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Bell System

# TECHNICAL REFERENCE

## Switched Network Transaction Telephone System Interfacing With Transmission Control Units (Primary Response Mode Frequency Shift Keying)

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AT&T

Bell System Data Communications

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# Switched Network Transaction Telephone System Interfacing With Transmission Control Units (Primary Response Mode Frequency Shift Keying)

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Director - Data and Special Services

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# 1. INTRODUCTION

The Transaction telephone system is a short message inquiry/response system, connecting Transaction telephones to a customer's computer center via the switched telecommunications network. It provides a service in which inquiries are sent as TOUCH-TONE signals, and responses are returned as voice or data messages. The Transaction telephones are designed to serve as the user's main station telephone and to automate the short message, inquiry/response procedures which many users are now performing with less sophisticated telephones.

The users of this system include the financial industry, (including credit checking, check cashing and verification, and teller inquiry), those having inventory control applications for industry, hospitals, and airlines, and others utilizing the short message, inquiry/response format.

The Transaction telephone system provides the potential user with a choice of two distinct modes of operation. The first of these, Audio Response, utilizes either or both of the two Transaction telephones, designated Transaction I and Transaction II. Communication with the customer computer is via an Audio Response Unit at the computer center. This system application is discussed in a separate Bell System publication (PUB 41804 entitled *Switched Network Transaction Telephone System Interfacing With Audio Response Units*). The second mode of operation entails serial baseband data response. Communication between Bell System equipment and the customer's computer in this application is via a standard serial data interface. It is this system application which is covered by this publication. This system normally entails the use of Transaction II telephones and 407C data sets, and it is to this application that primary attention is paid. However, the use of Transaction I telephones in such a system is also possible, and this application is covered in detail as well. Detailed information regarding the use of other terminals, which transmit TOUCH-TONE signals, and receive Frequency Shift Keyed (FSK) data, is not presented here. However, it is anticipated that integration of such terminals into the system may be done simply.

## 1.1 Scope of this Document

This Technical Reference covers the operation of the Transaction telephone system as it interfaces with serial Transmission Control Units or Customer computers. Specifically, the operation of the system as three interfaces is defined. They are the interfaces between the customer computer and the telephone company equipment, between the telephone line and the Transaction telephone, and between the Transaction telephone and the user. Additional telephone company equipment at the computer location, including Automatic Call Distributors to concentrate and distribute calls, and CALL DIRECTORs are discussed. The functions and operation of both the Transaction I and Transaction II telephones, and the 407C data set, are described in detail.

This Technical Reference defines all the operational characteristics of the Transaction telephone system interfacing with transmission control units. Any characteristics of individual components not defined herein are subject to change and should not be presumed.

## 1.2 Use of this Document

This Technical Reference is of use to the system designers who will program the data center computer which interfaces with the Transaction telephone system. It is intended to provide sufficient information to generate all programming necessary for call control, message interpretation, error control, and response message generation for this system.

In addition, this reference is of value to the data center operations manager in that it describes in detail the size, amount, location, and operation of telephone company equipment located at the data center. It is valuable to potential Transaction telephone users, since it defines the operational characteristics of the telephones which they will operate. Transmission Control Unit (TCU)

manufacturers, credit card manufacturers and Bell System personnel will find this reference helpful as well.

### 1.3 Conventions

In order to clarify the operation of the Transaction telephone system, it is necessary to define the relationships among the alphabets utilized by the various parts of the system. For example, part of the data transmitted by the Transaction telephones is a translation of data encoded on magnetic stripe cards into a TOUCH-TONE alphabet.

Data is transmitted by the Transaction telephones in TOUCH-TONE form, using the digits 0 through 9, plus the special characters *, #, a, b, c, and d. Figure 1 shows the matrix which defines the TOUCH-TONE frequency components of the sixteen characters described above. TOUCH-TONE characters containing the $B_4$ frequency (shown in Figure 1) will always be represented as lower-case letters in this reference. Magnetic card information, on the other hand, is defined in a hexadecimal format. The characters are digits 0 through 9, A, B, C, D, E, and F. In this document, whenever reference is made to data transmitted from the Transaction telephones, the TOUCH-TONE characters will be used. Likewise, whenever reference is made to magnetic card data, the hexadecimal characters will be used. The American Standard Code for Information Interchange (ASCII) is also used for communication across the interface between the customer's computer and the Telephone Company supplied equipment. Baseband data is transmitted asynchronously with even parity, and start and stop bits. For a complete table of the relationships among all the codings, decimal, hexadecimal, TOUCH-TONE and ASCII, used in this reference, refer to Table 1. Table 1 also shows special TOUCH-TONE character sequences and their relation to the three buttons above the number pad on the face of the Transaction telephone.

Information is transferred from the data center to the Transaction I telephone in voice or keyed answer tone (2025 Hz). In addition, the Transaction II telephone is capable of receiving FSK data. Data transmitted in this manner to the telephone utilizes the ASCII alphabet, with even parity, and start and stop bits. Transmission is asynchronous with a marking frequency of 2225 Hz and a spacing frequency of 2025 Hz.

Throughout this document, whenever it is necessary to clarify the operation of the system by the use of an example, the example of credit verification or check authorization will be used. Accordingly, the computer location will be called the data center. The Transaction telephone location will be called the merchant premises, and the telephone user will be called the merchant. Two magnetic cards are used in a typical transaction. The first is called the "dialing" card. The second is called the "customer" card.

### 1.4 References

There are other Bell System documents which describe in greater detail some of the components of the system. Some other references are:

1. Bell System Technical Reference — Data Set 407 Interface Specification (PUB 41408)
2. Bell System Brochure — 2B Automatic Call Distributor How-to-Operate Manuals #99-500-100, #99-500-101
3. Bell System Technical Reference — Data Communications Using the Switched Telecommunications Network (PUB 41005)
4. Subscriber Instruction Booklet SIB-2459B — How to Use the Transaction I Telephone
5. Subscriber Instruction Booklet SIB-2482C — How to Use the Transaction II Telephone
6. Subscriber Instruction Brochure #2473 — CALL DIRECTOR
7. Bell System Brochure — 999-100-140 — How to Use the 407-Type Data Set.

8. Bell System Technical Reference — Switched Network Transaction Telephone System Interfacing with Audio Response Units (PUB 41804)

For further information contact your local Telephone Company business office.

## 2. SYSTEM CONFIGURATION

Figures 2a and 2b show the two system configurations for the serial data interface of the Transaction telephone system. The two systems differ in the equipment which provides for referral to a human operator. Referral capability is recommended, although it is provided on an optional basis in this system. The Transaction telephones shown in the figures may be Transaction I or Transaction II telephones, or both.

### 2.1 Telephone Company Provided Equipment

The telephone company provided equipment for the Transaction telephone system can be broken down into three categories: Transaction telephone, communication channel, and data handling equipment at the data center.

a. The Transaction telephones are used in this system to make inquiries of, and receive responses from, a remotely located computer. The set is located at the merchant's premises.

b. The communication channel for this system is the voice telecommunications network.

c. Telephone company provided equipment at the data center includes the equipment necessary to provide referral switching, and the 407C Data Station.

The two forms of referral switching are shown functionally in Figures 2a and 2b. Utilization of these arrangements allows a call to be transferred from the computer to an attendant, to permit the Transaction telephone user (merchant) to talk with an attendant in certain situations.

Figure 2a shows the system with CALL DIRECTORs or other key telephones as the referral equipment. Note that there are equal numbers of input trunks and data sets. During referrals the attendant positions are switched onto the incoming line by connections in the data sets.

Figure 2b shows the system with an Automatic Call Distributor (ACD) as the referral equipment. In this arrangement, call concentration is provided, thus reducing the required number of data sets by placing overflow calls in a queue. The attendants in this case are connected to referred calls by circuitry in the ACD.

The 407C Data Station is a multiple installation of data sets, each of which provides full service for two computer ports and two incoming lines simultaneously. The data sets translate incoming TOUCH-TONE signals into ASCII format for presentation to the computer. Outgoing ASCII data from the computer is transmitted as FSK or keyed answer tone (KAT). In addition, the data sets provide a number of features and options, which facilitate communication between the computer and the Transaction telephone, and allow the full use of the features available with the Transaction telephones. Finally the data set provides the interface between the computer and the telecommunications network.

### 2.2 Customer Provided Equipment

The customer provided equipment for this system is located at the data center. As shown in Figure 2a and 2b, the 407C interfaces with a Transmission Control Unit (TCU). In this context, TCU refers to communications processing equipment capable of serial baseband transmission and reception of ASCII data via an interface configured according to Electronic Industries Association (EIA) standard RS-232C.

Overall control of system operation is done by the data center computer. The computer makes decisions based on the data received from the Transaction telephone and sends the appropriate response via the TCU and 407C. When referral is provided, the attendant positions usually have access to the computer as shown in Figure 2.

## 3. SYSTEM ELEMENTS

This section is intended to be a general description of each of the elements of the system. Complete operational characteristics are given in Section 4. In this section, each of the elements — the Transaction I (Fig. 4) and Transaction II (Fig. 3) telephones, the optional Auxiliary Manual Entry Pad, also known as the PIN (Personal Identification Number) pad, 407C Data Station, and referral equipment — will be discussed, with emphasis on its contributions to system operation.

### 3.1 Transaction Telephones

The Transaction II telephone is designed to provide efficient operation in short message, TOUCH-TONE inquiry/FSK data response applications. It provides a means of reading information from plastic cards with an encoded magnetic stripe, and a buffer for storing this information prior to transmission. Instruction lamps guide the telephone user through the transaction. In addition, means are provided for manual entry of data via a manual entry pad, and for transmission of data, in TOUCH-TONE form, to the data center. The set has an FSK data receiver for accepting and storing data sent from a remote data center. It has a seven-segment visual display with eight character positions for displaying both locally keyed data and data received from the data center. An interface is provided for an optional printer as well.* A tone decoder is included for reception of keyed answer tone signals.

The set provides response lamps (hereinafter called the green/yellow lamps) which can be activated by an FSK data message or keyed answer tone responses from the data center to indicate approval or rejection of transactions. It has on-and-off buttons and a call progress monitoring speaker, which allow the set to be used in a hands-free mode. The user need not lift the receiver for many applications. A lamp on the face plate is provided which indicates that a call is in progress.

*Early versions of the Transaction II telephone do not have the printer interface.

Optionally, an Auxiliary Manual Entry Pad may be added for entry of customer Personal Identification Numbers (PINs). The PIN pad is described in greater detail in Section 3.1.3.

Other features include automatic dialing in dial pulse or TOUCH-TONE. The set can operate with key telephone systems and it can operate in an automatic dialing mode behind a PBX with two-part dialing when a second dial tone wait is required. It can also operate in a split mode, dialing the first part of a two-part number in dial pulse, the second in TOUCH-TONE, or vice-versa. For dial pulse service, button depressions on the manual entry pad are converted to dial pulses during dialing, but TOUCH-TONE is used after a call is completed to the data center.

Finally, the set provides basic telephone service. Manual dialing is via a TRIMLINE handset provided with the telephone, or, optionally, using the manual entry pad. Appropriately encoded cards can be used to automatically dial telephone numbers.

The Transaction I telephone is designed primarily for TOUCH-TONE inquiry/voice response systems. It has all the features of the Transaction II telephone except the data receiver, display, on-and-off buttons, printer interface and the call progress sounder. In addition, the "call in progress" lamp is replaced by a "special instructions" lamp. Use of this lamp is detailed in Section 5.4.

#### 3.1.1 Physical Description

Figure 3 is a picture of the Transaction II telephone with the optional Auxiliary Manual Entry Pad. The set is 9¼ inches wide by 12 inches deep by 5¾ inches high. On top of the set at the rear is the card reader. On the face of the Transaction II telephone is the manual entry pad. The button labeling differs from that found on a TOUCH-TONE telephone in that the (*) button is labeled by a (.) and the (#) button is replaced with a (/) button. The card reader, the manual entry pad, and the optional Auxiliary Manual Entry Pad are the ways of entering data into the Transaction telephone set.

Also on the face of the Transaction II telephone are a set of lamps, the visual display

and three additional buttons. The lamps are functionally separated into three categories. The first category consists of the three instruction lamps. These lamps are lit in sequence to guide the user through a transaction. The second group of lamps are the green/yellow response lamps. These are lighted in response to FSK data messages or answer tone signals from the data center. In the financial industry example, the green lamp might mean "credit approved" while the yellow lamp would indicate special circumstances, which might be explained on the display. Finally, a "call in progress" lamp is provided on the faceplate of the Transaction II telephone.

The three additional buttons mounted above the manual entry pad are labeled ATTN, END, and ERASE. The ATTN or "attention" button, when pressed during a call, causes the TOUCH-TONE sequence "**" to be transmitted to the data center. Under certain conditions, this will cause a referral to occur. The ERASE button causes the erasure from the buffer of the entire block of data being entered. "Block of data" can be defined as all the data entered in response to a given instruction light on the face plate. If transmission of the block has already been started or the telephone is in the unrestricted format mode (see Section 4.1.12), depression of the ERASE button causes a TOUCH-TONE "bb" sequence to be transmitted to the data center. Additional functions of the ATTN and ERASE buttons on the Transaction II telephone are described in Section 4.1.14. The END button signals the Transaction telephone that a block of data has been entered, and depending upon the particular entry, causes one of a variety of actions within the telephone (described in Section 4.1.4).

A TRIMLINE® handset is incorporated so that the set can be used as a telephone when AC power fails, and the optional auxiliary manual entry pad is available, which allows for private entry of a personal identification number (PIN) into the Transaction telephone's buffer. The on-off buttons allow "hands free" operation. The call progress tone sounder, which allows monitoring of the call setup when the set is used in the "hands free" mode, is mounted under the handset cradle. On the right hand side of the set is the volume control for the tone sounder. The set is also compatible with key telephone service, utilizing a separate key strip.

Figure 4 shows the Transaction I telephone. It has many of the features of the Transaction II telephone, including the green/yellow response lamps (lighted by tone response only), the instruction lamp, the ATTN and ERASE functions described above, the TRIMLINE handset, PIN pad interface, and keystrip compatibility. It does not have the data receiver, visual display, ON-OFF buttons, or call progress tone sounder. The "Call in Progress" lamp is not provided. In its place is the "Special Instructions" lamp, used for operation when the computer is unavailable (see Section 5.4).

### 3.1.2 Environmental Specifications

The Transaction telephones have been designed to operate in the temperature range of 50°F to 120°F. Storage temperature range is -40°F to 150°F. The telephone will operate over a relative humidity range of 20 percent to 95 percent at 75°F. The sets operate on a 117 VAC ±10 percent, 60 Hz ±5 percent non-switched power source, connected via a three-prong plug at the end of a six-foot power cord.

The Transaction I telephone dissipates a maximum of 16 watts of power and Transaction II telephone dissipates a maximum of 22 watts.

### 3.1.3 Auxiliary Manual Entry Pad (PIN pad)

An Auxiliary Manual Entry Pad is available as an option for both the Transaction I and Transaction II telephones. This pad is intended primarily for entry of Personal Identification Numbers and is therefore called the PIN pad. The PIN pad is equipped with 12 buttons configured as a standard TOUCH-TONE pad arrangement, except that the "*" button is labeled "." and the "#" button is labeled END as shown in Figure 3. The standard alphabetic

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arrangement is also shown on the buttons. In addition, the letters Q and Z (normally absent from a TOUCH-TONE pad) appear on the "1" button.

When a Transaction telephone is equipped with a PIN pad, a different faceplate with an additional button, illuminated with an LED is provided. The button enables or disables the PIN pad. The LED is on when the pad is enabled. There is also a light on the PIN pad itself which is on when the PIN pad is enabled.

The PIN pad may be used for entry of all or part of the manually entered data, and the buttons on the pad perform the same functions as the correspondingly labeled buttons on the manual entry pad on the face of the Transaction telephone.

The PIN pad is 4 inches wide by 4 inches deep by 2 1/2 inches high and is connected to the Transaction telephone by means of a 3/8 inch diameter cable of length 4 1/2 feet. Detailed operation of the PIN pad is described in Section 4.1.5.

## 3.2 Referral Switching Equipment

The equipment required at the data center to give attendants access to calls can be either of two types. The first is the CALL DIRECTOR and the other is the Automatic Call Distributor (ACD).

### 3.2.1 CALL DIRECTOR

The CALL DIRECTOR arrangement provides each attendant with access to all incoming lines. When an attendant is required, a flashing lamp indicates the call to be handled. The attendant answering the referral request transfers the call to the REFERRAL mode during which time no data can be received, nor can the data set associated with the call be made available for other calls. If more data transmission is required, the attendant can return the call to the DATA mode by depressing the HOLD key on the CALL DIRECTOR.

A typical CALL DIRECTOR station is shown in Figure 5.

### 3.2.2 2B and 3A Automatic Call Distributors (ACD)

If the data center installation includes a 2B or 3A ACD, a number of advantages over the CALL DIRECTOR system are provided. Among these are line concentration, which allows the use of fewer 407 data sets and fewer attendants for a given number of incoming lines, and queuing of incoming calls until a port becomes available. The queuing feature can be used to handle traffic peaks with a minimum number of data ports. In applications requiring short call-holding times (such as credit authorization) calls will reside in queue for a very short time if the system is properly engineered to handle the traffic. The ACD also allows the option of dropping the data set from a referred call once the attendant has been selected. This allows the data set to handle a new call while the referred call is handled by the attendant, thereby reducing the number of data sets and ports required to handle the traffic. In addition, the ACD system allows the use of recorded announcements.

The 2B and 3A ACDs have circuitry which transmits a two-digit code to the computer upon selection of an attendant position. This code may identify to the computer the location of the attendant answering the call. (See Section 4.2.3.2.)

The 2B ACD is a miniature crossbar switching system, while the 3A utilizes step by step switching. The 2B ACD can handle up to 70 output positions (attendants plus computer ports) and up to 68 incoming trunks. The 3A ACD can handle up to 48 data ports, 48 attendants and 198 trunks.

## 3.3 407C Data Station

The 407C Data Station is a multiple installation of 407C data sets. The 407C Data Set is a dual unit, that is, each data set serves two incoming lines and two computer ports simultaneously. The sets decode incoming TOUCH-TONE signals to one of three codes for presentation to the computer. Two of the codes are presented on a parallel interface suitable for communication with an Audio

Response Unit. These are a 2-out-of-8 parallel code identical to that used by the 407A and 407B data sets, and a Binary Coded Matrix (BCM) code. In the parallel interface mode, the 407C interface operates similarly to the 407B data set, as described in detail in PUB 41804, *Switched Network Transaction Telephone System Interfacing With Audio Response Units*, and PUB 41408, *407-Type Data Set Interface Specifications*.

In the serial interface mode, which is the focal point of this Technical Reference, the 407C decodes the TOUCH-TONE into a serial ASCII code for presentation to the computer on an interface which conforms to EIA Standard RS-232C. The serial interface should be assumed, unless otherwise indicated, throughout this document.

The 407C provides an FSK transmitter which is used to transmit ASCII data received by the 407C from the computer. In addition the 407C can transmit keyed answertone (KAT) signals upon receipt of ASCII sequences from the computer, under certain conditions. A voice port, not specified by EIA Standard RS-232C, is also provided, so that locally generated voice or tone signals can be transmitted according to system requirements. The 407C is equipped with status lamps which indicate the state of some of the important data set functions so that the data set status can be seen at a glance.

The 407C provides a number of options, some customer controlled and selected, and others installed by the Telephone Company in accordance with the service order. The installed options include the type of interface used (serial or parallel, and, if parallel, a closure-type or EIA voltage interface), operation via the switched network or on private lines, operation with an ACD used for referral, and enabling or disabling the call control code detectors when operating with the parallel interface. In addition, limited call-handling capability during computer service outages is provided by the "computer down" mode of operation.

The customer controlled features and options include automatic terminal initiated referral (TIR) whereby the calling party can initiate a referral by transmitting a TOUCH-TONE sequence. The 407C also has the capability of automatic disconnection from the telephone line upon receipt of a TOUCH-TONE code (*#*). This code is sent by the Transaction II telephone whenever it disconnects from a call.

Other features include three independent methods of making a data set section appear out-of-service, including the use of an out-of-service (OS) switch on the front panel of each section. In addition, a number of customer controlled options are available which facilitate communication between the 407C data set and the customer's computer. The options are controlled by switches on the front panel of the data set.

The 407C Data Station is designed for ease of testing, both locally and remotely. Each data set can be tested locally by either the customer or Telephone Company personnel using a test set built into the data station. Remote testing can be done by the Telephone Company data test center over a service line provided with the station.

A detailed description of all the features and options available with the 407C data set is given in Section 4.2.

### 3.3.1 Physical Description

Figure 6 depicts a 57A1 data mounting equipped with four 407C-L1 data sets, a 229A power unit, a test unit, and an 81A detector, installed in a KS20018, L20 cabinet (width 24 inches, height 32 inches, and depth 18 inches). Two 57-type data mountings, equipped with up to 8 data sets may be installed in the cabinet. When two data mountings are mounted in the same cabinet, one mounting must be a 57A1 type which includes the test unit. The other mounting would be a 57B1 unit which has no test unit.

The KS20018, L20 cabinet be used for all installations of 407C data sets. The mountings cannot be rack-mounted. The cabinet is equipped with a 150 cu ft/min (cfm) blower. In addition, an 81A detector and alarm unit, which provides thermal protection for the station, is also installed in the cabinet. The

407C operates in a room ambient of 40°F to 120°F. It will operate over a relative humidity of 20 to 75 percent at 75°F, 20 to 40 percent at 120°F.

Figure 7 depicts the faceplate of a 407C-L1 data set. The two data set sections (A&B) are distinguishable in the figure. The fourteen indicator lights are visible in this figure, as are the twenty customer option switches. Each switch activates an option which applies to both data set sections. Directly below the option switches on each data set section is the OS switch. This switch is used to take a section out-of-service. The customer interface connectors are below the OS switches and the test switch for each section is directly below the connector. This switch is operated, whenever the data set section is to be tested, by a "finger" built into the test connector (see Section 8).

### 3.3.2 Power and Grounding Requirements

Electric power is fed to the 407C from a customer-provided 117 volt ±10 percent, 60 ±.1 Hz nonswitched source by means of a 3-prong plug-ended power cord. One 10 foot long AC power cord is provided with a data station. The nests in a multiple data mounting station are interconnected to distribute AC power between the nests. Each nest of four data sets consumes approximately 250 watts of AC power. The blower and detector units consume an additional 80 watts of AC power.

Protective ground is established for the 407C through the ground wire of the power cord. A signal ground is provided to the customer for use as a signal level reference point. Provision is also made to connect signal ground and frame ground in the nest. If signal ground and frame ground are unconnected, then signal ground reference between nests is accomplished by installation wiring.

### 3.3.3 Location of Data Station

In accordance with the recommendations of EIA standard RS-232-C, the 407C Data Station should be located so that the customer-provided interface cord to the TCU will not exceed 50 feet in length.

## 3.4 Customer Provided Equipment

The customer provided equipment at the data center must be capable of receiving asynchronous start/stop ASCII data from the 407C at the data rate selected by the customer. In addition, it must provide serial ASCII data response at the same data rate. The customer interface equipment must be compatible with the serial ASCII interface, as detailed in Electronic Industries Associates (EIA) Standard RS-232C.

# 4. SYSTEM OPERATION — ELEMENTS

This section contains a detailed description of the components of the Transaction telephone system. The Transaction telephones and the 407C Data Set are described, as is the operation of the 407C with a CALL DIRECTOR or an ACD used for referral.

## 4.1 The Transaction Telephones

The Transaction II telephone is a telephone augmented by features to increase its utility in Digital Inquiry/FSK data response transactions. It is intended primarily for use in applications where a single complete inquiry is followed by a single response, although a means is provided to enter additional data after the initial inquiry.

The Transaction II telephone can receive Frequency-Shift Keyed (FSK) data to yield visual responses. It also allows hands-free operation, using ON and OFF buttons and a call progress sounder. These last three features are unavailable on the Transaction I telephone.

### 4.1.1 Sequence of Operation

There are three phases of operation of the Transaction telephone: data input, data transmission, and data center response.

#### 4.1.1.1 Data Input

Typical usage of the Transaction II telephone proceeds as follows:

1. The user presses the ON button and the first (topmost) instruction lamp comes on.
2. He listens for dial tone on the sounder, then slides the dialing card through the card reader. The second lamp comes on.
3. The user may listen again for dial tone, and then slide the second (customer) card through. The Transaction II telephone lights the third instruction lamp.*
4. Additional data is keyed in manually.

Meanwhile, the set automatically dials the data center or other telephone number and buffers all input data. The user may use the ERASE key to delete erroneous manual input. He depresses the END key when data input is complete.

Typical use of the Transaction I telephone is similar to that of the Transaction II set except that the Transaction I user lifts the handset to initiate the call.

#### 4.1.1.2 Data Transmission

When contact with the data center has been established, the telephone sends the data that has been entered and buffered. Data transmission is triggered by a 2025 Hz answer tone sent by the 407C data set and consists of TOUCH-TONE characters sent at a rate of 8.8 characters per second. If the user has not finished manual data entry, the Transaction telephone sends all data that has been entered, and then sends each additional individual character as it is entered by the user. When the END button is finally depressed, the set sends the End Of Text (ETX) sequence (that is, "##") followed by a longitudinal redundancy check character and a character count, and is then ready to receive the data center response.

If for any reason the answer tone is not detected by the Transaction telephone, data transmission may be triggered manually. This is done by pressing the END button two more times when entry of the transaction has been completed in the normal way. Extra depressions of the END button will not appear in the transmitted data sequence when they occur before transmission is complete. Note, however, that this procedure should only be used when the user is sure that the answer tone has been missed.

The data format is covered in detail in Section 4.1.15.

#### 4.1.1.3 Data Center Response

After data entry, final depression of the END button, and transmission of the data, the data center normally responds to the inquiry. The primary response mode for the Transaction II is FSK data transmission. The FSK response message can be configured to light or blink the green or yellow light and provide messages for display. The Transaction II telephone performs error checking on the message and acknowledges or rejects the message as discussed in Section 4.1.15.

Keyed answer tones can be used to light either the green or yellow response lamp on the Transaction I telephone. The 407C translates the appropriate baseband sequences from the computer into keyed answer tone to allow use of the Transaction I telephone in a serial data system. When either lamp is lit, the Transaction I telephone acknowledges the action taken by sending an appropriate TOUCH-TONE character, as discussed in Section 4.1.6.

### 4.1.2 The Magnetic Stripe Cards

The Transaction telephones accept input data through either a magnetic stripe card reader or a manual entry pad. The card reader is designed for the American Banking Association (ABA) track two, also described as the American National Standards Institute (ANSI) track two. The reader is hand powered, containing no moving parts, and is engineered for long service life and ease of use.

In its most general application, the telephone has as its input source two magnetic stripe cards. One card is encoded according to the

*Listening for dial tone a second time allows for two-part dialing where a user must actually wait for the second dial tone before inserting the second card.

ABA specification, and may be a bank card or credit card. The other card is a dialing card, encoded in a manner similar to the ABA standard but containing information pertinent to controlling the Transaction telephone.

The dialing card is used first, and has encoded on it the telephone number of the data center or other remote data set location to be reached. In addition, it contains identification information, access codes, LOGON characters, or transaction codes associated with the user, to be transmitted to the data center when the connection has been established. The dialing card also contains special characters that control features of the Transaction telephone. These are addressed later in this section, and in Section 6.3.

Typically, dialing cards are associated with and kept with the Transaction telephone in slots provided for them. There may be any number of dialing cards, one for reaching each of a number of data centers, or one containing each of several access or transaction codes.

The second card or customer card is typically not associated with a particular Transaction telephone, and contains information pertaining to the particular transaction being consummated. As a bank or credit card, it is carried by the customer, and has encoded on it an account number, an expiration date, and, possibly, additional discretionary data. Alternatively, the card could be an inventory control card, with a part number and inventory control information on it.

Magnetic stripe cards are inserted by placing the edge of the card containing the stripe into the right hand end of the long slot of the reader, with the stripe facing the user as he faces the keyboard. (See Figure 8.) Note that, although the figure shows a Transaction I telephone in use, the reader on the Transaction II telephone is identical. The edge of the card should be resting against the bottom of the slot, to align the encoded portion of the stripe with the reading equipment. The card is then moved steadily from right to left through the slot.

The card reader is designed to be insensitive to the velocity at which the card is moved through the reading slot, and to accommodate reasonable changes in velocity as the card moves. However, jerky motion of the card, or extremely fast or slow motion, is not recommended. The card reader will accept velocities between 2.5 and 50 inches per second.

If a card is misread, the Transaction telephone will detect the error because it checks both the parity of each individual character and the card longitudinal redundancy check (LRC) character. (Detailed in Section 6.3.7.) The error condition is noted by flashing the corresponding instruction lamp on the faceplate. When an error is detected, the set does not transmit the suspected data but instead expects the data to be reentered. The user may reenter the data, by card or manually, without hanging up. (**Note:** The set flashes an instruction lamp only when one would normally be lighted to correspond to a card entry. If a card is misread when no instruction lamp is on, the only indication of the error is the absence of outgoing TOUCH-TONE data.)

### 4.1.3 Manual Dialing

The Transaction telephone is equipped with a TRIMLINE handset which can be used for manual dialing, or the manual entry pad may also be used for manual dialing. Use of the manual entry pad for dialing may be disabled by the installer in accordance with the service order. The dialing feature of the TRIMLINE handset is not disabled by this option.

