651A (J86809) POWER PLANT
130 VOLTS OUTPUT
OPERATING METHODS

CONTENTS PAGE

1. GENERAL

1.01 The 651A power plant converts negative 48-volt central office battery to a 130-volt dc output. It is designed primarily for small loads up to a maximum of 15 amperes.

1.02 This section is reissued to:

(a) Add the KS-21952, L1, converter

(b) Rate the KS-19815, L1, converter as Mfr Disc.

(c) Rate the KS-19815, L2, converter as Mfr Disc.

(d) Remove specific references to the Centralized Status Alarm and Control System (CSACS)

(e) Provide fuse failure alarm test using the fuse alarm testing cord

(f) Provide updated starting procedures

(g) Update operational procedures.

Revision arrows are used to emphasize the more significant changes. This reissue does affect the Equipment Test List.

Danger: The voltages in this unit exceed 150 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time as destructive and dangerous short circuits may occur. Disconnect the ac input power to the converter before working on the unit except when necessary to make tests.

Caution: Whenever a converter is removed from service, the remaining converters must have the capacity to supply the bus load.

1.03 The 651A power plant is designed primarily for small No. 5 crossbar offices to provide a positive or negative 130-volt dc supply. For anticipated loads of 2 to 4 amperes of positive 130 volts, two 5-ampere converters are used. For anticipated loads of less than 2 amperes of negative 130 volts, two 2-ampere converters are used. Additional converters up to a maximum of four per polarity may be furnished. Since there is no 130-volt battery to provide reserve in case of a converter failure, one more converter than the number necessary to carry the peak load is provided so that failure of a single converter will not reduce the capacity of the plant. The working limits of this plant are 125 to 135 volts dc output and 44 to 52 volts dc input.

Note: The converter should not be connected to a 48-volt filtered supply.

1.04 ▶The 651A power plant outputs are protected by 70-type and 15-ampere load fuses. If any of these fuses fail, the FA relay is operated, and a major alarm is sent. In the case of the failure of only one converter, a minor alarm is sent. Failure of any converter causing a low-voltage condition will cause a major alarm to be given. Wiring options ZA and ZB provide connections to alarm sending circuits.◀

1.05 The following abbreviated terms are used to identify converters used in this power plant:

CST-1—Lorain Model CST-1, 2-Ampere DC-to-DC Converter (Mfr Disc.)

CST-3—Lorain Model CST-3, 5-Ampere DC-to-DC Converter (Mfr Disc.)

KS—KS-19303, L1, 2-Ampere DC-to-DC Converter (Mfr Disc.)

KS—KS-19303, L3, 2-Ampere DC-to-DC Converter (Mfr Disc.). Replaced by ▶KS-21952, L1,◀ Converter

KS—KS-19304, L1, 5-Ampere DC-to-DC Converter (Mfr Disc.)

KS—KS-19304, L2, 5-Ampere DC-to-DC Converter (Mfr Disc.)

KS—KS-19815, L1, 5-Ampere DC-to-DC Converter ▶(Mfr Disc.). Replaced by KS-21952, L1, Converter◀

KS—KS-19815, L2, 2-Ampere, DC-to-DC Converter ▶(Mfr Disc.). Replaced by KS-21952, L1, Converter◀

KS—KS-19866, L1, 5-Ampere DC-to-DC Converter (Mfr Disc.). Replaced by ▶KS-21952, L1,◀ Converter

▶KS—KS-21952, L1, 5-Ampere, DC-to-DC Converter◀

1.06 The converters may be equipped with the ZX option. This is a series of plugs and sockets for the safe disconnection of the converter from the distribution circuit.

1.07 This issue of the section is based on drawing SD-81570-01, Issue ▶14B.◀ For a detailed description of operation, see the corresponding circuit description. If this section is to be used with equipment that is associated with an earlier or later issue of the drawing, 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.

1.08 Checks and adjustments, other than those required by trouble conditions, should be made during a period when they will not interfere with service.

