

Bell System

TECHNICAL REFERENCE

MODEL 37
TELETYPEWRITER
STATIONS FOR
DATA-PHONE[®] SERVICE

●
September 1968



Bell System Data Communications

TECHNICAL REFERENCE

●

**Model 37 Teletypewriter
Stations for DATA-PHONE [®]
Service**

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ENGINEERING DIRECTOR - TRANSMISSION SERVICES



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1. INTRODUCTION

This reference provides a brief description of the features and functional characteristics of the Bell System Model (M) 37 receiving only (RO) keyboard send-receive (KSR), and automatic send-receive (ASR) teletypewriter (TTY) stations for DATA-PHONE service. Included is a list of the features of the basic stations and optional features that are available or are planned to be available. On-line signaling and station characteristics that are critical to the design of data terminals with which the stations will communicate are detailed.

2. GENERAL DESCRIPTION

Pictures of the M37 RO, KSR and ASR TTY stations in the DATA-PHONE configuration are shown in Figures 1, 2 and 3 respectively.

The M37 TTY is arranged to function with the USA Standard Code for Information Interchange (ASCII) shown in Figure 4. The TTY functions with all 128 code combinations. The printer for the basic station prints 94 graphics including the upper and lower case alphabet. The 94 printable graphics are shown in Columns 2 through 7 in Figure 4, except for the SPACE and DELETE which are not printed.

The arrangement of the ASCII for the M37 keyboard is shown in Figure 5. The layout is similar to that of a typewriter. All 128 code combinations are generated with even parity. The manner in which this is accomplished for the various codes is depicted in Figure 6.

The basic M37 TTY stations for DATA-PHONE service operate at 150 words per minute (wpm) and have the following major features:

- (A) Alternate voice-data capability with transfer between voice and data mode and vice versa.
- (B) Loudspeaker for monitoring call progress tones.
- (C) Automatic answering capability (ringing tripped followed by answerback).
- (D) Automatic answerback for answering station, on line with (ENQ) character, and local by manual operation of "Here is" key.

- (E) Transmission blind and unblind control - (ACK) unblind (proceed to transmit), (NAK) blind. This feature not applicable to RO stations.
- (F) Disconnect capability (data mode CLEAR key).
- (G) Disconnect capability (data mode EOT character).
- (H) Automatic disconnect if data mode connection is not established on an incoming call.
- (I) Generation and detection of interrupt signals. (BREAK) Detection not used in RO stations.
- (J) All 128 characters (ASCII) are generated with even parity at the maximum keying rate of 15 characters a second (150 wpm). Not used in RO stations.
- (K) Receiving capability of the 128 characters (ASCII) at the maximum rate of 15 characters a second (150 wpm), printing 94 graphics including the upper and lower case alphabet.
- (L) Parity sensitive control functions. Control functions perform actions other than printing and for the basic stations the functions listed below are involved. The ASCII characters assigned to perform these functions must be received with the correct parity in order for the function to be performed. An exception is made for the LINE SPACE (LF) function which has been modified to disregard parity. Printing is performed on either parity on all characters, except for space (SP) and delete (DEL), shown in the code chart Figure 4, Columns 2 through 7. A lamp designated ALARM on the TTY control panel is activated when a character with wrong vertical parity is received.
 - (1) RO stations require correct parity on:
 - (a) Carriage Return (CR)
 - (b) Backspace (BS)

