TYPE N3 CARRIER TELEPHONE SYSTEM
POWER SUPPLY UNIT
DESCRIPTION

1. GENERAL

1.01 This section describes the J87245A power supply unit which is one of the plug-in units of the N3 carrier terminal. It provides a regulated −21 volt supply for one N3 carrier terminal.

1.02 The unit is 8 inches high, 3-1/2 inches wide, and 11 inches deep and occupies two module spaces in the N3 terminal. It weighs approximately 6 pounds. The unit is shown in Fig. 1 and 2. A circuit schematic of the power supply is shown in Fig. 3.

1.03 The unit delivers an output of 0.7 to 4.0 amperes. With an output of 4.0 amperes, its efficiency is 82 per cent. It will regulate to within 1 per cent of the nominal 21 volts with a fixed ambient temperature and an input voltage of −42.5 to −52 volts, or with a fixed voltage input and a temperature of approximately 10° to 65 C.

2. DESCRIPTION OF OPERATION

A. General

2.01 A −21 volt dc regulated output is obtained from a nominal −48 volt dc input by automatically controlling the operation of transistor Q1 which operates as a switch. Transistor Q1 switches at a nominal 10,000-cps rate; the output voltage is determined by the per cent break or fraction of total cycle, during which Q1 is nonconducting. The power supply contains input and output filtering to prevent excessive noise, created by the switching action, from being imposed on the input and output leads. The power supply also contains overload and trouble voltage protection and a high- and low-voltage alarm circuit.

B. Control of Switching Transistor Q1

2.02 Transistor Q1 is driven into saturation by current transformer T1 which provides a base drive from winding 3-4 proportional to the current in the collector of Q1. Once transistor Q1 is saturated, the base drive starts to diminish at a rate determined by the inductance of transformer T1 and the total impedance in the base circuit of Q1. This impedance consists of the network composed of diode CR3, capacitor C4, resistor R4, the forward voltage drop of diode CR7, and the emitter-to-base voltage drop of Q1.

2.03 When the base current is no longer sufficient to maintain transistor Q1 in saturation, the transistor is turned off by the energy stored in transformer T1 which reverse biases transistor Q1. This energy diminishes with time at a rate determined by the effective impedance of paralleled transistors Q2 and Q3.

2.04 When the energy stored in transformer T1 is no longer sufficient to reverse bias transistor Q1, transistor Q1 turns on again.

2.05 The effective resistance of paralleled transistors Q2 and Q3 is controlled by their base drive which, in turn, is controlled by transistor Q4. Transistor Q4 is the error detector, determining any departure of the output voltage from the desired value. It does so by comparing a portion of the output voltage, provided by resistors R12 and R14 and part of ADJ VOLTS potentiometer R13, with the reference voltage provided by voltage regulator diode CR11 in series with diode CR12. Resistor R16 limits the maximum collector current of transistor Q4. The ADJ VOLTS potentiometer R13 is used to set the output to −21 volts.

