INSTALLING, OPERATING AND MAINTAINING

LAKE SHORE ELECTRIC CORPORATION

AUTOMATIC

TRANSFER SWITCHES

WITH MP 7600 CONTROLLER

STYLE 2 – SINGLE MOTOR

STYLE 3 – DUAL MOTOR

LAKE SHORE ELECTRIC CORPORATION

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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.

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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.

1. CONSTRUCTION

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

These molded case switches and/or circuit breakers are electrically interlocked through the MP7600 Controller and auxiliary switches, and mechanically interlocked through a walking beam mechanism which is located on the rear of the base plate. This mechanism is a fulcrum and lever device, which positively prevents both of the molded case switches or circuit breakers from being in the **ON** position simultaneously. This redundant interlocking system provides a "Fail-Safe" design. **Note:** This mechanical interlock is not provided on units equipped with the Closed Transition Transfer Option.

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. Please note that the manual-operating handle allows the operator to manually operate the transfer switch under load.

All interface 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 MP7600 Controller, which is the heart of our control system, is a rugged, durable industrial quality device that assures minimum maintenance.

All timers including the plant exerciser are incorporated in the microprocessor control. All timer values are stored in non-volatile memory.

Wiring harnesses are manufactured from 16-gauge insulated machine tool wire. The transfer motor control circuits are protected with miniature overload circuit breakers.

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

2.1 STYLE 2 SINGLE MOTOR

The Style 2 Automatic Transfer Switch utilizes a single motor to operate both the normal and emergency molded case switches. 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 100% of the nominal voltage. In the event of a drop in

any phase of the preferred voltage below the dropout set point, the voltage relay sends a signal to the MP 7600, Microprocessor controller. The MP7600 in turn initiates a Time Delay to Engine Start (TDES) timer. Upon completion of the TDES a signal is given via a dry "form C" contact to the engine start circuit, and the Minimum Run Timer (MRT) is initiated. After the engine has started and develops frequency and voltage, the frequency voltage relay will send a signal to initiate a Time Delay to Emergency (TDE) timer. Upon completion of the TDE, the single motor operator will transfer the source from normal to emergency power. With the Automatic Transfer Switch now operating on the emergency source, the voltage relay continues to monitor the normal source.

Upon restoration of normal power as sensed by the voltage relay, a Time Delay to Return (TDR) is initiated. Upon completion of the TDR, the single motor operator will retransfer the source from emergency to normal power. After retransfer to normal a Time Delay to Engine Cool down (TDEC) timer is initiated. Upon completion of the TDEC and upon the completion of the MRT, the engine start signal will be removed.

The preceding sequence of operation describes the operation of a basic Style 2, single motor, 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.

2.2 STYLE 3 DUAL MOTORS

The 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 motor operator. 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, one motor operator disconnects its source, which transfers the switch to the **open** position. This initiates a Time Delay in Neutral (TDN) which when timed out, allows the alternate motor operator to connect its source to the load.

The Style 3 Automatic Transfer Switch is used exclusively for Service Entrance Rated Transfer Switches because the dual motor design allows the necessary condition of having both switches in the off position so that the load is isolated and disconnected from the two sources.

The Style 3 Automatic Transfer Switch is also used exclusively for Closed Transition Transfer Switches because the dual motor design allows the necessary condition of having both switches in the on position so that the load is momentarily connected to both sources when they are synchronized providing a "make before break" transfer.

The Style 3 Automatic Transfer Switch utilizes a dual motors to operate the normal and emergency molded case switches. 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 100% of the nominal voltage. In the event of a drop in

any phase of the preferred voltage below the dropout set point, the voltage relay sends a signal to the MP 7600, Microprocessor controller. The MP7600 in turn initiates a Time Delay to Engine Start (TDES) timer. Upon completion of the TDES a signal is given via a dry "form C" contact to the engine start circuit, and the Minimum Run Timer (MRT) is initiated. After the engine has started and develops frequency and voltage, the frequency voltage relay will send a signal to initiate a Time Delay to Emergency (TDE) timer. Upon completion of the TDE, the normal will open. This will initiate a Time Delay in Neutral (TDN) timer. Upon completion of the TDN, the emergency switch shall close and complete the transfer. With the Automatic Transfer Switch now operating on the emergency source, the voltage relay continues to monitor the normal source.

Upon restoration of normal power as sensed by the voltage relay, a Time Delay to Return (TDR) timer is initiated. Upon completion of the TDR, the emergency switch will open. This will initiate a Time Delay in Neutral (TDN) timer. Upon completion of the TDN, the normal switch shall close and complete the transfer. After retransfer to normal a Time Delay to Engine Cool down (TDEC) timer is initiated. Upon completion of the TDEC and upon the completion of the MRT, the engine start signal will be removed.

The preceding sequence of operation describes the operation of a basic Style 3, dual motor, 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.

3. INSTALLATION

3.1 MOUNTING AND CONNECTING

The standard Lake Shore transfer switch 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 1400 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 cables are 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 cables are 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 requirement for the switch (see Appendix B).

Connect DC voltage source and start contacts. Please refer to page 13 MP7600 installation.

There are numerous accessories available on Lake Shore transfer switches, which require external connections. Refer to the wiring diagram included with your transfer switch for specific instructions on connecting these accessories.

3.2 PLACING THE TRANSFER SWITCH 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 red LED on the Voltage Sensing Relay should be lighted, indicating that the normal source is available and within the pick-up setting of the relay. If this does not light (i.e. pick up), place a voltmeter on the normal source to be sure that the voltage is adequate and within the range of the relay. The switch will not operate on a voltage other than that stamped on the nameplate 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 MP7600 controlled Transfer Switches have a "Load Test" operational mode which is menu selectable at the HMI. A test of the automatic circuitry can be initiated by placing the Transfer Switch in the load test mode. This will cause the normal control circuits to de-energize and give a signal to start the engine. After the generator is up to voltage and frequency, the transfer switch will transfer to the emergency source.

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. CONTROLLER MP 7600

4.1 INTRODUCTION

The LSEC MP7600 is a sophisticated state of the art, microprocessor based controller. It consists of four major parts: a Power Supply board, a Relay Interface Board, a Main Control Board and a Human Machine Interface Panel. It is designed to operate in the "industrial" temperature range of –40 to +85 deg C.

Power Supply (Figure 1)

The Power Supply (PS) unit accepts a 12-volt dc or 24-volt dc input from automotive quality, or better power source. It is designed to function on starting batteries. Voltage regulation for the power supply is within 2% volts from no load to full load. External voltage sources can vary from 7 volts dc to 36 volts dc without harm to the MP7600 or interruption of its operation. Momentary losses of power will not compromise the efficient operation of the controller. This is a negative ground system. The board has provision to accommodate a large external "hold-up" capacitor for installations that may experience momentary input-voltage dropouts or reversals.

