E-Series
AC Servodrives

Installation & Operation Manual
SAC-E01b

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Chapter 1
Welcome

1 Welcome

This manual provides information about ORMEC's E-Series AC Brushless Servodrives---providing both a technical description and information required for their installation, operation and maintenance.

The 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 E-Series product family.
Chapter 3	**Specifications** provides a detailed list of servodrive and compatible E-Series brushless servomotor performance specifications.
Chapter 4	**Installation** provides instructions on how to install your unit. It also provides a complete hardware description of the E-Series servodrives, including detailed information on each unit's interface.
Chapter 5	**Operation** documents the powerup and initial configuration approach for the E-Series.
Chapter 6	**Getting Started** provides detailed instructions on how to run your E-Series servodrive for the first time.
Chapter 7	**Maintenance and Troubleshooting** documents the various status and alarm indicators.
Appendixes	**Appendixes** contain a detailed drawing set.

Chapter 2
General Description

2 General Description

This manual covers the E-Series AC Serodrives, which interface with ORMEC's Generation III motion controllers, and control the MAC-E Series AC Servomotors. These AC Servodrives and their corresponding motors provide the following capabilities:

2.1 Servodrive Capabilities

- **Dual Input Power:** Most of the E-Series servodrives can be ordered in either a 115 VAC or 230 VAC input power configuration.
- **Wide Power Range:** Output power ratings range from 50 watts to 700 watts.
- **High Peak Current:** Results in high peak motor torque, up to three times rated current for a few seconds and twice rated current for up to a minute
- **Torque Mode Operation:** When combined with DSP based velocity loops in ORMEC Generation III 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 is derived from the digital position transducer and provides for testing and analog velocity loop closure.
- **Torque Monitor:** A calibrated torque monitor signal simplifies system test.

2.2 Servomotor Capabilities

- **Wide Power Range:** Output motor power ratings ranges from 0.07 to 1.0 HP.

- **Wide Torque Range:** Continuous stall torques range from 1.62 to 30 in-lb.
- **High Speed:** Maximum motor speeds range from 4,000 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 6,000 precise increments of position, or counts, per revolution.
- **Low Torque Ripple:** Sinusoidal and trapezoidal construction combined with precise electronic commutation provide low motor output torque ripple.

2.3 Modular Servodrive Construction

- **Shunt Regulator:** All E-Series servodrive models capable of 200 watts output power or more have a built-in shunt regulator on the bus power supply to handle regenerative load conditions.
- **Main Circuit Breaker:** Each drive includes a main circuit breaker for output power stage overload protection.
- **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 E-Series drives to provide an added measure of safety.
- **Rack Mounting:** The E-Series servodrives are rack mounted with narrow "footprints" to conserve panel space. Several standard ORMEC mounting racks are available to allow a variety of servodrive configurations.

2.4 Fault Detection and Diagnostics

- **Fault Detection and Protection:** Fault detection and protection features include overvoltage, undervoltage, overload, overcurrent, open phase detection, loss of feedback detection, main circuit breaker trip detection, and excessive regeneration detection.
- **Diagnostics:** Diagnostic messages are coded and displayed on the seven segment LED Alarm indicator.

2.5 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 Generation III controller to reset servodrive faults without the need to press a button on the servodrive or cycling control power.

Chapter 3
Specifications

3 Specifications

Servodrives covered by this manual:

SAC-E01A	SAC-E04H
SAC-E02B	SAC-E05E
SAC-E03C	SAC-E06F
SAC-E04D	SAC-E08J

3.1 E-Series Motors Overview

Maximum Speed:	4,000 to 4,500 RPM
Continuous stall torques:	1.62 to 30 lb-in
Peak Torques:	4.22 to 65 lb-in
Peak Acceleration:	up to 29,455 rad/sec^2
Rated Power:	0.07 to 1.0 HP
Position Encoder Resolution:	6,000 cts/rev (1,500 lines/rev)

3.2 General 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: (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:	150 VDC	270 VDC
Shunt Regulator Activation Bus Voltage:	190 VDC	380 VDC
Excess Bus Voltage Fault:	220 VDC	420 VDC
Undervoltage Bus Voltage Fault:	70 VDC	150 VDC
Encoder Power Voltage:	5 vdc (+/- 5%)	
Maximum Encoder Power Current:	200 mA	
Input Interlock Circuitry:		
Input Voltage Requirements:	+24 vdc @ 20 mA maximum	
Input Current (at each input):	5 mA typical	
Output Interlock Circuitry:		
Maximum Applied Voltage:	+30 vdc	
Maximum Current Sink Capability:	-50 mA	

3.2.1 MAC-E Series Servomotors Specifications (115 VAC)

MAC-E Series Servomotor Specifications (115 VAC Input)

PERFORMANCE[1]	Units	E002A1	E003B1	E007C1	E010D1
Maximum Speed	RPM	4,000	4,000	4,000	4,000
Continuous Stall Torque	lb-in (N-m)	1.62 (0.18)	3.24 (0.37)	6.47 (0.73)	9.71 (1.10)
Rated Torque at 3000 RPM	lb-in (N-m)	1.41 (0.16)	2.81 (0.32)	5.63 (0.64)	8.44 (0.96)
Rated Power	HP	0.07	0.13	0.27	0.4
	watts	50	100	200	300
Peak Torque	lb-in (N-m)	4.22 (0.48)	8.44 (0.96)	16.88 (1.91)	25.31 (2.86)
Continuous StallTorque/Inertia	rad/sec^2	23,824	29,455	14,378	14,279
MECHANICAL					
Moment of Inertia	lb-in-sec^2 (kg-cm^2)	0.000068 (0.076)	0.00011 (0.125)	0.00045 (0.507)	0.00068 (0.766)
Friction Torque, static	lb-in (N-m)	0.1 (0.89)	0.1 (0.89)	0.2 (1.17)	0.3 (2.66)
Servomotor Weight	lbs (kg)	2.2 (1.0)	2.9 (1.3)	4.4 (2.0)	5.7 (2.6)
Mounting Bolt Diameter	inches (mm)	3.150 (80)	3.150 (80)	3.543 (90)	3.543 (90)
Pilot Diameter	inches (mm)	1.970 (50)	1.970 (50)	2.756 (70)	2.756 (70)
Length, mounting face to rear	inches (mm)	4.00 (101.5)	4.69 (119)	4.98 (126.5)	5.93 (150.5)
Maximum Radial Shaft Load (at 1/2 shaft length from pilot)	lbs (kg)	18 (8)	18 (8)	55 (25)	55 (25)
Maximum Axial Shaft Load	lbs (kg)	9 (4)	9 (4)	22 (10)	22 (10)
ELECTRICAL					
Servodrive	SAC-	E01A1	E02B1	E03C1	E04D1
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	0.89 (0.100)	1.27 (0.143)	1.49 (0.169)	1.81 (0.204)
Continuous Current	amps	1.7	2.3	4.3	6
Peak Current	amps	5	7	12	16
Servodrive Weight	lbs (kg)	5.7 (2.6)	5.7 (2.6)	6.4 (2.9)	7.7 (3.5)
THERMAL					
Ambient Temperature	deg. C	40	40	40	40
Thermal Time Constant	minutes	12	14	16	17
Insulation Class		B	B	B	B
ENCODER & TACH					
Encoder Quadrature Resolution[2]	linecount	1500	1500	1500	1500
Tachometer sensitivity	volts/Krpm	2	2	2	2

[1] Ratings are obtained with servomotor ambient temperature at 40°C, and servodrive ambient temperature 55°C.

[2] Effective encoder resolution is four times the stated linecount for motion controllers like ORMEC's Generation III which decode every edge of the "A" and "B" quadrature encoder channels.

3.2.2 MAC-E Series Servomotors Specifications (230 VAC)

MAC-E Series Servomotor Specifications (230 VAC)

PERFORMANCE[1]	Units	E002A2	E003B2	E007C2	E009G2	E010D2
Maximum Speed	RPM	4,500	4,500	4,500	4,000	4,500
Continuous Stall Torque	lb-in (N-m)	1.62 (0.18)	3.24 (0.37)	6.47 (0.73)	10 (1.18	9.71 (1.10)
Rated Torque at 3000 RPM	lb-in (N-m)	1.41 (0.16)	2.81 (0.32)	5.63 (0.64)	8.7 (0.98	8.44 (0.95)
Rated Power	HP	0.07	0.13	0.27	0.4	0.4
	watts	50	100	200	308	300
Peak Torque	lb-in (N-m)	4.22 (0.48)	8.44 (0.95)	16.88 (1.91)	26 (2.94)	25.31 (2.86)
Continuous Stall Torque/Inertia	rad/sec^2	23,824	29,455	14,378	22,222	14,279
MECHANICAL						
Moment of Inertia	$lb\text{-}in\text{-}sec^2$ ($kg\text{-}cm^2$)	0.000068 (0.076)	0.00011 (0.125)	0.00045 (0.507)	0.00045 (0.507	0.00068 (0.766)
Friction Torque, static	lb-in (N-m)	0.1 (0.01)	0.1 (0.010)	0.2 (0.02	0.5 (0.06)	0.3 (0.03)
Servomotor Weight	lbs (kg)	2.2 (1.0)	2.9 (1.3)	4.4 (2.0)	5.7 (2.6)	5.7 (2.6)
Mounting Bolt Diameter	inches (mm)	3.150 (80)	3.150 (80)	3.543 (90)	3.543 (90)	3.543 (90)
Pilot Diameter	inches (mm)	1.970 (50)	1.970 (50)	2.756 (70)	2.756 (70)	2.756 (70)
Length, mounting face to rear	inches (mm)	4.00 (101.5)	4.69 (119)	4.98 (126.5)	5.85 (148.5)	5.93 (150.5)
Maximum Radial Shaft Load (at 1/2 shaft length from pilot)	lbs (kg)	18 (8)	18 (8)	55 (25)	55 (25)	55 (25)
Maximum Axial Shaft Load	lbs (kg)	9 (4)	9 (4)	22 (10)	55 (10)	22 (10)
ELECTRICAL						
Servodrive	SAC-	E01A2	E02B2	E03C2	E03G2	E04D2
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	1.2 (0.17)	2.2 (0.25)	2.15 (0.24)	3.1 (0.35)	2.41 (0.27)
Continuous Current	amps	1	1.4	2.8	2.7	3.7
Peak Current	amps	3	4	8	7.8	11
Servodrive Weight	lbs (kg)	4.4 (2.0)	5.7 (2.6)	5.7 (2.6)	6.4 (2.9)	7.7 (3.5)
THERMAL						
Ambient Temperature	deg. C	40	40	40	40	40
Thermal Time Constant	minutes	12	14	16	15	17
Insulation Class		B	B	B	B	B
ENCODER & TACH						
Encoder Quadrature Resolution[2]	linecount	1500	1500	1500	1500	1500
Tachometer sensitivity	volts/Krpm	2	2	2	2	2

[1] Ratings are obtained with servomotor ambient temperature at 40°C, and servodrive ambient temperature at 55°C.

[2] Effective encoder resolution is four times the stated linecount for motion controllers like ORMEC's Generation III which decode every edge of the "A" and "B" quadrature encoder channels.

MAC-E Series Servomotor Specifications (230 VAC)

PERFORMANCE[1]	Units	E015H2	E016E2	E023F2	E030J2
Maximum Speed	RPM	4,000	4,500	4,500	4,000
Continuous Stall Torque	lb-in (N-m)	15 (1.67)	16.18 (1.87)	22.69 (2.56)	30 (3.33)
Rated Torque at 3000 RPM	lb-in (N-m)	13 (1.47)	14.06 (1.59)	19.75 (2.23)	22 (2.45)
Rated Power	HP	0.6	0.67	0.93	1
	watts	462	500	700	771
Peak Torque	lb-in (N-m)	36 (4.02)	42.19 (4.76)	59.25 (6.67)	65 (7.35)
Continuous Stall Torque/Inertia	rad/sec^2	22,388	6,686	6,876	12,000
MECHANICAL					
Moment of Inertia	lb-in-sec^2 (kg-cm^2)	0.00067 (0.75)	0.00242 (2.72)	0.0033 (3.72)	0.0025 (2.85)
Friction Torque, static	lb-in (N-m)	0.7 (0.08)	0.4 (0.05)	0.5 (0.06)	1.9 (0.21)
Servomotor Weight	lbs (N-m)	7.3 (3.3)	9.7 (4.4)	11.8 (5.4)	12.8 (5.8)
Mounting Bolt Diameter	inches (mm)	3.543 (90)	5.12 (130)	5.12 (130)	5.118 (130)
Pilot Diameter	inches (mm)	2.756 (70)	4.331 (110)	4.331 (110)	4.331 (110)
Length, mounting face to rear	inches (mm)	6.71 (170.5)	6.67 (169.5)	7.58 (192.5)	7.83 (199)
Maximum Radial Shaft Load (at 1/2 shaft length from pilot)	lbs (kg)	55 (25)	88 (40)	88 (40)	88 (39)
Maximum Axial Shaft Load	lbs (kg)	22 (10)	33 (15)	33 (15)	33 (15)
ELECTRICAL					
Servodrive	SAC-	E04H2	E05E2	E06F2	E08J2
Torque Sensitivity, K_t	lbs-in/amp (N-m/amp)	3.28 (0.37)	2.83 (0.32)	3.78 (0.43)	4.49 (0.51)
Continuous Current	amps	3.6	5.3	5.7	5.7
Peak Current	amps	10.6	16	16.3	16.3
Servodrive Weight	lbs (kg)	7.7 (3.5)	7.7 (3.5)	11.9 (5.4)	11.9 (5.4)
THERMAL					
Ambient Temperature	deg. C	40	40	40	40
Thermal Time Constant	minutes	18	18	20	45
Insulation Class		B	B	B	B
ENCODER & TACH					
Encoder Quadrature Resolution[2]	linecount	1500	1500	1500	1500
Tachometer sensitivity	volts/Krpm	2	2	2	2

[1] Ratings are obtained with servomotor ambient temperature at 40ºC, and servodrive ambient temperature at 55ºC.

[2] Effective encoder resolution is four times the stated linecount for motion controllers like ORMEC's Generation III which decode every edge of the "A" and "B" quadrature encoder channels.

Chapter 4
Installation

4 Installation

4.1 Connection Diagram

A Connection Diagram for a typical system is 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.**

4.2 Terminal Block Connections

Terminal blocks are provided for connecting main power, control power, and the servomotor. They are also provided for connecting an external regenerative resistor, if required by the application. They are clearly marked in the table that follows, where these individual functions are briefly described.

