REPLACING PAGE ADDENDUM
Filing Instructions:

1. REMOVE FROM THE SECTION THE PAGES NUMBERED THE SAME AS THOSE ATTACHED TO THIS PINK SHEET.
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DATA AUXILIARY SET 828C

DESCRIPTION AND OPERATION

1. GENERAL

1.001 This addendum supplements Section 598-080-101, Issue 1. The attached pages must be inserted in the section in accordance with the filing instructions above.

1.002 This addendum is issued to:

- include a method to provide 2-line DDD backup to private line data sets that are not sufficiently sensitive for DDD receive levels (data sets such as 208A and 201C possess this characteristic)
- make additions and corrections to Table D
- reflect changes to power supply information.

2. PHYSICAL DESCRIPTION

The following change applies to Part 2 of the section:

(a) Table D—revised

6. DDD BACKUP CONSIDERATIONS

The following revisions apply to Part 6 of the section.

(a) 6.03.1—added

(b) 6.06—revised

7. POWER SUPPLIES

The following revisions apply to Part 7 of section.

(a) 7.06—revised

(b) Fig. 12—revised

8. REFERENCES

One additional reference has been added to the list of references.

Attached:

Page 13 dated October 1973, revised
Page 14 dated October 1973, reissued
Page 23 dated October 1973, revised
Page 24 dated October 1973, revised
Page 25 dated October 1973, revised
Page 26 dated October 1973, revised

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DATA AUXILIARY SET 828C
DESCRIPTION AND OPERATION

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section provides the description and operating information on data auxiliary set

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(DAS) 828C. This data auxiliary set provides an interface point between Telephone Company-provided 2-wire (2W) and 4-wire (4W) voiceband data sets and the switched network. The 4W data sets use a pair of 2-wire dial-up lines to provide a 4-wire transmission path on the switched network, while 2W data sets use a single 2W dial-up line. The dial-up lines are referred to as DDD lines.

1.02 DAS 828C is typically used to provide switched network backup (DDD backup) to a 4W private line (PL) voicegrade data channel, where the PL is equipped with DAS 828A, or equivalent. DAS 828A is described in Section 598-080-100.

1.03 DAS 828C is designed for use with Telephone Company-provided data sets in conjunction with the DAS 828A or similar locally engineered arrangements. Customers who provide their own data sets are required to access the switched network through Data Access Arrangements. The equipment necessary to transfer customer-provided data sets from the PL to the interface of the Data Access Arrangements should be the responsibility of the customer.

1.04 DAS 828C is used to provide backup for a 4W PL facility terminated by DAS 828A or equivalent. It also provides 4W transmission over the switched network with no private line transmission (without 828A). Other possible variations (eg, 2-wire private line, 2-wire backup) are not discussed in this section, but may be engineered on a local basis. Table A lists the options available for DAS 828C.

A. Functions Provided by DAS 828C

1.05 DAS 828C-L1 provides the following functions:

(a) Connection of a 4W or 2W data set to switched network lines for data transmission

(b) A backup transmission path over the switched network for 2W or 4W data sets normally using 4-wire private line facilities

(c) Control of station using a 6-button key telephone set

(d) Control of "not-in-data" signal to the data set (contact indication)

(e) Ability to control associated DAS 828A so that the 4W PL facilities can be tested via loop-back or used for PL voice transmission while the data set is connected to the switched network backup circuit

(f) Access terminals to connect external equipment

(g) Protection against lightning surges

TABLE A

DAS 828C OPTIONS

OPTION	DESCRIPTION	USE
W	Single line back-up	Provide DDD back-up for 2-wire data set.
X	Not-in-data indication controlled only by 828C. Generates an in-data indication only when in backup mode.	Applications where no private line transmission is required.
Y	Not-in-data indication during setup of call. Generates a not-in-data indication between first and second calls.	Initial use is for 4-wire data set 203A when DAS 828A or equivalent is used in PL. This option forces DS 203 to adjust (retrain) to the DDD backup path or PL path as required.
Z	Terminate modem while in idle state.	Applications where no private line transmission is required.

(h) Attenuation to adjust level of transmitted signal on DDD connection

(i) Ring detection and lamp indication on each DDD line pair

(j) Lamp indication when DAS 828C is in backup mode

(k) Means to exclude stations when in the backup mode

(l) Lamp indication to added stations when in the backup mode

(m) Termination of the data set line pairs in the idle state when private line transmission is not provided

(n) Repeat coils for matching 600-ohm data set to 900-ohm line and for holding lines in backup mode.

B. General Description

1.06 DAS 828C connects the 4W data set to two 2W switched lines (or a 2W data set to a single 2W switched line). These switched lines are hereafter referred to as DDD lines. The switching operation is made through a transfer relay controlled by a key telephone set. The data set is normally connected through the 828C to either the 828A and the 4W PL or to the 600-ohm terminations. When the DDD backup call procedure is followed, the data set is switched from the 4W PL or the terminations and connected to the switched network. For 4W data sets, each DDD line pair provides for one direction of transmission.

1.07 The 828C can be used with either full data (FD) or full data/alternate voice (FDA) versions of the 828A. The FDA arrangement uses a 6-button key telephone set (568HAA) normally supplied with the 828A to control the operation of the 828C. When the 828C is used in an FD arrangement, a locally supplied telephone set, such as a 565HK or equivalent, must be used to control the operation of the 828C, and may also be used to control the loop-back (LB) relay in the 828A.

1.08 An 828C is not necessarily required at each end when DDD backup is used on a 2-point private line circuit. The distant end may use any local arrangement that allows receipt of ringing, line holding, and means of connecting the data set to the dialed-up pairs. This can include an arrangement where automatic answer is provided at the one end if both calls over the two dial-up lines are originated by the station equipped with the 828C.

1.09 Table B is a summary of options and components required for private line with DDD backup.

2. PHYSICAL DESCRIPTION

2.01 DAS 828C used for DDD backup service on PL service is identified by the following list codes:

- 828C List 1 (rack-mounted)
- 828C List 1A (wall-mounted).

A. DAS 828C-L1

2.02 The DAS 828C-L1 shown in Fig. 1 and 2 consists of two units: the repeat coil and ring-up relay assembly shown on the left of Fig. 1, and the transfer, control, and signaling assembly shown on the right of Fig. 2. These units are assembled on hanger bars, prewired, and tested. The two units are interconnected using a 25-pair cable supplied with DAS 828C.

2.03 Connections from the DAS 828C to other units are made as follows (Fig. 2):

(a) Connections to power supplies and DDD lines are made on a 66-type connecting block (TB2) using regular inside wire.

(b) Connection to the data set is made via a standard 50-pin plug (P1) mounted on the 828C. If the 828C is being used with a existing 828A, the connector-ended cable from the data set is merely removed from the 828A and plugged into the 828C. In the event that such a cable is not available, one must be ordered, depending upon the data sets being used. Table C lists the cables required.

(c) Connection of the key telephone set is made via the standard 50-pin connector (J1) mounted on the 828C by means of the cable shipped with the key telephone set.

TABLE B

SUMMARY OF OPTIONS AND COMPONENTS REQUIRED FOR PRIVATE LINE WITH DDD BACKUP

COMPONENT	REQUIREMENT
1. 828C Plug-In (89-type resistor)	Specify value on service order based on loop loss. Refer to Section 598-080-501 for loop loss test and pad verification procedure.
2. 828C Options	Per Table A
3. 828A Options	Use Z for 4-wire data set, X for 2-wire data set.
4. 828A Plug-Ins	Specify and order Section 598-080-200, Tables C through J.
5. 828A Loop-back	(a) For 828A-L1/2 or -L1A/2 (PL data/alternate voice), loop-back is controlled by keyset supplied with 828A. No installer wiring required. (b) 828A-L1 or -L1A (PL data only), specify remote loop-back wiring in the 828A per Section 598-080-200, Fig. 2, if it is desired to operate the LB circuit over the PL simplex pair. (c) For 828A-L1 or -L1A (PL data only), specify wiring per Section 598-080-201, Fig. 2, if local (key telephone set) operation of the LB circuit is desired. Also, order resistor per Fig. 2.
6. Key Telephone Set	Order 565HK unless key telephone set already supplied with DAS 828A.
7. Data Set Options	Specify per Table D. Also select and specify customer and other telco options per data set practice.
8. Data Set Connection to DAS 828C	Specify and order cord per Table C. For data set 202-type, also specify wiring per Section 598-080-201, Fig. 4.
9. Power Supplies	Specify and order per information in Part 7.

(d) Connection to the DAS 828A for PL data transmission is made via a 25-pair connector-ended cable (J3) and for PL voice transmission via a 25-pair plug-ended cable (P3). Both cables are shipped as part of the 828C.

(e) Connection of wiring options and locally provided external equipment is made at TB3. Access to key telephone set and data set leads appears on TB1 and TB2.

2.04 The repeat coil and ring-up assembly consists of two 39A1 data units mounted adjacent to each other. More descriptive information on the 39A1 data unit is given in Section 590-100-130.

2.05 The transfer, control, and signaling assembly consists of a 227B key telephone unit (KTU), a 229B KTU, and a 36A1 data unit. The 227B and 229B KTUs provide switching control of the line circuits and control of the not-in-data indication. The 36A1 data unit provides a ringing relay, a resistance lamp, and a 1C pad socket for housing the pad of DDD line 1. More descriptive information on the 36A1 data unit is given in Section 590-100-127.

