

## RINGING AND TONE POWER PLANT

### 853A (J87809)

### OPERATING METHODS

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#### 1. GENERAL

**1.01** The 853A (J87809A and J87809B) ringing and tone power plant provides 6 amperes of interrupted and continuous 20-Hz ringing current, continuous and interrupted precise call progress tones, and signaling interruptions, as required, by the No. 5 crossbar offices. Twenty-Hz ringing current (not audible) is generated by duplicate transistorized dc-to-ac inverters. TOUCH-TONE® dial tone, audible ringing tone, high tone, and busy tone are generated by duplicate transistorized tone generators, each consisting of four oscillators supplying 1-VA amplifiers in different combinations to provide the precise call progress signals. All generators, both regular and reserve, are continuously monitored for low voltage. All interrupted ringing outputs, as well as interrupted grounds, for both units are continuously monitored for failure of either

the ringing switches or the interrupter timing circuit. In the event of failure of any element in the regular side of the plant, the office load is automatically transferred to the reserve side of the plant. Minor alarms are provided if any element in either the regular or reserve units should fail. Major alarms are provided if both units should fail or if any fuse should fail. Solid state interrupters are driven by the two 20-Hz inverters to produce the various interruptions for interrupted ringing, tones, and signaling of 30, 60, and 120 ipm through load transfer relays.

**1.02** This issue does affect the Equipment Test List.

**1.03** The *J87809A, AC-DC Ringing and Tone Power Plant* (Fig. 1) is used for 2- and 4-party ac-dc ringing and 5-code type-D ringing and grounds, while the *J87809B, Superimposed Ringing and Tone Power Plant* (Fig. 2) is used for 2- and 4-party superimposed ringing, 5-code type-D ringing and grounds, and 8-party ground codes. The following items are furnished for these plants.

- (1) RINGING CURRENT—20-Hz AC-DC AUD, 6A, 84 to 88V ac with -48V dc, and 105V±, 102 to 110V ac for J87809A plants or 20-Hz SUP-AUD, 84 to 88V ac with -38V dc, SUP+AUD, 84 to 88V ac with +38V dc, 105V±, 102 to 110V ac, SUP-AUD (94 to 101V ac), and SUP+AUD (94 to 101V ac).
- (2) TOUCH-TONE DIAL TONE—Combined 350 and 440 Hz, 1VA, 1.80V rms.
- (3) AUDIBLE RINGING TONE—Combined 440 and 480 Hz, 1VA, 3.80V rms.
- (4) HIGH TONE—480 Hz, 1VA, 0.95V rms.
- (5) BUSY TONE—Combined 480 and 620 Hz, 1VA, 0.49V rms.

