

**680B CONVERTER POWER PLANT
(J86899A), (J86899B)
30 TO 1150 VOLTS OUTPUT
910 OR 835 MILLIAMPERE OUTPUT
DESCRIPTION**

CONTENTS	PAGE	CONTENTS	PAGE
1. GENERAL	2	H. Current Shutdown Circuit (J86891AE)	10
A. Introduction	2	I. Voltage Shutdown and Current Alarm Circuit (J86891AF)	11
B. Purpose of 680B Converter Power Plant	2	J. Feedback Regulator Circuit (J86891AG)	11
C. Single-Ended Power Feed	2	K. Ground Panel Floating	11
D. Double-Ended Power Feed	6	L. Ground Panel Solid	12
E. Equipment Characteristics	6	4. OPERATION	12
F. 680B Power Limits (Per Converter)	6	A. Introduction	12
2. PHYSICAL DESCRIPTION	6	B. Operating Procedures	12
A. Regular Converter (J86899A)	6	5. MAINTENANCE	12
B. Spare Converter (J86899B)	9	A. Introduction	12
3. FUNCTIONAL DESCRIPTION	9	B. Maintenance Tasks	12
A. General	9	6. REFERENCES	12
B. Regular Converter (J86899A)	9		
C. Spare Converter (J86899B)	10	Figures	
D. Power Stage (J86899AA)	10	1. Regular Converter (J86899A)	3
E. Oscillator (J86899AB)	10	2. Spare Converter (J86899B)	4
F. Control Circuit (J86891AC)	10	3. T4M or L5/L5E Single-Ended Power Feed Using 680B Power Plant	5
G. Alarm Sending Circuit (J86891AD)	10		

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	CONTENTS	PAGE
4.	T4M or L5/L5E Double-Ended Power Feed Using 680B Power Plant	7
5.	T4M or L5/L5E Coaxial Cable System Power Feed Arrangement	8

Table

A.	680B Operation Status Indicators	14
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1. GENERAL

A. Introduction

1.01 This section describes the 680B converter power plant. Included in this section are the following:

- General description and purpose of the 680B power plant
- Physical description of the 680B power plant
- Functional description of the 680B power plant
- Operational description of the 680B power plant
- Description of maintenance requirement.

1.02 Whenever this section is reissued, the reasons will be given in this paragraph. This issue does not affect the Equipment Test List.

1.03 This issue of the section is based on the following schematic drawings (SDs):

SD-82128-01, Issue 2B: Power Supply Circuit, +140 VDC Input, Positive and Negative Outputs, 0 to 1150 Volts, 835 Milliampere DC for T4M Digital Line, or 0 to 1150 Volts, 910 Milliampere DC for L5/L5E Coaxial Systems, 680B Power Plant, J86899A

SD-82129-01, Issue 1: Power Supply Circuit +140 VDC Input, Positive or Negative Output, 0 to 1150 Volts, 835 Milliampere DC for T4M Digital Line, 0 to 1150 Volts,

910 Milliampere DC for L5/L5E Coaxial System, 680B Power Plant, J86899B

SD-82130-01, Issue 2B: Power Systems Interconnection and DC Distribution Circuit for 680B Power Plants, L5/L5E Coaxial Systems, T4M Digital Line

If this section is to be used with equipment or apparatus reflecting an earlier or later issue of the SD(s), reference should be made to the SD(s) and circuit descriptions CD(s) to determine the extent of the changes and the manner in which the section may be affected.

B. Purpose of 680B Converter Power Plant

1.04 The 680B power plant consists of two major units.

- The regular CONVERTER (J86899A) bay
- The SPARE CONVERTER (J86899B) bay

The purpose of the regular CONVERTER (J86899A) (see Fig. 1) is to furnish dc power for the line repeaters in the L5/L5E or the line regenerators in the T4M coaxial carrier system. The purpose of the SPARE CONVERTER (J86899B) (see Fig. 2) is as follows:

- (1) Furnish power to power any coaxial cable whose regular CONVERTER is out of service.
- (2) Provide a test load for any regular CONVERTER (J86899A) in its patch system.
- (3) Provide a test facility for CONVERTER plug-in subunits.

C. Single-Ended Power Feed

1.05 If the length of the coaxial line is no greater than 37.5 miles for a L5/L5E system, or 53 miles for a T4M system, a single-ended (see Fig. 3) power feed arrangement is used. A single-ended power feed is powered at one end of the cable by one regular CONVERTER (J86899A) bay supplying NEGATIVE voltage to one tube and POSITIVE voltage to the other tube. The opposite end will be nonpowered and will have a solid dc ground provided by the Power Separation Filters (PSF).

