



TRANE™

General Service Bulletin

CTV-SB-77

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**Subject: CUTLER-HAMMER SOLID-STATE OVERLOAD (SSOL; "A1")
OPERATION, CALIBRATION AND TROUBLESHOOTING**

Introduction:

This service bulletin describes the operation of the Cutler-Hammer solid-state overload module (electrically designated as "A1"), as well as appropriate procedures for SSOL calibration and trouble analysis. This module is provided in all current-production starter panels built to Trane specifications for CVHE and CVHB CenTraVacs (excluding those designed for use with the microcomputer-based UCP695 chiller control system).

It is important to note that by March 1st, 1987 4 different versions of the Cutler-Hammer solid-state overload (electrically designated as "A1") will be available in the field. Identifying characteristics that will enable you to distinguish one version from another are described below.

[] **"Version 1."** The original—and most familiar—version of the Cutler-Hammer SSOL was introduced in 1981 and manufactured until September 1986.

[] **"Version 2."** Built from September 1986 through December 1986, this variation of the SSOL is most readily identified by the "REV A" that appears on the front cover of the module. It can also be distinguished from Version 1 by comparing the printed circuit (p.c.) board assemblies: Version 2 does not include the 50/60-Hertz frequency adjustment switch, and all of the IC chips are soldered into place.

[] **"Version 3."** Identified by a "REV B" on the module's front cover, this SSOL variation is scheduled for production from January 1987 until March 1987, and includes these factory modifications:

- a. removal of the locked rotor potentiometer;
- b. a different transformer;
- c. removal of the J1-J2 jumper;
- d. a transition relay (RLY-849) with all-silver contacts; and,
- e. factory-installation a metal oxide varistor (SPS-11), an electrolytic capacitor (CPT-335), and a TRANS ZORB surge suppressor (SPS-14). (Because these components are now installed at the factory, service bulletin CTV-SB-75—which describes field installation of these components—is not applicable.)

[] **"Version 4."** Scheduled for initial production in March 1987, Version 4 of the SSOL will be known as the "AG-5". In addition to all of the modifications described for Version 3, the AG-5 also includes these changes:

- a. a redesigned p.c. board; and,
- b. relocation of the terminal strip and acceleration time DIP switch to the outside of the SSOL module.

Discussion:

Following is a list of the SSOL's operational functions and features:

1. provides precise compressor motor overload protection;
2. protects against excessive locked rotor (inrush) current draw;
3. limits the length of time that inrush current is drawn;
4. protects the chiller from damage that could be caused by an electrical distribution fault;
5. initiates starter transition when compressor motor current drops to 85% of RLA;
6. provides a DC voltage signal that is proportional to the load;
7. can be adjusted to compensate for high line voltage; and,
8. can be adjusted for either 50- or 60-Hertz operation.

SSOL Calibration Procedure

WARNING: To prevent injury or death due to electrical shock, lock unit disconnect switch open before servicing SSOL module (A1).

The adjustments and calibration procedures itemized below—and detailed on the following pages of this bulletin—must be completed before the chiller is started. Remember to use a grounding strap whenever working on a SSOL module!

1. Adjust line frequency (SSOL Version 1 only).
2. Calibrate the motor overload resistor.
3. Adjust locked rotor current (SSOL Versions 1 and 2 only).
4. Set the maximum motor acceleration time.
5. Adjust for high-voltage compensation.

If the unit is equipped with the distribution fault function, the small circuit board mounted in the center of the SSOL must be tilted outward to calibrate the module. To move this circuit board out of the way, gently pull on the 2 black tabs located at the top of the board, and tilt it down on its hinges.

Note: To verify that the existing—or new—SSOL is operational, use Trane service tool TOL-90 to perform a functional checkout of the module. TOL-90 is available from Trane ServiceFirst, and is provided with operating instructions (TOL-OM-1). If you are using TOL-90 to test the module's integrity while it is still mounted in the starter panel:

- a. remove the high voltage power supply from the starter panel;
- b. connect a separate 115 VAC source to power up the SSOL; and,
- c. disconnect the fuses on the primary side of the transformer.

Line Frequency Adjustment (SSOL Version 1 Only)

"Version 1" of the Cutler-Hammer SSOL module can be adapted to operate in either 50- or 60-Hertz electrical systems. To select the appropriate line frequency for a specific application:

1. Determine the line frequency of the installation. (Remember that all U.S. installations are 60 Hz.)
2. Position the SSOL's frequency adjustment switch at the appropriate setting. Refer to Figure 1 for the location of this switch on the SSOL's p.c. board; Figure 2 indicates the appropriate switch position for both 50 Hz and 60 Hz settings.
3. Check the appropriate box on the SSOL's nameplate (Figure 3) to record the line frequency switch setting selected in Step 2.

