

**INSTALLING, OPERATING AND MAINTAINING**

**VCP-T VACUUM BREAKER  
FIXED AND DRAW OUT**

**AUTOMATIC TRANSFER SWITCHES**

**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 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 **Section #9 REQUIRED MAINTENANCE** of this manual in order to maintain Lake Shore Electric Corporation's one year exclusive warranty. Failure to perform this maintenance shall void this warranty.

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**NOTE**

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

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

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## 1. CONSTRUCTION

Vacuum Breaker Transfer Switches manufactured by Lake Shore Electric Corporation use two stored energy vacuum breaker switches and/or circuit breakers to accomplish the transfer between two separate power sources to a single load.

These vacuum breaker(s) and/or switch/switches are interlocked via electrical and mechanical control systems.

The MP7650 Controller combined with an auxiliary contact switch located on the vacuum breaker unit encompasses the electrical interlock system.

The mechanical cable interlock installed between the vacuum units encompasses the mechanical interlock system. The mechanical interlock is located on the right side of the two switches. This mechanism is a factory-installed device, which positively prevents both of the vacuum breaker switches or circuit breakers from being in the **ON** position simultaneously.

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

Manually operable push buttons are accessible from the front of the switch to enable personnel to manually operate the transfer switch should this become necessary. These pushbuttons are permanently mounted and readily accessible in an emergency. This transfer switch can be manually operated under load.

All interface relays are of the enclosed industrial type to ensure long life and minimum maintenance. All relays are rated for continuous duty to eliminate overheating of coils.

The 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 Vacuum Breaker Transfer Switches. Certain accessory additions may modify the sequence of operations as required to suit specific applications.

The Vacuum Breaker Automatic Transfer Switch utilizes the internal motor of each of the normal and emergency switches for its operation. Normally, the transfer switch operates on the preferred power source with the normal switch in the closed position and the emergency switch in the open position.

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 nescience tripping. 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, (emergency side), frequency and voltage outputs. 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 engine.
5. TDN – Time Delay in Neutral allows the normal side to complete the transition from the closed to open state for the normal side vacuum breaker unit. Upon completion of the timer, the emergency will then transition from the open to close state for the emergency side vacuum breaker 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 to complete the transition from the closed to open state for the emergency side vacuum breaker unit. Upon completion of the timer, the normal will then transition from the open to close state for the normal side vacuum breaker 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.

**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.

For those Transfer Switches built as Draw Out switches, additional safety and reliability is provided. The transfer switch itself inherently functions to bypass either source by connecting the alternate source to the load. By offering the draw out feature, either or both of the vacuum breaker switches can be withdrawn, thereby isolating them from live parts. This allows maintenance, service or replacement of the switch without loss of service to the load or danger to the maintenance personnel. Please refer to the VCP-T manual, provided with each Vacuum breaker Automatic Transfer Switch, for detailed instruction on the operation of these products.

Note: When draw out transfer switches are placed in the test position, they are considered to be “not in automatic”



notwithstanding the HMI display of the Mode of Operation. See page 14, 4.2, **OPERATIONAL CONFIGURATION**.

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

The Vacuum Breaker Automatic Transfer Switch is also effectively used for Closed Transition Transfer Switches because the independent motor design allows the necessary condition of having both switches in the on position so that the load is momentarily connected to both sources when they are synchronized providing a “make before break” transfer.

### **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.

Vacuum Breaker Transfer Switches are manufactured in free standing enclosures with NEMA enclosure ratings of 1, 3, 3R, 12, 4 and 4X. Open transfer switches are generally mounted in a customer-supplied enclosure; consequently, there are certain steps, which should be followed:

1. Allow adequate space for placement of the control panel and HMI.
2. Mount to a rigid framework to prevent vibration.
3. Review all electrical clearances with the enclosure door or panels closed.
4. Insure there is no strain on the bus bars 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 Corporation.

The Normal source power cables are to be connected to the Normal Bus extensions marked NL1, NL2, and NL3. Please refer to the specific wiring diagram supplied with the switch.

