144A1, 144B1, 144B2, AND 144C1
COUPLING UNITS
TESTS AND ADJUSTMENTS

This section contains information for testing and maintaining 144A1, 144B1 (manufacture discontinued), 144B2, and 144C1 coupling units.

This section is reissued to include information pertaining to the use of switches and hybrid integrated networks (HINs) in place of various vacuum tubes used by the coupling units. For the 144B1 (MD) and 144B2 coupling units, vacuum tube V2 may be replaced with a 262C switch, provided tube V1 is also replaced with a 4143B network. For the 144C1 coupling unit, vacuum tubes V2 and V3 may be replaced with 262A switches, and tube V1 may be replaced with a KS-21703 HIN.

The tests and adjustments covered in this section are either in preparation for initial service in a new installation, or as a result of observations made at the service or testboard. The coupling units should be dismounted from the bay before these tests or adjustments are performed.

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 (MD) 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 144C1 coupling units equipped with KS-21703 HINs)

KS-13753 Tube Puller

Pin Straightener (for coupling units using 396A tubes).

The 144B1 (MD), 144B2, and 144C1 coupling units equipped with 262-type switches must be tested by the 165B1-L6 test set which contains provisions for individual testing of the 262-type switches.

Before testing the coupling unit it is important to insure that the EQPT TEST button on the 165B1 test set is correctly set for the type of active device used in the repeater. When testing a coupling unit equipped with 429A vacuum tubes, the EQPT TEST—429A button must be depressed and remain depressed for the duration of the test.

When testing 144B1 (MD), 144B2 or 144C1 coupling units equipped with 429A vacuum tubes, it is necessary to monitor the EQPT TEST—429A button during testing since it is interlocked with other function buttons and may become released.

When the coupling unit 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.

The Tables in this section contain either voltage measurements or nominal and measured values of circuit resistances. 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 coupling unit is connected to the 165B1 test set. Each piece of apparatus may be located by referring to the associated SD of the coupling unit. The 144A1 coupling unit circuit is shown in SD-70531-01. The 144B1 (MD) and 144B2 coupling unit circuits are shown in SD-70638-01, and the 144C1 coupling unit circuit is shown in SD-70639-01. 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 will affect the reading across the terminals (measured value) and it will be necessary to isolate each component resistance from the group in order to determine the one at fault. If the value as measured differs by more than ±10 percent from the measured value, it is an indication that there may be trouble, and steps should be taken to check for defective resistors, varistors, or capacitors.

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CHART 1

TEST OF 396A VACUUM TUBE

This test is performed by plugging the 396A vacuum tube into the 396A vacuum tube (VT) socket on the 165B1 test set panel. The test checks both sides of the 396A dual triode vacuum 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 vacuum tube. Replacement should be made with a 396A tube known to be good.

CHART 1 (Contd)

APPARATUS:

165B1-L5 or 165B1-L6 Test Set

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

CHART 1 (Contd)

STEP	PROCEDURE
	Requirement: 165B1 meter indicates 0 mA.
13	While holding GRID SHORT button depressed, tap tube lightly.
	Requirement: 165B1 meter does not deflect intermittently.
14	Release GRID SHORT button.
15	Depress and hold CATH SHORT button.
	Requirement: 165B1 meter indicates 0 mA.
16	While holding CATH SHORT button depressed, tap tube lightly.
	Requirement: 165B1 meter does not deflect intermittently.
17	Release CATH SHORT button.
18	Depress 396A RIGHT button.
19	Repeat Steps 13 through 18 for the right side of the tube.
20	Test is complete. Replace 396A vacuum tube in coupling unit and, if no further testing is required, replace coupling unit in bay.

CHART 2

TEST OF 429A VACUUM TUBE

This test is performed by plugging the 429A vacuum 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 vacuum tube and replacement should be made with a 429A vacuum tube known to be good.

APPARATUS:

165B1-L5 or 165B1-L6 Test Set

CHART 2 (Contd)

