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Bell System

TECHNICAL REFERENCE

150 BAUD PRIVATE LINE CHANNELS INTERFACE SPECIFICATION

SEPTEMBER 1975

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150 Baud
Private Line Channels
Interface Specification

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ENGINEERING DIRECTOR-TRANSMISSION SERVICES

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FIGURES

150 BAUD PRIVATE LINE CHANNELS INTERFACE SPECIFICATION

1. DESCRIPTION

1.1 General

1.11 The purpose of this specification is to define the interface of the 150 Baud Private Line Channel as presented to Customer-Provided Terminals (CPT).

1.12 These private line channels are capable of transmitting two state ("mark-space," "binary") signals at speeds up to 150 bauds for teletypewriter, data, metering, supervisory control, and miscellaneous signaling purposes. For speeds of 75 bauds and below, other channels are available and are described in separate Bell System Technical References. The term "baud" is a unit of signaling speed derived from the duration measured in seconds of the shortest signaling element to be transmitted. Therefore, the minimum permissible signaling element length on 150 Baud Channels is 6.67 milliseconds, ie, 1 ÷ 150 seconds.

1.13 150 Baud Service is different in nature than familiar voiceband private line and DDD networks. It (150 Baud Service) will consist of ac or dc terminal links interconnected by a network of narrowband transmission facilities. These private line channels are full or half duplex (capable of 2-way transmission arranged for simultaneous or nonsimultaneous transmission, respectively). There will be no overall end-to-end supervision (knowledge of circuit continuity). The interface to business machines will be EIA Standard RS-232C type. The send and receive data leads of this interface will be compatible with existing voiceband private line services; the remaining leads may not function in exactly the same manner as their counterparts in other services. The meaning of this is clarified in detail in the lead-by-lead description of the interface that follows in Section 2.22.

Although the type of local loop facilities and physical transmission equipment arrangements provided by the telephone company will be subject to local conditions, the interface to the CPT will perform in essentially the same manner.

1.2 Physical

1.21 There are several possible transmission equipment arrangements for 150 Baud Channels.

1.22 One basic transmission equipment arrangement consists of a Data Auxiliary Set of mounting for single-station arrangements. Another data mounting designed for multiple set arrangements can be provided. These mountings and Data Auxiliary Sets may be internally equipped with Data Sets or carrier multiplex channels by the telephone company.

A Data Auxiliary Set is required with each Data Set for private line service at single-station installations. The Data Auxiliary Set provides the housing, power, and interface connector as described in Section 2.2 and in some cases performs additional operating functions. Figures 4A and 8A are photographs of typical single-station equipments.

For multiple set installations, the above functions are performed in data mountings and auxiliary apparatus units illustrated in Figures 5A and 5B which may be mounted in either a relay rack or a multiple set cabinet such as those shown in Figures 6 and 7.

1.23 Where a large number of channels are to be terminated at a single location, the physical arrangements of the equipment may vary due to space and maintenance considerations. Therefore, it is strongly recommended that these be discussed with the telephone company representatives well in advance of installation.

1.24 The general term Data Communication Equipment (DCE) will be used in this document, hereafter, to designate all of the complete transmission equipment arrangements provided by the telephone company and described in Section 1.21 and 1.22. The sizes and weights of the arrangements are shown in Table A.

1.3 Power Requirements

1.31 The customer must provide a receptacle supplying continuous 117 volt, 60 Hz ac power. The regulated power supplies provided in the DCE will work properly over a frequency deviation of ±0.45 Hz and a voltage range of 105 to 129 volts. The DCE is equipped with a demountable, 10-foot long gray cord equipped

with a U-blade ground-type plug. The power receptacle provided must accept such a plug and supply a valid ground to the ground pin. It is preferred to have this ground the same as the one used by the CPT.

The approximate power consumption per channel of the DCE equipment arrangements is shown in Table A.

1.4 Environment

1.41 The DCE will operate properly over an ambient room temperature range of 40° to 120° F and over a relative humidity range of 20 percent to 95 percent.

2. INTERFACE — ELECTRICAL

2.1 General

2.11 Interface Connector

The CPT equipment should be equipped with a cable terminating in a Cinch or Cannon DB-19604-432 plug mounted in a Cinch DB-51226-1 hood assembly.

