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DATASPEED® TYPE 4 SYSTEM

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ENGINEERING DIRECTOR-TRANSMISSION SERVICES

NOTICE

This Technical Reference is specifically intended for the developers and designers of business machine data terminal equipments and devices which interface with Bell System data communications equipment and for technical consultants for use in designing data communications systems and arrangements employing Bell System data communications services and equipments. The right to revise this Technical Reference for any reason, such as conformity with USASI, EIA, CCITT or other standards, to utilize new advances in the state of the technical arts, or to reflect changes in the design of the equipment and/or service described herein is expressly reserved.

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1. INTRODUCTION

A new high speed paper tape transmission system with automatic error detection and correction capability – called the DATASPEED® Type 4 System – has been developed by the Bell System for data services. As shown in Figure 1, the Type 4 System consists of a Sender terminal containing a paper tape reader and a Receiver terminal containing a paper tape punch. Transmission speed is 1050 WPM or 1200 WPM using Data Sets 202C or 202D.

The information presented here is intended to describe:

1. The on-line signaling and terminal characteristics which are critical to the design of other data equipment with which the DATASPEED Type 4 Sender and Receiver terminals will communicate.
2. The DATASPEED Type 4 System operating characteristics with which a user should be acquainted.

1.1 GENERAL DESCRIPTION

The DATASPEED Type 4 System is intended for application in data transmission systems where error correction is desired. The output tape is "clean" (detected errors are deleted) and requires no further processing before use.

The high speed of operation reduces line time and produces more effective use of equipment, lines, and operating personnel. It is expected that this error detection and correction system will find many applications in data distribution and collection systems.

Block diagrams of the Sender and Receiver terminals are shown in Figures 2 and 3. In normal operation, data is sent in blocks of 80 characters. Blocking is done automatically as an internal function of the terminals and no special format is required. Error detection is accomplished by using block-by-block transmission with 2 check characters being transmitted at the end of the block. The error detection system begins at the Sender with a separate reading head and extends to the Receiver where a photo-reader reads the tape after it has been punched. As a result, the error detection extends from tape to tape, checking not only the transmission but also the quality of the terminal equipment. The check characters are derived via a horizontal and spiral parity check of each 80-character block.

Error correction is accomplished by retransmission of the errored block, the received error block being deleted by overpunching with the all marks (delete) character. Notification of a received error and request for retransmission is accomplished by use of the reverse channel (secondary) feature of the 202-type data sets.

Deletion and retransmission is continued until the block has been properly received or 3 attempts have been made. A rerun counter counts the number of attempts to correct an errored block, and if after three tries the block is not correctly received, the system will go into an alarm condition.

The Sender reads the input tape with a DX Reader. This reader has a reversible drive which can read the tape in the forward direction and can back the tape up to re-read an 80-character block of data. The input at the Sender is 5- to 8-level punched paper tape; 11/16", 7/8", or 1" wide. The reader and Type 4 System are code insensitive and compatible with any format. However, if vertical parity is to be used for improved detection power, the 8th level must be reserved. The reader has two sets of reading heads; the first set develops the transmitted data, the second set develops the two check characters. An extra contact reads the feed holes and is used for a feed error indication. The Sender has a normal capacity of 800' of tape.

The Receiver uses a DRPE punch to produce the output tape. This punch is equipped with a back-up mechanism which backs the tape up through the punch block so that errored blocks may be deleted by overpunching.

Thus, the output at the Receiver consists of a fully punched product tape which is identical to the input tape except where an additional 80-character block of "all marks" (delete) has occurred, indicating the location of a corrected block. The punch has a photo electric reader for reading the tape after it has been punched, the output being used to generate two check characters. A ninth photocell senses the feed hole and is used for a feed error indication. The punch uses a universal punch block that can punch 11/16" or 1" wide paper tape. A 3000' supply of tape and an 800' take-up reel are provided.

Both terminals have provision for manual and unattended operation. The Sender has a feed alarm and a tape-out alarm. The Receiver has a feed alarm, a back-up alarm, and a low tape warning flasher. In the unattended mode a terminal will

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automatically answer calls, transmit or receive data, and will automatically disconnect. An unattended Sender may be protected from unauthorized calls by the Discrete Calling Accessory whereby the Sender requires a special code to be sent to it from the Receiver before it will operate.

1.2 SUMMARY OF PHYSICAL AND ELECTRICAL CHARACTERISTICS

Features

	Sender	Receiver
A.	Size 54" high, 20-1/2" wide 24" deep	54" high, 20-1/2" wide, 24" deep
B.	Weight 325 pounds (Approx.)	350 pounds (Approx.)
C.	Mounting Floor	Floor
D.	Tape Handling 800' tape boat and take-up reel	3000' supply 800' take-up reel
E.	Tape Size 11/16" - 7/8" - 1" width	11/16" - 7/8" - 1" width
F.	Operating Room Temp. 50°F to 110°F	50°F to 110°F
G.	Run Current 3.0 amps	6.7 amps
H.	Stand-by Current 1.6 amps	4.5 amps
I.	Voltage 115V AC ± 10%	115V AC ± 10%
J.	Frequency 60 ± .5 Hz	60 ± .5 Hz
K.	Fusing Self-contained	Self-contained
L.	Signal voltage for interface RS232B	RS232B
M.	Power Cord Length 6 feet	6 feet

1.3 DATA SET INTERFACE

The following data set (202C2) leads are used (EIA RS232 Standard):

Receiver	Sender	Lead	Function
X	X	1	Protective Ground
	X	2	Transmitted Data
X		3	Received Data
	X	4	Request to Send
	X	5	Clear to Send
X	X	6	Data Set Ready
X	X	7	Signal Ground
X		8	Data Carrier Detector
X		11	Supervisory Trans.
	X	12	Supervisory Rec.
		15*	Serial Clock - Trans.
		17*	Serial Clock - Rec.
X	X	20	Data Terminal Ready
X	X	22	Ring Indicator

* For possible future use.

Standard EIA voltage levels are used at receiver and sender terminals for data and control functions. These functions are stated briefly as:

Binary State	One	Zero
Signal Condition	Marking	Spacing
Paper Tape	Hole	No Hole
Control Function	OFF	ON
EIA Voltage	-3 to -25V	+3 to +25V
Normal Signal Voltage	OV	-6V

Reverse channel is transmitted over the supervisory data channel. The Receiver applies the reverse channel signal (on or off) to the supervisory transmitted data lead and it is received at the Sender on the supervisory received data lead.

At 1050 WPM, the Sender uses its own clock and the Receiver operates start-stop directly from the received data. After the procedures for establishing a call have been completed the Sender begins sending Sender Ready Characters (SRS) and must get reverse channel before it can begin transmission. The Receiver is ready to receive when it detects carrier and a Sender Ready Character (SR).

2. GENERAL CHARACTERISTICS OF THE ERROR DETECTION AND CORRECTION SCHEME

Each terminal has an Error Detection and Correction (EDC) module that controls the operation of the terminal. The control functions are selected and performed by the EDC module. Both the Sender and Receiver terminals have eight modes of operation and are advanced through these modes sequentially by the logic of the EDC modules in the following order: (See Figures 4 and 5 for logic diagrams describing the operation of the Sender and Receiver.)

Sender Modes:

SR (Sender Ready character sent)

BN (Block Number character sent)

BK (Block – 80 characters of data from the input tape are sent. The 80 characters are counted mechanically in the forward direction and in the reverse direction by a special gear on the reader. A contact associated with this gear determines the end of block)

EOB (End-of-Block character is sent)

CK1 (Horizontal Parity – Check character #1 is sent)

CK2 (Spiral Parity – Check character #2 is sent)

R1 (Tape is reversed 80 characters)

R2 (Tape is reversed 80 characters)

As will be explained below, the R1 and R2 modes are used only when an error occurs. Otherwise, the Sender resets itself to the BN mode following CK2.

Receiver Modes:

SR (Sender Ready – detects SR character)

BN (Block Number – detects incoming BN and compares it with Receiver generated BN)

BK (Block – data from input tape is punched and check characters are generated)

EOB (End-of-Block character received from sender is checked and if incorrect, an error is recorded)

CK1 (Check character #1 locally generated is compared with the incoming check character #1)

CK2 (Check character #2 locally generated is compared with the incoming check character #2)

BU (Back-up; when error occurs tape is backed up 80 characters)

DEL (Delete – 80 all mark characters overpunch the errored block)

2.1 CONTROL CHARACTERS

The Sender EDC module generates control characters. These are fixed characters and cannot be changed. (See Figure 6) In addition, it takes signals from the second set of read heads (verify contacts) of the DX Reader and generates two check characters for error detection.

The Receiver EDC module controls the punch and back-up mechanism and programs the error detection procedure. It checks the validity of the control characters received from the Sender and also checks for block synchronization. It generates two check characters derived from the photo reader (associated with the punch) outputs. These two check characters are then compared with the two transmitted check characters – any discrepancy means an error has been detected.

The control characters are internal to the system and do not appear in the tape. Some have been specially chosen to differ from standard codes.

2.1.1 Sender Ready (SR) character levels 1, 5, 6, 7 marking. This character is sent by the Sender when it is ready to start transmission. The Sender continues to send SR's at a rate of 25 per second until it detects reverse channel.

2.1.2 Block Numbers (BN):

BN1, levels 1, 3, 6, 8 marking
BN2, levels 2, 4, 5, 7 marking
BN3, levels 1, 2, 7, 8 marking

A BN is transmitted immediately prior to each 80-character block. The Receiver advances a number for each block successfully received. The progression BN1, BN2, BN3, BN1, BN2, BN3, BN1, etc., is followed. When the input tape is backed-up at the Sender for rereading, the BN is correspondingly lowered. The Block Numbers are used to maintain synchronization between the Sender and the Receiver. The Receiver looks at the transmitted block number and compares it to the Block number it expects to receive. If there is no agreement, an error

is recorded with various responses by each terminal as explained below.

2.1.3 End-of-Block (EOB) character levels 2, 3, 4, 5, 6, 7, 8 marking. The EOB is transmitted after each 80-character block. If the EOB is not detected by the Receiver, an error is recorded requiring an error correction sequence.

2.2 CHECK CHARACTERS

In addition to the above fixed control characters, two parity or check characters are generated by the Sender and by the Receiver. These two check characters are derived from each 80-character block transmitted from the input tape when the terminals are in the Block mode. (See Figures 7 and 8)

The DX Reader at the Sender has two sets of eight code reading contacts. The first set of contacts that the tape sees as it moves in the forward direction is used to present the data in the tape to the transmitter distributor to be serialized and then transmitted. The second set of contacts, called the verify contacts are spaced one character past the first set of contacts and reads the tape a second time. It is from this second reading that the parity or check characters are derived. The check characters are transmitted at the end of each 80-character block of data. As stated previously, the 80 characters are counted mechanically by the Reader.

At the Receiver, the product tape is read by a photo verifier one character after it has been punched. Each of the 8 data levels and the feed level of the punch has a photo verifier cell which senses a hole that has been punched. The location of the photo verifier is one hole displaced from the punching position. After a character has been punched, the tape feeds and the character just punched will come in position to be read by the photo verifiers. The photo verifier output is used to generate (to the Receiver EDC unit) two parity or check characters.

At the Receiver, the check characters from the Sender are compared with those generated by the Receiver in order to check a given block of 80 data characters for errors. Since the check characters are developed by independent reading devices (one at the Sender and one at the Receiver), the error detection extends from tape to tape.

The parity used by the system is odd block length parity. Check Character 1 (CK1) is derived from a horizontal parity check of an 80-character block of data. Each level of CK1 is derived by summing the marks in the appropriate level of each of the 80 characters in a block. If the sum of the marks for a level is an even number, that level will be transmitted as a mark in CK1. If the sum of the marks for a level is an odd number, that level will be transmitted as a space in CK1. (See Figure 7)

Check Character 2, CK2, is derived from a spiral check of the 80-character block. Each level of CK2 is derived by summing the number of mark bits that occur along a spiral pattern in the block of 80 characters. An even number of marking bits will produce a mark for the check character level. An odd number of marking bits will produce a space for the check character level. Figure 8 provides a means to determine which level of each character is used to derive a specific check character level (also, see Figure 7 for an abbreviated display of this method). The lower section of Figure 8 shows the 80-character block. The upper section of the chart indicates which level of each character is to be used, the particular line being chosen to correspond to the check character level being generated. As an example, if the bit for the 4th level of CK2 is being generated, the level line begins with a 4. Read down the chart to see which characters will have the 4th level used in the sum. The 4th level will be used from characters 1, 9, 17, 25, etc. Similarly the 5th level of characters 2, 10, 18, 26, etc., will be used, the 6th level of characters 3, 11, 19, 27, etc., will be used and so on.

3. ON-LINE SIGNAL CHARACTERISTICS

A 10-bit start-stop code is used for all transmission. The desired tape level (5, 6, 7 or 8) at which the customer desires to operate is selectable on the Sender and Receiver via Level Selector knobs located in the bottom of each cabinet. When reading 7-level tape, the 8th level is sent as a mark; when reading 6-level tape, the 7th and 8th levels are marks; when reading 5-level tape, the 7th and 8th levels are sent as marks and the 1st level is sent as a space.

Serial data is transmitted from Sender to Receiver and reverse channel is transmitted from Receiver to Sender.

Using an 80-character block for proper EDC operation, the system round trip transmission time, including data sets (data propagation time to Receiver plus reverse channel signal back to Sender) must be less than listed below:

Operating Speed	Max. Round Trip Delay
1050 WPM	772 milliseconds
1200 WPM	674 milliseconds

This requirement is necessary to prevent the sender from being more than two blocks ahead when it receives notification of an error since the reader backs up only two blocks. Hence, system problems may be encountered on transmission systems with abnormally large over-all delay, such as via satellite. Proper operation can be assured, however, on facilities within the U.S. and Canada.

Noisy or sub-standard transmission facilities will not necessarily cause an increase in the undetected error rate, but will probably cause the transmission efficiency or thruput to go down due to the increased number of reruns. The timing and distortion tolerances for Type 4 terminals are:

Signal Speeds	Bit Rate Tolerance	Character Rate Tolerance
1050 WPM	.952 ± 0.5% MS	9.52 ± 5.0%
1200 WPM	.833 ± 0.5% MS	8.33 ± 5.0%

4. DETAILED SYSTEM OPERATIONAL PROCEDURES

The DATASPEED Type 4 System can be used with DATA-PHONE®service or two wire, half duplex, point-to-point private line service. The appropriate Bell System Data Communications Technical Reference should be consulted for information on a specific data set.

On DATA-PHONE service, either terminal can initiate a call and the called terminal can be arranged to answer automatically or be manually operated. For data on establishing a call, refer to Figures 9 through 12. Point-to-point private line operation will be similar except that dialing, setup time and ringing will not occur.

The reverse channel is used as a control link from the Receiver to the Sender. Reverse channel can be either "ON" or "OFF." Each state is used to notify the Sender to take certain actions such as, "begin transmission," "retransmit" or "resynchronize." The Receiver turns off reverse channel when it detects an error. This notifies the Sender that an error has been detected and it advances into its error correction mode in order to retransmit the errored block.