Terminal	Function	Description
R T	Main Power[1]	Single-phase 115 VAC or 230 VAC, 50/60 Hz.
r t	Control Power[1]	Single-phase 115 VAC or 230 VAC, 50/60 Hz.
U V W	Motor Power	Power to Motor, Connections are: U on drive - A on motor V on drive - B on motor W on drive - C on motor.
⏚	Frame Ground	Connects to Motor terminal D. Must also be securely attached to earth ground.
Y3 Y4[2]	Regenerative Resistor	Regenerative resistor is internal, no external connection is normally required. An external regenerative resistor can be added if required by the application.

[1] Refer to the General Servodrive Specifications section for Main and Control Power specifications.

[2] These terminals are not available on the SAC-E01A1 and SAC-E01A2, and SAC-E02B2 servodrives.

4.3 Input Power Considerations

E-Series servodrives can be operated directly on commercial power lines which supply between 200 and 230 VAC, or between 100 and 115 VAC. 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.

Input Voltage	Servodrive	Power Required[1]	Recommended Service[2]
115 VAC	SAC-E01A1	0.3 kVA	3 A / 0.5 kVA
	SAC-E02B1	0.5 kVA	5 A / 0.8 kVA
	SAC-E03C1	0.75 kVA	8 A / 1.3 kVA
	SAC-E04D1	1.0 kVA	11 A / 1.8 kVA
230 VAC	SAC-E01A2	0.3 kVA	3 A / 1.0 kVA
	SAC-E02B2	0.5 kVA	4 A / 1.3 kVA
	SAC-E03C2	0.75 kVA	5 A / 1.6 kVA
	SAC-E03G2	1.0 kVA	7 A / 2.3 kVA
	SAC-E04D2	1.0 kVA	7 A / 2.3 kVA
	SAC-E04H2	1.4 kVA	11 A / 3.6 kVA
	SAC-E05E2	1.4 kVA	11 A / 3.6 kVA
	SAC-E06F2	2.0 kVA	15 A / 4.9 kVA
	SAC-E08J2	2.0 kVA	15 A / 4.9 kVA

[1] The listed incoming power requirements are with the servodrive operating at rated power.

[2] The line current and power ratings listed represent the recommended incoming line capacity for the 115 and 230 VAC, single phase service.

4.3.1 Servodrive Power Dissipation at Rated Output

The 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-E01A1	30	20	--	50
	SAC-E02B1	30	25	0	55
	SAC-E03C1	30	40	0	70
	SAC-E04D1	30	50	0	80
230 VAC	SAC-E01A2	30	20	--	50
	SAC-E02B2	30	25	--	55
	SAC-E03C2	30	30	5	65
	SAC-E03G2	30	35	6	71
	SAC-E04D2	30	35	10	75
	SAC-E04H2	30	55	6	91
	SAC-E05E2	30	55	30	115
	SAC-E06F2	30	50	15	95
	SAC-E08J2	30	50	15	95

4.3.2 Shielding, Power Line Filtering & Noise Suppression

The servodrive uses 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 section 4.3.3.

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 section 4.3.

4.3.3 Recommended Line Filters

Once the incoming power service is determined as described in section 4.3, the appropriate line filter can be selected from the chart below.

Input Voltag e	Servodrive Model	Power Required	Recommended Line Filter
115 VAC	SAC-E01A1	0.3 kva	SAC-LF215
	SAC-E02B1	0.5 kva	SAC-LF215
	SAC-E03C1	0.75 kva	SAC-LF215
	SAC-E04D1	1.0 kva	SAC-LF215
230 VAC	SAC-E01A2	0.3 kva	SAC-LF215
	SAC-E02B2	0.5 kva	SAC-LF215
	SAC-E03C2	0.75 kva	SAC-LF215
	SAC-E03G2	1.0 kva	SAC-LF215
	SAC-E04D2	1.0 kva	SAC-LF215
	SAC-E04H2	1.4 kva	SAC-LF215
	SAC-E05E2	1.4 kva	SAC-LF215
	SAC-E06F2	2.0 kva	SAC-LF230
	SAC-E08J2	2.0 kva	SAC-LF230

If the noise filter connection or wiring methods are improper, the filters effectiveness is significantly reduced. This approach below is recommended:

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

4.3.4 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).

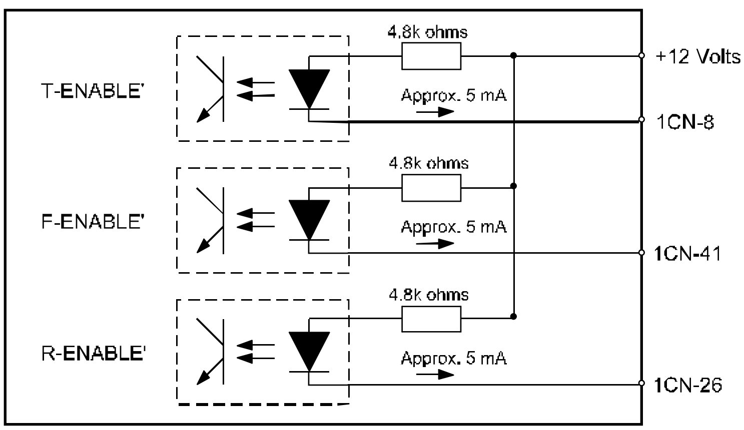
4.4 Control Circuit Interconnections - Connector 1CN

Connector 1CN is a 50 pin male connector, Honda part number MR-50RMA. Cable CBL-AE\NN is used to connect the servodrive to a GN3-DSP Axis Module. The interface connections for connector 1CN are described below. Refer to Appendix C for further information regarding cable CBL-AE\NN.

4.4.1 Interlock Input Signals

The interlock input signals consist of three optically coupled isolators intended for use with +24 vdc. The Model 20/40 implementation of these signals uses +/-12 vdc to achieve the 24 vdc requirement.

Signal	Pin #	Function	Description
T-ENABLE'	8	Torque Enable'	For normal motor operation, this input must be asserted, (-12 vdc, providing 5 mA of input current to the optically coupled isolator). When not asserted, the servodrive's output transistors are disabled, and a solid state dynamic braking circuit is enabled. **Note:** Control power voltage (at terminals r & t) must be present for the dynamic braking circuit to operate. If control power is removed while the motor is running, dynamic braking torque will be exerted for a few seconds, until the power supply capacitor discharges.
F-ENABLE'	41	Forward Enable'	For the servodrive to generate torque in the "forward direction", this input must be asserted, (-12 vdc, providing 5 mA of input current to the optically coupled isolator).
R-ENABLE'	26	Reverse Enable'	For the servodrive to generate torque in the "reverse direction", this input must be asserted, (-12 vdc, providing 5 mA of input current to the optically coupled isolator).



S-Series Servodrive Interlock Interface Input Signals (1CN)

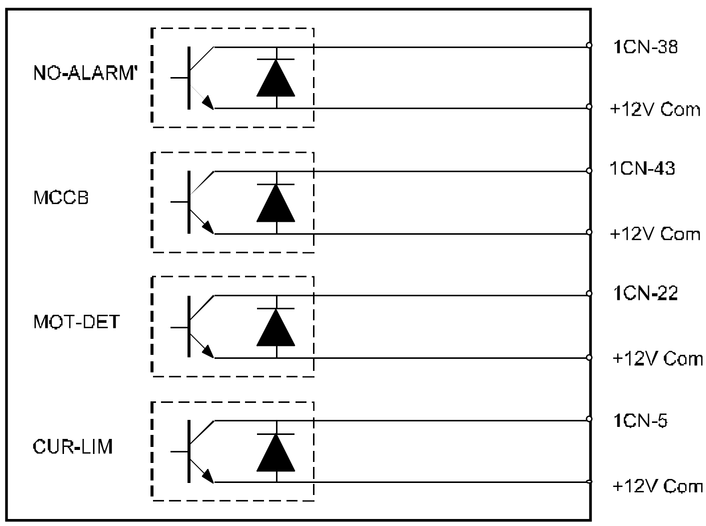
4.4.2 Interlock Output Signals

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.

Signal	Pin #	Function	Description
NO-ALARM'	38	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 Section.
ALO1' ALO2' ALO3'	4 21 37	Alarm Code	When the NO-ALARM' transistor is OFF, these output transistors are reporting the existing alarm condition



S-Series Servodrive Interlock Interface Output Signals (1CN)

4.4.3 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	14	Current Command	Applying an analog signal from zero to +/- 10 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.
AGND	15	Current Command Common	This is the current command reference (zero) signal.

4.4.4 Quadrature Position feedback Signals

Quadrature position feedback signals are provided for position control and monitoring electronics. ORMEC motion control systems use the differential line driver outputs.

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
ENCB ENCB'	33 34	Encoder Feedback Channel B	differential line receivers (TI 75115 or equivalent)
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

4.4.5 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	10	Speed Monitor	This +/-10 volt analog signal is proportional to motor velocity, and is calibrated for

4.4.6 D.C. Power Supply Voltages Available on Connector 1CN

The servodrive optical isolator inputs require a 24 VDC input signal. The +/- 12 VDC supplied by the servodrive is used to achieve the required input signal voltage.

Signal	Pin #	Function	Description
+12 V -12 V	48 31	+/- 12 VDC Output Power	+/- 12 VDC, +/- 5%, 30 mA maximum output current capability.

4.5 Optical Position Encoder Connections - Connector 2CN

Connector 2CN is a 20 pin male connector, Honda part number MR-20RMA. It is the interface between the optical position encoder of the servomotor and the servodrive. Cable CBL-SMACE\NN is used to connect the servomotor to the servodrive. Refer to Appendix D for further information regarding cable CBL-SMACE\NN.

4.6 Motor Installation

4.6.1 Motor Use and Environment

The servomotor is designed for use as described below:

- Either horizontal or vertical mounting orientation
- Indoors, clean and dry
- Free from corrosive and/or explosive gases or liquids
- If the location is subject to excessive water or oil, protect the motor with a cover. The motor can withstand a small amount of splashed water or oil.
- Accessible for inspection and cleaning
- Environmental conditions:

  Ambient Temperature: 0^{o} to $+40^{o}$C

  Storage Temperature: -20^{o} to $+80^{o}$C

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

4.6.2 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.

With a direct drive application a flexible coupling should be used. Timing belts and chains are also commonly used in servo applications. Bearing loading should be kept to a minimum. The allowable radial and axial bearing loading is listed in Section 3.

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.

Chapter 5
Operation

5 Operation

5.1 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 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 Model 20/40 NO FAULT relay. Therefore, when a Controller or servodrive alarm is detected, the NO FAULT relay disables the main circuit power.

The recommended interlock approaches for both single and multiple axes 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 pushbutton, which must be manually pulled out (reset) after it has been pressed in (asserted).

2) The momentary contact E-Stop Reset pushbutton 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 relay NF 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 Model 20/40 then disables the T-ENABLE signal causing the servomotor to go into dynamic braking.

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 D.C. 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 relay. The servomotor goes into 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 asserting the ALM-RESET' input.

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

5.2 Current Command Input

The servodrive is configured for torque or 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.

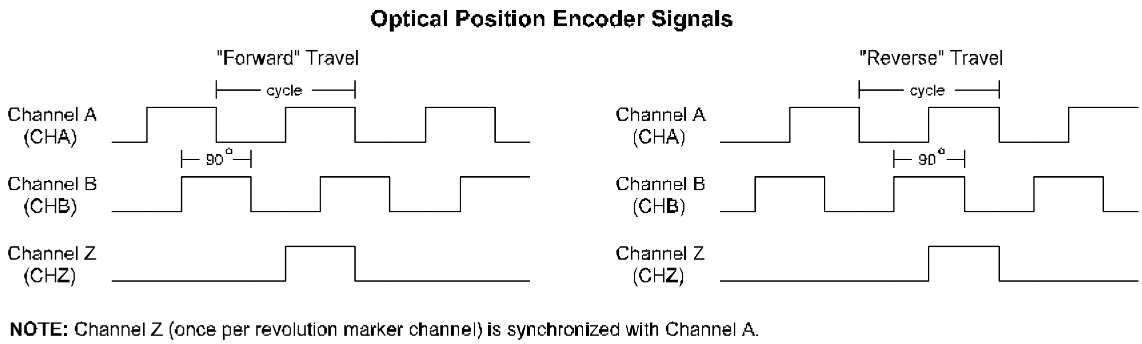
5.3 Overload Characteristics

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 and provide a "1" code on the seven-segment LED ALARM indicator to display the overcurrent condition. The overcurrent set point is set to protect the servodrive at an ambient temperature of 55°C and cannot be changed.

5.4 Position Encoder Signals

Optical position encoder 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 Generation III series, typically decode each transition of both encoder channels, yielding a resolution of four times the linecount specification per revolution e.g. A position encoder with 1500 linecount/rev, when decoded by a Generation III Controller yields a positioning resolution of 6,000 cts/rev.



5.5 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:

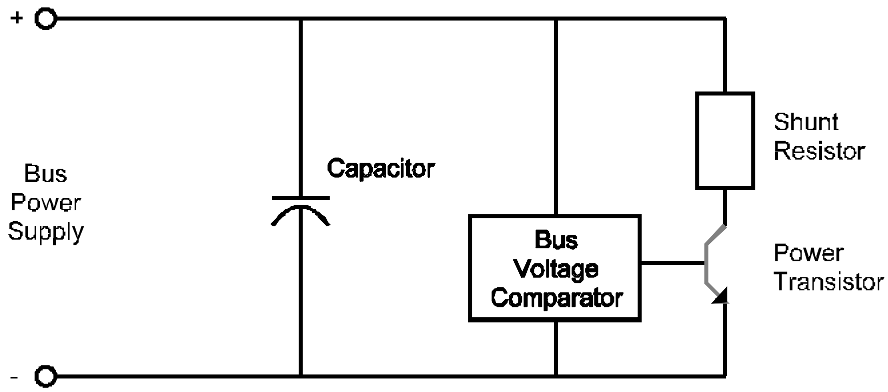
1) Decelerating the machine faster than it would coast. This is especially critical at high speeds and with large inertias;
2) Using the motor to lower a load that is not counterbalanced, and;
3) Using the motor to control an unwind stand for rolls of material, where the tension in the web causes the motor to have to hold back while moving forward.

