VOICE BANDWIDTH PRIVATE LINE DATA CIRCUITS

DESCRIPTION

CONTENTS PAGE

Figures

1. GENERAL

1.01 This section describes the voice bandwidth (300-3200 Hz) channels used for private line (PL) data services. Voice bandwidth data is defined as data signals occupying a single voice-frequency channel (approximately 300 to 3200 Hz or less with some types of facilities). These services include

NOTICE
Not for use or disclosure outside the
Bell System except under written agreement

data, telemetry, and alternate voice/data service; for example, 2001 and 3002 channels covered by FCC Tariff No. 260. These channels may be used to provide 2-point, multipoint, and certain switching arrangements. The information in this section includes the description of various types of conditioning that can be obtained on these different channels.

1.02 This section is reissued to update and realign information consistent with the Data General Layer, 314-010-ZZZ. Since this is a general revision, no revision arrows have been used to denote significant changes.

1.03 Descriptive information common to the transmission of data on the Public Switched Network (PSN), private line (PL) services, and Switched Service Networks (SSN) is covered in the following sections:

- Data General—Analog Transmission Parameters—Description (Section 314-010-100)
- Data General—Data Testing Principles (Section 314-010-101)
- Data General—Data Services Support (Section 314-010-102)
- DataGeneral—Interconnection/Interpositioning (Section 314-010-103).

A basic understanding of the Data General Sections is recommended prior to the use of this section.

1.04 The references to various related voiceband data maintenance sections are given in Fig. 1. Voice-only operation is not covered in this section but may be found in the Division 310 and 311 series of practices.

1.05 There is no difference technically in the transmission requirements of the 2000 series channels when ordered for data operation and those of a 3002 channel, except in some cases (such as PBX tie trunks) for standard 1004-Hz loss. The difference arises from applications that are described in FCC Tariff No. 260 and the local administration of these channels. The 2000 series of channels may be connected to exchange and toll services, but the 3002 channel must not.

1.06 Although operation of these services is basically 2-point, certain multipoint and switched arrangements are also used. One-way, half-duplex, and full-duplex modes may be used. Both 2-wire and 4-wire facilities and terminals are employed. Where 4-wire facilities are used, an equal-level loop-back arrangement is specified in all cases.

2. APPLICATION OF PROTECTIVE ARRANGEMENTS

2.01 The standard means of terminating PL data channels is with the data auxiliary set (DAS) 829 channel interface unit (CIU). The DAS 829 provides signal level adjustments and equalization as required. It also provides maintenance features, such as test jacks and equal-level loop-back capability. These functions are necessary in providing and maintaining the service, and the DAS 829is therefore required in all installations involving Bell System and customer-provided equipment (CPE).

2.02 Protection of the network from hazardous voltages and longitudinal imbalances is provided by inherent characteristics of the DAS 829. That is, the protection is assured by components (diodes, transformers, fuses) which are an integral part of the device and essentially used in its other functions. Signal level protection is provided at the central office (CO) by means of surveillance. Customer transmit levels are not usually sources of trouble on PL data channels. PL data channels are designed for a fixed overall loss of 16 dB, and therefore the customer does not have the incentive to raise the signal level to improve performance.

3. CHANNEL INTERFACE UNITS (CIU)

A. General

3.01 The DAS 829 is the Bell System standard CIU for terminating 4-wire PL voiceband data channels. Other types of station equipment may be specified and are generally similar in function, such as the older DAS 828. The work order record detail (WORD) document should indicate the type of station equipment to be used to provide protection against potentially hazardous voltages and longitudinal imbalance.