4.1 EDC – Without Error (See Figure 13)

The Sender sends SR characters indicating that it is ready to send. As long as reverse channel is off, the Sender terminal will transmit an SR character every 40 milliseconds. When the Receiver recognizes the SR character, it will turn on the reverse channel to indicate that it is ready to receive.

When the Sender detects reverse channel "ON," it sends a BN followed by an 80-character block. The Sender then sends the EOB character and checks to see if reverse channel is still "ON." If reverse channel is "ON" the Sender then sends CK1 and CK2 followed by the next higher BN and the next 80-character block.

After detecting SR's the Receiver turns on reverse channel and waits until it receives a non-SR character. The first non-SR character will be a BN. After receiving a proper BN, the Receiver punches the 80-character block, then stops punching and checks for a valid EOB.

The Receiver then checks the received CK1 and CK2 with those it generates from the product tape to determine if an error has occurred. If no error is detected, the Receiver then checks the next BN, punches the next block and continues the procedure of punching and checking as described.

4.2 EDC – WITH TEXT ERROR, INVALID BN, OR INVALID EOB (See Figure 14)

If an error occurs in transmission, the CK1 and/or CK2 characters generated by the Sender may not be the same as those generated by the Receiver or the BN or EOB may be invalid. The Receiver EDC module will detect this difference. If any one of the three characters CK1, CK2 or EOB is in error or if the BN is invalid, the Receiver turns off reverse channel (after punching the errored block) and goes into an error correcting mode. All incoming data is ignored and the tape is backed up 80 characters through the punch block. The errored block is then overpunched with the delete character (all marks). The Receiver then waits for an SR and upon its receipt, transmission will proceed as described above. The BN that the Receiver will be looking for is the one for the errored block, i.e., the Receiver will be looking for a retransmission of the errored block.

The Sender detects reverse channel "OFF" after it has transmitted the block following the errored block. This occurs because the Sender samples reverse channel when it sends EOB for the errored block and before the Receiver has turned off reverse channel. It, therefore, does not detect reverse channel "OFF" until after it has transmitted EOB of the block that follows the errored block (in cases of

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text error, invalid BN and invalid EOB). When reverse channel is detected "OFF" the Sender will go into its error correction mode. It puts "mark hold" (steady mark) on the line and the reader backs the tape up 2 blocks (160 characters). The BN is decreased by two numbers. When the reader back-up is complete, the errored block is in a position for rereading. The Sender and Receiver BN should still be synchronized. The Sender then starts sending SR characters. The receiving terminal recognizes the SR's and turns reverse channel "ON." The Sender detects reverse channel "ON," sends the BN, and retransmits the errored block. It will continue to transmit the data in blocks of 80 characters correcting any errors that occur by backing up the tape and retransmitting the errored block. After 3 unsuccessful tries to transmit a block the Sender stops transmission, returns to the beginning of the errored block, and goes into an alarm condition.

When receiving 5-level data a problem arises from the fact that a delete character corresponds to a "Letters" character of the 5-level code. Thus, if the last correct block received prior to an errored block contains a "Figs" character, that "Figs" character would be superseded by the overpunching (delete) of the errored block. When that tape is subsequently read the delete characters would be interpreted as "Letters" and would nullify the correctly received "Figs" that appears in the block preceding the errored block. To remedy this situation, the Receiver stores the "Figures" command if it is present before a delete, and an additional "Figures" character is added to the tape after the errored block is overpunched with deletes and before the next block is punched.

4.3 BLOCK NUMBER SYNCHRONIZATION

In normal BN operation the Sender advances one BN after each block sent. Similarly the Receiver advances one BN after each block that is successfully punched. In normal operation without errors these BN's will always agree and transmission will remain in synchronism. However, at the beginning of a data call, there is a possibility that the BN's will be out of "SYNC:"

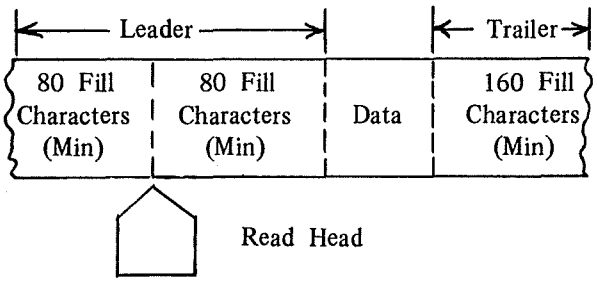
	Received BN		
Expected BN	Correct BN	BN Low	BN High
BN1	BN1	BN3	BN2
BN2	BN2	BN1	BN3
BN3	BN3	BN2	BN1

Notice that the block numbers (BN) have no numerical value. They are referred to as 1, 2, or 3 for convenience only. They are actually fixed characters whose bit configurations were arbitrarily chosen. Therefore, BN3 can be a block number low condition relative to BN1 or BN1 can be a block number high condition relative to BN3 - - this is so because of their sequence of appearance in the system logic: BN1, BN2, BN3, BN1, BN2, BN3, BN1, etc.

If the received BN is low, the Receiver interprets this to mean that the data being sent has already been received and punched. Thus, as shown in Figure 15, it will leave reverse channel "ON" and ignore all incoming data. It does nothing until the next (BN) is received. The Sender will have received no indication that the first block it sent was ignored by the Receiver and will continue into the next block, this time sending the correct BN (the one the Receiver is expecting).

If the received BN is high the Receiver interprets this to mean that some data has been missed. Upon detecting a BN high condition the Receiver immediately turns off reverse channel as shown in Figure 16. The Sender detects the absence of reverse channel when sending the EOB character and backs the tape up two blocks (160 characters) and starts sending again. The BN is decreased by two numbers and so the next BN seen by the Receiver will be the correct one. The Receiver in the meantime punched the block that was preceded by a high BN, recorded the high BN as an error, backed up 80 characters (1 block) and over-punched or deleted that block. It then awaited retransmission of the block which should be preceded by the proper BN since the Sender backed up two blocks.

To allow for BN synchronization, it is required that 160 fill characters (any convenient code pattern) be inserted in the tape preceding the actual data. Further, the tape should be placed in the reader so that 80 or more fill characters precede the data read heads and 80 or more fill characters follow the data read heads:



These fill characters allow for the first transmitted block to be ignored by the Receiver (in case of BN low) or a 160 character pull back by the Sender after the first block of data has been transmitted (in case of BN high). If the reader tape take up is being used, there should be a minimum of 5 ft. of leader for tape threading. A trailer of 160 fill characters is required.

4.4 EDC – INCOMPLETE BLOCK (See Figure 17)

If the transmission of data ceases or is interrupted while a block is being punched, the following corrective actions occur:

4.4.1 Transmission break – with a break in transmission, carrier is lost. Upon loss of carrier, the Receiver immediately turns off reverse channel. The punch completes the 80-character block with meaningless characters and the Receiver goes into its error correction mode as explained above. When the Sender reaches the end of the block it is sending when carrier is lost, it checks for reverse channel. Finding reverse channel "OFF," the Sender backs up two blocks and begins sending SR's. When transmission is restored, the Receiver will detect these SR's and transmission will proceed.

It should be noted that it is possible that a break in transmission could be accompanied by a peculiar noise condition that could be interpreted as reverse channel by the Sender. In such a case, the Sender would proceed to send the next block. The Sender would then detect reverse channel "OFF" and back-up two blocks. The retransmitted block would represent a BN high condition and a resynchronization would occur. If three successive noise conditions were interpreted erroneously as reverse channel "ON," the retransmitted block would represent a BN low condition which would be ignored so three blocks of data would be lost.

4.4.2 Tape Out – When the Sender reaches the end of its message, transmission stops due to lack of data to read. The carrier remains on line but data will not be sent. This condition forces the Receiver to finish the 80-character block with meaningless characters. Since there will be no check characters sent, there is no means for checking the validity of what was punched. Thus, the block is deleted and the Receiver waits for retransmission. A maximum of 79 characters can be lost as a result of a situation whereby the number of characters at the end of an input tape is insufficient to make up a complete 80-character block.

Notice also that even if the final block is complete (80-characters), if it is errored the Sender will have no means for being notified of the error. This is so because the Sender detects reverse channel off at the end of the block following the errored block . . . in this case there would be no block following the errored block. Therefore, while the Receiver would have deleted the errored block, it would not be retransmitted by the Sender.

To avoid the loss of data at the end of an input tape it is necessary to include 160 fill characters of trailer. These characters will "fill out" any incomplete block and also provide an additional 80-character block to facilitate error correction in the case where an error is detected in the final transmitted block that contains meaningful data.

4.5 NON-EDC OPERATION (See Figure 18)

The Sender and Receiver are capable of operating with the error detection and correction feature disabled. NON-EDC operation is selected by pressing the "NON-EDC" push button on the respective control panels. When the button is pressed, the terminals can operate with any "NON-EDC" terminal of compatible speed, including Type 2 DATASPEED terminals.

At the Receiver, all incoming information will be punched, regardless of content. If the remote Sender is an EDC Sender and EDC control and check characters are being transmitted, these control and check characters will be punched. This feature can be used to check whether a Sender is generating and sending the correct BN's, EOB, and check characters.

In the NON-EDC mode, the Sender will send the input tape without pause. When reverse channel is detected, transmission will start and continue until reverse channel is turned off or the reader runs out of tape. If the Sender is transmitting to a Type 2 terminal which has no reverse channel feature, a switch on the Sender's EDC module can be turned "ON" to simulate reverse channel. Without reverse channel, the remote terminal will be unable to control the start-up and stopping of the Sender.

4.6 STOPPING TRANSMISSION

4.6.1 Sender

The Sender Terminal can be stopped in three different ways: It can be automatically stopped by the remote terminal, it can be stopped manually by the action of the operator at the Sender terminal; or

it will automatically stop if alarms are present in the Sender terminal.

The remote terminal can stop the Sender by removing reverse channel in either the EDC or NON-EDC mode. In the EDC mode, it will back-up and retransmit as explained above. In the NON-EDC mode, the Sender will stop transmission as soon as reverse channel is detected "OFF." With reverse channel "OFF," the "Receiver Stopped" indicator light on the Sender front panel will light indicating the operator at the remote terminal is requesting voice coordination with the sending operator.

The Sender attendant can manually stop the Sender in two ways. The primary means of manually stopping the Sender is to depress the "STOP/ALARM-RESET" button. This essentially inserts an error into the 80-character block being transmitted and inhibits the reverse channel signal. The button will light up to indicate this fact. In the EDC mode, the Sender will finish out the block, back-up 80-characters, reset its logic to the SR mode and stop. In the NON-EDC mode the Sender stops immediately. At this point, the attendant may go into the talk mode, drop the call or restart transmission by again pressing the "STOP/ALARM-RESET" button.

The second means of stopping the Sender manually is to place the data set in the "TALK" mode directly. The EDC and NON-EDC mode responses are the same as in the preceding paragraph. Data communication can be resumed by returning the data set to the "DATA" mode.

The Sender will stop automatically if an alarm condition occurs in the terminal. The two alarm conditions recognized are tape out and no tape motion detected. In both cases the response is the same. With EDC operation, the Sender continues to the end of the block, resets itself to the SR mode and then stops. In the NON-EDC mode, the Sender will stop as soon as tape out or no tape motion is detected. No back-up occurs in either EDC or NON-EDC operation. The "STOP/ALARM-RESET" button will light. To start again the operator clears the trouble and presses the "STOP/ALARM-RESET" button.

4.6.2 Receiver NON-EDC

The reception of data can be stopped three different ways:

4.6.2.1 Press the "STOP/ALARM-RESET" button. This will stop the punch immediately and will shut off reverse channel. To restart transmission, press the "STOP/ALARM-RESET" button again. Notice that data will be lost, since the Sender does not stop simultaneously with the Receiver and does not automatically back-up for retransmission in the NON–EDC mode.

4.6.2.2 Press the "MANUAL" button. This takes the Receiver out of the NON-EDC mode and places it in the EDC mode. If the remote Sender is not sending EDC information, transmission will stop.

4.6.2.3 Press the "TALK" button on the data set. This will instantly stop the punch and will shut off reverse channel. Transmission is re-established by pressing the "DATA" button on the data set.

4.6.3 Receiver EDC

There are three different ways to stop transmission in the EDC mode at the Receiver: automatically by the remote Sender; manually by the Receiver operator; automatically by any alarm present in the Receiving terminal.

The remote terminal stops the Receiver automatically by stopping data transmission. The Receiver performs its "Transmission Break" sequence explained above under EDC operation. Transmission will not resume until an SR character is detected. An indicating light on the control panel "Sender Stopped" will be lit. This light being on for several seconds indicates that the operator of the remote terminal desires voice coordination with the Receiver operator.

The Receiver operator can manually stop the Receiver in two ways. The primary means of manually stopping the Receiver is to depress the "STOP/ALARM-RESET" button. This essentially inserts an error into the last 80-character block being received and turns off reverse channel. The remainder of the 80-character block will be punched, then backed-up and deleted. When the Sender detects reverse channel "OFF" it will back-up two blocks. At this point the operator can go to the "TALK" mode. Transmission is resumed by again pressing the "STOP/ALARM-RESET" button.

The second means of stopping the Receiver manually is to place the data set in the "TALK" mode directly. Transmission will be stopped instantaneously and reverse channel will be turned off. Data transmission is resumed by returning to the "DATA" mode.

There are two alarm conditions that automatically stop transmission: feed alarm and

back-up alarm. In both instances reverse channel is turned off. The "STOP/ALARM-RESET" button will light to indicate the alarm condition. Operator intervention is required to correct the alarm condition and restart transmission. Restart is accomplished by pressing the "STOP/ALARM-RESET" button.

4.7 INDICATING LAMPS AND CONTROL BUTTONS

4.7.1 Sender (See Figure 19)

Button or Lamp and Function

STOP/ALARM-RESET – (Push-button, Lamp)

Provides for manually interrupting and stopping transmission. It lights when an alarm condition is detected. The terminal logic is reset by depressing the button a second time. (Button is red.)

RECEIVER STOPPED – (Lamp)

Lights an amber color when reverse channel is lost. It is used to notify the Sender attendant that the Receiver attendant desires voice coordination. Since the loss and recovery of reverse channel is a normal part of the EDC operation, the indicator light on for a period of time less than 6 seconds indicates an error correction procedure.

POWER – (Push-button, Lamp)

This button controls the AC power to the terminal. When pushed, AC power is supplied and the button will illuminate (white).

NON-EDC – (Push-button, Lamp)

To select the NON-EDC mode, the operator must depress the NON-EDC button. Both the NON-EDC button and the MANUAL button will be illuminated.

UNATTEND – (Push-button, Lamp)

To select unattended operation, this button is depressed. It is pressed simultaneously with the "NON-EDC" button to obtain automatic answering in the "NON-EDC" mode. The button is illuminated when operated.

MANUAL – (Push-button, Lamp)

To select the manual mode, the attendant depresses this button. Lights when depressed. This button returns the terminal to its normal attended – EDC condition.

AUX MOTOR START – (Push-button, Lamp)

The motors on the tape transport assembly and on the Reader are turned off when there is no call in progress or when there is an alarm present. This button is provided to turn on the motors when desired. It is illuminated when it is depressed.