TB1

1 Input Positive
2 Input Negative
3 Output Negative
4 Output Hold Up Capacitor (if necessary)
5 Output Positive

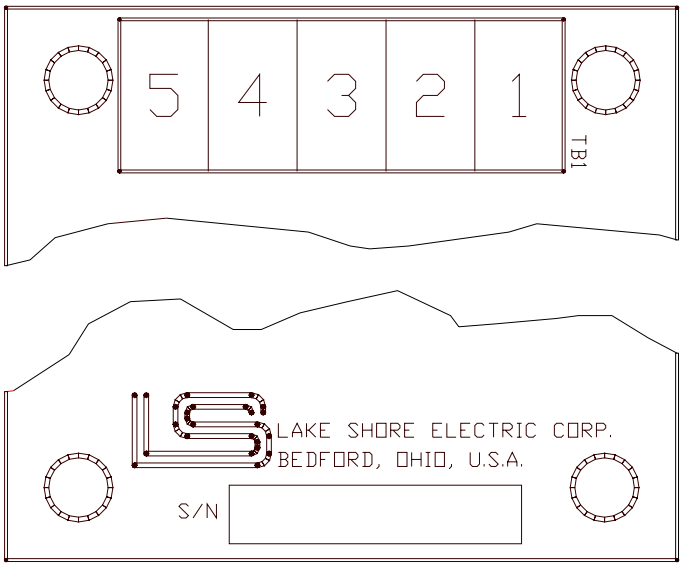


Figure 1

Relay Interface Board (Figure 2)

The Relay Interface Board (RIB) is the electro mechanical interfacing device between the MP7600 microprocessor controls and the power panel and the user interfaces. When the transfer switch is ordered, 12-volt dc or 24-volt dc operation must be selected. Although the power supply will accept any voltage within its range, the relays that populate the Relay Interface Board must be either 12-volt dc or 24-volt dc. Please insure that the relay voltage agrees with your dc power source voltage.

Customer Connections

SIE Switch in Emergency Position
EMR Emergency Source Available
SIN Switch in Normal Position
NOR Normal Source Available
TRBL Trouble
EC Transfer Pre-signal
EB Emergency Breaker Tripped
NB Normal Breaker Tripped
ES Engine Start

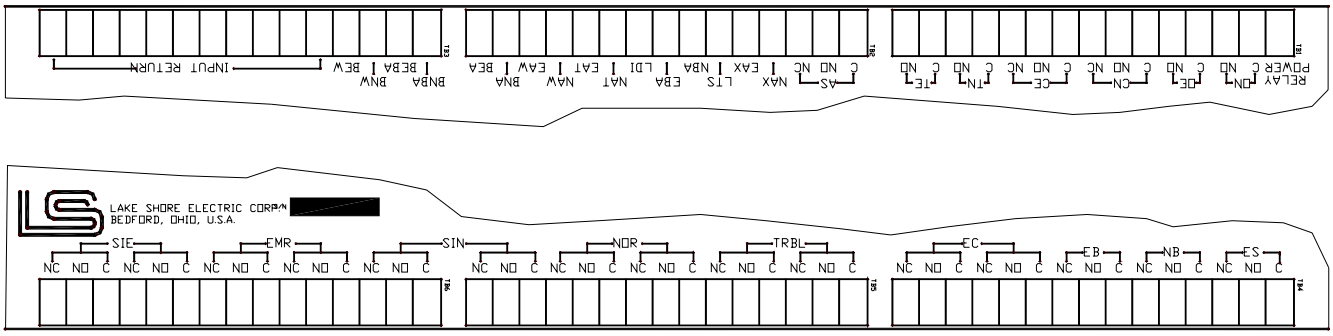


Figure 2

Main Control Board (Figure 3)

The Main Control Board (MCB) contains the microprocessor and performs all of the logic necessary to control the transfer switch. It contains a perpetual date and time clock, which is programmed to automatically adjust for leap years. It contains the timers listed in the section marked "Setting Timers". All timers, date and time settings are stored in battery backed-up non-volatile memory which can be maintained de-energized for 10 out of 100 years.

There are no user serviceable components in the MCB; however, there are connections that need to be made to it.

TB1

1	Ground	Power supply grounded Negative
2	+9V	Power supply Positive
3	NOR	Normal Power Available
4	EMR	Emergency Power Available
5	LTS	Load Test Switch
6	ORPB	Override Push Button
7	MSE	Menu System Enable
8	GFR	Ground Fault Relay
9	PS	Peak Shaving
10	RPN	Reverse Power Normal
11	RPE	Reverse Power Emergency
12	SYNC	Synchronizing

13	XIN2	Special
14	XIN3	Special
15	Input Return	Input Return

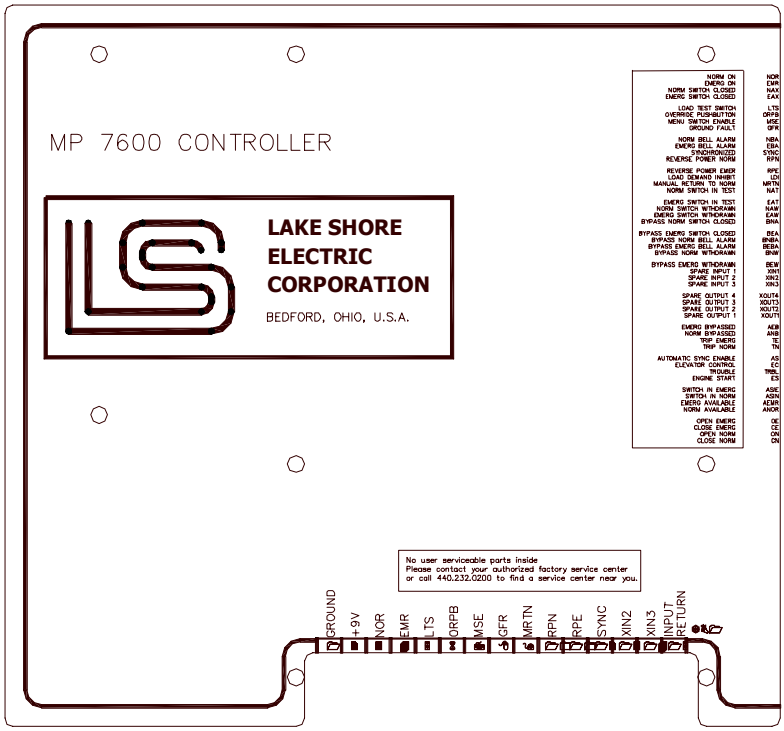


Figure 3

Human Machine Interface Panel (Figure 4)

The Human Machine Interface Panel consists of a graphic overlay which displays a one-line representation of a transfer switch, various LED's to annunciate status of the switch, a two line, 40 character LCD to display transfer switch mode of operation, date, time, timers status, fault condition, exerciser status other pertinent data. Additionally, the HMI Panel contains a keypad, which allows the transfer switch to be programmed.