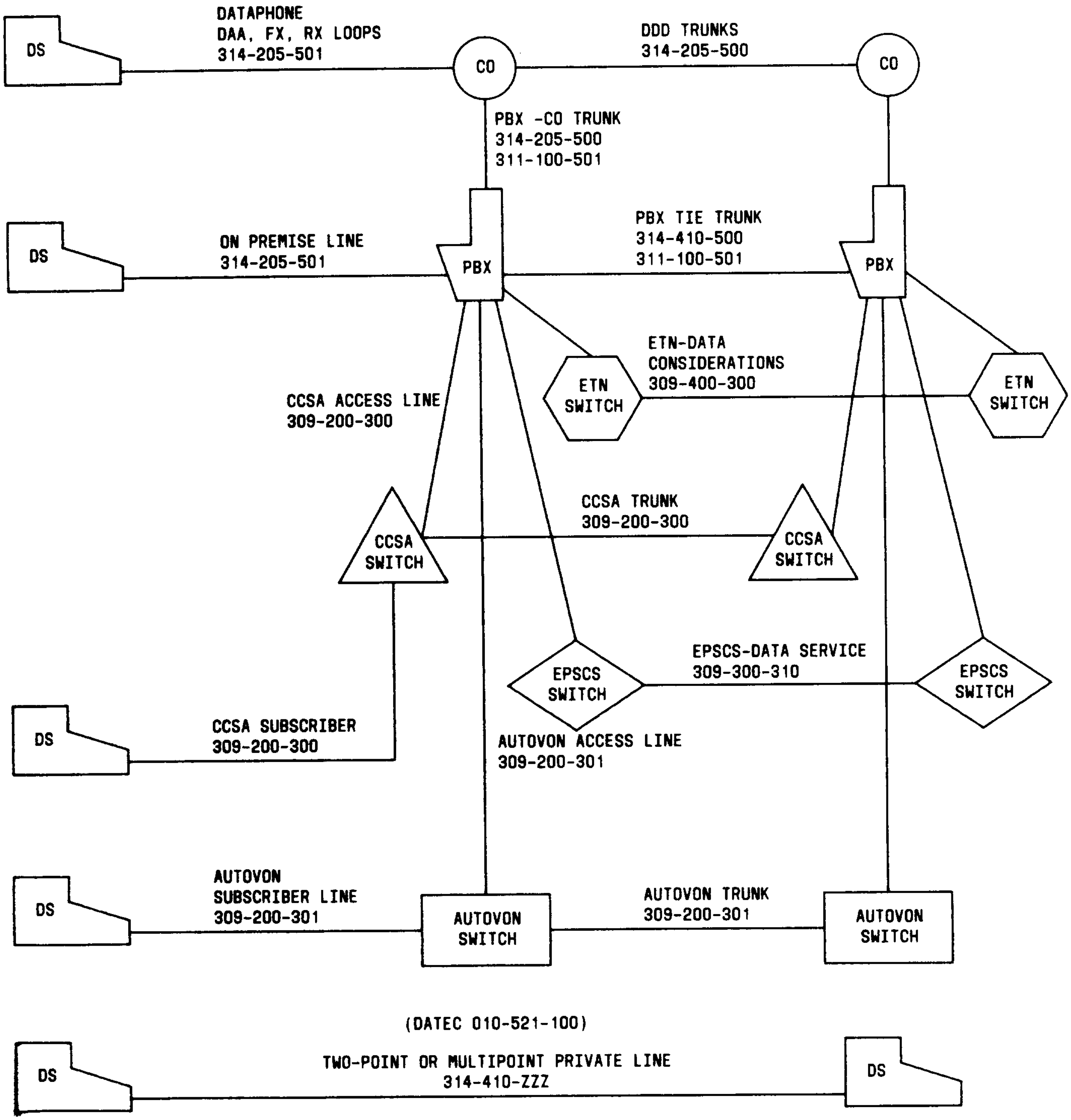

Fig. 1—Reference for Voiceband Data Transmission

B. Channel Interface Levels

3.02 The current standard transmit power at the data set interface is 0 dBm. This design is used for those data sets which can transmit at 0 dBm. The standard receiver power at the data set interface is -16 dBm. Typical arrangements showing the DAS 829 using these designs are shown in Fig. 2, 3, 4, and 5.

3.03 The basic ground rules for determining 4-wire circuit design when using DAS 829-type are as follows:

(a) The modem interface will be 0 dBm transmit and -16 dBm receive.

(b) Equal-level loop-back is always provided.

Additional transmission circuit design guidelines for use with DAS 829-type are provided in Section 598-082-100.

C. Data Auxiliary Set 829-Type

3.04 As previously mentioned, the standard CIU for 4-wire PL data circuits is the DAS 829. The physical interface is the miniature 50-position ribbon plug provided as part of the mounting arrangement of the DAS 829 and associated data units. Additional information covering interconnection/interpositioning is found in Section 314-010-103. Additional information covering the 50-position ribbon plug and associated leads is found in Section 598-082-100.