1.09 ▶When this plant is connected to an alarm surveillance and control center, notify that facility when performing steps in this section which affects alarm outputs. Notify the center before a plant or converter is turned down, after a plant or converter has been turned up, and before and after any series of maintenance steps which might affect alarm outputs. This will assure that the alarm interface is functioning properly. It will also permit personnel at the center to take appropriate action in response to alarm signals that may be activated.◀

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

1.11 For more detailed information on the operation and maintenance of individual equipment or apparatus, refer to the appropriate Bell System Practice.

SECTION	TITLE
▶161-279-301	KS-19815, L1, DC-to-DC Converter
161-283-301	KS-19303, L1, DC-to-DC Converter
161-283-302	KS-19815, L2, DC-to-DC Converter
161-284-301	KS-19304, L1 and L2, DC-to-DC Converter
161-299-303	KS-21952, L1, DC-to-DC Converter, 130-Volt Supply Circuit.◀

2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
—	3-Inch C Screwdriver
▶W1AY	Testing Cord, 8 feet 6 inches long (Equipped with a 360A tool at each end)
141	Cord Tip
411C	Test Tool
720A	Test Voltage Pickup Tool (or one KS-6278 Connecting-Clip)
—	70-Type Fuse (blown)
TEST APPARATUS	
KS-20538	Volt-Ohm-Milliammeter (a digital multimeter is a suitable substitute)◀

3. OPERATION

A. Preparing to Start

3.01 Before putting the plant into service, check that:

(1) ▶The converter input circuit breakers or input switches are in the OFF position; or, if the converter is a Model CST-1, remove the converter input fuse.

(2) The 48-volt fuses at the 48-volt power board are removed.

(3) The converter output fuse, if so equipped, is removed.◀

(4) All external connections are made in accordance with the SD drawings covering the circuits associated with the plant.

(5) The disconnects (P plugs and J sockets) of each converter are properly connected, if the ZX option is provided.

(6) The converters in the plant are connected for the proper output polarity.

(7) The ADJ VOLTS potentiometer of each converter is rotated fully ccw.

(8) ▶If the converter is a KS-21952, L1, converter, continue with Step (9); otherwise, proceed to Step (10).

(9) On the KS-21952, L1, converters:

(a) Release the two twist-type fasteners located at the top of the converter panel and pivot the front forward and downward on its hinge.

(b) Verify that fuses F2 and F3 are of the correct size and are installed.

(c) Close and secure the converter front panel.

(d) Verify that fuse CAP CHARGE (F1) is the correct size and installed.

(e) Proceed to Step (11).

(10) The OUTPUT FUSE located on the converter panel is removed. To remove the OUTPUT FUSE, press in and down.

(11) The plant load fuses associated with the bus are removed.

Caution: Inductive filtering should not be used between the 48-volt battery and the converter inputs since an input filter may cause voltage peaks which may damage components in the converter.

B. Starting

3.02 To place the plant in service, proceed as follows:

Note: Before starting a parallel connected converter, the ADJ VOLTS potentiometer should be turned completely ccw. The potentiometer is set to its proper voltage position after the converter is started. This will reduce the output voltage transients which occur with abrupt load changes on parallel connected converters.

(1) Verify that converters are ready to start in accordance with paragraph 3.01.

(2) Install the 48-volt input fuses located at the 48-volt power board for each converter being started.

(3) If the converter being started is a KS-21952, L1, converter, continue with Step (4); otherwise, proceed to Step (5).

(4) On the KS-21952, L1, converter:

(a) Operate and hold the PRECHARGE switch (S1) to the up position for a period of 10 seconds.

(b) At the end of 10 seconds, while still holding the PRECHARGE switch in the up position, operate the DC INPUT SWITCH (S2) to the ON position.

(c) Release the PRECHARGE switch.

Warning: If substeps (a) through (c) are not followed, the contacts of DC INPUT SWITCH (S2) may be damaged.

