DATA SET 109F
PRIVATE LINE APPLICATION
INSTALLATION

1. GENERAL

1.01 This practice provides information on the installation and connection procedures required when providing private line service using the data set 109F.

1.02 The data station will be shipped from the service center with the data set already installed in the teletypewriter. Installation of the station requires that the line be correctly connected, the line pads adjusted to provide the proper current level, verification that the proper options or features are provided, and power supplied to the data station.

1.03 The data set 109F derives its power from the TTY. A 3-conductor cord is used to connect the TTY to a 117-volt 60-Hz ac power supply. The customer must furnish a 3-wire outlet that is not under control of a switch.

2. TOOLS AND APPARATUS

2.01 The data station is assembled at the distributing house; therefore, the only special equipment required is a KS-20538-L1 or equivalent volt-ohm-milliameter (VOM). This meter is required to set the line resistor pads to provide the proper line current.

3. OPTION CONNECTIONS

3.01 Before any connections are made to the station, a check should be made to determine that the station is equipped with the proper features and options necessary for this installation. The service order should indicate the features and options being provided for this service.

3.02 The options provided by data set 109F are given in Table A, which shows the letter designation assigned to these options. Table A also indicates the options that are "factory furnished"; ie, the data set is shipped with the options installed. Table A shows only the options that are applicable to private line service.

3.03 The additional features that can be provided by the data set 109F are indicated by the assigned list numbers associated with each data set. Table B shows the feature provided by each list number and the combination of list numbers that are available for private line application. Table B also indicates the applicable wiring table and corresponding figure that can be used to check the options and features being provided by a data set.

3.04 To determine if the proper options and features are provided, refer to the service order, circuit layout record card (CLRC), and Table B. After determining the features and options required by the service order, look up the applicable figure and connection diagram given in Table B.

Note: Options are installed in the data set 109F by first making the connections required to install either the W or V options. The additional options are then installed by making

TABLE A

FEATURE OR OPTION		DESIGNATION
Private line arrangement		Q
Receiver arranged for space crossover shift		Z (See note)
Receiver arranged for mark crossover shift		Y
No crossover shift		X
Full-duplex operation		W (See note)
Half-duplex operation		V
Motor stops upon reception of an end-of-transmission character (EOT) and transmission of a timed space signal (send space timer—SST)	EOT	R (See note)
	SST	T
	EOT & SST	S
Send mark in idle condition		K
Send space in idle condition		M

Note: The options that are indicated by this note are factory-furnished, ie, factory-installed options. The data set is shipped with these options already installed. In order to provide a different feature or option, the wiring of the data set will have to be changed.

TABLE B

REFERENCES

FEATURE	CODE	PRIVATE LINE	
		TABLE	FIGURE
Basic data set (EU2CP and keystrip)	L1	C	1
Data set equipped with ET1 circuit pack (EOT and send space timer)	L1/2	D	2

the connection indicated in the applicable option column.

3.05 The physical locations of the terminals and leads referred to in Table C, Table D, Fig. 1 and 2 are shown in Fig. 3 and 4.

3.06 After checking the data set connections and verifying that the required features and options have been provided, the data station is ready for installation.

4. INSTALLATION AND CONNECTION PROCEDURES

GENERAL

4.01 When connecting the data set, it is important that the line polarity be correct with respect

TABLE C

OPTION CONNECTIONS FOR DATA SET 109F-L1—PRIVATE LINE APPLICATION

LEADS FROM CORD	SPADE-ENDED LEAD COLOR	CONNECTIONS REQUIRED TO INSTALL OPTIONS (See Notes 1 and 2)	
		TERMINALS FOR OPTION W	TERMINALS FOR OPTION V
CA1	BL-W	21	21
	O-W	17	17
	G-W	6	6
	BR-W	10	18
	S-W	28	28
	O-R	20	20
	G-R	1	1
	BR-R	12	12
	S-R	19	19
	BL-BK	16	16
	BR-BK	3	3
	BL-R (M option)	25	25
	BL-R (K option)	21	21
CA2	BL-V	2	10
	O-Y	27	27
	BR-Y	8	8
	S-Y	10	18
	G-Y	17	17
	O-V	See Note 3	See Note 3
	BL-Y	21	21
	S-BK	2	10
Teletypewriter Call Control Unit	W-O-BR	6	6
	W-O-BL	18	2
	W-BK-O	18	2
	W-BK-P	15	15
	W-R-G	9	9
	R-G	15	15
	W-O-G	24	24
	R-BL	15	15
	R	24	24
	R-Y	9	9
	W-P	9	9
	BL	4	4
	W-G	4	4
	O	19	19
	S	1	1
Tip and Ring (to metallic loop)	—	7	7
	—	22	22