3.05 The DAS 829 is available in three basic station codes as follows:

DAS 829A

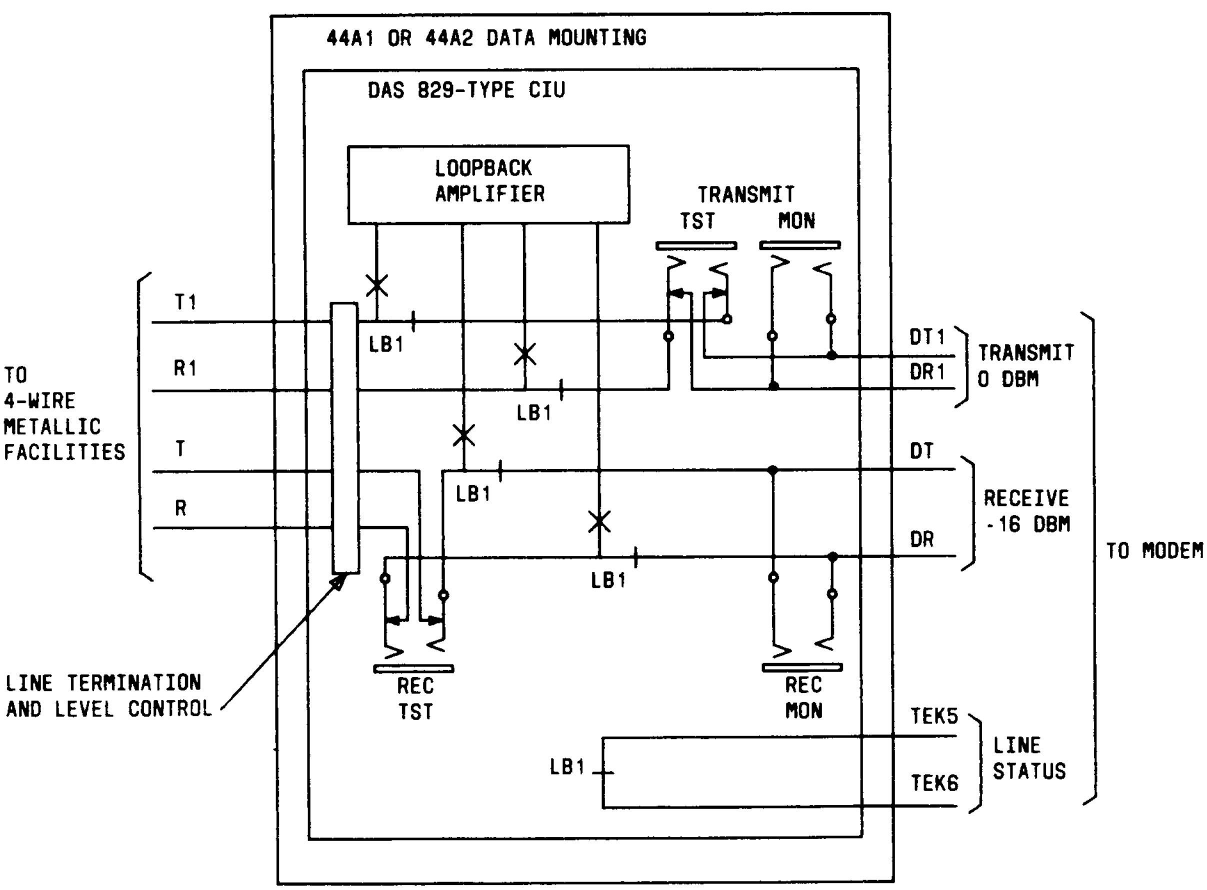

Fig. 2—Circuit Design for Data Only, 4-Wire Data Set

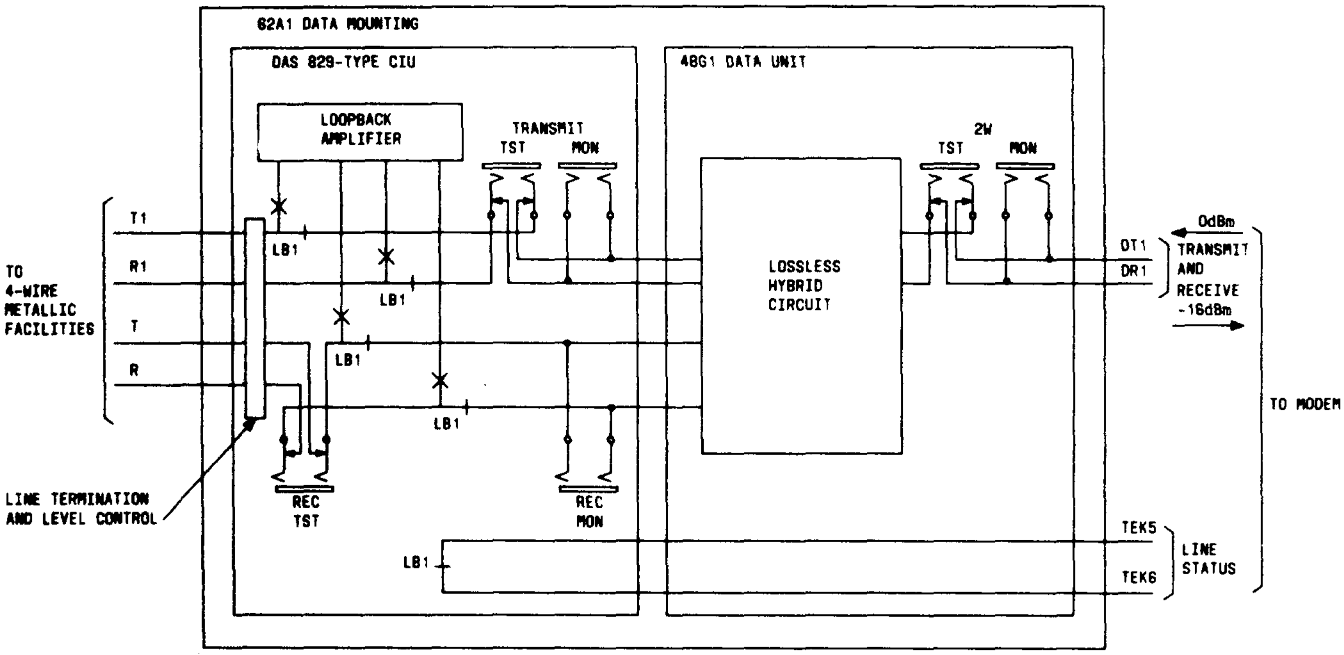

Fig. 3—Circuit Design for Data Only, 2-Wire Data Set

DAS 829B

DAS 829C

Any one particular PL channel termination requires the use of only one code of CIU. The CIU code that is used depends on the facilities involved.

3.06 Each of the three DAS 829 types is described as follows:

DAS 829A—is used for nonloaded or short loaded loops when no gain is required in transmit or receive paths. Slope equalization is accomplished with 600- or 1200-ohm line terminations. Attenuation is accomplished in the transmit or receive paths.

DAS 829B—is used for nonloaded or short loaded loops. It is required for long nonloaded loops and provides 150-, 600-, or 1200-ohm line termination for slope equalization. Gain or attenuation can be provided in the receive path. Attenuation is provided in the transmit path.

DAS 829C—is used for short nonloaded or for loaded loops and provides extensive equalization capability. This unit provides the same equalization capabilities as the 359A or the 359K equalizer. Gain or attenuation can be provided in the receive path. Attenuation is provided in the transmit path.

3.07 A standard, self-contained, tone-activated, loop-back capability is present in each DAS 829-type. Loop-back is equal level and provides controlled impedances.

