

## DATA SETS 108D- AND 108E-TYPES USED IN STATION APPLICATIONS

### DESCRIPTION

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**1.02** Data sets 108D and E (Fig. 1 and 2) are full-duplex (FDX), frequency-shift-keyed (FSK), serial-transmission data sets which provide low-speed (up to 300 baud) 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 and data mountings.

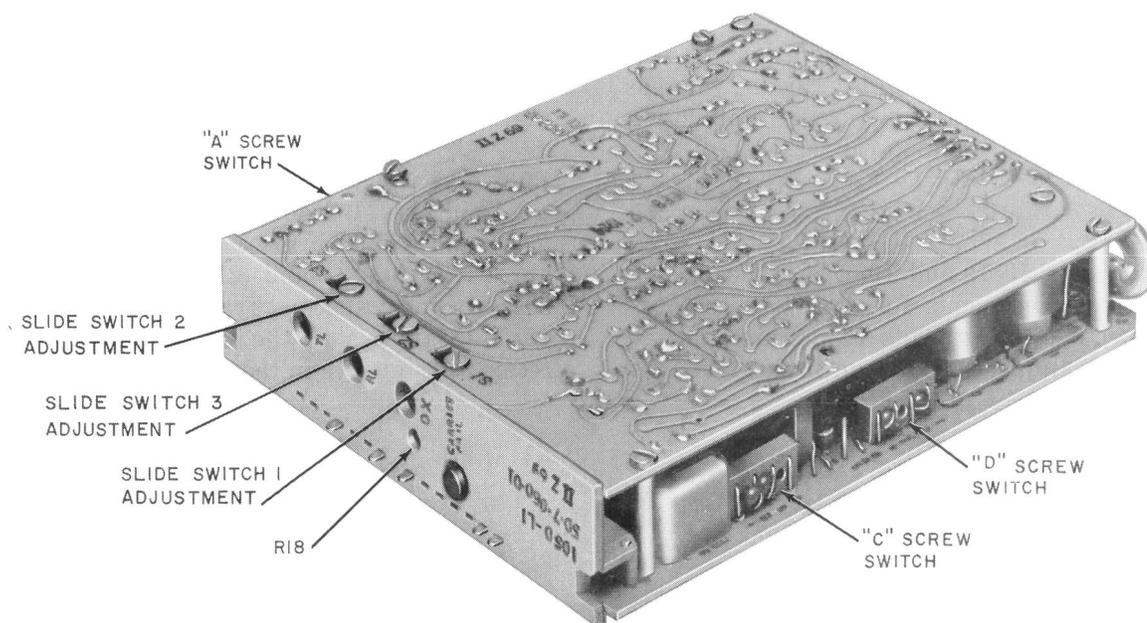
**1.03** Data sets 108D and E are very similar; they differ in send and receive frequencies and data set restore characteristics. Data set 108E send and receive frequencies complement those of data set 108D.

#### 1. GENERAL

**1.01** This section covers the physical and functional description of data sets 108D- and 108E-types used in private line station applications, hereafter referred to as data sets 108D and 108E.



