

DATA SET 109H-TYPE
USED IN A DATA LINE CONCENTRATOR SYSTEM
DESCRIPTION AND OPERATION

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1. GENERAL

1.01 This practice provides information on Data Set 109H-type. A physical and functional description of the data set is provided. Information on the data set arrangements or features and general information on the applications of the data set are also provided by this practice.

1.02 The Data Set 109H-type is a low-speed, full-duplex (FDX), dc data set that presents an EIA interface to a customer-provided terminal (CPT).

1.03 The Data Set 109H is a serial transmission data set designed for use over 2-wire metallic line facilities. The data set employs a tri-current level baseband transmission scheme. The Data Set 109H can operate in either the half-duplex (HDX)

mode or FDX mode and therefore is compatible with all Data Sets 109-type.

1.04 The Data Set 109H will operate in the FDX mode at speeds up to 150 bauds in each direction over a loop with less than 2000-ohms resistance and up to 1-microfarad capacitance. The data set can operate in the HDX mode with an extended range to 2500-ohms resistance and up to 1-microfarad capacitance.

Note: Loops shorter than 2000 ohms are adjusted to a nominal 2000-ohm value by using a resistor pad that is provided as part of the data set. Information on making the pad adjustments is contained in the section entitled Data Set 109H-Type—Used in a Data Line Concentrator System—Installation and Connections (591-037-201).

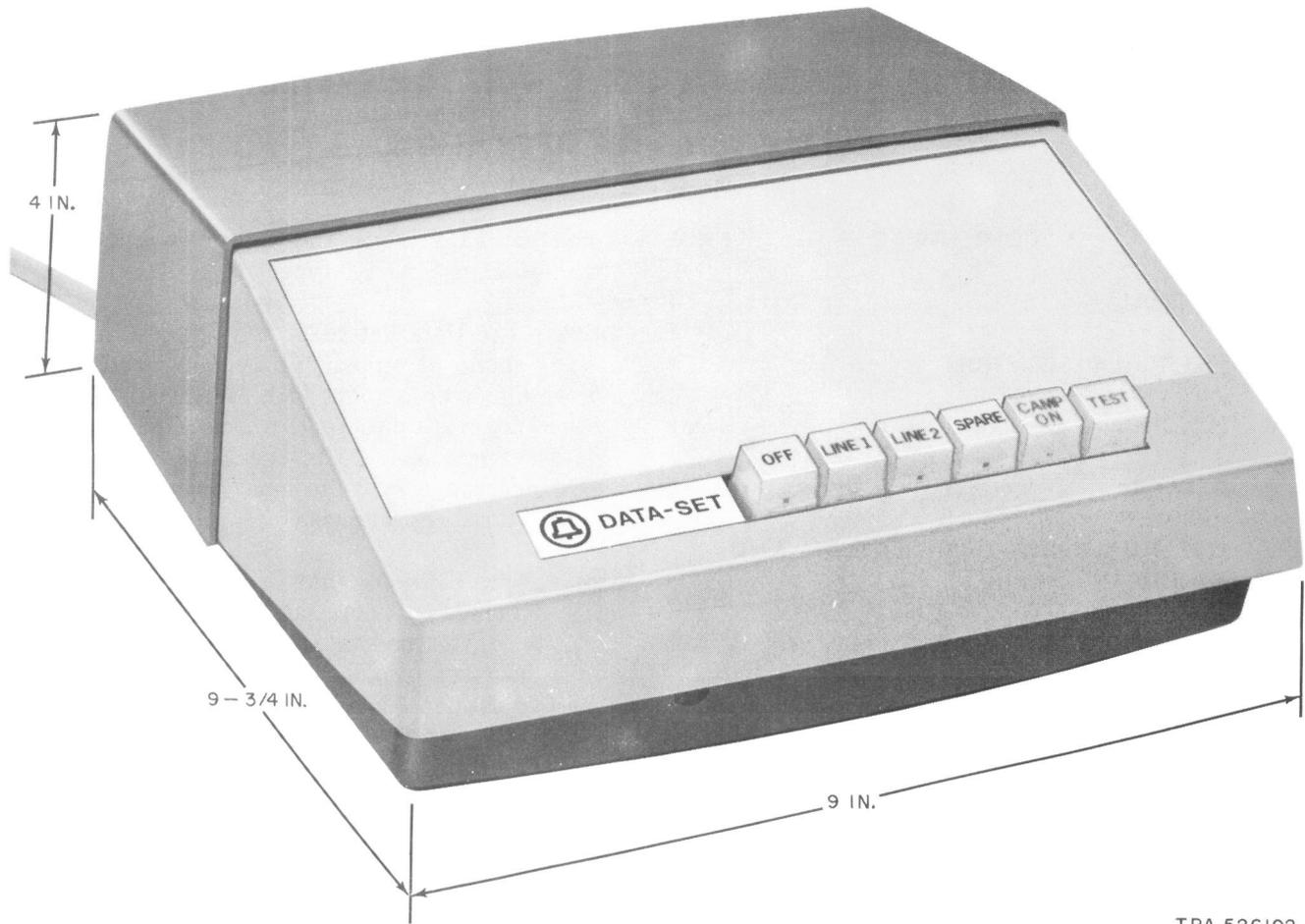
2. PHYSICAL DESCRIPTION

2.01 The Data Set 109H has several list numbers which provide optional features in addition to the basic data set functions. The basic data set is designated 109H-L1 (see Fig. 1).

