INSTALLING, OPERATING AND MAINTAINING

MOLDED CASE AUTOMATIC TRANSFER SWITCHES

SINGLE OR DUAL MOTOR OPERATED

WITH MP7650 CONTROLLER

WARNING!

WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER OF ELECTROCUTION EXISTS THAT MAY RESULT IN INJURY OR DEATH. DO NOT ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT FIRST TAKING THE APPROPRIATE PRECAUTIONS TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE.

DURING INSTALLATION AND USE OF THIS PRODUCT, COMPLY WITH THE NATIONAL ELECTRICAL CODE (NEC), FEDERAL, STATE AND LOCAL CODES, AND ALL OTHER APPLICABLE SAFETY CODES.

MAIN UTILITY POWER MUST BE OFF DURING INSTALLATION, WHEN PERFORMING EQUIPMENT MAINTENANCE OUTSIDE THE EQUIPMENTS NORMAL MAINTENANCE SCOPE AND WHEN PERFORMING REQUIRED MAINTENANCE ON ANY POWER CABLE(S) CONNECTED TO THE EQUIPMENT.

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 requires valid warranty work and 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 the warranty.

Table of Contents

Table of Contents Continued . . .

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.

PAGE INTENTIONALLY LEFT BLANK

1. CONSTRUCTION

The Transfer Switches covered in this manual use molded case switches and/or circuit breakers to accomplish the transfer of two separate power sources to a single load.

These molded case circuit breaker(s) and/or switch/switches, (molded case units), are interlocked via electrical and mechanical control systems.

> The MP7650 Controller combined with an auxiliary contact switch located on the molded case unit encompasses the electrical interlock system.
>
> The walking beam interlock installed between the two molded case units encompasses the mechanical interlock system. The interlock is located on the rear of the base plate and 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.

The two control systems provide for a redundant interlocking which provides a "Fail-Safe" design. **Note:** This mechanical interlock is not provided on units equipped with the Closed Transition Transfer operation.

The gear motors are operated at 120VAC, supplied by the unit. 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 in the event of an emergency. The handle is permanently mounted and readily accessible and 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. They are rated for continuous duty to eliminate overheating of coils.

The MP7650 Controllers are rugged, durable industrial quality devices that assure minimum maintenance. These controllers offer programmable timers, including the plant exerciser, and these values are stored in non-volatile memory.

2. DESCRIPTION OF OPERATION

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

2.1. SINGLE MOTOR OPERATOR

The Single Motor Automatic Transfer Switch utilizes a single motor to operate both the normal and emergency molded case units. Normally, the transfer switch operates on the preferred power source with the Normal molded case unit in the closed position and the Emergency molded case unit in the open position. (Refer to Individual Unit Wiring Diagrams Included with the Transfer Switch.)

All phases of the preferred power source are continuously monitored by a voltage sensitive relay (PFR), 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 PFR sends a signal to the MP7650 Microprocessor controller to initiate specific timers.

1. TDES – Time Delay to Engine Start provides a short time delay before starting the generator to help prevent nuisance transfers. Once timer is complete, an engine start signal is sent to the generator via a dry “form C” contact.
2. MRT – Then the Minimum Run Timer for the generator is initiated. This insures that the generator is kept running for a predetermined amount of time before allowing it to be turned off. This helps improve the life expectancy of the engine.
3. FVR – Frequency Voltage Relay monitors the generators frequency and voltage. Once the proper levels have been reached, it will send a signal to initiate a Time Delay to Emergency (TDE) timer.
4. TDE – The Time Delay to Emergency provides a short time delay before the system transfers the load to the emergency source to prevent premature loading of the generator.
5. The PFR continues to monitor the normal source and will signal the controller once the normal source is available. Once it is, the signal from the PFR is received by the MP7650; it will start the return to normal source sequence.
6. TDR – Time Delay to Return is a short time delay and upon completion of the timer, the load will be transferred back to the normal source.
7. TDEC – Time Delay to Engine Cool down timer is initiated and upon completion of TDEC and MRT, the engine start signal will be removed.

The preceding sequence of operation describes the operation of a basic single motor operated, Automatic Transfer Switch. Lake Shore Electric Corporation offers a wide variety of accessory equipment to meet customer specifications. Please refer to the schematic diagram provided with your Lake Shore automatic transfer switch for the specific controls provided.

2.2. DUAL MOTOR OPERATOR

The Dual Motor Automatic Transfer Switch operates in much the same way as described in section 2.1 SINGLE MOTOR with the exception that each molded case unit 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 timer, Time Delay in Neutral (TDN), which when timed out, allows the alternate motor operator to connect its source to the load.

1. TDES – Time Delay to Engine Start provides a short time delay before starting the generator to help prevent nuisance transfers. Once the timer is complete, an engine start signal is sent to the generator via a dry “form C” contact.
2. MRT – Then the Minimum Run Timer for the generator is initiated. This insures that the generator is kept running for a predetermined amount of time before allowing it to be turned off. This helps improve the life expectancy of the engine.
3. FVR – Frequency Voltage Relay monitors the generators frequency and voltage. Once the proper

levels have been reached, it will send a signal to initiate a Time Delay to Emergency (TDE) timer.

