DATA SET 109H-TYPE
PRIVATE LINE APPLICATION
INSTALLATION

CONTENTS PAGE

1. GENERAL

1.01 This practice provides information on the installation and connection procedures required when providing service in a private line system using the data set 109H-type (Fig. 1).

1.02 This practice is reissued to indicate differences in the 2245A transformer used with these data sets. The information is provided to prevent improper transformer connections and resulting damage to the data set. Additional minor changes and corrections have also been made. Since this reissue constitutes a general revision, arrows ordinarily used to denote changes have been omitted.

1.03 Installation of the data set 109H-type consists of connecting the line to the data set, adjusting the line pads, verifying the options to be used, providing power, and connecting the data set to the terminal equipment via the EIA interface connector (Fig. 2).

1.04 The cord and connector required for connecting the terminal equipment to the data set 109H-type is supplied by the customer. This cord should not exceed 50 feet in length and must be equipped with a plug to mate with a KS-19087-L2 connector on the data set.

1.05 The customer must furnish a 117-volt 60-Hz, 3-wire grounding type power receptacle that is not under control of a switch. The data set power is supplied by a 2245A transformer and cord that is plugged into the customer-supplied power receptacle. Figure 3 shows the 2245A transformer, transformer mounting bracket, 44A connecting block, and data set 109H-L1.

2. TOOLS AND APPARATUS

2.01 When the data set 109H-type is installed, a KS-20538-L1 volt-ohm milliammeter (VOM), or equivalent, will be required to set the data set pads to the proper value. No other special equipment is required when installing the data set 109H-type.

3. OPTION CONNECTIONS

3.01 Before starting installation of the data set, a check must be made to determine that the data set has been equipped with the required features and options. The service order will indicate the features and options that are required for this specific installation.

3.02 The options provided by the data set 109H-type are given in Table A, which shows the letter designation of each option and the connections or action required to install the option.

Note: The screw switches and terminals used to install the options are located on the GA1 circuit pack. For information on gaining access to the GA1 circuit pack, refer to the cover removal part of the section entitled Data Set 109H-Type—Private Line Application—Maintenance (591-037-300).

