

SEE: 333-122-501 for use

2A, 2B, AND 2B-1 SIGNALING TEST SETS AND ASSOCIATED PULSE-REPEATING ADAPTER CIRCUIT

J64730

TESTS AND INSPECTIONS

1. GENERAL

1.01 This section describes a method of testing the 2A signaling test set (J64730A) and the 2B (2B-1) signaling test set and associated pulse-repeating adapter circuit (J64730B,D).

1.02 This section is reissued to add test D-3 using the Hewlett-Packard 5232A electronic counter or equivalent. The wording in Parts 2 and 3 of the section is changed to comply with the STEP, ACTION, VERIFICATION format.

1.03 The tests covered are.

2A, 2B, or 2B-1 SIGNALING TEST SET TESTS

A. Test of Tubes and Pulse Relay P: This test checks that the two vacuum tubes, the cold cathode gas-filled tube, the pulse relay and the associated tube circuits are operating but not necessarily in the proper manner. Subsequent tests determine whether their operation is in the proper manner.

B. Test and Adjustment of Tube Heater Voltage: This test checks the tube heater voltage and provides a method for readjustment if voltage is out of limits.

C. Test of Line (L) and Drop (D) Lamps: This test checks the ability of the L and D lamps to light.

D1. Pulses-Per-Second Calibration and Range Using an Oscilloscope: This test checks the pulsing rate of the set and the calibration of the PULSES PER SECOND meter. This is accomplished by checking the pulsing rate of the set with an oscilloscope. If necessary, the PULSES PER SECOND meter is then calibrated to indicate this rate.

D2. Pulses-Per-Second Calibration and Range Using a KS-14510 L1 Meter: This test checks the pulsing rate of the set and the calibration of the PULSES PER SECOND meter. The calibration of the set is made by connecting a 60-Hz voltage (see 2.16) and the output of the test set to the KS-14510 L1 meter and determining from the observed null point the frequency of the set. Calibrate the PULSES PER SECOND meter to indicate the frequency the set is producing.

D3. Pulses-Per-Second Calibration and Range Using an Electronic Counter: This test checks the pulsing rate of the set and the calibration of the PULSES PER SECOND meter. This is accomplished by checking the pulsing rate of the set with an electronic counter.

E. PERCENT BREAK Meter Calibration and Range of Set: This test checks the calibration of the PERCENT BREAK meter for 100 percent break output of the set. It also checks that the set will produce pulses at 3 and 10 pps with a percent break range of at least 10 to 75 percent.

F. Test of Key and Jack Contacts: This test checks various contacts that have not been automatically checked in previous tests.

PULSE REPEATING ADAPTER TESTS

Note: Tests G through O are to be performed only if the adapter circuit is provided. These tests check all switching combinations of the adapter as well as the values of all essential components. It is recommended that all adapter tests (G through O) be performed when checking this circuit. Calibrate the 2B-1 signaling test set as specified in Tests A

through F of this practice before testing the adapter.

G. Pulsing Test of PR Relay: This test checks the pulsing of the PR relay in the adapter circuit.

H. Complete Test of CX and Miscellaneous Tests of TA and TB FUNCTION Switch Positions: This test checks the value of various resistive measurements with the FUNCTION switch in the CX, TA, and TB positions.

I. Test of Current Reversal Network (TE Position): This test checks the current reversal network with the FUNCTION switch on the adapter in the TE position.

J. Test of Loop Resistance Values and Other Tests of the TA, TC, LP1, and LP2 FUNCTION Switch Positions: This test checks the resistance value of the SEND LOOP keys in their operated position.

K. DC Leak Tests and Other Tests of LP1, LP2, and TB FUNCTION Switch Positions: This test checks the value of the dc LEAK resistors.

L. AC Leak Tests and Other Tests of LP1, LP2, TA, and TC FUNCTION Switch Positions: This test uses 1000-Hz tone to check AC leak with the FUNCTION switch and LEAD switch in various operated positions.

M. Test of CF and TB FUNCTION Switch Positions: This test checks the impedance of various circuits in the adapter with the FUNCTION switch in the CF and TB positions. It also checks the operation of the A1 relay in the adapter.

N. Pulsing Tests of A1 Relay: This test checks the percent break output of the A1 relay in the adapter when the pulsing speed to the input of the A1 relay is adjusted to 12 pps.

O. Final Tests of TB, TC, LP1, LP2, and CF FUNCTION Switch Positions: This test checks the connections to the E1, R, and S jacks with the FUNCTION switch on the adapter in TB, TC, LP1, and LP2 positions.

1.04 Only one of Tests D1, D2, or D3 needs to be made. Tests D1 and D3 are preferred over D2. Tests G through O are to be performed only if the adapter circuit is provided.

1.05 The 2A or 2B test set circuit is a source of controlled pulses or supervisory signals and provides means of measuring percent break of received continuous pulses or of observing received supervisory signals. The 2B-1 test set is a 2B test set plus a modification to make it compatible with the pulse-repeating adapter circuit. The adapter circuit repeats the controlled pulses of the 2B-1 set in a converted form such that toll and local pulse-repeating relays; CX, SX, and DX circuits; and E1S and E1C SF units may be tested.

1.06 If the test set requires frequent readjustment other than that required to compensate for office battery variations, the tubes may be defective. The tubes may be checked in accordance with Section 100-630-101 relating to heater-type tubes and Section 024-707-701 or 100-611-101 relating to cold cathode tubes. The mercury contact polar relays, P and PR, may be checked in accordance with Section 040-263-501. Any tube or relay may be replaced with a good one if testing equipment is not available.

1.07 The 2B set or adapter will operate correctly only if operated face up. If it is tilted more than 30 degrees, the mercury contact P or PR relays cannot operate correctly.

1.08 If the 2A signaling test set is equipped with 396A tubes and is used in various offices in a maintenance area, it is advisable to check the heater voltage as described in Test B each time the test set is moved to a different office. The 2A or 2B test sets equipped with 407A tubes will not require this check.

1.09 Lettered Steps: A letter a, b, c, etc., added to a step number in Part 3 or 4 of this section, indicates an action which may or may not be required depending on local conditions. The condition under which a lettered step or a series of lettered steps should be made is given in the ACTION column, and all steps governed by the same condition are designated by the same letter within a test. Where a condition does not apply, all steps designated by that letter should be omitted.

2. APPARATUS

2.01 The apparatus required for the tests of the 2A, 2B, and 2B-1 test sets is shown in Table A. The details of each item are covered in the paragraph indicated by the number in parentheses.

2.02 The 2A signaling test set (J64730A) (SD-56134-01) or 2B (2B-1) signaling test set (J64730B) (SD-56134-02) includes TST BAT A and TST BAT B cords which terminate in a plug at one end and are attached to the set at the other end. If a bay mounted 2B set is provided, the TST BAT A and B cords will not be provided.

