

**J94024C (24C) LOOP CHECKER GENERATOR**  
**ADJUSTING PROCEDURES**

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**1. GENERAL**

**1.01** This section describes methods of adjusting the 24C loop checker generator.

**1.02** This section is being reissued to include references to the SD-1A218-01 circuit associated with the No. 1 two-wire Electronic Switching System (ESS).

**1.03** This section covers both minor and complete adjustments. The procedure should be followed in sequence whenever the generator fails to meet the tests described in Section 103-344-501. If the minor adjustments fail to remedy the trouble, either make the complete adjustments or send the generator to a repair center.

**1.04 *Lettered Steps:*** A letter a or b added to a step number in Part 4 or 5 of this section indicates an action which may or may not be required depending on local conditions. Where a condition does not apply, all steps designated by that letter should be omitted.

**2. APPARATUS**

**All Adjustments**

**2.01** 23A Transmission Measuring Set (TMS) or 21A Transmission Measuring Set (TMS) and a 2AB Auxiliary Transmission Test Set.

**2.02** Test Cord, P3N cord, 3 feet long, equipped with one 310 plug and one 241A plug (3P17A cord).

**2.03** Testing Cord, P2B cord, 6 feet long, equipped with two 310 plugs (2P4C cord).

**2.04** Testing Cord, P3U cord, 7 feet long, equipped with one 310 plug and one 351A plug (3P27A cord).

**2.05** Testing Cord, W2C cord, 10 feet long, equipped with one 310 plug and two 59 cord tips (2W6A cord).

**2.06** Dial Handset, 1011G or equivalent.

**Complete Adjustments**

**2.07** Electronic Voltmeter, Hewlett-Packard Model 410B, or RCA Senior Voltohmyst (WV 98A, B, or C), or equivalent.

**2.08** Frequency Counter, Hewlett-Packard Model 524B, or equivalent.

**2.09** KS-19355, List 1 Adjuster (inductor) for adjusting 1586-type coils.

**3. PREPARATION**

**All Adjustments**

**3.01 *Using the 23A TMS:***

- (1) Set DIAL MEAS SLV key to MEAS.
- (2) Set INPUT 600 to 900 switch to 900.

**3.02 *Using the 21A TMS and 2AB auxiliary transmission test set:***

- (1) Connect the 21A set power cord to the 115-volt ac supply. Operate the power switch to ON and allow the set to warm up for 5 minutes before using for measurements.

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- (2) Patch the 21A set DET IN 600 $\Omega$  jack to the 2AB set TMS jack.
- (3) Operate 2AB keys or switches as follows:
  - (a) DIAL-SLV key to midposition.
  - (b) 2DB PAD key to OUT position.
  - (c) TEST switch to REC 900 $\Omega$  position.

**Note:** Level measurements and requirements in this practice have been corrected for the 0.5-dB loss in the 2AB auxiliary set.

### Complete Adjustments

**3.03** Connect the electronic voltmeter and frequency counter to the 115-volt ac supply. Turn switches to ON and allow 5 minutes for the sets to warm up before using for measurements.

## 4. PROCEDURE FOR MINOR ADJUSTMENTS

### Flat Output Level Adjustment

**4.01a** If the 23A set is used, connect the MEAS jack of the 23A set to the FLAT OUT CAL jack of the 24C generator. Adjust the FLAT GAIN potentiometer on the 24C generator panel until the 23A set indicates a level of  $-8.4$  dBm.

**4.02b** If the 21A and 2AB sets are used, connect the MEAS jack of the 2AB set to the FLAT OUT CAL jack of the 24C generator. Adjust the FLAT GAIN potentiometer on the 24C generator panel until the 21A set indicates a level of  $-8.9$  dBm.

**4.03** Observe the flat output level for 30 seconds. The 24C generator output should not vary from the adjusted value by more than  $\pm 0.1$  dBm during the 30-second period.

### Determination of Office Transmission Loss

**4.04** Select ten spare subscriber lines from various line link or line finder frames.

**4.05** Using the 1011G handset, the 23A TMS, or the 21A and 2AB TMS, connect the MEAS jack of the TMS to the T & R appearance of one of the subscriber lines at the HMDF.

**4.06** Operate the DIAL-SLV key to DIAL and the MON-TALK key of the handset to TALK; then dial the telephone number of the milliwatt supply.