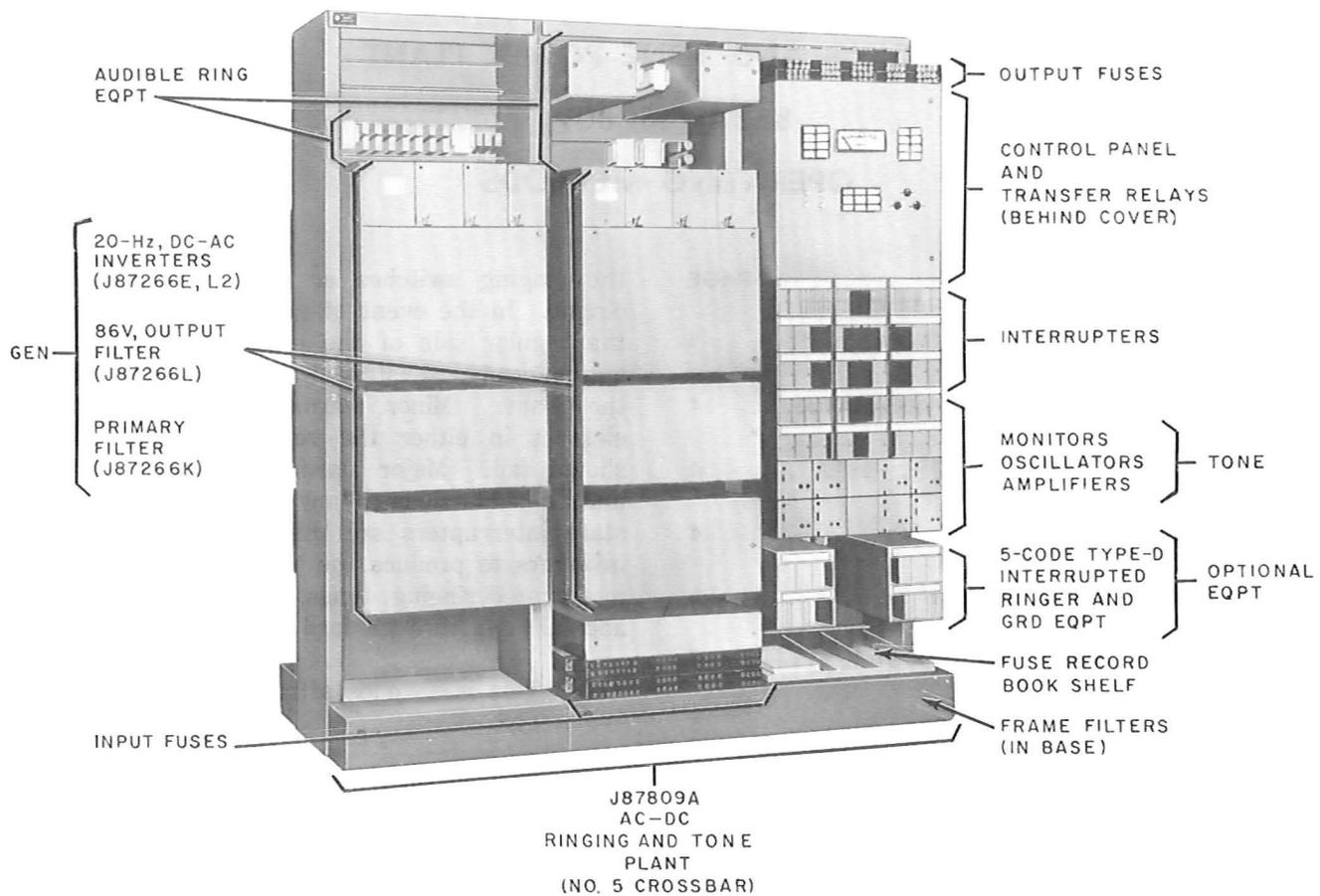


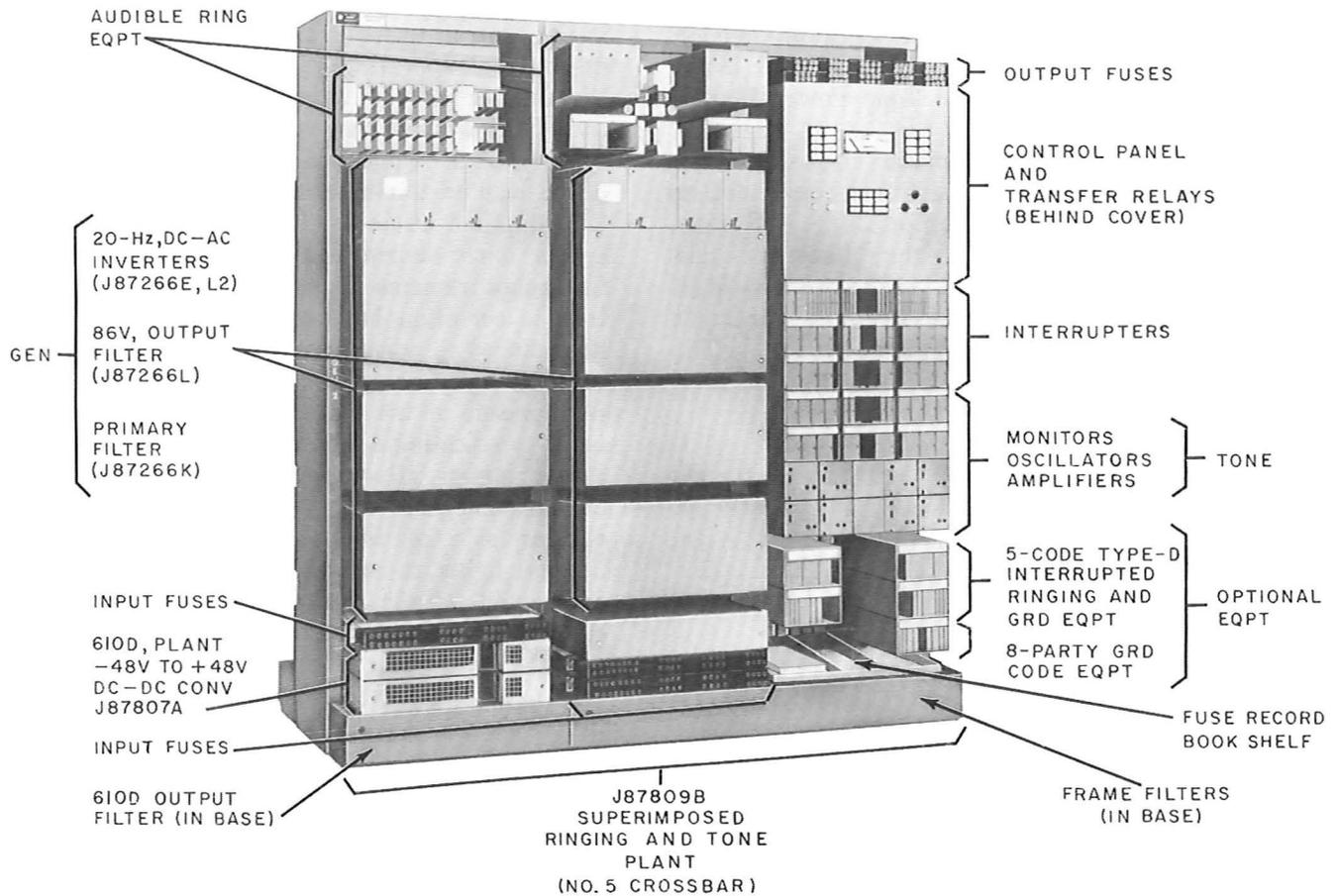
Fig. 1—J87809A AC-DC Ringing & Tone Plant (No. 5 Crossbar)

**Caution:** The plant includes automatically controlled equipment. Care must be exercised to prevent transfer to those parts of the plant on which work is to be done. Before starting work on a ringing generator, tone oscillator, or interrupter, remove the power to the side of the plant involved by following procedure outlined in 3.06.

1.04 During *normal* operation, all generators, both the regular side and the reserve side, are powered with the regular GEN 1 supplying the output load. In the event of a malfunction of any element in the regular side of the plant, the office load is automatically transferred to the reserve side of the plant. Manual transfer for maintenance purposes is also provided. Power-off switches for each side of the plant are furnished so that power can be removed from either side. An electrical interlock prevents removal of power

from both sides at the same time and guarantees that the load is connected to the unit that is powered. The plant is powered exclusively from -48 volt central office battery.

1.05 Both ac-dc and superimposed ringing are provided. The 5-code type-D interrupted ringing can be provided with either ac-dc or superimposed ringing, on an optional basis. The 8-party ground codes are provided in superimposed offices only. Each dc-to-ac inverter provides two 86-volt outputs, two 97-volt outputs (for dial long lines), and one  $105 \pm$  output (for miscellaneous uses, such as PBX feeders for manual switchboards). In superimposed offices, the low side of one 20-Hz, 86-volt (A) ac output on the inverter is connected to -48 volts dc, while the other 20-Hz, 86-volt (B) ac output is connected to +48 volts dc. Each 86-volt (A) and (B) output is connected to a network that superimposes audible ringing tone on the 20-Hz



**Fig. 2—J87809B Superimposed Ringing & Tone Plant (No. 5 Crossbar)**

ringing current. Then, the 20-Hz ringing current superimposed on either -48 volt or +48 volt is supplied from the high side on the inverter to the DB1-1, DB2-1 and DB1-2, DB2-2 diode board packages. These boards have a varistor string in series with the load that drops the dc components by 10 volts. During power failure when the battery is on discharge, control relays short-out some of the varistors to hold the dc component between 36 and 40 volts. In AC-DC plants, only the 86-volt (A) output and networks are required, and the diode board packages are not provided.

**1.06** In the J87809B superimposed ringing and tone power plant, the +48 volt dc tripping supply is obtained from the 610D dc-to-dc converter operating from -48 volts dc, and the -48 volt dc tripping supply is obtained from the power distributing frame of the regular battery supply. The +38 and -38 volt dc superimposed voltages are derived

from the +48 and -48 volt dc tripping voltages, by means of dc voltage dropping diodes in the 20-Hz outputs.

**1.07** Instructions are based on the following drawings. For detailed description of the operation of individual circuit, refer to the corresponding circuit description.

SD-81571-01	DC-to-DC Transistor Converter +48 Volt, 1.5 Ampere Output -48 Volt Input, 610D Plant
SD-81717-02	Inverter Circuit 20 Hz, DC-to-AC, 86V, 6A
SD-81885-01	Signaling Circuit—Circuit Pack Schematics

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SD-81886-01 Ringing Circuit—AC-DC or Superimposed Ringing—No. 5 Crossbar Offices—852A & 853A Ringing and Tone Power Plants.

**1.08** For more detailed information on the operation and maintenance of individual equipment or apparatus, refer to the appropriate Bell System Practices. All relays except the 316-type should be adjusted, when required, in accordance with the appropriate section and the circuit requirement tables of the schematic circuit drawings. The 316-type relay should be replaced in the event of a malfunction.

**1.09** The abbreviations cw and ccw refer to clockwise and counterclockwise, respectively.

### 2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
411B	Test Pick
723B	Tool
W1AF	Cord (8-1/2 feet long equipped with one 360A tool at each end) (2 reqd)
KS-6278	Connecting Clip (2 reqd)
—	Blocking Tools as required (Use and apply as outlined in Section 069-020-801.)
<b>TEST APPARATUS</b>	
—	Voltmeter, Hewlett-Packard Model 3400A RMS 300/100/10/3/1 — V, or equivalent such as Voltmeter, Greibach Model 500 RMS or Voltmeter, Weston Model 622 AC-DC Thermo
KS-14510	Volt-Ohm-Milliammeter
158A	Board Extender

### 3. OPERATION

#### Automatic Operation of Plant

**3.01** Under normal operating conditions with the regular side of the plant supplying the office load, and the regular 20-Hz inverter, tone generators,

and interrupter operating properly, the GT relay in the control, transfer and alarm circuit is shunted down from operating. If any of the outputs of the regular side of the plant fail for any reason, the shunt will be removed, allowing the GT relay to operate in about two seconds and transfer the office load to the reserve side of the plant. The GT lamp and other trouble indicating lamp(s) light and a minor alarm sounds. Once operated, the GT relay remains locked operated. When the trouble condition has been cleared, the plant can be restored to normal by depressing the GEN RST switch, transferring the office load back to the regular side of the plant. The GT lamp and other trouble indicating lamp(s) extinguish and the minor alarm retires. If some element in the reserve side of the plant fails without an earlier failure in the regular side of the plant, a trouble indicating lamp(s) lights to indicate which output has failed and sounds a minor alarm. When the trouble is cleared, the trouble indicating lamp(s) extinguishes and the minor alarm retires. If some element in the reserve side of the plant fails after an earlier failure in the regular side of the plant, the GF lamp and other trouble indicating lamp(s) lights and a major alarm sounds. When the trouble is cleared, the trouble indicating lamp(s) extinguishes and the major alarm retires.

