

**DATA SETS 108D- AND 108E-TYPE
USED WITH TYPE-3 LOW-VOLTAGE HUB ARRANGEMENTS
DESCRIPTION**

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1. GENERAL

1.01 This section covers the physical and functional descriptions of data sets 108D- and 108E-type when either is used in a low-voltage hub in telegraph central offices (COs) or other low-voltage hub locations. For information concerning the application, installation, and maintenance of data sets 108D- or 108E-type when either is used in the type-3 low-voltage hub, refer to the series of sections entitled Type-3 Low-Voltage Hub (312-807-ZZZ).

1.02 This section is reissued to combine information on data set 108E-type with data set 108D information. Due to extensive changes in this section, change arrows have been omitted.

1.03 Data sets 108D- and 108E-type (Fig. 1 and 2) are full-duplex (FDX), frequency-shift-keyed (FSK), serial-transmission data sets which provide low-speed (up to 300 bauds) data transmission over 2-wire or 4-wire private line (PL) voiceband facilities. These data sets may be inserted into a number of data auxiliary sets or data mountings.

1.04 Data sets 108D- and 108E-type are designed to work directly into low-voltage hubs and use transmit and receive frequencies compatible with each other for hub-to-hub operation. Data sets 108D- and 108E-type are also suitable for use in low-voltage hub-to-station arrangements.

1.05 Data sets 108D- and 108E-type have a fixed mode of operation. Transmission from data set 108E is always in the f2 frequency band (2225 Hz for a mark and 2025 Hz for a space), and reception is always in the f1 band (1270 Hz for a mark and 1070 Hz for a space). Transmission from data set 108D is always in the f1 frequency band, and reception is always in the f2 band.

1.06 The data set is designed to connect directly to 4-wire facilities. However, depending on the option installed in the data set, connection may be made to 2-wire or 4-wire facilities.

1.07 Data set 108E-type is very similar to data set 108D-type. They differ in send and receive frequencies and data set restore characteristics. Data set 108E-type restores upon detection of either *marking or spacing carrier*, whereas all other data sets 108-type restore only upon detection of incoming marking carrier.

2. PHYSICAL DESCRIPTION

2.01 Each data set 108D and 108E-type consists of two printed wiring circuit boards mounted together in piggyback fashion (Fig. 3 and 4). Each data set 108D- and 108E-type is approximately 5-1/2 inches high, 7-1/10 inches deep, 1-1/8 inches wide, and weighs approximately 2 pounds.

2.02 Figures 1 and 2 show all items visible on the faceplates of data sets 108D (series 2) and E (series 1), respectively. Three slide switches (S1, S2, and S3) are visible from the front faceplate of the data set; however, the data set must be removed from the data auxiliary set (DAS) in order to change the slide switch settings. Loosen the screw holding the slide in place to slide the switch contact to the proper option as indicated by the tab. After positioning the contact, tighten the screw (see Fig. 1 and 2).