STEP	PROCEDURE
1	Remove coupling unit to be tested from bay.
2	Remove 429A vacuum tube using KS-13753 tube puller.
3	At 165B1 test set, insert 429A vacuum tube into appropriate VT socket on the test set panel and allow ample warm-up time.
	Note: For testing of 492A vacuum tube using 165B1-L5 test set, perform Steps 4 through 9, then proceed to Step 13. For testing of 429A vacuum tube using 165B1-L6 test set, perform Steps 10 through 12.
	Saturation and Cutoff Test Using 165B1-L5 Test Set
4	Depress LOOP button on 165B1-L5 test set.
	Requirement: 165B1 meter indicates no less than 32-mA plate current (75-0-75 mA scale).
5	Depress and hold CUTOFF button.
	Requirement: 165B1 meter does not indicate a reading exceeding 7.5 on red scale (a current of 0.5 mA)
6	Release CUTOFF button.
7	Depress HUB button.
	Requirement: Meter indicates no less than 30-mA plate current (75-0-75 mA scale).
8	Depress and hold CUTOFF button.
	Requirement: 165B1-L5 meter does not indicate a reading exceeding 7.5 on red scale (a current of 0.5 mA).
9	Release CUTOFF button.
	Saturation and Cutoff Test Using 165B1-L6 Test Set
10	On 165B1-L6 test set depress EQPT TEST—262 button.
	Requirement: 165B1-L6 meter indicates no less than 32-mA plate current (75-0-75 mA scale).
11	Depress and hold CUTOFF button.

CHART 2 (Contd)

STEP	PROCEDURE
	Requirement: 165B1 meter does not indicate a reading exeeding 7.5 on red scale (a current of 0.5 mA).
12	Releases CUTOFF button.
	Grid and Cathode Short Test
13	For 165B1-L5 test set, depress LOOP button. For 165B1-L6 test set, depress EQPT TEST—262 button.
14	Depress and hold GRID SHORT button.
	Requirement: 165B1 meter indicates 0 mA.
15	While holding GRID SHORT button depressed, tap tube lightly.
	Requirement: 165B1 meter does not deflect intermittently.
16	Release GRID SHORT button.
17	Depress and hold CATH SHORT button.
	Requirement: 165B1 meter indicates 0 mA.
18	While holding CATH SHORT button depressed, tap tube lightly.
	Requirement: 165B1 meter does not deflect intermittently.
19	Release CATH SHORT button.
20	Test is complete. Replace 429A tube in coupling unit and, if no further testing is required, replace coupling unit in bay.

CHART 3

TEST OF 262A AND 262C SWITCHES

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

CHART 3 (Contd)

APPARATUS:

165B1-L6 Test Set

STEP	PROCEDURE
1	Remove coupling unit to be tested from bay.
2	Remove 262-type switch from coupling unit.
3	Insert 262-type switch in appropriate socket located on 165B1 test set panel. For a 262C switch, connect external lead to SW connector.
4	On 165B1 test set, depress EQPT TEST-262 button.
5	Depress and hold appropriate SWITCH TEST button for 262-type switch being tested. ***Requirement:*** For a 262A switch, 165B1 meter indicates 55 ±3 mA (±75 mA scale) and HIT INDICATOR LAMP LIGHTS. For a 262C switch, 165B1 meter indicates 57 ±5 mA (±75 mA scale) and HIT INDICATOR lamp is off.
6	Depress and hold CUTOFF button. ***Requirement:*** For a 262A switch, 165B1 meter indicates 0 mA and HIT INDICATOR lamp lights. For a 262C switch, 165B1 meter indicates 0 mA and HIT INDICATOR lamp is off.
7	Release CUTOFF and SWITCH TEST buttons.
8	Test is complete. Replace 262 switch in the coupling unit and, if no further testing is required, replace coupling unit in bay.

CHART 4

TEST OF KS-21703 HIN

This test is performed by plugging KS-21703 HIN into the appropriate socket on 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 (Contd)

APPARATUS:

KS-21697 HIN Tester

STEP	PROCEDURE
1	Remove coupling unit to be tested from bay.
2	Remove KS-21703 HIN to be tested from coupling unit.
3	Insert KS-21703 HIN into socket 4 on KS-21697 HIN tester.
4	Operate test set switch marked ABC to B position.
5	Operate test set switch marked WX to W position. ***Note:*** The position of any unspecified switch on the test set is immaterial and will not affect testing provided HIN is in its proper socket.
6	Operate test set switch marked 1,2 to 2 position.
7	Operate test set switch marked 3,4 to 4 position.
8	Depress and hold red VOLTS ON pushbutton on test set.
9	Depress black 10 mA CURRENT pushbutton. ***Note:*** Always operate red VOLTS ON pushbutton before designated black CURRENT pushbutton. Simultaneous operation of both buttons could cause damage to the test set 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 red VOLTS ON pushbutton.
12	Release black 10 mA CURRENT pushbutton.
13	Operate switch marked 1,2 to 1 position.
14	Operate the switch marked 3,4 to 3 position.

CHART 4 (Contd)

STEP	PROCEDURE
15	Depress and hold red VOLTS ON pushbutton.
16	Depress black 10 mA CURRENT pushbutton.
17	Read test set current meter ***Requirement:*** The test set current meter indicates a reading equal to or greater than 2.0 mA.
18	Release red VOLTS ON pushbutton.
19	Release black 10 mA CURRENT pushbutton.
20	Operate switch marked WX to X position.
21	Repeat Steps 6 through 19.
22	Test is complete. Replace KS-21703 HIN in coupling unit and, if no further testing is required, replace coupling unit in bay.