#### Ringling Generators

**3.02** One of the 86-volt outputs of each 20-Hz dc-to-ac inverter is monitored with a low-voltage alarm. When the outputs of the inverters are normal, the LVA1 (GEN 1) and LVA2 (GEN 2) relays are operated. If the output of inverter GEN 1 fails, the LVA1 relay releases causing an automatic transfer of the office load to the reserve side of the plant. The GT and LVA1 lamps light and a minor alarm sounds. If the output of inverter GEN 2 fails without an earlier failure in the regular side of the plant, the LVA2 lamp lights and a minor alarm sounds. If the output of inverter GEN 2 fails after an earlier failure in the regular side of the plant, the GF and LVA2 lamps light and a major alarm sounds. The plant is restored to normal as described in 3.01.

#### Tone Generators and 1-VA Amplifiers

**3.03** The output signals of all of the tone amplifiers are checked by marginal low-voltage monitors. When the input signal of the low-voltage monitors drops by more than 3 dB, the LV relay releases.

Depending upon which LV relay releases, a ground is placed on the associated TT-1 or TT-2, HT-1 or HT-2, BT-1 or BT-2, or AR-1 or AR-2 lead to light the related trouble indicating lamp(s). If the regular tone generator is not operating properly, the office load will automatically transfer to the reserve side of the plant, the GT and tone trouble indicating lamps light, and a minor alarm sounds. If the reserve tone generator fails without an earlier failure in regular side of the plant, a tone trouble indicating lamp lights and a minor alarm sounds. If the reserve tone generator fails after an earlier failure in the regular side of the plant, the GF and other tone trouble indicating lamps light and a major alarm sounds. The plant is restored to normal as described in 3.01.

#### Solid State Interrupters

**3.04** Interrupter monitors are provided for each of the interrupted ringing and interrupted ground outputs. The IM- relays are normally held operated by contacts of *follow* relays. Both make and break contacts of each *follow* relay are used so that failure in either the operated or released position will result in the release of one or more of the IM- relays long enough to operate the INT-1 (MON 1) or INT-2 (MON 2) relay which locks through its own contacts to the INT-1 RST or INT-2 RST switch. The INT-1 relay operated causes an automatic transfer, lights the INT-1 and GT lamps, and sounds a minor alarm. The INT-2 relay operated lights the INT-2 lamp and sounds a minor alarm. At least one of the contacts of the *follow* relays in series with the IM- relay windings is closed at any instant. The contacts selected from different *follow* relays to operate the IM- relays are closed so that the loss of an output can be detected. By observing the released IM- relay(s) and the associated *follow* relays, it is possible to determine which output has failed. (See trouble charts B through F). The INT-1 or INT-2 relays can be released after the trouble has been cleared by depressing the INT-1 RST or the INT-2 RST switch, respectively. The INT-1 or INT-2 lamp will extinguish. To restore the office load from the reserve side of the plant to the regular side of the plant, depress the GEN RST switch. The GT lamp extinguishes and the minor alarm retires.

**Note:** To silence the audible alarm after an automatic transfer occurs, depress the GEN TRFR switch. The GEN TRFR lamp lights

in addition to the GT and trouble indication lamps.

#### Manual Operation of Plant

**3.05** Manual transfer of the office load to the reserve unit is accomplished by depressing the GEN TRFR switch. The GEN TRFR switch locks operated under control of the GEN RST switch, the lamp in the GEN TRFR switch lights, and the GT relay operates in the same manner as with an automatic transfer. The audible alarm is silent during manual transfer. To restore the plant to normal operation, depress the GEN RST switch. The GEN TRFR and GT lamps extinguish.

**3.06** Power can be removed from either side of the plant by depressing either the PWR OFF 1 or PWR OFF 2 switch. A red lamp in the switch, whichever is operated, will light. To restore the regular side of the plant to normal, depress the PWR OFF 1 switch again and depress the GEN RST switch to restore the office load to the regular unit. To restore the reserve side of the plant to normal, depress the PWR OFF 2 switch again.

**3.07** The VM voltmeter is normally connected to the AC-DC AUD or SUP-AUD of GEN 1. To check the voltage of GEN 2, depress the VM G2 switch. A lamp in the VM G2 switch lights to indicate that it is off-normal. Depress the VM G2 switch again to restore the VM voltmeter connection to GEN 1. The lamp in the VM G2 switch extinguishes.

#### 4. ROUTINE CHECKS AND ADJUSTMENTS

**4.01** The power failure packages (PF), the tone low-voltage monitors, and the amplifiers are the only packages that require adjustments. These units are factory adjusted and should rarely require readjustments when in service. On most of the circuit packages, the adjustments are internal to the packages; therefore, it is necessary to make use of the *158A board extender*. The *723B tool* is required for the removal of the circuit packages.

#### Tone Generators

##### 4.02 Oscillator Checks:

- (1) Connect the model 3400A voltmeter, using the 10-volt scale, between the TP1 (GRD)

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and TP2 (OUTPUT) pin jacks of each of the four oscillators (350, 440, 480, and 620) of GEN 2, one at a time and in turn.

**Requirement:** The voltmeter indicates between 4.0 and 4.6 volts rms on each of the four oscillators.

(2) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.

(3) Connect the model 3400A voltmeter, using the 10-volt scale, between the TP1 (GRD) and TP2 (OUTPUT) pin jacks of each of the four oscillators of GEN 1, one at a time and in turn.

**Requirement:** The voltmeter indicates between 4.0 and 4.6 volts rms on each of the four oscillators.

(4) Disconnect the model 3400A voltmeter.

(5) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

**4.03 1-VA Amplifier Adjustments:**

**Caution:** Before removing or replacing a circuit package on all of the subsequent adjustments, turn off the -48 volt battery to the side of the plant involved by depressing the PWR OFF 1 or PWR OFF 2 switch. Restore battery by depressing the switch again.

(a) Dial Tone—TT-2 (GEN 2)

(1) Remove the F45 fuse supplying -48 volts to the T6 transformer of GEN 2.

(2) Connect the model 3400A voltmeter, using the 3-volt scale, to terminals 5 and 8 of transformer T6, GEN 2.

(3) Remove the OSC, 440-2 oscillator and adjust the ADJ 1 potentiometer of amplifier TT-2.

**Requirement:** The voltmeter indicates 1.44 volts.

(4) Replace the OSC, 440-2 oscillator; remove the OSC, 350-2 oscillator; and adjust the ADJ 2 potentiometer of amplifier TT-2.

**Requirement:** The voltmeter indicates 1.10 volts.

(5) Replace the OSC, 350-2 oscillator.