When the manual entry pad is used to dial numbers, it is used just like a TOUCH-TONE pad. Both Transaction telephones will do automatic push-button to rotary dial pulse conversion, if required. When the manual entry pad is used to call a telephone number other than that of a data center, the END button should not be pressed at the end of the number.

When the manual entry pad is used to manually address a data center, the END button is pressed after dialing the telephone number. Then the user identification information is keyed in, and the END button is pressed again to signify the end of the user in-

formation, before entering the customer data or card. User information may be punctuated with the (.) or (/) keys. The Transaction telephone will transmit the information after the answer tone from the data center is detected and after entry of customer data has begun.

The Transaction telephone can also be used as a TOUCH-TONE telephone to call data centers which are programmed to communicate with TOUCH-TONE telephones only. In this case, the manual entry pad is used exactly like the pad on the TOUCH-TONE telephone and the END key is not depressed.

For manual entry of dialing and user identification information, the ERASE button can only be used to clear the user identification information while the first instruction lamp is on. It does not affect the telephone number, and should not be used during the entry of a telephone number.

When the user data has been manually entered, data corresponding to the second card should not be entered until the second instruction lamp comes on. This will occur immediately after pressing the END button if dialing is TOUCH-TONE, but not until rotary dial pulsing is complete when rotary dialing is employed.

#### 4.1.3.1 Keyboard Characteristics

The keyboard or manual entry pad is similar in appearance to an ordinary TOUCH-TONE dial. However, all entries through the pad go into the logic circuits of the Transaction telephone.

There are slight differences between the 12-button pad and the TOUCH-TONE dial with respect to characters transmitted. The (/) button, which is located in the lower right hand portion of the manual entry pad, causes transmission of the TOUCH-TONE "b" ($A_2B_4$) character when the Transaction telephone is in the data mode after dialing and receipt of the answer tone. In the dialing mode, this button sends "#". This differs from the ordinary telephone which always transmits TOUCH-TONE "#" ($A_4B_3$) when the button in the corresponding position is depressed.

In the place of the (*) sign on the TOUCH-TONE telephone a decimal point (.) has been placed on the Transaction telephone's lower left hand button. The TOUCH-TONE signals transmitted in either the Transaction telephone or TOUCH-TONE telephone are the same for this button. In the Transaction II telephone, unlike the Transaction I, disabling the manual entry pad for dialing also protects the information stored in the telephone's repertory from inadvertent erasure through untimely use of the manual entry pad. This information is used by the automatic one number dialing feature (described in Section 4.1.9). Note that previously stored numbers are lost whenever the manual entry pad is used for dialing in both sets.

### 4.1.4 Manual Data Entry

Information can be manually entered using the manual entry pad in place of either card operation described in the Section 4.1.2. Section 4.1.3 deals with manual entry of information in place of the dialing card, or when the first instruction lamp is on. More typically, data is manually entered after the two cards have been inserted to provide specific information that is not reasonably stored on cards. In the banking and credit industry, this information could include the dollar amount of the transaction. Information entered using the manual entry pad is displayed by the Transaction II telephone.

Additional data that could be entered here include a transaction code or inventory control number. Also a personal identification number (PIN) could be entered at this time by the bank's customer using the optional remote entry pad. Information entered using the PIN pad is not displayed by the Transaction II telephone.

#### 4.1.4.1 When the Third Instruction Lamp is On

The Transaction telephone has storage space for up to 61 additional characters in its buffer after the cards (or equivalent manual data) have been entered. If a field separator (/) is used, it can be placed any where in the 61 character data field.

Experience has shown that mistakes in manual entry are likely to be the most frequent cause of error when using the Transaction telephone. Therefore, when very reliable information transfer is required, it is suggested that important information, (such as the amount of a transaction) be keyed in twice so that manual entry errors can be detected at the data center.

#### 4.1.4.2 When the Second Instruction Lamp is On

Data may be entered manually to replace use of the customer card whenever the second instruction lamp is either on or blinking. It will be on after entry of the dialing card or after manual entry of the telephone number and user data as above. It will be blinking if the customer card has been misread, or does not contain a properly encoded magnetic stripe.

Up to 47 characters can be manually entered in the "customer card" field, and can include any of the digits as well as the (.) and (/) keys. The Transaction telephone denotes manually entered data in this field by sending a different TOUCH-TONE character between the user identification field and the second field than it would if card entry were used. The ERASE button, if used when the second lamp is on, applies to all of the characters entered while the second lamp is on, and cannot affect entries made while the first lamp was on.

The END button should be depressed at the end of data to be manually entered in this block; it will cause the third instruction lamp to light. Data entry is completed from this point just as if cards had been inserted. When using manual entry, care should be taken not to press two buttons at once. The output of the Transaction telephone in response to multiple button depressions is not specified.

### 4.1.5 The Auxiliary Manual Entry Pad

#### 4.1.5.1 Use With the Transaction II Telephone

When the optional Auxiliary Manual Entry Pad (PIN pad) is provided, the Transaction II telephone has a key (at the upper right of the faceplate) by which the merchant can enable and disable the PIN pad. The "push on-push off" type key is lighted when the PIN pad is enabled, as is a lamp on the pad itself. The manual entry pad of the Transaction telephone remains enabled, regardless of the state of the PIN pad.

The PIN pad may be used for keying all or part of any block of manually entered data. The PIN pad has 12 buttons labeled with the digits 0 through 9, a decimal point (.) and END. Because some personal identification numbers are based in part on customer initials, all 26 letters of the alphabet appear on the buttons of the pad (Q and Z appear on the 1 button).

The information entered by either the Transaction II telephone manual entry pad or the PIN pad is not displayed when the PIN pad is enabled. Instead, the letter "P" is displayed for each keyboard entry while the PIN pad is enabled. This protects the security of the PIN or other information entered by the customer. The display, however, functions normally for displaying incoming FSK data. After the transaction is completed, it is important that the PIN pad be disabled. Otherwise, subsequent manually entered data will not be displayed.

As an illustration of the use of the PIN pad, consider a typical transaction. After the merchant has entered the second (customer) card, the third instruction lamp lights. Using the manual entry pad on the Transaction II telephone, the merchant then enters the dollar amount of the sale, followed by the field separator (/). The merchant then presses the PIN key to enable the pad, then instructs the customer to key in his PIN (or other information) on the PIN pad when the light on the pad comes on. The customer presses END when he has completed data entry. The merchant then must press the PIN key to disable the pad, otherwise subsequent manually entered data would not be displayed, even if this data is part of a later transaction.

#### 4.1.5.2 Use With Transaction I Telephone

When the PIN pad is provided with the Transaction I telephone, the physical configuration is the same as described above. Operation is also the same except that there is no visual

display. The PIN pad should nevertheless be disabled after the customer has finished entering his PIN in order to protect subsequent messages from interference by untimely use of the PIN pad.

### 4.1.6 Data Center Response

The mode of response for the Transaction telephone is normally selected by a control character on the dialing card. The character can select voice-only operation, keyed answer tone and voice operation, or FSK data reception only (Transaction II only), at either of two data rates. Data rates are selectable at 110 or 150 bits per second. The required control characters are given in Section 6.3.4.

After data entry, final depression of the END button, and transmission of data, both the manual entry pad and the card reader are active when the Transaction I and II sets are being used in a voice or keyed answer tone mode. They can be used to enter more data, usually as requested by the data center response.

The two response lamps are intended to reduce the user's need for listening for a response from the data center. The green lamp may be used when an inquiry is approved, and no further action is necessary. The yellow lamp may be used to mean the response is more complicated, and that the user should listen for a detailed audio response, or follow procedures outlined on the display.

When the Transaction II telephone is used with the data receiver activated, then the card reader and manual entry pad are disabled following transmission of the initial inquiry (or follow-up messages followed by END), until a data message is received. An exception to this is that the ATTN key can be used, by lifting the handset and pressing the button, to unlock the pad and send out the attendant request signal (**).

In the case of data receiver operation in the Transaction II telephone, numerous different responses are possible, using combinations of nine different response codes. These codes allow lighting either of the response lamps (or blinking them), causing the set to hang up, to hold on for an extended period, completing the execution of the response, or to unmute the call progress sounder. (Normally, the call progress sounder is muted while the set is in contact with the data center.) In addition to control characters, the data receiver can receive characters for presentation on the visual display. Although the visual display contains only eight characters, more characters can be sent for later presentation. These additional characters are accessed by operating the "ERASE" button, which clears the display contents and brings in the next display stored in the buffer. The total number of characters that can be received for display is limited by the buffer size. The buffer has a capacity of 120* characters, including control characters as well as characters for display. Details on use of the visual display are covered under message formats in Section 4.1.15.5. The visual display is a seven segment display, thus, all of the digits and certain alphabetic characters can be displayed. For example, the display can show a capital "A," but not, for example, a "W." See Figure 9 for a list of the displayable characters. Blanks are substituted for non-displayable characters. Control characters in the ASCII alphabet, as well as nonprintable characters, are ignored, and not buffered except as described in Section 4.1.15.5.

The ASCII character "/" can be used as a display format control character. It is used as a display field delimiter when the user wants to display fewer than eight characters at a time.

Keyed answer tone responses can be used to light either the green or the yellow response lamp on the Transaction telephones. When either lamp is lit in this manner, the Transaction telephone acknowledges receipt of the answer tone by sending either a TOUCH-TONE "a" (for the green lamp) or a TOUCH-TONE "b" (for the yellow lamp) to verify that the correct response is received. If the incorrect response is indicated, the data

*Early versions of the Transaction II have a 63 character buffer. The 120 character buffer is available with the printer interface.

center may retransmit the correct signal. If the user has not disconnected, the new signal will cause the appropriate response at the Transaction I telephone. The correct lamp will be lit, and the acknowledgment will be sent. An erroneous green light can be corrected in this manner in the Transaction II telephone, but an erroneous yellow light cannot be changed unless the user goes off hook within 20 seconds of the lighting of the yellow light.

In the case of the yellow lamp response, the Transaction I telephone automatically sends a signal, "##", indicating it is ready for the audio response, after the "b" acknowledging activation of the yellow lamp.

If the Transaction II telephone is used in the KAT response mode with the receiver on-hook, then the ready for voice (##) signal following the yellow response will not be sent until the receiver is lifted.

Keyed answer tone reception will not work properly if buttons are pressed on the pad between the end of data transmission and receipt of the tone signal, unless the END button is used after such button depressions. Therefore, if extra data is needed by the data center after the initial transmission before lighting either response lamp, the additional data should be followed by pressing END.

In the voice-only mode of the Transaction telephone, neither the answer-tone detector nor the FSK receiver is active. In the Transaction II telephone, a call using a voice-only dialing card can be initiated only with the handset off-hook. Although the data receiver is inactive, data entered on the manual entry pad is displayed by the Transaction II telephone in this mode.

### 4.1.7 Referral to an Attendant

With their telephone functions, the Transaction telephones offer a unique opportunity for referral to a human attendant of complicated inquiries, or inquiries that the computer is otherwise unable to answer. Referral under control of the computer is a feature provided in the 407C data set. In addition, a simplified means of referring a call to an attendant at the initiative of the user is built into the Transaction telephone when operating with a 407C data set.

To request an attendant, the user lifts the handset and depresses the "ATTN" button on the Transaction II telephone. Further data transmission is interrupted, and the special signal, "**", is sent immediately. Operation is the same with the Transaction I telephone. If the data center is equipped with a 407C data set optioned for "Terminal Initiated Referral", a referral is automatically executed by the 407C data set. (Details of data set operation are covered in Section 4.2.) If the data center is not equipped with a 407C with this option, appropriate action should be programmed into the host computer to handle the "**" situation. The ATTN button should not be depressed until the call has reached the data set and the initial 2025 Hz answer tone has been detected.

An attendant can also be requested by the data center by transmission of a special ASCII code to the 407C data set. This has application when the computer detects a condition which requires the intervention of an attendant.

Sometimes it will be useful to return to the data mode of either Transaction telephone after talking with an attendant. Therefore, after using the ATTN button, the user can enter additional data using the manual entry pad or the card reader.

**Note:** A return to the data mode of the Transaction telephone must be coordinated with the return to the corresponding mode at the data center.

Once this is done, and the END button has been pressed, the Transaction II telephone will return to its original mode of operation, be it voice only, KAT, or FSK. However, the receiver cannot be placed back on-hook until the end of the call. In the same manner, the Transaction I telephone returns to the voice only or KAT mode of operation following depression of the END button.

### 4.1.8 When the Data Center Computer is Unavailable

When the computer is down, it may be advantageous to answer calls and notify the caller that problems exist. Or, there may be applications in which most calls can be handled in a limited manner without data center contact while only exceptional calls need be handled by attendants at the data center. For example, in credit authorization, transactions below a floor limit might be handled by the merchant's use of a "hot card" list periodically distributed to all system users by the data center. Transactions which have a dollar amount above a certain threshold would be referred to an attendant having up to the minute information only available at the data center.

To provide these features, the Transaction telephone has a special "computer down" mode of operation that is operable with a 407C data set. If the computer down mode is in effect, the 407C responds to ringing with a 3.0 second answer tone rather than the normal 1.5 second answer tone. The Transaction telephone detects the long answer tone and goes into its computer down mode, in which it does one of two things, depending on "floor limit" characters entered from the dialing card and on the manually entered "dollar amount."

If the dollar amount is less than the floor limit specified by the data center in a special field on the dialing card, the Transaction II telephone will display the word "SPECIAL" on the visual display. Similarly, the Transaction I telephone will light the fourth instruction lamp labeled "follow special instructions." If the dollar amount is equal or greater, the Transaction II telephone will light the yellow response lamp and, when the handset is lifted, send the "**" signal to automatically request an attendant for special processing. In the case of Transaction I, the "**" signal is sent out immediately after the lighting of the yellow lamp. The specified floor limit may be any 3-digit number between 000 and 999 or it may be omitted, in which case, whenever the computer down mode is detected, the set acts as if the floor limit were infinite. When no floor limit is used, the ATTN button can still be used to send out the "**" signal.

For purposes of floor limit comparison, the Transaction telephone uses as the "dollar amount" the numbers entered preceding either a decimal point (.) or a field separator (/) while the third instruction lamp is lit. Characters entered after the decimal point or field separator are not utilized in the comparison.

### 4.1.9 Dialing Card Options

In general, the data center need not be concerned with the dialing mode of the Transaction telephone. However, there are optional characters on the dialing card that are used to control special dialing features. These characters can be included on the dialing card as required to simplify system operation. These features include:

1. Two-part dialing, to serve customers who must dial part of a telephone number, wait for dial tone, and then dial the rest.
2. Two-part dialing, with a change in dialing mode (split-mode dialing) to allow for part rotary and part TOUCH-TONE dialing.
3. Predialing, to cause the telephone number to be dialed after insertion of the dialing card rather than the customer card. (Particularly useful on TOUCH-TONE lines for long distance calls).
4. Automatic repertory dialing without insertion of the dialing card. In this case, the Transaction telephone automatically dials the number on the last dialing card entered.

These features are designed to facilitate user operation of the sets. The card requirements for control of the options are described in Section 6.3.

The two-part dialing option is used with PBX or tie line installations where a second dial tone wait is required. Note that in some installations, such as with CENTREX in some localities, the second dial tone is instantaneous, so that no wait is required; one-part dialing can be used in these cases. The local telephone company should be consulted for details.

Note that if a dialing card that is not encoded with the characters for two-part dialing is used in a location requiring two-part dialing, the first portion of the telephone number should not be encoded on the card. Rather, the first part of the number, before the second dial tone, must be dialed using the TRIMLINE handset.

The predialing option is useful on TOUCH-TONE installations where the telephone number is easily transmitted between card insertions, particularly when long distance calls are being placed. Dialing is accomplished in about 1 second, using TOUCH-TONE, which is less than the time usually required to enter the second card. However, in the predialing case, the second instruction lamp does not come on until after dialing is complete; the second card should not be inserted until after the lamp comes on. Therefore, predialing should not be used with rotary dialing because of the relatively long time required to complete dialing, during which time the user cannot enter the next card. Nor should predialing be used when a short duration is anticipated for connection to the data center and a magnetic stripe customer card is used, since the answer tone may be missed if it occurs while the customer card is being read. If the answer tone is missed, the data in the buffer can be transmitted by depressing the END key two more times, after data has been entered in the normal manner.

Use of predialing can also cause reduced sensitivity in the 407C data set, if the customer card is not entered before the answer tone is received. This happens because the data set waits, after transmitting the answer tone, for the first character from the Telephone (which identifies it as a Transaction telephone). If the character is received within 1 second after the answertone ends, the computer cannot transmit any data until the initial message is complete. However, if a delay occurs in entry of the customer card, the Transaction telephone will not transmit any data and the data set, after the 1-second wait, will allow computer generated data to go onto the line as FSK. The outgoing FSK signals can reduce the sensitivity of the 407C and cause errors in the system. Therefore, if significant delay is anticipated between the entering of the dialing card and that of the customer card, predialing should be avoided.*

The automatic repertory dialing feature is most useful when the user usually or always wants to call the same data center and provide the same identification information. Unless this feature is disabled by a special dialing card character, the Transaction telephones store the information from the dialing card. Insertion of the customer card will automatically cause the stored information to be utilized, and the set will dial the last number entered with a dialing card. All information on the stored dialing card is retained, and the set transmits data just as if the dialing card had been inserted. So long as power is continuously applied to the set, the old dialing and user information will remain in memory until different information is entered, either via a dialing card or by using the manual entry pad for dialing. If power is removed from the set, and later restored, the yellow light will flash to indicate that the stored information has been lost.

When the manual entry pad is used for dialing, the dialed number is not stored for future use in the Transaction I telephone, and the previously stored data is erased even if the keyboard is locked out. The information entered manually while the first instruction lamp is on is stored, however, by the Transaction II telephone.

When two-part dialing is required and the one number dialing feature is used in the Transaction I telephone, the predialed portion of the number must be entered on the TRIMLINE handset before the customer card is entered. The predialed portion must not be encoded on the dialing card.

The Transaction II telephone offers additional one-number dialing features. In the case of two-part dialing, the first part of the number

*This application assumes the selection of the Data Flow Control (DFC) "Protocol" option in the 407C, see Section 4.2.5.1. Otherwise, the computer should not be transmitting before the initial inquiry is complete, to avoid any possibility of error.

can be recalled by pressing the ATTN button. After the second dial tone begins and the second instruction lamp comes on, either the insertion of the customer's card or the beginning of entry of customer data on the manual entry pad causes transmission of the rest of the telephone number. In the case of single part dialing, depression of the ATTN button causes the Transaction II to sequence to the second instruction lamp, exactly as if the dialing card were inserted, after which the customer data can be entered. In both cases above, depression of the ATTN button causes the telephone to turn on the second instruction lamp.

The options controlled by the dialing card are summarized in Table 2, and discussed in detail in Section 6.3.

### 4.1.10 Default Options With Manual Dialing

Control characters normally on the dialing card cannot be keyed in manually. Thus, when manual dialing is used, the following options are implemented in the Transaction I telephone:

1. The floor limit feature is set so that the fourth instruction lamp always comes on when the computer is unavailable.
2. The second and subsequent card ABA check characters are checked.
3. Information keyed in is not stored for future automatic one-number dialing.
4. The green and yellow lamps are inoperable except when the computer-unavailable condition exists.

Operation with the Transaction II telephone is similar, with the following additions:

1. The symbols "SPECIAL" appear on the display when the computer is down.
2. Information keyed in is saved for future automatic one-number dialing if the END button is pressed at the end of the telephone number and at the end of the user number.
3. The set operates in the voice-only mode when the call is originated by lifting the receiver, then dialing. However, if the call is initiated by pressing the ON button, then dialing, the set will operate with the data receiver active at 150 bps.

### 4.1.11 Use With Operator Intercept

Special operating procedures must be followed when using the Transaction II telephone in areas where operator intercept is used to identify the calling telephone.

In normal operation involving intercept, the dialing card (which must be encoded for the pre-dial option) is entered in normal fashion. The user must wait for the intercepting operator before inserting the customer card or manually entering data. When the operator is heard through the call progress sounder, the user picks up the handset and gives the required information. Then the handset can be returned to the cradle while the ON button is simultaneously depressed. The call then proceeds normally.

In cases other than the one described above, (i.e., manual dialing or two-part dialing, etc.), the transaction may begin with the handset on-hook, but, after the intercept has occurred, the handset cannot be replaced on-hook.

### 4.1.12 Unrestricted Format Data Transmission

There are applications of the Transaction telephones where an extended dialogue between the user and the data center is desirable. Such a dialogue is possible with the Transaction telephones after the initial inquiry and response have taken place. In this mode of operation, magnetic stripe cards are read, checked for parity, and transmitted exactly as encoded (except that the start sentinel, end sentinel, and card LRC are not transmitted). The set appends the message LRC and character count to the message only if the original merchant number begins with hexa-decimal D8 (See 4.1.15.3). Similarly, manually entered data is also transmitted exactly as entered. Manual entries in this mode should be limited to 64 characters before depressing the END button.

If it is desired to conduct an entire call in the unrestricted format mode, the user must depress the END button four times during the time that the call to the data center is being completed. Note that if a dialing card is used, it must be a "predial" card. This operation causes transmission of the fixed format data originally stored in the Transaction telephone buffer and allows unrestricted dialogue with the data center once the call is completed. (Answer tone no longer has an effect on data transmission once the END button has been depressed four times). The above mode of operation is useful in communicating with data centers which are intended for use with TOUCH-TONE telephones.

**Note:** This application is valid only if a single TOUCH-TONE "#" is not needed, since the (/) button causes transmission of a TOUCH-TONE "b" in this mode.

The instruction lights are not operative when the set is in the unrestricted mode. However, the Transaction II telephone display is active. EOO appears on the visual display when the data center sends a NAK (negative acknowledgment) or a "1" in the action field to the telephone following an error in a transmitted message.

### 4.1.13 Options Set at Installation

These options, summarized in Table 3, include selection of the primary dialing mode as either TOUCH-TONE or rotary dial pulse, and enabling or disabling manual dialing and entry of user data (normally read from a dialing card) via the manual entry pad. Disabling the manual entry pad for dialing and user data entry forces the user to have a dialing card to execute a transaction. Other options include installation of the Transaction telephone as part of a key telephone system utilizing a separate keystrip. The optional auxiliary manual entry pad (PIN pad), which allows the customer to privately enter his personal identification number (PIN) for security purposes, is also available.

A final option, available only with the Transaction II telephone (with the printer interface) is one-number dialing. With this option installed only one number, loaded into the memory after a power interruption (using a dialing card) can be dialed. The handset, keyboard, and dialing cards are ignored for dialing purposes. A call to a data center can be initiated only by pressing the ATTN button or entering a customer card. The memory must be reloaded by a dialing card whenever AC power is interrupted.

### 4.1.14 The Effect of ATTN and ERASE Keys

The ATTN and ERASE buttons have a number of separate functions in the Transaction telephones. When the ATTN key is depressed, the character sequence "**" is transmitted. Transmission of this signal is accomplished immediately when the button is depressed. No further information is transmitted until another button is depressed on the manual entry pad or the card reader is used.

**Note:** If the initial inquiry has been entered completely, including the final depression of the END button, the ATTN button has no effect until the data has been transmitted.

The ERASE button, when pressed while any of the first three instruction lamps are on, will cause the Transaction I telephone to attempt to erase all of the manually entered data blocks entered while the instruction lamp is on. If any of the data has already been transmitted, or no lamp is on the set will not erase any data; instead it will transmit the TOUCH-TONE sequence "bb". The ERASE button must not be operated during the dialing or entry of a telephone number.

In addition to the above operation, the ATTN and ERASE buttons have additional functions in the Transaction II telephone only.

The ATTN button, if it is pressed before any other button after going off hook (by lifting the handset or by pressing the ON button) has the same effect as inserting the last-used dialing card if information is stored in the repertory. If the card was a predial card, the telephone number will be sent immediately. If the card was coded for normal dialing, the telephone number will be sent as soon as a customer

card is read or any digit is pressed. If two-part dialing was encoded, then the predial portion of the number will be sent when "ATTN" is pressed, and the rest will be sent when the customer card is inserted or the manual entry pad is used. This feature does not affect normal use of the repertory dialer, which is activated by inserting a customer card immediately after going off hook.

The ERASE button in the Transaction II telephone, in addition to the function described above, also controls the visual display on the set. When more than eight characters have been received for display or the "/" was used to segment the display, pressing ERASE cycles the display to show the next eight characters. When ERASE is pressed and there are no further characters to display the display is cleared. In this regard, the ERASE button functions whether the set is on or off hook.

### 4.1.15 Message Formats

The Transaction telephone transmits five kinds of information in a normal inquiry message. These include, in order of transmission: the telephone type identification (TID), the user (merchant) identification information, the customer identification information, the amount field, and the message check characters. The TID and message check characters are generated automatically by the Transaction telephone. The other kinds of information correspond directly to the information entered through card entry or from the manual entry pad or PIN pad. The message format is illustrated in Table 4.

#### 4.1.15.1 Terminal Identifiers (TID)

The Transaction telephone transmits TID characters at the beginning of data transmission immediately following the 1.5 second answer tone (see Table 5). These characters identify the type of set in use and provide certain information about how it is being used. The first character transmitted is always a TOUCH-TONE "b" ($A_2B_4$) for Transaction telephone sets. The next two characters are digits in the range of 0 through 7 that identify features. The digits are interpreted in accordance with their binary representation as follows:

The low order bit of the first character after the "b" indicates whether the message check characters include both a character count (CCT) and a longitudinal redundancy check (LRC), or only an LRC. A one (1) in this position indicates an LRC only; a zero indicates both an LRC and a CCT. Early versions of the Transaction telephone have the LRC only. Calculation of LRC and CCT are detailed later in this section.

The next bit is used for the Transaction II telephone, which is offered with "hands-free" operation. A one in this position indicates that the set is being used with the handset "off-hook" so that it is ready to receive audio messages. A zero indicates it is "on-hook" and unable to receive an audio message. The bit is always a one in the Transaction I telephone.

The next bit, the highest order bit used for TID, indicates whether the user information, normally encoded on a dialing card, was entered on the manual entry pad or from the card reader. A one indicates manual entry, and a zero indicates that the dialing card was used.

The third TID character (second character following the initial "b") is nonzero only for the Transaction II telephone. If the high order TID bit is one, (the character has value 4) then the Transaction II telephone is in use and the data receiver is active. If it is a zero, the data receiver is inactive.

The middle bit in the third TID character is reserved for use with a printer and is always zero in the present Transaction II telephone, without printer.

To allow for the possibility of expansion to more sophisticated sets, allowance has been made in the TID for additional characters by using the low order bit as a chain bit. Thus, if the low order bit of the third character is a one, the next character is also a TID character. The last TID character is then identified by a zero in the low order bit position. The chain bit is always zero in the Transaction I and Transaction II telephones. The TID characteristics are summarized in Table 5.

#### 4.1.15.2 Data Following the TID

Following the telephone type identification characters the Transaction telephone transmits data in the order that it has been entered. The first transmitted data is the merchant identification information, part of which may be used for LOGON characters, (see Section 4.2.5.6) just as it is read from the dialing card or is keyed in. Next the customer data follows. Customer data is preceded by a TOUCH-TONE "a" ($A_1B_4$) if a customer card is used. It is preceded by a TOUCH-TONE "b" ($A_2B_4$) if the customer data were keyed in using the manual entry pad, and/or the PIN pad.

When customer data is entered via a customer card, only the data (and not the control characters) are transmitted to the data center. The start sentinel, end sentinel, and card LRC are replaced by the TOUCH-TONE "a" at the onset and at the end of the card data. The card LRC is checked automatically by the telephone unless the dialing card option to inhibit the check is selected.

Finally, data entered in the amount field is transmitted. This data is preceded by the TOUCH-TONE "a" sent at the end of customer data. When the merchant presses the END button after keying in the amount field, the telephone sends the end of text (ETX) character sequence (##) followed by the message check characters. A typical inquiry is shown in Table 4.

These data fields correspond to use of the Transaction telephone as described in Section 4.1. Note that when the END button is pressed after manually entering the user identification information, a TOUCH-TONE "a" or "b" is sent depending on the mode of entering the customer data.

When the END button is used after manually entering the customer data, the TOUCH-TONE "a" is sent. When the END button is used after the amount field, the end of text sequence and message check character(s) are sent. Finally, when the END button is used later on rekey messages, the telephone sends the ETX sequence, and, possibly, the message check character(s). This situation is covered in Section 4.1.15.3.

The LRC on the transmitted message is calculated by summing the binary representation of the TOUCH-TONE characters, without carry, using translation Table 1. The transmitted LRC is the corresponding TOUCH-TONE character. The LRC calculation includes the first character transmitted (the TOUCH-TONE "b") through the end of text sequence.* For the example shown in Table 4, the LRC is 0.

The character count CCT, is the modulo-10 count of all characters, including the ETX sequence and LRC. It will appear immediately following the LRC in the message character sequence, if the TID so indicates. The character count for the example shown in Table 4 is 2.

#### 4.1.15.3 Messages Following the Initial Message

After the Transaction telephone has sent the initial inquiry message, additional data can be sent either from the card reader or from the manual entry pad. Such data may be sent in response to data center-originated requests for reentry of information, or they may be sent as part of a normal procedure.

When used to send such additional messages, the Transaction I telephone sends what is entered from the card reader or keyed in from the manual entry pad; for card reader entries, data on the card, exclusive of the start sentinel, the end sentinel, and the LRC, are transmitted. Any card characters encountered in the text, exclusive of the end sentinel, will be sent. Thus, if the dialing card is reentered, the telephone number and control information will be transmitted. Before entering additional information after entering a card, the user must wait until the card data is sent. Manually entered information should not exceed 64 characters before pressing the END button, after which another 64 characters can be entered manually. This message format is illustrated in Tables 4 and 5.

