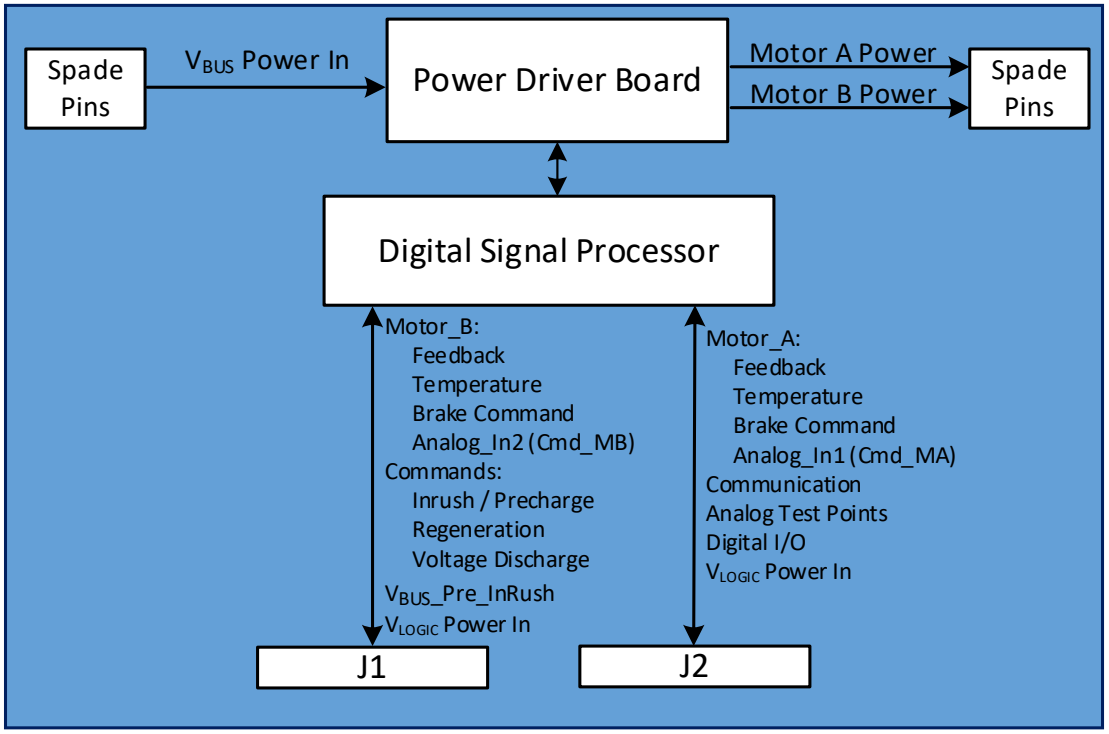
Options

- Single, Dual or Parallel axis configuration
- DC brushless, brushed, and induction motor types
- Feedback:
  - Encoder
  - Resolver
  - Hall
  - BiSS-C
  - Sensorless
- I/O Board option for rapid initial integration

Customization Available

ESI Motion has the expertise to customize a solution for your project's needs – contact us to see how we can tailor a solution for you.

Mite Block Diagram (Dual Axis Model):



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 MAX	UNIT
Bus Voltage (V_{BUS}), 170V Model	200	VDC
Bus Voltage (V_{BUS}), 75V Model	100	VDC
Bus Voltage (V_{BUS}), 48V Model	70	VDC
Bus Voltage (V_{BUS}), 28V Model	35	VDC
Bus Voltage (V_{BUS}), 12V Model	20	VDC
Digital Logic Voltage (V_{LOGIC})	6.5	VDC
Analog Inputs	±22	V
Resolver Inputs	±22	V
Hall Inputs	±22	V
Encoder Inputs (1)	7.6	V
BiSS-C Inputs (1)	7.6	V
Temperature Sensor Input	+7	V
Digital I/O (Input value)	4.8	V
Operating Case Temperature: Standard Temperature Model Extended Temperature Model	-40 to +85 -55 to +85	°C
Storage Temperature	-55 to +100	°C

Notes:

1. For Encoder and BiSS-C Inputs, 7.6V is the maximum differential voltage (assumes 50% duty cycle) and common mode voltage maximum is +/-7V.

Recommended Operating Conditions

DC INPUT CHARACTERISTICS			
PARAMETER	**MIN**	**MAX**	**UNIT**
Bus Voltage (V_{BUS}), 170V Model	12	170	VDC
Bus Voltage (V_{BUS}), 75V Model	12	75	VDC
Bus Voltage (V_{BUS}), 48V Model	12	48	VDC
Bus Voltage (V_{BUS}), 28V Model	12	28	VDC
Bus Voltage (V_{BUS}), 12V Model	12	12	VDC
V_{LOGIC} Digital I/O Logic Voltage Input (nominal 5V)	4.5	5.5	V
V_{LOGIC} Current		0.45	A

OUTPUT CHARACTERISTICS (PER AXIS)		
PARAMETER	**MAX**	**UNIT**
Continuous Output Current, 40A Model (1) (2)	40	A
Continuous Output Current, 20A Model (1)	20	A
Continuous Output Current, 10A Model (1)	10	A
Continuous Output Current, 5A Model (1)	5	A
Continuous Output Current, 2A Model (1)	2	A
Continuous Output Current, 1A Model (1)	1	A
Transient Output Current, 40A Model (1) (3)	80	A
Transient Output Current, 20A Model (1) (3)	40	A
Transient Output Current, 10A Model (1) (3)	20	A
Transient Output Current, 5A Model (1) (3)	10	A
Transient Output Current, 2A Model (1) (3)	4	A
Transient Output Current, 1A Model (1) (3)	2	A
Continuous Output Power (4)	2	kW
Motor Speed	75,000	RPM

Notes:

1. Peak Sine Wave.
2. Up to a Maximum Continuous Output Current of 40 A, or 80 A for Parallel Axes configuration
3. Transient Output Current Duration: 2 Seconds
4. Output Power may be limited by the maximum input current at low input voltages.

Recommended Operating Conditions, cont.

I/O CHARACTERISTICS				
PARAMETER	**MIN**	**NOM**	**MAX**	**UNIT**
Analog Input Range (1)	-10		10	V
Analog Input Impedance		20		KΩ
Analog Test Point (TP) Output Range (1)	-3		+3	V
Analog Test Point Output Load		50		Ω
Thermistor Resistance at 25°C (1) (2)	1	5	10	KΩ
Resolver Excitation Output (1)	3.8	4	4.2	V_{RMS}
Resolver Excitation Output Frequency (3)		5		kHz
Resolver SIN, COS Input Differential Range (1)	2		4.2	V_{RMS}
Resolver SIN, COS Input Differential Impedance		20		KΩ
Hall Inputs (1)	0		5	V
Digital Encoder Inputs Voltage (1)	0		5	V
Digital Encoder Inputs Impedance		120		Ω
BiSS-C Clock Inputs (1) (4)	3		3.5	V
BiSS-C Data Inputs Voltage (1) (4)	0		5	V
BiSS-C Inputs Impedance		120		Ω
Digital Input / Output Voltage (1)		3.3		V
Digital Input / Output Current	9		54	mA
CAN (1) (5) (6)			1,000	Kbps
RS-422 (1) (6) (7)			1,000	Kbps
USB 2.0 (1)			12	Mbps
Commands: Regeneration, Brakes, Inrush, Discharge	0		3.3	V
V_{BUS} Monitor Pre-Inrush (analog voltage)	0		5	V
HSSB, SCI	0		3.3	V

Notes:

1. ESD Protected
2. Recommended: NTC 5k thermistor, Epcos part # B57540G502F
3. Default Resolver Frequency is 5 kHz. Contact Factory for custom frequencies.
4. Physical Interface compliant to EIA-422-B
5. Compliant to ISO 11898-2 specification
6. Short circuit protection from -7 V to +12 V
7. Compliant to EIA-422-B