2.03 Data sets 108D (series 3) and E (series 2) use a 3-part, rotary screw switch S1 in

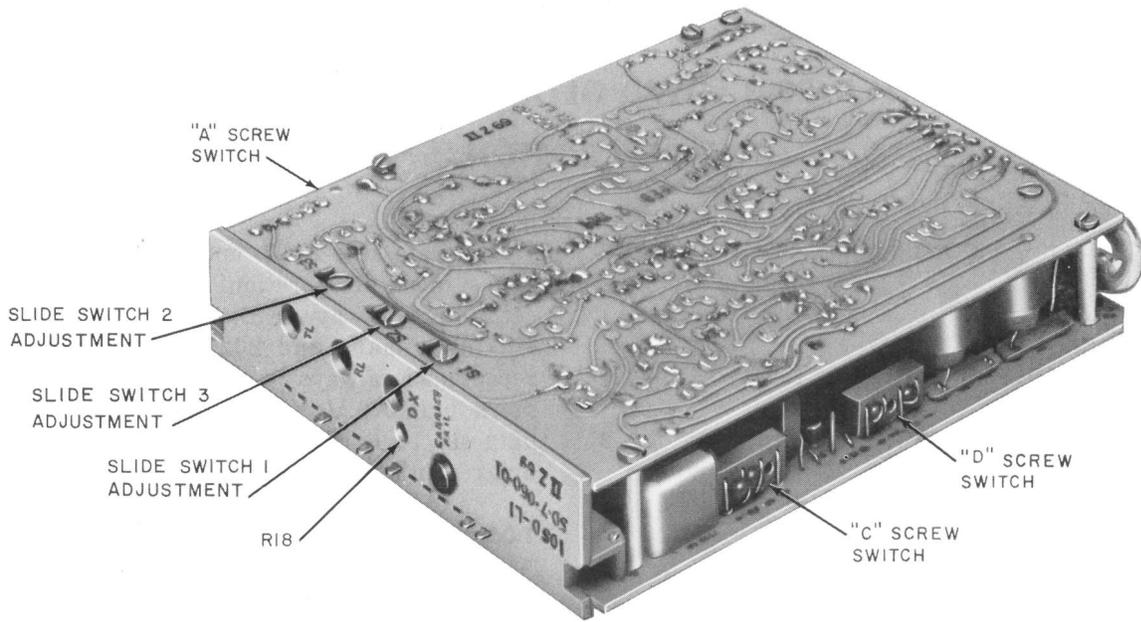


Fig. 1—Data Set 108D-Type (Series 2)

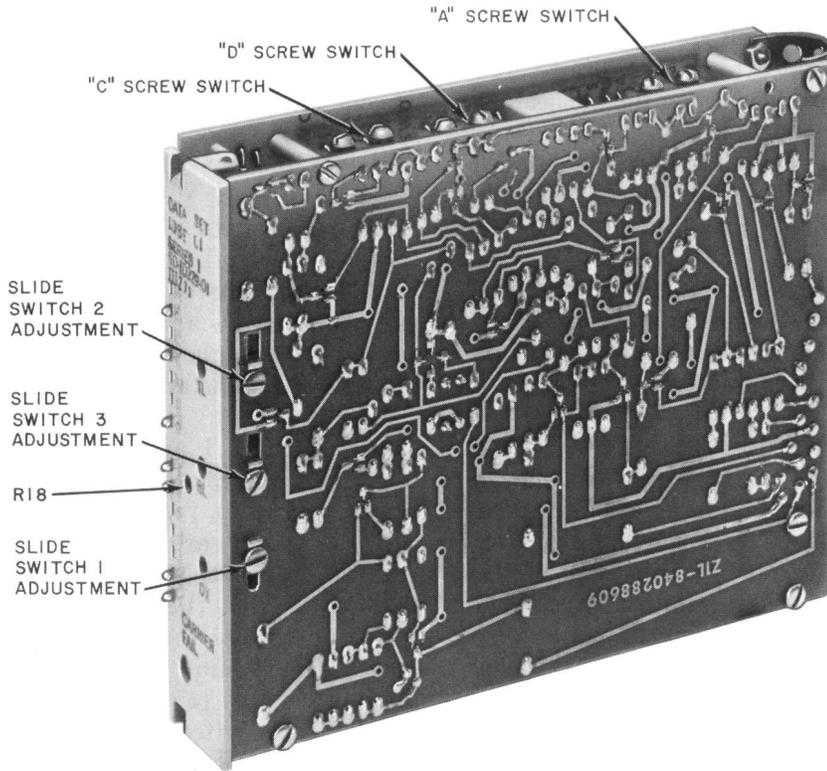


Fig. 2—Data Set 108E-Type (Series 1)

