

Bell System Data Communications

TECHNICAL REFERENCE



**DATA SET
203-TYPE**

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June 1970

Engineering Director Data Communications



Bell System Data Communications

TECHNICAL REFERENCE MANUAL



**Data Set
203-Type**



June 1970



ENGINEERING DIRECTOR - DATA COMMUNICATIONS



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This Technical Reference supersedes the following Technical References:

Data Set X203A(M10) – Preliminary – August 1967
Data Set 203-Type – Preliminary – May 1969

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This Technical Reference contains information concerning the operating and interface characteristics of Data Sets 203-Type and their associated optional features. As additional operating characteristics are introduced, this specification will be revised to reflect them. Other pertinent Bell System Data Communications Technical References are listed below and elsewhere in this Technical Reference:

Bell System Data Communications Services – March 1964

Data Set Interface Connectors – July 1963

Also, this Technical Reference supersedes the following Technical References:

Data Set X203A(M10) – Preliminary – August 1967

Data Set 203-Type – Preliminary – May 1969

1. GENERAL

The Data Set 203 family is designed to provide transmission and reception of high-speed digital data over the switched message telecommunications network and 2- or 4-wire private line facilities with C2 conditioning. The data sets have the following basic design features:

- a) synchronous data transmission with transmitter bit timing supplied by the data set or by the customer, and receiver bit timing supplied only by the data set;
- b) 2-, 4- or 8-level amplitude modulation with suppressed carrier;
- c) vestigial sideband (VSB) line signal shaping;
- d) synchronous detection with upper and lower pilot tones transmitted near the edges of the VSB spectrum providing means for carrier recovery;
- e) automatic, adaptive equalization.

Data Sets 203-Type are offered with five optional speed configurations. Their data rates and recommended applications are:

DATA SET SPEED OPTION AND RECOMMENDED APPLICATION

2400 baud option, List 2

Operates at data rates of 2400 bps (2-level) and 4800 bps (4-level) over 4-wire C2 conditioned private lines.

Will also operate at 7200 bps (8-level) over 4-wire C2 conditioned private lines with reduced performance.

1800 baud option, List 3

Operates at data rates of 1800 bps (2-level) and 3600 bps (4-level) over the switched message network and 2- or 4-wire C2 conditioned private lines. Will also operate at 5400 bps (8-level) over C2 conditioned private lines with reduced performance.

2400 baud option, List 4

Operates at data rates of 2400 bps (2-level) and 4800 bps (4-level) over the switched message network and 2- or 4-wire C2 conditioned private lines. Will also operate at 7200 bps (8-level) over C2 conditioned private lines with reduced performance.

3200 baud option, List 5

Operates at data rates of 3200 bps (2-level) and 6400 bps (4-level) over 4-wire C2 conditioned private lines.

Will also operate at 9600 bps (8-level) over 4-wire C2 conditioned private lines with reduced performance.

3600 baud option, List 6

Operates at data rates of 3600 bps (2-level) and 7200 bps (4-level) over 4-wire C2 conditioned private lines.

Will also operate at 10,800 bps (8-level) over 4-wire C2 conditioned private lines with reduced performance.

Data Sets 203-Type may contain, as standard or optional equipment, depending on the type of line facility, a low-speed secondary channel. Also, when used in association with Data Auxiliary Set 804-Type, unattended answering and compatibility with Automatic Calling Units (Data Auxiliary Sets 801-Type) is available.

The interface signals exchanged between the business machines and Data Sets 203-Type are in bipolar voltage form and conform to the Electronic Industries Association Standards RS-232C and RS-334. However, for special applications, Data Sets 203-Type can be optionally equipped to conform to Military Standard 188B. (EIA interface is coded L8. Military Standard 188B interface is coded L9. See Section 4.2.2 for L9 arrangement.)

2. SYSTEM DESCRIPTION

2.1 Data Sets 203-Type

The Data Sets 203-Type have been designed on a modular basis to facilitate implementation of optional configurations and speeds. The three basic parts of the data set are the 22A-Type Data Unit containing the basic transmitter circuitry, the 23A-Type Data Unit containing the basic receiver circuitry, and the 24A-Type Data Unit containing the customer and telephone line interface circuits, data set control circuits, remote test circuits, power unit, and provision for adding the low-speed secondary channel. The data sets have also been designed for future inclusion of error control encoder (transmitter) and decoder (receiver) units.

2.1.1 The Data Set 203A-Type is a transmitter and receiver consisting of 22A-, 23A- and 24A-Type Data Units plus the associated plug-in cards and networks to provide a particular baud (or symbol) rate. The Data Set 203A also may contain, as standard or optional equipment depending on the type of line facility, a low-speed secondary channel.

2.1.2 The Data Set 203B-Type is a transmitter-only consisting of 22A- and 24A-Type Data Units plus the associated plug-in cards and networks to provide a particular baud rate. The Data Set 203B also contains, as standard equipment, the low-speed secondary channel.

2.1.3 The Data Set 203C-Type is a receiver-only consisting of 23A- and 24A-Type Data Units plus the associated plug-in cards and networks to provide a particular baud rate. The low-speed secondary channel is also standard equipment in the Data Set 203C.

2.2 Data Set 203-Type Operation

The Data Set 203-Type operates in much the same manner as the previously developed Data Set X203A. However, the X203A operated only as a transceiver, whereas the Data Set 203-Type has independent transmitter and receiver circuits.

2.2.1 Transmitter (Figure 1)

Serial data from the business machine is clocked into the transmitter using a bit clock supplied internally by the data set or externally by the business machine. The data is then scrambled with a quasi-random word in order to maintain a constant line power and ensure a sufficient number of level transitions to maintain bit synchronization at the receiver. The

scrambled data is converted into parallel form and applied to a digital-to-analog (D/A) converter. The output of the D/A converter is either a 2-level, 4-level or 8-level signal, depending on the bit rate; 2-level for bit rate at the baud rate, 4-level for bit rate twice the baud rate, 8-level for bit rate three times the baud rate. The output of the D/A converter is applied to a low-pass filter for baseband shaping and then to a balanced modulator. The modulated carrier is applied to a VSB filter which provides half (square root) of the passband shaping, the other half being provided at the receiver. The output of the VSB filter is applied to a summing amplifier along with two pilot tones. These pilot tones have a precise frequency relationship with the carrier and are utilized at the receiver for carrier recovery. The composite signal is subsequently applied to the telephone line.

2.2.2 Receiver (Figure 2)

The Data Set 203 receiver employs an AGC circuit which maintains a nearly constant output for normal variations in the received line signal levels. Outputs of the AGC are applied to pilot tone filters for carrier recovery and to a VSB filter to provide the remaining passband shaping. The output of the VSB filter is applied to the demodulator. The demodulator output is low-pass filtered, amplified, and then applied to the equalizer. The equalizer is an adaptive, automatic transversal filter which compensates for the amplitude and delay distortions of the transmission facilities. The equalizer output is applied to an analog-to-digital (A/D) converter, a parallel-to-serial converter and a descrambler to provide received data signals to the customer. Bit timing is recovered from the baseband data transitions and is provided to the customer via the Serial Clock Receiver (SCR) interface lead.

2.3 Physical Description

Data Sets 203-Type may be mounted in a 2' high x 2' wide x 1' deep cabinet as a "stand-alone" unit as shown in Figure 3, or it may be mounted on standard 23-inch relay racks. A height of 20 inches is required for rack mounting a 203A transmitter/receiver with or without error control, or a 203C receiver with error control. A height of 14 inches is required for rack mounting a 203C receiver without error control, or a 203B transmitter with or without error control. These different equipment configurations are available as ordering options (see Table 1). Data Sets 203-Type are designed to operate in an environment where the ambient temperature is in the range of 40 to 120 degrees Fahrenheit and the relative humidity is a maximum of 95 percent. The Data Set 203A weighs approximately 110 pounds, Data Set 203B,

72.5 pounds and Data Set 203C, 89.5 pounds when mounted in the above described cabinet. The weights of these three configurations, when rack mounted, are shown in Table 3.

2.3.1 Power

Data Sets 203-Type operate on 117 volts ± 10 percent ac power at a frequency of 47.5 to 63 Hz. The data sets are equipped with a power cord terminated in a 3-prong plug which fits a standard 117-volt receptacle. Power consumption varies between 17 and 55 watts, depending on the configuration.

2.4 Use with Data Auxiliary Set 804-Type

Data Sets 203-Type are associated with a Data Auxiliary Set 804A or 804M (Figure 3) when voice coordination (telephone set), network control signaling, automatic answer, and compatibility with Data Auxiliary Sets 801-Type (Automatic Calling Units) are required. Data Auxiliary Set 804A-Type is used when operating on the switched message network and on various private line configurations where alternate voice is required. Data Auxiliary Set 804M-Type is intended for use on a 4-wire switched private line type network or for use with two dial switched network lines used as a 4-wire facility.

2.4.1 Data Auxiliary Set 804A-Type

Data Auxiliary Set 804A-Type, shown in Figure 3 with associated Data Set 203-Type, consists of an integrated telephone, a Rotary or TOUCH-TONE® dial, a six-button key unit, and a line control unit. The line control unit contains the logic for transfer between TALK and DATA, unattended answering, disabling echo suppressors, and compatibility with automatic calling units. The overall dimensions are approximately 9 inches wide, 9 inches deep, and 4-1/2 inches high. The Data Auxiliary Set 804A-Type will operate satisfactorily over the same temperature and relative humidity ranges as Data Sets 203-Type. It weighs approximately 9 pounds.

The Data Auxiliary Set 804A-Type is used in conjunction with Data Sets 203-Type when operating over the switched message network, on private lines where alternate voice is desired, and whenever it is desired to switch between private line facilities and a switched message network backup. Some of the configurations available when using Data Auxiliary Set 804A-Type with Data Sets 203-Type and, where required, additional telephone equipment, are listed below:

- * 2-wire operation on switched message network.

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- * Operation on 2-wire private line with alternate voice.
- * Operation on 2-wire private line with switched message network backup.
Operation on 4-wire private line with alternate voice.
- * Operation on 4-wire private line with switched message network backup.
- * 4-wire operation using two switched message network lines.

*[1800 baud (L3) and 2400 baud (L4) options only (1800 or 3600 bps and 2400 or 4800 bps operation)]

2.4.2 Data Auxiliary Set 804M-Type

Data Auxiliary Set 804M-Type consists of an integrated telephone, a Rotary or TOUCH-TONE dial, a six-button key unit, and a 4-wire line control unit. The 4-wire line control unit provides the logic for transfer between TALK and DATA, unattended answering, and compatibility with 4-wire Automatic Calling Units (Data Auxiliary Set 801C-Type only). The overall dimensions are approximately 9 inches wide, 11-1/2 inches deep, and 4-1/2 inches high. It will operate satisfactorily over the same temperature and relative humidity ranges as Data Sets 203-Type. It weighs approximately 4 pounds.

The Data Auxiliary Set 804M-Type is used in conjunction with the Data Sets 203-Type when operating over a 4-wire switched network. It can also be used on 4-wire private lines requiring alternate voice and with two dial switched network lines used as a 4-wire facility.

2.5 Manual Controls

The associated Data Auxiliary Set 804A- or 804M-Type which performs the network control functions is equipped with an integrated, six-button control panel for manual control and testing. Figure 4 shows the designation of each button. The purpose of each button is as follows:

2.5.1 TEST

This nonlocking button is provided to permit the Telephone Company to evaluate the condition of the data set from a specially equipped central testing station. If the user suspects the data set is operating in a faulty manner, he will place a call to a Repair Service telephone number given to him at the time the data set is installed. He will then be contacted by the testing station (Data Test Center) and will be instructed as to when to push the TEST button.

Following operation of the TEST button, the TEST lamp will light and the data set will enter the Remote Test mode. It will then be evaluated by the Data Test Center. Upon completion of the tests, the user will be notified of the results. If a fault is indicated, the necessary maintenance will be undertaken.

2.5.2 AUTO

This button is used if it is desired to automatically answer an incoming call. The button must be depressed (it then stays down) before the data set will be able to automatically answer an incoming call. If desired, the data auxiliary set can be arranged, by wiring option, for permanent automatic answer in which case the AUTO button is not used. With the permanent automatic answer feature, all incoming calls will be automatically answered provided the station is idle and the Data Terminal Ready (DTR) interface lead is properly conditioned by the business machine. A lamp is associated with the AUTO button in the 804M only.

2.5.3 TALK

This button stays down when depressed to permit use of the telephone and to allow for the manual answering of an incoming call. On the Data Auxiliary Set 804A-Type only, the TALK button is lighted at the called station.

2.5.4 DATA

This button places the data set in the Data mode to allow data to be transmitted or received. It does not stay down when depressed and, when released after being depressed, it also releases all other buttons. The DATA button lamp will be lighted to indicate the data set is in the Data mode.

2.6 Internal Control Panel

In addition to the Data Auxiliary Set 804A- or M-Type which allows manual control of the data set, Data Set 203-Type has controls provided inside the front cover on an internal panel (see Figure 5). The following controls are supplied:

2.6.1 Speed Select Switch

This 4-position switch allows the customer to select what data rate is to be used for high-speed data transmission and reception. The first three positions allow the selection of any one, but only one, of the three possible data rates of a specific Data Set 203-Type. The fourth position, labeled CC (Customer Control), activates the Speed Select (SS) interface

lead so that the business machine can choose between the higher two data rates by properly controlling the SS interface lead.

2.6.2 Mode Control Switch

A separate 3-position switch is provided which allows the customer to place the data set in either the Remote Test mode, the Local Test mode, or Line-Mode for normal operation. When the Local Test mode is selected, the modem is disconnected from the communications circuit and looped back on itself through a pad while the line is terminated toward the other end. When the Remote Test mode is selected, the data set is conditioned to be tested by a Telephone Company Data Test Center. (This mode is used when the data set is not equipped with a Data Auxiliary Set 804-Type.) The Line mode position is used for normal data transmission.

2.6.3 Error Control In-Out Switch

A 2-position switch is provided to place the error control feature in or out of the data transmission path. If the error control feature is not provided in the data set, the switch should be placed in the Out position.

3. CUSTOMER FEATURES

Data Sets 203-Type are provided with a number of customer features or options which may be requested by the user (see Tables 1, 2 and 3). Some of these features are only available as ordering options, whereas others are supplied as installer strapping options. The desired features and options must be specified when the set is ordered. A description of these features follows:

3.1 Features Available as Ordering Options

To obtain certain features in a Data Set 203-Type, different ordering options must be requested. The features provided in this way are listed below:

3.1.1 Miscellaneous

The Data Set 203-Type can be ordered as a transmitter and receiver (203A), a transmitter only (203B) or a receiver only (203C). Each of these three arrangements can be ordered in a cabinet (LIC) or a 23-inch rack mounting (LID) assembly. The 203C can also be ordered without provision for error control in a 23-inch rack mounting (LIE). The voice and control arrangements possible are described in Section 2.

3.1.2 High-Speed Data Rate Option (Lists 2, 3, 4, 5 and 6)

Five speed options are available when ordering Data Set 203-Type. The List 2 speed option (2400 baud) will allow operation at 2400 bps (2-level), 4800 bps (4-level), and 7200 bps (8-level) over 4-wire C2 conditioned private lines. The List 3 speed option (1800 baud) will allow operation at 1800 bps (2-level) and 3600 bps (4-level) over the switched message network and 2- or 4-wire C2 conditioned private lines and at 5400 bps (8-level) over 2- or 4-wire C2 conditioned private lines. The List 4 speed option (2400 baud) will allow operation at 2400 bps (2-level) and 4800 bps (4-level) over the switched message network and 2- or 4-wire C2 conditioned private lines and at 7200 bps (8-level) over 2- or 4-wire C2 conditioned private lines. The List 5 speed option (3200 baud) will allow operation at 3200 bps (2-level), 6400 bps (4-level), and 9600 bps (8-level) over 4-wire C2 conditioned private lines. The List 6 speed option (3600 baud) will allow operation at 3600 bps (2-level), 7200 bps (4-level), and 10,800 bps (8-level) over 4-wire C2 conditioned private lines.

3.1.3 Secondary Channel

Data Sets 203-Type may contain, as standard or in some cases optional equipment, a low-speed secondary transmitter/receiver (also referred to as auxiliary, supervisory or reverse channel). The secondary channel has the following design features:

- a) nonsynchronous data transmission at data rates of up to 150 bits per second,
- b) binary frequency modulation with a mark frequency of 450 Hz and a space frequency of 375 Hz,
- c) frequency spectrum of 300 Hz to 525 Hz which only allows simultaneous operation with the 1800 baud (List 3) and 2400 baud (List 4) speed options of the high-speed channel over the switched message network or 2-wire private lines.

The low-speed secondary channel is designed to provide up to 150 bits per second nonsynchronous data transmission primarily for acknowledgement of high-speed data, data set control without turnaround, or for systems where only low-speed, low-volume data is to be transmitted in the opposite direction to the high-speed data.

On the switched message network or 2-wire private line facilities (List 3 or List 4 configurations only), the low-speed secondary channel is required equipment. On the switched message network, the secondary channel is intended to operate simultaneously in the reverse direction to the transmission of high-speed data (that is, as a backward secondary channel). On 2-wire private lines, the secondary channel may operate as a reverse channel or it may be connected to operate as an auxiliary channel with independent controls to allow simultaneous or nonsimultaneous transmission in the same direction as the high-speed data.

On 4-wire facilities (any speed option), the low-speed secondary channel is optional equipment since simultaneous transmission of high-speed data is possible in both directions. When the secondary channel is used, it can operate simultaneously on the same pair of wires only with the 1800 baud speed option (List 3) or the 2400 baud option (List 4). For the 2400 baud (List 2), the 3200 baud (List 5) or the 3600 baud (List 6) speed options, the high-speed and low-speed channels have overlapping spectra and, therefore, simultaneous transmission is possible only in opposite directions on opposite direction pairs of the 4-wire line. This precludes simultaneous use of the high-speed and secondary channels in both directions simultaneously. (See 5.3.2.)