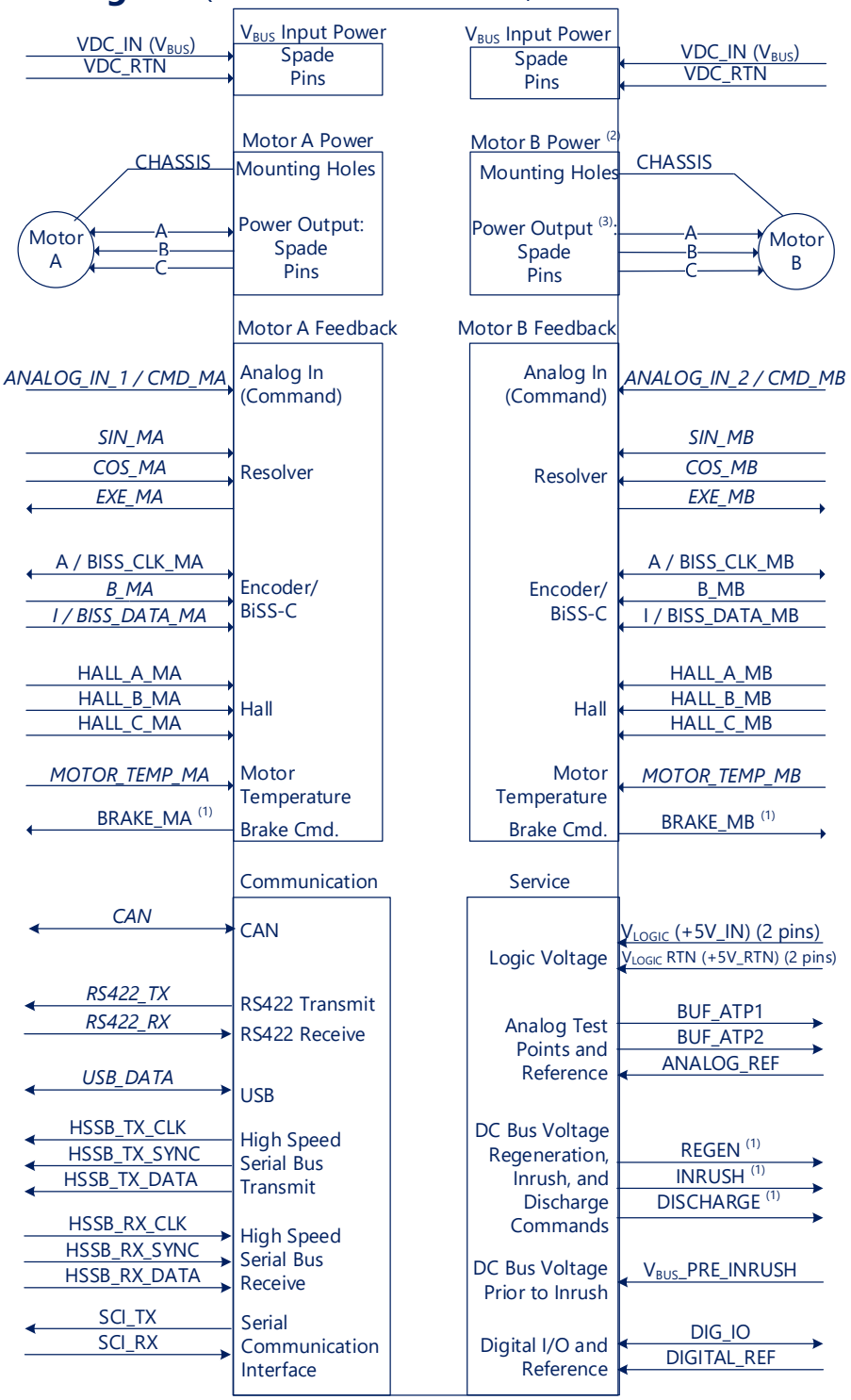
Mechanical Characteristics

PARAMETER	VALUE	UNIT
Weight, Single Axis	1.9	oz.
Size, Single Axis	2.0 L x 1.8 W x 0.8 H	inches
Weight, Dual Axis	3.7	oz.
Size, Dual Axis	2.0 L x 3.0 W x 0.6 H	inches

Connectors

Ref. No.	FUNCTION	INSERT ARRANGEMENT	Config, #, TYPE CONTACTS	CONTACTS SIZE	MITE CONNECTOR (CONTACTS)	MATING CONNECTOR (CONTACTS)
--	V_{BUS} Input Power & Return	spade pins	Dual: 4 pins Single: 2 pins	0.063″ x 0.200″	(spade pins)	(Plated holes)
--	Motor Phase Power Out	spade pins	Dual: 6 pins Single: 3 pins	0.063″ x 0.200″	(spade pins)	(Plated holes)
J1	Motor B Feedback, Commands	2 x 20 0.05″ pitch	40 pins	0.016″ dia. Square Pins	FCI 20021121-00040T4LF, (pins)	Samtec CLP-120-02-F-D-TR (sockets)
J2	Motor A Feedback, Communication	2 x 20 0.05″ pitch	40 pins	0.016″ dia. Square Pins	FCI 20021121-00040T4LF, (pins)	Samtec CLP-120-02-F-D-TR (sockets)

Mite Connections Diagram (Dual Axis Model Shown, with Dual Resolver Feedback)



NOTES:
Signals shown in italics indicates differential (high and low) signal pair
1. Logic level only, external circuit required.
2. Available on Dual or Parallel Axis Models Only
3. Used in parallel with Motor A Power pins for parallel drives with continuous current requirements greater than 40 A.

Interfaces Description

Overview

This section describes application interfaces for the Mite Servo Module by functional group. The groups are: Power Input, Motor Power Output, Motor Feedback, Communications and System (Service) Interface.

Power Input

Voltage DC In & Return is the high voltage / high current input, referred to as V_{BUS}. (For V_{LOGIC}, see System Interface). The power signals are isolated from control circuitry.

Motor Power

Motor Power outputs three-phase power to the motor(s). Dedicated motor power pins are provided for each Motor A and B, allowing for individual current loading. In the Paralleled Axis configuration, for output current >40A, both sets of motor power outputs are paralleled.

The Power Input and Motor Power Output pins are designed to be soldered to a carrier printed circuit board.

Motor Feedback

The Motor Feedback connections for Motor A, (and Motor B, if Dual Axis), consists of feedback options and motor temperature inputs.

The Mite Servo Module supports the following motor feedback devices:

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

Feedback options are software configurable via ESI Motion's servo motor controller software tool, Host Interface for Drive/Servo Controller (HiDS). External feedback interfaces are 5V tolerant, and feedback sensors should be powered from the same 5VDC V_{LOGIC} supply used to power the Mite.

The temperature input is an active circuit that measures a negative temperature coefficient (NTC) thermistor, which is directly proportional to motor temperature. The temperature vs. resistance polynomial can be configured through HiDS.

Communications Interface

Communication busses, or networks, are the main User Interface with the Mite in an end application. Networking has been emphasized in the communication interface to the Mite, which can connect to CAN Bus or USB Serial interfaces for motor control. CAN Bus is strongly preferred, since it is ideal for real-time embedded networking – it has been proven to be stable and robust, as well as flexible. (For RS-422 motor control, please contact ESI.)

Using one of these interfaces, the Mite Servo Module can easily be modified through software to accept commands and report feedback, without hardware modification, using the Host Interface for Drive/Servo Controller (HiDS, see page 10). These interfaces have a defined software protocol, and provide the user with complete flexibility in controller configuration, commands, and feedback.

The CAN physical interface is compliant to the ISO 11898-2 specification, with a maximum data rate of 1 Mbps for a bus length of up to 40 meters, and meets the extended common mode range of -7 to +12 V.

Note: for maximum system flexibility, no internal CAN bus 120 ohm-termination is provided (so the User must provide them, as required – refer to the Typical Mite Application diagram on page 7). This can be added in the wire harness. (During development, a DB9 connector version is available from Gridconnect as Part Number GC-CAN-TERM-GC)

The RS-422 physical interface is compliant to the TAI/EIA-422-B specification, is capable of a 1 Mbps data rate, and is short circuit protected from -7 V to +12V.

USB is compliant to USB 2.0 and can be also used to reprogram internal flash memory (a Flash update program is provided). CAN is preferred over USB for motor control.

The High-Speed Serial Bus (HSSB) and Serial Communication Interface (SCI) are reserved for customer-specific applications.

System (Service) Interface

The System / Service interface includes low-level voltage input (V_{LOGIC}), and several discrete I/O signals.

The V_{LOGIC} 5VDC Input is required to power the internal electronics.

The Mite provides the following software-controlled, 3.3V-level output "Command" signals, which are used in conjunction with external hardware:

- Brakes Command
- Regeneration Command
- Inrush (Precharge) Command
- Discharge Command

See the Signal and Voltages Descriptions Table (page 12) for details.

Analog input signal V_{BUS}_Pre-inrush is an analog voltage input for monitoring the DC Bus Voltage, measured prior to the Inrush hardware. This analog input needs to be scaled between 0 to 5V.

Digital I/O, Analog Inputs, and Analog Test Point Output signals can be configured by ESI Motion's "HiDS" motor controller software tool for test control, test inputs or status functions (see page 10). In Control Mode, the signal may be used to give the Dragon Servo Drive a torque or velocity command. In Test Mode, the signal may be used to inject a test signal into the system.

The optically-isolated Digital I/O is a TTL-level discrete that can be configured via the HiDS software and is ESD protected to 2kV.

The two analog inputs can be mapped to various control parameters, and have a differential voltage input range of ± 10 V. One use of an analog input is the Command for Motor A (or B), which is mapped and scaled through software configuration, to the motor current or velocity control loop. This analog input is provided to support legacy analog systems – ESI recommends the use of a serial command on new implementations: CAN (preferred), or USB.

The user may use HiDS to setup the four analog test points for monitoring. The voltage range on the analog test points is from -3V to +3V (buffered with a 50 Ohm series resistor.)

Mechanical Interface

The Mite Servo Module is designed to be mated to a carrier printed circuit board (PCB). Connectors J1 and J2 are designed to be mated with connectors on the PCB, and the Power Input and Motor Power Output pins are designed to be soldered to the PCB.

The Mite module has an integrated heat sink, which is located opposite to the motor pins and connectors. The integrated heat sink is designed to be used alone, without any external heat sink mass, for motor currents, up to 5A per axis. Care must be taken when using the Mite module for high-power applications. Motor currents greater than 5A will require an external heat sink. Proper heat sinking practices should be followed.

