

(365-226-500)

DIGITAL TRANSMISSION SYSTEMS

T1 DIGITAL LINE

INITIAL SPAN LINE POWERING

This section outlines the procedures for initially powering T1 span lines and procedures for making initial span line current and voltage measurements.

This section is reissued to include procedures for span line powering from a T1C/T1 office repeater bay and to introduce Form E-6900 (T Carrier Span Profile). The procedures and tables have been rearranged for simplicity, therefore change arrows have been omitted. This reissue does *not* affect the Equipment Test List.

The procedures of Chart 1 (powering from a 201 ORB) results in a line current between 130 and 150 mA. On properly designed and adjusted systems, the line current is within the required limits with normal office battery voltage variations and normal cable temperature variations. On aerial cable systems when cable temperatures exceed 120°F and office battery voltages are more than two percent low, the line current may fall below the prescribed limit and thus require slight readjustment.

On properly designed systems using the 206 ORB (Chart 2) or the T1C/T1 ORB (Chart 3) for span line powering, the line current remains very close to 140 mA (standard powered lines) or 60 mA (low powered lines). This is due to a line current regulator built into the office repeater circuitry. Some of the office repeaters (power looping type) have the regulator circuitry omitted and these are used when power is fed from the other end of the span. The line current regulator circuitry will control the line current over a wide range of battery voltage and cable temperature variations. On repeatered lines subject to either unusually cold or hot temperatures, line resistance may vary sufficiently to exceed the operating range of the regulator. This variation should occur, however, only when the normal temperature operating point is established too close to either end of the operating range of the regulator. Preferably, the span should be powered by a battery voltage which causes the regulator to operate near the low end of the range without falling below the lower limit at the hottest time of the year.

Before measuring the line current, all repeaters in the power loop must be installed according to the appropriate section in the 640 division.

An office has two main power supplies for repeater bays. When D1C channel banks are used with the T1 digital line to handle Traffic Service Position System (TSPS) traffic, the A and D systems should always be assigned to odd-numbered repeater bay shelves and the B and C systems to even-numbered shelves. This arrangement prevents a failure in one power supply from disrupting both A and B systems.

NOTICE

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CHART 1

Span Line Powering From a 201 ORB

APPARATUS:

- 1—KS-14510 Volt-Ohm-Milliammeter (VOM)
- 1—45B Tool (5/16 hexagon socket wrench)

STEP

PROCEDURE

Note: A 208D or 208AB repeater with a 215A adapter may be used in the 201 ORB in place of the 201-type office repeaters.

A. Preparation

- 1 Check the span line record card to determine the type of control unit required (unidirectional or bidirectional line repeaters), the line powering option (power looping or power feed), the local power option (office repeater powered separately or in series with the line), and the protection option (required or not).
- 2 Check that the power simplex strapping option is wired according to the carrier layout information (see Fig. 1, 2, and 3).
- 3 If power looping is required and power to the line is not required, continue with Step 4. If power to the line is required, proceed to Step 8.

B. Power Looping

- 4 Connect and solder the proper looping option according to the carrier layout information (see Fig. 1, 2, and 4).
- 5 Insert 72A dummy fuses in circuit 1 and circuit 2 positions on the control unit.

CHART 1 (Cont)

STEP

PROCEDURE

Note: Fuses must be inserted by pushing in and turning to the maximum clockwise position so that the two dots on the fuse cap align horizontally.

- 6 Insert a 70R (0.15 amp) or a 72A dummy fuse in the OFFICE RPTR position, as required, according to Fig. 4.
- 7 Proceed to Step 27.

C. Power Feed

- 8 Connect and solder the proper power feed option according to the carrier layout information (see Fig. 1, 2, and 5).

Note: If terminals A, B, C, and/or D (strapping options 1 and 2 of Fig. 5) are strapped to ground, strap out associated fuse(s) F1, F2, F3, or F4 at fuse holder terminals and replace removed fuse(s) with 72A dummy fuse(s) per SD-97082-01.

- 9 Remove the strap from R1, R2, R3, and R4 (Fig. 6) as specified on the span line record card. On R2 and R4 remove the strap from the 110-ohm side only. Then determine the need to remove the strap from the 147-ohm side by means of the following test (Steps 10 through 23).
- 10 Check the span line record card for the specified value of control unit resistance.
- 11 Check the span line record card for the voltage supplies to be used for power feed (-48 volt, -130 volt, and/or +130 volt supply).
- 12 At the rear of the bay, connect the VOM to the miscellaneous terminals of terminal strip A on the span terminating assembly as follows to measure the total (nominal) voltage (read black DC scale).

VOLTAGE SUPPLIES	VOM + TO TERM	VOM - TO TERM	TOTAL VOLTAGE
-48V, GRD	6	5	48V
+130V, GRD	3	6	130V
-48V, +130V	3	5	178V
-130V, +130V	3	1	260V

CHART 1 (Cont)

STEP

PROCEDURE

- 13 Watch the meter for several minutes to determine the average voltage. (This is the normal voltage for the office.)
- 14 Determine the difference between the normal voltage (Step 13) and the nominal voltage (Step 12).
- 15 Referring to the following listing, use the difference voltage (Step 14) to obtain the resistance correction value.

DIFFERENCE VOLTAGE	0.0 TO 0.9V	1.0 TO 1.9V	2.0 TO 2.9V	3.0 TO 3.9V	4.0 TO 4.9V	5.0 TO 5.9V
RESISTANCE CORRECTION (OHMS)	0	10	18	25	32	40

- 16 If the resistance correction value (Step 15) is 0, proceed to Step 27; otherwise, continue with Step 17.
- 17 If the normal voltage (Step 13) is *higher* than the nominal voltage (Step 12), add the resistance correction value to the control unit resistance value specified on the span line record card, and proceed to Step 19.
- 18 If the normal voltage (Step 13) is *lower* than the nominal voltage (Step 12), subtract the resistance correction value from the control unit resistance value specified on the span line record card.
- 19 Temporarily strap together the two power feed terminals selected in Step 8 (-48V, GRD, +130V, and/or -130V).
- 20 Insert 70R (0.15 amp) fuses in circuit 1 and circuit 2 positions as required. If one circuit is not used, insert 72A dummy fuses in that circuit position.
- 21 Using the 45B tool, loosen the locknuts on the control unit ADJ potentiometers.
- 22 Connect the VOM between the circuit 1 or circuit 2 terminals as shown below and adjust the control unit ADJ potentiometer to obtain the resistance value determined in Step 17 or 18.

CHART 1 (Cont)

STEP

PROCEDURE

	STRAPPING USED IN FIG. 3				CIRCUIT
	A	B	C	D	
CONNECT OHMMETER BETWEEN	S12-S13	P11-S13	S12-P12	P11-P12	1
	P12-S14	P12-S14	S14-S13	S14-S13	2

- 23 If the ADJ potentiometer is near the end of its range and 110-ohm portion of R2 and/or R4 was cut in Step 9, cut the strap on the 147-ohm portion of R2 or R4.
- 24 Using the 45B tool, tighten the locknuts on the ADJ potentiometers.
- 25 Remove the temporary strap installed in Step 19.
- 26 Remove the fuses that were inserted into the control unit in Step 20.
- 27 Check that the office repeater option is selected for loop condition (201-type or 208AB repeater only).
- 28 Place the control unit in the span terminating assembly.
- 29 Set the VOM to the 3-VOLTS-DC scale.
- 30 Connect the VOM - terminal to the white TST jack and the VOM + terminal to the red TST jack on the control unit (Fig. 7).

Warning: Watch the VOM when performing Steps 31 and 32. If a negative reading is shown or if the voltage is greater than +2.2 volts, remove the fuses immediately to avoid damaging the repeaters.

- 31 Insert 70R (0.15 amp) fuses in circuit 1 and circuit 2 positions as required. If one circuit is not used, insert 72A dummy fuses in that circuit position.
- 32 Insert a 70R (0.15 amp) or a 72A dummy fuse in the OFFICE RPTR position, as required, according to Fig. 5.

D. Check of Line Current

Note: All repeaters being fed power must be in place and the proper power options must be made before checking the line current.

- 33 Read the black DC scale of VOM.

Requirement: 1.3 to 1.5 volts.

CHART 1 (Cont)

STEP	PROCEDURE
34	<p>If the requirement of Step 33 is met, set the ADJ potentiometer for a VOM indication of 1.4 volts (see Note 1) and proceed to Step 41; otherwise, continue with Step 35.</p> <p>Note 1: For T1 lines that are exposed (aerial) for a considerable distance, the ADJ potentiometer should be set for 1.5 volts in cold weather.</p> <p>Note 2: Inability to obtain the voltage requirement specified above indicates a short or an open in the span; therefore, continue with Step 35.</p>
35	<p>Note voltage indication obtained in Step 33.</p>
36	<p>Turn the ADJ potentiometer counterclockwise and read the meter indication.</p> <p>Requirement: The voltage indication should decrease.</p>
37	<p>Reset the ADJ potentiometer to obtain the meter indication noted in Step 35.</p> <p>Note: Failure to obtain the recorded indication means no control and indicates a possible short on the line.</p>
38	<p>Remove the lower (+) fuse in the control unit of circuit being powered and read the meter indication.</p> <p>Requirement: Voltage indication should be zero.</p> <p>Note: Failure to meet the requirement of Step 38 indicates a possible leakage of current or a short to ground in the span.</p>
39	<p>Reinsert the fuse removed in Step 38, and proceed to Section 365-227-500 to clear trouble.</p>
40	<p>After the line trouble has been corrected, remeasure the line current and set the ADJ potentiometer for VOM indication of 1.4 volts.</p> <p>Note: For T1 lines that are exposed (aerial) for a considerable distance, the ADJ potentiometer should be set for 1.5 volts in cold weather.</p>
41	<p>If the office repeater is powered separately, check the office repeater by connecting the positive lead of the VOM to pin 5 and the negative lead to pin 7 on the back of the office repeater connector.</p> <p>Requirement: 9.5 to 12.5 volts.</p> <p>Note: If the span line (being powered) will not be placed in service immediately, perform one of the following operations to prevent nonintergrated circuit-type repeaters from</p>

CHART 1 (Cont)

STEP

PROCEDURE

oscillating: remove repeater power by removing the applicable fuse(s) in the control unit or use a quasi-random signal source (QRSS) with the line terminated per Section 365-224-500, to provide a signal to the span line. The QRSS method is preferred over removing the power because the line can be tested quickly.

