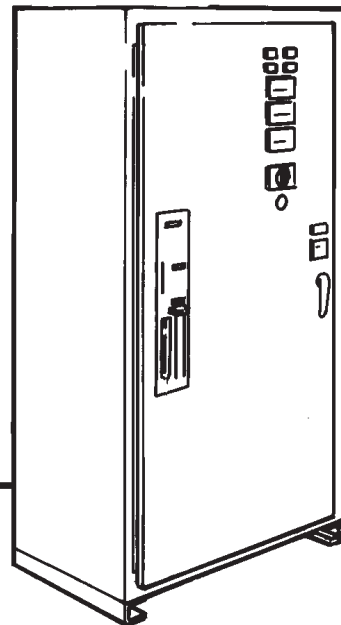




# Operator's Manual

## BT

**Bypass-Isolation  
Transfer  
Switches**



**Utility-to-Utility**

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**962-0122**  
Begin Spec B  
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** WARNING**

***INCORRECT SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN DEATH, SEVERE PERSONAL INJURY, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.***

# Safety Precautions

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

**⚠ DANGER** *This symbol warns of immediate hazards that will result in severe personal injury or death.*

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

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

High voltage in transfer switch components presents serious shock hazards that can result in severe personal injury or death. Read and follow these suggestions.

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

Due to the serious shock hazard from high voltages within the cabinet, all service and adjustments to the transfer switch must be performed only by an electrician or authorized service representative.

If the cabinet must be opened for any reason, remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

Place rubber insulative mats on dry wood platforms over metal or concrete floors 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 the electrical equipment.

Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

# Section 1. Introduction

## OPERATOR'S MANUAL

This operator's manual provides information necessary for operation of a BT bypass-isolation transfer switch with an automatic utility-to-utility control. The utility-to-utility control automatically directs transfer of the load from one utility power source to another, providing nearly continuous power.

## BT BYPASS-ISOLATION TRANSFER SWITCH

The BT bypass-isolation transfer switch combines an automatic transfer switch, a manual bypass switch, and a drawout isolation mechanism in a single unit.

### Automatic Transfer Switch Function

Transfer switches are an essential part of a building's standby or emergency power system. The Normal power source (source 1) is backed up by an Emergency power source (source 2). 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 (Figure 1-1). Under normal conditions, the load is supplied with power from the Normal source (as illustrated). If the Normal power source 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.

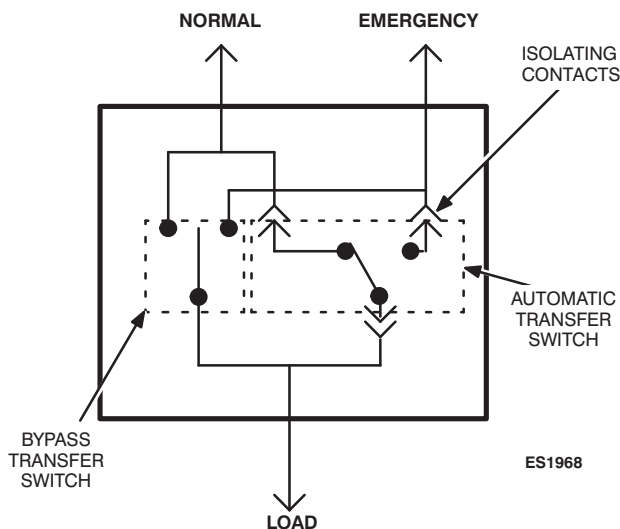


FIGURE 1-1. BT TRANSFER SWITCH (TYPICAL FUNCTION)

**Automatic Operation:** Automatic transfer switches, capable of automatic operation without operator involvement, perform the following basic functions:

1. Sense the interruption of the Normal power source.
2. Transfer the load to the Emergency power source.
3. Sense the return of the Normal power source.
4. Retransfer the load to the Normal power source.

### Bypass Switch Function

The bypass switch allows the operator to manually connect the load to the available power source, bypassing the automatic transfer switch (Figure1-1). When bypassed, the automatic transfer switch can be isolated for service or removal without causing a power interruption.