See pages 24 and 25 for drawings representing Mite installations on customer boards. Headers J1 and J2 can be soldered directly to the PCBA or mated with Samtec part number CLP-120-02-F-D-TR. The mating height for J1 and J2 to the Samtec mate is 0.14". The length of the "spade" pins will accommodate either configuration. If PCBA area is at a premium, the use of mating connectors for J1 and J2 will allow the user to place low-profile components underneath the Mite Module.

Mite I/O Board Option

The Mite Servo Drive Module is designed to mount to a PCBA. The Mite Servo Drive Module can be purchased with an ESI-furnished I/O Board, designed to be used for initial system development and software integration. Please refer to ESI Document 101470-00, *I/O Board for the Dual Axis Mite Servo Module* for more information (available from ESI Motion's website at:

https://www.esimotion.com/support/downloads/).

To specify inclusion of the I/O Board, add the "-I" to the part number, as explained in Ordering Information on page 28 & 29. An image of the I/O Board, mounted on the Mite, is included in the Mechanical Diagrams section on page 26.

ESI Motion's HiDS Application

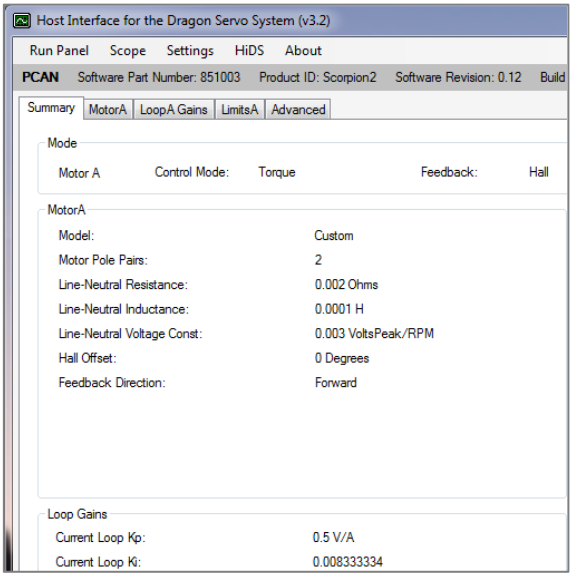
The Host Interface for Drive/Servo Controller (HiDS) is ESI Motion's servo motor controller software tool.

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.

On Mite, the HiDS functions can be accessed via CAN (for RS-422 motor control, please contact ESI). HiDS and the Controller User's Manual can be downloaded from ESI Motion's website at:
https://www.esimotion.com/support/downloads/

ESI's motion control products employ industry-standard current-loop, velocity-loop, and in some applications, a position-loop. Each of these control loops utilizes proportional, integral, and derivative (PID) error correction to achieve the desired performance. The Controller User's Manual includes a procedure for tuning each control loop to match the intended application. After the tuning is completed, additional initial configuration using feedback is described in detail.

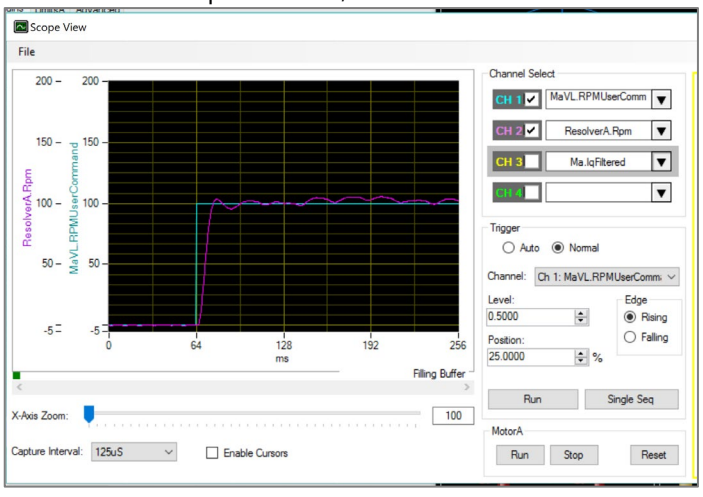
The Controller User's Manual walks you through the steps to set up limits, enter motor parameters, and tune the motor using the desired loop configuration. An excerpt from the summary tab shown below is an example view of key device configuration parameters:



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 design of the ESI Motion Mite Servo Module and HiDS tool allow for tremendous flexibility and capabilities in motor control and monitoring, to ensure success of the most challenging motion control applications.

Built-In Protection

The Mite Servo Drive Module includes the following protection. For details, please refer to the ESI Motion Controller User's Manual.

Over Current

The Mite Servo Drive Module's motor phase current is continuously monitored and when the current on any phase exceeds the over current limit, (typically set at 1.25 * peak current), the servo drive module will disable itself. The servo drive module can only be re-enabled when the fault is removed and the fault state cleared.

Over Voltage

The Mite Servo Drive Module's bus voltage is continuously monitored and when the V_{BUS} exceeds the over-voltage limit for motor or the servo drive module, (whichever is lower), the servo drive module will disable itself. The servo drive module can only be re-enabled when the fault is removed and the fault state cleared.

Over Temperature

The Mite Servo Drive Module has sensors that monitor the processor temperature, as well as both Motor A and B power driver sections. Software will alert the User with a warning, if the temperature nears the critical level, and is programmed to shut itself off, or shut down the power driver section, if the temperature reaches the critical level. The servo drive module can only be re-enabled when the fault is removed and the fault state cleared.

ESD and Short Circuit Protection

As described in I/O Characteristics on page 4, the Mite I/O signals are ESD protected, and communications busses are short circuit protected.

Other Built-In Protection

The Mite Servo Drive Module has other protection including Built-In Test (BIT), Motor Over-Temperature sensing from a user-provided thermistor, Motor Over-Speed, Bus Under-Voltage, Motor Loss of Feedback, and I-squared-T (I^2T) protection, which is an estimate of the energy content in current transient conditions, used to protect against motor overheating. The servo drive module can only be re-enabled when the fault is removed and the fault state cleared.

Powering Up

The Mite Servo Drive Module has two voltage sources, Bus Voltage (V_{BUS}) and Controller Voltage (V_{LOGIC}). The bus voltage should be set to a voltage below the V_{BUS} level shown on page 3. If the Absolute Maximum Voltage (page 2) is exceeded, software will trigger a bus over-voltage fault, and disable the servo drive.

V_{LOGIC} should be set to +5V +/- 10%. V_{BUS} and V_{LOGIC} voltages can be applied to the servo drive in either order. When the controller voltage is applied to the servo drive, the configuration of the module is read and voltage and current limits are set to their default values.

Initializing the System

The Mite Servo Drive Module will remain disabled until it receives a command to enable and no system faults are active. If the servo drive module is disabled, due to a system fault, the system fault or faults must be resolved and a reset command sent to servo drive module prior to another enable command. The ESI Motion Controller User's Manual provides the additional information necessary to successfully configure and run the Mite Servo Drive Module.

Signal and Voltage Descriptions

For details using Digital and Analog I/O, please refer to the Controller User's Manual, downloadable from ESI Motion's website at: https://www.esimotion.com/support/downloads/
For electrical characteristics, see Recommending Operating Conditions and Absolute Maximum Values Tables.

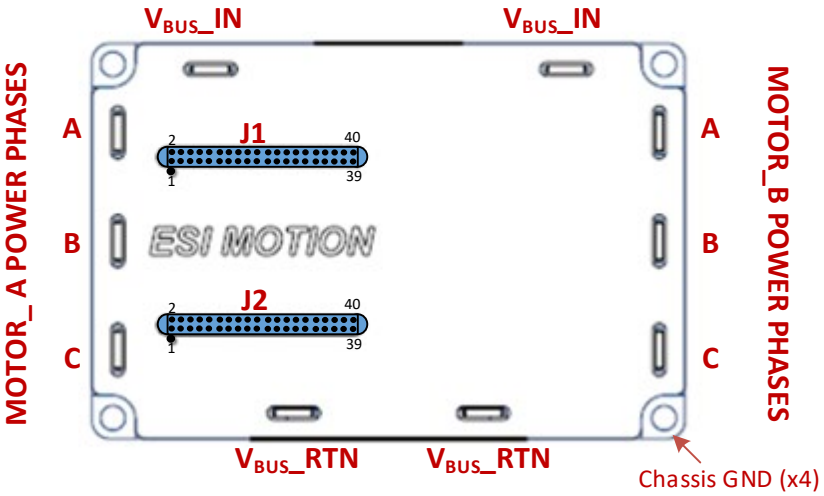
Name	I/O	Description
V_{BUS}	I	V Bus Input power, potentially High Voltage and/or High Current, which is converted to Motor Power.
V_{LOGIC}	I	Logic Voltage inputs (nominal 5VDC), required to run internal electronics. The feedback power source (for Encoder, Hall or BiSS-C sensors) can be either the same 5V for the controller, or another supply, however they must share a common ground.
Motor X Phase A/B/C	O	3-phase output power to Motor A or B. For Single Paralleled Axes, both Motor Phase outputs are routed to one motor, to double output current.
Brake Command	O	3.3V-level (LVTTL) output which can be used to engage or disengage an external brake circuit. The user is required to implement the external brake circuit (e.g., using a MOSFET switch). When the logic level is high, the brake is assumed to be engaged -- the MOSFET switch is open and no current is flowing through the brake coil.
Regeneration Command	O	3.3V-level (LVTTL) output which commands external circuitry to switch V_{BUS} to a load resistor, when the bus voltage exceeds a software configurable limit, to avoid an over-voltage condition. The duty cycle and duration of the Regeneration discrete is also configurable through software.
Inrush (Precharge) Command	O	3.3V-level (LVTTL) output can be used to control an external switch that will slow the RC rise time of the bus voltage as it charges the capacitor bank during power up, thus protecting from damage due to an abrupt voltage change when connecting Motor Power to a motor. When the bus voltage reaches a software configurable limit, the Inrush discrete will switch off.
Discharge Command	O	3.3V-level (LVTTL) output used, with an external circuit, to discharge the bus voltage capacitor bank, during power down, safely removing power from the system in a timely fashion.
V_{BUS}_Pre-inrush	I	Analog voltage input for monitoring the DC Bus Voltage, measured prior to the Inrush switch hardware. This analog input needs to be scaled between 0 to 5V.
CAN +/-	I/O	CAN Bus main communication: commands and status (highly recommended for motor control)
USB D+/-	I/O	Universal Serial Bus Data main communication: commands and status (including motor control)
RS-422 TX/RX+/-	I/O	Serial bus main communication: commands and status (For RS-422 motor control, please contact ESI.)
HSSB	I/O	High-Speed Serial Bus: reserved for customer-specific applications