*Data sets 108D and 108E are not designed to handle supervisory line current.*



**Fig. 1—Data Set 108D**

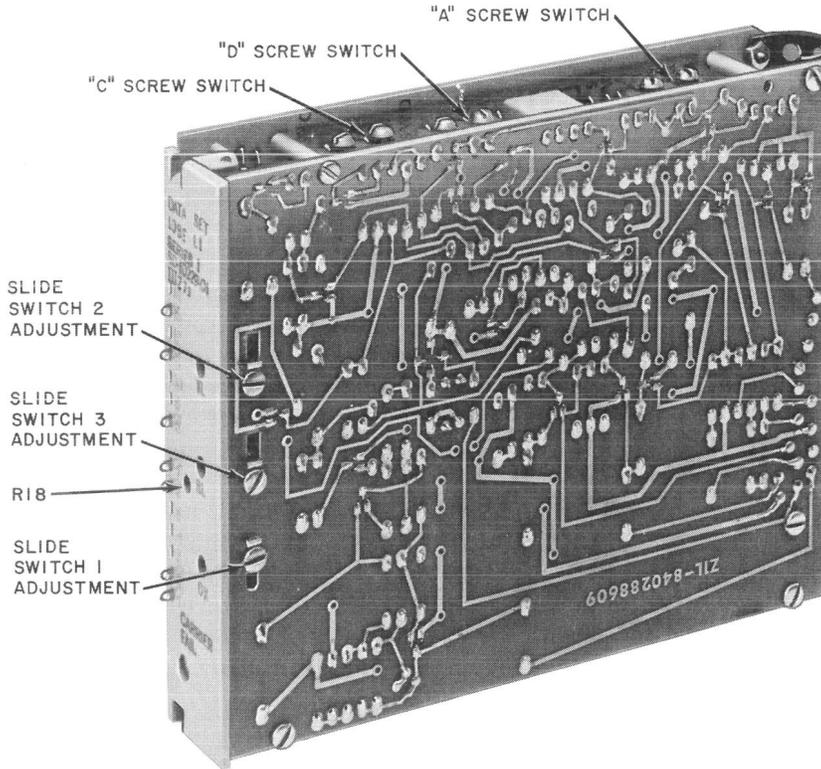


Fig. 2—Data Set 108E

1.04 Data set 108E restores upon detection of either *marking or spacing* carrier, whereas all other data sets 108-type restore only upon detection of incoming marking carrier.

1.05 Data sets 108D and 108E may be used as direct replacements for data sets 108C and 108A, respectively. Data sets 108C and 108A have been rated manufacture discontinued (MD). A

comparison of these data sets and their frequencies, features, and differences is contained in Table A.

1.06 Transmission from data set 108D is always in the f1 frequency band (1270 Hz for a mark and 1070 Hz for a space), and reception is always in the f2 band (2225 Hz for a mark and 2025 Hz for a space). Transmission from data set 108E is always in the f2 frequency band and reception is always in the f1 band.

**TABLE A**  
**DATA SET 108-TYPE – A COMPARISON**

FEATURES		DATA SET 108D	DATA SET 108E	DATA SET 108C	DATA SET 108A
Transmit Level (dBm)		Continuous -6 to -26	Continuous 0 to -26	Continuous 0 to -14	Continuous 0 to -14
Loop Termination		900-ohm 2-wire or 600-ohm 4-wire	900-ohm 2-wire or 600-ohm 4-wire	900-ohm 2-wire	900-ohm 2-wire
Lamp		CF Lamp	CF Lamp	None	None
Carrier Squelch		EIA Voltage or Contact Controlled	EIA Voltage or Contact Controlled	Contact Controlled	Contact Controlled
BB Lead Condition When Loss of Received Carrier Is Detected		Mark or Space	Mark or Space	Mark	Mark
Transmit Frequency	Mark	1270 Hz	2225 Hz	1270 Hz	2225 Hz
	Space	1070 Hz	2025 Hz	1070 Hz	2025 HZ
Receive Frequency	Mark	2225 Hz	1270 Hz	2225 Hz	1270 Hz
	Space	2025 Hz	1070 Hz	2025 Hz	1070 Hz
Signal Required to Restore BB Lead Condition Upon Detection of Carrier		Marking	Marking or Spacing	Marking	Marking
Primary Uses		Station-to-Station Station-to-Hub	Station-to-Station Station-to-Hub	Station-to-Station	Station-to-Station Station-to-Hub

