# 2600-HZ E1C OR E2C SINGLE-FREQUENCY SIGNALING CIRCUIT OUT-OF-SERVICE TESTS USING TESTING CIRCUIT SD-96519-01 OR SD-96519-02 AND 4A SIGNALING TEST SET SD-1C244-01 (J94743A)

## 1. GENERAL

**1.01** This section describes methods of making out-of-service tests of 2600-Hz single-frequency signaling circuits per SD-98086-01 or SD-98086-02 using testing circuit per SD-96519-01 or SD-96519-02. If the requirements of this section cannot be met after readjustment of potentiometers or relays, the units should be returned to a repair center, since special techniques are involved in testing and clearing trouble in some of the components.

**1.02** The tests covered are:



**1.03** The J94021A (21A) transmission measuring set is referred to in this section as the TMS.

**1.04** The J98613AY test panel (SD-96519-01 or SD-96519-02) is referred to in this section as test circuit.

**1.05** The 4A signaling test set (SD-1C244-01) is referred to in this section as 4A test set.

**1.06** ***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 each test is shown in Table A. The details of each item are covered in the paragraph indicated by the number in parentheses.

**TABLE A**

| APPARATUS | TESTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H |
| Test Circuit (2.02) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4A Test Set (2.03) | 1 | 1 | | | | 1 | 1 | |
| TMS (2.04) | 1 | | 1 | 1 | 1 | | | 1 |
| Cord (2.05) | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| Cord (2.06) | 1 | | | | | | | |
| Cord (2.07) | | | | | | | 1 | |
| 258D (dummy) Plug | 1 | | | | | 1 | | |
| Screwdriver, C | | | | 1 | 1 | | | – |
| Tool (2.08) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Blocking Tool (2.09) | √ | | – | √ | – | – | – | – |

√ As required

**2.02** Test circuit, J98613AY (SD-96519-01 or SD-96519-02) including folding test fixture J98613AC.

**2.03** 4A test set, J94743A including the E&M J94743AD and SF, J94743AA interface units.

**2.04** 21A Transmission measuring set, J94021A.

**2.05** Patching cord, P3N cord, 6 feet long, equipped with a 241 plug and a 310 plug, (3P17B cord assembly).

**2.06** Patching cord, P1P cord, 2 feet long, equipped with a KS-8585 L10 plug and a 347 plug.

**2.07** Testing cord, W2CF cord, 1 foot long, equipped with a 310 plug and one 360B tool and one 360C tool (2W17D cord assembly).

**2.08** 725A tool, used to remove signaling units from bay jacks.

**2.09** Blocking and insulating tools, as required. Use tools and apply as covered in Section 069-020-801.

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

## 3. PREPARATION

**All Tests**

1 At test circuit—
Set all keys to normal position and set attenuator controls to 0 before beginning any test.

***Note:*** The twist keys in the test circuit are operated when the white line is in the vertical position and normal when the white line is in the horizontal position.

2 Obtain release of signaling circuit in accordance with approved procedures.

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 3 | Using 725A tool as shown in Fig. 1 or 2, remove signaling unit from its in-service position. | |
| 4 | Plug SF unit into folding test fixture of test circuit. | |
| 5 | Operate 2-WIRE key, set RECEIVER switch to position 2. | |
| 6a | If test circuit is mounted in a REVERTIVE-TERMINATING bay, J98613AP—<br>Operate CT key. | |
| **Tests A, C, D, E, and H** | | |
| 7 | Using P3N cord, connect DET IN jack of TMS to SF SUP jack of test circuit.<br><br>***Note:*** The 21A TMS requires that the DET INPUT switch be set to the proper position for each measurement. The TMS indications called for as verification in this section are the combined total of the DET INPUT switch setting and the meter indication. | TMS indicates between −14.6 and −16.1 dB. |
| 8 | Disconnect cord from SF SUP jack, connect to AMP OUT jack. | TMS indicates 0 dB.<br>See Step 9B. |
| 9b | If requirement in Step 8 is not met—<br>Adjust gain control of MON amplifier to obtain 0 dB. | |
| 10 | Disconnect cord from AMP OUT jack, connect to TMS jack. | |
| **Tests A, B, F, and G** | | |
| 11 | Connect 4A test set to 110 volts ac power, operate POWER switch to ON . | |
| 12 | Equip 4A test set with E&M and SF interface units. | |
| 13 | Using P3N cord, connect LINE/R jack of 4A test set to E jack and M jack of test circuit with notched side of 241 plug toward E jack of test circuit. | |
| 14 | At 4A test set—<br>Set MS RANGE switch to 999. | |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 15 | Set SELECTOR switch to NORM. | |
| 16 | Set FUNCTION switch to MSEC BK or MSEC MK.<br><br>*Note:* When verification calls for an indication in ms make or ms break, set the FUNCTION switch accordingly to obtain the proper indication. | |
| 17 | Set READ switch to MSEC UPDATE. | |
| 18 | Set RECEIVE switch to EM. | |
| 19 | Set SEND switch to EM. | |
| 20 | Set PULSE MODE switch to CONT. | |
| 21 | Operate START-STOP key. | |
| 22 | Operate OPERATE-CLEAR key.<br><br>*Note:* The OPERATE-CLEAR and START-STOP keys are operated when the lamps behind the keys are lighted and released when the lamps are extinguished. | |

