Operation/Installation/Service

DETROIT DIESEL®

mtu

Automatic Transfer Switches

Models:

DSE TS 870

Power Switching Device:
Service Entrance Rated
100–1200 Amperes

Electrical Controls:
TSC 80

DETROIT DIESEL ISO CERTIFIED ORGANIZATION 9001 CORPORATION

MP-6295 11/06c

Product Identification Information

Transfer Switch Identification Numbers

Record the product identification numbers from the transfer switch nameplate.

Product Code _____

Serial Number _____

Accessory	Accessory Description

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IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. SAVE THESE INSTRUCTIONS.

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

⚠ DANGER

Danger indicates the presence of a hazard that ***will cause severe personal injury, death***, or ***substantial property damage***.

⚠ WARNING

Warning indicates the presence of a hazard that ***can cause severe personal injury, death,*** or ***substantial property damage***.

⚠ CAUTION

Caution indicates the presence of a hazard that ***will*** or ***can cause minor personal injury*** or ***property damage***.

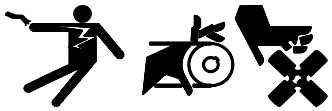
NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Hazardous Voltage/ Electrical Shock

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Close and lock the transfer switch enclosure door before connecting power sources.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Open the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Making line or auxiliary connections. Hazardous voltage can cause severe injury or death. To prevent electrical shock deenergize the normal power source before making any line or auxiliary connections.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically. *(600 volts and under)*

Transfer switch service disconnect. Hazardous voltage can cause severe injury or death. Move the service disconnect switch to the DISCONNECTED position and verify that the transfer switch mechanism is in the neutral position before servicing the transfer switch. *(100-1200 Amp service entrance models with molded-case power switching units.)*

Transfer switch service disconnect. Hazardous voltage can cause severe injury or death. Move the service disconnect switch to the DISCONNECTED position and verify that both the utility and generator set power switching devices are open before servicing the transfer switch. *(800-4000 Amp service entrance models with insulated-case power switching units.)*

Heavy Equipment

⚠ WARNING

Unbalanced weight.
Improper lifting can cause severe injury or death and equipment damage.

Use adequate lifting capacity.
Never leave the transfer switch standing upright unless it is securely bolted in place or stabilized.

Moving Parts

⚠ WARNING

Airborne particles.
Can cause severe injury or blindness.

Wear protective goggles and clothing when using power tools, hand tools, or compressed air.

Notice

NOTICE

Hardware damage. The transfer switch may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of the bolt heads and nuts.

NOTICE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. To indicate hardness, American Standard hardware uses a series of markings, and metric hardware uses a numeric system. Check the markings on the bolt heads and nuts for identification.

NOTICE

Foreign material contamination. Cover the transfer switch during installation to keep dirt, grit, metal drill chips, and other debris out of the components. Cover the solenoid mechanism during installation. After installation, use the manual operating handle to cycle the contactor to verify that it operates freely. Do not use a screwdriver to force the contactor mechanism.

NOTICE

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

This manual provides operation and installation instructions for DDC/MTU Power Generation Model DSE TS 870 service entrance rated automatic transfer switches with TSC 80 controls.

DDC/MTU Power Generation transfer switches are used to provide a continuous source of power for lighting and other critical loads by automatically transferring from Source 1 power to Source 2 power in the event that Source 1 voltage falls below preset limits.

Voltage sensing and system control is performed via a state-of-the-art microcontroller located on the cabinet door. It is designed to give highly accurate control of the transfer switch system.

All DDC/MTU Power Generation service entrance rated transfer switches are designed for use on emergency or standby systems, and are rated for total system or motor loads. Transfer switches are UL listed under Standard 1008 and CSA certified under Standard C22.2 No. 178.

Information in this publication represents data available at the time of print. The manufacturer of DDC/MTU Power Generation products reserves the right to change this literature and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

The equipment service requirements are very important to safe and efficient operation. Inspect parts often and perform required service at the prescribed intervals. Obtain service from an authorized service distributor/ dealer to keep equipment in top condition.

List of Related Materials

A separate operation/installation/service manual covers information specific to the transfer switch's electrical controls. The following table lists the related document part numbers.

Document Description	Part Number
TSC 80 Controller Operation/Installation/Service	MP-6296
SDM Instructions	TT-1408

Service Assistance

For professional advice on generator set power requirements and conscientious service, please contact your nearest DDC/MTU Power Generation distributor.

- Consult the Yellow Pages under the heading Generators—Electric
- Visit the DDC/MTU Power Generation website at ddcmtupowergeneration.com
- Look at the labels and stickers on your DDC/MTU Power Generation product or review the appropriate literature or documents included with the product

1.1 General Description

The TS 870 series automatic transfer switches employ two mechanically interlocked enclosed contact power switching units and a microprocessor-based controller to automatically transfer system load to a generator supply in the event of a utility supply failure. System load is then automatically retransferred back to the utility supply following restoration of the utility power source to within normal operating limits.

The standard TS 870 series automatic transfer switch is rated for 100% system load. The DDC/MTU Power Generation TS 870 automatic transfer switch is supplied with optional integral overcurrent protection within the enclosed contact power switching units for applications such as service entrance rated equipment. Refer to Section 3 for detailed information on overcurrent protection.

The TS 870 series transfer switches use a type TSC 80 microprocessor-based controller that provides necessary control functions for fully automatic operation. The TSC 80 controller is mounted on the door of the transfer switch enclosure and operating status is shown via LED lights. For further information on the TSC 80 transfer controller, refer to separate instruction manual.

The power switching devices used for the utility and generator sources are operated by an electrically driven motor mechanism in the transfer switch. The transfer switch motor utilizes the power from the source to which the electrical load is being transferred. The mechanism provides a positive mechanical interlock to prevent both power switching units from being closed at the same time, allowing an interrupted break-before-make transfer sequence. The TSC 80 transfer controller provides a standard neutral position delay timer to allow adequate voltage decay during transfer operation to prevent out of phase transfers.

Note: For the purpose of this manual, the following standard nomenclature is utilized:

- Utility to indicate the source of primary power.
- Generator to indicate the source of standby power.
- Power switching device to indicate the transfer switch power switching device.

1.2 Environmental Conditions

Caution. Failure to store and operate equipment under the specified environmental conditions may cause equipment damage and void warranty.

1.2.1 Equipment Storage

Store the transfer switch in an environment with a temperature range not exceeding –20°C to 70°C (–4°F to 158°F) and a humidity range not exceeding 5%–95% non-condensing. Before storing, unpack sufficiently to check for concealed damage. If concealed damage is found, notify the ATS supplier and the carrier immediately. Repack with the original, or equivalent, packing materials. Protect from physical damage. Do not stack. Store indoors in a clean, dry, well-ventilated area free of corrosive agents including fumes, salt, and concrete/cement dust. Apply heat, as necessary, to prevent condensation.

1.2.2 Equipment Operation

Operate the transfer switch in an environment with a temperature range not exceeding –15°C to 50°C (–5°F to 122°F) and a humidity range not exceeding 5%–95% non-condensing.

1.3 Product Code

The type of TS 870 transfer switch supplied is identified by a 21-digit product code that appears on the equipment rating plate (MODEL) on the door of the transfer switch and on the transfer switch drawings. The product code structure and definitions are shown in Figure 1-1.