2.06 DAS 828C-L1 is intended for mounting on relay racks, on a 16C or 31B apparatus mounting, and in various equipment cabinets, as described in Section 463-140-100. The overall dimensions, assuming side-by-side mounting of the two units, are 6-15/16 inches high, 14-11/32 inches

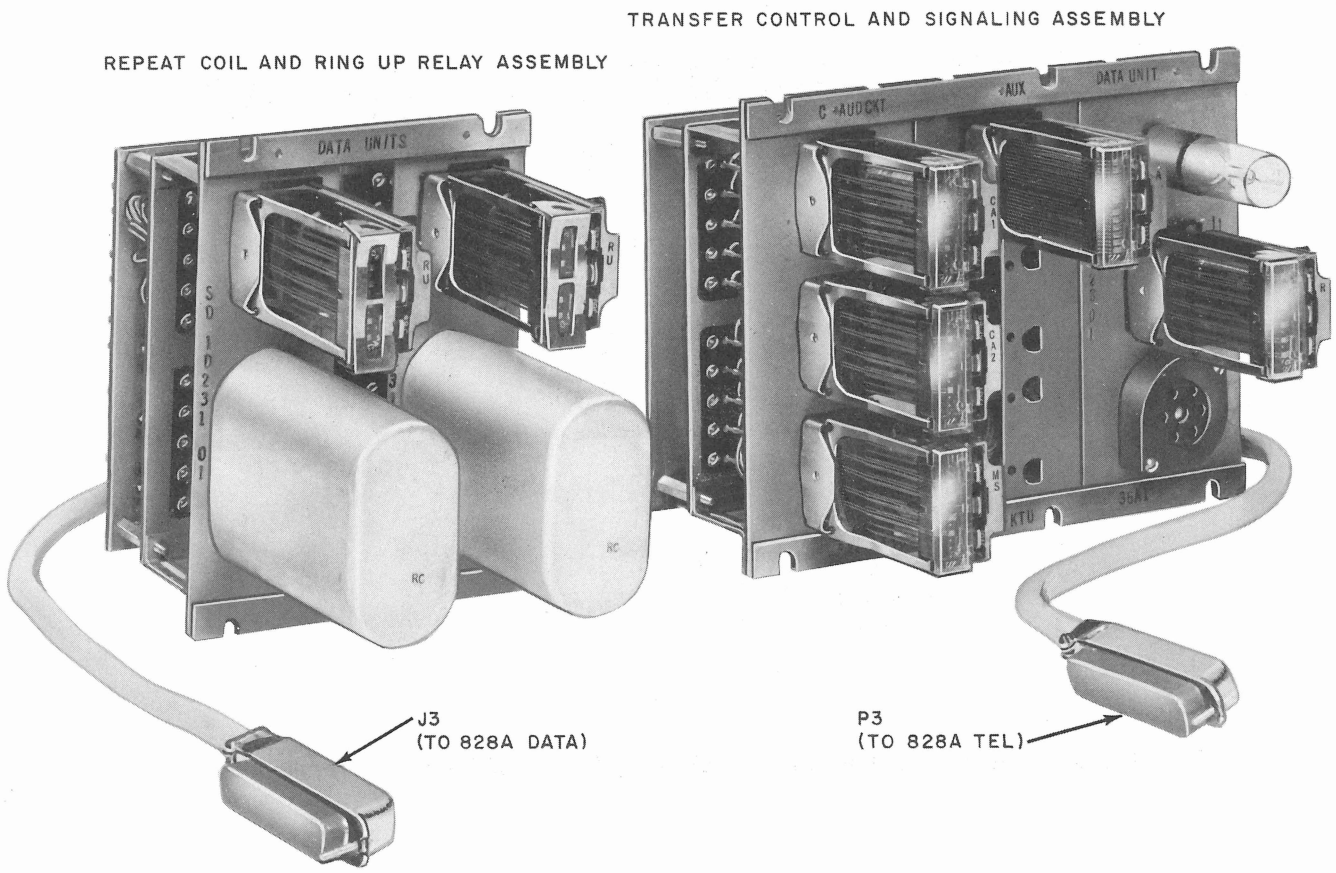


Fig. 1—Front View of DAS 828C-L1

wide, and 8-7/32 inches deep. The combined weight of the two units is approximately 16-3/4 pounds.

2.07 The dimensions of the individual units are as follows:

(a) Repeat coil and ring-up assembly—6-15/16 inches high, 5-7/32 inches wide and 8-7/32 inches deep

(b) Transfer, control, and signaling assembly—6-15/16 inches high, 9-1/8 inches wide and 7-23/32 inches deep.

B. DAS 828C-L1A

2.08 DAS 828C-L1A, shown in Fig. 3, consists of a basic 828C-L1 prewired, tested, and assembled on a 31B apparatus mounting, and is ready to be wall-mounted. The complete enclosure, supplied as part of the DAS 828C-L1A, is composed of the following items:

- 31B apparatus mounting
- 177A backboard
- 116A dust cover
- P-15C309 bracket
- P-48F305 bracket
- P-40J997 cover supports.

The mounting frame is hinged to a 177A backboard, providing access to the rear of the units as shown in Fig. 4. The package arrangement is completed by a light olive gray dust cover (116A).

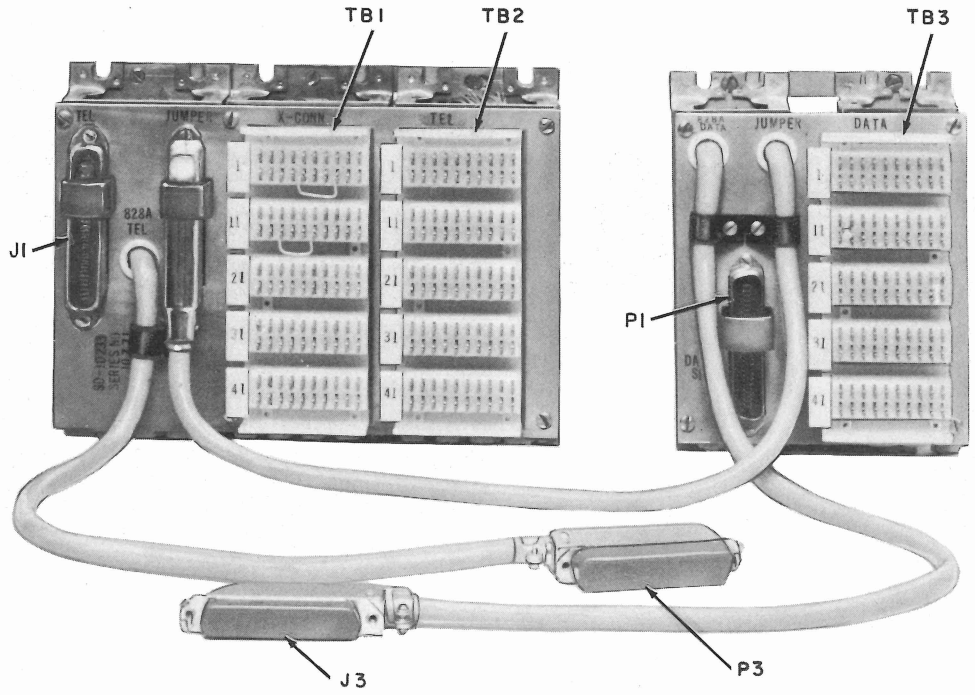


Fig. 2—Rear View of DAS 828C-L1 Showing Connector Cords and Terminal Blocks

TABLE C

CHARACTERISTICS OF DATA SET CONNECTING CORDS

CHARACTERISTIC	DATA SET CONNECTING CORD		
	M6AK-61	M8J-61	D50AA-3
Used with data set	Data Set 201-type	Data Set 203-type	Data Set 202-type
Connector on cord at 828C end	KS-16690-L3 Connector: Mates with A- and B-type connector cables		
Connector on cord at data set end	KS-19087-L2 Connector e/w KS-19196-L2 locking hood (plugs directly into data set)		Spade-tipped leads
Length of cord	5 feet 6 inches		13-1/2 inches, plus 8-inch spade-tipped leads
Color	Light gray		Black

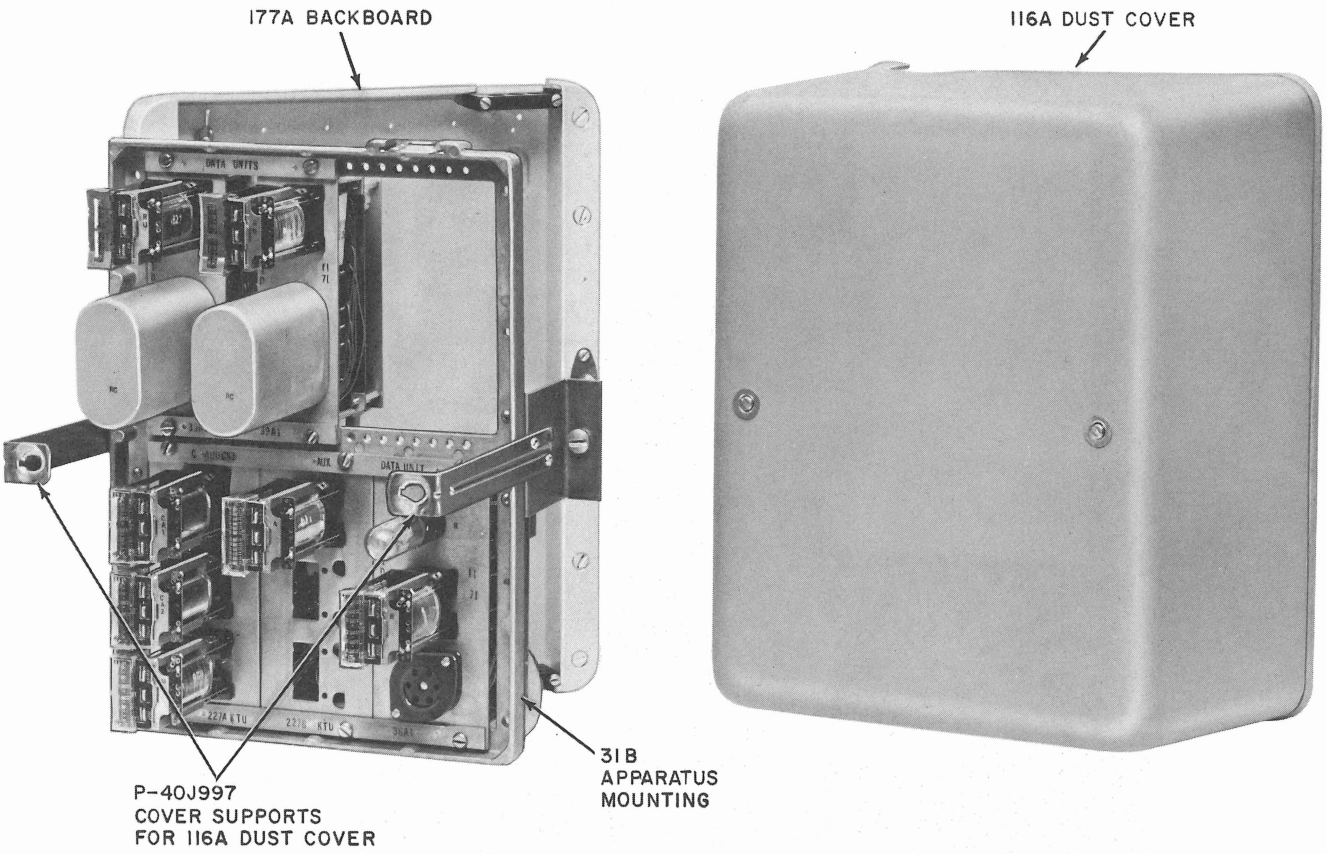


Fig. 3—Front View of DAS 828C-L1A and Cover Assembly

2.09 The dimensions of the unit with the cover in place are 16-5/8 inches high, 13-9/32 inches wide, and 10-1/16 inches deep. The complete assembly weighs approximately 23 pounds.

