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TECHNICAL REFERENCE

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Bell System Data Communications

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Type 2 DATASPEED SYSTEM

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ENGINEERING DIRECTOR-DATA COMMUNICATIONS

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1. INTRODUCTION

This Technical Reference describes the DATASPEED® Type 2 medium speed, serial data transmission system. The system consists of a Sender terminal containing a paper tape reader and a Receiver terminal containing a paper tape punch. Transmission speed is 1050 words per minute. The system includes 202-type data sets.

The information presented herein is intended to describe:

1. The on-line signalling and terminal characteristics which are necessary for the design of data equipment with which the DATASPEED Type 2 Sender and Receiver terminals will communicate.
2. The DATASPEED Type 2 System operating characteristics with which a user should be acquainted.

1.1 General Description

The DATASPEED Type 2 System provides 105 characters per second data communication in either private line or DATAPHONE® service. Station arrangements permit data transmission or reception. Systems may be arranged for point-to-point data gathering (many Senders with few Receivers) or for data distribution (few Senders to many Receivers). Stations may also be used at outlying points, exchanging data with a data processing terminal such as a computer. It is also possible to connect a Sender and Receiver at a particular site, to a common communications line. This arrangement constitutes a Send-Receive station.

The primary data medium in this system is punched paper tape having 5, 6, 7, or 8 data levels (hole positions per character). The Sender input tape may be fully perforated or chadless. The Receiver output tape is fully perforated. The equipment is not code sensitive; that is, the particular scheme used to represent data by means of holes in paper tape may be arbitrarily chosen by the user.

The basic DATASPEED Type 2 System provides for transmission and reception under manual control of an operator; however, optional features are available which permit unattended operation of a Sender or Receiver.

Nonadjustable 6-level Sender and Receiver units with advanced feed holes are also available on special order for typesetting applications. These terminals contain Type 2 electronics which provide for the transmission and reception of only 6-level advanced feed hole paper tape. On-line signals from these special units are compatible with the Type 2 Sender and Receiver but the advanced feed hole tape cannot be handled by a Type 2 Reader or Reperforator.

1.2 Physical and Electrical Characteristics

Feature or Requirement	Sender	Receiver
Size	16" wide 54" high 24" deep	16" wide 54" high 24" deep
Weight (Less data sets)	160 pounds	176 pounds
Mounting	Floor	Floor
Tape Type and Size	Fully perforated or chadless 11/16", 7/8", 1" width	Fully perforated 11/16" or 1" width
Operating Temperature Range	+40°F to +110°F	

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1.2 Physical and Electrical Characteristics (Con't)

Average AC Power Consumption-Operating (Less Data Sets)	200 watts	255 watts
Voltage	117 volts, AC ± 10%	
Frequency	60 ± .75% Hertz	
Start Current	4 amperes	9 amperes
Run Current	2.5 amperes	3.6 amperes
Signal Interface	Start-stop polar signal	
Power Cord	Three-wire grounded type of 10' length	
Speed	1050 words per minute	
Levels of Operation	Variable: 5, 6, 7, or 8	

Table 1A

1.3 Sender and Receiver Description

1.3.1 Sender

The Sender is basically composed of a tape reader, tape handling equipment, electronic modules, and a 202-type data set. The tape reader and tape handling equipment are mounted on a sliding drawer in the upper half of a floor mounted, sheet metal cabinet. The electronic modules are mounted in the lower half of the cabinet behind a hinged door. These modules include a power supply, signal converter, and sending distributor. Space is also provided near the center of a cabinet for a 202-type data set. The Sender includes a tape supply reel and a tape winder reel each with a basic capacity of 800 feet of fully perforated tape. The Sender is shown in Figure 1.

The serial signal transmitted by the Sender is a 10-unit code composed of a start bit, 8-data bits, and a stop bit. The 8-data bits are numbered 0 and 1 through 7, respectively. The 10-bit character format remains constant for any allowable level of operation. When variable code level operation is desired, a three-position level selector switch is set for the number of code levels to be used. The selector switch is located in the upper right hand corner of the front panel and controls the unused levels when less than 8-level code is being used. This switch operates on the bit positions as follows:

Code Level	Bit Positions	Switch Action
8	0 to 7	All bit positions used
7	0 to 6	Bit 7 held marking
6	0 to 5	Bits 6 and 7 held marking
5	1 to 5	Bits 6 and 7 held spacing and Bit 0 held spacing

The marking and spacing signals in the unused bit positions are required for system timing.

The universal tape reader can sense 5-, 6-, 7-, or 8-level tapes. Changing from one level to another is accomplished by turning a numbered dial located at the lower left hand corner of the reader tape guide plate to the number corresponding to the desired tape level. This action will mechanically hold the unused bit positions in the spacing (no hole) condition.

1.3.2 Receiver

The Receiver is a floor mounted unit with the same general cabinet design as the Sender. The receiver modules include a power supply, signal

converter, and receiving distributor. The Receiver will accommodate a 3000-foot tape supply reel and an 800-foot take-up reel. The Receiver is shown in Figure 2.

The universal tape punch can perforate 11/16 inch tape with 5-level code or 1 inch tape with either 5-, 6-, 7-, or 8-level codes. A marking pulse (current) is represented by a hole in the tape and a spacing pulse (no current) by the absence of a hole. To change code levels, a manually operated mechanism is provided to vary the size of the punch block tape path to accept either 11/16 inch or 1 inch tape. Associated with this mechanism are a variable tape guide and three slide switches which electrically control the 0-, 6-, and 7-level codes. The slide switches are located on top of the punch. When a slide switch is operated to the OMIT position, the associated level circuit is opened to prevent the marking or spacing signals required for timing from being acted upon by the punch as data.

1.4 System Operation

The signal transmission path for operation of the system is established by means of the data sets associated with the Sender and Receiver. A simplified block diagram of the system appears in Figure 3.

Basically, the system operates in the following manner. Punched paper tape is placed in the tape reader and the proper controls are operated. As tape feeds through the reader, tape signals, plus start-stop signals, are fed to the signal converter in parallel arrangement. The signal converter reshapes the signals and passes them on to the sending distributor. The sending distributor converts the signals from parallel form into serial form. From here they are passed, a bit at a time, back through the signal converter to the data set in the form of positive and negative direct current (dc) voltage signals. The data set converts the dc signals into voice-frequency tones. These tones are transmitted over the previously established telephone circuit to the distant receive station.

At the receive station, signals received by the data set are converted from voice-frequency tones to dc serial signals and passed through the signal converter to the receiving distributor. Here they are converted into parallel signals and routed back through the signal converter to the tape punch which punches the received message in paper tape.

1.5 Optional Features

1.5.1 Sender

A. Circuit Assurance and Break Option

The circuit assurance and break feature requires a data set which has the reverse channel feature. This option will shut down the Sender automatically if a line break occurs. It will also permit the receiving operator to stop the Sender when a trouble condition such as low or tight tape occurs. In either case the LINE BREAK lamp at the Sender illuminates and an audible alarm activates to notify of the shutdown.

B. Rubout Delete Option

The rubout delete feature prevents the transmission of an all-mark signal from a sender terminal to a receiver terminal. While punching a message tape, an operator may accidentally insert errors into the tape. To "erase" these mistakes, the errored characters are deleted by overpunching all errored characters with the all levels marking (delete) code. The correct message is then repunched into a new area on the tape. When the tape is transmitted, any delete characters are inhibited.

C. Discrete Calling Recognizer

The recognizer enables an unattended Sender to answer incoming calls automatically, transmit a tape message, and disconnect automatically at the end of transmission. The Sender recognizer kit is used in conjunction with the Receiver identifier kit. The recognizer feature prevents an unattended Sender from transmitting a tape message to an unauthorized Receiver. With this feature, a discrete code must be generated by the attended receiving station and recognized by the unattended sending station before any tape message transmission occurs.

1.5.2 Receiver

A. Circuit Assurance and Break Option

The circuit assurance and break feature requires a data set which has the reverse channel feature. This option will shut down the Receiver automatically if a line break occurs. It will also permit the receiving operator to stop the Sender when a trouble condition such as low or tight tape occurs.

B. Unattended Answering Option

The unattended answering option is built into the receiver and allows data reception on an unattended basis. This option will cause a station to automatically answer a call when the AUTO key on the receiving data set is operated.

2. INTERFACE

2.1 Data Sets:

The Type 2 System uses 202-type data sets. The Sender and Receiver can use either 202C or 202D data sets. The 202C provides DATAPHONE Service where an integrated equipment arrangement is desired and alternate voice data private line service. The 202D provides data only private line service. Data Auxiliary Set 804A can be used with a 202D data set to provide DATAPHONE Service and alternate voice data private line service where a separate equipment arrangement is desired. For additional data set information refer to:

Bell System Data Communications
Technical Reference Manual
Data Sets 202C and 202D Interface Specification which is available from:

Engineering Director – Data Communications
American Telephone and Telegraph Company
195 Broadway
New York, New York 10007

2.2 Interface Diagrams

Interface diagrams for various Type 2 station arrangements using a 202C data set are given in the Figure section. These diagrams give interface terminal numbers, lead designations, and connector markings. All wires which terminate in a Sender or Receiver interface connector are shown whether they perform a function or not. Actual cable construction has been accurately represented. In some instances where no mating wire or terminal is shown in a connector, they are actually not present. The dashed circle symbol used on the transmitted and received data leads indicate shielded wire. When spare leads are present, they are taped and tied back along the interface leg of a cable as shown.

The interface diagram figure numbers and arrangements follow:

Figure 4 Basic Send-Only Station

Figure 5 Send-Only Station with Discrete Calling (Recognizer) Feature

Figure 6 Basic Receive-Only Station

Figure 7 Receive-Only Station with Discrete Calling (Identifier) Feature

Figure 8 Send-Receive Station with Discrete Calling (Recognizer and Identifier) Features

2.3 Signal Characteristics and Requirements

2.3.1 Data Signals

The serial data output of a Sender consists of a start-stop type polar signal. The nominal output signal voltage across a load of 1000 ohms is +6 volts for a space and -6 volts for a mark. The Receiver is designed to operate from a start-stop polar input signal. The nominal input signal voltage from 1000-ohm source is +3 volts or more positive (+25 volts maximum) for a space and -3 volts or more negative (-25 volts maximum) for a mark. Signal voltages between +3 volts and -3 volts are undefined. During data transmission, the marking condition is used to denote the binary state ONE which corresponds to a hole punched in paper tape and the spacing condition is used to denote the binary state ZERO which corresponds to a no hole tape condition.

2.3.2 Control Signals from a Type 2 Set

A Type 2 Set provides two kinds of control signals to its data set, contact closures and polar signals. A contact closure between Ready, lead 21, and Remote Control, lead 20, or between

Remote Control, lead 20, and Remote Release, lead 19, indicates an ON condition. All other leads to the data set provide +6 volts to indicate an ON or spacing condition and -6 volts to indicate an OFF or marking condition. All voltages are referred to Signal Ground, lead 7.

2.3.3 Control Signals from a Data Set

A data set can provide two kinds of control signals to its Type 2 Set, contact closures and polar signals. The ring indicator leads provide a single contact closure between Ring Indicator 1, lead 22, and Ring Indicator 2, lead 23, to indicate an ON condition. All other leads, with one exception, provide +6 volts to indicate an ON or spacing condition and -6 volts to indicate an OFF or marking condition. The exception is lead 6, Data Set Ready (Interlock). This lead provides a low resistance ground signal (0 volts) to indicate an OFF condition and +6 volts to indicate an ON condition. All voltages are referred to Signal Ground, lead 7.

