

**PULSE REPEATING RELAYS**  
**PULSE REQUIREMENTS A1 THROUGH J1**  
**USING PULSING TEST SET SD-31481-01 (J34717A) AND**  
**PULSE REPEATING TEST SET SD-31667-01 (J34720A)**

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**1. GENERAL**

1.01 This section covers the method of checking the pulse repeating requirements (percent break maximum and minimum values) for a pulse repeating relay using pulsing test set SD-31481-01 (J34717A) and pulse repeating test set SD-31667-01 (J34720A). The method of checking the pulse repeating requirements using the 2B-1 signaling test set can be found in Section 040-012-712 and for the 4A signaling test set in Section 040-012-713.

1.02 This section is reissued for the following reasons:

- (a) To add pulsing requirement A6.

- (b) To make major revisions in the format of the section for clarification purposes.

This reissue does not affect the Equipment Test List.

1.03 The circuit requirements table of the circuit under test will provide a pulse repeating requirement (e.g. A1, B1, etc) and a minimum and maximum output percent break value (e.g. 48 to 78% BK). Using this provided information, refer to the specified pulsing requirement in this section. The information for the specified pulsing requirement will provide the following:

- (a) Definition of the pulse repeating requirement
- (b) Test set control settings
- (c) Test set connections to relay under test
- (d) Special conditioning instructions to assure the accurate testing of the relay under test.

1.04 *The pulsing test set* referred to herein is the SD-31481-01 (J34717A) pulsing test set or equivalent.

1.05 *The pulse repeating test set* referred to herein is the SD-31667-01 (J34720A) pulse repeating test set or equivalent.

1.06 The pulsing circuit of the pulsing test set in combination with the pulse repeating test set will provide a source of pulses suitable for application toward the relay under test. The pulse repeating test set provides the percent break meter to measure the received pulses from either the relay under test or the A relay in the pulse repeating test set. Supervisory signals are observed by a BY lamp located on the pulse repeating test set. Refer to Section 100-232-501 for pulsing test set SD-31481-01 tests and inspections.

1.07 Some of the pulse repeating requirements in this section will specify LOOP and LEAK conditions to be set up on the pulsing and pulse repeating test sets and applied to the relay under test. These conditions are applied one at a time to the relay under test. For example, set the specified LOOP condition on pulsing and pulse repeating test sets loop resistance keys, and by operating the loop key on the 36B remote test set, determine if the output percent break of the relay

under test is below the specified maximum level. Set the specified LEAK condition on the pulsing test set leak resistance keys, and by operating the leak key on the 36B remote test set, determine if the output percent break of the relay under test is above the specified minimum level; the definitions for these conditions are as follows:

- (a) **Loop Condition:** When the input loop conditions of a given resistance (zero, 800 ohms, 1200 ohms, etc) are specified in the requirements herein, the resistances of the specified value are connected in series with the pulsing contacts of the pulsing test set, which provide continuous pulsing at 12 pulses per second and 68.5 percent break. Where circuits have compensation resistance as part of the pulsing circuit, this resistance shall be considered as part of the loop resistance specified herein.
- (b) **Leak Zero Condition:** When "leak zero condition" is specified in the requirements herein, no leak resistance is connected in parallel with the pulsing contacts of the pulsing test set, which provides continuous pulsing at 12 pulses per second and 60.5 percent break.
- (c) **Leak Zero Condition Low Speed:** When "leak zero condition low speed" is specified in the requirements herein, no leak resistance is connected in parallel with the pulsing contacts of the pulsing test set, which provide continuous pulsing at 6 pulses per second and 30.25 percent break.
- (d) **Leak A Condition:** When "leak A condition" is specified in the requirements herein, 10,250 ohms in multiple with 2.16 MF and 5050 ohms are connected in parallel with the pulsing contacts of the pulsing test set which provide continuous pulsing at 12 pulses per second and 60.5 percent break.
- (e) **Leak B Condition:** When "leak B condition" is specified in the requirements herein, 10,250 ohms are connected in parallel with the pulsing contacts of the pulsing test set which provide continuous pulsing at 12 pulses per second and 60.5 percent break.
- (f) **Leak C Condition:** When "leak C condition" is specified in the requirements herein, 10,250 ohms in multiple with 2.16 MF and 600 ohms are connected in parallel with the

pulsing contacts of the pulsing test set which provide continuous pulsing at 12 pulses per second and 60.5 percent break.

(g) **Leak D Condition:** When "leak D condition" is specified in the requirements herein, 20,250 ohms in multiple with 2.16 MF and 600 ohms are connected in parallel with the pulsing contacts of the pulsing test set which provide continuous pulsing at 12 pulses per second and 60.5 percent break.

**1.08 Lettered Steps:** A letter a, b, c, etc, added to a step number in Part 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. DEFINITIONS OF PULSE REPEATING REQUIREMENTS

### A. A1 Requirement

**2.01** A1 requirement is specified primarily for 221- and similar-type pulse repeating relays used in outgoing repeaters and 2-party message rate trunks on which the residual airgap and spring tension of the relay should be adjusted until the percent break is within 1 percent of the maximum limit to facilitate meeting the minimum limit.

### B. A2 Requirement

**2.02** A2 requirement is specified primarily for 280-, 239-, and similar-type pulse repeating relays used in outgoing repeaters which will meet the requirements providing the relays are within their electrical adjustment and are not defective.

### C. A3 Requirement

**2.03** A3 requirement is the same as requirement A1 except that no effort should be made to hold the percent break to within 1 percent of the maximum limit. It is specified primarily for 221- and similar-type pulse repeating relays used in certain other types of outgoing repeaters.

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### D. A4 Requirement

2.04 A4 requirement is specified primarily for H-type pulse repeating relays used in coin box trunks on which the spring tension of the relay should be adjusted to meet the requirement. The cover must be on the relay when the percent break is measured.

### E. A5 Requirement

2.05 A5 requirement is specified primarily for 221-type pulsing relays used in message ticketer trunk circuits for stepping a 204-type selector.

### F. A6 Requirement

2.06 A6 requirement is specified primarily for 221-type pulsing relays used in SXS originating registers (SD-32351-01).

### G. B1 Through B6 Requirements

2.07 B1 through B6 requirements are specified primarily for toll transmission selectors or toll incoming trunks. These requirements are fundamentally the same. The requirements differ by variations specified in resistances inserted for pulsing tests and in whether or not the incoming trunk circuit is connected during the test.

### H. C1 Requirement

2.08 C1 requirement is specified for SXS loop signaling type pulse correcting repeaters having 221- or similar-type pulse timing relays.