4.7.2 Receiver (See Figure 20)

Button or Lamp and Function

POWER, FLASH – LOW TAPE – (Push-button, Lamp)

Controls AC power to the terminal and lights (white when power is on). If there is a "low tape" condition of less than 400', this light will flash.

SENDER STOPPED – (Lamp)

This lamp will light an amber color when the sending terminal stops transmitting and carrier is lost.

STOP/ALARM-RESET – (Push-button, Lamp)

Used to manually start and stop the terminal. In the STOP/ALARM condition it lights red. One press of the button stops the terminal and the next press will restart the terminal. It also lights in response to alarm conditions.

NON-EDC – (Push-button, Lamp)

Disables error detection and correction features. Illuminates when depressed. It is released by depressing the MANUAL, UNATTEND or AUX MOTOR START buttons.

UNATTEND – (Push-button, Lamp)

When depressed allows response to incoming calls automatically. For unattended NON-EDC, depress both buttons simultaneously.

MANUAL – (Push-button, Lamp)

To select the manual mode, the attendant depresses this button. Lights when depressed.

AUX MOTOR START – (Push-button, Lamp)

Used for off-line terminal set up. It energizes the motor for the punch and the tape transport. It lights up when depressed.

BLANK FEED – (Push button)

Feeds out blank tape with only feed holes punched.

ALL FEED – (Push button)

Same as "Blank Feed" except an "All-Mark" character is punched in addition to each feed hole.

4.7.3 Other Sender Switches

Switches are available on the front of the EDC module as shown in Figure 21, to provide for a means of testing the EDC program (SR mode through the R2 mode) and to test the reader. When the "Program Test" switch is thrown to the "ON" position, the EDC program will perform a step at a time. It is advanced a step at a time through each successive mode by manually depressing a "Program Advance" push button. An indicator lamp for each mode is mounted on the front plate of the EDC module. There are also three indication lamps on the module showing the BN status. These lamps help to isolate any source of trouble by providing a visual picture of the logic scheme.

The "Reader Test" switch provides a means of locally checking the reading efficiency of the two sets of code-reading contacts on the DX Reader. In the "Reader Test" mode the Sender will read and verify data on a character by character basis and a "Reader Test Alarm" lamp indicates any error (discrepancy between what is sensed by the first read head contacts and what is sensed by the second read head contacts).

The Reverse Channel Simulate switches provide means for locally simulating reverse channel for testing and for transmitting to a Type 2 Receiver that is not equipped with reverse channel.

4.7.4 Other Receiver Switches

Located on the EDC module front panel as shown in Figure 22 are the "Program Test" switch, "Punch Test" switch, Level Selector and EDC module Indicating Lights. The Program Test permits manual stepping through of the EDC operation a mode at a time, e.g., SR, BN, etc.

The Punch Test allows each character to be checked. When an error is detected, the punch is stopped on the errored character. The Indicating Lights reflect the status of the EDC program and logic at any given time.

4.8 UNATTENDED OPERATION

4.8.1 Receiver

This permits the Receiver to answer incoming calls automatically. The feature is key, low tape and alarm controlled. To prepare for unattended EDC operation, the "UNATTND" button is depressed. For unattended NON-EDC operation, the NON-EDC and "UNATTND" buttons must be pressed simultaneously. The set will then answer incoming calls automatically and will receive data when the Sender begins transmission. Disconnect will be accomplished 50 seconds after the end of transmission, low tape or an alarm. The Receiver will ignore incoming calls if an alarm or low tape condition exists.

4.8.2 Sender

As with the Receiver, the Sender can answer incoming calls automatically. The feature may be either key controlled only or key/and tape-out alarm controlled.

The operator prepares the Sender for unattended operation by placing tape in the reader and depressing the "UNATTND" button. For unattended NON-EDC operation, the operator must depress the NON-EDC button simultaneously with the "UNATTND" button. The set will then answer incoming calls automatically and will begin transmission when one receiving terminal is ready to accept traffic. Transmission will continue until the end of the tape is reached.

When key/and tape-out alarm controlled, the Sender will answer automatically only when the "UNATTND" button is pushed and there is tape in the reader.

5. SYSTEM ACCESSORIES (See Figure 23)

5.1 VERTICAL PARITY

This accessory enables the EDC system to check the vertical parity of each character in addition to the horizontal and spiral block parity. It does not disable the block parity schemes but adds to them independently to improve the error detection ability of the system.

Level 8 of each character will contain the vertical parity bit. Either even or odd vertical parity may be used. If the transmitted tapes contain vertical parity the inserter accessory is not necessary at the Sender. Otherwise the TP308510 Vertical Parity Inserter may be added to the Sender to generate the proper vertical parity automatically. In all cases the TP308511 Vertical Parity Detector must be added to the Receiver. It checks the parity of each data character and when an error is detected, generates an error indication which is recognized by the EDC to initiate the correction.

Physically, the vertical parity accessory is wired into the basic terminals with the "ODD-EVEN" parity switch appearing on the corresponding distributor front panel. The addition of the vertical parity circuit cards adds the accessory to the equipment.

5.2 DISCRETE CALLING

This accessory is intended as a protection device for an unattended sending terminal. The TP308512 Discrete Calling Generator is applied to the Receiver where it is used to generate a discrete 14 bit code. This code is recognized at the unattended Sender by the TP308513 Discrete Calling Recognizer. This accessory is mounted in the accessory module of each terminal.

In operation the Receiver attendant places the call and the unattended Sender will automatically answer. Before the Sender will send data the proper 14 bit code must be received and recognized. The Receiver attendant sends the code by pressing the "Sender Stopped, Push to Start" button which starts the Discrete Calling Generator. Upon recognition, the Sender will start transmission (SR characters for EDC or data for NON-EDC operation).

5.3 "Y" CABLE

This accessory allows one data set to alternately serve one Sender terminal and one Receiver terminal. The cable plugs into the data set and into the two terminals. The switch is mounted in one of the terminals, requiring a new panel with the mounting hole and lettering for the modes of operation.

In the "Send" mode, the Sender is connected to the data set. In the "Receive" mode the Receiver is connected to the data set. In the "Local" mode the data set is disconnected and the Sender is connected directly to the Receiver. This allows the Type 4 DATASPEED system to be operated locally for troubleshooting, tape duplication, demonstration, and other uses. The "Send/Receive" mode is used when the Discrete Calling accessory is used.

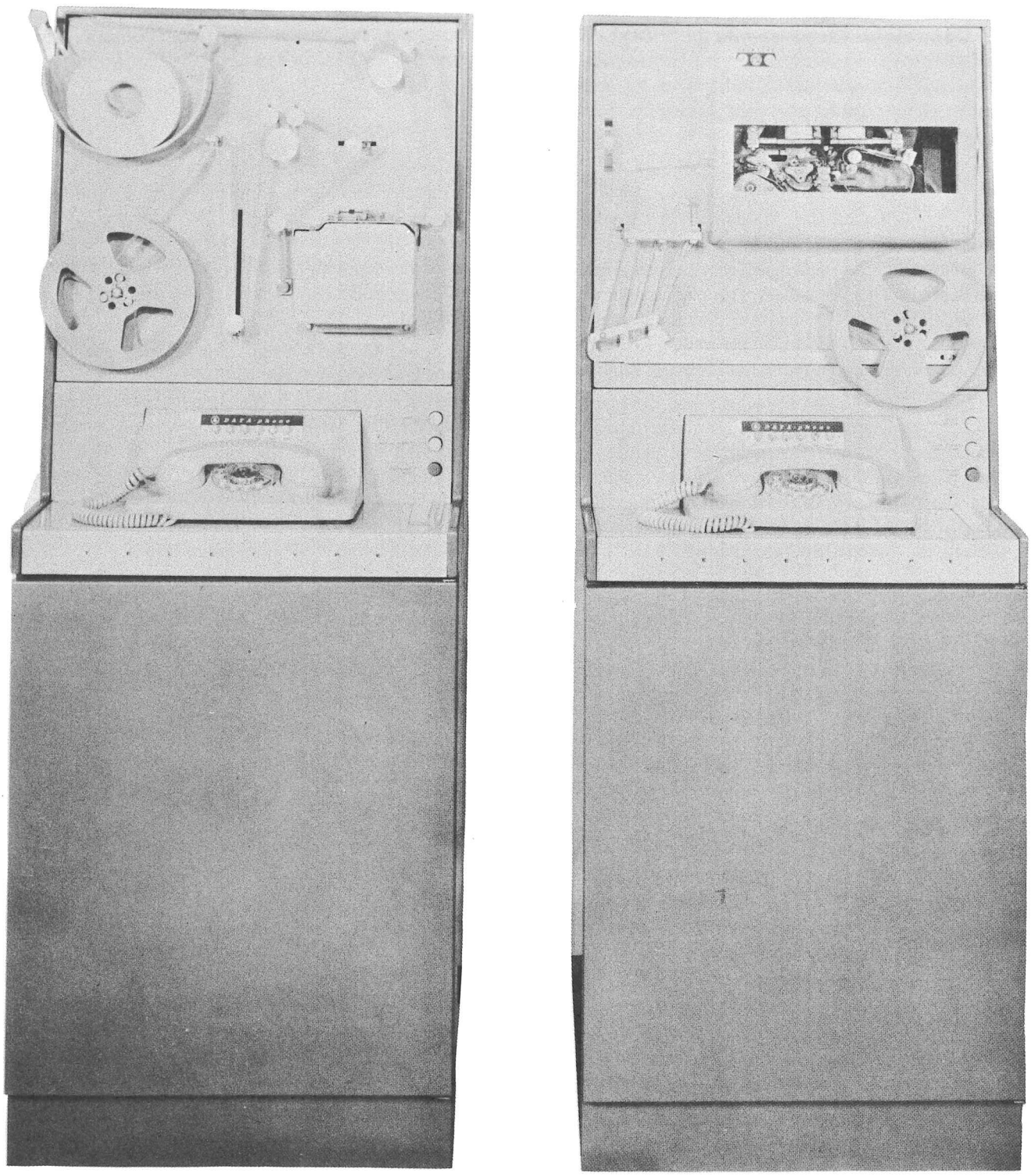
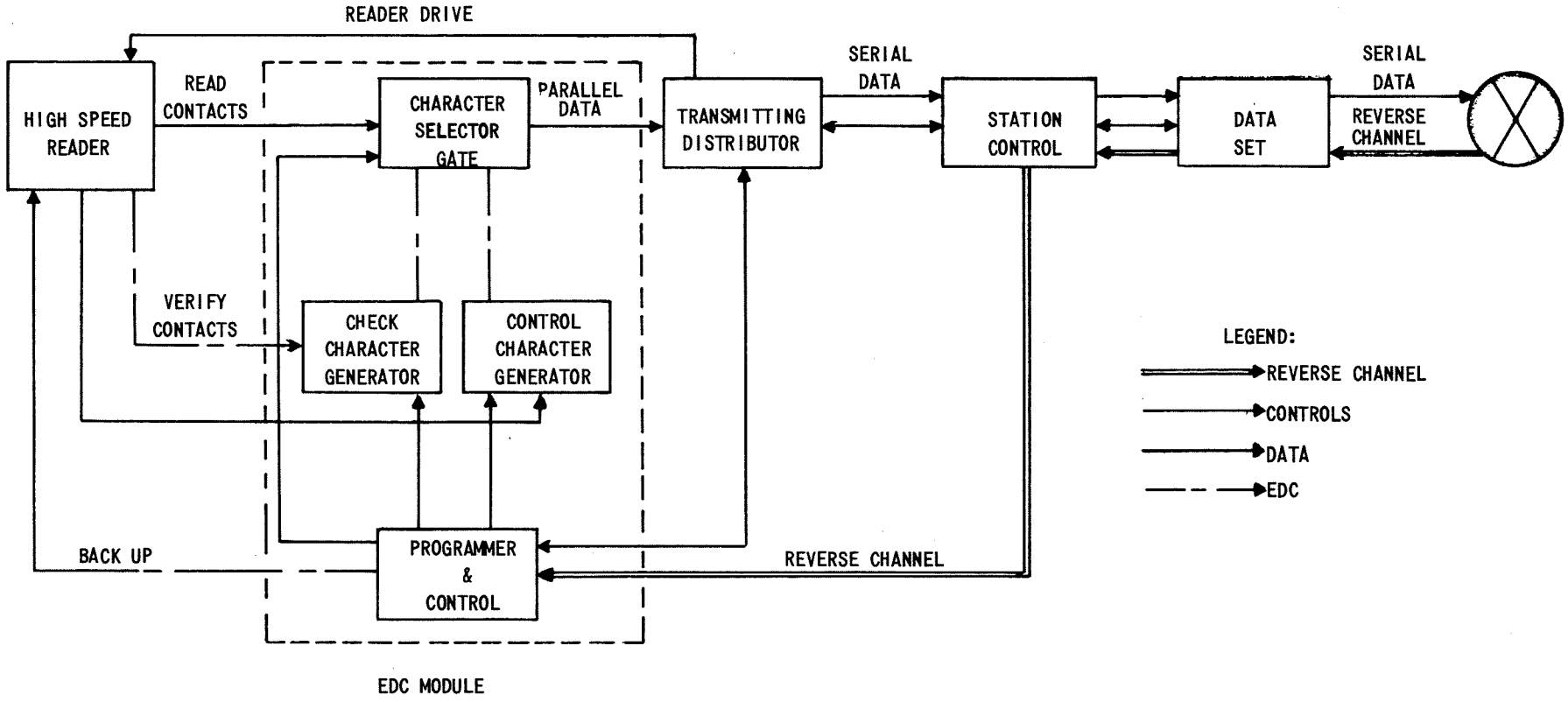