**1.07** The private line circuits may be divided into the following types:

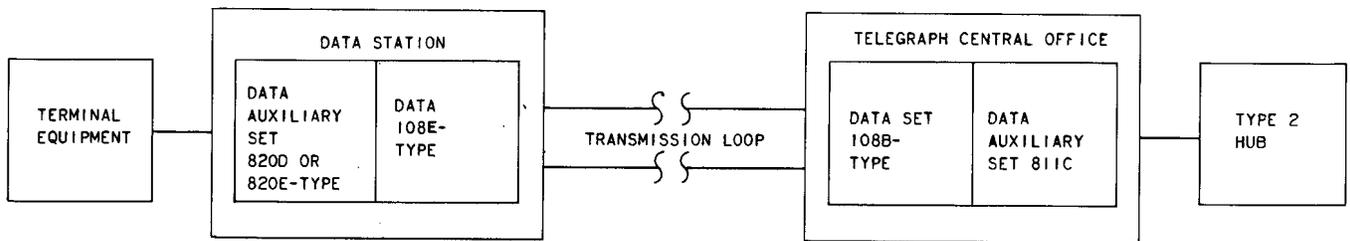
- (a) Station-to-hub circuits
- (b) Station-to-station circuits.

Examples of typical private line station circuit arrangements are shown in Fig. 3.

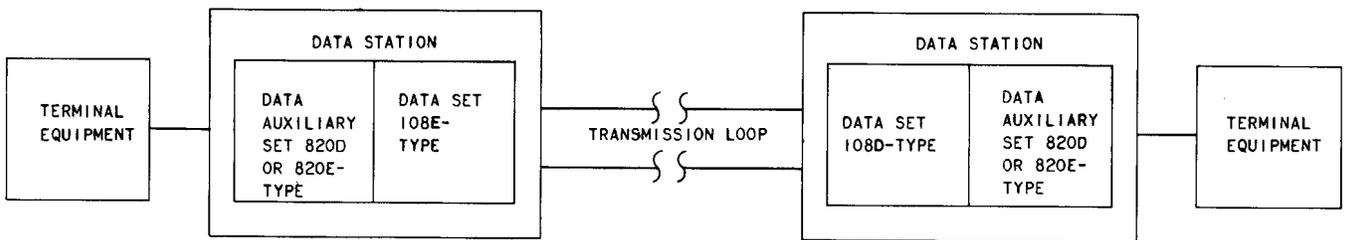
**1.08** For information on data sets 108D and 108E when used in a hubbing arrangement, refer to Section 312-805-100.

**2. PHYSICAL DESCRIPTION**

**2.01** Data sets 108D and 108E each consist of two printed wiring circuit boards mounted together in piggyback fashion (Fig. 4 and 5). The piggyback arrangement provides a narrower faceplate than data set 108A or 108C, and occupies only two-thirds of the space necessary for data set 108A or 108C. Data sets 108D and 108E are each approximately 5-1/2 inches high, 7-2/10 inches deep, 1-1/8 inches wide, and weigh approximately 2 pounds.