CHART 2

SPAN LINE POWERING FROM A 206 ORB

APPARATUS:

1—KS-14510 Volt-Ohm-Milliammeter (VOM)

STEP

PROCEDURE

Note: The 206 ORB may be equipped with either 206- or 236-type repeaters. However, the intermixing of standard power (140 mA) and low power (60 mA) repeaters in the same shelf or shelf-pair is not recommended.

A. Preparation

Note: If the shelf in the ORB being equipped has an in-service repeater installed, proceed to Step 23; otherwise, continue with Step 1.

- 1 Set the VOM to the 300-VOLT-DC scale.
- 2 Using the VOM, measure the various office battery voltages at TSA and TSB of the fuse and alarm panel and read the black DC scale.

Note: The office battery voltages are nominally -48, +130, and -130 volts. The normal voltage range and the emergency limits for power plant operation during commercial ac power failure are as follows:

NOMINAL VOLTAGE	NORMAL RANGE	EMERGENCY LIMITS
-48	-45 to -50	-42.5 to -53
+130	+125 to +135	+115 to +140
-130	-125 to -135	-110 to -140

CHART 2 (Cont)

STEP

PROCEDURE

Caution: Do not interrupt service by removing fuses associated with any in-service repeater on the shelf being equipped.

- 3 If shelf is *not* equipped with in-service repeaters, remove all fuses and/or dummy fuses from the fuse and alarm panel for the repeater shelf being equipped.
- 4 Remove all fuses and/or dummy fuses from the office repeaters being installed.

B. Power Feed

- 5 Check the span line record card for the office repeater code, the power feed voltage required, and the line current required; then determine the type of power dissipation arrangement, if any, from the following listing:

LINE CURRENT (mA)	POWER FEED VOLTAGE (VOLTS)	REPEATER CODE	J98710M, L1 POWER DISSIPATION UNIT REQUIRED	M OPTION (FIG. 8) REQUIRED
140	48	206- or 236-type	No	No*
140	130, 178, or 260	206- or 236-type	Yes	No
60	48	206T, 206Y, or 236-type	No	No*
60	130, 178, or 260	206U or 206AA	Yes	No
60	130, 178, or 260	236-type	No†	Yes†

* If the M option was previously installed, it is not necessary to remove it for this powering arrangement.

† A power dissipation unit is not necessary for this powering arrangement; however, one may be used if desired. If a power dissipation unit is used, the M option need not be installed.

- 6 If no power dissipation unit is required, proceed to Step 9; otherwise, continue with Step 7.
- 7 Set the VOM to the OHMS X100 scale and make continuity tests between the following resistor terminals on the power dissipation unit.

CHART 2 (Cont)

STEP	PROCEDURE
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<u>A</u>	<u>B</u>	<u>E</u>
<u>From</u>	<u>To</u>	<u>To</u>
T1	T2	T3
T4	T5	T6
T7	T8	T9
T10	T11	T12
T13	T15	T16
T17	T18	T19
T20	T21	B1
B2	B3	B4
B5	B6	B7
B9	B10	B11
B12	B13	B14
B15	B16	B17
B18	B19	B20

Note: T and B terminals are located on the top and bottom connectors, respectively, of the power dissipation unit.

Requirement: For the J98710M, L1 power dissipation unit, the meter should indicate 400 to 500 ohms between columns A and B, and 850 to 1000 ohms between columns A and E.

- 8 Plug the power dissipation units into the office repeater bay slots as required and proceed to Step 10.
- 9 Install option M, if required, per Step 5 (see Fig. 8 and SD-97080-02).
- 10 In the fuse and alarm panel, locate the strapping points designated Q, R, and Z (one set for each repeater shelf). Connect the required strapping in accordance with the information contained on the span line record card, Table A, and Fig. 9.

Note: The S option is normally furnished in the power distribution circuit (Fig. 9); however, it should be removed if not specified in Table A.
- 11 Install option YY for all positions associated with spans equipped with unidirectional line repeaters which are powered from the other end (see Fig. 10).
- 12 Check the span line record card for the line feed supply option, the office repeater power option, and the power feed supply voltage.

CHART 2 (Cont)

STEP

PROCEDURE

- 13 Obtain the 206- or 236-type repeaters required for the power feed circuits and turn down the screws on the power option block in accordance with the information contained in Table B and Fig. 11 and 12.

Note: Options in the 206- and 236-type repeaters are selected as follows:

<u>TYPE OPTION CONTROL</u>	<u>OPTION SELECTED BY</u>
Screw	Turning screw clockwise (closed) or by turning two complete turns counter-clockwise (open)
Switch	Setting switch toward option letter on printed wiring board
Plug (Selector Block)	Inserting plug with arrow on option plug pointing toward option letter on printed wiring board

- 14 Record options selected on Form E-5416, Office Repeater Bay Record Card (Fig. 13).
- 15 If a 236-type repeater with a regulator is required, set the voltage options for the office battery supplied according to the following information:

POWER FEED VOLTAGE	OPTIONS REQUIRED	
	SCREW OPTION R	OPTION PLUG (SELECTOR BLOCK) Y OR Z
-48V and Battery Return (48V)	R (Open)	Y
+130V and Battery Return (130V)	R (Closed)	Z
+130V and -48V (178V)	R (Open)	Z
+130V and -130V (260V)	R (Open)	Z

- 16 If the 206- or 236-type repeater selected has the 60/140-mA line current option, select the proper option according to the following information:

CHART 2 (Cont)

STEP	PROCEDURE															
	<table border="1"> <thead> <tr> <th>REPEATER CODE</th> <th>NOMINAL LINE CURRENT (mA)</th> <th>OPTION REQUIRED</th> </tr> </thead> <tbody> <tr> <td>206U, AA, T, Y</td> <td>140</td> <td>ZZ Screw (Closed)</td> </tr> <tr> <td>206U, AA, T, Y</td> <td>60</td> <td>ZZ Screw (Open)</td> </tr> <tr> <td>236E, G, AA, AB, AC, AD</td> <td>140</td> <td>X</td> </tr> <tr> <td>236E, G, AA, AB, AC, AD</td> <td>60</td> <td>W</td> </tr> </tbody> </table>	REPEATER CODE	NOMINAL LINE CURRENT (mA)	OPTION REQUIRED	206U, AA, T, Y	140	ZZ Screw (Closed)	206U, AA, T, Y	60	ZZ Screw (Open)	236E, G, AA, AB, AC, AD	140	X	236E, G, AA, AB, AC, AD	60	W
REPEATER CODE	NOMINAL LINE CURRENT (mA)	OPTION REQUIRED														
206U, AA, T, Y	140	ZZ Screw (Closed)														
206U, AA, T, Y	60	ZZ Screw (Open)														
236E, G, AA, AB, AC, AD	140	X														
236E, G, AA, AB, AC, AD	60	W														

Note: When 206-type repeaters are used to power the line at 60 mA, they must be powered separately from the line repeaters.

- 17 Record options selected in Steps 15 and 16 on Form E-5416 (Fig. 13).
- 18 If the repeater being installed is a 206 or 236 EXCP type, install the 983-type equalizer (see Section 365-222-200).
- 19 If the office repeater has a regulator, insert the 70R fuses and/or 72A dummy fuses (see Table C) into the correct LINE - and LINE + fuse receptacles located on the front of each 206- or 236-type repeater (Fig. 14).

Note: Fuses must be pushed in and turned to the maximum clockwise position so that the two dots on the fuse cap align horizontally.

- 20 Select repeater option R (option P on older 206B and F), if required, per Table C, and record on Form E-5416 (Fig. 13).
- 21 Insert the 206- or 236-type repeater into the proper slot in the repeater shelf.

Note: To restrict the use of repeater receptacles to only one type of repeater, keys have been provided in each connector. The keys should be located as follows:

REPEATER TYPE	JACK CONTACT OF BAY CONNECTOR WITH KEY
206B, F, J, M, U, AA; 236A, C, E, G, J, L, N, AA, AC	8*
206C, P, R, S; 236P	10*
206D, G, K, N, W, AB; 236B, D, F, H, K, M, AB, AD	14*
206A, E, H, L, T, Y	20

* For 236-type repeaters, if option M (Fig. 8) has been included, all connectors should have a key in pin 19.

