INTERTOLL DIALING
TYPE B CX, DX, AND SX SIGNALING CIRCUIT
OVERALL PULSING TESTS
USING 2B TEST SET SD-56134-02 (J64730)
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 the 2B test set and associated pulse repeating adapter circuit SD-56134-02 (J64730). The method of checking the pulse repeating requirements using the pulse repeating test set SD-64540-01 and where available the pulsing test set SD-31481-01 can be found in Section 179-708-501.

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

1.03 The tests covered are:

1.04 The test equipment specified in this section is designed to apply proper marginal tests (simulated critical circuit conditions) when the circuit under test and 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, DS, 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 2B test set and associated pulse repeating adapter circuit SD-56134-02 are located at the signaling circuit or at the circuit patching bay and control the sending of pulses on the M lead from that point.

1.10 At the receiving end, when percent break measurements are being made, a 2B test set and associated pulse repeating adapter circuit are 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 the 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 (Sending and Receiving)

2.01 Two 2B test sets and associated pulse repeating adapter circuit SD-56134-02 (J64730).

2.02 Two 2P1D cord assemblies (P2A cord, length as required, equipped with 347C plugs on each end).

2.03 Two 2P3B cord assemblies (P2A cord, length as required, equipped with 347D plugs on each end).

2.04 Two 3P6F cord assemblies (P3E cord, 10 feet long, equipped with two 310 plugs).

2.05 Two modified 3P6F cord assemblies (P3E cord, 10 feet long, equipped with 310 plugs on each end). See Fig. 4.

2.06 Two 3W3A cord assemblies (W3A cord, 12 feet long, equipped with 310 plug on one end and 59 cord tips on the ring and sleeve leads of the other end).

2.07 Two grounding straps (meter lead wire with alligator clips on each end).

2.08 Two operator telephone sets.

3. PREPARATION

Sending End

All Tests

STEP	ACTION	VERIFICATION
1	Establish talking path from testboard or circuit patch bay to distant office.	
2	At 2B test set— Operate the CONT PLS, PLS, TWD L, TWD D, and MEAS % BK keys to normal position (middle position).	
3	Operate SCALE SEL switch to PPS position.	
4	Operate the ADJ % BK switch to M position.	
5a	If tests are being performed at the equipment— At 2B test set— Connect -48 volt cord to -48 volt jack on testboard.	Percent break meter should indicate 100 on black scale. L and D lamps light. Pulses-per-second meter indicates 0.
6a	At 2B test set— Connect -24 +130 volt cord to -24 +130 volt jack on testboard.	Percent break meter should indicate approximately half scale. Pulses-per-second meter should indicate approximately 12 pps.
7b	If tests are being performed at circuit patch bay— At 2B test set— Connect -48 volt cord to TEST SET JACK A on circuit patch bay.	Same as verification in Step 5a.
8b	At 2B test set— Connect -24 +130 volt cord to -24 +130 volt jack on circuit patch bay.	Same as verification in Step 6a.
9	At 2B test set— Operate CONT PLS key to DIAL PLS.	Percent break meter should indicate 0 on black scale. Pulses-per-second meter should indicate 0.
10c	If meters do not indicate 0 in Step 9— At 2B test set— Adjust zero screw adjustments for zero on black scale of percent break meter and zero on pulses-per-second meter. ***Note:*** If zero cannot be obtained in Step 10C, calibrate the 2B test set per Section 100-263-501, Test E.	

