

OWNER'S MANUAL 193111-019

Revised January 26, 2001

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

SC1000 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 as instructed in the Maintenance chapter of this manual. Replace any precautionary or instruction label that cannot be easily read.

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.

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 SC1000 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 SC1000 Control in the "on" position.

S2-1	6 Cells
S2-2	12 Cells
S2-3	18 Cells
S2-4	24 Cells
S2-5	36 Cells
S2-6	Optional Cell Size (Requires unique part number Control PC board)

Only one of the above DIP switches should be in the "on" 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 S1-1 and S1-2 as follows:

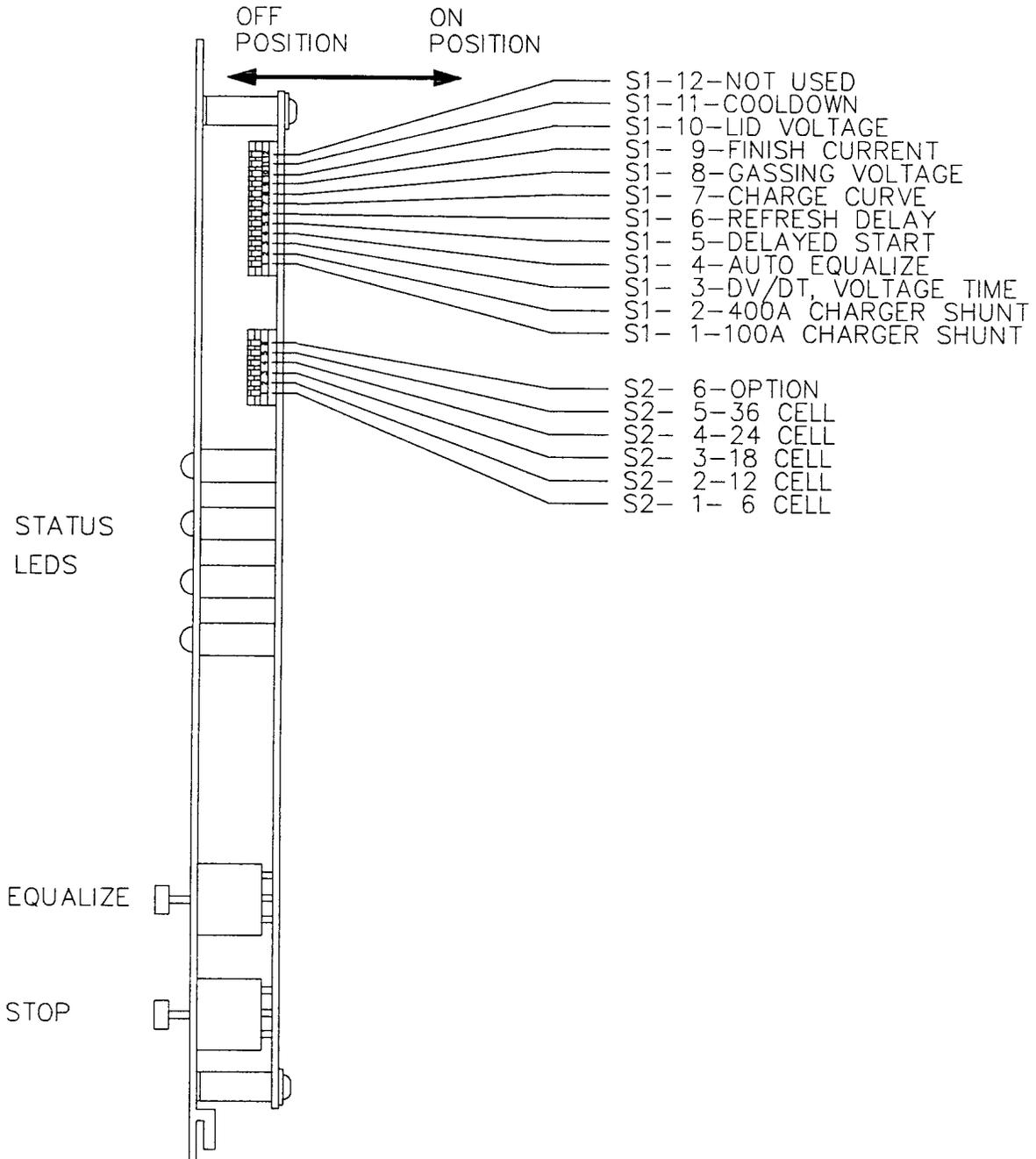
DC Output per Circuit Max. Amps	S1-1	S1-2	Full Scale Current
0 – 80	ON	OFF	100
81 – 176	OFF	OFF	200
177 – 340	OFF	ON	400

Charge Termination Selection

S1-3	OFF – DV/DT
S1-3	ON – Voltage Time

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LOCATION DIAGRAM – SC1000 CONTROL



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OPERATION

The operating procedure given here explains the operation of a Prestolite Terminator Charger equipped with the Prestolite SC1000 Control.

Preliminary

1. Make sure that charger is installed and grounded as instructed in this manual.
2. Turn on main fused disconnect switch that supplies AC power to charger.
3. Maintain electrolyte level in batteries to be charged, as instructed by battery manufacturer. The volume of electrolyte will expand during the charge. Therefore, to avoid overfilling, do not add water until the battery has received at least an 80% charge. This will usually be reached at the time gassing starts.

Normal or Daily Charge

1. Insure that battery size matches the charger (Number of cells and ampere-hour capacity is within charger nameplate information).
2. Insure that battery type matches the charger setting. When no battery is connected, the charger displays one of the codes below to indicate the current battery type setting.

FLd	Standard Flooded Lead Acid Type Batteries
CUS	Programmable Custom Curve Values
dSL	Sealed Gel Batteries (Deka Dominator)
SLA	AGM Type Sealed Batteries

3. Connect AC power to charger.
4. Connect the battery to the charger.
5. After a 5 second downcount, the charger will turn on and the "Charge in Progress" LED will light.