### Drawout Isolation Mechanism

The drawout isolation mechanism allows the automatic transfer switch to be withdrawn for testing or service. The transfer switch is mounted on rails and is connected to the load, power sources, and controls through isolation contacts. Turning a drawout cranking handle moves the automatic transfer switch along the rails and engages and disengages the isolation contacts to permit testing or service. If necessary, the switch can be lifted from its rails and removed for service.

## MODEL IDENTIFICATION

Identify your model by referring to the Model and Specification number as shown on the nameplate. Electrical characteristics are shown on the lower portion of the nameplate, which is located on the cabinet door.

If it is necessary to contact a dealer or distributor regarding the transfer switch, always give the complete Model, Specification, and Serial number. This information is necessary to properly identify your unit among the many types manufactured.

## HOW TO OBTAIN SERVICE

When the transfer switch requires servicing, contact your nearest dealer or distributor. Factory-trained Parts and Service representatives are ready to handle all your service needs.

If unable to locate a dealer or distributor, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS-ELECTRIC,  
ENGINES-GASOLINE OR DIESEL, OR  
RECREATIONAL VEHICLES-EQUIPMENT,  
PARTS AND SERVICE.

For the name of your local Cummins/Onan or Onan-only distributor in the United States or Canada, call 1-800-888-ONAN. (This automated service utilizes touch-tone phones only.) By entering your area code and the first three digits of your local telephone number, you will receive the name and telephone number of the distributor nearest you.

For the name of your local Cummins-only distributor, or if you need more assistance, please call Onan Corporation, 1-612-574-5000, 7:30 AM to 4:00 PM, Central Standard Time, Monday through Friday.

When contacting your distributor, always supply the complete Model Number and Serial Number as shown on the nameplate.

# Section 2. Description

This section describes the standard and optional components of the cabinet, the bypass operator panel, the automatic transfer switch, the bypass switch, the isolation mechanism, and the electronic control system.