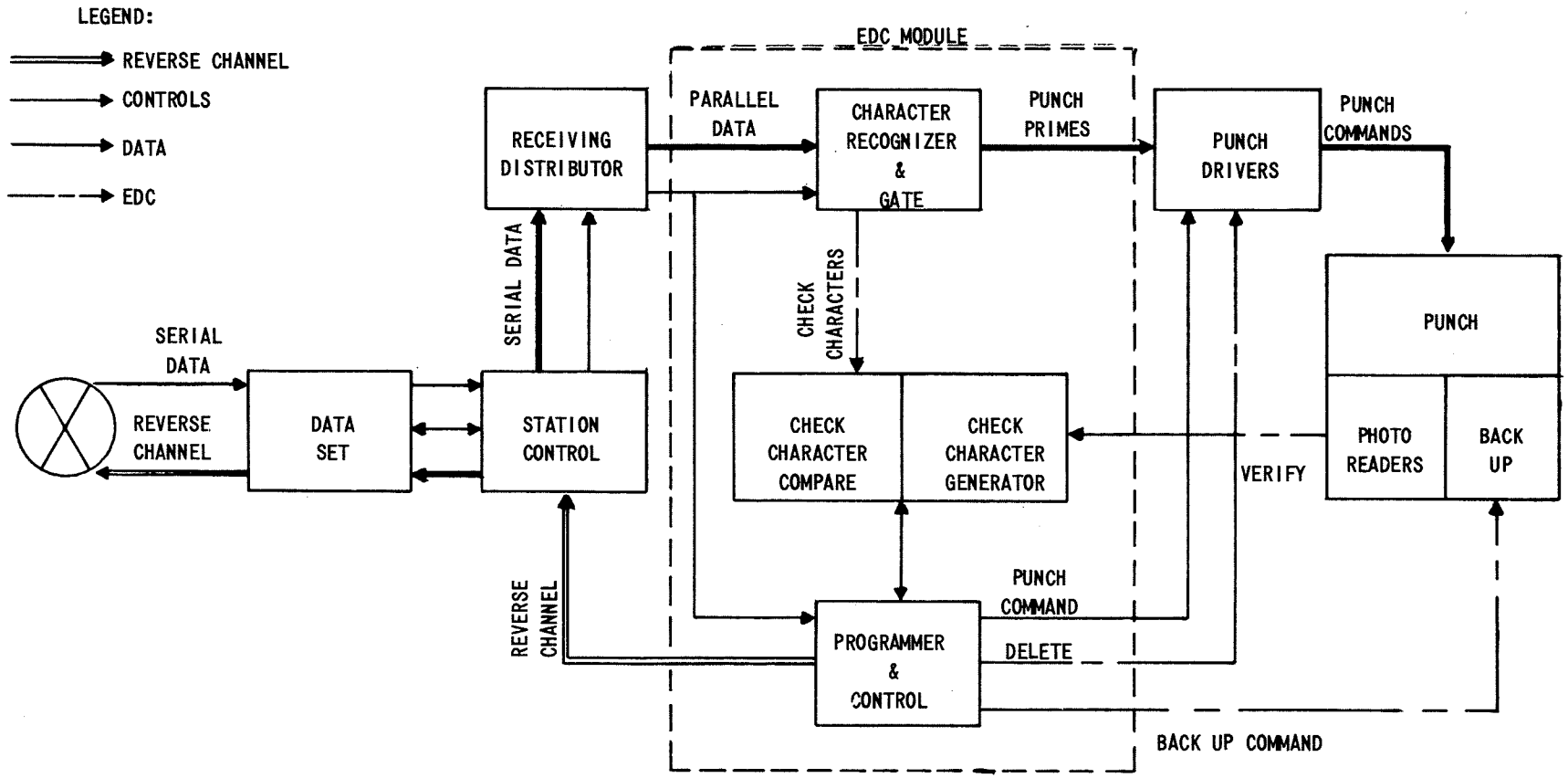
FIGURE 1

DATASPEED TYPE 4 SYSTEM



BLOCK DIAGRAM OF TAPE SENDER

FIGURE 2



BLOCK DIAGRAM OF TAPE RECEIVER

FIGURE 3

FIGURE 4

SENDER LOGIC

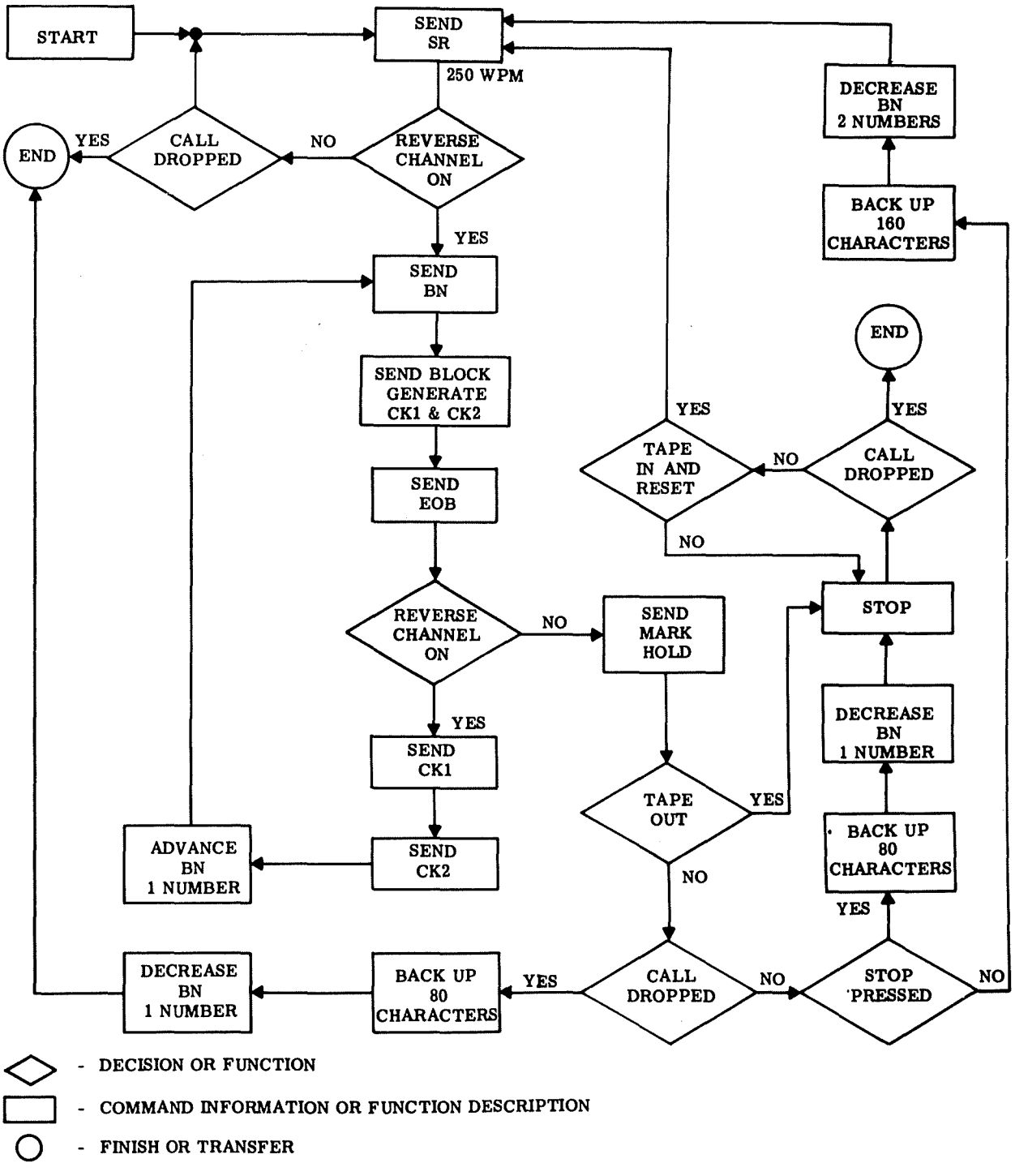
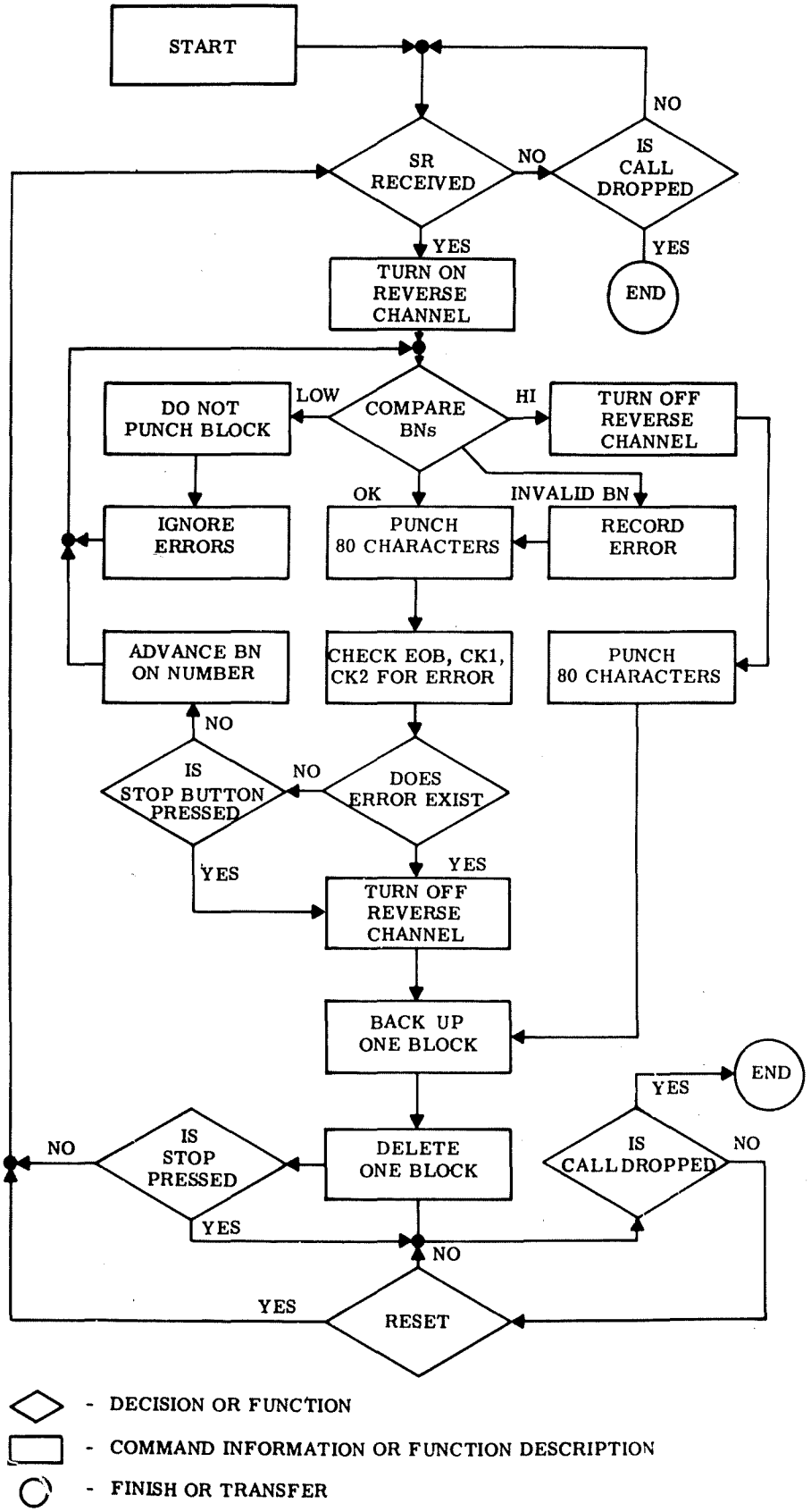


FIGURE 5

RECEIVER LOGIC



CONTROL CHARACTERS

CHARACTER	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	LEVEL 6	LEVEL 7	LEVEL 8
SR	MARK	SPACE	SPACE	SPACE	MARK	MARK	MARK	SPACE
BN1	MARK	SPACE	MARK	SPACE	SPACE	MARK	SPACE	MARK
BN2	SPACE	MARK	SPACE	MARK	MARK	SPACE	MARK	SPACE
BN3	MARK	MARK	SPACE	SPACE	SPACE	SPACE	MARK	MARK
EOB	SPACE	MARK	MARK	MARK	MARK	MARK	MARK	MARK

Mark = Hole in tape
Space = Tape not punched

FIGURE 6

DATA FORMAT

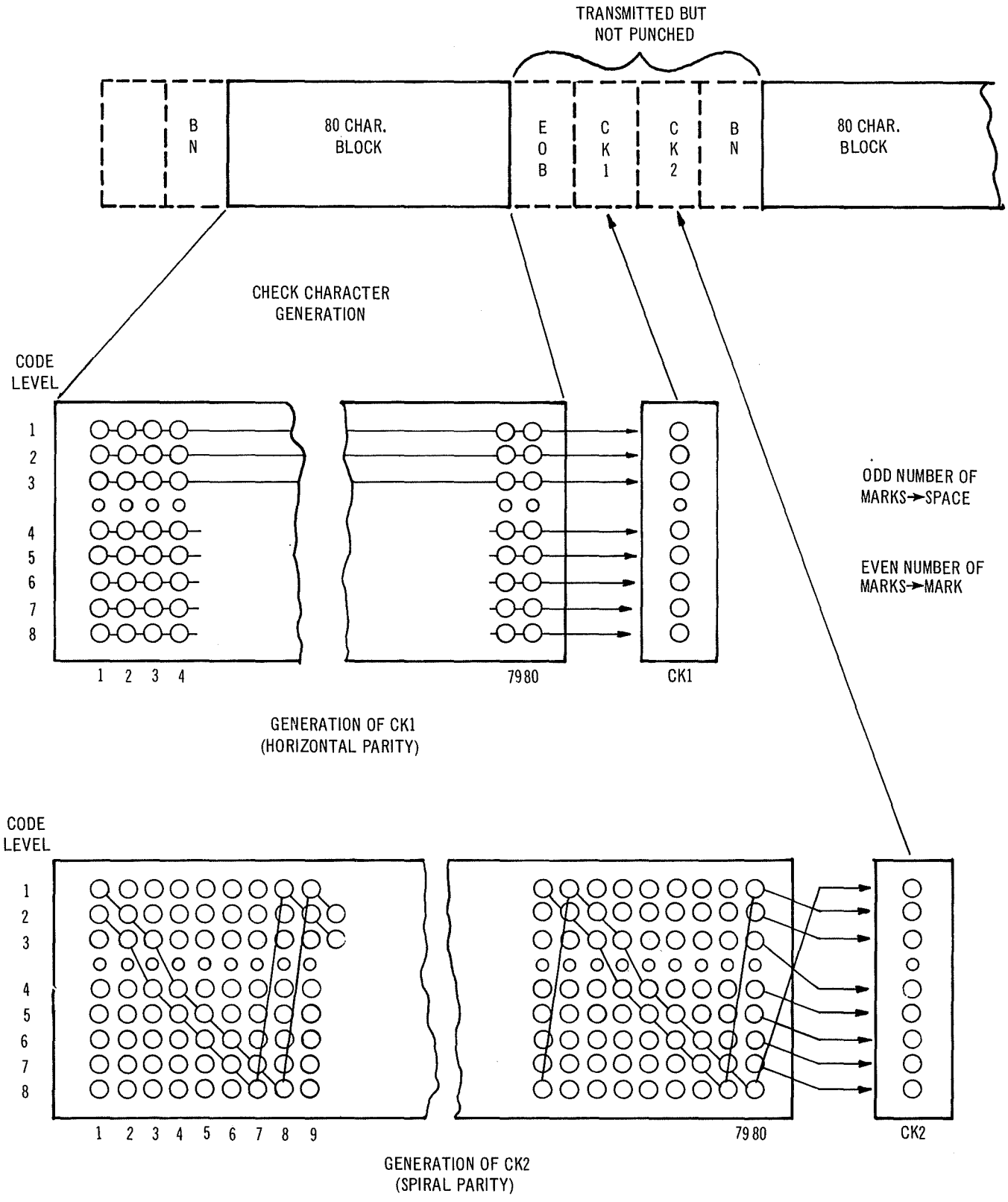


FIGURE 7

CK2 GENERATION

BLOCK CHARACTER LEVEL

CK2 LEVEL (CHECK CHARACTER LEVEL)								
1st LEVEL	1	2	3	4	5	6	7	8
2nd LEVEL	2	3	4	5	6	7	8	1
3rd LEVEL	3	4	5	6	7	8	1	2
4th LEVEL	4	5	6	7	8	1	2	3
5th LEVEL	5	6	7	8	1	2	3	4
6th LEVEL	6	7	8	1	2	3	4	5
7th LEVEL	7	8	1	2	3	4	5	6
8th LEVEL	8	1	2	3	4	5	6	7

