INSTALLING, OPERATING AND MAINTAINING ELECTRO-MECHANICAL AUTOMATIC TRANSFER SWITCHES

STYLES 2, 3 AND T-200

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NOTE: **Engineering changes may have been made after publication date. Any departure from this manual should be checked with Lake Shore Electric Corporation.**

Lake Shore Electric Corporation reserves the right to change specifications without prior notice.

WARNING!

WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER OF ELECTROCUTION EXISTS WHICH MAY RESULT IN INJURY OR DEATH. DO NOT ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT FIRST TAKING EVERY PRECAUTION TO PREVENT ACCIDENTAL INJURIES.

IN INSTALLATION AND USE OF THIS PRODUCT, COMPLY WITH THE NATIONAL ELECTRICAL CODE, FEDERAL, STATE AND LOCAL CODES, AND ALL APPLICABLE SAFETY CODES. IN ADDITION, TURN OFF POWER AND TAKE OTHER NECESSARY PRECAUTIONS TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE.

WARRANTY

Lake Shore Electric Automatic Transfer Switches are guaranteed against defective materials and workmanship for a period of one year from date of shipment. If, within one year after shipment, it is proved to Lake Shore's satisfaction that the equipment does not meet the above warranty, and if Lake Shore is promptly notified of same, Lake Shore will make necessary corrections, free of charge, F.O.B. works where manufactured.

Such necessary corrections constitute the full extent of Lake Shore's warranty. There are no warranties which extend beyond those described herein. This warranty is exclusive and is in lieu of all other warranties, whether written, oral, implied or statutory. No warranty of merchantability or of fitness for purpose shall apply.

Lake Shore is not responsible for damage to its equipment through improper installation or use, unauthorized repair or modifications, or attempts to operate it above its rated capacities or in abnormal environments. In no event, whether as a failure to meet conditions of the warranty or otherwise, shall Lake Shore be liable for any special, incidental, or consequential damages, including, but not limited to, loss of profit or revenues, loss of good will, damages to associated equipment, cost of capital, cost of substitute products, facilities, service or replacement power, costs of downtime or claims of third parties for such damages.

Notice: The owner of this automatic transfer switch must perform certain required maintenance functions as described in **Appendix A, Appendix B,** and **Appendix C** of this manual in order to maintain Lake Shore's one year exclusive warranty. Failure to perform this maintenance shall void this warranty.

1. CONSTRUCTION

Transfer Switches as manufactured by Lake Shore Electric Corporation use molded case switches and/or circuit breakers to effect the transfer of two separate power sources to a single load.

These molded case switches and/or circuit breakers are electrically interlocked through control relays and auxiliary switches, and mechanically interlocked through a walking beam mechanism which is located on the rear of the baseplate. This mechanism is a fulcrum and lever device which positively prevents both molded case switches or circuit breakers from being in the **ON** position simultaneously. It provides a "Fail-Safe" design.

The gear motors are capable of operating on either AC or DC voltage, and the gear reduction unit is permanently lubricated so that it requires no maintenance.

All styles of transfer switches are provided with an insulated operating handle to enable personnel to manually operate the transfer switch should this become necessary. The handle is permanently mounted and readily accessible in an emergency.

All relays are of the enclosed industrial type to ensure long life and minimum maintenance. All relays are rated for continuous duty to eliminate overheating of coils. The only relays that are continuously energized are the Outage Delay Relay (ODR) or Control Relay (CR), Phase Failure Relay Normal (PFRN) and the Accessory Relay (ACRN - if provided).

All timed control relays are of the solid state or pneumatic type with the exception of the Plant Exerciser (PE) which is motor driven.

Wiring harnesses are manufactured from 16-gauge insulated machine tool wire. The transfer motor control circuits are protected with miniature overload circuit breakers. All control relays and logic are unfused in accordance with UL 1008.

2. DESCRIPTION OF OPERATION

The following are general descriptions of operation applying to the different styles of Trans-O-Matic Transfer Switches. Certain accessory additions may modify the sequence of operations as required to suit specific applications.

AUTOMATIC TRANSFER SWITCHES

Style 2 and T-200

Normally, the transfer switch operates on the preferred power source with the Normal molded case switch in the closed position and the Emergency molded case switch in the open position. (Refer to Wiring Diagrams, Appendix "E". **Note:** These wiring diagrams are for reference only and should not be used in place of wiring diagrams for a specific switch.) All phases of the preferred power source are continuously monitored by a voltage sensitive relay which is adjustable from 70% to 90% of the nominal voltage. In the event of a drop in any phase of the preferred voltage below the drop-out set point, the voltage relay interrupts the voltage to a control relay coil which drops out, closing the engine start contact. After the engine has started, which generally takes from three to ten seconds, the transfer motor is energized by the Emergency Relay, (ER) opening the Normal breaker and closing the Emergency breaker, thus effecting the power source transfer. With the switch now operating on the emergency source, the voltage relay continues to monitor the preferred source. When all phases of the preferred source return to the pickup level of the voltage relay, the control relay is again energized, disconnecting the engine-start contact and transferring the load back to the preferred source.

Style 3

The Style 3 transfer switch is primarily used in inductive load applications. A Style 3 Automatic Transfer Switch operates in much the same way as described in the preceding paragraph with the exception that each molded case switch has its own drive motor. This allows the load to be disconnected from both the Normal and Emergency power sources essentially placing the load in a "Neutral" position. When the signal to transfer is received, the drive motor on the Normal side switch transfers the switch to the **open** position. A Timing Relay (TDT) is then energized.

After the TDT times out, the drive motor on the Emergency side is energized transferring the Emergency switch to the **closed** position connecting the load to a power source. By utilizing the time delay (TDT) it is possible to regulate the length of time where the load is neither connected to the Normal or Emergency source. This is useful in allowing residual voltage in inductive loads to decay before reapplying power, thereby avoiding large and possibly damaging in-rush currents.

Upon resumption of Normal power, the TDT Timer is again used to provide a delay between transfer to the Emergency and Normal molded case switches.

The preceding sequences of operation describe the operation of a basic automatic transfer switch. Lake Shore Electric Corporation offers a wide variety of accessory equipment to meet specification and customer requirements. Please refer to the schematic diagram provided with your Lake Shore automatic transfer switch for the specific controls provided.

MANUAL TRANSFER SWITCHES

Style 2 & T-200

A manual transfer switch cannot transfer automatically to the Emergency source of power or from the Emergency source to the Normal source of power. It must be operated manually by transferring the operating handle provided.

The transfer may be performed by hand or, if the switch has the electrical assist option (E1), the transfer is performed with the two pushbuttons on the enclosure door. The switch is electrically operated by the source to which it is being transferred. To transfer the switch to the Emergency position, the Emergency Close Pushbutton (ECP) is pressed. This opens the Normal switch and closes the Emergency switch. To transfer the switch back to the Normal source, the Normal Close Pushbutton (NCP) is pressed. This opens the emergency switch and closes the Normal switch. The two buttons are electrically interlocked so that they cannot both be pushed at the same time.

Style 3

As in the Style 2 and T-200, the transfer switch is incapable of transferring automatically to the Emergency source of power or from the Emergency source to the Normal source of power. It must be operated manually by transferring the operating handle provided.

The transfer may be performed by hand or, if the switch has the electrical assist option (E1), the transfer is performed with the four pushbuttons on the enclosure door. As in the Style 2 and T-200, the switch is electrically operated by the source to which it is being transferred. To transfer the switch to the Emergency source, first the Open Normal Pushbutton (ONP) is pressed. This places the switch in a neutral position, with the Load disconnected from both the Normal and Emergency power sources. The time period that the switch is in the neutral position is determined by the transfer switch operator. The Close Emergency Pushbutton (CEP) is then pressed. This connects the Load to the Emergency source.

To transfer the switch back to the Normal source, first the Open Emergency Pushbutton (OEP) is pressed. This again puts the switch in a neutral position, with the Load disconnected from either power source. Then the Close Normal Pushbutton (CNP) is pressed. This connects the Load back to the Normal source.

3. INSTALLATION

Mounting and Connecting

The standard Trans-O-Matic is designed for operation in a clean, dry, dust-free location where a minimum of vibration is present.

When used in conjunction with an engine generator set, it is recommended that the transfer switch be located as close as possible to the generator set, as this will reduce the length of the DC control wiring (required for automatic operation) thus preventing voltage drops and improper operation. The maximum recommended distance the automatic transfer switch should be installed from the engine generator set is fifty (50) feet.

Enclosed transfer switches can be designed for wall mounting or free standing. Open transfer switches are generally mounted in a customer supplied enclosure; consequently, there are certain steps which should be followed:

1. Allow adequate space for movement of the manual operating handle.
2. Mount to a rigid framework to prevent vibration.
3. Review all electrical clearances with the enclosure door or panels closed.
4. On rear connected switches, insure there is no strain on the studs due to improper alignment.
5. Lug size and arrangements may vary depending on molded case switch manufacturer.
6. Optional lug arrangements are available, but must be specified at the time the transfer switch is ordered. Consult Lake Shore Electric for details.

Before bringing the power cables into the enclosure, be certain that the lugs will be of the correct size. If not, different sizes may be ordered from Lake Shore Electric.

The Normal source power cable is connected to the Normal molded case switch at the terminals marked NL1, NL2, and NL3 (refer to Wiring Diagrams, Appendix "E"), or to the specific wiring diagram supplied with the switch.

The Emergency source power cable is connected in a like manner to the Emergency molded case switch terminals marked EL1, EL2 and EL3.

Note: Be careful to pass the cable through any current transformers or other devices which may be part of a generator control.

The load cables are connected to the common bus at the terminals marked L1, L2 and L3. On three-phase, four-wire transfer switches, or single-phase, three-wire transfer switch, a neutral lug is provided.

Note: Verify that phase sequence rotation of normal and emergency sources are identical. Failure to do this will result in damage to the transfer switch and other equipment and will void the warranty extended by Lake Shore Electric Corporation.

When installing the power cables, be careful not to disturb or damage the control wires that go to the various terminals. A ground lug is provided on all transfer switches. This lug **must** be connected to earth ground.

CAUTION: Be sure to check that all power cable lugs are torqued to the applicable require-

ment for the switch (see Appendix B).

The only external control circuit provided on standard transfer switches is the engine start contact, which is rated 5 amps at 120 VAC (32 VDC) resistive.

There are numerous accessories available on Trans-O-Matics which require external connections. Refer to the wiring diagram included with your transfer switch for specific instructions on connecting these accessories.

Placing the Trans-O-Matic in Operation

Before energizing the switch electrically, be certain all external connections have been properly made according to the wiring diagram provided with the switch. Inspect all wires, cables, and bus bar for abraded insulation, foreign matter, and electrical clearance.

Manually set the transfer switch to the Normal source (Normal breaker **ON**) and energize the normal source. The Control Relay (CR) or Outage Delay Relay (ODR) will immediately energize and the transfer switch will stay on the preferred normal source.

If the Outage Delay Relay (ODR) or Control Relay (CR) does not pick up, place a voltmeter on the normal source to be sure that the voltage is adequate and within the range of the Phase Failure Relay (PFR). The switch will not operate on a voltage other than that stamped on the name plate of the transfer switch.

Do not attempt to energize the Emergency source until the switch is operating satisfactorily on normal. With the Normal source operating, the Emergency source may now be **manually** energized for testing. The Emergency source, including all safety interlocks, should be checked over before an attempt is made at a complete automatic systems test. When the Emergency source has been tested satisfactorily and de-energized, a test of the automatic system can now be tried.

All Lake Shore Electric Automatic Transfer Switches are furnished with a Load Test Switch. This switch may be mounted on the wiring panel or the door. A test of the automatic circuitry can be initiated by moving this load test switch to the Test position. This will cause the normal control circuits to de-energize and give a signal to start the engine.

To test the full automatic operation of the transfer switch, make sure the transfer switch is operating on the Normal source. Place the load test switch in the test position. The engine start contracts will close, sending a signal to the engine's automatic start panel to crank the engine. After the generator is up to voltage and frequency, the transfer switch will transfer to the emergency source.