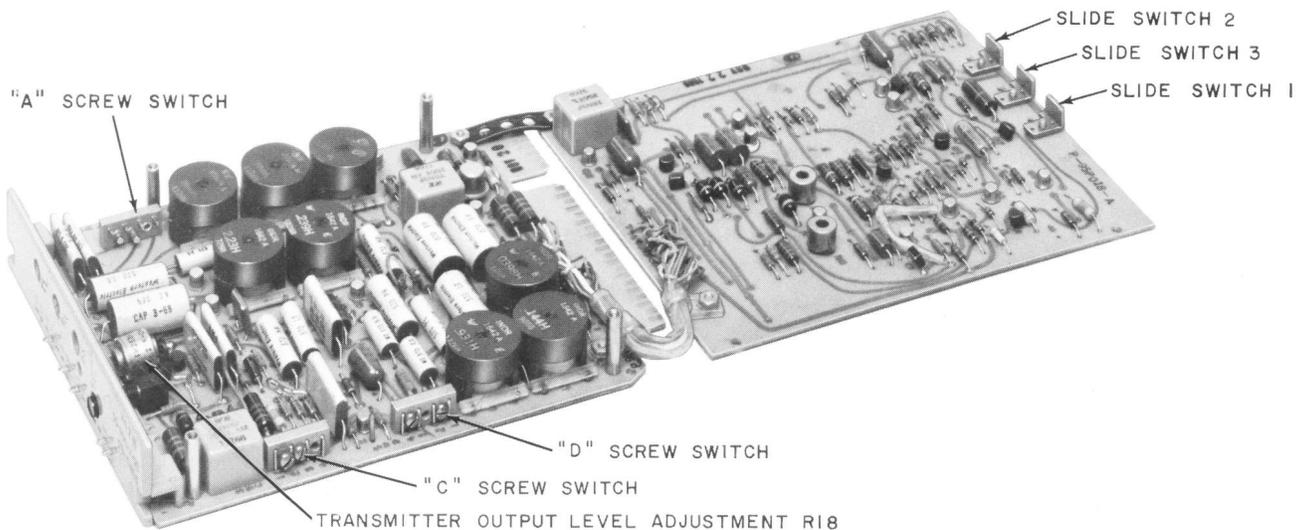


Fig. 3—Data Set 108D-Type (Series 2) Showing Location of Switches

place of the three slide switches. Switch S1 facilitates a change in switch settings *without* removing the data set from the DAS. Switch S1 is divided into three sections: S1A, S1B, and S1C (Fig. 5). To access the switch screws, the hinged protective cover must first be opened by prying it from the end marked with a dot. Each switch section is individually adjusted to one of two positions using a small screwdriver (KS-20193-L1 or equivalent) to *gently* rotate the screw to either the upper or the lower position. The final position of the screw must be such that it, butts up against the spacer and the screwdriver slot is parallel with the spacer.

2.04 The power required for the operation of the data sets is a maximum of 5 watts. The data sets require filtered $+24 \pm 3$ volts and -24 ± 3 volts dc. When the data sets are at a low-voltage hub location, the dc voltages required are supplied by a power source at the hub.

3. FUNCTIONAL DESCRIPTION (Fig. 6)

3.01 In addition to the power and ground leads, leads are provided to interface the data set to the hub. These leads and their purposes are listed below:

(a) Send Lead (SL)—A nominal signal of -10 volts, $+10$ volts, and $+22$ volts from the hub on this lead represents a mark, space, and

double space, respectively. The SL lead has an input impedance of 13,300 ohms. This permits up to 20 legs to be connected to the hub.

(b) Receive Lead (RL)—A current of 10 mA for a space and 0 mA for a mark is supplied to the hub on this lead.

(c) Hit Indicator Lead (TL)—This lead has a voltage output more negative than -6 volts for a space and more positive than $+6$ volts for a mark as an indication of the signal received from the transmission facility.

(d) Receive Supervision (RS)—This lead (card terminal 7 on data set) connects to the EIA interface lead CF (Received Line Signal Detector Lead). When a carrier is being received from the line, the RS lead will be at a positive potential and the CF lamp will be extinguished. When a loss of carrier is detected by the data set, the RS lead will go to a negative potential and the CF lamp will light.

(e) Data Carrier Detector Lead (CF1)— $+12$ volts is provided on this lead to the hub when a loss of received carrier is detected. The $+12$ volts on CF1 leads from other data set legs is multiplied by the hub and then delivered to a remote alarm location.