2.10 A complete installation for 4W FDA with DDD backup, consisting of an 828A-L1/2 and 828C-L1 mounted on a 16C apparatus mounting, is shown in Fig. 5. The plug-in units shown are typical. However, they are not supplied with the 828A and 828C and must be selected and ordered separately. See Table B.

2.11 The 568HAA-3 telephone set (shown in Fig. 5 and 6) is supplied with DAS 828A-L1/2 or -L1A/2 and is used at station locations arranged for FDA and DDD backup. For stations not arranged for alternate voice-data but requiring DDD backup capability, a 565HK key telephone set (shown in Fig. 7) is required and must be ordered separately. More information on these telephone sets is given in 2.12 through 2.17.

C. 568HAA-3 and 565HK Key Telephone Sets

2.12 The 568HAA telephone set (2W/4W) is supplied with the 828A-L1/2 or -L1A/2 when private line voice transmission is required.

2.13 The 568HAA-3 key telephone set contains a 6-button key of the type used with key systems. The telephone set also contains a relay that converts the set from its normal 2W to 4W circuit for talking on the 4W PL.

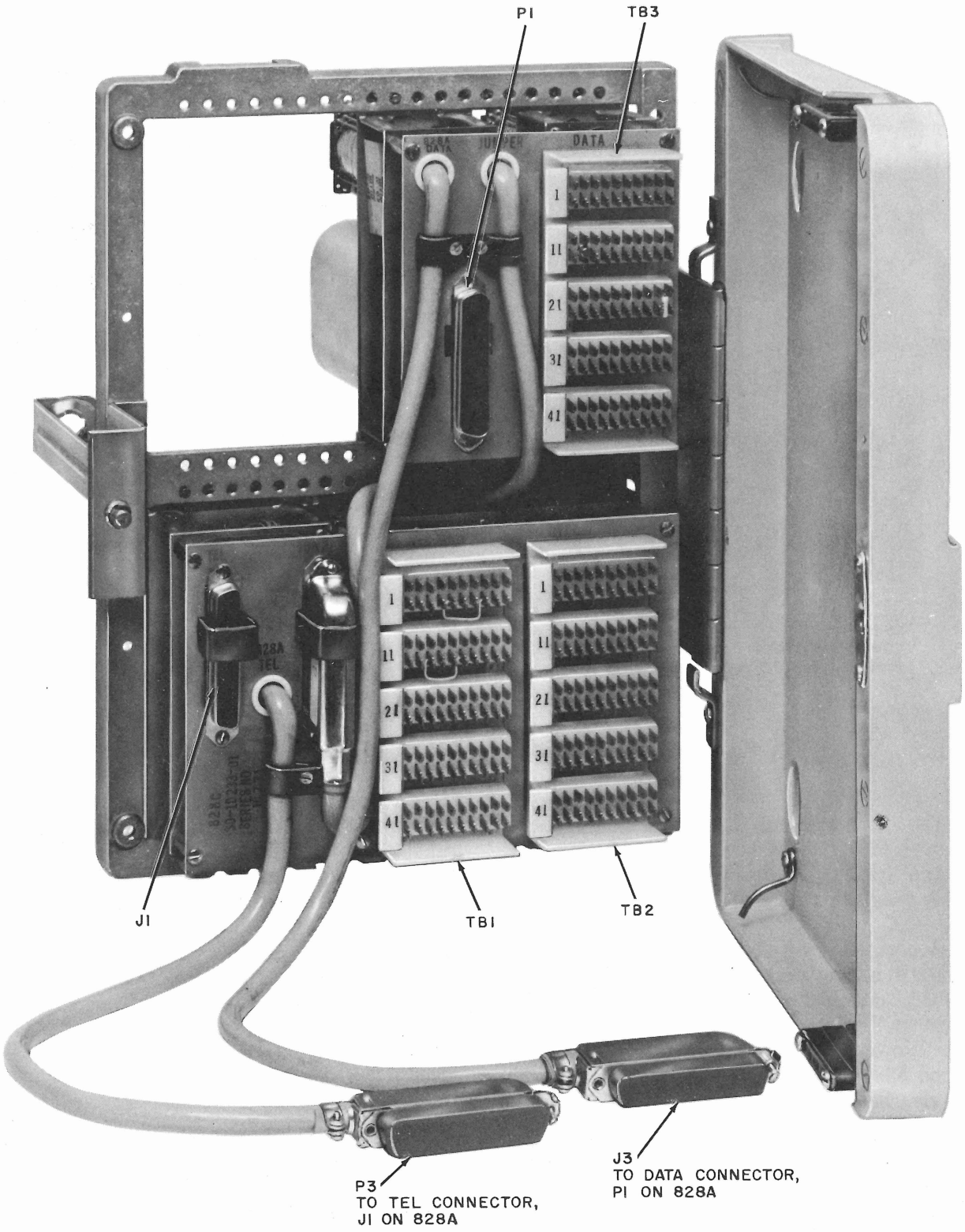


Fig. 4—Rear View of DAS 828C-L1A Showing Connector Cords and Terminal Blocks

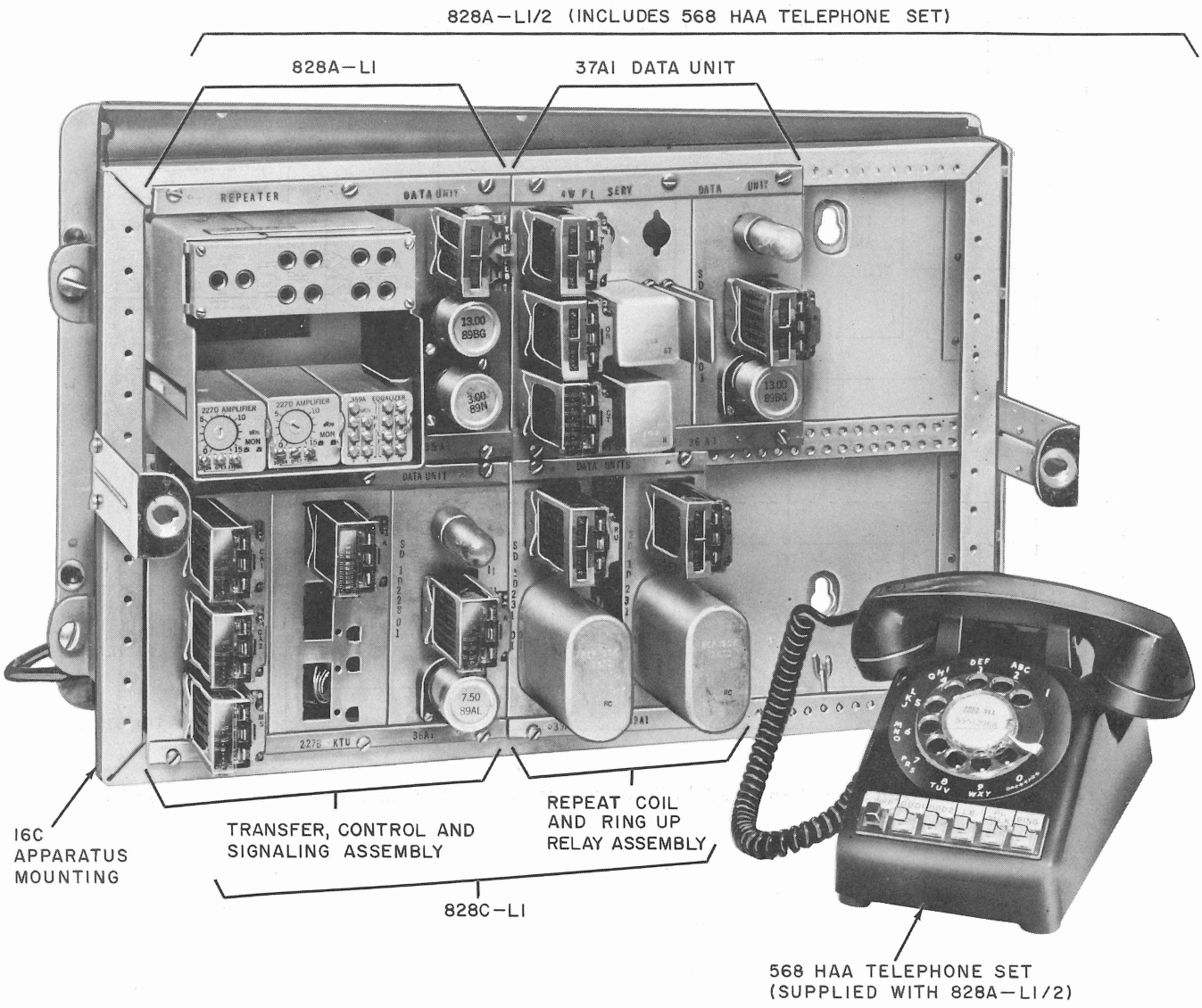


Fig. 5—Front View of DAS 828C-L1 and 828A-L1/2 Shown With Locally Supplied Plug-In Units