NOTE: If an Outage Delay Relay (ODR) is included on the transfer switch, the engine start signal will be delayed until the ODR has timed out. If any Frequency and/or Voltage Sensitive relays and/or Time Delay to Emergency (TDE) is used in the Emergency source logic, the transfer switch won't transfer until the generator voltage and/or frequency are within the required pickup levels of the relays and/or the timer has timed out.

After the emergency operation has been tested, return the Load Test Switch to the Normal position. This will cause the transfer switch to return to the Normal source and shut down the engine.

NOTE: A Time Delay to Return Timer (TDR) may be supplied. If so, the transfer to Normal position will be delayed until the TDR has timed out. Also, some transfer switches are equipped with an adjustable Engine Maintained Timer (EMT) which

will keep the engine running unloaded for the duration of its setting.

The above tests are sufficient to place the transfer switch in operation. The following pages contain specific information on the various components and troubleshooting information.

4. OPERATING MECHANISM

General Information

The operating mechanism, pictured in Figure 1 (page 13), is used in Styles 2, 3 and T-200 transfer switches. The motor (4) is a universal type, reversible motor and is shipped as a complete component including the gearbox. The gearbox is a sealed unit, which should never require maintenance or attention. Because of the wide range of molded case switches used on Lake Shore Electric Transfer Switches, if motor replacement is necessary, please specify the serial number and model number of the transfer switch.

The operating mechanism pictured in Figure 2 (page 13) is used on all Style 2 and Style 3, 1600 Amp Switches and larger. Like the motor gearbox used on lower amperage units, this motor gearbox is also reversible and is only shipped as an assembled unit.

Operation

When a signal to transfer is received through the contacts of the auxiliary switch, the motor is energized and the gear box turns the drive drum (8) which sets up a friction pull between itself and the drive shoe lining (13). This friction pull is sufficient to pull the drive arms (2) over to the new position, actuating the switch handle. As soon as the drive arms have reached their new position, the auxiliary switch changes position cutting off the motor, while at the same time, setting up the circuit for the next transfer in the opposite direction. Because of the built-in features of the friction drive, it is possible to manually operate the switch by moving the manual handle (1) without engaging any clutches or devices, except for 1600 Amp and larger. With transfer switches rated 1600 amps and above, it is necessary to disengage the transfer mechanism by way of a mechanical latch before manual operating the switch.

Required Maintenance

Please refer to the Appendix for required maintenance on the operating mechanism necessary to maintain your exclusive one year Lake Shore Electric Corporation warranty.

Motor Assembly (less than 1600 amp)

To assemble the operating mechanism, first place the drive drum keys (11) on the two shafts which extend from the gear box. Next, slide the two drive drums (8) on the shafts. Insert one drive shoe pivot (10) into one drive arm (2) from the bottom, followed by the drive shoe (12) and the drive shoe lining (13). Be sure that the lining fits snugly into the drive shoe and that the concave cup end of the drive shoe pivot (10) engages the nipple on the drive shoe. Hold the entire assembly together and slip it onto one shaft, pushing it all the way to the drive drum. Now the spring (9) and adjustment screw (3) may be assembled into the drive arm (2) from the top. Repeat this procedure for the other drive arm assembly, if present.

Place the lever arm support (17) in such a way that it straddles the gearbox and engages the drive arm assemblies on both sides of the gear box. Tighten the mounting screws and assemble the lever arm across the two molded case switches by fastening the lever arm to the lever arm support with the manual handle assembly (1). Observe the molded case switch actuating lever as it is manually opening and closing the molded case switch, checking that it completely transfers the molded case switches.

The disassembly procedure of the mechanism is the reverse of the above. However, it is recommended that, before disassembling any of the components, center punch marks be placed at appropriate locations so that reassembly can be made quickly and correctly.

Motor Assembly (1600 Amps and Larger)

The motor (1) will always be shipped with the hub (2) already attached to the motor shaft. To further assemble the motor operator, first place one of the friction discs (3) over the hub. Next, slide the nylon collar (4) over the drive hub. Then the drive gear (5) over the nylon collar. Slide the second friction disc next to the drive hub. Then place the pressure plate (6) with the spring holes facing away from the motor on the shaft. Add the six compression springs (7) into each hole of the pressure plate (6). Then slide the 2" O.D. diameter washer over the shaft to hold the springs (7) in place. Take the 3/4 - 16 jam nut (9) and secure tightly to the shaft. The motor operating mechanism can then be mounted with the appropriate motor mount plate (10), to the base plate and engaged with the pivot arm rack for operational purposes. It is a **must** that when engaging the pivot arm rack, the switch operator handle (lever arm) is either in the up or down position so that the gear will be positioned at the upper or lower end of the pivot arm rack.

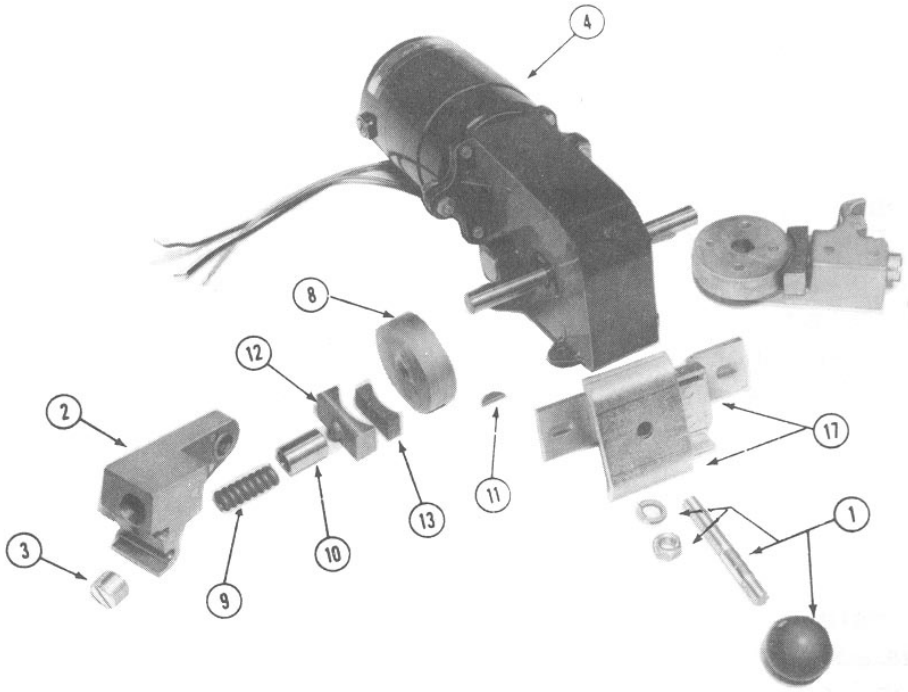


Figure 1. Operating Mechanism Parts.

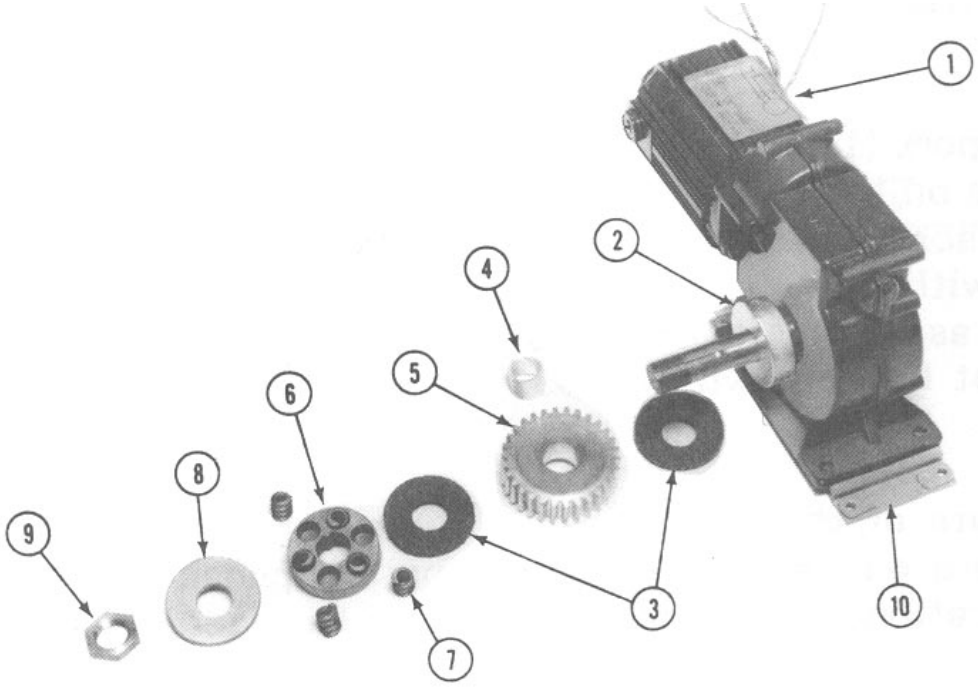


Figure 2. Operating Mechanism Parts.

5. MOLDED CASE SWITCHES

The molded case switches used in Trans-O-Matic switches are the standard devises supplied by molded case switch manufactures. See Figure 3 below.

Thermal magnetic or magnetic trip units may be installed (Accessory 23) for thermal overload and short circuit protection. When these trips are provided, a bell alarm contact is included inside the breaker to indicate to the transfer switch circuit that the breaker has tripped due to an overload. This breaks the motor circuit and prevents the transfer switch from connecting the other power source into a potential short circuit.

If either breaker trips due to overload, it can be reset by manually operating the transfer switch to the position that the breaker relatches, and then returning to the **ON** position. A shunt trip (Accessory 30) may also be provided. This allows the breaker to be electrically tripped from a remote location and can also be reset manually.

Inspect and Maintenance

Terminal lugs and trip units must be tight to prevent overheating. Due to the inherent wiping action built into the moving contacts of all molded case switches, operating the switch several times under load will remove any high resistance film that may have formed. Under normal conditions, additional cleaning of contacts is not required. However, should operating and/or atmospheric conditions make it desirable to clean the contacts further, the following procedure is recommended. (Refer to Figure 3).

Remove cover, arc chutes, and cable terminal assemblies. Wipe contact surfaces with a clean, lint free cloth. If surfaces are excessively oxidized or corroded, scrape lightly with a fine file before wiping.

The auxiliary microswitches are mounted internally to the molded case switch. Internal mounting of the auxiliary switch is done by Lake Shore and limits the amount of auxiliary switches that can be mounted. On the older style (non-UL) transfer switches, external microswitches are mounted on an actuator platform, which is then mounted on the side of the molded case switch. An entrance hole is drilled in the side of the molded case switch for the actuator finger to penetrate the case and touch the contact arm of the molded case switch. This allows actuation of the auxiliary switches with the movement of the contact arm of the molded case switch.

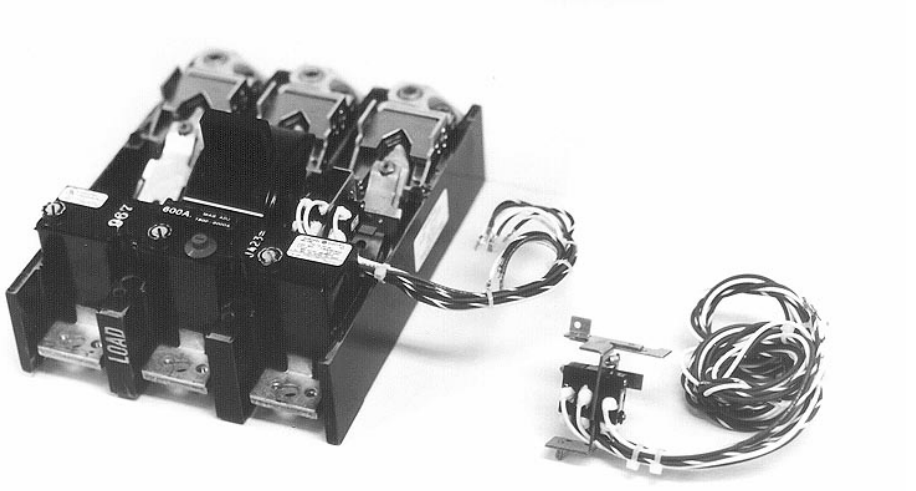


Figure 3. Parts of typical molded case switch with auxiliary switch.

