

**INTERTOLL DIALING**  
**TYPE B CX, DX, AND SX SIGNALING CIRCUIT**  
**OVERALL PULSING TESTS**  
**USING PULSE REPEATING TEST SET (SD-64540-01)**  
**ON E AND M LEADS**

**1. GENERAL**

**1.01** This section describes a method of applying pulsing tests to type B CX, DX, and SX signaling circuits using pulse repeating test set SD-64540-01 and where available the pulsing test set SD-31481-01. The method of checking the pulse repeating requirements using the 2B signaling test set can be found in Section 179-708-502 and for the 4A signaling test set in Section 179-708-503.

**1.02** Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

**1.03** The tests covered are:

**A. Overall and Sectional Percent Break Pulsing at Sending End Using Pulse Repeating and Pulsing Test Set:** This test applies continuous pulses to the overall signaling circuit so that the distant end can measure the percent break of the CX, DX, or SX circuit. If troubles are encountered and built-up circuit arrangements of one or more steps of pulse repetition are involved, this test is used to apply pulses to the intermediate office.

**B. Overall and Sectional Percent Break Pulsing at Sending End Using Pulse Repeating Test Set Only:** This test applies pulses, which are generated by a dial that is calibrated to 12 pulses-per-second, to the overall signaling circuit so that the distant end can measure the percent break of the CX, DX, or SX circuit. If troubles are encountered and built-up circuit arrangements of one or more steps of pulse repetition are involved, this test is used to apply pulses to the intermediate office.

The pulses of this test are intermittent in character.

**C. Overall Percent Break Measurements of Continuous Pulses at Receiving**

**End:** This test measures the percent break of the overall CX, DX, or SX signaling circuit. The pulses are generated at the sending end by the pulsing test set and are continuous pulses.

**D. Overall Percent Break Measurements of 12 Pulses-Per-Second at Receiving**

**End:** This test measures the percent break of the overall CX, DX, or SX signaling circuit. The pulses are generated by a dial calibrated to 12 pulses-per-second and are intermittent in character.

**E. Sectional Percent Break Measurements of Continuous Pulses at Receiving**

**End:** This test locates troubles in built-up circuit arrangements of one or more steps of pulse repetition. The measurements are made at each CX or DX section. The test pulses are generated by the pulsing test set at the sending end and are continuous pulses.

**F. Sectional Percent Break Measurements of 12 Pulses-Per-Second at Receiving**

**End:** This test locates troubles in built-up circuit arrangements of one or more steps of pulse repetition. The measurements are made at each CX or DX section. The test pulses are generated at the sending end by a dial calibrated to 12 pulses-per-second.

**1.04** The test equipment specified in this section is designed to apply proper marginal tests

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(simulated critical circuit conditions) when the circuit under test and the test equipment have an applied voltage of 48.5 to 50. In those offices where power plants are normally operated at more than 50 volts, the battery voltage should be reduced and maintained within the required limits while the tests are being made.

**1.05** The methods involve the sending of dialing pulses of a definite percent break from one end of a CX, DX, or SX signaling circuit and of measuring the percent break of the pulses received at the distant end of the trunk. Limits are set for the character of the received pulse and if these limits are exceeded, a trouble condition is indicated.

**1.06** The same testing procedures are employed whether the CX, DX, or SX signaling circuits consist of a single pulsing link from one office to an adjacent office or of two or more links joined together in a tandem arrangement and involving pulse repetition at one or more intermediate offices.

**1.07** Ordinarily, it is expected that these tests will be performed on an end-to-end basis and will include all CX, DX, or SX pulsing facilities which are permanently wired together and in which no switching points are involved. Single sections of a built-up circuit are also tested in a similar manner when it is necessary to do so for the purpose of analyzing trouble or lining up the circuits initially. Typical layouts of terminal, toll, and intermediate offices showing test connections are illustrated in Fig. 1, 2, and 3.

**1.08** A tester is required at both ends of the trunk under test.

**1.09** At the sending end, the pulse repeating test set SD-64540-01 is located at the signaling circuit or at the circuit patching bay and controls the sending of pulses on the M lead from that point. When percent break measurements are being made, the pulsing test set SD-31481-01, if available, is used as the source of pulses; otherwise, the dial in the pulse repeating test set is used.

**1.10** At the receiving end, when percent break measurements are being made, another pulse repeating test set SD-64540-01 is located at either the signaling circuit or at the circuit patching bay. The received pulses on the E lead are measured for percent break by means of the percent break meter associated with this test set.

**1.11** For 2-way pulsing measurements, the same patching arrangements are used for pulsing in either direction.

**1.12** On all circuits provided with earth potential compensation, the limits given in this section assume that the EPC lead is properly wired and has continuity.

**1.13** The associated trunk should be removed from service in the approved manner at all originating offices. Care should be exercised not to send a seizure forward on any trunk which might seize equipment at the distant office prior to opening the E lead or removing the trunk from service at that point. The trunk should be restored to service when the tests are completed, except when an out-of-service failure is encountered.

**1.14 *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

### All Tests

**2.01** Pulse repeating test set SD-64540-01 (J64722A).

**2.02** 2P9A cord assembly (P2J cord, 9 feet long, equipped with two 310 plugs).

**2.03** 3P6F cord assembly (P3E cord, 10 feet long, equipped with two 310 plugs) for use when testing at signaling equipment.

**2.04** 258C plug (dummy).

**2.05** Two 258C plugs (dummy) for use when testing at the circuit patching bay. See Steps 39g and 40f in preparation.

**2.06** 3P7A cord assembly (P3E cord, 6 feet long, equipped with two 310 plugs) connected as shown in Fig. 1 for use when testing at the circuit patching bay.

**2.07** 3W3A cord assembly (W3A cord, 12 feet long, equipped with one 310 plug and 59 cord tips on the ring and sleeve). Used only when testing at the equipment bay on equipment not equipped with PLS jack.

**2.08** Operator Telephone Set.

**Tests A, C, and E**

**2.09** Pulsing test set SD-31481-01 (J34717A).

**2.10** 2P9A cord assembly (P2J cord, 9 feet long, equipped with two 310 plugs).

**2.11** 4P8A cord assembly (P4N cord, 4 feet long, equipped with two 289A plugs).

**2.12** 3P7A cord assembly (P3E cord, 6 feet long, equipped with two 310 plugs).

**2.13** 36B remote control test set.

**2.14** 310 plug with tip and ring short-circuited for use only where the pulse repeating test set is provided with an SC key.

### 3. PREPARATION

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

**Sending End**

**All Tests**

- |    |   |  |
|----|---|--|
| 1  | Establish a talking path from testboard or circuit patch bay to distant office.   |  |
| 2  | Verify that no plugs are plugged into the jack block located on the bottom end of the pulse repeating test set J64722A (SD-64540-01). |  |
| 3  | At pulse repeating test set—<br>Rotate ADJ, LK, LP, MIN and MAX potentiometers to a fully CCW position.                               |  |
| 4  | At pulse repeating test set—<br>Connect one end of 2P9A cord to BAT jack.   |  |
| 5a | If tests are being performed at the equipment—<br>Connect other end of 2P9A cord to 48-volt jack on testboard.                        |  |
| 6b | If tests are being performed at the circuit patch bay—<br>Connect other end of 2P9A cord to TEST SET JACK A.                          |  |

**Note:** To avoid grounding of the battery supply leads, connect the cord to the test set first and when disconnecting, remove the cord from the test set last.