2.4 Lead Descriptions

A functional description of each lead found in a Type 2 Set interface connector follows:

Lead 1, Frame Ground

In the data set this conductor is electrically connected to the data set equipment frame. It is also connected to external grounds through the data set power cord. A Type 2 Set does not have a mating lead present in its interface connector for this data set lead. The frame ground connection on a Type 2 Set is made through its power cord.

Lead 2, Transmitted Data

Signals on this circuit are generated by the Sender to the data set for transmission to a receiving station. A Sender holds the Transmitted Data lead in the OFF or marking condition when no signals are to be transmitted. The OFF (mark) or ON (space) signal is held for the total duration of each signal element of the character transmitted.

Lead 3, Received Data

Signals on this circuit are generated by the receiving data set in response to data signals received from the line. The receiving data set holds the Received Data lead in the OFF (mark) condition when both Type 2 Stations have their Request to Send leads, if present, in the OFF condition. The OFF (mark) or ON (space) signal is held for the total duration of each signal element of the character received.

Lead 4, Request-to-Send

Signals on this circuit are generated by the Type 2 Sets to condition the local data set to transmit. The carrier signal is transmitted during the ON condition of this lead. The OFF condition holds the data set in the receive data condition, and the ON condition holds the data set in the transmit data condition. These conditions are established without regard to signals on the Transmitted and Received Data leads. On a basic send-only set, the Request-to-Send lead is permanently in the ON condition.

Lead 5, Clear-to-Send

Signals on this circuit are generated by the transmitting data set to indicate that it is prepared to transmit data. This lead is not used by the Sender or Receiver in any form of operation although present in the send-receive station interface.

Lead 6, Data Set Ready (Interlock)

Signals on this circuit are generated by the local data set to indicate that it is ready to operate. The OFF condition indicates either:

a. An abnormal or test condition which prevents normal data set operation.
b. That the communication channel is switched to the voice mode.
c. That the local data set is not connected to a communication channel (data set on-hook).

The ON condition appears at all other times.

Lead 7, Signal Ground

This conductor establishes the common ground reference potential for all interface circuits except protective ground. It is connected to the frame and Protective Ground lead in both the

data set and the Type 2 Sets to minimize the introduction of noise into the electronic circuitry.

Lead 8, Data Carrier Detector

Signals on this circuit are generated by the receiving data set to indicate that data carrier is being received and has been received for at least 40 ± 10 milliseconds. When data carrier is lost because the transmitting data set is turned OFF or because of a fault condition, the OFF condition follows after a 15-millisecond guard time delay. The ON condition indicates reception of the data carrier. The OFF condition indicates the end of transmission activity or a fault condition.

Lead 9, + Voltage

This conductor provides +18 volts from the data set through a 2.7K-ohm resistor to Request-to-Send, lead 4, and Supervisory Transmitted Data, lead 11, when permanent control functions are required.

Lead 10, – Voltage

This conductor provides -18 volts from the data set. This lead is not used by the Type 2 sets in any form of operation.

Lead 11, Supervisory Transmitted Data

Signals on this circuit are generated by the Type 2 Sets to provide a circuit assurance and break feature. The signals are generated simultaneously with normal data channel operation and operate only when Request-to-Send, lead 4, is OFF. This lead, data set option T, is provided only on data sets equipped with the reverse channel feature.

Lead 12, Supervisory Received Data

Signals on this circuit are used to inform the transmitting data set of conditions at the receiving data set. The signals are generated simultaneously with normal data channel operation. This lead, data set option T, is provided only on data sets equipped with the reverse channel feature.

Leads 13 through 18

These leads are not used nor are they present in any of the Type 2 Set interface cables.

Lead 19, Remote Release and Lead 20, Remote Control

These conductors are controlled by contact closure in a Type 2 Set. When the Remote Release lead is connected to the Remote Control lead, the local data set is allowed to go into the data mode. Opening these leads will disconnect the data set from the line and terminate the call.

Lead 21, Ready

This conductor is closed to the Remote Control lead by a Type 2 Set when automatic answering of incoming calls is desired.

Leads 22 and 23, Ring Indicators 1 and 2

These conductors provide a single contact closure from the data set to indicate an ON condition. These leads are not used by the Type 2 Sets in any form of operation.

Leads 24 and 25

These leads are not used nor are they present in any of the Type 2 Set interface cables.

3. GENERAL OPERATING PROCEDURES

3.1 Indicating lamps and controls used on the Sender and Receiver are described below.

3.1.1 Basic Sender Lamps and Controls (Figure 1)

Designations and Functions

Power Lamp

This yellow lamp lights to indicate that ac power is being supplied to the set. The lamp is controlled by the POWER toggle switch located on the front panel of the power module.

Line Break Lamp

This red lamp lights to indicate that data transmission has ended. When the circuit

assurance and break (reverse channel) feature is used, the lamp also lights when connection to a receiver is broken or the receiving station interrupts transmission. Whenever this lamp lights an alarm sounds.

Auto Manual Toggle Switch

This switch conditions the equipment for automatic or manual operation. In the AUTO position, the set will provide unattended operation. In the MANUAL position, an operator must be present for set operation.

Winder Toggle Switch

This switch starts or stops the tape take-up reel motor. The winder should be started after a message tape is placed in the reader and prior to placing a call. The winder should be stopped when replacing a tape reel.

Reader Pushbutton

This switch starts or stops the reader motor. It is operated during attended call establishment and termination procedures.

5,6,7, or 8 Numbering Dial

The reader numbering dial is located at the lower left corner of the tape guide plate and allows the reader to alternately sense either 5-, 6-, 7-, or 8-level tapes. Changing from one level to another is done by rotating the dial to the number corresponding to the desired tape level. This action will mechanically hold any unused bit positions in the spacing condition.

Run, Stop, or Free Lever

The reader control lever is located at the rear of the tape guide plate and controls tape sending by the reader. In the Run position, reading and feeding occurs; in the Stop and Free positions, it does not. The Free position allows the reader feed wheel to rotate freely and permits tape insertion without lifting the tape lid. When the reader lever is in the Run position and no tape is in the reader, the Break lamp will light and an alarm will sound. This condition is cleared by moving the lever to the Stop or Free position, or by inserting tape.

Transmission Levels 5-6, 7, or 8 Rotary Switch

This switch conditions the electronic modules to transmit the number of levels corresponding to the desired tape level. It is located in the upper right corner of the front panel.

3.1.2 Optional Sender Controls (Figure 1)

The "Y" connector mode switch is part of the send-receive terminal modification kit. It is a four-position rotary switch which selects the desired terminal or terminals to be connected to the data set. The four positions and their functions follow:

Positions and Functions

Send
Manual or Unattended Sending

Receive
Manual or Unattended Receiving

Send-Receive
Unattended Sending or Receiving

Test
Terminal Testing

The LOCAL toggle switch can be used with the optional local control feature. It is located in the spare terminal control position adjacent to the READER pushbutton switch. When this switch is operated, transmission between a Sender and a Receiver at a send-receive station can occur without engaging the on-line condition of the local data set.

3.1.3 Basic Receiver Lamps and Controls (Figure 2)

Designations and Functions

Power Lamp

This yellow lamp lights to indicate that ac power is being supplied to the set. The lamp is controlled by the Power toggle switch located on the front panel of the power module.

Low Tape Lamp

This red lamp lights to indicate that the local tape supply is low.

Winder Toggle Switch

This switch starts or stops the tape take-up reel motor. The winder should be started after tape is threaded through the punch and onto the take-up reel. The winder should be stopped when replacing a tape reel.

Punch Pushbutton

This switch starts or stops the punch motor. It is operated in order to thread tape through the punch and onto the tape take-up reel.

LTRS. F.O. Pushbutton

This switch conditions the punch to feed out an all-mark tape with the punch motor running for as long as the button is held operated. It is operated for punch and take-up reel tape threading.

0, 6, or 7 Slide Switches

These slide switches condition the punch to receive the number of levels corresponding to the transmitted tape level. For 5-level tape, the 0, 6, and 7 switches are set to the OMIT position. For 6-level tape, the 6 and 7 switches are set to the OMIT position. For 7-level tape, the 7 switch is set to the OMIT position. For 8-level tape, none of these slide switches are set to OMIT. The level selector slide switches are located on top of the punch behind the punch cover.

3.1.4 Optional Receiver Control (Figure 2)

The TRANSMITTER START pushbutton switch is part of the discrete calling identifier kit. It is located on the cabinet front panel directly beneath the tape supply reel. This switch is operated only when establishing a call to an unattended sending station and causes a discrete code to be transmitted to the sending station.

3.2 Sending Station Operating Procedures

3.2.1 Attended Operation Without Variable Features

The Sender is conditioned to originate or answer an attended call by the following procedure:

(1) Operate the set POWER switch on.
(2) Move the AUTO MANUAL switch to the MANUAL position.
(3) Place a message tape in the reader and thread tape onto take-up reel.
(4) Operate the WINDER switch on.

A receiving station can now be called. Depress the TALK pushbutton on the data set and dial the desired station's number in the normal manner of placing a telephone call. The telephone of the receiving station rings until answered at which time conversation may take place. When both operators are ready to begin data transmission, the answering operator depresses the DATA pushbutton on the data set. This action causes a 2025 Hertz tone to be transmitted to the calling station. The sending operator listens for this tone and after hearing it proceeds to:

(5) Depress the DATA pushbutton on the data set.
(6) Operate the READER pushbutton on.
(7) Move the reader control lever to the RUN position.

Transmission will now begin and the handset can be replaced on its cradle. At the end of transmission, a bell will sound and the red LINE BREAK lamp will light. The call is terminated by the following procedure:

(8) Move the reader control lever to the STOP position.
(9) Operate the READER pushbutton off.
(10) Depress the TALK pushbutton on the data set.
(11) Lift the handset off its cradle momentarily, then hang up.

A sending station can answer a call almost in the same manner as originating a call. The only difference in procedure is that after the telephone rings, the TALK pushbutton is depressed and the handset lifted to answer the call. After the receiving station operator answers, the procedure is the same as for originating a call.

3.2.2 Attended Operation With Circuit Assurance and Break Feature

The operating procedure for a sending station equipped with the circuit assurance and break feature is the same as that given for a sending station without variable features. The break feature allows the receiving station operator to interrupt transmission usually for a trouble such as low or torn tape. When this occurs, data transmission will stop, the red LINE BREAK lamp will light, and a bell will sound at the sending station. Return to the talk mode by

depressing the TALK pushbutton on the data set to establish the reason for the transmission interruption.

To resume transmission, the sending and receiving data sets are returned to their data modes as is done when originating a call. A trouble stop usually involves some loss of data which requires partial or complete message tape retransmission.

3.2.3 Unattended Operation

The Sender is conditioned to answer automatically by the following procedure:

(1) Operate the set POWER switch on.
(2) Move the AUTO MANUAL switch to the AUTO position.
(3) Place a message tape in the reader and thread tape on the take-up reel.
(4) Move the reader control lever to:
   a. The RUN position if alarm bell and LINE BREAK lamp are required to operate after transmission stops.
   b. The STOP position if no warnings are desired.
(5) Depress the automatic answer pushbutton on the data set.