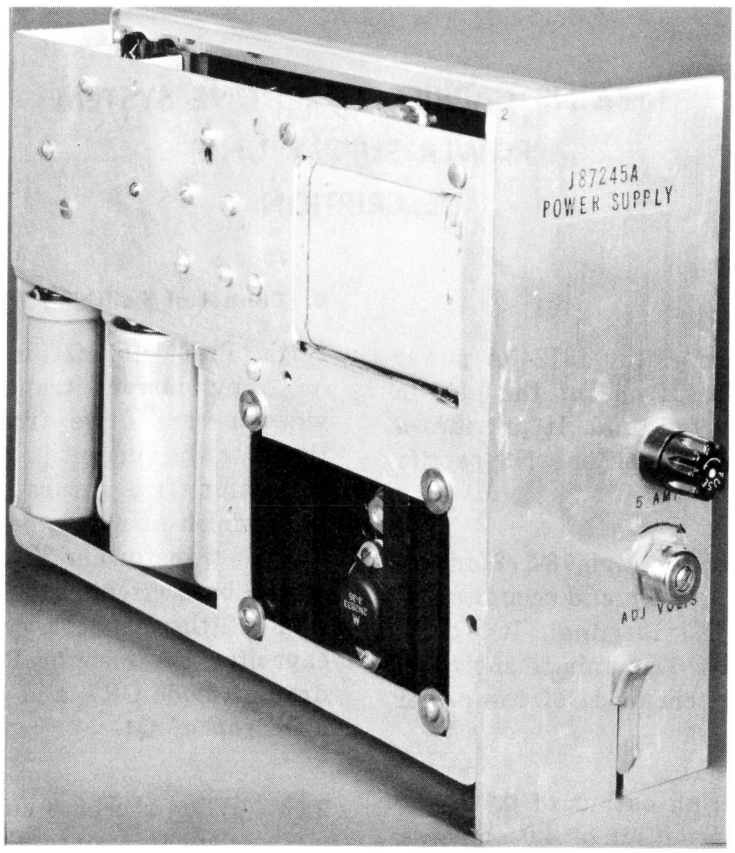

Fig. 1 – J87245A Power Supply Unit

2.06 Since the current in inductor L2 is continuous throughout the cycle, diode CR6 is needed to conduct this current when Q1 is turned off. When Q1 turns on, CR6 is reverse biased and, thus, nonconducting. The network, composed of capacitor C3, diode CR4, and resistor R2, reduces the turn-off switching losses of transistor Q1, since it prevents the voltage from building up appreciable across Q1 until the current through Q1 has fallen toward zero.

2.07 Resistor R3 provides bias current to transistor Q1 to ensure that switching will commence when input power is connected to the unit. Voltage limiting is provided by diodes CR1 and CR2 across transformer T1 primary, diode CR5 across Q1 base to emitter, and diode CR7 across the circuit consisting of paralleled Q2, Q3, and load sharing resistors R5 and R6. The network, composed of diode CR9, resistors R9 and R10, and winding 3-4 of inductor L2, provides bias current for the proper operation of Q2 and Q3. The network composed of resistor R11 and capacitor C5 and the network composed of resistors R15 and R36 and capacitor C6 prevent oscillation of the power supply output voltage.

C. Regulating Action

2.08 Assume the output voltage exceeds its proper value. This will increase the base-to-emitter voltage of transistor Q4. Transistor Q4 will conduct more heavily, reducing the effective resistance of paralleled transistors Q2 and Q3. This increases the time during which transistor Q1 is off and reduces the output voltage to its proper value. If the output voltage decreases below its proper value, it will be restored to normal by the above effects acting in reverse.

D. Filters

2.09 Inductor L1 and capacitors C1 and C2 prevent the power supply from imposing excessive noise on the input power leads. Resistor R1 provides damping which prevents the

