630A POWER PLANT
USING DC-TO-DC CONVERTERS
24 VOLTS, 300 AMPERES AND
48 VOLTS, 150 AMPERES OUTPUT
140 VOLTS INPUT
OPERATING METHODS

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1. GENERAL

1.01 The 630A (J86900) converter power plant operates from a positive or negative 140-volt dc input and provides a dual output of positive 24 volts and negative 48 volts. Four J87371A 100-ampere converters supply the 24-volt bus with a maximum output of 300 amperes. Four J87400A 50-ampere converters supply the 48-volt bus with a maximum output of 150 amperes. Plants for lesser current ratings may be provided by using fewer converters. For each bus the number of converters provided to serve any given load is equal to the minimum number of converters required to provide the desired output current plus one additional converter. Thus, a redundant converter is on line at all times. The redundant converter normally shares the load. If a converter fails in the plant, capacity will not be reduced. The 630A dc-to-dc converter plant is a general purpose plant and may be used whenever its characteristics and design apply. Refer to Fig. 1 and 2 for typical 630A power plant arrangements.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph. This issue does affect the Equipment Test List.

1.03 This section covers the use of the 630A power plant and its associated converters. For information on the converters when the converters are used individually and are not a part of the 630A power plant, refer to the following sections.

CONVERTER	SECTION
J87371A	161-270-301
J87400A	161-256-301

1.04 The instructions given in this practice are based on the following circuit schematic drawings. For a detailed description of operation, refer to the corresponding circuit descriptions.

SD-82195-01 Discharge Circuit, +24-Volt, 300-Ampere, −48-Volt, 150-Ampere, Converter Plant, 630A Power Plant

SD-82097-01 DC-to-DC Converter, 140-Volt Input, 24-Volt, 100-Ampere Output, J87371

SD-82144-01 DC-to-DC Converter, 140-Volt Input, 48-Volt, 50-Ampere Output, J87400

If this section is to be used with equipment or apparatus that is associated with earlier or later issues of the circuit schematic drawings, reference should be made to the SDs and CDs to determine the extent of the changes and the manner in which the section may be affected.

1.05 Each individual converter output can be manually connected or disconnected and automatically disconnected if certain trouble conditions develop in the converter by using the associated plant circuit breaker (CB1, CB2, CB3, or CB4).

Warning: Hazardous voltages may be encountered in the 630A power plant. Avoid all contact with terminals to prevent injuries from occurring. Do not allow a test pick to touch two metal parts at the same time as dangerous or destructive short circuits may occur.

1.06 Each converter in the plant is regulated internally when the associated plant circuit breaker is open and externally when the associated plant circuit breaker is closed.

1.07 The output voltages from the plant converters can be adjusted within the following limits.

CONVERTER	VOLT RANGE
J87371A	20 to 30 volts
J87400A	44 to 54 volts

1.08 The converter automatically shuts down if an overcurrent condition occurs. Each converter is equipped with an adjustable high voltage shutdown circuit that shuts the converter down if a high voltage condition occurs. The high voltage shutdown circuit is selective. When a high voltage condition occurs on the plant output bus, the individual converter that is responsible for the high voltage condition will shut down. Should reverse current appear at the output of a converter, a signal will be provided to the reverse current level detector. The reverse current level detector will in turn provide signaling that will shut down the defective converter and disconnect the unit

from the bus. The plant also contains an adjustable low voltage alarm circuit. When a low voltage condition occurs on the output bus, a major alarm is activated. The low voltage alarm will not automatically extinguish when the bus voltage returns to normal. The ACO key must be momentarily depressed after the bus voltage returns to normal to extinguish the low voltage alarm.

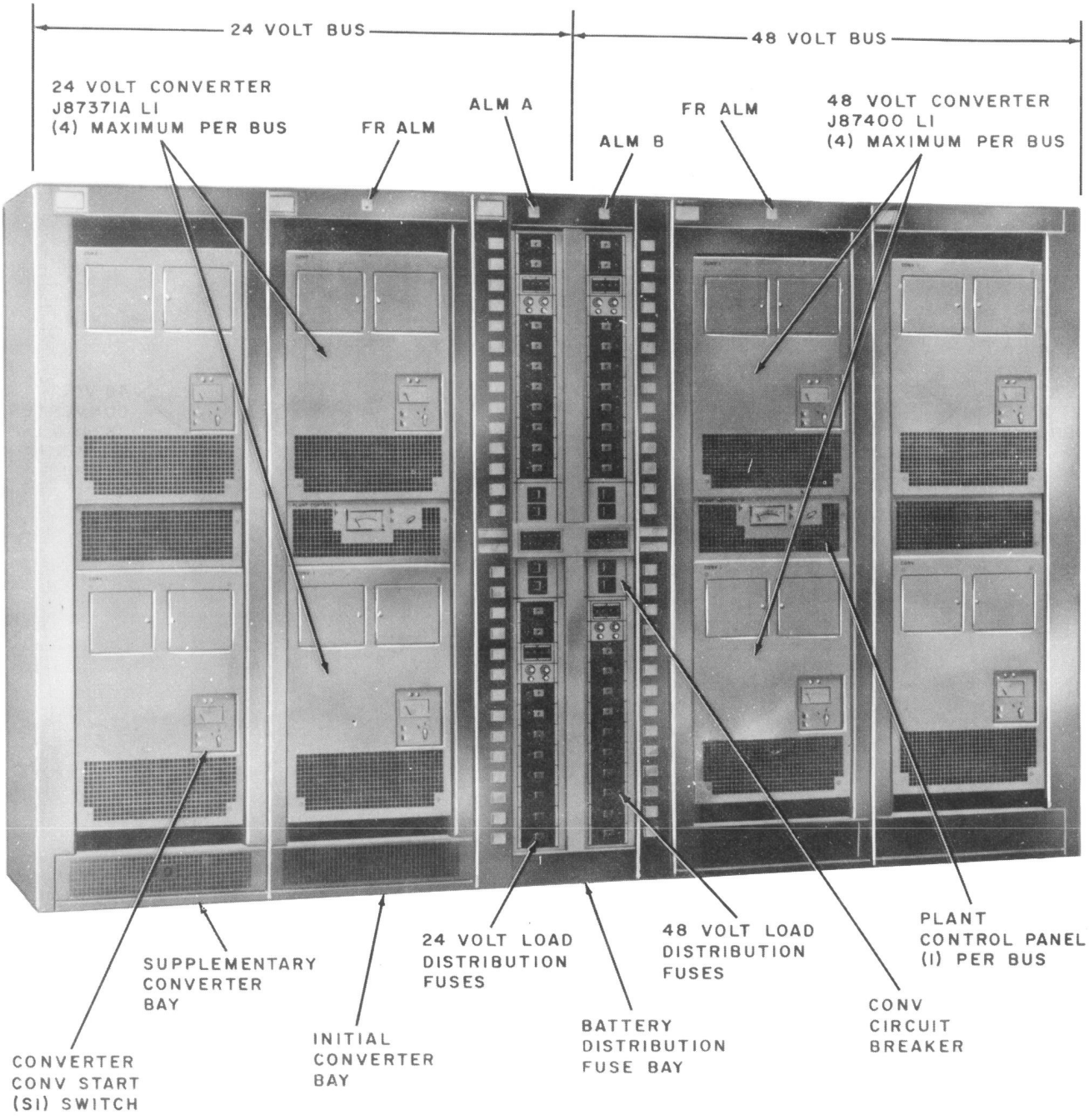


Fig. 1—Fully Equipped 630A Power Plant—Front View

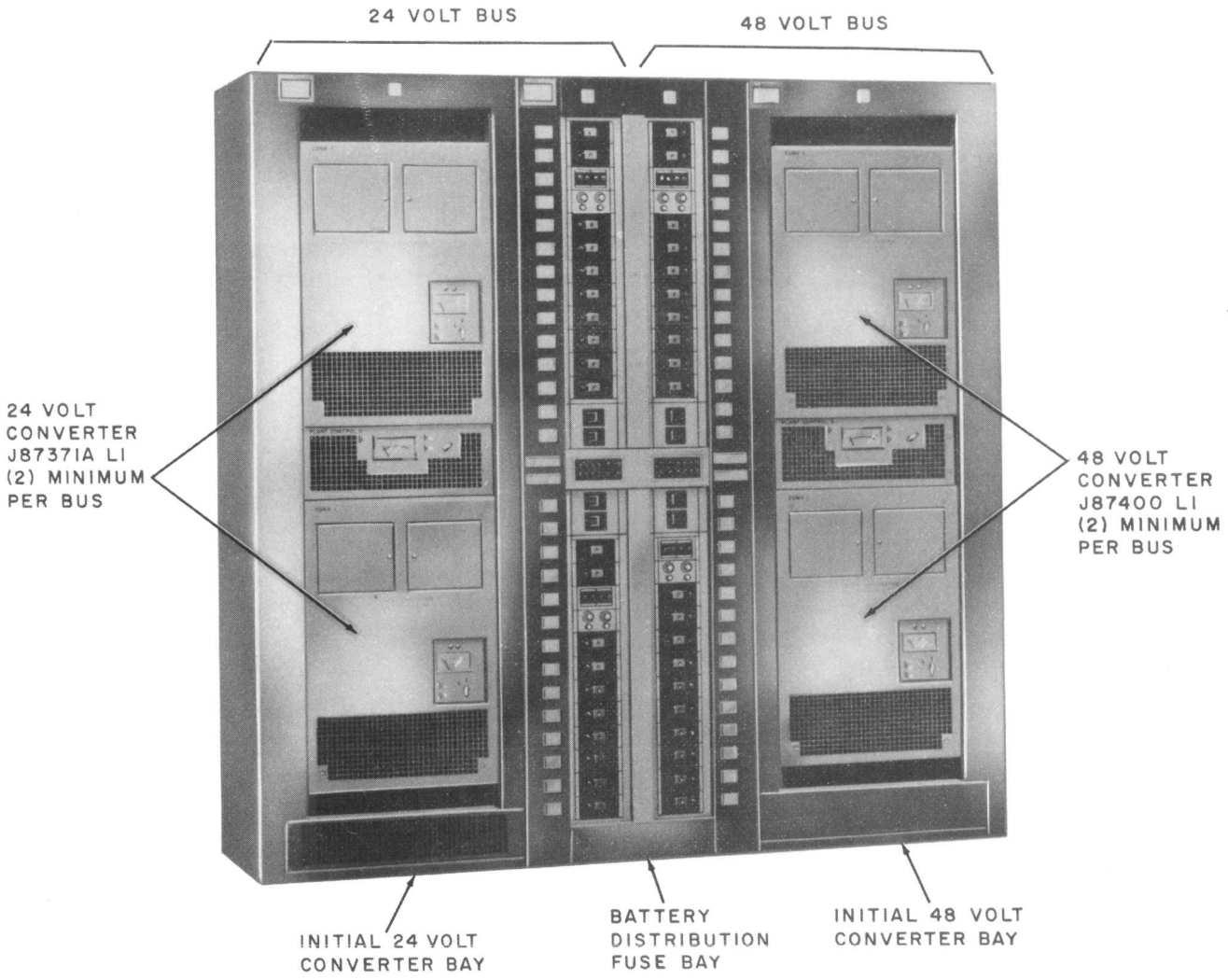


Fig. 2—630A Power Plant—Minimum Arrangement

1.09 Routine checks should be performed during a period when they will cause the least service reaction.

2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO	DESCRIPTION
TOOLS	
1005	Jewelers Screwdriver
783A	Filter Charger 30-Ampere (See Note)
—	3-Inch C Screwdriver
TEST APPARATUS	
35D or F Type	Test Set (see Section 100-101-301)
2W17A	Cord (W2W cord, 6 feet long, equipped with No. 310 plug and two No. 360 tools)
KS-8039	DC Volt-Milliammeter
KS-14510	Volt-Ohm-Milliammeter
KS-6278	Connecting Clips
—	Digital Meter (Suitable digital meters are as follows: Hickok Model 3300 or 3310, Fluke Model 8100A, Weston Model 1240, or KS-20599 L4. See Warning.)
—	Tektronix Type 545B Oscilloscope equipped with Differential Vertical Amplifier
—	P6021 Current Probe With Type 134 Amplifier

TEST APPARATUS	DESCRIPTION
—	Isolation Plug—Hubbell No. BL12-767. (Three-prong to two-prong plug for isolating the meter from the ac input supply ground)
—	Clip Lead (minimum 3 feet long)
—	Timing Device (wrist watch with seconds hand)
411C	Test Pick
720A	Battery Pickup Tool
W1AY	Cord (equipped with a 360A tool in each end)

Note: The 783A filter charger is a modified KS-16364 fuse holder equipped with a series resistor, fuse, and lamp combination. Refer to Fig. 3 for a schematic diagram of the filter charger. When the converters are supplied from the 415A power plant equipped with 140-volt input circuit breakers, the filter charger circuit is included in the 140-volt plant circuit.