5.5.1 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 shunt resistor. When the voltage comparator detects excess power supply voltage (at approximately 190 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 shunt resistor. The amount of energy that it can dissipate is dependent on the current capability of the switching transistor and the wattage specification of the shunt resistor.

Shunt Regulator Circuitry & Specificaitons



Input Voltage	Servodrive	Internal Shunt Resistor		Power Transistor		Peak Power (kW)
		Resistance (ohms)	Power (watts)	Continuous. Current (amps)	Peak Current (amps)	
115 VAC	SAC-E01A1	*				
	SAC-E02B1	100	30	1.9	12	0.29
	SAC-E03C1	100	30	1.9	12	0.29
	SAC-E04C1	100	30	1.9	12	0.29
230 VAC	SAC-E01A2	*				
	SAC-E02B2	*				
	SAC-E03C2	100	30	3.8	12	1.4
	SAC-E03G2	100	30	3.8	12	1.4
	SAC-E04D2	100	30	3.8	12	1.4
	SAC-E04H2	100	30	3.8	12	1.4
	SAC-E05E2	100	30	3.8	12	1.4
	SAC-E06F2	50	70	7.6	15	2.9
	SAC-E08J2	50	70	7.6	15	2.9

* No shunt regulation support provided for this model servodrive

5.5.2 Applications Strategies

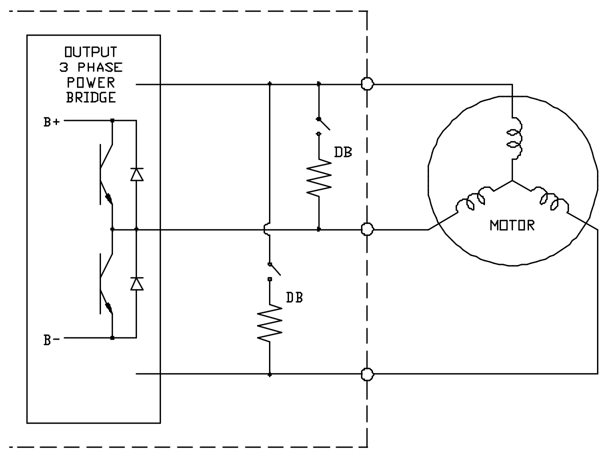
If regeneration is excessive, an overvoltage alarm or heat sink overheat alarm may occur. If this happens, the following actions may resolve the problem:

- 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.

5.6 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. Control power must be present for it to operate properly, however, in the case of power loss, dynamic braking will continue to operate for a few seconds until the power supply capacitor discharges. Refer to the figure below for a diagram of the dynamic braking circuitry.



NOTE: Only the SAC-E06F2 and SAC-E08J2 servodrives contain dynamic braking resistors (2.5 ohms, 20 watts), to provide additional power dissipation capability. The other servodrives have sufficient power dissipation capability without a braking resistor.

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 motors permanent magnets. This causes the motor to decelerate until no voltage is generated by the motor rotation.

The servodrive dynamic braking circuit is enabled as long as the motor has not yet come to a stop. The first time the motor stops after the dynamic braking circuitry is enabled the dynamic braking feature is disabled.

Chapter 6
Getting Started

6 Getting Started

6.1 Receiving and Inspection

The servomotors and servodrives are put through several severe tests at the factory before shipment. After unpacking, however, check to ascertain that they have sustained no damage while in transit. The motor output shaft should rotate freely by hand, and the bolts and screws should all be tight. Check the servodrive for any bent or broken components or other physical damage before applying power.

Before mounting the servomotor: Dissolve and remove the anticorrosive coating on shaft extension and flange surface with paint thinner before attaching the motor to the driven machine.

6.2 Servodrive Installation

6.2.1 Servodrive Environment

- Keep the temperature of the servodrive at 55°C or below.
- If the electrical panel is subject to vibration, mount the servodrive rack on shock absorbing material. In this case the servodrive must be externally grounded to the control panel.
- Avoid locations where corrosive gases exist, as it may cause extensive damage over long periods. The switching contacts of contactors and relays are especially vulnerable.
- Select a location with minimum exposure to oil, water, hot air, high humidity, excessive dust or metallic particles.
- The preferred mounting orientation for the servodrive rack is vertical on a panel using the mounting holes (4) on the base plate.

6.3 Test Run

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

6.3.1 Servomotor Check

- Motor mounting and grounding are correct.
- Bolts and nuts are tight.
- For motors with oil seals, the seals are not damaged and are properly lubricated.
- Motor and Encoder Cables are properly attached.

6.3.2 Servodrive Check

- For the 230 VAC version of the servodrive the supply voltage should be between 200 to 230 VAC, **WITH AN ABSOLUTE MINIMUM OF 170 VAC AND ABSOLUTE MAXIMUM OF 253 VAC.** **<u>CHECK POWER BEFORE APPLYING IT TO THE SERVODRIVE!!!!</u>**
- For the 115 VAC version of the servodrive the supply voltage should be between 100 and 115 VAC, **WITH AN ABSOLUTE MINIMUM OF 85 VAC AND AN ABSOLUTE MAXIMUM OF 126 VAC.** **<u>CHECK POWER BEFORE APPLYING IT TO THE SERVODRIVE!!!!.</u>**
- Connections are firmly seated.
- Motor cable lug termination's are tight.
- Motor wiring, fuse connection, and grounding are correct.
- The main power interlock circuit disables main power under servo alarm condition.

6.3.3 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.
- 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 correct, the power circuit in the servodrive will operate and the motor is ready to run.

Chapter 7
Maintenance and Troubleshooting

7 Maintenance and Troubleshooting

7.1 Alarm Problem Indications

The Alarm Status Indicator is a seven-segment red LED display which provides an indication of the servodrive and servomotor status. If any of the on-board diagnostic functions are activated, the output transistors are disabled, the NO-ALARM Interlock Output is turned OFF, and the Alarm Status Indicator will indicate the alarm code.

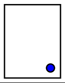
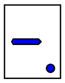
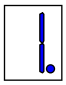
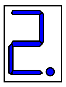
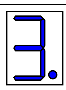
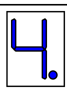
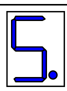
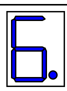
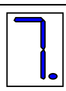
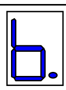
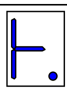
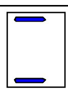
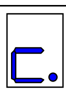
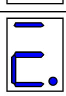
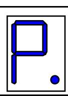
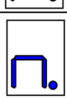
Check the cause, correct the problem, and restart the operation. Before checking the cause, turn off the power to the main circuit to avoid danger.

The power to the control circuit (r,t) should be maintained in case of drive fault so that the Alarm Status Indicator can operate and indicate the alarm code.

Notes:

1) When an alarm signal cuts off only the main circuit, the current command should be reset to 0 V before supplying power to the main circuit.
2) Asserting the ALM-RESET' input resets the servo alarm.
3) If Alarm 7. or A. is on, due to servodrive being overloaded or the heat sink overheated, the Alarm will not reset until the servodrive has cooled down.

The Alarm Indicators and Status Descriptions are listed below:

Alarm	**Status**	**Description**
	Normal Operation	Servodrive is enabled and operating normally
	Servo Disabled	Base current is interrupted in the output circuitry
	Overcurrent	Excess current in the main circuit (1.2 times the instantaneous max. current or more)
	Circuit Breaker	Main circuit breaker is tripped
	Regeneration Problem	Regeneration circuit not operating properly, or excess regeneration
	Overvoltage	Excessive DC voltage in the bus power supply (approximately 420 vdc or more)
	Overspeed	Actual motor speed is 20% over maximum speed.
	Low Voltage	Low DC voltage in the bus power supply after Power ON
	Overload	Overload condition of the motor and servodrive
	A/D Error	Component problem on the printed circuit board of the servodrive
	Overrun Prevention	Alarm occurs only during accel with Motor Speed>20% of max. speed, and Motor Torque>120% rated torque,
	CPU Error	Any error in the servodrives microprocessor CPU.
	Optical Encoder Signal Error	The pole-sensor signals (PU, PV, PW) are out of phase
		The pole-sensor signals are either all high logic level, or all low logic level.
	Forward Overtravel	Servodrive forward overtravel limit input unasserted
	Reverse Overtravel	Servodrive reverse overtravel limit input unasserted

7.2 TM-1 Servodrive Test Points

Terminal	Description	
VTG	Speed Monitor	Bi-directional, 2.0 v/kRPM
SG	Signal Ground	
T-MON	Torque Monitor	Bi-directional, 3.0 v/100% rated torque

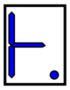
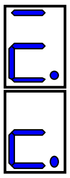
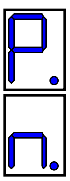
7.3 Servomotor Troubleshooting Guide

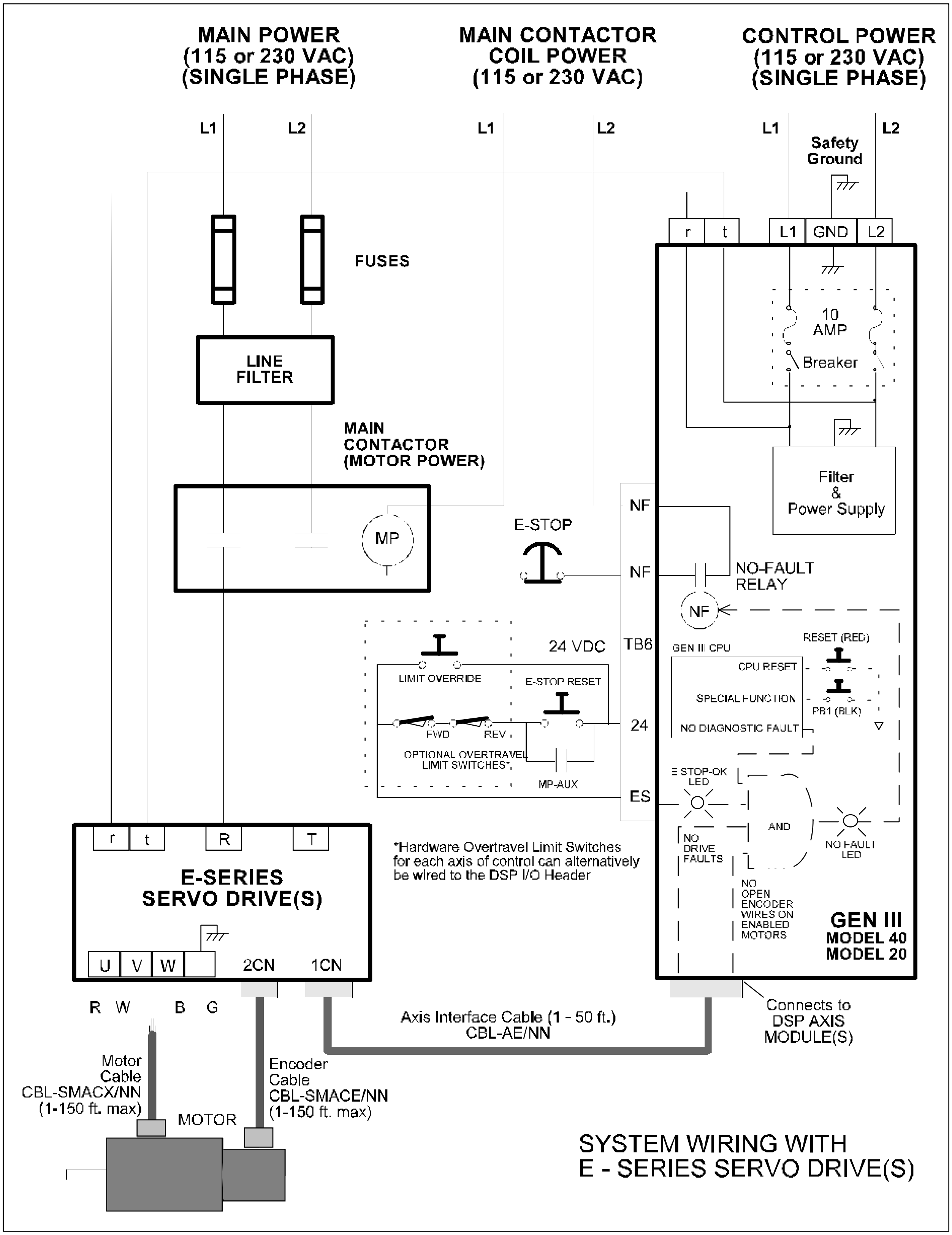
Problem	Cause	What to do
Motor does not start	Loose Connection	Tighten connection
	Wrong wiring	Correct wiring
	Overload	Reduce load or use a larger motor
	Motor defective	Measure voltage across motor terminals U, V, & W on the servodrive with a tester. If correct voltage levels, replace motor.
	Improper control and/or main bus power	Check the control and main bus power connections and voltages.
	Servodrive not enabled	Verify that the Alarm Status Indicator shows that the servodrive is in normal operation.
Unstable Operation	Wrong Wiring	Inspect and correct wiring of motor terminals U, V, & W and/or the encoder.
Motor Overheats	Excessive ambient temperature	Reduce ambient temperature below 40°C, or use a larger motor.
	Motor dirty	Clean motor surface
	Overload	Reduce load or use a larger motor.
Unusual Noise	Motor loosely mounted	Tighten mounting bolts
	Motor misaligned	Realign
	Coupling out of balance	Balance coupling
	Noisy bearing	Check alignment, loading of bearing, lubrication.
	Vibration of driven machine	Check the machine's mechanical operation.
WARNING!!! Turn off power before working on the servomotor		

7.4 Servodrive Troubleshooting Guide

ALARM STATUS INDICATION AND TROUBLESHOOTING IDEAS				
LED	**Status**	**Detection Condition**	**Probable Cause**	**Corrective Action**
1.	Over-current	When power is supplied to the control circuit	Defective control circuit board	Replace the servodrive
		When power is supplied to the main circuit, servo power is turned on & MCCB does not trip	Defective current feedback circuit	
			Defective main circuit transistor	
		When power is supplied to the main circuit, servo power is turned on & MCCB trips	Defective motor grounding	Replace servomotor
			Defective main circuit transistor module	Replace servodrive
		When power is supplied to the main circuit	Defective main circuit transistor	Replace servodrive
		During operation	Faulty servodrive components	Replace servodrive
2.	Circuit Protector tripped	When power is supplied to the control circuit	Defective control circuit board	Replace servodrive
		When power is supplied to the main circuit	Defective main circuit	Replace servodrive
			MCCB trips	Reset MCCB
3.	Regener-ative Discharge Problem	When power is supplied to the control circuit	Defective control circuit board	Replace servodrive
		Approximately 0.5 to 1 second after power is supplied to the main circuit	Defective regenerative	Replace servodrive
			Regenerative resistor	Check and replace the regenerative resistor (replace servodrive)
			No regenerative resistor connection	

