IBM

Customer Engineering

Reference Manual

7608 Power Converter

7618 Power Control

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Mr John V Gardner
2950 Stonecreek Rd SE
Smyrna GA 30080-3320

Preface

This manual is a minor revision of the 7608/7618 sections of the Customer Engineering Reference Manual, *IBM 7090 Data Processing System*, Form 223-6864-1, now obsolete. A companion document is the Customer Engineering Manual of Instruction, *IBM 7090 Power Supply Control and Distribution*, Form 223-6904.

Address comments regarding this publication to:
IBM Corporation
Customer Engineering Manuals, Dept. 296
P.O. Box 390
Poughkeepsie, N. Y.

Contents

Safety

Lethal voltages are plentiful in the 7090 power system. Do not work on the power converter or power control unless power is turned off. In some portions of the power control, lines remain live even with power turned off at the machine. For example, HR29, CB30, and fuse 1 are in a sealed box because they are unsafe to work on until power is shut off at the wall switch.

Beware of rotating machinery when removing covers from the power converter.

1 Scheduled Maintenance

1.1 Introduction

Scheduled maintenance is cleaning, lubrication of moving parts, and observation (to check for wear, rust, loose screws, and so on).

Do not unnecessarily adjust or disassemble properly operating units. Adjustments may be necessary when new parts are being broken in but, when the parts have been in place for some time, wear against each other results in perfectly mated surfaces. When this stage is reached, further wear is at a minimum because the parts are polished and offer little friction to each other. If adjustments are made at this point, the wearing-in process must be repeated, and the life of these parts is shortened because of wear.

If the machine is operating correctly, adjusting parts to bring them within specified tolerances cannot make it operate better but may make it worse.

1.2 Scheduled Maintenance Procedures

A punched card from the local customer engineering office will be sent to your installation when scheduled maintenance is due on a machine unit. When you receive this card, open the IBM Customer Engineering Reference Manual to the inspection routine chart. This chart has information on the routine scheduled maintenance to be done. Scheduled maintenance usually may be performed by referring only to this chart; in some cases, such as a routine check of waveforms, it is also necessary to refer to the manual page listed in the chart.

If the machine continues to operate satisfactorily after scheduled maintenance and nothing unusual turns up, sign the card, and send it back. If something out of the ordinary is found, particularly with mechanical units, refer to the page noted in the chart for more detailed information about how to check, adjust, and/or remove the troublesome item.

SCHEDULED MAINTENANCE ROUTINE

Code	Unit or Routine	Freq		Operation	Page
8	POWER SUPPLY	26	7618	Check 48-volt supply. Measure 48 ± 4.8 volts across fuse 1	11
7	RELAYS	52		Check relays and contactors. Look for burned points, binding, air gap, and rise	18 20
9	ROUTINE 9			Check for loose terminal connections and charred insulation	
9	ROUTINE 9	13	7608	Check generator brushes for wear	25
		52		Clean base. Lubricate bearings. Check for loose terminal connections and charred insulation. Note: The 52-week schedule for bearing lubrication is based on 3-shift operation.	25

2 Diagnosis

2.1 Troubleshooting

Trouble in the power converter and control system will usually show up as:

1. Lack of output voltage because of power shutdown
2. High or low output voltage
3. Incorrect output frequency

See Figure 2.1-1 which is a troubleshooting guide.

2.2 Performance Tests

Power is usually turned on for the system as follows:

1. Turn on main wall switch
2. Depress power-on-reset switch
3. Reset MG-CB-1 on the front of the 7608 power converter
4. Depress the power-on switch, either on the 7618 power control or the 7151 console

Steps 1, 2, and 3 are necessary only for an initial power-on or after using the emergency off switch.

The following circuit breaker points must be closed to complete a normal power-on sequence (the physical location of these components may be found on Systems 9.08.02.0 or in Section 4):

CB30 supplies the 60 cycle control circuits and must be closed to energize the power-on-reset switch. It is on the front of the 7618 power control.

CB32 supplies 60 cycle power to the cooling blower motor in the 7608 power converter; it must be closed to start the motor generator. It is on the front of the 7618 power control.