2.02 The Data Set 109H-L1 provides the basic GA1 circuit pack, 6-button key, spade-ended cord, baseplate, brackets, and plastic housing. A wall-mounted 2245A transformer that is used to obtain +24 volt and ± 8 volt dc power is also provided as part of the basic data set.

2.03 The data set can be provided with both rotary dial (Data Set 109H-L1/2) shown by Fig. 2 or TOUCH-TONE® dial (Data Set 109H-L1/3) shown by Fig. 3. Since all other list numbers are provided by internally mounted circuit packs, the external physical appearance of the data set is not changed. The ET2 circuit pack, required with the TOUCH-TONE dial, is shown by Fig. 4.

2.04 The list numbers assigned for the Data Set 109H, the features provided by the list



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Fig. 1—Data Set 109H-L1

numbers, and the circuit packs or components required to provide these features are given in Table A. For a functional description of the features provided, refer to Part 3 of this section.

2.05 The L4 and L5 features are provided by circuit packs that snap on and are wired into the basic Data Set 109H-L1. The L4 feature is provided by using circuit pack ET3 which is shown by Fig. 5. The L5 features are provided by using circuit pack GR1 which is shown by Fig. 6.

2.06 In addition to the features that can be added to the basic data set by the various list numbers (Table A), the basic data set provides the screw switch options listed in Table B. The option switches are mounted on circuit pack GA1. For information on the installation and use of these

options, refer to the section entitled Data Set 109H-Type—Used in a Data Line Concentrator System—Installation (591-037-201).

3. FUNCTIONAL DESCRIPTION

GENERAL

3.01 The Data Set 109H-type presents an EIA interface to a customer-provided terminal (CPT) for the purpose of connecting the CPT into a Data Line Concentrator System (Fig. 7). The interface leads presented to the CPT are given by Table C.

3.02 A 6-button key provides the human interface for operation of the data set. The function



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Fig. 2—Data Set 109H-L1/2

and designation of the buttons are given by Table D.

LIST NUMBERS—DESIGNATION AND FUNCTION

3.03 When the Data Set 109H is arranged for Data Line Concentrator System service, the combination of list numbers provides optional features in addition to the basic data set functions.

The codes which can be ordered for the data set and the features provided by each combination of codes are described in the following list.

- **Data Set 109H-L1:** The basic data set including plastic housing, baseplate and brackets, spade-ended cord, 6-button key, GA1 circuit pack, and 2245A transformer. The data set interconnects to a



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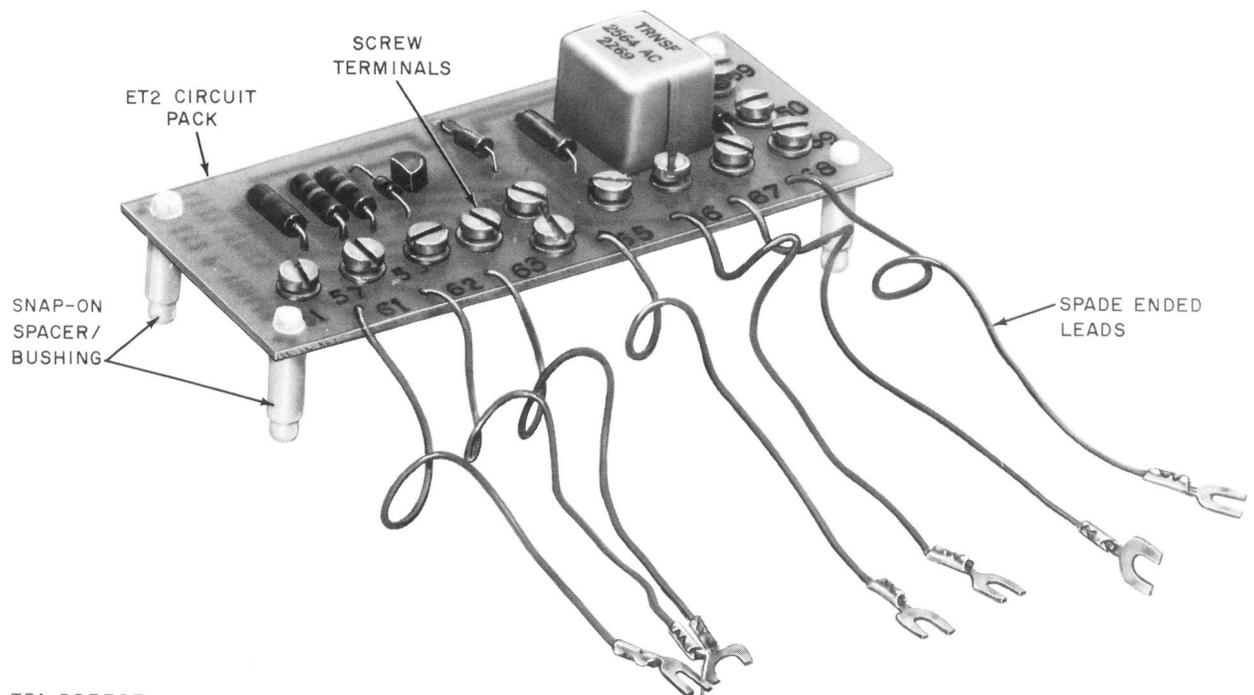
Fig. 3—Data Set 109H-L1/3