CHART 2 (Cont)

STEP	PROCEDURE
22	Insert the 70D fuses and/or 72A dummy fuses into the correct fuse receptacles of the fuse and alarm panel in accordance with Table C.
23	Refer to Form E-5416 and select options as in Steps 13 through 20 for the remaining repeaters to be installed in shelf being equipped. <i>Note:</i> 236-type repeaters may be mixed on the same shelf-pair with 206-type repeaters. However, all repeaters must be either standard power (140 mA) or low power (60 mA). In this case, the options selected for the 236-type repeaters will not be the same as those selected for the 206-type repeaters.
24	Insert the repeaters into the proper slots in the repeater shelf.
25	Proceed to Chart 4 and perform current and voltage measurements.

CHART 3

SPAN LINE POWERING FROM A T1C/T1 ORB

APPARATUS:

1—KS-14510 Volt-Ohm-Milliammeter (VOM)

Note: The T1C/T1 ORB may be equipped with either 221- or 231-type repeaters.

A. Preparation

Note: If the shelf in the ORB being equipped has an in-service repeater installed, proceed to Step 20; otherwise, continue with Step 1.

- Set the VOM to the 300-VOLT-DC scale.
- Using the VOM, measure the various office battery voltages at TSA and TSB of the fuse, alarm, and fault-locate filter panel and read the black DC scale.

Note: The office battery voltages are nominally -48, +130, and -130 volts. The normal voltage range and the emergency limits for power plant operation during commercial ac power failure are as follows:

NOMINAL VOLTAGE	NORMAL RANGE	EMERGENCY LIMITS
-48	-45 to -50	-42.5 to -53
+130	+125 to +135	+115 to +140
-130	-125 to -135	-110 to -140

CHART 3 (Cont)

STEP

PROCEDURE

Caution: Do not interrupt service by removing fuses associated with any in-service repeater on the shelf being equipped.

- 3 If shelf is *not* equipped with in-service repeaters, remove all fuses and/or dummy fuses from the fuse, alarm, and fault-locate filter panel for the repeater shelf being equipped.
- 4 Remove all fuses and/or dummy fuses from the office repeaters being installed.
- 5 Check the span line record card for the power feed voltage required and the line current required; then determine the power dissipation unit, if any, or arrangement required from the following listing:

LINE CURRENT (mA)	POWER FEED VOLTAGE (VOLTS)	REPEATER CODE	ED-3C554-30 POWER DISSIPATION UNIT REQUIRED
140	48	221- or 231-type	None
140	130, 178, or 260	221- or 231-type	Group 1
60	48, 130, 178, or 260	221-type	None*
60	48, 130, 178, or 260	231-type	None†

* Do not provide P option for this powering arrangement.

† P option (Fig. 15) is required for this powering arrangement.

- 6 If no power dissipation unit is required, proceed to Step 9; otherwise, continue with Step 7.

B. Power Feed

- 7 Set the VOM to the OHMS X100 scale and make continuity tests between the following terminals on the power dissipation unit.

A FROM	B TO
1	2
3	4
5	6
7	8
9	10
11	12
13	14
15	16
17	18
19	20
21	22
23	24
25	26

CHART 3 (Cont)

STEP

PROCEDURE

Requirement: The meter should indicate 950 to 1050 ohms between columns A and B.

- 8 Plug the power dissipation units into the office repeater bay slots as required and proceed to Step 10.
- 9 Install option P (Fig. 15 and SD-3C252-02), if required, per Step 5 and proceed to Step 11.
- 10 Install option W (Fig. 16) for all positions associated with spans equipped with unidirectional line repeaters which are powered from the other end.
- 11 Check the span line record card for the office repeater code, the line feed supply option, the office repeater power option, and the power feed supply voltage.
- 12 Obtain the 221- or 231-type repeaters required for the power feed circuits and turn down the screws on the power option block in accordance with the information contained in Table B and Fig. 11 and 12.
- 13 Record options selected on Form E-5416, Office Repeater Bay Record Card (Fig. 13).
- 14 If a 221- or 231-type repeater with a regulator is required, set the voltage options for the office battery supplied according to the following information:

POWER FEED VOLTAGE	OPTIONS REQUIRED		
	SWITCH SELECTOR BLOCK		SCREW OPTION
	221	231	221 AND 231
-48V and Battery Return (48V)	W	Z	V (Closed)
+130V and Battery Return (130V)	X	Z	V (Open)
+130V and -130V (260V)	W	Y	V (Open)
+130V and -48V (178V)	W	Z	V (Open)

- 15 If the 221- or 231-type repeater selected has the 60/140-mA line current option, select the proper option according to the following information:

CHART 3 (Cont)

STEP	PROCEDURE		
	<u>REPEATER CODE</u>	<u>LINE CURRENT</u>	<u>OPTION REQUIRED</u>
	221A	140	T Screw (Closed)
	221A	60	T Screw (Open)
	231A	140	Arrow on plug toward T
	231A	60	Arrow on plug away from T
	<i>Note:</i> When 221-type repeaters are used to power the line at 60 mA, they must be powered separately from the line.		
16	Record options selected in Steps 14 and 15 on Form E-5416.		
17	Insert the 221- or 231-type repeaters into the proper slots in the repeater shelf.		
18	Insert the 70D fuses and/or 72A dummy fuses into the correct receptacles of the fuse, alarm, and fault-locate filter panel in accordance with Table D.		
19	Insert the 70R fuses and/or 72A dummy fuses (see Table D) in the correct LINE - and LINE + fuse receptacles located on the front of each 221- or 231-type repeater (Fig. 17).		
	<i>Note:</i> Fuses must be pushed in and turned to the maximum clockwise position so that the two dots on the fuse cap align horizontally.		
20	Refer to Form E-5416 and select options as in Steps 11 through 15 for the remaining repeaters to be installed in shelf being equipped.		
21	Insert the remaining repeaters to be installed into the proper slots in shelf being equipped.		
22	Proceed to Chart 4 and perform current and voltage measurements.		

CHART 4

CURRENT AND VOLTAGE MEASUREMENTS AT A 206 ORB and T1C/T1 ORB

APPARATUS:

1-KS-14510 Volt-Ohm-Milliammeter (VOM)

CHART 4 (Cont)

STEP

PROCEDURE

Note 1: When performing the following current and voltage measurements, the results should be recorded on Form E-6900 (T Carrier Span Profile, Fig. 18) for future routine and corrective maintenance activities.

Note 2: The following number of decimal places is recommended for recording all measurements in each voltage range:

<u>VOLTAGE RANGE</u>	<u>DECIMAL PLACES</u>
0 to 3 volts dc	2
3 to 12 volts dc	1
Over 12 volts dc	0

Note 3: After recording the measurements for all repeaters installed, the normal regulator and line voltage for each shelf-pair is established. This is accomplished by recording the most frequently measured voltage at the base of each column on Form E-6900. The normal regulator and line voltage must then be recorded on Form E-5416.

Note 4: All line repeaters in the span being fed power must be in place and all cross-connections completed before performing this task.

A. Line Current Test

- 1 Set the VOM to 3-VOLT-DC scale.
- 2 Connect the VOM leads as follows and read the black DC scale.

LINE CURRENT TEST POINTS

<u>VOM LEADS</u>		<u>206 OR 236 REPEATERS (Fig. 14)</u>		<u>221 OR 231 REPEATERS (Fig. 17)</u>
-	to	-I	or	-V
+	to	+	or	-I

Requirement: 1.33 to 1.47 volts (140-mA line current) or 0.57 to 0.63 volts (60-mA line current).

- 3 Record VOM reading and jacks used in the LINE CURRENT column of Form E-6900, T Carrier Span Profile (Fig. 18).

B. Regulator Voltage Test

- 4 Set the VOM to 300-VOLT-DC scale.

CHART 4 (Cont)

STEP

PROCEDURE

- 5 Connect the VOM leads as follows and read the black DC scale.

REGULATOR VOLTAGE TEST POINTS

<u>VOM LEADS</u>		<u>206 OR 236 REPEATERS</u>		<u>221 OR 231 REPEATERS</u>
-	to	+	or	REG
+	to	REG	or	-V

Requirement: For spans being powered with 130 volts or more, the VOM should indicate between 2 and 120 volts (see Note 1). For spans being powered with 48 volts, the VOM should indicate between 1 and 40 volts.

Note 1: When using 206U or AA repeaters for powering 60-mA lines, the VOM should indicate between 2 and 60 volts.

Note 2: With repeaters of the same kind and in the same span, the regulator voltages must measure within the following tolerance:

<u>POWER FEED VOLTAGE</u>	<u>TOLERANCE</u>
-48V and GRD	±2 volts
+130V and GRD	±5 volts
+130V and -48V	±7 volts
+130V and -130V	±10 volts

Note 3: During cold weather, the measured regulator voltage will be higher by several volts than it will be during hot weather. Therefore, if the regulator voltage is near the lower limit during cold weather, the regulator voltage limit will be exceeded during seasonal warm-up periods. Conversely, during hot weather a measured regulator voltage near the upper limit must be regarded with caution.

- 6 Record VOM reading and jacks used in the REGULATOR VOLTAGE column of Form E-6900.

C. Line Voltage Test

- 7 Set the VOM to 300-VOLT-DC scale.
- 8 Connect the VOM leads as follows and read the black DC scale.

