SECTION 161-283-302
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AT&TCo Standard

DC-TO-DC CONVERTER

KS-19303 L3

OPERATING METHODS

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1. GENERAL

1.01 This section covers the operation of the KS-19303 L3 dc-to-dc converter which is primarily intended as a power supply for the 651A and 660 power plants. The converter is a dc multiplier which enables a positive or negative 130-volt dc supply to be obtained from a 48-volt battery. The converter is designed to mount on a 23-inch relay rack.

1.02 The KS-19303 L3 converter is designed to operate on 44 to 52 volts direct current, 9 amperes. The output is adjustable from 120 volts to 140 volts direct current, 2 amperes at full load. The dc output is transformer-isolated from the dc input so either positive or negative output can be grounded, regardless of input ground polarity.

1.03 Two or more converters may be connected in parallel to provide additional current to the 130-volt dc load. Each converter is self-protected against overload; in the event of an overload, the dc output voltage will decrease as necessary to limit the output current to a safe value. If two converters of the same list number are operated in parallel, the setting of the output voltage adjustment should be identical.

1.05 Keep the ventilating passages of the converter unobstructed to ensure adequate cooling during operation.

1.06 The abbreviations cw and ccw used herein, refer to clockwise and counterclockwise, respectively.

1.07 Routine checks are intended to detect defects and to guard against circuit failures which are liable to interfere with service. Checks and adjustments, other than those required by trouble conditions, should be made when they will cause the least unfavorable reaction to service.

1.08 The instructions are based on circuit schematic drawing SD-81832-01. For detailed description of the operation, see the corresponding circuit description.

2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
KS-16346 L2	Soldering Copper
—	3-inch C Screwdriver
—	P Long-Nose Pliers
TEST APPARATUS	
KS-14510	Volt-Ohm-Milliammeter

3. OPERATION

3.01 *General*

(a) This dc-to-dc converter contains an inverter which changes 50-volt direct-current input to square-wave alternating current,

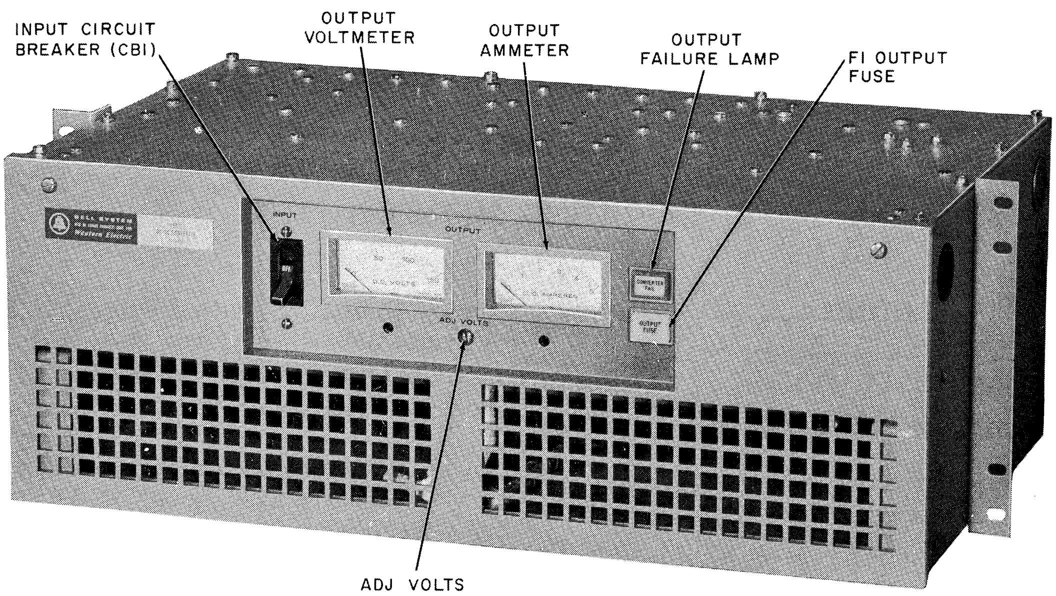

Fig. 1 — KS-19303 L3 Converter (Front View)