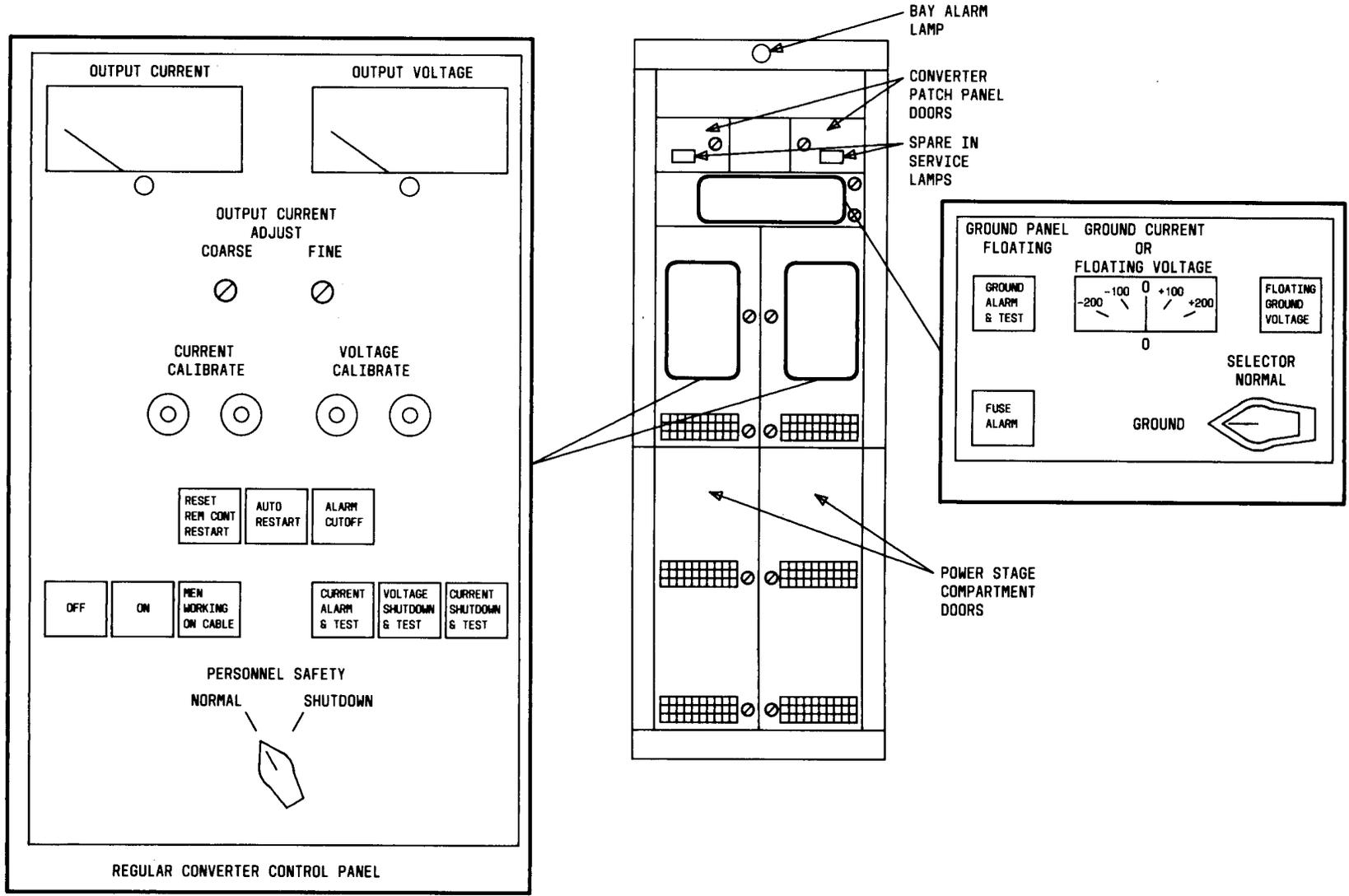


Fig. 1—Regular Converter (J86899A)

