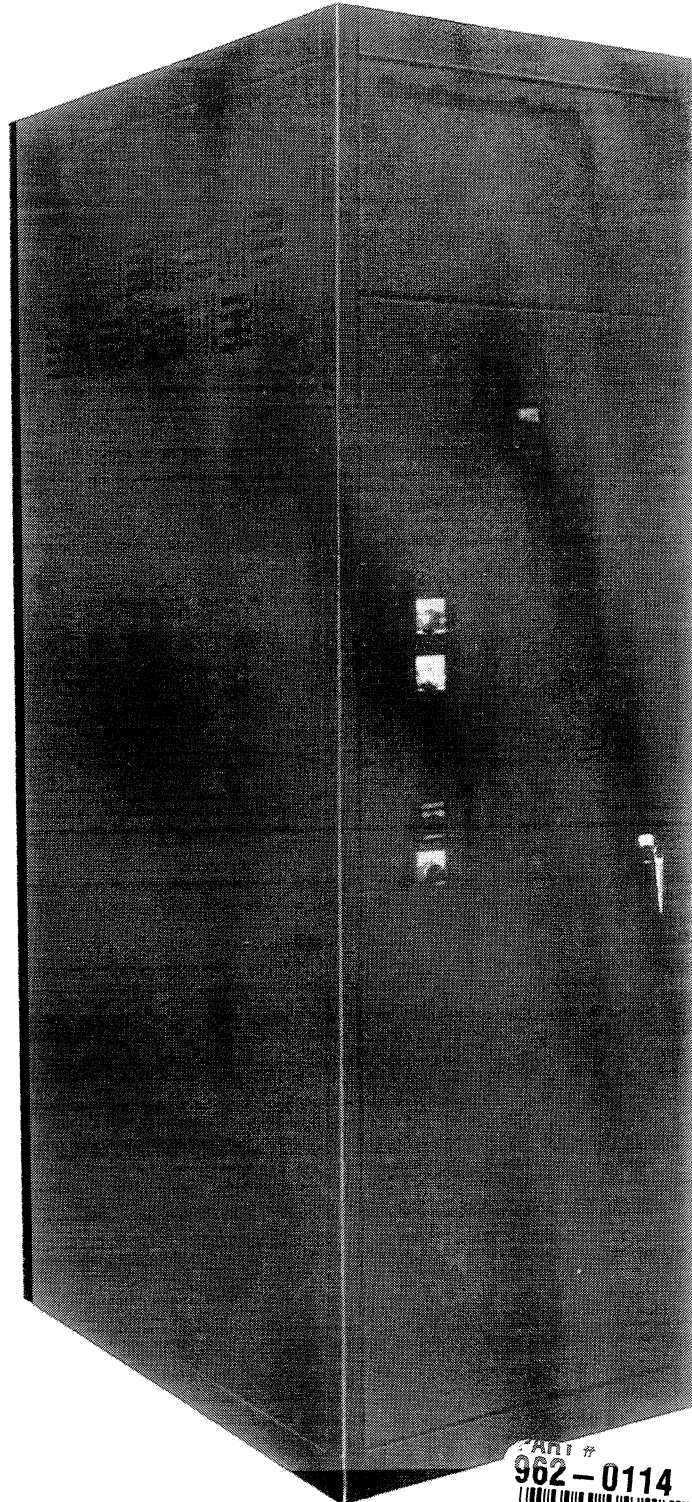




Instructions for  
1200-4000 Amp  
Solid-State, Split Panel  
Systems Pow-R Breaker  
Transfer Switch



PART #  
962-0114



MANUAL-OPR

Onan  
Genuine  
Parts

QUANTITY: ONE  
SERIAL#: 5450

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## SAFETY PRECAUTIONS

**⚠ DANGER**

*This symbol if used warns of immediate hazards which will result in severe personal injury or death.*

**⚠ WARNING**

*This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

**⚠ CAUTION**

*This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

**⚠ WARNING**

*High voltages inside the transfer switch present the hazard of severe personal injury or death. Follow proper installation, operation, and maintenance instructions to avoid these hazardous voltages.*

1. The transfer switch should be accessible to authorized personnel only.
2. The power source should be disconnected before attempting service to the switch.
3. Remove any metallic jewelry that could contact any hazardous voltage before performing any service to the transfer switch.
4. Avoid wearing damp clothing or wet shoes when working on any electrical apparatus.
5. Service personnel should use rubber mats where required to avoid accidental grounding of hazardous voltages.
6. If any repairs are necessary they should be made by a qualified electrician.

## INTRODUCTION

This instruction manual provides installation, testing, and subsequent operation of Onan split panel, Systems Pow-R breaker (SPB) transfer switches.

Operators should be familiar with this manual before attempting to install or operate the transfer switch.

## TRANSFER SWITCH DESCRIPTION

Onan transfer switches are reliable, safe, rugged, versatile, and compact assemblies for use in electrical distribution systems.

The intelligence/supervisory circuits on the SPB transfer switches constantly monitor the condition of both the normal and the emergency power sources. These circuits automatically initiate an immediate transfer of power from the normal source to the emergency source, when power fails or voltage levels drop below a preset value. Transfer back to the normal source is automatic upon return of the normal power source.

Monitoring of the power source is always performed on the line side of the power source to which the switch is connected, and power to drive each breaker's motor mechanism is taken from the side to which the load is being transferred. The normal power source is the preferred source and the switch will always seek this source when it is available.