CHART 4 (Cont)

STEP

PROCEDURE

LINE VOLTAGE TEST POINTS

<u>VOM LEADS</u>		<u>206 OR 236 REPEATERS</u>	or	<u>221 OR 231 REPEATERS</u>
-	to	-V		-V
+	to	+	or	+V

Note: When measuring line voltage on a line equipped with unidirectional line repeaters, one VOM lead is connected to one side of the first power loop and the other lead is connected to the other side of the second power loop. Both of these test points appear on the same repeater. Under normal conditions the correct line voltage will be indicated on the VOM. However, if a trouble condition exists on either power loop, the incorrect line voltage may be indicated. In this case, the correct line voltage can be measured by connecting one VOM lead to the test point on the first repeater of the power loop and the other lead to the test point on the power mate repeater.

- 9 Record VOM reading and jacks used in the LINE VOLTAGE column of Form E-6900.

Note: All line voltage measurements in a shelf must be within ± 4 percent of each other.

- 10 Repeat Steps 1 through 9 for all repeaters installed in the shelf-pair.
- 11 Establish the normal regulator and line voltage by recording the most frequently measured voltage at the base of each column of Form E-6900.
- 12 Record the normal regulator and line voltage on Form E-5416 (Fig. 13).

Note: If the span line (now powered) will not be placed in service immediately, perform one of the following operations to prevent nonintegrated circuit-type repeaters from oscillating: remove repeater power by removing the LINE - and/or LINE + fuse(s) in the office repeater, or use a quasi-random signal source to provide a signal to the span line and terminate the span line per Section 365-224-500.

TABLE A

**FUSE ALARM AND POWER DISTRIBUTION
OPTIONS FOR 206 ORB**

Warning: *Failure to remove option S with 260-volt line powering per Note will contribute to a fire hazard when using older 206B and F repeaters.*

POWER FEED VOLTAGE	OFFICE REPEATER CODE (206-TYPE)	OFFICE REPEATER CODE (236-TYPE)	OPTIONS (Fig. 9)	
			POWER DISTRIBUTION CIRCUIT	FUSE AND ALARM CIRCUIT
260 Volts (see warning)	B, F, J, M, U, or AA	A, C, E, G, J, L, AA, or AC	Note	Q
178 Volts	B, F, J, M, U, or AA	A, C, E, G, J, L, AA, or AC	S	R
130 Volts	B, F, J, M, U, or AA	A, C, E, G, J, L, AA, or AC	S	Z
48 Volts	A, E, H, L, T, or Y	A, C, E, G, J, L, AA, or AC	S	R
Line Powered From Other End	D, G, K, N, W, or AB	B, D, F, H, K, M, AB, or AD	S	None

Note: When the power loop voltage is 260 volts, remove the normally furnished S option in the power distribution circuit by cutting the strap across resistor R1. See SD-97080-02, Fig. 8, and circuit note 124.

TABLE B

REPEATER POWER OPTIONS FOR 206-, 221-, 231-, OR 236-TYPE REPEATERS

METHOD OF POWERING OFFICE REPEATER (NOTE 1)		POWER OPTION (NOTE 2)	POWERING ARRANGEMENT	REPEATER POWER OPTION BLOCK SCREWS (NOTE 3)
Office Repeater Powered In Series With Line Repeaters	At Powering Office	1	Bidirectional Operation	C, E, K†
		1	Unidirectional Operation* — 1st shelf of power loop, office repeater powered in series with receive line repeaters	
		7	Unidirectional Operation* — 1st shelf of power loop, office repeater powered in series with transmit line repeaters	
		2	Unidirectional Operation* — 2nd shelf of power loop, office repeater powered in series with receive line repeaters	
	At Power Looping Office	3	Bidirectional Operation	D, K
		1	Unidirectional Operation* — 1st shelf of power loop, office repeater powered in series with receive line repeaters	C, E, K†
		7	Unidirectional Operation* — 1st shelf of power loop, office repeater powered in series with transmit line repeaters	B, D, G†
		2	Unidirectional Operation* — 2nd shelf of power loop, office repeater powered in series with receive line repeaters	A, G, M
Office Repeater Powered Separately From Line	At Powering Office	4	Bidirectional Operation	B, E, H, N
		4	Unidirectional Operation* — 1st shelf of power loop	
		5	Unidirectional Operation* — 2nd shelf of power loop	
	At Power Looping Office	6	Bidirectional Operation	H, J, N
		4	Unidirectional Operation* — 1st shelf of power loop	B, E, H, N
		5	Unidirectional Operation* — 2nd shelf of power loop	A, F, H, N

Note 1: When using 221-type or 206T, U, Y and AA repeaters for powering low power (60 mA) lines, they cannot be powered in series with the line because the regenerators in these repeaters require a minimum of 70 mA.

Note 2: Power options are covered by seven different combinations of screwdown straps as shown in Fig. 12. Options 1, 2, 3, and 7 provide for powering the office repeater in series with the line for both unidirectional and bidirectional operation. Options 4, 5, and 6 provide for powering the office repeater and line separately.

Note 3: Power conditions are furnished by turning option screws to the maximum clockwise position. Option screws not specified in the table should be turned back two complete turns counterclockwise.

* For unidirectional operation, two office repeaters are required to complete the power loop (see Fig. 11). For looping the power in unidirectional operation in an office, see Fig. 10 and 16.

† When the office repeaters are powered in series with the line from both ends, these options must be used in pairs at both ends. When the office repeaters in only one of the two offices are powered in series with the line, options C, E, K on the first shelf and A, G, M on the second shelf will result in one of the two power loops having two more power supply drops than the other. Whereas options B, D, G on the first shelf and A, G, M on the second shelf will result in both power loops having an equal number of power supply drops. However, when using options B, D, G and A, G, M, the loss of either power loop will affect both directions of transmission. When using options C, E, K and A, G, M, only one direction of transmission will be affected in the case of a power loop failure.

TABLE C

FUSE REQUIREMENTS FOR 206 ORB

Warning: A fire hazard exists if repeater option P is not turned two complete turns counterclockwise on 206B or F repeaters when used with 178- or 260-volt line powering.

POWER FEED VOLTAGE	OFFICE REPEATER CODE (206-TYPE)	OFFICE REPEATER CODE (236-TYPE)	FUSES REQUIRED				
			FUSE AND ALARM PANEL			REPEATER	
			A (-130V)	B (-48V)	C (+130V)	LINE -	LINE +
260 Volts (see warning)	B, F, J, M, U, or AA	A, C, E, G, J, L, AA, or AC	70D, 5 amp	72A* dummy	70D, 5 amp	70R, 0.15 amp	70R, 0.15 amp
178 Volts (see warning)	B, F, J, M, U, or AA	A, C, E, G, J, L, AA, or AC	72A, dummy	70D, 5 amp	70D, 5 amp	70R, 0.15 amp	70R, 0.15 amp
130 Volts	B, F, J, M, U, or AA	A, C, E, G, J, L, AA, or AC	72A, dummy	72A,* dummy	70D, 5 amp	72A,† dummy	70R, 0.15 amp
48 Volts	A, E, H, L, T, or Y	A, C, E, G, J, L, AA, or AC	72A, dummy	70D, 5 amp	72A, dummy	70R, 0.15 amp	72A,† dummy
Line Powered From Other End	D, G, K, N, W, or AB	B, D, F, H, K, M, AB, or AD	72A, dummy	72A,* dummy	72A, dummy	—	—

Note: When using 206T, U, Y, and AA repeaters for powering low power (60 mA) lines, they cannot be powered in series with the line because the regenerators in these repeaters require a minimum of 70 mA.

* Install a 5-amp (70D) fuse when the office repeater is a 206T, U, Y, or AA powering low-powering lines (see Note), or the office repeater is powered separate from the line. Always install 70D fuses for F2B, F4B, and F6B to power the bridging repeater in even-numbered shelves.

† When powering with +130 volts and battery return (ground) using 206- or 236-type repeaters, ground is obtained by turning repeater option R (option P on older 206B and F) to maximum clockwise position and replacing LINE - fuse with a 72A dummy fuse. When using 236-type repeaters to power with -48 volts and battery return, the LINE + fuse on the repeater must be replaced with a 72A dummy fuse.

