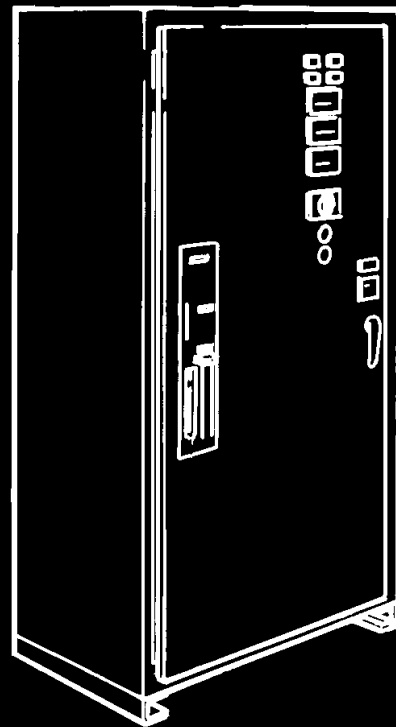


Operator's Manual

BT

Bypass-Isolation

Transfer Switches



Utility-to-Generator Set

Supplement 962-1027

Date: 5-95

Insert with-

Title: OT III Transfer Switch Manuals

Numbers: 962-0113, 962-0116, 962-0118
962-0125, 962-0600, 962-0602
962-0604, 962-0611, 962-0512
962-0513

Title: BT Transfer Switch Manuals

Numbers: 962-0121, 962-0607, 962-0514

PURPOSE

A new exerciser/change-over clock is available that requires new programming instructions. If the exerciser/change-over clock in the transfer switch matches the one shown in Figure 1 of this supplement, follow the programming instructions provided in this supplement.

This clock is referred to as an exerciser clock in manuals that cover utility-to-genset applications and it is called a change-over clock in genset-to-genset applications. The clock is the same for both applications. Refer to the manuals provided with the transfer switch for important safety precautions and for general information on *exercising* or *changeover*.

Keep this copy with the transfer switch manuals for future reference.

NEW EXERCISER/CHANGE-OVER CLOCK

The clock is used as an exerciser clock in **utility-to-genset applications**. The clock is set to start and run the generator set at programmable intervals and for selected durations.

In **genset-to-genset applications**, the clock is used as a change-over clock to initiate generator set changeover at programmable intervals. When programming for a changeover, the program is set only long enough to allow the genset to start. (As an example, if the clock is programmed to come ON once each week for five minutes, a changeover will occur between the generator sets at that time.)

The clock is a 7-day, 24-hour clock that can store and execute up to four start/stop programs per day (one minute minimum duration). The clock also has a test feature that can be used to initiate a genset start and run cycle.

Programming the exerciser/change-over clock requires setting the time of day and entering the start and stop times as described in the following sections.

The clock has backup power for a minimum of six hours. (When the clock is running on backup power the segments around the display will flash on and off). After loss of backup power, the day and time will have to be reset. Exerciser/change-over programs will not be lost during a power outage (programs are stored in EEPROM).

To Reset The Clock:

Resetting the clock erases all existing day, time and program settings.

Depress and hold the arrow, plus and set buttons (→) (+) (●) simultaneously. Release the plus and set buttons while continuing to hold the arrow button. When all aspects of the LCD display appear, release the arrow button.

To Set The Day And Time:

1. With the clock powered, press all three buttons simultaneously to reset the time. The time display area will show (- - : - -) and a small clock symbol will appear in the upper left-corner of the display. Refer to Figure 1.

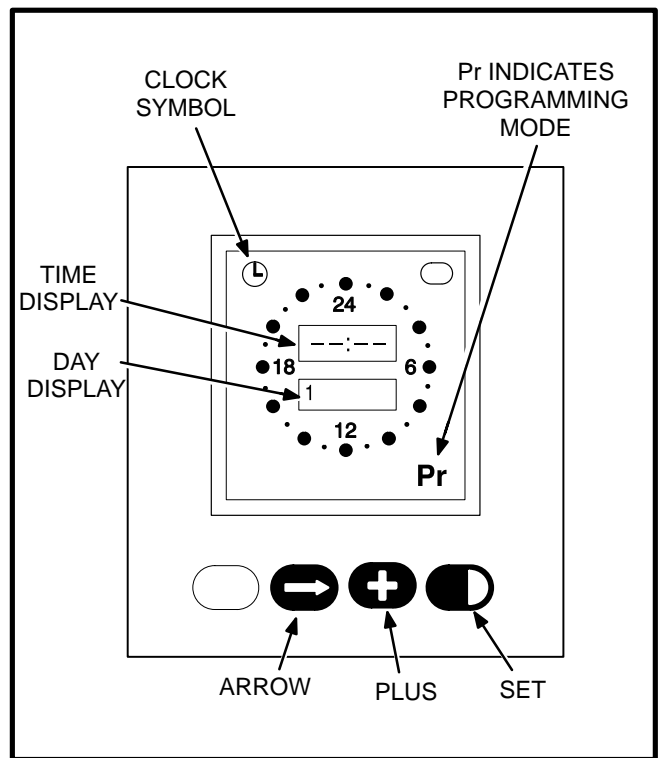


FIGURE 1. EXERCISER/CHANGEOVER CLOCK

2. Press the arrow (→) button once to set the day-of-week. The clock symbol will begin flashing to indicate the clock is being programmed and the display will show midnight (0:00).
3. Press the plus (+) button as many times as necessary until the current day-of-week is displayed.
Example: 1 = Monday, 2 = Tuesday, etc.
4. Press the arrow (→) button again to set the hour of the day. The clock uses 24-hour (military) time.
5. Press the plus (+) button until the current hour is displayed.
Example: 2:00 PM is 14:00.
6. Press the arrow (→) button again to set the minutes.
7. Press the plus (+) button until the current minutes are displayed.
Note that by holding the plus (+) button down, the minutes will increment in 5 minute intervals.
8. To set or change the exerciser/change-over program, press the arrow (→) button again and go to step two in the following section. To return to the normal operating mode, press the arrow (→) button eight times (clock symbol appears in the display).