Name	I/O	Description
SCI	I/O	Serial Communication Interface: reserved for customer-specific applications
Analog In X+/-	I	Differential Analog Input. These flexible signals are typically used as the input command source (current command, velocity command, or position command). Note that ESI recommends using one of the digital main communication interfaces for commands whenever possible. The analog input is provided for backwards combability with legacy systems.
Analog Test Point X	O	Analog Test Point Output. Used with HiDS, these flexible signals are used to output status for many possible selections, including for display on the HiDS oscilloscope feature. Referenced to Analog Reference.
Digital Input / Output	I/O	The Digital I/O are software configurable input or output pins and can be mapped to various system events. Depending on configuration, several other Digital I/O signals may be available (contact ESI Motion for further information). See the HiDS Controller User's Manual for more information.
Motor Temp. X+/-	I	Two wire interface for a PTC thermistor.
Resolver X Excitation+/-	O	Resolver Excitation outputs (reference signal to a resolver)
Resolver X Sin/Cos+/-	I	Resolver inputs provide motor position information
Encoder X A/B/I	I	Encoder inputs provide motor position information. **NOTE:** When Encoder feedback is not used, these six digital signals may be used as additional differential digital inputs. Refer to the ESI Controller User's Manual for further information.
Hall X A/B/C	I	Hall Effect Encoder inputs provide motor position information. **NOTE:** When Hall feedback is not used, these signals may be used as Open Collector inputs. Refer to the ESI Controller User's Manual for further information.

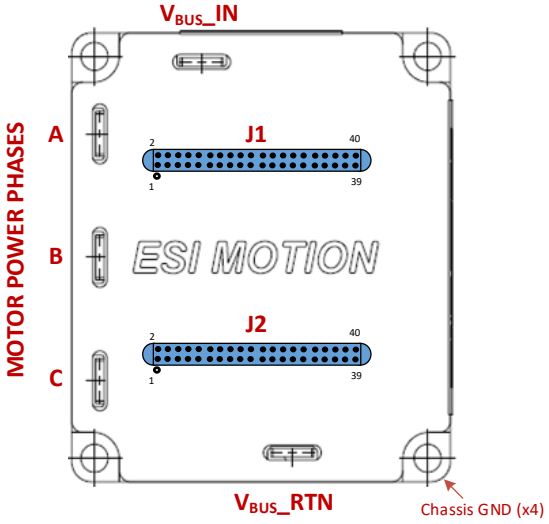
Notes:

1. For signals available to both Motor A and Motor B, or multiple instances, "X" is used in this table.
2. Suffix "+/-" indicates differential pair

Connection Locations (Dual Axis)



Connection Locations (Single Axis)



ELECTRICAL INTERFACES

Connector Pinouts (see also Connector Chart on page 7)

V_{BUS} Power In Pin Assignments

V_{BUS} Power and Return are provided by "spade"-shaped copper pins (1 each for Single Axis, 2 each for Dual Axis). Chassis Ground is provided by the mounting holes.

For locations, see diagrams on page 15. See also Mechanical Drawings, for physical details.

NAME	I/O	DESCRIPTION	TYPE
V_{BUS}_IN (1)	IN	Bus Voltage, (V_{BUS}), Voltage DC In	DC Bus Voltage Input
V_{BUS}_RTN (1)	IN	Bus Voltage Return	DC Bus Return
CHA (2)	---	Chassis Ground	Chassis Ground

NOTES:
1. For dual axis configuration, two V_{BUS}_IN and two V_{BUS}_RTN pins are provided.
2. Chassis Ground connections also provided via the four mounting holes.

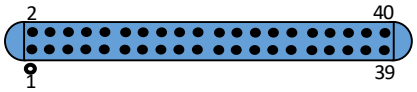
Motor Phase Power Out Pin Assignments

Motor Phase Power Outputs are provided by "spade"-shaped copper pins (three per motor).
For locations, see diagrams on page 15. See also Mechanical Drawings, for physical details.

NAME	I/O	DESCRIPTION	TYPE
A_MA	OUT	Motor A Phase A	Motor Power
B_MA	OUT	Motor A Phase B	Motor Power
C_MA	OUT	Motor A Phase C	Motor Power
A_MB	OUT	Motor B Phase C (1)	Motor Power
B_MB	OUT	Motor B Phase B (1)	Motor Power
C_MB	OUT	Motor B Phase A (1)	Motor Power

NOTES:
1. Motor B connections are for second motor in Dual Axis Configurations. Also, Motor B Phase pins are used in parallel with Motor A Phase-pins for single axis drives with continuous current requirements greater than 40 A (Paralleled Axis configuration).

J1 Pin Assignments (see also Connector Chart on page 7)



View looking into chassis pins (dot indicates Pin1)

J1 Connector (P/N 20021121-00040T4LF, Mate: Samtec CLP-120-02-F-D-TR) pin assignments are shown below. For location, see diagrams on page 15. See also Mechanical Drawings.

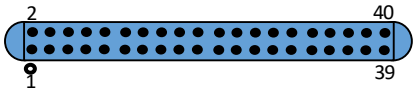
J1 PIN	NAME	I/O	DESCRIPTION	TYPE
1	ANALOG_IN_2+ (CMD+_MB)	IN	Analog In 2 (+), *can be used as* Command Positive Motor B	Analog Input
2	ANALOG_IN_2- (CMD-_MB)	IN	Analog In 2 (-), *can be used as* Command Negative Motor B	Analog Input
3	SIN+_MB	IN	Resolver Sin Positive Motor B	Resolver
4	SIN-_MB	IN	Resolver Sin Negative Motor B	Resolver
5	COS+_MB	IN	Resolver Cos Positive Motor B	Resolver
6	COS-_MB	IN	Resolver Cos Negative Motor B	Resolver
7	EXE+_MB	OUT	Resolver Excitation Positive Motor B	Resolver
8	EXE-_MB	OUT	Resolver Excitation Negative Motor B	Resolver
9	A+_MB *or* BISS_CLK+_MB	IN/ OUT	Digital Encoder B Positive / BiSS-C Clock Positive Motor B	Encoder / RS-422
10	A- _MB *or* BISS_CLK-_MB	IN/ OUT	Digital Encoder B Negative / BiSS-C Clock Negative Motor B	Encoder / RS-422
11	B+_MB	IN	Digital Encoder B Positive Motor B	Encoder
12	B-_MB	IN	Digital Encoder B Negative Motor B	Encoder
13	I+_MB *or* BISS_DATA+_MB	IN/ IN	Digital Encoder I Positive / BiSS-C Data Positive Motor B	Encoder / RS-422
14	I-_MB *or* BISS_DATA-_MB	IN/ IN	Digital Encoder I Negative / BiSS-C Data Negative Motor B	Encoder / RS-422
15	HALL_A_MB	IN	Hall A Motor B	Hall Encoder
16	HALL_B_MB	IN	Hall B Motor B	Hall Encoder
17	HALL_C_MB	IN	Hall C Motor B	Hall Encoder
18	DIGITAL_REF	---	Digital Reference	Digital Ref.
19	MOTOR_TEMP+_MB	IN	Temperature Positive Motor B	Temp. Sensor
20	MOTOR_TEMP-_MB	IN	Temperature Negative Motor B	Temp. Sensor
21	V_{LOGIC}	IN	V_{LOGIC} (+5V) Input	Low Voltage In
22	V_{LOGIC}_RTN	IN	V_{LOGIC} Return	Low Voltage Rtn
23	Reserved	---	Reserved	No Connect
24	Reserved	---	Reserved	No Connect
25	Reserved	---	Reserved	No Connect

J1 PIN	NAME	I/O	DESCRIPTION	TYPE
26	Reserved	---	Reserved	No Connect
27	Reserved	---	Reserved	No Connect
28	Reserved	---	Reserved	No Connect
29	Reserved	---	Reserved	No Connect
30	Reserved	---	Reserved	No Connect
31	BRAKE_MA	OUT	Brake Command Motor A	Digital Out
32	BRAKE_MB	OUT	Brake Command Motor B	Digital Out
33	REGEN	OUT	DC Bus Voltage Regeneration Command	Digital Out
34	INRUSH	OUT	DC Bus Voltage Inrush (Precharge) Command	Digital Out
35	DISCHARGE	OUT	DC Bus Voltage Discharge Command	Digital Out
36	VBUS_PRE_INRUSH	IN	DC Bus Voltage Monitor Prior to Inrush	Analog In
37	SCI_TX	OUT	Serial Communication Interface (SCI) Transmit	SCI
38	SCI_RX	IN	Serial Communication Interface (SCI) Receive	SCI
39	Reserved	---	Reserved	No Connect
40	Reserved	---	Reserved	No Connect

Notes:

1. Differential pairs are indicated by "+/-". Twisted pairs should be used in wire harness.

J2 Pin Assignments (see also Connector Chart on page 7)



View looking into chassis pins (dot indicates Pin1)

J2 Connector (P/N 20021121-00040T4LF, Mate: Samtec CLP-120-02-F-D-TR) pin assignments are shown below. For location, see diagrams on page 15. See also Mechanical Drawings.

