

Bell System  
**TECHNICAL  
REFERENCE**

9131 TELETYPEWRITER  
SELECTIVE CALLING  
STATION ARRANGEMENT  
JANUARY 1974



**Bell System Data Communications**

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Selective Calling  
Station Arrangement**



**January 1974**



**ENGINEERING MANAGER-DATA SYSTEMS**

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## 1. INTRODUCTION

The Model 9131 Selective Calling Stations are half-duplex, teletypewriter stations arranged for use in multipoint, private line telegraph systems. The 9131 Stations provide for 100-word per minute operation using Model 33- or 35-type teletypewriter (TTY) equipment. The stations use the American National Standard Code for Information Interchange, commonly referred to as ASCII, ANS X3.4-1968 (see Figure 1).

The 9131 Stations are intended for use in a system application similar to the five level 83A-type stations. When used in such a system (see Figure 2) the 9131 stations do not require a Line Control Station to provide a central polling function. Any station may seize control of the line and act as the Master or Line Control Station. A selective calling format is used and the transmission mode is half-duplex. When selected, any station may send to any other station by waiting for its turn. Transmission may be manual (keyboard) or automatic (tape reader).

The 9131 stations are arranged to:

- Seize control of the line.
- Select any other station or designated group of stations on the line.
- Exchange messages with the selected stations.
- Perform a roll call function.
- Exercise control over the associated TTY.
- Recognize address codes and various delineator codes and generate appropriate responses.

Compared to the older five level stations, the 9131 Stations offer many improved operational features. These include use of the ASCII code

set, stations remain silent (motor off) except when selected and a higher degree of flexibility in operational behavior.

## 2. GENERAL CHARACTERISTICS OF 9131 STATIONS

### 2.1 General

Figure 3 illustrates the general organization of the 9131 Station. The terminal device may be either a Model 33- or 35-TTY. The 9131 Controller which provides the logic functions for the station consists of an electronics package and is arranged to mount in the pedestal of the TTY. The block shown interfacing the line (see Figure 3) consists of a 108- or 109- type data set housed in a Data Auxiliary Set (DAS) such as the 820D. This DAS will mount in the pedestal of the TTY along with the 9131 Controller.

### 2.2 9131 Controller

The 9131 controller is approximately 6 by 12 by 16 inches. All of the electronic circuitry is on a single circuit card which attaches to a 12-by 16-inch mounting plate. The power supply mounts on the reverse side of the mounting plate.

The 9131 controller has the capability of operating the terminal on-line or off-line in a Local mode. Also it permits placing the terminal Out of Service which prevents the station from responding to incoming calls and inhibits the motor from being energized, or placing the data set in the Test mode.

### 2.3 9131 Control Keys and Lamps

The Controller is associated with a six-position, lighted, push-button switch which mounts in the bezel area to the right of the teletypewriter keyboard. The switch designations are OFF, BUSY/LINE, FORMAT/PAPER, LOCAL, OUT OF SERVICE and TEST. Functional descriptions of the switches are listed below:

#### Designation

#### Functional Description

OFF (Non-locking; releasing)

SWITCH:	Normalizes unit. Removes unit from Local, Out-of-Service or Test modes.
STEADY LAMP:	Not applicable (N/A).
FLASHING LAMP:	When bidding for the line or during operation, loss of carrier (CF) to the station will cause the OFF lamp to flash.

**Designation**

**Functional Description**

**BUSY/LINE** (Non-locking; releasing)

- SWITCH: LINE switch bids for use of the line; not effective when the lamp is flashing.
- STEADY LAMP: The station is able to send and receive data when the LINE lamp is continuously on.
- FLASHING LAMP: A BUSY lamp indicates that line activity has been initiated or is taking place. A flashing lamp along with the unit's motor energized indicates that the terminal has been selected but is not able to send or receive data.

**FORMAT/PAPER** (Nonlocking; nonreleasing)

- SWITCH: N/A
- STEADY LAMP: A low paper condition. The unit cannot be selected when a low paper condition exists. The Positive Response Character (PRC) is disabled and the Negative Response Character (NRC) is enabled.
- FLASHING LAMP: Indicates a Format error. The error occurs when originating a call and two consecutive noncontrol characters are transmitted while in the Select mode. A call may be originated when a Paper alarm condition exists. A flashing Format error indication overrides the steady Paper alarm indication.