RECEIVING END

All Tests

STEP	ACTION	VERIFICATION
11	Establish talking path to sending end at testboard or circuit patch bay.	
12	At 2B test set— Operate the CONT PLS, PLS, TWD L, TWD D, and MEAS % BK keys to normal position (middle position).	
13	Operate SCALE SEL switch to PPS position.	
14	Operate ADJ % BK switch to M position.	
15	At 2B test set— Insert one end of 2P1D cord in M jack.	
16	Insert one end of 2P3B cord in E jack.	
17	At pulse repeating adapter circuit— Insert other end of 2P1D cord in M1 jack.	
18	Insert other end of 2P3B cord in E1 jack.	
19	Operate function switch to CX position.	
20a	If tests are being performed at equipment— At 2B test set— Connect -48 volt cord to -48 volt jack on testboard.	Percent break meter should indicate 100 on black scale. L and D lamps light. Pulses-per-second meter indicates 0.
21a	At 2B test set— Connect -24 +130 volt cord to -24 +130 volt jack on testboard.	Percent break meter should indicate approximately half scale. Pulses-per-second meter should indicate approximately 12 pps.
22b	If tests are being performed at circuit patch bay— At 2B test set— Connect -48 volt cord to TEST SET JACK A on circuit patch bay.	Same as verification in Step 20a.
23b	At 2B test set— Connect -24 +130 volt cord to -24 +130 volt jack on circuit patch bay.	Same as verification in Step 21a.

STEP	ACTION	VERIFICATION
24a	If tests are being performed at equipment— At pulse repeating adapter circuit— Connect one end of 3P6F cord to A1 jack.	
25a	At signaling circuit— Connect other end of 3P6F cord to PLS jack.	
26d	If PLS jack is not provided— At signaling circuit— Disconnect E lead at terminal strip.	
27d	At pulse repeating adapter circuit— Disconnect 3P6F cord from A1 jack.	
28d	Connect 310 plug of 3W3A cord to A1 jack.	
29d	At signaling circuit— Connect ring lead of 3W3A cord to E lead.	
30b	If tests are being performed at circuit patch bay— At pulse repeating adapter circuit— Connect one end of modified 3P6F cord to A1 jack.	
31b	At circuit patch bay— Connect other end of modified 3P6F cord to SIG LINE or DSL jack. ***Note:*** In some offices the F lead is wired through the DSL jack to ground.	
32e	If F lead is not grounded through DSL jack— Connect the F lead to ground with grounding strap.	

4. METHOD

STEP	ACTION	VERIFICATION
	A. Overall and Sectional Percent Break Pulsing at Sending End Using 2B Test Set	
11	At 2B test set— Insert one end of 2P1D cord in M jack.	
12	Insert one end of 2P3B cord in E jack.	

STEP	ACTION	VERIFICATION
13	At pulse repeating adapter circuit— Insert other end of 2P1D cord in M1 jack.	
14	Insert other end of 2P3B cord in E1 jack.	
15	Operate function switch to PC position.	
16	At 2B test set— Adjust the ADJ PPS control for meter indication of 12 pps.	
17	Adjust the ADJ % BK control for meter indication of 58% on black scale.	
18	At pulse repeating adapter circuit— Operate function switch to CX position.	
19a	If tests are being performed at equipment— At pulse repeating adapter circuit— Connect one end of 3P6F cord to A1 jack.	
20a	At signaling circuit— Connect other end of 3P6F cord to PLS jack.	
21d	If PLS jack is not provided— At signaling circuit— Disconnect M lead at terminal strip.	
22d	At pulse repeating adapter circuit— Disconnect 3P6F cord from A1 jack.	
23d	Connect 310 plug of 3W3A cord to A1 jack.	
24d	At signaling circuit— Connect ring lead of 3W3A cord to M lead.	
25b	If tests are being performed at circuit patch bay— At pulse repeating adapter circuit— Connect one end of modified 3P6F cord to A1 jack.	
26b	At circuit patch bay— Connect other end of modified 3P6F cord to SIG LINE or DSL jack.	
27e	When tester at receiving end requests steady closure to obtain zero setting— At 2B test set— Operate TWD L key to OFF HK.	