### I. C2 Requirement

2.09 C2 requirement is specified for loop signaling type pulse correcting repeaters having 280-, 239-, or similar-type pulse timing relays.

### J. C3 Requirement

2.10 C3 requirement is specified for incoming composite signaling type pulse correcting repeaters having 221- or similar-type pulse timing relays.

### K. C4 Requirement

2.11 C4 requirement is specified for incoming composite signaling type pulse correcting repeaters having 280-, 239-, or similar-type pulse timing relays.

### L. D1 Requirement

2.12 D1 requirement is specified primarily for composite signaling type pulse correcting repeaters outgoing from panel tandem and having 280-, 239-, or similar-type pulse timing relays.

### M. E1 and E2 Requirements

2.13 E1 and E2 requirements are specified primarily for outgoing composite signaling type pulse correcting repeaters having 221-, 239-, 280-, or similar-type pulse timing relays. The requirements E1 and E2 are fundamentally the same, the difference being in the maximum external pulsing loop over which the pulse timing relays and in the leak conditions under which the pulse timing relays are tested.

### N. F1 Through F6 Requirements

2.14 F1 through F6 requirements are specified primarily for 2-speed pulse correcting repeaters and trunk circuits having U- or similar-type pulse timing relays. The specific use of the requirement is as follows.

- (a) **F1 requirement** is specified for outgoing composite signaling circuits.
- (b) **F2 requirement** is specified for incoming composite signaling circuits.
- (c) **F3 requirement** is specified for battery and ground signaling outgoing circuits.
- (d) **F4 requirement** is specified for battery and ground signaling type circuits.
- (e) **F5 requirement** is specified for loop signaling type circuits having a minimum insulation resistance of 15,000 ohms.
- (f) **F6 requirement** is specified for loop signaling type circuits with a minimum insulation resistance of 30,000 ohms.

**O. G1 and G2 Requirements**

2.15 G1 and G2 requirements are specified primarily for outgoing composite signaling repeaters having 221- or similar-type pulse repeating relays where no pulse corrector is used.

**P. H1 Requirement**

2.16 H1 requirement is specified for use in composite type B or simplex signaling trunk circuits having 221-type pulsing relays used in crossbar tandem offices for trunk and repeater circuits to step-by-step offices.

**Q. H2 Requirement**

2.17 H2 requirement is specified for loop or battery and ground pulsing repeaters having 221-type pulse repeating relays used in crossbar tandem offices for trunk and repeater circuits to step-by-step offices.

**R. J1 Requirement**

2.18 J1 requirement is specified primarily for 280- or 239-type pulse repeating relays used in 2-way trunk circuits for use at intermediate offices to connect loop signaling trunks to composite signaling circuits.

**3. APPARATUS**

3.01 Pulse repeating test set J34720A (SD-31667-01).

**4. PREPARATION**

**All Tests**

STEP	ACTION	VERIFICATION
1	At pulsing test set— Using 2P9B cord, connect BAT & G jack to 48-volt battery supply jack.  <b>Note:</b> To avoid grounding of the battery supply leads, connect cord to the test set first and when disconnecting, remove cord from test set last.	
2	At pulse repeating test set— Using 2P9B cord, connect BAT & G jack to 48-volt battery supply jack. (See Note in Step 1.)	

3.02 Pulsing test set J34717A (SD-31481-01).

3.03 36B (remote control) test set.

3.04 Patching cords, one or two P2J cords, each 6 feet long, equipped with two 310 plugs (2P9B cords).

3.05 Patching cord, P3K cord, 12 feet long, equipped with two 310 plugs (3P15B cord).

3.06 One or two of the following cords for connecting to the relay under test.

(a) Patching cord, two P3H cords, each 5 feet long, equipped with 310 plugs and one 240B plug (6P3A cord). (For input and output connections.)

(b) Patching cord, P3E cord, 6 feet long, equipped with two 310 plugs (3P7A cord). (For input or output connections or both.)

(c) Patching cord, P3H cord, 10 feet long, equipped with a 310 plug and a 240A plug (3P2A cord). (For input connections.)

(d) Testing cord, W2W cord, 6 feet long, equipped with a 310 plug, a 360B tool, and a 360C tool (2W17A cord). (For output connections.)

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
3	Using 3P15B cord, connect pulsing test set TL jack to pulse repeating test set INT jack.	
4	At pulsing test set— Insert 36B remote test set cord into A and B jacks.	
5	At pulse repeating test set— Verify the percent break meter indication.	Percent break meter indicates 100. If necessary, adjust the zero adjusting screw on meter; then back the screw off slightly.
6	Operate SL key.	
7	Short-circuit tip and ring of B jack.  <b>Note:</b> Step 7 should be rechecked occasionally to compensate for variation in office voltage.	Precent break meter indicates 0. If necessary, adjust R1 rheostat to get a full-scale meter deflection of 0.
8	Operate LK-A key.	
9	At 36B remote test set— Momentarily operate LK key.	Pulsing test set generates pulses.
10	At pulse repeating test set— Operate and hold ADJ key.  <b>Note:</b> If extensive testing is to be performed, Steps 9 through 12 should be occasionally rechecked.	Percent break meter should indicate 58 to 63. If necessary, readjust A relay to meet requirement.
11	Release ADJ key.	
12	At 36B remote test set— Momentarily operate RLS key.	

**5. METHOD**

**A. A1 Through A6 Pulse Repeating Requirements**

**5.01** The pulse repeating relays shall meet the percent break limits specified on the circuit requirements table when checked under the following test procedures. Requirement A4 shall be met with the cover on the relay.

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
13	Make busy circuit to be tested per local instructions.	
14a	If using A1, A2, A3, or A4 requirement and relay under test outpulses over outside trunk conductors to a distant office— Connect test setup as shown in Fig. 1.	