3.03 The only additional feature that can be provided by the data set 109H-type (private

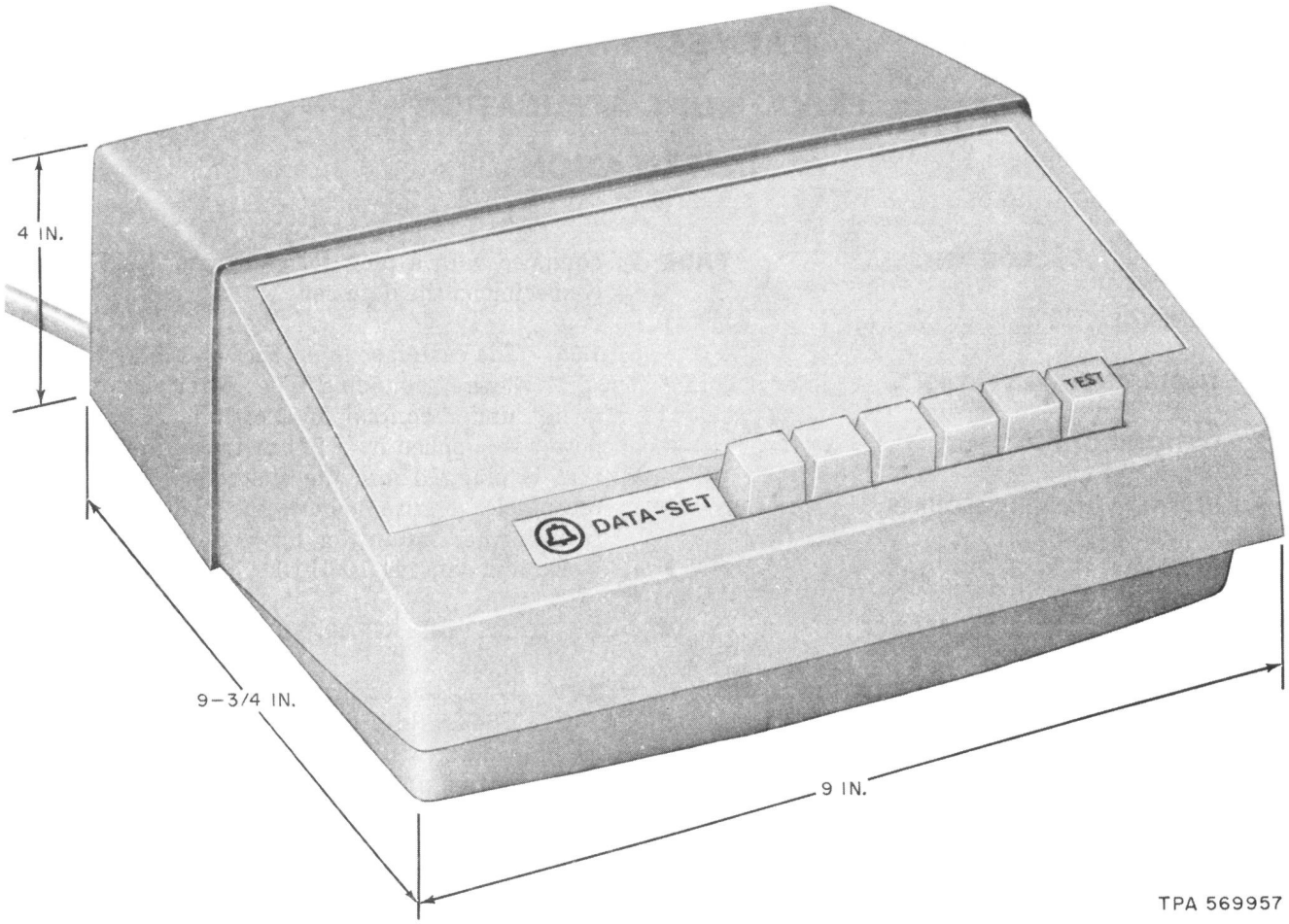


Fig. 1—Data Set 109H-L1

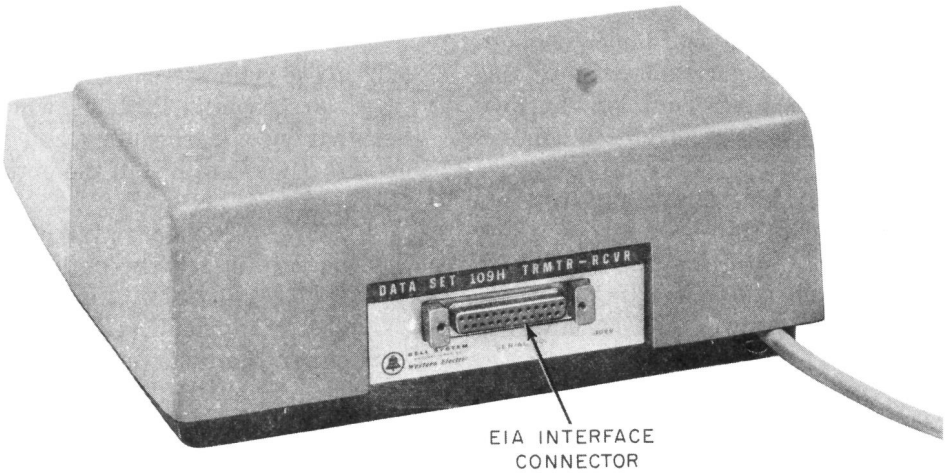


Fig. 2—Data Set 109H-Type—Rear View

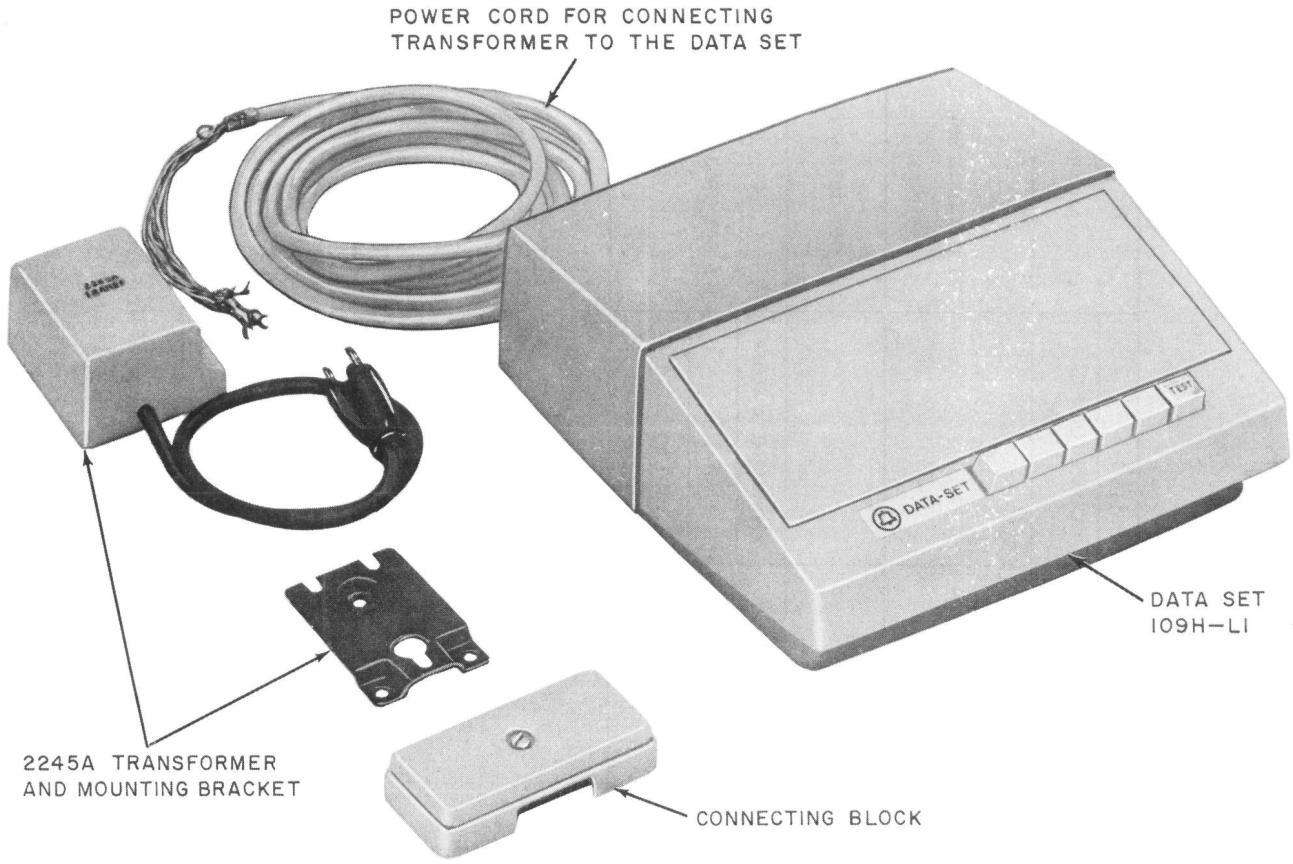


Fig. 3—Data Set 109H-L1—Accessories

line arrangement) is receive supervision (RS), which is associated with data set 109H-L1/5. Data set 109H-L1 is covered in Table B and Fig. 4. Data set 109H-L1/5 is covered in Table C and Fig. 5. These are the only two list numbers available for a private line arrangement. Data set 109H-L1/5 requires an additional circuit pack (GR1 CP).

3.04 Verify that the features and options specified on the service order are provided by performing the following operations. The screw terminals and spade-ended leads referred to in the figures, text, and tables can be located and identified by Fig. 6, 7, and 8.

(a) Remove the cover from the data set. Refer to Section 591-037-300.

(b) Refer to 3.03 to determine the applicable wiring table, associated wiring diagram, and required circuit pack.

(c) Check to ensure that the snap-on circuit pack required to provide a specified list number has been mounted in the data set.

(d) Using the applicable wiring table and wiring diagram, check the data set and circuit pack connections.