Note: Versions 2, 3 and 4 of the SSOL can also be used in 50-cycle applications. Though a specific line frequency adjustment is not necessary for any of these SSOL versions, the maximum acceleration time setting must be readjusted by multiplying the 60 Hz maximum acceleration time setting by "5/6". (For instance, if the maximum acceleration time setting is 30 seconds for a 60 Hz application, the corresponding 50 Hz setting is "30 x 5/6", or 25 seconds.)

Figure 1
Solid-State Overload
Module (SSOL)

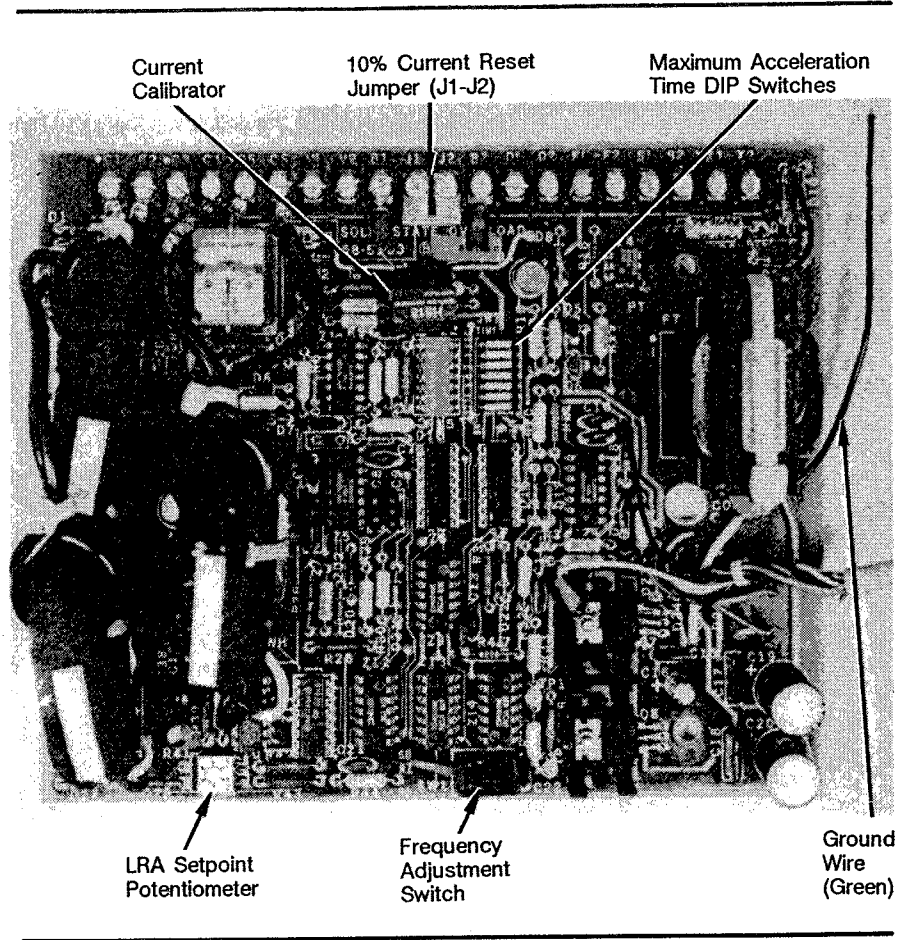


Figure 2
Line Frequency Adjustment
Switch Positions

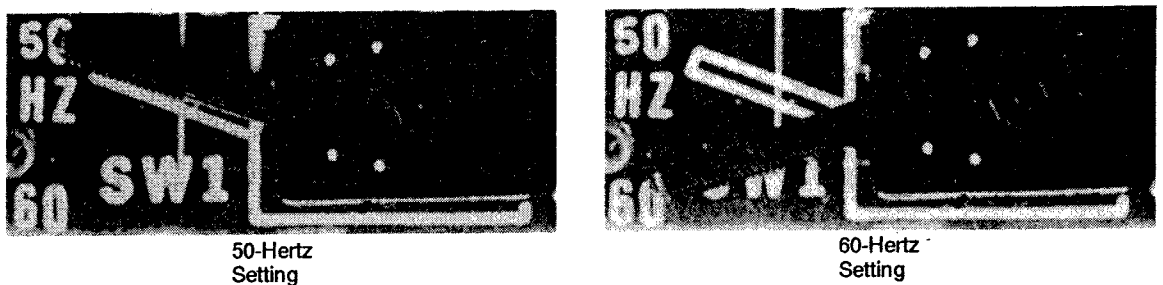


Figure 3
SSOL Nameplate

| | | | |
|----------------|-------|-----------------------------|--------------------------------|
| TRANE NO. | | | |
| CALIBRATOR NO. | | | |
| CALIBRATOR | OHMS | C.T. RATIO | /5 |
| MOTOR LRA | _____ | RATIO | _____ % |
| MOTOR RLA | _____ | | |
| L.R. TRIP TIME | SEC. | 50 <input type="checkbox"/> | 60 <input type="checkbox"/> HZ |

Compressor Motor Overload Setup (SSOL Versions 1, 2, 3 and 4)

Compressor motor overload calibration is accomplished by adjusting the resistance of the current calibrator (shown in Figure 1). When the current calibrator is adjusted properly, the SSOL will trip at 107% of the compressor motor's RLA value. (This particular "trip" point prevents nuisance full-load lockouts, while still protecting the compressor motor from potentially damaging overloads.)