The display will indicate output current only for the first 12 seconds of the charger. After this period, the display reading will alternate between charger output current and output volts/cell.

6. The "80% Charged" LED will light when the battery voltage has reached the gassing point (Standard = 2.40 volts/cell).
7. When the charge termination point is reached, the charger will turn off. The "Charge Complete" LED will be on and the "Equalize" LED will be on if this was an equalize charge.

Equalize or Weekend Charge

Batteries may need periodic equalizing to correct for inequalities between cells that result from daily or frequent cycling. An equalizing charge should be given if any of the following conditions exist:

1. The specific gravity of any cell at the end of charge is 20 points less than the average.
2. The on-charge voltage of any cell at the end of charge is 20 MV less than the average.
3. The battery has been stored for 30 days.
4. A large volume of water has been added.

When the equalize mode is desired, follow the operation outlined for a normal charge and press "Equalize" key to set the charge control for an additional 3 hours more than required for a normal charge. During the equalize charge period, the "Equalize" LED will flash on and off. The charge is complete when both the "Charge Complete" and "Equalize" LEDs light solidly.

NOTE: The SC1000 is shipped from the factory set to the Auto Equalize mode, and will automatically provide an equalize charge every 5 cycles. The manual equalize key is disabled in this mode. See the Programming chapter in this manual for further information on the Auto-Equalize feature.

Manual Stop

To stop any charge cycle before charge complete, press the red "STOP" key. For maximum shift run times and longest battery life, the charger should be allowed to always reach charge complete.

WARNING: Do not connect a battery to this charger if any lamp is lit. Do not disconnect a battery from this charger while a charge is in progress; otherwise, damage to charger, arcing and burning of connector parts or 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.

AC Power Fail

The SC1000 Control will resume the charge where it left off when the AC power failure occurred, virtually unaffected charge time. If the battery is disconnected from the charger during an AC power failure and it or any other battery is reconnected, the control will recognize this when AC power returns and restart the charge cycle from the beginning.

SC1000 CONTROL FEATURES

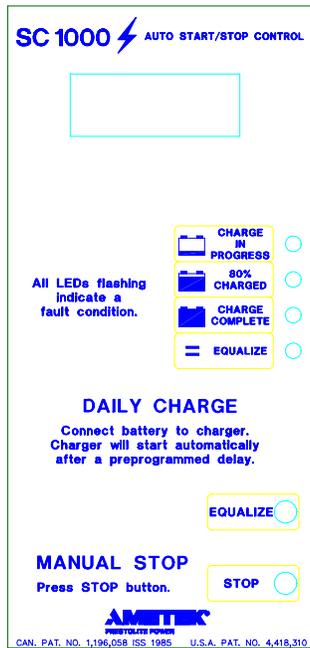


Figure 6-1

Main Features

1. Universal Control
2. User Selectable Output Curves
3. Improved DV/DT Charge Termination
4. Four Character, Seven-Segment Display
5. Four LEDs for Status Display; automatic LED lamp test provided on start up
6. Manual Stop Capability
7. Automatic Start Operation
8. Manual or Automatic Equalize Operation
9. Backup Timer Shutdowns
10. Failure Mode Diagnostics:

Failure Mode

Control Display Reading

- | | |
|-------------------------|------|
| - High Battery Reject | HI-b |
| - Low Battery Reject | Lo-b |
| - 0 – 80% Backup Timer | 0-80 |
| - 80% - CC Backup Timer | 80-E |
| - Low Current S.D. | Lo-A |
| - Manual Stop | OFF |
| - Charge Curve Error | CUEr |
| - Set-Up Error | SUEr |

11. One Part Number Control is User/Factory Programmable for 6-12-18-24-36 Cells and 100-200-400 Amp Digital Ammeter
12. Adjustable 8-99 Hour Refresh Charge Delay
13. Voltage Time Feature (DV/DT Disable)
14. Delayed Start Mode
15. Programmable Cool Down Time

Description of Features

Universal Control – The SC1000 Control provides the capability to charge batteries of different cell sizes. The cell size setting is selected via DIP switch S2 on the control PC board. The SC1000 Control will safely charge 6,12,18,24, and 36 cell batteries. The cell size setting should be selected in accordance with the charger output voltage rating. Refer to the Initial Set-Up chapter in this manual for detailed instructions on selecting battery cell size.

User Selectable Output Curves – As the technologies associated with battery construction change, so do the charging requirements. The SC1000 Control comes equipped with four user selectable charging output curves to accommodate a user's specific charging requirements.

Three output curves are preprogrammed into the control and are easily selected using DIP switch S1-7 on the control PC board. A standard curve is provided for **flooded lead acid** batteries. A second curve is preprogrammed for **sealed lead acid** batteries. The third curve is preset to match the Characteristics for sealed lead acid recombinant type batteries. Should a new battery technology arise, the SC1000 offers a fourth user programmable custom curve. This curve allows the user to customize the charger output for new battery technologies, unusual application requirements, or simply to meet customer preference. The digital display will indicate the selected output curve when no battery is connected to the charger. See the "Programming your SC1000 Control" chapter in this manual for further details.

Charge Termination – The SC1000 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 SC1000 Control is ten minutes. The SC1000 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 four hours after the battery reaches the "80% Charged" point.

Digital Display – A 7 segment, 4 character display is Standard on the SC1000 Control. The characters are .56 inches tall, making the information on the digital display legible at distances exceeding ten feet. Easy to understand abbreviations are used to indicate charge status output current and voltage and other functions including; programming information, fault information, and operating status. A blank display is utilized for AC power fail indication. The standard range of the digital ammeter is 0-200 amps. If a range from 0-100 amps is desired, DIP switch S1-1 should be set to the "on" position. If a range from 0-400 amps is desired, DIP switch S1-2 should be set to the "on" position. See the "Initial Set-Up" chapter in this manual for further information on shunt set-up.