- |   |  |  |
|---|--|--|
| 7 | At pulse repeating test set SD-64540-01—<br>Check percent break meter for zero current setting of 100. |  |
|---|--|--|

| STEP          | ACTION   | VERIFICATION |
|---------------|--|--------------|
| 8c            | If meter does not indicate 100—<br>Rotate zero adjuster screw on face of meter until pointer indicates 100 and then slightly rotate adjuster screw in opposite direction without disturbing meter pointer.   |              |
| <b>Test A</b> |  |              |
| 9             | At pulse repeating test set—<br>Connect cable from 36B remote control test set to jacks A1 and B1.   |              |
| 10            | At pulsing test set—<br>Connect one end of 2P9A cord to BAT-G jack.  |              |
| 11a           | If tests are being performed at the equipment—<br>Connect other end of 2P9A cord to 48-volt battery supply.  |              |
| 12b           | If tests are being performed at circuit patch bay—<br>Connect other end of 2P9A cord to 48-volt supply.  |              |
| 13            | At pulsing test set—<br>Connect one end of 4P8A cord to A and B jacks.   |              |
| 14            | At pulse repeating test set—<br>Connect other end of 4P8A cord to A and B jacks.   |              |
| 15            | Connect one end of 3P7A cord to INT jack.  |              |
| 16            | At pulsing test set—<br>Connect other end of 3P7A cord to TL jack.   |              |
|               | <b>Note:</b> If pulse repeating test set is wired in accordance with an issue prior to 10B, Steps 17 through 23 need not be performed. Proceed with method Step 24h in Test A at sending end.                |              |
| 17d           | If pulse repeating test set is wired in accordance with SD-64540-01, Issue 10B (or higher), perform the following tests—<br>At pulse repeating test set—<br>Operate CX IN-CX OUT key to the center position. |              |
| 18d           | Operate DS-RLS key to DS.  |              |

| STEP  | ACTION  | VERIFICATION   |
|---|---|--|
| 19d   | Operate PLS CK key.   |  |
| 20d   | At remote control test set—<br>Operate LK key.  |  |
| 21d   | At pulse repeating test set—<br>Adjust LK potentiometer for 60 percent break<br>reading on percent break meter.   |  |
| 22d   | Operate CX IN-CX OUT key to CX-OUT<br>position.   | Percent break meter indicates between 40<br>and 50 percent break.<br><br><b>Note:</b> If requirement is not met, the C relay<br>in the pulse repeating test set should be<br>adjusted. |
| 23  | Restore CX OUT key.   | Percent break meter should indicate 60 percent<br>break.   |
| <b>Test B</b>   |   |  |
| <b>Note:</b> If pulse repeating test set is wired<br>in accordance with an issue prior to 10B,<br>Steps 24d through 30 need not be performed.<br>Proceed with method Step 31 in Test B at<br>sending end. |   |  |
| 24d   | If pulse repeating test set is wired in accordance<br>with SD-64540-01, Issue 10B (or higher),<br>perform the following tests—<br>At pulse repeating test set—<br>Operate CX IN-CX OUT key to the center<br>position. |  |
| 25d   | Operate DS-RLS key to DS.   |  |
| 26d   | Operate PLS CK key.   |  |
| 27d   | Operate LK-LP key to LK.  |  |
| 28d   | Adjust LK potentiometer for 60 percent break<br>reading on percent break meter.   |  |
| 29d   | Operate the CX OUT key.   | Percent break meter indicates between 40<br>and 50 percent break.<br><br><b>Note:</b> If requirement is not met, the C relay<br>in the pulse repeating test set should be<br>adjusted. |
| 30  | Restore the CX OUT key.   | Percent break meter should indicate 60 percent<br>break.   |

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| STEP                 | ACTION  | VERIFICATION |
|----------------------|---|--------------|
| <b>Receiving End</b> |   |              |
| <b>All Tests</b>     |   |              |
| 31                   | Verify that no plugs are inserted into the jack block located on the bottom end of the pulse repeating test set J64722A (SD-64540-01).  |              |
| 32                   | At pulse repeating test set—<br>Rotate ADJ, LK, LP, MIN and MAX potentiometers to a fully CCW position.   |              |
| 33                   | At pulse repeating test set—<br>Check percent break meter for zero current setting of 100.  |              |
| 34c                  | If meter does not indicate 100—<br>Rotate adjust screw on face of meter until pointer indicates 100 and then slightly rotate adjust screw in opposite direction without disturbing meter pointer. |              |
| 35                   | At pulse repeating test set—<br>Connect one end of 2P9A cord to BAT jack.   |              |
| 36a                  | If tests are being performed at the equipment—<br>Connect other end of 2P9A cord to 48V jack on testboard.  |              |
| 37a                  | At pulse repeating test set—<br>Connect one end of 3P6F cord to RLY jack.   |              |
| 38a                  | At signaling circuit—<br>Connect other end of 3P6F cord to PLS jack.  |              |
| 39e                  | If PLS jack is not provided—<br>At signaling circuit—<br>Disconnect E lead at terminal strip.   |              |
| 40e                  | At pulse repeating test set—<br>Disconnect 3P6F cord from RLY jack.   |              |
| 41e                  | At pulse repeating test set—<br>Connect 310 plug of 3W3A cord to RLY jack.  |              |
| 42e                  | At signaling circuit—<br>Connect other end of 3W3A cord to E lead.  |              |
| 43b                  | If tests are being performed at circuit patch bay—<br>Connect other end of 2P9A cord to TEST SET JACK A.  |              |

| STEP | ACTION  | VERIFICATION |
|------|---|--------------|
| 44b  | At pulse repeating test set—<br>Connect 310 plug of special 3P7A cord (Fig. 1) to RLY jack.   |              |
| 45b  | At circuit patch bay—<br>Connect other end of 3P7A cord to SIG LINE or DSL jack.  |              |
|      | <b>Note:</b> In some offices the F lead is wired through the DSL jack to ground.  |              |
| 46f  | If F lead is connected to DSL jack—<br>At pulse repeating test set—<br>Insert 258C (dummy) plug in LP OUT and SX OUT jacks to provide ground.                           |              |
| 47   | Insert 258C (dummy) plug in INT jack.   |              |
| 48g  | When measurements are made at intermediate point of auxiliary pulse link circuit not equipped with pulse repeating relay—<br>At CX signaling circuit—<br>Ground F lead. |              |