- (c) End-of-Transmission (EOT)
 - (d) Bell (BEL)
 - (e) Answerback Start (ENQ)
 - (f) Print Suppression (ESC)
- (2) KSR stations require correct parity on the characters listed for RO stations as well as the following:
- (a) Keyboard Blind (NAK) proceed lamp on TTY control panel extinguished.
 - (b) Keyboard Unblind (ACK) proceed lamp on TTY control panel lighted.
 - (c) Mode Shift (ESC;) no home copy (full duplex)
 - (d) Mode Shift (ESC;) home copy (half duplex)
- (3) ASR stations require correct parity on the characters listed for RO and KSR stations as well as the following:
- (a) On-Line Control of Reperforator (DC2), (DC4)
 - (b) On-Line Control of Reader (DC1), (DC3)
- (M) On-Line backspace.
 - (N) Alarm indication (low paper or received line signal with incorrect vertical parity).
 - (O) Seventy-two characters on a line (10 per inch) telephone company adjustable for shorter lengths.
 - (P) Friction-feed roll paper.
 - (Q) Single color printing.
 - (R) Adjustable margins by the telephone company.
 - (S) Lamp indication for end of printed line telephone company adjustable.
 - (T) Manual paper feed-out.
 - (U) Manual carriage return.
 - (V) On-line control of home copy, home copy off (ESC;) providing full-duplex capability, home copy on (ESC;) no full-duplex capability, (See paragraphs 4.5 and 4.5A.) This feature not available for RO stations.
- The basic M37 TTY stations for DATA-PHONE service may be arranged with optional features to meet the particular needs of a customer's service. The optional features presently planned are:
- *(A) Two color printing under control of on-line signals red printing on the two character sequence ESC3 black printing on the two character sequence ESC4.
 - *(B) Forward Half-line feed on a sequence of two characters.
 - *(C) Reverse Half-line feed on a sequence of two characters.
 - *(D) Reverse line feed on a sequence of two characters.
 - (E) Horizontal tabulation for friction-feed and sprocket-feed machines on (HT) character.
 - *(F) On-line horizontal tabulation for friction-feed and sprocket-feed machines on a sequence of two characters to set and a sequence of two characters to clear tabulator stops.
 - (G) Vertical tabulation for friction-feed and sprocket-feed machines on (VT) character.
 - *(H) On-line vertical tabulation for friction-feed and sprocket-feed machines on a sequence of two characters to set and a sequence of two characters to clear tabulator stops.
- *These features are not presently available.

- (I) Form advance for friction-feed and sprocket-feed machines on (FF) character.
- (J) Parity sensitive control functions. These are in addition to those listed in (1) for the basic stations and cover the functions performed for the added features.
 - (1) Print red (sequence ESC 3)
 - (2) Print black (sequence ESC 4)
 - (3) Horizontal tabulation HT
 - (4) Vertical tabulation VT
 - (5) Form advance FF
 - (6) Forward Half-line feed (sequence of two characters)
 - (7) Reverse Half-line feed (sequence of two characters)
 - (8) Reverse line feed (sequence of two characters)
 - (9) On-line horizontal tabulation set (sequence of two characters)
 - (10) Horizontal tabulation clear (sequence of two characters)
 - (11) Vertical tabulation set (sequence of two characters)
 - (12) Vertical tabulation clear (sequence of two characters)
- (K) Print additional graphics of the ASCII up to the total 128.
- (L) Sprocket-feed paper operation.
- (M) Eighty-six characters on a line (12 per inch).

3. ON-LINE SIGNALING CHARACTERISTICS

3.1 General

The DATA-PHONE station provides alternate voice-data capabilities.

*These features are not presently available.

The voice capability is provided via the telephone handset and the attendant set. With the handset off hook and the attendant set keys not operated, the voice mode can be established by dialing in the conventional manner. (AUTO KEY may be operated).

The teletypewriter is connected to the telephone transmission facilities via the interface conversion circuitry of the logic and via the data set. The operation of the DATA key on the attendant set arranges the station for establishing the telephone transmission circuit by dialing in the conventional manner. When a connection is established, the data transmission path is completed via the Data Set 103E which is a part of the 103G and H data sets recommended for use with the M37 TTY DATA-PHONE station. The data set is a full-duplex, frequency-shift, serial data set which operates asynchronously. The data set accepts voltage signals from the interface and logic unit and converts these signals into voice frequency tones. These tones are transmitted over the telephone transmission facilities to the distant terminal where a compatible data set converts the voice frequency tones into voltage signals. The data set 103E characteristics are covered in a preliminary Bell System Data Communications TECHNICAL REFERENCE Issue A, dated February 21, 1966, copies of which may be obtained from

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Technical Reference for compatible data sets with which the M37 TTY station may have to function are also available.

3.2 Code

The M37 TTY station will send (not the RO) and receive the 1967 USA Standard Code for Information Interchange (ASCII). The code is shown in Figure 4.

3.3 Transmission Speed

The standard transmission speed for the M37 sending stations is 150 words per minute (wpm), 15 characters per second asynchronous (start-stop). The on-line asynchronous signaling rate is a nominal 150 bauds. At this speed one character requires 66.67 milliseconds (msec).

3.4 Character Structure

At the operating speed of 150 wpm each character is composed of a 1.0 unit start bit, which is always a space, seven 1.0 unit information bits (ASCII), a 1.0 unit parity bit (even), which may be mark or space, and a 1.0 unit stop bit, which is always a mark, totaling a 10-bit character structure.

