

**TYPE N2 REPEATER  
REPEATERED HIGH-FREQUENCY LINE  
N2 REPEATER-TO-N1 AND -N1A ADAPTERS  
DESCRIPTION**

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**1. GENERAL**

**1.01** This section describes the J99321K N2 repeater-to-N1 adapter assembly and the J99321L N2 repeater-to-N1A adapter assembly.

**1.02** This section is reissued to change the title of the section, to delete the description of the N2 repeater mounting-shelf assembly for relocation to Section 362-450-100, to add a description of the N2 repeater-to-N1 adapter assembly, and to make various other changes. Since this revision is of a general nature, arrows ordinarily used to indicate changes are omitted.

**1.03** The N2 repeater offers the advantages of superior transmission performance, reduced maintenance over the N1A transistor repeater, and greatly reduced power requirements over the N1 electron-tube repeater. Existing vacant N1 or N1A repeater mountings may be used in N2 repeatered lines to obtain these advantages in new systems by the use of N2 repeater-to-N1 and -N1A adapter

assemblies. The N2 repeater-to-N1A adapter assembly allows direct replacement of existing N1A repeaters with N2 repeaters. The N2 repeater-to-N1 adapter assembly may also be used to replace existing N1 electron-tube repeaters with N2 repeaters, but when remotely powered N1 repeaters are replaced, the line current must be reduced at the power supply point.

**1.04** Although the N2 repeater-to-N1 and -N1A adapter assemblies are similar electrically and in appearance, they are not interchangeable because of important differences in the power circuits. Structural differences prevent the insertion of the wrong adapter assembly into the N1 or N1A mounting bracket. The N2 repeater-to-N1A adapter assembly is shown in Fig. 1. The adapters contain much the same equipment as that provided in the N2 repeater-mounting shelf. There are four versions each of the -N1 and -N1A adapters, designated lists 1 through 4. Each adapter contains mounting facilities, input transformers, and appropriate power circuits. List 1 and 2 adapters contain provisions for line build-out facilities which include lightning protective equipment, line power-feed circuits, and sockets for the addition of plug-in type span pads and input equalizers. List 3 and 4 adapters are not equipped with line build-out equipment and are used when such equipment is provided in the N2 (J99323) line build-out bay. Table A shows the use of the four versions of -N1 and -N1A adapters. The adapter serves as a mounting for the N2 repeater. The combination of an N2 repeater with an adapter occupies the same space as an N1 or N1A repeater.

**2. EQUIPMENT DESCRIPTION**

**2.01** Each N2 repeater-to-N1 or -N1A adapter assembly is similar to one subassembly of an N2 repeater-mounting shelf. The assembly is a metal casting which contains input transformers

