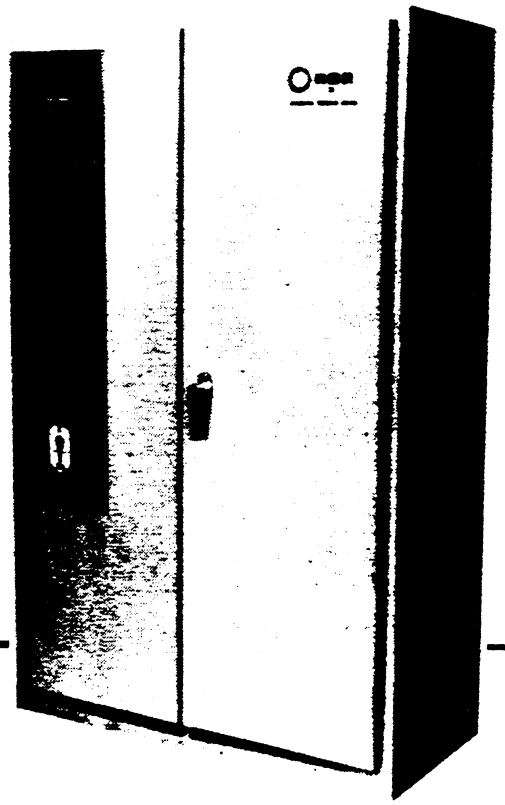
Onan

Operators Manual

OT
Switches



Utility-to-Utility Automatic Control

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Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC–rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work–harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.
- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [–] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (–) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocution can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [–] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [–] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

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SAFETY PRECAUTIONS

This manual includes the following symbols to indicate potentially dangerous conditions to the operator or equipment. Read the manual carefully and know when these conditions exist. Then take the necessary steps to protect personnel and the equipment.

WARNING **Onan uses this symbol throughout the text to warn of possible injury or death.**

CAUTION **This symbol is used to warn of possible equipment damage.**

The Series OT transfer switch has components with high voltages which present serious shock hazards. For this reason, read the following suggestions:

Keep the transfer switch cabinet(s) closed and locked. Make sure authorized personnel only have the cabinet keys.

Use the rubber insulative mats placed on dry wood platforms over floors which are metal or concrete when working on any electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling any electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on electrical equipment.

Do not work on this equipment when mentally or physically fatigued.

Remove AC power sources from the automatic transfer switch before performing any maintenance or adjustments. Tag any disconnect switches.

GENERAL INFORMATION

INTRODUCTION

This manual covers Series OT transfer switches with an automatic, utility-to-utility control. The OT Series includes transfer switches with continuous current ratings from 100 to 1000 amperes at standard distribution voltages up to and including 600 volts. The utility-to-utility control commands the transfer switch between either of two utility power sources, automatically, providing nearly continuous power to the connected load.

Four chapters divide the body of this manual into parts. A guide for troubleshooting and information on parts and service follow.

Installation: This chapter assumes that an experienced and qualified electrical contractor installs the transfer switch, complying with all local codes governing electrical installations. The emphasis is on customer connections. Here the operator will find descriptions of common circuits, such as transfer inhibit, area protection, etc., that are external to the transfer switch.

Description: Description is important because this manual covers transfer switches with different current ratings, operating procedures, features, etc. The description helps to identify these differences.

Operation: This chapter includes the sequence of operation for a utility-to-utility automatic control as well as operating procedures for automatic, test, and manual operation. The sequence of operation will also help the operator with adjustments and troubleshooting.

Adjustments: This chapter includes step-by-step procedures for making adjustments which an operator may need to do.

AUTOMATIC TRANSFER SWITCHES

Transfer switches are an essential part of a building's standby or emergency power system. The normal power source is backed up by an emergency power source. A transfer switch supplies the electrical load with power from one of these two power sources. The load is connected to the common of the transfer switch as in Figure 1. Under normal conditions the load is supplied with power from the normal source as illustrated. If normal power is interrupted, the load is transferred to the emergency power source. When normal power returns, the load is retransferred to the normal power source. The transfer and retransfer of the load are the two most basic functions of a transfer switch.

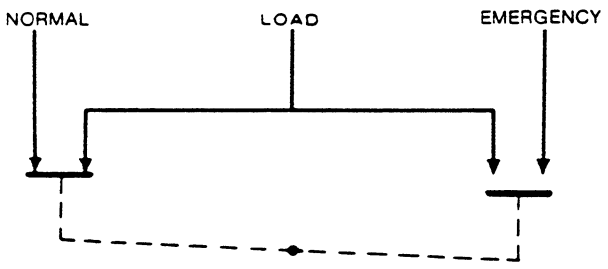


FIGURE 1. TRANSFER SWITCH

Automatic transfer switches are capable of operation without operator involvement. During automatic operation, automatic transfer switches perform the following basic functions:

1. Senses the interruption of the normal power source.
2. Transfers the load to the emergency power source.
3. Senses the return of the normal power source.
4. Retransfers the load to the normal power source.

INSTALLATION

The installation of a Series OT transfer switch must meet the requirements of all applicable codes governing electrical installations and the requirements of the authority having jurisdiction for enforcement of those codes.

WIRING

Connect wires of sufficient size to carry rated current from the line, load, and emergency power source directly to the transfer switch terminals which are marked A, B, and C (A and B on single-phase switches). Table 2 gives the type and maximum wire size the transfer switch will accept.

The phase rotations of the normal and emergency sources must agree. Check and correct, if necessary.