4. TDE – The Time Delay to Emergency provides a short time delay before the system transfers the load to the emergency source to prevent premature loading of the generator.
5. TDN – Time Delay in Neutral allows the normal side motor to complete the transition from the closed to open state for the normal side molded case unit. Upon completion of the timer, the emergency motor will then transition from the open to closed state for the emergency side molded case unit.
6. The PFR continues to monitor the normal source and will signal the controller once the normal source is available. Once it is, the signal from the PFR is received by the MP7650; it will start the return to normal source sequence.
7. TDR – Time Delay to Return is a short time delay and upon completion of the timer, the load will be transferred back to the normal source.
8. TDN – Time Delay in Neutral allows the emergency side motor to complete the transition from the closed to open state for the emergency side molded case unit. Upon completion of the timer, the normal motor will then transition from the open to close state for the normal side molded case unit.
9. TDEC – Time Delay to Engine Cool down timer is initiated and upon completion of TDEC and MRT, the engine start signal will be removed.

The Dual Motor Automatic Transfer Switch is used EXCLUSIVELY FOR **SERVICE ENTRANCE** RATED TRANSFER SWITCHES because the dual motor design allows for the necessary condition of having both switches in the "OFF" position so that the load is isolated and disconnected from the two sources.

The Dual Motor Automatic Transfer Switch is also used EXCLUSIVELY FOR **CLOSED TRANSITION TRANSFER** SWITCHES because the dual motor design allows for 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.

(Refer to Individual Unit Wiring Diagrams Included with the Transfer Switch.)

The preceding sequence of operation describes the operation of a basic dual motor, Automatic Transfer Switch. Lake Shore Electric Corporation offers a wide variety of accessory equipment to meet customer specification(s)/requirement(s). Please refer to the schematic diagram provided with your Lake Shore automatic transfer switch for the specific controls provided.

NOTE: For a UTILITY TO UTILITY application, a preferred source selector switch is provided on all transfer switches built for Utility-to-Utility applications. The sequence of operation does not include the Time Delay Engine Start (TDES), Time Delay Engine Cool Down (TDEC) and Minimum Run Timer (MRT). Otherwise the operation is the same as described above.

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, using #10 gage wire.

Enclosed transfer switches are designed in one of two enclosures: 1) "Wall Mount" or 2) "Free Standing". With NEMA enclosure ratings of 1, 3R, 12, 4 and 4X.

Open transfer switches are generally mounted in a customer-supplied enclosure(s); 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 minimize 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.

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.

1. Lug size and arrangements may vary depending on molded case switch manufacturer.
2. Optional lug arrangements are available, but must be specified at the time the transfer switch is ordered. Consult Lake Shore Electric for details.

The Normal source power cables are connected to the Normal molded case switch at the terminals marked NL1, NL2, and NL3. Please refer 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 a three-phase, four-wire transfer switch, or a single-phase, three-wire transfer switch, a neutral lug is provided.

Note: Verify that the phase sequence rotation of the normal and emergency sources, are identical. Failure to do this will result in damage to the transfer switch/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 section 4.3 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 CLOSED & Emergency breaker OPEN) and energize the normal source. Place the maintenance disconnect switch in the "Normal" position. 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 MP7650 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.

Place the transfer switch back into the 'AUTO' position to allow the transfer switch to transfer back to normal and shut down the engine.

Now return the operating mode to "Auto" at the HMI panel. The transfer switch should, after the appropriate time delays, return to normal if normal power is available. To test the Load Test Cycle, press the momentary Load Test Cycle pushbutton inside the door for two seconds. The transfer switch should start the engine, transfer to emergency, and return to normal after the appropriate time delays.

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 MP7650

4.1. INTRODUCTION

The LSEC MP7650 is a sophisticated, state of the art, microprocessor based controller.

It consists of four major parts:

1. Power Supply board
2. Relay Interface Board
3. Main Control Board
4. 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% of the base voltage from no load to full load. External voltage sources can vary from 7 volts dc to 36 volts dc without harm to the MP7650 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 a provision to accommodate a large external “hold-up” capacitor for installations that may experience momentary input-voltage dropouts or reversals. For more information on the use of a “Hold Up” capacitor in this circuit, please contact the factory.

TB1

1 + Battery Input (Positive)
2 - Battery Input (Negative)

TB2

1 Battery Output to MDS, unfused
2 Battery Input from MDS, unfused
3 Battery Output to Relay Interface Board
4 Battery Output, spare
5 Battery Negative
6 Battery Negative
7 9VDC regulated Output
8 Capacitor Input

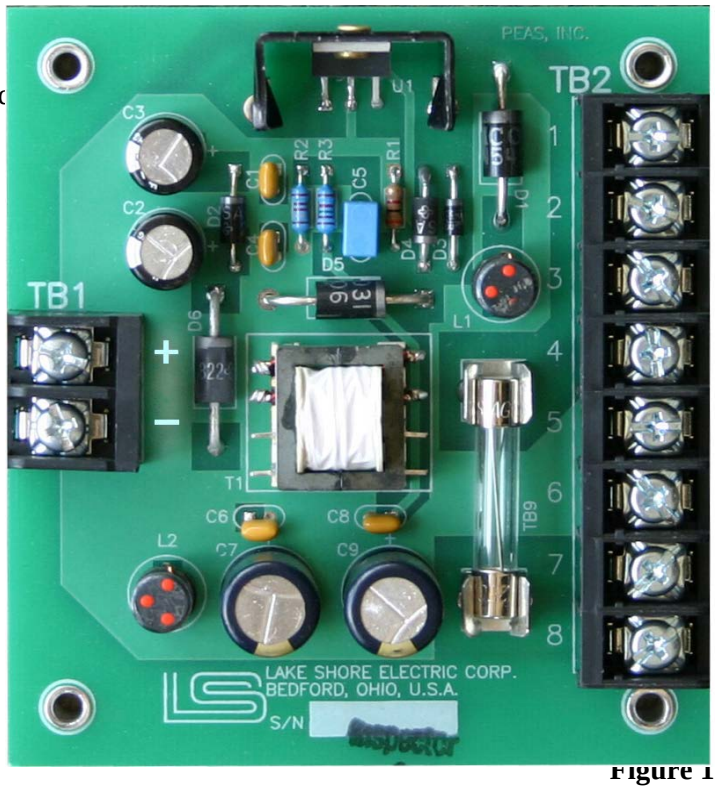

Figure 1

Relay Interface Board (Figure 2)

