

806H (J86815)
RINGING AND TONE POWER PLANT
OPERATING METHODS

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1. GENERAL

1.01 The 806H (J86815A and J86815B) Ringing and Tone Power Plant provides interrupted and continuous ringing current, tones, and signaling interruptions for the No. 1 Electronic Switching System. The 20-Hz ringing current (not audible) is generated by duplicate 110A frequency generators which furnish various regulated outputs through transfer relays to load distribution fuses. Some of the tones consist of two frequencies which are generated by transistor oscillators mixed together

and amplified by power transistor amplifiers. The tones consisting of one frequency are generated by single oscillators and amplified by power transistor amplifiers (see 1.03 and 1.04). Duplicate motor-driven rotary interrupters (Mfr Disc.) or the newly developed solid state interrupters provide the interruptions for machine ringing, tones, and signaling. (See Fig. 1.)

1.02 This section is reissued to delete the oscillator checks, to revise the list of tools and test apparatus, to revise pre-empt tone voltage check, to revise the pulsing signal output check, to revise the trouble chart, and to add a caution concerning the use of a Hubbell isolation plug. This reissue does affect the Equipment Test List.

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, follow instructions as outlined in 3.02 or 3.03, as required, to prevent automatic transfer. If work is to be performed on the 400A tone generator (receiver-off-hook circuit), disconnect the input power by depressing the ROH PWR OFF key. When the work is completed, be sure to restore the circuits to normal.

1.03 The J86815A, AC-DC Ringing and Tone Power Plant is used for 4-party semiselective and 10-party, 5-code, ac-dc offices; while the J86815B, Superimposed Ringing and Tone Power Plant is used for 8-party semiselective and 4-party full-selective superimposed offices. The following items are furnished for these plants:

- (1) RINGING CURRENT—(20 Hz, 0.5A, 84 to 88V and 102 to 110V ac for J86815A plants) or (20 Hz, 0.5A, 84 to 88V, 94 to 101V, and 90 to 120V ac for J86815B plants)—*See Note 1 and 2.*

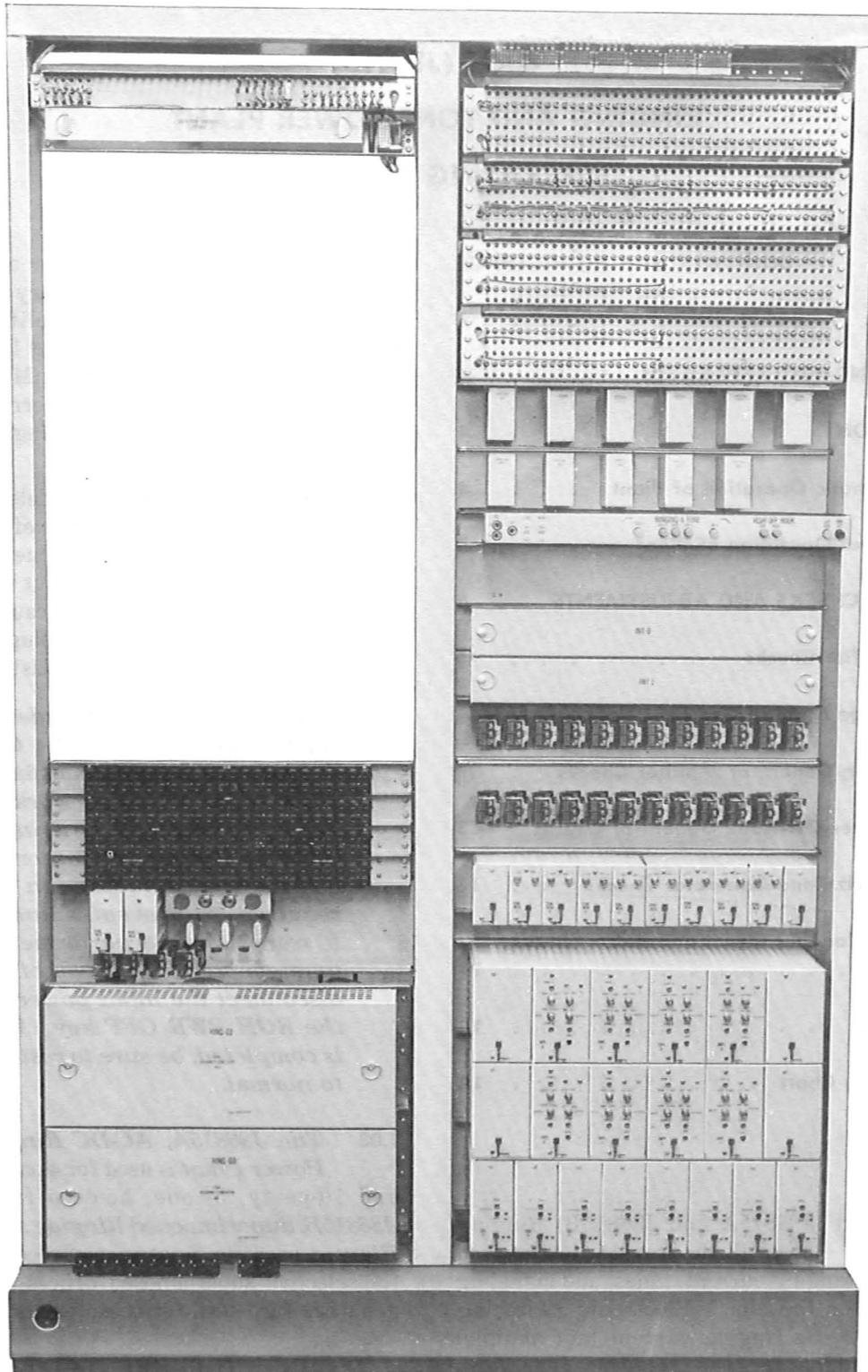


Fig. 1—806H Ringing and Tone Power Plant

- (2) TOUCH-TONE® DIAL TONE—combined 350 and 440 Hz, 1VA, 1.20V ac.
- (3) AUDIBLE RINGING TONE—combined 440 and 480 Hz, 1VA, 0.36V ac. *See Note 2.*
- (4) HIGH TONE—480 Hz, 1VA, 0.29V ac. *See Note 3.*
- (5) LOW TONE—combined 480 and 620 Hz, 1VA, 0.18V ac. *See Note 3.*
- (6) CALL WAITING TONE—440 Hz, 1VA, 0.48V ac.
- (7) BUSY VERIFICATION TONE—440 Hz, 1VA, 2.0V ac.
- (8) RECEIVER-OFF-HOOK TONE—combined frequencies of 1400, 2060, 2450, and 2600 Hz.