The SPB automatic transfer switch has the following features as standard:

- Plug-in solid state cards are provided for voltage sensing, frequency sensing and time delay functions. Each card has adjustment knobs which can be screwdriver or finger adjusted. Captive screw locks positively lock the adjustment settings with a uniform force that does not alter the setting when it is tightened. All sensing cards are interchangeable. However, a timing card cannot be used in a voltage/frequency slot, or vice versa, since the cards are keyed to prevent improper insertion. Each card is held in place by two screws. Empty card slots are covered by blank covers. All cards have conformal coating for environmental protection.
- Adjustable voltage sensing protection on all phases of the normal power source.
- Automatic transfer operation.
- Wiring gutter space to meet code requirements.
- Safe manual operation.
- Test selector switch (TSS) — test, auto.
- Solid neutral bar assembly.
- Engine Start Contact provided on a red colored terminal block. This contact closes upon a loss of normal power, thus initiating an engine start.
- Rear terminal connections suitable for top or bottom cable or busway entrance.
- Wiring leads are clearly identified with hot ink stamped numbers.
- Common load bus conveniently located behind the power switching panel.
- Two interlocked, high withstand Systems Pow-R devices.
- High speed, stored-energy, switching mechanisms for fast transfer operation — less than five cycles.
- Mechanical interlocks prevent paralleling both power sources.
- Ventilated NEMA 1 enclosure with keylock handle.
- Split panel construction for ease of equipment maintenance.
- Transfer mechanism is powered from the source to which the load is being transferred.
- Transfer switches are 100 per cent equipment rated in either open or enclosed mounting arrangements.
- Continuous rating for all classes of loads.
- Auxiliary contacts — three normally open (NO) and three normally closed (NC) for both normal and emergency switch positions.
- Integral multi-voltage transformer taps to satisfy any required application voltage. Selector plug provides quick-change capability to desired voltage rating.
- Intelligence panel disconnect between the power switching panel and the intelligence panel.