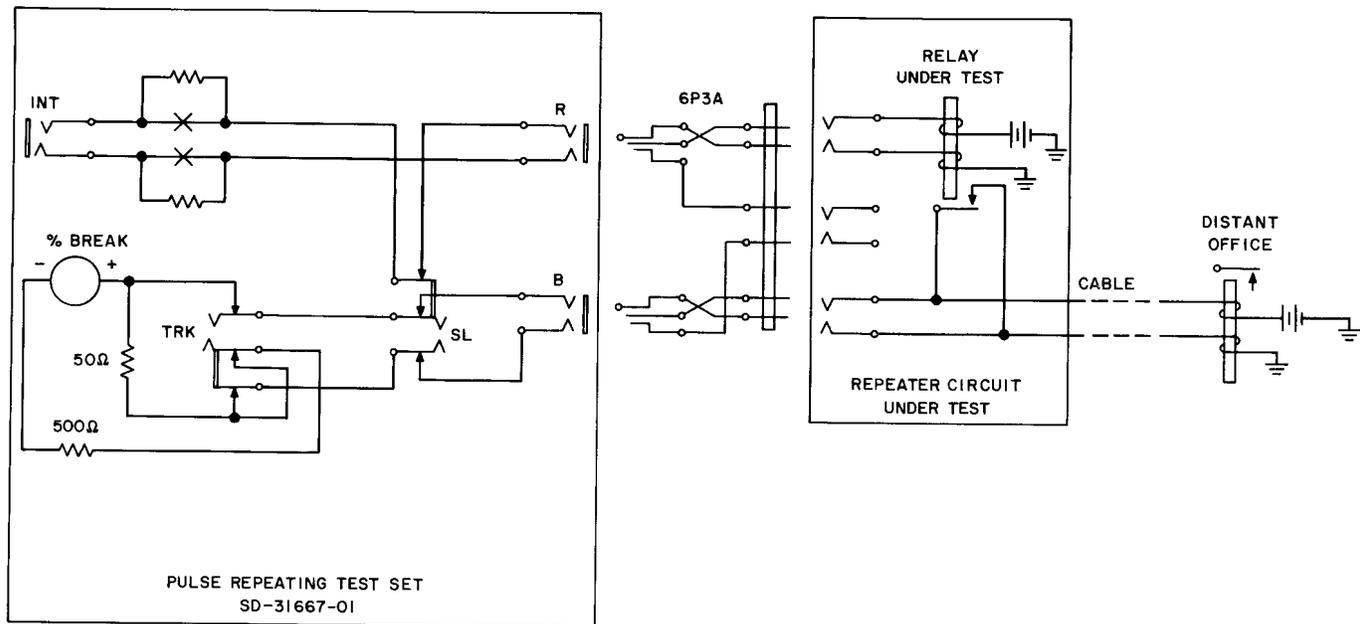


Fig. 1—Method of Compensating for Trunk Conductor Resistance to Distant Office

STEP	ACTION	VERIFICATION
15a	At pulse repeating test set— Operate SL and TRK keys.	Indication on percent break meter. (Note for future use.)
16a	Release TRK key.	
17a	Operate AT key.	
18a	Adjust R rheostat and R1400 key and/or R3000 key.	Same indication as Step 15a.
<p><b>Note:</b> Steps 14a through 18a adjust the resistance of the artificial trunk in series with the A relay so that the current reading in the artificial trunk to the A relay is the same as the current reading in the trunk loop to the relay in the distant office.</p>		
19a	Release AT key.	
20a	Disconnect test setup shown in Fig. 1.	
22b	If using A1, A2, A3 or A4 requirement— Connect input and output connections between pulse repeating test set and circuit under test	

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STEP	ACTION	VERIFICATION
	as specified by the circuit requirements table and as shown in Fig. 2.	
23b	At associated selector in distant office— Disconnect pulsing relay.	
	Leave cable to distant office bridged across pulsing contacts of relay under test as shown in Fig. 1 to provide the capacitance effect.	
24c	If using A5 or A6 requirement— Connect input and output connections between pulse repeating test set and circuit under test as specified by the circuit requirements table and as shown in Fig. 3.	
25d	If using A1, A2, A3, A4, or A6 requirement— At pulsing test set— Operate 800, 400, LK-A and PR keys.	
26e	If using A5 requirement— At pulsing test set— Operate 800, 400, 200, LK-A and PR keys.	
27	At pulse repeating test set— Operate SL key.	
28	At 36B remote test set— Momentarily operate LP key.	<p>At pulse repeating test set— If using A1, A2, A3, A4, or A6 requirement— Percent break meter indicates that the output percent break is below the maximum limit specified on circuit requirements table for relay under test.</p> <p>If using A5 requirement— Percent break meter indicates that the output percent break is above the minimum limit specified on the circuit requirements table for relay under test.</p>
		<p><b>Note:</b> If relay under test fails to meet specified limits, refer to Part 6 for adjusting procedures.</p>
29	Momentarily operate RLS key.	
30	Momentarily operate LK key.	<p>At pulse repeating test set— If using A1, A2, A3, A4, or A6 requirement— Percent break meter indicates that the output percent break of relay under test is above the minimum limit specified on the circuit requirements table.</p>