STEP	ACTION	VERIFICATION
28f	When receiving end indicates zero setting has been obtained and requests continuous pulses— At 2B test set— Operate TWD L key to normal position.	
29f	Operate PLS key to LINE position.	At 2B test set— Percent break meter should indicate 0 on black scale.
30g	When tester at receiving end reports that measurements have been obtained and measurements of other trunks are desired— Repeat Steps 19a through 29f.	
31h	If tests in reverse direction are desired— At 2B test set— Operate PLS key to normal.	Pulses-per-second meter should indicate 12 pps. Percent break meter should indicate 58%.
32h	Operate MEAS % BK key to LINE.	Percent break meter should indicate 0 on black scale.
33h	Perform PREPARATION Steps 12 through 32e and METHOD, Test B Steps 33 through 37g.	
34i	If no other tests are to be performed— Disconnect all test connections and restore all keys to normal.	

B. Overall Percent Break Measurements of Continuous Pulses at Receiving End

33	At 2B test set— Operate MEAS % BK key to LINE.	Percent break meter should indicate 0 on black scale.
34	Request steady closure from sending end.	At 2B test set— Percent break meter indicates 100 on black scale.

STEP	ACTION	VERIFICATION
35f	If percent break meter does not indicate 100 in Step 34— At 2B test set— Adjust CAL % BK control for meter reading of 100 on black scale.	
36	Request pulses from sending end.	At 2B test set— Percent break meter should indicate between MIN and MAX percent break as prescribed in Table A, Column A for circuit conditions given in 5.02.
37g	If circuit conditions are not as favorable as those indicated in 5.02 but are within working limits of circuit drawing— At 2B test set— Observe percent break meter.	Percent break meter should indicate between MIN and MAX percent break as prescribed in Table A, Column B. ***Note:*** 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 5.07 should be taken into account.
38h	If tests of other trunks are desired— Perform PREPARATION Steps 20a through 32e and METHOD Steps 33 through 37g of Test B.	
39i	If tests in reverse direction are desired— Perform PREPARATION Steps 1 through 10c and METHOD Steps 11 through 33h of Test A.	
40j	If no other tests are to be performed— Disconnect all test connections and restore all keys to normal.	
	C. Sectional Percent Break Measurements of Continuous Pulses at Receiving End	
33	At 2B test set— Operate MEAS % BK key to LINE.	Pulses-per-second meter should indicate 0 on black scale. Percent break meter should indicate 0 on black scale.
34	Request steady closure from sending end.	At 2B test set— Percent break meter indicates 100 on black scale.

STEP	ACTION	VERIFICATION
35f	If percent break meter does not indicate 100 in Step 34— At 2B test set— Adjust CAL % BK control for meter reading of 100 on black scale.	
36	Request pulses from sending end.	
37g	If sectional percent break measurements are taken at PLS jack— At 2B test set— 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 5.02.
38h	If circuit conditions are not as favorable as those indicated in 5.02 but are within working limits of circuit drawing— At 2B test set— Observe percent break meter.	Percent break meter should indicate percent break as prescribed in Table B, Column B. ***Note:*** 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 5.07 should be taken into account.
39i	If sectional percent break measurements are taken at E lead of CX section— At 2B test set— 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 5.02.
40h	If circuit conditions are not as favorable as those indicated in 5.02 but are within working limits of circuit drawing— At 2B test set— Observe percent break meter.	Percent break meter should indicate between MIN and MAX percent break as prescribed in Table A, Column B. ***Note:*** 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 5.07 should be taken into account.
41j	If tests of other trunks are desired— Perform PREPARATION Steps 20a through 32e and METHOD Steps 33 through 40h of Test C.	
42k	If no other tests are to be performed— 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 20 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 A 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 B, 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.

(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 when 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.