Status Display LEDs – All four status LEDs are illuminated for five seconds at the start of the charge, providing a lamp test feature. There are four status LEDs provided to indicate the present operating status of the charger and battery (see Figure 6-1). The "Charge in Progress" LED is illuminated whenever the charger is flowing current to the battery. During this period, the digital display readout alternates between charger output volts/cell and amps. A charger fault condition is indicated by the flashing of all four status LEDs. See the "Troubleshooting" chapter in this manual for a description of all charger fault modes.

Manual Stop – If it is necessary to remove a battery from a charger while the charger is running, first press the "Manual Stop" push-button. The charger will turn off and all four status LEDs will flash on and off. The digital display will read "OFF". The battery may now be disconnected.

Automatic Start Operation – The control will start the charger five seconds after the battery is connected. During the five second countdown, all four status LEDs will be illuminated and the display will scroll the number of seconds left until the start of charge.

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. SC1000 Controls are shipped from the factory with the automatic equalize feature enabled for every fifth charge cycle. The number of complete charge cycles between equalize charges is programming from 0 to 30. If the number of automatic equalize cycles is set to zero, then the automatic equalize function is disabled. When automatic equalize is disabled, an equalize charge is requested by pressing the "Equalize" key on the front panel of the SC1000 Control after the charge cycle has started. The "Equalize" status LED will light, signifying an equalize request. If this key is pressed again during the charge cycle, the equalize request will be canceled and the "Equalize" status LED will extinguish. An equalize request cannot be canceled once the equalize charge period has started ("Charge in Progress" LED is on. "Equalize" LED is flashing. When the automatic equalize feature is active, the "Equalize" key on the front panel is disabled.

Back-Up Timer Shutdown – The standard SC1000 Control has two back-up timers. The charger will shutdown and “0-80” will be displayed if ten hours has passed since the start of a charge cycle and the battery has not reached the gassing voltage (80% charged). “80-E” will be displayed if five hours has passed since the battery has reached the gassing voltage and a DV/DT charge termination has not occurred. If the DV/DT feature has been disabled (see the “Initial Set-Up” chapter in this manual), only the ten-hour back-up timer is active.

Battery Discrimination – The SC1000 Control has the ability to reject batteries which have a different number of cells than the control has been programmed for via the PCB DIP switch S2. If the battery connected to the charger has an average terminal voltage of greater than 2.3 volts/cell, the charger will not start a charge sequence. All four status LEDs will flash on and off and the display will read “HI-b”. If the battery voltage eventually falls below 2.3 volts/cell, the control will begin a normal charge sequence.

If the battery connected to the charger has an average terminal voltage of less than 1.75 volts/cell, the charger will not start and all of the status LEDs will flash on and off. The display will read “Lo-b” indicating a low battery condition. If the battery connected to the charger has a terminal voltage of less than 1.75 volts/cell and the operator wishes to start the charge regardless of the low battery voltage, the charge cycle will start if both the “Equalize” and “Manual Stop” push-buttons are held pushed for two seconds until the status LEDs remain illuminated and then released.

One Part Number Control – The standard SC1000 Control is user/factory programmable for 6,12,18,24, and 36 cell Terminator 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 PC boards. This feature reduces the quantity of spare parts inventory.

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 SC1000 Control has an adjustable 8 to 99 hour refresh charge timer which starts with a normal charge complete, either DV/DT or voltage time. If a battery is left connected to the charger for the programmed number of hours after a charge complete, the control will automatically begin a refresh charge cycle. The charge termination technique for a fresh charge will be DV/DT regardless of how the control is user programmed, and the 0-80% back-up timer will be five hours 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.

80% Charged Point – a standard SC1000 Control will light the “80% Charged” LED and enable the charge termination routine when the battery voltage reaches the gassing voltage and the charger output has decreased below start current. The gassing voltage is nominally 2.40 volts/cell.

Delayed Start – The SC1000 Control can be programmed to delay the start of a charge cycle for a specific period of time. Any time period from 15 minutes to 23 hours and 45 minutes, in fifteen minute increments, can be used for the delayed start period. When a SC1000 is programmed for delayed start, and a battery is connected to the charger, the middle segments of the display will alternate between the readings “ds” and “- -”. The delayed start feature can be used to save on energy costs, provide a battery cool down period, or to prevent opportunity charging.

Programmable Cool Down Time – A programmable cool down feature allows the battery to cool down for 0 to 8 hours before the charger signals charge complete. During the cool down period the display reads “COOL”. This feature allows the battery to cool down before being returned to use and can be used to minimize the battery maximum temperature during operation.

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PROGRAMMING YOUR SC1000 CONTROL

The SC1000 programming feature allows 8 functions to be programmed to customize your SC1000 Control to your particular charging application. Programming is not available during the active charge cycle, and can only be accessed when no battery is connected to the charger. With no battery connected, the display will indicate the current battery type:

- “FLd” - Flooded Lead Acid Battery
- “CUS” - Custom Curve
- “dSL” - Deka Dominator Battery
- “SLA” - Sealed Lead Acid Recombinant Type Battery

In this mode, DIP switches S1-4 thru S1-11 can be independently closed to program a particular charge parameter. The display will indicate the initial value of the parameter that is selected. The user can then press the “Equalize” or “Manual Stop” push-buttons to increment or decrement the parameter to the desired value. The DIP switch is then returned to its original position and the new parameter value is stored in the control.

Table 7-1 contains the programming steps required to change the number of automatic equalize cycles from the factory setting of 05 to 00 (automatic equalize disabled). Descriptions of the programmable functions are listed after Table 7-1. The example below is for a Flooded Lead Acid Battery Type. If a programmable feature is modified by the user to a value other than the factory setting, then the **left-most decimal point on the display will blink on and off** indicating the change. The factory settings for all of the features are also included below.