(e) Use Table A to check and verify the option connections specified by the service order.

Note: Do not reinstall the cover on the data set at this time since the data set line pads must be set before completing the station installation.

4. INSTALLATION PROCEDURES

GENERAL

4.01 Install the mounting bracket for the 2245A power transformer. This bracket must be

TABLE A

OPTIONS

DESIGNATION		REQUIRED CONNECTIONS TO INSTALL OPTION				OPTION AVAILABILITY
FEATURE	OPTION	LOOSEN SCREW	TIGHTEN SCREW	SPADE-ENDED LEAD DESIG	CONN TO CP CA1 TERM.	
Space crossover shift	Z	S6	S7			1 per data set
Mark crossover shift	Y	S7	S6			
No crossover shift	X	S7, S6	—			
Frame GRD for SIG GRD	W	—	S5			1 per data set
Isolated signal ground	V	S5	—			
CB lead open	M			BK-BL (CA3 cord)	Insulate & store	1 per data set
CB looped to CA	K				17	
CB common to CC	J				Conn to same term. as CC lead	
CC lead—data in test mode	H			W-BL (CA3 cord)	34	1 per data set except with L1 See note
CC lead—no data in test mode	G				16	
CC lead—for private line (Data set 109H-L1 only)	E				36	
CC lead—steady ON	F				15	
CF lead—data in test mode	B			BK-G (CA3 cord)	34	1 per data set except with L1/5 See note
CF lead—no data in test mode	A				16	
CF lead—steady ON	ZA				15	

Note: Refer to Table C for BK-G wire connection required when data set 109H-L1/5 is used in private line arrangements. Options A, B, and ZA cannot be provided for private line arrangements using data set 109H-L1/5. Options F, G, and H cannot be provided with data set 109H-L1 for private line arrangements (see Table B).

TABLE B

DATA SET 109H-L1 – PRIVATE LINE ARRANGEMENT – WIRING

CORD OR COMPONENT	LEAD OR TERM.	GA1 CP TERM.	44A CONNECTING BLOCK TS 1
CA1 Cord	S-Y	37	
CA2 Cord	The CA2 cord (plug P2) on GA1 CP shall be stored in POS B of the 6-button keyset, and the lamp shall be removed at POS B		
CA3 Cord	BK-BL	36 (J)	
		Insulate & store (M)	
		17 (K)	
	BK-G	15 (ZA)	
		16 (A)	
		34 (B)	
	W-BL	36 (E)	
CA4 Cord	Store plug P3-P6 on the 6-button keyset (POS C-F) and insulate and store the spade-ended leads, or discard entire cord		
CA5 Cord (D10R-61)	BL-W	1 10	
	W-BL	2 9	
	W-BR	10 6	
	W-G	5 5	
	BR-W	11 4	
	G-W	6 3	
	W-O	7 2	
	O-W	8 1	
Spade-ended lead from GA1 CP	32	28	
2245A Transformer (See Notes 6 and 7)	Term.3 (1)		Term.1
	Term.4 (2)		Term.2
	Term.5 (3)		Term.3
	Term.6 (4)		Term.4
	Term.7 (5)		Term.5

TABLE B (Cont)

DATA SET 109H-L1 – PRIVATE LINE ARRANGEMENT – WIRING

CORD OR COMPONENT	LEAD OR TERM.	GA1 CP TERM.	44A CONNECTING BLOCK TS 1
TEL Line			Term. 9
			Term. 10

Note 1: When both ends of a cord are to be connected, two terminal numbers will be shown for each designated lead.

Note 2: All unused spade-ended leads shall be individually insulated and stored.

Note 3: Refer to Table A for information of installing options.

Note 4: A circled letter indicates the connection is required to install the option indicated by the letter.

Note 5: Each end of the S-W and W-S leads of cord CA5 shall be insulated and stored.

Note 6: Two models of the 2245A transformer have been produced. Earlier models have the terminals numbered 1 through 6. Later models have the terminals numbered 3 through 8. Earlier models are connected as indicated by terminal numbers given in parentheses.

Note 7: The end of these wires must be stripped and wrapped around the screw terminals of the transformer and connecting block.

mounted within 15 inches of the customer-supplied power receptacle so that the power cord from the transformer will reach the receptacle.