It should be noted that at most two 2-wire pairs can be connected to the data set line connector, i.e., the high-speed and low-speed channels cannot be separated in order to connect to four 2-wire pairs.

The low-speed secondary channel is also standard equipment on all Data Sets 203B (transmitter-only) and Data Sets 203C (receiver-only) type. The operation of the secondary channel with these data sets is the same as mentioned above.

3.1.4 Unattended Automatic Answer

When a Data Auxiliary Set 804A- or M-Type is ordered to control Data Set 203, an unattended answer feature is available for most applications which permits automatic answering of incoming calls. A 2025 Hz answer tone is transmitted to the calling station when the unattended answer is accomplished.

This feature may be provided on a permanent basis which allows the data set to automatically answer an incoming call when the Data Terminal Ready (DTR) interface lead is turned ON by the associated business machine. Or, it may be under control of the AUTO button, which means that automatic answer can only be accomplished if the AUTO button is depressed (Paragraph 2.4.2) and Data Terminal Ready (DTR) is turned ON by the business machine. Selection of permanent or key-controlled automatic answer is by installer strapping option.

3.1.5 Compatibility with Automatic Calling Units (Data Auxiliary Sets 801A- or C-Type)

Data Sets 203-Type, when used in conjunction with Data Auxiliary Sets 804A- or M-Type are compatible with Automatic Calling Units (Data Auxiliary Sets 801A- or C-Type). Automatic Calling Units (ACU) permit a business machine to call any number in the switched message network and transfer the circuit to the associated data set for the automatic transmission of data. The ACU, under control of the business machine, will perform all the functions usually performed by an attendant in originating a data call. For information about ACU's, please refer to the following Bell System Technical References:

Data Auxiliary Set 801A – March 1964

Data Auxiliary Set 801C – September 1965

3.1.6 Interface

Two interface arrangements are available. One is an EIA voltage per RS-232C and coded L8. The other is a MIL STD 188B-Type interface and coded L9. Both are described in detail in Section 4.

3.1.7 Error Control Units

The Data Sets 203-Type (LIC and LID) have been designed for future inclusion of error control encoder and decoder units. These error control encoder and decoder units are presently under development, and when they are introduced this Technical Reference will be reissued to include appropriate technical documentation. (Introduction is expected in late 1971.)

3.2 Features Provided as Installer Strapping Options

In addition to the features that can only be provided by ordering special equipment, Data Sets 203-Type have other optional features that may be provided by the addition or deletion of certain installer options. The features provided this way are described below:

3.2.1. Clamp Disable Options

If desired by the customer, the clamp circuitry associated with the high-speed Receive Data (RD) and Serial Clock Receive (SCR) leads can be disabled. With the SCR unclamped option, the SCR lead will constantly supply the associated business machine with bit timing that will only be in synchronism with the data when the receiver has been trained (Section 4.3.16). This option is primarily intended to allow Data Set 203A-Type to be used as a regenerative repeater but may be used for other purposes if desired. With the RD unclamped option, signals on the RD lead will only be valid when the Data Carrier Detector (CO) lead is ON (Section 4.3.3).

3.2.2 Data Set Timing

The data set transmitter accepts serial binary data at the selected data rate synchronous with a bit rate timing signal which may be obtained from the business machine or internally from the data set. When the customer elects to supply the bit rate timing signal, it will be accepted by the transmitter in accordance with EIA standards. However, to achieve satisfactory performance of the data set, the external timing furnished by the business machine must be accurate to at least 0.001 percent.

3.2.3 Speed Control

As discussed previously, Data Sets 203-Type utilize a 2-, 4- or 8-level amplitude modulation scheme which results in three separate operating speeds in the same data set. The data set is equipped with a switch on the front control panel (located behind the outer cover of the data set) to permit selection of the desired speed (see Figure 5). The switch can be turned to four different positions. The first three positions select one of the three operating speeds of the data set. The fourth position, labeled CC (Customer Control) will allow the business machine to select between the two highest speeds through a control lead, Speed Select (SS), on the interface.

3.2.4 Training Options

The Data Sets 203-Type require a start-up or training period of the high-speed channel to enable the data transmitter to condition the data receiver prior to actual transmission of high-speed customer data. The total time required for this training period is given in Figure 6. There are three different ways in which Data Set 203-Type can be arranged to enter and complete the training period. These are:

- 1) Exclusive Transmitter Control – The training interval can only be initiated under customer terminal control by turning ON the high-speed Request-to-Send (RS) interface lead at the transmitter. This option assumes the data receiver is on-line prior to the initiation of the training sequence.
- 2) Receiver Inhibit Using Secondary Channel – This option is provided to insure that the receiver is on-line and ready for training. Essentially, the initiation of the training sequence is triggered by turning on the high-speed Request-to-Send (RS) interface lead at the transmitter. However, with this option, the completion of training is delayed until the reception of secondary channel energy from the station with the high-speed receiver.
- 3) Automatic Training – This training option is one which allows the transmitter to automatically train the receiver whenever needed. It is available only when full modems (Data Sets 203A) are used on 4-wire lines. Basically, the high-speed receiver decides when it needs to be trained and signals the appropriate transmitter using the other side of the 4-wire line. This process cycles until both sides of the 4-wire connection are ready for data transmission. This cycling will take place only when both high-speed Request-to-Send (RS) interface leads are held ON. With this option, Clear-to-Send (CS) can be arranged to be either inhibited by Carrier On-Delayed (COD) or be independent of Carrier On-Delayed (COD).

Option 2 (Receiver Inhibit Using Secondary Channel) above is intended for use on 2-wire half-duplex data services. Option 3 (Automatic Training) or Option 1 (Exclusive Transmitter Control) is suggested for use on 4-wire full-duplex services. The basic start-up sequence and various optional modes are described in detail in Section 5.

3.2.5 Secondary Channel Carrier Control

To support the training options described in Section 3.2.4, three different strapping options have been provided to control the transmission of secondary channel carrier. These are:

- 1) Exclusive High-Speed Channel Control – This option allows no independent control of the secondary channel. Whenever the high-speed Request-to-Send (RS) interface lead is OFF, secondary channel energy will be transmitted and the high-speed receiver will be placed on-line. Similarly, an ON condition on the high-speed Request-to-Send (RS) lead will cause high-speed energy to be transmitted and the secondary channel receiver will be placed on-line. The additional Secondary Request-to-Send (SRS) interface lead associated with the secondary channel will have no effect on Data Set 203-Type when this option is used.
- 2) Independent Secondary Channel Control – This option allows the business machine to control the state of the secondary channel exclusively through the use of the Secondary Request-to-Send (SRS) interface lead. The state of the high-speed channel will have no effect on the secondary channel mode of operation when this option is selected.
- 3) Semi-Independent Control of Secondary Channel – When the List 2, List 5 or List 6 speed options are selected, the spectrum of the main data channel overlaps with that produced by the secondary channel. Consequently, this option has been provided to insure that both signals are not transmitted over the same line pair at the same time (i.e., a single modem cannot transmit the carriers of both the high- and low-speed channels simultaneously). To achieve this, the state of the high-speed Request-to-Send (RS) interface lead is given priority over the state of the Secondary Request-to-Send (SRS) lead. Consequently, the table below is followed regarding the transmission of carrier.

State of High-Speed Request-to-Send	State of Secondary Request-to-Send	High-Speed		Secondary	
		Transmitter	Receiver	Transmitter	Receiver
ON	ON	ON	ON	OFF	ON
ON	OFF	ON	ON	OFF	ON
OFF	ON	OFF	ON	ON	ON
OFF	OFF	OFF	ON	OFF	ON

The recommended use of the above strapping options is as follows:

Option	Type of Service
Exclusive High-Speed Channel Control	List 3 or List 4 speed option on switched message network or 2-wire private line.
Independent Secondary Channel Control	List 3 or List 4 speed option on 2- or 4-wire private line.
Semi-Independent Control of Secondary Channel	List 2, List 5 or List 6 speed options on 4-wire private line.

4. INTERFACE

4.0 The interface is the point of connection between the data set and the business machine. Each data set is equipped with a 25-pin female connector. The user must supply the plug and necessary cable to connect his equipment to the data set. As the male connector, a plug such as the DB-19604-432 Plug manufactured by Cannon* or Cinch+, is suggested. This type plug provides a reliable, low-resistance contact. In addition, a DB-51226-1 Hood manufactured by Cinch+ or equivalent is recommended to protect the connections, anchor the cable to the plug, provide a finger grip for easy insertion or removal, and provide a positive screw-in locking arrangement to prevent the connector from being pulled out inadvertently.

* ITT — Cannon Electric, Division of IT&T Corp., 3208 Humboldt St., Los Angeles, California 90031

+ Cinch Manufacturing Co., 1026 S. Homan Avenue, Chicago, Illinois 60624

4.1 Electrical Considerations

Data Sets 203-Type are equipped to follow the recommendations of the Electronic Industries Association for digital data sets as described in the published Standards RS-232C and RS-334. The following tables detail the electrical characteristics of each interface lead for the EIA L8 code. It is suggested that the reader also refer to the Standards RS-232C and RS-334.

4.1.1 For transmit and receive data, the signal is considered in the marking condition when the voltage on the circuit is more negative than minus three volts with respect to Signal Ground, and in the spacing condition when the voltage on the circuit is more positive than three volts with respect to Signal Ground.

For all control circuits the control function is considered "ON" when the voltage on the circuit is more positive than plus three volts with respect to Signal Ground, and is considered "OFF" when the voltage on the circuit is more negative than minus three volts with respect to Signal Ground.

Summary of Data and Control Circuit Interface Terms

Voltage	Negative	Positive
Binary State	ONE	ZERO
Single Condition	Marking	Spacing
Control Function	OFF	ON

- 4.1.2 The terminating impedance of the receiving end of interchange circuits has a dc resistance of not less than 3000 ohms nor more than 7000 ohms over the range of voltages for which the signal is defined. When the interface plug is disconnected, internal voltage on receiving leads is between 0 and ± 2 volts.
- 4.1.3 The operation of the circuitry that receives signals from an interchange circuit is dependent only on the signal voltage and is, therefore, insensitive to the rise time, fall time, presence of signal overshoot, etc. For the Transmitted Data and Timing Circuits, neither the rise time nor the fall time, through

the six-volt range in which the signal condition is not defined, may exceed four percent of the nominal duration of the signal element.

- 4.1.4 The open circuit driver voltage with respect to Signal Ground on any interchange circuit shall not exceed ± 25 volts. The terminator on an interchange circuit shall be designed to withstand any input signal within the ± 25 volt limit. The driver design shall be such that when the terminating impedance is in the proper range (3000 ohms to 7000 ohms) and the terminator open circuit voltage is zero, the potential at the point of interface shall not be less than ± 5 volts or more than ± 15 volts.

4.2 Interchange Circuit Connections

4.2.1 EIA-L8

All interchange leads for Data Sets 203-Type are terminated in a 25-pin receptacle mounted on the front of the data set. The following pin assignments are applicable to the various Data Sets 203-Type.

<u>Pin No.</u>	<u>EIA RS-232C Nomenclature</u>	<u>Lead Designation</u>
1	Protective Ground (AA)	Frame Ground (FG)
2	Transmitted Data (BA)	Send Data (SD)
3	Received Data (BB)	Receive Data (RD)
4	Request-to-Send (CA)	Request-to-Send (RS)
5	Clear-to-Send (CB)	Clear-to-Send (CS)
6	Data Set Ready (CC)	Data Set Ready (DSR)
7	Signal Ground (AB)	Signal Ground (SG)
8	Received Line Signal Detector (CF)	Data Carrier Detector (CO)
9	Reserved for Data Set Testing	+V dc for testing
10	Reserved for Data Set Testing	-V dc for testing
11	Unassigned	Not Used
12	Secondary Received Line Signal Detector (SCF)	Secondary Carrier ON (SCO)
13	Secondary Clear-to-Send (SCB)	Secondary Clear-to-Send (SCS)
14	Secondary Clear-to-Send (SBA)	Secondary Send Data (SSD)
15	Transmitter Signal Element Timing (DB)	Serial Clock-Transmitter (internal) (SCT)
16	Secondary Received Data (SBB)	Secondary Receive Data (SRD)
17	Receiver Signal Element Timing (DD)	Serial Clock-Receiver (SCR)
18	Unassigned	Data Carrier Detector Delayed (COD)
19	Secondary Request-to-Send (SCA)	Secondary Request-to-Send (SRS)
20	Data Terminal Ready (CD)	Data Terminal Ready (DTR)

21	Signal Quality Detector (CG)	Received Signal Quality (SQ)
22	Ring Indicator (CE)	Ring Indicator (RI)
23	Data Signal Rate Selector (CH)	Speed Select (SS)
24	Transmitter Signal Element Timing (DA)	Serial Clock-Transmitter (External) (SCTE)
25	Unassigned	Not Used

DATA SET 203B

<u>Pin No.</u>	<u>EIA RS-232C Nomenclature</u>	<u>Lead Designation</u>
1	Protective Ground (AA)	Frame Ground (FG)
2	Transmitted Data (BA)	Send Data (SD)
3	Received Data (BB)	Not Applicable
4	Request-to-Send (CA)	Request-to-Send (RS)
5	Clear-to-Send (CB)	Clear-to-Send (CS)
6	Data Set Ready (CC)	Data Set Ready (DSR)
7	Signal Ground (AB)	Signal Ground (SG)
8	Received Line Signal Detector (CF)	Not Applicable
9	Reserved for Data Set Testing	+V dc for testing
10	Reserved for Data Set Testing	-V dc for testing
11	Unassigned	Not Used
12	Secondary Received Line Signal Detector (SCF)	Secondary Carrier ON (SCO)
13	Secondary Clear-to-Send (SCB)	Secondary Clear-to-Send (SCS)
14	Secondary Clear-to-Send (SBA)	Secondary Send Data (SSD)
15	Transmitter Signal Element Timing (DB)	Serial Clock Transmitter (Internal) (SCT)
16	Secondary Received Data (SBB)	Secondary Received Data (SRD)
17	Receiver Signal Element Timing (DD)	Not Applicable
18	Unassigned	Not Applicable
19	Secondary Request-to-Send (SCA)	Secondary Request-to-Send (SRS)
20	Data Terminal Ready (CD)	Data Terminal Ready (DTR)
21	Signal Quality Detector (CG)	Not Applicable
22	Ring Indicator (CE)	Ring Indicator (RI)
23	Data Signal Rate Selector (CH)	Speed Select (SS)
24	Transmitter Signal Element Timing (DA)	Serial Clock-Transmitter (External) (SCTE)
25	Unassigned	Not Used

DATA SET 203C

<u>Pin No.</u>	<u>EIA RS-232C Nomenclature</u>	<u>Lead Designation</u>
1	Protective Ground (AA)	Frame Ground (FG)
2	Transmitted Data (BA)	Not Applicable
3	Received Data (BB)	Receive Data (RD)
4	Request-to-Send (CA)	Not Applicable
5	Clear-to-Send (CB)	Not Applicable
6	Data Set Ready (CC)	Data Set Ready (DSR)
7	Signal Ground (AB)	Signal Ground (SG)
8	Received Line Signal Detector (CF)	Data Carrier Detector (CO)
9	Reserved for Data Set Testing	+V dc for testing
10	Reserved for Data Set Testing	-V dc for testing
11	Unassigned	Not Used
12	Secondary Received Line Signal Detector (SCF)	Secondary Carrier ON (SCO)
13	Secondary Clear-to-Send (SCB)	Secondary Clear-to-Send (SCS)
14	Secondary Clear-to-Send (SBA)	Secondary Send Data (SSD)
15	Transmitter Signal Element Timing (DB)	Not Applicable
16	Secondary Received Data (SBB)	Secondary Receive Data (SRD)
17	Receiver Signal Element Timing (DD)	Serial Clock-Receiver (SCR)
18	Unassigned	Data Carrier Detector Delayed (COD)
19	Secondary Request-to-Send (SCA)	Secondary Request-to-Send (SRS)
20	Data Terminal Ready (CD)	Data Terminal Ready (DTR)
21	Signal Quality Detector (CG)	Received Signal Quality (SQ)
22	Ring Indicator (CE)	Ring Indicator (RI)
23	Data Signal Rate Selector (CH)	Speed Select (SS)
24	Transmitter Signal Element Timing (DA)	Not Applicable
25	Unassigned	Not Used

4.2.2 MIL STD 188B – L9

4.2.2.1 Any of the Data Sets 203-Type can be ordered with a MIL STD 188B Interface which is coded List 9. A special applique is provided (located on the 24A-Type Data Unit just above the Control Panel) which permits connection to all the high-speed data and clock signals through a 15-pin connector. The

mating connector (Cinch DA-19603-403 or equivalent), locking hood (Cinch DA-51225-1 or equivalent) and connecting cable must be supplied by the customer. A standard 25-pin connector is also provided for interfacing with all the provided circuits. The data and clock leads in the 15-pin connector are paired with separate ground leads. The listing of both 15- and 25-pin connectors is provided below.

15-PIN CONNECTOR

<u>Signal Pin</u>	<u>Ground Pin</u>	<u>Data Set 203-Type Nomenclature</u>
—	1	FG (Frame Ground)
2	9	SD (Send Data)
3	10	RD (Receive Data)
13	6	SCR (Serial Clock Receive)
15	8	SCT (Serial Clock Transmit)
4	11	SCTE (Serial Clock Transmit External)
5,7,12,14	—	Unassigned

25-PIN CONNECTOR

<u>Pin No.</u>	<u>Data Set 203-Type Nomenclature</u>
1	FG (Frame Ground)
2	SD (Send Data)
3	RD (Receive Data)
4	*RS (Request-to-Send)
5	CS (Clear-to-Send)
6	DSR (Data Set Ready)
7	SG (Signal Ground)
8	CO (Data Carrier Detector)
9	*+V (Test – for Telephone Company use only)
10	*-V (Test – for Telephone Company use only)
11	– Unassigned
12	SCO (Secondary Carrier On)
13	SCS (Secondary Clear-to-Send)
14	SSD (Secondary Send Data)
15	SCT (Serial Clock Transmitter)
16	SRD (Secondary Receive Data)
17	SCR (Serial Clock Receive)
18	COD (Data Carrier Detector Delayed)
19	*SRS (Secondary Request-to-Send)
20	*DTR (Data Terminal Ready)
21	SQ (Received Signal Quality)
22	RI (Ring Indicator)
23	*SS (Speed Select)
24	SCTE (Serial Clock Transmitter External)
25	– Unassigned

* These leads conform to EIA RS-232C.