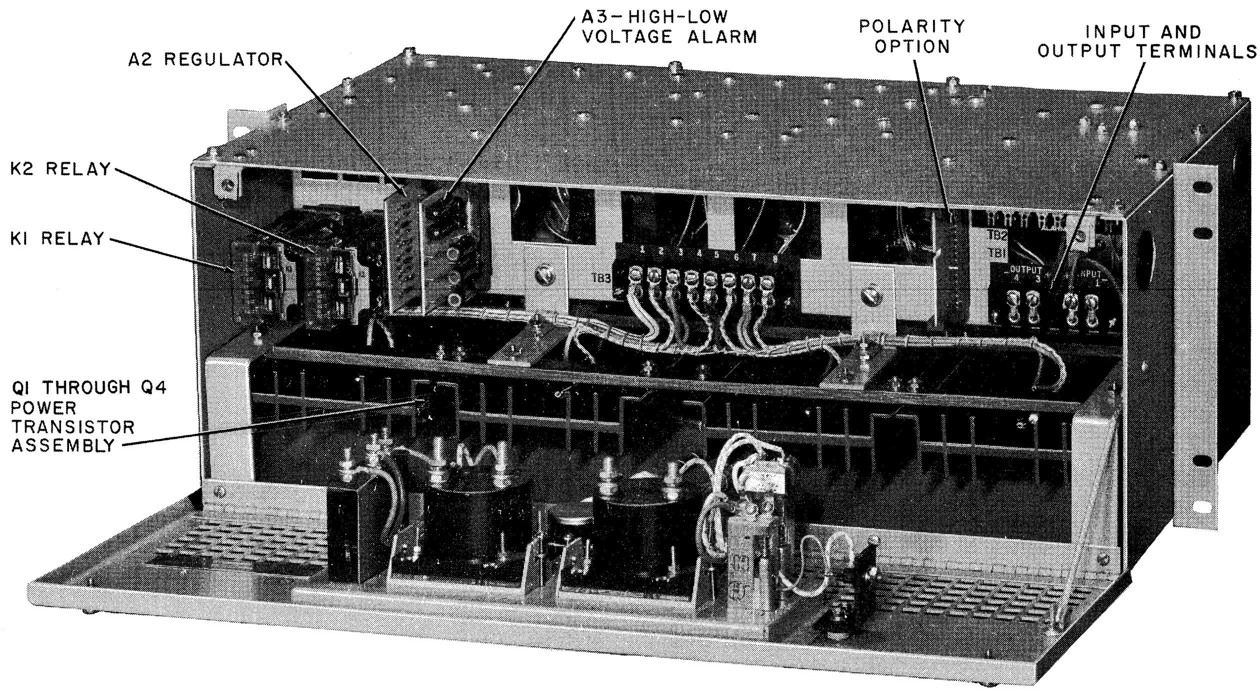

Fig. 2 — KS-19303 L3 Converter (Front Cover Removed)

a power transformer which increases inverter output voltage to higher ac voltage, and a power rectifier which converts this ac voltage to 130 volts direct current. Both dc input and dc output circuits are filtered to prevent transmission of noise to input battery or dc load.

