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D/DE-Series
AC Servodrives

Installation & Operation Manual
SAC-D01d

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Chapter 1
Welcome

1 Welcome

This manual provides information about ORMEC's D/DE-Series (SAC-D and SAC-DE) AC Brushless Servodrives. It provides both a technical description and information required for their installation, operation, and maintenance.

This manual is divided into the following chapters:

Chapter 1	**Welcome** introduces you to this manual and how it is organized.
Chapter 2	**General Description** gives an overview of the D/DE-Series product family.
Chapter 3	**Installation** provides instructions on how to install you servodrive unit. It also provides a complete hardware description of the D/DE-Series servodrives, including detailed interface information.
Chapter 4	**Operation** documents the power up and initial configuration approach for the D/DE-Series.
Chapter 5	**Getting Started** provides detailed instructions on how to run your D/DE-Series system for the first time.
Chapter 6	**Specifications** provides a detailed list of D/DE-Series servodrive and compatible servomotor performance specifications.
Chapter 7	**Maintenance and Troubleshooting** documents the various status and alarm indicators.
Appendixes	**Appendixes** contain a detailed drawing set.

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Chapter 2
General Description

2 General Description

This manual covers the D/DE-Series AC servodrives, which interface with ORMEC's ORION™ motion controllers[1], and control the D/DE-Series Servomotors. These AC servodrives and their corresponding motors provide the following capabilities:

2.1 Servodrive Capabilities and Features

- **Wide Power Range:** Output power ratings from 100 watts to 11 kW.
- **High Peak Current:** High peak output current resulting in high peak motor torque, up to three times rated current for a few seconds and twice rated current for up to a minute.
- **All Digital Design:** High speed DSP controlled current loops for precise torque mode operation.
- **Torque Mode Operation:** When combined with DSP based velocity loops in ORMEC ORION™ motion controllers, torque mode operation eliminates the need for user adjustable potentiometers and allows extremely high load inertia to motor inertia ratios.
- **Wide Current Loop Bandwidth:** For high positioning accuracy and response.
- **Velocity Monitor:** A high quality velocity monitor signal, derived from the digital position transducer, provided for testing and analog velocity loop closure.
- **Torque Monitor:** A calibrated torque monitor signal simplifies system test.

[1] D-Series (SAC-D) servodrives and cables are compatible with Generation III motion controllers. DE-Series (SAC-DE) servodrives require a modified axis interface cable for use with Generation III motion controllers, contact your ORMEC Sales and Application Engineer for further information.

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Modular Servodrive Construction

- **Shunt Regulator:** All D/DE-Series servodrive models (except the SAC-DE02A1) have a built-in shunt regulator on the bus power supply to handle regenerative load conditions. The SAC-D47, D55, and D59 servodrives require the use of an external resistor (SAC-DRR/0880 and /1760) with the shunt regulator.
- **Safety:** The integral control power supply input is distinct from the main power used for electromotive power. This provides superior safety and diagnostic features. Separate control power for fault-detection and diagnostics allows the main power to be disrupted by normally-open relay contacts whenever a fault condition is detected by the built-in microprocessor.
- **Dynamic Braking:** Solid-state dynamic braking circuitry is built-in on all D/DE-Series drives to provide an added measure of safety.
- **Panel Mounting:** All D/DE-Series servodrives are panel mounted with "footprints" significantly smaller than other servodrives with equivalent output power ratings.

Fault Detection and Diagnostics

- **Fault Detection and Protection:** Fault detection and protection features include high bus voltage, low bus voltage, overload, overcurrent, open phase detection, loss of feedback detection, and excessive regeneration detection.
- **Diagnostics:** D/DE-Series servodrive diagnostic messages are coded. SAC-D servodrives can display these diagnostic messages using the 5 position seven segment LED Servodrive Display/Monitor Module (SAC-OP03A). SAC-DE servodrives have an integral seven segment LED Alarm indicator for displaying diagnostic messages.

Optically Coupled Safety Interlocks

- **Torque Enable Input:** The fail-safe Torque Enable input requires the motion control electronics to actively sink current in order to enable motor output torque.
- **No Alarm Output:** The No Alarm output transistor is normally ON (Sinking current) and turns OFF whenever a fault is detected. Fail-safe interlocking is provided when this output is attached to a fail-safe input of the control electronics, as it is with all ORMEC motion controllers.
- **Coded Alarm Outputs:** Three alarm outputs are provided to indicate the most recent servodrive fault. Coded alarm outputs provide unique indication for each alarm condition.
- **Remote Alarm Reset:** A remote alarm reset allows the ORION™ motion controller to reset servodrive faults without the need to press a button on the servodrive or cycle control power.

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2.1.1 Servodrive Model Number Description

SAC-D##M_1/O_1O_2
SAC-DE##M_1V_1/O_1

Current
= continuous current output rating

Motor Identifier
M_1 = A - U (motor matching reference letter)

Input Voltage (SAC-DE only)

V_1 = 1 (115 VAC input power)
= 2 (230 VAC input power)

Options (see note):

Encoder Type (must be specified)
O_1 = I (incremental encoder)
= A (multi-rev absolute encoder)[2]

Monitor Module (SAC-D only)
O_2 = M(monitor module included with servodrive)

NOTE: The encoder type, option O_1, must be specified.

2.2 Servomotor Capabilities

- **Wide Power Range:** Output motor power ratings ranges from 0.13 to 15 HP.
- **Wide Torque Range:** Continuous stall torques range from 2.8 to 696 in-lb.
- **High Speed:** Maximum motor speeds range from 2,000 to 4,500 RPM.
- **High Torque-to-Inertia Ratios:** Motors with high *Torque-to-Inertia* ratios deliver a higher percentage of rated power to the load in applications which require high acceleration and deceleration rates.
- **Durable Construction:** Service life is maximized by the brushless motor construction, high thermal efficiency frame and rugged sealed bearings.
- **Industrial Internal Position Transducer:** The rugged internal position transducer measures 8,160to 32,640 (incremental encoder motors) precise increments of position, or counts, per revolution.
- **Low Torque Ripple:** Sinusoidal construction combined with precise electronic commutation provide low motor output torque ripple.

[2] An ORION™ DSP Axis Module with absolute encoder support option is required for use with a D-Series or DE-Series absolute encoder motor/servodrive system (ORN-DSP-A_/_A). Refer to the ORION™ Installation and Operation manual for further information regarding the DSP Axis Module absolute encoder support option.

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- **Harsh Environment Operation:** Standard IP-65 motor sealing with optional IP67 sealing permits motor operation in harsh industrial environments.
- **Fail-Safe Brake:** An optional fail-safe brake is available integral to the motor.
- **Multi-Revolution Absolute Encoder:** An optional multi-revolution absolute encoder is available, which allows a servomotor to "remember" it's position through power cycles.

2.2.1 Servomotor Model Number Description

MAC-D##M_1/$O_1O_2O_3$
MAC-DE###M_1V_1/$O_1O_2O_3$

Torque
= continuous stall torque

Motor Identifier
M_1 = A - U (motor matching reference letter)

Input Voltage (MAC-DE only)

V_1 = 1 (115 VAC input power)
= 2 (230 VAC input power)

Option (see note):

Encoder Type (must be specified)

O_1 = I (incremental encoder)
= A (multi-rev absolute encoder)[3]

Sealing
O_2 = V (IP-67 sealing)

Fail-Safe Brake
O_3 = B (fail-safe brake with 24 VDC coil)

NOTE: After the encoder type, option O_1, only the desired options in the motor model number are specified.

[3] An ORION™ DSP Axis Module with absolute encoder support option is required for use with a D-Series or DE-Series absolute encoder motor/servodrive system (ORN-DSP-A_/_A). Refer to the ORION™ Installation and Operation manual for further information regarding the DSP Axis Module absolute encoder support option.

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Chapter 3
Installation

3 Installation

3.1 Connection Diagram

Connection Diagrams for typical D/DE-Series systems are shown in Appendix A. The connections to the servodrive are also described in the next few sections. **BEFORE APPLYING POWER, REFER TO THE TEST RUN SECTION OF THE "GETTING STARTED" CHAPTER.**

NOTE: **Install all servodrive and servomotor power wiring (including ground wiring) according to NEC (National Electric Code) or UL (Underwriters Laboratories) specifications and in compliance with local ordinances.**

WARNING: **D/DE-Series servodrives and Servomotors are high voltage equipment, using 230 VAC input power and a 325 VDC main DC Bus (NOTE: The SAC-DE servodrives also use 115 VAC input power and a 163 VDC main DC Bus).**

3.2 Receiving and Inspection

ORMEC servodrives, servomotors, and their associated accessories are put through rigorous tests at the factory, prior to shipment. After unpacking, however, check for damage which may have been sustained in transit. The bolts and screws should all be tight, and motor output shafts should rotate freely by hand (except motors with integral fail-safe brakes, MAC-D__/_B). Check the servodrives, and any accessories, for bent or broken components, or any other physical damage before installation.

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3.3 Servodrive Panel Mounting and Environment

Panel mounting data is available in the Specifications Section and **Appendix B**. The servodrive environment should be maintained as follows:

- Ambient operating temperature should be between 0 and 55C.
- If the electrical panel is subjected to vibration, mount the units on shock absorbing material.
- Avoid use in corrosive atmospheres which may cause damage over time.
- Select a location with minimum exposure to oil, water, hot air, high humidity, excessive dust, or metallic particles.
- The proper mounting orientation for the servodrives is vertical on a panel using the mounting holes on the base plate.
- Allow sufficient clearance around servodrives for airflow, and provide proper ventilation. Clearance: 2 inches (50 mm) minimum above and below, and 0.4 inches (10 mm) minimum between servodrives.
- External regenerative discharge resistors should be mounted in an enclosure separate from the servodrive enclosure, if possible. Regenerative discharge resistors can become extremely hot, and so proper ventilation must be provided.

3.4 Terminal Block Connections

3.4.1 Input and Output Power Connections

Terminal blocks on the servodrives are provided for connecting main and control input power, and the servomotor output power. Refer to Table 1 for a description of the SAC-D, and Table 2 for the SAC-DE, input and output power terminal block connections. Refer to Figures 1, 2, and 3 for D-Series (SAC-D) wiring diagrams to various transformer configurations. Refer to Appendix A for typical D/DE-Series system wiring diagrams.

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Terminal	Function	Description
R S T	Main Power[1]	Three-Phase 230 VAC, 50/60 Hz. (SAC-D___/)
r t	Control Power[1]	Single-phase 230 VAC, 50/60 Hz. (SAC-D___/)
U V W	Motor Power	Power to Motor, Connections are: U on drive - A on motor - Red on CBL-DMAC#/NNN V on drive - B on motor - White on CBL-DMAC#/NNN W on drive - C on motor - Black on CBL-DMAC#/NNN
⏚	Frame Ground	Connects to Motor terminal D and motor cable shield drain. Must also be securely attached to earth ground using braided copper wire. Two frame ground terminal connections are provided per servodrive.
P1 B	External Regen Resistor Connection	The P1 terminal is supplied on the SAC-D47 - D59 servodrives only. Connection to the B is not normally required for the SAC-D04 - SAC-D37 servodrives. For the SAC-D47 - SAC-D59 the appropriate external regen resistor unit must be connected to these terminals (P1 & B). Refer to the External Regenerative Discharge Resistor Connections section of this chapter for further information.
P N	Main DC Power Supply Output	These terminals are connected to the high and low sides of the main DC power supply respectively. The main DC power supply voltage can be measured between these terminals. Connection to these terminals is not normally required.

[1] Refer to Figures 1-3 for wiring diagrams for various transformer configurations.

***Table 1**, SAC-D Input & Output Power Terminal Block Connections*

Terminal	Function	Description
R T	Main Power	Single-phase 115 VAC, 50/60 Hz.(SAC-DE___1/) Single-phase 230 VAC, 50/60 Hz. (SAC-DE___2/)
r t	Control Power	Single-phase 115 VAC, 50/60 Hz.(SAC-DE___1/) Single-phase 230 VAC, 50/60 Hz. (SAC-DE___2/)
U V W	Motor Power	Power to motor, Connections are: U on drive - A on motor - Red on CBL-DMAC#/NNN V on drive - B on motor - White on CBL-DMAC#/NNN W on drive - C on motor - Black on CBL-DMAC#/NNN
⏚	Frame Ground	Connects to motor terminal D. Must also be securely attached to earth ground using braided copper wire. Two frame ground terminal connections are provided per servodrive.
P B	External Regen Resistor Connection	Connection to these terminals is not normally required. Refer to the External Regenerative Discharge Resistor Connections section of this chapter for further information.

***Table 2**, SAC-DE Input & Output Power Terminal Block Connections*

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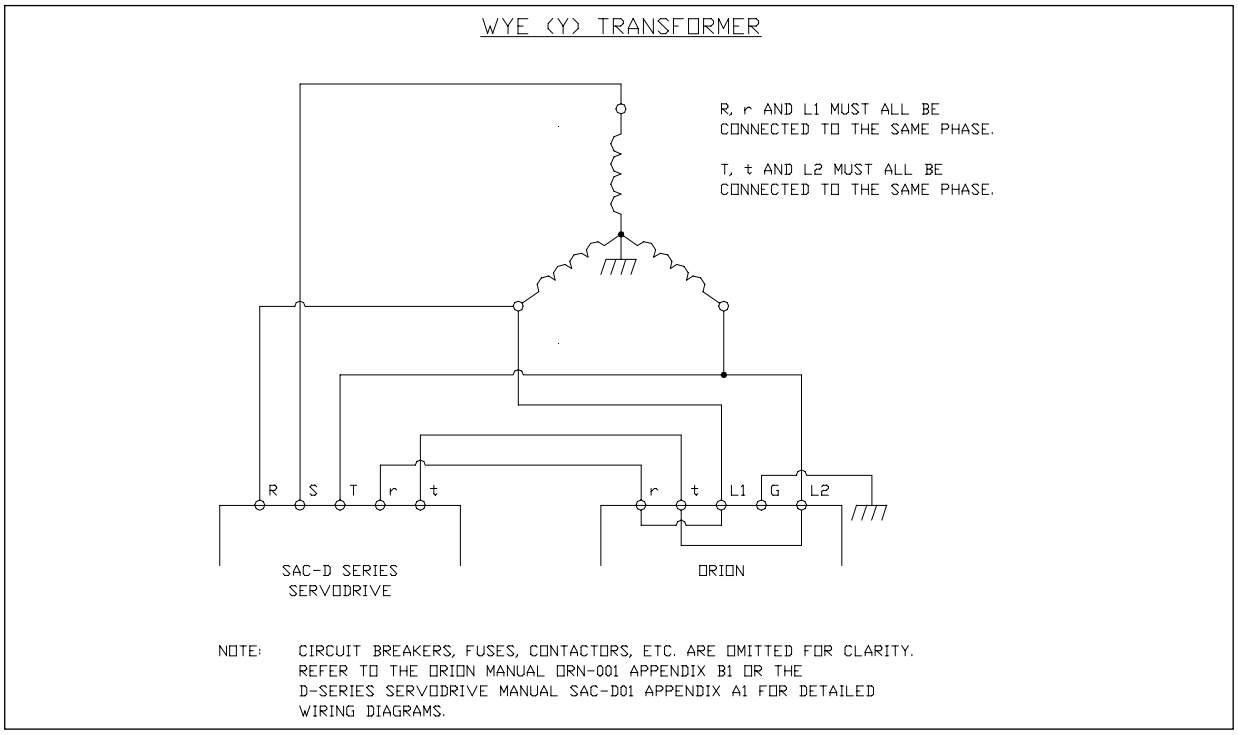


***Figure 1**, SAC-D Input Power Wiring for Wye (Y) Transformer*

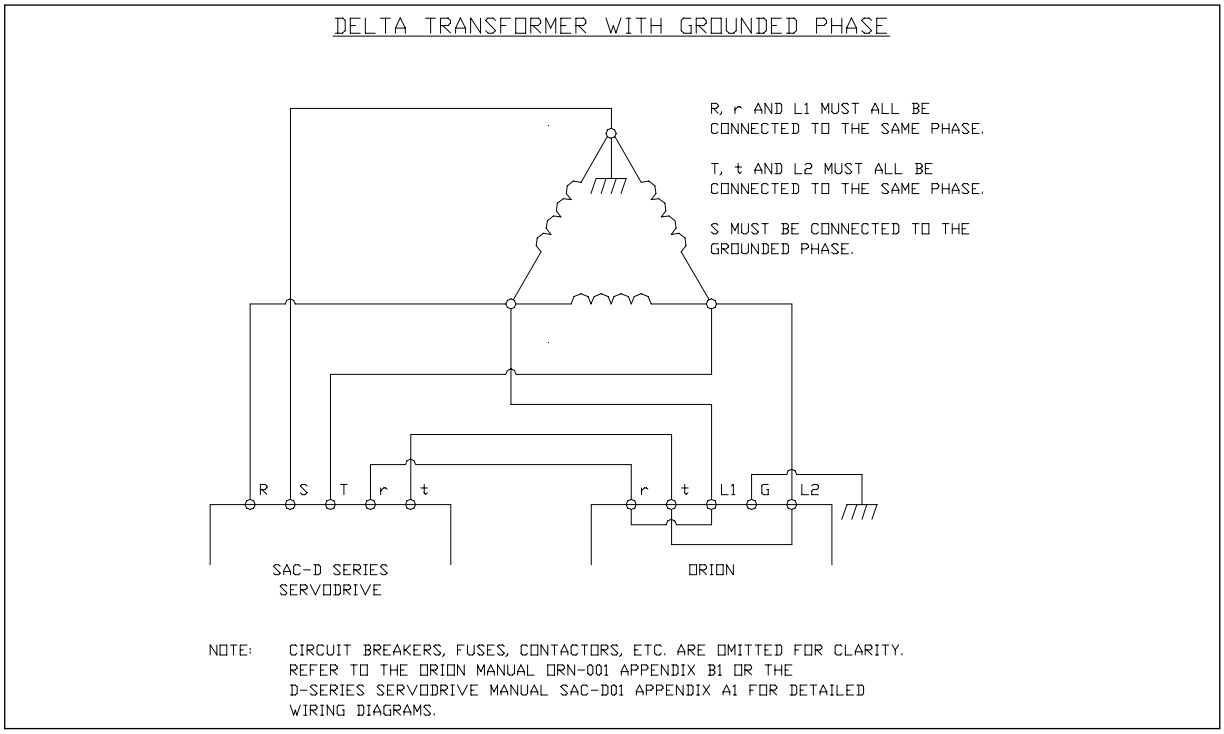


***Figure 2**, SAC-D Input Wiring for Delta Transformer with Grounded Phase*

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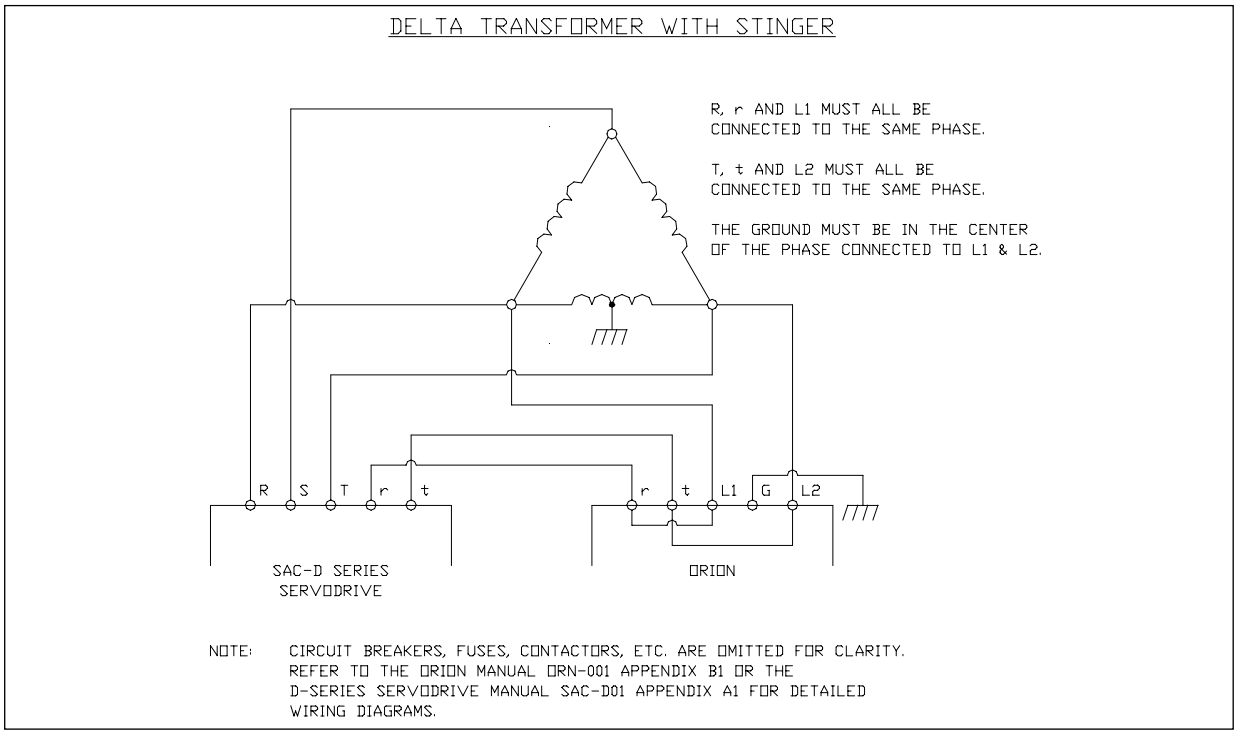


***Figure 3**, SAC-D Input Wiring for Delta Transformer with Stinger*

3.4.2 External Regenerative Discharge Resistor Connections

Terminal blocks are provided for connecting an external regenerative resistor. Refer to Table 3 for a description of the external regen resistor connections for each all the D/DE-Series servodrives.

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Terminal	Servodrive	Comments
P B	SAC-DE01A1	Neither an internal regen resistor, or support for an external regen resistor is provided.
	SAC-DE01A2 SAC-DE02B2	An internal regen resistor is not provided with these units. An external regen resistor can be added if required by an application. Contact your ORMEC Sales and Application Engineer for further information.
	SAC-DE02B1 SAC-DE03C1 SAC-DE03C2 SAC-DE04D2	An internal regen resistor is provided with these units, connection to these terminals is not normally required. If required by an application, support for an external regen resistor can be provided. Contact your ORMEC Sales and Application Engineer for further information.
	SAC-D04 SAC-D08 SAC-D12 SAC-D19 SAC-D37	
P1 B	SAC-D47	SAC-DRR/0880 (Connection of an external regen resistor required)
	SAC-D55	SAC-DRR/1760 (Connection of an external regen resistor required)
	SAC-D59	SAC-DRR/1760 (Connection of an external regen resistor required)

***Table 3**, External Regen Resistor Terminal Block Connections*

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3.5 Input Power Considerations

D/DE-Series servodrives can be operated directly on commercial power lines which supply 230 VAC or 115 VAC (DE-Series only). To prevent power line accidents due to grounding error, contact error or to protect the system from a fire, circuit breakers or fuses must be installed according to the number of servodrives used. Slow-blow circuit breakers or fuses should be used, because the internal D. C. power supply capacitors draw substantial inrush current at powerup. To select a transformer and/or fuses for the system, add the required power for the transformer and recommended fuse capacities (Tables 4 & 5) for each servodrive in the system.

Servodrive Model	**Power Required**[1] (KVA)	**Recommended Fuse**[2] (amps)	**Recommended Line Filter**
SAC-D04	1.1	5	SAC-LF15U
SAC-D08	2.0	8	SAC-LF15U
SAC-D12	2.5	10	SAC-LF15U
SAC-D19	4.0	12	SAC-LF30U
SAC-D37	7.5	28	SAC-LF45U
SAC-D47	12.5	32	SAC-LF60U
SAC-D55	15.0	41	SAC-LF60U
SAC-D59	19.0	60	SAC-LF100

[1] Power listed is the capacity at rate load.

[2] Current listed is the recommended slow-blow capacity for each leg of the three-phase power.

***Table 4**, SAC-D Input Power Requirements*

Input Voltage	**Servodrive Model**	**Power Required** (KVA)	**Recommended Fuse**[1] (amps)	**Recommended Line Filter**
115 VAC	SAC-DE02A1	0.50	5	SAC-LF215U
	SAC-DE03B1	0.75	8	SAC-LF-215U
	SAC-DE04C1	1.40	15	SAC-LF230U
230 VAC	SAC-DE01A2	0.50	5	SAC-LF215U
	SAC-DE02B2	0.75	5	SAC-LF215U
	SAC-DE03C2	1.20	9	SAC-LF215U
	SAC-DE04D2	2.20	16	SAC-LF230U

[1] Current listed is recommended slow-blow fuse capacity of the single-phase power.

***Table 5**, SAC-DE Input Power Requirements*

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3.5.1 Servodrive Power Dissipation at Rated Output

The D/DE-Series servodrive power dissipation information listed below is provided to assist in the specification of cabinet cooling system requirements.

Input Voltage	Servodrive Model	Control Circuitry (watts)	Main Circuitry (watts)	Regeneration Resistor (watts)	Total Dissipation (watts)
115 VAC	SAC-DE01A1	13	12.0	--	25.0
	SAC-DE02B1	13	16.2	--	35.2
	SAC-DE03C1	13	20.1	--	39.1
230 VAC	SAC-DE01A2	13	6.3	--	19.3
	SAC-DE02B2	13	14.5	--	27.5
	SAC-DE03C2	13	22.2	6	41.2
	SAC-DE04D2	13	36.1	6	55.1
	SAC-D04	20	27	30	77.0
	SAC-D08	20	55	30	105
	SAC-D12	20	80	30	130
	SAC-D19	20	120	30	170
	SAC-D37	24	260	60	344
	SAC-D47	27	290	180	497
	SAC-D55	27	330	350	707
	SAC-D59	30	360	350	740

***Table 6**, Power Dissipation at Rated Output*

3.5.2 Shielding, Power Line Filtering, and Noise Suppression

The D/DE-Series servodrives use high voltage switching power transistors in the main circuit. When these transistors are switched, the $^{di}/_{dt}$ or $^{dv}/_{dt}$ switching noise may sometimes prove objectionable, depending on the wiring and/or grounding method. The servodrive also utilizes a microprocessor, which can be susceptible to power line interference caused either by the output switching transistors or other equipment on the power line, such as welders, electrical discharge machines, induction heating equipment, etc. Careful layout of wiring and power line filtering will prevent noise interference. Recommendations with respect to wiring and grounding are described later in this section.

It is recommended that line filters be installed to eliminate electro-magnetic interference coming into the system from the power line, as well as blocking switching noise from being transmitted back out to the power line from the servodrives. The recommended noise filters available from ORMEC are shown in Tables 3 and 4.

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For a single servodrive installation, the line filter recommended is listed. In the case of a system using multiple servodrives, only one noise filter is required per cabinet. Select the appropriate line filter by adding the incoming power line power recommendations in Tables 3 and 4.

If the noise filter connection or wiring methods are improper, it's effectiveness is significantly reduced. The following is the recommended approach:

1) Separate the input and output leads by a minimum of 10 inches (25.4 cm). Do not bundle them in the same duct or wireway.

2) Do not bundle the ground lead with the filter output line or other signal lines, and do not run them in the same duct.

3) Connect the filter ground lead with a single wire (preferably braid) to the enclosure or the control panel frame grounding terminal.

3.5.3 Recommended Motor and Servodrive Wiring Methods

1) When the motor is mounted to the machine and grounded through the machine frame, $^{dv}/_{dt}$ current flows from the PWM power through the floating capacitance of the motor. To prevent noise effects from this current, and also for safety, the motor housing (terminal D of the motor connector) should be connected to the frame of the servodrive, which should be directly grounded to the control panel frame ground terminal.

2) Wire the frame ground connection (also designated FG) directly to the servodrive case, and connect to the control panel.

3) When motor wiring is contained in metal conduits, the conduits and boxes must be grounded. Use wires of 12 AWG or heavier for grounding to the case (preferably flat woven silver plated copper braid).

4) Route signal and power leads (including motor power) in separate conduits or wireways, separated by a minimum of 10 inches (25 cm).

3.5.4 Servomotor Overload Protection

Thermal overload protection for the Servomotor is not provided internal to the Servodrive, and must be provided externally. External overload relays can be used to protect the Servomotor from overheating. Refer to the National Electric Code for information regarding the proper sizing of overload protection.

The overload protection should be wired such that it causes the Servodrive main power to be interrupted when an overload occurs, and remain interrupted (latched) until an operator reset occurs. **The overload protection must not break the connection between the Servodrive and Servomotor.** Refer to the System Wiring Diagram in Appendix A.

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3.6 Control Circuit Interconnections - Connector CN1

Connector CN1 is a 50 pin male connector, 3M part number 10150-3000VE for SAC-D servodrives, and Honda part number MR-50RMA for SAC-DE servodrives. Cable CBL-AD\NN or CBL-ADE\NN is used to connect a SAC-DE or SAC-D respectively to an ORION™ DSP Axis Module (ORN-DSP). The interface connections for connector CN1 are described below. Refer to Appendix C for further information regarding cables CBL-AD\NN and CBL-ADE\NN.

3.6.1 Interlock and Alarm Reset Input Signals

The interlock and alarm reset input signals consist of optically coupled isolators intended for use with +24 VDC. The ORION™ implementation of these signal uses +/-12 VDC to achieve the 24 VDC requirement. To assert each signal a low resistance connection from the input to - 12 VDC must be provided allowing 5 mA of input current to the optically coupled isolator.

Signal	Pin #	Function	Description
T-ENABLE'	40	Torque Enable	For normal motor operation, this input must be asserted. When not asserted, the servodrive's output transistors are disabled, and a solid state dynamic braking circuit is enabled.
ALM-RESET'	44	Alarm Reset	If the servodrive has a fault condition, this input can be momentarily asserted to clear it.
D-ENABLE	47	Drive Enable	This input provides power to the servodrive interlock and alarm reset input opto-isolator circuits, which are controlled by the T-ENABLE' and ALM-RESET' inputs respectively. This signal is connected to CN1 pin 23 for a SAC-D, and the ORION™ DSP Axis Module +12V output for a SAC-DE.

Table 7, Interlock and Alarm Reset Input Signals

3.6.2 Interlock Output Signals

Each of the four interlock output signals is an optically isolated coupled transistor intended for +24 VDC operation, and has the following specifications:

- Maximum Applied Voltage: 30 VDC
- Maximum Current Sink Capability: 50 mA

When attaching electromechanical relays to these outputs, a fly-back diode or other transient suppression device is required across the relay coil.

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Signal	Pin #	Function	Description
NO-ALARM'	31	Servo Alarm	This output transistor is normally ON, and turns OFF when a Servo Alarm fault is detected. For details on the alarms, refer to the Maintenance & Troubleshooting section.
NO-ALARM-	32	Servo Alarm Common	This output is connected to CN1 pin 2 (servodrive ground). It provides the common for the servodrive no alarm output circuit, which is controlled by the NO-ALARM' output.
AL01' AL02' AL03'	37 38 39	Alarm Code	When the NO-ALARM' transistor is OFF, these output transistors are reporting the existing alarm condition.

***Table 8**, Interlock Output Signals*

3.6.3 Current Command Input Signals

The current command input signals are analog voltage inputs used in the control of the output current, and therefore torque, of the servodrive-servomotor combination.