The Emergency source power cables are to be connected in a like manner to the Emergency bus extensions 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 to be connected to the load bus extensions marked L1, L2 and L3. On three-phase, four-wire transfer switches, or single-phase, three-wire transfer switches, a neutral bus is provided.

**Note:** Verify that the phase sequence of normal and emergency sources, are identical. Failure to do this could result in damage to the transfer switch and/or 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. Ground lugs are provided on all transfer switches. These lugs **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 Section 9, REQUIRED MAINTENANCE.

Connect DC voltage source and start contacts. Please refer to section 4.3 installation.

There are numerous accessories available on Lake Shore Electric Corporation 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** and Emergency Breaker **Open**) and energize the normal source. The red LED on the Voltage Sensing Relay should be lighted, indicating that the normal source is available and within the pick-up setting of the relay. If this does not light (i.e. pick up), place a voltmeter on the normal source to be sure that the voltage is adequate and within the range of the relay. The switch will not operate on a voltage other than that stamped on the nameplate of the transfer switch.

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

All MP7650 controlled Transfer Switches have a “Load Test” operating mode which is menu selectable at the HMI panel. 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 should 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.

## 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. It is designed to function on the engine starting batteries. Voltage regulation for the power supply is within 2% 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. This is a negative ground system. The board has provision to accommodate a large external “hold-up” capacitor for installations that may experience momentary input-voltage dropouts or reversals. 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

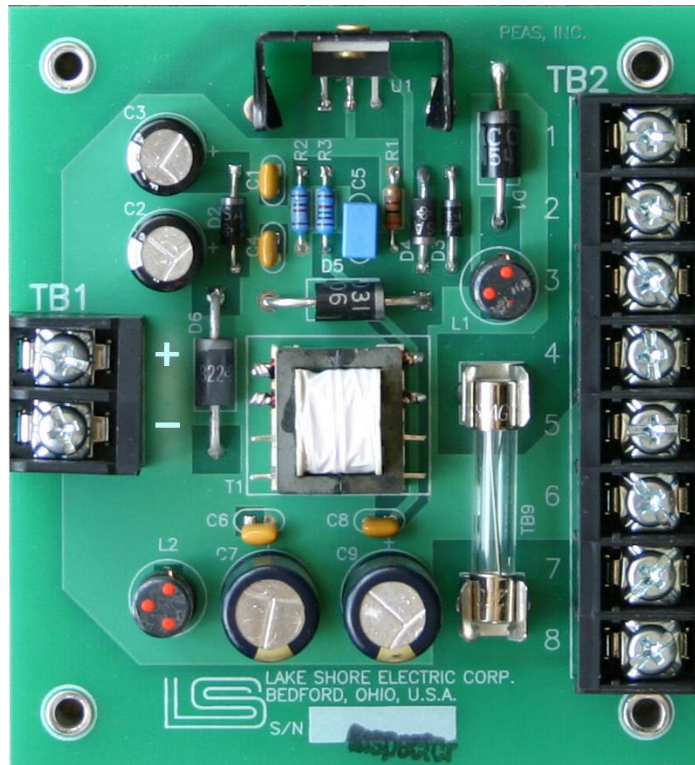


Figure 1

## 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 | TRBL | Trouble             |
| EMR | Emergency Source Available   | EC   | Transfer Pre-signal |
| SIN | Switch in Normal Position    |      |                     |
| NOR | Normal Source Available      |      |                     |
| ES  | Engine Start                 |      |                     |

