S-Series
AC Servodrives

Installation & Operation Manual
SAC-S01d

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Chapter 1
Welcome

1 Welcome

This manual provides information about ORMEC's S-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 S-Series product family.
Chapter 3	**Specifications** provides a detailed list of servodrive and compatible A, B, & C- 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 S-Series servodrives, including detailed information on each unit's interface.
Chapter 5	**Operation** documents the powerup and initial configuration approach for the S-Series.
Chapter 6	**Getting Started** provides detailed instructions on how to run your S-Series servodrive for the first time.
Chapter 7	**Maintenance and Troubleshooting** describes the various servodrive status and alarm indicators.
Appendixes	**Appendixes** contain a detailed drawing set.

Chapter 2
General Description

2 General Description

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

2.1 Servodrive Capabilities

- **Wide Power Range:** Output power ratings range from 300 watts to 6.1 kW.
- **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 range from 0.21 to 8.2 HP.
- **Wide Torque Range:** Continuous stall torques range from 10 to 560 in-lb.
- **High Speed:** Maximum motor speeds range from 1,500 to 4,000 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 between 6,000 and 24,000 precise increments of position, counts, per revolution.
- **Low Torque Ripple:** Sinusoidal construction and precise electronic commutation provide low motor output torque ripple.

2.3 Modular Servodrive Construction

- **Shunt Regulator:** The integral bus power supply has a built-in shunt regulator 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 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 S-Series drives to provide an added measure of safety.

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, and excess 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.

Chapter 3
Specifications

3 Specifications

Servodrives covered by this manual:

SAC-S03A	SAC-S19E
SAC-S04B	SAC-S26F
SAC-S08C	SAC-S33G
SAC-S12D	SAC-S45H

3.1 Motor and Servodrive Combinations

S-Series servodrives operate with three series of high performance brushless AC Servomotors as detailed below:

- **A-Series**: The A-Series motors, with rare earth magnetics and medium resolution encoders, are ideal for applications requiring high speed motions (4,000 RPM maximum versus 2,500) or high torque to inertia ratios.
- **B-Series**: For most applications the B-Series provide the best value with their combination of ceramic magnets and high-resolution encoders.
- **C-Series:** The C-Series motors are similar to the B-Series, but, combine somewhat lower maximum speed with higher torque ratings to extend the torque/power range beyond the largest B-Series motors.

3.2 General 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 panel mounting, four 10-32 screws.

Electrical Specifications

Incoming Line Voltage:	200-230 VAC[1] 3 phase, 50/60 Hz
Minimum Incoming Line Voltage:	170 VAC
Absolute Maximum Incoming Line age:	253 VAC
Encoder Power Voltage:	5 vdc +/- 5%
Maximum Encoder Power Current:	200 mA
Input Interlock Circuitry:	
Input Voltage Requirements:	+24 vdc @25 mA maximum
Input Current (at each input)	5 mA typical
Output Interlock Circuitry:	
Maximum Applied Voltage:	+30 vdc
Maximum Current Sink Capability:	-50 mA
Rated Bus Voltage:	270 vdc
Shunt Regulator Activation Bus Voltage:	380 vdc
Excess Bus Voltage Fault:	420 vdc
Undervoltage Bus Voltage Fault:	150 vdc

[1] Conforming to better line voltage specifications will result in operation above the output specifications stated for the individual motor-drive combination.

3.2.1 A-Series Motors Overview

Maximum Speed:	4,000 RPM
Continuous stall torques:	10 to 110 lb-in
Peak Torques:	26 to 257 lb-in
Peak Acceleration:	greater than 50,000 rad/sec^2 (including the largest unit)
Rated Power:	0.43 to 4.2 HP
Position Encoder Resolution:	6,000 cts/rev (1,500 lines/rev)

3.2.2 B-Series Motors Overview

Maximum Speed:	2,500 RPM
Continuous stall torques:	10 to 330 lb-in
Peak Torques:	26 to 675 lb-in
Peak Acceleration:	up to 28,888 rad/sec^2 (largest unit is 5,315 rad/sec^2)
Rated Power:	0.21 to 6.1 HP
Position Encoder Resolution:	24,000 cts/rev (6,000 lines/rev)

3.2.3 C-Series Motors Overview

Maximum Speed:	1,500 to 2,000 RPM
Continuous stall torques:	290 to 560 lb-in
Peak Torques:	570 to 945 lb-in
Peak Acceleration:	up to 4,488 rad/sec^2 (largest unit is 4,337 rad/sec^2)
Rated Power:	4.1 to 8.2 HP
Position Encoder Resolution:	24,000 cts/rev (6,000 lines/rev)

3.2.4 MAC-A Series Servomotors Specifications

MAC-A Series Servomotor Specifications

PERFORMANCE[1]	UNITS	A010A	A015B	A030C	A055D	A110F
Maximum Speed	RPM	4,000	4,000	4,000	4,000	4,000
Continuous Stall Torque	lb-in	10	15	30	55	108
	(N-m)	(1.18)	(1.67)	(3.33)	(6.17)	(12.2)
Rated Torque at 3000 RPM	lb-in	8.7	13	22	43	87
	(N-m)	(0.98)	(1.47)	(2.45)	(4.90)	(9.80)
Rated Power	HP	0.4	0.6	1	2.1	4.1
	watts	308	461	771	1,540	3,080
Peak Torque	lb-in	26	36	65	122	257
	(N-m)	(2.94)	(4.02)	(7.35)	(13.7)	(29.0)
Continuous Stall Torque/Inertia	rad/sec^2	22,222	22,388	11,858	19,097	21,218
MECHANICAL						
Moment of Inertia	lb-in-sec^2	0.00045	0.00067	0.00253	0.00288	0.00509
	(kg-m^{2}x10^{-4})	(0.51)	(0.75)	(2.85)	(3.30)	(5.74)
Friction Torque, static	lb-in	0.5	0.7	1.9	1.9	3.2
	(N-m)	(0.056)	(0.079)	(0.2145)	(0.2145)	(0.361)
Servomotor Weight	lbs	5.7	7.3	12.8	24.3	52.9
	(kg)	(2.6)	(3.3)	(5.8)	(11)	(24)
Mounting Bolt Diameter	inches	3.543	3.543	5.118	5.71	7.874
	(mm)	(90)	(90)	(130)	(145)	(200)
Pilot Diameter	inches	2.756	2.756	4.331	4.331	4.500
	(mm)	(70)	(70)	(110)	(110)	(114.3)
Length, mounting face to rear	inches	5.846	6.713	7.835	10.217	11.654
	(mm)	(148.5)	(170.5)	(199)	(259.5)	(296)
Maximum Radial Shaft Load	lbs	55	55	88	110	154
	(N)	(245)	(245)	(392)	(490)	(686)
Maximum Axial Shaft Load	lbs	22	22	33	33	44
	(N)	(98)	(98)	(147)	(147)	(196)
ELECTRICAL						
Servodrive	SAC-	S03A	S04B	S08C	S12D	S26F
Torque Sensitivity, K_t	lb-in/amp	3.10	3.28	4.49	4.43	4.64
	(N-m/amp)	(0.35)	(0.37)	(0.51)	(0.50)	(0.524)
Continuous Current	amps	3	4.3	5.3	10.4	19.9
Peak Current	amps	8.5	11	15.6	28	56.5
Servodrive Weight	lbs	13	13	13	13	21
	(kg)	(5.5)	(5.5)	(5.5)	(5.5)	(9.5)
THERMAL						
Ambient Temperature	deg. C	40	40	40	40	40
Thermal Time Constant	minutes	15	18	45	50	55
Insulation Class		B	B	F	F	F
ENCODER & TACH						
Encoder Quadrature Resolution[2]	linecount	1,500	1,500	1,500	1,500	1,500
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.m

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

3.2.5 MAC-B Series Servomotor Specifications

MAC-B Series Servomotor Specifications

PERFORMANCE[1]	UNITS	B010A	B020A	B025B	B050C
Maximum Speed	RPM	2,500	2,500	2,500	2,500
Continuous Stall Torque	lb-in	10	19	26	52
	(N-m)	(1.1)	(2.2)	(2.9)	(5.9)
Rated Torque at 1500 RPM	lb-in	8.7	17	25	48
	(N-m)	(1.0)	(2.0)	(2.8)	(5.4)
Rated Power	HP	0.2	0.4	0.6	1.1
	watts	150	300	450	850
Peak Torque	lb-in	26	52	79	135
	(N-m)	(2.9)	(5.7)	(8.9)	(15.2)
Continuous Stall Torque/Inertia	rad/sec^2	8,333	10,556	2,167	2,419
MECHANICAL					
Moment of Inertia	lb-in-sec^2	0.0012	0.0018	0.012	0.0215
	(kg-m^{2}x10^{-4})	(1.30)	(2.06)	(13.5)	(24.3)
Friction Torque, static	lb-in	0.5	0.7	1.9	2.6
	(N-m)	(0.056)	(0.079)	(0.214)	(0.294)
Servomotor Weight	lbs	8.0	9.0	22.0	33.0
	(kg)	(3.5)	(4)	(10)	(15)
Mounting Bolt Diameter	inches	3.937	3.937	5.709	5.709
	(mm)	(100)	(100)	(145)	(145)
Pilot Diameter	inches	3.150	3.150	4.331	4.331
	(mm)	(80)	(80)	(110)	(110)
Length, mounting face to rear	inches	6.024	7.835	7.992	10.236
	(mm)	(153)	(199)	(203)	(260)
Maximum Radial Shaft Load	lbs	33	33	110	110
	(N)	(147)	(147)	(490)	(490)
Maximum Axial Shaft Load	lbs	11	11	22	22
	(N)	(49)	(49)	(98)	(98)
ELECTRICAL					
Servodrive	SAC-	S03A	S04B	S04B	S08C
Torque Sensitivity, K_t	lb-in/amp	3.2	6.3	7.1	8.2
	(N-m/amp)	(0.36)	(0.72)	(0.80)	(0.92)
Back EMF Constant, K_b	v/Krpm	37.8	74.4	83.9	96.9
Armature Resistance	ohms/phase	1.3	2	1.3	0.67
Continuous Current	amps	3	3	3.8	6.2
Peak Current	amps	8.5	8.5	11	17
Servodrive Weight	lbs	13	13	13	13
	(kg)	(5.5)	(5.5)	(5.5)	(5.5)
THERMAL					
Ambient Temperature	deg. C	40	40	40	40
Thermal Time Constant	minutes	15	18	45	50
Insulation Class		F	F	F	F
ENCODER & TACH					
Encoder Quadrature Resolution[2]	linecount	6,000	6,000	6,000	6,000
Tachometer sensitivity	volts/Krpm	3	3	3	3

[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 lll which decode every edge of the "A" and "B" quadrature encoder channels.

MAC-B Series Servomotor Specifications

PERFORMANCE[1]	UNITS	B080D	B110E	B200F	B330G
Maximum Speed	RPM	2,500	2,500	2,500	2,500
Continuous Stall Torque	lb-in	78	104	200	330
	(N-m)	(8.8)	(11.8)	(22.6)	(37.3)
Rated Torque at 1500 RPM	lb-in	74	102	165	252
	(N-m)	(8.3)	(11.5)	(18.6)	(28.4)
Rated Power	HP	1.7	2.4	3.9	5.9
	watts	1,300	1,800	2,900	4,400
Peak Torque	lb-in	219	301	479	675
	(N-m)	(24.7)	(34.0)	(54.1)	(76.2)
Continuous Stall Torque/Inertia	rad/sec[2]	2,400	1,757	2,058	2,605
MECHANICAL					
Moment of Inertia	lb-in-sec[2]	0.0325	0.0592	0.0972	0.1267
	($kg\text{-}m^2 x10^{-44}$)	(36.7)	(66.8)	(110)	(143)
Friction Torque, static	lb-in	3.2	4.1	4.4	5.4
	(N-m)	(0.361)	(0.463)	(0.497)	(0.610)
Servomotor Weight	lbs	46.0	53.0	71.0	95.0
	(kg)	(21)	(24)	(32)	(43)
Mounting Bolt Diameter	inches	5.709	7.874	7.874	7.874
	(mm)	(145)	(200)	(200)	(200)
Pilot Diameter	inches	4.331	4.500	4.500	4.500
	(mm)	(110)	(114)	(114)	(114)
Length, mounting face to rear	inches	13.701	10.669	12.953	16.299
	(mm)	(348)	(271)	(329)	(414)
Maximum Radial Shaft Load	lbs	154	331	331	331
	(N)	(686)	(1470)	(1470)	(1470)
Maximum Axial Shaft Load	lbs	77	110	110	110
	(N)	(343)	(490)	(490)	(490)
ELECTRICAL					
Servodrive	SAC-	S12D	S19E	S26F	S33G
Torque Sensitivity, K_t	lb-in/amp	8.2	7.3	8.7	9.0
	(N-m/amp)	(0.92)	(0.82)	(0.98)	(1.02)
Back EMF Constant, K_b	v/Krpm	96.9	86.3	102	106
Armature Resistance	ohms/phase	0.35	0.35	0.15	0.01
Continuous Current	amps	9.7	15	20	30
Peak Current	amps	28	36	57	77
Servodrive Weight	lbs	13	21	21	24
	(kg)	(5.5)	(9.5)	(9.5)	(11)
THERMAL					
Ambient Temperature	deg. C	40	40	40	40
Thermal Time Constant	minutes	55	55	60	65
Insulation Class		F	F	F	F
ENCODER & TACH					
Encoder Quadrature Resolution[2]	linecount	6,000	6,000	6,000	6,000
Tachometer sensitivity	volts/Krpm	3	3	3	3

[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 lll which decode every edge of the "A" and "B" quadrature encoder channels.

3.2.6 MAC-C Series Servomotor Specifications

MAC-C Series Servomotor Specifications

PERFORMANCE[1]	UNITS	C290F	C410G	C560H
Maximum Speed	RPM	2,000	1,500	1,500
Continuous Stall Torque	lb-in	286	408	557
	(N-m)	(32.3)	(46.1)	(62.9)
Rated Torque at 1000 RPM	lb-in	252	372	507
	(N-m)	(28.4)	(41.9)	(57.2)
Rated Power	HP	4	5.9	8
	watts	3,000	4,400	6,000
Peak Torque	lb-in	564	807	938
	(N-m)	(63.7)	(91.1)	(105.8)
Continuous Stall Torque/Inertia	rad/sec^2			
MECHANICAL				
Moment of Inertia	lb-in-sec^2	0.1267	0.2126	0.2126
	(kg-m^{2}x10^{-4})	(240)	(240)	(240)
Friction Torque, static	lb-in	4.5	5.5	6.2
	(N-m)	(0.508)	(0.621)	(0.700)
Servomotor Weight	lbs	95.0	154.0	165.0
	(kg)	(43)	(70)	(75)
Mounting Bolt Diameter	inches	7.874	7.874	7.874
	(mm)	(200)	(200)	(200)
Pilot Diameter	inches	4.500	4.500	4.500
	(mm)	(114.3)	(114.3)	(114.3)
Length, mounting face to rear	inches	16.299	24.213	27.953
	(mm)	(414)	(615)	(710)
Maximum Radial Shaft Load	lbs	330	397	397
	(N)	(1470)	(1764)	(1764)
Maximum Axial Shaft Load	lbs	110	132	132
	(N)	(490)	(588)	(588)
ELECTRICAL				
Servodrive	SAC-	S26F	S33G	S45H[2]
Torque Sensitivity, K_t	lb-in/amp	10.2	11.8	11.8
	(N-m/amp)	(1.16)	(1.33)	(1.33)
Continuous Current	amps	26	33	45
Peak Current	amps	56.5	70	80.6
Servodrive Weight	lbs	21	24	29
	(kg)	(9.5)	(11)	(13)
THERMAL				
Ambient Temperature	deg. C	40	40	40
Thermal Time Constant	minutes	15	15	18
Insulation Class		F	F	F
ENCODER & TACH				
Encoder Quadrature Resolution[3]	linecount	6,000	6,000	6,000
Tachometer sensitivity	volts/Krpm	4	4	4

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

[2] Shunt Resistor is external on the S45H model servodrive.