1.4 Dimensions

Refer to the dimension drawing provided with the transfer switch for enclosure dimensions.

Product Code

Interpret the product code for your transfer switch configuration as indicated below. Accessories are specified separately.

T	S		8	7	3	A	0	6	0	0	B	1	A	E	1	D	N	N	A	A
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

1-3. Series
TS: Transfer switch

4-5. Model
87: 870 switch

6. Poles
2: 2 pole
3: 3 pole
4: 4 pole

7. Configuration Type
A: ATS

8-11. Current Rating
in amperes:

0100	0600
0150	0800
0200	1000
0250	1200
0400	

12. Application
B: Service entrance

13. Operation Type
1: Open transition

14. Certification
A: UL 1008

15. Voltage
1-phase 3-wire:
D: 120/240

3-phase 4-wire (grounded neutral):
E: 120/208
G: 120/240 (delta)
M: 277/480

3-phase 3-wire:
P: 208
R: 240
V: 480

16. Controller:
1: TSC 80

17. Enclosure Type
A: NEMA 1 ASA #61 GREY
C: NEMA 12 ASA #61 GREY
D: NEMA 3R SD ASA #61 GREY
E: NEMA 3R DD ASA #61 GREY
F: NEMA 4X, STAINLESS STEEL

18. Utility Switching Device
M: Molded case switch w/ther-mag trip 100-200 A
N: Molded case switch w/electronic trip 250-800 A
P: Molded case switch w/electronic and GF trip 250-1200 A

19. Generator Switching Device
K: Molded case switch 100-1200 A
M: Molded case switch w/ther-mag trip 100-200 A
N: Molded case switch w/electronic trip 250-800 A
P: Molded case switch w/electronic and GF trip 250-1200 A

20. Power Connections
A: Standard

21. Connection Configuration
A: Standard

Figure 1-1 Product Code Structure and Definitions

1.5 Installer Notes

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Open the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (–) leads first. Reconnect negative (–) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Making line or auxiliary connections. Hazardous voltage can cause severe injury or death. To prevent electrical shock deenergize the normal power source before making any line or auxiliary connections.

Before opening the transfer switch enclosure to perform service or to manually transfer the mechanism, it is imperative to isolate the transfer switch from any possible source of power.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Note: All installation and/or service work must be performed by qualified personnel only.

1.6 Upstream Circuit Protective Devices/Electrical Connections

To ensure satisfactory installation of this equipment, observe Section 1.11, Cable Terminal Information, regarding power cable connection tightness and Section 1.12, Requirements for Upstream Circuit Protective Devices.

Check mechanical and electrical connections for tightness prior to placing this equipment in service to ensure proper operation and to validate applicable warranty coverage.

1.7 Transfer Switches with Integral Overcurrent Protection

For transfer switch models with integral overcurrent protection, the overcurrent protection must be set prior to operation. The equipment will be shipped from the factory with a long-time current setting of 100% (of the equipment rating) and maximum short-time/ instantaneous current and time delay settings.

Note: Do not energize this equipment until device settings have been verified to ensure proper system protection and coordination.

Refer to Section 3 for additional information on operation of the transfer switch following an overcurrent trip condition.

Refer to information supplied with the transfer switch documentation package for adjustment procedures on the power switching units overcurrent protection trip unit. Contact the manufacturer if any additional information is required.

1.8 Transfer Switches with Multi-Tap Voltage Capability

If the transfer switch has programmable multi-tap voltage capability (i.e. ATS product code with voltage code Y), confirm the transfer switch has been configured for the correct system voltage prior to installation.

Note: Failure to confirm and match transfer switch voltage with the system voltage could cause serious equipment damage.

The voltage selections and connections are shown on the engineered drawings included with each transfer switch. The factory default settings will be indicated on the calibration label attached on the inside of the enclosure door (supplied loose on open style models). A blank label is included to record the applicable settings if the configuration is changed from the factory default settings.

To change the transfer switch configuration, the following must be accomplished:

- Change voltage taps on potential transformers (PT's) to correct system voltage (refer to drawings).
- Change TSC 80 programming for nominal system voltage. Refer to MP-6296 for further information.
- Once the PT voltage taps and TSC 80 have been reprogrammed to the correct operating voltage, the control circuit isolation plug on the mechanism may be reconnected before voltage energization.

1.9 System Phasing, High Leg Delta Systems

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Note: All installation and/or service work must be performed by qualified personnel only.

For systems using high leg delta 240 V 3-phase 4-wire systems, connection of supply conductors must have the correct phasing as shown in Figure 1-2.

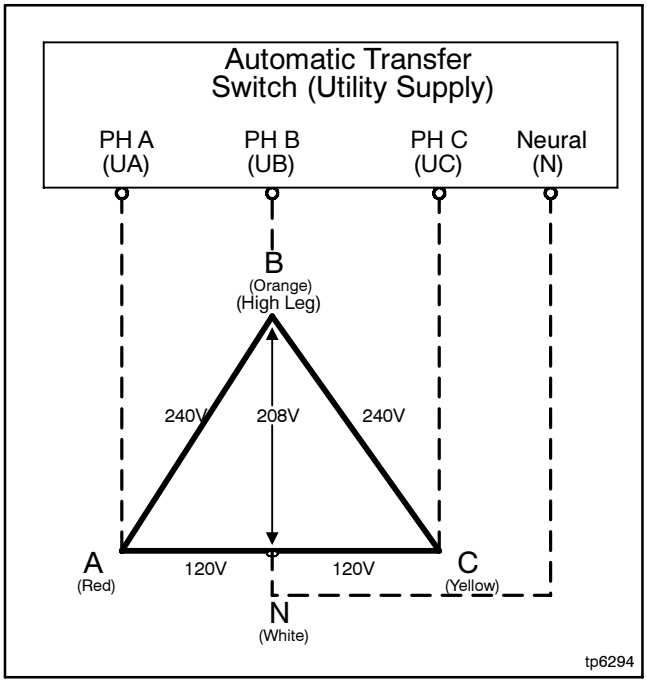


Figure 1-2 System Phasing

Note: Failure to match correct system phasing will result in serious damage to the transfer switch controller.

Where transfer switches are supplied without power isolation transformers (PT1 and PT2) for ATS control logic, it is essential that the orientation of phase conductors of the supply source be arranged such that the phase of highest potential with respect to ground is not connected to the power supply inputs to the controller (A phase for both supplies). Failure to do so will result in equipment damage.

Per NEC Article 384-3 (f), the B phase shall be the phase having the higher voltage to ground on a 3-phase, 4-wire delta connected system.

1.10 Remote Start Contact Field Wiring

As a minimum, the remote engine start control field wiring shall conform to the local regulatory authority on electrical installations. Field wiring of a remote start contact from a transfer switch to a control panel should conform to the following guidelines to avoid possible controller malfunction and/or damage.

1. Minimum #14 AWG wire size shall be used for distances up to 30 m (100 ft.). For distances exceeding 30 m (100 ft.), consult the manufacturer.
2. Remote start contact wires should be run in a separate conduit.
3. Avoid wiring near AC power cables to prevent pickup of induced voltages.
4. An interposing relay may be required if field-wiring distance is excessively long, i.e. greater than 30 m (100 ft.), and/or if a remote contact has a resistance of greater than 5.0 ohms.
5. The remote start contact must be voltage free (i.e. dry contact). The use of a powered contact will damage the transfer controller.