2.12 Pin Assignments in the interface connector are shown in Table B and in Figure 3.

2.2 Data Communication Equipment (DCE) — EIA Interface

2.21 General

All interface circuits between a CPT and the DCE (Figure 3) should be designed to meet the EIA Standard RS-232C.

2.22 Functional Description

Descriptions of the operation or function of the interchange leads and the signals appearing on each are as follows:

Pin 1) AA — Protective Ground: Electrically bonded to the machine or equipment frame and ac power service ground.

Pin 2) BA — Transmitted Data: The BA circuit is designed to accept serial binary data from the CPT. The DCE sends a marking signal to the line facility when the EIA connector is removed or when the CPT power is OFF.

Pin 3) BB — Received Data: The BB circuit is designed to deliver serial binary data to the CPT.

Pin 4) CA — Request-to-Send: The CA circuit is directly connected to the Clear-to-Send (CB) circuit.

Pin 5) CB — Clear-to-Send: The CB circuit is directly connected to the Request-to-Send (CA) circuit.

Pin 6) CC — Data Set Ready: The CC circuit presents an ON signal at all times except for the following conditions:

a) When the power to the DCE is OFF.

b) When the DCE is in either a test mode or local mode if implemented. (CC circuit held OFF.)

Pin 7) AB — Signal Ground: Establishes the common reference potential for all interchange circuits except circuit AA.

Pin 8) CF — Data Carrier Detector: The CF circuit delivers an ON signal to the CPT when the DCE is receiving carrier or line current and an OFF when received carrier or line current is not detected by the DCE.

Pin 12) CX — Local Mode: The 820D or 820E DAS may be placed in the local mode as described below by an ON signal on the CX circuit.

2.3 Data Communication Equipment (DCE) — Additional Functions

In addition to providing the above interfaces, the DCE provides the functions described below.

2.31 Test Mode

2.31.1 As an aid in determining whether trouble is located in the local ac terminal link including the DCE or in the CPT, a Test Mode is provided on the Data Auxiliary Set or data mounting arrangements. This mode permits the telephone company to check both the send and receive transmission path from the serving test center on a loop-back basis. (The test mode of the DAS is inoperable when equipped with the half duplex dc Data Set 109.)

Thus, although the element is 30 percent shorter than its nominal length, its telegraph distortion, as defined, is 20 percent.

2.32 When the DCE is placed in the test mode by operation of the Test Key, it acts as follows:

1. Connects the BB circuit (Received Data) to the BA circuit (Transmitted Data) in the DCE.
2. Opens BA circuit on the data set from the BA circuit of the CPT.
3. An installer's option is generally available to either hold a steady marking condition on BB lead or to allow data to be received on BB lead.
4. The CC lead is held OFF toward the CPT.
5. Lights the TEST Lamp.
6. If received carrier is present, CF lead is ON towards CPT.

A second operation of the Test Key releases the DCE from this mode.

A Test Lamp is provided on the DCE to indicate when the DCE is in the Test Mode as initiated by the above method. An arrangement is provided to allow the use of an external indicator lamp as an installer's option when the DCE is not in view of the attendant.

2.33 Received Carrier Detector Option

An installer's option is provided in the DCE which will allow loss of received carrier to squelch outgoing carrier. This option can be used to automatically notify the telephone company test center that the station has lost its incoming carrier.

3. TRANSMISSION CHARACTERISTICS OF CHANNEL

3.1 Channel Distortion — Definition

The 150 Baud Channels are normally lined up and maintained by the telephone company using "start-stop" data characters as a source of test signals. The exception to this is when the CPT always uses synchronous signals and the channel requires regenerative repeaters. The characters will generally be transmitted at the highest rated speed of the channel, namely 150 baud. The received signals will be measured in terms of telegraph distortion.

Each start-stop data character is composed of several elements; a single unit start element which is always a space, 5, 6, or 7 single unit information elements, and sometimes a single unit parity element which may be "mark" or "space," and a stop element which is always a "mark" and is one unit or longer in length. A typical 8-element character with start and stop elements for asynchronous operation is illustrated in Figure 1.