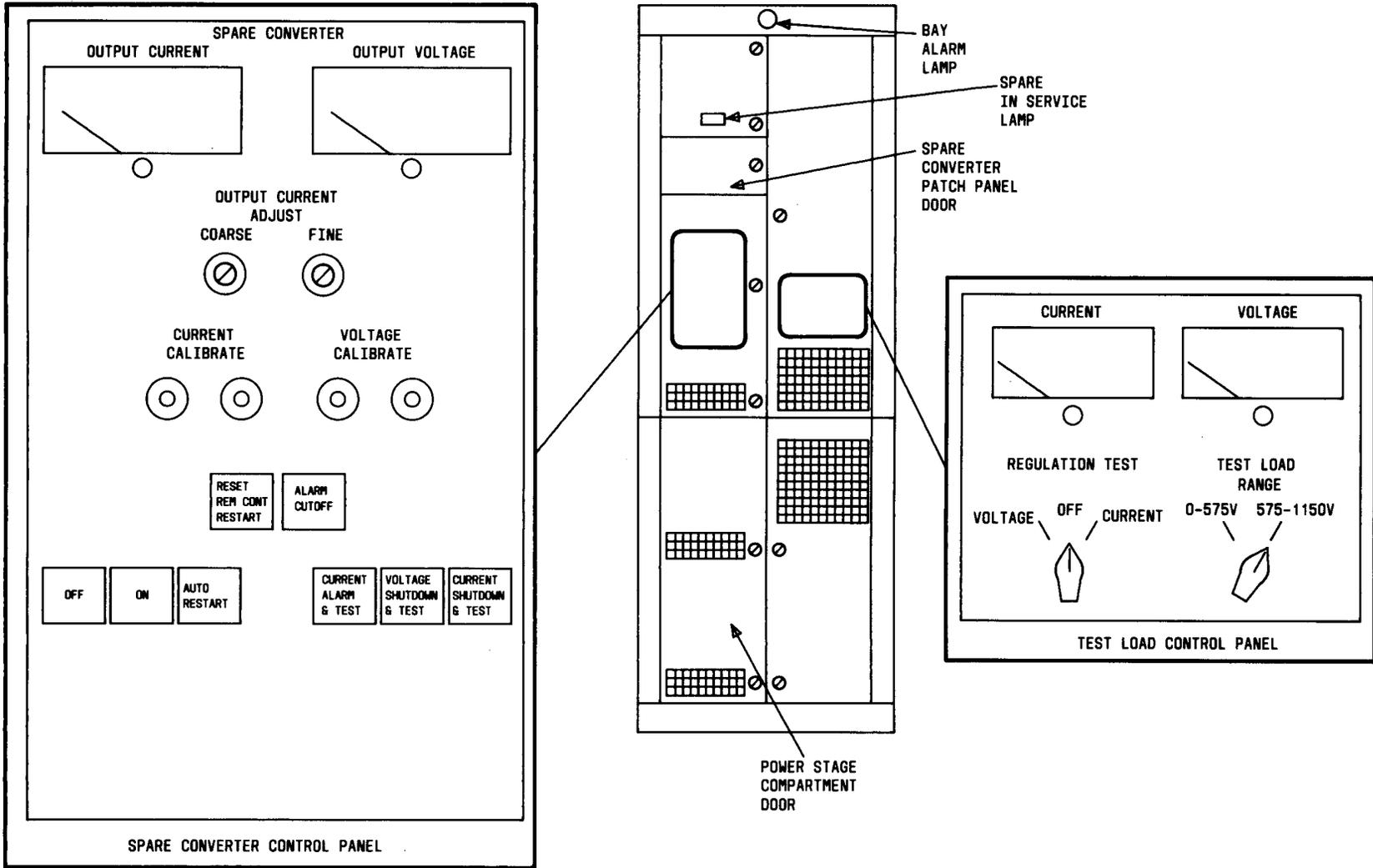


Fig. 2—Spare Converter (J86899B)

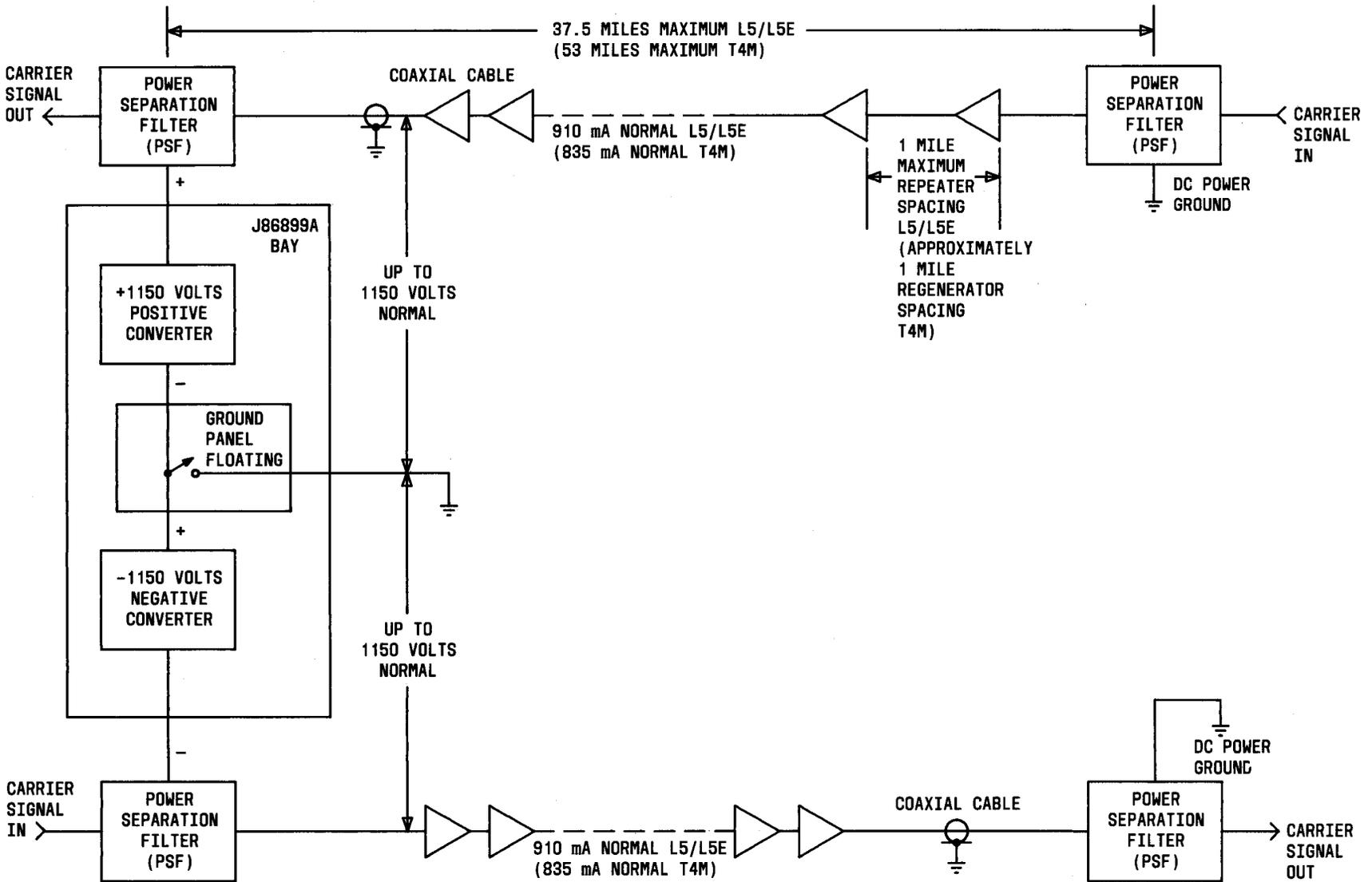


Fig. 3—T4M or L5/L5E Single-Ended Power Feed Using 680B Power Plant

D. Double-Ended Power Feed

1.06 If the length of the coaxial line is in the range of 37.5 to 75 miles for a L5/L5E system, or 53 to 106 miles for a T4M system, a double-ended power feed arrangement is used (see Fig. 4). A double-ended power feed is powered by two regular CONVERTER bays. One regular CONVERTER bay is used at both ends of the coaxial cable pair. The POSITIVE CONVERTER at one end, together with the NEGATIVE CONVERTER at the opposite end, powers one of the coaxial tubes. The remaining NEGATIVE and POSITIVE CONVERTER supplies power to the other cable (tube).