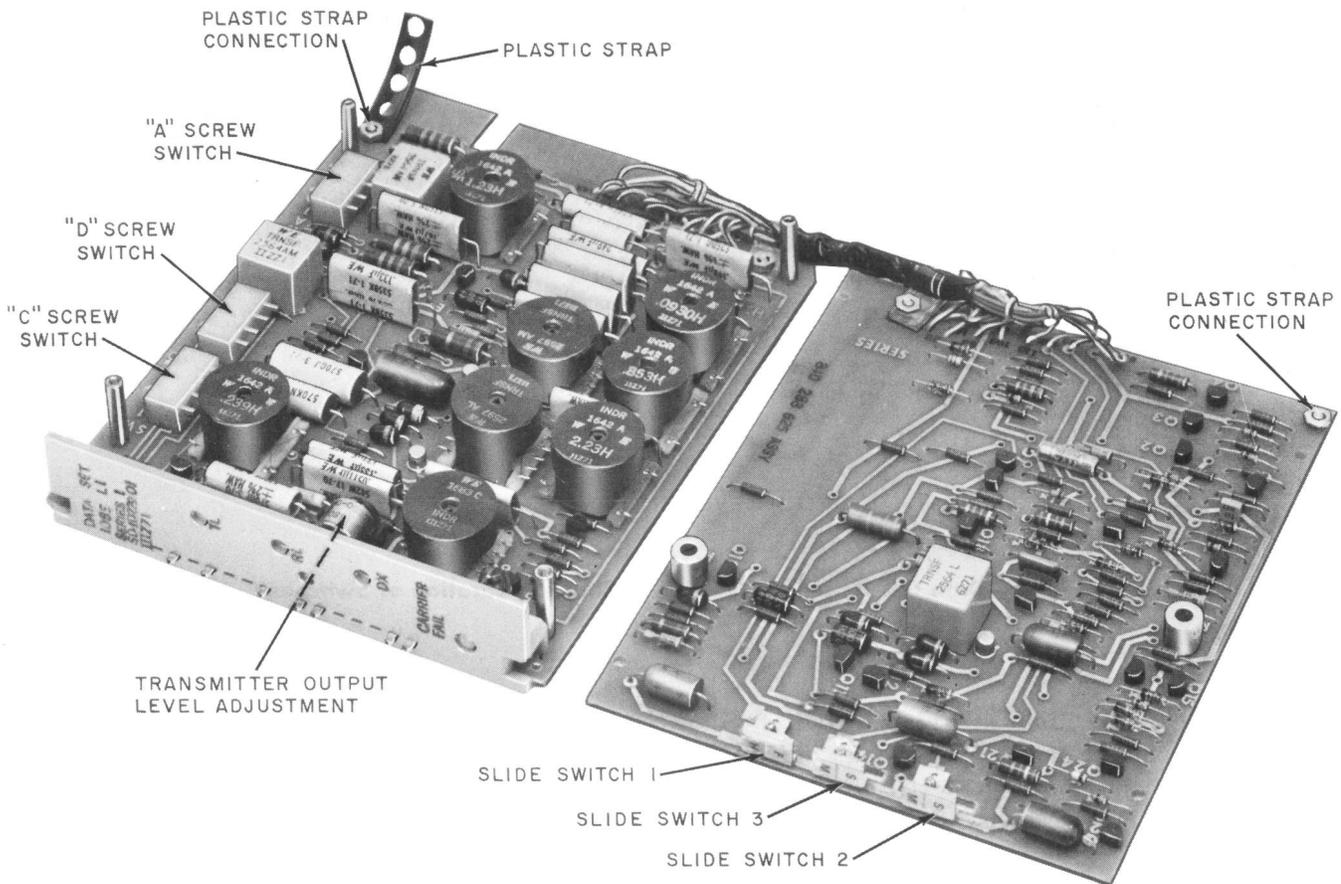


Fig. 4—Data Set 108E-Type (Series 1) Showing Location of Switches

3.02 The data sets convert ac signals received from the PL facilities into low-level dc voltages and delivers them on the SL lead to the hub circuit. Conversely, the data sets convert low-level dc voltages received from the hub on the RL lead into voice frequency ac signals and transmits them onto the PL facilities. Since the dc signals are transmitted in opposite directions and occupy different frequency bands, the line can function as if it were two separate one-way channels.

Transmitter Circuit

3.03 Each data set transmitter circuit consists of an oscillator (frequency-shift keyer), sending low-pass filter (data set 108D) or sending high-pass filter (data set 108E), sending buffer amplifier, and the line transformer T2.

3.04 When a mark signal is applied to the SL lead, the oscillator (frequency-shift keyer)

has a portion of an inductor connected into the tank circuit of the oscillator. This results in an oscillator output of 1270 Hz (mark) for data set 108D or 2225 Hz (mark) for data set 108E. The application of a spacing signal to the SL lead causes the complete inductor to be connected into the tank circuit of the oscillator. This shifts the output of the oscillator to 1070 Hz (space) with a data set 108D or 2025 Hz (space) for data set 108E.

3.05 The output of the oscillator is fed to the sending filter. The filter attenuates the unwanted frequencies in the receive band, thereby reducing the balance requirements of the hybrid transformer for 2-wire operation of either data set.

3.06 The sending buffer amplifier is used to deliver the proper power level to transmit onto the PL facilities. The output of the sending buffer amplifier is adjusted by varying R18 (see