A. STATION-TO-HUB OPERATION



B. STATION-TO-STATION OPERATION

TPA 570307

**Fig. 3—Data Set 108-Type Typical Station Circuit Arrangements**

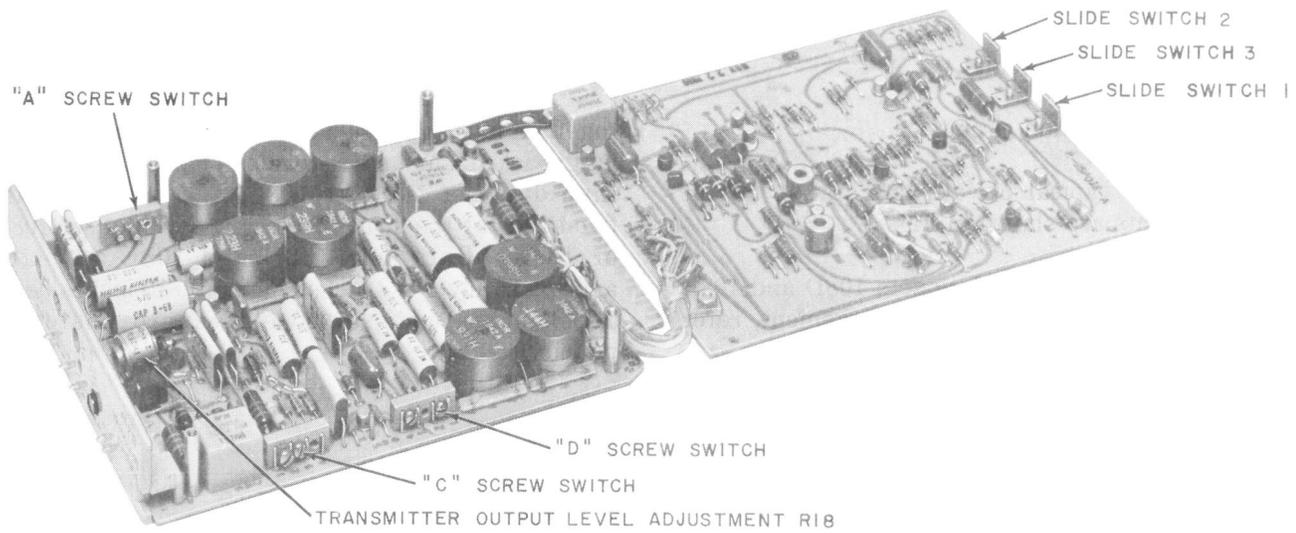