TABLE C (Cont)

Note 1: The Z, Y, and X options are provided by screw switches which are opened (screws turned out) or closed (screws turned in) to install the options as follows:

- The Z option is installed by closing the Z switch and opening the Y switch (see Fig. 5).
- The Y option is installed by closing the Y switch and opening the Z switch (see Fig. 5).
- The X option is installed by opening both the Z switch and the Y switch (see Fig. 5).

Note 2: In addition to the connections required to install the W and V options, screw switch W must be closed when the W option is provided and open when the V option is provided (see Fig. 5).

Note 3: These leads must be insulated and stored.

to the far-end data set. Therefore, the state or condition of the far-end data station must be considered in order to connect the data set to the line correctly. In the following instructions on connecting the data sets, the far-end station is assumed to be in a marking condition and conventional current flow (positive to negative) is used in determining the required connections. For a private line installation using data sets 109F-L1 or -L1/2, the line must be connected so that the positive side of the line is connected to terminal 22 and the negative side of the line is connected to terminal 7. The VOM should be used to check polarity of the line and to check that the far-end station is in a marking condition (3.5 to 4.6 volts).

Note: When the far-end station has not been installed, either side of the line may be connected to the designated terminals, and the far-end station will have to be checked for correct polarity at the time of installation.

SETTING OF LOOP RESISTANCE

4.02 The following procedure can be used to determine the screw-switch settings required to adjust the loop resistance when an operative data set is installed at the far end.

Note: When setting the data set pads by measuring the line current, make sure power is supplied to the data sets and that the far data set is transmitting a steady mark.

(1) Connect the VOM in series with the loop of the near-end data station and measure the current by disconnecting the metallic loop lead on terminal 7 and putting the ammeter in series with the loop.

(2) 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.

(3) The screw switches are designated as S1, S2, S4, and S8 for each side of the line. These switches are always closed and opened in pairs, ie, both the S1 switches, S2 switches, etc, are opened and closed so that the resistance will always be equal to both sides of the line. The locations of these switches are shown in Fig. 5. Table E 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 side of the line, will add resistance to the line. Therefore, opening the S2 screw switches

TABLE D

OPTION CONNECTIONS FOR DATA SET 109–L1/2–PRIVATE LINE APPLICATION

LEADS FROM CORD	SPADE-ENDED LEAD COLOR OR NUMBER	CONNECTIONS REQUIRED TO INSTALL OPTIONS (See Notes 1 and 2)				
		TERMINALS FOR OPTION W	TERMINALS FOR OPTION V	TERMINALS FOR OPTION R	TERMINALS FOR OPTION S	TERMINALS FOR OPTION T
CA1	BL-W	21	21			
	O-W	17	17			
	G-W	6	6			
	BR-W	10	18			
	S-W	28	28			
	O-R	20	20			
	G-R			35	35	1
	BR-R	12	12			
	S-R	19	19			
	BL-BK			34	34	16
	BR-BK	3	3			
	BL-R (M option)	25	25			
	BL-R (K option)	21	21			
CA2	BL-V	2	10			
	O-Y	27	27			
	BR-Y	8	8			
	S-Y	10	10			
	G-Y	17	17			
	O-V	(Note 3)	(Note 3)			
	BL-Y	21	21			
	S-BK	2	10			
Teletype-writer Call Control Unit	R-G	15	15			
	R-BL	15	15			
	R	24	24			
	W-O-G	24	24			
	W-O-BR			6	33	33
	W-O-BL (K option)			(Notes 4&5)	31	31
	W-O-BL (M option)			32	31	31
	W-BK-P	15	15			
	W-R-G	9	9			
	W-P	9	9			
	BL	4	4			
	W-G	4	4			
	O	19	19			
	S	1	1			
	R-Y	36	36			
	W-BK-O	18	2			

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, of course, removes the resistance in the same increments.