**4. METHOD**

| STEP | ACTION | VERIFICATION |
|---|---|---|
| | **A. Pulsing of Transmitter A Relay** | |
| 23 | At test circuit—<br>Set KEYERS switch to position 7. | |
| 24 | Set RECEIVER switch to position 1. | |
| 25 | At 4A test set—<br>Set PULSE PERIOD switch to 100. | |
| 26 | Set PULSE WIDTH switch to 55. | |
| 27 | Operate TWD DROP key to ON HK. | |
| 28 | Operate TWD LINE key to OFF HK. | |
| 29 | Operate PULSE/MEAS key to LINE. | |
| 30 | Set E&M CX—S/R key to E&M/CX. | |
| 31 | Operate GEN SUPV key to OFF HK. | 4A display indicates 55 ms make.<br>See Step 32c. |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 32c | If requirement in Step 31 in not met—<br>Adjust M potentiometer of test circuit to obtain 55 ms make. | |
| 33 | Set PULSE WIDTH switch to 45. | |
| 34 | Using P1P cord, connect S jack of SF unit under test to M1 jack of test circuit. | 4A display indicates 0 ms make. |
| 35 | At test circuit—<br>Set KEYERS switch to position 2. | |
| 36 | Operate E1C 1, E1C 2 keys. | |
| 37 | Depress MIN LP key. | At SF unit—<br>B relay operated.<br>A relay pulses.<br>4A display indicates between 34 and 44 ms make.<br>(If requirement is not met, check the A relay of SF unit per circuit requirement table of SD-98086). |
| 38 | Rlease MIN LP key. | |
| 39d | If adjustment was made on the A relay of SF unit—<br>Remove cord from M1 jack, restore E1C-1, E1C-2 keys, repeat Steps 33 through 37. | |
| 40e | If testing E2C unit—<br>At 4A test set—<br>Lower PULSE WIDTH switch setting until display indicates 10. | Setting on PULSE WIDTH switch is 23, $\pm$2. |
| 41e | At test circuit—<br>Simultaneously depress TMS A, TMS B keys. | TMS indicates $-$45 dBm or less power. |
| 42e | Release TMS A, TMS B keys. | |
| 43e | At 4A test set—<br>Raise PULSE WIDTH switch setting until display indicates 30. | Setting on PULSE WIDTH switch is 38, $\pm$2. |
| 44e | At test circut—<br>Simultaneously depress TMS A, TMS B keys. | TMS indicates between $-$26 and $-$31 dB. |
| 45e | At 4A test set—<br>Raise PULSE WIDTH switch setting 1 ms at a time until TMS power indication just begins to rise. | 4A display indicates between 45 and 55 ms make. |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 46e | At test circuit—<br>Release TMS A, TMS B keys. | |
| 47 | At 4A test set—<br>Set PULSE WIDTH switch 70. | |
| 48 | Depress MAX LP key. | At SF unit—<br>B relay operated. (If B relay does not operate, momentarily depress MIN LP key.)<br>A relay pulses.<br>4A display indicates between 70 and 80 ms make. (If requirement is not met, check the A relay per circuit requirement table of SD-98086.) |
| 49f | If adjustment was made on the A relay of SF unit—<br>Remove cord from M1 jack, restore E1C 1, E1C 2 keys, repeat Steps 30 through 49. | |
| 50g | If testing E2C unit—<br>Block operated B relay. | |
| 51g | At 4A test set—<br>Set PULSE WIDTH switch to 89. | A relay pulses.<br>(If A relay does not pulse, lower PULSE WIDTH switch setting until it pulses.) |
| 52g | Simultaneously depress TMS A, TMS B keys. | TMS indicates between −24 and −28 dB. |
| 53g | At 4A test set—<br>Lower PULSE WIDTH switch setting until TMS power indication just begins to lower. | Setting on PULSE WIDTH switch is 65, ±5 ms.<br><br>4A display indicates between 65 and 79 ms make. |
| 54g | Release TMS A, TMS B keys. | |
| 55g | Remove blocking tool from B relay. | |
| 56g | At test circuit—<br>Release MAX LP key. | |
| 57g | At 4A test circuit—<br>Set PULSE PERIOD switch to 333. | |
| 58g | Set PULSE WIDTH switch to 100. | |
| 59g | At test circuit—<br>Insert dummy plug into SF SUP jack. | |
| 60g | Simultaneously depress MIN LP, TMS A, TMS B keys. | TMS pointer pulsates at approximately 3 PPS. See note in Step 63g. |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 61g | Release MIN LP key. | |
| 62g | Operate MAX LP key. | |
| 63g | At 4A test set—<br>Raise PULSE WIDTH switch settings until TMS pointer just stops pulsating.<br><br>***Note:*** If requirements of Step 60f and 63f are not met, cut circuit is not functioning properly. Replace SF unit. | Setting on PULSE WIDTH switch is 266 or less. |
| 64g | Release MAX LP, TMS A TMS B keys. | |
| 65g | Remove dummy plug from SF SUP jack. | |
| 66h | If no other test are to be made—<br>Disconnect all test cords and restore all circuits to normal. | |