Follow the instructions outlined below to correctly set the SSOL's current calibrator:

1. Determine the chiller's RLA value and current transformer ratio; be sure to consider the conditions described below when arriving at these values:

a. If the job site voltage is equal to—or lower than—the specified voltage rating stamped on the chiller nameplate, base the current calibrator setting on the nameplate RLA value. However, if the actual voltage is higher than the specified voltage, refer to the instructions provided under "High Voltage Compensation" later in this bulletin.

b. If the chiller is equipped with power factor correction capacitors (PFCCs) that are connected to the load side of the overload current transformers, the RLA value shown on the unit nameplate must be recalculated in order to correctly set the current calibrator.

This "adjusted" RLA value is already calculated for those units with factory-installed PFCCs, and it is marked on the cover of the solid-state overload (SSOL).

To determine the "adjusted" RLA value for other units, run the unit at full load; then take amperage readings on the load and line sides of the capacitor terminal points. Multiply the line-to-load-side ratio of these amp readings by the nameplate RLA to arrive at an "adjusted" RLA value.

Example

100 amps = Motor Rating (RLA Value) from Nameplate
84 amps = Line-Side Current Reading
92 amps = Load-Side Current Reading

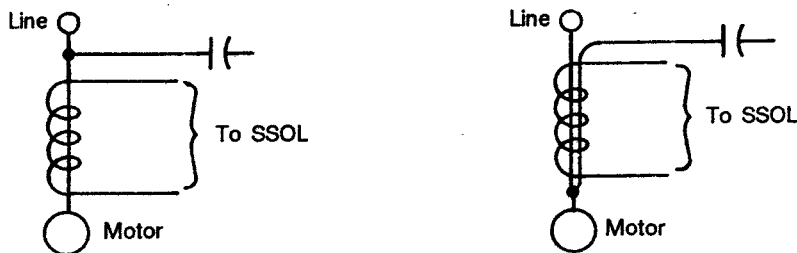
Nameplate RLA x $\frac{\text{Line-Side Current}}{\text{Load-Side Current}}$ = "Adjusted" RLA

100 amps x $\frac{84 \text{ amps}}{92 \text{ amps}}$ = 91.3, or 91 amps

If the PFCCs are connected on the line side of the SSOL current transformers—or if the capacitor leads are run through the current transformers with the motor leads (Figure 4), do not recalculate compressor RLA; use the RLA value stamped on the chiller nameplate to establish the current calibrator setting.

Note: For additional information and recommendations regarding field additions of power factor correction capacitors, refer to Trane Engineering Bulletin EB-CTV-44. Remember, too, that the PFCCs must be installed on Leads T1, T2 and T3—not on Leads T4, T5 and T6!

Figure 4
Current Transformers



2. Once the appropriate RLA value is determined (Step 1), calculate the rated load secondary current ("Isec") using 1 of the two methods described below. Notice that the calculation method selected—and the resulting Isec value—are dependent on the location of the current transformers (CTs).

a. CTs Monitoring Line Current. If the CTs are located to monitor line current, determine the Isec value by dividing the appropriate RLA value by the CT ratio.

Example

RLA Value = 91 amps
CT Ratio = 100:5 (or 20)

$$\frac{\text{RLA}}{\text{CT Ratio}} = \text{Isec}$$

$$\frac{91 \text{ amps}}{20} = 4.55$$

b. CTs Monitoring Phase Current. If the CTs in a wye-delta starter are positioned to monitor phase current, the Isec value is calculated by dividing the appropriate RLA value by the CT ratio, and then multiplying the result by 0.58.

Example

RLA Value = 91 amps
CT Ratio = 100:5 (or 20)

$$\frac{\text{RLA}}{\text{CT Ratio}} \times 0.58 = \text{Isec}$$

$$\frac{91 \text{ amps}}{20} \times 0.58 = 2.639, \text{ or } 2.64$$

Note: Where donut-type CTs are used, the wires routed through them are sometimes wrapped around and passed through the CTs more than once; this alters the "actual" CT ratio. To determine the CT ratio in this situation, divide the CT ratio by the number of times that the wire passes through the CT; in other words, the "actual" ratio for a 200:5 CT with a wire passed through it twice is 100:5.

3. Using Table 1 and the rated load secondary current ("Isec") value calculated in Step 2, determine the appropriate current calibrator and its potentiometer setting.