**LOCAL** (Locking; releasing)

- SWITCH: Transmitted data lead (BA) is held marking. Any signal on the Received data lead (BB) is disconnected from the teletypewriter. The station's motor(s) turn on. The teletypewriter's sending devices are connected to the receiving devices for Local operation. The station detecting its Station Address will generate its NRC.
- STEADY LAMP: Indicates Local Mode.
- FLASHING LAMP: N/A

**OUT OF SERVICE** (Locking; releasing)

- SWITCH: Transmitted data lead (BA) is held marking. Any signal on the Received data lead (BB) is disconnected from the teletypewriter. The station's motor(s) will not turn on. The station detecting its Station Address will generate its NRC.
- STEADY LAMP: Indicates Out-of-Service mode.
- FLASHING LAMP: N/A

**TEST** (Locking; releasing)

- SWITCH: Not wired to logic circuitry. Can be wired to operate in parallel with the 820D Data Auxiliary Set's Test switch.
- STEADY LAMP: Indicates loss of CC (Data Set Ready) signal. When CC is off, the terminal is normalized.
- FLASHING LAMP: N/A

## 2.4 Teletypewriters

Model 33 and 35 TTYs (see Figure 4) are provided for this service. These may be Receive Only (RO) which provide receiving capability for page copy. Keyboard Send Receive (KSR) for keyboard sending or receiving, or Automatic Send Receive (ASR) which combines a Tape Punch and Reader with a KSR.

### 2.4.1 Power Requirements

The customer must provide a standard 3-prong grounding receptacle supplying continuous 115-volt, 60 Hz AC power. The TTY will operate satisfactorily over a frequency deviation of  $\pm 0.45$  Hz and a voltage range of 103 to 127 volts. Power consumptions in watts when operating at nominal line voltage is given in Table 1.

**TABLE 1**  
**STATION POWER CONSUMPTION (WATTS)**

<u>Equipment</u>	<u>Model 33</u>	<u>Model 35</u>
KSR or RO	95	120
ASR	110	210
DAS 820D	15	15
9131 Controller	30	30

### 2.4.2 Teletypewriter Features

TTY terminals provided as part of 9131 stations have the following features:

- a. Line Length — The printers are generally factory adjusted to accept 72 characters per line; however, other line lengths can be accommodated up to the maximum capability of a specific terminal. (Assuming 10 char./inch friction feed printer — 74 on Model 33 and 85 on Model 35.)
- b. Parity — All TTYs generate an even parity in the 8th bit.
- c. Bell — All TTYs are arranged to ring the signal bell in response to the reception of the BEL character.
- d. The Model 35 ASR has a control panel which enables/disables the reader control contact DC1. Table 2 contains a detailed description of the mode switching.

**TABLE 2**  
**COMPONENTS ON**

<u>Mode</u>	<u>External Loop</u>	<u>Internal Loop</u>	<u>Blinded</u>
K	Printer, Reader, Keyboard	—	Punch
KT	Printer, Reader, Keyboard Punch	—	—
T	Printer, Reader	Punch, Keyboard	—
TTs	Reader	Punch, Keyboard	Printer
TTr	Punch	—	Printer

External Loop — A 20 ma. DC loop which interfaces the 9131 logic package.

Internal Loop — A 20 ma. DC loop generated by the TTY for operating its components independent of the 9131 logic package.

- e. End of Line Indication — The Model 33 sounds the bell when the typing unit spaces over approximately 62 characters. The bell also sounds at the end of the line. The Model 35 KSR turns ON the End of Line Indicator after the typing unit spaces

over approximately 66 characters. The Model 35 ASR (K and KT mode) turns on the End of Line Indicator after the typing unit spaces over approximately 66 characters. The Model 35 ASR (T mode) turns on the End of Line Indicator after punching approximately 66 characters in the tape which would cause a typing unit to space. On the Models 33 and 35, a Carriage Return returns the carriage to the beginning of the line and resets all character counter mechanism.

- f. Form Feed Option — The Models 33 and 35 may be equipped with a Form Feed option which will allow the paper to move to a new form position in response to the Form Feed (FF) character.
- g. Vertical Tab Option — The Model 35 may be equipped with a Vertical Tab option (fixed tab positions) which will cause the paper to move to a new position in response to a VT character.
- h. Horizontal Tab Option — The Model 35 may be equipped with a Horizontal Tab option (fixed tab positions) which allows the type box to be positioned in response to an HT character.
- i. Full/Half Duplex — All TTYs are arranged to have separate Send and Receive circuits which are internally connected for half-duplex operation. Half-duplex operation is required.

## 2.5 Data Set

A 108- or 109-type Data Set is used to terminate the 150 baud telegraph channel. (See PUB 41003.) The data set is housed in a DAS such as the 820D and an RS-232C EIA interface is provided to the 9131 Controller.

