ESI MOTION™
2250-A Union Place, Simi Valley, CA 93065
Tel: 800.823.3235 – sales@esimotion.com
www.esimotion.com Product of USA

# DRACO

## Dual-Axis Servo Drive

### *Rugged, 300 or 600 VDC, Up to 120 Amps*

**ESI Motion's Draco Servo Drive provides power house performance in a small, lightweight package. Draco incorporates our rugged, high-density DSP controller and power driver modules, offers several feedback options, and is packaged in a military-grade submersible case.**

This versatile servo drive is ideal for high-performance applications operating at high temperatures, in high vibration, or other extreme environmental conditions. ESI Motion's servo drive systems 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 at our USA facility.

### Features:

- MIL-STD-461 EMI Filter
- Nominal Voltage Options: 300VDC or 600VDC
- Maximum Continuous Output Current to 120A
- Maximum DC Power to 33.35 kW
- Multiple Feedbacks Supported:
  - BiSS-C (Unidirectional)
  - Quadrature Encoder
  - Resolver
  - Hall
  - Sensorless
- Maximum Motor Speed 75,000 RPM
- Torque, Velocity, or Position control
- Brake drivers
- Regeneration Controller
- Active Inrush Limiter
- Includes configurable, user-friendly GUI with enhanced data collection capability and integrated oscilloscope feature

### Specifications:

- Operating Case Temperature: -40 to 71°C
- Weight: 2.36 – 3.30 kg (5.20 – 7.27 lbs.)
- Size: 238 x 159 x 66 mm – 250 x 174 x 77 mm
- Efficiency: >97% (full load)

### Compliance:

- Electromagnetic interference per MIL-STD-461*:
  - CE102
  - CS101
  - CS114
  - CS115
  - CS116
  - RE101
  - RE102
  - RS103
- Shock/Vibration per MIL-STD-810G:
  - Random Vibration 514.7 Category: 16.3 Grms, 15 – 2,000 Hz (0.20 g2/Hz)
  - Shock 516.7 Procedure 1: 40G Terminal Peak Sawtooth, 11ms
- 28V Electrical power characteristics: MIL-STD-704F
- Optional Software design assurance: DO-178C
- IP67 Compliant

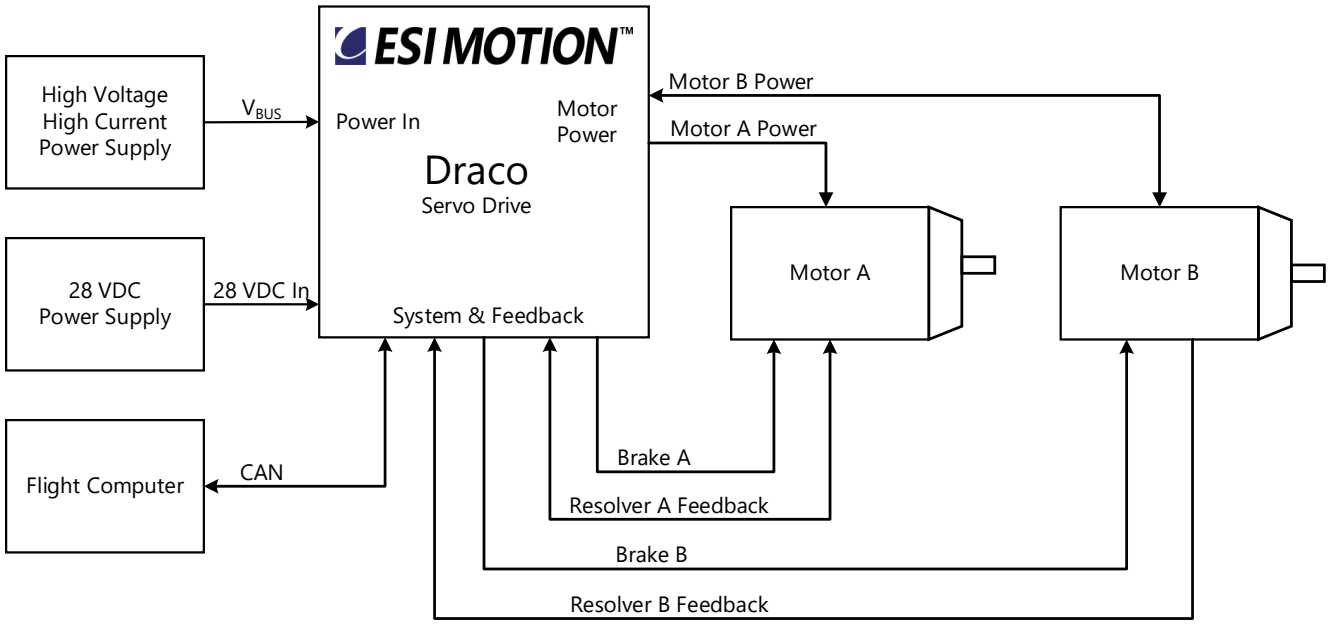
### Customization Available

ESI Motion has the expertise to customize a solution for your project's needs. Contact us today at sales@esimotion.com to see how we can tailor a solution for you.

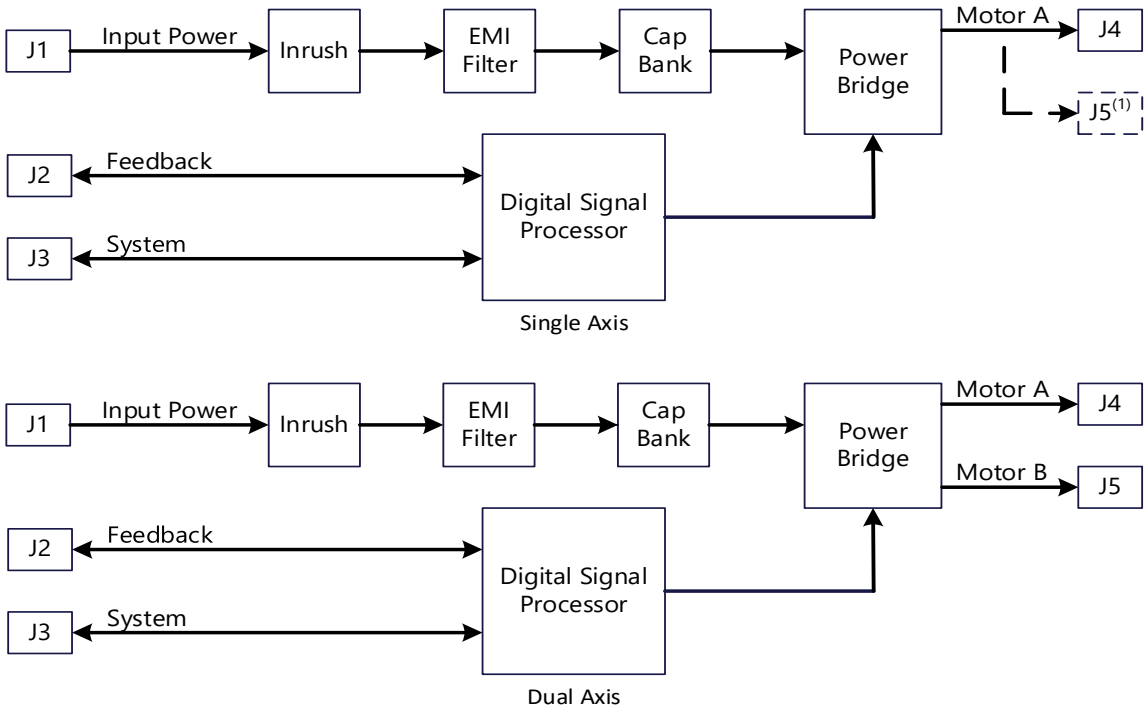
*The EMI features on ESI's Draco drive are being sold AS-IS, without warrantee. EMI compliance is a complex requirement involving the controller, cabling, and the motor. All parts in the system will require special consideration in order to fully comply with EMI features. Due to this complexity, ESI does not warrantee system level EMI compliance.

ESI offers EMI certification services. Certification services can be customized to your needs and typically include a system EMI review, formal compliance testing, and a compliance report. Please contact ESI for details on how to get your system certified to MIL-STD-461.