The Relay Interface Board (RIB) is the electro mechanical interfacing device between the MP7650 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
ES	Engine Start

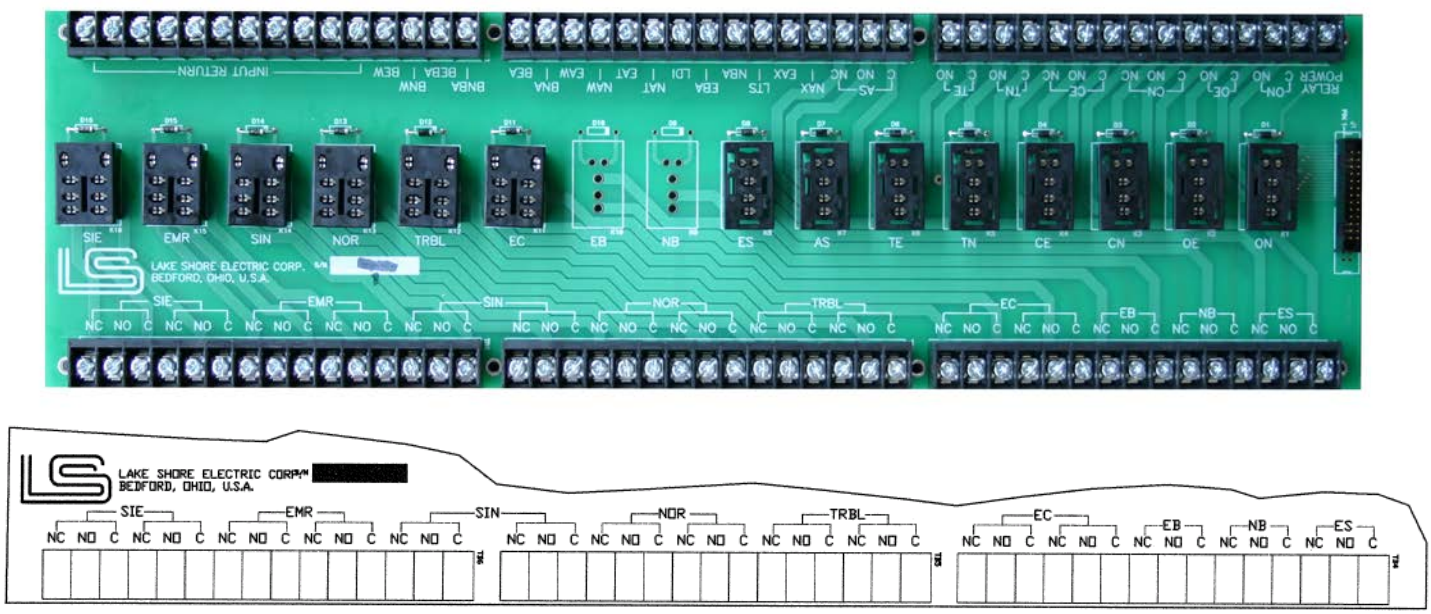

Figure 2

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 real time 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 non-volatile memory, with battery backup, which can be maintained de-energized for up to 10 years.

There are no user serviceable components in the MCB. All of these connections are made at the factory. There are no field connections to be made.

TB1

1	Ground	Power Supply Grounded Negative
2	+9V	9Vdc Regulated Power Supply Positive
3	NOR	Normal Power Available
4	EMR	Emergency Power Available
5	LTS	Load Test Switch
6	RN	Return to Normal
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	RD	Remote Disconnect
14	XIN	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, back lit, 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.

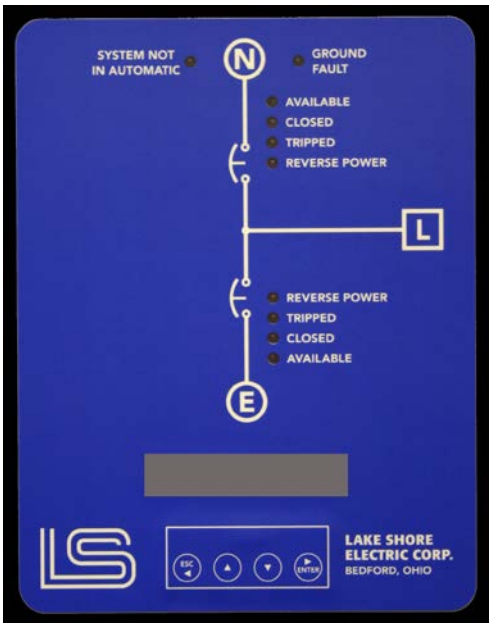

Figure 4

4.2. OPERATIONAL CONFIGURATION

The MP7650 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 (Utility to Generator)

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
5. Fault

The fifth mode, Fault, is not selectable. In the Fault mode, the transfer switch has failed to perform some function. If the MP7650 receives a Fault or trouble condition, the display will begin to scroll through the present operating mode that the unit is in and all of the troubles and/or faults it has registered. The MP7650 will continue to operate on some trouble/fault modes as described on each fault below.