(d) Connect the KS-20538 volt-ohm-milliammeter set to measure 300 volts dc, observing the proper polarity, to the (+) and (-) OUTPUT VOLTAGE test jacks located on the converter control panel.

(e) Adjust the converter OUTPUT VOLTAGE ADJ potentiometer cw until the KS-20538 volt-ohm-milliammeter indicates a nominal 130 volts dc.

(f) Disconnect the KS-20538 volt-ohm-milliammeter from the converter OUTPUT VOLTAGE test jacks.

(g) Proceed to Step (8).

(5) Operate the INPUT circuit breaker on the converter, to be started, to the ON position or insert the input fuse in the CST-1 converter.

(6) Rotate the ADJ VOLTS potentiometer cw until the converter output voltage is a nominal 130 volts dc.

(7) Install the converter OUTPUT FUSE in the converter control panel fuse holder.

(8) Repeat from Step (3) for each converter associated with the bus to be turned up.

(9) Permit all converters associated with the bus to operate at no-load for at least 5 minutes.

Note: One converter in addition to the number of converters required to carry the bus load should be connected to the bus so that a failure of a single converter will not reduce the capacity of the plant.

(10) Install the plant load distribution fuses.

Warning: See paragraph 3.14 before installing plant load fuses to prevent fuse damage.

3.03 If the load is greater than the rating of one converter, additional converters are required. To place the additional converters in service, proceed as in paragraph 3.04 for all

converters except the KS-21952, L1, converter, if the converter is a KS-21952, L1, converter, proceed as in paragraph 3.05.◀ For converters with current limiting, it is not necessary that the converters be adjusted to share the load equally. For plants using the KS-type converters and the CST-1 or CST-3 converters together, observe the adjustment procedures outlined in paragraphs ▶3.07 and 3.08.◀

C. ▶Adding Converters to Plant (All Converters Except the KS-21952, L1, Converter)

3.04 When adding any converter, except the KS-21952, L1, converter to the plant, proceed as follows:

(1) Determine if the adjustment procedures in paragraphs 3.07 and 3.08 apply and take the necessary action.

Caution: Before starting a parallel connected converter, the ADJ VOLTS potentiometer on the converter being started should be turned completely ccw. This will reduce the output voltage transients which occur with abrupt load changes on parallel connected converters.

(2) For the converter being added, verify the following:

- The input circuit breaker or input switch is in the OFF position, or if the converter is a CST-1 converter, the input fuse is removed.
- The 48-volt input fuse located at the 48-volt power board is removed.
- The converter output fuse is removed.
- The disconnects (P plug and J socket) for the converter is properly connected, if the ZX option is provided.
- The converter is connected for the proper output polarity.
- The ADJ VOLT potentiometer on the converter is rotated fully ccw.

(3) Install the 48-volt input fuse located at the 48-volt power board for the converter being started.

(4) Operate the INPUT circuit breaker on the converter to the ON position or insert the input fuse in the CST-1 converter.

(5) Rotate the ADJ VOLTS potentiometer cw until the converter output voltage is a nominal 130 volts dc.

(6) Allow the converter to operate for 30 minutes to temperature-stabilize.

(7) After the time interval, rotate the ADJ VOLTS potentiometer ccw until the output voltage is at least 1 volt below the bus voltage.◀

(8) Install the converter output fuse to connect the converter to the load bus.

(9) Rotate the ADJ VOLTS potentiometer cw until the ammeter indicates the desired output current.

D. ▶Adding KS-21952, L1, Converters to Plant

3.05 When adding a KS-21952, L1, converter to the plant, proceed as follows:

(1) Determine if the adjustment procedures in paragraphs 3.07 and 3.08 apply and take the necessary action.

Caution: Before starting a parallel connected converter, the ADJ VOLTS potentiometer on the converter being started should be turned completely ccw. This will reduce the output voltage transients which occur with abrupt load changes on parallel connected converters.