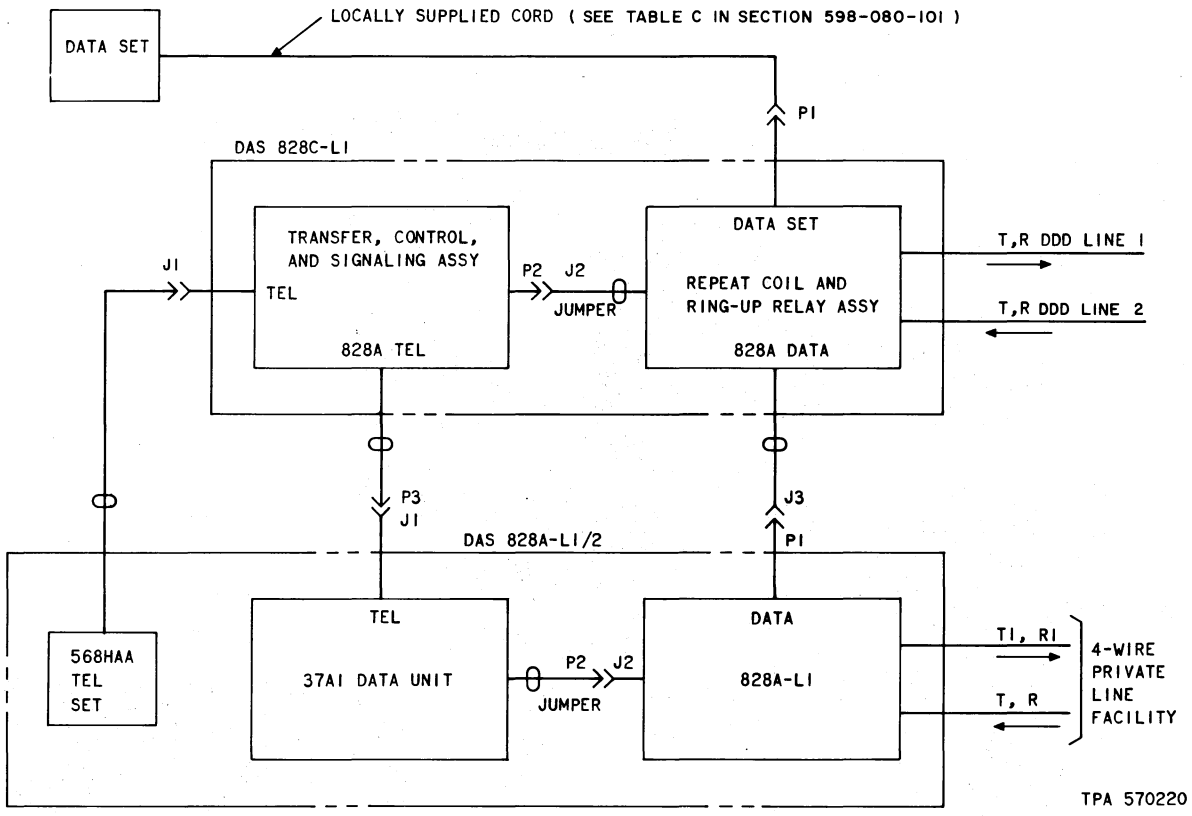


Fig. 6—Circuit Arrangement for DDD Backup of 4-Wire Private Line With Alternate Voice/Data

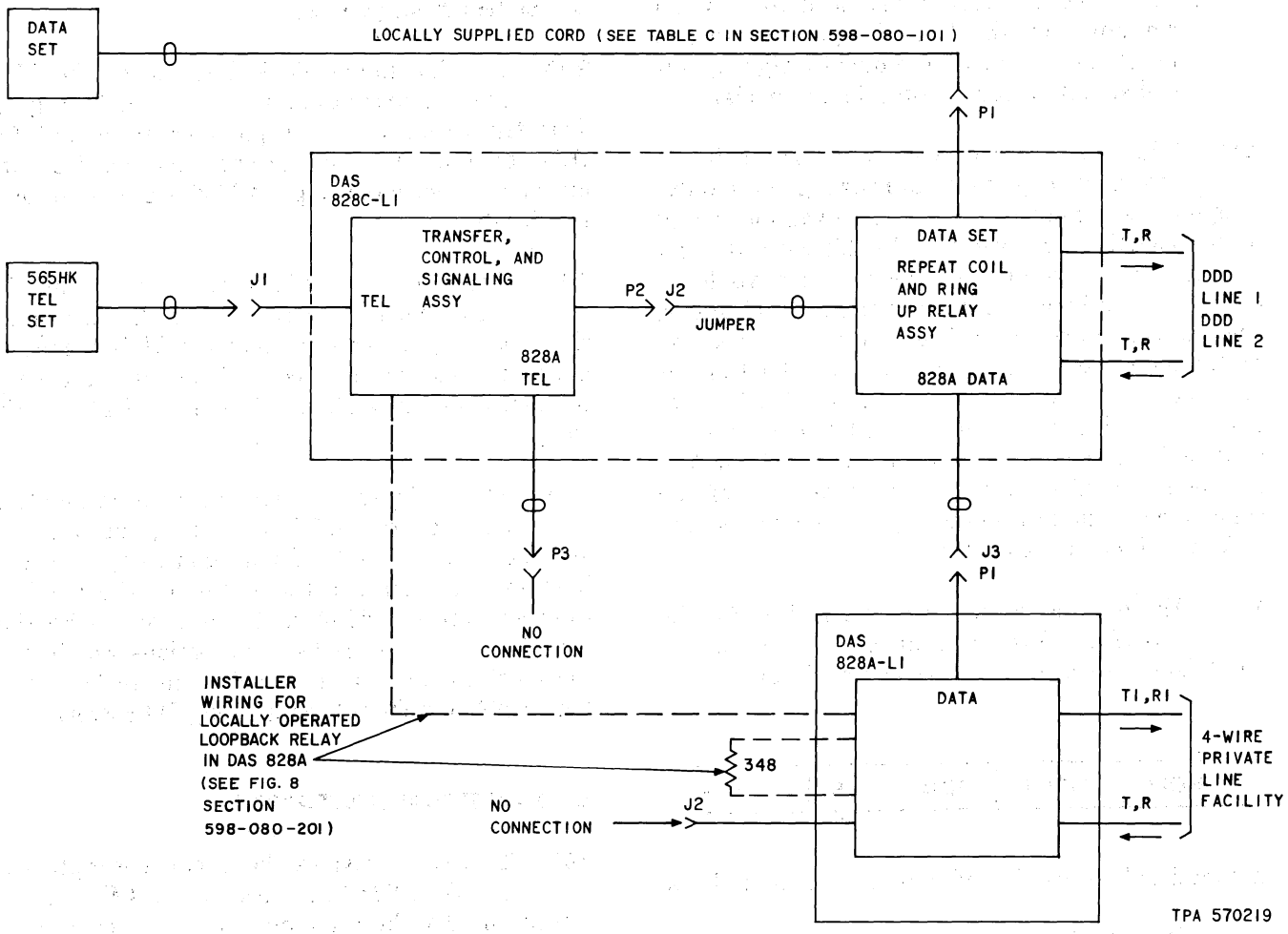
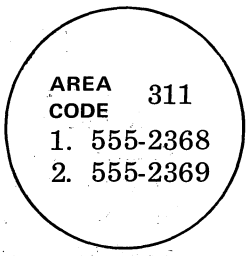


Fig. 7—Circuit Arrangement for DDD Backup of 4-Wire Private Line Without Alternate Voice Transmission

2.14 The line 1 and line 2 directory numbers should be stamped or typed on the dial insert as follows:



2.15 The six pushbuttons on the 568HAA-3 telephone key set must be marked as follows:

HOLD	DDD1	DDD2	LB	PL TALK	RING

A functional description of these keys is as follows:

- HOLD—A nonlocking key used to clear the locking keys and to place each line in the hold mode for backup.
- DDD1—A locking key used to pick up line 1.
- DDD2—A locking key used to pick up line 2.
- LB—A locking key used to operate the line loop-back relay in the 828A.
- PL TALK—A locking key depressed in order to enter the talk mode on the 4W PL channel.

- RING—A nonlocking key used for manual ringdown on the PL. Originating station must be in the talk mode to signal, but called station can be rung in any mode.

2.16 When private line voice transmission is not required, a general purpose (2-wire only) telephone set may be used. An example would be the 565HK telephone set. In this case, the last two or three keys on the telephone set would be blank or could be used for other circuit applications, such as control of spare lines. However, because of telephone set wiring required at the time of installation and given in Section 598-080-201, features using A lead control (such as HOLD) cannot be provided on these spare lines. The 565HK key telephone set also contains a 6-button key of the type used with key systems, and provides line pickup and loop-back control.

2.17 The dial insert should be marked as for the 568HAA. The pushbuttons on the 565HK key telephone set must be marked as follows:

HOLD	DDD1	DDD2	LB	–	–

A functional description of these keys is as follows:

- HOLD—A nonlocking key used to clear the locking keys and to place each line in the hold mode for backup.

- DDD1—A locking key used to pick up line 1.

- DDD2—A locking key used to pick up line 2.

- LB—A locking key used to operate the line loop-back relay in the 828A.

  Note: This key is used only when it is desired to operate the 828A-L1 or -L1A loop-back relay from the station key telephone set. Otherwise, the key is a blank spare.

- BLANK—Spare.

- BLANK—Spare.

D. Station Arrangements

2.18 The functional block diagram of the FDA station arrangement is shown in Fig. 6. This figure shows the typical arrangement for DDD backup of 4-wire private line service with alternate voice/data using DAS 828A-L1/2 or -L1A/2 for the PL.

2.19 The functional block diagram of the FD arrangement is shown in Fig. 7. This figure shows the typical arrangement for DDD backup of 4-wire private line service without alternate voice transmission using DAS 828A-L1 or -L1A for the PL.

2.20 These figures show the interconnection between the 828C, the 828A, the data set and the telephone set. Connection to specific Bell System data sets are the same for the 828C as they are for the 828A and are given in Section 598-080-200. Table D lists the options required in the most common data sets for private line using DAS 828A and DDD backup using DAS 828C.

3. FUNCTIONAL DESCRIPTION

3.01 This part provides the circuit description of the DAS 828C and assumes a 4W data set. Details of 2W data set operation are covered in Part 5. An understanding of Part 3 below is also required.