Signal	Pin #	Function	Description
DRV-CMD	9	Current Command	Applying an analog signal from zero to approx. +/-9 volts to this input results in servodrive output current from zero to plus or minus full output, and consequently torque from zero to plus or minus full output torque. (NOTE: +/-3 VDC = +/- rated torque)
AGND	10	Current Command Common	This is the current command reference (zero) signal.

***Table 9**, Current Command Signals*

3.6.4 Quadrature Position Feedback Signals

Quadrature position feedback signals are provided for position control and monitoring electronics. D/DE-Series servodrive quadrature position feedback signals are differential line driver outputs, which are compatible with ORMEC DSP Axis Module differential line receiver inputs.

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Signal	Pin #	Function	Description
ENCA ENCA'	35 36	Encoder Feedback Channel A	Quadrature position encoder outputs after frequency division; driven with differential line drivers (TI 75174), to be received by differential line receivers (TI 75115 or equivalent)
ENCB ENCB'	33 34	Encoder Feedback Channel B	
ENCZ ENCZ'	19 20	Encoder Reference Channel Z	Once per motor revolution reference signal; driven with differential line drivers (TI 75174).
Note: These differential encoder signals are wired with individual twisted pairs within a shielded cable.			

***Table 10**, Quadrature Position Feedback Signals*

3.6.5 Velocity Monitor Signal

An analog output signal is provided for monitoring the speed of the servomotor. This signal is driven by an operational amplifier.

Signal	Pin #	Function	Description
TACH	17	Speed Monitor	This +/-10 volt analog signal is proportional to motor velocity, and is calibrated for +/-1.0 V/1000 RPM, +/- 5% (MAC-DA & MAC-DE) +/- 2.0 V/1000 RPM, +/-5% (MAC-DB)

***Table 11**, Velocity Monitor Signal*

3.6.6 DC Power Supply Voltages Available on Connector CN1

The D/DE-Series servodrive optical isolator inputs require a 24 VDC input signal. The +/-12 VDC supplied by the SAC-D servodrives is used to achieve the required input signal voltage for SAC-D servodrives. For SAC-DE servodrives the +/-12 VDC is supplied by the DSP Axis Module (refer to the SAC-DE Series Servodrive Interface and Servodrive Interface Configuration Jumpers sections of the ORION™ Installation & Operation Manual for further information), the +/-15 VDC supplied by the servodrive cannot be used for this purpose.

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Signal	Pin #	Function	Description
+12 V	23	Output Power	+/-12 VDC for SAC-D servodrive and +/-15 VDC for SAC-DE servodrives (not used), +/- 5%, 30 mA maximum output current capability. NOTE: This output power is not used on DE-Series servodrives, interlock power for these servodrives is provided by either the ORION™ DSP Axis Module, or an external power supply.
-12 V	24		
DGND	1	Digital Ground	Common for servodrive interface power supply (connected to frame ground).

***Table 12**, DC Power Supply on CN1*

3.6.7 Absolute Encoder Support Input Signals

Signal	Pin #	Function	Description
ABS	4	Absolute Encoder Read Command	TTL-level signal asserted by the motion controller to cause the absolute encoder position information to be sent; and normal operation initiated for motors with the absolute encoder option only (MAC-D____/A).
BAT+ BAT-	21 22	Absolute Encoder Backup Battery	Absolute encoder backup power input. An optional 3 VDC battery is available for ORION™ DSP Axis Modules which supplies backup power for the absolute encoder (MAC-D____/A).

***Table 13**, Absolute Encoder Support Signals*

3.7 Optical Position Encoder Connector - Connector CN2

Connector CN2 is a 20 pin male connector, Honda part number MR-20RMA for SAC-DE servodrives and 3M part number 10120-3000VE for SAC-D servodrives. It is the interface between the optical position encoder of the servomotor and the servodrive.

DE-Series Motor

- Cable CBL-DEMAC/NNN is used to connect a MAC-DE encoder to a SAC-DE servodrive.
- Cable CBL-DEMACD/NNN is used to connect a MAC-DE encoder to a SAC-D servodrive.

D-Series Motor

- A CBL-DMAC/NNN is used to connect a MAC-D encoder to a SAC-D servodrive

Refer to Appendix D for further information regarding cables CBL-DEMAC/NN, CBL-DEMACD/NN, and CBL-DMAC/NN.

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3.8 Display Monitor Module Connector - Connector CN3

Connector CN3 is a 9 pin D-Sub connector for attachment of the Servodrive Display Monitor Module (SAC-OP03A). Refer to the Servodrive Display Monitor Module Operation (SAC-OP03A) section of the Operation chapter for further information.

3.9 Analog Monitor Output Connections (SAC-D only) - Connector CN4

Connector CN4 on the SAC-D servodrives is a 4 pin header which provides an interface to the analog speed and torque monitors. A CBL-MON/3 can be connected to CN4 to provide convenient access to the analog monitor signals. Refer to Table 14 for a description of the analog monitor output connections.

CBL-MON	Pin #	Function	Description
Red	1	Speed Monitor	Bi-directional speed monitor 1 v/kRPM DE & DA-Series, +/- 5% 2 v/kRPM DB-Series, +/- 5%
White	2	Torque Monitor	Bi-directional torque monitor (2 v/rated torque, +/- 10%)
Black	3, 4	Signal Ground	Signal common

***Table 14**, Analog Monitor Outputs*

3.10 Motor with Integral Fail-Safe Brake Wiring

For the D/DE-Series motors with integral fail-safe brakes (MAC-D____/__B), the appropriate motor cable with brake support must be used (CBL-DMAC_B/NNN or CBL-DEMAC_B/NNN). In the case of the MAC-DB330, DB465, and DB700, a CBL-DMACB/NNN is also required. Two additional conductors are supplied in each of these cables (In the case of the MAC-DB330, DB465, and DB700, the additional conductors are in the CBL-DMACB/NNN), for supplying brake coil power. Refer to the CBL-DMACX/NNN and CBL-DEMACX/NNN drawings included in Appendix D for further cable information. Refer to the Fail-Safe Brake Specifications section of the Specifications chapter for further information.

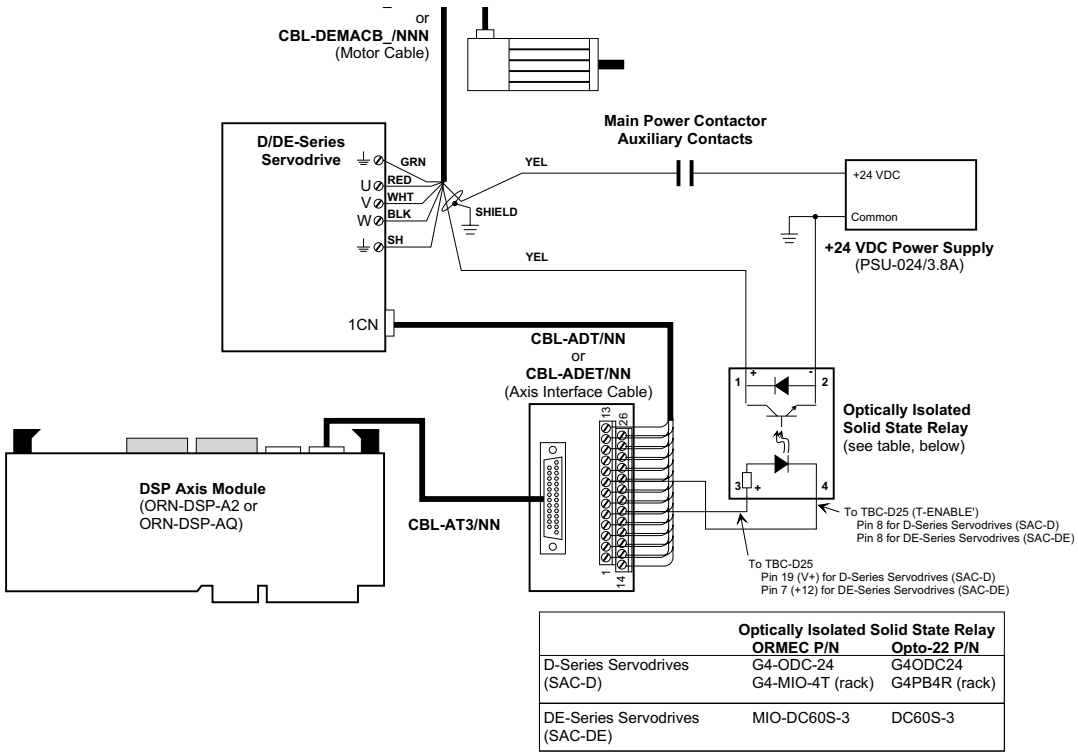
3.10.1 Brake Coil Circuit Wiring

Figure 4 shows the recommended safety and fault interlock wiring for D/DE-Series motors with integral fail-safe brakes. The primary features of this interlock implementation are:

- If the main power is disabled by the main power contactor the brake coil power is disabled and the brake engages.
- If the servodrive is disabled (i.e. the T-ENABLE' signal is unasserted) the brake coil power is disabled, and the brake is engaged.
- If both the main power and the servodrive are enabled the brake coil power is enabled, and the brake is disengaged.

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- Requires the use of a CBL-ADT/NN or CBL-ADET, for D-Series and DE-Series servodrives respectively, for access to the T-ENABLE' signal from the DSP Axis Module to the servodrive, and an optically isolated solid state relay to control the brake coil power. **NOTE: The T-ENABLE' signal is a +24 VDC signal.**
- **DO NOT USE THE ORION™ POWER SUPPLY FOR COIL POWER!!!** The ORION™ power supply should not be used for switching inductive loads, such as a relay coil, a separate 24 VDC power supply must be used.



	Optically Isolated Solid State Relay ORMEC P/N	Opto-22 P/N
D-Series Servodrives (SAC-D)	G4-ODC-24 G4-MIO-4T (rack)	G4ODC24 G4PB4R (rack)
DE-Series Servodrives (SAC-DE)	MIO-DC60S-3	DC60S-3

***Figure 4**, Fail-Safe Brake Interlock Circuit*

3.11 Motor Installation

3.11.1 Motor Use and Environment

The servomotor is designed for use as described below:

- Either horizontal or vertical mounting orientation
- Indoors, clean and dry (for IP-65 motors)
- Free from corrosive and/or explosive gases or liquids

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- If the location is subject to excessive water or oil, protect the motor with a cover. The standard (IP65) motors can withstand a small amount of splashed water or oil.
- Accessible for inspection and cleaning
- IP-67 rated motors (MAC-D____/_V_) require shaft seal lubrication. Refer to the IP-67 Shaft Seal Lubrication section of the Maintenance & Troubleshooting section for further information.
- Environmental conditions:

  Ambient Temperature: 0 to +40C

  Storage Temperature: -20 to +80C

  Humidity: 20% to 80% Relative Humidity (non-condensing)

3.11.2 Coupling the Servomotor to the Load

Good alignment of motor and the driven machine is essential to prevent vibration, increase bearing and coupling life, and prevent shaft and bearing failures.

For a direct drive application, a high quality zero-backlash taper lock coupling should be used. Timing belts and gear boxes are also commonly used in servo applications. Bearing loading should be kept to a minimum. The allowable radial and axial bearing loading for each motor is listed in the MAC-D_ Motor Performance Specifications section of the Specifications chapter.

To insure adequate load stiffness, the driven machine shaft, to which the motor is coupled, should have the same diameter as the motor shaft, or greater.

In either case, it is preferable to attach the coupling or pulley to the shaft with a clamping arrangement rather than transmit torque through the keyway, because of the reversing shock torques which the servomotor can generate. A number of mechanical approaches afford this type of attachment including tapered hubs, split hubs, ringfeder devices, etc.

The motors are designed for face mounting, and the structural integrity of the mounting can be critical to obtaining the maximum performance from your servomotor application.

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Chapter 4
Operation

4 Operation

4.1 Power On and Off Sequencing

For proper operation, input power must be supplied to the control circuit (r, t) first, followed by the main circuit (R, S, T), or simultaneously supplied to both. On power-down (including momentary power failure), the power should be either simultaneously disabled, or the power to the main-circuit removed first, followed by the control power.

The main power circuit should be arranged so that it is interlocked with the ORION™ NO FAULT (NF) relay. Therefore, when a controller or servodrive alarm is detected, the NO FAULT (NF) relay disables the main circuit power.

The recommended interlock approaches for both single and multiple axis D/DE-Series systems are detailed in Appendix A.

Note the features of the recommended interlock circuit:

1) The E-Stop switch, powered by 115 or 230 VAC, must conduct current for the servomotor to provide output torque. The recommended E-Stop switch is a maintained-contact, red mushroom-head push-button, which must be manually pulled out (reset) after it has been pressed in (asserted).

2) The momentary contact E-Stop Reset push-button switch must be asserted after all power is applied and the E-Stop switch is closed. The E-Stop Reset switch must be closed long enough for the NO FAULT (NF) relay to "pull-in", so that the main power contactor coil circuit is energized.

3) If the E-Stop switch is pressed (asserted) the main circuit power is disconnected. The ORION™ motion controller then disables the T-ENABLE' signal causing the servomotor to enter dynamic braking.

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4) When power is applied, it will take up to 1 second (normally 200 to 300 msec) to initialize the servodrive, and for the NO-ALARM' signal to be turned on, allowing power to again be applied to the main circuit.

5) Since the servodrive has a large capacity DC. Power Supply for driving the servomotor, high current is present, for approximately one-half second when the main-circuit power is applied . If power is turned on and off frequently, the input current limit resistor may be degraded, causing a malfunction.

6) If any Alarm condition occurs within the servodrive, the main circuit power is disconnected by opening the NO FAULT (NF) relay. The servomotor enters dynamic braking. In this case, the ALARM seven-segment LED display on the front of the servodrive will indicate the type of problem detected. Alarm conditions are cleared by momentarily asserting the ALM-RESET' input.

7) Not only must any alarm condition, including E-Stop, be cleared, but the E-Stop Reset push-button must then be depressed long enough for the relays to pull-up again.

4.2 Current Command Input

The servodrive is configured for torque (current) command input. This determines the output current of the servodrive, and therefore the output torque of the motor. The output torque is proportional to the ±10 volt analog input signal (DRV-CMD). The peak torque of the servomotor is obtained when DRV-CMD is at approximately 9 volts.

4.3 Overload Characteristics

The overload protection circuitry built into the servodrive prevents the motor and servodrive from RMS power overload. Peak currents of 200% to 300% of the RMS rating are typical for this equipment, with a 200% overcurrent typically allowed for more than one minute, and 300% allowed for a few seconds.

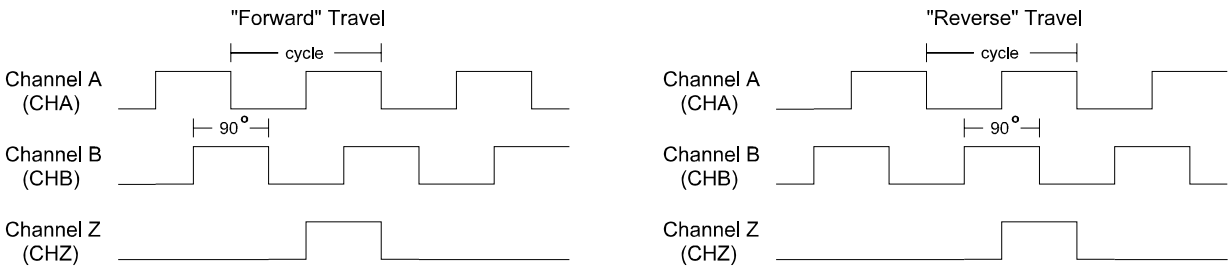
Should an overload current greater than 100% of rated current be drawn for too long a time, the protective circuitry will turn off the output power. The overcurrent set point is set to protect the servodrive at an ambient temperature of 55C, and cannot be changed.

4.4 Position Encoder Signals

Quadrature position signals for "Forward" and "Reverse" travel are illustrated below. Channel A and Channel B are phase quadrature output signals, which allow the servodrive, and associated digital positioning electronics, to determine both travel distance and direction. Programmable motion controllers, such as ORMEC's ORION™ family, typically decode each transition of both encoder channels, yielding a resolution of four times the linecount specification per revolution e.g. Quadrature signals with 8,160

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pulses/rev, when decoded by a ORION™ controller yields a positioning resolution of 32,640 cts/rev.



NOTE: Channel Z (once per revolution marker channel) is synchronized with Channel A.

***Figure 5**, Optical Position Encoder Signals*

4.5 Regenerative Load Conditions

When conditions exist such that the direction of power flow is from the machine into the motor, the motor acts as a generator. This can occur for a variety of reasons including:

1) Decelerating the machine faster than it would coast. This is especially critical at high speeds and with large inertias;

2) Using the motor to lower a load that is not counterbalanced, and;

3) Using the motor to control an unwind stand for rolls of material, where the tension in the web causes the motor to have to hold back while moving forward.

This power flow from the machine into the motor must be dissipated by the servodrive as explained in the Shunt Regulator section of this chapter.

4.5.1 Shunt Regulator

The servodrive uses PWM (pulse width modulation) technology to deliver power to the motor. The switching of the PWM amplifier, in conjunction with the inductances and capacitances in the motor and the output circuitry can cause the power supply voltage to increase as energy is generated and returned to the drive from the machine. The power supply has no mechanism for returning energy to the power line in these cases, where the motor acts as a generator, but it does have a shunt regulator for dissipating this excessive voltage build-up.

The shunt regulator consists of a voltage comparator, a switching transistor and a regen resistor. When the voltage comparator detects excess power supply voltage (at approximately 220 and 380 VDC for the 115 and 230 VAC versions respectively) it turns on the transistor, dissipating excess energy from the power supply capacitor to the regen resistor. The amount of energy

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that it can dissipate is dependent on the current capability of the switching transistor and the wattage specification of the regen resistor.

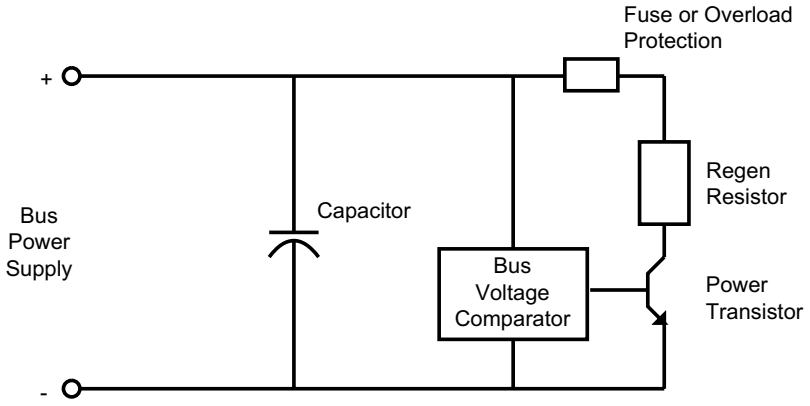


***Figure 6**, Shunt Regulator Circuitry*

Input Voltage (VAC)	Servodrive	Capacitor (uF)	Internal Shunt Regulator		Power Transistor	Minimum External Shunt Resistor (ohms)
			Resistance (ohms)	Power (watts)	Peak Current (amps)	
115	SAC-DE01A1	780	--	--	--	--
	SAC-DE02B1	1920	100	30	12	50
	SAC-DE03C1	1920	100	30	12	50
230	SAC-DE01A2	180	--	--	--	--
	SAC-DE02B2	780	--	--	--	--
	SAC-DE03C2	1920	100	30	12	50
	SAC-DE04D2	1920	100	30	12	50
	SAC-D04	680	50	140	30	50
	SAC-D08	680	50	140	30	50
	SAC-D12	680	25	140	50	25
	SAC-D19	1800	25	140	50	25
	SAC-D37	3000	6.25	280	75	6.25
	SAC-D47	3600	6.25	880*	75	6.25
	SAC-D55	5400	3.13	1760*	150	3.13
	SAC-D59	9900	3.13	1760*	150	3.13

* SAC-D47, D55, and D59 servodrives require the use of an external regen resistor.

***Table 15**, Shunt Regulator Specifications*

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4.5.2 Applications Strategies

If regeneration is excessive, a high bus voltage alarm or heat sink overheat alarm may occur. If this happens, the following actions may resolve the problem:

- Reduce the current limit.
- Slow down the deceleration curve.
- Decrease the maximum speed.
- Change the gearbox.

If you have any questions regarding the amount of regenerative power dissipation capacity required by your application call the ORMEC Service Department.

4.6 Dynamic Braking Circuitry

The servodrives all contain integral solid-state dynamic braking circuitry for intrinsic safety, which consists of a triac across the output bridge of the PWM amplifier, which is in series with an internal dynamic braking resistor. Refer to Figure 7 for a diagram of the dynamic braking circuitry.

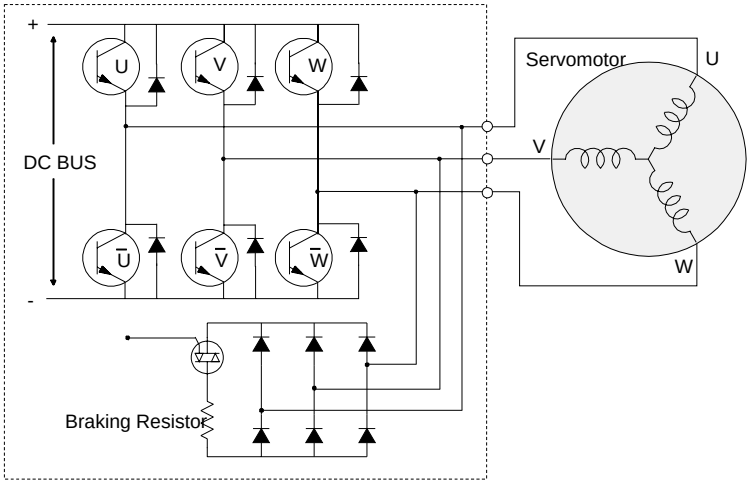


***Figure 7**, Dynamic Braking Line Diagram*

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Input Voltage	Servodrive	DB Resistor		Max. Current
		(ohms)	(watts)	(amps)
115 VAC	SAC-DE01A1	0	--	3.8
	SAC-DE02B1	2	10	4.6
	SAC-DE03C1	2	10	10.1
230 VAC	SAC-DE01A2	0	--	1.6
	SAC-DE02B2	0	--	3.5
	SAC-DE03C2	2	10	5
	SAC-DE04D2	2	10	6.9
	SAC-D04	2.5	20	
	SAC-D08	2.5	20	35
	SAC-D12	1.5	20	57
	SAC-D19	1.5	20	58
	SAC-D37	1.0	30	109
	SAC-D47	1.0	60	125
	SAC-D55	1.0	60	147
	SAC-D59	0.5	80	220

***Table 16**, Dynamic Braking Circuit Specifications*

When the servodrive bus power is disabled, the output power transistors switch to a tri-state, which appears as high impedance to the motor. The dynamic braking circuitry (DB) short circuits all three motor phases together. In this way the power generated by the motor rotation is used to bring the motor to a stop. The voltage created by the motor rotation is fed back into the motor and creates a magnetic field opposing that of the motor's permanent magnets. This causes the motor to decelerate until no voltage is generated by the motor rotation. The servodrive dynamic braking circuit is enabled whenever the servodrive is disabled.

4.7 Absolute Encoder Support

The D/DE-Series servomotor absolute encoder system consists of three parts: 1) an optical single revolution absolute encoder, 2) a revolution counter, and 3) a micro-controller circuit. The optical single revolution absolute encoder indicates the motor shaft's position within a single revolution. The revolution counter maintains a count of the complete motor revolutions since the absolute encoder was reset (revolution count set to 0). The combination of the absolute position within a revolution, and the cumulative revolution counter determines the servomotor's absolute position. The micro-controller circuitry is the interface between the servomotor and servodrive, it "reads" both the optical absolute encoder and revolution counter data and "sends" the numeric result as serial data to the servodrive via one of the servomotor's encoder quadrature feedback channels.

During a loss of control power to the servodrive, the absolute encoder system is able to maintain a cumulative count of servomotor revolutions. The power

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supply for the absolute encoder system is provided through an optional battery on the ORION™ DSP Axis Module (the absolute encoder backup battery), which maintains the charge on the storage capacitor in the servomotor. This capacitor supports the revolution counter and micro-controller circuitry only. The optical absolute encoder is disabled while system control power is off to conserve the absolute encoder backup battery. When the ORION™ polls the servodrive for the servomotor's absolute position, the servodrive again supplies power to all the absolute encoder system circuits.

NOTE: **An ORION™ DSP Axis Module with absolute encoder support option is required for use with a D-Series or DE-Series absolute encoder motor/servodrive system (ORN-DSP-A_/_A)**. Refer to the DSP Model Number Description section of the ORION™ Installation and Operation manual for further information.

NOTE: In order for the ORION DSP Axis Module (with absolute encoder support option) to supply backup power to the absolute encoder, the axis interface and encoder cables must be connected. **Disabling the servodrive control power and disconnecting either the axis interface or encoder cables for more than 48 hours may result in the loss of the absolute encoder data.**

4.7.1 Reading the Absolute Encoder

During normal operation the servomotor issues quadrature position data as does a standard incremental encoder, additionally, a circuit in the motor's encoder counts the motor revolutions. When the servodrive and MotionDATA are disabled (MODE@=0 and MD.MODE@=0 respectively), the DSP can poll the servodrive for the absolute position information via axis interface cable (CBL-AD/NN or CBL-ADE/NN) using the MotionBASIC® POS.ABS@ variable. The servodrive polls the motor counter circuit for the absolute position data via the motor encoder cable (CBL-DMAC/NN, CBL-DEMAC/NN, or CBL-DEMACD/NN). The servodrive then passes the absolute position information back to the DSP.

A poll of the absolute encoder position information should not be attempted until the servodrive has had logic power for 1 second. The entire process required for polling the absolute encoder position data takes approximately 0.5 seconds per motor. The absolute encoder position value returned by the POS.ABS@ variable is in quadrature counts, not User Units. For further information regarding User Units and polling the absolute encoder position refer to the POS.ABS@ variable explanation in the "MotionBASIC® Hypertext Manual".

4.7.2 Absolute Encoder Power

During loss of ORION™ and servodrive logic power, the revolution counting circuitry in the motor is powered via the absolute encoder backup battery in the DSP Axis Module. Reading the absolute position data, using the MotionBASIC® POS.ABS@ variable, asserts an ABS interface signal which causes the servodrive to supply the encoder with power for the counter circuit. This is done to conserve the absolute encoder backup battery on the

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DSP Axis Module. For further information on polling the absolute encoder position refer to the POS.ABS@ variable explanation in the "MotionBASIC® Hypertext Manual".

If the encoder is disconnected from the servodrive, or the ORION™ and servodrive logic power is off and the servodrive is disconnected from the DSP Axis Module (and therefore disconnected from the absolute encoder backup battery), then a capacitor in the motor itself supplies enough power to allow the revolution counter circuitry to operate. The encoder can be disconnected from the servodrive and/or absolute encoder backup battery for up to 48 hours without loss of the revolution counter information.

4.7.3 Resetting the Absolute Encoder

The revolution counter circuit will only need to be reset to zero if the capacitor in the motor is nearly fully discharged, as a result of more than 48 hours without ORION™ or servodrive logic power or absolute encoder backup battery power. The need to reset the absolute encoder revolution counter is indicated by an ALARM@=10 or 15 on the ORION™ and/or an "A.00", "A.8_", or "A.C_" on the servodrive monitor module, SAC-OP03A.

NOTE: Resetting the absolute encoder resets only the revolution counter to zero. The incremental position value will remain. Therefore, after resetting the absolute encoder, the absolute position value will be somewhere between 0 and the encoder counts/rev.

Your application program should be written such that it is not necessary to reset the absolute encoder revolution counter to set the machine home position. The application program should be able to reference a non-zero home position, which is the case even if the revolution counter is reset. Refer to the MotionBASIC® Hypertext for further information regarding absolute encoder application programming. You can also call the ORMEC Service Department to obtain a copy of Customer Support Engineering Tech Note 16, Continuous Rotary Motion with Absolute Encoder Support.

To reset the absolute encoder revolution counter, the capacitor in the servomotor must be fully discharged. The capacitor can quickly be discharged by following the steps listed later in this section.

The following steps outline the procedures for resetting the absolute encoder revolution counter:

1) Connect the encoder cable (CBL-DMAC/NNN, CBL-DEMAC/NNN or CBL-DEMACD/NNN) between the servodrive and motor.

2) Connect the axis interface cable (CBL-AD or CBL-ADE for SAC-D and SAC-DE servodrives respectively) between the servodrive and the DSP Axis Module.

3) Turn on logic power to the ORION™ and the servodrive, and establish communications with the ORION™ using MotionPRO.

4) Set the ABS@ variable (ABS@=TRUE) for at least 3 minutes. Ignore any servodrive alarms generated during this time.

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5) Turn the servodrive power off, and disconnect the encoder cable from the servodrive.

6) Attach the absolute encoder capacitor discharge adapter (MACABSRD with SAC-D, and MACABSRDE with SAC-DE) to the servodrive end of the encoder cable (refer to Figure 8) for at least fifteen minutes.

7) Remove the absolute encoder capacitor discharge adapter, reconnect the encoder cable to the servodrive, apply power, and test the axis.

8) If the axis has an absolute encoder error (ALARM@=10 or 15 on the ORION™ and/or an "A.00", "A.8_", or "A.C_"" on the servodrive monitor module, SAC-OP03A, and/or a "0", "8" or "C on the SAC-DE 7-Segment display) repeat this procedure.

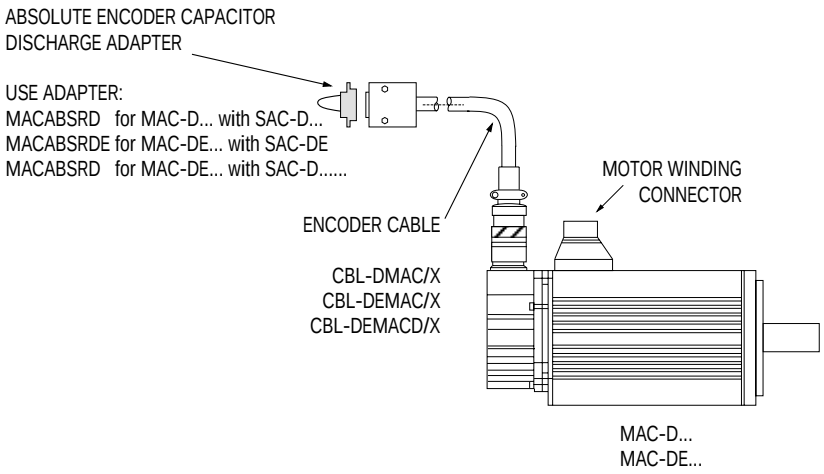


***Figure 8**, Absolute encoder reset adapter*

4.7.4 Absolute Position

Polling the absolute position of the motor returns a number between -[50,000*counts/rev]+1(reverse limit) and +[50,000*counts/rev]-1 (forward limit). The absolute position of the motor is relative to the motor position when the encoder was last reset (revolution count set to 0). The absolute position is derived by the following equation:

Absolute Pos. = (**Number of Revs** x **Counts/Rev**) + **Incremental Pos.**

For Example: POS.ACT@ = POS.ABS@
= (2000 revs * 32,640 cts/rev) + 3956
= 65,283,956

The absolute encoder can count up to 50,000 revolutions in either direction. Resetting the absolute encoder sets the revolution counter value to zero.