## Typical Draco Application:




## Draco Block Diagram:




Notes:

1. See the Motor Power Connector section to determine the presence of J5.

# 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), 600V model | | 900 | VDC |
| V_BUS (Motor Power), 300V model | | 450 | VDC |
| 28VDC_IN (Logic Power) | | 50 | V |
| ±10 Volt Analog Inputs | | ±22 | V |
| ±5 Volt Analog Inputs (Resolver Inputs) | | ±22 | V |
| Single Ended Analog Input | | ±22 | V |
| Open Collector Inputs (Hall Inputs) | | ±22 | V |
| CAN SIGNALS | Differential (CAN+ – CAN-) | ±27 | V |
| | Common-Mode | ±27 | V |
| Isolated CAN SIGNALS | Differential (CAN+ – CAN-) | ±27 | V |
| | Common-Mode | ±250 | 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 Input | | -3 to +6 | V |
| Operating case temperature | | -40 to +71 | °C |
| Storage Temperature | | -55 to +100 | °C |

## Recommended Operating Conditions

| Motor Power DC Input Characteristics – 600 VDC Model | | | | |
|---|---|---|---|---|
| **PARAMETER** | **MIN** | **NOM** | **MAX** | **UNIT** |
| V_BUS (Motor Power) | 50 | 600 | 725 | VDC |
| V_BUS (Motor Power) Input Current | | | 46 | Amps |
| Input Power | | 27.6 | 33.35 | kW |
| Internal Bus Capacitance | | 54 | | uF |
| Chassis Capacitance (Common Mode) | | 12 | | uF |

Notes:

1. Power is limited by the EMI filter current capability. Higher power customized solutions are available.

| Motor Power DC Input Characteristics – 300 VDC Model | | | | |
|---|---|---|---|---|
| **PARAMETER** | **MIN** | **NOM** | **MAX** | **UNIT** |
| V_BUS (Motor Power), 300V Model | 50 | 300 | 400 | VDC |
| V_BUS (Motor Power) Input Current | | | 46 | Amps |
| Input Power (1) | | 13.8 | 18.4 | kW |
| Internal Bus Capacitance (Differential Mode) | | 114 | | uF |
| Chassis Capacitance (Common Mode) | | 12 | | uF |

Notes:
1. Power is limited by the EMI filter current capability. Higher power customized solutions are available.

| 28 Volt Logic DC Input Characteristics | | | | |
|---|---|---|---|---|
| **PARAMETER** | **MIN** | **NOM** | **MAX** | **UNIT** |
| 28VDC_IN Operating Voltage | 22 | 28 | 36 | VDC |
| 28VDC_IN Operating Current w/o Brakes | | | 0.75 | A |
| 28VDC_IN Operating Current | | | 4.25 | A |

Notes: N/A

| Motor Power Output Characteristics | | | |
|---|---|---|---|
| **PARAMETER (Per Axis)** | **Continuous** | **Peak (2)** | **Units** |
| Output current, 20A Model | 20 | 40 | Amps Peak-of-Sin |
| Output current, 40A Model (1) | 40 | 80 | Amps Peak-of-Sin |
| Output current, 60A Model (1) | 60 | 80 | Amps Peak-of-Sin |
| Output current, 80A Model (1) | 80 | 80 | Amps Peak-of-Sin |
| Output current, 120A Model (1) | 120 | 120 | Amps Peak-of-Sin |
| Motor Speed | | 75,000 | RPM |

Notes:
1. Output power may be limited by the maximum input current
2. Two Second Peak

| I/O Characteristics | | | | |
|---|---|---|---|---|
| **PARAMETER** | **MIN** | **NOM** | **MAX** | **UNIT** |
| **±10 Volt Analog Inputs**<br>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 |
| **Analog Output**<br>ANALOG_OUT_1, ANALOG_OUT_2 | | | | |

| I/O Characteristics | | | | |
|---|---|---|---|---|
| **PARAMETER** | **MIN** | **NOM** | **MAX** | **UNIT** |
| Output Range | -3 | | +3 | V |
| Analog Output Impedance | | 50 | | Ω |
| Update Rate | | 2X | | PWM Frequency |
| **Brake**<br>BRAKE+MA, BRAKE-MA, BRAKE+MB, BRAKE-MB | | | | |
| Output Voltage | | 98% | | Percent of 28VDC_IN |
| Output Current Limit | 1.3 | 1.4 | 1.5 | Amps |
| **CAN Signals**<br>CAN+, CAN-, ISO_CAN+, ISO_CAN- | | | | |
| Voltage Levels | Compliant to ISO 11898-2 | | | |
| Standard Bit Rates | 100, 250, 500, and 1,000 | | | Kbps |
| **Encoder, Hall, BiSS-C, and Auxiliary Equipment Power Signals**<br>5VDC_OUT, SIGNAL_GND | | | | |
| Output Voltage | 4.75 | 5.0 | 5.25 | Volts |
| Output Current (Total for all 5VDC_OUT connections) | | | 500 | mA |
| **Encoder and BiSS-C Signals**<br>A+MA, A-MA, B+MA, B-MA, I+MA, I-MA,<br>A+MB, A-MB, B+MB, B-MB, I+MB, I-MB | | | | |
| Voltage Levels | Compliant to EIA-422-B | | | |
| Differential Input Impedance | | 120 | | Ohms |
| Input Frequency | | | 25 | MHz |
| **Encoder Power**<br>5VDC_OUT | | | | |
| Output Voltage | 4.75 | 5.0 | 5.25 | VDC |
| Output Current | | 500 | | mA |
| **Interlock**<br>INTERLOCK+MA, INTERLOCK-MA<br>INTERLOCK+MB, INTERLOCK-MB, | | | | |
| Interlock Short Resistance | 0 | | 1 K | Ohm |
| Interlock Open Resistance | 1 Meg | | | Ohm |
| **Motor Temperature**<br>MOTOR_TEMP+, MOTOR_TEMP- | | | | |
| Thermistor Resistance at 25°C | 1 | 5 | 10 | KΩ |
| Recommended Thermistor | TDK/Epcos PN B57861S0502F040 | | | |
| Excitation Voltage | | 3.0 | | V |
| Excitation Impedance | | 2.0 | | kOhm |
| Input Bandwidth | | 1.6 | | kHz |
| **Open Collector Inputs (Hall Inputs)**<br>HALL_A_MA, HALL_B_MA, HALL_C_MA, | | | | |

| I/O Characteristics | | | | |
|---|---|---|---|---|
| **PARAMETER** | **MIN** | **NOM** | **MAX** | **UNIT** |
| HALL_A_MB, HALL_B_MB, HALL_C_MB<br>Alternate Function Name<br>DIGITAL_IN_1, DIGITAL_IN_2, DIGITAL_IN_3,<br>DIGITAL_IN_4, DIGITAL_IN_5, DIGITAL_IN_6, | | | | |
| 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 |
| **Regen**<br>REGEN+, REGEN- | | | | |
| Continuous Current | | | 23 | Amps |
| Peak (2 Second) Current | | | 40 | Amps |
| **Resolver Excitation**<br>EXE+MA, EXE-MA, EXE+MB, EXE-MB | | | | |
| Output Voltage | 3.8 | 4 | 4.2 | $V_{RMS}$ |
| Resolver Excitation Output Frequency (1) | | 5.0 | | kHz |
| **Resolver SIN, COS (ANALOG_IN_3 – ANALOG_IN_6)**<br>SIN+MA, SIN-MA, COS+MA, COS-MA,<br>SIN+MB, SIN-MB, COS+MB, COS-MB<br>Alternate Function Name<br>ANALOG_IN_3+, ANALOG_IN_3-, ANALOG_IN_4+,<br>ANALOG_IN_4-<br>ANALOG_IN_5+, ANALOG_IN_5-, ANALOG_IN_6+,<br>ANALOG_IN_6- | | | | |
| Differential Range | 2 | | 4.2 | $V_{RMS}$ |
| Differential Impedance | | 20 | | KΩ |
| Input Bandwidth | | 70 | | kHz |
| **RS422 Signals**<br>RS422_TX, RS422_RX | | | | |
| Voltage Levels | Compliant to EIA-422-B | | | |
| Standard Bit Rates | 115.2, 230.4, 460.8, 1000 | | | Kbps |
| **Thermal Information** | | | | |
| Maximum Case Temperature | | | 71 | °C |

Notes:

1. Default resolver frequency is 5 kHz (contact ESI for custom frequencies)

## Mechanical Characteristics & Connectors

| Mechanical Characteristics | | | |
|---|---|---|---|
| **PARAMETER** | | **Value** | **UNIT** |
| Weight | Conduction-Cooled, Single Motor Power Connector<br>Conduction-Cooled, Dual Motor Power Connectors<br>Liquid-Cooled, Single Motor Power Connector<br>Liquid -Cooled, Dual Motor Power Connectors | 2.36 (5.20)<br>2.62 (5.78)<br>3.04 (6.69)<br>3.30 (7.27) | Kg (lbs.) |
| Size | Conduction-Cooled, Single Motor Power Connector<br>Conduction-Cooled, Dual Motor Power Connectors<br>Liquid-Cooled, Single Motor Power Connector<br>Liquid -Cooled, Dual Motor Power Connectors | 238 x 159 x 66<br>238 x 174 x 66<br>250 x 159 x 77<br>250 x 174 x 77 | mm |

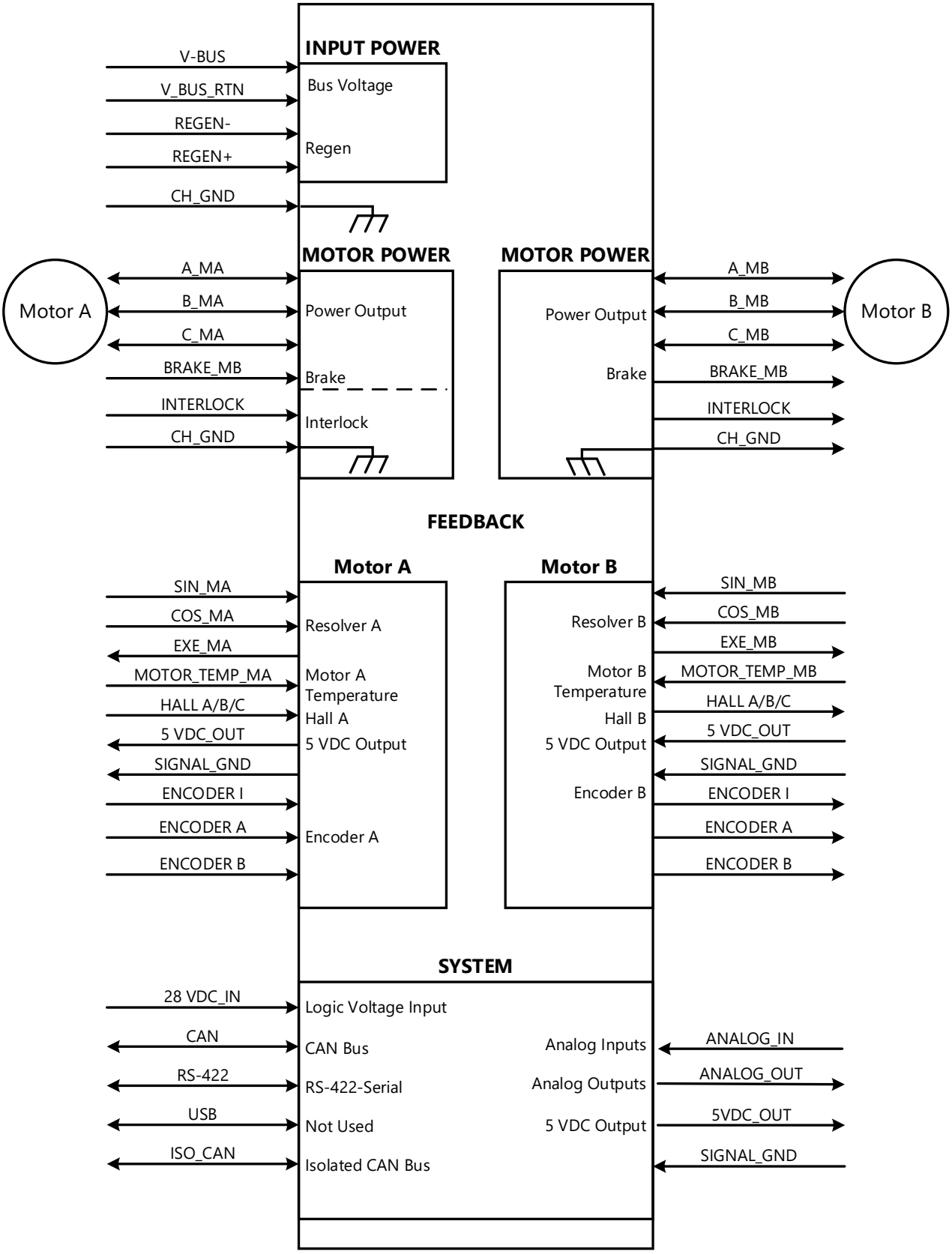
Notes: N/A

| Connectors | | | | | | | |
|---|---|---|---|---|---|---|---|
| **No.** | **Function** | **Insert Arrangement** | **Clocking** | **Number of contacts** | **Contact size** | **Connector Part Number** | **Mating Connector Part Number** |
| J1 | Input Power | 21-11 | Normal | 11 | 12 | D38999/24FG11PN | D38999/26FG11SN |
| J2 | Feedback | 17-35 | Normal | 55 | 22D | D38999/24FE35PN | D38999/26FE35SN |
| J3 | System | 15-35 | Normal | 37 | 22D | D38999/24FD35PN | D38999/26FD35SN |
| J4 | Motor Power Output | 21-11 | Normal | 11 | 12 | D38999/20FG11SN or D38999/24FG11SN | D38999/26FG11PN |
| J5[1] | Motor Power Output | 21-11 | "A" | 11 | 12 | D38999/20FG11SA | D38999/26FG11PA |

Notes:

1. Not included on all controllers. See Motor Power section to determine if a configuration includes J5.

## Draco Interconnect Diagram



## Interfaces Description

### Overview

The Draco servo drive is a rugged servo controller with very high-power capability in a small size and low weight package. This section describes the Draco electrical interfaces by functional group.

### Power Input (J1)

Motor power (V_BUS) is supplied to the Draco through the Power Input connector. This connector also includes the connection for an external regen resistor.

### Motor Feedback (J2)

The motor feedback interface is connected to the Motor Feedback connector.

The Draco servo drive supports the following motor feedback devices:

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

Feedback options are software configurable via HiDS.

The connector provides connector for a motor thermistor. It is compatible with a negative temperature coefficient (NTC) thermistor. The temperature vs. resistance can be configured through software.

Two 24V brake drivers are provided. The brake drives normally power brakes in application to prevent Z-axis movement while the motor is disabled. The brakes are electrically asserted when the motor is enabled.

An auxiliary 5-volt power supply (5VDC_OUT) is provide to power encoders, hall sensors, or other 5-volt devices. Several 5VDC_OUT signals are provided for ease of connection to multiple devices. Internally, all of the 5VDC_OUT is connected together. The current rating for the 5VDC_OUT is the combined current of all of the 5VDC_OUT signals. The return signal for 5VDC_OUT is SIGNAL_GND.

### System Interface (J3)

The connector provides user interface signals. This interface includes 28 VDC power input (28VDC_IN and 28VDC_RTN) to power the Draco's logic circuits. Do not connect the 28VDC_RTN to the SIGNAL_GND. The 28VDC_RTN is pre-EMI filter while the SIGNAL_GND is post-EMI filter.

ESI recommends communication via a CAN network. CAN is ideal for real-time embedded networking. It is proven to be robust as well as flexible. The supported CAN protocol can be downloaded from the ESI web site. ESI plans to support CANOpen in a future software update.

RS-422 is a good alternate to CAN. It is robust like CAN but not as flexible. The supported RS-422 protocol can be downloaded from the ESI web site.

USB is not supported. Do not connect the USB to a computer while the Draco is enabled as the USB us highly susceptible to noise and has been known to damage USB ports on the computer.

A separate isolated CAN interface is provided with the following signals:

- ISO_CAN+
- ISO_CAN-
- ISO_GND

The isolated CAN allows communication on system without a common ground.

While ESI recommends a digital system interface such as CAN or RS-422, analog inputs and outputs are provided for legacy systems where digital communication is not possible.

### Motor Power (J4, J5)

The Motor Power connector provides three-phase power to the motor.