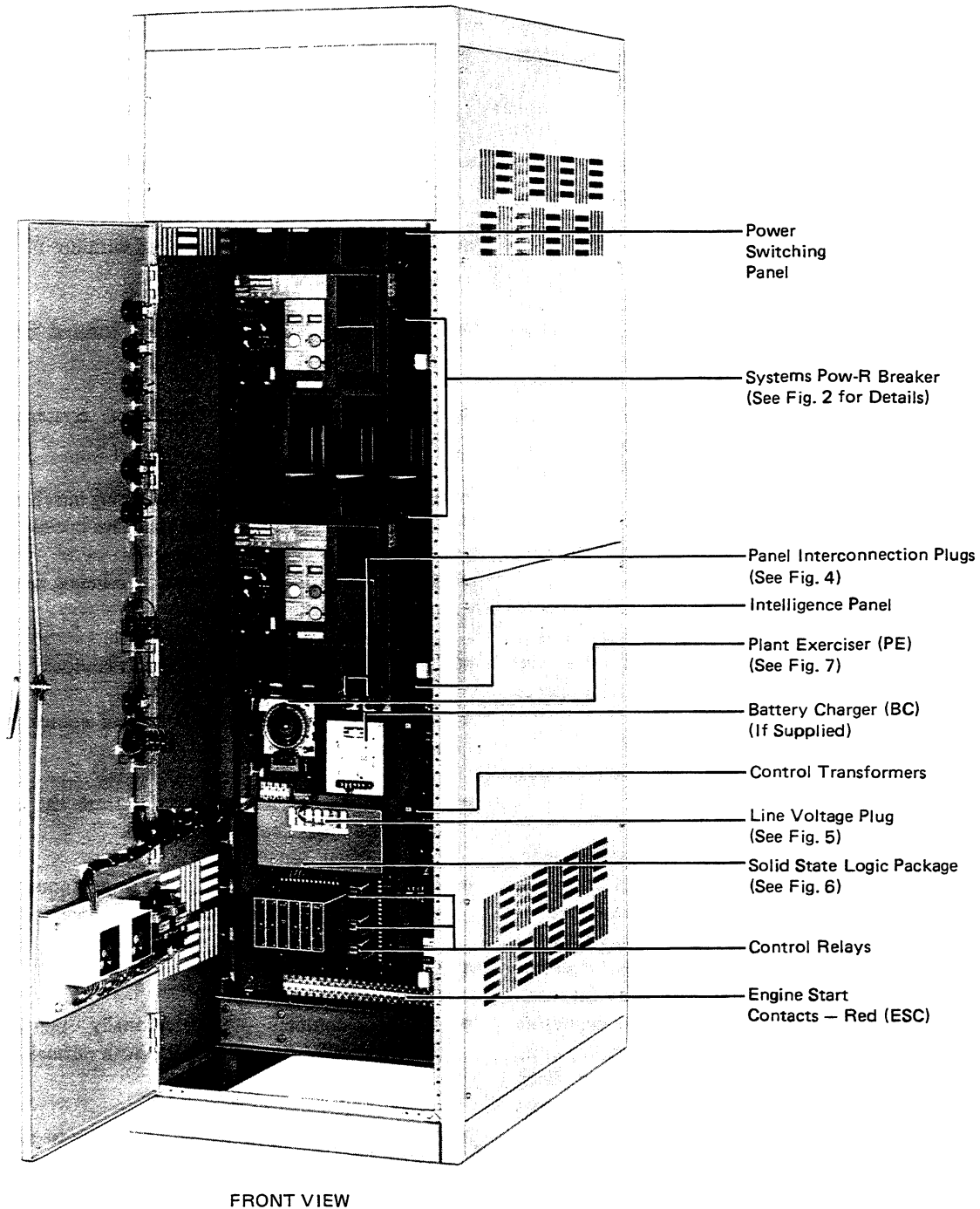


Fig. 1 Systems Pow-R Breaker Automatic Transfer Switch

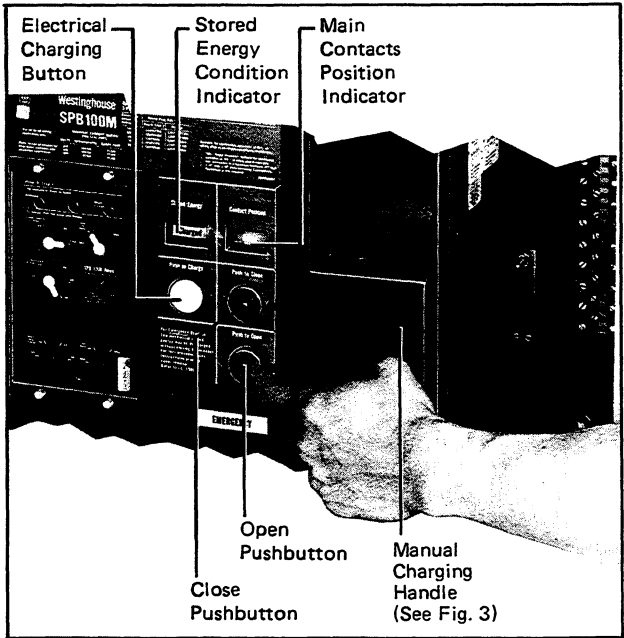


Fig. 2 Systems Pow-R Breaker

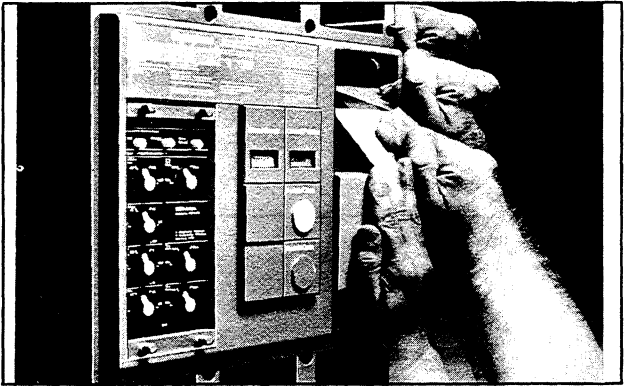


Fig. 3 Manual Charging of SPB Breaker

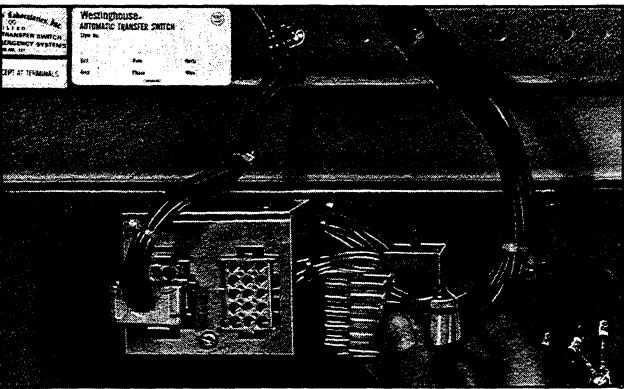


Fig. 4 Panel Interconnection Plugs

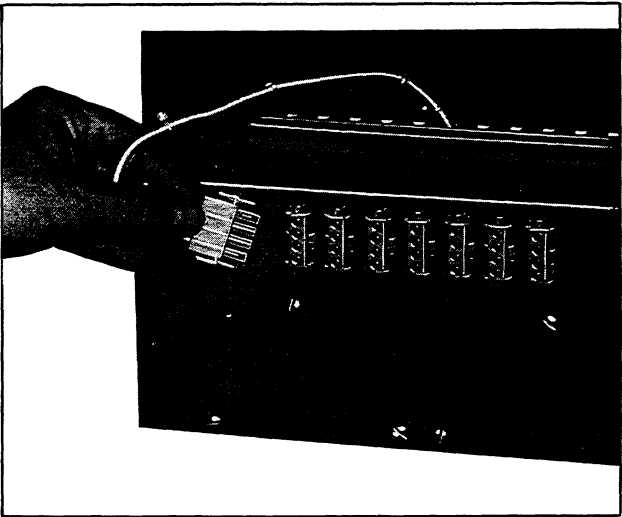


Fig. 5 Line Voltage Plug

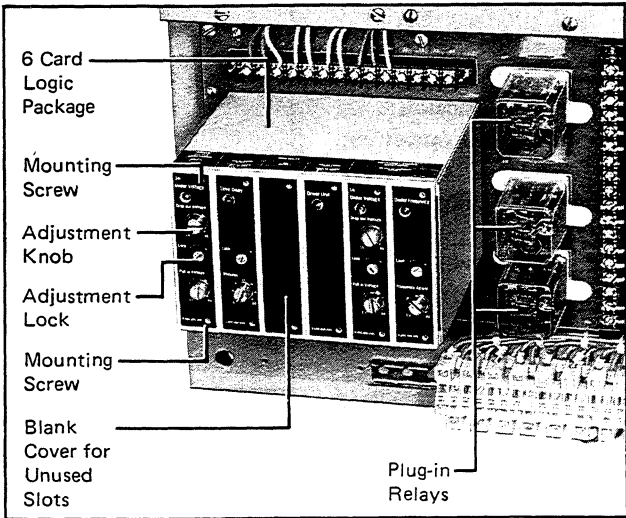


Fig. 6 Solid State Logic Package

## TORK TIME SWITCH

This is a seven (7) day timer switch used to exercise the engine-driven generator. Two timing wheels are visible from the front, the 24 hour dial ① and the seven day dial ②.