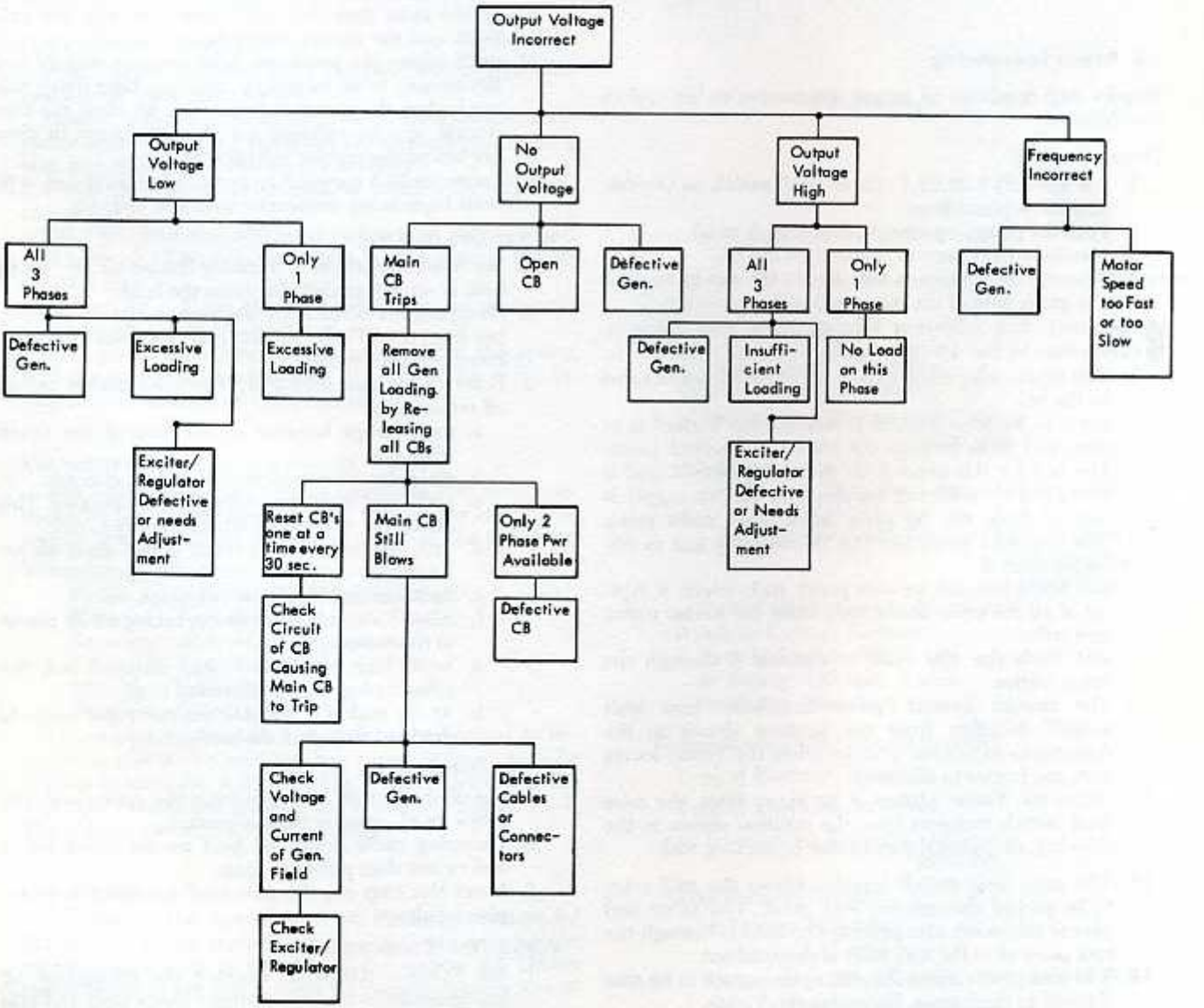


Figure 2.1-1. Troubleshooting Guide

HR30 is operated by a key on front of the enclosure to reset the thermal overload devices that protect the large motor. It requires resetting only after a motor overload. It is on the front of the 7618 power control.

MG-CB1 is a protective unit in the output of the alternator and must be reset (after pushing power-on-reset) when initially bringing up power, or after an emergency off. It is located on the front of the 7608 power converter.

