

OWNER'S MANUAL 430429-082

Revised February 5, 2001

IMPORTANT: Read these instructions before installing, operating, or servicing this system.

950C

CHARGE CONTROL

DO NOT DESTROY

AMETEK/PRESTOLITE POWER , TROY, OHIO 45373-1099, U.S.A.

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INTRODUCTION

How To Use This Manual

IMPORTANT: It is especially important that all charger internal components be kept clean and dry, and all electrical connections tightened. Replace any precautionary or instruction label that cannot be easily read.

To ensure safe operation, read the entire manual, including the chapter on Safety Instructions and Warnings.

Throughout this manual, the words **WARNING**, **CAUTION**, and **NOTE** may appear. Pay particular attention to the information provided under these headings. These special annotations are easily recognized as follows:

WARNING gives information regarding possible personal injury. Warnings will be enclosed in a box such as this.

CAUTION refers to possible equipment damage. Cautions will be shown in bold type.

NOTE offers helpful information concerning certain operating procedures. Notes will be shown in italics.

Equipment Identification

The unit's identification number (specification, model, serial number) usually appears on a nameplate attached to the front panel.

Receipt Of Equipment

When you receive the equipment, check it against the invoice to make sure it is complete and inspect the equipment for possible damage due to shipping. If there is any damage, notify the carrier immediately to file a claim. Furnish complete information concerning damage claims or shipping errors to the company shown on the cover of this manual. Include all equipment identification numbers and group part numbers (if any) as described above along with a full description of the parts in error.

Move the equipment to the site of installation before uncrating. Use care to avoid damaging the equipment when using bars, hammers, etc., to uncrate the unit.

Additional copies of this manual may be purchased by contacting the company shown on the cover of this manual. Include the Owner's Manual number and equipment identification numbers.

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SAFETY INSTRUCTIONS AND WARNINGS

FOR OPERATION OF BATTERY CHARGING EQUIPMENT

IMPORTANT – READ AND UNDERSTAND THESE INSTRUCTIONS. DO NOT LOSE THEM. ALSO READ OPERATING/INSTRUCTION MANUAL BEFORE INSTALLING, OPERATING, OR SERVICING THIS EQUIPMENT.

A. General

Battery charging products can cause serious injury or death, or damage to other equipment or property, if the operator does not strictly observe all safety rules and take precautionary actions.

Safe practices have developed from past experience in the use of charging equipment. These practices must be learned through study and training before using this equipment. Anyone not having extensive training in battery charging practices should be taught by experienced operators.

Only qualified personnel should install, use, or service this equipment.

B. Shock Prevention

Bare conductors, or terminals in the output circuit, or ungrounded, electrically-live equipment can fatally shock a person. To protect against shock, have competent electrician verify that the equipment is adequately grounded and learn what terminals and parts are electrically HOT.

The body's electrical resistance is decreased when wet, permitting dangerous current to flow through the body. Do not work in damp area without being extremely careful. Stand on dry rubber mat or dry wood and use insulating gloves when dampness or sweat cannot be avoided. Keep clothing dry.

1. Installation and Grounding of Electrically Powered Equipment – Electrical equipment must be installed and maintained in accordance with the National Electrical Code, NFPA 70, and local codes. A power disconnect switch must be located at the equipment. Check nameplate for voltage and phase requirements. If only 3-phase power is available, connect *single-phase* equipment to only two wires of the 3-phase line. DO NOT CONNECT the equipment grounding conductor (lead) to the third live wire of the 3-phase line as this makes the equipment frame electrically HOT, which can cause a fatal shock.

If a grounding lead (conductor) is part of the power supply cable, be sure to connect it to a properly grounded switch box or building ground. If not part of the supply cable, use a separate grounding lead (conductor). Do not remove a ground prong from any plug. Use correct mating receptacles. Check ground for electrical continuity before using equipment.

The grounding conductor must be of a size equal to or larger than the size recommended by Code or in this manual.

2. Charging Leads – Inspect leads often for damage to the insulation. Replace or repair cracked or worn leads immediately. Use leads having sufficient capacity to carry the operating current without overheating.
3. Battery Terminals – Do not touch battery terminals while equipment is operating.
4. Service and Maintenance – Shut OFF all power at the disconnect switch or line breaker *before* inspecting, adjusting, or servicing the equipment. Lock switch OPEN (or remove line fuses) so that the power cannot be turned ON accidentally. Disconnect power to equipment if it is to be left unattended or out of service.

Disconnect battery from charger. Measure voltage on capacitors and discharge through an insulated screwdriver if there is any voltage reading.

Keep inside parts clean and dry. Dirt and/or moisture can cause insulation failure. This failure can result in high voltage at the charger output.

C. Burn and Bodily Injury Prevention

The battery produces very high currents when short circuited, and will burn the skin severely if in contact with any metal conductor that is carrying this current. Do not permit rings on fingers to come in contact with battery terminals or the cell connectors on top of the battery.

Battery acid is very corrosive. Always wear correct eye and body protection when near batteries.

D. Fire and Explosion Prevention

Batteries give off explosive flammable gases which easily ignite when coming in contact with an open flame or spark. Do not smoke, cause sparking, or use open flame near batteries. Charge batteries only in locations which are clean, dry, and well ventilated. Do not lay tools or anything that is metallic on top of any battery. All repairs to a battery must be made only by experienced and qualified personnel.

E. Arcing and Burning of Connector

To prevent arcing and burning of the connector contacts, be sure the charger is OFF before connecting or disconnecting the battery. (If the charger is equipped with an ammeter, the ammeter should not indicate current flow.) Always connect battery before turning charger ON.

F. Medical and First Aid Treatment

First aid facilities and a qualified first aid person should be available for each shift for immediate treatment of electrical shock victims.

EMERGENCY FIRST AID: Call physician and ambulance immediately. Use First Aid techniques recommended by the American Red Cross.

DANGER: ELECTRICAL SHOCK CAN BE FATAL. If person is unconscious and electric shock is suspected, do not touch person if he or she is in contact with charging leads, charging equipment, or other live electrical parts. Disconnect (open) power at wall switch and then use First Aid. Dry wood, wooden broom, and other insulating material can be used to move cables, if necessary, away from person. IF BREATHING IS DIFFICULT, give oxygen. IF NOT BREATHING, BEGIN ARTIFICIAL BREATHING, such as mouth-to-mouth. IF PULSE IS ABSENT, BEGIN ARTIFICIAL CIRCULATION, such as external heart massage.

IN CASE OF ACID IN THE EYES, flush very well with clean water and obtain professional medical attention immediately.

G. Equipment Warning Labels

Inspect all precautionary labels on the equipment. Order and replace all labels that cannot be easily read.

INITIAL SET-UP

See Location Diagram of Selector Switches included in this manual.

For proper operation, the 950C Control must be set to match the charger in which it is installed.

Cell Size Selection

From the data plate on the charger, note the number of cells. Place the corresponding DIP switch (S2) on the 950C Control in the "closed" position.

S1-1	6 Cells
S1-2	12 Cells
S1-3	18 Cells
S1-4	24 Cells
S1-5	36 Cells
S1-6	Unique Part Number

Only one of the above DIP switches should be in the "closed" position at any one time.

Full Scale Digital Ammeter Selection

From the data plate on the charger, note the DC output per circuit – Max. Amps. Set S1-7 and S1-10 as shown in the following chart.

DC Output per Circuit Max. Amps	S1-7	S1-10	Full Scale Current
0 – 76	OFF	ON	100
77 – 171	OFF	OFF	200
172 – 320	ON	OFF	400

Flashing Digital Display

When the nickel-cadmium battery, which is used for maintaining charge cycle data, time of day, and day of week, has been depleted (discharged), the digital display will flash at a rate of twice per second. Most new 950C controls received by customers will flash when AC power is first applied. The control can be reset (stop flashing) by holding the "Push to Equalize" pushbutton for at least two seconds while no battery is connected to the charger. The 950C has an on-board trickle charger which will fully charge the Ni-Cad battery in 1-2 days.

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STANDARD OPERATION

WARNING: Do not disconnect a battery from this charger while the charge in progress LED is lit; otherwise, a battery explosion may result. BATTERIES PRODUCE EXPLOSIVE GASES. Keep sparks, flame, and cigarettes away. Ventilate when charging in an enclosed area. Always shield eyes when working near batteries.

1. Insure that battery size matches charger (Number of cells and ampere hour capacity are within nameplate information).
2. Connect AC power to charger.
3. Connect the battery to the charger.
4. After a five second downcount, the charger will turn on and the "Charge in Progress" LED will light.
The digital display will indicate output current.
5. The "80% Charged" LED will light when the battery voltage reaches the gassing point (Standard = 2.37 volts/cell).
6. When the charge termination point is reached, the charger will turn off. The "Charge Complete" LED will light and the "Equalize" LED will be lit if this was an equalize charge.

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950C CONTROL FEATURES

Main Features

1. 30 Minute dV/dT Charge Termination
2. Digital Display
3. Four LEDs for Status Display; LED lamp test provided
4. Manual Stop Capability
5. Review of Charge Cycle Information
 - Amp hours returned during charge cycle
 - Start to 80% point timer
 - 80% to dV/dT point timer
 - Open circuit voltage
 - Start current
 - Start voltage
 - Finish current
 - Finish voltage
 - Charge termination code
6. Review of Programmed Features
- *7. Automatic or Push-to-Start Operation
8. Manual or Automatic Equalize Operation
- *9. Fault Lock-out or No Fault Lock-out Operation
10. Dual Back-up Timer Shutdowns
11. Failure Mode Diagnostics
12. One Part Number Control is User/Factory programmable for 6-12-18-24-36 Cells and 100-200-400 Amp Digital Ammeter
13. 72 Hour Refresh Charge
- *14. Voltage Time Feature (dV/dT Disable)
- *15. "Cell Forming" Feature
- *16. Low Current Shutdown Disable
- *17. Digitally Adjustable 80% Point

- *18. Digitally Adjustable "Cell Mismatch" Window
 19. Programmed Features maintained for a minimum of 10 Years
 20. Charge Cycle Data and Time-of-Day/Date maintained for a minimum of 30 days
 - *21. 5 Programmable Start Modes
 - Automatic Start (5 Second Delay)
 - * - Push-To-Start
 - * - Delayed Start
 - * - Time-of-Day Start
 - * - Time-of-Day Blockout
 - *22. Programmable Manual Override of Start Modes
 - *23. Automatic Equalize by Number of Cycles or Day of Week
- * = Requires Optional Programming Module to Program These Features.