3.08 Two data mountings, the 44A1 and 46A1, are designed for use with the DAS 829-type.

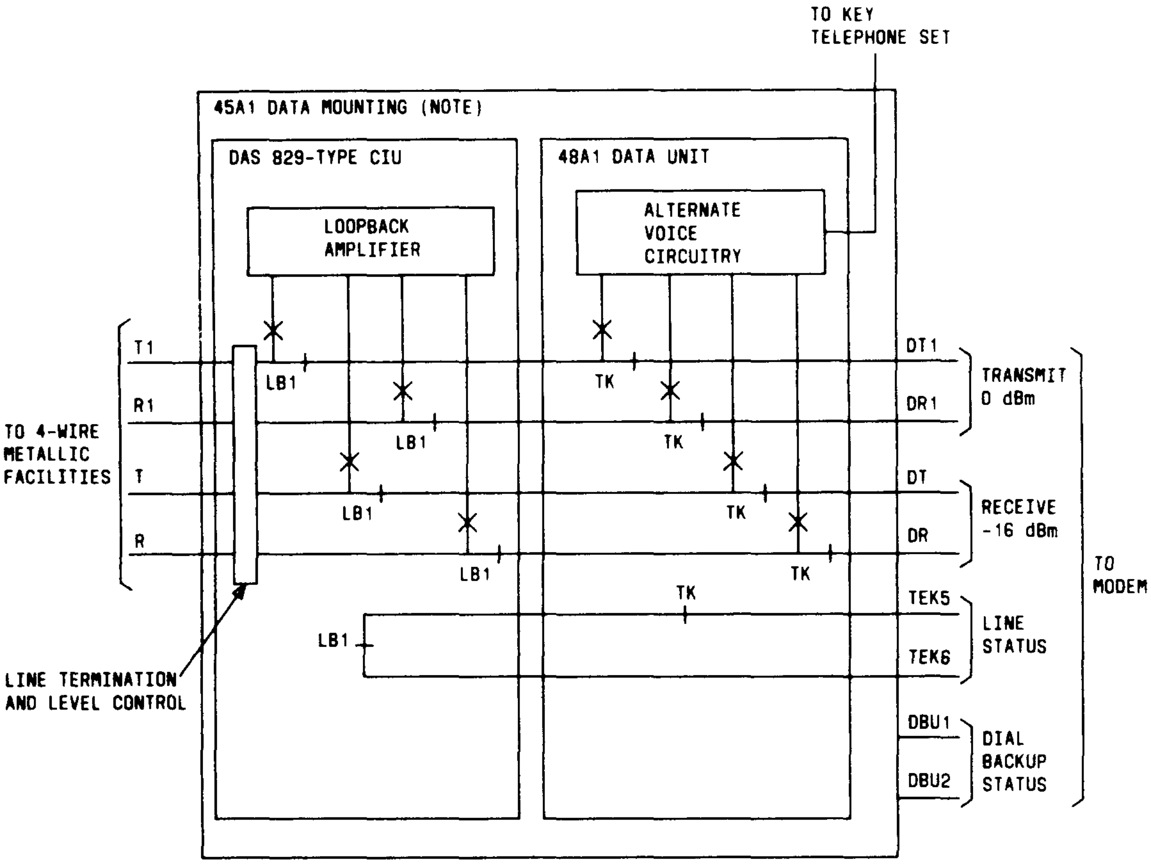

Fig. 4—Circuit Design for Data/Voice, 4-Wire Data Set

The 44A1 provides a single card housing for one DAS 829-type. The 46A1 provides a housing for a maximum of eight DAS 829-type and can be any combination of the three codes of DAS 829. The single card mounting is the same size as the new data set 202 S/T, and the multiple housing is the same size as the data set 202 S/T multiple housing. These arrangements are considerably smaller than the equivalent DAS 828-type described in Section 598-080-100.

3.09 Supplementary functions of alternate voice and dial backup are provided by data units, which are plug-in circuit packs of the same size as the DAS-829-type. These are the 48A1 and the 48B1 data units, respectively. Various single and multiple channel termination arrangements are available and are described in Sections 598-082-100 and 598-082-101.

3.10 The 2-wire data set option is provided by the use of the 48G1 data unit. A hybrid transformer provides the interface between the 2-wire modem and the DAS 829-type CIU that terminates a standard 16-dB channel. The transmit and receive amplifiers in the transmit and receive pairs of the 48G1 data unit have a fixed gain that offsets the circuit losses and provides a 0-dB insertion loss in the transmit and receive paths.

D. 150 Channel Service Unit (CSU)

3.11 The 150A channel service unit (CSU) is a passive device which provides a 2-wire interface between voiceband data station equipment and a 2-wire PL circuit. The 150A CSU provides the following:

- 2-way transmission path
- 2-way protection against hazardous voltages
- 2-way current surge protection

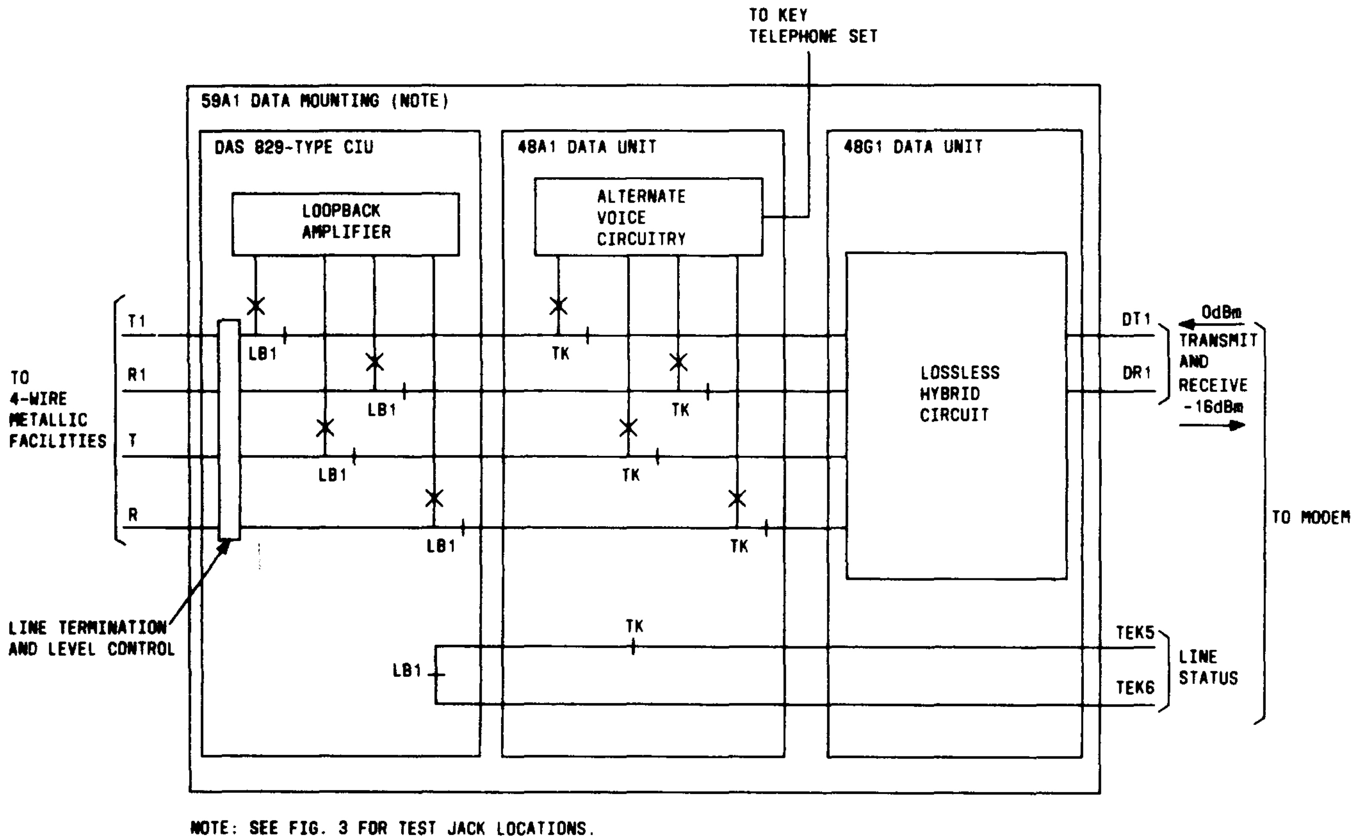

Fig. 5—Circuit Design for Data/Voice, 2-Wire Data Set

- Balanced termination
- Signal level adjustment
- Dc isolation between the station equipment and the telephone facilities.

Additional information covering the 150 CSU can be found in Section 590-101-000.

E. Loop-Back Arrangements

3.12 A remotely controlled equal-level loop-back arrangement is required at the customer location on those circuits which may be accessed by an STC (or similar organization equipped with a voice-frequency transmission testing capability).

3.13 The DAS 829-type has tone loop-back circuitry which operates like a DAS 828A equipped with a 44A1 data unit. The tone activated loop-back circuit is an integral part of all codes of the DAS 829-type.