CB28, CB29, and CB31 are in the 400 cycle lines that supply the frames. They must be on to make power-on switches operable. They are located on the front of the 7618 power control.

CB1 to CB13 protect the cable wires associated with individual frame blowers. The CB for a particular frame must be on to allow 400 cycle power to be supplied to that frame. They are on the power control panel of the 7618 power control.

CB33 supplies 60 cycle power to the core storage heater-pump unit and must be on to bring up power on the core storage. It is on the front of the 7618 power control.

2.3 Power Sequencing

Step-by-step operation of power sequencing in the system is as follows:

POWER ON

1. See Systems 9.02.01.1. Throw wall switch on to energize three-phase lines.
2. Push the power-on-reset button to pick HR29.
3. Manually reset MG-CB1, located on the MG.
4. Pressing the power-on key causes the MG to start. It also picks both of the DC-on relays.

CAUTION: Not following this sequence may cause a blown fuse in the 48-volt supply.

5. The DC-on relay causes the pick of HR30. HR30 turns on the MG.
6. Refer to Systems 9.02.02.1. Assume the Variac* is at zero. HR1 picks through the 400 cycle interlock point. The coil for this point is on Systems 9.02.06.1 and is energized by a 48 volt supply. The 48 volt supply is derived from the 60 cycle input after HR29 picks. This interlock point ties the DC-on relay bus to 60-cycles neutral.
7. HR1 holds through its own point. HR1, which is typical of all the other contactors, starts the Variac motor upwards.
8. HR1 feeds the 400 cycle to channel 1 through the rising Variac.
9. The contact named "power-on Variac zero limit switch" transfers from the position shown in the drawing to its normal position when the Variac leaves zero and begins to move up.
10. When the Variac arrives at its upper limit, the raise limit switch transfers from the position shown in the drawing, dropping the HR1 relay by picking HR2.
11. The raise limit switch transfer allows the HR2 relay to be picked through the HR1 point. The M/C1 and blower relays are also picked. The hold is through the HR2 point after the HR1 relay is dropped out.
12. The HR2 points allow the 400 cycle supply to be sent directly to the frames, bypassing the Variac.
13. The Variac is driven downward when HR1 drops out. When it reaches its lowest point, the zero limit switch transfers to the position shown in the drawing.
14. Systems 9.02.03.1 and 9.02.04.1 are similar to 9.02.02.1 except for differences in the arrangement of the switches and lights of CPU2 and the console.
15. Refer to Systems 9.02.05.1. DR15 is picked at the same time as HR1. The core storage standard supply is brought up in the same way as any standard supply, except that DR15 is used as a return. DR15 is also used to pick the core storage blower relay and HR38 on 9.02.06.1.
16. HR25 operates as did HR1, and HR26 as HR2. But when HR26 is picked so is DR14, giving a return for HR27.
17. When the zero limit switch returns to the position shown (see step 13), HR27 picks. Now HR27 and HR28 operate as did HR1 and HR2, driving the Variac up and down again for a second time.
18. The Variac is brought up for a second time to allow the core storage special voltages (+30, +60 volts) to come up later than regular voltages. The Variac is connected only to these supplies for its second trip.
19. At the same time that HR28 picks, we also get TD1, DR32, and the system reset relay.
20. DR32 allows the power-on light for core storage and the console to be turned on. TD1 is a time delay unit used when the power is turned off, to allow the core storage special voltages (+30, +60 volts) to drop out before the regular voltages do.
21. Points HR26-4 are used to prevent the +30 and +60 volts from being sequenced with low voltages.

POWER OFF (DC OFF)

1. See Systems 9.02.01.1. Pushing the DC-off key drops both DC-on relays and also drops the hold.
2. Dropping the DC-on relay disconnects the DC-on relay bus from the 60 volt neutral. This drops out all frames except for core storage.
3. Refer to Systems 9.02.05.1. The core storage power off sequence is:
   a. DR15 drops because of the loss of the DC-on relay bus.
   b. DR14 drops because the DR15 point opened.
   c. HR28 and DR32 drop because DR14 opened. This allows the +30 and +60 volt supply to fall.
   d. TD1, because of its built-in delay, stays on for 5 seconds.
   e. HR26 holds through the TD1 point.
   f. After 5 seconds HR26 drops, taking off all power to the memory frame.
   g. HR38 stays on. When DR15 dropped out, the other timing unit, TD2, started to go.
   h. At the end of 3 minutes the TD2 point opens to drop out HR38 and the blower relay.