3.5 Bit Order

Transmission of information bits (ASCII) within a character is low order bit first. The parity bit is considered to be the eighth bit, not counting the start bit. The start bit is always spacing and the stop bit always marking.

3.6 Distortion Objectives at Interface

To assure that correct operation of a receiving terminal shall be possible, the following values for distortion sent and tolerance to distortion received are given as guidelines. For a given connection, increasing the amount of distortion generated or reducing the tolerance to received distortion will increase the probability of errors. Signals transmitted by a terminal are acceptable if they contain not more than 5 percent telegraph distortion. A receiver should be capable of correct operation when receiving signals containing up to 40 percent telegraph distortion. A definition of telegraph distortion is given in the following paragraphs.

3.7 Definition – Telegraph Distortion

Telegraph distortion is the measure of the the displacement of any mark-to-space or space-to-mark transition from its proper location. The reference point used when measuring telegraph distortion is the initial mark-to-space transition of each character which occurs at the beginning of each start element. The slicing level for all measurements is at approximately the 50 percent point on the rising and falling waveforms. Referring to Figures 7 and 8, transitions measured at the slicing level should occur at integral multiples of an element length, t_e , from the start transition for no distortion. If a transition occurs at a time Δt earlier or later than this time, the distortion of that transition is:

$$\text{Percent Distortion} = \frac{\Delta t \times 100}{t_e}$$

To calculate the peak distortion in a character, reference is made to Figure 8. For a trans-

mission rate of 15 characters a second and 10 elements per character, the element length is:

$$t_e = \frac{1000}{(15)(10)} = 6.67 \text{ milliseconds}$$

Assuming $\Delta t_1 = \Delta t_2 = 1$ millisecond and $\Delta t_3 = 2$ milliseconds then $\Delta t_{\text{max}} = \Delta t_3 = 2$ milliseconds.

$$\text{Percent Peak Distortion Per Character} = \frac{\Delta t_{\text{max}}}{t_e} \times 100 = 30 \text{ percent}$$

Although element number 3 is 45 percent shorter than its nominal length, the maximum telegraph distortion occurs at the end of the element and is 30 percent.

3.8 Propagation Time Considerations

(A) Teletypewriter Turn-Around Time
When in the half-duplex mode, a terminal receiving data from a M37 TTY DATA-PHONE station should not turn around and begin to send data until the entire stop pulse of the last character has been received.

(B) Long Circuits
Line Facility Propagation Time –
Signal propagation time is a function of the complexity and length of the circuit. An allowance of 500 milliseconds round trip transmission delay should suffice for most circuits. However, if propagation time is critical to the terminal operating procedure, it is recommended that the specific case be discussed with the Telephone Company.

3.9 Interrupt (break) Signal

This feature is used at the receiving station for interrupting transmission from a sending station when operating in the half-duplex or home copy data mode. During an established data call, if it is desired to interrupt the transmission of data from a M37 TTY DATA-PHONE station, a continuous spacing signal of 380-750 ms (early sets 200-360 ms) sent toward the M37 station will cause it to stop transmitting.

During transmission of data from a customer-provided station, the M37 station attend-

ant may send a break signal to interrupt transmission. The originating customer-provided equipment, not the data set, should interpret a continuous space signal of nominally 150 ms as an interrupt signal and stop sending data. Any space signal longer than 190 ms should be interpreted as an interrupt and a space signal as short as 100 ms may be interpreted as an interrupt.

3.10 Disconnect

It is recommended and expected that a station will normally be arranged to utilize all three of the following provisions for disconnect:

(A) Disconnect on EOT

The preferred method of disconnecting when in the home copy or half-duplex data mode is by transmitting the end-of-transmission (EOT) character of the ASCII. The M37 TTY DATA-PHONE station is arranged to disconnect after receipt of the EOT character. When EOT is sent from a distant terminal it should be followed by a marking period of approximately 50 milliseconds.

(B) Disconnect Signal (CLEAR)

The signal is generated from the M37 TTY DATA-PHONE station by the operation of the CLEAR/TALK key of the attendant set when the station is in the data mode. A spacing signal of approximately 3-sec duration is sent over the data line facilities.

(C) Disconnect on Carrier Fail

The M37 TTY DATA-PHONE stations are equipped with an installer option which, when applied, will cause the data set to disconnect upon prolonged periods of no carrier as covered in the 103E-type data set reference listed in Paragraph 3.1.