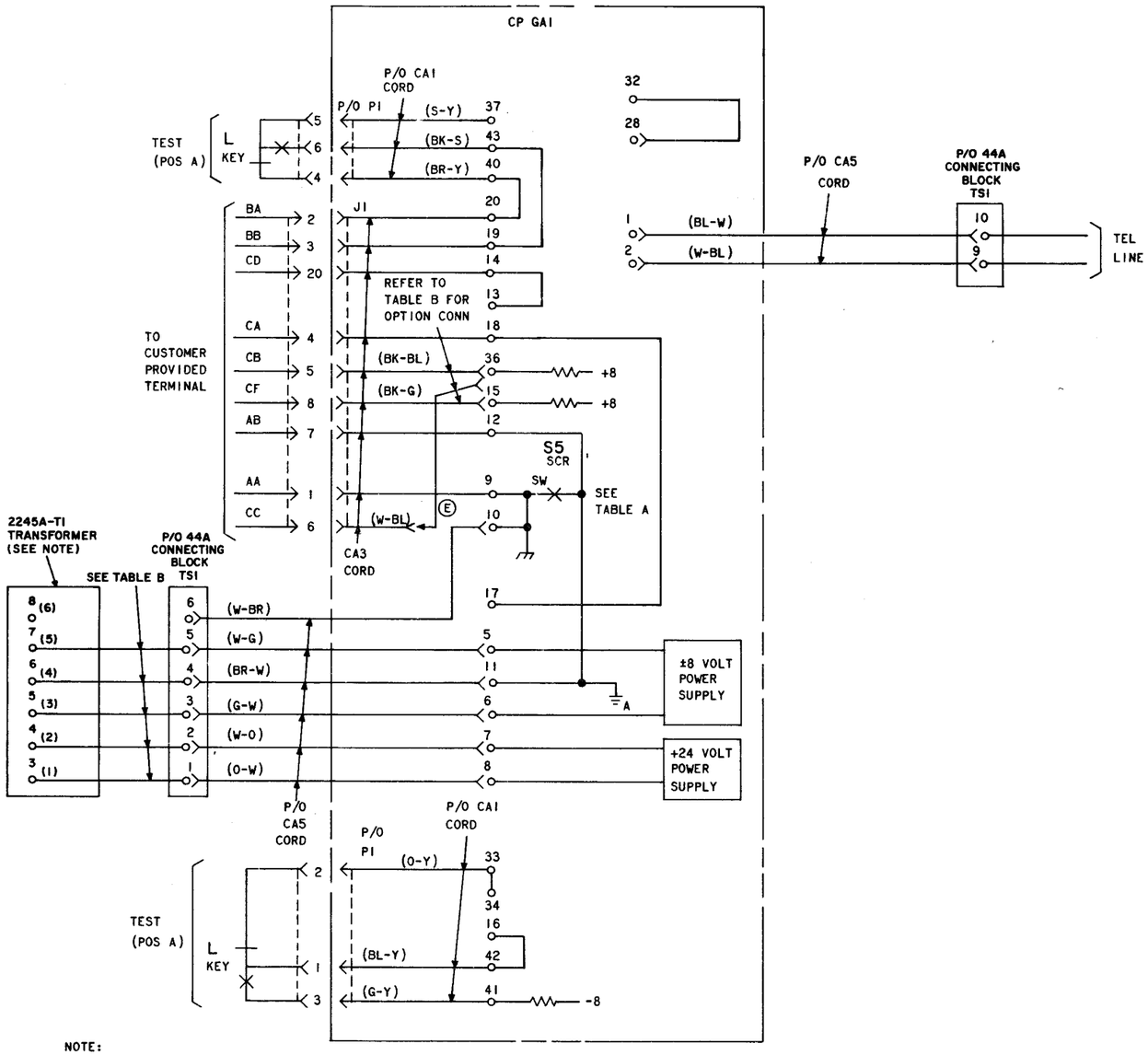
Note: The customer must furnish a 3-wire, 117-volt 60-Hz power receptacle that is not under control of a switch.

4.02 Install the 44A connecting block (shown as TS-1 on wiring diagrams and tables) in a convenient location near the data set. The 44A connecting block cover (101A-49) is not furnished with the connecting block and must be ordered separately. The 44A connecting block (TS-1) must be located within 9 feet of the data set so that the D10R-61 cord (designated CA5) can reach the data set.

4.03 Use D-type station wire to connect the transformer terminals to the 44A connecting block terminals as indicated by the applicable wiring diagram and wiring table (see ***Note***). The length of the station wire between the transformer and the 44A connecting block must not exceed 50 feet.

Note: **Two models of the 2245A transformer have been produced. Early models have the terminals numbered 1 through 6. Later models have terminals numbered 3 through 8. The early models are connected as indicated by the terminal numbers given in parentheses.**

4.04 The 2245A transformer may now be installed on the mounting bracket; however, the power cord must not be plugged in at this time.



NOTE:
TWO MODELS OF THE 2245A TRANSFORMER HAVE BEEN PRODUCED. EARLY MODELS HAVE TERMINALS NUMBERED 1 THROUGH 6.
LATER MODELS HAVE THE TERMINALS NUMBERED 3 THROUGH 8. EARLY MODELS ARE CONNECTED AS INDICATED BY THE TERMINAL NUMBERS IN PARENTHESES.

Fig. 4—Data Set 109H-L1—Wiring Diagram

TABLE C

DATA SET 109H-L1/5 – PRIVATE LINE ARRANGEMENT – WIRING

CORD OR COMPONENT	LEAD OR TERM.	GA1 CP TERM.	GR1 CP TERM.	44A CONNECTING BLOCK TS 1
CA1 Cord	S-Y	37		
CA2 Cord	The CA2 Cord (plug P2) on CA1 CP shall be stored in POS B of the 6-button keyset, and the lamp shall be removed at POS B			
CA3 Cord	BK-BL	Connect to same term. as W-BL wire J		
		Insulate and store M		
		17 K		
	BK-G		98	
	W-BL	15 F		
		16 G		
		34 H		
CA4 Cord	Store plug P3-P6 on the 6-button keyset (POS C-F) and insulate and store the spade-ended leads, or discard entire cord			
CA5 Cord (D10R-61)	BL-W	1	10	
	W-BL	2	9	
	W-BR	10	6	
	W-G	5	5	
	BR-W	11	4	
	G-W	6	3	
	W-O	7	2	
	O-W	8	1	

TABLE C (Cont)

DATA SET 109H-L1/5 – PRIVATE LINE ARRANGEMENT – WIRING

CORD OR COMPONENT	LEAD OR TERM.	GA1 CP TERM.	GR1 CP TERM.	44A CONNECTING BLOCK TS 1
Spade-ended lead from GR1 CP	90	26		
	91	27		
	93	30		
	95	23		
	96	22		
	100		106	
	101	3		
	102	34		
	108	21		
Spade-ended lead from GA1 CP	32	28		
2245A Transformer (See Notes 6 and 7)	Term. 3 (1)			Term. 1
	Term. 4 (2)			Term. 2
	Term. 5 (3)			Term. 3
	Term. 6 (4)			Term. 4
	Term. 7 (5)			Term. 5
TEL Line				Term. 10
				Term. 9

Note 1: When both ends of a cord are to be connected, two terminal numbers will be shown for each designated lead.

Note 2: All unused spade-ended leads shall be individually insulated and stored.

