

Section III

NTN4633C, NTN4634B, and NTN4921B

Single-Unit Rapid-Charge Battery Chargers

1. INTRODUCTION

The NTN4633C (117Vac, UL approved), the NTN4634B (220Vac), and the NTN4921B (240Vac) Single-Unit Rapid-Charge Battery Chargers are accessory items for charging rechargeable nickel-cadmium batteries. The chargers are approved for use with the following standard-charge and dual-charge batteries:

| KIT NUMBER | CAPACITY | CHARGE TYPE |
|--|----------|-------------|
| NTN4564, NTN4584, NTN4822, NTN4823, NTN4871, NTN5047, ZLN6408 | Medium | Dual |
| NTN4585, NTN4586, NTN4824, NTN4825, NTN5049, NTN5414, NTN5415, NTN5447, NTN5448, ZLN6409 | High | Dual |
| NTN4563, NTN4868, NTN5046 | Medium | Standard |
| NTN4588, NTN4869, NTN5048, NTN5413, NTN5446 | High | Standard |

2. SPECIFICATIONS

| | |
|---------------------------------|---|
| INPUT POWER | 117Vac, 220Vac, 240Vac; 50/60Hz |
| SIZE | 7.72 x 5.12 x 3.14 in. (193 x 128 x 78.5mm) |
| WEIGHT | 3.54 lbs. (1.61kg) |
| CHARGE RATE | Approximately 1 hour |
| OPERATING TEMPERATURE RANGE | 0° C to 50° C. |
| RAPID-CHARGE TEMPERATURE WINDOW | 8°C. to 41°C. |

3. DESCRIPTION

These single-unit rapid chargers are current sensing, voltage sensing, current regulating devices which provide two different charger rates; a one-hour rate and a 16-hour rate. A dual-charge nickel-cadmium battery is charged initially at a one-hour charge rate, after which the charging rate is automatically reduced to the 16-hour rate. A standard-charge nickel-cadmium battery is charged only at the 16-hour rate. Either of the batteries (dual or standard) can be left in the charger indefinitely without any resultant harm.

The NTN4633C charger operates from a 117Vac, 60Hz power source; the NTN4634B charger operates from a 220Vac, 50Hz power source, and the

NTN4921B operates from a 240Vac, 50Hz power source. Two light-emitting diode (LED) indicators display charging conditions and battery fault indications, such as open or shorted battery cells.

4. OPERATION

Normal battery operation is eight hours of use followed by approximately 1 hour of rapid charge. Place the charger in operation as follows:

- Visually check the battery and charger charging contacts for dirt, grease or other material which may prevent good conduction, and clean if necessary.
- Connect the charger's ac plug to the appropriate ac power source. Both LED's will light momentarily.

CAUTION

Turn radio off before inserting battery (with radio) into the charger.

- Insert the battery, with or without radio, into the charger pocket. When the battery contacts mate with the charger's charging contacts, charging begins. If the battery is within the proper temperature range (+8 to +41 degrees C.), the red (CHARGING) LED will light to indicate that the battery is rapid-charging.

NOTE

To ensure proper charging, make certain that the battery is pushed fully into the charger pocket.

- Allow sufficient time for the battery to fully charge (approximately 1 hour). When rapid-charging is complete, trickle-charging begins. The red (CHARGING) LED will turn off and the green (charge COMPLETE) LED will turn on.

At this time, the battery has reached approximately 90% full charge and can be used. If the battery is left in the charger, it will reach 100% full charge after approximately two hours of trickle-charging. The battery can be removed from the charger and used or remain in the charger indefinitely.

If a battery which is outside the +8 to +41 degree C. temperature range is inserted into the charger, it will be trickle-charged. The green LED will light if the battery temperature is above 41°C, or the red LED will light if the battery temperature is below 8°C. Once the battery moves inside the temperature window, the

charger automatically switches to the rapid-charge rate and charging continues as described in the steps above.