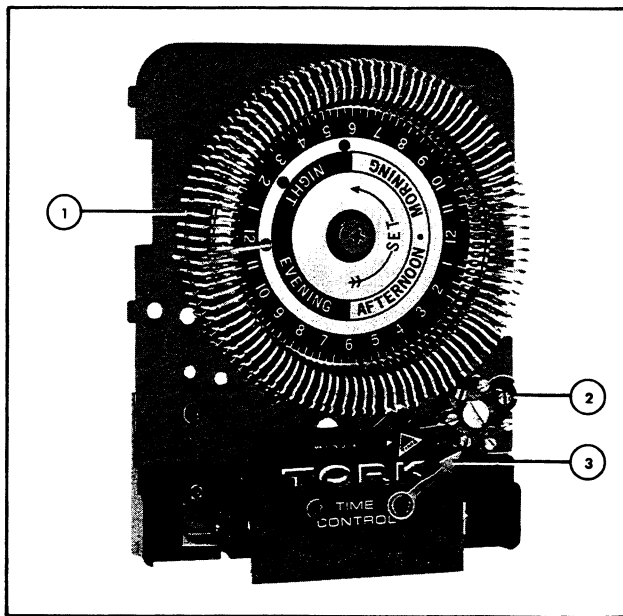


Fig. 7 Tork Time Switch (Plant Exerciser)

**Setting Tork Time Switch:** Select day(s) engine-driven generator is to function; then on seven day spoked dial, back the appropriate brass knurled screw(s) out, leaving all other brass screws tightened down.

**CAUTION** Do not attempt to insert screw into spoke when adjacent to copper-colored arrow ③ or damage will occur. If necessary, turn seven-day wheel, then insert screw.

Select time of day and length of time engine-driven generator is to function. On 24 hour dial, tilt tabs inward toward center of dial at hour mark that operation is intended. Each tab represents 15 minutes of operation.

**EXAMPLE:** Operation Days: Monday and Thursday  
Time: 3:00 – 4:00 P.M.  
Duration: 1 hour

1. Back brass screws out on days indicated Monday and Thursday on seven day dial.
2. On 24 hour dial, tilt four (4) tabs inward at 3:00 – 4:00 on the “evening” side of dial. All other tabs should be tilted outward.

**To Set Time of Day:** Turn 24 hour dial counterclockwise until the correct time of day is indicated by the arrow on the nameplate. Be sure to check whether time set is A.M. or P.M.

**To Set Correct Day:** If setting is being made later than 2:00 A.M. turn wheel **CLOCKWISE** until present day of week is indicated by copper arrow. (Between midnight and 2:00 A.M., setting must be made to the day just ended at midnight.)

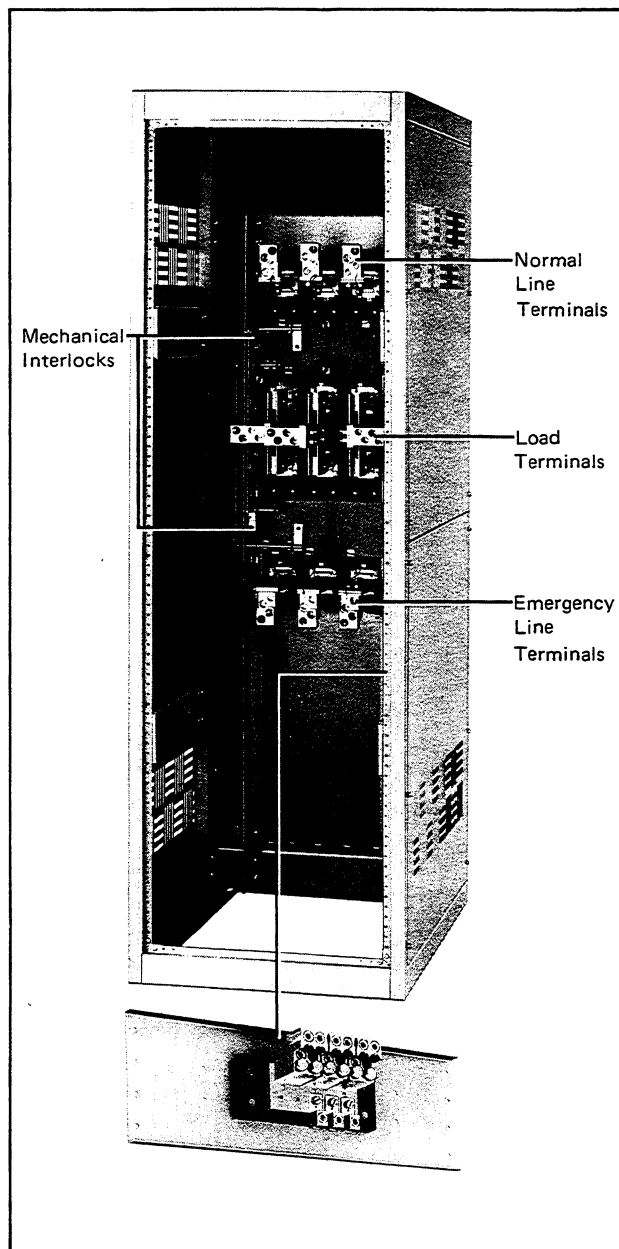


Fig. 8 Rear View, Systems Pow-R Automatic Transfer Switch

## INSTALLATION

### Preliminary Comments

Transfer switches are factory-wired and tested. Installation requires mounting of cabinet, connection of power cables, and wiring control items requiring field connections.

### Control Items Requiring Field Connection

If your transfer switch includes any of the following, connections must be made in the field as part of the installation procedure. Connection diagrams are located in the Appendix.

Control

Item No. Description

	Engine Start Contact
	Plant Exerciser with Selector Switch
	Battery Charger, 24 Volts
	Load Shed - Emergency Side

**NOTE:** Do not remove protective packing until ready for complete installation. Protect switch at all times from excessive moisture, construction grit, metal chips, plaster, etc.

