

BATTERY CHARGER POWER SUPPLY 675 W, 110/220 V, 60 Hz

MODEL TPN1271A (110 V) MODEL TPN1273A (110/220 V)

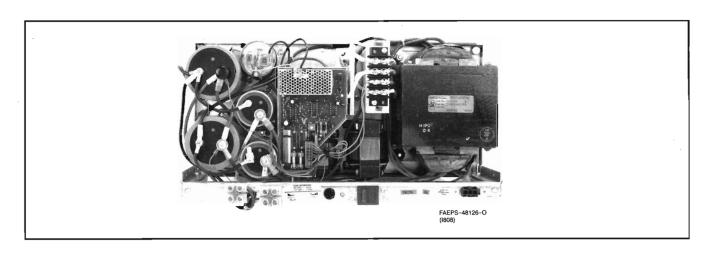


Figure 1. Model TPN1271A & TPN1273A Power Supply

PERFORMANCE SPECIFICATIONS

Weight Operating Temp	22 kg (48.5 lb.) -30° to +80°C (-22° to +176°F)
Input Voltage	90-140 / 180-280 V ~; 60 Hz (Model TPN1273A)
Line Current*	96-132 V ~; 60 Hz (Model TPN1271A) 11 A max. at full rated power supply output (110 V ~)
Steady State Output Voltage	A+ adjustable from 13.0 (26.0) V to 15.0 (30.0) V with S650 set to FLOAT,
Output Power (Rated)	S650 set to EQUALIZE provides 1 V (2 V) increase, 14.25 V (28.5 V) if battery is not connected 675 Watts continuous
Output Ripple	50 mV p-p 25° to 80°C (77° to 176°F)
1	Derate to 100 mV p-p at -30°C(-22°F)
Efficiency	Greater than 76% (full load)
Short Circuit Current	Equal to or less than 130 A (measured at TB601)

^{*}When calculating power requirements, do not use Line Current to calculate dissipated power. Use a power meter with provisions for non-unity power factor.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

1. DESCRIPTION

The TPN1271A and TPN1273A Power Supplies are a high efficiency, solid state, power source for operation of base or repeater radio stations. The power supply consists of two main sections: a ferroresonant transformer–rectifier–filter chassis, and a battery charger control board.

The transformer has two primary windings, a high current secondary winding, and a resonant secondary winding. Under normal operations, the current in the resonant winding causes the transformer core to saturate, limiting the transformer output voltage. Rectifying and filtering the transformer output produces a stable direct current output.

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The features of this power supply include short circuit protection which is inherent in the ferroresonant power transformer, and overvoltage protection. The features of the battery charger function include adjustable output voltage, temperature compensation option, low voltage battery disconnect option, and battery equalization.

Table 1. Model Complement For TPN1271A & TPN1273A Power Supply

Kit	Description
TKN8665A	Internal 28/14 V DC Cable
TKN8666A	External 28/14 V DC Cable
TRN7277A	Battery Charger Control Board
TRN7098A	Power Supply Hardware Kit (TPN1271A)
TRN7276A	Battery Charger Hardware Kit
TRN7237A	Power Supply Hardware Kit (TPN1273A)
TRN7332A	Battery Charger 14/28 V Hardware Kit
TRN7281A	Option C29, Low Battery Voltage Dropout Kit

2. DESCRIPTION OF OPERATION

2.1 TRN7098A OR TRN7237A POWER SUPPLY CHASSIS

The Power Supply Chassis performs the conversion of ac line voltage to the dc voltages required by the radio. The supply provides rectification, filtering, and regulation. Refer to the functional and schematic diagrams for circuit details.

2.1.1 Rectification and Filtering

The secondary voltage of transformer T651 is rectified by CR651 thru CR654. Ground connection for the diodes is provided through the grounded heat sink to the chassis. Output filtering is provided by the network of C652, L651, and C653 for 28 V at TB651. A 14 V output is provided at J603 by a center tap on the secondary, and is filtered by C654, L652, and C655.

2.1.2 Regulation

Line and load regulation is provided by the ferroresonant action in the resonant secondary winding of power transformer T651. The high voltage winding resonates with C651, causing the secondary to saturate the core and reduce the secondary output voltage.

2.2 TRN7277A BATTERY CHARGER CONTROL BOARD

Line and load regulation is controlled by the TRN7277A Battery Charger Control Board. Regulation is accomplished by controlling the saturation of ferroresonant transformer T651 by way of control inductor L650. This inductor is switched across the resonant winding of the transformer as the output voltage reaches a preset level. Potentiometer R662 (VOLT ADJ) permits adjustment of the output voltage from 13.0 to 15.0 V. Switching and timing circuitry for the control inductor is described in the following paragraphs.

2.2.1 5 V and 11 V Reference Voltages

A 5 V reference voltage is generated by the power supply output voltage, R637, R641, and Zener diode VR600. The 5 V reference is used in the control voltage generator circuit, overvoltage protection circuits, and (optional) low voltage battery disconnect circuit. An 11 V reference voltage is generated by the power supply output voltage, R647, and Zener diode VR601. The 11 V reference is used to power U600 thru U602, and to provide a bias voltage for the ac filter, clock generator, and ramp generator circuits.

2.2.2 Secondary AC Filter and Clock Generator

A clock signal, at twice the line frequency, is generated via the secondary ac signal. The signals are bandpass filtered by U601C and U601D, and the output is compared to a dc bias voltage. As each signal increases above the dc bias voltage, a pulse is generated at the output of U600C and U600D.

2.2.3 Ramp Generator

The clock circuit is used to generate a ramp signal by controlling transistor Q600. The ramp signal is generated by C607, R624, and the reference voltage from Zener diode VR601, in conjunction with Q600.

2.2.4 Control Voltage Generator

U601B compares the 5 V reference voltage with a representative power supply voltage, generated by U601A. It then generates a control voltage with gain to the pulse width modulator.

2.2.5 Pulse Width Modulator

U600B compares the control voltage with the ramp signal, and generates a pulse whose width is determined by how early in the ramp cycle the control voltage is equal to the ramp voltage.

2.2.6 Power Switch

SCR Q656 and TRIAC Q657 operate together to switch control inductor L650 in and out of the resonant winding of transformer T601. The diode bridge between the TRIAC and SCR allows the TRIAC to be triggered every half cycle. The trigger point during each half cycle is determined by the pulse width modulator.

2.2.7 FLOAT/EQUALIZE Switch S650

The EQUALIZE position of switch S650 allows the battery charger output voltage to be increased by 1 volt for the initial charging and recharging of certain battery types. Refer to the specifications for the battery type being used to determine the charging requirements. The FLOAT position of S650 is used to maintain the battery

charge at a constant level. If temperature compensation is used, the equalize increment will be 0.5 V.

2.2.8 Overvoltage Protection

The battery charger board contains two overvoltage protection circuits. Resistors R642, R638, R623, and R615 determine the trigger points of each rail. The first rail is set to trigger at 15.5 V, and is used to limit the output voltage to 15.5 V, independent of the temperature compensation voltage (optional, see paragraph 2.2.10) and output voltage adjust potentiometer R662. Once this rail is triggered. it limits the voltage by turning on transistor Q602. If the main regulator or the first rail fails, the final rail will trigger at 17 V and shut down the power supply output voltage. The station will then revert to battery mode if the batteries are connected and charged. If battery mode is not possible, the station will be inoperable. When U602B is triggered, it turns on SCR Q615, which turns on TRIAC Q606. The TRIAC then places control choke L650 across the ferroresonant winding of T601 until C615 charges up to a voltage sufficient to trigger Q603 (from 15 to 25 seconds). This cycle repeats until the output voltage falls below 17 V. This rail also sends an overvoltage alarm to the station control, signaling a battery charger failure. A serviceperson should respond immediately.