customer-provided terminal via an EIA interface.

- **Data Set 109H-L1/2:** This data set consists of the basic data set plus rotary dial and receiver. Electrical connections from the dial and receiver are made with spade-ended leads. Data Set 109H-L1/2 provides all the features of Data Set 109H-L1 as previously

stated plus the ability to access the DDD network through the concentrator and some special trunk-side terminal equipment. List 2 is associated with the rotary dial station arrangement.

- **Data Set 109H-L1/3:** This data set consists of the basic data set plus the ET2 circuit pack, TOUCH-TONE dial, and receiver.



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Fig. 4—ET2 Circuit Pack

TABLE A

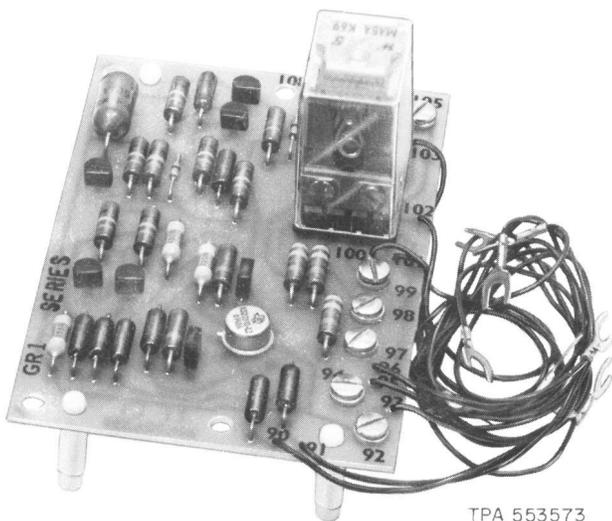
LIST NO.	SPECIAL FEATURES PROVIDED IN ADDITION TO BASIC DATA SET	COMPONENTS PROVIDED IN ADDITION TO BASIC DATA SET
L1	—	—
L2	Rotary Dial and Receiver	8J Dial, 731A-61 Receiver, Dial Brackets, and Faceplate for Rotary Dial
L3	TOUCH-TONE Dial and Receiver	35C3A Dial, 731A-61 Receiver, Dial Mounting Brackets, ET2 Circuit Pack, TOUCH-TONE Dial Faceplate
L4	Line Control by CD Lead (Squelch Feature CSQ)	ET3 Circuit Pack
L5	Loop Current Supervision (RS)	GR1 Circuit Pack

The ET2 circuit pack is arranged piggyback style and is connected to the GA1 circuit pack by four standoff teflon posts. Electrical connections to the ET2 circuit pack, dial and receiver are made with screw terminals

and spade-ended leads. Data Set 109H-L1/3 provides all the features of Data Set 109H-L1 as previously stated, plus the ability to access the DDD network through the concentrator and some special trunk-side



Fig. 5—ET3 Circuit Pack



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Fig. 6—GR1 Circuit Pack

terminal equipment. List 3 is associated with the TOUCH-TONE dial station arrangement.

- **Data Set 109H-L1/4:** This data set consists of the basic data set plus ET3 circuit pack arranged piggyback style and connected to the GA1 circuit pack by four standoff Teflon posts. Electrical connections to the ET3 circuit pack are made with screw terminals

TABLE B
OPTIONS

OPTION	FEATURE
Z	Space Crossover Shift
Y	Mark Crossover Shift
X	No Crossover Shift
W	Frame GRD to SIG GRD
V	Isolated Signal Ground
M	CB Lead Open
K	CB Looped to CA
J	CB Common to CC
H	CC Lead — Data in Test Mode
G	CC Lead — No Data in Test Mode
F	CC Lead — Steady "ON"
E	CC Lead — for Private Line
B	CF Lead — Data in Test Mode
A	CF Lead—No Data in Test Mode
ZA	CF Lead — Steady "ON"

and spade-ended leads. Data Set 109H-L1/4 provides all the features of Data Set 109H-L1 as previously stated, plus the ability to open or close the metallic line from a signal on the data terminal ready (CD) lead. This optional feature is called the squelch (CSQ) option. The OFF lamp is active when this option is used. List 4 is associated with the CSQ option. The CSQ option affects the state of the data set as indicated in Table E.