LED	Status	Detection Condition	Probable Cause	Corrective Action
4.	Over-voltage	When the motor starts or slows down	Load inertia too large	Check the effective inertia of the machine as reflected to the motor shaft
			Deceleration rate too high	Reduce deceleration rate
			Defective regenerative circuit	Replace servodrive
5.	Over-speed	When the actual motor speed is 20% greater than the maximum	Motor connection error	Correct motor connection
			Optical encoder connection error	Check encoder connection
6.	Voltage Drop	When power is supplied to the main circuit	Defective main circuit thyristor-diode	Replace servodrive
7.	Overload	When power is supplied to the control circuit	Defective control circuit board	Replace servodrive
		During operation: when power to the control circuit is turned off and then turned on again, the operation starts.	Operation with 105% to 130% or more of the rated load.	Check and correct the load
				Use a larger servomotor
		The motor rotates, but the torque is unavailable. When power to the control circuit is turned off and then turned on again, the operation starts, but the torque	Motor circuit error connection, such as U to V, V to W, W to U or single phase connection	Correct motor connection
b.	A/D Error or CPU Error	When power is supplied to the control circuit	Defective control circuit board	Replace servodrive
		During operation	Faulty internal elements	Resume after reset operation
			Defective internal elements	Replace servodrive

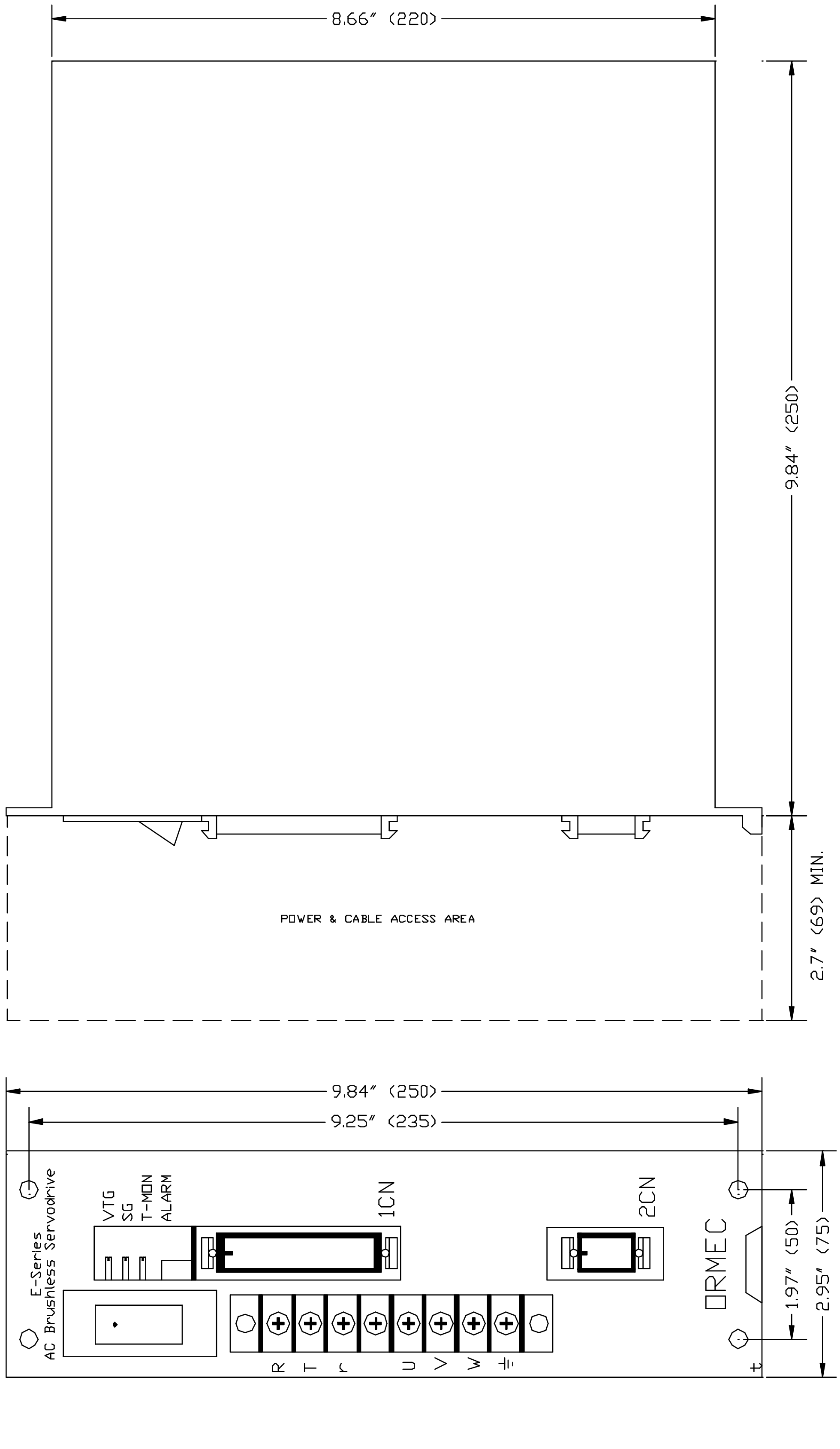
LED	Status	Detection Condition	Probable Cause	Corrective Action
	Overrun Prevent-ion	When power is supplied to the control circuit	Defective control circuit board	Replace the servodrive
		Motor starts momentarily	Motor connection error	Correct the motor connection
			Optical encoder connection error	Check and correct encoder connection
	Optical Encoder Signal Error	During Operation	Defective optical	Replace
			Defective control circuit board	Replace servodrive
		When power is supplied to the control circuit	Defective encoder cable	Check encoder cable connection and/or replace encoder cable.
			Defective optical	Replace
			Defective control circuit board	Replace servodrive
	Over-Travel Limits	During Operation	Defective wiring between DSP and servodrive	Check DSP to servodrive cable/wiring.



SYSTEM WIRING WITH
E - SERIES SERVO DRIVE(S)

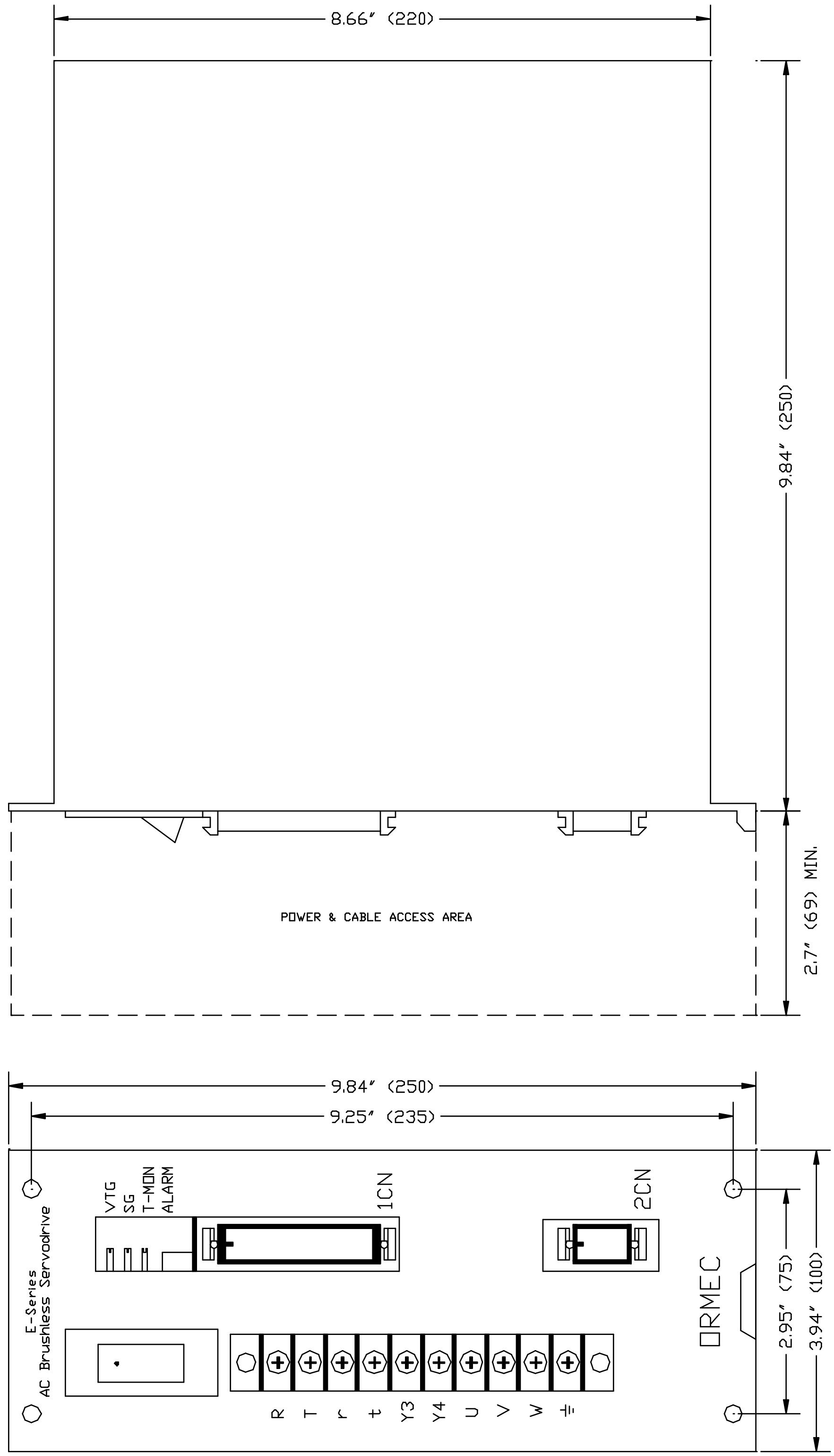
Servodrive Layout

SAC-E01A1, SAC-E01A2, SAC-E02B2



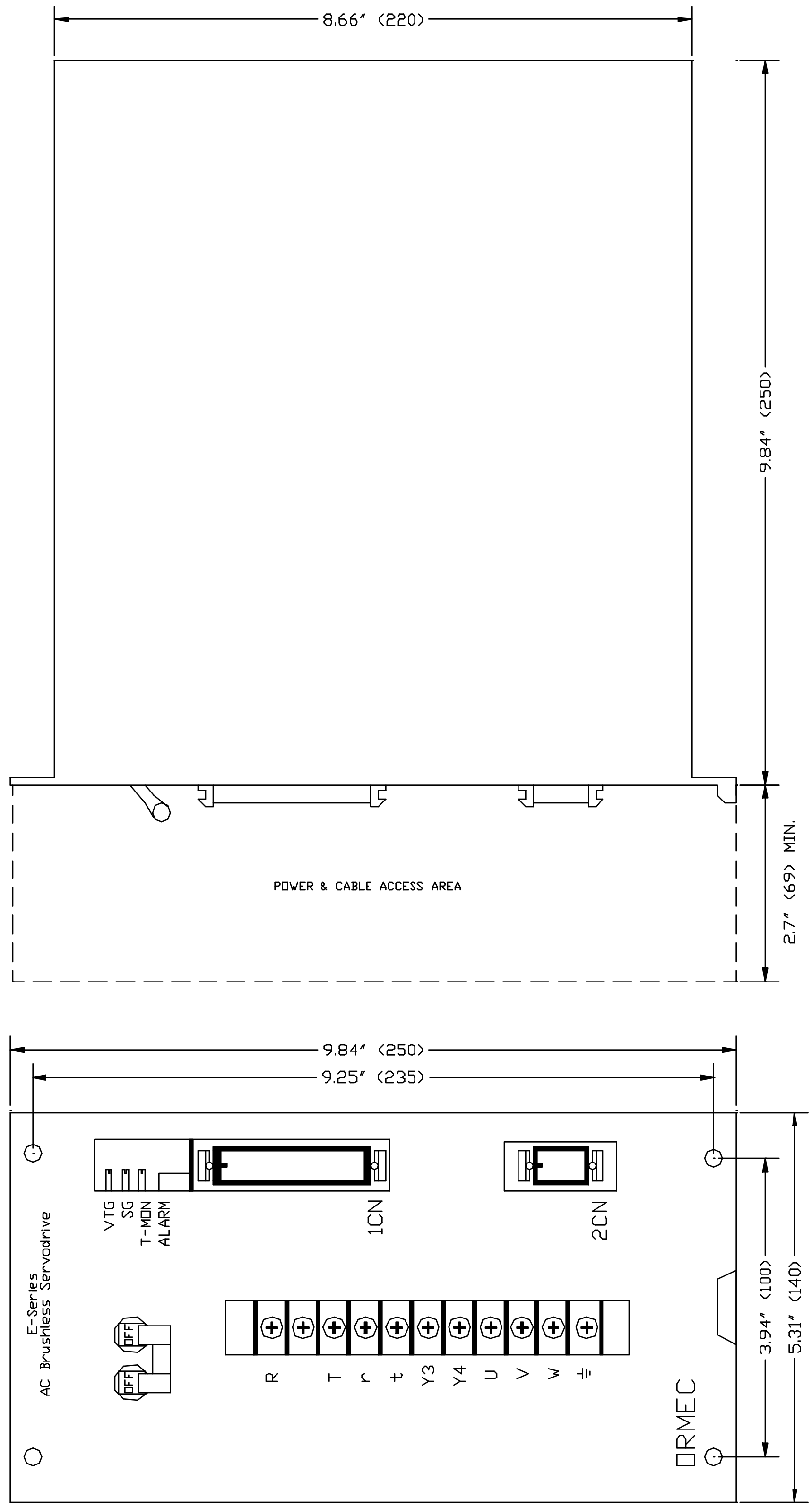
Servodrive Layout

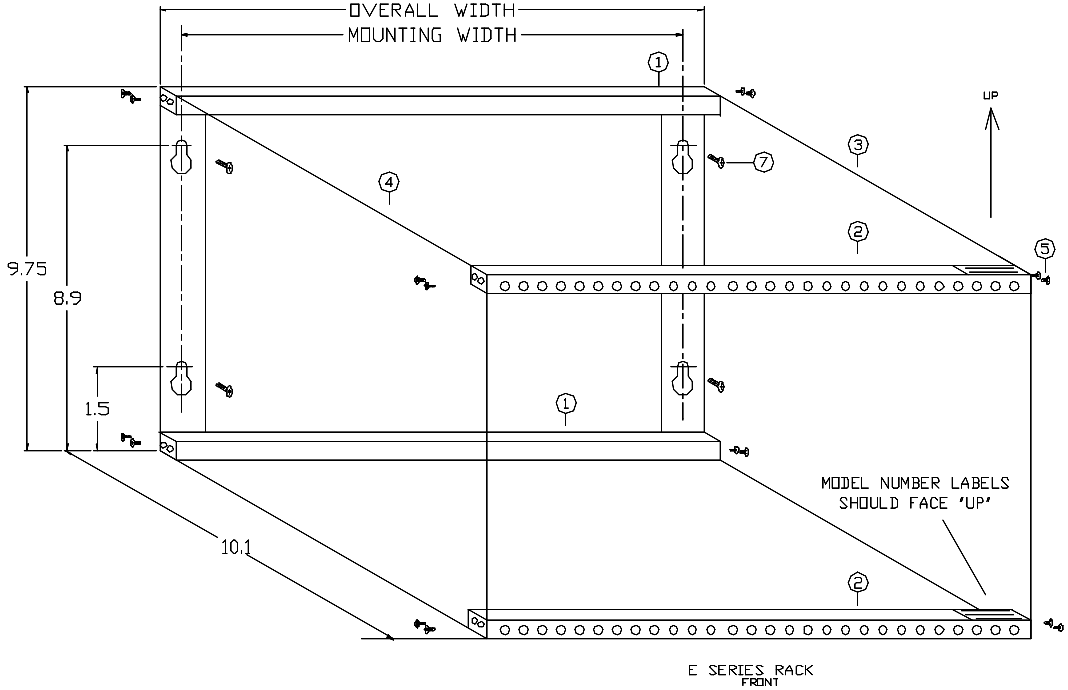
SAC-E02B1, SAC-E03C1, SAC-E03C2, SAC-E03G2, SAC-E04D1, SAC-E04D2, SAC-E04H2, SAC-E05E2