3.14 To activate the loop-back at locations equipped with the 44A1 data unit, a 2713 ±2 Hz tone is applied toward the station at data level for not less than 5 seconds. Upon removal of the tone, the loop-back path will be established. To deactivate the loop-back, the 2713-Hz tone is again applied for a minimum of 5 seconds. The 406A tone generator is available for use at the testboard to supply the 2713-Hz signal for activation and release of the tone activated loop-back. More descriptive information on the 406A tone generator is given in Section 314-821-100.

4. SIGNALING ARRANGEMENTS

4.01 When DAS 829-type is used at the station, inband, end-to-end locked-in signaling with 30-second time-out can be provided by the addition of the 48A1 data unit. This data unit provides for alternate voice use of the PL and uses an inband signal of 2600-Hz for ringdown signaling. An interrupted tone signal is returned to the calling station to indicate that the called station is receiving the 2600-Hz signaling tone at -13 dBm0. A 2-wire telephone set is used. Additional information on this type of signaling is given in Section 598-082-101.

> ***Note:*** The alternate voice arrangement provided by the 48A1 data unit is not interchangeable with alternate voice arrangements of either the DAS 828-type or locally engineered systems requiring 20-Hz ringdown signaling unless signal conversion equipment is provided.

4.02 On those installations where the DAS 829 is not used, as in the case of the DAS 828, CO signaling equipment must be used. The typical arrangement uses a D1B ringdown converter (SD-56163-01) or the Metallic Facility Terminal (MFT) ringdown converter signaling unit (J99343EB). The ringdown converter converts a 20-Hz signal on the 4-wire simplex path to E&M signaling. The E&M signaling is compatible with out-of-band signaling carrier channels, such as N1, ON, or T carrier using D1, D2, or D3 channel banks. On carrier channels requiring in-band signaling, such as L and R, a single frequency (SF) unit is used.

5. CIRCUIT CONDITIONING

5.01 FCC Tariff No. 260 provides for a basic voicegrade channel (2001, 3002) and eight types of C conditioning. These are designated as follows:

- 2001, 3002—Basic channel
- C1
- C2
- C3—Used only for Switched Services Networks (SSN) such as CCSA or SCAN (See Section 309-200-300)
- C4
- C5—Used only for 2-point circuits
- C6-Used only for protective relaying channel (See Sections 310-540-100 and 310-540-500)
- C7 and C8—Used only for Electronic Tandem Network (ETN) (See Section 309-400-300).

5.02 The differences between the C1, C2, C4, and C5 grades of conditioning are the attenuation distortion and envelope delay distortion limits which must be met in order to meet the requirements of FCC Tariff No. 260. All other parameters are the same for both basic and C-conditioning selected. The parameter requirements are listed in Section 314-410-500.

High Performance Data Conditioning (HPDC)

5.03 An offering called HPDC or D-type conditioning is available on interstate voicegrade analog data channels. This conditioning provides more stringent control over intermodulation distortion and signal-to-noise ratio than that on previously offered data channels. These parameters are the ones most likely to affect high-speed voiceband modems operating on analog channels.

5.04 High performance data conditioning (HPDC) is available in any one of three offerings. They are listed and defined as follows:

(a) ***Type D1 HPDC*** is designed for a 2-point channel not arranged for switching where there is not more than one station per service point (see Fig. 6).

(b) ***Type D2 HPDC*** is designed for a 3-point channel equipped with central office (CO)

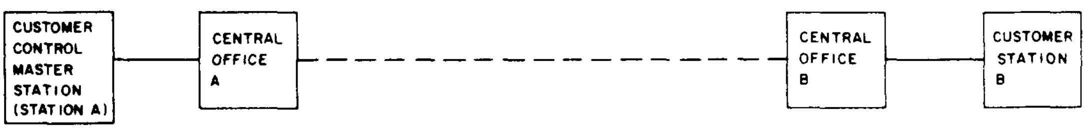

Fig. 6—Type D1 HPDC Circuit

switching arranged so that only two of the three stations may transmit to each other at any given time as illustrated in Fig. 7 and 8. The customer master station (CMS) can communicate with customer station B or, when switched, with customer station C. In no case can customer stations B and C communicate with each other. The CO switching can be assigned to be controlled from any one of the three stations. A dc control channel between the CO and the control station is included in the offering if both the CO and the control station are located within the same rate center (see Fig. 7). A separate series 1000 channel must be provided to control the switching if the CO and the control station are located in different rate centers (see Fig. 8). In the examples shown in Fig. 7 and 8, the CMS is shown as the control station.

(c) ***Type D3 HPDC*** is designed for access lines associated with AUTOVON networks, formally called switched circuits automatic network (SCAN). Type D3 HPDC is discussed in Section 309-200-301.

Restrictions

5.05 The HPDC should be provided on Type 3002, 5032, 5302, and 8302 voicegrade channels. The HPDC may be provided on an alternate voice-data arrangement (if degraded voice performance due to removal of compandors is acceptable to the customer). The option should not be provided on transfer arrangements, such as alternate night use of PBX tie trunks, because of degraded voice performance.

5.06 The HPDC equipped channel may be equipped with C-type conditioning if desired by the customer.

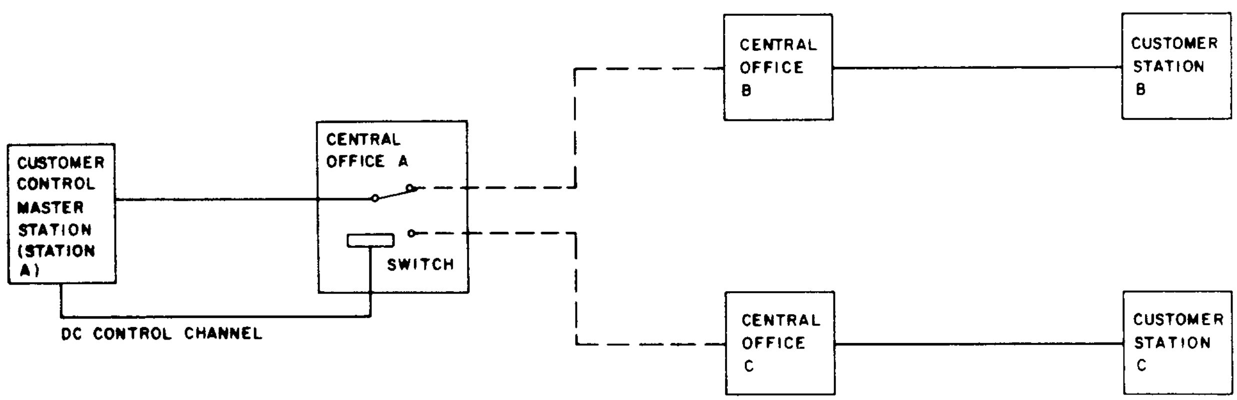

Fig. 7—Type D2 HPDC Circuit With CO Switch in Same Rate Center as Control Station