4.2.2.2 A summary of the electrical characteristics provided by the MIL STD 188B drivers and terminators is presented below.

Driver Characteristics

- a) Open Circuit Output Voltage:
6.1 volts ± 7 percent for both positive and negative voltages.
- b) Source Impedance:
Less than 90 ohms.
- c) Output Waveforms:
Rise and fall times of 11.7 microseconds ± 2.0 microseconds with a load impedance of 5000 ohms or more.
- d) Short Circuit Current:
Between 50 and 90 milliamperes.

Terminator Characteristics

- a) Input Impedance:
Greater than 8000 ohms for input levels less than or equal to an 18.5 volts absolute value.
- b) Input Capacitance:
Less than 1000 picofarads.
- c) Maximum Operating Current:
Less than 100 microamperes.

4.3 Purpose and Use of Interface Leads

Data Set 203-Type is provided with at most twenty-three (23) interchange leads for connection to the customer's data equipment or associated installer test equipment. A description of the operation of each and the signals appearing on each follows:

4.3.1 AA-Frame Ground (FG) – Lead 1

This conductor is electrically bonded to the equipment frame. It is further connected to external grounds through the power cord.

4.3.2 BA-Send (Transmitted) Data (SD) – Lead 2

Signals on this circuit are generated by the transmitting business machine at the bit rate supplied by the data set or by the customer's own clock. The transitions of the data shall be coincident with the positive transitions of the bit clock SCTI (Serial Clock Transmitter- Internal) or SCTE (Serial Clock Transmitter-External). A positive signal is a binary "0" or SPACE and a negative signal is a binary "1" or MARK.

The transmitting business machine equipment should hold Send Data (SD) in the "MARK" condition when no signals are to be transmitted. This lead is not used in Data Set 203C. No attempt should be made to transmit data until the Clear-to-Send (CS) lead is in the ON state.

4.3.3 BB-Receive Data (RD) – Lead 3

Received Data is supplied by the data set receiver in synchronism with the serial clock in the receiver (SCR). The data transitions are coincident with the positive transitions of SCR. A positive signal is a binary "0" or SPACE, and a negative signal is a binary "1" or MARK. RD is normally clamped to "MARK" whenever the Data Carrier Detector (CO) lead is OFF. However, when option RD unclamped is provided (Section 3.2.1), data on this lead will only be valid when CO (Data Carrier Detector) is ON. With option RD unclamped provided and no signal being received, RD consists of one of two possible codes for each of the three bit rates. At the lowest bit rate (2-level operation), RD will be either a steady "0" or steady "1" code. At mid-range bit rate (4-level operation), RD will be either a dotting or steady "1" code. At the highest bit rate (8-level operation), RD will be either a "010" or a "110" code.

This lead is clamped marking in Data Set 203B.

4.3.4 CA-Request-to-Send (RS) – Lead 4

This signal is supplied by the customer and is used by the Data Set 203 to turn on high-speed carrier and, subsequently, condition the data set for transmission of high-speed data (initiate training). On 2-wire facilities, an ON condition on RS (Request-to-Send) will condition the data set as a high-speed transmitter. An OFF condition will condition the data set as a high-speed receiver. On 4-wire facilities, the data set is always conditioned for high-speed reception, and RS (Request-to-Send) is used to turn ON only the high-speed transmitter to enable the training of the distant receiver.

As described in Section 3.2.5, installer option straps may be provided for control of the low-speed channel with RS (Request-to-Send). When the secondary channel is used and installer option Exclusive High-Speed Channel Control is provided, the RS (Request-to-Send) signal exclusively controls the low-speed channel. With RS (Request-to-Send) ON, the low-speed channel is conditioned to receive and with RS (Request-to-Send) OFF, the low-speed channel is conditioned to transmit. With installer option Semi-Independent Control of Secondary Channel provided, both RS (Request-to-Send) and

SRS (Auxiliary Request-to-Send) control the low-speed channel. With this option, the low-speed channel is conditioned to transmit only when RS (Request-to-Send) is OFF and SRS (Auxiliary Request-to-Send) is ON. Otherwise, the low-speed channel is conditioned to receive. With installer option Independent Secondary Channel Control provided, only the SRS (Auxiliary Request-to-Send) signal controls the low-speed channel.

The Request-to-Send (RS) lead is internally clamped OFF in Data Set 203C.

4.3.5 CB-Clear-to-Send (CS) – Lead 5

The Clear-to-Send (CS) signal is supplied by the data set and indicates when data can be sent over the high-speed channel. Its state is primarily controlled by the operation of the Request-to-Send (RS) lead. However, the various data set speed and timing options somewhat affect the operation of this lead.

When the training of the distant receiver is under exclusive transmitter control, there is a fixed time interval between the placement of the ON condition on the Request-to-Send (RS) lead and the appearance of an ON signal on the Clear-to-Send (CS) lead, provided that the Data Set Ready (DSR) lead is ON. This time interval for the available data set speed options is shown below.

<u>Data Set Speed Option</u>	<u>RS to CS Time</u>
1800 baud (List 3)	10.5 seconds
2400 baud (List 2)	7.9 seconds
2400 baud (List 4)	7.9 seconds
3200 baud (List 5)	6.0 seconds
3600 baud (List 6)	5.2 seconds

When the training of the distant receiver is controlled by both the state of Request-to-Send (RS) and the presence of secondary channel energy, the time interval between Request-to-Send (RS) ON and Clear-to-Send (CS) ON may be variable inasmuch as it depends on how rapidly the data set receiver enters the Data mode. This variable time, however, can be no shorter than that encountered under exclusive transmitter control. Once again, an ON condition on the Clear-to-Send (CS) lead will only occur if the Data Set Ready (DSR) lead is ON.

When the Automatic Training with CS inhibit by COD-OFF option is selected (4-wire operation), the timing between the initial turn ON of Request-to-Send (RS) and the Clear-to-Send (CS) ON

indication will be the same as that described for the exclusive transmitter control option providing the receiver has detected a line signal before this time. If the receiver decides it needs to be retrained, it will signal the transmitter and the Clear-to-Send (CS) lead will automatically be turned OFF even though the business machine is holding the Request-to-Send (RS) lead in the ON state. After retraining, the Clear-to-Send (CS) lead will again turn ON to indicate when data transmission can take place.

In addition to independently switching to the OFF state for automatic retraining, the Clear-to-Send (CS) lead will switch from ON to OFF immediately after Request-to-Send (RS) or Data Set Ready (DSR) is switched OFF. However, when the error control unit becomes available and is being used, the ON to OFF transition of the Clear-to-Send (CS) lead will be delayed with respect to the ON to OFF transition of the Request-to-Send (RS) lead. This delay is the result of the encoder unit holding the data set in the Transmit mode until all of the customer's data stored in the encoder is transmitted. This delay is expected to be less than one second.

This lead is clamped OFF in Data Set 203C.

4.3.6 CC-Data Set Ready (DSR) – Lead 6

Signals on this circuit are generated by the local data set to indicate that it is ready to operate. A Data Set Ready ON indication is given when the associated Data Auxiliary Set 804-Type line control unit is switched to the Data mode, after a call has been established and the business machine is supplying a DTR (Data Terminal Ready) ON indication to the data set. If the Data Auxiliary Set 804-Type is switched to the TALK mode, or if the call is terminated by the business machine switching DTR (Data Terminal Ready) OFF, a DSR (Data Set Ready) OFF indication is given. The DSR (Data Set Ready) lead will also be held in the OFF condition when the data set is in the Remote or Local TEST modes.

The OFF condition indicates one of the following:

- A. Any abnormal or test condition exists which disables or impairs the service furnished.
- B. That the communications channel is switched to the Voice mode.
- C. That the local data set is not connected to a communications channel (i.e., the data set is on-hook).

When no Data Auxiliary Set 804-Type line control unit is used, the Data Set Ready (DSR) lead is permanently clamped ON except when the data set is in the Remote or Local TEST mode.

4.3.7 AB-Signal Ground (SG) – Lead 7

This conductor establishes the common ground reference potential for all interchange circuits except Frame Ground. It is strapped to Frame Ground on the data set side of the interface to minimize the introduction of noise into electronic circuitry. However, this strap can be removed, if consistent with local electrical code regulations.

4.3.8 CF-Data Carrier Detector (CO) – Lead 8

This signal is provided by the data set to indicate when the signals appearing on the Receive Data (RD) lead should be valid data. The Data Carrier Detector (CO) lead initially switches from OFF to ON immediately after the data set receiver has been completely trained.

The CO (Data Carrier Detector) lead will immediately switch from ON to OFF if any one of the following conditions occur:

- 1) High-speed carrier is lost due to line outage lasting longer than 70 milliseconds.
- 2) The remote data transmitter begins to retrain the receiver.
- 3) The data set is receiving data over 2-wire facilities and is switched to the Transmit mode. (Request-to-Send [RS] is switched from OFF to ON.)
- 4) The DSR (Data Set Ready) lead switches to the OFF state.

Once trained, the CO (Data Carrier Detector) lead will switch from OFF to ON when line signal is again received following a dropout of less than the holdover time shown in Section 4.3.17 (CGD has not gone OFF).

This lead is clamped OFF in Data Set 203B.

4.3.9 + Volts – Lead 9

This signal is supplied by the data set for test purposes by Telephone Company personnel. The business machine should not be connected to this lead.

4.3.10 -Volts – Lead 10

This signal is supplied by the data set for test purposes by Telephone Company personnel. The business machine should not be connected to this lead.

4.3.11 SCF-Secondary Carrier On (SCO) – Lead 12

This signal is provided by the data set to indicate when energy, within the bandwidth of the secondary channel and greater than -48 dBm, is being received by the secondary channel receiver. The SCO (Secondary Carrier On) lead will switch from OFF to ON upon receipt of sufficient signal energy (within 80 milliseconds for Data Set 203-Type List 1, List 1A or List 1B and 0.9 to 1.1 seconds for Data Set 203-Type List 1C, List 1D or List 1E). When the energy level drops below -48 dBm, the SCO (Secondary Carrier On) will switch from ON to OFF within 130 milliseconds following the loss of signal energy.

This interface lead will be clamped in the OFF state whenever the secondary channel receiver is not connected to the telephone line (see Section 4.3.11). When the secondary channel is not ordered (List 7 not requested), this interface signal will be clamped OFF.

4.3.12 SCB-Secondary Clear-to-Send (SCS) – Lead 13

This signal is provided by the data set to indicate when low-speed data can be transmitted assuming the low-speed receiver is on-line. A SCS (Secondary Clear-to-Send) ON indication can only be given when the DSR (Data Set Ready) lead is ON. With either the DSR (Data Set Ready) lead OFF or the low-speed receiver on-line in a 2-wire configuration, the SCS (Secondary Clear-to-Send) lead will be clamped in the OFF state.

When the data set is strapped to allow control of the low-speed transmitter by the SRS (Secondary Request-to-Send) lead, the SCS (Secondary Clear-to-Send) lead will turn ON 80 to 120 milliseconds for Data Set 203-Type List 1, 1A or 1B and 1.4 to 2.3 seconds for Data Set 203-Type List 1C, 1D or 1E after the SRS (Secondary Request-to-Send) lead is switched from the OFF to ON state. When option secondary transmitter controlled by Request-to-Send (RS) lead is in the data set (Exclusive High-Speed Channel Control), the SCS (Secondary Clear-to-Send) lead will turn ON 80 to 120 milliseconds for Data Set 203-Type List 1, 1A or 1B and 1.4 to 2.3 seconds for Data Set 203-Type List 1C, 1D or 1E after the RS (Request-to-Send) lead is switched from ON to OFF.

After the business machine either turns OFF the SRS (Secondary Request-to-Send) lead or turns ON the RS (Request-to-Send) lead (depends on the option), the SCS (Secondary Clear-to-Send) lead will switch to the OFF state in 20 to 40 milliseconds for Data Set 203-Type List 1, 1A or 1B and 70 to 140 milliseconds for Data Set 203-Type List 1C, 1D or 1E.

When the secondary channel is not ordered in Data Set 203A (List 7 is not requested), this interface signal will be clamped OFF.

4.3.13 SBA-Secondary Send Data (SSD) – Lead 14

This low-speed nonsynchronous data signal is provided by the business machine at data rates of up to 150 bits per second. A positive voltage on this lead is treated as a binary “0” or SPACE signal and a negative voltage is a binary “1” or MARK.

The business machine should clamp the SSD (Secondary Send Data) lead in a MARK condition whenever the SCS (Secondary Clear-to-Send) interface circuit is in the OFF state. When the SCS (Secondary Clear-to-Send) lead switches to the ON state, low-speed data can be presented on the SSD (Secondary Send Data) lead for transmission to the remote secondary channel receiver.

This interface lead is not used on Data Set 203A when ordered without the secondary channel (List 7 not requested).

4.3.14 DB-Serial Clock Transmitter-Internal (SCTI) – Lead 15

SCTI (Serial Clock Transmitter-Internal) is supplied by the data set to synchronize the business machine with the data set. This signal is a square wave at a frequency equal to the bit rate selected for data transmission. Consequently, the frequency of this CLOCK signal can be either equal to the baud rate, twice the baud rate, or three times the baud rate, depending on the speed selected. Speed selection is accomplished by the proper manual operation of the BIT RATE switch in conjunction with the SS (Speed Select) interface lead. As long as power is supplied to the data set, the SCTI (Serial Clock Transmitter-Internal) lead will continue to supply a CLOCK signal independent of the transmitter timing option selected (see Section 3.2.2).

This interface lead is clamped marking in Data Set 203C.

4.3.15 SBB-Secondary Receive Data (SRD) – Lead

16

This interface lead passes the nonsynchronous data received by the secondary channel to the business machine. A positive voltage on this lead represents a binary “0” or SPACE signal, whereas a negative voltage is a binary “1” or MARK. The SRD (Secondary Receive Data) lead will be clamped in a MARK condition when the SCO (Secondary Carrier On) lead is in the OFF state. Whenever the SCO (Secondary Carrier On) lead switches from OFF to ON, the SRD (Secondary Receive Data) lead will immediately pass the received low-speed data to the business machine.

This interface signal is clamped marking in Data Set 203A when the secondary channel is not ordered (List 7 is not requested).

4.3.16 DD-Serial Clock Receiver (SCR) – Lead 17

This signal provided by the data set is used to synchronize the receiving business machine to the received data and is a square wave at a frequency equal to the bit rate selected for data transmission. Consequently, the frequency of this clock signal can be either equal to, twice, or three times the baud rate, depending on the speed selected using the BIT RATE switch in conjunction with the Speed Select (SS) interface lead.

When the data set is on-line in the Receive mode (RS [Request-to-Send] OFF) and high-speed carrier is not being received, the SCR (Serial Clock Receiver) lead will be clamped in the MARK condition. Once the remote transmitter begins to train the receiver, the SCR (Serial Clock Receiver) lead will stay clamped in the MARK condition until the end of the Binary mode (Section 5). At this point, the SCR (Serial Clock Receiver) lead will be unclamped and properly phased received timing will be passed to the business machine. If the COD (Data Carrier Detector Delayed) lead switches from ON to OFF at any time, the SCR (Serial Clock Receiver) lead will be once again clamped in the MARK condition. However, this clamp circuit can be disabled with a strapping option (Section 3.2.1) for operation as a regenerative repeater.

This interface lead is clamped spacing in Data Set 203B, without Error Control.

This interface lead is clamped marking in Data Set 203B, with Error Control.

4.3.17 Data Carrier Detector Delayed (COD) – Lead 18

This signal is provided by the data set and is essentially a high-speed carrier detector. When the high-speed receiver is on-line and the remote transmitter is quiet, the COD (Data Carrier Detector Delayed) lead will be clamped in the OFF state. Once the high-speed transmitter is activated, the COD (Data Carrier Detector Delayed) lead will switch from OFF to ON within 70 milliseconds following the reception of carrier. If high-speed carrier disappears, the COD (Data Carrier Detector Delayed) lead will switch from ON to OFF after the following holdover intervals have elapsed:

<u>Speed Option</u>	<u>Hold-Over (Seconds)</u>
2400 baud (List 2)	1.39
1800 baud (List 3)	1.85
2400 baud (List 4)	1.39
3200 baud (List 5)	1.04
3600 baud (List 6)	0.92

This interface signal is clamped OFF in Data Set 203B, List 1 or 1A.

This interface signal is clamped ON in Data Set 203B, List 1C or 1D.

4.3.18 SCA-Secondary Request-to-Send (SRS) – Lead 19

This interface lead is provided to enable the business machine to independently control the low-speed secondary channel in certain private line configurations.

On 2-wire facilities, an ON state on SRS (Secondary Request-to-Send) will cause the data set to place the secondary channel transmitter on-line allowing for the eventual transmission of low-speed data. An OFF state will correspondingly cause the data set to place the secondary channel receiver on-line. On 4-wire facilities, the secondary channel receiver will always be connected to the receive pair. Consequently, the state of the SRS (Secondary Request-to-Send) lead will only control the low-speed transmitter.

As long as the data set is strapped for independent control (Section 3.2.5) of the secondary channel, the preceding description holds. If the data set is strapped for semi-independent control (Section 3.2.5), the RS (Request-to-Send) lead must be OFF to allow an ON condition on the SRS (Secondary Request-to-Send) lead to activate the low-speed transmitter.

This interface signal will not be recognized by any Data Set 203-Type providing service over the switched message network because the option Exclusive High-Speed Channel Control (Section 3.2.5) will be installed. When the secondary channel is not ordered with Data Set 203A (List 7 not requested), this interface signal will not be recognized by the data set.