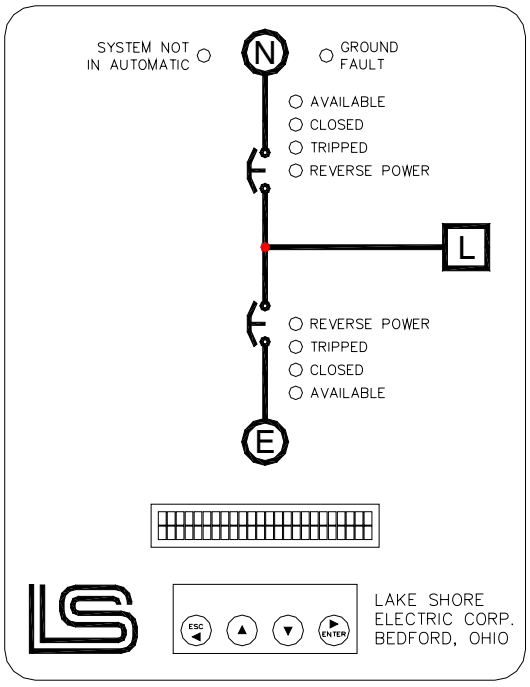


Figure 4

4.2 OPERATIONAL CONFIGURATION

The MP7600 controls the operation of the automatic transfer switch and contains as standard features five modes of operation, up to nine timers, a plant exerciser, and various sets of dry contacts for customer use.

Modes of Operation

There are five modes of operation. Four of which are selectable by using the HMI Panel

1. Automatic
2. Hand Crank
3. Load Test
4. Off/Reset

The fifth mode is Fault. In the fault mode, the transfer switch has failed to perform some function and the fault is displayed on the HMI Panel LCD. The eight types of fault that will be displayed are:

1. Ground Fault*
2. Reverse Power*
3. Bell Alarm (normal or emergency)*
4. Open Normal Failed

5. Open Emergency Failed
6. Both Opens Failed
7. Close Normal Failed
8. Close Emergency Failed

* Optional Equipment

Timers

Up to eight timers are available:

TDES Time Delay Engine Start. This timer is adjustable from 0 to 300 seconds and is factory set at 3 seconds. It is initiated upon sensing the loss of normal power and once timed out will initiate an engine start signal.

TDE Time Delay Emergency. This timer is adjustable from 0 to 300 seconds and is factory set at 3 seconds. It is initiated upon the sensing of the emergency source and once timed out will initiate the transfer to the emergency source.

TDN Time Delay Neutral. This timer is adjustable from 0 to 300 seconds and is factory set at 3 seconds. It is initiated upon the opening of one source and will inhibit the closing of the oncoming source until it has timed out.

TDR Time Delay Return. This timer is adjustable from 0.0 to 60.0 minutes and is factory set at 12 minutes. It is initiated upon the restoration of normal power and will inhibit the switch from retransferring to the normal source until it has timed out. If at any time during the timing cycle normal power is not maintained, this timer will be terminated and will be reinitiated when normal power returns.

TDEC Time Delay Engine Cool down. This timer is adjustable from 0.0 to 60.0 minutes and is factory set at 10 minutes. This timer is initiated upon the retransfer of the switch to the normal source and will keep the engine running until it has timed out.

MRT Minimum Run Timer. This timer is adjustable from 0.0 to 60.0 minutes and factory set at 10 minutes. It is initiated upon the initiation of starting the engine generator set and will keep the engine running until it has timed out.

SFT* Synchronize Fail Timer. This timer is adjustable from 0.0 to 60.0 minuets and is factory set at 15 minutes. It is only used for closed transition transfer switches. It is initiated at the time that actual transfer is permitted by the controller. If it times out prior to a transfer being complete, it will display "Trouble: SFT timed out", but will not terminate operation of the transfer switch.

TDBT* Time Delay Before Transfer. This timer is adjustable from 0 to 300 seconds and is factory set at 10 seconds. It is initiated when the switch is ready to transfer and upon its completion the transfer will take place. This is typically used in elevator circuits.

* Optional Equipment

Plant Exerciser.

The Plant Exerciser operates on a weekly basis and operates as follows:

1. It can be disabled
2. It can be enabled with or without load
3. Any time of day can be selectable as start time
4. Any duration of exercise period is selectable (hh:mm) from 00:01 through 24:00
5. Any day or days of the week (SMTWTFS) are selectable for exercising.

Dry Contacts.

Dry contacts are provided for:

1. One set of "form C" contacts to initiate engine start
2. Two sets of "form C" contacts for remote "Switch in Emergency" indication
3. Two sets of "form C" contacts for remote "Switch in Normal" indication
4. Two sets of "form C" contacts for remote "Emergency Available" indication *
5. Two sets of "form C" contacts for remote "Normal Available" indication *
6. Two sets of "form C" contacts for remote "Trouble Indication" indication
7. Two sets of "form C" contacts for remote "Equipment Control" initiation *

* Optional Equipment

4.3 INSTALLATION

Installation of the MP7600 Controller is straightforward and easy. Please follow the steps below and consult the drawings provided with the transfer switch.

Wiring

1. Connect your external power source (12 or 24 volts dc) to the customer interconnect terminal block terminals 011 (Positive) and 010 (Negative).

2. Connect the two wires to the engine start circuit to TBA. Terminals 028 & 029 for energize to run and terminals 028 & 030 for energize to stop.

3. Verify that the external voltage source to the transfer switch is compatible with the relays supplied on the Relay Interface Board (i.e. either 12 vdc or 24 vdc).

Setting Date & Time

At the LCD display on the front of the switch (see Figure 4) depress the "Enter" pad. The LCD will display "Main Menu/Select Mode". Depress "⇓" and the LCD will display "Main Menu/Set Current Time & Date". Depress "Enter" this will select that you wish to set the current time and/or date. The LCD will now display the current time and date. A single character will be underlined. To increase or decrease its value, depress either "⇓" or "⇑" until the value you

desire is displayed. When the correct value is displayed depress "Enter" and that value will be accepted. The curser will advance to the next character and the same value selection procedure should be followed until the correct time and date have been entered into the non-volatile memory.

At any time throughout programming the "ESC" pad may be pressed to return to the previous screen without accepting any new values.

Setting Timers

At the LCD display on the front of the switch (see Figure 4) depress the "Enter" pad. The LCD will display "Main Menu/Select Mode". Depress "⇓" twice and the LCD will display "Main Menu/Set Timers".

Depress "Enter" this will select that you wish to set any or all of the timers. The LCD will now display "SET UP TIMERS/Select Timer: TDES". If you do not wish to change the TDES timer, depress "⇓" and the display will advance to the next timer.

If you wish to change the TDES timer, depress "Enter". The LCD will now display "SET UP TIMERS/Set Time TDES: XXX sec". Notice the first digit of the available time range will be underlined. If you wish to increase or decrease its value, depress either "⇓" or "⇑" until the value you desire is displayed. When the correct value is displayed depress "Enter" and that value will be accepted.

The LCD will sequence through all the timers in the same manner. Depress either "⇓" or "⇑" to select the timer you which to change and then depress "Enter". Always complete any timer change by depressing the "Enter" pad. Failure to do so will not enter the value you wish to store in memory.

Timer settings can be reviewed by going through the SET UP TIMERS routine.

Setting Plant Exerciser

At the LCD display on the front of the switch (see Figure 4) depress the "Enter" pad. The LCD will display "Main Menu/Select Mode". Depress "⇓" three times and the LCD will display "Main Menu/Set Up Plant Exerciser". Depress "Enter" and the LCD will display "SET UP EXERCISER/Load? Yes : Start: XX:XX.