To Set The Exerciser Start and Stop Time:

1. Press the arrow (→) button four times to start the programming mode.
2. The letters **Pr** will appear in the lower right hand corner of the display when the programming mode is reached (**Pr** will be flashing if there are no existing programs). Press the arrow (→) button as many times as necessary to advance to the day to be programmed.

To clear an existing program for the day selected, press the plus and set (+) (⏏) buttons at the same time.

3. Press the plus (+) button to increment the **Start** time of the exercise program. The display will show midnight (0:00). Note that by holding the (+) button down, the minutes will increment in 15 minute intervals. When the **Start** time is reached, press the set (⏏) button (On Mode is indicated, Figure 2).

Then increment the time with the plus (+) button to the desired **Stop** time. When the **Stop** time is reached, press the set (⏏) button (Off Mode is indicated, Figure 2).

Example to exercise the genset one hour:

Set Start at 7:00 PM (19:00)

Set Stop at 8:00 PM (20:00)

Note that the exercise time is indicated by a band of segments illuminated around the outer ring of the clock from the start to the stop time (Figure 2).

To clear the program, press the plus and set (+) (⏏) buttons at the same time.

4. Pressing the arrow (→) button advances to the next day. The program will be copied to the next day if the next day does not have an existing program.

To change or clear the program, press the plus and set (+) (⏏) buttons at the same time.

Double check the program setting for each day. Press the arrow (→) button repeatedly until the clock mode is passed and the program mode (Pr) is reached. Carefully check each days program and clear any unwanted programs.

5. When finished programming, press the arrow (→) button until the clock appears in the upper left corner of the display.

During the exercise period, the ON mode is indicated in the ellipse in the upper right corner of the display (Figure 2).

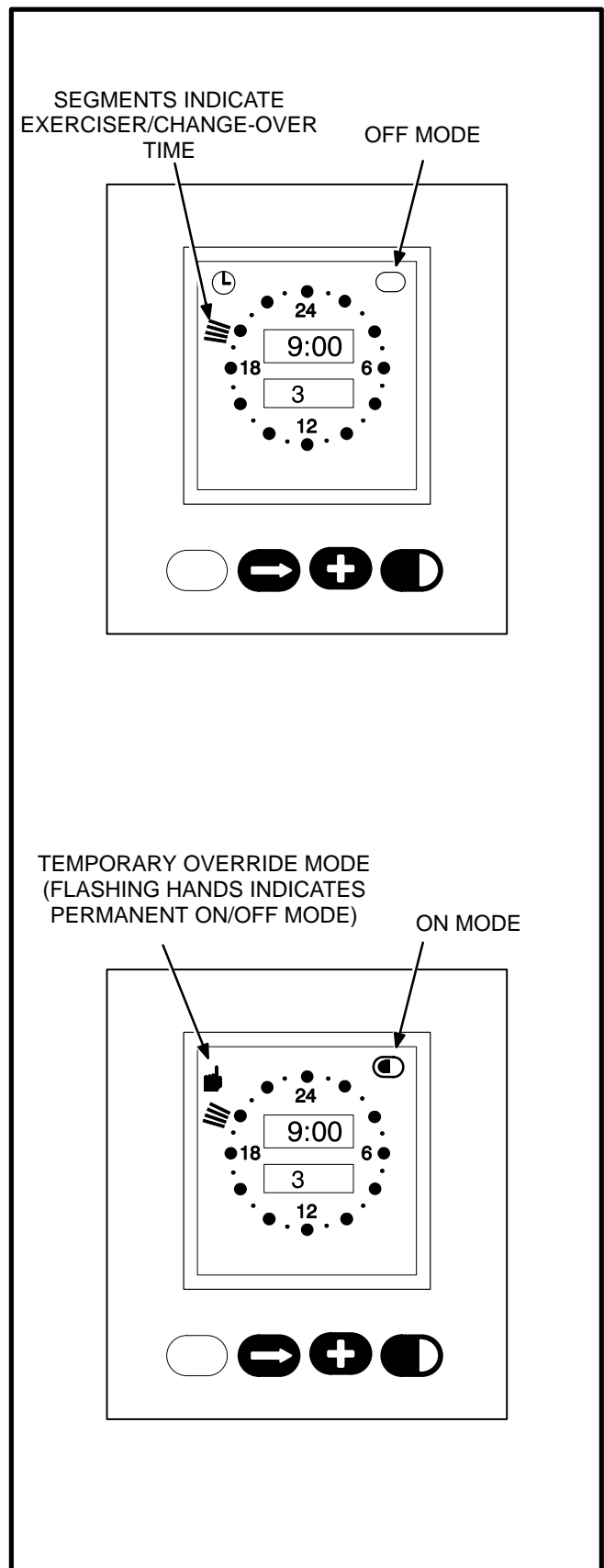


FIGURE 2. CLOCK ON/OFF MODE

To Set The Change-Over Time:

1. Press the arrow (→) button four times to start the programming mode.
2. The letters **Pr** will appear in the lower right hand corner of the display when the programming mode is reached (**Pr** will be flashing if there are no existing programs).
Press the arrow (→) button as many times as necessary to advance to the day to be programmed.
To clear an existing program for the day selected, press the plus and set (+) (⬇) buttons at the same time.

3. Press the plus (+) button to increment the **Start** time of the change-over program. The display will show midnight (0:00). When the **Start** time is reached, press the set (⬇) button (On Mode is indicated, Figure 2).
Then increment the time with the plus (+) button to the desired **Stop** time. When the **Stop** time is reached, press the set (⬇) button (Off Mode is indicated, Figure 2).

Example to change-over the genset at 7:00 PM:

Set Start at 7:00 PM (19:00)

Set Stop at 7:05 PM (19:05)

Note that the change-over time is indicated by a segment illuminated around the outer ring of the clock from the start to the stop time (Figure 2). Note also that the genset will start and continue to run after the five minute ON time expires until the next program ON time.

To clear the program, press the plus and set (+) (⬇) buttons at the same time.