Single Axis units rated for under 60 amps include J4 only while Single Axis units rated for more than 80 amps include both J4 and J5. All Dual Axis units include J4 and J5. Single Axis units rated for more than 80 amps must be parallel the connections on J4 and J5 in order to meet the published current rating. See the table to determine if the unit includes two connectors based on the rated current and the number of axes.

| Rated Current | Single-Axis | Dual-Axis |
|---|---|---|
| 20 |  |  |
| 40 | | |
| 60 | | |
| 80 |  | Contact ESI |
| 120 | | Contact ESI |

Interlock connections are provided for each motor connector. The Interlock is safety feature which prevents high voltage from being applied to the motor when the Interlock is broken. Ideally the interlock signals are shorted together inside the motor. If the motor cable is disconnected, the Interlock is broken and the unit will not apply high voltage to the motor power connector. The interlock loop must be shorted on every connector before the user can enable any motor. If the loop is broken, both motors are disabled. The interlock can be enabled via software.

Digital and Analog IO signals can be configured by ESI Motion's "HiDS" motor controller software tool for use in the end application.

Digital units can be configured for various functions such as drive enable. Analog inputs can be configured as inputs to the system as well. For example, the analog inputs can be used to give the Draco servo drive a torque or velocity command. They can also be used to inject a test signal for use with a Dynamic Signal Analyzer or other test equipment.

Analog outputs can be setup in HiDS to represent an analog value for any variable in software in real-time. The unit provides two analog outputs. The user must account for the output impedance of the analog output when using these signals.

This analog input is provided to support legacy analog systems. ESI recommends the use of a digital interface (CAN or RS-422) when possible.

## ESI Motion's HiDS Application

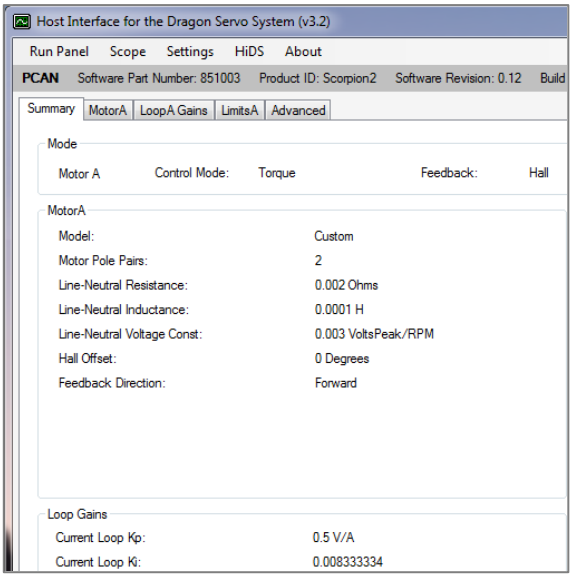
The Host Interface for Drive/Servo Controller (HiDS) is ESI Motion's servo motor controller software tool.

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 Draco, the HiDS functions can be accessed via CAN. 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.

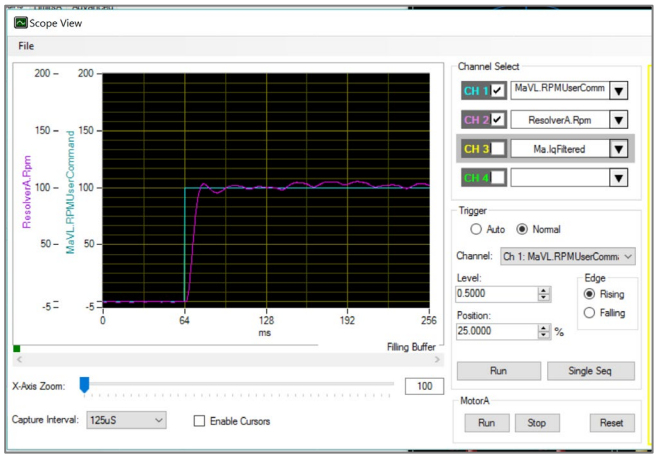
The Controller User's Manual walks you through the steps to set up limits, enter motor parameters, and tune the motor using the desired loop configuration. An excerpt from the summary tab shown below is an example view of key device configuration parameters:




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:

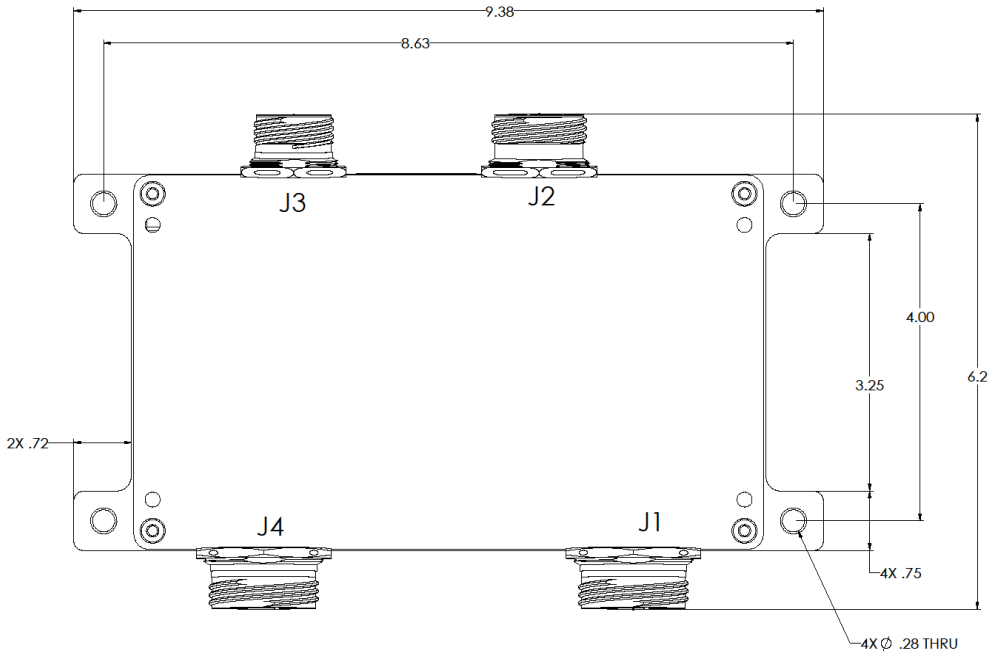


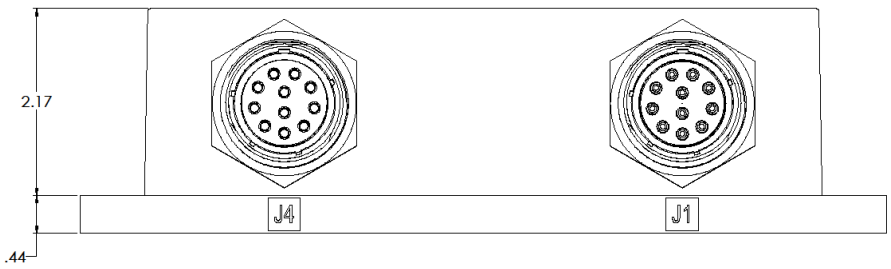

The design of the ESI Motion Draco servo controller and HiDS tool allow for tremendous flexibility and capabilities in motor control and monitoring, to ensure success of the most challenging motion control applications.