Description of Features

Charge Termination — The standard 950C utilizes a patented dV/dT technique in order to determine the charge termination point. This technique returns approximately 107% of the amp hours removed from a battery (regardless of the state of discharge) and prevents variations in the incoming AC line voltage from affecting the amount of energy returned to the battery. The minimum time required for a dV/dT charge termination on the 950C Control is ten minutes. The 950C Control can be programmed to utilize a voltage-time charge termination technique. If the dV/dT charge termination is disabled, the control will terminate the charge cycle three hours after the battery reaches the "80% Charged" point.

Digital Display — A seven segment, four digit display is standard on the 950C Control. The characters are a minimum of .56 inches tall, making the information on the digital display legible at distances exceeding ten feet. The decimals of the digital display is used to indicate when delayed start, time of day start, time of day blockout, or automatic equalize are enabled.

These decimals will flash at a 25% duty cycle rate when the corresponding feature is enabled. A blank display is utilized for AC power fail indication.

Status Display LEDs — The “Charge In Progress” LED (Amber) is illuminated whenever the charger is flowing current to the battery. There are five status LEDs provided to indicate the present operating status of the charger and battery (see Figure 5-1). A lamp test feature is provided. See Review of Charge Cycle feature.

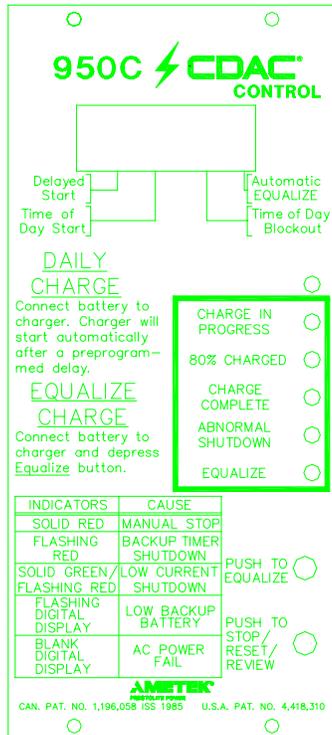


Figure 5-1 Status LEDs and Trouble Chart

Review of Charge Cycle — When the charge has been terminated, either by the 950C Control, the operator, or the removal of battery, the charge cycle history can be automatically read out by pressing the “Stop/Reset/Review” pushbutton. After displaying the information from memory, the unit will return to the normal (Model Number) display. All status LEDs will be illuminated during a standard review of function number one, thus providing a lamp test feature. Nine functions are displayed during a standard review. The information in all 32 functions can be displayed without the use of a programming module. See the Use of the Review Feature chapter in this manual. In order to terminate the review feature prematurely, the stop switch should be pressed during the display of any function other than functions nine or ten.

This feature can greatly aid in the analyzing of charge data and in situations where troubleshooting is required. See the Troubleshooting and Charge Cycle Data Analysis chapter in this manual.

Function	Description
0	Normal Display
1	Amp-Hours Returned
2	Start to 80% Time
3	80% to dV/dT Time
4	Battery Open Circuit Voltage
5	Start Current
6	Start Volts/Cell
7	Finish Current
8	Finish Volts/Cell
9	Charge Termination Code

Figure 5-2 List of Functions 1-9

Automatic, Push-to-Start Operation— In the automatic start mode, the charger will start five seconds after the battery is connected. The digital display will count down during this five second period (i.e., 5-4-3-2-1). In the push-to-start mode, the charger will not start the charge cycle until the “Push to Stop/Reset/Review” pushbutton is pressed. The model number displayed will be “951” when this feature has been selected.

Manual or Automatic Equalize — An equalize charge is a prolonged charge cycle (by 3 hours) used to correct any inequalities of voltage and specific gravity which may have developed between the cells during service. Standard 950C controls are shipped from the factory with the automatic equalize feature enabled. This mode of operation is indicated by a flashing decimal point on the digital display. There are two modes of automatic equalize. See the Automatic Equalize section in this chapter for further details. When the automatic equalize feature is active, the “Push To Equalize” pushbutton on the front panel is disabled. When automatic equalize is disabled, an equalize charge is requested by pressing the “Push To Equalize” pushbutton on the front panel of the 950C Control after a battery is connected to the charger. If this pushbutton is pressed again during the charge cycle, the equalize request will be canceled.

Fault Lockout Operation – In the normal operating mode (No fault lock-out), if an abnormal shutdown occurs, disconnecting and reconnecting the battery will clear the fault and the 950C will restart the charge cycle as programmed. If an abnormal shutdown occurs with the fault lock-out feature enabled, disconnecting and reconnecting a battery will not clear the fault condition.

The status LEDs will continue to display the fault condition even with no battery connected to the charger until the fault condition is cleared. The "Push to Stop/Reset/Review" pushbutton will clear the fault if it is pressed while a battery is not connected to the charger. A review cycle is initiated when the fault is cleared and can be terminated by pressing the "Push to Stop/Reset/Review" switch. When fault lock-out is enabled, the model number displayed is "952".

Back-Up Timer Shutdown — The standard 950C Control has two back-up timers. The charger will shutdown and the red "Abnormal Shutdown" LED will flash if nine hours has passed since the start of a charge cycle and the battery has not reached gassing voltage (80% charged), or if five hours has passed since the battery has reached gassing voltage and a dV/dT charge termination has not occurred. If the dV/dT feature has been disabled (see Voltage Time section), only the nine-hour back-up timer is active.

One Part Number Control — The standard 950C Control is user/factory programmable for 6, 12, 18, 24, and 36 cell Accu-Chargers with 100, 200, and 400 amp shunts. Any combination of the above cell sizes and current shunt sizes can be selected by DIP switches on the P.C. board. This feature reduces the quantity of spare parts inventory. See the Initial Set-Up chapter for further information.

Refresh Charge Feature — A refresh charge of a storage battery is a charge given to charged and wet batteries which are in storage or inactive periods to replace losses due to local action and to insure that every cell is brought periodically to a full state of charge. The 950C Control has a 72 hour refresh charge timer which starts with normal charge complete, either dV/DT or voltage time. If a battery is left connected to the charger for seventy-two hours after a charge complete, the control will automatically begin a refresh charge cycle. The control will start automatically even if programmed for time-of-day start, delayed start or push-to-start operation. The 950C will not start the charge cycle during a time-of-day blackout period. It will automatically request an equalize cycle if it is programmed to equalize on that day. The refresh charge cycle will not count as a charge cycle if the control is programmed to provide an equalize charge by number of cycles. Charge cycle data (Functions #1-12) is not affected by a refresh charge. The charge termination technique for a refresh charge will be dV/dT regardless of how the control is user programmed, and the 0-80% back-up timer will be four hours and fifteen minutes during a refresh charge.

This feature will insure that any battery left connected to the charger for extended periods of time will not be damaged due to self-discharge, and will be kept in a fully charged state.

Finish Cell Forming Feature — The 950C Control can be programmed to provide voltage-time charge termination and disable the low current shutdown feature for a limited number of charge cycles. The number of cycles programmed into function 27 will be forming cycles and the number in function 27 will be decremented each time a charge complete condition is reached. The number of forming cycles selected can be from 0 to 30 charge cycles.

WARNING: Enabling the Finish Cell Forming feature will cause the charger to continue to run for a period of time if the battery has been disconnected before Charge Complete or pressing the Manual Stop switch. This condition will continue until the programmed number of cycles have been completed. The battery should never be disconnected while a charge is in progress.

Low Current Shutdown Disable – The low current shutdown feature of the 950C Control can be disabled. This feature should only be utilized for troubleshooting and service of batteries.

WARNING: Care should be exercised when disabling the low current shutdown feature as the charger will continue to run if a battery is disconnected without first pressing the stop switch when the low current shutdown is disabled.

80% Charged Point — A standard 950C Control will light the "80% Charged" LED and enable the charge termination routine when the battery voltage reaches 2.37 volts/cell. The 80% charged voltage, in volts/cell, is stored in function number 30. The 80% charged point can be digitally adjusted with the use of the programming module from 2.30 V/C to 2.49 V/C. This allows the user to alter the battery's time on charge when utilizing the voltage-time charge termination method.

Battery Voltage Discrimination — A standard 950C Control will not initiate a charge cycle if the open circuit voltage of the battery is less than 1.75 volts/cell or greater than 2.30 volts/cell. The high battery discrimination feature can be digitally adjusted with the use of the programming module from 2.00 V/C to 2.45 V/C. The low battery discrimination voltage can be digitally adjusted with the use of the programming module from 1.73 V/C to 1.98 V/C. The low battery discrimination feature can be overridden by simultaneously pressing the “Push to Stop/Reset/Review” and the “Push to Equalize” pushbuttons for two seconds while the “Low Battery” status is displayed. This feature aids in the prevention of charger operation on mismatched batteries and chargers; and changing the standard limits may result in a mismatched charger/battery condition being accepted by the 950C Control.

CAUTION: Care should be exercised when overriding the low battery discrimination feature as the charger will run for nine hours if a battery is connected to the charger with a lower number of cells than the charger is rated for.

Data Retention — The 950C Control uses two types of electronic memory for data retention. Charge cycle data (functions 1-12) is kept in battery backed-up RAM. The nickel-cadmium battery which supports this data also maintains the time-of-day and day-of-week circuitry. The Ni-Cad battery is only utilized during AC power failures and will maintain date, time, and data for a minimum of thirty days. A trickle charge circuit is built into the 950C Control and requires approximately two days to fully charge the Ni-Cad battery. If this battery has been depleted (discharged), the digital display will flash twice per second (see “Initial Set-Up” chapter). The second type of memory utilized for data retention is EEPROM. User programmed information (functions 15-17, 20-32) is stored in EEPROM and has a minimum data retention time of ten years.

Time-of-Day Start – The 950C Control can be programmed to delay the start of a charge cycle until a specific time of day. Any time of day, in one minute increments, can be used for the time-of-day start time. This mode is indicated by a flashing decimal point on the digital display. When a 950C is programmed for the time-of-day start, and a battery is connected to the charger, the programmed start time will be displayed.

This feature can be used to save energy costs, provide a battery cool down period, or to prevent opportunity charging.