2.2.9 AC Line Sense Fail

Transistors Q614 and Q616 generate an AC FAIL signal to the station control when loss of the secondary ac signals is detected.

2.2.10 Temperature Compensation Option

When the temperature compensation option is ordered, a temperature sensing probe is installed near the emergency battery bank, and is connected to the battery charger board connector J604 by way of the station junction box. The temperature probe generates a temperature-dependent voltage which is used by U601A to adjust the power supply output voltage. The amount of output voltage change is -39 mV per +1 degree Celsius of temperature change. When installing this option, the normal ambient temperature of the battery room must be determined in order to set the power supply output voltage.

2.2.11 Low Voltage Battery Disconnect Option

This option adds relay K600 to the battery charger board. When the 14 V battery bank output voltage drops below 10.25 V, as measured by U602C; or when the 28 V battery bank output voltage drops below 20.5 V, as measured by U602D, K600 opens, disconnecting the emergency batteries from the power supply. In order for K600 to close and reconnect the batteries, the output voltage, as measured by U602C, must increase to greater than 11.5 V; and the output voltage, as measured by U602D, must increase to greater than 23 V.

3. BATTERY CONNECTION AND INSTALLATION

3.1 GENERAL

Installation of the station with the battery charger option is standard except for connection of the 12-volt battery (ten cells nickel-cadmium type, six cells lead-acid or gelcell type).

Locate the batteries in a secure place, and as close to the station as possible. The battery cable length must be kept as short as practical, because of possible voltage drops on the battery cable. A substantial voltage drop can be developed across the low resistance of the battery cable due to the high currents drawn from the battery during transmit.

Select a battery location that has unobstructed air circulation, preferably a cool, dry place with ample width aisles to allow easy access to the cells for installation, taking readings, adding fluid, and cleaning. The batteries must not be placed near radiators, boilers, or other heat generating devices.

Battery capacity should be carefully determined before purchase. Factors influencing battery capacity include busy hour load, protection time duration desired, final cell voltage limit, and minimum operating temperatures. For further information on battery selection, contact your Motorola Area Systems Engineer.

Proper connection of the battery cables to the battery terminals is extremely important to the service life of the batteries. If connections are made carefully to clean, acid-free surfaces, and connections are kept tight by periodic checking, they will give trouble-free service over the life of the battery.

CAUTION

DO NOT connect batteries to the power supply before setting the float voltage.

3.2 FLOAT VOLTAGE ADJUSTMENT

The float voltage of the power supply must be adjusted at the time the batteries are installed. The float voltage is the A+ output voltage of the power supply which will keep a battery fully charged when connected across the A+ output terminals. The float voltage adjustment varies with the type batteries being installed and the ambient temperature at the battery installation location. Refer to paragraph 3.4 A+ Voltage Level Adjustment, and to the battery manufacturer's specifications for information on adjusting the float voltage.

Give the battery a freshening or boost charge prior to installation. do this in accordance with the battery manufacturer's instructions.

3.3 BATTERY CABLE INSTALLATION

See Figure 2 for component locations. Connect the battery cable from the junction box to the battery as follows:

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- Step 1. Make certain that the dc power sources are capable of the specified input requirementa as indicated in the performance specifications chart on page 1.
- Step 2. Remove fuses F610 and F611 from the external battery cable to prevent accidental short circuiting during installation.

CAUTION

Observe proper polarity when connecting batteries and battery cables.

- Step 3. Connect the battery cable plug (P605) to connector J605 on the junction box, and route the battery cable to the battery connection sources. Be sure the BLACK plus WHITE cable pair connects to side "B" and the RED plus EMPTY cable pair connects to side "A".
- Step 4. Connect the RED external battery cable wire to the positive (+) terminal of the 28 V external dc source.
- Step 5. Connect the WHITE external battery cable wire to the positive terminal of the 14 V external dc source.
- Step 6. Connect the BLACK wire of the battery cable to the negative (-) terminals of the external dc sources..
- Step 7. Check to ensure proper polarity of the battery cable leads, then reinstall fuse F611 (28 V source) first, then F610 (14 V source), removed in step 2.

NOTE

CR655 and CR656 provide reverse polarity protection, and will cause F610 and/or F611 to open, should the polarity of the applied dc voltage be incorrect.

NOTE

If power is to be removed from the station for any reason after the initial installation, the most convenient method is to remove the in-line fuse (F601) from the battery cable.

3.4 A+ VOLTAGE LEVEL ADJUSTMENT

The A+ output of the power supply is factory adjusted for use with nickel-cadmium batteries at 14.25 volts. Refer to the schematic diagram at the end of this section. If adjustment is required for use with other battery types, set voltage adjust potentiometer R662 (VOLT ADJ) for the desired float voltage as follows:

NOTE

Level adjustment is allowed for the 14 V input. The 28 V input will track the 14 V input by 2×14 V output $\pm 5\%$ at no 28 V load. When batteries are connected, the 28 V output will be 2×14 V output $\pm 2\%$.

- Step 1. If connected, disconnect the batteries. Set FLOAT/EQUALIZE switch S650 to the FLOAT position.
- Step 2. Connect a dc voltmeter, with at least 3% accuracy, between terminals TB601 + and TB601 on the power supply. Allow the power supply to warm up under PTT load for at least 10 minutes.

CAUTION

Refer to the battery manufacturer's specifications for the precise voltage setting required for charging the type of emergency battery to be used. If specific information is unavailable, set the charging voltage for the type of battery as specified in step 3.

NOTE

If the temperature compensation option was not ordered, perform following step 3. If the temperature compensation option was ordered, skip step 3 and perform following steps 4 thru 6.

- Step 3. Set VOLT ADJ potentiometer R662 to provide a charging voltage: (a) as specified by the battery manufacturer; (b) of 14.25 volts if batteries are not to be connected at this time; (c) of 14.25 volts for nickel-cadmium batteries at 25° C; (d) of 13.25 volts for lead-acid batteries at 25° C; or (e) of 13.5 volts for gel-cell batteries at 25° C.
- Step 4. If temperature compensation option was ordered, connect the temperature probe cable to the outside of the junction box at J5. Route the temperature probe to a location on or near the battery bank which will provide an accurate ambient temperature reading.
- Step 5. Set VOLT ADJ potentiometer R662 to provide a charging voltage: (a) as specified by the battery manufacturer; (b) of 14.25 volts if batteries are not to be connected at this time; (c) of 14.25 volts for nickel-cadmium batteries at 25° C; (d) of 13.25 volts for lead-acid batteries at 25° C; or (e) of 13.5 volts for gel-cell batteries at 25° C.
- Step 6. Measure the ambient temperature at the location of the temperature probe. Adjust R662 to change the output voltage by -39 mv for each 1° C change from 25° C to 30° C. If the ambient temperature is above 30° C, change the voltage to the proper value as if the ambient temperature was 30° C. For temperatures below 25° C, adjust R662 to change the output voltage by +39 mv for every 1° C change below 25° C.