## 3. ON-LINE SIGNAL CHARACTERISTICS

The Model 9131 Stations operate with the following on-line signal characteristics:

### 3.1 Code

The transmission code used is ANS X3.4-1968, the American National Standard Code for Information Interchange (ASCII), illustrated in Figure 1.

### 3.2 Transmission Speed

The Models 33 and 35-type TTYs operate at 100 words per minute (wpm) (10 characters per second).

### 3.3 Character Structure and Baud Rate

At the operating speed of 100 wpm, the on-line character structure should be 11.0 units — a 1.0 unit start pulse, seven 1.0 unit information bits, a 1.0 unit parity bit, and a 2.0 unit stop interval.

This results in a transmission rate of 110 baud. It is recommended that even parity be used.

### 3.4 Bit Order

Transmission of information bits within a character is low order bit first. The parity bit is considered to be the eight bit following the start pulse.

### 3.5 Distortion Requirements

The stations should transmit data with not more than 5 percent telegraph distortion and accept incoming signals with up to 40 percent telegraph distortion. Detailed information relative to these distortion requirements is covered in PUB 41003 referred to earlier.

### 3.6 Timing Considerations

This section provides timing information relative to the 9131 Stations and the TTY terminal.

#### 3.6.1 Station Motor Turn On

The use of automatic motor control on 9131 Stations requires that sufficient time be provided after originating a call or after a call-in function to allow the TTY motors to attain operating speed before signals are delivered to

the line. A two-second pause is used for this purpose in 9131 Stations operation.

### 3.6.2 Idle Line Timer

The controller includes an idle line timer which will normalize the station if the line is busy and no activity is encountered on the line for  $4 \pm 2$  minutes. Such would be the case if:

- EOT was not transmitted following a message.
- A hit on the line activated the station Busy circuit.
- Contention on line by two or more stations prevents one station from assuming the Originate mode.

### 3.6.3 Station Mechanical Functions

The following timing considerations involve the mechanical functions of the TTY:

- All control characters that result in the control of a TTY component (i.e., reader, punch) should be followed by a DELETE character or a timing interval equal to a character in length.
- The Line Feed character or an equivalent time interval is required following the Carriage Return

function to assure proper carriage return operation.

- Models 33 and 35 TTYs form feed at the rate of six lines per character interval. Only the Model 35 has vertical tab. The vertical tabulation rate is six lines per character interval.
- Model 35 horizontal tabulation rate is three spaces per character interval.

## 4. 9131 STATION LOGIC

The Model 9131 Controller includes logic circuitry to:

- Allow a station to bid for the line.
- Recognize that a station is bidding for the line and provide appropriate indications.
- Recognize the station address code and generate an appropriate response.
- Recognize a broadcast or group address code.
- Recognize various delineator codes (e.g., NULL, STX, ETX, and EOT).
- During the roll call state, recognize a station address code and generate an appropriate response.

## 5. 9131 STATION ON-LINE STATES

The station has the following on-line states or modes of operation:

<u>Mode</u>	<u>Description</u>
Off	The state after being normalized and before receiving a NULL or going into the Originate mode. EOT, an idle line time out, or depressing the OFF key will normalize the unit.
Originate	With the terminal off, depressing the BUSY/LINE key will cause the terminal to go into the Originate mode. When in this mode, the terminal is enabled to permit transmission of Station or Group Addresses. The Originate mode is terminated by transmitting STX or EOT.
Busy	The transmission of a NULL on line causes the Busy lamp to flash at all stations and disables the Originate function at called station. The stations are now capable of being selected.
Select	A terminal is switched from the Busy mode to the Select mode when the Station Address or Group Address code is detected and an alarm is not present. The terminal's motor(s) will turn on when the unit goes into the Select

mode. Receiving STX terminates the Select mode. Once a terminal has been selected and switched out of the Select mode, the terminal will switch back into the Select mode by detecting ETX. Only a normalizing signal will deselect a unit once selected.

Message (Print)

A selected station is switched from the Select mode to the Message (Print) mode upon receipt of STX and terminates with ETX or EOT. A station which switches from the Originate to the Message (Print) mode will have the Format Error detector disabled and will remove the mark hold to the typing unit. ETX switches the station from the Message (Print) mode to the mode the station was in prior to going into this mode.

Message (Nonprint)

An unselected station is switched from the Busy to the Message (Nonprint) mode upon receipt of STX and will remain in that mode until receipt of ETX or a normalizing signal. ETX will place the unselected station back into the Busy mode for possible selection or to accommodate the roll call of selected stations.