(2) For the KS-21952, L1, being added, verify the following:

- The converter DC INPUT SWITCH is in the OFF position.
- The 48-volt fuse at the 48-volt power board is removed.
- The disconnect (P plug and J socket) for the converter is properly connected if the ZX option is provided.

- The converter is connected for the proper output polarity.
- The OUTPUT VOLTAGE ADJ potentiometer on the converter is rotated fully ccw.
- Release the two twist-type fasteners located at the top of the converter panel and pivot the front forward and downward on its hinge.
- Verify that fuses F2 and F3 are of the correct size and are installed.
- Close and secure the converter front panel.
- Verify that fuse CAP CHARGE (F1) is the correct size and installed.

(3) Install the 48-volt input fuse located at the 48-volt power board for the converter being started.

(4) On the KS-21952, L1, converter:

(a) Operate and hold the PRECHARGE switch (S1) to the up position for a period of 10 seconds.

(b) At the end of 10 seconds, while still holding the PRECHARGE switch in the up position, operate the DC INPUT SWITCH (S2) to the ON position.

(c) Release the PRECHARGE switch.

Warning: If substeps (a) through (c) are not followed, the contacts of DC INPUT SWITCH (S2) may be damaged.

(5) Connect the KS-20538 volt-ohm-milliammeter set to measure 300 volts dc, observing the proper polarity, to the (+) and (-) OUTPUT VOLTAGE test jacks located on the converter control panel.

(6) Adjust the converter OUTPUT VOLTAGE ADJ potentiometer cw until the KS-20538 volt-ohm-milliammeter indicates a nominal 130 volts dc.

(7) Allow the converter to operate for 30 minutes to temperature-stabilize.

(8) Verify that the KS-20538 volt-ohm-milliammeter indicates a nominal 130 volts dc (readjust the OUTPUT VOLTAGE ADJ potentiometer if necessary).

(9) Disconnect the KS-20538 volt-ohm-milliammeter from the converter OUTPUT VOLTAGE test jacks.◀

E. Removing Plant From Service

3.06 To remove the plant from service, proceed as follows:

(1) ▶Slowly remove all load distribution fuses.

(2) Rotate the ADJ VOLTS potentiometer of each converter fully ccw.

(3) Remove the converter output fuse, if converters are so equipped.

Danger: The KS-21952, L1, converter is not equipped with output fuses; therefore, the converter output bus may have 130 volts potential even when the INPUT switch is turned off.

(4) Operate each converter, input circuit breaker, or input switch to the OFF position, or if the converters are CST-1 converters, remove the input fuses.

(5) Remove the 48-volt input fuses located at the 48-volt power board for the plant converters.

(6) If the converters are equipped with the ZX option, disconnect the plug-socket disconnects.

Note: Maintain electrolytic capacitors in accordance with Section 032-110-701.◀

F. Configurations of Converter Types

3.07 Where two CST-1 type converters are installed, the addition of another converter or converters, either a KS-type, 2-ampere converter, or a CST-1 type converter for loads over 2 amperes, requires that a modification kit be added to each CST-1. This kit, Current Limiting Circuit Kit No. 1448AS, is manufactured by the Lorain Products Corporation. Instructions for mounting and connecting this feature are furnished with the kit.

The kit provides a current limiting feature for the CST-1 to prevent possible loss of the 130-volt supply in case of a single converter failure. CST-1s used in any plant with a load in excess of 2 amperes require the current limiting feature, since the CST-1 may attempt to assume all the load of the plant.

3.08 Where the CST-3 type dc-to-dc converters are installed, a current limiting modification kit is available which, when installed, improves the operating characteristics of the 651A plant and results in the elimination of the F3 fuse and the need for an alarm circuit. This modification kit, No. 4833-003, is manufactured by the Lorain Products Corporation. The addition of KS-type 5-ampere converters requires voltage adjustment of the KS converters to a value high enough to assure full output from the KS converters in the event of a failure of one of the CST-3s. Loss of the 130-volt supply may be prevented by adjusting ⧫the KS-21952, L1, converter as outlined in paragraph 3.10 or as outlined in paragraph 3.09 for all other KS converters used in the 651A plant.⧫

G. Adjusting KS Converters

3.09 ⧫***Adjusting Non-KS-21952, L1, KS Converters to Full Load:*** To adjust each individual KS converter, follow the procedures outlined below.