A data set option is available which makes step (5) unnecessary. The sending data set is then wired to answer all incoming calls automatically. The sending station will now automatically answer an incoming call, start the reader and tape winder motors, and transmit a tape message. After the tape has been transmitted, automatic disconnection will also occur. To restore the Sender to attended service, depress the data set TALK pushbutton and move the AUTO MANUAL switch to the MANUAL position.

3.2.4 Unattended Operation With Circuit Assurance And Break Feature

The operating procedure for this form of service is the same as that given for unattended operation. The circuit assurance and break feature operates in the same manner as explained for attended operation. Loss of the reverse channel signal will stop the Sender and begin a thirty-second timer after which call disconnection occurs if the receiving station does not return to the data mode during the time out period.

3.2.5 Calling An Unattended Receiver

A sending station can place a call to an unattended receiving station in the same manner as if the receiving station was attended.

3.3 Receiving Station Operating Procedures

3.3.1 Attended Operation Without Variable Features

The Receiver is conditioned to originate or answer an attended call by the following procedure:

(1) Operate the set POWER switch on.
(2) Check for adequate tape supply.
(3) Thread tape through punch and onto take-up reel.

The receiving station can now answer an incoming call. When the data set telephone rings, depress the TALK pushbutton on the data set, remove the handset, and answer the call.

When both operators are ready to begin transmission, the answering operator depresses the DATA pushbutton on the data set and replaces the handset. The receiving station is now in the data mode and transmission will begin as soon as the sending station operator moves the reader control lever to the RUN position. At the end of transmission the call is automatically disconnected.

A receiving station can originate a call almost in the same manner as answering a call. The only difference in procedures is that a call is placed by depressing the TALK pushbutton and dialing the desired station's number in the normal manner of placing a telephone call. After the sending station operator answers, the procedure is the same as for answering a call. At the end of transmission, the call is terminated by depressing the TALK pushbutton, lifting the handset momentarily and then hanging up.

3.3.2 Attended Operation With Circuit Assurance and Break Feature

The operating procedure for a receiving station equipped with the circuit assurance and break feature is the same as that given for a receiving station without variable features. The break feature allows the receiving station operator to interrupt transmission usually for a trouble such as low or torn tape. The receiving operator sends a line break signal by depressing the TALK pushbutton and lifting the handset. Data transmission will stop at the sending station. When voice communication with the sending operator is established, the reason for message interruption can be given. After the trouble has been eliminated, data transmission can be started by returning to the data mode as is done when answering a call. A trouble stop usually involves some loss of data which requires partial or complete message tape retransmission.

3.3.3 Unattended Operation

The Receiver is conditioned to answer automatically by the following procedure:

(1) Operate the set POWER switch on.
(2) Check for adequate tape supply.
(3) Thread tape through punch and onto take-up reel.
(4) Depress the automatic answer pushbutton on the data set.

A data set option is available which makes step (4) unnecessary. The receiving data set is then wired to answer all incoming calls automatically. The receiving station will now automatically answer an incoming call, start the punch and tape winder motors, and receive a tape message. After the punch stops perforating tape, automatic disconnection will also occur. The Receiver is restored to attended service by depressing the data set TALK pushbutton.

3.3.4 Unattended Operation With Circuit Assurance And Break Feature

The operating procedure for this form of service is the same as that given for unattended operation. The circuit assurance and break feature operates in the same manner as explained for attended operation with one exception. The exception is that transmission of a line break signal from a receiving station cannot occur since the presence of an operator is required for this feature.

3.3.5 Calling An Unattended Sender

The Receiver can place a call to an unattended sending station in the same manner as if the sending station was attended, with one exception. The exception is that immediately after the receiving operator depresses the DATA pushbutton, the TRANSMITTER START pushbutton is also depressed. Operating the TRANSMITTER START pushbutton causes the Receiver to transmit an identification code which must be recognized by the sending station. Without proper recognition, data transmission cannot take place and the call will be terminated. This arrangement assures that an unattended sending station will transmit only to an authorized receiving station.

3.4 Send-Receive Station Operating Procedures

3.4.1 Attended Operation

The operating procedures required for an attended send-receive station are the same as given for the individual attended send and receive stations with one exception. The use of a single data set requires the positioning of a mode switch. When a Sender and a Receiver are connected as a send-receive station, the data set normally mounted in the Receiver is not required. A four-position mode switch is mounted on the front of the Sender. To send data, the switch is set to the SEND position. To receive data, the switch is set to the RECEIVE position. The TEST position of the switch is for maintenance purposes only.

3.4.2 Unattended Operation

With the exception of mode switch positioning, the operating procedures required for an unattended send-receive station are the same as given for the individual, unattended, send and receive stations. To condition a send-receive station for unattended sending service, the mode switch is set to the SEND position. Similarly, for unattended receiving service, the mode switch is set to the RECEIVE position. For unattended send or receive service, the mode switch is set to the SEND-RECEIVE position.

4. DISCRETE CALLING GENERATOR

4.1 General Description

4.1.1 The Discrete Calling Generator is a self-contained module which enables a data processing terminal with no Type 2 terminal at the same location to gather data from a remote unattended Type 2 terminal. The remote station can be a Send-Only or Send-Receive Terminal. The data processing terminal, which can be a computer, and remote terminal are initially connected through conventional telephone facilities. Upon completion of initial contact, the data processing terminal identifies itself as an authorized receiver by transmitting a discrete code with the Discrete Calling Generator. When the discrete code is recognized typically, a Sender will begin tape transmission to the data processing terminal. All terminals within a given system are encoded with the same discrete code.

4.1.2 The Generator is located at the interface between the data processing terminal and its data set. A typical system is shown in Figure 9. Only one Generator is required per system. The Type 2 Senders must be equipped with recognizer units which compare and recognize the 14-bit code. The discrete calling code is required to start unattended Type 2 terminals in order to prevent data from being lost to wrong numbers or unauthorized calls. System security is provided by having the code and speed intentionally difficult for ordinary business equipment to generate. When the Discrete Calling Generator is not transmitting its identification code, it is transparent and has no effect on signalling.

4.1.3 The Generator has three service options:

a. Option A – Automatic operation; terminal and data set connections only.

b. Option R – Remote control; terminal, data set, and auxiliary control connections.

c. Option RD – Remote control through available data set circuits; terminal and data set connections only. Option RD allows the use of data set leads 11 and 12 for remote control operation of the Generator instead of using the auxiliary control connector. This option cannot be used when the data processing terminal is using the reverse channel feature of the local data set.

4.1.4 The physical and electrical characteristics of the Discrete Calling Generator are listed in Table 4A.

Physical and Electrical Characteristics of the Generator
Table 4A

Feature or Requirement	
Size	11" wide, 5.5" high, 10.25" deep
Weight	13.2 pounds
Operating Temperature Range	+40°F to +110°F
Average AC Power Consumption-Operating	36.5 watts
Voltage	117 volts AC ± 10%
Frequency	60 ± .75% Hertz
Current	0.31 amperes
Interface	Polar Signal
Power Cord	Three-wire grounded type of 10' length

4.2 Interface

4.2.1 The Discrete Calling Generator is designed to interface with a 202-type data set and data processing terminal. The interface conforms to EIA Standard RS-232-A for serial operation. All interface connectors are located at the rear of the generator cabinet housing. The generator requires polar input signals of +3 volts or more positive (+25 volts maximum) to indicate an ON or spacing condition and -3 volts or more negative (-25 volts maximum) to indicate an OFF or marking condition. Input signal voltages between +3 volts and -3 volts are undefined. The generator output signals conform to the input signal requirements for 202-type data sets.

4.2.2 For 202-type data set operation, the disposition of the data set circuits through the Generator are listed in Table 4B. The circuit conditions for operation of the Generator are shown in Table 4C. When the generator is not in operation, all leads have a one-to-one correspondence between the input and output. The input and output interfaces, therefore, are

the same; the data processing terminal will not detect the presence of the Discrete Calling Generator between itself and the data set with the following exceptions. The signals on circuits Data Set Ready (Pin 6) and Data Carrier Detect (Pin 8) are partially loaded when the Generator is not in operation since current is drawn by two of its logic elements. Each circuit is required to supply 0.228 milliamperes (mA) when ON and .030 mA when OFF.

SERIAL TYPE DATA SET OPERATION

TABLE 4B

DISCRETE CALLING GENERATOR INTERFACE	SIGNALS CONNECTED STRAIGHT THROUGH	SIGNALS USED BY GENERATOR	SIGNALS CONTROLLED BY GENERATOR	STATE OF INTERFACE LEADS WHEN GENERATOR IS OPERATED INPUT	OUTPUT
1. FRAME GROUND	X			-	-
2. SEND DATA			X	-	M
3. RECEIVE DATA			X	0	M
4. REQUEST TO SEND		X	X	0	I
5. CLEAR TO SEND			X	0	I
6. DATA SET READY	X	X		I	I
7. SIGNAL GROUND	X	X		-	-
8. CARRIER DETECT		X	X	0	I
9. +18 VOLTS	X			-	-
10. -18 VOLTS	X			-	-
11. REVERSE CHANNEL SEND	X			-	-
12. REVERSE CHANNEL RECEIVE	X			-	-
13. NOT USED	X			-	-
14. NEW SYN.	X			-	-
15. TRANSMIT CLOCK	X			I	I
16. DIBIT TRANSMIT CLOCK	X			I	I
17. RECEIVE CLOCK	X			I	I
18. DIBIT RECEIVE CLOCK	X			I	I
19. NOT USED	X			-	-
20. DATA TERMINAL READY	X			I	I
21, NOT USED	X			-	-
22. RING INDICATOR	X			0	0
23. NOT USED	X			-	-
24. EXTERNAL CLOCK	X			-	-
25. REMOTE TEST	X			-	-

0 - OFF STATE OR MARKING

I - ON STATE OR SPACING

M - MODULATED

CIRCUIT CONDITIONS FOR OPERATION OF DISCRETE CALLING GENERATOR WITH SERIAL DATA SET

TABLE 4C

SERVICE OPTION	DATA SET READY (LEAD 6)	REQUEST TO SEND (LEAD 4)	DATA CARRIER DETECT (LEAD 8)	AUXILIARY CONTROL (PIN 1)	DATA SET INTERFACE (PIN 11)
A (AUTOMATIC)	ON (+3 VOLTS)	OFF (-3 VOLTS)	OFF (-3 VOLTS)	NOT USED	NOT USED
R (REMOTE CONTROL)	ON (+3 VOLTS)	OFF (-3 VOLTS)	OFF (-3 VOLTS)	+3 VOLTS	NOT USED
RD(REMOTE CONTROL THROUGH DATA SET CONNECTOR)	ON (+3 VOLTS)	OFF (-3 VOLTS)	OFF (-3 VOLTS)	NOT USED	+3 VOLTS

NOTE: VOLTAGES SHOWN FOR SERIAL OPERATION ARE MINIMUM VOLTAGES; MAXIMUM VOLTAGE ARE +25 VOLTS FOR ON AND -25 VOLTS FOR OFF. OPTION R USES THE AUXILIARY CONTROL CONNECTOR; OPTION RD USES THE DATA SET CONNECTOR IN PLACE OF THE AUXILIARY CONNECTOR.