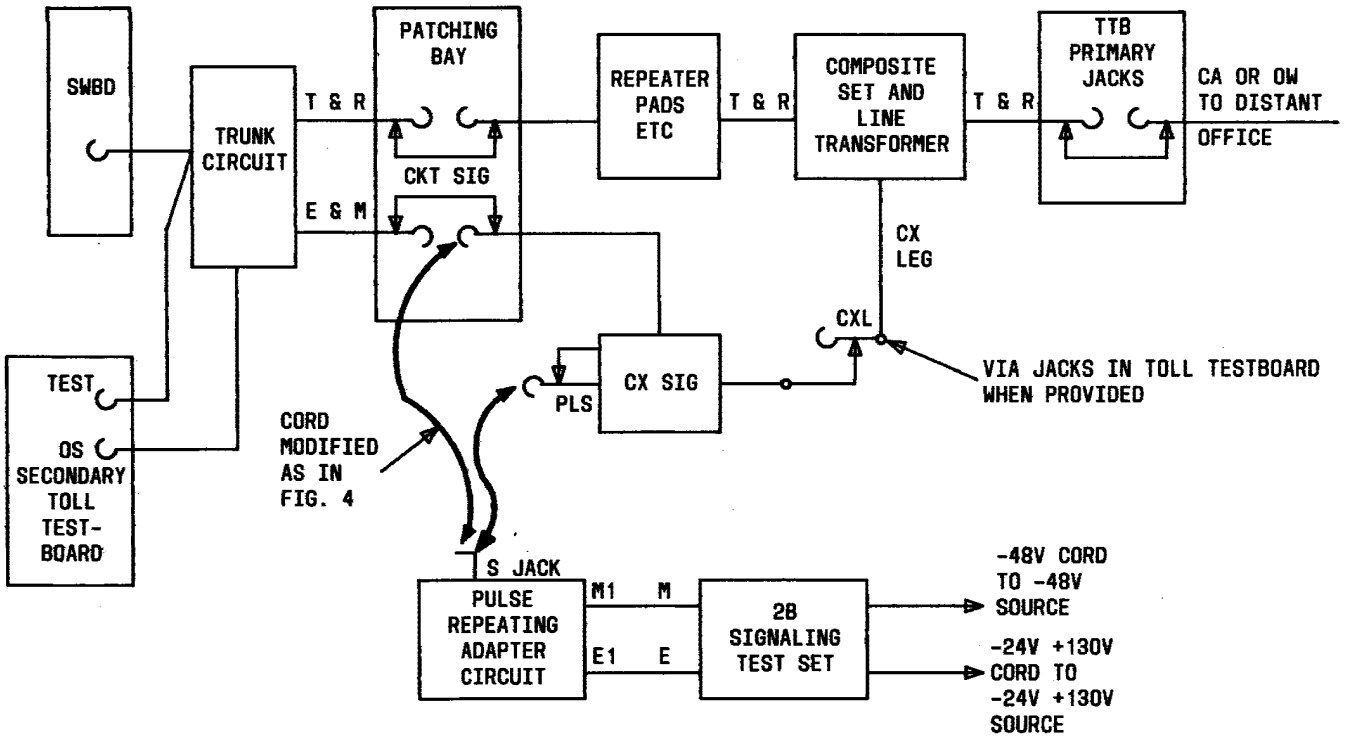


Fig. 1—Typical Layout of Terminal Office With 2A Type Showing Connections to 2B Test Set for Sending or Receiving Dial Pulses on E and M Leads