[3] 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 the main power, the control power, and the servomotor. They are also provided for connecting a motor fan and/or a regenerative resistor, if applicable. They are clearly marked in the table that follows, where these individual functions are briefly described.

Terminal	Function	Description
R S T	Main Power	Three-phase 200-230 VAC, +10%, -15%, 50/60 Hz.
r t	Control Power	Single-phase 200 to 230 VAC, +10%, -15%, 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	Regenerative Resistor	Regenerative resistor is internal except for the S45H, which requires an external SAC-SRDU regenerative discharge unit.
F1 F3	Fan Power[1]	Single-Phase 200-230 VAC, +10%, -15%, 50/60 Hz. **Note:** Airflow direction is across the motor.

[1] Fan Power is provided only by the SAC-S45H servodrive for it's corresponding MAC-C560H servomotor, which is *Totally-Enclosed, Fan-Cooled*. All other servomotors are *Totally-Enclosed, Non-Ventilated*. Fan operation begins as soon as logic power is supplied to the drive.

4.3 Input Power Considerations

S-Series servodrives can be operated directly on commercial power lines which supply between 200 and 230 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 capacitive D. C. power supplies draw substantial inrush current at powerup.

Servodrive	Power Required[1]	Recommended Service[2]
SAC-S03A	0.7 kva	3 A/1.0 kva
SAC-S04B	1.1 kva	4 A/1.6 kva
SAC-S08C	2.1 kva	8 A/3.0 kva
SAC-S12D	3.1 kva	10 A/4.0 kva
SAC-S19E	4.1 kva	12 A/4.8 kva
SAC-S26F	6.0 kva	18 A/7.2 kva
SAC-S33G	8.0 kva	24 A/9.6 kva
SAC-S45H	11.0 kva	32 A/12.7 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 230 VAC, three 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.

Servodrive Model	Control Circuitry (watts)	Main Circuitry (watts)	Regeneration Resistor (watts)	Total Dissipation (watts)
SAC-S03A	60	20	10	90
SAC-S04B	60	40	10	110
SAC-S08C	60	70	20	150
SAC-S12D	60	80	20	160
SAC-S19E	60	100	40	200
SAC-S26F	60	160	80	300
SAC-S33G	60	210	100	370
SAC-S45H	60	300	120	480

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 in section 4.3.4.

It is recommended that line filters be installed to eliminate electro-magnetic interference coming into the system from the power line, as well as block switching noise from being transmitted back out to the power line from the servodrives. The recommended line filters available from ORMEC are shown in section 4.3.3.

For a single servodrive installation, the line filter recommended is listed in the table in section 4.3.3. In the case of a system using multiple servodrives, only one line filter is required per cabinet. Select the appropriate line filter by adding the incoming power line power recommendations above, and selecting a line filter with sufficient power capacity from the table in section 4.3.3.

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.

Servodrive Model	Power Required[1]	Recommended Line Filter[2]
SAC-S03A	0.7 kva	SAC-LF10
SAC-S04B	1.1 kva	SAC-LF10
SAC-S08C	2.1 kva	SAC-LF20
SAC-S12D	3.1 kva	SAC-LF20
SAC-S19E	4.1 kva	SAC-LF20
SAC-S26F	6.0 kva	SAC-LF30
SAC-S33G	8.0 kva	SAC-LF30
SAC-S45H	11.0 kva	SAC-LF40

[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 230 VAC, three phase service.

If the line filter connection or wiring methods are improper, it's effectiveness is significantly reduced. This approach below is recommended:

1) Separate the input and output leads by a minimum of 10 inches. 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.

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 capacity of the motor. To prevent this 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.

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 ductwork, separated by a minimum of 10 inches.

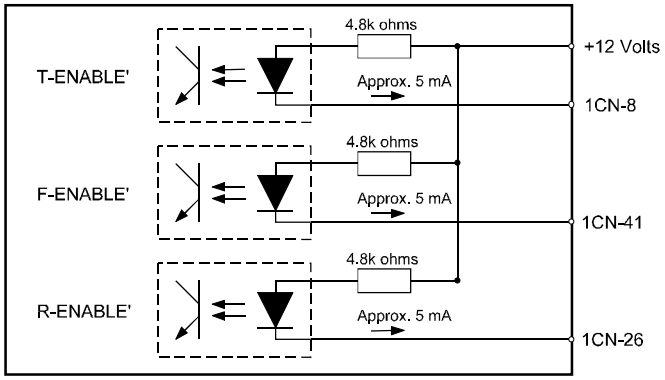
4.4 Control Circuit Interconnections - Connector 1CN

Connector 1CN is a 50 pin male connector, Honda part number MR-50RMA. Cable CBL-AS\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)

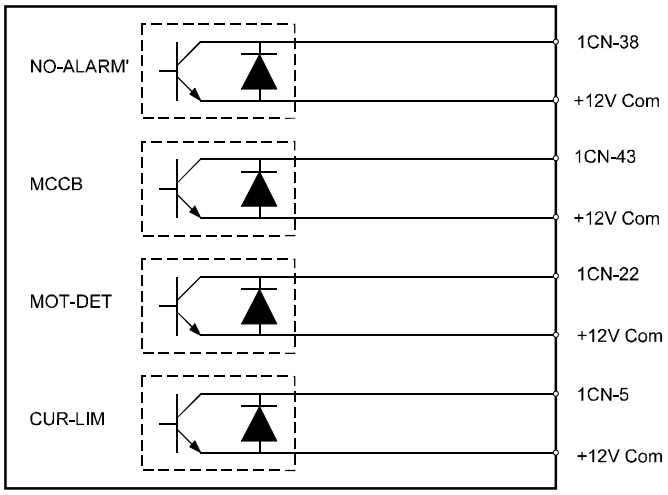
4.4.2 Interlock Output Signals

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 should be used 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.
MCCB	43	Circuit Breaker Trip Detection	This output transistor is normally OFF, and turns ON when the Main Circuit Breaker trips for a current overload condition.
MOT-DET	22	Motor Running	This output transistor turns ON when motor speed exceeds the following speeds: A Series Motors: Approximately 40 RPM B Series Motors: Approximately 25 RPM C Series Motors: Approximately 20 RPM
CUR-LMT	5	Current Limit	This output transistor turns ON when the output torque reaches the level set by the current limit (CUR) potentiometer.



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	12	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	13	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 use 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 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 differntial encoder signals are wired with individual twisted pairs within a shielded cable.

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 as follows: A Series: +/-2.0 V/1000 RPM, +/- 5% B Series: +/-4.0 V/1000 RPM, +/- 5% C Series: +/-4.0 V/1000 RPM, +/- 5%

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-SMAC\NN is used to connect the servomotor to the servodrive. Refer to Appendix D and the Model 20/40 Installation and Operation Manual for further information regarding this cable. Refer to Appendix C for further information regarding the CBL-SMAC\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: 0º to +40ºC

  Storage Temperature: -20º to +80ºC

  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 the Specifications Section.

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 of the NO FAULT relay, and 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. All servo alarm conditions must be cleared by pressing the blue RESET button located near the seven-segment display on the front of the servodrive.

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-in 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.

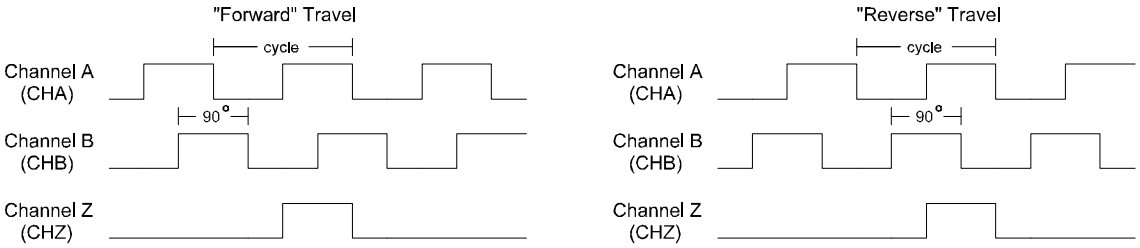
Should an overload current greater than 100% of rated current be drawn for too long, the protective circuitry will turn off the output power and provide a "1" code on the seven-segment LED ALARM indicator to display the overcurrent condition. The overcurrent set point is set to protect the servodrive at an ambient temperature of 55ºC 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 6000

linecount, when decoded by a Generation III Controller yields a positioning resolution of 24,000 cts/rev.

Optical Position Encoder Signals



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

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;

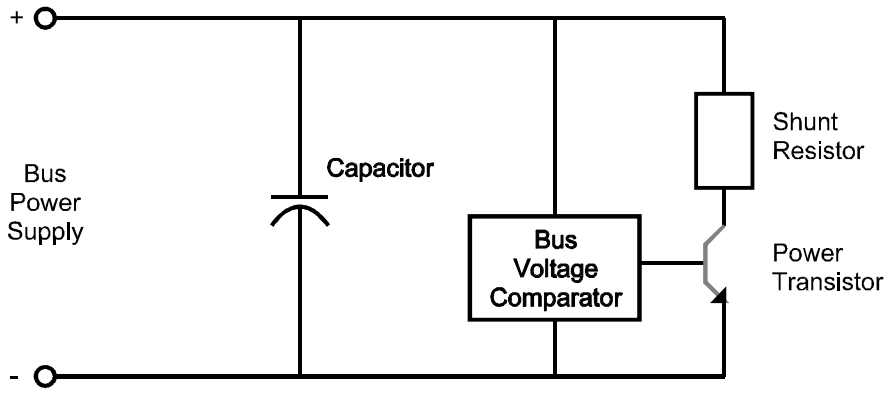
3) Using the motor to control an unwind stand for rolls of material, where the tension in the web causes the motor to have to hold back while moving forward.

5.5.1 Shunt Regulator

The servodrive uses PWM sine-wave 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 to gain voltage 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 energy 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 380 vdc) 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



Servodrive	Capacitor (uf)	Internal Shunt Resistor		Power Transistor		Minimum External Shunt Resistor (ohms)	Peak Power (kW)
		Resistance (ohms)	Power (watts)	Continuous. Current (amps)	Peak Current (amps)		
SAC-S03A	470	100	30	3.8	16	25	1.44
SAC-S04B	470	100	30	3.8	16	25	1.44
SAC-S08C	680	50	70	7.6	16	25	2.89
SAC-S12D	680	50	70	7.6	16	25	2.89
SAC-S19E	1800	50	70	15.2	16	25	5.78
SAC-S26F	1800	12.5	280	30.4	32	12.5	11.6
SAC-S33G	3600	12.5	280	30.4	32	12.5	11.6
SAC-S45H	3600	8[1]	420	47.5	50	8	18.1

[1] Model SAC-S45H servodrive has an external shunt resistor (Regenerative Discharge Unit SAC-SRDU)

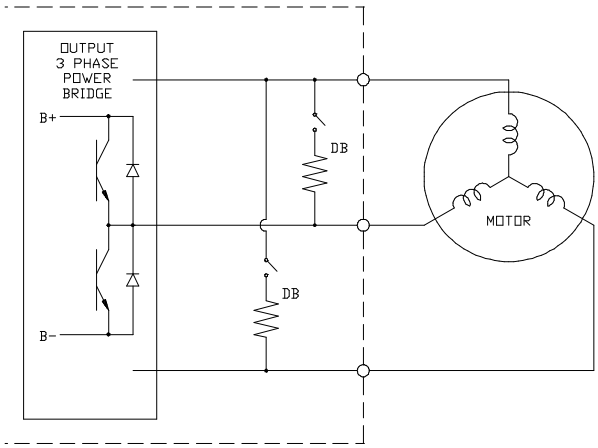
5.5.2 Applications Strategies

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.
- Use an external shunt resistor with lower resistance and/or higher wattage. In this case, be sure to disconnect the internal shunt resistor and to select the external shunt resistance and wattage appropriately. Call ORMEC if you have any questions.

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.



Servodrive	S03A	S04B	S08C	S12D	S19E	S26F	S33G	S45H
DB Resistor (ohms)	2.5	2.5	2.5	1.5	1.5	1.0	1.0	1.0
DB Resistor (watts)	50	50	50	50	50	50	50	50
Max. Current (amps)	16	16	16	16	30	30	30	30

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.

To disable the automatic dynamic braking circuitry, terminals 2 and 3 of the dynamic braking resistor (white block in the bottom of the servodrive) must be disconnected. **IT IS RECOMMENDED THAT THIS CHANGE BE PERFORMED ONLY BY AUTHORIZED FACTORY SERVICE PERSONNEL.**

Chapter 6
Getting Started

6 Getting Started

6.1 Receiving and Inspection

The servomotors and servodrives are put through 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 paint on shaft extension and flange surface with paint thinner before attaching the motor to the driven machine.

6.2 Servodrive Installation

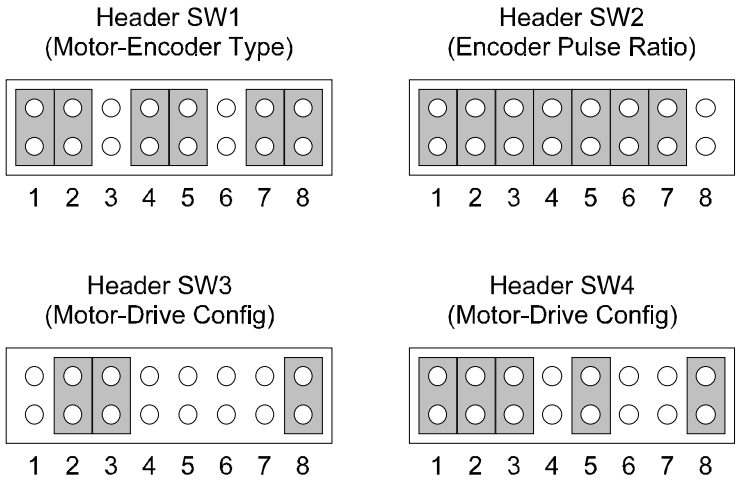
6.2.1 Servodrive Environment

- Keep the temperature of the servodrive at 55ºC or below.
- If the electrical panel is subject to vibration, mount the servodrive unit on shock absorbing material and externally ground 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 is vertical on a panel using the mounting holes (4) on the base plate, with electrical terminals at the bottom.

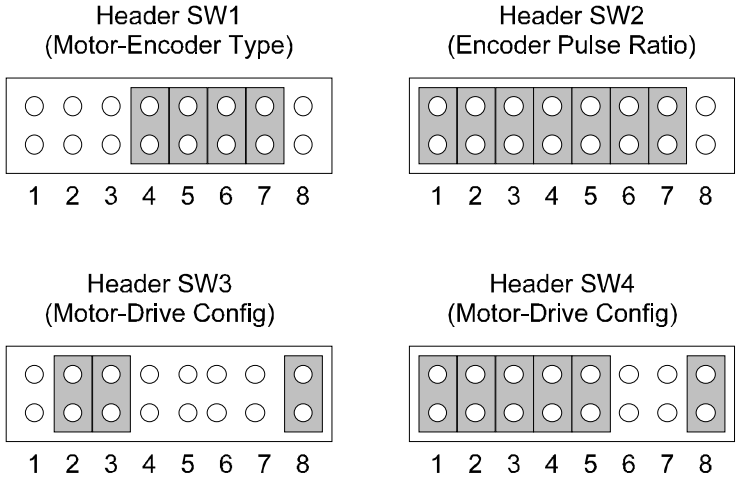
6.2.2 Jumper Strap Positions

Since an S-Series Brushless Servodrive is sold as a part of a "matched pair" with a Servomotor, the unit will be factory configured for the motor with which it is sold. The factory default configurations are listed below.