4. Pressing the arrow (→) button advances to the next day. The program will be copied to the next day if the next day does not have an existing program.

To change or clear the program, press the plus and set (+) (⬇) buttons at the same time.

Double check the program setting for each day. Press the arrow (→) button repeatedly until the clock mode is passed and the program mode (Pr) is reached. Carefully check each days program and clear any unwanted programs.

5. When finished programming, press the arrow (→) button until the clock appears in the upper left corner of the display.

During the change-over period, the ON mode is indicated in the ellipse in the upper right corner of the display (Figure 2).

To Check The Programs:

Push the arrow (→) button to review each setting.

To Erase (Clear) A Program:

Press the arrow (→) button until the program mode (Pr) is reached. Press the arrow (→) button again to select the desired day. To clear the program for the day selected, press the plus and set (+) (⬇) buttons at the same time.

To Initiate Or Override An Exerciser/Change-over Program:

The clock has a built-in test feature. Once the clock time has been set, the set button (⬇) can be used to initiate an exercise test/changeover or to cancel an exercise test/changeover in progress.

Exercise Applications: The Load/No Load switch, on the control circuit board can be set to test the genset with or without load, as desired.

With the normal source connected and available, pressing the set (⬇) button once will initiate an exercise test. A hand will be displayed in the upper left corner of the display and the On mode will be indicated inside the ellipse in upper right corner of the display (Figure 2). Pressing the set (⬇) button again will stop the exercise test and the ellipse will indicate the OFF mode.

To temporarily override an activated exercise program, *momentarily* press the set (⬇) button. A small hand will appear in the upper left corner of the display (Figure 2). The current program will be overridden and the clock will automatically set for the next program. Momentarily pressing the set (⬇) button again will return to the current program.

Changeover Applications: Pressing the set (⬇) button once will initiate a changeover. A hand will be displayed in the upper left corner of the display and the On mode will be indicated inside the ellipse in upper right corner of the display (Figure 2). Press the set (⬇) button again after the genset is running and the changeover will continue. The ellipse will indicate the OFF mode. Repeat this procedure to change back to the original genset.

Permanent On/Off Mode:

Note this feature is not used for any current applications. It is described here to help recognize and get out of this mode.

Holding the set (**■**) button down until a *flashing hand appears* in the upper left corner of the display initiates the permanent On/Off mode (Figure 2).

The On mode is indicated by a continuous band of segments illuminated around the clock. The Off mode is indicated by all of the segments around the clock being off. Pressing the set (**■**) button momentarily toggles between the permanent On and permanent Off modes. Holding the set (**■**) button down until the clock symbol returns to the upper left corner of the display, ends the continuous On/Off mode and returns to the normal program mode.

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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

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:

1. Move the operation selector switch on the generator set to Stop.
2. Disconnect the starting batteries of the generator set (remove the ground [-] lead first).
3. 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, and includes models produced under the Cummins®/Onan® and Cummins Power Generation brand names.

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 standby or emergency power system. The Normal power source, commonly the utility line, is backed up by an Emergency power source, often an electric generating set. The 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.

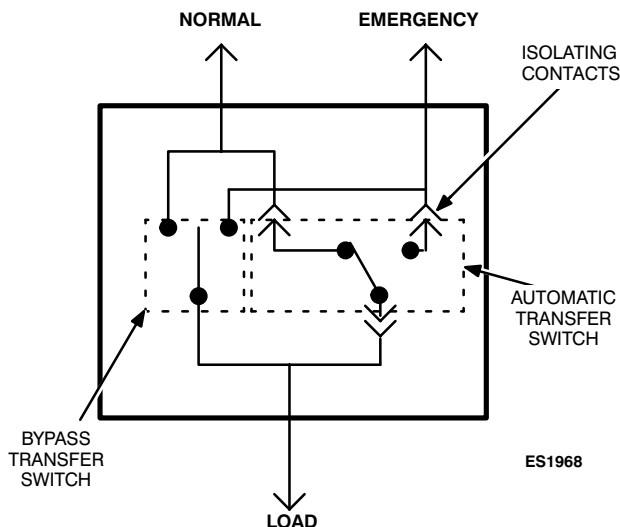


FIGURE 1-1. BT TRANSFER SWITCH (TYPICAL FUNCTION)

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. Send a start signal to the generator set (Emergency power source).
3. Transfer the load to the Emergency power source.
4. Sense the return of the Normal power source.
5. Retransfer the load to the Normal power source.
6. Send a stop signal to the generator set.

Bypass Switch Function

The bypass switch allows the operator to manually connect the load to the available power source, bypassing the automatic transfer switch (Figure 1-1). 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 Power Generation distributor or if you need more assistance, please call the phone number listed on the back cover of this manual during the hours of 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.