**4.07** When tone is heard, operate the DIAL-SLV key to normal or MEAS and note the reading on the TMS.

**4.08** Repeat 4.05 through 4.07 for the remaining nine subscriber lines.

**4.09** Total the ten readings and divide by 10. This number is the office transmission loss.

**Note:** If measurements were made with the 21A and 2AB TMS, subtract 0.5 dB from the value above to correct for the loss of the 2AB auxiliary transmission set.

### Shaped Output Level Adjustment

**4.10** Block the test line OS relay (SD-98100-01) or A relay (SD-1A218-01) operated.

**4.11** Obtain the value of office loss from 4.09. This value should be recorded on the front panel of the 24C generator. Let  $x$  denote the office loss in dB.

**4.12a** If the 23A set is used, connect the MEAS jack of the 23A set to the line link, connector bank multiple, or final frame appearance of the test line (SD-98100-01) or to the trunk switching circuit or service link circuit (SD-1A218-01) associated with the 24C generator. Test connections to the 23A set shall not exceed 10 feet in length. Operate the CHECK switch on the 24C generator to its LEV CHK position. Adjust the OUT GAIN potentiometer on the 24C generator until the level indicated by the 23A set is  $x - 0.5 \pm 0.2$  dBm where  $x$  is the value of office loss, which should be recorded on the front panel of the 24C or which may be obtained from office records. Record the measurement.

### Example 1:

If  $x = 0.7$ -dB loss, then  $0.7 - 0.5 = +0.2$  dBm. The 24C generator would then be adjusted to provide an indication at the 23A set of  $+0.2 \pm 0.2$  dBm or to an indication between 0.0 and  $+0.4$  dBm.

**4.13b** If the 21A and 2AB sets are used, connect the MEAS jack of the 2AB set to the line link, connector bank multiple, or final frame appearance of the test line (SD-98100-01) or to the trunk switching circuit or service link circuit (SD-1A218-01) associated with the 24C generator. Test connections shall not exceed 10 feet in length. Operate the CHECK switch on the 24C generator to its LEV CHK position. Adjust the OUT GAIN potentiometer on the 24C generator until the 21A set indicates a level of  $x - 1.0 \pm 0.2$  dBm where  $x$  is the value of office loss, which should be recorded on the front panel of the 24C or which may be obtained from the office records. Record the measurement.

**Example 2:**

If  $x = 1.2$ -dB loss, then  $1.2 - 1.0 = +0.2$  dBm. The 24C generator would then be adjusted to provide an indication at the 21A set of  $+0.2 \pm 0.2$  dBm or to an indication between 0.0 and +0.4 dBm.

- 4.14** Remove the test connections and blocking tool from the test line OS relay or A relay.
- 4.15** Relocate the measuring equipment near the 24C generator panel.
- 4.16a** If the 23A set is used, connect the MEAS jack of the 23A set to the GEN OUT CAL jack of the 24C generator and operate the generator CHECK switch to the LEV CHK position. The level as measured at the 23A set should be within 0.5 dB of the level obtained in 4.12a. Record the measurement.
- 4.17b** If the 21A and 2AB sets are used, connect the MEAS jack of the 2AB to the GEN OUT CAL jack of the 24C generator and operate the generator CHECK switch to the LEV CHK position. The 21A set should indicate within 0.5 dB of the level obtained in 4.13b. Record the measurement.

**Output Power at 3000-Hz End of Sweep**

- 4.18** Operate the generator CHECK switch to the FREQ CHK position.
- 4.19a** If the 23A set is used, start from the clockwise end and slowly turn the FREQ CHK potentiometer R34 counterclockwise until the

23A measuring set indicates a maximum. This maximum should be  $2.8 \pm 0.7$  dB greater than the measurement obtained in 4.12a. If this measurement is not obtained, carefully adjust potentiometer R29 until the correct indication is obtained. Potentiometer R31 may also be adjusted if more range is needed.

**4.20b** If the 21A and 2AB test sets are used, start from the clockwise end and slowly turn the FREQ CHK potentiometer R34 counterclockwise until the 21A set indicates a maximum. This maximum should be  $2.8 \pm 0.7$  dB greater than the measurement obtained in 4.13b. If this measurement is not obtained, carefully adjust the FREQ ADJ 2 FINE potentiometer R29 until the correct indication is obtained. Potentiometer R31 may also be adjusted if more range is needed.

