
96A1 ELECTRONIC LOOP REPEATER

TESTS AND ADJUSTMENTS

This section contains information for testing and maintaining the 96A1 loop repeater.

This section is reissued to include information pertaining to the use of the 262-type electronic switch and 4143-type network in place of the 429A electron tubes, and the use of KS-21703 hybrid integrated networks (HINs) in place of the 396A electron tubes.

The following equipment is required at the test bench:

- 165B1 Test Set

Note: The test bench must be equipped with an 11-conductor socket (KS-13930-L3) which is supplied with the test set. This socket provides for connecting an M11E (rated manufacture discontinued) or P11C cord assembly to supply power to the test set. Two M11E (MD) or P11C cords are supplied with the test set.

- KS-14510, L1 Meter (Triplett Model 630D) or equivalent meter.
- KS-21697 HIN Tester (for repeaters using HINs)
- KS-13753 Tube Puller
- Pin Straightener (for repeaters using 396A tubes)

Loop repeaters equipped with 262-type switches are tested by the 165B1-L6 test set which contains provisions for individual testing of the 262-type switches.

Before testing of the 96A1 loop repeater begins, it is important to insure that the EQPT TEST button on the 165B1-L6 test set is correctly set for the type of active device used in the repeater. When testing a loop repeater equipped with 429A electron tubes, the EQPT TEST-429A button must be depressed and remain depressed for the duration of the test.



When testing 96A1 loop repeaters equipped with 429A electron tubes, it is necessary to monitor the EQPT TEST-429A button during testing since it is interlocked with other functional buttons and will be released.

When the loop repeater is equipped with 262-type switches, the EQPT TEST-262 button may be either depressed or released. However, the EQPT TEST-429A button **must be released** for the duration of the test. The EQPT TEST-429A button may be released by momentarily depressing the EQPT TEST-262 button.

NOTICE

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The tables in this section contain either voltage measurements or nominal and measured values of circuit resistance. The Tables are to be used in conjunction with a test failure to help locate trouble sources or faulty circuit components. The voltage measurements are to be made using the KS-14510, L1 or equivalent meter while the 96A1 loop repeater is connected to the 165B1 test set. The resistance measurements are to be made with the 96A1 loop repeater disconnected from the 165B1 test set. This ensures that all voltages are removed from the coupling unit before the resistance measurements are made. Table A gives the nominal and measured values of the resistances and varistors used in the loop repeater. Each piece of apparatus may be located in the repeater by reference to SD-70627-01. In some cases the "measured resistance" value differs from the "nominal resistance" value. This is because the measured value is the resistance measured across the particular terminals and includes other resistance components. If one of the components is faulty, it affects the reading across the terminals (measured value) and it is necessary to isolate each component resistance from the group in order to determine the one at fault. If the value as measured differs from the measured value in Table A by more than ± 10 percent it is an indication that there may be trouble and steps should be taken to check the individual component resistances.

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CHART 1

TEST OF 396A ELECTRON TUBE

This test is performed by plugging the 396A electron tube into the 396A vacuum tube (VT) socket on the 165B1 test panel. The test checks both sides of the 396A dual triode electron tube for plate saturation and cutoff leakage currents, and for grid-to-cathode and/or cathode-to-filament shorts. Failure to meet any requirement in this test indicates a faulty 396A electron tube. Replacement should be made with a 396A tube known to be good.

APPARATUS:

165B1-L5 or 165B1-L6 Test Set

CHART 1 (Contd)