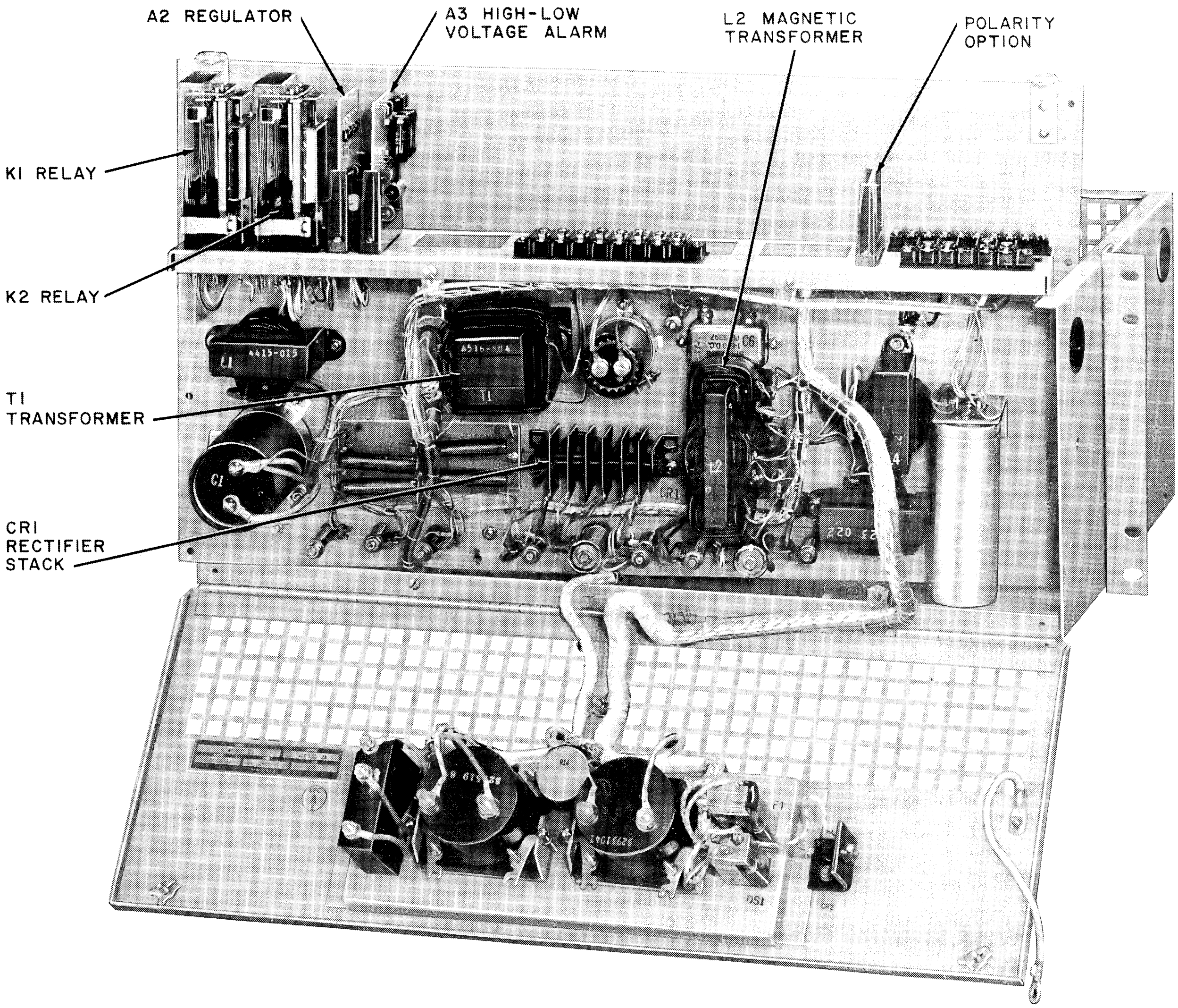

Fig. 3 — KS-19303 L3 Converter (Upper Panel — Power Transistor Assembly Removed)

(b) An output voltage regulator maintains dc output voltage within plus-or-minus 2 percent of value to which it is adjusted at any output current between zero and rated output current of 2 amperes, despite variation of dc input voltage between 44 volts and 52 volts.

(c) An external alarm is given if dc output voltage decreases to 125 volts or in event of dc output failure. If dc output voltage should increase to 135 volts, the converter is automatically turned off and an external alarm is given. These alarm conditions are indicated by an alarm lamp. (See Fig. 1.)

Preparing to Start

3.02 When preparing to put the converter into service initially, check that:

(a) All external connections are made in accordance with the SD drawing covering the associated circuit of which the unit is a part. To gain access to the input and output terminals on the KS-19303 L3 converter, release the two twist-type fasteners and pivot the front panel outward on its hinge. (See Fig. 2 and 3.)

Caution 1: ***Before making electrical connections, be certain that the CB1 input circuit breaker is in the OFF position.***

Caution 2: ***Inductive filtering should not be used between the 48-volt battery and the converter input, since an input filter may cause voltage peaks which would damage transistors.***

Note: Positive dc input (terminal 2) is connected to chassis ground by a jumper. This protects Q1 through Q4 transistors on the power transistor assembly (Fig. 4) against damage in case input battery polarity is incorrect. If desired, this jumper can be removed once proper input connections have been made.

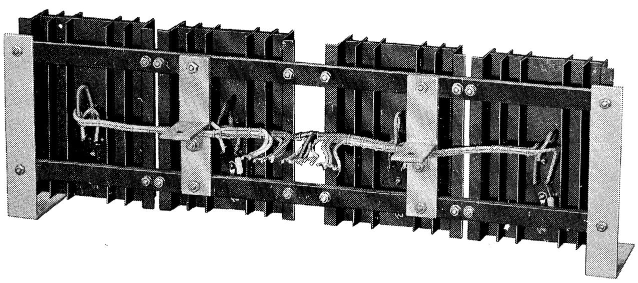

Fig. 4 — KS-19303 L3 Converter Power Transistor Assembly

(b) The reversible plug designated "+130" and "—130" (Fig. 2 and 5) is positioned as follows.