Notice the first Letter of "Yes/ or No" will be underlined. If you wish to change from Yes to No or visa versa, depress either "⇓" or "⇑" until the value you desire is displayed. Then depress "Enter", this will advance the underlined text to the first digit of the start time (XX:XX). If you wish to increase or decrease its value, depress either "⇓" or "⇑" until the value you desire is displayed. When the correct value is displayed depress "Enter" and that value will be accepted.

The LCD will now display "SET UP EXERCISER/Duration (hh:mm): XX:XX. Notice that the first digit of the hour and minute duration timer is underlined. If you wish to increase or decrease its value, depress either "⇓" or "⇑" until the value you desire is displayed. When the correct value is displayed depress "Enter" and that value will be accepted. Continue until the LCD then displays "SET UP EXERCISER/Days (Caps = ON) : s m t w t f s". Notice that the first character will be underlined. If you depress either "⇓" or "⇑", the underlined letter will change case.

Upper case means that the day selected will perform an exercise.

Note: If no days are selected (i.e. left in lower case), the exerciser will be disabled. This will be displayed in the operational display as "DO NOT EXERCISE".

Setting Mode of Operation

At the LCD display on the front of the switch (see Figure 4) depress the "Enter" pad. The LCD will display "Main Menu/Select Mode". Depress "Enter" and the LCD will display "MODE SELECT/Automatic". If you do not wish to select "Automatic", depress "⇓" and the display will advance to the next mode of operation.

If you wish to select "Automatic" as the mode of operation depress "Enter". The display will return to the operating position.

Operational Display

When not in programming mode the LCD on the HMI panel will display (Operational Display) the mode selected, the status of the exerciser, time and date. Figure 5 shows a standard display of the controller in the automatic position with a programmed load test exerciser period. Also displayed is the time and date.

Figure 5

Whenever the controller requires any action, the LCD displays the status of each timer. Figure 6 shows a standard display of the controller waiting for the TDES to time out before the engine is started.

Figure 6

Whenever there is a fault, the operation of the switch is terminated and the LCD displays the appropriate error message. Figure 7 shows a standard display of the controller displaying a Close Normal Failed fault.

Figure 7

5. OPERATING MECHANISM

5.1 GENERAL INFORMATION

The operating mechanism, pictured in Figure 1 (page 17), is used in Styles 2, and Style 3 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.

5.2 OPERATION

When a signal to transfer is received through the contacts of the Relay Interface Board, 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 toggle. As soon as the drive arms have reached their new position, the auxiliary switch changes position signaling the controller to cut 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.

5.3 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.

5.4 MOTOR ASSEMBLY

To assemble the operating mechanism, first place the drive drum keys (11) on each side of the shaft, which extends from the gearbox. 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 gearbox. 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.

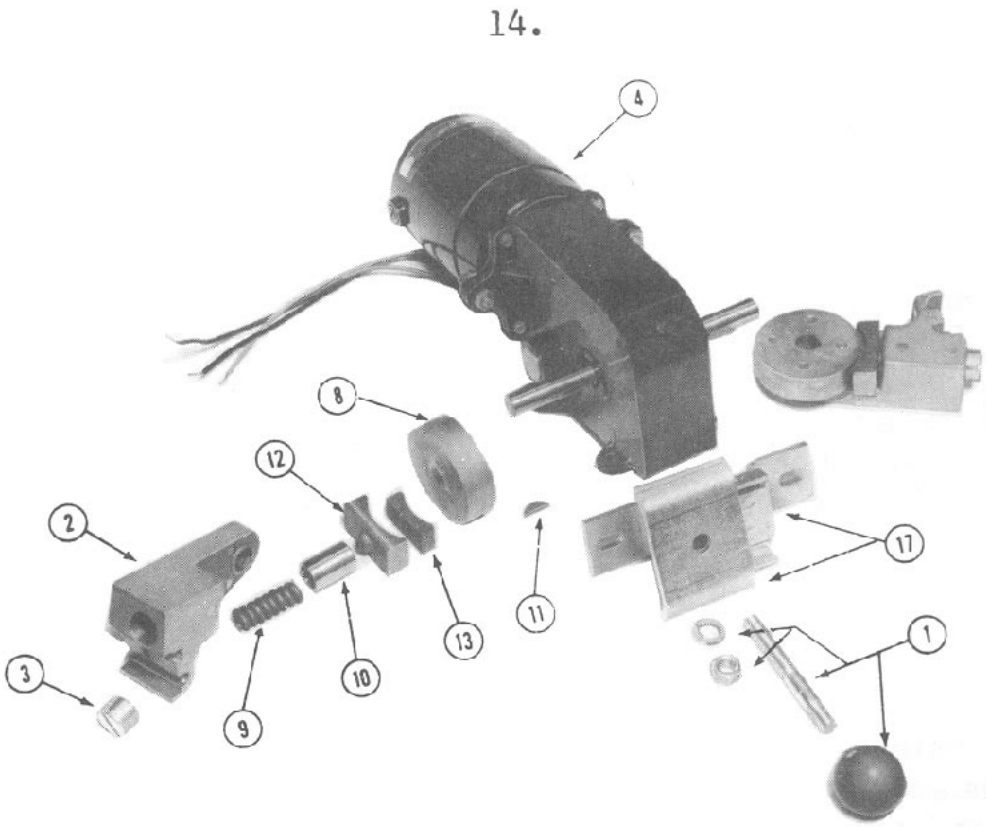


Figure 1.

6. MOLDED CASE SWITCHES

6.1 GENERAL INFORMATION

The molded case switches used in Trans-O-Matic switches are the standard devices supplied by molded case switch manufactures. Figure 2 (page 19).

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 signals the controller 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 a position so that the breaker resets. After resetting, return the transfer switch to the proper position. A shunt trip may also be provided. This allows the breaker to be electrically tripped from a remote location and can also be reset manually.

6.2 INSPECTION 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 2).

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 micro switches are mounted internally to the molded case switch