STEP	CONTROL DISPLAY READING
1. Make sure that the battery is disconnected from charger.	“FLd”
2. Close DIP Switch S1-4	“05”
3. Press the “Equalize” button until the display reading is “00”	“00”
4. Open DIP Switch S1-4	“FLd” - Left Most Decimal Point Flashing
5. Operation Complete	“FLd” - Left Most Decimal Point Flashing

Table 7-1 SC1000 Control Programming Example

Auto-Equalize Cycles – The number of complete charge cycles between equalize charges. This setting is programmed by closing DIP Switch S1-4 with no battery connected to the charger. Setting this parameter to 0 disables the auto-equalize feature and equalize charge requests are performed by pressing the “Equalize” push-button on the control front panel. When the auto-equalize function is enabled (programmed to a value other than 0) then the “Equalize” push-button cannot be used to request an equalize charge. The SC1000 Control is shipped from the factory with the auto-equalize feature set for every five cycles.

Delayed Start – The time from battery connection to the start of a charge sequence is programmable from 0 minutes to 23 hours and 45 minutes in fifteen minute increments. The delay time is programmed by closing DIP switch S1-5 with no battery connected to the charger. The control is shipped from the factory with the delayed start time set to 0.

Refresh Delay – The time from a normal charge termination to the start of a refresh charge is adjustable from 8 to 99 hours in 1 hour increments. The refresh delay time is programmed by closing DIP switch S1-6 with no battery connected to the charger. The control is shipped from the factory with the refresh delay time set to 72 hours.

Battery Type – The battery type the charger uses to select the proper output voltage and current characteristic. The battery type is selected by closing DIP switch S1-7 with no battery connected to the charger. The available battery types are listed below:

- 0 = Standard flooded lead acid industrial type battery. Factory setting. Display reads “FLd”
- 1 = Custom Curve – uses the programmed voltage and current values set by the user via DIP switches S1-8 thru S1-10 (described below). Display reads “CUS”
- 2 = Charge curve that meets the requirements of the “DEKA Dominator” battery. Display reads “dSL”
- 3 = Sealed Lead Acid recombinant type battery. Display reads “SLA”

When no battery is connected the charger displays one of the codes below to indicate the current battery Type setting.

FLd	Standard Flooded Lead Acid Type Batteries
CUS	Programmable Custom Curve Values
dSL	Sealed Gel Batteries (Deka Dominator)
SLA	AGM Type Sealed Batteries

Gassing Voltage (volts/cell) - The custom output curve (battery type #1 above) gassing voltage is adjustable from 2.25 to 2.60 volts/cell. The parameter is adjusted by closing DIP switch S1-8 with no battery connected to the charger. The factory setting is 2.40 volts/cell.

Finish Current (amps) - The custom output curve finish current is adjustable from the charger low current shutdown amperage (2 amps for an 100A shunt, 4 amps for a 200A shunt, and 8 amps for a 400A shunt) to 6.75A/100 AH. The parameter is adjusted by closing DIP switch S1-9 with no battery connected to the charger. The factory setting is 4.5A/100AH.

Lid Voltage (volts/cell) - The custom output curve lid Voltage is adjustable from 2.25 to 2.99 volts/cell. The parameter is adjusted by closing DIP switch S1-10 with no battery connected to the charger. The factory Setting is 2.70 volts/cell.

Cool Down Delay – The battery cool down delay time is adjustable from 0 to 8 hours in 1 hour increments. The parameter is adjusted by closing DIP switch S1-11 with no battery connected to the charger. The factory setting is 0 hours.

TROUBLESHOOTING

Troubleshooting Table

SYMPTOM	PROBABLE CAUSES	ACTION	
		PARAGRAPH	PAGE
No Display And No LED's	(1) No AC Voltage To Charger	8.01	8-5
	(2) Input Fuse(s) Blown	8.02	8-5
	(3) Control Trans. Breaker Tripped	8.03	8-5
	(4) Bad Control Transformer	8.04	8-5
	(5) Wrong Control Trans. Connection	8.05	8-6
	(6) Bad Harness/Connection – Loose or Incorrect	8.06	8-6
	(7) Bad Control Board	8.07	8-6
Bad Lamp Test	(1) Bad Control Board	8.07	8-6
Display Illegible	(1) Noisy Environment	8.08	8-6
	(2) Low Input Voltage	8.09	8-6
	(3) Bad Control Transformer	8.04	8-5
	(4) Bad Control Board	8.07	8-6
Charger Doesn't Respond To Battery Being Connected	(1) Output Fuse Bad	8.10	8-6
	(2) Bad Harness/Connections – Loose Or Incorrect	8.06	8-6
	(3) Bad Control Board	8.07	8-6
	(4) Output Cables Reversed	8.11	8-6
	(5) Bad Output Connector	8.12	8-6
Control Not Responding (Locked Up)	(1) Noisy Environment	8.08	8-6
	(2) Bad or Missing Suppressor Core	8.13	8-6
	(3) Low Input Voltage	8.09	8-6
	(4) Power Interruption	8.08	8-6