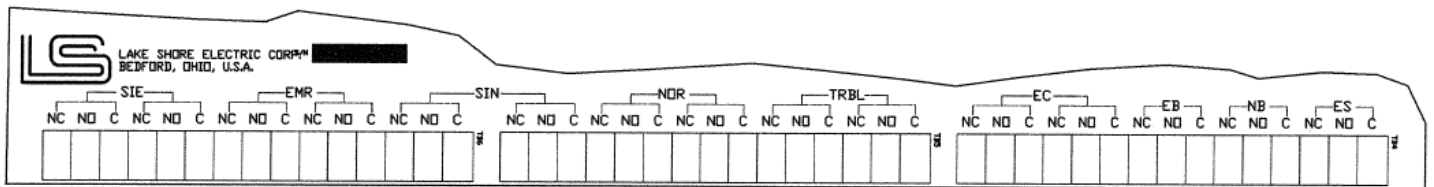
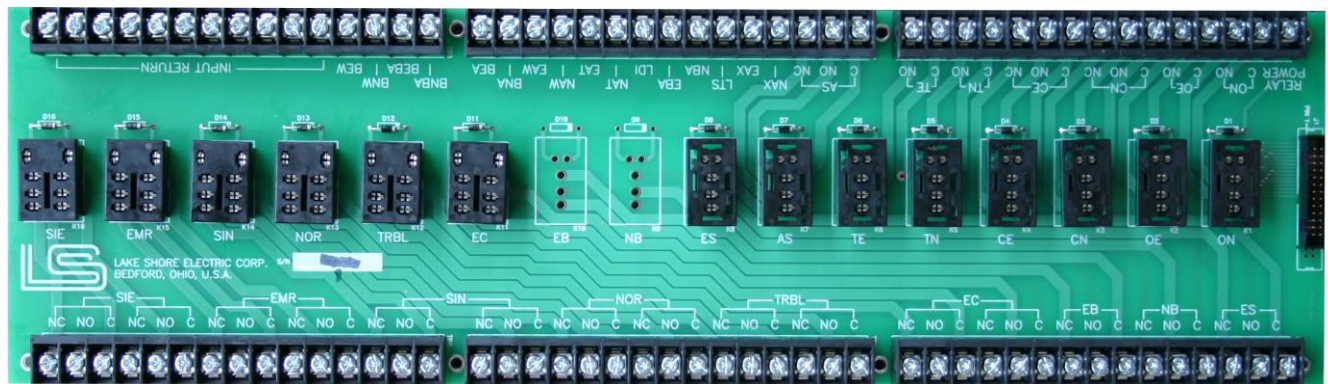


Figure 2

### Main Control Board (Figure 3)

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

There are no user serviceable components in the MCB. 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.

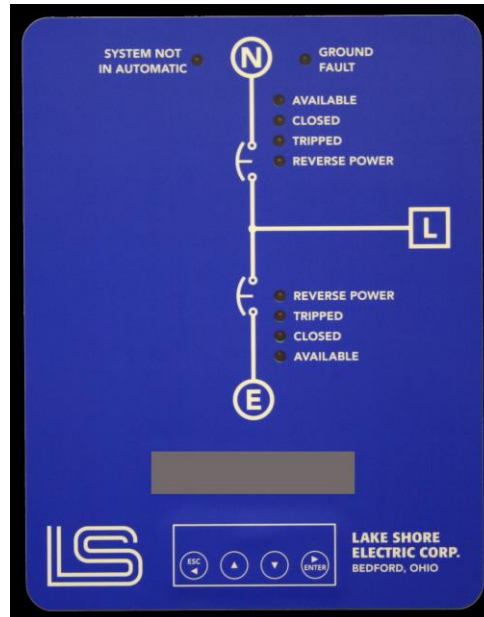


Figure 4

### 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 for this configuration. Three 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 9 faults and 3 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. **TROUBLE – REVERSE POWER**  
Upon receiving a reverse power, an vacuum breaker transfer switch continues operating as an open transition switch with the trouble code stored until cleared by an operator.  
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. **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 Generators)

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 minutes and is FACTORY SET AT 10 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. On vacuum breakers this operates without any operator intervention because opening and tripping the breaker are the same mechanism and the breaker does not need to be reset.