(1) Remove the converter output fuse.

(2) Operate the input circuit breaker to the ON position and operate the converter for 30 minutes to allow the voltage to temperature-stabilize.

(3) Rotate the ADJ VOLTS potentiometer cw until the converter voltage is 1 volt below the bus voltage.

(4) Install the converter output fuse.

(5) Rotate the ADJ VOLTS potentiometer cw until the ammeter indicates 4.5 to 5 amperes.

(6) Remove the converter output fuse.

(7) Rotate the ADJ VOLTS potentiometer cw until the output voltage is increased between 1 to 2 volts.

(8) Install the output fuse.

Note: Steps (7) and (8) are performed with the input battery at float voltage to compensate for high input battery conditions.

3.10 ***Adjusting KS-21952, L1, Converters to Full Load:*** To adjust each individual KS-21952, L1, converter, follow the procedures outlined below and in Section 161-299-303.

(1) Operate the converter for 30 minutes to allow the converter voltage to temperature stabilize.

(2) Connect the KS-20538 volt-ohm-milliammeter set to measure 300 volts dc, observing the proper polarity to the (+) and (-) OUTPUT VOLTAGE test jacks located on the converter control panel.

(3) Adjust the converter OUTPUT VOLTAGE ADJ potentiometer until the KS-20538 volt-ohm-milliammeter indicates a nominal 130 volts dc.

(4) Disconnect the KS-20538 volt-ohm-milliammeter from the converter test jacks.

(5) Repeat from Step (1) for remaining KS-21952, L1, converters.⧫

H. Operation of the 651A Power Plant

3.11 With all input and output fuses in place and circuit breakers closed, the converters should continuously operate in parallel to supply a regulated voltage to the load.

3.12 ***Stopping and Restarting Converters:***

(a) To stop an individual converter, proceed as follows:

Caution: ⧫Before disconnecting any converter, a working spare unit should be connected to the load bus to prevent overloading the remaining converters.

(1) Remove the converter output fuse, if converters are so equipped.

Danger: The KS-21952, L1, converter is not equipped with an output fuse; therefore, the converter output bus

may have 130 volts potential even when input is turned off.

(2) Operate the circuit breaker or DC INPUT switch to the OFF position, or remove the CST-1 input fuse to turn the converter down.

(3) Remove the 48-volt input fuse to disconnect the converter from the battery bus.

(b) To restart the converter, follow the procedures in paragraph 3.05 if converter is a KS-21952, L1, converter; otherwise, follow the procedures in paragraph 3.04.

3.13 To restart the plant in the event of a fault which has caused complete plant shutdown, proceed as follows:

(1) Remove the load fuses.

(2) Remove the converter output fuses, if converters are so equipped.

(3) Operate the converter input circuit breaker, or DC INPUT SWITCH to the OFF position or remove the CST-1 input fuse.

(4) Correct the cause of plant shutdown (see Part 5).

(5) Follow the procedures in paragraph 3.01 to prepare the plant for restarting.

(6) Follow the procedures in paragraph 3.02 to start the plant. If necessary, repeat paragraph 3.03.

I. Installing Plant Load Fuses

3.14 ***CHG Key or CHG SEL Switch:*** To install load fuses for plants with decentralized filters, the CHG key or CHG SEL switch is operated. This places the CHG resistor in series with the load to limit the filter charging current to prevent fuse operation. To install a load fuse in these plants, proceed as follows:

(a) ***CHG key:***

(1) Operate the CHG key for the selected load (LOAD 1 or LOAD 2).

(2) Install the load fuse.

(3) Release the CHG key.