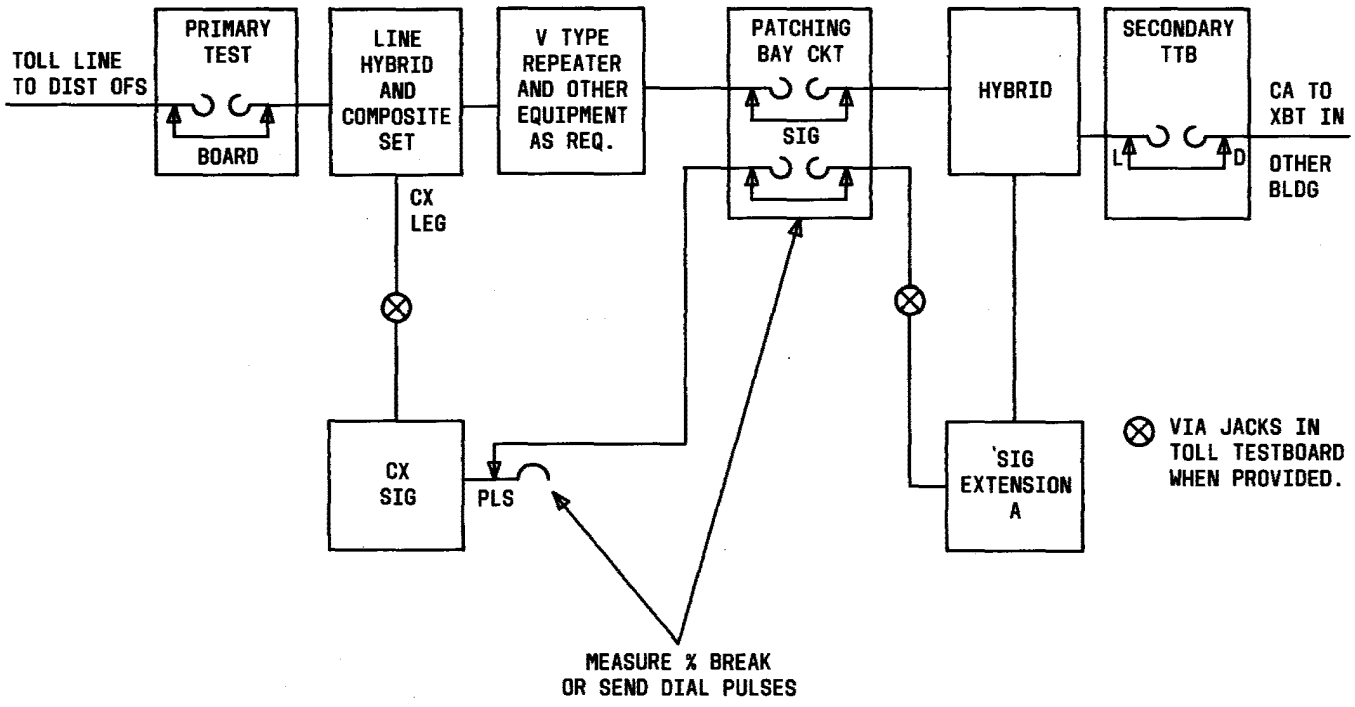
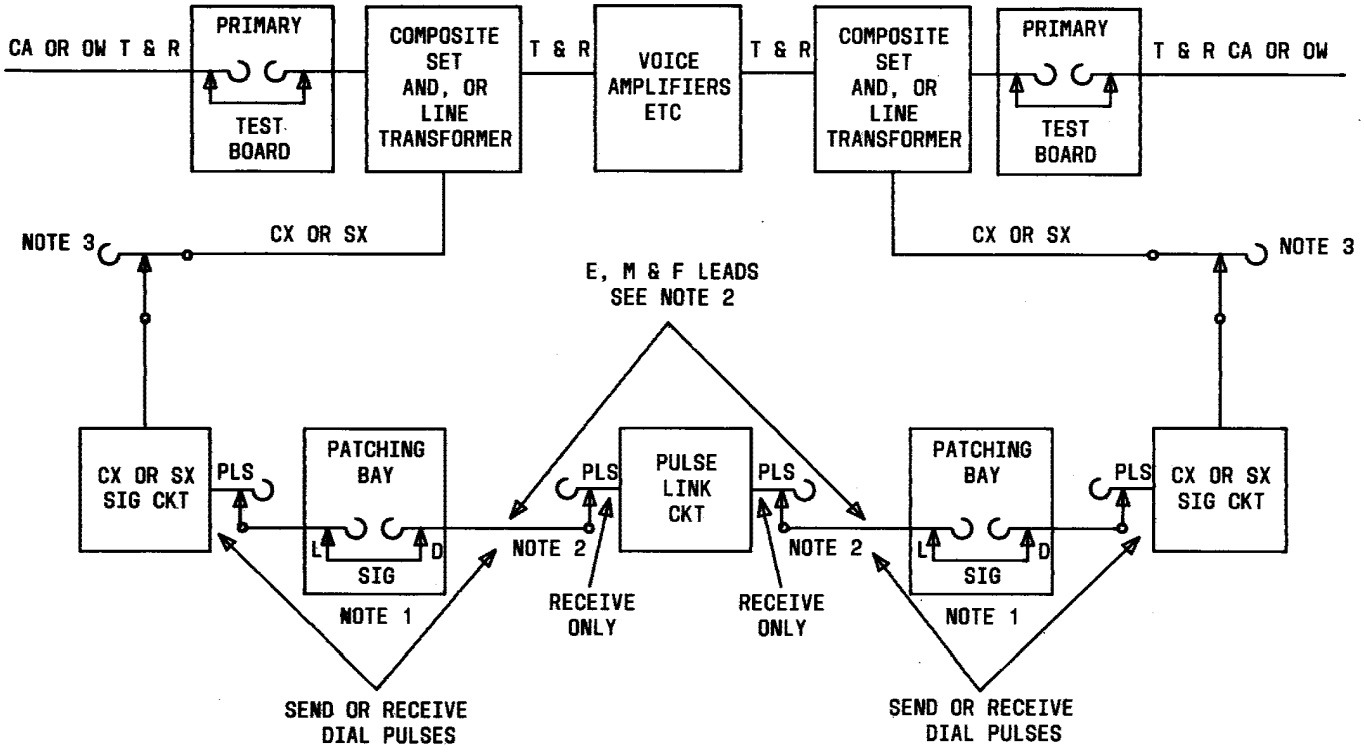