Servodrive Layout

SAC-E06F2, SAC-E08J2

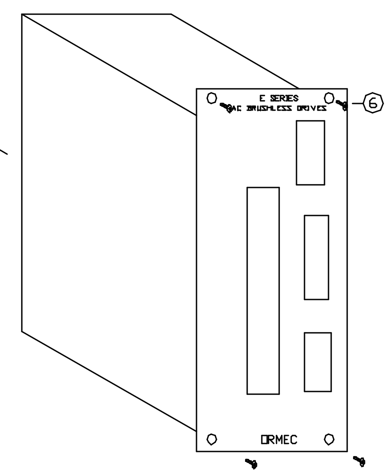




E SERIES RACK
FRONT

MODEL #	MOUNTING WIDTH	OVERALL WIDTH
SACER100	3-1/4	4-1/2
SACER150	5-1/4	6-1/2
SACER200	7-3/16	8-7/16
SACER250	9-1/8	10-3/8
SACER300	11-1/8	12-3/8
SACER350	13-1/16	14-5/16
SACER400	15-1/16	16-5/16
SACER450	17	18-1/4
SACER500	19	20-1/4
SACER563	21-7/16	22-11/16

E SERIES SERVODRIVE

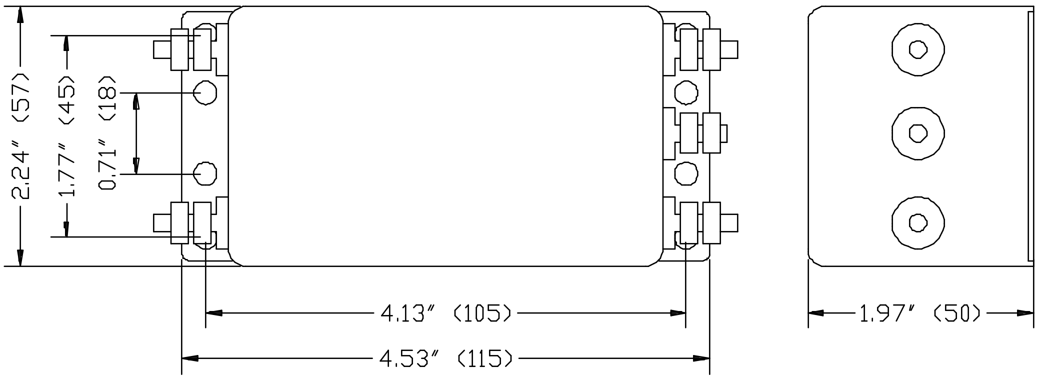


1. (2) SUPPORT RAIL
2. (2) TAPPED SUPPORT RAIL
3. (1) RIGHT SIDE
4. (1) LEFT SIDE
5. (16) 8-32 X 1/2 SCREWS, FOR RACK CONSTRUCTION
6. (16) 8-32 X 1/2 SCREWS, FOR SERVODRIVE INSTALLATION INTO RACK
7. (4) 10-32 X 1/2, FOR RACK INSTALLATION ONTO PANEL

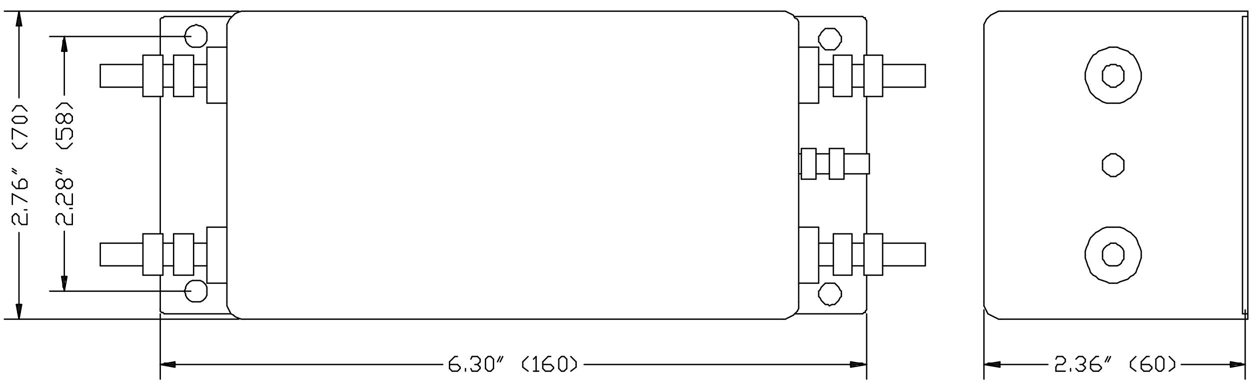
ORMEC SYSTEMS CORP
DATE 900828 | SACERNNN
DRAWN EJB | E RACK, ASSEMBLY
APPROVE | D M.A.N.0.3.3 | REV A | SHT 1 | OF 1

