DIGITAL DATA SYSTEM
DIGITAL 56-KB/S REPEATER
DESCRIPTION

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1. GENERAL

1.01 This section provides information on the J70177AT, ▶list 2◀ digital 56-kb/s repeater, Fig. 1, which is used to extend the range of 56-kb/s Digital Data System (DDS) loops.

1.02 ▶This section is reissued to rate the J70177AT, list 1, as manufacture discontinued (MD) and to incorporate the J70177AT, list 2.◀

1.03 The 9.6-kb/s serving plan adopted for the DDS (see Section 880-602-102) places a DDS end office within a digital serving area (DSA) so that customers can be served over a 4-wire metallic loop at a data rate of 9.6 kb/s or lower. This means that some 56-kb/s customers cannot be served from a DDS end office, since the maximum transmission range at 56 kb/s is approximately one-half that at 9.6 kb/s. To fill this void (or 56-kb/s "hole") and to extend the transmission range to serve all 56-kb/s customers within the 9.6-kb/s serving area, a 56-kb/s regenerative repeater has been developed.

1.04 The 56-kb/s repeater operates over DDS loops with a data service unit (DSU) or a channel service unit (CSU) at the customer location and the office channel units (OCUs) at the central office (CO). The signal on the loop is a 56-kb/s bipolar return-to-zero signal which is attenuated and distorted in proportion to the length of cable. The repeater equalizes and amplifies the received signal, samples and retimes it, and retransmits the regenerated pulses.

1.05 Three CO, installer-provided, power options are available on the 56-kb/s repeater to accommodate the six configurations described in 1.06 through 1.11. These options are listed in Table A along with their maximum current drain.

1.06 Many customers who are beyond the present 56-kb/s loop transmission range are not directly connected to the DDS end office, but rather, are served by a baseband office (a CO which contains no DDS multiplexing equipment) connected to the end office via interoffice trunk cable. The local loop distance from the serving baseband office to the customer premises is usually within the 56-kb/s signaling range, but the total transmission loss from the DDS end office exceeds this range. Such customers can be served by a CO repeater placed in the baseband office. This arrangement is shown in Fig. 2a.

1.07 A customer whose local loop loss to the baseband office (or hub office) exceeds the 56-kb/s transmission range will require an outside plant (OP) repeater. If the transmission loss between the DDS end office and the OP repeater exceeds the 56-kb/s signaling range, a second repeater will be required. Figure 2b shows a CO digital 56-kb/s repeater in tandem with an OP repeater.

1.08 In some of the cases where two repeaters are needed, both could be CO repeaters. Figure 2c shows two CO repeaters, each in a