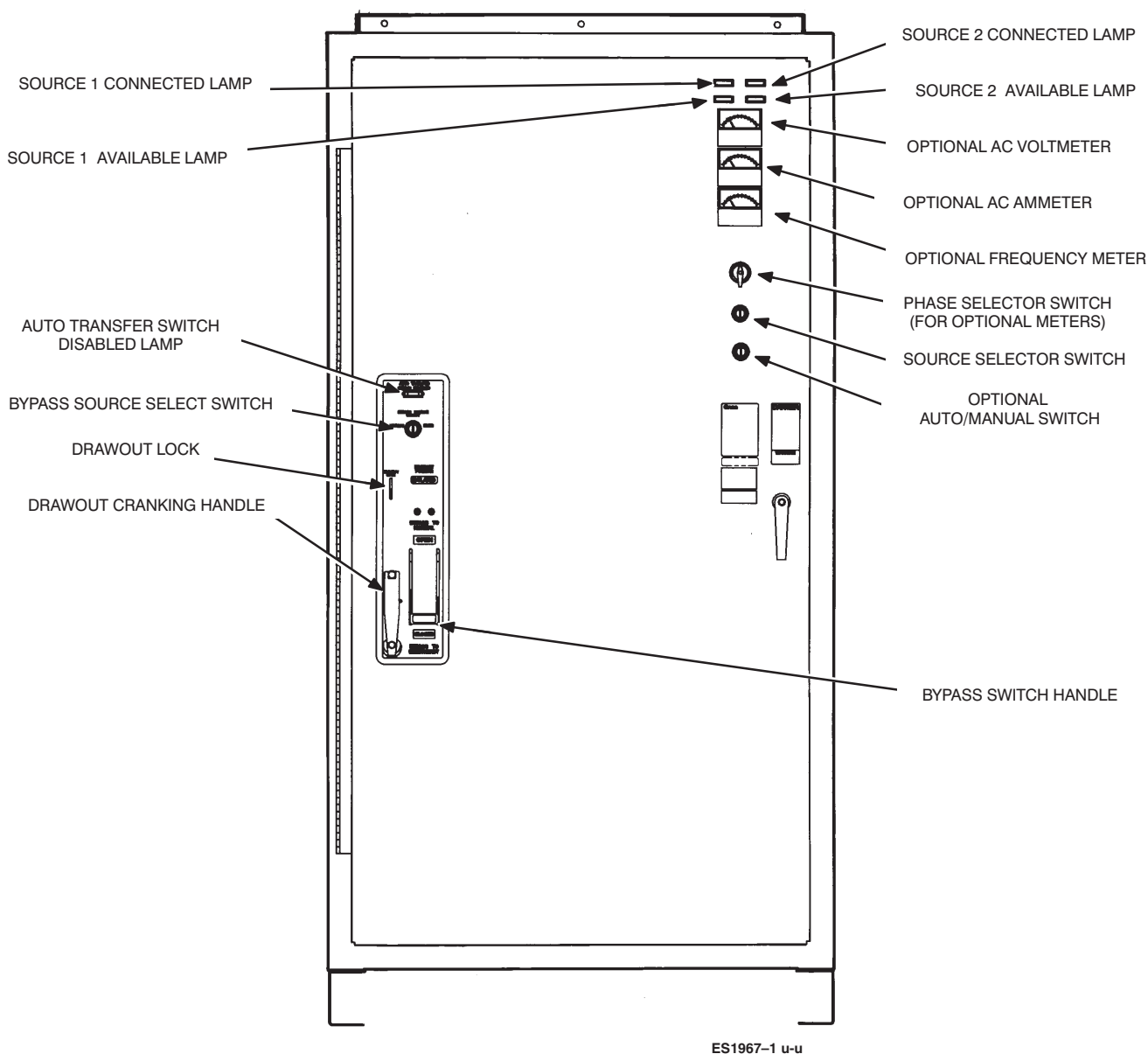
## CABINET

The standard cabinet (Figure 2-1) meets the requirements for a UL Type 1 cabinet. This type is designated as a general-purpose, indoor cabinet.

## Indicator Lamps

There are four indicator lamps on the cabinet door. The Source 1 Available and Source 2 Available lamps are lit whenever their corresponding power sources are producing power. These two lamps can be lit simultaneously.

The Source 1 Connected and Source 2 Connected lamps indicate which power source is connected to the load. These two lamps **cannot** be lit simultaneously.



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FIGURE 2-1. CABINET WITH OPTIONS

## Source Selector Switch

This two-position switch is used to select which source is preferred and which source is the backup.

In the Source 1 position, the Normal power source supplies the load power until a power interruption occurs.

In the Source 2 position, the Emergency power source supplies the load power until a power interruption occurs.

## Optional Auto/Manual Switch

The optional Auto/Manual switch is used to enable or disable the automatic retransfer function. This switch has two positions. In the Auto position, normal automatic retransfer is enabled. In the Manual position, automatic retransfer (from the non-preferred source back to the preferred source) is disabled; only manual retransfer (using the Preferred Source Selector switch) is possible. In the event of power source failure, however, the Power Sentry control logic will ignore the Auto/Manual switch and initiate retransfer to the other source.

**When the optional Auto/Manual switch is installed, the standard Source Selector Switch is replaced with a three-position, spring-return-to-center switch.**

## Optional Meter Package

The optional meter package includes an AC ammeter, an AC voltmeter, a frequency meter, and a phase selector switch.

**AC Voltmeter:** The voltmeter measures line-to-line voltage of the selected power source.

**AC Ammeter:** The ammeter measures the line currents of the load.

**Frequency Meter:** This meter measures the output frequency of the selected power source in hertz.

**Phase Selector Switch:** This switch is used to select the source and phase to be measured.

## BYPASS OPERATOR PANEL

### Bypass Switch Handle and Bypass Source Select Switch

The bypass switch handle is used in conjunction with the Bypass Source Select switch. The Bypass Source Select switch controls an interlock device, which prevents the bypass switch from connecting the load to a dead source or to both sources at the same time. Before operating the bypass switch handle, the Bypass Source Select switch must be turned to select the source that will be connected to the load. Mechanical and electrical interlocks control the bypass operation.