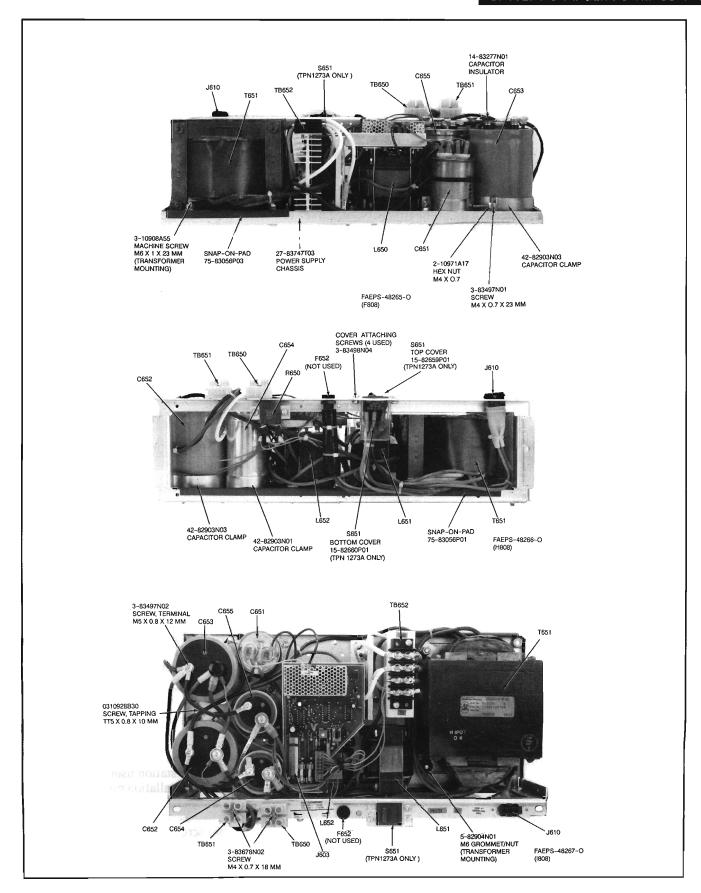


Figure 2. Mechanical Parts Location Photographs

4. AC INPUT POWER AND GROUND CONNECTIONS

4.1 INTRODUCTION

The Power Supply is shipped from the factory for operation from a 110 V $^{\sim}$, 60 Hz power source. However, the power supply may also be operated from a 220 V $^{\sim}$, 60 Hz (TPN1273A only) power source by switching selection and proper fusing. Refer to the Initial Power Supply Setup paragraph for details.

If a station has a separate power circuit, it should be either a 15.0 ampere (minimum), $110 \,\mathrm{V}^{\sim}$, $60 \,\mathrm{Hz}$ or a 8.0 ampere (minimum), $220 \,\mathrm{V}^{\sim}$, $60 \,\mathrm{Hz}$ circuit, depending upon the power source. (If a station has two power supplies, the line current requirements double.) The power lines should be installed in accordance with local electrical codes. A substantial earth ground must be provided as close to and in as straight a line as possible with a ground terminal on the station cabinet. DO NOT consider the electrical outlet box as a substantial ground. Refer to the Lighting Protection Recommendation Instruction section, 68P81111E17, for additional grounding recommendations.

The primary ac power line may be installed prior to installation of the cabinet and terminated near the location chosen for the station if the power line cord supplied with the station is to be used. If the station power is to be supplied via conduit protected wiring, the station must be installed first. The following paragraphs provide a separate procedure for each type of installation.

WARNING

A main power ON-OFF switch is not normally provided with the station. Therefore, the equipment will be immediately operational when main power is applied from a live ac outlet.

4.2 INITIAL POWER SUPPLY SET-UP

Step 1. Determine the primary power source voltage (110 V \sim , 60 Hz or 220 V \sim , 60 Hz).

Step 2. Ensure that the switch (S651, TPN1273A only) on the power supply chassis is set to correspond with the primary power source voltage.

Step 3. Check the value of line fuse (located in the junction box). If the station is to be operated on $110\,\mathrm{V}$ \sim , 60 Hz, install a 10A (15A for dual power supplies) ampere fuse and fuse cap. If the station is to be operated on 220 V \sim , 60 Hz, install the 5.0A (6.3A for dual power supplies) ampere fuse and fuse cap supplied.

4.3 INSTALLATION USING POWER LINE CORD SUPPLIED WITH THE POWER SUPPLY

Step 1. Install the station as described in the station instruction manual.

Step 2. Refer to Figure 2 for component locations. If the station does not have an installed junction box, connect the female plug of the supplied three—wire ac line cord (P604) to the ac inlet (P605) mounted on the bracket which is mounted on the power supply chassis. If the station has an installed junction box, connect the female plug of the supplied three—wire ac line cord (P604) to the main ac power connector (J604) on the junction box. Refer to Figure 3 for connection details.

NOTE

The primary power wire colors used conform to international standards. Refer to the following cross reference table as required.

Table 2. Primary Power Wire Color Standards

Power	International	US Standard Wire
Connection	STD Wire Color	Color
Line	Brown	Black
Neutral	Blue	White
Ground	Green/Yellow	Green

Step 3. Connect the power cord to an ac outlet provided near the station.

Step 4. Connect the station cabinet to a substantial earth ground located as close as possible to the station, and in as straight a line as possible with the station ground terminal.

WARNING

Even if a three-wire grounded primary ac power source is available, the radio equipment must be grounded separately to prevent electrical shock hazards and provide lightning protection.

4.4 STATION INSTALLATION USING CONDUIT PROTECTED WIRE

The station junction box has provisions to facilitate the connection of ac power to the station using conduit protected wiring. The following installation procedure is recommended.

Step 1. Remove the two screws attaching ac input connector J604 to the station junction box and carefully pull the connector away from the junction box.

Step 2. Cut the wires as close as possible to the ac input connector.

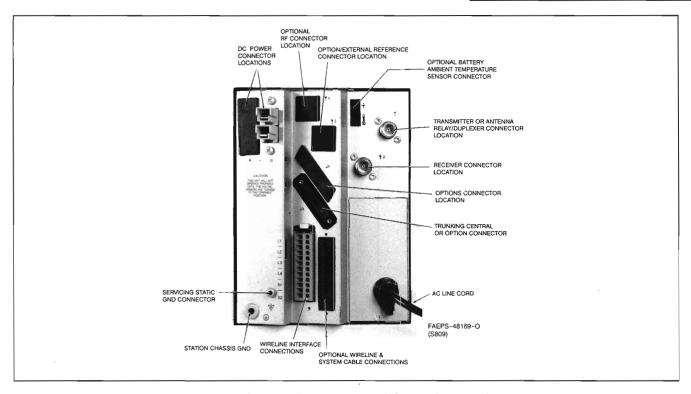


Figure 3. Junction Box External Connection Detail

- Step 3. Strip insulation from the wires for a sufficient length to allow connection to the incoming power leads.
- Step 4. Attach a 4-1/8" x 2-3/8" x 1-1/2" electrical box (Appleton Catalog No. 184-E, universal code 69351 or equivalent box, using an extension ring to protect the wires from sharp edges, not supplied) to the junction box using two 6-32 x 5/16" self-tapping washer head screws in the holes provided. See Figure 3.
- Step 5. Attach conduit to the electrical box and make the electrical connections. It may be desirable to provide an ON-OFF switch or convenience outlet on the electrical box.

Step 6. Attach a suitable cover to the electrical box.

5. MAINTENANCE

5.1 INTRODUCTION

Maintenance and repair of the power supply requires an understanding of its operation. Refer to the power supply Description of Operation paragraph for this information.

5.2 TEST EQUIPMENT REQUIRED

The following test equipment is necessary for servicing in the event that maintenance is required.

- 3½ digit DVM (Motorola Model R1001 or equivalent).
- DC current meter (50 amperes)

- Load resistor (variable from 0 to 15 ohms, capable of carrying 20 amperes).
- Variable voltage ac line transformer (0-130 volts).
- Oscilloscope.
- Bench service line cord, consisting of:

Quantity	Motorola Part No.	Description
1	15-83183N01	Housing
2	39-83145N01	Contact
1	39-83146N01	Contact
1	30-865903	Cord

5.3 POWER SUPPLY REMOVAL

WARNING

The power supply can be unexpectedly heavy. It balances sharply to the right. Be sure to follow the removal instructions exactly.