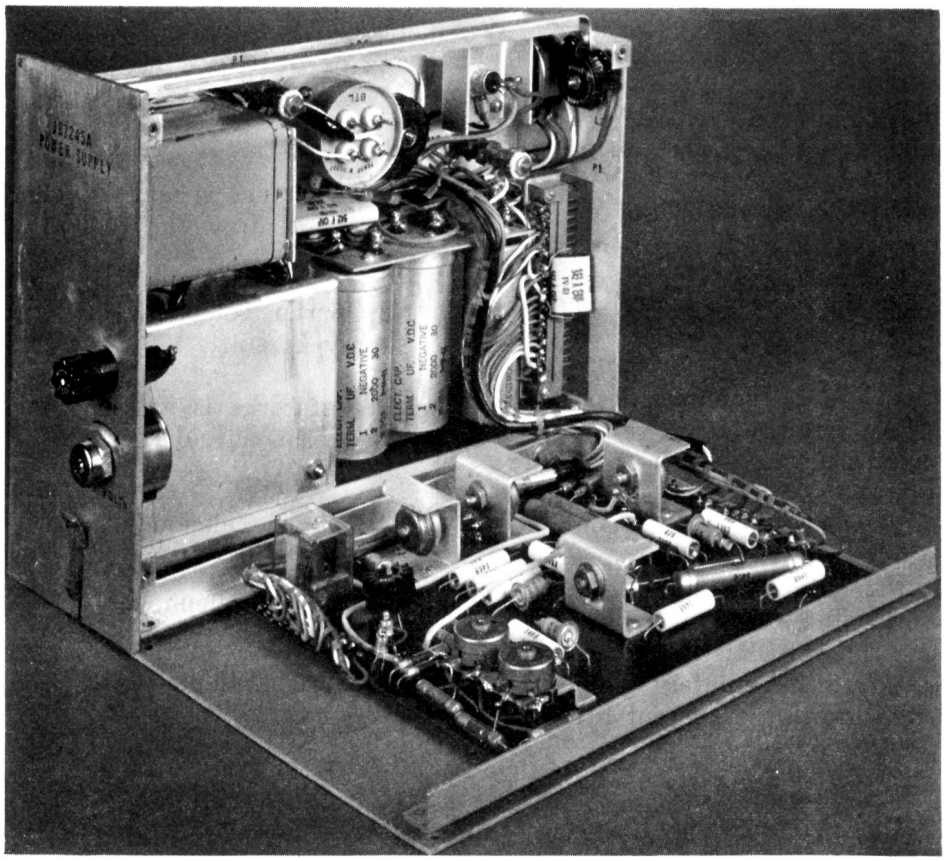

Fig. 2 – J87245A Power Supply Unit — Partially Disassembled

input filter from amplifying noise at its resonant frequency.

2.10 Inductor L2 (winding 1-2) and capacitors C7 and C8 provide filtering to smooth the rectangular waves created by switching transistor Q1.

2.11 Inductor L3 and capacitor C10 filter radio-frequency spikes created by the switching action. The network, composed of resistor R25 and capacitor C9, provides damping.

E. Alarm Circuit

2.12 A high- or low-voltage alarm indication is provided by relay K1 and transistors Q6 through Q8. Relay K1 is normally operated, with transistors Q6 and Q7 conducting and Q8 cut off. A low-voltage alarm condition causes the voltage at the base of Q7 to be reduced below the conducting level, cutting off Q6 and Q7 and releasing relay K1. A high-voltage alarm condition causes the base of Q8 to rise and drive Q8 into conduction. This loads the voltage divider circuit, composed of resistors R26 through R29, cutting Q7 off. This cuts Q6 off, releasing relay K1. Resistors R33 through R35 provide a voltage divider for high-voltage sensing transistor Q8. A lock feature is provided whereby ground placed on pin 6 of the connector will lock relay K1 in the unoperated (alarm) position after it has released.

2.13 Voltage regulator diode CR15, in series with diode CR16, provides a reference voltage for transistors Q7 and Q8. Diode CR14 and resistor R30 provide bias for transistor Q6. Resistor R32 provides bias current for CR14 through CR16. Resistor R31 limits the current in transistor Q7. The network, composed of C12 and R37, protects transistor Q6 from voltage transients caused by the inductance of the coil of relay K1.

F. Protection Features

2.14 The network, composed of resistors R7 and R8 and diode CR8, limits the current through transistor Q1 in the event of a short circuit on the power supply output terminals. A continuous overload may open fuse F1 or the input fuse located externally on the N3 carrier bay.

2.15 Connected equipment is protected against abnormally high voltages on the −21 volt output by means of transistor Q5 and controlled rectifier SCR1. Transistor Q5 compares a portion of the output voltage obtained from voltage dividers R22 through R24 with reference voltage provided by voltage regulator diode CR13. An excessive output voltage causes Q5 to conduct, triggering SCR1. This places a low impedance across the output, immediately reducing the output voltage to a low value. Resistor R19 reduces the surge current through SCR1 which is caused by capacitors C7 and C8 immediately after triggering. Resistor R20 limits the current through Q5. Resistor R21 provides a bias current for diode CR13. Resistor R18 prevents undue triggering of SCR1.