**Bypass to the Same Source:** If the automatic transfer switch is already connected to the same source, the operator can move the bypass switch handle, closing the bypass contacts to that same source, without interrupting the load.

**Bypass to the Opposite Source:** If the automatic transfer switch is NOT already connected to the same source, the interlocks force the following conditions to be met:

1. The bypass operation is permitted only when the selected source is available. When bypassing to the emergency source, for example, it is necessary to first check that the Source 2 Available lamp is lit. (Refer to the *Operation* section.)
2. As the bypass switch handle is moved to the opposite source, electrical and mechanical interlocks force the automatic transfer switch to the neutral position in a break-before-make action. This operation causes a brief power interruption. (Refer to the *Operation* section.)

## Bypass Switch Position Indicators

The Bypass to Normal and Bypass to Emergency position indicators show the position of the bypass switch contacts.

When the Bypass switch handle is in the Bypass to Normal position, the bypass switch contacts connect the load to the Normal source and the word “Closed” is shown in the Bypass to Normal indicator slot. When the Bypass switch handle is in the Bypass to Emergency position, the bypass switch contacts connect the load to the Emergency source and the word “Closed” is shown in the Bypass to Emergency indicator slot. In both cases, the word “Open” is shown in the opposite indicator slot.

When the Bypass switch handle is in the center position, the bypass switch contacts are disconnected from both sources and the word “Open” is shown in both indicator slots.

## Drawout Lock and Drawout Cranking Handle

The Drawout Lock and the drawout cranking handle are used to isolate and reconnect the automatic transfer switch. The cranking handle turns a gear reduction drive that moves the transfer switch along a mechanically guided path. The Drawout Lock must be lifted to enable operation of the cranking handle.

## Drawout Position Indicator

The drawout mechanism can be latched in one of three positions: Connected, Test, and Isolated. The Drawout Position indicator shows which position the automatic transfer switch is in.

## Auto Transfer Switch Disabled Lamp

This lamp is lit whenever the automatic transfer switch is disabled. Mechanical and electrical interlocks prevent the automatic transfer switch from transferring load when the bypass switch is connected to a power source or when the drawout lock is lifted.

**When the automatic transfer switch is in the Test position, it is isolated from the load and, therefore, cannot transfer load. For this reason, the Auto Transfer Switch Disabled Lamp will be lit. However, the automatic transfer switch controls and the linear actuator are not disabled when the transfer switch is in the Test position. When the automatic transfer switch reaches the Test position, the linear actuator drives the contact assemblies to the available power source.**

## **AUTOMATIC TRANSFER SWITCH**

The automatic transfer switch (Figure 2-2) opens and closes the contacts that transfer the load between Normal and Emergency power. The main parts of the transfer switch discussed here are the contact assemblies, the linear actuator, and the auxiliary contacts.

### **Contact Assemblies**

The automatic transfer switch has either three or four poles. Three pole transfer switches are provided with a neutral bar. The contact assemblies make and break the current flow. When closed to either the Normal or the Emergency power source, the contacts are mechanically held. Electrical and mechanical interlocks prevent them from closing the load to a dead source or to both power sources at the same time.

### **Linear Actuator**

The linear actuator is a linear induction motor that actuates the contact assemblies. It moves the contact assemblies between the Normal power source and the Emergency power source as required. The linear actuator operation is initiated automatically with automatic transfer switches.

### **Auxiliary Contacts**

Auxiliary contacts are provided on the Normal and Emergency sides of the transfer switch. They are actuated by operation of the transfer switch during transfer and retransfer. The Normal side auxiliary contact switch is actuated when the transfer switch is in the Normal position. The Emergency side auxiliary contact switch is actuated when the transfer switch is in the Emergency position. The auxiliary contacts have current ratings of 10 amperes at 250 VAC. The contacts are wired to terminal block TB1, which is located on the top of the bypass frame assembly.

## **BYPASS SWITCH**

The bypass switch, located behind the automatic transfer switch, is used to open and close the contacts that connect the load to the Normal or Emergency power source. The manually operated bypass switch is mechanically interlocked to prevent simultaneous closing to both power sources. Operation of the bypass switch is accomplished with the bypass switch operator handle and the Bypass Source Select switch.