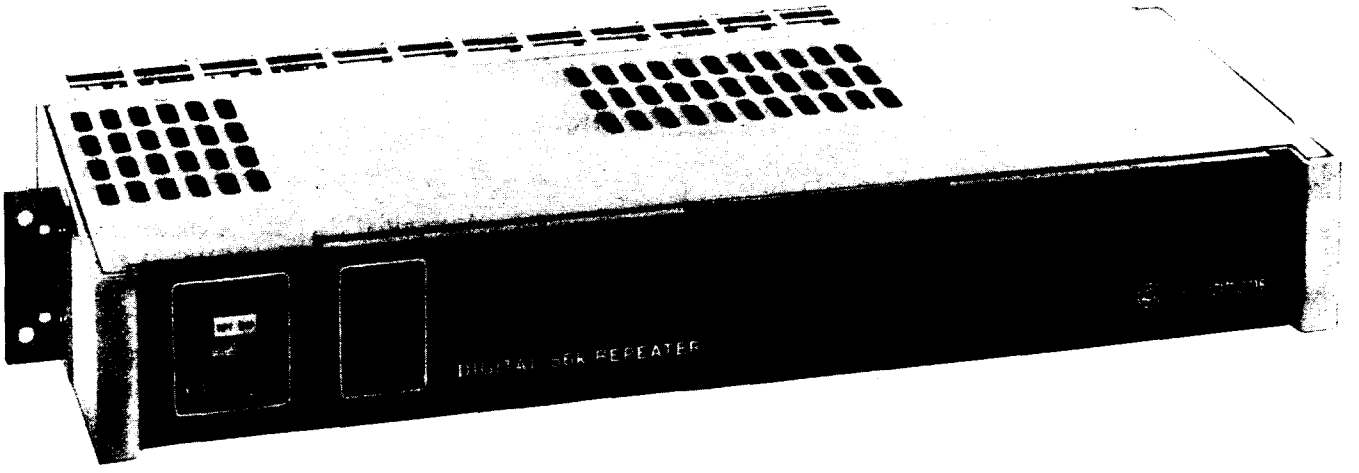


Fig. 1—◆56-kb/s Repeater—Central Office Configuration◆

◆TABLE A◆

POWER OPTIONS FOR CENTRAL OFFICE REPEATER

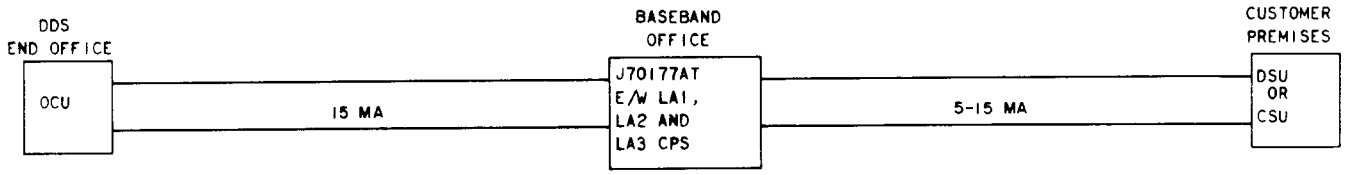
OPTION	DESCRIPTION	LIST 1 REPEATER SHELF		LIST 2 REPEATER SHELF		
		CENTRAL OFFICE BATTERY		CENTRAL OFFICE BATTERY		
		−48V	+130V	−130V	−48V	+130V
X	Provides power to 56-kb/s repeater and 5- to 15-mA simplex current to station loop or next CO repeater.	230 mA	0 mA	0 mA	250 mA	0 mA
Y	Provides power to 56-kb/s repeater and 115-mA simplex current to a OP repeater.	400 mA	130 mA	130 mA	420 mA	130 mA
Z	Provides 115-mA simplex current to an OP repeater.	160 mA	130 mA	130 mA	180 mA	130 mA

baseband office. In no case will more than two repeaters be used in tandem.

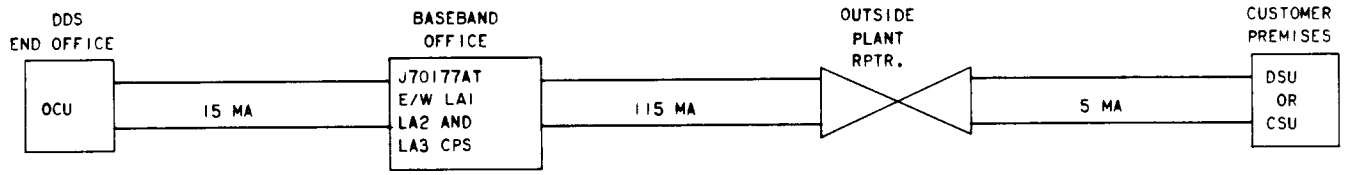
1.09 In some cases only an OP repeater is needed and the CO repeater shelf need only supply power to the OP repeater. Figure 2d shows an OP 56-kb/s loop repeater obtaining power from a repeater shelf mounted in a CO. Only the LA2 circuit pack (CP) is required and should be installed in the shelf to supply power.

1.10 In some cases two OP repeaters are needed and a CO repeater shelf is required for each of the OP repeaters to supply power. Figure 2e shows two OP repeaters in tandem.