(1) For use in a positive (negative ground) system, the "+130" designation shall read upright; the F1 output fuse, CR2 diode, and the ammeter will then be in series with positive dc output. (See Fig. 5).

(2) For use in a negative (positive ground) system, the "—130" designation shall read upright; the F1 output fuse, CR2 diode, and the ammeter will then be in series with negative dc output. (See Fig. 5).

(c) 130-volt dc load at OUTPUT terminals 3 (positive) and 4 (negative) is connected.

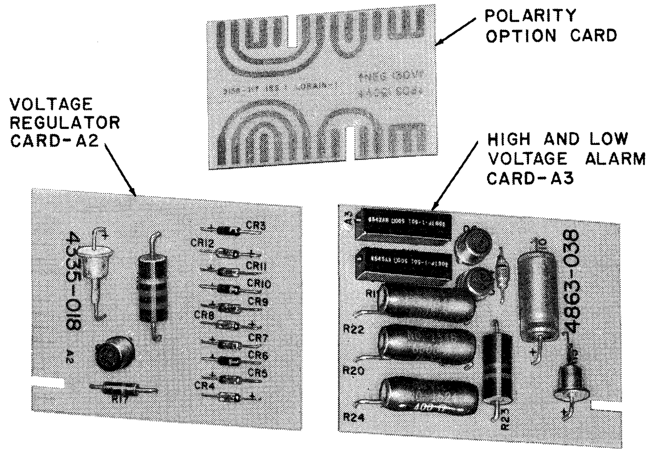

Fig.5 — KS-19303 L3 Converter Component Card Assemblies

(d) Nominal 50-volt direct current at input terminals 1 (negative) and 2 (positive) is connected.

(e) To cause OUTPUT FAILURE lamp to light in event of high or low dc output voltage or output failure, check that nominal 50-volt negative battery is supplied at terminal 11 of alarm terminal strip. (See Fig. 2.) Alarm terminals 5 and 6 furnish positive ground, while terminals 7 to 8 and terminals 9 to 10 each supply a closed loop to give an external alarm in event of any alarm conditions. If two converters are operated in parallel, closed-loop alarm terminals of each unit can be connected in series to give an external major alarm.

(f) F1 output fuse is connected in series with either positive or negative dc output (option) as necessary to cause it to protect whichever side of dc output is ungrounded. Since this converter is self-protected against overload, an overload condition will not cause the F1 output fuse to open. If necessary to replace the fuse, replace only with fuse type and size or equivalent as follows.

F1 OUTPUT fuse: Bussmann type AGC cartridge, 3 amperes

Initial Adjustments (Fig. 1 and 3)

3.03 To turn converter on or off, throw toggle of INPUT CB1 circuit breaker to ON or OFF position.

(a) The dc output voltage is varied by adjusting the OUTPUT VOLTS ADJ potentiometer (R14) to any value between 120 and 140 volts. To increase the output voltage, rotate screwdriver adjustment shaft cw; to decrease output voltage, rotate shaft ccw.

(b) To adjust the low output voltage alarm, proceed as follows.

(1) Rotate the screwdriver adjustment shaft of the LOW VOLT ALM potentiometer (R21) to extreme ccw position.

(2) Rotate the screwdriver adjustment shaft of the OUTPUT VOLTS ADJ potentiometer (R14) to set the output voltage to a value at which the low-voltage alarm is desired. [See 3.01(c).]

(3) Slowly rotate the adjustment shaft of the LOW VOLT ALM potentiometer (R21) cw until the OUTPUT FAILURE lamp lights and the alarm is given.

(c) To adjust the high output voltage alarm proceed as follows.

(1) Rotate the screwdriver adjustment shaft of the HIGH VOLT ALM potentiometer (R19) to extreme cw position.

(2) Rotate the screwdriver adjustment shaft of the OUTPUT VOLT ADJ potentiometer (R14) to set the output voltage to a value at which the automatic cutoff is desired. [See 3.01(c).]