Delayed Start — The 950C Control can be programmed to delay the start of a charge cycle for a specific period of time. Any time period from 1 minute to 23 hours and 59 minutes, in one minute increments, can be used for the delayed start period. This mode is indicated by a flashing decimal point on the digital display. When a 950C is programmed for delayed start, and a battery is connected to the charger, the programmed delay time will be displayed. The time displayed will be decremented once per minute so that the time displayed is always the amount of time remaining before the start of charge. This feature can be used to save on energy costs, provide a battery cool down period, or to prevent opportunity charging.

Time-of-Day Blockout – The 950C Control can be programmed to disable the charger during a specific time of day. The charger will turn off at the beginning of the blockout period, and resume the charge cycle at the end of the blockout period. Any period of time of day, in one minute increments, can be used for the time-of-day blockout period. This mode is indicated by a flashing decimal point on the digital display. When a 950C is programmed for time-of-day blockout, and a battery is being charged when the blockout period occurs, the programmed end of blockout time will be displayed. This feature can be used to save on energy costs, provide a battery cool down period, or to prevent opportunity charging.

Manual Override of Programmed Start Modes – A standard 950C Control, when programmed for time-of-day start, delayed start, or time-of-day blockout, can be manually overridden by pressing the “Push to Stop/Reset/Review” pushbutton while the start of the charge cycle is being automatically delayed by the control. This manual override feature can be disabled with the use of the programming module. The manual override feature allows the operator to start a charge cycle immediately if a battery is needed sooner than the programmed start time would allow.

Automatic Equalize – The 950C Control can be programmed for two different types of automatic equalize. Standard 950C controls are shipped from the factory programmed to automatically provide an equalize charge to every fifth complete charge cycle. The number of cycles between equalize requests can be varied from 0 to 30. If the 950C is programmed to automatically provide an equalize cycle every zero cycles, then an equalize charge cannot be requested manually and will never be provided automatically.

The second type of automatic equalize mode is when an equalize charge is desired on a particular day of the week. When programmed for automatic equalize by day of week, the 950C will provide an equalize charge to any battery which is connected to the charger on the programmed equalize day. The automatic equalize features allow for the consistent application of equalize charges without constant attention by the operators.

Extended Features – The 950C Control has 32 functions which can be displayed through the use of the review feature or the programming module. See the “Use of the Review Feature” and “Programming Module Functions” chapters of this manual for further details.

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PROGRAMMING THE 950C

A programming module is necessary in order to program the control for the following features:

<u>Function Numbers</u>	<u>Feature</u>
15, 16	Automatic Equalize by other than five cycles
15, 17	Automatic Equalize by day of week
20	DV/DT Disable
21, 26	Time of Day Start
22, 26	Delayed Start
23, 24, 26	Time of Day Blockout
25	Disable Start Mode Override
27	Forming Cycles
28	Disable Low Current Shutdown
29	Push to Start Enable
29	Fault Lockout
30	Change "80% Charged" Trip Point
31	Change Voltage Discrimination Levels

WARNING: Hazardous voltages may be present inside the charger.

To use the programming module, plug one end of the retractable cord into J2 (See Location Diagram included in this manual) and the other end into the programming module. If the programming function number which is to be accessed is 21 or higher, the DIP Switch S1-9 will need to be placed in the "closed" position. S1-9 only needs to be closed while the unit is being programmed and can be returned to the "open" position when programming is complete. It is not required for S1-9 to be returned to the "open" position once a feature has been programmed. When S1-9 is open, the full review stops at function # 20; and when the programming module is being used, functions #21 through #32 cannot be accidentally programmed.

Depress and hold the function switch on the programming module. The number which appears on the digital display while the function button is depressed is the "function" number (see "Programming Module Functions"). Release the function button. The function information is now displayed.

Depress and release the function button until the information for function number 13 is displayed. This is the time of day. While in function number 13, the time of day can be set by holding down the minute and hour buttons (much like a digital clock). The format for time of day in the 950C Control is "military time" (i.e., 09:00 = 9:00 AM and 21:00 = 9:00 PM). Any time that time of day minutes are changed, the time of day seconds are reset to zero.

Depress and release the function button until the information for function number 14 is displayed. This is the day of the week. While in function number 14, the day of the week is set by use of the minute button. The days of the week are represented by numbers with 0 = Sunday, 1 = Monday, - 6 = Saturday.

This information can be reviewed without the use of a programming module through the use of the "Review" feature whenever the model number (950, 951, 952) is on the digital display.

Automatic Equalize by Number of Cycles

In order for automatic equalize to be enabled, S1-8 must be in the "open" position. All standard 950C controls are shipped from the factory with S1-8 in the "open" position. To select automatic equalize by number of cycles, function number 15 should be set to "00" and function number 16 should be set to the desired number of charge cycles which should be completed before the 950C will automatically provide an equalize charge. If the 950C is programmed to automatically provide an equalize cycle every zeroth cycle (function #16 = 00), then an equalize charge cannot be requested manually and will never be provided automatically. Automatic equalize information is kept in permanent memory (EEPROM and will not be lost even in the case of extended AC power failures. Whenever the automatic feature is active (S1-8 in the "open" position), the front panel Equalize switch is disabled.

Automatic Equalize by Day of Week

In order for automatic equalize to be enabled, S1-8 must be in the "open" position. All standard 950C controls are shipped from the factory with S1-8 in the "open" position.

To select automatic equalize by day of week, function number 15 should be set to "01" and function number 17 should be set to the number corresponding to the day of the week that the 950C should automatically provide an equalize charge to any battery connected to the charger on that day. The days of the week are represented by numbers with 0 = Sunday, 1 = Monday, - - 6 = Saturday. Automatic equalize information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures. However, in order to provide the equalize on the proper day, the day of week and time of day need to be programmed correctly. Whenever the automatic equalize feature is active (S1-8 in the "open" position), the front panel Equalize switch is disabled.

Type of Equalize	Function Numbers			S1-8
	15	16	17	
Manual Equalize	X	X	X	Closed
Auto-Equalize By # of Cycles	00	00-30 # of Cycles	X	Open
Auto-Equalize By Day of Week	01	X	00-06 Sun-Sat	Open

Figure 6-1 Equalize Programming Table

DV/DT Disable

The Standard 950C Control utilizes a patented dV/dT technique to terminate the charge cycle. If a voltage-time charge termination is preferred, function number 20 should be set to "01" by pressing the minute button on the programming module once the information for function number 20 has been displayed. When function number 20 has been set to "01", the 950C will terminate the charge cycle three hours after the 80% charged point is reached. Function number 20 information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures. Care should be taken when disabling the dV/dT charge termination feature as excessive gassing and reduced life will be the result if batteries which are less than 60% discharged are connected to the charger.

Setting Time of Day and Day of Week

Depress and hold the function switch on the programming module. The number which appears on the digital display while the function button is depressed is the "function" number (see "Programming Module Functions"). Release the function button. The function information is now displayed. Depress and release the function button until the number 13 is displayed. This is the time of day. While in function number 13, the time of day can be set by holding down the minute and hour buttons (much like a digital clock). The format for time of day in the 950C Control is "military time" (i.e., 09:00 = 9:00 AM and 21:00 = 9:00 PM). Any time that time of day minutes are changed, the time of day seconds are reset to zero. Next, depress and release the function button until the information for function number 14 is displayed. This is the day of the week. While in function number 14, the day of week is set by use of the minute button. The days of the week are represented by numbers with 0 = Sunday, 1 = Monday, - - 6 = Saturday.

This information can be reviewed without the use of a programming module through the use of the "Review" feature whenever the model number (950, 951, 952) is on the digital display.

Time of Day Start

The desired time of day start time should be programmed into function number 21. This time is set in the same manner as time of day. Programming a time into function number 21 does not enable the time of day start feature. Function number 26 will display the programmed start mode. In order to enable time of day start, Function number 26 should be set to a "01". S1-9 must be in the "closed" position to program the 950C for time-of-day start mode. Once the 950C has been programmed for time of day start, S1-9 can be returned to the "open" position. Any time of day, in one minute increments, can be used for the time-of-day start time. This mode is indicated by a flashing decimal point on the digital display. Time of day start information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures. However, time of day will be lost during extended AC fails and in order to start at the proper time, the time of day (Function number 13) needs to be programmed correctly. When the 950C is programmed for time of day start, and a battery is connected to the charger, the programmed start time will be displayed. This time will remain on the display, as long as the battery is left connected to the charger, until that time of day is reached, then the downcount will begin and the 950C will start a normal charge cycle.

Delayed Start

The desired delayed start time period should be programmed into function number 22. This time is set in the same manner as time of day. Programming a time into function number 22 does not enable the delayed start feature. Function number 26 will display the programmed start mode. In order to enable delayed start, function number 26 should be set to a "02". S1-9 must be in the "closed" position to program the 950C for delayed start mode. Once the 950C has been programmed for delayed start, S1-9 can be returned to the "open" position. Any period of time up to 23 hours and 59 minutes, in one minute increments, can be used for the delayed start time. This mode is indicated by a flashing decimal point on the digital display. Delayed start information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures. When the 950C is programmed for delayed start, and a battery is connected to the charger, the programmed delay time will be displayed. This time will decrement once per minute, on the display, as long as the battery is left connected to the charger. When the displayed time reaches zero, the downcount will begin and the 950C will start a normal charge cycle.

Time of Day Blockout

The start of the desired time of day blockout period should be programmed into function number 23. The end of the desired time of day blockout period should be programmed into function number 24. These times are set in the same manner as time of day. Programming times into functions 23 and 24 does not enable the time of day blockout feature. Function number 26 will display the programmed start mode. In order to enable time of day blockout, function number 26 should be set to a "03". S1-9 must be in the "closed" position to program the 950C for time of day blockout mode. Once the 950C has been programmed for time of day blockout, S1-9 can be returned to the "open" position. Any time of day, in one minute increments, can be used for the start and end of the time of day blockout period. This mode is indicated by a flashing decimal point on the digital display. Time of day blockout information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures. However, time of day will be lost during extended AC fails and in order to prevent the charger from running during the desired blockout time period, the time of day (Function number 13) needs to be programmed correctly.

When the 950C is programmed for time of day blockout, and a battery is connected to the charger during the blockout period, the end of blockout time will be displayed. When the end of blockout time is reached, the downcount will begin and the 950C will start a normal charge cycle. If a charge cycle has already started before the blockout period is reached, the charger will automatically turn off at the start of the blockout period and display the end of blockout time. All charge cycle information is retained in battery back-up memory and the charge cycle will resume when the end of the blockout period is reached.

