NATIONAL RAILWAY SUPPLY

Installing, Operating and Service Instructions for the 120/12 Solid State Charger

MODEL ELC-120/12 BATTERY CHARGER

PLEASE SAVE THESE IMPORTANT SAFETY AND OPERATING INSTRUCTIONS

For correct operation of the equipment, it is important to read and be familiar with this entire manual before installing and operating the charger. DO NOT DISCARD THIS MANUAL AFTER READING.

LOOK FOR THIS SYMBOL TO POINT OUT SAFETY PRECAUTIONS. IT MEANS: *BECOME ALERT—YOUR SAFETY IS INVOLVED.* IF YOU DO NOT FOLLOW THESE SAFETY INSTRUCTIONS, INJURY OR PROPERTY DAMAGE CAN OCCUR.

1. IMPORTANT SAFETY INSTRUCTIONS

a. Before using the battery charger, read all the instructions and caution markings on the battery charger, the battery, and all of the products using the battery.

b. Do not touch the uninsulated parts of the AC input or the DC wires, the charger's binding posts, or the battery terminals, as there is a possibility of electrical shock.

c. Batteries produce hydrogen gas while operating, which can explode if ignited. Never smoke, use an open flame, or create sparks in the vicinity of the battery. Ventilate the area well when the battery is charging in an enclosed area.

d. Batteries contain caustic material, which may cause burns. Do not get in eyes, on skin, or clothing. If the gelled or liquid content of the batteries contacts the skin or clothing, wash the area thoroughly with water. In the case of contact with the eyes, flush immediately with clean water for 15 minutes and obtain medical attention.

e. Only qualified personnel should program or service this equipment.

f. De-energize all AC and DC power connections and allow the internal capacitors in the charger to discharge before servicing this unit. If injury does occur, apply standard treatment for electrical shock and, if necessary, consult with a physician.

g. The charger is not for outdoor use. Do not expose the charger to rain or snow.

h. Do not operate the charger if it has received a sharp blow, been dropped, or otherwise damaged.

i. Do not disassemble the charger. Have the charger examined by a NATIONAL RAILWAY SUPPLY service agent. If the charger is assembled incorrectly, damage to the charger and the batteries or an electrical shock may result.

2. DESCRIPTION

The NATIONAL RAILWAY SUPPLY charger, model ELC-120/12, is a convection-cooled, solid-state, Silicon Controlled Rectifier (SCR) regulated charger that provides either a constant current or constant voltage output. The charger can be set to charge batteries within a voltage range of 100.0 to 150.0 volts for gel-cell, liquid lead-acid, starved electrolytic, and nickel-cadmium batteries.

3. THEORY OF OPERATION

The charger is manufactured to operate at either 115 or 230 Vac. When the charger is connected to the correct AC voltage source (115 or 230 Vac), the transformer creates auxiliary voltages for the electronic control module. The electronic control module controls and monitors the charger so it will perform properly. The transformer also supplies the power output used for charging the batteries and provides electrical isolation between the charger's output and the AC source.

The charger's output current flows through a shunt. The output current and voltage are sensed by the electronic control module. These values are converted into drive pulses for the SCRs by the control module. This pulsating charge current (a pulse occurs each time an SCR is on) is then filtered by large capacitors and the batteries to provide a smooth output.

The charger has an "IE" profile which is: (a) High rate constant current and (b) Constant voltage. When the charger is first started, the SCRs will conduct for a certain portion of the sinusoidal anode voltage to provide the required charging current at the low level of battery voltage. In this start region, a constant current is applied to the battery. The SCR conduction will then increase as the battery voltage increases in order to provide a higher output voltage while maintaining a constant charging current.

When the battery voltage reaches the float voltage, the SCRs will start to decrease their output. This causes the charger to automatically change from a constant current charge region to a constant voltage charge region. As the batteries become fully charged, the output current decreases. A continuous constant float voltage will be supplied to the batteries to maintain their charge.

Another feature of the charger is remote temperature compensation, which keeps the batteries from getting under- or over-charged. **TEMPERATURE COMPENSATION ONLY OCCURS WHEN USING A TEMPERATURE PROBE.** The red LED on the front of the charger will be off when using a functional temperature probe. If the LED is on, either a temperature probe is not being used, or the temperature probe is working improperly.