(4) In order to adjust the line current to 3.0-3.2 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 of resistance that is required can be judged. This trial and error method can be repeated

TABLE D (Cont)

LEADS FROM CORD	SPADE-ENDED LEAD COLOR OR NUMBER	CONNECTIONS REQUIRED TO INSTALL OPTIONS (See Notes 1 and 2)				
		TERMINALS FOR OPTION W	TERMINALS FOR OPTION V	TERMINALS FOR OPTION R	TERMINALS FOR OPTION S	TERMINALS FOR OPTION T
Circuit Pack ET1	37	9	9			
	38			31	(Notes 4&5)	(Notes 4&5)
	39			31	6	6
	40	11	11			
	41			1	1	35
	42	32	32			
	43 (M option)	(Note 4)	(Note 5)			
	43 (K option)	32	32			
Tip and Ring (to metallic loop)	—	7	7			
	—	22	22			

Note 1: The Z, Y, and X options are provided by screw switches which are opened (screws turned out) or closed (screws turned in) to install the options as follows:

- The Z option is installed by closing the Z switch and opening the Y switch (see Fig. 5).
- The Y option is installed by closing the Y switch and opening the Z switch (see Fig. 5).
- The X option is installed by opening both the Z switch and the Y switch (see Fig. 5).

Note 2: In addition to the connections required to install the W and V options, screw switch W must be closed when the W option is provided and open when the V option is provided (see Fig. 5).

Note 3: These leads must be insulated and stored.

Note 4: To install the option in this column in conjunction with option W, connect to terminal 18 on EU2 CP.

Note 5: To install the option in this column in conjunction with option V, connect to terminal 2 on EU2 CP.

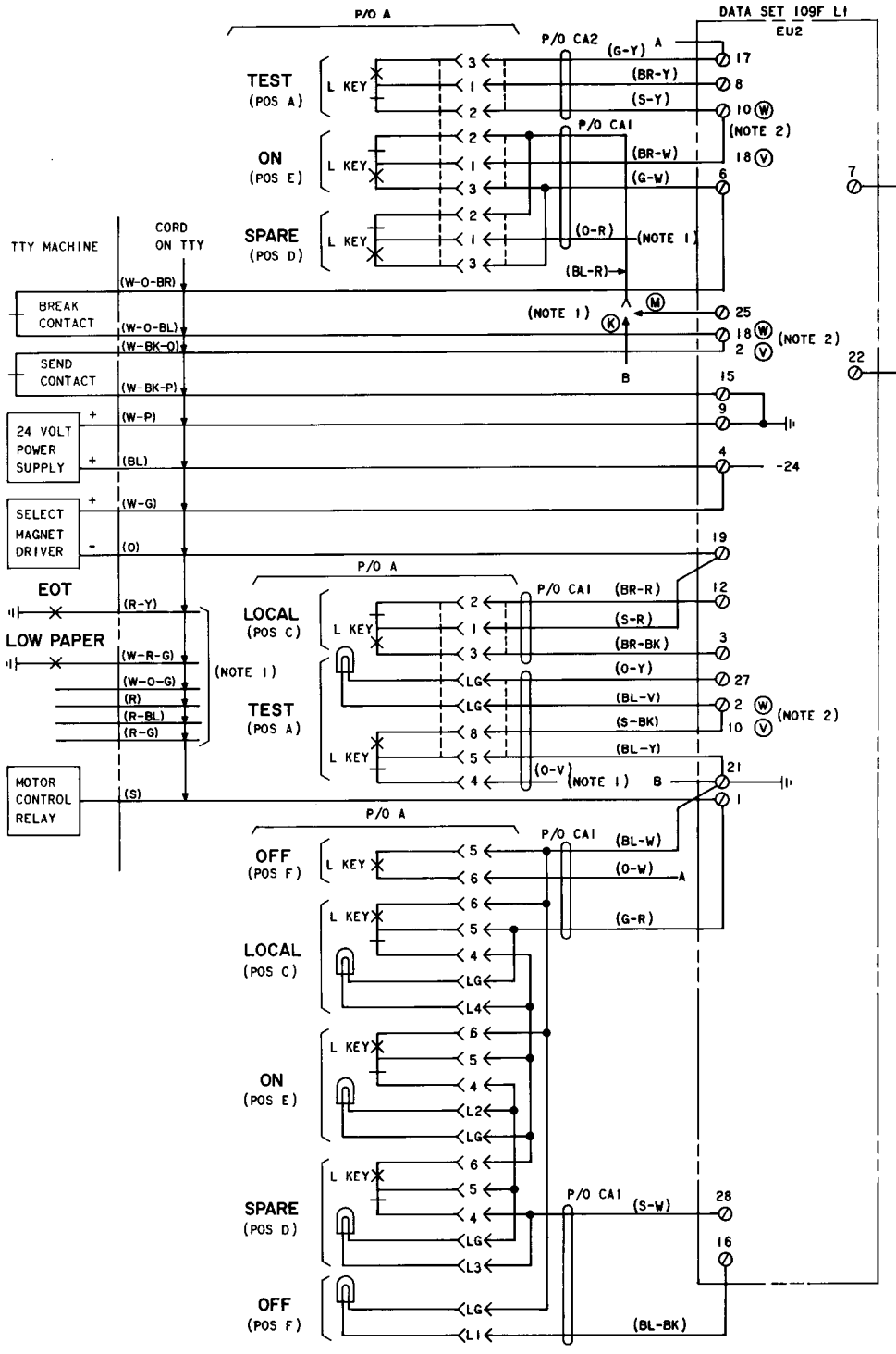
until a current level between 3.0 and 3.2 mA is obtained. This method provides a quick way of adjusting the loop current.