#### 4. METHOD

| STEP  | ACTION  | VERIFICATION |
|---|---|--------------|
| <b>A. Overall and Sectional Percent Break Pulsing at Sending End Using Pulse Repeating and Pulsing Tests Sets</b> |   |              |
| 24h   | If pulse repeating test set is not equipped with SC key—<br>Operate and hold ADJ key.   |              |
| 25i   | If pulse repeating test set is equipped with SC key—<br>At pulsing test set—<br>Insert 310 plug that has tip and ring short-circuited into SW jack. |              |
| 26i   | Operate PR key, if provided.  |              |
| 27j   | If pulsing test set does not have PR key—<br>Operate CHK PLS key.   |              |
| 28  | At pulse repeating test set—<br>Operate DS and PLS CHK keys.  |              |
| 29  | At 36B remote control test set—<br>Momentarily operate LK key.  |              |

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| <b>STEP</b> | <b>ACTION</b>  | <b>VERIFICATION</b> |
|-------------|--|---------------------|
| 30          | At pulse repeating test set—<br>Rotate ADJ potentiometer for percent break meter indication of 0.  |                     |
| 31k         | If Step 24h was performed—<br>At pulse repeating test set—<br>Release ADJ key.   |                     |
| 32l         | If Step 25i was performed—<br>At pulsing test set—<br>Remove 310 plug from SW jack.  |                     |
| 33          | At pulse repeating test set—<br>Adjust LK potentiometer for percent break meter indication of 58.  |                     |
| 34          | Restore the PLS CHK key.   |                     |
| 35a         | If tests are being performed at equipment—<br>At pulse repeating test set—<br>Connect one end of 3P6F cord to RLY jack.                              |                     |
| 36a         | At signaling circuit testboard—<br>Connect other end of 3P6F cord to PLS jack.   |                     |
| 37e         | If PLS jack is not provided—<br>At signaling equipment—<br>Disconnect M lead at terminal strip.  |                     |
| 38e         | At pulse repeating test set—<br>Disconnect 3P6F cord from RLY jack.  |                     |
| 39e         | At pulse repeating test set—<br>Insert 310 plug of 3W3A cord to RLY jack.  |                     |
| 40e         | At signaling equipment—<br>Connect ring conductor of other end of 3W3A cord to M lead of CX relay.   |                     |
| 41b         | If tests are being performed at circuit patch bay—<br>At pulse repeating test set—<br>Insert 310 plug of special 3P7A cord (see Fig. 1) to RLY jack. |                     |
| 42b         | At circuit patch bay—<br>Insert other end of special 3P7A cord to SIG LINE or DSL jack.  |                     |
| 43          | At pulse repeating test set—<br>Operate CX OUT key.  |                     |

| STEP  | ACTION   | VERIFICATION  |
|---|--|---|
| 44m   | When tester at receiving end requests steady pulses to obtain a zero setting—<br>At pulse repeating test set—<br>Operate SC key, if provided.  |   |
| 45h   | If pulse repeating test set is not equipped with SC key—<br>Operate and hold ADJ key.  |   |
| 46n   | When receiving end indicates zero setting has been obtained and requests continuous pulses—<br>At pulse repeating test set—<br>Restore SC or ADJ key.<br><br><i>Note:</i> Continuous pulses of 58 percent break are being sent to the receiving end. | Pointer on percent break meter at sending end should be steady and rest on 100.<br><br><i>Note:</i> If the pointer is unsteady or does not rest on 100, a trouble is indicated. |
| 47o   | When tester at receiving end reports that measurements have been obtained and measurements of other trunks are desired—<br>Repeat Steps 24h through 46n.   |   |
| 48p   | If test in reverse direction is desired—<br>At pulse repeating test set—<br>Operate CX IN key and request steady closure from distant end.   | Percent break meter should indicate 0.  |
| 49p   | Perform test of Steps 51t through 54v of Test C.   |   |
| 50q   | If no other tests are to be performed—<br>Disconnect all test connections and restore all keys to normal.  |   |
| <b>B. Overall and Sectional Percent Break Pulsing at Sending End Using Pulse Repeating Test Set Only</b>  |  |   |
| <i>Note:</i> Before starting tests, verify that dial in connector block of pulse repeating test set has been adjusted to a speed of 12 pulses-per-second. |  |   |
| 31  | At pulse repeating test set—<br>Operate DS and PLS CHK keys.   |   |
| 32  | Operate and hold ADJ key.  |   |
| 33  | Rotate ADJ potentiometer for percent break meter indication of 0.  |   |
| 34  | Release ADJ key.   |   |

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| STEP | ACTION   | VERIFICATION   |
|------|--|--|
| 35   | Operate MAX key.   |  |
| 36   | Rotate MAX potentiometer for percent break meter indication of 58.   |  |
| 37   | Operate LK key.  |  |
| 38r  | If LK key is nonlock type—<br>Operate and hold LK key.   |  |
| 39   | Dial 0.  | Meter pointer may rise or fall during return of dial.  |
|      | <b>Note:</b> Rotate LK potentiometer in clockwise direction to compensate for fall of meter pointer.   | <b>Note:</b> Disregard possible slight kick of meter pointer at beginning and ending of dialing operation. |
| 40   | Dial 0 and rotate LK potentiometer until meter pointer shows little or no tendency to rise or fall from preset value of 58.                          |  |
| 41   | Restore PLS CK key.  |  |
| 42a  | If tests are being performed at equipment—<br>At pulse repeating test set—<br>Insert 310 plug of 3P6F cord in RLY jack.                              |  |
| 43a  | At signaling circuit testboard—<br>Insert 310 plug of other end of 3P6F cord in PLS jack.  |  |
| 44e  | If PLS jack is not provided—<br>At signaling equipment—<br>Disconnect M lead from terminal strip.  |  |
| 45e  | At pulse repeating test set—<br>Insert 310 plug of 3W3A cord in RLY jack.  |  |
| 46e  | At pulse repeating test set—<br>Disconnect 3P6F cord from RLY jack.  |  |
| 47e  | At signaling equipment—<br>Connect ring conductor of other end of 3W3A cord to M lead of CX relay.   |  |
| 48b  | If tests are being performed at circuit patch bay—<br>At pulse repeating test set—<br>Insert 310 plug of special 3P6F cord (see Fig. 1) in RLY jack. |  |

| STEP | ACTION  | VERIFICATION                                   |
|------|---|--|
| 49b  | At circuit patch bay—<br>Insert 310 plug of other end of special 3P6F cord (see Fig. 1) in SIG LINE or DSL jack.  |  |
| 50   | At pulse repeating test set—<br>Operate CX OUT key.   | Steady closure is being sent to receiving end. |
| 51s  | When tester at receiving end is ready to receive pulses—<br>At pulse repeating test set—<br>Dial 0 until accurate measurement of percent break output at receiving end has been obtained. |  |
| 52o  | When tester at receiving end reports that measurements have been obtained and measurements of other trunks are desired—<br>Repeat Steps 31 through 51s.                                   |  |
| 53p  | If test in reverse direction is desired—<br>At pulse repeating test set—<br>Insert dummy plug in INT jack.  | Percent break meter should indicate 0.         |
| 54p  | Operate CX IN key.  |  |
| 55p  | Perform tests of Steps 49 through 71w of Test D.  |  |
| 56q  | If no other tests are to be performed—<br>Disconnect all test connections and restore all keys to normal.   |  |