## 6. MESSAGE FORMAT

### 6.1 Format Characters

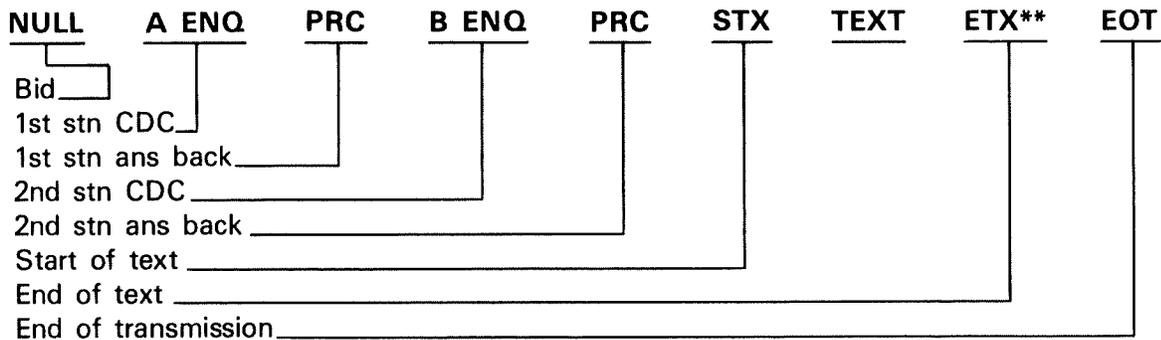
The Model 9131 station uses the following ASCII format characters:

<u>Function</u>	<u>Character</u>
Bit for line	NULL. Electronically generated when BUSY/LINE key is depressed.
Station Address or Call Directing Code	Two character sequence (programmable) The last character is ENQ or other control character.
Group address or Broadcast code	A single character (programmable)
Start of text	STX
End of text	ETX
End of transmission	EOT
Positive response character	A single character* (programmable) electronically generated.
Negative response character	A single character* (programmable) electronically generated.

\*Should be a printing character to permit operator to recognize the response.

## 6.2 On-Line Dialogue

A typical on-line message format would be:



\*\*ETX is required only if a second message is to be sent (e.g., multiple messages per transmission) or if the roll call option is used.

An optional feature known as Roll Call may be evoked between ETX and EOT in the on-line format. Roll Call involves resending the station address code to verify the receipt of the transmitted message.

## 7. DETAILED SYSTEM DESCRIPTION

This section describes the operation of the 9131 Stations in a typical system application. Reference should be made to the sequence charts shown as Figures 5 and 6.

### 7.1 Originating a Call to Another Station

To originate a call, the operator depresses the Line Control key. This action electronically generates a NULL character which is transmitted to all stations on the network indicating that a station is bidding for control of the line. The NULL will activate the Busy Circuit in all stations causing the Busy Lamp to flash and preventing the stations from bidding for the line. This represents the Busy mode. Approximately 0.75 seconds after operating the Line control key, the originating stations motor turns on but it requires approximately two seconds to reach operating speed. After this pause, the address code of the station to be called may be sent from the originating station. The called station detects its address code and generates a Positive Response Character (PRC) if it is able to communicate or a Negative

Response Character (NRC) if it cannot communicate because of Paper Alarm or Local or Out-of-Service conditions. If NRC is received, an EOT should be transmitted to turn off the originating station and restore all stations to the idle state. If a PRC is received, the station has changed from the Busy to the Select mode and STX should be sent after a two second pause to allow the called station's motor to reach operating speed. The STX is detected by all stations on the line. The station that was selected will change from the Select mode to the Message (Print) mode and the unselected stations will change from the Busy to the Message (Nonprint) mode. The Busy lamp at the selected station changes from flashing to steady ON upon receipt of STX and the station is able to send and receive traffic. The communication is terminated by transmission of EOT which returns all stations to the Off mode. The Busy lamp at the unselected stations will continue to flash until receipt of EOT.

### 7.2 Originating a Call to a Series of Stations

The procedure for multiple station addressing is similar to the above selection process except a series of station address codes are sent with pauses for the answer-back response. After all desired stations have been selected, STX is sent as noted above after a two second pause to allow the last station to reach operating speed.