6. TIMING RELAYS

(September 1982 and Later)

The following timing relays are used on Lake Shore Automatic Transfer Switches, however, only the TDR is standard on **all** styles of Lake Shore switches and the TDT is used on only the Style 3. All other timing relays discussed are optional.

Factory Setting

Unless specific settings are required by a customer or specifications, factory settings of the timing relays are as follows:

Timing Relay	Setting
TDR	5 Minutes
TDE	5 Seconds
EMT	5 Minutes
ODR	10 Seconds
TDT (Style 3 Only)	10 Seconds

TDR, TDE, EMT, & TDT Timing Relays

The same model timer is used for all these functions. As such, these timers can be used interchangeably. They are all **ON** delays and have identical operating characteristics. The setting accuracy is 10% of the range. Each timer has five dial selectable ranges as follows:

Ranges and minimum settings:

Ranges	Minimum Setting
0-0.03 sec.	0.02 sec.
0-3 sec.	0.07 sec.
0-30 sec.	0.6 sec.
0-3 min.	3.5 sec.
0-30 min.	35.0 sec.

Setting the Range

Position the knob near mid scale. Pull the spring loaded knob out and turn clockwise to increase the timing range; turn counter clockwise to decrease the timing range. A click will be heard as you make the progression through the ranges. All graphics and electrical connections are switched by rotating the knob.

The timing beings when 120 VAC is applied to terminals 2 and 7. At the end of the delay period N.O. contacts 1 - 3 and 7 - 8 and N.C. controls 1 - 4 and 5 - 8 transfer. The timer resets when power is interrupted to terminals 2 and 7.

ODR Relay

This timer may be pneumatic, or of solid state design. In both cases, it is a true **OFF** delay relay as no power is required for timing. When power is applied to the relay coil the N.O. and N.C. contacts transfer. When power is removed from the relay coil, the timing cycle starts. After the timer has timed out, the contacts will transfer to their original state.

7. VOLTAGE RELAYS

PHASE FAILURE RELAY

General

This relay continuously monitors the voltage of a three phase or a single phase power source. When the voltage in each phase attains a value equal to or greater than the "pick-up" setting, the output contacts change state and the L.E.D. energizes. When the voltage of any phase falls below the "drop-out" setting, the output contacts revert to their de-energized state and the "LED" turns off.

Pick-up and drop-out values are adjustable from 70 to 100% of nominal voltage via two potentiometers that are externally accessible.

Factory Setting

Unless specific settings are required by a customer or specifications, the Phase Failure Relay will be factory set to drop-out at 80% and pick-up at 90% of nominal voltage.

Three Phase Style

The three phase unit comes in two models, each with a different voltage range. Part number 9926220 has a range of 208-240 VAC and 380-480 VAC. These are selectable by changing the position of a small printed circuit board inside the chassis of the unit and may be done in the field. Part number 9926221 is used when 120 VAC is to be monitored. Its voltage is fixed and is not selectable like number 9926220.

CALIBRATION:

1. Select proper voltage range.
2. Set pickup potentiometer full clockwise.
3. Set dropout potentiometer full counter-clockwise
4. Using a small screwdriver, turn the calibrate potentiometer fully clockwise.
5. Apply nominal input voltage to unit.
6. Slowly turn the calibration potentiometer counter-clockwise until the units picks up as indicated by the "energized" light.
7. Set pickup and dropout potentiometers to desired settings.
8. Unit is ready for operation.

Note: Field adjustment can only be considered approximate if potentiometers are set using the scale on the front of the unit. For an accurate setting of the pickup and dropout points, a variable voltage power supply must be used.

Single Phase Style

The single phase unit is available in four models. Each model is adjustable to 70 to 100% of the voltage range selected. The voltage ranges and Model numbers are as follows:

Numbers	Voltage Ranges
1925024	208 VAC
1925025	240 VAC
1925026	480 VAC
1925027	120 VAC

CALIBRATION:
Indication of pickup or dropout of the PFR can only be seen by attaching a continuity meter to terminals #3 and #4 (Common and N.O.) When the meter shows continuity, the PFR is picked up.

1. Remove protective black plugs.
2. Using a small slotted screwdriver, turn the dropout potentiometer fully counter-clockwise.
3. Using a small slotted screwdriver, turn the pickup potentiometer fully clockwise.
4. Apply required level of pickup voltage to the unit.
5. Turn the pickup potentiometer slowly counter-clockwise until the meter shows continuity.
6. Reduce the voltage to the required voltage dropout level.
7. Turn the dropout potentiometer slowly clockwise until the meter shows no continuity.

FREQUENCY VOLTAGE RELAY

General
This device is used to prevent transferring to the Emergency power source until the emergency power generator has reached correct operating voltage and frequency.

Factory Setting:
The unit pickup set point is factory set at 48HZ (50HZ line) or 58HZ (60HZ line) and 108 VAC. This device is not field adjustable.

8. PROGRAM TIME CLOCK

General
This unit is used to provide the plat exerciser (Option 6) and uses a contact to initiate a test cycle at customer required days and times. There are two basic types of timers used in this option- an electro-mechanical and digital- both of which are covered here.

ELECTROMECHANICAL TIME CLOCK – TORK MODEL #8007

Description
The Plant Exerciser consists of a 120VAC timing motor (terminals L and 2) and a microswitch with terminals labeled Common (C), Normally Open (NO) and Normally Closed (NC). In a Lake Shore Electric Transdfer Switch the Plant Exerciser (PE) contact is installed in the control circuitry using microswitch terminals Common and Normally Closed. The 120VAC supply in connected to motor terminals L and 2. at installation, all of the spring clips located around the Time Dial are rotated outward away from the center of the dial. With the spring clips rotated outward, the Plant Exerciser microsiwtch is always activated and the Normally Closed contact is held open in the transfer switch control circuit. This prevents the Plant Exerciser function from initiating. When a spring clip is rotated inward toward the center of the dial, the microswitch is deactivated and the normally closed contact is allowed to close. This starts the Plant Exerciser function of the transfer switch.

TO SET THE TIME DIAL
Rotate the dial by hand counterclockwise only until the correct time of day is opposite the time arrow. To activate the exerciser, rotate a spring clip inward toward the center of the dial at the desired time of day. Eah spring clip will operate the exerciser for 15 minutes. This is the smallest time increment that can be chosen. If more exercise time is required, more spring clips can be rotated inward.

TO SET THE DAY WHEEL
Rotate the Day Wheel until the present day of th week is opposite the day arrow. Eath tab of the Day Wheel is stanped with the first tow letters fo each day of the week. Screw a brass pin inot the Day Wheel tab on the days which exercising is not desired. The tabs which do not have a pin in them are the dasy on which the exerciser switch will activate. The small arm on the Time Dial advances the Day Wheel one day at 2:00 A.M.

CAUTION: DO NOT ATTEMPT TO INSERT A BRASS SCREW IN A DAY WHEEL TAB WHILE THE DAY ARROW IS POINTING TO THAT TAB. THIS WILL LOCK THE TIME DIAL IN PLACE AND NOT ALOW THE EXERCISER TO ADVANCE.

DIGITAL TIME CLOCK TORK ES120

INSTALLATION
UNIT IS TO BE INSTALLED BY A LICENSED ELECTRICIAN

1. To remove unit from enclosure: Push tab on right to swing unit to the left and remove.
2. Mount the enclosure at eye level using screws or other suitable fastening device. Bring supply and load wires in through bottom or side knockouts. DO NOT USE TOP.
3. Install 9 volt alkaline battery (not supplied) by sliding battery cover in direction of arrow and removing(located above key pad). Pull out the battery connector and connect the battery. Reinstall battery cover Note: Unit can be fully programmed using battery power only.
4. Reinstall unit by reversing step #1 above and connect wires to unit as per suggested wiring diagrams. See illustration on back page.

KEY FUNCTIONS

DAY: Press to select proper day of the week in the CLK (clock) mode and to select days to be skipped in the SKIP mode.

HOUR: Press to set the hours in the CLK mode and in the SCH (schedule) mode.

MIN: Press to set the minutes in the CLK mode and in the SCH mode.

OVERRIDE: Press to alter the current load status (operates in both AUTO and MAN modes).

MODE: Press to advance to next mode. Sequence is: CLK, SCH, AUTO, MAN, SKIP. In the CLK, SCH, and SKIP modes, UNIT AUTOMATICALLY REVERTS TO THE AUTO MODE IF NO ENTRIES ARE MADE FOR 5 MINUTES.

DELETE: Press to delete the displayed information when in the SCH mode.

SKIP: Press to set or delete skip days (those on which no schedule is executed).

ENTER: Press to store the displayed information into memory. **Information will not be stored until ENTER key is pressed.**

NOTE: During settings, each press of the key will advance one number. For rapid advance, hold key in.

TO SET CLOCK

1. Press MODE key until display shows CLK.
2. Press DAY key to select current day. Press HOUR key to select current hour. Check A (AM) or P (PM). Press MIN key to select current minute. Press ENTER key and the clock is set for current time and day.

TO SET SCHEDULE

1. If display does not show SCH, press mode key until display shows SCH.
   Note: There are 7 ON and 7 OFF set points which alternate (set point #1 is ON; #2 is OFF; #3 is ON).
   The display will Indicate it is ready to receive SCH setpoint #1 which is an ON event.
2. Press HOUR and MIN keys for the first ON setting (check for AM or PM).
3. Press ENTER key to store the information and display will indicate it is ready to receive SCH setpoint #2 which is an OFF event.
4. Press HOUR and MIN keys for the first OFF setting. Then press ENTER key to store the information and display will indicate it is ready to receive SCH setpoint #3 which is the next ON event.
5. Proceed for up to 7 ON and 7 OFF setpoints. Then press MODE key and unit will go to the AUTO (run) mode.
   In the AUTO mode, the unit will display current time and day as well as load status (ON and OFF).
   Note: When the unit is returned to the auto mode, check the load status of the current setting. If it is showing OFF but should be ON, press the override key. The unit will correct itself at the next scheduled event and no further alteration will be necessary.

TO SET SKIP DAYS

1. Press mode key until display shows SKIP. Press DAY key and M (Monday) starts flashing. Press SKIP key to set or delete a flashing day. Press DAY key to advance the days. When all desired skip days are selected (showing solid on LCD), press ENTER key.
   Note: During skip days, only OFF events are executed. This will allow the load to turn off if it was overridden ON during these days.

REVIEW/MODIFY

1. CLOCK - ALTER TIME
   Press mode key until display shows CLK.
   Press DAY, HOUR, and MIN keys to change to the correct time. Press ENTER.

2. SCHEDULE - REVIEW
   Press mode key until display shows SCH.
   Press ENTER key repeatedly to review all the scheduled entries. During the review, any selected skip days will appear on the display with the word SKIP.
3. SCHEDULE - MODIFY
   During the review (see previous section) any set point can be modified or deleted. Use the HOUR, and MIN keys to modify. Use the DELETE key to eliminate that event. Press ENTER key after each modification.
4. SKIP DAYS - ADD/DELETE
   Press mode key until display shows SKIP. All previously selected skip days will appear. To add or delete days, follow steps in section titled “TO SET SKIP DAYS”.

OVERRIDE - TEMPORARY

In order to temporarily change the current ON or OFF status of a load, simply press the override key when the unit is in the AUTO mode. The altered load status will flash. Override is in effect until the next scheduled event. In order to cancel the override, press override key again.

OVERRIDE - LONG TERM

Press mode key until display shows MAN (manual).
Normal schedule will not be executed and the load status will remain unchanged as indicated. Press the OVERRIDE key to obtain the correct status or to alter the load status

9. TROUBLESHOOTING GUIDE

This guide is intended to assist an individual with a basic understanding of electrical circuitry to troubleshoot an automatic transfer switch as manufactured by Lake Shore Electric Corporation. Any questions relating to the use of this Manual should be referred to the Service Department of Lake Shore Electric Corporation, 205 Willis Street, Bedford, Ohio 44146, Phone (440) 232-0200, Fax (440) 232-5644.