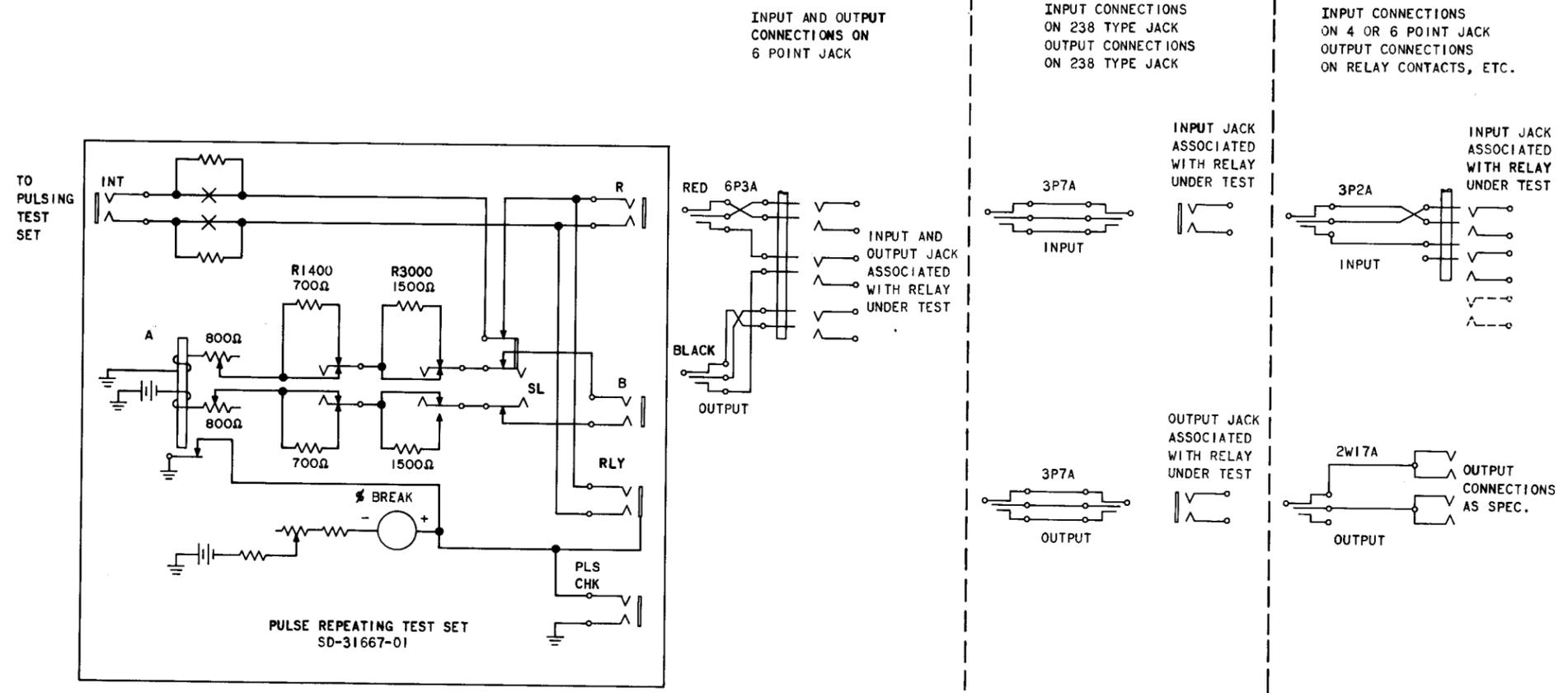


Fig. 2—Method of Connecting Pulse Repeating Test Set to Relay Under Test—Pulsing Contacts of Relay Under Test Connected to Winding of A Relay in Pulse Repeating Test Set

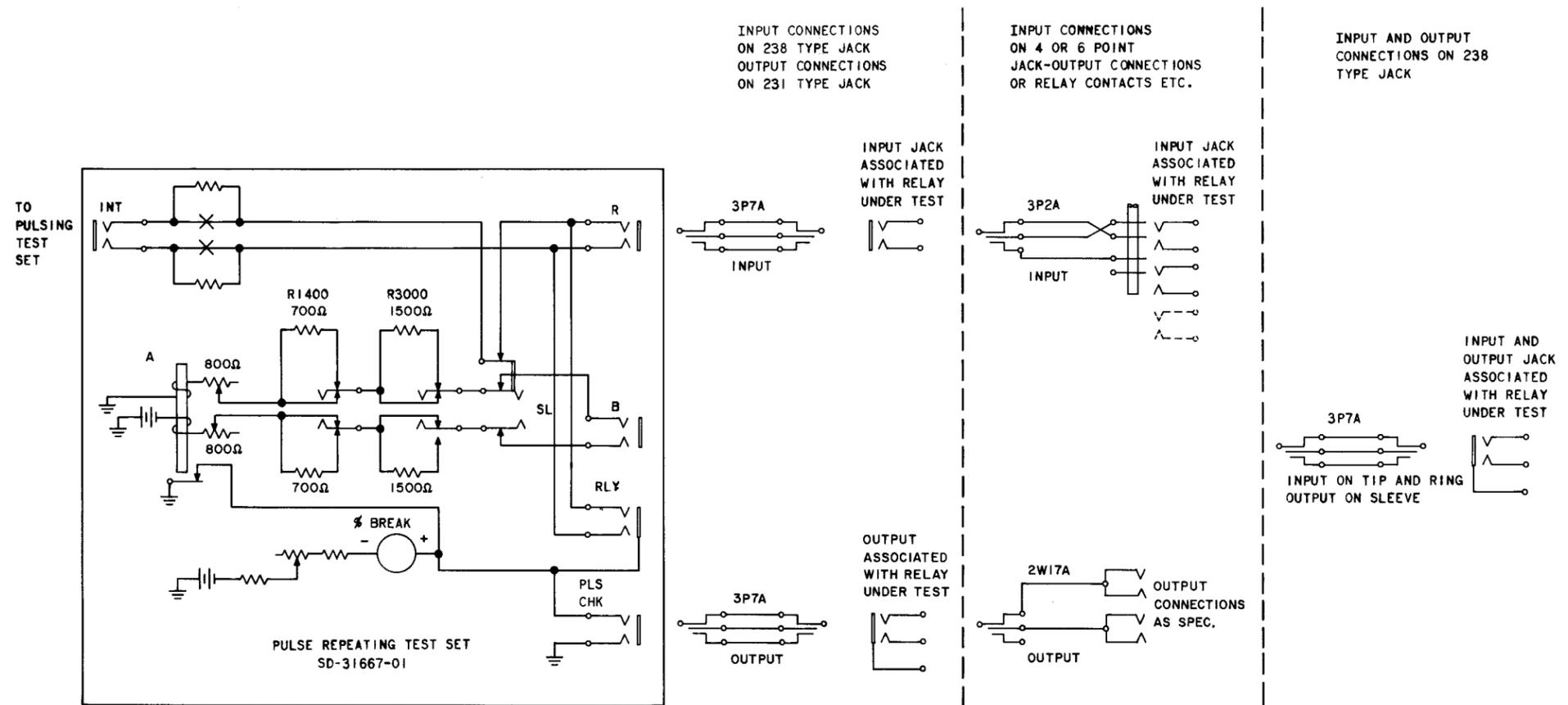


Fig. 3—Method of Connecting Pulse Repeating Test Set to Relay Under Test—Pulsing Contacts of Relay Under Test Connected to Percent Break Meter in Pulse Repeating Test Set

STEP	ACTION	VERIFICATION
		<p>If using A5 requirement— Percent break meter indicates that the output percent break of relay under test is below the maximum limit specified on circuit requirements table for relay under test.</p> <p><b>Note:</b> If relay under test fails to meet the specified limits, refer to Part 6 for adjusting procedures.</p>
31	Momentarily operate RLS key.	
32f	If no further tests are to be made— Remove all test equipment and restore all circuits to normal.	

#### B. B1 Through B6 Pulse Repeating Requirements

**5.02** The pulse repeating relay shall meet the percent break limits specified on the circuit requirements table when checked under the following test procedures.