SYMPTOM	PROBABLE CAUSES	ACTION	
		PARAGRAPH	PAGE
Battery has Low S. G.'s	(1) Reading Not Temperature Corrected	8.14	8-6
	(2) Bad Battery	8.15	8-7
	(3) Bad Equalize Schedule	8.16	8-7
	(4) Charge Curve Incorrect	8.17	8-7
Battery Doesn't Last Full Shift	(1) Faulty Lift Interrupt	8.18	8-7
	(2) Manual Disconnect	8.19	8-7
	(3) A.H. Required > Battery Nameplate	8.20	8-7
	(4) Battery Not Providing Nameplate Rating	8.15	8-7
	(5) Bad Equalize Schedule	8.16	8-7
	(6) Charge Curve Incorrect	8.17	8-7
Battery Water Usage Is Too High	(1) Charger too Large for Battery	8.21	8-7
	(2) Charge Curve Incorrect	8.17	8-7
	(3) Bad Equalize Schedule	8.16	8-7
	(4) Control Set for Voltage/Time	8.22	8-7
Low Number Of A.H.'s Returned To Battery	(1) Faulty Lift Interrupt	8.18	8-7
	(2) Battery Not Fully Discharged	8.23	8-7
	(3) Manual Disconnect	8.19	8-7
	(4) Charge Curve Incorrect	8.17	8-7
	(5) Battery Not Providing Nameplate Rating	8.15	8-7
	(6) Bad Control Board	8.07	8-6
Battery Temperature Too High	(1) Insufficient Cool Down before and/or after Charging	8.24	8-7
	(2) Battery Power Demand too Great	8.20	8-7
	(3) Charger too Large for Battery	8.21	8-7
	(4) Charge Curve Incorrect	8.17	8-7
	(5) Bad Equalize Schedule	8.16	8-7
	(6) Control Set for Voltage/Time	8.22	8-7
Incorrect Charge Rate	(1) Charge Curve Incorrect	8.17	8-7
	(2) Battery A.H. not Equal to Charger A.H.	8.25	8-7
	(3) Bad Control Board	8.07	8-6

SYMPTOM	PROBABLE CAUSES	ACTION	
		PARAGRAPH	PAGE
Charger Doesn't Shutdown When Battery Is Disconnected	(1) Control Set for Curve #2	8.26	8-7
	(2) Bad Control Board	8.07	8-6
Noisy Unit	(1) Loose Sheet Metal	8.27	8-7
	(2) Bad Contactor	8.28	8-7
	(3) Loose Transformer Mounting	8.29	8-7
	(4) Noisy Transformer	8.30	8-7
	(5) Placed On Rack That Makes Noise	8.31	8-8
Meter Reading Wrong (V/C)	(1) Bad Output Connect	8.12	8-6
	(2) Bad Harness/Connections – Loose Or Incorrect	8.06	8-6
	(3) Internal Power Connection	8.32	8-8
	(4) Bad Control Board	8.07	8-6
Meter Reading Wrong (Amps)	(1) Control Board Shunt DIP Switch Set Incorrectly	8.33	8-8
	(2) Bad Output Connector	8.12	8-6
	(3) Bad Harness/Connections – Loose Or Incorrect	8.06	8-6
	(4) Internal Power Connection	8.32	8-8
	(5) Bad Control Board	8.07	8-6
	(6) Bad/Incorrect Shunt	8.34	8-8
Unbalanced Input Current	(1) Incorrect Wiring To Primary Of Transformer	8.35	8-8
	(2) Incorrect Cabling To Transformer Secondary	8.36	8-8
	(3) Bad Harness/Connections – Loose Or Incorrect	8.06	8-6
	(4) Bad SCR	8.37	8-8
	(5) Bad Control Board	8.07	8-6
	(6) AC Supply	8.01	8-5
	(7) Bad Transformer	8.38	8-8

SYMPTOM	PROBABLE CAUSES	ACTION	
		PARAGRAPH	PAGE
High Input Current	(1) Incorrect Wiring To Primary Of Transformer	8.35	8-8
	(2) Incorrect Cabling To Transformer Secondary	8.36	8-8
	(3) Incorrect AC Input Jumper Setting	8.39	8-8
	(4) Bad Harness/Connections – Loose Or Incorrect	8.06	8-6
	(5) Bad SCR	8.37	8-8
	(6) Bad Control Board	8.07	8-6
	(7) AC Supply	8.01	8-5
	(8) Bad Transformer	8.39	8-8
LEDs Flashing, Display Reads “CUEr” (Charge Curve Error)	(1) Bad Harness/Connections – Loose Or Incorrect	8.06	8-6
	(2) Bad SCR	8.37	8-8
	(3) Bad Control Board	8.07	8-6
	(4) Incorrect Wiring To Primary Of Transformer	8.35	8-8
	(5) Bad Shunt	8.34	8-8
LEDs Flashing, Display Reads “0-80” or “80-E” (Backup Timer Timeout)	(1) Bad A.H. > Charger A.H.	8.40	8-8
	(2) Bad Output Cable Connector	8.12	8-6
	(3) Incorrect Charge Curve Setting	8.17	8-7
	(4) Bad Battery	8.15	8-7
LEDs Flashing, Display Reads “OFF” (Manual Stop)	(1) Someone Pressed Manual Stop Button	8.19	8-7
	(2) Bad Control Board	8.07	8-6
LEDs Flashing, Display Reads “Lo-A” (Low Current Shutdown)	(1) Bad Harness/Connections – Loose Or Incorrect	8.06	8-6
	(2) Bad Battery	8.15	8-7
	(3) Bad Internal Power Connection	8.32	8-8
	(4) AC Supply	8.01	8-5
	(5) Bad AC Fuse	8.02	8-5
	(6) Bad Contactor	8.28	8-7
	(7) Output Fuse Bad	8.10	8-6
	(8) Bad Control Board	8.07	8-6
	(9) Bad Transformer	8.38	8-8
LEDs Flashing, Display Reads “Lo-b” (Low Battery Reject)	(1) Battery Over Discharged	8.41	8-8
	(2) Bad Harness/Connections – Loose Or Incorrect	8.06	8-6
	(3) Bad Battery	8.15	8-7
	(4) Bad Control Board	8.07	8-6
	(5) Bad Output Cables/Connector	8.12	8-6

SYMPTOM	PROBABLE CAUSES	ACTION	
		PARAGRAPH	PAGE
LEDs Flashing, Display Reads “HI-b” (Hi Batt. Reject)	(1) Wrong Cell Size Battery	8.42	8-8
	(2) Bad Control Board	8.07	8-6
LEDs Flashing, Display Reads “SUEr” (Setup Error)	(1) Shunt Size Setting has been Changed on Control Board	8.33	8-8
	(2) A.H. Resistor (R2) has been Changed on Control Board	8.43	8-8
	(3) Bad Connection between A.H. Resistor (R2) and Control Board	8.44	8-8
	(4) Bad Control Board	8.06	8-6
Display Reads “ACLo” (AC Fail)	(1) Intermittent AC Fail (Supply)	8.01	8-5
	(2) Control Transformer Connection	8.05	8-6
	(3) Bad Harness/Connection – Loose Or Incorrect	8.06	8-6
	(4) Bad Control Transformer	8.04	8-5
	(5) Bad Control Board	8.07	8-6

