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Instruction Bulletin

Replaces 30072-013-47B dated 8/98

2- and 3-Pole AC Magnetic Contactors and 3-Pole AC Magnetic Starters
Classes 8502 and 8536—Size 5
Type SG, Series A, Form H••

INTRODUCTION

This instruction bulletin illustrates and describes Class 8502, two- and three-pole magnetic contactors and Class 8536, three-pole magnetic starters incorporating MOTOR LOGIC™ solid-state overload relays (SSOLR). It also contains assembly, modification and parts ordering instructions. To identify parts, refer to Figure 1.

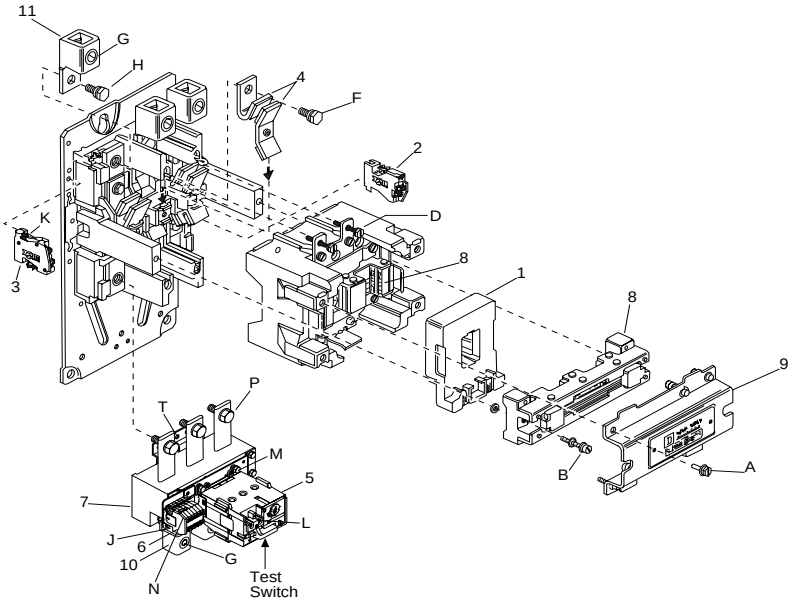

Figure 1: Contactor and Starter Assembly Drawing

⚠ DANGER

HAZARDOUS VOLTAGE

Disconnect all power before working on equipment.

Failure to follow this instruction will result in death or serious injury.

INSTALLATION

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD

- Remove blocking foam from between coil and cover prior to device energization.
- Do not remove blocking foam until controller installation is complete.

Failure to follow these instructions can prevent the controller from energizing and/or result in equipment damage.

AUXILIARY CONTACTS

All contactors and starters feature a normally-open (N.O.) holding circuit contact. Additional normally-open or normally-closed (N.C.) auxiliary contacts can be installed in the field. Table 7 on page 7 lists the class and types for auxiliary contacts. Instruction bulletin 30072-013-21 and the Square D Digest contain application information.

COVER MOUNTED CONTROL UNITS

NEMA 1, 4, and 12 enclosures are supplied with three punched holes with closing plates for field addition of Class 9001, Type K oiltight/watertight control units. Table 1 lists the Class 9999 parts kits needed to add control units in the field.

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Table 1: Field Modification Kits

Kit	Class 9999/Type	Form
Push Button, Start–Stop	SA3	A
Push Button, On–Off	SA3	A3
Selector Switch, Hand–Off–Auto	SC8	C
Red Pilot Light (120 V only)	SP28R [1]	P1

[1] For other voltages or colors, refer to the Class 9001 Type K section of the Square D Digest.

WIRING

Use only copper wire on device power and control terminals.

Terminals

Box lugs are suitable for wire sizes #4–500 kcmil. Pressure wire control terminals are suitable for wire sizes #16–12 AWG (1.5–4 mm^2), solid or stranded.

Short-Circuit Withstand Ratings

Contactors and starters are suitable for use on a circuit capable of delivering not more than 10,000 rms symmetrical amperes, 600 volts maximum.

OVERLOAD RELAY

⚠ DANGER

HAZARDOUS VOLTAGE

Do not energize the starter without the current transformer leads connected to the overload relay. Current transformers that power the overload relay can develop dangerous voltages if energized without a load on their secondary terminals. This voltage will be present at the current transformer leads.