*Note that the ETX sequence does not contribute to the LRC because the sum without carry of two identical characters — in this case, ## — is zero.

Messages following the initial message for the Transaction II telephone are handled similarly in the voice and keyed answer tone modes. In the FSK mode, follow-on messages cannot be entered until after the set receives a response message from the data center. Until this occurs, the manual entry pad and PIN pad are locked out from further data entry and the card reader is inoperative.

The Transaction telephones will append the LRC and CCT characters to all subsequent messages if and only if the user identification field on the dialing card (see Section 6.3.5) starts with the hexadecimal sequence "D8." The Transaction telephone also appends an STX sequence (TOUCH-TONE "b9") to the beginning of the subsequent messages.

#### 4.1.15.4 2025 Hz Answer Tone Signals

A 2025 Hz tone, with a duration of either 1.5 or 3.0 seconds, is used to control some features of the Transaction telephone. Because such a 2025 Hz tone is used after tripping ringing in the 407C data set, the 2025 Hz tone is called answer tone. The tone is generated automatically by the data set when the call is answered; in addition, the computer can cause the 407C to generate the tone by transmitting the proper ASCII character sequence to the 407C (see Section 4.2.8). The Transaction telephones receive keyed answer tone signals for triggering data transmission, for triggering computer-down operation, or for operating the green and yellow response lamps.

Data transmission and computer-down operation are triggerable only after inserting a dialing card or after an initial depression of the END button when manual dialing is used. As described in Section 4.1.4, manual dialing is accomplished by first keying in the telephone number, then depressing the END button, then keying in any user identification information. For manual entries, the first END button depression must be accomplished before the keyed answer tone can be detected, even if no telephone number is to be dialed.

Data transmission is triggered by a 2025 Hz tone of 1.5 seconds (±5) duration. The computer-down operation is triggered by a 3.0 to 4.0 second answer tone.

In addition, the 1.5-second answer tone operates the green lamp indication (if enabled by the dialing card) on the Transaction telephone when it is received after transmission of the ## and LRC sequence. (In the Transaction II telephone the lamps will not operate after the ATTN button has been depressed unless the END button has been subsequently pressed.) Upon receipt of the green lamp signal, the Transaction telephone lights the lamp and sends the TOUCH-TONE character "a" ($A_1B_4$). The operation of the 407C when communicating with these telephones is described in Section 4.2.8. In the Transaction I telephone, or when the Transaction II telephone is used with KAT response, if the wrong lamp indication is received, the condition can be corrected by sending the correct signal (again), as described in Section 4.1.6.

A 3-second answer tone sent in lieu of the 1.5 second tone in this mode will operate the yellow lamp. Upon receipt of the lamp signal, the Transaction telephones light the lamp and send the TOUCH-TONE characters "b##" ($A_2B$-$A_4B_3$-$A_4B_3$). In the Transaction II telephones using KAT response, the "##" portion of this signal will not be sent until the merchant picks up the handset in response to the yellow light.) The "b" should be interpreted as meaning that the yellow lamp has been turned on and the "##" shall be interpreted as meaning that the set is ready to receive an audio message.

#### 4.1.15.5 Use of FSK Data Signaling

There are two aspects to consider for using FSK signaling as the primary response mode for the Transaction II telephone. These are the message format and the data link control protocol. The format merely determines the content of the actual response message. The protocol determines the way that message integrity is guaranteed, for either the inquiry or response message, as well as the steps the user must take when using the terminal.

### The Data Message Format

In general, response messages should be of the format shown in Figure 10. Messages sent under this format allow full control of the Transaction II telephone's features. In this format, the STX is always required to allow the terminal to synchronize to the incoming message. The action field, which appears next, is optional and is used to control operation of the set, exclusive of the numeric display. The action field can contain any number of characters, each individually having a control function. The "?", used as a field separator, *must* be included whether or not there are any characters in the action field. The action field characters for control of set functions are shown in Table 6. Note that these characters include provision for a negative acknowledgment, which requests retransmission of the inquiry message. It is recommended that no characters for display be sent following the "?" when this character, i.e., (1) is used in the action field.

Only one lamp can be lit at once. However, any combination of characters that does not violate this rule can be used. For example, to blink the yellow lamp and disconnect, send 789 in the action field.

Inclusion of a disconnect character in the message will cause the set to send *#* and disconnect immediately, if the receiver is on-hook. If disconnect is not included, the set will be ready for entry of more data by the user. If the user takes no action, then the set will send *#* and disconnect after 45 seconds. Alternatively, if the long time out control character (0) is received, the set will disconnect and send *#* after approximately 3 minutes.

The LRC character in the message is optional in the sense that the character "3" may be included at the beginning of the action field to prevent checking of the LRC. This may be used as a diagnostic aid or to enable using the set in some systems unable to calculate the value of the LRC. (The 407C may be optioned to perform this calculation and other error control functions.) When used, the LRC character is computed as the sum, without carry, of the bits of all 7-bit characters in the message, including the ETX, but not the STX, characters.

If the character "5" is included in the action field, the telephone will acknowledge the completion of the response message by transmitting the sequence "4##" when the last response held has been executed. Use of this character in the action field causes the character "9",to be ignored if it occurs in the action field. In addition, after transmitting the "4##" sequence, the telephone will be ready to receive FSK data.*

Characters following the first "?" delineating the action field will be displayed on the visual display. Displayable characters are given in Figure 9. Non-displayable characters are displayed as blanks. In addition, the ASCII character "/" can be used as a display field delimiter. An example of a message that would cause the green lamp to light and the display to show "A 456" is shown in Figure 10b. When the ERASE button is pressed, the display changes to "78" and when pressed again, it shows "9." Space characters can be used to center the display, as desired. The use of the "?" character in the display field is reserved for future offerings. In addition, the ETX, ENQ, ACK and NAK characters may not be used in the display field.

## 4.1.15.6 Data Link Protocol and Error Control

### Control Sequences and Overview

Control sequences sent to the Transaction II telephone in FSK are ASCII. Similar codes have been defined as TOUCH-TONE sequences for the Transaction II telephone operating with the data receiver, and these are given in Table 7. Certain other codes have been defined, and their use will be described in the following paragraphs. Remember that the Transaction II telephone sends TOUCH-TONE and receives FSK.

The data line protocol for the Transaction II telephone has been designed so that three

*This function is not available with early Transaction II telephones.

different levels of error control are possible, depending on the level of sophistication the data center operator wants to design into the system. The three levels are, the simple protocol, full protocol, and an optional simplified protocol with a reduced character set. Each of these will be discussed. The level of protocol is invoked in the telephone by the response of the data center to the initial message sent by the telephone.

**Selection of Protocol for Operation with 407C**

The 407C data set is functionally designed to operate in its most efficient mode with a Transaction II telephone using the simple protocol. As will be described later, the 407C provides error control features compatible with the operation of the telephone in this mode. It is possible to invoke the full protocol in the Transaction II telephone in this system. However, a number of features of the 407C must be sacrificed to do so.

**Responses to the Initial Messages: Invoking Protocol**

After sending the initial message, the Transaction II telephone sets a timer for 20 seconds. During that interval, the keyboard is locked out, except for the ATTN button, as discussed earlier.

After sending the initial message, the Transaction II telephone is receptive to six control characters or sequences: The positive and negative acknowledgment characters (ACK and NAK), the STX character, the start of header character (SOH) (not used in this type of system), the disconnect sequence (DLE-EOT), the ENQ character, and the special NAK sequence (DLE-NAK). The use of some of these characters is explained in this section.

Control of the protocol mode in which the set operates is accomplished by receipt of the ACK or STX control characters. If the set receives an ACK after the initial message, it will enter the full protocol mode. If the response message follows the initial inquiry directly, the STX character, which begins the response, invokes the simple protocol. If, instead, the set receives a NAK, it will retransmit the inquiry message without affecting the protocol mode. The subsequent response then selects the mode. Operation in response to ENQ, DLE NAK, and DLE EOT will be discussed shortly.

If, after transmission of the initial inquiry message, the ACK control character is received, then the set will send the EOT sequence (5#5) in TOUCH-TONE, set its internal timer to 45 seconds, and await a response message. When a response is received correctly it will send the ACK sequence (4#4), but the terminal will not execute the contents of the message until after it has received the EOT control character from the data center.

**The Simple Protocol**

Normally, the Transaction II will receive an FSK message in response to the initial inquiry. The STX at the beginning of this message will invoke the simple protocol. If the message has no detectable errors, then the terminal will send the TOUCH-TONE "ACK" sequence (4#4) and execute the contents of the message. If the set detects an error, it will instead send the "NAK" sequence (3#3) and await retransmission of the message for a new 20-second interval.

Detectable errors in the message include the following:

1. Incorrect message LRC
2. Incorrect parity on any character
3. Missing ETX character or an interruption in transmission lasting more than 3 seconds

One of two levels of error control can be selected here through use of the character "3" in the action field, as discussed in 4.1.15.5. If the "3" is present, then the message LRC is not checked, and the simplest protocol is in effect.

If, before receipt of a data message, 20 seconds elapses, and if the call was initiated by pressing the "ON" button and if the receiver is still on hook, then the set will automatically send the disconnect sequence, *#*, and disconnect. If the receiver is off-hook and the time out elapses, no action will be taken automatically, and the set will still be

able to receive messages until the user hangs up.

### Full Protocol

The full protocol is invoked, as mentioned before, by the receipt of the ACK signal following the initial message from the terminal. In addition, when the full protocol has been invoked, the telephone will transmit the EOT sequence (5#5) whenever it receives the ACK sequence. Moreover, when the telephone receives and verifies a valid FSK message, it will transmit the ACK sequence (4#4), but, unlike the simple protocol, the telephone will not act upon the message until an EOT signal is received. If the EOT is not received within 45 seconds, the telephone will disconnect and send "*#*"

### Rekeys

Messages following the initial message are treated by the full protocol if that was invoked by the initial response. If the simple protocol was invoked, the telephone can be placed in the full protocol mode at any time by the receipt of ACK following any follow-up message. If the full protocol is invoked, the Transaction II telephone will respond to a correct message with the ACK (4#4) sequence and await the EOT before executing the message. In the simple protocol, the set will send the ACK sequence and execute the message immediately.

If the telephone receives the ASCII NAK character after transmitting a follow-up message, the message will not be retransmitted (as the initial message would be). Instead the legend "EOO" is displayed on the face of the telephone.

### Additional Control Characters

If at any time the Transaction II telephone receives the DLE-EOT control sequence, it will send the disconnect signal (*#*) and automatically hang up, unless the receiver is off-hook. If the receiver is off-hook, then the characters HANG UP will appear on the visual display.

When the Transaction II telephone receives the DLE-NAK control sequence, it will send EOT (5#5) signifying that it is ready to receive FSK data. This feature is useful in the case of slow data entry by the user, in which the data center wants to inform the user that he is taking too long. More important, it is a valuable tool for error recovery, as discussed in detail in Section 4.2.4.5. The telephone can receive the DLE-NAK sequence during the pauses between manual entry pad button depressions, when TOUCH-TONE characters are not being sent. However, such reception is not always reliable because of the possibility that TOUCH-TONE characters may be ready to go out concurrent with DLE-NAK reception. Therefore, DLE-NAK should always be sent again by the data center if the proper response is not received within a few seconds after the first transmission.

Similarly, the telephone can handle a DLE-EOT sequence during pauses between characters, in which case it will send the disconnect sequence and hang up. Once again, it is recommended that the DLE-EOT sequence be sent repeatedly until the *#* is received — when the Transaction II telephone is in a Transmit condition — because of the possibility of concurrent TOUCH-TONE and FSK transmission.

Another character that can be used by the data center is the ENQ control character. This is used, in the full protocol, when the data center does not receive the ACK or NAK control character after a response message; it will cause the telephone to retransmit the last control character. If there is no "last control character", which could happen if the telephone does not receive the ETX character in the message from the data center, then the telephone will send NAK. During that interval, until the ETX is received, the keyboard is locked out, except for the "ATTN" button, as noted earlier.

## 4.2 407C Data Set and Referral Equipment

This section describes in detail the operational features of the 407C Data Set in the Transaction telephone system. In addition, the operation of the 407C in conjunction with commonly provided referral equipment, namely, CALL DIRECTORs and Automatic Call Distributors, is also described.

### 4.2.1 Customer Interface

The 407C data set provides a serial interface that conforms to the characteristics of EIA standard RS-232-C. A 25-pin connector that provides an interface identical to that described in the standard, with the addition of a voice port, is employed for connection to the Transmission Control Unit (TCU). An optional parallel interface, identical to that of the 407A and 407B data sets, and intended primarily for interface with Audio Response Units is also available. This interface is described in detail in PUB 41804. TCU manufacturers must supply a matching plug and hood for the interface. The basic connector shall be a Cinch DB-19604-432, or equivalent, terminating a 25-conductor cable. If the cable used has a 1.125-inch maximum bending radius, such as that obtainable from Alpha Wire Company 1181/25-22 AWG, then a Cinch DB-51226-1 straight molded hood may be used. If the cable has a larger bending radius, a right-angle hood, Cinch 239-13-99-140 or its equivalent, must be used. Cables with a bending radius greater than four inches are not recommended. A summary of the serial interface leads is given below and is followed by a detailed description of each of the circuit functions.

### 4.2.2 Interface Summary

| Pin No. | Designation | EIA Circuit Designation | Discussed in Paragraph |
|---|---|---|---|
| 1 | Frame Ground (FG) | AA | a |
| 2 | Send Data (SD) | BA | b |
| 3 | Received Data (RD) | BB | c |
| 4 | Request to Send (RS) | CA | d |
| 5 | Clear to Send (CS) | CB | e |
| 6 | Data Set Ready (DSR) | CC | f |
| 7 | Signal Ground (SG) | AB | g |
| 8 | Data Carrier Detector (DCD) | CF | h |
| 9-16 | Not Used | — | — |
| 17 | Voice Answer-back A | — | i |
| 18 | Voice Answer-back B | — | i |
| 19 | Not Used | — | — |
| 20 | Data Terminal Ready (DTR) | CD | j |
| 21 | Not Used | — | — |
| 22 | Ring Indicator | CE | k |
| 23 | Not Used | — | — |
| 24 | Not Used | — | — |
| 25 | Out-of-Service | — | l |

a. Frame Ground, Lead 1: This conductor is electrically bonded to the data set frame. It is further connected to external grounds through the power cord. This should be the same ground as used for Frame Ground by the TCU.

b. Send Data, Lead 2 — From TCU to Data Set: Signals on this lead are used by the 407C to modulate the Frequency Shift Keyed (FSK) transmitter which transmits the signals onto the telephone line. The TCU must keep this lead in the MARKING (ONE) state except when data is being passed to the 407C. Data passed to the 407C data set is asynchronous, in start/stop ASCII format (seven data bits, plus start bit, stop bit(s), and parity bit) with even parity, at the data rate selected by the customer.

c. Received Data, Lead 3 — From Data Set to TCU: Signals are passed to the TCU on this lead in ASCII format at the data rate selected by the customer. The data set holds this lead in the MARKING (ONE) state except when data is being passed to the computer.

d. Request to Send, Lead 4 — From TCU to Data Set: This lead is normally used by the TCU to place the data set in a transmit mode. However, since the 407C is in a transmit mode whenever it is connected to the telephone line (except when data flow control (DFC) protocol prohibits), this lead is ignored by the 407C.

e. Clear to Send, Lead 5 — From Data Set to TCU: This lead follows, in all cases, the state of the Data Set Ready (DSR) lead. It is not dependent on the state of the Request to Send lead (Lead 4).

f. Data Set Ready, Lead 6 — From Data Set to TCU: An ON condition on this lead indicates that the data set is connected to the telephone line and is ready to transmit data to or receive data from the computer. An OFF condition of this lead indicates that no call is present, and the computer should ignore signals on all other interface leads, except RI. An exception to the above occurs when a

Terminal Initiated Referral or line disconnection occurs. In this case, the 407C keeps DSR ON until the computer turns off DTR even though there may be no connection to the telephone line.

g. Signal Ground, Lead 7: This conductor establishes a common ground for use as a signal reference point. At the power supply, which serves a nest of four data sets, this lead is brought to one point and connected to frame ground by a wire strap. This strap can be connected or removed at installation, as may be required to meet applicable regulations or to minimize the introduction of noise into electronic circuits.

h. Data Carrier Detector, Lead 8 — From Data Set to TCU: This lead follows, in all cases, the state of the Data Set Ready (DSR) lead (see paragraph f).

i. Voice Answer-Back, Leads 17 and 18 — From TCU to Data Set: The Voice Answer-Back leads are terminated within the data set in a 600-ohm balanced transformer. Voice signals should be delivered from the customer's equipment at -7 to 0 dBm. Tone signals should be delivered from the customer's equipment at 0 dBm ±1 dBm. Any direct current present must be less than five milliamperes. The impedance of the customer's equipment furnishing the voice signals should be balanced with respect to ground, to prevent unwanted noise transmission. The out-of-band power should meet the following specifications:

| | |
|---|---|
| 3995 — 4005 Hz | < — 19 dBm |
| 4006 — 10000 Hz | < — 16 dBm |
| 10000 — 25000 Hz | < — 24 dBm |
| 25000 — 40000 Hz | < — 36 dBm |
| > 40000 Hz | < — 50 dBm |

j. Data Terminal Ready, Lead 20 — From TCU to Data Set: The TCU must place this lead in the ON state to prepare the data set for connection to the telephone line. The TCU must maintain DTR in the ON state in order to maintain connection once it is established. Placing the DTR lead in the OFF state for longer than 50 msec causes the data set to be disconnected from the line (unless FSK or KAT signals are still being applied to the telephone line, in which case disconnection is delayed until the signals end). Moreover, if the out-of-service function is controlled by DTR, placing DTR in the OFF state for greater than 200 msec removes the data set from service.

Under option control, placing DTR in the off state on all data sets in a cabinet causes the station to enter the "computer down" mode. (See Section 4.2.7.)

Finally, the 407C provides an "interlock" feature whereby the computer must turn DTR OFF for at least 50 msec in order to completely disconnect any call regardless of the cause of the disconnection, as described in Section 4.2.9.

k. Ring Indicator, Lead 22 — From Data Set to TCU: An ON condition on this circuit indicates that ringing signal is being received from the communications line. The ON condition approximately coincides with the application of ringing signal.

l. Out-of-Service, Lead 25 — From TCU to Data Set: The presence of an ON condition on this lead will make the data set appear busy to incoming calls, under option control. When an ACD is employed, or when the option to control the out-of-service function with this lead is disabled, this lead is ignored by the 407C.

A "fail safe" function is provided by the 407C data set. This function causes the OS lead to appear ON and takes the data set out-of-service if the customer interface connector is removed. If the OS lead is ignored as described above, the data set will still be taken out-of-service if the option to control out-of-service by DTR is enabled. Neither of these functions is provided in the parallel contact equivalent interface.

All other leads are unused by the 407C. To guarantee proper system operation, there should be no connection to these unused leads on the computer side of the interface, as well.

### 4.2.3 Options

This section describes the options available on the 407C data set. Some of these options are selectable at installation and are installed or changed by Telephone Company personnel only. The remaining options are controlled by switches on the front panel of the data set and can be changed by the data center personnel at any time. The switches on the front panel are arranged in two groups, labeled A and B. They are numbered in each group from 1 to 10 with switch No. 1 at the top. The location of each switch is given by a letter and number. Thus A-6 is the sixth switch from the top in group A. Note that all options apply to both data set sections (A and B) in a 407C.

A. **Telephone Company Installed Options**

1. **Switched Network/Private Line** — Selected by option straps internal to the data set, this option allows the data set to be used via dial-up connections over the DDD network, or in direct connection to the remote terminal via a dedicated private line.
2. **ACD/Non-ACD** — This internal option is set to correspond to the presence or absence of an Automatic Call Distributor for referral.
3. **Serial/Parallel Interface** — This internal option selects the mode of interface for the set. Serial mode operation is assumed in this document.
4. **EIA/Closure Interface** — This option allows a selection, in the parallel mode, between an interface which conforms to the voltage levels of EIA Standard RS-232C or a "closure type" interface which is suitable for many ARU's requiring a contact closure interface. It is not available with option 7 below. If the serial interface is installed, this option is strapped for "EIA Interface."
5. **Call Control Code Detectors Enable/Disable** — When the parallel interface is enabled, this option enables the user to select additional features currently available on the 407B but not on the 407A. These include: automatic disconnection upon receipt of a special TOUCH-TONE code, terminal initiated referral, and "computer down" operation. This option must be enabled if the serial interface is selected, as is assumed in this document.
6. **Computer Down Detection Wiring Option** — If "computer down" operation of the 407C Data Set is desired, the call control code detectors must be enabled (see 5 above), and one or both of the two optional wiring arrangements selected. One configuration allows the 407C to enter the "computer down" mode upon detection of the operation of an external switch. The other wiring option causes the 407C to monitor all of the DTR leads in the data station. If all DTRs are OFF for longer than 200 msec, the set enters the computer down mode. When the computer down mode is in effect, the 407C answers calls, sends a special answertone signal, and allows terminal initiated referrals (if option A-5 is selected), as well as up to 15 seconds of data reception. If no computer down operation is desired, it is disabled by installation wiring.

B. **Customer Options**

Customer options are selected when the switch is in the ON position. A list of these options is given in Table 8.

1. *#* **Disconnection (A-1)** — When this option is selected, the 407C will disconnect from the telephone line at any time upon receipt of the TOUCH-TONE sequence *#*. It will not answer another call until DTR is turned off for at least 50 msec.
2. **OS Controlled by DTR (A-2)** — When the option is selected, the data set will be out-of-service whenever the DTR

lead is OFF for longer than 200 msec. (Note that if all DTRs in a station are off, and if this configuration causes the computer down mode to be entered, the station will be returned to service even if this option is selected.)

3. **OS Controlled by OS Lead (A-3)** — This option causes the data set to be out-of-service whenever the OS interface lead is ON. With the EIA voltage interface, and with A-3 ON, if no connection is made to the OS interface lead, this section of the data set will be out-of-service. Any combination of A-2 and A-3 can be installed. However, the OS switch on the front panel can always be used to take the data set out of service, regardless of the state of A-2 or A-3.

4. **TIR-Computer Up (A-4)** — When this option is ON, the 407C will respond, whenever the computer is up, to the TOUCH-TONE sequence ** by initiating a referral in a manner dictated by the referral equipment present (ACD or CALL DIRECTOR).

5. **TIR-Computer Down (A-5)** — When this option is selected, the 407C will allow a terminal initiated referral upon receipt of the ** sequence, during computer down periods. If both A-4 and A-5 are OFF, no terminal initiated referral is allowed.

6. **End of Message Characters (A-6, A-7)** — These two switches are encoded to select one of four end-of-message (EOM) sequences with the serial interface only. The EOM sequence is transmitted at the end of all control messages to the computer (See Table 9). The encoding is as follows:

| A-6 | A-7 | EOM |
|---|---|---|
| OFF | OFF | No Characters |
| ON | OFF | CR |
| OFF | ON | CR LF DC3 |
| ON | ON | DC3 |

7. **BCM Interface (A-8)** — This option applies only to a data set with the parallel interface. It provides translation of incoming TOUCH-TONE signals into BCM. The BCM translation is provided on interface pins 3, 4, 5 and 6.

8. **Closure Type/EIA Voltage Interface (B-8)** — This option is effective only with the parallel interface. It should be ON when the closer-type interface has been selected by installer option, and OFF if the EIA voltage interface was selected.

9. **Speed Selection I (A-9)** — This option selects the ASCII data rate across the serial interface. It selects either 110 BPS (ON) or 150 BPS (OFF) provided that B-9 is OFF.

10. **Speed Selection II (B-9)** — This option selects a 300 BPS data rate across the serial interface (provided that A-9 is OFF).

11. **Message Blocking (B-1)** — This option, available only with the serial interface, forms the groundwork for all of the remaining options. If B-1 is OFF, none of the remaining options are then available and **all of the remaining switches should be OFF**. If B-1 is ON, the data set "blocks" messages to the computer by translating the TOUCH-TONE sequence ## to the ASCII sequence "X EOM". In return, the computer should end all messages with the ASCII control character "DC3". If transmitting to an FSK receiver, the 407C will turn off carrier when the DC3 is sent.* In addition, as described later, if message blocking is in effect, the sequence ";;" from the computer will be translated and sent as the ASCII sequence "DLE NAK" when the "DC3" is received. If message blocking is not in effect, the 407C operation defines the end of a block of data as the last character received before any 2-second

*If B-1 is ON and the computer ends a transmission without a "DC3", the 407C continues to send marking frequency for 4 seconds (with an ASCII "NULL" character sent after 2 seconds) before dropping carrier. If B-1 is OFF, marking frequency is dropped 200 MS after the last character from the computer is received.

silent period. The first character after such a period is considered to be the first character of the next block.

12. **STX and ETX Punctuation (B-2)** — If this option is selected, along with B-1, an outgoing message from the computer will be punctuated automatically with the ASCII STX and ETX characters. The STX precedes each message. the ETX is transmitted instead of the DC3.

13. **Error Control (B-3)** — This option, if selected, provides an error control package tailored to the Transaction I and II telephones. A description of the operation of the 407C with error control is given in Section 4.2.4.

14. **Positive Acknowledgment (B-4)** — When this switch is ON (in conjunction with B-3) a proper acknowledgment to a tone or FSK message will cause an ASCII "A EOM" to be transmitted to the computer. If it is OFF, nothing will be transmitted if the proper acknowledgment is received within 1.5 seconds.

15. **Data Flow Control (DFC) Protocol (B-5):** — This option, when selected, causes the 407C to control the direction of the data flow in the Transaction telephone system. Operation with DFC protocol selected is detailed in Section 4.2.5.

16. **Logon (B-6)** — This option is ON whenever the computer system requires characters to be transmitted to the computer before data can be transmitted to, and accessed by, an applications program. Operation with logon is also covered in a Section 4.2.5.6. The logon option will not function if the DFC protocol option (B-5) is OFF.

17. **Multiple Message Segments (B-7)** — Some computer systems are configured to allow segmented messages from remote terminals. These systems require a different communications protocol. Use of this option allows the 407C to communicate with such a system. Operation under this option is detailed in Section 4.2.9. This option is also inoperative if the DFC protocol option is OFF.

### 4.2.4 Typical Call — No DFC Protocol

A typical call to a 407C data set begins when the serving central office applies ringing current to the incoming line. The ringing signal is detected by the data set or ACD. With DTR ON, the set goes off-hook, tripping ringing, and, after a 1.5 second silent interval, it generates a 1.5 second, 2025 Hz answer tone. Approximately three to four seconds after ringing is tripped, DSR, CS and DCD go ON to indicate to the computer that the 407C is connected to the line and ready to exchange data with the computer. Data reception and/or data transmission can then take place. The computer responds to the Transaction telephone inquiry by data transmission from the TCU which is transmitted to the telephone as FSK by the 407C. Alternatively, the computer can cause tones to be generated by the 407C and transmitted to the Transaction I or II terminal. Termination of the call can be effected in several ways, as described in Section 4.2.9.

If the DFC protocol option is not selected, control of the interface must be done by the computer, because whenever the computer transmits data, the 407C halts data transmission to the computer (since the operation is half-duplex), buffers any incoming TOUCH-TONE, and transmits the out-going FSK to the terminal. Recall that reception of TOUCH-TONE signals in the presence of outgoing FSK is not guaranteed.

#### 4.2.4.1 Operation with CALL DIRECTORs

When a call is received in a 407C Data Station employing CALL DIRECTORs for attendant access to referred calls, the ringing signal is detected by the data set and this is indicated to the TCU by means of an ON condition of the RI

lead. The Data Terminal Ready (DTR) interface lead may already be ON, but if it is not, the TCU must turn it ON in response to RI ON to answer the call. The associated lamp on the CALL DIRECTOR is then lighted, indicating that the connection has been made. The procedure described in the previous section beginning from the ringing tripped point is then followed. When DSR goes ON, the set enters the DATA mode, during which an exchange of data between the 407C and the computer may take place.

If the set is in the DATA mode and a referral request is initiated, the button on the CALL DIRECTOR corresponding to that line will flash at a rate of approximately one Hz, indicating that a referral clerk should pick up the handset to place the call in the REFERRAL mode.* The call is transferred to the REFERRAL mode by depressing the flashing button and lifting the handset. The data set then indicates by a message to the computer that the REFERRAL mode has been entered. A detailed description of the referral procedure is given in Section 4.2.6.

In the REFERRAL mode, the data set is disconnected from the telephone but not from the computer. The attendant may return the call to the DATA mode by pressing the DATA (HOLD) button on the CALL DIRECTOR. The 407C then disconnects the call from the CALL DIRECTOR, and reconnects it to the data set for further data transmission.

If the attendant lifts the handset of the CALL DIRECTOR when a call is present, and no referral has been requested by the terminal or the computer, the data set enters the REFERRAL mode without sending any message to the computer.

The TALK mode of the 407C data set is entered whenever the attendant lifts the handset of an associated CALL DIRECTOR when no incoming call is present. If this occurs, the data set remains disconnected from the telephone line, but the attendant is connected to the line and can initiate an outgoing call. If the attendant subsequently transfers the call to the DATA mode (by depressing the HOLD button on the CALL DIRECTOR) the data set performs a normal answering sequence (1.5 seconds of silence, 1.5 seconds of answer tone, etc.) if DTR is on and the computer is up.