STEP	ACTION	VERIFICATION
13	Make busy circuit to be tested per local instructions.	
14	Connect input and output connections between pulse repeating test set and circuit under test as specified by the circuit requirements table and as shown in Fig. 2.	
15a	If the circuit under test is an incoming trunk circuit and repeats pulses from a manual or toll office— At associated selector— Disconnect pulsing relay.	
16d	If using B1, B2, or B3 requirement— Leave incoming trunk conductors connected to the circuit.	
17c	If using B4, B5, or B6 requirement— Disconnect incoming trunk conductors.	
18	At pulsing test set— Operate PR and LK-B key.	
19	At pulse repeating test set— Operate SL and D keys.	
20d	If using B2 or B5 requirement and circuit requirements table specifies 0 to 600 ohm	

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STEP	ACTION	VERIFICATION
	loop— At pulse repeating test set— Operate 400 and 200 keys.	
21e	If using B2 or B5 requirement and circuit requirements table specifies 0 to 1200 ohm loop— At pulse repeating test set— Operate 800 and 400 keys.	
22f	If using B1 or B4 requirement— At pulse repeating test set— Operate 800 and 200 keys.	
23g	If using B3 or B6 requirement— At pulse repeating test set— Operate 1600 and 400 keys.	
24	At 36B remote test set— Momentarily operate LP key.	At pulse repeating test set— Percent break meter indicates that the output percent break is below maximum limit specified on circuit requirements table for relay under test.  <b>Note:</b> If relay under test fails to meet specified limits, refer to Part 6 for adjusting procedures.
25	Momentarily operate RLS key.	
27	At 36B remote test set— Momentarily operate LK key.	At pulse repeating test set— Percent break meter indicates the output percent break is above minimum limits specified on circuit requirements table for relay under test.  <b>Note:</b> If relay under test fails to meet the specified limits, refer to Part 6 for adjusting procedures.
28	Momentarily operate RLS key.	
29h	If no further tests are to be made— Remove all test equipment and restore all circuits to normal.	

C. C1 Through C4 Pulse Repeating Requirements

5.03 The pulse repeating relay shall meet the percent break limits specified on the circuit requirements table when checked under the following test procedures.

STEP	ACTION	VERIFICATION
13	Make busy circuit to be tested per local instructions.	
14	Connect input and output connections from pulse repeating test set to circuit under test as specified by the circuit requirements table and as shown in Fig. 2.	
15a	If the circuit under test is an incoming repeater— At associated selector— Disconnect pulsing relay.	
16b	If circuit under test is an outgoing repeater— At circuit under test— Disconnect trunk conductors.	
17	At pulse repeating test set— Operate SL key.	
18c	If using C1 or C2 requirement— At pulse repeating test set— Operate 1600 key.	
	Verify that the loop and leak keys at the pulsing test set are in nonoperated position.	
19d	If using C3 or C4 requirement— At test sets— Verify loop and leak resistance keys are in a nonoperated position.	
20	At pulsing test set— Operate PR key.	
21	At 36B remote test set— Momentarily operate LK key.	At pulse repeating test set— Percent break meter indicates that the output percent break is within the specified limits of the circuit requirements table for relay under test.
		<b>Note:</b> If relay under test fails to meet specified limits, refer to Part 6 for adjusting procedures.
22	Momentarily operate RLS key.	
23c	If no further tests are to be made— Remove all test equipment and restore all circuits to normal.	

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**D. D1 Pulse Repeating Requirement**

**5.04** The pulse repeating relay shall meet the percent break limits specified on the circuit requirements table when checked under the following test procedures.

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
13	Make busy the circuit to be tested per local instructions.	
14	Connect input and output connections between pulse repeating test set and circuit under test as specified by the circuit requirements table and as shown in Fig. 3.	
15	At test sets— Verify loop and leak resistance keys are in a nonoperated position.	
16	At pulse repeating test set— Operate SL key.	
17	At pulsing test set— Operate PR key.	
18	At 36B remote test set— Momentarily operate LK relay.	At pulse repeating test set— Percent break meter indicates that the output percent break is within the specified limits of the circuit requirements table for the relay under test.
	Momentarily operate RLS key.	<b>Note:</b> If relay under test fails to meet specified limits, refer to Part 6 for adjusting procedures.
20a	If no further tests are to be made— Remove all test equipment and restore all circuits to normal.	

**E. E1 and E2 Pulse Repeating Requirements**

**5.05** The pulse repeating relay shall meet the percent break limits specified on the circuit requirements table when checked under the following test procedures.

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
13	Make busy the circuit to be tested per local instructions.	
14	Connect input and output connections between pulse repeating test set and circuit under test	

STEP	ACTION	VERIFICATION
	as specified by the circuit requirements table and as shown in Fig. 3.	
15	At circuit under test— Disconnect incoming signaling lead to composite signaling relay under test.	
16	At pulse repeating test set— Operate SL key.	
	<b>Note:</b> Verify loop resistance keys are in a nonoperated position.	
17a	If using E1 requirement— At pulsing test set— Operate LK-A and PR keys.	
18b	If using E2 requirement— At pulsing test set— Operate LK-B and PR keys.	
19b	If using E2 requirement— At pulse repeating test set— Operate D key	
20	At 36B remote test set— Momentarily operate LK key.	At pulse repeating test set— Percent break meter indicates that the output percent break is within the specified limits of the circuit requirements table for the relay under test.  <b>Note:</b> If relay under test fails to meet specified limits, refer to Part 6 for adjusting procedures.
21	Momentarily operate RLS key.	
22c	If no further tests are to be made— Remove all test equipment and restore all circuits to normal.	

#### F. F1 Through F6 Pulse Repeating Requirements

5.06 The pulse repeating relays shall meet the percent break limits as specified on the circuit requirements table when checked under the following test procedures.

STEP	ACTION	VERIFICATION
13	Make busy the circuit to be tested per local instructions.	

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
14	Connect input and output connections between pulse repeating test set and circuit under test as specified by the circuit requirements table and as shown in Fig. 3.	
15a	If using F1 requirement— At circuit under test— Disconnect signaling lead to composite signaling relay.	
16b	If using F2, F3, or F4 requirement— At associated circuit— Disconnect associated pulsing relay.	
	<b>Note:</b> In the case of repeaters per SD-31929-01, disconnect battery and ground from the associated incoming selector by inserting an open plug into the P jack.	
17c	If using F5 or F6 requirement— At circuit under test— Disconnect conductors to succeeding circuit.	
18c	Disconnect incoming trunk conductors.	
19d	If using F1, F3, F4, F5, or F6 requirement— At test sets— Operate loop resistance keys at pulse repeating test set, to equivalent of minimum working limit of pulse receiving relay in circuit under test.	
	Verify that leak keys are in nonoperated position.	
	<b>Note:</b> The minimum working limit of the pulse receiving relay can be found in the schematic drawing for the circuit under test.	
20e	If using F2 requirement— At test sets— Verify loop and leak resistance keys are in nonoperated positions.	
21	At pulse repeating test set— Operate SL key.	
22	At pulsing test set— Operate 6 PPS key.	
23	At 36B remote test set— Momentarily operate LK key.	At pulse repeating test set— Percent break meter indicates that the output

STEP	ACTION	VERIFICATION
		percent break meets the specified requirement for low speed shown in the circuit requirements table of circuit under test.
		<b>Note:</b> If relay under test fails to meet the specified requirement, refer to Part 6 for low speed adjusting procedures.
24	Momentarily operate RLS key.	
25f	If using F1, F3, F4, or F5 requirement— At pulsing test set— Operate LK-A key.	
26e	If using F2 requirement— At test sets— Verify loop and leak resistance keys are in a nonoperated position.	
27g	If using F6 requirement— Operate LK-D key.	
28	At pulsing test set— Release 6 PPS key and operate PR key.	
29	At 36B remote test set— Momentarily operate LK key.	At pulse repeating test set— Percent break meter indicates that the output percent break meets the specified requirement for high speed shown in the circuit requirements table of circuit under test.
		<b>Note:</b> If relay under test fails to meet the specified requirement, refer to Part 6 for high speed adjusting procedures.
30	Momentarily operate RLS key.	
31h	If no further tests are to be made— Remove all test equipment and restore all circuits to normal.	