Moving the motor in the counter-clockwise direction (looking at the motor shaft) causes the absolute position counter to increment, moving in the clockwise direction causes it to decrement. The operation of the absolute encoder, and therefore the polled absolute position information, is not affected by the state of the CW.FWD@ MotionBASIC® variable. For further

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information regarding the CW.FWD@ MotionBASIC® variable refer to the "MotionBASIC® Hypertext Manual".

Moving the motor counter-clockwise (positively) through the forward limit position value causes the absolute position counter to "wrap around" to the reverse limit position value, and continue incrementing. Moving the motor clockwise (negatively) through the reverse position limit value causes the absolute position counter to "wrap around" to the forward limit position value, and continue decrementing. No position counts are lost during "wrap around" at the limit positions. Refer to Figure 9 for a graphical representation of the absolute position "wrap around" feature.

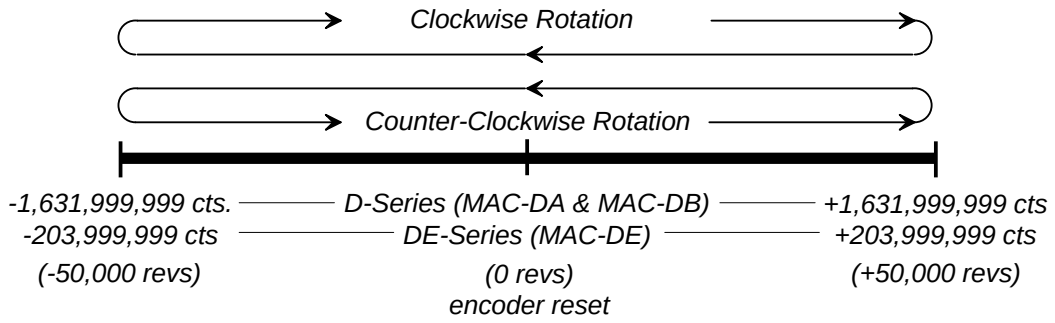


***Figure 9**, Absolute Encoder Wrap-Around*

Note: In order for continuous motion applications (where the motor is not rotating through a fixed range of motion) to accurately indicate the absolute motor position after passing through the "wrap around" positions, be sure that the number of revolutions of the motor per load cycle can be evenly divided into 50,000 with no remainder. For example: A load coupled to a motor through a 10:1 gear reduction (50,000 / 10 = 5,000) will properly indicate the absolute motor position, a load coupled through a 7:1 reduction (50,000 / 7 = 7142.8571...) will not.

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4.8 Servodrive Display Monitor Module Operation (SAC-OP03A)

The Servodrive Display Monitor Module (SAC-OP03A) is a five character seven segment LED display with an integral four button keypad intended for use with SAC-D servodrives only[4]. The SAC-OP03A can be used to monitor current servodrive status or to review a log of the last ten servodrive alarm codes. Three times more alarm code information is available using the SAC-OP03A than with the three standard alarm code outputs, indicated by the MotionBASIC® ALARM@ variable.

4.8.1 Installation

To install the SAC-OP03A simply plug it into CN3 on a SAC-D servodrive. This may be done with power applied to the unit. Refer to Appendix B for diagrams indicating the location of CN3 on the D-Series servodrives.

4.8.2 Modes of Operation

The SAC-OP03A has two functional modes of operation, STATUS and ALARM REVIEW (refer to Figure 10). D-Series servodrives are configured at ORMEC prior to shipment, therefore, SETUP and MONITOR modes and the DATA button (refer to Figure 10) are not required, and have been disabled.

The SAC-OP03A mode of operation sequence is STATUS, SETUP (disabled), MONITOR (disabled), and ALARM LOG REVIEW. Pressing the MODE/SET button advances the SAC-OP03A to the next mode of operation.

4.8.2.1 STATUS Mode

During STATUS mode operation, the SAC-OP03A displays the current drive status. The SAC-OP03A uses a combination of three horizontal LED segments, two decimal points, and a three character code (alarm codes have an extra decimal point) to indicate the current servodrive status. Refer to the STATUS MODE INDICATOR KEY, in Figure 10, for a definition of the STATUS mode servodrive codes. Refer to the Status Indicator Code Descriptions section of the Maintenance and Troubleshooting chapter for a list of the servodrive alarm codes.

While in STATUS mode, you can reset a servodrive alarm by simultaneously pressing the UP and DOWN arrow keys.

From STATUS mode (the default mode after powerup), you must advance through SETUP and MONITOR modes, by pressing the MODE/SET button twice, to get to ALARM LOG REVIEW mode.

[4] The SAC-OP03A can be used with a SAC-DE servodrive only through the use of an extension cable, which prevents mounting the display on the servodrive. Therefore, the SAC-OP03A is not recommended for use with SAC-DE servodrives.

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4.8.2.2 ALARM LOG REVIEW Mode

During ALARM LOG REVIEW mode operation, the SAC-OP03A can be used to display the contents of the servodrive alarm log. The servodrive ALARM LOG is a history of the 10 most recent alarm/reset codes, and is maintained (not erased) through servodrive logic power cycles. Refer to Figure 10 for a pictorial representation of the servodrive ALARM LOG.

Each alarm/reset code in the ALARM LOG has a sequence number. The current alarm/reset code has sequence number 0, the alarm/reset code before the current code has sequence number 1, and so on through sequence number 9.

An A.99 (reset code) is added to the log whenever a servodrive alarm is cleared. Servodrive alarms can be cleared by the ORION (refer to the MotionBASIC® Hypertext), power cycling the servodrive logic power, or simultaneously pressing the UP and DOWN buttons on the SAC-OP03A while in STATUS mode. NOTE: If the servodrive logic power is cycled, an A.99 will only be added if the servodrive had an alarm when power was turned off.

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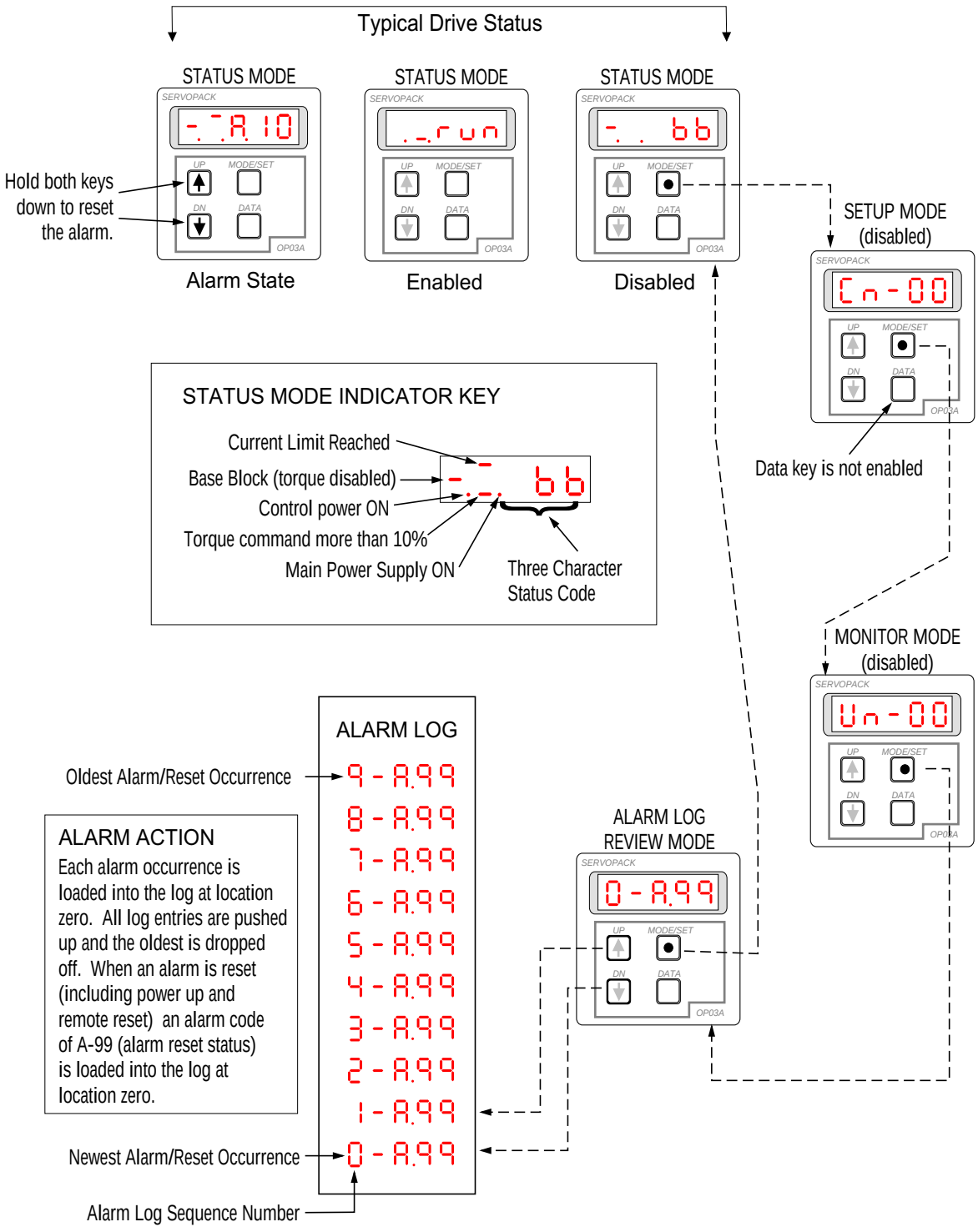


***Figure 10**, SAC-OP03A Operation Overview*

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Chapter 5
Getting Started

5 Getting Started

5.1 Test Run

Before test run, check the following. Correct any problems before proceeding.

5.1.1 Servomotor Check

- Motor mounting and grounding are correct.
- Bolts and nuts are tight.
- For IP-67 rated motors, the shaft seals are not damaged and are properly lubricated. Refer to the IP-67 Shaft Seal Lubrication section of the Maintenance & Troubleshooting section for further information.
- Motor and Encoder Cables are properly attached.

5.1.2 Servodrive Check

- For the SAC-D and 230 VAC version of the SAC-DE servodrives the supply voltage should be 230 VAC, **WITH AN ABSOLUTE MINIMUM OF 170 VAC AND ABSOLUTE MAXIMUM OF 253 VAC. CHECK POWER BEFORE APPLYING IT TO THE SERVODRIVE!!!!**
- For the 115 VAC version of the SAC-DE servodrive the supply voltage should be 115 VAC, **WITH AN ABSOLUTE MINIMUM OF 85 VAC AND AN ABSOLUTE MAXIMUM OF 126 VAC. CHECK POWER BEFORE APPLYING IT TO THE SERVODRIVE!!!!.**
- Cable connections are firmly seated.
- Motor cable lug termination's are tight.
- Motor wiring, fuse connection, and grounding are correct.

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- The main power interlock circuit disables main power under servo alarm condition.

5.1.3 Preparation for Test Run

During test run, the driven machine should not be attached to the servomotor. If it is necessary to start with the driven machine connected to the motor, proceed with great care.

- After checking items above, turn on the control power.
- For SAC-D servodrives check the ALARM LED. If there is a servodrive alarm condition either the MotionBASIC® ALARM@ variable or the SAC-OP03A may be used to determine the cause. Refer to the Maintenance & Troubleshooting section for further information.
- For SAC-DE servodrives check the Alarm Status Indicator. The Alarm Status Indicator, described in the Maintenance & Troubleshooting Section provides several status indications.

When the interlock input signals are appropriately configured (ALARM@=0, MODE@>2), the power circuit in the servodrive will operate and the motor is ready to run.

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Chapter 6
Specifications

6 Specifications

Servodrives covered by this manual:

SAC-DE01A1/_	SAC-DE01A2/_	SAC-D04_/__
SAC-DE02B1/_	SAC-DE02B2/_	SAC-D08_/__
SAC-DE03C1/_	SAC-DE03C2/_	SAC-D12_/__
	SAC-DE04D2/_	SAC-D19_/__
		SAC-D37_/__
		SAC-D47_/__
		SAC-D55_/__
		SAC-D59_/__

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6.1 DE-Series Motors Overview

Maximum Speed:	4,500 RPM
Continuous stall torques:	2.8 to 42 lb-in
Peak Torques:	8.4 to 127 lb-in
Peak Acceleration:	up to 147,219 rad/sec^2
Rated Power:	0.13 to 2.0 HP
Position Encoder Resolution:	incremental: 8,160 cts/rev (after quadrature decode) absolute: 4,080 cts/rev (after quadrature decode)

6.2 DA-Series Motors Overview

Maximum Speed:	4,500 RPM
Continuous stall torques:	28 to 140 lb-in
Peak Torques:	84 to 422 lb-in
Peak Acceleration:	up to 59,929 rad/sec^2
Rated Power:	1.3 to 6.7 HP
Position Encoder Resolution:	incremental: 16,320 cts/rev (after quadrature decode) absolute: 32,640 cts/rev (after quadrature decode)

6.3 DB-Series Motors Overview

Maximum Speed:	2,000 to 3,000 RPM
Continuous stall torques:	26 to 696 lb-in
Peak Torques:	79 to 1550 lb-in
Peak Acceleration:	up to 12,324 rad/sec^2
Rated Power:	0.6 to 15 HP
Position Encoder Resolution:	incremental: 32,640 cts/rev (after quadrature decode) absolute: 32,640 cts/rev (after quadrature decode)

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6.4 General Servodrive Specifications

6.4.1 SAC-DE Servodrive Specifications

Environmental Specifications

Operating Temperature:	0 to +55ºC
Storage Temperature:	-20 to +85ºC
Operating and Storage Humidity:	0 to 90%, non-condensing

Mechanical Specifications

Mounting Method:	Vertically oriented chassis mounting, three or four 10-32 screws.

Electrical Specifications

Incoming Line Voltage: (Single Phase, 50/60 Hz)	115 VAC	230 VAC
Minimum Incoming Line Voltage:	85 VAC	170 VAC
Absolute Maximum Incoming Line Voltage:	126 VAC	253 VAC
Rated Bus Voltage:	163 VDC	325 VDC
Shunt Regulator Activation Bus Voltage:	220 VDC	380 VDC
High Bus Voltage Fault:	240 VDC`	415 VDC
Low Bus Voltage Fault:	75 VDC	150 VDC
Encoder Power Voltage:	5 VDC, +/-5%	
Maximum Encoder Power Current:	300 mA, incremental encoder 400 mA, absolute encoder[1]	
Input Interlock Circuitry[2]:		
Input Voltage Requirements:	+24 VDC @ 15 mA maximum	
Input Current (at each input):	5 mA typical	
Output Interlock Circuitry:		
Maximum Applied Voltage:	+30 VDC	
Maximum Current Sink Capability:	-50 mA	

[1] The maximum encoder power current for absolute encoders is 400 mA during the encoder's capacitor charging phase.

[2] SAC-DE servodrive interlock power is supplied by either the ORION DSP Axis Module or an external power supply.

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6.4.2 SAC-D Servodrive Specifications

Environmental Specifications

Operating Temperature:	0 to +55°C
Storage Temperature:	-20 to +85°C
Operating and Storage Humidity:	0 to 90%, non-condensing

Mechanical Specifications

Mounting Method:	Vertically oriented chassis mounting, four 10-32 screws.

Electrical Specifications

Incoming Line Voltage: (Three Phase, 50/60 Hz)	230 VAC
Minimum Incoming Line Voltage:	170 VAC
Absolute Maximum Incoming Line Voltage:	253 VAC
Rated Bus Voltage:	325 VDC
Shunt Regulator Activation Bus Voltage:	380 VDC
High Bus Voltage Fault:	415 VDC
Low Bus Voltage Fault:	150 VDC
Encoder Power Voltage:	+5 VDC, +/- 5%
Maximum Encoder Power Current:	300 mA, incremental encoder 400 mA, absolute encoder[1]
Input Interlock Circuitry[2]:	
Input Voltage Requirements:	+24 VDC @ 15 mA maximum
Input Current (at each input):	5 mA typical
Output Interlock Circuitry:	
Maximum Applied Voltage:	+30 VDC
Maximum Current Sink Capability:	-50 mA

[1] The maximum encoder power current for absolute encoders is 400 mA during the encoder's capacitor charging phase.

[2] The SAC-D servodrive interlock power is supplied by the servodrive.

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6.5 MAC-DE Series Incremental Encoder Servomotors Specifications (115 VAC)

PERFORMANCE[1]	Units	DE003A1/I	DE006B1/I	DE008C1/I
Maximum Speed	RPM	4,500	4,500	4,500
Continuous Stall Torque	lb-in (N-m)	2.8 (0.32)	5.6 (0.64)	8.4 (0.96)
Rated Torque at 3000 RPM	lb-in (N-m)	2.8 (0.32)	5.6 (0.64)	8.4 (0.96)
Rated Power	HP	0.13	0.27	0.40
	watts	100	200	300
Peak Torque	lb-in (N-m)	8.4 (0.96)	17 (1.91)	25 (2.86)
Continuous Stall Torque/Inertia[2]	rad/sec^2	49,182	30,439	27,439
MECHANICAL				
Moment of Inertia[2]	lb-in-sec^{2}x10^{-3} (kg-m^{2}x10^{-4})	0.057 (0.065)	0.185 (0.209)	0.308 (0.347)
Friction Torque, static	lb-in (N-m)	0.05 (0.006)	0.11 (0.012)	0.20 (0.023)
Servomotor Weight[2]	lbs (kg)	1.5 (0.7)	3.1 (1.4)	4.6 (2.1)
Mounting Bolt Diameter	inches (mm)	2.76 (70)	3.54 (90)	3.54 (90)
Pilot Diameter	inches (mm)	1.97 (50)	2.76 (70)	2.76 (70)
Shaft Diameter	inches (mm)	0.315 (8)	0.551 (14)	0.551 (14)
Length, mounting face to rear[2]	inches (mm)	2.3 (57)	2.5 (63)	2.5 (63)
Maximum Radial Shaft Load[3]	lbs (N)	17 (78)	55 (245)	55 (245)
Maximum Axial Shaft Load	lbs (N)	11 (49)	15 (68)	15 (68)
ELECTRICAL				
Servodrive Model Number[2]	SAC-	DE01A1/I	DE02B1/I	DE03C1/I
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	1.4 (0.16)	2.3 (0.26)	2.2 (0.25)
Continuous Current	amps	2.2	2.7	4.3
Peak Current	amps	7.1	8.4	13.9
Servodrive Weight	lbs (kg)	4.9 (2.2)	7.3 (3.3)	7.3 (3.3)
THERMAL				
Ambient Temperature	deg. C	40	40	40
Thermal Time Constant	minutes	8	14	16
Insulation Class		B	B	B
ENCODER & TACH				
Quadrature Output Resolution[4]	counts/rev	8,160	8,160	8,160
Tachometer sensitivity	volts/Krpm	2	2	2

1 Ratings are obtained with servomotor ambient temperature at 40ºC.

2 Specification for incremental encoder motor only. Refer to the Absolute Encoder and Brake Options Servomotor Performance Specifications section for specification of servomotor with absolute encoder and/or brake options.

3 Maximum radial shaft load specification is for a load centered 0.2 inches (5 mm) from the end of the motor shaft.

4 Quadrature output resolution is after four times quadrature decode. Refer to footnote 2 (above).

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6.6 MAC-DE Series Incremental Encoder Servomotors Specifications (230 VAC)

PERFORMANCE[1]	Units	DE003A2/I	DE006B2/I	DE011C2/I
Maximum Speed	RPM	4,500	4,500	4,500
Continuous Stall Torque	lb-in (N-m)	2.8 (0.32)	5.6 (0.64)	11 (1.27)
Rated Torque at 3000 RPM	lb-in (N-m)	2.8 (0.32)	5.6 (0.64)	11 (1.27)
Rated Power	HP	0.13	0.27	0.54
	watts	100	200	400
Peak Torque	lb-in (N-m)	8.4 (0.96)	17 (1.91)	34 (3.82)
Continuous Stall Torque/Inertia[2]	rad/sec^2	49,182	30,439	36,789
MECHANICAL				
Moment of Inertia[2]	$lb\text{-}in\text{-}sec^2x10^{-3}$ $(kg\text{-}m^2x10^{-4})$	0.057 (0.065)	0.185 (0.209)	0.308 (0.347)
Friction Torque, static	lb-in (N-m)	0.05 (0.006)	0.11 (0.012)	0.20 (0.023)
Servomotor Weight[2]	lbs (kg)	1.5 (0.7)	3.1 (1.4)	4.6 (2.1)
Mounting Bolt Diameter	inches (mm)	2.76 (70)	3.54 (90)	3.54 (90)
Pilot Diameter	inches (mm)	1.97 (50)	2.76 (70)	2.76 (70)
Shaft Diameter	inches (mm)	0.315 (8)	0.551 (14)	0.55 (14)
Length, mounting face to rear[2]	inches (mm)	2.3 (57)	2.5 (63)	3.3 (84)
Maximum Radial Shaft Load[3]	lbs (N)	17 (78)	55 (245)	55 (245)
Maximum Axial Shaft Load	lbs (N)	11 (49)	15 (68)	15 (68)
ELECTRICAL				
Servodrive Model Number	SAC-	DE01A2/I	DE02B2/I	DE03C2/I D04C/I
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	3.5 (0.39)	3.1 (0.35)	4.7 (0.54)
Continuous Current	amps	0.89	2.0	2.6
Peak Current	amps	2.8	6.0	8.0
Servodrive Weight	lbs (kg)	4.9 (2.2)	4.9 (2.2)	7.3/8.8 (3.3/4.0)
THERMAL				
Ambient Temperature	deg. C	40	40	40
Thermal Time Constant	minutes	8	14	16
Insulation Class		B	B	B
ENCODER & TACH				
Quadrature Output Resolution[4]	linecount	8,160	8,160	8,160
Tachometer sensitivity	volts/Krpm	2	2	2

[1] Ratings are obtained with servomotor ambient temperature at 40°C.

[2] Specification for incremental encoder motor only. Refer to the Absolute Encoder and Brake Options Servomotor Performance Specifications section for specification of servomotor with absolute encoder and/or brake options.

[3] Maximum radial shaft load specification is for a load centered 0.2 inches (5 mm) from the end of the motor shaft.

[4] Quadrature output resolution is after four times quadrature decode. Refer to footnote 2 (above).

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PERFORMANCE[1]	Units	DE021D2/I	DE042E2/I
Maximum Speed	RPM	4,500	4,500
Continuous Stall Torque	lb-in (N-m)	21 (2.39)	42 (4.77)
Rated Torque at 3000 RPM	lb-in (N-m)	21 (2.39)	42 (4.77)
Rated Power	HP	1.0	2.0
	watts	750	1500
Peak Torque	lb-in (N-m)	63 (7.10)	127 (14.3)
Continuous Stall Torque/Inertia[2]	rad/sec^2	11,304	11,839
MECHANICAL			
Moment of Inertia[2]	lb-in-sec^{2}x10^{-3} (kg-m^{2}x10^{-4})	1.87 (2.11)	3.57 (4.03)
Friction Torque, static	lb-in (N-m)	0.32 (0.036)	0.53 (0.060)
Servomotor Weight[2]	lbs (kg)	10.1 (4.6)	14.6 (6.6)
Mounting Bolt Diameter	inches (mm)	5.71 (145)	5.71 (145)
Pilot Diameter	inches (mm)	4.33 (110)	4.33 (110)
Shaft Diameter	inches (mm)	0.63 (16)	0.75 (19)
Length, mounting face to rear[2]	inches (mm)	3.21 (81.5)	4.31 (109.5)
Maximum Radial Shaft Load[3]	lbs (N)	88 (392)	110 (490)
Maximum Axial Shaft Load	lbs (N)	33 (147)	33 (147)
ELECTRICAL			
Servodrive Model Number[2]	SAC-	DE04D2/I D08D/I	D12E/I
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	5.7 (0.64)	6.1 (0.69)
Continuous Current	amps	4.1	7.5
Peak Current	amps	13	28
Servodrive Weight	lbs (kg)	7.3/8.8 (3.3/4.0)	8.8 (4.0)
THERMAL			
Ambient Temperature	deg. C	40	40
Thermal Time Constant	minutes	18	18
Insulation Class		B	B
ENCODER & TACH			
Quadrature Output Resolution[4]	linecount	8,160	8,160
Tachometer sensitivity	volts/Krpm	2	2

1 Ratings are obtained with servomotor ambient temperature at 40ºC.

2 Specification for incremental encoder motor only. Refer to the Absolute Encoder and Brake Options Servomotor Performance Specifications section for specification of servomotor with absolute encoder and/or brake options.

3 Maximum radial shaft load specification is for a load centered 0.2 inches (5 mm) from the end of the motor shaft.

4 Quadrature output resolution is after four times quadrature decode. Refer to footnote 2 (above).

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6.7 MAC-DA Incremental Encoder Servomotor Performance Specifications

PERFORMANCE[1]	Units	DA030F/I	DA055G/I	DA090H/I
Maximum Speed	RPM	4500	4,500	4,500
Continuous Stall Torque	lb-in (N-m)	28 (3.18)	56 (6.36)	87 (9.8)
Rated Torque at 3000 RPM	lb-in (N-m)	28 (3.18)	56 (6.36)	87 (9.8)
Rated Power	HP	1.3	2.7	4
	watts	1000	2000	3000
Peak Torque	lb-in (N-m)	84 (9.54)	169 (19.1)	260 (29.4)
Continuous Stall Torque/Inertia[2]	rad/sec^2	18,312	20,000	14,032
MECHANICAL				
Moment of Inertia[2]	lb-in-sec^{2}x10^{-3} (kg-m^{2}x10^{-4})	1.54 (1.74)	2.82 (3.19)	6.20 (7.00)
Friction Torque, static	lb-in (N-m)	0.43 (0.049)	0.62 (0.070)	0.74 (0.084)
Servomotor Weight[2]	lbs (kg)	10.1 (4.6)	15.4 (7.0)	24.2 (11.0)
Mounting Bolt Diameter	inches (mm)	4.53 (115)	4.53 (115)	5.71 (145)
Pilot Diameter	inches (mm)	3.740 (95)	3.740 (95)	4.331 (110)
Shaft Diameter	inches (mm)	0.945 (24)	0.945 (24)	1.102 (28)
Length, mounting face to rear[2]	inches (mm)	5.9 (150)	7.8 (200)	7.9 (200)
Maximum Radial Shaft Load[3]	lbs (N)	154 (686)	154 (686)	221 (980)
Maximum Axial Shaft Load	lbs (N)	44 (196)	44 (196)	88 (392)
ELECTRICAL				
Servodrive Model Number[2]	SAC-	D08F/I	D19G/I	D37H/I
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	5.7 (0.64)	5.0 (0.56)	5.1 (0.57)
Continuous Current	amps	5.7	12.4	18.8
Peak Current	amps	17	42	56
Servodrive Weight	lbs (kg)	8.8 (4.0)	11.0 (5.0)	17.6 (8.0)
THERMAL				
Ambient Temperature	deg. C	40	40	40
Thermal Time Constant	minutes	12	23	33
Insulation Class		F	F	F
ENCODER & TACH				
Quadrature Output Resolution[4]	linecount	16,320	16,320	16,320
Tachometer sensitivity	volts/Krpm	2	2	2

[1] Ratings are obtained with servomotor ambient temperature at 40ºC.

[2] Specification for incremental encoder motor only. Refer to the Absolute Encoder and Brake Options Servomotor Performance Specifications section for specification of servomotor with absolute encoder and/or brake options.

[3] Maximum radial shaft load specification is for a load centered 0.2 inches (5 mm) from the end of the motor shaft.

[4] Quadrature output resolution is after four times quadrature decode. Refer to footnote 2 (above).

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PERFORMANCE[1]	Units	DA110J/I	DA140K/I
Maximum Speed	RPM	4,500	4,500
Continuous Stall Torque	lb-in (N-m)	112 (12.6)	140 (15.8)
Rated Torque at 3000 RPM	lb-in (N-m)	112 (12.6)	140 (15.8)
Rated Power	HP	5.4	6.7
	watts	4000	5000
Peak Torque	lb-in (N-m)	336 (37.8)	422 (47.6)
Continuous Stall Torque/Inertia[2]	rad/sec^2	13,176	12,844
MECHANICAL			
Moment of Inertia[2]	lb-in-sec^{2}x10^{-3} (kg-m^{2}x10^{-4})	8.50 (9.60)	10.9 (12.3)
Friction Torque, static	lb-in (N-m)	0.95 (0.11)	1.1 (0.12)
Servomotor Weight[2]	lbs (kg)	30.9 (14.0)	37.5 (17.0)
Mounting Bolt Diameter	inches (mm)	5.71 (145)	5.71 (145)
Pilot Diameter	inches (mm)	4.331 (110)	4.331 (110)
Shaft Diameter	inches (mm)	1.102 (28)	1.102 (28)
Length, mounting face to rear[2]	inches (mm)	9.3 (236)	10.9 (277)
Maximum Radial Shaft Load[3]	lbs (N)	265 (1176)	265 (1176)
Maximum Axial Shaft Load	lbs (N)	88 (392)	88 (392)
ELECTRICAL			
Servodrive Model Number[2]	SAC-	D37J/I	D37K/I
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	4.9 (0.55)	5.4 (0.61)
Continuous Current	amps	24.1	28.2
Peak Current	amps	77	84
Servodrive Weight	lbs (kg)	17.6 (8.0)	17.6 (8.0)
THERMAL			
Ambient Temperature	deg. C	40	40
Thermal Time Constant	minutes	36	40
Insulation Class		F	F
ENCODER & TACH			
Quadrature Output Resolution[4]	linecount	16,320	16,320
Tachometer sensitivity	volts/Krpm	2	2

1 Ratings are obtained with servomotor ambient temperature at 40ºC.

2 Specification for incremental encoder motor only. Refer to the Absolute Encoder and Brake Options Servomotor Performance Specifications section for specification of servomotor with absolute encoder and/or brake options.