1.11 Cable Terminal Information

Model	Terminal Rating		Connection Tightness, Nm (in. lb.)	
	Qty. Per Phase	Range	Terminal Mounting Screw	Cable Clamp
TS87 x B-0100	1	#14-1/0	13.6 (120)	5.7 (50)
TS87 x B-0150	1	#2-4/0	13.6 (120)	13.6 (120)
TS87 x B-0200	1	#6-350 MCM	16.9 (150)	31.1 (275)
TS87 x B-0250	1	#6-350 MCM	16.9 (150)	31.1 (275)
TS87 x B-0400*	2	2/0-500 MCM	8.1 (72)	31.1 (275)
TS87 x B-0600*	2	2/0-500 MCM	8.1 (72)	31.1 (275)
TS87 x B-0800*	3	2/0-500 MCM	12.4 (110)	42.4 (375)
TS87 x B-1200*	4	4/0-500 MCM	42.4 (375)	42.4 (375)

* Optional terminal ratings are available in some models, consult the manufacturer.
Note: For other model types not shown, contact the manufacturer for further information.

1.12 Requirements for Upstream Circuit Protective Devices

Fuse ratings shown are maximum allowable to permit use of the transfer switch in an application with available fault current not exceeding that shown. Consideration must be given to fuse sizing when fuses also provide overload protection.

Model	Max. Voltage	Rated Current (A)	Withstand Current Rating Amps (RMS) †				
			With Upstream Circuit Breaker Protection			With Upstream Fuse Protection	
			@240 V	@480 V	@600 V	@ Up to 600 V	Fuse Type
TS87 x B-0100	600	100	65000	25000	18000	100000	T, J
TS87 x B-0150	600	150	65000	25000	18000	100000	T, J
TS87 x B-0200	240	200	65000	N/A	N/A	N/A	T, J
TS87 x B-0250	600	250	65000	35000	25000	100000	T, J
TS87 x B-0400	600	400	65000	50000	35000	100000	T, J
TS87 x B-0600	600	600	65000	50000	35000	100000	T, J
TS87 x B-0800	600	800	65000	50000	35000	100000	Consult Manufacturer
TS87 x B-1000	600	1000	65000	50000	42000	100000	Consult Manufacturer
TS87 x B-1200	600	1200	65000	50000	42000	100000	Consult Manufacturer

† Standard ratings only are shown. Consult the manufacturer for versions with higher withstand current ratings.
Note: For other model types not shown, contact the manufacturer for further information.

Figure 1-3 Withstand Current Ratings, All Models Without Integral Overcurrent Protection Option

Model	Max. Voltage	Rated Current (A)	Interrupting Capacity Current Rating Amps (RMS) † No Upstream Circuit Breaker Protection Required		
			@240 V	@480 V	@600 V
TS87 x B-0100	600	100	65000	25000	14000
TS87 x B-0150	600	150	65000	25000	14000
TS87 x B-0200	240	200	65000	N/A	N/A
TS87 x B-0250	600	250	65000	35000	22000
TS87 x B-0400	600	400	65000	50000	25000
TS87 x B-0600	600	600	65000	50000	25000
TS87 x B-0800	600	800	65000	50000	25000
TS87 x B-1000	600	1000	65000	50000	50000
TS87 x B-1200	600	1200	65000	50000	50000

† Standard ratings only are shown. Consult the manufacturer for versions with higher interrupting capacity current ratings.
Note: For other model types not shown, contact the manufacturer for further information.

Figure 1-4 Interrupting Capacity Current Ratings, All Models With Integral Overcurrent Protection Option

1.13 Dielectric Testing

Do not perform any high voltage dielectric testing on the transfer switch with the TSC 80 controller connected into the circuit as serious damage will occur to the controller. Remove AC control fuses and control circuit isolation plugs connected to the TSC 80 if high voltage dielectric testing is performed on the transfer switch.

1.14 Installation of Open Type Transfer Switches

Please contact the manufacturer for additional information.

1.15 Ground Fault Site Test Requirements

Per NEC and UL1008, a ground fault protected system shall be performance tested when first installed onsite. A written record of this shall be made and be available to the authority having jurisdiction. A form is provided in Section 7 for this purpose. Confirm and record actual trip setpoints on the form.

Performance Test

Qualified field service technicians require a calibrated current injection test apparatus and must be knowledgeable in breaker testing to provide primary neutral CT injection up to or greater than the trip setpoint as selected by the responsible party. As indicated in the NEC, the maximum setting of the ground fault protection shall be 1200 amps, and the maximum time delay shall be 1 second for ground faults equal to or greater than 3000 amps.

Contact the inspection authority to confirm actual test requirements as these may vary by region or local code requirements.

Evaluate the interconnected system to ensure compliance with the appropriate schematic drawings. Determine the proper location of sensors and power cabling. Verify the grounding points of the system to determine that ground paths do not exist that would bypass the sensors. The use of high-voltage testers and resistance bridges may be required. A simulated fault current is to be generated by a coil around the sensors. The reaction of the circuit-interrupting device is to be observed for correct response. Record the results of the test on the test form provided.

1.16 Typical Commissioning Procedures

Note: Qualified personnel only must perform commissioning procedures. Ensure the automatic transfer switch (ATS) isolation plug is disconnected prior to energizing the supply sources. Manually place the transfer switch mechanism in the neutral position prior to applying power.

Note: Appendix B, Typical Automatic Transfer Switch Commissioning Procedures, is provided for general information only pertaining to typical site installations and applications. Contact the manufacturer for further information as may be required.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Note: An optional hand held, plug-in service display module (SDM) is available for the TSC 80 transfer controller. The SDM provides an LCD screen to display additional detailed information on the operation and settings of the TSC 80 controller for simplified servicing/ troubleshooting procedures. For detailed information, refer to the separate SDM instruction manual.

Notes

2.1 Standard Automatic Transfer Switch Normal Operation

When utility supply voltage drops below a preset nominal value (adjustable from 70%–100% of nominal) on any phase, an engine start delay circuit will be initiated and the transfer to utility supply signal will be removed (i.e. contact opening). Following expiration of the engine start delay period (adjustable from 0–60 seconds), an engine start signal (contact closure) will be given.

Once the engine starts, the transfer switch controller will monitor the generator voltage and frequency levels. Once the generator voltage and frequency rises above preset values (adjustable from 70%–95% of nominal), the engine warmup timer will be initiated. Once the warmup timer expires (adjustable from 0– 60 seconds), the Transfer to Generator Supply signal (contact closure) will be given to the transfer switch mechanism. The load will then transfer from the utility supply to the generator supply via the motor driven mechanism.

The generator will continue to supply the load until the utility supply has returned. The retransfer sequence is completed as follows: when the utility supply voltage is restored to above the preset values (adjustable from 70%–95% of nominal) on all phases, a transfer return delay circuit will be initiated. Following expiration of the Utility Return Timer (adjustable from 0–30 minutes), the Transfer to Generator Supply signal will be removed (contact opening) and the Transfer to Utility Supply signal (contact closure) will be given to the transfer switch mechanism. The load will then retransfer the load from the generator supply back to the utility supply.

Note: A neutral delay timer circuit will delay the transfer sequence in the neutral position (i.e. both power switching devices open) until neutral time delay period expires (adjustable from 0–60 seconds).