**Output Power at 1000-Hz End of Sweep**

- 4.21** Operate the CHECK switch to its FREQ CHK position.
- 4.22a** If the 23A set is used, start from the counterclockwise end and slowly turn the FREQ CHK potentiometer R34 clockwise until the 23A measuring set indicates a minimum. This minimum should be  $6.0 \pm 0.3$  dB lower than the reading obtained in 4.16a.
- 4.23b** If the 21A and 2AB sets are used, start from the counterclockwise end and slowly turn the FREQ CHK potentiometer R34 clockwise until the 21A set indicates a minimum. This minimum should be  $6.0 \pm 0.3$  dB lower than the reading obtained in 4.17b. If this measurement is not obtained, carefully adjust potentiometer R22 until correct indication is obtained.
- 4.24** Repeat the steps given in 4.19a through 4.23b alternately until the correct indications are obtained without further need of adjustment. Remove the test connections.
- 4.25** Release the 24C generator CHECK switch.

**5. PROCEDURE FOR COMPLETE ADJUSTMENTS**

**Caution:** Care should be exercised when replacing components in or making connections to the 24C loop checker generator since it utilizes solid-state components which are easily damaged by excess heat or overloads.

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**5.01** Circuit components are mounted on four plug-in circuit cards and on the front panel. Those components which are mounted on the front panel are labeled with their circuit designations.

**5.02** A coordinate system is used to identify terminal lugs on cards A, C, and D. Letters are used for the vertical columns of holes and numbers are used for the horizontal rows of holes. Thus, A-2a represents the terminal lug at coordinate 2a on card A.

**5.03** If the 24C loop checker generator is not functioning correctly, all of the voltages in the voltage table should be checked before any factory adjustments are changed. In this way it may be possible to isolate the trouble. If the trouble can be isolated to a particular circuit card, a replacement card can be obtained from Western Electric. Otherwise, the following order should be followed.

### DC Regulator

**5.04** With the CHECK switch in its OPR position, check the direct voltages at terminals C-28p, C-29p, and C-21a (see Table A).

### Swept Oscillator Test and Adjustment

**5.05** Operate the CHECK switch to the FREQ CHK position.

**5.06** Turn the FREQ CHK potentiometer R34 fully clockwise and the potentiometer R22 fully counterclockwise. Turn potentiometer R31 fully clockwise. Note and record the dc voltage measurement at terminal A-27.

**5.07** Set the direct voltage at terminal A-34p to 1.5 volts higher than at A-27e by turning potentiometer R22. The variable capacitance diode CR23 is now back-biased by 1.5 volts.

**5.08** Connect the counter to terminals A-7a and A-2a (A-2a is circuit ground). Set the swept oscillator frequency to 25,000  $\pm$ 50 Hz by adjusting inductor L11. Release the CHECK switch.

### Fixed Oscillator Test and Adjustment

**5.09** Connect the counter to terminals A-5a and A-2a (A-2a is circuit ground).

**5.10** Set the fixed oscillator frequency to 28,000  $\pm$ 50 Hz by adjusting inductor L1.

### Modulator Drive, Modulator, Buffer Amplifier, and Filter

**5.11** With the CHECK switch in the FREQ CHK position and potentiometers R34 fully clockwise and R22 fully counterclockwise, the alternating voltage at C-16f should be 0.69  $\pm$ 0.10 volt. This checks the modulator drive, modulator, buffer amplifier, and filter.

### Frequency Sweep Adjustment

**5.12** Connect the counter between terminals C-16f and C-31a (C-31a is circuit ground). Connect the dc vacuum tube voltmeter between terminals A-32d and A-2a (A-2a is circuit ground).

**5.13** Turn potentiometer R31 and potentiometer R22 fully counterclockwise.

**5.14** Operate the CHECK switch to FREQ CHK position. Starting from the counterclockwise end, slowly turn the FREQ CHK potentiometer R34 clockwise until the direct voltage at A-32d is at a minimum. This minimum shall be less than 6.0 volts.

**5.15** Slowly turn potentiometer R22 clockwise until the counter indicates approximately 1000 Hz.

**5.16** Starting from the clockwise end, slowly turn the FREQ CHK potentiometer R34 counterclockwise until the direct voltage at A-32d reaches a maximum. This maximum shall be 20  $\pm$ 4 volts.