4.3.19 CD-Data Terminal Ready (DTR) – Lead 20

This signal is supplied by the business machine equipment and is only used when the data set is equipped with a Data Auxiliary Set 804-Type.

When the data set is in the “Automatic Answer” mode, a Data Terminal Ready (DTR) ON will permit the data set to automatically answer a call on detection of ringing. After a call has been established, a DTR (Data Terminal Ready) ON signal enables the data set to be switched between the “TALK” and “DATA” modes. Placing DTR (Data Terminal Ready) OFF after a call has been established will immediately put the station “on-hook”. To put the station “on-hook” while in the DATA mode, the DTR (Data Terminal Ready) lead must be switched to the OFF state for a minimum of 50 milliseconds.

4.3.20 CG-Received Signal Quality (SQ) – Lead 21

This signal is supplied by the data set to indicate when the high-speed receiver is presenting good data. Without the error control unit, the Signal Quality (SQ) indication is generated by the high-speed receiver. When the high-speed receiver has not been trained, the SQ (Received Signal Quality) lead will be clamped in the OFF state. Once the training period begins, the Received Signal Quality (SQ) will normally come ON at the end of the Binary mode (Section 5). A SQ (Received Signal Quality) ON indication is given providing: a) carrier recovery is successfully maintained, b) receiver bit timing is successfully recovered and, c) the number of data crossings occurring near the center of the received “eye pattern” has not exceeded a predetermined threshold. After a Signal Quality (SQ) ON indication has been initially given, the SQ lead will switch OFF if the data crossings exceed a threshold corresponding roughly to an error performance of one error per hundred bits. For the SQ (Received Signal Quality) lead to switch back ON, the data crossings must be reduced to roughly correspond to an error performance of one error or less per thousand bits. The SQ lead will be clamped in the OFF state when the COD (Data Carrier Detector Delayed) lead is OFF.

When an error control unit is being used, the Signal Quality (SQ) indication is also controlled by a sync loss indication from the error control decoder.

This interface signal is clamped OFF in Data Set 203B.

4.3.21 CE-Ring Indication (RI) – Lead 22

Signals on this circuit indicate to the business machine that a ringing signal is being received. A Ring Indication ON is given to the business machine equipment whenever ringing is occurring. When Data Auxiliary Set 804-Type is not provided, the Ring Indication (RI) lead is clamped in the OFF state.

4.3.22 CH-Speed Select (SS) – Lead 23

This interface lead is furnished to allow the business machine to switch between the two highest bit rates of the data set when the BIT RATE (Figure 5) switch of the data set is placed in the CC (Customer Control) position. When the Speed Select (SS) lead is ON, the highest bit rate of the speed option provided is selected. With the Speed Select (SS) lead in the OFF state, the next to the highest bit rate of the speed option provided is selected.

Note: The high-speed receiver should be retrained whenever the data set speed is switched.

4.3.23 DA-Serial Clock Transmitter-External (SCTE) – Lead 24

This interface circuit is provided to allow the business machine to supply the bit timing for the high-speed transmitter. The SCTE (Serial Clock Transmitter-External) signal must be a rectangular wave with a duty cycle of 50 ± 10 percent at a fundamental frequency nominally equal to the bit rate selected for data transmission. Consequently, the nominal frequency of this clock signal will be either equal to, twice, or three times the baud rate, depending on both the setting of the BIT RATE switch and the state of the SS (Speed Select) interface lead. The frequency of SCTE (Serial Clock Transmitter-External) must be held within 0.001 percent of nominal.

This interface lead is not used in Data Set 203C and has no effect on the data set when the strapping option for internal timing is provided.

5. OPERATION

5.1 Training Sequence – General

The Data Set 203-Type is entirely different from any previous Bell System data sets as it requires:

- 1) The linear distortion characteristics (delay and slope) of every connection to be precisely compensated for to allow higher data rates.
- 2) Different receiver carrier phase adjustments to be made for each connection used for transmission since the demodulation scheme is coherent.

To achieve this, Data Set 203-Type utilizes a training or start-up period to condition the receiving data set prior to actual transmission of customer data. In the training period, the high-speed transmitter sends a fixed sequence of signals which is used by the receiver to make the necessary adjustments for the channel.

5.1.1 Modes of Training Sequence

The training period is broken down into five different modes. These are the Operator Tone mode, the Steady Carrier mode, the Binary Data mode, the Multilevel Data mode, and the Error Control Sync mode (see Figure 6). These modes follow any sequences involved in establishing the voiceband channel (see 5.2.1).

When in the Operator Tone mode, the transmitting data set sends a single tone whose frequency is half the baud rate (i.e., 900 Hz for the 1800 baud speed option – List 3). This tone lasts for nominally either 2.3 seconds (List 3), 1.7 seconds (List 2 or List 4), 1.3 seconds (List 5) and 1.1 seconds (List 6). The purpose of this tone is:

- 1) To trigger the data receiver to recognize that the training sequence is starting.
- 2) To give the operator of the data receiver some time to transfer the data set from TALK to DATA when using a Data Auxiliary Set 804A- or M-Type.

After the Operator Tone mode, the transmitting data set sends only the carrier signal and the two pilot tones. During this Steady Carrier mode, the data receiver adjusts the phase of the recovered carrier. The Steady Carrier mode lasts for nominally either 1.4 seconds (List 3), 1.1 seconds (List 2 and List 4), 0.8 second (List 5) or 0.7 second (List 6).

Following the Steady Carrier mode, the transmitting data set sends the carrier modulated with the outermost levels of the quasi-random baseband signal generated internally by the scrambler. As this binary data (Binary Data mode) is being received, the receiver bit timing is properly synchronized with the zero crossings of the data and the automatic equalizer is coarsely adjusted to compensate for the line. The Binary Data mode lasts for nominally either 3.1 seconds (List 3), 2.3 seconds (List 2 and List 4), 1.8 seconds (List 5) and 1.6 seconds (List 6).

The next mode of the training period is the Multilevel Data mode where the transmitting data set sends the carrier modulated with all levels generated by the quasi-random word of the data set scrambler. Using this multilevel signal, the receiver fine-adjusts the automatic equalizer to complete the line compensation process, and the descrambler of the receiver synchronizes itself. The Multilevel Data mode lasts for nominally either 3.4 seconds (List 3), 2.6 seconds (List 2 and List 4), 1.9 seconds (List 5) or 1.7 seconds (List 6).

Finally, the last mode of the training period – Error Control Sync – is reached during the time the decoder of the receiver is synchronized with the encoder of the transmitter. This mode is provided even when error control is not used. The Error Control Sync mode lasts nominally for either 0.3 second (List 3), 0.2 second (List 2, List 4 and List 5) or 0.1 second (List 6).

When the training period is executed without interruption (Section 3.2.4), the total time required is nominally 10.5 seconds (List 3), 7.9 seconds (List 2 and List 4), 6.0 seconds (List 5) and 5.2 seconds (List 6).

5.1.2 Training Under Exclusive Transmitter Control

This option allows the Data Set 203-Type to transmit the entire training sequence whenever the business machine turns ON the Request-to-Send (RS) interface lead (see Figure 7). In this mode, the business machine at the transmitting station has exclusive control over when the receiver is to be trained. As Figure 7 indicates, with this exclusive mode of control, the transmitting business machine must be sure that the remote data receiver is on-line before turning ON Request-to-Send (RS). If this is not done, a portion of the training signal may not be received and, consequently, proper training will not occur. In particular, the data receiver must be on-line before the steady carrier and pilot's portion of the training sequence is transmitted. Because of this restriction, this method of Training Sequence Control should not

be used when manually calling a data transmitter arranged for automatic answer. This option can be used in private line arrangements or in dial switched network arrangements where a transmitter always calls a receiver and no turnaround operation is used.

5.1.3 Training with Secondary Channel Inhibit

To reliably insure that the data receiver is on-line before training begins, another Telephone Company installer option (Section 3.2.4) is available which uses the secondary channel provided in Data Set 203. This option arranges the data transmitter to begin transmitting the training sequence when the Request-to-Send (RS) lead is turned ON but inhibits the completion of the training until reverse secondary channel energy is detected at the transmitter (see Figure 8). This option is recommended for dial switched network operation.

When this option is provided, the training sequence will be initiated by the transmission of operator tone as soon as the Request-to-Send (RS) lead of the transmitter is turned ON. Operator tone will be continuously transmitted, however, until the receiving data set goes on-line and sends secondary channel carrier back to the transmitter. When this occurs, the training sequence will continue with the transmission of the rest of the training modes.

5.1.4 Automatic Retraining (4-Wire Operation Only)

When Data Set 203-type is provided on a 4-wire circuit to supply full-duplex high-speed data service, a third mode of training sequence control can be supplied on a Telephone Company installer option basis. This option is one that will provide automatic retraining of the data receivers in addition to the usual training sequence control via the Request-to-Send (RS) interface lead (Section 5.1.2).

The automatic retrain feature is operational only when the Request-to-Send (RS) leads of both modems are held in the ON state. In this configuration, the data receivers will look for either an excessive line dropout or loss of Signal Quality (SQ) as an indicator that a retrain is required. When either condition is observed in a receiver, that receiver's companion transmitter will be automatically triggered to send the training sequence to the distant modem. When the remote modem detects the Operator Tone mode of the training sequence, it will appear to be an excessive line dropout. Consequently, the remote receiver will trigger its associated transmitter to send the training signals to the near-end receiver that initially originated the retrain sequence.

When the high-speed transmitters are triggered to automatically send the training sequence, the appropriate Clear-to-Send (CS) interface leads will be switched to the OFF state. With option CS inhibited by COD installed, the Clear-to-Send (CS) ON indication will only reappear after the sequence of training signals have been sent and high-speed carrier is being received by the modem. In this case, both transmit and receive channels must be operational before a Clear-to-Send ON is given. With option CS not inhibited by COD installed, the Clear-to-Send (CS) ON indication will reappear after the sequence of training signals have been sent. In this case, the transmit channel is not inhibited by a loss of the received line signal. An additional feature of the automatic retrain option is that it provides remote control of the far-end transmitter via the Request-to-Send (RS) lead on the local data set.

Figure 9 is a timing diagram which depicts the interface operation that will take place when a temporary line dropout occurs on one side of the 4-wire circuit. If a complete collapse of one of the sides of the 4-wire facility occurs, the data set will respond as shown in Figure 10. When the circuit is restored, another retrain will take place (Figure 11). If the 4-wire circuit remains intact but for some reason signal quality is lost, a retrain will occur automatically as depicted in Figure 12.

5.2 Switched Message Network Operation

As indicated in Section 3.1.1, the List 3 and List 4 speed options of Data Set 203-Type can be used for operation on the switched message network. For this service, the following operations should be followed to insure proper operation of the data set.

5.2.1 General Call Set-Up Procedure

Attendant depresses the "TALK" button on the Data Auxiliary Set 804A, lifts the handset, and dials the number of the distant data set.

The calling operation could also have been performed by the business machine using an Automatic Calling Unit (Data Auxiliary Set 801-Type) if the called data set is arranged for unattended answering.

If the call is answered manually, after the attendants have decided to enter the Data mode, the attendant at the called end depresses the "DATA" button. The attendant at the calling (originating) end then listens for a high-pitched (2025 Hz) tone, and when that tone changes to a lower pitch, he will then depress and release the nonlocking "DATA" button and place the handset on-hook.

If the call is answered automatically, the attendant at the calling (originating end will hear a high-pitched (2025 Hz) tone, and when that tone changes to a lower pitch, he will then depress and release the nonlocking "DATA" button and place the handset on-hook. If the call was originated by an ACU, the ACU will detect the end of the high-pitched (2025 Hz) tone and place the originating data set in the Data mode.

The call will be terminated when the "TALK" button is pushed and the telephone handset is momentarily lifted off-hook and then replaced on-hook or when the DTR (Data Terminal Ready) interface lead is turned OFF for 50 milliseconds or more.

5.2.2 Transmitter Calling Receiver

Figure 13 depicts the call set-up procedure that will be encountered when a high-speed transmitter calls a high-speed receiver. As shown in the figure, the receiver will enter the Data mode first and disable echo suppressors. For this call set-up arrangement, the high-speed receiver will be on-line before the high-speed transmitter.

As Figure 13 shows, the time required at the transmitter to enter the Data mode will be typically less than 92 milliseconds when an Automatic Calling Unit originates the call. If the call is manually originated, the response time may be lengthened quite a bit. As a result, the receiving business machine should delay the transmission of low-speed data until the COD (Data Carrier Detector Delayed) interface lead turns ON. This additional delay will insure that the low-speed receiver is unclamped and ready to receive data.

5.2.3 Receiver Calls Transmitter

The call set-up procedure that will be followed when a high-speed receiver calls a high-speed transmitter is shown in Figure 14. In this situation, the transmitter will enter the Data mode first and subsequently disable echo suppressors.

As indicated in Figure 14, the time required for the receiver to enter the Data mode will be typically less than 92 milliseconds when an Automatic Call Unit originates the call. If the call is manually originated, this response time may be lengthened quite a bit.

5.2.4 Turnaround Sequence

One method that can be used to turn around Data Set 203A is shown in Figure 15. This procedure is based on having the high-speed transmitter request the turnaround.

As Figure 15 clearly shows, the total time required to turnaround will be at least the duration of the training interval. (See Figure 6.)

5.3 Private Line Operation

Private line operation is different from dial switched network operation inasmuch as private line facilities are dedicated between local station locations and may or may not have alternate voice capability. If alternate voice capability is provided, the Data mode is entered by the pushing of the "DATA" button on the associated Data Auxiliary Set 804-Type. If the service is data-only (no voice capability required), the data sets are continuously in the Data mode and the training sequence can be initiated by business machine control of the Request-to-Send (RS) interface lead or automatically (4-wire).

A number of the possible private line configurations are described in the following sections.

5.3.1 Two-Wire Private Line

Due to the amount of time required to train Data Sets 203-Type, it is recommended that the data set only be operated when some reverse transmission channel is available. As a result, the only 2-wire private line configurations available for service are ones employing the List 3 or List 4 speed options with the simultaneous reverse channel.

When the List 3 or List 4 speed options are used with a reverse channel for data-only service on a 2-wire private line, Telephone Company installer options (Sections 3.2.4 and 3.2.5) should be provided to insure that the initiation of the training sequence is controlled by the secondary channel and the backward secondary channel is controlled only by Request-to-Send. Figure 16 depicts the start-up procedure that would take place with this 2-wire configuration. When turnaround is required, the sequence depicted in Figure 15 could be employed.

5.3.2 Four-Wire Private Line

Since the 4-wire configuration always insures that both forward and reverse signaling channels are available, any speed option of Data Set 203-Type may be used on 4-wire private lines without a secondary channel. When the List 2, List 5 or List 6 speed options are used, the secondary channel cannot be transmitted simultaneously with the primary data signal due to spectrum overlap between the high- and low-speed channels. To prevent this, an installer strapping option to control the secondary channel by either Request-to-Send or both Request-to-Send and

Auxiliary Request-to-Send (Section 3.2.5) should be installed. When either strapping option is selected, the 4-wire configuration will be capable of:

- 1) Half-duplex high-speed operation using the low-speed acknowledgement channel.
- 2) Full-duplex high-speed operation,
- or
- 3) Full-duplex low-speed operation.

In addition, with the List 3 or List 4 speed option and installer option to control the secondary channel by the Auxiliary Request-to-Send only, the 4-wire configuration is capable of simultaneous full-duplex high-speed and low-speed operation.

When the List 3 or List 4 speed option is provided on a 4-wire private line, any one of the optional training sequence control modes (Section 5.1) can be supplied together with the appropriate secondary channel control. Consequently, this creates quite a bit of flexibility in controlling the operation of the 4-wire service. A complete listing of possible configurations is shown in Table 2 of the Summary Sheets.

One of the more important Data Set 203-Type 4-wire configurations will be the one offering full-duplex high-speed operation. The initial start-up of this mode of operation is shown in Figure 17. For this mode of operation, it is recommended that the automatic retrain option be used (Section 5.1).

6. TESTING

6.1 Remote Test

A comprehensive remote test feature is contained in the Data Set 203-Type. This feature permits a Bell System Data Test Center to determine whether the data set is in working condition. The remote test measures margins as well as operability by checking such things as high-speed channel performance, data set timing accuracy, auxiliary channel performance, and data set control logic.

The data set to be tested is placed in the Remote Test mode using a Data Auxiliary Set 804-Type or by a switch on the data set. When using a Data Auxiliary Set 804-Type, the procedure for entering the Remote Test mode after establishing a call to the test center is to push and release the TEST and other related buttons that the attendant at the data test center may request. The handset may then be replaced on its cradle. Successful entry into the remote test is

indicated by the lighting of the TEST lamp on the Data Auxiliary Set 804-Type and the REMOTE TEST lamp (Figure 5) on the data set. Without the Data Auxiliary Set 804-Type, entry into the Remote Test mode is made by momentarily placing the LOCAL TEST – LINE – REMOTE TEST Key (Figure 5) on the data set to REMOTE TEST and then back to LINE.

The Data Test Center will normally release the data set from the Remote Test mode. The release will be indicated by an OFF condition of the TEST lamp on the Data Auxiliary Set 804A or 804M and the REMOTE TEST lamp on the data set. The remote test may also be released at the data set by:

- a) pushing and releasing the TEST button on the Data Auxiliary Set 804A while on-hook, or
- b) going off-hook (lifting the handset) and going into the TALK mode (pushing the TALK button) on the Data Auxiliary Set 804M, or
- c) momentarily placing the LOCAL TEST – LINE – REMOTE TEST Key on the data set to LOCAL TEST and then back to the LINE position.

7. ADDITIONAL INFORMATION

- 7.1 The absolute delay of a signal through a Data Set 203-Type transmitter and receiver is approximately 15 milliseconds (without error control).
- 7.2 The rates charged by Telephone Companies for data services employing Data Sets 203-Type may vary from location to location. For this reason, the Telephone Company, operating in a specific location, should be contacted to obtain rate information.

8. PERFORMANCE

This section is included to provide the business machine designer with some insight into the performance that can be expected from systems employing Data Sets 203-Type.