### **7.3 Originating a Call to a Group of Stations**

The procedure for selecting all stations on the line is to send a broadcast code, pause for two seconds and send STX. Since multiple station responses would result in line garble, the stations are not arranged to answer-back to the broadcast code. If the system operations requires a response to the broadcast code, one stations may be coded to answer-back. Since the controller logic requires a two character sequence to activate the answer-back code, two characters must be sent for this application; the first character as the broadcast code and the second to initiate the designated stations answer-back. Special coding is also required for the station supplying the answer-back (e.g., the station code and broadcast code must have common second characters and code compatible first characters).

An alternative to using the all stations broadcast code is to divide the stations into groups by community of interest and assign each group a discrete code. The selection process would be similar to that for broadcast except a NULL must be transmitted between single character group codes.

### **7.4 Performing a Roll Call**

An alternate disconnect procedure is to transmit ETX at the end of the message and evoke a roll call. By transmitting the Address code of the selected station, the originating station will receive the response character which signifies that the station is still active. A positive response at both the beginning and end of the message is an indication that the station received the entire message. The originating station should now transmit EOT to turn off all stations or send STX if an additional message is going to be transmitted to the selected station.

### **7.5 Special Applications**

The inherent flexibility of the 9131 Stations permits several variations in operational behavior which may be desirable in some applications. Examples of these are listed below.

#### **7.5.1. Message Monitor**

One station on a network can be assigned the

task of copying all messages on a network. Coding the Group Address for NULL will activate the station whenever a call is originated. STX will place the station in the Message (Print) mode permitting the message to be received. Only the message is printed, not any station identification nor the PRC or NRC.

#### **7.5.2 Fast Addressing With Station Verification Later**

In an emergency all stations could be activated by a Group or Broadcast Address. STX would then place the stations in the Message (Print) mode and the message could be transmitted. The Select mode would then be reinstated by transmitting ETX and each station on the line could be individually selected using its Station Address. The originating station now receives the PRC or NRC indicating which stations received the message. This is a variation of the roll call feature.

#### **7.5.3 Intermixing Group and Station Addresses**

The method of selecting the stations, either by Group or Station Addresses, can be intermixed. Standard operating procedures are followed.

#### **7.5.4 Pyramiding of Selected Stations**

It is possible to pyramid or increase the number of selected stations during a call. At the conclusion of the original message, ETX is transmitted. The new stations which are to receive the new message are now selected. STX is transmitted removing the mark hold from all of the selected stations. The message will be received by the originally selected stations and the newly added stations. The call should be terminated by transmitting EOT in the normal manner.

### **7.6 Special Transmitter Control Feature**

The basic controller logic does not provide for starting the station transmitters. It is possible, however, to equip the teletypewriter with transmitter control contacts and use ASCII characters DC1 and DC3 to control the

transmitter. The station would be selected\* and placed in the Message (Print) mode in the normal manner. Control character DC1 would then be sent to start the transmitter and DC3 or EOT transmitted from the tape would stop the transmitter.

\*If more than one station is selected and tape is available in the transmitter, all transmitter would start to send. Therefore, this type transmitter control is limited to single station selection per transmission such as tape pickup by a central location.