E. Equipment Characteristics

1.07 The 680B power plant once turned up into its coaxial line is fully automatic. The power plant will automatically detect and shut itself down due to abnormal voltage and current conditions. Because many shutdown conditions are transitory in nature, that is short-lived faults, each CONVERTER in the 680B power plant has an automatic restart circuit that will, if activated, automatically attempt one restart of the CONVERTER. The 680B is designed to be monitored by a remote restart, alarm, and control center. The remote control center has the capability to restart a CONVERTER after an automatic shutdown. The remote start capability is enabled by pressing RESET REM CONT RESTART switch after a manual CONVERTER turn up.

1.08 The 680B power plant was designed for humidity conditions normally encountered when installed indoors in the continental United States.

1.09 The normal operating temperature range for the 680B power plant is from 40° to 100°F. The short-term operating temperature range is from 35° to 140°F.

Note: Short-term is a time duration of less than 3 days and for a total occurrence of 15 days in one year.

1.10 Each 680B power plant installation (see Fig. 5) consists of at least two regular CONVERTER (J86899A) and one SPARE CONVERTER (J86899B). One of the regular CONVERTERS powers the in-service line and the other CONVERTER powers

the protection line. One protection line provides service protection for up to ten regular in-service lines. The SPARE CONVERTER (J86899B) can replace any regular POSITIVE or NEGATIVE CONVERTER in its PATCH SYSTEM. Whenever the SPARE CONVERTER is patched to a coaxial line, the regular CONVERTER is patched into the test load side of the SPARE CONVERTER (J86899B) bay.

F. 680B Power Limits (Per Converter)

1.11 DC Input Voltage: The 680B operates at a nominal input voltage of +140 volts dc. The normal operational input voltage range is +120 to +155 volts and will accept up to +160 volts transiently.

1.12 DC Input Current: To calculate the input current of the regular CONVERTER, refer to circuit notes of SD-82128-01. To calculate the input current of the SPARE CONVERTER, refer to circuit notes of SD-82129-01.

1.13 DC Output Current: As used in the L5/L5E carrier system, the output current is 910 ±40 milliamperes (Option Y), or when used in the T4M carrier system, the output current is 835 ±37 milliamperes, (Option W). The current is fully adjustable from zero to its maximum limit.

1.14 DC Output Voltage: When a CONVERTER of the 680B power plant is in its current or impedance regulation mode (see paragraph 3.15), its dc output voltage is a function of the coaxial cable or the connected load. When the CONVERTER is in the voltage regulation mode (see paragraph 3.15), the CONVERTER output voltage is limited to 1000 ±30 volts (Option X), or 1500 ±80 volts (Option Z). A normally operating Option X CONVERTER can supply output voltage from 30 to 575 volts at normal cable current. A normally operating Option Y or Option W CONVERTER can supply output voltage from 30 to 1150 volts at normal cable current.

2. PHYSICAL DESCRIPTION**A. Regular Converter (J86899A)**

2.01 Each regular CONVERTER (J86899A) bay consists of two CONVERTERS, one POSITIVE and one NEGATIVE. Each CONVERTER has five plug-in circuit packs, one OSCILLATOR module