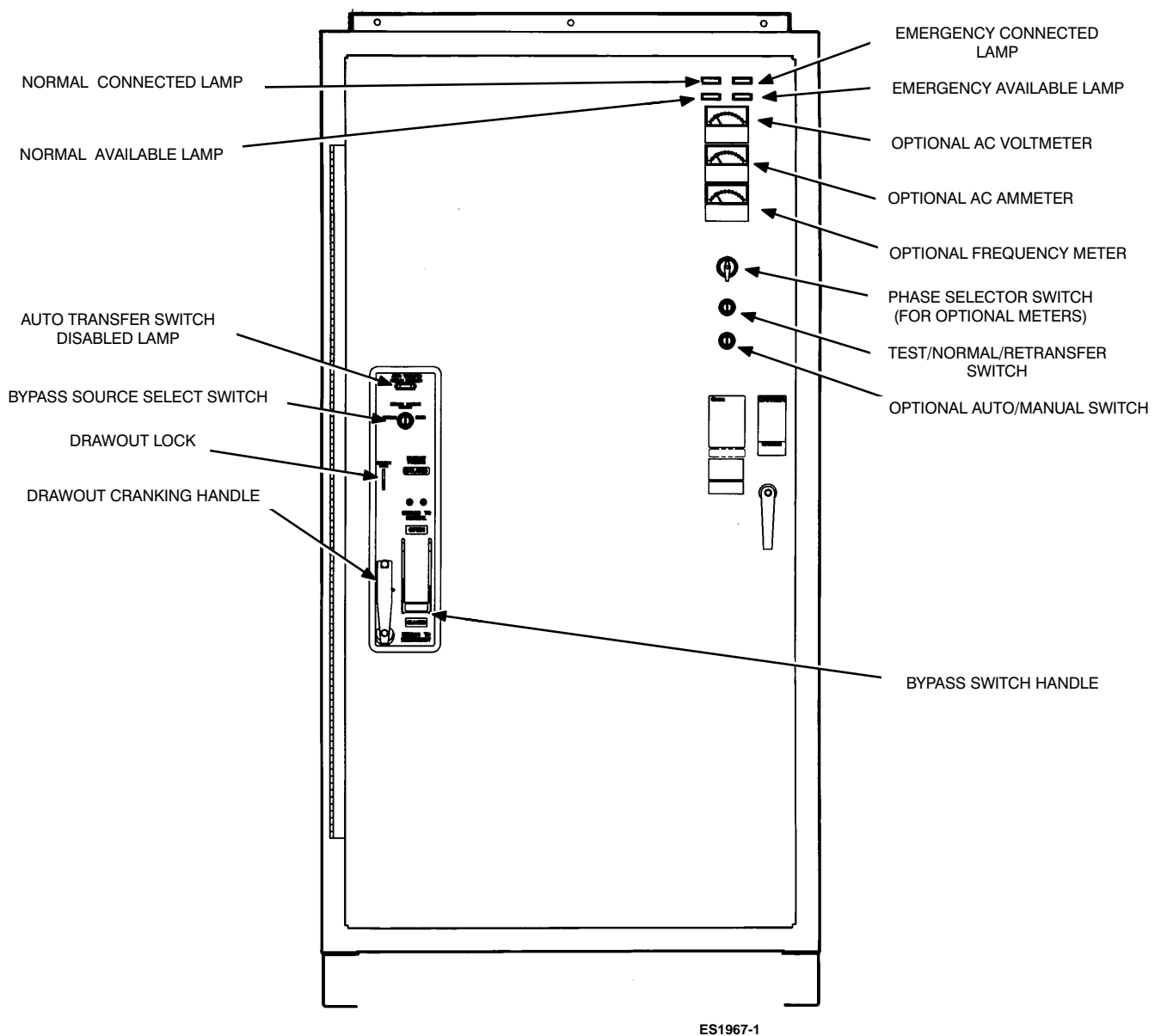
CABINET

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 Normal Available and Emergency Available lamps are lit whenever their corresponding power sources (utility or generator set) are producing power. These two lamps can be lit simultaneously.

The Normal Connected lamp is lit when the automatic transfer switch is in the normal position. The Emergency Connected lamp is lit when the automatic transfer switch is in the emergency position.



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FIGURE 2-1. CABINET WITH OPTIONS

Test/Normal/Retransfer Switch

This switch has three positions. In the Normal position, the transfer switch is set for automatic operation. Moving the switch to Test sends a start signal to the generator set. After the transfer time delay, the generator set will assume the load—provided that the automatic transfer switch is in the Connected position and the Test With/Without Load switch (on the Power Sentry control) is in the With Load position.

Moving the switch to Normal causes the load to retransfer to the Normal power source after the retransfer time delay. To avoid the delay and cause a fast retransfer of load to the Normal power source, move the switch to the Retransfer position.

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.

Optional Auto/Manual Switch

The 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 a functioning generator set back to utility power) is disabled; only manual retransfer (using the Test/Normal/Retransfer switch) is possible. In the event of generator set failure, however, the Power Sentry control logic will ignore the Auto/Manual switch and initiate retransfer to utility power.

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 start the generator set. (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 re-transfer. 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

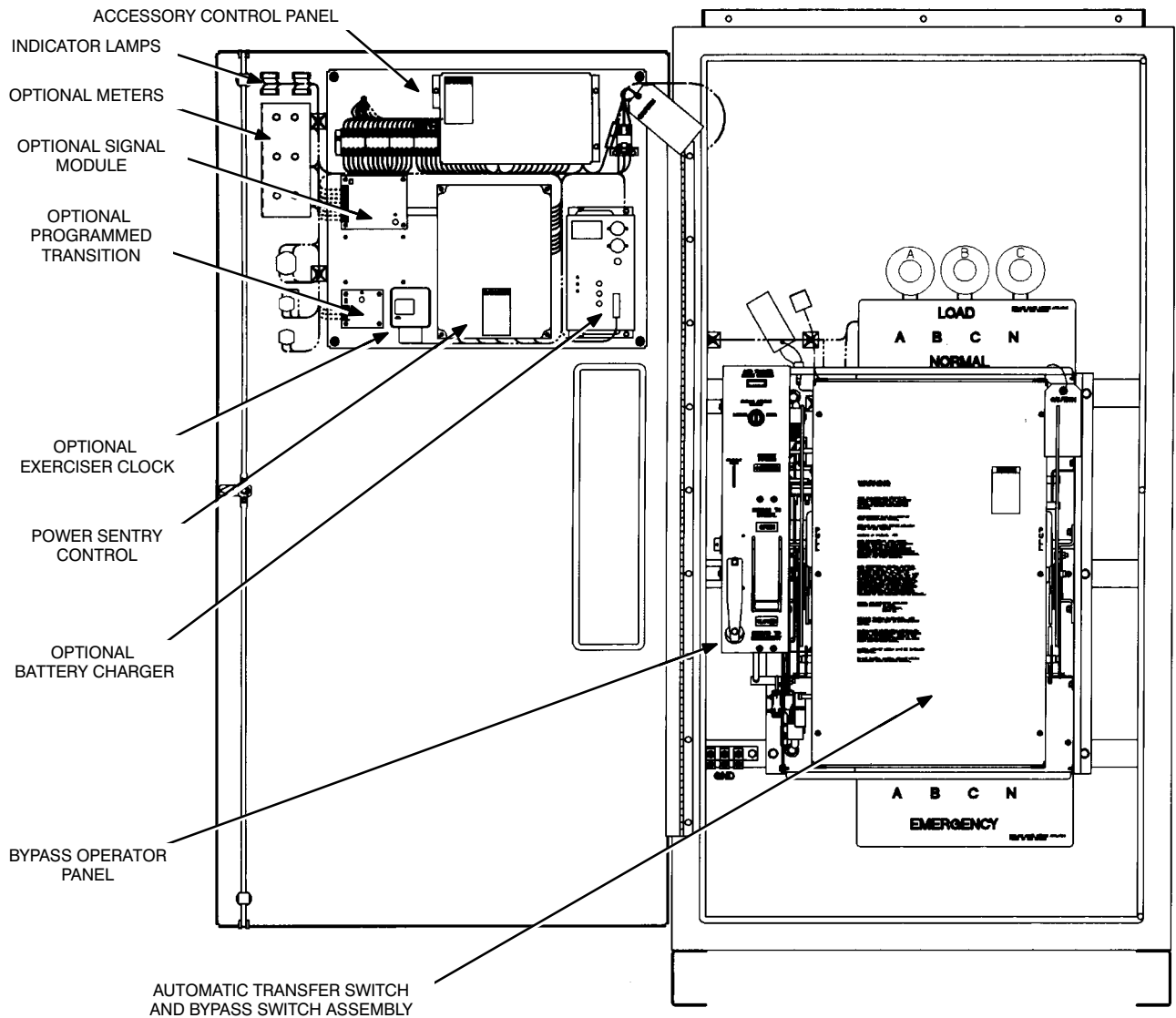
The drawout-isolation mechanism allows the automatic transfer switch to be isolated for testing or service. Three sets of primary isolation contacts (Normal source, Emergency source, and Load) connect the switching contacts to the terminal lugs. A set of secondary isolation contacts connects the automatic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