### ***Methods at Receiving End***

#### **C. Overall Percent Break Measurements of Continuous Pulses at Receiving End**

|     |  |  |
|-----|--|--|
| 49  | At pulse repeating test set—<br>Operate CX IN key.   |  |
| 50  | Request steady closure from sending end.   |  |
| 51t | If pulse repeating test set percent break meter does not indicate 0—<br>At pulse repeating test set—<br>Rotate ADJ potentiometer for indication of 0 on percent break meter. |  |
| 52  | Request pulses from sending end.   | At pulse repeating test set—<br>Percent break meter should indicate between MIN and MAX percent break as prescribed in Table A, Column A for circuit conditions given in 7.02. |

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| STEP | ACTION  | VERIFICATION  |
|------|---|---|
| 53u  | If circuit conditions are not as favorable as those indicated in 7.02 but are within working limits of circuit drawing—<br>At pulse repeating test set—<br>Observe percent break meter. | Percent break meter should indicate between MIN and MAX percent break as prescribed in Table A, Column B.<br><br><i>Note:</i> If percent break is outside of limits specified in Table A, Column B, a definite trouble is indicated. When analyzing cause of pulsing irregularities, conditions in 7.07 should be taken into account. |
| 54v  | If test of other trunks is desired—<br>Repeat Steps 49 through 53u.   |   |
| 55p  | If test in reverse direction is desired—<br>At pulse repeating and pulsing test sets—<br>Perform Preparation Steps 1 through 23 and Method Steps 24h through 47o.                       |   |
| 56q  | If no other tests are to be performed—<br>Disconnect all test connections and restore all keys to normal.   |   |

**D. Overall Percent Break Measurements of 12 Pulses-Per-Second at Receiving End**

- 49 At pulse repeating test set—  
Operate CX IN key.
- 50 Request steady closure from sending end.
- 51t If pulse repeating test set percent break meter does not indicate 0—  
At pulse repeating test set—  
Rotate ADJ potentiometer for indication of 0 on percent break meter.
- 52 Operate MIN key.
- 53 Momentarily operate RESET key.
- 54 Adjust MIN potentiometer for expected percent break meter indication as prescribed in Table A, Column A for circuit conditions given in 7.02.
- 55u If circuit conditions are not as favorable as those indicated in 7.02 but are within working limits of circuit drawing—  
At pulse repeating test set—  
Adjust MIN potentiometer for expected percent break meter indication as prescribed by Table A, Column B.

| STEP | ACTION   | VERIFICATION  |
|------|--|---|
| 56   | Restore MIN key to normal.   |   |
| 57   | Operate MAX key.   |   |
| 58   | Momentarily operate RESET key.   |   |
| 59   | Adjust MAX potentiometer for expected percent break meter indication as prescribed in Table A, Column A for circuit conditions given in 7.02.  |   |
| 60u  | If circuit conditions are not as favorable as those indicated in 7.02 but are within working limits of circuit drawing—<br>Adjust MAX potentiometer for expected percent break meter indication as prescribed in Table A, Column B.  |   |
| 61   | Request sending end to dial 0 until accurate meter reading has been recorded.<br><br><b>Note:</b> RESET key must be momentarily operated after each dialing operation.   | Percent break meter pointer should remain stationary or show a tendency to fall.<br><br><b>Note:</b> If meter pointer has tendency to rise, the indication is that the percent break of the pulses is above the limit set up on the MAX potentiometer.                                      |
| 62w  | If meter pointer rises or falls when Step 61 is performed and actual percent break output is desired—<br>Request sending end to dial 0 until measurement of rise or fall of meter pointer is completed.<br><br><b>Note:</b> RESET key must be momentarily operated after each dialing operation. | Disregard possible slight kick of meter pointer at beginning and ending of dialing operation.<br><br>At pulse repeating test set—<br>Meter pointer will rise or fall.<br><br><b>Note:</b> Disregard possible slight kick of meter pointer at the beginning and ending of dialing operation. |
| 63w  | At pulse repeating test set—<br>Rotate MAX potentiometer so meter pointer moves in same direction indicated by rise or fall of pointer during dialing operation.   |   |
| 64w  | Record meter reading.  |   |
| 65   | Restore MAX key.   |   |
| 66   | Operate MIN key.   |   |
| 67   | Momentarily operate RESET key.   |   |

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| STEP   | ACTION   | VERIFICATION   |
|--|--|--|
| 68   | Request sending end to dial 0 until accurate meter reading has been recorded.<br><br><b>Note:</b> RESET key must be momentarily operated after each dialing operation.   | Percent break meter pointer should remain stationary or show a tendency to rise.<br><br><b>Note:</b><br><br>If meter pointer has tendency to fall, the indication is that the percent break of the pulses is below the limit set up on the MIN potentiometer.<br><br>Disregard a possible slight kick of meter pointer at beginning and ending of dialing operation. |
| 69w  | If meter pointer rises or falls when Step 68 is performed and actual percent break output is desired—<br>Request sending end to dial 0 until measurement of rise or fall of meter pointer is completed.<br><br><b>Note:</b> RESET key must be momentarily operated after each dialing operation. | At pulse repeating test set—<br>Meter pointer will rise or fall.<br><br><b>Note:</b> Disregard possible slight kick of meter pointer at beginning and ending of dialing operation.   |
| 70w  | At pulse repeating test set—<br>Rotate MIN potentiometer so meter pointer moves in same direction as indicated by rise or fall of meter pointer during dialing operation.  |  |
| 71w  | Record meter reading.  |  |
| 72v  | If test of other trunks is desired—<br>Repeat Steps 49 through 71w.  |  |
| 73p  | If test in reverse direction is desired—<br>At pulse repeating test set—<br>Perform Preparation Steps 1 through 6c, 24d through 30 of Test B and Method Steps 31 through 52o of Test B.  |  |
| 74q  | If no other tests are to be performed—<br>Disconnect all test connections and restore all keys to normal.  |  |
| <b>E. Sectional Percent Break Measurements of Continuous Pulses at Receiving End</b> |  |  |
| 49   | At pulse repeating test set—<br>Operate CX IN key.   |  |
| 50   | Request steady closure from sending end.   |  |

| STEP | ACTION  | VERIFICATION  |
|------|---|---|
| 51t  | If pulse repeating test set percent break meter does not indicate 0—<br>At pulse repeating test set—<br>Rotate ADJ potentiometer for indication of 0 on percent break meter.            |   |
| 52   | Request pulses from sending end.  |   |
| 53x  | If sectional percent break measurements are taken at PLS jack—<br>At pulse repeating test set—<br>Observe percent break meter.  | Percent break meter should indicate between MIN and MAX percent break as prescribed in Table B, Column A for circuit conditions given in 7.02.  |
| 54u  | If circuit conditions are not as favorable as those indicated in 7.02 but are within working limits of circuit drawing—<br>At pulse repeating test set—<br>Observe percent break meter. | Percent break meter should indicate percent break as prescribed in Table B, Column B.<br><br><b>Note:</b> If percent break is outside of limits specified in Table B, Column B, a definite trouble is indicated. When analyzing cause of pulsing irregularities, conditions in 7.07 should be taken into account.                     |
| 55y  | If sectional percent break measurements are taken at E lead of CX section—<br>At pulse repeating test set—<br>Observe percent break meter.  | Percent break meter should indicate between MIN and MAX percent break as prescribed in Table A, Column A for circuit conditions given in 7.02.  |
| 56u  | If circuit conditions are not as favorable as those indicated in 7.02 but are within working limits of circuit drawing—<br>At pulse repeating test set—<br>Observe percent break meter. | Percent break meter should indicate between MIN and MAX percent break as prescribed in Table A, Column B.<br><br><b>Note:</b> If percent break is outside of limits specified in Table A, Column B, a definite trouble is indicated. When analyzing cause of pulsing irregularities, conditions in 7.07 should be taken into account. |
| 57v  | If test of other trunks is desired—<br>Repeat Steps 49 through 56u.   |   |
| 58g  | If no other tests are to be performed—<br>Disconnect all test connections and restore all keys to normal.   |   |