Warning: When using an electronic-type voltmeter for testing in an energized circuit, the meter must be isolated from external power ground. If the meter does not float ground, erroneous readings and equipment damage may result. If the meter is not isolated from ground, use a three-prong to two-prong adapter in the external power cord. The use of an adapter in the external power cord can create a voltage hazard on the meter chassis. Avoid bodily contact between the meter and equipment frames. Use of a meter not requiring ground isolation of the external power cord (battery pack) is preferred.

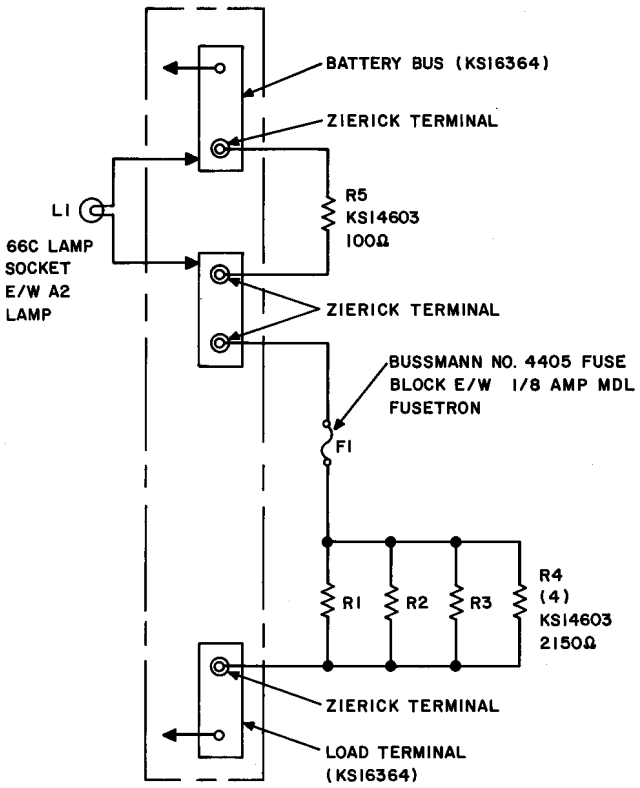


Fig. 3—Schematic Diagram of 783A Filter Tool Charger

3. OPERATION

A. Preparing to Start a Plant Bus

3.01 When preparing to start a plant bus, proceed as follows.

(1) Verify that the 140-volt input fuses are removed, or the 140-volt input circuit breakers are in the OFF position for each converter associated with the bus.

Note: The 140 volts dc is supplied from a 140-volt battery plant such as a 413- or 415-type. The 140-volt fuses or circuit breakers are located at the battery plant or at the area bus center (ABC).

(2) Remove the load distribution fuses from the distribution fuse panel for all of the converters associated with the bus.

(3) Verify that the following converter and plant controls are positioned as indicated:

CONV START (S1) switch set to OFF

OUTPUT VOLTS (S1) switch set to OFF

All CONV Circuit Breakers (CONV1, CONV2, CONV3, and CONV4) set to OFF

(4) Verify that all associated fuses are of the proper type and size and installed in their respective fuse holders except for those fuses specified in (1) and (2).

(5) Verify that all external connections are made in accordance with the associated circuit schematic drawings.

(6) Using the digital meter, set on the DC VOLTS scale, measure the dc input voltage to each converter at the distribution panel where the 140-volt input fuses or circuit breakers are located.

Requirement: The test meter should indicate between 120 and 155 volts dc.

B. Charging Input Filter Capacitors

3.02 To charge the input filter capacitors in the plant converters, proceed as follows.

Caution: The converter input filter capacitors must be charged before installing the associated 140-volt input fuses or closing the 140-volt input circuit breaker to prevent arcing the fuse holder or circuit breaker contacts.

Note: The converter input filter capacitors normally require charging only when the associated 140-volt input fuse is removed from the fuse panel or if the 140-volt input circuit breaker is operated to the OFF position.

(a) ***When Equipped with 140-Volt Fuses***

(1) Verify that the procedures in 3.01 have been followed.

Warning: The fuse and resistors of the 783A filter charger become hot when the

filter charger is being used. Avoid contact with these components when the filter charger is being used to prevent injuries from occurring.

(2) Insert the 783A filter charger in the 140-volt fuse distribution panel to charge the input filter capacitors for the converter being started.

Requirement: The lamp on the filter charger should glow brightly initially and then dim out in approximately 30 seconds. When the filter charger lamp extinguishes, the input filter capacitors should be sufficiently charged. The DS1 (red) lamp lights on the converter inside panel.

Note: If the requirement in (2) is not met, quickly remove the filter charger from the fuse distribution panel and refer to the trouble chart in 5.02.

(3) When the filter charger lamp extinguishes, wait an additional 15 seconds and then remove the filter charger from the input fuse distribution panel and quickly install the associated KS-16364 fuse holder containing the correct fuses in its place. The dc input fuses should be installed quickly to prevent the input filter capacitors from discharging.

(4) Repeat (2) and (3) for the remaining converters associated with the bus.

(b) ***When Equipped with 140-Volt Circuit Breakers:*** Each circuit breaker is equipped with a pushbutton which permits the operator to automatically connect a capacitor charge circuit furnished in the 140-volt control and dc distribution bay. Before closing the 140-volt circuit breaker, proceed as follows.

(1) Verify that the procedures in 3.01 have been followed.

(2) Check the capacitor charge lamp by operating the toggle switch to the LAMP TEST position.

Requirement: The capacitor charge lamp lights to indicate that the lamp is good.

(3) Operate the toggle switch to CAP CHG position.

(4) Depress the pushbutton on the 140-volt circuit breaker and observe the charge lamp.

Requirement: The charge lamp should glow brightly initially and then dim out in approximately 15 to 45 seconds.

Note: If the charge lamp does not extinguish, a ground fault is apparent in the 140-volt output circuit. Do not close the 140-volt circuit breaker. Refer to trouble chart in 5.02.

(5) When the charge lamp dims out, close the 140-volt circuit breaker to the ON position.

(6) Repeat (4) and (5) for each converter.

(7) Operate the toggle switch to the OFF position.

C. Starting or Restoring a Complete 24-Volt Bus To Service

Starting or Restoring Bus With Load Distribution Fuses Removed

3.03 To start a 24-volt plant bus, proceed as follows.

Note: Failure of a bus CONV( ) circuit breaker to stay closed when starting the power plant may be due to slow manual operation of the circuit breaker.

(1) Verify that the procedures in 3.01 have been followed.

(2) Charge the converter input filter capacitors in accordance with 3.02(a) or (b).

(3) Operate the OUTPUT VOLTS (S1) switch on the plant to the associated converter position for the first converter to be started.

Note 1: The converters will be started individually. An OUTPUT VOLTS (S1) switch and OUTPUT VOLTS (M1) voltmeter are provided for each bus of the plant.

Note 2: The CONV OFF lamp is supplied power from the 24-volt bus. Due to a no-voltage condition on the bus, the CONV OFF lamp will not be lighted.

(4) Operate the CONV START (S1) switch on the converter to be started to the START position.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter indicates the converter output voltage.

(5) Adjust the VOLT ADJ (R16) potentiometer on the converter until the plant OUTPUT VOLTS (M1) meter indicates 0.5 volt above the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) meter should indicate 24.5 volts.

Note 1: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

Note 2: The VOLT ADJ (R16) potentiometer is adjusted to 0.5 volt above the required bus voltage to accommodate the light load voltage uptilt circuit when the converter is not loaded.

(6) Operate the bus CONV( ) circuit breaker for the converter that was started to the ON position (refer to Fig. 4).

Requirement: The ALM lamp on the plant control panel lights and a major alarm is initiated. The CONV OFF lamp lights on all other converters associated with the bus.

(7) Momentarily depress the ACO pushbutton to reset the low voltage monitor and retire the alarm.

(8) Slowly install some of the associated load distribution fuses in the plant distribution fuse panel until the converter is supplying a maximum of 90 amperes to the load, as indicated on the converter OUTPUT CURRENT (M1) ammeter.

(9) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position. Observe the OUTPUT VOLTS (M1) voltmeter.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 24 $\pm$0.25 volts.

Note: If necessary, adjust the VOLT ADJ (R16) potentiometer on the converter until the requirement is met.

(10) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the associated position for the next 24-volt converter to be started.

(11) Operate the CONV START (S1) switch on the converter to be started to the START position.

Requirement: The CONV ALM (red) lamp on the converter lights due to a no-load condition. The lamp will extinguish when the converter is connected to the bus. The CONV OFF lamp extinguishes and the plant OUTPUT VOLTS (M1) voltmeter indicates the converter output voltage.

(12) Adjust the VOLT ADJ (R16) potentiometer on the converter until the plant OUTPUT VOLTS (M1) meter indicates 0.5 volt above the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) meter should indicate 24.5 volts.

(13) Operate the bus CONV( ) circuit breaker for the converter that was started to the ON position (see Fig. 4).

(14) Slowly install additional load distribution fuses associated with the bus to increase the bus load by a maximum of 90 amperes. The total bus load is equal to the sum of the current readings on the individual converters.

(15) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position. Observe the OUTPUT VOLTS (M1) voltmeter.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required bus voltage as specified by local instructions.

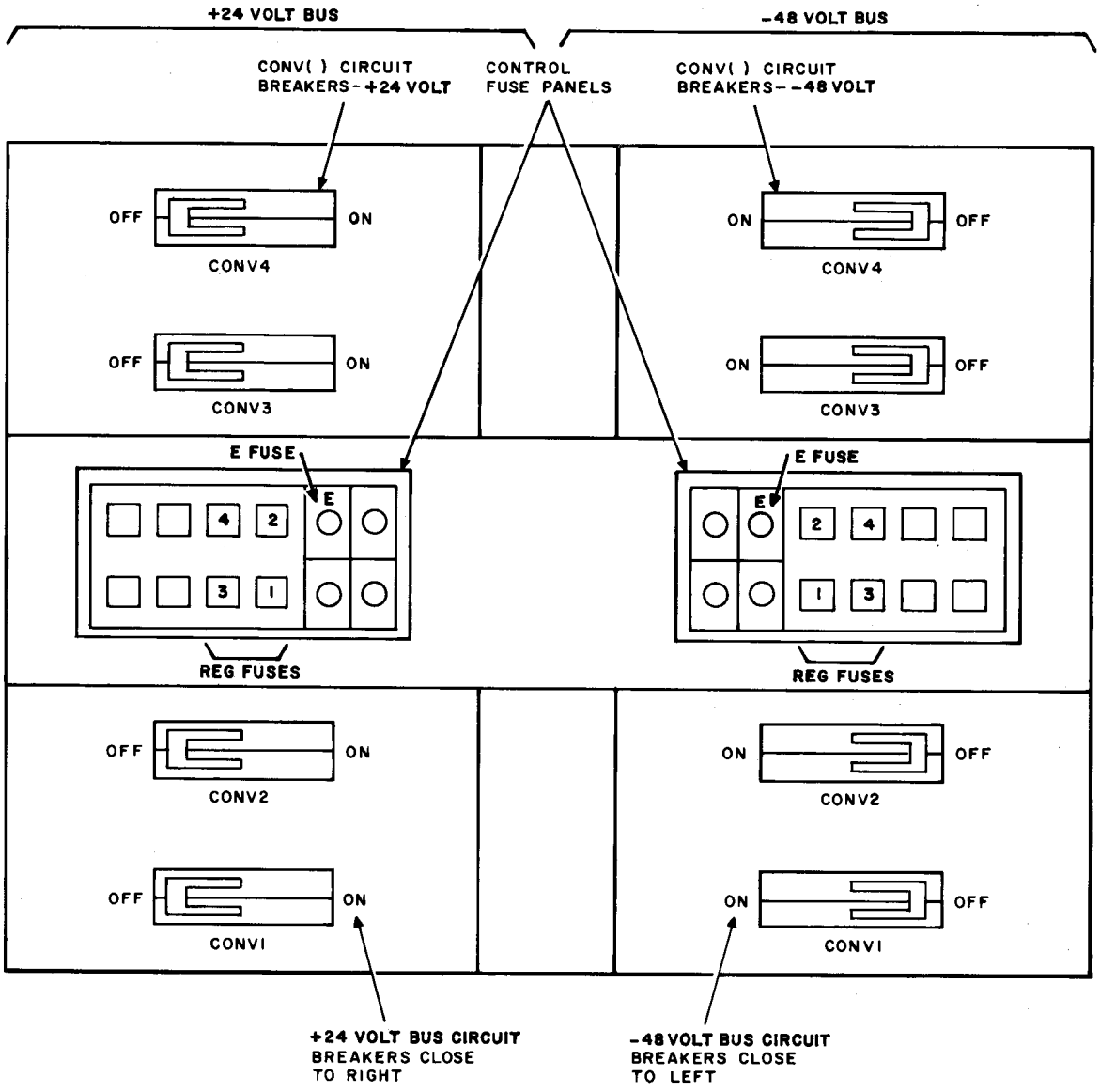


Fig. 4—Plant Distribution Panel—CONV Circuit Breakers

In the absence of local instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 24 $\pm$0.25 volts.