5. CIRCUIT DESCRIPTION
(Refer to the schematic diagram)

a. General

Operating voltage (B+) is developed from a step down transformer (T1), with a fused primary, driving a full-wave bridge rectifier (CR1-CR4). The B+ (approximately 30Vdc) output is applied to a number of transistor stages and to a precision 12-volt regulator circuit (U4). The regulated 12Vdc (A) is applied to various transistor stages and to most of the logic circuits. A reduced B+ voltage (approximately 27Vdc) is applied to the Vcc input at U1 pin 4.

Charging current for the battery is provided by a constant-current source. The charging current is controlled by a current regulator with negative feedback. The current regulator is comprised of transistor circuits (Q1-Q6), a differential amplifier (U1C), and a single-input amplifier (U1D). Under normal charging conditions, transistors Q2 and Q6 are turned on, R10 is effectively shorted (rapid charge condition). For a momentary increase in charging current, the voltage across R14 will increase. The input to U1C pin 10 increases, which produces an increased output at U1C pin 8. The higher potential at U1C pin 8 is fed through CR8, R21, and R22 to U1D pin 13. This higher input at pin 13 reduces the output at U1D pin 14, which is passed through R15, CR7, and VR2 to reduce the drive of Q3, then Q1. The reduced drive of Q1 results in a reduction of charging current, returning back to normal.

Diodes CR5, CR6, transistor Q4, and resistor R73 provide for a constant current input of transistor Q2, ensuring Q2 to be turned on, independent of battery terminal voltage and charge rate. Together with Q5, this constant current source can be switched off for trickle-charging, by switching off Q5, consequently Q4, and Q2. With Q2 turned off, resistor R10 is added in the charging path.

Rapid-charge charging current for a high-capacity rapid-charge battery is approximately 830mA. Trickle-charge current for the same battery is approximately 72mA. The following chart lists the two different capacity batteries and the battery's respective RC, rapid charging current, and trickle charging current.

| BATTERY CAPACITY | RC | T1 CHARGE CURRENT | |
|------------------|------|-------------------|-------|
| | | TRICKLE | RAPID |
| Medium | 5.6k | 50mA | 550mA |
| High | 3.3k | 80mA | 830mA |

b. Maximum Current Limiter

The maximum current limiter is a protective circuit for the charger. If the charge rate exceeds a predetermined threshold, set by resistors R30 and R31, the output at U2A pin 1 goes high. This high turns on Q7, which turns off Q6. With Q6 turned off, the charging rate is no longer a function of RC, but a function of resistor R23. The charging current is limited to approximately 830mA.

c. Battery Sense Detect

With no battery in the charger, the voltage at U1B pin 6 is approximately 9.6V, which holds the output at U1B pin 7 low. When a battery is placed in the charger, via the conduction of transistor Q6, the voltage at U1B pin 6 drops to approximately 2.2V (during normal charging) or lower (if either the dynamic voltage clamp circuit or the open cell detect circuit is activated). The voltage drop at pin 6 of U1B, results in a high output at U1B pin 7, which turns on transistor Q8 and the red CHARGING LED, CR18.

d. Temperature Window and Bistable Multivibrator

Comparators U2C and U2D sense the RT line and set the cold and hot sides of the temperature window respectively. The cold side temperature is 8 degrees C. The hot side temperature is 41 degrees C. In a normal rapid-charge condition, a voltage level which represents the battery's temperature is felt at U2C pin 10 and U2D pin 9. As the battery charges and the battery's temperature rises, the voltage at U2D pin 9 decreases. At 41 degrees C., the low level input at U2D pin 9 reaches a point that triggers the output at U2D pin 14 to go low. The low output of U2D is applied through CR12, CR13, and R13 to the base of Q5 and the following sequence occurs. Transistor Q5 turns off, Q4 turns off, Q2 turns off, resistor R10 is placed in the charging circuit, and the battery trickle charges. The low output at U2D is also applied through coupling capacitor C15 to U3A pin 7, which triggers the output of U3A at pin 1 to switch from high to low. This low output at U3A pin 1 is applied to the LED display circuitry via Q8, turning off the red (CHARGING) LED, and via Q10/Q9, turning on the green (charge COMPLETE) LED. When the battery's temperature cools down below 41 degrees C., the outputs of U2D and U3A are latched low via feedback through diode CR14. This feedback latching prevents a fully charged battery from being rapid-charged again.