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 (refer to Fig. 6), the screw-switch settings can be made in the same manner to provide only part of the resistance at this installation.

4.03 After making the line connections and setting the resistance pad as indicated in the preceding text, installation of the station is complete, with the exception of an operational test to verify that it is operating properly.

ALTERNATE METHOD OF ADJUSTING LOOP RESISTANCE

4.04 In order to ensure proper operation of a system that uses data sets 109-type, the total resistance must be limited. When full-duplex



NOTES:

1. THE FOLLOWING LEADS MUST BE TERMINATED AS INDICATED BELOW:

SPADE-ENDED LEAD COLOR	COLOR TO TERMINAL
(BL-R)(K-OPTION)	21
(BL-R)(M-OPTION)	25
(O-R)	20
(O-V)	INSULATE AND STORE
(W-R-G)	9
(R-Y)	9
(W-O-G)	24
(R)	24
(R-G)	15
(R-BL)	15

2. TERMINAL NUMBERS FOLLOWED BY AN OPTION DESIGNATION INDICATE THE TERMINAL NUMBER ONLY FOR THAT SPECIFIC OPTION

SPADE-ENDED LEAD COLOR	CONNECT TO TERMINAL	
	W OPTION	V OPTION
(S-BK)	2	10
(BL-V)	2	10
(S-Y)	10	18
(BR-W)	10	18
(W-O-BL)	18	2
(W-BK-O)	18	2