CAUTION: WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER FROM ELECTRICAL HAZARD EXITS. DO NOT ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT TAKING EVERY PRECAUTION TO PREVENT AN ACCIDENT.

WARNING!

IN INSTALLATION AND USE OF THIS PRODUCT, COMPLY WITH THE NATIONAL ELECTRICAL CODE, FEDERAL, STATE AND LOCAL CODES, AND ALL APPLICABLE SAFETY CODES. IN ADDITION, **TURN OFF** POWER AND TAKE OTHER NECESSARY PRECAUTIONS TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE.

WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER OF ELECTROCUTION EXISTS, WHICH MAY RESULT IN INJURY OR DEATH. **DO NOT** ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT FIRST TAKING EVERY PRECAUTION TO PREVENT ACCIDENTAL INJURIES.

The following conditions **MUST** be met before attempting to troubleshoot a Trans-O-Matic:

1. A wiring diagram for the switch must be available.
2. Normal and Emergency voltage and frequency must be available and within the correct operating limits.
3. Control circuit voltage (if transformers are used) must be 110 to 125 volts.
4. Connections to the PFR must be correct and the relay must be adjusted to pick up on the voltage at which the switch is operating. See voltage relay instructions on a Page 17.
5. All timers must be turned down or consideration given to them while the tests are being conducted.
6. If trip units are included in the switch, they must be reset if previously tripped due to an overload.
7. All electrical connections must be tight and in accordance with the wiring diagram.
8. All components must be free of obvious defects with the exception of normal usage.
9. The switch must be connected to a good earth ground.

When you are satisfied that all the above conditions are met, and all accessories are either working correctly or eliminated, the problem will be confined to:

1. The control relays and timers
2. The molded case switches

3. The adjustment of the operating mechanism
4. The motor and microswitches

The troubleshooting procedures outlined here are designed to test the control circuit and the operating mechanism of the transfer switch. It is, therefore, necessary that all factors external to the transfer switch be correct, and that all accessory devices which are not imperative to switch operation either operate satisfactorily or bypassed and jumpered out of the circuit.

Many of the accessory devices described below may not exist in the transfer switch being examined. The proper wiring diagrams should be on hand before beginning work on the switch. We recommend that the entire manual be read before attempting to make any adjustment. Above all, **CAUTION** is recommended.

Many of the troubleshooting tests require a simulated failure of the normal source. This can be done with the Load Test Switch.

I. NORMAL POWER FAILS - ENGINE DOES NOT START

1. Maintenance Disconnect Switch (MDS)

Verify that the maintenance disconnect switch is in the **"NORMAL"** position.

2. Selector Switch (SS)

Verify that the Selector Switch is in the **"AUTOMATIC"** position.

3. Outage Delay Relay (ODR) Defective

Disconnect the wires connected to Terminals 28 and 29 of the Printed Circuit Board. Then place an OHM-Meter or continuity checker on terminals 28 & 29. If the meter indicates a closed or short circuit, the ODR is okay; continue to Step 3. If the meter indicates an open circuit, the ODR is defective.

4. Engine Batteries Bad

a. Check engine battery voltage. If voltage is proper, continue to Step b.
b. Place generator control in the **manual** position to crank engine. If engine fails to crank, troubleshoot the engine starting system.

II. ENGINE STARTS - AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO EMERGENCY

1. Improper Generator Voltage

Using an appropriately set voltmeter, check the Generator output voltage on terminals EL1 to EL2, and EL2 to EL3, and EL3 to EL1. If each set of readings indicate the generator's proper line to line voltage, continue to Step 2. If the readings do not indicate proper line to line voltage, further checks are required on the generator, generator circuit breaker and/or voltage regulator.

2. Frequency Voltage Relay Not Energizing (FVR)

a. Using an appropriately set voltmeter, check the voltage on terminals 23 to 25 (23 to NE for transfer switches without control transformers). If the reading is 120 VAC nominal, continue to Step b. If the reading is not 120 VAC nominal, check the ECT transformer and/or return to Step 1.
b. Using an appropriately set voltmeter, check the voltage at the input of the FVR terminals (0 to 120). If the voltage is 120 VAC nominal, continue to Step c. If the reading is not 120 VAC nominal, the circuit between ECT and the FVR is broken.

c. Check the voltage at the terminals 16 to 25 (16 to NE for transfer switches without control transformers). If this voltage is 120 VAC nominal, continue to Step d. If it is not 120 VAC nominal, replace ODR 2 Relay.

d. Check the voltage at terminal 18 to 25 (18 to NE for transfer switches without control transformers). If this voltage is 120 VAC nominal continue to Step 3. If it not 120 VAC nominal, replace FVR Relay.

3. Time Delay to Emergency (TDE)

a. If neither the "timing" or "timed out" lights are energized, replace the TDE Timer Relay with the EMT or TDR Timer Relay. If the "timing light" energizes, replace the defective TDE timer relay. If the "timing light" still does not energize, return to Step 2.

b. If only the "timing light" is energized and will not time out, the timer is defective and must be replaced.

c. If only the "timed-out" light is energized, the timer relay is functioning; continue to Step 4.

4. Emergency Control Breaker (EB1) Protective Circuit Breaker Tripped

If the button on the top of EB1 is popped out, it must be pressed in to reset EB1. This indicates the clutch could have excessive slip and should be adjusted according to the routine adjustment section of the operating manual. It can also be an indication of a shorted motor winding. If the button is not popped out, continue to Step 5.

5. Emergency Microswitch (MSE-1) Defective

a. Using an appropriately set voltmeter, check the voltage at terminals 13 to 25 (13 to NE for transfer switches without control transformers) if the voltage is 120 VAC nominal, continue to Step b; if voltage is not 120 VAC nominal, return to Step 4 and continue to check the components in the series circuit to the transfer motor emergency winding.

b. Using an appropriately set voltmeter, check the voltage at terminals 14 to 25 (14 to NE for transfer switches without control transformers). If the voltage is 120 VAC nominal, continue to Step 6; if voltage is not 120 VAC nominal, microswitch MSE should be checked and replaced, if necessary.

6. Transfer Motor (TM) Defective

Using an appropriately set voltmeter, check the voltage at terminals 14 to 25 (14 to NE for transfer switches without control transformers). If the voltage is 120 VAC nominal, the motor winding should be checked and the motor gear box should be replaced, if necessary.

III. AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO NORMAL

1. Improper Utility Voltage

Using an appropriately set voltmeter, check the utility voltage on terminals NL1 to NL2, and NL2 to NL3, and NL3 to NL1. If each set of readings indicate the proper utility line to line voltage, continue to Step 2. If the readings do not indicate proper line to line voltage, the incoming voltage circuitry should be looked at with possible help from the local utility company.

2. Improper Control Voltage

Using an appropriately set voltmeter, check the voltage on terminals NX1 to 25 (NX1 to NE for transfer switches without control transformers). If the reading is 120 VAC nominal, continue to Step 3. If the reading is not 120 VAC nominal, check the NCT transformer

and/or return to Step 1.

3. Phase Failure Relay Not Functioning (PFR)

Using an appropriately set voltmeter, check the voltage on the phase failure relay terminal C to 25 and terminal NO to 25 (C to NE and NO to NE for transfer switches without control transformers). If the voltage of both readings is 120 VAC nominal, continue to Step 4. If only one set indicates 120 Volt nominal, check the applied voltage at the PFR. If this is normal, the PFR is defective.

4. Load Test, Selector Switch and Maintenance Disconnect Switch

a. Verify that the Load Test Switch is in the **"Normal"** position.
b. Verify that the Selector Switch (if used) is in the **"Automatic"** position.
c. Maintenance Disconnect Switch (if used) is in the **"Normal"** position.

5. Time Delay to Return (TDR)

a. If neither the "timing or "timing out" lights are energized, replace the TDR Timer Relay with the EMT or TDE Timer Relay, if available. If the "timing light" energizes, replace the defective TDR timer. If the timing light" still does not energize, the Microswitch MSN-1 should be checked and replaced if necessary.
b. If only the "timing light" is energized and will not time out, the timer is defective and must be replaced.
c. If only the "timed-out" light is energized, the relay is functioning; continue to Step 6.

6. Normal Control Breaker (NB1) Protective Circuit Breaker Tripped

If the button on the top of the NB1 is popped out, it must be pressed in to reset NB1. This indicates the clutch could have excessive slip and should be adjusted according to the routine adjustment section of the operating manual. This can also be an indication of a shorted motor winding. If the button is not popped out, continue to Step 7.

7. Normal Microswitch (MSN-1) Defective

a. Using an appropriately set voltmeter, check the voltage at terminals 7 to 25 (7 to NE for transfer switches without control transformers). If the voltage is 120 VAC nominal, continue to Step b; if voltage is not 120 VAC nominal, return to Step 6 and continue to check the components in the series circuit to the transfer motor normal winding.
b. Using an appropriately set voltmeter, check the voltage at terminals 9 to 25 (9 to NE for transfer switches without control transformers). If the voltage is 120 VAC nominal, continue to Step 8; if voltage is not 120 VAC nominal, Microswitch MSN-2 should be checked and replaced if necessary.

8. Transfer Motor (TM) Defective

Using an appropriately set voltmeter, check the voltage at terminals 9 to 25 (9 to NE for transfer switches without control transformers). If the voltage is 120 VAC nominal, the motor winding should be checked and the motor gearbox should be replaced, if necessary.NOTES

10. APPENDIXES

APPENDIX A

Tension adjustment for transfer mechanism of Lake Shore Electric Transfer Switch 1200 amperes and under.

Refer to Figure 1, Page 10

When excess slippage occurs in the friction drive, it is necessary to increase the tension on the friction drive shoe lining. This is done by turning the adjustment screw (3) clockwise. This action compresses the tension spring (9), and thus increases the friction. The adjustment screw should not be tightened all the way.

Proper adjustment of the tension on the drive shoe may be set by the following method. With the Automatic Transfer Switch in the Normal position, using a marker, make a line on the drive drum (8) along the edge of the drive shoe (12). Transfer the switch automatically either by the Load Test switch or interrupting the Normal source power.

After the switch has transferred to the Emergency position, observe the position of the line on the drive drum. The line position should be approximately 1/2" to 3/4" from the edge of the drive shoe indicating slippage. Transfer switches utilizing smaller circuit breakers are equipped with a single friction drive arm as they require less force to activate. On these switches an idle arm with no adjusting screw replaces one of the drive arms. If both drive drums are used for transferring the switch, the spring tension on the drive shoes should be adjusted equally. Please note that this is an approximate setting and it may be necessary to try the transfer switch several times to assure that the adjustment is sufficient.

Do not tighten the adjustment screw to its limit as this will compress the spring entirely and cause the operating mechanism to jam. When this happens, the gears may strip or the roll pins inside the gear box may shear. Sheared roll pins and/or stripped gears are indicated when the motor operates but does not turn the drive drum. This situation can only be remedied by replacing the motor gearbox.

Over a period of time, the spring may loose its tension. This is indicated when the motor operates and the drive drum turns, but the unit does not have sufficient friction to operate the circuit breakers. In this case, the spring must be replaced with a new one.

Tension Adjustments for transfer mechanism of Lake Shore Electric Transfer Switch 1600 Amperes and Above.

Refer to Figure 2, Page 9

Adjustment of the motor drive transfer mechanism is accomplished by tightening or loosening part #9, the locknut. The locknut should be adjusted so that a space approximately the thickness of a dime can fit in the space between part #8 (washer) and part #6 (pressure plate.) This should provide sufficient pressure to function the switch.

If the motor continues to slip during transfer, first try adjusting the locknut a quarter turn at a time until this problem is corrected. If the problem persists, there may be something wrong in the transfer mechanism itself. This can only be corrected by disassembly and inspection.

APPENDIX B

*FIELD CABLE SIZE & LUG TORQUE REQUIREMENTS

USE COPPER WIRE ONLY

LINE-LOAD-NEUTRAL

REQUIRED MAINTENANCE

The following cable lug torques are required to be checked every six months in order to maintain the Lake Shore Electric Corporation exclusive "one year" warranty.