\* 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. Weeks 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 in 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 customer 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 cursor 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 displays the appropriate error message. 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 (VACUUM SWITCH / BREAKER)

The operating or switching mechanisms used in the Vacuum Breaker Transfer switches are Cutler-Hammer Type VCP Vacuum automatic and non-automatic circuit breakers. The Cutler-Hammer devices may be non-automatic, automatic, fixed or draw-out as required by the transfer switch configuration. See the Cutler-Hammer Type VCP Vacuum Circuit Breaker O & M manual provided with the Vacuum Breaker Transfer Switch for necessary technical information on these products. If additional information is necessary, please contact the factory; call 800-225-0141.



**Figure 8 - Cutler-Hammer VCP-T Medium Voltage Circuit Breaker**

## **6. VOLTAGE RELAYS**

### **6.1. 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.

## **6.2. 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.



## 7. 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 EXISTS. 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 an Vacuum Breaker 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 23.
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
4. The Molded Case Switches
5. The Adjustment of the Operating Mechanism
6. 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.

### 7.1. NORMAL POWER FAILS – ENGINE DOES NOT START

- 1) Verify:
  - a) Maintenance Disconnect Switch (if applicable) is in the “NORMAL” position.
  - b) LCD Display indicates that the ATS is in the “AUTOMATIC” position.
  - c) 12VDC or 24VDC is available on the control circuit input terminals to the ATS.
- 2) Check the fuse in the DC circuit. Verify that DC voltage is available from either side of the fuse to battery negative. If not, replace the fuse.
- 3) Look at the diagnostic LED’s on the main controller board. Verify that the LED labeled “NOR” is 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 12VDC or 24VDC) across diode D8 on the Relay interface board.
  - a) If there is no voltage on diode D8, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 16. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 16. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but, not across D8, the relay interface board has failed.
  - b) If there is voltage available on D8 continue to the next step.
- 6) Verify that the “ES” relay is functioning. Remove the wires from C and NO for the ES relay on the Relay Interface Board. Place 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, 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 C and NO of the ES Relay 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.

## 7.2. ENGINE STARTS – AUTO TRANSFER SWITCH WON'T 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) are 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 or 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 between Open Transition and Closed Transition.

A Vacuum Breaker Transfer Switch 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 Vacuum Breaker Automatic Transfer Switch "ON" (open normal) will begin the transfer to emergency. If the Normal Vacuum 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 control voltage at the "C" and "NO" terminals of the "ON" relay on the Relay Interface Board to common – (common is neutral or ground). There are three possibilities:
  - a.) Control 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.
  - b.) Control voltage is only available on the "C" or "NO" terminal but not both. This indicates that the "ON" relay is not closed. Check for DC voltage across D1.

- (1) If there is no voltage on D1, the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 20. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 20. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D1, the relay interface board has failed. If there is nominal DC voltage across D4, continue to the next step.
  - (2) Verify that the “ON” relay is functioning. Remove the wires from C and NO for the ON relay on the Relay Interface Board. Place 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 is bad. Now reconnect the wires from C and NO for the ON relay on the Relay Interface Board. This should resolve the problem.
- c.) Control Voltage is available on both “C” and “NO” terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the normal switch open coil C1 & C2 and the wiring between the Relay Interface Board and the open coil of the Vacuum Switch.
- b) EMERGENCY FAILS TO CLOSE – (OPEN TRANSITION)
- 1.) For a Vacuum Breaker Automatic Transfer Switch “CE” (close emergency) will complete the transfer to emergency. If the Emergency Vacuum Switch remains open verify that the “CE” LED on the main control board is on. If the “CE” LED is not on, the main control board has failed. If the “CE” LED is on continue to the next step.
  - 2.) Verify that the CE relay on the Relay Interface Board is working by measuring 120VAC nominally at the “C” and “NO” terminals of the CE relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:
    - a.) 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.
    - 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, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 17. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 17. If voltage is not present on this pin of

the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D4, the relay interface board has failed. If there is nominal DC voltage across D4, continue to the next step.