Modes of Operation (Utility to Utility)

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

1. Automatic – U1 Preferred

2. Automatic – U2 Preferred
3. Off/Reset

The fourth mode is Fault and will be displayed as shown above.

RESET FAULT OR TROUBLE CODE

1. Depress “Enter”.
2. The display will read “MAIN MENU / Reset Faults / Troubles”.
3. Depress “Enter” again and the display will read “Reset Faults / Troubles Now? No”.
4. The word “No” will be underlined.
5. Depress either “⇓” or “⇑” until “Yes”, the desired value, is displayed.
6. Depress “Enter”.
7. All faults / troubles will be reset and the display will show the operating mode again.

The 10 faults and 2 troubles that may be displayed and the operation of the MP7650 during these conditions is described below:

1. FAULT – BELL ALARM
   Reset C/B first, and then reset microprocessor.
   This requires operator intervention. The MP7650 will not operate once this fault is registered until the unit is reset as described above.
   The trouble relay will remain “Dropped Out” until the unit is reset as described above.
2. FAULT – REMOTE DISCONNECT
   This requires operator intervention. The MP7650 will not operate once this fault is registered until the unit is reset as described above.
   The trouble relay will remain “Dropped Out” until the unit is reset as described above.
3. FAULT – REVERSE POWER
   Upon receiving a reverse power, a molded case transfer switch will shunt trip open the breaker and will require operator intervention to clear the fault.
   The trouble relay will remain “Dropped Out” until the unit is reset as described above.
4. FAULT – GROUND FAULT
   This appears if the unit has been programmed for ground fault protection.
   This requires operator intervention. The MP7650 will not operate once this fault is registered until the unit is reset as described above.
   The trouble relay will remain “Dropped Out” until the unit is reset as described above.
5. TROUBLE – GROUND FAULT
   This appears if the unit has been programmed for ground fault indication.
   The MP7650 will continue to operate.
   The trouble relay will remain “Dropped Out” until the unit is reset as described above.
6. FAULT – BOTH OPENS FAILED
   This requires operator intervention. The MP7650 will not operate once this fault is registered until the unit is reset as described above.
   The trouble relay will remain “Dropped Out” until the unit is reset as described above.
7. FAULT – CLOSE EMR FAILED
   The processor will display the trouble and continue to close the normal switch if and when normal power becomes available to place the system back on normal power.
   The trouble relay will remain “Dropped Out” until the unit is reset as described above.
8. FAULT – CLOSE NOR FAILED
   The processor will display the trouble and continue to re-close the emergency and keep the

engine running to provide emergency power to the load.
The trouble relay will remain “Dropped Out” until the unit is reset as described above.

9. FAULT – OPEN EMR FAILED

The processor will display the trouble and continue to keep the engine running to provide emergency power to the load.
The trouble relay will remain “Dropped Out” until the unit is reset as described above

10. FAULT – OPEN NOR FAILED

This requires operator intervention. The MP7650 will not operate once this fault is registered until the unit is reset as described above.
The trouble relay will remain “Dropped Out” until the unit is reset as described above.

11. TROUBLE – SFT TIMED OUT

The MP7650 will continue to operate and wait for synchronization or perform an open transition depending on how it was configured.
The trouble relay will remain “Dropped Out” until the unit is reset as described above.

12. FAULT – SINGLE PHASE PROTECTION

This requires operator intervention. The MP7650 will not operate once this fault is registered until the unit is reset as described above.
The trouble relay will remain “Dropped Out” until the unit is reset as described above.

13. MEMORY CORRUPTION

If the microprocessor detects a memory problem, it will display “MEMORY CORRUPTION” on the top line of the display and the bottom line will scroll:

“ . . . Factory Settings(s) Restored . . . Hold Enter to Acknowledge”

The operator must press “Enter” and hold it until the entire message scrolls though which takes about 12 seconds. This will acknowledge that the operator was aware of the issue and reset the display to its normal operating condition.

Timers (Utility to Generator)

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 60 SECONDS. 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. This is to alert the operator that the system took longer to synchronize than expected. The operator can clear this message by pressing “Enter” and then select “Clear Trouble”. The operator can also program the MP7650 to continue to try for a closed transition transfer or to do an open transition transfer when this timer times out. This also drops out the trouble relay to annunciate that this transfer switch requires attention.

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.

SPPT* Single Phase Protection Timer. The SPPT timer begins timing when the under voltage relay drops out. If the transfer to emergency begins before this timer times out, this timer is turned off. If this timer times out before the transfer to emergency begins, an output is sent to trip the normal breaker to trip it open. This is to prevent damage to the load in case the system is on a utility single phase condition. Tripping the breaker places it in the tripped position which requires the operator to manually reset the normal breaker and MP7650 controller before the automatic Transfer Switch can continue its automatic operation. Because of this, on Molded Case applications the display will read “FAULT SNGL PHSE PROTECT” and drops out the trouble relay.

* Optional Equipment

Timers (Utility to Utility)

Up to four timers are available:

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.