Action

- 8.01** Refer to the Installation chapter in the charger manual.
- 8.02** Disconnect AC power and replace the bad AC fuse. Reapply AC power to the charger. If the fuse (s) blows instantly, check the connections on the input side of the contactor to make sure there are no shorts between any of the input wires. If that's okay, then check or change the control transformer. If the fuse (s) blow after the contactor closes, then check the input wiring from the contactor to the main transformer (s). Refer to the charger manual and locate the diagram for your charger to confirm that the charger is wired correctly. Also check the wires going up to the terminal block on the transformer, the wires will have numbers that correspond to the number on the terminal block. If they are incorrect, change them and start over. If it still blows fuse (s), the transformer will have to be replaced.
- 8.03** Disconnect AC power and reset the breaker. Disconnect the control and reapply AC power to the charger. Measure to see if 24VAC is on the output side of the control transformer. If there is, the control has failed. If there isn't 24VAC, then replace the control transformer. It is still possible that the control has failed; so once the control transformer is replaced, measure to see if the 24VAC drops once the control is connected.
- 8.04** Check and see if any input fuses are blown. Visually inspect the control transformer for discoloration on the casing of the input side of the control transformer. Disconnect the control before applying AC power. Once AC power is reapplied, measure the input voltage to the control transformer; it should be the AC supply voltage (208/240/480) (240/480/575). If not, check the control transformer input wiring. If you did read the supply voltage, then measure the output side and you should read 24VAC. If not, replace the control transformer.

- 8.05** Look at the casing of the control transformer on the input side. Reference the Charger manual to determine the input. There will be four pins and each one will be labeled as follows: COM (common), 208 (208VAC), 240 (240VAC), and 480 (480VAC). Some chargers are equipped with higher input voltage control transformers labeled as follows: COM (common), 240 (240VAC), 480 (480VAC), and 575 (575VAC). There should always be a wire on the common pin no matter what voltage is applied to the charger, and the second wire will go to the pin labeled as the voltage that is applied to operate the charger. Measure the voltage on the output side of the control transformer, it should read approximately 24VAC.
- 8.06** A bad harness/connection can cause many different problems. The best way to confirm a bad harness/connection problem is to take measurements where the harness is connected to the charger and then follow the wire (s) up the harness to the PC boards and measure there also. The measurement should match what was measured at the charger connection. If it doesn't, check the following: Check the connectors at the square plugs where the control harness connects to the charger harness; the connectors could be pressed out of the plugs. Make sure the connectors look okay inside the edge mount connector at the PC board (s). Make sure the harness connections are tight where they connect to the charger. Make sure the wires are crimped to the terminals tightly; and also check to make sure that they are crimped to the bare wire and not to the insulation only.
- 8.07** To check the Control Board for proper operation, first check the DIP Switch settings of S2. Make sure the proper cell size is set to match the charger. Also make sure the shunt size setting matches the shunt in the charger (S1-1 on = 100A shunt, S1-2 on = 400A, S1-1 and S1-2 off = 200A).
- If the control still does not work properly even though the above settings are correct, the Control Board still may need to be replaced. However, this is unlikely and all other possibilities should be taken before this step.
- 8.08** Temporarily shut down any equipment on the same voltage supply line and see if the control starts to respond normally. If the control does, then check all grounds going to the equipment that is shut down. If the problems still exist, then return power to all the other equipment and call your local Prestolite Power representative.
- 8.09** Measure the AC supply voltage coming into the charger to confirm that it matches the charger input tap settings.
- 8.10** Use an Ohmmeter and measure directly across the DC fuse. A good fuse will measure almost (0) Ohms; and a bad one will measure a very high resistance, in the megohm range or greater. If for some reason a DC fuse measures somewhere in between, replace the DC fuse and send it in to your local Prestolite Power representative.
- 8.11** Refer to the DIAGRAM chapter in the charger owners' manual and locate where the output cables connect to the charger. The black (negative) output cable goes into the charger and connects to a bus bar on the end of the DC fuse which is located on the left portion of the interior panel. The red (positive) output cable goes into the charger and connects to the secondary of the power transformer in the front portion of the charger. The output connector will have a (+) and (-) symbol on it; the (+) terminal should have the red output cable connected to it, and the (-) should have the black output cable connected to it.
- 8.12** Make sure the output connector does not have any cracks on its casing that could result in a short. Make sure the output cable lugs are making a good connection with the battery connector. You will see traces of pitting on the lug surface from arcing if there isn't a good connection. This could be the result of a weak retainer clip in the connector or lugs that were soldered incorrectly. If the lugs had too much heat applied to them when the cables were soldered on, the solder will wick up the cable and make it very stiff. When they are inserted into the connector, the stiff cable forces the retainer clip down and creates poor connection between the battery connector and the charger connector.
- 8.13** Make sure the suppressor core is attached to the control wire harness with the green wire outside the core, and that it is not missing. Visually inspect the suppressor core for missing pieces or cracks. If deformations are present, replace the suppressor core.
- 8.14** Specific Gravity readings vary with the temperature of the electrolyte. To temperature correct the readings to match the nameplate ratings of the battery, use the following rule of thumb; + 1 S.G. point per 3 degrees F increase of the electrolyte temperature from 77 degrees F.