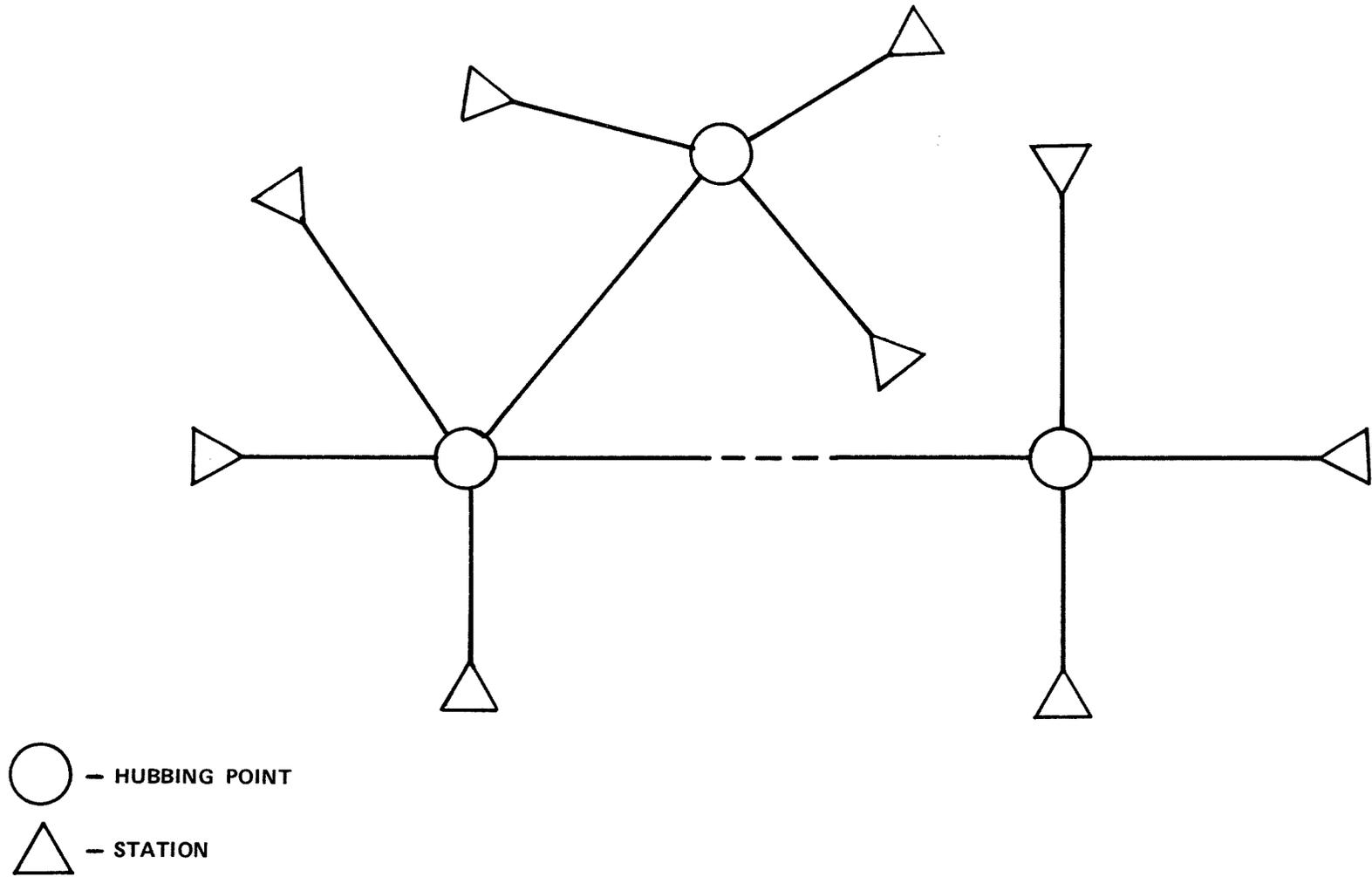


FIGURE 2 – BLOCK DIAGRAM REPRESENTATION OF TYPICAL 9131 SYSTEM