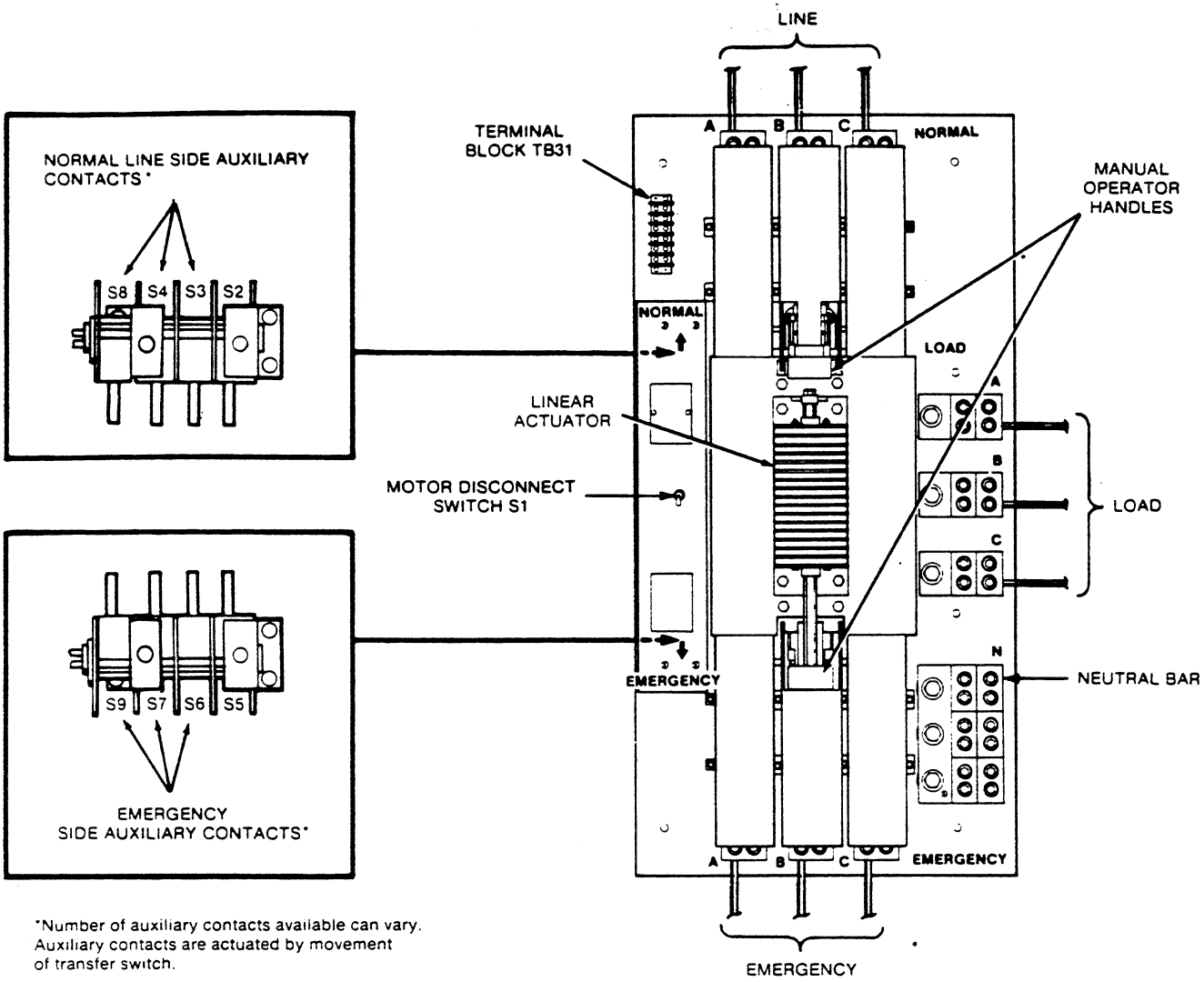
Neutral Bar (if used): Connect the neutral wires to the netural bar. Table 2 lists the wire sizes and types the neutral bar accepts.

Auxiliary Contacts: Auxiliary contacts are located on the normal and emergency sides of the transfer switch for external alarm or control circuitry. To gain access to the auxiliary contacts, remove the cover which houses the motor disconnect switch S1 (cover held in place by four screws). See Figure 2. The contacts have ratings of 25 amperes at 125, 250, or 480 VAC; 1 horse-power at 125 VAC; 2 horsepower at 250 VAC or 480 VAC; and a pilot duty rating of 750 VA at 277 VAC maximum.

TABLE 1. SERIES OT ENCLOSURE DIMENSIONS (OVERALL)

AMP	NEMA TYPE*	SWITCHED NEUTRAL POLE	PROGRAMMED TRANSITION	H	W	D
100-280	1	No	No	36"	28"	14"
100-150	1	No	Yes or No	36	28	14
100-150	1	Yes	No	41	36	21
225-280	1	No	Yes	41	36	21
225-280	1,3R,5	Yes	Yes or No	60	36	18
400-600	1,3R,5	Yes or No	Yes or No	60	36	18
800-1000	1,3R,5	Yes or No	Yes or No	72	40	24
100-225	4	Yes or No	Yes	72	48	24
280-1000	4	No	Yes or No	90	72	24
100-1000	4	Yes	Yes or No	90	72	24

*NEMA TYPE 1 - General Purpose
3R - Rainproof
4 - Waterproof
5 - Dustproof



*Number of auxiliary contacts available can vary. Auxiliary contacts are actuated by movement of transfer switch.

FIGURE 2. TRANSFER SWITCH WIRE CONNECTIONS

TABLE 2. SERIES OT TRANSFER SWITCH WIRE CAPACITIES

TRANSFER SWITCH (AMPERES)	TERMINAL LUGS Number of Conductors and Size Per Pole	
	Switch Pole*	Neutral Bar*
100	ONE No. 6 - 250 MCM	ONE No. 6 - 250 MCM
150 & 225	ONE No. 6 - 350 MCM	ONE No. 6 - 350 MCM
280	ONE No. 4 - 500 MCM	ONE No. 4 - 500 MCM
400	ONE 350 MCM -1000 MCM	ONE 350 MCM - 1000 MCM
600	TWO No. 2 - 600 MCM	TWO No. 2 - 600 MCM
800 & 1000	FOUR No. 2 - 600 MCM	FOUR No. 2 - 600 MCM

* Connectors compatible with copper and aluminum.

Area Protection or Remote Test Switch (if used):

1. Remove terminal jumper located between terminals 4 and 5 of terminal strip TB1 (Figure 3).
2. Connect the two leads from the normally closed circuit of area protection equipment or single-pole, single-throw remote test switch to terminals TB1-4 and TB1-5. Use number 16 wire up to 800 feet or 244 metres (maximum resistance of 4 ohms per line).

Transfer Inhibit Circuit: To inhibit transfer of the automatic transfer switch by another control, remove the jumper between TB1-6 and TB1-7. Connect the wire leads from the external equipment to these two terminals. See Figure 3.

Normal Source Failure Contacts: A power failure of the normal line operates a set of contacts, one normally open and one normally closed, that can be used by the customer for signal circuits external to the transfer switch. Make connections to TB1-9 and 10 (closed with normal power) or to TB1-9 and 8 (open with normal power).

Contact ratings are:

10 amp, 28 VDC/120 VAC, 80% PF
6 amp, 240 VAC, 80% PF
3 amp, 480/600 VAC, 80% PF

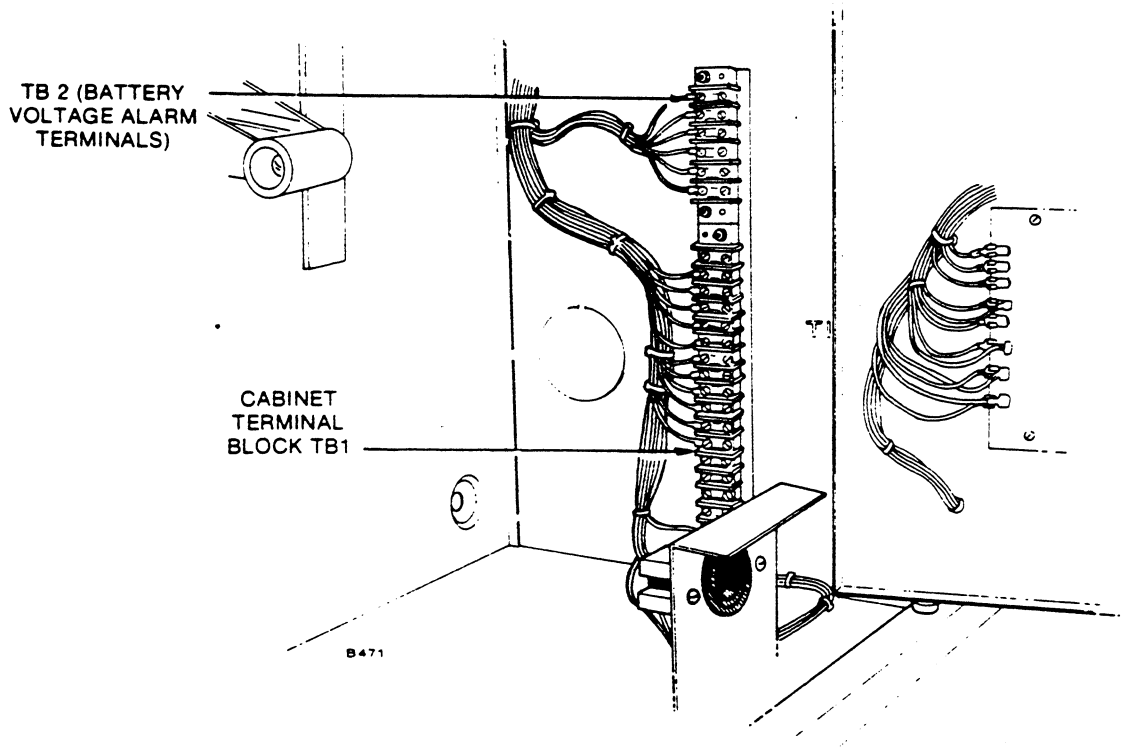


FIGURE 3. CABINET TERMINAL BLOCKS TB1 AND TB2

DESCRIPTION

An Onan Series OT automatic transfer switch has four main parts; the transfer switch itself, the automatic control, the meter-lamp panel and the enclosure.

The model number of a Series OT transfer switch contains coded information that completely describes the product. When corresponding with Onan be sure to include the complete model number. Model numbers are located on the inside of the right-hand enclosure door.

TRANSFER SWITCH

The transfer switch (a common model is illustrated in Figure 2) connects the load either to the normal or to the emergency power source as called for by the control. Mechanical interlocks prevent the transfer switch from closing to both power sources simultaneously. (Switched neutral transfer switches have additional mechanical interlocks. See manual operation). The prinicipal parts of the transfer switch are the linear actuator, the motor disconnect switch, and the manual operators.

Linear Actuator

The linear actuator is a linear induction motor that provides the force to move the transfer switch contacts. A downward force transfers the load to emergency power and an upward force retransfers the load to normal power.

Transfer switches with a switched neutral pole have a second, separate linear actuator to move the neutral contacts. The neutral pole contacts are make - before - break. Switched neutral transfer switches have additional mechanical interlocks which set a specific switching sequence. See manual operation.

Motor Disconnect Switch

The motor disconnect switch opens one side of the power supply to the linear actuator allowing safe manual operation. The motor disconnect switch is closed in the UP position and electrical operation is automatic. The motor disconnect switch is open in the DOWN position, which stops automatic operation.

Manual Operators

One pair of manual operator handles for each linear actuator allow the operator to transfer or retransfer the load manually. See manual operation.

AUTOMATIC CONTROL

The automatic control (illustrated in Figure 4) decides which utility power source the transfer switch connects to the load and decides when the transfer switch will do it. Voltage Sensors monitor both power sources and determine which power source the control will select. The control prefers the normal power source, but will call for the emergency source if the normal source voltage falls below preset limits and the emergency source voltage remains above preset limits. The control waits for the Transfer-Retransfer Time Delay to finish timing before calling for the transfer switch to operate. The Test Transfer Switch checks the transfer operation and the Transfer Inhibit Switch stops automatic transfer operation.

Voltage Sensors

The utility-to-utility control uses solid-state, adjustable voltage sensors to monitor both the normal line and the emergency line for undervoltage. Each voltage sensor module (illustrated in Figure 5) has two voltage limit settings: the pickup voltage and the drop-out voltage.

Pickup Voltage: The lower adjusting knob on the voltage sensor module sets the pickup voltage. The pickup voltage scale is graduated from 90 to 140 volts, based on a nominal 120 volt system. For other system voltages, correct the scale using the factor given in Table 3.

Example: Pickup Voltage Setting = 108 volts
Nominal System Voltage = 480 volts
Correction Factor = 4.0
Pickup Voltage = 108 x 4.0 = 432 volts