POWER OFF (NORMAL OFF)

1. See Systems 9.02.01.1. Pushing the normal-off key drops HR30, opening the MG contacts.
2. Dropping HR30 drops the hold on the DC-on relays and causes their points to open.
3. From this step on, the power-off sequence is as explained above.

POWER OFF (EMERGENCY OFF)

1. See Systems 9.02.01.1. Pushing the emergency off key drops HR29 to open all three-phase lines and kills everything, including the convenience outlets.

* Trademark of General Radio Company

3.1 Power Control

The IBM 7618 Power Control unit houses the motor-generator controls, power sequencing and marginal check motor driven autotransformers, and the power distribution system.

3.1.1 Power Control Panel

The following parts are mounted on the power control panel of the power control unit:

1. Power on-off switches
2. Voltmeter and range selector switch
3. Circuit breakers for the blowers in each unit of the system
4. Circuit breakers for the convenience outlets in each unit of the system

Power On-Off Switches

Power on-off switches are of the push button type. The functions of these switches are:

Power On Reset – Makes 60 cycle power available in the power control unit (PC); energizes the memory heater-pump unit; energizes the 48 volt supply in the PC.

Power On – Starts the MG and/or initiates the DC power-on sequence.

DC Off – Removes 400 cycle power from each unit and thus turns off all DC voltages in each unit of system. The MG set stays on.

Normal Off – Turns off all DC voltages in the same manner as DC off, but also stops the MG set.

Emergency Off – Removes all power from the system with the exception of a few lines in a sealed box in the PC. This sealed box encloses CB30 and HR29.

Voltmeter and Selector Switch

The voltmeter on the control panel has two ranges selected by the selector switch at the right of the meter. The voltmeter measures the 400 cycle output of the generator.

Voltmeter specifications are:

Range	116-124, 200-216 volts AC
Type	Peak sensing
Accuracy	.25% at room temperature .5% from 0°C to +40°C
Mounting	Vertical
Frequency	375-425 CPS

To read the high range, voltage must be applied to terminals A and B. To read the low range, voltage must be applied to terminals A and C while D and E are connected together. Terminal G grounds the meter. See Figure 3.1-1. The selector switch is wired as shown.

Circuit Breakers

Mounted on the control panel are 13 circuit breakers for the blowers in the system and 14 circuit breakers for the convenience outlets in all units of the system. All blower circuit breakers are alike except the memory blower circuit breaker which is rated for a higher current. All circuit

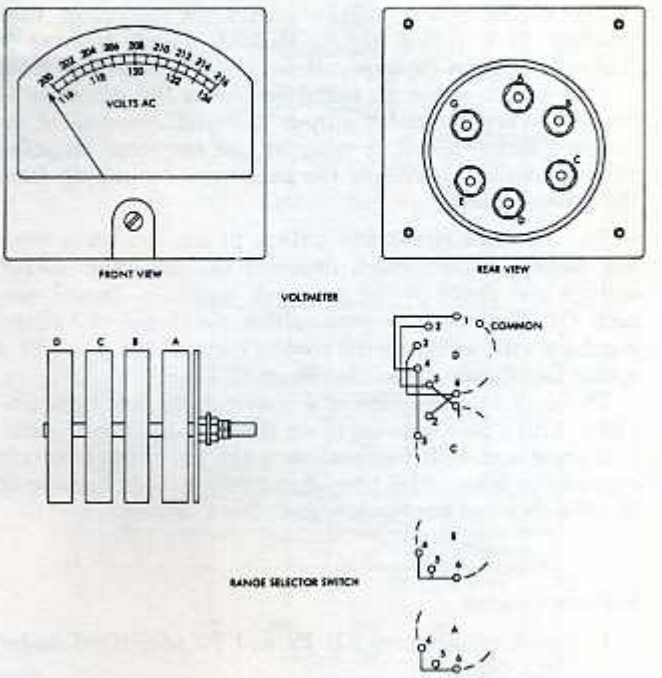


Figure 3.1-1. Voltmeter and Selector Switch

breakers for the convenience outlets are alike. See Figure 3.1-2 and the following table:

Blower Circuit Breakers

Type of Element: Magnetic
Type of Trip Circuit: Series
AC Interrupting Capacity: 250 volts
1000 amp
Trip Element Ratings
AC Rating: 250 volts, 1 amp (8 amp for memory blower)
Resistance at Rated Current: 1.0 ±.2 ohms (0.2 ±.004 ohms for memory blower)
Operating Frequency: 60 cycles
Auxiliary Contact Ratings:
Type of Circuit: SPDT
AC Rating: 125 volts, 5 amp
DC Rating: 50 volts, 1 amp

Convenience Outlet Circuit Breakers

Type of Element: Magnetic
Type of Trip Circuit: Series
AC Interrupting Capacity 125 volts
2000 amp
Trip Element Ratings
AC Rating: 120 volts
15 amp
Resistance at Rated Current: .007 ±.0014 ohm
Operating Frequency: 60 cycles

3.1.2 *Generator Exciter-Regulator Control Panel*

The exciter-regulator has two basic circuits, an exciter power supply to energize the generator field initially, and a regulator circuit for voltage regulation and removal of transient voltages from the output. See Figure 3.1-3.

The exciter power supply excites the generator field winding. It is called a field flashing circuit because it flashes (energizes for a short time) the generator field from a DC source to cause an initial output as the generator is rotated. When generator output increases, because of increasing motor speed, a relay in the magnetic amplifier control circuit disconnects the exciter power supply from the generator field.

The regulator circuit has a three phase, full wave rectifier sensing circuit which monitors the generator output voltage and develops the magnetic amplifier control current. Q1, the transistor preamplifier stabilized by voltage regulator VR1, amplifies the control current and provides a means for adjusting gain. See Figure 3.1-4.

The magnetic amplifier is a conventional feedback amplifier with a bias winding to set the control current operation point and with feedback to make the control current curve more linear. This type of amplifier is used because of its reliability and large power gain. See Figure 3.1-5.

Service Checks

1. Check adjustments P1, P2 and P3 (described under "Adjustments").
2. Check that CR1 relay points open when the generator voltage builds up to about 200 volts.
3. Measure the magnetic amplifier bias current with a volt-ohmmeter; 13 ma DC should be flowing in bias winding (F6 and F10).
4. Check the magnetic amplifier output waveform at the generator field winding terminals. See Figure 3.1-6.
5. Measure the voltage drop across VR1 when it is ignited. This voltage should be 97v DC.
6. Measure the field flashing power supply terminal voltage with CR1 de-energized. It should be 8.75 volts.
7. Check diodes (D1-D6) in the three phase, full-wave rectifier line voltage sensing circuit. It is difficult to measure accurately their forward and back resistance with a standard volt-ohmmeter (VOM). Therefore, if a standard VOM gives a ratio of at least 1000 to 1 between forward and back resistance, consider the diodes normal.
8. Check the magnetic amplifier load winding diodes (D8-D11 and D14-D17) with a VOM as explained above.

Inspection

Inspect all terminal boards for loose screws and wires. Inspect the potentiometers for burned windings or cracked carbon wiper brushes. Inspect for loose hardware, leaking capacitors, frayed cables and broken wires.

Adjustments

1. Exciter-Regulator Controls (Potentiometer P1). To compensate for load variations, adjust for correct terminal voltage at the generator output (208 volts as measured on the panel meter).
2. Bias (Potentiometer P2). Adjust to produce 13 ma DC through the bias winding (F10 and F6).
3. Stability Adjustment (Potentiometer P3). With no load on the generator, rotate the positive feedback potentiometer (P1) suddenly through 50% of its total range. Observe the generator output voltage envelope on an oscilloscope. The stability potentiometer (P3) should be adjusted to produce three swings or less of the generator output voltage.