CHARACTER NUMBER (80 CHARACTER BLOCK)							
1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64
65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80

FIGURE 8

FIGURE 9

MANUAL CALL SET UP - SENDER ORIGINATES CALL

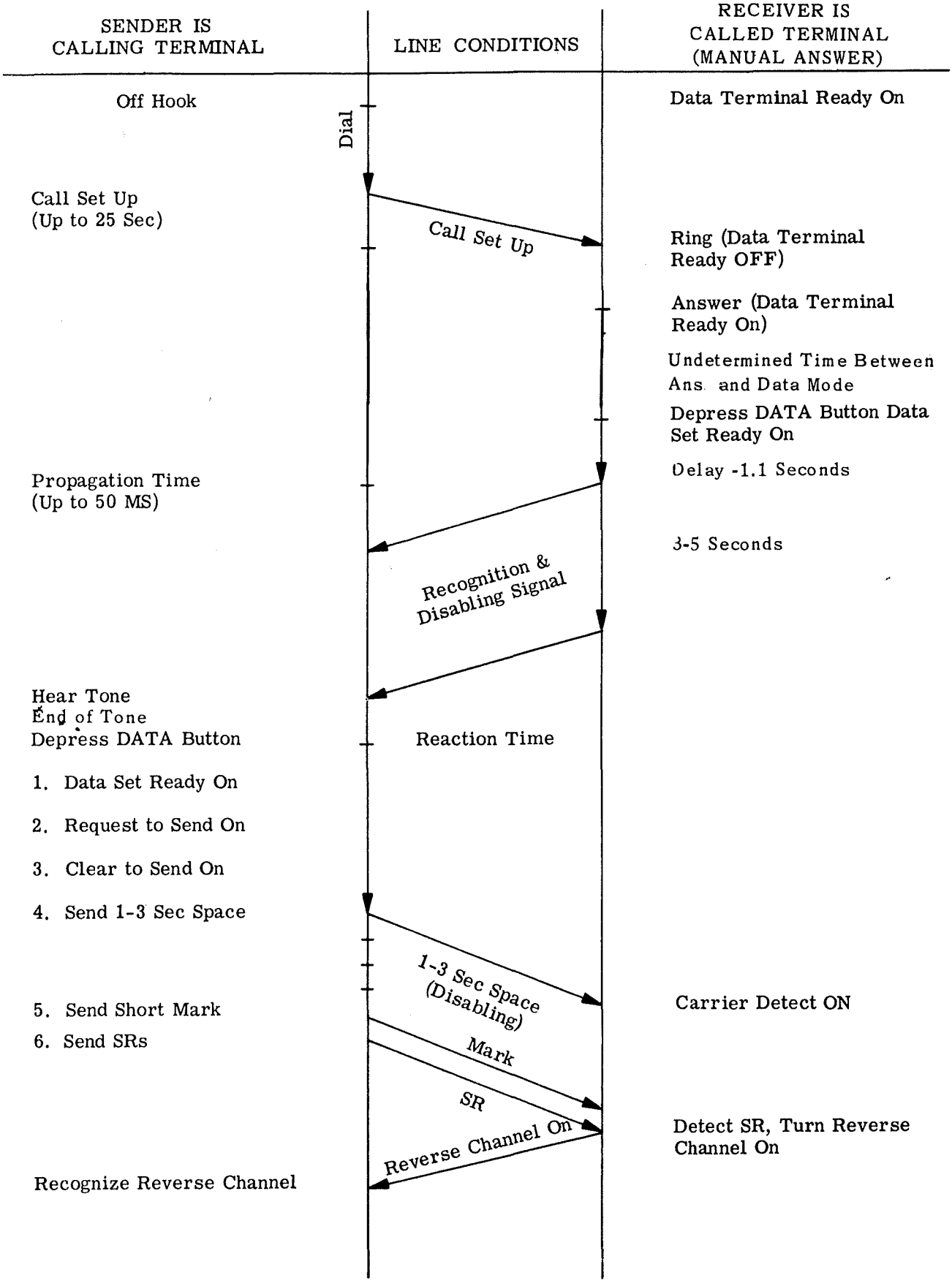


FIGURE 10

MANUAL CALL SET UP - RECEIVER ORIGINATES CALL

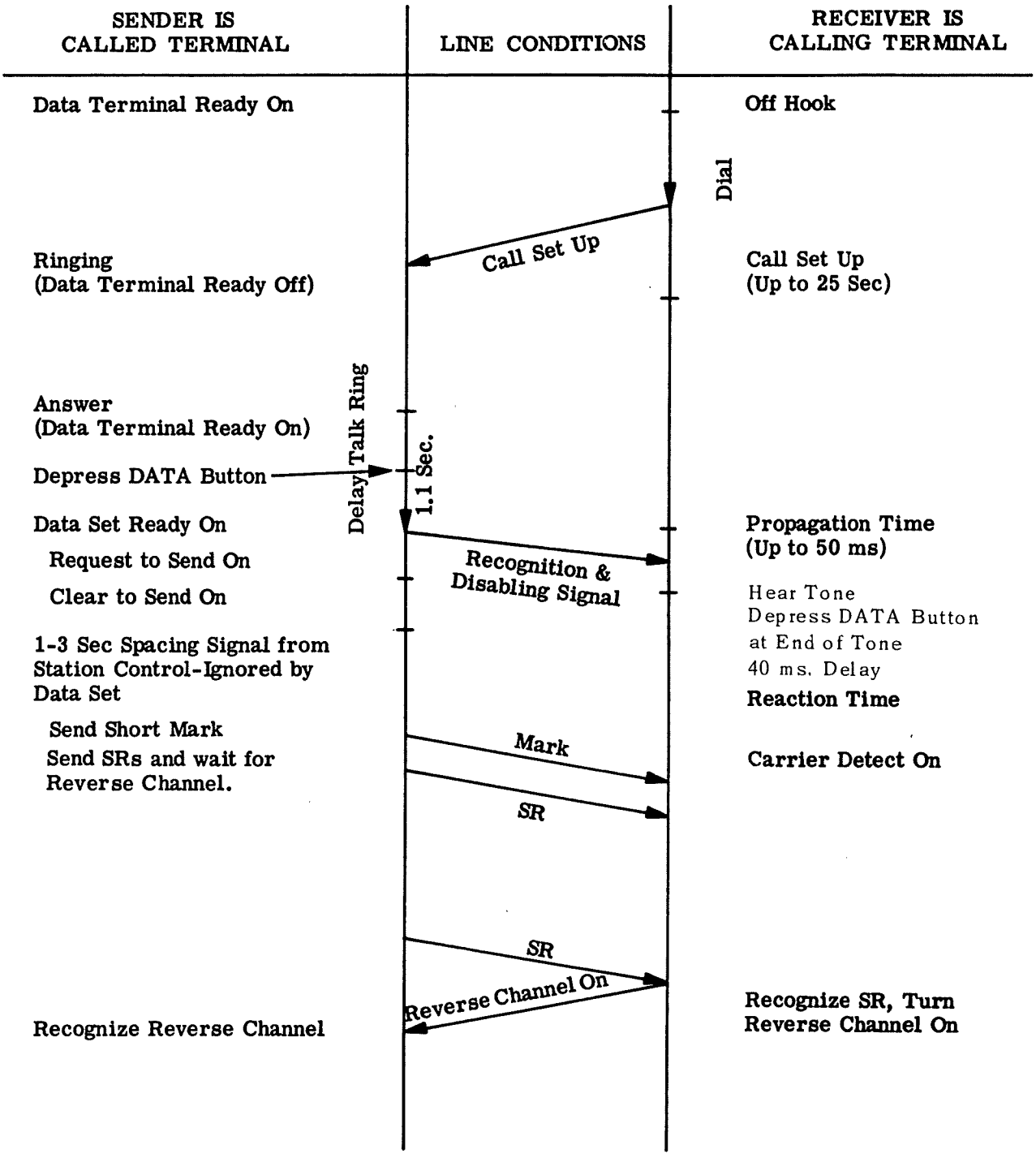


FIGURE 11

CALL SET UP - UNATTENDED RECEIVER

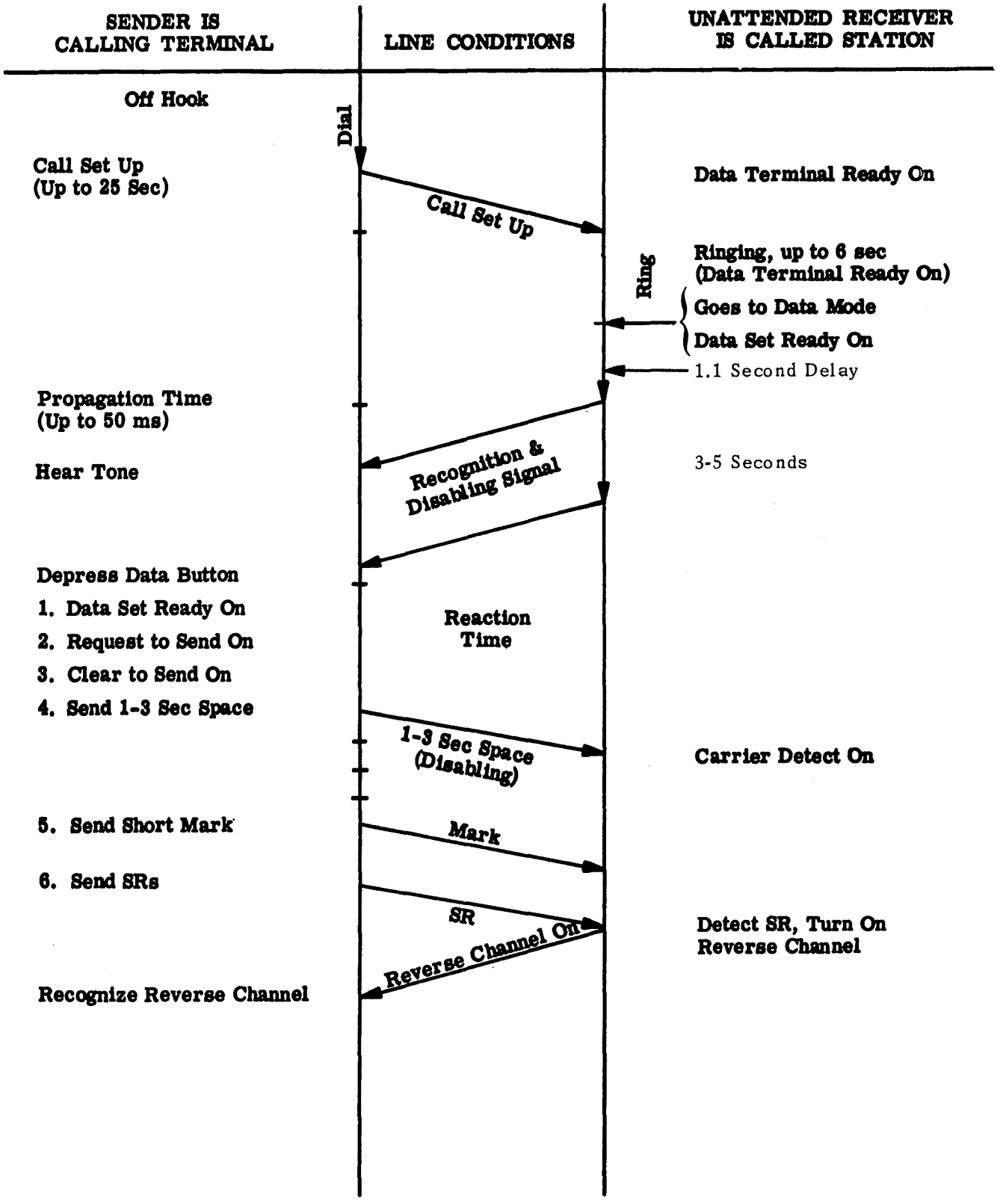


FIGURE 12

CALL SET UP - UNATTENDED SENDER

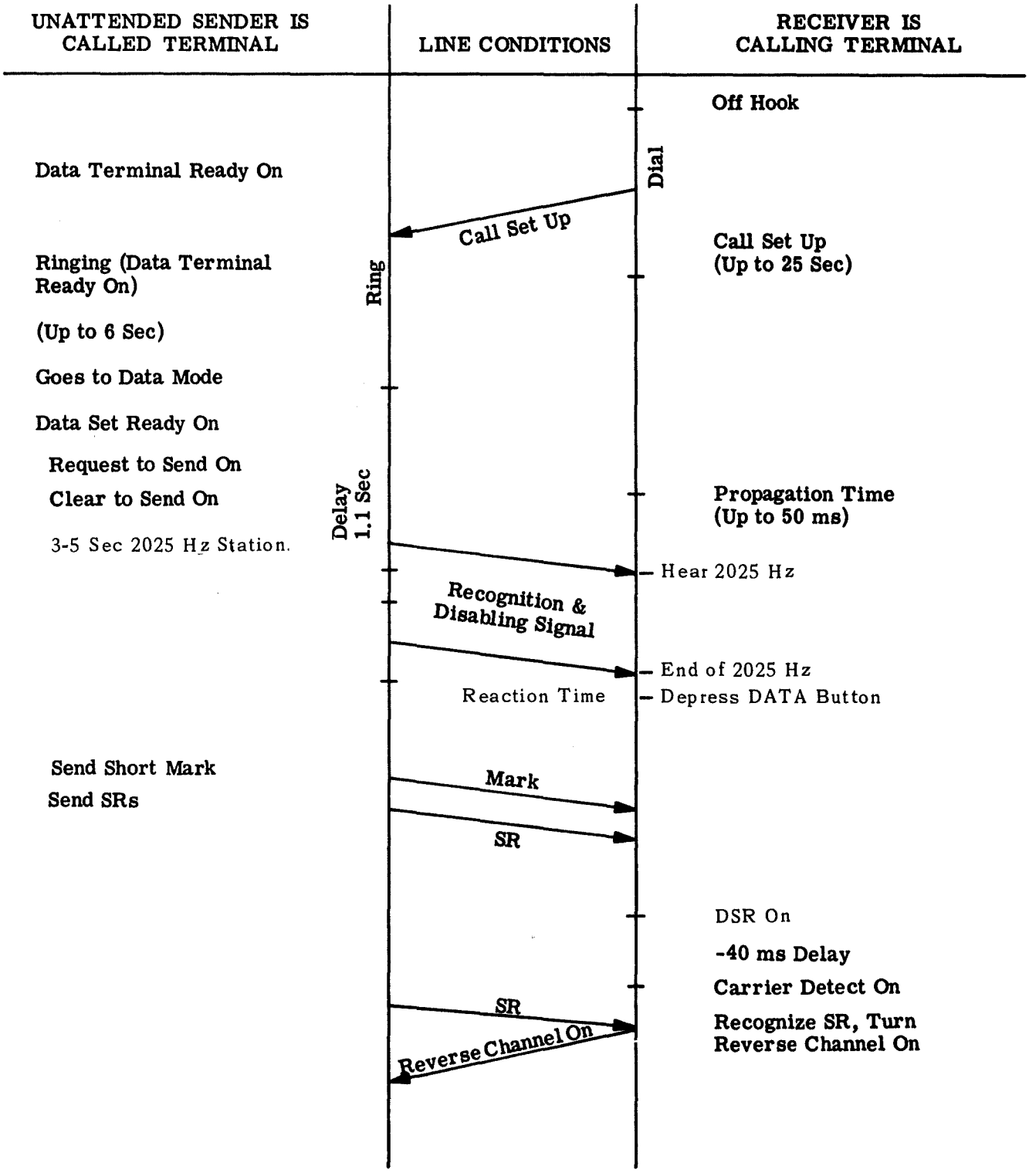


FIGURE 13

EDC - NO DETECTED ERROR TRANSMISSION

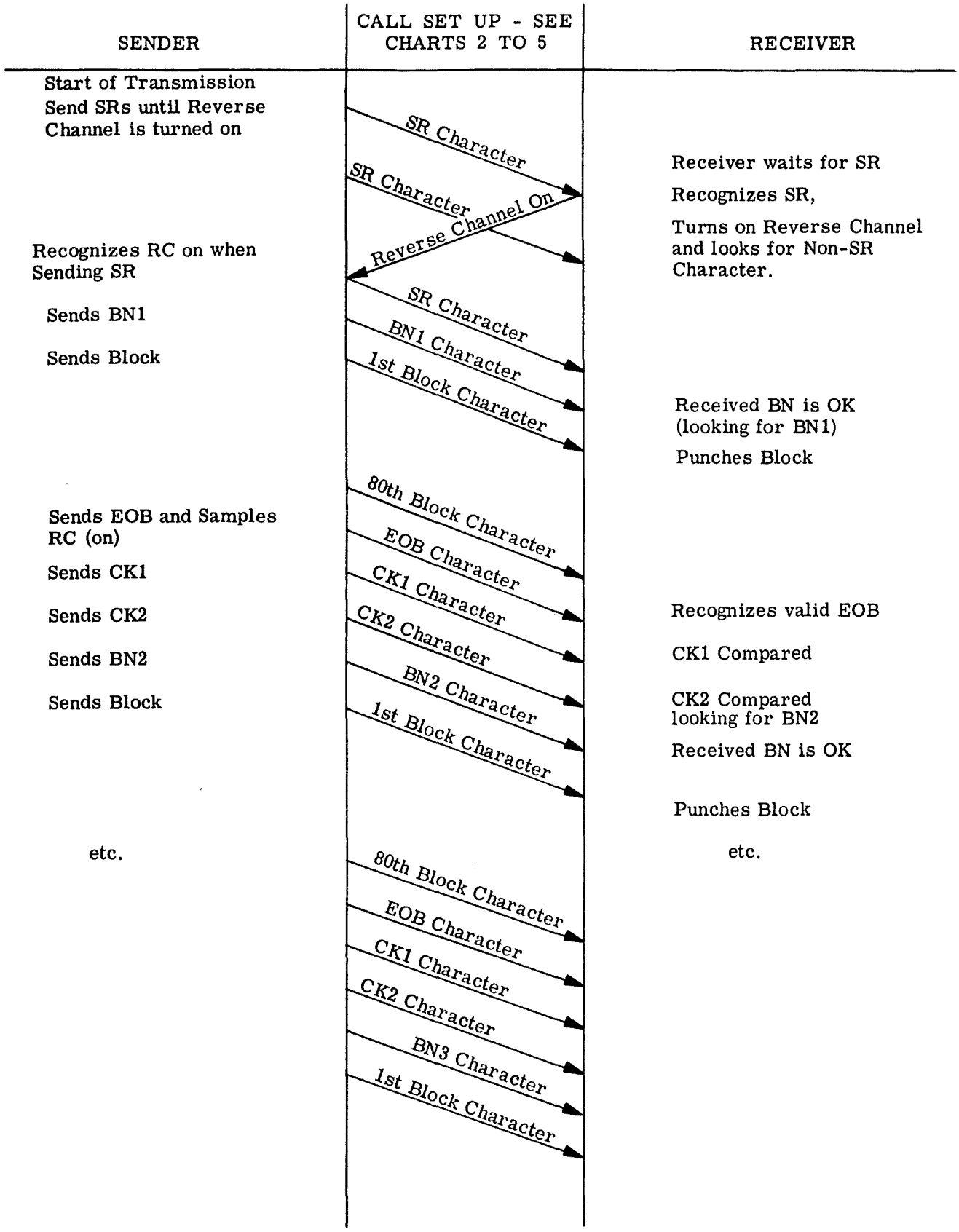


FIGURE 14

TEXT ERROR (INVALID EOB)

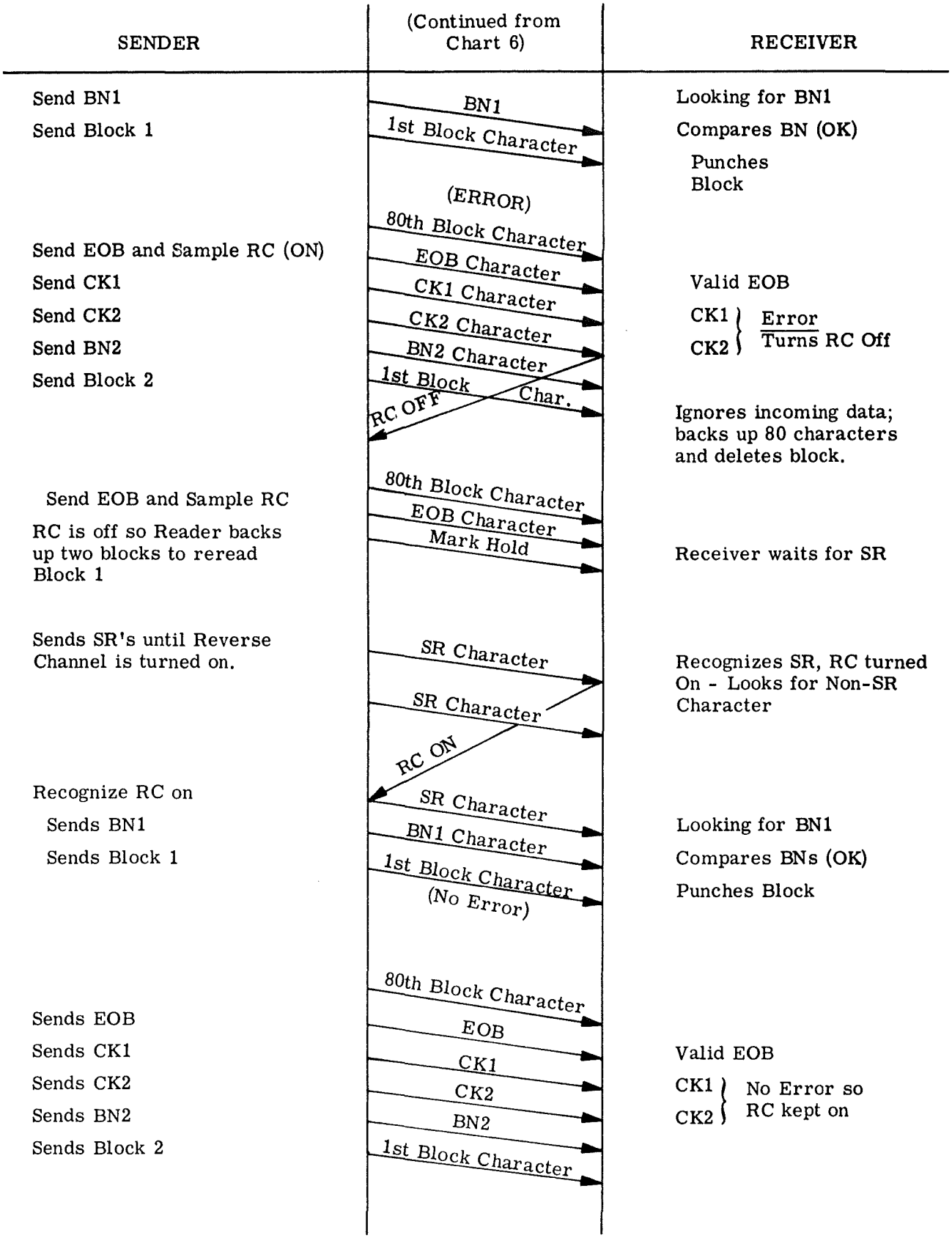


FIGURE 15

BN LOW

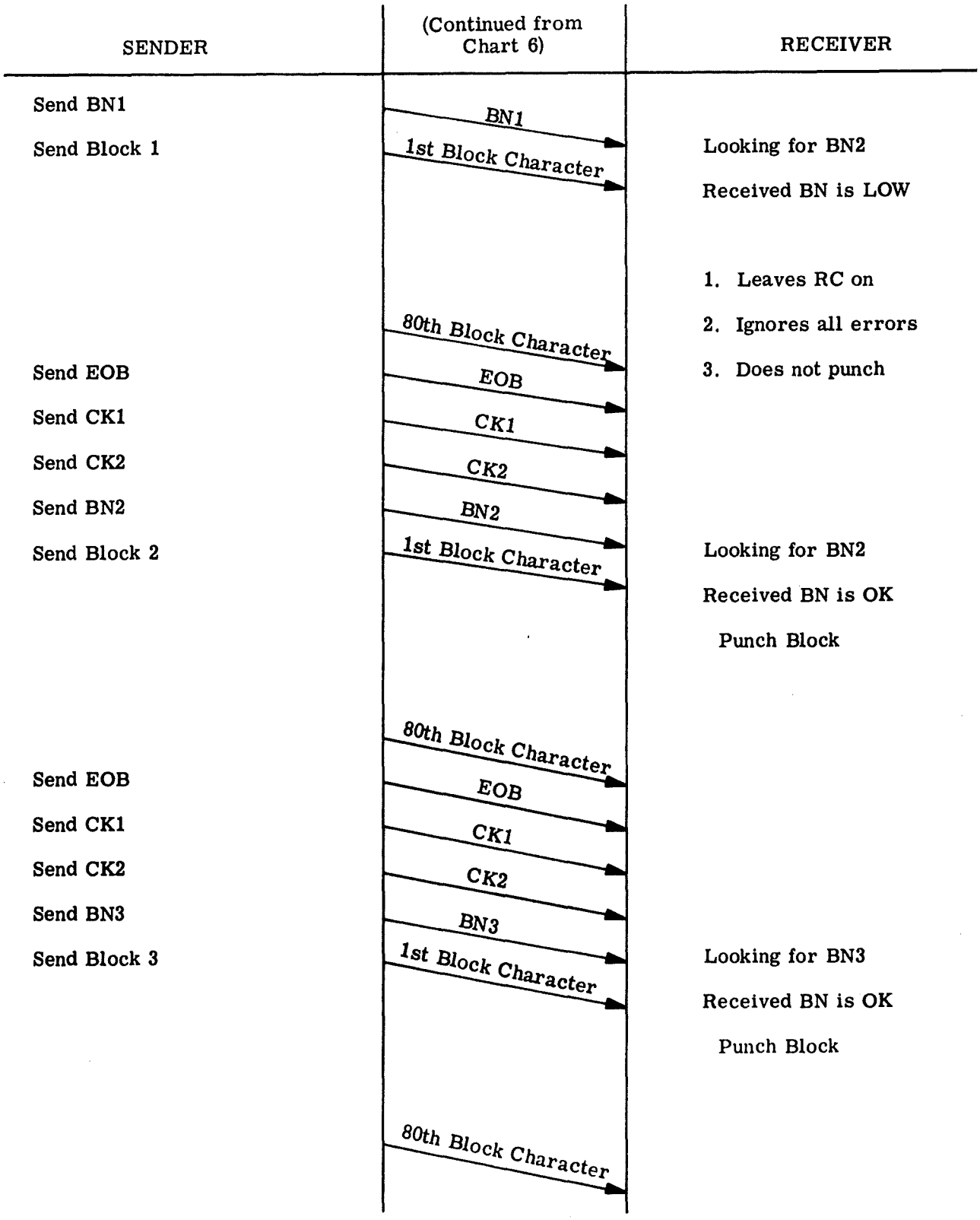