There is no requirement for the converters in this plant to share the load current equally. The individual converters should be adjusted as close to 24 volts as possible, always maintaining the voltage requirement at the bus.

(16) If the plant OUTPUT VOLTS (M1) voltmeter indicates that the bus voltage is too high or too low and/or the converter OUTPUT CURRENT (M1) ammeters do not indicate within 30 amperes of each other, proceed as follows.

(a) ***Bus Voltage Low:*** Rotate the VOLT ADJ (R16) potentiometer clockwise (cw) on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(b) ***Bus Voltage High:*** Rotate the VOLT ADJ (R16) potentiometer counterclockwise (ccw) on the converter whose OUTPUT

CURRENT (M1) ammeter indicates the highest load current.

(c) ***Bus Voltage Normal—Load Balance Greater than 30 Amperes:*** Slightly rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(17) Repeat the procedures in (10) through (16) for the remaining 24-volt converters associated with the bus.

(18) Install any remaining load distribution fuses associated with the 24-volt bus.

Starting or Restoring Bus With Load Distribution Fuses Not Removed

3.04 To restore power to a complete 24-volt bus without removing the load distribution fuses, proceed as follows.

(1) Verify that the CONV START (S1) switch for each converter associated with the 24-volt bus is in the OFF position.

(2) Verify that the bus CONV( ) circuit breaker for each converter associated with the 24-volt bus is in the OFF position.

(3) If the associated 140-volt input fuse is removed from the fuse panel or if the 140-volt input circuit breaker is in the OFF position, charge the converter input filter capacitors in accordance with 3.02(a)(2) and (3) or 3.02(b)(2) through (7).

(4) Start all converters associated with the 24-volt bus as follows.

(a) Operate the OUTPUT VOLTS (S1) switch on the plant to the associated converter position for one of the converters to be restored to service.

(b) Operate the CONV START (S1) switch on the converter to be restored to service to the START position.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter indicates the converter output voltage.

Note 1: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

Note 2: The VOLT ADJ (R16) potentiometer is adjusted to approximately 0.5 volt above the required bus voltage to accommodate the light load voltage uptilt circuit when the converter is not loaded.

(d) Repeat the procedure in (a) through (c) for each converter associated with the 24-volt bus.

(5) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position.

Caution: The associated equipment that is connected to the 630A bus may require special filter charging starting techniques. Use the approved starting procedures for the associated equipment.

(6) Close at one time sufficient bus CONV( ) circuit breakers to carry the bus load as follows.

(a) ***Two-Converter Bus:*** Close the bus CONV( ) circuit breaker for one converter (maximum 100 amperes).

(b) ***Three-Converter Bus:*** Close the bus CONV( ) circuit breakers for two converters at exactly the same time (maximum 200 amperes).

(c) ***Four-Converter Bus:*** Close the bus CONV( ) circuit breakers for three converters at exactly the same time (maximum 300 amperes).

(7) Close the bus CONV( ) circuit breaker for any remaining converter associated with the 24-volt bus.

(8) Momentarily depress the ACO pushbutton to reset the low voltage monitor and retire the alarm.

(9) Observe the indications on the plant OUTPUT VOLTS (M1) voltmeter and converter OUTPUT CURRENT (M1) ammeters.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required bus voltage as specified by local instructions, and the converter OUTPUT CURRENT (M1) ammeters should indicate within 30 amperes of each other. In the absence of local instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 24 $\pm$0.25 volts.

(10) If the plant OUTPUT VOLTS (M1) voltmeter indicates that the bus voltage is too high or too low and/or the converter OUTPUT CURRENT (M1) ammeters do not indicate within 30 amperes of each other, proceed as follows.

(a) ***Bus Voltage Low:*** Rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(b) ***Bus Voltage High:*** Rotate the VOLT ADJ (R16) potentiometer ccw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the highest load current.

(c) ***Bus Voltage Normal—Load Balance Greater than 30 Amperes:*** Slightly rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current. [See READ statement in 3.03(15).]

D. Starting or Restoring a Complete 48-Volt Bus to Service

Starting or Restoring Bus With Load Distribution Fuses Removed

3.05 To start a 48-volt plant bus, proceed as follows.

Note: Failure of a bus CONV( ) circuit breaker to stay closed when starting the power plant may be due to slow manual operation of the circuit breaker.

(1) Verify that the procedures in 3.01 have been followed.

(2) Charge the converter input filter capacitors in accordance with 3.02(a) or (b).

(3) Operate the OUTPUT VOLTS (S1) switch on the plant to the associated converter position for the first converter to be started.

Note 1: The converters will be started individually. If the plant is equipped with both A and B bus bars, there will be an OUTPUT VOLTS (S1) switch and OUTPUT VOLTS (M1) voltmeter for each bus of the plant.

Note 2: The CONV OFF lamp is supplied power from the 48-volt bus. Due to a no-voltage condition on the bus, the CONV OFF lamp will not be lighted.

(4) Operate the CONV START (S1) switch on the converter to be started to the START position.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter indicates the converter output voltage.

(5) Adjust the VOLT ADJ (R16) potentiometer on the converter until the plant OUTPUT VOLTS (M1) meter indicates 1.25 volts above the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) meter should indicate 49.25 volts.

Note 1: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

Note 2: The VOLT ADJ (R16) potentiometer is adjusted to 1.25 volts above the required bus voltage to accommodate the light load voltage uptilt circuit when the converter is not loaded.

(6) Operate the bus CONV( ) circuit breaker for the converter that was started to the ON position (refer to Fig. 4).

Requirement: The ALM lamp on the plant control panel lights and a major alarm is initiated. The CONV OFF lamp lights on all other converters associated with the bus.

(7) Momentarily depress the ACO pushbutton to reset the low voltage monitor and retire the alarm.

(8) Slowly install some of the associated load distribution fuses in the plant distribution fuse panel until the converter is supplying a maximum of 45 amperes to the load, as indicated on the converter OUTPUT CURRENT (M1) ammeter.

(9) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position. Observe the OUTPUT VOLTS (M1) voltmeter.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 48 $\pm$0.25 volts.

Note: If necessary, adjust the VOLT ADJ (R16) potentiometer on the converter until the requirement is met.

(10) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the associated position for the next 48-volt converter to be started.

(11) Operate the CONV START (S1) switch on the converter to be started to the START position.

Requirement: The CONV ALM (red) lamp on the converter lights due to a no-load condition. The lamp will extinguish when the converter is connected to the bus. The CONV OFF lamp extinguishes and the plant OUTPUT VOLTS (M1) voltmeter indicates the converter output voltage.

(12) Adjust the VOLT ADJ (R16) potentiometer on the converter until the plant OUTPUT VOLTS (M1) meter indicates 1.25 volts above the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) meter should indicate 49.25 volts.

(13) Operate the bus CONV( ) circuit breaker for the converter that was started to the ON position (see Fig. 4).

(14) Slowly install additional load distribution fuses associated with the bus to increase the bus load by a maximum of 45 amperes. The total bus load is equal to the sum of the current readings on the individual converters.

(15) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position. Observe the OUTPUT VOLTS (M1) voltmeter.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 48 $\pm$0.25 volts.

There is no requirement for the converters in this plant to share the load current equally. The individual converter should be adjusted as close to 48 volts as possible, always maintaining the voltage requirement at the bus.

(16) If the plant OUTPUT VOLTS (M1) voltmeter indicates that the bus voltage is too high or too low and/or the converter OUTPUT CURRENT (M1) ammeters do not indicate within 20 amperes of each other, proceed as follows.

(a) ***Bus Voltage Low:*** Rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(b) ***Bus Voltage High:*** Rotate the VOLT ADJ (R16) potentiometer ccw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the highest load current.

(c) ***Bus Voltage Normal—Load Balance Greater Than 20 Amperes:*** Slightly rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(17) Repeat the procedures in (10) through (16) for the remaining 48-volt converters associated with the bus.

(18) Install any remaining load distribution fuses associated with the 48-volt bus.

Starting or Restoring Bus With Load Distribution Fuses Not Removed

3.06 To restore power to a complete 48-volt bus without removing the load distribution fuses, proceed as follows.

(1) Verify that the CONV START (S1) switch for each converter associated with the 48-volt bus is in the OFF position.

(2) Verify that the bus CONV( ) circuit breaker for each converter associated with the 48-volt bus is in the OFF position.

(3) If the associated 140-volt input fuse is removed from the fuse panel or if the 140-volt input circuit breaker is in the OFF position, charge the converter input filter capacitors in accordance with 3.02(a)(2) and (3) or 3.02(b) (2) through (7).

(4) Start all converters associated with the 48-volt bus as follows.

(a) Operate the OUTPUT VOLTS (S1) switch on the plant to the associated converter position for one of the converters to be restored to service.

(b) Operate the CONV START (S1) switch on the converter to be restored to service to the START position.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter indicates the converter output voltage.

(c) Adjust the VOLT ADJ (R16) potentiometer on the converter until the plant OUTPUT VOLTS (M1) meter indicates 1.25 volts above the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) meter should indicate 49.25 volts.

Note 1: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

Note 2: The VOLT ADJ (R16) potentiometer is adjusted to approximately 1.25 volts above the required bus voltage to accommodate the light load voltage uptilt circuit when the converter is not loaded.

(d) Repeat the procedure in (a) through (c) for each converter associated with the 48-volt bus.

(5) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position.

Caution: The associated equipment that is connected to the 630A bus may require special filter charging starting techniques. Use the approved starting procedures for the associated equipment.

(6) Close at one time sufficient bus CONV( ) circuit breakers to carry the bus load as follows.

(a) ***Two-Converter Bus:*** Close the bus CONV( ) circuit breaker for one converter (maximum 50 amperes).

(b) ***Three-Converter Bus:*** Close the bus CONV( ) circuit breakers for two converters at exactly the same time (maximum 100 amperes).

(c) ***Four-Converter Bus:*** Close the bus CONV( ) circuit breakers for three converters at exactly the same time (maximum 150 amperes).

(7) Close the bus CONV( ) circuit breaker for any remaining converter associated with the 48-volt bus.

(8) Momentarily depress the ACO pushbutton to reset the low voltage monitor and retire the alarm.

(9) Observe the indications on the plant OUTPUT VOLTS (M1) voltmeter and converter OUTPUT CURRENT (M1) ammeters.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required bus voltage as specified by local instructions, and the converter OUTPUT CURRENT (M1) ammeters should indicate within 20 amperes of each other. In the absence of local

instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 48 ±0.25 volts.

(10) If the plant OUTPUT VOLTS (M1) voltmeter indicates that the bus voltage is too high or too low and/or the converter OUTPUT CURRENT (M1) ammeters do not indicate within 20 amperes of each other, proceed as follows.

(a) ***Bus Voltage Low:*** Rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(b) ***Bus Voltage High:*** Rotate the VOLT ADJ (R16) potentiometer ccw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the highest load current.

(c) ***Bus Voltage Normal—Load Balance Greater Than 20 Amperes:*** Slightly rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current. [See READ statement in 3.05(15).].

E. Restoring Individual 24-Volt Converter to Service

3.07 To restore an individual 24-volt converter to service, proceed as follows.

Note: Failure of a bus CONV( ) circuit breaker to stay closed when starting the power plant may be due to slow manual operation of the circuit breaker.

(1) Verify that the CONV START (S1) switch for the converter to be restored is in the OFF position.

(2) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position.

(3) Note the bus voltage that is being indicated on the OUTPUT VOLTS (M1) voltmeter.

(4) Operate the OUTPUT VOLTS (S1) switch on the plant to the associated converter position for the converter to be restored to service.

(5) Verify that the bus CONV( ) circuit breaker for the converter to be restored to service is in the OFF position.

(6) If the associated 140-volt input fuse is removed from the fuse panel or if the 140-volt input circuit breaker is in the OFF position, charge the converter input filter capacitors in accordance with 3.02(a)(2) and (3) or 3.02(b)(2) through (7).

(7) Operate the CONV START (S1) switch on the converter to be restored to service to the START position.

Requirement: The CONV OFF lamp extinguishes. The plant OUTPUT VOLTS (M1) voltmeter indicates the converter output voltage. The CONV ALM (red) lamp on the converter lights due to a no-load condition.

(8) Adjust the VOLT ADJ (R16) potentiometer on the converter until the plant OUTPUT VOLTS (M1) meter indicates 0.5 volt above the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) meter should indicate 24.5 volts.

Note 1: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

Note 2: The VOLT ADJ (R16) potentiometer is adjusted to approximately 0.5 volt above the required bus voltage to accommodate the light load voltage uptilt circuit when the converter is not loaded.

(9) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position.

(10) Operate the bus CONV( ) circuit breaker for the converter being restored to service to the ON position (see Fig. 4).