Failure to follow these instructions will result in death or serious injury.

A base version MOTOR LOGIC three-phase SSOLR is standard (feature version optional) on starters. It is designed to protect three-phase motors from overload, phase loss, and phase unbalance conditions and incorporates the following features:

- 3:1 current adjustment range:
  45–135 A (135 A SSOLR)
  90–270 A (270 A SSOLR)
- –25 to +70 °C operating range
- Class 10 or Class 20 operation available (switch-selectable on feature version)
- Overload contacts—A600/P300 rated
- Auxiliary contacts (optional)—A600/P300 rated
- Permanent tamper guard
- Visible trip indication
- Self-powered
- Trip-free operation
- Thermal memory
- Power-on LED
- 50/60 Hz operation
- Accepts optional communication modules (feature version only)
- Available remote reset

Contact Ratings

The trip contacts and the optional auxiliary contacts (N.O. or N.C.) are rated A600/P300. These ratings are summarized in Table 2.

Table 2: SSOLR Contact Ratings

NEMA Rating	Maximum Application Voltage	Thermal Continuous Current	Maximum Current Make/Break	Rated VA	
				Make	Break
A600	600 Vac	10 A	[1], [3]	7200 VA	720 VA
P300	300 Vdc	5 A	[2]	138 VA	138 VA

[1] For application voltages between 120 volts and 600 volts, the maximum make and break currents are obtained by dividing the rated volt-amperes by the application voltage. For application voltages below 120 volts, the maximum make current is the same as for 120 volts, and the maximum break current is obtained by dividing the break volt-amperes by the application voltage, but these currents must not exceed the thermal continuous current.

[2] For applications voltages of 300 volts or less, the maximum make and break currents are obtained by dividing the rated volt-amperes by the application voltage, but the current values must not exceed the thermal continuous current.

[3] 35% power factor.

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Adjustment

For continuous rated motors having a service factor (SF) of 1.0, set the SSOLR's current adjustment dial to 90% of the motor's full-load current (MFLC). For continuous rated motors having a service factor of 1.15 to 1.25, set the SSOLR's current adjustment dial to the MFLC.

Examples:

- For MFLC = 200 A, SF = 1.0
  the SSOLR's dial setting = 90% of 200 = 180 A
- For MFLC = 200 A, SF = 1.25
  the SSOLR's dial setting = 200 A

Trip Class Selection

On starters incorporating the optional feature version SSOLR, select the desired trip class by placing the SSOLR's trip class selector switch to the appropriate position (Class 10 or Class 20).

Trip Current Rating

The trip current rating is 1.25 times the SSOLR's current adjustment dial setting. Thus, the trip current ratings for the previous examples are approximately 225 A for the 1.0 service factor (1.25 x 180 = 225) and approximately 250 A for the 1.25 service factor (1.25 x 200 = 250).

Trip Curves

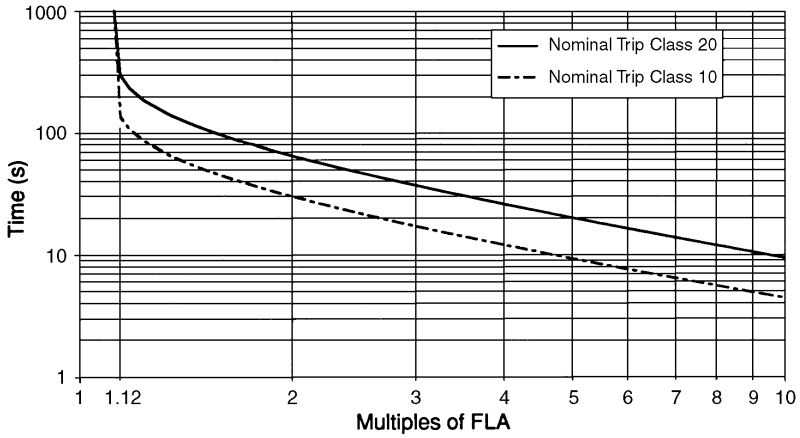

Figure 2: Trip Current Curves

Operation

The MOTOR LOGIC three-phase SSOLR monitors the motor current during start and run conditions and protects the motor against overload, phase-loss, and phase unbalance. A mechanically-latched trip mechanism opens (unlatches) in the event of a protective trip, opening the N.C. overload contacts at terminals 95 and 96. A visible trip indication is provided via a viewing window on the front of the SSOLR, in which a yellow marker appears when the device is tripped.