### **Contact Assemblies**

Like the automatic transfer switch, the bypass switch has either three or four poles. Three pole transfer switches

are provided with a neutral bar. The contact assemblies are manually actuated to connect the load to one of the two power sources, bypassing the automatic transfer switch. When closed to either the Normal or the Emergency power source, the contacts are mechanically held. Electrical and mechanical interlocks prevent the operator from manually closing the load to a dead source or to both power sources at the same time.

### **Auxiliary Contacts**

Auxiliary contacts are provided on the Normal and Emergency sides of the bypass switch. The Normal side auxiliary contact switch is actuated when the bypass switch is in the Normal position. The Emergency side auxiliary contact switch is actuated when the bypass switch is in the Emergency position. The auxiliary contacts have current ratings of 10 amperes at 250 VAC. The contacts are wired to terminal block TB1, which is located on the top of the bypass frame assembly.

## **DRAWOUT-ISOLATION MECHANISM**

The drawout-isolation mechanism allows the automatic transfer switch to be isolated for testing or service. Three sets of primary isolation contacts (Normal source, Emergency source, and Load) connect the switching contacts to the terminal lugs. A set of secondary isolation contacts connects the automatic transfer switch controls to the available power source.

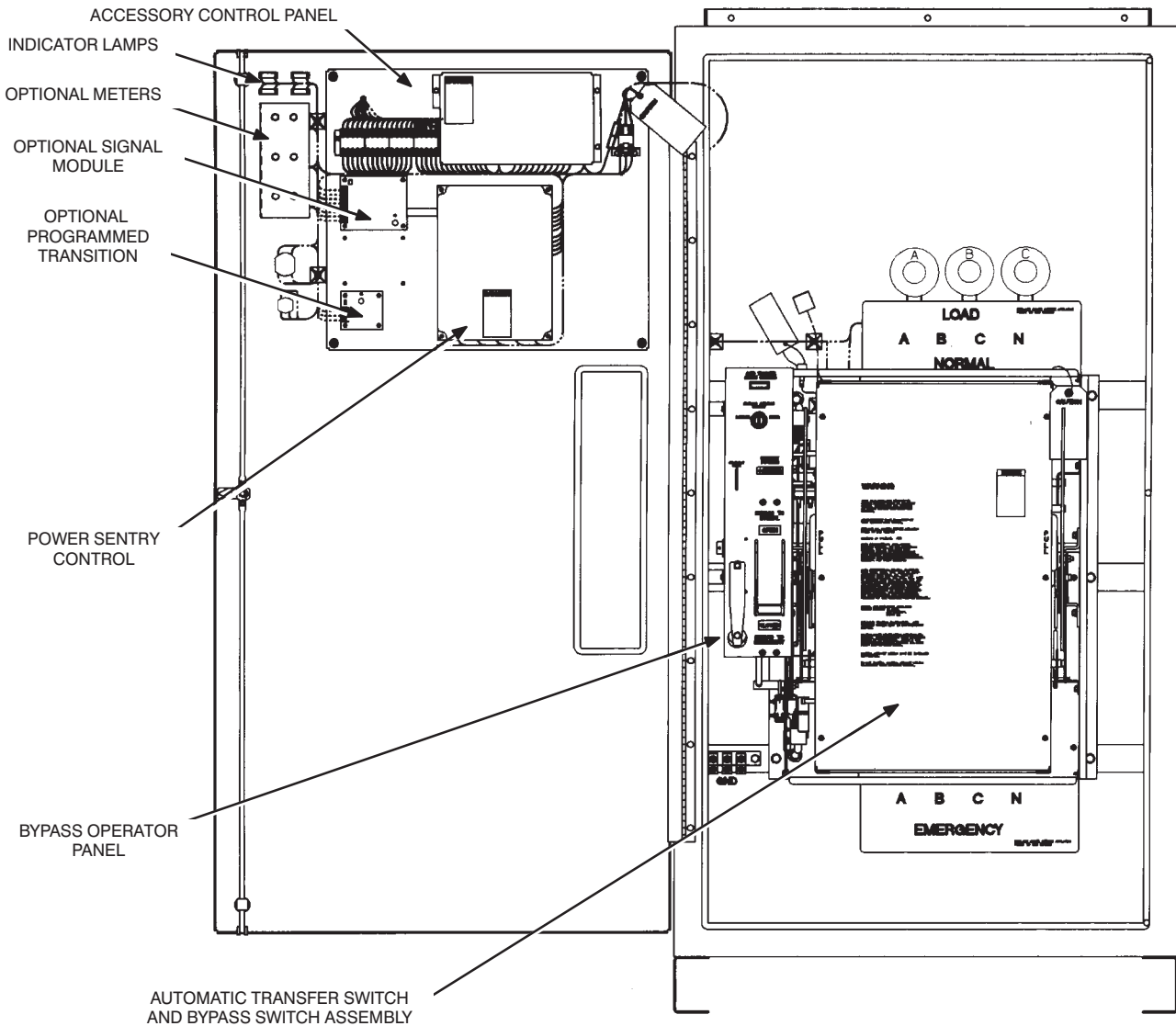
The automatic transfer switch is mounted on rails and is drawn out by turning the drawout cranking handle. The drawout-isolation mechanism has three positions: Connected, Test, and Isolated.