3.02 The circuit description includes drawings showing various relays, contacts, and switches. The designation and use of these items are as follows:

DESIG	USE IN 828C
CA1	Hold line 1
CA2	Hold line 2
A	Transfer data set to PL
MS	Generate "not-in-data"
RU	Indicate incoming ringing
R	Activate key set ringer

Circuit Description

3.03 The functional circuitry of the 828C-L1 is shown in Fig. 8, along with the 568HAA-3

◗ TABLE D ◖

DATA SET OPTIONS REQUIRED FOR PRIVATE LINE (E/W DAS 828A) AND DDD BACKUP (E/W DAS 828C)

DATA SET CODE	OPTION *(Note 1)*					
	600-OHM IMPEDANCE	0-dBM TRANSMIT	DATA SET RECEIVE LEVEL	DATA SET READY CONTROL	4-WIRE	2-WIRE
201A1, B1, A2, B2	G	ZI	ZF	None	ZN or ZO	ZP, E
201A3, B3, A4, B4	Y	G, ZJ	K	None	ZA or ZB	ZC, V
201A, B LIST CODE	ZJ	X	ZF	None	E or B	A, ZN
201C	ZQ	ZA	ZU	YI	XA, XB, or XC	XE
202D	X	K	None	Remove ZJ option strap TB1 19-23. Leave other ZJ straps installed.	Y, ZH	Z, R, V
202R	None	Screwdriver Adjust	None	None	Y	Z, R, G, K, M
202T	None	None	None	B	ZK	ZD, R, N, G, B, F, ZM
203A	S	ZP	B	YA	Z or Y	*Note 2*
208A	None	None	None	S3C-UP	None	Not provided

Note 1: Consult data set BSP for other options required by customer or Telco.

Note 2: This arrangement is not recommended for use with DAS 828C. Refer to data set 203A BSPs (592-019-ZZZ) for possible arrangements.

telephone set that is normally provided as part of DAS 828A-L1/2 or -L1A/2. The circuitry of Fig. 8 as shown is capable of the functions listed in 1.05.

3.04 The transmit (DT1, DR1) and receive (DT, DR) pairs from data set connector P1 connect to TB3-7, 8 and 9, 10 respectively. The line pairs then pass on to the A relay transfer contacts. With the A relay released, the transmit and receive pairs pass on to the data set interface circuit where they either connect to a 4W private line or are each terminated in 600 ohms as in the case where no private line transmission is provided at the station.

3.05 When the A relay is operated, the data set line pairs are each transferred to a separate path that leads to a dial-up line. Line 1, connecting to TB1-11 and 12, is used for the transmit direction; and line 2, connecting to TB1-21 and 22, is used for the receive direction. With the A relay operated, the data set transmit pair is connected through R3 and R4 to the pad input. The pad is used to set the transmit signal level arriving at the serving central office. From the pad, the transmit line pair passes to the repeat coil that is used to hold the dialed-up connection and to provide impedance matching. From the repeat coil, the line pair passes through the CA1 contacts (if relay CA1 is operated) to DDD line 1. With the A relay operated, the receive pair is connected through R1 and R2 to the repeat coil that provides impedance matching and holds line 2. From the repeat coil, the receive pair connects to DDD line 2 through the operated CA2 contacts.

3.06 Diodes CR1 and CR2 provide lightning protection. Both are bipolar break-down diodes with a voltage rating of 18 volts and a

current rating of 50 amperes surge. The repeat coil provides the series resistance that limits the current applied to the diode.

3.07 Diode CR3 and resistors R1 through R4 are provided for possible future applications which will not be discussed in this section. However, the way these components affect transmission for current applications is discussed in 3.08.

3.08 Diode CR3 has the same characteristics as CR1 and CR2. From a transmission standpoint, diode CR3 has no effect on the signal. Resistors R1 and R2 do affect the signal in that they introduce 0.3-dB loss in the receive transmission path. Similarly, R3 and R4 introduce 0.3-dB loss in the transmit transmission path.

3.09 Access terminals on TB1 are provided in the line side of each repeat coil as shown in Fig. 8. Access terminals on TB3 are also provided on the drop side of the receive line repeat coil. These terminals are provided for any special application required in connecting external equipment.

Interface to DAS 828A and Data Set

3.10 The data set interface circuit connects the 828C to the data set through plug P1 and to the 828A through jack J3. It also provides terminating resistors R7 and R8 and straps required when the 828C is used without a private line.

3.11 The receive pair, DT and DR, from the data set connects through P1 terminals 30 and 5, respectively, and the corresponding terminals 9 and 10 on TB3. From TB3 the receive pair passes on to the line circuits where connection to the switched network can be made through operated contacts of the A relay. If the A relay is not operated, the receive pair connects to terminals 19 and 20 of TB3 and the corresponding terminals 30 and 5 of J3.

3.12 The transmit pair, DT1 and DR1, from the data set connects to P1 and through the line circuit to J3 in a similar manner.

Not-In-Data Indication

3.13 The 828C (and 828A when provided) gives a "not-in-data" indication to the data set whenever data cannot be transmitted. The indication is a contact closure, contact open, or contact closure to a resistor as required by the particular data set. The indications are brought out to pairs of terminals on TB3.

3.14 When DAS 828C is used without the 828A to provide 4W transmission on switched network, certain straps are required in order to make connections that would otherwise be made by the 828A. These straps are designated option X. When DAS 828C is associated with an 828A, the straps must be removed.

3.15 The A relay contacts shown in Fig. 8 are arranged so that when the data set is transmitting and receiving data over the switched network, an "in-data" indication is given to the data set by the 828C. Also, while the 828C is in this mode, any not-in-data indication from the 828A is inhibited. Therefore, the PL may be looped back for testing or may be used for voice transmission while the data set is operating over the switched network. Figure 9 shows the composite 828A/828C circuit.

3.16 When DAS 828C is used without the 828A and with option X installed, the not-in-data indication is controlled by the A relay. When A is released, the not-in-data indication is given. Figure 10 shows this circuit.

3.17 The MS contacts shown in Fig. 8 are used when it is desired to generate a not-in-data indication during the setup of a call, and are only effective when the 828C is used in conjunction with DAS 828A. This transient indication may be used, for example, to indicate to a data set that the transmission path has switched from the PL to the switched network. The data set could use this indication to initiate a startup routine to adjust to the new transmission path. The MS relay may be inhibited from operating by removing a Y option strap shown in Fig. 8. The diode across MS limits the back emf generated when direct current is interrupted.

Ring Detection

3.18 A ring detector circuit and key telephone set line are connected to each 2W pair. Incoming ringing to either idle line operates the corresponding RU relay (RU1 or RU2) shown in Fig. 8. This is turn operates the R relay which causes the key telephone set to ring. The RU relay also causes the line lamp to flash during the

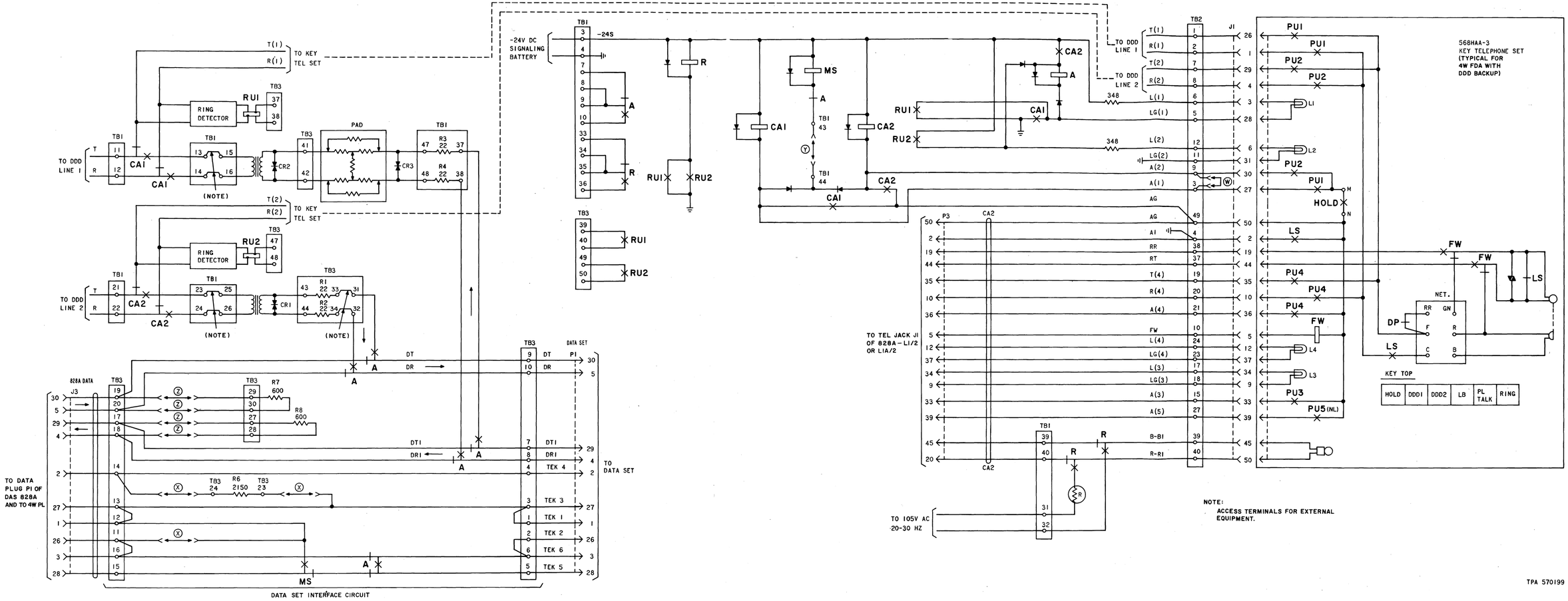


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Fig. 8—Functional Diagram of DAS 828C-L1 for DDD Backup