TABLE D

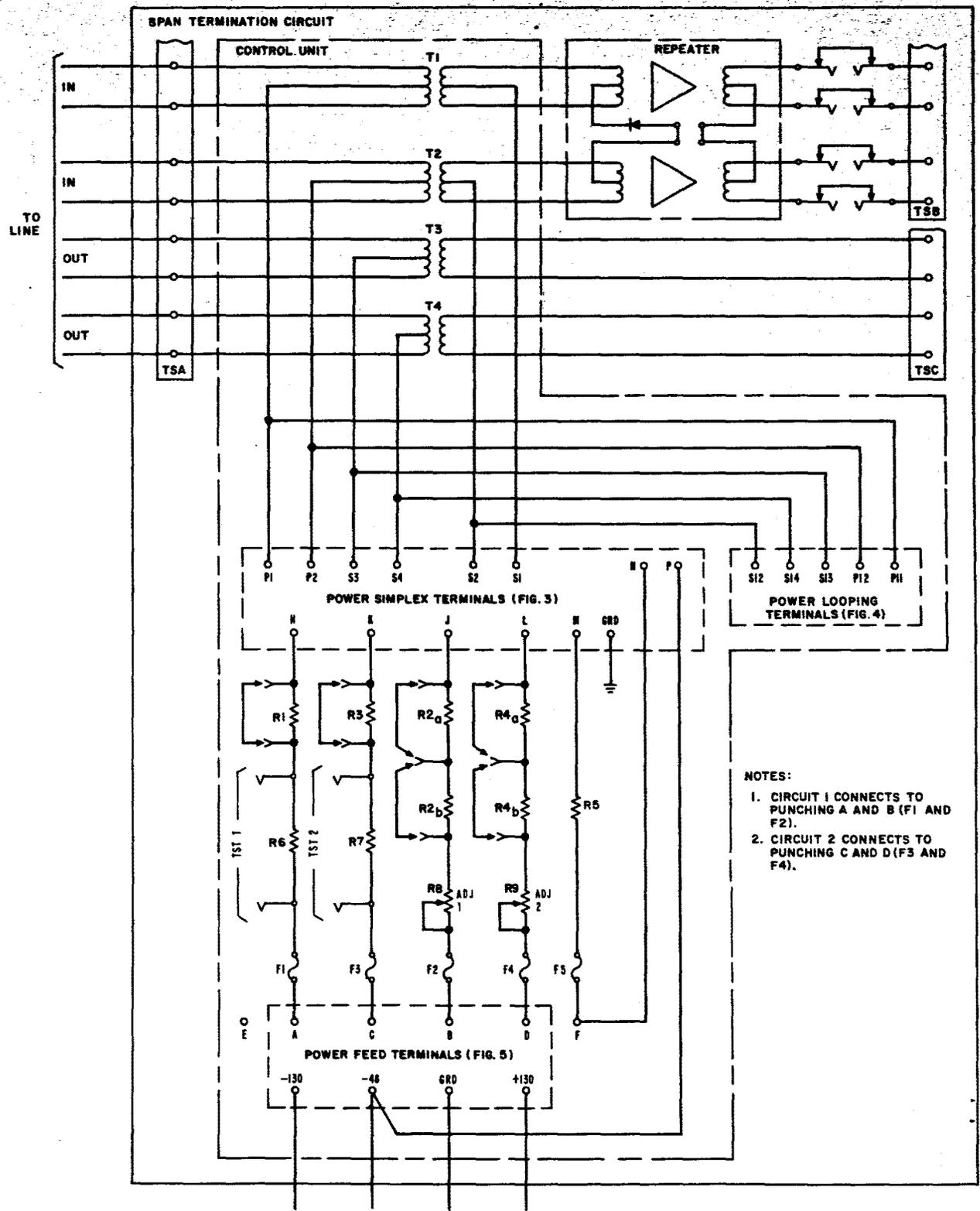
FUSE REQUIREMENTS FOR TIC/TI ORB

POWER FEED VOLTAGE	OFFICE REPEATER CODE	FUSES REQUIRED				
		FUSE, ALARM, AND FILTER PANEL			REPEATER	
		A (-130V)	B (-48V)	C (+130)	LINE -	LINE +
260 Volts	221A, 231A or D	70D, 5 amp	72A,* dummy	70D, 5 amp	70R, 0.15 amp	70R, 0.15 amp
178 Volts	221A, 231A or D	72A, dummy	70D, 5 amp	70D, 5 amp	70R, 0.15 amp	70R, 0.15 amp
130 Volts	221A, 231A or D	72A, dummy	72A,* dummy	70D, 5 amp	72A,† dummy	70R, 0.15 amp
48 Volts	221A, 231A or D	72A, dummy	70D, 5 amp	72A, dummy	70R, 0.15 amp	72A,† dummy
Line Powered From Other End	221B, 231B or E	72A, dummy	72A,* dummy	72A, dummy	—	—

Note: When using 221-type repeaters for powering low-power (60 mA) lines, they cannot be powered in series with the line because the regenerators in these repeaters require a minimum of 70 mA.

* Install a 5-amp (70D) fuse when the office repeater is a 221-type powering low-power lines (see Note), or the office repeater is powered separate from the line. Always install 70D fuses for F2B, F4B, F6B, and F8B also F10B and F12B (TIC/TI DSX-DED ORB) to power the bridging repeater in even-numbered shelves.

† When -48 volt office battery and battery return is used, it is necessary to replace fuse LINE + with a 72A dummy fuse. Conversely, when +130 volt battery and battery return is used, replace fuse LINE - with a 72A dummy fuse.



- NOTES:
1. CIRCUIT 1 CONNECTS TO PUNCHING A AND B (F1 AND F2).
 2. CIRCUIT 2 CONNECTS TO PUNCHING C AND D (F3 AND F4).

Fig. 1—Power Feed Circuit, 201 ORB

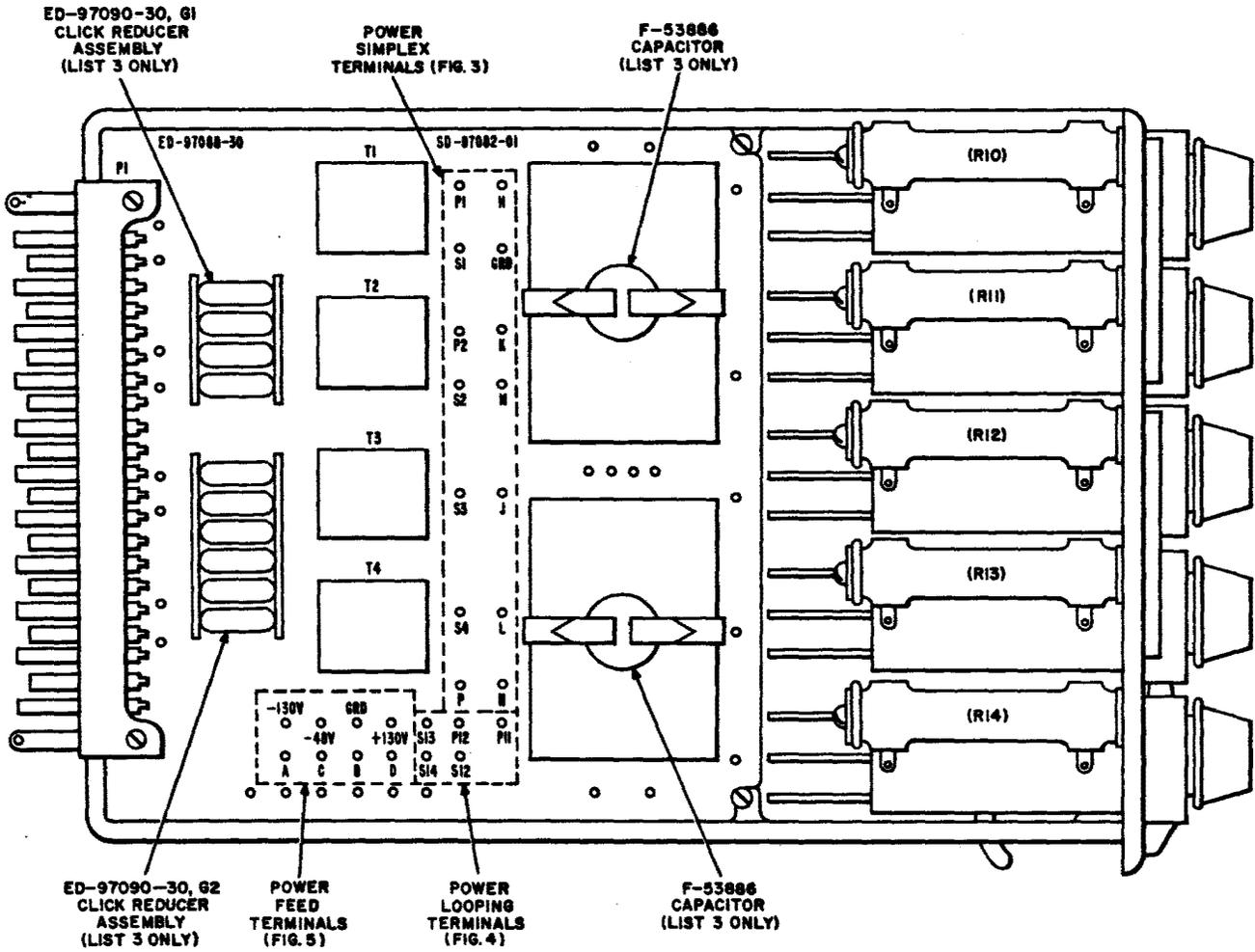
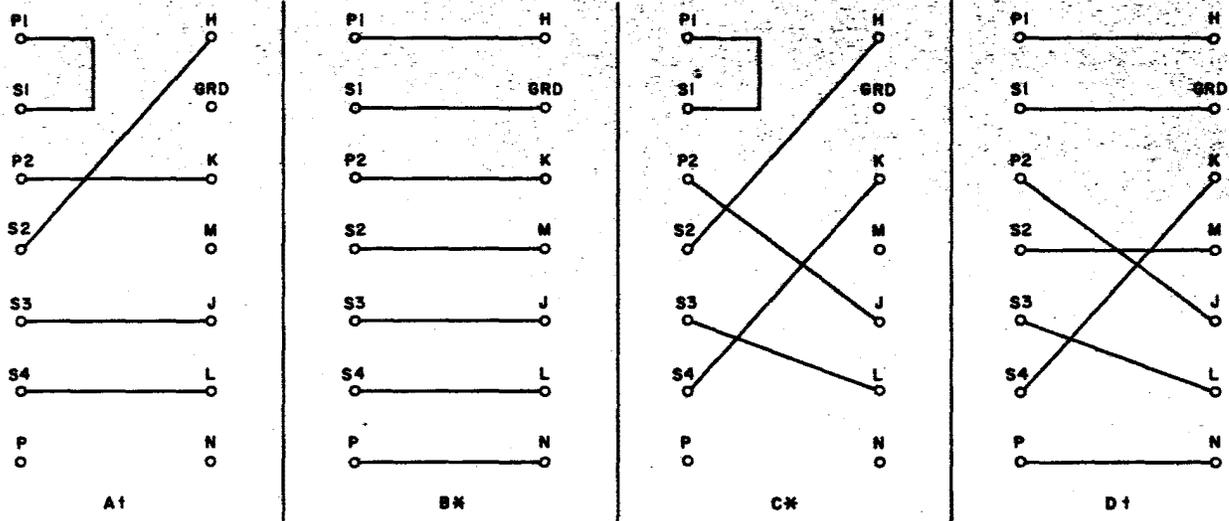