FIGURE 16

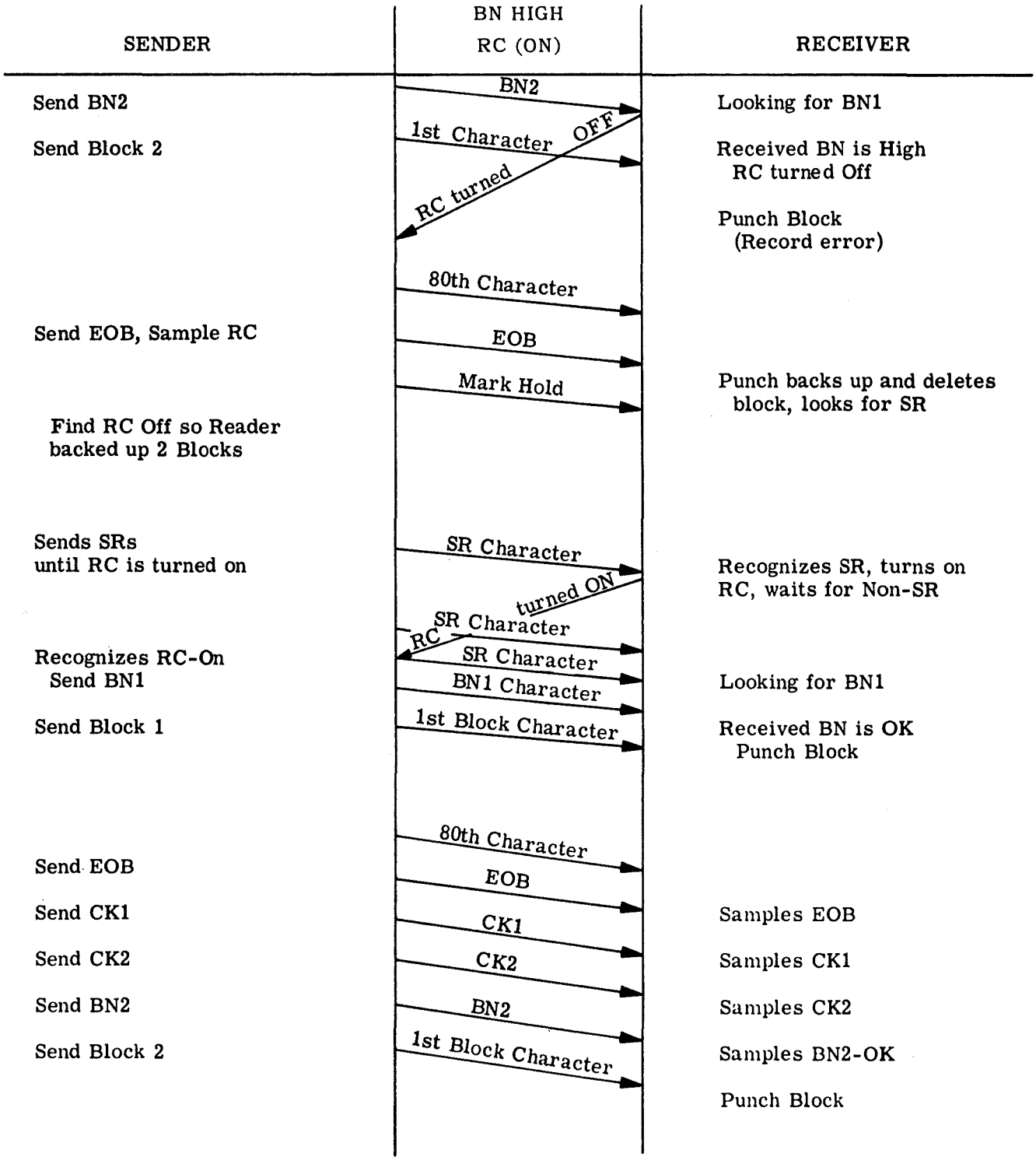

SENDER
BN HIGH
RC (ON)
RECEIVER
BN2
Send BN2
Looking for BN1
1st Character
OFF
Send Block 2
Received BN is High
RC turned Off
RC turned
Punch Block
(Record error)
80th Character
Send EOB, Sample RC
EOB
Mark Hold
Punch backs up and deletes
block, looks for SR
Find RC Off so Reader
backed up 2 Blocks
Sends SRs
until RC is turned on
SR Character
Recognizes SR, turns on
RC, waits for Non-SR
turned ON
SR Character
RC
Recognizes RC-On
Send BN1
SR Character
BN1 Character
Looking for BN1
Send Block 1
1st Block Character
Received BN is OK
Punch Block
80th Character
Send EOB
EOB
Send CK1
CK1
Samples EOB
Send CK2
CK2
Samples CK1
Send BN2
BN2
Samples CK2
Send Block 2
1st Block Character
Samples BN2-OK
Punch Block