Disabling the Manual Override of Programmed Start Modes

A standard 950C Control, when programmed for time of day start, delayed start, or time of day blockout, can be manually overridden by pressing the "Push to Stop/Reset/Review" pushbutton while the start of a charge cycle is being delayed by the control. This manual override feature can be disabled by programming function number 25 to a "01". S1-9 must be in the "closed" position to change the data in function number 25. Once the 950C has been programmed to Disable the manual override, S1-9 can be returned to the "open" position. Override start mode disable information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures.

Cell Forming Cycles

The 950C Control can be programmed to provide voltage time charge termination and disable the low current shutdown feature for a limited number of charge cycles. The number of cycles programmed into function number 27 will be forming cycles and the number in function number 27 will be decremented each time a charge complete condition is reached. When function number 27 is decremented to zero, the control will return to its previous charge termination technique. DIP switch position S1-9 must be in the "closed" position in order to program function number 27. Once the 950C has been programmed to provide forming cycles, S1-9 can be returned to the "open" position. Forming cycles information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures.

WARNING: Enabling the Finish Cell Forming feature will cause the charger to continue to run for a period of time if the battery has been disconnected before Charge Complete or pressing the Manual Stop switch. This condition will continue until the programmed number of cycles have been completed. The battery should never be disconnected while a charge is in progress.

Low Current Shutdown Disable

The low current shutdown feature of the 950C Control can be disabled by programming a "01" into function Number 28. S1-9 must be in the "closed" position in order to program function number 28. Once the 950C has been programmed to disable the low current shutdown, S1-9 can be returned to the "open" position. Low current shutdown information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures. Caution should be exercised when disabling the low current shutdown feature as the charger will continue to run if a battery is disconnected without first pressing the stop switch when the low current shutdown is disabled. Most battery manufacturers recommend that a minimum current be maintained at the finish of the charge cycle. Disabling the low current shutdown will remove the ability of the 950C Control to notify the user that the finish current is below desirable levels. This feature should only be utilized for troubleshooting and service of batteries.

CAUTION: Care should be exercised when disabling the low current shutdown feature as the charger will continue to run if a battery is disconnected without first pressing the stop switch when the low current shutdown is disabled.

Push-to-Start Operation

Standard 950C controls are shipped from the factory in the automatic start mode, and the charger will start five seconds after the battery is connected. In the push-to-start mode, the charge will not start the charge cycle until the "Push to Start/Reset/Review" pushbutton is pressed. The push-to-start mode is selected by programming function number 29 to a "01".

Function number 29 can only be accessed when S1-9 is in the "closed" position. Once the 950C has been programmed for push-to-start operation, S1-9 can be returned to the "open" position. Push-to-start information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures. The model number displayed will be "951" when this feature has been selected.

Fault Lockout Operation

Fault lockout is enabled by using a programming module to set function number 29 to a "02". S1-9 must be in the "closed" position in order to program function number 29. Once the 950C has been programmed for fault lockout operation, S1-9 can be returned to the "open" position. Fault lockout information is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures. If an abnormal shutdown occurs with the fault lockout feature enabled, disconnecting and reconnecting a battery will not clear the fault condition. The status LEDs will continue to display the fault condition even with no battery connected to the charger until the fault condition is cleared. The "Push to Stop/Reset/Review" pushbutton will clear the fault if it is pressed while a battery is not connected to the charger. When fault lockout is enabled, the model number displayed is "952".

Adjusting the "80% Charged" Trip Point

A standard 950C Control will light the "80% Charged" LED and enable the charge termination routine when the voltage at the battery reaches 2.37 volts/cell. The 80% charged voltage, in volts/cell, is stored in function number 30. The 80% charged point can be digitally adjusted with the use of the programming module from 2.30 V/C to 2.49 V/C. In order to change the 80% charged trip point once the information in function number 30 is displayed, press the minute button on the programming module. S1-9 must be in the "closed" position in order to program function number 30. Once the 950C has been programmed for the new 80% charged trip point, S1-9 can be returned to the "open" position. The 80% charged trip point is kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures.

Battery Voltage Discrimination

A standard 950C Control will not initiate a charge cycle if the open circuit voltage of the battery is less than 1.75 volts/cell or greater than 2.30 volts/cell. The low battery discrimination voltage, in volts/cell, is stored in function number 31.

The low battery discrimination voltage can be digitally adjusted with the use of the programming module from 1.73 V/C to 1.98 V/C. In order to change this level once the information in function number 30 is displayed, press the minute button on the programming module. The high battery discrimination voltage, in volts/cell, is stored in function number 32. The high battery discrimination voltage can be digitally adjusted with the use of the programming module from 2.00 V/C to 2.45 V/C. In order to change this level once the information in function number 30 is displayed, press the minute button on the programming module.

S1-9 must be in the "closed" position in order to program either function number 31 or 32. Once the 950C has been programmed for the new battery voltage discrimination levels, S1-9 can be returned to the "open" position. These levels are kept in permanent memory (EEPROM) and will not be lost even in the case of extended AC power failures.

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TROUBLESHOOTING

AND CHARGE CYCLE DATA ANALYSIS WITH THE 950C CONTROL

It is advisable to read the beginning of this manual before attempting to make use of the following troubleshooting procedures. The increased understanding of the operation of the 950C Control which would be obtained by reviewing the preceding chapters of this manual will be invaluable in the use of the following procedures.

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Manual Stop Indication

Solid Red "Abnormal Shutdown" LED

Probable Cause: "Push to Stop/Reset/Review" pushbutton pressed.

CAUTION: Battery is not fully recharged.

Action: Measure specific gravity of a pilot cell to determine state of charge of battery. Disconnect and reconnect battery to initiate a new charge cycle.

Back-up Timer Indication

Flashing Red "Abnormal Shutdown" LED (Green "Charge Complete" LED off)

Probable Cause # 1: If 0-80% timer (function number 2) equals 9:00, battery did not reach the 80% trip point in 9 hours.

Actions: Check for the following conditions:

1. *One or more low voltage battery cells*
 - 1.1 *"Shorted" cells*
2. *Low charger output*
 - 2.1 *Incorrect line voltage/connection*
 - 2.2 *Blown input fuse*
 - 2.3 *Charge rate set low*
 - 2.4 *Defective resonant capacitor*
 - 2.5 *Defective power transformer*
 - 2.6 *Incorrect cell switch setting on 950C*
 - 2.7 *High resistance in cable or connector*
 - 2.8 *Open rectifier diode*
3. *Ampere hour capacity of battery exceeds that of charger by 50% or greater*

Probable Cause # 2: 80% to charge termination (Function No. 3) equals 5:00 because dV/dT shutoff did not occur within 5 hours after the 80% trip point was reached.

1. *Abnormally high battery counter EMF.*
 - 1.1 *Sulfation on plates*
 - 1.2 *Loose/corroded inter-cell connectors.*
 - 1.3 *Battery # of cells not matched to charger*
2. *Incorrect cell switch setting on 950C.*

Low Current Shutdown Indication

Flashing Red "Abnormal Shutdown" LED Solid Green "Charge Complete" LED

Probable Cause: Low Output Current Shutdown

1. *Battery # cells greater than charger cell rating.*
2. *Battery ampere hour much less than charger ampere hour rating,*
3. *High resistance in charge circuit*
 - 3.1 *Cable*
 - 3.2 *Connector*
 - 3.3 *Inter-cell Connectors*
 - 3.4 *Open Battery Cells*
4. *Sulfated Battery*
5. *Low Electrolyte level*
6. *Charger Rate incorrectly set*
7. *Blown input fuses*
8. *Incorrect line voltage/connections*
9. *Open rectifier diode*
10. *Open resonant capacitor*
11. *Defective power transformer*
12. *Blown output fuse*
13. *950C DIP switches (ammeter range select)*

Low Battery Voltage Indication

Flashing Red "Abnormal Shutdown" LED Flashing Yellow "Equalize" LED

Probable Cause # 1: Battery number of cells is less than rated charger number of cells.

Action: Disconnect the battery from the charger and connect to a charger with the same number of cells rating as the battery.

Probable Cause # 2: Battery is over discharged and has an open circuit terminal voltage of less than the low voltage discrimination setting (1.75 volts/cell).

Action: Confirm that the battery matches the rating of the charger and that none of the battery cells are defective. If it is desired to start the charge cycle on this low voltage battery, then hold both the "Push to Stop/Reset/Review" and "Push to Equalize" pushbuttons for at least 1 second. The 950C will ignore the low battery indication and start the charge cycle.

Probable Cause # 3: Battery has shorted or reversed cells.

Action: Disconnect the battery from the charger and refer to qualified battery service personnel.

Probable Cause # 4: DIP switch settings on the 950C Control are incorrect.

Action: Set the 950C DIP switch (S1) according to the "Initial Set-Up" chapter in this manual.

High Battery Voltage Indication

Flashing Green "Charge Complete" LED

Flashing Red "Abnormal Shutdown" LED

Flashing Yellow "Equalize" LED

Probable Cause # 1: Battery number of cells is greater than rated charger number of cells.

Action: Disconnect the battery from the charger and connect to a charger with the same number of cells rating as the battery.

Probable Cause # 2: Battery was just removed from a charger and has an open circuit terminal voltage greater than the high voltage discrimination setting (2.30 volts/cell).

Action: Confirm that the battery matches the rating of the charger and that none of the battery cells are defective. If it is desired to start the charge cycle on this battery, then all that needs to be done is to wait. The battery voltage will decay to within the voltage discriminator's window in less than 1-2 minutes.

Probable Cause # 3: DIP switch settings on the 950C control are incorrect.

Action: Set the 950C DIP switch (S1) according to the "Initial Set-up" chapter in this manual.

950C Does Not Respond to Battery

No change in indication when battery is connected.

Probable Cause # 1: Battery open circuit voltage is less than 5 volts.

Action: Use the 'full review' feature and note the battery open circuit voltage (function # 18). If it reads between 1 and 5 volts, disconnect the battery from the charger and refer to qualified battery service personnel.

Probable Cause # 2: Lack of continuity in the charging cables or inter-cell connectors.

Action: Use the 'full review' feature and note the battery open circuit voltage (function # 18). If function number 18 is less than 1 volt, determine the cause of loss of continuity and repair/replace appropriate components.