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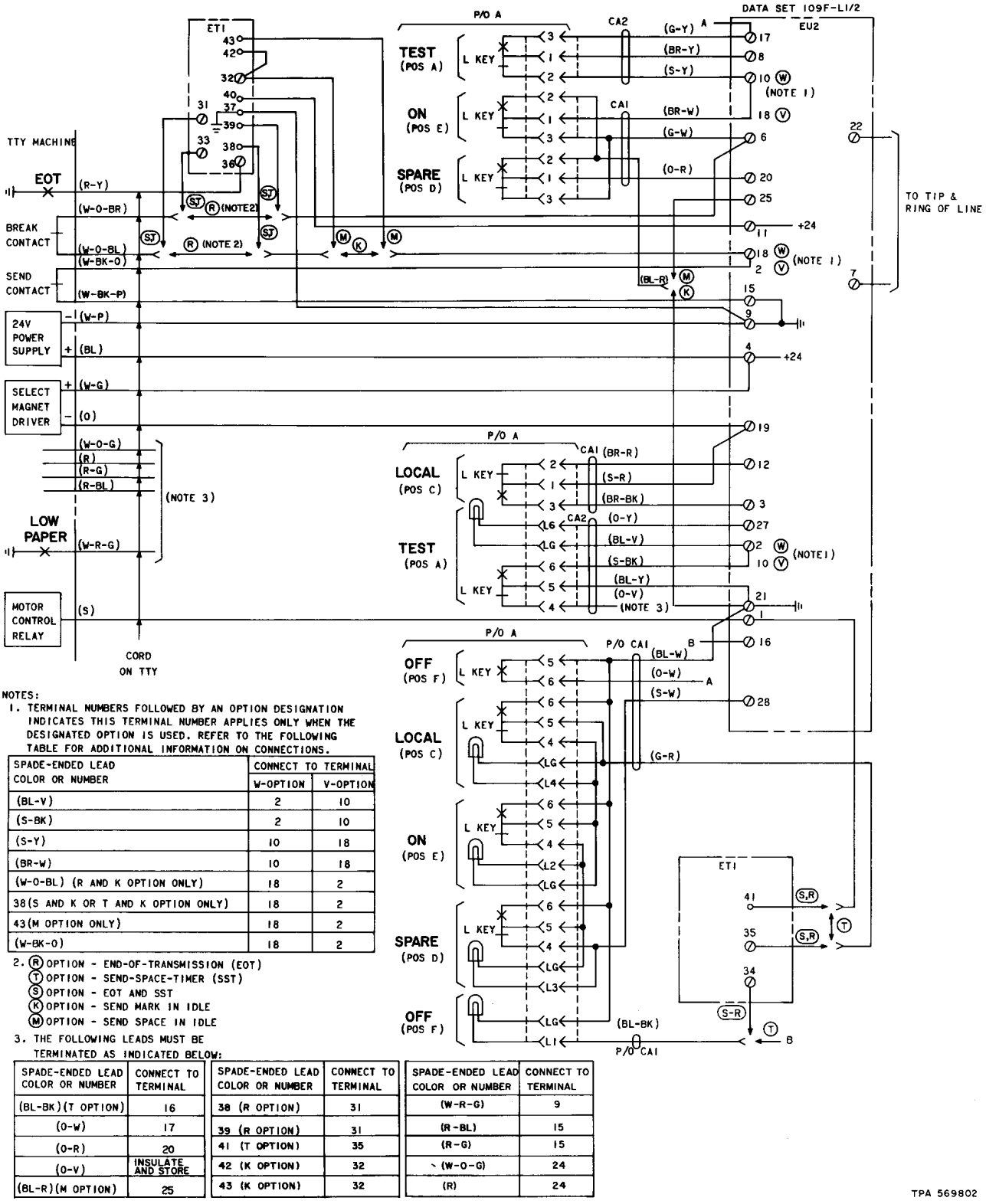
Fig. 1—Data Set 109F-L1—Private Line Arrangement



NOTES:

1. TERMINAL NUMBERS FOLLOWED BY AN OPTION DESIGNATION INDICATES THIS TERMINAL NUMBER APPLIES ONLY WHEN THE DESIGNATED OPTION IS USED. REFER TO THE FOLLOWING TABLE FOR ADDITIONAL INFORMATION ON CONNECTIONS.

SPADE-ENDED LEAD COLOR OR NUMBER	CONNECT TO TERMINAL	
	W-OPTION	V-OPTION
(BL-V)	2	10
(S-BK)	2	10
(S-Y)	10	18
(BR-W)	10	18
(W-O-BL) (R AND K OPTION ONLY)	18	2
38(S AND K OR T AND K OPTION ONLY)	18	2
43(M OPTION ONLY)	18	2
(W-BK-O)	18	2

2. (R) OPTION - END-OF-TRANSMISSION (EOT)
   (T) OPTION - SEND-SPACE-TIMER (SST)
   (S) OPTION - EOT AND SST
   (K) OPTION - SEND MARK IN IDLE
   (M) OPTION - SEND SPACE IN IDLE