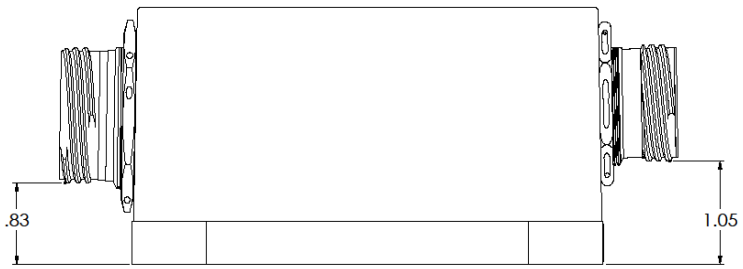
## Envelope and Dimensions

### Mechanical Dimensions - Chassis Cooled
### All Dimensions are in Inch. Tolerance: +- 0.01”

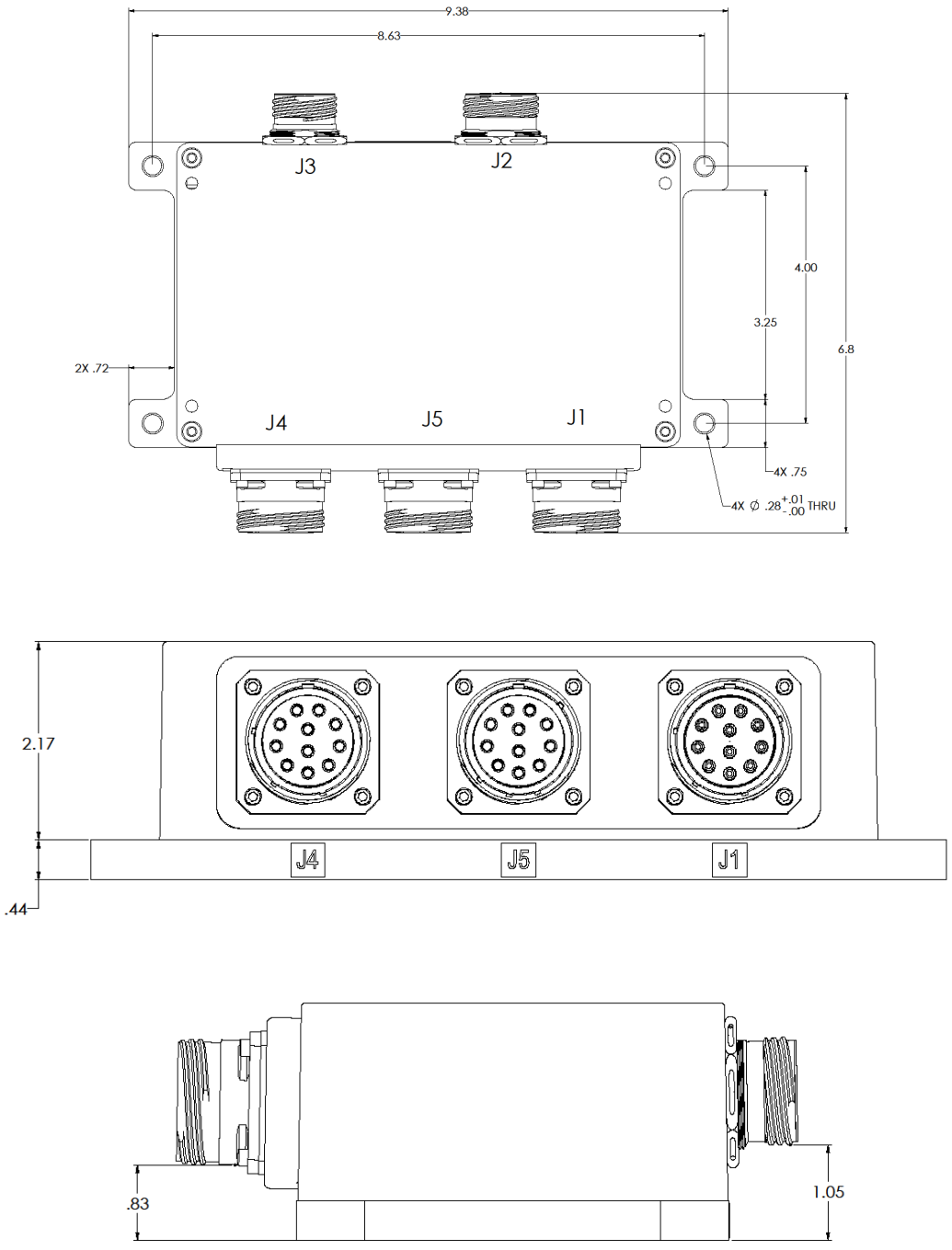
#### 20A, 40A, and 60A Single-Axis Units