8.1 DATA-PHONE® Service

A paper titled "Nationwide Field Trial Performance of a Multilevel Vestigial-Sideband Data Terminal for Switched-Network Voice Channels" by C.W. Farrow and L.N. Holzman is published in the IEEE

International Conference on Communications, Conference Record, June 1968, pp. 782-787. This paper covers the results of a field trial involving early experimental Data Sets 203-Type operating over the switched message network. The results are based on a total of 164 dialed calls from all 17 cities involved in the trials. The cumulative distribution of average bit error rate for the trial indicated that at 1800 bits per second (2-level operation), the performance was equal to or better than an error rate of approximately 10^{-5} errors per bit for 95 percent of the calls. At 3600 bits per second (bps) (4-level operation), a 10^{-4} or better error rate was obtained on 84 percent of all calls and an error rate better than 10^{-5} errors per bit on 62 percent of all calls. This data is a summation of a number of calls from a number of locations and performance from any one location may deviate substantially from that indicated by the trials. (No results are available for operation at 4800 bps but early indications show performance is approximately equal to that at 3600 bps.)

The present standard production Data Sets 203-Type employ a self-synchronizing scrambler. As a result, single bit transmission errors will be presented as a sequence of three bits in error that occur within 23 bits of the original transmission error. However, bursty connections will mask this effect whereas relatively quiet lines will exhibit average error rates that are higher by a factor of three. Taking this into effect, coupled with the fact that normal formatting of data dictates the use of some type of error detection with block retransmission, the system throughput using the 1800 baud option should be comparable to that expected using the error performance criteria listed above from the field trial. Also, it is expected that a nonself-synchronizing scrambler will be available on an optional basis late in 1971 for use in those systems where loss of scrambler synchronization can be adequately detected.

8.2 Private Line Service

Since Data Sets 203-Type use automatic adaptive equalization which compensates for slope and delay whether on the switched message network or on private line, it is anticipated that the performance of 4-level operation (3600 bps, 4800 bps, 6400 bps or 7200 bps, respectively) over C2 conditioned private line facilities will be comparable to the performance at 3600 bits per second (4-level) over the switched message network indicated in Section 8.1 above. The results of recent laboratory tests involving private line applications have confirmed this.

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NOTE: The performance at 8-level operation (5400 bps, 7200 bps, 9600 bps or 10,800 bps) will be substantially less than that achieved at the corresponding 4-level operation in the majority of the cases. [Operation at 8-level is not permitted over the dial switched message network. It is of a permissive nature over private lines. It should only be used in systems capable of operating with reduced performance. If a choice is available between list options to attain a required speed (e.g., 7200 bps with L2 at 8 levels or with L6 at 4 levels), the option utilizing fewer levels is generally superior.]

9. SYSTEM CONSIDERATIONS

- 9.1 Data Set 203-Type is essentially provided in two varieties. One is for use on private lines (L2, L5, L6) and the other for use on both private lines and the dial switched message telecommunications network (L3 and L4). The dual purpose variety (L3 and L4) offers considerable flexibility in system applications. The set can be used over a 4-wire private line as the basic facility. Two dial switched network lines can be used as a 4-wire back-up facility without a speed reduction (2- and 4-level operation only). In addition, the set can use one or two dial switched network lines as the basic facility. Finally, with the optional secondary channel, two simultaneous data streams are possible over 4-wire line arrangements.
- 9.2 The Data Set 203-Type is not specifically designed to operate in a multipoint polling environment. The lengthy turnaround time can result in reduced throughput in those systems with frequent short message transmission. However, secondary channel operation can be effectively used in this type environment. The short polling and acknowledgement messages can be handled by the secondary channel while the remote high-speed transmitter need only be turned ON when there is data to send.
- 9.3 The signal propagation time through both the facility and the data set at each end is an important throughput consideration. As the facility becomes longer, its propagation time tends to become controlling rather than the data set turnaround and propagation time, especially with frequent short messages. Secondary channel operation can prove very beneficial in a system with this type facility. Rather than turnaround the receiving data set to acknowledge each block transmitted, continuous transmission is used. The secondary channel is used to alert the transmitter to resend only those particular blocks that were received with errors.
- 9.4 If dial switched network operation is contemplated but the Data Set 203-Type turnaround time is considered to have a controlling effect on data throughput, two dial switched network lines can be used as the basic facility. With this arrangement the data sets do not have to be turned around. (Equivalent to 4-wire continuous carrier operation.) Data throughput will approach the data set operating speed. A field trial was conducted comparing Data Set 201A3 operating at 2000 bps over one dialed-up line (200 millisecond turnaround time) and Data Set 203AL1, L3 operating at 3600 bps over two dialed-up lines. Data throughput was more than doubled with the Data Set 203A operation.
- 9.5 Block size and message length are additional data throughput considerations. If the length of each can be suitably chosen, the effect of turnaround time will be minimized and the high-speed capability maximized.

SUMMARY SHEET
DATA SET 203 SERIES

PURPOSE	<ol style="list-style-type: none">1. Provide serial data service at data rates of 1800 bps or 3600 bps and 2400 bps or 4800 bps on the Direct Distance Dialing Network or C2 conditioned private lines.2. Provide serial data service at data rates of 2400 bps or 4800 bps; 3200 bps or 6400 bps; and 3600 bps or 7200 bps on 4-wire C2 conditioned private lines.
TYPE OF OPERATION	Synchronous using multi-level encoding.
INTERFACE	Conforms to EIA RS-232-C and RS-334 (can be optionally equipped to conform to Military Standard 188B)
MODULATION	VSB-AM suppressed carrier, lower sideband transmitted.
DEMODULATION	Coherent using carrier recovered from pilot tones.
AMBIENT TEMPERATURE	40° –120°F.
RELATIVE HUMIDITY	20% to 95%.

DATA SET FEATURES AVAILABLE BY ORDERING OPTION

TABLE 1

DATA SET *+ ORDERING CODE	Recommended Data Rates (BPS)				High Speed Trans.	High Speed Recvr.	Second- ary Channel	Auto- matic# Answer	ACU# Compati- bility	Switched Message Network Operation	2-Wire P.L. Operation	4-Wire P.L. Operation	EIA or Mil STD 188B Interface **
	1800 or 3600	2400 or 4800	3200 or 6400	3600 or 7200									
203A-L1C/2/8		X			X	X		X	X			X	X
203A-L1C/2/7/8 §		X			X	X	X	X	X			X	X
203A-L1C/3/8	X				X	X		X	X			X	X
203A-L1C/3/7/8	X				X	X	X	X	X	X	X	X	X
203A-L1C/4/8		X			X	X		X	X			X	X
203A-L1C/4/7/8		X			X	X	X	X	X	X	X	X	X
203A-L1C/5/8			X		X	X		X	X			X	X
203A-L1C/5/7/8 §			X		X	X	X	X	X			X	X
203A-L1C/6/8				X	X	X		X	X			X	X
203A-L1C/6/7/8 §				X	X	X	X	X	X			X	X
203B-L1C/2/8		X			X		X	X	X			X	X
203B-L1C/3/8	X				X		X	X	X	X	X	X	X
203B-L1C/4/8		X			X		X	X	X	X	X	X	X
203B-L1C/5/8			X		X		X	X	X			X	X
203B-L1C/6/8				X	X		X	X	X			X	X
203C-L1C/2/8		X				X	X	X	X			X	X
203C-L1C/3/8	X					X	X	X	X	X	X	X	X
203C-L1C/4/8		X				X	X	X	X	X	X	X	X
203C-L1C/5/8			X			X	X	X	X			X	X
203C-L1C/6/8				X		X	X	X	X			X	X

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SEE NOTES ON FOLLOWING PAGE.

NOTES FOR TABLE 1

- * In addition to the L1C code used to obtain Data Set 203 mounted in its freestanding cabinet, all units can be ordered using a L1D code which allows rack mounting in standard 23-inch relay racks. Both the L1C and L1D codes allot room for inclusion of the forward-acting error control which will be available at a later date. A L1E code is also available for Data Set 203C only which will allow rack mounting in 23-inch racks where the forward-acting error control is not required.
- † The L1C code replaces the L1 code. The L1D code replaces the L1A code. The L1E code replaces the L1B code. These new codes are scheduled to become available during the 3Q'70. The old codes will not operate with the forward-acting error control.
- # The provision of the automatic answer feature and capability of using a Data Auxiliary Set 801-Type Automatic Calling Unit (ACU) to output calls are features that are available only when a Data Auxiliary Set 804A or 804M is provided with Data Set 203.
- ** An Interface conforming to Military Standard 188B can be ordered by substituting L9 for L8.
- § These codes provide full-duplex private line capability for both the primary (high-speed) and secondary channel. However, these capabilities cannot be simultaneously exploited. See 3.1.2 and 5.3.2.

DATA SET FEATURES AVAILABLE BY INSTALLER OPTION

TABLE 2

DATA SET CODE	Key Selector or Permanent Automatic Answer *	Internal or External Trans. Timing	RD & SCR Clamp Disable Option	Auto. Retrain. (4-Wire)	Second- ary Chan. Control of Train.	Exclus. Trans. Control Train.	Exclus. Hi-Speed Chan. Con- trol of Secondary Channel	Independ. Secondary Channel Control	Semi- Independ. Secondary Channel Control
203A-L1C/2/8	X	X	X	X		X			
203A-L1C/2/7/8	X	X	X	X	X	X	X		X
203A-L1C/3/8	X	X	X	X		X			
203A-L1C/3/7/8	X	X	X	X	X	X	X	X	X
203A-L1C/4/8	X	X	X	X		X			
203A-L1C/4/7/8	X	X	X	X	X	X	X	X	X
203A-L1C/5/8	X	X	X	X		X			
203A-L1C/5/7/8	X	X	X	X	X	X	X		X
203A-L1C/6/8	X	X	X	X		X			
203A-L1C/6/7/8	X	X	X	X	X	X	X		X
203B-L1C/2/8	X	X				X	X		X
203B-L1C/3/8	X	X				X	X	X	X
203B-L1C/4/8	X	X				X	X	X	X
203B-L1C/5/8	X	X				X	X		X
203B-L1C/6/8	X	X				X	X		X
203C-L1C/2/8	X		X					X	
203C-L1C/3/8	X		X					X	
203C-L1C/4/8	X		X					X	
203C-L1C/5/8	X		X					X	
203C-L1C/6/8	X		X					X	

* These options are Data Auxiliary Set 804A and M-Type installer options and are not available in all data set applications, i.e., 4-wire service using two switched message network lines.

PHYSICAL CHARACTERISTICS

TABLE 3

DATA SET CODE	LIC	Weight LID	LIE
	(Note 1) L1C Cabinet	(Note 2) L1D Rack	(Note 3) L1E Rack
203A	110 lbs.	90 lbs.	N/A
203B	72.5	53	N/A
203C	89.5	70	65 lbs.

NOTES:

1. The "stand-alone" cabinet is 2-foot high x 2-foot wide x 1-foot deep. (See Figure 3.)
2. A height of 14 inches is required for each mounting of Data Set 203B, whereas 20 inches is required for Data Set 203A and Data Set 203C.
3. A height of 14 inches is only required for this rack mounting of Data Set 203C because no space has been provided for the addition of forward-acting error control as with the L1D rack.

POWER REQUIREMENTS: The Data Set 203 power supply requires from 17 to 55 watts, depending on the configuration. The set operates on 117 volts $\pm 10\%$ AC at a frequency of 47.5 to 63 Hz.

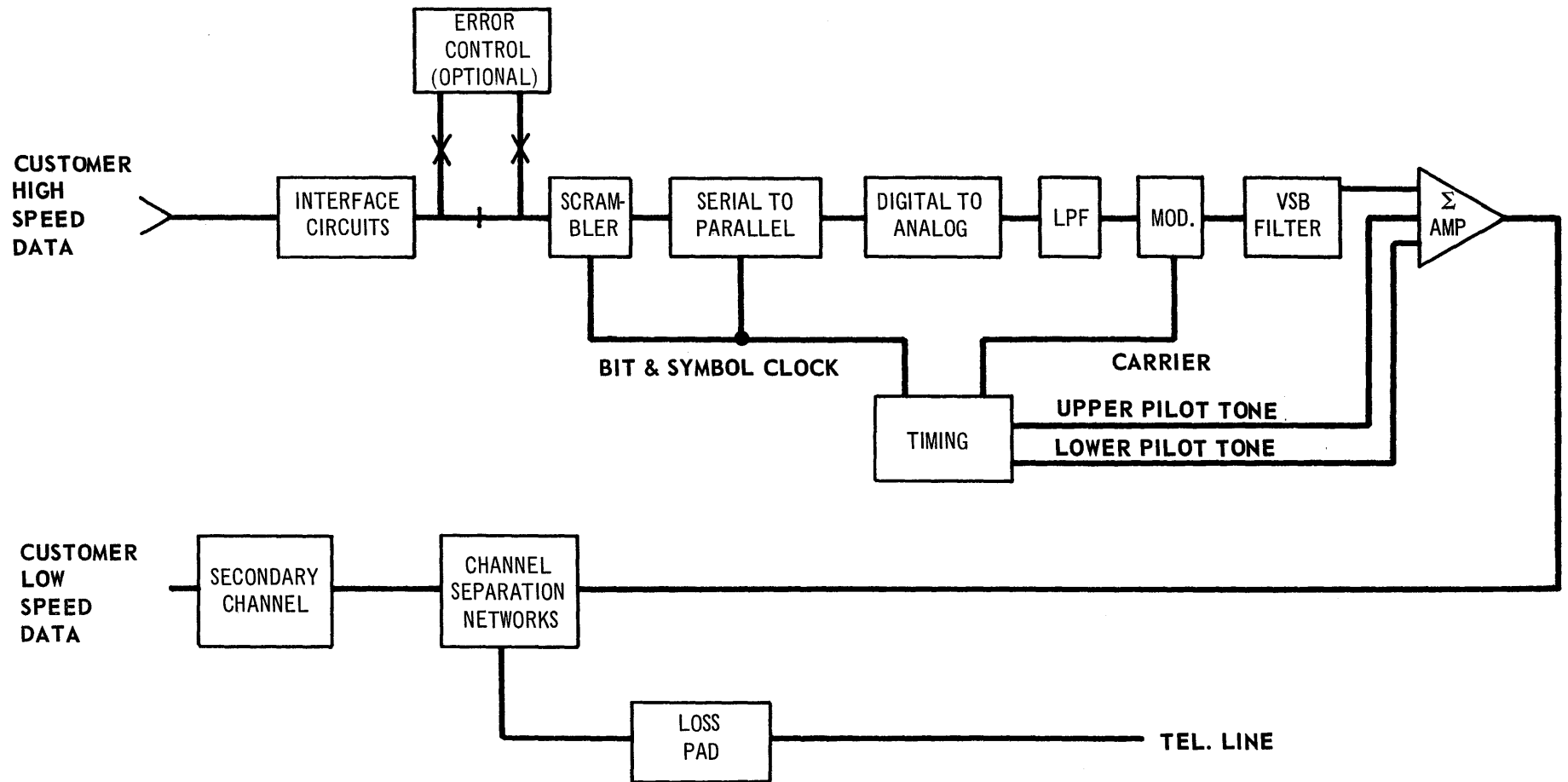
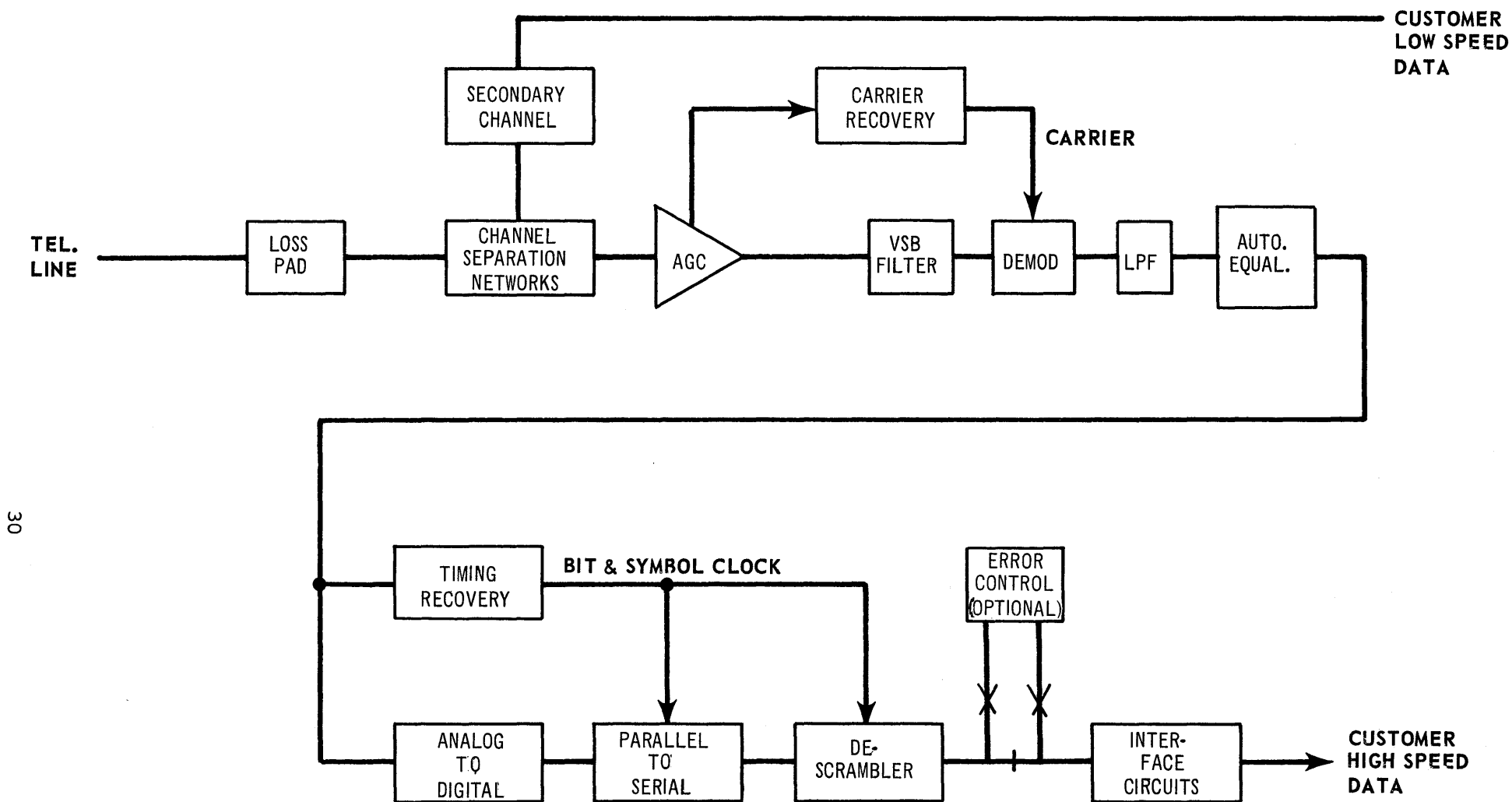