Fig. 4—Data Set 108D Showing Location of Switches

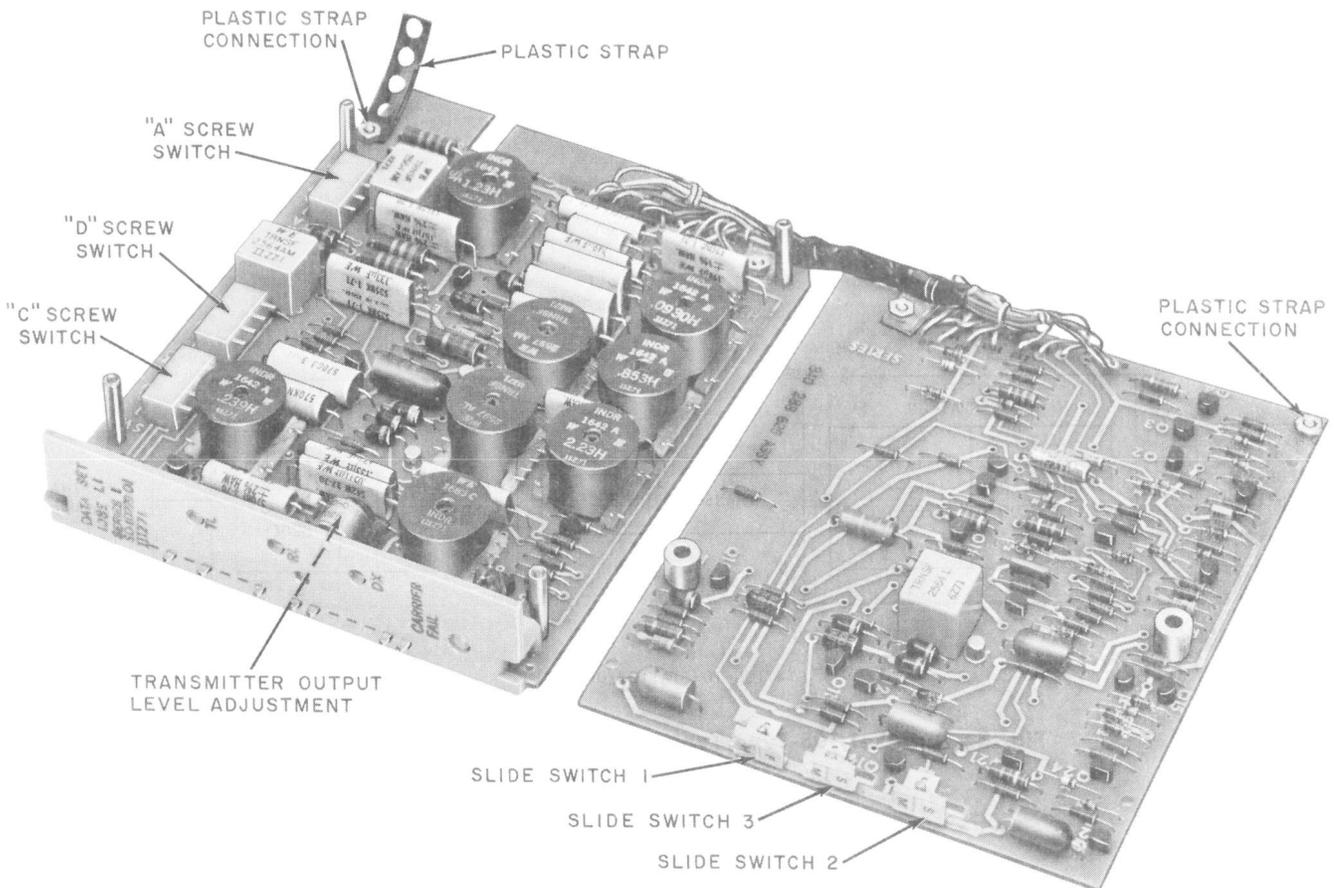


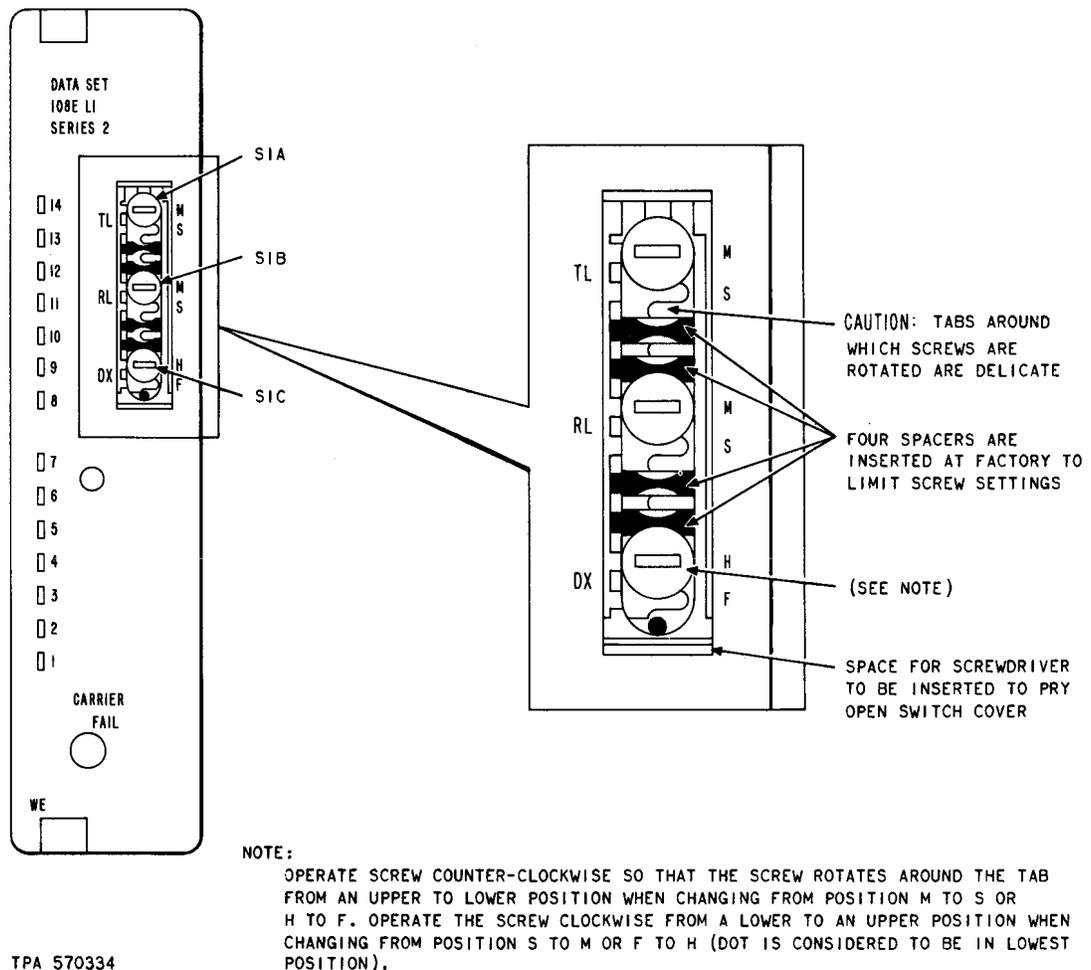
Fig. 5—Data Set 108E Showing Location of Switches