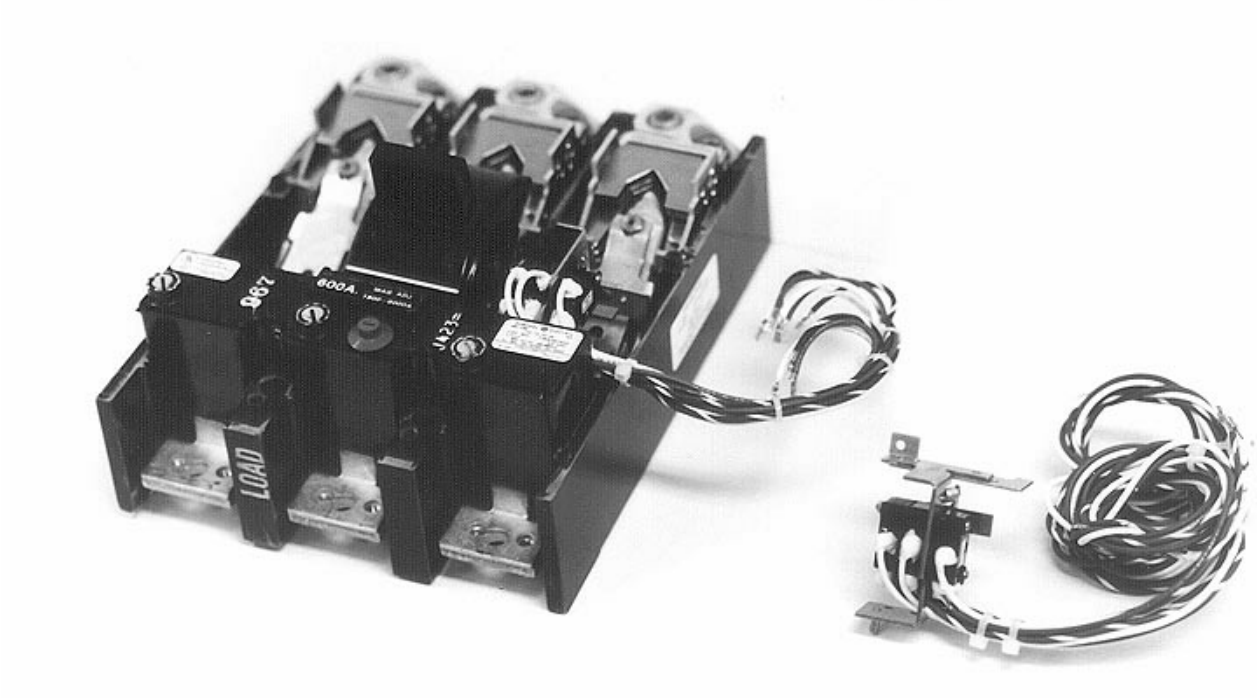


Figure 2.

7. VOLTAGE RELAYS

7.1 VOLTAGE SENSING – CLOSE DIFFERENTIAL

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 dropout values are adjustable from 70 to 100% of nominal voltage via two potentiometers that are externally accessible.

Factory Setting

Unless a customer or specifications require specific settings, the voltage Sensing Relay will be factory set to dropout at 80% and pick-up at 90% of nominal voltage.

Three Phase Style

The Lake Shore voltage-sensing relay is field adjustable. Voltage is selectable by changing the position of a small printed circuit board inside the chassis of the unit.

CALIBRATION:

Select proper voltage range.
Set pickup potentiometer full clockwise.
Set dropout potentiometer full counter-clockwise
Using a small screwdriver, turn the calibrate potentiometer fully clockwise.
Apply nominal input voltage to unit.
Slowly turn the calibration potentiometer counter-clockwise until the units picks up as indicated by the "energized" light.
Set pickup and dropout potentiometers to desired settings.
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 voltage sensing relays are adjustable to 70 to 100% of the voltage range selected. Indication of pickup or dropout can only be verified by attaching a continuity meter to the common and normally open terminals. When the meter shows continuity, the PFR is picked up.

CALIBRATION:

Remove protective black plugs (if present).
Using a small slotted screwdriver, turn the dropout potentiometer fully counter-clockwise.
Using a small slotted screwdriver, turn the pickup potentiometer fully clockwise.
Apply required level of pickup voltage to the unit.
Turn the pickup potentiometer slowly counter-clockwise until the meter shows continuity.
Reduce the voltage to the required voltage dropout level.
Turn the dropout potentiometer slowly clockwise until the meter shows no continuity.

7.2 FREQUENCY VOLTAGE RELAY

General

This device is used to prevent transfer 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 48 Hz (50 Hz line) or 58 Hz (60 Hz line) and 108 vac.

This device is not field adjustable.

8. 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 considerations 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 MP 7600 Controller

2. The interface control relays

3. The interconnections and cable connections

2. The molded case switches

3. The adjustment of the operating mechanism

4. The motor and micro switches

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.

8.1 STYLE 2 SWITCH TROUBLESHOOTING

I) NORMAL POWER FAILS – ENGINE DOES NOT START

1) Verify:

a) Maintenance Disconnect Switch (if applicable) is in the "NORMAL" position.

b) LCD Display indicates that the ATS is in the "AUTOMATIC" position.

c) 12VDC or 24VDC is available on the control circuit input terminals to the ATS.

2) Check the fuse in the DC circuit. Verify that DC voltage is available from either side of the fuse to battery negative. If not, replace the fuse.

3) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "NOR" is <u>NOT</u> on.

a) If the LED is on, either the main controller board or voltage sensing relay has failed. To determine which unit failed, disconnect the wire on terminal NOR of the main controller board. If the LED remains on, the main controller board has failed. If the LED turns off, the voltage sensing relay has failed.

b) If the LED is <u>NOT</u> on, continue to the next step.

4) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "ES" is on. If the LED is not on, the main control board has failed. It the LED is on, continue to the next step.

5) Verify that the "ES" relay on the Relay Interface Board is being signaled to energize by measuring the proper DC voltage (either 12VDC or 24VDC) across diode D8 on the Relay interface board.

   a) If there is no voltage on diode D8, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 16. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 16. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but, not across D8, the relay interface board has failed.

   b) If there is voltage available on D8 continue to the next step.

6) Verify that the "ES" relay is functioning. Remove the wires from C and NO for the ES relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity; the Relay Interface Board has failed. If there is continuity here, reconnect the wires from C and NO for the ES relay on the Relay Interface Board and continue to the next step.

7) Remove the customer's engine starting wires from terminals 033 and 034 and measure continuity across these terminals. If continuity exists across these terminals, the problem is in the wiring to the engine generator set or the starting system of the engine generator set. If continuity does not exist here check the wiring between these terminals and terminal C and NO for the ES relay on the Relay Interface Board.

II) ENGINE STARTS – AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO EMERGENCY

1) Check for proper voltage on the generator output. This should be measured at the input terminals to the Automatic Transfer Switch EL1, EL2, and EL3. If the output voltage of the generator is incorrect, contact the engine generator set supplier. If the generator has the proper output voltage continue to the next step.

2) Check to see that the Frequency Voltage Relay (FVR) or Emergency Relay (ER) is energized. The FVR has a red LED to indicate that it is energized, the Emergency

relay has a yellow neon light to do the same. If not energized review connections from generator input to the FVR of ER relay. If energized continue to next step.

3) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "EMR" is on.

   a) If the LED is not on, either the FVR or ER has a failed output contact or the main control board has failed. To determine what has failed, place a jumper on the main control board from terminal "input return" to "EMR". If the "EMR" LED turns on, the FVR or ER output contact has failed. If the "EMR" LED remains off, the main control board has failed.

   b) If the LED is on, continue to the next step.

4) Check the CE relay on the Relay Interface Board. Relay "CE" (Close Emergency) is used to transfer to emergency. If the "CE" LED is not on, the Main control board has failed. If the "CE" LED is on continue to the next step.

   Verify that the CE relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CE relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

   a) <u>120 VAC voltage is not available on "C" or "NO".</u> This indicates that power is not getting to the Relay Interface Board. Check the wiring between the generator input terminals and this Relay Interface board, also check that the Emergency Control Circuit Breaker (EB1) is not tripped.

   b) <u>120 VAC is only available on the "C" or "NO" terminal but not both.</u> This indicates that the "CE" relay is not closed. Check for DC voltage across D4.

      1.) If there is no voltage on D4, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 17. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 17. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D4, the relay interface board has failed. If there is nominal DC voltage across D4, continue to the next step.