Telegraph distortion is the measure of the displacement of any mark-to-space or space-to-mark transition from its proper location. The reference point used when measuring telegraph distortion is the initial mark-to-space transition of each character which occurs at the beginning of each start element. The slicing level for all measurement is at about the 50 percent point on the rising and decaying waveforms. Sensing of signal elements is assumed to be timed for the nominal center of each element. The waveforms at the interface meet the rise and decay times specified in RS-232-C. Spurious short duration impulses (on the order of 1/10 a signal element) are not characteristic of the channel and would be regarded as a trouble condition.

Referring to Figures 1 and 2, transitions measured at the slicing level should occur at integral multiples t_e from the start transition for no distortion. If a transition occurs at a time t earlier or later than this time, the distortion is:

$$\text{Percent Distortion} = \frac{t \times 100}{t_e}$$

For example, refer to Figure 2 and let us examine the distortion of information element No. 3 which is in the space condition. Assume the nominal element length te = 10 milliseconds and that t_2 = 1 millisecond and that t_3 = 2 milliseconds.

$$\text{Peak Distortion Per Character} = \frac{t \text{ max.}}{t_e} \times 100 =$$

$$2/10 \times 100 = 20\%$$

Thus, although the element is 30 percent shorter than its nominal length, its telegraph distortion, as defined, is 20 percent.

3.2 Channel Distortion — Factors

The amount of inherent channel distortion encountered on 150 Baud Channels is a function of the channel length and its complexity (number of transmission links in tandem between any two stations). If the CPT character code format and baud rate is any one of those listed in Table C, the telephone company may place a regenerative repeater in the channel to ensure that it will perform as specified in Section 3.3. For this reason, the telephone company will generally ask for the speed and code format used by the CPT.

However, if the CPT uses the channel for transmitting other codes, variable length bits or characters, or if the CPT uses it alternately at different signaling rates and/or different character code formats, standard regenerative repeaters cannot be provided and the inherent distortion of the channel is not specified.

3.3 Performance Objectives

The long-term objective of 150 Baud Channels is to have an average performance of one error in 10^5 bits transmitted. The CPT should deliver no more than 5 percent telegraph distortion at the interface, and should be capable of processing received data signals at the interface with up to 40 percent telegraph distortion.

3.4 Turnaround Time — Half-duplex Operation

3.41 Near-end Turnaround Time

The near-end or local turnaround time of a half-duplex 150 Baud Channel (the required time interval for any telephone company supplied local transmission equipment to condition itself to reverse the direction of transmission) is essentially zero. However, the CPT should not be arranged to reverse its direction of transmission until it has received the entire nominal length "stop" pulse of the last received character in a message.

3.42 Far-end Turnaround Time

The far-end or distant turnaround time of a half-duplex channel (the time interval consisting of the 2-way propagation time of the channel, delay through regenerative repeaters and directional control circuit operation in the transmission equipment) may be as high as 500 milliseconds. However, if far-end turnaround time is critical to the CPT operating procedure, it is recommended that the specific case be discussed with the local telephone company representatives.

TABLE A

	# of 150 Baud Channel Termination	Weight of Data Aux. Set or Empty Cabinet	Dimensions (inches) Width Depth Height	Mounting Wall (W) Floor (F) Table (T) Cabinet (C)	Power Consumption per Channel Unit Watts
1. 820- Type Data Auxiliary Sets Equipped With Data Sets 108- or 109-type					
820D Data Auxiliary Set	1	11-1/2#	11 x 5-1/2 x 10-1/2	(T)	15
820E Data Auxiliary Set	up to 3	22-1/2#	23 x 8-3/4 x 6	(C)	
Associated Cabinets					
KS-20018 List 1	up to 3	14-1/2#	24 x 12 x 11	(F)	
List 2	up to 6	17-1/2#	24 x 12 x 18	(F)	
List 3	up to 9	23-1/2#	24 x 12 x 24	( )	
List 4	up to 12	27-1/2#	24 x 12 x 30	(F)	
KS-20093	up to 140*	300 #	30 x 30-1/2 x 72	(F)	
2. 830A Data Auxiliary Set Equipped With Data Set 108- or 109-type	1	11	10-1/2 x 8.7 x 2.7	(T)	15
3. 28A Data Mounting Equipped With 108-type Data Sets	8	35	25 x 6 x 10		10
4. 28A Data Mounting Equipped With 109E-type Data Sets	16	27	25 x 6 x 10		5
5. 37A1 Data Mounting Equipped With Channel	1	23	13 x 12 x 9		6
6. 1A Data Station Equipped With 8 Channels in KS-20018 L7 Cabinet	8	75	24 x 17 x 30	(F)	6.5

*This is a maximum based on space in the cabinet. If room temperature exceeds 90 degrees Fahrenheit, this quantity should be reduced and the telephone company should be consulted.