- 8.15 Take "Specific Gravity" readings and measure "Cell Voltages". If acid has been spilled or the battery has been extremely heated, it is possible that a battery's capacity could be greatly reduced, and the acid is not capable of increasing to the battery nameplate rating.
- 8.16 The proper equalize schedule is one that is tailored to the specific battery and charger operation. The SC1000 auto equalize feature can be used to automate the equalize schedule (See the "SC1000 Control Features" chapter of this manual).
- 8.17 Using the Programming Feature of the control (Refer to the "Programming Your SC1000 Control" chapter of this manual), check the charge curve setting of the charger. If it does not match the battery type (Standard, Custom, "DEKA Dominator" sealed lead acid, sealed lead acid recombinant) then reprogram the control to the proper curve.
- 8.18 A faulty lift interrupt on a lift truck can cause the battery to be over or under discharged. Check the interrupt voltage of the interrupt following the procedures found in your truck and/or lift interrupt operator's manual (s).
- 8.19 Repeated manual disconnecting of the battery from the charger before charge complete can cause long term battery damage and lead to inefficient truck/battery/charger operations. When it is necessary to stop the charge cycle before charge complete *always terminate the charge cycle by pressing the STOP key before disconnecting the battery from the charger.*
- 8.20 If the application requires a larger AH battery than is presently in use, the only long term solution is to replace the battery with one of the proper AH rating.
- 8.21 Check the charger A.H. rating. If the charger A.H. rating exceeds the battery nameplate rating by more than 20%, then either the A.H. ID jumper can be changed to lower the charger A.H. output or the battery should be charged using a charger with a lower A.H. capacity. Contact your local Prestolite Power representative for details on changing the A.H. ID jumper.
- 8.22 Set the control to DV/DT termination (see the "Initial Set-Up" chapter of this manual).
- 8.23 If fully discharged batteries are desired for efficient operations, lift interrupts can be installed on the trucks to allow the operators to recognize a fully discharged battery.
- 8.24 A cool down can be programmed into the SC1000 Control to add a specified cool down time between charge termination and the signaling of charge complete (See the "Programming Your SC1000 Control" chapter of this manual). A delayed start can be programmed into the SC1000 Control to add a specified delay time between battery connection and the start on the charge (See the "Programming Your SC1000 Control" chapter of this manual).
- 8.25 Check the charger A.H. rating. If it does not match the battery nameplate A.H. rating (it should be within 20% of the battery nameplate rating), then the battery should be charged using a charger with the correct output rating to match the battery rating within 20%.
- 8.26 Using the Programming Feature of the control (Refer to the "Programming Your SC1000 Control" chapter of this manual), check the charge curve setting of the control. If the control is set for curve #2 ("DEKA Dominator" sealed lead acid battery type), then the low current shutdown feature is disabled and the charger will continue to run when the battery is disconnected. The control will possibly shut down the charger due to a charge curve error. All LEDs will flash and the display will read "CUER". Due to the possibility of personnel coming in contact with the output leads while the charger is running, *the manual stop button should always be pressed prior to disconnecting a battery during charging.*
- 8.27 Check and tighten all sheet metal fasteners (screws and bolts).
- 8.28 If the contactor is not functioning properly, then check the voltage across the contactor coil. If the voltage is 24VAC +/- 10%, replace contactor with a properly functioning part.
- 8.29 Check and tighten all transformer mounting screws.
- 8.30 Check transformer for visible damage. Coat the transformer coil with a Prestolite approved (contact Prestolite Service) air dry varnish. If that fails to reduce the noise level, drive a shim of the proper material (contact Prestolite Service) between coil and core.

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TROUBLESHOOTING

- 8.31** Check for and tighten any loose fasteners on the rack. Remove any lightweight loose objects that are on the rack near the charger.
- 8.32** Check charger internal connection points that visually appear to be poorly connected or heat damaged. Any connections that appear loose or overheated must be re-lugged. Recheck any repaired connections by performing a continuity test.
- 8.33** Check the shunt size DIP switch setting (see the "Initial Set-Up" chapter in this manual) and ensure that it matches the shunt in the charger.
- 8.34** Replace damaged and/or incorrect shunt with one of correct size.
- 8.35** Reconnect transformer primary winding to match the schematic included in charger manual.
- 8.36** Reconnect transformer secondary winding to match the schematic included in charger manual.
- 8.37** Check the SCR as described below. If it tests faulty, replace with an SCR of the proper type.
Connect a VOM set on the 1k Ohms scale; positive to SCR anode (stud), negative to SCR cathode (heavy red lead). Touch and hold the SCR gate lead (small white lead) to the SCR anode. The VOM should read a low impedance (near short circuit). If the SCR reads shorted before the gate is touched to the anode, the SCR is bad. If the SCR reads open when the gate is touched to the anode, the SCR is bad (A DVM may be used if it is set to the diode scale). A high impedance will be indicated by an over range indication (usually OL), a low impedance will be indicated by a low reading 1.00.
- 8.38** AC fuses are most likely to have failed. Visually inspect the transformer. If a winding has failed, the winding will appear to be burnt or look black. The varnish might be flaking off. Refer to the "Diagram" chapter in the charger manual and locate the diagram for your charger. On the diagram, there will be a winding configuration for the transformer. With power removed, disconnect the SCR's from the transformer. Reapply AC to the charger. Measure the transformer secondary voltage. If less than 25 VAC is present, replace the transformer.
- 8.39** Refer to the "Installation" chapter in the charger manual and reconnect the input primary jumpers to match the input voltage. Be sure to connect the control transformer primary properly.
- 8.40** Check the charger A.H. rating. If the battery A.H. rating exceeds the charger nameplate rating by more than 20%, then the battery should be charged using a charger with a higher A.H. capacity.
- 8.41** If the battery has been over discharged and the open cell voltage is less than 1.75 volts/cell, the low battery reject feature is enabled. The control will not start the charge until the battery voltage rises or the user overrides the low battery reject mode. See the "SC1000 Control Features" chapter of this manual for details concerning the low battery reject feature. An over discharged battery could be indicative of a faulty lift interrupt.
- 8.42** The battery connected to the charger may be the wrong cell size for the charger. Check the nameplate on the battery and verify that it matches the cell size of the charger.
- 8.43** Hold in the "Manual Stop" and "Equalize" buttons simultaneously for two seconds until the display reads "EEEE". Release the two buttons. The control should now function properly.
- 8.44** Measure the DC voltage between connector pins J3-5 and J3-1 on the control PC board; positive of DMM to J1-5, negative of DMM to J1-3. The measured voltage should be between 1.00 and 1.86 VDC. If the measured voltage is out of range, remove the jumper from the connector and inspect it for loose or damaged connections.