3 Maximum radial shaft load specification is for a load centered 0.2 inches (5 mm) from the end of the motor shaft.

4 Quadrature output resolution is after four times quadrature decode. Refer to footnote 2 (above).

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6.8 MAC-DB Incremental Encoder Servomotor Performance Specifications

PERFORMANCE[1]	Units	DB025L/I	DB055M/I	DB080N/I
Maximum Speed	RPM	3,000	3,000	3,000
Continuous Stall Torque	lb-in (N-m)	26 (2.96)	54 (6.07)	79 (8.90)
Rated Torque at 1500RPM	lb-in (N-m)	25 (2.84)	48 (5.39)	74 (8.34)
Rated Power	HP	0.6	1.1	1.7
	watts	450	850	1300
Peak Torque	lb-in (N-m)	79 (8.92)	122 (13.8)	207 (23.3)
Continuous Stall Torque/Inertia[2]	rad/sec^2	4,082	4,369	4,328
MECHANICAL				
Moment of Inertia[2]	lb-in-sec^{2}x10^{-3} (kg-m^{2}x10^{-4})	6.41 (7.24)	12.3 (13.9)	18.2 (20.5)
Friction Torque, static	lb-in (N-m)	0.43 (0.049)	0.65 (0.073)	0.87 (0.10)
Servomotor Weight[2]	lbs (kg)	12.1 (5.5)	16.8 (7.6)	21.2 (9.6)
Mounting Bolt Diameter	inches (mm)	5.71 (145)	5.71 (145)	5.71 (145)
Pilot Diameter	inches (mm)	4.331 (110)	4.331 (110)	4.331 (110)
Shaft Diameter	inches (mm)	0.748 (19)	0.748 (19)	0.866 (22)
Length, mounting face to rear[2]	inches (mm)	5.4 (137)	6.3 (160)	7.3 (185)
Maximum Radial Shaft Load[3]	lbs (N)	110 (490)	110 (490)	154 (686)
Maximum Axial Shaft Load	lbs (N)	22 (98)	22 (98)	77 (343)
ELECTRICAL				
Servodrive Model Number[2]	SAC-	D08L/I	D08M/I	D12N/I
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	7.3 (0.82)	7.3 (0.83)	7.4 (0.84)
Continuous Current	amps	3.8	7.1	10.7
Peak Current	amps	11	17	28
Servodrive Weight	lbs (kg)	8.8 (4.0)	8.8 (4.0)	8.8 (4.0)
THERMAL				
Ambient Temperature	deg. C	40	40	40
Thermal Time Constant	minutes	12	17	25
Insulation Class		F	F	F
ENCODER & TACH				
Quadrature Output Resolution[4]	linecount	32,640	32,640	32,640
Tachometer sensitivity	volts/Krpm	2	2	2

[1] Ratings are obtained with servomotor ambient temperature at 40°C.

[2] Specification for incremental encoder motor only. Refer to the Absolute Encoder and Brake Options Servomotor Performance Specifications section for specification of servomotor with absolute encoder and/or brake options.

[3] Maximum radial shaft load specification is for a load centered 0.2 inches (5 mm) from the end of the motor shaft.

[4] Quadrature output resolution is after four times quadrature decode. Refer to footnote 2 (above).

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PERFORMANCE[1]	Units	DB100P/I	DB200Q/I	DB300R/I
Maximum Speed	RPM	3,000	3,000	3,000
Continuous Stall Torque	lb-in (N-m)	102 (11.5)	199 (22.5)	303 (34.3)
Rated Torque at 1500RPM	lb-in (N-m)	102 (11.5)	165 (18.6)	252 (28.4)
Rated Power	HP	2.4	3.9	5.9
	watts	1800	2900	4400
Peak Torque	lb-in (N-m)	254 (28.7)	404 (45.6)	630 (71.1)
Continuous Stall Torque/Inertia[2]	rad/sec^2	3,630	4,893	5,074
MECHANICAL				
Moment of Inertia[2]	lb-in-sec^{2}x10^{-3} (kg-m^{2}x10^{-4})	28.1 (31.7)	40.7 (46.0)	59.8 (67.5)
Friction Torque, static	lb-in (N-m)	1.0 (0.11)	1.4 (0.16)	2.3 (0.26)
Servomotor Weight[2]	lbs (kg)	30.9 (14.0)	39.7 (18.0)	50.7 (23.0)
Mounting Bolt Diameter	inches (mm)	7.87 (200)	7.87 (200)	7.87 (200)
Pilot Diameter	inches (mm)	4.500 (114.3)	4.500 (114.3)	4.500 (114.3)
Shaft Diameter	inches (mm)	1.379 (35)	1.379 (35)	1.379 (35)
Length, mounting face to rear[2]	inches (mm)	6.5 (165)	7.5 (190)	8.9 (226)
Maximum Radial Shaft Load[3]	lbs (N)	265 (1176)	331 (1470)	330 (1470)
Maximum Axial Shaft Load	lbs (N)	110 (490)	110 (490)	110 (490)
ELECTRICAL				
Servodrive Model Number[2]	SAC-	D19P/I	D37Q/I	D37R/I
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	6.5 (0.73)	7.3 (0.83)	8.1 (0.91)
Continuous Current	amps	16.7	23.8	34.7
Peak Current	amps	42	56	84
Servodrive Weight	lbs (kg)	11.0 (5.0)	17.6 (8.0)	17.6 (8.0)
THERMAL				
Ambient Temperature	deg. C	40	40	40
Thermal Time Constant	minutes	34	35	36
Insulation Class		F	F	F
ENCODER & TACH				
Quadrature Output Resolution[4]	linecount	32,640	32,640	32,640
Tachometer sensitivity	volts/Krpm	2	2	2

1 Ratings are obtained with servomotor ambient temperature at 40°C.

2 Specification for incremental encoder motor only. Refer to the Absolute Encoder and Brake Options Servomotor Performance Specifications section for specification of servomotor with absolute encoder and/or brake options.

3 Maximum radial shaft load specification is for a load centered 0.2 inches (5 mm) from the end of the motor shaft.

4 Quadrature output resolution is after four times quadrature decode. Refer to footnote 2 (above).

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PERFORMANCE[1]	Units	DB330S/I	DB465T/I	DB700U/I
Maximum Speed	RPM	3,000	3,000	2,000
Continuous Stall Torque	lb-in (N-m)	333 (37.6)	466 (52.6)	696 (78.6)
Rated Torque at 1500RPM	lb-in (N-m)	310 (35.0)	425 (48.0)	620 (70.0)
Rated Power	HP	7.4	10	15
	watts	5500	7500	11000
Peak Torque	lb-in (N-m)	776 (87.6)	1050 (119)	1550 (175)
Continuous Stall Torque/Inertia[2]	rad/sec^2	4,220	4,197	2,795
MECHANICAL				
Moment of Inertia[2]	lb-in-sec^{2}x10^{-3} (kg-m^{2}x10^{-4})	78.8 (89.0)	111 (125)	249 (281)
Friction Torque, static	lb-in (N-m)	3.0 (0.34)	4.0 (0.45)	7.2 (0.81)
Servomotor Weight[2]	lbs (kg)	66.1 (30.0)	88.2 (40.0)	127 (57.5)
Mounting Bolt Diameter	inches (mm)	7.87 (200)	7.87 (200)	9.25 (235)
Pilot Diameter	inches (mm)	4.500 (114.3)	4.500 (114.3)	7.874 (200)
Shaft Diameter	inches (mm)	1.634 (42)	1.634 (42)	1.634 (42)
Length, mounting face to rear[2]	inches (mm)	10.2 (259)	13.2 (335)	13.3 (337)
Maximum Radial Shaft Load[3]	lbs (N)	397 (1764)	396 (1764)	397 (1764)
Maximum Axial Shaft Load	lbs (N)	132 (588)	132 (588)	132 (588)
ELECTRICAL				
Servodrive Model Number[2]	SAC-	D47S/I	D55T/I	D57U/I
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	7.8 (0.88)	8.2 (0.93)	11.1 (1.25)
Continuous Current	amps	42.1	54.7	58.6
Peak Current	amps	110	130	140
Servodrive Weight	lbs (kg)	33.1 (15.0)	33.1 (15.0)	50.7 (23.0)
THERMAL				
Ambient Temperature	deg. C	40	40	40
Thermal Time Constant	minutes	44	46	68
Insulation Class		F	F	F
ENCODER & TACH				
Quadrature Output Resolution[4]	linecount	32,640	32,640	32,640
Tachometer sensitivity	volts/Krpm	2	2	2

[1] Ratings are obtained with servomotor ambient temperature at 40°C.

[2] Specification for incremental encoder motor only. Refer to the Absolute Encoder and Brake Options Servomotor Performance Specifications section for specification of servomotor with absolute encoder and/or brake options.

[3] Maximum radial shaft load specification is for a load centered 0.2 inches (5 mm) from the end of the motor shaft.

[4] Quadrature output resolution is after four times quadrature decode. Refer to footnote 2 (above).

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6.9 Incremental Encoder Servomotor with Fail-Safe Brake Performance Specifications

The fail-safe brake holding torque is equivalent to the motor's rated torque. Refer to the Motor with Integral Fail-Safe Brake wiring section of the Installation chapter further fail-safe brake information.

Servomotor	Servodrive	Continuous Stall Torque/Inertia	Moment of Inertia	Servomotor Length	Servomotor Weight	Quadrature Output Res.
MAC-	SAC-	rad/sec^2	lb-in-sec^{2}x10^{-3} (kg-m^{2}x10^{-4})	inches (mm)	lbs (kg)	counts/rev
DE003A1/I_B	DE02A1/I	30,890	0.091 (0.103)	3.4 (86)	2.0 (0.9)	8,160
DE006B1/I_B	DE03B1/I	20,713	0.272 (0.307)	3.7 (94)	4.2 (1.9)	8,160
DE008C1/I_B	DE04C1/I	21,395	0.394 (0.445)	4.5 (114)	5.7 (2.6)	8,160
DE003A2/I_B	DE01A2/I	30,890	0.091 (0.103)	3.4 (86)	2.0 (0.9)	8,160
DE006B2/I_B	DE02B2/I	20,713	0.272 (0.307)	3.7 (94)	4.2 (1.9)	8,160
DE011C2/I_B	DE03C2/I D04C/I	28,685	0.394 (0.445)	4.5 (114)	5.7 (2.6)	8,160
DE021D2/I_B	DE04D2/I D08D/I	9,468	2.23 (2.52)	4.7 (118)	13.5 (6.1)	8,160
DE042E2/I_B	D12E/I	9,971	4.24 (4.78)	5.8 (146)	17.9 (8.1)	8,160
DA030F/I_B	D08F/I	16,301	1.73 (1.96)	7.6 (193)	13.2 (6.0)	16,320
DA055G/I_B	D19G/I	18,543	3.01 (3.41)	9.6 (242)	18.7 (8.5)	16,320
DA090H/I_B	D37H/I	11,097	7.84 (8.85)	9.4 (237)	30.9 (14.0)	16,320
DA110J/I_B	D37J/I	11,045	10.14 (11.45)	10.8 (274)	37.5 (17.0)	16,320
DA140K/I_B	D37K/I	9,831	12.5 (14.2)	12.4 (314)	44.1 (20.0)	16,320
DB025L/I_B	D08L/I	3,106	8.05 (9.09)	7.0 (176)	16.5 (7.5)	32,640
DB055M/I_B	D08M/I	3,670	13.9 (15.8)	7.9 (199)	21.2 (9.6)	32,640
DB080N/I_B	D12N/I	3,730	19.8 (22.4)	8.8 (223)	26.5 (12.0)	32,640
DB100P/I_B	D19P/I	2,918	35.0 (39.5)	8.6 (217)	41.9 (19.0)	32,640
DB200Q/I_B	D37Q/I	4,121	47.6 (53.8)	9.6 (243)	51.8 (23.5)	32,640
DB300R/I_B	D37R/I	4,500	66.7 (75.3)	11.0 (277)	62.8 (28.5)	32,640
DB330S/I_B	D47S/I	4,028	85.7 (96.8)	12.3 (311)	77.1 (35.0)	32,640
DB465T/I_B	D55T/I	3,818	118 (133)	15.2 (385)	100.3 (45.5)	32,640
DB700U/I_B	D59U/I	2,551	261 (294)	15.1 (383)	143.3 (65.0)	32,640

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6.10 Absolute Encoder Servomotor Performance Specifications

Servomotor	Servodrive	Continuous Stall Torque/Inertia	Moment of Inertia	Servomotor Length	Servomotor Weight	Quadrature Output Res.
MAC-	SAC-	rad/sec^2	$lb\text{-}in\text{-}sec^2 x10^{-3}$ ($kg\text{-}m^2 x10^{-4}$)	inches (mm)	lbs (kg)	counts/rev
DE003A1/A	DE02A1/A	35,512	0.079 (0.090)	4.1 (102)	2.0 (0.9)	4,080
DE006B1/A	DE03B1/A	27,221	0.207 (0.234)	3.5 (87)	3.5 (1.6)	4,080
DE008C1/A	DE04C1/A	25,617	0.329 (0.372)	4.2 (107)	5.1 (2.3)	4,080
DE003A2/A	DE01A2/A	35,512	0.079 (0.090)	4.1 (102)	2.0 (0.9)	4,080
DE006B2/A	DE02B2/A	27,221	0.207 (0.234)	3.5 (87)	3.5 (1.6)	4,080
DE011C2/A	DE03C2/A D04C/A	25,617	0.329 (0.372)	4.2 (107)	5.1 (2.3)	4,080
DE021D2/A	DE04D2/A D08D/A	11,155	1.89 (2.14)	4.2 (106)	10.6 (4.8)	4,080
DE042E2/A	D12E/A	11,757	3.59 (4.06)	5.3 (134)	14.7 (7.1)	4,080
DA030F/A	D08F/A	17,060	1.65 (1.87)	6.4 (163)	11.0 (5.0)	32,640
DA055G/A	D19G/A	19,093	2.93 (3.32)	8.4 (212)	16.3 (7.4)	32,640
DA090H/A	D37H/A	13,781	6.31 (7.13)	8.4 (213)	25.4 (11.5)	32,640
DA110J/A	D37J/A	13,004	8.61 (9.73)	9.9 (250)	32.0 (14.5)	32,640
DA140K/A	D37K/A	12,712	11.0 (12.4)	11.5 (290)	38.6 (17.5)	32,640
DB025L/A	D08L/A	4,028	6.5 (7.34)	6.0 (152)	13.0 (5.9)	32,640
DB055M/A	D08M/A	4,338	12.4 (14.0)	6.9 (175)	17.6 (8.0)	32,640
DB080N/A	D12N/A	4,308	18.3 (20.6)	7.9 (199)	22.0 (10.0)	32,640
DB100P/A	D19P/A	3,619	28.2 (31.8)	7.1 (180)	30.9 (14.0)	32,640
DB200Q/A	D37Q/A	4,882	40.8 (46.1)	8.2 (206)	40.8 (18.5)	32,640
DB300R/A	D37R/A	5,067	59.9 (67.9)	9.5 (240)	52.9 (24.0)	32,640
DB330S/A	D47S/A	4,216	78.9 (89.1)	10.8 (274)	66.1 (30.0)	32,640
DB465T/A	D55T/A	4,193	111 (125)	12.8 (327)	88.2 (40.0)	32,640
DB700U/A	D59U/A	2,795	249 (281)	13.9 (352)	127 (57.5)	32,640

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6.11 Absolute Encoder Servomotor with Fail-Safe Brake Performance Specifications

The fail-safe brake holding torque is equivalent to the motor's rated torque. Refer to the Motor with Integral Fail-Safe Brake wiring section of the Installation chapter for further fail-safe brake information.

Servomotor	Servodrive	Cont. Stall Torque/Inertia	Moment of Inertia	Servomotor Length	Servomotor Weight	Quadrature Output Res.
MAC-	SAC-	rad/sec^2	lb-in-sec^{2}x10^{-3} (kg-m^{2}x10^{-4})	inches (mm)	lbs (kg)	counts/rev
DE003A1/A_B	DE02A1/A	24,917	0.113 (0.128)	5.2 (131)	2.7 (1.2)	4,080
DE006B1/A_B	DE03B1/A	19,170	0.294 (0.332)	4.7 (118)	4.6 (2.1)	4,080
DE008C1/A_B	DE04C1/A	20,270	0.416 (0.470)	5.5 (138)	6.2 (2.8)	4,080
DE003A2/A_B	DE01A2/A	24,917	0.113 (0.128)	5.2 (131)	2.7 (1.2)	4,080
DE006B2/A_B	DE02B2/A	19,170	0.294 (0.332)	4.7 (118)	4.6 (2.1)	4,080
DE011C2/A_B	DE03C2/A D04C/A	27,177	0.416 (0.470)	5.5 (138)	6.2 (2.8)	4,080
DE021D2/A_B	DE04D2/A D08D/A	9,363	2.26 (2.55)	5.6 (142)	13.7 (6.2)	4,080
DE042E2/A_B	D12E/A	9,912	4.26 (4.81)	6.7 (170)	19.0 (8.6)	4,080
DA030F/A_B	D08F/A	15,301	1.84 (2.08)	8.2 (207)	14.3 (6.5)	32,640
DA055G/A_B	D19G/A	17,874	3.12 (3.53)	10.1 (256)	19.8 (9.0)	32,640
DA090H/A_B	D37H/A	10,939	7.95 (8.98)	9.9 (251)	32.0 (14.5)	32,640
DA110J/A_B	D37J/A	10,924	10.25 (11.58)	11.4 (288)	38.6 (17.5)	32,640
DA140K/A_B	D37K/A	9,754	12.7 (14.3)	13.0 (328)	45.2 (20.5)	32,640
DB025L/A_B	D08L/A	3,072	8.14 (9.19)	7.5 (190)	17.4 (7.9)	32,640
DB055M/A_B	D08M/A	3,648	14.0 (15.8)	8.4 (213)	22.0 (10.0)	32,640
DB080N/A_B	D12N/A	3,714	19.9 (22.4)	9.4 (237)	26.5 (12.0)	32,640
DB100P/A_B	D19P/A	2,910	35.0 (39.5)	9.1 (231)	43.0 (19.5)	32,640
DB200Q/A_B	D37Q/A	4,114	47.6 (53.8)	10.2 (257)	51.8 (23.5)	32,640
DB300R/A_B	D37R/A	4,495	66.7 (75.3)	11.5 (291)	63.9 (29.0)	32,640
DB330S/A_B	D47S/A	4,023	85.7 (96.8)	12.8 (325)	79.3 (36.0)	32,640
DB465T/A_B	D55T/A	3,815	118 (133)	15.8 (399)	110.2 (50.0)	32,640
DB700U/A_B	D59U/A	2,550	261 (294)	15.7 (397)	144.4 (65.5)	32,640

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6.12 Fail-Safe Brake Specifications

The time delay between application of brake coil power and the releasing of the brake is 180 msec (maximum). The time delay between disabling the coil power and the brake engaging is 100 msec (maximum).

Servomotor	**Holding Torque**	**Coil Resistance**	**Coil Voltage**	**Coil Current**
MAC-	lb-in (N-m)	ohms (at 20C)	VDC	amps (at 20C)
DE003A1/__B	4.3 (0.49)	114	24	0.23
DE006B1/__B	8.6 (0.98)	116	24	0.21
DE008C1/__B	17 (1.96)	89	24	0.29
DE003A2/__B	4.3 (0.49)	114	24	0.23
DE006B2/__B	8.6 (0.98)	116	24	0.21
DE011C2/__B	17 (1.96)	89	24	0.29
DE021D2/__B	32 (3.63)	77	24	0.31
DE042E2/__B	63 (7.16)	58	24	0.42
DA030F/__B	28 (3.1)	82	24	0.29
DA055G/__B	56 (6.3)	82	24	0.29
DA090H/__B	87 (9.8)	70	24	0.34
DA110J/__B	112 (12.6)	70	24	0.34
DA140K/__B	140 (15.8)	70	24	0.34
DB025L/__B	25 (2.8)	70	24	0.34
DB055M/__B	48 (5.3)	70	24	0.34
DB080N/__B	74 (8.3)	70	24	0.34
DB100P/__B	102 (11.5)	31	24	0.77
DB200Q/__B	165 (18.6)	31	24	0.77
DB300R/__B	252 (28.4)	31	24	0.77
DB330S/__B	310 (35.0)	25	24	0.98
DB465T/__B	425 (48.0)	18	24	1.3
DB700U/__B	620 (70.0)	18	24	1.3

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Chapter 7
Maintenance and Troubleshooting

7 Maintenance and Troubleshooting

7.1 LED Status Indicators

7.1.1 SAC-D LED Status Indicators

LED	Description
POWER	Illuminated when the servodrive logic power is on (r, t).
ALARM	Illuminated when there is a servodrive alarm condition.
CHARGE or BUS POWER	Illumination indicates bus capacitor is charged. This LED is recessed in the servodrive chassis, be sure you can see this LED before deciding it is not illuminated. **WARNING: DO NOT SERVICE THE SERVODRIVE WHEN THIS LED IS EVEN DIMLY ILLUMINATED. WAIT FOR IT TO BE COMPLETELY UNILLUMINATED (SERVODRIVE BUS TO FULLY DISCHARGED) BEFORE SERVICING THE SERVODRIVE, THIS CAN TAKE SEVERAL MINUTES.**

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7.1.2 SAC-DE LED Status Indicators

LED	Description
7-Segment Display	Single character display which indicates the servodrive status. Refer to the Status Indicator Code Descriptions section of this chapter for a description of the 7-Segment Display codes.
BUS POWER	Illumination indicates bus capacitor is charged. **WARNING: DO NOT SERVICE THE SERVODRIVE WHEN THIS LED IS EVEN DIMLY ILLUMINATED. WAIT FOR IT TO BE COMPLETELY UNILLUMINATED (SERVODRIVE BUS TO FULLY DISCHARGED) BEFORE SERVICING THE SERVODRIVE, THIS CAN TAKE SEVERAL MINUTES.**

7.2 Status Indicator Code Descriptions

SAC-DE 7-Seg. LED	SAC-OP03A	ALARM@	Status	Description
-.	bb	n.a.	Servodrive disabled	Servodrive output current is disabled in the output circuitry (not an error).
.	run	n.a.	Servodrive enabled	Servodrive output current is enabled and the unit is operating normally (not an error).
0.	A.00	10	Absolute encoder data error	Absolute encoder data not received or not valid.
0.	A.02	10	Configuration Parameter Fault	Servodrive configuration data checksum error.
0.	A.04	10	Configuration Parameter Error	Servodrive configuration data out of range.
1.	A.10	11	Overcurrent	Servodrive commanding excessive current output.
2.	A.20	12	Input power fuse blown	Input power fuse blown (SAC-DE only).
3.	A.30	13	Regenerative discharge fault	Regenerative discharge circuit not operating properly, or excessive regen. current.
3.	A.31	13	Servodrive Config. Error	Servodrive configuration incorrect.
4.	A.40	14	High Bus Voltage Fault	Servodrive bus voltage too high.
5.	A.51	15	Overspeed	Servomotor speed is at least 10% higher than the maximum motor speed.

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SAC-DE 7-Seg. LED	SAC-OP03A	ALARM@	Status	Description
7.	A.71	17	Overload (twice rated)	Servomotor torque greater than approx. twice rated torque for at least 3 secs.
7.	A.72	17	Overload (rated torque)	Servomotor torque greater than rated torque, but less than twice rated, for at least 100 secs.
8.	A.80	10	Absolute encoder error	Absolute encoder data incorrect or absent. (MAC-DE only)
8.	A.81	10	Absolute encoder backup error	Absolute encoder backup power failure caused loss of rev. counter data. (MAC-DE only)
8.	A.82	10	Absolute encoder checksum error	Absolute encoder data checksum is not correct. (MAC-DE only)
8.	A.83	10	Absolute encoder battery error	Absolute encoder backup battery voltage is below 2.8 VDC. (MAC-DE only)
8.	A.84	10	Absolute encoder data error	Absolute encoder data invalid. (MAC-DE only)
8.	A.85	10	Absolute encoder overspeed	Absolute encoder polled while motor is rotating over 400 RPM. (MAC-DE only)
	A.99	n.a.	Servodrive reset	Indicates the servodrive has been reset, this is not an error condition. Displayed in the ALARM LOG only.
A.	A.A1	17	Heat sink high temperature error	Servodrive heat sink temperature too high.
b.	A.b1	10	Invalid torque command input	Servodrive torque command input either absent or invalid.
C.	A.C1	15	Encoder error (overrun)	Encoder speed higher than the maximum motor speed.
C.	A.C2	15	Encoder channel error	Encoder feedback data absent or invalid.
C.	A.C3	15	Encoder channel A or B open wire	Encoder channel A or B wiring not connected to encoder.
C.	A.C4	15	Encoder reference channel open wire	Encoder reference channel wiring not connected to encoder.
F.	A.F1	12	Input power phase error	One phase of the main servodrive power (R, S, T) absent or the wrong voltage.
F.	A.F3	12	Input power loss	Servodrive main power (R, S, T) voltage or frequency incorrect.

***Table 17**, Status indicator code descriptions*

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7.3 Servodrive Test Points

7.3.1 SAC-D Servodrive Test Points

The SAC-D servodrive test points are accessible through a 4 pin header (TEST POINTS) on the top of the servodrive. Refer to Table 18 for a description of the test points. The CBL-DMON/3 column indicates the color wire, in a CBL-DMON/3, on which the corresponding signal is available. The CBL-DMON/3 is recommended for easier access to the SAC-D servodrive test points.

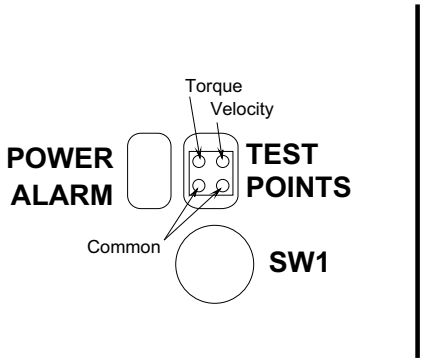


***Figure 11**, SAC-D Test Point Layout*

CBL-DMON	Description
Red	Speed monitor: +/-2 VDC/1000 RPM (MAC-DB), or +/-1 VDC/1000 RPM (MAC-DA and MAC-DE)
White	Torque monitor: +/-2 VDC/100% rated torque
Black Black	Monitor common

***Table 18**, SAC-D Servodrive Test Points*

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7.3.2 SAC-DE Servodrive Test Points

The SAC-DE servodrive test points are accessible through the 3 terminals (TORQ, TACH, and GND) on the front of the unit. Refer to Table 18 for a description of the test points. The Locator column indicates the PC board locator for each test point.

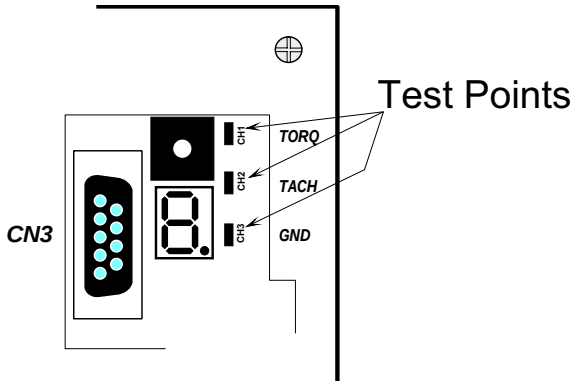


***Figure 12**, SAC-DE Test Point Layout*

Terminal	Locator	Description
TORQ	CH1	Torque monitor: +/-2 VDC/100% rated torque
TACH	CH2	Speed monitor: +/-1 VDC/1000 RPM
GND	CH3	Monitor common

***Table 19,** SAC-DE Servodrive Test Points*

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7.4 Servodrive Troubleshooting Guide

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
0.	A.00	10	Absolute encoder data error	Absolute encoder data not received or not valid.

Detection Condition	Probable Cause	Corrective Action
When power is applied to the control circuit or the ABS input is asserted (ABS@=ON or POS.ACT@=POS.ABS@)	Servodrive not supplying power to the absolute encoder	Check the encoder cable model number and connection.
	Incorrect absolute encoder signal channel wiring	
	Absolute encoder malfunction	Perform absolute encoder reset procedure, refer to the Resetting the Absolute Encoder section of the Operation chapter.
	Incorrect servodrive encoder configuration	Verify that the servodrive is configured for absolute encoder operation (/A option).
	Defective absolute encoder	Replace servomotor.
	Defective servodrive	Replace servodrive

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
0.	A.02	10	Configuration parameter fault	Servodrive configuration data checksum error.

Detection Condition	Probable Cause	Corrective Action
When power is applied to the control circuit	Defective servodrive	Replace servodrive

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
0.	A.04	10	Configuration parameter fault	Servodrive configuration data out of range.

Detection Condition	Probable Cause	Corrective Action
When power is applied to the control circuit	Defective servodrive	Replace servodrive

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SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
1.	A. 10	11	Overcurrent	Servodrive commanding excessive output current.

Detection Condition	Probable Cause	Corrective Action
During servomotor operation	Wiring grounded between servodrive and motor	Check motor wiring.
	Motor phase (U, V, W) grounded at motor	Replace motor.
When power is applied to the main circuit, or the servodrive is enabled (MODE@>2)	Defective servodrive	Replace servodrive.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
2.	A.20	12	Input power fuse blown	Input power fuse blown (SAC-DE only).

Detection Condition	Probable Cause	Corrective Action
When power is applied to the main circuit.	Blown input power fuse blown	Replace servodrive.
	Defective servodrive	Replace servodrive

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
3.	A.30	13	Regenerative discharge fault	Regenerative discharge circuit not operating properly, or excessive regen. current.

Detection Condition	Probable Cause	Corrective Action
During servomotor operation or approximately 1 second after power applied to main circuit	Defective regenerative discharge transistor	Replace servodrive.
	Disconnection of the regen. resistor	For servodrives with an external regen. resistor (SAC-D47S - 59U), check the regen resistor unit wiring. For all other servodrives, replace servodrive.
When power is applied to the control circuit	Defective servodrive	Replace servodrive.

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SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
3.	A.31	13	Servodrive configuration error	Servodrive configuration incorrect.

Detection Condition	Probable Cause	Corrective Action
During servomotor operation	Defective servodrive	Replace servodrive.
When power is applied to the main circuit	Defective servodrive	Replace servodrive.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
4.	A.40	14	High bus voltage fault	Servodrive bus voltage too high.

Detection Condition	Probable Cause	Corrective Action
When power is applied to the control or main circuits	Defective servodrive	Replace servodrive
	Load exceeds regenerative discharge capacity of the servodrive	Reduce the load inertia.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
5.	A.51	15	Overspeed	Servomotor speed at least 10% higher than the maximum motor speed.

Detection Condition	Probable Cause	Corrective Action
When the servodrive is enabled (MODE@>2) or during servomotor operation	Incorrect motor and/or encoder wiring	Check the motor cable connection, and the encoder cable model number and connection.
	Electrical noise in encoder wiring	Check the encoder cable connection. If cables were not supplied by ORMEC, verify proper shielding as shown in the CBL-DMAC and CBL-DEMAC in Appendix D.
	Wrong servodrive model	Check the servodrive model number to verify that it is the appropriate servodrive for use with this motor.
	Defective servodrive	Replace servodrive
When power is applied to the control or main circuits.	Defective servodrive	Replace servodrive

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SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
7.	A.71	17	Overload (twice rated)	Servomotor torque greater than approx. twice rated torque for at least 3 secs.
7.	A.72	17	Overload (rated torque)	Servomotor torque greater than rated torque, but less than twice rated, for at least 100 secs.

Detection Condition	Probable Cause	Corrective Action
When the servodrive is enabled (MODE@>2) or during servomotor operation	Incorrect motor wiring	Check the motor cable connection.
	Incorrect encoder wiring	Check the encoder cable model number and connection.
	Load exceeds the motor torque rating	Reduce the load inertia, or switch to a higher torque motor and servodrive.
When power is applied to the control or main power circuit.	Defective servodrive	Replace servodrive.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
8.	A.80	18	Absolute encoder error	Absolute encoder data is incorrect or absent.

Detection Condition	Probable Cause	Corrective Action
When power is applied to the control power circuit.	Defective servodrive	Replace servodrive.
During servomotor operation.	Incorrect encoder wiring.	Check the encoder cable model number and connection.
	Absolute encoder malfunction.	Reset servodrive alarm, and poll absolute encoder (POS.ACT@=POS.ABS@).
	Electrical noise in encoder data.	Check the encoder cable connection, and separate encoder and power wiring. If cables were not supplied by ORMEC, verify proper shielding as shown in the CBL-DMAC and CBL-DEMAC drawings in Appendix D.