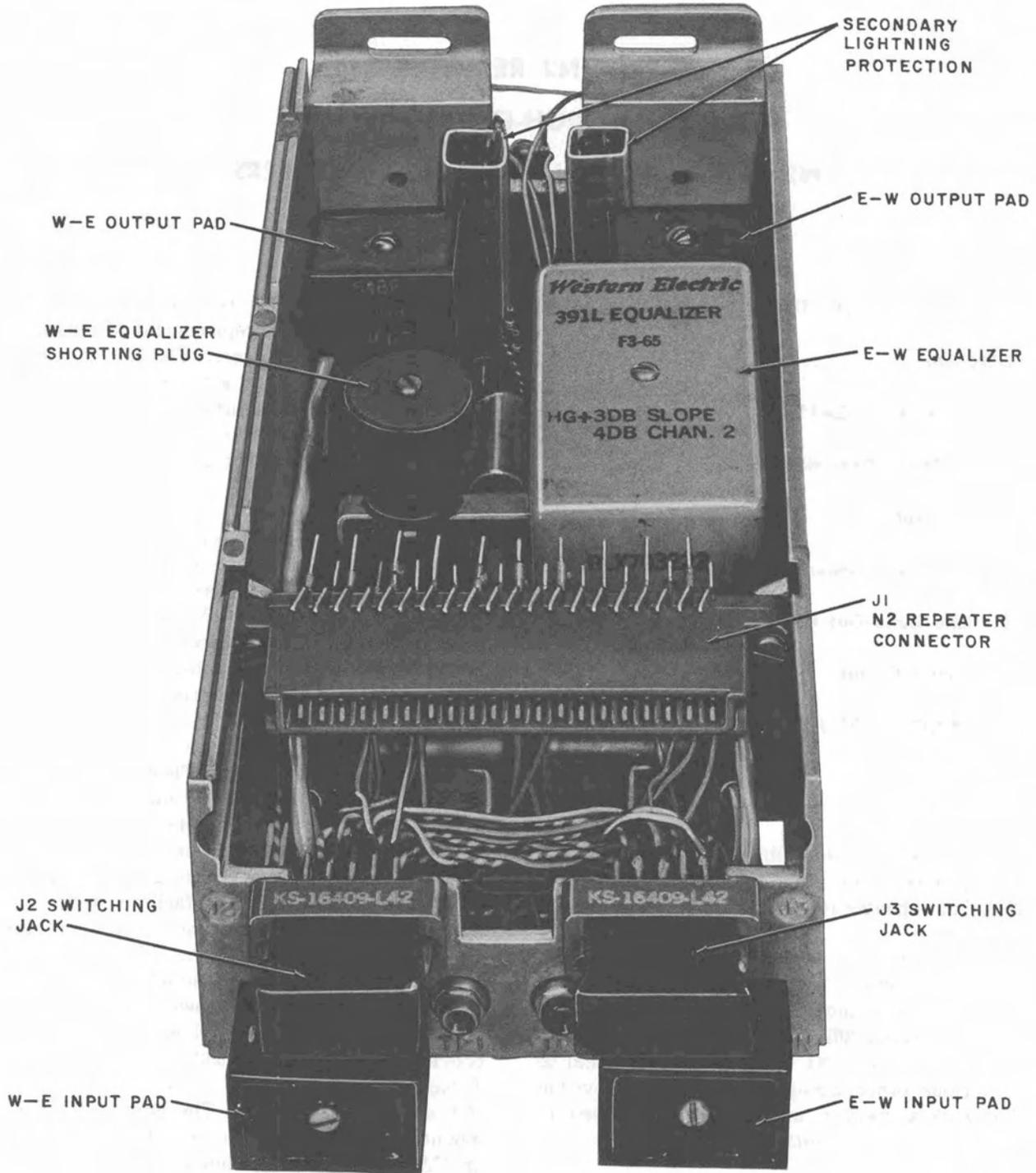


Fig. 1—N2 Repeater to N1A Adapter Assembly

**TABLE A**  
**APPLICATIONS OF N2 REPEATER—**  
**TO-N1 AND -N1A ADAPTERS**

TYPE ADAPTER	TYPE REPEATER	POWER SOURCE	ADAPTER	
			WITH LBO	WITHOUT LBO
N2-TO-N1	High-Low	Local	List 1	List 3
		Remote	List 1	—
	Low-High	Local	List 2	List 4
		Remote	List 2	—
N2-TO-N1A	High-Low	Local	List 1	List 3
		Remote	List 1	—
	Low-High	Local -48V	List 1	List 3
		Local +130 or +152V	List 2	List 4
		Remote	List 2	—

on a printed wiring board, a power-regulating circuit, test points, and switching jacks. Adapters with provisions for line build-out equipment (L1 and L2) also contain sockets on the face of the adapter for 54-type input span pads, and on the printed wiring board for output span pads and 391- or 916-type equalizers, in addition to line power filters and lightning-protection equipment. The equalizer sockets are initially equipped with shorting plugs which must be removed when equalizers are required. Initially, shorting straps are provided around the output span-pad sockets. These straps must be cut before plugging 54-type span pads, where required, into the sockets. The N2 repeater-to-N1 and -N1A adapter assemblies are approximately 3-1/2 inches high, 4-1/4 inches wide, and 9 inches deep.

### 3. FUNCTIONAL DESCRIPTION

#### A. General

**3.01** The N2 repeater connects to the outside cable pairs through line build-out, line-protection, and line-powering circuits. When N2 repeaters are used in N1 or N1A repeater mountings, these circuits may be located in the N2 repeater-to-N1 or -N1A adapter, or in a separate J99323 line

build-out bay. The N1 or N1A repeater mounting may contain solder-connected span pads and slope networks, which may be used in conjunction with, or instead of plug-in pads and equalizers in the adapters. However, maximum flexibility is obtained if the plug-in units are used to provide all of the required line build-out. List 1 or 2 adapters should be provided at all locations not provided with J99323 line build-out bays to obtain the line transformers and power supply filters required to receive or transmit power over the line. Figure 2 illustrates, in simplified form, the various circuits required in the N2 repeater-to-N1 or -N1A adapter assembly when a line build-out bay is not used; Fig. 3 illustrates the circuits required when it is used.

#### B. Repeater Connecting Circuit

**3.02** The repeater connecting circuit is shown in Fig. 4. The receiving pairs from the line building-out circuits connect to transformers T2 and T4 for the two directions of transmission. The hybrid arrangements in the secondary windings of these transformers provide a means of coupling the received carriers to the N2 repeater via jack J1 and to external test equipment via jack J2 or J3 without introducing level changes in the system.