TABLE A

NOMINAL AND MEASURED RESISTANCE

APPARATUS	NOMINAL RESISTANCE	MEASURED RESISTANCE	NOTE
R1	.1 MEG	.0978 MEG or .1 MEG	1
R2	1.5 MEG	.099 MEG or 1.5 MEG	1
R3	.1 MEG	.0958 MEG	
R4	.39 MEG	.39 MEG	
R5	.619 MEG	.619 MEG	
R6	1.3 MEG	1.3 MEG	
R7	4700 Ω	3720 Ω	
R8	8200 Ω	5240 Ω	
R9	5100 Ω	3950 Ω	
R11	1.21 MEG	.95 MEG	
R12	1.0 MEG	.822 MEG	
R13	2.21 MEG	1.73 MEG	
R14	1.0 MEG	.822 MEG	
R15	1.2 MEG	.875 MEG or 1.2 MEG	1
R16	.82 MEG	.668 MEG or .82 MEG	1
R17	.1 MEG	.0958 MEG	
R18	.1 MEG	.0978 MEG or .1 MEG	1
R19	.511 MEG	.442 MEG	
R20	.619 MEG	.518 MEG	
R21	1.82 MEG	1.82 MEG	
R22	2.43 MEG	.858 MEG	
R23	2.61 MEG	2.61 MEG	
R24	24.9 Ω	24.9 Ω	2
R25	68,000 Ω	68,000 Ω	
R26	33,000 Ω	33,000 Ω	
R27	.2 MEG	.19 MEG or .2 MEG	1
R28	.12 MEG	.0757 MEG	
R29	2200 Ω	2200 Ω	
R30	100 Ω	100 Ω	
R31	100 Ω	100 Ω	
R32	1500 Ω	1500 Ω	
R33	1200 Ω	1200 Ω	
BIAS (Pot)	.5 MEG	.443 MEG or .5 MEG	1
LP CUR (Pot)	5000 Ω	3900 Ω	
CI	.005 MF	Open Ckt.	
CR1	100 Ω	100 Ω or 200,000 Ω	3
CR2	100 Ω	100 Ω or 200,000 Ω	3
CR3	100 Ω	100 Ω or 200,000 Ω	3
CR4	100 Ω	100 Ω or 200,000 Ω	3
CR5	100 Ω	100 Ω or 200,000 Ω	3
CR6	100 Ω	100 Ω or 200,000 Ω	3
CR7	100 Ω	100 Ω or 200,000 Ω	3

Notes:

1. This resistance should be measured in both directions owing to the presence of varistors in the interconnected circuit.
2. V2 should be removed from its socket while the resistance of R24 is measured.
3. The 400A varistor has a resistance of approximately 100 Ω in the forward direction and approximately 200,000 Ω in the other direction.

CHART 1 (Cont)

STEP	PROCEDURE
1	Remove the repeater to be tested from the bay.
2	Remove the 396A tube using the KS-13753 tube puller.
3	At the 165B1 test set, insert the 396A tube into the appropriate VT socket on the test set panel and allow ample warm-up time.
	Saturation Test
4	On the 165B1 test set, depress the button marked 396A LEFT.
	Requirement: 165B1 meter indicates a minimum of 5 mA (± 15 mA scale).
5	Depress the 396A RIGHT button.
	Requirement: 165B1 meter indicates a minimum of 5 mA (± 15 mA scale).
	Cutoff Test
6	Depress the 396A LEFT button.
7	Depress and hold the CUTOFF button.
	Requirement: 165B1 meter indication does not exceed a reading of 3 on red scale (a current of 0.2 mA).
8	Release the CUTOFF button.
9	Depress the 396A RIGHT button.
10	Depress and hold the CUTOFF button.
	Requirement: 165B1 meter indication does not exceed a reading of 3 on red scale (a current of 0.2 mA).
11	Release the CUTOFF button.
	Grid and Cathode Short Test
12	Depress the 396A LEFT button.
13	Depress and hold the GRID SHORT button.
	Requirement: 165B1 meter indicates 0 mA.
14	While holding GRID SHORT button depressed, tap tube lightly.
	Requirement: 165B1 meter does not deflect intermittently.

CHART 1 (Contd)

STEP	PROCEDURE
15	Release the GRID SHORT button.
16	Depress and hold the CATH SHORT button.
	Requirement: 165B1 meter indicates 0 mA.
17	While holding the CATH SHORT button depressed, tap the tube lightly.
	Note: If 165B1 meter deflects intermittently, tube is defective.
18	Release the CATH SHORT button.
19	Depress the 396A RIGHT button.
20	Repeat Steps 13 through 18 for the right side of the tube.
21	Test is complete. If requirements are met, replace 396A electron tube in loop repeater. If one or more requirements are not met, replace faulty 396A tube with a 396A electron tube known to be good.