No indication is given to the computer that the set is in the TALK mode. When the data set is subsequently transferred to the DATA mode and the data set goes through the answering sequence, no indication is given that the call originated at the attendant location rather than at the remote terminal.

The telephone line side of a call is terminated when the calling station hangs up (in most central offices) or the equipment at the data center is in one of the following modes:

1. Data set in the REFERRAL mode and the handset of the CALL DIRECTOR is returned to its cradle. This operation causes the data set to be disconnected from the line. Full disconnection occurs when the computer turns off DTR (see 2 below).
2. Data set in the DATA mode and the computer turns OFF the Data Terminal Ready lead for a period of at least 50 milliseconds.

The lights on the CALL DIRECTOR corresponding to the incoming line indicate the mode of the associated data set section as follows:

| Mode | Light |
|---|---|
| IDLE | OFF |
| DATA | ON |
| REFERRAL | ON |
| TALK | ON |
| DATA and Referral Request | Flashing |
| TEST (LOCAL or REMOTE) | ON |

#### 4.2.4.2 Operation with an Automatic Call Distributor

When an Automatic Call Distributor (ACD) is used in place of CALL DIRECTORs, several additional functions are introduced into the system:

1. Concentration of incoming lines to fewer data sets (computer ports).
2. Queueing of incoming calls until a data set is available.

*A common audible signal on referral can be provided as well.

3. Automatic selection of an available attendant in response to a referral request.
4. Indication back to the computer of selection of a referral clerk's line.
5. Ability of the data set to receive TOUCH-TONE data while the referral clerk is on the line.
6. Ability to free the data set and computer port for new calls once the attendant has been selected.

When a call comes in to the data station through an ACD, ringing is detected by the ACD. This allows the ACD to hunt for an idle port (data set) that has DTR in the ON state, indicating that it is ready to accept a call. When a port with DTR ON is found, the call proceeds again as described in Section 4.2.3.1, beginning from the ringing tripped point. A ring indication is *not* given on lead 22 in this case.

Referrals are made under control of the ACD, upon receipt of a request from the 407C, initiated by the computer or the Transaction telephone. When the ACD selects an attendant position, it notifies the computer of the identity of the position by means of TOUCH-TONE signals. Once a referral is completed, the computer may either remain on-line or cause the data set to disconnect from the line. The data set may then be made ready to receive other calls (by bringing DTR back ON) while the referral clerk completes the original call. Once the computer has caused the data set to disconnect, no further data can be entered. Connection to a data set can then be reestablished only by redialing. A complete description of the referral procedure when an ACD is present is given in Section 4.2.6.

When an ACD is employed, out-of-service is accomplished by placing DTR in the OFF state, thereby making that line appear busy to the ACD. The ACD will then direct the call to the next idle data set. The OS lead, and options A-2 and A-3, should be OFF at all times when operating with an ACD.

### 4.2.5 Error Control

When the error control option (B-3) has been selected, a number of features are enabled which allow the computer to utilize the error control features of both the Transaction I telephone and the Transaction II telephone (using the "short protocol") with a minimum of difficulty. It should be pointed out that the error control features of the 407C are tailored to operation with the Transaction telephone, and therefore, this option, if selected, is invoked by the reception of the leading TOUCH-TONE "b" normally transmitted by the Transaction telephone. If the "b" is not received, error control is disabled, *regardless of the state of Option B-3.*

#### 4.2.5.1 Messages from the Transaction Telephone

When a message is received from the Transaction telephone and passed to the computer, the ## is translated into one of three characters. If a longitudinal redundancy character (LRC) and character count (CCT), if appropriate, are transmitted, the 407C checks them for accuracy. If the check indicates a good message, the 407C sends "K", followed by the selected EOM in place of the ## LRC CCT sequence. If the check indicates a message error, the set sends "F" followed by EOM. Finally, if there is no LRC, the 407C sends "X" EOM.

#### 4.2.5.2 Messages to the Transaction Telephone

Outgoing messages from the computer will be preceded by the ASCII character STX, and followed by an ASCII ETX and the LRC required by the Transaction telephone, whenever error control is in effect. This will occur regardless of the state of the STX and ETX Punctuation option (B-2).

#### 4.2.5.3 Acknowledgments from the Transaction Telephone

Another feature provided under the error control option is automatic check of acknowledgments. The Transaction telephones, as described earlier, acknowledge the

receipt of correct FSK or tone message, after checking for error. The Transaction II telephone also acknowledges the receipt of incorrect or incomplete messages. Accordingly, when an FSK or tone message (1.5 or 3 seconds:* See Section 4.2.8 for tone operation.) has been transmitted, the 407C starts a timer while waiting for the appropriate response. The timing interval (1.5 seconds) begins when the tone ends or the DC3, terminating the computer message, is received from the computer, whichever occurs last. If an appropriate response (4#4, 3#3, a for 1.5 second tone, b for 3 second tone) is not received before the time-out expires, the 407C passes the control message "T" EOM to the computer. Characters received before the time-out occurs, except for "#" of an incomplete control sequence, are transmitted before the T. Characters received after the time-out, however, will be transmitted when DFC protocol permits. (For operation with DFC protocol, see Section 4.2.5.)

The control sequences in response to FSK and tone messages, if received intact before the time-out, are translated as follows assuming that option B-4 is also on (see 4.2.4.4):

| Sequence | Function | Translation |
|---|---|---|
| 3#3 | NAK | "N" EOM |
| 4#4 | ACK | "A" EOM |
| a | Green light ACK | "A" EOM |
| b | Yellow light ACK | "A" EOM |

**Note:** If the wrong light acknowledgment is received, the data set translates it to "N" EOM.

### 4.2.5.4 Positive Acknowledgments

The description of acknowledgments in the previous section was based on the assumption that the "Positive Acknowledgments" option was selected. This option causes the data set to pass the sequence "A" EOM to the computer whenever a correct acknowledgment is received within the time-out period after an FSK or tone message has been sent. When the "Positive Acknowledgment" option is disabled (B-4 is OFF), however, no indication is given to the computer if the proper acknowledgment is received. The data set merely disables the acknowledgment timer. This application reduces the processing load for the applications program in that only abnormal situations (incomplete responses, NAKs, time-outs, etc.) require any action.

### 4.2.5.5 Error Recovery Using DLE NAK

As described earlier, the Transaction II telephone, because its operation is essentially half duplex, does not respond to FSK transmissions during periods when it is configured to accept data input from the user and to transmit it as TOUCH-TONE. During these periods, however, it will respond to the FSK ASCII sequence "DLE NAK" by disabling user data input, enabling the FSK receiver for incoming data, and acknowledging the sequence by sending the TOUCH-TONE EOT sequence "5#5". Therefore, the DLE NAK sequence can be used to recover from error conditions which leave the system in a mode where data is transmitted in both directions.

Accordingly, the 407C will respond to the ASCII sequence ;; in the "action field" of all computer messages by transmitting, upon receipt of the DC3 ending the computer message, the sequence DLE NAK to the Transaction telephone and with B-3 ON, starting the acknowledgment timer. If the "5#5" from the Transaction II telephone is received within the time-out period, the 407C passes the message "E" EOM to the computer. If not, the set passes "T" EOM as in the cases described in Section 4.2.4.3. If the "T" EOM is received, several more attempts should be made to send the DLE NAK sequence, since the reception of the DLE NAK signal can be disrupted by outgoing TOUCH-TONE at the telephone.

Thus, if it becomes necessary (such as during error recovery situations) for the computer to send data to the telephone when the telephone may be in a mode where it cannot receive data, the computer message should be preceded by the ;;DC3 message. When the "E" EOM is received, the computer can then proceed with the desired transmission.

*A nonacknowledged beeping tone of 100 msec ON and 500 msec OFF may also be transmitted as discussed later.

### 4.2.6 Data Flow Control Protocol Operation

The selection of the DFC protocol option causes the 407C to assume control of the direction of data flow. When the 407C is transmitting data to the computer, data messages from the computer (except ";;" and "::" (see 4.2.6.1)) are ignored. When data is being transmitted from the computer to the terminal via the 407C, incoming TOUCH-TONE data from the terminal is buffered until the computer message block ends.

#### 4.2.6.1 Answering Sequence with DFC Protocol

When a call is directed to a 407C data set with the DFC protocol option activated, the initial answering sequence is identical to that of the non-protocol operation, up to the turning ON of the DSR, CS, and DCD interface leads. The data set waits one second after the transmission of the answertone before turning ON these leads. This wait is intended to allow for the receipt of the initial "b" transmitted by the Transaction telephone.

When the initial "b" identifying the caller as a Transaction telephone is received within the time-out, the 407C turns on DSR, DCD, and CS, and enters a state in which:

1. Incoming TOUCH-TONE is buffered.
2. Data from the computer is not transmitted as FSK, but is scanned for the occurrence of DC3.

If the initial "b" is not received within the time-out, the 407C turns on DSR, CS, and DCD, and enters a state in which outgoing computer data is transmitted as FSK. In this state, any incoming TOUCH-TONE data is buffered. If, with the data set in this mode, the first character received is a "b", the data set immediately stops FSK transmission, and reverts to the mode described above, as if the "b" had been received within 1 second.

#### 4.2.6.2 Inquiry and Response with DFC Protocol

In normal operation of this system, the "b" will be received within the time-out. If this occurs, any "Hello" message from the computer is not transmitted to the telephone. Instead, the 407C waits until the initial computer message is complete (signified by the receipt of DC3 from the computer). When the DC3 is received, the 407C begins passing the buffered TOUCH-TONE data to the computer. The Transaction telephone TID was scanned by the 407C to discover the presence of an active data receiver at the terminal. When the END sequence ##, is encountered, the 407C, if error control is enabled, checks the subsequent LRC and CCT, and concludes transmission with K, F, or X followed by EOM.* Once the EOM has been passed to the computer, the 407C reverses the direction of data flow; that is, any incoming TOUCH-TONE is buffered, and the computer is allowed to transmit to the remote terminal.

**Note:** At this time the Transaction telephone is in its "receive" mode. Thus, no incoming TOUCH-TONE (except ** — see Section 4.2.6) is expected. Any characters which are received may be suspect due to errors introduced by outgoing FSK.

When the computer begins to pass data to the 407C, the data set sends, in FSK, the ASCII character STX, followed by the computer generated ASCII data up to the DC3 ending the response message. The DC3 is translated to the ASCII character ETX and transmitted, an LRC is appended to the message, and the acknowledgment timer is started.

#### 4.2.6.3 Acknowledgments with DFC Protocol

Once the acknowledgment timer is started, the 407C waits for 1.5 seconds for the expected response from the Transaction II telephone. If the acknowledgment (4#4) is received, the 407C sends "A" EOM (for non-

*If error control is disabled, the 407C will translate the ## sequence to X EOM, and hold the LRC and the CCT in its buffer until the computer retrieves it by sending another DC3. Operation with DFC protocol enabled and error control disabled is cumbersome when the calling terminal is a Transaction telephone. Henceforth, "error control enabled" is assumed.

positive acknowledgment — see Section 4.2.5.5) and returns to the state in which incoming TOUCH-TONE is buffered and data from the computer is searched for DC3 but not transmitted. This is done because the Transaction II telephone is in the "transmit" mode after an acknowledgment. When the DC3 is received, any buffered data is passed to the computer.

If, however, a NAK (3#3) is received, the sequence is translated to "N" and followed by EOM. If a time-out occurs before a valid sequence is recognized, the set sends "T" EOM (possibly preceded by other characters). In either case, the 407C enters the "response" mode after the EOM; that is, any incoming TOUCH-TONE is buffered until the next DC3 from the computer and ASCII from the computer is transmitted as FSK.

### 4.2.6.4 DLE NAK with DFC Protocol

The use of the DLE NAK feature with the protocol option invoked allows the computer to interrupt the flow of data toward the computer if it is necessary to send a message to the telephone. If, when the 407C is passing data to the computer, the computer sends ;; before a "?" and followed by a DC3, the 407C will stop sending and transmit DLE NAK, set the timer, then resume passing data. If the telephone responds with 5#5, the 407C sends "E" EOM to the computer and enters the "response" mode in which computer data is transmitted. If the 5#5 is not forthcoming, the time-out and subsequent "T" EOM will also result in the "response" mode.* At this point, the ";;DC3" message should be repeated until the proper acknowledgment (E EOM) is received. Then the message can be transmitted.

### 4.2.6.5 Non-Positive Acknowledgments with DFC Protocol

Disabling the Positive Acknowledgment option when the DFC protocol option is selected reduces the complexity of system operation, especially if multiple transactions or retransmissions are anticipated.

If the option is disabled (B-4 OFF), the receipt of the correct acknowledgment to an FSK or tone message results solely in the disabling of the 407C acknowledgment timer. The "mode" of the 407C with respect to data flow remains unchanged; that is, data from the computer is ignored (except for ";;" and "::" (see Section 4.2.6.1)) and incoming TOUCH-TONE is translated and passed immediately to the computer. This is compatible with the Transaction II telephone, which remains in the "transmit" mode after sending the acknowledgment.

In contrast, if the acknowledgment is passed to the computer as described in Section 4.2.5.4, the computer must pass an additional DC3 to the 407C to trigger the subsequent buffered message.

### 4.2.6.6 Logon

When the logon option is selected, several changes in the operation under the DFC protocol mode occur. It should be noted that the logon option is *automatically disabled* if the leading "b" (identifying the caller as a Transaction telephone) is not received. Under this option, the incoming message is buffered as before, but when the first DC3 is transmitted from the computer, there are three departures for normal operation:

1. The TID transmitted by the telephone is *not* transmitted first.
2. The buffered data starting with the first user character is transmitted to the computer up to and including the first TOUCH-TONE "*" or "c" followed by EOM. The logon information and delimiter are normally coded on the dialing card in this application.
3. The 407C returns to the mode in which incoming TOUCH-TONE is buffered and the computer data is scanned for DC3 but not transmitted.

The reception of the second DC3 from the terminal, indicating contact with an applications program, returns the 407C to the

*If the 407C still has buffered data to pass to the computer, the "5#5" may be missed. If this occurs, the timeout feature will pass T EOM to the computer and clear the buffer. The next ";;DC3" will then elicit the desired response.

normal DFC protocol operation and the rest of the inquiry, preceded by the TID, is transmitted as described before.

#### 4.2.6.7 Multiple Message Segments

The DFC protocol is altered when multiple message segments are expected by the computer. If the 407C option B-7 (as well as B-1 and B-5) is enabled, the following exchange crosses the interface in a typical transaction. Assume also that the logon option is enabled and that an EOM which includes a "DC3" has been selected.

| 407C | Computer |
|---|---|
| | 1. Sends message ending with "ENQ" |
| 2. Searches message for "ENQ", or "DC3", then sends logon characters, followed by EOM. | |
| | 3. Sends prompt, ending with "DC3". |
| 4. Sends a lone "DC3". | |
| | 5. Sends prompt, ending with "DC3". |
| 6. Searches for "DC3", then sends inquiry message, followed by EOM. | |
| | 7. Sends prompt, ending with "DC3". |
| 8. Sends a lone "DC3" after a 1-second delay. | |
| | 9. Sends response message beginning with " @ " and ending with "DC3". |
| 10. Searches message for "DC3", then sends acknowledgment ending with EOM. | |

Conversation can continue indefinitely, repeating steps 3 to 10.

Note that a response message must begin with ASCII " @ ". Otherwise, it will appear as another prompt and elicit another lone "DC3" from the 407C. Similarly, the special sequences ";;" and "::" must also be preceded by " @ ".

### 4.2.7 Referral

Referral can be initiated in two ways, when the 407C is in the serial interface configuration. The computer can request a referral by transmitting the ASCII sequence "::" before the first "?" in any message. The terminal can request a referral by transmitting the TOUCH-TONE sequence ** at any time. The terminal's request will be honored by the 407C if the proper options have been selected.

#### 4.2.7.1 Computer Initiated Referral

Consider first computer generated referral. After receiving "::" before the first "?" in any message from the computer, the 407C will initiate a referral upon receipt of DC3 (with B-1 ON) or 2 seconds after the last received character (with B-1 OFF).* Computer output is monitored by the 407C for this sequence at all times, even with the DFC protocol option ON. Once the sequence is received, any buffered characters awaiting transmission to the computer will be lost. It is possible that transmission to the terminal has not yet begun when "::" is received. In any case, further transmission to the terminal will be halted at the second ":". Operation at this point diverges based on the referral equipment present:

1. If an ACD is used for referral, the ACD will transmit two TOUCH-TONE digits, identifying the attendant position selected, when it honors the referral request. The 407C will transmit these characters, followed by "R" EOM to indicate completion of the referral. Any other TOUCH-TONE characters received (except *) will cause the referral to be aborted and the sequence "B" EOM to be sent to the computer to indicate an aborted referral.
2. If a CALL DIRECTOR is used for referral, no indication is given to the computer until the referral is completed. Incoming TOUCH-TONE is ignored by the data set until the referral is completed. When

*A block completion is assumed (with B-1 OFF) whenever such a 2-second silence occurs.

the referral has been made, the data set enters the REFERRAL mode, in which the telephone line at the data set is disconnected, and "≪R" EOM is sent, thus informing the computer.

**Note:** The operation with a Transaction II telephone normally would entail a message lighting the yellow lamp and unmuting the Transaction II telephone handset. After receipt of the 4#4, a follow-up message of ":: DC3" would then normally be sent.

#### 4.2.7.2 Terminal Initiated Referral

Receipt of the sequence "**" from the terminal notifies the 407C of a referral request and causes the following operations in the data set. If the ** is received, and the 407C is in the process of transmitting previously received data to the computer, it will continue transmitting until it can no longer transmit (either because there is no further buffered data, or, in the DFC protocol mode, because ## has been encountered). When it can no longer transmit, the 407C initiates a referral in the same manner as described in 4.2.3. At this point the process diverges.

1. If an ACD is present, the 407C will transmit "(digit) (digit) R", followed by EOM, where the digits are those transmitted by the ACD upon honoring the referral request. If the referral request occurs while the 407C is timing for receipt of an acknowledgment, the "R" will be changed to an "I" to indicate that the acknowledgment was interrupted by receipt of **.
2. If a CALL DIRECTOR is used, the sequence "≪R", followed by EOM, is transmitted when the attendant goes off-hook. In this case, too, if the ** is received during timing for an acknowledgment, the R is replaced by I.

In both cases above, any data preceding the ** which cannot immediately be transmitted to the computer will be lost. Also, any characters transmitted following the ** (except for *) and before completion of the referral may cause the referral to be abandoned. If this occurs, the ** is translated to "≪" as in Table 1.

#### 4.2.7.3 Return to DATA from REFERRAL Mode

A call can be returned from the REFERRAL mode to the DATA mode by the attendant. Depressing a button on the referral telephone or CALL DIRECTOR marked DATA or HOLD will cause the data set to disconnect the call from the CALL DIRECTOR and reconnect the line to the data set.

At this point, data transmission can be initiated. No answering sequence or interface changes occur.

If, while the data set is in the REFERRAL mode, the computer turns DTR OFF for more than 50 msec, and then turns it ON, the 407C enters the TALK mode. A return to the DATA mode at this time would result in a new answering sequence as described in Section 4.2.3.1.

If DTR is OFF when the DATA button is depressed, the entire call will be disconnected.

#### 4.2.7.4 Referral with DFC Protocol

The selection of the DFC protocol option causes some additional action by the 407C to ensure that the computer is notified that a referral has taken place. The need for this action arises from the fact that a Terminal Initiated Referral can be received while the computer "has the line" but is not transmitting. In this case, the 407C performs the referral request and holds the ≪R or (digit) (digit) R message until the computer retrieves the message by sending DC3.

If, when a CALL DIRECTOR is used, the attendant returns the call to the DATA mode before the computer sends DC3, the referral sequence will be replaced by the sequence "Z" EOM to indicate that a complete referral took place while the computer was unavailable. Subsequent data from the Transaction telephone will be buffered until it is retrieved by the next DC3 from the computer.

If a call is retuned to DATA after a normal referral, Transaction telephone data will be buffered and computer data will be ignored (except for ";;" and "::"), until a DC3 is received from the computer.

### 4.2.8 Computer Down

The computer down condition is indicated, as in the 407B, by the use of an external switch, or by the state of all DTR leads in the station, or both. When the 407C answers a call during a computer down period, it transmits a 3 second answer tone, instead of 1.5 seconds, and starts a 15 second timer. If the first character received is not a B colum character (TOUCH-TONE "a", "b", "c", or "d") the 407C will transmit a beeping tone (1 second off, 1 second on) for the duration of the timer. If it is a B character, a beeping tone will not be transmitted. During the 15 seconds after the answer tone, the 407C will detect and translate all incoming characters and transmit them on interface lead RD. (If appropriate, the LRC and CCT will be checked.) If an attendant request (**) is received and A-5 is ON, the referral will be made immediately.* Beeping, if started, will cease. In the CALL DIRECTOR case, the TALK mode will be entered. In the ACD case, the 407C will be automatically disconnected from the line when the second ACD generated digit is received. In both cases, the usual referral control message will be passed on RD.

If the 407C does not receive the ** sequence from the terminal within the 15 second time-out period, it will automatically disconnect from the line and will be available to answer another call.

### 4.2.9 Operation with Transaction I Telephone

The 407C has been designed to facilitate operation of a system including both Transaction I and Transaction II telephones, calling the same computer port. Accordingly, the 407C design minimizes any differences in operation from the computer's point of view.

When a Transaction telephone calls in, the 407C checks the TID to determine the type of operation (FSK or keyed answer tone) required by the terminal. If Keyed Answer Tone (KAT) is required, whenever the computer generates a response message for the terminal, the 407C scans the action field (characters preceding the first "?") for the characters 6, 7 or 8. These characters correspond to the characters which cause lighting of the green light, lighting of the yellow light, and blinking of lamps in the Transaction II telephone.† For the KAT response case, these characters cause the following actions:

6 — 1.5 second answer tone — lights green light in tone response set

7 — 3 second answer tone — lights yellow light in tone response set

8 — 5 seconds of beeping tone, 100 ms ON 500 ms OFF

In addition, if the error control option is ON, the 6 and 7 cause the acknowledgment timer to start, when the tone ends and DC3 is received.

Tone transmission begins when the "?" is received. All subsequent characters (except "DC3") are ignored. With error control but no DFC protocol optioned, when the "?" is received, the computer must finish sending all subsequent characters in the message by the end of the tone transmission.

With error control, the 407C will translate the correct TOUCH-TONE response to the 1.5 or 3 second answer tone into the sequence "A" EOM. If the incorrect response is received, e.g., if "a" is received when a 3 second tone was sent, the 407C passes an "N" EOM to the computer. If no response is received, the timer times out, and "T" EOM is passed.

The only other variation from Transaction II operation occurs if the computer sends ";;DC3" in order to "reclaim" the line. In this case, no DLE NAK is transmitted; however, the 407C sends "H" EOM to the computer (and "turns the line around" if the DFC protocol option is ON).

*If a ** is received before any other characters, and succeeding characters cause premature abandonment of the referral, the 407C will begin beeping the answer tone.

†The reception of "::" in the action field takes precedence over all of these functions.

### 4.2.10 Disconnection

The 407C responds to two indications that a calling terminal has disconnected. The first is a positive TOUCH-TONE sequence, namely, *#*, transmitted by the terminal prior to disconnection. When the 407C detects this sequence (with A-1 ON), it immediately disconnects from the telephone lines and passes the control message "D" EOM to the computer. The interface remains in the "ready" or "connected" configuration, however, until the computer turns DTR OFF for 50 msec.* Any data which has not been transmitted to the computer when the sequence is received will be lost. If DFC protocol precludes transmission of the "D" EOM message, the 407C will wait until the computer sends "DC3" and then transmit the control message.

The identical operation occurs when an interruption of line current is detected by the 407C, with the exception that the "D" EOM message is replaced by "I" EOM.

If either the *#* sequence or the line current interruption is detected while the 407C is timing for an acknowledgment from the terminal, the 407C will transmit the message "P" EOM to the computer to indicate that a premature disconnection occurred.

Since the *#* sequence may be missed if a transmission error occurs and a line current interruption is not guaranteed by all central offices, it is recommended that the computer have a time-out feature which turns DTR OFF after a suitable inactive period.

When the computer turns DTR OFF for at least 50 msec, the 407C will drop the interface (turn off DSR, CS, and DCD) and, if necessary, disconnect from the telephone line. If timing is difficult, positive disconnection can be accomplished by turning DTR OFF until DSR goes OFF.

### 4.2.11 Control Messages

A summary of all the control messages transmitted to the computer by the 407C, and the circumstances under which they are transmitted, is presented in Table 9.

## 5. SYSTEM OPERATIONS — TRANSACTIONS

This section describes, from start to finish, typical transactions accomplished via the Transaction telephone system. It details the activities and operations at both the Transaction I and Transaction II telephones, the 407C, and the data center computer/TCU. As an example, a financial industry application, namely credit checking, will be considered. In addition, certain other assumptions are made. It is initially assumed that the KAT receiver on the Transaction I telephone and the data receiver on the Transaction II telephone are active, and that the transactions require two card operation. Subsequently, referrals, computer down operation and error conditions are described. At the data center, it is assumed that an ACD is present, and the 407C is optioned for Terminal Initiated Referral-Computer Up and Computer Down. Furthermore, it is assumed that the DFC protocol and error control options are ON, and that no logon is required.

### 5.1 Typical Transaction — Transaction II Telephone

To initiate the transaction, the merchant leaves the handset in its cradle and presses the ON button on the Transaction II telephone. He listens for dial tone (via the call progress tone sounder) and, when it occurs, he inserts the dialing card in the card reader. When the second instruction lamp lights, he inserts the customer card. The telephone automatically dials the telephone number of the data center, and buffers the merchant and customer data.

At the data center, the ACD queues the call, if necessary, and directs it to the first available computer port. The 407C associated with that port answers the call and sends the 1.5 second answer tone. When the answer tone is received by the Transaction II telephone, the call progress tone sounder is muted and the buffered data is transmitted.

While the call is being dialed, set up, and answered, the merchant can manually enter the transaction amount, then press the END button. Alternatively, the merchant can press the (/) button after the transaction amount,

which allows additional data, such as inventory numbers or a PIN (Personal Identification Number), to be entered either on the manual entry pad, or via the PIN pad (if it is available and enabled). All data entered on the manual entry pad, while the PIN pad is disabled, is displayed on the visual display. When the additional data has been entered, the merchant presses the END button. When the answer tone ends, the Transaction telephone begins to output the buffered data. If all the data in the buffer goes out before the merchant has finished manual entry, the remaining keyed data are transmitted as they are entered.

The data is received and buffered by the 407C. When the 407C recognizes the initial "b" transmitted by the Transaction II telephone, the 407C turns DSR, CS and DCD ON. It decodes the TID to determine that the telephone's data receiver is active. The computer, when it is ready to accept the buffered data, sends a baseband ASCII message (which is ignored by the 407C) ending in DC3. When the 407C receives the DC3, it passes the buffered data (and any subsequently received data) until the END sequence (## LRC CCT) is encountered. The 407C checks the LRC and CCT for accuracy, and, if they check, passes the ASCII sequence K EOM to the computer.

The computer then processes the received data and formulates a response. If credit is to be approved, the message generally has a 6 in the action field to light the green lamp on the Transaction II telephone. The action field is defined in Section 4.1.15.5. A 7 in that field would cause the yellow lamp to be lighted. The action field is terminated by a "?". Characters following the initial "?" are displayed by the Transaction II telephone (see Figure 9 for a list of displayable characters). The 407C automatically precedes the outgoing ASCII message with the STX character. The computer response is ended by a DC3, which is replaced with an ETX and a longitudinal redundancy character (LRC) by the 407C.

The Transaction II telephone acknowledges all incoming FSK messages with an ACK sequence (4#4) if the parity of each character checks, and the LRC is correct. (If the LRC check is disabled by a character in the response message, after parity checks, the ACK sequence is sent after ETX is received as described in Section 4.1.15.) If the parity or LRC is incorrect, the NAK sequence (3#3) is transmitted. No special codes are transmitted to differentiate between the lighting of the green or yellow lamp as in the Transaction I telephone.

The 407C translates the 4#4 to A EOM (if the positive acknowledgment option is selected) and passes it to the computer. If the NAK (3#3) sequence is received, the 407C translates it to N EOM. If neither sequence is received within 1.5 seconds after the LRC is transmitted to the terminal, the 407C passes T EOM to the computer. These error conditions are described in Section 5.5. The receipt of the ACK control message indicates to the computer that the telephone has executed the contents of the message.

If no referral is necessary, the merchant presses the OFF button after seeing the light and the display, and the telephone transmits the hang-up code (*#*) before disconnecting. The 407C detects the hang-up code and disconnects the call at the telephone line, and passes the control message D EOM to the computer.

The sequence of operation utilizing FSK response is shown in Figures 11 and 12 for green and yellow lamp operation, respectively.

### 5.2 Typical Transaction — Transaction I Telephone

The user of the Transaction I telephone initiates a transaction by lifting the handset, listening for dial tone, and inserting the dialing and customer cards. The Transaction I telephone automatically dials the telephone number of the data center. While the call is being dialed and set up, the merchant enters the dollar amount of the transaction, and other variable data, on the manual entry pad, and/or the PIN pad, and then presses the END button.

The call handling sequence at the data center is identical to that of Section 5.1. When the 1.5

second answer tone is returned to the Transaction I telephone, the Transaction telephone begins data transmission.