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

When the exercise period is in effect, the first line of the display will read “Exerciser On”. The Plant Exerciser operates on a weekly, or monthly, basis and is configured as follows:

1. Disabled Mode
2. Enabled Mode: With or Without Load
3. 24 hr. Selectable for Start Time
4. Time Duration of Exercise Period: (hh:mm) from 00:01 through 24:00
5. Day(s) Available for Exercise Selection: (S M T W T F S)
6. Week(s) of the Month Available for Exercise Selection: (1. 2. 3. 4. 5)

Dry Contacts

Dry contacts of “form C” are provided for:

1. One set to initiate Engine Start, (ES) **
2. Two sets for remote “Switch in Emergency”, (SIE), indication
3. Two sets for remote “Switch in Normal”, (SIN), indication
4. Two sets for remote “Emergency Available”, (EMR), indication *
5. Two sets for remote “Normal Available”, (NOR), indication *
6. Two sets for remote “Trouble Indication”, (TRBL), indication
7. Two sets for remote “Transfer Pre-signal”, (TDBT), initiation *

* Optional Equipment
** Not included on Utility to Utility Switches

Switches

Transfer switches are provided with four standard switches mounted internally:

1. Maintenance disconnect switch – which disconnects ac and dc power from the control circuit to allow for service and maintenance of the controls.

2. Load Test Switch – This provides for a complete load test cycle with load. When pressed for two seconds the transfer switch will perform a complete transfer to emergency and return to normal after operation of all applicable timers. NOTE: When the switches are withdrawn to the test position, the "not in automatic" light will flash and the load test switch will be inoperative.

3. Keypad enable switch – which will enable or disable the HMI keypad. When disabled, The HMI will display "Keypad Disabled" when any key is pressed.

4. Override TDR Switch – This will override the time delay imposed by the TDR timer.

4.3. INSTALLATION

Installation of the MP7650 Controller is straightforward and easy. Please follow the steps below and consult the drawings provided with the transfer switch.

Wiring

1. 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 or 24 Vdc).
2. Connect your external power source (12 or 24 Vdc) to the terminal block on the power supply board.
    a. TB1+ (Positive)
    b. TB1– (Negative)
3. Connect the two wires to the engine start circuit to the Relay Interface Board ES contacts.
    a. Use the common "C" and normally open "NO" contacts.

Setting Date & Time

NOTE 1: Refer to Figure 4 for all following instructions.

NOTE 2: At any time throughout programming, the "ESC" pad may be pressed to return to the previous screen without accepting any new values.

1. Depress the "Enter" key on the LCD pad.
2. The LCD displays "Main Menu/Select Mode".
3. Depress "⇓" and the LCD will display "Main Menu/Set Current Time & Date".
4. Depress "Enter" this will select that you wish to set the current time and/or date.
5. The LCD will now display the current time and date stored.
6. A single character will be underlined.
7. Depress either "⇓" or "⇑" until the desired value is displayed.
8. Depress "Enter" to store value.
9. The curser will advance to the next character.
10. Repeat the process until the correct Time & Date values have been entered into the non-volatile memory.

Setting Timers

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

1. Depress the "Enter" key on the LCD pad.
2. The LCD will display "Main Menu/Select Mode".

3. Depress "⇓" twice and the LCD will display "Main Menu/Set Timers".
4. Depress "Enter" this will select that you wish to set any or all of the timers.
5. The LCD displays "SET UP TIMERS/Select Timer: TDES".
6. To skip modifying a timer, depress "⇓" and the display will advance to the next timer.
7. Timers are displayed in the following order.
   NOTE: Several timers are optional. If the timer does not apply to your application, it will not be shown.
   a. TDES – Time Delay to Engine Start
   b. TDE – Time Delay to Emergency
   c. TDBT – Time Delay Before Transfer
   d. SPPT – Single Phase Protection Timer
   e. TDN – Time Delay in Neutral
   f. TDR – Time Delay to Return
   g. TDEC – Time Delay for Engine Cool Down
   h. MRT – Minimum Run Timer
   i. SFT – Synchronize Fail Timer
8. To change the TDES timer, depress "Enter".
9. The LCD displays "SET UP TIMERS/Set Time TDES: XXX sec".
10. The first digit of the available time range will be underlined.
11. Depress either "⇓" or "⇑" until the desired value is displayed.
12. Depress "Enter" to store value.
13. The LCD will sequence through all the timers in the same manner.
14. Repeat these steps to modify other timers.

Setting Plant Exerciser

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".

1. Depress the "Enter" key on the LCD pad.
2. The LCD displays "Main Menu/Select Mode".
3. Depress "⇓" three times.
4. The LCD displays "Main Menu/Set Up Plant Exerciser".
5. Depress "Enter".
6. The LCD displays "SET UP EXERCISER/Load? Yes : Start: XX:XX.
7. The first Letter of "Yes or No" will be underlined.
8. Depress either "⇓" or "⇑" to change between "Yes" or "No".
9. Depress "Enter".
10. This will advance the underlined text to the first digit of the start time (XX:XX).
11. Depress either "⇓" or "⇑" until the desired value is displayed.
12. Depress "Enter" to store value.
13. The LCD displays "SET UP EXERCISER/Duration (hh:mm): XX:XX.
14. The first digit of the hour and minute duration timer is underlined.
15. Depress either "⇓" or "⇑" until the desired value is displayed.
16. Depress "Enter" to store value.
17. Depress "Enter" until the LCD then displays "SET UP EXERCISER/Days (Caps = ON) : s m t w t f s".
18. Notice that the first character will be underlined.
19. Depress "⇓" or "⇑" to change the selected days case.
    a. Capital – Exercise Performed
    b. Lower Case – No Exercise
20. Depress "Enter" to store value.
21. Depress "Enter" until the LCD then displays "SET UP WEEKS OF MONTH (NUMBER = ON) : 1 2 3 4 5".
22. Notice that the first character will be underlined.
23. Depress "⇓" or "⇑" to change the selected number to a dot.

a. Number – Exercise Performed
b. Dot – No Exercise

24. Depress “Enter” to store value.

Setting Mode of Operation

1. Depress the “Enter” key on the LCD pad.
2. The LCD displays “Main Menu/Select Mode”.
3. Depress “Enter” and the LCD displays “MODE SELECT/AUTO”.
    a. To select “Manual” mode, depress “⇓” and the display will advance to the next mode of operation.
4. Depress “Enter” once the appropriate mode of operation has been selected.
5. 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.