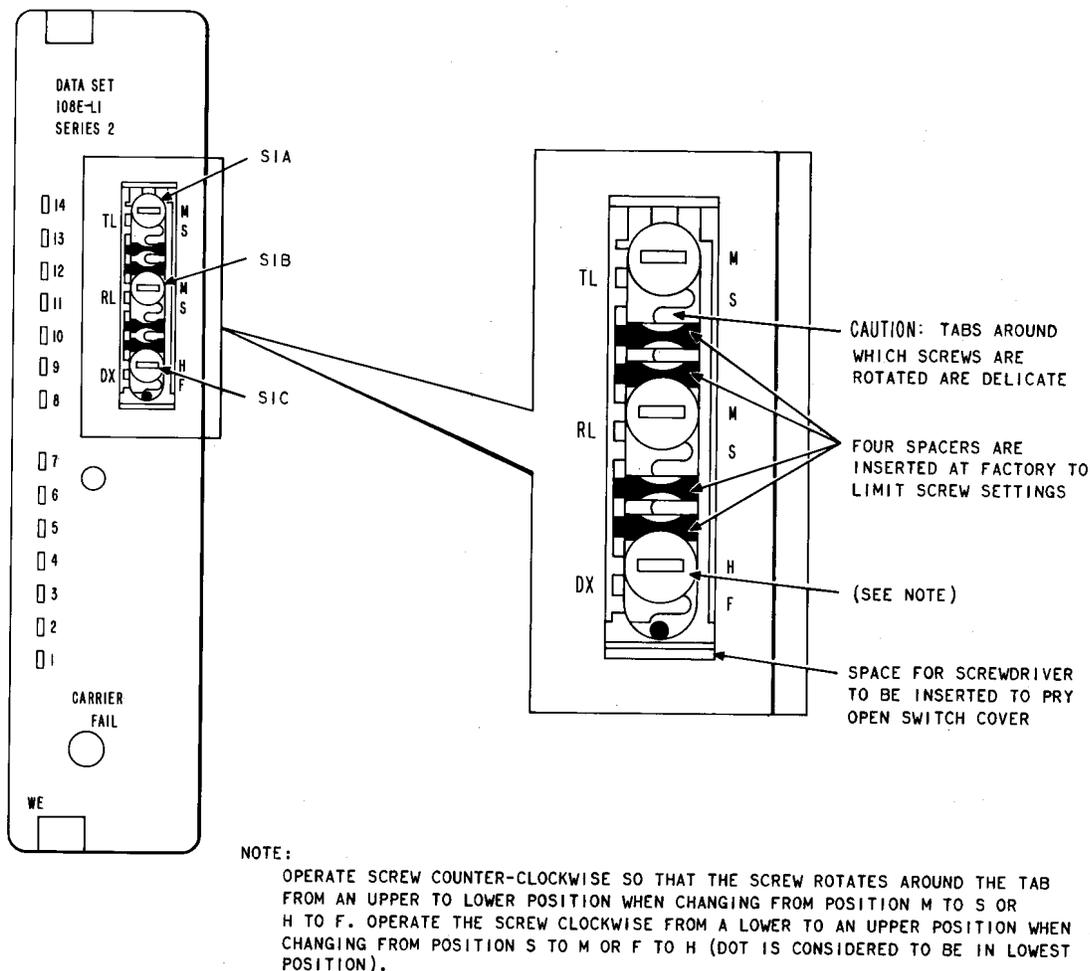


Fig. 5—Data Set 108D (Series 3) or 108E (Series 2) Rotary Screw Switch S1

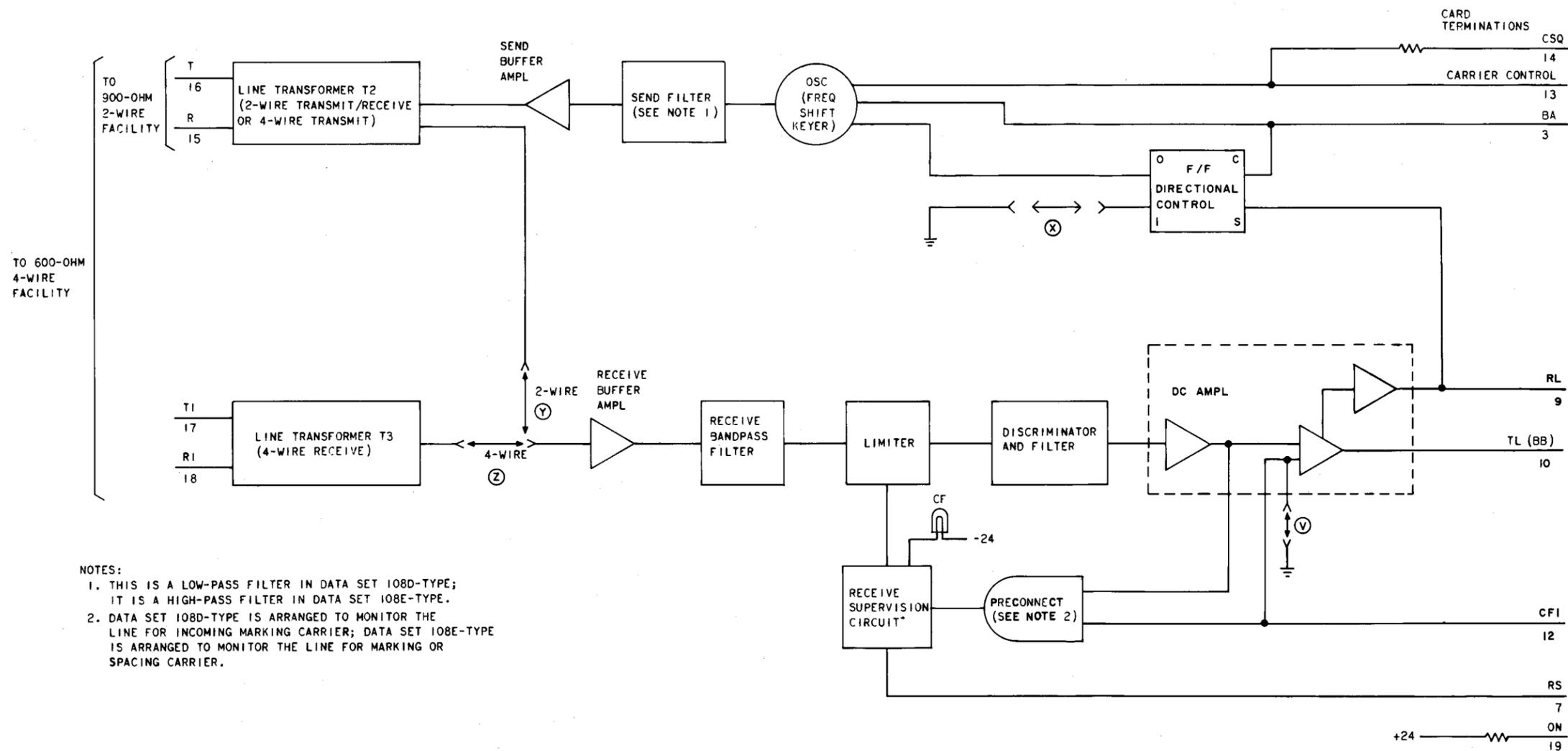
Figures 1 and 2). In addition, the amplifier isolates the PL facilities and provides a suitable termination for the sending high-pass filter (data set 108E) or low-pass filter (data set 108D).

3.07 The T2 line transformer can be arranged for connection to either a 600-ohm 4-wire line or a 900-ohm 2-wire line. The transformer is arranged as a hybrid for 2-wire operation. For the settings of the C and D screw switches necessary for selection of the proper hybrid network, refer to Tables A and B. A compromise switching arrangement of the hybrid network for most applications is indicated in Tables A and B under typical loop impedance for 900 ohms.

Receiver Circuit

3.08 The receiver circuit consists of the T3 (4-wire operation) or T2 (2-wire operation) line transformer, receiving buffer amplifier, receiving bandpass filter, limiter, discriminator, and dc amplifier.

3.09 Depending on the type of connection (2-wire or 4-wire), line transformer T3 (4-wire) or T2 (2-wire) will be connected to the receiving buffer amplifier. This amplifier isolates the line from variations in impedance of the bandpass filter which follows this amplifier.