TABLE 3. SYSTEM VOLTAGE CORRECTION

NOMINAL SYSTEM VOLTAGE	FACTOR
120	1.0
208	1.7
240	2.0
480	4.0
600	5.0

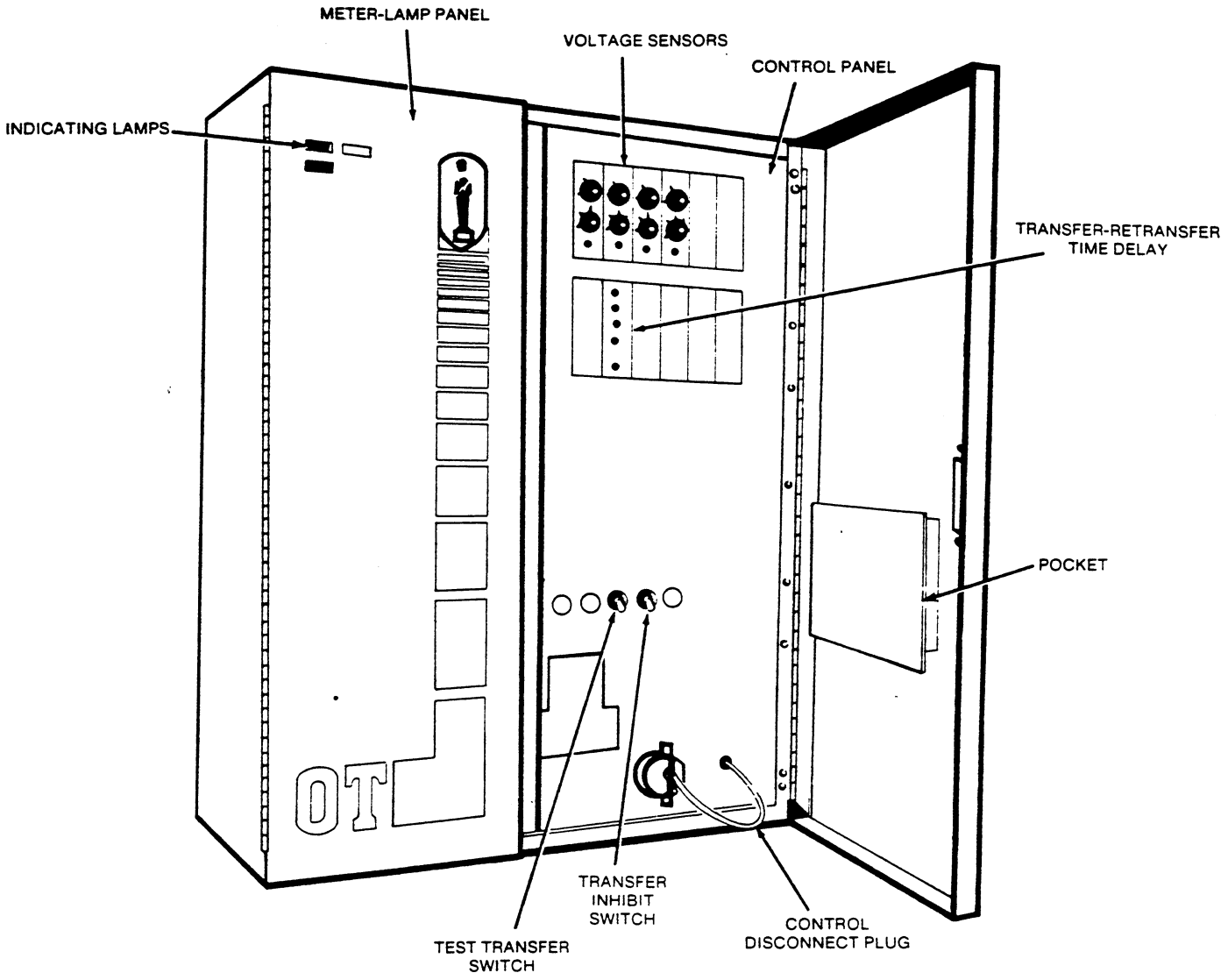


FIGURE 4. UTILITY-UTILITY CONTROL PANEL

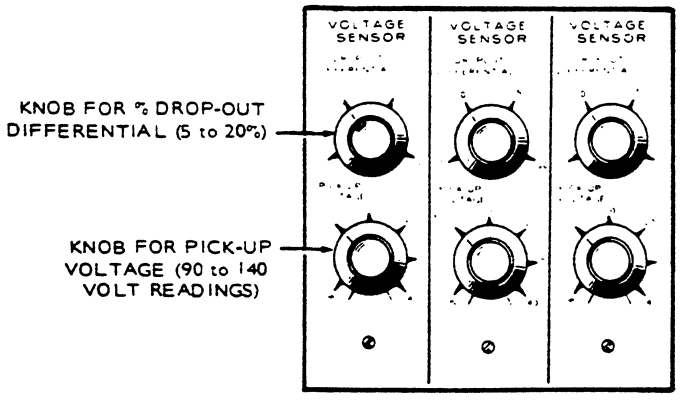


FIGURE 5. VOLTAGE SENSORS

Dropout Voltage: The upper adjusting knob (labeled dropout differential) sets the dropout voltage. This scale is graduated from 5 to 20%. The dropout voltage is the difference between the pickup voltage and the product of the pickup voltage and the dropout differential setting.

Dropout Voltage = (Pickup Voltage) - (Pickup Voltage x Dropout Differential)

Example: Pickup Voltage = 432 volts
Dropout Differential = 10%
Dropout Voltage = (432) - (432 x 10%) = 389 volts

Normal Source Voltage Sensors: The normal source voltage sensors function to tell when the normal line voltage falls below the dropout voltage limit and when the normal line voltage rises above the pickup voltage limit. The dropout voltage limit is the voltage below which a transfer sequence (normal to emergency) begins. The pickup voltage limit is the voltage at which the retransfer sequence (emergency to normal) begins.

Normal source voltage sensors are solid-state plug-in modules located in the top rack of the control accessory panel. With a single-phase system, the normal line sensor is in rack position 1. With a three-phase system, the normal line sensors are in positions 1, 2, and 3.

Emergency Source Voltage Sensor: The emergency source voltage sensor functions to tell when the emergency line voltage falls below the dropout voltage limit and when the emergency line voltage rises above the pickup voltage limit. The emergency source dropout voltage is the voltage below which (1) the control will not carry out a transfer (normal to emergency) operation or (2) if the retransfer time delay is timing, then the control will carry out an immediate retransfer (emergency to normal). The emergency source pickup voltage is the voltage which the emergency line must have been above (and must stay above the dropout voltage) for the control to consider the emergency source acceptable.

The emergency source voltage sensor is a solid-state plug-in module similar to the normal source sensors, but is located in rack position 4 on the control accessory panel.

Transfer-Retransfer Time Delay

The Transfer-Retransfer Time Delay functions to introduce a time delay before the events of transfer and retransfer. A time delay before the transfer operation (normal to emergency) prevents "nuisance" transfer switch operations when normal line voltage flucuations are shorter than the transfer time delay. A time delay before retransfer (emergency to normal) allows time for the returning normal line to stabilize.

The Transfer-Retransfer Time Delay is a solid-state plug-in module located in rack position 8 of the control accessory panel. Figure 14 shows the front of this module.

The Transfer-Retransfer time delays are adjustable. The transfer time delay is adjustable from 0.1 to 15 seconds. The retransfer time delay is adjustable from 0.5 to 30 minutes. See ADJUSTMENTS for a step-by-step adjustment procedure.

Test Transfer Switch

The Test Transfer Switch gives the operator the means for checking the operation of the transfer switch. The Test Transfer Switch has two positions. In the NORMAL position the control will respond automatically to changes in normal line voltage. The TEST position starts a transfer operation (normal to emergency).

Transfer Inhibit Switch

The Transfer Inhibit Switch provides a means for disabling the transfer switch while making adjustments or opening the control panel. Under normal conditions the Transfer Inhibit Switch must be in the NORMAL position. To prevent "nuisance" transfer operations while making adjustments or opening the control panel, move this switch to TEST.

Control Disconnect Plug

The Control Disconnect Plug is the twist-lock plug near the bottom of the control accessory panel. The Control Disconnect Plug opens the normal line voltage to the control.

To gain access to the transfer switch:

1. Move the Transfer Inhibit Switch to the TEST position.
2. Remove the Control Disconnect Plug.
3. Swing the control panel open.

WARNING **Unplugging the Control Disconnect Plug removes the normal line power only from the control only. Normal line power is still present on the transfer switch terminals and emergency line power is still present on the transfer switch terminals and control. A serious electrical shock hazard is present unless both utility lines are opened to the transfer switch.**

METER-LAMP PANEL

The Meter-Lamp panel supports two indicating lamps. On Onan provided enclosures the Meter-Lamp panel is the left-hand front panel of the enclosure so that the indicating lamps can be seen without opening the doors.

A green indicating lamp marked NORMAL lights when the load is connected to the normal power source.

A red indicating lamp marked EMERGENCY lights when the load is connected to the emergency power source.