#### G. G1 and G2 Pulse Repeating Requirements

5.07 The pulse repeating relays shall meet the percent break limits as specified on the circuit requirements table when checked under the following test procedures.

STEP	ACTION	VERIFICATION
13	Make busy the circuit to be tested per local instructions.	

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STEP	ACTION	VERIFICATION
14	Connect input and output connections between pulse repeating test set and circuit under test as specified by the circuit requirements table and as shown in Fig. 3.	
15	At circuit under test— Disconnect signaling lead to composite signaling relay.	
16a	If using G1 requirement— At pulsing test set— Operate 800 and 400 keys.	
17b	If using G2 requirement— At pulse repeating test set— Operate 1600 and 400 keys.	
	Verify that resistance keys in the pulsing test set are in nonoperated position.	
19	At pulse repeating test set— Operate SL key.	
20	At pulsing test set— Operate PR and LK-A keys.	
21	At 36B remote test set— Momentarily operate LP key.	At pulse repeating test set— Percent break meter indicates that the output percent break is above the minimum limit specified on the circuit requirements table for relay under test.
		<b>Note:</b> If relay under test fails to meet the specified requirement, refer to Part 6 for adjusting procedures.
22	Momentarily operate RLS key.	
22a	If using G2 requirement at pulse repeating test set— Restore 1600 key to normal and operate 800 key.	
23	At 36B remote test set— Momentarily operate LK key.	At pulse repeating test set— Percent break meter indicates that the output percent break is below the maximum limit specified on the circuit requirements table for relay under test.
		<b>Note:</b> If relay under test fails to meet the specified requirements, refer to Part 6 for adjusting procedures.

STEP	ACTION	VERIFICATION
24	Momentarily operate RLS key.	
25c	If no further tests are to be made— Remove all test equipment and restore all circuits to normal.	

#### H. H1 and H2 Pulse Repeating Requirements

**5.08** The pulse repeating relays shall meet the percent break limits as specified on the circuit requirements table when checked under the following test procedures.

STEP	ACTION	VERIFICATION
13	Make busy the circuit to be tested per local instructions.	
14a	If using H2 requirement— Connect test set as shown in Fig. 1.	
15a	At pulse repeating test set— Operate SL and TRK keys.	Indication on percent break meter. (Note for future use.)
16a	Release TRK key.	
17a	Operate AT key.	
18a	Adjust the R rheostat and R-1400 and/or R-3000 keys.	Same indications as Step 15a.
	<b>Note:</b> Steps 14a through 18a adjust the resistance of the artificial trunk in series with A relay in the pulse repeating test set so that the current reading in the artificial trunk to the A relay is the same as the current reading in the trunk loop to the relay in the distant office.	
19a	Release AT key.	
20a	Disconnect test setup as shown in Fig. 1.	
21b	If conductor loop is 2000 ohms or less and using H2 requirement— At distant office— Disconnect associated selector pulsing relay.	
22c	If conductor loop is over 2000 ohms and using H2 requirement— At Crossbar Tandem office— Disconnect associated selector pulsing relay.	

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STEP	ACTION	VERIFICATION
23d	If using H1 requirement— Connect input and output connections between pulse repeating test set and circuit under test as specified by the circuit requirements table and as shown in Fig. 3.	
24a	If using H2 requirement— Connect input and output connections between pulse repeating test set and circuit under test as specified by the circuit requirements table and as shown in Fig. 2.  Leave cable to distant office bridged across pulsing contacts of relay under test as shown in Fig. 1 to provide capacitance effect.	
25	At pulse repeating test set— Operate SL, 1600, and 200 keys.	
26	At pulsing test set— Operate PR and LK-D keys.	
27	At 36B remote test set— Momentarily operate LP key.	At pulsing test set— Percent break meter indicates that percent break is below maximum limit specified on circuit requirements table for relay under test.  <b>Note:</b> If relay under test fails to meet specified limits, refer to Part 6 for adjusting procedures.
28	Momentarily operate RLS key.	
29	At pulse repeating test set— Release 1600 and 200 key.	
30	At 36B remote test set— Momentarily operate LK key.	At pulsing test set— Percent break meter indicates that the percent break of relay under test is above the minimum limit specified on the circuit requirements table.  <b>Note:</b> If relay under test fails to meet the specified limits, refer to Part 6 for adjusting procedures.
31	Momentarily operate RLS key.	
32e	If no further tests are to be made— Remove all test equipment and restore all circuits to normal.	

I. J1 Pulse Repeating Requirement

5.09 The pulse repeating relays shall meet the percent break limits as specified on the circuit requirements table when checked under the following test procedures.

STEP	ACTION	VERIFICATION
13	Make busy the circuit to be tested per local instructions.	
14	Connect input and output connections between pulse repeating test set and circuit under test as specified by the circuit requirements table and as shown in Fig. 3.	
15	At circuit under test— Insert an open plug into C jack to remove signaling battery from front pulsing contact of relay under test.	
16	At pulse repeating test set— Operate SL key.  <b>Note:</b> Verify loop resistance keys are in a nonoperated position.	
17	At pulsing test set— Operate PR key.  <b>Note:</b> Verify loop and leak resistance keys are in a nonoperated position.	
18	At 36B remote test set— Momentarily operate LP key.	At pulse repeating test set— Percent break meter indicates that the percent break of relay under test is below maximum limit specified on circuit requirements table.  <b>Note:</b> If relay under test fails to meet specified limits, refer to Part 6 for adjusting procedures.
19	Momentarily operate RLS key.	
20	At pulse repeating test set— Operate D key.	
21	At 36B remote test set— Momentarily operate LK relay.	At pulse repeating test set— Percent break meter indicates that the percent break of relay under test is above the minimum limit specified on the circuit requirements table.  <b>Note:</b> If relay under test fails to meet the specified limits, refer to Part 6 for adjusting procedures.
22	Momentarily operate RLS key.	