Figure 1

SIMPLIFIED TRANSMITTER BLOCK DIAGRAM
INCLUDING SECONDARY CHANNEL



30

Figure 2

SIMPLIFIED RECEIVER BLOCK DIAGRAM
INCLUDING SECONDARY CHANNEL



Figure 3
DATA SET 203-TYPE WITH
ASSOCIATED DATA AUXILIARY
SET 804A OR M TYPE



Figure 4
DATA AUXILIARY SET
804-TYPE PUSHBUTTONS

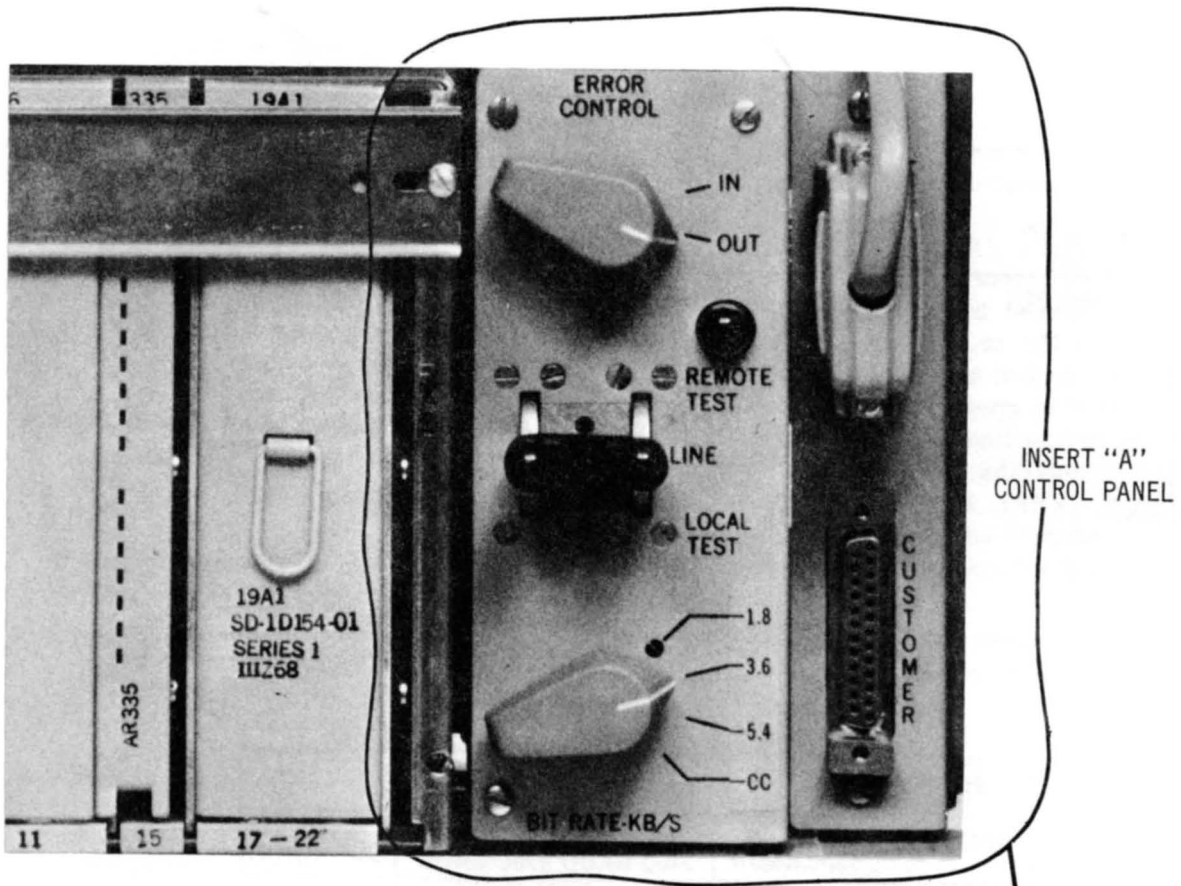
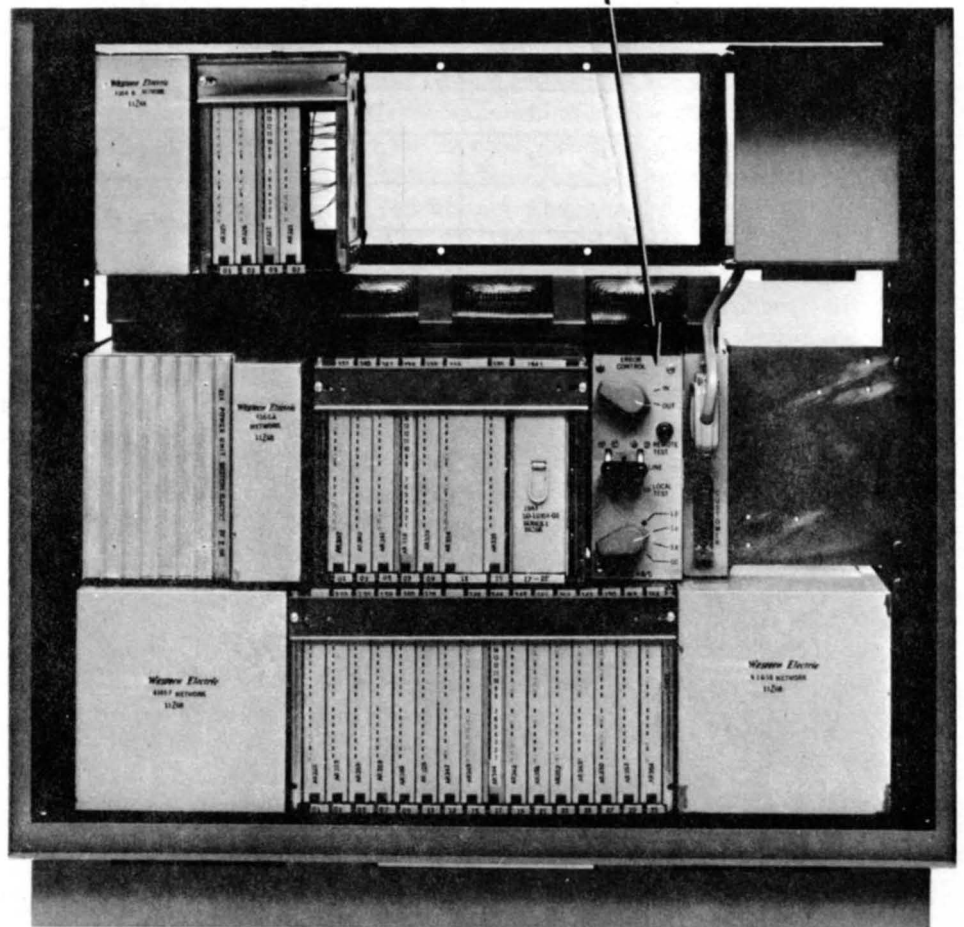
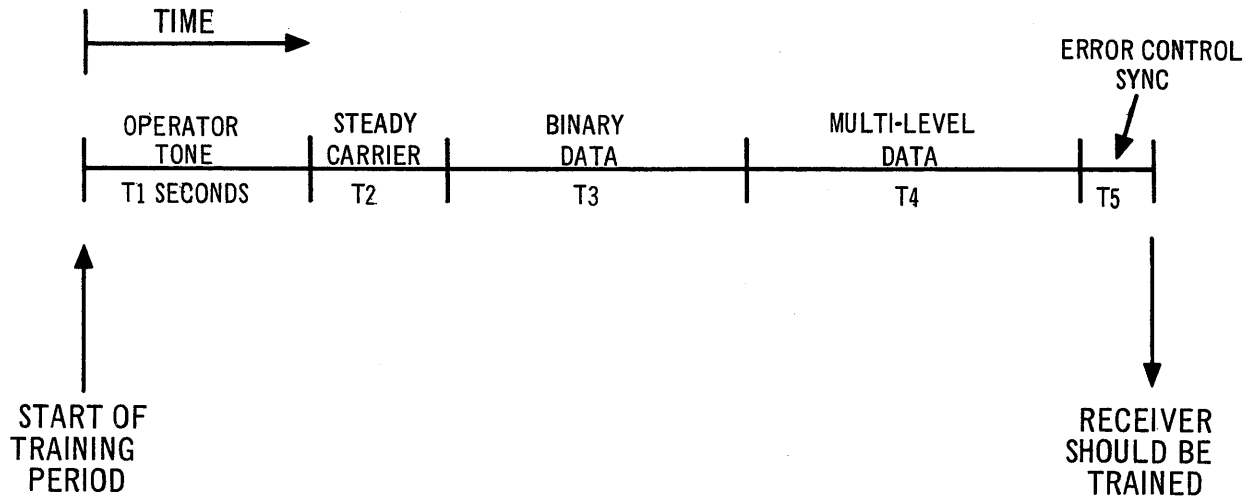


Figure 5
DATA SET 203
CONTROL PANEL





TIME IN SECONDS	SPEED OPTION			
	LIST 3 1800 BAUD	LIST 2 OR 4 2400 BAUD	LIST 5 3200 BAUD	LIST 6 3600 BAUD
T1	2.3	1.7	1.3	1.1
T2	1.4	1.1	0.8	0.7
T3	3.1	2.3	1.8	1.6
T4	3.4	2.6	1.9	1.7
T5	.3	.2	0.2	0.1
TOTAL	10.5	7.9	6.0	5.2