TABLE B

ALLOCATION OF PINS AT THE CUSTOMER INTERFACE

Pin Number	Circuit	Description
1	AA	Protective Ground
2	BA	Transmitted Data
3	BB	Received Data
4	CA	Request-to-Send
5	CB	Clear-to-Send
6	CC	Data Set Ready
7	AB	Signal Ground
8	CF	Data Carrier Detector
9	(telephone co. use only)	Data Set Test (+ P)
10	(telephone co. use only)	Data Set Test (-P)
12	CX	Local Mode
11,13 to 25		Not used in this application

TABLE C

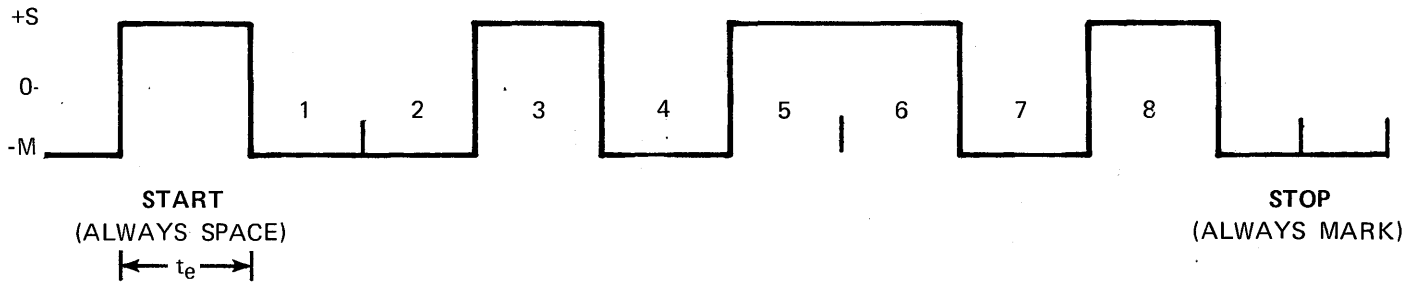
COMMON DATA CHARACTERS FORMATS

Start-Stop	
Start Element	—Unity length
	—Always "Space"
Information Elements	—5,6,7, or 8 per character
	—Unity length
	—"Mark" or "Space"
Stop Element	—Unity or greater in length
	—Always "Mark"
Synchronous	
All Elements	—Unity length
	—"Mark" or "Space"