**5.17** Slowly turn potentiometers R31 and R29 clockwise until the counter indicates approximately 3000 Hz.

**5.18** Repeat Steps 5.15 through 5.17 alternately until the end frequencies are 1000  $\pm$ 25 Hz and 3000  $\pm$ 15 Hz, respectively. Lock potentiometers R22, R29, and R31 in place. Recheck the end frequencies by repeating Steps 5.14 through 5.17 after locking the potentiometers to see that they are 1000  $\pm$ 50 Hz and 3000  $\pm$ 50 Hz, respectively.

**Output Amplifier Test**

**5.19** Check the direct voltage at terminal C-24c (see Table A).

**5.20a** If the 23A set is used, connect the 23A set to the GEN OUT CAL jack. Turn the CHECK switch to the LEV CHK position and turn the OUT GAIN potentiometer R50 over its complete range. The 23A set should indicate from less than  $-0.5$  dBm to greater than  $+2$  dBm.

**5.21b** If the 21A and 2AB sets are used, connect the MEAS jack of the 2AB to the GEN OUT CAL jack. Turn the CHECK switch to the LEV CHK position and turn the OUT GAIN potentiometer R50 over its complete range. The 21A set should indicate from less than  $-1$  dBm to greater than  $+1.5$  dBm.

**5.22** Release the CHECK switch.

**Flat Output Amplifier Test**

**5.23** Check the direct voltage at terminal D-4p (see Table A).

**5.24a** If the 23A set is used, turn the CHECK switch to the OPR position and connect the MEAS jack of 23A set to the FLAT OUT CAL jack on 24C generator. Adjust the FLAT GAIN potentiometer R80 until the 23A set indicates  $-8.4$  dBm. Observe the flat output level for at least 30 seconds. The level should not vary by more than  $\pm 0.1$  dB.

**5.25b** If the 21A and 2AB sets are used, turn the CHECK switch to the OPR position and connect the MEAS jack of the 2AB to the FLAT OUT CAL jack on the 24C generator. Adjust the FLAT GAIN potentiometer R80 until the 21A set indicates  $-8.9$  dBm. Observe the flat output level for at least 30 seconds. The level should not vary by more than  $\pm 0.1$  dB.

**Shaping Network Test**

**5.26** If the end frequencies have been set as in 5.12 through 5.18, the shaping network may be tested.

**5.27** Connect the MEAS jack of the test set to the GEN OUT CAL jack of the 24C generator.

**5.28** Turn the CHECK switch to the LEV CHK position.

**5.29a** If the 23A set is used, adjust the OUT GAIN potentiometer until the 23A set indicates a reading of 0.0 dBm.

**5.30b** If the 21A and 2AB sets are used, adjust the OUT GAIN potentiometer until the 21A set indicates a reading of 0.0 dBm.

**5.31** Turn the CHECK switch to the FREQ CHK position.

**5.32a** If the 23A set is used, start from the clockwise end and slowly turn the FREQ CHK potentiometer counterclockwise until the 23A set indicates a maximum. This maximum should be  $2.8 \pm 0.7$  dBm. Starting from the counterclockwise end, slowly turn the FREQ CHK potentiometer clockwise until the 23A set indicates a minimum. The minimum value should be  $-6.0 \pm 0.3$  dBm.

**5.33b** If the 21A and 2AB sets are used, start from the clockwise end and slowly turn the FREQ CHK potentiometer counterclockwise until the 21A set indicates a maximum. This maximum should be  $2.8 \pm 0.7$  dBm. Starting from the counterclockwise end, slowly turn the FREQ CHK potentiometer clockwise until the 21A set indicates a minimum. The minimum value should be  $-6.0 \pm 0.3$  dBm.

**Output Level**

**5.34** Reset the output level as specified in 4.10 through 4.14.

**5.35** Disconnect the test equipment.

TABLE A

DIRECT VOLTAGES	
TERMINAL	VOLTAGES
C-21a	48 ±4
C-28p	33 ±4
C-29p	18 ±2
C-24c	14.5 ±3
D-4p	6 ±2
A-30c	18.5 ±2.5
A-12p	24 ±4 when pilot light is off 0.5 ±0.15 when pilot light is on
A-20n	26 ±6
C-3n	8 ±2
A-30j	Sweeps at rate of 4 to 18 seconds
ALTERNATING VOLTAGES	
TERMINAL	VOLTAGES
A-21m	0.65 ±0.15
A-5a	5.1 ±0.5

**Note 1:** All direct voltages are negative with respect to circuit ground. All alternating voltages are referenced with respect to circuit ground.

**Note 2:** All voltages shall be measured with a voltmeter having at least a 1-megohm input impedance.