**2.02** Figures 1 and 2 show all items and designations 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 card must be removed from the data auxiliary set in order to change the slide switch settings. The screw holding the slide in place is loosened to slide the switch contact to the proper option as indicated by the tab. After positioning the contact, the screw is tightened (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 place of the three slide switches. Switch S1 facilitates a change in switch settings *without* removing the

data set card from the data auxiliary set. Switch S1 is divided into three sections: A, B, and C (Fig. 6). To access the switch screws, the hinged protective cover must first be pried open 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 either data set is a maximum of 5 watts. The data sets require filtered +24  $\pm$ 3 and -24  $\pm$ 3 volts dc. The dc voltages required are supplied by the associated data auxiliary set or data mounting.



**Fig. 6—Data Set 108D (Series 3) or 108E (Series 2) Rotary Screw Switch S1**

### 3. FUNCTIONAL DESCRIPTION

**3.01** This functional description will refer to data sets 108D and 108E as "the data set" since most functions are the same. When an exception occurs, the data set will be referred to by full designation. Figure 7 shows a block diagram of the data sets.

#### Interface Leads

**3.02** In addition to power and ground leads, the data set provides six interface leads. The interface between the data set and the associated station equipment conforms to the Electronic Industries Association (EIA) Standard RS-232-C for signal characteristics except where noted. The interface leads and their functions are as follows:

- (a) BA on card terminal 3 connects to the EIA interface BA lead (transmitted data lead). A signal on this lead of less than  $-3$  volts represents a mark, and a signal greater than  $+3$  volts represents a space. The BA lead accepts data from the customer data terminal.
- (b) TL on card terminal 10 connects to the EIA interface BB lead (received data lead). This lead has a voltage output of less than  $-5$  volts for a mark and greater than  $+5$  volts for a space. The BB lead presents data output from the data station to the customer data terminal.
- (c) ON from card terminal 19 connects to the EIA interface CC lead (data set ready lead). This lead is connected to a positive potential in the data set. The positive potential is an indication that the data set has power.
- (d) RS on card terminal 7 connects to the EIA interface CF lead (received line signal detector lead). This lead will be at a positive potential when a carrier is being received from the line. When a loss of carrier is detected by the data set, the CF lead will have a negative potential and the CF lamp will light.
- (e) CSQ (carrier squelch) on terminal 14 can be used for carrier control. This is a non-EIA lead to the station. A negative voltage on this lead squelches the outgoing carrier.

(f) Card terminal 13 can be used for carrier control. This is a non-EIA (contact control) lead to the station. The outgoing carrier can be turned off by connecting a ground to the carrier control lead.

**3.03** The data set converts ac signals received from the line into low-level dc voltages and delivers them to the station circuit on the TL (BB) lead. Conversely, the data set converts low-level dc voltages received from the station on the BA lead into voice frequency ac signals and transmits them onto the line. Since the ac signals are transmitted in opposite directions and occupy different frequency bands, the line functions as if it were two separate one-way channels (full-duplex mode).