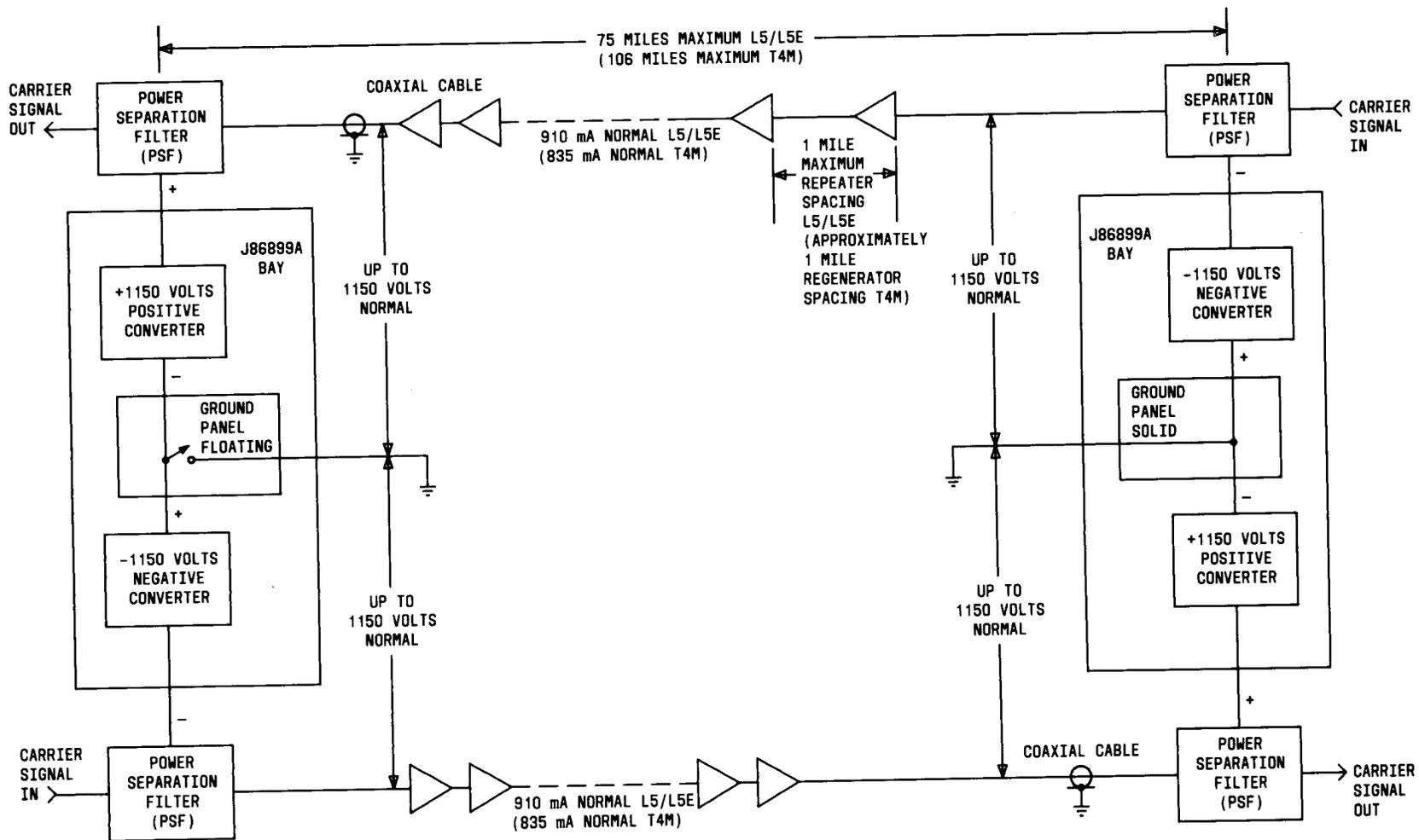


Fig. 4—T4M or L5/L5E Double-Ended Power Feed Using 680B Power Plant

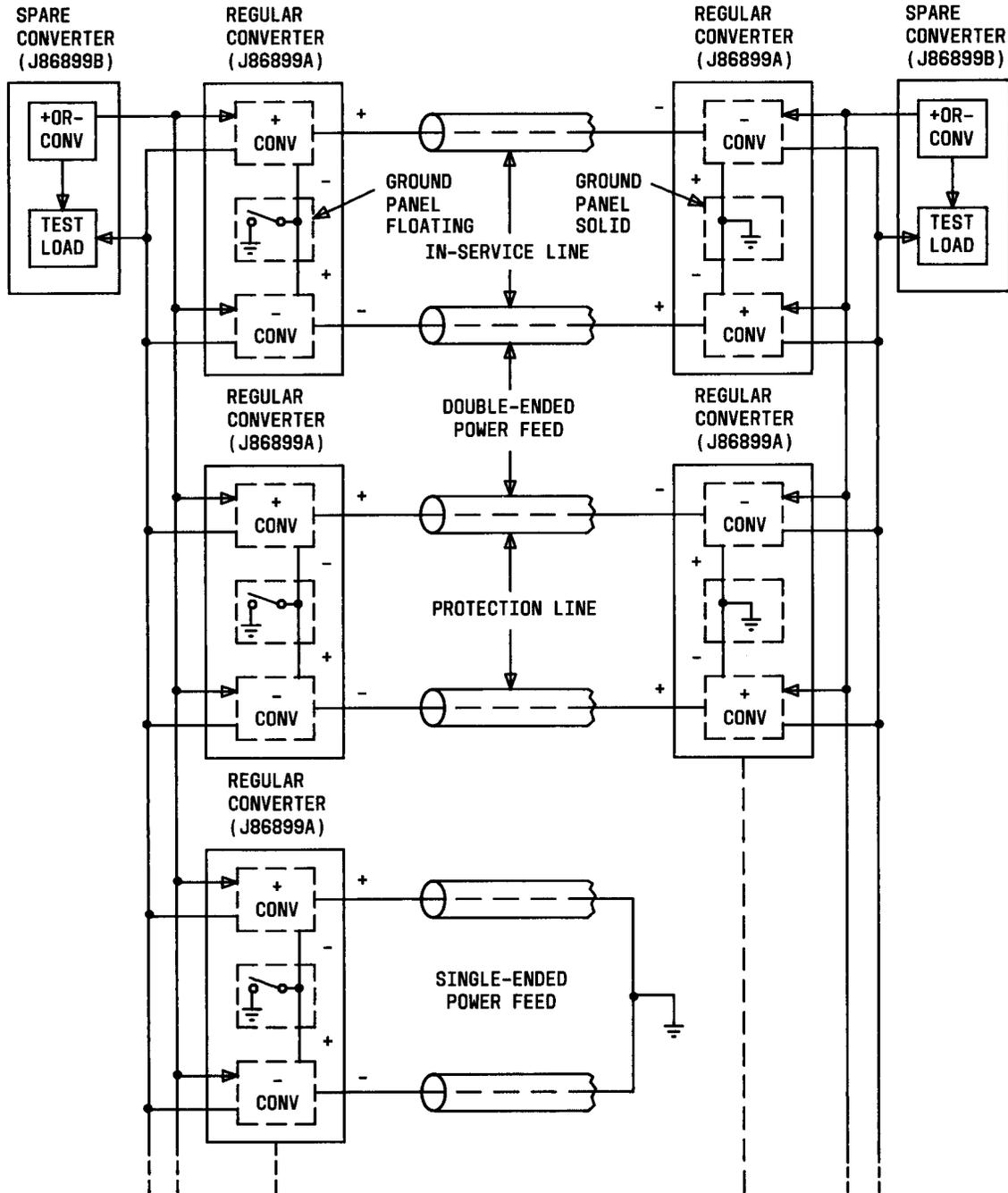


Fig. 5—T4M or L5/L5E Coaxial Cable System Power Feed Arrangement

and one POWER STAGE module. To connect the output of the CONVERTER to either the coaxial line or the test load in the SPARE CONVERTER (J86899B) bay, each CONVERTER has its own patch panel. If the regular CONVERTER (J86899A) bay is powering a single-ended power feed or is the floating end of a double-ended power feed, it will be equipped with a GROUND PANEL FLOATING which contains a ground protection circuit.

2.02 The regular CONVERTER (J86899A) is contained in a cabinet 7 feet high, 19-3/8 inches wide, and 14-1/2 inches deep. When fully equipped, the J86899A converter weighs approximately 510 pounds.