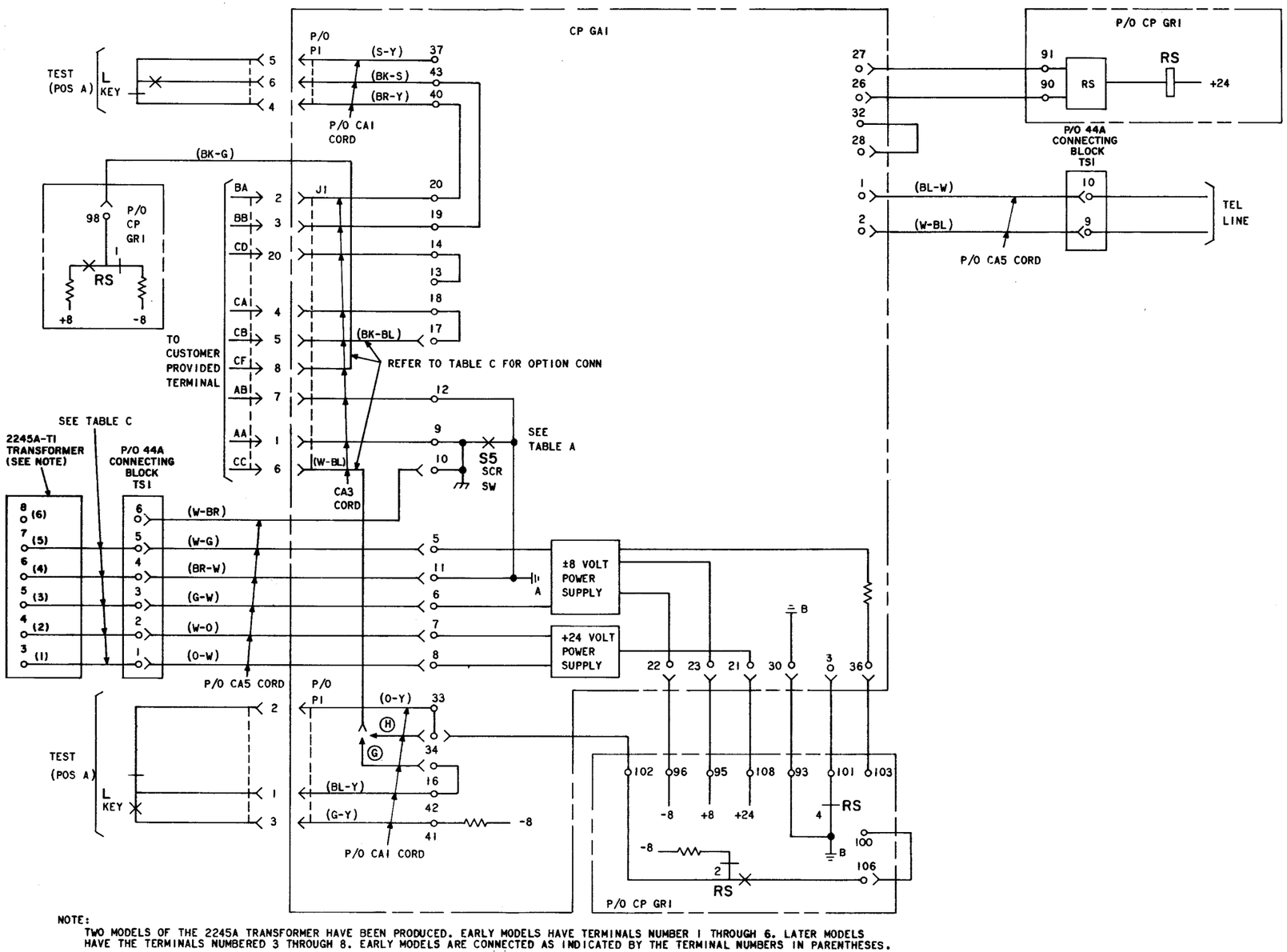
Note 3: Refer to Table A for information on installing options.

Note 4: A circled letter indicates the connection is required to install the option indicated by the letter.

Note 5: Each end of the S-W and W-S leads of cord CA5 shall be insulated and stored.

Note 6: Two models of the 2245A transformer have been produced. Early models have the terminals numbered 1 through 6. Later models have the terminals numbered 3 through 8. Early models are connected as indicated by the terminal numbers given in parentheses.

Note 7: The end of these wires must be stripped and wrapped around the screw terminals of the transformer and connecting block.



NOTE:
TWO MODELS OF THE 2245A TRANSFORMER HAVE BEEN PRODUCED. EARLY MODELS HAVE TERMINALS NUMBER 1 THROUGH 6. LATER MODELS HAVE THE TERMINALS NUMBERED 3 THROUGH 8. EARLY MODELS ARE CONNECTED AS INDICATED BY THE TERMINAL NUMBERS IN PARENTHESES.