FIGURE 17

INCOMPLETE BLOCK
(TRANSMISSION BREAK OR TAPE OUT)

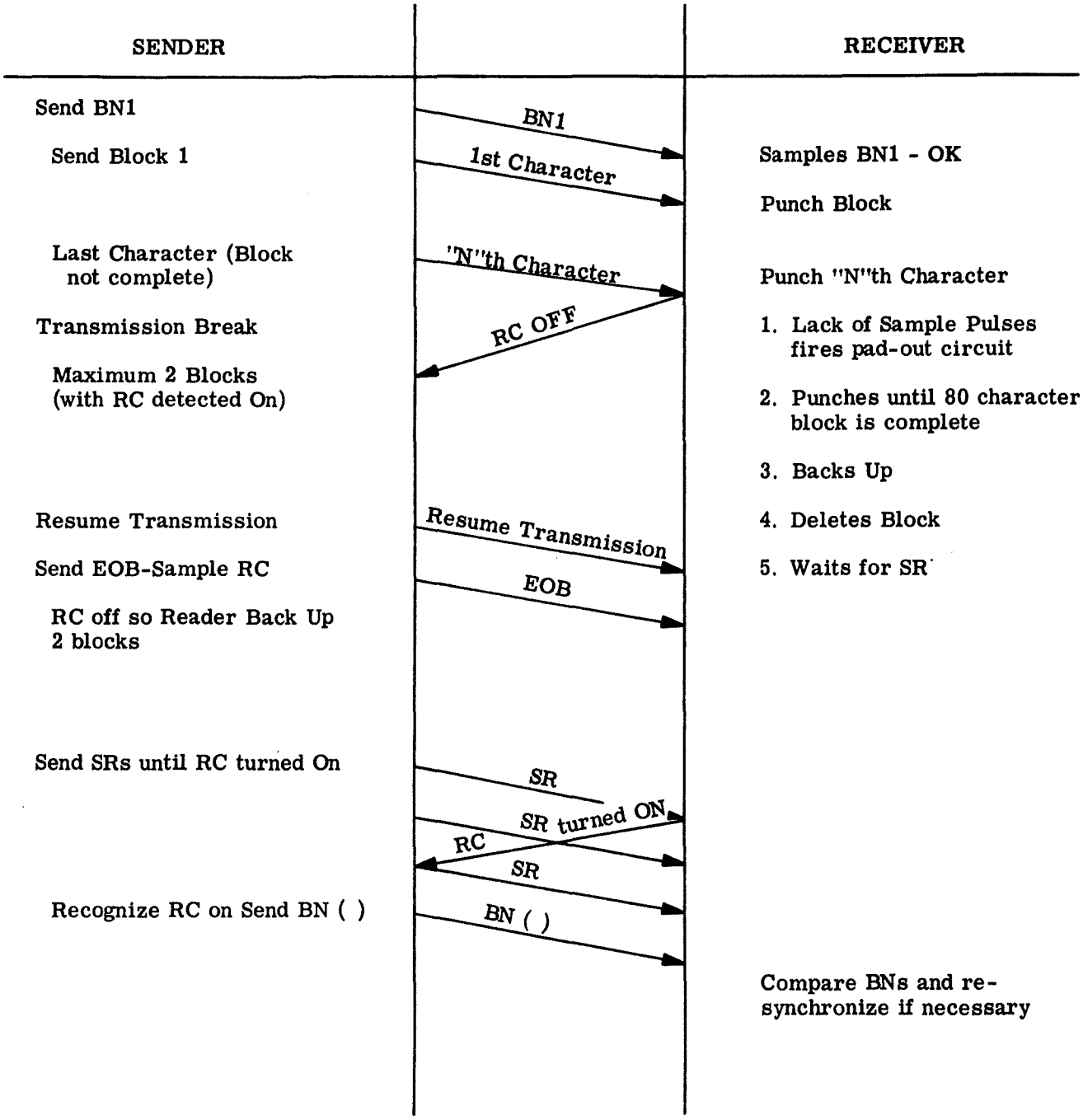
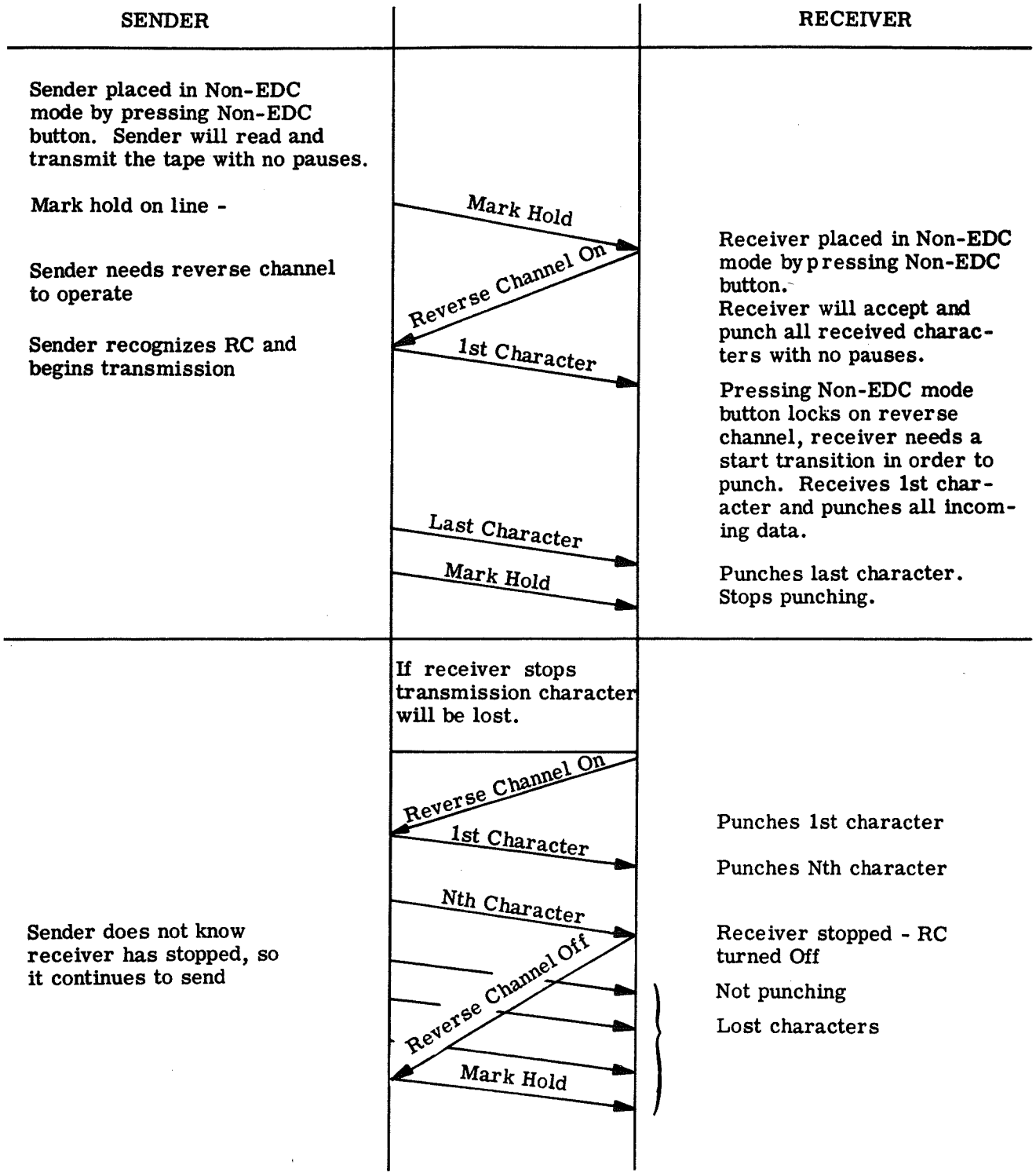