Low Back-up Battery Indication

Flashing Digital Display

Probable Cause # 1: 950C Nickel Cadmium memory battery has been depleted by lack of AC power to charger for a period longer than 30 days.

Action: Clear flashing display by pressing the "Push To Equalize" switch on the front panel for two seconds while no battery is connected to the charger

NOTE: All charge cycle data, as well as time of day and day of week, has been lost and time and day will need to be reprogrammed if necessary for selected features. AC power should be present at the charger fuse block for 2-3 days in order to bring the Ni-Cad to a full state of charge.

Probable Cause # 2: 950C Nickel Cadmium memory battery is defective.

Action: Clear flashing display by pressing the "Push To Equalize" switch on the front panel for two seconds while no battery is connected to the charger.

NOTE: All charge cycle data, as well as time of day and day of week, has been lost and time and day will need to be reprogrammed if necessary for selected features. AC power should be present at the charger fuse block for 2-3 days in order to bring the Ni-Cad to a full state of charge. Then remove AC power from the charger for 1 to 24 hours. When AC power is re-connected to the charger, the digital display should not be flashing.

AC Power Fail Indication

Blank Digital Display

Probable Cause # 1: AC Power Fail

Action: Reapply AC power to Charger

Probable Cause # 2: Blown Fuse (s)

1. Input Line Fuse
2. Control Transformer Fuse

WARNING: Hazardous voltages may be present inside the charger. Refer maintenance to qualified service personnel.

Action: Determine cause of excess current and replace fuse with one of proper rating.

Probable Cause # 3: Control Transformer/Wiring.

WARNING: Hazardous voltages may be present inside the charger. Refer maintenance to qualified service personnel.

Action: Determine point at which power is lost and repair or replace components as necessary.

Battery Has Low Specific Gravity

(S. G. Readings not within Manufacture's nameplate rating at completion of charge cycle)

Probable Cause No. 1: S. G. readings are not temperature corrected.

Action: Temperature correct specific gravity readings using rule of thumb; + 1 S. G. point per 3 degrees F increase, from 77 degrees F

Probable Cause # 2: Battery specific gravity is not capable of being returned to within manufacturer's limits.

Action: Perform an equalize charge on the battery. Record the temperature corrected specific gravity readings. Initiate another equalize charge cycle and continue until the S. G. readings no longer rise over a 1/2 hour period. This is the maximum specific gravity potential of the battery. If this is not within the manufacturer's limits, some amounts of electrolyte may have been spilled or boiled out of the cells. It is also possible that the maximum possible specific gravity of this particular battery was never within the manufacturer's limits.

Probable Cause # 3: Charger output adjustment taps not set to provide proper finish rates.

Action: Use the review feature to verify that function numbers 7 (Finish Current) and 8 (Finish Volts/Cell) are within desirable limits. See section on incorrect finish rates in this chapter

Probable Cause # 4: 950C did not reach a "normal" charge complete.

Action: Use the review feature to verify that function number nine is equal to "01" (normal charge termination).

See "Programming Module Functions" for a description of charge termination (function # 9) codes. If the 950C did not reach a normal charge complete, refer to the appropriate fault shutdown procedure in this section of this manual.

Probable Cause # 5: AC input power is not within NEMA $\pm 10\%$ limits or AC input taps are set incorrectly.

Action: Use the review feature to verify that function numbers 7 (Finish Current) and 8 (Finish Volts/Cell) are within desirable limits. See section on incorrect finish rates in this chapter

Probable Cause # 6: Battery has not been provided with sufficient equalize cycles.

Action: Program the 950C control to automatically provide equalize charges at the desired frequency

Battery Doesn't Last (Power Truck) for Entire Shift

Probable Cause # 1: Faulty lift interrupt

Action: Record the battery specific gravity prior to charge using a hydrometer. If a hydrometer is not available, use the review feature to determine the battery open circuit voltage. The battery open circuit voltage is recorded after the 5 second downcount and prior to the charger being energized. Once the battery voltage has stabilized (stopped changing), the specific gravity can be estimated (if the electrolyte temperature is known) from the battery open circuit voltage (See Figure 7-1). The voltage versus specific gravity relationship depicted in Figure 7-1 is only applicable to open circuit conditions (no load and no charging current). Once load is removed (battery disconnected from truck), the battery voltage will increase for some period of time. Programming the 950C Control for a delayed start of 30 minutes should allow sufficient time for the battery open circuit voltage to stabilize. Use the graph of Figure 7-1 to estimate average specific gravity prior to charge. If the battery is being removed from the truck prior to reaching the desired state of discharge (S. G. level) due to a signal from the lift interrupt, then the lift interrupt should be adjusted.

Probable Cause # 2: The number of ampere-hours required to complete a shift is greater than the ampere-hour rating of the battery.

Action: Use a portable battery monitor to record the number of ampere hours necessary in a typical shift's work. The ampere hour rating of the battery should exceed that total by at least 20 percent. If a portable battery ampere hour accumulator is not available, and the battery open circuit voltage prior to charge indicates that it is fully discharged, and the specific gravity readings after charge indicate that it is fully charged, note the ampere hours returned during the charge cycle through the use of the review feature (function # 1). The ampere hours returned during the charge cycle is approximately 107% of the ampere hours removed from the battery during discharge. If the estimated number of ampere hours delivered by the battery is within the manufacturer's rating, and the truck is Operating properly, then a battery with a larger ampere hour rating should be used.

Probable Cause # 3: The battery is not capable of providing its nameplate rating of ampere hours.

Action: If the battery open circuit voltage prior to charge indicates that it is fully discharged, and the specific gravity readings after charge indicate that it is fully charged, note the ampere hours returned during the charge cycle through the use of the review feature (function # 1). The ampere hours returned during the charge cycle is approximately 107% of the ampere hours removed from the battery during discharge. If the estimated ampere hours provided by the battery during discharge is unacceptable, the battery should be removed from the application for service.

Probable Cause # 4: The 950C did not terminate the charge cycle normally.

Action: Use the review feature to verify that function number 9 is "01", and if not, follow the steps outlined in this chapter for the applicable fault shutdown. See "Programming Module Functions" on page 9-1 for a description of charge termination (function # 9) codes.

Battery Water Usage Is Too High

Probable Cause # 1: Charger output rates have been set too high.

Action: Use the review feature to verify that function numbers 7 (Finish Current) and 8 (Finish Volts/Cell) are within desirable limits. See section on incorrect finish rates in this chapter

Probable Cause # 2: Battery is being "Equalized" too often.

Action: Program the 950C to automatically provide an equalize charge either by number of cycles, or by day of week.

Probable Cause # 3: 950C is programmed for voltage time charge termination.

Action: In applications where the batteries are discharged less than 60% of their manufacturers nameplate rating when connected to the charger, voltage-time charge termination is not recommended.

Probable Cause # 4: 950C is programmed to provide forming cycles.

Action: In applications where the batteries are discharged less than 60% of their manufacturers nameplate rating when connected to the charger, voltage-time charge termination, which is automatically provided during forming cycles, will cause excessive water usage.

Battery Temperature Is Too High

Probable Cause # 1: Battery is not allowed a sufficient cool down period between uses.

Action: The temperature of the battery will increase during both the charge and discharge cycles. Most battery manufacturers warn against using their batteries when the electrolyte temperature is greater than 110-115 degrees Fahrenheit. Utilizing batteries with elevated electrolyte temperatures will greatly reduce the life of the battery. If the battery is not allowed a sufficient cool down period between cycles, then the temperature rises become accumulative and will be excessive after only a few charge/discharge cycles.

Probable Cause # 2: Charger output rates have been set too high.

Action: Use the review feature to verify that function numbers 7 (Finish Current) and 8 (Finish Volts/Cell) are within desirable limits. See section on incorrect finish rates in this chapter.

Probable Cause # 3: The power demand of the battery application is excessive.

Action: Qualified battery service personnel should be contacted to determine if the battery is capable of providing the power being demanded by its application without adversely increasing its internal temperature.

Probable Cause #4: Battery is being "Equalized" too often.

Action: Program the 950C to automatically provide an equalize charge either by number of cycles, or by day of week. While periodic equalize charges are recommended, a battery should not be equalized more than once per week.

Probable Cause # 5: 950C is programmed for voltage-time charge termination.

Action: In applications where the batteries are discharged less than 60% of their manufacturer's nameplate rating when connected to the charger, voltage-time charge termination is not recommended.

Low Number of Ampere Hours Returned To The Battery

(950C function # 1 is lower than desired after a complete charge cycle)

Probable Cause # 1: Battery was connected to the charger before it was adequately discharged.

Action: In order to get the maximum use from a lead-acid battery, it should be discharged to approximately 80% of its nameplate capability before it is recharged. For example, a 1050 ampere hour battery which is discharged 10% of its rating should last for 2000 cycles, 40% of its rating should last for 1625 cycles, 80% of its rating should last for 1250 cycles. This means that the 10% discharged battery produces approximately 210 thousand ampere hours of service, the 40% discharged battery produces approximately 682 thousand ampere hours of service, and the 80% discharged battery produces approximately 1 million ampere hours of service throughout its wet life. Truck lift interrupts can be used to insure that the battery is 80% discharged before it is removed from the truck to be charged.

Probable Cause No. 2: Faulty Lift Interrupt

Action: Record the battery specific gravity prior to charge using a hydrometer. If a hydrometer is not available, use the review feature to determine the battery open circuit voltage. The battery open circuit voltage is recorded after the 5 second downcount and prior to the charger being energized. Once the battery voltage has stabilized (stopped changing), the specific gravity can be estimated (if the electrolyte temperature is known) from the battery open circuit voltage (see Figure 7-1). The voltage versus specific gravity relationship depicted in Figure 7-1 is only applicable to open circuit conditions (no load and no charging current). Once load is removed (battery disconnected from truck), the battery voltage will increase for some period of time. Programming the 950C Control for a delayed start of 30 minutes should allow sufficient time for the battery open circuit voltage to stabilize. Use the graph of Figure 7-1 to estimate average specific gravity prior to charge. If the battery is being removed from the truck prior to reaching the desired state of discharge (S. G. level) due to a signal from the lift interrupt, then the lift interrupt should be adjusted.