I. G.E. MOLDED CASE SWITCH

ATS SIZE	TORQUE LB-IN.	(HOLES)	CABLE RANGE
100	55	(1)	#14 - 1/0
150 - 225	275	(1)	#14 - 300 MCM
			LOAD 250 MCM
400	275	(1)	#6 - 250 MCM
		(1)	2/0 - 600 MCM
600	275	(2)	250 - 350 MCM
800 - 1000	375	(3)	3/0 - 500 MCM
1200	375	(4)	250 - 350 MCM

II. WESTINGHOUSE MOLDED CASE SWITCH

ATS SIZE	TORQUE LB-IN.	(HOLES)	CABLE RANGE
150-225	275	(1)	#6 - 350 MCM
400	275	(2)	250 - 500 MCM
600	275	(3)	3/0 - 300 MCM
800	275	(3)	3/0 - 500 MCM
1000	275	(3)	3/0 - 500 MCM
1600 - 2000	275		T Connectors
			Optional Lugs
		(2)	500 - 750 MCM

III. GROUND

ATS SIZE	TORQUE LB-IN.	(HOLES)	CABLE RANGE
100-800	200	(1)	#8 - 1/0
1000 - 2000	275	(1)	#6 - 250 MCM

*Per UL 1008

APPENDIX C

INTERNAL MOLDED CASE TORQUE REQUIREMENTS

REQUIRED MAINTENANCE

The following lug torques are required to be checked every six months in order to maintain the Lake Shore Electric Corporation exclusive "one year" warranty.

GENERAL ELECTRIC LUG TO MOLDED CASE SWITCH

E150 LINE	30 IN. - LBS.
F225 LINE	90 IN. - LBS.
J600 LINE	60 IN. - LBS.
K1200 LINE	200 IN. - LBS.

WESTINGHOUSE LUG TO MOLDED CASE SWITCH

DA JA KA LB	6-8 FT. - LBS. 1/4" SCR 15 FT. - LBS. 7/16 SCR
LA LC	6-8 FT. - LBS. 1/4" SCR 15 FT. - LBS. 7/16" SCR CU TERMINAL 10 FT. - LBS. 7/16" SCR AL TERMINAL
MA MC	30-35 FT. - LBS.
NB NC	30-35 FT. - LBS.
PA PB PC	15 FT. - LBS. (REAR CONNECTED)
KB HKB JB	6-8 FT. - LBS

GENERAL ELECTRIC TRIP TO MOLDED CASE SWITCH

F225 LINE	75 IN. - LBS.
J600 LINE	100 IN. - LBS.
K1200 LINE	100 IN. - LBS.

WESTINGHOUSE TRIP TO MOLDED CASE SWITCH

JA KA DA KCL LB	6-8 FT. - LBS.
MA MC NB NC LA LC LCL	15 FT. - LBS.
PB-PC PCL	10 FT. - LBS.
KB-HKB-JB	6-8 FT. - LBS.

APPENDIX D

AUTOMATIC TRANSFER SWITCH OPTIONAL EQUIPMENT AND ACCESSORIES

STANDARD AUTOMATIC TRANSFER SWITCH FEATURES

P5	Timer Group		
	3	**ODR**	Outage Delay Relay
	2	**TDE**	Time Delay Emergency
	5	**TDN**	Time Delay Neutral**
	1	**TDR**	Time Delay Return
8	**UVN**	Under Voltage Sensing Normal	
17	**SC**	Engine Start Contacts	
18	**ACRN**	Auxilliary Contacts Relay Normal	
19	**ACRE**	Auxilliary Contacts Relay Emergency	
22	**PL**	Switch Position Pilot Lights	
29	**MD**	Maintenance Disconnect Switch	
34A	**LTS**	Load Test Switch, Maintained	

** Dual Motor & Style IC Automatic Transfer Switch

POSITIVE CONTROL SYSTEM CONFIGURATIONS

The following configurations are available for ease of ordering the most common timer groups utilized on transfer switches.

P1 TDR, ODR, TDE, EMT (1, 2, 3, 4)
P2 TDR, ODR, EMT (1, 3, 4)
P3 TDR, ODR, TDE (1, 2, 3)
P4 TDR, TDE, EMT (1, 2, 4)
P5 TDR, ODR (1, 3)
P6 TDR, TDE (1, 2)
P7 TDR, EMT (1, 4)
P8 TDR

1. **TDR -** Time Delay to Return - Provides a delay after the return of Normal power before retransferring the load from the Emergency source. This feature allows Normal voltage to stabilize and ensures against the premature return when the Normal power grid is potentially unbalanced. Provided in a five-range model 0.02-0.3 sec., 0.07-3 sec., 0.6-30 sec., 3.5 sec.-3 min., and 35 sec.-30 min., the timing ranges are field adjustable. This time delay is **standard** on all electro-mechanical automatic transfer switches.

2. **TDE -** Time Delay to Emergency - Provides a delay after the engine has started before transferring the load to the Emergency source. This feature allows voltage to stabilize at the Emergency source to protect against initial wide fluctuations and can provide a brief warm-up period before loading the engine. Provided in a five-range model 0.02-0.3 sec., 0.07-3 sec., 0.6-30 sec., 3.5 sec.-3 min., 35 sec.-30 min., the timing ranges are field adjustable.

3. **ODR -** Outage Delay Relay - Provides an adjustable delay after failure of the Normal source before initiating an Engine-Start signal to allow for temporary short-duration fluctuations in voltage. This feature prevents unnecessary starting of the engine, and is usually supplied with an adjustable range of 1 to 300 seconds although other delay times are available.

4. **EMT -** Engine Maintained Timer - Provides a time delay after retransferring the load to the Normal source before shutting down the engine. This feature allows the engine to run under no-load conditions for cooling before shut-down to prevent against thermal and mechanical shocks. Provided in a five-range model 0.02-0.3 sec., 0.07-3 sec., 0.6-30 sec., 3.5 sec.-3 min., 35 sec.-30 min., the timing ranges are field adjustable.

5. **TDT -** Time Delay to Transfer - (for Dual Motor & Style IC Transfer Switches) - Provides a time delay between opening the contacts on one source and closing the contacts on the other source. This feature is recommended where there are high inductive loads, since with both sources open the residual field currents are allowed to decay to acceptable limits preventing electrical and mechanical overloads. This time delay functions in both directions (Normal to Emergency and Emergency to Normal) provided in a five-range model 0.02-0.3 sec., 0.07-3 sec., 0.6-30 sec., 3.5 sec.-3 min., 35 sec.-30 min., the timing ranges are field adjustable.

6. **PE** - Plant Exerciser / Switchable Load - Provides for regular automatic exercising of the Emergency Power System on a pre-selected schedule. The basic timer provides for a flexible period (in 15-minute increments) of exercise, and the periods can be scheduled for any specific day (or days) within a 7-day cycle. In the event of engine-generator failure, when operating in the plant exerciser mode, the Automatic Transfer Switch will immediately return to the Normal source, if available. A selector switch is included allowing exercising under either “load” or “no-load” conditions.

7. **FPC** - Fire Pump Control - Provides necessary features required by NFPA 20 for the automatic transfer switch to be used with centrifugal fire pump controllers. For Dual Motor and Style IC Transfer Switches only. Two configurations are available:
7A. Utility to Generator
7B. Utility to Utility

8. **PFRN** - Phase Failure Relay Normal - Provides for close differential monitoring of the Normal Source voltage to ensure that it is within acceptable limits.

The factory setting for the PFRN is 90% Pickup and 80% Dropout of the nominal voltage. The 3 phase units can be adjusted to guard against long term reduced voltage conditions ("brownouts") to as close a differential as 2% (i.e. 89% Pickup and 87% Dropout). This relay is **standard** on all automatic transfer switches.
8A. Single Phase
8B. Three Phase

9. **PFRN/O -** Phase Failure Relay Normal/ Overvoltage -Provides for close-differential monitoring of the Normal source to ensure that it is within acceptable limits with respect to overvoltage. The usual setting for the PFRN/O is 115% Pickup and 110% Dropout. This relay can also be adjusted to as close a differential as 2% (i.e. 116% Pickup and 114% Dropout), and is available as follows:
9A. Single Phase
9B. Three Phase

10. **PFRE -** Phase Failure Relay Emergency - This relay provides protection against transferring the load to the Emergency source until voltage has reached acceptable limits. In the event the relay drops out when Normal power is available, the TDR will be bypassed and retransfer to Normal will be initiated immediately. This relay is available as follows:
10A. Single Phase
10B. Three Phase

11. **PFRE/O -** Phase Failure Relay Emergency/ Overvoltage -similar to the PFRN/O above but for use on the Emergency source. The same bypassing action is provided as with the PFRE (10). This relay is available as follows:
11A. Single Phase
11B. Three Phase

12. **FR** - Frequency Relay (single-phase) -Provides Protection against transferring to the Emergency Source until the generator has reached operating frequency.

13. **FVR** - Frequency/Voltage Relay (single-phase) -Provides protection against transferring to the Emergency Source until the generator has reached both operating frequency and voltage.

14. **SS** - Selector Switch -Provides selection of four modes of operation of the Transfer Switch :
Automatic The transfer switch is in the fully Automatic mode.
Manual Provides engine start signal only. The transfer switch will not operate and the load will not be transferred.
Test Provides engine start signal plus transfer of the load to Emergency source .
Off Disables the control logic, ensuring that the transfer switch will remain in the same position regardless of Normal or Emergency source conditions.

14A. **SS** Selector Switch only
14B. **SS-WL** Selector Switch plus **12VDC light** to indicate transfer switch not in automatic.
14C. **SS-WL** Selector Switch plus **24VDC light** to indicate transfer not in automatic.

15. **MRTN -** Manual Return to Normal Push Button -Provides immediate return to the Normal source when Normal voltage is present, by **Manual operation only** (TDR is not present). Dual Motor application allows for time delay (TDT) between Emergency source Open and Normal source Closed. Transfer to Normal will automatically take place when there is loss of Emergency source and the Normal source is present

16. **ORPB -** Override Push Button -Provides for immediate return to Normal position by manual operation when Normal source voltage is present bypassing the TDR timer. Dual Motor application allows for time delay (TDT) between Emergency source Open and Normal source Closed.

17. **SC** - Starting Contact -Provides dry (no voltage) contact for starting an engine when initiated by the transfer switch. This is **standard** on all automatic transfer switches.

18. **ACRN** - Auxiliary Contacts Relay (Energized from Normal source) -Provides for two auxiliary Form "C" (Common + Normally Open + Normally Closed) 10 ampere contacts on the normal source.

19. **ACRE** - Auxiliary Contacts Relay (Energized from Emergency source) -Provides for two auxiliary Form "C" (Common + Normally Open + Normally Closed) 10-ampere contacts on the emergency source.

20. **OPTION NO LONGER AVAILABLE**

21. **OPTION NO LONGER AVAILABLE**

22. **PL** Pilot Lights -Provides two LED indicating lights mounted on the exterior of the transfer switch enclosure, showing the position of the switch or the available sources. Pilot Lights may also be mounted at any remote location.
22A. Switch Position (GREEN = Normal, RED = Emergency)
22B. Source Available

23. **CBT** Circuit Breaker Trips -Provides overcurrent protection within the transfer switch. This feature may eliminate the requirement to install separate overcurrent protective devices on either the Normal or Emergency source (or both sources). Trips will be of the following configurations and will be installed on the **Normal** or **Emergency** side molded case switch:
Thermal-Magnetic - Providing both overload and short circuit protection, the thermal-magnetic type will not trip under momentary overloads, but will trip instantly on heavy short circuit currents (against a definite current/time curve).

Magnetic Only - Providing short circuit protection only, the magnetic only type will trip instantly (within one cycle, or approximately 0.017 seconds) when current reaches the selected setting.
23A. Normal Source - provides trip on Normal source molded case switch or circuit breaker.
23B. Emergency Source - provides trip on Emergency source molded case switch or circuit breaker

24. **SCPD** Special Circuit Protection Devices Provides for the many special additions that can be added to the transfer switch. Consult Sales Representative for details and availability.