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
23a	If no further tests are to be made— Remove all test equipment and restore all circuits to normal.	
<b>6. ADJUSTING PROCEDURES FOR PULSE REPEATING RELAYS</b>		<b>6.06</b> After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.
<b>A. A1 Through A6 Requirements</b>		
<b>Requirement A1 and A6</b>		<b>Requirement A3</b>
<b>6.01</b> If the pulse requirements are not met, check the relay under test as covered in Section 040-236-701 covering 221-type relays and readjust the relay as required. If the percent break is above the maximum specified when making the loop test, decrease the spring tension of the relay under test as required. If the percent break is below the minimum specified for the leak test, increase the spring tension as required. The leak adjustment will be facilitated if the percent break is held within 1 percent of the maximum limit on the loop test.		<b>6.07</b> If the pulse repeating requirements are not met, check the relay under test as covered in Section 040-236-701 covering 221-type relays and readjust the relay as required. If the percent break is above the maximum specified when making the loop test, decrease the spring tension of the relay under test as required. If the percent break is below the minimum specified for the leak test, increase the spring tension as required. No effort should be made to hold the percent break within 1 percent of the maximum limit.
<b>6.02</b> If the percent break is still above the maximum limit, some improvement can be gained by decreasing the residual airgap setting of the pulse repeating relay. If the percent break is still below the minimum limit, increase the residual airgap setting of the pulse repeating relay. In certain cases, it may be necessary to decrease or increase the heel gap to decrease or increase the percent break, respectively. If this is done, recheck the relay including the electrical requirements.		<b>6.08</b> If the percent break is still above the maximum limit, some improvement can be gained by decreasing the residual airgap of the pulse repeating relay. If the percent break is still below the minimum limits, increase the residual airgap of the pulse repeating relay. In certain cases, it may be necessary to decrease or increase the heel gap to decrease or increase the percent break, respectively. If this is done, recheck the relay including the electrical requirements.
<b>6.03</b> If all the requirements cannot be met, replace the relay with a new one and repeat the test.		<b>6.09</b> If all the requirements cannot be met, replace the relay with a new one and repeat the test.
<b>6.04</b> After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.		<b>6.10</b> After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.
<b>Requirement A2</b>		<b>Requirement A4</b>
<b>6.05</b> Readjust the relay under test as covered in Section 040-267-701 covering 280-type relays or Section 040-228-701 covering 239-type relays. If all the requirements cannot be met, replace the relay with a new one and repeat the test.		<b>6.11</b> If the pulse repeating requirements are not met, check the relay under test as covered in Section 040-510-701 covering H-type relays and readjust the relay as required. If the percent break is above the maximum specified when making the loop test, decrease the spring tension of the relay under test as required. If the percent break

is below the minimum specified for the leak test, increase the spring tension as required.

**6.12** If all the requirements cannot be met, replace the relay with a new one and repeat the test.

**6.13** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

#### **Requirement A5**

**6.14** If the pulse repeating requirements are not met, check the relay under test as covered in Section 040-236-701 covering 221-type relays and readjust the relay as required. If the percent break is below the minimum specified when making the loop test, decrease the spring tension of the relay under test as required. If the percent break is above the maximum specified for the leak test, increase the spring tension as required.

**6.15** If the percent break is still below the minimum limit, some improvement can be gained by decreasing the residual airgap of the pulse repeating relay. If the maximum percent break requirement is still not met, increase the residual airgap of the pulse repeating relay. In certain cases, it may be necessary to decrease or increase the heel gap to increase or decrease the percent break, respectively. If this is done, recheck the relay including the electrical requirements.

**6.16** If all the requirements cannot be met, replace the relay with a new one and repeat the test.

**6.17** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

#### **B. B1 Through B6 Requirements**

**6.18** If the pulse repeating requirements are not met, check the relay under test as covered in the section covering the particular type of relay involved and readjust the relay as required. If the percent break is above the maximum specified when making the loop test, decrease the spring tension of the relay under test as required. If the percent break is below the minimum specified

for the leak test, increase the spring tension as required. In making this adjustment, the leak adjustment will be facilitated if the percent break is held within 1 percent of the maximum limit on the loop test. If necessary, adjust the residual airgap and the spring tension of the B relay toward the minimum limit until it will hold.

**6.19** If the percent break is still above the maximum limit, some improvement can be gained by decreasing the residual of the pulse repeating relay. If the percent break is still below the minimum limit, increase the residual of the pulse repeating relay. In certain cases, it may be necessary to decrease or increase the heel gap to decrease or increase the percent break, respectively. If this is done, recheck the relay, including the electrical requirements.

**6.20** If all the requirements cannot be met, replace the relay with a new one and repeat the test.

**6.21** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

#### **C. C1 Through C4 Requirements**

##### **Requirements C1 and C3**

**6.22** If the pulse repeating requirement is not met, check the relay under test as covered in Section 040-236-701 covering 221-type relays, and readjust the relay as required. If the percent break is above the maximum specified, increase the spring tension of the relay under test (usually designated H) or if the percent break is below the minimum specified, decrease the spring tension. If the required percent break cannot be obtained by adjusting the relay under test within its requirements, check to see that the auxiliary relay (usually designated K) meets its requirements. Increase the spring tension of the auxiliary relay to increase the percent break and decrease the spring tension of the relay to decrease the percent break.

**6.23** If all the requirements cannot be met, replace the relay under test with a new one and repeat the test.

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**6.24** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

### Requirements C2 and C4

**6.25** If the pulse repeating requirement is not met, check the relay under test as covered in Section 040-267-701 covering 280-type relays or Section 040-288-701 covering 239-type relays, and readjust the relay as required. If the percent break is still not within the specified limits, change the strapping of the biasing resistance or change the setting of the potentiometer as required. A change of 100 ohms in the biasing resistance will change the percent break by approximately 2 percent. An increase in the biasing resistance will increase the percent break, while decreasing the resistance will decrease the percent break. If the required percent break cannot be obtained by adjusting the relay under test (usually designated H) within its requirements, or by changing the biasing resistance, check to see that the auxiliary relay (usually designated K) meets its requirements. Increase the spring tension of the auxiliary relay to increase the percent break, and decrease the spring tension of that relay to decrease the percent break.

