



NATIONAL
RAILWAY
SUPPLY

Installation, Operating and
Service Instructions for ERB-C
5/5 Solid State Track Charger

MODEL ERB-C 5/5 TRACK 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 in an enclosed place and when it is being charged.
- 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 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, or local qualified service facility. If the charger is reassembled incorrectly, damage to the charger and the batteries or an electrical shock may result.

2. DESCRIPTION

The NATIONAL RAILWAY SUPPLY TRACK CHARGER, Model ERB-C 5/5, is a convection-cooled, solid state, 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 0 to 5 volts for gel-cell, liquid lead-acid, nickel cadmium, nickel iron, and valve regulated batteries.

3. THEORY OF OPERATION

When the charger is connected to the desired AC voltage source (115 or 230), 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 and is sensed by the electronic control module along with the charger's output voltage. 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 a large capacitor 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 charge 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 five amp 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 voltage set with the switches), 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.

If the battery is disconnected from the track circuit (maintenance purposes only), the track charger will maintain the float voltage for the track circuit. NEVER DISCONNECT THE BATTERIES FROM THE TRACK CIRCUIT OTHER THAN FOR SHORT PERIODS OF BATTERY MAINTENANCE.

⚠ WARNING: IF THE BATTERY IS DISCONNECTED AND THE TRACK CHARGER IS OPERATING, MAINTAIN A DISTANCE OF AT LEAST TEN FEET (10') FROM THE CHARGER BEFORE USING A HAND-HELD TRANSCEIVER. USING A TRANSCEIVER CLOSER THAN 10' MAY MOMENTARILY AFFECT THE CHARGER'S OUTPUT REGULATION.

Another feature of the track charger is 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 operating improperly.

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

$$V_{comp} = V - k(t - 77°F)$$

Where V is the voltage of the battery at 77°F, t is the temperature in °F, and $k = V / (0.003 / 2.23)$.

Example 1:

If a 2.23 volt battery is charging and the temperature increases to 100°F, then the output voltage decreases to 2.20 volts.

$$2.23 - .003(100°F - 77°F) = 2.16$$

Example 2:

If a 1.45 volt battery is charging and the temperature increases to 100°F, then the output voltage decreases to 1.40 volts.

$$1.45 - .00195(100°F - 77°F) = 1.40$$

Example 3:

If 4.54 volt batteries are charging and the temperature decreases to 0°F, the output voltage increases to 5.00 volts.

$$4.54 - .006(0°F - 77°F) = 5.00$$

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 air flow for convection cooling, allow two inches (2") minimum between the charger sides and other equipment and four inches (4") minimum on top of the charger.

⚠ 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 UP FOR THE PROPER USER SPECIFICATIONS BEFORE STARTING THE INITIAL CHARGE.

5. AC ELECTRICAL SUPPLY

The charger must be connected to a single-phase, 60 Hertz AC power source, which can be either 115 or 230 VAC. Use 8 or 10 AWG wire for the AC power input. Quarter-inch (1/4") ring terminals are required for proper connection to the AC input binding posts (A.A.R.). Remove the small door cover on the front of the charger by removing the two retaining screws. Connect the AC power terminals to the two posts on the left, as marked on the panel behind the posts. Connect the AC ground to the terminal lug provided on the back plate between the mounting holes.

⚠ WARNING: FAILURE TO CONNECT THE AC VOLTAGE CONDUCTORS PROPERLY COULD CAUSE SERIOUS DAMAGE TO THE CHARGER. BE SURE TO SET THE VOLTAGE SELECTION SWITCHES ON THE FRONT OF THE CHARGER TO THEIR PROPER POSITION.

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

6. DC OUTPUT

The DC output wires are connected on the two right-most binding posts as labeled on the panel behind the binding posts (positive on the left and negative on the right). The DC cables should have quarter-inch (1/4") terminals for connecting them to the binding posts. Check to make sure the polarity of the DC output wires is the same as those connected to the battery. The charger will not operate in a reversed polarity condition. **When connecting the DC wires to the charger with the AC power disconnected, a spark may occur.** This is caused by the output capacitors being charged by the batteries. If the DC polarity is reversed, a circuit breaker will protect the charger from internal damage. Correct the reversed wires and push the circuit breaker button back in. Replace the door cover on the front of the charger after tightening all of the binding post nuts.

⚠ 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 CAPACITOR.

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 connects into the front of the charger into a receptacle labeled TEMP PROBE. The other end of the cable has the temperature sensor sealed into a metal box which has a high performance adhesive tape on it for securing it to the battery. Clean a spot for the probe on the middle battery about three inches (3") down from the top on the front side. Make sure the spot is free of all dirt and oil or the probe will not adhere properly. For proper adhesion, the battery surface must be cleaned with isopropyl alcohol. Ideal application temperature range is 70°F to 100°F. Initial application to surfaces at temperatures below 50°F is not recommended. Under cold conditions, the surface should be warmed before application. Once properly applied, low temperatures will not affect bonding strength.

⚠ WARNING: IT IS IMPORTANT TO PLACE THE TEMPERATURE PROBE ON THE BATTERIES FOR THE PROPER TEMPERATURE COMPENSATION. IF THIS CANNOT BE DONE, LOCATE THE PROBE AS LOW AS POSSIBLE IN THE BUNGALOW OR CABINET. FOR LIGHTNING PROTECTION, LEAVE A MINIMUM CLEARANCE OF TWO INCHES (2") FROM THE PROBE TO ANY METAL OBJECT OR GROUND POTENTIAL.