- NOTES:
1. THIS IS A LOW-PASS FILTER IN DATA SET 108D-TYPE; IT IS A HIGH-PASS FILTER IN DATA SET 108E-TYPE.
 2. DATA SET 108D-TYPE IS ARRANGED TO MONITOR THE LINE FOR INCOMING MARKING CARRIER; DATA SET 108E-TYPE IS ARRANGED TO MONITOR THE LINE FOR MARKING OR SPACING CARRIER.

Fig. 6—Block Diagram of Data Sets 108D- and 108E-Type

3.10 The receiving filter has a bandpass of 1170 \pm 150 Hz (data set 108E) or 2125 \pm 150 Hz (data set 108D). This serves to reduce interference by attenuating out-of-band line noise. This filter also reduces the balance requirements of the hybrid transformer in 2-wire arrangements by providing discrimination against locally transmitted signals in the f_1 band (data set 108D) or in the f_2 band (data set 108E).

3.11 The output of the receiving bandpass filter is connected to the limiter. The limiter amplifies the incoming frequencies and limits the output to provide a constant amplitude signal to the discriminator. The limiter is transformer-coupled to the discriminator. The discriminator converts the carrier frequency variations into dc voltage variations and delivers them to the dc amplifier. The limiter is also transformer-coupled to the receive supervision circuit.