Note: For 4-wire ESS application, the following tones (9) through (13) are furnished in addition to tones (1) through (8). Tones (9) and (11) are used in 2-wire Centrex offices.

- (9) PRE-EMPT TONE—combined 440 and 620 Hz, 1VA, 0.36V ac. *See Note 4.*
- (10) CONFERENCE NOTIFICATION TONE—440 Hz, 1VA, 0.20V ac.
- (11) PRECEDENCE AUDIBLE RINGING TONE—combined 440 and 480 Hz, 1VA, 0.36V ac. *See Note 5.*
- (12) ROUTINE ALERTING SIGNALING—2600 Hz, 1VA, 0.32V ac. *See Note 2.*
- (13) PRIORITY ALERTING SIGNALING—2600 Hz, 1VA, 0.32V ac. *See Note 6.*

Note 1: The plants provide, in ac-dc and superimposed offices, CODE 1 GEN BR1, BR2, and BR3 only. All code ringing is provided by ESS circuits.

Note 2: Provides three brushes interrupted at 10 ipm, 2 seconds on and 4 seconds off.

Note 3: Provides balanced distribution of continuous and interrupted tone at 60 and 120 ipm.

Note 4: To be replaced by routine alerting and priority signaling.

Note 5: Provides three brushes interrupted at 30 ipm, 0.25 second on and 1.75 seconds off.

Note 6: Provides balanced distribution of interrupted tone at 30 ipm.

1.04 During normal operation, power is on both groups, "0" and "1", of the ringing generators and tone generators, but only the interrupter group, "0" or "1", supplying the load is powered. The outputs of both ringing generators are monitored for low voltage and all tone amplifiers are monitored for high and low voltage. The tone and ringing monitor outputs are supplied to the system control to determine which group, "0" or "1", of the ringing generators, set of tone generators, and interrupters will supply the load. The system control likewise provides for automatic transfer in case of failure of either group, "0" or "1", of the ringing generator and interrupter units connected to the load. All generators and interrupters are transferred as a unit. Manual control is also provided in the plant which supersedes the system control for maintenance purposes.

1.05 In the J86815B, Superimposed Ringing and Tone Power Plant, the +48V tripping supply is obtained from the 610D power plant. The -48V tripping supply is obtained from the regular battery supply. The positive and negative superimposed voltages are obtained from the +48V and -48V tripping voltages which are connected in series with the 20-Hz outputs by means of voltage dropping diodes in the 20-Hz outputs.

1.06 The receiver-off-hook tone circuit consists of four oscillators, a pulse generator, amplifiers, and a tone level alarm. The oscillators provide frequencies of 1400, 2060, 2450, and 2600 Hz of equal amplitude and are linearly combined to synthesize the desired tone. Signaling interruptions are provided by a KS-15634 L7 interrupter. Reserve receiver-off-hook tone power is not provided.

1.07 The ringing generators and the rotary interrupters operate from commercial alternating current, 60 Hz at 208V and 115V, respectively. During ac power failures, these units are powered from the 504B power plant. The solid state interrupters operate from +24 volts.

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1.08 These plants also furnish 105V continuous ringing current for miscellaneous uses such as PBX feeders for manual switchboards. In addition, the J86815B plant provides 97V ringing current for dial long-line circuits.

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

SD-81605-01	Ringling Circuit—Generators, Control and Distribution—AC-DC or Superimposed Ringing
SD-81652-01	Tone Circuit—Interruption, Control and Distribution
SD-81654-01	Oscillator Circuit
SD-81655-01	Amplifier Circuit
SD-99303-01	400A Tone Generator Circuit

1.10 For more detailed information on the operation and maintenance of individual equipment or apparatus, refer to the appropriate Bell System Practices. The relays, interrupters, etc, should be adjusted, when required, in accordance with the sections and the circuit requirement tables of the circuit drawings.

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

2. TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
R-2959	1/16 Inch Allen Wrench
—	Blocking tools as required. (Use and apply as outlined in Section 069-020-801.)

716C	Test Receiver
411B	Test Pick
W1AF (2 reqd)	Cord (8 1/2 feet long, equipped with one 360A tool at each end)

TEST APPARATUS

—	Voltmeter, Hewlett-Packard Model 3400A RMS 300/100/10/3/1-V, or equivalent true rms meter such as Voltmeter, Greibach Model 500 RMS
KS-14510	Volt-Ohm-Milliammeter
KS-16653 L1	Volume Indicator
—	Milliammeter, Clip-On, Hewlett-Packard, Model 428B

Note: Equivalents may be substituted.

3. OPERATION

Automatic Operation of Plant

3.01 The 806H power plant operates automatically to supply ringing current, tones, and signaling interruptions at the voltage and power levels required by the No. 1 Electronic Switching System. With the NOR and ROH NOR keys depressed, the system control determines which group, "0" or "1", of the ringing generators, set of tone generators, and interrupters will supply the load. Manual control (see 3.02 and 3.03) is also provided which supersedes the automatic system control.

Note: The OFF-1, NOR, OFF-0 (S1) and the ROH OFF, ROH NOR (S2) keys are both provided with mechanical interlocks so that only one position of each key can be operated at a time.

Caution: *This power plant is under system control. Do not attempt any transfers or work operations without prior consultation with personnel of the Electronic Switching System.*

Manual Operation of Plant

3.02 Advise personnel in the ESS to prepare for manual operation so that adequate preparations may be initiated. If, for example, work is to be performed on the "0" side of the plant, the load must be transferred in the ESS to the "1" side of the plant. Then, and only then, depress the OFF-0 key on the control panel. The OFF NOR, PWR OFF, and OS-0 lamps light. With the OFF-0 key depressed, the "1" ringing generator (RING G1), tone generators (OSC 1 and AMPL 1), and interrupter (INT 1) will supply the required ringing currents, tones, and signaling interruptions; and the ac and dc input power to the "0" units is disconnected. When work is completed, depress the NOR key. All lamps extinguish. Advise personnel in the ESS to restore the plant to normal operation. **Do not depress the OFF-1 key.**

3.03 If work is to be performed on the "1" side of the plant, personnel in the ESS must be advised to transfer the load to the "0" side of plant. Then, and only then, depress the OFF-1 key on the control panel. The OFF NOR, PWR OFF, and OS-1 lamps light. When work is completed, depress the NOR key. All lamps extinguish. Advise personnel in the ESS to restore the plant to normal operation. **Do not depress the OFF-0 key.**

3.04 The ROH NOR and the ROH OFF keys are provided for connecting and disconnecting the input power to the receiver-off-hook generator. Depressing the ROH OFF key will remove the power to the generator, light the OFF NOR and PWR OFF lamps, and transmit an alarm signal to the office alarm circuit.