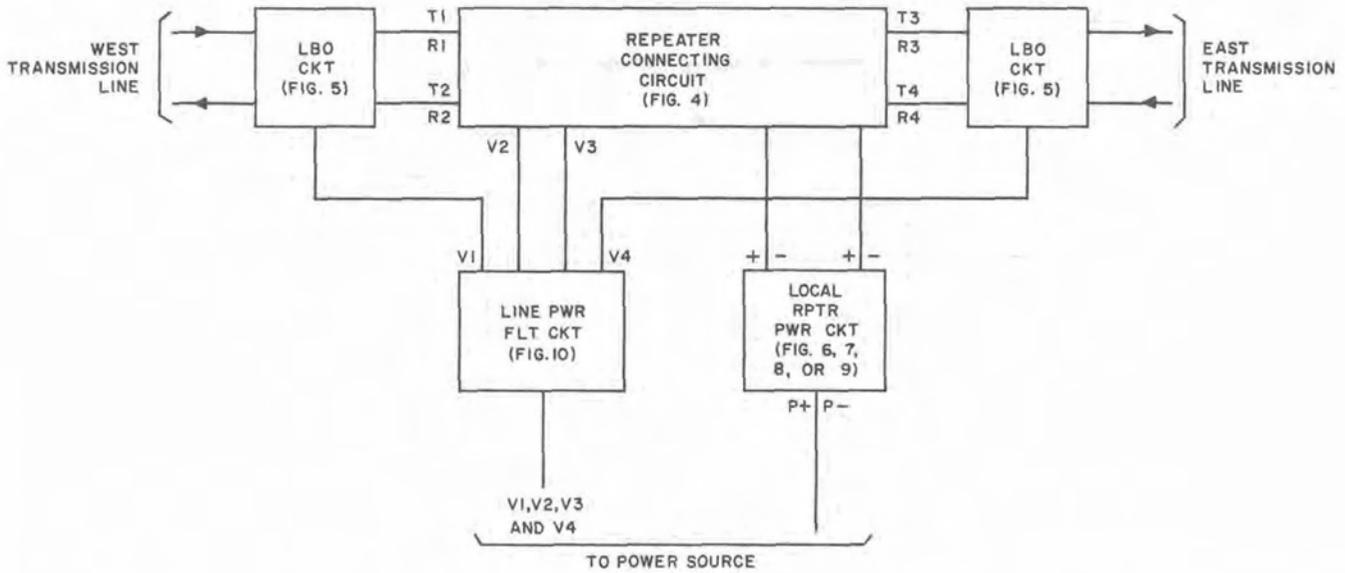


Fig. 2—N2 Repeater to N1 or N1A Adapter—LBO Bay Not Furnished—Block Diagram

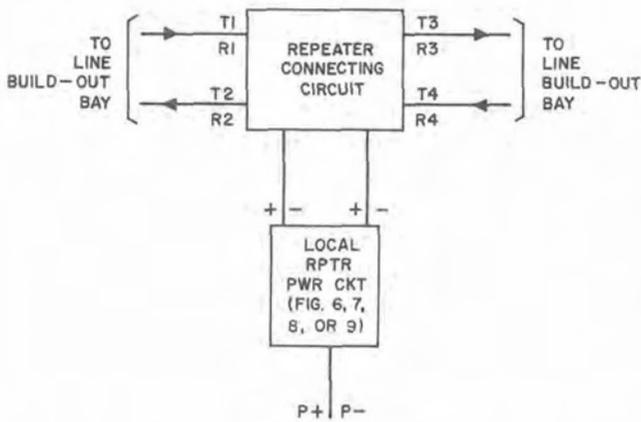


Fig. 3—N2 Repeater to N1 or N1A Adapter—LBO Bay Furnished—Block Diagram

The repeater outputs at jack J1 are connected to the transmitting pairs in both directions via jacks J2 and J3 in conjunction with shorting plugs P2 and P3. Jacks J2 and J3 provide for switching the N2 repeater using the N2 repeater switching set.

**C. Line Build-Out Circuit**

**3.03** The line build-out circuit, illustrated in Fig. 5, connects to the repeater connecting circuit and is identical for each direction of transmission.