J2 PIN	NAME	I/O	DESCRIPTION	TYPE
1	ANALOG_IN_1+ (CMD+_MA)	IN	Analog In 1 (+), *can be used as* Command Positive Motor A	Analog Input
2	ANALOG_IN_1- (CMD-_MA)	IN	Analog In 1 (-), *can be used as* Command Negative Motor A	Analog Input
3	SIN+_MA	IN	Resolver Sin Positive Motor A	Resolver
4	SIN-_MA	IN	Resolver Sin Negative Motor A	Resolver
5	COS+_MA	IN	Resolver Cos Positive Motor A	Resolver
6	COS-_MA	IN	Resolver Cos Negative Motor A	Resolver
7	EXE+_MA	OUT	Resolver Excitation Positive Motor A	Resolver
8	EXE-_MA	OUT	Resolver Excitation Negative Motor A	Resolver
9	A+_MA *or* BISS_CLK+_MA	IN/ OUT	Digital Encoder A Positive / BiSS-C Clock Positive Motor A	Encoder / RS-422
10	A- _MA *or* BISS_CLK-_MA	IN/ OUT	Digital Encoder A Negative / BiSS-C Clock Negative Motor A	Encoder / RS-422
11	B+_MA	IN	Digital Encoder B Positive Motor A	Encoder
12	B-_MA	IN	Digital Encoder B Negative Motor A	Encoder
13	I+_MA *or* BISS_DATA+_MA	IN/ IN	Digital Encoder I Positive / BiSS-C Data Positive Motor A	Encoder / RS-422
14	I-_MA *or* BISS_DATA-_MA	IN/ IN	Digital Encoder I Negative / BiSS-C Data Negative Motor A	Encoder / RS-422
15	HALL_A_MA	IN	Hall A Motor A	Hall Encoder
16	HALL_B_MA	IN	Hall B Motor A	Hall Encoder
17	HALL_C_MA	IN	Hall C Motor A	Hall Encoder
18	DIGITAL_REF	---	Digital Reference	Digital Ref.
19	MOTOR_TEMP+_MA	IN	Temperature Positive Motor A	Temp. Sensor
20	MOTOR_TEMP-_MA	IN	Temperature Negative Motor A	Temp. Sensor
21	V_{LOGIC}	IN	V_{LOGIC} (+5V) Input	Low Voltage In
22	V_{LOGIC}_RTN	IN	V_{LOGIC} Return	Low Voltage Rtn
23	RS422_TX+	OUT	RS422 Transmit Positive	RS-422
24	RS422_TX-	OUT	RS422 Transmit Negative	RS-422
25	RS422_RX+	IN	RS422 Receive Positive	RS-422

J2 PIN	NAME	I/O	DESCRIPTION	TYPE
26	RS422_RX-	IN	RS422 Receive Negative	RS-422
27	CAN+	I/O	CAN High	CAN
28	CAN-	I/O	CAN Low	CAN
29	USB_D+	I/O	USB Data Positive	USB 2.0
30	USB_D-	I/O	USB Data Negative	USB 2.0
31	ANALOG_REF	---	Analog Reference	Analog Ref.
32	DIG_IO	I/O	Digital Input / Output	Digital In / Out
33	HSSB_TX_CLK	OUT	High Speed Serial Bus Transmit Clock	HSSB
34	HSSB_RX_CLK	IN	High Speed Serial Bus Receive Clock	HSSB
35	HSSB_TX_SYNC	OUT	High Speed Serial Bus Transmit Sync	HSSB
36	HSSB_RX_SYNC	IN	High Speed Serial Bus Receive Sync	HSSB
37	HSSB_TX_DATA	OUT	High Speed Serial Bus Transmit Data	HSSB
38	HSSB_RX_DATA	IN	High Speed Serial Bus Receive Data	HSSB
39	BUF_ATP1	OUT	Analog Test Point 1	Analog Out
40	BUF_ATP2	OUT	Analog Test Point 2	Analog Out

Notes:

1. Differential pairs are indicated by "+" and "-". Twisted pairs should be used in wire harness.
2. Depending on configuration, several other Digital I/O signals may be available (contact ESI Motion for further information.

Thermal

Max. Case Temperature

The maximum operating case temperature is +100ºC.

Thermal Conductivity Data

The Mite Servo Drive Module thermal resistance was measured from component junction to the heat sink base plate. Refer to Thermal Resistance Table below.

Symbol	Description	ºC/W
Tjb	Theta Junction to Base Plate	9.52

Thermal Resistance

The following is thermal data collected from the Mite Servo Drive Module mounted on a 5" x 6" x 0.5" aluminum heat sink with phase change thermal interface compound, (Aavid Thermalloy, part number 100300F00000G.)

Current Command (A)	Case Temperature Rise (ºC)
10	3.5
20	6.0
30	9.8
40	14.3
50	20.9
60	27.5
70	36.4

Current Command vs. Case Temperature Rise

Heat Sink Interface Materials

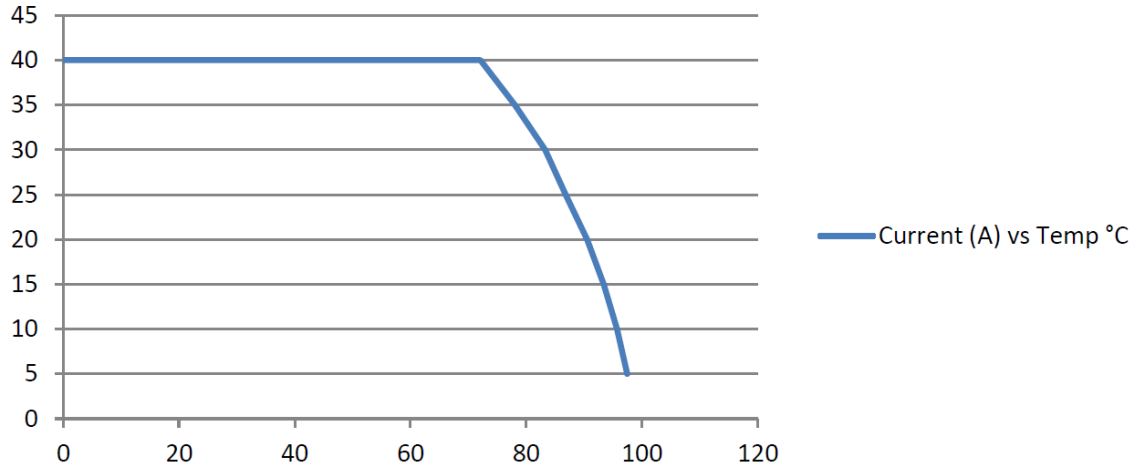
If a heat sink is needed, effective coupling of the Mite base plate to the heat sink is essential for optimum heat transfer. Depending on the operating current and the amount of heat dissipated, various methods are available to achieve a good thermal bond. The Thermal Interface Compounds table below shows examples of thermal interface compounds which can be used with the Mite Servo Drive Module.