ENCLOSURE

There are a variety of enclosures that contain Onan Series OT transfer switches. Application factors such as environmental conditions, continuous current rating of the transfer switch, the number of poles of the transfer switch, and others determine the specific enclosure required.

OPERATION

A utility-to-utility automatic transfer switch connects the load to one of two independent utility power sources. One power source is preferred by the control and is designated as the normal or preferred source. The other power source is the emergency or alternate source. The transfer switch operates either to transfer the load from the normal source to the emergency source, or to retransfer the load from the emergency source back to the normal source. The transfer switch executes either a transfer or a retransfer operation at the command of the control.

UTILITY-TO-UTILITY CONTROL

A simplified block diagram, Figure 6, represents the logic the utility-to-utility control follows. In the diagram, diamond-shaped blocks represent decisions the control must make and rectangular blocks represent the transfer or retransfer commands. The four basic sequences are the normal sequence, transfer sequence, retransfer sequence, and test transfer sequence.

Normal Sequence

Starting at the top of the block diagram, the control decides whether or not the voltage of the normal source is acceptable. The voltage is acceptable if it is above the dropout voltage setting of the normal source voltage sensor(s). Then, with the Test Transfer Switch in the NORMAL position and the load connected to the normal power source, the normal sequence is complete.

Transfer Sequence

A transfer sequence begins when the normal source voltage falls below the dropout voltage setting of the normal source voltage sensors. Then, with the load connected to the normal source and the voltage of the emergency source above the dropout voltage setting of the emergency source voltage sensor, the control begins the transfer time delay. When the transfer time delay is complete, the control starts a transfer operation. When the load is connected to the emergency source the transfer sequence is complete.

Retransfer Sequence

With the load connected to the emergency source, the retransfer sequence begins when the normal source voltage rises above the pickup voltage setting of the normal source voltage sensors (top decision block). Then, with the Test Transfer Switch in the NORMAL position and the load connected to the emergency source, the control begins the retransfer time delay.

Note that if the emergency source voltage falls below the dropout voltage setting of the emergency source voltage sensor while the retransfer time delay is timing, the control will call for an immediate retransfer to the normal source.

If the normal source voltage has remained above the normal source dropout voltage setting for the entire retransfer time delay, then when the retransfer time delay is complete the control calls for a retransfer operation. When the load is connected to the normal source the retransfer sequence is complete.

Test Transfer Sequence

The test transfer sequence begins when the operator moves the Test Transfer Switch from NORMAL to TEST, simulating a normal source voltage failure. The control then follows the transfer sequence. When the Test Transfer Switch is returned to NORMAL, the control follows the retransfer sequence.

AUTOMATIC OPERATION

A utility-to-utility automatic transfer switch is set for automatic operation by placing the:

1. Test Transfer Switch at NORMAL, and
2. Motor Disconnect Switch in the UP position, and the
3. Transfer Inhibit Switch at NORMAL.

TEST OPERATION

To test the operation of the transfer switch, move the Test Transfer Switch from NORMAL to TEST. After waiting for the transfer time delay, the transfer switch will operate, provided the emerency power source is acceptable.

To return to automatic operation, move the Test Transfer Switch from TEST to NORMAL. After waiting for the retransfer time delay, the transfer switch will operate.

MANUAL OPERATION

An operator can manually transfer or retransfer a Series OT transfer switch using direct manpower. The transfer switch is equipped with manual operator handles for this purpose. Operators must follow the procedure that matches the description of their transfer switch.

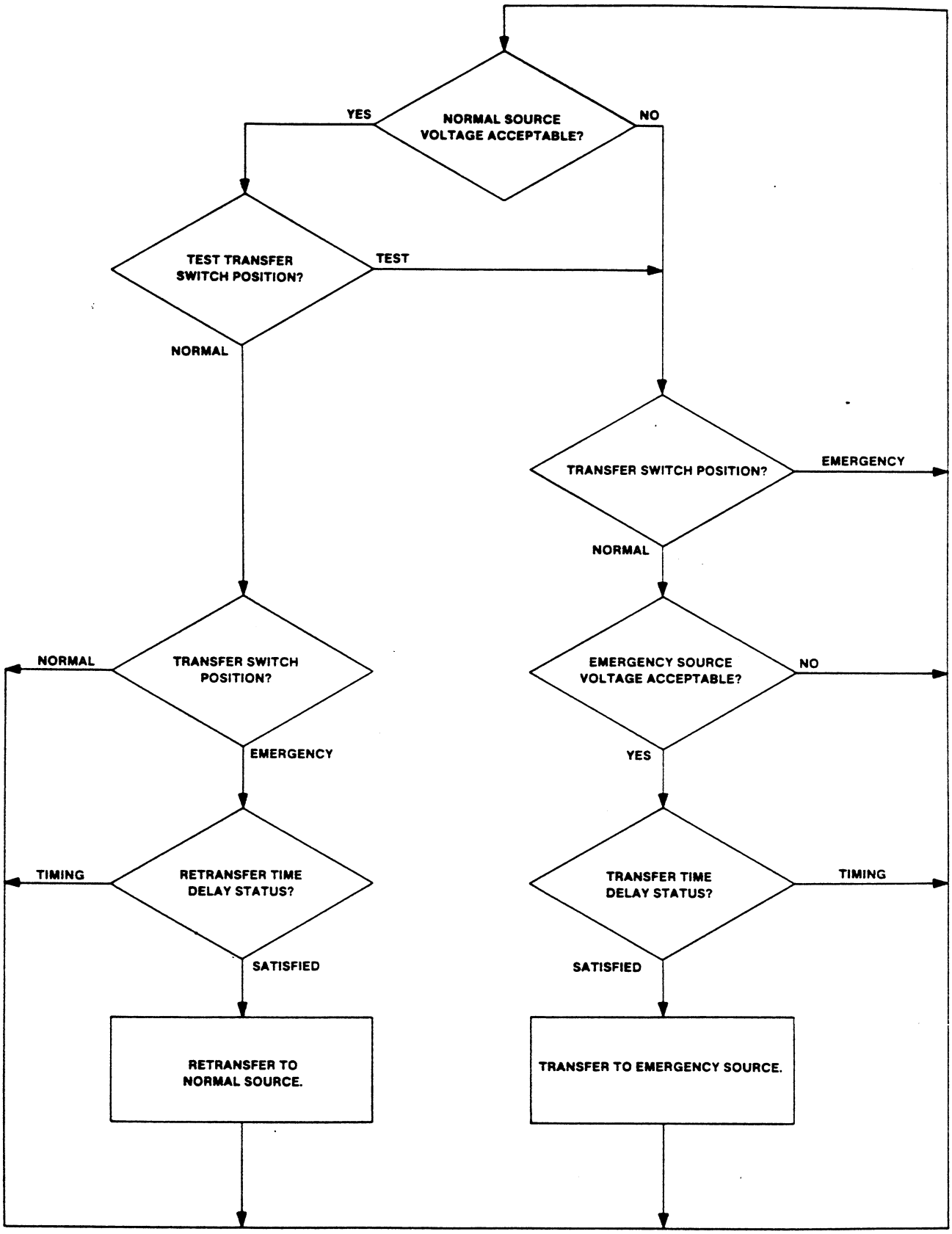


FIGURE 6. SIMPLIFIED LOGIC DIAGRAM

WARNING **Use extreme care when operating the transfer switch manually. High voltage on transfer switch terminals presents personal injury hazard.**

When the motor disconnect switch is moved from manual to automatic operation, an automatic transfer switch will return to the active power source in this order of preference: first, the normal power source; second, the emergency power source. The operator must put the transfer switch in its preferred position, manually, before moving the motor disconnect switch to automatic operation position.