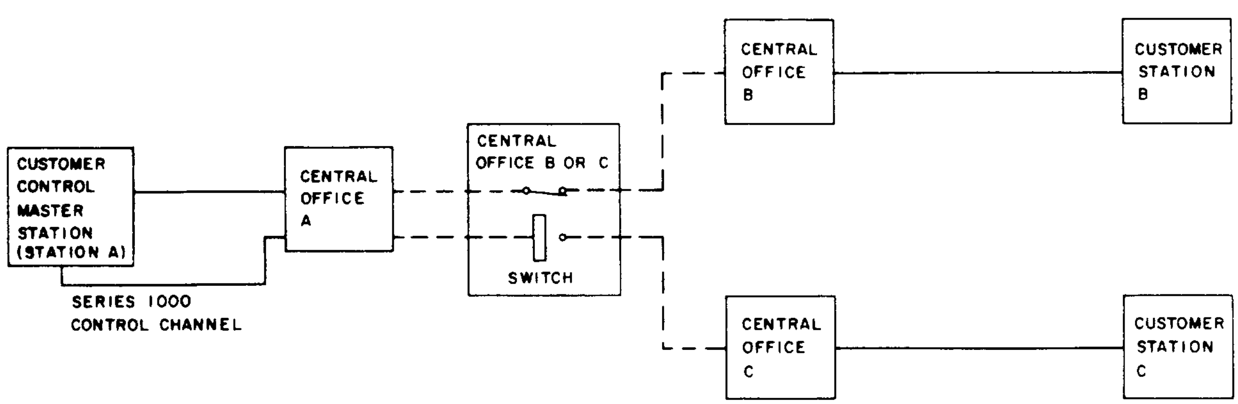

Fig. 8—Type D2 HPDC Circuit With CO Switch Not in Same Rate Center as Control Station

5.07 The HPDC will not be provided in locations where facilities capable of supporting it (such as, consistent with the following facility considerations) are not available.

Facility and Equipment Considerations

5.08 All facility selection should be made by or under the direction of the circuit design engineer. The following information is included for completeness only and is not intended to imply that such selection or design considerations should be made in the field.

5.09 Careful selection of facilities is necessary in order to meet the strict C-notched noise and intermodulation distortion requirements for HPDC circuits. LMX channels and metallic facilities are preferred. When a choice of short-haul carrier systems is available, select T carrier equipped with D1D, D2, or D3 channel banks.

5.10 If N2, N3, or ON carrier must be used, VF amplifiers will generally be required. Enhanced levels should be used on N2 channels as specified in Section 362-800-510. N1 carrier and T carrier equipped with D1A or D1B channel banks normally should not be used.

5.11 No more than three links of short-haul carrier (such as N, ON, or T carrier) should be used. No more than two links of N or ON carrier should be used in the overall channel.

> ***Note:*** A link is defined as a facility terminated by a pair of channel banks.

5.12 The use of noncompandored N or ON channels will generally result in higher C-notched noise levels than if compandored channel units are used. However, the compandored channel units have greater intermodulation distortion than the noncompandored channel units, and this may be a greater problem than noise. In cases where the overall HPDC C-notched noise requirements cannot be met but the intermodulation distortion requirements can be easily met, it may be worthwhile to try compandored channel units as a means of improving the noise performance. The intermodulation distortion test must be repeated after making this equipment substitution to ensure that it is still within limits.

5.13 The facility C-notched noise and intermodulation distortion requirements for T-carrier channels and compandored N- and ON-carrier channels are given in Section 314-410-500. Noncompandored N and ON channels that barely meet the noise requirements in Division 362 practices may not be satisfactory for HPDC circuits. The N and ON channels which meet a C-notched noise requirement of 31 dB or better will generally be satisfactory.

5.14 Where alternate voice is provided, mode signaling may be implemented using SF equipment. F-type equipment is preferred over E-type. The E3B and E4B signaling units should not be used because they may contribute an excessive amount of third-order intermodulation disorder.

6. CIRCUIT CONFIGURATIONS

6.01 The basic circuit configurations for PL data service are as follows:

(a) 2-Point

(b) Multipoint

(c) Central Office Relay Switched

(d) Customer Premises Switched.

Combinations of these configurations may appear in a single PL circuit.

6.02 The "point" in 2-point and multipoint is defined to be one or more stations terminating a serving link (local channel). This is typically a single station on a long-haul circuit but may consist of more than one data station, providing the local distributing arrangement introduces negligible distortion to data and none of the stations requires more than 1500 feet of cable from the distributing arrangement. This distributing arrangement may consist of a bridging and/or a switching arrangement. To meet the requirement of negligible distortion, a bridge in such an application needs to be of the 2-wire resistive type that presents 600 ohms to all legs. In the case of 4-wire, a separate 2-wire bridge is installed for each direction of transmission on the 4-wire circuit.

> ***Note:*** The facilities on the two sides of a local distributing arrangement are considered to be a part of the station equipment and are not considered as constituting separate links.

If more than 1500 feet of cable is required to connect a station with the local distributing arrangement, that station should be served by a separate end link from a CO bridge as shown in the lower portion of Fig. 9.

Intraexchange circuits may be subject to fewer restrictions, depending on local practice.