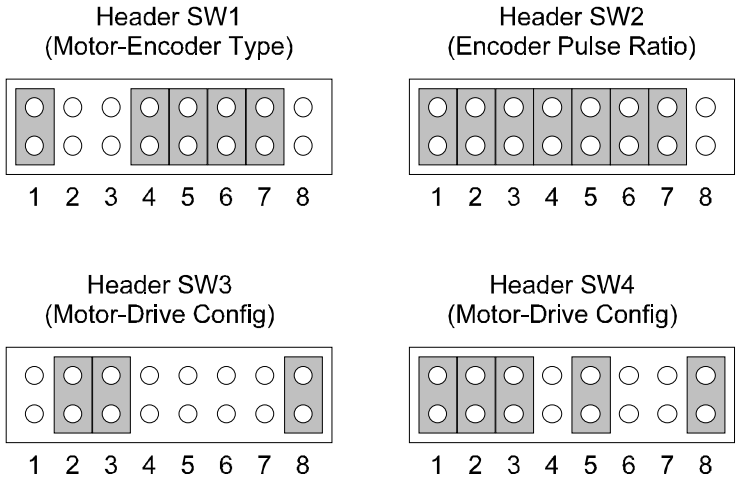
6.2.2.1 Factory Default Jumper Strap Positions for A-Series Motors



6.2.2.2 Factory Default Jumper Strap Positions for B-Series Motors



6.2.2.3 Factory Default Jumper Strap Positions for C-Series Motors



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

- Voltage supplied to servodrive should be between 200 to 230 VAC, **WITH AN ABSOLUTE MINIMUM OF 170 VAC AND ABSOLUTE MAXIMUM OF 253 VAC. CHECK POWER BEFORE APPLYING IT TO THE SERVODRIVE!!!!**
- Servodrive Jumper Straps are properly set to satisfy the specifications for the applicable servomotor and optical encoder.
- 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 power is correctly supplied, the following green LEDs will light:
  MP - indicates that the main circuit voltage (200-230vac) is proper
  P - indicates that the logic voltage (+5vdc) is proper
  IN - indicates that the current command (DRV-CMD) is greater than 60mV
- 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 LED Status Indications

The Green status LEDs will be on for the following conditions.

LED	Condition
IN	Current command (DRV-CMD) of approx. 60 mV or more.
P	Servodrive control circuit voltage (+5 VDC) is proper.
MP	Servodrive main circuit voltage (200 VDC or more) is proper.

7.2 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.

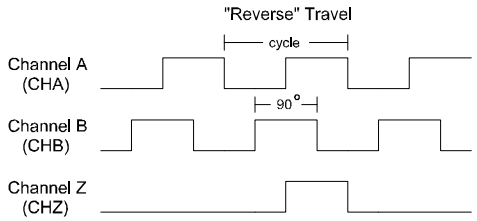
2) To reset the servo alarm, press the blue RESET pushbutton switch located on the servodrive printed circuit board near the Alarm Indicator.

3) If Alarm 7. or A. is on, due to servodrive being overloaded or the heat sink overheated, the Alarm will not reset for a few minutes and the servodrive has cooled down.

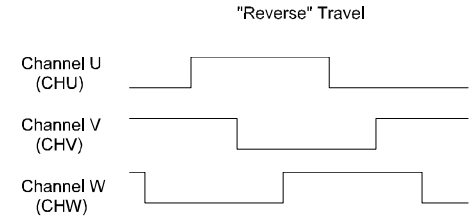
The Alarm Indicators and Status Descriptions are listed below:

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
	Over Voltage	Excessive DC voltage in the bus power supply (approximately 420 vdc or more)
	Excess DRV-CMD	Excessive current command input (DRV-CMD)
	Low Voltage	Low DC voltage in the bus power supply after Power ON (150 V or less)
	Overload	Overload condition of the motor and servodrive
	Heat Sink Overheat	Overheat of the heat sink (approximately 85°C or more)
	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, Motor Torque>120% rated torque, Torque
	Open Phase	Any phase open in the three-phase Main Power supply
	CPU Error	Any error in the servodrive's microprocessor CPU, or lack of Control Power.
	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.

7.3 TM-1 Servodrive Test Points

Terminal	Signal	Description	
TM1-1 TM1-2	ENCA ENCA'	Encoder Feedback Channel A & A'	
TM1-3 TM1-4	ENCB ENCB'	Encoder Feedback Channel B & B'	
TM1-5 TM1-6	ENCZ ENCZ'	Encoder Feedback Channel Z & Z'	
TM1-7 TM1-8	Unused +5VDC	---- +5 VDC Encoder Pwr	The encoder channels are quadrature incremental signals with +5 volt logic levels, which are driven by TI 75174 differential line drivers.

7.4 TM-2 Servodrive Test Points

Terminal	Signal	Description	
TM2-1 TM2-2	CHU CHU'	Encoder Position Channel U & U'	
TM2-3 TM2-4	CHV CHV'	Encoder Position Channel V & V'	
TM2-5 TM2-6	CHW CHW'	Encoder Position Channel W & W'	
TM2-7 TM2-8	Unused COMM.	---- Encoder Power Comm.	

7.5 TM-3 Servodrive Test Points

Terminal	Signal	Description	
TM3-1 TM3-2	DRV-CMD Unused	Current Command ----	Monitors the Current Command reference input
TM3-3 TM3-4	TACH TORQ	Speed Monitor Torque Monitor	Bi-directional 2 v/kRPM (A-Series),4 v/kRPM (B C) Bi-directional 3 vdc for 100% of rated torque
TM3-5	TORQ-R	Internal Torque Ref.	Bi-directional 2-3 volts for 100% rated torque
TM3-6 TM3-7	U-SINE V-SINE	Phase U Sine Torque Phase V Sine Torque	Frequency varies with speed and amplitude varies with torque.
TM3-8	COMM.	Analog Signal Comm.	Common for measuring test points

7.6 TM-4 Servodrive Test Points

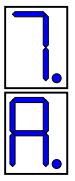
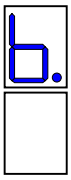
Terminal	Signal	Description	S03C	S04B	S08C	S12D	S19E	S26F	S33G	S45H
TM4-1 TM4-2	CUR-U CUR-V	Phase U Current Mon. Phase V Current Mon.	0.4	0.24	0.16	0.08	0.08	0.04	0.04	0.04
TM4-3 TM4-4	Unused CUR-UO	---- Phase U Current Output	(volts/ amp)							
TM4-5 TM4-6	CUR-VO CUR-WO	Phase V Current Output Phase W Current Out.								
TM4-7 TM4-8	F-PWM COMM.	PWM Triangle Freq. Analog Common								

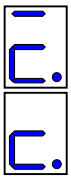
7.7 Servomotor Troubleshooting Guide

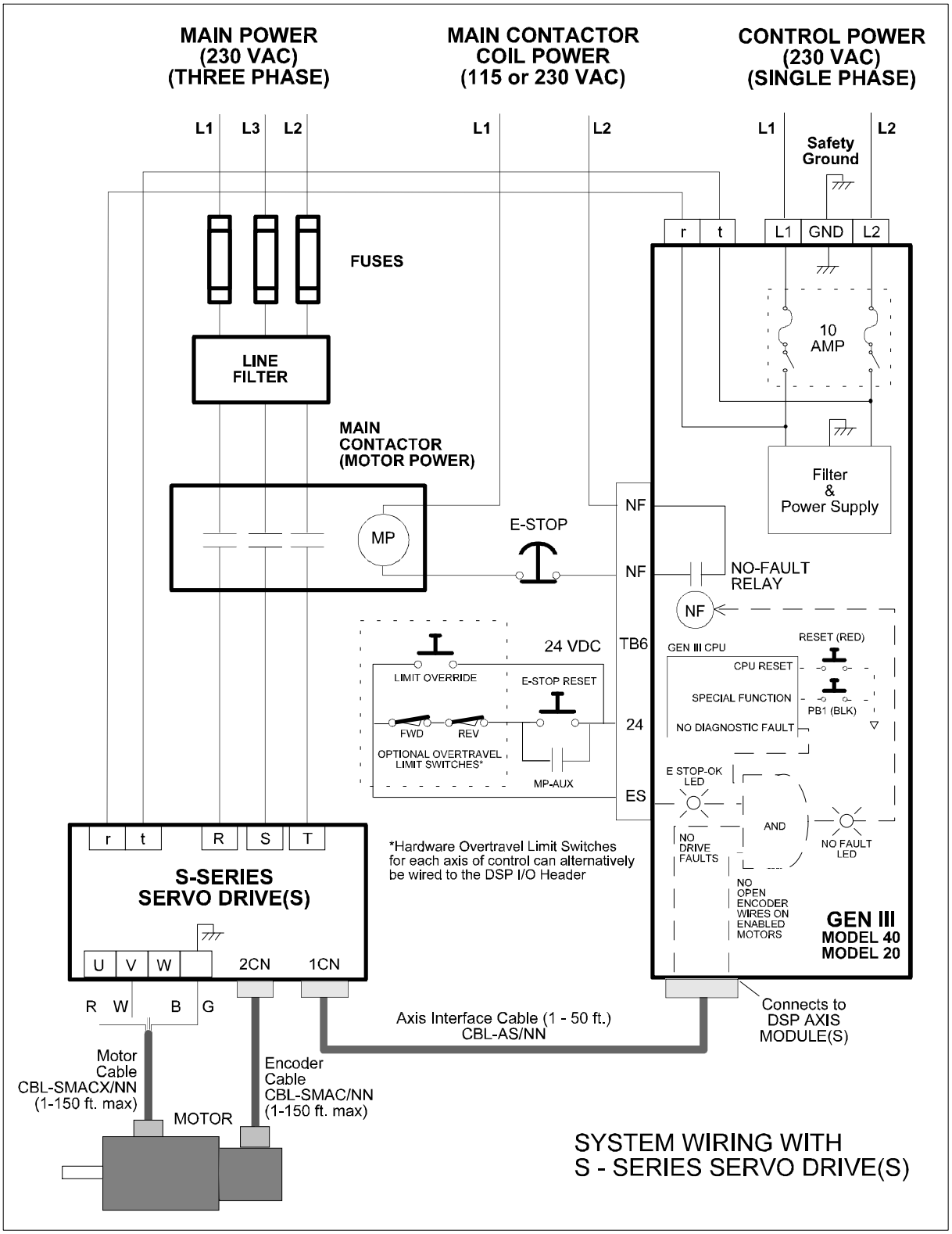
Problem	Cause	What to do
Motor does not start	Loose Connection	Tighten connection
	Wrong wiring	Correct wiring
	Overload	Reduce load or use a larger motor
	Motor defective	Measure voltage across motor terminals U, V, & W on the servodrive with a tester. If correct voltage levels, replace motor.
Unstable 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 40ºC, 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**		

7.8 Servodrive Troubleshooting Guide

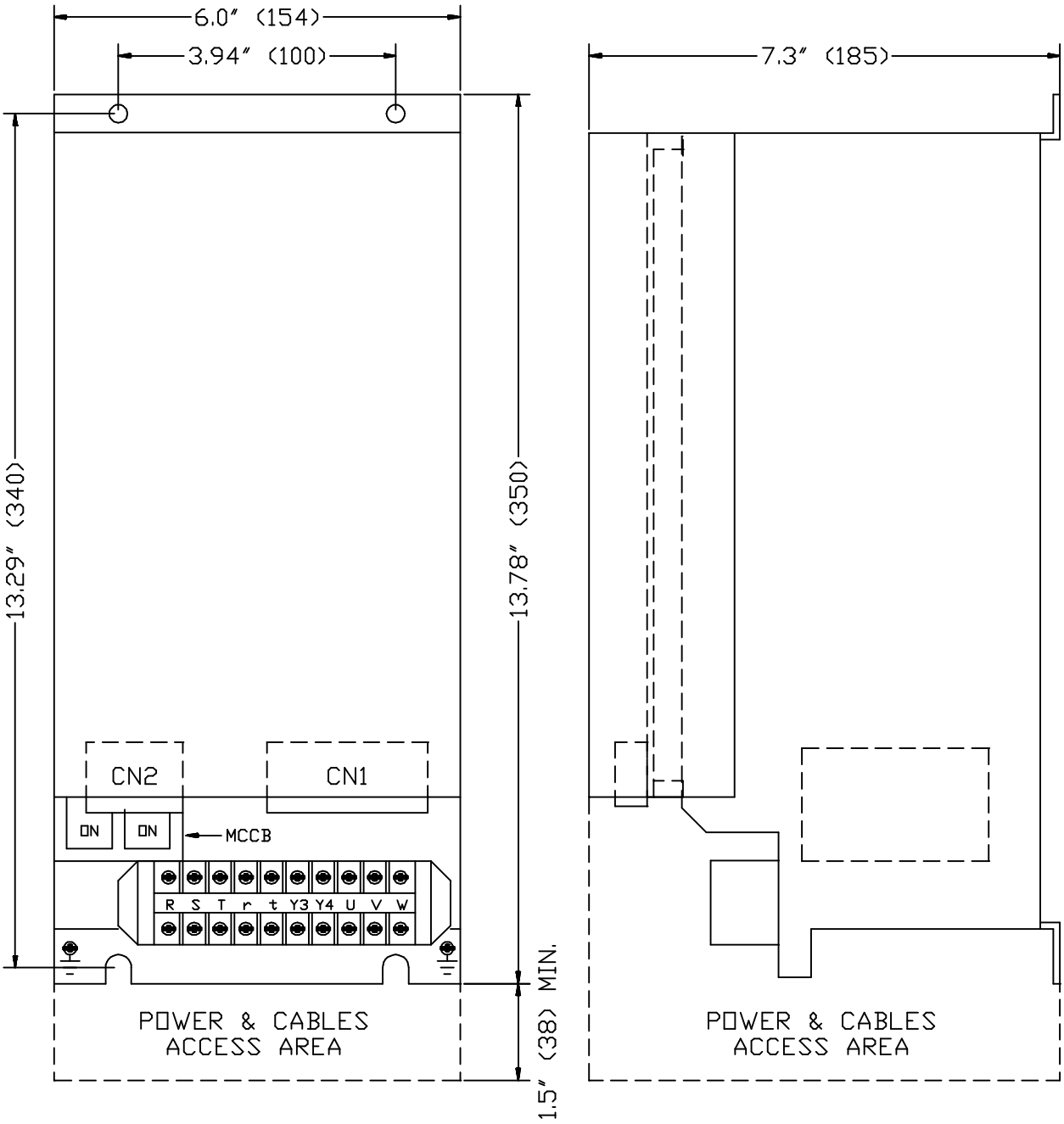
ALARM STATUS INDICATION AND TROUBLESHOOTING IDEAS				
LED	**Status**	**Detection Condition**	**Probable Cause**	**Corrective Action**
	Over-current	When power is supplied to the control circuit	Defective control circuit board	Replace the servodrive
		When power is supplied to the main circuit, servo power is turned on & MCCB does not trip	Defective current feedback circuit	
			Defective main circuit transistor module.	
		When power is supplied to the main circuit, servo power is turned on & MCCB	Defective motor grounding	Replace servomotor
			Defective main circuit transistor module	Replace servodrive
		When power is supplied to the main circuit	Defective main circuit transistor module	Replace servodrive
		When the motor starts or slows down	Improper VR8 adjustment	Replace servodrive
	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 thyristor-diode module	Replace servodrive
			MCCB trips	
	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 resistor	Replace servodrive
			Regenerative resistor disconnection	Check and replace the regenerative resistor (replace servodrive)
			No regenerative resistor connection	
	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
			Defective regenerative circuit	Replace servodrive