**Requirement:** The voltmeter indicates 1.80 volts.

(6) Replace the F45 fuse.

(b) Dial Tone—TT-1 (GEN 1)

(1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.

(2) Remove the F5 fuse supplying -48 volts to the T3 transformer of GEN 1.

(3) Connect the model 3400A voltmeter, using the 3-volt scale, to terminals 5 and 8 of transformer T3, GEN 1.

(4) Remove the OSC, 440-1 oscillator and adjust the ADJ 1 potentiometer of amplifier TT-1.

**Requirement:** The voltmeter indicates 1.44 volts.

(5) Replace the OSC, 440-1 oscillator; remove the OSC, 350-1 oscillator; and adjust the ADJ 2 potentiometer of amplifier TT-1.

**Requirement:** The voltmeter indicates 1.10 volts.

(6) Replace the OSC, 350-1 oscillator.

**Requirement:** The voltmeter indicates 1.80 volts.

(7) Replace the F5 fuse.

(8) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

(c) Audible Ringing Tone—AR-2 (GEN 2)

(1) Connect the model 3400A voltmeter, using the 10-volt scale, to TP1 and TP2 jacks of the AR-2 amplifier, GEN 2.

(2) Remove the OSC, 480-2 oscillator and adjust the ADJ 1 potentiometer of amplifier AR-2.

**Requirement:** The voltmeter indicates 3.35 volts.

(3) Replace the OSC, 480-2 oscillator; remove the OSC, 440-2 oscillator; and adjust the ADJ 2 potentiometer of amplifier AR-2.

**Requirement:** The voltmeter indicates 3.0 volts.

(4) Replace the OSC, 440-2 oscillator.

**Requirement:** The voltmeter indicates 4.5 volts.

(d) Audible Ringing Tone—AR-1 (GEN 1)

(1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.

(2) Connect the model 3400A voltmeter, using the 10-volt scale, to TP1 and TP2 jacks of the AR-1 amplifier, GEN 1.

(3) Remove the OSC, 480-1 oscillator and adjust the ADJ 1 potentiometer of amplifier AR-1.

**Requirement:** The voltmeter indicates 3.35 volts.

(4) Replace the OSC, 480-1 oscillator; remove the OSC, 440-1 oscillator; and adjust the ADJ 2 potentiometer of amplifier AR-1.

**Requirement:** The voltmeter indicates 3.0 volts.

(5) Replace the OSC, 440-1 oscillator.

**Requirement:** The voltmeter indicates 4.5 volts.

(6) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

(e) High Tone—HT-2 (GEN 2)

(1) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 7 of transformer T7, GEN 2.

(2) Adjust the ADJ 1 potentiometer of amplifier HT-2.

**Requirement:** The voltmeter indicates 0.95 volt.

(f) High Tone—HT-1 (GEN 1)

(1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.

(2) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 7 of transformer T4, GEN 1.

(3) Adjust the ADJ 1 potentiometer of amplifier HT-1.

**Requirement:** The voltmeter indicates 0.95 volt.

(4) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

(g) Busy Tone—BT-2 (GEN 2)

(1) Remove the F46 fuse supplying -48 volts to the T8 transformer of GEN 2.

(2) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 6 of transformer T8, GEN 2.

(3) Remove the OSC, 620-2 oscillator and adjust the ADJ 1 potentiometer of amplifier BT-2.

**Requirement:** The voltmeter indicates 0.39 volt.

(4) Replace the OSC, 620-2 oscillator; remove the OSC, 480-2 oscillator; and adjust the ADJ 2 potentiometer of amplifier BT-2.

**Requirement:** The voltmeter indicates 0.29 volt.

(5) Replace the OSC, 480-2 oscillator.

**Requirement:** The voltmeter indicates 0.49 volt.

(6) Replace the F46 fuse.

(h) Busy Tone—BT-1 (GEN 1)

(1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.

(2) Remove the F6 fuse supplying -48 volts to the T5 transformer of GEN 1.

(3) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 6 of transformer T5, GEN 1.

(4) Remove the OSC, 620-1 oscillator and adjust the ADJ 1 potentiometer of amplifier BT-1.

**Requirement:** The voltmeter indicates 0.39 volt.

(5) Replace the OSC, 620-1 oscillator; remove the OSC, 480-1 oscillator; and adjust the ADJ 2 potentiometer of amplifier BT-1.

**Requirement:** The voltmeter indicates 0.29 volt.

(6) Replace the OSC, 480-2 oscillator.

**Requirement:** The voltmeter indicates 0.49 volt.

(7) Replace the F6 fuse.

(8) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

#### 4.04 10-VA Amplifier Adjustments:

(a) Audible Ringing Tone—AR2-2 (GEN 2)

(1) Remove the F61 and F85 fuses supplying -48 volts to the T10 transformer of GEN 2.

(2) Connect the model 3400A voltmeter, using the 10-volt scale, to terminals 7 and 8 of transformer T10, GEN 2.

(3) Adjust the INPUT ADJ potentiometer of amplifier AR2-2.

**Requirement:** The voltmeter indicates 3.8 volts.

(4) Replace the F61 and F85 fuses.

(b) Audible Ringing Tone—AR2-1 (GEN 1)

(1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.

(2) Remove the F21 and F77 fuses supplying -48 volts to the T9 transformer of GEN 1.

(3) Connect the model 3400A voltmeter, using the 10-volt scale, to terminals 7 and 8 of transformer T9, GEN 1.

(4) Adjust the INPUT ADJ potentiometer of amplifier AR2-1.

**Requirement:** The voltmeter indicates 3.8 volts.

(5) Replace the F21 and F77 fuses.

(6) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

#### 4.05 Low-Voltage Monitor Adjustments:

(a) Dial Tone—TT-2 (MON 2)

(1) Rotate the R1 potentiometer of monitor LVTT-2 fully ccw.

(2) Remove the OSC, 440-2 oscillator.

**Requirement:** The TTLV-2 lamp lights.

- (3) Slowly rotate the R1 potentiometer cw until the TTLV-2 lamp extinguishes.
- (4) Slowly rotate the R1 potentiometer ccw until the TTLV-2 lamp lights.
- (5) Replace the OSC, 440-2 oscillator. The TTLV-2 lamp extinguishes.

(b) Dial Tone—TT-1 (MON 1)

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.
- (2) Rotate the R1 potentiometer of monitor LVTT-1 fully ccw.
- (3) Remove the OSC, 440-1 oscillator.

**Requirement:** The TTLV-1 lamp lights.

- (4) Slowly rotate the R1 potentiometer cw until the TTLV-1 lamp extinguishes.
- (5) Slowly rotate the R1 potentiometer ccw until the TTLV-1 lamp lights.
- (6) Replace the OSC, 440-1 oscillator. The TTLV-1 lamp extinguishes.
- (7) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

(c) Audible Ringing Tone—AR-2 (MON 2)

- (1) Rotate the R1 potentiometer of monitor LVAR-2 fully ccw.
- (2) Remove the OSC, 480-2 oscillator.

**Requirement:** The ARLV-2 lamp lights.

- (3) Slowly rotate the R1 potentiometer cw until the ARLV-2 lamp extinguishes.
- (4) Slowly rotate the R1 potentiometer ccw until the ARLV-2 lamp lights.
- (5) Replace the OSC, 480-2 oscillator. The ARLV-2 lamp extinguishes.