3.11 Mechanical Functions

Timing is required after various machine control functions to allow time for the teletypewriter to complete the necessary mechanical operation. Perhaps the most often used function of this type is the carriage return - line feed function. When performing this function at an

operating speed of 150 wpm, two fill characters, or their equivalent time, are required following the carriage return (CR) character to allow sufficient time for the maximum physical return of the typing mechanism. The line feed (LF) character if used, provides one of these timing character intervals. The other may be a timed interval of continuous marking or a DELETE character. It is suggested that the terminal communicating with the M37 TTY DATA-PHONE station adopt the policy of sending the sequence CR LF DEL when executing this function to allow sufficient time for the carriage return function to be completed. Where the option of carriage return and line feed on the line feed character is used two DEL characters should follow. The two fill-character timing following the LINE SPACE provides a safe margin for proper operation.

The timing required for the tabulation and form feed functions varies according to the tab settings and length of form employed. Therefore, it is not possible to specify exact timing intervals required for these functions. The M37 teletypewriter performs the vertical tabulation and form feed functions at the rate of approximately 3 lines per character time for any operating speed in machines having the conventional arrangement of manually selectable single/double line feed. On machines having on-line half/full line feed, the vertical tabulation and form feed rate is 1.5 lines per character time. The horizontal tabulation rate is approximately 3 spaces per character time.

4. STATION COMPONENT FEATURES AND FUNCTIONS

The characteristics of the M37 TTY DATA-PHONE stations are described below. Included in these characteristics are the station configuration, keyboard, printer, and tape module characteristics, control features, and attendant set functions.

4.1 Station Mode for KSR and ASR Teletypewriters

The KSR TTY contains a keyboard to transmit signals and a page printer to receive signals. The ASR TTY contains a keyboard and reader to transmit signals and a page printer and tape reperforator (punch) to receive signals. Two circuit configurations referred to as sta-

tion modes are possible for these sending and receiving units. In the first, signals from the keyboard or reader are sent to the line and to the printer and/or reperforator; hence, home-copy is produced of the data transmitted. The printer and/or reperforator may also receive signals from the line when the keyboard or reader are idle. This circuit configuration is referred to as the half-duplex mode for the TTY and is telephone company adjustable.

In the second circuit configuration (optional) signals from the sending units are sent only to the line; home-copy is not made. The receiving units receive signals only from the line. This circuit configuration is referred to as full-duplex mode for the TTY and is telephone company adjustable.

On-line control of home copy is provided as covered in Section 4.5A for the KSR and ASR stations. The station will be in the home-copy mode at the beginning of a call.

4.2 Keyboard

A sketch of the keyboard arrangement for the M37 KSR and ASR TTY stations is shown in Figure 5. It is possible to generate all 128 code combinations of the revised ASCII (plus even parity). Upper and lower case alphabetic characters, numerics, and special graphic characters designated on the keytops are generated in a manner indicated in Figure 6. Control characters are designated on the keyboard in two ways. The most often used controls appear on separate keys and are active in both the shifted and unshifted modes without use of the CONTROL key. Another group of controls appear on the same keytop with a graphic. To generate these code combinations, it is necessary to depress the CONTROL key while the particular key is struck. All control character designations requiring the depression of the CONTROL key, as well as the individual key, appear on the keyboard in a distinctive color. ASCII control characters and the method of generating them from the M37 keyboard are given in Figure 6.

A repeat feature is provided on each key generating a character. Further depression of the key beyond its normal stop position will cause the associated character to be generated repetitively at the maximum character rate.

This feature is disabled on all keys except for the following for the keyboards used in DATA-PHONE service. SPACE, LINE SPACE, BACK SPACE, NULL, DELETE, PERIOD, DASH, UNDERSCORE, ASTERISK, and the character X.

The repeat feature can be enabled or disabled by the telephone company.

A transmission disabled feature is provided to prevent transmission from the keyboard and reader. The transmission may be disabled and enabled under control of on-line signals as covered in Section 4.5C following. This feature does not physically lock the keys of the keyboard but inhibits output from the distributor.