LED	Status	Detection Condition	Probable Cause	Corrective Action
	Over-speed	When the reference is input & the motor runs fast	Motor connection error	Correct motor
			Optical encoder connection error	Check encoder connection
	Voltage Drop	When power is supplied to the main circuit	Defective main circuit thyristor-diode module	Replace servodrive
	Overload or Heat Sink Overheat	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
		During operation: when power to the control circuit is turned off and then turned on again, "7" or "A" goes on again. When reset later the operation starts.	Fan has stopped	Check the fan
			Temperature around the servodrive exceeds 55°C	Decrease the temperature below 55°C
		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 is still unavailable.	Motor circuit error connection, such as U to V, V to W, W to U or single phase connection	Correct motor connection
	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
	Open Phase	When power is supplied to the control circuit	Defective control circuit board	Replace servodrive
		When power is supplied to the main circuit	Poor connections to 3-phase power supply	Check and correct power connection

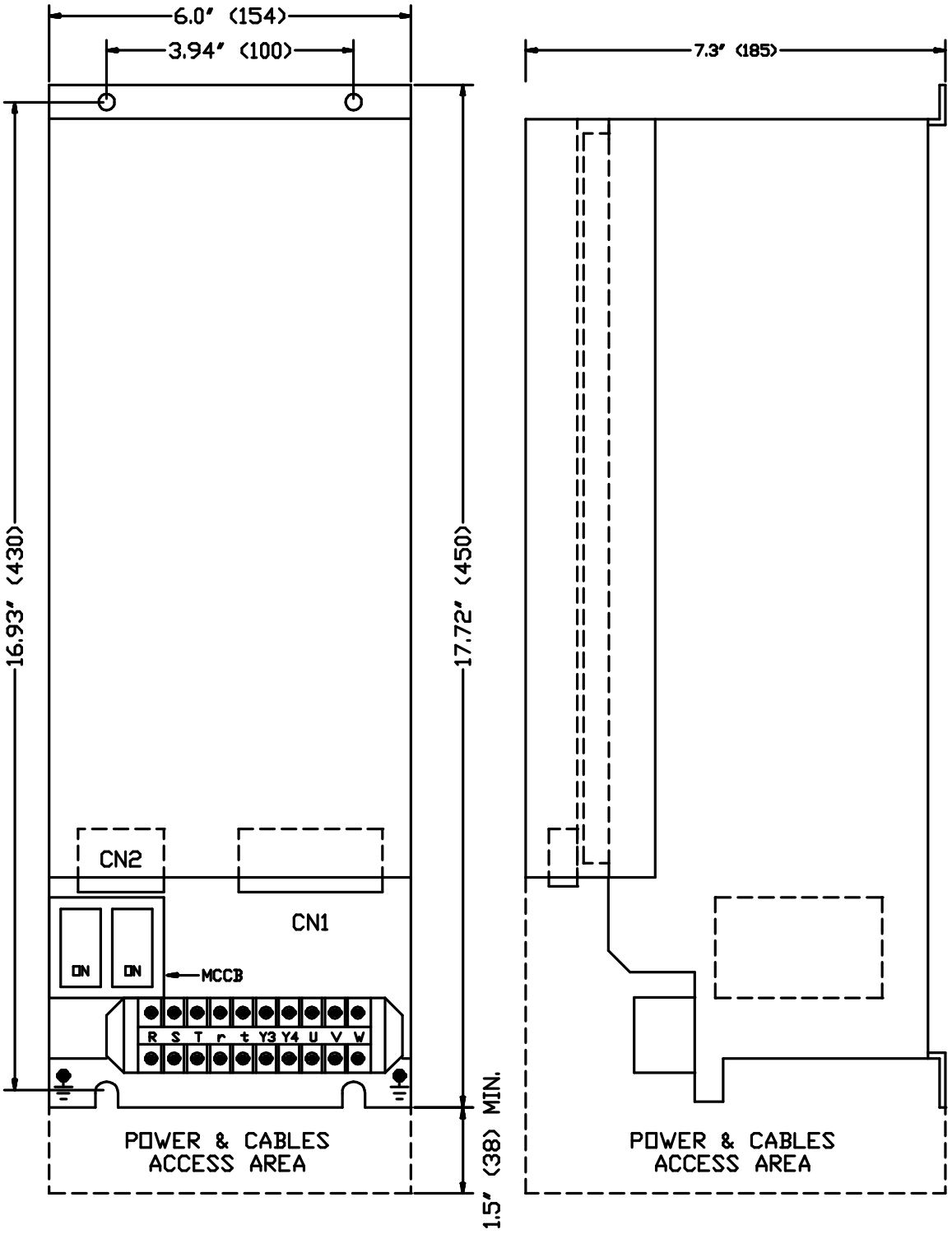
LED	Status	Detection Condition	Probable Cause	Corrective Action
	Overrun Prevent-ion	When power is supplied to the control circuit	Defective control circuit board	Replace the servodrive
		Motor starts momentarily , then "C'" goes on	Motor connection error	Correct the motor
			Optical encoder connection error	Check and correct encoder connection
	Optical Encoder Signal Error	During Operation	Defective optical encoder	Replace servomotor
			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 encoder	Replace servomotor
			Defective control circuit board	Replace servodrive


MAIN POWER
(230 VAC)
(THREE PHASE)
MAIN CONTACTOR
COIL POWER
(115 or 230 VAC)
CONTROL POWER
(230 VAC)
(SINGLE PHASE)
L1
L3
L2
L1
L2
L1
Safety
Ground
L2
r
t
L1
GND
L2
FUSES
LINE
FILTER
10
AMP
MAIN
CONTACTOR
(MOTOR POWER)
Filter
&
Power Supply
MP
E-STOP
NF
NF
NO-FAULT
RELAY
NF
24 VDC
TB6
GEN III CPU
RESET (RED)
CPU RESET
SPECIAL FUNCTION
PB1 (BLK)
NO DIAGNOSTIC FAULT
LIMIT OVERRIDE
E-STOP RESET
FWD
REV
24
OPTIONAL OVERTRAVEL
LIMIT SWITCHES*
MP-AUX
E STOP-OK
LED
ES
AND
NO
DRIVE
FAULTS
NO FAULT
LED
NO
OPEN
ENCODER
WIRES ON
ENABLED
MOTORS
GEN III
MODEL 40
MODEL 20
r
t
R
S
T
S-SERIES
SERVO DRIVE(S)
*Hardware Overtravel Limit Switches
for each axis of control can alternatively
be wired to the DSP I/O Header
U
V
W
2CN
1CN
R
W
B
G
Axis Interface Cable (1 - 50 ft.)
CBL-AS/NN
Connects to
DSP AXIS
MODULE(S)
Motor
Cable
CBL-SMACX/NN
(1-150 ft. max)
Encoder
Cable
CBL-SMAC/NN
(1-150 ft. max)
MOTOR
SYSTEM WIRING WITH
S - SERIES SERVO DRIVE(S)

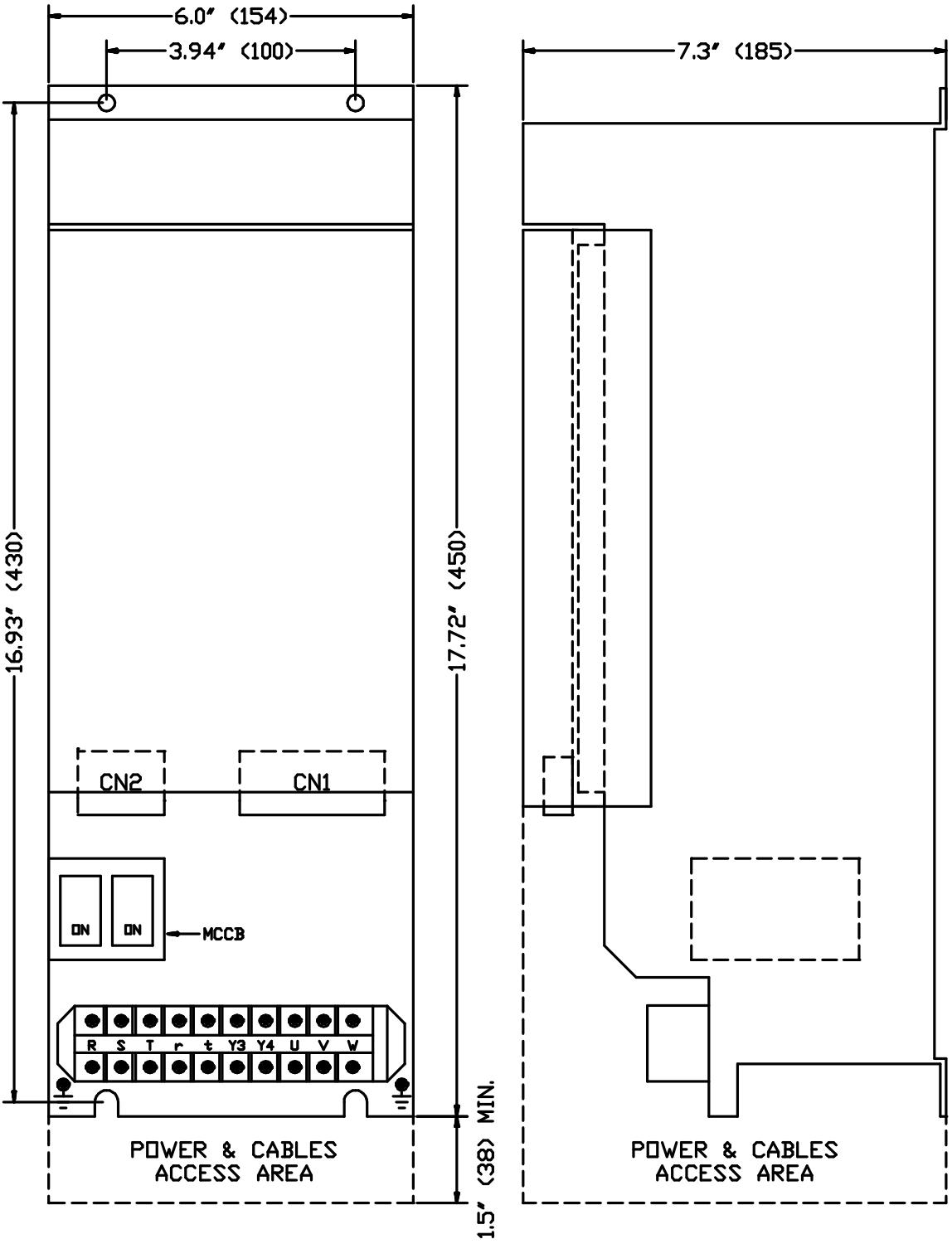
Servodrive Layout
SAC-S03A, SAC-S04B, SAC-S08C, SAC-S12D