CHART 2

TEST OF 429A ELECTRON TUBE

This test is performed by plugging the 429A electron tube into the 429A vacuum tube (VT) socket on the 165B1 test panel. The test checks the tube for plate saturation and cutoff leakage currents and for grid-to-cathode and/or cathode-to-filament shorts. Failure to meet any requirement in this test indicates a faulty 429A electron tube and replacement should be made with a 429A tube known to be good.

APPARATUS:

165B1-L5 or 165B1-L6 Test Set

CHART 2 (Cont)

STEP

PROCEDURE

1 Remove the repeater to be tested from the bay.

2 Remove the 429A tube using the KS-13753 tube puller.

3 At the 165B1 test set, insert the 429A tube into the appropriate VT socket on the test set panel and allow ample warm-up time.

Note: For testing of the 429A electron tube using the 165B1-L5 test set, perform Steps 4 through 9, then proceed to Step 13. For testing of the 429A electron tube using the 165B1-L6 test set, perform Steps 10 through 12.

Saturation and Cutoff Test Using 165B1-L5 Test Set

4 Depress the LOOP button on the 165B1 test set.

Requirement: 165B1 meter indicates no less than 32-mA plate current (75-0-75 mA scale).

5 Depress and hold the CUTOFF button.

Requirement: 165B1 meter does not indicate a reading exceeding 7.5 on red scale (a current of 0.5 mA).

6 Release the CUTOFF button.

7 Depress the HUB button on the 165B1 test set.

Requirement: Meter indicates no less than 30-mA plate current (75-0-75 mA scale).

8 Depress and hold the CUTOFF button.

Requirement: 165B1 meter does not indicate a reading exceeding 7.5 on red scale (a current of 0.5 mA).

9 Release the CUTOFF button.

Saturation and Cutoff Test Using 165B1-L6 Test Set

10 On the 165B1 test set depress the EQPT TEST-262 button.

Requirement: 165B1 meter indicates no less 32-mA plate current (75-0-75 mA scale).

11 Depress and hold the CUTOFF button.

Requirement: 165B1 meter does not indicate a reading exceeding 7.5 on red scale (a current of 0.5 mA).

CHART 2 (Contd)

STEP	PROCEDURE
12	Release the CUTOFF button.
	Grid and Cathode Short Test
13	For the 165B1-L5 test set, depress the LOOP button. For the 165B1-L6 test set, depress the EQPT TEST-262 button.
14	Depress and hold the GRID SHORT button.
	Requirement: 165B1 meter indicates 0 mA.
15	While holding the GRID SHORT button depressed, tap the tube lightly.
	Requirement: 165B1 meter does not deflect intermittently.
16	Release the GRID SHORT button.
17	Depress and hold the CATH SHORT button.
	Requirement: 165B1 meter indicates 0 mA.
18	While holding the CATH SHORT button depressed, tap the tube lightly.
	Requirement: 165B1 meter does not deflect intermittently.
19	Release the CATH SHORT button.
20	Test is complete. If requirements are met, replace the 429A tube in loop repeater. If one or more requirements are not met, replace faulty 429A tube with a 429A electron tube known to be good.

CHART 3
TEST OF 262A AND 262C SWITCHES

This test is performed by plugging the 262 switch into the socket marked 429A 262 on the 165B1 test panel. The test checks the switch in the "on" and "off" conditions. Failure to meet any requirement in this test indicates a faulty 262 switch. Replacement should be made with a 262 switch known to be good.

APPARATUS:

165B1-L6 Test Set

CHART 3 (Cont)