**B. Hold of B Relay**

| | | |
|---|---|---|
| 23 | At test circuit—<br>Set KEYERS switch to position 1. | |
| 24 | Set RECEIVER switch to position 1. | |
| 25 | At 4A test set—<br>Set PULSE PERIOD switch to 333. | |
| 26 | Set PULSE WIDTH switch to 267. | |
| 27 | Operate TWD DROP key to ON HK. | |
| 28 | Operate TWD LINE key to OFF HK. | |
| 29 | Operate PULSE/MEAS key to LINE. | |
| 30 | Set E&M/CX—S/R switch to E&M/CX. | |
| 31 | Operate GEN SUPV key to OFF HK. | |
| 32 | At test circuit—<br>Operate E1C 1, E1C 2 keys. | |
| 33 | Depress MAX LP key. | At SF unit—<br>A relay pulses.<br>B relay operated during pulsing.<br>At test circuit—<br>S lamp lighted. |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 34 | Release MAX LP key. | A, B relays released.<br>S lamp extinguished. |
| 35 | At 4A test set—<br>Release OPERATE-CLEAR key. | |
| 36 | At test circuit—<br>Depress MAX LP key. | At SF unit—<br>A, B relays operated. |
| 37 | Release MAX LP key. | A relay released.<br>In less than 1 second—<br>B relay released. |
| 38c | If no other tests are to be made—<br>Disconnect all test cords, restore all circuits to normal. | |