Fig. 5—Data Set 109H-L1/5—Wiring Diagram

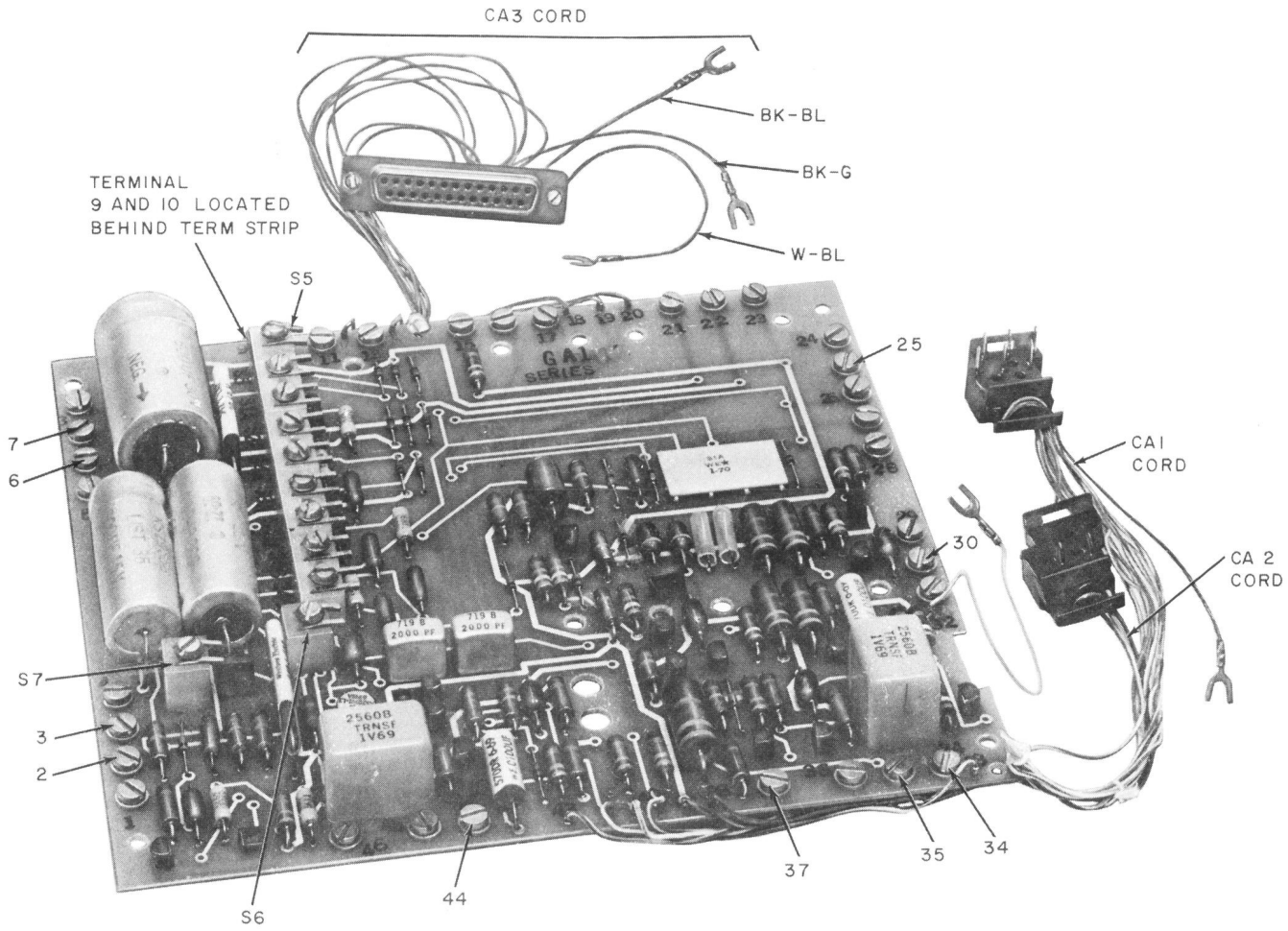


Fig. 6—GA1 Circuit Pack—Location and Identification of Terminals and Spade-ended Leads

4.05 Install the D10R-61 cord (CA5) by making the required connections to the data set and the 44A connecting block (TS-1) terminals. Refer to the applicable wiring table and wiring diagram for information on making these connections.

> ***Note:*** The line must be connected to the data set so that the marking voltages are series aiding. When a connection to a far-end data set can be established, the polarity of the line can be determined and the data set connected as indicated in the following text.

4.06 Connect the loop facility to the 44A connecting block (TS-1). When the line polarity can be established, the negative side of the line will be connected to terminal TS1-10 and the positive side to TS1-9. When the far-end data set has not been connected, the polarity cannot be established. In this case, the line is connected to terminals 9 and 10 and the far-end station will have to have correct polarity with respect to this station.

4.07 To ensure proper operation of a system that uses data sets 109-type, the total **loop resistance must be set** as indicated in the following text.

(a) When full-duplex (FDX) operation is provided, the resistance must be limited to 2000 ohms, which is the optimum resistance for FDX operation.

(b) When half-duplex (HDX) operation is provided, an extended range to 2500 ohms is possible; however, the optimum value is 2000 ohms. With