AUTO – EXERCISE W/LOAD **08:25 Fri 1 APR, 2011**

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.

AUTO – EXERCISE W/LOAD **Awaiting TDES: 3 sec**

Figure 6

Whenever there is a fault, the operation of the switch is modified as described in section 4.2 **OPERATIONAL CONFIGURATION**. The LCD display scrolls through the recorded FAULTS/TROUBLES error message(s). Figure 7 shows a standard display of the controller displaying a Close Normal Failed fault.

FAULT – Close NOR failed **08:27 Fri 1 APR, 2011**

Figure 7

5. OPERATING MECHANISM

5.1. GENERAL INFORMATION

The operating mechanism, pictured in Figure 8 (page 24), is used in single motor operated, and dual motor operated 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 A, APPENDIX B and APPENDIX C 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 opens and closes 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.

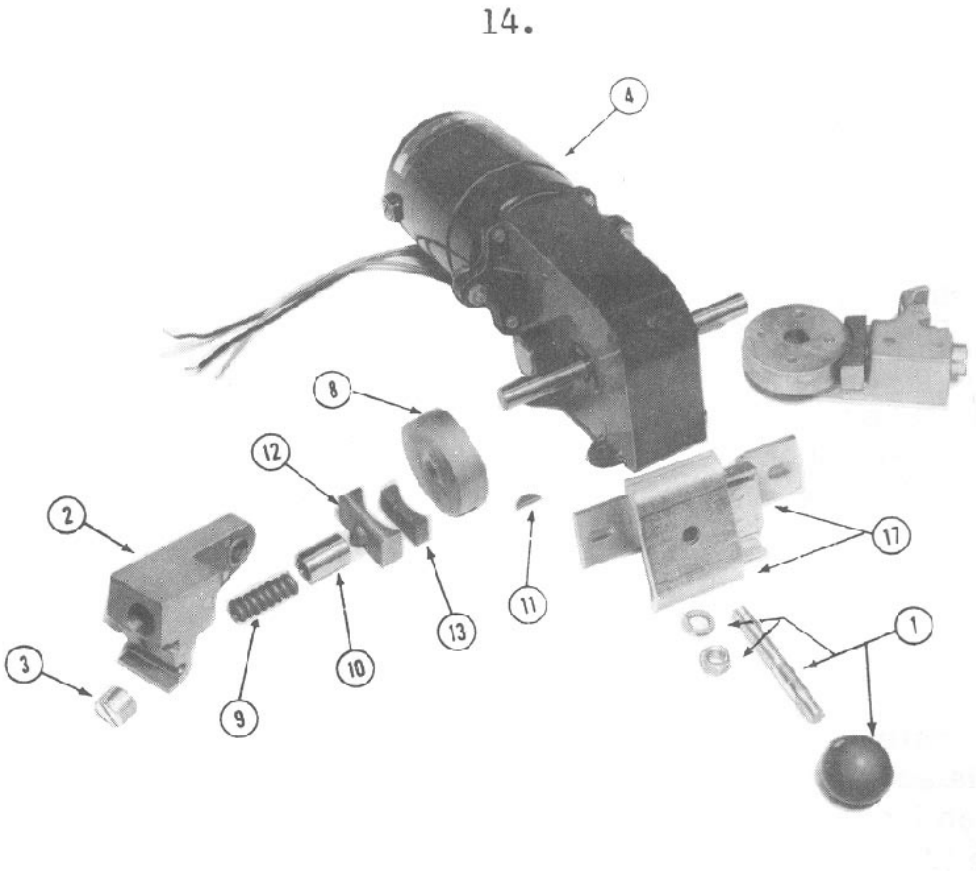

Figure 8

LEGEND

1. Manual Handle
2. Drive Arms
3. Adjustment Screw
4. Motor

8. Drive Drums
9. Spring
10. Drive Shoe Pivot
11. Drive Drum Keys
12. Drive Shoe
13. Drive Shore Lining

17. Lever Arm Mounting Bracket

6. MOLDED CASE SWITCHES

6.1. GENERAL INFORMATION

The molded case switches used in transfer switches are the standard devices supplied by molded case switch manufactures. Figure 9 (page 25).

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 9).

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 9

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.

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 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:

1. Remove protective black plugs (if present).
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.

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 HAZARDS 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. THIS 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 molded case transfer switch:

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 26.
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 MP7650 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 are correct, and that all accessory devices which are not imperative to switch operation either operate satisfactorily or are disconnected from 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. SINGLE MOTOR – 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) 12 or 24 Vdc 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 NOT 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 the NOR terminal located on 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. If 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 12 or 24 Vdc) 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 pin 16, 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.

5) 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 pin 17, 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 and must be replaced. 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.

3.) 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. Too 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 Single Motor 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 pin 19, but not across D3, the relay interface board has

failed and must be replaced. 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 and must be replaced. 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.

3.) 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.

8.2. DUAL MOTOR OPERATOR – 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) 12 or 24 Vdc 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 NOT 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. If 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 12 or 24 Vdc) 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 pin 16, 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 Dual Motor Operator Open Transition and Dual Motor Closed Transition.