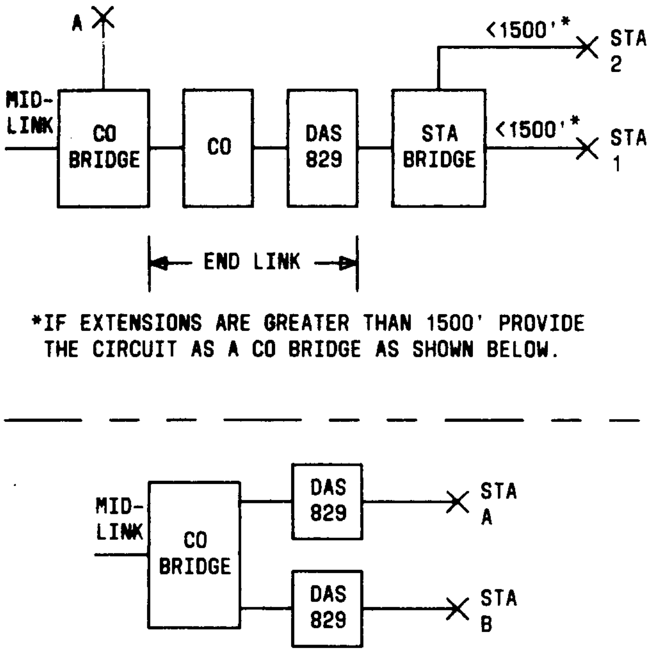

Fig. 9—Circuit Conversion of End Link to Midlink

A. 2-Point Circuits

6.03 Two-point circuits provide data communication between two locations. These circuits may be basic or have C1, C2, C4, or C5 conditioning. C5 conditioning can be ordered only on 2-point circuits.

B. Multipoint Circuits

6.04 These circuits may be basic or have C1, C2, or C4 conditioning. If any part of a multipoint circuit is conditioned, all parts must be conditioned to the same degree. C4 conditioning on multipoint circuits is restricted to 3- or 4-point operation. An example of 4-point operation is given in Fig. 10 where only one station is shown for each exchange. Station A is the master station and B, C, and D are remote stations. The grade of C4 conditioning can be specified between A and B, A and C, and A and D. No conditioning is specified between remote stations. Three-point operation is similar, with Station D omitted.

6.05 Figure 11 shows the maximum of four midlinks permitted with the basic or the C1 or C2 conditioned channel.

> *Note:* The links between bridges in the same building are not considered middle links. These bridges should be electrically as close together as feasible and in no case farther than 1500 feet of 22-gauge wire apart.

C. Central Office Relay Switched Circuits

6.06 Figure 12 shows a configuration utilizing a maximum of three CO switches that are allowed under the interstate tariff. The circuit may be unconditioned or have C1 or C2 conditioning between all pairs of stations.

D. Customer Premises Switched Circuits

6.07 Figure 13 shows a customer premises switched connection. This arrangement is permissible; however, no overall conditioning can be guaranteed.

7. SEALING CURRENT

7.01 Sealing current is low-level dc applied to a cable pair to break down a high resistance film which may build up at nonsoldered hand-to-twisted splices. Continued application of this current sustains the normal resistance of the cable pair.

7.02 The application of sealing current is a recommended maintenance action as well as a preventive maintenance item. The following troubles can be resolved by the application of sealing current:

- High dc resistance, often more than 60 percent above normal
- High 1-kHz loss, often more than 50 percent (of the value in dB) above normal.
- C-notched noise, often more than 20 dB above normal, and
- Unbalance in resistance of tip and ring conductors.

The recommended sealing current is 15 milliamps of continuous dc preceded by 30 to 50 milliamps dc for several seconds, commonly referred to as "zap".