Note: Reserve receiver-off-hook tone power is not provided.

4. ROUTINE CHECKS AND ADJUSTMENTS

4.01 The ringing and tone power plant is factory adjusted and normally should not require maintenance readjustments. However, if trouble conditions or local experience indicates a need for

such checks of adjustments, the following procedures are recommended to be used.

Caution: *When using the Hewlett-Packard 3400A RMS voltmeter, be sure to use a Hubbell isolation plug to prevent damage to components of the ringing and tone power plant.*

4.02 Deleted

4.03 Deleted

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Amplifier Checks

Caution: *This power plant is under system control. Do not attempt any transfers or work operations without prior consultation with personnel of the Electronic Switching System.*

Note: *If the required outputs from the amplifiers cannot be obtained, check that each of the oscillators has an ac output as follows. Connect the model 3400A voltmeter, set on the .10-volts scale, across the oscillator OUTPUT TONE (J1) and OUTPUT GRD (J2) test jacks. The meter should indicate an ac output voltage.*

4.08 DC Balance Checks:

- (1) Connect the positive lead of the KS-14510 volt-ohm-milliammeter to terminal 4 of the J5 connector and the negative lead to the GRD (J4) jack on the AMPL 0-TT amplifier.
- (2) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
- (3) Note the voltage on the 60-volt dc scale of the volt-ohm-milliammeter.
- (4) Disconnect the positive lead of the volt-ohm-milliammeter from terminal 4 of

the J5 connector and connect it to the OUTPUT TONE (J3) jack.

Requirement: The volt-ohm-milliammeter indicates one-half the value noted in (3).

- (5) Rotate the DC BAL (R7), as required, until the requirement is met.
- (6) Repeat (2) through (5) for the remaining amplifiers in group "0" using the following connector-terminal information.

AMPL-0	CONN	TERM
TT	J5	4
AR	J6	4
HT	J7	4
LT	J8	4
PT	J13	4
MT	J15	4

- (7) Remove the block from the P0 relay.
- (8) Follow procedure outlined in 3.03; then block the P1 relay operated. The OS-1 lamp extinguishes.
- (9) Repeat (2) through (5) for the amplifiers associated with group "1" using the following connector-terminal information.

AMPL-1	CONN	TERM
TT	J9	4
AR	J10	4
HT	J11	4
LT	J12	4
PT	J14	4
MT	J16	4

- (10) Remove the block from the P1 relay.
- (11) Disconnect the KS-14510 volt-ohm-milliammeter.
- (12) Depress the NOR key on the control panel. All lamps extinguish.
- (13) Advise personnel in the ESS to restore the plant to normal operation.

4.09 TOUCH-TONE Dial-Tone Voltage Check:

- (1) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
- (2) Connect the Model 3400A voltmeter, using the 10-volt scale, across terminal 8 of the J5 connector and the GRD (J4) jack on the AMPL 0-TT amplifier.
- (3) Remove the OSC 0, 440-Hz oscillator.

Requirement: The voltmeter indicates between 2.80 and 2.90 volts.

Note: If the requirement was not met in (3), adjust the INPUT TONE 1 ADJ (R1) potentiometer on the AMPL 0-TT amplifier for a meter indication of 2.85 volts.

- (4) Replace the OSC 0, 440-Hz oscillator and remove the OSC 0, 350-Hz oscillator.

Requirement: The voltmeter indicates between 2.80 and 2.90 volts.

Note: If the requirement was not met in (4), adjust the INPUT TONE 2 ADJ (R2) potentiometer on the AMPL 0-TT amplifier for a meter indication of 2.85 volts.

- (5) Replace the OSC 0, 350-Hz oscillator.

Requirement: The voltmeter indicates between 3.85 and 4.05 volts.

Note: If the requirement was not met in (5), adjust the OUTPUT LEV (R5) potentiometer on the AMPL 0-TT amplifier for a meter indication of 3.95 volts.

- (6) Disconnect the Model 3400A voltmeter from the amplifier.
- (7) Remove the block from the P0 relay.
- (8) Depress the NOR key on the control panel. All lamps extinguish.
- (9) Advise personnel in the ESS to restore the plant to normal operation.

Note: To check amplifier "1", follow procedure outlined in 3.03; then block the P1 relay operated, and repeat the checks similar to (2) through (9) using the J9 connector instead of the J5 connector.

4.10 Audible Ringing Tone and Precedence Audible Ringing Tone Voltage Check:

- (1) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
- (2) Connect the Model 3400A voltmeter, using the 10-volt scale, across terminal 8 of the J6 connector and the GRD (J4) jack on the AMPL 0-AR amplifier.
- (3) Remove the OSC 0, 480-Hz oscillator.

Requirement: The voltmeter indicates between 2.80 and 2.90 volts.

Note: If the requirement was not met in (3), adjust the INPUT TONE 1 ADJ (R1) potentiometer on the AMPL 0-AR amplifier for a meter indication of 2.85 volts.

- (4) Replace the OSC 0, 480-Hz oscillator and remove the OSC 0, 440-Hz oscillator.

Requirement: The voltmeter indicates between 2.80 and 2.90 volts.

Note: If the requirement was not met in (4), adjust the INPUT TONE 2 ADJ (R2) potentiometer on the AMPL 0-AR amplifier for a meter indication of 2.85 volts.

- (5) Replace the OSC 0, 440-Hz oscillator.

Requirement: The voltmeter indicates between 3.85 and 4.05 volts.

Note: If the requirement was not met in (5), adjust the OUTPUT LEV (R5) potentiometer on the AMPL 0-AR amplifier for a meter indication of 3.95 volts.

- (6) Disconnect the Model 3400A voltmeter from the amplifier.
- (7) Remove the block from the P0 relay.

- (8) Depress the NOR key on the control panel. All lamps extinguish.
- (9) Advise personnel in the ESS to restore the plant to normal operation.

Note: To check amplifier "1", follow procedure outlined in 3.03; then block the P1 relay operated and repeat the checks similar to (2) through (9), using the J10 connector instead of the J6 connector.