(d) Audible Ringing Tone—AR-1 (MON 1)

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.
- (2) Rotate the R1 potentiometer of monitor LVAR-1 fully ccw.
- (3) Remove the OSC, 480-1 oscillator.

**Requirement:** The ARLV-1 lamp lights.

- (4) Slowly rotate the R1 potentiometer cw until the ARLV-1 lamp extinguishes.
- (5) Slowly rotate the R1 potentiometer ccw until the ARLV-1 lamp lights.
- (6) Replace the OSC, 480-1 oscillator. The ARLV-1 lamp extinguishes.
- (7) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

(e) Busy Tone—BT-2 (MON 2)

- (1) Rotate the R1 potentiometer of monitor LVBT-2 fully ccw.
- (2) Remove the OSC, 620-2 oscillator.

**Requirement:** The BTLV-2 lamp lights.

- (3) Slowly rotate the R1 potentiometer cw until the BTLV-2 lamp extinguishes.
- (4) Slowly rotate the R1 potentiometer ccw until the BTLV-2 lamp lights.
- (5) Replace the OSC, 620-2 oscillator. The BTLV-2 lamp extinguishes.

(f) Busy Tone—BT-1 (MON 1)

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.
- (2) Rotate the R1 potentiometer of monitor LVBT-1 fully ccw.
- (3) Remove the OSC, 620-1 oscillator.

**Requirement:** The BTLV-1 lamp lights.

- (4) Slowly rotate the R1 potentiometer cw until the BTLV-1 lamp extinguishes.
  - (5) Slowly rotate the R1 potentiometer ccw until the BTLV-1 lamp lights.
  - (6) Replace the OSC, 620-1 oscillator. The BTLV-1 lamp extinguishes.
  - (7) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.
- (g) High Tone—HT-2 (GEN 2)

- (1) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 7 of transformer T7, GEN 2.
- (2) Slowly rotate the ADJ 1 potentiometer of amplifier HT-2, as required.

**Requirement:** The voltmeter indicates 0.67 volt.

- (3) Rotate the R1 potentiometer of monitor HTLV-2 fully ccw.

**Requirement:** The HTLV-2 lamp lights.

- (4) Slowly rotate the R1 potentiometer cw until the HTLV-2 lamp extinguishes.
- (5) Slowly rotate the R1 potentiometer ccw until the HTLV-2 lamp just lights.
- (6) Slowly rotate the ADJ 1 potentiometer of amplifier HT-2, as required.

**Requirement:** The voltmeter indicates 0.95 volt and the HTLV-2 lamp extinguishes.

- (h) High Tone—HT-1 (GEN 1)

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.
- (2) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 7 of transformer T4, GEN 1.

- (3) Slowly rotate the ADJ 1 potentiometer of amplifier HT-1, as required.

**Requirement:** The voltmeter indicates 0.67 volt.

- (4) Rotate the R1 potentiometer of monitor HTLV-1 fully ccw.

**Requirement:** The HTLV-1 lamp lights.

- (5) Slowly rotate the R1 potentiometer cw until the HTLV-1 lamp extinguishes.
- (6) Slowly rotate the R1 potentiometer ccw until the HTLV-1 lamp just lights.
- (7) Slowly rotate the ADJ 1 potentiometer of amplifier HT-1, as required.

**Requirement:** The voltmeter indicates 0.95 volt and the HTLV-1 lamp extinguishes.

- (8) Disconnect the model 3400A voltmeter.
- (9) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

#### Ringling Generator Monitor

#### 4.06 PF1 and PF2 Monitor Adjustments (Superimposed Offices Only):

- (a) Generator 2

- (1) Using the 60-volt dc scale of the KS-14510 volt-ohm-milliammeter, connect the negative lead to the TP1 jack of the PF2 circuit pack and the positive lead to ground.
- (2) Operate and hold the S1 switch and rotate the PF TST (R1) potentiometer, as required.

**Requirement:** The volt-ohm-milliammeter indicates -47 volts dc.

- (3) Rotate the PF ADJ (R4) potentiometer cw until the PF2 relay releases; then slowly rotate the PF ADJ (R4) potentiometer ccw until the PF2 relay operates.
- (4) Release the S1 switch.

**Requirement:** The PF2 relay releases.

(b) Generator 1

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.
- (2) Using the 60-volt dc scale of the KS-14510 volt-ohm-milliammeter, connect the negative lead to the TP1 jack of the PF1 circuit pack and the positive lead to ground.
- (3) Operate and hold the S1 switch and rotate the PF TST (R1) potentiometer, as required.

**Requirement:** The volt-ohm-milliammeter indicates -47 volts dc.

- (4) Rotate the PF ADJ (R4) potentiometer cw until the PF1 relay releases; then slowly rotate the PF ADJ (R4) potentiometer ccw until the PF1 relay operates.
- (5) Release the S1 switch.

**Requirement:** The PF1 relay releases.

- (6) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.

**Distribution Fuse Alarm Checks**

**Caution:** *The W1AF cord is equipped with an internal resistance of 188 ohms and must not be substituted by any other similar cord as serious equipment damage may result.*

**4.07 Battery Distribution Circuit Alarm Check:**

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN 2. The GT and GEN TRFR lamps light.
- (2) Using a W1AF cord with a KS-6278 connecting clip attached to one end and a 411B test pick attached to the other end, attach the connecting clip to the distribution bus bar for generator 1, as shown on the following table, and insert the test pick through the aperture in the front of any **one** of the fuses in the associated group. The alarm relay shown on the table

operates; the FA lamp lights; and the audible major alarm sounds.

- (3) Repeat similar checks on each subsequent step (2 through 4) for generator 1, as shown on the following table.
- (4) Depress the GEN RST switch. The office load will transfer back to GEN 1. The GT and GEN TRFR lamps extinguish.
- (5) Attach the connecting clip of the W1AF cord to the distribution bus bar of Step 5 for generator 2, as shown on the following table, and insert the test pick through the aperture in the front of any one of the fuses in the associated group. The alarm relay shown on the table operates; the FA lamp lights; and the audible major alarm sounds.
- (6) Repeat similar checks on each subsequent step (6 through 8) for generator 2, as shown on the following table.

	STEP	DISTRIBUTION BUS BAR	FUSE TO BE CHECKED	ALARM RELAY
GENERATOR 1	1	-48V	F1 through 8, F10 through 15, F17 through 20, or F22	FA1
	2		F25, 26, 29, or 30	
	3		F33 through 36	
	4	+48V	F73 through 76, F78 through 80	
GENERATOR 2	5	-48V	F41 through 48, F50 through 55, F57 through 60, or F62	FA1
	6		F27, 28, 31, or 32	
	7		F65 through 68	
	8	+48V	F81 through 84, F86 through 88	

**4.08 Power Ringing and Tone Distribution Circuit Alarm Check:**

- (1) Using a W1AF cord with a KS-6278 connecting clip attached to one end and a 411B test pick attached to the other end, attach the connecting clip to the distribution bus bar of

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Step 1 as shown on the following table, and then insert the test pick through the aperture in the front of any **one** of the fuses in the associated group. The alarm relay shown on the table operates; the FA lamp lights; and the audible major alarm sounds.

(2) Repeat similar checks on each subsequent step (2 through 19), as shown on the following table.