For example, if the "Isec" value is 4.55, the correct current calibrator is H818 and the potentiometer should be adjusted to 82.6 ohms; this adjustment will result in an overload trip point that is 107% of the nameplate RLA.

4. To adjust the current calibrator to the setting determined in Step 3, remove it from the SSOL module. Use a digital ohmmeter with a minimum accuracy of 3-1/2 places to obtain the desired resistance setting.

5. Return the current calibrator to the SSOL module. Be sure to record the calibrator number and setting on the SSOL nameplate.

Locked Rotor Current Lockout Adjustment (SSOL Versions 1 and 2 Only)

The SSOL is designed to protect the compressor motor from excessive LRA current draw during start-up by tripping the motor overload circuit breaker any time the set LRA is exceeded. Remember that the LRA current trip point value depends on the type of starter used with the CenTraVac compressor motor. It is set with the "LRA Setpoint" potentiometer found near the lower right-hand corner of the SSOL p.c. board. (See Figure 1.)

To properly set the LRA setpoint potentiometer:

1. Insert a screwdriver in the potentiometer adjusting slot; then turn the pot to the fully-counterclockwise (CCW) stop to establish a reference point.

2. Refer to Figure 5; then rotate the pot clockwise (CW) to the position that corresponds to the type of compressor motor starter used.

Note: The LRA setpoint pot positions illustrated in Figure 5 represent approximate settings for various starter types. To calculate a specific potentiometer setting, see Step 5.

Figure 5
LRA Setpoint Potentiometer
Settings for Various Starter
Types

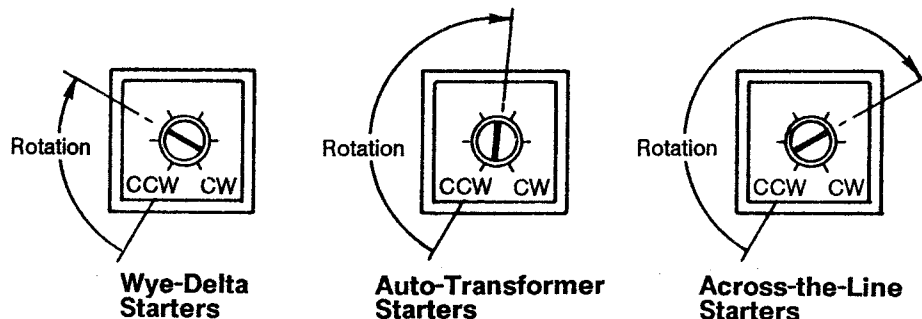


Table 1
Current Calibrator Settings

| I.D. No. on Current Calibrator | Isec Ampere Rating | | Current Calibrator "Pot" Setting (Resistance) | I.D. No. on Current Calibrator | Isec Ampere Rating | | Current Calibrator "Pot" Setting (Resistance) | |
|--------------------------------------|--------------------|------------|--|--------------------------------------|--------------------|-----------|--|-----------|
| | Minimum | Maximum | | | Minimum | Maximum | | |
| H816 | 2.01 | 2.05 | 185.0 ohms | H818 | 3.66 | 3.70 | 102.0 ohms | |
| | 2.06 | 2.10 | 180.0 ohms | | 3.71 | 3.75 | 101.0 ohms | |
| | 2.11 | 2.15 | 176.0 ohms | | 3.76 | 3.80 | 99.2 ohms | |
| | 2.16 | 2.20 | 172.0 ohms | | 3.81 | 3.85 | 97.9 ohms | |
| | 2.21 | 2.25 | 168.0 ohms | | 3.86 | 3.90 | 96.6 ohms | |
| | 2.26 | 2.30 | 165.0 ohms | | 3.91 | 3.95 | 95.4 ohms | |
| | 2.31 | 2.35 | 161.0 ohms | | 3.96 | 4.00 | 94.2 ohms | |
| | 2.36 | 2.40 | 158.0 ohms | | 4.01 | 4.05 | 93.0 ohms | |
| | 2.41 | 2.45 | 155.0 ohms | | 4.06 | 4.10 | 91.8 ohms | |
| | 2.46 | 2.50 | 151.0 ohms | | 4.11 | 4.15 | 90.7 ohms | |
| | H817 | 2.51 | 2.55 | | 148.0 ohms | 4.16 | 4.20 | 89.6 ohms |
| | | 2.56 | 2.60 | | 146.0 ohms | 4.21 | 4.25 | 88.5 ohms |
| | | 2.61 | 2.65 | | 143.0 ohms | 4.26 | 4.30 | 87.5 ohms |
| | | 2.66 | 2.70 | | 140.0 ohms | 4.31 | 4.35 | 86.5 ohms |
| 2.71 | | 2.75 | 138.0 ohms | 4.36 | 4.40 | 85.5 ohms | | |
| 2.76 | | 2.80 | 135.0 ohms | 4.41 | 4.45 | 84.5 ohms | | |
| 2.81 | | 2.85 | 133.0 ohms | 4.46 | 4.50 | 83.5 ohms | | |
| 2.86 | | 2.90 | 130.0 ohms | 4.51 | 4.55 | 82.6 ohms | | |
| 2.91 | | 2.95 | 128.0 ohms | 4.56 | 4.60 | 81.7 ohms | | |
| 2.96 | | 3.00 | 126.0 ohms | 4.61 | 4.65 | 80.8 ohms | | |
| 3.01 | | 3.05 | 124.0 ohms | 4.66 | 4.70 | 79.9 ohms | | |
| 3.06 | | 3.10 | 122.0 ohms | 4.71 | 4.75 | 79.1 ohms | | |
| 3.11 | | 3.15 | 120.0 ohms | 4.76 | 4.80 | 78.2 ohms | | |
| 3.16 | | 3.20 | 118.0 ohms | 4.81 | 4.85 | 77.4 ohms | | |
| 3.21 | 3.25 | 116.0 ohms | 4.86 | 4.90 | 76.6 ohms | | | |
| 3.26 | 3.30 | 114.0 ohms | 4.91 | 4.95 | 75.8 ohms | | | |
| 3.31 | 3.35 | 113.0 ohms | 4.96 | 5.00 | 75.1 ohms | | | |
| 3.36 | 3.40 | 111.0 ohms | | | | | | |
| 3.41 | 3.45 | 109.0 ohms | | | | | | |
| 3.46 | 3.50 | 108.0 ohms | | | | | | |
| 3.51 | 3.55 | 106.0 ohms | | | | | | |
| 3.56 | 3.60 | 105.0 ohms | | | | | | |
| 3.61 | 3.65 | 103.0 ohms | | | | | | |