STEP	PROCEDURE
1	Remove the repeater to be tested from the bay.
2	Remove the 262 switch from the repeater.
3	Insert the 262 switch in the appropriate socket located on the 165B1 test set panel. For the 262C switch, connect the external lead to the SW connector.
4	On the 165B1 test set, depress the EQPT TEST-262 button.
5	Depress and hold the appropriate SWITCH TEST button for the type of 262 switch being tested. Requirement: For a 262A switch, the 165B1 meter indicates 55 ± 3 mA (± 75 mA scale) and HIT INDICATOR lamp lights. For a 262C switch, the 165B1 meter indicates 57 ± 5 mA (± 75 mA scale) and HIT INDICATOR lamp is off.
6	Depress and hold the CUTOFF button. Requirement: For a 262A switch, the 165B1 meter indicates 0 mA and HIT INDICATOR lamp lights. For a 262C switch, the 165B1 meter indicates 0 mA and HIT INDICATOR lamp is off.
7	Release the CUTOFF and SWITCH TEST buttons.
8	Test is complete. If requirements are met, replace the 262 switch in loop repeater. If one or more requirements are not met, replace faulty 262 switch with a 262 switch known to be good.

CHART 4

TEST OF KS-21703 HIN

This test is performed by plugging the KS-21703 HIN into the appropriate socket on the KS-21697 HIN tester and checking for specified current and voltage levels on the test set meters. The proper full-scale voltage meter range is automatically selected by the combination of switch positions used for the designated HIN. The proper full-scale current meter range is manually selected by means of pushbutton switches. Failure to meet a required level indicates a faulty KS-21703 HIN and replacement should be made with a KS-21703 HIN known to be good.

CHART 4 (Cont)

APPARATUS:

KS-21697 HIN Tester

STEP	PROCEDURE
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- 1 Remove the repeater to be tested from the bay.
- 2 Remove the KS-21703 HIN to be tested from the repeater.
- 3 Insert the KS-21703 HIN into socket 4 on the KS-21697 HIN tester.
- 4 Operate the test set switch marked ABC to the B position.
- 5 Operate the test set switch marked WX to the W position.

Note: The position of any unspecified switch on the test set is immaterial to the test of the HIN and will not affect testing provided the HIN is in its proper socket.

- 6 Operate the test set switch marked 1,2 to the 2 position.
- 7 Operate the test set switch marked 3,4 to the 4 position.
- 8 Depress and hold the red VOLTS ON pushbutton on the test set.
- 9 Depress the black 10 mA CURRENT pushbutton.

Note: Always operate the red VOLTS ON pushbutton before the designated black CURRENT pushbutton. Simultaneous operation of both buttons could possibly cause damage to the milliammeter in the event a shorted device is being tested.

- 10 Read the test set voltage and current meters.

Requirement: The test set voltage meter indicates a voltage inside the range of 0.5 volts to 10.0 volts. The test set current meter reads 0.0 mA.

Note: A slight positive current meter deflection may be noted during the test. If the deflection exceeds the width of the pointer the HIN is defective.

- 11 Release the red VOLTS ON pushbutton.
- 12 Release the black 10 mA CURRENT pushbutton.
- 13 Operate the switch marked 1,2 to the 1 position.
- 14 Operate the switch marked 3,4 to the 3 position.

CHART 4 (Contd)

STEP	PROCEDURE
15	Depress and hold the red VOLTS ON pushbutton.
16	Depress the black 10 mA CURRENT pushbutton.
17	Read the test set current meter. Requirement: The test set current meter indicates a reading equal to or greater than 2.0 mA.
18	Release the red VOLTS ON pushbutton.
19	Release the black 10 mA CURRENT pushbutton.
20	Operate the switch marked WX to the X position.
21	Repeat Steps 6 through 19 for the KS-21703 HIN.
22	Test is complete. If requirements are met, replace KS-21703 HIN in loop repeater. If one or more requirements are not met, replace faulty KS-21703 HIN with a KS-21703 HIN known to be good.

CHART 5

TEST OF RL LEAD CURRENT

This test is performed with the 96A1 loop repeater connected directly to the 165B1 test set and checks for current flowing through the RL lead of the loop repeater. For a test failure, the voltage measurements listed in the accompanying tables may be used to help locate faulty components.

APPARATUS:

165B1 Test Set

Note: Loop repeaters equipped with 262-type switches require testing by a 165B1-L6 test set. Loop repeaters equipped with 429A electron tubes may be tested by either the 165B1-L5 or 165B1-L6 test set.