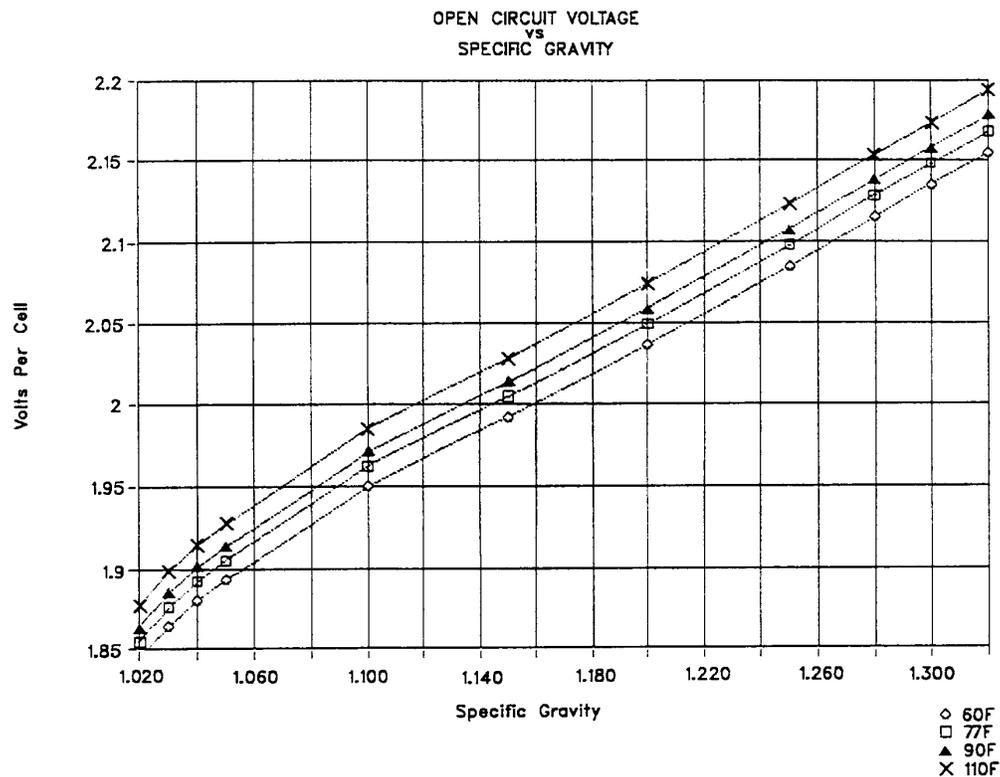


Figure 7-1

Probable Cause # 3: The battery is not capable of providing its nameplate rating of ampere hours.

Action: If the battery open circuit voltage prior to charge indicates that it is fully discharged, and the specific gravity readings after charge indicate that it is fully charged, note the ampere hours returned during the charge cycle through the use of the review feature (function # 1). The ampere hours returned during the charge cycle is approximately 107% of the ampere hours removed from the battery during discharge. If the estimated ampere hours provided by the battery during discharge is unacceptable, the battery should be removed from the application for service.

Probable Cause # 4: The 950C did not terminate the charge cycle normally.

Action: Use the review feature to verify that function number 9 is "01 ", and if not, follow the steps outlined in this chapter for the applicable fault shutdown. See "Programming Module Functions" on page 9-1 for a description of charge termination (function # 9) codes.

Incorrect Finish Rates

Prestolite Power recommends that the finish rates of taper chargers be set from 2.5 to 3.5 Amps/100AH at 2.50 to 2.56 Volts/Cell. The nominal finish rate is 3.33 amps/1 00 AH at 2.52 Volts/Cell. NEMA standard IB6 states that the finish output current shall not exceed 5 amperes for each 100 ampere hours of the rated ampere hour capacity of the battery. Various technologies of batteries may require different finish rates and Prestolite Accu-Chargers can be adjusted to raise or lower the charger output. Too high a setting may cause increased water usage and higher charging temperatures and too low a setting may lead to low current shutdowns and batteries which are not completely charged. The 950C Control records the finish current (function # 7) and finish volts per cell measured at the control (function # 8) when the charger quits flowing current to the battery. The standards noted above are for charge cycles which end in a normal charge complete mode.

Finish Rates Too Low

Once the desired finish rates have been determined, and the chargers adjusted accordingly, one or more of the following conditions may result in a drop in finish current.

1. *Battery # cells greater than charger cell rating.*
2. *High resistance in charge circuit*
 - 2.1 *Cable*
 - 2.2 *Connector*
 - 2.3 *Inter-cell Connectors*
3. *Sulfated battery*
4. *Low electrolyte /eve/*
5. *Charger rate incorrectly set too low*
6. *Blown input fuses*
7. *Incorrect line voltage/connections*
8. *Open rectifier diode*
9. *Open resonant capacitor*
10. *950C DIP switches (ammeter range select) set incorrectly.*

Finish Rates Too High

Once the desired finish rates have been determined, and the chargers adjusted accordingly, one or more of the following conditions may result in an increase in finish current.

1. *Battery # cells less than charger cell rating.*
2. *Charger rate incorrectly set too high.*
3. *Incorrect line voltage/connections*
4. *Battery has a "shorted " cell.*
5. *950C DIP switches (ammeter range select) set incorrectly.*

Incorrect Start Rates

Prestolite Power recommends that the start rates of taper chargers be set from 18 to 22 amps/100AH at 2.13 Volts/Cell. The nominal start rate is 20 amps/100 AH at 2.13 Volts/Cell. NEMA standard IB6 states that the charger output current shall not exceed a value which will cause an increase in battery temperature of more than 30 degrees fahrenheit during the charge cycle. Too high a setting may cause higher charging temperatures and too low a setting will lead to longer charging times. The 950C Control will record start current (function # 5) and start volts per cell measured at the control (function # 6) when the battery reaches 2.13 volts per cell, but will not record start data until a minimum of 3 seconds after the charger has started flowing current to the battery.

Start Rate Too Low

1. *Battery # cells greater than charger cell rating.*
2. *High resistance in charge circuit*
 - 2.1 *Cable*
 - 2.2 *Connector*
 - 2.3 *Inter-cell connectors*
3. *Sulfated battery*
4. *Charger rate incorrectly set too low*
5. *Blown input fuse*
6. *Incorrect line voltage/connections*
7. *Open rectifier diode*
8. *Open resonant capacitor*
9. *950C DIP switches (ammeter range select) set incorrectly.*

Start Rate Too High

1. *Charger rate incorrectly set too high.*
2. *Incorrect line voltage/connections*
3. *950C DIP switches (ammeter range select) set incorrectly.*

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USE OF THE 950C "REVIEW" FEATURE

Various information is constantly maintained in "memory" in the 950C Control. This information can be separated into three categories and is stored in one of two types of memory. The categories are standard review, full review, and extended review. This information can be accessed without the use of a programming module any time the model number is on the digital display (950, 951, 952) except when a "push-to-start" is pending. The review cycle can be accessed any time that a battery is not connected to the charger. The information from the last charge cycle is maintained until a new battery is connected to the charger. To activate the standard review cycle, simply press the "Push to Stop/Reset/Review" pushbutton. The control will automatically display each function number, followed by its respective data, until the first 9 functions have been displayed. In addition, all status LEDs will be illuminated during the display of function number 1 and its data, providing a lamp test feature.

This is the "standard" review. Any review can be ter-

minated by pressing the "Push to Stop/Reset/Review" pushbutton while the review cycle is in progress (except when review is displaying functions 9 or 10).

In order to access the data in functions 10 through 20, the "Push to Stop/Reset/Review" pushbutton should be pressed and held while the information for function number 9 is being display. Once function number 10 appears on the display, the pushbutton should be released. The information in functions 10 through 20 will now be displayed. This is the "full" review. If the full review is enabled, and S1-9 is in the "closed" position, the information in functions 21 through 32 will be displayed. This is the "extended" review.

For a description of information by function number, including the type of memory each function utilizes, see "Programming Module Functions" on page 9-1 of this manual.

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PROGRAMMING MODULE FUNCTIONS

<u>Function</u>	<u>Description</u>	<u>Memory</u>
<u>Standard Review</u>		
0	Normal Display	N/A
1	Amp-Hours Returned	BBR
2	Start to 80% Time	BBR
3	80% to dv/dt Time	BBR
4	Battery Open Circuit Voltage	BBR
5	Start Current	BBR
6	Start Volts/Cell	BBR
7	Finish Current	BBR
8	Finish Volts/Cell	BBR
9	Charge Termination Code	BBR
	00 - Charger Running	
	01 - Normal Charge Complete	
	02 - Low Current Shutdown	
	03 - Manual Stop	
	04 - Battery Disconnect	
	05 - Back-up Timer, 0-80%	
	06 - Back-up Timer, 800/o-CT	
 <u>Full Review</u>		
10	Time in Equalize	BBR
11	Start of Charge (TOD)	BBR
12	End of Charge (TOD)	BBR
13	Time of Day	BBR
14	Day of Week (0= Sunday)	BBR
15	Type of Auto-Equalize	EE
	00 - AE By # of Cycles	
	01 - AE By Day of Week	
16	Auto-Equalize Count	EE
17	Auto-Equalize Day	EE
18	Battery Voltage	N/A
19	Status Code (Factory Use Only)	BBR
20	DV/DT Disable	EE
	00 - DV/DT	
	01 -Voltage Time	

<u>Function</u>	<u>Description</u>	<u>Memory</u>
<u>Extended Review</u>		
21	Time of Day Start	EE
22	Delayed Start	EE
23	Start of Blockout	EE
24	End of Blockout	EE
25	Override Start Mode	EE
26	Start Mode	EE
	00 - Normal Start Mode	
	01 - Time of Day Start	
	02 - Delayed Start	
	03 - Time of Day Blockout	
27	Forming Cycles	EE
28	Low Current Disable	EE
29	Special Options - PTS, FL	EE
	00 - Normal	
	01 - PTS	
	02 - FL	
30	80% Charged Voltage	EE
31	Low Battery Level	EE
32	High Battery Level	EE

N/A - Not Applicable; this data is not stored.

BBR - This data is stored in Battery Backed-up RAM (Min. - 1 Month).

EE - This data is stored in EEPROM (Min. - 10 Years).