Temperature compensation uses a temperature reference of 77°F (25°C), a voltage reference of 2.23 volts (the voltage of a standard sealed battery at 77°F), and a compensation value of 3.0 mV per °F). The equivalent equation for the compensated voltage is:

$$Vcomp = V - k\,(t - 77°F)$$

Where V is the voltage of the battery at 77°F, t is the temperature in °F, and k = V (.003 / 2.23).

The control module has a temperature compensation range between 32°F and 95°F (0°C and 35°C) that does not allow charger voltage to increase or decrease beyond the calculated values.

Example 1:

If a 133.8 volt battery is charging and the temperature increases to 95°F, then the output voltage decreases to 130.6 volts.

133.8 - .18 (95°F - 77°F) = 130.6

Example 2:

If a 145.0 volt battery is charging and the temperature increases to 95°F, then the output voltage decreases to 141.5 volts.

145.0 - .195 (95°F - 77°F) = 141.5

Example 3:

If 133.8 volt batteries are charging and the temperature decreases to 32°F, the output voltage increases to 141.9 volts.

133.8 - .18 (32°F - 77°F) = 141.9

4. RECEIVING AND INSTALLING THE CHARGER

Proper installation of the charger is important in order to achieve good charger performance and to prevent damage to the charger and batteries. When a charger is received, a check for possible in-transit damage should be made. If any damage is found, it should be reported as a claim to the carrier.

To permit free airflow for convection cooling, allow three inches (3") minimum between the charger and other equipment.

⚠WARNING: NEVER PLACE ANYTHING ON TOP OF THE CHARGER WHILE OPERATING. DAMAGE TO THE CHARGER OR BATTERIES COULD OCCUR.

⚠WARNING: THE CHARGER MUST BE SET FOR THE PROPER BATTERY VOLTAGE BEFORE STARTING THE INITIAL CHARGE.

5. AC ELECTRICAL SUPPLY

⚠WARNING: THE CHARGER IS SHIPPED FROM THE FACTORY SET FOR EITHER 115 VAC OR 230 VAC AS INDICATED ON THE CHARGER NAMEPLATE. THE AC INPUT VOLTAGE SETTING CANNOT BE CHANGED.

DANGER: THIS CHARGER CONTAINS LETHAL VOLTAGES WHEN CONNECTED TO BATTERIES OR THE AC POWER SOURCE. DISCONNECT FROM BATTERIES AND AC POWER SOURCE AND ALLOW CHARGERS INTERNAL CAPACITORS TO DISCHARGE BEFORE OPENING ACCESS PANEL.

The charger must be connected to a single-phase, 50/60 Hertz AC power source, which can be either 115 or 230 Vac depending on the charger name plate.

Use an appropriate size wire for the conditions and for the AC amperage shown on the ratings information on the charger. Quarter-inch (1/4") ring terminals are required for proper connection to the AC input binding posts (A.A.R.) located on the front of the charger. Open the small door cover on the front of the charger by pulling out on the push tabs. Connect the AC power terminals on the two posts on the right, as marked on the panel behind the posts. Connect the ground wire to the ground lug next to the binding posts.

WARNING: FAILURE TO PROPERLY CONNECT THE AC INPUT COULD CAUSE SERIOUS DAMAGE TO THE CHARGER. BE SURE TO CONNECT PROPER AC SUPPLY VOLTAGE FOR CHARGER CONFIGURATION.

WARNING: DO NOT OPERATE THE CHARGER WITHOUT PROPER GROUNDING. IMPROPER GROUNDING CAN RESULT IN THE RISK OF AN ELECTRIC SHOCK.

6. DC OUTPUT

WARNING: DO NOT TOUCH THE CHARGER'S TERMINALS OR AN ELECTRICAL SHOCK COULD OCCUR. A VOLTAGE IS PRESENT ON THE DC TERMINALS EVEN AFTER THE AC IS DISCONNECTED BECAUSE OF THE ENERGY STORED IN THE CAPACITORS.