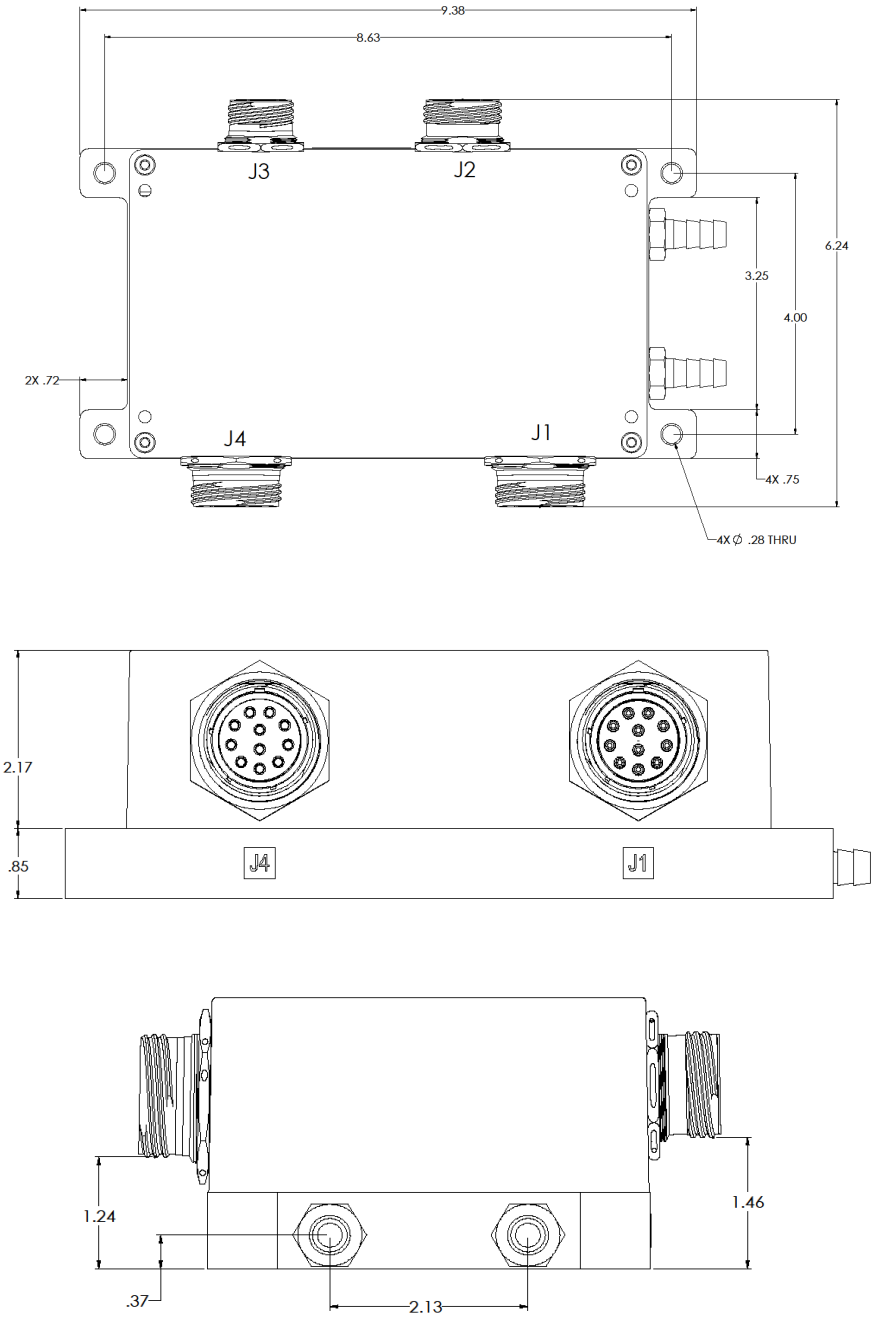



## 80A, 120A Single-Axis, All Dual-Axis Units

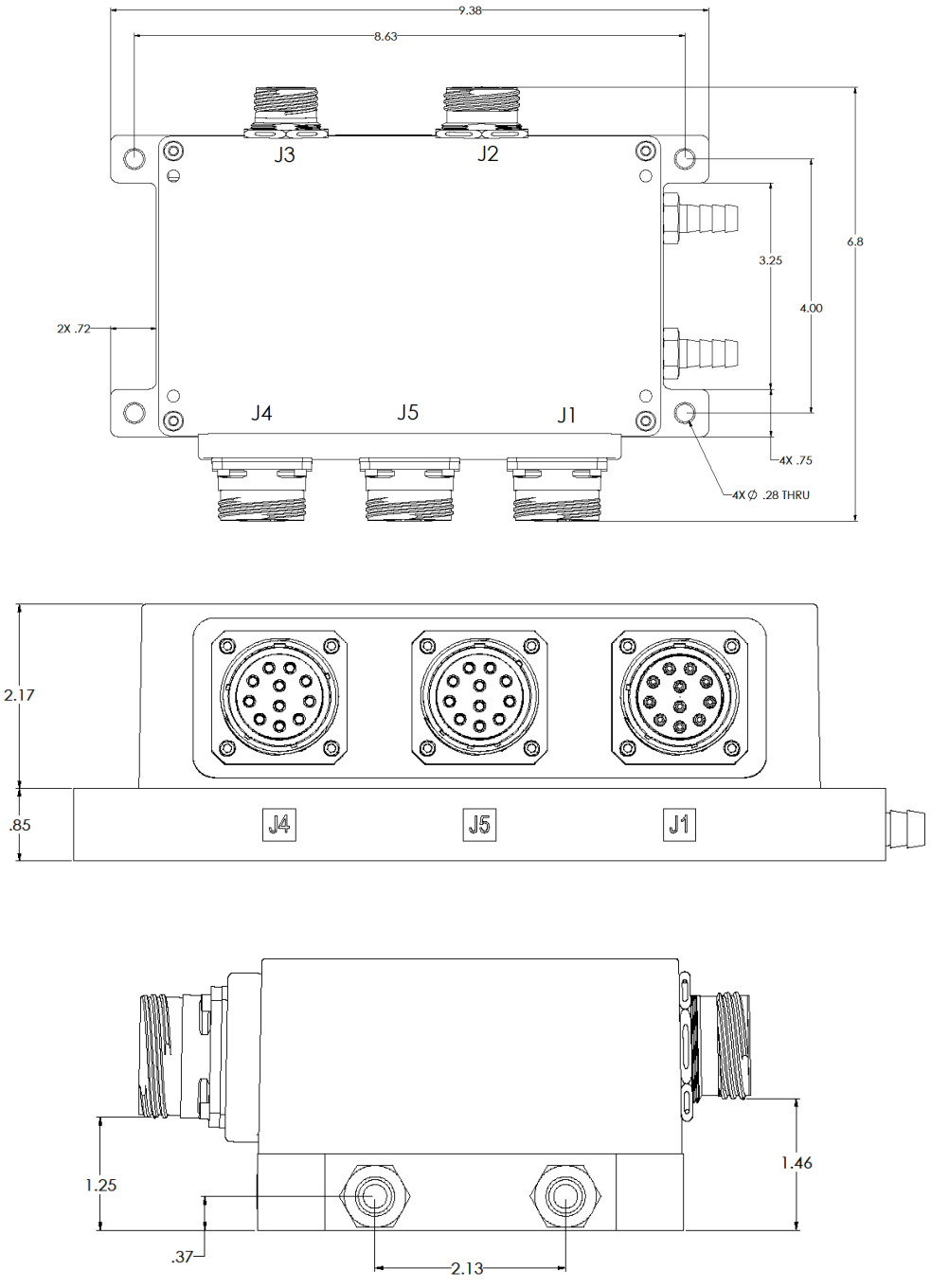


## Mechanical Dimensions – Liquid Cooled

### 20A, 40A, and 60A Single-Axis Units



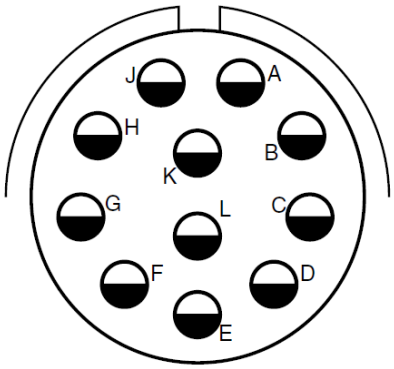
## 80A, 120A Single-Axis, All Dual-Axis Units



## Connector Pinouts

Interfaces for each of the six connectors are shown in this section. See each respective diagram for the pinout numbering.

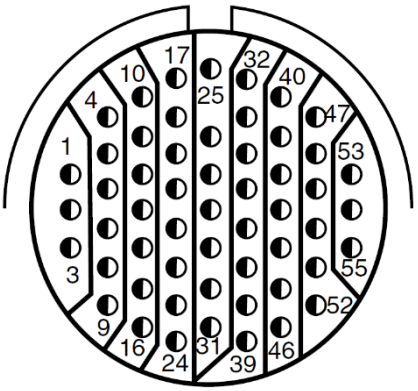
### J1 Input Power Pinout Assignments




View looking into connector

| J1 Pin | Name | I/O | Description | Type |
|---|---|---|---|---|
| A | V_BUS_RTN | IN | Motor Power Return | Power |
| B | V_BUS_RTN | IN | Motor Power Return | Power |
| C | Reserved | --- | Do not connect | |
| D | REGEN- | OUT | External Regen Resistor Connection | Power |
| E | REGEN+ | OUT | External Regen Resistor Connection | Power |
| F | Reserved | --- | Do not connect | |
| G | Reserved | --- | Do not connect | |
| H | V_BUS | IN | Motor Power | Power |
| J | V_BUS | IN | Motor Power | Power |
| K | Reserved | --- | Do not connect | |
| L | CH_GND | --- | Chassis Ground | Chassis Ground |

## J2 Feedback Pinout Assignments




View looking into connector

| J2 Pin | Name | I/O | Description | Type |
|---|---|---|---|---|
| 1 | CH_GND | --- | Chassis Ground (1) | Chassis Ground |
| 2 | EXE+MA | OUT | Resolver excitation output positive motor A | Resolver |
| 3 | EXE-MA | OUT | Resolver excitation output negative motor A | Resolver |
| 4 | SIN+MA (ANALOG_IN_3+) | IN | Resolver SIN positive motor A, can be used as ANALOG_IN_3+ | Resolver Input ±5 Volt Analog Input |
| 5 | SIN-MA (ANALOG_IN_3-) | IN | Resolver SIN negative motor A, can be used as ANALOG_IN_3- | Resolver Input ±5 Volt Analog Input |
| 6 | COS+MA (ANALOG_IN_4+) | IN | Resolver COS positive motor A, can be used as ANALOG_IN_4+ | Resolver Input ±5 Volt Analog Input |
| 7 | COS-MA (ANALOG_IN_4-) | IN | Resolver COS negative motor A, can be used as ANALOG_IN_4- | Resolver Input ±5 Volt Analog Input |
| 8 | EXE+MB | OUT | Resolver excitation positive motor B | Resolver Output |
| 9 | EXE-MB | OUT | Resolver excitation negative motor B | Resolver Output |
| 10 | SIN+MB (ANALOG_IN_5+) | IN | Resolver SIN positive motor B, *can be used as* ANALOG_IN_5+ | Resolver Input ±5 Volt Analog Input |
| 11 | SIN-MB (ANALOG_IN_5-) | IN | Resolver SIN negative motor B, *can be used as* ANALOG_IN_5- | Resolver Input ±5 Volt Analog Input |
| 12 | COS+MB (ANALOG_IN_6+) | IN | Resolver COS positive motor B, *can be used as* ANALOG_IN_6+ | Resolver Input ±5 Volt Analog Input |
| 13 | COS-MB (ANALOG_IN_6-) | IN | Resolver COS negative motor B, *can be used as* ANALOG_IN_6- | Resolver Input ±5 Volt Analog Input |
| 14 | MOTOR_TEMP+MA | IN | Temperature positive motor A | Temperature Input |
| 15 | MOTOR_TEMP-MA | IN | Temperature negative motor A | Temperature Input |
| 16 | MOTOR_TEMP+MB | IN | Temperature positive motor B | Temperature Input |
| 17 | MOTOR_TEMP-MB | IN | Temperature negative motor B | Temperature Input |
| 18 | 5VDC_OUT | OUT | 5 Volt Encoder/Hall/Aux Power | Low Voltage Power |
| 19 | SIGNAL_GND | --- | 5VDC_OUT Return and Ground Reference (2) | Ground |
| 20 | A+MB | IN | Quadrature encoder A positive | Differential Digital In |
| 21 | A-MB | IN | Quadrature encoder A negative | Differential Digital In |
| 22 | B+MB | IN | Quadrature encoder B positive motor B | Differential Digital Input |