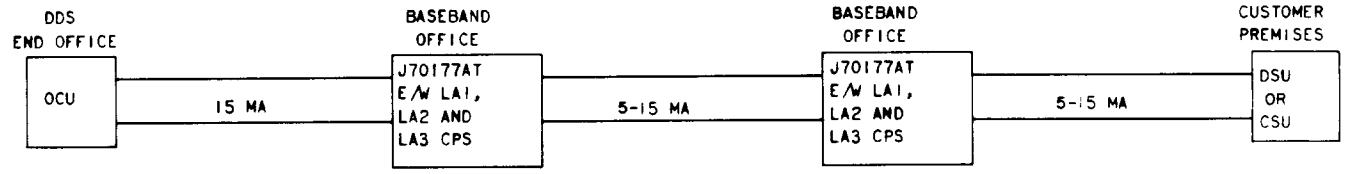
1.11 The last possible case would require an OP repeater between the DDS end office and the baseband office. Figure 2f shows an OP repeater in tandem with a CO repeater.



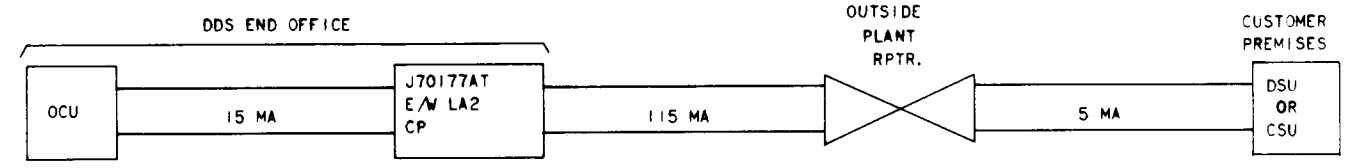
A. CENTRAL OFFICE DIGITAL 56 kb/s REPEATER



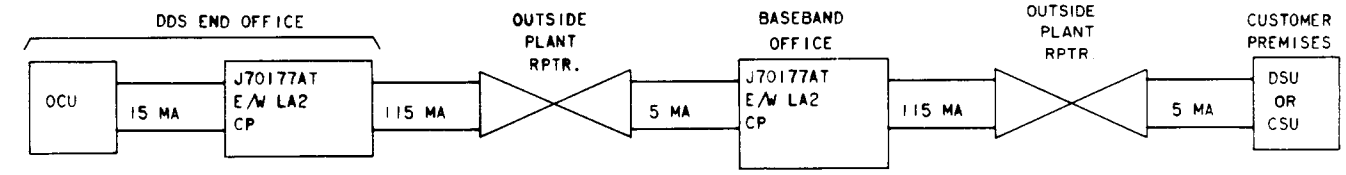
B. CENTRAL OFFICE DIGITAL 56 kb/s REPEATER IN TANDEM WITH AN OUTSIDE PLANT REPEATER



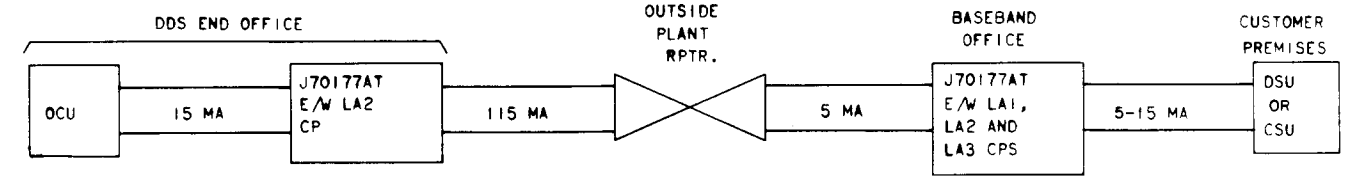
C. CENTRAL OFFICE DIGITAL 56 kb/s REPEATER IN TANDEM WITH ANOTHER CENTRAL OFFICE REPEATER



D. OUTSIDE PLANT 56 kb/s LOOP REPEATER POWER OBTAINED FROM BASEBAND OFFICE OR DDS END OFFICE



E. OUTSIDE PLANT 56 kb/s LOOP REPEATER IN TANDEM WITH ANOTHER OUTSIDE PLANT LOOP REPEATER



F. OUTSIDE PLANT 56 kb/s LOOP REPEATER IN TANDEM WITH A CENTRAL OFFICE REPEATER

NOTE: SIMPLEX DC CURRENTS SHOWN ARE APPROXIMATE.