When a battery outside the cold temperature window is placed in the charger, the battery sense detect circuit, via U1B, turns on the red (CHARGING) LED. The temperature window circuit, via an increased voltage level at U2C pin 10, triggers a low from U2C pin 13 to initiate trickle charging. The output of U2C is

isolated from the output of U2D by diode CR13. Thus, the green LED remains off and the red LED remains on. When the battery's temperature rises and enters the temperature window, the output at U2C goes high, Q5, Q4, and Q2 turn on, and the battery begins rapid charging.

e. Oscillator

The oscillator circuit turns the green and red LEDs on and off (flashing) to indicate that a problem (shorted or open cells or shorted contacts) is detected with the battery or battery contacts. Whenever the potential at the cathode is lower than the anode of diode CR26 (a low from U2B pin 2 or a low from U3D pin 14), the oscillator becomes activated. The oscillator output at U3B pin 2 flips back and forth (high to low), and is sent to the LED display circuit. On the low cycle, both transistors (Q8 and Q9) are turned off and both LEDs are turned off. On the high cycle, both transistors are turned on and both LEDs are turned on. If a problem occurs during the charge complete cycle, only the green LED will flash.

f. Battery Open Circuit (O/C) Detect

During normal charging conditions (good battery) or when a battery is not in the charger, the voltage at the cathode of CR16 is somewhat higher than the anode voltage. The output of U2B at pin 2 is high. When an open-circuited battery is detected (RC present but no charging current), the low impedance path of RC (compared to R53) causes the voltage at the anode to drop to a very low level. This low-level input (2.2V to 1.2V) at U2B pin 5 flips the output (U2B pin 2) high to low. The U2B low is passed to the LED display circuit, turning on the green LED (CR21). The U2B low is also passed to the oscillator circuit, which triggers both LEDs to flash.

g. Shorted Cells and Short Circuit Detect

This circuit detects shorted battery cells and shorted contacts by monitoring the battery's terminal voltage (BATT B+). Low battery voltage at U3D pin 9 triggers the comparator (for rapid-charge battery or standard-charge battery) to produce a low output at U3D pin 14. A low from the comparator keys the oscillator to flash the LEDs and to trickle-charge the battery.

h. Dynamic Voltage Clamp

During normal charging conditions, a low voltage level at U1A pin 2 holds the output at U1A pin 1 high. As the battery voltage (BATT B+) increases, the input voltage level at U1A pin 2 increases. If the BATT B+ voltage increases to a predetermined threshold level (approximately 15.5 volts), the higher potential at U1A pin 2 triggers the output at U1A pin 1 low. This low output from U1A pin 1 overrides the output at U1D pin 14, and reduces the base drive current of transistor Q3, hence that of Q1. This negative feedback action to reduce the charging current results in maintaining a constant battery terminal voltage (15.5 volts). This circuit prevents overvoltage conditions that could damage the radio's electronics if the radio is attached to the battery when charging.

b. Radio Contacts

If the red LED does not turn on when a battery is inserted into the pocket, check the contacts of the radio for dirt, grease, or other foreign material. Clean the contacts if necessary.

c. DC Voltage Measurement Charts

In the following charts,

- Measurements were taken at 25 degrees C with a Fluke 8010A digital multimeter
- All voltage readings are dc and referenced to charger ground
- DC voltages designated with an "*" will vary with the temperature of the battery