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SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
8.	A.81	18	Absolute encoder backup error	Absolute encoder backup power failure caused loss of the revolution counter data (MAC-DE only).

Detection Condition	Probable Cause	Corrective Action
When power is applied to the control power circuit.	Defective servodrive	Replace servodrive.
When the absolute encoder position is polled (POS.ACT@=POS.ABS@).	48 hours, or more, without ORION™ or servodrive logic power, or absolute encoder backup battery power, and the axis interface (CBL-AD or CBL-ADE) and encoder cables (CBL-DMAC, CBL-DEMAC, or CBL-DEMACD) connected.	Follow the procedure in the Resetting the Absolute Encoder section of the Operation chapter.
	Defective absolute encoder	Replace servomotor.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
8.	A.82	18	Absolute encoder checksum error	Absolute encoder data checksum is not correct (MAC-DE only).

Detection Condition	Probable Cause	Corrective Action
When the absolute encoder position is polled (POS.ACT@=POS.ABS@) or during motor operation.	Absolute encoder memory error.	Follow the procedure in the Resetting the Absolute Encoder section of the Operation chapter.
		If error occurs frequently, replace servomotor.
When power is applied to the control power circuit.	Defective servodrive	Replace servodrive.

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SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
8.	A.83	18	Absolute encoder battery error	Absolute encoder backup battery voltage is below 2.8 VDC (MAC-DE only).

Detection Condition	Probable Cause	Corrective Action
When the absolute encoder position is polled (POS.ACT@=POS.ABS@) or during motor operation.	Incorrect encoder or axis interface wiring	Check the encoder (CBL-DEMAC) and axis interface (CBL-ADE) cable model numbers and connection
	Absolute encoder backup battery voltage below 2.8 VDC.	Check the absolute encoder backup battery (DSP Axis Module) voltage. Refer to the Measuring Battery Voltage section of the Maintenance & Troubleshooting chapter of the ORION™ Installation & Operation Manual for further information.
When power is applied to the control power circuit.	Defective servodrive	Replace Servodrive.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
8.	A.84	18	Absolute encoder data error	Absolute encoder data invalid (MAC-DE only).

Detection Condition	Probable Cause	Corrective Action
When power is applied to the control power circuit, when the absolute encoder position is polled (POS.ACT@=POS.ABS@), or during motor operation.	Defective servodrive	Replace servodrive.

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SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
8.	A.85	18	Absolute encoder overspeed	Absolute encoder polled while the motor was rotating over 400 RPM (MAC-DE only).

Detection Condition	Probable Cause	Corrective Action
When absolute encoder position is polled (POS.ACT@=POS.ABS@).	Motor rotating at 400 RPM or greater.	Reduce motor speed below 400 RPM, reset the servodrive alarm, and poll the absolute encoder again.
When power is applied to the control circuit	Defective servodrive	Replace servodrive.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
A.	A.A 1	17	Heat sink temperature too high	Servodrive heat sink temperature too high.

Detection Condition	Probable Cause	Corrective Action
During servomotor operation	The ambient temperature of the servodrive exceeds 55C	Lower the ambient temperature below 55C.
	Air flow around the servodrive is restricted	Provide sufficient space around the servodrive as indicated in the Servodrive Panel Mounting and Environment section of the Installation chapter.
	Defective servodrive fan	Replace servodrive
	Motor load excessive	Reduce the motor load inertia, or command slower motor motion.
When power is applied to the control circuit	Defective servodrive	Replace servodrive.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
b.	A.b 1	10	Invalid torque command input	Servodrive torque command input either absent or invalid.

Detection Condition	Probable Cause	Corrective Action
During servomotor operation	Loss of torque command input	Check axis interface cabling.
During servomotor operation or when enabling the servodrive (MODE@>2)	Defective servodrive	Replace servodrive.

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SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
C.	A.C 1	15	Encoder error (overrun)	Encoder speed higher than the maximum motor speed.

Detection Condition	Probable Cause	Corrective Action
During servomotor operation	Incorrect servomotor wiring	Check the motor cable connection.
	Incorrect encoder wiring	Check the encoder cable model number and connection.
	Defective encoder	Replace motor.
	Defective servodrive	Replace servodrive.
When power is applied to the control circuit	Defective servodrive	Replace servodrive.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
C.	A.C2	15	Encoder channel error	Encoder feedback data absent or invalid.

Detection Condition	Probable Cause	Corrective Action
Within 1 to 3 seconds after power is applied to the control circuit, or during normal servomotor operation	Electrical noise on encoder channels	Separate encoder cabling from motor cabling and other high voltage wiring. If cables were not supplied by ORMEC, verify proper shielding as shown in the CBL-DMAC and CBL-DEMAC in Appendix D.
	Incorrect encoder wiring	Check the encoder cable model number and connection.
	Defective encoder	Replace motor.
	Defective servodrive	Replace servodrive.
When power is applied to the control circuit	Defective servodrive	Replace servodrive.

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SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
C.	A.C3	15	Encoder channel A or B open wire	Encoder channel A or B wiring not connected to encoder.

Detection Condition	Probable Cause	Corrective Action
Within 1 to 3 seconds after power is applied to the control circuit, when the servodrive is enabled (MODE@>2), or during normal servomotor operation	Electrical noise on encoder channels	Separate encoder cabling from motor cabling and other high voltage wiring. If cables were not supplied by ORMEC, verify proper shielding as shown in the CBL-DMAC and CBL-DEMAC in Appendix D.
	Incorrect encoder wiring	Check the encoder cable model number and connection.
	Defective encoder	Replace motor.
	Defective servodrive	Replace servodrive.
When power is applied to the control circuit	Defective servodrive	Replace servodrive.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
C.	A.C4	15	Encoder reference channel open wire	Encoder reference channel wiring not connected to encoder.

Detection Condition	Probable Cause	Corrective Action
Within 1 to 3 seconds after power is applied to the control circuit, when the servodrive is enabled (MODE@>2), or during normal servomotor operation	Electrical noise on encoder channels	Separate encoder cabling from motor cabling and other high voltage wiring. If cables were not supplied by ORMEC, verify proper shielding as shown in the CBL-DMAC and CBL-DEMAC in Appendix D.
	Incorrect encoder wiring	Check the encoder cable model number and connection.
	Defective encoder	Replace motor.
	Defective servodrive	Replace servodrive.
When power is applied to the control circuit	Defective encoder	Replace motor.

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SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
F.	A.F 1	12	Input power phase error	One phase of the main servodrive power (R, S, T) absent or the wrong voltage.

Detection Condition	Probable Cause	Corrective Action
When power is applied to the main circuit	One phase of the main circuit power (R, S, T) is disconnected	Check the incoming power line voltage and wiring. Check noise filter, contactor, etc. and associated wiring.
	One phase of the main circuit power has a low line voltage	Check the incoming power line voltage.
When power is applied to the control circuit	Defective servodrive	Replace servodrive.

SAC-DE 7 Seg. LED	SAC-OP03A	ALARM@	Status	Description
F.	A.F 3	12	Input power loss	Servodrive main power (R, S, T) voltage or frequency incorrect.

Detection Condition	Probable Cause	Corrective Action
When power is applied to the main circuit	Time between main power (R, S, T) cycles less than 0.5 seconds	Disable the main power and wait at least 0.5 seconds before reapplying main power.
During normal servomotor operation	Main power (R, S, T) input voltage drop	Check the main power input line voltage.
	Main power (R, S, T) input voltage interrupted for at least 1/2 cycle	Check the main power input frequency/integrity.

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7.5 IP-67 Motor Shaft Seal Lubrication

Motors with the IP-67 sealing option (MAC-D_____/_V_) have a shaft seal (Figure 13), which requires lubrication. You should check the shaft seal frequently, depending on your application, and verify that it is lubricated. An insufficiently lubricated shaft seal will deteriorate with use (motor rotation), and decrease in effectiveness. A gear oil (SAE70 to 90) should be applied directly to the shaft seal as lubrication.

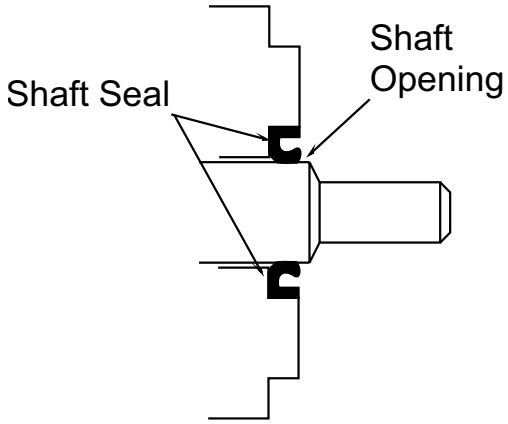
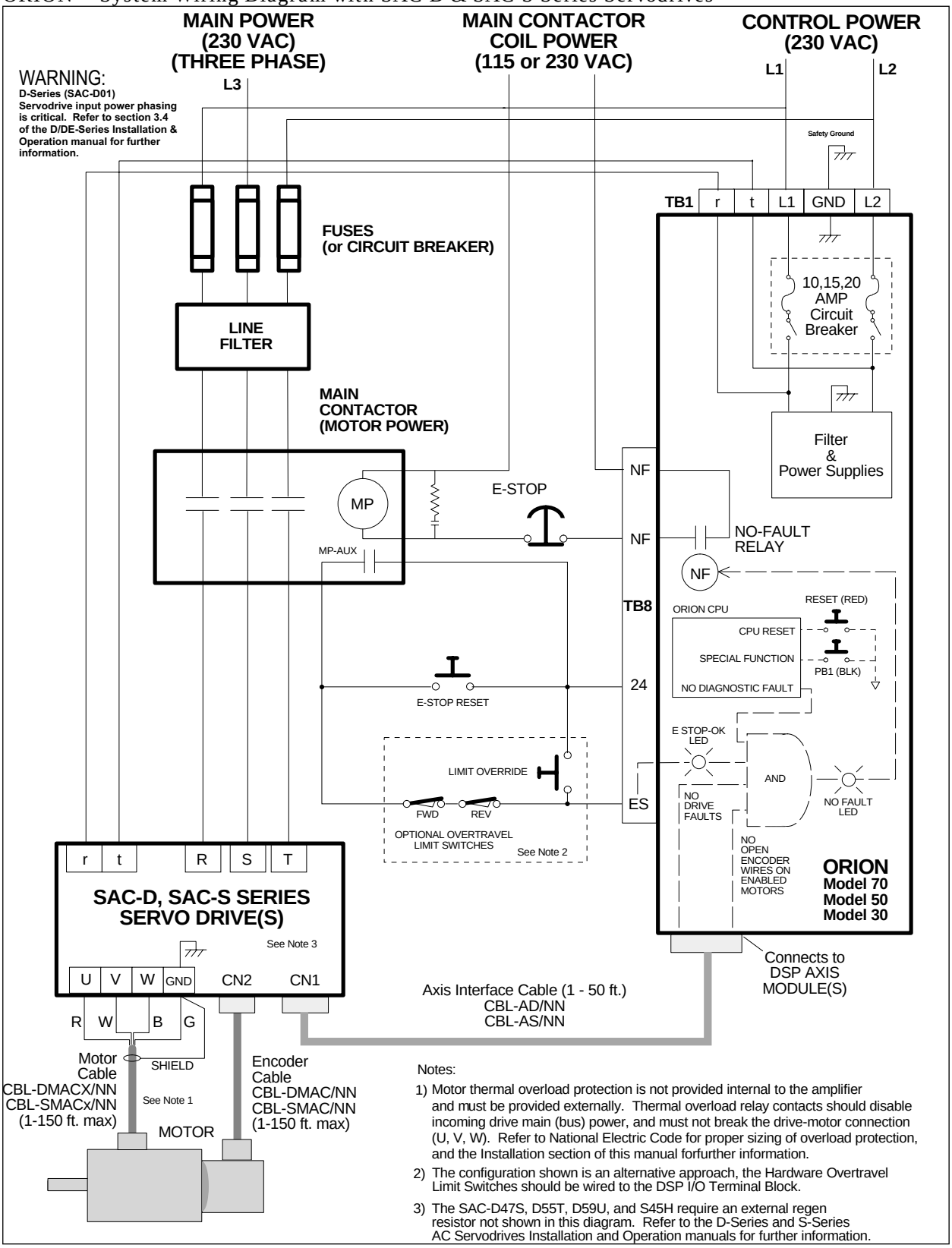


***Figure 13**, Motor Shaft/Oil Seal Cross Section*

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System Wiring Diagrams

ORION™ System Wiring Diagram with SAC-D & SAC-S Series Servodrives

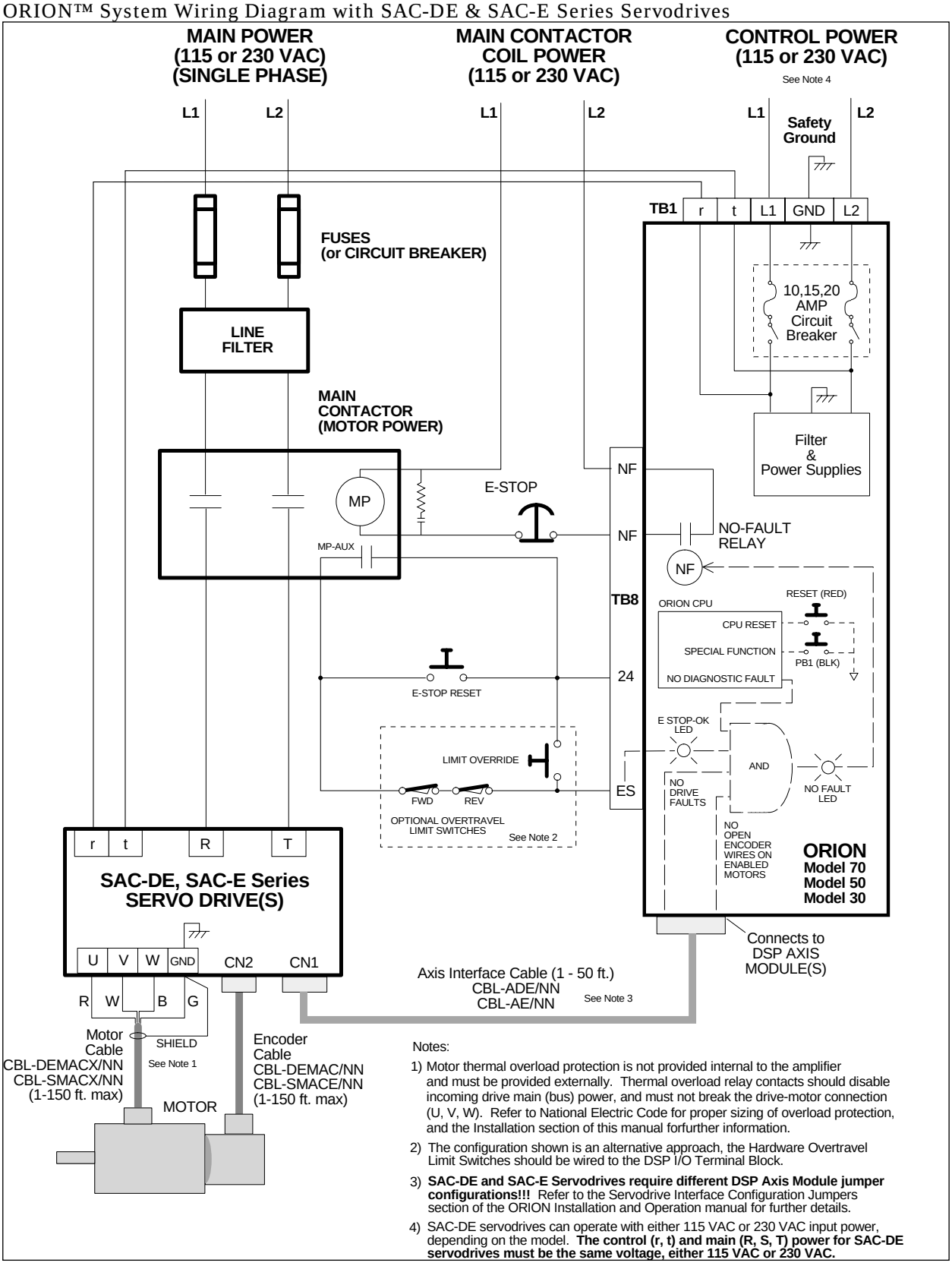


Notes:

1) Motor thermal overload protection is not provided internal to the amplifier and must be provided externally. Thermal overload relay contacts should disable incoming drive main (bus) power, and must not break the drive-motor connection (U, V, W). Refer to National Electric Code for proper sizing of overload protection, and the Installation section of this manual forfurther information.
2) The configuration shown is an alternative approach, the Hardware Overtravel Limit Switches should be wired to the DSP I/O Terminal Block.
3) The SAC-D47S, D55T, D59U, and S45H require an external regen resistor not shown in this diagram. Refer to the D-Series and S-Series AC Servodrives Installation and Operation manuals for further information.

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ORION™ System Wiring Diagram with SAC-DE & SAC-E Series Servodrives

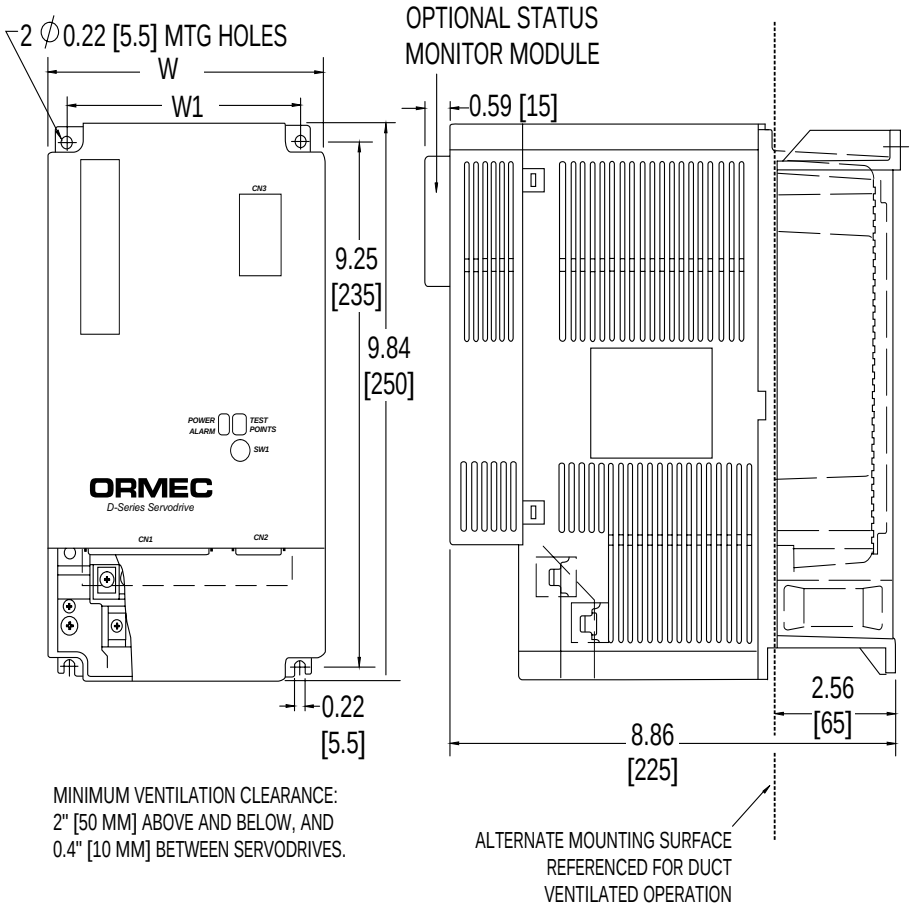


Notes:

1) Motor thermal overload protection is not provided internal to the amplifier and must be provided externally. Thermal overload relay contacts should disable incoming drive main (bus) power, and must not break the drive-motor connection (U, V, W). Refer to National Electric Code for proper sizing of overload protection, and the Installation section of this manual forfurther information.
2) The configuration shown is an alternative approach, the Hardware Overtravel Limit Switches should be wired to the DSP I/O Terminal Block.
3) **SAC-DE and SAC-E Servodrives require different DSP Axis Module jumper configurations!!!** Refer to the Servodrive Interface Configuration Jumpers section of the ORION Installation and Operation manual for further details.
4) SAC-DE servodrives can operate with either 115 VAC or 230 VAC input power, depending on the model. **The control (r, t) and main (R, S, T) power for SAC-DE servodrives must be the same voltage, either 115 VAC or 230 VAC.**

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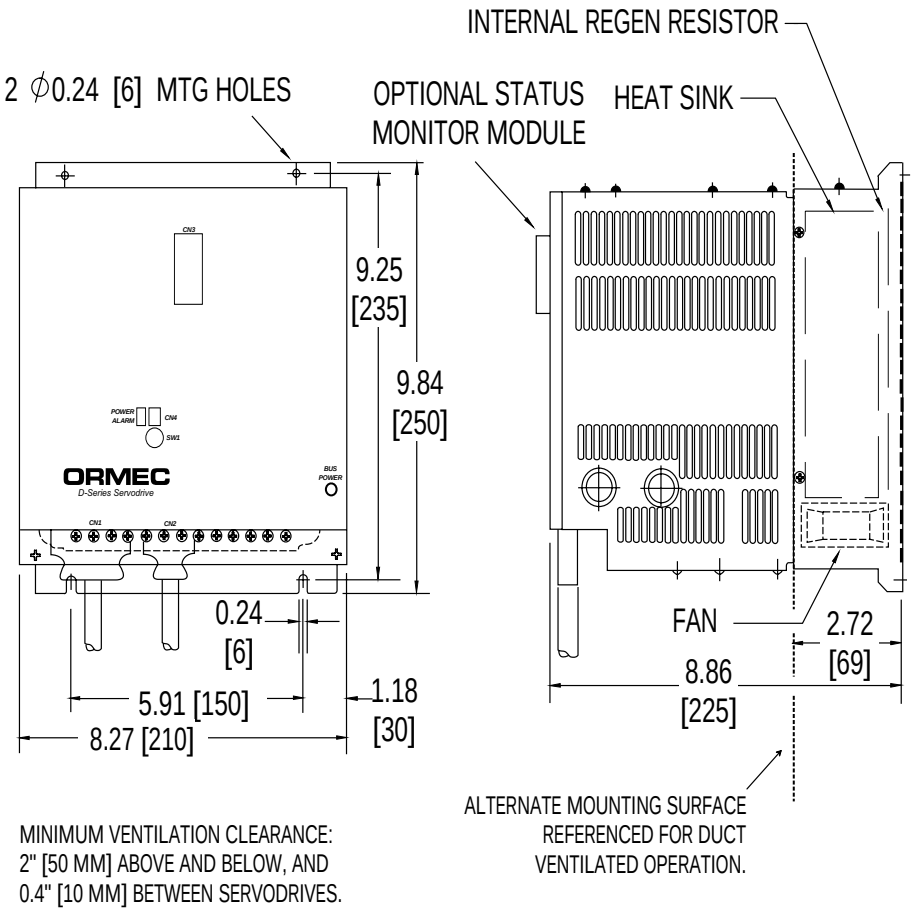
Component Layout Diagrams
SAC-D04 , D08, D12, & D19 Servodrive Layout



Servodrive	**W** inches [mm]	**W1** inches [mm]
SAC-D04	4.33 [110]	3.62 [92]
SAC-D08	4.33 [110]	3.62 [92]
SAC-D12	4.33 [110]	3.62 [92]
SAC-D19	5.31 [135]	4.61 [117]

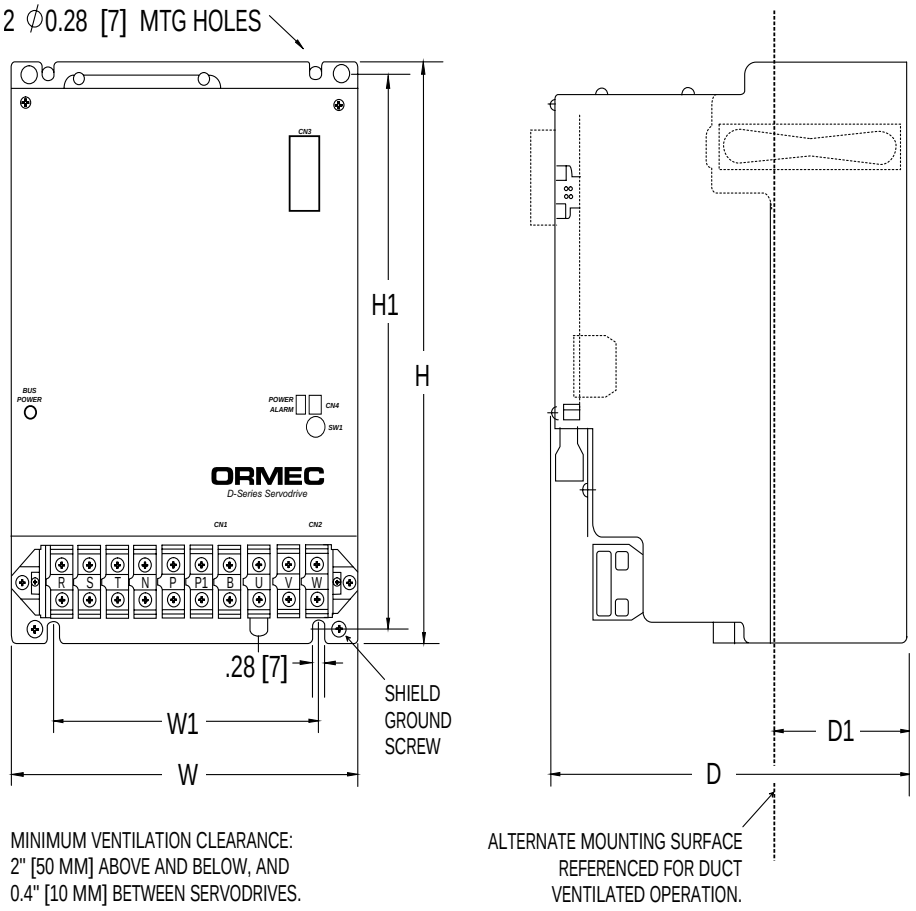
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SAC-D37 Servodrive Layout



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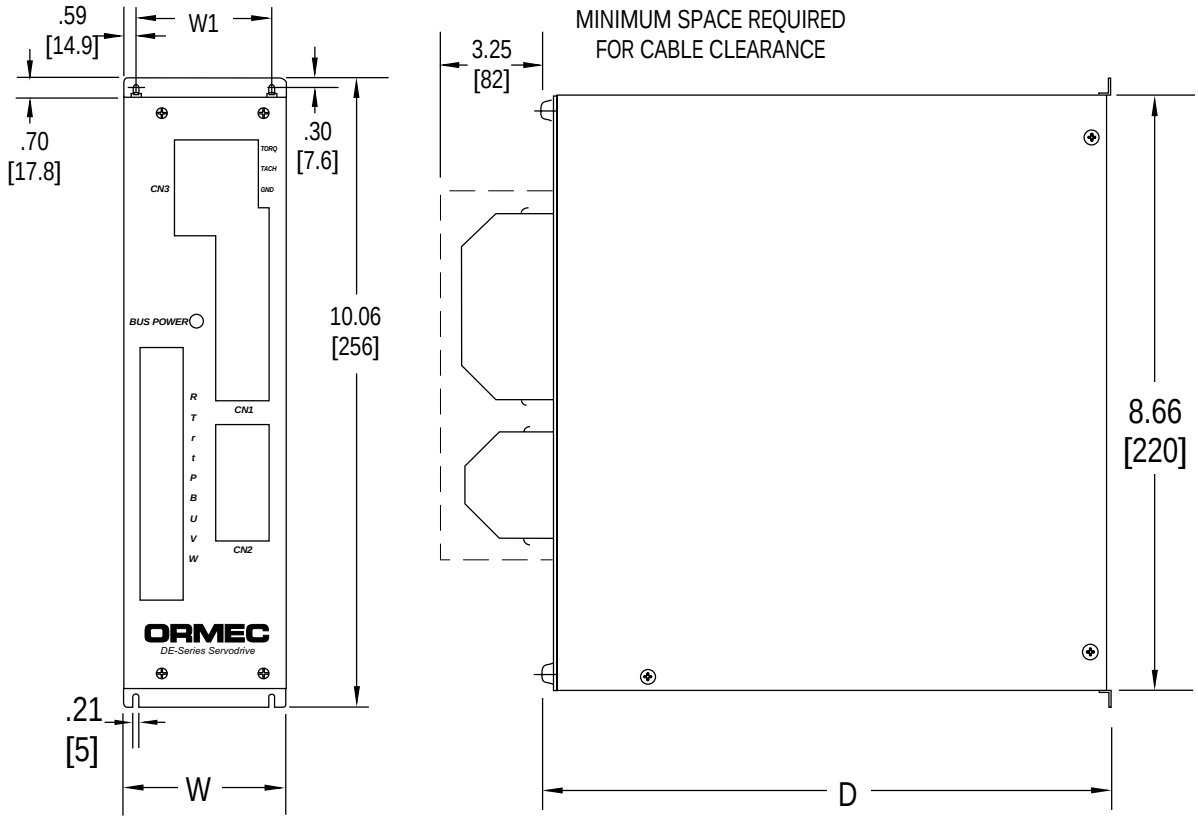
SAC-D47, D55, & D59 Servodrive Layout



Servodrive	**W** inches [mm]	**W1** inches [mm]	**H** inches [mm]	**H1** inches [mm]	**D** inches [mm]	**D1** inches [mm]
SAC-D47	9.06 [230]	7.09 [180]	13.78 [350]	13.19 [335]	9.25 [235]	3.54 [90]
SAC-D55	9.06 [230]	7.09 [180]	13.78 [350]	13.19 [335]	9.25 [235]	3.54 [90]
SAC-D59	10.24 [160]	7.87 [200]	17.72 [450]	17.13 [435]	11.2 [285]	4.92 [125]

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SAC-DE Servodrive Layout

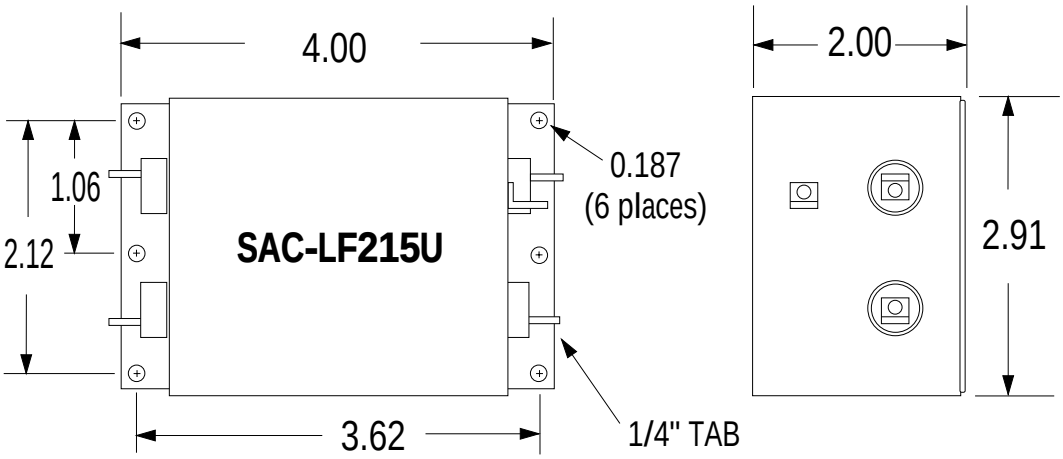


MINIMUM VENTILATION CLEARANCE:
2" [50 MM] ABOVE AND BELOW, AND
0.6" [15 MM] BETWEEN SERVODRIVES.