DANGER: THIS CHARGER CONTAINS LETHAL VOLTAGES WHEN CONNECTED TO BATTERIES OR THE AC POWER SOURCE. DISCONNECT FROM BATTERIES AND AC POWER SOURCE AND ALLOW CHARGER'S INTERNAL CAPACITORS TO DISCHARGE BEFORE OPENING ACCESS PANEL.

DANGER: DO NOT SHORT OUTPUT OF CHARGER TO DISCHARGE INTERNAL CAPACITORS.

When making the DC output connection to the charger, make sure the DC circuit breaker is in the off position. The DC output wires are connected on the two left-most binding posts as marked on the panel behind the posts (positive on the left and negative on the right). The DC cables should have quarter-inch (¼") ring terminals for connecting them to the binding posts. Check to make sure the polarity of the DC output wires are the same as those connected to the battery. The charger will not operate in a reversed polarity condition.

After connecting all wires, switch the DC breaker on. The DC breaker may trip due to the large current needed to charge the internal capacitor. If the breaker trips more than three times, disconnect from the AC power source, disconnect from the batteries, and verify all polarities. If the DC polarity is reversed, the DC breaker will protect the charger from internal damage. Correct the reversed wires and reset the breaker. Close the door cover on the front of the charger after verifying proper DC voltage.

WARNING: DO NOT TOUCH THE CHARGER'S TERMINALS OR AN ELECTRICAL SHOCK COULD OCCUR. A VOLTAGE IS PRESENT ON THE DC TERMINALS EVEN AFTER THE AC IS DISCONNECTED BECAUSE OF THE ENERGY STORED IN THE BATTERIES AND CAPACITORS.

7. TEMPERATURE PROBE

The external temperature probe is an optional way of extending battery life by using temperature compensation. One end of the temperature probe cable has a three-pin plug, which plugs into a receptacle labeled TEMP PROBE on the front of the charger. The other end of the cable has the temperature sensor sealed in a terminal.

WARNING: IT IS IMPORTANT TO MOUNT THE TEMPERATURE PROBE ON THE BATTERIES FOR PROPER TEMPERATURE COMPENSATION. IF THIS CANNOT BE DONE, LOCATE THE PROBE AS LOW AS POSSIBLE IN THE BUNGALOW OR CABINET.

Terminal-Type Probe

The terminal-type probe should be attached to the negative (-) battery post near the center of the battery pack. If the threaded stud is long enough above the battery jumper nut, attach the probe with another nut. Torque this nut to proper specifications. If the stud is too short, the nut holding the jumper wire will need to be removed. Open or remove the load and charging circuits to the batteries. Remove the nut holding the jumper and add the probe, then torque the nut to the proper specifications. Then close or connect the load and charging circuits back to the batteries.

Securely fasten the temperature probe cable to protect the probe from being torn from the battery. Secure the probe's cable to a fixed object to ensure the probe will not be pulled loose. Use a cable tie mount on the battery or on the adjacent battery, if necessary.

8. OPERATION

The battery charger is adjustable with the three rotary switches on the front of the charger. The switches (settable between 100.0 and 150.0) determine the float voltage for the batteries. **SET THE FLOAT VOLTAGE TO THE BATTERY MANUFACTURER'S SPECIFIED VOLTAGE FOR 77°F.** The charger will then electronically charge the batteries to the voltage specified on the switches. To set the switches, use a small screwdriver and turn the switch so that the arrowhead on the slot is pointing to the desired number. Set the switches in the following manner: If the desired battery voltage is 122.6 volts, set the top switch to 2, the middle switch to 2, and the bottom switch to 6 (see the figure 8.1). This will provide you with the proper charging voltage. The hundreds digit is always a one (1) and cannot be changed. **BE SURE EACH SWITCH IS SET ON A NUMBER AND NOT BETWEEN NUMBERS.** If a switch is set between numbers, the output current will go to zero and the yellow charging LED will flash.

The charger does not have a power switch. When AC power is applied to the charger, the DC output will start and the yellow LED will be on. To turn the charger off, disconnect the AC power source.