4.3 Control Panel

The control panel (key and lamp strip) located on the teletypewriter above the keyboard shown in Figure 9 for the RO, Figure 10 for the KSR and Figure 11 for the ASR contains the following:

(A) Figure 9 (RO station)

- (1) PAPER ADVANCE (key) – when depressed and the station is energized, causes the printer to feed out paper for the duration that the key is depressed. This operation has no effect on the line.
- (2) INTERRUPT (INTRPT) key – when momentarily depressed causes a timed spacing signal (BREAK) see Paragraph 3.9 to be sent to the line. It has no effect on the station sending it.
- (3) HERE IS (key) – when momentarily depressed activates the station answerback mechanism and causes a stored series of characters (20 or less) such as the station identification to be transmitted.
- (4) ALARM (key and lamp) – this lamp when lighted may signify a low paper supply condition for a

friction feed printer or a paper out condition for a sprocket feed printer. If the alarm was activated by the low or exhausted paper supply during a data call, the call continues until completed after which the station is disabled to further data service until the paper supply is replenished. At this time the alarm is restored.

The ALARM lamp also lights when the station has received a character with incorrect vertical parity. Under this condition the lighted ALARM lamp has no effect on the station's operation other than to direct attention to the fact that one or more characters received are incorrect. The lighted ALARM lamp can be restored by depressing the ALARM keytop.

- (5) PRINTER END-OF-LINE (PTR EOL) lamp – is an indication for end of printed line.
- (6) LOCAL RETURN (key) – when depressed causes the printer to carriage return. This operation causes no line signals to be generated.

(B) Figure 10 (KSR station)

- (1) OFF-LINE (key and lamp) – depressing this key lights its lamp and activates the station for use in the off-line (local) mode. In this mode the station does not answer automatically but its bell will ring. A second operation of the key extinguishes the light and conditions the equipment for incoming and outgoing calls. If this key is depressed while the station is in a data call, a disconnect will result.
- (2) PAPER ADVANCE (key) – when depressed and the station is energized, causes the printer to feed out paper for the duration that the key is depressed. This operation has no effect on the line.

- (3) LOCAL RETURN (key) – when depressed causes the printer to carriage return. This operation causes no line signals to be generated.

- (4) INTERRUPT (INTRPT) key – when momentarily depressed, causes a timed spacing signal (BREAK)(see Paragraph 3.9) to be sent to the line. It has no effect on the station sending it.

- (5) PROCEED (key and lamp) – the lamp lights when transmission from the keyboard is enabled; that is, it will light when the station receives the (ACK) character and will be extinguished when the (NAK) character or interrupt (BREAK) signal is received. If extinguished by NAK, ACK or manual operation of the PROCEED key, will relight the lamp. If extinguished because an interrupt (break) has been received, only operation of the PROCEED key will relight the lamp. The lamp is extinguished when a data call is completed.

- (6) HERE IS (key) – when momentarily depressed activates the station answerback mechanism and causes a stored series of characters (20 or less) such as the station identification to be transmitted.

- (7) ALARM (key and lamp) – this lamp when lighted may signify a low paper supply condition for a friction feed printer or a paper out condition for a sprocket feed printer. If the alarm was activated by the low or exhausted paper supply during a data call, the call continues until completed after which the station is disabled to further data service until the paper supply is replenished. At this time the alarm is restored.

The ALARM lamp also lights when the station has received a character with incorrect vertical

parity. Under this condition the lighted ALARM lamp has no effect on the station's operation other than to direct attention to the fact that one or more characters received are incorrect. The lighted ALARM lamp can be restored by depressing the ALARM keytop.

- (8) PRINTER END-OF-LINE (PTR EOL) lamp – is an indication for end of printed line, adjustable by the telephone company for any length of line suitable to the printer.

(C) Figure 11 (ASR station)