AUXILIARY CONTROL CONNECTOR CIRCUITS

TABLE 4D

CONNECTOR		SERIAL DATA SET APPLICATION
PIN	CIRCUIT	
1	REMOTE CONTROL	X
2	ACKNOWLEDGE SIGNAL	X
4	REMOTE CONTROL	
5	ACKNOWLEDGE SIGNAL	
7	SIGNAL GROUND	X
14	SIGNAL GROUND	X
15	TEST	X

4.2.3 The auxiliary connector provides an additional input for remote control (Option R) operation of the Discrete Calling Generator. The connector pins and circuits are listed in Table 4D. The auxiliary connector also passes a signal that acknowledges the operation of the generator. When remote control operation is selected, the input from either the auxiliary connector, Pin 1, or the data set connector, Pin 11, must be maintained for 200 ms minimum while the conditions for operation are present on the Request-to-Send, Pin 4, Data Set Ready, Pin 6, and Data Carrier Detect, Pin 8, circuits.

4.3 System Operation and Timing Diagrams

4.3.1 The operation of a system using the Generator depends on whether the data processing terminal is a receive-only or send-receive station. Unattended operation only is discussed though attended operation (manual dialing) is possible. Automatic dialing with 801A or 801C Automatic Calling Unit is not affected by Generator operation.

4.3.2 If no echo suppressors are present in the system, or if they have been held disabled by reverse channel signals, the only transmission delay will be the time required for the signal to propagate from one terminal to the other. If echo suppressors are present, there will be a loss of signal of up to 200 ms (when the generator starts and when the mark hold is sent) to turn them around. This loss has no effect on any other part of the operation. The absence or presence of echo suppressors are represented by separate vectors at these points on the timing diagrams. All diagrams give time in seconds.

4.3.3 The generator and recognizer events of the Generator are shown in Figure 10. The assumed line distance between the data processing terminal and the remote terminal is equivalent to a propagation time of 50 milliseconds (ms). The assumed number of echo suppressors (if present) between the sending and receiving terminals is equivalent to a turnaround time of 150 ms.

4.3.4 The timing diagrams (Figures 11 and 12) for serial operation are based upon using the 202C or 202D data set. These data sets generate a 2025 Hertz recognition tone which will disable echo suppressors.

4.3.5 The operational events of a typical system in which the data processing terminal receives-only or receives before transmitting, are shown in Figure 11. Dialing, call set-up, ringing, the delays for the data set to enter the data mode and to transmit the disabling and recognition tone, and the duration of the tone transmission are the same for both send-only and send-receive remote terminals.

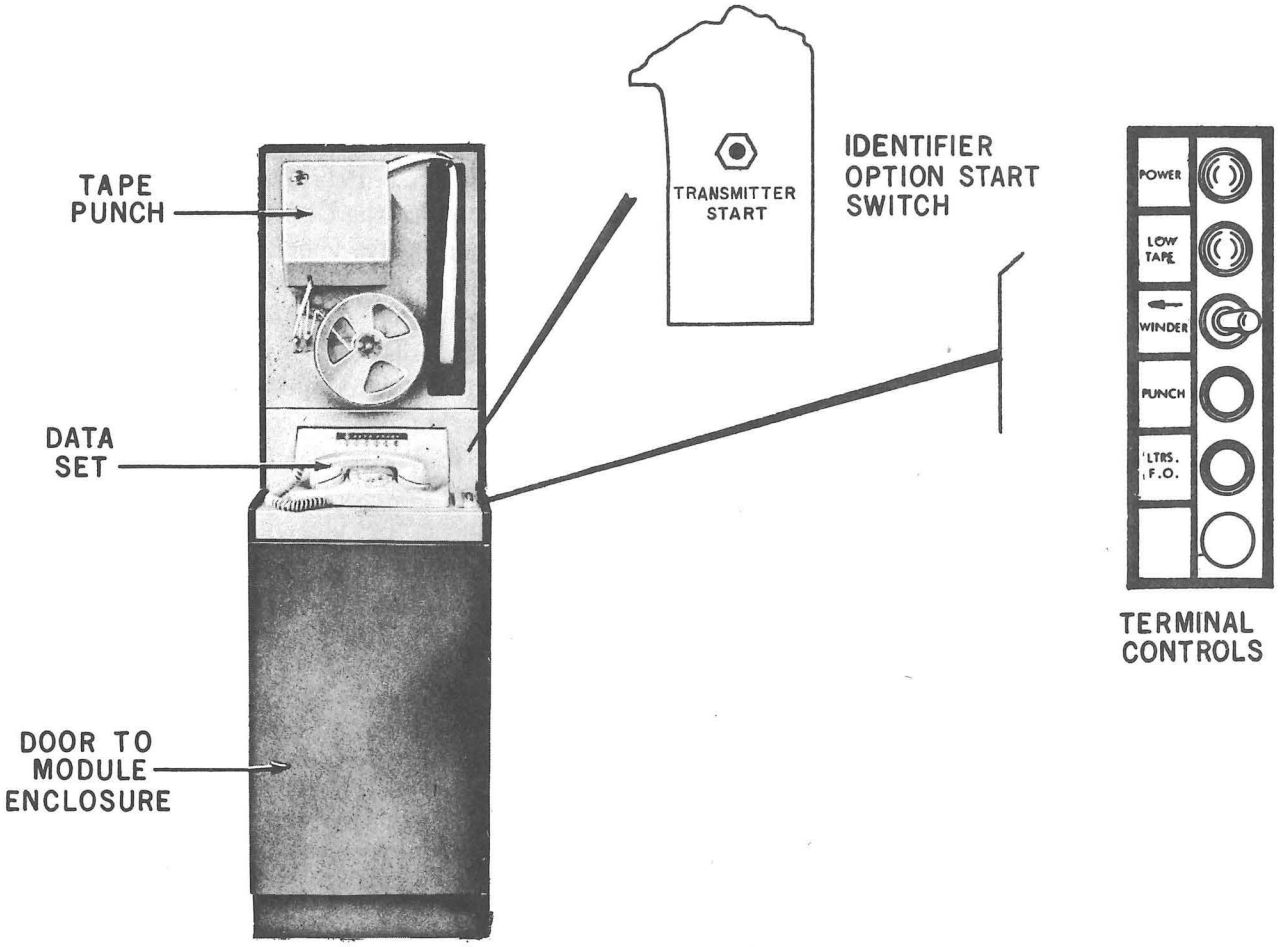
4.3.6 The automatic calling unit transfers the line to the data set approximately 100 ± 25 ms after it detects the end of the disabling and recognition tone. Reverse channel (if used) is turned ON by the remote terminal approximately 50 ms delay, the processing terminal data set enters the data mode, presenting the operate conditions for the Discrete Calling Generator. At this time reverse channel (if used) is also turned ON and is transmitted after a 12 ms delay. After a further delay of 200 ms (to allow the integrator pulse shaper in the Generator to time out and the signal generator clutch to engage), the discrete calling code is sent (as shown in Figure 10.) Reverse channel (if used) goes OFF at the data processing terminal when the code starts and comes ON again approximately 12 ms after the code stops.

4.3.7 After the last code bit is received by the remote sending terminal, there is a 207 ms delay before a relay is triggered, and after 24 ms more (231 ms total), the mark hold signal is sent by the remote terminal. Reverse channel (if used) goes OFF at the remote terminal when the mark hold signal comes ON. The receiving distributor at the processing terminal, is reset when the mark is detected. Meanwhile, at the remote sending terminal, the discrete calling recognizer unit will stop approximately 269 ms after the mark hold signal was started. The mark continues for another 30 ms as a relay pulls in. Data transmission then begins from the remote sending terminal.

4.3.8 The operational events of a typical system in which the data processing system sends first and then receives, is shown in Figure 12. Dialing,

call set-up, ringing, the delays for the data set to enter the data mode and to transmit the disabling and recognition tone, and the duration of the tone transmission are the same for both send-only and send-receive remote terminals.

4.3.9 The automatic calling unit transfers the line to the processing terminal data set approximately 100 ± 25 ms after it detects the end of the disabling and recognition tone. Reverse channel (if used) is turned ON by the remote terminal approximately 50 ms after sending the disabling and recognition tone. After a 50 ± 25 ms delay, the processing terminal data set enters the data mode, sending the mark hold signal for 200 ± 20 ms. Data is then transmitted from the data processing terminal. When data transmission is completed, Request-to-Send goes OFF (after a delay), presenting the operate conditions for the Discrete Calling Generator. At this time, reverse channel (if used) is also turned ON, and is transmitted after a 12 ms delay. After a further delay of 200 ms (to allow the integrator pulse shaper in the Generator to time out and the signal generator clutch to engage), the discrete calling code is sent as shown in Figure 10. Reverse channel (if used) goes OFF at the data processing terminal when the code starts and comes ON again approximately 12 ms after the code stops. The remaining operation is the same as previously given.