Figure 6

**DATA SET 203
TRANSMITTER START-UP SEQUENCE**

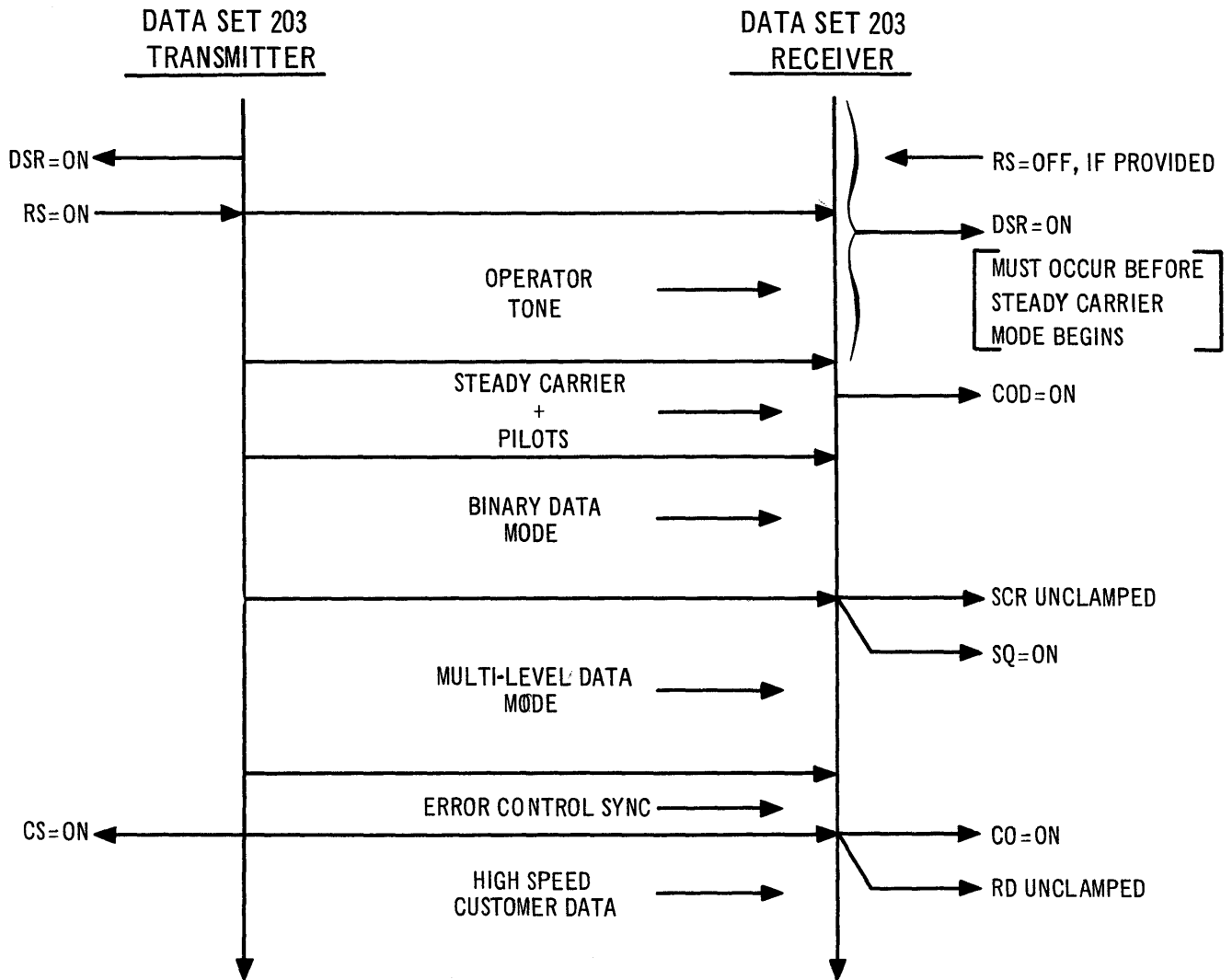


Figure 7

TRAINING UNDER EXCLUSIVE TRANSMITTER CONTROL

DATA SET 203
TRANSMITTER

DATA SET 203
RECEIVER

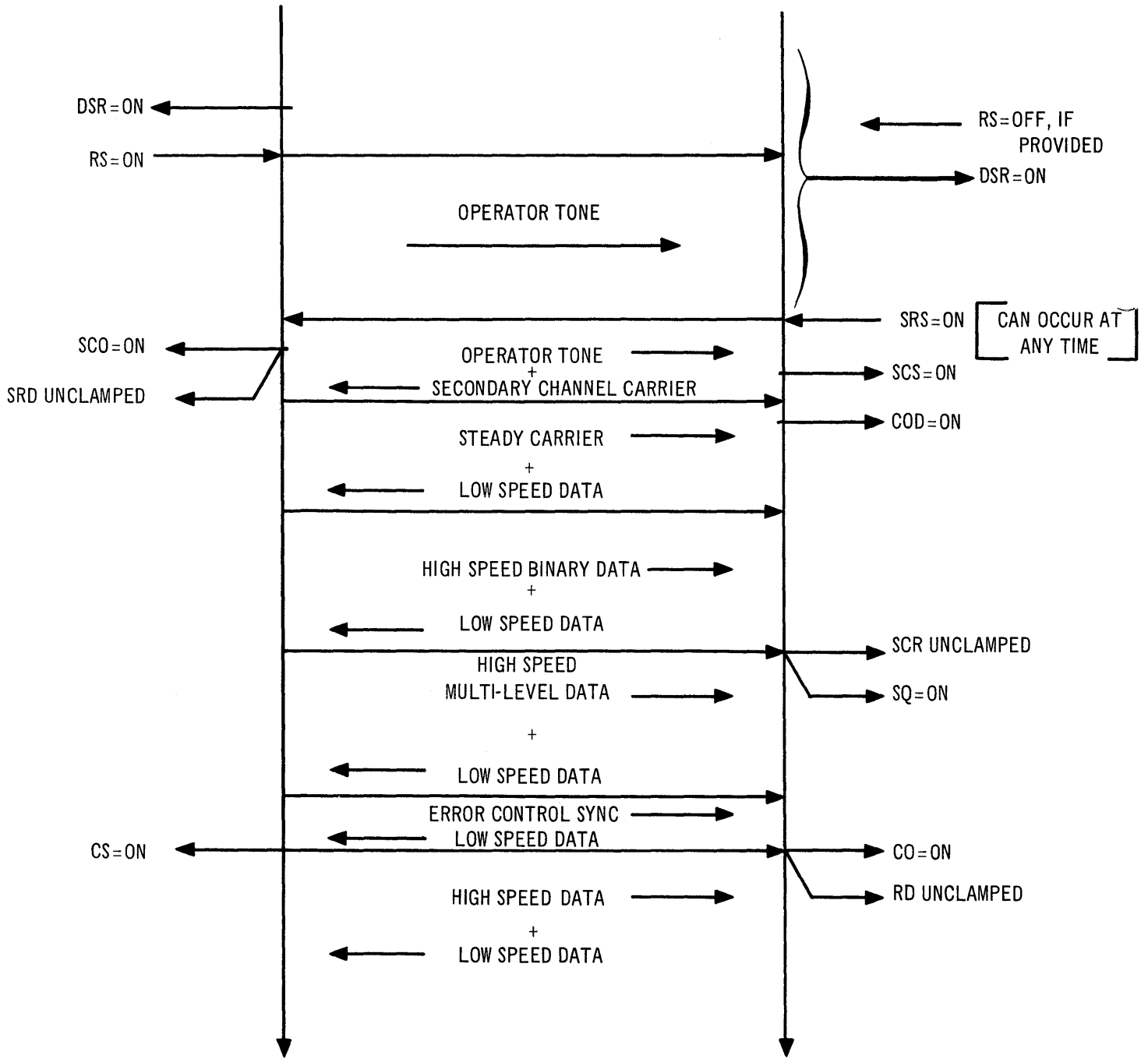


Figure 8

TRAINING WITH SECONDARY CHANNEL INHIBIT

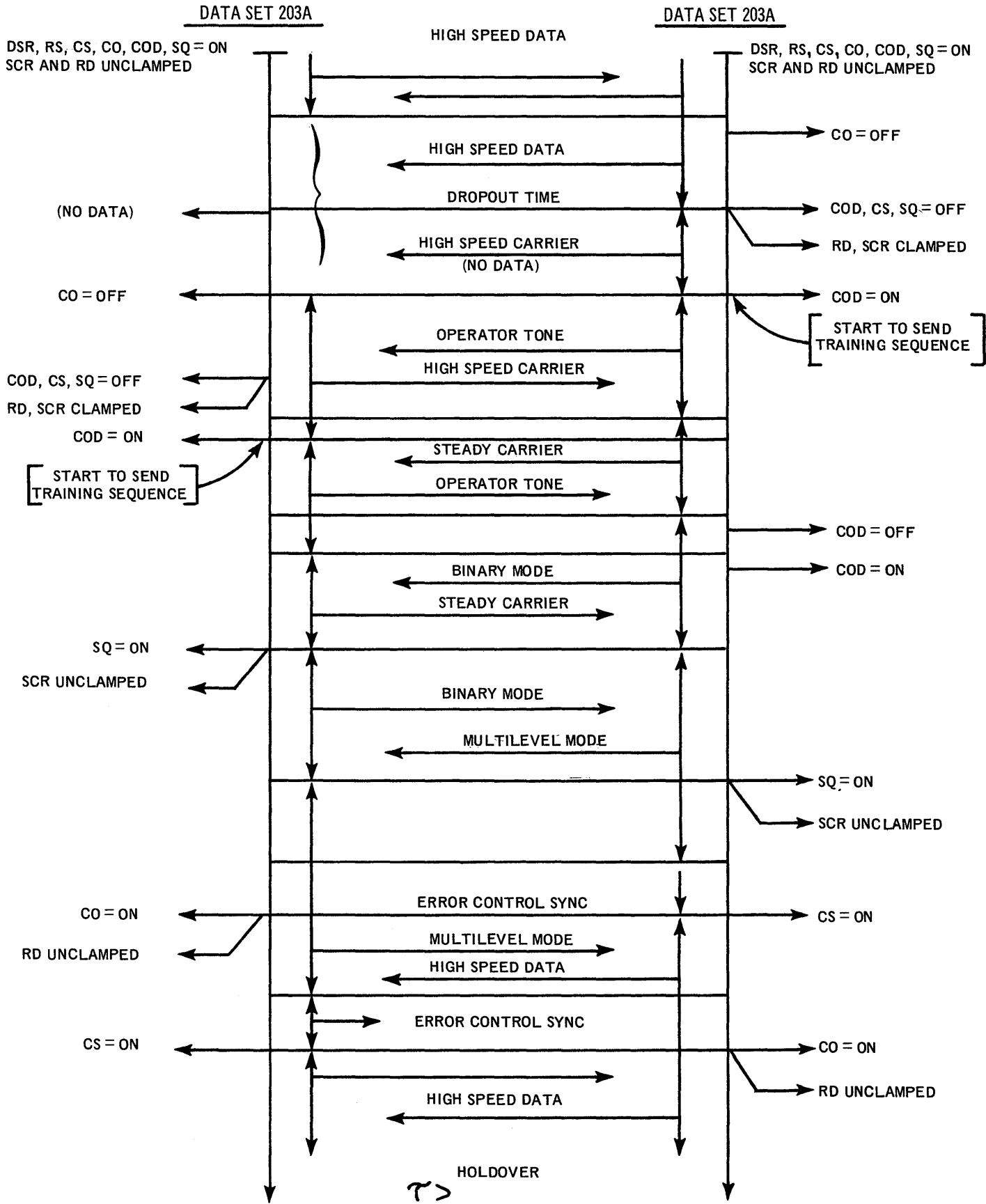
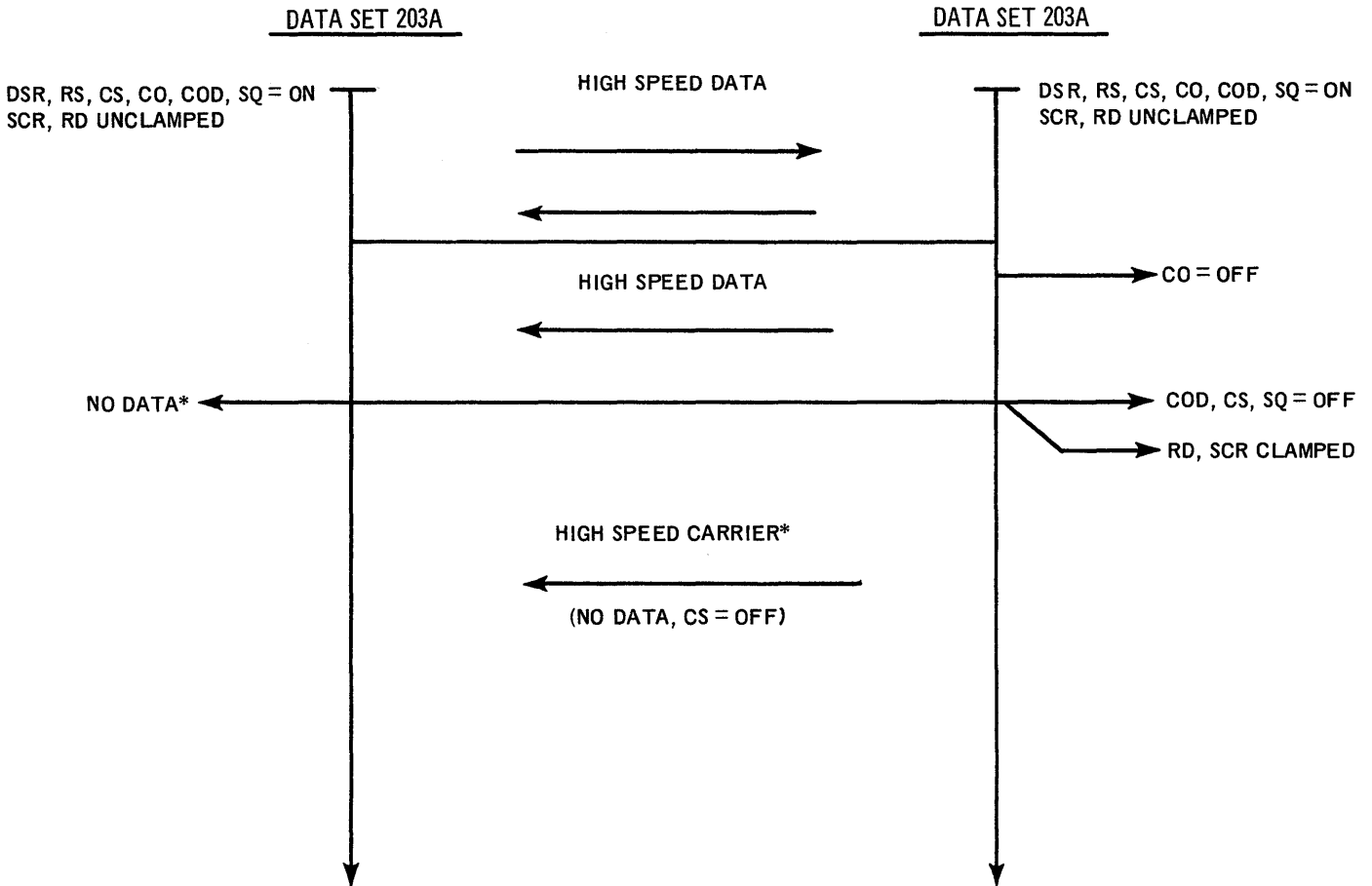


Figure 9
Automatic Retraining (Temporary Dropout)



*APPLIES WHEN OPTION CS INHIBITED BY COD IS PROVIDED – WHEN OPTION CS NOT INHIBITED BY COD IS PROVIDED CLEAR-TO-SEND (CS) IS NOT INHIBITED BY CARRIER-ON-DELAYED (COD) AND HIGH SPEED DATA MAY CONTINUE FROM RIGHT TO LEFT WHEN THE LEFT TO RIGHT PATH IS LOST

Figure 10

Automatic Retraining (Complete Loss)

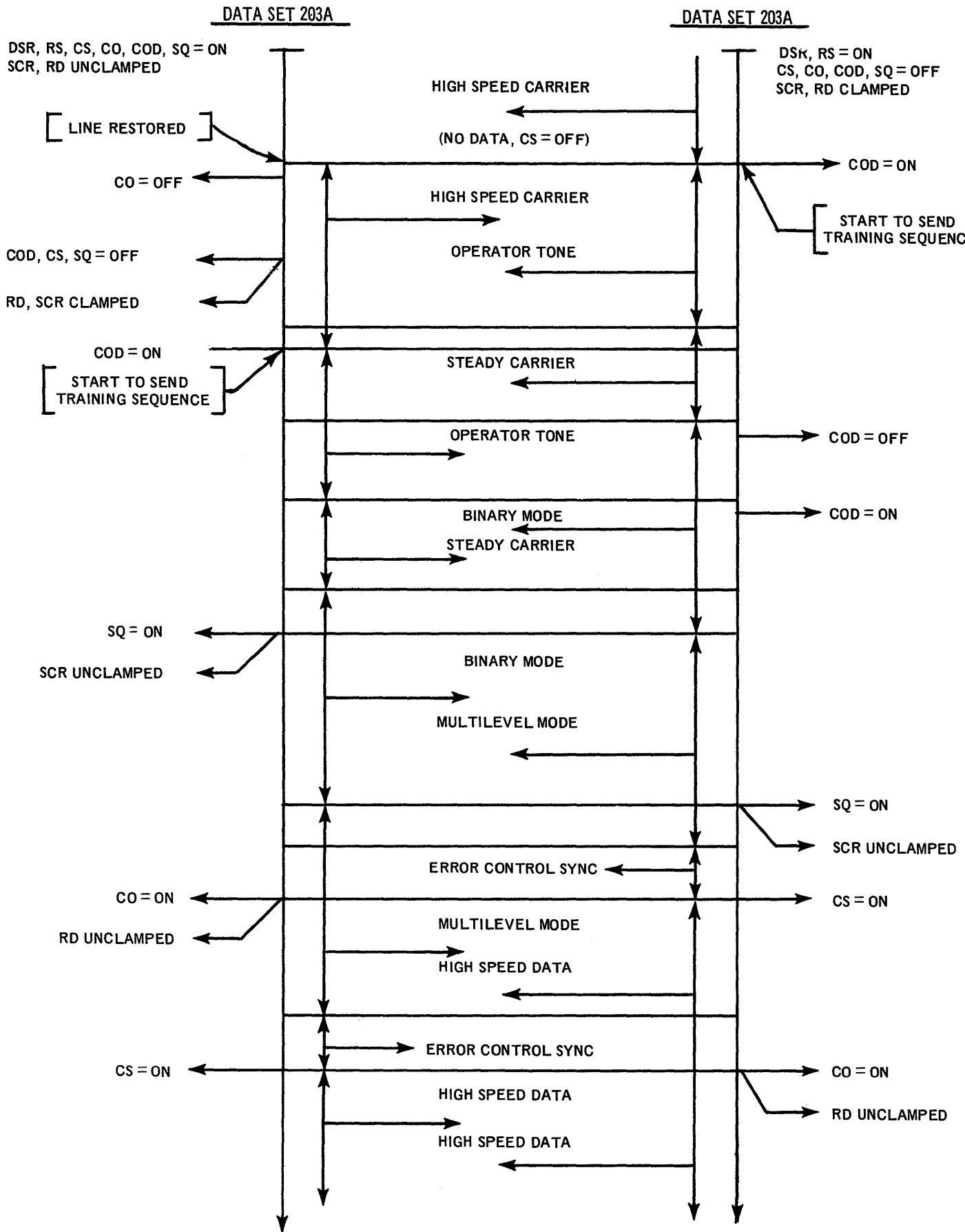


Figure 11
Automatic Retraining Upon
Circuit Restoral

DATA SET 203A

DATA SET 203A

DSR, RS, CS, COD, SQ = ON
SCR, RD UNCLAMPED

DSR, RS, CS, CO, COD, SQ = ON
SCR, RD UNCLAMPED

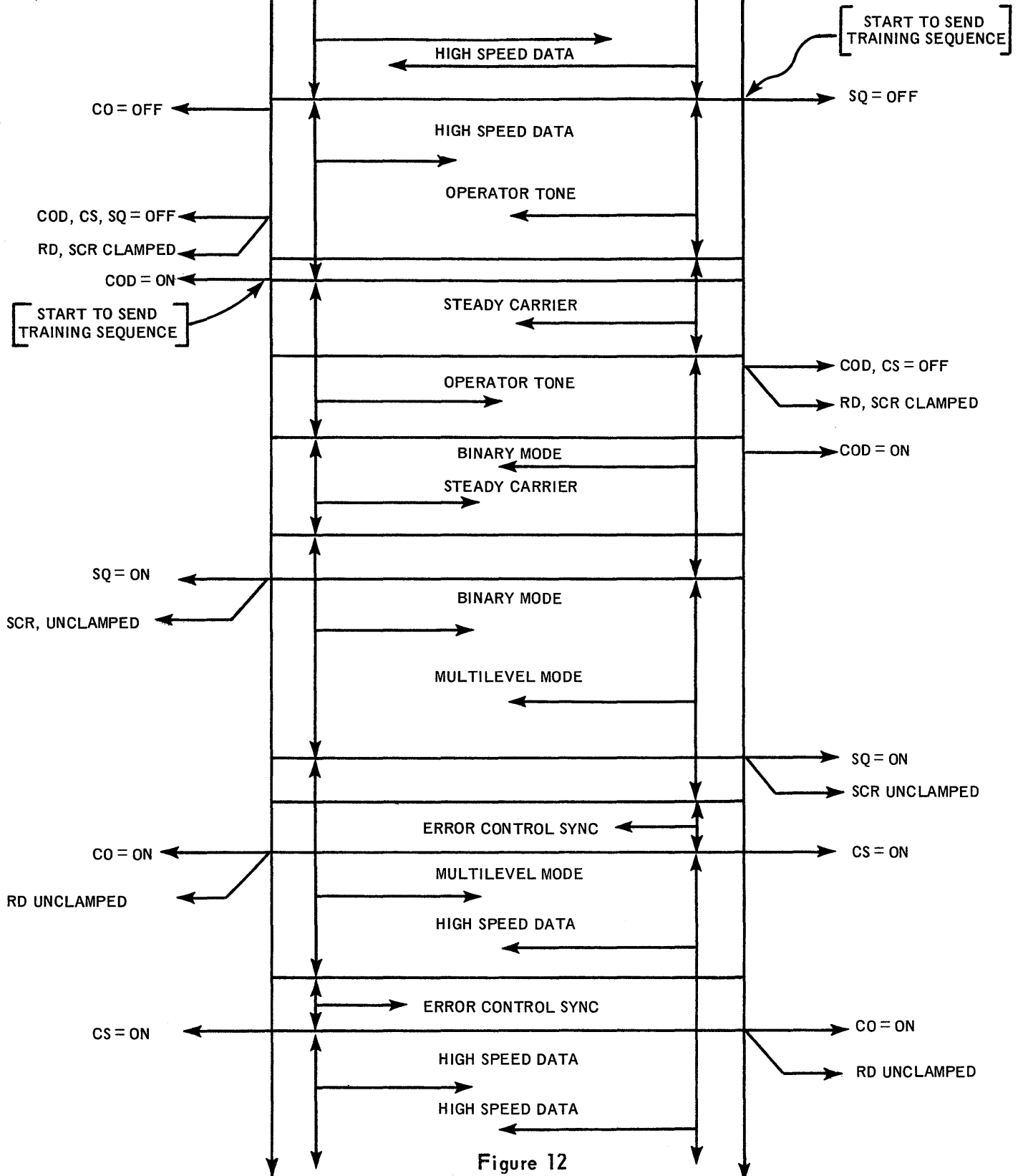
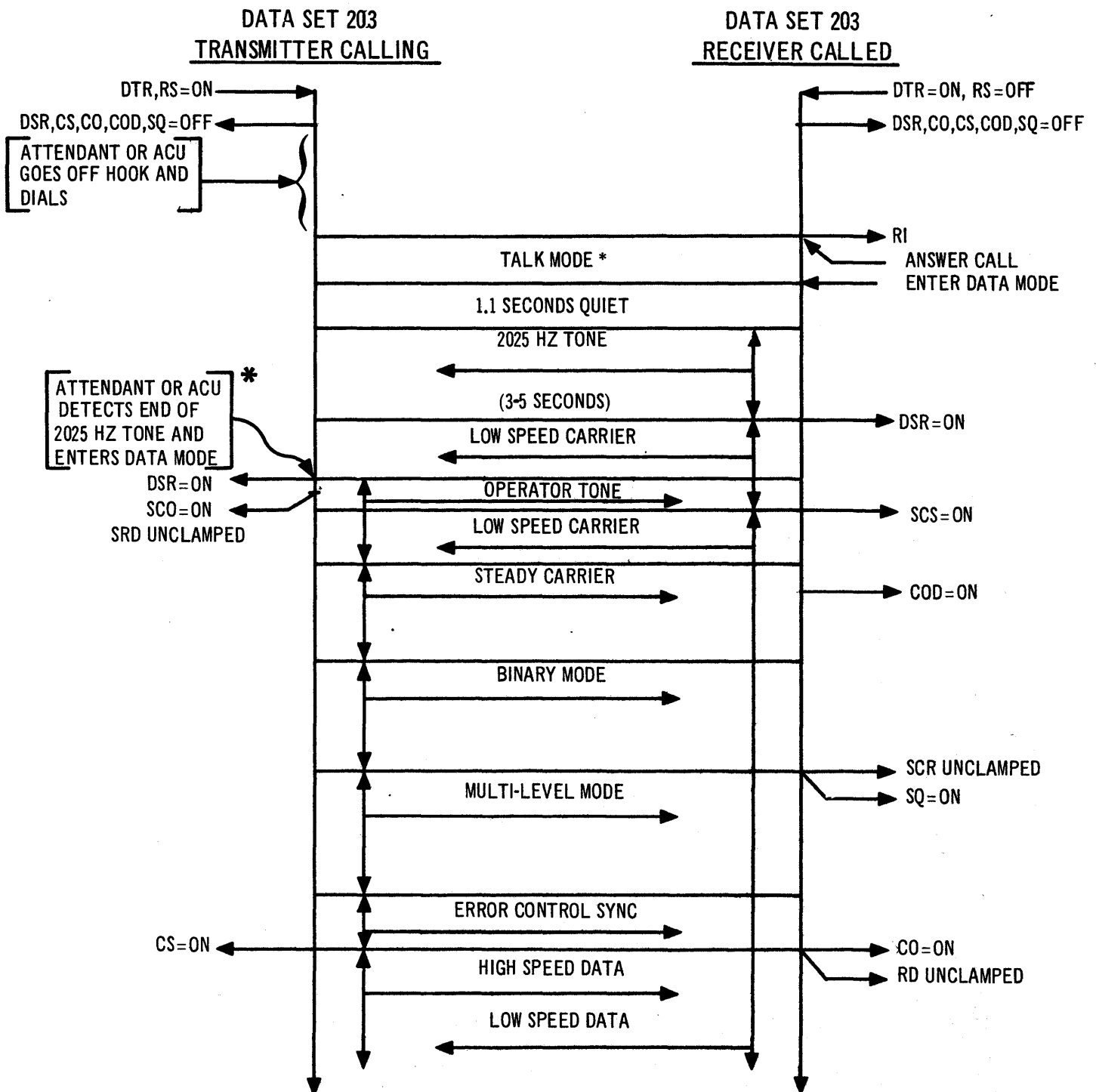