- (1) READER AUTO (key and lamp) – when depressed its lamp lights and conditions the station for on-line control of the reader. A second operation of the key extinguishes its light and disables the on-line reader control feature. (The reader and printer must be on line or off line together for the lamp to light and the feature to be effective.)
- (2) KEYBOARD LOCAL (KBD LOCAL) (key and lamp) – when depressed its lamp lights and places the keyboard in a local off-line circuit. A second operation of the key extinguishes its light and restores the keyboard to the on-line condition.
- (3) PRINTER LOCAL (key and lamp) – when depressed its lamp lights and places the printer in a local off-line circuit. A second operation of the key extinguishes its light and restores the printer to the on-line condition.
- (4) READER LOCAL (key and lamp) – when depressed, its lamp lights, its motor is started and the reader is placed in a local off-line circuit. Depressing the key again extinguishes its lamp, stops its motor, and places the reader in the on-line condition.
- (5) PUNCH LOCAL (key and lamp) – when depressed its lamp lights and places the reperforator (punch) in a local off-line circuit. The selector may be blinded or not depending upon the state of the PUNCH ON key. A second operation of the key extinguishes its light and restores the reperforator to the idle condition.
- (6) PUNCH ON (key and lamp) – when depressed its lamp lights and unblinds the reperforator (punch) selector for tape preparation. A second operation of the key extinguishes its light and restores the reperforator to the selector blind condition.
- (7) PAPER ADVANCE (key) – when depressed and the station is energized, causes the printer to feed out paper for the duration that the key is depressed. This operation has no effect on the line.
- (8) LOCAL RETURN (key) – when depressed causes the printer to carriage return. This operation causes no line signals to be generated.
- (9) INTERRUPT (INTRPT) key – when momentarily depressed causes a timed spacing signal (BREAK) (see Paragraph 3.9) to be sent to the line. It has no effect on the station sending it.
- (10) PROCEED (key and lamp) – the lamp lights when transmission from the keyboard and reader is enabled; that is, it will light when the station receives the (ACK) character and will be extinguished when the (NAK) character or interrupt (BREAK) signal is received. If extinguished by NAK, ACK or manual operation of the PROCEED key will relight the lamp. If extinguished because an interrupt (break) has been received, only operation of the PROCEED key

will relight the lamp. The lamp is extinguished when a data call is completed.

(11) HERE IS (key) – when momentarily depressed activates the station answerback mechanism and causes a stored series of characters (20 or less) such as the station identification to be transmitted.

(12) KEYBOARD END-OF-LINE (KBD EOL) lamp – is an indication that sufficient characters have been perforated in tape to produce a line of characters on page copy for which it has been set. It is lighted by the character counter which is a feature of the ASR teletypewriter. The character counter counts the number of forward spacing characters generated by the keyboard. Characteristics of the counter are as follows:

- (a) The character counter counts all characters appearing in Columns 2 through 7 of the 1967 ASCII Code shown in Figure 4, except for the Delete character, and except where characters appear as part of an Escape sequence.
- (b) Characters appearing in Columns 0 and 1 are not counted.
- (c) There are no provisions for “tabulation.”
- (d) The counter counts down on Backspace.
- (e) The counter is reset upon receipt of Carriage Return and optionally on Line Feed. (Line SPACE.)
- (f) The counter can be programmed by the telephone company to display “end of line” after any specified character count.

(13) ALARM (key and lamp) – this lamp when lighted may signify a low paper supply condition for a friction feed printer or a paper out condition for a sprocket feed printer. If the alarm was activated by the low or exhausted paper supply during a data call, the call continues until completed after which the station is disabled to further data service until the paper supply is replenished. At this time the alarm is restored.

The ALARM lamp also lights when the station has received a character with incorrect vertical parity. Under this condition the lighted ALARM lamp has no effect on the station’s operation other than to direct attention to the fact that one or more characters received are incorrect. The lighted ALARM lamp can be restored by depressing the ALARM keytop.

(14) PRINTER END-OF-LINE (PTR EOL) lamp – is an indication for end of printed line, adjustable by the Telephone Company for any length of line suitable to the printer.

4.4 Printer

The printer of the M37 TTY stations provides page copy and is capable of printing symbols for all 128 ASCII characters. Normally, however, it will be arranged to print the 94 graphic characters. These are represented by the characters in Columns 2 through 7 of the code table shown in Figure 4 with the exceptions of the space (SP) and delete (DEL) characters. Different type styles are planned and are optional.

Normally, the printer will print ten characters per inch allowing 72 characters on an 8-1/2 inch platen with normal margins on the paper. However, on an optional basis, the printer may be arranged to print twelve characters per inch allowing 86 characters on an 8-1/2 inch platen with normal margins on the paper. Line feed provides for spacing six lines per vertical inch.

wo-color printing is an option. Shifting
ie-color mode to the other is covered in
14.5D following.

Two types of paper feed options are
able:

A printer arranged for friction feed is
capable of accommodating roll paper in
widths of 3 to 8-1/2 inches and capable
of providing multiple copies of one
original and two carbons.

A printer arranged with sprocket feed
(optional) is capable of handling sprocket
feed paper 11 inches long and 9-1/2
inches wide.* One-half inch is needed on
each side of a page to allow for sprocket
holes. The printer is capable of providing
multiple copies consisting of one original
and up to five carbons.

Notes on supplies for teletypewriters are ob-
tainable through Telephone Company representa-
tives.