- **Data Set 109H-L1/5:** This data set consists of the basic data set plus GR1 circuit pack arranged piggyback style and connected to

the GA1 circuit pack by four standoff teflon posts. Electrical connections to the GR1 circuit pack are made with screw terminals and spade-ended leads. Data Set 109H-L1/5 provides all the features of Data Set 109H-L1 as previously stated, plus loop current supervision. This option, called the receive supervision (RS) option, detects the presence of normal loop current and, in the Data Line Concentrator System arrangement prevents lockout when the concentrator initiates a disconnect. In lockout, the metallic line of the station data set is terminated in a short circuit at the concentrator without a camp-on signal and is equivalent to a "high and dry" in the telephone plant. List 5 is associated with the RS option. The RS option affects the state of the data set as indicated in Table F.

- **Data Set 109H-L1/4/5:** This data set consists of the basic data set plus ET3 and GR1 circuit packs. Data Set 109H-L1/4/5 is a combination of and provides all the features of Data Sets 109H-L1/4 and 109H-L1/5 as previously stated. In combination, the CSQ and RS options affect the state of the data set as indicated in Table G.
- **Data Set 109H-L1/2/4:** This data set consists of the basic data set plus rotary dial, receiver, and ET3 circuit pack. Data Set 109H-L1/2/4 is a combination of and provides all the features of Data Sets 109H-L1/2 and 109H-L1/4 as previously described.
- **Data Set 109H-L1/2/5:** This data set consists of the basic data set plus rotary dial, receiver, and GR1 circuit pack. Data Set 109H-L1/2/5 is a combination of and provides all the features of Data Sets 109H-L1/2 and 109H-L1/5 as previously described.
- **Data Set 109H-L1/3/4:** This data set consists of the basic data set plus TOUCH-TONE dial, receiver, ET2, and ET3 circuit packs. Data Set 109H-L1/3/4 is a combination of and provides all the features of Data Sets 109H-L1/3 and 109H-L1/4 as previously described.
- **Data Set 109H-L1/3/5:** This data set consists of the basic data set plus TOUCH-TONE

dial, receiver, ET2, and GR1 circuit packs. Data Set 109H-L1/3/5 is a combination of and provides all the features of Data Sets 109H-L1/3 and 109H-L1/5.

- **Data Set 109H-L1/2/4/5:** This data set consists of the basic data set plus rotary dial, receiver, ET3, and GR1 circuit packs. Data Set 109H-L1/2/4/5 is a combination of and provides all the features of Data Sets 109H-L1/2 and 109H-L1/4/5 as previously described.
- **Data Set 109H-L1/3/4/5:** This data set consists of the basic data set plus TOUCH-TONE dial, receiver, ET2, ET3, and GR1 circuit packs. Data Set 109H-L1/3/4/5 is a combination of and provides all the features of Data Sets 109H-L1/3 and 109H-L1/4/5 as previously described.