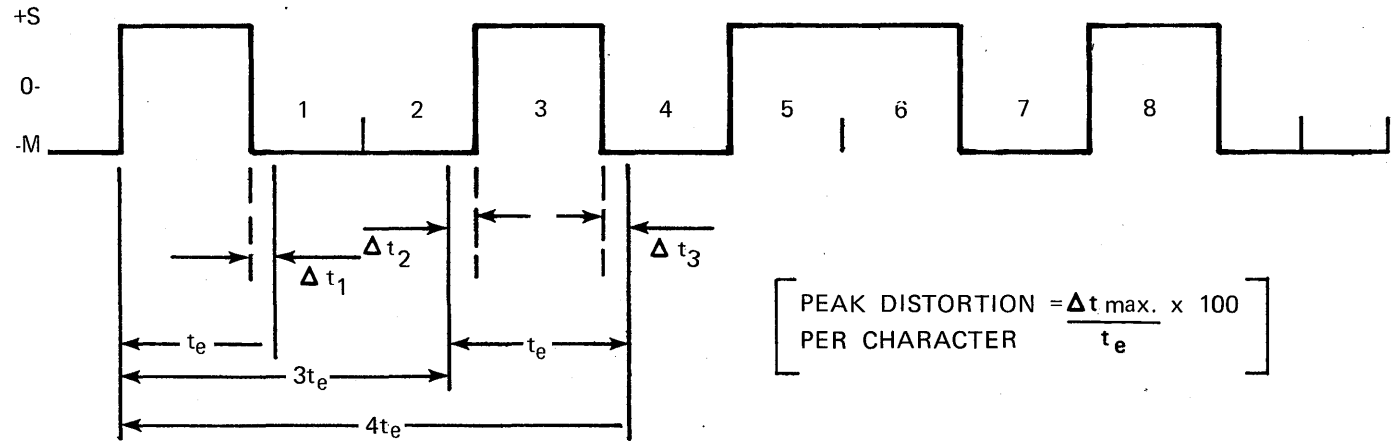
COMMON DATA RATES

(0-75 bauds)*	(76-150 bauds)
45.55 bauds	110.00 bauds
50.00 bauds	134.46 bauds
56.85 bauds	
61.12 bauds	
66.67 bauds	150.00 bauds
74.23 bauds	
75.00 bauds	

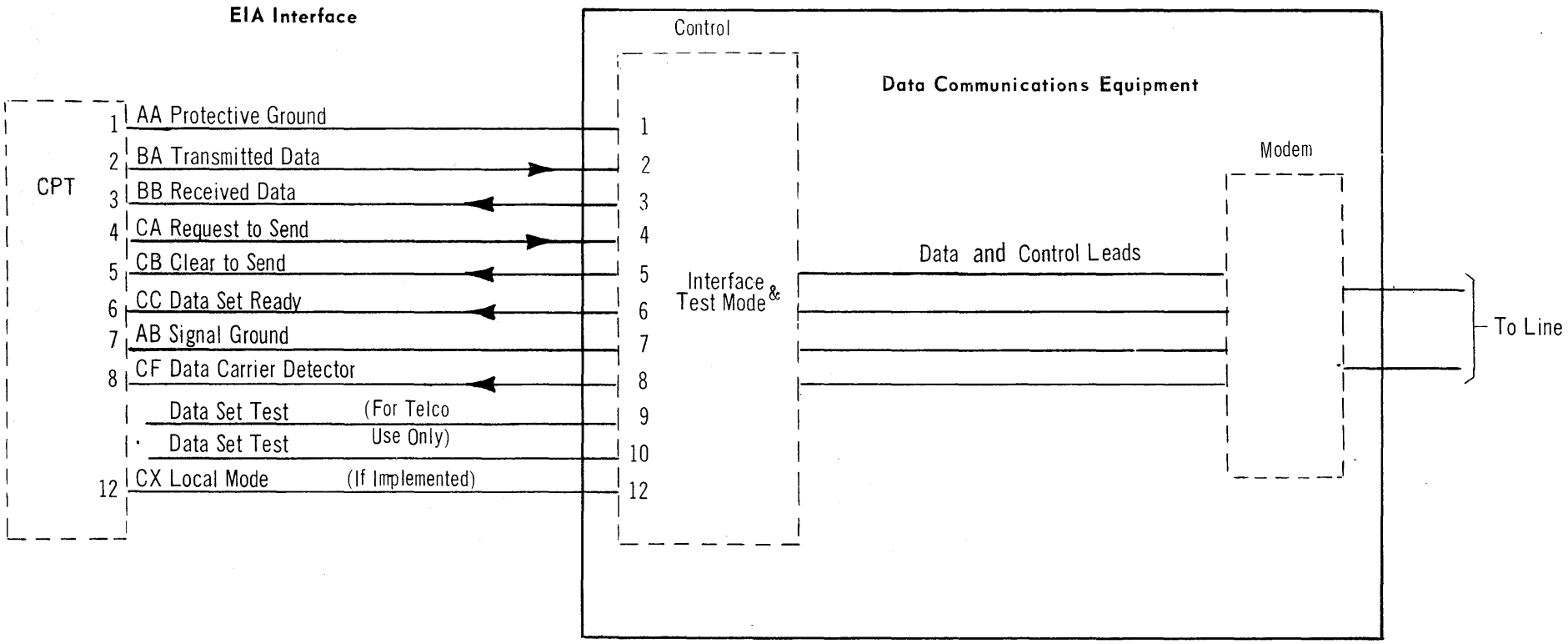
* These data rates may, of course, be used on 150 Baud Channels; however, other channels are available for transmission speeds up to 75 bauds. These are described in separate Bell System Technical References.