B. Spare Converter (J86899B)

2.03 The SPARE CONVERTER (J86899B) bay consists of a reversible polarity CONVERTER and a test load. The CONVERTER has five plug-in circuit packs, one OSCILLATOR module and one POWER STAGE module. The test load side of the SPARE CONVERTER (J86899B) bay provides a test load to turn up a CONVERTER to check the operation of the CONVERTER or a subassembly. The CONVERTER PATCH panel permits the substituting of the SPARE CONVERTER (J86899B) for a regular CONVERTER (J86899A) and at the same time connecting the regular CONVERTER (J86899A) to the test load.

2.04 The SPARE CONVERTER (J86899B) is contained in a cabinet 7 feet high, 19-3/8 inches wide, and 14-1/2 inches deep. When fully equipped, the (J86899B) weighs approximately 425 pounds.

3. FUNCTIONAL DESCRIPTION

A. General

3.01 The function of the 680B power plant is to supply up to 1150 volts of regulated direct current. The current level is regulated at either 910 mA or 835 mA. When used to power the line repeaters of a L5/L5E system, the current is regulated at 910 mA. When the 680B is used to power the line regenerators of a T4M system, the current is regulated at 835 mA. The power is applied to the center conductor of each coaxial cable by coupling through a power separation filter (PSF)

at power feed stations. The functional units of the 680B power plant are as follows:

- Regular CONVERTER (J86899A)
- SPARE CONVERTER (J86899B)

The functional subunits of both the regular CONVERTER (J86899A) and the SPARE CONVERTER (J86899B) are as follows:

- POWER STAGE (J86899AA)
- OSCILLATOR (J86899AB)
- CONTROL CIRCUIT (J86891AC)
- ALARM SENDING Circuit (J86891AD)
- CURRENT SHUTDOWN Circuit (J86891AE)
- VOLTAGE SHUTDOWN Circuit (J86891AF)
- FEEDBACK REGULATOR Circuit (J86891AG)

The functional subunits of only the regular CONVERTER (J86899A) are as follows:

- GROUND PANEL FLOATING
- GROUND PANEL SOLID

B. Regular Converter (J86899A)

3.02 Each regular CONVERTER (J86899A) bay contains two complete power converters: one CONVERTER supplies a negative voltage and the other one supplies a positive voltage. The two converters are connected in series to power one pair of tubes. One CONVERTER powers the transmit tube and the other CONVERTER powers the receive tube.

3.03 Each CONVERTER contains the circuitry necessary to automatically regulate the current, limit the voltage, detect abnormal current conditions, and automatically ground the floating ground. Automatic restart and remote restart are also possible. Protective shutdown for high current and voltages minimize personnel hazards and possibility of damaging repeaters and regenerators under trouble conditions. Each CONVERTER has its own CONVERTER PATCH panel to enable patching the regular CONVERTER to the test

SECTION 167-694-100

load. At the same time that the regular CONVERTER is patched to the test load, the SPARE CONVERTER must be patched to the line normally powered by the regular CONVERTER. Each regular CONVERTER has a PERSONNEL SAFETY switch. The PERSONNEL SAFETY switch is provided to prevent the accidental powering up of a CONVERTER. The PERSONNEL SAFETY switch also prevents a patched through SPARE CONVERTER (J86899B) from being turned up when the switch is in the SHUTDOWN position.

C. Spare Converter (J86899B)

3.04 The SPARE CONVERTER (J86899B) bay contains one reversible polarity CONVERTER, test load and a CONVERTER PATCH panel. The SPARE CONVERTER can furnish either a POSITIVE or a NEGATIVE voltage to power a coaxial line whose regular CONVERTER is out of service and patched to the test load. The polarity of the SPARE CONVERTER (J86899B) is automatically determined by the polarity of the regular CONVERTER (J86899A) it replaces.

3.05 The SPARE CONVERTER (J86899B) contains the circuitry necessary to automatically regulate the current, limit the voltage, and detect abnormal current conditions. Protective shutdowns for high current and voltages minimize personnel hazards and possibility of damaging repeaters or regenerators under trouble conditions. Because many trouble conditions are transitory, the SPARE CONVERTER can attempt an automatic restart. There is a CONVERTER PATCH panel to enable patching the SPARE CONVERTER to a coaxial line to replace a regular CONVERTER. Whenever the SPARE CONVERTER is patched to a coaxial line, the regular CONVERTER which normally powers that line is patched into the test load.

D. Power Stage (J86899AA)

3.06 The POWER STAGE (J86899AA) inverts the positive 140-volt dc input to a regulated ac. The POWER STAGE then rectifies the ac to an output of up to 1150 volts dc. When used in the L5/L5E system, the current is regulated at 910 mA. When used in the T4M system, the current is regulated at 835 mA.

E. Oscillator (J86899AB)

3.07 The OSCILLATOR (J86899AB) generates the internal 20-KHZ operating frequency of the CONVERTER. This 20-KHZ signal is used to supply the base drive for the power transistors in the POWER STAGE. The OSCILLATOR also functions as the internal power supply for the CONVERTER.

F. Control Circuit (J86891AC)

3.08 The CONTROL CIRCUIT (J86891AC) circuit pack automatically restarts the CONVERTER after a shutdown, provided the restart capacity is engaged. A timer is provided to delay the restart attempt so that possible transient faults may clear. The circuit also monitors the input battery voltage and provides protection for the CONVERTER by shutting down the CONVERTER if the input voltage drops below +120 volts.