**C. Transmitted Tone Level**

| | | |
|---|---|---|
| 11 | At test circuit—<br>Operate E1C 1, E1C 2 keys. | |
| 12 | Set KEYERS switch to position 3. | |
| 13 | Set RECEIVER switch to position 1. | |
| 14 | Simultaneously depress TMS A, TMS B keys. | TMS indicates between −34.4 and −37 dB. |
| 15 | Release TMS A, TMS B keys. | |
| 16 | Set KEYERS switch to position 4. | |
| 17 | Simultaneously depress MAX LP, TMS A, TMS B keys. | At SF unit—<br>A, B relays operated.<br>TMS indicates less power than −45 dBm. |
| 18 | Release MAX LP key. | |
| 19 | At SF unit—<br>Manually operate B relay. | TMS indicates between −22 and −25 dB. |
| 20 | Release TMS A, TMS B keys, B relay. | |
| 21c | If no other tests are to be made—<br>Disconnect all test cords, restore all circuits to normal. | |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| | **D. Test of 4-Wire Terminating Circuit, Gain of Receiver Voice Amplifier, Blocking of Amplifier, and Insertion of Band-Elimination Network** | |
| | **2-Wire to 4-Wire Loss** | |
| 11 | Operate 1000 ~ A key. | |
| 12 | Set KEYERS switch to position 5. | |
| 13 | Set RECEIVER switch to position 2. | |
| 14 | Operate BAT LP key. | |
| 15 | Operate LP CUR 1 key. | At SF unit—<br>A, B relays operated. |
| 16 | Simultaneously depress TMS A, TMS B keys. | TMS indicates: −15 to −16.3 dB for E1C through E1C-19, E2C-10 through E2C-14 units.<br>−15.5 to 16.1 dB for E1C-20, E2C-15 and higher units. |
| 17 | Restore LP CUR 1 key. | A, B relays released.<br>TMS indicates −45 dBm or less power. |
| 18 | Operate LP CUR 1 key. | A, B relays operated. |
| 19 | Release TMS A, TMS B keys. | |
| 20 | Restore 1000 ~ A key. | TMS indicates −45 dBm or less power. |
| | **4-Wire to 2-Wire Loss** | |
| 21 | Operate 1000 ~ B key. | |
| 22 | At SF unit under test—<br>Set REC or RCV potentiometer fully counterclockwise. | TMS indicates −39 dBm or less power. |
| 23 | Set REC or RCV potentiometer fully clockwise. | TMS indicates +1 dBm or greater power. |
| 24 | Adjust REC or RCV potentiometer until TMS indicates 0 dB. | TMS indicates 0 dB. |
| 25 | Manually operate R relay. | TMS indicates not less than −1.0 dB of power. |
| 26 | Release R relay. | |
| 27 | At test circuit—<br>Simultaneously depress TMS A, TMS B keys. | TMS indicates between −14 and −18 dB. |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 28 | Operate 2W TER key. | TMS indicates at least 15 dB less power than in Step 27. |
| 29 | Release TMS A, TMS B keys. | |
| 30 | Restore 2W TER key. | |
| 31 | Restore LP CUR 1, B keys. | A, B relays released. |
| 32 | Set KEYERS switch to position 6. | |
| 33 | Set RECEIVER switch to position 4. | |
| 34 | Set attenuator to 10. | TMS indicates 0 $\pm$.2 dB.<br>See Step 35c. |
| 35c | If requirement of Step 34 is not met—<br>Adjust gain potentiometer of TST amplifier to obtain 0 dB. | |
| 36 | Set KEYERS switch to position 5. | |
| 37 | Set RECEIVER switch to position 3. | |
| 38 | Operate LP CUR 1 key. | A, B relays operated. |
| 39 | At SF unit—<br>Block nonoperated R relay. | |
| 40 | At test circuit—<br>Set KEYERS switch to position 6. | TMS indicates −36 dBm or less power. |
| 41 | At SF unit—<br>Remove blocking tool from R relay. | R relay operated.<br>See Step 42d. |
| 42d | If R relay does not operate—<br>Perform Test F, then repeat Steps 31 through 40 before continuing with test. | |
| 43 | At test circuit—<br>Restore LP CUR 1 key. | A, B relays released.<br>TMS indicates −30 dBm or less power, or if test circuit is in a REVERTIVE-TERMINATING bay and CT key is operated (see Step 6a).<br>TMS indicates −28 dBm or less power. |
| 44e | If requirements of Step 43 are not met—<br>Adjust the oscillator of the 21A TMS to 2600 Hz at a level of −15.6 dB. | |
| 44e | Using P3N cord, connect OSC OUT jack of TMS to SF TST jack of test circuit— | TMS indicates −30 dBm or less power. |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 45 | At test circuit—<br>Set KEYERS switch to position 5. | |
| 46 | Set RECEIVER switch to position 2. | At SF unit—<br>R relay released. |
| 47 | At test circuit—<br>Operate LP CUR 1 key. | At SF unit—<br>A, B relays operated. |
| 48 | At test circuit—<br>Operate 1000 ~ B key. | |
| 49 | At SF unit—<br>Adjust RCV or REC potentiometer for 4-wire to 2-wire loss as specified on circuit layout record. | TMS indicates value specified on circuit layout record, plus 0.2 dB.<br>(Additional 0.2 dB is caused by measuring a 900-ohm circuit using a 600-ohm TMS). |
| 50 | At test circuit—<br>Restore all keys to normal. | At SF unit—<br>A, B relays released. |
| 51f | If no other tests are to be made—<br>Remove all test cords, restore all circuits to normal. | |
| **E. Operate Sensitivity of Receiver Signaling Amplifier** | | |
| 11 | At test circuit—<br>Set KEYERS switch to position 6. | |
| 12 | Set RECEIVER switch to position 4. | TMS indicates 0 $\pm$.2 dB.<br>See Step 13c. |
| 13c | If requirement of Step 12 is not met—<br>Adjust gain of TST amplifier to obtain 0 dB. | |
| 14 | Set attenuator to 36. | |
| 15 | Set RECEIVER switch to position 3. | At SF unit—<br>R relay released.<br>See Step 16d. |
| 16d | If R relay operated—<br>Adjust SS potentiometer slightly counterclockwise until R relay releases. | R relay released. |
| 17 | At test circuit—<br>Set attenuator to 32. | At SF unit—<br>R relay operated.<br>See Step 18e. |
| 18e | If R relay did not operate—<br>Adjust SS potentiometer clockwise until R relay operates. | |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 19 | Repeat Steps 14 through 18e until requirements of Steps 15 and 17 are met, starting with RECEIVER switch in position 4. | |
| 20 | Set attenuator to 40. | At SF unit—<br>R relay released. |
| 21f | If no other tests are to be made—<br>Remove all test cords, restore all keys, restore all circuits to normal. | |