Start Time Delay: This delay is adjustable from 0 to 15 or (optionally) from 0 to 90 seconds. This brief time delay prevents generator set starting during power interruptions of short duration. Timing starts the moment of Normal (utility) power interruption. If the duration of interruption exceeds the delay time, the control system signals the generator set to start.

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

Stop Time Delay: This delay is adjustable from 0 to 10 minutes. It begins timing when the load is retransferred to the Normal power source. At the end of the delay, the stop signal is sent to the generator set. This time delay allows the generator set to cool down at no load before stopping.

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

Transfer Time Delay: This delay begins when generator voltage and frequency reach the settings of the control. After the delay, the transfer switch transfers the load to the Emergency power source. This brief time delay allows the generator set to stabilize before the load is applied. 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 Normal line voltage and frequency return. After the delay, the transfer switch can retransfer the load to the Normal source. The delay allows the Normal 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 timing for generator set start and 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.

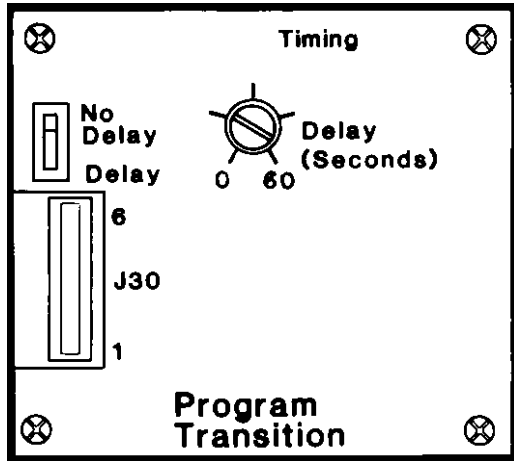
Starting Circuit

The starting circuit is a basic supervisory function of the electronic control. Water-cooled Cummins Power Generation generator sets use a two-wire start control.

Although the logic is more involved, the starting circuit can be thought of as a single pole, single throw switch. A closed switch signals the generator set to start. An open switch signals the electric generator set to stop.

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.

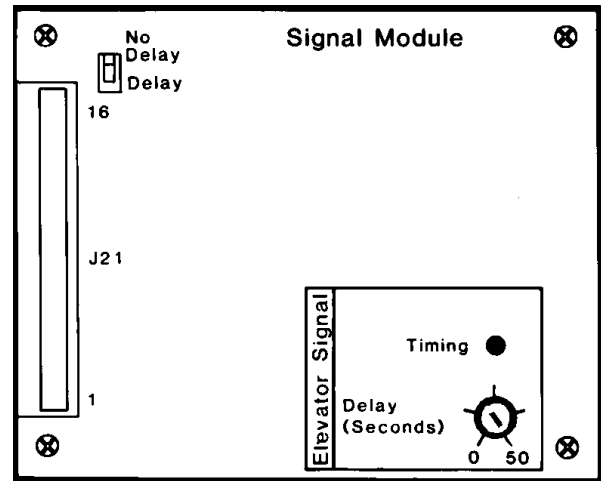
Signal Module Option

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 four 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.

Load Shed Option

The optional Load Shed function is used to disconnect the load from an available Emergency source in order to reduce the power consumed from that source. When the load shed function is initiated, the switch is moved to the neutral position.

The load shed function is initiated by a customer-supplied signal.

When load shedding is in effect, a return of Normal utility power will cause immediate retransfer to the Normal power source.

If the load shed signal is removed before Normal power returns, the switch will transfer back to the Emergency side.

Remote Test

The transfer switch may be wired with a remote test switch. Closure of a set of contacts across the remote test inputs sends a start/run signal to the generator set. If the With/Without Load switch is in the With Load position, the transfer switch senses a (simulated) utility power failure and transfers the load to the generator set when generator set power becomes available. (Refer to the Installation and Service manuals)

Float Battery Charger Option

A float-charge battery charger (Figure 2-5) regulates its charge voltage to continuously charge without damage to the battery. As the battery approaches full charge, the charging current automatically tapers to zero amperes or to steady-state load on the battery.