TYPICAL UNDISTORTED EIGHT ELEMENT
START-STOP SIGNAL
FIGURE 1



DISTORTED EIGHT ELEMENT
START-STOP SIGNAL
FIGURE 2



DATA COMMUNICATION EQUIPMENT INTERFACE
FIGURE 3

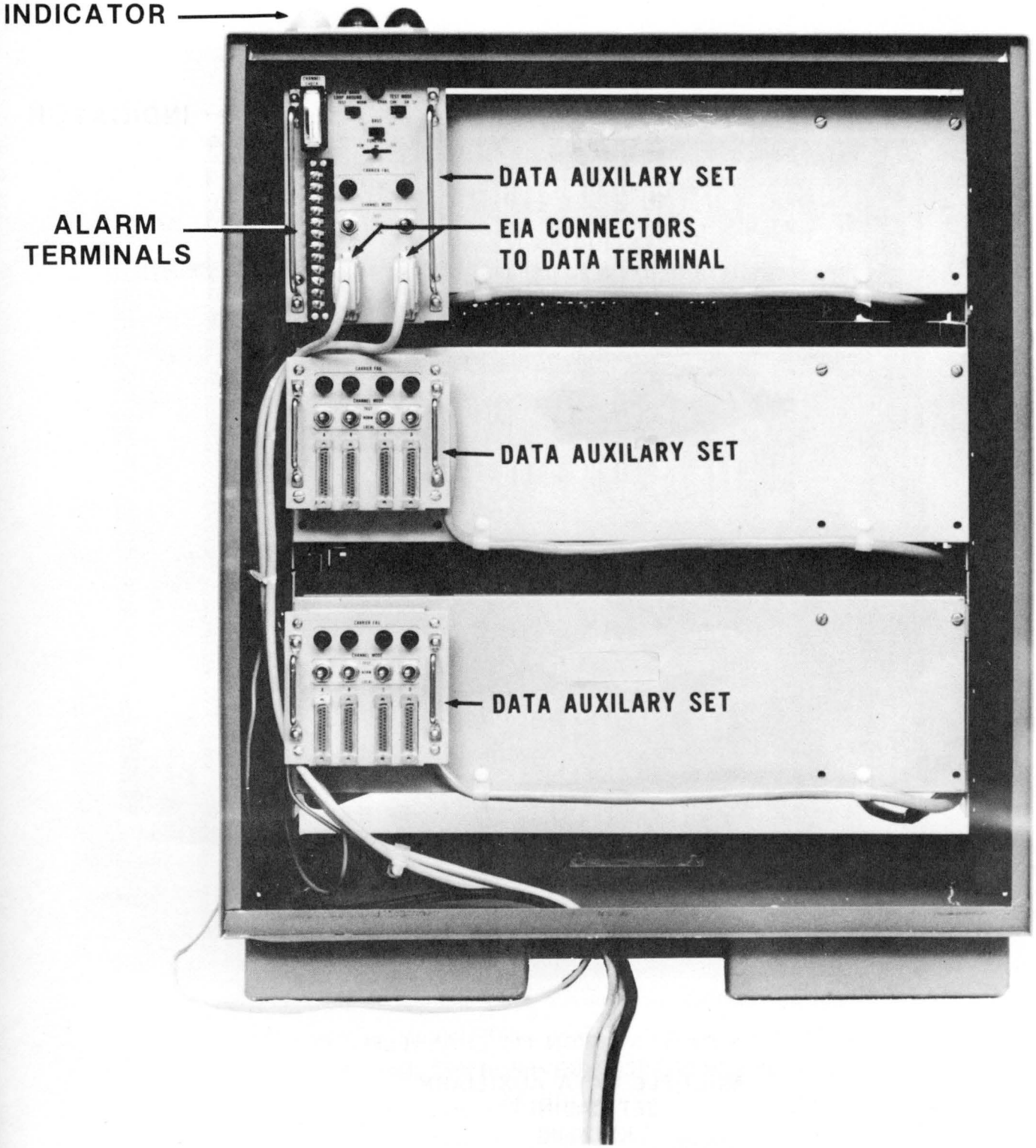
830A DATA AUXILIARY SET
FRONT VIEW

FIGURE 4A