CHART 5 (Contd)

STEP	PROCEDURE
	<p>Note: When using the 165B1-L6 test set for testing loop repeaters equipped with 429A electron tubes, the EQPT TEST-429A button must be depressed for the duration of the test. For loop repeaters equipped with 262-type switches, the EQPT TEST-429A button must be released. The EQPT TEST-262 button may be either depressed or released.</p>
1	Remove the repeater to be tested from the bay.
2	Using the M11E (MD) or P11C cord, connect the 165B1 test set to the 96A1 loop repeater. The cord plugs into the 165B1 test set at the socket labeled 96A1 LOOP REP.
3	Operate the DX switch on the repeater to the H position.
4	On the 165B1 test set, depress the RL CUR button.

Requirement: Meter indicates 0 mA.

Note: For a reading other than 0, Table B may be used to help locate the exact cause of trouble.

TABLE B

96A1 VOLTAGE MEASUREMENTS — MARK SIGNAL
TRANSMITTED TO HUB

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER			96A1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD	VOLTAGE REQUIRED	
None	Pin 2, V1	GND	+60 ± 5V	R32, R33, R29
None	GND	Pin 8, V1	-160 ± 20V	R3, R11, R12, R13, R14, R17
None	GND	Pin 6, V3	0V ± 5V	R3, R11, R12 R13, R14, R17
None	GND	Pin 8, V3	-47 ± 5V	R7, R8
None	GND	Pin 2, V4 or V5	-50 ± 5V	R1, R2, BIAS

5 Depress and hold the SPACE TOWARD HUB button.

Requirement: HIT INDICATOR lamp lights and test set meter deflects *right* indicating 30 mA (± 75 mA scale).

CHART 5 (Contd)

STEP

PROCEDURE

Note: This determines that the duplex control circuit will prevent a space from the station being reflected back toward the station. For a reading other than 30 mA, Tables C and D may be used to help locate the exact cause of trouble.

- 6 Release the SPACE TOWARD HUB button.

TABLE C

96A1 VOLTAGE MEASUREMENTS — SPACE SIGNAL
TRANSMITTED TO HUB

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER			96A1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD	VOLTAGE REQUIRED	
SPACE TOWARD HUB	GND	Pin 2, V1	-110 ± 10V	R32, R33, R29
SPACE TOWARD HUB	Pin 6, V3	GND	+120 ± 10V	R3, R11 and R12
SPACE TOWARD HUB	GND	Pin 8, V3	-47 ± 5V	R7, R8
SPACE TOWARD HUB	GND	Pin 2, V4 or V5	-130 ± 10V	R1, R2, BIAS

CHART 5 (Cont)

TABLE D
96A1 VOLTAGE MEASUREMENTS — DUPLEX
CONTROL CIRCUIT

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER			96A1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD	VOLTAGE REQUIRED	
SPACE TOWARD HUB	Pin 6, V2	GND	+120 ± 10V	R15,R16, R17, R18, R19, R20, R21, R22, R23, C1, CR1, CR2, CR3,
SPACE TOWARD HUB	GND	Pin 2, V3	-10 ± 2V	R4, R5, R6, R13, R15, R25
None	Pin 6, V2	GND	+120 ± 10V	R15, R16, R17, R18, R19, R20, R21, R22, R23, C1, CR1, CR2, CR3
None	GND	Pin 2, V3	-10 ± 2V	R4, R5, R6, R13, R14, R25
SPACE TOWARD UNIT — FROM RL & SL	GND	Pin 3, V2	-40 ± 5V	R15, R16, R17, R18, R19, R20, R21, R22, R23
SPACE TOWARD UNIT — FROM RL & SL	GND	Pin 6, V2	-4 ± 5V	R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, C1, CR1, CR2, CR3
SPACE TOWARD UNIT — FROM RL & SL	GND	Pin 3, V3	-100 ± 10V	R13, R14
SPACE TOWARD UNIT — FROM RL & SL	GND	Pin 2, V3	-80 ± 10V	R4, R5, R6, R13, R14, R25
None	GND	Pin 3, V2	-14 ± 2V	R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, C1 CR1, CR2, CR3
None	GND	Pin 6, V2	-4 ± 5V	R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, C1, CR1, CR2, CR3
None	GND	Pin 3, V3	-100 ± 10V	R13, R14
None	GND	Pin 2, V3	-14 ± 2V	R4, R5, R6, R13, R14, R25

CHART 5 (Contd)

STEP	PROCEDURE
7	Test is complete. If requirements are met, and no further testing is required, disconnect 165B1 test set from 96A1 loop repeater and replace repeater in bay. If requirements are not met, a faulty loop repeater is indicated, and appropriate action should be taken.