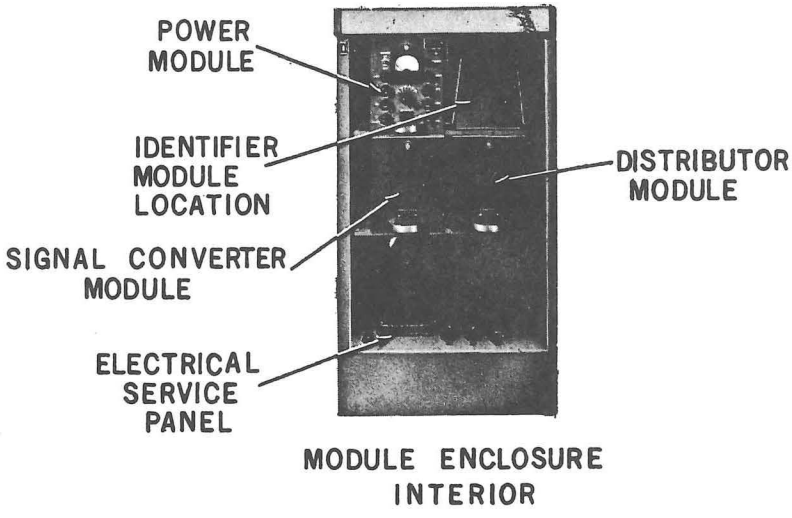
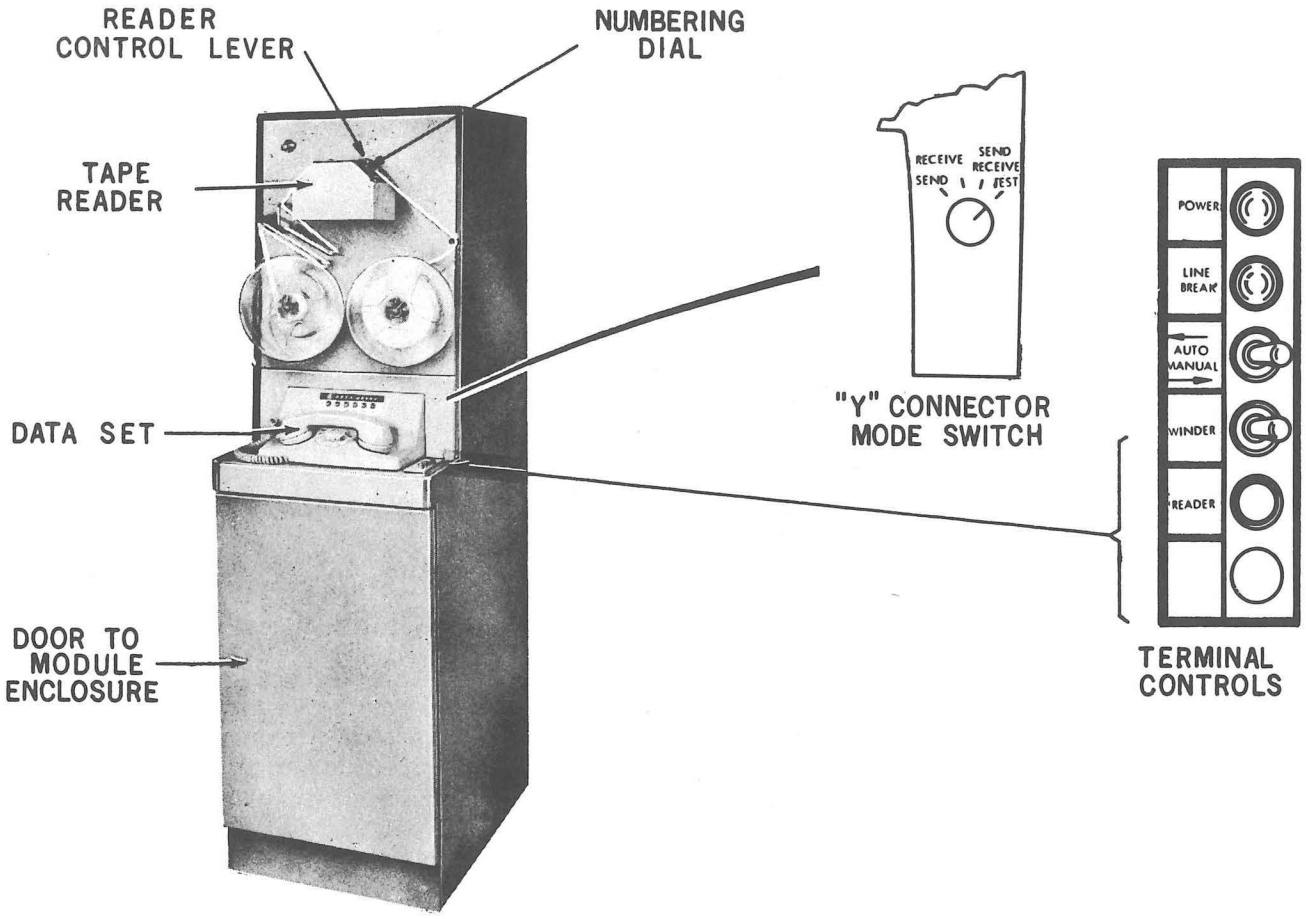
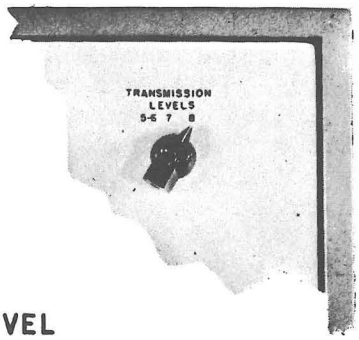
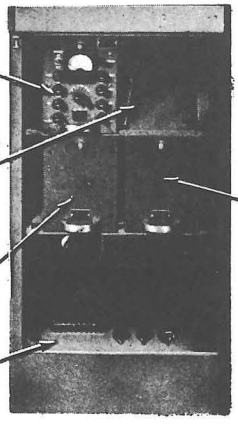


FIGURE 1 TAPE RECEIVER TERMINAL





LEVEL SELECTOR SWITCH



MODULE ENCLOSURE INTERIOR

FIGURE 2. TAPE SENDER TERMINAL

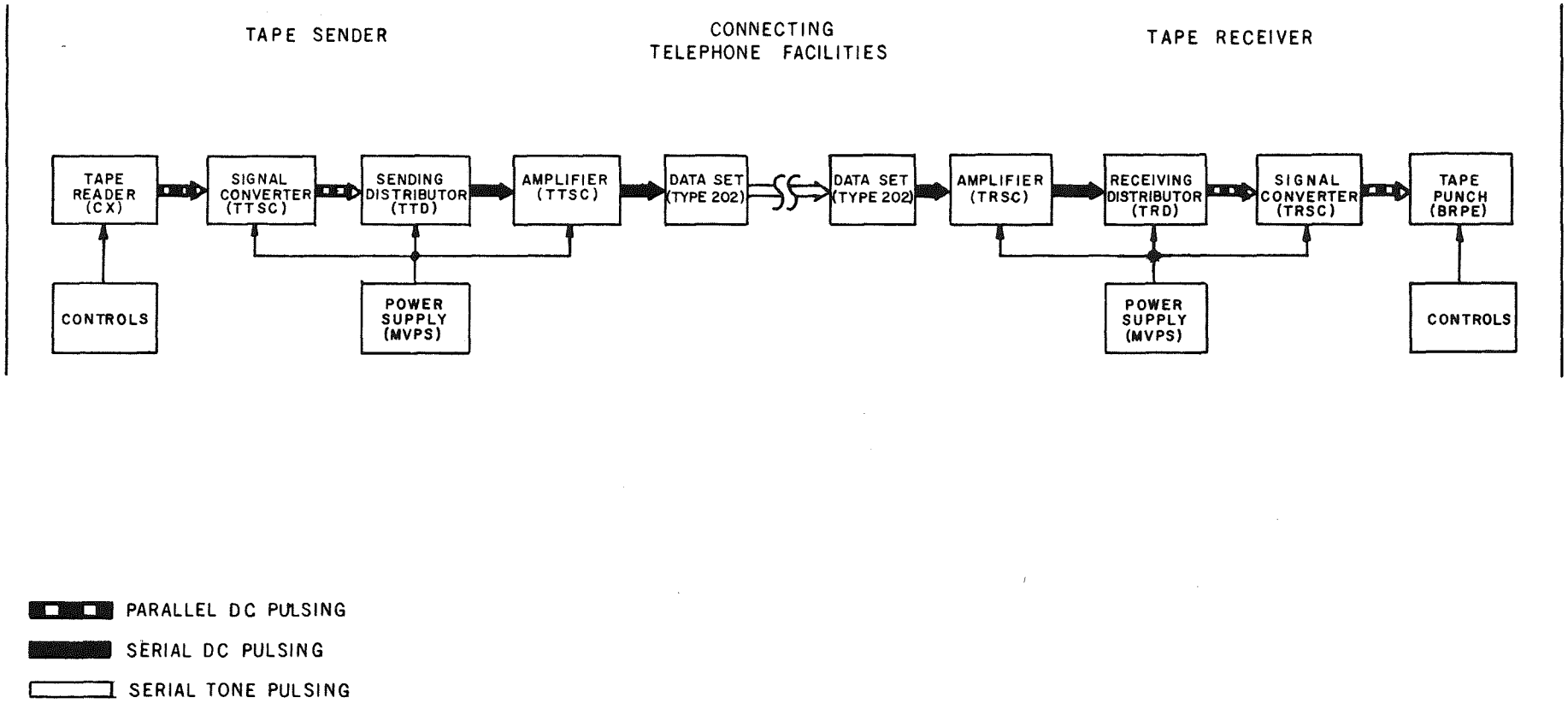


FIGURE 3 — SYSTEM BLOCK DIAGRAM

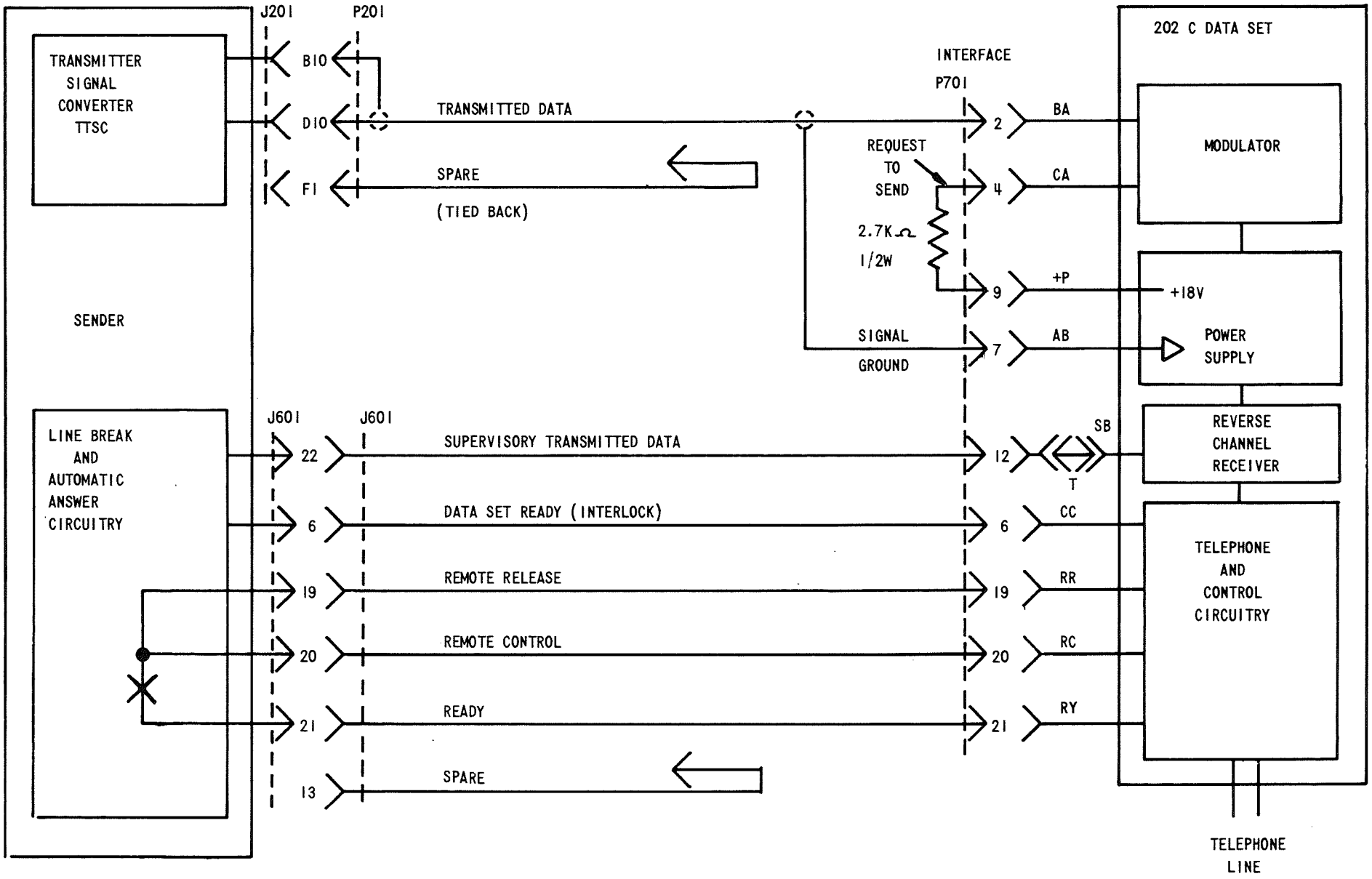


FIGURE 4 INTERFACE DIAGRAM FOR BASIC TYPE 2 SEND-ONLY STATION.