Overload

When the SSOLR detects motor currents in excess of 125% of the current adjustment dial setting, the overload contacts open and the optional auxiliary contacts change state (N.O. contacts close and N.C. contacts open). The time required for the SSOLR to trip depends upon:

- Current value
- Overload relay trip class (Class 10 or Class 20)
- Time elapsed since last trip

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The SSOLR is designed to meet NEMA standards for a 1.15 service factor motor. This means that the SSOLR ***must not trip*** *for currents that are 100%* of its current adjustment dial setting, and that it ***must trip*** *for currents that are 125%* of its current adjustment dial setting. Refer to "Adjustment" on page 3 for applications involving motors with service factors other than 1.15.

The overload function of the SSOLR is an inverse time function—the higher the level of current causing the trip, the quicker the trip occurs.

Phase Loss / Phase Unbalance

The phase loss/phase unbalance circuitry detects a phase loss and initiates a trip within three seconds (the response time will be somewhat longer for a phase loss condition that occurs during the transition between speeds on multi-speed applications only). Phase-loss detection extends to a phase loss in either the primary or the secondary of a wye-delta or delta-wye transformer. The circuitry detects a phase unbalance when any phase current drops 25% below or rises 25% above the average of the three phase currents and initiates a trip.

This phase loss/phase unbalance detection circuitry is fully operational at currents as low as 75% of the minimum current adjustment dial setting, in order to protect lightly loaded motors.

Class 2 Ground Fault Detection (Feature Version Only)

Class 2 ground fault detection circuitry senses and inhibits phase loss/phase unbalance tripping of the SSOLR for current levels above 9 to 12 times the maximum MFLC marking on the overload nameplate. The overload trip function is not affected. This feature provides an opportunity for circuit protection devices to interrupt these high phase loss/unbalance currents.

Reset

The SSOLR is reset by pressing the reset bar on the front of the device. Since the SSOLR trip function is of the "trip-free" design, *it* ***cannot be overridden*** *by holding down the reset bar.*

Power-On Indicator

A red LED indicates that the power necessary to operate the SSOLR's protective circuitry is present. This power is derived from the current flowing in the motor leads. When sufficient power is extracted to enable normal operation, the LED blinks. It blinks faster as the current being monitored increases. No other source of power is needed to operate the SSOLR.

Functional Test

To test for proper operation of the overload contacts, de-enerize the starter and disconnect the control circuit power. With a small, flat-blade screw driver, slide the TEST switch located on the bottom of the SSOLR (see Figure 1 on page 1) to the right. This operates the trip mechanism, opening the normally-closed overload contacts at terminals 95 and 96. Once proper operation of the overload contacts has been verified, reset the device by pressing the red reset bar, reconnect the control circuit power, and re-energize the starter as required.

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TROUBLESHOOTING

Table 3: Troubleshooting Procedures

Problem	Possible Causes	Corrective Action
SSOLR trips on start-up (**greater** than 3 seconds)	Load is too heavy for motor horsepower.	Remove excessive motor load or resize motor.
	Wrong overload trip class selected for the application.	Change from Class 10 to Class 20.
	Incorrect overload current setting.	Adjust overload current setting according to motor full-load current.
	Use of electronic DC injection brake.	Do not use electronic DC injection brakes with SSOLR.
SSOLR trips on start-up (**less** than 3 seconds)	Motor branch circuit fuse blown.	Replace blown motor branch circuit fuse(s).
	Loose motor branch circuit connection.	Tighten motor branch circuit connection.
	Motor circuit is not 3-phase.	Select starter with overload relay designed for applications other than 3-phase.
	Voltage unbalance on feeder.	Correct voltage unbalance on feeder.
	Motor winding damage in one or more windings.	Check motor winding impedance and rewind if necessary.
	Phase loss in primary of wye-delta or delta-wye transformer.	Replace blown fuse(s) or tighten loose connections.
SSOLR trips during normal running	Load is too heavy for motor horsepower.	Remove excessive motor load or resize motor.
	Incorrect overload current setting.	Adjust overload current setting according to MFLC.
	Use of electronic DC injection brake.	Do not use electronic DC injection brakes with SSOLR.