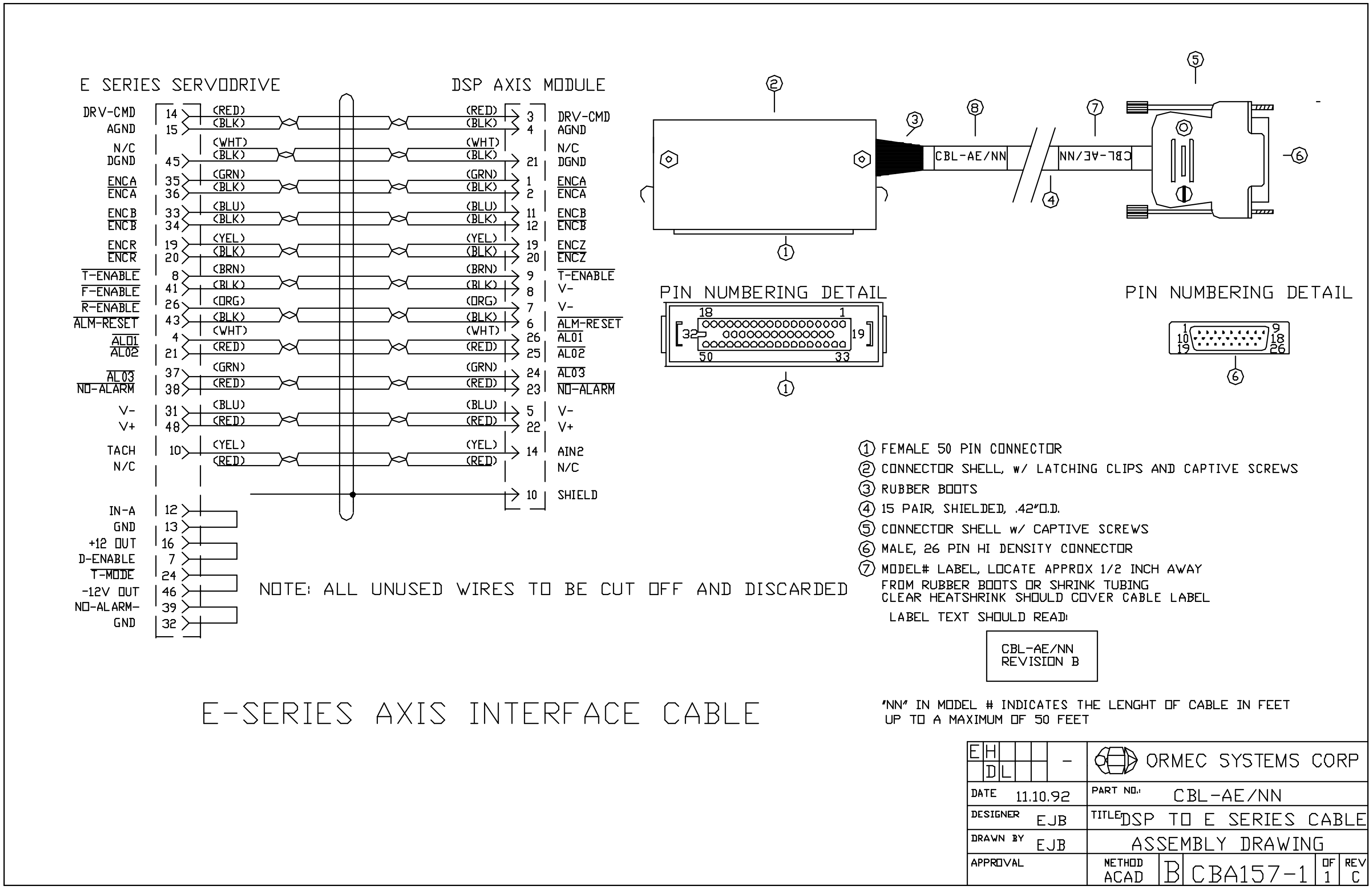
Line Filter Layout

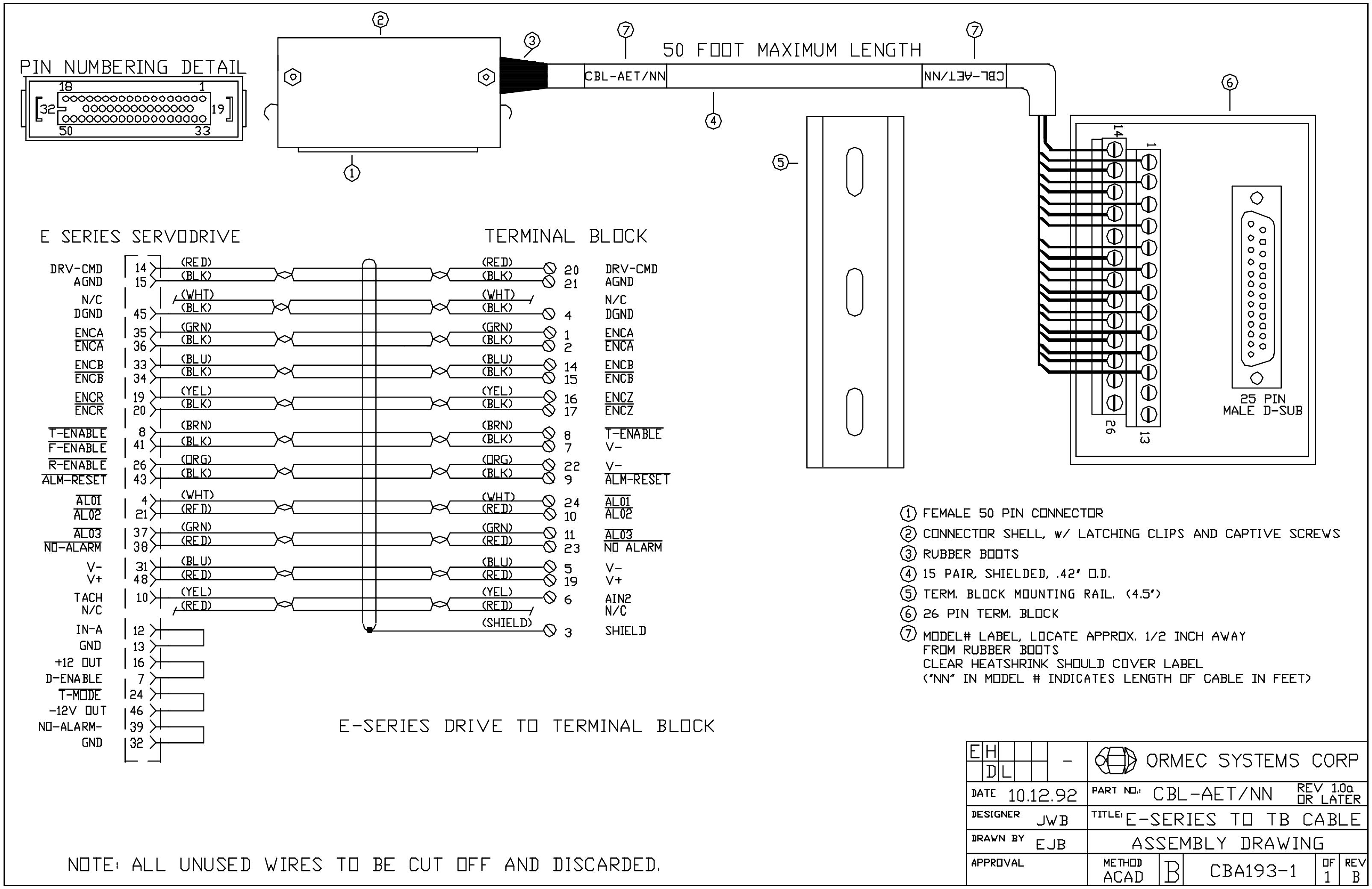
SAC-LF215

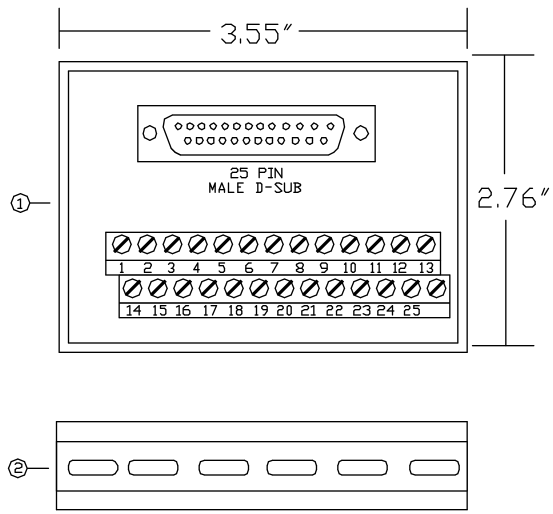


SAC-LF230




E SERIES SERVODRIVE
DSP AXIS MODULE
DRV-CMD 14 (RED) 3 DRV-CMD
AGND 15 (BLK) 4 AGND
N/C (WHT) N/C
DGND 45 (BLK) 21 DGND
ENCA 35 (GRN) 1 ENCA
ENCA 36 (BLK) 2 ENCA
ENCB 33 (BLU) 11 ENCB
ENCB 34 (BLK) 12 ENCB
ENCR 19 (YEL) 19 ENCZ
ENCR 20 (BLK) 20 ENCZ
T-ENABLE 8 (BRN) 9 T-ENABLE
F-ENABLE 41 (BLK) 8 V-
R-ENABLE 26 (ORG) 7 V-
ALM-RESET 43 (BLK) 6 ALM-RESET
AL01 4 (WHT) 26 AL01
AL02 21 (RED) 25 AL02
AL03 37 (GRN) 24 AL03
NO-ALARM 38 (RED) 23 NO-ALARM
V- 31 (BLU) 5 V-
V+ 48 (RED) 22 V+
TACH 10 (YEL) 14 AIN2
N/C (RED) N/C
10 SHIELD
IN-A 12
GND 13
+12 OUT 16
D-ENABLE 7
T-MODE 24
-12V OUT 46
NO-ALARM- 39
GND 32
NOTE: ALL UNUSED WIRES TO BE CUT OFF AND DISCARDED
CBL-AE/NN
PIN NUMBERING DETAIL
18 1 32 19 50 33
PIN NUMBERING DETAIL
1 9 10 18 19 26
① FEMALE 50 PIN CONNECTOR
② CONNECTOR SHELL, w/ LATCHING CLIPS AND CAPTIVE SCREWS
③ RUBBER BOOTS
④ 15 PAIR, SHIELDED, .42"O.D.
⑤ CONNECTOR SHELL w/ CAPTIVE SCREWS
⑥ MALE, 26 PIN HI DENSITY CONNECTOR
⑦ MODEL# LABEL, LOCATE APPROX 1/2 INCH AWAY FROM RUBBER BOOTS OR SHRINK TUBING CLEAR HEATSHRINK SHOULD COVER CABLE LABEL
LABEL TEXT SHOULD READ:
CBL-AE/NN
REVISION B
"NN" IN MODEL # INDICATES THE LENGHT OF CABLE IN FEET UP TO A MAXIMUM OF 50 FEET
E-SERIES AXIS INTERFACE CABLE
ORMEC SYSTEMS CORP
DATE 11.10.92
PART NO.: CBL-AE/NN
DESIGNER EJB
TITLE: DSP TO E SERIES CABLE ASSEMBLY DRAWING
DRAWN BY EJB
APPROVAL
METHOD ACAD
B CBA157-1
OF 1
REV C

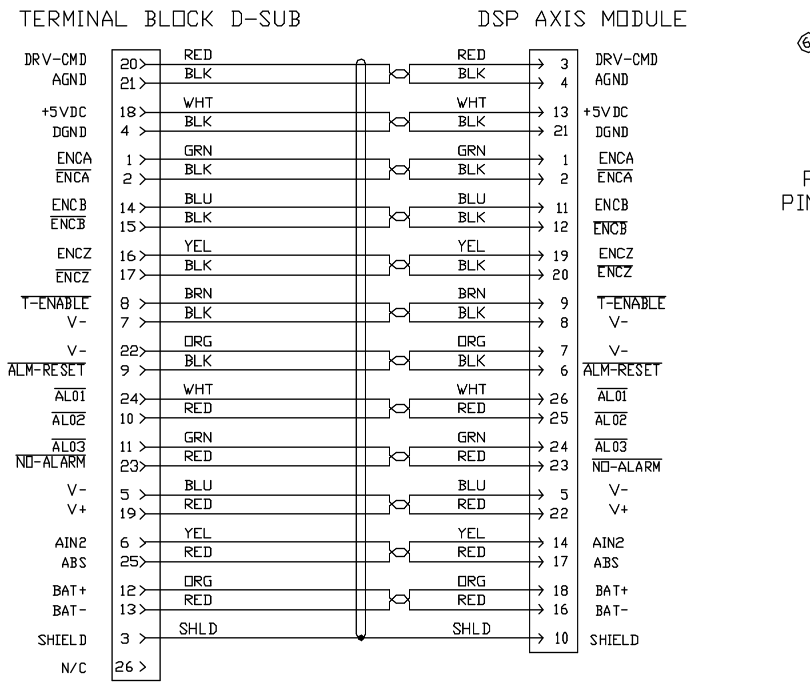

PIN NUMBERING DETAIL
18
1
32
19
50
33
50 FOOT MAXIMUM LENGTH
CBL-AET/NN
CBL-AET/NN
25 PIN
MALE D-SUB
14
1
26
13
E SERIES SERVODRIVE
TERMINAL BLOCK
DRV-CMD 14 (RED) 20 DRV-CMD
AGND 15 (BLK) 21 AGND
N/C (WHT) N/C
DGND 45 (BLK) 4 DGND
ENCA 35 (GRN) 1 ENCA
ENCA 36 (BLK) 2 ENCA
ENCB 33 (BLU) 14 ENCB
ENCB 34 (BLK) 15 ENCB
ENCR 19 (YEL) 16 ENCZ
ENCR 20 (BLK) 17 ENCZ
T-ENABLE 8 (BRN) 8 T-ENABLE
F-ENABLE 41 (BLK) 7 V-
R-ENABLE 26 (ORG) 22 V-
ALM-RESET 43 (BLK) 9 ALM-RESET
AL01 4 (WHT) 24 AL01
AL02 21 (RED) 10 AL02
AL03 37 (GRN) 11 AL03
NO-ALARM 38 (RED) 23 NO ALARM
V- 31 (BLU) 5 V-
V+ 48 (RED) 19 V+
TACH 10 (YEL) 6 AIN2
N/C (RED) N/C
(SHIELD) 3 SHIELD
IN-A 12
GND 13
+12 OUT 16
D-ENABLE 7
T-MODE 24
-12V OUT 46
NO-ALARM- 39
GND 32
E-SERIES DRIVE TO TERMINAL BLOCK
1 FEMALE 50 PIN CONNECTOR
2 CONNECTOR SHELL, w/ LATCHING CLIPS AND CAPTIVE SCREWS
3 RUBBER BOOTS
4 15 PAIR, SHIELDED, .42" O.D.
5 TERM. BLOCK MOUNTING RAIL. (4.5")
6 26 PIN TERM. BLOCK
7 MODEL# LABEL, LOCATE APPROX. 1/2 INCH AWAY
FROM RUBBER BOOTS
CLEAR HEATSHRINK SHOULD COVER LABEL
("NN" IN MODEL # INDICATES LENGTH OF CABLE IN FEET)
NOTE: ALL UNUSED WIRES TO BE CUT OFF AND DISCARDED.
E H
D L
-
ORMEC SYSTEMS CORP
DATE 10.12.92
PART NO.: CBL-AET/NN
REV 1.0a OR LATER
DESIGNER JWB
TITLE: E-SERIES TO TB CABLE
DRAWN BY EJB
ASSEMBLY DRAWING
APPROVAL
METHOD ACAD
B
CBA193-1
OF 1
REV B



① SNAP-TRACK TERMINAL BLOCK

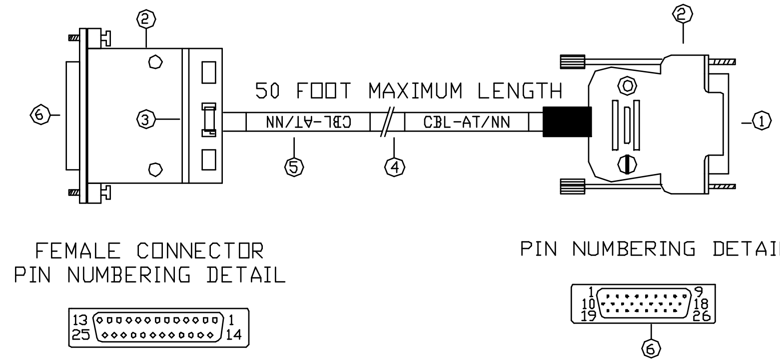
② 4.5" OF TERMINAL BLOCK MOUNTING RAIL

E H D L	–	ORMEC SYSTEMS CORP
DATE 020792	PART NO.: TBC-D25	
DESIGNER DVH	TITLE: TERMINAL BLOCK, 25 POSITION	
DRAWN BY EJB	ASSEMBLY DRAWING	
APPROVAL	METHOD ACAD B CBA998-1	OF 1 REV A



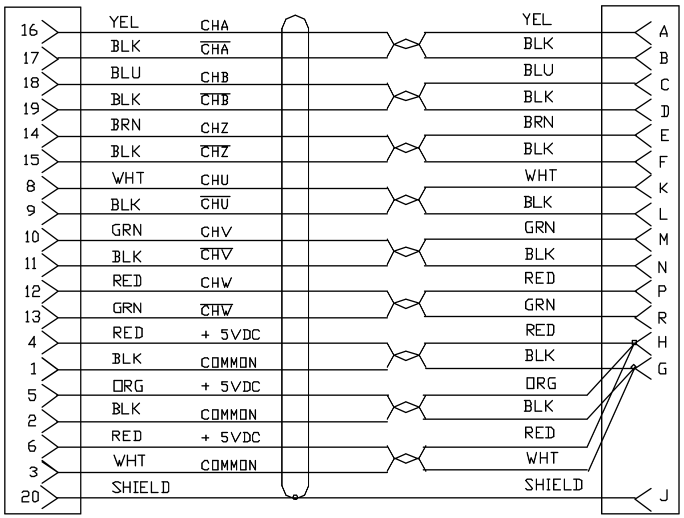
NOTE: ALL UNUSED WIRES TO BE CUT OFF AND DISCARDED

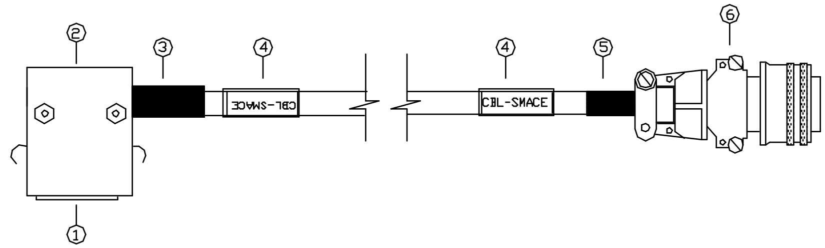
DSP AXIS INTERFACE TO D-SUB CABLE



1. MALE, 26 PIN HI DENSITY CONNECTOR
2. CONNECTOR SHELL W/ THUMB SCREWS
3. TIE WRAP
4. 15 TWISTED PAIR, SHIELDED, .42 O.D.
5. CABLE LABEL LOCATED AT EACH END
   CLEAR HEATSHRINK SHOULD COVER CABLE LABEL
6. 25 PIN FEMALE INSULATION DISPLACEMENT CONNECTOR

EH DL -	ORMEC SYSTEMS CORP
DATE 10.12.92	PART NO: CBL-AT/NN
DESIGNER RJM	TITLE: DSP TO TERMINAL BLOCK
DRAWN BY EJB	ASSEMBLY DRAWING
APPROVAL	METHOD ACAD 10 · B · CBA192-1 · OF 1 · REV B



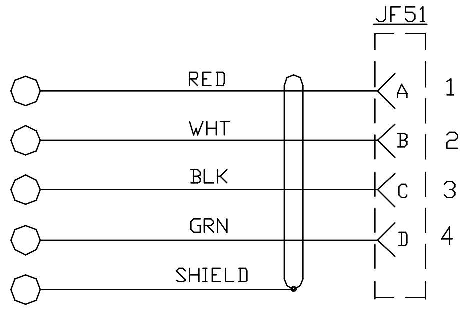


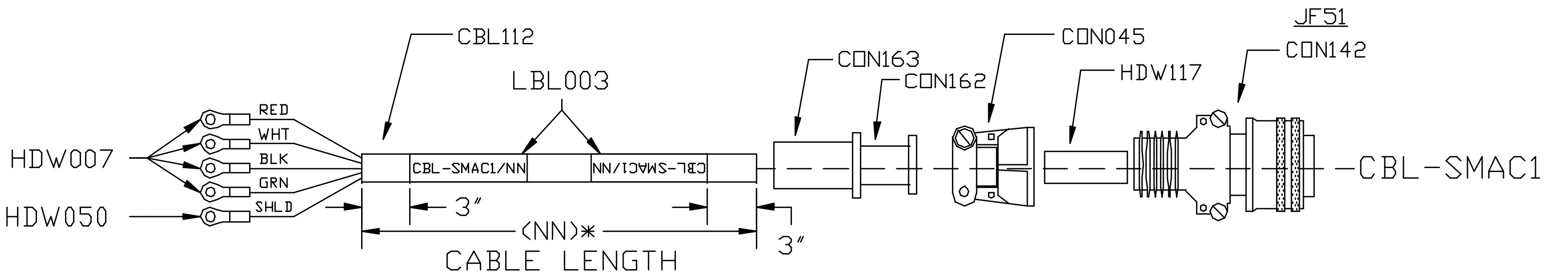
1. FEMALE 20 PIN CONNECTOR
2. CONNECTOR SHELL, w/LATCHING CLIPS AND CAPTIVE SCREWS
3. HEAT SHRINK TUBING 1.5'
4. MODEL NUMBER LABEL / COVERED WITH CLEAR HEATSHRINK
5. RUBBER BOOTS
6. HEAT SHRINK TUBING 1.5' (UNDER BOOTS)

NOTE:

1) WIRE SIZE 22AWG
2) MIN. CABLE LENGTH: 3 FEET
3) MAX. CABLE LENGTH: 150 FEET
4) THE LAST TWO DIGITS OF THE PART NO. SPECIFY THE LENGTH OF THE CABLE IN FEET. (NN) = 3 TO 150 FEET

E H I D L +	ORMEC SYSTEMS CORP
DATE 050690	PART NO.: CBL-SMACE/NN
DESIGNER EJB	TITLE: ENCODER CABLE
DRAWN BY EJB	ASSEMBLY DRAWING
APPROVAL	METHOD ACAD B CBA169-1 OF 1 REV A





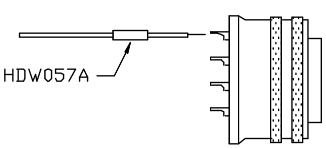
*NOTE:

1) HEATSHRINK IS TO BE USED INSIDE THE CONNECTOR COVERING BOTH THE WIRE AND THE SOLDER CUP.