There are two chargers available. One battery charger is rated for 10 amperes at 12 or 24 VDC. The other battery charger is rated for 2 amperes at 12 or 24 VDC.

The 2-ampere battery charger has an ammeter to indicate charging current and a fuse to protect the battery charger circuit.

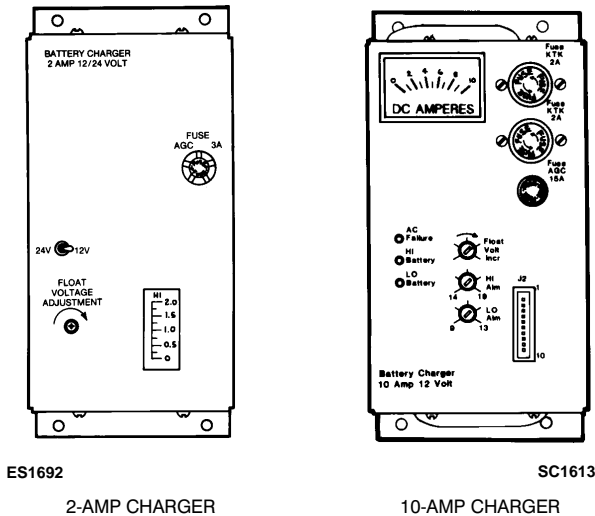


FIGURE 2-5. BATTERY CHARGER

The 10-ampere battery charger has three fuses (two on the AC input and one on the DC output), three fault display LEDs, and an ammeter for indication of charging current.

On the 10-ampere charger, three sets of (form C) alarm contacts (corresponding to the three fault LEDs) are also available. These contacts can be wired by the installer to activate other audible or visual alarms.

Under normal operating conditions, the Low Bat and AC Fail relays are energized and the High Bat relay is de-energized. In response to a Low Bat or AC Fail condition, the appropriate normally energized relay (Low Bat or AC Fail) drops out. In response to a High Bat condition, the normally de-energized High Bat relay is energized.

Auxiliary Relays Option

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

Exerciser Clock Option

The exerciser clock initiates generator set start/run cycles at programmable intervals and for programmable durations. It is a 7-day, 24-hour clock that can store and execute up to ten start/stop programs (exercise cycles).

Programming the exerciser clock requires setting the time of day and entering the exercise start and stop times.

Refer to the circled numbers in Figure 2-6 when reading the following instructions.

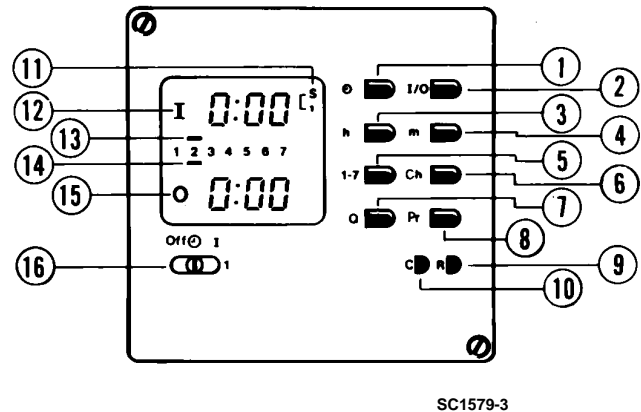


FIGURE 2-6. EXERCISER CLOCK

To set the time of day:

1. If you are performing installation and setup, press the R button (9) with the tip of a ball point pen to reset all memory. Do not press the R button if you are only changing the time of day.
2. Press the clock button (1).
3. Press the h button (3) to set the hour of the day. The clock uses 24-hour (military) time.
4. Press the m button (4) to set the minutes of the hour.
5. Press the 1-7 button (5) to advance the indicator bar over the desired day number (Use the 1 to represent Sunday.)
6. Press the Pr button (8) to enter the time.

To set the exercise start time:

1. Slide the output selector switch (16) to the center position. The output selector switch has three positions. The Off position overrides the program and causes an exercise stop. The I position overrides the program and causes an exercise start. The center position selects program control.
2. Press the I/O button (2). An "I" (12) appears in the upper display window. The "I" is a symbol for start time.

3. Press the h button (3) to set the start hour.
4. Press the m button (4) to set the start minute.
5. Press the 1-7 button (5) to advance the indicator bar (13) from 1 to 7 and back to 1. For each day to be selected for exercise, press the Q button (7) when the indicator is over the desired day number. (1 represents Sunday.)

To set the exercise stop time:

1. Press the I/O button (2). An “O” (15) appears in the lower left display window. The “O” is a symbol for stop time.
2. Press the h button (3) to set the stop hour.
3. Press the m button (4) to set the stop minute.
4. Press the 1-7 button (5) to advance the indicator bar (14) from 1 to 7 and back to 1. For each start time (selected in step 5 above), there must be a corresponding stop time. A program can start on day 2, pass through midnight, and stop on day 3 (for example); but there must be a stop time for every start time. Press the Q button (7) when the indicator is under the desired day number.
5. To enter the complete start/stop program, press the Pr button (8). If all program requirements have been satisfied, the display returns to the time of day. If the program requirements are not met, the display of the section that needs correction flashes on and off.

To enter more programs, repeat the two 5-step procedures. A maximum of ten programs can be entered. (The same ten programs can be repeated each day.)

The word “Full” appears in the display when the memory is full.

If the I/O button (2) is pressed and no program is to be entered, press the Ch button (6) and then the Pr button (8) to get out of the program mode.

To check the programs:

1. Press the Ch button (6). An “I” (12) and an “O” (15) are displayed.
2. Press the Ch button (6) again. The start and stop information for the first program is displayed.
3. Continued pressing of the Ch button (6) causes the display to sequence through all of the programs in memory. If ten programs have been entered, the word “Full” appears after the tenth program display.
4. Press the Pr button (8) to return to the time-of-day display.

To change (edit) a program:

1. Press the Ch button (6) until the program you want to change appears in the display window.
2. Press the I/O button (2) to select start or stop time.
3. Press the h (3), m (4), or 1-7 (5) and Q (7) buttons to change the hour, minute, or day.
4. Press the Pr button (8) to enter the edited program and return to the time-of-day display.