(b) ***CHG SEL Switch:***

(1) Operate the CHG SEL switch to the selected load position (LOAD 1 or LOAD 2).

(2) Install the load fuse.

(3) Operate the CHG SEL switch to the center position.

4. ROUTINE CHECKS

4.01 ***Load Bus Alarm Fuses:*** Check the FA alarm associated with these fuses as follows:

Note: When this plant is connected to an alarm surveillance and control center, notify that facility when performing steps which affect the alarm output. Notify the center before a plant or converter is turned down, after a plant or converter has been turned up, and before and after any series of maintenance steps which may affect the alarm outputs. This will assure that the alarm interface is functioning properly. It will also permit personnel at the center to take appropriate action in response to whatever alarm signals may be activated.

Fuse Cap With Test Point

Note: The later design of fuse caps for 70-type fuses contain an aperture or slot adjacent to the hole for the colored bead, providing access to the alarm test point (see Fig. 1). The P-344900 fuse cap assembly is for use on nonmodular fuse blocks (18A, 19A, and 21A) and the P-11F667 fuse cap assembly is for use on modular fuse blocks (22- through 27-type). This style cap should be used when testing fuse alarms.

Danger: Due to shock hazard, possible fuse damage, and/or equipment damage, the former procedure of testing fuse alarms by inserting a 411C tool or a 266C tool (wire burnisher) held in a 265C tool (contact burnisher holder) beside the colored bead on older fuse

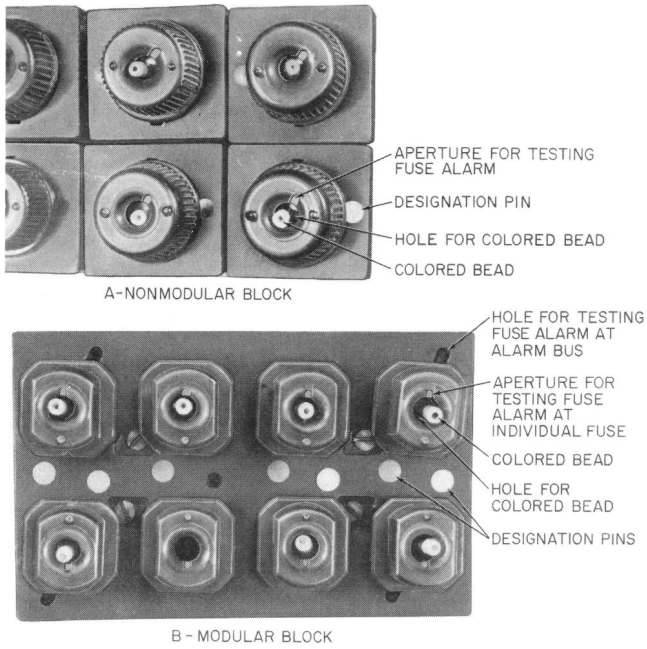

Fig. 1—Typical 70-Type Fuse Arrangement

caps without the slot or aperture, should be discontinued.

(1) Prepare the fuse alarm test cord (refer to Fig. 2) 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 tool.

(2) Install the 720A voltage pickup tool in a spare 70-type fuse position. (If the 720A tool is not available, obtain the same polarity 130-volt voltage supply by connecting a KS-6278 connecting clip with the W1AY testing cord to the positive or negative bus bay.)

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

(3) With the tip of the 411C tool (attached to the 130-volt connected W1AY testing cord) touch the exposed alarm test point on the fuse cap for one fuse.

Requirement: The FA alarm will operate. In addition to the local alarm, if wiring options ZA and ZB are provided, this alarm will also be provided to the alarm sending circuit to which the plant is interconnected.

Note: Tests made at the individual fuse cap check the contact between the fuse cap and the alarm bus bar. On modular type fuse blocks, there is also an aperture in the corner of the fuse block to test directly to the alarm bus bar (see Fig. 1).

(4) Remove the 411C tool from the fuse cap.