INSPECTING AND REPLACING CONTACTS

Discoloration and slight pitting do not harm contacts. **Do not file contacts**; this wastes contact material. Replace contacts (item 4 in Table 7 on page 7) only when worn thin.

To inspect or replace contacts, disconnect all power. Do not remove any wiring. Loosen the two screws (item B) holding the armature to the movable contact carrier and loosen the four screws (item D) holding the contact actuator to the contact block. Lift the contact actuator to expose the contacts.

To ensure proper alignment of the contact actuator when the device is reassembled, the four screws (item D) holding the contact actuator to the contact block should be tightened in sequence. As you face the contactor or starter, mounted in the normal vertical position, the tightening sequence is: lower left, upper left, upper right and lower right. Follow tightening torques listed in Table 4 on page 6 when assembling the device. Manually operate the device after it is reassembled to ensure that all parts function properly (see “Manual Operation”).

MANUAL OPERATION

⚠ WARNING

UNINTENTIONAL EQUIPMENT OPERATION

Disconnect all power before manually operating equipment to avoid contact arcing and unexpected load energization.

Failure to observe this precaution can result in death, serious injury or equipment damage.

Manually operate the contactor or starter by pushing on the armature screws (item B).

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COIL REPLACEMENT

To replace the coil:

1. Loosen the four screws (item A) and the two armature screws (item B).
2. Remove the cover and armature.
3. Disconnect the wires from the coil terminals and remove the coil.
4. Insert the new coil. Reassemble the contactor or starter in reverse order, following factory-recommended tightening torques listed in Table 4.
5. To ensure that all parts function properly, manually operate the contactor or starter (see“Manual Operation”).

ASSEMBLY INSTRUCTIONS

Figure 1 on page 1 shows how contactors and starters are assembled. Table 4 and the device instructions contain factory-recommended torques for mechanical, electrical, and pressure wire connections. Use these torques to ensure proper device operation.

Table 4: Factory-Recommended Tightening Torques

Item	Description	Tightening Torque	
		lb-in	N•m
A	Cover screws, 4 per cover	65–75	7.4–8.5
B	Armature screws, 2 per armature	44–50	5.0–5.7
D	Power plant screws, 4 per device	65–75	7.4–8.5
F	Stationary contact fasteners, 2 per pole	145–160	16.4–18.1
G	Lug screws, 2 per pole	see device instructions	
H	Lug retaining screws, 2 per pole on contactor, 1 per pole on starter	300–350	33.9–39.6
J	Lug retaining screws, 2 per pole on starter only	110–120	12.4–13.6
K	Auxiliary contact fastening screw, 1 per contact	13–16	1.5–1.8
L	Overload contact pressure wire connectors, 2 per SSOLR	9–12	1.0–1.4
Not shown	Optional auxiliary contact pressure wire connector, 2 per SSOLR (adjacent to overload contact)	9–12	1.0–1.4
Not shown	Optional auxiliary contact module fastening screw, 1 per module (adjacent to overload contact)	3–6	0.3–0.7
M	SSOLR fastening screws, 4 per SSOLR	30–38	3.4–4.3
N	Terminal block assembly pressure wire connectors, 12 per assembly	7–8	0.8–0.9
P	Overload assembly-to-contactor fastening screws, 1 per pole	300–350	33.9–39.6
T	Overload assembly-to-baseplate fastening screws, 4 per assembly	60–72	6.8–8.1

SHORT CIRCUIT PROTECTION

Provide branch-circuit overcurrent protection in accordance with the National Electrical Code (NEC). Do not exceed the maximum protective device ratings listed in Table 5.

Provide overcurrent protection for control circuits in accordance with the National Electrical Code and/or other applicable electrical codes. For applications requiring compliance with I.E.C. 947-5-1, use only Class CC fuses or better, 30 A maximum.

Table 5: Maximum Ampere Ratings

Maximum Voltage	Maximum Ampere Rating		
	Class K5, RK5 or RK1 Fuse [1]	Class J or T Fuse	Inverse-Time Circuit Breaker
600	400	600	400

[1] Time-delay fuse may be required.