2.03 Oscilloscope, Du Mont model 304 H or equivalent.

2.04 Meter, Volt-Ohm-Milliammeter KS-14510 or equivalent.

2.05 Electronic Counter, Hewlett—Packard 5232A or equivalent, equipped with input testing cord.

2.06 Cord, W2C, 10 feet long equipped with two 59 cord tips and a 310 plug (2W6A).

2.07 Cord, S3B, 10 feet long equipped with one 310 plug and three 131 tips (3W1A).

2.08 Cord, W1B, 10 feet long equipped with 310 plug (1W5B).

2.09 Cord, W1W, 12 feet long equipped with 310 plug (1W11A).

2.10 Cord, P3K, 12 feet long equipped with two 310 plugs (3P15B).

2.11 Cord, P2A, 6 feet long equipped with two 347A plugs (2P1D).

2.12 Outlet cord, 3 conductor, with third wire grounded to transformer case.

2.13 Screwdriver, 4 inch, H cabinet.

2.14 Stopwatch, KS-3008 or equivalent.

TABLE A

| APPARATUS | TESTS | | | | | | | | |
|---------------------------|-------|---|---|----|----|----|---|---|--|
| | A | B | C | D1 | D2 | D3 | E | F | |
| Signaling test set (2.02) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Oscilloscope (2.03) | | | | 1 | | | | | |
| Meter, volt-ohm (2.04) | | | | | 1 | | | | |
| Electronic counter (2.05) | | | | | | 1 | | | |
| Testing cord (2.06) | | 1 | | | | | | | |
| Testing cord (2.07) | | 1 | | 1 | 1 | | | | |
| Testing cord (2.08) | | | | | | 1 | | | |
| Testing cord (2.09) | | | | | | 1 | | | |
| Patching cord (2.10) | | | 1 | | | | | 1 | |
| Patching cord (2.11) | | | | | | | | 1 | |
| Outlet cord (2.12) | | | | | 1 | | | | |
| Plug (dummy) 258D | | | | | | 1 | 1 | 1 | |
| Screwdriver (2.13) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Stop watch (2.14) | | | | 1 | 1 | | | | |
| Test receiver (2.15) | | | | | | | | 1 | |
| Transformer (2.16) | | | | | 1 | | | | |
| Fuse (2.17) | | | | | 1 | | | | |

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2.15 Receiver, 716 E or 528, equipped with a W2AB cord with two 360A tools (2W21A), a 411A tool, and a 365 tool.

2.16 Transformer, KS-16886, L-2 arranged to provide 10.6 volts or other 5-watt bell transformer with an output of 8 to 12 volts.

2.17 Fuse 0.2 amp, 3AG, Slo-Blow Littelfuse, catalogue 313.200, with In Line fuse retainer, catalogue 155020, manufactured by Littelfuse Co, or equivalent.

2.18 The apparatus required for each pulse-repeating adapter test is shown in Table B. The details of each item are covered in the paragraph indicated by the number in parentheses.

2.19 Portable power supply KS-19653,L1 fits into the same container as the adapter and is arranged to power the 2B-1 set as well as the adapter. If the adapter is bay mounted, the KS-19653,L1 power supply will not be necessary.

2.20 The 2B-1 signaling test set (J64730B) (SD-56134-02) includes TST BAT A and TST

BAT B cords which terminate in a plug at one end and are attached to the set at the other end. If a bay-mounted 2B-1 set is provided, the TST BAT A and B cords will not be provided.

2.21 Wheatstone bridge.

2.22 VTVM, Hewlett-Packard model 400D or equivalent.

2.23 Milliwatt supply, 600 ohms, 1000 cycles, sinusoidal, nongrounded balanced output. The output of the supply should appear across the tip and ring of a milliwatt supply jack, and the sleeve of this jack should be open.

2.24 Cord, W3M, 6 feet long, equipped with a 310 plug and three 360-type tools. The 360-type tools should be equipped with three 364-type spades (3W4A).

2.25 Cord, 893, 6 feet long, equipped with a 360-type tool on both ends. The 360-type tools should be equipped with a 364 spade on one end and a 365 clip on the other (1W13B).

TABLE B

| APPARATUS | TESTS | | | | | | | | | |
|------------------------------|-------|---|---|---|---|---|---|---|---|--|
| | G | H | I | J | K | L | M | N | O | |
| Pulse-repeating adapter | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Portable power supply (2.19) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Signaling test set (2.20) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Wheatstone bridge (2.21) | | 1 | | 1 | 1 | | | | | |
| VTVM (2.22) | | | | | | 1 | 1 | | | |
| Milliwatt supply (2.23) | | | | | | 1 | 1 | | | |
| Testing cord (2.24) | | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Testing cord (2.25) | | 1 | | | | 1 | 1 | | | |
| Testing cord (2.26) | | 1 | 1 | | | | | | | |
| Patching cord (2.27) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Patching cord (2.28) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Patching cord (2.29) | | | 1 | | | 1 | 1 | 1 | 1 | |
| Screwdriver (2.30) | | 1 | | | | | | 1 | | |
| Tool (2.31) | | 1 | | | | | | | | |

- | | |
|---|---|
| <p>2.26 Cord, W3A, 12 feet long, equipped with a 310 plug and three 365-type clips (3W3A).</p> <p>2.27 Cord, P2A, 6 feet long, equipped with two 347B plugs (2P3B).</p> <p>2.28 Cord, P2A, 6 feet long, equipped with two 347A plugs (2P1D).</p> | <p>2.29 Cord, P3E, 10 feet long, equipped with two 310 plugs (3P6F).</p> <p>2.30 Screwdriver, 4-inch, H cabinet.</p> <p>2.31 Tool, 603A, for removing 303-type relays. Use in accordance with Section 040-263-501.</p> |
|---|---|

3. PREPARATION

| STEP | ACTION | VERIFICATION |
|------|--------|--------------|
|------|--------|--------------|

All Tests

Battery Supply of Set and Zero Adjustment of Meters

- | | |
|----|---|
| 1 | <p>At signaling test set— Set all keys to normal.</p> <p>Note: The OG-BG key is normal in the OG position.</p> |
| 2 | <p>Using TST BAT cords, connect signaling test set to TST BAT supply jacks.</p> <p>Note 1: Only one pair of A and B jacks shall be connected to a given battery supply filter circuit.</p> <p>Note 2: If the signaling test set is tested at locations where TST BAT jacks are not provided power supply should be furnished in accordance with Table C.</p> <p>Note 3: When signaling test set is bay mounted, power will be cabled to test set and cords will not be required.</p> |
| 3a | <p>If using portable ac power supply KS-19653 L1— At signaling test set— Connect TST BAT cords to BAT jacks provided on power supply.</p> |
| 4a | <p>At KS-19653 L1 power supply— Adjust 48-volt ADJ potentiometer until 48-volt supply voltage equals 48-volt office battery voltage.</p> <p>Note: The KS-14510 L1 meter may be used to measure the necessary voltages.</p> |
| 5b | <p>If testing 2A signaling test set— Operate PPS key to DIAL SUPV.</p> |

Pointers of the PULSES PER SECOND and PERCENT BREAK meters indicates 0 on their

STEP

ACTION

VERIFICATION

TABLE C
POWER CONNECTIONS

| PLUG | 2B SET (V OPTION) OR 2A SET | 2B OR 2B-1 SET (W OPTION) |
|------|--|---|
| 310 | T Swbd Grd R Fil Grd S -48V Sig. Bat. | Swbd Grd Fil Grd -48V Sig Bat. (Heaters) |
| 309 | T +130V R S -24V Fil Bat. (Heaters and Cathodes) | +130V - *Filtered -48V Sig. Bat. (Cathodes) |

* The drop through the filters in the 48-volt supply caused by the load of the set reduces the voltage delivered to the set to 24 volts. The filter should be equivalent to those at locations where the set is normally used.

black scales.

Note: Allow a few minutes for test set warm up.

- 6c If testing 2B or 2B-1 signaling test set—
On signaling test set—
Operate SCALE SEL switch to 20 MA.

- 7c Operate CONT PLS key to DIAL PLS.

Note: Allow a few minutes for test set warmup.

Pointers of the PULSES PER SECOND and PERCENT BREAK meters indicate 0 on their **black** scales.

- 8d If verification for Steps 5b and 7c is not met—
Set pointers to 0 by means of turning the pointer adjustment screw on the face of each meter.

Test B

- 9 On signaling test set—
Disconnect battery cords.