OPERATION

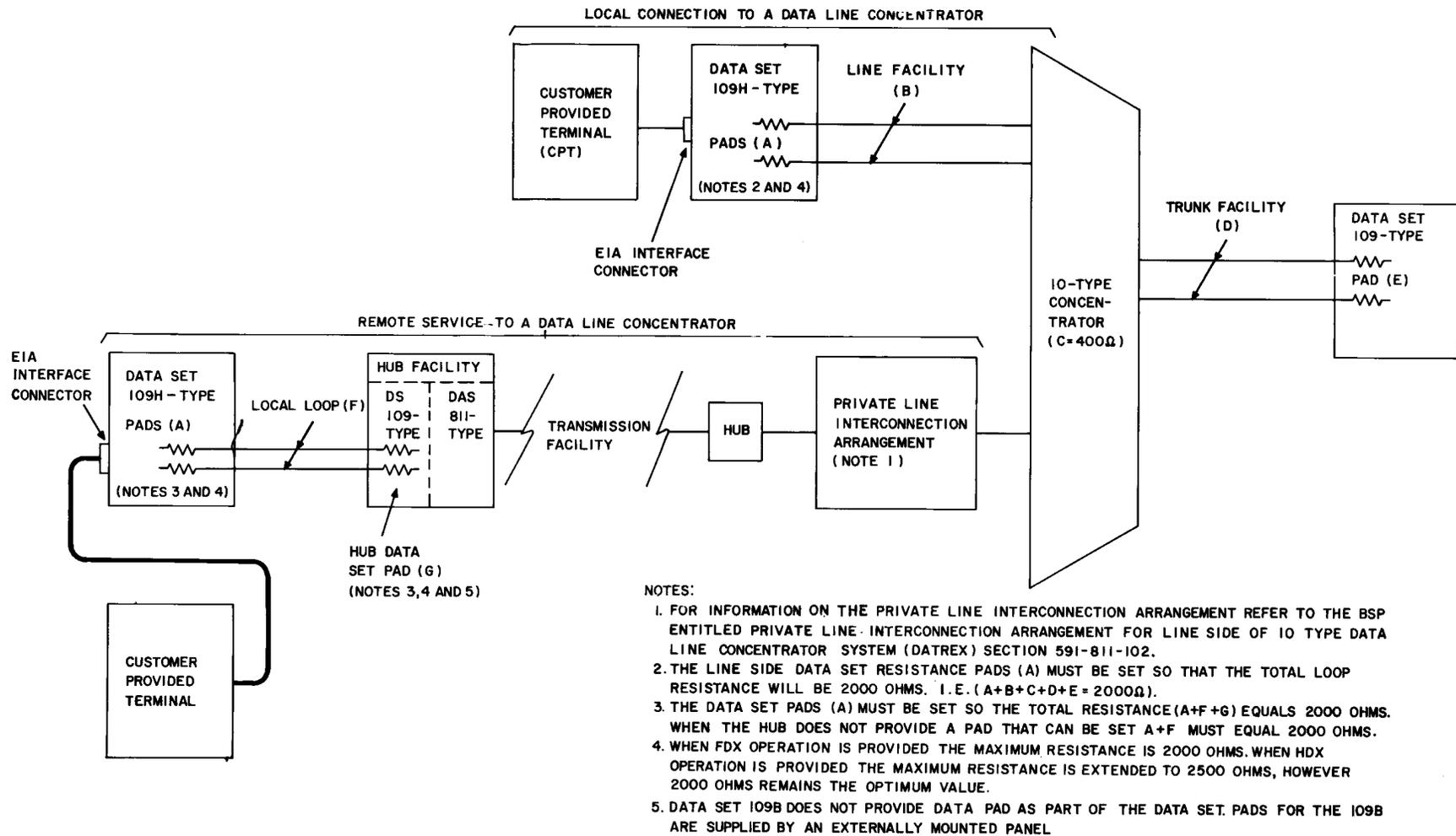
3.04 The basic dc transmission system consists of a pair of Data Sets 109-type at each end of a 2-wire metallic loop. Each data set applies a voltage to the metallic loop to transmit a mark or space and monitors the metallic loop current to receive a mark or space. The voltage applied to the loop by each data set can develop three possible current levels. Internal logic within each data set allows incoming data to be recovered from the tri-level loop current. All possible transmission states and the signal detected by each data set are shown in Table H and Fig. 8.

3.05 A functional block diagram of the data set is shown by Fig. 9. This diagram also shows the circuit packs used to provide additional features for the basic data set.

GA1 CIRCUIT PACK

3.06 The GA1 circuit pack is the basic building block for the Data Set 109H-type. The GA1 circuit pack includes the transmit and receive isolators, transmitter, receiver, bridge circuit, camp-on circuit, loop current adjusting resistors, power supply rectifiers and filters, and a 25-pin EIA connector.

3.07 The interface leads at the EIA connector have been identified in Table C. The important leads directly relating to the circuits on the GA1 circuit pack are the BA and BB leads.



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Fig. 7—Data Line Concentrator System—Block Diagram

3.08 Transmit data from the CPT is applied to the BA lead of the EIA connector. A negative signal on the BA lead causes the transmit isolator, to transmit a mark across a transformer-isolated interface to the input of the transmitter. A positive signal, on the BA lead causes a space to be transmitted across the transformer-isolated interface to the input of the transmitter.

3.09 The transmitter develops the appropriate marking or spacing voltage across the varistor-diode network. These signals are then applied to the metallic loop. The monitor bridge and loop current adjusting resistors are between the varistor-diode network and the metallic loop.

3.10 The monitor bridge circuit includes two low-valued loop resistors in series with the metallic loop with the high resistance bridge network connected between the loop resistors. The voltage developed at the midpoint of the monitor bridge is proportional to loop current when the local data set is transmitting a mark and is receiving data from the remote end. When the local data set is transmitting a space, a pair of nonlinear legs of the bridge introduces a slicing level shift of the voltage developed at the midpoint of the bridge. The slicing level shifts whenever the local data set

transmits a space. The overall effect is to develop a signal at the midpoint of the bridge that represents the data signal from the remote end while eliminating the signal due to locally transmitted data.