PARTS LIST

(See Illustration)

<u>ITEM</u>	<u>PART NUMBER</u>
950C Control	See Back of Control Panel
Main P.C. Board	Printed on P.C. Board
Harness	191303
Programming Module	398220-1
Back Label for Programming Module	191428

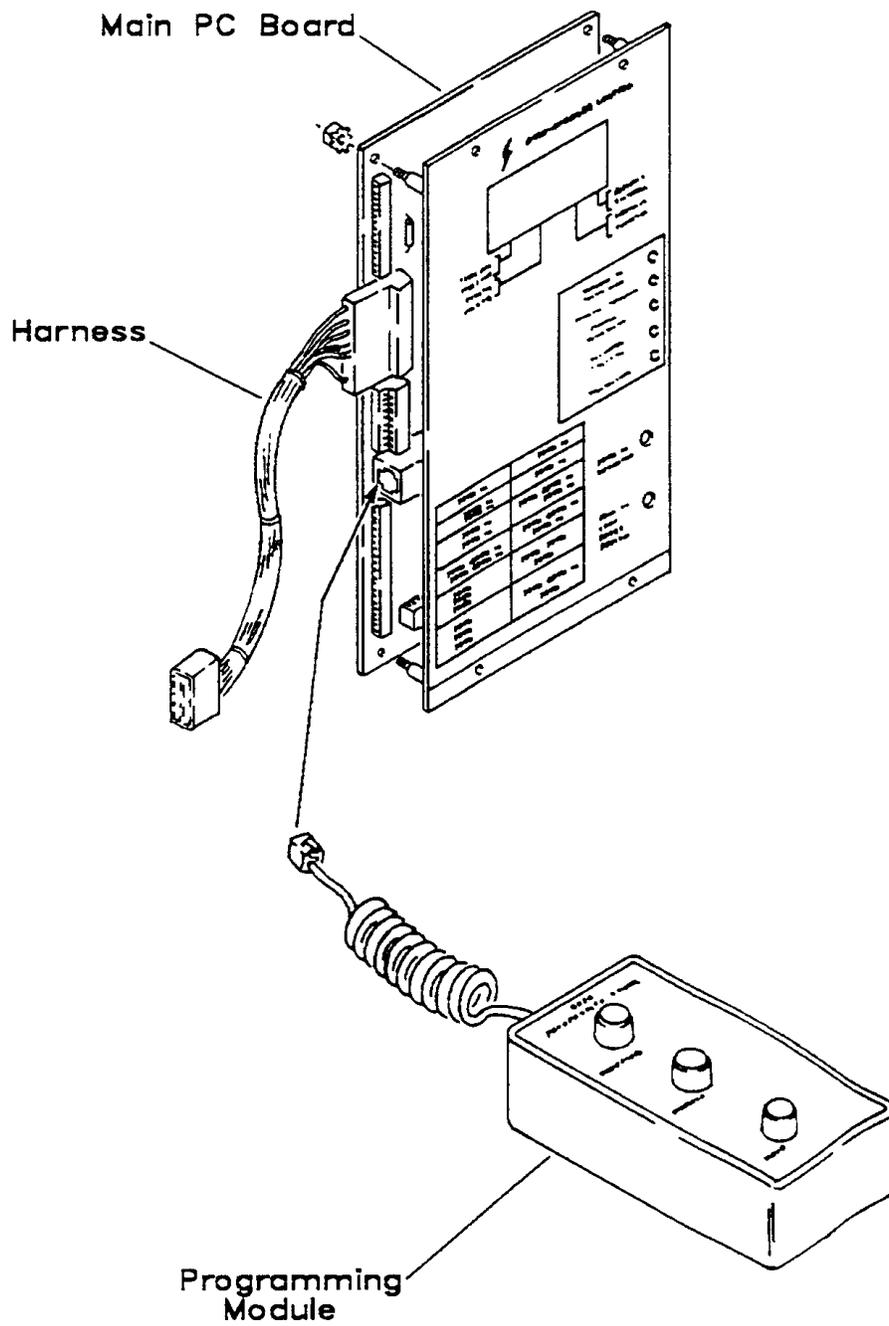
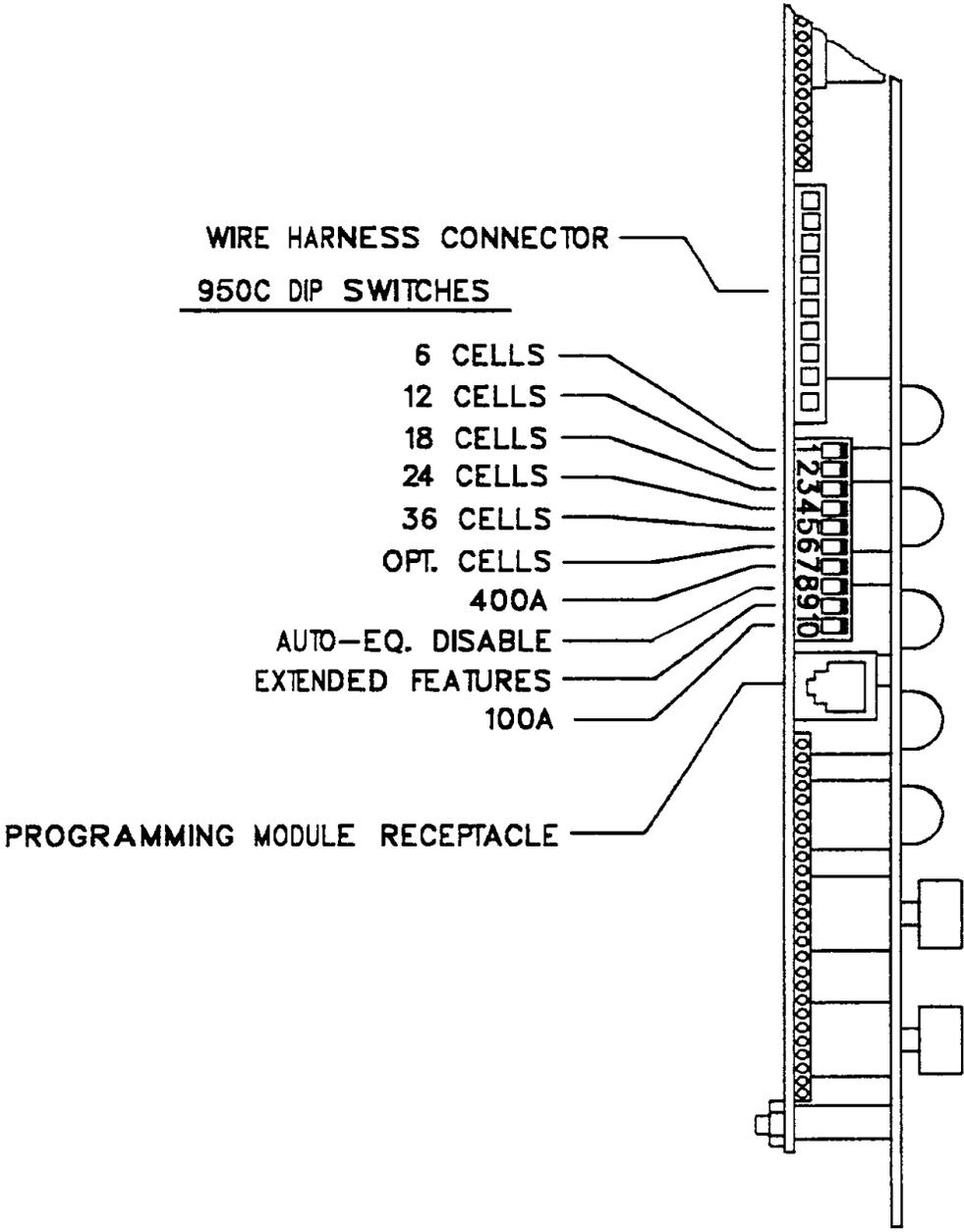


Figure 10-1 950C Charge Control

LOCATION DIAGRAM – 950C CONTROL



REFERENCES

- (1) STORAGE BATTERIES, George Vinal,
John Wiley & Sons, New York, 1955
- (2) THE GOULD BATTERY HANDBOOK, Gustav Mueller,
Gould, St. Paul, MN, 1973
- (3) HANDBOOK OF BATTERIES AND FUEL CELLS, David Linden
McGraw Hill, 1984
- (4) NEMA STANDARD IB6, MATERIAL HANDLING BATTERY CHARGERS
NEMA, Washington, D.C., 1983

ELECTRONIC PRINTED CIRCUIT BOARD EXCHANGE SERVICE POLICY

Because of the definite superiority of certain solid-state control components over conventional electro-mechanical relays and regulators, the company product lines now incorporate solid-state controls for applications in which they may be used to advantage. To facilitate testing and servicing, these control components and circuits have been assembled as modules on printed circuit boards, mounted in such a manner as to be quickly and easily removed. Electrical connections to other components of the unit are by means of plug-in, screw type, or "Faston" connectors.

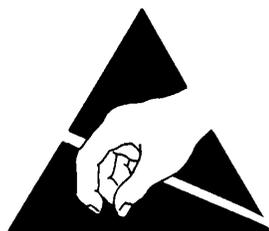
In recognition of the fact that most users of this equipment lack the facilities and specially trained personnel necessary to service and repair electronic equipment, the company has established an electronic printed circuit board exchange service plan.

Under the Printed Circuit Board Exchange Plan, the owner of the equipment may exchange the printed circuit board (s) in which fault has developed for a replacement.

A standard exchange price has been established for

each printed circuit board without regard to the amount of repair required to the original turned in, which is applied against the cost of the replacement. Exchange prices for a specific printed circuit board may be determined by contacting an authorized company distributor or by writing to the factory, giving the SPECIFICATION or ASSEMBLY, MODEL, and SERIAL numbers of the unit in which the printed circuit board is installed.