Fig. 2—56-kb/s Repeater Arrangements

1.12 The digital 56-kb/s repeater (CO configuration) is shelf mounted as shown in Fig. 3. It consists of the following units:

(1) Amplifier and data regenerator (LA1 CP)

(2) Input and output circuitry (LA2 CP)

(3) Looping logic, sync, and clock recovery circuitry (LA3 CP)

(4) Current regulators and alarm relay [CP1 CP (ED-73459-01) mounted on rear of shelf] for list 1 repeater shelf

(5) ▶Current regulators, automatic bypass, and alarm relay [CP2 CP (ED-73601-30) mounted on rear of the shelf] for list 2 repeater shelf◀

(6) Suitable hardware for rack mounting the shelf in a 23-inch miscellaneous bay.

1.13 The 56-kb/s loop repeater (OP configuration) is housed in the 468F apparatus case as shown in Fig. 4. It consists of the following units:

(1) Amplifier and data regenerator (LA4 CP)

(2) Input and output circuitry (LA5 CP)

(3) Looping logic, sync, and clock recovery circuitry (LA6 CP)

(4) Primary lightning and surge protection devices (460A electron tubes)

(5) An order wire terminal is also available on an optional basis (parts-shipped-loose item)

(6) Simplex current filter and sealing current distributor (NA1 CP mounted in the repeater housing)

(7) A 31A connector block for cable acceptance testing and fault locating on the 4-wire circuit and order wire pair.

2. PHYSICAL DESCRIPTION

A. Central Office Repeater

2.01 The 56-kb/s CO repeater operates in a CO or equivalent environment and functions in an ambient temperature range of 35 to 120°F and a relative humidity not exceeding 95 percent.

2.02 The CO repeater consists of a shop-wired sheet metal shelf equipped with current regulators, an alarm relay, ▶automatic bypass circuitry (if list 2 repeater),◀ and test jacks. The shelf is 21 inches wide, 10.625 inches deep ▶for list 1 and 11.625 inches deep for list 2,◀ and occupies 3 inches of vertical mounting space. It is arranged to mount on a 23-inch relay rack in a miscellaneous bay, and weighs approximately ▶7.5 pounds for list 1 and approximately 9 pounds for list 2. The CPs weigh a total of 4 pounds.◀

▶Do not mount the top of the CO repeater shelf lower than 36 inches from the floor as the test and pin jacks on the faceplate may be obscured