The receiving cable pair from the west transmission line connects to transformer T1 over leads T1 and R1. Transformer T1 matches the impedance of the line to the impedance of the build-out circuits. The center tap on the primary of transformer T1 is one connection of a simplex pair used to transmit or receive dc power over the carrier transmission pairs. The receiving path of the line build-out circuit includes an input span pad AT1 and an equalizer network EQ1. The span pads are 54-type plug-in devices available in attenuation values varying from 0 to 44 dB in 2-dB steps. The plug-in equalizers are available in various configurations and values with 391-type to correct for slope, bulge, or cubic distortion, and 916-type to correct for quartic distortion. The transmitting pair of the west transmission line connects to an output span pad AT2. These pads are also 54-type plug-in devices. Shorting straps (option Z) are normally provided and must be cut before inserting an output pad. Resistors R5 and R6, and varistors RV1 through RV16 provide secondary (low-voltage) lightning protection.

**3.04** The test jacks in the N1 or N1A repeater mounting bracket may be used with an N1 or N1A switching set to switch the line build-out equipment in an -N1 or -N1A adapter along with the N2 repeater. This permits changing the span pads and equalizers without service interruption.

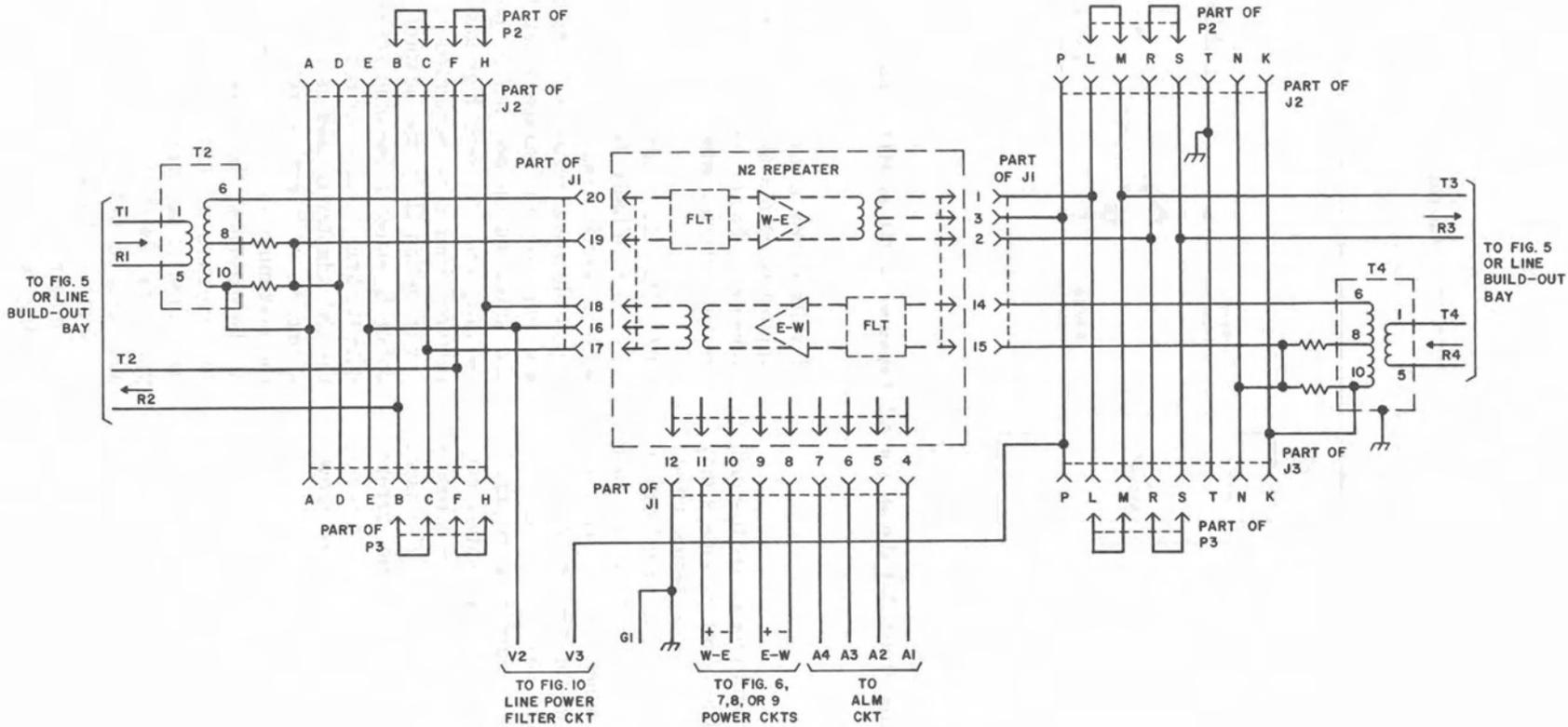


Fig. 4—N2 Repeater Connecting Circuit