The data is received and buffered by the 407C. When the 407C recognizes the initial "b", it turns on DSR, CS and DCD. It also decodes the second and third TID character, and determines that the calling telephone has no data receiver. When the computer sends the first DC3, the buffered data is passed by the 407C. When the END sequence (## LRC CCT) is encountered, the 407C checks the LRC and CCT for accuracy, and, if the check is good, passes K EOM to the computer.

When the computer formulates a reply, it includes a 6, 7, or 8 in the action field. The 407C, which has stored the fact that no data receiver is present at the calling terminal, response to the "6?" sequence by transmitting a 1.5 second answer tone to light the green lamp on the Transaction I telephone. A "7?" produces a 3-second tone which lights the yellow lamp on the telephone. The sequence "8?" causes the 407C to send a beeping tone for five seconds. Characters following the first "?" are ignored by the 407C. When the DC3 is received from the computer and the 1.5 or 3-second tone has ended, the 407C starts the acknowledgment timer.

The Transaction I telephone responds to the receipt of the answer tone signal by lighting the correct lamp and transmitting an acknowledgment. If the green lamp was lighted, the telephone transmits a TOUCH-TONE "a" ($A^1B^4$). If the yellow lamp was lighted, the telephone transmits the TOUCH-TONE sequence "b##" ($A_2B_4$-$A_4B_3$-$A_4B_3$). The 407C translates the correct acknowledgment (depending on the length of the transmitted answer tone) to the sequence A EOM (if the positive acknowledgment option is selected). If the incorrect acknowledgment is received (i.e., a when b was expected or vice versa), the 407C sends N EOM to the computer. If no acknowledgment is received within the timing interval, the 407C passes T EOM to the computer. It should be noted that the 407C translated the "b##" sequence into two separate control messages. The "b" is translated to A EOM, and the subsequent "##" is translated to X EOM. In order to retrieve the X EOM message, the computer must send another DC3. The X EOM informs the computer that the Transaction telephone handset is off-hook.

If no referral is necessary, the merchant hangs up. When the correct acknowledgment is received by the computer, it responds by turning DTR OFF for at least 50 msec to disconnect the call.

A typical transaction involving the Transaction I telephone is shown schematically in Figure 13.

### 5.3 Referral

If the data center computer decides that a call should be handled by a human attendant, it passes a message (27?DC3) to the 407C. This message causes the Transaction II telephone to light the yellow light and unmute the handset. (The 407C will transmit the appropriate tone to light the yellow light on the Transaction I telephone as well.) A suitable display can be appended to inform the merchant using a Transaction II telephone that a referral is taking place and instruct him to pick up the handset and wait. Additionally, if the capability exists, the computer could send a wait message via the 407C voice port to a merchant using a Transaction I. This message would also be heard by the Transaction II user if he picks up the handset in time. Upon receipt of the correct acknowledgment which indicates the yellow light is on, the computer passes the sequence ::DC3 to request referral. The 407C recognizes this message and causes the referral to take place as described in Section 4.2.6.4. This is illustrated in Figures 14A and 15.

During the transaction, the merchant may decide that he wants to speak with an attendant at the data center. Alternatively, he may have received instructions, via displayed FSK characters, to initiate a referral. In either case, the merchant will press the ATTN button. This sends a special code (**) to the data center. The 407C recognizes this code and, if the Terminal Initiated Referral-Computer Up option has been selected, it executes a referral in the manner described in

Sections 4.2.3 and 4.2.4. These activities are shown schematically in Figure 14B. With an ACD present, after the attendant line has been selected and the referral sequence has been sent to the computer, the data set can be released (by turning DTR OFF for 50 msec) to handle other incoming calls while the referral is in progress.

### 5.4 Computer Down

When a merchant initiates a transaction in the normal manner during a period when the computer is down, and the 407C recognizes the fact, the 407C will answer the incoming call and send a 3-second burst of answer tone. The Transaction telephone will automatically compare the transaction amount entered by the merchant with a floor limit encoded on the merchant card. If the transaction amount is less than or equal to the floor limit, the Transaction I telephone will light the "Follow Special Instructions" lamp on its face. The Transaction II telephone will, in this case, display "SPECIAL" on the visual display. Either of these tells the merchant to refer to (probably written) instructions from the data center. If the transaction amount is greater than the floor limit, the telephone will light the yellow lamp and generate an automatic terminal initiated referral. In the Transaction I telephone, "**" is sent as soon as the yellow lamp is lit. The Transaction II telephone sends "**" as soon as the handset is lifted in response to the yellow lamp. If the handset is not lifted within 20 seconds after the yellow lamp is lit or if the merchant hangs up, the Transaction II telephone sends the hang-up code (*#*) and disconnects from the telephone lines. The 407C will detect *#*, send D EOM across the interface, disconnect, and be ready to receive a new call. If the referral or disconnect sequence is not received, the 407C will time out in 15 seconds, disconnect and be ready for a new call.

**Note:** Automatic terminal initiated referral during computer down periods can be eliminated by omitting the floor limit on the dialing card. However, the ATTN button is still active.

Computer down operation is described schematically in Figure 16.

### 5.5 Error Conditions

A number of anomalous conditions may arise in this system which are detectable and correctable by the computer. For example, the Transaction I telephone does not send a hang-up code. Thus, if the 407C does not receive or recognize a battery interruption from the central office, the associated computer port will stay on the line. Accordingly, to avoid lock-up, the computer should have a time out feature which disconnects the call after a suitable silent interval.

The Transaction telephone is equipped to detect certain errors from the card reader, such as improperly coded or damaged cards. If this occurs, the set will flash the appropriate sequence lamp, (if the lamp is on) instructing the merchant to try again or else manually enter the required data.

The Transaction telephone also verifies the lighting of the green or yellow light by tone responses by sending "a" or "b" as an acknowledgment. If, due to a transmission error, the green lamp is erroneously lit, the Transaction I telephone is receptive to a correction until the merchant presses a button on the manual entry pad, (provided the merchant has not hung up). The Transaction II telephone is receptive to green light correction for seven seconds. Erroneous activation of the yellow lamp can be similarly corrected, with no time limit (unless the merchant presses a button or hangs up), in the Transaction I telephone and in the Transaction II telephone (if the merchant goes off-hook within 20 seconds). Such errors and corrections are expected to be rare.

The coding of the customer and dialing cards includes a longitudinal redundancy character (LRC) which allows the telephone to check for data errors, (see Section 6.3.7 for a discussion of the LRC). In addition, the Transaction telephone adds an LRC and character count (CCT) to the first and sometimes subsequent (see Section 7) data transmissions (after "##") so that the 407C can check for transmission errors. If transmission errors are detected by the 407C error control or the computer, either by format error or an F EOM control message, a "rekey" can be requested. When operating

with a Transaction I telephone, or a Transaction II telephone with the KAT receiver active, this is done by transmitting a 3-second answer tone, and giving the appropriate voice message to the merchant after receipt of a TOUCH-TONE "b" followed by "##" signaling that they yellow light is on and the handset is off-hook. If an error is detected in a message from the Transaction II telephone with the FSK data receiver active, a number of corrective measures can be taken. If the handset of the telephone is off-hook, a voice message can be used to request rekeyed data. Alternatively, a message for display can be sent. If the error detected indicates a transmission error in the initial inquiry, the computer can send "1?DC3" to the 407C and the Transaction II telephone automatically retransmits the message. On messages subsequent to the initial message, this response (1?DC3) will cause the display to show EOO. The number of times this sequence takes place is likewise controlled by the computer.

If the response to a Transaction II telephone is in FSK, the Transaction II telephone sends ACK or NAK depending on the LRC and parity checks. If NAK is sent, the message is considered invalid, and no action (including lighting lamps) is taken by the telephone. Receipt of the N EOM by the computer should cause retransmission of the FSK message. The number of retransmissions is likewise under the control of the computer.

An error may also occur when an acknowledgment is anticipated from the Transaction telephone after transmission of an FSK or tone message. In this case, the 407C will pass the sequence T EOM to the computer to indicate that the proper acknowledgment was not received. The computer should respond to this by passing ;;DC3 to the 407C (to insure that the Transaction II telephone, if present, is capable of receiving FSK), waiting for the "E" EOM acknowledgment, and retransmitting the appropriate message. (In the Transaction I case, retransmission of the message is sufficient response to the receipt of the "T". If the ;;DC3 is sent, the acknowledgment will be "H" EOM.)

Typical error recovery procedures for the Transaction II telephone are detailed in Figure 17.

## 6. MAGNETIC STRIPE CARDS

As previously described, the Transaction telephone employs two cards in conducting a typical transaction: a dialing card, used to access the data center and enter information pertinent to the user, and a second or "customer" card containing information pertinent to the particular transaction (e.g., account number, etc.). The following sections present requirements for the manufacturing and encoding of these cards.

When the card is made according to good practice and these requirements, card useful life expectancy will be over 50,000 insertions in the magnetic strip reader.

### 6.1 Applicable Standards

The Transaction telephone is fully compatible with cards manufactured and encoded according to the American National Standards Institute, Inc., (ANSI) standards for credit cards. Specifically, cards produced in accordance with ANSI X4.13-1971 and ANSI X4.16-1976 are compatible with the Transaction telephone. Applicable paragraphs of these standards are:

X4.13-1971 — Paragraph 2.1 and 3.1

X4.16-1976 — All of sections 2, 3, and 4

— Paragraphs 5.1 through 5.6.*

### 6.2 Summary of Requirements

The assignment of 4-bit characters and the corresponding characters in decimal, hexadecimal, and TOUCH-TONE are given in Table 1.

*Note: An expansion of paragraph 5.6 to include control information encoded on the dialing card specific to the Transaction telephone is given in Section 6.3. Portions of Section 6 are reproduced with permission from American National Standards (X4.13 and X4.16) copyright 1971 and 1976 by the American National Standards Institute, copies of which may be purchased from the American National Standards Institute at 1430 Broadway, New York, New York 10018.

### 6.2.1 Summary of Card Standards — Mechanical

Pertinent physical dimensions of the card and the location of the magnetic stripe are shown in Figure 18. The length of the card is not critical. Signature panels and the like should not be placed opposite the magnetic stripe due to possible damage from a tension spring in the card reader. Edge burrs normal to the card face shall not exceed 0.003 inch (0.08 mm) above the card surface. No point on any edge of the card shall lie more than 0.004 inch (0.10 mm) from a straight edge against which that edge is resting. The card material shall not contain elements which migrate into and modify the magnetic material. A warped card will be ready by the card reader if a force of 0.5 pounds placed over any point along the magnetic strip will render that card in contact with a flat surface on which the card rests.

Any surface distortions, irregularities, or raised areas which might interfere with a recording or playback head must be at least 0.250 inch from either the top or bottom edge of the magnetic stripe. Raised areas in excess of 0.005 inch from the card surface must reside in the area allowed for embossing as per Figure 18.

### 6.2.2 Magnetic Material — Physical Characteristics

Magnetic material shall be located on the card so that it permits the encoding of the data track specified in Section 6.2.4. The card shall contain no elements which migrate into and modify the magnetic material. The reading surface must not be lower than the surface of the surrounding card area. Thickness of the card plus the read surface shall not exceed 0.035 inch.

The average peak-to-peak surface irregularity of the reading surface shall not exceed 50 microinches (1.3 $\mu$m) Centerline Average in either the longitudinal or the transverse direction, using a cutoff wavelength of 0.01 inch (0.25 mm) or 0.03 inch (0.76 mm) when using a probe having a minimum radius of 100 microinches (2.54 $\mu$m).

The profile of the reading surface of the magnetic stripe, as measured parallel to the height of the card with a probe having a radius of 0.015 inch (0.38 mm) to 0.100 inch (2.54 mm), shall show a deviation from high point to low point of not more than 0.00015 inch (150 microinches, 3.8 $\mu$m) for each 0.100 inch (2.54 mm) of the stripe width.

### 6.2.3 Performance Characteristics of Magnetic Material

The magnetic material shall be capable of producing peak readback signals of not less than 80 percent of the read-head voltage calibration, when written with any current between 350 percent and 500 percent of a defined write-head current calibration.

The 100 percent read-head voltage calibration is defined as the maximum peak readback signal obtained from a saturation plot of a "secondary signal amplitude reference tape" (Standard Reference Material [SRM] 3200 as given in American National Standard Unrecorded Magnetic Tape for Information Interchange (9-Track 200 and 800 CPI, NRZI, and 1600 CPI, PE), X3.40-1973), corrected to the primary standard, written at 200 flux reversals per inch [FRPI] (8 flux reversals per millimeter [FR/mm]), nonreturn-to-zero, and transported at a velocity equal to that of the card encoder/reader.

The 100 percent write-head current calibration is defined as that square wave current required to achieve 80 percent of maximum voltage from the National Bureau of Standards tape, corrected to the primary standard.

**Note:** Saturation plots for both the SRM 3200 tape and the plastic card specimen must be conducted using the same set of write-heads and read-heads, and associated electronics, and the same transport velocity.

Write-heads and read-heads must be aligned for maximum signal transfer on both the tape transport and the card encoder/reader.

Transport velocity differences should be kept to an absolute minimum since readback signal varies with transport velocity. Saturation plots should be performed at velocities such that head frequency response remains constant.

Head pressure should be applied to produce uniform results in readback signal throughout the length of the card specimen. It is desirable to provide minimum head-to-material spacing. Head pressure should not, however, be excessive enough to cause magnetic-material damage or head damage. This procedure Characterizes the material and does not compensate for signal loss due to stripe curvature allowed in 6.2.1. **CAUTION:** This test does not guarantee any minimum or maximum value of intrinsic coercivity, $H_{ci}$.

The specification of this parameter (if required) is left to the individual card purchasers. In general, higher coercivities provide greater encoded ermanence at increased cost.

The standard environment for signal amplitude measurements is 73°F ±5°F (23°C ±3°C) and 40 percent to 60 percent relative humidity. When tested under otherwise identical conditions, the readback signal amplitude from the magnetic strip shall not deviate from its value in the standard environment by more than 15 percent over the range, as follows:

Temperature: -30°F to +122°F (-35°C to +50°C)

Relative humidity: 5 percent to 95 percent with a maximum wet bulb temperature of 77°F (25°C).

### 6.2.4 Encoding Specifications

Data read by the Transaction telephone is encoded on Track 2 of the magnetic stripe only. Other tracks may be encoded for other purposes.

The encoded data shall extend between two lines 0.353 inch (8.97 mm) and 0.463 inch (11.76 mm) from the top edge of the card.

Data shall be arranged as given below and shall begin in sequence from the right-hand side of the card as viewed from the side containing the stripe — with the encoded tracks at the top.

The centerline of the first data bit (low order bit of the start sentinel) is 0.293 ±0.020 inch (7.44 ±0.51 mm) from the right edge of the card. The centerline of the last data bit (longitudinal redundancy check [LRC] character) recorded shall not extend closer than 0.273 inch (6.93 mm) from the left edge of the card.

The lead-in up to the first data bit (start sentinel) shall be clocking bits (zeros), and the distance from the last data bit (LRC character) to the end shall also be clocking bits. The first clocking bit shall not begin further than 0.115 inch from the right-hand edge of the card.

The encoding technique was developed by Aiken in 1954 and is known as Two-Frequency, Coherent Phase Recording. This method allows for serial recording of self-clocking data (on one channel).

The data is comprised of data bits and clockings bits together. An intermediate flux transition occurring between clocking transitions signifies a "one"; the absence of an intermediate flux transition signifies a "zero."

The data shall be recorded as a synchronous sequence of characters without intervening gaps. Table 1 lists the hexadecimal characters which may be encoded on this stripe.

Recording shall be in a saturation mode with magnetization parallel to a line in the plane of the track. The direction is determined by the recording angle.

The signal on Track 2 shall be recorded in such a way that the maximum playback amplitude will occur when the magnetic centerline along the head gap is at an angle of 0° ±20' for Track 2 to a line normal to the top edge of the card.

### 6.2.5 Additional Characteristics of Track 2-Bit Density

The average bit density of the recorded signal shall be 75 bits per inch (2.95 bits per millimeter) (±3 percent) when measured along a line parallel to the longitudinal centerline of the signal. The spacing between adjacent flux changes shall be 13,333 ±400 microinches (0.3387 ±0.0102 millimeter) (±3 percent) for a "zero" and 6667 ±267 microinches (0.1693 ±0.0068 mm) (±4 percent) for a "one." For a sequence of recorded "ones" the density corresponds to a nominal 150 FRPI (5.91.FR/mm).

## 6.3 The Dialing Card

The dialing card contains the telephone number of the remote data center to be accessed, the user or merchant identification information, and control characters that affect certain functions of the Transaction telephone. The possible combinations of these functions are shown in Table 4. The fields provided for on the dialing card in the order of their appearance are:

1. Start Sentinel and Dialing Card Identification — 2 characters.
2. Telephone number and control characters — up to 15 characters.
3. Field separator — 1 character.
4. Floor limit field — 0 or 3 characters.
5. Response mode identification — 1 character.
6. User Identification characters — up to 24 characters.
7. Special control character — 0 to 1 character.
8. End sentinel and LRC — 2 characters.

The total number of characters allowed on the card by most card encoders is 40. However, the Transaction telephone can handle the total number of characters indicated by summing items 1-8 above. That total is 49.

The recommended dialing card designed is shown in Figure 19. Note that the magnetic stripe should be in the lower portion of the face of the card, on the same side as the printed information. This facilitates placing the cards in the card holding slots so that they can easily be removed and used in the card reader.

### 6.3.1 Dialing Card Identification

The dialing card is identified on the magnetic stripe by the appearance of the hexadecimal "C" as the first character after the start sentinel (hexadecimal "B"). The presence of this character instructs the Transaction telephone to treat the card as a dialing card.

### 6.3.2 Telephone Number

The telephone number field contains the telephone number of the data center to be accessed, along the control characters which dictate the mode of dialing to be used. There are four modes of dialing to be considered. Therefore, to provide optimal Transaction telephone service to data center users it is necessary to know the dialing modes required for a particular Transaction telephone installation. It is suggested that the data center management set up a means for acquiring this information prior to making dialing cards. The five dialing modes are:

1. Normal one part dialing, in which the entire telephone number is dialed after the customer card has been entered or manual entry has begun. In this mode, the entire number is encoded on the card, followed by a hexadecimal "D", as shown in the first card format in Table 4. This mode will serve most Transaction telephone installations, and all of those where a Transaction telephone is put on a regular business line.
2. Two-part dialing, in which the first part of a number, an access code requiring listening for a second dial tone, is dialed between card insertions. The rest of the number is dialed after the customer card has been inserted. Upon reading a card with a two-part number, the set immediately dials the first part of the number. The merchant is instructed to insert the customer card when the second dial tone is received. The call then progresses as in the normal dialing case. Two-part dialing is activated by a hexadecimal "C" between the parts of the telephone number as shown in the second example in Table 4.
3. Split mode dialing, which is two-part dialing in which the two parts are dialed in different modes. For instance, the first part of a number can be dialed in dial pulse, and the second part in TOUCH-TONE. The first part of the number will always be dialed in the mode selected by the installer for the type of service provided. The change in

mode is invoked by replacing the hexadecimal "C" discussed in the previous paragraph with a hexadecimal "E" between the parts of the telephone number as shown in the third example of Table 10.

4. Predialing, in which the entire number is dialed immediately after the dialing card is entered, between the card insertions. This mode is activated by a hexadecimal "C" following the telephone number, as shown in the fourth example in Table 10. Predialing is recommended in TOUCH-TONE installations only, because the Transaction telephone cannot read the second card until it has finished dialing. Rotary dialing typically takes 7 to 8 seconds which may be too long a time for the user to wait between card insertions. In normal rotary dialing, the user would be keying manual data during the dialing interval. Even in TOUCH-TONE installations, however, care must be exercised in selection of predialing, because the answer tone may be missed if it occurs during customer card entry, and the situation discussed in Section 4.1.2 may also occur.
5. A fifth dialing option is specified for applications where the user does not want to use the Transaction telephone features except for automatic dialing. In this case, the dialing card should be encoded as shown in the last example of Table 10, that is with a hexadecimal "B" following the encoded telephone number.

The total number of characters allowed in the telephone number field, including any two-part number separator is 15 characters. This does not include the hexadecimal "D" delineating the end of the telephone number.

### 6.3.3 The Floor Limit

After the hexadecimal "D" ending the telephone number field, three digits are optionally included indicating the floor limit. These three digits are a whole dollar amount. The card must be encoded with either the full three digits or no digits.

When the computer unavailable signal is received (see Section 4.1) the value in the floor limit section of the card is compared to the dollar amount entered on the manual entry pad. The pad entry used for the comparison is the value keyed into the amount field immediately after the third instruction lamp comes on and before the decimal point or first field separator, if any. The actions taken as a result of this comparison are described in detail in Section 5.4.

If no floor limit is specified on the dialing card, no matter what is keyed in on the pad, the "follow special instructions" lamp (4th instruction lamp) on the Transaction I telephone always lights when the computer down indication is received. (A message indicating that the user should follow these instructions ("SPECIAL") is displayed visually in the Transaction II telephone.) It is recommended that the dialing card have printed on it special instructions to be followed when this lamp or display is activated. These may be printed on any part of the card, as appropriate. For example, such special instructions could say, "If the amount of this transaction is below your floor limit, consult the warning bulletin and proceed with the transaction."

### 6.3.4 Response Mode Control

The character following the floor limit, if there is a floor limit, or following the telephone number delimiter otherwise, controls the response mode of the Transaction telephone. This can be voice only, keyed answer tone (KAT) for lighting the green and yellow response lamps, or frequency shift keying (FSK). The frequency shift keying is not implemented in the Transaction I telephone design, but is available in the Transaction II telephone.

The control characters for the various response modes are as follows:

1. Hexadecimal "C" — voice only. In this mode, neither Transaction telephone will respond to any keyed answer tone

or FSK signals. If this character is on a dialing card used in the "hands free" mode, the telephone lights the yellow lamp immediately upon completion of transmission of the inquiry message.

2. Hexadecimal "E" — voice or keyed answer tone. In this mode the Transaction telephone will respond to the appropriate keyed answer tone signals by lighting either the green or yellow response lamp.
3. Hexadecimal "A" — Data reception via FSK at 110 bits per second, when used in the Transaction II telephone. A card with an "A" in this position must not be used in the Transaction I telephone.
4. Hexadecimal "D" — Data reception via FSK at 150 bits per second, when used in the Transaction II telephone. When used in the Transaction I telephone, hexadecimal "D" will cause the same response mode as hexadecimal "E."
5. Hexadecimal "B" — Reserved for data reception via FSK at 300 bits per second, when used in potential future offerings. A card with a "B" in this position must not be used in the Transaction I telephone.

These response mode control characters are present to allow a single set to communicate with different data centers, some of which may have available only limited response capability. This is the only character on the dialing card which differentiates between the Transaction I and Transaction II telephones.

### 6.3.5 User Identification Characters

Characters following the response mode character are transmitted to the remote data center by the Transaction telephone when the connection is established. There may be between 0 and 24 characters in this field but the number of characters must be within the constraint of the total number of characters allowed on the card, including dialing and control characters. If Logon characters are required by the data center, they are encoded in this field, followed by hexadecimal "A" or "E."

Specifically, the characters that may be used in the user identification field are the digits 0 through 9 and the hexadecimal characters "A", "D", and "E". The hexadecimal "E" is transmitted as a TOUCH-TONE "c" and, along with the hexadecimal "A" (transmitted as TOUCH-TONE "#") is used to separate the Logon characters, if required, from the rest of the user identification characters. Other hexadecimal characters encoded on the magnetic stripe may cause error conditions and consequently should be avoided. In addition, only under the special circumstances described in Section 7.1 should the user identification field start with the hexadecimal character "D."

### 6.3.6 Special Control Character

The user identification is typically followed by the ANSI end sentinel and LRC. However, the hexadecimal characters "A", "B", and "C" preceding the end sentinel have special meaning.

The hexadecimal "A", if used, will inhibit testing of the LRC on the second card. This feature was included to allow use of certain cards, known to be in use as of this writing, with incorrect LRC characters.

The hexadecimal "C" inhibits storage of the data entered by the dialing card and disables the one number repertory dialing feature (see Section 4.1). This feature has application when the user does not want information on the dialing card to be accessed subsequently.

A hexadecimal "B" will bring both of the features above into operation. If none of these characters is present before the end sentinel then neither feature is operated, i.e., the repertory dialer is activated, and the set will check the LRC of the customer card. Calculation of the LRC is described in the next section.

### 6.3.7 End Sentinel and LRC

The final two characters on the dialing card are the end sentinel (hexadecimal "F") and the longitudinal redundancy check (LRC) character. The LRC is a binary sum without carry of the characters preceding it on the card. The parity bit on the LRC corresponds to the parity of the LRC character.

### 6.4 The Customer Card

Any customer credit card or other magnetically-encoded plastic card conforming to ANSI X4.16-1973 will work in the Transaction telephone. Typically, these cards begin with a start sentinel (hexadecimal "B") followed by the customer number, the expiration date of the card, the end sentinel (hexadecimal "F") and the LRC. As noted in Section 6.3, the LRC may be optionally ignored by the Transaction telephone.

Only the start sentinel and the end sentinel have control functions in the Transaction telephone when used on the customer card. If the start sentinel appears at the beginning of the card, and in another position as well, only the first appearance will be considered a control character. Subsequent appearances will be treated as data characters. However, precautions should be taken in encoding customer cards to avoid the following characters and sequences due to their effect on the parts of the system.

The hexadecimal "A" will be transmitted as the TOUCH-TONE "#" (A B ). Two hexadecimal "A"'s, transmitted in sequence, will correspond to the end of text sequence sent by the Transaction telephone and should therefore be avoided. The hexadecimal "C" is transmitted as the TOUCH-TONE "*" (A B ). The hexadecimal sequence "CAC" will therefore correspond to the Transaction telephone system disconnect code, "*#*", (see Section 4.2). Similarly, the hexadecimal sequence "CC", transmitted as "**" may cause automatic referral at the 407C data set. This, too, should be avoided. In addition, applications of the Transaction telephone are being considered in which the hexadecimal "A" will always have special significance.

The hexadecimal "D" corresponds to the field separator described in ANSI X4.16-1976, and is transmitted as the TOUCH-TONE "b" (A B ). This character transmitted twice in sequence is equivalent to depression of the ERASE button (see Section 7.3) on the Transaction telephone, and therefore this sequence should not appear on customer cards.

Finally, the hexadecimal "F" cannot be used as part of data because it will be recognized as the end sentinel and will terminate reading of the card.

## 7. SIGNAL SPECIFICATIONS

### 7.1 The Transaction I Telephone

This section describes the output and input signal specification for the Transaction I telephone.

Output: TOUCH-TONE frequencies

| A Group | B Group | |
|---|---|---|
| 697 | 1209 | |
| 770 | 1336 | ±1.5 percent |
| 852 | 1477 | |
| 941 | 1633 | |

**Note:** The output specifications for the Transaction II telephone are identical.

The input signal is a timed, keyed answer tone (KAT) of nominal frequency of 2025 Hz. Two durations are decoded by the Transaction telephone. Specifications are:

Input: Answer Tone

| | |
|---|---|
| Durations: | 1.5 sec ±5 percent |
| | 3.0 sec ±5 percent |
| Frequency: | 2025 Hz ±0.5 percent |
| Minimum Level: | -33 dBm (900$\mu$) |

### 7.2 The Transaction II Telephone — FSK Response

The Transaction II telephone receives FSK data at speeds of 150, or 110 bits per second, ±1 percent. The data rate is selected by a character on the dialing card, as specified in Section 6. If no dialing card is used, and dialing information is manually entered, the data rate defaults to 150 bits per second.

The mark frequency is 2225 Hz, and the space frequency is 2025 Hz. The frequencies should be held to within ±0.5 percent. The Transaction II telephone is designed to operate at signal levels greater than -33 dBm (at 900$\mu$) at the telephone line connection.

The receiver is designed with a carrier detector so that erroneous responses will not occur in the absence of carrier responses. When carrier is turned on, it should be present and in the MARK STATE for at least 200 milliseconds before actual data transmission begins.

The Transaction II telephone utilizes standard Asynchronous START-STOP ASCII (USASCII) and 7-bit characters with even parity. The display character set is given in Figure 9. The telephone receives only upper case ASCII characters, but some of them are displayed as lower case, as is distated by the seven-segment display. Data are sent preceded by a single start bit characterized by a MARK-TO-SPACE transition lasting for one bit duration. Then the actual character, compromised of 7 data bits, is sent, least significant bit first. Parity follows, and the end of the character is identified by a stop bit at marking frequency. At both bit rates, the stop bit may be any duration greater than or equal to a bit duration.

Ten bits must be transmitted as described above for each data character or control character. Thus, 15 characters per second may be sent at 150 bps, and 10 characters per second may be sent at 110 bps.

## 8. MAINTENANCE AND TESTING

A number of maintenance and testing features are included in the various components of the Transaction telephone system. The Transaction telephone, for instance, has self checks built-in for card reader failure and incorrectly coded or damaged cards.

### 8.1 Automatic Test Line For Testing the Transaction Telephones

The Bell System provides an automatic testing facility for use by customers for verifying the proper operation of the Transaction I and II telephones. To access this test line, the customer dials the number provided using the TRIMLINE handset. The test line will answer the call and send a 3-second 2025 Hz answer tone. At this point, the test procedures for the Transaction I and II telephones diverge. If the set is a Transaction I telephone, at the end of the tone, the person testing the set will insert the test card (Test Card A, supplied with the set) twice and key the manual entry pad in the following sequence: 1,2,3,4,5,6,7,8,9,.,0,/, followed by END. The test set will meanwhile send a 1.5 second answer tone, triggering the data transmission. When all the data have been transmitted (it can be heard on the handset), the green lamp will come on, and in 3 seconds the green lamp will go off and the yellow lamp will come on. The person testing the set will then press the ERASE and ATTN buttons to acknowledge proper operation of the lamps and test the operation of the buttons. If the test is good, he will hear a long (3-second) answer tone. If the test fails, the response will be a beeping tone beginning at the point of the failure, or failure of the lamps to light properly.