### STORAGE

If the transfer switch is to be stored prior to installation, it should be ordered with packaging/crating suitable for the storage environment. The transfer switch is not designed or packaged for outdoor storage, and warranty will be withdrawn upon evidence of outdoor storage.

Onan strongly suggests that this equipment be stored in a climate controlled environment between the limits of -20°C to 85°C with a relative humidity of 80% or less, non-condensing.

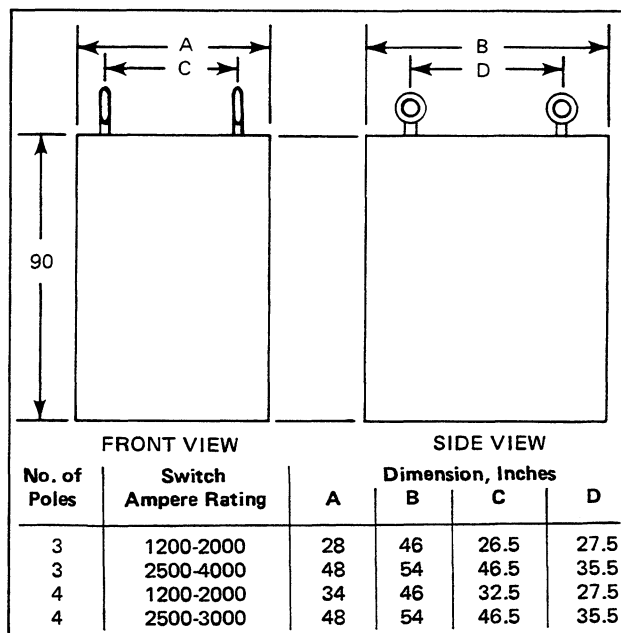
### Location Selection

The transfer panel must be mounted on a flat, rigid supporting surface and in an atmosphere free of excessive moisture and extreme temperatures, except those units approved for special environments. The panels provide ample room for rear cable entry from top, bottom or sides. At no time should cables be routed to retard the ac-

tion of relays or cover the logic in a way that restricts adjustments. Maintain proper electrical clearances between live metal parts and grounded metal.

For installation and maintenance purposes, the primary and secondary sources must have an overcurrent protective device upstream of the transfer switch, unless overcurrent protection is provided integral to the switch.

Dimensions of the transfer switch are an important consideration in determining proper location selection. Refer to table and drawing below for this information.



### Cabinet Mounting

1. Carefully uncrate the transfer switch. If damage is visible, please contact your local Onan sales representative.
2. Open door and visually verify that there are no broken or damaged components, or evidence of distorted metal or loose wires as a result of rough handling.
3. A label on the baseplate provides specifications for the given transfer switch. Verify that these specifications comply with your requirements.
4. Remove any braces or packing used to protect the transfer switch or internal components during shipping.

## Wiring Connections

### **▲WARNING**

High voltages present the hazard of severe personal injury or death. De-energize the normal, emergency, or any other power source to be connected to the switch before making any power or pilot circuit connections.

1. Verify that the line and load cables comply with applicable electrical codes.
2. Verify that transfer switch rated current and voltage (see specifications tag on the intelligence panel of transfer switch) agree with system current and voltage.
3. In desired location, provide conduit and/or cable openings as required. Take care to avoid entrance of any metal filings into the transfer switch components.
4. Remove surface residue from conductors and use joint compound, if required, especially if aluminum conductors are used. Tighten conductors and wipe away excessive compound.
5. Make necessary connection of control items using wiring diagrams in the Appendix.

## TESTING

### Functional Checkout Procedure

At installation or during planned power outages.

**NOTE:** With the Time Delay Engine Cool-off feature, an engine start signal is present for a period of time equal to the timer setting when the switch is first energized. To avoid starting the engine during this time, turn the generator controls to the "Off" position.

Energize the transfer switch using the following steps:

### **▲WARNING**

High voltages present the hazard of severe personal injury or death. Avoid contact with any voltage source while energizing the transfer switch.

#### A. With No Voltage Available on Either Power Source and Breakers Charged

1. Both the Normal (NB) and Emergency (EB) power switching devices should be in the "Open" and "Charged" position. (If breakers do not read "Charged", they can be manually charged. See Manual Charging of SPB Breaker and Fig. 4.)

2. The Test Selector Switch (TSS) should be in the "Normal" position.
3. The generator engine start controls should be in the "Off" position to prevent an undesired start.
4. Pre-set all timing circuits to meet job specifications.
5. Pre-check all transfer switch loads to ensure that they are ready to be energized.

#### B. Connect Power Sources

1. Close the normal source upstream protective device. The normal power switching device (NB) should charge and then automatically close.
2. Connect the engine-start battery cable.
3. With the emergency generator in the "Off" position, where used, close the emergency source upstream protective device.

**NOTE:** Prior to making any attempt to energize the transfer switch, the engine-driven generator should be operated. If necessary, the voltage regulator on the generator should be adjusted according to the manufacturer's recommendations. The Automatic Transfer Switch will respond only to rated voltage and frequency indicated on the switch rating nameplate.

4. Reclose any generator engine-start controls opened as a result of step A3 above.
5. Where required, use an accurate voltmeter to check phase-to-phase and phase-to-neutral voltages present at the transfer switch normal, emergency and/or load terminals.

#### C. Operational Checks

1. The normal switching device (NB) should be in the "Closed" position as a result of step B1 above.
2. Initiate an automatic transfer operation from the normal to emergency power source by moving the Test Selector Switch (TSS) from the "Normal" to the "Test" position.
  - a) The engine should start and run — building up to normal voltage and frequency — within a few seconds, depending upon the machine characteristics. The Time Delay on Engine Starting (TDES) must time out before the engine will start.