An engine cooldown timer circuit will be initiated once the load is transferred from the generator supply. Following expiration of the cooldown delay period (adjustable from 0–30 minutes), the engine start signal will be removed (contact opening) to initiate stopping of the generator set.

2.2 Service Entrance Automatic Transfer Switch

Note: This section applies only to service entrance transfer switches.

2.2.1 Normal Operation

Under normal conditions, the load is energized from the utility supply through the closed utility transfer power switching device. If the utility power fails, the generator set will start and the load will be reenergized via the closed generator transfer power switching device.

In the normal operating mode, the service disconnect switch shall be in the energized position.

2.2.2 Overcurrent Trip

Should the utility power switching device trip open due to an overcurrent condition, TSC 80 transfer controller will initiate an engine start signal and will permit transfer of the load to the generator set supply. The utility source will be locked out and the load will remain on the generator set supply until the TSC 80 alarm signal is manually reset.

Refer to the TSC 80 instruction manual, MP-6296, for further details on transfer fail operation.

Should the generator power switching device trip open due to an overcurrent condition, the TSC 80 transfer controller will initiate transfer of the load to the utility supply. The generator set source will be locked out and the load will remain on the utility supply until the TSC 80 alarm signal is manually reset.

2.3 Service Disconnect

Note: Applies only to service entrance transfer switches.

2.3.1 Service Disconnect Procedure

To perform a service disconnect (i.e. to disconnect the utility and generator supplies), the following procedure is required.

1. Move the service disconnect control switch located on the door of the transfer switch to the Disconnected position.

2. Verify that the service disconnected pilot light is illuminated. *If the light is illuminated, the service has been successfully disconnected and it is safe to perform any maintenance procedures (i.e. external to the transfer switch) as required*. In this condition, the transfer switch is in the neutral position, with both utility and generator transfer power switching devices open. The transfer switch will remain in this condition, regardless of condition of the utility and generator set supplies (i.e. if the utility power fails, the generator set will not receive a start signal, nor will the transfer switch move to the generator position.

   Note: If the service disconnected light is **not** illuminated, additional procedures are required. Proceed to Section 2.3.2.

3. Attach safety lockout padlock to the service disconnect control switch to prevent unauthorized change in operating condition and verify transfer switch door is locked closed. If the door is not locked, turn and remove door key.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Close and lock the transfer switch enclosure door before connecting power sources.

4. To reenergize the load, remove the padlock(s) from the service disconnect control switch, and move the switch to the energized position. The transfer switch will immediately return to the utility or generator supply if within normal operating limits.

2.3.2 Additional Procedures

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Transfer switch service disconnect. Hazardous voltage can cause severe injury or death. Move the service disconnect switch to the DISCONNECTED position and verify that the transfer switch mechanism is in the neutral position before servicing the transfer switch. *(100-1200 Amp service entrance models with molded-case power switching units.)*

If the service disconnected pilot light is *not* illuminated, the service has **not** been successfully disconnected and it is **not** safe to perform any maintenance until the following additional procedures are performed.

1. Open the door to the transfer switch using a suitable tool and opening the door lock with the key.

2. Visually inspect the actual position of the transfer switch mechanism. If the position of the transfer switch mechanism *is clearly in the neutral position and the load bus is deenergized on all phases*, the service has been successfully disconnected. Proceed to step 4.

   If the position of the transfer switch mechanism is not in the neutral position or the load bus is energized, further procedures are required. Proceed to step 3.

   Note: If the position of the transfer switch mechanism is clearly in the neutral position, the service disconnected pilot light may not have illuminated due to the following reasons:

   - Utility and generator supply voltages are not present (the pilot light requires AC supply voltage to be present).

   - The pilot light may be burnt out. The bulb should be immediately replaced with a suitably rated bulb.

- Failure of one or more of the sensing/ logic contacts. A qualified service technician is required to troubleshoot this specific condition. Switch the utility control circuit isolation switch to the deenergized position to remove utility power. To isolate the generator set supply, remove the control circuit isolation plug.

Note: The AC power conductors will remain energized. Once all the control circuits are deenergized and isolated, the Service Disconnected pilot light will not illuminate due to loss of control power.

Note: To return the transfer switch back to normal operation, *the utility control circuit disconnect switch and control circuit isolation plug must be reconnected and switched on for correct operation.*

3. *If the position of the transfer switch mechanism is* **not** *in the neutral position*, manually operate the transfer switch mechanism as follows: Pull the manual release plunger on the mechanism releasing the motor drive rod from motor drive arm and move the knob and yoke to the marked Neutral Position.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Close and lock the transfer switch enclosure door before connecting power sources.

4. Close the transfer switch door securely using a suitable tool. Lock the door in the closed position and remove the key.

5. Attach a safety lockout padlock to the service disconnect control switch to prevent unauthorized changes in operating condition and verify that the transfer switch door is locked closed.

6. To reenergize the load, remove the padlock(s) from the service disconnect control switch, and move the switch to the Energized position. The transfer switch will immediately return to the utility or generator supply if within normal operating limits.

2.4 Test Condition

The transfer switch may be tested utilizing the TSC 80 controller pushbuttons or optional 4-position test switch. A simulated utility power failure condition will be activated when the test mode is selected. The transfer switch will operate as it would during a normal utility power fail condition.

The transfer switch will remain on generator supply until the test mode is terminated. It will then immediately transfer back to the utility supply, continue to operate the generator set for its cooldown period, then stop.

Note: The transfer switch will automatically return to the utility supply (if within nominal limits) if the generator set fails while in the test mode.

Notes

Section 3 Overcurrent Protection

Model DSE TS 870 automatic transfer switches will have integral overcurrent protection supplied on the utility source as standard. The type of overcurrent protection utilized is dependent upon ATS amperage size and optional features specified. For transfer switches rated 100 amps through 200 amps, overcurrent protection is nonadjustable thermal-magnetic type trip units. For transfer switches rated 400 amps through 1200 amps, overcurrent protection is adjustable electronic type with long-time and instantaneous trip unit elements with optional ground fault protection elements. An upstream overcurrent protection device is required on the generator source that feeds the transfer switch if integral the overcurrent protection option is not specified on the ATS.

Note: Ground fault protection is supplied as standard on 1000 amp and 1200 amp transfer switches that are used on systems greater than 240 V.

An upstream overcurrent protection device is required on the generator that feeds the TS 870 transfer switch if the integral overcurrent protection option is not specified on the ATS.

Note: For transfer switch models with *adjustable* integral overcurrent protection trip units, the overcurrent protection *must be set prior to operation.* The equipment will be shipped from the factory with a long-time current setting of 100% (of the equipment rating) and maximum instantaneous/short-time current and time delay settings.

Note: Do not energize this equipment until the device settings have been verified to ensure proper system protection and coordination. Failure to do so may result in equipment failure.

Note: Refer to Section 1.3, Product Code, for types of integral overcurrent protection that are supplied with the transfer switch.

Notes

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Note: Qualified personnel only must perform all installation and/or service work.

Failure to correctly maintain an automatic transfer switch may present a hazard to life and equipment. Full operational testing must be done prior to placing a transfer switch in service subsequent to any maintenance or repair. Any service work involving electrical components requires high-potential testing to ensure that required insulation levels have been maintained.