- Step 1. Refer to Figure 2. Disconnect P610 from J610 on the power supply chassis. Disconnect P603 from J603 on the battery charger control board. Remove the two wires from the + and terminals of TB651 on the power supply chassis. Note the color coding of the wires and the polarity of the terminals. If necessary, tag the wires for ease of identification.
- Step 2. Refer to Figure 4. Remove main chassis screws and loosen main chassis captive screws.
- Step 3. Slide power supply chassis forward until chassis is flush with cabinet, as shown in Figure 5.

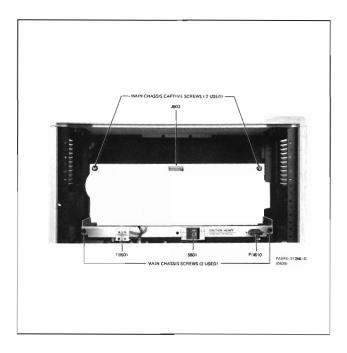


Figure 4. Power Supply Mounting Hardware and External Connections

WARNING

Do not allow chassis to slide freely beyond front of cabinet. Cabinet rail support ends abruptly.

Step 4. Grip the chassis with BOTH hands, as shown in Figure 6. Find a comfortable grip around the flattened parts of the metal. Adjacent parts have sharp edges.

IMPORTANT

Note wrist position in Figure 6.

Step 5. Plant feet firmly, with good body balance, in order to receive and control the heavy power supply.

Step 6. Reach under the bottom of the chassis with your left hand, to balance the heavy chassis on the cabinet. Press the chassis firmly against the rails, or else it may suddenly slide out of the cabinet. See Figure 6.

Step 7. Reposition the left hand from balancing the chassis to a point where a firm grip can be obtained.

Step 8. Brace your body to receive a heavy weight, and lift the power supply chassis free of the cabinet. See Figure 7.

Step 9. Re-install the power supply by reversing the removal procedure.



Figure 5. Power Supply Chassis Travel Distance

5.4 BATTERY MAINTENANCE

The battery or batteries used for emergency power require certain routine maintenance procedures to assure long trouble-free operation. Persons servicing the batteries should refer to the battery manufacturer's recommendations for routine maintenance. In addition, certain maintenance procedures are appropriate following each incidence of emergency power operation.

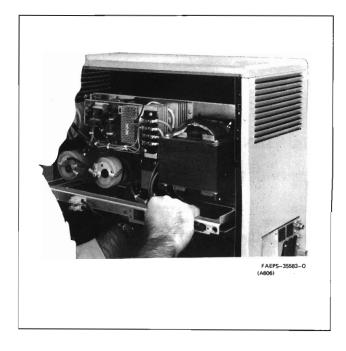


Figure 6. Properly Gripped Chassis

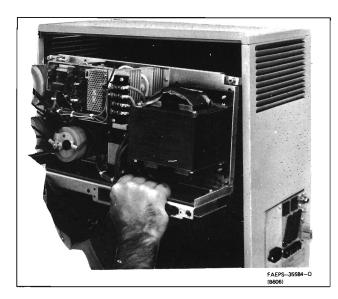


Figure 7. Power Supply Removed From Cabinet

Routine battery maintenance procedures for the two most common battery types (nickel-cadmium and lead-acid) are given in the following paragraphs. The importance of keeping accurate battery maintenance record cannot be over-emphasized. a chart or table should be constructed, listing all voltage readings, temperature and hydrometer readings (where applicable), and the dates the readings were taken or maintenance procedures were performed. To be most effective, the battery maintenance report charts should be kept at the battery location for ready use and reference.

5.4.1 Nickel-Cadmium Battery Maintenance

Perform the following routine maintenance procedures at six-month intervals.

Step 1. Clean the battery and inspect it for damage.

Step 2. Measure cell voltages and enter the voltage readings on the maintenance report. Most maintenance schedules require voltage readings of every cell each time maintenance is performed. If a difference of .05 volt or more exists between any two cells, apply an "equalizing charge" to the battery for 48 hours, or until three consecutive cell voltage measurements show no change (readings to be taken at 30 minute intervals). The terminal voltage of the battery should read $15.25 \pm .02 \text{ V}$.

Step 3. Add water as required to keep the electrolyte solution in each cell above minimum. Use *distilled water only*. Refer to the battery manufacturer's service literature for instructions on filling.

If frequent replacement of electrolyte is required, the charging rate may be too high. In this case, check the A+voltage with FLOAT/EQUALIZE switch S650 set to the FLOAT position. The A+ voltage should conform to the battery manufacturer's recommended charging voltage setting for the battery type being used. If the manufacturer's recommendations are not available, set the A+ volt-

age to 14.25 volts. Under certain conditions, the battery may require more electrolyte, even though the charging voltage is correct. In this case, the charging voltage should be reduced in small increments until infrequent addition of electrolyte is required.

CAUTION

DO not use any tool on a nickel-cadmium battery which may have been used with lead-acid batteries. To do so may destroy the nickel-cadmium battery due to chemical contamination by electrolyte or other foreign matter from the lead-acid battery on which the tool was used.

5.4.2 Lead-Acid Battery Maintenance

Perform the following routine maintenance procedures on a monthly basis, unless otherwise specified.

WARNING

The electrolyte solution in a lead-acid battery is caustic and corrosive. Avoid any type of direct contact with the electrolyte solution. If you do contact the solution, wash the affected area immediately with soap and water. If the solution enters the eyes, flush the eyes with copious amounts of clean water and contact a physician or first aid facility immediately.

Step 1. Clean the battery and inspect it for damage.

Step 2. Measure cell voltages and record the voltage readings on the maintenance report. Most maintenance schedules require voltage readings of every cell each time maintenance is performed. If a difference of .05 volt or more exists between any two cells, apply an "equalizing charge" to the battery for the period specified by the battery manufacturer.

Step 3. Take specific gravity readings on all cells with a hydrometer calibrated for the type of electrolyte being used.

Step 4. Observe the necessary precautions to ensure that the readings are accurate, that no chemical contamination of the cells occurs, and to prevent bodily injury from contact with the electrolyte.

Step 5. After taking a reading, always return the electrolyte in the hydrometer syringe to the cell from which it came. (Failure to do so will reduce the specific gravity of the cell when distilled water is added to fill the cell to the required level.)

Step 6. For an accurate comparison with "standard" specific gravity readings, as published in the manufacturer's specifications, a correction factor must be applied to all readings to normalize them with the standard values, when taken at temperatures other than 77° F (xx°C). However, if the battery temperature readings tend to be

taken at the same time as the specific gravity readings, a trend toward a change in the specific gravity will be apparent without having to apply the correction factor.

The correction factor is easily applied, due to a linear relationship between changes in temperature and specific gravity above and below 77°F (xx°C). For each three degrees above 77°F, add .001 (known as "1 point") to the "standard" value of specific gravity. Conversely, for each three degrees below 77°F (xx°C), subtract 1 point.

Step 7. Take a specific gravity reading of the "pilot cell" monthly. It is not necessary to continually check the specific gravity of all cells, because any gradual changes usually occur in all cells. One cell is therefore designated the pilot cell, and the monthly specific gravity readings are always taken from this cell. (Be sure to indicate on the maintenance chart which cell has been designated as the pilot cell.

Step 8. Every three months, take and record specific gravity readings for all cells.

Step 9. Add distilled water as required to maintain the electrolyte solution in each cell to the minimum level. In some batteries, the electrolyte level must be maintained between the high-level and low-level marks on the inside of each cell. If the cells have no such markers, refer to the battery manufacturer's literature.

CAUTION

DO not use any tool on a lead-acid battery which may have been used with nickel-cadmium batteries. To do so may destroy the lead-acid battery due to chemical contamination by electrolyte or other foreign matter from the nickel-cadmium battery on which the tool was used.