(11) Observe the indications on the plant OUTPUT VOLTS (M1) voltmeter and converter OUTPUT CURRENT (M1) ammeters.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required

bus voltage as specified by local instruction and the converter OUTPUT CURRENT (M1) ammeters should indicate within 30 amperes of each other. In the absence of local instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 24 $\pm$0.25 volts.

(12) If the plant OUTPUT VOLTS (M1) voltmeter indicates that the bus voltage is too high or too low and/or the converter OUTPUT CURRENT (M1) ammeters do not indicate within 30 amperes of each other, proceed as follows.

(a) ***Bus Voltage Low:*** Rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(b) ***Bus Voltage High:*** Rotate the VOLT ADJ (R16) potentiometer ccw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the highest load current.

(c) ***Bus Voltage Normal—Load Balance Greater than 30 Amperes:*** Slightly rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current. [See READ statement in 3.03(15).]

F. Restoring Individual 48-Volt Converter to Service

3.08 To restore an individual 48-volt converter to service, proceed as follows.

Note: Failure of a bus CONV( ) circuit breaker to stay closed when starting may be due to slow manual operation of the circuit breaker.

(1) Verify that the CONV START (S1) switch for the converter to be restored is in the OFF position.

(2) Operate the OUTPUTS VOLTS (S1) switch on the plant control panel to the PLANT position.

(3) Note the bus voltage that is being indicated on the OUTPUT VOLTS (M1) voltmeter.

(4) Operate the OUTPUT VOLTS (S1) switch on the plant to the associated converter position for the converter to be restored to service.

(5) Verify that the bus CONV( ) circuit breaker for the converter to be restored to service is in the OFF position.

(6) If the associated 140-volt input fuse is removed from the fuse panel or if the 140-volt input circuit breaker is in the OFF position, charge the converter input filter capacitors in accordance with 3.02(a)(2) and (3) or 3.02(b) (2) through (7).

(7) Operate the CONV START (S1) switch on the converter to be restored to service to the START position.

Requirement: The CONV OFF lamp extinguishes. The plant OUTPUT VOLTS (M1) voltmeter indicates the converter output voltage. The CONV ALM (red) lamp on the converter lights due to a no-load condition.

(8) Adjust the VOLT ADJ (R16) potentiometer on the converter until the plant OUTPUT VOLTS (M1) meter indicates 1.25 volts above the required bus voltage as specified by local instructions. In the absence of local instructions, the plant OUTPUT VOLTS (M1) meter should indicate 49.25 volts.

Note 1: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

Note 2: The VOLT ADJ (R16) potentiometer is adjusted to approximately 1.25 volts above the required bus voltage to accommodate the light load voltage circuit when the converter is not loaded.

(9) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position.

(10) Operate the bus CONV( ) circuit breaker for the converter being restored to service to the ON position (see Fig. 4).

(11) Observe the indications on the plant OUTPUT VOLTS (M1) voltmeter and converter OUTPUT CURRENT (M1) ammeters.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required bus voltage as specified by local instructions, and the converter OUTPUT CURRENT (M1) ammeters should indicate within 20 amperes of each other. In the absence of local instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 48 $\pm$0.25 volts.

(12) If the plant OUTPUT VOLTS (M1) voltmeter indicates that the bus voltage is too high or too low and/or the converter OUTPUT CURRENT (M1) ammeters do not indicate within 20 amperes of each other, proceed as follows.

(a) ***Bus Voltage Low:*** Rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(b) ***Bus Voltage High:*** Rotate the VOLT ADJ (R16) potentiometer ccw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the highest load current.

(c) ***Bus Voltage Normal—Load Balance Greater than 20 Amperes:*** Slightly rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current. [See READ statement in 3.05(15).]

G. Removing Complete Bus from Service

3.09 To remove a complete bus from service, proceed as follows.

Note: If a complete bus is removed from service, all output power to the connected loads associated with that bus will be lost. Major alarms will be initiated. The plant ACO will not function to retire the major alarms.

(1) To inhibit the plant alarms, remove the CP2 circuit board located inside the plant control panel.

(2) Slowly remove some of the associated load distribution fuses from the plant distribution fuse panel until the converter OUTPUT CURRENT (M1) ammeters indicate that the ***total*** current being supplied to the load is a maximum of 90 amperes for 24-volt converters or 45 amperes for 48-volt converters. The total bus load is equal to the sum of the current readings on the individual converters.

(3) Operate the CONV START (S1) switch on one converter to the OFF position.

Requirement: The associated CONV( ) circuit breaker trips automatically. The converter shuts down and the CONV OFF lamps lights.

(4) Repeat (3) for the remaining converters in the plant. Be certain to remove only one converter at a time.

Requirement: When the last converter is removed from the bus, all CONV OFF lamps extinguish.

(5) Remove the remaining load distribution fuses from the plant distribution fuse panel.

(6) If it is desired to disconnect the dc input power to the plant, remove all of the associated 140-volt input fuses from the fuse panel or operate all associated 140-volt input circuit breakers to the OFF position.

Note: If the power plant is to be left out of service for an extended period of time, refer to Section 032-110-701 for information on maintaining electrolytic capacitors when they are not in service.

H. Removing Individual Converter From Service

3.10 To remove an individual converter from service, proceed as follows.

Note: If one of the converters is removed from service and a second converter should fail, the plant may not have enough redundant power to supply all of the load requirements. Refer to SD-82195-01 for information on appropriate strapping to avoid false alarm indications.

(1) Operate the CONV START (S1) switch on the converter being removed from service to the OFF position.

Requirement: The associated CONV( ) circuit breaker trips automatically. The converter shuts down and the CONV OFF lamp lights.

(2) To disconnect the dc input power to the converter, remove the associated 140-volt input fuses from the fuse panel or operate the associated 140-volt input circuit breaker to the OFF position.

Note: If the converter is to remain out of service for an extended period of time, refer to Section 032-110-701 for information on maintaining electrolytic capacitors when they are not in service.

4. ROUTINE CHECKS

Note: The following routine checks should be performed periodically to assure proper operation of the plant and converter controls.

A. Clean Ventilating Passages

4.01 Keep the ventilating passages of the plant and plant converters unobstructed to ensure adequate cooling during operation.

B. Plant OUTPUT VOLTS (M1) Voltmeter Calibration Check

4.02 To calibrate the plant OUTPUT VOLTS (M1) voltmeter, proceed as follows.

(1) Verify that the OUTPUT VOLTS (S1) switch on the plant control panel is in the PLANT position.

Note: Only one bus of the plant will be checked at a time.

(2) Connect the digital meter, set on the DC VOLTS scale, between the associated bus bar and ground.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter indicates the same voltage as the test meter.

Note: If the requirement in (2) is met, proceed to (4). If the requirement is not met, continue with (3).

(3) Adjust the adjustment screw of the OUTPUT VOLTS (M1) voltmeter until its indication agrees with the indication on the test meter.

(4) Record the date of calibration in accordance with local procedures.

(5) Disconnect the test meter.

(6) Repeat the procedures in (1) through (5) that apply to the other bus of the plant.

C. 24-Volt Bus Output Voltage and Current Check

4.03 To check the 24-volt bus output voltage and current, proceed as follows.

(1) Verify that the plant OUTPUT VOLTS (S1) switch is in the PLANT position.

(2) Observe the indications on the plant OUTPUT VOLTS (M1) voltmeter and converter OUTPUT CURRENT (M1) ammeters.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required bus voltage as specified by local instructions and the converter OUTPUT CURRENT (M1) ammeters should indicate within 30 amperes of each other. In the absence of local instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 24 $\pm$0.25 volts. The total bus load is equal to the sum of the current readings on the individual converters.

(3) If the plant OUTPUT VOLTS (M1) voltmeter indicates that the bus voltage is too high or too low and/or the converter OUTPUT CURRENT (M1) ammeters do not indicate within 30 amperes of each other, proceed as follows.

Note: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

(a) ***Bus Voltage Low:*** Rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(b) ***Bus Voltage High:*** Adjust the VOLTS ADJ (R16) potentiometer ccw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the highest load current.

There is no requirement for the converters in this plant to share the load current equally. The individual converters should be adjusted as close to 24 volts as possible, always maintaining the voltage requirement at the bus.

(c) ***Bus Voltage Normal—Load Balance Greater than 30 Amperes:*** Slightly rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

D. 48-Volt Bus Output Voltage and Current Check

4.04 To check the 48-volt bus output voltage and current, proceed as follows.

(1) Verify that the plant OUTPUT VOLTS (S1) switch is in the PLANT position.

(2) Observe the indications on the plant OUTPUT VOLTS (M1) voltmeter and converter OUTPUT CURRENT (M1) ammeters.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the required bus voltage as specified by local instructions, and the converter OUTPUT CURRENT (M1) ammeters should indicate within 20 amperes of each other. In the absence of local instructions, the plant OUTPUT VOLTS (M1) voltmeter should indicate 48 $\pm$0.25 volts. The total bus load is equal to the sum of the current readings on the individual converters.

(3) If the plant OUTPUT VOLTS (M1) voltmeter indicates that the bus voltage is too high or too low and/or the converter OUTPUT CURRENT (M1) ammeters do not indicate within 20 amperes of each other, proceed as follows.

Note: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

(a) ***Bus Voltage Low:*** Rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

(b) ***Bus Voltage High:*** Rotate the VOLT ADJ (R16) potentiometer ccw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the highest load current.

There is no requirement for the converters in this plant to share the load current equally. The individual converters should be adjusted as close to 48 volts as possible, always maintaining the voltage requirement at the bus.

(c) ***Bus Voltage Normal—Load Balance Greater Than 20 Amperes:*** Slightly rotate the VOLT ADJ (R16) potentiometer cw on the converter whose OUTPUT CURRENT (M1) ammeter indicates the lowest load current.

E. Converter High Voltage and Overcurrent Alarm Check

4.05 To check the high voltage and overcurrent alarm circuit, proceed as follows.

Note: This check simulates a high voltage or overcurrent failure. This check determines that the high voltage and overcurrent alarm circuit has the ability to function but does not necessarily mean that the alarm circuit is adjusted within allowable tolerances. To adjust the high voltage shutdown circuit, follow the procedures in 4.06 for 24-volt converters or 4.07 for 48-volt converters.

(1) Operate the bus CONV( ) circuit breaker for the converter being checked to the OFF position (see Fig. 4).

Requirement: The CONV ALM (red) lamp lights due to no-load condition on the converter.

(2) Depress and hold the HV/OC (S2) pushbutton on the converter.

Requirement: After a time delay of 20 to 40 seconds, the HV/OC lamp should light; indicating that the high voltage monitor, overcurrent monitor, and shutdown circuits in the converter are operational.

Note: If the HV/OC lamp does not light; the high voltage monitor, overcurrent monitor, or shutdown circuit in the converter may not be properly adjusted or may be defective. If

necessary, refer to the trouble-locating information in Part 5.

(3) Release the HV/OC (S2) pushbutton.

Requirement: The HV/OC lamp should extinguish.

(4) Restore the converter being checked to service in accordance with 3.07 for a 24-volt converter or 3.08 for a 48-volt converter.

(5) Repeat the procedures in (1) through (4) for the remaining converters in the plant.

F. 24-Volt Converter High Voltage Monitor Adjustment Check

4.06 To check the high voltage monitor adjustment of the 24-volt converters, proceed as follows.

(1) Operate the bus CONV( ) circuit breaker for the converter being checked to the OFF position (see Fig. 4).

Requirement: The CONV ALM (red) lamp lights due to no-load condition on the converter.

(2) Operate the OUTPUT VOLTS (S1) switch on the plant to the associated converter position for the converter being checked.

(3) Connect the digital meter, set on the DC VOLTS scale to the TERM VOLTS (+) and (−) test jacks on the converter being checked.

(4) Slowly rotate the VOLT ADJ (R16) potentiometer cw on the converter being checked while observing the indication on the test meter.

Note: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

Requirement: The converter shuts down when the test meter indicates 28 $\pm$0.28 volts at no load. The voltage indication on the test meter drops to zero.

Note 1: If the requirement is not met, continue with (5). If the requirement is met, proceed to (10).

Note 2: When the high voltage monitor shuts the converter down at 28 $\pm$0.28 volts at no load, the converter will actually shut down at 27 $\pm$0.27 volts at full load.

(5) Rotate the VOLT ADJ (R16) potentiometer on the converter being checked ccw 5 turns.

(6) Continue with (7) if the converter did not shut down. If the converter shuts down at less than 27.72 volts, operate the CONV START (S1) switch to the OFF position. Wait at least 20 seconds and then operate the CONV START (S1) switch to the ON position.

Requirement: The converter starts and the CONV OFF lamp extinguishes.

(7) Rotate the HVSD (R37) potentiometer on the converter being checked cw 5 turns.

Note: The HVSD (R37) potentiometer is located in the bottom right corner of the control circuit (CP1) circuit pack.