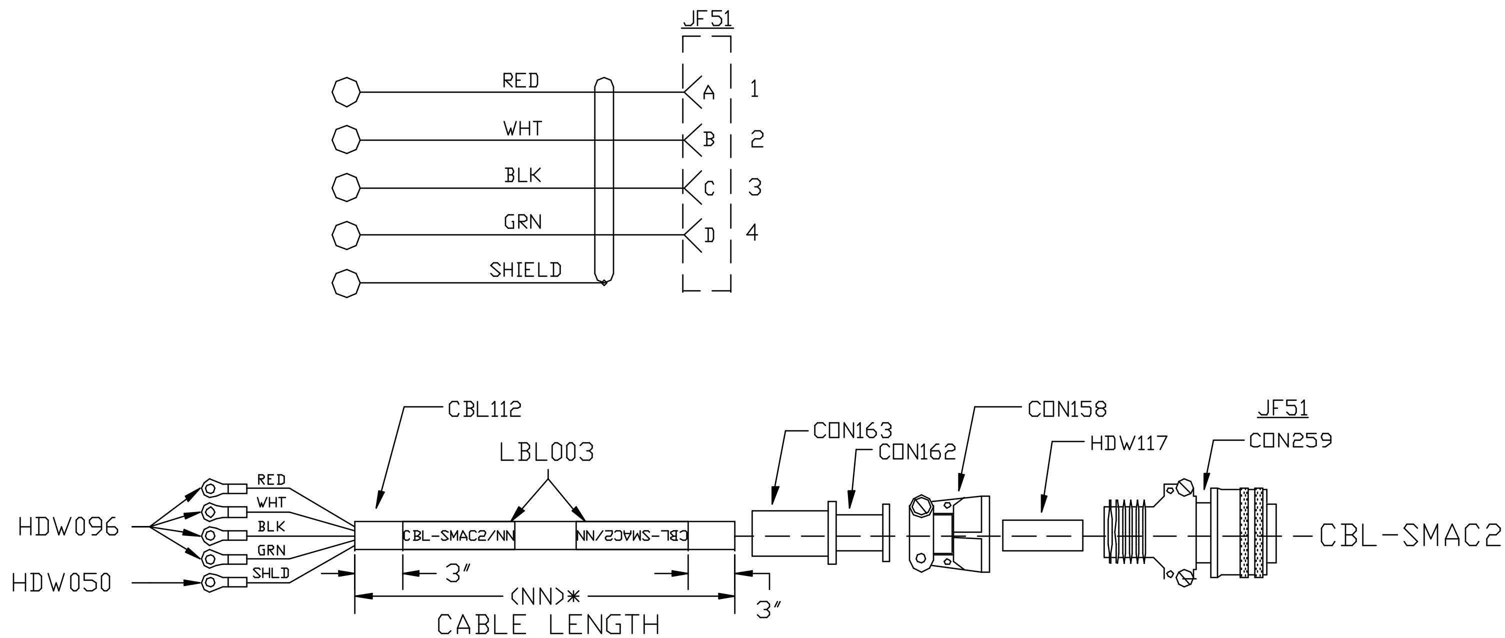
2) MAX. CABLE LENGTH 150 FEET.

3) THE LAST TWO DIGITS OF THE PART NO. SPECIFY THE LENGTH OF THE CABLE IN FEET. (NN) = 25 TO 150 FEET.

SOLDERING DETAIL:

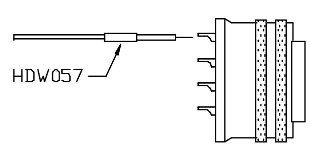


E H / I D L	*	ORMEC SYSTEMS CORP
DATE 050490	PART NO.: CBL-SMAC1/NN	
DESIGNER DTC	TITLE: E-SERIES MOTOR CABLE	
DRAWN BY EJB	ASSEMBLY DRAWING	
APPROVAL	METHOD ACAD B CBA171-1	OF 1 REV A

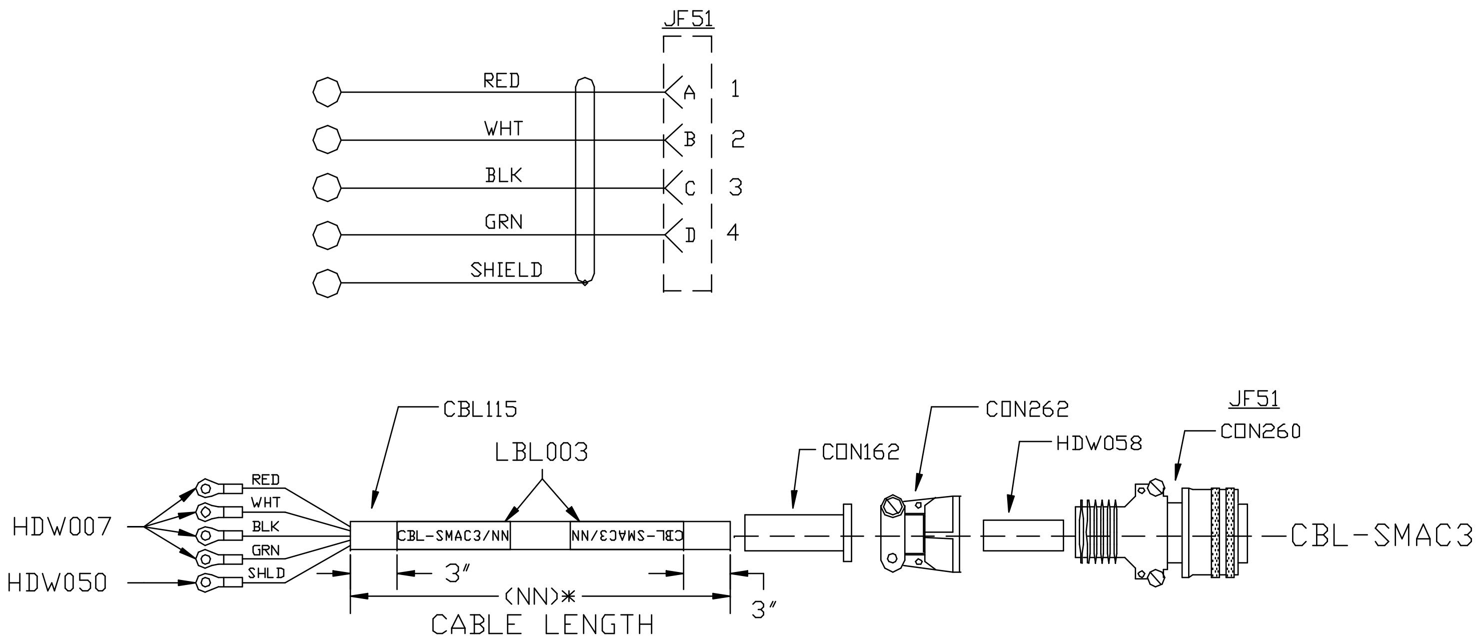


*NOTE:
1) HEATSHRINK IS TO BE USED INSIDE THE CONNECTOR COVERING BOTH THE WIRE AND THE SOLDER CUP.
2) MAX. CABLE LENGTH 150 FEET.
3) THE LAST TWO DIGITS OF THE PART NO. SPECIFY THE LENGTH OF THE CABLE IN FEET. (NN) = 25 TO 150 FEET.

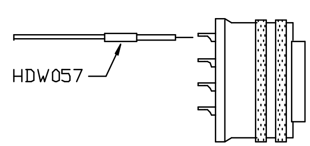
SOLDERING DETAIL:



E H I D L	*	ORMEC SYSTEMS CORP	
DATE 050490		PART NO.: CBL-SMAC2/NN	
DESIGNER DTC		TITLE: E-SERIES MOTOR CABLE	
DRAWN BY RJM		ASSEMBLY DRAWINGS	
APPROVAL	METHOD ACAD	B CBA172-1	OF 1 REV A



SOLDERING DETAIL:



*NOTE:

1) HEATSHRINK IS TO BE USED INSIDE THE CONNECTOR COVERING BOTH THE WIRE AND THE SOLDER CUP.

2) MAX. CABLE LENGTH 150 FEET.

3) THE LAST TWO DIGITS OF THE PART NO. SPECIFY THE LENGTH OF THE CABLE IN FEET. (NN) = 25 TO 150 FEET.

E H / I D L	*	ORMEC SYSTEMS CORP		
DATE 050490		PART NO.: CBL-SMAC3/NN		
DESIGNER DTC		TITLE: E-SERIES MOTOR CABLE		
DRAWN BY EJB		ASSEMBLY DRAWINGS		
APPROVAL		METHOD ACAD	B	CBA170	OF 1	REV A

Appendix E
Absolute Encoder Support

Absolute Encoder Support

E-Series servodrives and motors with absolute encoder support are not available as standard parts which can be ordered from the ORMEC Product Guide. The "**J**" in the part numbers shown below is used to distinguish custom servodrive and motors from standard ORMEC servodrives and motors.

SAC-J####

MAC-J####

If you are not certain that the servodrive and motor you are working with support absolute encoder operation, please call the ORMEC Service Department[1].

Theory of Operation

This section provides an general overview of the E-Series absolute encoder system. For a more complete explanation of the absolute encoder system operation refer to the Operation section of this Appendix.

The E-Series servomotor absolute encoder system consists of three parts: an optical single revolution absolute encoder, a magnetic revolution counter, and a micro-controller circuit. The optical single revolution absolute encoder indicates the motor shaft's position within a single revolution. The magnetic revolution counter maintains a count of the complete motor revolutions since the absolute encoder was reset (revolution count set to 0). The micro-controller circuitry is the interface between the servomotor and servodrive, "reading" the optical absolute encoder and magnetic revolution counter data and "sending" it serially to the servodrive via one of the servomotor's encoder quadrature feedback channelss. The combination of theabsolute position within a revolution and the revolution count is used to determine the servomotors absolute position.

During a loss of control power to the servodrive the absolute encoder system is able to maintain a count of the servomotor revolutions. A small power supply for the absolute encoder system is provided either through a battery on the Model 20/40 motion controller, or through the storage capacitor on the servomotor itself. This power supply is for the magnetic revolution counter and micro-controller circuitry

[1] To aid in serving you, have your servodrive and servomotor part and serial numbers available when calling the ORMEC Service Department

only, the optical absolute encoder is disabled when system control power is lost to conserve battery/capacitor power. When the Model 20/40 polls the servodrive for the servomotor's absolute position, the servodrive resumes supplying power to the absolute encoder system.

Specifications

All the specifications for E-Series servodrives and motors that support absolute encoder operation are the same as those for the equivalent standard E-Series servodrives and motors. Refer to the Specifications chapter of this manual for further information. If you are not certain which standard E-Series servodrive and motor are equivalent to the ones you are working with, please call the ORMEC Service Department.

Installation

All the installation instructions for E-Series servodrive and motors with absolute encoder support are the same as those for the equivalent standard E-Series servodrives and motors, except as noted in this section. Refer to the Installation chapter of this manual for further information. If you are not certain which standard E-Series servodrive and motor are equivalent to the ones you are working with, please call the ORMEC Service Department.

An additional battery (GN3-BAT), locator B2, is required for the Model 20/40 that is connected to the absolute encoder servodrive. Refer to Appendix H of the "Model 20/40 Motion Controllers Installation and Operation Manual" for the location of the absolute encoder battery B2. To have the additional battery required for the absolute encoder installed in the Model 20/40 prior to shipment append the "B" option to the controller part number. If you do not have an absolute encoder battery, please call your ORMEC Sales Representative.

When configuring MotionPRO for the motor, be sure that the Feedback type "Absolute" is selected. This will cause MotionPRO write the MP.CONFIG routine to read the motor's absolute position automatically.

Control Circuit Interconnections - Connector 1CN

Cable CBL-**AEA**\NN is used to connect an E-Series servodrive with absolute encoder support to a GN3-DSP, instead of cable CBL-**AE**\NN used with a standard E-Series servodrive. Refer to Appendix page E-5 for further information regarding cable CBL-**AEA**\NN.

Optical Position Encoder Connections - Connector 2CN

Cable CBL-**SMACEA**\NN is used to connect an E-Series servomotor with absolute encoder support to the servodrive, instead of cable CBL-**SMACE**\NN used with a standard E-Series servomotor. Refer to Appendix page E-6 for further information regarding cable CBL-**SMACEA**\NN.

Operation

The operation of E-Series servodrives and motors with absolute encoder support is the same as that of the equivalent standard E-Series servodrives and motors, in addition to the features noted in this section. Refer to the Operation chapter of this manual for further information. If you are not certain which standard E-Series servodrive and motor are equivalent to the ones you a working with, please call the ORMEC Service Department.

Reading the Absolute Encoder

During normal operation the servomotor issues quadrature position data as a standard incremental encoder, while a circuit in the motor's encoder counts the motor revolutions. When motor torque is disabled, the DSP can poll the servodrive for the absolute position information via axis interface cable (CBL-AEA\NN) using the MotionBASIC™ POS.ABS@ command. The servodrive polls the motor counter circuit for the absolute position data via the motor encoder cable (CBL-SMACEA\NN). The servodrive then passes the absolute position information back to the DSP.