G. Alarm Sending Circuit (J86891AD)

3.09 The ALARM SENDING (J86891AD) circuit pack controls the internal and external alarm indicators. For the external alarm system, two normally open contacts are provided for the major alarm (relay MJ) and two normally open contacts are provided for the minor alarm (relay MN). The external minor alarm may be inhibited by depressing and releasing the ALARM CUTOFF switch on the CONVERTER control panel. Because a major alarm is an indication of a serious trouble condition, the ALARM CUTOFF switch will not inhibit the major alarm.

H. Current Shutdown Circuit (J86891EA)

3.10 The CURRENT SHUTDOWN (J86891EA) circuit pack monitors the CONVERTER output current and shuts down the CONVERTER if a serious current trouble occurs. The circuit consists of three op-amps one of which will shut down the CONVERTER if one of the following conditions occurs:

- (a) Current shutdown (CSD) occurs after a time delay when the output current of the CONVERTER exceeds 1200 milliamperes for List 4 and 5 (L5/L5E) or 1100 milliamperes for List 6 and 7 (T4M).

(b) Fast shutdown (FSD) occurs whenever the output current exceeds 1600 milliamperes for List 4 and 5 (L5/L5E) or 1460 milliamperes for List 6 and 7 (T4M).

(c) Rate shutdown (RSD) occurs whenever the output current fluctuates at an amplitude exceeding 200 milliamperes.

3.11 An in-service test of the CURRENT SHUTDOWN circuit may be performed by pressing and releasing CURRENT SHUTDOWN and TEST switch on the CONVERTER control panel.

I. Voltage Shutdown and Current Alarm Circuit (J86891AF)

3.12 The VOLTAGE SHUTDOWN (J86891AF) circuit pack performs both the high output voltage and the abnormal output current monitoring activities. The circuit monitors the CONVERTER output voltage and shuts down the CONVERTER if the output voltage exceeds 1750 volts dc. This will prevent excessive and dangerous voltages from being applied to the line. The circuit will also shut down the CONVERTER if the CONVERTER load exceeds a series combination of 200 volts dc and 3600 ohms. This should prevent the CONVERTER from being turned up into an open cable.

3.13 The current alarm circuit monitors the CONVERTER output current. A minor alarm is activated, the bay alarm lamp lights, and the CURRENT ALARM and TEST lamp lights, if the output current exceeds 975 milliamperes or falls below 860 milliamperes for List 4 and 5 (L5/L5E) or if it exceeds 895 milliamperes or falls below 795 milliamperes for List 6 and 7 (T4M).

Note: A CURRENT ALARM will not shut down the CONVERTER.

3.14 An in-service test of the VOLTAGE SHUTDOWN and CURRENT ALARM is performed by pressing and releasing pushbuttons on the CONVERTER control panel.

J. Feedback Regulator Circuit (J86891AG)

3.15 The FEEDBACK REGULATOR (J86891AG) circuit pack regulates both the output current and voltage of each CONVERTER. The regulation is accomplished by controlling the POWER STAGE duty cycle. This is done by controlling the width

of the base current pulse being applied to the POWER STAGE switching transistors. The FEEDBACK REGULATOR responds to output current and voltage and operates in one of the three following modes:

(a) **Voltage Mode:** In the voltage mode, the FEEDBACK REGULATOR responds to and controls the OUTPUT VOLTAGE of the CONVERTER. This mode prevents excessive voltage on the line repeaters or regenerators when the load impedance is higher than normal.

(b) **Current Mode:** In the current mode, the FEEDBACK REGULATOR responds to and controls the OUTPUT CURRENT of the CONVERTER. This mode limits the line current if a cable short circuits.

(c) **Impedance Mode:** In the impedance mode, the FEEDBACK REGULATOR responds to both output voltage and current. This mode is the normal operating mode of the CONVERTER.

3.16 The FEEDBACK REGULATOR also controls the CONVERTER current during turnup. During CONVERTER turnup, a ramp circuit in the FEEDBACK REGULATOR causes the OUTPUT CURRENT to increase at a linear rate from zero to a value determined by the OUTPUT CURRENT ADJUST COARSE and FINE controls. The CONVERTER turnup process is started by pressing and releasing the ON switch or by remote control.

K. Ground Panel Floating

3.17 During normal operation of the 680B power plant, only one end of the power feed is grounded. The GROUND PANEL FLOATING is provided only at the floating end of a double-ended or the powered end of a single-ended power feed. The opposite end will have a permanent ground. Grounding the power feed only at one end accomplishes two things:

(a) Avoids the possibility of corrosion damage to the cable sheaths due to continuous dc current via an earth path.

(b) Minimizes the susceptibility of the metallic circuit to longitudinal voltage induced by lighting and power line faults.

SECTION 167-694-100

3.18 The GROUND PANEL FLOATING automatically grounds the floating end of the power feed to:

- (a) Protect the line repeaters and regenerators from excessive voltage.
- (b) To maintain operation of the power feed section if trouble develops in one coaxial cable or CONVERTER.

L. Ground Panel Solid

3.19 The GROUND PANEL SOLID is provided at the grounded end of a double-ended power feed. The panel contains only two bus bars to provide a permanent ground.

4. OPERATION

A. Introduction

4.01 The 680B power plant is automatic in supplying power to the coaxial cable line repeaters and regenerators. The 680B should not require any day-to-day adjustments. Normally the regular CONVERTER(s) are turned up and powering their coaxial lines.

B. Operating Procedures

4.02 Table A provides a listing of controls and indicators and the reasons they are lighted. Detailed procedures for routine operation is contained in TOP volume 167-694-102.

5. MAINTENANCE

A. Introduction

5.01 For proper automatic operation of the 680B power plant, scheduled routine maintenance should be performed on the plant.