      2.) Verify that the "CE" relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity, the

Relay Interface Board has failed. If there is continuity here, The relay was bad. Now reconnect the wires from C and NO for the CE relay on the Relay Interface Board. This should resolve the problem.

c.) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the close emergency winding of the transfer motor and the wiring between the Relay Interface Board and the transfer motor.

III AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO NORMAL

1) Check for proper voltage on the utility input. This should be measured at the input terminals to the Automatic Transfer Switch NL1, NL2, and NL3. If the voltage of the utility is incorrect, contact the local utility company. If the utility has the proper output voltage continue to the next step.

2) Check to see that the Phase Failure Relay (PFRN) is energized. The PFRN has a red LED to indicate that it is energized. If not energized review connections from generator input to the PFRN relay. If energized continue to next step.

3) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "NOR" (Normal On Relay) is on.

   a) If the LED is not on, either the PFRN has a failed output contact or the main control board has failed. To determine what has failed, place a jumper on the main control board from terminal "input return" to "NOR". If the "NOR" LED turns on, the PFRN output contact has failed. If the "NOR" LED remains off, the main control board has failed.

   b) If the LED is on, continue to the next step.

4) For a Style II Automatic Transfer Switch, only "CN" (Close Normal) is used to transfer to normal. If the "CN" LED is not on, the Main control board has failed. If the "CN" LED is on continue to the next step.

   Verify that the CN relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CE relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

   a) 120 VAC voltage is not available on "C" or "NO". This indicates that power is not getting to the Relay Interface Board. Check the wiring between the utility input terminals and this Relay Interface board, also check that the Normal Control Circuit Breaker (NB1) is not tripped.
   b) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "CN" relay is not closed. Check for DC voltage across D3.

1) If there is no voltage across D3, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 19. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 19. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D3, the relay interface board has failed. If there is nominal DC voltage across D3, continue to the next step.

2) Verify that the "CN" relay is functioning. Remove the wires from C and NO for the CN relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity, the Relay Interface Board has failed. If there is continuity here, The relay was bad. Now reconnect the wires from C and NO for the CN relay on the Relay Interface Board. This should resolve the problem.

c) <u>120 VAC is available on both "C" and "NO" terminals</u>. This indicates that power is getting through the Relay Interface Board. Check the voltage on the close normal winding of the transfer motor and the wiring between the Relay Interface Board and the transfer motor.

8.2 STYLE 3 TROUBLESHOOTING

I) NORMAL POWER FAILS – ENGINE DOES NOT START

1) Verify:

a) Maintenance Disconnect Switch (if applicable) is in the "NORMAL" position.

b) LCD Display indicates that the ATS is in the "AUTOMATIC" position.

c) 12VDC or 24VDC is available on the control circuit input terminals to the ATS.

2) Check the fuse in the DC circuit. Verify that DC voltage is available from either side of the fuse to battery negative. If not, replace the fuse.

3) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "NOR" is <u>NOT</u> on.

a) If the LED is on, either the main controller board or voltage sensing relay has failed. To determine which unit failed, disconnect the wire on terminal

NOR of the main controller board. If the LED remains on, the main controller board has failed. If the LED turns off, the voltage sensing relay has failed.

b) If the LED is NOT on, continue to the next step.

4) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "ES" is on. If the LED is not on, the main control board has failed. It the LED is on, continue to the next step.

5) Verify that the "ES" relay on the Relay Interface Board is being signaled to energize by measuring the proper DC voltage (either 12VDC or 24VDC) across diode D8 on the Relay interface board.

a) If there is no voltage on diode D8, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 16. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 16. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but, not across D8, the relay interface board has failed.

b) If there is voltage available on D8 continue to the next step.

6) Verify that the "ES" relay is functioning. Remove the wires from C and NO for the ES relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity, the Relay Interface Board has failed. If there is continuity here, reconnect the wires from C and NO for the ES relay on the Relay Interface Board and continue to the next step.

7) Remove the customer's engine starting wires from terminals 033 and 034 and measure continuity across these terminals. If continuity exists across these terminals, the problem is in the wiring to the engine generator set or the starting system of the engine generator set. If continuity does not exist here check the wiring between these terminals and terminal C and NO for the ES relay on the Relay Interface Board.

II) ENGINE STARTS – AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO EMERGENCY

1) Check for proper voltage on the generator output. This should be measured at the input terminals to the Automatic Transfer Switch EL1, EL2, and EL3. If the output voltage of the generator is incorrect, contact the engine generator set

supplier. If the generator has the proper output voltage continue to the next step.

2) Check to see that the Frequency Voltage Relay (FVR) or Emergency Relay (ER) is energized. The FVR has a red LED to indicate that it is energized, the Emergency relay has a yellow neon light to do the same. If not energized review connections from generator input to the FVR of ER relay. If energized continue to next step.

3) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "EMR" is on.

   a) If the LED is not on, either the FVR or ER has a failed output contact or the main control board has failed. To determine what has failed, place a jumper on the main control board from terminal "input return" to "EMR". If the "EMR" LED turns on, the FVR or ER output contact has failed. If the "EMR" LED remains off, the main control board has failed.

   b) If the LED is on, continue to the next step.

4) Check to see that the switches have been given a signal to open and close. This step varies Style III (Dual Motor Operator) Open Transition and Style III (Dual Motor) Closed Transition.

   A Style III (Dual Motor Operator) has two stages to transfer to emergency. First Normal must open and secondly, Emergency must close. For Closed Transition, Emergency must close first, then Normal must open.

   a.) NORMAL FAILS TO OPEN – OPEN TRANSITION

      1.) For a Style III Automatic Transfer Switch "ON" (open normal) will begin the transfer to emergency. If the Normal Molded Case Switch remains closed verify that the "ON" LED on the main control board is on. If the "ON" LED is not on , the main control board has failed. If the "ON" LED is on continue to the next step.

      2.) Verify that the "ON" relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the "ON" relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

         a) <u>120 VAC voltage is not available on "C" or "NO".</u> This indicates that power is not getting to the Relay Interface Board. Check the wiring between the generator input terminals and this Relay Interface board, also check that the Emergency Control Circuit Breaker (EB1) is not tripped.

         b.) <u>120 VAC is only available on the "C" or "NO" terminal but not both.</u> This indicates that the "ON" relay is not closed. Check for DC voltage across D1.

(1) If there is no voltage on D1, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 20. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 20. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D1, the relay interface board has failed. If there is nominal DC voltage across D4, continue to the next step.

(2) Verify that the "ON" relay is functioning. Remove the wires from C and NO for the ON relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity, the Relay Interface Board has failed. If there is continuity here, the relay was bad. Now reconnect the wires from C and NO for the ON relay on the Relay Interface Board. This should resolve the problem.

c) <u>120 VAC is available on both "C" and "NO" terminals</u>. This indicates that power is getting through the Relay Interface Board. Check the voltage on the open normal winding of the transfer motor and the wiring between the Relay Interface Board and the transfer motor.

b.) EMERGENCY FAILS TO CLOSE – (OPEN TRANSITION)

1) For a Style III Automatic Transfer Switch "CE" (close emergency) will complete the transfer to emergency. If the Emergency Molded Case Switch remains open verify that the "CE" LED on the main control board is on. If the "CE" LED is not on , the main control board has failed. If the "CE" LED is on continue to the next step.