CHART 5

TEST OF 144A1 COUPLING UNIT

This test is performed with the 144A1 coupling unit connected directly to the 165B1 test set. The test measures R leg and RL lead currents, and adjusts the S leg current. For a test failure, the voltage measurements and resistance values listed in the accompanying Tables may be used to help locate faulty components.

APPARATUS:

165B1-L5 or 165B1-L6 Test Set

STEP	PROCEDURE
1	Remove 144A1 coupling unit to be tested from bay.
2	Using M11E (MD) or P11C cord, connect 165B1 test set to 144A1 coupling unit. The cord plugs into 165B1 test set at socket labeled 144A1. ***Test of R Leg Current***

CHART 5 (Contd)

STEP	PROCEDURE
3	At 165B1 test set, depress R LEG CUR button. ***Requirement:*** 165B1 meter deflects ***right*** and indicates approximately 27 mA (±75 mA scale).
4	Depress and hold the SPACE TOWARD HUB button. ***Requirement:*** The HIT INDICATOR lamp lights and the 165B1 meter deflects ***left*** indicating approximately 31 mA (±75 mA scale).
5	Release SPACE TOWARD HUB button. ***Note:*** If the coupling unit fails the current flow test, attempt to locate the trouble by making voltage measurements outlined in Table A. If HIT INDICATOR lamp fails to light, check R27 and R28 of coupling unit.
	Test of RL Lead Current
6	Depress RL CUR button. ***Requirement:*** 165B1 meter indicates 0 mA (±75 mA scale).
7	Depress and hold SPACE TOWARD HUB button. ***Requirement:*** HIT INDICATOR lamp lights. 165B1 meter deflects ***right*** and indicates approximately 30 mA (±75 mA scale).
8	Depress and hold FDX POT button. ***Requirement:*** HIT INDICATOR lamp lights. 165B1 meter deflects ***right*** and indicates approximately 18 mA (±75 mA scale).
9	Release SPACE TOWARD HUB and FDX POT buttons. ***Note:*** If coupling unit fails to meet above requirements, attempt to locate the trouble by making voltage measurements outlined in Table B.
	Test and Adjustment of S Leg Current
10	Depress S LEG CUR button.
11	Depress and hold SPACE TOWARD UNIT—FROM RL & SL button. ***Requirement:*** 165B1 meter deflects ***left*** and indicates 7.2 ±0.6 mA (±15 mA scale).
12	Record 165B1 meter reading.

CHART 5 (Contd)

STEP	PROCEDURE

TABLE A

144A1 COUPLING UNIT
VOLTAGE MEASUREMENTS—RL LEG CURRENTS

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER		VOLTAGE REQUIRED	144A1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD		
R LEG CUR	GND	Jct R27 & R28	−47 ± 5V	R27, R28, R29
R LEG CUR	Pin 2 V1	GND	+20 ± 2V	CR6, CR7 (option K) or CR6 (option J) R6, R7, R8, R9, R29, C3
R LEG CUR	Jct R1 & R2	GND	+65 ± 5V	CR1 to CR5 Incl. (option K) or CR1 (option J) R1, R2, R3, R29
R LEG CUR and SPACE TOWARD HUB	GND	Jct R27 & R28	−120 ± 10V	R27, R28, R29
R LEG CUR and SPACE TOWARD HUB	GND	Pin 2 V1	−45 ± 5V	CR6, CR7 (option K) or CR1 (option J) R6, R7, R8, R9, R29, C3
R LEG CUR and SPACE TOWARD HUB	Jct R1 & R2	GND	−40 ± 5V	CR1 to CR5 Incl. (option K) or CR1 (option J); R1, R2, R3, R29

13 Release SPACE TOWARD UNIT—FROM RL & SL button. This conditions test set to transmit a mark toward coupling unit.

14 Adjust ADJ CUR potentiometer located on coupling unit so that 165B1 meter indicates the same value as measured in Step 12, but deflecting ***right.***

15 Alternately depressing and releasing SPACE TOWARD UNIT—FROM RL & SL button, insure that 165B1 meter indicates same magnitude for both right and left deviations.