If frequent replacement of electrolyte is required, the charging rate may be too high. In this case, check the A+voltage with FLOAT/EQUALIZE switch S650 set to the FLOAT position. The A+ voltage should conform to the battery manufacturer's recommended charging voltage setting for the battery type being used. If the manufacturer's recommendations are not available, set the A+ volt-

age to 13.25 volts. Under certain conditions, the battery may require more electrolyte, even though the charging voltage is correct. In this case, the 13.25 volts charging voltage should be reduced in small increments until infrequent addition of electrolyte is required.

Step 10. Equalize charging of a lead-acid battery should be performed under any of the following conditions:

- Following each known use (or discharge) of the battery.
- If the specific gravity of the pilot cell, or any other cell is more then ten-thousandths (10 points) below its full charge value.
- If the voltage difference between any two cells is .05 volts or greater.
- As part of each routine monthly maintenance procedure, independent of any of the previous stated conditions.

Equalize charging should continue for: (a) the number of hours specified by the battery manufacturer, which will vary according to temperature, charging voltage, and the battery manufacturer's recommendations, or; (b) until three successive readings of cell voltage and specific gravity show *no change* (readings to be taken at 30-minute intervals).

5.4.3 Gel-Cell Battery Maintenance

Gel-cell batteries are generally maintenance-free, and do not normally require an equalizing voltage for recharging. Refer to the battery manufacturer's literature and specifications for the battery being used. If there is an indication of trouble with the battery, and the manufacturer's literature does not provide troubleshooting instructions, contact the battery manufacturer, or remove and replace the battery.

5.5 TROUBLESHOOTING

Refer to Table 3 for troubleshooting tips and procedures, and to Figure 2 for mechanical details. Refer to the functional block diagram, circuit board details, and schematic diagram for electrical circuit details.

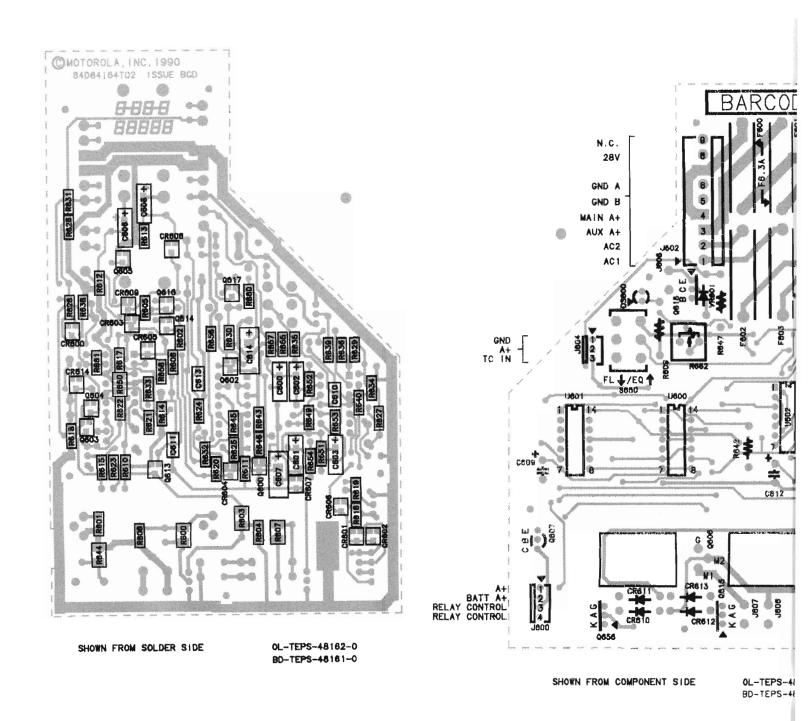
 Table 3. Battery Charger Power Supply Troubleshooting Procedures

Symptom	Action
A. No output voltage.	 Check primary line connection to supply. Check for transformer secondary voltage at TB602.
B. A+ output voltage too high and can- not be adjusted,	Check for trigger pulses at U600B, pin 14: 1) If no trigger is present, check for proper signals from RAMP GEN. back to CLOCK GEN. If proper signals are present, check voltages at CONTROL VOLTAGE GEN. 2) If correct pulses are present, check power switching circuitry (Q656 and Q657).
C. A+ output voltage too low.	 Check for trigger pulses at U600B, pin 14: a) If no trigger is present, check for proper signals from RAMP GEN. back to CLOCK GEN. If proper signals are present, check voltages at CONTROL VOLTAGE GEN. b) If correct pulses are present, check power switching circuitry (Q656 and Q657). Check power diodes CR601 and CR602. Check voltage at U602B, pin 7 to see if 17 V rail is pulling output voltage low.

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BATTERY CHARGER POWER SUPPLY