- 10 Loosen the four screws near the corners of the panel and lift the panel and its attached apparatus clear of the case.

| STEP | ACTION | VERIFICATION |
|------|---|---|
| | Caution: <i>If the test set is equipped with 396A tubes, the H (heater) resistor may run uncomfortably hot.</i> | |
| 11e | If signaling test set is bay mounted— Remove appropriate fuses. | |
| 12f | If signaling test set has 48-volt heater supply— On signaling test set— Rotate SCALE SEL switch to 200V position. | |
| 13f | Connect 310 plug end of W2C cord to VM jack. | |
| 14f | Connect tip of W2C cord (other end of cord from Step 13f) to tip (white) of S3B cord. | |
| 15f | Connect ring of W2C cord (other end of cord from Step 13f) to sleeve (red) of S3B cord. | |
| 16f | Clear all cord ends to prevent crosses and grounds. | |
| 17f | Connect 310 plug of S3B cord to TST BAT A jack of power supply. | Voltmeter on signaling test set indicates approximately 48 volts. |
| 18f | Record exact reading of voltmeter in Step 17f. | |
| 19f | Subtract 8.0 from reading recorded in Step 18f. | Result is voltage used for heater tests and adjustments. |

Tests G through O

- 20a If using portable ac power supply KS-19653
L1—
Operate ON-OFF switch to ON.
- 21 At 2B-1 signaling test set—
Restore all keys to normal.
- 22 Set SCALE SEL switch to PPS.
- 23 Set ADJ % BK switch to M.
- Note:** Allow a few minutes for warmup.
- 24 At adapter—
Operate SEND LOOP keys to OUT.
- 25 Set LEAK switch to OUT.

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| STEP | ACTION | VERIFICATION |
|------|--|--------------|
| 26 | Rotate ADJ RCV LOOP control to its fully counterclockwise position (OUT). | |
| 27 | Using 2P3B cord assembly, connect E1 jack of adapter to E jack of 2B-1 signaling set. | |
| 28 | Using 2P1D cord assembly, connect M1 jack of adapter to M jack of 2B-1 signaling test set. | |

4. METHOD

| STEP | ACTION | VERIFICATION |
|------|--------|--------------|
|------|--------|--------------|

A. Test of Tubes and Pulse Relay P

Note: This test checks that the two vacuum tubes, the cold cathode gas-filled tube, the pulse relay, and the associated tube circuits are operating but not necessarily in the proper manner. Subsequent tests determine whether their operation is in the proper manner.

| | | |
|-----|---|--|
| 9 | On signaling test set— Set all keys to normal. | |
| 10 | Rotate SCALE SEL switch to PPS. | |
| 11e | If PULSES PER SECOND meter indicates 0— Tube V1 is probably defective and should be tested. (See Steps 15h through 18h.) | |
| 12f | If PERCENT BREAK meter indicates 0— Tube V2 or relay P, or both are probably defective and should be tested. (See Steps 15h through 18h). | |
| 13g | If PULSES PER SECOND meter varies so much as to make it difficult to read— Tube V3 is probably defective and should be tested (See Steps 14h through 17h.) | |
| 14h | If requirement for Step 10 is not met— Remove test battery cords. | |
| 15h | Remove fuses if testing bay mounted signaling test sets. | |
| 16h | Remove the signaling test set from its case. | |

PULSES PER SECOND and PERCENT BREAK meters indicates other than 0.

| STEP | ACTION | VERIFICATION |
|------|--|---|
| 17h | Remove the three tubes (V1, V2, and V3) and the P relay from the set and test them in accordance with the sections outlined in 1.07. | |
| 18h | Any component which is found to be defective should be replaced with a spare. | |
| 19h | Reconnect power cords or fuses to signaling test set. | |
| 20i | If tubes V1 or V2 were found to be defective— Adjust heater voltage in accordance with Test B. | |
| | Caution: If the test set is equipped with 396A tubes, the H (heater) resistor may be uncomfortably hot. | |
| 21h | Repeat Steps 9 and 10. | PULSES PER SECOND and PERCENT BREAK meters indicate other than 0. |
| 22 | Restore all keys; remove all cords. | |

B. Test and Adjustment of Tube Heater Voltage

- 20 On signaling test set—
Operate SCALE SEL switch to position corresponding to type of tube (See Table D).
- 21 Connect 310 plug end of W2C cord in VM jack.
- 22 Connect tip of W2C cord (other end of cord from Step 21) to terminal FG located on the

TABLE D

| TYPE OF TUBE | TEST OR ADJUST | SCALE SEL | BAT. HEATER SUPPLY | |
|--------------|----------------|-----------|--------------------|-------------|
| | | | —24V | —48V |
| | | | volts | |
| 407A | Test | 200V | 20 ± 1.0 | $V \pm 2.0$ |
| 396A | Test | 20V | 6.3 ± 0.3 | — |
| 407A | Adj | 20V | 20 ± 0.2 | — |
| 396A | Adj | 20V | 6.3 ± 0.1 | — |
| 407A | Adj | 200V | — | $V \pm 1.0$ |

V = Battery voltage at time of adjustment minus 8. (See Step 7 of Preparation for Test B.)

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| STEP | ACTION | VERIFICATION |
|------|--|--|
| | resistor mounting card at the rear of signaling test set. | |
| 23 | Connect ring of W2C cord (other end of cord from Step 21) to the terminal of the H (heater) resistor to which the slider is connected. | Voltmeter indicates value as shown in Table D. |
| 24g | If requirement in Step 23 is not met— Loosen the slider on the H resistor and move it until voltmeter indicates adjust value as shown in Table D. Tighten slider. | |
| 25 | Remove W3C cord. | |
| 26 | Restore all keys; remove all cords. | |

C. Test of Line (L) and Drop (D) Lamps

| | | |
|-----|--|---|
| 9b | If testing 2A signaling test set— At signaling test set— Using P3K cord, connect the L jack to the D jack. | |
| 10b | Operate TWD L key to OFF HK. | On 2A signaling test set— D lamp lighted. |
| 11b | Restore TWD L key to normal. | D lamp extinguished. |
| 12b | Operate TWD D key to OFF HK. | L lamp lighted. |
| 13b | Restore TWD D key to normal. | L lamp extinguished. |
| 14b | Remove P3K cord from L and D jacks. | |
| 15c | If testing 2B or 2B-1 signaling test set— On signaling test set— Using P3K cord, connect L jack to D jack. | |
| 16c | Operate CONT PLS key to DIAL PLS. | On 2B or 2B-1 signaling set— L lamp lighted. |
| 17c | Operate TWD L key to ON HK. | D lamp lighted. |
| 18c | Restore TWD L key to normal. | D lamp extinguished. |
| 19c | Operate TWD D key to OFF HK. | L lamp extinguished. |
| 20c | Remove P3K cord from L and D jacks. | L and D lamps are lighted. |
| 21 | Restore all keys; remove all cords. | |

| STEP | ACTION | VERIFICATION |
|------|--|---|
| D1. | Pulses-Per-Second Calibration and Range Using an Oscilloscope | |
| | <i>Caution: Do not remove the case of the oscilloscope since hazardous voltages may remain after power is disconnected.</i> | |
| 9 | At signaling test set— Using S3B cord, connect 310 plug end to SYNC jack. | |
| 10 | At oscilloscope— Using S3B cord (other end of cord from Step 9) connect as follows: <i>Tip</i> (white) to Y-SIGNAL INPUT <i>Ring</i> (blue) to TEST SIGNAL (low voltage 60-Hz source) <i>Sleeve</i> (red) to GROUND. | |
| 11b | If testing 2A signaling test set— On signaling test set— Operate PPS key to DIAL SUPV. | |
| 12c | If testing 2B or 2B-1 signaling test set— On signaling test set— Operate CONT PLS key to DIAL PLS. | |
| 13c | Rotate SCALE SEL switch to PPS. | |
| 14 | At oscilloscope— Connect power cord to source of 110-volt 60-Hz power. | |
| 15 | Operate the POWER ON switch. <i>Note:</i> Allow a few minutes for warm up. | |
| 16 | Operate the controls on the front of the oscilloscope as follows: INTENSITY to full counterclockwise SYNC SELECTOR to LINE SYNC AMPLITUDE to 0 Y-ATTENUATOR to 10 AC AMPLIFIER SWEEP RANGE between 2 and 10 SWEEP VERNIER to 50 X-AMPLITUDE to 20 Y-AMPLITUDE to 20 X-SELECTOR to RECUR SWEEP | |
| 17 | While moving the FOCUS control back and forth slowly advance the INTENSITY control. | Glow appears on face of cathode-ray tube. |