WARNING **The rapid movement of the manual operator handles may cause personal injury. An automatic transfer switch must be placed in its preferred position, manually, before moving the motor disconnect switch to automatic operation.**

Single Actuator, 100-280 Ampere, Transfer Switch

1. Move the motor disconnect switch to the DOWN, manual operation position.
2. Pull either manual operator handle in the desired direction; down for emergency, up for normal.
3. Automatic Transfer Switch - Return the transfer switch to its preferred position.
4. Return the motor disconnect switch to the UP, automatic operation position.

Single Actuator, 400-1000 Ampere, Transfer Switch

1. Move the motor disconnect switch to the DOWN, manual operation position.
2. Transfer or retransfer, following these steps:
   Transfer, from normal power to the emergency power source:

   a. Pull the upper manual operator handle down.
   b. Push the lower manual operator handle down.

   Retransfer, from emergency power to the normal power source:

   c. Pull the lower manual operator handle up.
   d. Push the upper manual operator handle up.

3. Automatic Transfer Switches-Return the transfer switch to its preferred position.
4. Return the motor disconnect switch to the UP, automatic operation position.

Two Actuator Transfer Switches (Switched Neutral)

Manual operation of a transfer switch with two linear actuators, those having a switched neutral pole, is different than a single actuator transfer switch. The procedure that follows will overcome the mechanical interlock which prevents disconnecting the neutral pole while the power poles are connected to either power source. The mechanical interlock also prevents the power poles from closing to either power source before the neutral pole is closed to that source.

Automatic Transfer Switches - Be sure to return an automatic transfer switch to its preferred position before resuming automatic operation.

TRANSFER, MANUAL

The procedure for manual transfer, from the normal power source to the emergency power source, is:

1. Move the motor disconnect switch to the DOWN, manual operation position. See Figure 7.

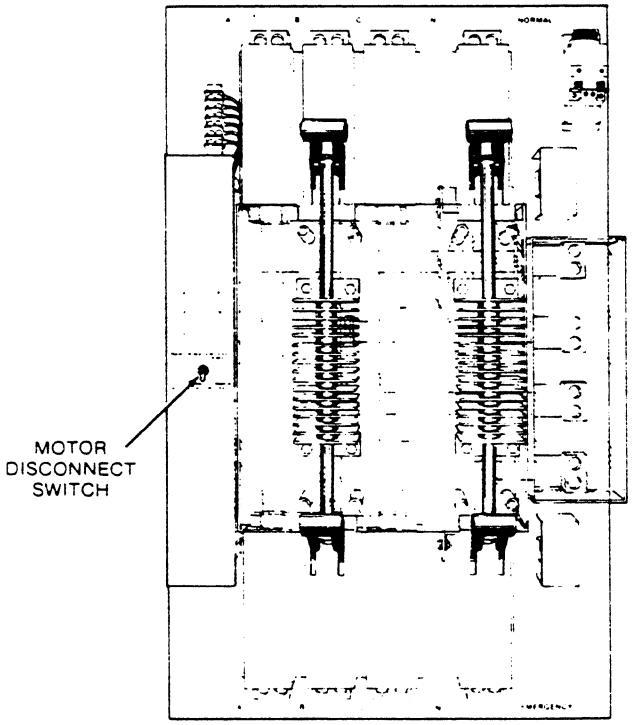


FIGURE 7.

WARNING **Automatic operation of the transfer switch can occur, causing personal injury, if the motor disconnect switch is not in the DOWN, manual operation position.**

2. Pull the top power handle down, as shown in Figure 8, disconnecting the power poles from the normal power source.
3. Pull the top neutral pole handle all the way down, as shown in Figure 9, connecting the load neutral to the emergency neutral and disconnecting it from the normal power source.

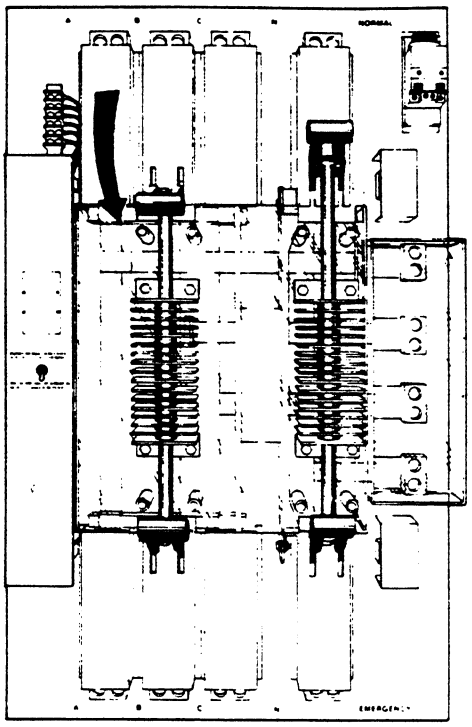


FIGURE 8.

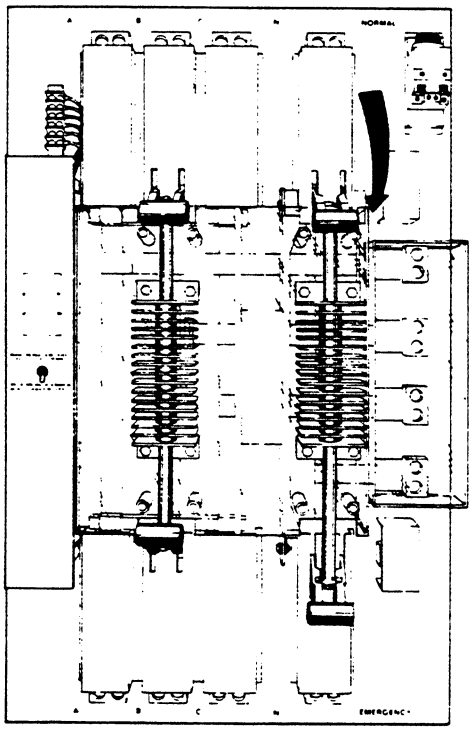


FIGURE 9.

4. Push the lower power pole handle down, as in Figure 10, connecting the load to the emergency power source. This completes the manual transfer switching sequence.