(8) Slowly rotate the VOLT ADJ (R16) potentiometer cw on the converter being checked until the test meter indicates 28 $\pm$0.28 volts.

(9) Slowly rotate the HVSD (R37) potentiometer ccw until the converter shuts down.

Requirement: The voltage indication on the test meter drops to zero.

Note: When the high voltage monitor shuts the converter down at 28 $\pm$0.28 volts at no load, the converter will actually shut down at 27 $\pm$0.27 volts at full load.

(10) Rotate the VOLT ADJ (R16) potentiometer on the converter being checked ccw 5 turns.

(11) Operate the CONV START (S1) switch on the converter being checked to the OFF position.

Note: Wait at least 20 seconds before continuing with (12).

(12) Operate the CONV START (S1) switch on the converter being checked to the START position.

(13) Adjust the VOLT ADJ (R16) potentiometer on the converter until the test meter indicates 0.5 volt above the required bus voltage as specified by local instructions. In the absence of local instructions, the test meter indicates 24.5 volts.

(14) Operate the CONV START (S1) switch on the converter being checked to the OFF position.

Requirement: The CONV OFF lamp lights.

(15) Disconnect the test meter from the converter.

(16) Restore the converter being checked to service in accordance with 3.07.

(17) Repeat the procedures in (1) through (16) for the remaining 24-volt converters in the plant.

G. 48-Volt Converter High Voltage Monitor Adjustment Check

4.07 To check the high voltage monitor adjustment of the 48-volt converters, proceed as follows.

(1) Operate the bus CONV( ) circuit breaker for the converter being checked to the OFF position (see Fig. 4).

Requirement: The CONV ALM (red) lamp lights due to no-load condition on the converter.

(2) Operate the OUTPUT VOLTS (S1) switch on the plant to the associated converter position for the converter being checked.

(3) Connect the digital meter, set on the DC VOLTS scale, to the TERM VOLTS (+) and (−) test jacks on the converter being checked.

(4) Slowly rotate the VOLT ADJ (R16) potentiometer cw on the converter being checked while observing the indication on the test meter.

Note: The VOLT ADJ (R16) potentiometer is located in the upper left corner of the control circuit (CP1) circuit pack.

Requirement: The converter shuts down when the meter indicates 56 $\pm$0.5 volts at no load. The voltage indication on the test meter drops to zero.

Note 1: If the requirement is not met, continue with (5). If the requirement is met in (4), proceed to (10).

Note 2: When the high voltage monitor shuts the converter down at 56 $\pm$0.5 volts at no load, the converter will actually shut down at 54 $\pm$0.5 volts at full load.

(5) Rotate the VOLT ADJ (R16) potentiometer on the converter being checked ccw 5 turns.

(6) Continue with (7) if the converter did not shut down. If the converter shuts down at less than 55.5 volts, operate the CONV START (S1) switch to the OFF position. Wait at least 20 seconds and then operate the CONV START (S1) switch to the ON position.

Requirement: The converter starts and the CONV OFF lamp extinguishes.

(7) Rotate the HVSD (R37) potentiometer on the converter being checked cw 5 turns.

Note: The HVSD (R37) potentiometer is located in the bottom right corner of the control circuit (CP1) circuit pack.

(8) Slowly rotate the VOLT ADJ (R16) potentiometer cw on the converter being checked until the meter indicates 56 $\pm$0.5 volts.

(9) Slowly rotate the HVSD (R37) potentiometer ccw until the converter shuts down.

Requirement: The voltage indication on the test meter drops to zero.

Note: When the high voltage monitor shuts the converter down at 56 $\pm$0.5 volts at no load, the converter will actually shut down at 54 $\pm$0.5 volts at full load.

(10) Rotate the VOLT ADJ (R16) potentiometer on the converter being checked ccw 5 turns.

(11) Operate the CONV START (S1) switch on the converter being checked to the OFF position.

Note: Wait at least 20 seconds before continuing with (12).

(12) Operate the CONV START (S1) switch on the converter being checked to the START position.

(13) Adjust the VOLT ADJ (R16) potentiometer on the converter until the test meter indicates 1.25 volts above the required bus voltage as specified by local instructions. In the absence of local instructions, the test meter indicates 49.25 volts.

(14) Operate the CONV START (S1) switch on the converter being checked to the OFF position.

Requirement: The CONV OFF lamp lights.

(15) Disconnect the test meter from the converter.

(16) Restore the converter being checked to service in accordance with 3.08.

(17) Repeat the procedures in (1) through (16) for the remaining 48-volt converters in the plant.

H. 24-Volt Converter Current Limit and Reverse Current Check

4.08 To check the current limit and reverse current circuits of the 24-volt converters, proceed as follows.

(1) Operate the bus CONV( ) circuit breaker for the converter being checked to the OFF position (see Fig. 4).

Requirement: The CONV ALM (red) lamp lights due to no-load condition on the converter.

(2) Connect the digital meter, set on the DC VOLTS scale, to the TERM VOLTS (+) and (−) test jacks on the converter being checked.

Requirement: The test meter indicates a nominal 24.5 volts.

(3) Operate the DROOP TST—REV CUR TST (S1) switch on CP3 of the converter being checked to the DROOP TST position and hold.

Requirement: The test meter indication should fall to approximately 13 to 18 volts.

(4) Release the DROOP TST—REV CUR TST (S1) switch.

Requirement: The test meter should indicate that the converter output voltage has returned to normal.

(5) Operate the DROOP TST—REV CUR TST (S1) switch on CP3 of the converter being checked to the REV CUR TST position and hold.

Requirement: The converter shuts down and the indication on the test meter decreases to zero.

(6) Release the DROOP TST—REV CUR TST (S1) switch.

Requirement: The converter does not start.

Note: If the requirements in (3) through (6) are not met, the CP3 circuit pack is defective. If the requirements in (3) through (6) are met, continue with (7).

(7) Operate the CONV START (S1) switch on the converter being checked to the OFF position.

Requirement: The CONV OFF lamp lights.

Note: Wait at least 20 seconds before continuing with (8).

(8) Operate the CONV START (S1) switch on the converter being checked to the START position.

Requirement: The converter starts and the CONV OFF lamp extinguishes.

((9) Restore the converter being checked to service in accordance with 3.07.

(10) Disconnect the test meter from the converter.

(11) Repeat the procedures in (1) through (10) for the remaining 24-volt converters in the plant.

I. 48-Volt Converter Current Limit and Reverse Current Check

4.09 To check the current limit and reverse current circuits of the 48-volt converters, proceed as follows.

(1) Operate the bus CONV( ) circuit breaker for the converter being checked to the OFF position (see Fig. 4).

Requirement: The CONV ALM (red) lamp lights due to no-load condition on the converter.

(2) Connect the digital meter set on the DC VOLTS scale, to the TERM VOLTS (+) and (−) test jacks on the converter being checked.

Requirement: The test meter indicates a nominal 49.25 volts.

(3) Operate the DROOP TST—REV CUR TST (S1) switch on CP3 of the converter being checked to the DROOP TST position and hold.

Requirement: The test meter indication should fall to approximately 38 to 42 volts.

(4) Release the DROOP TST—REV CUR TST (S1) switch.

Requirement: The test meter should indicate that the converter output voltage has returned to normal.

(5) Operate the DROOP TST—REV CUR TST (S1) switch on CP3 of the converter being checked to the REV CUR TST position and hold.

Requirement: The converter shuts down and the indication on the test meter decreases to zero.

(6) Release the DROOP TST—REV CUR TST (S1) switch.

Requirement: The converter does not start.

Note: If the requirements in (3) through (6) are not met, the CP3 circuit pack is defective. If the requirements in (3) through (6) are met, continue with (7).

(7) Operate the CONV START (S1) switch on the converter being checked to the OFF position.

Requirement: The CONV OFF lamp lights.

Note: Wait at least 20 seconds before continuing with (8).

(8) Operate the CONV START (S1) switch on the converter being checked to the START position.

Requirement: The converter starts and the CONV OFF lamp extinguishes.

(9) Restore the converter being checked to service in accordance with 3.08.

(10) Disconnect the test meter from the converter.

(11) Repeat procedures in (1) through (10) for the remaining 48-volt converters in the plant.

J. Plant Low Voltage Alarm Check

4.10 To check the operation of the plant low voltage alarm circuit, proceed as follows.

Note: This check requires that the voltage on the low voltage level detector be controlled by use of the 35-type test set. Refer to Section 100-101-301 for proper use of the 35-type test set.

(1) Operate the OUTPUT VOLTS (S1) switch on the plant control panel to the PLANT position.

(2) Set the locking levers of the No. 1 through No. 4 keys on the 35-type test set to the open position.

(3) Close all resistance knife or toggle switches on the 35-type test set to cut out all resistance.

(4) Move all resistance sliders of the 35-type test set to the extreme left.

(5) Position the controls on the 35-type test set as indicated.

CONTROL	POSITION
BAT & GRD CO	Operated
REV Key	Normal
VM Key	Normal
G Switch	Open

(6) Connect the 35-type test set to the plant control panel as follows.

(a) ***−48 Volt BUS:*** Using a 2W17A cord, connect the T terminal of the 35-type test set to terminal 4 of TB5 and the R terminal of the 35-type test set to terminal 20 of TB5.

(b) ***+24 Volt Bus:*** Using a 2W17A cord, connect the T terminal of the 35-type test set to terminal 20 to TB5 and the R terminal of the 35-type test set to terminal 5 of TB5.

(7) Remove the associated BAT B fuse for the control panel under test from the J86900C plant distribution fuse panel.

Note: When the BAT B fuse is removed from the J86900C plant distribution fuse panel, the input power to the associated low voltage level detector is disconnected from the plant output bus. If the alternate voltage path provided through the 35-type test set is an open or high resistance path, the LVA relay of the low voltage level detector will release. When the LVA relay releases, a major office audible and visual alarm and the plant ALM lamp will be activated. The office audible alarm can be silenced by momentarily depressing the ACO pushbutton.

(8) Close the No. 3 locking lever on the 35-type test set.

(9) Momentarily depress the ACO pushbutton to reset the low voltage monitor and retire the alarm.

Requirement: All alarm indications should be extinguished.

(10) Move the No. 3 sliders of the 35-type test set very slowly to the right until the office audible and visual alarms and the plant ALM lamp are activated.

Requirement: The plant OUTPUT VOLTS (M1) voltmeter should indicate the low voltage alarm activate voltage specified by local instructions. In the absence of local instructions, the low voltage alarm should activate at 22 volts for the 24-volt bus or at 45 volts for the 48-volt bus.

Note 1: If the input voltage to the low voltage level detector cannot be lowered enough to activate the low voltage alarms when both No. 3 sliders have reached the extreme right position, slide them fully back to the left. Then cut in an additional 25,000 ohms by opening one or more of the No. 3 knife or toggle switches and slowly moving the No. 3 sliders to the right to check the requirement in (10).

Note 2: If the requirement in (10) is met, proceed to (14). If the requirement is not met, continue with (11).

(11) Move the No. 3 sliders to the left.

(12) Momentarily depress the ACO pushbutton to reset the low voltage monitor and retire the alarm.

Requirement: All alarm indications should be extinguished.

(13) If the low voltage alarm setting is too low or too high, proceed as follows.

(a) ***Alarm Setting High:*** Rotate the OPR ADJ (R8) potentiometer, located on the plant control CP1 circuit pack, 1 turn ccw. Repeat (10) to check the setting.

(b) ***Alarm Setting Low:*** Rotate the OPR ADJ (R8) potentiometer, located on the plant control CP1 circuit pack, 1 turn cw. Repeat (10) to check the setting.

(14) Install the associated BAT B fuse for the control panel under test in the J86900C plant distribution fuse panel.

(15) Disconnect the 35-type test set from the plant.

K. Fuse Alarms Check

4.11 To verify that the fuse alarms will activate if the alarm fuse blows, proceed as follows.

Caution: Do not remove the REG (1 through 4) fuses. Removing the REG fuse while the converter is in service may disrupt plant operation.

Note: A test point is provided on the front of fuse cap for 70-type fuses (refer to Fig. 5). This test point should be used to test the fuse alarms.

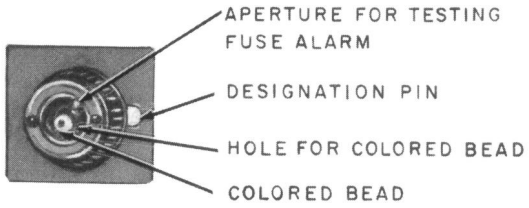


Fig. 5—70-Type Alarm Fuse With Alarm Test Point

(1) Prepare the alarm test cord by connecting one end of the W1AY testing cord to the 141 cord tip and 720A voltage pickup tool. (The KS-6278 connecting clip may be used to replace the 720A voltage pickup tool.) On the opposite end of the W1AY testing cord, connect the 411C test pick (see Fig. 6).