| STEP | ACTION | VERIFICATION |
|------|--|--------------|
| 18 | Adjust FOCUS control until glow forms a sharp trace. <i>Note:</i> The FOCUS control may require occasional minor readjustment. <i>Caution:</i> Do not advance the INTENSITY control farther than is necessary to give an easily visible trace in ordinary room light, or the cathode-ray tube may be damaged. If direct sunlight makes the trace hard to see, shield the face of the tube from this light. | |
| 19e | If the trace is not centered on the screen or cannot be seen— Adjust Y-POSITION and X-POSITION controls to center the trace on the screen. | |
| 20 | Adjust the X-AMPLITUDE control to make trace occupy approximately three-fourths of the width of the cathode-ray screen. | |
| 21 | Adjust the Y-AMPLITUDE control to make trace occupy approximately one-third the height of the cathode-ray screen. | |
| 22 | Adjust the SWEEP VERNIER of the oscilloscope so that eight complete voltage reversals appear on the cathode-ray screen (Fig. 1). | |

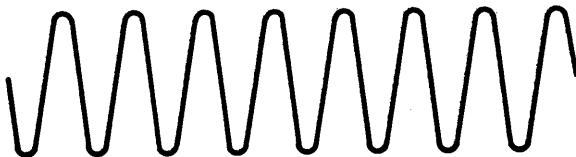


Fig. 1 – Eight Voltage Reversals

- 23 Slowly rotate SYNC AMPLITUDE control clockwise until the eight voltage reversals are firmly locked into position on the cathode-ray screen.
- Note:* Do not advance SYNC AMPLITUDE control clockwise more than necessary to ensure a firmly locked trace or distortion of the trace may occur. Occasional readjustment

| STEP | ACTION | VERIFICATION |
|--------------------------------------|--|--|
| | of the SWEEP VERNIER and the SYNC AMPLITUDE controls may be necessary during the test. | |
| Calibration at 15 and 7.5 PPS | | |
| 24b | If testing 2A signaling test set— On signaling test set— Restore PPS key to normal. | |
| 25c | If testing 2B or 2B-1 signaling test set— On signaling test set— Restore CONT PLS key to normal. | |
| 26 | Rotate ADJ PPS control clockwise until highest reading is obtained on PULSES PER SECOND meter. | At oscilloscope— Two sharp pips similar to those shown in Fig. 2 appear on the cathode-ray tube along with waves. |
| 27f | If pips travel along the trace— On signaling test set— Rotate ADJ PPS control counterclockwise until pips stand still or travel the length of the trace in not less than 10 seconds. | Pulsing rate of signaling test set is 15 ± 0.1 pps. Note: Although the set is producing 15 pps, the PULSES PER SECOND meter may read slightly different and need not be readjusted at this time. |
| 28 | Rotate ADJ PPS control slowly counterclockwise until only one pip appears and is almost stationary on the oscilloscope cathode-ray tube. | Pulsing rate of signaling test set is now producing 7.5 ± 0.1 pps. |

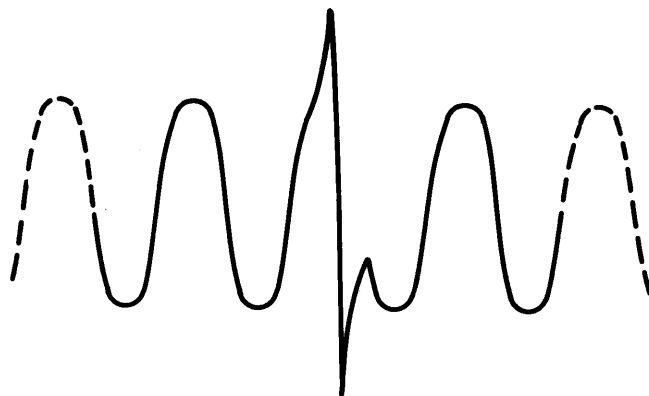


Fig. 2 – Shape of Pip

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| STEP | ACTION | VERIFICATION |
|-------------------------------------|--|--|
| <i>Calibration at 10 PPS</i> | | |
| 29 | At Oscilloscope— Adjust the SWEEP VERNIER control to produce six voltage reversals instead of eight. | |
| 30 | At signaling test set— Rotate ADJ PPS control slowly clockwise until a single pip appears and stands still or travels across the trace in not less than 10 seconds. | Signaling test set is now producing 10 ± 0.1 pps. PULSES PER SECOND meter indicates exactly 10 pps on 0-20 scale. |
| | | Note: Vibration of the pointer of the PULSES PER SECOND meter should not exceed two divisions on its scale. |
| 31g | If requirement for Step 30 is not met— Unlock CAL PPS control by loosening the knurled nut and using screwdriver adjust CAL PPS control until PULSES PER SECOND meter indicates exactly 10 pps. | |
| 32g | Relock CAL PPS control. | |

Calibration at 5 PPS

| | | |
|----|---|--|
| 33 | At signaling test set— Rotate ADJ PPS control slowly counterclockwise until the pip travels across the trace. | |
| 34 | Continue to rotate ADJ PPS control counterclockwise until pip stands still or travels across the trace in not less than 10 seconds. | At signaling test set— PULSES PER SECOND meter indicates 5 ± 0.2 pps on 0-20 scale. |
| | Note: This pip actually occurs only at every other sweep and could be mistaken for the 10 pps pip except for the precaution of making the 15 and 7.5 settings initially. | |
| 35 | At oscilloscope— Rotate INTENSITY control to 0. | |
| 36 | Operate POWER control to OFF. | |
| 37 | Restore all keys; Remove all cords. | |

D2. Pulse-Per-Second Calibration and Range Using the KS-14510 L1 Meter

| | |
|---|--|
| 9 | At signaling test set— Operate SCALE SEL switch to PPS. |
|---|--|

| STEP | ACTION | VERIFICATION |
|------|--|--------------|
| 10 | Rotate ADJ PPS control to its extreme clockwise position. | |
| 11 | Unlock the CAL PPS control by loosening the knurled knob and adjust control with a screwdriver until reading between 18 and 19 is obtained on PULSES PER SECOND meter. | |
| 12 | Operate OG-BG key to OG. | |
| 13 | Set ADJ % BK switch to S. | |
| 14 | Rotate ADJ % BK control to obtain a reading of between 10 and 20 on PERCENT BREAK meter. | |
| | <p>Note: The 10 percent setting will provide enough swing of the pointer on the KS-14510 meter to be easily seen when approaching a null point, as described later.</p> | |
| 15 | Operate PLS key to DROP. | |
| 16 | Operate TWD D key to OFF HK. | |
| 17 | At KS-14510 meter— Operate FUNCTION switch to 3 or 12 volt dc position. | |
| 18 | Connect power to KS-14510 meters negative terminal as shown in Fig. 3. | |