All M37 TTY station printers are equipped
with line feed and carriage return (both on-line
and local), on-line backspace, and margins
adjustable by the Telephone Company. The
following paper positioning controls are pro-
vided on an optional basis for either friction-
feed or sprocket feed printers.

* Facilities for a full line of form widths (from
3-5/8 to 9-1/2 inches) and forms in variable
lengths (from 2 inches to 15 inches) are planned.

(A) Form-Feed Option – When the printer
detects the form feed character, it
will position the paper for printing on
the first line of the next page. Pages
up to 15 inches in length, adjustable
by the Telephone Company, may be
accommodated. The printer form feeds
three lines during one character inter-
val. Two successive form feeds are
prevented unless there has been an
intervening line feed.

(B) Horizontal-Tabulation Option – This
feature may be either the fixed tabu-
lator stop or the on-line adjustable
tabulator stop type.* The fixed stops

are set by the Telephone Company to
the customer's specification. All stops
of the on-line adjustable option will
be cleared if after the carriage is
shifted to the left margin, a two-char-
acter clearing sequence is used. New
stops are set for this option by moving
the carriage with space or backspace
characters to the desired stop and
using a two-character tabulator set-
ting sequence.

(C) Vertical-Tabulation Option – This
feature may be either the fixed tabu-
lator stop or the on-line adjustable
tabulator stop type.* The fixed stops
are set by the Telephone Company
to the customer's specification. The
on-line adjustable tabulator stops are
set using a two-character sequence
and cleared by using a different two-
character sequence.

(D) Line Feed and Carriage Return –
Two methods of Carriage Return and
Line Feed are available. The preferred
provides Carriage Return and Line
Feed on the Line Feed character (NEW
LINE FEATURE). An option provides
only line feed on the Line Feed char-
acter. On early keyboards (as shown
in Fig. 5) the key lever which gener-
ates the line feed character is de-
signated "LINE SPACE." Two-char-
acter intervals of time are required
for the carriage return operation.

*(E) Half-Line Feed Option – The half-line
feed feature provides for one half the
normal line feed that is, a density of
12 lines per vertical inch. This feature
will be provided in addition to normal
single line feed. The printer will for-
ward line feed one half of a full line
feed upon detection of a two-character
sequence. It will reverse line feed
one half of a full line upon detection
of a two-character sequence. A sub-
script can be positioned using the for-
ward half-line feed and a superscript

*These features are not presently available.

using the reverse half-line feed. On machines equipped with this feature the form-out and vertical-tabulation speed will be 1.5 lines per character interval.

- *(F) Reverse Line Feed Option – When equipped with this feature, a printer will reverse line feed one line upon receipt of a two-character sequence.

The printer is arranged to suppress printing upon detection of the escape (ESC) character. The printing will resume after any character in the code table of Figure 4 is detected except for the characters in Column 2. A backspace feature is provided on all units. The printer backspaces one character upon receipt of the ASCII backspace code.

4.5 Interface and Logic Circuitry

Several optional station logic features are activated by receipt of certain ASCII control characters. The logic to act on these controls is associated with the printer or receiving part of the station. Thus, if a station is in the home-copy mode, it is responsive to control characters generated either from the keyboard or received from the line.

(Note: An exception to the above is the ENQ character which does not trigger the local answerback response.) However, if the station is in the no home-copy mode, it is only responsive to control codes received from the line.

The major station logic features are presented in the following paragraphs:

- (A) On-line control of HOME COPY – As stated previously, the station will be in the home-copy mode at the beginning of each data call. If the station receives the sequence (ESC:), it will stop producing home-copy when sending and will only print page copy for signals received over the line. If the station then receives the sequence (ESC;) over the line, it will produce home-copy when sending.

- (B) Station Answerback – The station answerback is a sequence of up to 20 characters including spaces which may be coded (by the Telephone Company at the request of the customer) in any way satisfactory for the system in which the station is used. The answerback sequence should end with the ACK character.

There are three control features which cause the station answerback to be transmitted. First, the station answerback will be sent if ENQ is received from the line. (Sending ENQ from the keyboard does not cause that station to send its identity even when the station is in the half-duplex mode.) Second, the HERE IS key in the control panel above the keyboard may be depressed. Third, at an answering station, the station answerback sequence will be automatically transmitted each time the answering station has gone through the circuit assurance mode. The keyboard is disabled while the answerback is sent.