In the Connected position, both the primary and the secondary isolation contacts are closed. The automatic transfer switch is in its normal operating position.

In the Test position, the primary isolation contacts are open and the secondary isolation contacts are closed. The load-supplying contacts of the automatic transfer switch are out of service, but the Power Sentry control and the linear actuator are powered and fully operational. In this position, the control, the linear actuator, and the contact mechanisms can be tested.

In the Isolated position, both the primary and the secondary isolation contacts are open. The automatic transfer switch mechanism is completely isolated from both the power and the control circuits and can be removed for service.





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FIGURE 2-2. INTERIOR/COMPONENTS

## ELECTRONIC CONTROL SYSTEM

This section describes the standard and optional components of the electronic control system.

**⚠WARNING** *Improper calibration or adjustment of electronic control modules can cause death, severe personal injury, and equipment or property damage. Calibration and adjustment of these components must be performed by technically qualified personnel only.*

All calibration and adjustment procedures are described in the Installation manual (which was shipped with the transfer switch) and in the Service manual (which is available through your distributor).

The most important component of the electronic control system is the Power Sentry control (Figure 2-2). The Power Sentry includes voltage sensing circuits, time delay circuits and control relays. There are also several adjustment potentiometers and indicator lamps on the Power Sentry. The adjustments must be performed only by qualified service personnel.

**⚠WARNING** *AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open.*

**⚠WARNING** *Accidental actuation of the linear actuator can cause severe personal injury. Isolate the transfer switch, as described in the Operation section, before making any adjustments.*

## Power Sentry Time Delays

**Transfer Time Delay:** This delay prevents "nuisance" transfers to the backup power source caused by brief line fluctuations. After the delay, the transfer switch transfers the load to the backup power source. It has an adjustable range of 0 to 120 seconds.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

**Retransfer Time Delay:** This delay begins the moment the preferred source voltage and frequency return. After the delay, the transfer switch can retransfer the load to the preferred source. The delay allows the preferred source to stabilize before retransfer. It has an adjustable range of 0 to 30 minutes.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

## Undervoltage Sensing

Two voltage sensors, one for the Normal side and one for the Emergency side, monitor source voltages for an undervoltage condition and generate signals, which are sent to the time delay module. If, for example, an undervoltage condition is sensed on the Normal source, the voltage sensor module sends a signal to the time delay module that initiates and controls the transfer of load.

The standard transfer switch has undervoltage sensing for all phases of the Normal and Emergency power sources.

## Overvoltage And Frequency Sensing Option

Overvoltage and frequency sensing are available as a single option.

**Overvoltage Sensing:** With optional overvoltage sensing, the Normal and Emergency sources are monitored for an overvoltage condition.