4.1 Power Switching, 100–250 Amp

4.1.1 General Description

The transfer mechanism consists of the transfer motor and drive assembly, which operates a common yoke which in turn operates both utility and generator power switching devices. Since the power switching devices are oriented opposite to each other, the action of turning one power switching device off will result in turning the other power switching device on. The geometry of the mechanism ensures that one power switching device always opens before the other closes, thus maintaining the required mechanical interlocking.

The motor operates the motor drive arm and rod assembly. The motor drive arm is normally held captive to the yoke via the manual release plunger assembly. A common yoke assembly operates both power-switching device toggles. There are two limit switches that are contacted by the yoke at its extremes of travel, which disconnects the motor circuit at the point of full power switching device toggle travel in the intended direction. Should adjustment be required, consult the manufacturer for further information.

The transfer switch mechanism has three possible positions:

1. Utility power switching device closed and generator power switching device open;
2. Generator power switching device closed and utility power switching device open;
3. Both utility and generator power switching devices open, but NEVER both utility and generator power switching devices closed at the same time.

4.1.2 Equipment Inspection

To maintain mechanical integrity, ensure that;

- Both limit switches are correctly adjusted to provide full travel of the power switching device toggles *without* exerting unnecessary forces associated with excessive travel. Ensure the power switching device travels far enough to reset any internal trip unit. Note: It is more important for the toggle to go fully in the off direction, than in the on direction).
- Mechanical interlocking is correct (i.e. one power switching device must be well open before the other should close).
- All fasteners are adequately tightened.
- The operating linkages are not damaged or bent, and that all bearing points operate freely.
- To maintain electrical integrity, ensure that:
- All electrical connections are clean and adequately tightened. Corroded or loose power connections will cause destructive heating, and may cause premature tripping.
- All insulating devices are in place and in good condition.
- No moisture or other contamination is present.
- Electrical conductors are adequately secured away from moving parts.
- To maintain operational integrity, ensure that:
- All control devices are in good condition and correctly calibrated.
- All control devices are adequately secured in their plug-in fixtures.

Failure to correctly maintain an automatic transfer switch may present a hazard to life and equipment. Full operational testing must be done prior to placing a transfer switch in service subsequent to any maintenance or repair. Any service work involving electrical components requires high-potential testing to ensure that required insulation levels have been maintained.

4.1.3 Manual Operation

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Note: Qualified personnel only must perform all installation and/or service work.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Open the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (–) leads first. Reconnect negative (–) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Isolate the transfer switch from all sources of supply before opening the enclosure for manual operation. With all sources of power deenergized to the transfer switch, the control circuit isolation plug an be unplugged to prevent subsequent operation.

To operate manually, pull the manual release plunger, releasing the motor drive rod from the motor drive arm, and push the yoke in the desired direction.

Automatic operation may be regained by replacing the isolation plug. With all sources of power deenergized to the transfer switch, the control circuit isolation plug can be reconnected. The drive system is self-engaging and will move the transfer switch mechanism to the required position. Refer to the manual operation instruction on front of transfer switch mechanism for further details.

4.1.4 Recommended Maintenance

- DO NOT perform dielectric tests on the equipment with the control components in the circuit.
- Check that control components are tight in sockets.
- Periodically inspect all terminals (load, line, and control) for tightness. Retorque all bolts, nuts, and other hardware. Clean or replace any contact surfaces that are dirty, corroded, or pitted.
- Transfer switches should be in a clean, dry, and moderately warm location. If signs of moisture are present, dry and clean transfer switch. If there is corrosion, try to clean it off. If cleaning is unsuitable, replace the corroded parts. Should dust and/or debris gather on the transfer switch, brush, vacuum, or wipe clean. *Do not* blow dirt into power switching devices.
- Test the transfer switch operation. While the unit is exercising, check for freedom of movement, hidden dirt, corrosion, or any excessive wear on the mechanical operating parts. Ensure that the power switching device travel is correct.
- Verify all program settings on the TSC 80 controller are as per the TSC 80 component calibration label on the rear cover of the controller.
- Confirm that the yoke operates freely on the yoke pivot bushings. Should lubrication be required, apply medium weight (SAE 20) oil sparingly at these points.
- The motor and gearbox are permanently lubricated and should not require attention under normal operating circumstances.

4.2 Molded Case Type, 400–1200 Amp

4.2.1 General Description

The transfer mechanism consists primarily of the transfer motor, a hub assembly, two operating rods, and two power switching device operating yokes.

The reversible transfer motor drives the hub assembly, which in turn moves the operating rods that are connected to the power switching device operating yokes. The power switching device toggles are set inside the yokes and are operated by the yoke. There are two limit switches, which are contacted by the operating yokes (one for each direction of travel), that disconnect the transfer motor power supply when the power switching devices have attained full travel. The adjuster screws located on the yokes determines the operating point of these limit switches. Should adjustment be required, consult the manufacturer for further information.

The transfer switch mechanism has three possible positions:

1. Utility power switching device closed and generator power switching device open.
2. Generator power switching device closed and utility power switching device open.
3. Both utility and generator power switching devices open, but NEVER both utility and generator power switching devices closed at the same time.

4.2.2 Equipment Inspection

To maintain mechanical integrity, ensure that:

- All limit switch linkages are correctly adjusted to provide full travel of the power switching device toggles *without* exerting unnecessary forces associated with excessive travel. Ensure that power switching devices travel far enough to reset any internal trip unit.

  Note: It is more important for the toggle to go fully in the off direction than in the on direction.

- Mechanical interlocking is correct (i.e. one power switching device must be well open before the other should close.
- All fasteners are adequately tightened.
- The operating linkages are not damaged or bent, and that all bearing points operate freely.

To maintain electrical integrity, ensure that:

- All electrical connections are clean and adequately tightened. Corroded or loose power connections will cause destructive heating and may cause premature tripping.
- All insulating devices are in place and in good condition.
- No moisture or other contamination is present.
- Electrical conductors are adequately secured away from moving parts.

To maintain operational integrity, ensure that:

- All control devices are in good condition and correctly calibrated.
- All control devices are adequately secured in their plug-in fixtures.
- Failure to correctly maintain an automatic transfer switch may present a hazard to life and equipment. Full operational testing must be done prior to placing a transfer switch in service subsequent to any maintenance or repair. Any service work involving electrical components requires high-potential testing to ensure that required insulation levels have been maintained.

4.2.3 Manual Operation

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Note: Qualified personnel only must perform all installation and/or service work.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Open the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (–) leads first. Reconnect negative (–) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Isolate the transfer switch from all sources of supply before opening the enclosure for manual operation. With all sources of power deenergized to the transfer switch, the control circuit isolation plug can be unplugged to prevent subsequent operation.

To operate manually, pull the release plunger and operate the handle in the desired direction.

Automatic operation may be regained by replacing the isolation plug. With all sources of power deenergized to the transfer switch, the control circuit isolation plug can be reconnected. The drive system is self-engaging and will operate the transfer switch to the required position. Refer to the manual operation instruction on front of transfer switch mechanism for further details.