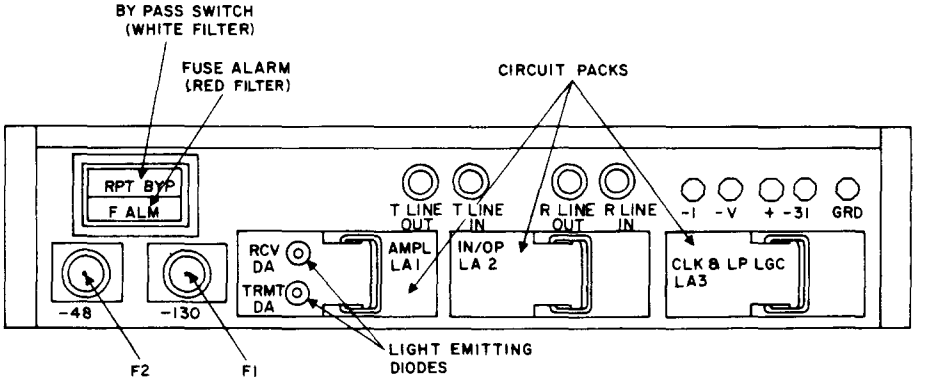


Fig. 3—▶Central Office Configuration of 56-kb/s Repeater—List 2◀

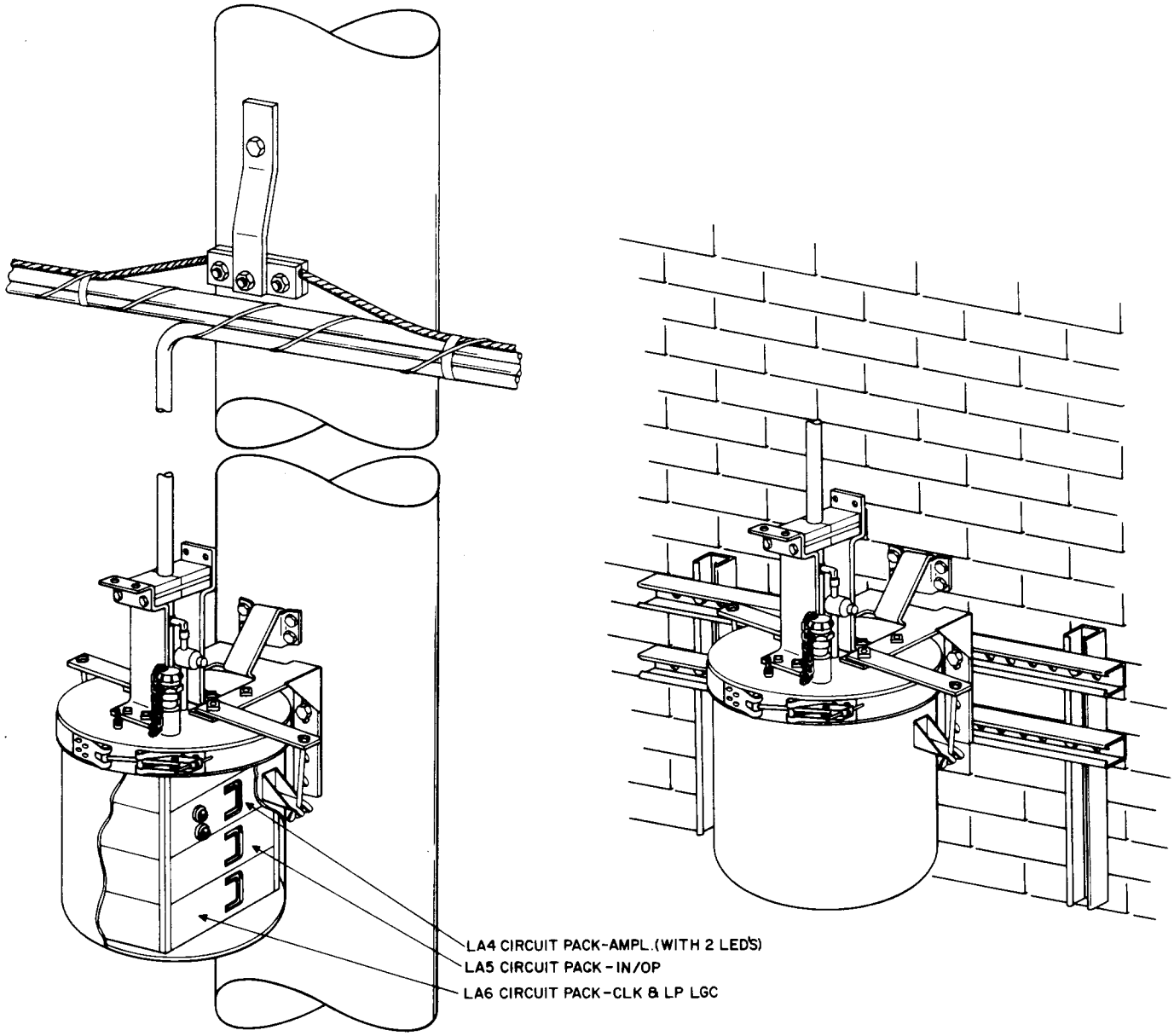


Fig. 4—Outside Plant Repeater

from view when the door is in its open position.

2.03 The mounting shelf accepts three LA-coded plug-in CPs, each of which is approximately 7.75 inches long, 5.2 inches wide, and 1.65 inches high.