As with the standard undervoltage sensing, the voltage sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay (0 to 120 seconds) overrides momentary overshoots in voltage.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

**Frequency Sensing:** With optional frequency sensing, the Normal and Emergency sources are monitored for variations in frequency. The sensors determine whether the source is within an adjustable bandwidth.

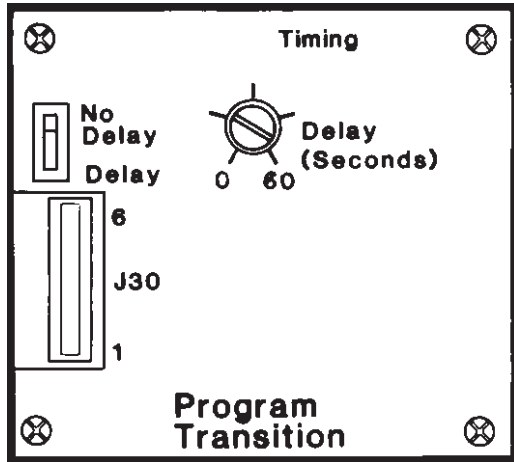
As with the standard undervoltage sensing, the frequency sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay (0 to 15 seconds) allows the control to ignore momentary dips or rises in frequency.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

## Programmed Transition Option

The optional Program Transition module (Figure 2-3) is used to introduce a pause during transition. Programmed transition allows the transfer switch to assume a midtransition position for an adjustable interval of time. In this position, the load is **not** connected to either (Normal or Emergency) power source.



SC1583

FIGURE 2-3. PROGRAM TRANSITION MODULE

This feature allows residual voltage from inductive loads to decay to an acceptable level before transfer is completed. The length of time that the transfer switch is in the midposition can be adjusted from 0 to 7.5 seconds or 0 to 60 seconds, depending on the timer option. The proper adjustment is a function of the load.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate (Figure 2-3).

If a time delay is desired, make sure that the Delay/No Delay switch is in the Delay position.

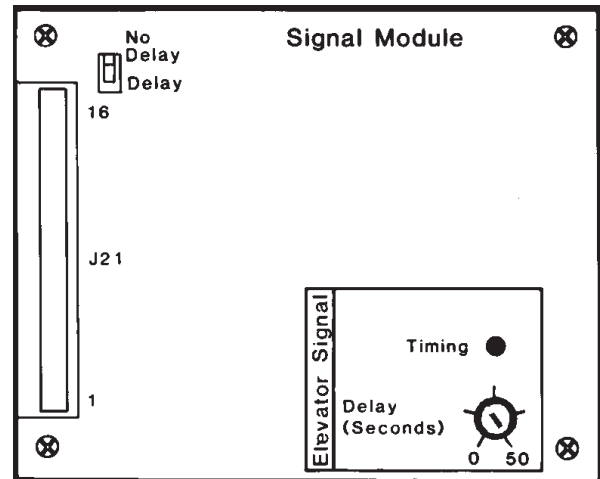
## Signal Module Option

The main function of the optional Signal Module (Figure 2-4) is to delay transfer (or retransfer) for a preset time while operating a signal contact to give warning that a transfer (or retransfer) is about to occur. This option is typically used in elevator applications.

This module also provides three other sets of form C signal contacts.

The Signal Module has one adjustable timer. The Elevator Signal delay controls the timing of two events. It delays transfer/retransfer and energizes the Elevator Transfer Signal relay during the delay period.

This time delay is adjustable over a range of 0 to 50 seconds.



SC1584

FIGURE 2-4. SIGNAL MODULE

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate (Figure 2-4).

If a time delay is desired, make sure that the Delay/No Delay switch is in the Delay position.

## Auxiliary Relays Option

Optional auxiliary relays provide contacts for energizing external alarms, remote indicators, and control equipment such as louver motors and water pumps.

# Section 3. Operation

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## AUTOMATIC OPERATION

Place control switches in the positions given below.

- **Bypass switch handle:** Center position. Both bypass switch position indicators show the word “Open.”
- **Source Selector switch:** Source 1 for Normal power source; Source 2 for Emergency power source.