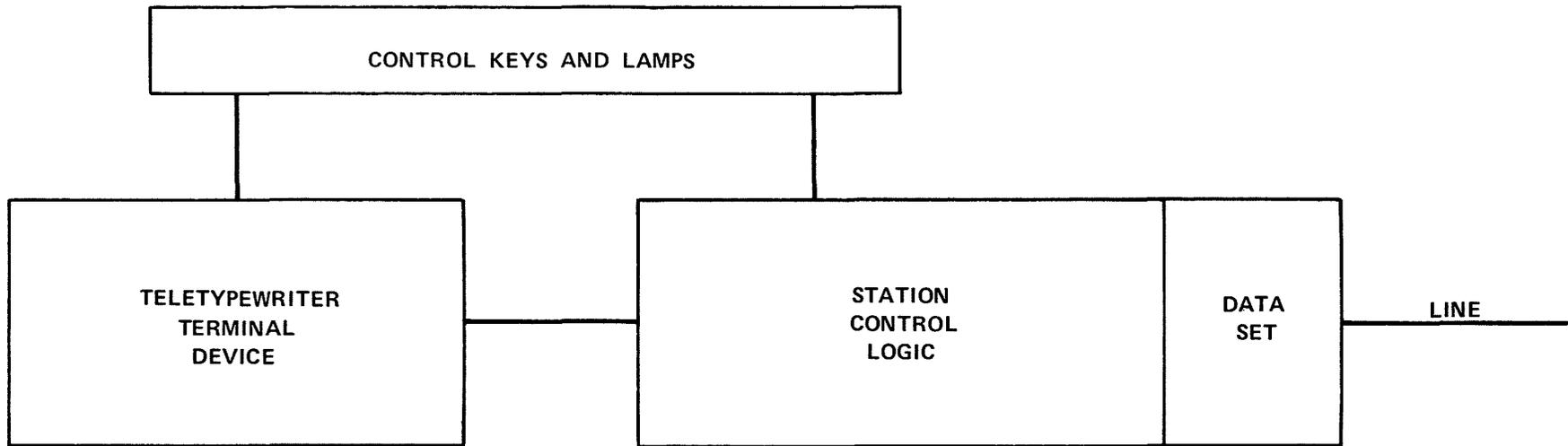
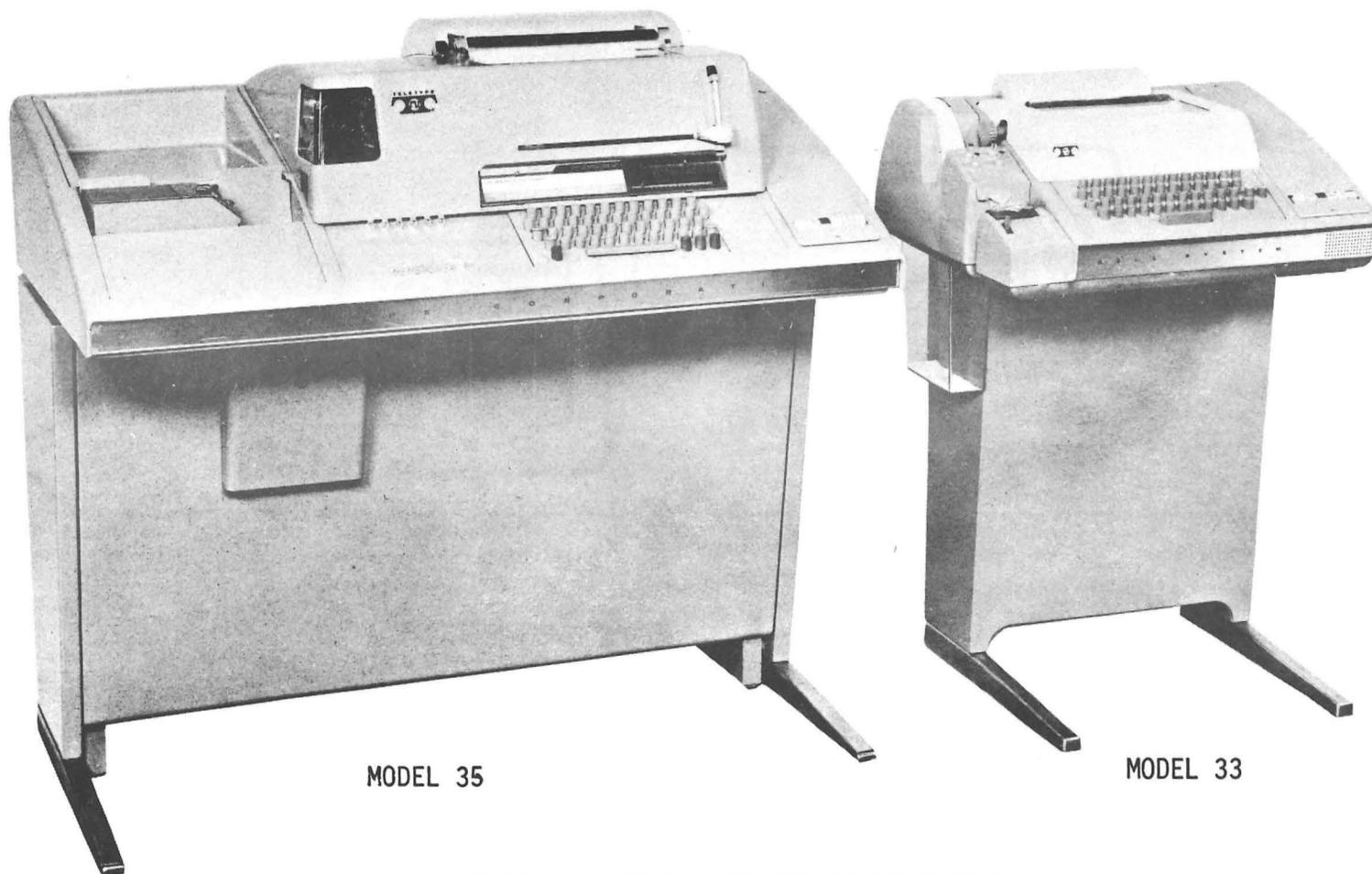