(2) Install the 720A voltage pickup tool in a spare 70-type fuse position. (If the 720A tool is not available, obtain the ***same magnitude*** voltage supply by connecting a KS-6278 connecting clip with the W1AY test cord to the ungrounded bus bar.)

Caution: Test only the fuses associated with the same magnitude voltage supply.

(3) With the tip of the 411C test pick (attached to the battery connected W1AY cord), touch the exposed alarm test point on the fuse cap for one fuse.

Requirement: The fuse alarm relay operates, the alarm lamp lights, and an audible alarm is activated. See Table A.

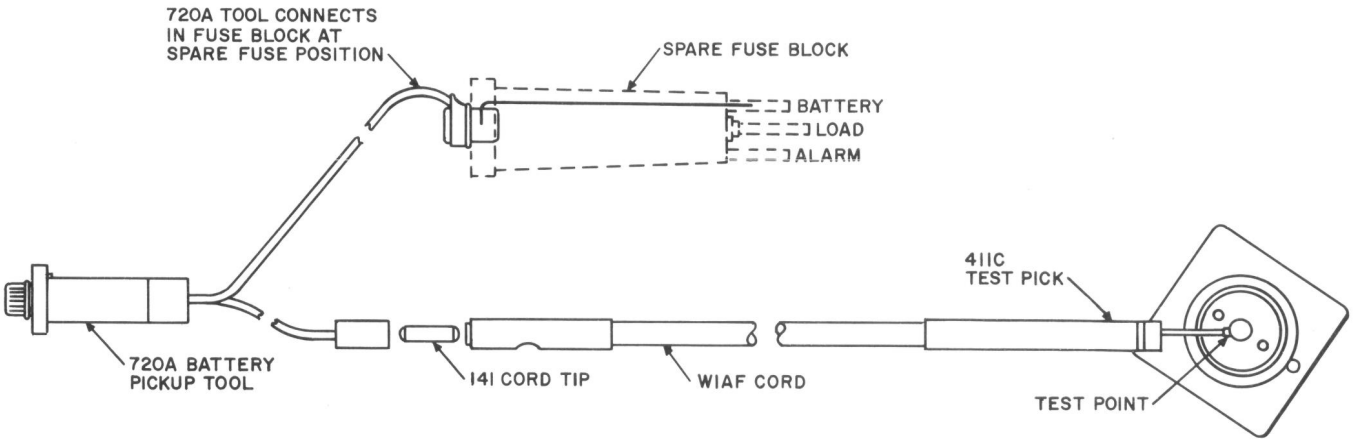


Fig. 6—Fuse Alarm Testing Cord—Tool Connection

TABLE A

FUSE ALARMS

FUSE	ALARM RELAY	ALARM LAMP	AUDIBLE ALARM
LOAD DISTRIBUTION (—AMP)	FAA or FAB	ALM A or ALM B	MAJOR *
CONTROL (A, B, C, or D)	PAF	ALM and FR ALM	MINOR *
CONTROL (E)	FAA or FAB	ALM A or ALM B	MAJOR *
REGULATION (REG 1-4)	NO ALARM		

**Note:* Alarm designations may vary in accordance with local alarm assignments.

(4) Remove the 411C test pick from the fuse cap.

Requirement: The fuse alarm relay releases, the alarm lamp extinguishes, and the audible alarm is deactivated.

(5) Repeat (3) and (4) for each fuse.

(6) Remove the 720A tool from the spare fuse position. (If the KS-6278 connecting clip is used, disconnect the clip from the bus bar.)

L. Bus Circuit Breaker CONV( ) Trip Supply Check

4.12 To verify that sufficient energy is stored in the trip supply circuit to open the CONV( ) circuit breaker in the event that the bus voltage should fall below nominal, proceed as follows.

Caution: Do not perform this check if any converter associated with the bus is out of service. Refer to Fig. 4 for circuit breaker arrangement.

(1) Operate the CONV START (S1) switch on one converter to the OFF position.

Requirement: The associated CONV( ) circuit breaker trips automatically. The converter shuts down.

Note: If the CONV( ) circuit breaker does not trip, operate the circuit breaker manually to the OFF position and refer to Trouble Chart 5.02. If the circuit breaker trips, continue with (2).

(2) Wait 5 seconds and operate the CONV START(S1) switch on the converter to the ON position.

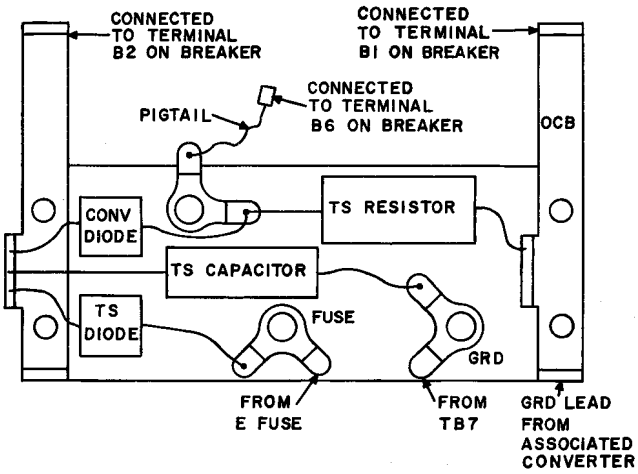
(3) Operate the bus CONV( ) circuit breaker to the ON position.

(4) Remove the E fuse from the fuse block.

Note: This isolates the battery supply from the trip coil of the CONV( ) circuit breaker.

(5) Connect a suitable clip lead between terminal A on TB7 terminal board and terminal FUSE on mounting detail at rear of CONV( ) circuit breaker (see Fig. 7). (The TB7 terminal board is mounted on the plant GRD bus bar.)

(6) After 5 seconds, operate the CONV( ) circuit (S1) switch on the converter to the OFF position.



NOTE: THE TRIP SUPPLY BOARD IS VIEWED FROM THIS SIDE FOR B BUS ONLY. ON A BUS, THE TRIP SUPPLY BOARD IS TURNED OVER WITH THE OCB TERMINAL ON THE LEFT SIDE.

Fig. 7—Circuit Breaker Trip Supply Board-Top View

Requirement: The associated CONV( ) circuit breaker trips automatically. The converter shuts down.

Note: The CONV( ) circuit breaker trips from the energy stored in the TS( ) capacitor. If the CONV( ) circuit breaker does not trip, refer to trouble test in 5.07 for a 24-volt converter or 5.08 for a 48-volt converter.

(7) Remove the clip lead from TB7 and the FUSE terminal.

(8) Replace the E fuse.

(9) Wait 5 seconds and operate the CONV START (S1) switch on the converter to the ON position.

(10) Operate the bus CONV( ) circuit breaker to the ON position.

(11) Observe the converter OUTPUT CURRENT (M1) ammeter to verify that the converter is supplying some load current.

(12) Repeat (1) through (11) for each circuit breaker associated with the bus.

Note: When the check is completed, verify that the E fuse is installed, all CONV( ) circuit breakers are in the ON position, and all clip leads have been removed.

5. TROUBLES

5.01 When trouble conditions develop in a converter of the plant, it is necessary to first decide whether to locate the troubles with the converter operating or de-energized. Some components in the converter may become overheated when the converter is operated for more than a few minutes with trouble conditions existing in the equipment. If the trouble is of a nature that causes excessive output from the converter, take the initial steps with the converter de-energized and energize the converter for short periods of time in order to make electrical measurements. When testing, it is essential to be alert in order to shut down the converter at any time until the trouble is localized and cleared.

Warning 1: Hazardous voltage may be encountered in the 630A power plant. Avoid all contact with terminals to prevent injuries from occurring. Do not allow a test pick to touch two metal parts at the same time as dangerous or destructive short circuits may occur.

Warning 2: When using an electronic-type voltmeter for trouble testing in an energized circuit, the meter must be isolated from external power ground. If the meter does not float ground, erroneous readings and equipment damage may result. If the meter is not isolated from ground, use a three-prong to two-prong adapter in the external power cord. The use of an adapter in the external power cord can create a voltage hazard on the meter chassis. Avoid bodily contact between the meter and equipment frames. Use of a meter not requiring ground isolation of the external power cord (battery pack) is preferred.

Caution 1: Before removing or installing circuit packs in the converter, operate the CONV START (S1) switch to the OFF position and remove the associated 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position.

Caution 2: When using an ohmmeter for checking semiconductors, use mid-range ohm scales (scales above R X 10 and below R X 10,000). A scale too high can damage some semiconductors by placing too high a voltage across the semiconductor. A scale too low can force excessive current through some semiconductors. Refer to Section 032-173-301.

Note: When performing maintenance on the converters and the plant, it is advisable to have copies of the associated circuit schematic drawings and circuit descriptions available to aid in component identification.

5.02 ***Trouble Chart:*** Should any of the following troubles develop, check the possible causes in the order given. If the trouble is not found, look for loose or open connections or short circuits due to foreign matter lying across wiring terminals. If a circuit pack is found to be defective, replace the circuit pack with a properly adjusted spare.

TROUBLE	POSSIBLE CAUSE	TEST PROCEDURE
Filter charger lamp does not light when filter charger is installed in the fuse panel or when the filter charger circuit is activated at the 140-volt circuit breaker. *Note:* For test procedures associated with the input circuit breaker filter charger, refer to the 140-volt plant Bell System Practice.	1. 140-Volt Fuse: Open in filter charger lamp or fuse (see note).	Remove filter charger from fuse panel. Using the test meter, set on OHMS scale, check the filter charger fuse and lamp. Replace a defective fuse or lamp. Charge filter capacitors in accordance with 3.02.
	2. 140-Volt Fuse and Circuit Breaker: Open lead to C2 capacitor.	Remove filter charger from fuse panel or release the pushbutton at the 140-volt circuit breaker. Using the test meter, set on OHMS scale, check continuity of leads to the C2 capacitor. Repair defective lead or connection charge filter capacitors in accordance with 3.02.
Filter charger lamp lights and remains bright.	1. Converter CONV START (S1) switch is in ON position.	Remove filter charger from fuse panel or release the pushbutton at the 140-volt circuit breaker. Check position of CONV START (S1) switch. Operate to OFF position. Charge filter capacitor in accordance with 3.02.
	2. Shorted Q1 or Q2 thyristor.	Remove filter charger from fuse panel or release the pushbutton at the 140-volt circuit breaker. Refer to 5.06.
	3. Shorted filter capacitor in converter.	Remove filter charger from fuse panel or release the pushbutton at the 140-volt circuit breaker. Disconnect and test each filter capacitor bank for a short circuit. Replace defective capacitor. Charge filter capacitor in accordance with 3.02.
Filter charger lamp lights to full brightness and then suddenly goes out.	1. Blown filter charger fuse.	Remove filter charger from fuse panel or release the pushbutton at the 140-volt circuit breaker. If fuse is blown in fuse holder, replace with a good fuse. Check circuit breaker filter charge circuit in accordance with the 140-volt plant Bell System Practice. Charge filter capacitors in accordance with 3.02.
Converter does not start when the CONV START (S1) switch is operated to the START position.	1. Blown 140-volt input fuse, or 140-volt circuit breaker tripped.	Connect the test meter, set on DC VOLTS scale, across terminals 1 and 2 on TB1 (input terminal board). If the 140 volts is not present, check the input fuse or the input circuit breaker. Charge filter capacitors in accordance with 3.02.
	2. Blown F1 or F2 fuse.	The fuse tip will be extended through the opening in the fuse block if the fuse is blown.
	3. Defective CP2.	See 5.03.

TROUBLE	POSSIBLE CAUSE	TEST PROCEDURE
	4. Blown F3, F4, F5, F6, F7, or F11 fuse.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. The fuses are located as follows: FUSE — LOCATION F3, F4 — Behind CP3 circuit pack. Loosen captive screws and remove CP3. Remove grid cover. F5, F6, F7 — Behind CP1 circuit pack. Loosen captive screws and remove CP1 and CP2. Remove grid cover. F11 — On front of G1 terminal board above the L3 inductor. Check the fuse with the ohmmeter portion of the test meter. Replace a defective fuse. Inspect fuse clip and install fuse. Install the grid covers and CP1, CP2, and CP3. Charge filter capacitors in accordance with 3.02.
	5. Defective CP1.	See 5.04.
	6. Defective CP3.	See 5.05.
	7. Open in power circuit primary.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. Using the test meter set on OHMS scale, check continuity of primary leads, L1 and L2 inductors, and T1 transformer. Repair any defective lead or connection. Charge filter capacitors in accordance with 3.02.
	8. Open in Q1 or Q2 thyristor.	See 5.06.