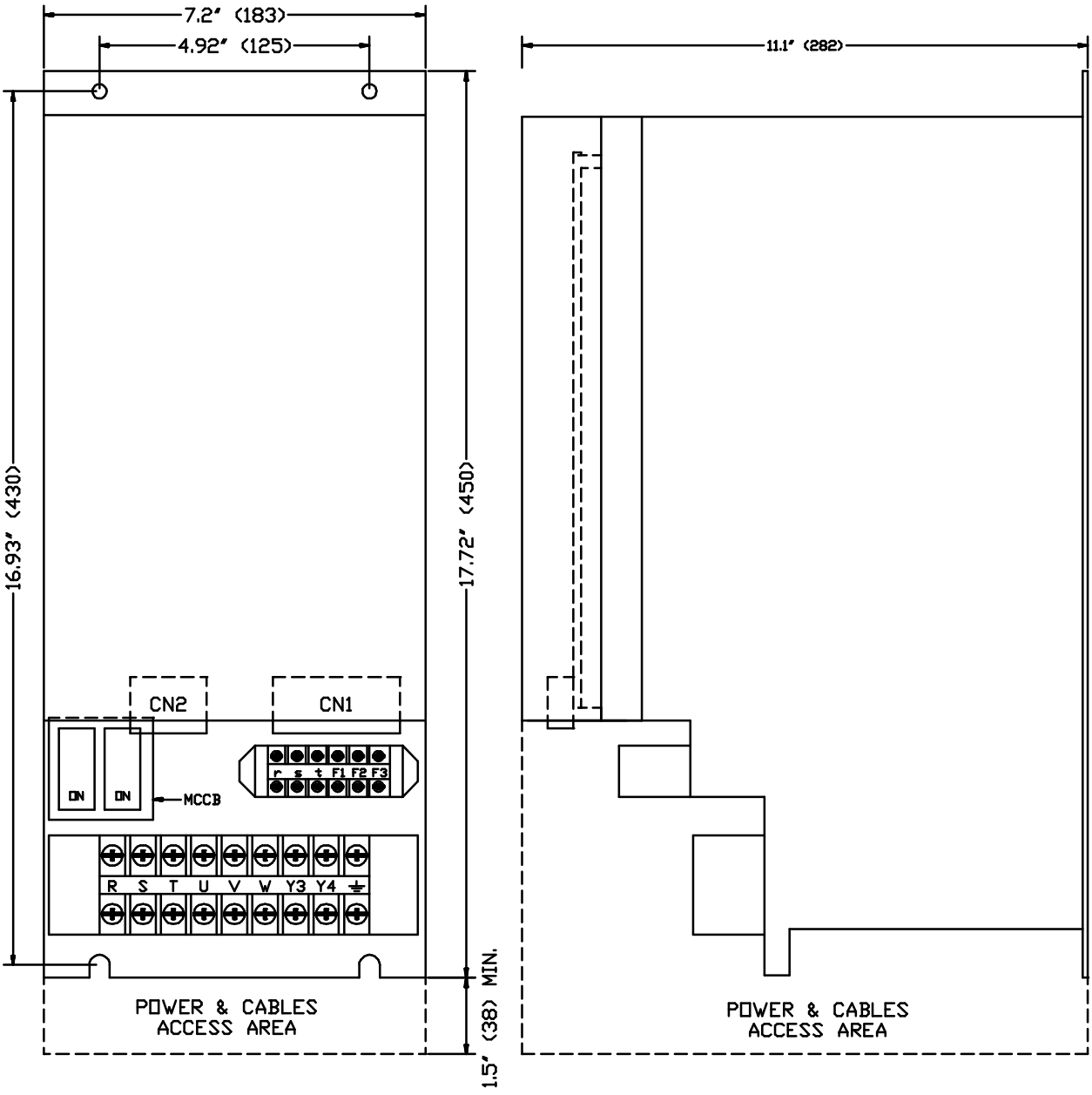
Servodrive Layout
SAC-S19E, SAC-S26F



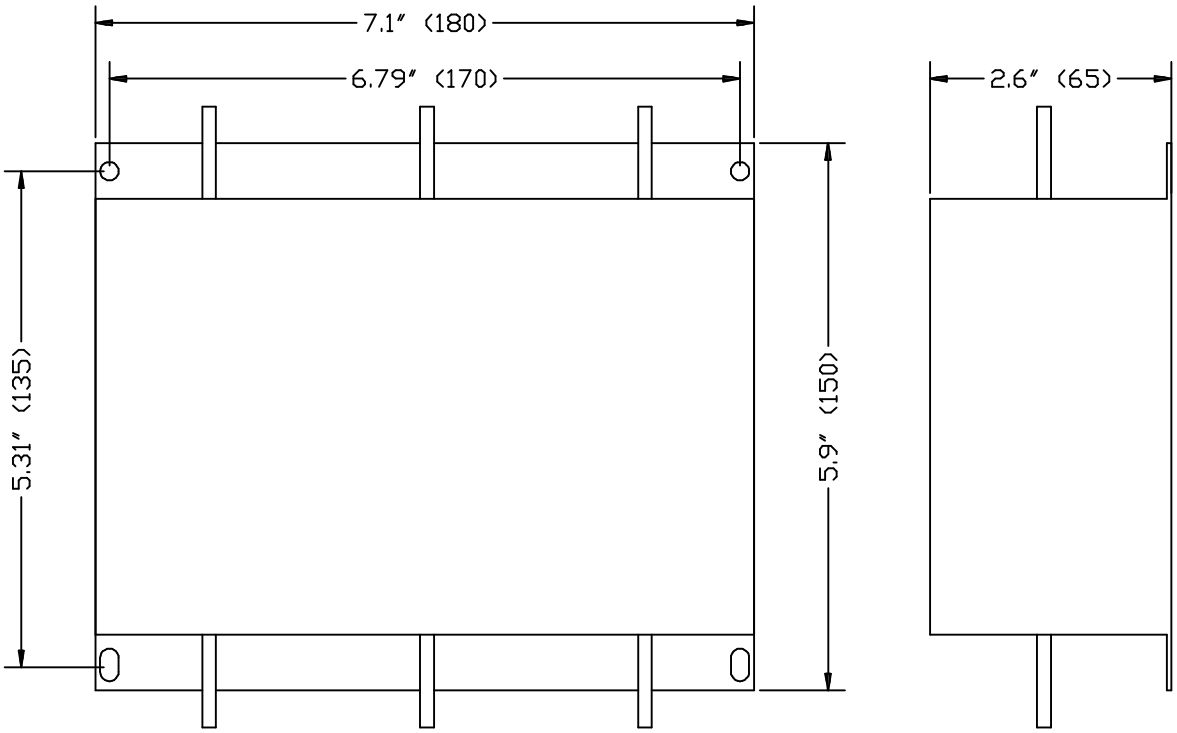
Servodrive Layout
SAC-S33G



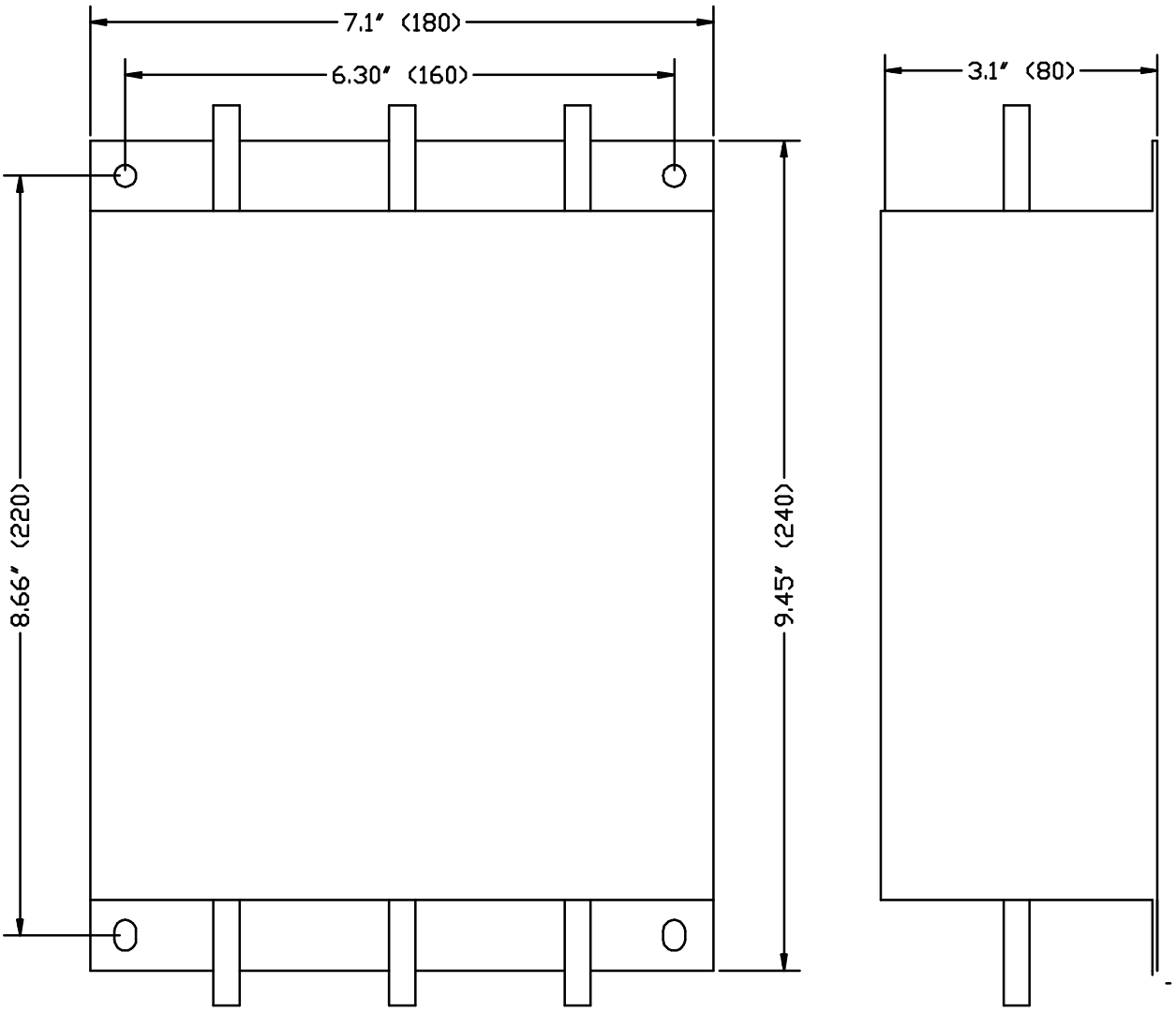
Servodrive Layout
SAC-S45H



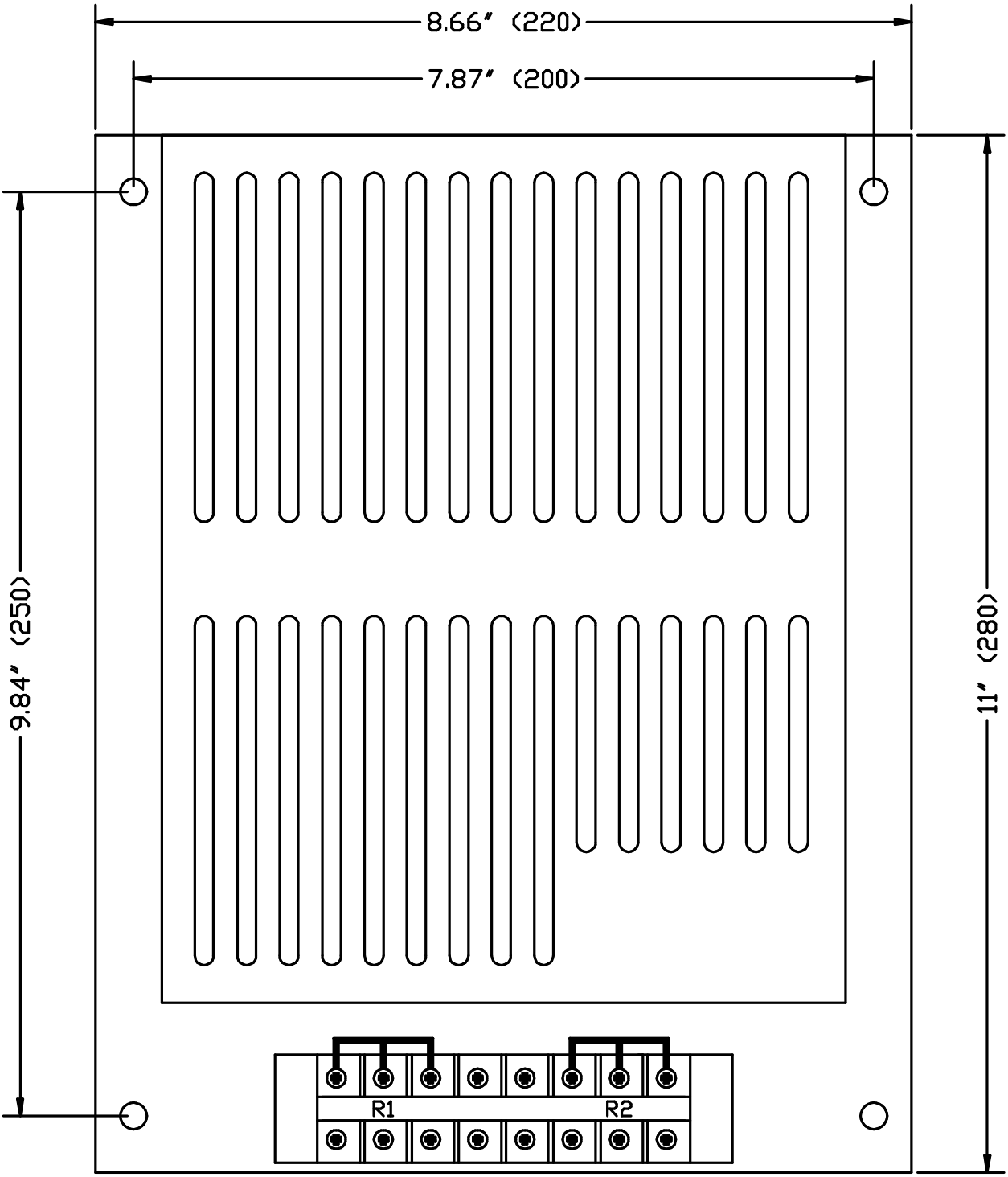
Line Filter Layout
SAC-LF10, SAC-LF20, SAC-LF30