4.2.4 Recommended Maintenance

- *Do not* perform dielectric tests on the equipment with the control components in the circuit.
- Check if control components are tight in sockets.
- Periodically inspect all terminals (load, line, and control) for tightness. Retorque all bolts, nuts, and other hardware. Clean or replace any contact surfaces that are dirty, corroded, or pitted.
- Transfer switches should be in a clean, dry, and moderately warm location. If signs of moisture are present, dry and clean transfer switch. If there is corrosion, try to clean it off. If cleaning is unsuitable, replace the corroded parts. Should dust and/or debris gather on the transfer switch, brush, vacuum, or wipe clean. *Do not* blow dirt into power switching devices.
- Test the transfer switch operation. While the unit is exercising, check for freedom of movement, hidden dirt, corrosion, or any excessive wear on the mechanical operating parts. Ensure that the power switching device travel is correct.
- Verify all program settings on the TSC 80 controller as per the TSC 80 controller component calibration label on the rear cover of the controller.
- Ensure that the manual handle moves freely on the hub when the lock pin is disengaged. If lubrication is necessary, apply medium weight (SAE 20) oil sparingly.
- Yoke pivot bearings and rod ends are permanently lubricated and do not require maintenance.
- The motor and gearbox are permanently lubricated and should not require attention under normal operating circumstances.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Open the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

Note: All troubleshooting/service must be performed by qualified personnel only.

Note: An optional hand held, plug-in Service Display Module (SDM) is available for the TSC 80 transfer controller. The SDM provides an LCD screen to display additional detailed information on the operation and settings of the TSC 80 controller for simplified servicing/ troubleshooting procedures. For detailed information, refer to the separate SDM instruction manual.

Note: There are no user-serviceable components located on the TSC 80 printed circuit board. If the TSC 80 controller is found defective, return it to the factory for repair or replacement.

Symptom	Possible Causes
Will not retransfer to utility source upon restoration	Isolation plug out.
	Utility disconnect switch is in the deenergized position (Service Entrance Rated ATS). Switch to the energized position.
	A test mode has been activated (check TSC 80 status LED).
	Utility voltage is below the preprogrammed limits (check utility source for adequate voltage).
	A loose control connection.
	Faulty motor limit switch.
	Defective motor.
	TSC 80 has incorrect voltage configuration jumper setting for correct system voltage.
	Defective TSC 80 controller (verify output signals with circuit board mounted diagnostic LEDs).
	TSC 80 has transfer fail alarm activated as indicated by flashing Load on Utility LED. Determine cause of alarm and rectify before TSC 80 is reset.
Will not transfer to generator source upon failure of utility source	Isolation plug out.
	Generator set not producing enough voltage/frequency or output circuit breaker open.
	TSC 80 has incorrect voltage configuration jumper setting for correct system voltage.
	Warmup time delay function has not timed out yet (verify TSC 80 timer setting).
	A loose control connection.
	Faulty motor limit switch.
	Defective motor.
	Defective TSC 80 controller (verify output signals with circuit board mounted diagnostic LEDs).
	TSC 80 has transfer fail alarm activated as indicated by flashing Load on Generator LED. Determine cause of alarm and rectify before TSC 80 is reset.
Transfer to generator source without a power failure in the utility source	A test mode has been activated (check TSC 80 status LED). Utility supply voltage is slightly below voltage sensing setpoints.
	Verify TSC 80 has correct voltage configuration jumper setting for system voltage.
	Defective TSC 80 controller (verify output signals with circuit board mounted diagnostic LEDs).
	Utility power switching device has tripped due to an overcurrent condition and TSC 80 transfer fail alarm activated as indicated by flashing Load on Utility LED. Determine cause of alarm and rectify before TSC 80 is reset.
Generator does not start up or stop when it should	Verify remote engine control panel is set for automatic mode.
No time delay when there should be	Verify time delay setting of the TSC 80 controller.
Power is not available at the load terminals but the utility or generator power switching device appears to be closed to a live source	The power switching device's overcurrent protection unit has opened due to a fault on the system. . Correct the fault, and manually reset the power switching device in the transfer switch by moving it off and then on again with the manual operating handle.
	Limit switch incorrectly adjusted.
The transfer switch has completed a transfer, but the motor has overheated and the internal thermal protector has opened	Limit switch failure or improper adjustment has failed to disconnect motor. Binding or jamming of the transfer mechanism.

Figure 5-1 Troubleshooting

Available replacement parts for the transfer switch are listed in Figure 6-1.

When ordering replacement parts, please provide the following information:

- Transfer switch product (model) code (e.g. TS 873AA0200AS).
- Transfer switch serial number (e.g. W-022345).

Note: The above information can be found on the transfer switch equipment rating plate located on the outside of the ATS door.

For parts not listed, please contact the supplier.

Motor Types

Motor types used on 100–250 amp transfer switches were changed during the first quarter of 2005 from unidirectional to reversing style motors.

A reversing type motor cannot be used as a direct replacement for a unidirectional motor due to mechanical and electrical wiring differences. Therefore, when ordering replacement motors, the same motor type must be specified to ensure it matches the original mechanism design. To distinguish between the two different motor types, refer to the following product descriptions:

- Unidirectional Transfer Switch Motor: 2 wire leads extend from the motor. The ATS Terminal block has number “M1” terminal, which connects to this type of motor.
- Reversing Transfer Switch Motor: 3 wire leads extend from the motor. ATS Terminal block does not contain terminal number “M1.” The reversing motor also uses a starting capacitor, which is mounted above the motor under the ATS mechanism.

Part No.	Description	Comments
GM42046	Replacement Controller Board (complete with faceplate), TSC 80	Must set configuration jumper prior to use. Refer to MP-6296, Operation/Installation/Service Manual.
GM42048	Faceplate, TSC 80	Contact the supplier for installation procedures.
GM42049	Cover, rear, TSC 80	
GM42050	Switch, limit 1 NO, 1 NC	Must install and adjust for proper operation before use. Contact the supplier for installation/ adjustment procedures.
GM42051 *	Motor, unidirectional, 100–250 amp, 1-phase, 120 volt	Motor is supplied with gear box assembly. Contact the supplier for installation procedures. See Motor Types, above.
GM42052 *	Motor, reversing, 100–250 amp, 1-phase, 120-volt	See Motor Types, above. Motor is supplied with gear box assembly. Contact the supplier for installation procedures.
GM42053	Motor, transfer switch, 400–1200 amp, 120 volt, 1/10 HP, 1-phase	Motor is supplied with gear box assembly. Contact the supplier for installation procedures.
GM42054	Relay, auxiliary plug-in, 120 VAC, 11-pin square (UX/GX)	Must ensure coil voltage is correct.
GM42055	Timer, auxiliary plug-in, 120 VAC	Must ensure coil voltage is correct.
GM42056	Transformer, control, 100 VA	
* See Motor Types, above, to determine whether a unidirectional or a reversing motor is required.		

Figure 6-1 Service Parts

Notes

Section 7 Performance Test Form

This form should be retained by those in charge of the building electrical installation in order to be available to the authority having jurisdiction.