3. Initiate the chiller start sequence. If the motor overload circuit breaker trips as soon as (within 1 second) the starter energizes, the LRA current trip point may need to be set higher. (This will not harm the operation of the SSOL module or the compressor motor.)

4. Record the LRA and RLA values from the chiller nameplate on the SSOL's nameplate.

5. Use the following procedure to calculate the "RATIO _____%" value; then record this value on the SSOL nameplate.

$$\text{Ratio \%} = \frac{\text{Motor LRA}^*}{\text{Motor RLA}} \times 100\%$$

*where LRA (locked rotor amperes) is the reduced value determined by starter type. See Table 2.

Example

Motor LRA = 200 amps
Motor RLA = 100 amps

$$\text{Ratio \%} = \frac{200 \text{ amps}}{100 \text{ amps}} \times 100\% = 200\%$$

**Maximum Acceleration Time Setup
(SSOL Versions 1, 2, 3 and 4)**

Designed to limit the time allowed for transition to occur, the SSOL trips—and shuts down the unit—whenever the compressor motor fails to transition within the time period established with maximum acceleration time switches (Figure 1). This prevents the motor from drawing LRA for an excessive period of time which, in turn, prevents the motor from overheating.

To set the maximum acceleration time switches properly:

1. Determine the appropriate maximum acceleration time—between 1 and 63 seconds—for the unit; refer to Table 3 for typical settings by starter type.

Keep in mind that the type of unit and starter, as well as job site conditions, will determine how much the actual maximum acceleration time setting varies from the typical settings shown in Table 3.

2. Locate the maximum acceleration time DIP switches on the SSOL p.c. board; refer to Figures 1 and 6. Notice that each DIP switch represents a specific number of seconds (e.g., DIP switch no. 1 is 32 seconds, no. 2 is 16 seconds, etc.). Determine what DIP switch "seconds" values can be added to yield the maximum acceleration time found in Step 1; then flip these DIP switches to the ON position. (For instance, if the desired maximum acceleration time setting is 27 seconds, flip DIP switch nos. 2, 3, 5 and 6 to ON.)

Note: If none of the DIP switches is set at ON, the unit will not start. (The SSOL will not allow any time for motor acceleration in this situation, so the motor overload circuit breaker trips as soon as a start-up is attempted.)

3. Record the maximum acceleration time setting on the SSOL nameplate.

For 50 Hz Applications w/SSOL Versions 2, 3 or 4. When determining the appropriate maximum acceleration time, remember to compensate for the difference in line frequency. Multiply the appropriate 60 Hz maximum acceleration time by "5/6" to arrive at the proper setting for 50 Hz applications. (For instance, if the maximum acceleration time setting is 30 seconds for a 60 Hz application, the corresponding 50 Hz setting is "30 x 5/6", or 25 seconds.)