3.11 The receiver consists of a high-gain operational amplifier in series with a low-pass filter and slicing circuit. Data signals at the midpoint of the monitor bridge are applied to the operational amplifier which acts as a switch by saturating when receiving a mark and cutting off when receiving a space. The output of the amplifier is applied to a low-pass filter and slicer. The low-pass filter is necessary to eliminate any transient pulses generated by the data set which may interfere with the receive data while transmitting. The signal developed at the output of the slicer is a copy of the data from the remote station data set.

3.12 The output of the receiver is applied through the receive isolator to the BB lead of the EIA connector. The output of the receiver is also applied to the camp-on circuit.

3.13 The camp-on circuit drives a CAMP-ON lamp from the signal taken from the receiver slicer. The camp-on circuit includes a monostable

TABLE C
INTERFACE LEADS

LEAD DESIGNATION		FUNCTION
AA	Protective or Frame Ground	
AB	Signal Ground	
BA	Transmitted Data	Data is received by the data sets from the CPT on the BA lead and is transmitted over the transmission facility.
BB	Received Data	Data is received from the transmission facility and is presented to the CPT on the BB lead.
CA	Request to Send	See Note 1.
CB	Clear to Send	See Note 1.
CC	Data Set Ready	Indicates to the CPT that the data set is capable of performing the function specified by the depression of one or more of the data set keys.
CD	Data Terminal Ready	See Note 2.
CF	Carrier Detector	This lead is attached to a positive voltage as a static condition for the DLCS arrangement.

Note 1: Leads designated by this note are not used by the data set but are optionally connected together by spade-ended leads, insulated and stored, or the CB lead is connected to the CC lead.

Note 2: The lead designated by this note is not used in Data Set 109H-L1. However, this lead is used with the CSQ arrangement of the List 4 data sets.

TABLE D
DATA SET 109H-TYPE — KEY DESIGNATION AND FUNCTION

KEY DESIG	FUNCTION
OFF	The data set is disconnected from the transmission line, a negative data set ready indication is presented on the CC lead to the EIA interface, and the received data (BB) lead is held marking.
LINE 1	The data set is connected to the transmission line and a positive data set ready indication is presented to the EIA interface.
LINE 2	(Installation Option) The data set is connected to the line with the tip and ring connections reversed and a positive data set ready indication is presented to the EIA interface. This key permits dual access features if the Data Line Concentrator is properly equipped. The key is blocked for single access service.
SPARE	This key is not connected and is blocked.
CAMP-ON (See Note)	The CAMP-ON key is blocked and functionless. A lamp under this key indicates the reception of a camp-on signal by lighting for 1 second at 3-second intervals. This lamp also signals the reception of data by flickering when data is received or lighting continuously when a space is received by the data set. A clear stop button provides light transmission but prevents the button from being depressed.
TEST	This key, when depressed with the LINE 1 or LINE 2 key, connects the received data (BB) lead to the transmitted data lead (BA) of the data set at the EIA interface to provide a loop-around test. Any data on the customer transmitted data lead is ignored. The data set ready lead may optionally be arranged to present either a positive or negative indication to the EIA interface in order that the test data may, or may not, be monitored by the terminal. In either case, however, the test data is present on the received data lead.

Note: The CAMP-ON lamp is the only active lamp in the data set 109H-L1.

multivibrator and lamp driver. A single spacing pulse of approximately 6 milliseconds causes the lamp driver to turn on for 1 second. A steady spacing input to the camp-on circuit causes the lamp driver to turn on continuously. A normal data input to the camp-on circuit causes the lamp driver to flash on and off.

3.14 The loop current adjusting resistors allow the loop current to be adjusted to the proper

current level for any loop less than 2000 ohms. The normal level, when both data sets transmit a mark or either data set transmits a space, is approximately 3 mA. For information on setting these resistors, refer to the section entitled Data Set 109H Type—Used in a Data Line Concentrator System—Installation and Connections (591-037-201).

3.15 The power supply rectifiers and filters on the GA1 circuit pack used in conjunction

TABLE E

	CD LEAD POSITIVE		CD LEAD NEGATIVE	
	LINE 1 OR 2 KEY DEPRESSED	OFF KEY DEPRESSED	LINE 1 OR 2 KEY DEPRESSED	OFF KEY DEPRESSED
CC Lead	Pos	Neg	Neg	Neg
Metallic Line	Closed	Open	Open	Open
OFF Lamp	Extin- guished	Extin- guished	Lighted	Extin- guished
BB Lead	—	Neg	Neg	Neg

TABLE F

	CURRENT		NO CURRENT	
	LINE 1 OR 2 KEY DEPRESSED	OFF KEY DEPRESSED	LINE 1 OR 2 KEY DEPRESSED	OFF KEY DEPRESSED
CC Lead	Pos	Neg	Neg	Neg
Metallic Line	Closed	Open	Open	Open
BB Lead	—	Neg	Neg	Neg

with the 2245A transformer are used to derive the +24 volt and ± 8 volt power for the data set. The 24-volt supply is used on the loop side of the isolation interface and the 8-volt supplies are used on the terminal side of the isolation interface.