**6.26** If all the requirements cannot be met, replace the relay under test with a new one and repeat the test.

**6.27** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

### D. D1 Requirement

**6.28** If the pulse repeating requirement is not met, check the relay under test as covered in Section 040-267-701 covering 280-type relays or Section 040-228-701 covering 239-type relays, and readjust the relay as required. If the percent break is not within the specified limits, change the strapping of the biasing resistance as required. An increase in the biasing resistance will reduce the percent break, while decreasing the resistance will increase the percent break.

**6.29** If all the requirements cannot be met, make sure that the auxiliary relays (usually the P and CP relays) meet their requirements.

**6.30** If these relays are in adjustment, replace the relay under test with a new one and repeat the test.

**6.31** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

### E. E1 and E2 Requirements

**6.32** If the pulse repeating requirement is not met, check the relay under test as covered in the section covering the particular type of relay involved and readjust the relay as required. If the required percent break cannot be obtained by adjusting the pulse timing relay within its requirements, check to see that the auxiliary relay (usually designated K) is within its current flow requirements and adjust if necessary.

**6.33** If all the requirements cannot be met, replace the relay under test with a new one and repeat the test.

**6.34** After readjustments or replacement, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

### F. F1 Through F6 Requirements

#### Requirement F1

**6.35** If the pulse repeating requirement is not met, check the relay under test as covered in Section 040-518-701 covering U-type relays and readjust the relay as required.

#### **6.36** *Low Speed Adjustment—To Be Applied*

**First:** If the reading of the percent break meter is above the maximum specified for the six pulses-per-second speed, decrease the spring tension of the relay under test (usually the H relay) and if the percent break reading is below the minimum specified for the 6 pulses-per-second speed, increase the spring tension. If the required percent break cannot be obtained by adjusting the relay under test within its requirements, check to see that the

auxiliary relays (usually the J or P relays) meet their requirements.

**6.37 High Speed Adjustment—To Be Applied Last:** If the reading of the percent break meter is above the maximum specified for the 12 pulses-per-second speed, increase the spring tension of the relay under test (usually the F relay) and if the percent break reading is below the minimum specified for the 12 pulses-per-second speed, decrease the spring tension. If the required percent break cannot be obtained by adjusting the relay under test within its requirements, check to see that the auxiliary relays (usually the E or P relays) meet their requirements.

**6.38** If all the requirements specified above cannot be met, replace the relay under test with a new one and repeat the test.

**6.39** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

#### Requirements F2 and F3

**6.40** If the pulse repeating requirement is not met, check the relay under test as covered in the section covering the particular type of relay involved, and readjust the relay as required.

**6.41 Low Speed Adjustment—To Be Applied First:** If the reading of the percent break meter is above the maximum specified for the 6 pulses-per-second speed, increase the spring tension of the relay under test (usually the H or H1 relay); and if the percent break is below the minimum specified for the 6 pulses-per-second speed, decrease the spring tension. If the required percent break cannot be obtained by adjusting the relay under test within its requirements, check to see that the auxiliary relays (usually the J and K or J and P relays) meet their requirements.

**6.42 High Speed Adjustment—To Be Applied Last:** If the reading of the percent break meter is above the maximum specified for the 12 pulses-per-second speed, decrease the spring tension of the relay under test (usually the F relay); and if the percent break is below the minimum value specified for the 12 pulses-per-second speed, increase the spring tension. If the required percent break cannot be obtained by adjusting the

relay under test within its requirements, check to see that the auxiliary relays (usually the E and K or E and P relays) meet their requirements.

**6.43** If all the requirements specified above cannot be met, replace the relay under test with a new one and repeat the test.

**6.44** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

#### Requirements F4, F5, and F6

**6.45** If the pulse repeating requirement is not met, check the relay under test as covered in the section covering the particular type of relay involved, and readjust the relay as required.

**6.46 Low Speed Adjustment—To Be Applied First:** If the reading of the percent break meter is above the maximum specified for the 6 pulses-per-second speed, increase the spring tension of the relay under test (usually the TO relay). If the percent break is below the minimum specified for the 6 pulses-per-second speed, decrease the spring tension.

**6.47 High Speed Adjustment—To Be Applied Last:** If the reading of the percent break meter is above the maximum specified for the 12 pulses-per-second speed, decrease the resistance of the shunt on the winding of the relay under test (usually the TC relay). If the percent break is below the minimum value specified for the 12 pulses-per-second speed, increase the resistance of the shunt. If sufficient change cannot be achieved by varying this shunt resistance, change the spring tension of the relay under test. Decrease the tension to decrease the percent break, and increase the tension to increase the percent break. If the required percent break cannot be obtained by adjusting the relay under test as outlined above, check to see that the auxiliary relay (usually the LU relay) meets its requirements.

**6.48** If all the requirements specified above cannot be met, replace the relay under test with a new one and repeat the test.

**6.49** After readjustments or replacements, check the relay for current flow requirements and

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test the circuit with its associated circuits for proper operation.

### G. G1 and G2 Requirements

**6.50** If the pulse repeating requirements are not met, check the relay under test as covered in Section 040-236-701 covering 221-type relays and readjust the relay as required.

**6.51** If the percent break reading is below the minimum specified when making the loop test, decrease the spring tension of the relay under test as required. If the percent break reading is above the maximum specified for the leak test, increase the spring tension as required.

**6.52** If all the requirements cannot be met, replace the relay under test with a new one and repeat the test.

**6.53** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

### H. H1 and H2 Requirements

**6.54** If the pulse repeating requirement is not met, check the relay under test as covered in Section 040-236-701 covering 221-type relays and readjust the relay as required. If the percent break is above the maximum specified in making the loop test, decrease the spring tension of the relay under test as required. If the percent break is below the minimum specified for the leak test, increase the spring tension as required.

**6.55** If the percent break is still above the maximum limit, some improvement can be

gained by decreasing the residual of the pulse repeating relay. If the percent break is still below the minimum limit, increase the residual of the pulse repeating relay. In certain cases, it may be necessary to increase or decrease the heel gap to decrease or increase the percent break, respectively. If this is done, recheck the relay including the electrical requirements.

**6.56** If all the requirements cannot be met, replace the relay with a new one and repeat the test.

**6.57** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.

### I. J1 Requirement

**6.58** If the pulse repeating requirement is not met, check the relay under test as covered in Section 040-267-701 covering 230-type relays or Section 040-228-701 covering 239-type relays and readjust the relay as required. If the percent break is still not within the specified limits, change the strapping of the biasing resistance as covered in a circuit note. An increase in the biasing resistance will decrease the percent break, while decreasing the resistance will increase the percent break.

**6.59** If all the requirements cannot be met, replace the relay under test with a new one and repeat the test.

**6.60** After readjustments or replacements, check the relay for current flow requirements and test the circuit with its associated circuits for proper operation.