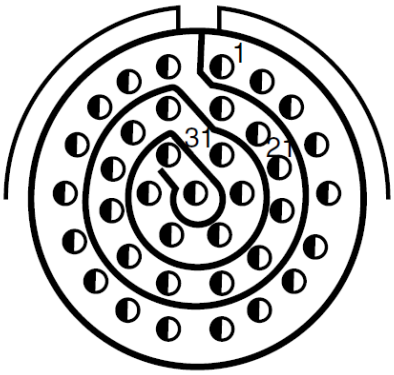
| J2 Pin | Name | I/O | Description | Type |
|---|---|---|---|---|
| 23 | B-MB | IN | Quadrature Encoder B Negative Motor B | Differential Digital Input |
| 24 | I+MB | IN | Quadrature Encoder I Positive | Differential Digital Input |
| 25 | I-MB | IN | Quadrature Encoder I Negative | Differential Digital Input |
| 26 | Brake-MA | OUT | Motor A Brake Driver | Brake |
| 27 | Brake+MA | OUT | Motor A Brake Driver | Brake |
| 28 | Brake-MB | OUT | Motor B Brake Driver | Brake |
| 29 | Brake+MB | OUT | Motor B Brake Driver | Brake |
| 30 | 5VDC_OUT | OUT | 5 Volt Encoder/Hall/Aux Power | Low Voltage Power |
| 31 | SIGNAL_GND | --- | 5VDC_OUT Return and Ground Reference (2) | Ground |
| 32 | A+MA | IN | Quadrature Encoder A Positive | Differential Digital Input |
| 33 | A-MA | IN | Quadrature Encoder A Negative | Differential Digital Input |
| 34 | B+_MA | IN | Quadrature Encoder B Positive Motor A | Differential Digital Input |
| 35 | B-_MA | IN | Quadrature Encoder B negative Motor A | Differential Digital Input |
| 36 | I+MA | IN | Quadrature Encoder I Positive | Differential Digital Input |
| 37 | I-MA | IN | Quadrature Encoder I Negative | Differential Digital Input |
| 38 | HALL_A_MB (DIGIAL_IN_4) | IN | Hall A Motor B DIGIAL_IN_4 | Open Collector Input |
| 39 | HALL_B_MB (DIGIAL_IN_5) | IN | Hall B Motor B DIGIAL_IN_5 | Open Collector Input |
| 40 | HALL_C_MB (DIGIAL_IN_6) | IN | Hall C Motor B DIGIAL_IN_6 | Open Collector Input |
| 41 | 5VDC_OUT | OUT | 5 Volt Encoder/Hall/Aux Power | Low Voltage Power |
| 42 | SIGNAL_GND | --- | 5VDC_OUT Return and Ground Reference | Ground |
| 43 | HALL_A_MA (DIGIAL_IN_1) | IN | Hall A Motor A DIGIAL_IN_1 | Open Collector Input |
| 44 | HALL_B_MA (DIGIAL_IN_2) | IN | Hall B Motor A DIGIAL_IN_2 | Open Collector Input |
| 45 | HALL_C_MA (DIGIAL_IN_3) | IN | Hall C Motor A DIGIAL_IN_3 | Open Collector Input |
| 46 | 5VDC_OUT | OUT | 5 Volt Encoder/Hall/Aux Power | Low Voltage Power |
| 47 | SIGNAL_GND | --- | 5VDC_OUT Return and Ground Reference (2) | Ground |
| 48 | BISS_CLK+MA | OUT | BiSS-C Clock Positive Motor A | Differential Digital Output |
| 49 | BISS_CLK-MA | OUT | BiSS-C Clock Negative Motor A | Differential Digital Output |
| 50 | BISS_DATA+MA | IN | BiSS-C data positive motor A | Differential Digital Input |

| J2 Pin | Name | I/O | Description | Type |
|---|---|---|---|---|
| 51 | BISS_DATA-MA | IN | BiSS-C Data Negative Motor A | Differential Digital Input |
| 52 | BISS_CLK+MB | OUT | BiSS-C Clock Positive Motor B | Differential Digital Output |
| 53 | BISS_CLK-MB | OUT | BiSS-C Clock Negative Motor B | Differential Digital Output |
| 54 | BISS_DATA+MB | IN | BiSS-C Data Positive Motor B | Differential Digital Input |
| 55 | BISS_DATA-MB | IN | BiSS-C data Negative Motor B | Differential Digital Input |

Notes:

1. ESI recommends terminating all shields in the connector back-shell if possible. Chassis connection are included for systems without back-shell termination.

## J3 System Pinout Assignments




View looking into connector

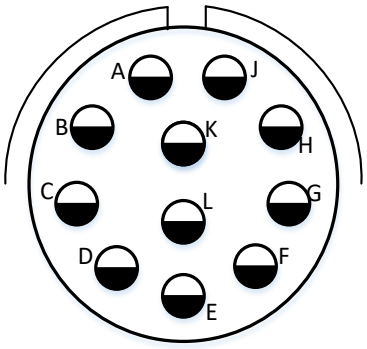
| J3 Pin | Name | I/O | Description | Type |
|---|---|---|---|---|
| 1 | CH_GND | --- | Chassis Ground (1) | Chassis Ground |
| 2 | 28VDC_IN | IN | 28 VDC In | Low Voltage Power |
| 3 | 28VDC_IN | IN | 28 VDC In | Low Voltage Power |
| 4 | OPTO_IN- | --- | Optically Isolated Digital Input Return | |
| 5 | 28VDC_RTN | --- | 28 VDC Return | Low Voltage Power |
| 6 | RS422_TX+ | OUT | RS422 Tx (+) | RS-422 |
| 7 | RS422_TX- | OUT | RS422 Tx (-) | RS-422 |
| 8 | RS422_RX+ | IN | RS422 Rx (+) | RS-422 |
| 9 | RS422_RX- | IN | RS422 Rx (-) | RS-422 |
| 10 | Reserved | --- | Do not connect | |
| 11 | Reserved | --- | Do not connect | |
| 12 | 28VDC_RTN | --- | 28 VDC Return | Low Voltage Power |
| 13 | OPTO_IN_1+ | IN | Optically Isolated Digital Input 1 | |
| 14 | SIGNAL_GND | --- | 5VDC_OUT Return and Ground Reference | Ground |
| 15 | ANALOG_IN_1+ (CMD+_MA) | IN | Analog In 1 (+), *can be used as* Command Positive Motor A | ±10 Volt Analog Input |
| 16 | ANALOG_IN_1- (CMD-_MA) | IN | Analog In 1 (-), *can be used as* Command Negative Motor A | ±10 Volt Analog Input |
| 17 | ANALOG_IN_2+ (CMD+_MB) | IN | Analog In 2 (+), *can be used as* Command Positive Motor B | ±10 Volt Analog Input |
| 18 | ANALOG_IN_2- (CMD-_MB) | IN | Analog In 2 (-), *can be used as* Command Negative Motor B | ±10 Volt Analog Input |
| 19 | SIGNAL_GND | --- | Ground Reference for all interface signals except the Isolated CAN | Ground |
| 20 | USB_D+ | I/O | USB D+ | USB |
| 21 | USB_D- | I/O | USB D- | USB |
| 22 | BOOTn | IN | Ground this to Modify Firmware | Low Voltage Power |
| 23 | SIGNAL_GND | --- | 5VDC_OUT Return and Ground Reference | Ground |
| 24 | OPTO_IN_2+ | IN | Optically Isolated Digital Input 2 | |
| 25 | SIGNAL_GND | --- | 5VDC_OUT Return and Ground Reference | Ground |
| 26 | OPTO_OUT- | --- | Optically Isolated Digital Output Return | |
| 27 | ANALOG_OUT_1 | OUT | Analog Output 1 can be bound to any internal variable | Analog Output |

| J3 Pin | Name | I/O | Description | Type |
|---|---|---|---|---|
| 28 | ANALOG_OUT_2 | OUT | Analog Output 2 can be bound to any internal variable | Analog Output |
| 29 | OPTO_OUT_1+ | OUT | Optically Isolated Digital Output 1 | |
| 30 | OPTO_OUT_2+ | OUT | Optically Isolated Digital Output 2 | |
| 31 | ISO_GND | --- | Isolated CAN Ground Reference | Low Voltage Power |
| 32 | SIGNAL_GND | --- | 5VDC_OUT Return and Ground Reference | Ground |
| 33 | CAN+ | I/O | CAN_A High (2) | CAN |
| 34 | CAN- | I/O | CAN_A Low (2) | CAN |
| 35 | ISO_CAN+ | I/O | Isolated CAN High | ISO_CAN |
| 36 | ISO_CAN- | I/O | Isolated CAN Low | ISO_CAN |
| 37 | 5VDC_OUT | OUT | 5 Volt Encoder/Hall/Aux Power | Low Voltage Power |

Notes:

1. ESI recommends terminating all shields in the connector back-shell if possible. Chassis connection are included for systems without back-shell termination.
2. CAN bus required for Software Upgrades