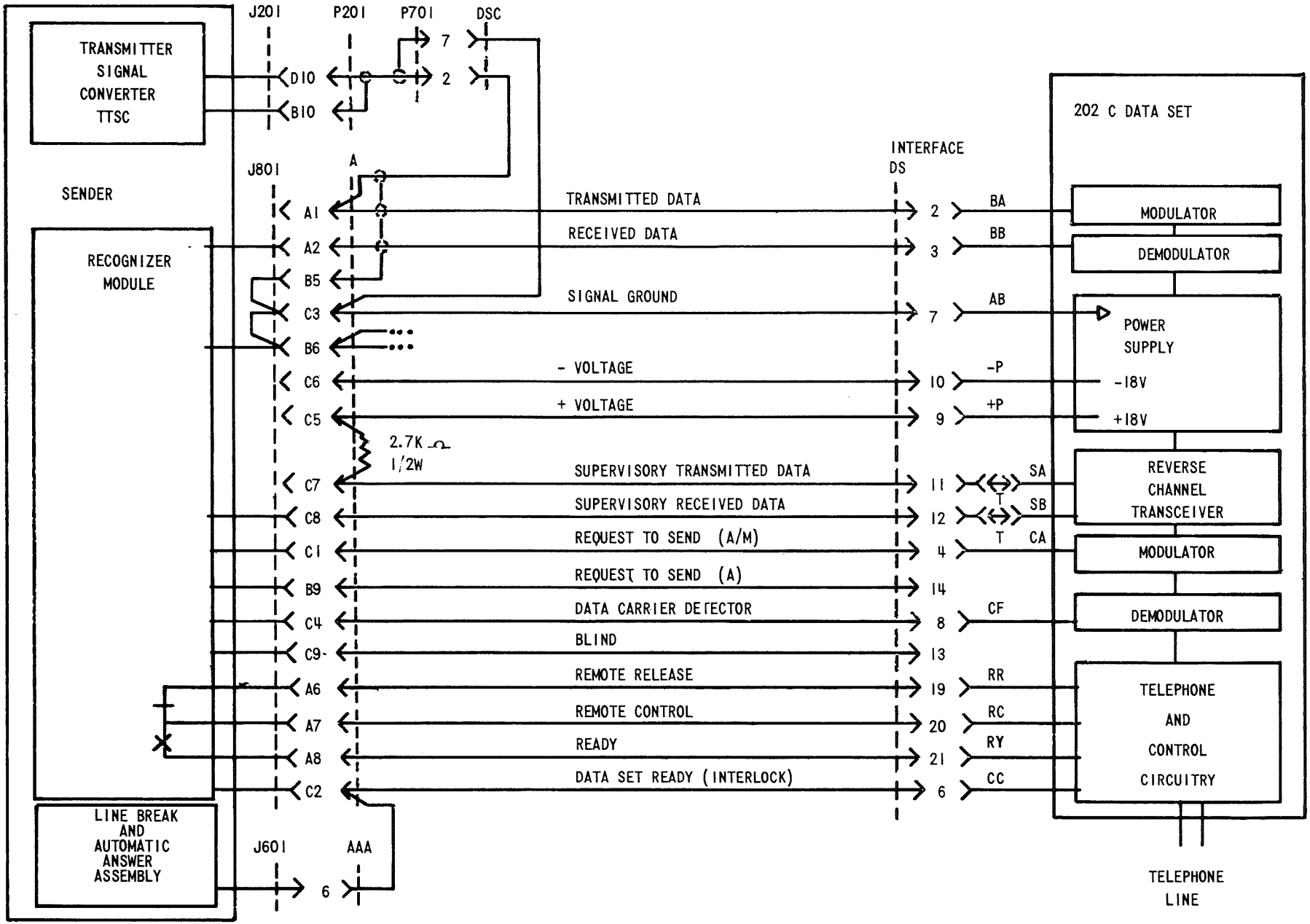


FIGURE 5 INTERFACE DIAGRAM FOR TYPE 2 SEND-ONLY STATION WITH DISCRETE CALLING (RECOGNIZER) FEATURE

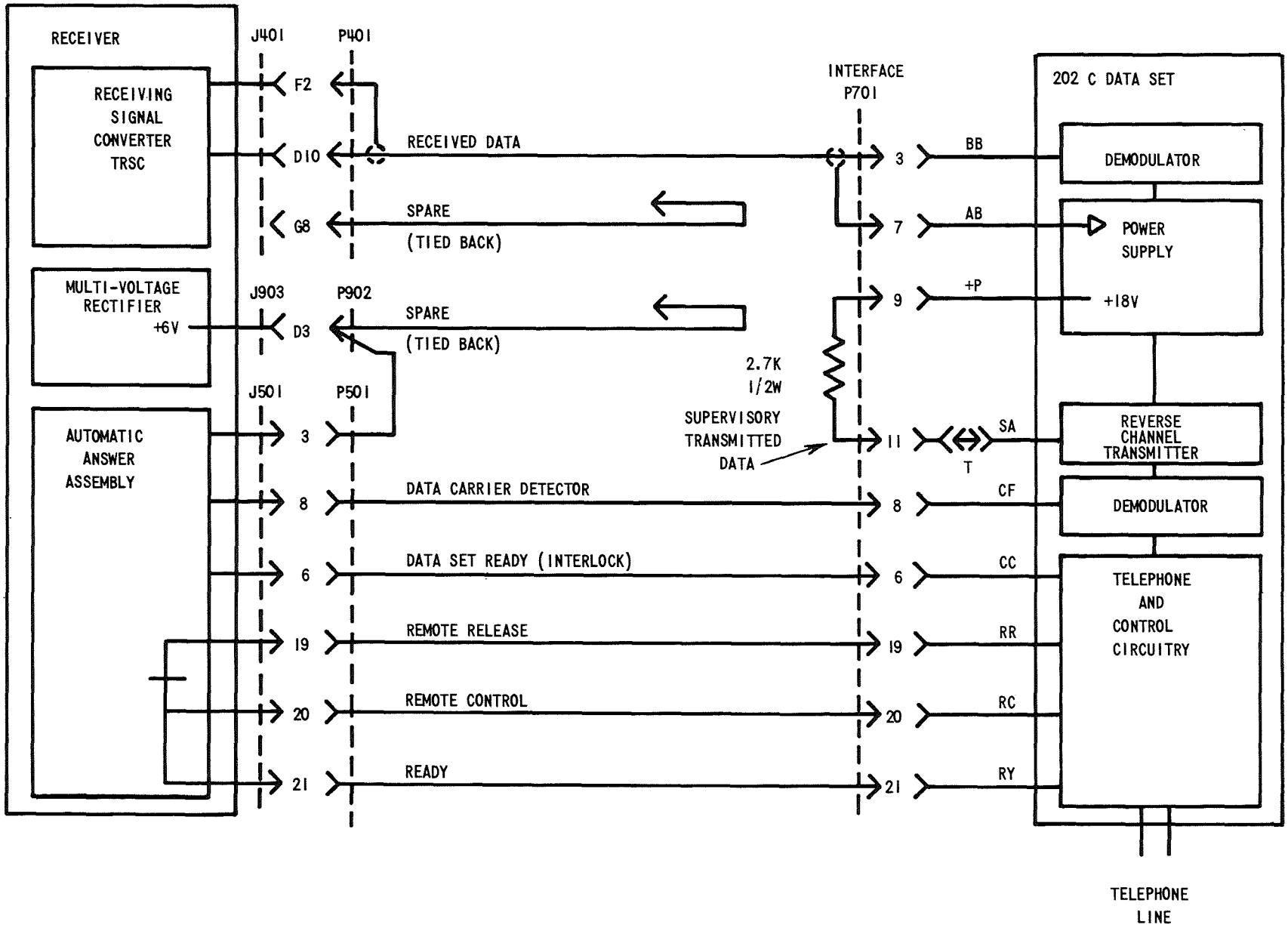


FIGURE 6 INTERFACE DIAGRAM FOR BASIC TYPE 2 RECEIVE-ONLY STATION

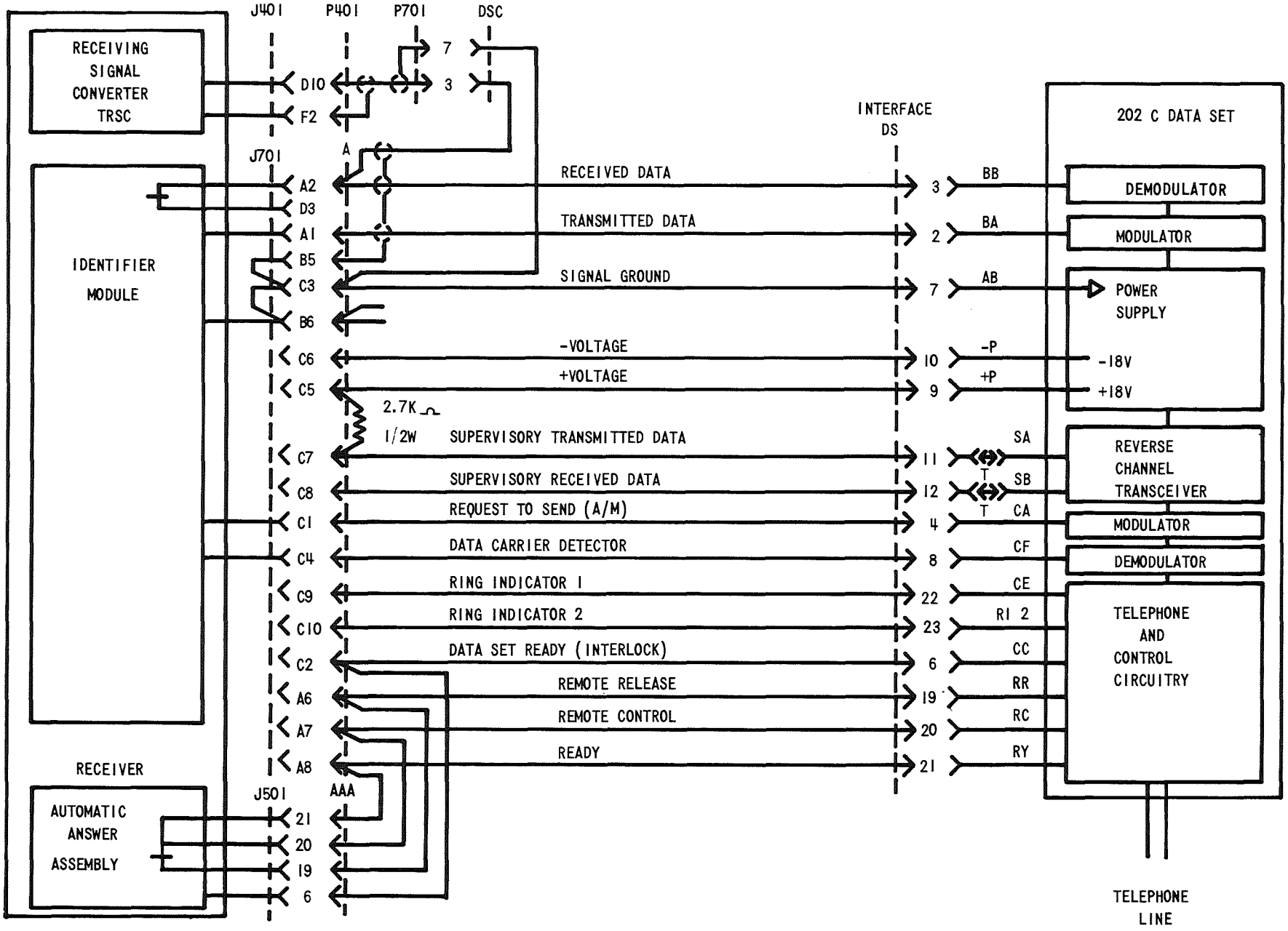


FIGURE 7 INTERFACE DIAGRAM FOR TYPE 2 RECEIVE-ONLY STATION WITH DISCRETE CALLING (IDENTIFIER) FEATURE.