(3) Slowly rotate the adjustment shaft of the HIGH VOLT ALM potentiometer (R19) ccw until the converter automatically shuts off, the OUTPUT FAILURE lamp lights, and the alarm is given.

(d) ***Factory Adjustments:*** R2, R12, and R13 resistors are factory adjusted and it is recommended that no change be made in these adjustment settings.

4. ROUTINE CHECKS

4.01 As often as local experience demands, the relays should be inspected for adjustment and condition of contacts, making sure that they are in accordance with the Bell System Practices which apply.

4.02 The dc output voltage and current should be checked periodically to make certain that they are correct.

4.03 Electrolytic capacitors should be maintained in accordance with Section 032-110-701.

5. TROUBLES

General

5.01 Various trouble symptoms and possible causes are listed in 5.05. A trouble test procedure opposite each cause will isolate the trouble to a few possible defective components. Since some unsatisfactory conditions will damage more than one component, all checks listed under a given cause should be made even though defective components are revealed before the entire check procedure has been completed.

5.02 Component test procedures are made with the converter disconnected from the external output circuit. Before testing the components, place the CB1 circuit breaker in the OFF position and remove the main distribution fuse and F1 fuses. Where necessary, momentarily shunt capacitors with a 100-ohm resistor to be certain that they are completely discharged. If any charge is left on the capacitors, it may cause inaccuracy in resistance reading.

Caution: In making continuity checks, use the ohmmeter portion of the KS-14510 meter. Do not use the X10,000 position for testing semiconductors as the higher voltage used may damage them.

5.03 Before disconnecting leads, mark or record the connection.

Caution: Soldering operation on semiconductors shall be done at the lowest possible temperature and in the shortest time practicable in order to localize the heating effect and thus prevent damaging the semiconductors. Because of its low operating temperature, use the KS-16346 L2, 12-watt soldering copper. For the protection of the semiconductors, use the P long-nose pliers as a heat sink.

5.04 Q1 through Q4 transistors are part of a separately removable heat sink assembly. In the event of failure of any Q1 through Q4 power transistors, it is recommended that this entire heat sink assembly be replaced. (See Fig. 4.)

Troubleshooting

5.05 Reference to input fuse shall be interpreted to mean the individual 48-volt main distribution fuse at the power board.

A. Low-Voltage Alarm Given, Input Fuse Open

POSSIBLE CAUSE	PROCEDURE
Failure of one or more Q1 through Q4 transistors.	Replace complete transistor heat sink assembly.
Short circuit of C7 or C8 capacitor.	Replace defective C7 or C8 capacitor; check CR1 rectifier and Q1 through Q4 transistors; replace if defective.
Short circuit of two diode sections of CR1 rectifier.	Replace CR1 rectifier; check Q1 through Q4 transistors; replace if defective.
Open circuit of Q5 transistor or R20 resistor.	Replace defective Q5 transistor or R20 resistor, or replace circuit card A2. (See Fig. 2 and 5.)
C1 shorted.	Replace C1.

B. Low-Voltage Alarm Given, Neither Input Fuse Nor CB1 Circuit Breaker Open, DC Output Voltage Low

POSSIBLE CAUSE	PROCEDURE
High-resistance dc input connection.	Tighten clamp screws of input terminals.
Short circuit of CR6 or CR10 zener diode.	Replace defective CR6 or CR10 zener diode, or replace circuit card A2. (See Fig. 2 and 5.)
Short circuit of CR13 diode.	Replace defective CR13 diode or replace circuit card A2.
Open circuit of control winding between terminals 5 and 6 of L2 magnetic amplifier or associated wiring.	Continuity check; repair defective wiring or replace defective L2 magnetic amplifier.
Open circuit of R6, R7, R8, R9, R17, R12, or R1 resistor, open circuit between slider of R14 potentiometer and R11 resistor, open circuit between slider of R2 potentiometer and R1 resistor, open circuit of associated wiring.	Continuity check; repair defective wiring; replace defective resistor or potentiometer.

C. Low-Voltage Alarm Given, Neither Input Fuse Nor CB1 Circuit Breaker Open, DC Output Voltage and Output Current Zero, Converter Emits Usual High-Pitched Hum

POSSIBLE CAUSE	PROCEDURE
Open circuit of R12 resistor, open circuit of T1 transformer secondary winding between terminals, open circuit of CR1 rectifier, open circuit of L3 or L4 choke, open circuit in associated wiring.	Continuity check; repair defective wiring; replace any defective component.