MODEL TPN1271A & TPN1273A CIRCUIT BOARD DETAIL AND PARTS LIST



SHOWN FROM SOLDER SIDE

SHOWN FROM COMPONEN

parts list

TRN7241A Battery Charger Control Board TRN7277A Battery Charger Control Board

PL-11673-A

		TRN7277A Battery	Charger Control Bo	ard PL-11673-A
		REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
				capacitor, fixed: uF +-10% 35V:
		C600 thru 603	2311049A01	unless otherwise stated 0.1
		C604	0884637L31	.047 250V
		C606 C607	2311049A01 2311049A08	0.1 1.0
		C608	2311049A01	0.1
		C609	2311019A21	10 ± 20%
		C610 C611	2113741B69 2113741B45	0.1 ±5% 50V .01 ±5% 50V
1 april 1997 July 2011 20	7)	C612	2311019A28	22 ± 20%
	}	C613	2113741869	0.1 ±5% 50V
DE.	1	C614 C615	2311049A08 2311019A45	1.0 100 ± 20% 16V
28	1			diada (ta)
J803 ®	1	CR600 thru 609	4811058A11	diode: (see note) silicon
	MAIN A+	CR610 thru 613 CR614	4882466H18 4811058A11	silicon silicon
	1	011014	4011030411	Silicon
142	AUX A+			light emitting diode: (see note)
11 3	GND D	DS600	4883636N03	green
P 40	GND A			
5	OVER VOLTAGE	E000 604	0E000471107	fuse:
	1	F600, 601	6582847N27	FUSE, F6.3 A, 250 V; 2 used
6	AC FAIL			connector
111 11	1	J600	2883143M05	connector: male: 4-contact
8	AC2	J601	2880006R02	male: 2-contact
4	AC1	J602	2882984N06 or 2882984N14	male: 6-contact (TRN7241A) male: 9-contact (TRN7277A)
	,	J603	2882984N14	male: 9-contact (TRN7277A) male: 9-contact
discount of the last of the la	T DEMOTE	J604	2883143M06	male: 3-contact
	REMOTE	J605 J606 thru 608	2882984N01 2910231A10	male: 2-contact terminal
. Ll 2	EQUALIZER	3000 thru 606	2910231A10	terminar
+	1			transistor: (see note)
7 7		Q600	4811056C21	NPN type M56C21
C. C.	-	Q602 thru 605	4811056C21	NPN type M56C21
7 6		Q606 Q607	4882965F02 4800869568	thyristor: 15A 800V NPN type M9568
The Control	1	Q613	4882233P14	PNP type M33P14
	1	Q614	4811056C21	NPN type M56C21
0 0 4	}	Q615 Q616,617	4882604N01 4811056C21	thyristor: 4A 500V NPN type M56C21
24	}	Q618	4800869829	PNP type M9829
	{	Q656	4882604N01	thyristor: 4A 500V
8,	1	Q657	4882965F02	thyristor: 15A 800V
d601	* *			resistor, fixed: ±5% 1/8W
4 3€				unless otherwise stated
A	1	R600	0611072A59	2.7k 1/4W
81	{	R601 R602	0611077A56 0611077B09	180 27k
\$	}	R603	0611072A59	2.7k 1/4W
	\$	R604	0611077A68	560
Prince P.	}	R605 R606	0611077B23 0611077B09	100k 27k
6.8	2	R607	0611072A59	2.7k 1/4W
M2	3	R608	0611077A56	180
4	and S	R609 R610	0611086A59 0611077B09	1k 1W 27k
N.E	3	R611	0611077A74	1k
	1	R612,613	0611077B09	27k
	Lag	R614 R615	0611077A90 0611077H06	4.7k 150k ± 1%
● H ●	1	R616	0611077A98	10k
C804	3	R617 R618	0611077B09	27k 100k
2001	\$	R619	0611077B23 0611077B03	100k 15k
gar true tree team than they	ng 10- }	R620	0611077A90	4.7k
		R621	0611077B09	27k
		R622 R623	0611077B43 0611077H42	680k 357k ± 1%
3-481600		R624	0611077F60	4.7k ± 1% (TRN7241A)
1-48159-0		R625	or 0611077F79 0611077B17	7.5k ±1% (TRN7277A) 56k
		R626	0611077B09	27k
2/		R627	0611077B27	150k (TRN7241A)
		R628	or 0611077B20 0611077F63	75k (TRN7277A) 5.11k ± 1%
INT SI	DE	R629	0611077E73	604 ± 1%
	_	R630	0611077A68	560 15 By + 1%
		R631,632 R633	0611077G11 0611077G14	15.8k ± 1% 16.9k ± 1%
		R634	0611077F91	10k ± 1%
		R635	0611077F71	6.19k ± 1%
		R636,637 R638	0611077F91 0611077E73	10k ± 1% 604 ± 1%
		R639,640	0611077F91	10k ± 1%
		R641	0611040C91	10k ±0.5% 1/4W
		R642 R643	0611040B96 0611077A90	1.05k ±0.5% 1/4W 4.7k
		R644	0611072A49	1k 1/4W
		R645	0611077A82	2.2k
		R646	0611077A90	4.7k
			_	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R647	0611086A42	200 1W (TRN7241A)
	or 0611066A41	180 1W (TRN7277A)
R649	0611077A84	2.7k
R650	0611072A49	1k 1/4W
3651,652	0611077B27	150k
R653	0611077A90	4.7k
3654,655	0611077F71	6.19k ± 1%
3656,657	0611077B16	51k
1658	0611077B09	27 ±5%; 1/8 W
3660	0611077B03	15k
3661	0611077A01	0-ohm jumper (TRN7277A)
R662	1883452F02	var 2k ± 10% 1/2W
		switch:
6650	4083204B02	dpdt slide
		integrated circuit: (see note)
J600	5184621K74	comparator
J601	5184621K32	quad operational amplifier
J602	5184621K74	comparator
		voltage regulator: (see note)
/R600	5183222M81	adjustable shunt precision regulator
/R601	4882256C34	Zener: 11V
	non-re	ferenced items
	0910548A04	SOCKET, 2-contact: for F600,601
	2683472R01	HEAT SINK: 2 used for Q606,Q657
	5483865R01	LABEL, white bar code
	5484246T01	LABEL, bar code
te: For optimum	performance, diod	es, transistors, and integrated circuits

TRN7275A Battery Charger Hardware Kit; 65 mH TRN7276A Battery Charger Hardware Kit; 120 mH

PL-1167

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	non-re	eterenced Items
	2582419N05	CHOKE, power supply: 65 mH 50 Hz (TRN7275A)
	or 2582419N03	CHOKE, power supply: 120 mH 50 Hz (TRN7276A)
	0210971A17	NUT, machine: M4 x 0.7
	0310928B30	SCREW, locking: TT5 x 0.8 x 10
	0383497N03	SCREW, machine: M5 x 0.8 x 25; 4 used
	0383497N05	SCREW, machine: M4 x 0.7 x 10
	0383498N04	SCREW, tapping: M4 x 0.7 x 7; 4 used
	0400007651	WASHER, #8 Internal lock: 5 used
	0582904N02	GROMMET, M9.58: 4 used
	0783006P02	BRACKET, battery charger bd (TRN72754
	or 0783006P01	BRACKET, battery charger bd (TRN7276)
	1483986N01	INSULATOR, circuit board
	1583901N01	COVER, battery option board
	2982907N07	TERMINAL, red ring: 2 used
	2983113N02	TERMINAL, red insulating: 2 used
	4210217A02	STRAP, .091 x 3.62 white tie: 8 used
	4382980N01	STANDOFF, white board support: 6 used
_	5483971N01	LABEL

note: P/N's 2582419N03, 0783006P02, and 0582904N02 are part of asse 0184373T01 (TRN7276A). P/N's 2582419N05, 0783006P02, and 0582904N02 are passembly 0184373T02 (TRN7275A).

TRN7332A Unique Hardware for 14/26 V Battery Charger

PL-116

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R650, R651	1783389G02	resistor, fixed: ±5%; 1/8 W unless otherwise stated RESISTOR, 30 + -5% 20W; 2 used
	non-r	eferenced items
	0310928A27 0383678N02 2900859118 2982907N05 2982907N07 2983113N03 3183576K02	SCREW, locking: TT4 x 0.7 x 30; 2 used SCREW, tapping: M4 x 0.7 x 18 LUG, crimp: 4 used TERMINAL, yellow ring TERMINAL, red ring TERMINAL, red insulating TERMINAL BLOCK

note: For optimum performance, diodes, transistors, and integrated circuits must ordered by Motorola part numbers.

	REFERENCE	Supply Hardware Ki MOTOROLA	t, 675 W, 60 Hz PL-11742-0
TION	SYMBOL	PART NO.	DESCRIPTION
			capacitor, fixed: uF ±5% 50V:
			unless otherwise stated
	C651	0882682N05	30 +-6%; 330
	C652,653 C654,655	2382681N13	93,000 -10 + 75%; 40V
	C654,655	2382681N06	73,500 -10 + 75%; 20V
			connector:
	P602	0983360N02	receptacle: 9-contact
			•
			coll:
	L651	2582686N01	420uH
	L652	2582620P01	1.1mH
	00054 050	4000700000	diode (see note):
	CR651-652, CR653-654	4882732C09 4882732C08	silicon silicon
	011000-004	4002/32000	Silicon
			fuse:
)	F652	6582847N26	5A; 250V, fast blow (use with 220Vac)
		6500138179	10A; 250V, (use with 110Vac)
			terminal block:
1	TB651 TB652	3183576K03 3100811350	4-contact 4-contact
gulator	10002	3100611350	4-contact
			transformer
	T651	2584158T01	transformer: power: 575W 50Hz 110/220V (TPN1273A)
601	, , ,	2583354T01	power, 675 W, 60 Hz 110 V (TPN1271A)
2657		non-r	eferenced Items
		0210971A17	NUT, hex: M4 x 0.7; 6 used
		0210971A19	NUT, hex: M6 x 1; 2 used
circuits must be		0310908A55	SCREW, machine; M6 x 1 x 25; 4 used
		0310928B30	SCREW, locking: TT5 x 0.8 x 10; 2 used
		0383497N01 0383497N02	SCREW, machine: M4 x 0.7 x 23; 5 used SCREW, machine; M5 x 0.8 x 12; 8 used
PL-11675-A		0383498N04	SCREW, tapping: M4 x 0.7 x 7; 29 used
PL-11075-A		0383498N06	SCREW. tapping: M4 x 0.7 x 16; 8 used
		0383678N02	SCREW, tapping: M4 x 0.7 x 18
<u>N</u>		0400007651 0400007658	WASHER, locking: No. 8 Int; 10 used WASHER, locking: No. 10 Int; 10 used
		0400119331	WASHER, locking: 1/4 med spt; 2 used
		0400135873	WASHER, flat: .281 x .750 x .060; 2 used
		0483423R01	WASHER, flat, rectangular, 2 used
		0483499N01 0484071T01	WASHER, lug, Insulator; 4 used WASHER, shoulder; 2 used
		0582904N01	GROMMET: M12.70; 4 used
10		0983641T01	FUSEHOLDER, w/mtg hdw
10 25; 4 used		0983641T02	FUSE CAP
10		1483277N01 1483988T01	INSULATOR LUG; 4 used INSULATOR
7; 4 used		1484548A01	INSULATOR, washer, 2 used
used		1582659P01	COVER, switch, front
(TRN7275A)		1582660P01	COVER, switch, rear
(TRN7276A)		2682902N01 2683876T01	HEAT SINK HEAT SINK, ps
,		2783747T01	CHASSIS, power supply
		2982607B05	LUG, ring; 7 used
used		2982607B06	LUG, ring
8 used		2982607B09 2982907N05	LUG, ring; 4 used TERMINAL, ring; yellow; 4 used
cont: 6 used		2982907N07	TERMINAL, ring: red; 5 used
		2983137N01	TERMINAL, Insulator, 4 used
art of assembly		2983501T01	LUG, male, terminal; 2 used
304N02 are part of		2984709N01 3983145N02	TERMINAL, crimp, Insulator, blue CONTACT, plug
		4210217A02	STRAP, tie: .091 x 3.62" lg; 14 used
		4210217A33	STRAP, tie: .190 x 15" lg; 2 used
PL-11676-A		4282828T01	CLAMP, cable
		4282903N01 4282903N03	CLIP, cap, 2"; 3 used CLIP, cap, 3"; 2 used
NN.		5483440T05	LABEL, SWITCH 220V AC
<u></u>		5483440T11	LABEL, PWR SET
		5483440T12	LABEL, PWR RATING
		5483440T13	LABEL, TPN1264A
2 used			LARFI
2 used		5483971N01 7583056P01	LABEL PAD, snap-on
2 used (30; 2 used		5483971N01	