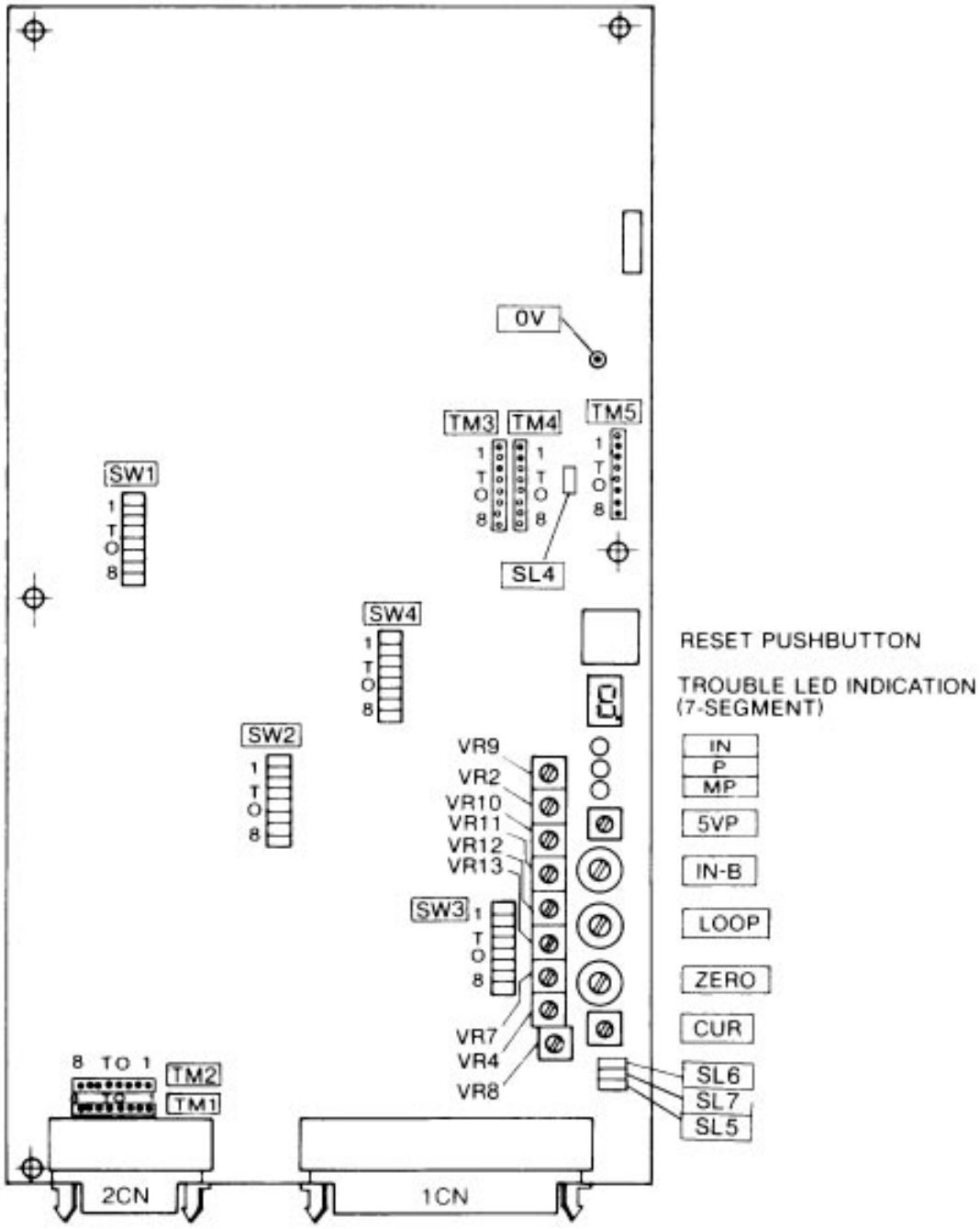
Line Filter Layout
SAC-LF40 , SAC-LF50

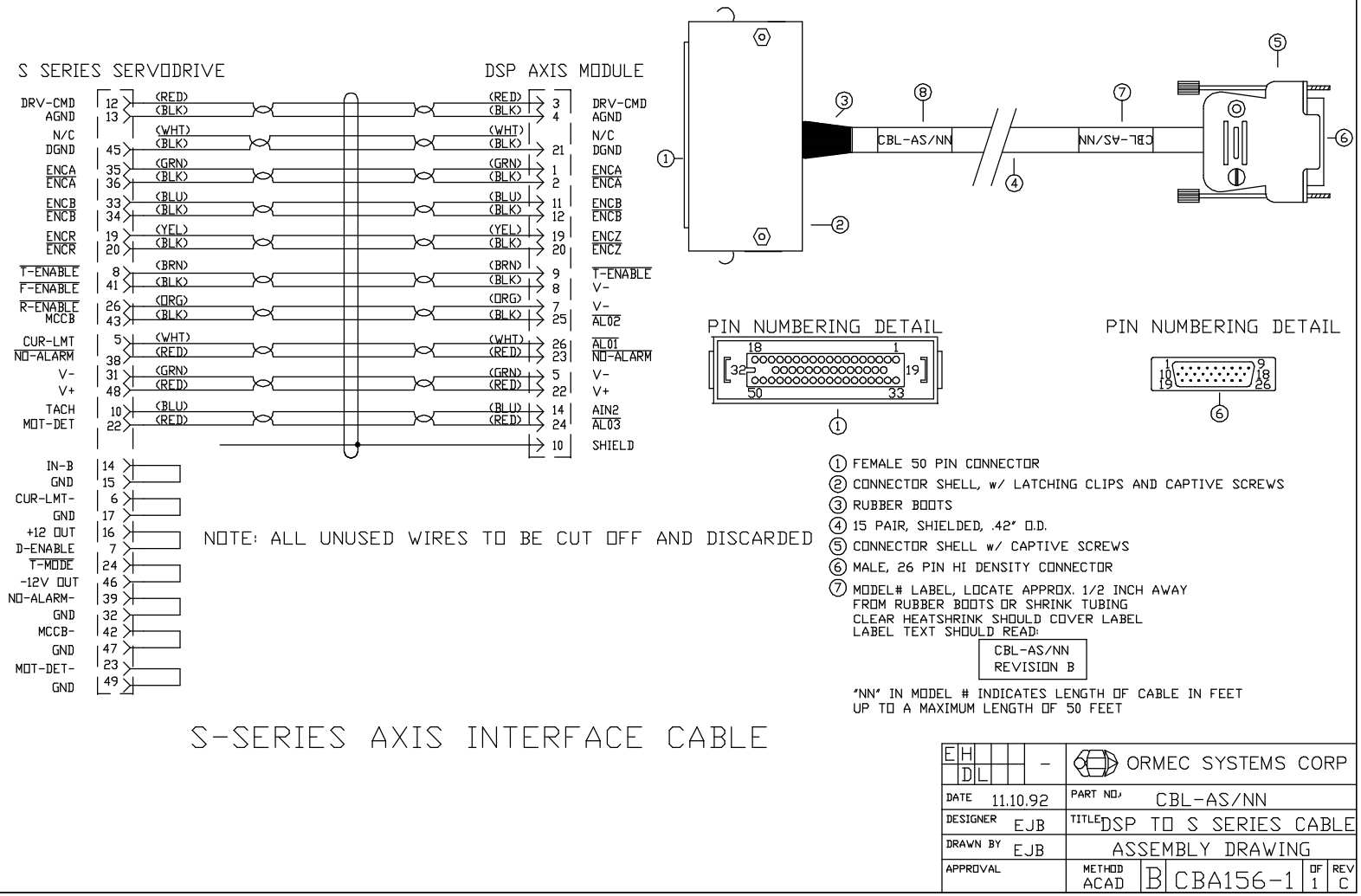


Regen Resistor Layout
SAC-SRDU



Serrvodrive PCB Layout





NOTE: ALL UNUSED WIRES TO BE CUT OFF AND DISCARDED

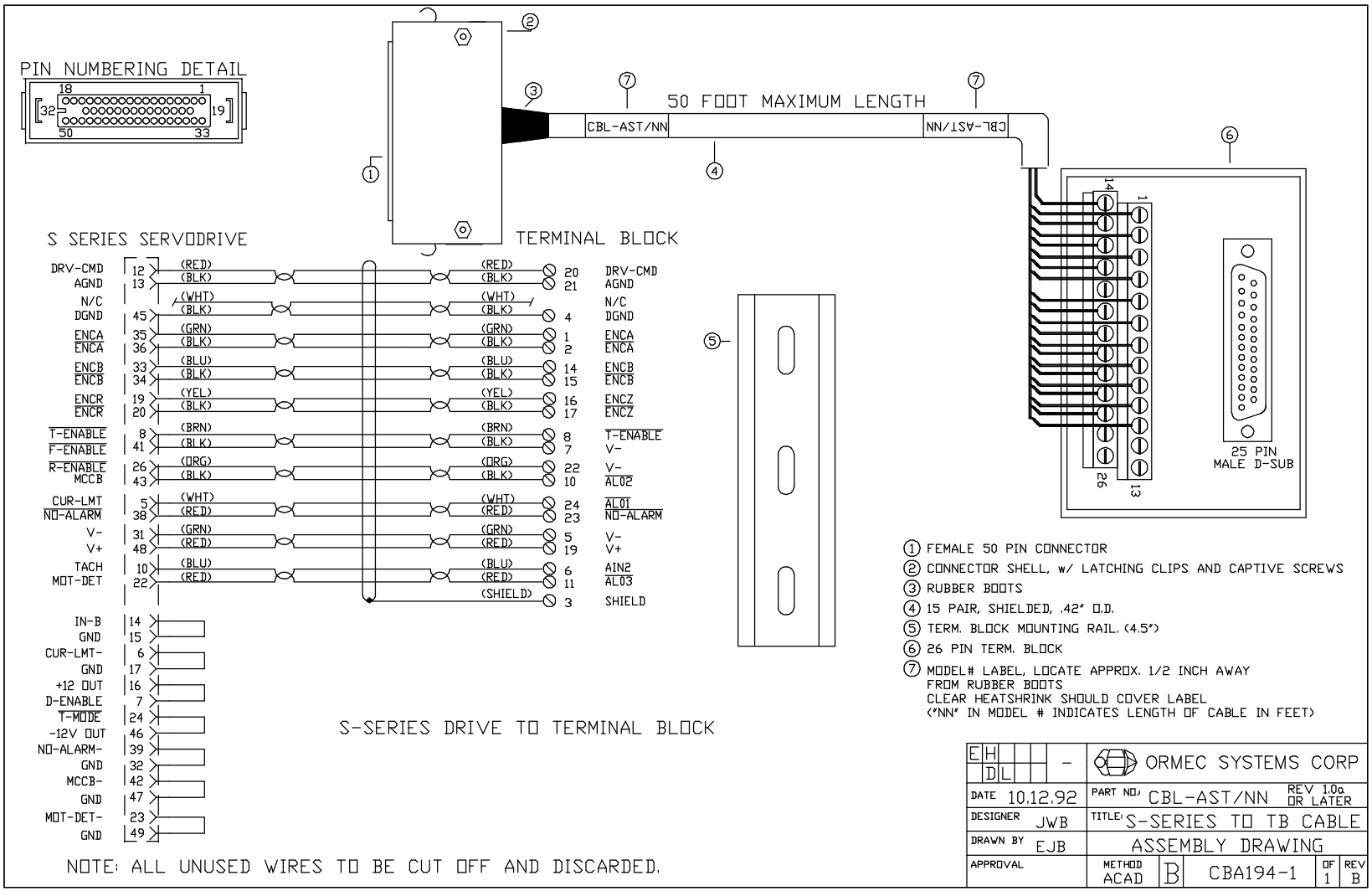
1. FEMALE 50 PIN CONNECTOR
2. CONNECTOR SHELL, w/ LATCHING CLIPS AND CAPTIVE SCREWS
3. RUBBER BOOTS
4. 15 PAIR, SHIELDED, .42" O.D.
5. CONNECTOR SHELL w/ CAPTIVE SCREWS
6. MALE, 26 PIN HI DENSITY CONNECTOR
7. MODEL# LABEL, LOCATE APPROX. 1/2 INCH AWAY FROM RUBBER BOOTS OR SHRINK TUBING
   CLEAR HEATSHRINK SHOULD COVER LABEL
   LABEL TEXT SHOULD READ:

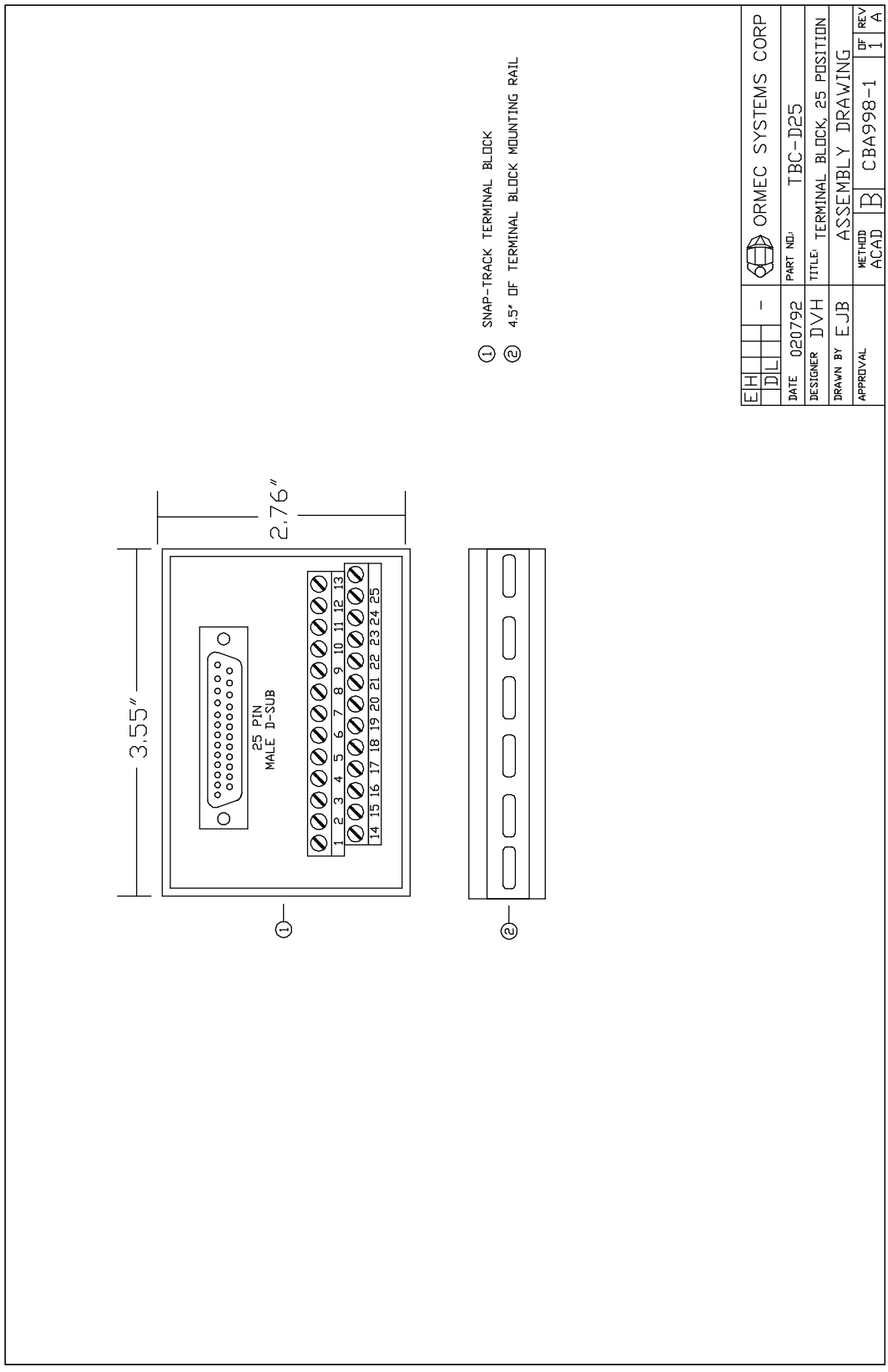
   CBL-AS/NN
   REVISION B

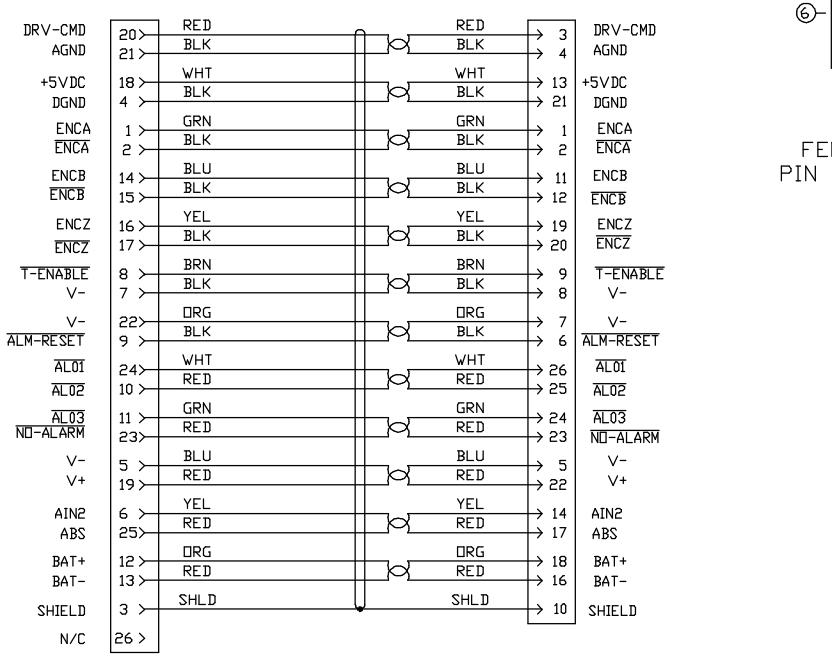
"NN" IN MODEL # INDICATES LENGTH OF CABLE IN FEET
UP TO A MAXIMUM LENGTH OF 50 FEET

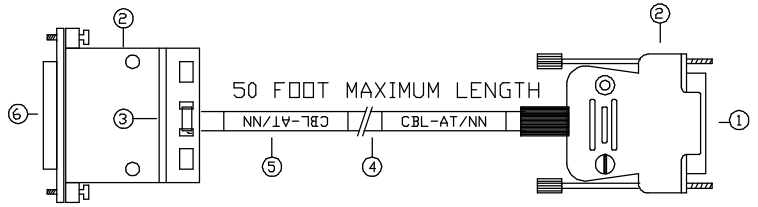
S-SERIES AXIS INTERFACE CABLE

E H / D L –	ORMEC SYSTEMS CORP	
DATE 11.10.92	PART NO. CBL-AS/NN	
DESIGNER EJB	TITLE DSP TO S SERIES CABLE	
DRAWN BY EJB	ASSEMBLY DRAWING	
APPROVAL	METHOD ACAD	B CBA156-1 DF 1 REV C


PIN NUMBERING DETAIL
18
1
32
19
50
33
50 FOOT MAXIMUM LENGTH
CBL-AST/NN
S SERIES SERVODRIVE
TERMINAL BLOCK
DRV-CMD 12 (RED) (RED) 20 DRV-CMD
AGND 13 (BLK) (BLK) 21 AGND
N/C (WHT) (WHT)
DGND 45 (BLK) (BLK) 4 DGND
ENCA 35 (GRN) (GRN) 1 ENCA
ENCA 36 (BLK) (BLK) 2 ENCA
ENCB 33 (BLU) (BLU) 14 ENCB
ENCB 34 (BLK) (BLK) 15 ENCB
ENCR 19 (YEL) (YEL) 16 ENCZ
ENCR 20 (BLK) (BLK) 17 ENCZ
T-ENABLE 8 (BRN) (BRN) 8 T-ENABLE
F-ENABLE 41 (BLK) (BLK) 7 V-
R-ENABLE 26 (ORG) (ORG) 22 V-
MCCB 43 (BLK) (BLK) 10 AL02
CUR-LMT 5 (WHT) (WHT) 24 AL01
NO-ALARM 38 (RED) (RED) 23 NO-ALARM
V- 31 (GRN) (GRN) 5 V-
V+ 48 (RED) (RED) 19 V+
TACH 10 (BLU) (BLU) 6 AIN2
MOT-DET 22 (RED) (RED) 11 AL03
(SHIELD) 3 SHIELD
IN-B 14
GND 15
CUR-LMT- 6
GND 17
+12 OUT 16
D-ENABLE 7
T-MODE 24
-12V OUT 46
NO-ALARM- 39
GND 32
MCCB- 42
GND 47
MOT-DET- 23
GND 49
S-SERIES DRIVE TO TERMINAL BLOCK
NOTE: ALL UNUSED WIRES TO BE CUT OFF AND DISCARDED.
14
1
26
13
25 PIN
MALE D-SUB
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)
E H D L -
ORMEC SYSTEMS CORP
DATE 10.12.92
PART NO: CBL-AST/NN REV 1.0a OR LATER
DESIGNER JWB
TITLE: S-SERIES TO TB CABLE
DRAWN BY EJB
ASSEMBLY DRAWING
APPROVAL
METHOD ACAD
B
CBA194-1
OF 1
REV B