Date	Personnel	Tests Performed	Comments
		Interconnection evaluation	
		Grounding point evaluation	
		Fault current test:	
		Ground fault settings – _____	
		Simulated current – _____	
		Results – _____	

Notes

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
API	American Petroleum Institute
approx.	approximate, approximately
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
A/V	audiovisual
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cert.	certificate, certification, certified
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
cogen.	cogeneration
com	communications (port)
coml	commercial
Coml/Rec	Commercial/Recreational
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dBA	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E, emer.	emergency (power source)
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example (*exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lb.	foot pounds (torque)
ft./min.	feet per minute
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temperature, high engine temperature
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lb.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard
k	kilo (1000)
K	kelvin

kA	kiloampere
KB	kilobyte (2^{10} bytes)
kg	kilogram
kg/cm^2	kilograms per square centimeter
kgm	kilogram-meter
kg/m^3	kilograms per cubic meter
kHz	kilohertz
kJ	kilojoule
km	kilometer
kOhm, kΩ	kilo-ohm
kPa	kilopascal
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kW	kilowatt
kWh	kilowatt-hour
kWm	kilowatt mechanical
L	liter
LAN	local area network
L x W x H	length by width by height
lb.	pound, pounds
lbm/ft^3	pounds mass per cubic feet
LCB	line circuit breaker
LCD	liquid crystal display
ld. shd.	load shed
LED	light emitting diode
Lph	liters per hour
Lpm	liters per minute
LOP	low oil pressure
LP	liquefied petroleum
LPG	liquefied petroleum gas
LS	left side
L_{wa}	sound power level, A weighted
LWL	low water level
LWT	low water temperature
m	meter, milli (1/1000)
M	mega (10^6 when used with SI units), male
m^3	cubic meter
m^3/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCM	one thousand circular mils
MCCB	molded-case circuit breaker
meggar	megohmmeter
MHz	megahertz
mi.	mile
mil	one one-thousandth of an inch
min.	minimum, minute
misc.	miscellaneous
MJ	megajoule
mJ	millijoule
mm	millimeter
mOhm, mΩ	milliohm
MOhm, MΩ	megohm
MOV	metal oxide varistor
MPa	megapascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
MW	megawatt
mW	milliwatt
μF	microfarad
N, norm.	normal (power source)
NA	not available, not applicable
nat. gas	natural gas
NBS	National Bureau of Standards
NC	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	newton meter
NO	normally open
no., nos.	number, numbers
NPS	National Pipe, Straight
NPSC	National Pipe, Straight-coupling
NPT	National Standard taper pipe thread per general use
NPTF	National Pipe, Taper-Fine
NR	not required, normal relay
ns	nanosecond
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OF	overfrequency
opt.	option, optional
OS	oversize, overspeed
OSHA	Occupational Safety and Health Administration
OV	overvoltage
oz.	ounce
p., pp.	page, pages
PC	personal computer
PCB	printed circuit board
pF	picofarad
PF	power factor
ph., ∅	phase
PHC	Phillips head crimptite (screw)
PHH	Phillips hex head (screw)
PHM	pan head machine (screw)
PLC	programmable logic control
PMG	permanent-magnet generator
pot	potentiometer, potential
ppm	parts per million
PROM	programmable read-only memory
psi	pounds per square inch
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart, quarts
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RDO	relay driver output
ref.	reference
rem.	remote
Res/Coml	Residential/Commercial
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTV	room temperature vulcanization
SAE	Society of Automotive Engineers
scfm	standard cubic feet per minute
SCR	silicon controlled rectifier
s, sec.	second
SI	*Systeme international d'unites,* International System of Units
SI/EO	side in/end out
sil.	silencer
SN	serial number
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec, specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TD	time delay
TDC	top dead center
TDEC	time delay engine cooldown
TDEN	time delay emergency to normal
TDES	time delay engine start
TDNE	time delay normal to emergency
TDOE	time delay off to emergency
TDON	time delay off to normal
temp.	temperature
term.	terminal
TIF	telephone influence factor
TIR	total indicator reading
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
US	undersize, underspeed
UV	ultraviolet, undervoltage
V	volt
VAC	volts alternating current
VAR	voltampere reactive
VDC	volts direct current
VFD	vacuum fluorescent display
VGA	video graphics adapter
VHF	very high frequency
W	watt
WCR	withstand and closing rating
w/	with
w/o	without
wt.	weight
xfmr	transformer

Typical Automatic Transfer Switch Commissioning Procedures

The following commissioning procedures are provided for general information only pertaining to typical site installations and applications. Contact the equipment supplier for further information as may be required.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Note: Commissioning procedures must be performed by qualified personnel only. Ensure that the automatic transfer switch (ATS) Control Isolation Plug is disconnected prior to energizing the supply sources. Manually place the transfer switch mechanism in the neutral position by opening both utility and generator power switching devices prior to applying power.

An optional hand-held, plug-in service display module (SDM) is available for the TSC 80 transfer controller. The SDM provides an LCD screen to display additional detailed information on the operation and settings of the TSC 80 controller for simplified servicing/ troubleshooting procedures. For detailed information, refer to the SDM instruction sheet, provided with the SDM.

Precommissioning Checks Prior to Commissioning Agent Onsite (to allow loads to be supplied prior to final commissioning)

1. Verify that the system voltage of both sources (i.e. generator and utility) to be applied to the transfer switch are of the correct nominal system value that matches the ATS drawings and the ATS equipment label ratings. If the system voltage is correct, proceed to step 3. If system voltage is *incorrect* for the rating of the ATS supplied, proceed to step 2.

   Note: Caution: Failure to reconfigure ATS voltage to match the system voltage will result in equipment malfunction and damage.

   Note: The factory default system voltage setting for multivoltage TS 840/870 transfer switches is **480 VAC**, which will be indicated by a letter Y in the voltage code as shown in TS 873A0250A1A**Y**1AKKAA, the ATS model code, and on a warning tag attached to the isolation plug.

2. To reconfigure the ATS for the correct system voltage *prior to* energization, refer to Appendix C, Changing System Voltage. For further information, refer to MP-6296, TSC 80 Operation/Installation/ Service manual, supplied with the transfer switch.

3. For 240 V high leg delta systems, refer to the ATS instruction manual for correct phasing required and reconfiguring procedures.

   Note: Caution: Failure to obtain the correct ATS phasing will result in equipment malfunction and damage.

4. Confirm cable size is correct for the lugs supplied in the transfer switch (line and load). Confirm the cables were meggered by the electrical contractor to ensure no cross phase connections or conduction to ground.

5. Confirm cable lugs are properly torqued. Confirm cable installation; ensure the cables do not interfere with normal equipment operation, which may cause component damage.

6. Manually operate the transfer mechanism to the appropriate source of supply. Leave the isolation plug disconnected until final transfer switch commissioning is to be completed.

Final Commissioning

1. Verify installation of the ATS per installation manual and verify wiring (also see the precommissioning checks). Confirm phase, neutral, and grounding conductors are installed per electrical code requirements.

   Note: Confirm neutral conductors of both sources are correctly installed and are solidly grounded for 3-phase 4-wire configurations.

2. Check for mechanical damage (shipping or installer).

3. Check for cable interference with mechanical moving parts or the motor brake on 100A–250A ATS mechanism.

4. Verify correct control wire interconnects to the engine/generator set auto start/stop circuitry. Ensure the engine controller automatic start circuit does not draw more than 5.0 amps (resistive) across the TSC 80 engine start contact. The TSC 80 engine start contact is voltage-free, and the only voltage measured should result from the engine controllers internal control logic.

   Note: The ATS engine start contact CLOSES to start the engine and OPENS to stop the engine.

5. Place the generator engine controller in the OFF position and open the generator local circuit breaker.

6. Ensure the ATS isolation plug is disconnected prior to application of voltage of the supply sources.

7. Energize the utility supply and the generator supply sources and verify these meet the correct voltage, phasing, and phase rotation for the ATS and system. Once these have been confirmed to be correct, deenergize both sources before installing the isolation plug.