3.12 The dc amplifier provides impedance matching and amplifies the output from the discriminator. An incoming marking frequency switches the output stage of the dc amplifier off, thereby causing a high impedance to be applied to the RL lead. A high impedance on the RL lead prevents any current flow into the RL hub circuitry which represents a mark. An incoming space frequency switches the output stage of the dc amplifier on, causing a 10-mA current to flow into the RL hub circuitry, thereby representing a space to the hub.

3.13 Since the dc voltage presented to the receive supervision circuit is proportional to the limiter output signal, it can be used to determine when the input signal level drops below the minimum operating level of -37 dBm for 4-wire operation or -34 dBm for 2-wire operation. When the receive carrier level drops 7 dBm below these values for a period of 110 to 300 milliseconds, the receive supervision circuit is turned off. This places a negative voltage on the RS lead, lights the CF lamp, activates the CF1 lead, and causes the RL and TL leads to be clamped either marking or spacing according to which option is installed in the set. In addition, the directional control circuit will be disabled in HDX hub arrangements and the data set will enter the preconnect mode.

Caution: *In hub-to-station systems using the space hold options at the hub, the "carrier squelch on carrier fail" option can be provided only with data set 108E*

(which also reenables on a space) at the station.

Preconnect Mode

3.14 In the preconnect mode, data set 108E is arranged to monitor the line for incoming marking or spacing carrier. Data set 108D can only monitor for incoming marking carrier. When the marking or spacing carrier is received for a sufficient period of time (200 to 600 milliseconds to ensure that the data set is not enabled on a momentary noise burst), the receive supervision circuit will turn on. This places a positive voltage on the RS lead, extinguishes the CF lamp, and unclamps the RL and TL leads. The directional control circuit is also enabled at HDX hub arrangements. In the preconnect mode, the slicer level is shifted toward the marking frequency. Thus, during the 200 and 600 ms that the carrier is being received for reinitialization of the data set, the signal from the PL facilities must be in either the upper marking or lower spacing band with data set 108E or in the upper marking band with data set 108D.

4. OPTIONS

Two-Wire/Four-Wire Option

4.01 Three screw switches (A, C, and D) are provided to implement 2-wire or 4-wire service (see Table C). For 4-wire connection, option Z must be installed in the data set. The sending loop facility must be connected to the terminals mating with card terminals 16 and 15 (T and R). The receiving loop facility must be connected to the terminals mating with card terminals 17 and 18, (T1 and R1). The 4-wire option requires that all of the C screw switches be opened. For 2-wire connection, option Y must be installed in the data set. The loop facility must be connected to the terminals mating with card terminals 16 and 15 (T and R) and the proper hybrid network selection installed. Options Y and Z are under control of the A screw switch (Fig. 2).

Data Set Faceplate Options

4.02 In addition to the screw switch options, the data set is provided with several slide switch or rotary screw options (refer to 2.03). The option designation, function of the options, and switch setting for each option are given in Table D.

TABLE A
DATA SET 108D
HYBRID NETWORK SWITCHING FOR 2-WIRE APPLICATION

OPTION	TYPICAL LOOP FACILITY	TYPICAL 2-WIRE LOOP IMPEDANCE MEASURED AT 1170 Hz	SCREW SWITCH C		SCREW SWITCH D	
			OPEN	CLOSE	OPEN	CLOSE
H	26 NL (HC)	* 900	1-2, 3-4	2-3		3-4
G	24 NL (HC)	700	1-2, 2-3	3-4	3-4	
F	22 NL (HC)	550	2-3	1-2, 3-4	3-4	
E	19 NL (HC)	400	1-2, 2-3	3-4		3-4
B	16 NL (HC)	280	2-3	1-2, 3-4		3-4
A	26 H88 (HC)	1180	1-2, 3-4	2-3	3-4	
A	24 H88 (HC)	1080	1-2, 3-4	2-3	3-4	
A	22 H88 (HC)	1060	1-2, 3-4	2-3	3-4	
A	19 H88 (HC)	1030	1-2, 3-4	2-3	3-4	
A	16 H88 (HC)	1130	1-2, 3-4	2-3	3-4	

NL—Nonloaded (HC)—High Capacity

* Compromise hybrid network switching

Receiving Level Adjustment

4.03 The gain of the receiving buffer amplifier is adjustable to allow compensations to be made for differences in receive level. If the receive carrier level is greater than -30 dBm (-29 , -28 , etc) the 6-dB reduction of gain should be installed (see Table E).

Transmitting Level Adjustment

4.04 The transmission level of the data set is adjustable to allow compensations to be made for differences in loop loss. Potentiometer R18 (Fig. 1 and 2) adjusts the data set output power level through a range of -6 to -26 dBm for data set 108D or 0 to -26 dBm for data set

108E by continuous adjustment into a 600-ohm loop, 4-wire circuit or a 900-ohm loop, 2-wire circuit.