Fig. 2—J98710B Control Unit, Left Side View

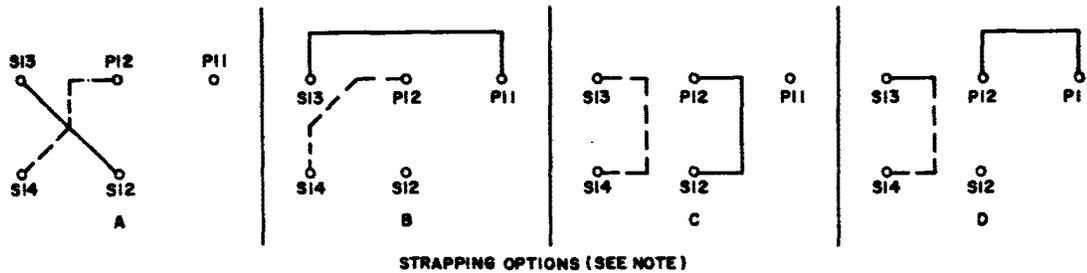


STRAPPING OPTIONS

LINE REPEATER OPERATION	OFFICE REPEATER POWERED	USE STRAPPING	CONTROL UNIT
BIDIRECTIONAL †	IN SERIES WITH LINE	A	J98710B, L1
BIDIRECTIONAL *	SEPARATELY	B	J98710B, L1
UNIDIRECTIONAL *	IN SERIES WITH LINE	C	J98710B, L2
UNIDIRECTIONAL †	SEPARATELY	D	J98710B, L2

* THESE OPTIONS ARE FACTORY PROVIDED.
 † THESE OPTIONS MUST BE WIRED LOCALLY.

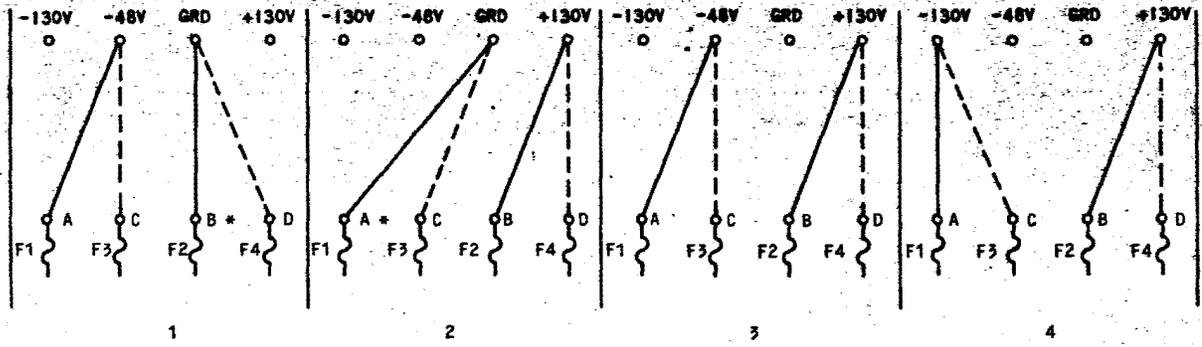
Fig. 3—Power Simplex Options, 201 ORB



LINE REPEATER OPERATION	OFFICE REPEATER POWERED	USE STRAPPING	REFERENCE (SD-97080-01)	OFFICE REPEATER FUSE	CIRCUIT FUSE
BIDIRECTIONAL	IN SERIES WITH LINE	A	FIG. 112B, SKETCH E	72A	72A
BIDIRECTIONAL	SEPARATELY	B	FIG. 112B, SKETCH D	70R	72A
UNIDIRECTIONAL	IN SERIES WITH LINE	C	FIG. 112C, SKETCH D	72A	72A
UNIDIRECTIONAL	SEPARATELY	D	FIG. 112C, SKETCH E	70R	72A

NOTE:
USE SOLID LINES FOR CIRCUIT 1. USE DASHED LINES FOR CIRCUIT 2.

Fig. 4—Power Loop Options, 201 ORB



STRAPPING OPTIONS (SEE NOTE 1)

POWER FEED VOLTAGE	USE STRAPPING	CONNECT A AND/OR C TO	CONNECT B AND/OR D TO	OFFICE RPTR FUSE	CIRCUIT FUSE
48	1	-48V	GRD*	72A OR 70R	72A OR 70R*
130	2	GRD*	+130V	(NOTE 2)	
178	3	-48V	+130V		
260	4	-130V	+130V		

* ON TERMINALS A, B, C, AND/OR D WHICH ARE STRAPPED TO GROUND, STRAP OUT ASSOCIATED FUSE(S) AT FUSE HOLDER AND INSTALL 72A DUMMY FUSE(S).

NOTES:

1. USE SOLID LINES FOR CIRCUIT 1. USE DASHED LINES FOR CIRCUIT 2.
2. IF OFFICE REPEATER IS POWERED SEPARATELY, INSTALL A 70R FUSE IN THE OFFICE REPEATER POSITION. IF THE OFFICE REPEATER IS POWERED IN SERIES WITH THE LINE, INSTALL A 72A DUMMY FUSE IN THE OFFICE REPEATER POSITION.