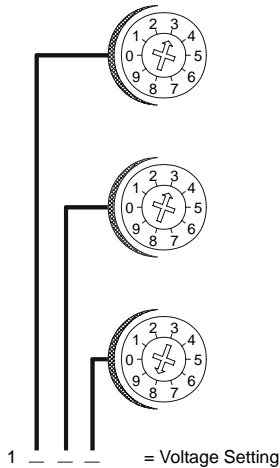
Remove the adhesive's protecting strip and press the probe firmly against the battery to ensure a good adhesion. Secure the probe's cable to a fixed object to ensure the probe will not be jerked or yanked loose. Use a cable tie mount on the battery or on the adjacent battery if necessary.

⚠ WARNING: SECURELY FASTEN THE TEMPERATURE PROBE CABLE TO PROTECT THE PROBE FROM BEING TORN FROM THE BATTERY.

8. OPERATION

The battery charger is adjustable with the three rotary switches on the front of the charger. The switches 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 the arrow head on the slot is pointing to the desired number.

Set the switches in the following manner: If the desired battery voltage is 2.23 volts, set the X1 switch to 2, the X0.1 switch to 2, and the X0.01 switch to 3. This will provide you with the proper charging voltage.



! WARNING: BE SURE EACH SWITCH IS SET ON A NUMBER AND NOT BETWEEN NUMBERS OR DAMAGE TO THE CHARGER OR BATTERIES COULD OCCUR.

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

9. MAINTENANCE

The battery charger requires minimum 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 NATIONAL RAILWAY SUPPLY service agent.

WHILE TESTING THE CURRENT IN THE TRACK CIRCUIT, USE A LOW IMPEDANCE METER TO MAINTAIN OPTIMUM CIRCUIT OPERATION. Charging through a high impedance meter will cause the track circuit float voltage to decrease.

10. SERVICING

If the battery operates improperly, follow the steps below.

- Begin by checking the voltage switches to verify their settings against the specifications of the batteries used. Also check the AC voltage selection switch for its proper setting.

- Check the circuit breaker to see if it has opened (popped out) and push it in to reset it, if necessary. Then check the fuses to make sure they have not blown.
- Next, remove the small cover on the front of the charger and make sure all of the binding post nuts are tight.
- Check the polarity between the DC output and the battery and make sure their connections are tight.
- If the steps above do not solve the problem, contact your local NATIONAL RAILWAY SUPPLY agent.

11. CHARGER SPECIFICATIONS

AC INPUT VOLTAGE:

115 VAC (105-128) or 230 VAC (210-256)

AC INPUT CURRENT:

.68 amps for 115 VAC (full power)

.34 amps for 230 VAC (full power)

AC INPUT FREQUENCY:

60 \pm 3% Hertz (single-phase)

AC LINE REGULATION:

for a constant output current at 2.20 volts/cell

+ 23.5% for 2 cells

+ 41.0% for 1 cell

AC FUSES:

MDA .5 or equivalent

POWER FACTOR:

A percentage is given for a high rate (.5 amps DC current at 2.0 volts/cell) and a low rate (.15 amps at 2.0 volts/cell)

	High Rate	Low Rate
Nickel iron	43.0 for 2 cells 34.0 for 1 cell	40.0 for 2 cells 38.0 for 1 cell
Lead acid	54.0 for 2 cells 39.0 for 1 cell	24.0 for 2 cells 39.0 for 1 cell

DC OUTPUT VOLTAGE MAXIMUM:

5.3 volts

DC OUTPUT RIPPLE:

20 mVp-p at 5.0 amps, 2.0 V/cell

< 5 mVp-p at .15 amps, 2.20 V/cell

DC OUTPUT REGULATION:

Voltage - \pm 0.5% maximum in a range from 1.0 to 5.0 volts

Current - 5.0 \pm .5 amps

WEIGHT, NET:

11.0 lbs.

12. PARTS LIST

The following is a list of all the parts found in the NATIONAL RAILWAY SUPPLY TRACK CHARGER MODEL ERB-C 5/5. When replacing a part, USE ONLY ORIGINAL FACTORY REPLACEMENT PARTS of the correct size and rating.

PART NO.	DESCRIPTION
12905S	TRANSFORMER ASSEMBLY
15802S	SHUNT ASSEMBLY
13215S	CONTROL MODULE
15788S	CONTROL MODULE MOUNT
21274S	BASE ASSEMBLY
15797S	COVER ASSEMBLY
05322S	FUSEHOLDER ASSEMBLY
15762S	FUSE, .5 AMP
06819S	CIRCUIT BREAKER ASSEMBLY
15811S	AC SWITCH ASSEMBLY
14197S	BUSHINGS, 1" DIA (4)
14123S	TEMPERATURE TRANSDUCER, 10'
14124S	TEMPERATURE TRANSDUCER, 20'
14126S	TEMPERATURE TRANSDUCER, 30'
15742S	SCR ASSEMBLY, 16 AMP
15988S	OUTPUT CAP, C, 4700 UF
12717S	VARISTOR W/ CAP, VR1
15799S	TAP STRIP ASSEMBLY
14759S	VARISTOR ASSEMBLY, VR2

The adhesive used on the temperature probe is 3M Scotch #Y-9473, which is a thermally conducting, two-sided adhesive tape. If a replacement adhesive is needed, use this type of tape or an equivalent adhesive.

13. WIRING DIAGRAM