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DISTANT CONTROL

Series impedance and shunt capacitance of the control circuit must be considered to assure proper operation of contactors and starters when controlled from remote operator stations. Depending upon the voltage, wire size, and number of control wires used, series impedance or shunt capacitance may limit the maximum distance of the wire run. If distances to start or stop stations are longer than those listed in Table 6, the wire-run configuration and materials must be analyzed. For further information, request data bulletin M379 from D-FAX (document #1188), the Square D website (www.squared.com), or your local Square D field office.

Table 6: Maximum Control Distance for Copper Wire

Coil Voltage (V) (60 Hz)	Maximum Control Distance (feet)	
	#14 AWG (2.08 mm^2)	#12 AWG (3.3 mm^2)
120 (2/3-wire)	130	200
240 (2/3-wire)	530	810
480 (2-wire)	2100	2200
480 (3-wire)	1300	1100

ORDERING INSTRUCTIONS

Specify the quantity, the part number or class and type, and the description of the part, giving the complete nameplate data of the device (for example, a Class 9999, Type SX6 circuit holding contact for a Class 8536, Type SGO1, Series A, Form H20 starter).

Table 7: Parts List

Item	Description	Part Number	Quantity	
			2-Pole	3-Pole
1	Coil	See Table 8 on page 8	1	1
2	Auxiliary contact: 1 N.O. 1 N.C.	Class 9999 Type SX6 Type SX7	 — —	 — —
3	Holding circuit contact, 1 N.O.	Class 9999, Type SX6	1	1
4	Contact kit	Class 9998 Type SL10 Type SL11	 1 —	 — 1
5	MOTOR LOGIC SSOLR	See Table 9 on page 8	—	1
[1]	SSOLR auxiliary contact, N.O. or N.C. (field-selectable)	Class 9999 Type AC04	—	—
6	Terminal block assembly	31161-155-50	—	1
7	Overload assembly	See Table 10 on page 8	—	1
8	Power plant assembly (includes housing, magnet, and armature)	31096-613-50	1	1
9	Cover assembly (without nameplate)	31104-030-50	1	1
10	Power lug (load side): Contactor Starter	 25050-44806 31102-081-01	 2 —	 3 3
11	Power lug (line side)	25050-44806	2	3
A	Cover screws	21926-20321	4	4
H	Lug retaining screw: 1/2-13 x 7/8 Contactor (line and load side) Starter (line side only)	21926-28280	 4 —	 6 3
J	Lug retaining screw: 5/16-18 X 7/8 (starter only) Screw (load side) Washer 7/8 (load side)	 21401-22280 23701-00220	 — —	 6 6
P	Overload-to-contactor fastening screw 1/2-13 X 7/8	21926-28280	—	3

[1] Not shown.

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The complete part number of the magnet coil consists of the prefix followed by the suffix (e.g. 120 V, 60 Hz coil = 31096-400-09). When ordering replacement coils, give the part number, voltage, and frequency of the coil being replaced.

Table 8: Magnet Coil Part Numbers

Coil Prefix	Hz	Coil Suffix										Coil VA	
		110 V	120 V	208 V	220 V	240 V	277 V	380 V	440 V	480 V	550 V	600 V	Inrush	Sealed
31096-400-	60	Use 120 V	09	15	Use 240 V	18	19	21	Use 480 V	24	Use 600 V	29	2970	212
	50	09	10	—	18	—	—	22	24	—	29	30	2970	250

The complete part number of the SSOLR consists of the class and type number (i.e., Class 9065, Type SR510).

Table 9: Class 9065 SSOLR Type Numbers

FLC Range	Trip Class 10	Trip Class 20	Trip Class 10/20 [1]
45–135 A	SR5109	SR5209	ST5209
90–270 A	SR510	SR520	ST520

[1] Feature version with selectable trip class and capable of accepting communication modules.

The complete part number of the overload assembly consists of the class and type number (i.e., Class 9065, Type SS510).

Table 10: Class 9065 Overload Assembly Type Numbers

FLC Range	Trip Class 10	Trip Class 20	Trip Class 10/20 [1]
45–135 A	SS5109	SS5209	SF5209
90–270 A	SS510	SS520	SF520

[1] Feature version with selectable trip class and capable of accepting communication modules.

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