Table 2
Starting Characteristics of
Various Types of Motor Starters

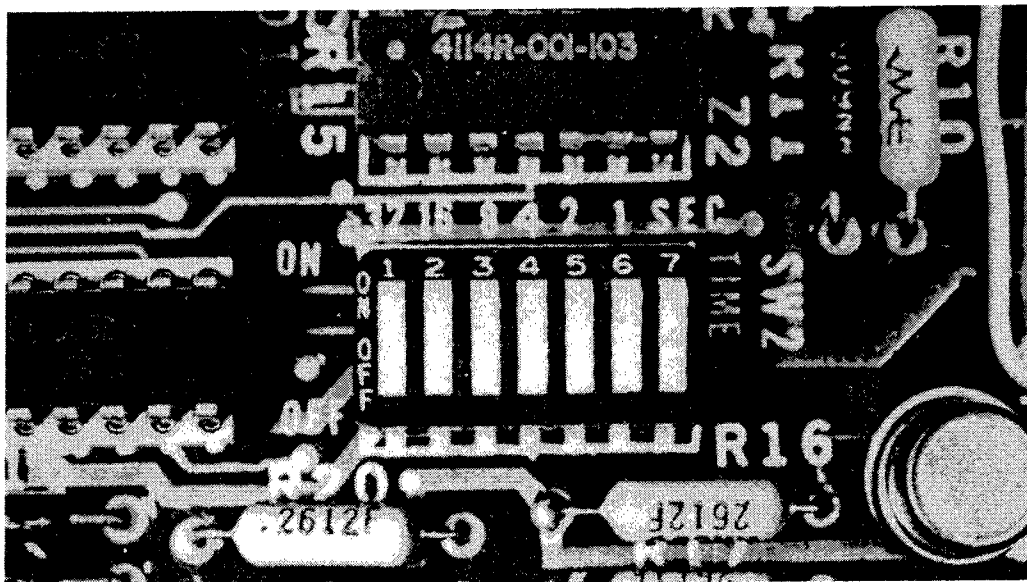
| Starter Type | Starting Characteristics--- % of Rated Value | | | |
|---|---|---------------|-----------|--------------|
| | % Tap | Motor Voltage | Motor LRA | Motor Torque |
| <u>Full-Voltage Type</u> Magnetic, Across-the-Line | n/a | 100% | 100% | 100% |
| <u>Reduced Voltage Types</u> Auto-Transformer | 80% | 80% | 64% | 64% |
| | 65% | 65% | 42% | 42% |
| | 50% | 50% | 25% | 25% |
| Primary Reactor | 80% | 80% | 80% | 64% |
| | 65% | 65% | 65% | 42% |
| | 50% | 50% | 50% | 25% |
| <u>Reduced Inrush Types</u> Wye-Delta | n/a | 100% | 33% | 33% |
| Open- or Closed-Transition | n/a | 100% | 33% | 33% |

Table 3
Typical Maximum Acceleration
Time Settings

| Starter Type | Recommended Max. Acceleration Time Setting |
|------------------|--|
| Wye-Delta | 27 seconds |
| Auto-Transformer | 16 seconds |
| Across-the-Line | 6 seconds |

Figure 6
Maximum Acceleration Time
DIP Switches

Example
 12 seconds = 8 seconds
 + 4 seconds; therefore,
 flip DIP switch nos. 3 and 4
 to ON.



High-Voltage Compensation Adjustment (SSOL Versions 1, 2, 3 and 4)

While the RLA value shown in the chiller nameplate represents the design nominal voltage, actual job-site voltage often varies from this value. Therefore, it is possible that a higher-than-nominal line voltage condition will cause the motor to generate excessive horsepower without exceeding the current draw shown on the nameplate.

To prevent motor overloading resulting from higher-than-rated voltage, recalibrate the SSOL module in 1 of 2 ways:

[] **SSOL Versions 1 and 2 Only.** Remove the 10% current reset jumper from Terminals J1-J2 in the SSOL (Figure 1); removal of this jumper automatically recalibrates the SSOL so that approximately 90% of the motor nameplate current rating is the new "rated" current for that application.

Note: SSOL setup does not change if the J1-J2 jumper is removed since all SSOL functions are automatically recalibrated.

[] **SSOL Versions 1 thru 4.** Reset the current calibrator. To arrive at a new current calibrator setting, multiply the Isec. value (calculated in "Compressor Motor Overload Setup") by the ratio of the rated line voltage to the actual line voltage.

$$\text{"New" Isec} = \text{Original Isec} \times \frac{\text{Rated Line Voltage}}{\text{Actual Line Voltage}}$$

Example

Original Isec = 4.55
Rated Line Voltage = 460V
Actual Line Voltage = 485V

$$\text{"New" Isec} = 4.55 \times \frac{460V}{485V} = 4.32$$

Using the "new" Isec value, the current calibrator number and Table 1, determine appropriate potentiometer setting; then readjust the pot to this value. (Remember that readjusting the current calibrator not only compensates for the high-voltage condition, but also recalibrates all other SSOL functions.)