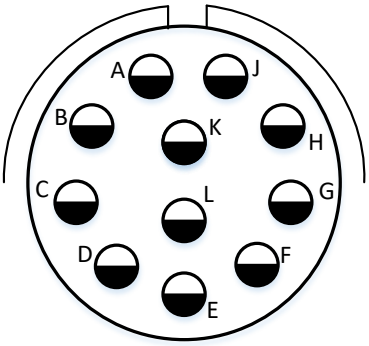
## J4 Motor Pinout Assignments




View looking into connector

| J4 Pin | Name | I/O | Description | Type |
|---|---|---|---|---|
| A | A_MA | OUT | Motor A Phase A | Motor Power |
| B | B_MA | OUT | Motor A Phase B | Motor Power |
| C | C_MA | OUT | Motor A Phase C | Motor Power |
| D | BRAKE+MA | OUT | Motor A Brake | Brake |
| E | BRAKE-MA | OUT | Motor A Brake Return | Brake |
| F | INTERLOCK+MA | IN | Interlock Loop Positive | Interlock |
| G | C_MA | OUT | Motor A Phase C | Motor Power |
| H | B_MA | OUT | Motor A Phase B | Motor Power |
| J | A_MA | OUT | Motor A Phase A | Motor Power |
| K | CH_GND | --- | Chassis Ground | Chassis Ground |
| L | INTERLOCK-MA | IN | Interlock Loop Negative | Interlock |

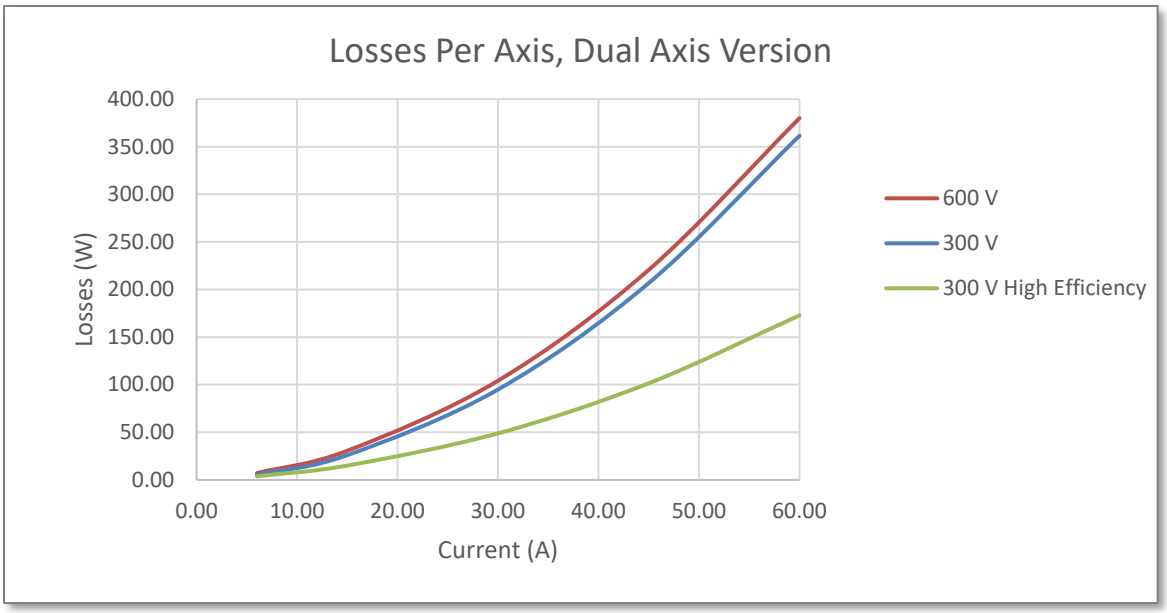
## J5 Motor Pinout Assignments




View looking into connector

| J5 Pin | Name | I/O | Description | Type |
|---|---|---|---|---|
| A | A_MB | OUT | Motor B Phase A | Motor Power |
| B | B_MB | OUT | Motor B Phase B | Motor Power |
| C | C_MB | OUT | Motor B Phase C | Motor Power |
| D | BRAKE+MB | OUT | Motor B Brake | Brake |
| E | BRAKE-MB | OUT | Motor B Brake Return | Brake |
| F | INTERLOCK+MB | IN | Interlock Loop | Interlock |
| G | C_MB | OUT | Motor B Phase C | Motor Power |
| H | B_MB | OUT | Motor B Phase B | Motor Power |
| J | A_MB | OUT | Motor B Phase A | Motor Power |
| K | CH_GND | --- | Chassis Ground | Chassis Ground |
| L | INTERLOCK-MB | IN | Interlock Loop Return | Interlock |

## Power Loss Curves

## Ordering Information

### Draco Servo Drive Configuration Options

DC XXXA YYYV C S – H – X

- **Servo Drive**: DC = Draco
- **Continuous Current** [1]: 020 = 20A, 040 = 40A, 060 = 60A, 080 = 80A, 120 = 120A
- **Voltage**: 300 = 300V, 600 = 600V
- **Cooling**: C = Chassis, L = Liquid
- **Axis**: S = Single, D = Dual
- **Options**: H = High Efficiency [2]
- **Options**: Blank = Leaded Solder, PBF = Lead-Free Solder

[1] Motor Phase Current, Peak Sine Wave, per Axis
[2] Option not Available on the 600V Versions

### Example

| | |
|---|---|
| Part Number: | DC040A300VCD |
| Servo Drive: | Draco |
| Continuous Current: | 40A |
| Nominal Voltage: | 300V |
| Cooling: | Chassis |
| Configuration: | Dual-Axis |
| Options: | Input Diode |

## Model Availability List

**Single-Axis**

| Rated Current | 300V | 600V |
|---|---|---|
| 20A | **DC020A300VCS**<br>DC020A300VCS-H<br>DC020A300VLS-PBF<br>DC020A300VLS-H-PBF | **DC020A600VCS**<br>DC020A600VCS-PBF |
| 40A | **DC040A300VCS**<br>DC040A300VCS-H<br>DC040A300VCS-D<br>DC040A300VLS<br>DC040A300VLS-H<br>DC040A300VLS-D | **DC040A600VCS**<br>DC040A600VCS-H<br>DC040A600VCS-D<br>DC040A600VLS<br>DC040A600VLS-H<br>DC040A600VLS-D |
| 60A | **DC060A300VCS**<br>DC060A300VCS-H<br>DC060A300VCS-D<br>DC060A300VLS | Contact ESI |

| | | |
|---|---|---|
| | DC060A300VLS-H<br>DC060A300VLS-D | |
| 80A | **DC080A300VCS**<br>DC080A300VCS-H<br>DC080A300VCS-D<br>DC080A300VLS<br>DC080A300VLS-H<br>DC080A300VLS-D | **DC080A600VCS**<br>DC080A600VCS-H<br>DC080A600VCS-D<br>DC080A600VLS<br>DC080A600VLS-H<br>DC080A600VLS-D |
| 120A | DC120A300VCS<br>DC120A300VCS-H<br>DC120A300VCS-D<br>DC120A300VLS<br>DC120A300VLS-H<br>DC120A300VLS-D | Contact ESI |

**Dual-Axis**

| Rated Current | 300V | 600V |
|---|---|---|
| 20A | **DC020A300VCD**<br>DC020A300VCD-H<br>DC020A300VCD-D<br>DC020A300VLD<br>DC020A300VLD-H<br>DC020A300VLD-D | **DC020A600VCD**<br>DC020A600VCD-H<br>DC020A600VCD-D<br>DC020A600VLD<br>DC020A600VLD-H<br>DC020A600VLD-D |
| 40A | **DC040A300VCD**<br>DC040A300VCD-H<br>DC040A300VCD-D<br>DC040A300VLD<br>DC040A300VLD-H<br>DC040A300VLD-D | **DC040A600VCD**<br>DC040A600VCD-H<br>DC040A600VCD-D<br>DC040A600VLD<br>DC040A600VLD-H<br>DC040A600VLD-D |
| 60A | **DC060A300VCD**<br>DC060A300VCD-H<br>DC060A300VCD-D<br>DC060A300VLD<br>DC060A300VLD-H<br>DC060A300VLD-D | Contact ESI |

Notes:
1. Standard Products are shown in **bold**, and have expedited lead times.