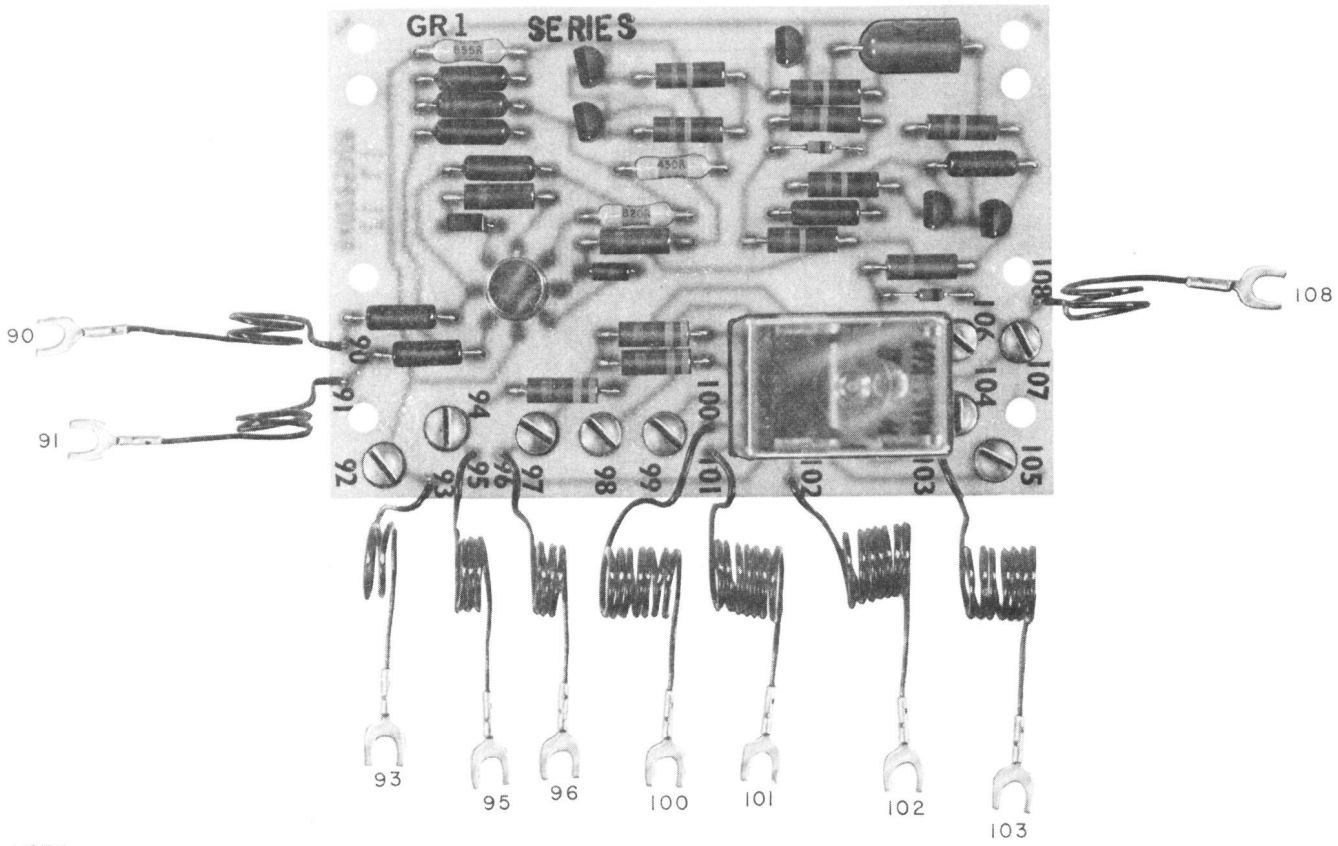


Fig. 7—GR1 Circuit Pack—Location and Identification of Terminals and Spade-ended Leads

the extended range, all padding resistance is removed from both data sets.

ADJUSTING LOOP RESISTANCE

4.08 The following procedure is used to determine the screw switch settings required to adjust the loop resistance when an operative data set 109H-type is connected to the far end.

> ***Note:*** When setting the data set pads by measuring the line current, make sure both data sets are installed and in a marking condition.

(1) Supply power to the data set by plugging in the power cord of the 2245A transformer.

(2) Connect the VOM in series with the data station and set it to measure in the milliamp current range.

(3) When the measured current is greater than 3.2 mA, additional resistance will have to be added to the circuit by opening one or more of the screw switches in each side of the line. If the measured current is less than 3.0 mA, the screw switches will have to be closed to remove some of the pad resistance.

(4) The screw switches are designated S1, S2, S4, and S8 for each side of the line. These switches are always closed and opened in pairs, ie, both of the S1 switches, S2 switches, etc, are opened and closed so that the resistance will always be equal in both sides of the line. The locations of these switches are shown in Fig. 8. Table D gives the resistance provided by these switches.

> ***Note:*** The S1 screw switches can be thought of as representing a basic unit of resistance, and the opening of this screw switch, in each

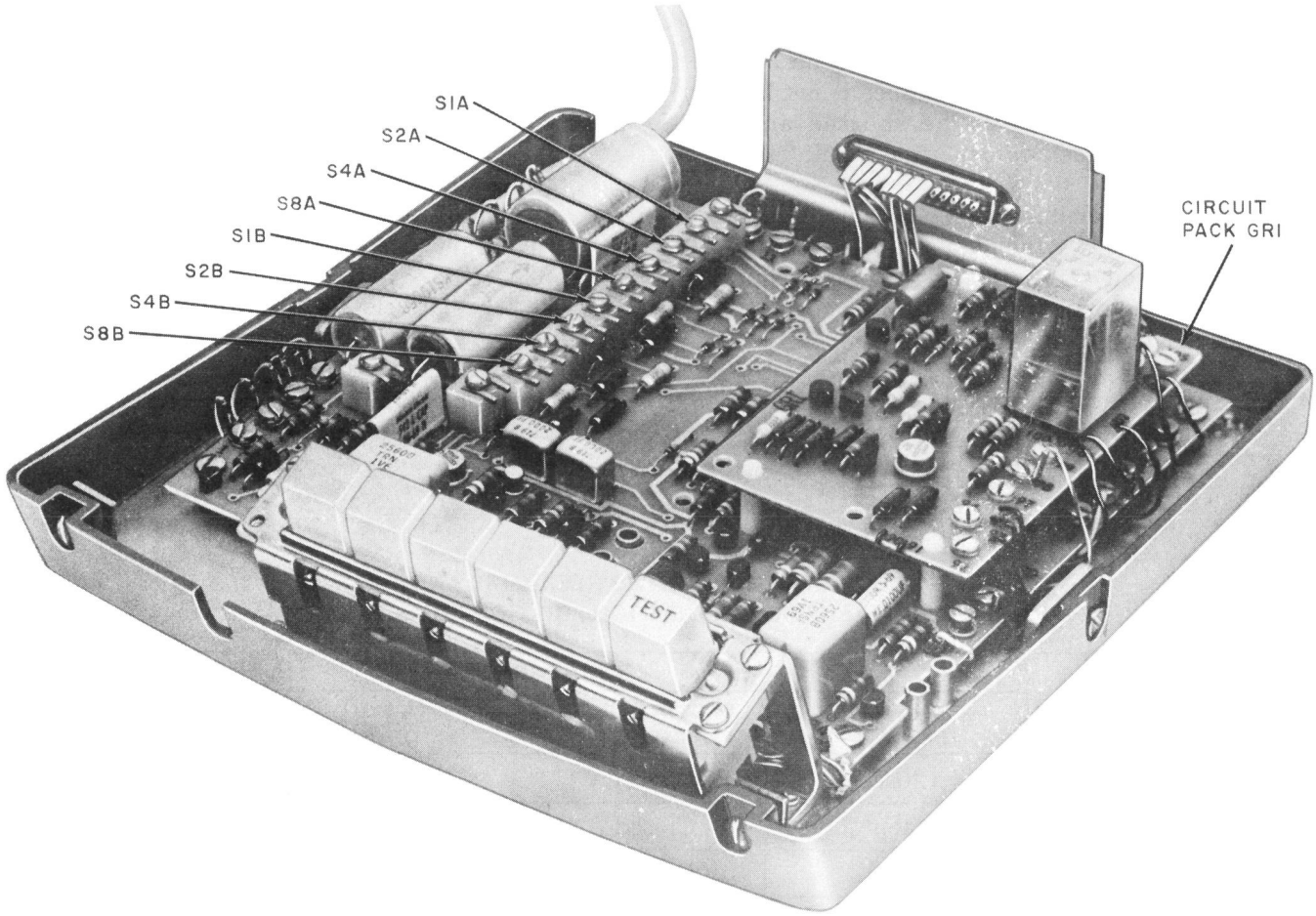


Fig. 8—Identification and Location of Line Pad Screw Switches

side of the line, will add resistance to the line. Therefore, opening the S2 screw switches adds twice as much resistance as S1, opening the S4 screw switches adds four times the resistance of S1, and opening the S8 screw switches adds eight times the resistance value of S1. Closing the screw switches removes the resistance in the same increments. The adjustment procedure may be started with S8 open in both sides of the line and S1, S2, and S4 closed in both sides of the line.