2.04 CP 1 is a printed wiring board mounted on the rear of the list 1 CO repeater. It is approximately 1.9 inches wide by 13 inches long and regulates the current supplied by the -48 and +130 Vdc supplies. CP 1 provides the necessary CO fuse alarm circuitry.

2.05. CP 2 is a printed wiring board which is connectorized and mounted on the rear of the list 2 CO repeater. It is approximately 2.7 inches wide by 14.8 inches long. CP 2 regulates the current supplied by the -130V, -48V, and +130 Vdc supplies. CP 2 also provides the automatic bypass function and the necessary CO fuse alarm circuitry.

B. Outside Plant Repeater

2.06 The 56-kb/s loop repeater is suitable for mounting on a pole or in a manhole and functions in an ambient air temperature range of

-40 to +125°F (aerial installations) or -40 to +140°F (manhole installations).

2.07 The repeater circuitry is mounted in a 468F apparatus case under a removable cover which is 11 inches in diameter by 9.5 inches long. The overall dimensions of the case and cover are approximately 17 inches in diameter and 22-1/2 inches long. The case weighs approximately 51 pounds (less CPs and stub cable). The CA1984 stub cable supplied with the 468F apparatus case consists of 40 feet of 10-pair, 24-AWG tinned copper wire which is covered with PVC insulation and enclosed under a lead sheath. The OP repeater is powered from the CO repeater shelf by a simplex current regulator which ranges between 113 and 127 mA as shown in Fig. 2d.

2.08 The 468F apparatus case nest accepts three LA-coded plug-in CPs, each of which is approximately 7.75 inches long, 5.2 inches wide, and 1.65 inches high and is enclosed in a metal cover. The NA1 CP (approximately 5 inches long by 2 inches high) is mounted above the LA-coded CP nest. It provides additional dc current filtering and distributes the sealing current to the loop.

2.09 The installation procedures for mounting a 468F apparatus case on a pole, in a manhole, or on a stub pole are covered in Section 640-251-106.

2.10 The 468F apparatus case is available in two basic versions, 468F1A and 468F1B. For aerial installations, the exterior of the cover is painted white to reflect the sun's rays and is identified by suffix A. For manhole installations, the exterior of the cover is hot-dipped galvanized with flamed-on zinc to protect it against corrosion. Table B lists the case application.

3. FUNCTIONAL DESCRIPTION

3.01 Signaling over the local loop is in the standard DDS modified bipolar format, eg, bipolar pulses with controlled violations. A block diagram of the repeater is shown in Fig. 5.

3.02 The signal received from the OCU is transformer-coupled to the automatic line buildout (ALBO) and equalizer circuit. The ALBO makes the cable appear to the receiver to be at maximum length. The equalizer then provides the receiver gain and frequency compensation required for the maximum length cable. The output signal from the equalizer is dual rail to preserve bipolar integrity.

3.03 The ALBO has a limited range and a fixed buildout pad option has been provided for short loops. When the calculated loss of the local loop, as defined in Section 880-601-115, is less than 10 dB, the short line option is installed by operating the screw switches located on the LA1 CP (CO repeater) or the LA4 CP (OP repeater) in accordance with Table C.

3.04 The dual outputs from the equalizer are sliced to provide logic level signals, logically ANDed together, and then applied to a clock recovery circuit. The clock recovery circuit provides sampling transitions that fall near the center of the incoming data pulses. The outputs of the slicer are also applied to the data sampler circuit. The properly timed output of the data sampler feeds the regenerator circuit which shapes the pulses,

TABLE B

CASE APPLICATIONS

INSTALLATION	METHOD OF PRESSURIZATION	ORDERABLE CODES
Pole e/w aerial cable or Stub pole e/w buried cable	Over feeder cable or Locally from other sources	468F1A
Manholes with non, mildly, or highly corrosive environments	Over feeder cable or Locally from other sources	468F1B