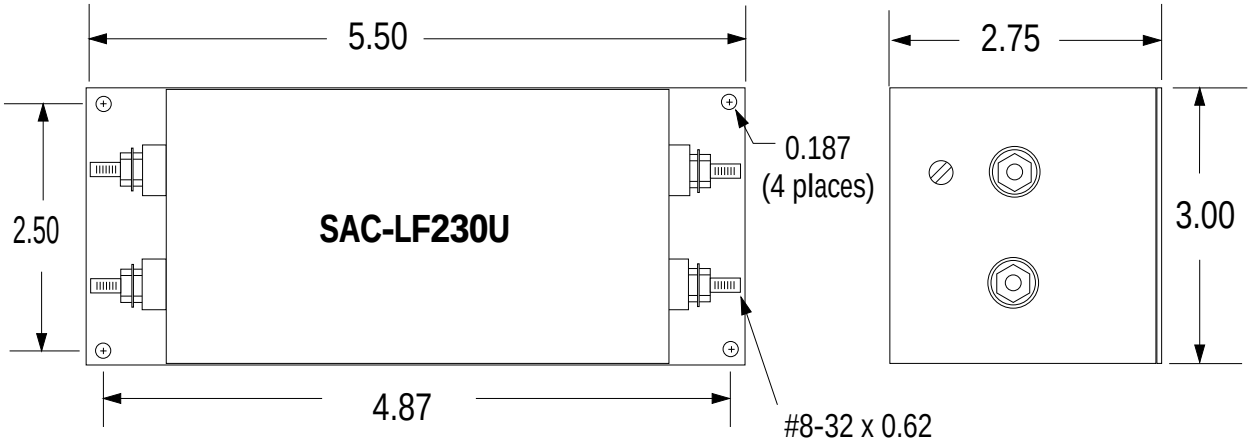
Servodrive	**W** inches [mm]	**W1** inches [mm]	**D** inches [mm]
SAC-DE02A1	2.36 [60]	1.19 [30]	8.46 [215]
SAC-DE03B1	2.95 [75]	1.77 [45]	10.39 [264]
SAC-DE04C1	2.95 [75]	1.77 [45]	10.39 [264]
SAC-DE01A2	2.36 [60]	1.19 [30]	8.46 [215]
SAC-DE02B2	2.36 [60]	1.19 [30]	8.46 [215]
SAC-DE03C2	2.95 [75]	1.77 [45]	10.39 [264]
SAC-DE04D2	2.95 [75]	1.77 [45]	10.39 [264]

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SAC-LF215U Line Filter Layout

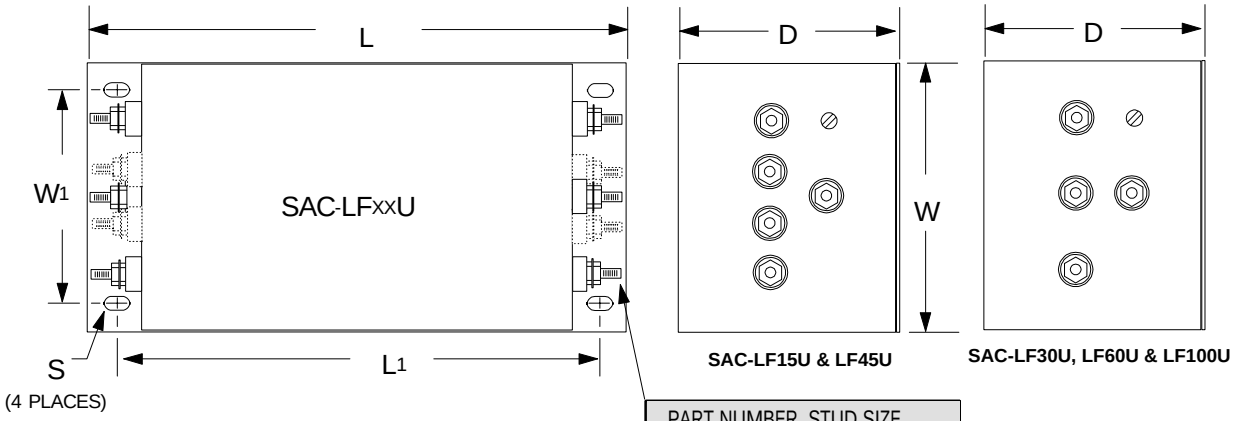


SAC-LF230U Line Filter Layout

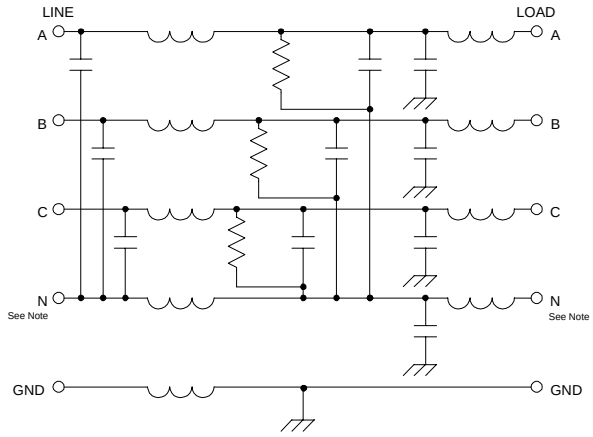


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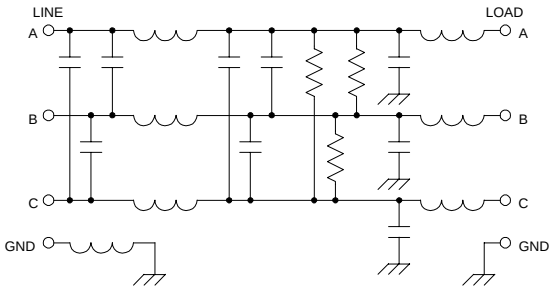
SAC-LF15U, 30U, 45U, 60U, & 100U Line Filter Layout



PART NUMBER	STUD SIZE
SAC-LF15U	#10-32 x 0.93
SAC-LF30U	#10-32 x 0.93
SAC-LF45U	#10-32 x 0.93
SAC-LF60U	1/4-20 x 1.12
SAC-LF100U	5/16-18 x 1.12



SAC-LF15U & SAC-LF45U



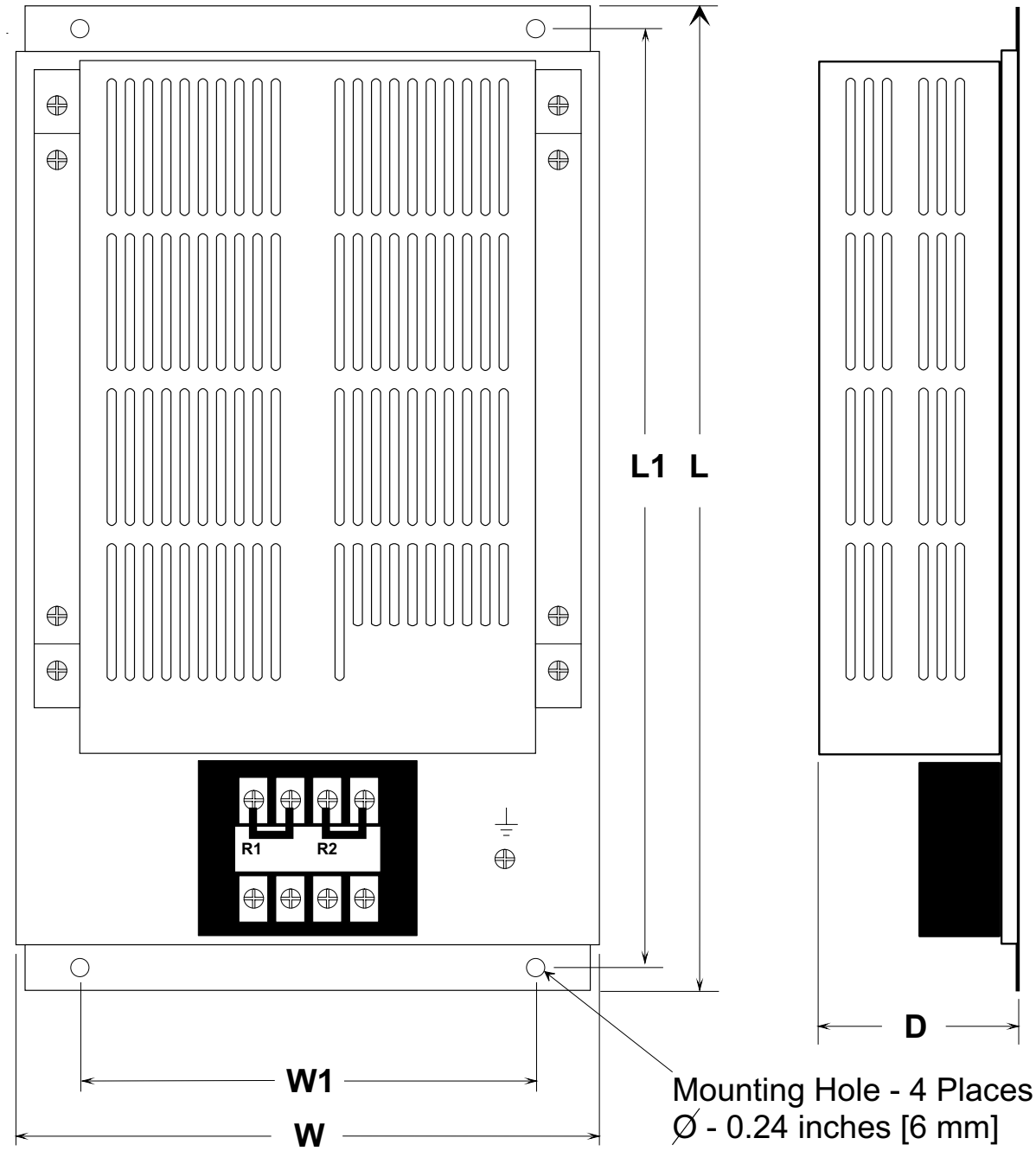
SAC-LF30U, SAC-LF60U & SAC-LF100U

NOTE:
1) The line filter neutral phase (N) should only be connected to the neutral of a wye configured transformer.
2) For a delta configured transformer, leave the neutral phase disconnected.
3) DO NOT CONNECT THE NEUTRAL PHASE (N) to CHASSIS GROUND (GND)
4) Refer to section 3.4.1 (Input and Output Power Connections) for further information regarding input power transformer configurations.

Line Filter	W inches [mm]	W1 inches [mm]	L inches [mm]	L1 inches [mm]	D inches [mm]	S inches [mm]
SAC-LF15U	4.0 [102]	3.3 [83]	8.6 [219]	7.8 [198]	4.0 [102]	0.2x0.4 [5x9]
SAC-LF30U	5.0 [127]	4.0 [102]	10.0 [254]	9.0 [229]	4.8 [121]	0.3x0.5 [7x13]
SAC-LF45U	5.0 [127]	4.0 [102]	13.0 [330]	12.0 [305]	4.8 [121]	0.3x0.5 [7x13]
SAC-LF60U	6.5 [165]	4.3 [108]	14.0 [356]	13.0 [330]	4.8 [121]	0.3x0.6 [8x16]
SAC-LF100U	6.5 [165]	4.3 [108]	14.0 [356]	13.0 [330]	4.8 [121]	0.3x0.6 [8x16]

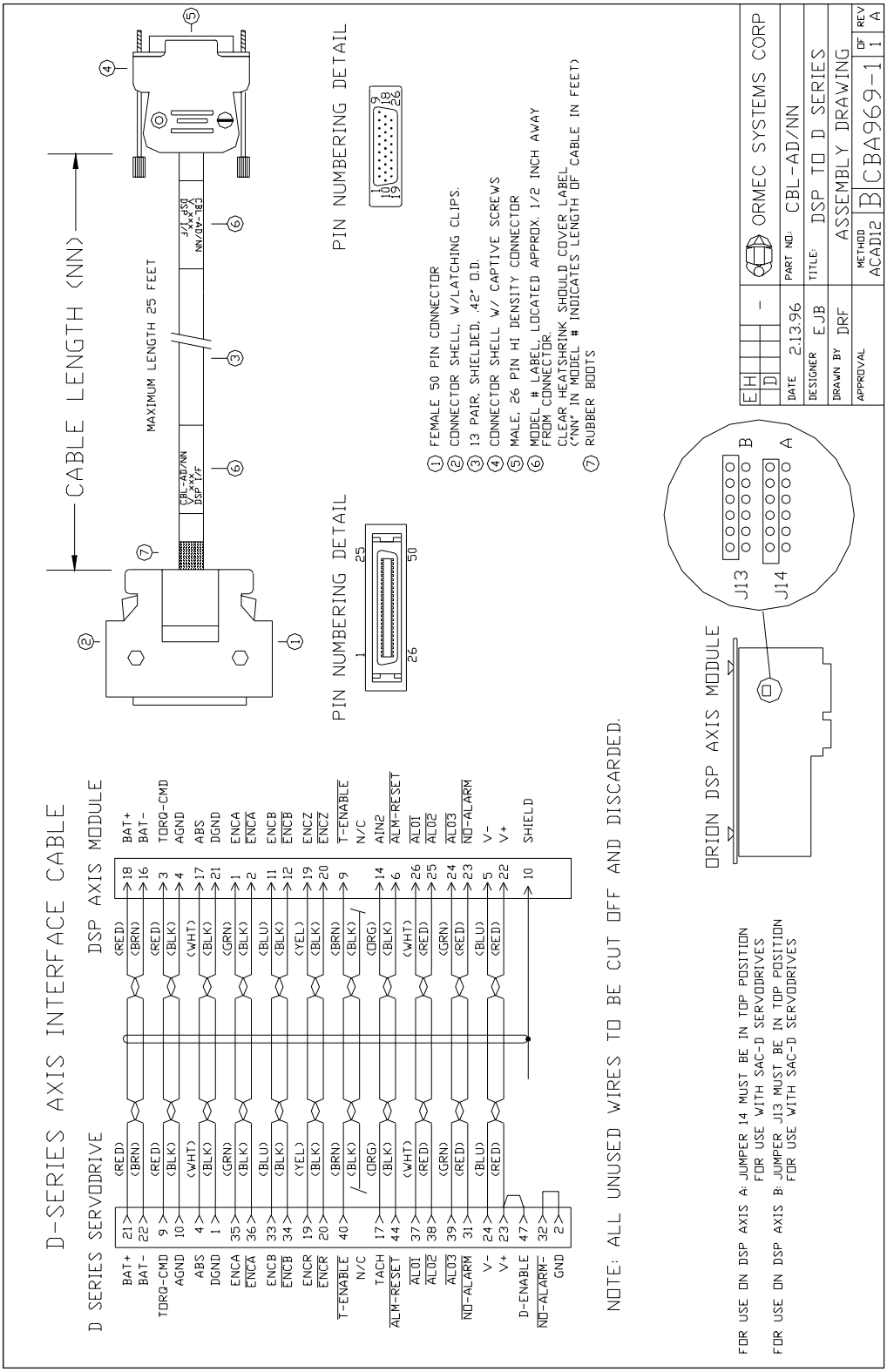
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SAC-DRR Regen Resistor Layout

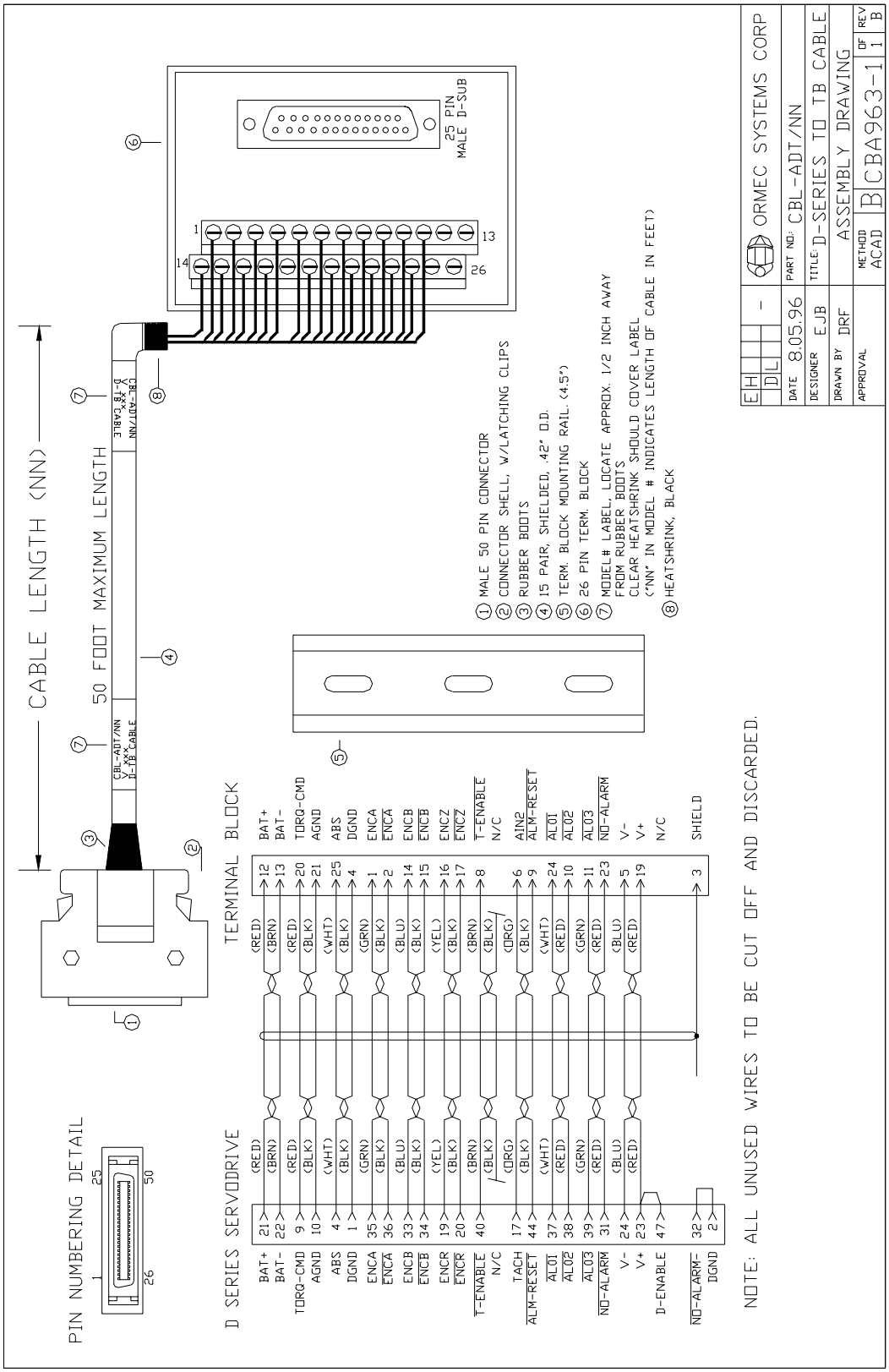


Regen Resistor	W inches [mm]	W1 inches [mm]	L inches [mm]	L1 inches [mm]	D inches [mm]
SAC-DRR/0880	8.7 [220]	7.1 [180]	13.8 [350]	13.2 [335]	3.7 [92]
SAC-DRR/1760	11.8 [300]	9.9 [250]	13.8 [350]	13.2 [335]	3.8 [95]