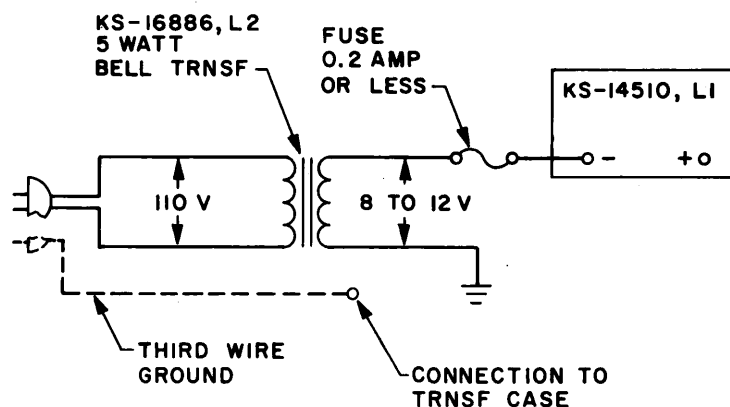


Fig. 3 – Transformer Connections

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| STEP | ACTION | VERIFICATION |
|-------------|--|---|
| 19 | Using S3B cord, connect tip (white) to positive terminal on KS-14510 meter. | |
| 20 | At signaling test set— Connect 310 plug end of S3B cord (other end of cord from Step 19) to D jack. | |
| 21 | Rotate ADJ PPS control <i>very slowly</i> counterclockwise until pointer on KS-14510 meter increases its swing and then gradually comes to rest. Note: This is referred to as the null point. | |
| 22 | Record reading on PULSES PER SECOND meter. | |
| 23 | Continue rotating ADJ PPS control counterclockwise until next two null points are found and record readings on PULSES PER SECOND meter. | |
| 24e | If pointer on KS-14510 meter drops to 0 during test— At signaling test set— Rotate ADJ % BK control slowly clockwise until the pointer starts to vibrate again. | |
| 25f | If the difference between first and second null points is approximately 3 and that between the second and third null points is approximately 2— Rotate the ADJ PPS control accurately to the third null point. | Signaling test set is now producing 10 pps. |
| 26 | Adjust CAL PPS control so that reading of 10 is obtained on PULSES PER SECOND meter. Note: Be careful not to disturb the ADJ PPS control. The null point used for calibrating the set should not drift more than one complete oscillation in 10 seconds. | |
| 27 | Rotate ADJ PPS control very slowly clockwise and observe KS-14510 meter for next two null points. Observe and record readings on PULSES PER SECOND meter. | |
| 28 | If the null points fall between 12 ± 0.1 and 15 ± 0.2 pps respectively— | PULSES PER SECOND meter is calibrated. |

| STEP | ACTION | VERIFICATION |
|------------|---|--|
| | Relock CAL PPS control and recheck 10-, 12-, and 15-pps points. | |
| 29 | Restore all keys; remove all cords. | |
| D3. | ▶Pulse-Per-Second Calibration and Range Using Electronic Counter | |
| 9 | On electronic counter— Connect power cord to ac outlet. | |
| 10 | Connect test cord to input jack. | |
| 11 | Connect KS-6780 test clip (one end of 1W5B cord) to black lead of input cord to electronic counter. | |
| 12 | Connect 59 cord tip (on 1W11A cord) to red input lead of electronic counter. | |
| 13 | Set counter to measure frequency over a 10-second time base. | |
| 14 | Set DISPLAY CONTROL switch with arrow up. | |
| 15 | On signaling test set— Set all keys to normal. | |
| 16 | Rotate SCALE SEL switch to PPS. | |
| 17 | Rotate ADJ % BK switch to M. | |
| 18 | Insert 258D dummy plug in P jack and adjust CAL % BK potentiometer to obtain a reading of 100 on black scale of PERCENT BREAK meter. | |
| 19 | Remove 258D dummy plug. | |
| 20 | Operate CONT PLS key to DIAL PLS. | PERCENT BREAK meter indicated 0 on black scale. |
| | Note: Adjust meter pointer to obtain a 0 reading if necessary. | |
| 21 | Restore CONT PLS key to normal. | |
| 22 | Adjust ADJ PPS potentiometer to obtain a reading of 10 on PULSES PER SECOND meter. | |

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| STEP | ACTION | VERIFICATION |
|------|--------|--------------|
|------|--------|--------------|

- | | | |
|----|---|--|
| 23 | Adjust ADJ % BK potentiometer to obtain a reading of 50 on black scale. | |
| 24 | Connect 310 plug end of 1W11A cord to SYNC jack (other end of cord connected to red lead of electronic counter). | |
| 25 | Connect 310 plug end of 1W5B cord to L jack. (Other end of cord connected to black lead of electronic counter). | |

Note: Connections between signaling test set and electronic counter are shown in Fig. 4.

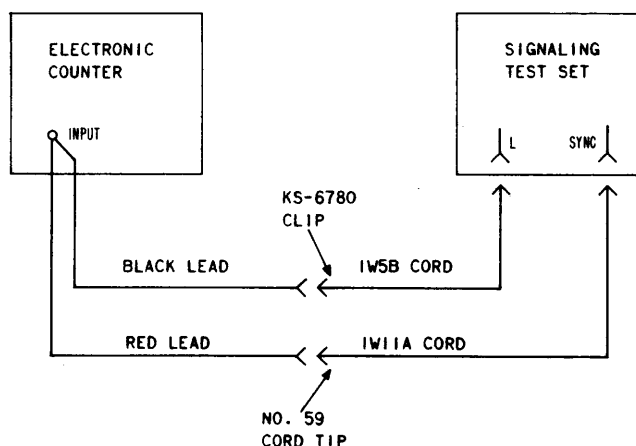


Fig. 4—Electronic Counter Connections

- | | | |
|----|-----------------------------|---------------------------------------|
| 26 | Operate OG-BG key to BG. | |
| 27 | Operate TWD-L key to ON-HK. | |
| 28 | Operate PLS key to DROP. | Electronic counter indicates 10.0 Hz. |

Note: Allow counter to register for several 10-second periods before proceeding to the next step.

- | | | |
|-----|--|--|
| 29e | If electronic counter does not indicate 10.0Hz—Adjust ADJ PPS potentiometer until requirement for Step 28 can be met. | |
| 30 | Unlock the CAL PPS control by loosening the knurled nut and adjust this control with a screwdriver so that a reading of 10 is obtained on PULSES PER SECOND meter. | |

| STEP | ACTION | VERIFICATION |
|------|---|---|
| 31 | Relock the CAL PPS control. | |
| 32 | Using the values shown below for PPS, repeat Steps 22 through 28. | Electronic counter should indicate as follows for respective PPS settings: |
| | PPS | PPS ELECTRONIC COUNTER INDICATION |
| | 12 | 12 12.0 \pm 0.2 Hz |
| | 6 | 6 6.0 \pm 0.3 Hz |
| | 4 | 4 4.0 \pm 0.3 Hz |
| 33 | After signaling test set has been tested at 4 pps— Set ADJ % BK switch to L. | |
| 34 | Rotate ADJ PPS control fully counterclockwise. Note: Do not change the setting of ADJ % BK potentiometer. | |
| 35 | Record indication of electronic counter. | |
| 36 | Restore PLS key to normal. | Indication of PULSES PER SECOND meter should be \pm 4% of result from Step 35.♦ |
| 37 | Restore all keys; remove all cords. | |

E. PERCENT BREAK Meter Calibration and Range of Set

| | | |
|-----|---|--|
| 9 | At signaling test set— Insert 258D dummy plug in P jack. | PERCENT BREAK meter indicates 100 on black scale. |
| 10e | If verification for Step 9 is not met— Unlock CAL & BK potentiometer and adjust until PERCENT BREAK meter indicates 100. | |
| 11e | Relock CAL % BK control and recheck reading. | |
| 12 | Remove 258D dummy plug from P jack and restore all keys. | |