CHART 6

TEST OF NEUTRAL LOOP CURRENT

This test is performed with the 96A1 loop repeater connected directly to the 165B1 test set and measures the neutral loop current of the loop repeater. Inherent in the test is a check of the repeaters duplex control circuit which insures that the repeater in the half duplex mode operates correctly when the sending and receiving hubs are isolated from one another by a regenerator.

APPARATUS:

165B1 Test Set

Note: Loop repeaters equipped with 262-type switches require testing by a 165B1-L6 test set. Loop repeaters equipped with 429A electron tubes may be tested by either the 165B1-L5 or 165B1-L6 test set.

STEP	PROCEDURE
<p>Note: When using the 165B1-L6 test set for testing loop repeaters equipped with 429A electron tubes, the EQPT TEST-429A button must be depressed for the duration of the test. For loop repeaters equipped with 262-type switches, the EQPT TEST-429A button must be released. The EQPT TEST-262 button may be either depressed or released.</p>	
1	Remove the repeater to be tested from the bay.
2	Using the M11E (MD) or P11C cord, connect the 165B1 test set to the 96A1 loop repeater. The cord plugs into the 165B1 test set at the socket labeled 96A1 LOOP REP.
3	Operate the DX switch on the repeater to the H position.
4	At the 165B1 test set, depress and hold the SPACE TOWARD HUB button.
5	Depress and release the SPACE TOWARD UNIT-FROM RL & SL button.
6	Release the SPACE TOWARD HUB button.

CHART 6 (Contd)

STEP	PROCEDURE
	<p>Note: This procedure correctly conditions the duplex control flip-flop circuit.</p>
7	<p>Depress the NEUT LP CUR button.</p> <p>Requirement: The 165B1 meter deflects <i>right</i> and indicates 62.5 mA (75-0-75 mA scale).</p> <p>Note: If this requirement is not met and the repeater is equipped with 429A electron tubes, adjust the LP CUR potentiometer in the repeater until the meter indicates 62.5 mA. If equipped with 262-type switches, adjust the LP CUR potentiometer fully CW.</p>
8	<p>Depress and hold the SPACE TOWARD UNIT—FROM SL ONLY button.</p> <p>Requirement: 165B1 meter remains deflected to the <i>right</i> and indicates 62.5 mA (± 75 mA scale).</p> <p>Note: This simulates the delay a space signal undergoes when it is transmitted from the receive to the send hub via a regenerative repeater. The requirement determines that the duplex control circuit will prevent a space received from the station from being reflected back toward the station even through the station is sending a mark toward the hub.</p>
9	<p>Release the SPACE TOWARD UNIT—FROM SL ONLY button.</p> <p>Requirement: 165B1 meter remains deflected to the <i>right</i> and indicates 62.5 mA (± 75 mA scale).</p>
10	<p>Depress and hold the SPACE TOWARD UNIT—FROM RL & SL button.</p> <p>Requirement: 165B1 meter indicates 0 mA.</p> <p>Note: If 165B1 meter still deflects right and indicates 62.5 mA, perform Bias Adjustment (HDX) procedure in CHART 7.</p>
11	<p>Release the SPACE TOWARD UNIT—FROM RL & SL button.</p> <p>Requirement: 165B1 meter deflects <i>right</i> and indicates 62.5 mA (± 75 mA scale).</p>
12	<p>Depress and hold the SPACE TOWARD UNIT—FROM SL ONLY button.</p> <p>Requirement: 165B1 meter indicates 0 mA.</p> <p>Note: This simulates a space received from another leg that is repeated from the receive to send hub via a regenerative repeater. The requirement verifies that the duplex control circuit will remain released and will allow the space to be transmitted through the repeater after the receive hub potential has been restored to marking.</p>
13	<p>Release the SPACE TOWARD UNIT—FROM SL ONLY button.</p>

CHART 6 (Contd)

STEP	PROCEDURE
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Note: If the repeater fails to meet the above neutral loop current requirements, attempt to locate the trouble by making the voltage measurements outlined in Tables E and F. For incorrect operation of the duplex control circuit, attempt to locate the trouble by making the voltage measurements outlined in Table D.