CHART 5 (Contd)

STEP	PROCEDURE

TABLE B

144A1 COUPLING UNIT
VOLTAGE MEASUREMENTS—RL LEAD CURRENTS

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER		VOLTAGE REQUIRED	114A1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD		
RL CUR	GND	Jct R27 & R29	+123 ± 5V	CR1 to CR5 Incl. (option K) or CR1 (option J); R29
RL CUR	Jct. R1 & R2	GND	+65 ± 5V	CR1 to CR5 Incl. (option K) or CR1 (option J); R29
RL CUR	Pin 2 V3	GND	+60 ± 5V	CR1 to CR5 Incl. (option K) or CR1 (option J)
RL CUR & SPACE TOWARD HUB	GND	Jct. R27 & R29	−123 ± 5V	CR1 to CR5 Incl. (option K) or CR1 (option J); R27
RL CUR & SPACE TOWARD HUB	GND	Jct R1 & R2	−34 ± 5V	CR1 to CR5 Incl. (option K) or CR1 (option J); R29
RL CUR & SPACE TOWARD HUB	GND	Pin 2 V3	−30 ± 2V	CR1 to CR5 Incl. (option K) or CR1 (option J)

16 Release SPACE TOWARD UNIT—FROM RL & SL button

Note: If coupling fails tests, attempt to locate trouble by making voltage measurements outlined in Table C.

Test of Duplex Control Circuit

17 Depress and hold SPACE TOWARD HUB button.

CHART 5 (Contd)

STEP	PROCEDURE

TABLE C

114A1 COUPLING UNIT
VOLTAGE MEASUREMENTS — S LEG CURRENTS

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER		VOLTAGE REQUIRED	144A1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD		
S LEG CUR and SPACE TOWARD UNIT FROM RL & SL	GND	Jct R20 & R22	−35 ± 5V	R19, R20, R22 R31
S LEG CUR and SPACE TOWARD UNIT FROM RL & SL	GND	Pin 8 V2	−2 ± 0.3V	C1, C5 (option K) or C1 (option J); R5, R21, R23
S LEG CUR	Jct R20 & R22	GND	+2V	R19, R20, R22, R31
S LEG CUR	Pin 8 V2	GND	−2 ± 0.3V	C1, C5 (option K) or C1 (option J); R5, R21, R23, R26, ADJ CUR, C4

Requirment: HIT INDICATOR lamp lights and 165B1 meter deflects ***right*** indicating 7.2 ±0.6 mA (±15 mA scale).

Note: This determines that the duplex control circuit will prevent a space received from the line or loop repeater from being reflected back toward repeater.

18 Release SPACE TOWARD HUB button.

19 Depress and hold SPACE TOWARD UNIT—FROM SL ONLY button.

Requirement: 165B1 meter deflects ***right*** and indicates 7.2 ±0.6 mA (±15 mA scale).

Note: This determines that the duplex control circuit will prevent a space received from the line or loop repeater from being reflected back toward the repeater even though the repeater is sending a mark toward the hub. This simulates the delay a space signal undergoes when it is transmitted from the receive to the send hub via a regenerative repeater.

CHART 5 (Contd)

STEP	PROCEDURE
20	Release SPACE TOWARD UNIT—FROM SL ONLY button.
21	Depress and hold SPACE TOWARD UNIT—FROM RL & SL button.
	Requirement: 165B1 meter deflects ***left*** and indicates 7.2 ±0.6 mA (±15 mA scale).
22	Release SPACE TOWARD UNIT—FROM RL & SL button.
	Requirement: 165B1 meter deflects ***right*** and indicates 7.2 ±0.6 mA (±15 mA scale).
23	Depress and hold SPACE TOWARD UNIT—FROM SL ONLY button.
	Requirement: 165B1 meter deflects ***left*** and indicates 7.2 ±0.6 mA (±15 mA scale).
	Note: This determines that the duplex control circuit will remain released so that a space received from another leg, and repeated from the receive hub to the send hub via a regenerative repeater, will be transmitted through the coupling unit after the receive hub potential has been restored to marking.
24	Release SPACE TOWARD UNIT—FROM SL ONLY button.
	Requirement: 165B1 meter deflects ***right*** and indicates 7.2 ±0.6 mA (±15 mA scale).
25	Depress and hold SPACE TOWARD HUB button.
	Requirement: 165B1 meter deflects ***right*** and indicates 7.2 ±6.0 mA (±15 A scale).
26	Depress and hold SPACE TOWARD UNIT—FROM RL & SL button.
	Requirement: 165B1 meter deflects ***left*** and indicates 7.2 ±0.6 (±15 mA scale).
	Note: This determines that a "double-space" potential on the receive hub will be transmitted outward through the coupling unit when a space is being transmitted inward toward the hub.
27	Release SPACE TOWARD HUB and SPACE TOWARD UNIT—FROM RL & SL buttons.
	Requirement: 165B1 meter deflects right and indicates 7.2 ±0.6 mA (±15 mA scale).
28	Depress and latch FDX POT button on 165B1 test set.
29	Depress and hold SPACE TOWARD HUB button.
	Requirement: 165B1 meter deflects ***right*** and indicates 7.3 ±0.6 (±15 mA scale).
30	Depress and hold SPACE TOWARD UNIT—FROM SL ONLY button.