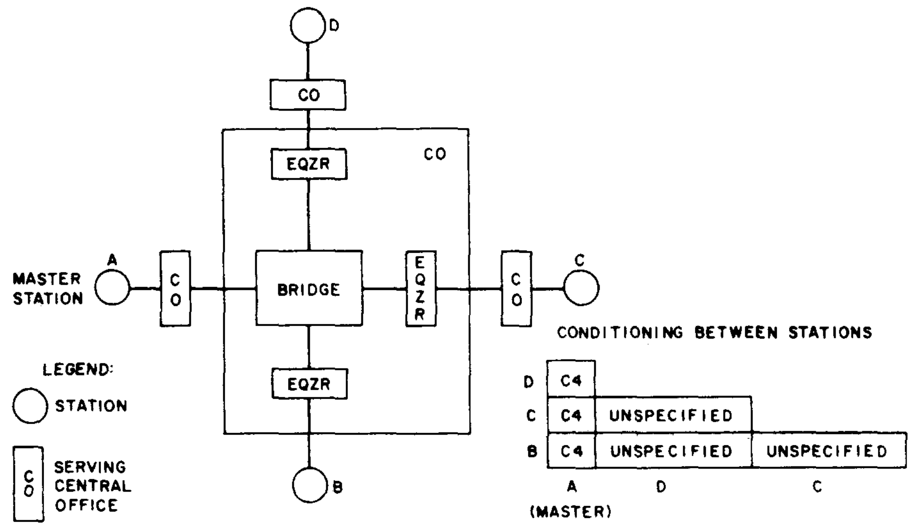

Fig. 10—4-Point Arrangement

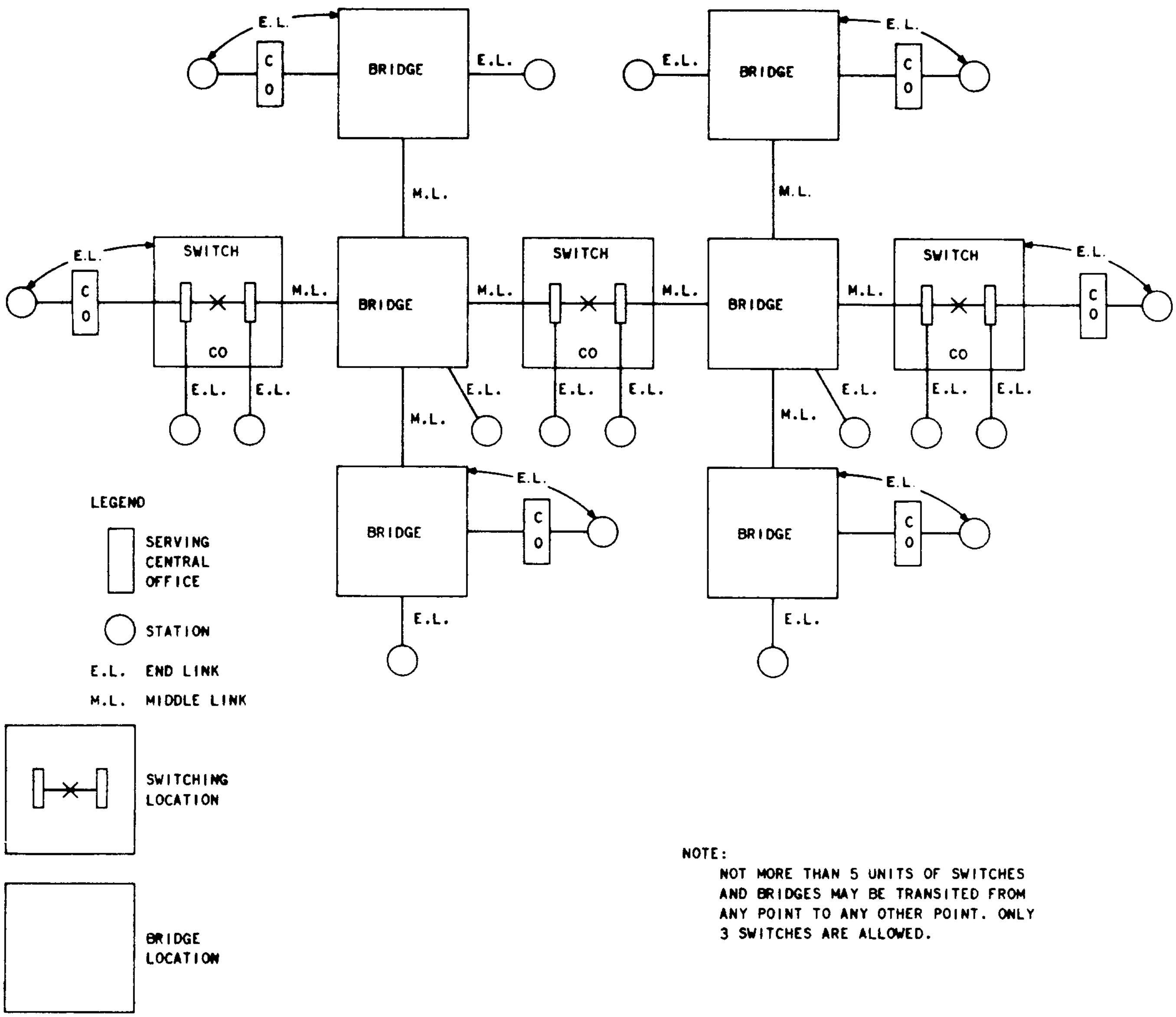

Fig. 11—Combined Central Office Switched Multipoint Circuit

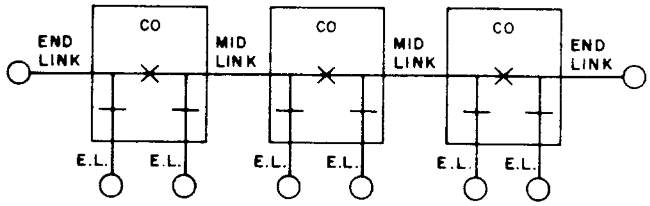

Fig. 12—Interstate Central Office Relay Switched Configuration

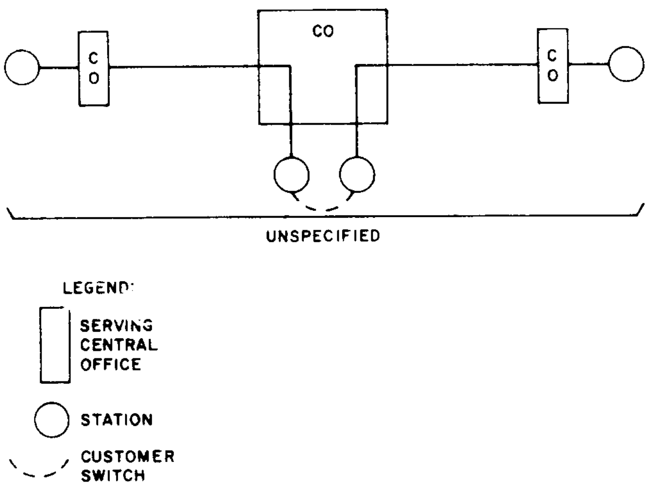

Fig. 13—Customer Switching Arrangement

8. REFERENCES

8.01 The following documents provide additional descriptive information on facilities and equipment associated with PL voiceband data service.

PUBLICATION	DESCRIPTION
AT&T PUB 41004	Data Communications Using Voiceband Private Line Channels—October 1973
AT&T PUB 41008	Analog Parameters Affecting Voiceband Data Transmission—Description of Parameters—July 1974
AT&T PUB 41009	Transmission Parameters Affecting Voiceband Data Transmission — Measuring Techniques—January 1972

SECTION	DESCRIPTION
010-521-100	Data Technical (DATEC) Support
309-200-301	Switched Services Network Using Central Office Switching Machine—AUTOVON—Service Maintenance
Division 310	Non-Switched Special Services System
Division 311	Switched Special Services System
314-010-100	Data General—Analog Transmission Parameters—Description
314-010-001	Data General—Data Testing Principles
314-010-102	Data General—Data Services Support
314-010-103	Data General—Interconnection/Interpositioning
314-410-104	Voice Bandwidth Private Line Data Circuits—Circuit Conditioning Requirements Using the Collins CLA-Type System
314-410-300	Voice Bandwidth Private Line Data Circuits—Maintenance
314-410-500	Voice Bandwidth Private Line Data Circuits—Tests and Requirements
314-820-100	Data Systems—Common Circuits, Equipment and Procedures—Envelope Delay Characteristics of 200-Type Delay Equalizers
314-820-104	Envelope Delay Characteristics of 384- and 385-Type Equalizers
314-820-106	J99347 VF Amplitude and Delay Equalizing Equipment—Description
314-820-107	950A-Type Equalizer—Description
314-820-108	950B-Type Equalizer—Description
314-820-207	950B-Type Equalizer—Prescription Settings
314-821-100	Data Systems—Central Office—406A Tone Generator—Description

SECTION	DESCRIPTION
332-912-250	Metallic Facility Terminal—Amplitude and Delay Equalizer (J99343SN)—SD-1C359-01—Description and Installation
598-080-100	Data Auxiliary Set 828A—Description and Operation
598-080-101	Data Auxiliary Set 828C—Description and Operation
598-082-100	Data Auxiliary Set 829-Type—Channel Interface Units— Voiceband Private Line Channels—Description
660-200-301	Special Services—Protection and Safeguarding