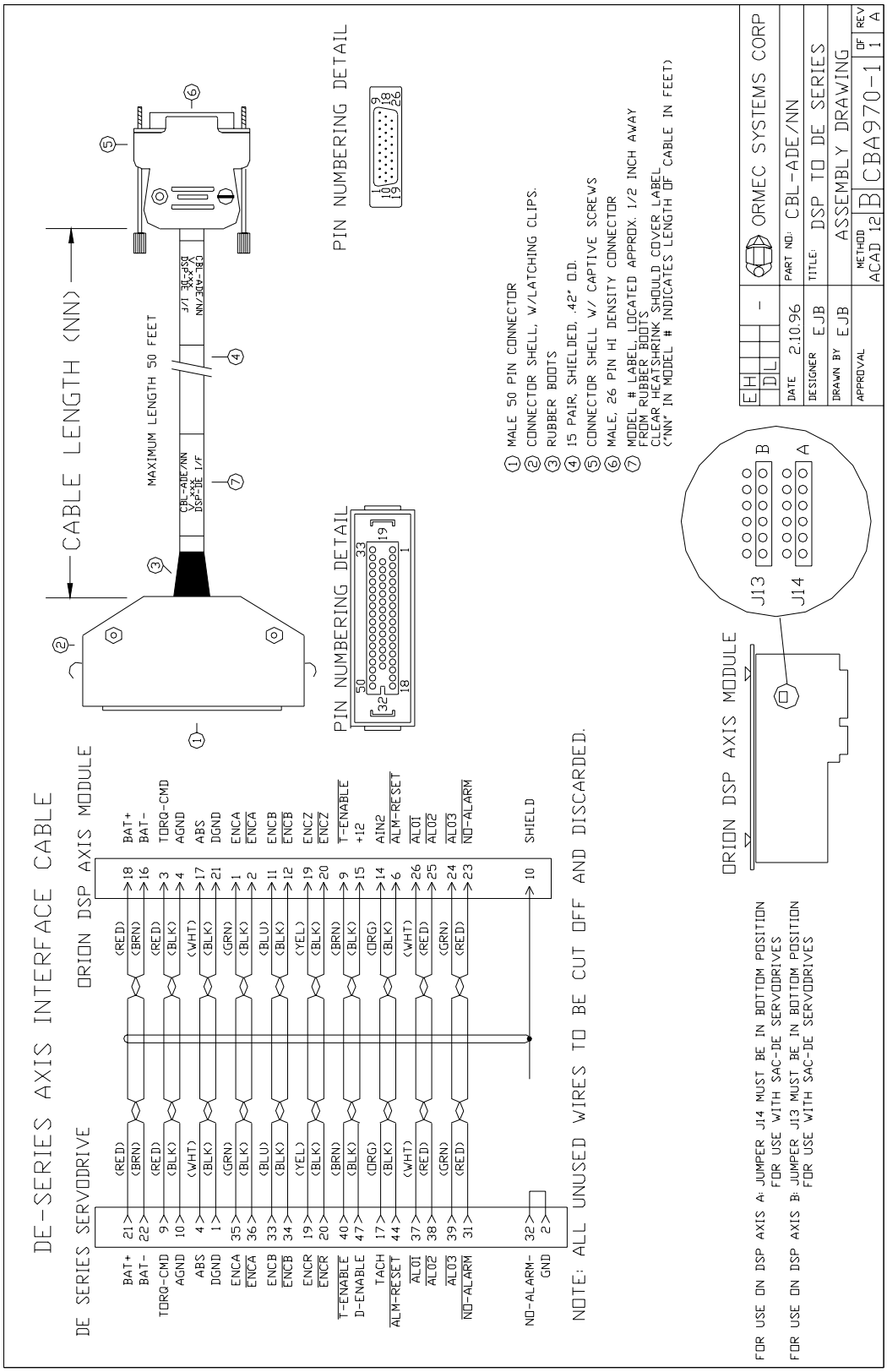
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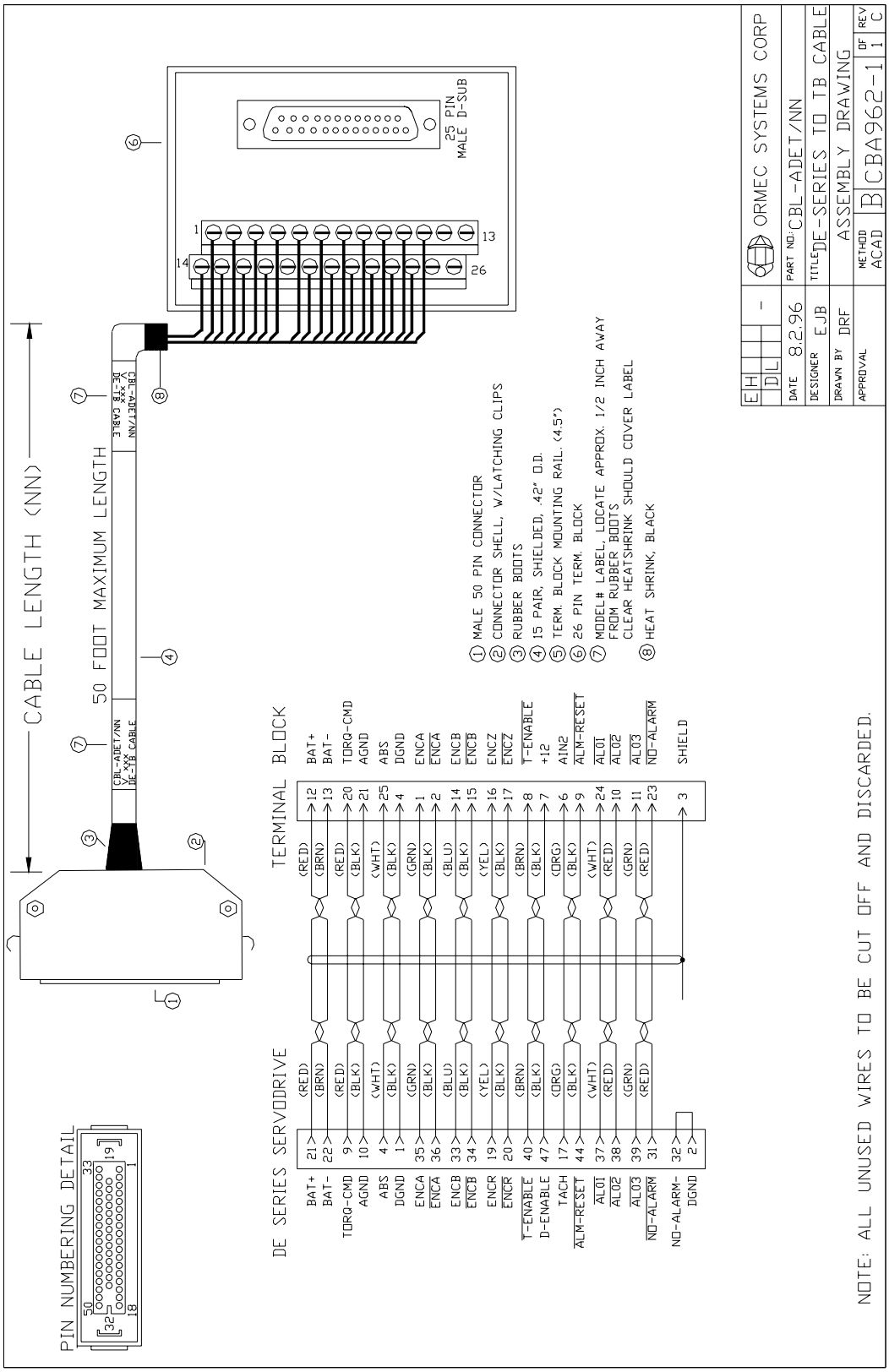
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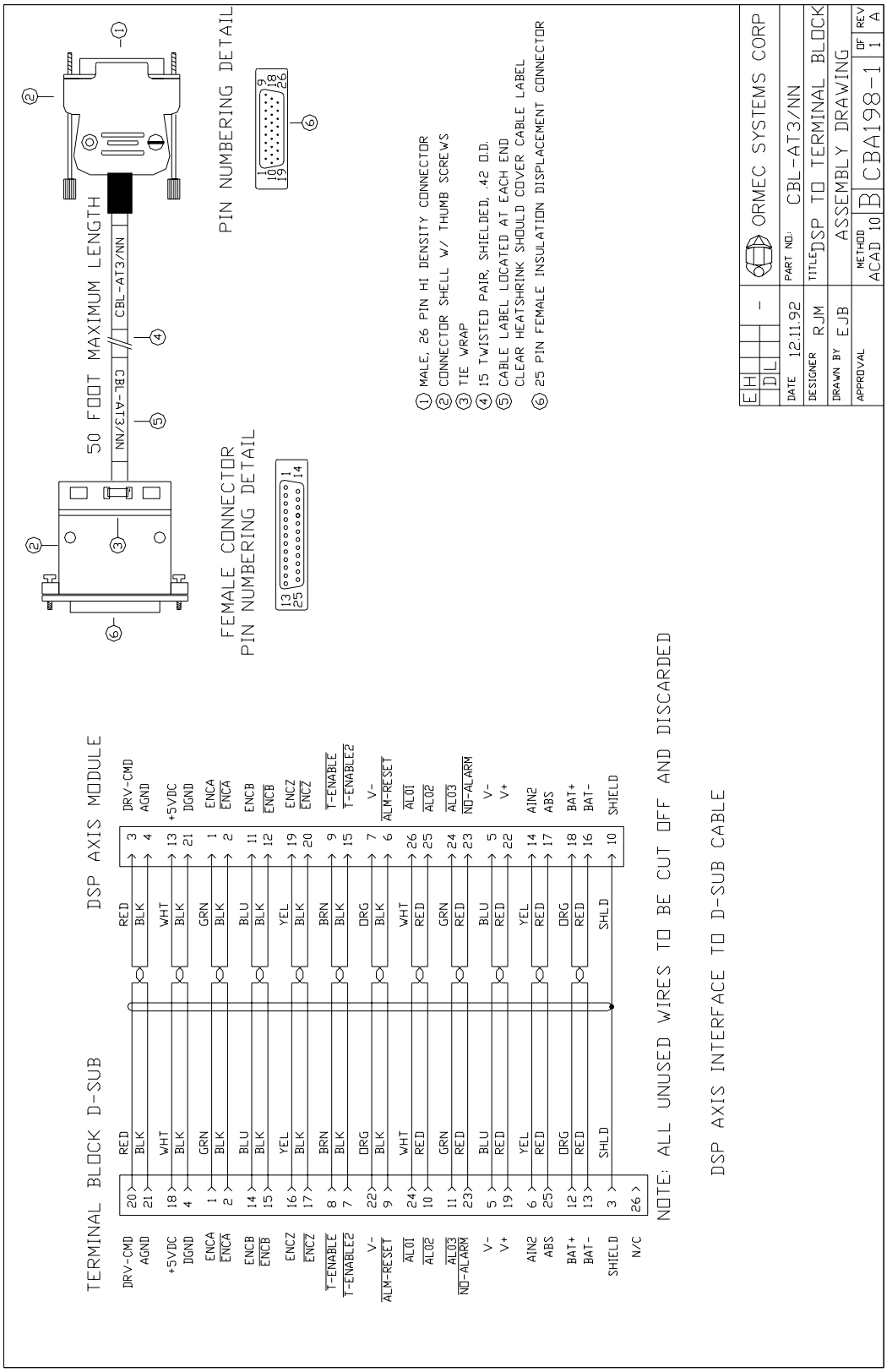
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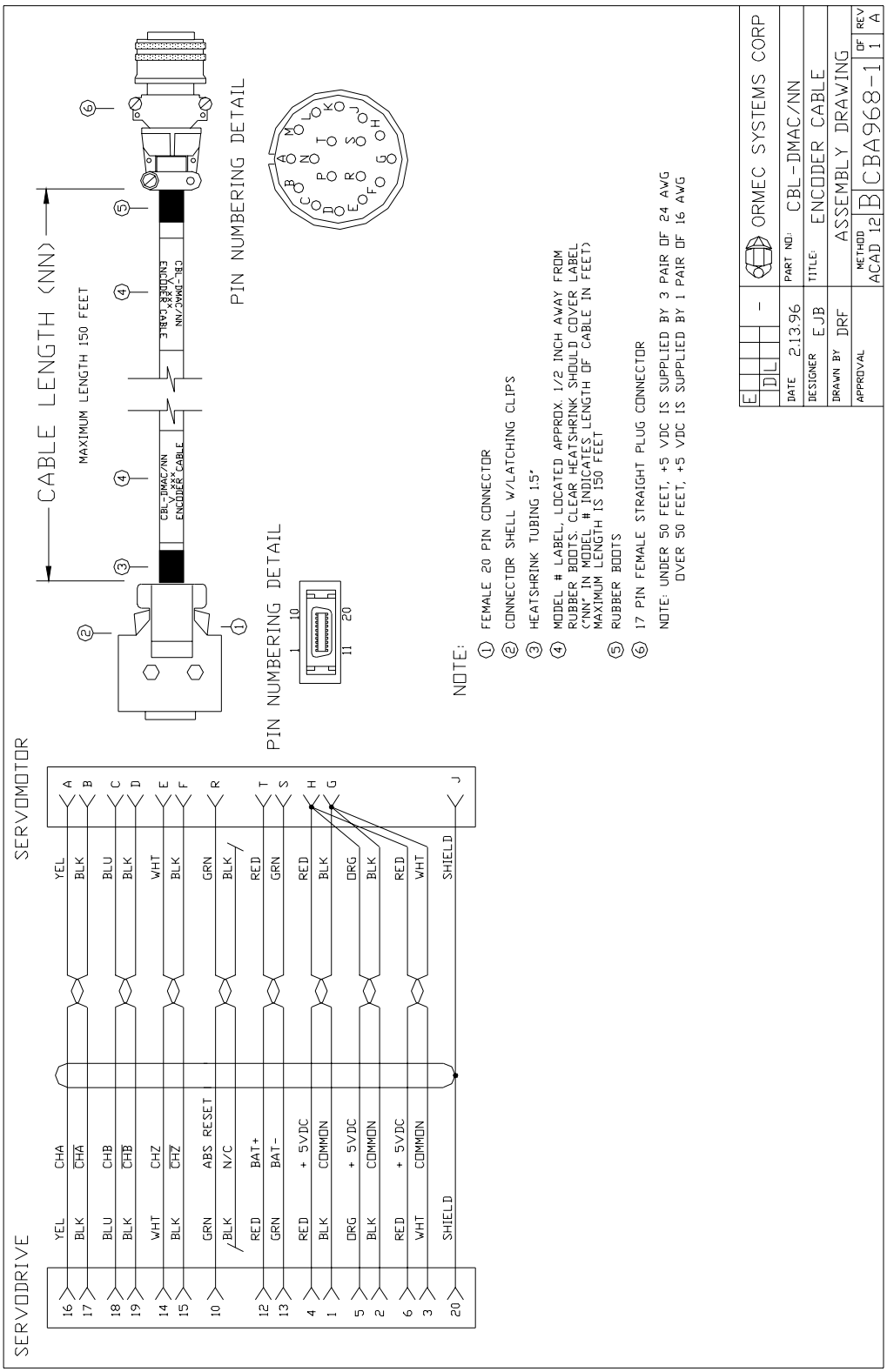
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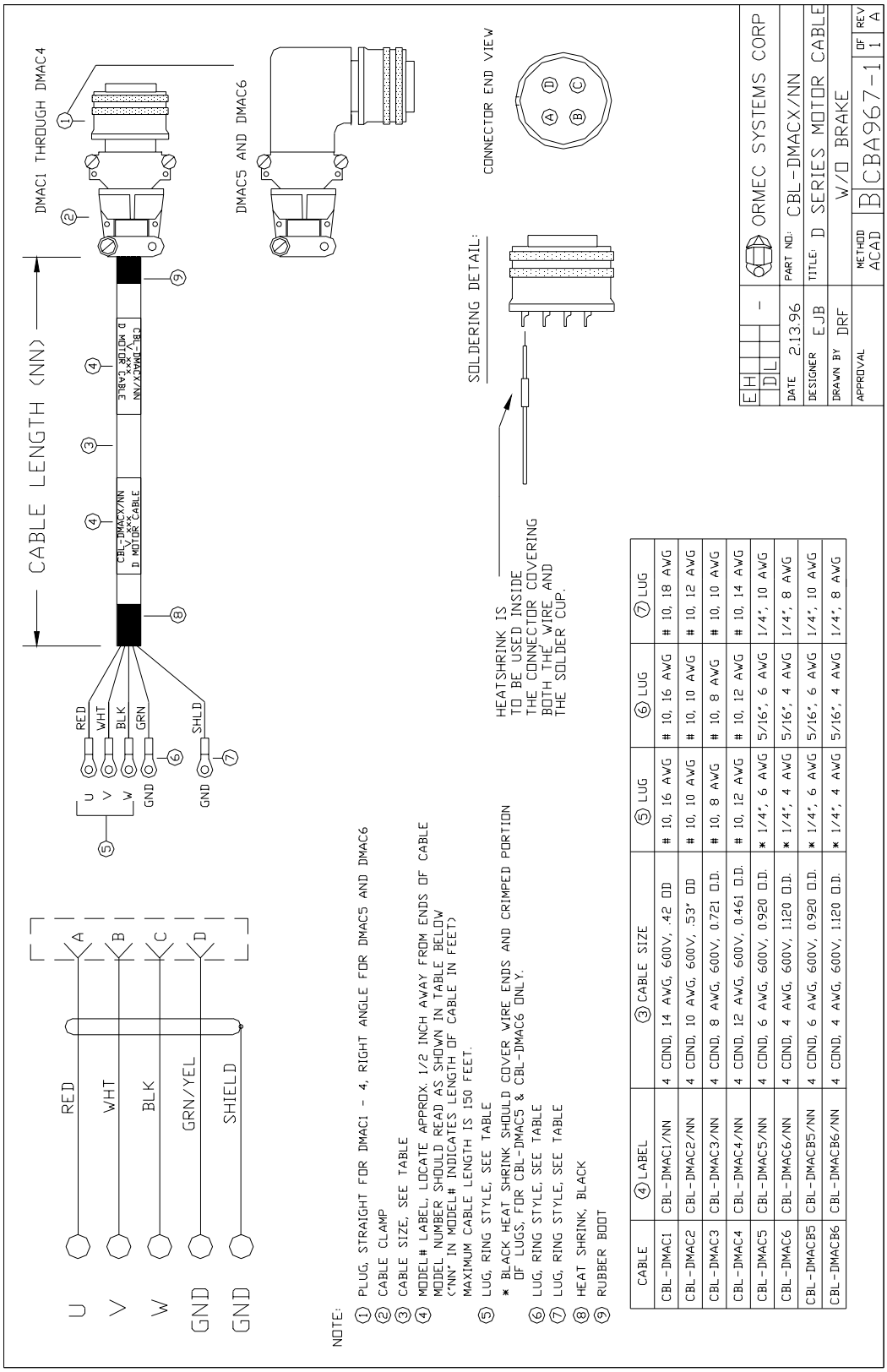
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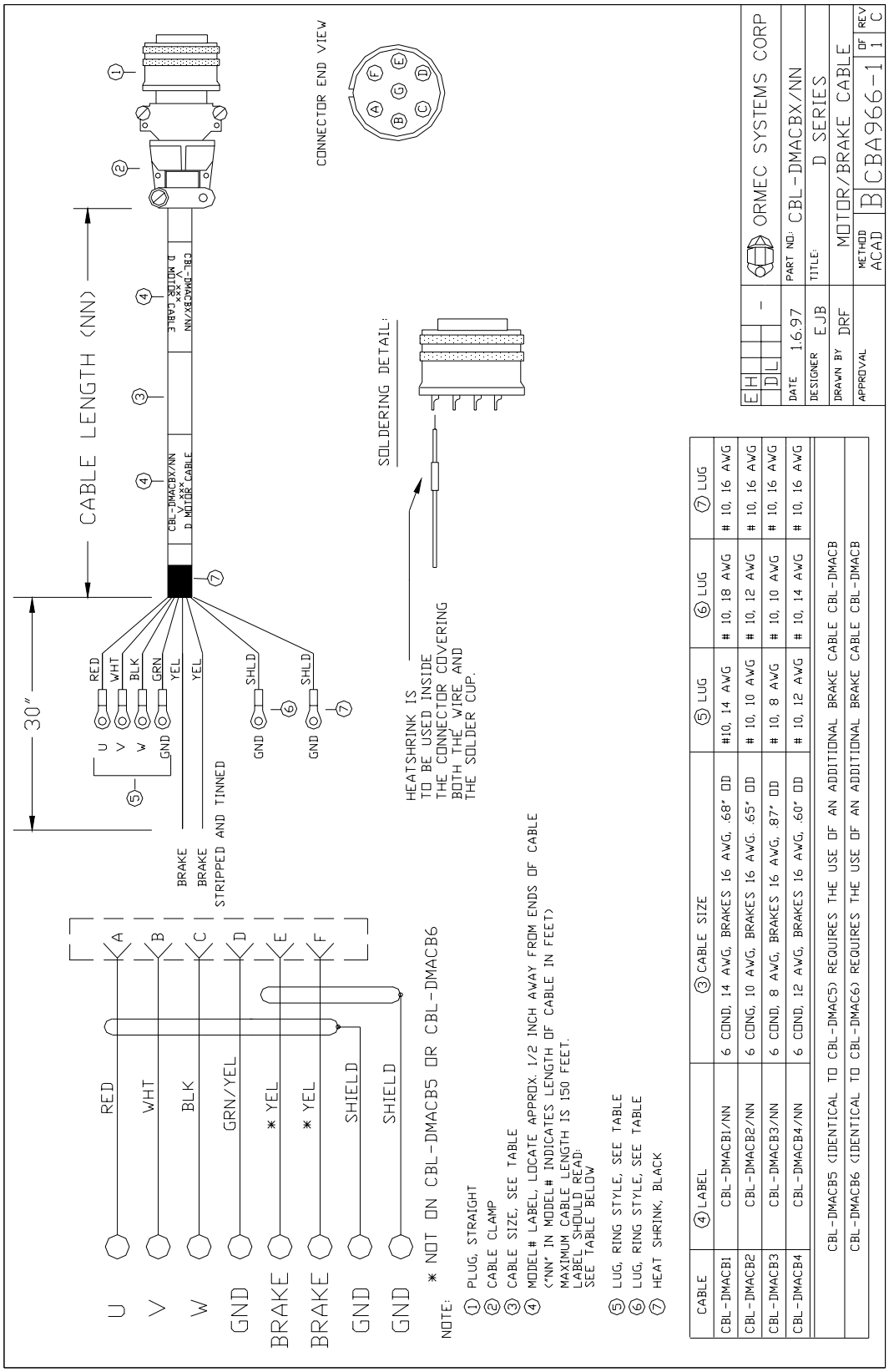
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NOTE:
① PLUG, STRAIGHT FOR DMAC1 - 4, RIGHT ANGLE FOR DMAC5 AND DMAC6
② CABLE CLAMP
③ CABLE SIZE, SEE TABLE
④ MODEL# LABEL, LOCATE APPROX 1/2 INCH AWAY FROM ENDS OF CABLE
MODEL NUMBER SHOULD READ AS SHOWN IN TABLE BELOW
("NN" IN MODEL# INDICATES LENGTH OF CABLE IN FEET)
MAXIMUM CABLE LENGTH IS 150 FEET.
⑤ LUG, RING STYLE, SEE TABLE
* BLACK HEAT SHRINK SHOULD COVER WIRE ENDS AND CRIMPED PORTION OF LUGS, FOR CBL-DMAC5 & CBL-DMAC6 ONLY.
⑥ LUG, RING STYLE, SEE TABLE
⑦ LUG, RING STYLE, SEE TABLE
⑧ HEAT SHRINK, BLACK
⑨ RUBBER BOOT

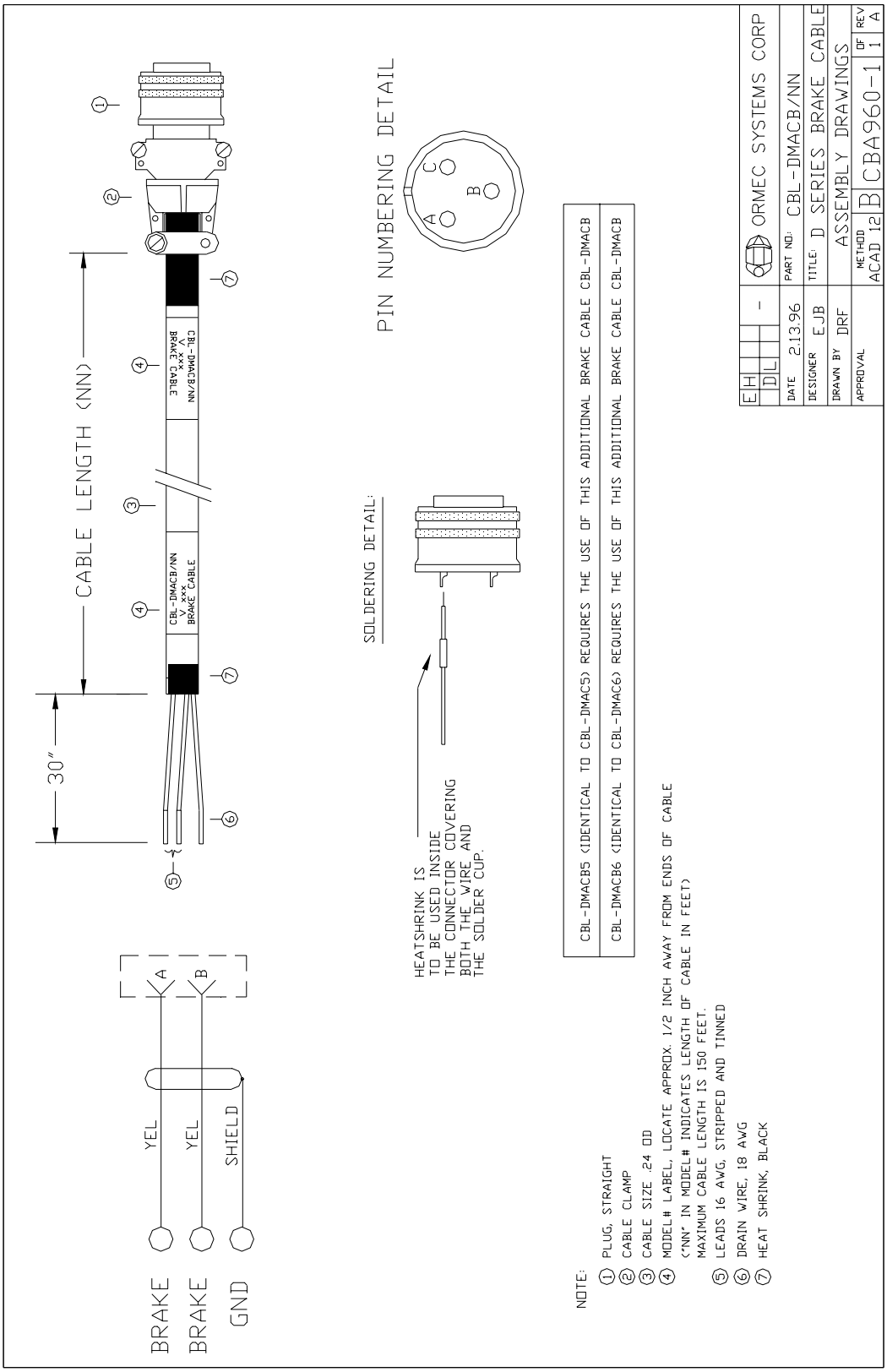
CABLE	④ LABEL	③ CABLE SIZE	⑤ LUG	⑥ LUG	⑦ LUG
CBL-DMAC1	CBL-DMAC1/NN	4 COND, 14 AWG, 600V, .42 OD	# 10, 16 AWG	# 10, 16 AWG	# 10, 18 AWG
CBL-DMAC2	CBL-DMAC2/NN	4 COND, 10 AWG, 600V, .53" OD	# 10, 10 AWG	# 10, 10 AWG	# 10, 12 AWG
CBL-DMAC3	CBL-DMAC3/NN	4 COND, 8 AWG, 600V, 0.721 O.D.	# 10, 8 AWG	# 10, 8 AWG	# 10, 10 AWG
CBL-DMAC4	CBL-DMAC4/NN	4 COND, 12 AWG, 600V, 0.461 O.D.	# 10, 12 AWG	# 10, 12 AWG	# 10, 14 AWG
CBL-DMAC5	CBL-DMAC5/NN	4 COND, 6 AWG, 600V, 0.920 O.D.	* 1/4", 6 AWG	5/16", 6 AWG	1/4", 10 AWG
CBL-DMAC6	CBL-DMAC6/NN	4 COND, 4 AWG, 600V, 1.120 O.D.	* 1/4", 4 AWG	5/16", 4 AWG	1/4", 8 AWG
CBL-DMACB5	CBL-DMACB5/NN	4 COND, 6 AWG, 600V, 0.920 O.D.	* 1/4", 6 AWG	5/16", 6 AWG	1/4", 10 AWG
CBL-DMACB6	CBL-DMACB6/NN	4 COND, 4 AWG, 600V, 1.120 O.D.	* 1/4", 4 AWG	5/16", 4 AWG	1/4", 8 AWG

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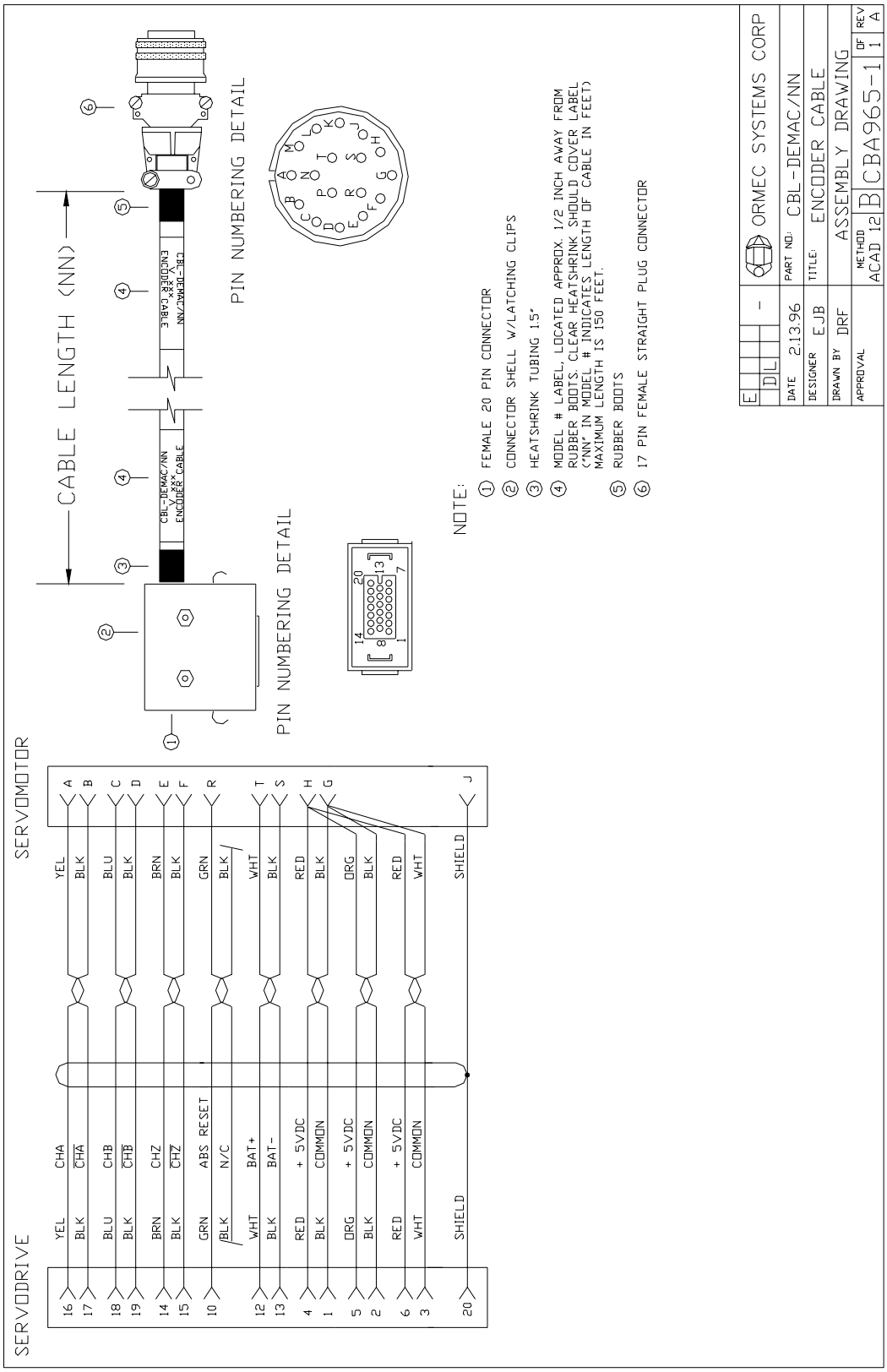


CABLE	④ LABEL	③ CABLE SIZE	⑤ LUG	⑥ LUG	⑦ LUG
CBL-DMACB1	CBL-DMACB1/NN	6 COND, 14 AWG, BRAKES 16 AWG, .68" OD	#10, 14 AWG	# 10, 18 AWG	# 10, 16 AWG
CBL-DMACB2	CBL-DMACB2/NN	6 COND, 10 AWG, BRAKES 16 AWG, .65" OD	# 10, 10 AWG	# 10, 12 AWG	# 10, 16 AWG
CBL-DMACB3	CBL-DMACB3/NN	6 COND, 8 AWG, BRAKES 16 AWG, .87" OD	# 10, 8 AWG	# 10, 10 AWG	# 10, 16 AWG
CBL-DMACB4	CBL-DMACB4/NN	6 COND, 12 AWG, BRAKES 16 AWG, .60" OD	# 10, 12 AWG	# 10, 14 AWG	# 10, 16 AWG
CBL-DMACB5 (IDENTICAL TO CBL-DMAC5) REQUIRES THE USE OF AN ADDITIONAL BRAKE CABLE CBL-DMACB					
CBL-DMACB6 (IDENTICAL TO CBL-DMAC6) REQUIRES THE USE OF AN ADDITIONAL BRAKE CABLE CBL-DMACB					

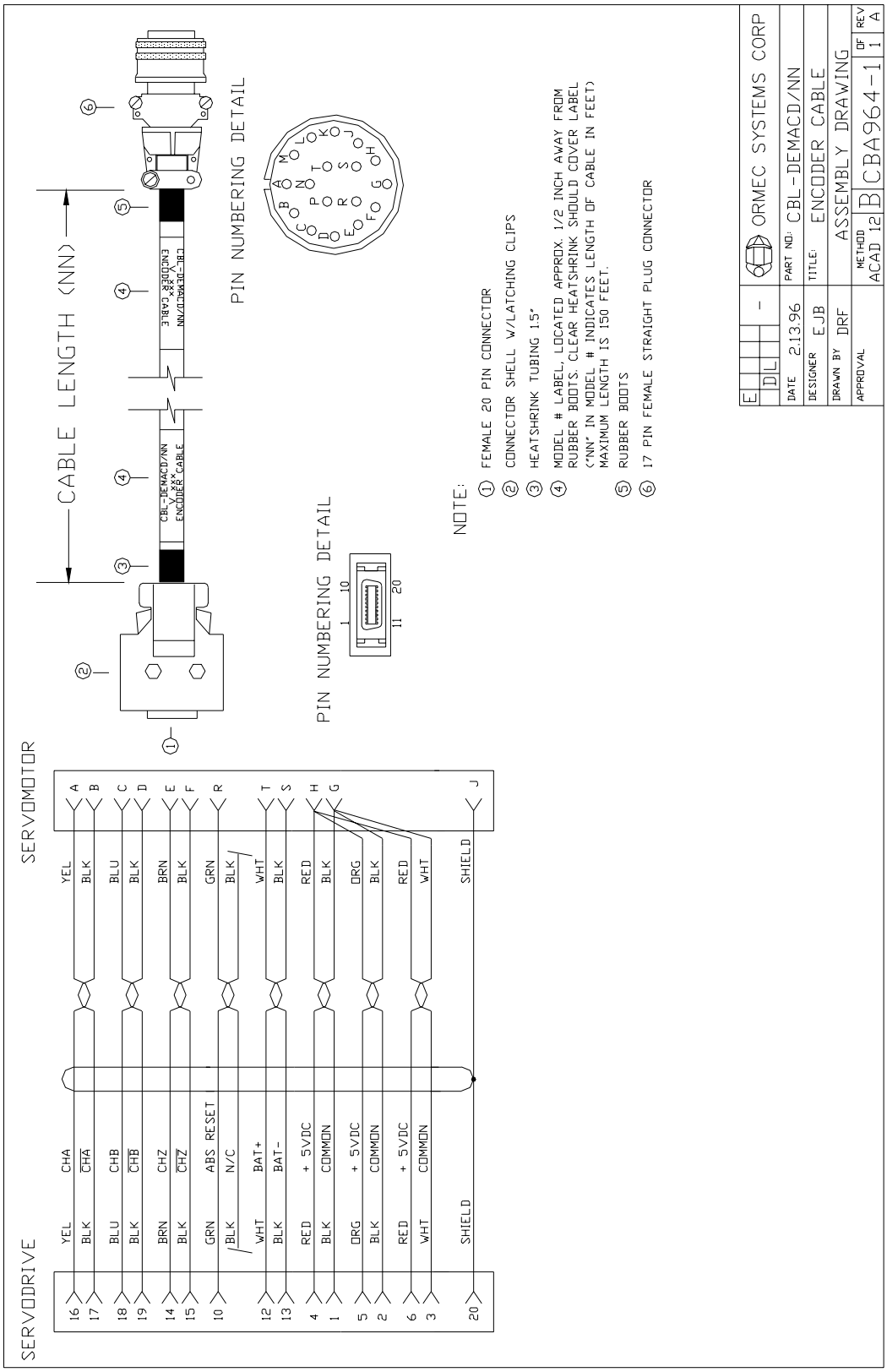
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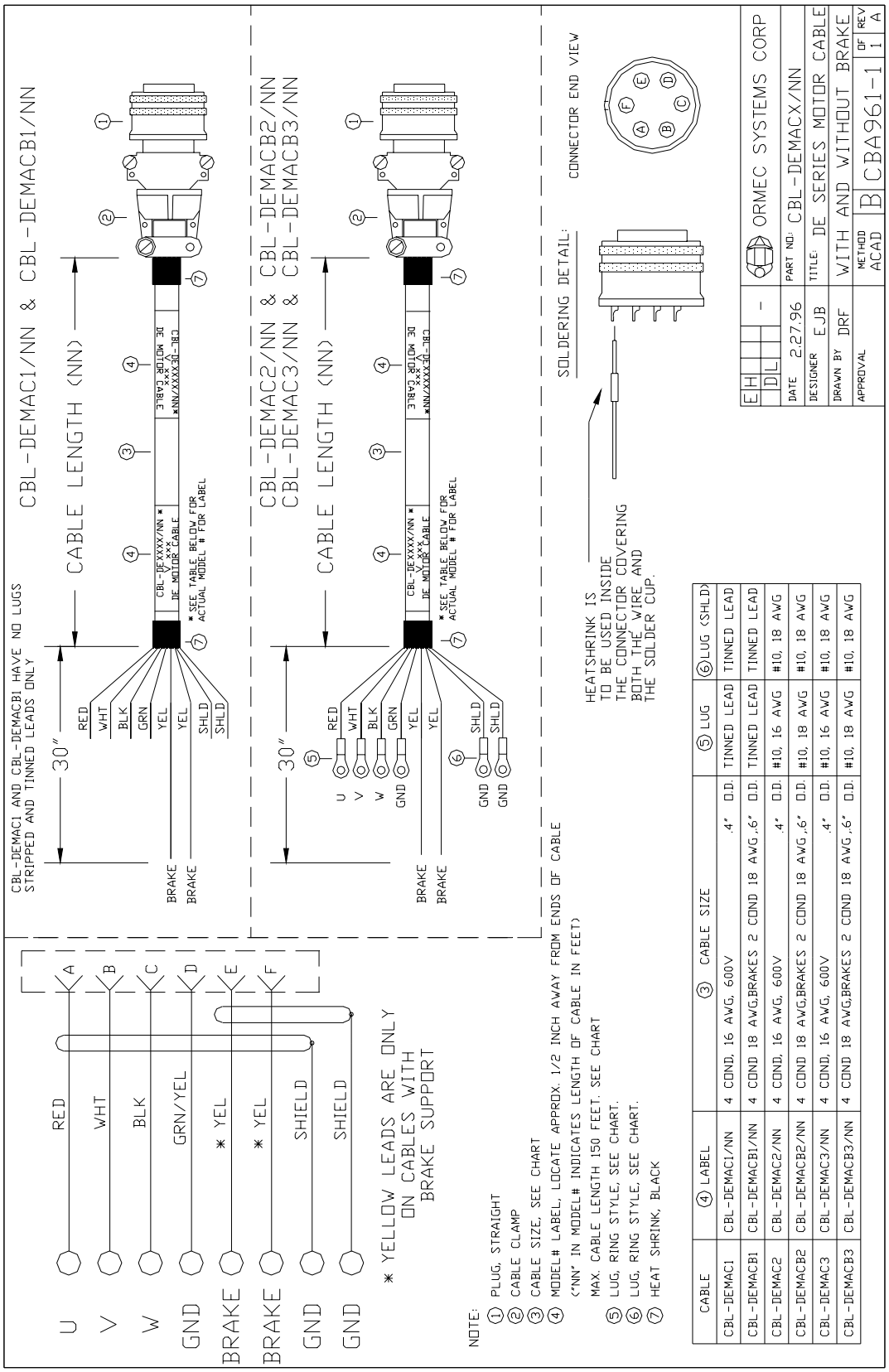
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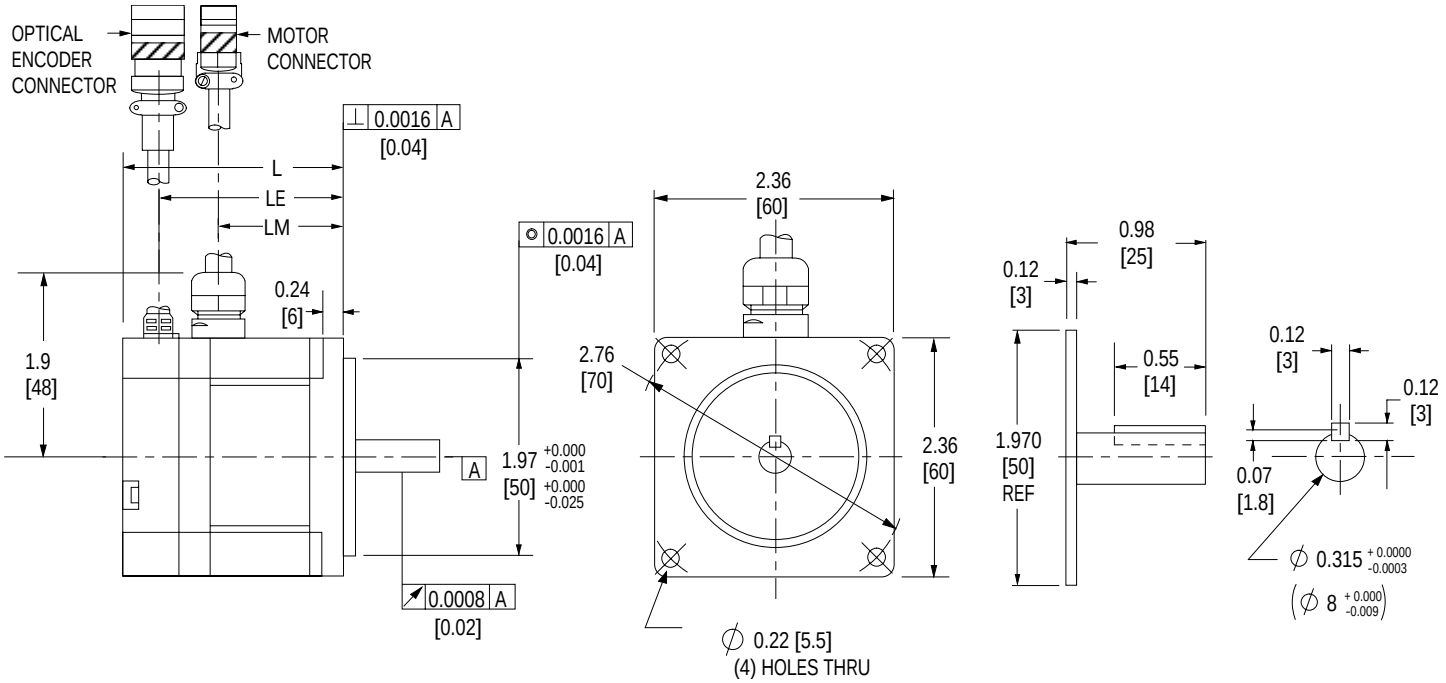