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| STEP | ACTION | VERIFICATION |
|------|---|---|
| 13 | Rotate ADJ PPS control until PULSES PER SECOND meter indicates 10. | |
| 14 | Set ADJ % BK switch to M. | |
| 15 | Rotate ADJ % BK control to its fully counterclockwise position. | |
| 16 | Set ADJ % BK switch to L. | |
| 17 | Rotate ADJ % BK control slowly clockwise until PERCENT BREAK meter suddenly indicates a lower reading and vibrates at about half the rate of the pointer of the PULSES PER SECOND meter. | PERCENT BREAK meter indicates 75 or more just before this occurs. |
| | Note: If the percent break controls are advanced too rapidly, at readings above 70, the rate of pulses produced by the set may suddenly drop to half the rate indicated on the PULSES PER SECOND meter. Once this occurs it is necessary to rotate the ADJ % BK control counterclockwise until the pointer on the PERCENT BREAK meter increases its vibrating rate to the same rate as that of the pointer on the PULSES PER SECOND meter. | |
| 18 | Rotate ADJ % BK control to approximately its center position. | |
| 19 | Set ADJ % BK switch to S. | |
| 20 | Rotate ADJ % BK control slowly counterclockwise until reading on PERCENT BREAK meter is at its minimum or until meter pointer becomes erratic. | PERCENT BREAK meter indicates 10 or less just before this occurs. |
| 21 | Rotate ADJ PPS control so that a reading of 3 is obtained on PULSES PER SECOND meter. | |
| 22 | Repeat Steps 15 through 20 then proceed to Test F. | |

F. Test of Key and Jack Contacts

- 9 At signaling test set—
Using P3K cord, connect L jack to D jack.
- 10 Operate MEAS % BK key to LINE.

| STEP | ACTION | VERIFICATION |
|------|--|---|
| 11 | Operate PLS key to DROP. | PERCENT BREAK meter indicates other than 0. |
| 12 | Restore MEAS % BK and PLS keys to normal. | |
| 13 | Operate MEAS % BK key to DROP. | |
| 14 | Operate PLS key to LINE. | PERCENT BREAK meter indicates other than 0. |
| 15 | Restore PLS and MEAS % BK keys to normal. | |
| 16 | Remove P3K cord from L and D jacks. | |
| 17 | Operate PLS key to LINE. | Battery pulses heard in test receiver. |
| 18 | Using P2A cord, connect one end to M jack. | |
| 19 | Connect one side of a test receiver to ground. | |
| 20 | Connect other side of test receiver to tip of P2A cord (other end of cord from Step 18). | |
| 21 | Remove P2A cord from M jack. | |
| 22 | Restore PLS key to normal. | |
| 23 | Operate OG-BG key to BG. | |
| 24 | Operate PLS key to DROP. | |
| 25 | Connect test receiver to sleeve of E jack (other side of test receiver connected to ground). | |
| 26 | Restore all keys to normal. | |
| 27 | Insert 258D dummy plug in RR jack. | Pulses of battery heard in test receiver. |
| 28 | Set SCALE SEL switch to 20MA. | |
| 29 | Operate PLS key to LINE. | |
| 30 | Connect one side of test receiver to sleeve of VM jack (other end of test receiver connected to ground). | |
| 31 | Remove 258D dummy plug from RR jack. | |
| 32 | Restore all keys to normal. | |

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| STEP | ACTION | VERIFICATION |
|------|---|---|
| 33b | If testing 2A signaling test set— At signaling test set— Using P3K cord, connect L jack to D jack. | |
| 34b | Operate TWD D key to OFF HK. | |
| 35b | Operate MEAS % BK key to LINE. | PERCENT BREAK meter indicates full scale reading. |
| 36b | Restore keys to normal. | |
| 37b | Operate TWD L key to ON HK. | |
| 38b | Operate MEAS % BK key to DROP. | PERCENT BREAK meter indicates full scale reading. |
| 39b | Restore all keys to normal. | |
| 40b | Remove P3K cord from L and D jacks. | |
| 41c | If testing 2B or 2B-1 signaling test set— At signaling test set— Using P2A cord, connect one end to E jack. | |
| 42c | Ground sleeve of P2A cord (other end of cord from Step 41c). | L lamp extinguished. |
| 43c | Remove ground from sleeve of P2A cord. | L lamp lighted. |
| 44c | Remove P2A cord from E jack and insert in M jack. | |
| 45c | Ground tip of P2A cord (other end of cord from Step 44c). | D lamp lighted. |
| 46c | Remove ground from tip of P2A cord. | D lamp extinguished. |

G. Pulsing Test of PR Relay

| | |
|----|--|
| 30 | At adapter— Set FUNCTION switch to P/C. |
| 31 | At 2B-1 signaling test set— Rotate ADJ PPS control to obtain a reading of 12 on PULSES PER SECOND meter (0-20 scale). |
| 32 | Rotate ADJ % BK control to obtain a reading of 50 on black scale of PERCENT BREAK meter. |
| 33 | Operate PLS key to LINE. |

| STEP | ACTION | VERIFICATION |
|--|--|---|
| 34 | Operate MEAS % BK key to LINE. | PERCENT BREAK meter indicates between 44 and 56 on <i>red</i> scale. |
| 35 | Restore all keys; remove all cords. | |
| H. Complete Test of CX and Miscellaneous Tests of TA and TB FUNCTION Switch Positions | | |
| 30 | At 2B-1 signaling set— Operate TWD L key to ON HK. | |
| 31 | At adapter— Disconnect power cord. | |
| 32 | Remove adapter from its case. | |
| 33 | Using 603A tool, remove PR relay from its socket. | |
| 34 | Set FUNCTION switch to CX. | |
| 35 | Using 3W4A cord, connect 310 plug end to S jack. | |
| 36 | Connect sleeve (red) and ring (black) conductors of 3W4A cord (other end of cord from Step 35) to input terminals on Wheatstone bridge. <i>Note:</i> After each Wheatstone bridge measurement restore sensitivity to minimum. | |
| 37 | Using 1W13B cord assembly, connect adapter circuit ground to sleeve (red) conductor of 3W4A cord (same end as used in Step 36). <i>Note:</i> This step checks the value of R100. Steps 38 through 40 check the connection between the sleeve of the S jack and the tip of the E1 jack when the FUNCTION switch is in the CX or TA position. | Resistance on Wheatstone bridge measures between 950 and 1050 ohms. |
| 38 | Remove end of 1W13B cord that is connected to adapter circuit ground and connect to power supply ground. | |
| 39 | At 2B-1 signaling test set— Operate MEAS % BK key to LINE. | PERCENT BREAK meter indicates 100 on <i>black</i> scale. |
| 40 | At adapter— Set FUNCTION switch to TA. | At 2B-1 signaling test set— PERCENT BREAK meter indicates 100 on <i>black</i> scale. |

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| STEP | ACTION | VERIFICATION |
|------|--|--|
| | Note: Steps 41 through 44 test connections to and the value of R104 and that C103 is not shorted when the FUNCTION switch is in the TB position. | |
| 41 | At adapter— Set FUNCTION switch to TB. | Resistance on Wheatstone bridge measures greater than 1 megohm. |
| 42 | Reinsert PR relay in its socket. | |
| 43 | At 2B-1 signaling test set— Operate TWD L key to OFF HK. | Resistance on Wheatstone bridge measures between 430 and 475 ohms. |
| 44 | Remove end of 1W13B cord from power supply ground and connect to adapter ground. | |
| 45 | At adapter— Set FUNCTION switch to CX. | Resistance on Wheatstone bridge measures between 0 and 5 ohms. |
| 46 | Remove 1W13B cord from Wheatstone bridge to adapter ground. | |
| 47 | Remove all other connections at Wheatstone bridge. | |
| | Note: <i>Do not</i> remove 310 plug of 3W4A cord from S jack. | |
| 48 | Insert adapter into its case and tighten hold-down screws. | |
| 49 | Reconnect power cord from power supply to adapter. | |
| | Note: Steps 50 through 55 check that the 48-volt battery in series with LP100 is connected to the ring of the S jack when the PR relay is operated. | |
| 50 | At 2B-1 signaling test set— Using 3W3A cord, connect 310 plug end to VM jack. | |
| 51 | Connect ring (black) conductor of 3W4A cord (other end of cord from note in Step 47) to ring (blue) conductor of 3W3A cord (other end of cord from Step 50). | |
| 52 | Connect tip (white) of 3W3A cord (other end of cord from Step 50) to ground. | |