**F. Sectional Percent Break Measurements of 12 Pulses-Per-Second at Receiving End**

- 49 At pulse repeating test set—  
Operate CX IN key.
- 50 Request steady closure.

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| <b>STEP</b> | <b>ACTION</b>   | <b>VERIFICATION</b> |
|-------------|---|---------------------|
| 51t         | If pulse repeating test set percent break meter does not indicate 0—<br>At pulse repeating test set—<br>Rotate ADJ potentiometer for indication of 0 on percent break meter.  |                     |
| 52          | Operate MIN key.  |                     |
| 53          | Momentarily operate RESET key.  |                     |
| 54x         | If sectional percent break measurements are taken at PLS jack—<br>At pulse repeating test set—<br>Adjust MIN potentiometer for expected percent break meter indication as prescribed in Table B, Column A for circuit conditions given in 7.02.             |                     |
| 55u         | If circuit conditions are not as favorable as those indicated in 7.02 but are within working limits of circuit drawing—<br>Adjust MIN potentiometer for expected percent break meter indication as prescribed in Table B, Column B.                         |                     |
| 56y         | If sectional percent break measurements are taken at E lead of CX section—<br>At pulse repeating test set—<br>Adjust MIN potentiometer for expected percent break meter indication as prescribed in Table A, Column A for circuit conditions given in 7.02. |                     |
| 57u         | If circuit conditions are not as favorable as those indicated in 7.02 but are within working limits of circuit drawing—<br>Adjust MIN potentiometer for expected percent break meter indication as prescribed in Table A, Column B.                         |                     |
| 58          | Restore MIN key.  |                     |
| 59          | Operate MAX key.  |                     |
| 60          | Momentarily operate RESET key.  |                     |
| 61x         | If sectional percent break measurements are taken at PLS jack—<br>At pulse repeating test set—<br>Adjust MAX potentiometer for expected percent break meter indication as prescribed in Table   |                     |

| STEP | ACTION   | VERIFICATION  |
|------|--|---|
|      | B, Column A for circuit conditions given in 7.02.  |   |
| 62u  | If circuit conditions are not as favorable as those indicated in 7.02 but are within working limits of circuit drawing—<br>Adjust MAX potentiometer for expected percent break meter indication as prescribed in Table B, Column B.  |   |
| 63y  | If sectional percent break measurements are taken at E lead of CX section—<br>At pulse repeating test set—<br>Adjust MAX potentiometer for expected percent break meter indication as prescribed in Table A, Column A for circuit conditions given in 7.02.                                      |   |
| 64u  | If circuit conditions are not as favorable as those indicated in 7.02 but are within working limits of circuit drawing—<br>Adjust MAX potentiometer for expected percent break meter indication as prescribed in Table A, Column B.  |   |
| 65   | Request sending end to dial 0 until accurate meter reading has been recorded.<br><br><b>Note:</b> RESET key must be momentarily operated after each operation.   | Percent break meter pointer should remain stationary or show a tendency to fall.<br><br><b>Note:</b><br><br>If meter pointer has tendency to rise; the indication is that the percent break of the pulses is above the limit set up on the MAX potentiometer.                               |
| 66w  | If meter pointer rises or falls when Step 65 is performed and actual percent break output is desired—<br>Request sending end to dial 0 until measurement of rise or fall of meter pointer is completed.<br><br><b>Note:</b> RESET key must be momentarily operated after each dialing operation. | Disregard possible slight kick of meter pointer at beginning and ending of dialing operation.<br><br>At pulse repeating test set—<br>Meter pointer will rise or fall.<br><br><b>Note:</b> Disregard possible slight kick of meter pointer at the beginning and ending of dialing operation. |
| 67w  | At pulse repeating test set—<br>Rotate MAX potentiometer so meter pointer moves in same direction indicated by rise or fall of pointer during dialing operation.   |   |

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| STEP | ACTION   | VERIFICATION   |
|------|--|--|
| 68w  | Record meter reading.  |  |
| 69   | Restore MAX key.   |  |
| 70   | Operate MIN key.   |  |
| 71   | Momentarily operate RESET key.   |  |
| 72   | Request sending end to dial 0 until accurate meter reading has been recorded.<br><br><b>Note:</b> RESET key must be momentarily operated after each dialing operation.   | Percent break meter pointer should remain stationary or show tendency to rise.<br><br><b>Note:</b><br><br>If meter pointer has tendency to fall, the indication is that the percent break of the pulses is below the limit set up on the MIN potentiometer.<br><br>Disregard a possible slight kick of meter pointer at beginning and ending of dialing operation. |
| 73w  | If meter pointer rises or falls when Step 72 is performed and actual percent break output is desired—<br>Request sending end to dial 0 until measurement of rise or fall of meter pointer is completed.<br><br><b>Note:</b> RESET key must be momentarily operated after each dialing operation. | At pulse repeating test set—<br>Meter pointer will rise or fall.<br><br><b>Note:</b> Disregard possible slight kick of meter pointer at beginning and ending of dialing operation.   |
| 74w  | At pulse repeating test set—<br>Rotate MIN potentiometer so meter pointer moves in same direction as indicated by rise or fall of meter pointer during dialing operation.  |  |
| 75w  | Record meter reading.  |  |
| 76v  | If test of other trunks is desired—<br>Repeat Steps 49 through 75w.  |  |
| 77q  | If no other tests are to be performed—<br>Disconnect all test connections and restore all keys to normal.  |  |

5. OVERALL CIRCUIT REQUIREMENTS

5.01 The percent break output of the CX relay at the receiving end will usually be found to differ from the percent break input applied at the sending end. This difference represents the total distortion introduced by the circuit networks, by the line or cable, by the CX relay at the receiving

end and, where pulse repetition is involved, by the CX relay at the intermediate office and the pulse repeating relay when provided in the auxiliary pulse link circuit.