Thermal Interface Compound	Supplier	Part Number	Thermal Conductivity	Operating Temperature
Phase Change	Aavid Thermalloy	100300F00000G	0.79 W/(m-°C)	-40°C to 200°C
Gap Pad	Bergquist	GP1500	1.5 W/(m-°C)	-60°C to 200°C
Thermal Grease	Aavid Thermalloy	100100F00000G	0.73 W/(m-°C)	-40°C to 200°C

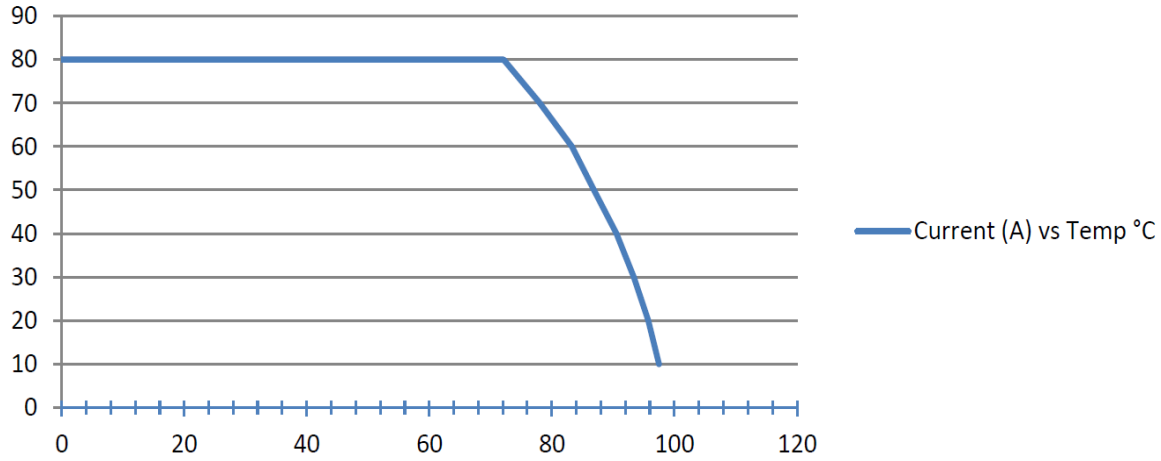
Thermal Interface Compounds

Current-Temperature Derating Curves

The following figures depict the maximum current command versus case temperature, per axis, and for paralleled axes.



Maximum Current Command vs Case Temperature (Per Axis)

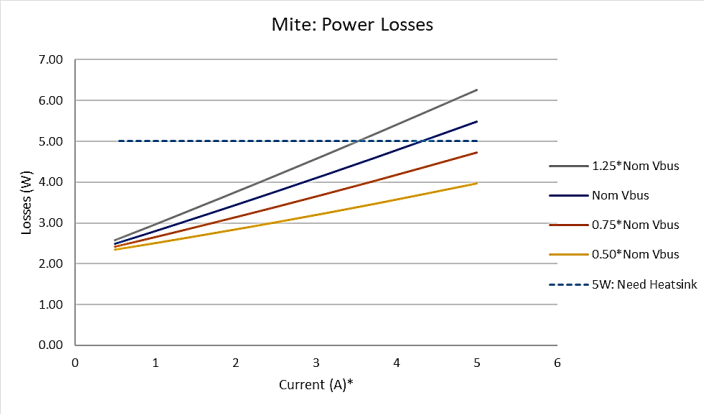


Maximum Current Command vs Case Temperature (Paralleled Axes)

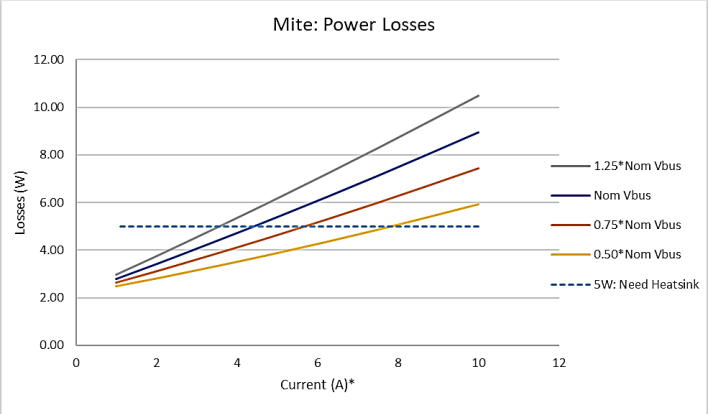
Power Loss Curves

The following are Power Loss Curves for a number of Mite models (contact ESI Motion for other models not shown), at several working voltages (shown as a factor of the Nominal Voltage, which in the Model Number).
These are power losses per Mite module (not per axis).
Each depicts a horizontal line at 5W, above which an external heatsink is required (Note: model M01A028VPS, not shown, does not need a heatsink).

Single Axis Models:

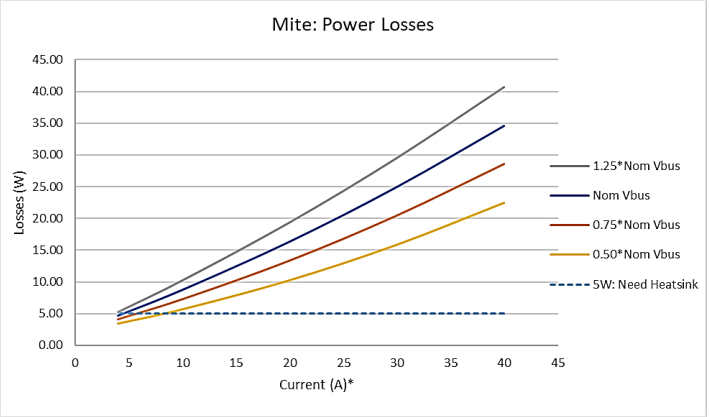


M05A028VPS Power Loss Curve

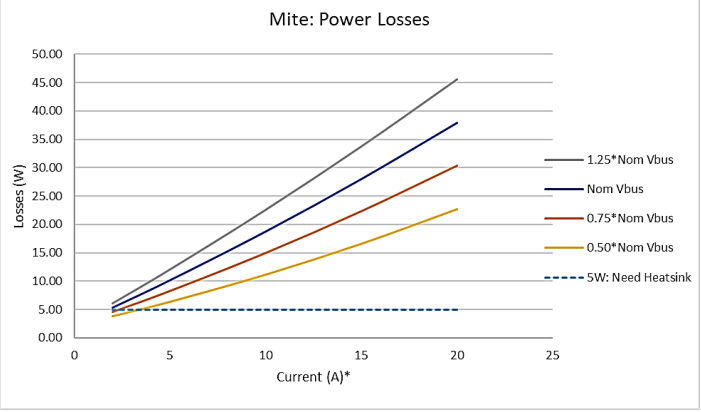


M10A028VPS Power Loss Curve

M20A028VPS Power Loss Curve



M40A028VPS Power Loss Curve



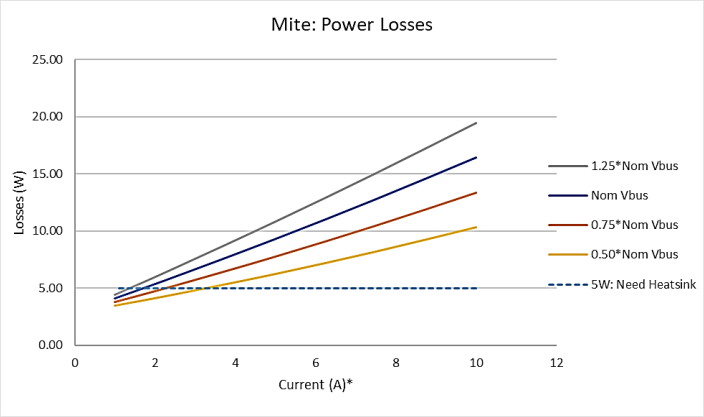
M20A048VPS Power Loss Curve

M20A075VPS Power Loss Curve

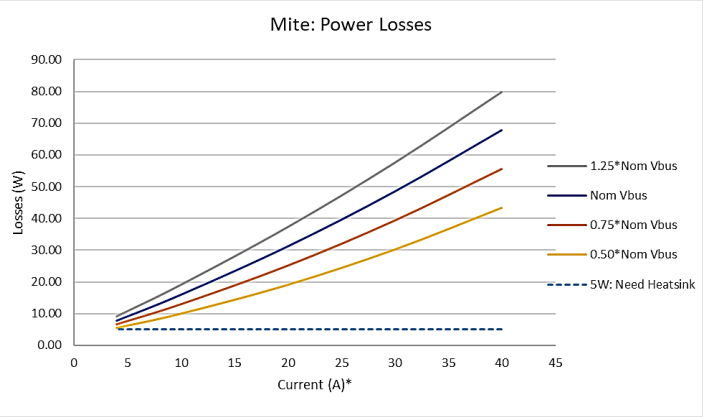
Power Loss Curves, cont.

These are power losses per Mite module (not per axis).
For Parallel Axis configurations, it is the same as Dual, but with twice the current: For example, curve for the dual axis model M40A028VPD (40A per Axis, 80A per module) can be used for Parallel Axis M80A028VPP.