The test procedure for the Transaction II set is similar. After dialing the telephone number of the test line, the person testing the set will keep the handset off-hook. When he hears the 3-second answer tone, he will insert the test card (Test Card B) twice and key the 12 buttons of the manual entry in the sequence above, followed by END. Meanwhile the test line will send the 1.5-second answer tone to trigger data transmission. If the data is correct the visual display will fill with 8s and the green response lamp will start flashing. At this point, the user will press the ERASE button and the display will fill with decimal points. He will then press "1,2,3,END" and the yellow lamp will light and the display erases. Finally, he will press ATTN; the handset will be unmuted and a single 3-second tone will indicate success. Failures will be indicated by a beeping tone when a failure is detected or failure of the lights or display to function properly. A failure may occur if the test is run too slowly; if this occurs, the test should be reattempted more rapidly.*

*The procedure is different if the one-number dialer option is installed. In this case, the test person must first interrupt AC power to the set. When power is restored, the display shows "DIALED". The test person lifts the handset once, then dials the test number on the manual entry pad, followed by END. After the 3 second answer tone is heard, he presses ATTN, enters the test card a second time, and the test proceeds normally. After the test is over, the tester must interrupt power again and reload the one-number dialer.

To verify proper operation of the computer down feature for either set, the testperson places a second call to the test line and depresses the END button four times before the answer tone is received. Proper operation of the Transaction I telephone is indicated by lighting of the fourth instruction lamp, normally labeled "follow special instructions." Proper operation of the Transaction II telephone is indicated by the appearance of the characters "SPECIAL" on the display.

## 8.2 Maintenance and Testing of the 407C

The 407C data set has several features that allow the data center personnel to detect data set malfunctions. There are essentially three stages in the trouble location procedure for the 407C data set: (1) lamp indications, (2) local test, and (3) remote test.

### 8.2.1 Lamp Indications

The seven lamps associated with each data set section have a certain "normal" operation. ON conditions of the lamps give the following indications:

1. ON — Indicates presence of +5 volt supply at the data set.
2. TR — Indicates that the data set section is ready for a new call or is handling a call.
3. RI — Indicates that ringing is being applied to the data set section.
4. MR — Indicates that the data set section has placed Data Set Ready (lead 6) in the ON condition.
5. DP — Indicates that the data set section is receiving a signal which it interprets as a valid data character.
6. AR — Indicates that a referral clerk has been requested by the receipt of an ASCII sequence from the computer or through the Terminal Initiated Referral feature.
7. OS — Indicates, during computer up operation, that the data set is put out-of-service by one of the following conditions:
   a. Out-of-service (lead 25) is placed in the ON state by the computer. Alternatively, if the OS controlled by DTR feature has been selected, this lamp is ON when DTR is OFF for longer than 200 msec.
   b. The OS switch on the front panel has been operated.
   c. The data set is under test.
   d. The connector to the computer is not plugged in correctly (if A-2 or A-3 is ON).
   e. The line side of the 407C has been disconnected by the data set.

   During computer down operation, the OS lamp is OFF at all times except while the data set is under test or during the "interlock" period described below or if the OS switch is ON. An out-of-service indication will be given to the ACD or central office, but the lamp will not be lit if:
   a. Power is lost to the data set.
   b. The data set is not plugged into the nest correctly or has been removed from the nest.

A unique pattern of lights occurs during the "interlock" period when the data set has disconnected from the line in response to *#* or a line current interruption, and is waiting for the computer to complete the disconnection at the interface by turning OFF DTR. At this time the ON, MR, and OS lamps are ON; all the other lamps are OFF. The data set appears out-of-service to incoming calls.

### 8.2.2 Testing

The 407C, like the 407A and 407B, has provision for testing of the functions of the set, both locally, by Telephone Company personnel or the customer, and remotely, from the data test center.

#### 8.2.2.1 Local Test

The local test is performed utilizing the 47A1 and 51A1 data units supplied with the 57A1 data mounting. (See Figure 20.) The steps are as follows:

1. The test switch on the 51A1 data unit is placed in the REMOTE TEST position.
2. The test cable, attached to the 51A1 data unit, is connected to the data set section to be tested, replacing the customer's interface cable. The test cable has a special "finger" which engages a button recessed into the face plate of the data set. Care should be taken to insure that this "finger" is fully engaged. This action places the data set in the TEST mode. The TR and OS lights should turn ON.
3. The test switch is moved to the LOCAL TEST position. The LOCAL TEST light on the 51A1 data unit should light immediately.
4. At this point, the data set performs an internal self-test. During the test, the RI and AR lights will flash briefly. If the internal test is successful, the MR lamp will light after a short delay. This should happen within 10 seconds. If the internal test fails, the MR lamp does not light. Instead the LOCAL TEST lamp flashes several times and then is turned OFF. In addition a diagnostic display is presented on the row and column lights of the 47A1 data unit, to aid Bell System personnel in repairing the data set.
5. If the self-test is passed, and the MR lamp is lighted, the tester proceeds to test TOUCH-TONE character reception. The tester depresses the buttons on the TOUCH-TONE pad of the 47A1. If the character is received correctly, the corresponding row and column lights on the 47A1 will flash at about a 10 Hz rate. The DP light on the data set section will flash at the same rate. In addition if the Terminal Initiated Referral-Computer Up Option (A-4) is selected, the AR lamp will light steadily or flash (depending on the ACD option) when the "*" button is depressed.

If trouble is suspected in the 407C data set, the local test should be performed by data center personnel before calling the Telephone Company for assistance.

### 8.2.2.2 Remote Test

The REMOTE TEST of the 407C data set is conducted by Telephone Company personnel at the Data Test Center. The sequence for remote testing is as follows:

1. The data set is prepared for the remote test by placing the TEST switch in the REMOTE TEST position and inserting the test cable into the customer interface connector, making sure the "finger" engages the test switch. The TR and OS lamps on the data set section should light.
2. When the data test center places a call to the 407C, the set answers the call, the remote test lamp lights and the self-test begins. 1.5 seconds into the self-test, the 407C sends 1.5 seconds of 2025 Hz answer tone.
3. While the self-test is being run, the 407C sends 15 seconds of 2225 Hz tone to the Data Test Center to allow level and frequency measurement.
4. When the 15 seconds has elapsed, the data set transmits a 7-character repeated FSK message to indicate the state of all customer selected options in the data set. The message is repeated 50 times, to allow the Data Test Center to lock onto the correct data rate.
5. After the FSK message has been transmitted, if the self-test was successful, the 407C enter the TOUCH-TONE character test by transmitting the 2025 Hz tone, and starts a 15-second timer. At this point, the Data Test Center can measure the frequency and level of the 2025 Hz tone. The timer can be disabled by the Test Center by transmitting the "*" character (see Step 6).
6. When the Data Test Center transmits TOUCH-TONE signals, the 407C responds by turning OFF the 2025 Hz tone and looping the TOUCH-TONE signal back to the test center for about 70 msec, then restoring the 2025 Hz tone for about 25 msec, then repeating the cycle for as long as a valid TOUCH-TONE signal is present. Receipt of the

TOUCH-TONE * ($A_4B_1$) during this part of the test disables the 15-second timer. Receipt of any other character reenables the timer. Receipt of the TOUCH-TONE "a" ($A_1B_4$) causes the data set to disconnect. If the timer elapses, the 407C will disconnect from the line.

### 8.3 Statistics at Data Center

It is both instructive and helpful for the data center computer to monitor per-line statistics. This would aid greatly in speeding trouble location to a specific computer port or 407C. Among the statistics of value to the Telephone Company would be:

1. Number of incoming calls (number of times DSR comes ON).
2. Number of calls in which DSR came ON but no digital data was received.
3. Number of calls in which no normal end-of-message transmission was received (abnormal end-of-call).
4. Errors on incoming and outgoing messages.

These statistics could then be reported to the Telephone Company at the same time the malfunction is reported.

### 8.4 Test Routine

In order to test the operation of the entire system, a test routine in the data center computer is strongly recommended. Such a routine might consist of a dummy account which generates an appropriate response when queried. System users should be instructed to try this mode of testing first, when trouble is suspected. If this test fails, they should call the Transaction telephone test line, as described earlier, to test the Transaction telephone. If this test fails, the Telephone Company should be notified that the Transaction telephone is experiencing trouble.

# SUPPLEMENT

## 1. PURPOSE

This supplement documents changes in the operation of the 407C data set which were made just prior to publication of this document. These additional features enhance the compatibility of the data set with customer computer systems, and provide consistent operation in certain nonstandard situations.

## 2. NEW FEATURES

The new features of the 407C data set affect four different sections of this publication. They are:

1. The addition of several new end-of-message sequences. These are described in Section 4.2.3. The use of the option switches A-6, A-7, and A-8 are also changed.
2. Changes to the operation of the data set when the "Multiple Message Segments" option is enabled. This is currently described in Section 4.2.9.
3. Changes in operation in the "computer down" mode — Section 5.4.
4. The addition of the special sequence ";;;" (not currently described) to allow the transmission of the ASCII character "ENQ".
5. A change in the remote testing operation of the data set — currently described in Section 8.2.2.2.
6. The admission of the ASCII 'STX' before the first '?' in the response message to the Transaction II telephone.

### 2.1 New End-of-Message Characters

At present, the end message (EOM) characters selected by the customer for transmission **to** the computer after all messages from the 407C are:

1. CR (carriage return)
2. DC3 (device control 3)
3. CR LF DC3 (carriage return, line feed, DC3)
4. no characters.

The only character currently accepted by the 407C as an end-of-message **from** the computer after most messages is 'DC3' (the exception is 'ENQ' for an initial "HELLO" message).

This operation is now changed to allow the selection of two additional EOM characters on messages **to** the computer. These are ASCII "ETX" and "EOT".

In addition, these two characters can be optioned as EOM characters on messages **from** the computer, when they have been selected as EOM characters going **to** the computer. This distinction was made to give a customer the flexibility to provide his own error control in the system (for which ETX is then a non-EOM character from the computer) while still receiving the 'ETX' or 'EOT' as an EOM from the 407C.

Finally, the ASCII character 'ENQ' has been made equivalent to 'DC3' on messages from the computer at all times.

Table 1 shows the expanded EOM sequences which can be selected by the customer. Note that this change requires the use of the A-8 option switch, which was formerly called the BCM option. It is now used in the serial interface to select the proper EOM. In the parallel interface, switch A-8 is still used to select a BCM or 2-out-of-8 code for transmission of parallel data to the computer.

**TABLE 1**

| Option Switches | | | EOM to the | EOM from the |
|---|---|---|---|---|
| **A-6** | **A-7** | **A-8** | **Computer** | **Computer** |
| OFF | OFF | OFF | No characters | DC3,ENQ |
| ON | OFF | OFF | CR | DC3,ENQ |
| ON | ON | OFF | DC3 | DC3,ENQ |
| OFF | ON | OFF | CR LF DC3 | DC3,ENQ |
| OFF | OFF | ON | ETX | DC3,ENQ |
| OFF | ON | ON | EOT | DC3,ENQ |
| ON | OFF | ON | ETX | DC3,ENQ or ETX |
| ON | ON | ON | EOT | DC3,ENQ or EOT |

### 2.2 Multiple Message Segments

In order to allow the data set to be integrated into multiple message segment environment without affecting the systems software of the data base, two changes have been added.

1. The LOGON characters received by the data set from the Transaction Telephone are currently transmitted to the computer at the appropriate time up to and including the delimiter (TOUCH-TONE "*" or "c" — translated to ASCII "<" or ">"). Under the new change, the delimiter is not transmitted.
2. The initial message to the applications program (after LOGON is complete) will be preceded henceforth by the ASCII characters "407 space". This serves as a transaction code for the system software.

### 2.3 Computer Down

Changes have been made in the "computer down" operation of the data set to allow for smooth recovery from the "computer down" state when the return to the "computer up" state occurs during a call.

1. On calls answered in "computer down", the 407C will activate the interface at the end of 1.5 seconds of answertone (3 seconds after ringing is tripped) giving any recording equipment monitoring the "receive data" lead a 1.5 second interval (the period of the extended answertone) to initialize.
2. On calls answered in "computer down", the 407C will indicate the termination of the call after 15 seconds by sending 'L' EOM on the receive data lead.
3. On calls answered in "computer down" if the computer recovers within 3 seconds after ringing is tripped, the call will continue as though it were answered

normally (in "computer up"). This will accommodate those customers who keep DTR off until ringing is detected and also would like "computer down" operation via all DTR's off.

4. On calls answered in "computer down", if the computer recovers after 3 seconds into the call, DTR control, **only**, will be returned to the computer so that it may demand a disconnect of this call by bringing DTR on for 50 ms and then off for 50 ms. Otherwise, the call will be disconnected by the data set (including the interface — the positive interlock is inhibited on such calls) at the end of 15 seconds after sending 'L' EOM as above. Of course, the call may be terminated sooner if the disconnect sequence *#* is received.

## 2.4 New Character Sequence

The sequence ';;;' in a response message followed by 'EOM' will cause the ASCII character 'ENQ' to be sent to the calling terminal.

## 2.5 Remote Testing

In the remote testing of the data set, a 1 second delay between the 1.5 second 2025 Hz answertone and the 14 second (was 15 second) 2225 Hz marking frequency was introduced so that a fault which causes tone always to be on can be detected more easily.

## 2.6 Use of 'STX' in Response Messages

The use of 'STX' in a response message to the Transaction II telephone when the Error Control (B-3) option is in effect will henceforth result in the correct LRC being sent to the terminal, as long as the STX occurs before the first '?' in a message. The use of the 'STX', as before, is most necessary when the B-3 option is selected.

TABLE 1

SWITCHED NETWORK TRANSACTION TELEPHONE SYSTEM ALPHABETS

| Card Coding (Hexadecimal) | Binary $2^3/2^2/2^1/2^0$ | Buttons | Characters Sent On Switched Network (TOUCH-TONE) | Characters At 407C Interface (ASCII) |
|---|---|---|---|---|
| 0 | 0000 | 0 | 0 | 0 |
| 1 | 0001 | 1 | 1 | 1 |
| 2 | 0010 | 2 | 2 | 2 |
| 3 | 0011 | 3 | 3 | 3 |
| 4 | 0100 | 4 | 4 | 4 |
| 5 | 0101 | 5 | 5 | 5 |
| 6 | 0110 | 6 | 6 | 6 |
| 7 | 0111 | 7 | 7 | 7 |
| 8 | 1000 | 8 | 8 | 8 |
| 9 | 1001 | 9 | 9 | 9 |
| A | 1010 | /+ | # | : |
| B | 1011 | | a | ; |
| C | 1100 | | * | < |
| D | 1101 | /+ | b | = |
| E | 1110 | | c | > |
| F | 1111 | | d | ? |
| | | ATTN | ** | |
| | | ERASE | bb | |
| | | END | ##, a or b (Depending on when used.) | |

+ The / button causes the # ($A_4B_3$) signal to be sent during dialing before use of the END button or insertion of a card, and the b ($A_2B_4$) signal at all other times.

## TABLE 2

## TRANSACTION TELEPHONE

## DIALING CARD CONTROLLED OPTIONS

1. Green/yellow response lamps enable
2. FSK receiver enable and data rate selection
3. Dialing mode change – dial pulse to TOUCH-TONE or TOUCH-TONE to dial pulse for split mode dialing
4. Two part dialing enable
5. Response mode in computer down – controlled by floor limit
6. Repertory dialer disable
7. Customer card LRC check inhibit
8. Predialing enable

## TABLE 3

## TRANSACTION TELEPHONE OPTIONS

## SET AT INSTALLATION

1. Primary Dialing Mode – TOUCH-TONE/Dial Pulse
2. Manual Dialing from Manual Entry Pad – Enable/Disable
3. Key Strip Installation – For Key Systems
4. PIN Pad
5. One number dialer

## TABLE 4. MESSAGE FORMATS

### A. Initial Inquiry Message

| TID | MERCHANT I.D. | SEP | CUSTOMER DATA | SEP | AMOUNT AND OTHER DATA | ETX | LRC | CCT |
|---|---|---|---|---|---|---|---|---|
| Terminal Type Identification Three characters generated by terminal beginning with TOUCH-TONE b. | Text from user identification part of the dialing card, or data entered while first instruction lamp is lit for manual entry. | TOUCH-TONE a for mag striped customer card; b for manual entry. | Text of customer card. Start Sentinel, End sentinel, and LRC removed. If manual entry, all data entered while second instruction lamp lamp is lit. | TOUCH-TONE a. | All data entered manually while third instruction lamp is lit. May include amount of transaction, transaction code, PIN, etc. | End of Text sequence. | Longitudinal Redundancy Check | Character Count |

EXAMPLE: The Merchant I. D. is 1122334455, the customer number is 98177484589763, the amount of the sale is $10.45, and the PIN is 9876. The clerk inserts both cards, then keys in the amount, using the decimal point. She presses the [/] button, and then the customer keys in the PIN and presses [END].
The transmitted message is:

b30 1122334455 a 98177484589763 a 10*45b 9876 ## $^{L}{}_{R}{}_{C}{}^{C}{}_{T}$

Spaces have been inserted to separate data corresponding to the different steps in the input process.

### B. Later Messages

| MANUAL OR CARD ENTRY | ETX |
|---|---|
| Data from manual entry pad exactly as they are keyed in, or text of card entry. Length of this field is unlimited | End of Text if END is pressed. |

## TABLE 5
## TRANSACTION TELEPHONE TERMINAL ID CHARACTERS

First character is always TOUCH-TONE "b" = hex "D" for Transaction Telephone.

| Character | Bit | Value | Meaning |
|---|---|---|---|
| Second | $2^0$ | 1 | LRC only |
| | | 0 | LRC and CCT transmitted |
| | $2^1$ | 1 | Receiver off hook |
| | | 0 | Receiver on hook |
| | $2^2$ | 1 | User information manually entered |
| | | 0 | User information entered via card |
| | $2^3$ | 0 | Always |
| Third | $2^0$ | 1 | Chain bit – next character is ID character |
| | | 0 | Last ID character |
| | $2^1$ | 0 | Reserved for printer use |
| | $2^2$ | 1 | Transaction II set-data receiver active |
| | | 0 | No data receiver active |
| | $2^3$ | 0 | Always |

## TABLE 6

## ACTION FIELD CONTROL CHARACTERS

Characters received by Transaction II Telephone following STX and preceding the first "?":

| | |
|---|---|
| 0 | Set automatic disconnect timer to 3 minutes. |
| 1 | "NAK" – Retransmit last message. |
| 2 | Unmute call progress tone sounder. |
| 3 | Do not check message LRC (must appear immediately after STX). |
| 4 | Reserved for future use. |
| 5 | Acknowledge end of display |
| 6 | Light green response lamp. |
| 7 | Light yellow response lamp. |
| 8 | Blink lamp. |
| 9 | Disconnect, send *#* |

TABLE 7

TOUCH-TONE CONTROL CHARACTER SEQUENCES

| Meaning | TOUCH-TONE Sequence |
|---|---|
| SOH | b (0-7)[1] |
| RS | bc |
| GS | b8 |
| NAK | 3#3 |
| ACK | 4#4 |
| EOT | 5#5 |
| STX | b9 |
| ETX | ## |
| DISCONNECT | *#* |
| Acknowledge green light lit by tone | a |
| Acknowledge yellow light lit by tone | b |
| Off Hook | ## |
| ATTN | ** |
| ERASE | bb |
| Acknowledge end of display | 4## |

1. The first character following "b" is in the range 0-7.

## TABLE 8

## CUSTOMER CONTROLLED OPTIONS

### GROUP A

| SWITCH | OPTION |
|---|---|
| 1 | AUTOMATIC DISCONNECT |
| 2 | OUT–OF–SERVICE CONTROLLED BY DTR |
| 3 | OUT–OF–SERVICE CONTROLLED BY OS |
| 4 | TERMINAL INITIATED REFERRAL – COMPUTER "UP" |
| 5 | TERMINAL INITIATED REFERRAL – COMPUTER "DOWN" |
| 6 | END OF MESSAGE SEQUENCE 1 (NOTE 2) |
| 7 | END OF MESSAGE SEQUENCE 2 (NOTE 2) |
| 8 | BINARY CODED MATRIX OUTPUT |
| 9 | 110 BITS PER SECOND DATA RATE (NOTE 1) |
| 10 | NOT USED |

### GROUP B

| SWITCH | OPTION |
|---|---|
| 1 | MESSAGE BLOCKING |
| 2 | STX/ETX PUNCTUATION |
| 3 | ERROR CONTROL |
| 4 | POSITIVE ACKNOWLEDGMENT |
| 5 | PROTOCOL |
| 6 | LOGON |
| 7 | MULTIPLE MESSAGE SEGMENTS |
| 8 | CONTACT EQUIVALENT OUTPUT (NOTE 3) |
| 9 | 300 BITS PER SECOND DATA RATE (NOTE 1) |
| 10 | NOT USED |

Notes:

1. If Neither The 110 Bits Per Second Nor 300 Bits Per Second Is Selected, A Default Of 150 Bits Per Second Is Used.
2. The End–Of– Message (EOM) 1 And 2 Switches Are Decoded As Follows:

| EOM1 | EOM2 | SEQUENCE |
|---|---|---|
| OFF | OFF | NOTHING |
| ON | OFF | ACSII "CR" (CARRIAGE RETURN) |
| OFF | ON | ASCII "CR LF DC3" (CARRIAGE RETURN-LINE FEED - DEVICE CONTROL 3) |
| ON | ON | ASCII "DC3" (DEVICE CONTROL 3) |

3. Must Be Operated In Conjunction With Internal Data Set Wiring Options.

## TABLE 9
## SUMMARY OF 407C CONTROL MESSAGES (NOTE 1)

X – END OF INPUT BLOCK; NO ERROR CHECK MADE

K – END OF INPUT BLOCK; GOOD ERROR CHECK (NOTE 2)

F – END OF INPUT BLOCK; BAD ERROR CHECK (NOTE 2)

A – POSITIVE ACKNOWLEDGMENT RECEIVED FROM REMOTE TERMINAL (NOTES 2, 3)

N – NEGATIVE ACKNOWLEDGMENT RECEIVED FROM REMOTE TERMINAL (NOTE 2)

T – TIME OUT EXPIRES BEFORE RECEIPT OF ACKNOWLEDGMENT (NOTE 2)

E – END OF TRANSMISSION SEQUENCE (5 # 5) RECEIVED FROM REMOTE TERMINAL (NOTE 2)

H – READY FOR TONE TRANSMISSION TO REMOTE LOCATION

<<R – REFERRAL MADE IN CALL DIRECTOR SYSTEM

DIGIT DIGIT R – REFERRAL MADE IN AUTOMATIC CALL DISTRIBUTOR SYSTEM (NOTE 4)

<<I – ERROR CONTROL INTERRUPTED BY REFERRAL IN CALL DIRECTOR SYSTEM (NOTE 2)

DIGIT DIGIT I – ERROR CONTROL INTERRUPTED BY REFERRAL IN AUTOMATIC CALL DISTRIBUTOR SYSTEM (NOTES 2, 4)

B – ATTENDANT REQUEST FROM COMPUTER EQUIPMENT ABORTED (AUTOMATIC CALL DISTRIBUTOR SYSTEM ONLY)

Z – REFERRAL MADE IN CALL DIRECTOR SYSTEM AND RETURN TO DATA ACTIVATED BEFORE CONTROL MESSAGE DELIVERED

D – AUTOMATIC DISCONNECT CODE (*#*) DETECTED

L – LINE CURRENT DISCONNECT OCCURRED

P – ERROR CONTROL INTERRUPTED BY PREMATURE DISCONNECT (NOTE 2)

Notes:
1. All Messages Are Followed By The Selected End–Of–Message (EOM) Sequence. If Protocol Is Selected, All But "A" Assign The Channel To The Computer Equipment For Transmission.
2. Used Only If Error Control Is Invoked.
3. Used Only When The Positive Acknowledgment Option Is Selected.
4. The Digits Identify The Selected Attendant.

## TABLE 10

## EXAMPLES OF DIALING CARDS

| START SENTINEL | DIALING CARD IDENTIFICATION | TELEPHONE NUMBER | FIELD SEPARATOR | FLOOR LIMIT (OPTIONAL) | RESPONSE MODE | MERCHANT I.D. | SPECIAL CONTROL | END SENTINEL | LRC | FEATURES |
|---|---|---|---|---|---|---|---|---|---|---|
| B | C | NN . . . N | D | | L | MM . . . M | K | F | L R C | One part dialing, no predialing, no floor limit |
| B | C | NCNN . . . N | D | | L | MM . . . M | K | F | L R C | Two part dialing, basic dialing mode, no floor limit |
| B | C | NENN . . . N | D | | L | MM . . . M | K | F | L R C | Two part dialing, basic mode for first part other mode for second, no floor limit. |
| B | C | NN . . . NC | D | | L | MM . . . M | K | F | L R C | One part dialing, predialing, no floor limit. |
| B | C | NN . . . N | D | 050 | L | MM . . . M | K | F | L R C | One part dialing, no predialing, $50 floor limit (see NOTE) |
| B | C | NN . . . NC | B | | D | | | F | L R C | One part dialing, telephone number only |

LEGEND:

A,B,C,D,E,F = hexadecimal characters encoded on card

N = any hexadecimal digit (0-9)

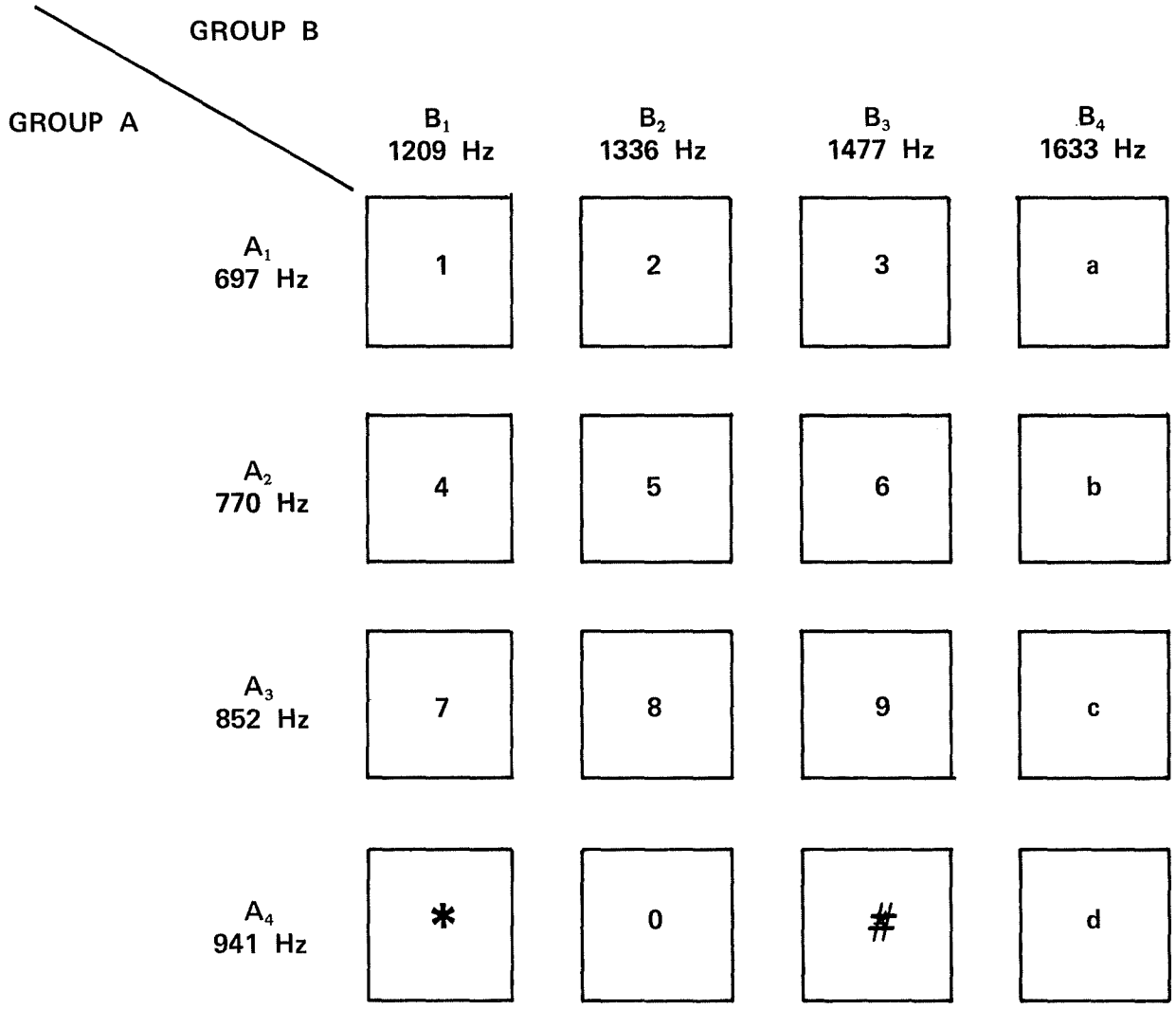
M = any hexadecimal digit (0-9), or hexadecimal characters D or E or A

L =
- C – Voice only
- E – Enable Keyed Answer Tone receiver
- D – Enable FSK receiver at 150 BPS (if FSK receiver is not available, Keyed Answer Tone receiver is enabled)
- A – Enable FSK receiver at 110 BPS

K =
- Omitted – Store card contents, check customer card LRC
- A – Store card contents, do not check customer card LRC
- B – Do not store card contents, do not check customer card LRC
- C – Do not store contents, check customer card LRC

LRC = Any hexadecimal character derived by summing (without carry) all previous characters on card.