6. MAINTENANCE

a. Fuse

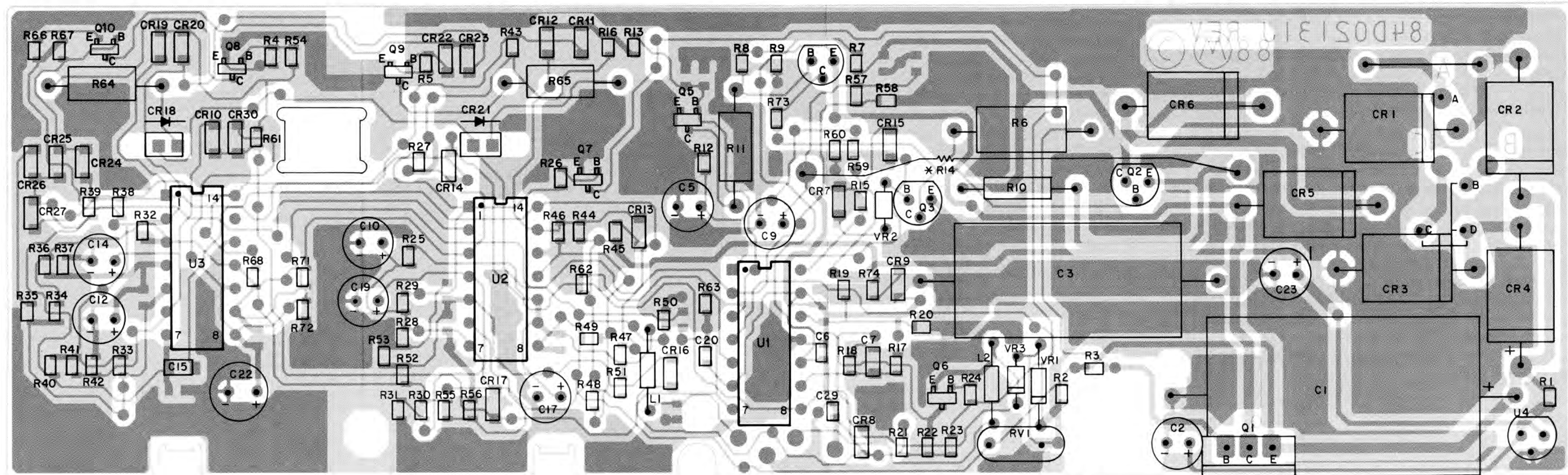
The fuse (F1) in the primary circuit of transformer (T1) is the only user serviceable part in the charger. If necessary, replace this fuse with one the same size and rating as marked, or refer to the electrical parts list for the proper electrical specifications. After replacing the fuse, if the charger still fails to operate properly, contact a local Motorola Service Shop (MSS) for repairs.

DC VOLTAGE MEASUREMENTS CHARTS

| | | | Q1 | | | Q2 | | Q3 | Q4 | Q5 | Q6 | | | Q7 | Q8 | | Q9 | | Q10 | | VR1 |
|--------------------------|---------|---------------|------|-------|-------|-------|-------|------|-------|------|------|------|------|------|------|------|-------|------|-------|------|-------|
| BATTERY AND CONDITION | B+ BATT | CHRG. CUR. mA | E | B | C | B | E | B | B | B | B | C | E | B | C | B | C | B | B | C | |
| NO BATTERY | 10.76 | - | 28.2 | 28.2 | 1.9 | 1.89 | 10.76 | 0.00 | 1.92 | 0.08 | 9.28 | 9.69 | 9.25 | 0.06 | 26.8 | 0.03 | 26.6 | 0.00 | 11.73 | 0.53 | 11.84 |
| RAPID CHARGE (MEDIUM) | 12.85 | 563.5 | 22.3 | 21.6 | 15.79 | 14.87 | 14.07 | 0.62 | 14.80 | 0.70 | 2.70 | 2.18 | 2.10 | 0.06 | 0.09 | 0.71 | 20.7 | 0.00 | 11.74 | 0.02 | 11.85 |
| COMPLETE CHARGE (MEDIUM) | 12.84 | 51.14 | 26.8 | 26.2 | 15.55 | 3.99 | 12.94 | 0.60 | 15.55 | 0.17 | 2.70 | 2.18 | 2.10 | 0.07 | 25.4 | 0.15 | 0.08 | 0.71 | 0.60 | 1.25 | 11.85 |
| RAPID CHARGE (HIGH) | 12.86 | 805.5 | 20.8 | 20.00 | 16.40 | 15.44 | 14.62 | 0.63 | 15.39 | 0.71 | 0.05 | 2.18 | 0.05 | 0.65 | 0.10 | 0.71 | 19.10 | 0.00 | 11.74 | 0.02 | 11.86 |
| COMPLETE CHARGE (HIGH) | 12.83 | 72.51 | 26.5 | 25.8 | 16.09 | 9.03 | 12.99 | 0.60 | 16.09 | 0.17 | 0.05 | 2.18 | 0.00 | 0.63 | 25.1 | 0.15 | 0.08 | 0.72 | 0.60 | 1.25 | 11.85 |