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|----|---|
| 14 | Test is complete. If requirements are met, and no further testing is required, disconnect 165B1 test set from 96A1 loop repeater and replace repeater in bay. If requirements are not met, a faulty loop repeater is indicated, and appropriate action should be taken. |
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CHART 7
BIAS ADJUSTMENT

This test is performed with the 96A1 loop repeater connected directly to the 165B1 test set. The test outlines the bias adjustment procedures for a repeater operating in either the full-duplex or half-duplex mode. The bias adjustment procedure adjusts the repeaters signal detection threshold and compensates for marking bias generally associated with signals transmitted over cable facilities. For an extreme signal bias condition where the repeater is used on a long or high-capacity loop, an in-service adjustment of the bias potentiometer may be necessary.

APPARATUS:

165B1 Test Set

Note: Loop repeater equipped with 262-type switches require testing by a 165B1-L6 test set. Loop repeaters equipped with 429A electron tubes may be tested by either the 165B1-L5 or 165B1-L6 test set.

STEP	PROCEDURE
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Note: When using the 165B1-L6 test set for testing loop repeaters equipped with 429A electron tubes, the EQPT TEST-429A button must be depressed for the duration of the test. For loop repeaters equipped with 262-type switches, the EQPT TEST-429A button must be released. The EQPT TEST-262 button may be either depressed or released.

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|---|---|
| 1 | Remove the repeater to be tested from the bay. |
| 2 | Using the M11E (MD) or P11C cord, connect the 165B1 test set to the 96A1 loop repeater. The cord plugs into the 165B1 test set at the socket labeled 96A1 LOOP REP. |

CHART 7 (Contd)

STEP

PROCEDURE

TABLE E

96A1 VOLTAGE MEASUREMENTS — MARK SIGNAL
RECEIVED FROM HUB

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER			96A1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD	VOLTAGE REQUIRED	
None	JCT R4 and R25	GND	+60 ± 5V	R4, R5, R25
None	GND	Pin 2 V4 or V5	-50 ± 5V	R1, R2, R4, R5, R6, R9, R30, R31 Bias, LP CUR

TABLE F

96A1 VOLTAGE MEASUREMENTS — SPACE SIGNAL
RECEIVED FROM HUB

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER			96A1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD	VOLTAGE REQUIRED	
SPACE TOWARD UNIT — FROM RL & SL	GND	JCT R4 and R25	-30 ± 5V	R4, R5, R25
SPACE TOWARD UNIT — FROM RL & SL	GND	Pin 8, V4 Or V5	-160 ± 20V	R4, R5, R6, R11, R12, R13, R14, R25
SPACE TOWARD UNIT — FROM RL & SL	Pin 2 V4 or V5	GND	+130 ± 5V	R1, R2, R9, R30, R31, BIAS, LP CUR

Bias Adjustment (HDX)

- 3 Operate the DX switch on the repeater to the H position.
- 4 At the 165B1 test set, depress the 96A1 BIAS button.

CHART 7 (Contd)

STEP	PROCEDURE
5	For repeaters equipped with 429A electron tubes, adjust the BIAS potentiometer on the repeater until the test set meter deflects right and indicates 15 mA (± 75 mA scale). For repeaters equipped with 262-type switches, adjust the BIAS potentiometer until the test set meter deflects right and indicates 30 mA.
	Note: The test set meter may fluctuate considerably as the bias potentiometer adjusts the current in the hub to the transition point between mark and space.
	Bias Adjustment (FDX)
6	Operate the DX switch on the repeater to the F position.
7	At the test set, operate the DX-LP switch (165B1-L5) or the DX-LP button (165B1-L6) to the F-2880 position.
8	For repeaters equipped with 429A electron tubes, adjust the ADJ FDX potentiometer on the repeater until the test set meter deflects right and indicates 15 mA (± 75 mA scale). For repeaters equipped with 262-type switches, turn the ADJ FDX potentiometer fully clockwise (CW).
9	Adjustment is complete. If requirements are met, and no further testing is required, disconnect 165B1 test set from 96A1 loop repeater and replace repeater in bay. If requirements are not met, a faulty loop repeater is indicated, and appropriate action should be taken.