5.02 Observe that the percent break output of the CX relay is between the MIN and MAX

limits shown in Column A, Table A when the following conditions prevail on the line:

- (a) For circuits which are arranged for earth potential compensation, the earth potential to be not more than 2 percent of the maximum indicated on the circuit drawing for the working limits. Except that on circuits adjusted for a nominal earth potential, the earth potential shall not vary from that nominal earth potential more than an amount equal to 20 percent of the maximum indicated on the circuit drawing for the working limits.
- (b) For circuits which are not arranged for earth potential compensation, the earth potential to be less than 20 percent of the maximum indicated on the circuit drawing for the working limits.
- (c) The insulation resistance to be not less than three times that of the working limits shown on the circuit drawing.

**5.03** If the conditions which prevail on the line at the time of the test are not as favorable as those indicated in 5.02 but are within the working limits shown on the circuit drawing, observe that the percent break output of the CX or SX relay is between the MIN and MAX limits given in Column B, Table A.

#### **CIRCUIT ANALYSIS**

**5.04** When checking for suspected trouble conditions on CX or SX trunks involving no pulse repetition or on single sections of a built-up circuit, the following order of procedure is recommended:

- (a) Check the signal path for earth potential and for low insulation resistance in accordance with standard test room practice.
- (b) Check of CX or SX relay for mechanical and electrical adjustments as covered in the Division 040 sections covering these relays.
- (c) Check of circuit networks of each office for grounds, opens or short circuits in the equipment or wiring.
- (d) Check of strapping of resistances or of other arrangements used for compensation of the loop resistance.

- (e) Check the CX or SX relay in the sending end for contact chatter while pulses are being sent by placing a test receiver between the E lead and ground. Clicks observed in the test receiver indicate contact chatter and the balance between the network and the line should be investigated.

**5.05** A method of determining whether or not a trouble condition exists is provided by the use of Table C. The circuit may be assumed to be free of trouble if the percent break meter indicates a reading between the MIN and MAX limits shown in Column C under the following conditions:

- (a) Potential divider resistances, if provided, strapped as shown on the circuit drawing.
- (b) Strapping of resistances or of other arrangements used to compensate for loop resistance of the line properly arranged.
- (c) For circuits arranged for earth potential compensation, earth potential not to exceed 20 percent of the maximum allowable under working limits shown on the circuit drawing.
- (d) For circuits not arranged for earth potential compensation, earth potential not to exceed 20 percent of the maximum allowable under working limits shown on the circuit drawing.
- (e) Insulation resistance to be not less than three times that of the working limits shown on the circuit drawing.

**5.06** If the conditions on the line are less favorable than those indicated in 5.05 (c), (d), and (e) but are within the working limits shown on the circuit drawing, the circuit may be assumed to be free of trouble if the percent break meter indicates a reading between the MIN and MAX limits shown in Column D, Table C.

**5.07** When analyzing the cause of pulsing irregularities, the following considerations should be taken into account:

- (a) The usual pulsing performance of the circuit as shown by the records of previous tests and as compared with the present test.

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- (b) General weather conditions prevailing at the time of the test. The insulation resistance or the loop resistance of the circuit is liable to be affected by changes in humidity or temperature, particularly where open wire lines are involved.
- (c) Magnetic disturbances may cause changes in the earth potential of a circuit, affecting the pulsing performance in various degrees.

### CIRCUIT ADJUSTMENTS

**5.08** With the circuit arranged for normal operation, if the percent break output is outside of the limits specified in Table A, Column A and investigation has shown that this is not due to trouble conditions but to unfavorable or variable factors not directly under control, the MIN and MAX percent break limits given in Column B, Table A may be used as an acceptable basis for pulsing performance.

**5.09** Potential divider resistances when furnished in the signaling circuit provide a means for closely adjusting the percent break output of the relay to 59 percent. However, after the strapping of these resistances has been initially arranged at the time the intertoll trunk is placed in service, further changes in strapping for maintenance should rarely be required. Before making changes of this kind, it should be determined that no trouble conditions of any kind exist and that the earth potential and the insulation resistance of the line are within a range of values corresponding to those which normally prevail on the line.

**5.10** To change the percent break output of CX or SX circuits which are equipped with potential divider resistances, proceed as in (a) or (b) below, readjusting the output to 59 percent as nearly as possible.

- (a) To raise the percent break, change the potential divider straps in the following manner: Increase the resistance in the ground side of the potentiometer and decrease the resistance in the battery side using the smallest steps possible in each case to obtain the desired result.
- (b) To lower the percent break, change the strapping in the following manner: Decrease the resistance in the ground side of the potentiometer and increase the resistance in the

battery side, using the smallest steps possible in each case to obtain the desired result.

**5.11** Pulsing requirements and testing methods for the pulse repeating relay (PR) in the auxiliary pulse link circuit are covered in appropriate sections of Division 040 of the Plant Series. By these methods, pulses of 59 percent break are applied directly to the PR relay and the output is required to measure between 57 and 59 percent. When the output is outside of these limits and the relay is within its mechanical requirements, the adjustable strapping which is associated with the relay should be changed so that the output measures 58 percent, as nearly as possible. The procedure is as follows:

- (a) If it is required to raise the percent break output, change the strapping to decrease the resistance.
- (b) If it is required to lower the percent break output, change the strapping to increase the resistance.

**5.12** When the percent break output of a built-up trunk is outside of the limits specified and, at the same time, all of the CX, SX, and PR relays in the layout apparently meet their individual pulsing requirements, it may be caused by one of the following conditions:

- (a) One or more of the relays involved may have excessive contact chatter. A condition of this kind is not always detected by measuring the percent break output of the relay involved, yet the character of the repeated pulses may be such as to produce the results mentioned. A careful recheck of the mechanical adjustments of all relays involved will usually reveal the cause of the trouble.
- (b) If two or more of the CX or PR relays have a percent break output which tends to approach the limits in the same direction (MIN or MAX), the effect on the overall pulses may be accumulative, resulting in a percent break output which is outside of the limits specified. Under these conditions, if the circuits are provided with potential divider resistances or pulse repeating relays, the overall performance may usually be brought within desired limits by changing the strapping of the CX or PR relays in the manner described in 5.10 and 5.11. If this does not

prove adequate, slight additional corrections may be made at these points, deviating from the midpoint adjustments specified in 5.10 and 5.11 but keeping within the MIN or MAX limits specified in Table A, Column A.