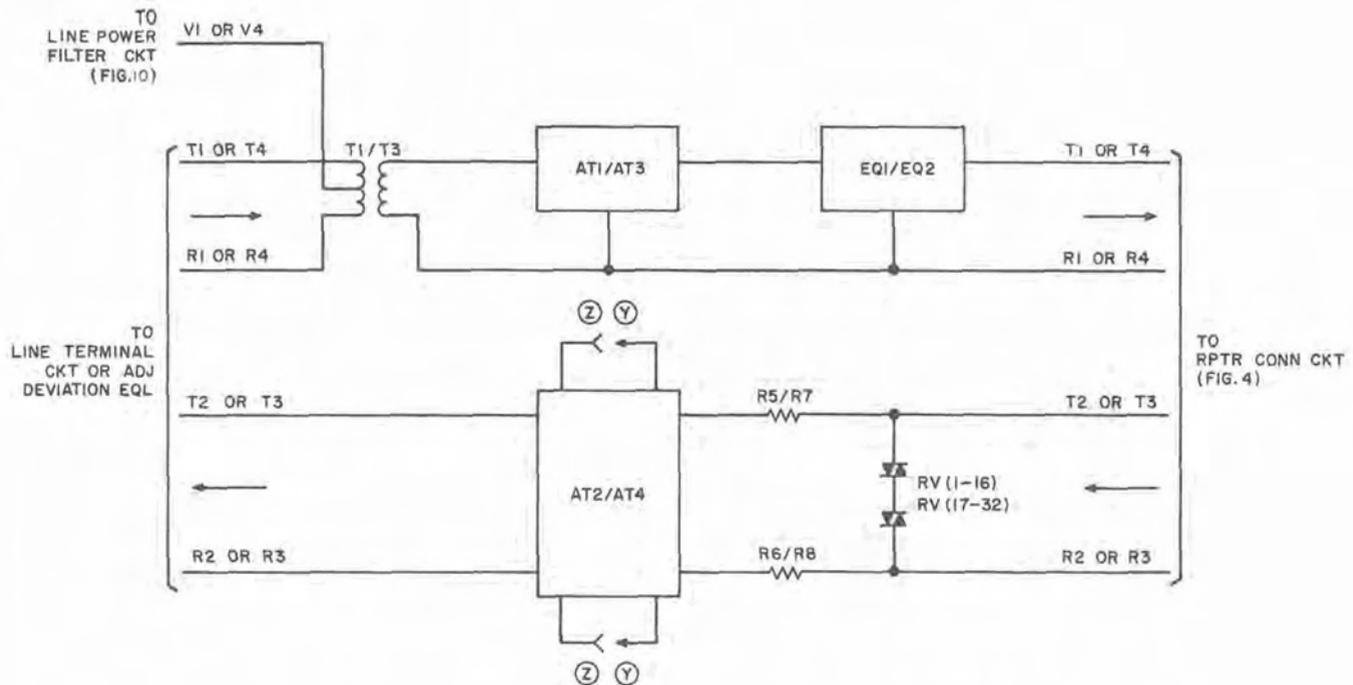


Fig. 5—Line Build-Out Circuit (In N2 Repeater to N1 or N1A Adapter)

#### D. Power Circuits

**3.05** Although the power requirements are unequal, the N2 high-low and low-high repeaters may be remotely powered in the same series circuit thereby supplying an equal current to each location. The N2 repeater-to-N1 and -N1A adapters have power regulating circuits which are different for the List 1 and 3 units than for the List 2 and 4 units. The -N1 adapters also have power resistors which are used to limit the line current as required. The value of current supplied to the repeaters may be determined from the voltage measured across a 24-ohm resistor at the TP1(+) and TP2(-) jacks on the adapters. The power options, line current, and test voltage requirements for the common applications of -N1 and -N1A adapters are shown in Table B.

**3.06** The N2 repeater-to-N1 adapter, List 1 or 3, uses the power circuit shown in Fig. 6. Voltage regulating diode CR4 maintains a constant 22 volts across the E-W and W-E sections of a high-low repeater in a parallel connection. Power resistors R12 and R15 are used, as required, to limit the line current. The power circuit provided in a List 2 or 4 adapter is shown in Fig. 7. Two regulating diodes, CR5 and CR6, maintain a constant

44 volts across a low-high repeater, with 22 volts supplied to each section, E-W and W-E, in a series connection. Power resistor R13 is used to limit the line current, when required.