ET2 CIRCUIT PACK

3.16 The ET2 circuit pack associated with List 3 data sets is connected to the GA1 circuit pack "piggyback style" with four teflon posts. The ET2 circuit pack provides the necessary

circuitry to activate and couple the TOUCH-TONE dial to the dc loop facility.

ET3 CIRCUIT PACK

3.17 The ET3 circuit pack is associated with List 4 data sets and is used to implement the CSQ option. The ET3 circuit pack is connected to the GA1 or GR1 circuit packs "piggyback style" with four teflon posts. The ET3 circuit pack is controlled by the signals on the CD lead of the EIA interface. Depending upon which data set

TABLE G

	CURRENT				NO CURRENT			
	CD POSITIVE		CD NEGATIVE		CD POSITIVE		CD NEGATIVE	
	LINE 1 OR 2 KEY*	OFF KEY*						
CC Lead	Pos	Neg	Neg	Neg	Neg	Neg	Neg	Neg
Metallic Line	Closed	Open	Open	Open	Open	Open	Open	Open
OFF Lamp	Extin- guished	Extin- guished	Lighted	Extin- guished	Extin- guished	Extin- guished	Lighted	Extin- guished
BB Lead	—	Neg	Neg	Neg	Neg	Neg	Neg	Neg

*Depressed

code and service arrangement are used, the functions of the ET3 circuit pack are as follows:

- (a) CC lead control
- (b) Open or close the metallic loop
- (c) Control OFF lamp
- (d) Send mark or space for on-hook
- (e) Mark hold on BB lead

GR1 CIRCUIT PACK

3.18 The GR1 circuit pack is associated with List 5 data sets and is used to implement the RS option. The GR1 circuit pack is connected to the GR1 circuit pack "piggyback style" with four teflon posts. The GR1 circuit pack is controlled by a signal which is proportional or loop current.

Depending upon which data set code and service arrangement are used, the functions of the GR1 circuit pack are as follows:

- (a) CC lead control
- (b) Open or close metallic loop
- (c) CF lead control
- (d) Mark hold on BB lead.

4. REFERENCES

4.01 For additional information on this data, refer to the following:

- CD-1D220-01
- SD-1D220-01

TABLE H

TRANSMITTING VOLTAGE			SIGNAL DETECTED BY		
DATA SET A (VOLTS) See Note 1	DATA SET B (VOLTS)	VOLTAGE AROUND THE LOOP (VOLTS) See Note 2	LOOP CURRENT (mA)	DATA SET A	DATA SET B
4 (M)	4 (M)	8 (M)	3 (M)	(M)	(M)
-12 (S)	4 (M)	-8 (S)	-3 (S)	(M)	(S)
4 (M)	-12 (S)	-8 (S)	-3 (S)	(S)	(M)
-12 (S)	-12 (S)	24 (3S)	-9 (3S)	(S)	(S)

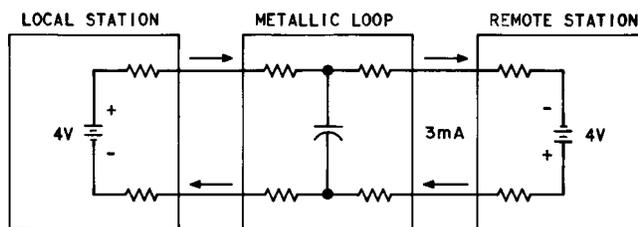
(M) = MARK

(S) = SPACE

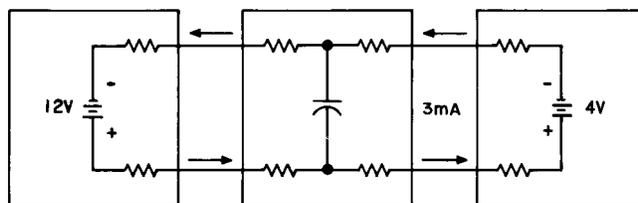
(3S) = TRIPLE SPACE

Note 1: The signal which is transmitted by data set A is received by data set B and the signal which is transmitted by data set B is received by data set A.

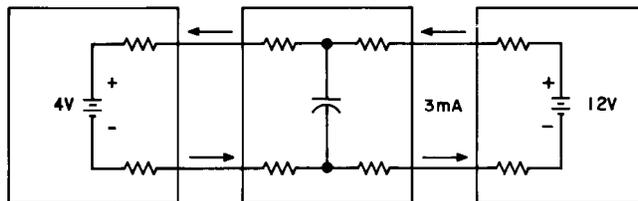
Note 2: The metallic loop connections to the data sets are made so that when both data sets transmit a mark the voltages applied to the loop are series aiding. Refer to Fig. 8.