8. After the isolation plug is connected, the ATS and system load may be energized with utility power if the site electrical contractor and or owner (as required) give authorization to proceed.

9. If utility power is within nominal limits, the ATS should transfer to the utility source. To determine correct operation, observe the following on the TSC 80 faceplate:

   a. Utility source green LED is ON.

   b. Green LED above mimic bus for the utility source is ON.

   c. Green load LED is ON.

10. To verify all LED's are operational, perform a LAMP TEST operation (lamp test is initiated by pressing and holding the two pushbuttons on the TSC 80 faceplate simultaneously ON until all the LED's change state).

11. Prior to operating the generator, ensure it is ready to be energized and the site electrical contractor and/or owner (as required) give authorization to proceed. In preparation for operation, turn the generator's engine control switch to the automatic start position.

12. To transfer the generator on load, perform a load test by pressing the utility power fail simulate pushbutton ON and holding it for approximately 5 seconds until the LED light above the pushbutton changes state. The engine should start following the 3-second engine start delay period, and the transfer switch will begin transferring to the generator supply once the 2-second engine warmup timer expires.

    Note: The engine warmup timer will only begin timing once the generator's output rises above 85% nominal voltage and 90% nominal frequency.

    After the utility power switching device opens, the transfer switch mechanism will pause in the neutral position for the 3-second neutral delay period, then the mechanism will complete the transfer and close the generator power switching device. To determine correct operation, observe the following on the TSC 80 faceplate:

    a. Generator source green LED is ON.

    b. Red LED above mimic bus for the generator source is ON.

    c. Green load LED is ON.

    d. Utility source green LED is ON.

    e. Utility power fail simulate yellow LED is ON.

    f. Green LED above mimic bus for the utility source is OFF.

13. To terminate the test, press the utility power fail simulate pushbutton on the TSC 80 faceplate again and hold until the LED above the pushbutton changes state. The transfer switch will begin transferring to the utility supply following the 2-minute utility return delay period.

    Note: The utility return delay timer will only begin timing if the utility voltage is above 85% nominal on all phases.

    After the generator power switching device opens, the transfer switch mechanism will pause in the neutral position for the 3-second neutral delay period, then the mechanism will complete the transfer and close the utility power switching device to return the load to the Utility source. When the load has transferred onto the utility source, the engine will continue to run for the 2-minute cool down time delay period and will then automatically stop.

14. Perform a power outage test by opening the upstream utility feeder breaker. The TSC 80 controller utility supply LED lights will deenergize; the generator set will start after the 3-second engine start delay has expired. The generator should transfer on load as described in item #12 above.

15. Return the transfer switch to utility power by reclosing the upstream utility breaker. The load should retransfer back to the utility supply, and the engine should stop as described in item #13 above.

16. Repeat tests #12 through 14 two (or more) times to ensure correct operation.

17. **Optional.** Automatic Plant Exercise Operation: If an automatic weekly plant exercise feature is desired, press the generator exercise mode pushbutton on the TSC 80 faceplate. Hold the pushbutton ON for approximately 5 seconds until the LED light changes state. Once the mode is initiated, the engine will immediately start and the generator will transfer on load as previously described.

    Note: The generator may or may not transfer on load, which is dependent on the TSC 80 configuration setting.

    The factory default setting is for a load transfer plant exercise test. The engine will remain operating on load until the plant exercise time delay period expires, then the load will retransfer back to the utility supply following the 2-minute utility return timer. The engine will be automatically retested on load every week (i.e. 7 days) *at the same time of day that the first test was initiated.* Refer to MP-6296, TSC 80 Operation/Installation/Service manual, for further information.

18. On completion of commissioning, ensure that all controls are left in automatic.

19. If required, forward document or drawing updates to the equipment supplier if revisions are required and provide the end user with a set of markups to be retained onsite.

20. Ensure copies of manuals for the equipment are onsite.

21. Record and forward list of deficiencies to the appropriate parties where applicable.

Appendix C Changing System Voltage

Instructions to Change System Voltage on TS 840 or TS 870 Series Transfer Switches with the TSC 80 Controller

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Note: CAUTION: Only qualified personnel should use these instructions to change system voltage on the transfer switch.

1. Ensure all power sources are deenergized prior to opening the transfer switch enclosure door.
2. Disconnect the control circuit isolation plug.
3. Change the voltage transformer primary taps settings to match new system voltage on <u>all</u> potential transformers. Refer to the wiring schematic diagram in Figure 1. Ensure all electrical connections are securely tightened.

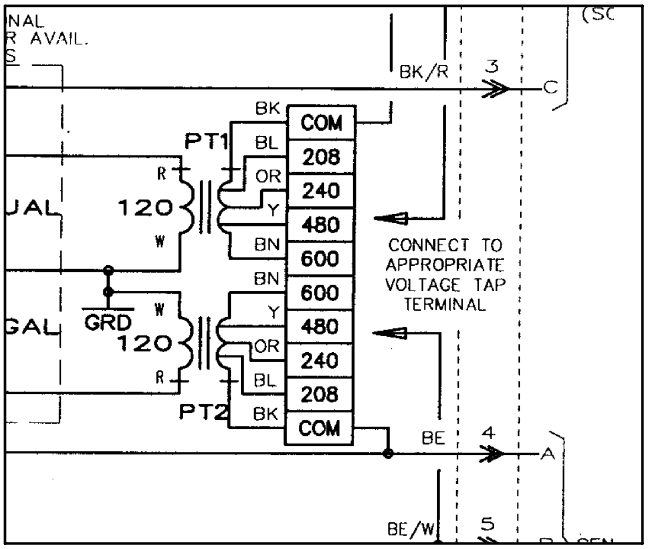


Figure 1 Schematic

4. Remove rear cover on door-mounted TSC 80 transfer controller.
5. Change voltage jumper setting to desired system voltage. See Figure 2.

   Note: 208 V systems do not require a jumper on any pins.

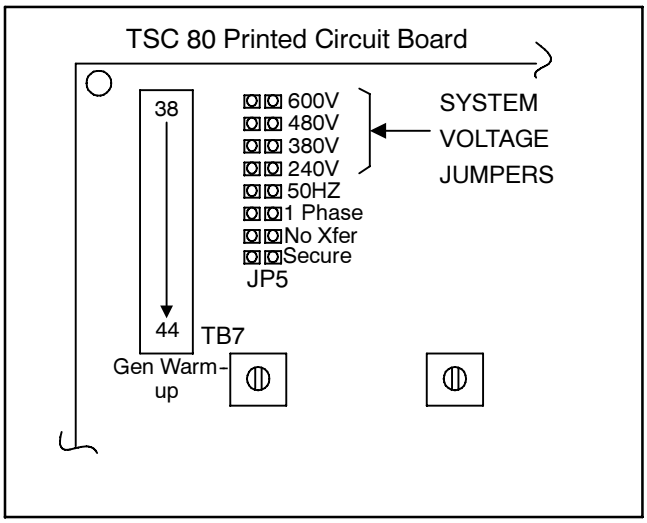


Figure 2 System Voltage Jumpers

6. Reinstall rear cover for TSC 80 transfer controller.
7. Record new programmed voltage on calibration label on TSC 80 rear cover.
8. Reconnect the control circuit isolation plug.
9. Remove all tools and close transfer switch enclosure door.
10. For further detailed information, refer to instruction manuals supplied with the transfer switch.

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MP-6295 11/06c