Fig. 2—Typical Layout of Toll Office With V Type Repeaters and Signal Extension Leads to Crossbar Tandem



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

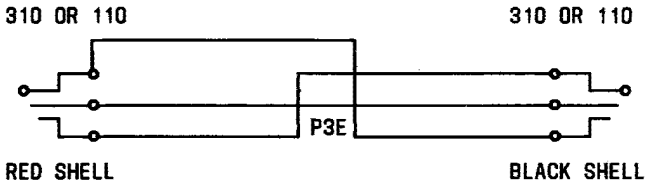


Fig. 4—Modified 3P6F Patch Cord

TABLE A

PERCENT BREAK OUTPUT

INPUT AT SENDING END, 58 PERCENT	A CIRCUITS WORKING UNDER FAVORABLE CONDITIONS WITH RESPECT TO WORKING LIMITS		B CIRCUITS WORKING UNDER UNFAVORABLE CONDITIONS WITH RESPECT TO WORKING 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, 58 PERCENT	A CIRCUITS WORKING UNDER FAVORABLE CONDITIONS WITH RESPECT TO WORKING LIMITS		B CIRCUITS WORKING UNDER UNFAVORABLE CONDITIONS WITH RESPECT TO WORKING LIMITS	
	MIN	MAX	MIN	MAX
Circuit arrangements involving pulse repeating relays	56	60	53	63

TABLE C

PERCENT BREAK OUTPUT AT CX RELAY

INPUT AT SENDING END, 58 PERCENT		A CIRCUITS WORKING UNDER FAVORABLE CONDITIONS WITH RESPECT TO WORKING LIMITS		B CIRCUITS WORKING UNDER UNFAVORABLE CONDITIONS WITH RESPECT TO WORKING LIMITS	
RELAYS	LOOP RESISTANCE IN OHMS	MIN	MAX	MIN	MAX
239-Type					
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
209-Type					
Cable	0-6000	56	62	53	65
Cable	6000-9000	55	63	52	66
Cable	9000-13000	54	64	51	67