* * * * *

Note: Whenever the SSOL is recalibrated for high voltage—whether by removing the J1-J2 jumper or by readjusting the current calibrator, turn the LRA potentiometer 1 dial setting higher than that indicated in Figure 5 to prevent nuisance "trips" at start-up (since higher-than-nameplate LRA current draw will occur). Also, be sure to record the method—and reason for—high-voltage compensation on the cover of the SSOL module!

Dry-Running Starters w/SSOL Modules

Starter panels equipped with the SSOL module can be dry-run at start-up in the same manner as starters without the SSOL. However, 2 important differences must be noted:

1. The distribution-fault circuit breaker must be disconnected before the starter can be dry run.

To disconnect the distribution-fault circuit breaker, simply remove a wire from it. If the breaker is not disconnected, the starter will not sequence, and the SSOL module will lock out on distribution fault as soon as the start sequence begins. (Lockout occurs because the distribution fault trip is initiated when motor current drops below 15% of the RLA with the M1 contactor energized; see "Distribution-Fault Circuit Breaker Operation". This situation will only occur during an actual distribution fault or during a starter dry-run.)

2. The starter will transition as soon as the dry-run is initiated. This immediate transition occurs because the SSOL initiates transition on the basis of motor current draw. During a normal start-up, motor current draw falls from the LRA value to one that is below the RLA because the inlet vanes are closed; when motor current draw falls to 85% of RLA during the start sequence, the SSOL initiates transition.

However, during a dry run, there is no current draw so the SSOL initiates transition immediately (within 1 second).

Note: The starter dry-run procedure is a good way to test the SSOL's distribution fault function; if it is working properly, the distribution-fault circuit breaker will trip as soon as the start sequence is initiated (provided that the breaker was not disconnected).

Operation of the Distribution-Fault Circuit Breaker

"Distribution fault" is defined as the total loss of line voltage for a period lasting less than 60 electrical cycles. This type of short-duration power interruption can be damaging to many types of induction-motor-driven equipment since an induction motor acts as a generator for several seconds after power is disconnected. The voltage generated by a water-cooled CenTraVac motor, for instance, is often sufficient to "hold in" control relays and starter contactors for approximately 60 electrical cycles—or 1 second—when a voltage-loss occurs.

If line voltage is re-established while the contactors are held in by motor-generated voltage—and the two voltages are out of phase, motor torques that are 6 to 10 times greater than the normal running torques can occur. These torques occur as the motor is pulled into phase and may be in either direction (forward or reverse). Such excessive torques severely overload the impeller hub area and may, in turn, upset the impeller keyway or—in severe cases—crack or destroy the impellers.

SSOL modules detect a distribution fault by monitoring current draw and the status of the M1 contactor. The distribution-fault circuit breaker is designed to trip when motor current draw is less than 15% of RLA while the M1 contactor is energized. The SSOL detects the existence of a distribution fault within 1-1/2 electrical cycles, and—within 6 cycles (1/10 of a second)—trips the distribution-fault circuit breaker to take the compressor motor off line.

Normally, this situation will only occur during an actual distribution fault (or during a starter dry run) since: (a) an induction motor will typically draw more than 15% of RLA—even when completely unloaded, and (b) when the M1 contactor is energized, the motor is running.

Troubleshooting the SSOL

Note: The information presented in the following troubleshooting chart is only applicable for the SSOL; use of this chart alone will not verify the integrity of other starter panel components.

SSOL Troubleshooting Chart

| Symptom | Recommended Action |
|---|---|
| Distribution-fault circuit breaker trips . . . | |
| 1. while the chiller is running. | 1. If this fault becomes a nuisance problem, use TOL-90 and the checkout procedures described in TOL-OM-1 to verify that the SSOL is functioning properly. If the results of this checkout indicate that the SSOL is defective, replace it. |
| 2. during the start sequence, at the point when transition should occur. | 2. Check for: a. installation of power-factor correction capacitors (PFCCs) on the start contactor (K27, or "1M"). If the PFCCs were incorrectly wired to the run contactor (K28, or "2M") instead of K27, the PFCCs will be placed in parallel at start-up, and the change in capacitance could drive the available current down to 15% of RLA. b. bouncing contacts---especially the auxiliary contacts on the starter contactors. |
| 3. when the starter de-energizes during the normal chiller shutdown sequence. | 3. This symptom is usually <u>not</u> the result of a SSOL problem; see service bulletin CTV-SB-76 for corrective action. However, if the suggestions described in CTV-SB-76 do not eliminate this problem, replace the SSOL. |
| Motor-current-overload circuit breaker trips . . . | |
| 1. at start-up. | 1. Check the: a. locked rotor setpoint potentiometer to make sure that it isn't turned too low. To properly set this pot, follow the instructions under "Locked Rotor Current Lockout Adjustment" in this bulletin. Note: The locked rotor setpoint pot is <u>only</u> found on Versions 1 and 2 of the SSOL. b. acceleration time setting. See "Maximum Acceleration Time Setup" in this bulletin. c. SSOL with TOL-90 and the instructions provided in TOL-OM-1. If this check indicates that the SSOL is defective, replace it. |
| 2. at transition. | 2. Check the SSOL module's terminal strip; if <u>Terminals 5 and 6 are labeled "F1" and "F2"</u> , complete the corrective action described in service bulletin CTV-SB-65. |