TROUBLE	POSSIBLE CAUSE	TEST PROCEDURE
Converter operates the 140-volt input fuse or trips the 140-volt circuit breaker on starting.	1. Blown REG(+) or REG(—) fuse.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse, if equipped. Check the REG(+) and (—) 70-type fuse. Replace a blown fuse. Charge filter capacitors in accordance with 3.02.
	2. Shorted Q1 or Q2 thyristor.	See 5.06.
	3. Defective CP1.	Check the output of CP1 in accordance with 5.04(b).
Converter shuts down while in operation.	1. Blown F10 or F11 fuse.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. The fuses are located as follows: FUSE — LOCATION F10 and F11 — On front of G1 terminal board above L3 inductor. Check the fuse with the ohmmeter portion of the test meter. Replace a defective fuse. Inspect fuse clip and install fuse. Charge filter capacitors in accordance with 3.02.
	2. Blown REG(+) or REG(—) fuse.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the input circuit breaker to the OFF position. Check the REG(+) or (—) 70-type fuses. Replace a blown fuse. Charge filter capacitors in accordance with 3.02.
	3. The high voltage shutdown HVSD (R37) potentiometer not adjusted properly.	Operate the CONV START (S1) switch to the OFF position. Rotate the HVSD (R37) potentiometer ½ turn cw and attempt to start converter. Repeat if necessary for a maximum of 1-½ turns. If the converter does start, readjust the HVSD (R37) potentiometer in accordance with 4.06 for 24-volt converters or 4.07 for 48-volt converters. If the converter does not start, continue with 4.
	4. Defective high voltage reference diode CR6 (located on CP1).	Operate the CONV START (S1) switch to the OFF position. Connect the KS-8039 volt-milliammeter, set on DC VOLTS scale, to TP8 on CP1 (positive lead connection) and A ground (negative lead connection). Operate the CONV START (S1) switch to the START

TROUBLE	POSSIBLE CAUSE	TEST PROCEDURE
		position. The voltmeter indicates 6.4±0.3 volts dc. If the voltage requirement is not met, check CP1 in accordance with 5.04.
	5. Defective CP3.	See 5.05.
	6. Open lead between CP1 and power circuit or between CP3 and power circuit.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. Loosen captive screws and remove CP1 and CP3. Check continuity on leads 19 and 21 (connects CP1 to power circuit). Check continuity on leads 15, 23, 11, 24, J, E, and C (connects CP3 to power circuit). If the leads are continuous and CP3 is not defective, CP1 is a possible cause. Check CP1 in accordance with 5.04.
When a converter is started, the associated F1 and F2 fuses blow.	1. Defective CP2.	See 5.03.
	2. F and S leads to CP2 circuit pack are not isolated from framework.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. Using the test meter set on OHMS scale, verify that the F and S leads are isolated from the converter frame. Repair grounded lead as necessary. Charge filter capacitors in accordance with 3.02.
Converter fails to transfer to external regulation.	1. Blown F8 or F9 fuses.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. The fuses are located as follows:

FUSE	LOCATION
F8	On front of G1 terminal board above the L3 inductor.
F9	Mounted in rear of center chassis bar or on G1 terminal board.

Check the fuse with the ohmmeter portion of the test meter. Replace a defective fuse. Inspect fuse clip and install fuse. Charge filter capacitors in accordance with 3.02.

TROUBLE	POSSIBLE CAUSE	TEST PROCEDURE
Converter output out of limits.	1. Low or high input voltage.	Connect the test meter, set on DC VOLTS scale, across the C2 input filter capacitor. The meter should indicate 120 to 155 volts dc. If input voltage is not within limits, check input supply.
	2. Overload on output.	Check indication on output ammeter M1. The M1 ammeter indication should not exceed 100 amperes for 24-volt converters or 50 amperes for 48-volt converters. Check converter current limit circuit in accordance with 4.08 for 24-volt converters or 4.09 for 48-volt converters.
	3. The VOLT ADJ (R16) potentiometer not properly adjusted.	Adjust converter output voltage in accordance with 4.03 for 24-volt converters or 4.04 for 48-volt converters.
	4. Blown REG(+) or REG(—) fuse.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. Check REG(+) and (—) 70-type fuses. Replace a blown fuse. Charge filter capacitors in accordance with 3.02.
	5. Defective CP1.	See 5.04.
Converter shuts down due to a high voltage output being supplied to the load.	1. Input voltage to converter above allowable tolerances.	Using the test meter, set on DC VOLTS scale, check converter input voltage at terminals 1 and 2 of TB1. The test meter indicates between 120 and 155 volts. If the meter does not indicate the required voltage, check the associated dc input voltage supply.
	2. Defective CP1.	See 5.04.
Converter output within limits with excessive noise.	1. Open C5.1 through C5.8 or C6.1 through C6.6 capacitors.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. Disconnect and test each capacitor bank for an open circuit. Use the ohmmeter portion of the KS-14510 volt-ohm-milliammeter. Replace a defective capacitor. Charge filter capacitors in accordance with 3.02.
	2. Open R11 resistor.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. Disconnect one lead from the R11 resistor, located on the back of the (+) terminal block. Check the

TROUBLE	POSSIBLE CAUSE	TEST PROCEDURE
		resistor for an open using the ohmmeter portion of the KS-14510 volt-ohm-milliammeter. Replace a defective resistor. Charge filter capacitors in accordance with 3.02.
Converter operating with 0 voltage and the output ammeter indicates load.	1. Shorted C6.1 through C6.6 capacitors.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. Disconnect and test the capacitor bank for a shorted capacitor. Use the ohmmeter portion of the KS-14510 volt-ohm-milliammeter. Replace a defective capacitor. Charge filter capacitors in accordance with 3.02.
	2. Power circuit secondary leads shorted to framework.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. Inspect all secondary leads for accidental grounds. Repair defective lead and or connection. Charge filter capacitors in accordance with 3.02.
Converter operating (audible sound) with 0 voltage and 0 current.	1. Shorted C5.1 through C5.8 capacitors.	Operate the CONV START (S1) switch to the OFF position. Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. Disconnect and test the capacitor bank for a shorted capacitor. Use the ohmmeter portion of the KS-14510 volt-ohm-milliammeter. Replace a defective capacitor. Charge filter capacitors in accordance with 3.02.
CONV ( ) circuit breaker will not trip when associated CONV START (S1) switch is operated to the OFF position. *Note:* Open the CONV ( ) circuit breaker. Do not reclose the circuit breaker until the trouble is corrected.	1. Blown E fuse or E fuse removed from fuse block.	Check that the E fuse is installed in fuse block. If fuse is blown, the fuse tip will be extended through the opening in the fuse block.
	2. No ground signal on the OCB lead from converter.	See 5.07(b) for 24-volt converters or 5.08(b) for 48-volt converters.
	3. Defective TRIP coil on circuit breaker.	See 5.07(c) for 24-volt converters or 5.08(c) for 48-volt converters.
	4. Defective trip supply board.	See 5.07(c) for 24-volt converters or 5.08(c) for 48-volt converters.

5.03 ***Test for Defective CP2 in Converter***

(a) Check the input circuit to CP2 as follows.

(1) Verify that the CONV START (S1) switch is in the ON position and that the 140-volt input fuse is installed or the 140-volt input circuit breaker is in the ON position.

(2) Connect the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, across terminals 1 and 2 of terminal board TB1. See Warning 2, 5.01.

Requirement: The meter indicates 120 to 155 volts dc.

Note: If the nominal 140 volts dc is not present, check the input supply.

(3) Disconnect the meter from TB1.

(4) Verify that the F1 and F2 fuses are not blown.

(5) Connect the test meter across the C1 capacitor on CP2.

Requirement: The meter indicates a nominal 140 volts dc.

Note: If the 140 volts dc is not present, check for proper seating of the circuit pack in the connector.

(6) Disconnect the meter from the C1 capacitor and continue with (b).

(b) Check the output circuit of CP2 as follows.

Note: If the requirement is not met in (1) and (3), the CP2 circuit pack is defective.

(1) Connect the test meter, set on the DC VOLTS scale, across the C5 capacitor.

Requirement: The meter indicates 12 $\pm$1 volts dc.

(2) Disconnect the meter from the C5 capacitor.

(3) Connect the test meter across the C6 capacitor.

Requirement: The meter indicates 12 $\pm$1 volts dc.

(4) Disconnect the meter from the C6 capacitor.

Note: If the CP2 circuit pack is defective, replace CP2 with a factory adjusted unit. The defective circuit pack is handled in accordance with local procedures.

5.04 ***Test for Defective CP1 in Converter***

(a) Check the input circuit to CP1 as follows.

(1) Verify that the CONV START (S1) switch is in the ON position and that the 140-volt input fuse is installed or the 140-volt input circuit breaker is in the ON position.

(2) Verify that the F3 through F7 fuses are not blown.

(3) Using the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, connect the meter positive lead to the C1 capacitor (+) terminal and the meter negative lead to ground A. See Warning 2, 5.01.

Requirement: The meter indicates 12 $\pm$1 volts dc.

(4) Disconnect the meter from the C1 capacitor and ground A.

(5) Connect the meter negative lead to the C2 capacitor (−) terminal and the meter positive lead to ground A.

Requirement: The meter indicates 12 $\pm$1 volts dc.

Note: If the requirement is not met, check CP2 and/or loose or broken leads between CP2 and CP1.

(6) Disconnect the meter from the C2 capacitor and ground A and continue with (b).

(b) Check the output of CP1 as follows.

(1) Operate the CONV START (S1) switch to the OFF position.

(2) Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position.

Warning: The nominal 140 volts dc may still be present at the input filter capacitor bank. Wait approximately 1 minute for the input filter capacitors to discharge.

(3) Connect a suitable clip lead across terminals E17 and E19. This shorts out the gate drive of thyristor Q2.

(4) Using the 545B oscilloscope equipped with a P6021 current probe and type 134 current probe amplifier, connect the current probe around the white lead connected at terminal E20. The arrow on the current probe should point toward terminal E20.

(5) Charge filter capacitors in accordance with 3.02.

(6) Operate the CONV START (S1) switch to the START position.

(7) Monitor the gate pulse waveform.

Requirement: The gate pulse waveform observed on the 545B oscilloscope should be in accordance with Fig. 8.

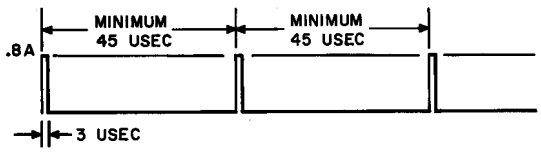


Fig. 8—Blocking Oscillator Gate Pulse Current Waveform

Note: If the pulses are not present, the CP1 circuit pack is defective. If the pulses are present, continue with (8).

(8) Operate CONV START (S1) switch to the OFF position.

(9) Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. See Warning in (2).

(10) Disconnect the oscilloscope current probe.

(11) Disconnect the clip lead at terminals E17 and E19.

(12) Remove the CP2 circuit pack.

(13) Connect a suitable clip lead across terminals E21 and E23. This shorts out the gate drive of thyristor Q1.

(14) Using the 545B oscilloscope equipped with a P6021 current probe and type 134 current probe amplifier, connect the current probe around the white lead connected at terminal E22. The arrow on the current probe should point toward terminal E22.

(15) Install the CP2 circuit pack.

(16) Charge filter capacitors in accordance with 3.02.

(17) Operate the CONV START (S1) switch to the START position.

(18) Observe the gate pulse waveform.

Requirement: The gate pulse waveform observed on the 545B oscilloscope should be in accordance with Fig. 8.

Note: If the pulses are not present, the CP1 circuit pack is defective. If the pulses are present, continue with (19).

(19) With the clip lead connected at terminals E21 and E23, remove the F7 fuse.

Requirement: The pulses are terminated when the F7 fuse is removed. If the pulses are not terminated, the CP1 circuit pack is defective. If the pulses do terminate, continue with (20).

(20) Operate CONV START (S1) switch to the OFF position.

(21) Remove the 140-volt input fuse or operate the 140-volt input circuit breaker to the OFF position. See Warning in (2).

(22) Remove the CP2 circuit pack.

(23) Disconnect the oscilloscope current probe.

(24) Disconnect the clip lead at terminals E21 and E23.

(25) Install the F7 fuse in the fuse clip.

(26) Install the CP2 circuit pack.

(27) Charge filter capacitors in accordance with 3.02.

(28) Operate the CONV START (S1) switch to the START position.

Note: If the requirements are met in (b), continue with (c).

(c) Check the voltage reference circuit of CP1 as follows.

(1) Using the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, connect the meter positive lead to TP4 and the meter negative lead to ground A on CP1.

Requirement: The meter indicates 6.4 $\pm$0.3 volts dc.

Note: If the requirement is not met, the CP1 circuit pack is defective.

(2) Disconnect the meter from TP4 and ground A.

(3) Connect the meter positive lead to TP8 and the meter negative lead to ground A.

Requirement: The meter indicates 6.4 $\pm$0.3 volts dc.

Note: If the requirement is not met, the CP1 circuit pack is defective.

(4) Disconnect the meter from TP8 and ground A.

Note: If the CP1 circuit pack is defective, replace CP1 with a factory adjusted unit. The defective circuit pack is handled in accordance with local procedures.

5.05 *Test for Defective CP3 in Converter*

Note: Components referred to in the following test are located on CP3 circuit pack.

(a) Check the input circuit to CP3 as follows.