Dual Axis Models:

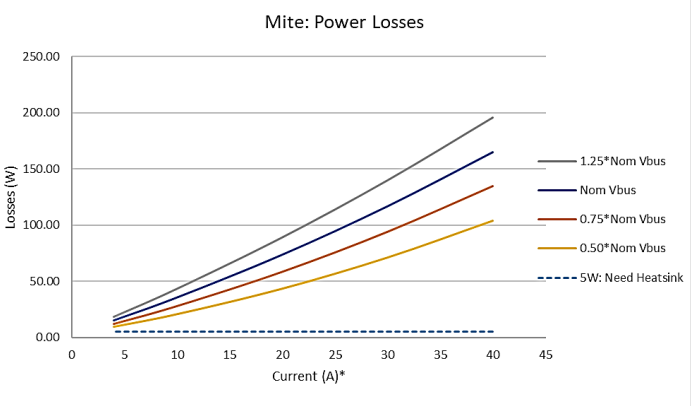


M10A028VPD Power Loss Curve



M40A028VPD Power Loss Curve

M20A048VPD Power Loss Curve

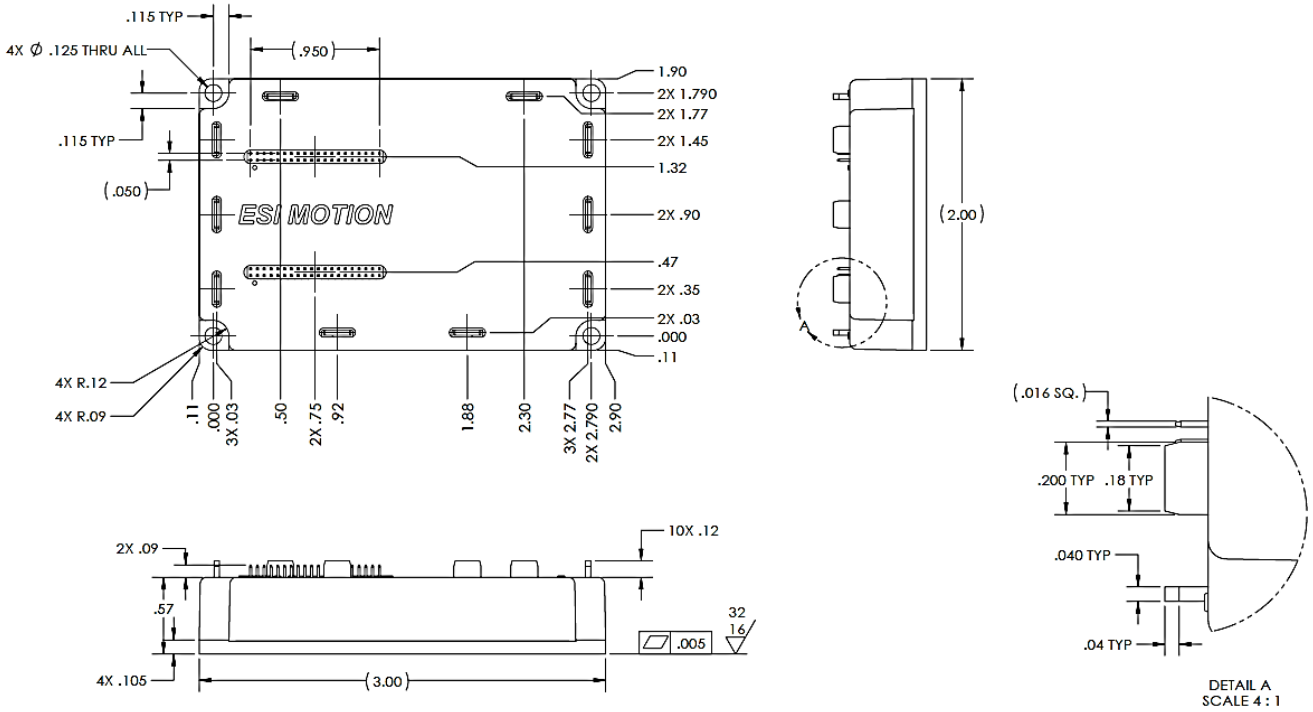


M40A048VPD Power Loss Curve

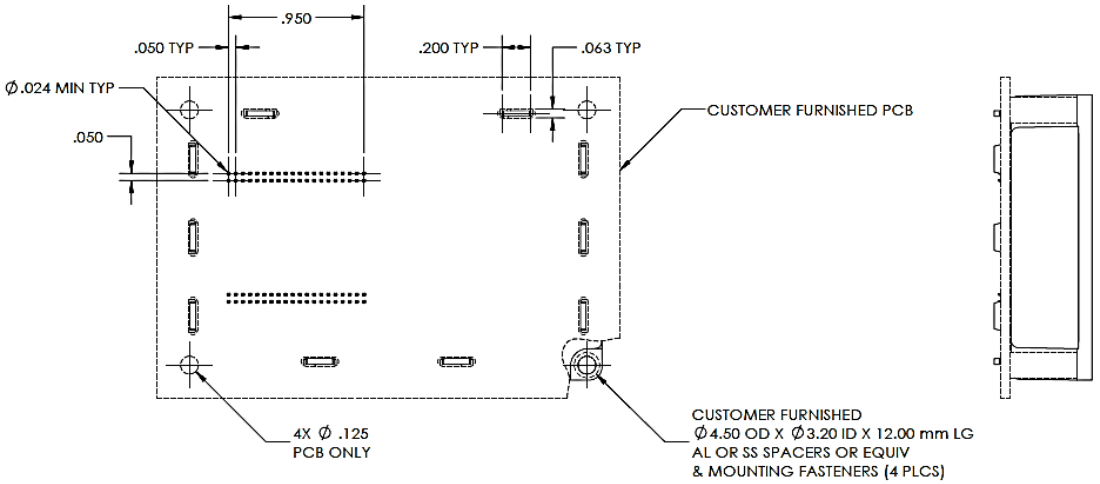
M05A170VPD Power Loss Curve

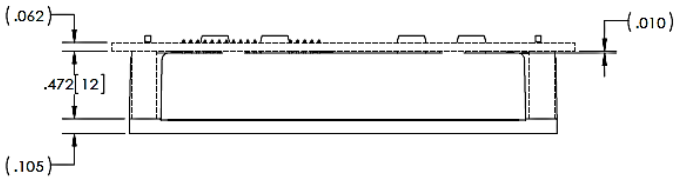
M10A170VPD Power Loss Curve

Mechanical Diagrams – Dual Axis



Dual Axis

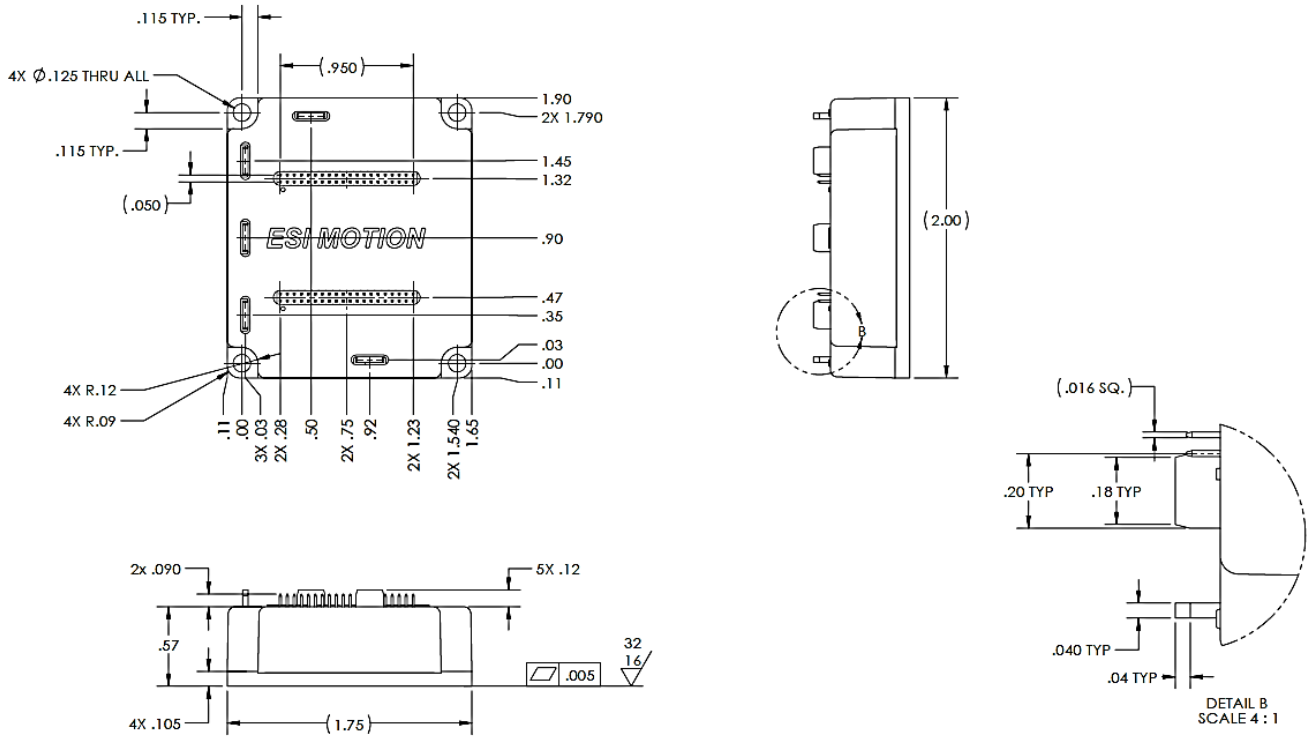




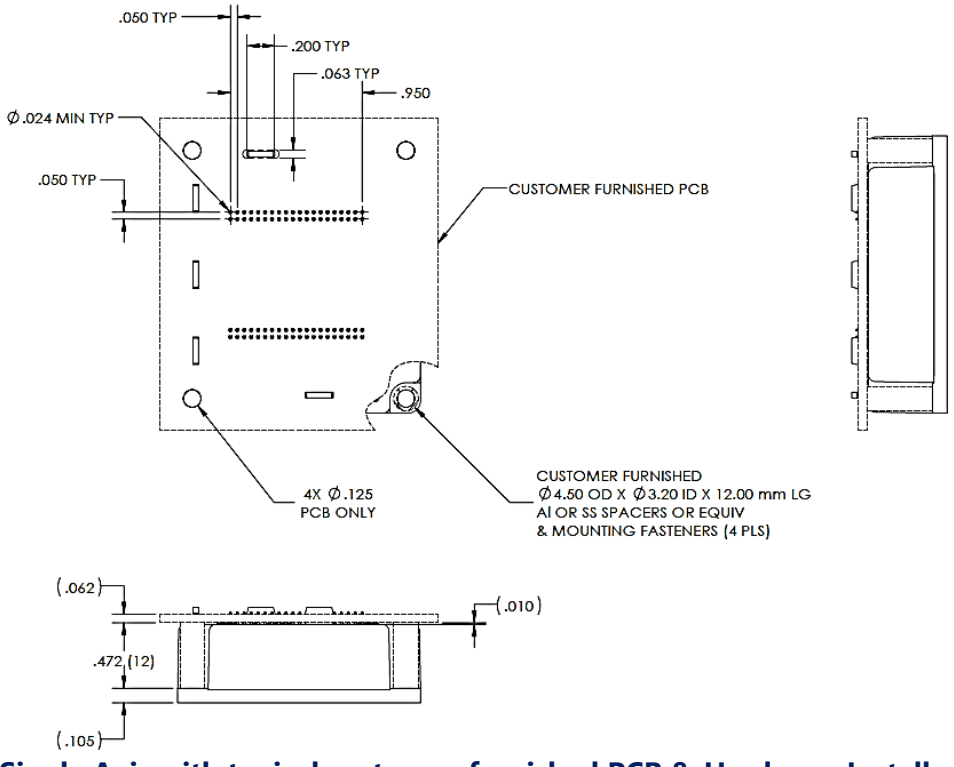
All dimensions are in inches

Dual Axis with typical customer-furnished PCB & Hardware Installed

Mechanical Diagrams – Single Axis

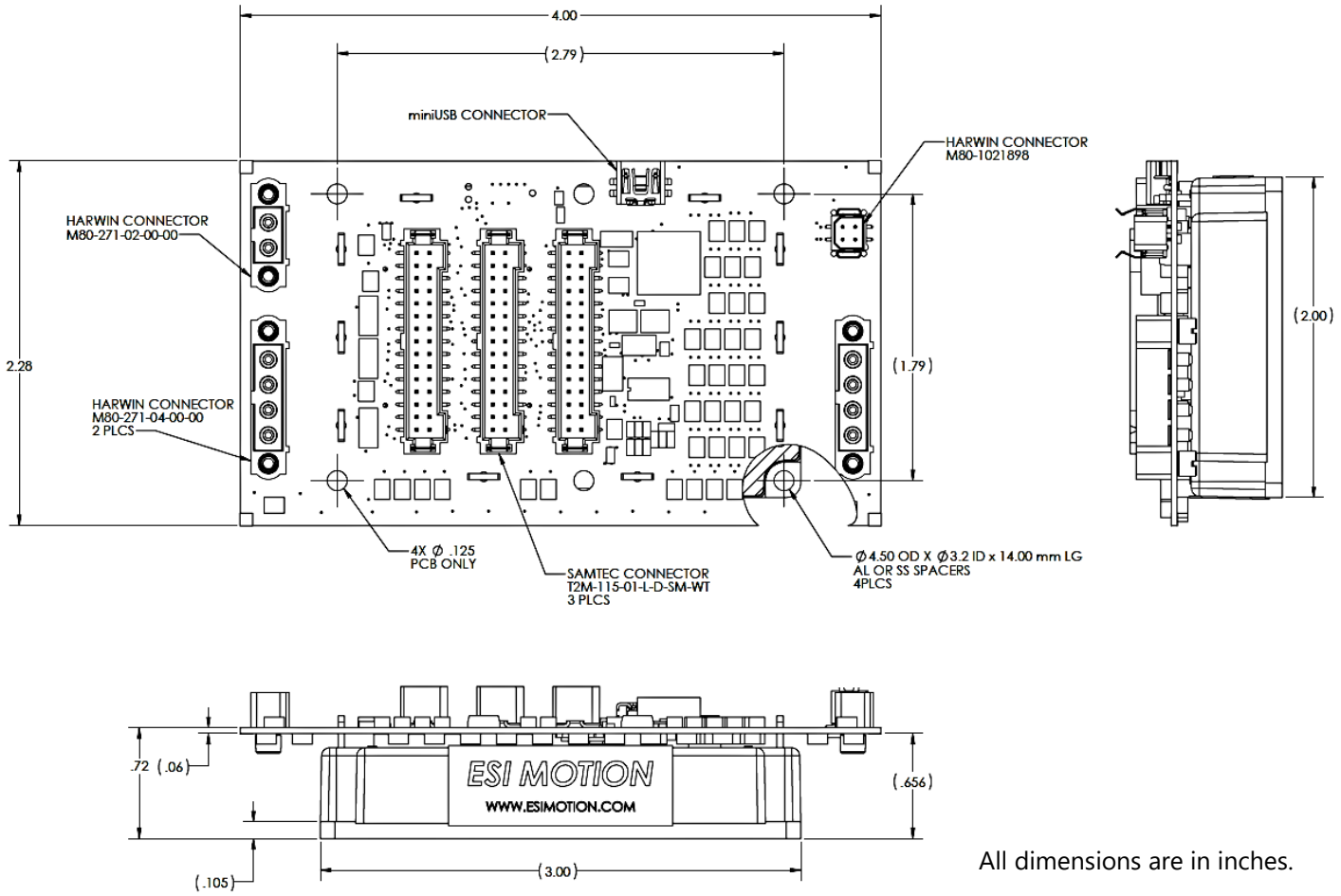


Single Axis



Single Axis with typical customer-furnished PCB & Hardware Installed

Mechanical Diagrams: Dual Axis with optional I/O Board Installed



All dimensions are in inches.

Dual Axis with I/O Board Installed

Ordering Information

M XXA YYYV P S D -E -I

Servo Drive Module	Nominal Continuous Current[1]	Nominal Voltage	Case	Configuration	Options (add all)
M – Mite	01 – 1A 02 – 2A 05 – 5A 10 – 10A 20 – 20A 40 – 40A 80 – 80A[2]	012 – 12V 028 – 28V 048 – 48V 075 – 75V 170 – 170V	P – Potted Plastic	S – Single Axis D – Dual Axis P – Single Paralleled Axes[3]	-E – Extended Operating Temperature -I – Include I/O Adapter Board

1) Peak Sine Wave, per axis
2) 80A: Use Single Paralleled Axis
3) 2 x Continuous Current (80A Maximum)

Example: Part Number M40A028VPS-E-I
Servo Drive Module: Mite
Continuous Current: 40A
Nominal Voltage: 28VDC