   A 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, and then Normal must open.

   a) NORMAL FAILS TO OPEN – OPEN TRANSITION

      1.) For a Dual Motor 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 120 Vac 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 pin 20, 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.) 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 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 Dual Motor 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 120 Vac 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 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 pin 17, 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 an 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 Dual Motor 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 one to all of three things is wrong. (1)The two sources are not in sync; (2)the synchronizer is not functioning; and/or (3)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 120 Vac 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 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 pin 17, 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 4)a) 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 between terminals "input return" and "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 Single Motor Operator, Dual Motor Operator open transition and Dual Motor Operator closed transition.

A 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, and then Emergency must open.

a) EMERGENCY FAILS TO OPEN – OPEN TRANSITION

1.) For a Dual Motor 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 120 Vac 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.) 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 "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 pin 18, 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 an 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 Dual Motor 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 120 Vac 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 pin 19, 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 Dual Motor 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 one to all of three things is wrong. (1)The two sources are not in sync; (2)the synchronizer is not functioning; and/or (3)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 120 Vac 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 pin 19, 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 Same as 4)a) EMERGENCY FAILS TO OPEN – OPEN TRANSITION

9. OPTIONAL ACCESSORIES

Lake Shore Electric offers many additional accessories for the Single Motor Operator and Dual Motor Operator transfer switches. Please check the documents and drawings for your particular switch to see what additional options are included.

9.1. SERVICE ENTRANCE – SE

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:

1. Padlockable Enclosure
2. Over Current Trip and Bell Alarm for the Service Disconnect
3. LED Indication of Source "Tripped"
4. A Means to Disable the HMI Keypad
5. Neutral Bus with Main and Ground Lugs
6. Main Bonding Jumper per NEC 2002 250.8
7. 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 – GFP / GFPE / GFPL / GFI

This option provides ground fault detection in one of three places; 1) normal power, 2) emergency power, or 3) 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
08:29 Fri 1 APR, 2011

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. AUXILIARY CONTACTS BEFORE TRANSFER – ACBT

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, both sources are available, 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.

While this timer is timing out, its status will be displayed on the HMI LCD display.

AUTO – EXERCISE W/LOAD
Awaiting TDBT: 4 sec

Two form “C” contacts are provided on the Relay Interface Board and labeled EC.

9.4. SURGE SUPPRESSION TVSS – SPD

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 lightning 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 per Phase. No field installation is necessary.

9.5. REMOTE DISCONNECT – RD

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 a terminal block.

9.6. CIRCUIT BREAKER TRIPS – CBTN / CBTE

This option provides circuit breaker trips on either or both sides of the transfer switch. Trips will come complete with bell alarms and when tripped, the appropriate light will be illuminated on the HMI.

9.7. AUXILIARY CONTACTS SOURCE AVAILABLE – ACSA

This option provides two form “C” contact output on the Relay Interface Board for customer use. They are identified as “EMR” (Emergency Available) and “NOR” (Normal Available).

9.8. MAINTAIN LOAD TEST SWITCH – MLT

This option replaces the standard momentary Load Test Switch with a maintained switch. The option also comes with a parallel terminal block connection for remote connection.

9.9. LOAD DEMAND INHIBIT – LDI

This option provides an input to the transfer switch, which forces transfer from emergency to normal (or neutral if normal is not available) and prohibits the transfer to emergency when normal is not available. This option is used in conjunction with load demand control in associated Lake Shore Electric Paralleling Switchgear. The input is a two-wire connection as shown on the drawings.

9.10. PEAK SHAVE – PS

This option provides a terminal block input, which will initiate a transfer of the load to emergency. Should emergency fail, the switch will return to normal. This is typically used in conjunction with peak shaving Lake Shore Electric Paralleling Switchgear. The input is a two-wire connection as shown on the drawings.

9.11. MANUAL RETURN TO NORMAL – MRTN

This option eliminates the “TDR” (Time Delay to Return) timer. In its place a switch and a parallel terminal block are provided. When equipped with this option, the transfer switch will never return to the normal source unless the return is initiated by the depressing of the switch or closing the remote contacts. The input is only momentary (Between .5 and 1.0 seconds).

9.12. CLOSED TRANSITION TRANSFER – CTT

This option provides for a closed transition (make before break) transfer from normal to emergency when both sources are available and a closed transition transfer from emergency to normal to complete the transfer cycle.

Included with this option is a timer "SFT" (Synchronize Fail) timer. This timer when timing will be displayed on the HMI LCD as shown here.

AUTO – EXERCISE w/LOAD
Awaiting Synchronization

Should the timer time out before the transfer is made, the HMI display will show the following and the trouble contacts will change state. This is not considered a fault mode; therefore the automatic operation of the transfer switch will not be terminated. However, as long as both sources are available, and the sync check relay has detected a match in the phase angles of those two sources, the transfer will not be completed. The operator can clear this message by pressing "Enter" and then select "Clear Trouble". The operator can also program the MP7650 to continue to try for a closed transition transfer or to do an open transition transfer when this timer times out. This also "Drops Out" the trouble relay to annunciate that this transfer switch requires attention.

AUTO – EXERCISE w/LOAD
TROUBLE: SFT Timed Out

As a safeguard, the Closed Transition Transfer Option provides a sync check relay and a reverse power relay for each source. In the event that both sources might be left in the closed position due to some form of a malfunction, the reverse power relays will sense a reverse power flow condition, if present, and trip/cross trip both sources. This will place the transfer switch in a fault condition and de-energize the trouble relay. The HMI panels will then display the following message along with the appropriate reverse power pilot light.