4.11 High Tone Voltage Check:

- (1) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
- (2) Connect the Model 3400A voltmeter, using the 10-volt scale, across terminal 8 of the J7 connector and the GRD (J4) jack of the AMPL 0-HT amplifier.

Requirement: The voltmeter indicates between 3.15 and 3.35 volts.

Note: If the requirement was not met in (2), determine that the INPUT TONE 1 ADJ (R1) potentiometer is in the approximate midpoint position; then adjust the OUTPUT LEV (R5) potentiometer for a meter indication of 3.25 volts.

- (3) Disconnect the Model 3400A voltmeter from the amplifier.
- (4) Remove the block from the P0 relay.
- (5) Depress the NOR key on the control panel. All lamps extinguish.
- (6) Advise personnel in the ESS to restore the plant to normal operation.

Note: To check amplifier "1", follow procedure outlined in 3.03; then block the P1 relay operated and repeat the checks similar to (2) through (6), using the J11 connector instead of the J7 connector.

4.12 Low Tone Voltage Check:

- (1) Follow procedure outlined in 3.02, then block the P0 relay operated. The OS-0 lamp extinguishes.
- (2) Connect the Model 3400A voltmeter, using the 10-volt scale, across terminal 8 of the J8 connector and the GRD (J4) jack of the AMPL 0-LT amplifier.
- (3) Remove the OSC 0, 620-Hz oscillator.

Requirement: The voltmeter indicates between 2.80 and 2.90 volts.

Note: If the requirement was not met in (3), adjust the INPUT TONE 1 ADJ (R1) potentiometer on the AMPL 0-LT amplifier for a meter indication of 2.85 volts.

- (4) Replace the OSC 0, 620-Hz oscillator and remove the OSC 0, 480-Hz oscillator.

Requirement: The voltmeter indicates between 2.80 and 2.90 volts.

Note: If the requirement was not met in (4), adjust the INPUT TONE 2 ADJ (R2) potentiometer on the AMPL 0-LT amplifier for a meter indication of 2.85 volts.

- (5) Replace the OSC 0, 480-Hz oscillator.

Requirement: The voltmeter indicates between 3.90 and 4.10 volts.

Note: If the requirement was not met in (5), adjust the OUTPUT LEV (R5) potentiometer on the AMPL 0-LT amplifier for a meter indication of 4.0 volts.

- (6) Disconnect the Model 3400A voltmeter from the amplifier.
- (7) Remove the block from the P0 relay.
- (8) Depress the NOR key on the control panel. All lamps extinguish.
- (9) Advise personnel in the ESS to restore the plant to normal operation.

Note: To check amplifier "1", follow procedure outlined in 3.03; then block the P1 relay operated and repeat the checks similar to (2) through (9), using the J12 connector instead of the J8 connector.

4.13 Call Waiting Tone, Busy Verification Tone, and Conference Notification Voltage Check:

- (1) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
- (2) Connect the Model 3400A voltmeter, using the 10-volt scale, across terminal 8 of the J15 connector and the GRD (J4) jack on the AMPL 0-MT amplifier.

Requirement: The voltmeter indicates between 3.90 and 4.10 volts.

Note: If the requirement was not met in (2), determine that the INPUT TONE 1 ADJ (R1) potentiometer is in the approximate midpoint position; then adjust the OUTPUT LEV (R5) potentiometer for a meter indication of 4.0 volts.

- (3) Disconnect the Model 3400A voltmeter from the amplifier.
- (4) Remove the block from the P0 relay.
- (5) Depress the NOR key on the control panel. All lamps extinguish.
- (6) Advise personnel in the ESS to restore the plant to normal operation.

Note: To check amplifier "1", follow procedure outlined in 3.03; then block the P1 relay operated and repeat the checks similar to (2) through (6), using the J16 connector instead of the J15 connector.

4.14 Pre-Empty Tone Voltage Check:

- (1) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
- (2) Connect the Model 3400A voltmeter, using the 10-volt scale, across terminal 8 of the

J13 connector and the GRD (J4) jack on the AMPL 0-PT amplifier.

- (3) Remove the OSC 0, 620-Hz oscillator.

Requirement: The voltmeter indicates between 2.80 and 2.90 volts.

Note: If the requirement was not met in (3), adjust the INPUT TONE 1 ADJ (R1) potentiometer on the AMPL 0-PT amplifier for a meter indication of 2.85 volts.

- (4) Replace the OSC 0, 620-Hz oscillator and remove the OSC 0, 440-Hz oscillator.

Requirement: The voltmeter indicates between 2.80 and 2.90 volts.

Note: If the requirement was not met in (4), adjust the INPUT TONE 2 ADJ (R2) potentiometer on the AMPL 0-PT amplifier for a meter indication of 2.85 volts.

- (5) Replace the OSC 0, 440-Hz oscillator.

Requirement: The voltmeter indicates between 3.90 and 4.10 volts.

Note: If the requirement was not met in (5), adjust the OUTPUT LEV (R5) potentiometer on the AMPL 0-PT amplifier for a meter indication of 4.00 volts.

- (6) Disconnect the Model 3400A voltmeter from the amplifier.

- (7) Remove the block from the P0 relay.

- (8) Depress the NOR key on the control panel. All lamps extinguish.

- (9) Advise personnel in the ESS to restore the plant to normal operation.

Note: To check amplifier "1", follow procedure outlined in 3.03; then block the P1 relay operated and repeat the checks similar to (2) through (9), using the J14 connector instead of the J13 connector.

Voltage Monitor Checks

Caution: This power plant is under system control. Do not attempt any transfers or

work operations without prior consultation with personnel of the Electronic Switching System.

4.15 Low-Voltage Monitor Test:

- (1) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
- (2) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to the T.S. F or T.S. H terminal (at top of bay) in Table A for the tone monitor under test.

TABLE A

	tone MON	TERMINAL	TERMINAL STRIP	RELAY
Tone MON 0	TT-LV	00	T.S. F	L10
	AR-LV	04	T.S. F	L20
	HT-LV	10	T.S. F	L10
	LT-LV	14	T.S. F	L20
	PT-LV	00	T.S. H	L20
	MT-LV	20	T.S. H	L20
Tone MON 1	TT-LV	20	T.S. F	L11
	AR-LV	24	T.S. F	L21
	HT-LV	30	T.S. F	L11
	LT-LV	34	T.S. F	L21
	PT-LV	10	T.S. H	L21
	MT-LV	30	T.S. H	L21

Note: Observe the polarity of the clip-on milliammeter probe when connecting the probe to the lead. These terminals are negative polarity; therefore, the arrow on the current probe should point toward the terminal.