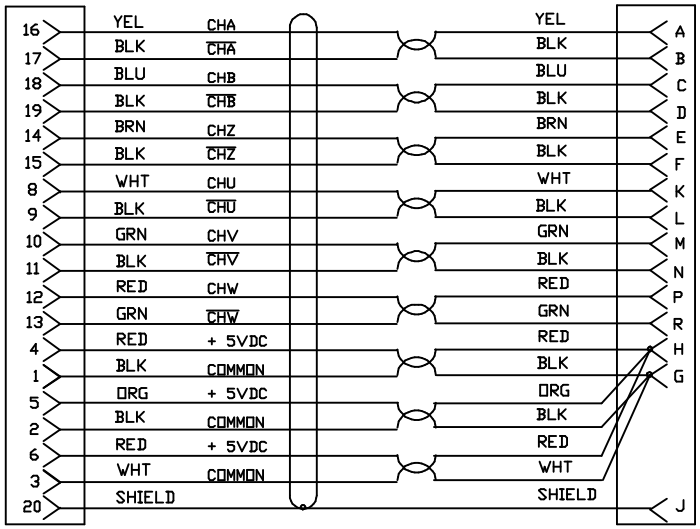

① SNAP-TRACK TERMINAL BLOCK
② 4.5" DF TERMINAL BLOCK MOUNTING RAIL
2.76"
3.55"
25 PIN
MALE D-SUB
1 2 3 4 5 6 7 8 9 10 11 12 13
14 15 16 17 18 19 20 21 22 23 24 25
ORMEC SYSTEMS CORP
PART NO.: TBC-D25
TITLE: TERMINAL BLOCK, 25 POSITION
ASSEMBLY DRAWING
DATE 020792
DESIGNER DVH
DRAWN BY EJB
APPROVAL
METHOD ACAD
B CBA998-1
DF 1
REV A

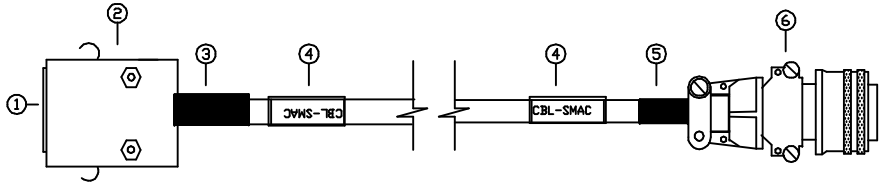




1. MALE, 26 PIN HI DENSITY CONNECTOR
2. CONNECTOR SHELL W/ THUMB SCREWS
3. TIE WRAP
4. 15 TWISTED PAIR, SHIELDED, .42 O.D.
5. CABLE LABEL LOCATED AT EACH END
   CLEAR HEATSHRINK SHOULD COVER CABLE LABEL
6. 25 PIN FEMALE INSULATION DISPLACEMENT CONNECTOR

E H / D L	-	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

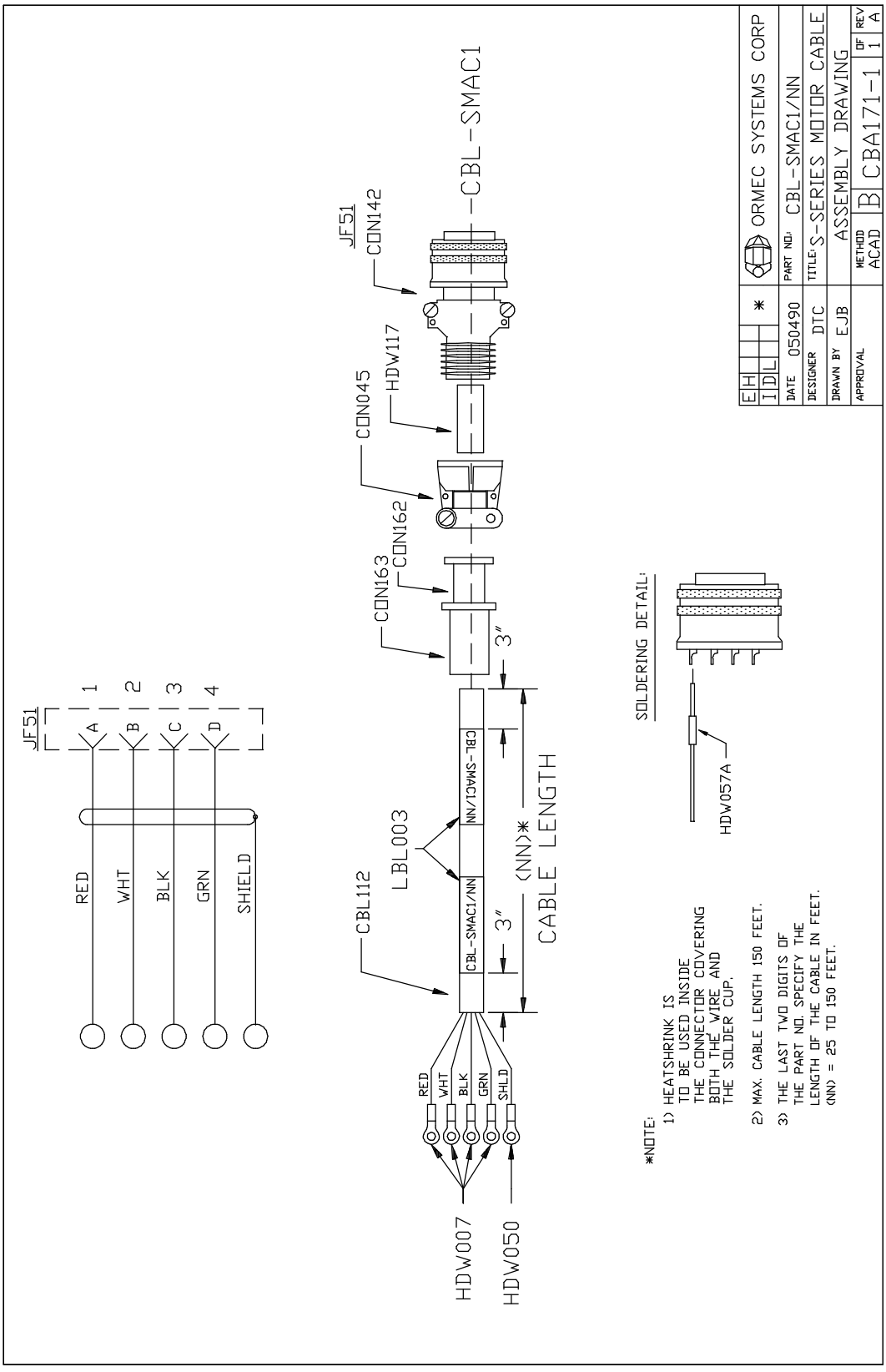


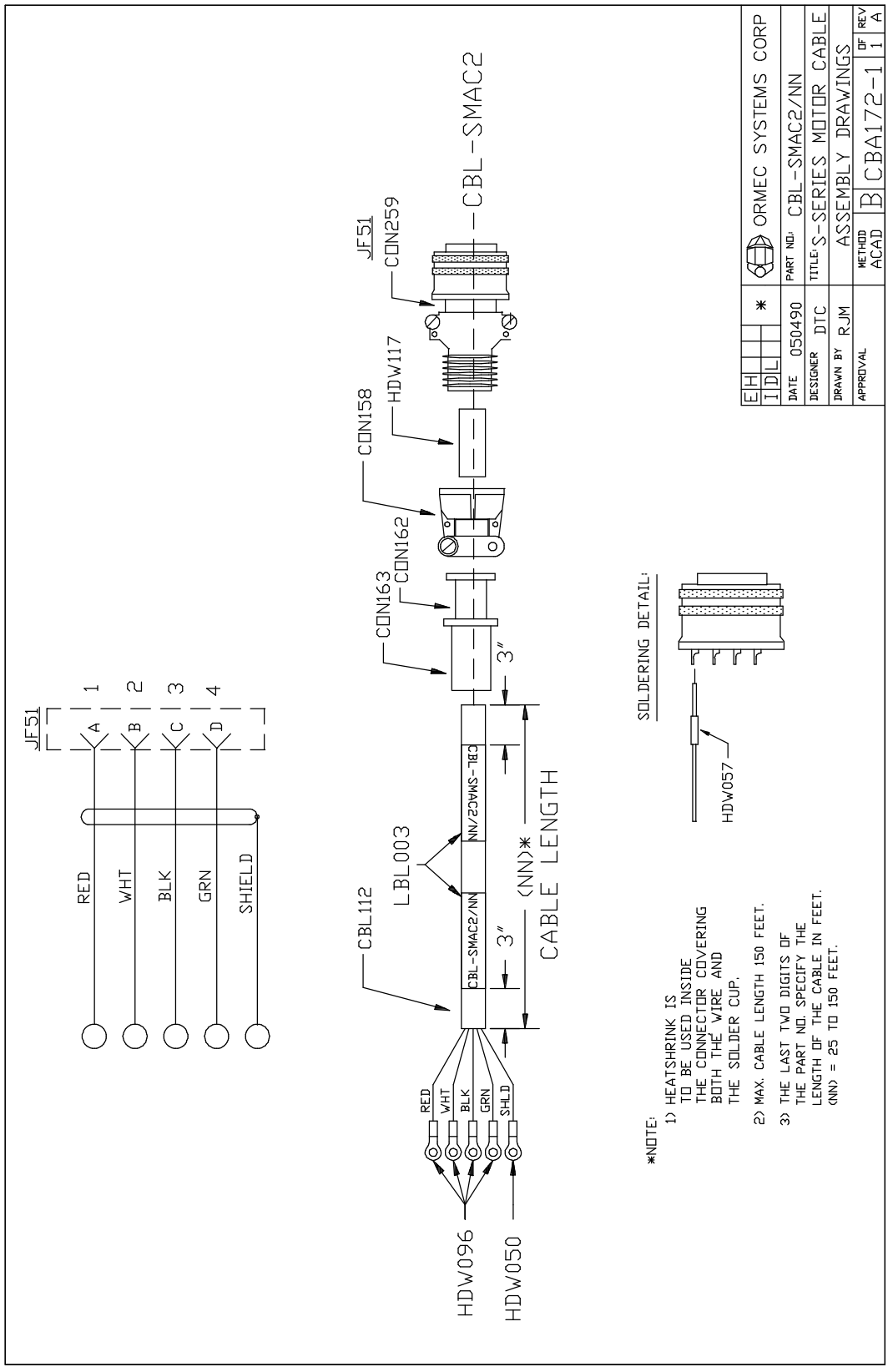


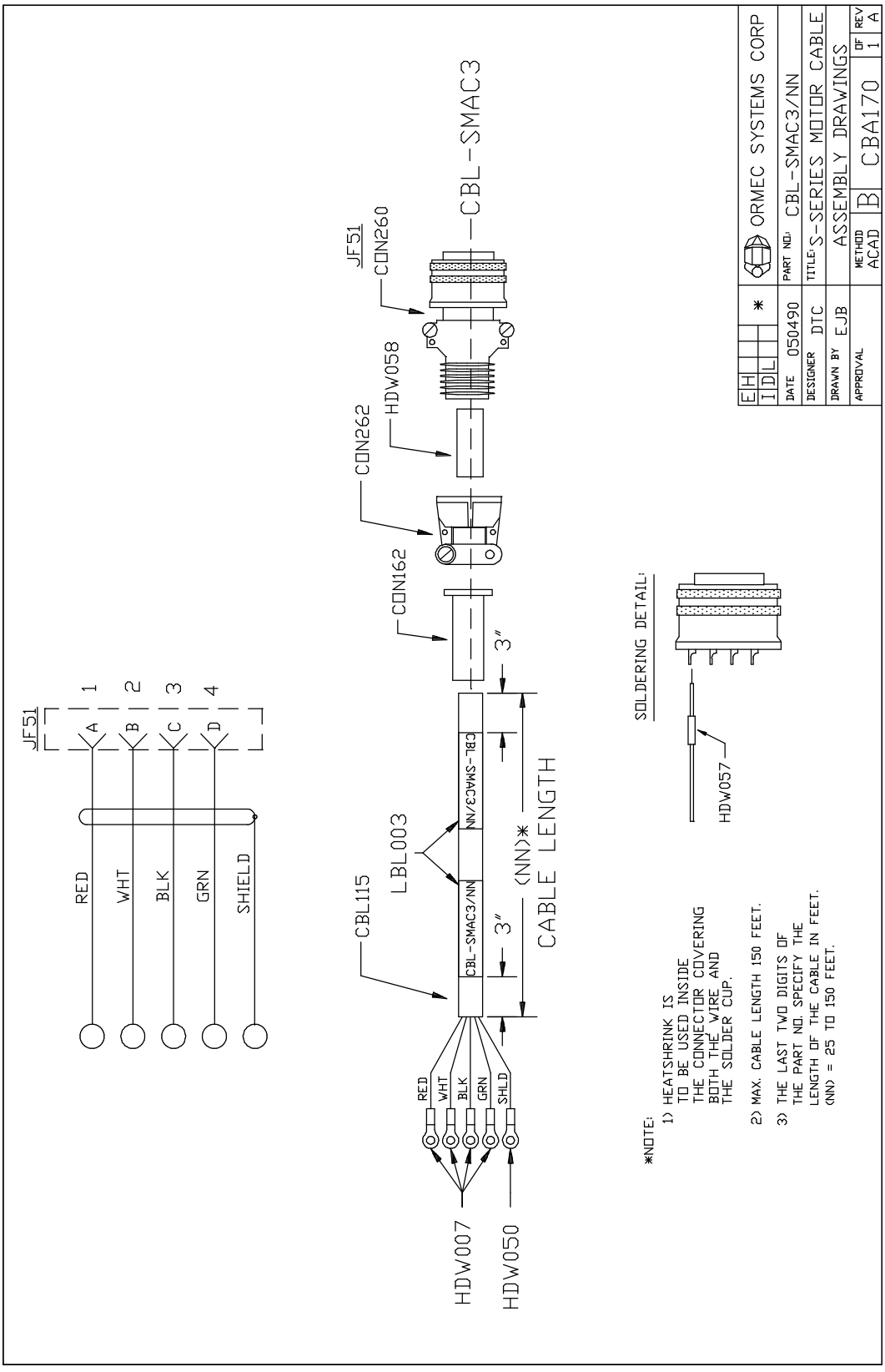
① FEMALE 20 PIN CONNECTOR
② CONNECTOR SHELL, w/LATCHING CLIPS AND CAPTIVE SCREWS
③ HEAT SHRINK TUBING 1.5"
④ MODEL NUMBER LABEL / COVERED WITH CLEAR HEATSHRINK
⑤ RUBBER BOOTS
⑥ HEAT SHRINK TUBING 1.5" (UNDER BOOTS)

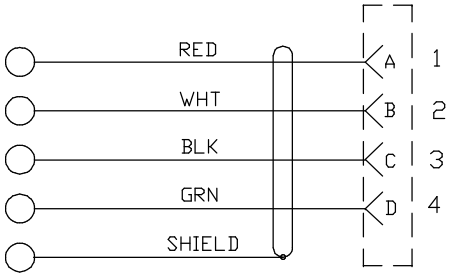
NOTE:
1) WIRE SIZE 22AWG
2) MIN. CABLE LENGTH: 3 FEET
3) MAX. CABLE LENGTH: 150 FEET
4) THE LAST TWO DIGITS OF THE PART NO. SPECIFY THE LENGTH OF THE CABLE IN FEET. (NN) = 3 TO 150 FEET

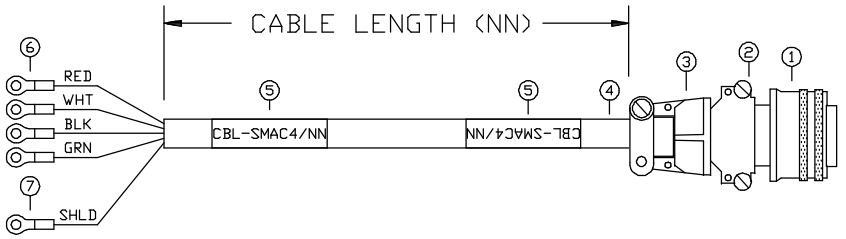
E H I D L +	ORMEC SYSTEMS CORP
DATE 062090	PART NO. CBL-SMAC/NN
DESIGNER EJB	TITLE: ENCODER CABLE
DRAWN BY EJB	ASSEMBLY DRAWING
APPROVAL	METHOD ACAD | B | CBA188-1 | OF 1 | REV A