Case: Potted Plastic
Configuration: Single Axis
Extended Operating Temperature
Include I/O Adapter

Model Availability List

The following tables lists available models:

Single Axis:

Continuous Current / Axis	12V	28V	48V	75V	170V
80A	M80A012VPP	M80A028VPP	M80A048VPP		
40A	M40A012VPS	**M40A028VPS**	M40A048VPS	M40A075VPP	
20A	M20A012VPS	**M20A028VPS**	**M20A048VPS**	**M20A075VPS**	M20A170VPP
10A	M10A012VPS	**M10A028VPS**	M10A048VPS	M10A075VPS	M10A170VPS
5A	M05A012VPS	**M05A028VPS**	M05A048VPS	M05A075VPS	M05A170VPS
2A	M02A012VPS	M02A028VPS	M02A048VPS	M02A075VPS	M02A170VPS
1A	M01A012VPS	**M01A028VPS**	M01A048VPS	M01A075VPS	M01A170VPS
	12V	28V	48V	75V	170V

Voltage

Dual Axis:

Continuous Current / Axis	12V	28V	48V	75V	170V
40A	M40A012VPD	**M40A028VPD**	**M40A048VPD**		
20A	M20A012VPD	**M20A028VPD**	**M20A048VPD**	M20A075VPD	
10A	M10A012VPD	**M10A028VPD**	**M10A048VPD**	M10A075VPD	**M10A170VPD**
5A	M05A012VPD	**M05A028VPD**	**M05A048VPD**	M05A075VPD	**M05A170VPD**
2A	M02A012VPD	M02A028VPD	M02A048VPD	M02A075VPD	M02A170VPD
1A	M01A012VPD	M01A028VPD	M01A048VPD	M01A075VPD	M01A170VPD
	12V	28V	48V	75V	170V

Voltage

Notes: 1. Standard Products are shown in bold, and have expedited lead times.
2. Parallel Axis models, uses dual-axis model and parallels Motor Power Outputs, shown in gold

Accessories

PART NUMBER	MANUFACTURER	DESCRIPTION
600302-00	ESI Motion	Mite IO Board
500157-00	ESI Motion	Mite Connector Kit
IPEH-002021	Peak Systems	USB-to-CAN Adapter (Required for PC Interface)
GC-CAN-TERM-GC	GRID CONNECT	DB9 CAN Termination