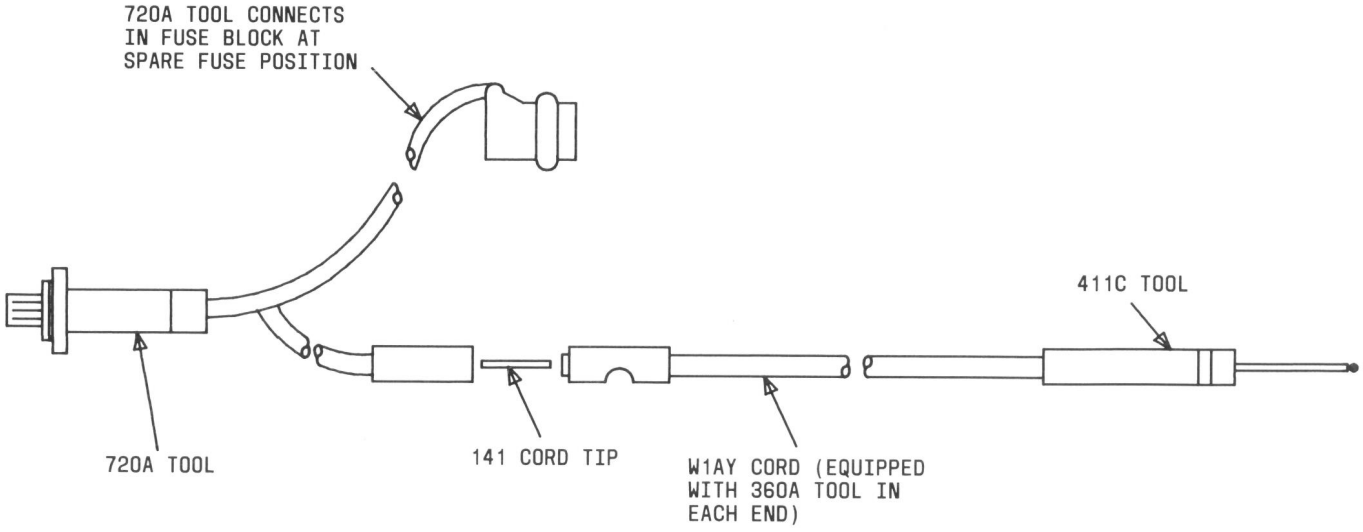

Fig. 2—Fuse Alarm Testing Cord—Tool Connection

Requirement: The FA alarm relay releases.

(5) Repeat (3) for each fuse associated with the fuse bus.

(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.)

(7) Notify the alarm center that fuse failure alarm check is completed.◀

4.02 ***Converter Failure Alarms:*** Periodically check these alarms by stopping and starting the converters as covered in ▶paragraph 3.12.◀ Check that when one converter is stopped, a minor alarm is given, and that when the first two converters are stopped or a low-voltage condition occurs, a major alarm is given. ▶Wiring options ZA and ZB provide local alarms and alarm sending circuit to the alarm surveillance and control interface.

Caution: Whenver a converter is removed from service, the remaining converters must have the capacity to supply the bus load.◀

4.03 ***Converter Operation Check:*** Since it is not necessary that the converters equally share the load, a periodic check should be made on converters indicating no output current to be sure that no malfunction exists. Raising the output voltage of the converter in question should cause it to deliver output current.

4.04 ▶***Output Voltage Check:*** Periodically check to ensure that the output voltage is a nominal 130 volts. Connect the KS-20538 volt-ohm-milliammeter to the plant bus bar and ground to measure the plant bus voltage.◀

5. TROUBLES

5.01 The troubles listed below pertain to the supply circuit. Troubles in the converter units are covered in sections on operating methods for the converters.

TROUBLE	POSSIBLE CAUSE
Output voltage low	Converter(s) overloaded
Output voltage high	Converter(s) out of adjustment
No output current	Input supply open (fuse blown or converter malfunction)