Directional Control

4.05 The data set is provided with a directional control circuit which prevents signal loop-around when the data set is used for HDX hub operation. The directional control circuit is disabled whenever the hub places a double space on the data set send lead and option W is used (see Table D).

4.06 All options available with data sets 108D and 108E are covered in Tables A through E. The implementation of the desired options is given in the applicable table.

TABLE B
DATA SET 108E
HYBRID NETWORK SWITCHING FOR 2-WIRE APPLICATION

OPTION	TYPICAL LOOP FACILITY	TYPICAL 2-WIRE LOOP IMPEDANCE MEASURED AT 2125 Hz	SCREW SWITCH C		SCREW SWITCH D	
			OPEN	CLOSE	OPEN	CLOSE
H	—	* 900	1-2, 3-4	2-3		3-4
G	26 NL (HC)	650	2-3	1-2, 3-4	3-4	
F	24 NL (HC)	500	2-3, 3-4	1-2		3-4
E	22 NL (HC)	400	1-2, 2-3	3-4		3-4
B	19 NL (HC)	280	2-3	1-2, 3-4		3-4
A	16 NL (HC)	200	2-3	1-2, 3-4		3-4
ZA	26 H88 (HC)	1300	1-2, 3-4	2-3	3-4	
ZA	24 H88 (HC)	1260	1-2, 3-4	2-3	3-4	
ZA	22 H88 (HC)	1250	1-2, 3-4	2-3	3-4	
ZA	19 H88 (HC)	1240	1-2, 3-4	2-3	3-4	
ZA	16 H88 (HC)	1340	1-2, 3-4	2-3	3-4	

NL—Nonloaded (HC)—High Capacity

* Compromise hybrid network switching

TABLE C
2-WIRE/4-WIRE OPTIONS IN DATA SET

OPTION	FUNCTION	"A" SCREW SWITCH SETTING		"C" SCREW SWITCH SETTING
		CLOSE (CW)	OPEN (CCW)	
Z	4-Wire	1-2, 3-4	2-3	1-2, 2-3, 3-4 All Open (CCW)
Y	2-Wire	2-3	1-2, 3-4	Refer to Table A or B

TABLE D
DATA SET FACEPLATE OPTIONS

OPTION DESIGNATION	FUNCTION OF OPTION	*SLIDE SWITCH		†ROTARY SWITCH S1		FACEPLATE DESIGNATION	
		SWITCH	SWITCH POSITION	SWITCH	‡SWITCH POSITION		
X	FDX HUB OPERATION — Disables the directional control circuit of the data set to allow FDX hub operation.	S1	Closed	S1C	Down	DX	F
W	HDX HUB OPERATION — Enables the directional control circuit of the data set to allow HDX hub operation.		Open		Up		H
V	SPACE HOLD ON TL — Enables the data set to provide a spacing condition on hit indicator (TL) lead when a loss of received carrier is detected by the data set.	S2	Closed	S1A	Down	TL	S
U	MARK HOLD ON TL — Enables the data set to provide a marking condition on the TL lead when a loss of received carrier is detected.		Open		Up		M
T	SPACE HOLD ON RL — Enables the data set to provide a spacing condition on the receive (RL) lead when a loss of received carrier is detected.	S3	Closed	S1B	Down	RL	S
S	MARK HOLD ON RL — Enables the data set to provide a marking condition on RL when a loss of received carrier is detected.		Open		Up		M

Note: Options X, U, and S are factory-installed options.

* Data sets 108D (series 2) and 108E (series 1)

† Data sets 108D (series 3) and 108E (series 2)

‡ *Down* refers to position closest to end of switch marked with dot.

Up refers to position farthest from end of switch marked with dot.

TABLE E
SCREW SWITCH D SETTINGS ON THE DATA SET
FOR REDUCTION IN GAIN

OPTION	DB REDUCTION IN GAIN	"D" SCREW SWITCH	
		CLOSED	OPEN
K	6	—	1-2
J	0	1-2	—

5. REFERENCES

5.01 For additional information on the data set 108D- or 108E-type, refer to the following:

		SD-73060-01	(Data Set 108D-Type—Schematic Diagram)
SD-1D229-01	(Data Set 108E-Type—Schematic Diagram)	CD-73060-01	(Data Set 108D-Type—Circuit Description)
CD-1D229-01	(Data Set 108E-Type—Circuit Description)	312-807-ZZZ	(Type-3 Low-Voltage Hub)