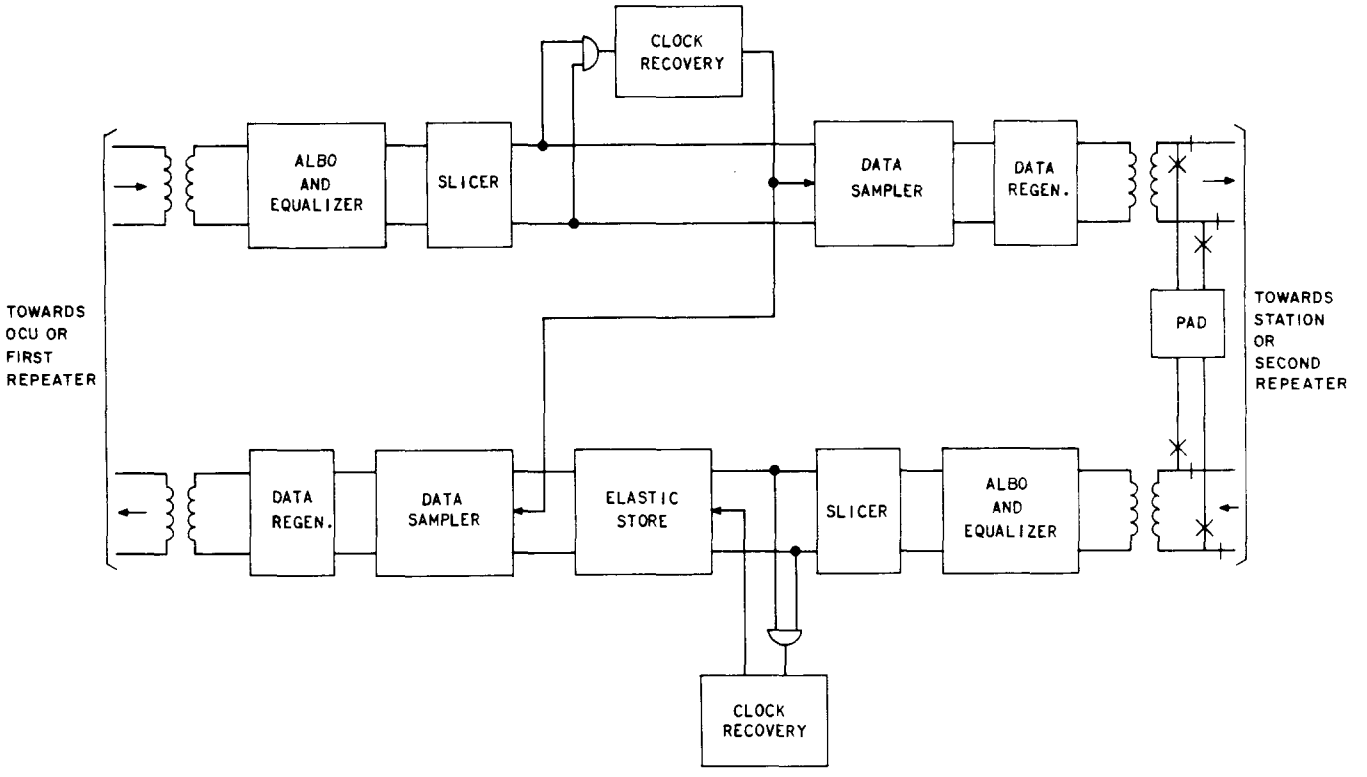


Fig. 5—Digital 56-kb/s Repeater—Block Diagram

♦TABLE C♦

LOOP LOSS COMPENSATION OPTIONS

OPTION FEATURE AND DESCRIPTION		OPTION DESIG.	OPEN SCREW SWITCH	CLOSE SCREW SWITCH
Line Side (Nearest to OCU)	FLBO network removed	V	S1	S2
	FLBO network installed	W	S2	S1
Drop Side (Nearest to Station)	FLBO network installed	U	S4	S3
	FLBO network removed	T	S3	S4

converts the dual rail logic level signals to bipolar format, and couples the signal to the line through an impedance matching transformer.

3.05 Transmission through the repeater in the opposite direction is accomplished in a manner identical to that described in 3.02 and 3.04, except that the signal is retimed to the OCU input signal. This limits the amount of pulse jitter on the data transmitted to the OCU.