STEP	DISTRIBUTION BUS BAR	FUSE TO BE CHECKED	ALARM RELAY
1	105±	F89, 90, 93, or 94	FA1, FA2
2	AC-DC AUD (Z) SUP – AUD (Y)	F91, 92, 95, or 96	FA2, FA3
3	CODE 1 GEN BR1	F97, 98, 101, or 102	
4	CODE 1 GEN BR2	F99, 100, 103, or 104	
5	CODE 1 GEN BR3	F105, 106, 109, or 110	
6	CODE 2 GEN	F107, 108, 111, or 112	
7	AC-DC AUD (Y)	F113, 114, 117, or 118	
8	CODE 3 GEN	F115, 116, 119, or 120	
9	CODE 4 GEN	F121, 122, 125, or 126	
10	CODE 5 GEN	F123, 124, 127, or 128	
11	CODE 1 + (Y)	F129, 130, 133, or 134	
12	CODE 2 + (Y)	F131, 132, 135, or 136	
13	SUP+AUD (Y)	F137, 138, 141, or 142	
14	+TRP	F139, 140, 143, or 144	
15	TT-1	F145 through 152	FA1, FA4
16	HT-1	F153, 154, 157, or 158	FA1, FA5
17	BT-1	F155, 156, 159, or 160	
18	SUP – AUD, 94-101V (Y)	F161, 162, 165, or 166	FA1, FA3
19	SUP + AUD, 94-101V (Y)	F163, 164, 167, or 168	

Y — SUPERIMPOSED RINGING

Z — AC-DC RINGING

**5. TROUBLE**

**5.01** Trouble in the plant is normally detected by visual trouble indicator lamps mounted in the control panel, and by audible minor or major alarms. If any element in the regular side of the plant fails, the office load will automatically transfer to the reserve side of the plant. The GT and other trouble indicating lamp(s) will light and a minor alarm will sound. The attached trouble charts are provided to assist maintenance personnel

in the analysis of the trouble indicator lamps of any affected unit in the ringing and tone generators and the solid state interrupters. Trouble Chart A identifies each trouble indicator lamp associated with the ringing and tone generators and includes a suggested remedy to localize the source of trouble. Trouble Charts B through F identify failures of the interrupted ringing or interrupted ground outputs of the solid state interrupters. Any failure of the interrupters will light either the INT-1 lamp for the regular unit or the INT-2 lamp for the reserve

unit. The interrupter monitor (IM- ) relays are normally operated. Under a trouble condition, these relays may release permanently or may alternately release and operate. Before attempting to localize the source of trouble, depress the PWR OFF 1 or PWR OFF 2 switch to remove the power from the side of the plant affected; then depress it again to restore power. Depress the INT-1 RST or INT-2 RST switch. If this does not clear the trouble condition, refer to the appropriate B through E Trouble Charts to localize the trouble. To illustrate an example, each of the machine ringing outputs, C1G BR1, C1G BR2, and C1G BR3, from the ringing switches is supplied to half-wave rectifiers to drive the *follow* relays, BR1-, BR2-, and BR3-. Both make and break contacts of each *follow* relay are used so that a failure in either the operated or released state will result in the release of an IM- relay. By observing the *follow* relays, it is possible to determine which output has failed. If using Table B, for instance, an assumption determines that the IM1-1 and BR1-1 relays have released indicating a failure of the C1G BR1 output lead. It will be required to check or replace the suspected faulty equipment. In this case, the RR1-1 CP

A757 circuit pack should be replaced, followed by the RS1-1 CP A756 circuit pack. If the replacement of these two equipments does not clear the trouble, then replace, one at a time in turn, the circuit packs associated with the output lead C1G BR1 shown on trouble Chart F.

## 6. TROUBLE CHARTS

- A. Ringing and Tone Generators
- B. Interrupter Monitors for 2- and 4-Party—AC-DC Ringing
- C. Interrupter Monitors for 2- and 4-Party—Superimposed Ringing
- D. Interrupter Monitors for 5-Code Type-D—AC-DC and Superimposed Ringing
- E. Interrupter Monitors for 8-Party Ground Codes—Superimposed Ringing
- F. Interrupter Output Leads Designations

**TROUBLE CHART A**  
**RINGING AND TONE GENERATORS**

LAMP	INDICATION
GT	Trouble condition in the <i>regular</i> 20-Hz inverter, tone generator, or interrupter. Indicates that all transfer relays operated to transfer the office load from the regular to the reserve side of the plant. A minor audible alarm sounds.
FA	Operated fuse(s) in either the battery distribution circuit for both the regular and reserve units or the distribution circuit to the power ringing and tone distributing frame. Some of the operated fuses in the battery distribution circuit of the regular unit automatically transfer the office load to the reserve unit. A major alarm sounds for all operated fuses.
GF	Indicates that some element in the reserve unit has failed after an earlier failure in the regular unit. A major audible alarm sounds.
HTLV-1 (HTLV-2)	The LV relay in the LVHT-1 (LVHT-2) monitor has released. The single 480-Hz frequency from the HT-1 (HT-2) amplifier dropped below 3 dB from normal output. Indicates a possible defective HT-1 (HT-2) amplifier or 480-1 (480-2) oscillator. (See 3.03.)
TT3 LV1 (TT3 LV2)	The LV relay in the LVTT-1 (LVTT-2) monitor has released. The combined 350- and 440-Hz frequencies from the TT-1 (TT-2) amplifier dropped below 3 dB from normal output. Indicates a possible defective TT-1 (TT-2) amplifier, 350-1 (350-2) oscillator, or 440-1 (440-2) oscillator. (See 3.03.)
BTLV-1 (BTLV-2)	The LV relay in the LVBT-1 (LVBT-2) monitor has released. The combined 480- and 620-Hz frequencies from the BT-1 (BT-2) amplifier dropped below 3 dB from normal output. Indicates a possible defective BT-1 (BT-2) amplifier, 480-1 (480-2) oscillator, or 620-1 (620-2) oscillator. (See 3.03.)
ARLV-1 (ARLV-2)	The LV relay in the LVAR-1 (LVAR-2) monitor has released. The combined 440- and 480-Hz frequencies from the AR-1 (AR-2) amplifier dropped below 3 dB from normal output. Indicates a possible defective AR-1 (AR-2) amplifier, 440-1 (440-2) oscillator, or 480-1 (480-2) oscillator. (See 3.03.)
LVA 1 (LVA 2)	Low/or no 86-volt (A) ac output from inverter GEN 1 or 86-volt (B) ac output from inverter GEN 2. (See 3.02.)
VM G2	Indicates that the VM G2 switch is operated off-normal. Depress the VM G2 switch to restore the voltmeter connection from GEN 2 to GEN 1. (See 3.07.)
PWR OFF 1 (PWR OFF 2)	Indicates that the PWR OFF 1 (PWR OFF 2) switch is manually operated off-normal and power is removed from the associated side of the plant. Depress the PWR OFF 1 (PWR OFF 2) switch to restore the power. If PWR OFF 1 lamp was lighted, depress the GEN RST switch to restore the office load to the regular unit. (See 3.06.)
GEN TRFR	Indicates a manual transfer of the office load from the regular to the reserve unit. (See 3.05.)