| | U1 | | | | | | | | | | | | | U2 | | | | | | | | | | U3 | | | | | | | | | | |
|--------------------------|-------|-------|------|------|------|------|-------|-------|-------|-------|------|------|------|-------|-------|------|------|------|------|------|-------|-------|------|-------|-------|-------|-------|------|-------|------|-------|------|------|-------|
| BATTERY AND CONDITION | B + | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 13 | 14 | 1 | 2 | 4 | 5 | 6 | 7 | 8 | 9 | 10* | 11 | 13 | 14 | 1 | 2 | 4 | 5 | 6 | 7 | 8 | 9 | 14 |
| NO BATTERY | 26.8 | 25.5 | 5.66 | 7.61 | 6.97 | 9.64 | 0.61 | 0.00 | 10.60 | 9.23 | 2.17 | 9.68 | 0.00 | 0.06 | 11.52 | 2.14 | 3.93 | 6.88 | 0.00 | 2.91 | 11.83 | 11.83 | 7.32 | 0.08 | 11.83 | 11.83 | 11.73 | 9.61 | 11.49 | 1.11 | 11.80 | 1.10 | 5.66 | 11.77 |
| RAPID CHARGE (MEDIUM) | 21.5 | 20.2 | 6.67 | 7.61 | 6.97 | 2.18 | 20.1 | 8.56 | 12.09 | 12.36 | 2.17 | 2.18 | 7.30 | 0.06 | 11.54 | 2.14 | 3.93 | 6.88 | 4.34 | 2.96 | 6.89 | 6.89 | 7.44 | 11.80 | 11.79 | 11.84 | 11.74 | 9.63 | 11.79 | 7.63 | 11.81 | 2.18 | 6.67 | 11.79 |
| COMPLETE CHARGE (MEDIUM) | 25.9 | 24.6 | 6.65 | 7.61 | 6.98 | 2.18 | 24.5 | 8.69 | 12.07 | 12.23 | 2.17 | 2.18 | 6.88 | 0.07 | 11.48 | 2.14 | 3.93 | 6.89 | 4.41 | 2.92 | 0.62 | 0.62 | 7.33 | 0.75 | 0.11 | 0.06 | 11.74 | 9.63 | 11.79 | 7.64 | 2.23 | 2.18 | 6.65 | 11.79 |
| RAPID CHARGE (HIGH) | 19.10 | 17.79 | 6.69 | 7.61 | 6.98 | 2.18 | 17.71 | 12.12 | 12.57 | 12.75 | 2.17 | 2.18 | 7.49 | 11.19 | 11.55 | 2.14 | 3.93 | 6.89 | 8.40 | 2.95 | 6.90 | 6.90 | 7.44 | 11.80 | 11.79 | 11.85 | 11.74 | 9.63 | 11.79 | 7.64 | 11.82 | 2.18 | 6.69 | 11.79 |
| COMPLETE CHARGE (HIGH) | 24.8 | 23.6 | 6.65 | 7.61 | 6.98 | 2.18 | 23.5 | 12.13 | 12.51 | 12.67 | 2.17 | 2.18 | 7.01 | 11.19 | 11.48 | 2.14 | 3.93 | 6.89 | 8.40 | 2.92 | 0.62 | 0.62 | 7.33 | 0.75 | 0.11 | 0.06 | 11.74 | 9.63 | 11.79 | 7.63 | 2.23 | 2.18 | 6.65 | 11.79 |