3.06 The CO and OP repeaters have a looping capability which allows the data from the OCU to be looped back at the output of the repeater under test to aid in fault sectionalization. The looping is done remotely from the serving test

center (STC) ▶or from KS test sets at OCU locations◀ as described in Section 314-410-510.

3.07 The loopback test of the repeater is initiated by a current reversal in the 4-wire loop between the OCU and the repeater. When the current reversal is detected (by the looping logic circuit), the repeater is looped at its output and current reversed to the following repeater or DSU. Test bytes transmitted through the OCU are received by the looped repeater and returned upstream for verification.

3.08 When the test is satisfactorily completed, the looping logic receives the all 1s test code (an all 1s byte interleaved with the control byte). The looping logic detects the all 1s code and unloops the repeater but still maintains the loop current reversal. Restoration of current polarity resets the looping logic and returns all repeaters in the loop to normal operating mode.

3.09 Four jacks located on the CO repeater shelf give direct access to the loops while breaking the connection to the repeater. There are also pin jacks on the CO repeater which allow checking of the dc simplex loop current and dc power of the repeater itself. On the OP repeater, the loops terminate on a terminal strip which allows access for testing. The CO repeater has a fuse alarm which signals the CO personnel when a fuse has blown.

3.10 Both types of repeaters also have a bypass feature which removes the repeater circuitry from the loop to allow dc testing of the loop all the way from the OCU to the station. The bypass in the CO repeater is accomplished by either operating a switch located on the front of the repeater ▶or by removing the loop current to the input of the repeater (list 2 repeaters only)◀ . The bypass in the OP repeater is accomplished remotely by operating the bypass switch on the CO power shelf ▶or by removing loop current to the input of the CO powering shelf.◀ These procedures are described in Sections 314-410-310 and -510.

3.11 Bypassing the repeater illuminates the bypass lamp and connects the incoming pairs directly to the outgoing pairs with only a small (about 9 ohms) lightning protection resistor left in the circuit. Bypassing the OP repeater results in the incoming pairs being connected to the outgoing pairs with a 2.87K-ohm resistor in each of the four legs of the connection.

4. REFERENCES

4.01 The following documents pertain to the 56-kb/s repeater.

NUMBER	TITLE
SD- & CD-73109-01	Digital Data System—Central Office—Digital 56-kb/s Repeater —Circuit
SD- & CD-1D257-01	Digital Data System—Station— 56-kb/s Loop Repeater— Circuit

SECTION	TITLE
314-410-310	Digital Data System—Local Loop—Maintenance Procedures
314-410-510	Digital Data System—Local Loop—Tests and Requirements
314-900-100	Digital Data System—Private Line Service— Overall Description
314-900-300	Digital Data System—Private Line Service—Maintenance
314-901-200	Digital Data System—Point-to-Point Circuit—Turn-up Procedures
314-901-300	Digital Data System—Serving Test Center— Two-Point Private Line Circuit— Maintenance Procedures
314-901-301	Digital Data System—Serving Test Center—Multipoint Circuit—Maintenance Procedures
314-901-500	Digital Data System—Serving Test Center—Two-Point Private Line Circuit—Test Procedures
314-901-501	Digital Data System—Serving Test Center—Multipoint Circuit—Test Procedures
314-920-300	Digital Data System—Digital 56-kb/s Repeater— Maintenance

SECTION	TITLE
314-920-500	Digital Data System—Digital 56-kb/s Repeater— Test Procedures
640-251-106	Digital Data System—468F-Type Apparatus Case—Description and Installation
640-251-107	Digital Data System—468F-Type Apparatus Case—Splicing, Maintenance, and Testing
807-610-191	Performance Requirements for Digital Data System Digital 56-kb/s Repeater
880-601-100	Private Line Transmission Plan and System Objectives
880-601-115	Digital Data System—Local Loop—Engineering Guidelines
880-601-120	Digital Data System—Facilities Engineering—Off-Net Extension Arrangements
880-602-102	Network Engineering—Private Line Digital Serving Area Planning
880-603-101	Central Office Engineering—Private Line Office Layout