**3.07** The N2 repeater-to-N1 adapter assemblies are initially furnished with options Q and R, or S which strap out the R12 and R15, or R13 current-limiting resistors. Where these resistors are required, the straps must be cut to remove the unwanted options before power is applied to the adapters. A single high-low repeater remotely powered from a nonregulated supply requires only power option R in the adapter. The removal of option Q places a 348-ohm resistor (R12) in series with the line. In all other remote power applications, the -N1 adapter is used as initially furnished, with Q and R, or S options retained. To ensure that the maximum allowable operating temperature will not be exceeded, the current for remotely powered N2 repeaters in N2-to-N1 adapters usually should be limited to no greater than 110 mA. Repeaters preceding 240-type amplifiers may require an additional 25 mA. In these instances, the 110-mA or 85-mA limit may be exceeded without exceeding the maximum allowable temperature. Where existing remotely powered N1 repeaters mounted in either bays or cabinets are replaced with N2

**TABLE B**  
**POWER OPTIONS AND REQUIREMENTS FOR**  
**N2 REPEATER-TO-N1 AND -N1A ADAPTERS**

ADAPTER APPLICATIONS			DC POWER			ADAPTER			
			BATTERY USED (VOLT)	REGULATED CURRENT (MA)	NON-REGULATED CURRENT (MA)	LIST NO.	OPTION USED	TEST VOLTAGE (AT TP1 AND TP2)	
N2 REPEATER TO N1 ADAPTER	LOCALLY POWERED		H-L	+130 or +152		95	L1/L3	None	2.0 to 2.7
			L-H	+130 or +152		110	L2/L4	None	2.0 to 3.0
	REMOTELY POWERED	(One Repeater Only in Power Loop)	H-L	+130	85	L1	Q & R	1.9 to 2.2	
					110		R	2.4 to 2.8	
			L-H	+130	85	L2	S	1.9 to 2.2	
					110			2.4 to 2.8	
	REMOTELY POWERED	(Two, Three, or Four Repeaters in Power Loop)	H-L	+130, +130 & -48, or +130 & -130	85	L1	Q & R	1.9 to 2.2	
					110			2.4 to 2.8	
			L-H	+130, +130 & -48, or +130 & -130	85	L2	S	1.9 to 2.2	
					110			2.4 to 2.8	
N2 REPEATER TO N1A ADAPTER	LOCALLY POWERED		H-L	-48, +130, or +152	110	L1/L3	—	2.2 to 3.0	
								3.6 to 4.9	
			L-H	-48	190	L2/L4	—	2.2 to 3.0	
	+130 or + 152	110	2.2 to 3.0						
	REMOTELY POWERED	(One, Two, Three, or Four Repeaters in Power Loop)	H-L	+130, +130 & -48 or +130 & -130	85	L1	—	1.9 to 2.2	
					110			2.4 to 2.8	
L-H			+130, +130 & -48 or +130 & -130	85	L2	—	1.9 to 2.2		
				110			2.4 to 2.8		

*Note:* Repeaters preceding 240-type amplifiers may require an additional 25 mA (see 3.07).

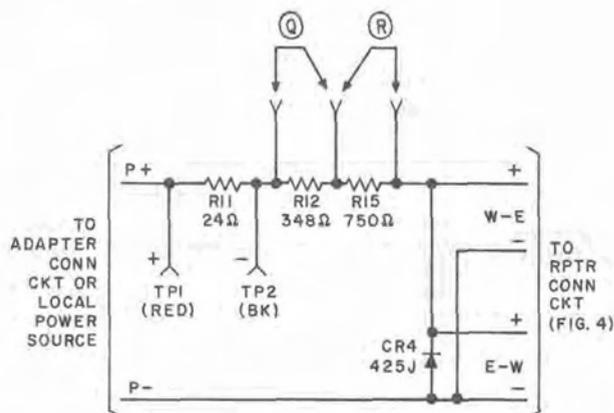


Fig. 6—N2 Repeater to N1 Adapter, List 1 or 3—Power Circuit for High-Low Repeater

repeaters in -N1 adapters, the power-feeding arrangements must be changed at the terminal or repeater location supplying the power, in order to meet these requirements. Where a terminal or repeater is equipped with a nonregulated power supply, the J99321D List 1 through List 4 alarm-fuse and constant-current regulator assemblies may be used to furnish regulated power for remote N2 repeaters in -N1 or -N1A adapters. The assemblies are arranged for mounting on 19-inch bay framework. The List 1 and List 3 assemblies are arranged to feed power to four repeated line circuits, and the List 2 and List 4 assemblies are arranged to feed power to eight circuits.