- (3) Set the milliammeter to the 30 MA scale, and verify that the current is between 5.0 and 12.0 mA.
- (4) Block the relay listed in Table A to check each monitor in TONE MON "0" and switch the milliammeter to the 3 MA scale.

Requirement: The milliammeter indicates between 0 and 1.4 mA.

- (5) Switch the milliammeter to the 30 MA scale and unblock the relay in (4).

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

- (6) The HT and MT monitors should be adjusted for a milliammeter indication of between 5.0 and 12.0 mA. This is accomplished by rotating the LEV ADJ LV (R1) potentiometer on the tone low voltage monitors. Operate the L10 or L11 relay (HT monitor) and the L20 or L21 (MT monitor).

Requirement: The milliammeter decreases to zero.

- (7) The TT, AR, LT, and PT monitors should be adjusted in accordance with the following instructions:

- (a) Remove the oscillator as covered in Table B for the tone low voltage monitor under test.

TABLE B

	TONE MON	REMOVE OSCILLATOR
Tone MON 0	TT-LV	OSC 0-350 Hz
	AR-LV	OSC 0-440 Hz
	LT-LV	OSC 0-480 Hz
	PT-LV	OSC 0-620 Hz
Tone MON 1	TT-LV	OSC 1-350 Hz
	AR-LV	OSC 1-440 Hz
	LT-LV	OSC 1-480 Hz
	PT-LV	OSC 1-620 Hz

- (b) Switch the milliammeter to the 3 MA scale and rotate the LEV ADJ LV (R1) potentiometer fully ccw and then slowly cw.

Requirement: The milliammeter indicates between 0 to 1.4 mA.

- (c) Switch the milliammeter to the 30 MA scale and replace the oscillator that was removed in (a).

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

- (8) Remove the block from the P0 relay.
- (9) Depress the NOR key on the control panel. All lamps extinguish.
- (10) Advise personnel in the ESS to restore the plant to normal operation.

Note: To check TONE MON "1", follow procedure outlined in 3.03; then block the P1 relay operated and repeat the checks similar to (2) through (10).

4.16 High-Voltage Monitor Test:

- (1) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
- (2) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to the T.S. F or T.S. H terminal (at top of bay) in Table C for the tone monitor under test.

TABLE C

	TONE MON	TERMINAL	TERMINAL STRIP
Tone MON 0	TT-HV	02	T.S. F
	AR-HV	06	T.S. F
	HT-HV	12	T.S. F
	LT-HV	16	T.S. F
	PT-HV	02	T.S. H
Tone MON 1	MT-HV	22	T.S. H
	TT-HV	22	T.S. F
	AR-HV	26	T.S. F
	HT-HV	32	T.S. F
	LT-HV	36	T.S. F
	PT-HV	12	T.S. H
	MT-HV	32	T.S. H

Note: Observe the polarity of the clip-on milliammeter probe when connecting the probe to the lead. These terminals are negative

- polarity; therefore, the arrow should point toward the terminal.
- (3) Set the milliammeter to the 3 MA scale, and verify that the current is between 0 and 1.4 mA.
 - (4) Switch the milliammeter to the 30 MA scale.
 - (5) Block relay H10 (TONE MON 0) or relay H11 (TONE MON 1) operated.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

- (6) Rotate the LEV ADJ HV (R1) potentiometer on the monitor under test fully cw.
- (7) Insulate and then short the contacts listed in Table D for the monitor under test (except the HT and MT monitors).

TABLE D

	TONE MON	INSULATE CONTACT	SHORT CONTACTS	ON RELAY
Tone MON 0	TT-HV	1M	1B-1 Fixed	H10, H10
	AR-HV	3M	3B-3 Fixed	
	HT-HV			
	LT-HV	7M	7B-7 Fixed	H10
Tone MON 1	PT-HV	5M	5B-5 Fixed	H10
	MT-HV			
	TT-HV	1M	1M-1 Fixed	H11
	AR-HV	3M	3B-3 Fixed	H11
	HT-HV			
	LT-HV	7M	7B-7 Fixed	H11
	PT-HV	5M	5B-5 Fixed	H11
	MT-HV			

- (8) Rotate the LEV ADJ HV (R1) potentiometer on the monitor under test slowly cw until the milliammeter indicates between 5.0 and 12.0 mA.
- (9) Remove the short and then the insulation for the H10 or H11 relay, and switch the milliammeter to the 3 MA scale.

Requirement: The milliammeter indicates between 0 and 1.4 mA.

- (10) Remove the block from the P0 relay.
- (11) Depress the NOR key on the control panel. All lamps extinguish.
- (12) Advise personnel in the ESS to restore the plant to normal operation.

Note: To check TONE MON "1", follow procedure outlined in 3.03; then block the P1 relay operated and repeat the checks similar to (2) through (12).

Ringling Generator Monitor Checks

Caution: *This power plant is under system control. Do not attempt any transfers or work operations without prior consultation with personnel of the Electronic Switching System.*

4.17 Ringling Monitor Checks (Superimposed Offices):

(a) "0" side of plant—

- (1) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
- (2) Using the 60-volt scale of the KS-14510 volt-ohm-milliammeter, connect the negative lead to the PF TST (J5) and the positive lead to ground on the RING MON 0 monitor.
- (3) Operate and hold the PF0 TST key and rotate the PF TST (R2) potentiometer as required.

Requirement: The meter indicates -48 volts.

- (4) Rotate the PF LEV ADJ (R5) potentiometer cw until the PF0 relay releases; then slowly rotate the PF LEV ADJ (R5) potentiometer ccw until the PF0 relay just operates.
- (5) Release the PF0 TST key.

Requirement: The PF0 relay releases.

- (6) Disconnect the volt-ohm-milliammeter.
- (7) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to T.S. A terminal 30.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

- (8) Remove the block from the P0 relay.

Requirement: The milliammeter drops to between 0 and 1.4 mA.

- (9) Block the P0 relay operated and remove fuse F21 from the battery distribution circuit.

Requirement: The milliammeter indicates between 0 and 1.4 mA.

- (10) Replace the F21 fuse.

- (11) Change the current probe of the Hewlett-Packard model 428B milliammeter from T.S. A terminal 30 to T.S. A terminal 33.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

- (12) Remove fuse F28 from the battery distribution circuit.

Requirement: The milliammeter drops to between 0 and 1.4 mA.