| STEP | ACTION | VERIFICATION |
|--|--|---|
| 53 | At 2B-1 signaling test set— Set SCALE SEL switch to 200V. | |
| 54 | Operate TWD L key to ON HK. | At 2B-1 signaling test set— VOLTS DC meter indicates 0 on 0-200 scale. |
| 55 | Operate TWD L key to OFF HK. | VOLTS DC meter indicates between 40 and 55 on 0-200 scale. |
| 56 | Restore all keys; remove all cords. | |
| I. Test of the Current Reversal Network (TE Position) | | |
| 30 | At adapter— Using 3W4A cord, connect 310 plug end to S jack. | |
| 31 | At 2B-1 signaling test set— Using 3W3A cord, connect 310 plug end to VM jack. | |
| 32 | Connect tip (white) conductor of 3W3A cord (other end of cord from Step 31) to ground. | |
| 33 | Connect ring (blue) conductor (other end of cord from Step 31) to tip (white) conductor of 3W4A cord (other end of cord from Step 30). | |
| 34 | At adapter— Set FUNCTION switch to TE. | At 2B-1 signaling test set— VOLTS DC meter indicates between 18 and 28 volts on 0-200 scale. |
| 35 | Remove cords from S jack on adapter and VM jack on 2B-1 signaling test set. | |
| 36 | Remove ground from tip (white) of 3W3A cord. | |
| 37 | At adapter— Using 3P6F cord, connect S jack to R jack. | |
| 38 | At 2B-1 signaling test set— Operate MEAS % BK key to LINE. | |
| 39 | Operate TWD L key to OFF HK. | PERCENT BREAK meter indicates between 12 and 20 on black scale. |
| 40 | Operate TWD L key to ON HK. | PERCENT BREAK meter indicates 0 on black scale. |
| 41 | At adapter— Remove 3P6F cord from S and R jacks. | |

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| STEP | ACTION | VERIFICATION |
|---|---|---|
| 41 | At 2B-1 signaling test set— Set SCALE SEL switch to PPS. | |
| 42 | Restore all keys to normal. | |
| J. Test of Loop Resistance Values and Other Tests of the TA, TC, LP1 and LP2 FUNCTION Switch Positions | | |
| 30 | At adapter— Using 3W4A cord assembly, connect 310 plug end to S jack. | |
| 31 | Set FUNCTION switch to TA. | |
| 32 | Connect tip (white) and ring (black) conductors of 3W4A cord (other end of cord from Step 30) to unknown terminals on Wheatstone bridge. | |
| 33 | At 2B-1 signaling test set— Operate TWD L key to ON HK. Note: This step verifies that C102 is not shorted. | At Wheatstone bridge— Resistance measured is greater than 1 megohm. |
| 34 | Operate TWD L key to OFF HK. Note: This step shows that the PR make contact has closed and provided continuity between the tip and ring conductors of the S jack. | Resistance measured at Wheatstone bridge is between 0 and 5 ohms. |
| 35 | At adapter— Set FUNCTION switch to TC. | Resistance measured at Wheatstone bridge measures between 0 and 5 ohms. |
| 36 | Operate SEND LOOP (100) key to IN. | Resistance at Wheatstone bridge measures between 95 and 110 ohms. |
| 37 | Operate SEND LOOP (200) key to IN. | Resistance at Wheatstone bridge measures between 285 and 320 ohms. |
| 38 | Operate SEND LOOP (400) key to IN. | Resistance at Wheatstone bridge measures between 665 and 740 ohms. |
| 39 | Operate SEND LOOP (800) key to IN. | Resistance at Wheatstone bridge measures between 1425 and 1580 ohms. |
| 40 | Operate SEND LOOP (1600) key to IN. | Resistance at Wheatstone bridge measures between 2945 and 3260 ohms. |

| STEP | ACTION | VERIFICATION |
|------|--|--|
| 41 | Operate SEND LOOP (3200) key to IN. | Resistance at Wheatstone bridge measures between 5985 and 6620 ohms. |
| 42 | Set FUNCTION switch to LP1. | Resistance at Wheatstone bridge measures between 5985 and 6620 ohms. |
| 43 | Set FUNCTION switch to LP2. | Resistance at Wheatstone bridge measures between 5985 and 6620 ohms. |
| 44 | At 2B-1 signaling test set— Operate TWD L key to ON HK. | Resistance at Wheatstone bridge is greater than 1 megohm. |
| 45 | At adapter— Restore all SEND LOOP keys to OUT. | |
| 46 | Restore all keys; remove all cords. | |

K. DC Leak Tests and Other Tests of LP1, LP2, and TB FUNCTION Switch Positions

| | | |
|----|--|--|
| 30 | At adapter— Using 3W4A cord assembly, connect 310 plug end to S jack. | |
| 31 | Connect tip (white) and ring (black) conductors of 3W4A cord (other end of cord from Step 30) to unknown terminals of Wheatstone bridge. | |
| 32 | Set FUNCTION switch to LP2. | |
| 33 | Set LEAK switch to A. | Resistance at Wheatstone bridge measures between 9,700 and 10,700 ohms. |
| 34 | Set LEAK switch to B. | Resistance at Wheatstone bridge measures between 9,700 and 10,700 ohms. |
| 35 | Set LEAK switch to C. | Resistance at Wheatstone bridge measures between 9,700 and 10,700 ohms. |
| 36 | Set LEAK switch to D. | Resistance at Wheatstone bridge measures between 19,250 and 21,300 ohms. |
| 37 | Set LEAK switch to SF1. | Resistance at Wheatstone bridge measures between 14,250 and 15,750 ohms. |
| 38 | Set FUNCTION switch to LP1. | Resistance at Wheatstone bridge measures between 14,250 and 15,750 ohms. |
| | Note: Steps 33 through 38 check the dc LEAK resistance values and that C106 is not shorted. | |

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| STEP | ACTION | VERIFICATION |
|---|--|--|
| 39 | Restore LEAK switch to OUT. | |
| 40 | Set FUNCTION switch to TB. <i>Note:</i> This test checks the value of the R103 and R104 resistors in series. | Resistance at Wheatstone bridge measures between 800 and 950 ohms. |
| 41 | Restore all keys; remove all cords. | |
| L. AC Leak Tests and Other Tests of LP1, LP2, TA, and TC FUNCTION switch Positions | | |
| 30 | At adapter— Set FUNCTION switch to LP1. | |
| 31 | Set LEAK switch to OUT. | |
| 32 | Using 3P6F cord, connect S jack to 1000-Hz, 600 ohm, balanced, milliwatt supply. <i>Note:</i> The 1000-Hz tone should appear across the tip and ring of the milliwatt supply jack, and the sleeve of this jack should be open. If this jack is not available, a 600 ohm ± 5 percent, 1000-Hz oscillator with a nongrounded, balanced output may be substituted (such as 21A test set) provided the output is adjusted to deliver 1 milliwatt into 600 ohms. | |
| 33 | Using 3W4A cord, connect 310 plug end to S/R jack. | |
| 34 | Connect tip (white) and ring (black) conductors of 3W4A cord (other end of cord from Step 33) to terminals of vacuum tube voltmeter (VTVM). <i>Note:</i> If VTVM has a ground terminal the ring (black) conductor of the 3W4A cord should be connected to the terminal designated ground on the VTVM. | |
| 35 | Using 1W13B cord, connect power supply ground to ring (black) conductor of 3W4A cord (Same cord used in Step 34). | |
| 36 | At 2B-1 signaling test set— Operate TWD L key to ON HK. <i>Note:</i> If this test fails, check the tone supply for proper level, frequency, and impedance. | VTVM indicates between 1.45 and 1.65 volts ac. |