- b) The transfer switch will transfer to the emergency power source, i.e., NB will open and EB will close after the Time Delay Normal to Emergency (TDNE) times out.
- 3. Initiate an automatic transfer operation back to the normal power source by moving the Test Selector Switch (TSS) from the "Test" to the "Normal" position.
  - a) The transfer switch will transfer back to the normal power source, i.e., EB will open and NB will close.
  - b) The transfer to normal power will be delayed by the Time Delay Emergency to Normal (TDEN) feature.
  - c) The Time Delay for Engine Cool-off (TDEC) allows the engine to run unloaded for a pre-set time after transfer to normal power is completed.

#### D. Alternate Tests

1. Alternate operational tests may be possible, depending upon the options provided with any given transfer switch. Refer to the schematic diagram provided with the given transfer switch.

### TROUBLESHOOTING

**⚠ WARNING** High voltages present the hazard of severe personal injury or death. Avoid contact with any voltage source while troubleshooting the transfer switch.

#### A. Generator Set Does Not Start When Test Switch is Operated

1. Check operation. Make sure Test Selector Switch (TSS) is in "Test" position until the Time Delay on Engine Starting (TDES) times out.
2. Check engine controls. Make sure control is in "Auto" position. Make sure batteries are charged and connected.
3. Check wiring. Make sure the start signal wires from the engine controls are connected to the correct terminals on the control panel. (Terminals 51 and 52).
4. Check signal circuit with TSS in "Auto" position. Disconnect and tape start signal wires. Connect ohmmeter between terminals 51 and 52. Reading should indicate

an open circuit. Operate test switch. After Time Delay on Engine Starting (TDES) times out, ohmmeter should indicate a closed circuit.

#### B. With Generator Set Running, Transfer Switch Does Not Transfer the Load to Emergency

1. Check operation. Allow sufficient time for Time Delay Normal to Emergency (TDNE) to time out.
2. Check engine controls. Check generator output frequency and voltage. Output should, typically, be at least 85% of nominal voltage and 95% of nominal frequency, unless frequency and voltage sensing function settings provide stricter tolerances for emergency source. Make sure generator upstream protective device is closed.
3. Check wiring. With a voltmeter, read phase-to-phase voltage between transfer switch terminals E1 and E2.

#### C. Transfer Switch Does Not Retransfer the Load After Normal Source is Returned or After Test Switch (TSS) is Released

1. Check operation. Make sure that sufficient time has passed to allow Time Delay Emergency to Normal (TDEN) to operate.
2. Check normal source voltage levels. With a voltmeter, read phase-to-phase voltage between transfer switch terminals N1 and N2.
3. Check signal circuit. Confirm that the Test Switch (TSS) has reclosed by measuring 0 volts between terminals 60 and 61.

#### D. Transfer Switch Retransfers the Load, But Generator Set Continues to Run

1. Check operation. Make sure that sufficient time has passed to allow Time Delay Engine Cool-off (TDEC) to operate.
2. Check engine controls. Make sure engine starting control circuit is in the "Auto" position.
3. Check signal circuit. Disconnect and tape wires to terminals 51 and 52. Connect ohmmeter between these terminals; reading should indicate an open circuit.

If above problem(s) continue or other problems exist, contact your Onan distributor.

## OPERATION

### Operation Sequence

**NOTE:** Only standard options are included in this operation sequence. Follow each step below while reviewing the schematic diagram provided with the transfer switch.

### Normal Source Failure

Standard normal source failure is defined as “a reduction or loss of voltage”. The sequence is as follows:

1. A voltage reduction in any phase of a three-phase unit is monitored by Undervoltage Sensors. If a voltage reduction reaches the voltage sensor preset voltage drop-out point, the voltage sensor circuit de-energizes the Normal Relay (NR).
2. The Normal Relay (NR) drops out, opening some contacts while closing others. One contact starts the engine-driven generator after the Time Delay on Engine Starting (TDES).
3. When the emergency source voltage reaches operational rating, an Emergency Relay (ER) closes, starting the transfer operation after the Time Delay Normal to Emergency (TDNE). This operation opens the Normal Breaker (NB) and closes the Emergency Breaker (EB).
4. The transfer switch then supplies the load with emergency power until the normal source is restored.

### Normal Source Restoration

1. The return to the normal power source begins when the voltage in all phases of a three-phase sensing unit is restored to a pre-set value.
2. At the preset pickup voltage, the voltage sensors operate causing the Normal Relay (NR) to pick up.
3. The NR closes several contacts while opening others, thus starting the return to normal transfer switch operation after the Time Delay Emergency to Normal (TDEN).
4. This operation opens the Emergency Source Breaker (EB) and closes the Normal Source Breaker (NB).

5. At the same time, the NR initiates the shut down of the engine-driven generator after the Time Delay for Engine Cool-off (TDEC).

6. The transfer to the normal power source is complete.

**NOTE:** This sequence can vary with the addition of control items as stated earlier.

## MANUAL OPERATION

### Manual Operation From Normal to Emergency

1. Isolate the transfer circuit by disconnecting the two interconnection plugs shown in Fig. 5.

**NOTE:** This action will cause the engine to start since control power is disconnected from the voltage sensing circuit, the same as if a normal power source failure had occurred.

2. Push the red “Push-to-Open” button on the Normal Breaker (NB). The breaker will open.
3. Push the green “Push-to-Close” button on the Emergency Breaker (EB). The breaker will close.

**NOTE:** Both breakers normally rest in a springs charged position denoted by the yellow flag on the breaker operating face.