PARTS LIST

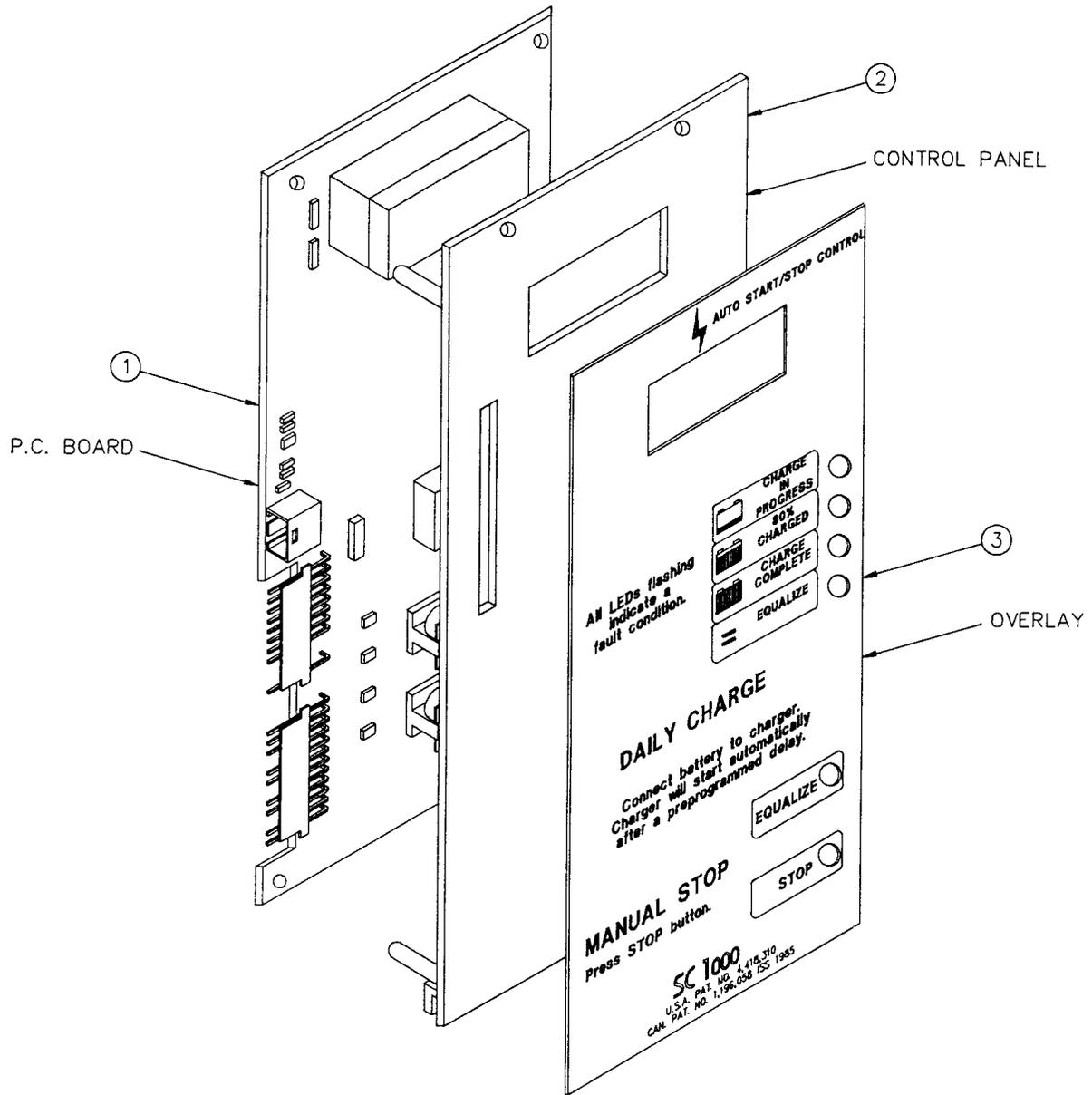


Figure 9-1 Control Assembly 193314-1

<u>ITEM NO.</u>	<u>ITEM DESCRIPTION</u>	<u>PART NUMBER</u>
1	CONTROL PC BOARD	193246-1
2	CONTROL PANEL	192820-11
3	OVERLAY	193354

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ELECTRONIC PRINTED CIRCUIT BOARD EXCHANGE SERVICE POLICY

Because of the definite superiority of certain solid-state control components over conventional electromechanical 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.

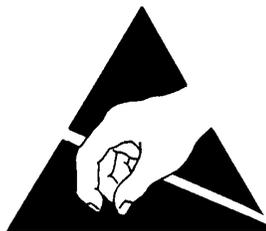
In recognition of the fact that most users of this equipment lack the facilities and specially trained personnel necessary to service and repair electronic equipment, the company has established an electronic printed circuit board exchange service plan.

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.

WARRANTY

AMETEK/PRESTOLITE POWER SCR 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 transformer, inductors, silicon diodes, and SCR's 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) Printed circuit board assemblies are warranted for three (3) years after Prestolite's shipment of the unit (s) of which they are a part, provided, however, that during the last two (2) years of this 3 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.
 - c) 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 judgment. 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 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. AS-

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, U.S.A.**

Data Sheet: 1148
Index: 110100
Replaces: 082499

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