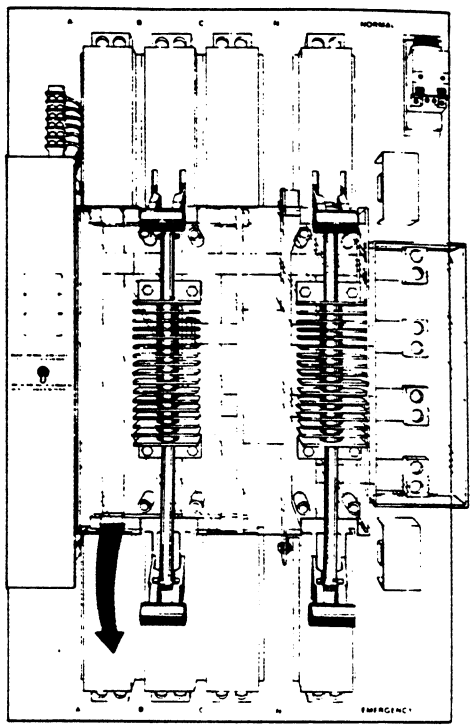


FIGURE 10.

RETRANSFER, MANUAL

The procedure for manual retransfer, from the emergency power source to the normal power source, is:

With the motor disconnect switch in the DOWN, manual position:

1. Pull the lower power pole handle up, as illustrated in Figure 11, disconnecting the load from the emergency power source.

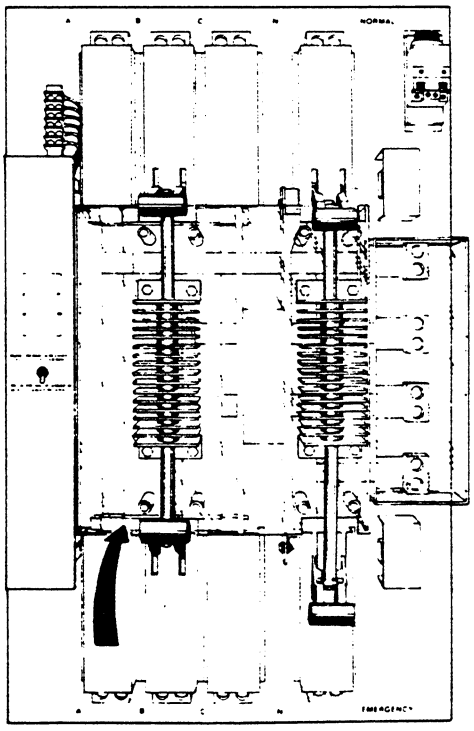


FIGURE 11.

2. Pull the lower neutral pole handle all the way up, as shown in Figure 12, connecting the load neutral to the neutral of the normal power source and disconnecting it from the emergency power source.

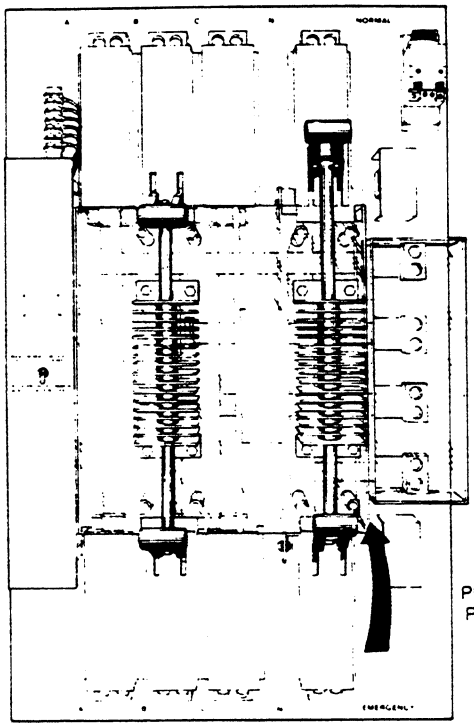


FIGURE 12.

3. Push the upper power pole handle up, as in Figure 13, connecting the load to the normal power source. This completes the manual retransfer switching sequence.
4. Being sure that the transfer switch is in its preferred position, return to automatic operation by moving the motor disconnect switch to the UP position.

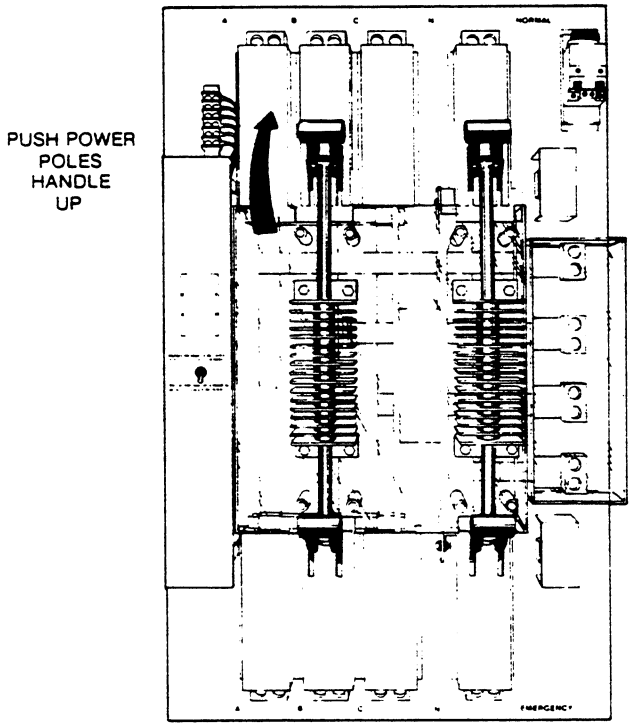


FIGURE 13.

ADJUSTMENTS

TRANSFER-RETRANSFER TIME DELAYS

The lengths of the transfer and retransfer time delays are adjustable using the following procedure. Refer to Figure 14.

1. Move the Transfer Inhibit Switch to TEST.
2. Marking the time with a stopwatch, or a sweep second hand, move the Test Transfer Switch to TEST. The transfer sequence will begin and the red transfer lamp on the module will light.
3. Measure the time the red transfer lamp remains lit. The transfer time delay is over when the red transfer lamp goes out. If the transfer time delay is the length desired, proceed to Step 5. If not, go to Step 4.
4. Insert a small screwdriver through the transfer adjustment opening (upper opening) of the transfer-retransfer module. Turn clockwise in small increments to increase the transer time delay, counterclockwise to decrease the transfer time delay.

CAUTION **Use minimal force when inserting and turning the screwdriver to make this adjustment. The adjustment potentiometer is easily damaged by excessive twisting force.**

5. Marking the time, move the Test Transfer Switch to NORMAL. The retransfer sequence will begin. The red retransfer lamp in the center of the module will light and the green timing lamp on the bottom of the module will begin flashing. Count the number of flashes the green timing lamp makes in sixty seconds.

   Convert the number of flashes in sixty seconds into the approximate retransfer time delay using the table that follows. The red retransfer lamp will go out when the retransfer time delay is over. If the retransfer time delay is the length desired, proceed to Step 7. If not, go to the next step.