6. REPORTS

6.01 The required record of these tests should be entered on the proper form.

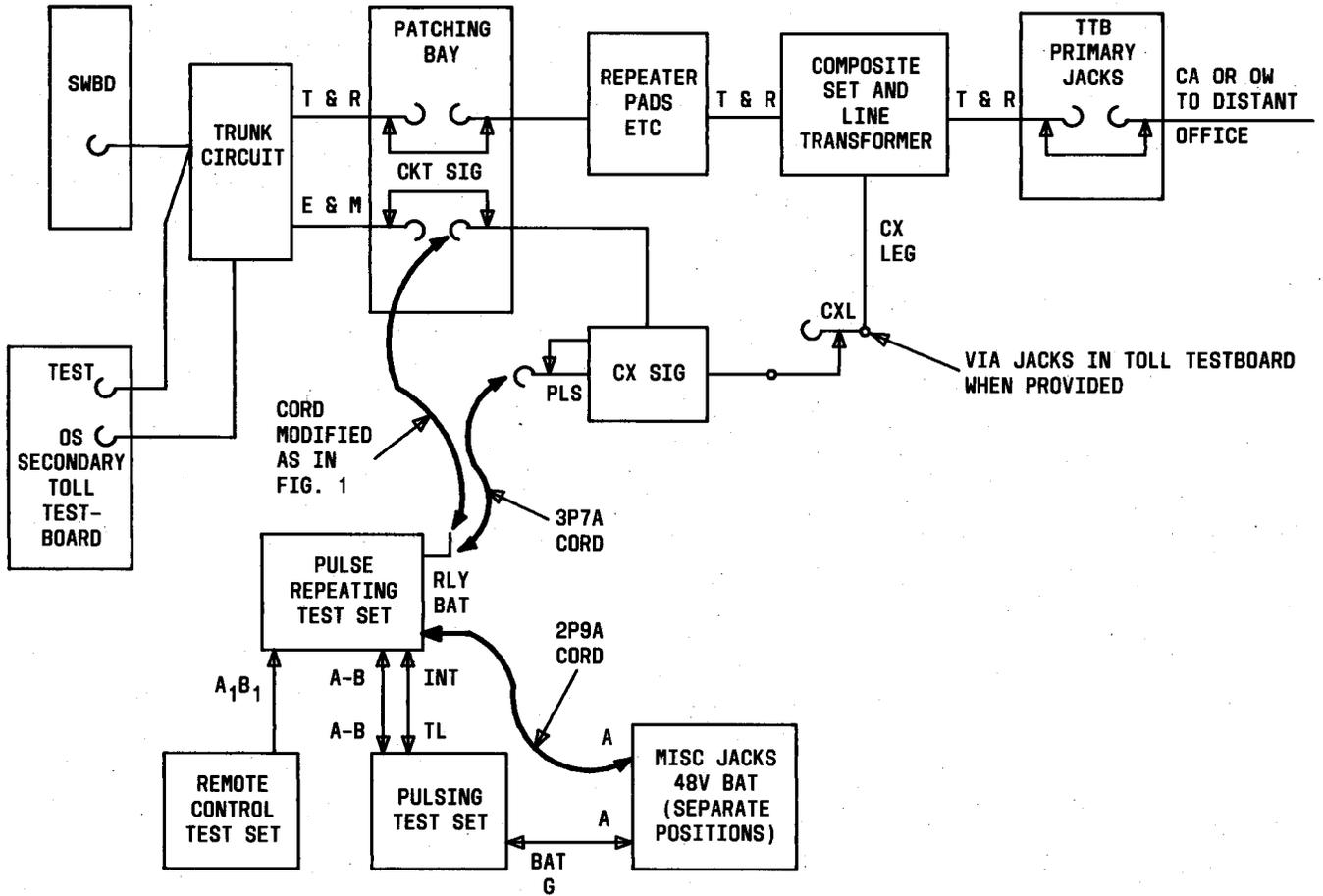


Fig. 1—Typical Layout of Terminal Office With 2A Type Showing Connections to Pulse Repeating Test Set for Sending or Receiving Dial Pulses on E and M Leads

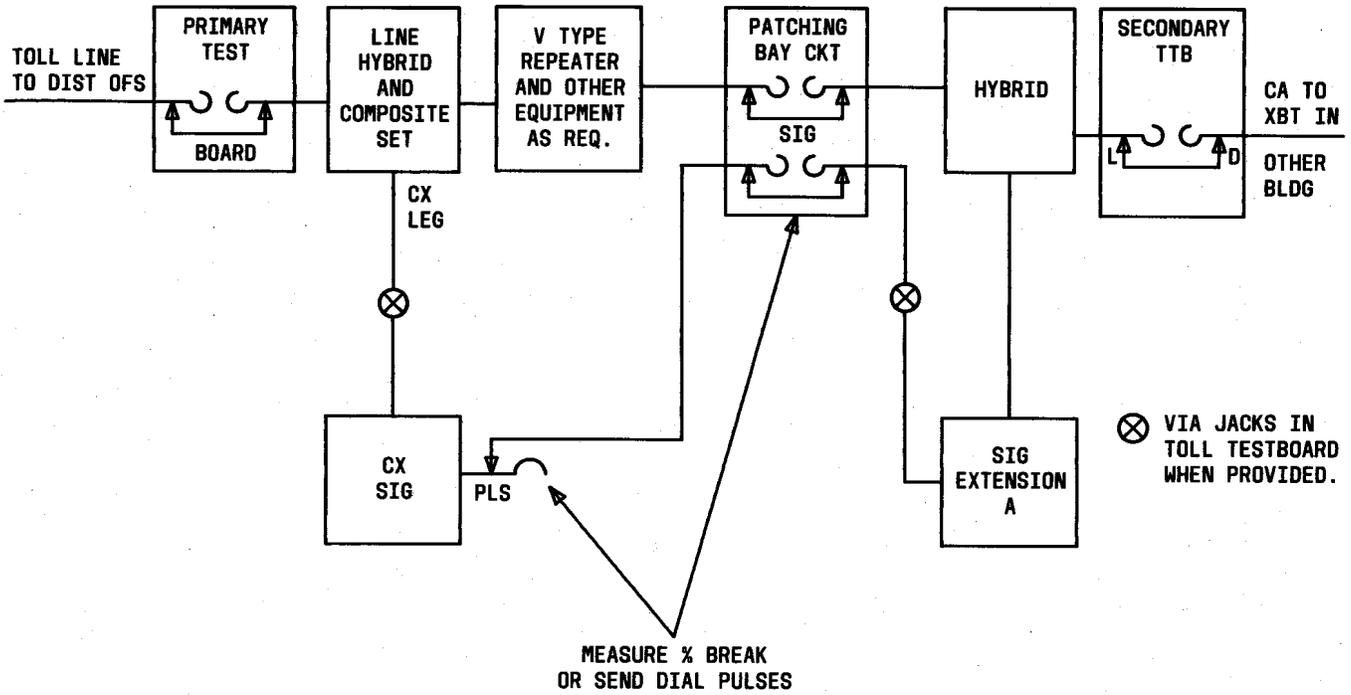
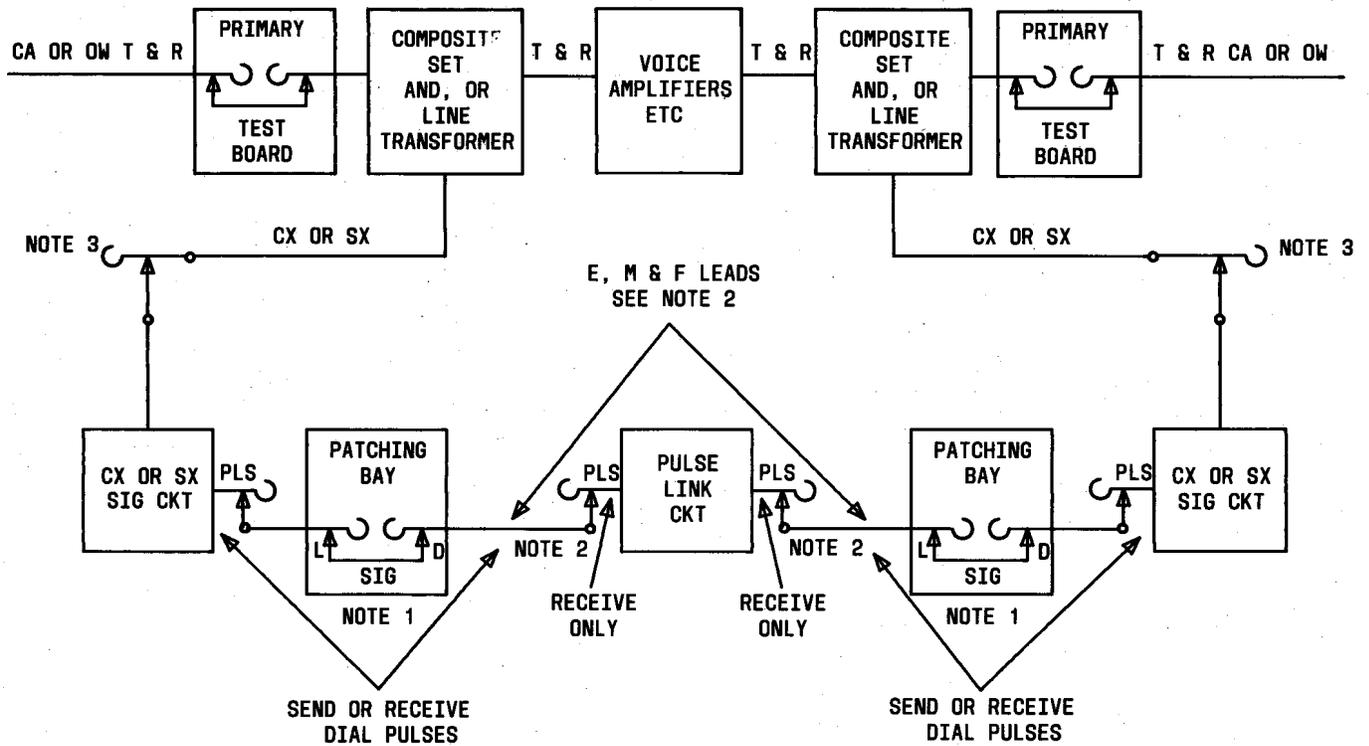