25. **OPTION NO LONGER AVAILABLE**

26. **OPTION NO LONGER AVAILABLE**

27. **OPTION NO LONGER AVAILABLE**

28. **SL** - Special Lugs -Provides for connection of both sources and the load (as well as the neutral when specified) to the Transfer Switch. Shall be furnished as supplied by the manufacturer of the molded case switch. Standard lugs are supplied on all Lake Shore Transfer Switches. Special lug arrangements must be specified when order is placed.

29. **MD** - Maintenance Disconnect -Disconnects control circuitry from line for maintenance purposes.

30. **ST** - Shunt Trips -Electrically trips switches from a remote location (not a protective type trip).

31. **SE** - Service Entrance -Provides for transfer switch (Dual Motor & Style IC only) to be approved for service entrance. Includes thermal-magnetic overcurrent trip on Service Source switch, selector switch, neutral bus bar, lugs, bonding jumper and strap, and special nameplate.

32. **OPTION NO LONGER AVAILABLE**

33. **DPS** Dual Prime Source -Provides for selection between two generators or two utilities. For Dual Prime Power consult factory for details.
33A. Manual, Generator to Generator
33B. Automatic, Generator to Generator
33C. Manual, Utility to Utility
33D. Automatic, Utility to Utility

34. **LTS** - Load Test Switch -Provides engine starting plus transfer of the load to the Emergency source without having to fail the Normal Source.
34A. Mounted inside the enclosure, maintained switch. This switch is **standard** on all electro-mechanical automatic transfer switches.
34C. Mounted inside the enclosure, momentary pushbutton.

35. **EC** - Elevator Control -This option provides 2 sets of dry (no voltage) contacts, 1 set N.O. and 1 set N. C., which change state prior to transfer in either direction. Time delay between initiation of these contacts and switch transfer is field adjustable .03 seconds to 30 minutes.

36. **CTT** - Closed Transition Transfer -Provides transfer of power from one source to another without interruption of power to the load. Applicable to Dual Motor and Style IC switches only.

37. **IPM** - In Phase Monitor -Monitors Normal and Emergency source for proper synchronization prior to transfer when both sources are available and is disabled if either source fails. Functions in both directions - Normal to Emergency and Emergency to Normal. Available on Single Motor Transfer Switches only.

38. **SSP** - Surge Suppressor - Provides for protection of transfer switch from voltage surges which may damage control circuitry. Protection includes surge suppressors on both power sources and MOV's on the control circuitry.

39. **GFP** - Ground Fault Protection - When a ground fault is detected, the Normal and Emergency source will be opened isolating the ground fault from external voltage sources.
39A. Ground Fault Protection
39B. Ground Fault Indication (provides indication only with no isolating action.)

40. **OPTION NO LONGER AVAILABLE**

41. **OPTION NO LONGER AVAILABLE**

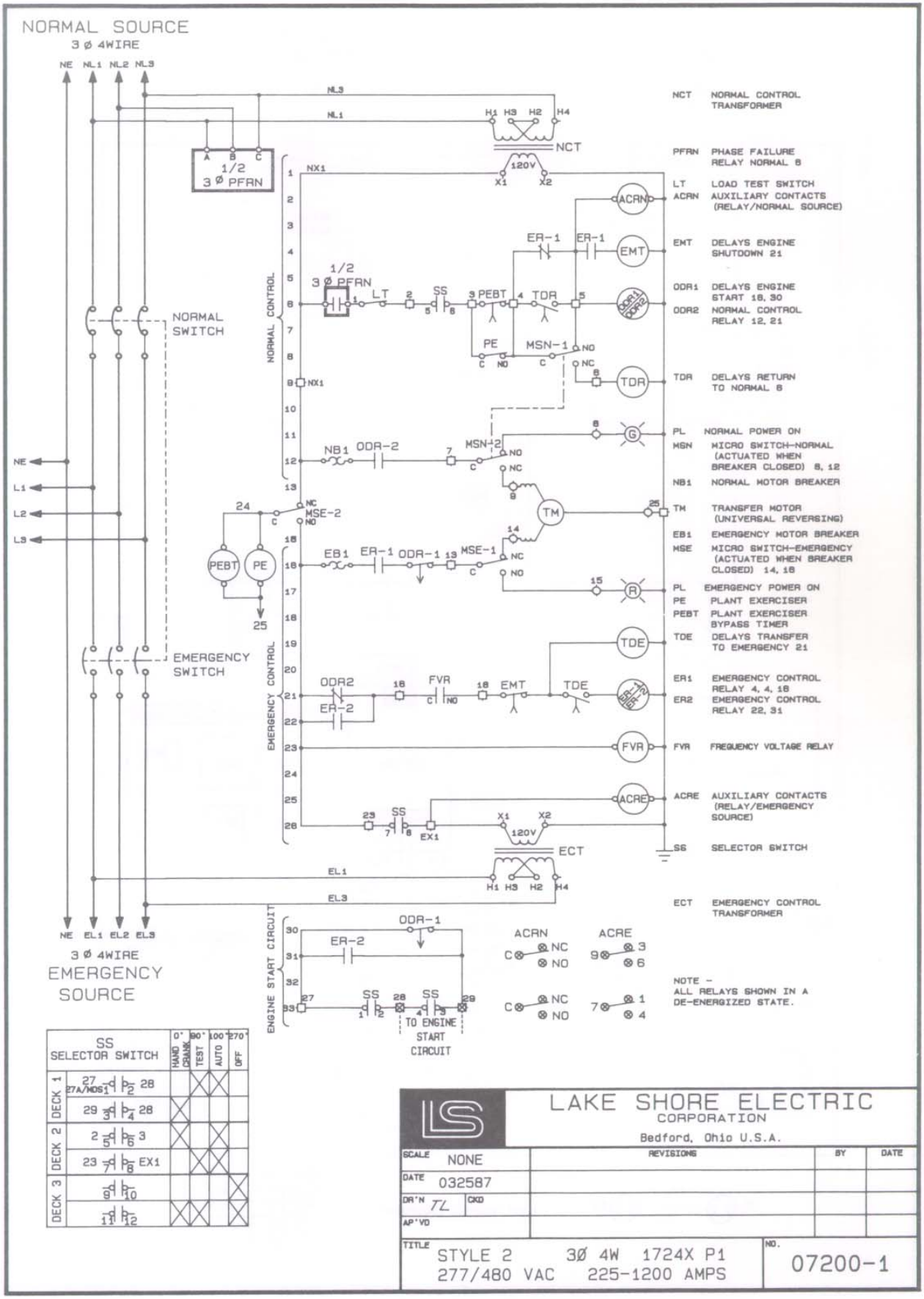
42. **OPTION NO LONGER AVAILABLE**

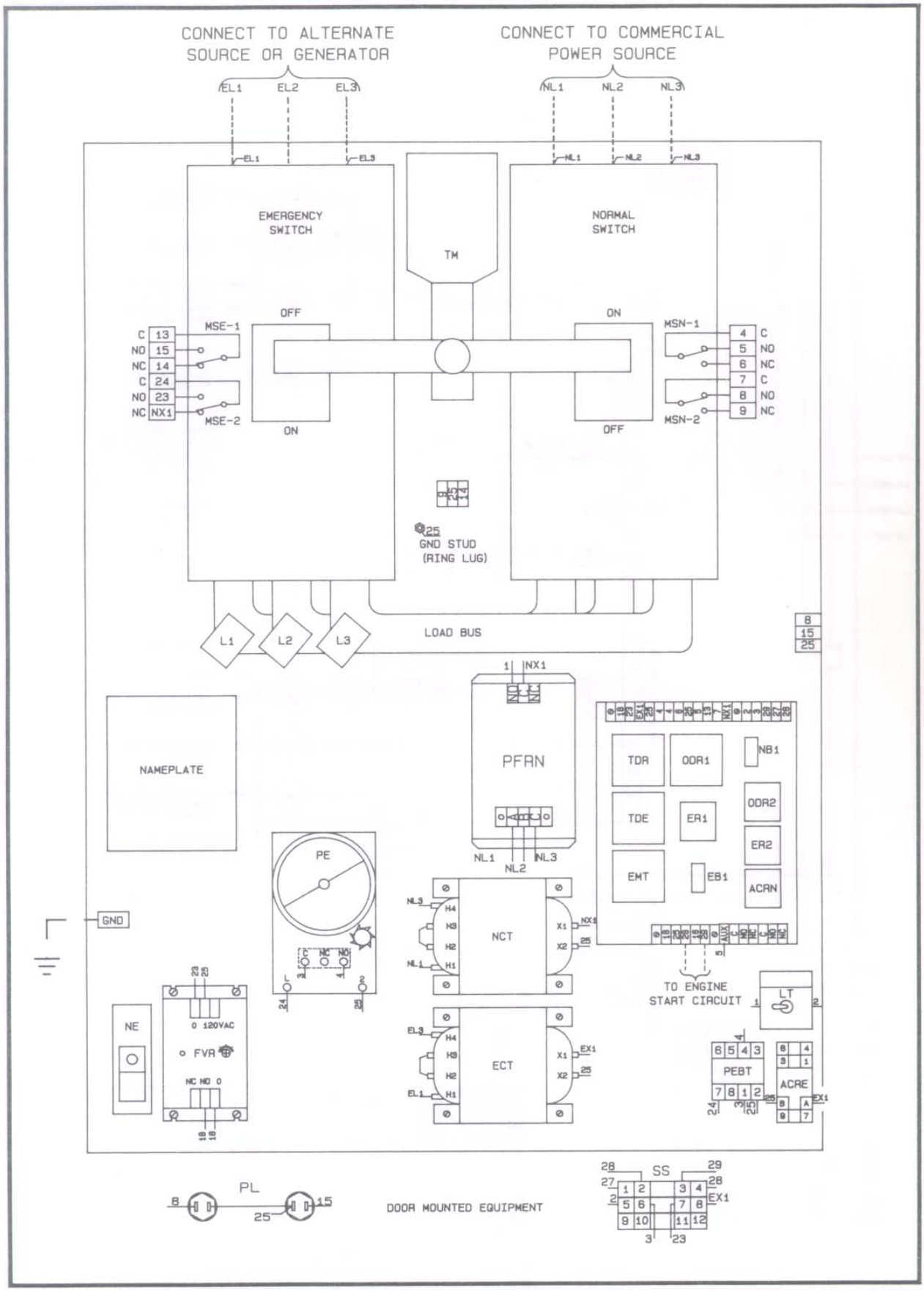
43. **TSO** - Test switch Override - Overrides the operation of a remote or local test switch that has been used to force the ATS to the Emergency position. If the Emergency power fails the ATS will automatically retransfer to the Normal position if normal power is available.