To erase (clear) a program:

1. Press the Ch button (6) until the program to be erased is displayed.
2. Press the C button (10) with a ball point pen to clear the program.
3. Press the Pr button (8) to return to the time-of-day display.

Section 3. Operation

AUTOMATIC OPERATION

Place control switches in the positions given below.

- **Test/Normal/Retransfer switch:** Normal position.
- **Bypass switch handle:** Center position. Both bypass switch position indicators show the word "Open."
- **Operation selector switch on engine control:** Remote position.

SYSTEM TESTING

Three types of tests can be performed.

- The **generator set start test** tests the start circuits of the Power Sentry control and starts the generator set. The linear actuator and contact mechanisms are not tested. There is no transfer of load to the Emergency source.
- The **with-load standby system test** simulates a power outage. This tests the start circuits of the Power Sentry control and starts the generator set. When the Power Sentry control senses that the generator set is producing acceptable power, the linear actuator is energized and the contact mechanism transfers load to the emergency source. Because there is transfer of load to the Emergency source, there is brief interruption of power to the load.
- The **non-load break transfer switch test** allows testing the Power Sentry control, the linear actuator, and the contact mechanisms without interrupting power to the load.

To perform this test, the operator must (first) bypass the automatic transfer switch by moving the manual bypass switch to the Normal position, and (second) isolate the automatic transfer switch from the load.

Like the other tests, this tests the start circuits of the Power Sentry control and starts the generator set. When the Power Sentry control senses that the generator set is producing acceptable power, the linear actuator is energized and the automatic transfer switch contact mechanism is driven to the emergency side. Because the automatic transfer switch is bypassed and isolated, there is NO transfer of load to the Emergency source and NO interruption of power to the load.

GENERATOR SET START TEST

⚠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.*

1. Place the With/Without Load selector switch, on the Power Sentry control, in the Without Load position.
2. Close the cabinet door.
3. Move the Test/Normal/Retransfer switch to Test. The generator set should start and run.

The With/Without Load selector switch must be in the Without Load position.

4. At the end of the test period, move the Test/Normal/Retransfer switch to the Normal position. The generator will stop.
5. In anticipation of scheduled or automatic generator set exercise, check that the With/Without Load selector switch is in the desired position. Refer to *Generator Set Exercise*.
6. Close and lock the cabinet door.

WITH-LOAD STANDBY SYSTEM TEST

⚠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.*

1. Place the With/Without Load selector switch, on the Power Sentry control, in the With Load position.

The With/Without Load selector switch must be in the With Load position in order to test with load.

2. Close the cabinet door.

⚠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. Close the cabinet door.*

3. Move the Test/Normal/Retransfer switch to Test. The generator set should start and assume the load after the transfer time delay.
4. At the end of the test period, move the Test/Normal/Retransfer switch to the Normal position if you want to retransfer load back to the Normal power source after the retransfer time delay. To bypass the retransfer time delay and cause immediate load retransfer, move the Test/Normal/Retransfer switch to Retransfer and release (the switch will return to Normal). The generator will stop after the stop time delay.
5. In anticipation of scheduled or automatic generator set exercise, check that the With/Without Load selector switch is in the desired position. Refer to *Generator Set Exercise*.
6. Close and lock the cabinet door.

NON-LOAD BREAK TRANSFER SWITCH TEST

1. Turn and hold the Bypass Source Select switch in the Normal position and move the bypass switch handle to the Normal position. Check that the word "Closed" is shown in the Bypass to Normal indicator slot. Release the Bypass Source Select switch.
2. Lift the Drawout Lock and turn the drawout cranking handle counterclockwise to move the automatic transfer switch to the Test position. After three rotations of the cranking handle, release the Drawout Lock. When the transfer switch reaches the Test position, the Drawout Lock engages, locking the transfer switch in the Test position. As the automatic transfer switch is being drawn out, mechanical interlocks force the switch to the neutral position. Check that the word "Test" appears in the Drawout Position indicator slot. Return the drawout cranking handle to its stored position.

In the Test position, 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.

⚠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.*

3. Place the With/Without Load selector switch, on the Power Sentry control, in the With Load position.

The With/Without Load selector switch must be in the With Load position in order to test the linear actuator and the contact mechanisms. Because the automatic transfer switch is bypassed and isolated from the load, there will NOT be an actual With Load test.

4. Close the cabinet door.
5. Move the Test/Normal/Retransfer switch to Test. The generator set will start and run. After the transfer time delay, the linear actuator will drive the contact mechanism to the Emergency side. Because the automatic transfer switch is bypassed and isolated from the load, there is NO transfer of load to the Emergency source and NO interruption of power to the load.
6. At the end of the test period, move the Test/Normal/Retransfer switch to the Normal position. After the retransfer time delay, the linear actuator will drive the contact mechanism back to the Normal side. To avoid the retransfer time delay, move the Test/Normal/Retransfer switch to Retransfer and release (the switch will return to Normal). The generator will stop after the stop time delay.
7. Lift the Drawout Lock and turn the drawout cranking handle clockwise to move the automatic transfer

switch back to the Connected position. After three rotations of the cranking handle, release the Drawout Lock. 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.

8. 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. In this procedure, the switch will return to the Normal position, provided the retransfer time delay has expired.

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

9. After the automatic transfer switch has returned to the Normal position, 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.
10. In anticipation of scheduled or automatic generator set exercise, check that the With/Without Load selector switch is in the desired position. Refer to *Generator Set Exercise*.
11. Close and lock the cabinet door.

GENERATOR SET EXERCISE

Cummins Power Generation recommends running the generator for at least 30 minutes once each week with at least 50 percent load (if possible). If you do not have an optional exerciser, use the Test/Normal/Retransfer switch to test the generator set each week.

The optional exerciser has preselected exercise periods and exercises the generator set automatically with or without load, depending on the position of the With/Without Load switch.