5.02 Personnel are notified of trouble conditions by audible and visible major and minor alarms.

B. Maintenance Tasks

5.03 Routine, acceptance, and trouble clearing tasks are contained in the associated TOP volume 167-694-102.

6. REFERENCES

6.01 The following list provides further information concerning the 680B converter power plant:

NUMBER	TITLE
167-694-102	680B Power Plant-TOP
SD-82128-01	Power Supply Circuit +140 VDC Input, Positive and Negative Outputs, 0 to 1150 Volts, 835 Milliamperes DC for T4M Digital Line or 0 to 1150 Volts, 910 Milliamperes DC for L5/L5E Coaxial Systems, 680B Power Plant, J86899A
SD-82129-01	Power Supply Circuit +140 VDC Input, Positive or Negative Output, 0 to 1150 Volts, 835 Milliamperes DC for T4M Digital Line, 0 to 1150 Volts, 910 Milliamperes DC for L5/L5E Coaxial System, 680B Power Plant, (J86899B)
SD-82130-01	Interconnection and DC Distribution Circuit for 680B Power Plant L5/L5E Coaxial Systems T4M Digital Line
SD-51110-01	Common Systems L5/L5E Carrier or Digital Transmission Facilities T4M Digital Line Power Separation Filter Circuit
802-867-151	680B Power Plant 0 to 1150 Volt, 835 or 910 Milliampere DC Output +140 Volt DC Input Equipment Design Requirement Power Systems
ED-82423-30	Power System Specification for Ground Protect or Unit Printed Wiring Board for L5 Coaxial System

ED-82497-30 Power Systems Specification for
Extender Board Unit for the
J86891A and J86891B Power
Supplies

Bay (J86899A and B) L5 Coaxial
System T4M Digital System

ED-82670-10 Power Systems Cabling Plan for
680B Power Plant Power Supply

ED-82671-10

Power Systems Spare Parts List
for the J86899A and B Power
Supplies 680B Power Plant

TABLE A	
680B OPERATION STATUS INDICATOR	
CONVERTER BAY AND PANEL LAMPS LIGHTED	INDICATION
CURRENT SHUTDOWN & TEST	<p>CONVERTER has shut down due to:</p> <p>(a) Current shutdown (CSD) occurs after a time delay of from 100 to 200 milliseconds whenever the CONVERTER output current exceeds 1200 \pm30 milliamperes (Option Y, used in L5/L5E Carrier System), or 1100 \pm30 milliamperes (Option W, T4M Carrier System)</p> <p>(b) Fast shutdown (FSD) occurs in 100 to 160 milliseconds whenever the CONVERTER output current exceeds 1600 \pm40 milliamperes (Option Y, used in L5/L5E Carrier System), or 1470 \pm35 milliamperes (Option W, used in T4M Carrier System)</p> <p>(c) Rate shutdown (RSD) occurs whenever the CONVERTER output current fluctuates at an amplitude exceeding 200 milliamperes peak-to-peak at frequencies up to 1000 Hz. Shutdown also occurs immediately if the current drops 500 milliamperes below the operating current</p>
	Or the CURRENT SHUTDOWN & TEST pushbutton has been depressed to simulate a current shutdown condition
CURRENT ALARM & TEST	CONVERTER output current is not within 860 to 975 mA for L5/L5E Coaxial System, or 795 to 895 mA for T4M Coaxial System, or the CURRENT ALARM & TEST pushbutton has been depressed to simulate a current alarm condition
VOLTAGE SHUTDOWN & TEST	<p>CONVERTER has shut down due to:</p> <p>(a) CONVERTER output voltage has exceeded 1750 \pm50 volts</p> <p>(b) CONVERTER load has exceeded a series combination of 200 volts and 3500 ohms</p>
	Or the VOLTAGE SHUTDOWN & TEST pushbutton has been depressed to simulate a voltage shutdown condition
FUSE ALARM [On GROUND PANEL FLOATING of Regular CONVERTER (J86899A)]	Fuse F1 has blown because SG1 or SG2 protector has operated

TABLE A (Contd)	
680B OPERATION STATUS INDICATOR	
CONVERTER BAY AND PANEL LAMPS LIGHTED	INDICATION
GROUND ALARM & TEST [On GROUND PANEL FLOATING of Regular CONVERTER (J86899A)]	The common point of the two line feed CONVERTER(s) at the floating end of the power feed section (normally ungrounded) is now grounded due to: (a) The dc ground voltage has exceeded 250 volts (b) The ground transient voltage has exceeded 800 volts (c) The sum of the POSITIVE and NEGATIVE CONVERTER output currents in less than 1550 mA (d) The difference between CONVERTER output currents is greater than 35 mA Or the GROUND ALARM & TEST pushbutton has been depressed to simulate a ground alarm condition
REM CONT RESET RESTART	The CONVERTER cannot be started remotely from E2 control terminal The CONVERTER will not attempt an automatic restart after a shutdown has occurred
AUTO RESTART	If RESET REM CONT RESTART is off, an automatic restart attempt has been made and alarm condition will be locked up. Operation of E2 remote restart will turn off all alarms and lamps and re-energize automatic restart feature
MEN WORKING ON CABLE	PERSONNEL SAFETY switch has been placed in SHUTDOWN position removing output of CONVERTER from line. CONVERTER cannot be turned up
ALARM CUTOFF	ACO relay is operated and external minor alarms are deactivated
Bay alarm (Red Lamp at Top of Bay)	Major or minor bay alarms are activated, or external major alarms are activated due to CONVERTER low battery shutdown
OFF	CONVERTER has automatically shut down due to a trouble condition, or OFF pushbutton has been depressed to turn CONVERTER down, [<i>DANGER: Even though CONVERTER OFF lamp is lighted, the power feed section may still be energized. To de-energize power feed section, turn down series-connected CONVERTER(s) and verify that all associated OUTPUT CURRENT ammeters and OUTPUT VOLTAGE voltmeters indicate zero.</i>]