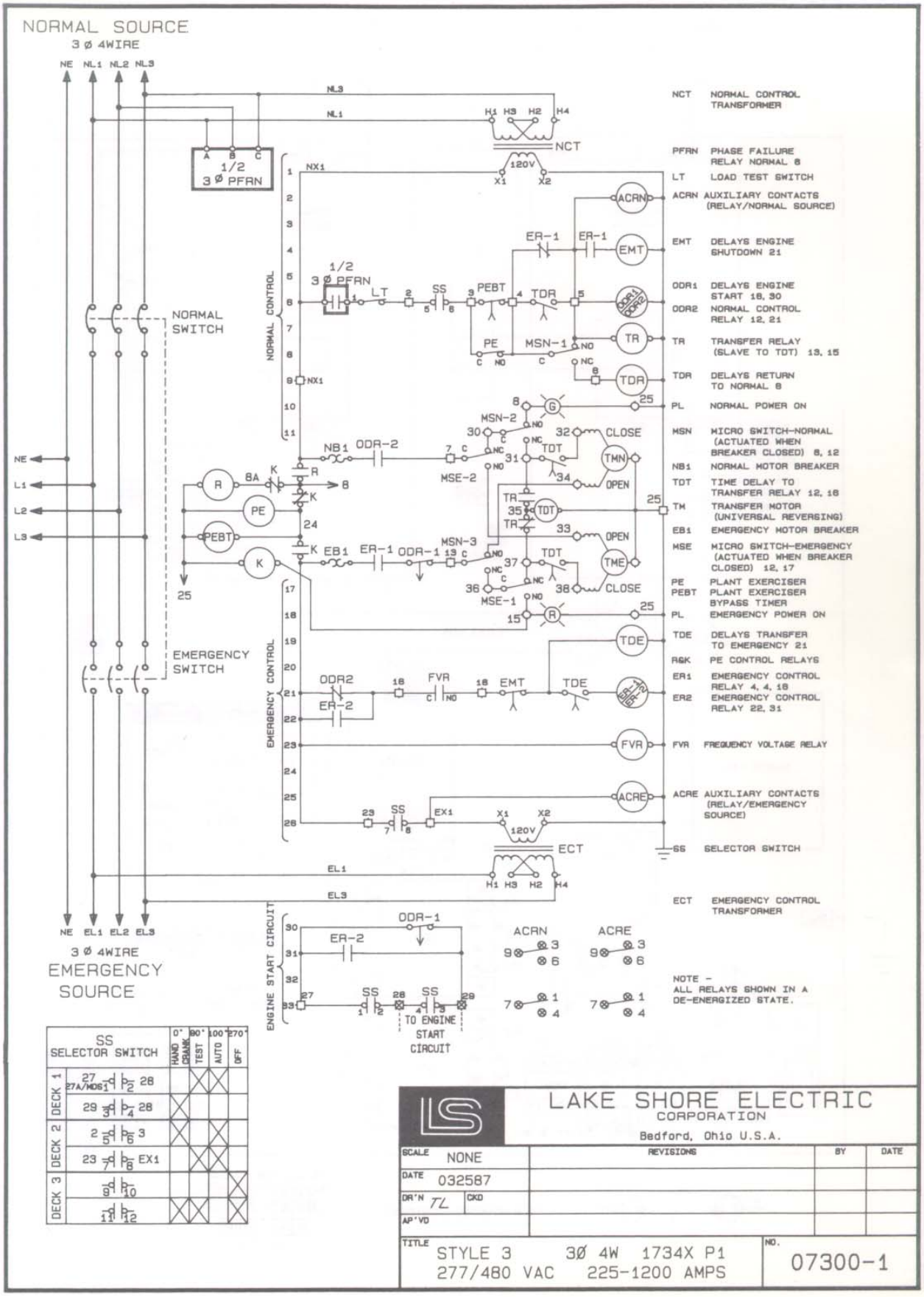
44. **HTR** - Strip Heater - 250 watt strip heater with thermostat to help eliminate moisture build-up in the enclosure. Provided as a standard with all Outdoor Enclosures.

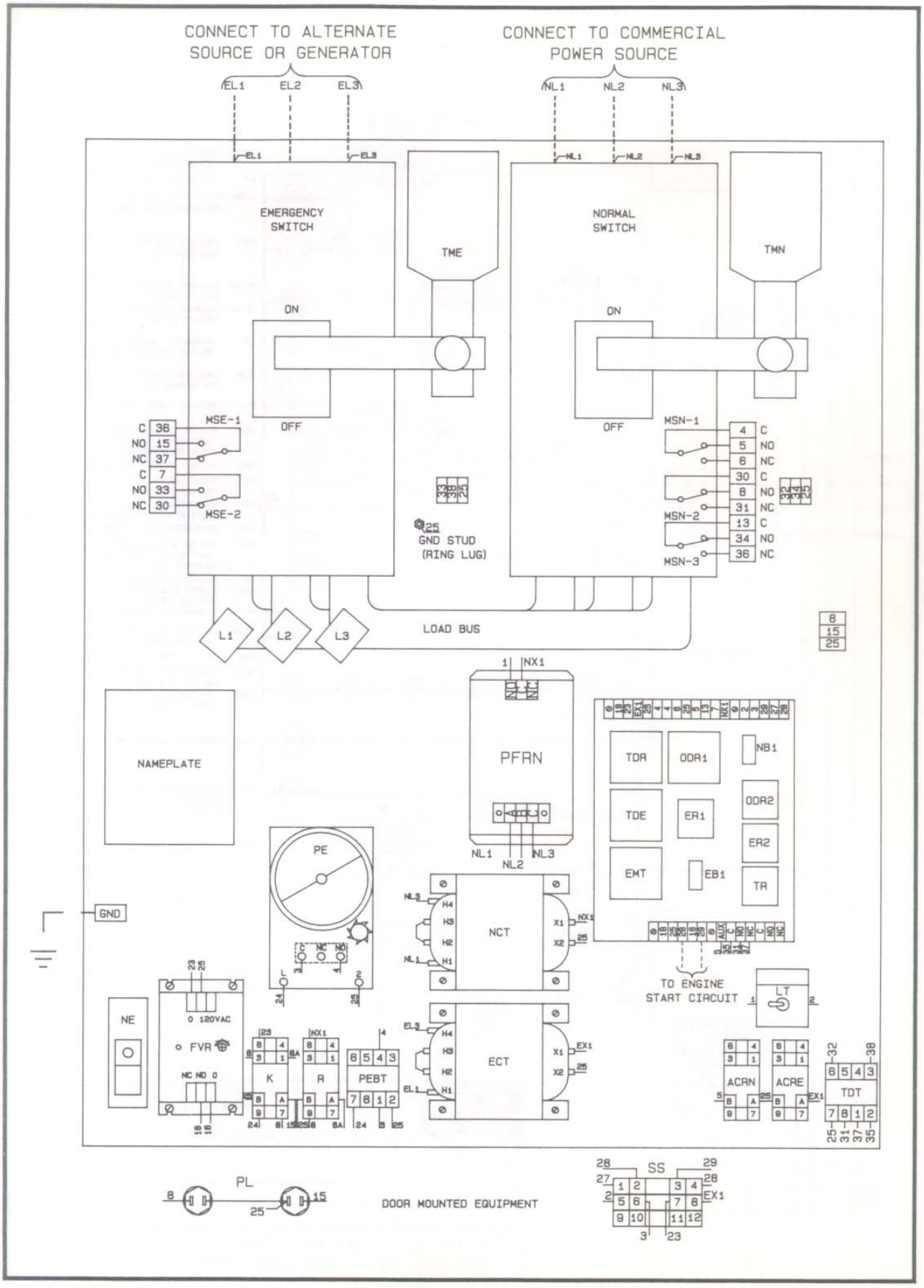
APPENDIX E

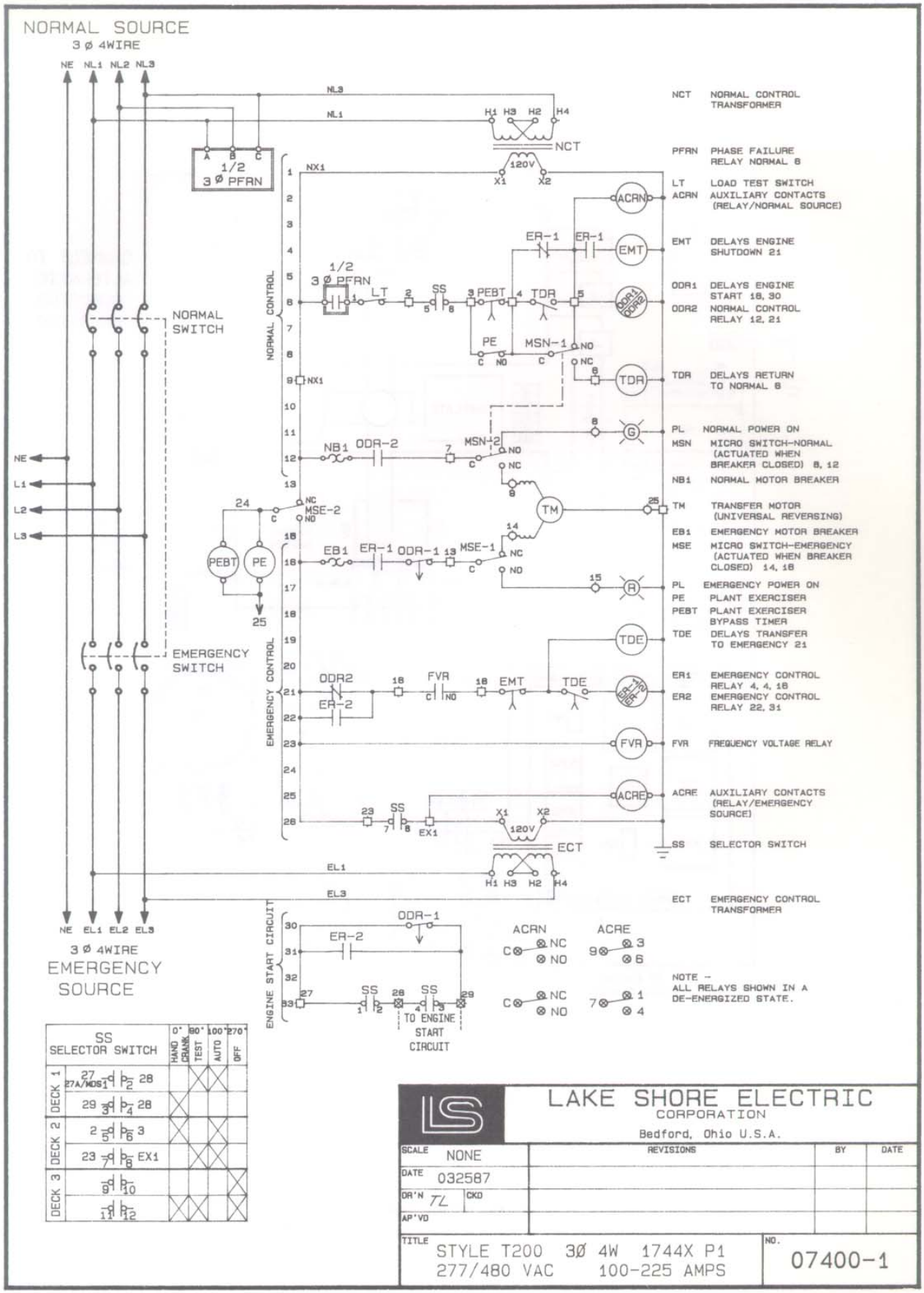
SAMPLE WIRING DIAGRAMS TO BE USED FOR REFERENCE ONLY.
THE SPECIFIED WIRING DIAGRAM FOR THE TRANSFER SWITCH SHOULD ALWAYS BE USED, IF AVAILABLE.


NORMAL SOURCE
3 Ø 4WIRE
NE NL1 NL2 NL3
NL3
NL1
H1 H3 H2 H4
NCT
120V
X1 X2
A B C
1/2
3 Ø PFRN
NX1
NORMAL CONTROL
LT
SS
PEBT
TDR
PE
MSN-1
NO
NC
ACRN
ER-1
EMT
ODR1
ODR2
TDR
G
NB1 ODR-2
MSN-2
TM
MSE-2
EB1 ER-1 ODR-1 MSE-1
R
TDE
EMERGENCY CONTROL
ODR2
FVR
EMT
ER-2
ACRE
23 SS EX1
ECT
EL1
EL3
NE EL1 EL2 EL3
3 Ø 4WIRE
EMERGENCY SOURCE
NORMAL SWITCH
EMERGENCY SWITCH
ENGINE START CIRCUIT
ODR-1
ER-2
27 SS 28 SS 29
TO ENGINE START CIRCUIT
NCT NORMAL CONTROL TRANSFORMER
PFRN PHASE FAILURE RELAY NORMAL 8
LT LOAD TEST SWITCH
ACRN AUXILIARY CONTACTS (RELAY/NORMAL SOURCE)
EMT DELAYS ENGINE SHUTDOWN 21
ODR1 DELAYS ENGINE START 18, 30
ODR2 NORMAL CONTROL RELAY 12, 21
TDR DELAYS RETURN TO NORMAL 8
PL NORMAL POWER ON
MSN MICRO SWITCH-NORMAL (ACTUATED WHEN BREAKER CLOSED) 8, 12
NB1 NORMAL MOTOR BREAKER
TM TRANSFER MOTOR (UNIVERSAL REVERSING)
EB1 EMERGENCY MOTOR BREAKER
MSE MICRO SWITCH-EMERGENCY (ACTUATED WHEN BREAKER CLOSED) 14, 16
PL EMERGENCY POWER ON
PE PLANT EXERCISER
PEBT PLANT EXERCISER BYPASS TIMER
TDE DELAYS TRANSFER TO EMERGENCY 21
ER1 EMERGENCY CONTROL RELAY 4, 4, 16
ER2 EMERGENCY CONTROL RELAY 22, 31
FVR FREQUENCY VOLTAGE RELAY
ACRE AUXILIARY CONTACTS (RELAY/EMERGENCY SOURCE)
SS SELECTOR SWITCH
ECT EMERGENCY CONTROL TRANSFORMER
ACRN
ACRE
NOTE – ALL RELAYS SHOWN IN A DE-ENERGIZED STATE.
SS SELECTOR SWITCH
0° HAND
90° CRANK TEST
100° AUTO
270° OFF
DECK 1
DECK 2
DECK 3
27 27A/MDS1 P2 28
29 P3 P4 28
2 P5 P6 3
23 P7 P8 EX1
P9 P10
P11 P12
LAKE SHORE ELECTRIC CORPORATION
Bedford, Ohio U.S.A.
SCALE NONE
DATE 032587
DR'N TL CKD
AP'VD
REVISIONS BY DATE
TITLE STYLE 2 3Ø 4W 1724X P1
277/480 VAC 225-1200 AMPS
NO. 07200-1