VIEWED FROM COMPONENT SIDE

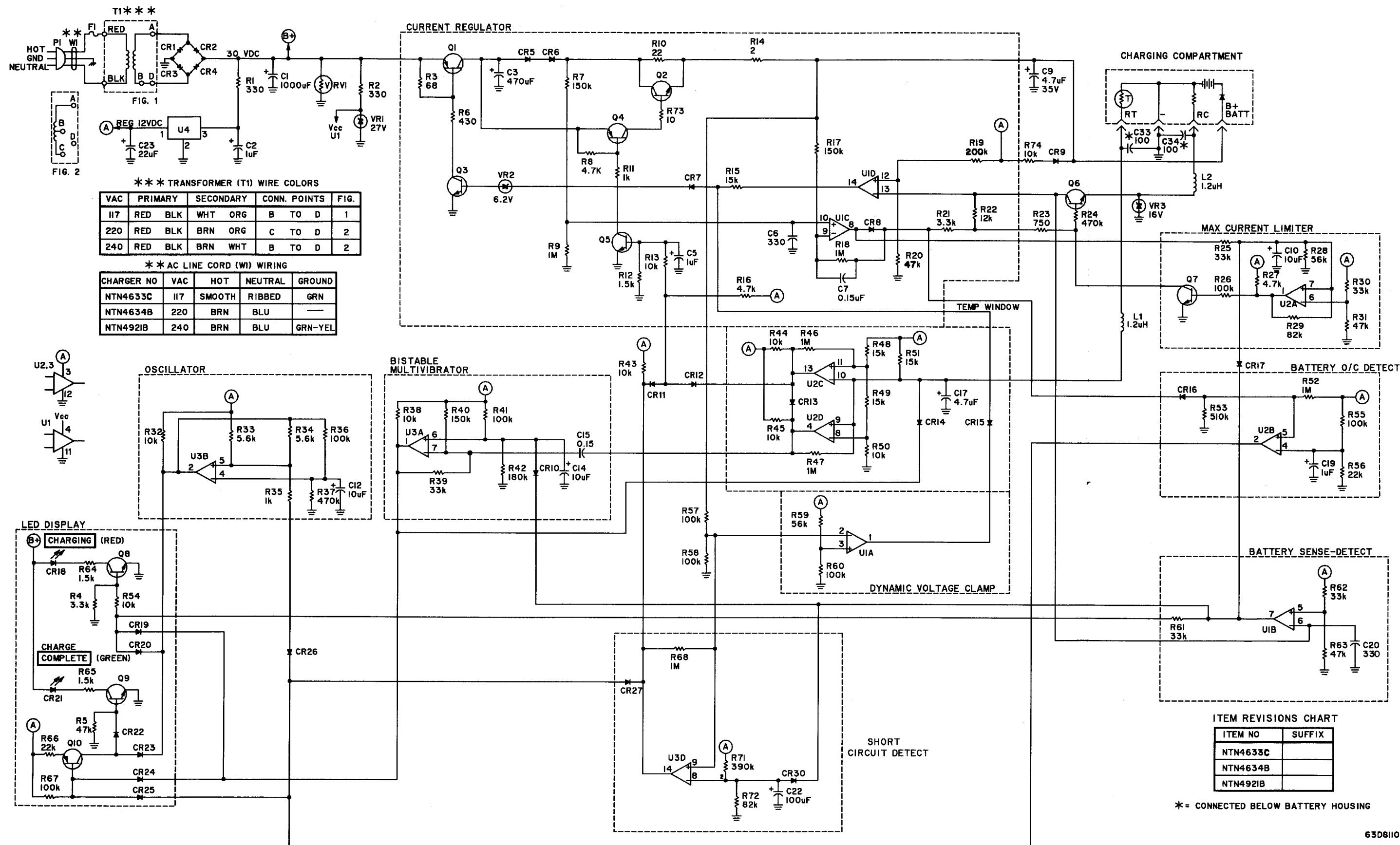


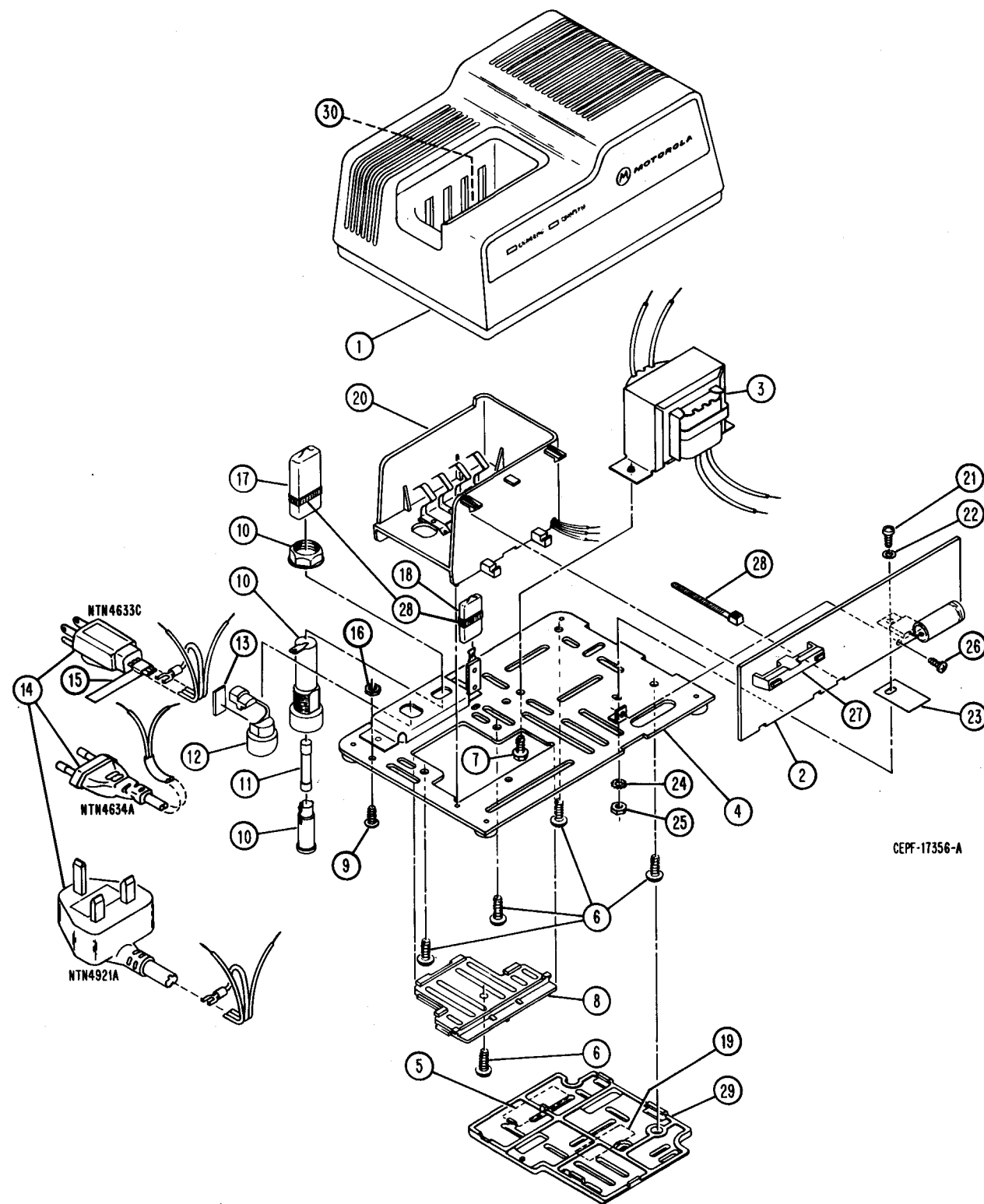
* MOUNTED ON BACK OF BOARD

OL-CEPF-198 08-A

Electrical Parts List **TPLF-3807-B**
NTN4633C (117Vac) Single-Unit Charger (Rapid)
NTN4634B (220Vac) Single-Unit Charger (Rapid)
NTN4921B (240Vac) Single-Unit Charger (Rapid)