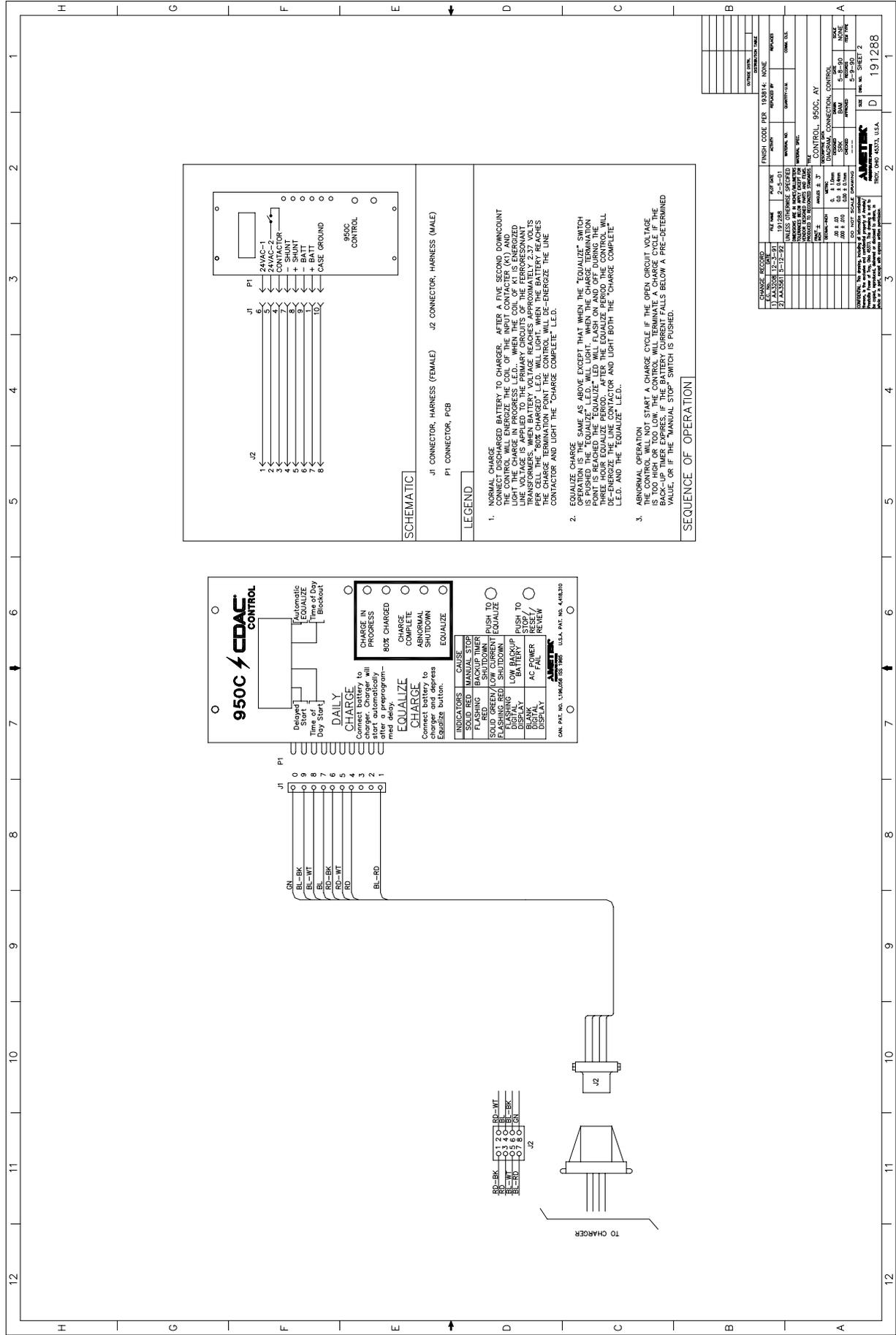
This Exchange Plan applies only to the specified solid-state control components circuitry which have failed due to electrical fault or normal deterioration resulting from use and age. The plan does not cover parts which have been physically damaged through accident or abuse, or to which unauthorized repairs have been made or attempted.



CAUTION: Printed circuits and other devices may be affected by static electricity. Handling precautions required.

DIAGRAMS

	CONNECTION DIAGRAM
STANDARD 950C	191288 Sheet 2
REMOTE 950C	191143



950C CONTROL

Delayed Start
 Automatic Equalize Times of Day
 Daily Start Backup

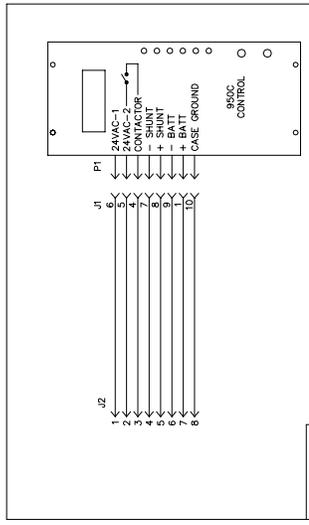
DAILY CHARGE
 Connect battery to charger. Charger will start automatically after programmed delay.

EQUALIZE CHARGE
 Connect battery to charger and depress Equalize button.

INDICATORS

INDICATORS	CAUSE
SOLID RED	MANUAL STOP
FLASHING RED	BACKUP TIMER
SOLID GREEN/LOW CURRENT	FLUSH TO EQUALIZE
FLASHING RED/SHUTDOWN	EQUALIZE
DIGITAL DISPLAY	LOW BACKUP
BLANK DISPLAY	AC POWER FAIL
DISPLAY	AC POWER REVIEW

U.S. PAT. NO. 4,494,310
 CAN. PAT. NO. 1,196,288



- LEGEND**
- NORMAL CHARGE**
 Connect battery to charger. After a five second countdown the control will energize the coil of the input contactor (K1) and light the charge in progress LED. When the coil of K1 is energized the transformer is energized and the battery voltage reaches approximately 2.37 volts per cell. The "80% CHARGED" LED will light. When the battery reaches approximately 2.37 volts per cell the control will de-energize the line contactor and light the "CHARGE COMPLETE" LED.
 - EQUALIZE CHARGE**
 Same as above except that when the "EQUALIZE" switch is pushed the "EQUALIZE" LED will light. When the charge termination point is reached the "EQUALIZE" LED will flash on and off during the equalization process. When the equalization process is complete the "EQUALIZE" LED and the "EQUALIZE" LED will de-energize the line contactor and light both the "CHARGE COMPLETE" LED and the "EQUALIZE" LED.
 - ABNORMAL OPERATION**
 The control will not start a charge cycle if the open circuit voltage is too high or too low. The control will terminate a charge cycle if the backup timer expires. If the battery current falls below a pre-determined value, or if the manual stop switch is pushed.

SEQUENCE OF OPERATION

CHARGE RECORD	FILE NAME	FILE DATE	FINISH CODE	REV	REVISION	DATE
1	131256	7-2-61				
2	131256	7-2-61				
3	131256	7-2-61				
4	131256	7-2-61				
5	131256	7-2-61				
6	131256	7-2-61				
7	131256	7-2-61				
8	131256	7-2-61				
9	131256	7-2-61				
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98	131256	7-2-61				
99	131256	7-2-61				
100	131256	7-2-61				

CONTROL, 950C, AT
 DIAGRAM CONNECTION, CONTROL
 SHEET NO. SHEET 2

WARRANTY

AMETEK/PRESTOLITE POWER INDUSTRIAL BATTERY CHARGERS

Ametek/Prestolite Power (hereinafter called "Prestolite") warrants that each new and unused Industrial Battery Charger manufactured and supplied by it is of good workmanship and is free from any inherent mechanical defects, provided that (1) the product is installed and operated in accordance with generally accepted industrial standards and in accordance with the printed instructions of Prestolite, (2) the product is used under normal conditions for which designed, (3) the product is not subjected to misuse, negligence or accident, and (4) the product receives proper care, protection and maintenance under supervision of competent personnel. This warranty is subject to the following provisions:

1. **PRODUCTS AND PARTS WARRANTED.** Subject to the exceptions listed below each Industrial Battery Charger is warranted for a period of one (1) year from the date of its shipment by Prestolite, provided the charger is used in accordance with Prestolite's published performance rating for the unit involved. The exceptions to this warranty are as follows:
 - a) Power transformers and silicon diodes on unit (s) shipped after January 1, 1997 are warranted for ten (10) years after Prestolite's shipment of the unit(s) of which they are a part, provided however that during the last nine (9) years of this 10 year period the warranty covers parts replacement only – no labor or other services are provided by Prestolite, nor shall Prestolite be obligated to reimburse the owner or any other person for any work performed.
 - b) Primary switch contacts, fuses, bulbs, and filters are not warranted unless found to be defective prior to use.
2. **COMMENCEMENT OF WARRANTY TIME PERIODS.** The warranty periods indicated in the Warranty Schedule shall commence on the date of shipment by Prestolite.
3. **PERSONS COVERED BY WARRANTY.** This warranty is extended by Prestolite only to the purchaser of new equipment from Prestolite or one of its authorized distributors. The products purchased under this agreement shall be used exclusively by the buyer and its employees and by no other persons; and therefore there shall be no third party beneficiary to this warranty.
4. **LIMITATION OF REMEDY.** The existence of claimed defects in any product covered by this warranty is subject to Prestolite's factory inspection and judgement. Prestolite's liability is limited to repair of any defects found by Prestolite to exist or, at Prestolite's option, the replacement of the defective product. F.O.B. factory after the defective product has been returned by the purchaser at its expense to Prestolite's shipping place. Replacement and exchange parts will be warranted for the remainder of the original Industrial Battery Charger Warranty or for a period of ninety (90) days, whichever is greater.

Prestolite and its authorized distributors or dealers shall not be liable for direct or indirect, special or consequential damages in excess of such repair or replacement. In no event shall the purchaser be entitled to recover for contingent expenses resulting from, but not limited to, telephone calls, telegrams, travel expenses, lodging, duties and taxes, labor, rental or replacement equipment, loss of business or profits or other commercial losses.
5. **USE OF DEFECTIVE PRODUCT.** Continued use of an Industrial Battery Charger after discovery of a defect VOIDS ALL WARRANTIES.
6. **ALTERED EQUIPMENT.** Except as authorized in writing, the warranty specified does not cover any equipment that has been altered by any party other than Prestolite.

EXCEPT AS STATED ABOVE, ALL OTHER WARRANTIES AND CONDITIONS, EITHER EXPRESSED OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXCLUDED AND BUYER ASSUMES ALL RISK AND LIABILITY RESULTING FROM USE OF THE GOODS. AMETEK/PRESTOLITE POWER NEITHER ASSUMES NOR AUTHORIZES ANY PERSONS TO ASSUME FOR AMETEK/PRESTOLITE POWER ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OR USE OF THE GOODS SOLD, AND THERE ARE NO ORAL AGREEMENTS OR WARRANTIES COLLATERAL TO OR AFFECTING THIS WRITTEN WARRANTY.

WARNING

At all times, safety must be considered an important factor in the installation, servicing, and operation of the product, and skilled, qualified technical assistance should be utilized.

AMETEK/PRESTOLITE POWER
TROY, OHIO USA

Data Sheet: 1140
Index: 110100
Replaces: 082499


PRESTOLITE POWER