### **CAUTION**

Do not push the green “Push-to-Close” button on the Emergency Breaker (EB) before pushing the red “Push-to-Open” button on the normal breaker. This action will “shock” the Emergency Breaker (EB) into discharging the closing springs without closing the breaker contacts. (If done repeatedly, this “shocking” action can damage the breaker closing mechanism.) Breaker (EB) is held in the “Trip-Free” position by the mechanical interlocks incorporated into the transfer switch to prevent simultaneous closing of the breakers.

4. With normal source power available, the transfer switch will return to normal when the control plugs in Fig. 5 are reconnected.

## MANUAL CHARGING OF SYSTEMS POW-R BREAKER

The Systems Pow-R Breaker Transfer Switch electrically charges the breaker closing mechanism automatically from either source. If for any reason the breaker mechanisms are not electrically charged, as indicated by the white “Discharged” flag, they can be manually charged by using four full strokes on the charging handle, or several partial inching strokes, for each breaker. [Refer to Fig. 4] .

## MAINTENANCE OF TRANSFER SWITCH

The Systems Pow-R Breaker Transfer Switch is maintenance-free under normal usage. Local conditions,

however, may make it necessary to periodically blow dust and dirt from the relays and timers, and to see that grease or oil does not accumulate on the switch components.

Good maintenance procedures call for periodic inspection of all electrical apparatus. Terminal lugs must be tight to prevent overheating. Due to the self-cleaning action built into the contact system of the switch, operating the switch during regular sequence checks will remove any high resistance film that may have formed.

### CAUTION

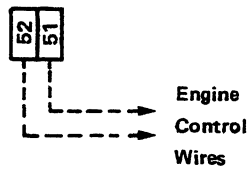
To ensure proper switch operation, the transfer switch should be serviced only by an authorized factory representative.

APPENDIX

Control Items Requiring Field Connection

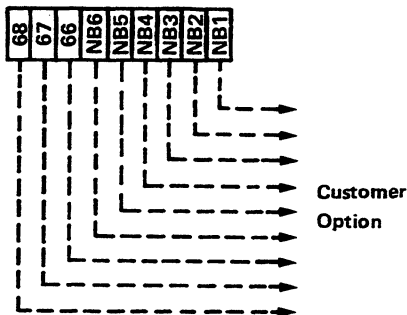
Control Item : Engine Start Contact

1. Wire as shown.



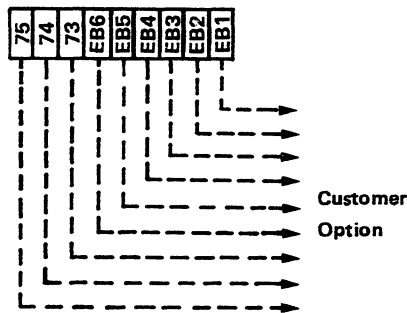
Control Item : Normal Source Breaker Auxiliary Contact

1. Wire as shown.



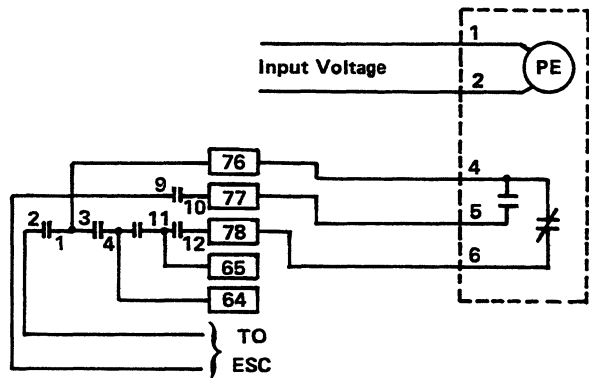
Control Item : Emergency Source Breaker Auxiliary Contact

1. Wire as shown.



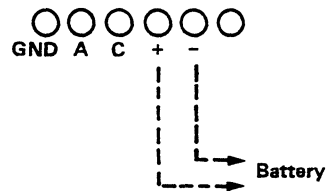
Control Item : Plant Exerciser with Selector Switch

1. Wire as shown.



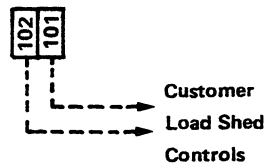
Control Item : Battery Charger (24 Volts)

1. Wire as shown.



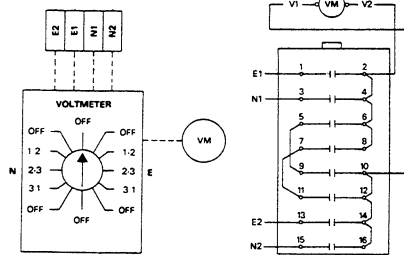
Control Item : Load Shed, Emergency Side

1. Wire as shown.

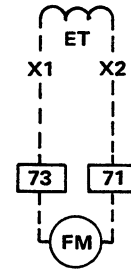


**Control Item: Voltmeter Mounted in Enclosure Cover® (Use this Diagram if the Switch is a Three Pole Unit)**

1. Mount selector switch and voltmeter.
2. Wire as shown.

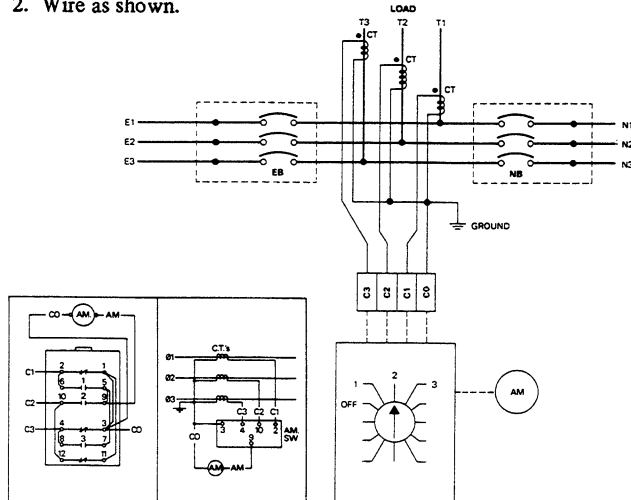


Control Item: Frequency Meter①

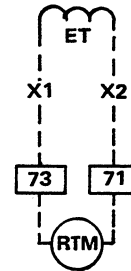


**Control Item: Ammeter Mounted in Enclosure Cover (Use this Diagram if the Switch is a Three Pole Unit)**

1. Mount selector switch and ammeter.
2. Wire as shown.



Control Item: Running Time Meter①



①These options require field connection for open units only. All other options require field connections on both open and enclosed units.