NOTE: The floor limit is a 3-digit field, hence a $50.00 floor limit is coded as 050.




**Touch - Tone Frequency Assignments**

**Figure 1**

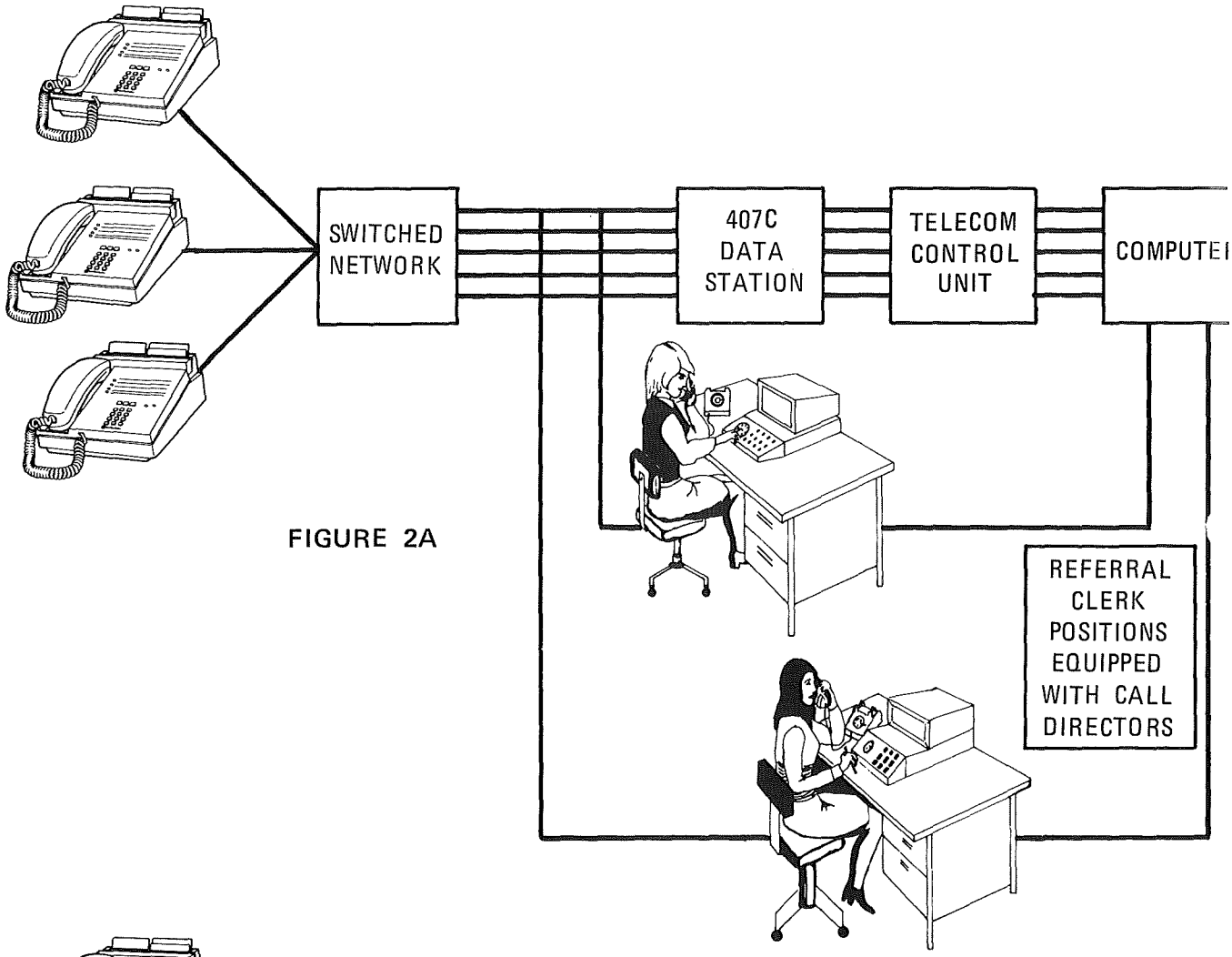



FIGURE 2A

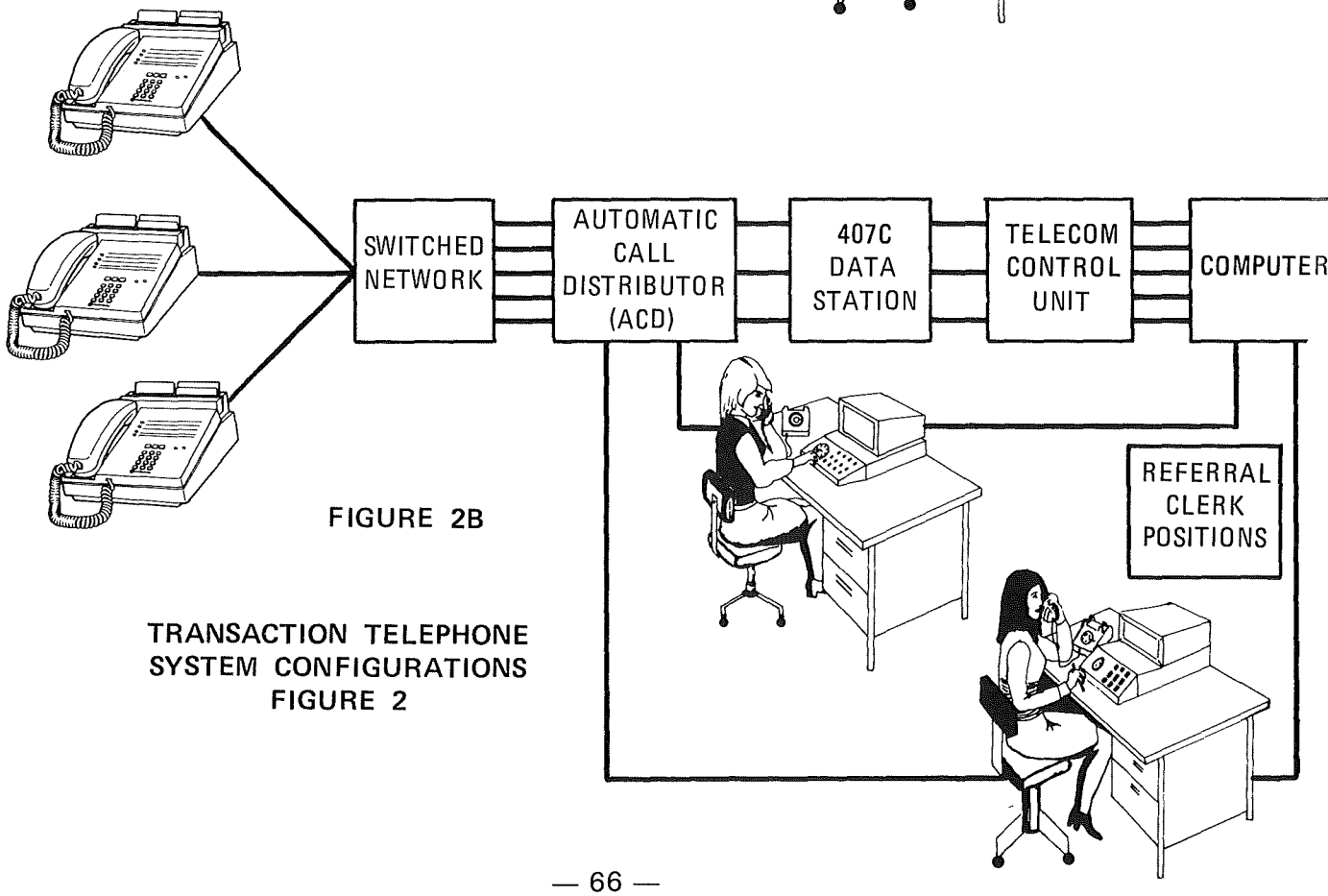
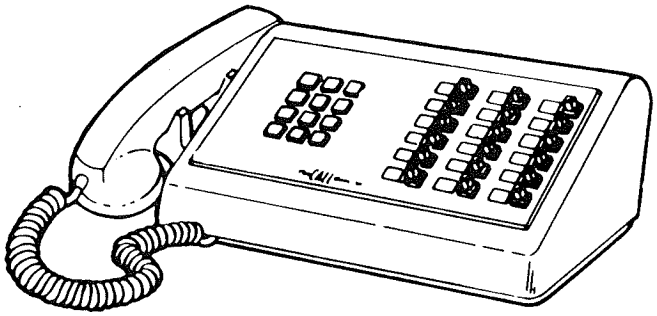



FIGURE 2B

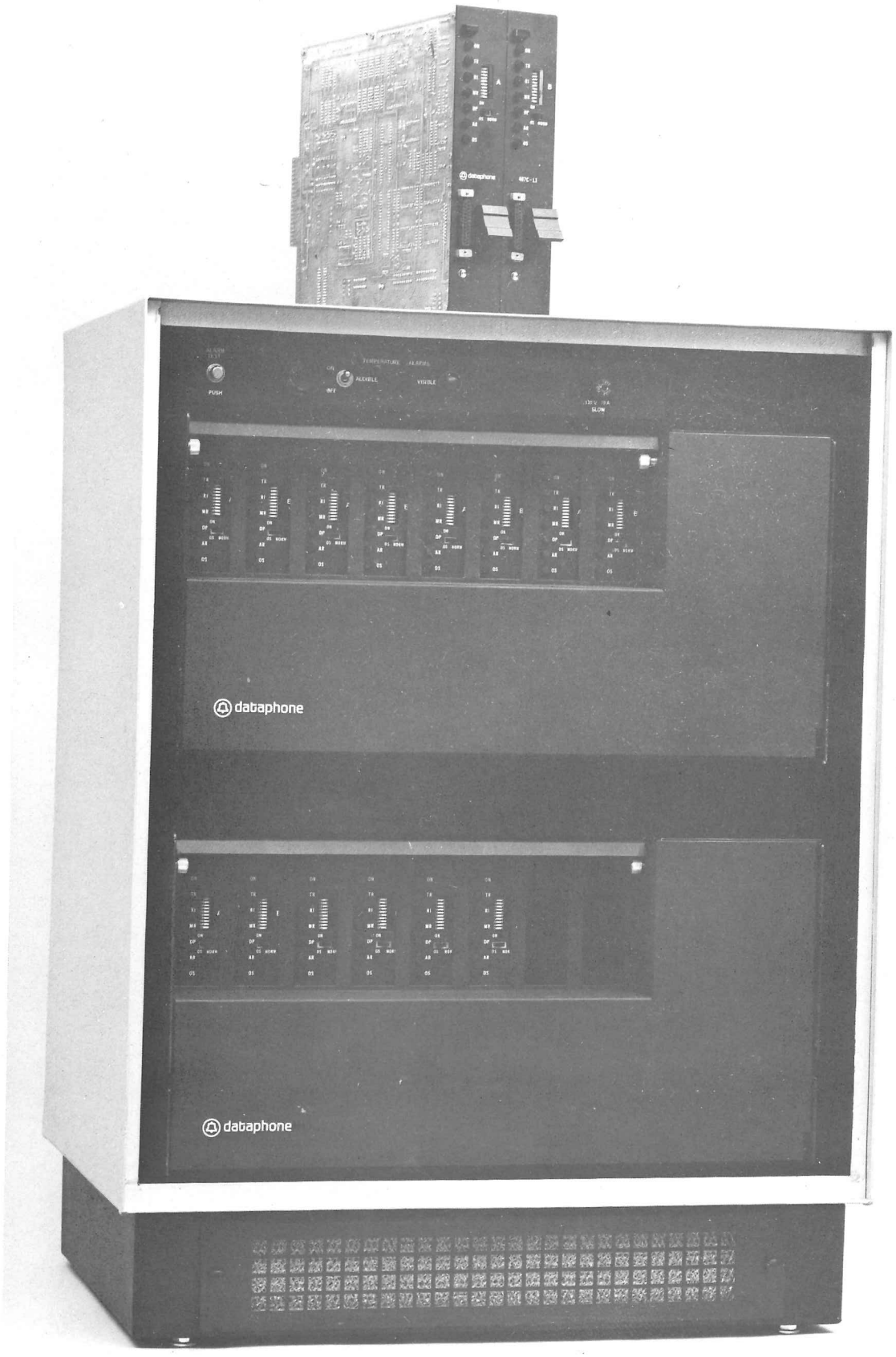
TRANSACTION TELEPHONE SYSTEM CONFIGURATIONS
FIGURE 2


**TRANSACTION II TELEPHONE WITH PIN PAD**
**FIGURE 3**

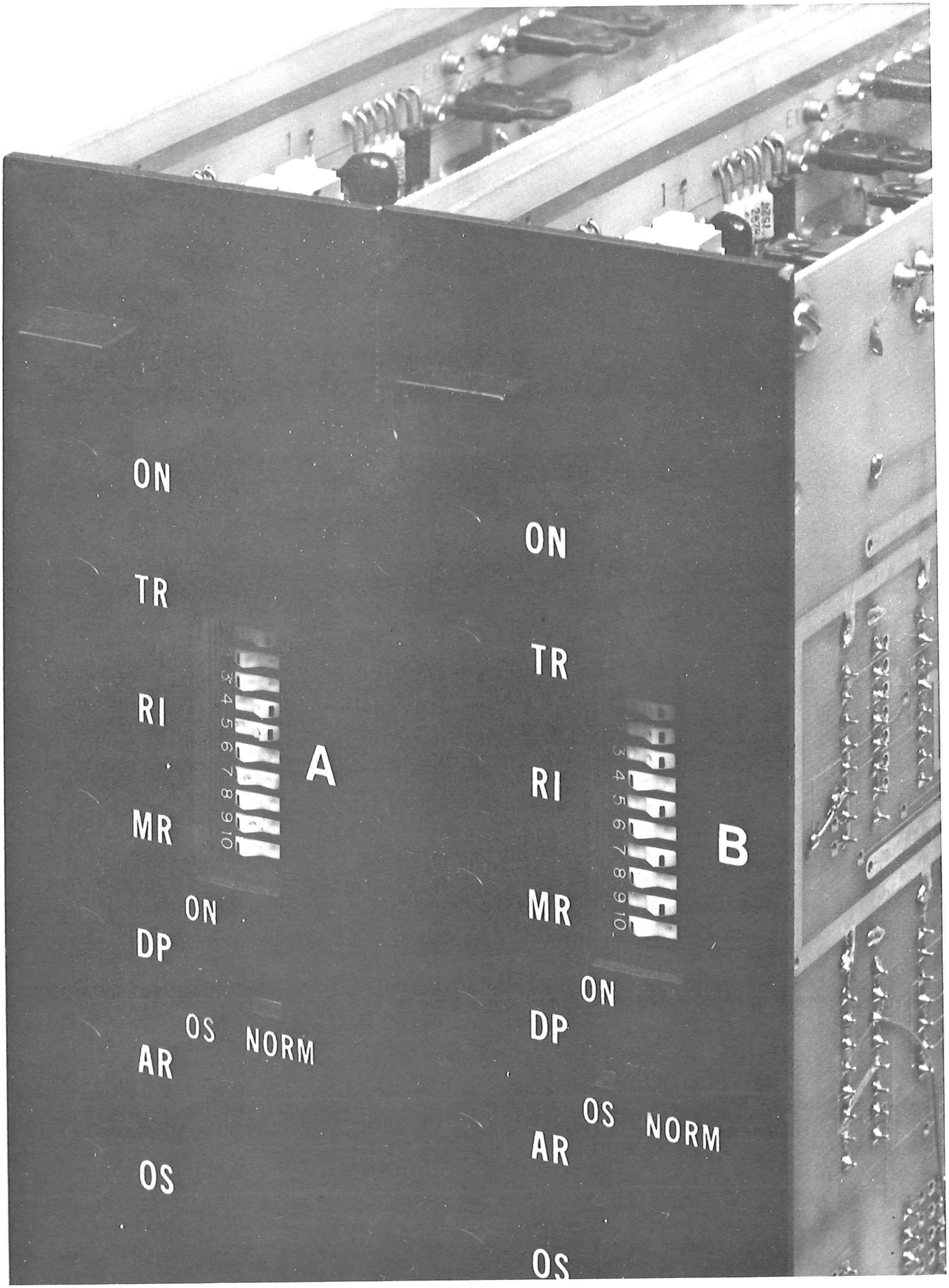

TRANSACTION I TELEPHONE



18-BUTTON CALL DIRECTOR
FIGURE 5

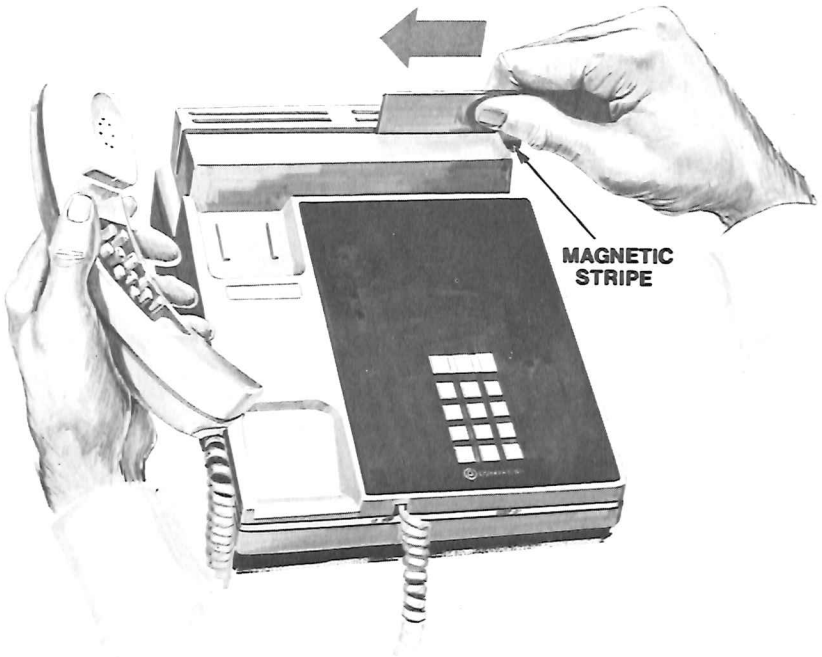



407C DATA STATION
FIGURE 6




407C FACEPLATE

FIGURE 7

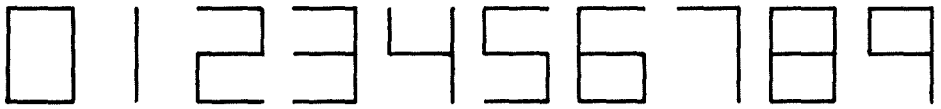



1. Set card in widened portion of slot so that it rests against slot bottom.

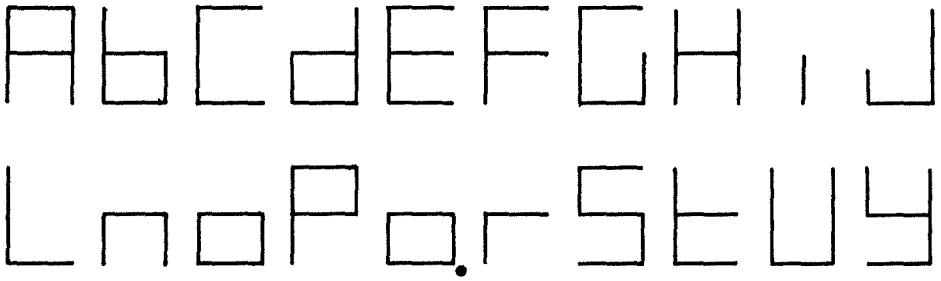
2. Slide card from right to left through slot.

USING THE MAGNETIC STRIPE CARD READER
FIGURE 8

DIGITS



LETTERS

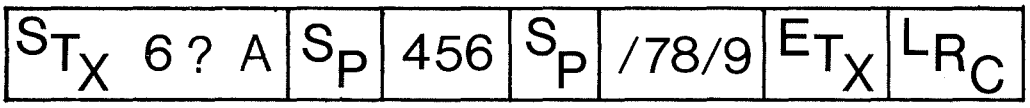


SPECIAL CHARACTERS

- DECIMAL POINT
- – DISPLAYED FOR (/) KEY OR FOR TRANSMITTED (–)