Fig. 5—Power Feed Options, 201 ORB

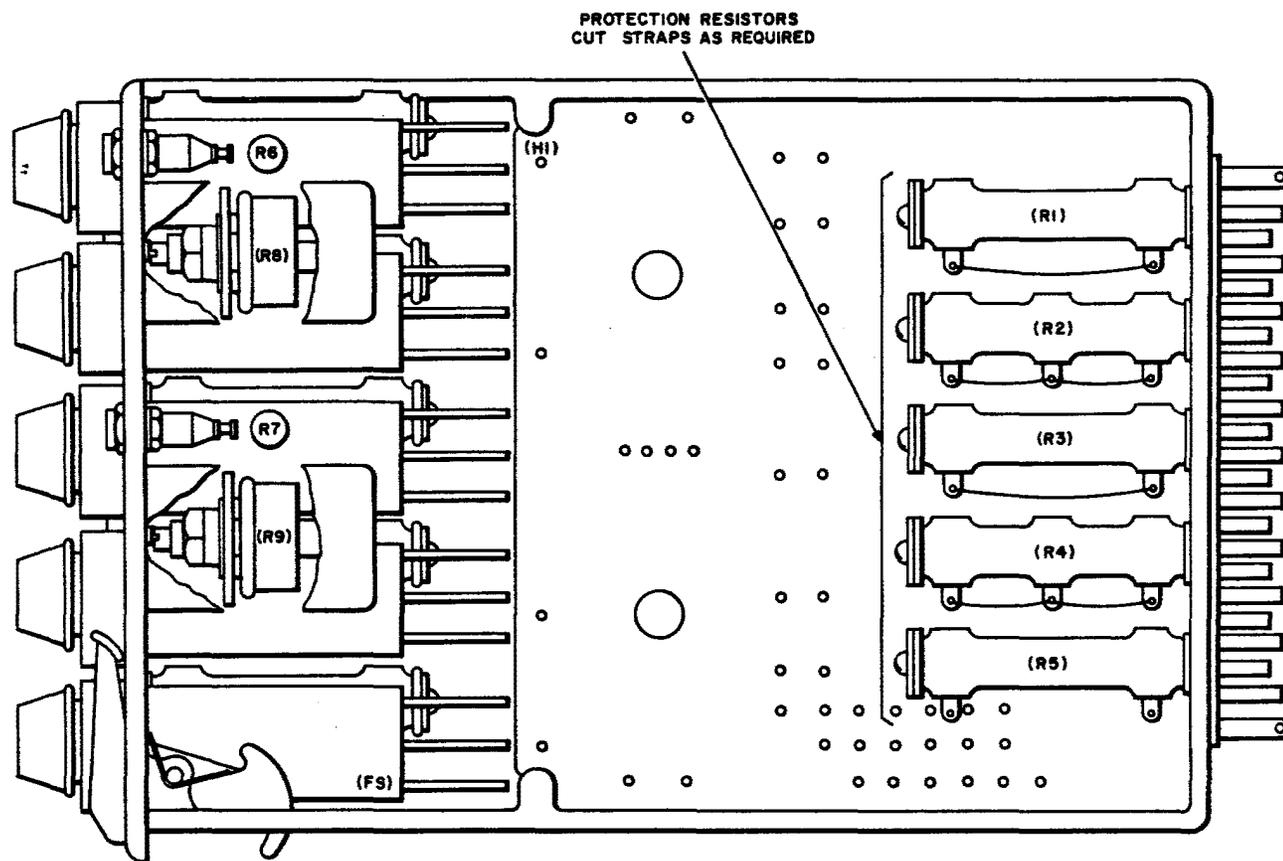


Fig. 6—J98710B Control Unit, Right Side View

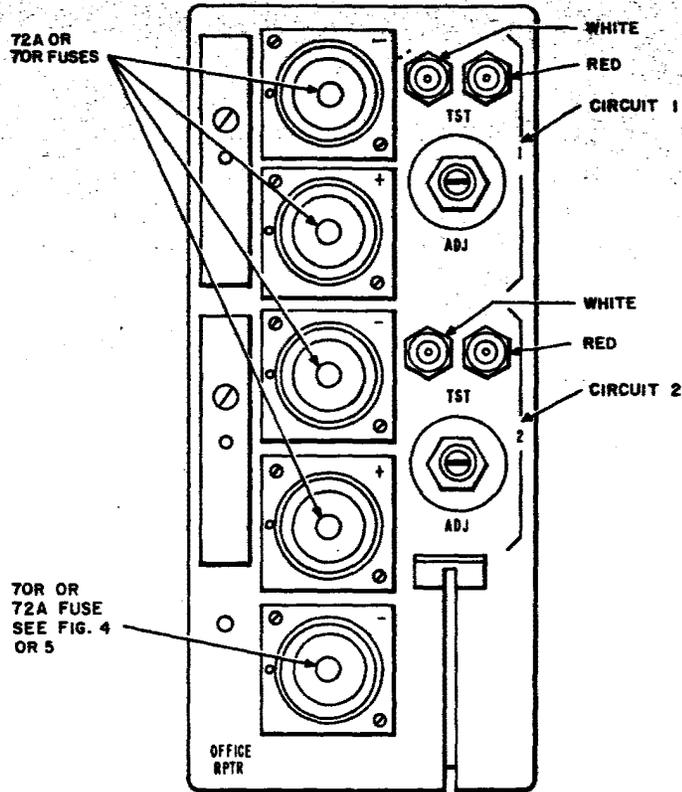


Fig. 7—J98710B Control Unit, Front View

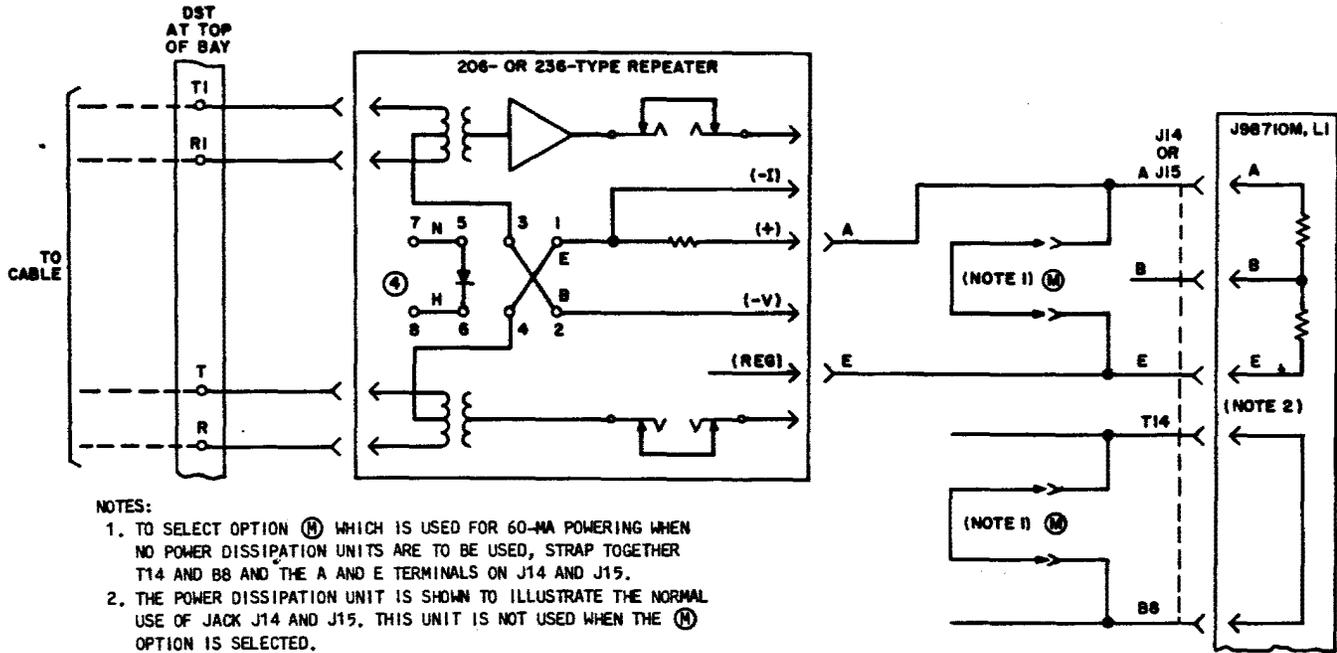


Fig. 8—M Option in 206 ORB

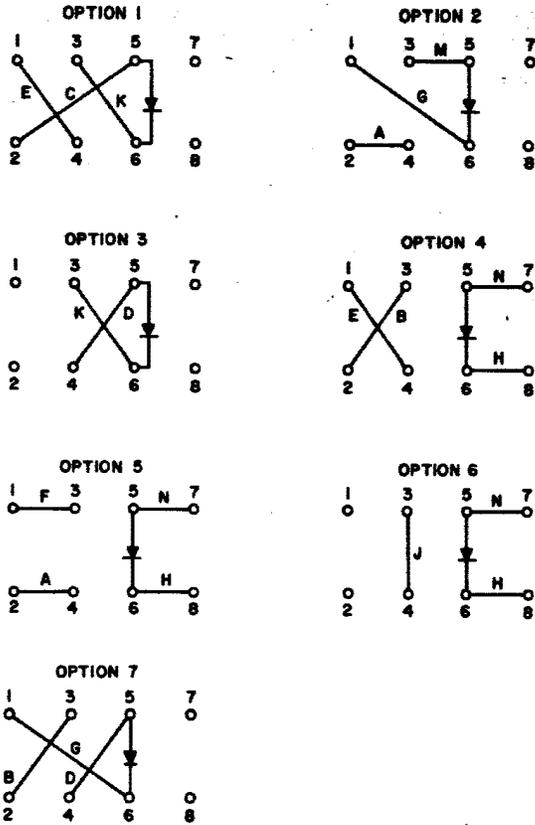
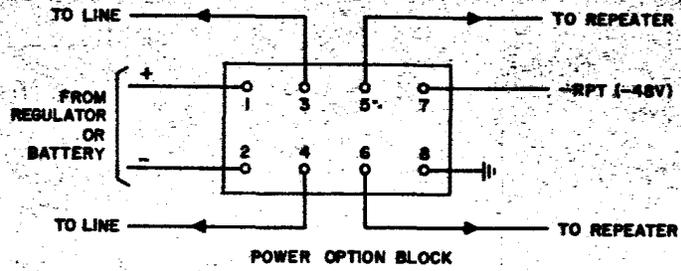


Fig. 12—Power Options for 206-, 221-, 231-, and 236-Type Repeaters

SPAN BENSENVILLE #7 BAY 216.08 SHELF 5		
OFF-RPTR 206J TYPE LINE CURRENT		
60 <input type="checkbox"/>	120 <input type="checkbox"/>	
140 <input checked="" type="checkbox"/>		
POWER FEED VOLTAGE		
-48 GRD <input type="checkbox"/>	+130 GRD <input checked="" type="checkbox"/>	
+130 -48 <input type="checkbox"/>	+130 -130 <input type="checkbox"/>	
9.4	114	
REG VOLT LINE VOLT (NORM)		
RPTR PWR. OPTIONS		
CEK <input checked="" type="checkbox"/>	AGM <input type="checkbox"/>	DK <input type="checkbox"/>
BEHN <input type="checkbox"/>	AFHN <input type="checkbox"/>	HJN <input type="checkbox"/>
BDG <input type="checkbox"/>	VMZ <input type="checkbox"/>	XY <input type="checkbox"/>
WY <input type="checkbox"/>	WZ <input type="checkbox"/>	P/R <input checked="" type="checkbox"/>
T <input type="checkbox"/>	ZZ <input type="checkbox"/>	XZ <input type="checkbox"/>
CABLE 5811	COMPLEMENT 401-413	
E-5416(10-76)		

Fig. 13—Office Repeater Bay Record Card (Form E-5416)