**F. Timing of Receiver R Relay**

***Note:*** Test E should be performed before beginning Test F.

| | | |
|---|---|---|
| 23 | Set PULSE PERIOD switch to 100. | |
| 24 | Set PULSE WIDTH switch to 55. | |
| 25 | Operate TWD LINE key to OFF HK. | |
| 26 | Operate TWD DROP key to ON HK. | |
| 27 | Operate PULSE/MEAS key to LINE. | |
| 28 | Set E&M/CX—S/R switch to E&M/CX. | |
| 29 | Operate GEN SUPV key to OFF HK. | |
| 30 | At test circuit—<br>Set KEYERS switch to position 7. | 4A display indicates 45 ms break. See Step 31c. |
| 31c | If requirement in Step 30 is not met—<br>Adjust M potentiometer of test circuit to obtain 45 ms break. | |
| 32 | Set attenuator to 11. | |
| 33 | At 4A test set—<br>Set PULSE PERIOD switch to 333. | |
| 34 | Set PULSE WIDTH switch to:<br>183 if R relay is AJ79 or 70 if R relay is AJ130. | |
| 35 | At test circuit—<br>Set KEYERS switch to position 8. | |
| 36 | Set RECEIVER switch to position 3. | At SF unit—<br>R relay pulses. |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| | | 4A display indicates:<br>146 to 219 ms break if R relay is AJ79 or 56 to 100 ms break if R relay is AJ130. |
| 37d | If testing E1C-10 or higher or E2C units—<br>Change attenuator settings in 2 dB steps from 5 to 17 dB. | 4A display indication same as in Step 36, $\pm$10 ms. |
| 38e | If R relay of SF unit is AJ130—<br>At 4A test set—<br>Set PULSE WIDTH switch to 127. | At SF unit—<br>R relay pulses.<br>4A display indicates 140 ms break or less. |
| 39f | If no other tests are to be made—<br>Remove all cords, restore all keys, restore all circuits to normal. | |

**G. Voice Amplifier Cutoff Transmitter**

| | | |
|---|---|---|
| 23 | Disconnect cord from DET IN jack of TMS, connect to FROM LINE jack of SF interface unit. | |
| 24 | At 4A test set—<br>Set MS RANGE switch to 99.9. | |
| 25 | Set RECEIVE switch to SF. | |
| 26 | Set PULSE PERIOD switch to 500. | |
| 27 | Set PULSE WIDTH switch to 50. | |
| 28 | At SF interface unit—<br>Operate PULSE/MEAS key to LINE. | |
| 29 | Operate TWD EQPT key to MON. | |
| 30 | Operate TWD LINE key to MON. | |
| 31 | Set NB-BB switch to NB. | |
| 32 | At E&M interface unit—<br>Operate TWD LINE key to OFF HK. | |
| 33 | At test circuit—<br>Set KEYERS switch to position 8. | |
| 34 | Set RECEIVER switch to position 3. | |
| 35 | Set attenuator to 12. | |

| STEP | ACTION | VERIFICATION |
|---|---|---|
| 36 | At 4A test set—<br>Operate START-STOP key. | |
| 37 | Operate OPERATE-CLEAR key. | 4A display indicates 5 to 25 ms break. |
| 38c | If no other tests are to be made—<br>Restore all keys, remove all cords, restore all circuits to normal. | |
| **H. Receiver Guard Action** | | |
| 11 | At test circuit—<br>Set KEYERS switch to position 5. | |
| 12 | Set RECEIVER switch to position 6. | TMS indicates between −18.5 and −19.5 dB. |
| 13 | Set attenuator to 32 for E1C units or 22 for E1C-( ) or E2C-( ) units. | |
| 14 | Set RECEIVER switch to position 5. | At SF unit—<br>R relay released. |
| 15 | Set KEYERS switch to position 6. | R relay remains released. |
| 16 | Set KEYERS switch to position 5. | |
| 17 | Set attenuator to 19 for E1C units or 13 for E1C-( ) or E2C-( ) units. | |
| 18 | Set KEYERS switch to position 6. | R relay operated. |
| 29 | Set KEYERS switch to position 5. | R relay released. |
| 20 | Remove all test cords, restore all keys, restore all circuits to normal. | |