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

d circuits must be

TKN8666A External	28/14 V DC Cable		PL-11727-O
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION	
	non-ı	referenced item	
	0300138490 90982842N01 1010043A02 1583502N01 2900847817 3000812505 300851785 3083920N02 4210217A02 5484697B01 6582846N01	SCREW, tapping: 8-18 x 1-1/4 RECEPTACLE, fuse WRAP, tie HOUSING, battery connector LUG, fing WIRE, #8 AWG, RED WIRE, #8 AWG, BLK WIRE, #10 AWG, WHT CONTACT, BATTERY STRAP, TIE LABEL FUSE, tubular, 60 A, 300 V	

TKN8665A Internal 28/14 V DC Cable			PL-11726-O
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION	
	non-	referenced item	
	0210971A18 0383497N02 040007658 0783504N01 0783505N01 1583502N01 3000813233 3000831572 3083920N02 3983503N02 4210217A02	NUT, machine, M5 x 0.8, hex SCREW, machine, M5 x 0.8 x 12 WASHER, lock, #10 BRACKET, battery connector BRACKET, battery connector HOUSING, battery connector WIRE, #10 AWG, RED WIRE, #10 AWG, BLK WIRE, #10 AWG, WHT CONTACT, battery STRAP, tie	



- 1. UNLESS OTHERWISE SPECIFIED RESISTOR YALUES ARE IN OHMS, CAPACITOR VALUES ARE IN MICROFARADS, AND INDUCTOR VALUES ARE IN MILLIHENRIES.
- 2, R651 AND R650 ARE MOUNTED ON THE POWER SUPPLY CHASSIS.

THEORY NOTE

CHASSIS
PROTECTIVE
EARTH GND

CIRCUIT END

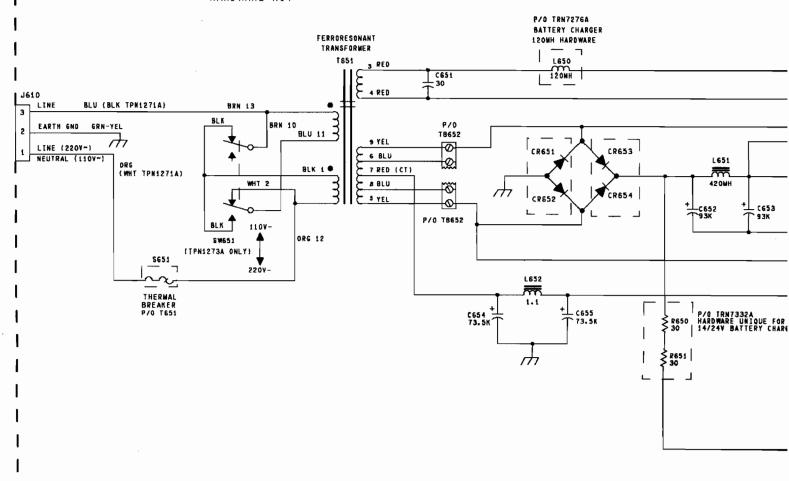
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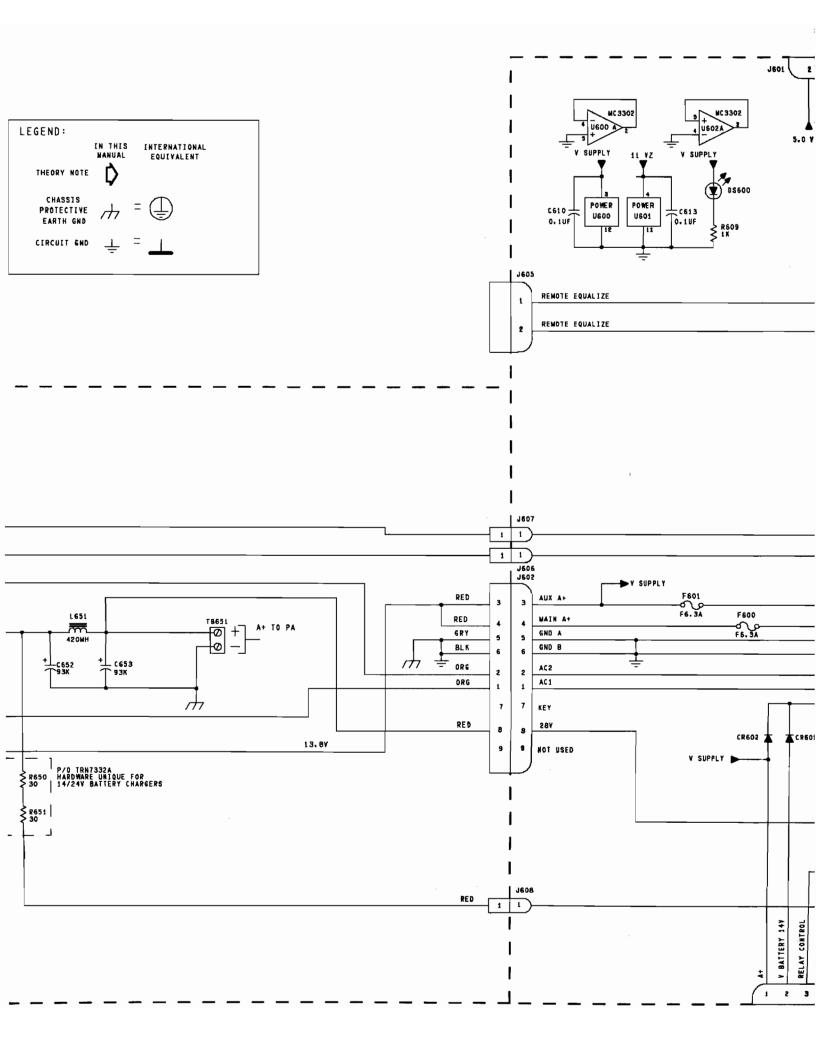
IN THIS
MANUAL