FAULT – Reverse Power
08:24 Fri 1 APR, 2011

9.13. BATTERY CHARGER – BC

This option provides a 12Vdc battery and charger kit for the MP7650 processor controls. It will automatically fix the transfer switch code to "M" for the relay DC voltage. Please refer to the transfer switches schematics for reference.

9.14. DUAL PRIME SOURCE – DPS

This option allows for selection between two utilities to provide power. A selector switch is provided to indicate which source is preferred when both are available. The MP7650 detects this input and constantly monitors for the preferred source.

9.15. MULTIFUNCTION METER – MFM

This option provides a multifunction meter on the load output that may be setup to monitor single or three phase systems. For three phase transfer switches, the unit can be setup to monitor delta or wye, 3-wire or 4-wire, systems. The unit measures the following:

1. Phase Voltage (V)
2. Phase to Neutral Voltage (V)
3. Phase Current (I)
4. Frequency (Hz)
5. Active Power (W)
6. Active Energy (kWh)
7. Reactive Power (VAR)
8. Apparent Power (VA)
9. Reactive Energy (VARh)

10. Power Factor (PF)
11. Instantaneous Amp Demand
12. Instantaneous Watt Demand
13. Instantaneous VA Demand
14. Maximum Amp Demand
15. Maximum Watt Demand
16. Maximum VA Demand

If communications are required for the meter, an RS-485 module is provided. If other communications protocols are needed, a conversion module may be used convert the RS-485 to the appropriate protocol. Please consult the factory for the appropriate converter.

9.16. PHASE SEQUENCE MONITOR – PSM

This option provides a visual indicator on the door of the transfer switch that shows the phase sequence of the bus that it is monitoring. Consult the factory for the various locations this equipment may be located.

9.17. STRIP HEATER – SH

This option provides heaters with an adjustable thermostat inside the enclosure of the transfer switch. The purpose is to help control condensation on the control equipment. When installing the transfer switch, it is important to make sure that all cables coming into the enclosure have the proper sealant installed around them.

9.18. SINGLE PHASE PROTECTION – SPP

This option provides a phase sequence and voltage sensing relay, PSR, in place of the standard voltage sensing relay, PFR. These relays come in various voltage configurations, so consult the wiring diagrams of a specific unit for additional details. The units are available as “Under Voltage” pick up only or “Over and Under Voltage” pick up. Please make sure to specify voltage pick up type when ordering this option.

This protective relay will be placed on the normal side breaker, but may be included on the emergency side breaker as well. The PSR provides a set of form “C” contacts that are used as inputs to the MP7650 for equipment control.

9.19. FIRE PUMP CONTROLLER – FPC

The Fire Pump Control accessory includes all features necessary for a Lake Shore Dual Motor Automatic Transfer Switch to meet or exceed NFPA 20 (Chapter 10), U.L. 1008 and NEMA ICS 227-47 requirements for an Automatic Transfer Switch to be used in a Fire Pump Circuit.

NFPA 20 requires the Automatic Transfer Switch to be a self-contained power switching assembly, housed in a separate enclosure. The transfer switch is dedicated to the fire pump load exclusively and is both electrically or manually operable and mechanically held.

An Isolating Switch, located within the Transfer switch enclosure and externally operable, is provided ahead of the input terminals of the emergency side of the switch.

9.20. ELECTRICAL ASSIST – EA

This option is included when operation of the breakers is required without opening the front door of a manual transfer switch. This will provide four push buttons for external breaker operation. The buttons are as follows:

1. Open Normal
2. Open Emergency
3. Close Normal
4. Close Emergency

NOTE: The Normal and Emergency breakers may not be closed at the same time, but they may both be open at the

same time.

9.21. PILOT LIGHTS – PL

This option provides pilot lights on the door of the transfer switch which indicate the current position of the normal and emergency breakers and when a source is available. This option is typically used in conjunction with a manual transfer switch which has the electrical assist option.

10. APPENDIXES

10.1. APPENDIX A

Tension Adjustment for Transfer Mechanism of Lake Shore Electric Transfer Switch

Refer to Figure 8, Page 24

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, use a marker to 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 lose 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.

10.2. APPENDIX B

***FIELD CABLE SIZE & LUG TORQUE REQUIREMENTS**
USE COPPER WIRE ONLY
LINE-LOAD-NEUTRAL UNLESS OTHERWISE SPECIFIED

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. TORQUE – SOCKET HEAD SCREWS

Socket Size (inches)	
Across Flats	**Torque (LB-IN.)**
1/8	45
5/32	100
3/16	120
7/32	150
1/4	200
5/16	275
3/8	375
1/2	500
9/16	600

Warning: Whenever bus and cable connections are being maintained, all power sources to the transfer switch must be disconnected and locked out.

10.3. 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.

I. EATON (CUTLER-HAMMER) LUG TO MOLDED CASE SWITCH

K – Frame	6 – 8 LBS. – FT.
L – Frame	6 – 8 LBS. – FT.
N – Frame	31.25 – 37.5 LBS. – FT.

II. EATON (CUTLER-HAMMER) TRIP TO MOLDED CASE SWITCH

K – Frame	6 – 8 LBS. – FT.
L – Frame	10 – 12 LBS. – FT.
N – Frame	N/A Electronic Trip Unit

10.4. APPENDIX D

FOR FUTURE USE

10.5. APPENDIX E

FOR FUTURE USE