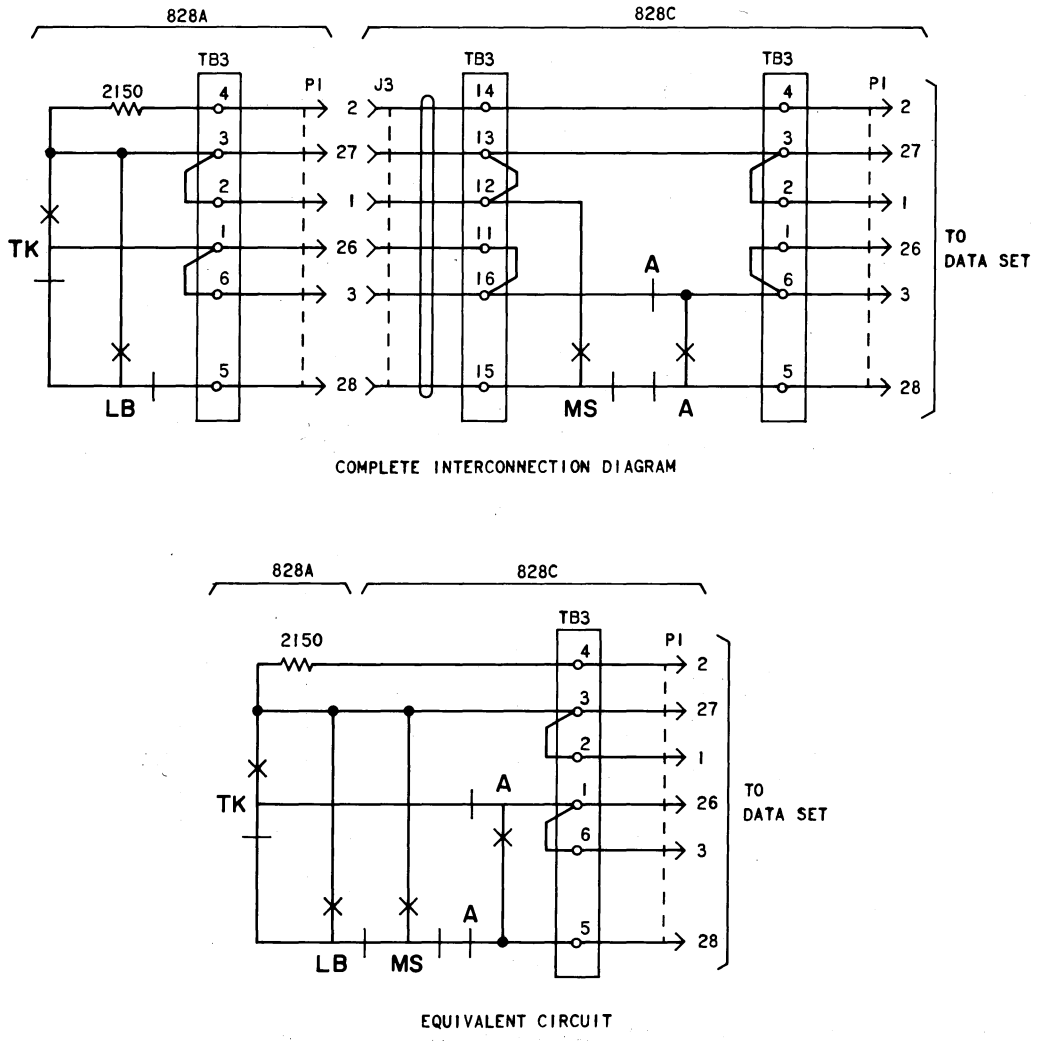

Fig. 9—Composite Circuit of DAS 828A/828C

ringing time. The primary windings of both RU relays are brought out to terminals on TB3-37, 38 and 47, 48 for use in locally engineered applications. The ring detectors and key telephone set lines are connected to the dial-up line pairs only when the CA relays are released. After relay CA1 or CA2 operates, the associated ring detector and line to the key telephone set are disconnected.

3.19 Spare A relay contacts are brought out to quick-connect terminal (TB1) for use as local conditions may require; for example, to light a remote indicator.

3.20 Spare RU1, RU2, and R relay contacts are brought out to quick-connect terminals (TB1 and TB3) for use in local engineering applications.

Key Telephone Set Control Circuits to DAS 828A

3.21 The control leads on plug P3 and the associated keys on the telephone set are used for control and voice transmission in the 828A and have no effect on the operation of the 828C, with the following exceptions:

(a) Depressing the LB or PL TALK key releases DDD1 and DDD2 line keys.

(b) Depressing DDD1 or DDD2 line keys releases LB and PL TALK keys.

Line and Lamp Control in DAS 828C

3.22 The DDD lines connect to the telephone set through the DDD1 (PU1) and DDD2 (PU2)

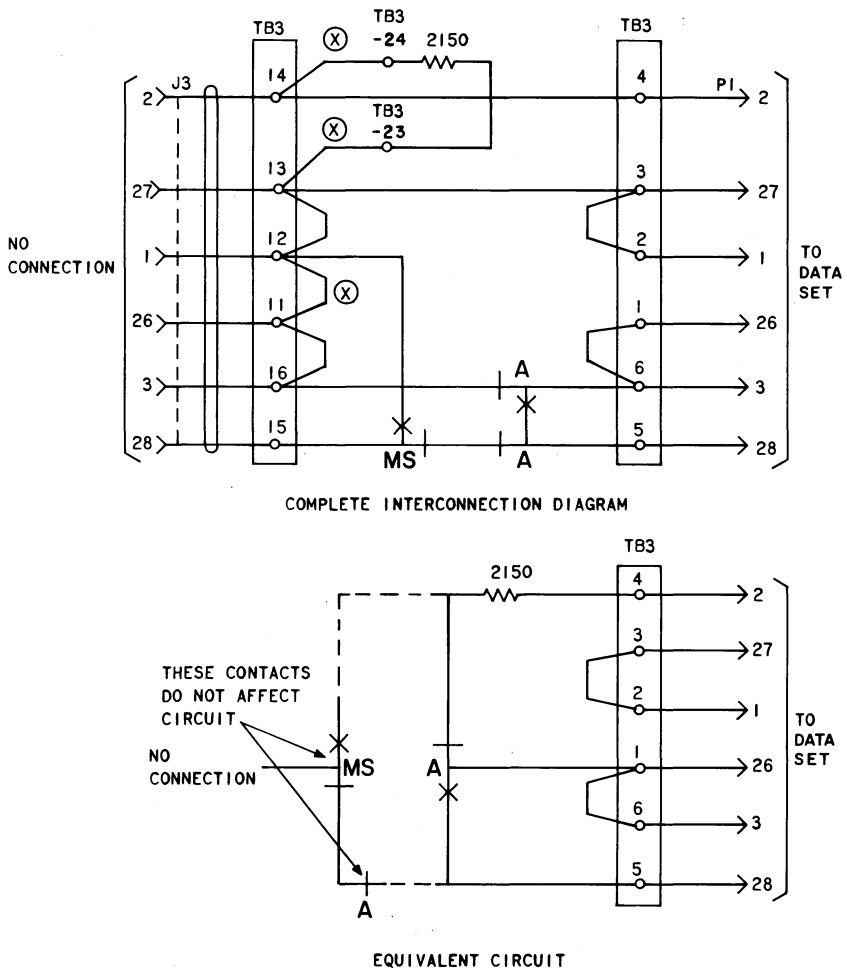

Fig. 10—DAS 828C Control of Not-In-Data Indication

keys, respectively. Depressing either key picks up the corresponding line and connects it to the telephone set network. The lamps associated with either line are controlled through circuits associated with the A, CA1, and CA2 relays as shown in Fig. 8. The lamp circuit is designed so that a line lamp lights when the line is put on HOLD. Both line lamps are lit when the data set is transferred to the switched network.

> ***Note:*** The line lamps ***do not*** light when the lines are picked up for dialing or answering a call.

3.23 Each line pickup key has a contact used in conjunction with the HOLD key to control the line holding circuit. For example, with the telephone set off-hook and the DDD1 key (PU1) depressed, momentarily depressing the HOLD key places a ground on the A1 lead. This ground operates the CA1 relay. As shown in Fig. 8, contacts on the CA1 relay place the repeat coil across the line pair to hold the connection. The same contacts also remove the ring detector and telephone set from the DDD line.

3.24 The A1 lead associated with jack J1 is the signal battery ground. With the telephone set off-hook, the line switch (LS) places a ground on the AG lead that is also associated with jack J1. This lead holds the CA1 and CA2 relays operated as long as the telephone set is off-hook. Therefore, if the telephone set is placed on-hook, the lines are dropped and the data set is returned to the private line or 600-ohm terminations.

3.25 Control of the line transfer and telephone set lamps is accomplished through the CA1

and CA2 relays. The CA1 relay operates when both the DDD1 key is depressed on the telephone set and the HOLD key is momentarily depressed. After the CA1 relay operates, it locks up through its own CA1 contact to the AG lead. The CA2 relay operates in a similar manner. Relays CA1 or CA2 also operate the MS relay as shown in Fig. 8 if option Y has been installed.

3.26 After the CA1 and CA2 relays operate, the A relay is energized. When the A relay operates, it transfers the data set to the dialed-up pairs and applies an "in-data" signal to the data set interface. The A relay also releases the MS relay as shown in Fig. 8 if option Y has been installed.

3.27 Contacts on the CA1 and CA2 relays are also used to light their respective line lamps in the key telephone set. These lamps also light in response to incoming ringing by operation of the RU1 or RU2 relays. Diode logic that is associated with the A relay and lamp operate paths is used to operate both lamps and the A relay by one CA1 make contact and one CA2 make contact.

Use of Private Line While in Backup Mode

3.28 After the data set is connected to the switched network by placing both DDD1 and DDD2 lines on hold, the LB, PL TALK, and RING keys may be depressed and used without interfering with the data transmission. This permits testing on the private line using loop-back or using the private line as a voice channel while the data set is connected to the switched network.

4. CALL SEQUENCE (Fig. 11)

4.01 This part describes a typical call sequence procedure for two stations, A and B. The following conditions are assumed to exist:

(a) The 4W data set is used to transmit and receive data over a private line using a DAS 828A, and the 828C is used for backup service.

(b) Station A initiates the first call on DDD line 1 and answers the second call on DDD line 2.

The sequence provided is not the only permissible sequence. Any procedure is allowable, provided that line 1 of one station is connected to line 2 at the other station. In this manner, either station A or station B could make both calls.

After the calls are established, the telephone set must remain off-hook until it is desired to return to the idle condition which restores the data set to the private line or 600-ohm termination.

Idle State (Start of Sequence)

4.02 The initial conditions at both stations are as follows:

(a) All relays are released.

(b) All key telephone set lamps are extinguished.

(c) Both telephone handsets are on-hook.

(d) The data set is connected through the 828C to the 828A.

(e) Both 2-wire switched pairs are released and connected to their ring detector circuits.

The 828C passes an in-data or not-in-data indication to the data set as determined by the 828A. It is assumed, for this example, that the 828A is conditioned for data transmission and an in-data indication is passed.