Fig. 2—Typical Layout of Toll Office With V Type Repeaters and Signal Extension Leads to Crossbar Tandem



- NOTES:
1. PROVIDED ONLY AT PATCHING POINTS.
  2. F LEAD IS GROUNDED WHEN RELAY TYPE PLR IS USED
  3. CXL OR SXL JACKS IN TESTBOARD WHEN PROVIDED

Fig. 3—Typical Layout of Intermediate Office Showing Test Points for Sectional Percent Break Measurements

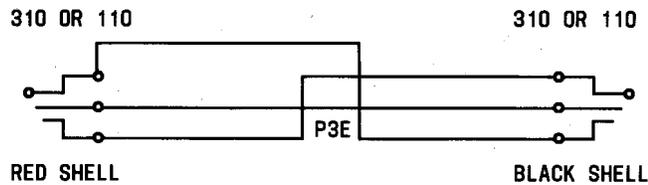


Fig. 4—Special Testing Cord

**TABLE A**  
**PERCENT BREAK OUTPUT**

| INPUT AT SENDING END,<br>58 PERCENT  | A<br>CIRCUITS WORKING UNDER<br>FAVORABLE CONDITIONS<br>WITH RESPECT TO WORK-<br>ING LIMITS |     | B<br>CIRCUITS WORKING UNDER<br>UNFAVORABLE CONDITIONS<br>WITH RESPECT TO WORK-<br>ING LIMITS |     |
|--|--|-----|--|-----|
|  | MIN  | MAX | MIN  | MAX |
| (a) Circuit arrangements not involving pulse repetition; or single links of a built-up circuit | 57   | 61  | 54   | 64  |
| (b) Circuit arrangements involving one step of pulse repetition                                |  |     |  |     |
| (1) Auxiliary pulse link circuit not equipped with pulse repeating relay                       | 56   | 62  | 52   | 66  |
| (2) Auxiliary pulse link circuit equipped with pulse repeating relay                           | 57   | 61  | 54   | 64  |
| (c) Circuit arrangements involving two or more steps of pulse repetition                       |  |     |  |     |
| (1) Auxiliary pulse link circuits not equipped with pulse repeating relay                      | 55   | 63  | 51   | 67  |
| (2) All auxiliary pulse link circuits equipped with pulse repeating relay                      | 57   | 61  | 54   | 64  |
| (3) Auxiliary pulse link circuits some equipped, some not equipped with pulse repeating relays | 56   | 62  | 53   | 65  |

*Note:* It is not to be expected that the readings will approach either the MIN or the MAX limits given in Column B unless the circuit is working under the worst conditions with respect to its working limits of insulation resistance, ground potential, and loop resistance. The amount of allowable variation from the values given in Column A is roughly proportionate to the severity of the conditions which exist on the line.

**TABLE B**  
**PERCENT BREAK OUTPUT**

| INPUT AT SENDING END,<br>58 PERCENT                        | A<br>CIRCUITS WORKING UNDER<br>FAVORABLE CONDITIONS<br>WITH RESPECT TO WORK-<br>ING LIMITS |     | B<br>CIRCUITS WORKING UNDER<br>UNFAVORABLE CONDITIONS<br>WITH RESPECT TO WORK-<br>ING LIMITS |     |
|--|--|-----|--|-----|
|  | MIN  | MAX | MIN  | MAX |
| Circuit arrangements involving pulse repeat-<br>ing relays | 56   | 60  | 53   | 63  |

**TABLE C**  
**PERCENT BREAK OUTPUT AT CX RELAY**

| INPUT AT SENDING END,<br>58 PERCENT |                               | C<br>CIRCUITS WORKING UNDER<br>FAVORABLE CONDITIONS<br>WITH RESPECT TO WORK-<br>ING LIMITS |     | D<br>CIRCUITS WORKING UNDER<br>UNFAVORABLE CONDITIONS<br>WITH RESPECT TO WORK-<br>ING LIMITS |     |
|-------------------------------------|-------------------------------|--|-----|--|-----|
| RELAYS                              | LOOP<br>RESISTANCE<br>IN OHMS | MIN  | MAX | MIN  | MAX |
| <b>239-TYPE</b>                     |                               |  |     |  |     |
| Cable                               | 0-3000                        | 57   | 61  | 54   | 64  |
| Cable                               | 3000-6000                     | 56   | 62  | 53   | 65  |
| Open Wire                           | 0-600                         | 57   | 61  | 54   | 64  |
| Open Wire                           | 600-1300                      | 56   | 62  | 53   | 65  |
| <b>209-TYPE</b>                     |                               |  |     |  |     |
| Cable                               | 0-6000                        | 56   | 62  | 53   | 65  |
| Cable                               | 6000-9000                     | 55   | 63  | 52   | 66  |
| Cable                               | 9000-13000                    | 54   | 64  | 51   | 67  |