| STEP | ACTION | VERIFICATION |
|------|---|---|
| 37 | Set FUNCTION switch to TA. | VTVM indicates between 0.70 and 0.85 volt ac. |
| 38 | Set FUNCTION switch to TC. <i>Note:</i> Steps 37 and 38 check the values of R101 and C102. | VTVM indicates between 0.70 and 0.85 volt ac. |
| 39 | Set FUNCTION switch to LP1. | |
| 40 | Set LEAK switch to A. | VTVM indicates between 1.2 and 1.45 volts ac. |
| 41 | Set LEAK switch to C. | VTVM indicates between 0.68 and 0.87 volt ac. |
| 42 | Set LEAK switch to D. | VTVM indicates between 0.69 and 0.88 volt ac. |
| 43 | Set LEAK switch to D1. | VTVM indicates between 0.70 and 0.89 volt ac. |
| 44 | Set LEAK switch to SF1. | VTVM indicates between 0.68 and 0.87 volt ac. |
| 45 | Set FUNCTION switch to LP2. | VTVM indicates between 0.68 and 0.87 volt ac. |
| 46 | Restore LEAK switch to OUT. | |
| 47 | Restore all keys; remove all cords. | |

M. Tests of CF and TB FUNCTION Switch Positions

- 30 At adapter—
Set FUNCTION switch to CF.
- 31 Operate CF key to S.
- 32 Using 3P6F cord, connect CF jack to 1000-Hz, 600 ohm, balanced, milliwatt supply.

Note: The 1000-Hz tone should appear across the tip and ring of the milliwatt supply jack, and the sleeve of this jack should be open. If this jack is not available, a 600-ohm ± 5 percent, 1000-Hz oscillator with a nongrounded, balanced output may be substituted (such as 21A test set) provided the output is adjusted to deliver 1 milliwatt into 600 ohms.

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| STEP | ACTION | VERIFICATION |
|------|--|--|
| 33 | Using 3W4A cord assembly, connect 310 plug end to S/R jack. | |
| 34 | Connect tip (white) and ring (black) conductors of 3W4A cord (other end of cord from Step 33) to terminals of vacuum tube voltmeter (VTVM). Note: If VTVM has a ground terminal the ring (black) conductor of the 3W4A cord should be connected to the terminal designated ground on the VTVM. | VTVM indicates between 1.45 and 1.65 volts ac. |
| 35 | Using 1W13B cord, connect power supply ground to ring (black) conductor of 3W4A cord (Same cord used in Step 34). | |
| 36 | Operate CF key to R. | VTVM indicates less than 0.1 volt ac. |
| 37 | Remove 310 plug end of 3W4A cord from S/R jack and insert into R jack. | VTVM indicates between 1.45 and 1.65 volts ac. |
| 38 | At 2B-1 signaling test set— Operate TWD L key to ON HK. | |
| 39 | At adapter— Set FUNCTION switch to TB. | |
| 40 | Remove 310 plug end of 3P6F cord from CF jack and insert into S jack. | |
| 41 | Remove 310 plug end of 3W4A cord from R jack and insert into S/R jack. Note: Steps 38 through 41 check the values of R102 and C103. | VTVM indicates between 0.75 and 0.95 volt ac. |
| 42 | Remove 3W4A cord from VTVM and S/R jack. | |
| 43 | Remove 1W13B ground cord. | |
| 44 | Remove 3P6F cord from S jack and 1000-Hz supply. | |
| 45 | At adapter— Rotate ADJ RCV LOOP control fully clockwise. | |
| 46 | At 2B-1 signaling test set— Set SCALE SEL switch to 20 MA. | |
| 47 | Using 3P6F cord, connect CF jack of adapter to MA jack of 2B-1 signaling test set. | |

| STEP | ACTION | VERIFICATION |
|------|---|---|
| 48 | At adapter— Operate CF key to A1. | |
| 49 | Set FUNCTION switch to CF. | |
| 50 | At 2B-1 signaling test set— Operate MEAS % BK key to LINE. | At adapter— A1 relay does not operate (indicated by a reading of 100 on black scale of PERCENT BREAK meter on 2B-1 signaling test set). At signaling test set— PULSES PER SECOND meter indicates between 6.0 and 10.0 pps. |
| 52 | At adapter— Rotate ADJ RCV LOOP control slowly counterclockwise until reading on PULSES PER SECOND meter of 2B-1 signaling test set is 20. | A1 relay operates (indicated by a reading of 100 on black scale of PERCENT BREAK meter. |
| 53 | Restore all keys; remove all cords. | |

N. Pulsing Tests of A1 Relay

| | | |
|----|--|---|
| 30 | At adapter— Set FUNCTION switch to P/C. | |
| 31 | At 2B-1 signaling test set— Operate PLS key to LINE. | |
| 32 | Operate MEAS % BK key to LINE. | |
| 33 | Rotate ADJ PPS control to obtain a reading of 12 pps on PULSES PER SECOND meter. | |
| 34 | Rotate ADJ % BK control to obtain a reading of 60.5 on red scale of PERCENT BREAK meter. | |
| 35 | At adapter— Set FUNCTION switch to LP2. | |
| 36 | Operate SEND LOOP (400) and SEND LOOP (800) keys to IN. | |
| 37 | Set LEAK switch to A. | |
| 38 | Using 3P6F cord, connect S jack to R jack. Note: If the A1 relay does not meet this requirement, readjust as in Section 040-236-701 to obtain a reading of between 60 and 61 on red scale of PERCENT BREAK meter. | At 2B-1 signaling test set— PERCENT BREAK meter indicates between 58 and 63 on red scale. |

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| STEP | ACTION | VERIFICATION |
|---|---|---|
| | <i>Caution: When readjusting the A1 relay it may be necessary to remove the portable power supply from its case. If this is done, exercise caution when handling the power supply because it contains hazardous voltages (+130V, -48V, -24V).</i> | |
| 39 | Restore all keys; remove all cords. | |
| O. Final Tests of TB, TC, LP1, LP2, and CF FUNCTION Switch Positions | | |
| 30 | At 2B-1 signaling test set— Operate MEAS % BK key to LINE. | |
| 31 | At adapter— Set FUNCTION switch to TB. | |
| 32 | Using 3P6F cord, connect S/R jack to S jack. | At 2B-1 signaling test set— PERCENT BREAK meter indicates 100 on black scale. |
| 33 | Set FUNCTION switch to TC. | PERCENT BREAK meter indicates 100 on black scale. |
| 34 | Set FUNCTION switch to LP1. | PERCENT BREAK meter indicates 100 on black scale. |
| 35 | Set FUNCTION switch to LP2. | PERCENT BREAK meter indicates 100 on black scale. |
| 36 | Set FUNCTION switch to CF. <i>Note: Steps 30 through 36 test for ground on the sleeve of the S jack in the TB, TC, LP1, LP2, and CF positions.</i> | PERCENT BREAK meter indicates 100 or black scale. |
| 37 | Set FUNCTION switch to TC. | |
| 38 | Remove 310 plug end of 3P6F cord from S/R jack and insert into R jack. | |
| 39 | At 2B-1 signaling test set— Operate TWD L key to OFF HK. | PERCENT BREAK meter indicates 100 on black scale. |
| 40 | At adapter— Set FUNCTION switch to LP1. | PERCENT BREAK meter indicates 100 on black scale. |
| 41 | At 2B-1 signaling test set— Operate TWD L key to ON HK. | |

| STEP | ACTION | VERIFICATION |
|------|---|--|
| 42 | At adapter— Set FUNCTION switch to TB. <i>Note:</i> Steps 37 through 42 test the connections to the springs of the E1 and R jacks in the TC, TB, and LP1 positions. | PERCENT BREAK meter indicates between 45 and 60 on <i>black</i> scale. |
| 43 | Restore all keys; remove all cords. | |