⚠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.*

If the Normal power source has an interruption while the generator set is exercising without load, the automatic transfer switch will transfer the load to the generator set.

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 start the generator set by moving the Test/Normal/Retransfer switch to Test.
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, move the Test/Normal/Retransfer switch to the Normal position. 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. To avoid the retransfer time delay, move the Test/Normal/Retransfer switch to Retransfer and release (the switch will return to Normal). The generator will stop after the stop time delay.

Section 4. Troubleshooting

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

POWER OUTAGE OCCURS, BUT GENERATOR SET DOES NOT START

⚠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.

1. Check the generator set. The operation selector switch on the generator set control panel should be set at Remote. Check for fault indicators on the generator set control.
2. Start the generator set using its start-stop controls. If it does not crank, check the starting batteries. If it cranks but does not start, check the fuel supply. If the problem persists, call your dealer or distributor.

⚠WARNING Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.

⚠WARNING Ignition of fuel can cause severe personal injury or death by fire or explosion. Do not permit any flame, cigarette, spark, pilot light, arcing equipment, or other possible source of ignition near the fuel system.

GENERATOR SET STARTS DURING NORMAL POWER SERVICE

1. The operation selector switch on the generator set control panel should be set at Remote.

⚠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.

2. Check the Test/Normal/Retransfer switch to make sure it is in the Normal position.
3. Check the exerciser clock to see if it is in an exercise period. When the exerciser clock is in an exercise period, a "1" appears in the upper right-hand corner of the display window (Figure 4-1). You can view the

display by looking through the transparent clock cover. Check that the red slide switch is in the center position (Figure 4-1).

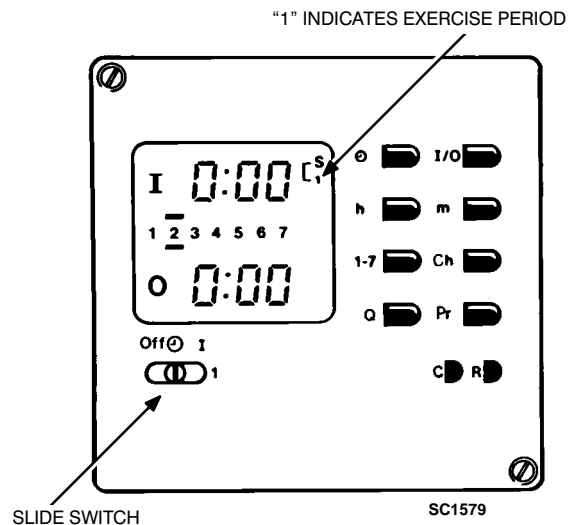


FIGURE 4-1. EXERCISER CLOCK

If the exercise period occurs at an unexpected time or for an excessive duration, refer to the exerciser clock programming procedure or call your dealer or distributor.

4. Momentary voltage dips might cause voltage sensors to initiate generator set starting. If the problem persists, call your dealer or distributor.

GENERATOR SET DOES NOT EXERCISE (IF EQUIPPED WITH EXERCISER)

1. The operation selector switch on the generator set control panel should be set at Remote.

⚠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.

2. Check the exerciser to see if it is in an exercise period. When the exerciser clock is in an exercise period, a "1" appears in the upper right-hand corner of the display window (Figure 4-1). You can view the display by looking through the transparent clock cover. Check that the red slide switch is in the center position (Figure 4-1).

3. Start the generator set using its start-stop controls. If it does not crank, check the starting batteries. If it cranks but does not start, check the fuel supply. If the problem persists, call your dealer or distributor.

▲WARNING *Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.*

▲WARNING *Ignition of fuel can cause severe personal injury or death by fire or explosion. Do not permit any flame, cigarette, spark, pilot light, arcing equipment, or other possible source of ignition near the fuel system.*

AFTER A POWER FAILURE, GENERATOR SET STARTS BUT DOES NOT ASSUME LOAD

1. Check the output voltage of the emergency power source by observing the voltmeter on the generator set or the optional voltmeter on the automatic transfer switch.
2. Check that the Auto Transfer Switch Disabled lamp, on the bypass operator panel, is off.

▲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.*

3. Check the Source 2 Available lamp on the Power Sentry control.
4. Check that the bypass switch handle is in the center position.
5. If the automatic transfer switch is not operable, manually bypass the switch. (Refer to: *Isolating the Transfer Switch for Service* in the *Operation* section.) Call your dealer or distributor.

AFTER POWER RETURNS, TRANSFER SWITCH DOES NOT RETURN TO NORMAL POSITION

1. The retransfer time delay period may not have expired. Check the Retransfer Timing lamp on the Power Sentry control.
2. Check that the Auto Transfer Switch Disabled lamp, on the bypass operator panel, is off.

▲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.*

3. Check that the bypass switch handle is in the center position.
4. Check to see if the automatic transfer switch is withdrawn for testing or service. Check that the word Connected appears in the Drawout Position indicator slot.
5. Manually initiate retransfer by turning the Test/Normal/Retransfer switch to Retransfer.
6. Stop the generator set with the Start/Stop switch (located on the generator set). When the generator set stops, the transfer switch will transfer load to the Normal power source if power is acceptable. Call your dealer or distributor.

GENERATOR SET CONTINUES TO RUN AFTER RETRANSFER OF LOAD TO NORMAL POWER

The stop time delay function may not have expired. Check the Stop Timing lamp on the Power Sentry. Stop the generator set with the Start/Stop switch (located on the generator set). Call your dealer or distributor.

BATTERY CHARGER FAILS TO CHARGE (IF EQUIPPED)

Check the battery charger fuse(s). Replace, if necessary, with fuses of the correct rating. Fuse ampere ratings are shown on the charger faceplate.

▲WARNING *Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.*

If the fuse is OK, call your dealer or distributor.

BATTERY LOSES WATER

The battery charger float voltage could be too high (if equipped with battery charger). Call your dealer or distributor.

BATTERY LOSES CHARGE

Battery charger float voltage could be too low (if equipped with battery charger). Call your dealer or distributor.

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