- (13) Replace the F28 fuse; remove the block from the P0 relay and disconnect the milliammeter.

- (14) Depress the NOR key on the control panel. All lamps extinguish.

- (15) Advise personnel in the ESS to restore the plant to normal operation.

(b) "1" side of plant—

- (1) Follow procedure outlined in 3.03; then block the P1 relay operated. The OS-1 lamp extinguishes.

- (2) Using the 60-volt scale of the KS-14510 volt-ohm-milliammeter, connect the negative lead to the PF TST (J5) and the positive lead to ground on the RING MON 1 monitor.

- (3) Operate and hold the PF1 TST key and rotate the PF TST (R2) potentiometer as required.

Requirement: The meter indicates -48 volts.

- (4) Rotate the PF LEV ADJ (R5) potentiometer cw until the PF1 relay releases; then slowly rotate the PF LEV ADJ (R5) potentiometer ccw until the PF1 relay just operates.

- (5) Release the PF1 TST key.

Requirement: The PF1 relay releases.

- (6) Disconnect the volt-ohm-milliammeter.

- (7) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to T.S. A terminal 34.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

- (8) Remove the block from the P1 relay.

Requirement: The milliammeter drops to between 0 and 1.4 mA.

- (9) Block the P1 relay operated and remove fuse F29 from the battery distribution circuit.

Requirement: The milliammeter indicates between 0 and 1.4 mA.

- (10) Replace the F29 fuse.

- (11) Change the current probe of the Hewlett-Packard model 428B milliammeter from T.S. A terminal 34 to T.S. A terminal 37.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

- (12) Remove fuse F32 from the battery distribution circuit.

Requirement: The milliammeter drops to between 0 and 1.4 mA.

- (13) Replace the F32 fuse; remove the block from the P1 relay and disconnect the milliammeter.
- (14) Depress the NOR key on the control panel. All lamps extinguish.
- (15) Advise personnel in the ESS to restore the plant to normal operation.

4.18 Ringing Monitor Checks (AC-DC offices):

- (a) "0" side of plant—
 - (1) Follow procedure outlined in 3.02; then block the P0 relay operated. The OS-0 lamp extinguishes.
 - (2) Follow same procedure outlined in 4.17(a)(7) through (15).
- (b) "1" side of plant—
 - (1) Follow procedure outlined in 3.03; then block the P1 relay operated. The OS-1 lamp extinguishes.
 - (2) Follow same procedure outlined in 4.17(b)(7) through (15).

Receiver-Off-Hook Generator Checks

4.19 Pulsing Signal Output check:

- (1) Verify that the ROH NOR key is depressed.
- (2) Connect the KS-16653 L1 volume indicator (key in HIGH IMP position and selector switch in 18 position) between terminals 17 and 27 on TB1 of the 400A tone generator.

Requirement: The volume indicator indicates 11.

Note: If the requirement in (2) is not met, adjust the R313 potentiometer (gain control) until the volume indicator indicates 11.

- (3) Disconnect the volume indicator.

4.20 Tone Signal Alarm Check:

- (1) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead of T.S. A terminal 25 (tone distribution circuit).

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

- (2) Depress the ROH OFF key.

Requirement: The milliammeter drops to zero.

- (3) Depress the ROH NOR key.
- (4) Manually operate the L10 and L11 relay, in turn, and verify that the milliammeter drops to zero each time.
- (5) Disconnect the milliammeter.

2600-Hz Tone Generator Checks

Caution: This power plant is under system control. Do not attempt any transfers or work operations without prior consultation with personnel of the Electronic Switching System.

4.21 Oscillator Voltage Check:

- (1) Connect the Model 3400A voltmeter, using the 10-volt scale, between the output TP2 jack and the ground TP1 jack of the 2600-0 OSC.

Requirement: The voltmeter indicates between 4.0 and 4.6 volts.

Note: A Z1 network, consisting of taps 5, 6, and 7, is provided for field strapping to reduce the frequency which may increase due to aging. (See circuit description.)

- (2) Remove the test leads of the voltmeter from the 2600-0 OSC and connect to the output TP2 jack and the ground TP1 jack of the 2600-1 OSC.

Requirement: The voltmeter indicates between 4.0 and 4.6 volts.

- (3) Disconnect the voltmeter.

4.22 Amplifier Voltage Check:

- (1) Connect the Model 3400A voltmeter, using the 10-volt scale, between the output TP2 jack and the ground TP1 jack of the 2600-0 AMP.

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Requirement: The voltmeter indicates a nominal 4.25 volts.

Note: If the requirement is not met in (1), carefully rotate the ADJ 1 potentiometer as required.

- (2) Remove the test leads of the voltmeter from the 2600-0 AMP, and connect to the output TP2 jack and the ground TP1 jack of the 2600-1 AMP.

Requirement: The voltmeter indicates a nominal 4.25 volts.

Note: If the requirement is not met in (2), carefully rotate the ADJ 1 potentiometer as required.

- (3) Disconnect the voltmeter.

4.23 Low-Voltage Monitor:

- (1) Connect the Model 3400A voltmeter, using the 10-volt scale, between the output TP2 jack and the ground TP1 jack of the 2600-0 AMP.

Requirement: The voltmeter indicates 4.25 volts.

- (2) Rotate the R1 potentiometer on the 2600 LV-0 MON fully cw.

Requirement: The LV relay releases (indicated by a low-voltage alarm in the master scanner circuit).

- (3) Very slowly rotate the R1 potentiometer ccw until the LV relay operates (indicated by release of low-voltage alarm).
- (4) Remove the test leads of the voltmeter from the 2600-0 AMP and connect to the output

TP2 jack and the ground TP1 jack of the 2600-1 AMP.

Requirement: The voltmeter indicates 4.25 volts.

- (5) Rotate the R1 potentiometer on the 2600 LV-1 MON fully cw.

Requirement: The LV relay releases (indicated by a low-voltage alarm in the master scanner circuit).

- (6) Very slowly rotate the R1 potentiometer ccw until the LV relay operates (indicated by release of low-voltage alarm).
- (7) Disconnect the voltmeter from the 2600-1 AMP.

Miscellaneous Circuit and Alarm Checks

4.24 Transfer and Alarm Checks:

Caution: *The following checks should be accomplished only in periods of light traffic and coordinated with personnel in the ESS. The power plant is under system control, and these checks will cause the plant to transfer from one side to the other indicating trouble conditions to the ESS.*

- (1) Coordinate routine checks with personnel in the ESS.
- (2) Verify that the OFF NOR and PWR OFF lamps are not lighted.
- (3) Momentarily short the pairs of terminals listed in Table E and check that the relays operate and release.