CONNECT TO ALTERNATE SOURCE OR GENERATOR
CONNECT TO COMMERCIAL POWER SOURCE
EL1
EL2
EL3
NL1
NL2
NL3
EMERGENCY SWITCH
NORMAL SWITCH
TM
OFF
ON
MSE-1
MSE-2
MSN-1
MSN-2
C
NO
NC
NX1
GND STUD (RING LUG)
LOAD BUS
L1
L2
L3
NAMEPLATE
PFRN
PE
NCT
ECT
TDR
ODR1
NB1
ODR2
TDE
ER1
ER2
EMT
EB1
ACRN
TO ENGINE START CIRCUIT
LT
NE
0 120VAC
FVR
PEBT
ACRE
SS
PL
DOOR MOUNTED EQUIPMENT


NORMAL SOURCE
3 Ø 4WIRE
NE NL1 NL2 NL3
1/2 3 Ø PFRN
NCT
120V
NORMAL CONTROL
NORMAL SWITCH
EMERGENCY SWITCH
EMERGENCY CONTROL
ENGINE START CIRCUIT
TO ENGINE START CIRCUIT
ACRN
ACRE
3 Ø 4WIRE
EMERGENCY SOURCE
NOTE – ALL RELAYS SHOWN IN A DE-ENERGIZED STATE.
NCT NORMAL CONTROL TRANSFORMER
PFRN PHASE FAILURE RELAY NORMAL 8
LT LOAD TEST SWITCH
ACRN AUXILIARY CONTACTS (RELAY/NORMAL SOURCE)
EMT DELAYS ENGINE SHUTDOWN 21
ODR1 DELAYS ENGINE START 18, 30
ODR2 NORMAL CONTROL RELAY 12, 21
TR TRANSFER RELAY (SLAVE TO TDT) 13, 15
TDR DELAYS RETURN TO NORMAL 8
PL NORMAL POWER ON
MSN MICRO SWITCH–NORMAL (ACTUATED WHEN BREAKER CLOSED) 8, 12
NB1 NORMAL MOTOR BREAKER
TDT TIME DELAY TO TRANSFER RELAY 12, 18
TM TRANSFER MOTOR (UNIVERSAL REVERSING)
EB1 EMERGENCY MOTOR BREAKER
MSE MICRO SWITCH–EMERGENCY (ACTUATED WHEN BREAKER CLOSED) 12, 17
PE PLANT EXERCISER
PEBT PLANT EXERCISER BYPASS TIMER
PL EMERGENCY POWER ON
TDE DELAYS TRANSFER TO EMERGENCY 21
R&K PE CONTROL RELAYS
ER1 EMERGENCY CONTROL RELAY 4, 4, 18
ER2 EMERGENCY CONTROL RELAY 22, 31
FVR FREQUENCY VOLTAGE RELAY
ACRE AUXILIARY CONTACTS (RELAY/EMERGENCY SOURCE)
SS SELECTOR SWITCH
ECT EMERGENCY CONTROL TRANSFORMER
SS SELECTOR SWITCH
0° HAND CRANK
90° TEST
100° AUTO
270° OFF
DECK 1
DECK 2
DECK 3
LAKE SHORE ELECTRIC CORPORATION
Bedford, Ohio U.S.A.
SCALE NONE
DATE 032587
DR'N TL
CKD
AP'VD
REVISIONS
BY
DATE
TITLE STYLE 3 3Ø 4W 1734X P1 277/480 VAC 225-1200 AMPS
NO. 07300-1


CONNECT TO ALTERNATE SOURCE OR GENERATOR
CONNECT TO COMMERCIAL POWER SOURCE
EL1
EL2
EL3
NL1
NL2
NL3
EMERGENCY SWITCH
NORMAL SWITCH
TME
TMN
ON
OFF
MSE-1
MSE-2
MSN-1
MSN-2
MSN-3
GND STUD (RING LUG)
LOAD BUS
L1
L2
L3
NAMEPLATE
PFRN
NX1
TDR
ODR1
NB1
ODR2
TDE
ER1
ER2
EMT
EB1
TR
PE
NCT
ECT
GND
NE
FVR
0 120VAC
K
R
PEBT
TO ENGINE START CIRCUIT
LT
ACRN
ACRE
TDT
PL
DOOR MOUNTED EQUIPMENT
SS


NORMAL SOURCE
3 Ø 4WIRE
NE NL1 NL2 NL3
NL3
NL1
H1 H3 H2 H4
NCT
120V
X1 X2
A B C
1/2
3 Ø PFAN
NX1
NORMAL CONTROL
ACRN
ER-1 ER-1
EMT
1/2
3 Ø PFAN
LT
SS
PEBT
TDR
ODR1 ODR2
PE
MSN-1
NO
NC
TDR
G
NB1 ODR-2
MSN-2
NO
NC
NE
L1
L2
L3
NORMAL SWITCH
24
MSE-2
TM
25
PEBT
PE
EB1 ER-1 ODR-1
MSE-1
NC
NO
R
25
EMERGENCY SWITCH
TDE
EMERGENCY CONTROL
ODR2
ER-2
FVR
EMT
TDE
ER1 ER2
FVR
ACRE
23 SS
EX1
X1 X2
120V
ECT
SS
EL1
H1 H3 H2 H4
EL3
NE EL1 EL2 EL3
3 Ø 4WIRE
EMERGENCY SOURCE
ENGINE START CIRCUIT
ODR-1
ER-2
27 SS 28 SS 29
TO ENGINE START CIRCUIT
ACRN
ACRE
C NC NO
9 3 6
C NC NO
7 1 4
NCT NORMAL CONTROL TRANSFORMER
PFAN PHASE FAILURE RELAY NORMAL 8
LT LOAD TEST SWITCH
ACRN AUXILIARY CONTACTS (RELAY/NORMAL SOURCE)
EMT DELAYS ENGINE SHUTDOWN 21
ODR1 DELAYS ENGINE START 18, 30
ODR2 NORMAL CONTROL RELAY 12, 21
TDR DELAYS RETURN TO NORMAL 8
PL NORMAL POWER ON
MSN MICRO SWITCH-NORMAL (ACTUATED WHEN BREAKER CLOSED) 8, 12
NB1 NORMAL MOTOR BREAKER
TM TRANSFER MOTOR (UNIVERSAL REVERSING)
EB1 EMERGENCY MOTOR BREAKER
MSE MICRO SWITCH-EMERGENCY (ACTUATED WHEN BREAKER CLOSED) 14, 16
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ER2 EMERGENCY CONTROL RELAY 22, 31
FVR FREQUENCY VOLTAGE RELAY
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SS SELECTOR SWITCH
ECT EMERGENCY CONTROL TRANSFORMER
NOTE - ALL RELAYS SHOWN IN A DE-ENERGIZED STATE.
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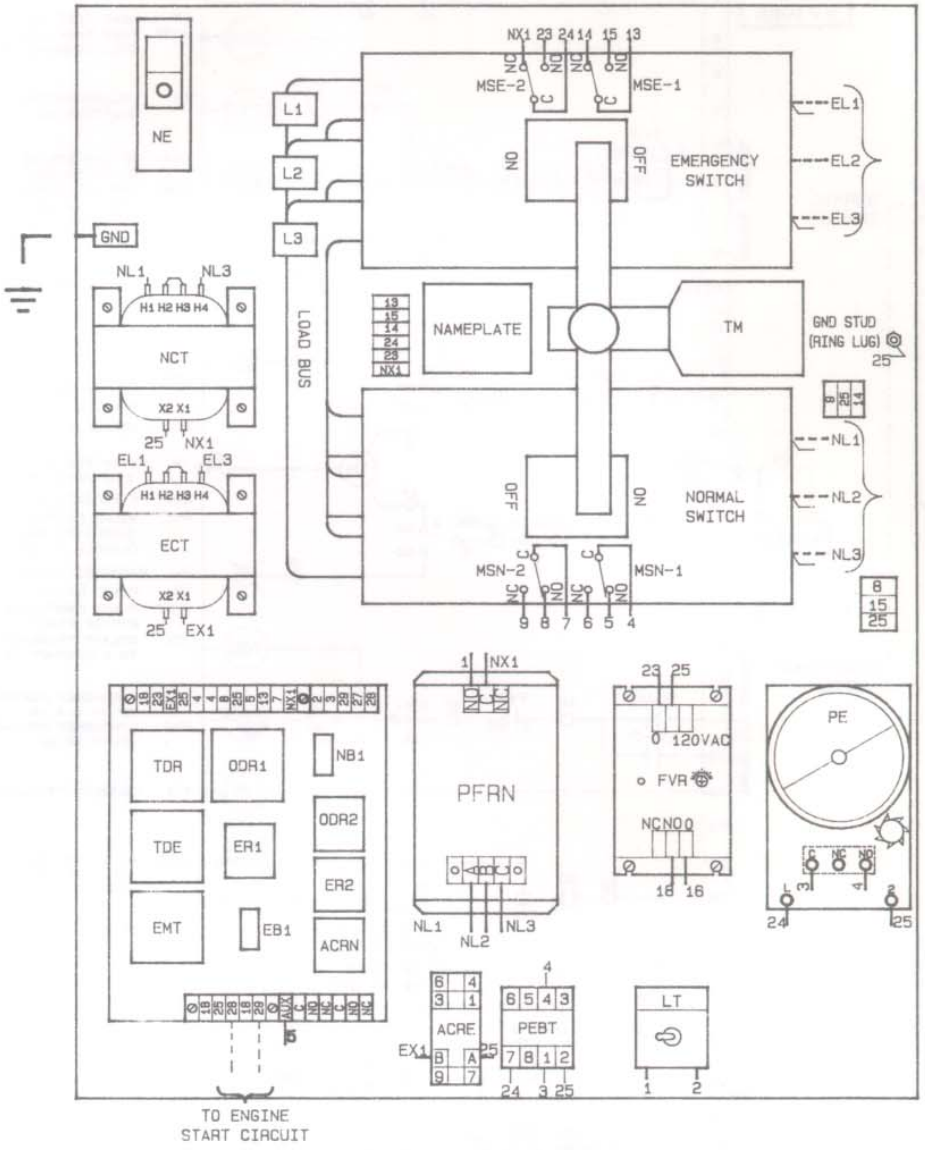
0° HAND CRANK
90° TEST
100° AUTO
270° OFF
DECK 1
27 27A/MDS1 P2 28
29 P3 P4 28
DECK 2
2 P5 P6 3
23 P7 P8 EX1
DECK 3
P9 P10
P11 P12
LAKE SHORE ELECTRIC
CORPORATION
Bedford, Ohio U.S.A.
SCALE NONE
DATE 032587
DR'N TL CKD
AP'VD
REVISIONS BY DATE
TITLE STYLE T200 3Ø 4W 1744X P1
277/480 VAC 100-225 AMPS
NO. 07400-1



DOOR MOUNTED EQUIPMENT