FIGURE 3 - BLOCK DIAGRAM REPRESENTATION OF TYPICAL 9131 STATION



MODEL 35

MODEL 33

FIGURE 4 - MODELS 33 AND 35 TERMINALS  
ARRANGED AS 9131 STATIONS

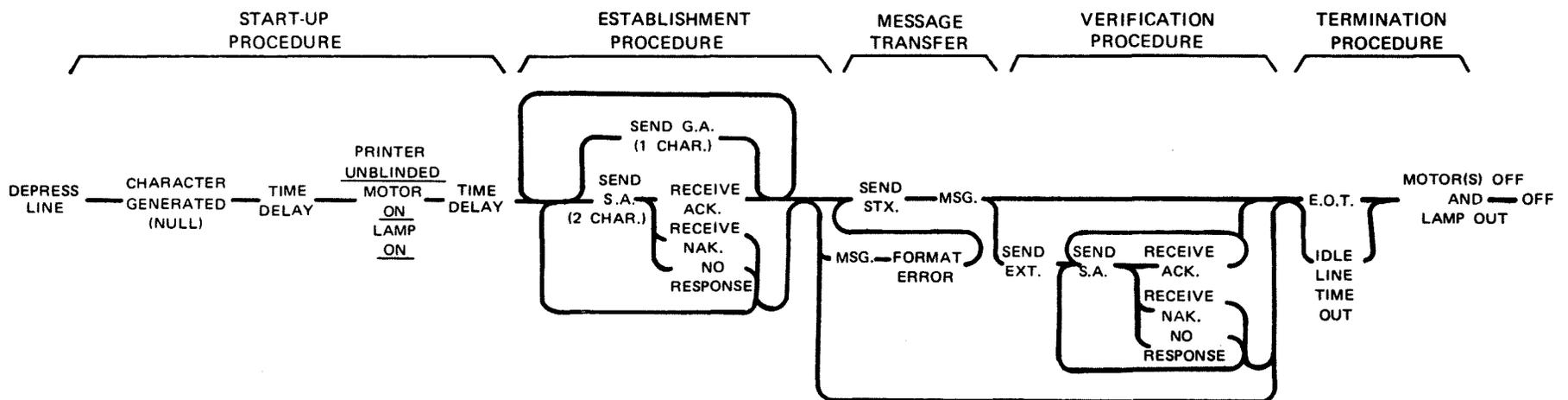


FIGURE 5 - STATION ORIGINATING A CALL

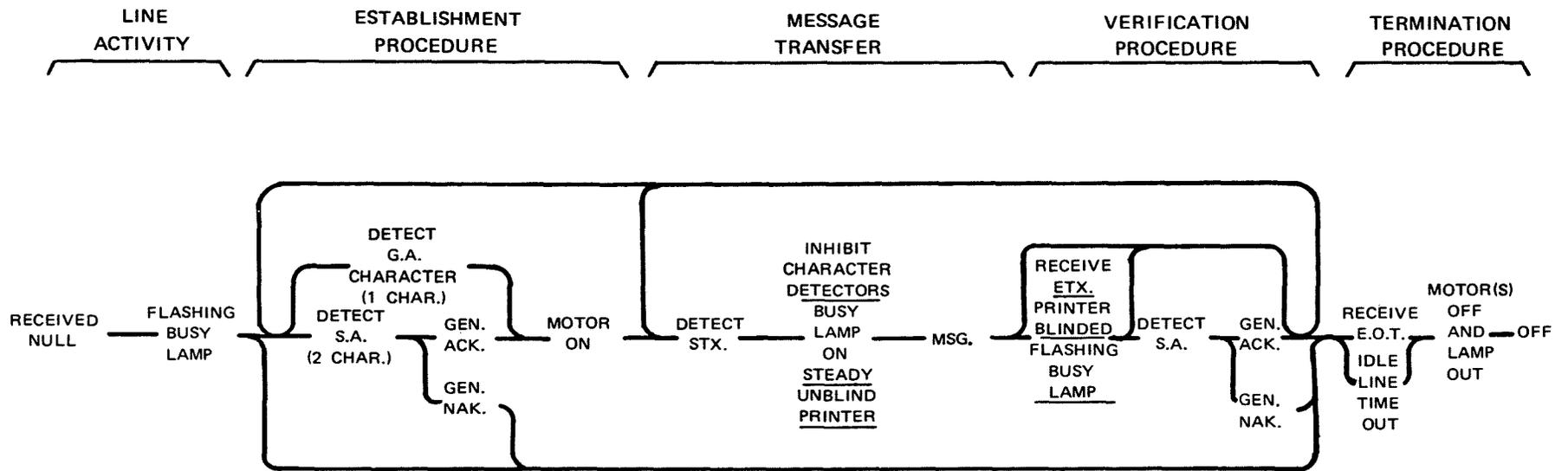


FIGURE 6 — NON-ORIGINATING STATION ACTIVITY