2) Verify that the CE relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CE relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

(a) <u>120 VAC voltage is not available on "C" or "NO".</u> This indicates that power is not getting to the Relay Interface Board. Check the wiring between the generator input

terminals and this Relay Interface board, also check that the Emergency Control Circuit Breaker (EB1) is not tripped.

(b) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "CE" relay is not closed. Check for DC voltage across D4.

(1) If there is no voltage on D4, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 17. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 17. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D4, the relay interface board has failed. If there is nominal DC voltage across D4, continue to the next step.

(2) Verify that the "CE" relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity; the Relay Interface Board has failed. If there is continuity here, The relay was bad. Now reconnect the wires from C and NO for the CE relay on the Relay Interface Board. This should resolve the problem.

c) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the close emergency winding of the transfer motor and the wiring between the Relay Interface Board and the transfer motor.

c.) EMERGENCY FAILS TO CLOSE – (CLOSED TRANSITION)

1.) For a Style III Automatic Transfer Switch with Closed transition option and both sources available, the "AS" (activate synchronization) LED on the main control board must be on. If the "AS" LED is not on , the main control board has failed. If the "AS" LED is on continue to the next step.

2.) Once the normal and emergency source are in sync, the synchronizing device closes it's contact lighting up the "SYNC" LED on the main control board. If this LED is not lit, either the two sources are not in sync, the synchronizer is not functioning and/or the main control board has failed. To verify it is not the control board, remove the "CE" (close emergency) relay from the relay interface board to prevent the emergency molded case switch from closing out of phase and then place a jumper across terminals "input return" and "sync" on the main control board. The "SYNC" LED should light indicating that the main control board is functioning. If the "SYNC" LED is on continue to the next step.

3.) If the Emergency Molded Case Switch remains open verify that the "CE" LED on the main control board is on. If the "CE" LED is not on , the main control board has failed. If the "CE" LED is on continue to the next step.

4.) Verify that the CE relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CE relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

a) <u>120 VAC voltage is not available on "C" or "NO".</u> This indicates that power is not getting to the Relay Interface Board. Check the wiring between the generator input terminals and this Relay Interface board, also check that the Emergency Control Circuit Breaker (EB1) is not tripped.

b) <u>120 VAC is only available on the "C" or "NO" terminal but not both.</u> This indicates that the "CE" relay is not closed. Check for DC voltage across D4.

(1) If there is no voltage on D4, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 17. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 17. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D4, the relay interface board has failed. If there is nominal DC voltage across D4, continue to the next step.

(2) Verify that the "CE" relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity.

If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity, the Relay Interface Board has failed. If there is continuity here, The relay was bad. Now reconnect the wires from C and NO for the CE relay on the Relay Interface Board. This should resolve the problem.

c.) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the close emergency winding of the transfer motor and the wiring between the Relay Interface Board and the transfer motor.

d.) NORMAL FAILS TO OPEN – (CLOSED TRANSITION)

Same as 4B – Normal Fails to open – (open transition)

III AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO NORMAL

1) Check for proper voltage on the utility input. This should be measured at the input terminals to the Automatic Transfer Switch NL1, NL2, and NL3. If the voltage of the utility is incorrect, contact the local utility company. If the utility has the proper output voltage continue to the next step.

2) Check to see that the Phase Failure Relay (PFRN) is energized. The PFRN has a red LED to indicate that it is energized. If not energized review connections from generator input to the PFRN relay. If energized continue to next step.

3) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "NOR" (Normal On Relay) is on.

a) If the LED is not on, either the PFRN has a failed output contact or the main control board has failed. To determine what has failed, place a jumper on the main control board from terminal "input return" to "NOR". If the "NOR" LED turns on, the PFRN output contact has failed. If the "NOR" LED remains off, the main control board has failed.

b) If the LED is on, continue to the next step.

4) Check to see that the switches have been given a signal to open and close. This step varies for a Style II (Single Motor Operator), Style III (Dual Motor Operator) open transition and Style III (Dual Motor) closed transition..

A Style III (Dual Motor Operator) has two stages to transfer to normal. First emergency must open and secondly, normal must close. For Closed Transition, normal must close first, then Emergency must open.

a) EMERGENCY FAILS TO OPEN – OPEN TRANSITION

1) For a Style III Automatic Transfer Switch "OE" (open emergency) will begin the transfer to normal. If the Emergency Molded Case Switch remains closed verify that the "OE" LED on the main control board is on. If the "OE" LED is not on , the main control board has failed. If the "OE" LED is on continue to the next step.

2) Verify that the "OE" relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the "OE" relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

   a) <u>120 VAC voltage is not available on "C" or "NO".</u> This indicates that power is not getting to the Relay Interface Board. Check the wiring between the utility input terminals and this Relay Interface board, also check that the Normal Control Circuit Breaker (NB1) is not tripped.

   b) <u>120 VAC is only available on the "C" or "NO" terminal but not both.</u> This indicates that the "OE" relay is not closed. Check for DC voltage across D2.

      (1) If there is no voltage on D2, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 18. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 18. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D2, the relay interface board has failed. If there is nominal DC voltage across D2, continue to the next step.

      (2) Verify that the "OE" relay is functioning. Remove the wires from C and NO for the ON relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity, the Relay Interface Board has failed. If there is continuity here, the relay was bad. Now reconnect the wires from C and NO for the OE relay on the Relay Interface Board. This should resolve the problem.

c) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the open emergency winding of the emergency transfer motor and the wiring between the Relay Interface Board and the emergency transfer motor.

b.) NORMAL FAILS TO CLOSE – (OPEN TRANSITION)

1) For a Style III Automatic Transfer Switch "CN" (close normal) will complete the transfer to normal. If the Normal Molded Case Switch remains open verify that the "CN" LED on the main control board is on. If the "CN" LED is not on , the main control board has failed. If the "CN" LED is on continue to the next step.

2) Verify that the CN relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CN relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

a) 120 VAC voltage is not available on "C" or "NO". This indicates that power is not getting to the Relay Interface Board. Check the wiring between the utility input terminals and this Relay Interface board, also check that the Normal Control Circuit Breaker (NB1) is not tripped.

b) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "CN" relay is not closed. Check for DC voltage across D3.

(1) If there is no voltage on D3, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 19. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 19. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D3, the relay interface board has failed. If there is nominal DC voltage across D3, continue to the next step.

(2) Verify that the "CN" relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if

there is still no continuity, the Relay Interface Board has failed. If there is continuity here, The relay was bad. Now reconnect the wires from C and NO for the CN relay on the Relay Interface Board. This should resolve the problem.

c) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the close normal winding of the transfer motor and the wiring between the Relay Interface Board and the transfer motor.

c.) NORMAL FAILS TO CLOSE – (CLOSED TRANSITION)

1) For a Style III Automatic Transfer Switch with Closed transition option and both sources available, the "AS" (activate synchronization) LED on the main control board must be on. If the "AS" LED is not on , the main control board has failed. If the "AS" LED is on continue to the next step.