CHART 5 (Contd)

STEP	PROCEDURE
	Requirement: 165B1 meter delfects ***left*** and indicates 7.2 ±0.6 mA (±15 mA scale).
	Note: This verifies the connection of a full-duplex potentiometer to the receive hub and maintains the duplex control circuit in a release condition which will permit spaces to be transmitted independently outward through the coupling unit although a space is being transmitted toward the hub.
31	Release SPACE TOWARD UNIT—FROM SL ONLY button.
32	Release SPACE TOWARD HUB button.
33	Unlatch and release FDX POT button.
34	Test is complete. If no further testing is required, disconnect 165B1 test set from 144A1 coupling unit and replace coupling unit in bay.
	Note: If the coupling unit fails to meet the duplex control circuit test requirements, attempt to locate the trouble by making voltage measurements outlined in Table D. Table E lists nominal and measured resistance values for the 144A1 coupling unit. These resistances may be used to help locate faulty circuit components. When making resistance measurements, the coupling unit should be disconnected from 165B1 test set. This insures that all voltages are removed from the coupling unit before the resistance measurements are made.

CHART 5 (Cont)

TABLE D

144A1 COUPLING UNIT
VOLTAGE MEASUREMENTS—DUPLEX CONTROL CIRCUIT

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER		VOLTAGE REQUIRED	144A1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD		
SPACE TOWARD HUB (Monmentarily)	Pin 6 V1	GND	+122 ± 5V	C2 (option F), R10, R11, R12, R15, R16, R17, R18, R30
SPACE TOWARD HUB (Momentarily)	Pin 4 V3	GND	+60 ± 5V	C2 (option F), R10, R11, R12, R15, R16, R17, R18, R30
SPACE TOWARD HUB (Momentarily)	Pin 8 V3	GND	+27 ± 5V	R13 & R14
SPACE TOWARD UNIT FROM RL & SL (Momentarily)	Pin 6 V1	GND	0 ± 5V	C2 (option F), R10 R11, R12, R15, R16, R17, R18, R30
SPACE TOWARD UNIT FROM RL & SL (Momentarily)	Pin 4 V3	GND	0 ± 5V	C2 (option F), R10 R11, R12, R15, R16, R17, R18, R30
SPACE TOWARD UNIT FROM RL & SL (Momentarily)	Pin 8 V3	GND	+30 ± 5V	R13 & R14

TABLE E

144A1 COUPLING UNIT
NOMINAL AND MEASURED RESISTANCE

APPARATUS	NOMINAL RESISTANCE	MEASURED RESISTANCE	NOTE
R1	6,800Ω	6,100Ω	1
R2	11,000Ω	7,420Ω	
R3	6,200Ω	4,950Ω	1
R4	3.48Ω	3.48Ω	
R5	18,000Ω	18,000Ω	
R6	20,000Ω	10,840Ω	
R7	56,200Ω	10,000Ω	
R8	9,090Ω	6,800Ω	
R9	22,000Ω	22,000Ω or 200Ω	2

CHART 5 (Cont)

TABLE E (Contd)

144A1 COUPLING UNIT
NOMINAL AND MEASURED RESISTANCE

APPARATUS	NOMINAL RESISTANCE	MEASURED RESISTANCE	NOTE
R10	1.0 MEG	1.0 MEG	
R11	.47 MEG	.447 MEG	
R12	0.1 MEG	99,000Ω	
R13	1.21 MEG	1.06 MEG	
R14	2.0 MEG	1.59 MEG	
R15	3.57 MEG	2.26 MEG	
R16	2.37 MEG	1.80 MEG	
R17	7,500Ω	5,700Ω	
R18	3,900Ω	3,440Ω	
R19	20 MEG	20 MEG	
R20	20 MEG	20 MEG	
R21	2,200Ω	2,200Ω	
R22	1.0 MEG	1.0 MEG	
R23	2,200Ω	2,200Ω	
R26	2,400Ω	2,400Ω	
R27	0.1 MEG	35,000Ω	
R28	47,000Ω	32,000Ω	
R29	2,645Ω	2,400Ω	
R30	1.0 MEG	1.0 MEG	
R31	1.2 MEG	1.2 MEG	
C1 (option J)	0.2 mf	—	
C1 (option K)	0.1 mf	24,600Ω	
C2 (option F0	.02 mf	3 MEG	
C3	0.1 mf	28,460Ω or 6,600Ω	2
C4	1.0 mf	24,000Ω	
C5 (option K)	0.1 mf	24,600Ω	
CR1	100Ω	100Ω or 200,000Ω	3
CR2	100Ω	100Ω or 200,000Ω	3
CR3	100Ω	100Ω or 200,000Ω	3
CR4	100Ω	100Ω or 200,000Ω	3
CR5	100Ω	100Ω or 200,000Ω	3
CR6	100Ω	100Ω or 200,000Ω	3
CR7	100Ω	100Ω or 200,000Ω	3