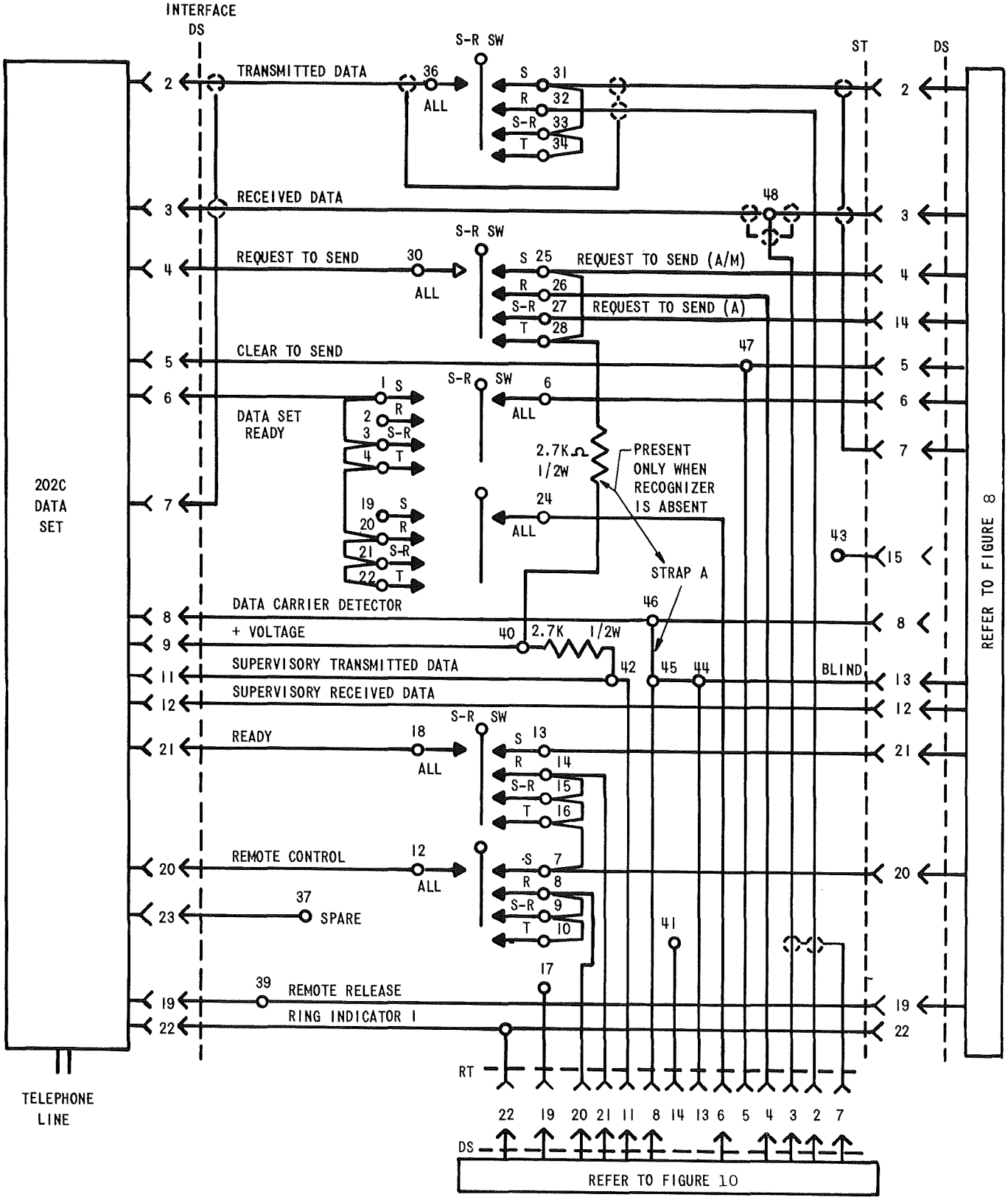


FIGURE 8 INTERFACE DIAGRAM FOR SEND-RECEIVE STATION WITH DISCRETE CALLING (RECOGNIZER AND IDENTIFIER) FEATURES.

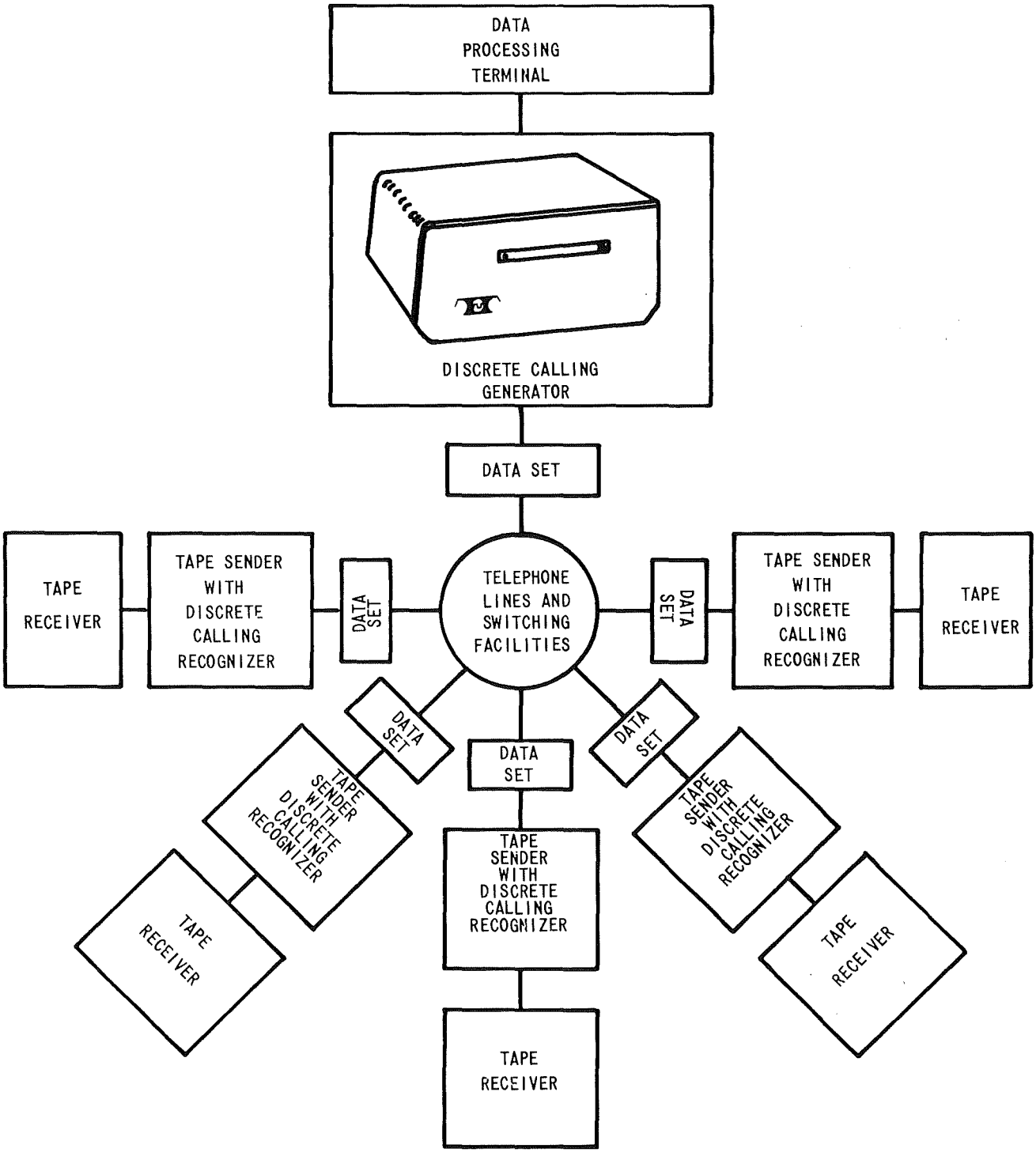
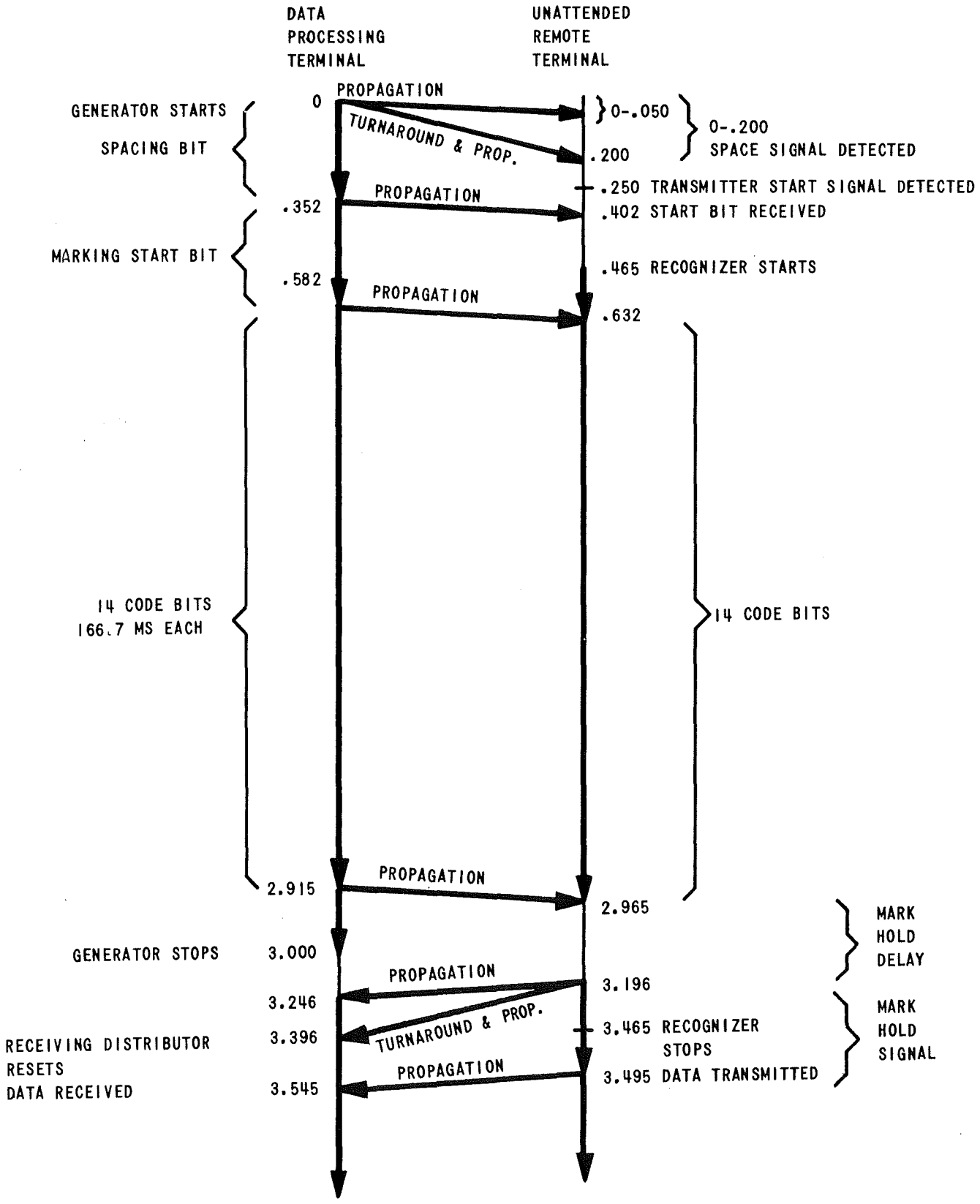