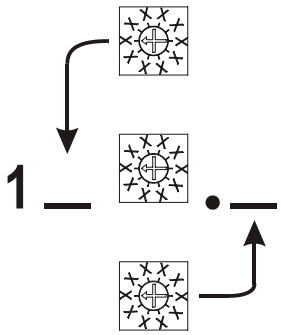


Figure 8.1

9. MAINTENANCE

The battery charger requires minimal maintenance. It should be kept clean, and all connections are to be periodically tightened. **BE SURE THE CHASSIS IS SECURELY GROUNDED.** If any problem cannot be resolved, consult the nearest NRS service agent at 1-800-357-3572.

10. SERVICING

If the battery charger operates improperly, follow the steps below.

a. Begin by checking the voltage switches to verify their settings against the specifications of the batteries.

b. Check the AC fuses to make sure they have not blown.

c. Check the DC circuit breaker to see if it has tripped and reset it, if necessary.

⚠WARNING: DO NOT TOUCH THE CHARGER'S TERMINALS OR AN ELECTRICAL SHOCK COULD OCCUR. A VOLTAGE IS PRESENT ON THE DC TERMINALS EVEN AFTER THE AC IS DISCONNECTED BECAUSE OF THE ENERGY STORED IN THE BATTERIES AND CAPACITORS.

d. Check the polarity between DC output and the battery and make sure their connections are tight.

e. Open the small cover on the front of the charger and make sure all of the binding posts nuts are tight.

f. If the steps above do not solve the problem, contact your local NRS service agent at 1-800-357-3572.

11. CHARGER SPECIFICATIONS

AC INPUT VOLTAGE:

115 Vac (108-128) or 230 Vac (216-256)

AC INPUT CURRENT:

28 amps for 115 Vac (full power, 60Hz)

14 amps for 230 Vac (full power, 60Hz)

AC INPUT FREQUENCY:

50/60 Hertz (single phase)

AC LINE REGULATION:

DC output at 136.2 volts (2.27 volts/cell for 60 cells) @ 12 amps 15% for 50 or 60 Hz 115 or 230 Vac

DC output at 122.6 volts (2.27 volts/cell for 54 cells) @ 12 amps 23% for 50 or 60 Hz 115 or 230 Vac

AC FUSES:

20 Amp time delay (MDA-20 or equivalent)

DC CIRCUIT BREAKER:

25 Amp time delay

DC OUTPUT:

Voltage range 100.0 – 150.0 $\pm$ 1 volt

Current Maximum 12.0 $\pm$ .6 amp

TEMPERATURE COMPENSATION:

3mV per °F per cell

WEIGHT, NET:

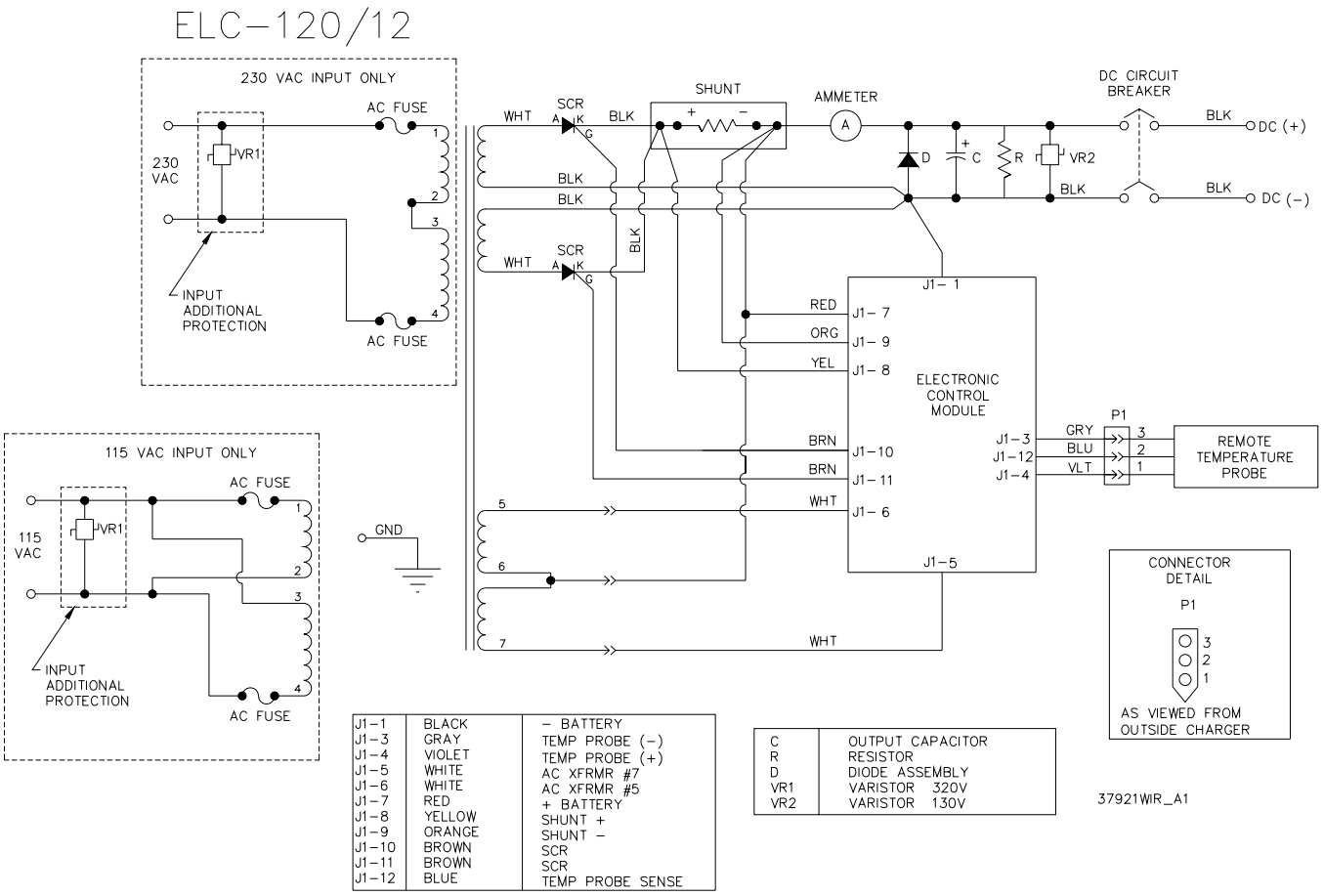
100 lbs.

12. PARTS LIST

The following is a list of parts found in the NRS Model ELC-120/12. When replacing a part, USE ONLY ORIGINAL FACTORY REPLACEMENT PARTS of the correct size and rating.

PART NO.	QTY.	DESCRIPTION
38263S	1	CASE ASSEMBLY
37927S	1	CONTROL MODULE (W/ ELECTRONIC BOARD
37914S	1	CONTROL CABLE (W/ SHUNT)
03837S	2	FUSE HOLDER ASSEMBLY
10749S	2	FUSE
37636S	1	CIRCUIT BREAKER ASSEMBLY
27317S	1	AMMETER
14197S	6	BUSHING, 1”
29741S	1	TEMPERATURE TRANSDUCER, 10’ (W/ TERMINAL)
29742S	1	TEMPERATURE TRANSDUCER, 30’ (W/ TERMINAL)
37941S	1	HEATSINK ASSEMBLY, W/ SCR’s
37923S	1	CAPACITOR ASSEMBLY, W/ DIODE ASSEMBLY
31309S	1	VARISTOR, 320V
32207S	1	TAP STRIP ASSEMBLY

13.WIRING DIAGRAM:



J1–1	BLACK	– BATTERY
J1–3	GRAY	TEMP PROBE (–)
J1–4	VIOLET	TEMP PROBE (+)
J1–5	WHITE	AC XFRMR #7
J1–6	WHITE	AC XFRMR #5
J1–7	RED	+ BATTERY
J1–8	YELLOW	SHUNT +
J1–9	ORANGE	SHUNT –
J1–10	BROWN	SCR
J1–11	BROWN	SCR
J1–12	BLUE	TEMP PROBE SENSE

C	OUTPUT CAPACITOR
R	RESISTOR
D	DIODE ASSEMBLY
VR1	VARISTOR 320V
VR2	VARISTOR 130V