(5) In order to adjust the line current within the range of 3.0 and 3.2 mA, observe the line current and open or close the S1, S2, S4, or S8 screw switch. By observing the change in the current, the amount or resistance that is required can be judged. This trial and error method can be repeated until a current level between 3.0 and 3.2 mA is obtained.

Note: It may be necessary or desirable to split the resistance being added to the loop between the two data sets. When this is the case, the screw switch settings can be made in the same manner to provide only the part of the resistance at one installation; however, the method of determining the resistance required at each end is the same as previously given.

ALTERNATE METHOD OF ADJUSTING LOOP RESISTANCE

4.09 The total resistance for either a local or remote private line installation can be broken down into several components as shown in Fig. 9. The data set pads must be set as indicated in Fig. 9.

Note: The resistance value for the far-end data set can be obtained from the service order. When the line resistance is not known, the line will have to be shorted and the resistance measured using the VOM.

4.10 After determining the resistance that must be provided by the data set, refer to Table D for the line pad screw switch settings required. The location and identification of these screw switches are shown in Fig. 8.

4.11 Set the screw switches as indicated in Table D.

Note: The data set 109H-type screw switches are designated S1, S2, S4, and S8 for each side of the line. These switches are always closed and opened in pairs, ie, both the S1A and S1B, etc, are opened and closed so that the resistance in both sides of the line will always be equal. (Example: If 788 ohms are to be added to the total circuit resistance, S2A, S2B, S4A, and S4B are open; all other switches are closed as indicated in Table D.)

4.12 Reinstall the cover on the data set. Refer to Section 591-037-300 for information on reinstalling the data set cover.

TABLE D

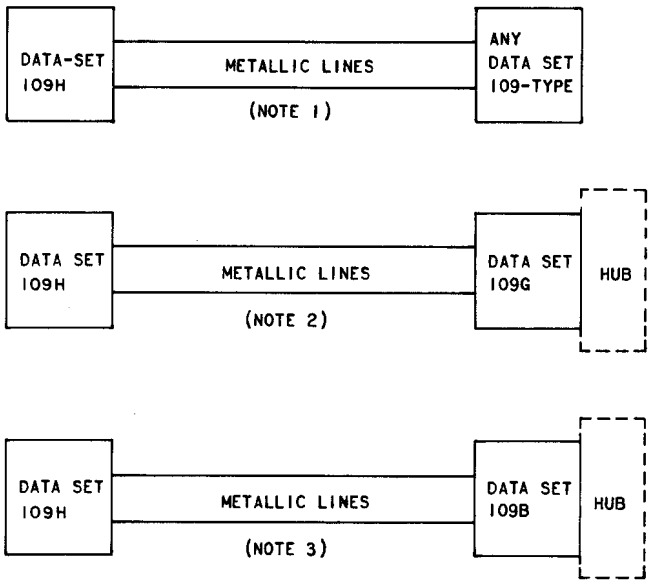
VALUE OF SCREW SWITCH RESISTORS AND RESISTANCE VALUE FOR ALL SWITCH POSITION COMBINATIONS

RESISTANCE VALUE (A) (OHMS)	SWITCH CONDITION			
	S1 (A & B) 136.2 OHMS*	S2 (A & B) 266 OHMS*	S4 (A & B) 522 OHMS*	S8 (A & B) 1022 OHMS*
0	Closed	Closed	Closed	Closed
136.2	Open	Closed	Closed	Closed
266	Closed	Open	Closed	Closed
402.2	Open	Open	Closed	Closed
522	Closed	Closed	Open	Closed
658.2	Open	Closed	Open	Closed
788	Closed	Open	Open	Closed
924.2	Open	Open	Open	Closed
1022	Closed	Closed	Closed	Open
1158.2	Open	Closed	Closed	Open
1288	Closed	Open	Closed	Open
1424.2	Open	Open	Closed	Open
1544	Closed	Closed	Open	Open
1680.2	Open	Closed	Open	Open
1810	Closed	Open	Open	Open
1946.2	Open	Open	Open	Open

* The A designated screw switches are located in one side of the line, and the B switches are located in the other side of the line. In order to keep the resistances equal in each side of the line, the A and corresponding B switch should be operated as a pair and both either opened or closed. The values given in this table show the total resistance of both switches and a closed or open indication means that both the A and B switches are in the condition indicated.

4.13 If power has not been supplied previously, provide power for the data set by plugging in the power cord of the 2245A transformer.

4.14 Connect the terminal device EIA interface connector to the data set. An operational test of the data set can now be made. The data set 109H-type operation can be verified by testing in accordance with the procedures outlined in the section entitled Data Set 109H-Type—Private Line Application—Test Procedures (591-037-500). When an operational test of the data set indicates that the set is performing properly, the installation is completed and no additional testing is required.



NOTES:
1. FOR POINT-TO-POINT SERVICE,THE BALANCE OF 2000 OHMS RESISTANCE NOT FURNISHED BY THE LINES IS EQUALLY DIVIDED BETWEEN THE DATA SETS.
2. WHEN LINE RESISTANCE IS LESS THAN 1500 OHMS,THE DATA SET 109G WILL BE PADDED WITH 522 OHMS AND THE BALANCE OF 2000 OHMS WILL BE PADDED AT THE DATA SET 109H. WHEN LINE RESISTANCE IS 1500 OHMS OR MORE,THE ENTIRE BALANCE OF 2000 OHMS WILL BE PADDED AT THE DATA SET 109H.
3. THE BALANCE OF 2000 OHMS RESISTANCE NOT FURNISHED BY THE LINE IS PADDED AT DATA SET 109H.

Fig. 9—Block Diagram for Typical Private Line Configuration