3. THE FOLLOWING LEADS MUST BE TERMINATED AS INDICATED BELOW:

SPADE-ENDED LEAD COLOR OR NUMBER	CONNECT TO TERMINAL
(BL-BK)(T OPTION)	16
(O-W)	17
(O-R)	20
(O-V)	INSULATE AND STORE
(BL-R)(M OPTION)	25

SPADE-ENDED LEAD COLOR OR NUMBER	CONNECT TO TERMINAL
38 (R OPTION)	31
39 (R OPTION)	31
41 (T OPTION)	35
42 (K OPTION)	32
43 (K OPTION)	32

SPADE-ENDED LEAD COLOR OR NUMBER	CONNECT TO TERMINAL
(W-R-G)	9
(R-BL)	15
(R-G)	15
(W-O-G)	24
(R)	24

Fig. 2—Data Set 109F-L1/2—Private Line Arrangement

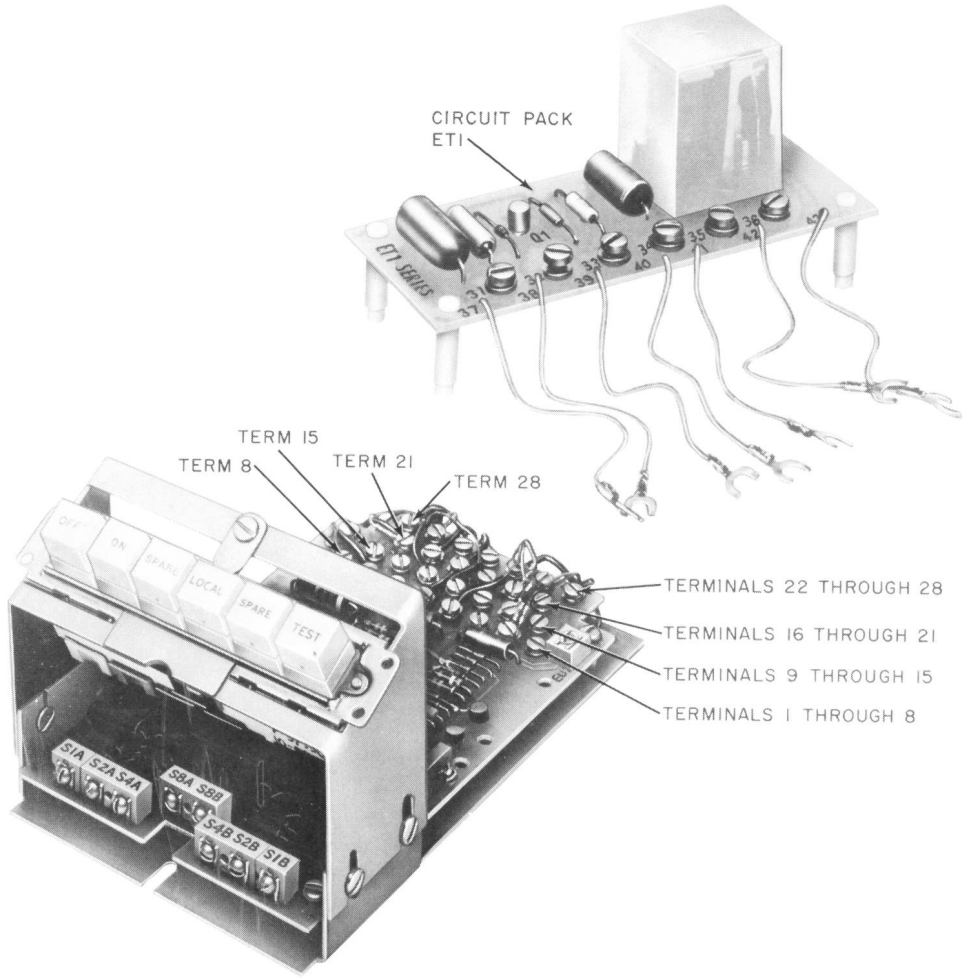


Fig. 3—Data Set 109F-Type Showing Locations and Designations of Screw Terminals

(FDX) operation is provided, the resistance must be approximately 2000 ohms. When half-duplex (HDX) operation is provided, the total resistance may be extended to 2500 ohms; however, the optimum value is still 2000 ohms.

Note: The total resistance must allow a line current of 3.0 to 3.2 mA.