FIGURE 9 TYPICAL DATA PROCESSING SYSTEM UTILIZING DISCRETE CALLING FEATURE

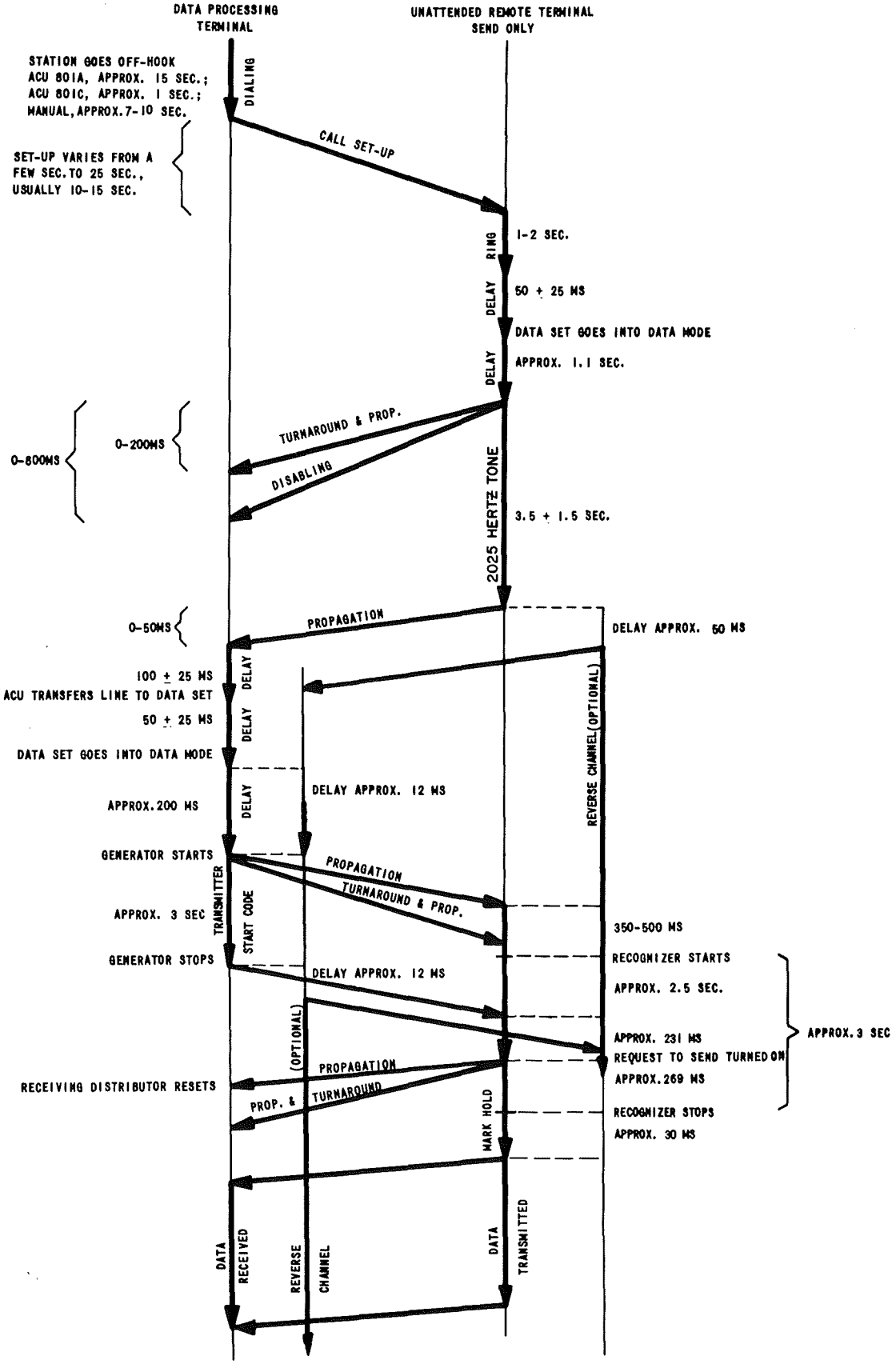
SYSTEM TIMING DIAGRAM FOR DISCRETE CALLING
GENERATOR - SERIAL TYPE TRANSMISSION



NOTE: MAXIMUM ECHO SUPPRESSOR TURNAROUND TIME (150 MS) AND PROPAGATION TIME (50MS) ARE ASSUMED.
IF ECHO SUPPRESSORS ARE NOT PRESENT OR ARE DISABLED, TURNAROUND TIME IS ABSENT.

FIGURE 10

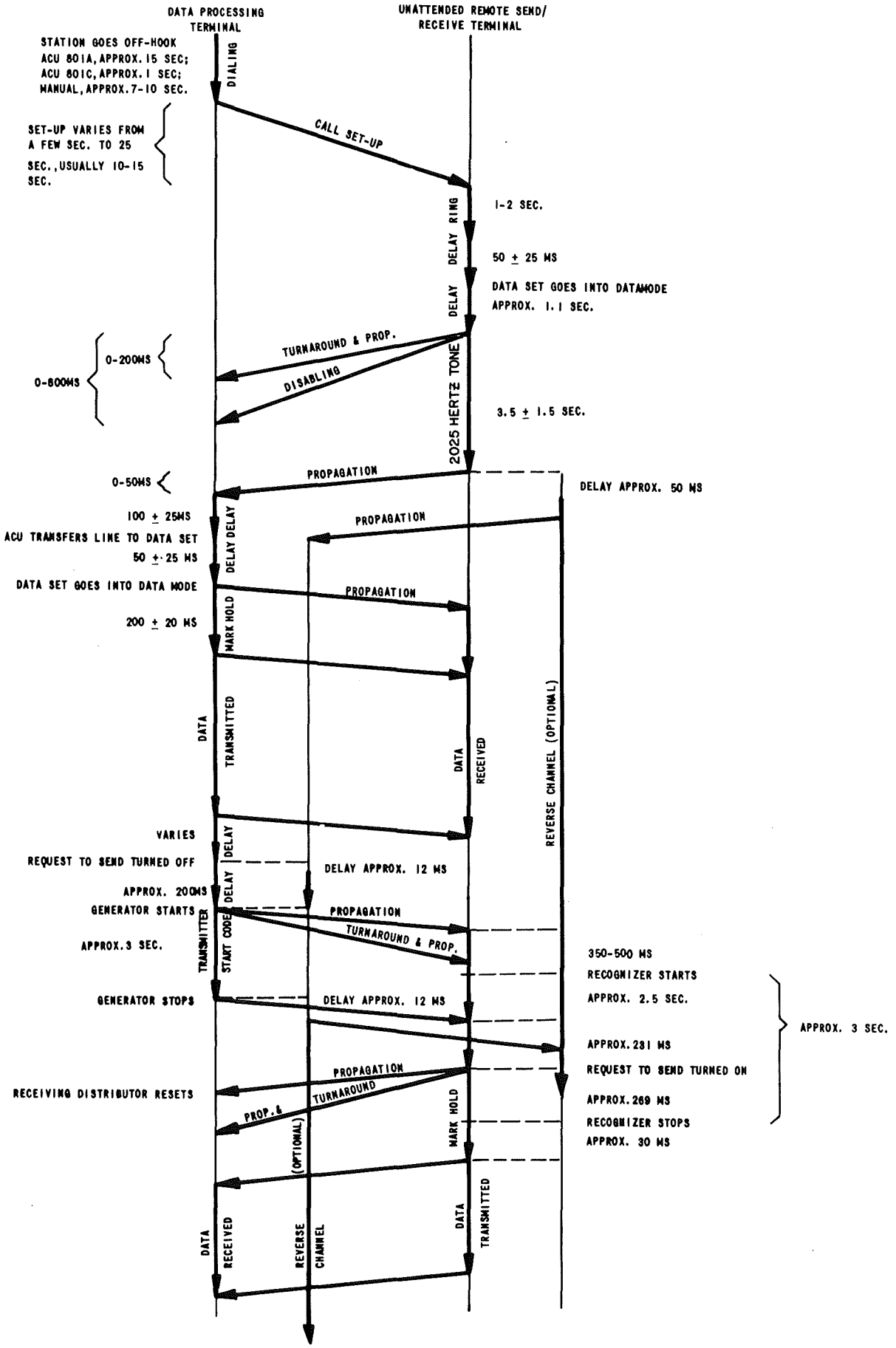
SYSTEM TIMING DIAGRAM FOR TYPE 2 DATASPEED TRANSMISSION WITH DISCRETE CALLING FEATURE DATA PROCESSING TERMINAL RECEIVES DATA ONLY



NOTE: TURNAROUND AND DISABLING TIMES APPLY TO ECHO SUPPRESSORS WHICH MAY APPEAR ON THE SWITCHED NETWORK FACILITIES. IF ECHO SUPPRESSORS ARE NOT PRESENT OR ARE DISABLED, TURNAROUND TIME IS ABSENT. OPTIONAL REVERSE CHANNEL TIMING IS SHOWN WITH REVERSE CHANNEL SENDS PERMANENTLY TURNED ON.

FIGURE 11

SYSTEM TIMING DIAGRAM FOR TYPE 2 DATASPEED
TRANSMISSION WITH DISCRETE CALLING FEATURE
DATA PROCESSING TERMINAL SENDS FIRST AND THEN RECEIVES



NOTE: TURNAROUND AND DISABLING TIMES APPLY TO ECHO SUPPRESSORS WHICH MAY APPEAR ON THE SWITCHED NETWORK FACILITIES. IF ECHO SUPPRESSORS ARE NOT PRESENT OR ARE DISABLED, TURNAROUND TIME IS ABSENT. OPTIONAL REVERSE CHANNEL TIMING IS SHOWN WITH REVERSE CHANNEL SENDS PERMANENTLY TURNED ON.

FIGURE 12

PROCEDURES FOR OBTAINING COPIES OF REFERENCED ARTICLES AND ADDITIONAL COPIES OF TECHNICAL REFERENCES

I. Bell System Technical Journals (BSTJ), Institute of Electrical and Electronics Engineers (IEEE), American Institute of Electrical Engineers (AIEE) and most other material from technical journals may be ordered from:

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   Montreal, Quebec
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