If the field flashing power supply fails to provide enough voltage, substitute a DC power source (such as a battery). Place it across the field terminals F1 and F2 for a very short time. Observe correct polarity: negative terminal on F1, positive terminal on F2. When the generator is producing enough output, remove the DC source and check the power supply.

Trouble Isolation

When there is a loss of output from the motor generator, trouble may be isolated to the MG set or to the generator exciter-regulator control circuits by the following information and procedures.

Three basic circuits are involved:

1. Exciter power supply to energize the generator field initially. This supply (T3) is dropped by the CR1 points when the generator output picks the CR1 relay.
2. Regulator circuits for voltage regulation and removal of transients from the output. The regulator circuit contains a 3-phase, full-wave rectifier sensing circuit that monitors the generator output voltage and develops the magnetic amplifier control current (SX1).
3. Generator field circuit in the MG set.

The following procedure may isolate the trouble to either the MG set or the 7618 control circuits:

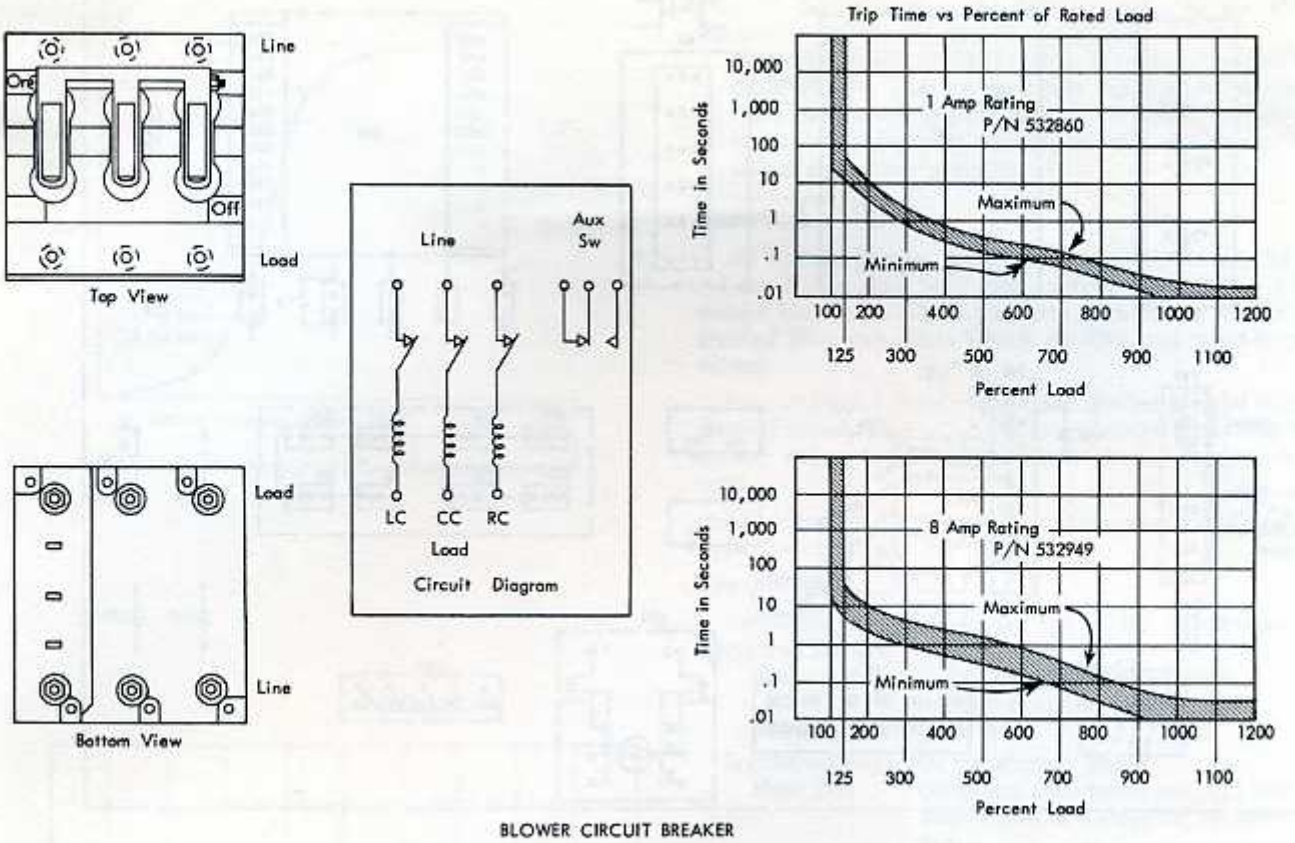
1. With the system emergency off switch tripped and all wall circuit breakers tripped, disconnect field terminals F1 and F2 at TB1 in the 7618 (Systems 09.09.01.1).
2. Check across F1 and F2 for continuity in the generator field winding, which should measure about 6-8 ohms.
3. If this resistance is within limits, "flash" the generator field by using the 60-cycle, 48-volt DC portion of the 48-volt supply. Be sure that the positive side of 48 volts is applied to F2.
4. Reset the wall circuit breakers and the emergency off switch on the system.
5. Hit "power-on reset" at the PDF. The MG should now be turning over.
6. Apply 48 volts across F1 and F2 and check the voltage at L1, L2, and L3. Terminals for these points are located at TB1.