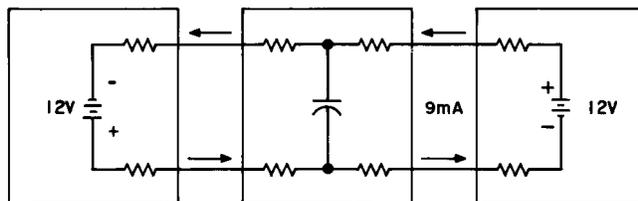
A. LOCAL STATION SENDING MARK, REMOTE STATION SENDING MARK



B. LOCAL STATION SENDING SPACE, REMOTE STATION SENDING MARK



C. LOCAL STATION SENDING MARK, REMOTE STATION SENDING SPACE



D. LOCAL STATION SENDING SPACE, REMOTE STATION SENDING SPACE
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Fig. 8—Transmission States of Data Sets 109-Type (FDX System)

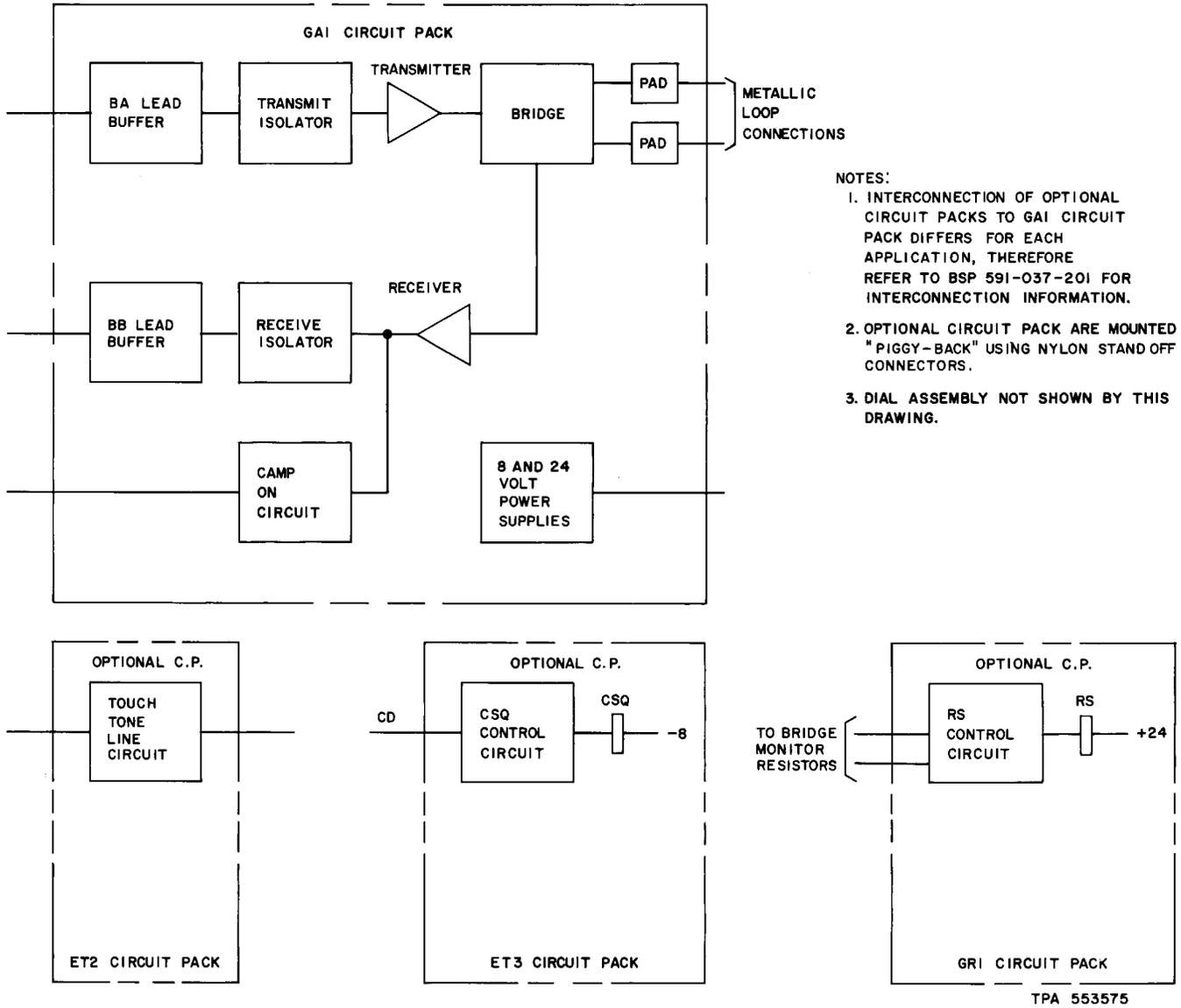


Fig. 9—Data Set 109H-Type—Functional Block Diagram