- (2) Verify that the “CE” relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place 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 is 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 emergency switch close coil and the wiring between the Relay Interface Board and the Emergency Switch close coil.

c) EMERGENCY FAILS TO CLOSE – (CLOSED TRANSITION)

- 1.) For a Vacuum Breaker 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 its contact lighting up the “SYNC” LED on the main control board. If this LED is not lit, the two sources are not in sync, the synchronizer is not functioning and/or the main control board has failed. To verify it is not the control board, remove the “CE” (close emergency) relay from the relay interface board to prevent the Emergency Vacuum 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 Vacuum Switch remains open verify that the “CE” LED on the main control board is on. If the “CE” LED is not on, the main control board has failed. If the “CE” LED is on continue to the next step.
- 4.) Verify that the CE relay on the Relay Interface Board is working by measuring 120VAC nominally at the “C” and “NO” terminals of the CE relay on the Relay Interface Board to common – (common is neutral or ground). 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.
  - 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, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 17. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 17. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D4, the relay interface board has failed. If there is nominal DC voltage across D4, continue to the next step.
  - (2) Verify that the “CE” relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place 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 is 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 emergency switch close coil and the wiring between the Relay Interface Board and the Emergency Switch close coil.
- d) NORMAL FAILS TO OPEN – (CLOSED TRANSITION)
- Same as 4)a) NORMAL FAILS TO OPEN – OPEN TRANSITION

### **7.3. AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO NORMAL**

- 1) Check for proper voltage on the utility input. This should be measured at the input terminals to the Automatic Transfer Switch NL1, NL2, and NL3. If the voltage of the utility is incorrect, contact the local utility company. If the utility has the proper output voltage, continue to the next step.
- 2) Check to see that the Phase Failure Relay (PFRN) is energized. The PFRN has a red LED to indicate that it is energized. If not energized review connections from generator input to the PFRN relay. If energized continue to next step.
- 3) Look at the diagnostic LED’s on the main controller board. Verify that the LED labeled “NOR” (Normal On Relay) is on.
  - a) If the LED is not on, either the PFRN has a failed output contact or the main control board has failed. To determine what has failed, place a jumper on the main control board from terminal “input return” to “NOR”. If the “NOR” LED turns on, the PFRN output contact has failed. If the “NOR” LED remains off, the main control board has failed.
  - b) If the LED is on, continue to the next step.
- 4) Check to see that the switches have been given a signal to open and close. This step varies between an open transition and closed transition switch.

A Vacuum Breaker Transfer Switch 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 Vacuum Breaker Automatic Transfer Switch “OE” (open emergency) will begin the transfer to normal. If the Emergency Vacuum 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 control power at the “C” and “NO” terminals of the “OE” relay on the Relay Interface Board to common – (common is neutral or ground). There are three possibilities:
  - a.) Control 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.
  - b.) Control voltage 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, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 18. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 18. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D2, the relay interface board has failed. If there is nominal DC voltage across D2, continue to the next step.
    - (2) Verify that the “OE” relay is functioning. Remove the wires from C and NO for the ON relay on the Relay Interface Board. Place 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 is bad. Now reconnect the wires from C and NO for the OE relay on the Relay Interface Board. This should resolve the problem.
  - c.) Control voltage is available on both “C” and “NO” terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the emergency switch open coil and the wiring between the Relay Interface Board and the emergency switch open coil.

b) NORMAL FAILS TO CLOSE – (OPEN TRANSITION)

- 1.) For a Vacuum Breaker Automatic Transfer Switch “CN” (close normal) will complete the transfer to normal. If the Normal Vacuum Switch remains open verify that the “CN” LED on the main control board is on. If the “CN” LED is not on, the main control board has failed. If the “CN” LED is on continue to the next step.
- 2.) Verify that the CN relay on the Relay Interface Board is working by measuring 120VAC nominally at the “C” and “NO” terminals of the CN relay on the Relay Interface Board to common – (common is neutral or ground). 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.
  - 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, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 19. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the Relay Interface Board on J1 pin 19. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D3, the relay interface board has failed. If there is nominal DC voltage across D3, continue to the next step.
    - (2) Verify that the “CN” relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place 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 is 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 normal switch close coil and the wiring between the Relay Interface Board and the normal switch close coil.
- c) NORMAL FAILS TO CLOSE – (CLOSED TRANSITION)
  - 1.) For a Vacuum Breaker 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 its contact lighting up the “SYNC” LED on the main control board. If this LED is