Notes:

1. In newer coupling units, resistors R1 and R2 are replaced by a single resistor designated R1 with a nominal resistance of 13,000Ω
2. This resistance must be measured in both directions owing to the presence of parallel connections with varistors.
3. Each varistor has an average forward resistance of approximately 100 ohms. In the backward direction the resistance should be in the order of 200,000 ohms.

CHART 6

TEST OF 144B1 (MD) and 144B2 COUPLING UNITS

This test is performed with 144B1 (MD) or 144B2 coupling unit connected directly to 165B1 test set. The test measures the R leg and RL leg currents. The test also measures and adjusts loop current. For a test failure, the voltage measurements listed in the accompanying Tables may be used to help locate faulty components.

APPARATUS:

165B1-L5 or 165B1-L6 Test Set.

STEP	PROCEDURE

Note: For 144B1 (MD) or 144B2 coupling units equipped with 429A vacuum tubes, EQPT TEST—429A button on 165B1 test set must be depressed for duration of test. For 144B1 (MD) or 144B2 coupling units equipped with 262-type switches, EQPT TEST—429A button must be released. EQPT TEST—262 button may be either depressed or released.

1 Remove 144B1 (MD) or 144B2 coupling unit to be tested from bay.

2 Using M11E (MD) or P11C cord, connect 165B1 test set to 144B1 (MD) or 144B2 coupling unit. The cord plugs into 165B1 test set at the socket labeled 144B1/144B2.

Note: When testing 144B1 (MD) coupling units, or 144B2 coupling units with switch S1 in the 800 position, insure that DX-LP switch (165B1-L5 test set) or DX-LP button (1651-L6 test set) is in the H-800 position, and perform all steps in the test. When testing 144B2 coupling units with switch S1 in the 2880 position, insure that DX-LP switch (165B1-L5 test set) or DX-LP button (165B1-L6 test set) is in the F-2880 position, and perform only Steps 6 through 12.

Test of R Leg Current

3 At 165B1 test set, depress R LEG CUR button.

Requirement: 165B1 meter deflects ***right*** and indicates 23 ±23 mA (±75 mA scale).

4 Depress and hold SPACE TOWARD HUB button.

Requirement: HIT INDICATOR lamp lights. The 165B1 meter deflects ***left*** and indicates 28 ±2 mA (±75 mA scale).

CHART 6 (Contd)

STEP	PROCEDURE
5	Release SPACE TOWARD HUB button.
	Note: If the coupling unit fails the current flow test, attempt to locate trouble by making the voltage measurements outlined in Table F. If HIT INDICATOR lamp fails to light, check R4 and R5 of coupling unit.
	Test of RL Lead Current
6	Depress RL CUR button.
	Requirement: 165B1 meter indicates 0 mA.
7	Depress and hold SPACE TOWARD HUB button.
	Requirement: HIT INDICATOR lamp lights. The 165B1 meter deflects ***right*** and indicates approximately 30 mA (±75 mA scale).
8	Release SPACE TOWARD HUB button.
	Note: If coupling unit fails to meet current flow requirements, attempt to locate trouble by making voltage measurements outlined in Table F.
	Test of Loop Current
9	Depress NEUT LP CUR button.
	Requirement: The 165B1 meter deflects ***right*** and indicates 62.5 mA (75-0-75 mA scale).
	Note: If this requirement is not met and coupling unit is equipped with 429A vacuum tubes, adjust LP CUR potentiometer on coupling unit until meter indicates 62.5 mA. If coupling unit is equipped with 262-type switches, adjust LP CUR potentiometer fully clockwise.
10	Depress and hold SPACE TOWARD UNIT—FROM SL ONLY button.
	Requirement: 165B1 meter indicates 0 mA.
11	Release SPACE TOWARD UNIT—FROM SL ONLY button.
	Note: If coupling unit fails to meet current flow requirements, attempt to locate trouble by making voltage measurements outlined in Table G.
12	Test is complete. If no further testing is required, disconnect 165B1 test set from 144B1 (MD) or 144B2 coupling unit and replace coupling unit in bay.