**FIGURE 9**
**DISPLAYABLE CHARACTERS – TRANSACTION II**


A. NORMAL RESPONSE MESSAGE




B. EXAMPLE OF MESSAGE

**FIGURE 10**
**RESPONSE MESSAGE FORMATS**

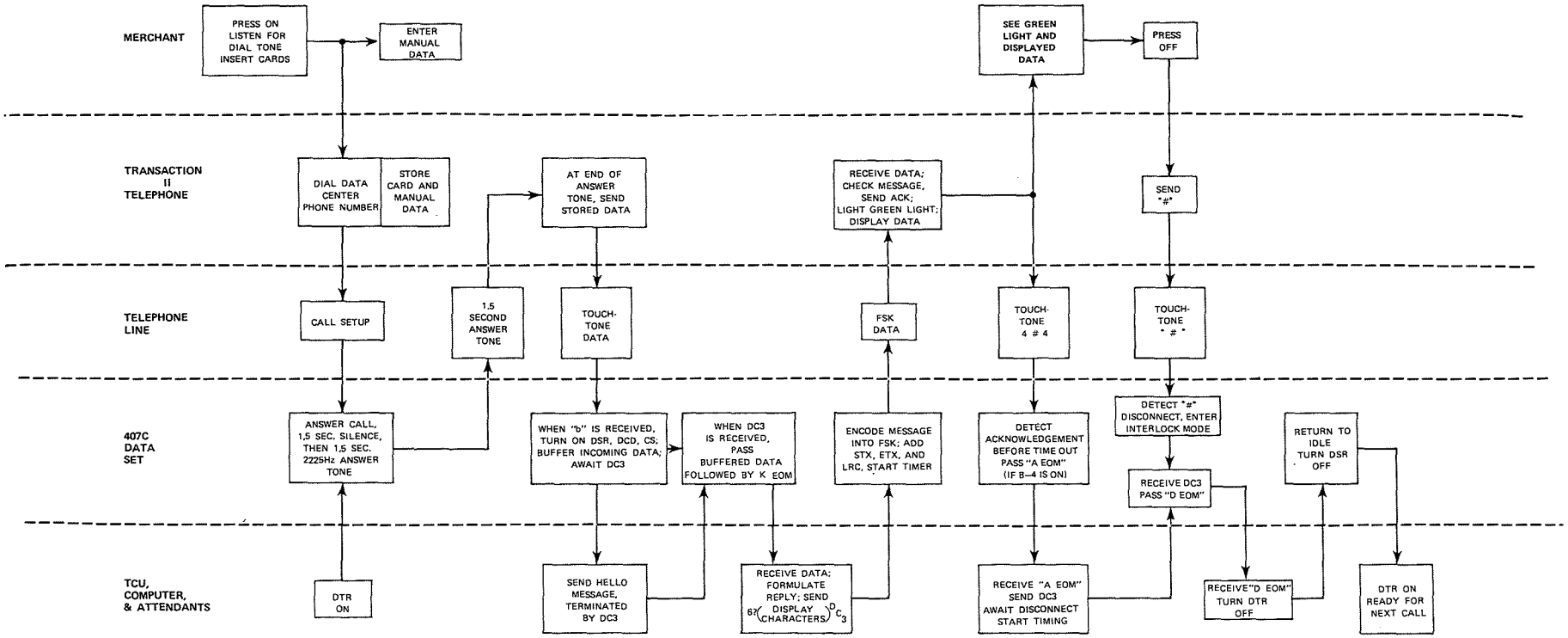



FIGURE 11
**TYPICAL TRANSACTION - TRANSACTION II - GREEN LIGHT**

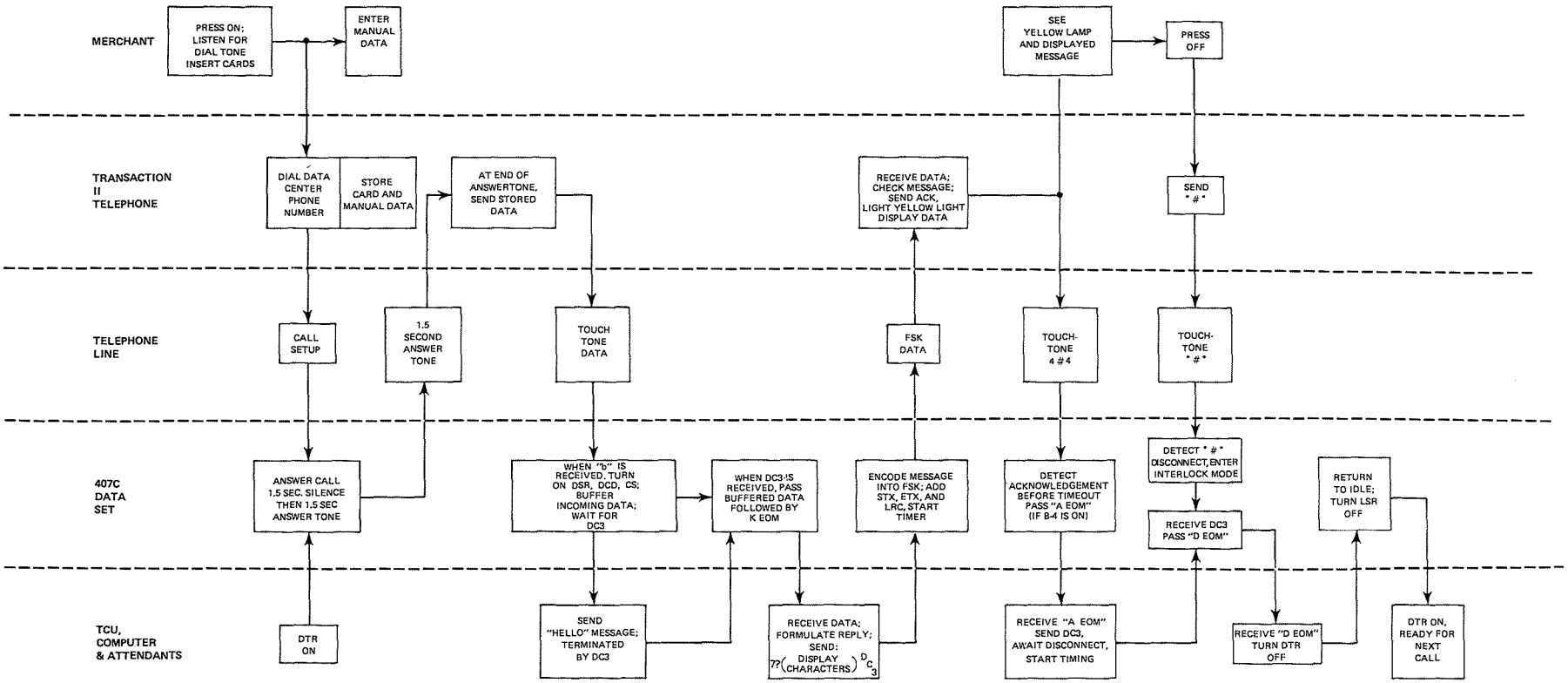



FIGURE 12
**TYPICAL TRANSACTION - TRANSACTION II - YELLOW LIGHT**

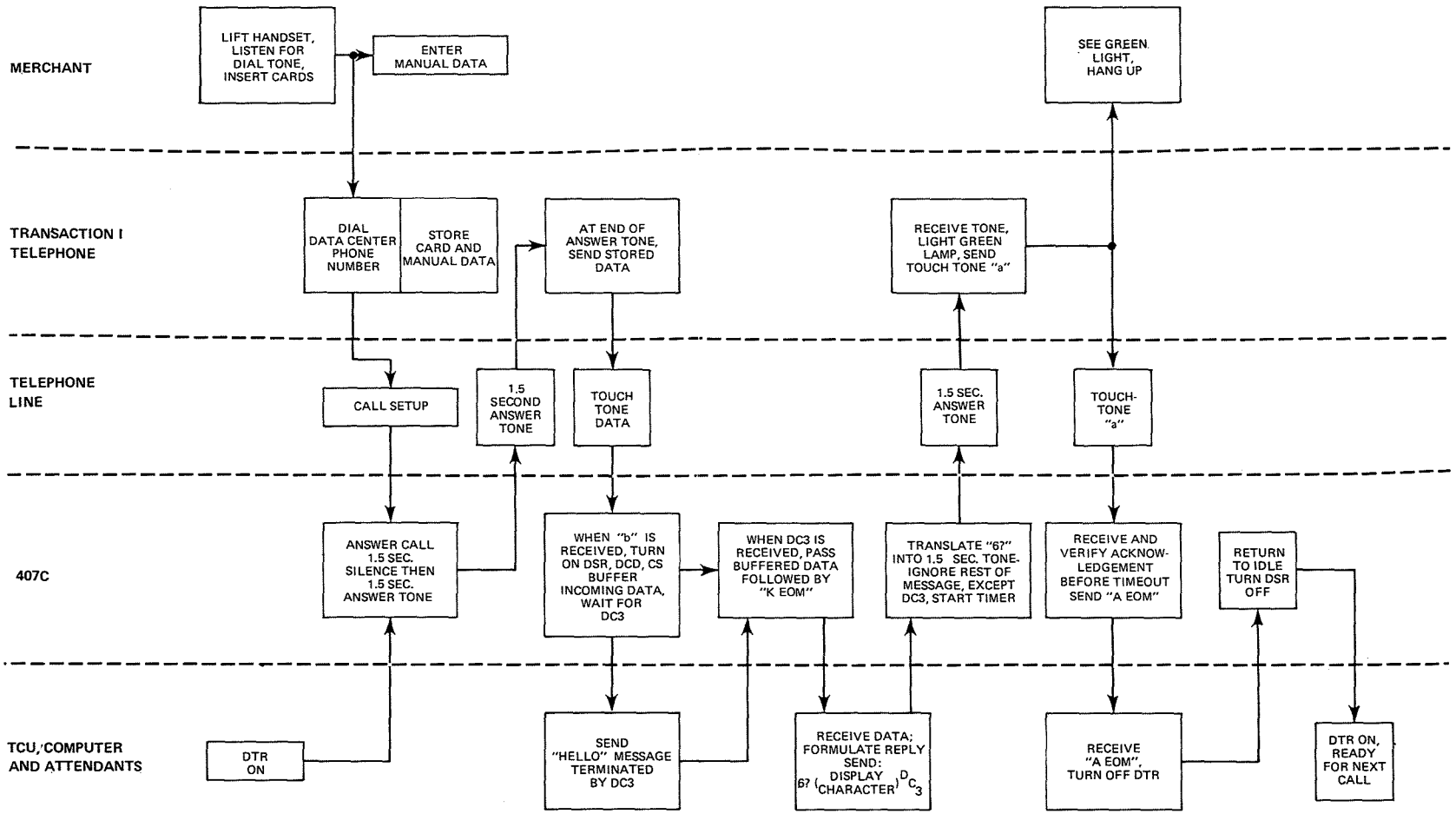
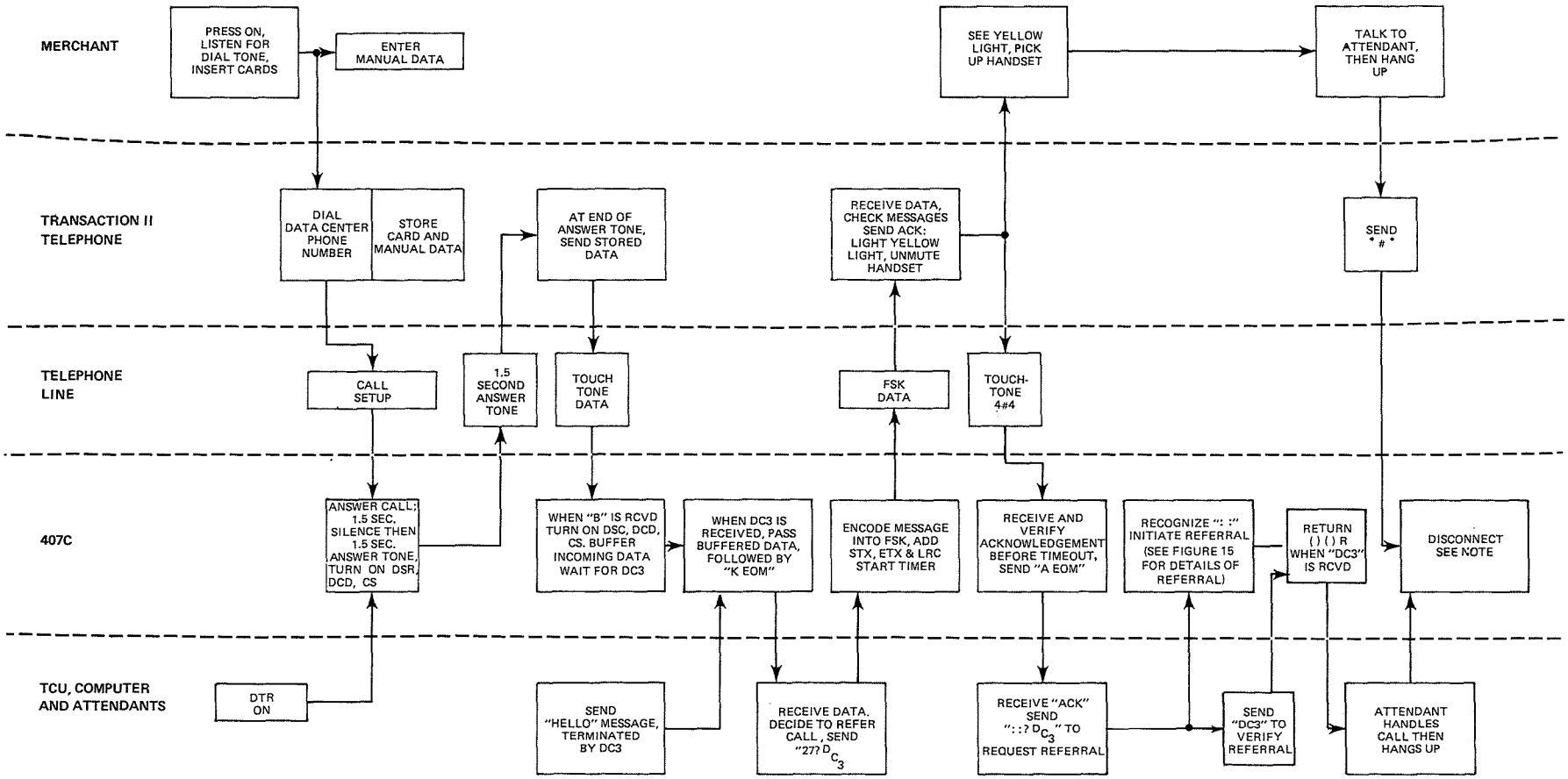



FIGURE 13
**TYPICAL TRANSACTION - TRANSACTION I**




Note: In Call Director case, line side disconnects when attendant hangs up; with ACD, line side disconnects (and "D" EOM) when merchant hangs up. Full disconnect occurs when DTR is turned off.

FIGURE 14A
**COMPUTER GENERATED REFERRAL**

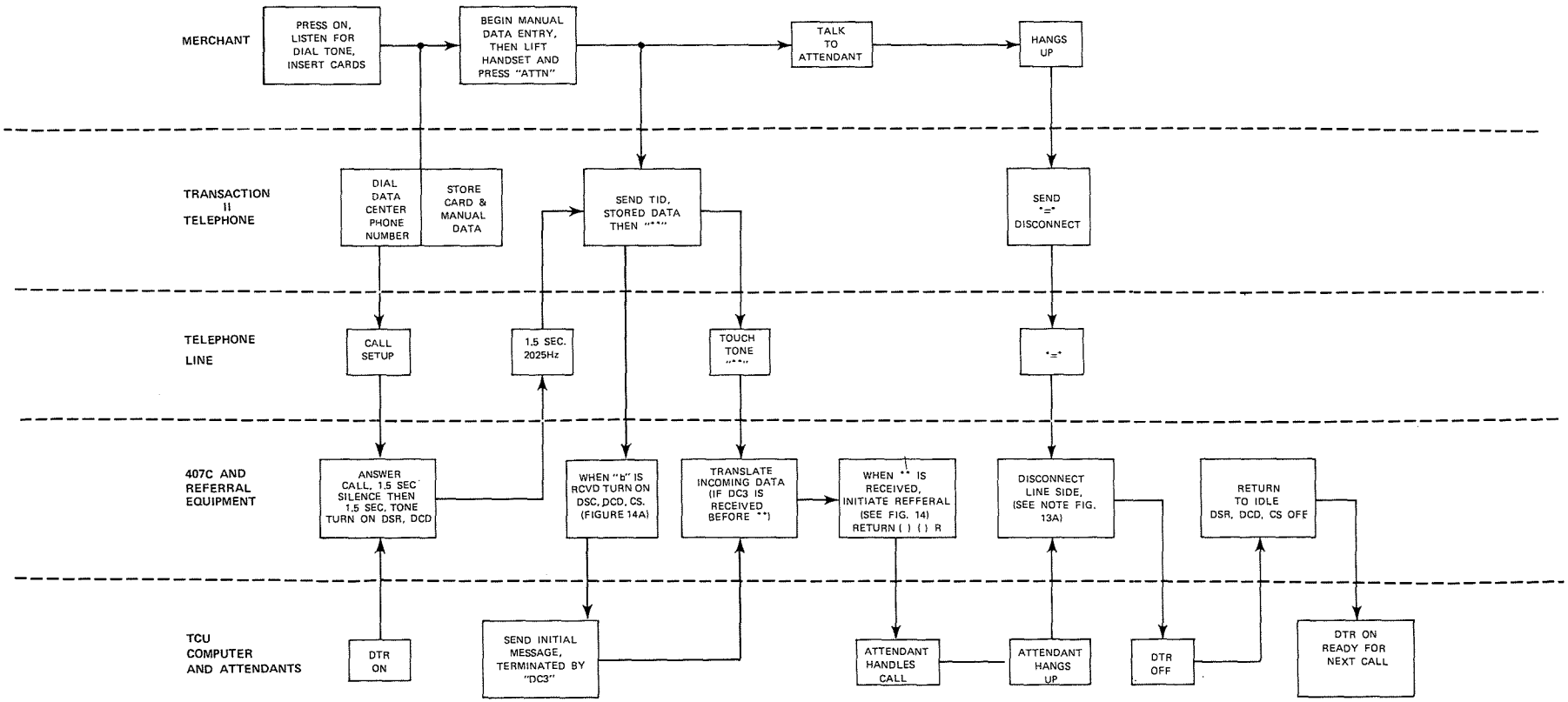



FIGURE 14B
**TERMINAL INITIATED REFERRAL**

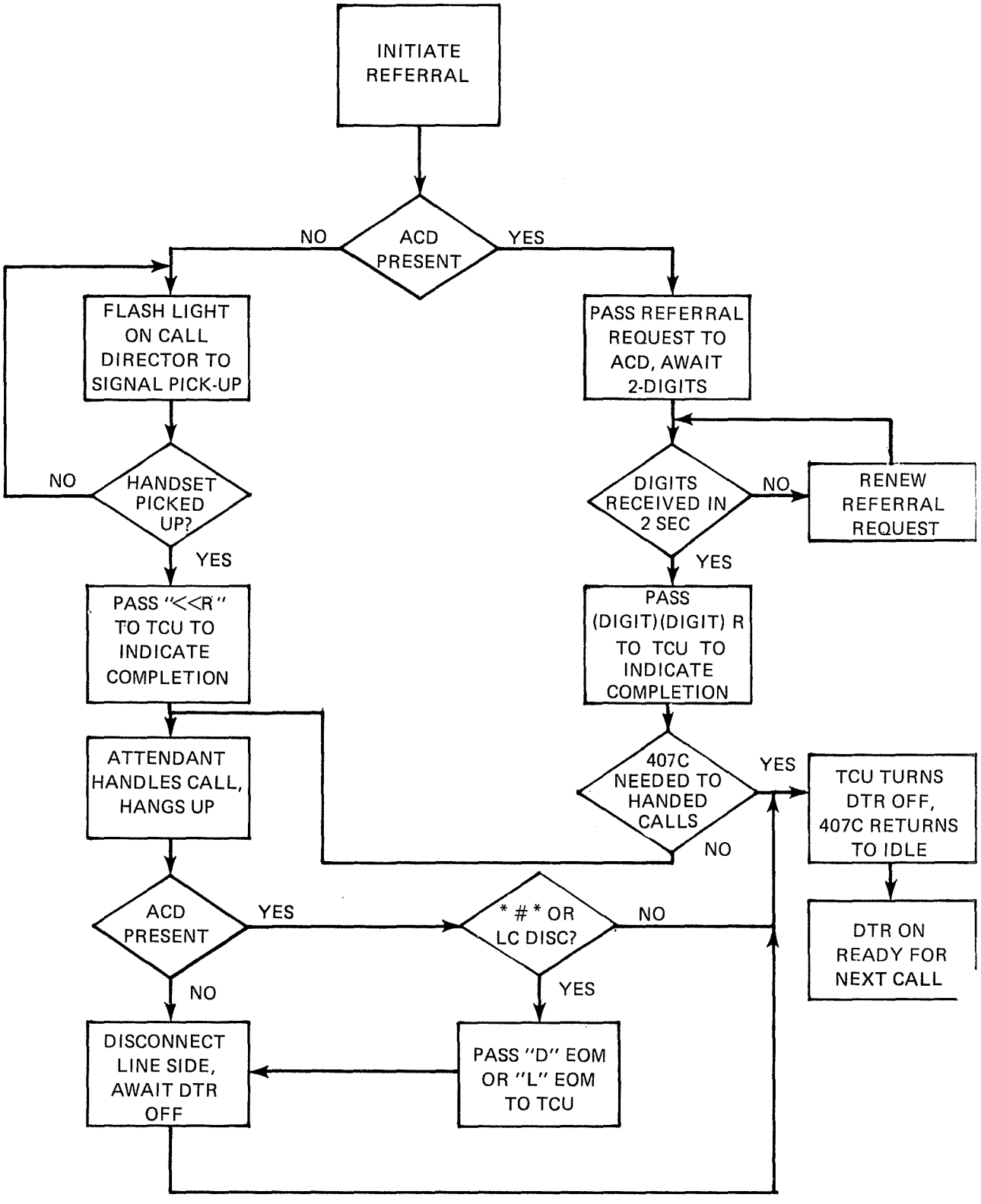
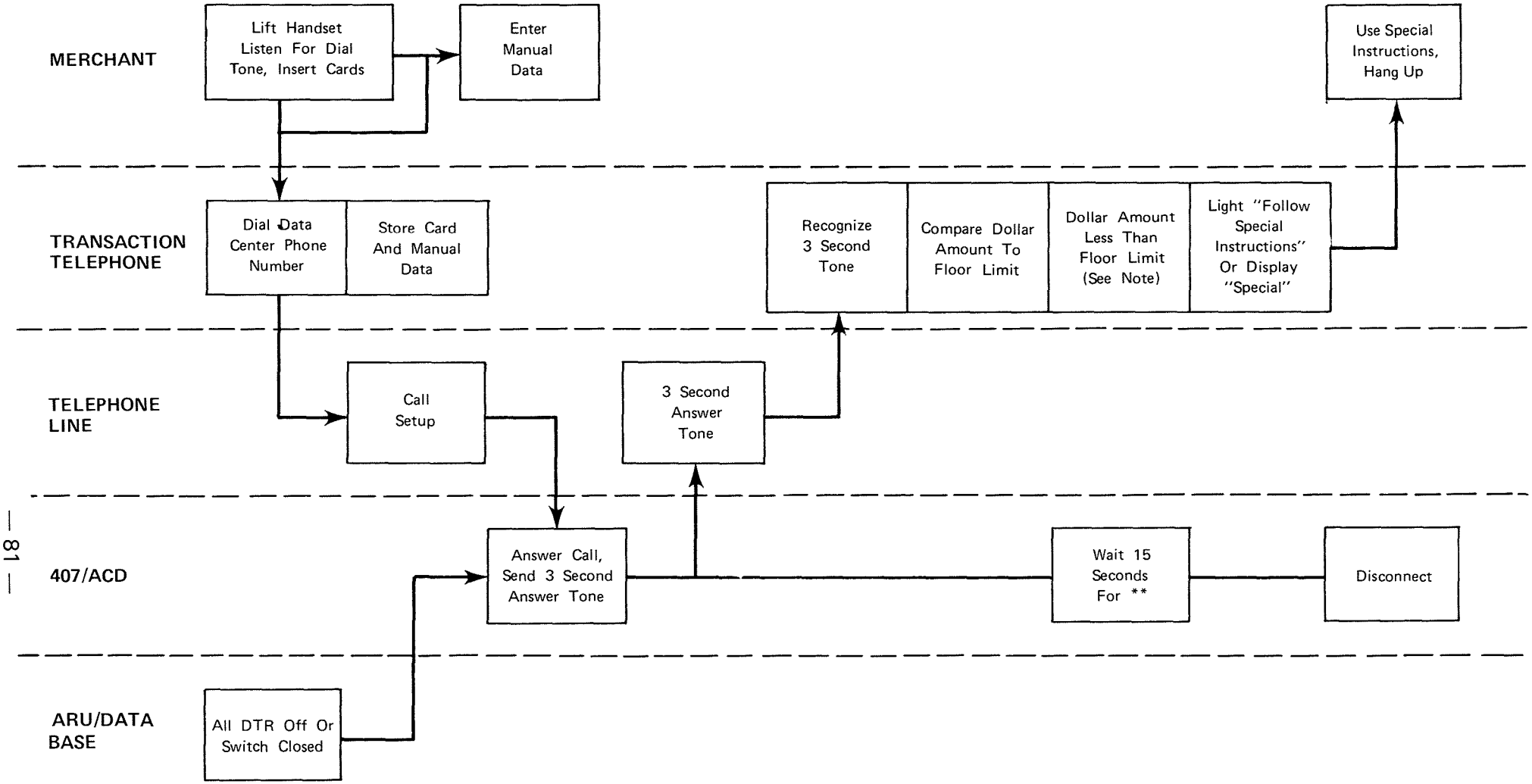



FIGURE 15

## 407C REFERRAL PROCEDURE




Note: If dollar amount is above floor limit Transaction II lights the yellow lamp, waits for the merchant to pick up the handset, and sends** (Transaction 1 sends ** immediately). Referral then proceeds as in Figure 14B and Figure 15 except that the data set automatically drops from the call upon receipt of two TOUCH-TONE characters from the ACD, and is readied for the next call.

**COMPUTER DOWN**

**Figure 16**

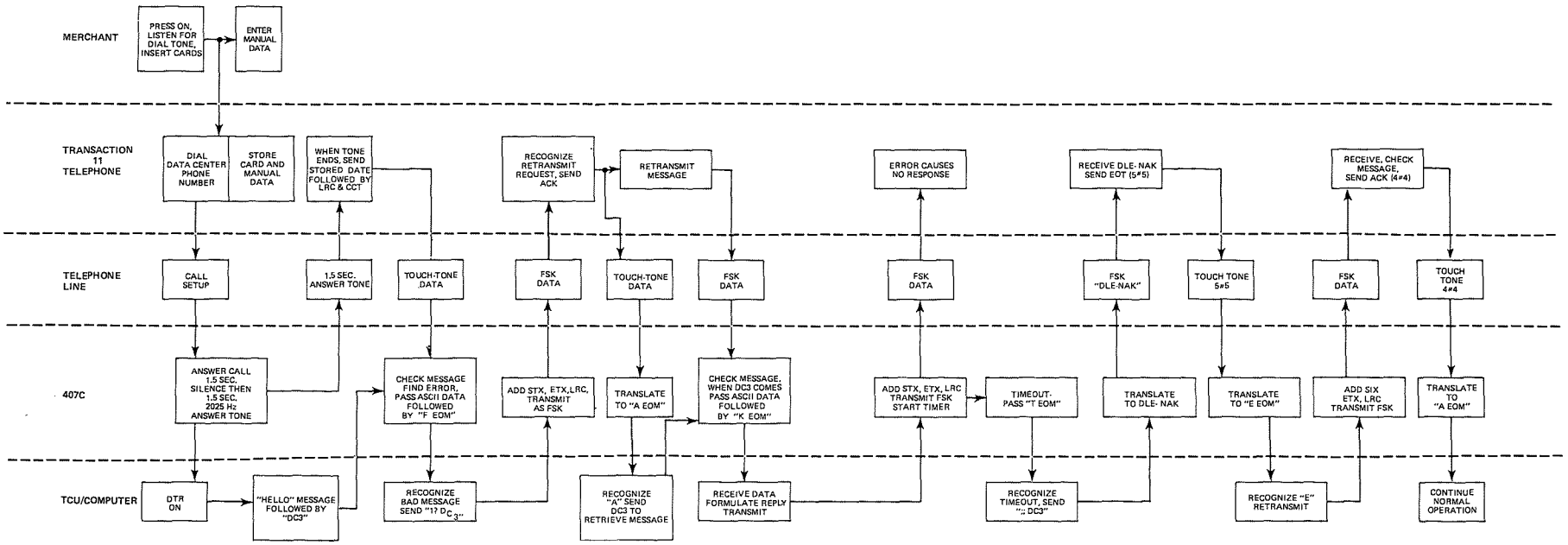
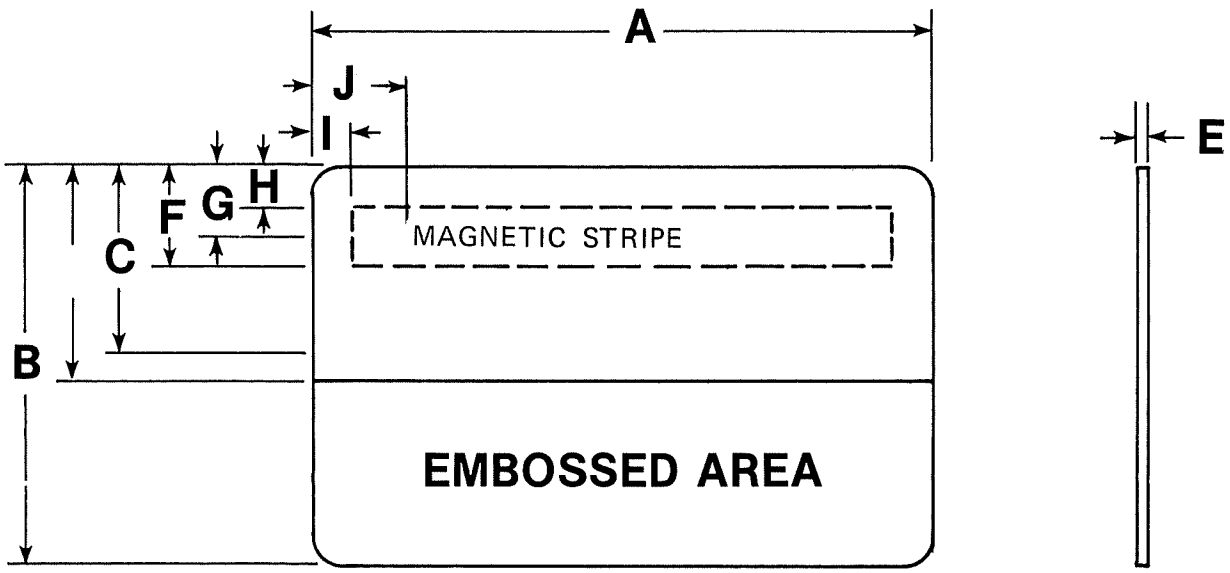


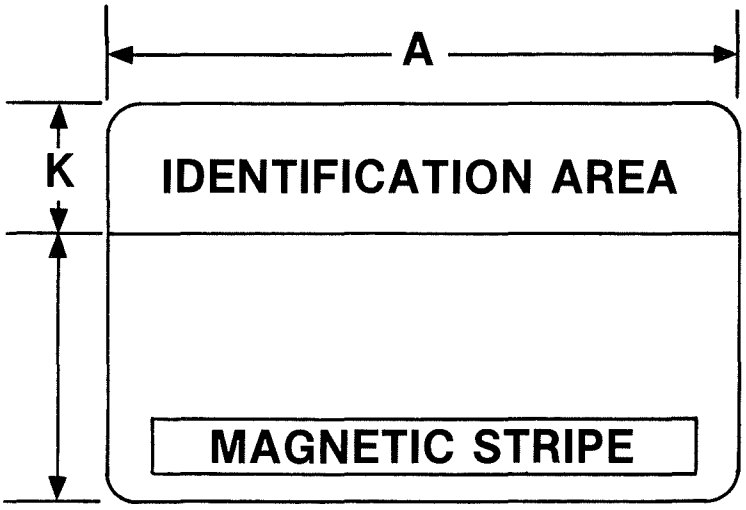

FIGURE 17
**TYPICAL ERROR PROCEDURES - TRANSACTION II**




| | | |
|---|---|---|
| A | NOT CRITICAL | LENGTH OF CARD |
| B | NOT CRITICAL | HEIGHT OF CARD |
| C | 1.06 | MINIMUM DISTANCE FROM TOP OF CARD FOR EMBOSSING PROTRUDING ON BACK FACE |
| D | 1.22 | MINIMUM DISTANCE FROM TOP OF CARD FOR EMBOSSING PROTRUDING ON FRONT OF CARD |
| E | 0.030 ±.003 | THICKNESS OF CARD |
| F | 0.463 | BOTTOM OF ENCODED ANSI STRIPE 2 FROM TOP OF CARD |
| G | 0.353 | TOP OF ENCODED ANSI STRIPE 2 FROM TOP OF CARD |
| H | 0.218 MAX. | TOP OF MAGNETIC MATERIAL FROM TOP OF CARD |
| I | 0.115 | MAXIMUM DISTANCE TO START OF MAGNETIC MATERIAL FROM CARD EDGE |
| J | 0.273 ± 0.020 | MINIMUM DISTANCE TO FIRST BIT OF START SENTINEL |

NOTE: ALL DIMENSIONS IN INCHES

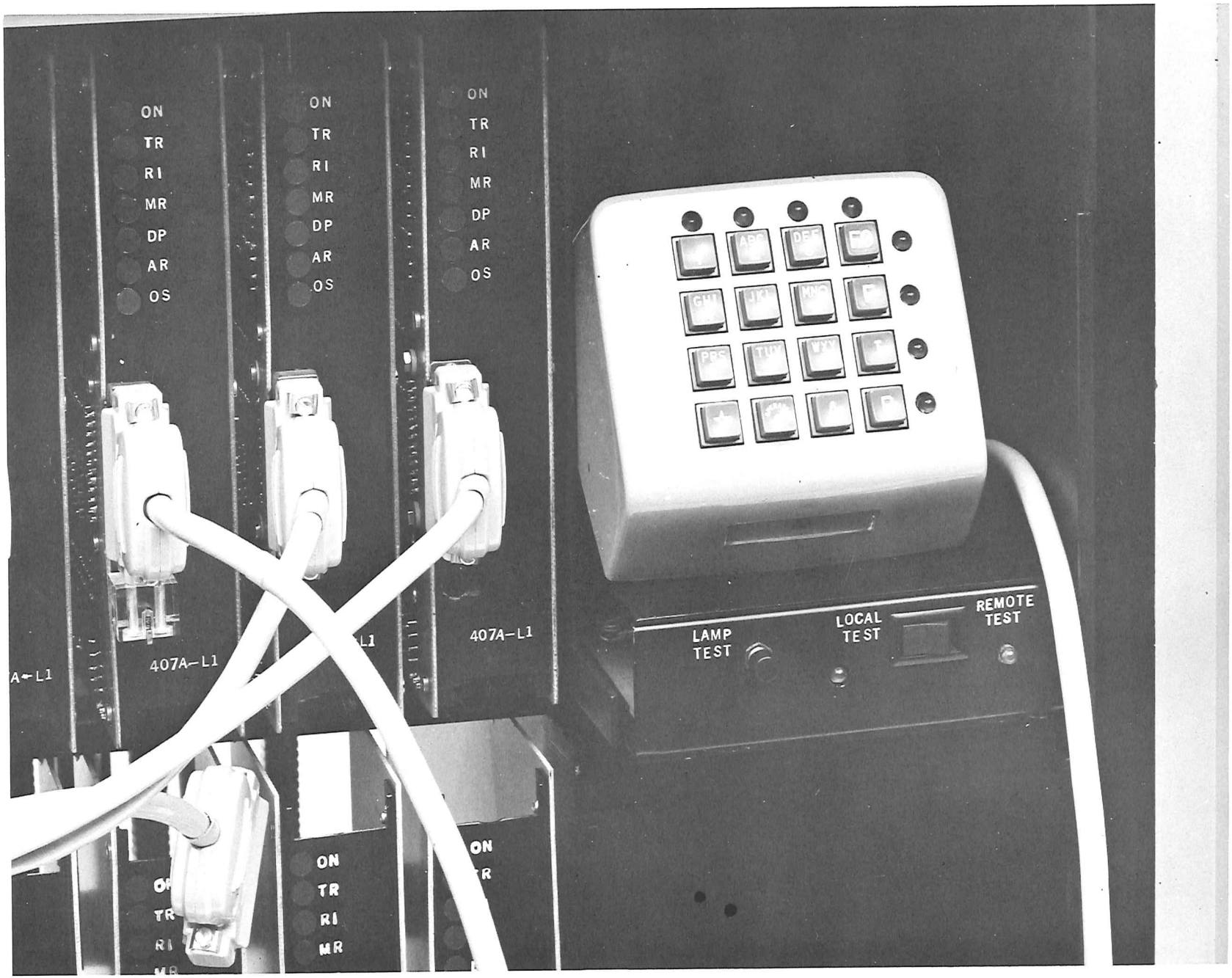
**CARD DIMENSIONS CRITICAL TO TRANSACTION TELEPHONE**
**FIGURE 18**




| | | |
|---|---|---|
| A | 3.4 | MAXIMUM CARD LENGTH FOR STORAGE IN CARD HOLDING SLOTS |
| K | 0.65 | LIMIT OF CARD VISIBLE AREA |

NOTE: DIMENSIONS IN INCHES
AREA BOUNDED BY DIMENSIONS A AND K SHOULD BE USED TO IDENTIFY DIALING CARD FOR USER. READABLE PORTION SHOULD BE ON SAME SIDE OF CARD AS THE MAGNETIC STRIPE. ANY OTHER PERTINENT INFORMATION SUCH AS SPECIAL INSTRUCTIONS, ETC., CAN BE PRINTED ELSEWHERE ON THE CARD. HOWEVER, EMBOSSING CONSTRAINT (FIG. 15) MUST BE MET WITH RESPECT TO THE STRIPE LOCATION.

**RECOMMENDED DIALING CARD CONFIGURATION**
**FIGURE 19**




TEST UNIT
FIGURE 20