First Call

4.03 The call sequence begins by station A deciding that a backup connection should be made. The telephone handset at station A is taken off-hook, operating the LS switch in the telephone set. Line 1 is then selected by depressing the DDD1 key, and the directory number of station B line 2 is dialed.

4.04 The incoming ringing signal to station B causes the DDD2 lamps to flash and the telephone set ringer to ring. Station B then goes off-hook to answer the call and depresses the DDD2 key. This action trips the ringing signal and normal voice transmission can now take place.

Note: Both line lamps on the key telephone set are extinguished.

4.05 Both stations now hold their respective lines by performing the following procedure:

(1) At the station, the HOLD key is depressed. This causes the CA relay to hold the line by placing a repeat coil across the line and removing the ring detector and the telephone set line.

(2) The line lamp illuminates at this time, indicating to the station attendant that the line is being held. At this point, one lamp is lit at each station.

Note: After the line lamp lights, the HOLD key may be released, which releases the PU key. Both stations ***must*** stay off-hook in order to hold the first call.

4.06 If the 828C is wired for option Y, "not-in-data during setup of call", the MS relay operates on either CA1 or CA2 contact closure. This generates a not-in-data signal to the data set.

Second Call

4.07 In this example, station B makes the second call by depressing the DDD1 key, and dialing the directory number of station A line 2. At station A, DDD2 line lamp flashes in response to incoming ringing and the telephone set rings. Station A then depresses the DDD2 key and answers the call. Normal voice transmission can now take place. Both stations then hold their respective lines by depressing the HOLD keys. When the line lamps light, the HOLD keys can be released.

Note: If for some reason the connection is not satisfactory, the second call can be dropped by depressing the first call line key. This releases the second call and the call procedure is repeated.

4.08 After the second call is placed on hold, the respective CA relays operate. This action places the repeat coils across each line and lights the line lamps. In addition, the ring detector and telephone set line are removed.

4.09 After both CA1 and CA2 relays operate, the A relay is picked up. This transfers the data set from the private line to the backup circuit and signal an in-data indication toward the data set.

The telephone sets at both stations must remain off-hook to keep the data set connected to the backup circuit.

Retraining Data Set to DDD Lines

4.10 Assuming that option Y was installed, the return to an in-data condition can be used by the data set to start an automatic adjustment to the backup path. At present, only data set 203-type can use this feature.

Data Transmission Over Switched Network

4.11 The data set now has a complete 4-wire transmission path using a pair of 2-wire dial-up lines. While in the backup mode, the 4-wire private line can be used for loop-back tests or for voice transmission by using the appropriate keys on the telephone set, provided the private line terminates in an 828A. These keys will not interfere with data transmission over the backup circuit.

Return to Idle

4.12 After the private line is again ready for normal data service, the data set may be transferred back to the private line simply by placing the telephone set on-hook. This causes the CA1, CA2, and A relays to release and extinguishes the line key lamps. The 828C is now idle.

Retraining Data Set 203-Type to Private Line

4.13 Again assuming that option Y is installed, data set 203-type can be forced to retrain to the PL by going through the following sequence.

(1) Go off-hook.

(2) Depress either DDD1 or DDD2 button.

(3) Depress and release the HOLD button.

(4) Go on-hook.

4.14 This sequence causes the MS relay to generate a not-in-data signal from the time the HOLD button is depressed until the set is placed on-hook. The data set will again go through a retraining sequence to adjust to the PL path.

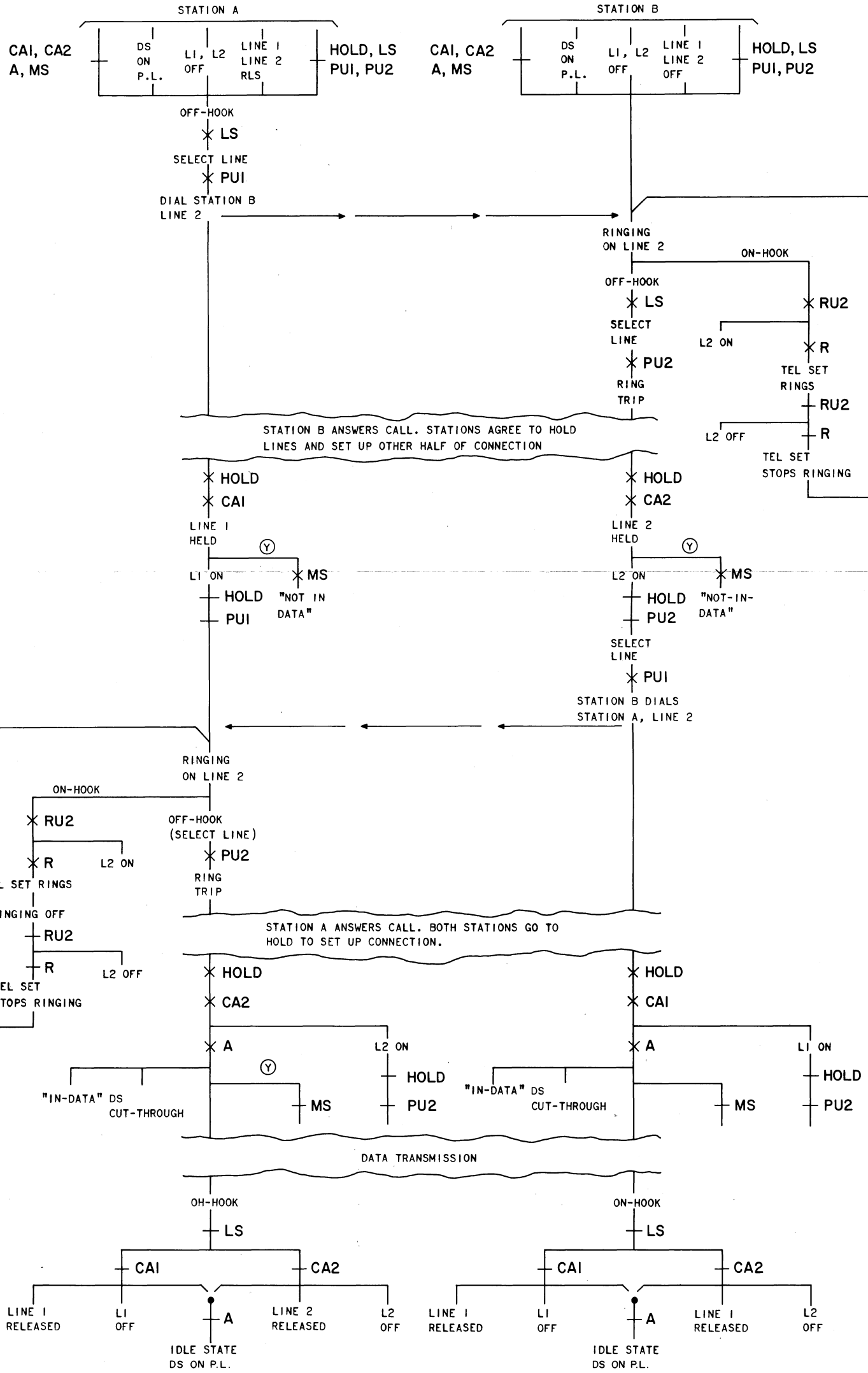

Fig. 11—Typical Call Sequence

5. 2-WIRE DATA SET OPERATION

5.01 Only the transmit pair, DT1-DR1, of the DAS 828C is used for 2W data set operation. In the associated key telephone set, the second line cannot be used and a blocking ring should be installed in the line 2 position.

5.02 To condition the 828C for 2W operation, a strap is made on TB2 from terminal 3 to terminal 9. This connection is designated option W. Reference to Fig. 8 shows that the strap causes both the A(1) and A(2) leads to be operated through the PU1 key. Depressing the HOLD button while PU1 is depressed will cause the 828C to transfer from the PL mode to the backup mode.

5.03 As is the case for 4-wire, the pad in the 828C is used to adjust the transmit level at the serving central office. In a 2-wire configuration, the pad is also in the receive path. However, this does not add excessive loss, and current Bell System data sets (201A, 201B, 202D, and 202R) have sufficient sensitivity to compensate. Table D lists the recommended data set options to provide the proper sensitivity.

5.04 There is no need to provide a ringing supply for a 2W data set installation when the PL facilities are for data only (no alternate voice). The key telephone set ringer may be attached directly to the T1-R1 pair inside the key telephone set.

5.05 The 2W PL data sets pose certain problems with regard to DDD backup and echo suppressors. Refer to 6.07 through 6.10 for discussion.

Data Set Interface Wiring for Data Set 202-Type

5.06 DAS 828C and 828A present identical interfaces to the data set, and with the exception of 2W data set 202-type, the wiring shown in Section 598-080-200 also applies to the 828C. However, data set 202-type uses its T-R pair for 2W operation and therefore, a change is required at data set 202-type to connect the data set T-R pair to the 828C DT1-DR1 pair. To accomplish the change, certain connections at data set 202-type must be made. This wiring is shown in Section 598-080-201.

5.07 Because the 2W data set 202-type now appears on the DT1-DR1 pair, DAS 828A must be wired for option X (rather than option Y, as is the case for data set 202-type with no DDD backup). As a general rule, if the 828C is to be used with an 828A and the data set is 2-wire, the 828A should always be wired with option X.

6. DDD BACKUP CONSIDERATIONS

6.01 Operation of a PL data set over the switched network requires that consideration be given to receiver sensitivity and range, equalization, and polling applications.

Receiver Sensitivity and Range

6.02 In the PL environment, the nominal 1000 Hz receive level is −16 dBm with a possible variation of ±7 dB. Thus, the receiver sensitivity must be at least −23 dBm with a range of −23 dBm to −9 dBm. When operating on the switched network, the nominal 1000 Hz receive level is −23.0 dBm with a range of −13 dBm to −33 dBm. These figures include the loss of the 828C (0.7 dB) and assume a level of −12 dBm at the originating end office.

6.03 In order to adequately cover both private line and DDD applications without requiring gain in the receive path of the 828C, the data set must be able to detect signals in the range of −36 dBm to −9 dBm. Such is the case for current data sets 201A, 201B, 202D, 202R, and 203-type. Table D specifies the data set options that will select the proper range and sensitivity. In some cases, the option also selects a compromise equalizer in the data set.