CHART 6 (Contd)

TABLE F

144B1 (MD) AND 144B2 COUPLING UNITS
VOLTAGE MEASUREMENTS—INWARD TRANSMISSION CIRCUIT

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER		VOLTAGE REQUIRED	COMPONENTS	
	POSITIVE LEAD	NEGATIVE LEAD		144B1	144B2
NONE	Jct R9 & R5	GND	+122 ± 10V	R6, R7 (option T) or R13 (option U), R4, R5, R8, R9	R4, R5, R8, R9, R13
NONE	144B1-Jct R7 (option T) or R13 (option U) & R9 144B2-Jct R13 & R9	GND	+65 ± 5V	R6, R7 (option T) or R13 (option U) CR1 to CR5 incl. (option N) or CR1 (option M), R4, R5, R8, R9	CR1 to CR5 incl. (option K) or CR1 (option J), R4, R5, R8, R9, R13
NONE	Term. 3 of connector	GND	+60 ± 5V	CR1 to CR5 incl. (option N) or CR1 (option M)	CR1 to CR5 incl. (option K) or CR1 (option J)
SPACE TOWARD HUB	Jct R9 & R5	GND	−122 ± 10V	R6, R7 (option T) or R13 (option U), R4, R5, R8, R9	R4, R5, R8, R9, R13
SPACE TOWARD HUB	144B1-Jct R7 (option T) or R13 (option U) & R9' 144B2-Jct R13 & R9	GND	−45 ± 5V	R6, R7 (option T) or R13 (option U), CR1 to CR5 incl. (option N) or CR1 (option M), R4, R5, R8, R9	CR1 to CR5 incl. (option K) or CR1 (option J), R4, R5, R8, R9, R13
SPACE TOWARD HUB	Term. 3 of connector	GND	−30 ± 5V	CR1 to CR5 incl. (option N) or CR1 (option M)	CR1 to CR5 incl. (option K) or CR1 (option J)

CHART 7 (Contd)

TABLE G

144B1 (MD) AND 144B2 COUPLING UNITS
VOLTAGE MEASUREMENTS—OUTWARD TRANSMISSION CIRCUIT

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER		VOLTAGE REQUIRED	COMPONENTS	
	POSITIVE LEAD	NEGATIVE LEAD		144B1	144B2
SPACE TOWARD UNIT FROM SL ONLY	Pin 8 V1 or V2	GND	−38 ± 5V	R1, R2	R16, CR6, CR7 (option J) or R3, BL (option K), R1, R2
SPACE TOWARD UNIT FROM SL ONLY	Pin 2 V1 or V2	GND	+130 ± 5V	R3, LP CUR, R10, R11, R12	LP CUR, R10, R11, R12, R14
NONE	Pin 2 V1 or V2	GND	+80 ± 5V	R3, LP CUR, R11, R12	LP CUR, R10, R11, R10 R12, R14

CHART 7

TEST OF 144C1 COUPLING UNIT

This test is performed with 144C1 coupling unit connected directly to 165B1 test set. The 144C1 coupling unit is comprised of two independent, one-way electronic paths. The test checks the ability of each path to repeat or couple standard hub voltages (+60 volt mark/-30 volt space) or full-duplex hub voltages (-10 volt mark/-60 volt space) to a +60 volt mark/-30 volt space electronic hub circuit. For purposes of testing, one path of the 144C1 coupling unit is referred to as east-to-west, and the other is referred to as west-to-east. The 165B1 test set provides independent testing of each path. For a test failure, voltage measurements and resistance values listed in the accompanying Tables may be used to help locate faulty components.

APPARATUS:

165B1-L5 or 165B1-L6 Test Set

CHART 7 (Contd)

STEP	PROCEDURE

Note: For 144C1 coupling units equipped with 429A vacuum tubes, EQPT TEST—429A button on 165B1 test set must be depressed for duration of test. For 144C1 coupling units equipped with 262-type switches, EQPT TEST—429A button must be released. The EQPT TEST—262 button may be either depressed or released.

1 Remove the 144C1 coupling unit to be tested from the bay.

2 Using M11E (MD) or P11C cord, connect 165B1 test set to 144C1 coupling unit. The cord is plugged into 165B1 test set at the socket labeled 144C1.

East to West Path

+60 Volt Mark/-30 Volt Space Input

3 At 165B1 test set, insure UP E-W—DOWN W-E button is released (in up position).

4 Depress RL CUR button.

Requirement: 165B1 meter indicate 0 mA.

5 Depress and hold SPACE TOWARD HUB button.

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

6 Release SPACE TOWARD HUB button.

Note: If coupling unit fails to meet the above requirements, attempt to locate the trouble by making the voltage measurements outlined in Table H.

-10 Volt Mark/-60 Volt Space Input

7 Depress and latch UP SL1—DOWN Sl2 button on 165B1 test set.

Requirement: 165B1 meter indicates 0 mA.