## ISOLATING THE AUTOMATIC TRANSFER SWITCH FOR SERVICE

To isolate the automatic transfer switch for servicing, the operator must manually bypass the load to either the Normal source or to the Emergency source, and then crank the transfer switch out to the Isolated position.

**⚠WARNING** *AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.*

### To Isolate the Automatic Transfer Switch:

1. Interlocks prevent the operator from bypassing the load to a dead source. If bypassing the load to the Emergency source, first check that the Source 2 Available lamp is lit.
2. Turn and hold the Bypass Source Select switch in the desired position (Normal or Emergency) and move the bypass switch handle to the source to be connected. Check that the word “Closed” is shown in the corresponding (Bypass to Normal or Bypass to Emergency) indicator slot. Release the Bypass Source Select switch.

**IF BYPASSING TO THE OPPOSITE SOURCE:** As the bypass switch handle is moved to the opposite source, electrical and mechanical interlocks force the automatic transfer switch to the neutral position in a break before make action. This operation causes a brief power interruption.

3. Lift the Drawout Lock and turn the drawout cranking handle counterclockwise to move the automatic transfer switch to the Isolated position. Release the Drawout Lock after the transfer switch travels past the Test position. Turn the cranking handle until the Drawout Lock drops, locking the cranking handle. As the automatic transfer switch is being drawn out, mechanical interlocks force the switch to the neutral position. Check that the word “Isolated” appears in the Drawout Position indicator slot. Return the drawout cranking handle to its stored position.

### To Reconnect the Automatic Transfer Switch:

1. Lift the Drawout Lock and turn the drawout cranking handle clockwise to move the automatic transfer switch back to the Connected position. Release the Drawout Lock after the transfer switch travels past the Test position. Turn the cranking handle until the Drawout Lock drops, locking the cranking handle. As the automatic transfer switch is being cranked back to the Connected position, mechanical interlocks force the switch to the neutral position. Check that the word “Connected” appears in the Drawout Position indicator slot. Return the drawout cranking handle to its stored position.
2. After the automatic transfer switch is returned to the Connected position and the Drawout Lock is released, the switch will respond to transfer/retransfer signals from the Power Sentry control.

If the bypass switch has been placed in the Emergency position, electrical and mechanical interlocks will prevent the automatic transfer switch from retransferring to the Normal source.

**If the load had been bypassed to the Normal source:** The transfer switch will automatically return to the Normal position, provided the retransfer time delay has expired. After the automatic transfer switch has returned to the Normal source, move the bypass switch handle to the center position. Check that the word “Open” is shown in both the Bypass to Normal and the Bypass to Emergency indicator slots.

**If the load had been bypassed to the Emergency source:** To return to normal automatic operation, first check that the Source 1 Available lamp is lit and that the Source Selector switch is in the Source 1 position, and then move the bypass switch handle to the center position to return the transfer switch to automatic operation. Check that the word “Open” is shown in both the Bypass to Normal and the Bypass to Emergency indicator slots. After the retransfer time delay, the linear actuator will transfer the load to the Normal side.



# Section 4. Troubleshooting

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The following procedures describe preliminary troubleshooting checks. If the trouble persists, call your dealer or distributor.

**⚠WARNING** *AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. For this reason; do not touch or allow clothing, tools, or jewelry to contact exposed electrical terminals whenever the cabinet door is open. Make sure you are standing on a dry, insulating surface.*

## **Transfer Switch Does Not Transfer Automatically**

1. Is the Source Selector switch in the correct position?
2. Has the transfer time delay expired?
3. Has the programmed transition time delay (if equipped) expired?
4. Is backup source voltage sufficient to trigger the backup source voltage sensor?

## **Transfer Switch Does Not Retransfer Automatically**

1. Is the Source Selector switch in the correct position?
2. Has the retransfer time delay expired?
3. Has the programmed transition time delay (if equipped) expired?
4. Is preferred source voltage sufficient to trigger the preferred source voltage sensor?



**Cummins Power Generation**  
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Minneapolis, MN 55432  
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