| REFERENCE SYMBOL | MOTOROLA PART NO. | DESCRIPTION |
|------------------|-------------------|--|
| | | CAPACITOR, Fixed: pF±5%; 50V unless stated |
| C1 | 2360563A01 | 1000μF |
| C2 | 2360561M09 | 1μF |
| C3 | 2360561N02 | 470μF; 35V |
| C5 | 2360561M09 | 1μF |
| C6 | 2160520C13 | 330 |
| C7 | 2160521H39 | 0.1μF +80-20%; 25V |
| C9 | 2360561M15 | 4.7μF; 35V |
| C10 | 2360561M19 | 10μF; 35V |
| C12 | 2360561M19 | 10μF; 35V |
| C14 | 2360561M19 | 10μF; 35V |
| C15 | 2160521H39 | 0.1μF +80-20%; 25V |
| C17 | 2360561M15 | 4.7μF; 35V |
| C19 | 2360561M09 | 1μF |
| C20 | 2160520C13 | 330 |
| C22 | 2360561M44 | 100μF; 16V |
| C23 | 2360561M23 | 22μF; 16V |
| C33,34 | 2105455G12 | 100; 63V |
| | | DIODE: See Note |
| CR1thru 6 | 4805746G16 | Silicon |
| CR7 thru 17 | 4805494Q08 | Silicon |
| CR18 | 4805729G08 | LED, Red |
| CR19, 20 | 4805494Q04 | Silicon |
| CR21 | 4805729G09 | LED, Green |
| CR22 thru 27 | 4805494Q04 | Silicon |





TORQUE CHART

| ITEM NO. | SCREW SIZE | TORQUE IN INCH POUNDS |
|----------|--------------|-----------------------|
| 6 | 8-32 x 3/8" | 10 |
| 7 | 8-32 x 3/8" | 30 |
| 9 | 6-32 x 3/8" | 8 |
| 21 | 4-40 x 3/8" | 5 |
| 26 | 4-40 x 3/16" | 5 |

TEPF-20974-O

Exploded View Parts List, Rapid Charger TPLF-3454-B
NTN4633C (117Vac)
NTN4634B (220Vac)
NTN4921B (240Vac)

| ITEM NO. | MOTOROLA PART NO. | DESCRIPTION |
|----------|-------------------|---|
| 1 | 0105957M08 | ASSEMBLY, Top Housing; includes: Housing, Escutcheon, and Fastener Clip |
| 2 | 0102712J16 | ASSEMBLY, Circuit Board with LED's |
| 3 | See Note | TRANSFORMER (T1) |
| 4 | 0102712J13 | ASSEMBLY, Base Plate; includes: Brackets, Single Lug Terminal Strip, Base Plate, and 4 Rubber Bumpers |
| 5 | 5405228Q02 | LABEL, Caution |
| 6 | 0300138574 | SCREW, Phillips Hd.; 8-32 x 3/8" (5 req'd) |
| 7 | 0300131632 | SCREW, Tapping; Slotted Hd.; 8-32 x 3/8" (2 req'd) |
| 8 | 1305130Q01 | GRILL, Base |
| 9 | 0300138035 | SCREW, Phillips Hd.; 6-32 x 3/8" |
| 10 | 0905724C02 | RECEPTACLE, Fuse Holder |
| 11 | See Note | FUSE (F1) |
| 12 | 4205723C01 | RETAINER, Cable |
| 13 | 4305233D01 | SPACER |
| 14 | See Note | ASSEMBLY, Cable (P1, W1) |
| 15 | 3305360N01 | LABEL, Cable |
| 16 | 0200007005 | NUT, Hex; 6-32 x 1/4" x 3/32" |
| 17 | 3805637M02 | CAP GUARD, Fuse Holder |
| 18 | 3805637M01 | CAP GUARD, Terminal |
| 19 | 3305334N22 | LABEL, Info |
| 20 | 0105957M07 | ASSEMBLY, Partition; includes: Thermal Partition, Charging Contacts, Fastener Clip, and Capacitors C33, C34 |
| 21 | 0300120938 | SCREW, Phillips Hd.; 4-40 x 5/16" |
| 22 | 4305552N01 | BUSHING, Nylon |
| 23 | 1405154N01 | INSULATOR, Mica |
| 24 | 0400007667 | LOCKWASHER, #4 External Tooth |
| 25 | 0200120486 | NUT, Hex; 4-40 x 1/4" x 3/32" |
| 26 | 0300120938 | SCREW, Phillips Hd.; 4-40 x 5/16" |
| 27 | 0705567P01 | HOLDER, LED |
| 28 | 4210217A26 | TIE WRAP |
| 29 | 1305412R01 | GRILL, Thermal |
| 30 | 3305455U01 | LABEL, Pocket |

NOTE: Refer to Electrical Parts List for part number and description.

END OF DOCUMENT