8 Depress and hold SPACE TOWARD HUB button.

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

9 Release SPACE TOWARD HUB button and unlatch UP SL1—DOWN SL2 button.

Note: If coupling unit fails to meet the above requirements, attempt to locate the trouble by making the voltage measurements indicated in Table H.

CHART 7 (Contd)

STEP PROCEDURE

TABLE H

144C1 COUPLING UNIT
VOLTAGE MEASUREMENTS—EAST-TO-WEST PATH

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER		VOLTAGE REQUIRED	144C1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD		
NONE	Pin 4 V1	GND	0V	R1, R2, R3, R4, R5, R6
NONE	Pin 2 V2	GND	+60 ± 5V	R7, R8, R9, R10, R21
SPACE TOWARD HUB	Pin 4 V1	GND	+105 ± 10V	R1, R2, R3, R4, R5, R6
SPACE TOWARD HUB	Pin 2 V2	GND	−110±10V	R7, R8, R9, R10, R21

West to East Path

10 Depress and latch UP E-W—DOWN W-E button.

11 Depress RL CUR button.

Requirement: 165B1 meter indicates 0 mA.

12 Depress and hold SPACE TOWARD HUB button.

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

13 Release SPACE TOWARD HUE button.

Note: If the coupling unit fails to meet the above requirements, attempt to locate the trouble by making the voltage measurements outlined in Table I.

-10 Volt Mark/-60 Volt Space Input

14 Depress and latch UP SL1—DOWN SL2 button on 165B1 test set.

CHART 7 (Contd)

STEP	PROCEDURE
	Requirement: 165B1 meter indicates 0 mA.
15	Depress and hold SPACE TOWARD HUB button.
	Requirement: 165B1 meter deflects ***right*** and indicates 30 mA (±75 mA scale).
16	Release SPACE TOWARD HUB button and unlatch UP SL1—DOWN SL2 button.
	Note: If coupling unit fails to meet the above requirements, attempt to locate the trouble by making the voltage measurements indicated in Table I.
17	Test is complete. If no further testing is required, disconnect 165B1 test set from 144C1 coupling unit and replace coupling unit in bay.
	Note: Table J lists nominal and measured resistance values for the 144C1 coupling unit. These resistances may be used to help locate faulty circuit components. When making resistance measurements, the coupling unit should be disconnected from 165B1 test set. This insures that all voltages are removed from the coupling unit before the resistance measurements are made.

TABLE I

144C1 COUPLING UNIT
VOLTAGE MEASUREMENTS—WEST-TO-EAST PATH

165B1 TEST SET BUTTON DEPRESSED	VOLTMETER		VOLTAGE REQUIRED	144C1 COMPONENTS
	POSITIVE LEAD	NEGATIVE LEAD		
UP E-W—DOWN W-E	Pin 6 V1	GND	0V	R11, R12, R13, R14, R15, R16
UP E-W—DOWN W-E	Pin 2 V3	GND	+60 ± 5V	R17, R18, R19 R20, R22
UP E-W—DOWN W-E SPACE TOWARD HUB	Pin 6 V1	GND	+105 ± 10V	R11, R12, R13, R14, R15, R16
UP E-W—DOWN W-E SPACE TOWARD HUB	Pin 2 V3	GND	−110 ± 10V	R17, R18, R19, R20, R22

CHART 6 (Contd)

TABLE J
144C1 COUPLING UNIT
NOMINAL AND MEASURED RESISTANCE

APPARATUS	NOMINAL RESISTANCE	MEASURED RESISTANCE	NOTE
R1	.62 MEG	.62 MEG	
R2	.1 MEG	.1 MEG	
R3	1.0 MEG	1.0 MEG	
R4	8,200Ω	5,600Ω	
R5	4,700Ω	3,840Ω	
R6	.1 MEG	.0978 MEG	
R7	1.21 MEG	.9 MEG	
R8	1.05 MEG	.817 MEG	
R9	1,500Ω	1,500Ω	
R10	1,200Ω	1,200Ω	
R11	.62 MEG	.62 MEG	
R12	.1 MEG	.1 MEG	
R13	1.0 MEG	1.0 MEG	
R14	8,200Ω	5,600Ω	
R15	4,700Ω	3,840Ω	
R16	.1 MEG	.0978 MEG	
R17	1.21 MEG	.9 MEG	
R18	1.05 MEG	.817 MEG	
R19	1,500Ω	1,500Ω	
R20	1,200Ω	1,200Ω	
R21	2,200Ω	2,200Ω	
R22	2,200Ω	2,200Ω	
R23	45Ω	45Ω	1

Notes:

1. Remove tube V1 from coupling unit before measuring the resistance of R23.