Note: If the requirement is not met in (2) and (4), the CP3 circuit pack is defective.

(1) Verify that the CONV START (S1) switch is in the ON position and that the 140-volt fuse is installed or the 140-volt input circuit breaker is in the ON position.

(2) Using the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, connect the meter positive lead to TP8 [C1 capacitor (+) terminal] and the meter negative lead to ground D. See Warning 2, 5.01.

Requirement: The test meter indicates 12 $\pm$1 volts dc.

(3) Disconnect the meter from TP8 and ground D.

(4) Connect the meter negative lead to TP9 [C2 capacitor (−) terminal] and the meter positive lead to ground D.

Requirement: The meter indicates 12 $\pm$1 volts dc.

(5) Disconnect the meter from TP9 and ground D.

Note: If the requirement is met in (2) and (4), continue with (b).

(b) Check the output of CP3 as follows.

Note: If the requirement is not met in (1) and (3), the CP3 circuit pack is defective.

(1) Using the test meter, set on the DC VOLTS scale, connect the meter negative lead to TP14 (anode of CR15) and the meter positive lead to ground D.

Requirement: The meter indicates 12 $\pm$1 volts dc.

Note: If a negative indication is noted, CP3 is defective.

(2) Disconnect the meter from TP14 and ground D.

(3) Connect the meter positive lead to TP7 and the meter negative lead to ground D.

Requirement: The meter indicates 0.0 volt.

Note: If the meter indicates a positive voltage exceeding 0.25 volt dc, the CP3 is defective.

(4) Disconnect the meter from TP7 and ground D.

Note: If the CP3 circuit pack is defective, replace CP3 with a factory adjusted unit. The defective circuit pack is handled in accordance with local procedures.

5.06 ***Test for Defective Q1 and Q2 Thyristors***

Note: If either Q1 or Q2 fails, replace both Q1 and Q2.

(a) Prepare the circuit as follows.

(1) Verify that the CONV START (S1) switch is in the OFF position, and the 140-volt, input fuse is removed or the 140-volt input circuit breaker is operated to the OFF position.

(2) Remove the CP1 and CP3 circuit packs.

(3) Remove the F5 and F6 fuses to check Q1, or F3 and F4 fuses to check Q2.

Note: Removing F3 and F4 fuses or F5 and F6 fuses isolates the gate leads.

(b) ***Q1 or Q2 Shorted:*** Check for a shorted thyristor as follows.

(1) Isolate the Q1 thyristor cathode (terminal 2) or Q2 thyristor anode (terminal 1) from the circuit (see Fig. 9).

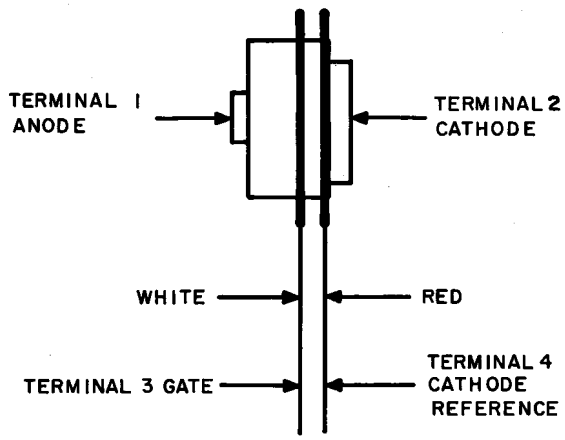


Fig. 9— Terminal Designations of Q1 and Q2 Thyristors

(2) Using the KS-14510 volt-ohm-milliammeter, set on OHMS scale, measure the resistance between anode and cathode in both directions. Do not measure to the gate terminal. See Caution 2, 5.01.

Requirement: The ohmmeter should indicate 1000 ohms or greater in either direction.

Note: If the ohmmeter indication is less than 1000 ohms, the thyristor is defective.

(3) Disconnect the test meter.

(c) ***Q1 or Q2 Open:*** An open condition in a thyristor is difficult to detect in the field. If a thyristor has failed open, the porcelain should be cracked with burned or scorched spots on the porcelain surface.

5.07 ***Test for Defective 24-Volt Bus CONV( ) Circuit Breaker Trip Supply:*** The CONV( ) circuit breaker should trip automatically when the CONV START (S1) switch is operated to the OFF position. If the circuit breaker trips with the E fuse installed but does not trip when the E fuse is removed, the TRIP coil is not defective and ground is supplied to the OCB terminal. The trouble is a defective trip supply circuit board or a faulty connection between the GRD terminal and terminal A of TB7 terminal board. If the circuit

breaker does not trip automatically with the E fuse installed or removed, the trouble is either no ground signal on the OCB terminal, a defective TRIP coil, or a defective component on the trip supply circuit board. Check the input connections, ground on the OCB lead, and/or a defective TRIP coil as follows.

(a) ***Input Supply Connections:*** To check that 24 volts dc is connected at the FUSE terminal and that ground is supplied at the GRD terminal, proceed as follows.

(1) Verify that the bus CONV( ) circuit breaker and the converter CONV START (S1) switch are in the OFF position.

(2) Verify that the E fuse is installed.

(3) Using the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, connect the meter leads between terminals FUSE and GRD on the trip supply circuit board (see Fig. 7).

Requirement: The test meter indicates a nominal 24 volts dc.

Note: If the requirement is met in (3), disconnect the test meter and proceed to (b). If the test meter indicates 0 volt, continue with (4).

(4) Connect the test meter leads between the FUSE terminal and terminal A on the TB7 terminal board.

Requirement: The test meter indicates 24 volts dc.

Note: If the requirement is met in (4) and is not met in (3), a faulty connection exists between TB7 and the GRD terminal. If the test meter indicates 0 volt, check the 24-volt connection at the E fuse block. When a trouble condition is corrected, repeat the trip supply check in 4.12.

(5) Disconnect the test meter.

(b) ***Ground on OCB Lead:*** To check that the converter circuit supplies ground on the OCB lead when the CONV START (S1) switch is operated to the OFF position, proceed as follows.

(1) Verify that the bus CONV( ) circuit breaker and the converter CONV START (S1) switch are in the OFF position.

(2) Verify that the input supply is connected in accordance with (a).

(3) Using the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, connect the meter leads between terminals OCB and FUSE on the trip supply circuit board (see Fig. 7).

Requirement: The test meter indicates 24 volts dc.

Note: If the test meter indicates 24 volts, the converter circuit is supplying ground on the OCB lead to the circuit breaker. Proceed to (c) to check the TRIP coil. If the test meter indicates 0 volt dc, the converter is not connecting ground on the OCB lead (check CP3 in converter) or a loose connection exists on the OCB lead [check J( ) connector at the converter]. Repair a faulty connection and repeat the trip supply test in 4.12.

(4) Disconnect the test meter.

(c) ***TRIP Coil:*** Check the TRIP coil as follows.

Note: The CONV( ) diode is connected in parallel with the TRIP coil. If the CONV( ) diode is shorted, the TRIP coil will not energize.

(1) Verify that the bus CONV( ) circuit breaker and the converter CONV START (S1) switch are in the OFF position.

(2) Verify that ground is supplied on the OCB lead in (b).

(3) Verify that the E fuse is installed.

(4) Using the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, connect the meter leads between terminal A on TB7 terminal board and terminal B2 on the rear of the CONV( ) circuit breaker (see Fig. 7).

Requirement: The test meter indicates a nominal 24 volts dc.

Note: If the requirement is not met, check for a faulty connection at terminal B2. When the trouble condition is corrected, repeat the trip supply check in 4.12.

(5) Reconnect the test meter leads between terminal A on TB7 terminal board and terminal B6 on the rear of the CONV( ) circuit breaker.

Requirement: The test meter indicates a nominal 17 volts dc.

Note 1: If the requirement is met, the TRIP coil is not defective. The trouble is a defective circuit breaker.

Note 2: If the test meter indicates either 24 volts or 0 volt, the trouble is either a defective TRIP coil or a defective CONV diode or the TS resistor on the trip supply board.

(6) To check continuity of the TRIP coil, disconnect the pigtail lug from terminal B6 on the circuit breaker (see Fig. 7). Using the test meter, set on the OHMS scale, connect the meter leads across the TRIP coil at terminals B6 and B2. If the meter indicates an open or short circuit, the TRIP coil is defective. If the meter indicates a nominal 80 ohms, the trouble is a defective trip supply circuit board. When a trouble condition is corrected, repeat the trip supply check in 4.12.

(7) Disconnect the test meter.

5.08 ***Test for Defective 48-Volt Bus CONV( ) Circuit Breaker Trip Supply:*** The CONV( ) circuit breaker should trip automatically when the CONV START (S1) switch is operated to the OFF position. If the circuit breaker trips with the E fuse installed but does not trip when the E fuse is removed, the TRIP coil is not defective and ground is supplied to the OCB terminal. The trouble is a defective trip supply circuit board or a faulty connection between the GRD terminal and terminal A of TB7 terminal board. If the circuit breaker does not trip automaticaly with the E fuse installed or removed, the trouble is either no ground signal on the OCB terminal, a defective TRIP coil, or a defective component on the trip supply circuit board. Check the input connections, ground on the OCB lead, and/or a defective TRIP coil as follows.

(a) ***Input Supply Connections:*** To check that 48 volts dc is connected at the FUSE terminal and that ground is supplied at the GRD terminal, proceed as follows.

(1) Verify that the bus CONV( ) circuit breaker and the converter CONV START (S1) switch are in the OFF position.

(2) Verify that the E fuse is installed.

(3) Using the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, connect the meter leads between terminals FUSE and GRD on the trip supply circuit board (see Fig. 7).

Requirement: The test meter indicates a nominal 48 volts dc.

Note: If the requirement is met in (3), disconnect the test meter and proceed to (b). If the test meter indicates 0 volt, continue with (4).

(4) Connect the test meter leads between the FUSE terminal and terminal A on the TB7 terminal board.

Requirement: The test meter indicates 48 volts dc.

Note: If the requirement is met in (4) and is not met in (3), a faulty connection exists between TB7 and the GRD terminal. If the test meter indicates 0 volt, check the 48-volt connection at the E fuse block. When a trouble condition is corrected, repeat the trip supply check in 4.12.

(5) Disconnect the test meter.

(b) ***Ground on OCB Lead:*** To check that the converter circuit supplies ground on the OCB lead when the CONV START (S1) switch is operated to the OFF position, proceed as follows.

(1) Verify that the bus CONV( ) circuit breaker and the converter CONV START (S1) switch are in the OFF position.

(2) Verify that the input supply is connected in accordance with (a).

(3) Using the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, connect the meter leads between terminals OCB and FUSE on the trip supply circuit board (see Fig. 7).

Requirement: The test meter indicates 48 volts dc.

Note: If the test meter indicates 48 volts, the converter circuit is supplying ground on the OCB lead to the circuit breaker. Proceed to (c) to check the TRIP coil. If the test meter indicates 0 volt dc, the converter is not connecting ground on the OCB lead (check CP3 in converter) or a loose connection exists on the OCB lead [check J( ) connector at the converter]. Repair a faulty connection and repeat the trip supply test in 4.12.

(4) Disconnect the test meter.

(c) ***TRIP Coil:*** Check the TRIP coil as follows.

Note: The CONV( ) diode is connected in parallel with the TRIP coil. If the CONV( ) diode is shorted, the TRIP coil will not energize.

(1) Verify that the bus CONV( ) circuit breaker and the converter CONV START (S1) switch are in the OFF position.

(2) Verify that ground is supplied on the OCB lead in (b).

(3) Verify that the E fuse is installed.

(4) Using the KS-14510 volt-ohm-milliammeter, set on the DC VOLTS scale, connect the meter leads between terminal A on TB7 terminal board and terminal B2 on the rear of the CONV( ) circuit breaker (see Fig. 7).

Requirement: The test meter indicates a nominal 48 volts dc.

Note: If the requirement is not met, check for a faulty connection at terminal B2. When the trouble condition is corrected, repeat the trip supply check in 4.12.

(5) Reconnect the test meter leads between terminal A on TB7 terminal board and terminal B6 on the rear of the CONV( ) circuit breaker.

Requirement: The test meter indicates a nominal 42 volts dc.

Note 1: If the requirement is met, the TRIP coil is not defective. The trouble is a defective circuit breaker.

Note 2: If the test meter indicates either 48 volts or 0 volt, the trouble is either a defective TRIP coil or a defective CONV diode or the TS resistor on the trip supply board.

(6) To check continuity of the TRIP coil, disconnect the pigtail lug from terminal B6 on the circuit breaker (see Fig. 7). Using the test meter, set on the OHMS scale, connect the meter leads across the TRIP coil at terminals B6 and B2. If the meter indicates an open or short circuit, the TRIP coil is defective. If the meter indicates a nominal 80 ohms, the trouble is a defective trip supply circuit board. When a trouble condition is corrected, repeat the trip supply check in 4.12.

(7) Disconnect the test meter.