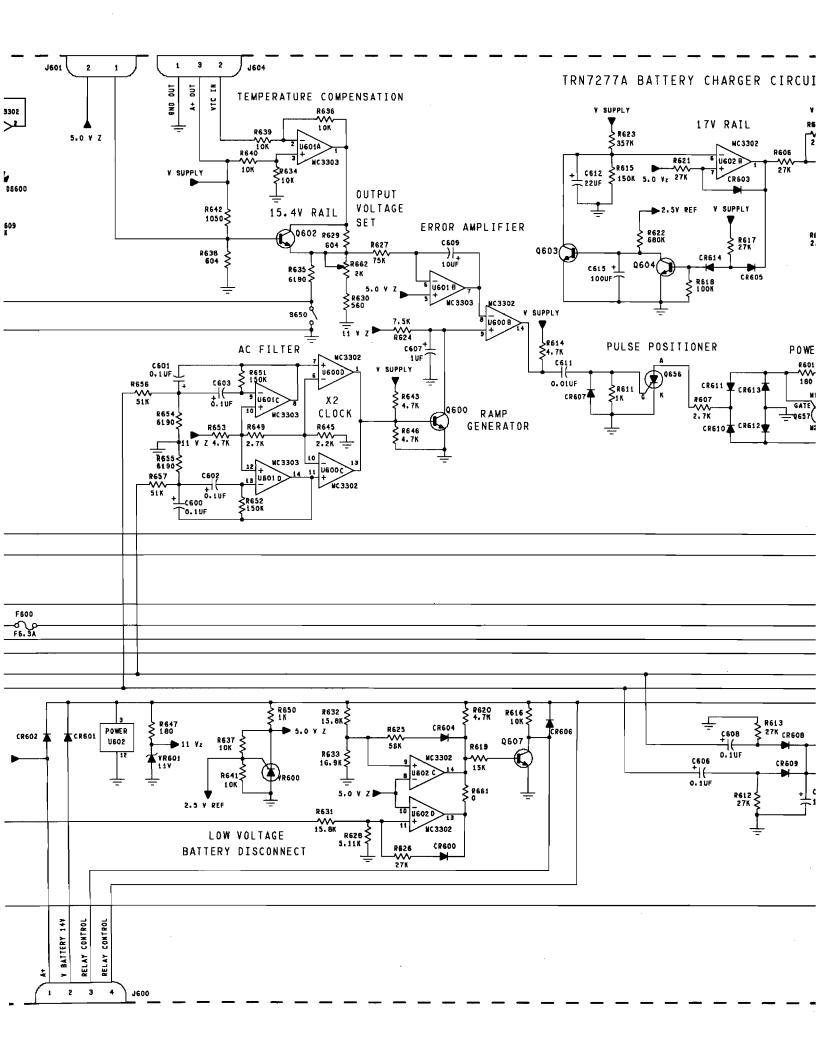
THEORY NOTE

THEORY

TRN7098A (TPN1271A) TRN7237A (TPN1273A) POWER SUPPLY HARDWARE KIT



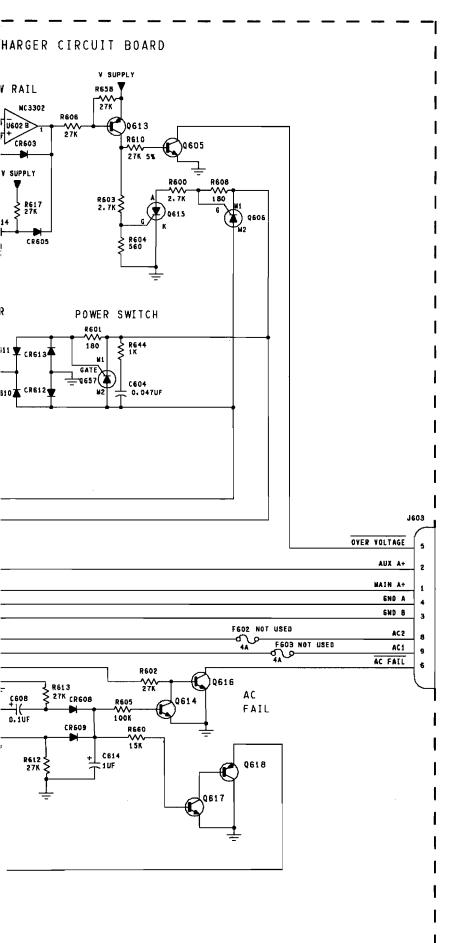


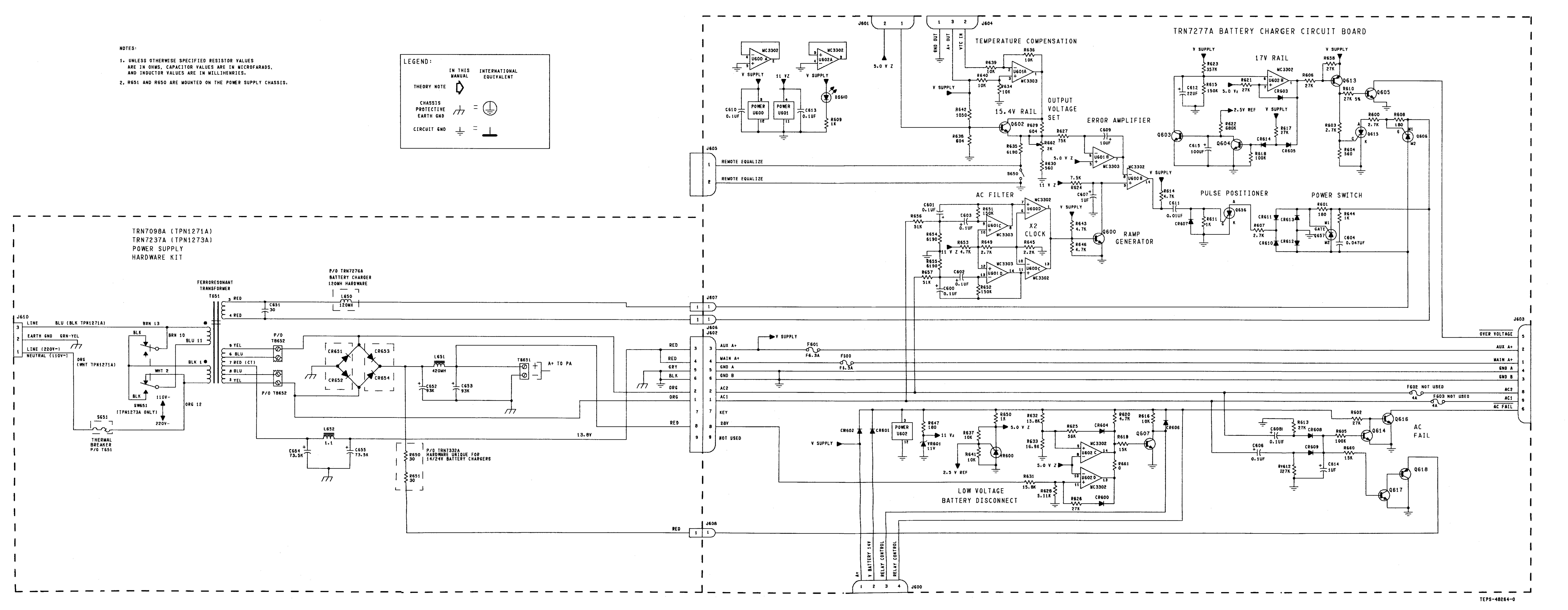


BATTERY CHARGER POWER SUPPLY

BATTERY CHARGER POWER SUPPLY

MODEL TPN1271A & TPN1273A SCHEMATIC DIAGRAM





BATTERY CHARGER POWER SUPPLY

MODEL TPN1271A & TPN1273A SCHEMATIC DIAGRAM