not lit, the two sources are not in sync, the synchronizer is not functioning and/or the main control board has failed. To verify it is not the control board, remove the “CN” (close normal) relay from the relay interface board to prevent the Normal Vacuum 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 Vacuum Switch remains open verify that the “CN” LED on the main control board is on. If the “CN” LED is not on, the main control board has failed. If the “CN” LED is on continue to the next step.
- 4.) Verify that the CN relay on the Relay Interface Board is working by measuring 120VAC nominally at the “C” and “NO” terminals of the CN relay on the Relay Interface Board to common – (common is neutral or ground). 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.
  - 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, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 19. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 19. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D3, the relay interface board has failed. If there is nominal DC voltage across D3, continue to the next step.
    - (2) Verify that the “CN” relay is functioning. Remove the wires from C and NO for the CN relay on the Relay Interface Board. Place 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 is 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 normal switch close coil and the wiring between the Relay Interface Board and the normal switch close coil.

d) EMERGENCY FAILS TO OPEN – (CLOSED TRANSITION)

Same as 4)a) EMERGENCY FAILS TO OPEN – OPEN TRANSITION

## **8. OPTIONAL ACCESSORIES**

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

### **8.1. 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

## 8.2. 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.

## 8.3. 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.

#### **8.4. 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.

#### **8.5. 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.

#### **8.6. 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.

#### **8.7. 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).

#### **8.8. 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.

#### **8.9. 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 on the Relay Interface Board and is marked “LDI”.

#### **8.10. 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 to terminal blocks marked as shown on the drawings.

#### **8.11. 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).

#### **8.12. 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 energize the trouble relay. The HMI panels will then display the following message along with the appropriate reverse power pilot light. The transfer switch will continue to operate as an open transition transfer switch if this occurs.

**TROUBLE – Reverse Power  
08:24 Fri 1 APR, 2011**

### **8.13. BATTERY CHARGER – BC**

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

### **8.14. 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.

### **8.15. 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)            | 6. Active Energy (kWh)    | 11. Instantaneous Amp Demand  |
| 2. Phase to Neutral Voltage (V) | 7. Reactive Power (VAR)   | 12. Instantaneous Watt Demand |
| 3. Phase Current (I)            | 8. Apparent Power (VA)    | 13. Instantaneous VA Demand   |
| 4. Frequency (Hz)               | 9. Reactive Energy (VARh) | 14. Maximum Amp Demand        |
| 5. Active Power (W)             | 10. Power Factor (PF)     | 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.

#### **8.16. 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.

#### **8.17. 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.

#### **8.18. 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.

#### **8.19. 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.

#### **8.20. 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.

**9. REQUIRED MAINTENANCE**

**LUG TORQUE REQUIREMENTS - USE COPPER WIRE ONLY  
LINE-LOAD-NEUTRAL**

**The following cable lug torque values are required to be checked at installation and every six months in order to maintain the Lake Shore Electric Corporation exclusive one year warranty.**

***TIGHTENING TORQUE VALUES***

**FOR  
SCREW CONNECTIONS**

AWG. Or Circular Mill Size	Tighten Torque in Inch Pounds	
	Screw Driver	External Drive Wrench
14	35	75
12	35	75
10	35	75
8	40	75
6	45	110
4	45	110
2	50	150
1	50	150
1/0	50	180
2/0	50	180
3/0		250
4/0		250
250		325
350		325
500		375
600		375
700		375
750		375
800		500
1000		500

***TIGHTENING TORQUE VALUES***

**FOR  
SOCKET-HEAD SCREW CONNECTORS**

Internal Socket Size Across Flats Inches	Tightening Torque in Inch Pounds
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.