JF51
1
2
3
4
A
B
C
D
RED
WHT
BLK
GRN
SHIELD
CBL112
LBL003
CBL-SMAC1/NN
CBL-SMAC1/NN
3"
(NN)*
CABLE LENGTH
3"
CON163
CON162
CON045
HDW117
JF51
CON142
CBL-SMAC1
HDW007
HDW050
RED
WHT
BLK
GRN
SHLD
SOLDERING DETAIL:
HDW057A
*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-SMAC1/NN
DESIGNER DTC
TITLE S-SERIES MOTOR CABLE
DRAWN BY EJB
ASSEMBLY DRAWING
APPROVAL
METHOD ACAD
B CBA171-1
DF 1
REV A


JF51
1
2
3
4
A
B
C
D
RED
WHT
BLK
GRN
SHIELD
CBL112
LBL003
CBL-SMAC2/NN
CBL-SMAC2/NN
3"
(NN)*
CABLE LENGTH
3"
CON163
CON162
CON158
HDW117
JF51
CON259
CBL-SMAC2
RED
WHT
BLK
GRN
SHLD
HDW096
HDW050
SOLDERING DETAIL:
HDW057
*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-SMAC2/NN
DESIGNER DTC
TITLE: S-SERIES MOTOR CABLE
DRAWN BY RJM
ASSEMBLY DRAWINGS
APPROVAL
METHOD ACAD
B CBA172-1
DF 1
REV A


JF51
1
2
3
4
A
B
C
D
RED
WHT
BLK
GRN
SHIELD
CBL115
LBL003
CBL-SMAC3/NN
CBL-SMAC3/NN
3"
<NN>*
CABLE LENGTH
3"
CON162
CON262
HDW058
JF51
CON260
CBL-SMAC3
RED
WHT
BLK
GRN
SHLD
HDW007
HDW050
SOLDERING DETAIL:
HDW057
*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.
ECN
DCL
*
DATE 050490
DESIGNER DTC
DRAWN BY EJB
APPROVAL
ORMEC SYSTEMS CORP
PART NO.: CBL-SMAC3/NN
TITLE: S-SERIES MOTOR CABLE ASSEMBLY DRAWINGS
METHOD ACAD
B
CBA170
DF 1
REV A

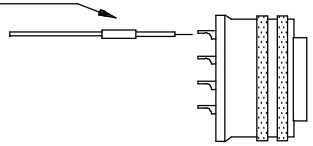




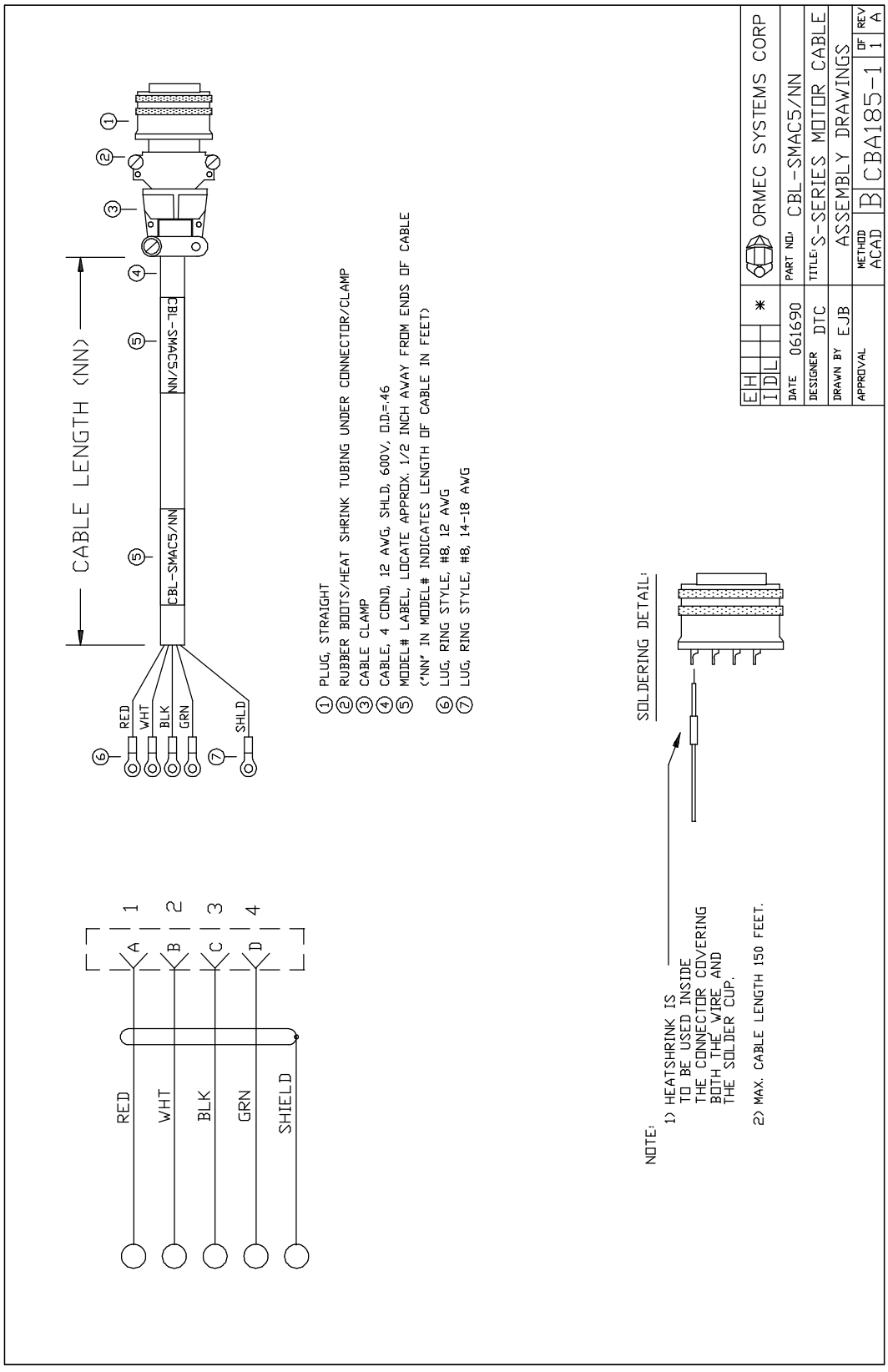
① PLUG, STRAIGHT
② RUBBER BOOTS/HEAT SHRINK TUBING UNDER CONNECTOR/CLAMP
③ CABLE CLAMP
④ CABLE, 4 COND, 12 AWG, SHLD, 600V, O.D.=.46
⑤ MODEL# LABEL, LOCATE APPROX. 1/2 INCH AWAY FROM ENDS OF CABLE
('NN' IN MODEL# INDICATES LENGTH OF CABLE IN FEET)
⑥ LUG, RING STYLE, #10, 14-18 AWG
⑦ LUG, RING STYLE, #8, 14-18 AWG

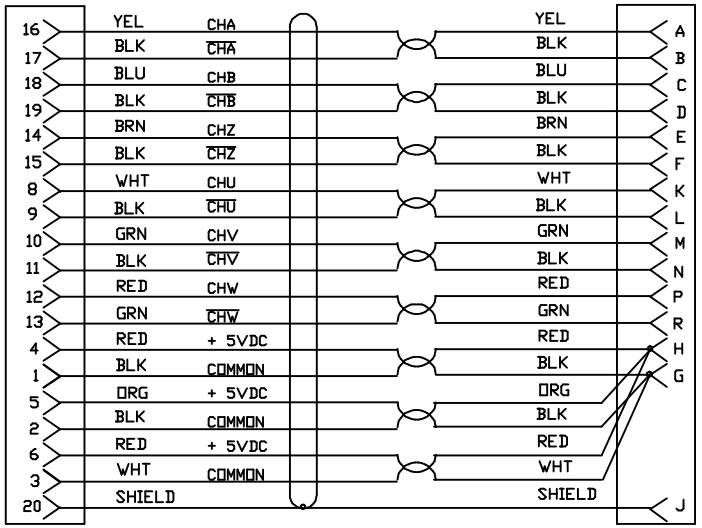
NOTE:
1) HEATSHRINK IS TO BE USED INSIDE THE CONNECTOR COVERING BOTH THE WIRE AND THE SOLDER CUP.
2) MAX. CABLE LENGTH 150 FEET.

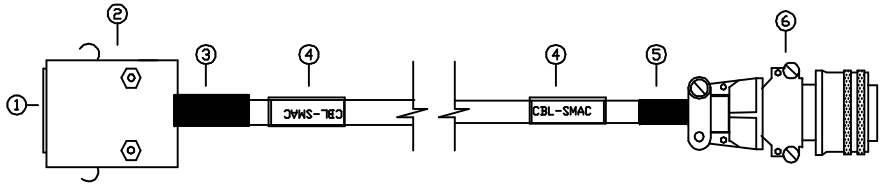
SOLDERING DETAIL:



E H / I D L	*	ORMEC SYSTEMS CORP
DATE 061690		PART NO.: CBL-SMAC4/NN
DESIGNER DTC		TITLE: S-SERIES MOTOR CABLE
DRAWN BY EJB		ASSEMBLY DRAWINGS
APPROVAL		METHOD ACAD / B / CBA184-1 / OF 1 / REV A


CABLE LENGTH (NN)
CBL-SMAC5/NN
NN/SJOWS-TBD
RED
WHT
BLK
GRN
SHLD
1 PLUG, STRAIGHT
2 RUBBER BOOTS/HEAT SHRINK TUBING UNDER CONNECTOR/CLAMP
3 CABLE CLAMP
4 CABLE, 4 COND, 12 AWG, SHLD, 600V, O.D.=.46
5 MODEL# LABEL, LOCATE APPROX. 1/2 INCH AWAY FROM ENDS OF CABLE ('NN' IN MODEL# INDICATES LENGTH OF CABLE IN FEET)
6 LUG, RING STYLE, #8, 12 AWG
7 LUG, RING STYLE, #8, 14-18 AWG
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.
ORMEC SYSTEMS CORP
PART NO. CBL-SMAC5/NN
TITLE S-SERIES MOTOR CABLE ASSEMBLY DRAWINGS
DATE 061690
DESIGNER DTC
DRAWN BY EJB
APPROVAL
METHOD ACAD
B CBA185-1
DF 1 1
REV A

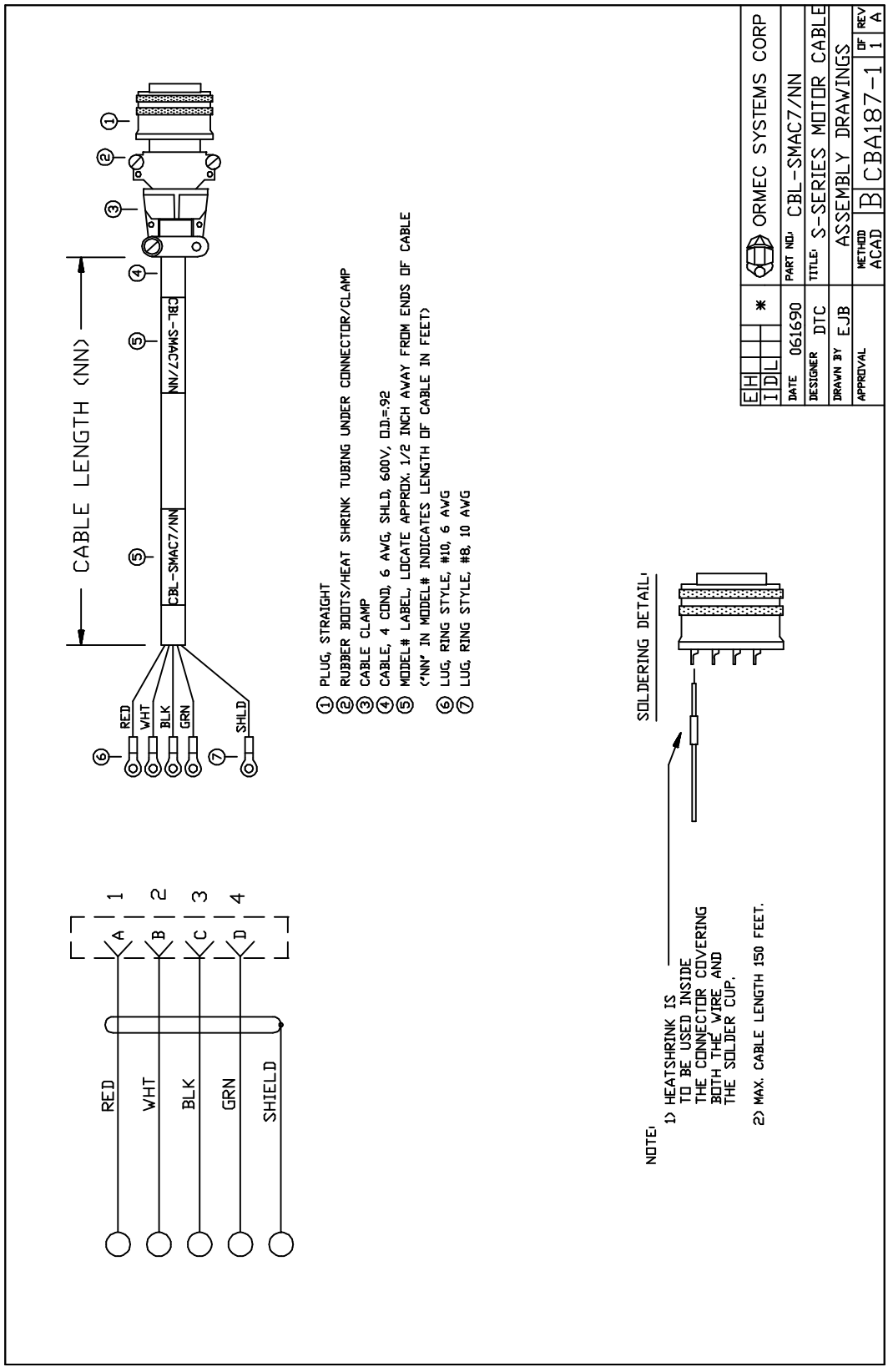




① FEMALE 20 PIN CONNECTOR
② CONNECTOR SHELL, w/LATCHING CLIPS AND CAPTIVE SCREWS
③ HEAT SHRINK TUBING 1.5"
④ MODEL NUMBER LABEL / COVERED WITH CLEAR HEATSHRINK
⑤ RUBBER BOOTS
⑥ HEAT SHRINK TUBING 1.5" (UNDER BOOTS)

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 062090	PART NO.: CBL-SMAC/NN
DESIGNER EJB	TITLE: ENCODER CABLE
DRAWN BY EJB	ASSEMBLY DRAWING
APPROVAL	METHOD ACAD | B | CBA188-1 | OF 1 | REV A


CABLE LENGTH (NN)
CBL-SMAC7/NN
RED
WHT
BLK
GRN
SHLD
1 PLUG, STRAIGHT
2 RUBBER BOOTS/HEAT SHRINK TUBING UNDER CONNECTOR/CLAMP
3 CABLE CLAMP
4 CABLE, 4 COND, 6 AWG, SHLD, 600V, O.D.=.92
5 MODEL# LABEL, LOCATE APPROX. 1/2 INCH AWAY FROM ENDS OF CABLE ('NN' IN MODEL# INDICATES LENGTH OF CABLE IN FEET)
6 LUG, RING STYLE, #10, 6 AWG
7 LUG, RING STYLE, #8, 10 AWG
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.
ORMEC SYSTEMS CORP
PART NO: CBL-SMAC7/NN
TITLE: S-SERIES MOTOR CABLE ASSEMBLY DRAWINGS
DATE 061690
DESIGNER DTC
DRAWN BY EJB
APPROVAL
METHOD ACAD
B CBA187-1
REV A
SHEET 1 OF 1

Manual Correction/Suggestion Form

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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