TABLE E

STEP	T.S. G TERMINALS	RELAYS OPERATE	RELAYS RELEASE
1. Momentarily Short 2. Connect	34-24 33-23	P1 T1, I1	P0
3. Disconnect 4. Connect	33-23 30-20	L11	T1, I1
5. Disconnect 6. Connect	30-20 31-21	L21	L11
7. Disconnect 8. Connect	31-21 32-22	H11	L21
9. Disconnect 10. Momentarily Short	32-22 04-14	P0	H11 P1
11. Connect 12. Disconnect	03-13 03-13	T0, I0	T0, I0
13. Connect 14. Disconnect	00-10 00-10	L10	L10
15. Connect 16. Disconnect	01-11 01-11	L20	L20
17. Connect 18. Disconnect	02-12 02-12	H10	H10

(4) Depress the ROH OFF key.

Requirement: The OFF NOR and PWR OFF lamps light.

(5) Depress the ROH NOR key to extinguish the OFF NOR and PWR OFF lamps.

(6) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to T.S. A terminal 23.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

(7) Depress the OFF-0 key and the OFF-1 key and operate the FA1 relay, one at a time, in turn.

Requirement: The milliammeter drops to zero for each operation.

(8) Operate the NOR key.

(9) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to T.S. A terminal 21.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

(10) Block the FA1 relay operated.

Requirement: The milliammeter drops to 0 and the major alarm sounds.

(11) Depress the OFF-0, OFF-1, and ROH OFF keys in turn.

Requirement: The milliammeter increases to between 5.0 and 12.0 mA. each time and the major alarm retires.

(12) Unblock the FA1 relay.

(13) Depress the OFF-1 key and verify that the OS-1 lamp lights.

- (14) Depress the OFF-0 key and verify that the OS-0 lamp lights.

4.25 Fuse Alarm Checks:

Caution: *The following checks are made with equipment in service.*

- (1) Follow procedure outlined in 3.03.
- (2) Using the W1AF cord equipped with the 411B test pick and a connecting clip, connect the clip of the cord to +24 volts, and then insert the test pick through the aperture in front of the fuse holder of fuses F1-F3, F5, F9-F11, and F13.

Requirement: The FA1 relay operates each time.

- (3) Remove the connecting clip of the W1AF cord from +24 and connect it to -48 volts; then insert the test pick through the aperture in front of the fuse holder of fuses F17-F21, F25-F27, and F29.

Requirement: The FA1 relay operates each time.

- (4) Depress the NOR key on the control panel. All lamps extinguish.
- (5) Advise personnel in the ESS to restore the plant to normal operation.

4.26 Interrupter Checks:

- (a) "0" side of plant—

Caution: *The following checks are made with equipment in service.*

- (1) Follow procedure outlined in 3.03.
- (2) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to the terminals in Table F for INT-0, in turn, one at a time.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA for 4 seconds and then between 0 and 1.4 mA for 2 seconds.

TABLE F

INT-0	INT-1
T.S. E TERMINAL	T.S. E TERMINAL
01	11
03	13
05	15

- (3) Verify that the 30-0, 60-0, and 120-0 relays operate if rotary interrupters are provided, or the 30-00, 60-00, and 120-00 relays operate if solid state interrupters are provided.
- (4) Using the KS-14510 volt-ohm-milliammeter set on the $R \times 1000$ ohm range, check for 30 ipm between each set of 30A and 30B leads, 60 ipm between each set of 60A and 60B leads, and 120 ipm between each set of 120A and 120B leads. See CADS 1, 2, and 3 of the schematic drawing for the terminal number of each pair of output leads.
- (5) Depress the NOR key on the control panel. All lamps extinguish.
- (6) Advise personnel in the ESS to restore the plant to normal operation.
- (b) "1" side of plant—

Caution: *The following checks are made with equipment in service.*

- (1) Follow procedure outlined in 3.02.
- (2) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to the terminals in Table F for INT-1, in turn, one at a time.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA for 4 seconds, then between 0 and 1.4 mA for 2 seconds.

- (3) Verify that the 30-1, 60-1, and 120-1 relays operate if rotary interrupters are provided, or the 30-01, 60-01, and 120-01 relays operate if solid state interrupters are provided.
- (4) Using the KS-14510 volt-ohm-milliammeter set on the $R \times 1000$ ohm range, check

for 30 ipm between each set of 30A and 30B leads, 60 ipm between each set of 60A and 60B leads, and 120 ipm between each set of 120A and 120B leads. See CADS 1, 2, and 3 of the schematic drawing for the terminal number of each pair of output leads.

- (5) Depress the NOR key on the control panel. All lamps extinguish.
- (6) Advise personnel in the ESS to restore the plant to normal operation.

4.27 Distribution Circuit Checks:

Caution: The following checks are made with the equipment in service.

- (1) Follow procedure outlined in 3.03.
- (2) Using a 716C test receiver with a 10,000 ohm resistor in series with the test lead, check the outputs at the centerpoint of each distribution resistor using the test points designated in Table G.

TABLE G

DISTRIBUTION RESISTORS	SIGNAL	INTERRUPTIONS
AR1T- AR1R- AR2T- AR2R- AR3T- AR3R-	AUDIBLE RINGING TONES	10 IPM
AR4T- AR4R-	PRECEDENCE AUDIBLE RINGING TONE	30 IPM
HT1T- HT1R- HT2T- HT2R- HT3T- HT3R-	HIGH TONES	120 IPM 60 IPM
LT1T- LT1R- LT3T- LT3R- LT4T- LT4R-	LOW TONES	60 IPM 120 IPM
ROHT- ROHR-	RECEIVER-OFF-HOOK TONE	
TTT- TTR-	TOUCH-TONE DIAL TONE	
MTT- MTR-	CONFERENCE NOTIFICATION TONE	
MT1T- MT1R-	CALL WAITING TONE	
MT2T- MT2R-	BUSY VERIFICATION TONE	
PTT- PTR-	PRE-EMPT TONES	
RA1T- RA1R- RA2T- RA2R- RA3T- RA3R-	ROUTINE ALERTING TONES	10 IPM
PA1T- PA1R-	PRIORITY ALERTING TONE	30 IPM

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(3) Using the 716C test receiver with a 10,000 ohm resistor in series with the test lead, check the outputs for interrupted ringing at the CODE 1 GEN BR1, CODE 1 GEN BR2, and CODE 1 GEN BR3 fuse receptacles.