## TROUBLE CHART B

## INTERRUPTER MONITORS FOR 2- AND 4-PARTY AC-DC RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES	
INT-1	IM1-1	BR1-1	RR1-1	CP A757	3-14-34	C1G BR1 C1G BR2 C1G BR3	F33	
		BR2-1	RS1-1	CP A756	3-18-9		F34	
		BR3-1	RS2-1	CP A756	3-18-19		F35	
	IM2-1	C2 GEN-1 C2G-1 RR2-1	RS3-1	RR2-1	CP A757	3-14-38	C2 GEN C2 GRD RR	F36
				RS4-1	CP A756	3-16-19		
				C2 GRD-1 RR1-1	316M Rly 316M Rly			
	IM3-1	C2G-1 C2 GEN-1 RR2-1	RR2-1	RR2-1	CP A757	3-14-38	C2 GRD C2 GEN RR	F36
				C2 GRD-1	316M Rly	3-16-19		
				RS4-1 RR1-1	CP A756 316M Rly			
IM4-1	C2 GEN-1 60-1 C2G-1	RR2-1	RR2-1	CP A757	3-14-38	C2 GEN 60 IPM C2 GRD	F36	
			RS4-1	CP A756	3-16-19			
			60 BR3-1 C2 GRD-1 RR1-1	276B Rly 316M Rly CP A757	3-14-34			
IM5-1	RR2-1 PK2-1 120-1 60-1 BR3-1	RR1-1	RR1-1	316M Rly	3-16-9	RR PKU 120 IPM 60 IPM C1G BR3	F35	
			PK-1	316M Rly				
			120 BR3-1 60 BR3-1 RS3-1	276B Rly 276B Rly CP A756				
IM8-1	BR3-1 PK2-1	RR-1	RR-1	CP A757	3-14-34	C1G BR3 PKU	F35	
			RS3-1 PK1-1	CP A756 316M Rly	3-16-9			
IM9-1	30B-1 60-1 120-1	30A-1 60 BR3-1 120 BR3-1	276B Rly 276B Rly 276B Rly			30 IPM 60 IPM 120 IPM		
INT-2	IM1-2	BR1-2	RR1-2	CP A757	3-14-62	C1G BR1 C1G BR2 C1G BR3	F65	
		BR2-2	RS1-2	CP A756	3-18-93		F66	
		BR3-2	RS2-2	CP A756	3-18-83		F67	
	IM2-2	C2 GEN-2 C2G-2 RR2-2	RS3-2	RR2-2	CP A757	3-14-58	C2 GEN C2 GRD RR	F68
				RS4-2	CP A756	3-16-83		
				C2 GRD-2 RR1-2	316M Rly 316M Rly			
IM3-2	C2G-2 C2 GEN-2 RR2-2	RR2-2	RR2-2	CP A757	3-14-58	C2 GRD C2 GEN RR	F68	
			C2 GRD-2	316M Rly	3-16-83			
			RS4-2 RR1-2	CP A756 316M Rly				

## TROUBLE CHART B (Cont)

## INTERRUPTER MONITORS FOR 2- AND 4-PARTY AC-DC RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT-2	IM4-2	C2 GEN-2 60-2 C2G-2	RR2-2	CP A757	3-14-58	C2 GEN 60 IPM C2 GRD	F68
			RS4-2	CP A756	3-16-83		
	IM5-2	RR2-2 PK2-2 120-2 60-2 BR3-2	RR1-2	316M Rly	3-14-62	RR PKU 120 IPM 60 IPM C1G BR3	F67
			PK1-2	316M Rly			
IM8-2	BR3-2 PK2-2	RR-2	CP A757	3-14-62	C1G BR3 PKU	F67	
		RS3-2	CP A756	3-16-93			
IM9-2	30B-2 60-2 120-2	30A-2 60 BR3-2 120 BR3-2	276B Rly 276B Rly 276B Rly		30 IPM 60 IPM 120 IPM		

## TROUBLE CHART C

## INTERRUPTER MONITORS FOR 2- AND 4-PARTY SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT-1	IM1-1	BR1-1 BR2-1 BR3-1	RR1-1	CP A757	3-14-34	C1G BR1 C1G BR2 C1G BR3	F33
			RS1-1	CP A756	3-18-9		F34
			RS2-1	CP A756	3-18-19		F35
IM2-1	C2 GEN-1 C2G-1 RR2-1	RR2-1 RS4-1 C2 GRD-1 RR1-1	RR2-1	CP A757	3-14-38	C2 GEN C2 GRD RR	F36
			RS4-1	CP A756	3-16-19		
			316M Rly	316M Rly			
IM3-1	RR2-1 C2 GEN-1 C2G-1	RR2-1 RR1-1 RS4-1 C2 GRD-1	RR2-1	CP A757	3-14-38	RR C2 GEN C2 GRD	F36
			RR1-1	316M Rly	3-16-19		
			RS4-1	CP A756			
		C2 GRD-1	316M Rly				

## TROUBLE CHART C (Cont)

## INTERRUPTER MONITORS FOR 2- AND 4-PARTY SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES		
INT-1	IM4-1	C1+-1 C2G-1	RR2-1	CP A757	3-14-30	C1+	F76		
			RS5-1	CP A756	3-18-29			C2 GRD	
	IM5-1	C2G-1 C2+-1 60-1	RR2-1	CP A757	3-14-38	C2 GRD	F78		
			C2 GRD-1	316M Rly	3-16-29			C2+	
	IM6-1	C1+-1 PK2-1	RS6-1	CP A756	3-14-38	C1+	F76		
			60 BR3-1	276B Rly	3-18-29			PKU	
	IM7-1	BR3-1 60-1 RR2-1 120-1 PK2-1	RR1-1	CP A757	3-14-34	C1G BR3	F35		
			RS3-1	CP A756	3-16-9			60 IPM	
	IM8-1	RR2-1 C2G-1 C2+-1	RR1-1	316M Rly	3-14-38	RR	F78		
C2 GRD-1			316M Rly	3-16-29				C2 GRD	
IM9-1	30B-1 60-1 120-1	RS6-1	CP A756	3-14-38	C2+	F78			
		30A-1	276B Rly				30 IPM		
INT-2	IM1-2	BR1-2 BR2-2 BR3-2	RR1-2	CP A757	3-14-62	C1G BR1	F65		
			RS1-2	CP A756	3-18-93			C1G BR2	
			RS2-2	CP A756	3-18-83			C1G BR3	
	IM2-2	C2 GEN-2 C2G-2 RR2-2	RS3-2	CP A756	3-16-93	C2 GEN	F68		
			RR2-2	CP A757	3-14-58			C2 GRD	
			RS4-2	CP A756	3-16-83			RR	
	IM3-2	RR2-2 C2 GEN-2 C2G-2	RR1-2	316M Rly	3-14-58	RR	F67		
			RR2-2	CP A757				3-16-83	C2 GEN
			RS4-2	CP A756				316M Rly	C2 GRD
	IM4-2	C1+-2 C2G-2	C2 GRD-2	316M Rly	3-14-58	C1+	F84		
			RR2-2	CP A757				3-18-73	C2 GRD
			RS5-2	CP A756					
C2 GRD-2			316M Rly						

## TROUBLE CHART C (Cont)

## INTERRUPTER MONITORS FOR 2- AND 4-PARTY SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT-2	IM5-2	C2G-2 C2+-2 60-2	RR2-2	CP A757	3-14-58	C2 GRD C2+ 60 IPM	F86
			C2 GRD-2	316M Rly	3-16-73		
	IM6-2	C1+-2 PK2-2	RR2-2	CP A757	3-14-58	C1+ PKU	F84
			RS5-2 PK1-2	CP A756 316M Rly	3-18-73		
	IM7-2	BR3-2 60-2 RR2-2 120-2 PK2-2	RR1-2	CP A757	3-14-62	C1G BR3 60 IPM RR 120 IPM	F67
RS3-2 60 BR3-2 RR1-2 120 BR3-2 PK1-2			CP A756 276B Rly 316M Rly 276B Rly 316M Rly	3-16-93			
IM8-2	RR2-2 C2G-2 C2+-2	RR2-2 RR1-2 C2 GRD-2 RS6-2	CP A757 316M Rly 316M Rly CP A756	3-14-58 3-16-73	RR C2 GRD C2+	F86	
IM9-2	30B-2 60-2 120-2	30A-2 60 BR3-2 120 BR3-2	276B Rly 276B Rly 276B Rly		30 IPM 60 IPM 120 IPM		