The absolute encoder position information should not be read until after the servodrive has had logic power for 1 second. The entire process required for reading the absolute encoder position data takes approximately 0.5 seconds. The position value returned by the POS.ABS@ command as the absolute encoder position is in encoder counts, not User Units. For further information regarding User Units and reading the absolute encoder position refer to the POS.ABS@ variable explanation in the "MotionBASIC ™ Hypertext Manual".

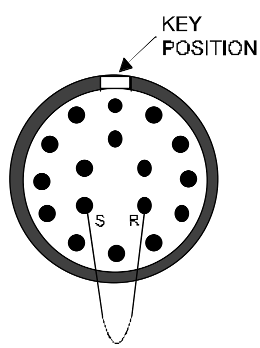
Absolute Encoder Power

During loss of logic power the revolution counting circuitry in the motor is powered by the battery in the Model 20/40 controller. Reading the absolute position data, using the MotionBASIC™ POS.ABS@ command, asserts the ABS servodrive interface signal which causes the servodrive to begin supplying the motor with the power required for the counter circuit. This should be done to help conserve the Model 20/40 battery power. For further information regarding reading the absolute encoder position refer to the POS.ABS@ variable explanation in the "MotionBASIC ™ Hypertext Manual".

If the motor is disconnected from the servodrive and/or Model 20/40 battery, a capacitor in the motor itself supplies enough power to allow the counter circuitry to maintain the revolution information. The servomotor can be disconnected from the servodrive and/or Model 20/40 battery for up to 96 hours without loss of the absolute position information.

Resetting the Absolute Encoder

The revolution counter circuit will reset to zero if the capacitor in the motor is allowed to fully discharge. The counter circuit can also be reset by short circuiting pins "R" and "S" of the motor encoder connector for at least 2 minutes, refer to the figure below.



Resetting the absolute encoder clears the revolution counter circuit, however, the incremental position value remains. Therefore resetting the absolute encoder results in an absolute position value between 0 and 5,999.

Absolute Position

Reading the absolute position of the motor returns a number between -299,999,999 (reverse limit) and +299,999,999 (forward limit). The absolute position of the motor is relative to the motor position when the encoder was reset (revolution count set to 0). The absolute position is derived by the following equation:

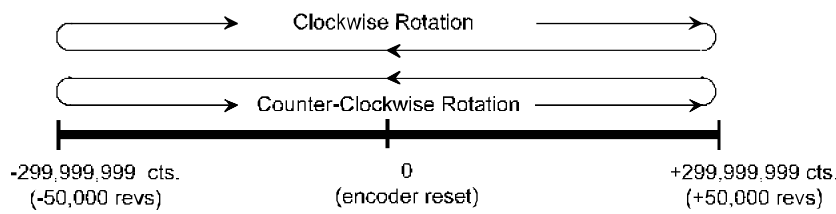
Absolute Position = (**Number of Revs** x **6000**) + **Incremental Position**

For Example: POS.ACT@ = POS.ABS@
= (2000 revs * 6000 cts/rev) + 3956
= 12003956

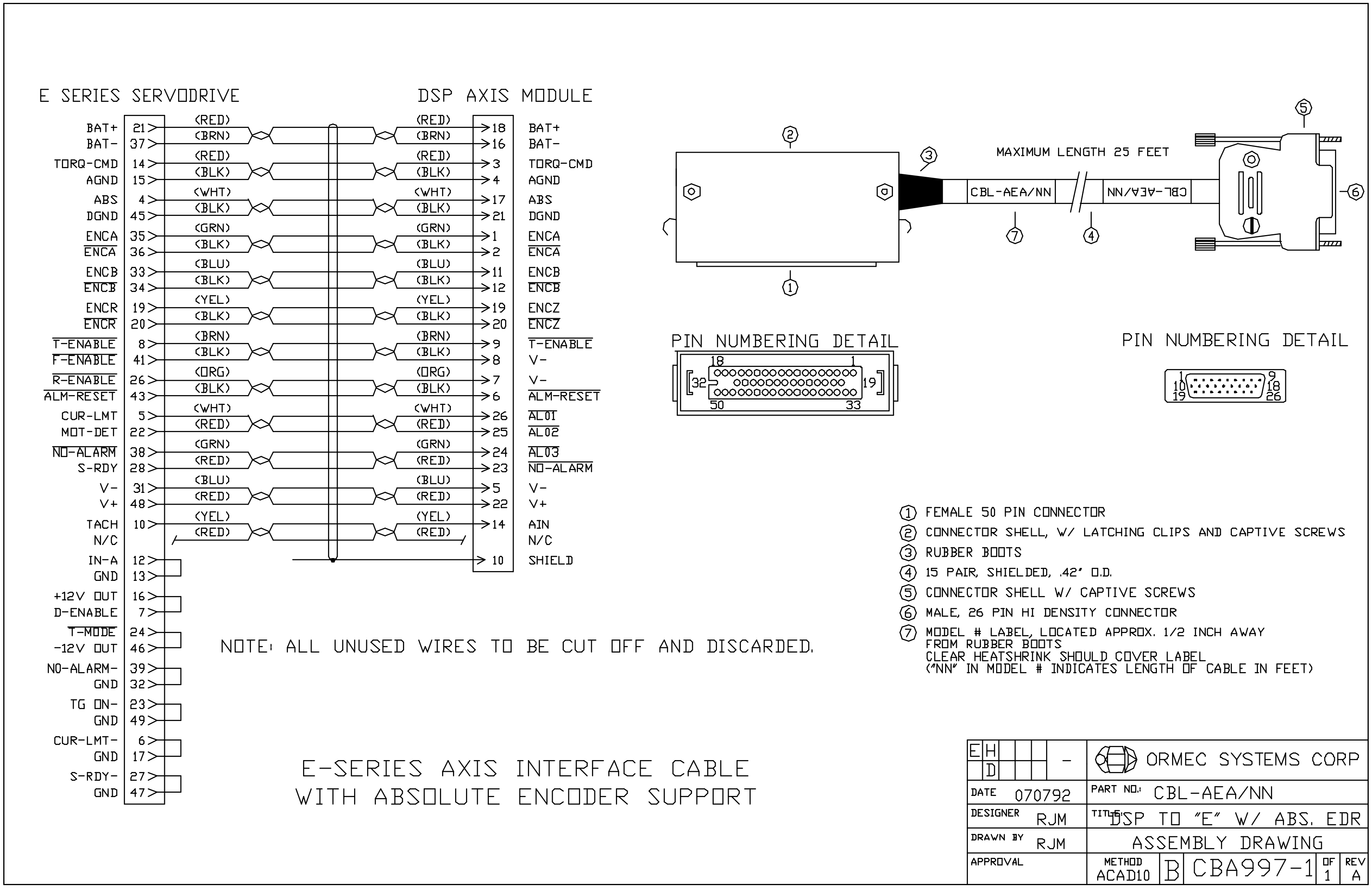
The absolute encoder can count up to 50,000 revolutions in either direction. Resetting the absolute encoder sets the revolution count value to zero.

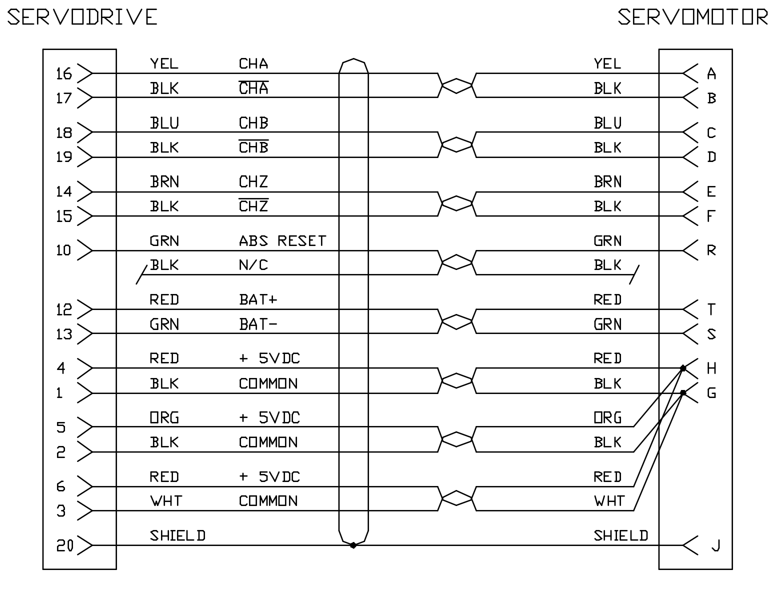
Moving the motor in the counter-clockwise direction (looking at the motor shaft) causes the absolute position counter to increment, moving in the clockwise direction causes it to decrement. The operation of the absolute encoder, and therefore the absolute position information is not affected by the configuration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

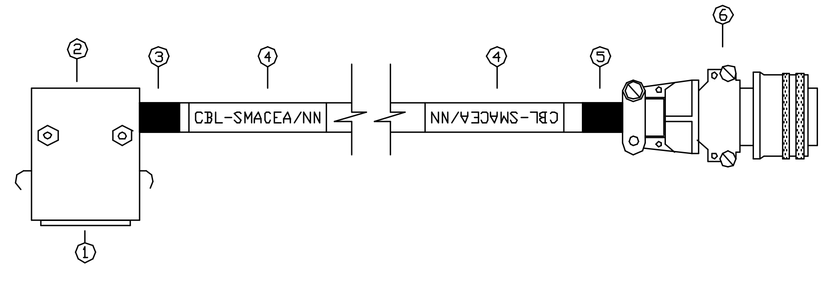
Moving the motor counter-clockwise through the forward limit position causes the absolute position counter to "wrap around" to the reverse limit position, and continue counting upward. Moving the motor clockwise through the reverse position limit causes the absolute position counter to "wrap around" to the forward limit position, and continue counting downward. No position counts are lost during "wrap around" at the limit positions. Refer to the figure below for a graphical representation of the absolute position "wrap around" feature.



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.


E SERIES SERVODRIVE
DSP AXIS MODULE
BAT+ 21 (RED) (RED) 18 BAT+
BAT- 37 (BRN) (BRN) 16 BAT-
TORQ-CMD 14 (RED) (RED) 3 TORQ-CMD
AGND 15 (BLK) (BLK) 4 AGND
ABS 4 (WHT) (WHT) 17 ABS
DGND 45 (BLK) (BLK) 21 DGND
ENCA 35 (GRN) (GRN) 1 ENCA
ENCA 36 (BLK) (BLK) 2 ENCA
ENCB 33 (BLU) (BLU) 11 ENCB
ENCB 34 (BLK) (BLK) 12 ENCB
ENCR 19 (YEL) (YEL) 19 ENCZ
ENCR 20 (BLK) (BLK) 20 ENCZ
T-ENABLE 8 (BRN) (BRN) 9 T-ENABLE
F-ENABLE 41 (BLK) (BLK) 8 V-
R-ENABLE 26 (ORG) (ORG) 7 V-
ALM-RESET 43 (BLK) (BLK) 6 ALM-RESET
CUR-LMT 5 (WHT) (WHT) 26 AL01
MOT-DET 22 (RED) (RED) 25 AL02
NO-ALARM 38 (GRN) (GRN) 24 AL03
S-RDY 28 (RED) (RED) 23 NO-ALARM
V- 31 (BLU) (BLU) 5 V-
V+ 48 (RED) (RED) 22 V+
TACH 10 (YEL) (YEL) 14 AIN
N/C (RED) (RED) N/C
10 SHIELD
IN-A 12
GND 13
+12V OUT 16
D-ENABLE 7
T-MODE 24
-12V OUT 46
NO-ALARM- 39
GND 32
TG ON- 23
GND 49
CUR-LMT- 6
GND 17
S-RDY- 27
GND 47
NOTE: ALL UNUSED WIRES TO BE CUT OFF AND DISCARDED.
MAXIMUM LENGTH 25 FEET
CBL-AEA/NN
CBL-AEA/NN
PIN NUMBERING DETAIL
18 1 32 19 50 33
PIN NUMBERING DETAIL
1 9 10 18 19 26
(1) FEMALE 50 PIN CONNECTOR
(2) CONNECTOR SHELL, W/ LATCHING CLIPS AND CAPTIVE SCREWS
(3) RUBBER BOOTS
(4) 15 PAIR, SHIELDED, .42" O.D.
(5) CONNECTOR SHELL W/ CAPTIVE SCREWS
(6) MALE, 26 PIN HI DENSITY CONNECTOR
(7) MODEL # LABEL, LOCATED APPROX. 1/2 INCH AWAY FROM RUBBER BOOTS
CLEAR HEATSHRINK SHOULD COVER LABEL
("NN" IN MODEL # INDICATES LENGTH OF CABLE IN FEET)
E-SERIES AXIS INTERFACE CABLE
WITH ABSOLUTE ENCODER SUPPORT
E H D -
ORMEC SYSTEMS CORP
DATE 070792
PART NO.: CBL-AEA/NN
DESIGNER RJM
TITLE DSP TO "E" W/ ABS. EDR
DRAWN BY RJM
ASSEMBLY DRAWING
APPROVAL
METHOD ACAD10
B
CBA997-1
OF 1
REV A





① FEMALE 20 PIN CONNECTOR
② CONNECTOR SHELL W/LATCHING CLIPS AND CAPTIVE SCREWS
③ HEATSHRINK TUBING 1.5"
④ MODEL NUMBER LABEL COVERED WITH CLEAR HEATSHRINK
⑤ RUBBER BOOTS
⑥ 17 PIN FEMALE STRAIGHT PLUG CONNECTOR

NOTE:
1) WIRE SIZE 22AWG
2) MIN. CABLE LENGTH: 3 FEET
3) MAX. CABLE LENGTH: 150 FEET
4) THE LAST TWO DIGITS OF THE PART NO. SPECIFY THE LENGTH OF THE CABLE IN FEET. (NN) = 3 TO 150 FEET

E DL	-	ORMEC SYSTEMS CORP		
DATE 8.27.92	PART NO.: CBL-SMACEA/NN			
DESIGNER RJM	TITLE: ABSOLUTE ENCODER CABLE			
DRAWN BY EJB	ASSEMBLY DRAWING			
APPROVAL	METHOD ACAD 10	B CBA991-1	OF 1	REV A

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We are providing this form to help track any errors or suggestions for improvement in our manuals. Please use this form if you find any errors or suggestions, by describing them using the space provided below. Be sure and indicate any page, table, or figure numbers as appropriate. Then remove this form from the manual and fold it into thirds such that the pre-printed address is visible, and tape form closed.

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Manual Correction/ Suggestion Form

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19 Linden Park
Rochester, NY 14625

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