Figure 12

Automatic Retraining Upon
Loss of Signal Quality

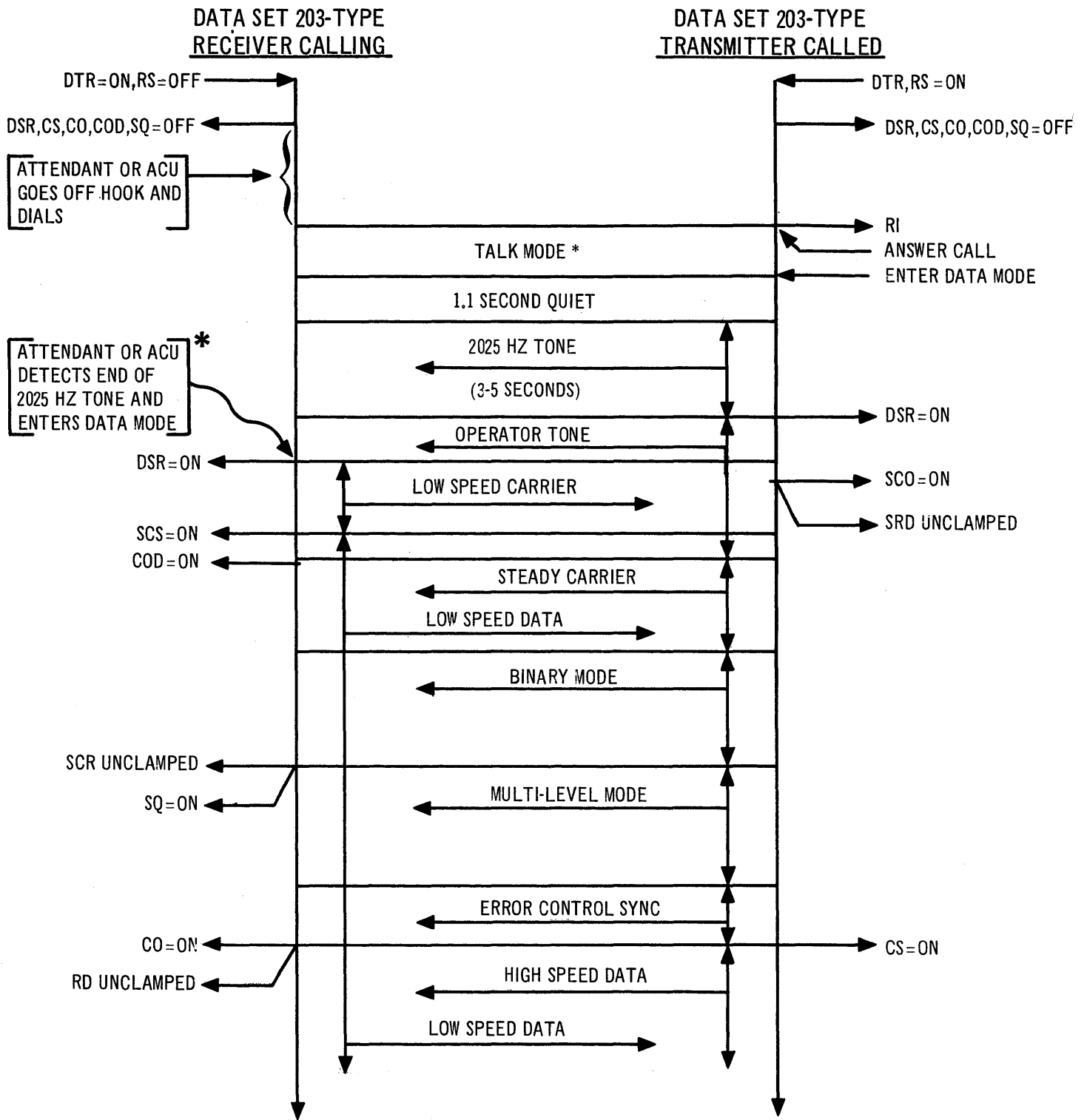


* When receiver automatically answers TALK MODE is eliminated.

* This response time is typically less than 92 milliseconds when using an ACU (automatic calling unit).

Figure 13

**SWITCHED MESSAGE NETWORK OPERATION -
TRANSMITTER CALLING RECEIVER**



* When transmitter automatically answers, TALK MODE is eliminated.

* This response time is typically less than 92 milliseconds when using an ACU (Automatic Calling Unit).

Figure 14

SWITCHED MESSAGE NETWORK OPERATION
RECEIVER CALLING A TRANSMITTER

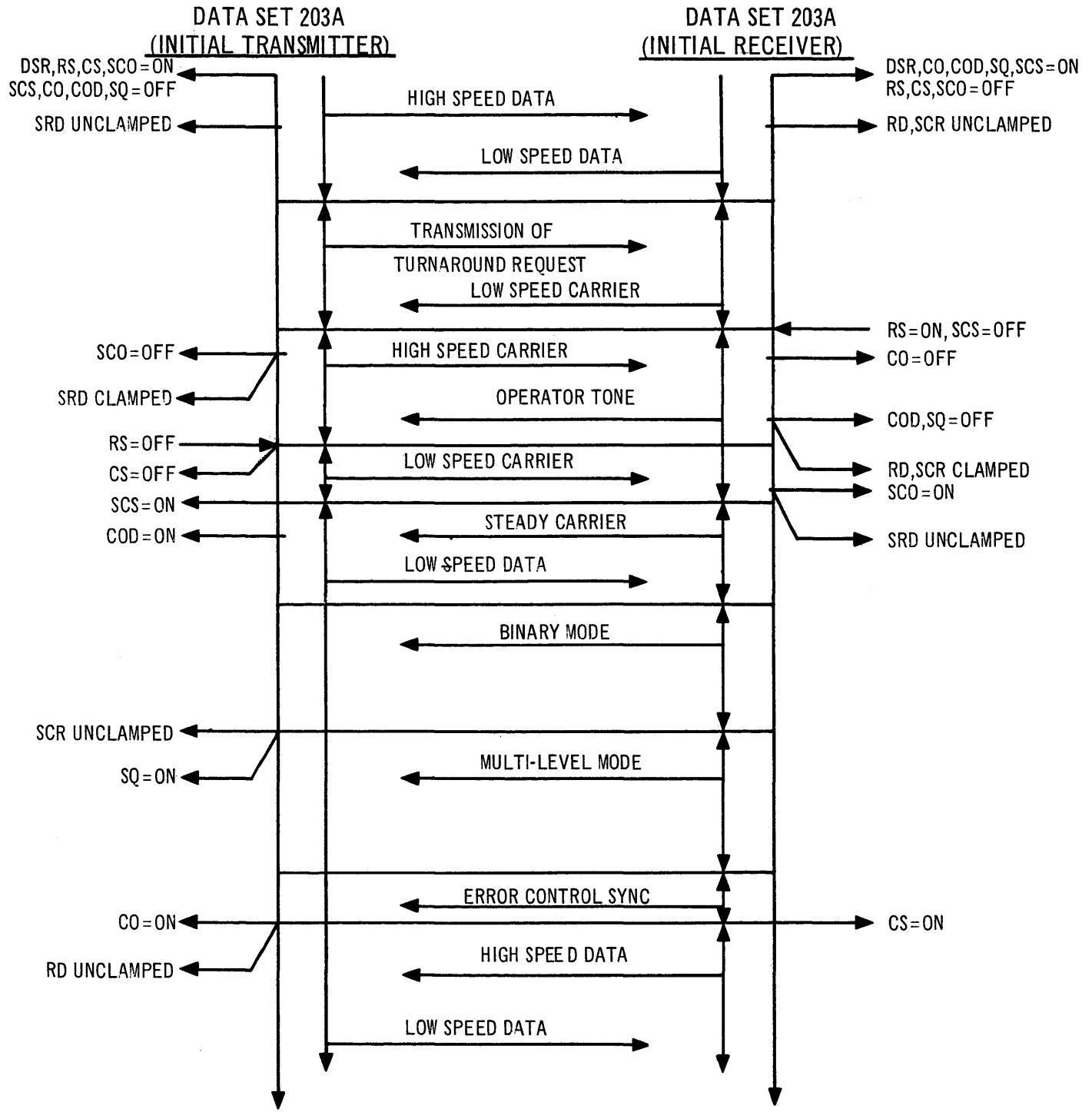


Figure 15

**SWITCHED MESSAGE NETWORK OPERATION
TURNAROUND SEQUENCE**

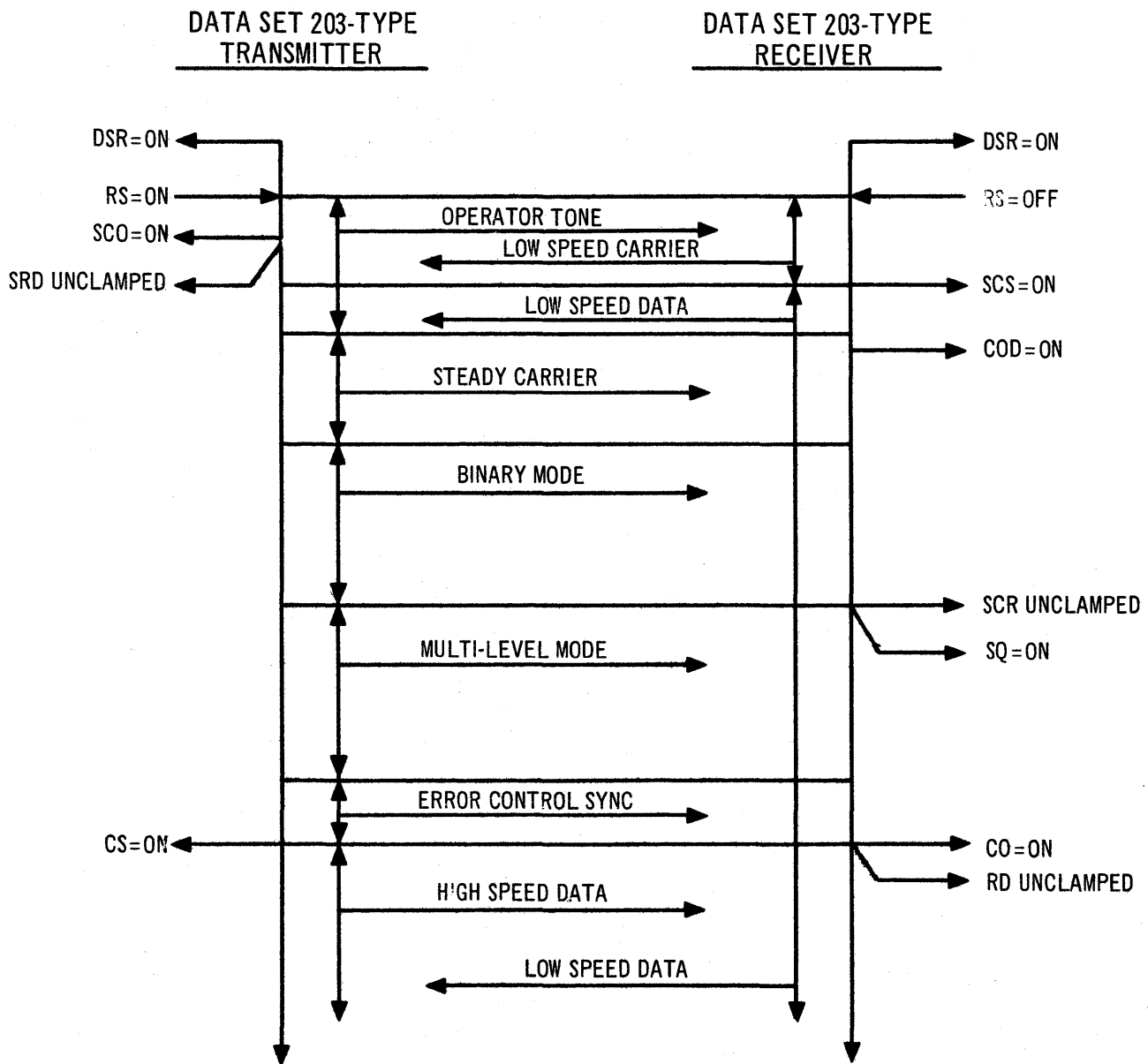


Figure 16

**2-WIRE PRIVATE LINE -
TRAINING SEQUENCE (DATA ONLY)**

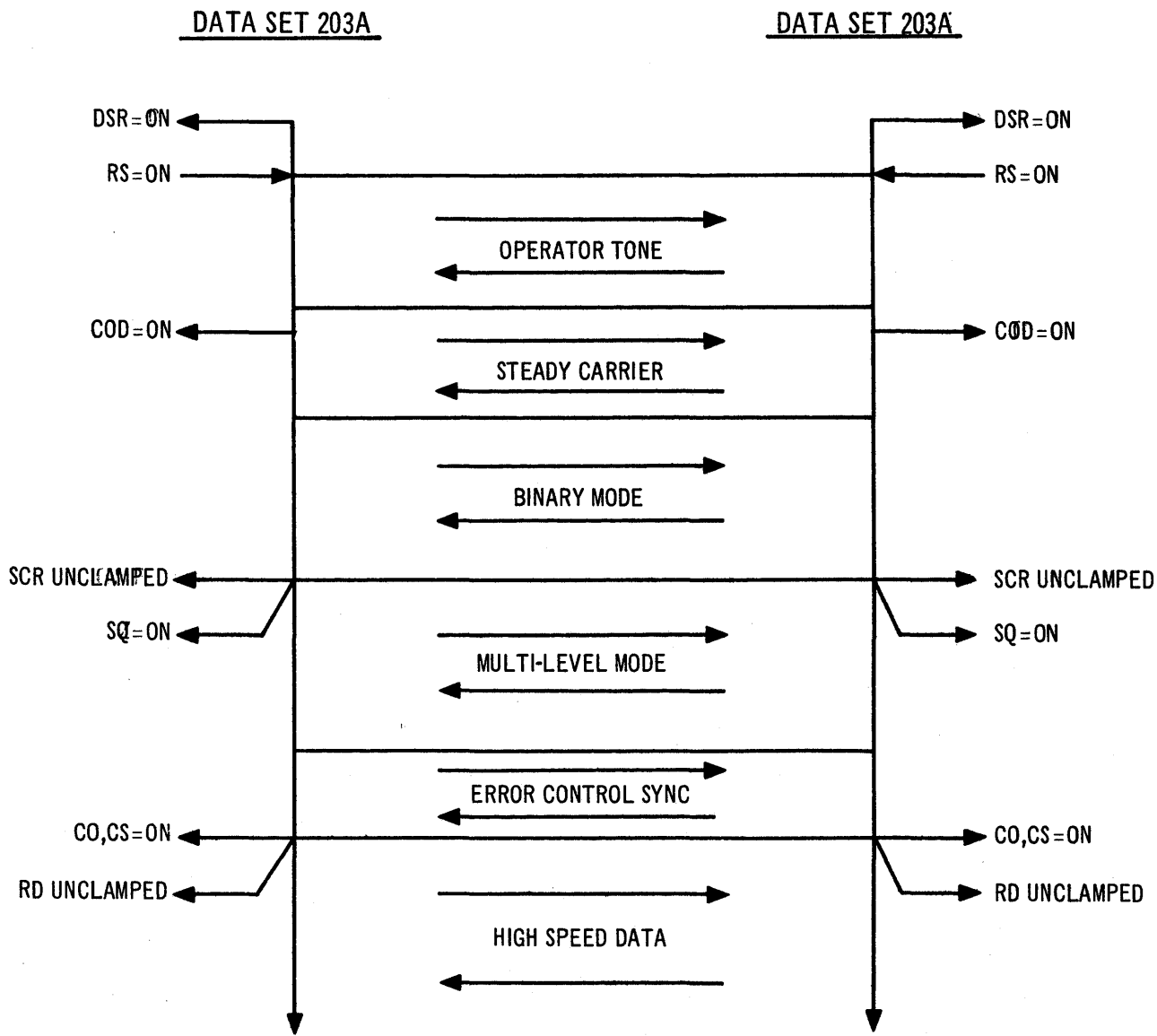


Figure 17

**4-WIRE PRIVATE LINE
TRAINING SEQUENCE (DATA ONLY)**

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