FIGURE 18

NON-EDC OPERATION



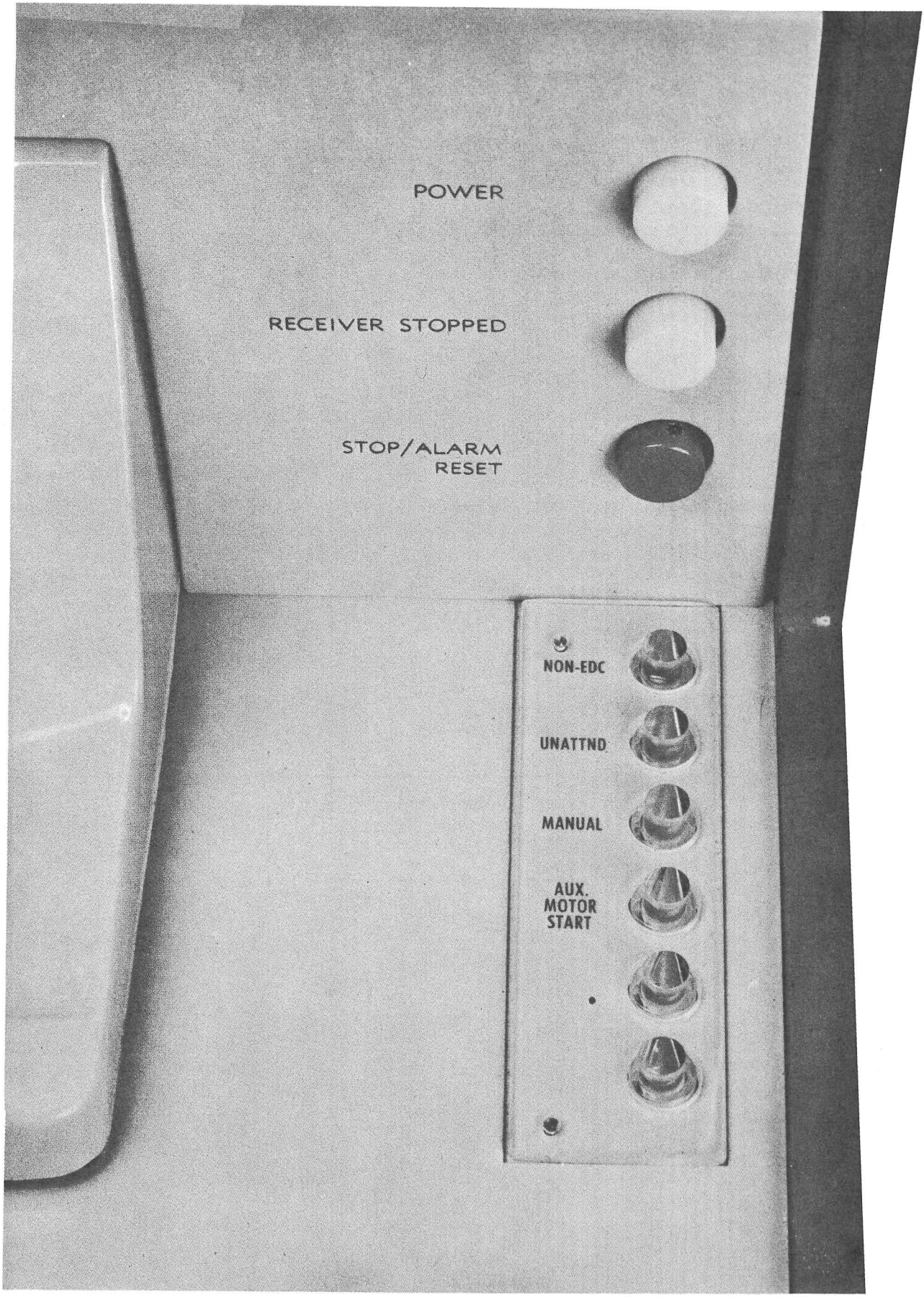


FIGURE 19

SENDER CONTROL PANEL

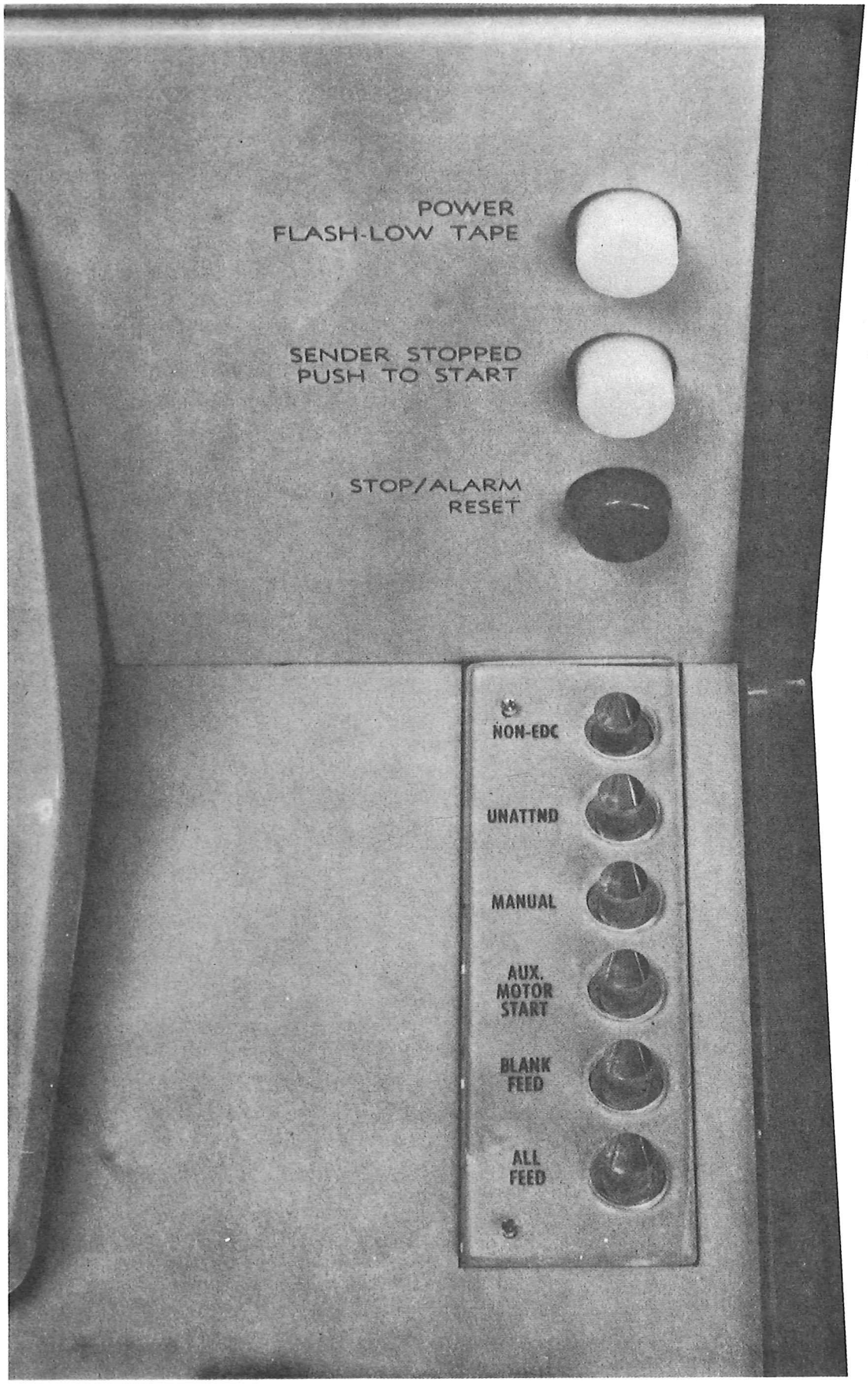


FIGURE 20
RECEIVER CONTROL PANEL

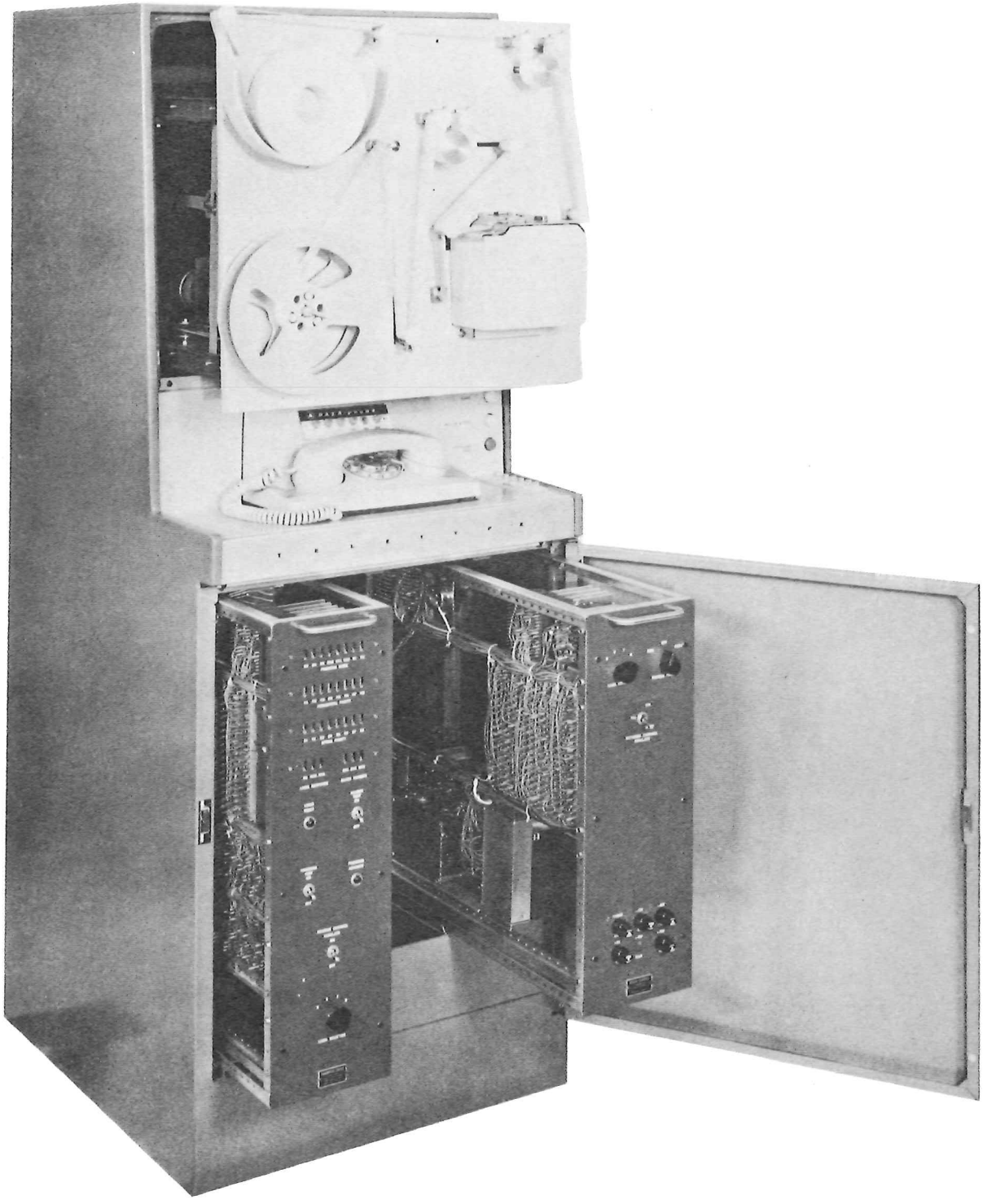


FIGURE 21

SENDER – DOORS OPEN

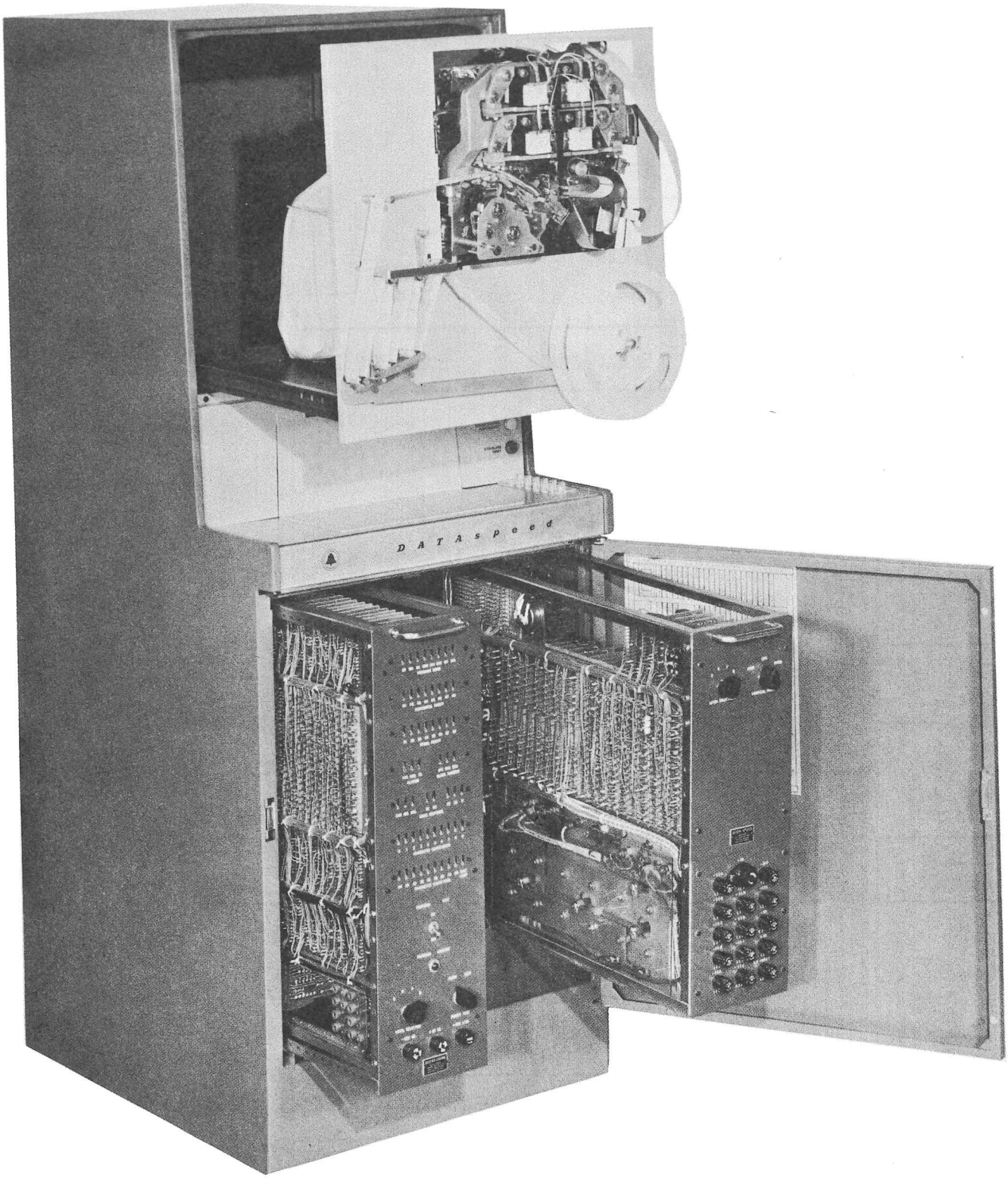


FIGURE 22

RECEIVER – DOORS OPEN

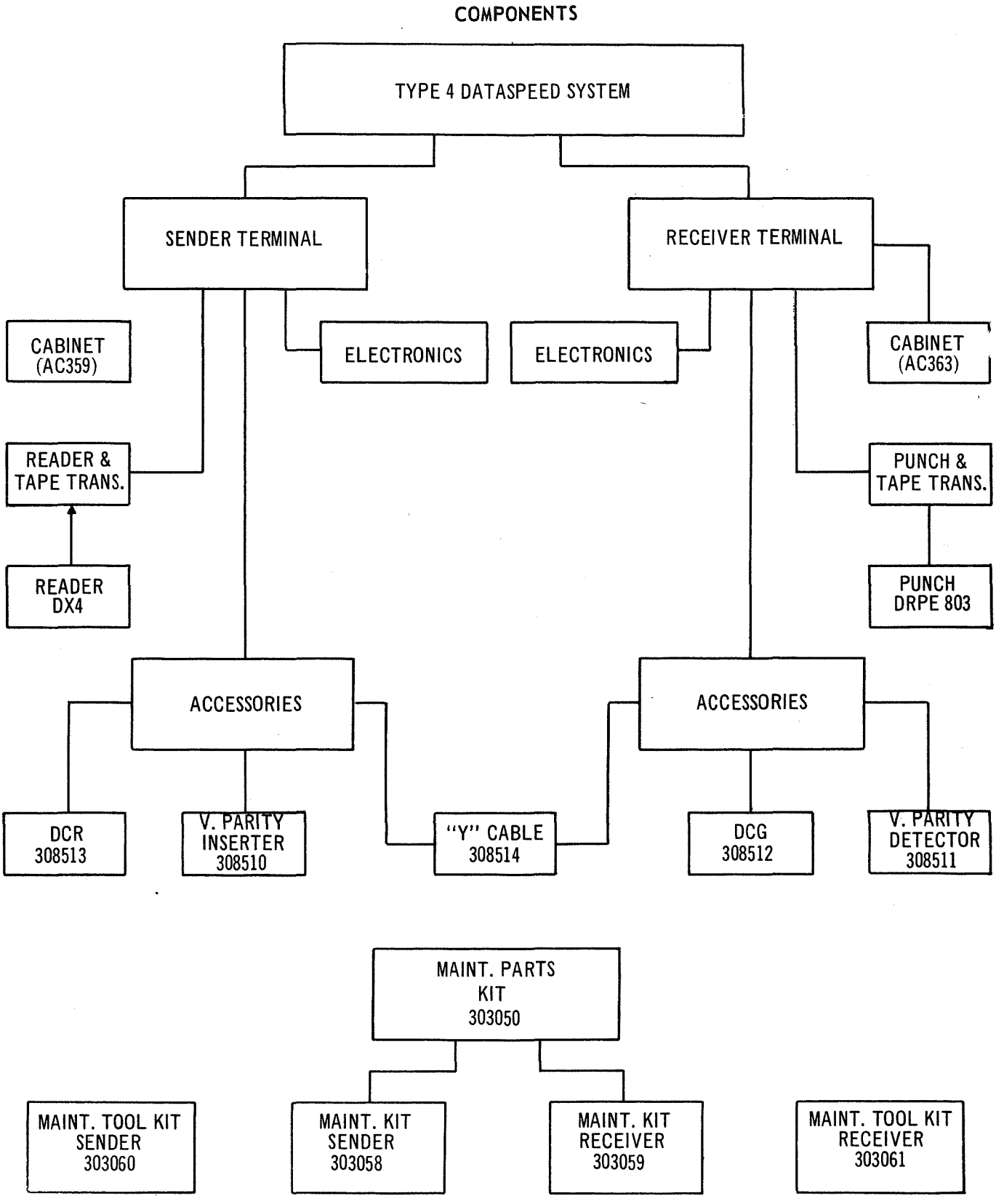

COMPONENTS
TYPE 4 DATASPEED SYSTEM
SENDER TERMINAL
RECEIVER TERMINAL
CABINET (AC359)
ELECTRONICS
ELECTRONICS
CABINET (AC363)
READER & TAPE TRANS.
PUNCH & TAPE TRANS.
READER DX4
PUNCH DRPE 803
ACCESSORIES
ACCESSORIES
DCR 308513
V. PARITY INSERTER 308510
"Y" CABLE 308514
DCG 308512
V. PARITY DETECTOR 308511
MAINT. PARTS KIT 303050
MAINT. TOOL KIT SENDER 303060
MAINT. KIT SENDER 303058
MAINT. KIT RECEIVER 303059
MAINT. TOOL KIT RECEIVER 303061

FIGURE 23

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

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

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345 East 47th Street
New York, New York 10017

II. Bell Telephone Laboratories, Inc., "Transmission Systems for Communications," Fourth Edition; and additional Technical References may be obtained in the following manner:

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Indiana Publication Center
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Order as follows:

(Quantity)–Book–Transmission Systems for Communications, Fourth Edition

(Quantity)–Technical Reference–(Catalog Number)

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