4.05 The total resistance of a private line system is made up of the following parts (refer to Fig. 5):

- The resistance supplied by the near-end data set (data set 109F)
- The loop resistance of the metallic line
- The resistance that can be supplied by the data set at the far end of the loop (any data set 109-type).

4.06 The near-end data set pad is adjusted to make the total resistance of the circuit approximately (within $\pm$65 ohms) 2000 ohms (2500 ohms when extended range HDX service is being provided). The resistance of the near-end data set is determined and established as follows:

(1) Obtain the resistance of the far-end data set from the CLR.

(2) Short the line at the far-end data set and measure the resistance of this loop using the VOM.

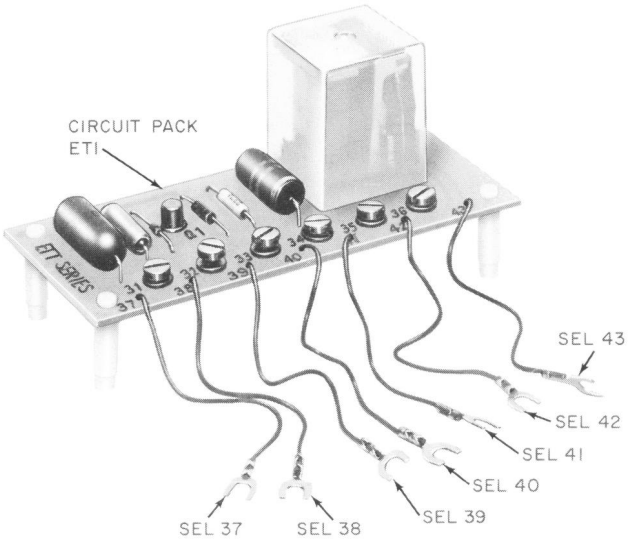


Fig. 4—ET1 Circuit Pack Showing Spade-Ended Leads—Designation

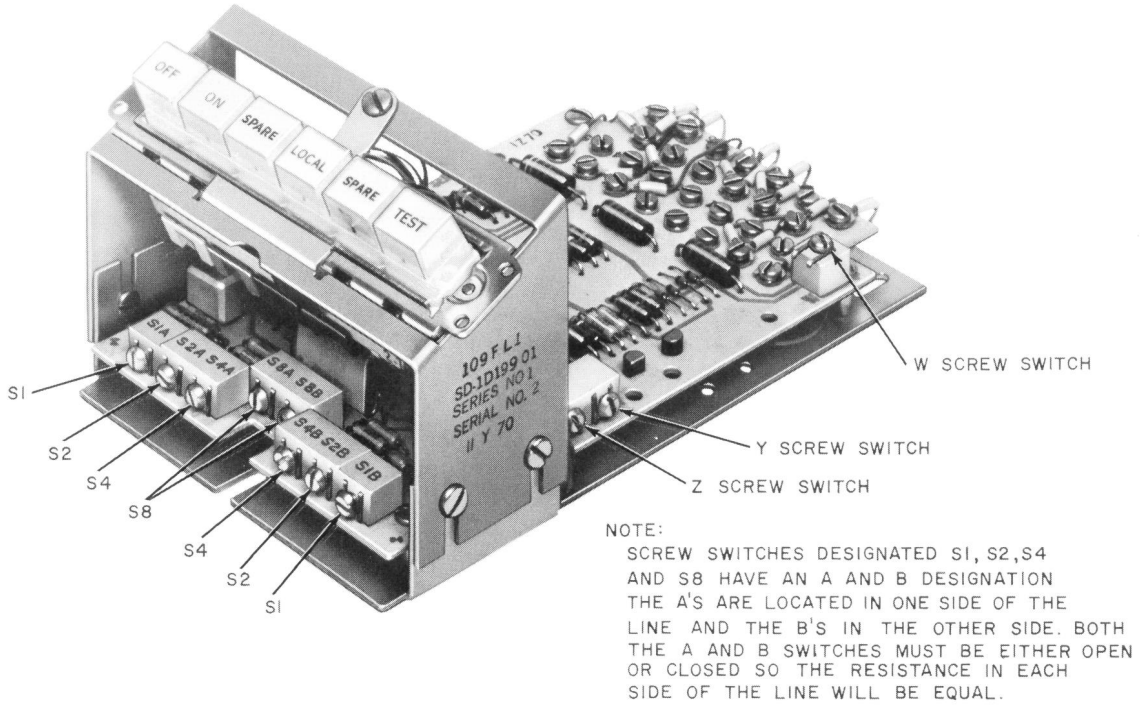


Fig. 5—Data Set 109F-Locations of Screw Switches

TABLE E

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.