**3.08** At a locally powered repeater point, the N2 repeater-to-N1 adapter must be used with the Q and R, or S options removed. For high-low repeaters, the power circuit shown in Fig. 6 is provided, and power resistors R12 and R15 limit the current to 95 mA. For low-high repeaters, the power circuit shown in Fig. 7 must be provided, and power resistor R13 limits the current to 110 mA. The power is supplied from the N1 repeater power supply, which uses a +130 volt power source, or a +152 volt source with dropping resistors. In either case the N2 repeater with the -N1 adapter directly replaces the locally powered N1 repeater, requiring no options or adjustments in the local power supply.

**3.09** Locally powered N2 repeaters in -N1A adapters receive power from the N1A repeater power supply, which uses a -48 volt, +130 volt, or +152 volt power source with appropriate dropping resistors. The N2 repeater-to-N1A adapter, List 1

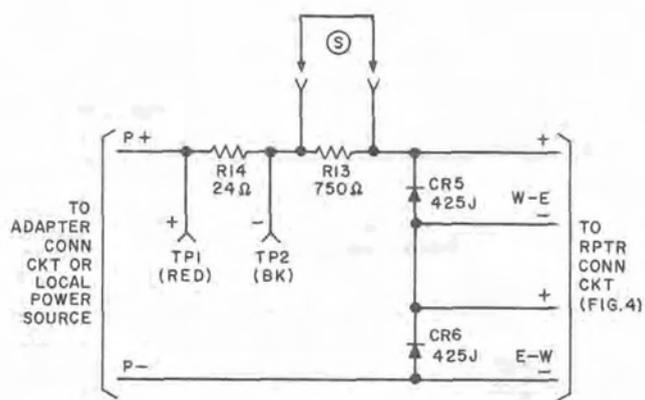


Fig. 7—N2 Repeater to N1 Adapter, List 2 or 4—Power Circuit for Low-High Repeater

or 3 is provided with a power regulating circuit as shown in Fig. 8, and is used with an N2 low-high repeater locally powered from a -48 volt source, or with a high-low repeater locally powered from a -48, +130, or +152 volt source, or remotely powered. A single regulating diode (CR1) is used to maintain a constant 22 volts across the E-W and W-E sections of the repeater connected in parallel. The power circuit shown in Fig. 9 is provided in the List 2 or 4 adapter used with an N2 low-high repeater locally powered from a +130 volt source, or remotely powered. Regulating diodes CR2 and CR3 maintain a constant 44 volts across the repeater, with 22 volts supplied to each section, E-W and W-E, in a series connection.

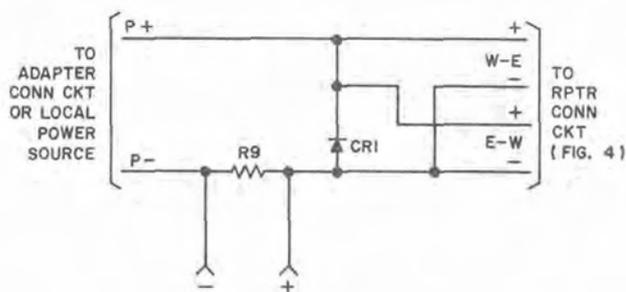
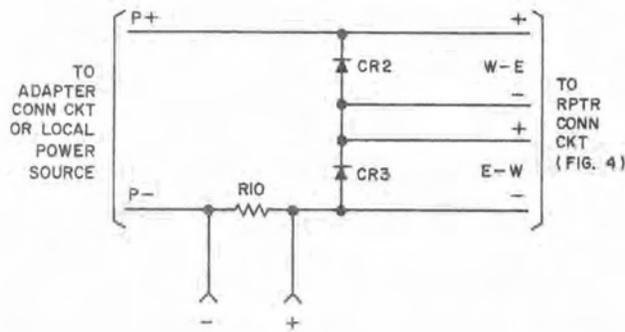
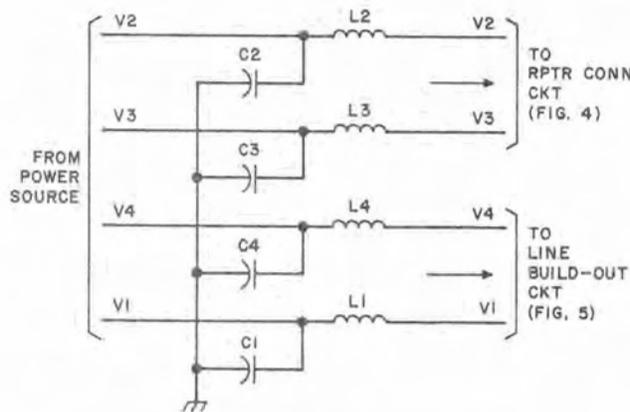