CHART 8

TEST OF LOOP-TO-HUB AND HUB-TO-LOOP
TRANSMISSION

This test is performed with the 96A1 loop repeater connected directly to the 165B1 test set. The test checks the ability of the repeater to receive current signals from a 62.5-mA neutral loop and convert them to voltage signals for transmission over a voltage operated hub circuit. The test also checks the ability of the repeater to perform the reverse operation of receiving signals from a voltage operated hub and converting them to current signals for transmission over a 62.5-mA neutral loop circuit. For a test failure, the voltage and resistance measurements listed in Tables A through F may be used to help locate faulty components.

CHART 8 (Contd)

APPARATUS:

165B1 Test Set

Note: Loop repeaters equipped with 262-type switches require testing by a 165B1-L6 test set. Loop repeaters equipped with 429A electron tubes may be tested by either the 165B1-L5 or 165B1-L6 test set.

STEP

PROCEDURE

Note: When using the 165B1-L6 test set for testing loop repeaters equipped with 429A electron tubes, the EQPT TEST—429A button must be depressed for the duration of the test. In loop repeaters equipped with 262-type switches, the EQPT TEST—429A button must be released. The EQPT TEST—262 button may be either depressed or released.

- 1 Remove the repeater to be tested from the bay.
- 2 Using the M11E (MD) or P11C cord, connect the 165B1 test set to the 96A1 loop repeater. The cord plugs into the 165B1 test set at the socket labeled 96A1 LOOP REP.
- 3 Operate the DX switch on the repeater to the F position.

Loop-to-Hub Transmission

- 4 On the 165B1 test set, depress the RL CUR button.

Requirement: 165B1 meter indicates 0 mA RL hub current.

Note: This requirement verifies that the marking send loop is causing the output of V1 to cut off and allow the hub potentiometer on the RL lead to maintain a steady marking voltage of +60 volts.

- 5 Depress and hold the SPACE TOWARD HUB button.

Requirement: HIT INDICATOR lamp lights. 165B1 meter deflects **right** and indicates 30 mA (± 75 mA scale).

Note: This requirement verifies that the sending loop has gone spacing. The 30 mA output of V1 causes the hub potentiometer on the RL lead to produce a spacing voltage of -30 volts.

- 6 Release the SPACE TOWARD HUB button.

Requirement: 165B1 meter indicates 0 mA.

Hub-to-Loop Transmission

CHART 8 (Contd)

STEP	PROCEDURE
7	Depress the NEUT LP CUR button. Requirement: 165B1 meter deflects <i>right</i> and indicates 56 ± 3 mA (± 75 mA scale).
8	Operate the test set DX-LP switch (165B1-L5) or button (165B1-L6) to the H-800 position. Requirement: 165B1 meter indicates 0 mA. The HIT INDICATOR lamp lights. Note: This requirement verifies that a -30 volt spacing signal on the SL hub lead causes V4 and V5 to cut off.
9	Depress and latch the FDX POT button on the test set. Requirement: 165B1 meter deflects <i>right</i> and indicates 62.5 mA (± 75 mA scale). The HIT INDICATOR lamp lights. Note: This requirement verifies that a +60 volt marking signal on the SL hub head causes V4 and V5 to deliver 62.5 mA marking current to the transmission loop.
10	Unlatch the FDX POT button. Requirement: 165B1 meter indicates 0 mA. The HIT INDICATOR lamp lights.
11	Test is complete. If requirements are met, and no further testing is required, disconnect 165B1 test set from 96A1 loop repeater and replace repeater in bay. If requirements are not met, a faulty loop repeater is indicated, and appropriate action should be taken.