(3) Add the resistance obtained in (1) and (2). Subtract this total value from 2000 ohms (2500 ohms when extended range HDX service is provided); the remainder is the value of resistance that must be supplied by the line pads. Refer to Table E and determine the screw-switch settings required to obtain the total loop resistance required, or the amount closest to the required value.

Note: The data set 109F-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 is to be added to the total circuit resistance, S2A, S2B, S4A, and S4B are open; all other switches are closed as indicated in Table E.)

4.07 Make the screw-switch settings as determined in 4.06. The locations of the screw switches referred to in this text are shown in Fig. 5.

Note: An alternate method of setting the near-end data set screw switches is given in 4.02.

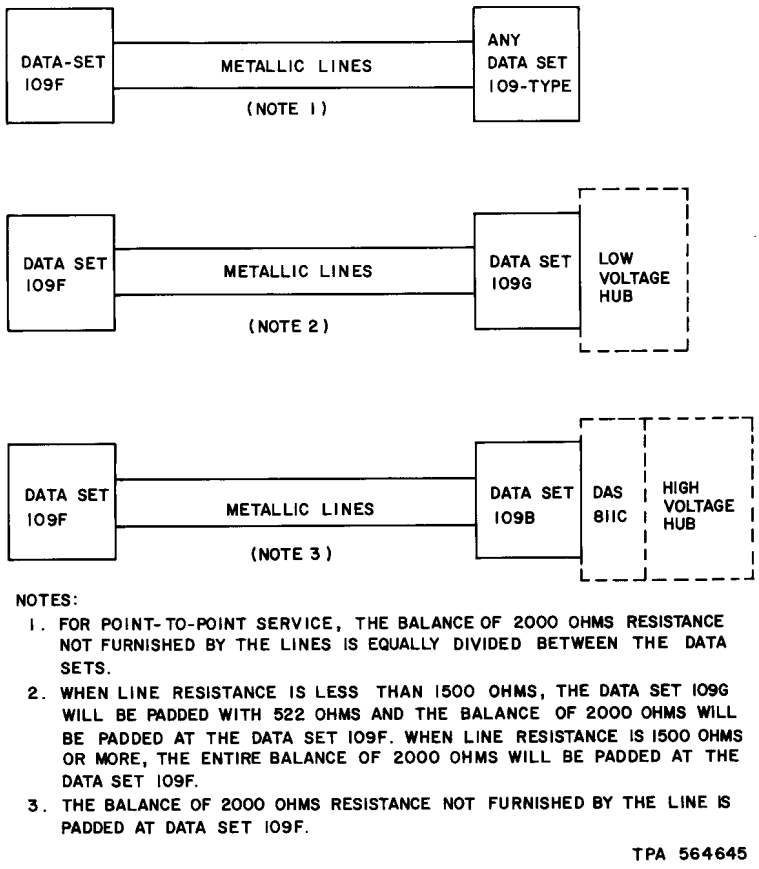


Fig. 6—Block Diagram for Typical Private Line Configurations

5. INSTALLATION TESTS

5.01 When a far-end data set or central office hub is available for testing, the installation can be checked by operating the data station to verify that it can send and receive messages. By placing the far-end data set in the test mode, a test sentence such as "FOX" can be used to verify that the near-end data set, line, and teletypewriter are operative. When the teletypewriter is suspected of causing a trouble condition, it should be tested in accordance with the applicable practices for the type TTY used in this installation. For specific trouble clearing procedures and tests, refer to the sections entitled Data Set 109F—Private Line Application—Maintenance (591-035-300) and Test Procedures (591-035-500).

5.02 Successful operation of the data station with the far-end station precludes the necessity of making additional tests to verify the operational status of the installation.