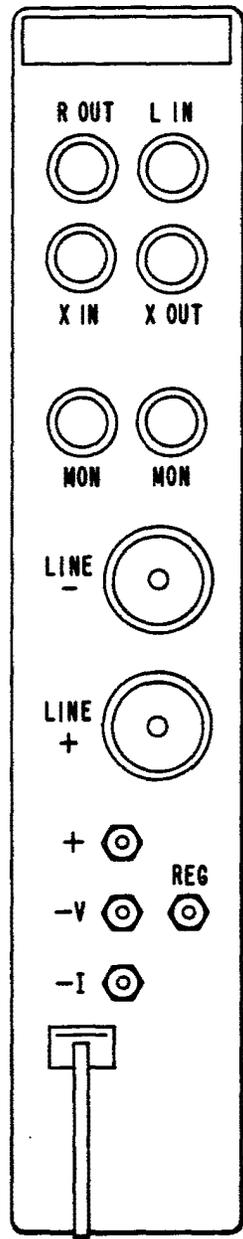
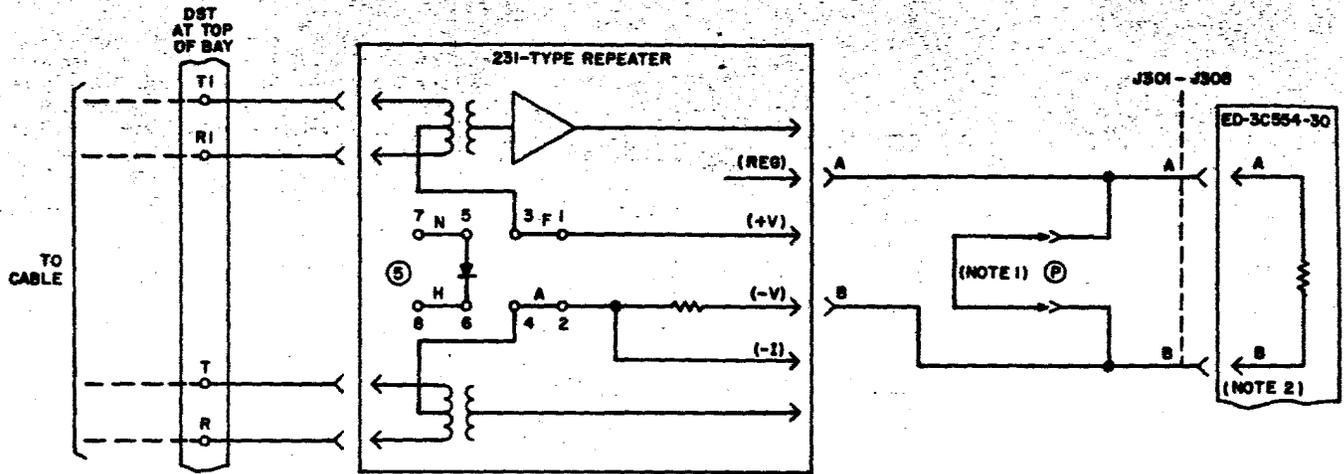


Fig. 14—206- and 236-Type Repeater, Fuse and Jack Locations



NOTES:

1. SELECT OPTION (P) WHEN USING 231-TYPE REPEATERS TO POWER 60-MA LINES.
2. THE POWER DISSIPATION UNIT IS SHOWN TO ILLUSTRATE THE NORMAL USE OF JACKS J301 THROUGH J308. IT IS NOT NECESSARY TO USE THIS UNIT WHEN THE (P) OPTION IS SELECTED.

Fig. 15—P Option in T1C/T1 ORB

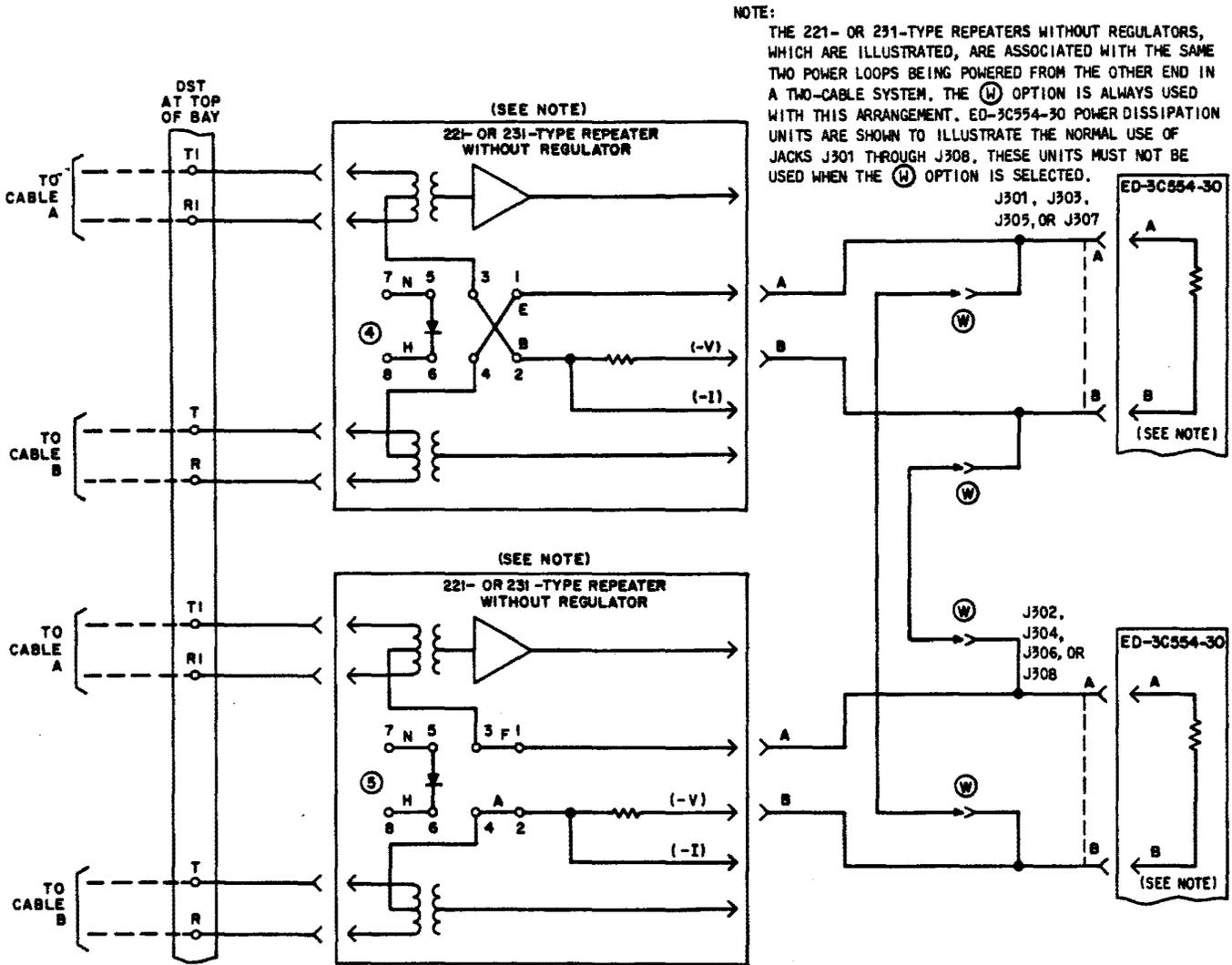


Fig. 16—W Option in TIC/T1 ORB

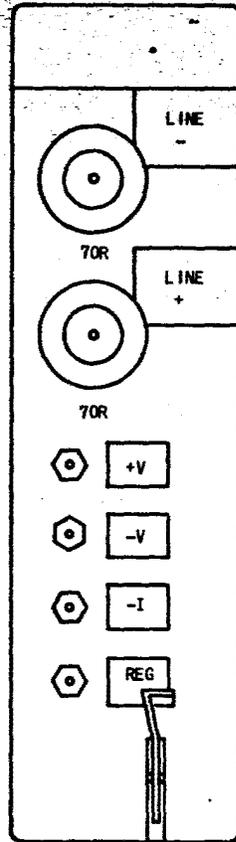


Fig. 17—221- and 231-Type Repeater, Fuse and Jack Locations

T CARRIER SPAN PROFILE

OFFICE Elmhurst
 SPAN 7 Bensenville
 R.R. 216-08 SHELVES 5 and 6
 OFFICE REPEATER TYPE 206J
 DATE 2-1-77 OUTSIDE TEMPERATURE 31°F

POWER FEED VOLTAGE			
-48V GRD	+130V GRD	+130V -48V	+130V -130V
	✓		
60MA <input type="checkbox"/>	120MA <input type="checkbox"/>	140MA <input checked="" type="checkbox"/>	

	LINE CURRENT	REGULATOR VOLTAGE	LINE VOLTAGE	NOTES	INITIAL ERROR RATE TEST			
					RECEIVE PULSES?	BPV		ERROR COUNT 10 _____
						YES	NO	
TEST POINTS								
	+ to - I	+ to REG	+ to - V					
1	1.38	9.5	112					
2	1.41	8.8	115					
3	1.40	9.4	114					
4	1.41	9.4	114					
5	1.42	9.3	115					
6	1.40	9.4	114					
7	1.39	9.7	113					
8	1.41	9.4	114					
9	1.41	9.4	114					
10	1.38	9.9	112					
11				<i>Not Assigned</i>				
12	1.39	9.5	114					
13	1.41	9.4	115					
14	1.43	9.1	116					
15	1.41	9.4	114					
16				<i>Not Assigned</i>				
17	1.41	9.4	114					
18	1.40	9.4	114					
19	1.41	9.2	115					
20	1.40	9.3	114					
21	1.39	9.9	111					
22	1.41	9.4	114					
23	1.42	9.9	114					
24	1.41	9.6	113					
25	1.40	9.4	114					
		9.4	114					

*NORM READINGS

*THE NORM IS THE MOST FREQUENTLY OBSERVED VALUE IN EACH COLUMN.

TESTER Jim Daniels
 APPROVED BY SUPERVISOR Scarlet Seales

Fig. 18—Typical Recordings on Form E-6900 (Page 1)