6.03.1 ▶Some private line data sets, such as data sets 208A and 201C, do not possess sufficient sensitivity to receive DDD signals. They are designed to receive a signal level range of −23 dBm to −9 dBm at 1000 Hz. In this case, a 227D amplifier must be added to the receive side of the DAS 828C to increase the receive level to the data set. This has the effect of shifting the range of the DDD received signal level so that it nearly coincides with the private line receive level of the data set (***from*** −33 dB to −13 dBm ***to*** −23.5 dBm to −8.5 dBm). This arrangement will meet requirements for over 99% of all calls but applies only when the signal level at the sending central office is −12 dBm.◀

Equalization

6.04 Data sets 201A, 201B, and 202D have internal

compromise equalizers that must be selected as specified in Table D when DDD backup operation is desired. Tests indicate that the compromise equalization does not significantly degrade PL performance, and therefore, it can be in the circuit for both private line and DDD transmission.

Transmission Rate on Switched Network

6.05 Performance (error rate) on the switched network may not equal PL performance given the same transmission rate. In some cases, it may not be possible to provide satisfactory performance in the DDD backup mode at the same transmission rate as in the private line. For these cases, a change to a lower speed may be necessary in the DDD backup mode, or if this is not feasible, both private line and DDD may be operated at the same lower speed. Each case must be considered on the basis of the data set and customer terminal capabilities.

Polling Applications

6.06 Certain 4W PL polling applications with data sets ▶201A, 201B, 202C, and 202D◀ use an additional 12-dB or 16-dB pad in the receive path to desensitize the data set receiver. These applications are discussed in Section 314-410-500. Applications such as this are not expected to be arranged for DDD backup, and therefore are not covered in the 828C practice. However, on a local basis, it may be desirable to engineer such an arrangement. In doing so, the private line level, DDD level, and data set receiver sensitivity must be considered.

Echo Suppressors

6.07 The 4W private line facilities for 4W and 2W data sets do not normally have echo suppressors, since they are not required for data sets. Echo suppressors only become a problem when the private line data set is switched to a DDD backup facility.

6.08 Assuming a 4W data set with two 2W lines for backup, the echo suppressors in each DDD circuit should not create any problem since they never have to be turned around. They are always in a state that presents no loss to the line signal (which is always in one direction).

6.09 While operating on the private line, the data set does not encounter an echo suppressor until it is switched to the DDD backup line. At this time, an echo suppressor may be encountered. This requires that for DDD backup operation, the 2W data set use compatible request-to-send clear-to-send timing and receive squelch timing, or send an echo suppressor disabling tone followed by nearly continuous energy. Energy must be maintained in one direction or the other so that there are no gaps in the signal long enough to allow the echo suppressor to be enabled. This time is specified as 100 milliseconds in Bell System Technical Reference entitled "Data Communications Using the Switched Telecommunications Network", dated May 1971, AT&TCo.

6.10 Initiating the disabling tone is generally accomplished in switched network data sets by some sort of line control circuit. Typically, private line data sets do not have this ability. Therefore, the 2W private line data set (assuming DDD backup) must be arranged with the timing features required to allow echo suppressor turnaround. Other arrangements may be possible; however, it is assumed that 2W PL data sets using the 828C for DDD backup have the options installed that provide the proper timing for both PL and DDD. Thus, PL operation may suffer in terms of time delays incurred. In addition, reverse channel or full-duplex operation is not provided. Table D includes the proper options for 2W with DDD backup.

7. POWER SUPPLIES

7.01 DAS 828C does not come equipped with a power supply. One may be selected in accordance with the information given in the following paragraphs.

Current Drain

7.02 The 828C draws no current in the idle state and draws a nominal 220 mA at 24 volts in the backup mode. An additional 25 percent should be added to the nominal to cover line and component variation.

Voltage Limits

7.03 The DAS 828C may be used over the same range of voltage as the 828A (22 to 26 volts dc).

Suitable Supplies

7.04 The power supplies listed in Section 598-080-100 as suitable for the 828A may also be used for the 828C. In addition, DAS 828C may use either 20 or 30 Hz for ringing supply. The comments regarding ac input voltage and frequency limits for 828A supplies also apply to the 828C supplies.

7.05 When the private line circuit is for data only and the data set is 2-wire, no ringing supply is required. The key telephone set ringer may be connected directly to the DDD line being used for backup.

Sharing Supplies

7.06 ▶The dc power supplies previously listed in Section 598-080-100 do not have the capacity to power both a DAS 828A and 828C that together may be providing service on a circuit. Furthermore, the 828C current drain is such that the 828C alone is close to the maximum load that the supply can handle and still remain above the 22-volt lower limit. Therefore, assuming the above supplies, each 828C should be provided with a separate dc supply, and two dc supplies are required to power both DAS 828A and 828C. Supplies having larger current capacity, such as 29-type or 30-type power units, are available and can be used to power both DAS 828A and 828C as long as the voltage and noise requirements are met. These power supplies are listed in Section 598-080-200.◀

7.07 The 828C ringing supply can be shared with other equipment since it presents a light load to the supply. Thus, the 20-Hz supplies listed in Section 598-080-200 may be used on a shared basis between a DAS 828A and 828C. The 828C may also use 30-Hz supplies but the 828A cannot.

7.08 Figure 12 is a typical example of a cabinet-mounted DAS 828C-L1 with a power supply and key telephone set. In this arrangement, the cabinet, hardware, power supply, and key telephone set would be locally supplied.

8. REFERENCES

8.01 The following documents provide additional information on facilities and equipment that may be associated with DAS 828C.

SECTION	TITLE
CD&SD-1D233-01	Data Systems—Station Data Auxiliary Set 828C
502-541-415	Multiline Service Practices—500 Series—565HK
502-541-425	Multiline Service Practices—500 Series—568HAA
590-100-127	36A1 Data Unit—Identification
590-100-130	39A1 Data Unit—Identification
598-080-100	Data Auxiliary Set 828A—Data Service Unit—Description and Operation
598-080-181	Data Auxiliary Set 828C For 4-Wire Voiceband Data Transmission — Summarizing Specification—Data Systems
598-080-201	Data Auxiliary Set 828C—Installation and Connections
598-080-501	Data Auxiliary Set 828C—Test Methods
999-100-128	▶How to Operate the 828-Type Data Auxiliary Sets Using a Key Telephone Set◀

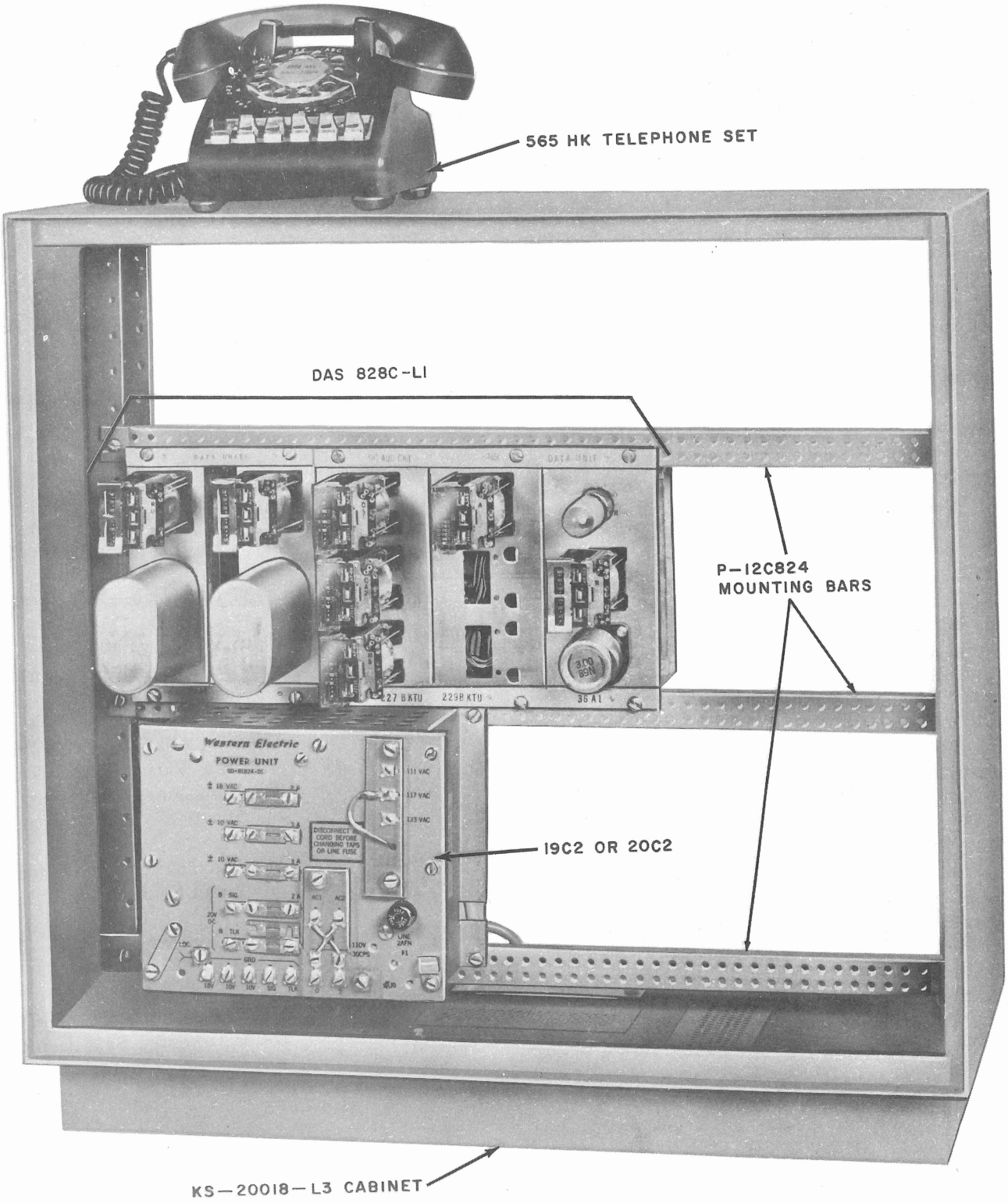

Fig. 12—Front View of Cabinet-Mounted DAS 828C-L1 Equipped With Locally Supplied DC Power Supply and Plug-In