CABLE	④ LABEL	③ CABLE SIZE	⑤ LUG	⑥ LUG (SHLD)
CBL-DEMAC1	CBL-DEMAC1/NN	4 COND, 16 AWG, 600V .4" O.D.	TINNED LEAD	TINNED LEAD
CBL-DEMACB1	CBL-DEMACB1/NN	4 COND 18 AWG,BRAKES 2 COND 18 AWG,.6" O.D.	TINNED LEAD	TINNED LEAD
CBL-DEMAC2	CBL-DEMAC2/NN	4 COND, 16 AWG, 600V .4" O.D.	#10, 16 AWG	#10, 18 AWG
CBL-DEMACB2	CBL-DEMACB2/NN	4 COND 18 AWG,BRAKES 2 COND 18 AWG,.6" O.D.	#10, 18 AWG	#10, 18 AWG
CBL-DEMAC3	CBL-DEMAC3/NN	4 COND, 16 AWG, 600V .4" O.D.	#10, 16 AWG	#10, 18 AWG
CBL-DEMACB3	CBL-DEMACB3/NN	4 COND 18 AWG,BRAKES 2 COND 18 AWG,.6" O.D.	#10, 18 AWG	#10, 18 AWG

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Motor Outline Drawings
MAC-DE003A1 & DE003A2

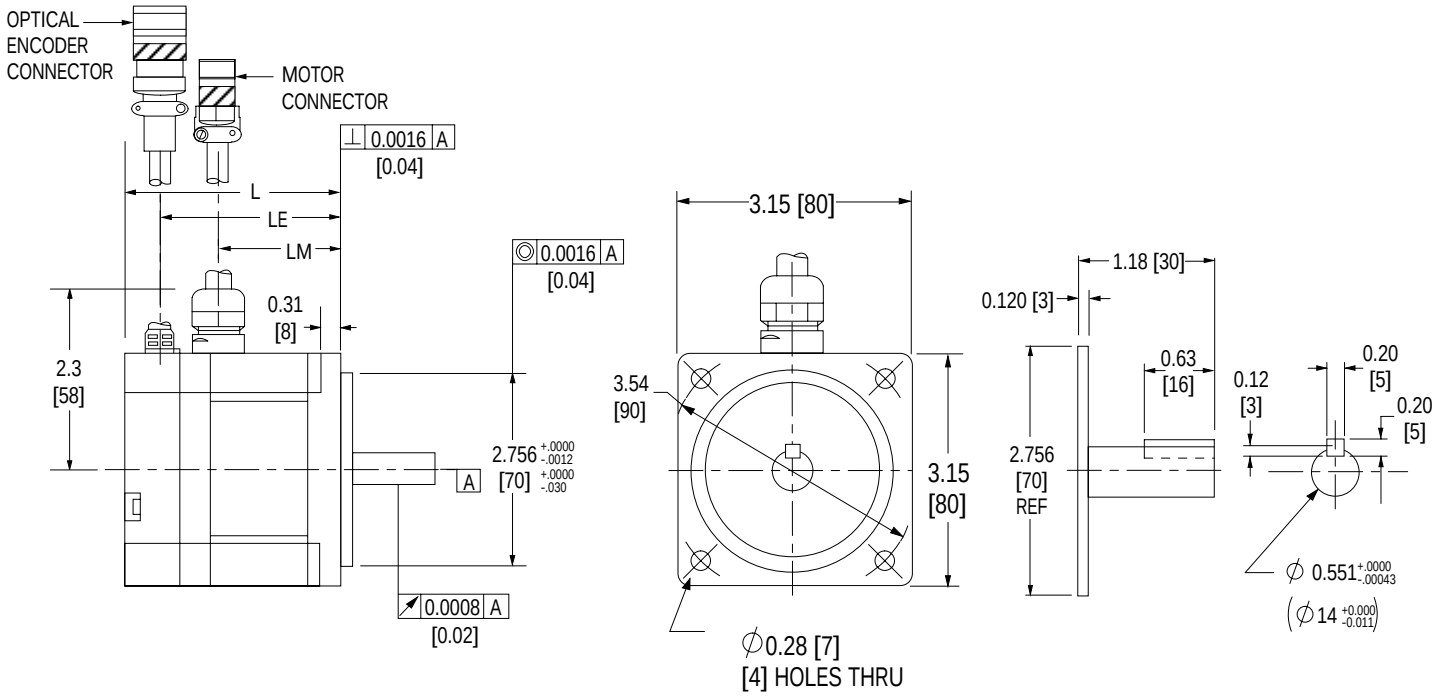


	L		LE		
Motor Model Number	Incremental	Absolute	Incremental	Absolute	**LM**
MAC-DE003A1	2.3 [57]	4.1 [102]	1.9 [48]	3.7 [94]	1.3 [32]
MAC-DE003A2	2.3 [57]	4.1 [102]	1.9 [48]	3.7 [94]	1.3 [32]

NOTE: Minimum cable clearance from motor centerline for Encoder Cable is 2.8 inches [71 mm]; for Motor Cable is 3.8 inches [97 mm]. Cable lengths to connector approximately 11 inches [280 mm].

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MAC-DE006B1, DE006B2, DE008C1 & DE011C2

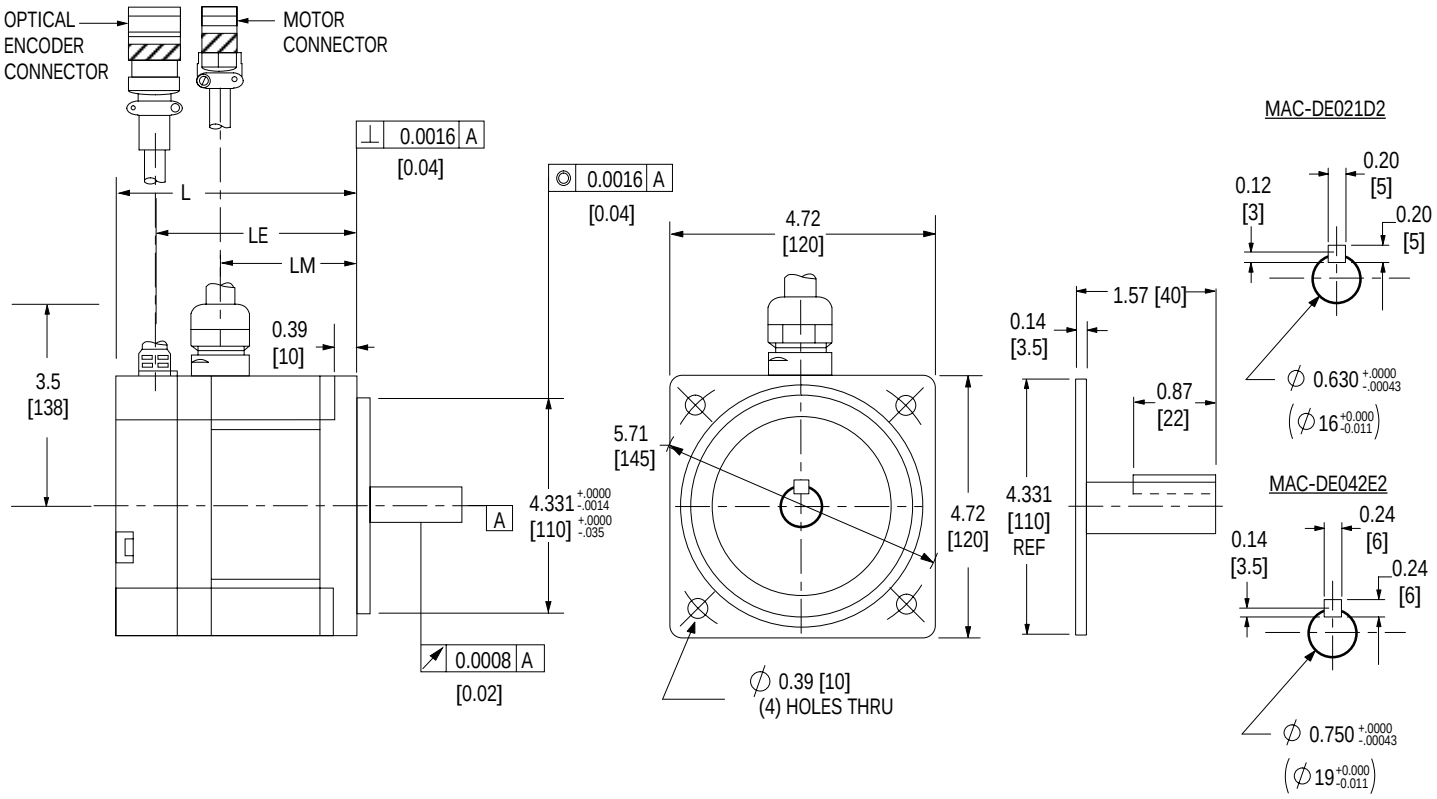


	L		LE		
Motor Model Number	Incremental	Absolute	Incremental	Absolute	**LM**
MAC-DE006B1	2.5 [63]	3.5 [87]	2.1 [53]	2.9 [75]	1.6 [40]
MAC-DE006B2	2.5 [63]	3.5 [87]	2.1 [53]	2.9 [75]	1.6 [40]
MAC-DE008C1	3.3 [84]	4.2 [107]	2.9 [73]	3.7 [95]	2.4 [60]
MAC-DE011C2	3.3 [84]	4.2 [107]	2.9 [73]	3.7 [95]	2.4 [60]

NOTE: Minimum cable clearance from motor centerline for Encoder Cable is 3.2 inches [81 mm]; for Motor Cable is 4.2 inches [107 mm]. Cable lengths to connector approximately 11 inches [280 mm].

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MAC-DE021D2 & DE042E2

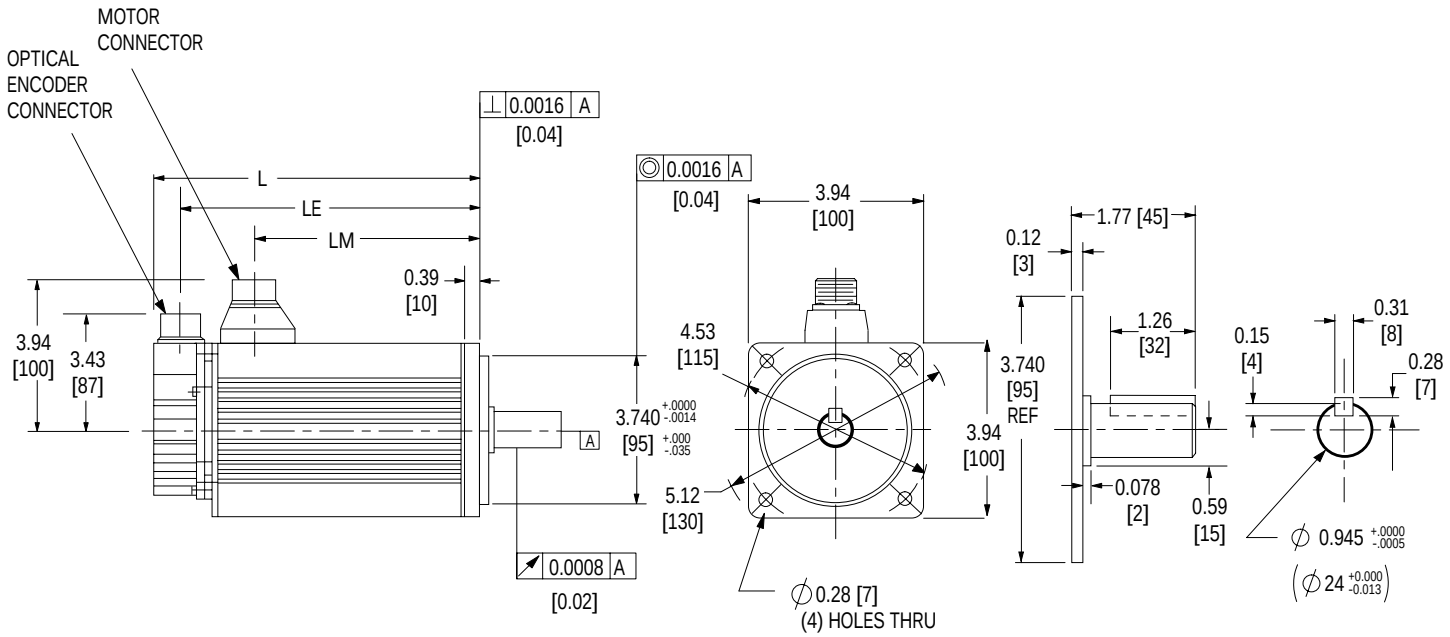


	L		LE		
Motor Model Number	Incremental	Absolute	Incremental	Absolute	**LM**
MAC-DE021D2	3.2 [82]	4.2 [106]	2.8 [72]	3.5 [89]	2.2 [56]
MAC-DE042E2	4.3 [110]	5.3 [134]	3.9 [100]	4.7 [120]	3.3 [84]

NOTE: Minimum cable clearance from motor centerline for Encoder Cable is 4.0 inches [102 mm]; for Motor Cable is 5.0 inches [127 mm]. Cable lengths to connector approximately 11 inches [280 mm].

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MAC-DA030F & DA055G

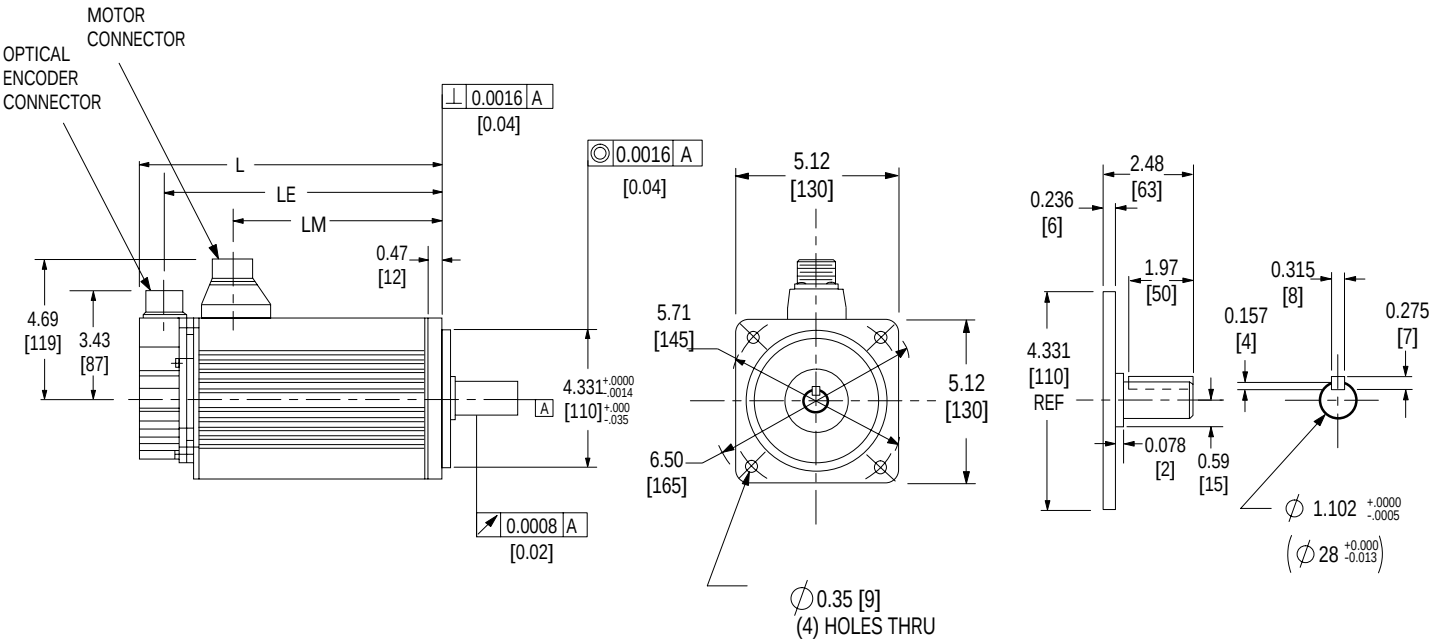


	L		LE		
Motor Model Number	Incremental	Absolute	Incremental	Absolute	**LM**
MAC-DA030F	5.9 [150]	6.4 [163]	5.1 [130]	5.6 [142]	3.0 [76]
MAC-DA055G	7.8 [200]	8.4 [212]	7.0 [178]	7.5 [191]	4.9 [125]

NOTE: Minimum cable clearance from motor centerline for Encoder Cable is 6.2 inches [157 mm]; for Motor Cable is 6.6 inches [168 mm].

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MAC-DA090H, DA110J & DA140K

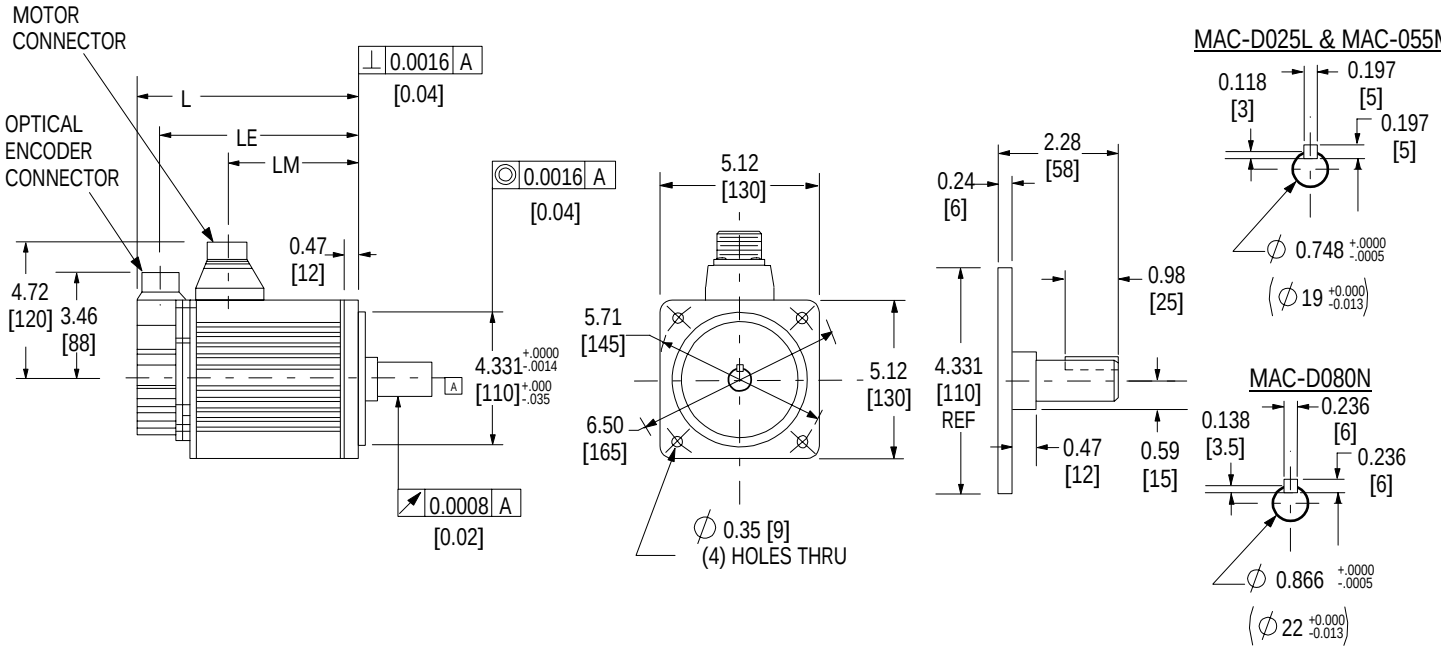


	L		LE		
Motor Model Number	Incremental	Absolute	Incremental	Absolute	**LM**
MAC-DA090H	7.9 [200]	8.4 [213]	7.0 [177]	7.6 [192]	4.8 [122]
MAC-DA110J	9.3 [236]	9.9 [250]	8.4 [213]	9.0 [229]	6.2 [157]
MAC-DA140K	10.9 [277]	11.5 [290]	10.0 [254]	10.6 [269]	7.8 [198]

NOTE: Minimum cable clearance from motor centerline for Encoder Cable is 6.2 inches [157 mm]; for Motor Cable is 7.5 inches [191 mm].

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MAC-DB025L, DB055M & DB080N

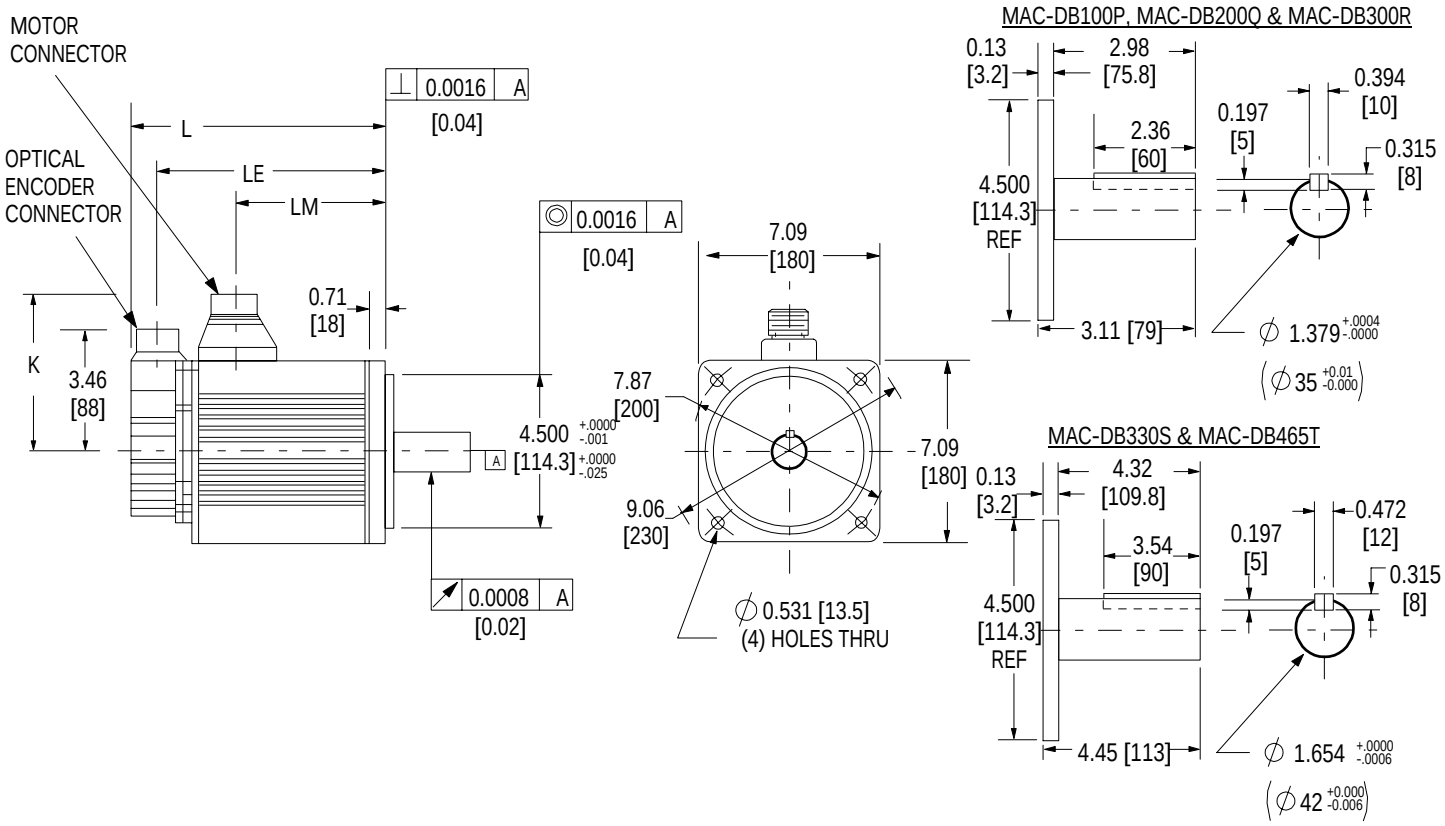


	L		LE		
Motor Model Number	Incremental	Absolute	Incremental	Absolute	**LM**
MAC-DB025L	5.4 [137]	6.0 [152]	4.6 [117]	5.1 [131]	2.5 [64]
MAC-DB055M	6.3 [160]	6.9 [175]	5.5 [140]	6.0 [154]	3.4 [86]
MAC-DB080N	7.3 [185]	7.9 [199]	6.4 [162]	7.0 [178]	4.4 [112]

NOTE: Minimum cable clearance from motor centerline for Encoder Cable is 6.3 inches [160 mm]; for Motor Cable is 7.0 inches [178 mm].

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MAC-DB100P, DB200Q, DB300R, DB330S & DB465T

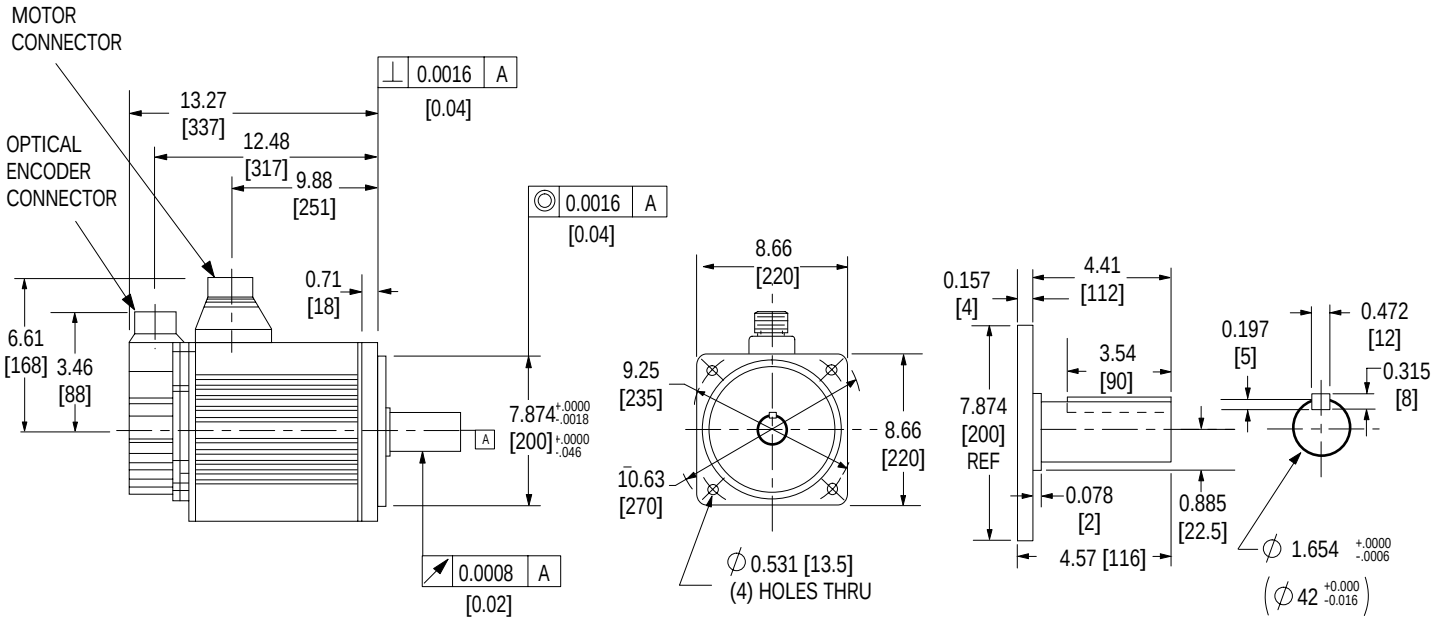


	L		LE			
Motor Model Number	Incremental	Absolute	Incremental	Absolute	**LM**	**K**
MAC-DB100P	6.5 [165]	7.1 [180]	5.7 [145]	6.2 [159]	3.5 [89]	5.8 [147]
MAC-DB200Q	7.5 [190]	8.2 [206]	6.7 [170]	7.2 [185]	4.5 [114]	5.8 [147]
MAC-DB300R	8.9 [226]	9.5 [240]	8.1 [205]	8.6 [219]	5.8 [147]	5.8 [147]
MAC-DB330S	10.2 [259]	10.8 [274]	9.4 [239]	9.9 [253]	6.8 [173]	5.9 [150]
MAC-DB465T	13.2 [335]	13.7 [348]	12.3 [312]	12.8 [327]	9.7 [246]	5.9 [150]

NOTE: Minimum cable clearance from motor centerline for Encoder Cable is 6.3 inches [160 mm]; for Motor Cable is 9.5 inches [241 mm].

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MAC-DB700U



	L		LE		
Motor Model Number	Incremental	Absolute	Incremental	Absolute	**LM**
MAC-DB700U	13.3 [337]	13.9 [352]	12.5 [314]	13.0 [331]	9.8 [249]

NOTE: Minimum cable clearance from motor centerline for Encoder Cable is 6.3 inches [160 mm]; for Motor Cable is 9.5 inches [241 mm].

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