If the MG set is functioning correctly, the output at L1, L2, and L3 should be half the normal 208-volt output. The reason for this low output is that only 48 volts is being applied, whereas the normal field voltage is 97 volts. If there is no output at L1, L2, and L3, the trouble is in the MG set. If these MG set tests do not indicate failure, the trouble is in the 7618 generator exciter-regulator control circuits.

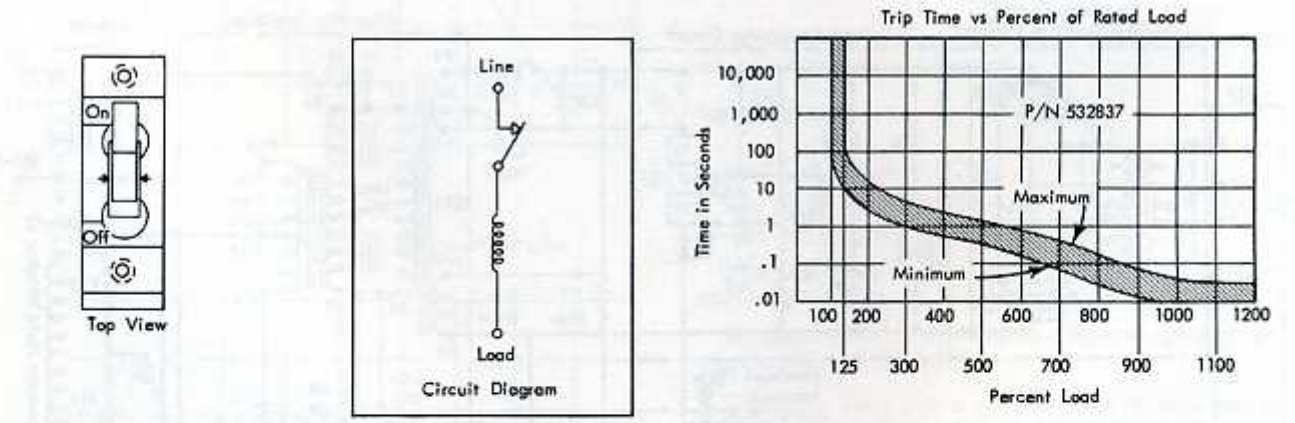
DANGER: Because this area of the machine contains dangerous voltages throughout, be extremely careful and observe all safety precautions.

Removal and Replacement

Unfasten all connecting wires, remove mounting screws and remove the defective component from the exciter-regulator chassis.



BLOWER CIRCUIT BREAKER



CONVENIENCE OUTLET CIRCUIT BREAKER

Figure 3.1-2. Control Panel Circuit Breakers

3.1.3 48 Volt Power Supply

Power to all power-on and power-check lights in the system is supplied by the 48-volt supply, which is also used with the open fuse, open thermal, and open air flow indication circuits.

This supply consists of a 60-cycle supply and a 400-cycle supply, operating in parallel. An output of 42 to 43 volts comes from the 60-cycle supply during the starting or stopping of the MG. Inadvertent tripping of CB1 in the individual power supplies in each SMS frame is prevented. The 48-volt output of the 400-cycle supply prevents trip-