## CONTROL ITEM DESCRIPTIONS

The following describes control items (other than the basic transfer switch control functions which were described under the transfer operation section) either as standard items or options.

### Time Delay Normal to Emergency (TDNE)

Delays the transfer from normal source to override momentary power outages on fluctuations. Timing begins when emergency source voltage appears. Does not affect initiation of engine start circuit.

Adjustable 1 to 60 seconds.

### Time Delay on Engine Starting (TDES)

This option is for use only where the emergency source is an engine generator. It delays initiation of the engine start circuit in order to override momentary normal power outages or fluctuations.

Adjustable .5 to 15 seconds.

### Time Delay Emergency to Normal (TDEN)

Delays return from emergency source to permit stabilization of the normal power source before re-transfer is made. Timing begins when the normal source voltage appears. If the emergency source fails during timing, transfer to normal source is immediate, overriding the time delay.



**Transferring large motor loads can cause synchronization problems.**

**When large motor loads will be transferred, a delayed return to normal is desired to avoid synchronization problems. See TDNC Accessory.**

Adjustable 0.2 to 30 minutes.

### Time Delay for Engine Cool-Off (TDEC)

Permits the generator to run under a no-load condition after transfer to normal has been made. Timing begins when transfer is made.

Adjustable 0.1 to 10 minutes.

### Frequency/Voltage Sensing Function for Emergency Source

Solid state card constantly monitors the emergency source. This function prevents transfer from normal to

emergency, until the engine generator has reached its operating frequency and/or voltage.

Undervoltage/underfrequency: voltage is fixed at 90% pick-up, 70% drop-out; frequency is adjustable 45-60 Hz (drops out two Hz lower than setting). Single phase protection.

Overfrequency: adjustable 50-65 Hz (drops out two Hz above setting). Single phase protection.

Overvoltage: adjustable 100%-115% (nominally set at 115% drop-out, pick-up below 105%). Single phase protection.

**NOTE: For adjustable voltage sensors, settings should not be made without the test kit designed for this equipment. To check or to change settings other than the factory settings, contact the Onan distributor for more information.**

### Test Selector Switch

"Test" position provides test operation of the transfer switch by simulating a loss of normal power. Engine starting will be initiated and transfer to the emergency source will occur. "Normal" position is the normal operating mode for automatic operation. The "Retransfer" position bypasses the TDEN to provide immediate transfer to the normal source before the time delay has completed.

Mounting in cover of enclosed switch.

### Control Circuit Disconnect

Disconnects power from motor control circuit. "A and B" provides a selector switch, used for maintenance, which disconnects power to the transfer motors. Marked "Off/Auto".

In cover of enclosed switch (two position selector switch).

### Pilot Lights

Pilot lights are furnished to indicate source position.

Normal supply (green) in cover of enclosed switch.

Emergency supply (red) in cover of enclosed switch.

**Plant Exerciser (PE)**

168-hour clock timer provides for automatic test operation of the plant for pre-selected intervals (adj. 0-168 hours in multiples of 15 minutes) at least once a week, mounted on intelligence circuit. Refer to instructions on setting timer.

Plant exerciser with selector switch for choosing automatic test operation of plant either by simulation of power outage or without interrupting the normal supply, or for bypassing exerciser. Exerciser includes fail safe feature during simulation of power failure.

**Battery Charger (BC)**

The trickle charge D-c output is 24 volts. Units are panel-mounted. Automatic high-low charge with 2 amp high rate maximum.

**Type of Protection (Normal Source)**

Provided as standard is a solid state voltage sensing card which monitors each phase of the normal power supply. Card is adjustable 70%-100% (nominally set at 70% drop-out and 90% pick-up).

Overvoltage: adjustable 100%-115% (nominally set at 115% drop-out, pick-up below 105%). A solid state voltage sensing card monitors each phase of the normal power supply.

Underfrequency, adjustable 45-60 Hz (drops out two Hz lower than setting). A solid state frequency sensing card is connected to one phase only of the normal source constantly monitoring that phase. Reference chart below.

Type	Dial Setting Hz	Pickup Hz	Dropout Hz
Underfrequency	60	57	55
Underfrequency	50	47	45

**Time Delay Neutral (TDNC)**

Provides a time delay in the neutral position when the load is transferred in either direction to prevent excessive inrush currents due to out-of-phase switching of large motor loads. Timers are marked TDNC-N and TDNC-E.

Adjustable 5 to 50 seconds.

**Load Shed – Emergency**

The load shed accessory enables the transfer switch to transfer to a neutral position from the emergency side after the ATS controls receive an externally supplied load shed signal. The transfer switch will automatically initiate transfer to the normal source when the normal source is restored.

**Metering Package**

Voltmeter mounted in cover (includes selector switch).Ⓢ

Ammeter mounted in cover (includes current transformers and selector switch).Ⓢ

Frequency meter.Ⓢ

Running time meter.Ⓢ

For availability of additional options, contact the factory.

ⓈRefer to field connection instructions for these options.









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