2) Once the normal and emergency source are in sync, the synchronizing device closes it's contact lighting up the "SYNC" LED on the main control board. If this LED is not lit, either the two sources are not in sync, the synchronizer is not functioning and/or the main control board has failed. To verify it is not the control board, remove the "CN" (close normal) relay from the relay interface board to prevent the normal molded case switch from closing out of phase and then place a jumper across terminals "input return" and "sync" on the main control board. The "SYNC" LED should light indicating that the main control board is functioning. If the "SYNC" LED is on continue to the next step.

3) If the Normal Molded Case Switch remains open verify that the "CN" LED on the main control board is on. If the "CN" LED is not on , the main control board has failed. If the "CN" LED is on continue to the next step.

4) Verify that the CN relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CN relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

a) 120 VAC voltage is not available on "C" or "NO". This indicates that power is not getting to the Relay Interface Board. Check the wiring between the utility input terminals and this Relay Interface board, also check that the Normal Control Circuit Breaker (NB1) is not tripped.

b) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "CN" relay is not closed. Check for DC voltage across D3.

(1) If there is no voltage on D3, either the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 19. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 19. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D3, the relay interface board has failed. If there is nominal DC voltage across D3, continue to the next step.

(2) Verify that the "CN" relay is functioning. Remove the wires from C and NO for the CN relay on the Relay Interface Board. Place and Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity; the Relay Interface Board has failed. If there is continuity here, the relay was bad. Now reconnect the wires from C and NO for the CN relay on the Relay Interface Board. This should resolve the problem.

c) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the close normal winding of the transfer motor and the wiring between the Relay Interface Board and the transfer motor.

d.) EMERGENCY FAILS TO OPEN – (CLOSED TRANSITION)

Same as 4B – Emergency Fails to open – (open transition)

9. OPTIONAL ACCESSORIES

Lake Shore Electric offers many additional accessories for the style 2 and style 3 transfer switches. Please check the documents and drawings for your particular switch to see what additional options are included.

9.1. Service Entrance

This option provides for the Automatic Transfer Switch to be labeled as suitable for use as service equipment. The Actual determination of designating it as service equipment rests with the engineer in charge of the project or the authority having jurisdiction. When the Service Entrance accessory is selected, the Transfer Switch is suitable for use as Service Entrance Equipment and is provided with the following additional equipment:

Padlockable Enclosure
Over Current Trip and Bell Alarm for the Service Disconnect
LED indication of source "Tripped".
A means to disable the HMI keypad
Neutral bus with main and ground lugs.
Main bonding jumper per NEC 2002 250.8.
Appropriate nameplates and instructions to be applied in the field.

Instructions and labeling that accompanies the service entrance transfer switch will be in the following format.

1. When required by the National Electric Code or the engineer in charge of the project, connect one side of the grounding strap that is presently mounted on the neutral bar to ground. The other side of the grounding strap will remain connected to the neutral bar.

2. Apply the "SERVICE DISCONNECT" label on or near the operating handle of the Normal circuit breakers as required per the National Electrical Code or the engineer in charge of the project.

3. Apply the "SERVICE ENTRANCE" label on the outside of the enclosure door above the door handle.

4. If the building is supplied by more than one service, a permanent plaque or directory should be installed at this service disconnect denoting the location of all other services, feeders and branch circuits supplying this building in accordance with 2002 NEC 230-2.E.

SERVICE ENTRANCE

1. Place Operating Mode of HMI to "Off/Reset".
2. Unlock and open the enclosure door.
3. Place the "Menu System Enable" switch in the "Disabled" position.
4. Depress any pad on the HMI to verify that → Keypad Disabled ← is displayed.
5. Place the service disconnect switch in the OFF or OPEN position.
6. Open the fused disconnect for F1, F2, and F3.
7. Close and lock the enclosure door.
8. Reverse the above procedure to place the equipment back in service.

SERVICE ENTRANCE LABEL

9.2 Ground Fault Protection or Indication

This option provides ground fault detection on the load bus of the transfer switch. Once the ground fault is detected, the switch can be factory configured to provide either protection or indication.

Ground fault protection means that the "GROUND FAULT" LED will light, the source connected to the load will be opened, the switch will be automatically placed in the Fault Mode and the HMI LCD will display:

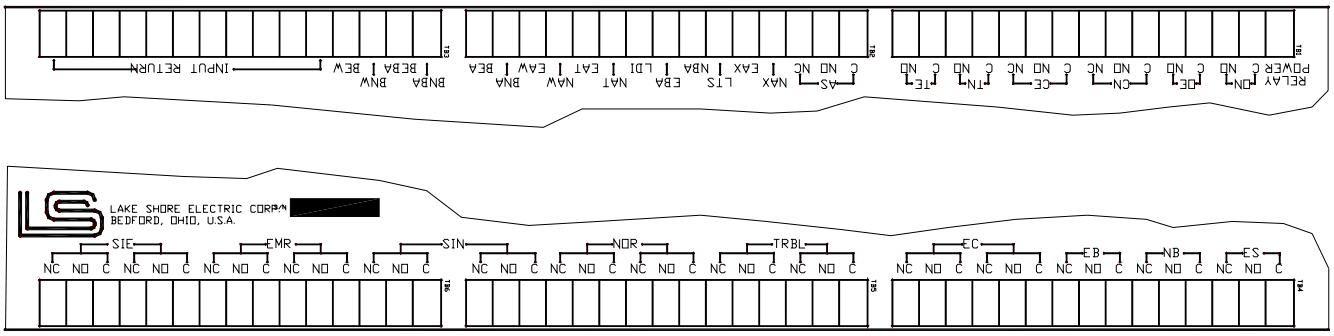
FAULT – Ground Fault
08:24 Fri OCT 4, 2002

Ground fault indication means that the "GROUND FAULT" LED will light, however the operation of the transfer switch will not be interrupted and the mode of operation will not be changed.

9.3 Pre-Transfer Signal

This option provides an additional timer, TDBT Time Delay Before Transfer. This timer is adjustable from 0 to 300 seconds and is factory set at 10 seconds. It is initiated when the switch is ready to transfer and upon its completion, the transfer will take place. This is typically used in elevator circuits, but can be used in other applications where motor disconnection before transfer is desirable. This timer is not initiated wherever there is a failure of either power source, since its implementation would only serve to delay a transfer to the available source.

Two form "C" contacts are provided on the Relay Interface Board. They are labeled "EC" and can be seen below.



9.4 Surge Suppression TVSS

This option provides hard-wired secondary surge arrestors on both the normal and emergency sources. This provides a degree of protection for voltage surges and lightening strikes. They are suitable for use in service entrance locations and meet the requirements of NEC 280, UL 1449 and ANSI C62.11. They protect surges up to 40 kA/Phase. No field installation is necessary.

9.5 Shunt Trips

This option provides a shunt trip input to the transfer switch so that from a remote location either or both of the switches can be tripped and the transfer switch sent to the Fault mode. Customer interconnection can be made at TB1.

10. APPENDIXES

APPENDIX A

Tension adjustment for transfer mechanism of Lake Shore Electric Transfer Switch.

Refer to Figure 1, Page 18

When excess slippage occurs in the friction drive, it is necessary to increase the tension on the friction drive shoe lining. Turn the adjustment screw (3) clockwise to increase the tension. 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 gearbox 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.

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.
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.
KB-HKB-JB	6-8 FT. - LBS.