D. Low-Voltage Alarm Given, Neither Input Fuse Nor CB1 Circuit Breaker Open, Converter Does Not Emit Usual High-Pitched Hum

POSSIBLE CAUSE	PROCEDURE
Open circuit of dc input connections.	Repair defective wiring; tighten clamp screws of input terminals.

POSSIBLE CAUSE	PROCEDURE
Open circuit of wiring between input terminals, C1 capacitor, oscillator circuit.	Continuity check; repair defective wiring.
Open circuit of T1 transformer primary winding between terminals 4 to 14; open circuit of associated wiring.	Continuity check; repair defective wiring; replace defective T1 transformer.

E. Low-Voltage Alarm Given, CB1 Circuit Breaker Open

POSSIBLE CAUSE	PROCEDURE
Temporary condition has caused CB1 circuit breaker to open	Throw toggle of CB1 circuit breaker to ON position to reset; if temporary condition has caused CB1 circuit breaker to open, it will remain closed.
Open circuit of CR3, CR6, or CR10 zener diode, open circuit of R15 or R13 resistor, open circuit between slider of R14 potentiometer and R6 resistor, open circuit between slider of R2 potentiometer and R3 resistor; open circuit of associated wiring.	Rotate screwdriver adjustment shaft of HIGH VOLT ALM potentiometer (R19) to extreme clockwise position to obtain maximum value of shut-off voltage, then throw toggle of CB1 circuit breaker to ON position to reset; if CB1 circuit breaker remains closed, repair defective wiring; replace any defective component; in the event of open circuit of either CR6 or CR10 zener diode, replace Q5 transistor or circuit card A2. (See Fig. 2 and 5.)
Short circuit of Q7, short circuit of CR14 zener diode.	Rotate screwdriver adjustment shaft of HIGH VOLT ALM potentiometer (R19) to extreme clockwise position to obtain maximum value of shut-off voltage, then throw toggle of CB1 circuit breaker to ON position to reset; if CB1 circuit breaker again opens, replace defective components or circuit card A3.

F. No Low-Voltage Alarm Given Despite Low DC Output Voltage

POSSIBLE CAUSE	PROCEDURE
Short circuit of Q6 transistor or CR14 diode. Open circuit of wiper arm of R21. *Note:* Open circuit of wiper arm of R21 may damage Q6 transistor.	Continuity check; repair defective wiring; replace defective components or circuit card A3.

G. No Shutoff Despite High DC Output Voltage

POSSIBLE CAUSE	PROCEDURE
Open circuit of Q7 transistor, open circuit of CR14 diode, short circuit of CR15 diode	Continuity check; repair defective wiring; replace any defective component; check for and correct, if necessary, open circuit of R19 resistor which will damage Q7 transistor; replace defective components or circuit card A3.

H. Variation of Ambient Temperature Causes Variation of DC Output Voltage

POSSIBLE CAUSE	PROCEDURE
Short circuit of one or more of diodes CR4, 5, 7, 8, 9, 11 and 12.	Replace defective components or circuit card A2 (See Fig. 2 and 5.)

I. DC Output Voltage and Output Current Zero, No Fuse or Circuit Breaker Open, No Low-Voltage Alarm Given

POSSIBLE CAUSE	PROCEDURE
Poor contact of output polarity selector plug.	Clean contacts if necessary; reinsert plug to make proper contact.

J. Noise At Input Battery

POSSIBLE CAUSE	PROCEDURE
Open circuit of C1 capacitor, short circuit of L1 choke.	Replace defective capacitor or choke. To test L1 choke for short circuit, with converter in operation, carefully apply a short circuit across L1 choke; if this does not increase noise at dc input, a short circuit of L1 choke exists.

K. Noise At DC Load

POSSIBLE CAUSE	PROCEDURE
Open circuit of C7 or C8 capacitor, short circuit of L3 or L4 choke.	Replace defective C7 or C8 capacitor; replace defective L3 or L4 choke. To test L3 choke for short circuit, with converter in operation, carefully short-circuit L4 choke; if this does not increase noise at dc input, a short circuit of L4 choke exists.

Caution: Under no circumstances should a short circuit be applied across L3 choke. Short circuit of L3 choke may cause failure of one or more Q1 through Q4 transistors.