Fig. 8—N2 Repeater to N1A Adapter Power Circuit for H-L Repeater Receiving Power Over Line or From Local -48, +130, or +152 Volt Supply, or for L-H Repeater Receiving Power From Local -48 Volt Supply



**Fig. 9—N2 Repeater to N1A Adapter Power Circuit for L-H Repeater Receiving Power Over Line or From Local +130 or +152 Volt Supply**

**3.10** Power is transmitted or received at a repeater through the power filter circuit, shown in Fig. 10, provided in the N2 repeater-to-N1 or -N1A adapter. The adapter may be arranged to terminate power at a remote location, or to receive power from one direction and transmit power to additional repeaters and 240-type amplifiers in the other direction. For the -N1 adapter these connections are made on terminal strip TS1 on the N1 repeater mounting bracket as shown in Fig. 11.



**Fig. 10—Line Power Filter Circuit**

**4. DRAWINGS (NOT ATTACHED)**

**4.01** The detailed circuit information for the N2 repeater-to-N1 and -N1A adapters is shown on SD-97374-01.

**4.02** The following schematic drawings (not attached) provide connecting information for the adapters.

SD-95124-01 Application Schematic for N1, ON1, and ON2 Repeater

SD-95124-02 Application Schematic for N1A Transistorized Repeater

SD-97262-01 N Repeater Fuse and Alarm Circuit

SD-97272-01 Application Schematic For Powering N1, N1A, N2, ON1 and ON2 Repeaters

SD-97274-01 Repeater Connecting Circuit (For N1 and N1A Repeaters)

SD-97281-01 Local Repeater Fuse and Alarm Circuit

SD-97374-01 Application Schematic for N2 Repeaters

SD-97399-01 Repeater Power Distribution And Alarm Circuit for Use With Line Build-Out Circuit or N2 Repeater.

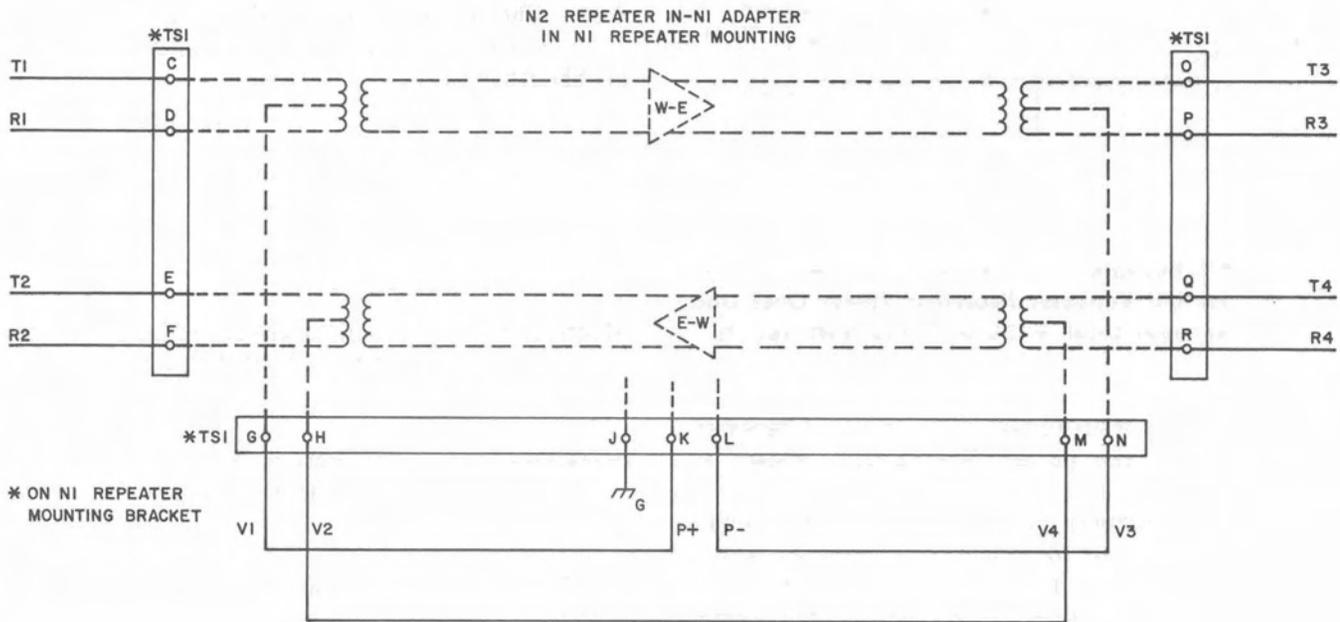


Fig. 11—Power Connections at N1 Repeater Mounting, - for Power Received + Continued to Other Repeaters