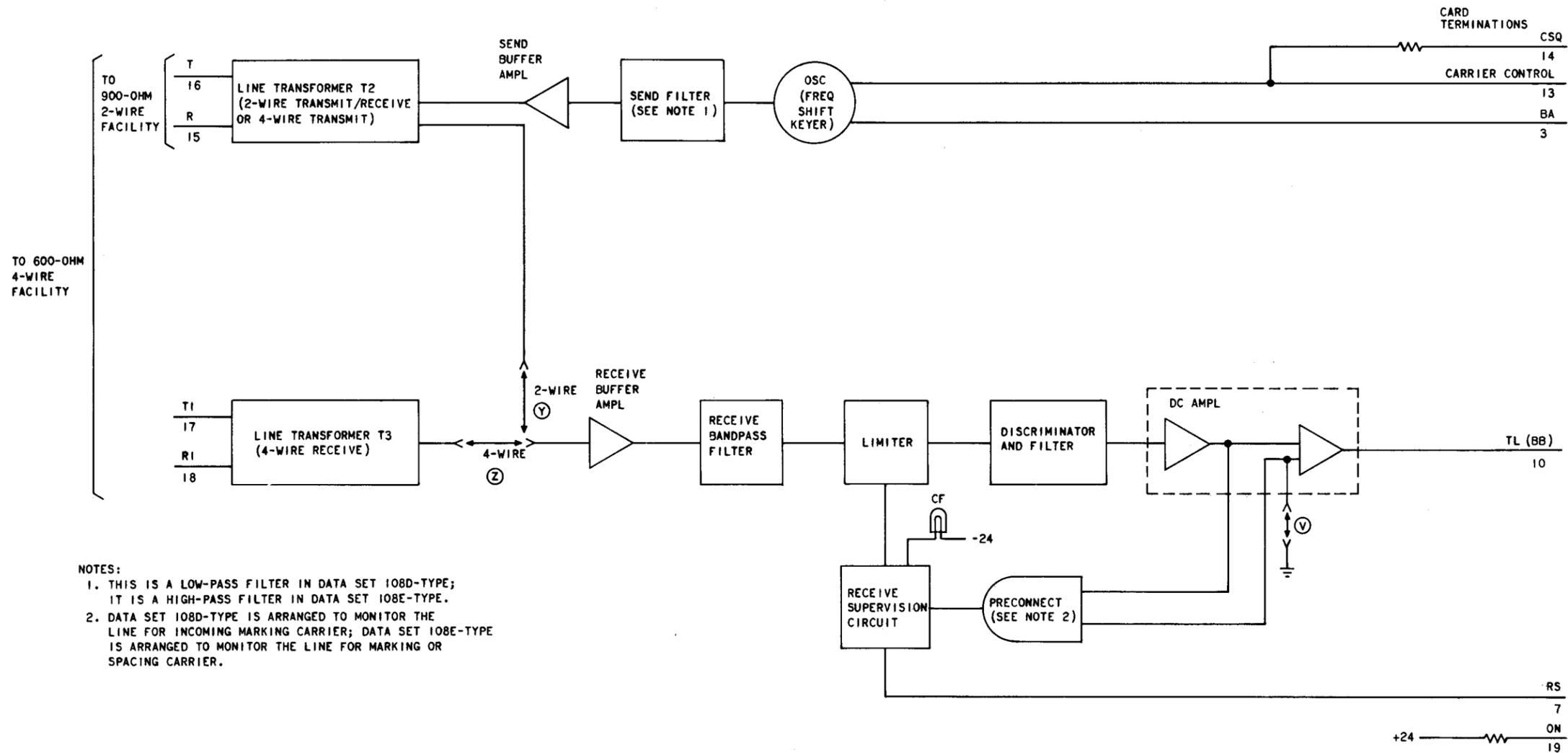
#### Transmitter Circuit

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

**3.05** When a mark signal is applied to the BA 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 space to the BA 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) for data set 108D or 2025 Hz (space) for data set 108E.

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

**3.07** The sending buffer amplifier is used to deliver the proper power level to drive the line. The output of the sending buffer amplifier is adjusted by varying R18 (see Fig. 1 and 2). In addition, the amplifier isolates the line and provides a suitable termination for the sending high-pass filter (data set 108E) or low-pass filter (data set 108D).



- 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. 7—Block Diagram of Data Sets 108D and 108E

**3.08** 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 T2 is arranged as a hybrid for 2-wire operation.



*The data sets are designed for a direct 4-wire loop connection in order to minimize equipment need for those transmission links consisting of 4-wire facilities.*

#### Receiver Circuit

**3.09** 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.

**3.10** Depending on the type of connection (2-wire or 4-wire), line transformer T2 or T3 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.

**3.11** 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 by providing attenuation of the locally transmitted signals in the f1 band (data set 108D) or in the f2 band (data set 108E).