## TROUBLE CHART D

INTERRUPTER MONITORS FOR 5-CODE TYPE-D  
AC-DC AND SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT-1	IM10-1	C4G-1 C5G-1	RR3-1	CP A757	3-03-16	C4G C5G	F19
			RS8-1 RS9-1	CP A756 CP A756	3-05-19 3-05-29		F20
	IM11-1	C4G-1 C3G-1	RR3-1	CP A757	3-03-16	C4G C3G	F19
			RS8-1 RS7-1	CP A756 CP A756	3-05-19 3-05-9		F18
	IM12-1	BR1-1 C3G-1 C5G-1	RR1-1	CP A757	3-14-34	C1G BR1 C3G C5G	F33
RR3-1			CP A757	3-03-16	F18		
RS1-1			CP A756	3-18-9			
RS7-1			CP A756	3-05-9			
RS9-1			CP A756	3-05-29			

## TROUBLE CHART D (Cont)

INTERRUPTER MONITORS FOR 5-CODE TYPE-D  
AC-DC AND SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT-2	IM10-2	C4G-2 C5G-2	RR3-2	CP A757	3-03-80	C4G C5G	F59 F60
			RS8-2	CP A756	3-05-83		
			RS9-2	CP A756	3-05-73		
	IM11-2	C4G-2 C3G-2	RR3-2	CP A757	3-03-80	C4G C3G	F59 F58
			RS8-2	CP A756	3-05-83		
			RS7-2	CP A756	3-05-93		
	IM12-2	BR1-2 C3G-2 C5G-2	RR1-2	CP A757	3-14-62	C1G BR1 C3G C5G	F65 F58 F60
			RR3-2	CP A757	3-03-80		
			RS1-2	CP A756	3-18-93		
			RS7-2	CP A756	3-05-93		
			RS9-2	CP A756	3-05-73		

## TROUBLE CHART E

INTERRUPTER MONITORS FOR 8-PARTY GROUND CODES  
SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES	
INT-1	IM13-1	CBG-1 CCG-1 BR1-1	RR1-1	CP A757	3-14-34	CB GRD CC GRD C1G BR1	F14 F14 F33	
			CB-1	316M Rly	3-18-9			
			CC-1	316M Rly				
	IM14-1	CBG-1 CCG-1 BR1-1	RR1-1	CP A757	3-14-34	CB GRD CC GRD C1G BR1	F14 F14 F33	
			CB-1	316M Rly	3-18-9			
			CC-1	316M Rly				
	IM15-1	CAG-1 CBG-1	CA-1	316M Rly	3-14-34	CA GRD CB GRD	F14 F14	
			CB-1	316M Rly				
	IM16-1	CAG-1 BR1-1	RR1-1	CP A757	3-14-34	CA GRD C1G BR1	F14 F33	
			CA-1	316M Rly	3-18-9			
			RS1-1	CP A756				
	INT-2	IM13-2	CBG-2 CCG-2 BR1-2	RR1-2	CP A757	3-14-62	CB GRD CC GRD C1G BR1	F54 F54 F65
				CB-2	316M Rly	3-18-93		
				CC-2	316M Rly			
				RS1-2	CP A756			

## TROUBLE CHART E (Cont)

INTERRUPTER MONITORS FOR 8-PARTY GROUND CODES  
SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT-2	IM14-2	CBG-2	RR1-2	CP A757	3-14-62	CB GRD CC GRD C1G BR1	F54 F54 F65
		CCG-2	CB-2	316M Rly	3-18-93		
		BR1-2	CC-2	316M Rly			
	IM15-2	CAG-2	CA-2	316M Rly	3-14-62	CA GRD CB GRD	
		CBG-2	CB-2	316M Rly			
	IM16-2	CAG-2	RR1-2	CP A757	3-14-62	CA GRD C1G BR1	F54 F65
BR1-2			CA-2	316M Rly	3-18-93		
		RS1-2	CP A756				

**TROUBLE CHART F**  
**INTERRUPTER OUTPUT LEADS DESIGNATIONS**

INTERRUPTER OUTPUT LEADS DESIGNATION	EQUIPMENT TO BE CHECKED OR REPLACED	EQUIPMENT LOCATION INTERRUPTER 1	EQUIPMENT LOCATION INTERRUPTER 2
120 IPM	CP A5	3-20-15	3-20-79
	CP A340	3-20-21	3-20-73
	CP A341	3-20-29	3-20-65
60 IPM	CP A5	3-20-15	3-20-79
	CP A340	3-20-23	3-20-71
	CP A341	3-20-31	3-20-63
30 IPM	CP A4	3-20-17	3-20-77
	CP A340	3-20-23	3-20-71
	CP A341	3-20-31	3-20-63
C1G BR1	CP A5	3-20-15	3-20-79
	CP A4	3-20-17	3-20-77
	CP A340	3-20-23	3-20-71
	CP A341	3-20-31	3-20-63
C1G BR2	CP A5	3-20-15	3-20-79
	CP A340	3-20-23	3-20-71
	CP A341	3-20-31	3-20-63
C1G BR3	CP A5	3-20-15	3-20-79
	CP A340	3-20-23	3-20-71
	CP A341	3-20-31	3-20-63
RR	CP A4	3-20-19	3-20-75
	CP A340	3-20-23	3-20-71
		3-20-27	3-20-67
	CP A341	3-20-31	3-20-63
CODE 2 GEN		3-20-34	3-20-60
	CP A4	3-20-17	3-20-77
	CP A340	3-20-23	3-20-71
		3-20-25	3-20-69
	CP A341	3-20-31	3-20-63
PKU		3-20-32	3-20-62
	CP A4	3-20-17	3-20-77
	CP A340	3-20-23	3-20-71
		3-20-25	3-20-69
	CP A341	3-20-31	3-20-63
	3-20-32	3-20-62	

**TROUBLE CHART F (Cont)**  
**INTERRUPTER OUTPUT LEADS DESIGNATIONS**

INTERRUPTER OUTPUT LEADS DESIGNATION	EQUIPMENT TO BE CHECKED OR REPLACED	EQUIPMENT LOCATION INTERRUPTER 1	EQUIPMENT LOCATION INTERRUPTER 2
C2 GRD	CP A4	3-20-19	3-20-75
	CP A340	3-20-25	3-20-69
		3-20-27	3-20-67
	CP A341	3-20-32	3-20-62
		3-20-34	3-20-60
CODE 3 GEN	CP A4	3-03-1	3-03-93
CODE 4 GEN	CP A4	3-03-1	3-03-93
CODE 5 GEN	CP A4	3-03-3	3-03-91
CODE A GRD	CP A4	3-01-63	3-01-93
	CP A753	3-01-65	3-01-91
CODE B GRD	CP A4	3-01-63	3-01-93
CODE C GRD	CP A4	3-01-63	3-01-93