(4) Follow procedure outlined in 3.02.

(5) Repeat (2) and (3).

(6) Depress the NOR key on the control panel. All lamps extinguish.

(7) Advise personnel in the ESS to restore the plant to normal operation.

4.28 Ground Cross Detection Checks:

Caution: *The following checks are made with equipment in service.*

(1) Follow procedure as outlined in 3.03.

(2) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to T.S. A terminal 13.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

(3) Momentarily operate the L10, L11, L20, L21, H10, and H11 relays one at a time.

Requirement: The milliammeter drops to zero each time.

(4) Follow procedure as outlined in 3.02.

(5) Clip the current probe of the Hewlett-Packard model 428B milliammeter around the cable lead connected to T.S. A terminal 15.

Requirement: The milliammeter indicates between 5.0 and 12.0 mA.

(6) Momentarily operate the L10, L11, L20, L21, H10, and H11 relays one at a time.

Requirement: The milliammeter drops to zero each time.

5. TROUBLES

5.01 Trouble in the plant is normally detected by the system control of the ESS office. The outputs of high- and low-voltage monitors are supplied to ferrods in the master scanner to provide signals for automatic transfer. There is no automatic transfer logic in the power plant. Failure of an interrupter is also indicated to the system control. Failure of a dc input fuse or ringing-distribution fuse will light the PWR OFF lamp in the plant and transmit a fuse alarm signal to the system control.

Trouble Chart

5.02 The possible causes of trouble in a unit and the action to be taken are given in the following chart. In addition to the action specified, check for loose or open connections or short-circuits due to foreign matter lying across associated wiring terminals.

TROUBLE CHART

TONE-OSCILLATORS (5D-81654-01)

ITEM	TROUBLE CONDITION	PROBABLE CAUSE	REMEDY
1	No output tone	Defective 218-type reed selector.	Using a test receiver connected to the HRG and OUTPUT TONE (J1) pin jacks, check for tone of the oscillators (see 1.03).
		No +24V input to oscillator.	Using KS-14510 V.O.M. between OUTPUT TONE (J1) and OUTPUT GRD (J2) pin jacks of oscillators (see 1.03), check for the presence of an ac output voltage. Check input fuses F1 and F9 in tone distribution circuit.
		Defective Q1 amplifier input, Q2 voltage stage, or Q3 and Q4 output power stage transistors.	Replace appropriate oscillator (see 1.03).
		Defective bandpass filter.	After checking +24V input to oscillators, check for an ac output voltage from the oscillators.
	High-voltage output	D1, D2, or D3 diodes open or R12 resistor shorted or relay and resistor in tone distributing circuit defective.	Check for an ac output voltage from the oscillators.
	Low-voltage output	D1, D2, or D3 diodes shorted or R12 resistor open or relay and resistor in tone distributing circuit defective.	Check for an ac output voltage from the oscillators.
	Unstable or noisy	Defective 218-type reed selector.	Replace appropriate 218-type reed selector (see schematic drawing).

TROUBLE CHART (Cont)

TONE-AMPLIFIERS (SD-81655-01)

ITEM	TROUBLE CONDITION	PROBABLE CAUSE	REMEDY
2	No output tone	DC BAL (R7) potentiometer not properly adjusted. OUTPUT LEVEL (R5) potentiometer not properly adjusted. Defective Q1 input stage amplifier transistor or power amplifier made up of the Q2, Q3, Q4, and Q5 transistors. No +24V input to amplifier.	Follow procedure outlined in Part 4 for the appropriate amplifier. Follow procedure outlined in the appropriate paragraph, 4.09 through 4.14. Replace appropriate amplifier and then follow procedure outlined in the appropriate paragraph, 4.09 through 4.14. Using KS-14510 V.O.M. between OUTPUT TONE (J3) and OUTPUT GRD (J4) pin jack of amplifier (see schematic drawing), check for reading between 3.90 and 4.10V . Check input fuse F2 in tone distribution circuit.
	High or low output voltage	INPUT TONE 1 (J1) and/or INPUT TONE 2 (J2) potentiometer not properly adjusted.	Adjust appropriate amplifier in accordance with appropriate paragraph, 4.09 through 4.14.
TONE LOW- AND HIGH-VOLTAGE MONITORS (SD-81652-01)			
3	Low-voltage indication in master scanner	Low collector current of Q1 transistor.	Adjust appropriate low-voltage monitor in accordance with 4.15. If requirements cannot be acquired, replace monitor.
	High-voltage indication in master scanner	High collector current of Q1 transistor.	Adjust appropriate high-voltage monitor in accordance with 4.16. If requirements cannot be acquired, replace monitor.
	False low- or high-voltage indication in master scanner	Defective ferrod sensor in master scanner.	Check master scanner in accordance with local instructions.

TROUBLE CHART (Cont)

RECEIVER-OFF-HOOK GENERATOR (SD-99303-01)

ITEM	TROUBLE CONDITION	PROBABLE CAUSE	REMEDY
5	No output or low output voltage	No dc input. Component failure in generator.	Check that ROH NOR key is depressed. Check -48V fuse on generator. Check the pulse generator, oscillator, and amplifier as outlined in 4.19 and 4.20. Replace defective circuit.
INTERRUPTERS (SD-81652-01)			
6	Fails to operate (rotary interrupter) Irregular signal interruptions (rotary interrupter) Fails to operate (solid stage interrupter) Irregular signal interruptions (solid state interrupter)	No ac input. Failure of interrupter motor. Interrupter contact springs out of adjustment. No +24V input. Faulty interrupter switches.	Check that ac INT plug is properly connected to ac receptacle. Replace the motor in accordance with 201-576-501. Check interrupter in accordance with 163-220-701. If requirements cannot be met, replace the interrupter. Check battery distribution fuses F5 and F13. Make sure circuit packs are firmly in place. Check for ground on terminal 13 and +24V on terminal 14 of circuit packs A4, A340, and A341. Check for +24V on terminal 14 of circuit pack A752. Substitute capsulated 316-type relays after isolating relay in trouble.
2600-Hz TONE GENERATORS (SD-81652-01)			
7	No output tone Low output voltage	No -48V input to oscillator or amplifier. Component failure in oscillator or amplifier.	Check battery distribution fuse F23. Make sure circuit packs are firmly in place. Test oscillator as outlined in 4.21. Test amplifier as outlined in 4.22. Test tone generator as outlined in 4.21 and 4.22. Replace defective circuit pack.