**3.12** 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 and also to the receive supervision circuit. The discriminator converts the carrier frequency variations into dc voltage variations and delivers them to the dc amplifier.

**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  $-43$  dBm for 4-wire operation or  $-40$  dBm for 2-wire operation. When the receive carrier level drops 7 dBm below these values for a period of 110 to 300 ms, the receive supervision circuit is turned off. This places a negative voltage

on the RS lead, lights the CF lamp, and causes the TL (BB) lead to send marking or spacing to the terminal devices, depending upon which option is installed in the data set. In addition, the data set will enter the preconnect mode.



*In hub-to-station systems using the space hold options at the hub, the carrier fail option can be provided only with data set 108E (which also reenables on a space) at the station.*

**3.14** 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 negative marking signal to be applied to the TL lead. An incoming **space** frequency switches the output stage of the dc amplifier on, causing a **positive spacing** signal to be applied to the TL lead.

#### Preconnect Mode

**3.15** In the preconnect mode, data set 108D is arranged to monitor the line for incoming marking carrier, while data set 108E is arranged to monitor the line for incoming marking or spacing carrier. When the marking carrier, or marking or spacing carrier, is received for a sufficient period of time (200 to 600 ms to ensure that the data set does not enable 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 TL (BB) lead. In the preconnect mode, the slicer level is shifted towards the marking frequency. Thus, during the 200 to 600 ms that the carrier is being received for reinitialization of the data set, the signal power 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

### 2-Wire/4-Wire Option

**4.01** Three screw switches (A, C, and D) are provided to implement 2-wire or 4-wire service (see Table D). 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 15 and 16 (R and T); the receiving loop facility must be connected

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to the terminals mating with card terminals 17 and 18 (T1 and R1). The 4-wire option requires all of the C screw switches to 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 15 and 16 (R and T) and the proper hybrid network option installed. Options Y and Z are under control of screw switch A (Fig. 4 and 5). The A screw switch setting for each option is listed in Table D.

### Mark Hold or Space Hold Option on TL (BB) Lead

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

### 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 F).

### Transmitting Level Adjustment

**4.04** The transmission level of the data set is continuously adjustable over a range (see

Table A) to allow compensations to be made for differences in local loop loss. Potentiometer R18 (Fig. 4 and 5) 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.

**4.05** All options available with the data set are covered in Tables B, C, D, E, and F. The implementation of the desired options is given in the applicable table or paragraph.

## 5. REFERENCES

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

- (1) SD-1D229-01 (Data Set 108E-Type—Schematic Diagram)
- (2) CD-1D229-01 (Data Set 108E-Type—Circuit Description)
- (3) SD-73060-01 (Data Set 108D-Type—Schematic Diagram)
- (4) CD-73060-01 (Data Set 108D-Type—Circuit Description)

**TABLE B**  
**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

**TABLE C**  
**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 – Nonload (HC) – High Capacity

\*Compromise hybrid network switching

TABLE D  
2-WIRE/4-WIRE OPTIONS

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 B or C

TABLE E  
DATA SET FACEPLATE OPTIONS

OPTION DESIGNATION	FUNCTION OF OPTION	SLIDE SWITCH*		ROTARY SWITCH S1†		FACEPLATE DESIGNATION	
		SWITCH	SWITCH POSITION	SWITCH	SWITCH ‡ POSITION		
X	FDX Operation — Disables the directional control circuit of the data set to allow FDX operation.	S1	Closed	S1C	Down	DX	F
W	Not used in station application		Open		Up		H
V	SPACE HOLD ON TL(BB) — Enables the data set to provide a spacing condition on the 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(BB) — 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	Not used in station application	S3	Closed	S1B	Down	RL	S
S	Not used in station application		Open		Up		M

*Note:* S2 and S3 (S1A and S1B) will be operated to the same position (ie, open) unless it is specified otherwise in the service order.

\* 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 F  
SCREW SWITCH D SETTINGS ON THE DATA SET  
FOR REDUCTION IN GAIN

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

Tables D, E, and F