(Continued on next page)

SSOL Troubleshooting Chart (concluded)

| Symptom | Recommended Action |
|---|---|
| <p>Motor-current-overload circuit breaker trips . . . (continued)</p> <p>3. immediately after chiller loads up.</p> <p>4. at a value less than 100% of RLA.</p> | <p>3. Check the:</p> <p>a. polarity of the V1-V2 wires connected to the capacity control module in the chiller control panel.</p> <p>b. voltage at V1-V2 in the SSOL. <u>If the voltage measured at V1---with respect to V2---is positive</u>, replace the SSOL.</p> <p>4. Check:</p> <p>a. the balance of the 3-phase current. It may be necessary to add the electrolytic capacitor (CPT-335) described in CTV-SB-75.</p> <p>Note: The check just described in 4a is only applicable for SSOL Versions 1 and 2.</p> <p>b. for phase loss or phase reversal at the SSOL. To do this, connect the positive (+) lead of an oscilloscope to SSOL Terminal B1 and the negative (-) lead to Terminal B2. The oscilloscope should display a normal sine wave, as shown in Figure 7.</p> <p>If 1 phase is missing, the sine wave will appear as shown in Figure 8; Figure 9 shows the type of sine wave produced if 1 phase is reversed.</p> |
| <p>Chiller does not transition.</p> | <p>1. Check for closure of the auxiliary K27 contacts in the SSOL's S1-S2 circuit.</p> <p>2. Use TOL-90 to perform the "transition level" functional test described in TOL-OM-1. If test results verify that the transition relay on the SSOL is "pulling in", use an ohmmeter to check for closure of the transition relay contacts. If these contacts fail to close, replace the SSOL's transition relay (RLY-849).</p> |
| <p>Chiller transitions as soon as the start sequence is initiated.</p> | <p>1. Check the 3-phase current signals with an oscilloscope; see Item 4b under "Recommended Action" above.</p> <p>2. Use TOL-90 and the checkout procedures described in TOL-OM-1 to check SSOL operation. If test results indicate that the SSOL is defective, replace it.</p> |

Figure 7
Normal Sine Wave

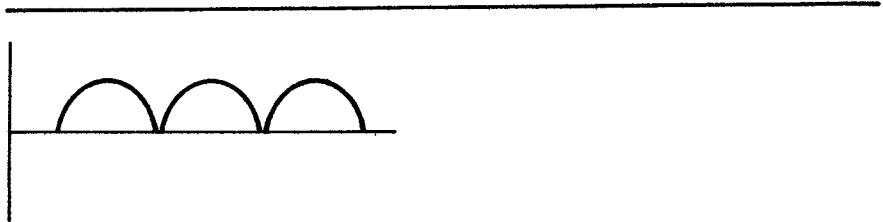


Figure 8
Abnormal Sine Wave:
Missing Phase

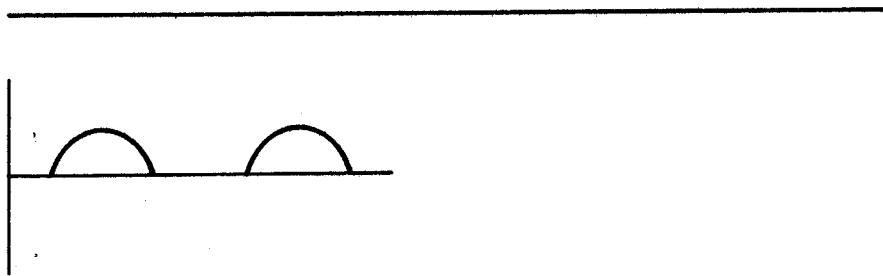
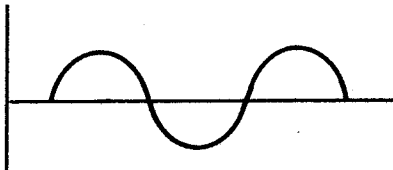


Figure 9
Abnormal Sine Wave:
Phase Reversal



For further information on this product or other Trane products, refer to the "Trane Service Literature Catalog", ordering number IDX-IOM-1. This catalog contains listings and prices for all service literature sold by Trane. The catalog may be ordered by sending a \$20.00 check to: The Trane Company, Service Literature Sales, 3600 Pammel Creek Road, La Crosse, WI 54601.