Flashes/60 sec	Time Delay (min)
50	5
25	10
17	15
13	20
10	25
8	30

   Example: With 15 flashes in 60 seconds, the retransfer time delay is then approximately 13 minutes.

6. Insert a small screwdriver through the retransfer adjustment opening (lower opening). Turn clockwise in small increments to increase the retransfer time delay, counterclockwise to decrease the retransfer time delay.

CAUTION **Use minimal force when inserting and turning the screwdriver to make this adjustment. The adjustment potentiometer is easily damaged by excessive twisting force.**

7. Repeat Steps 2 thru 6 as required until both the transfer and the retransfer time delays are the desired lengths.
8. Return the Transfer Inhibit Switch to NORMAL.

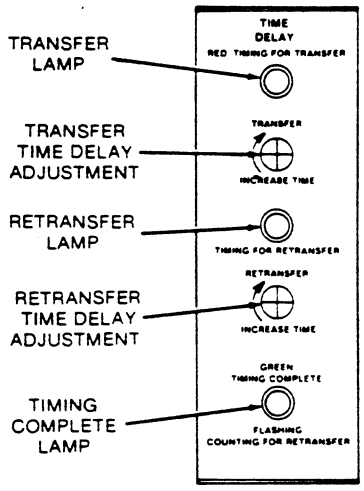


FIGURE 14. TRANSFER-RETRANSFER TIME DELAY

VOLTAGE SENSORS

Use the following procedure for adjusting both normal and emergency voltage sensors. Your settings, however, might vary considerably from the example shown because of specific load requirements. Generally, use settings which give load protection and yet will avoid "nuisance" load transfers

1. With the load connected to the normal power source, move the Transfer Inhibit Switch to TEST.
2. Set the pickup voltage with the lower knob. Use the appropriate correction factor for voltage systems other than nominal 120 volt. Three-phase sensors should be set alike.

   Example: Pickup Voltage Setting = 115 volts
   Nominal System Voltage = 480 volts
   Correction Factor = 4.0
   Pickup Voltage = 115 x 4.0 = 460 volts

3. Set the dropout differential with the upper knob. The dropout differential together with the pickup voltage determines the dropout voltage. Three-phase sensors should be set alike.

   Example: Pickup Voltage = 460 volts
   Dropout Differential = 10%
   Dropout Voltage = (460) - (460 x 10%)
   = 414 volts

4. Return the Transfer Inhibit Switch to NORMAL.

SYSTEM VOLTAGE CORRECTION

NOMINAL SYSTEM VOLTAGE	FACTOR
120	1.0
208	1.7
240	2.0
480	4.0
600	5.0

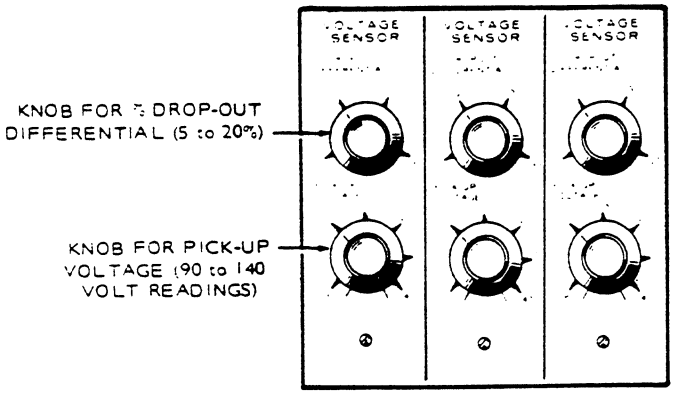


FIGURE 15. VOLTAGE SENSORS

PROGRAMMED TRANSITION

Programmed transition is an optional feature of Onan Series OT transfer switches. Programmed transition is the capability of the transfer switch to assume a mid-transition position, for an adjustable interval of time, when the load is neither connected to the normal power source nor to the emergency power source. This feature allows residual voltages in a motor load to decay to an acceptable level before transition is completed. The length of time that the transfer switch is in the mid-position can be adjusted from 0.5 to 5 seconds. The proper adjustment is a function of the motor and its connected load.

1. Move the Transfer Inhibit Switch to TEST.
2. Unplug the Control Disconnect.
3. Open the control panel.

WARNING **Unplugging the Control Disconnect removes normal line power only from the control only. Normal line power is still present on the transfer switch terminals and emergency line power is still present on the transfer switch terminals and the control. A serious electrical shock hazard is present unless both utility lines are opened to the transfer switch.**

4. Locate the programmed transition timer (Figure 16) mounted on the upper right-hand corner of the transfer switch base. Adjust the time delay using marks on knob.
5. Close the control panel.
6. Plug in the Control Disconnect.
7. Return the Transfer Inhibit Switch to NORMAL.

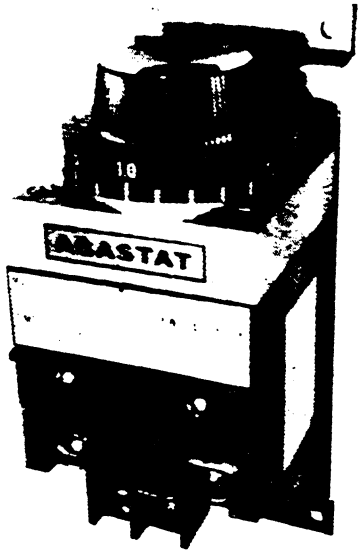


FIGURE 16. PROGRAMMED TRANSITION TIME DELAY RELAY

TROUBLESHOOTING

TRANSFER SWITCH DOES NOT TRANSFER, AUTOMATICALLY

1. Check the Motor Disconnect Switch, should be in the UP position.
2. Has the transfer time delay timed out?
3. Has the programmed transition time delay relay (if equipped) timed out?
4. Is the emergency source voltage sufficient to pick-up the emergency source voltage sensor?
5. Check Transfer Inhibit Switch, should be in NORMAL.

TRANSFER SWITCH DOES NOT RETRANSFER, AUTOMATICALLY

1. Check the Motor Disconnect Switch, should be in the UP position.
2. Is the Test Transfer Switch in the NORMAL position?
3. Has the retransfer time delay timed out?
4. Has the programmed transition time delay relay (if equipped) timed out?
5. Is the normal source voltage sufficient to pick-up the normal source voltage (sensor(s)?

PARTS AND SERVICE INFORMATION

This Series OT transfer switch is custom engineered and specially constructed. Because of the individuality of each automatic transfer switch, contact the dealer from whom you purchased this equipment for service and parts. Remember to give the complete model and serial number when requesting service or parts information. The wiring diagrams furnished with your Series OT transfer switch should be kept with your instruction manual in the "pocket" inside the cabinet.

Any shipments made are complete. Shipments are properly packed and in good order when delivered to the transportation company. Any claim for loss or damage in transit should be filed promptly against the transportation company making the delivery.