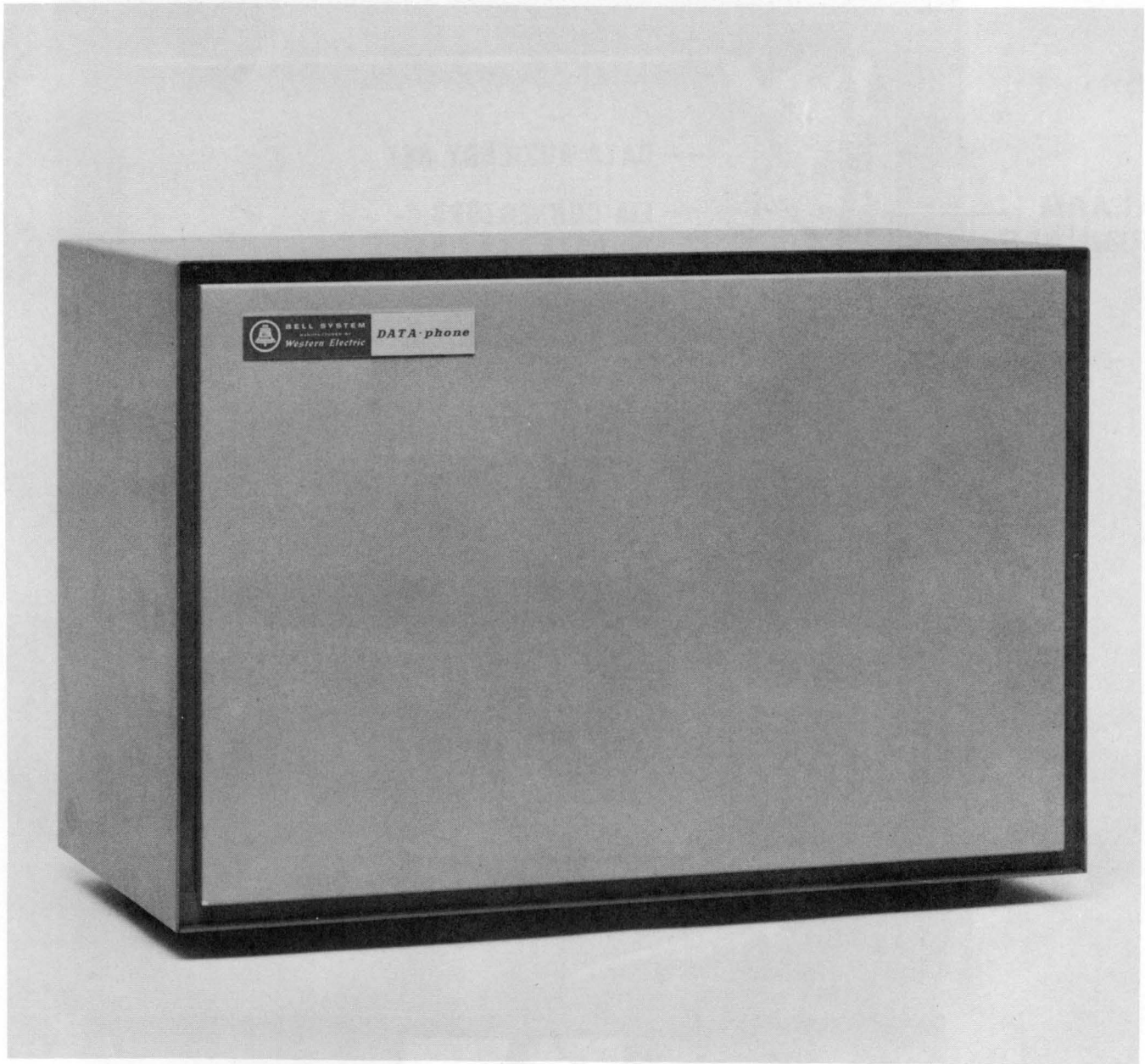
830 DATA AUXILIARY SET
REAR VIEW

FIGURE 4B

1A DATA STATION (10 CHANNELS)
FRONT VIEW (COVER REMOVED)
FIGURE 5A



1A DATA STATION CPT ACCESS
REAR VIEW (COVER REMOVED)
FIGURE 5B

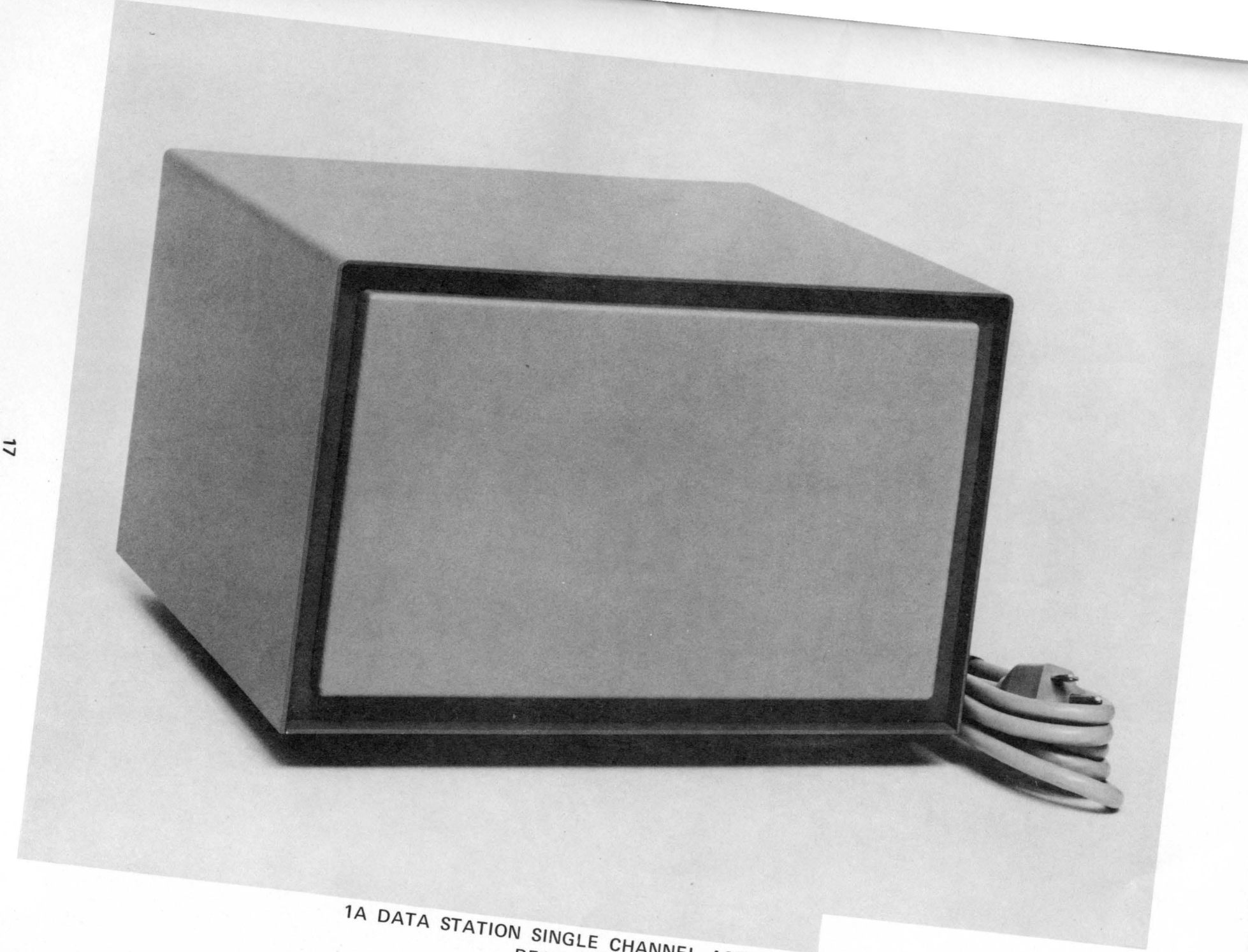


MULTIPLE DATA AUXILIARY
SET CABINET
KS 20018
FIGURE 6

MULTIPLE DATA AUXILIARY
SET CABINET
KS 20093

FIGURE 7

1A DATA STATION SINGLE CHANNEL ASSEMBLY
FRONT VIEW
FIGURE 8A



1A DATA STATION SINGLE CHANNEL ASSEMBLY
REAR VIEW
FIGURE 8B