3. DRAWINGS

3.01 Reference is made to the following schematic drawing (not attached):

SUBJECT	NUMBER
N3 Carrier Telephone Power Supply Circuit	SD-81638-01

3.02 Reference is made to the following connecting circuit drawings (not attached):

SUBJECT	NUMBER
N3 Carrier Telephone — Terminal Bay Circuit	SD-97185-01
N3 Carrier Telephone — Switching and Alarm Circuit	SD-99732-01
N3 Carrier Telephone — Carrier Supply	SD-99735-01

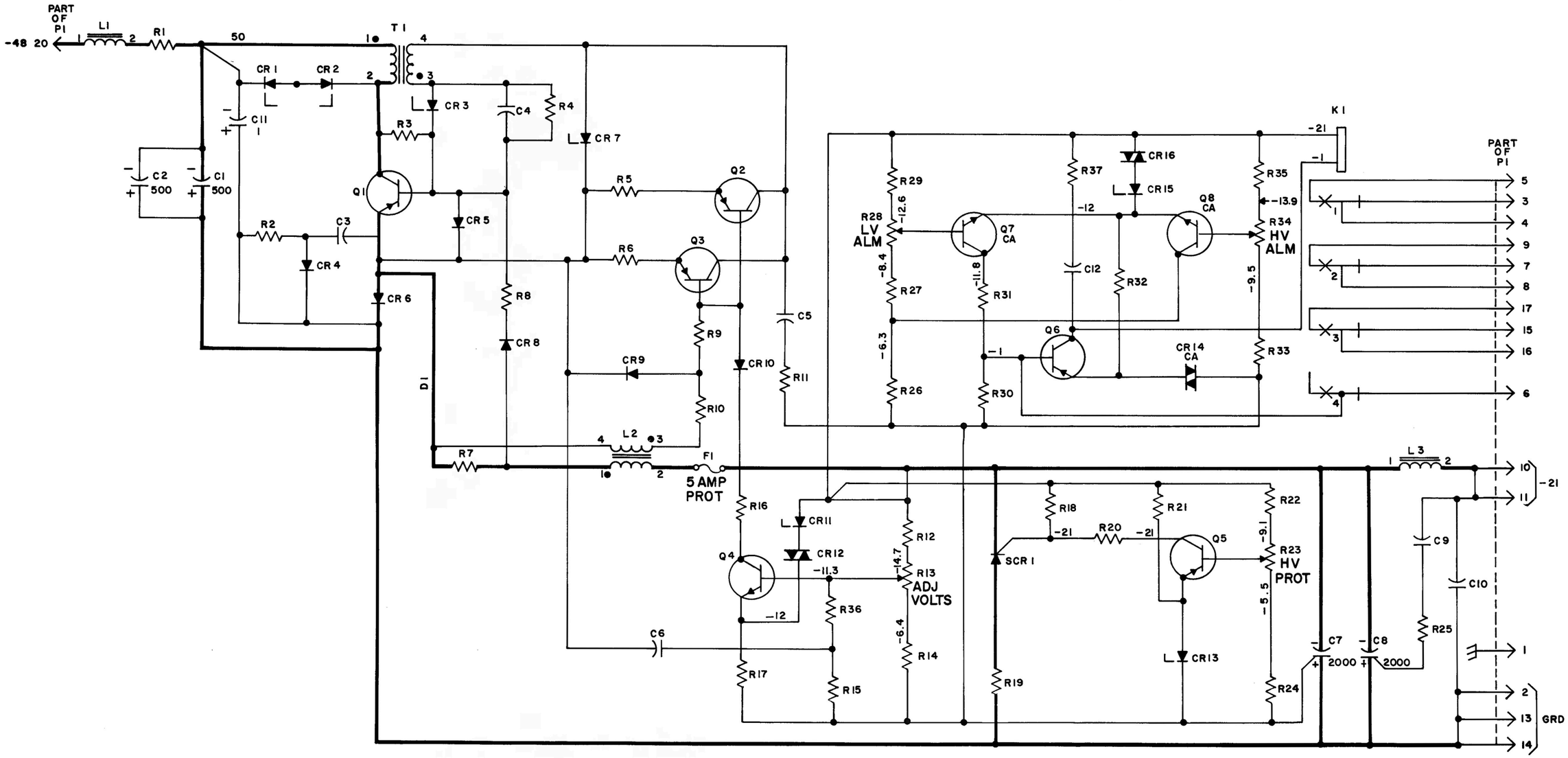

Fig. 3 – Power Supply Unit Schematic