- (C) Transmission Disable Feature – At the beginning of each connection, transmission from the keyboard for the KSR and ASR, and from the reader for the ASR will be disabled. If the station receives the ACK character, transmission from the keyboard and reader will be enabled and the PROCEED lamp will light. If the NAK character is detected, transmission will again be disabled and the PROCEED lamp will go out. It is also possible to enable the keyboard and reader by depressing the PROCEED key on the control panel above the keyboard.
- (D) Ribbon control (optional) – At stations with 2-color printing, the station will begin each connection in the black printing mode. If the station receives the (ESC 3) characters, it will assume the alternate color (red) printing mode. If the station detects

*These features are not presently available

the (ESC 4) characters, it will again assume the black printing mode.

- (E) On-Line Punch and Reader Control Feature – This feature permits automatic turn-on and turn-off, in response to line signals, of the punch and reader. The ASCII control character DC1, when received, automatically turns on the reader, provided tape is in its reading head and the reader control lever is in the RUN or STOP position. The ASCII control character DC1 when used in a message tape will stop the reader of the station sending it and will start the reader at the station receiving it if tape is in its reading head and the reader control lever is in the RUN or STOP position. The ASCII control character DC3 is normally used in message tapes to turn the reader off at a station. A one character delay in time can be provided following the reading of a control character to eliminate the need for a fill character in the tape. With this feature the reader will stop on the control character read. The ASCII control character DC2, when received, activates the punch to receive on line signals, DC4, when received, deactivates the punch. The on-line reader control feature is activated by operation of a "RDR AUTO" pushbutton switch (with associated lamp) located on the control panel. The reader and printer must be on-line or off-line together for the feature to be effective. The feature is normalized at the end of the data call.

4.6 Attendant Set

The attendant set is available with the following dialing features:

- (A) Rotary dial
- (B) TOUCH-TONE^R dial
- (C) Rotary and card dialer
- (D) TOUCH-TONE and card dialer

Each type has associated with it a hand telephone set, a loudspeaker, amplifier, loudspeaker control, ringer, network and the following keys and their associated lamps. Figure 12 shows an enlarged view of the attendant set.

DATA key: When depressed it lights its lamp indicating that the station is in the data mode. In this mode the telephone mode is disabled even if the handset is not on its switchhook. The data mode can only be disabled by depressing the CLEAR/TALK key. (The telephone mode is functional until handshaking occurs.)

CLEAR/TALK key: It is depressed to clear or disconnect a data call. Its lamp lights for the duration of the clearing cycle. The station disconnects unless the handset is off its switchhook, in which case the call is placed in the telephone mode. This key when depressed also deactivates the actions initiated by a previously depressed DATA, or TEST key, extinguishing their associated lamp.

TEST key: Operation of the test key, lights its lamp, electrically separates the data set from the teletypewriter and conditions the data set for remote testing from a data test center.

AUTO is a push-to-operate and push-to-release type key, which operates independently from the other keys, and is provided to condition the station for automatic answering. The auto answer mode is effective only when the station is conditioned to receive a call, i.e., there is paper in the machine.

4.7 Tape Module

The tape module is a part of the ASR teletypewriter and contains a nontyping reperforator (punch), perforated tape transmitter (reader), and their local controls.

- (A) PUNCH – a nontyping reperforator is the standard unit for the basic ASR teletypewriter. A typing reperforator that is interchangeable with this unit is under development. The units perforate 8-level fully perforated tape dimensioned in accordance with USA STANDARD, USASX3.18.1967.

The units are equipped with the off-line tape-backspace feature. The punch backspaces the tape one character for each operation of the key designated "PUNCH BACK SPACE."

The units are equipped with a manually operated tape feed-out arrangement. The feed-out lever is located inside the cover. While the lever is

operated, DELETE characters are perforated at machine speed. The feed out is an "interfering" type arrangement and, consequently, obliterates the character if signals are received during its operation.

A tape container accommodates a roll of tape (1000 feet) and is equipped with a low tape alarm feature which when actuated lights the lamp designated "TAPE ALARM."

- (B) READER - senses fully perforated eight-level tape, produced in accordance with USA STANDARD, USA-SX3.18.1967.

A tape-out sensor is provided, located on the reader four characters ahead of tape sensing. Tape-out occurs before the last four characters have been read thereby requiring a "trailer" of at least four characters. The tape-out sensor when actuated lights the lamp designated "TAPE ALARM."

The tape lid sensor when actuated by twisted or bunched tape lights the lamp designated "TAPE ALARM."

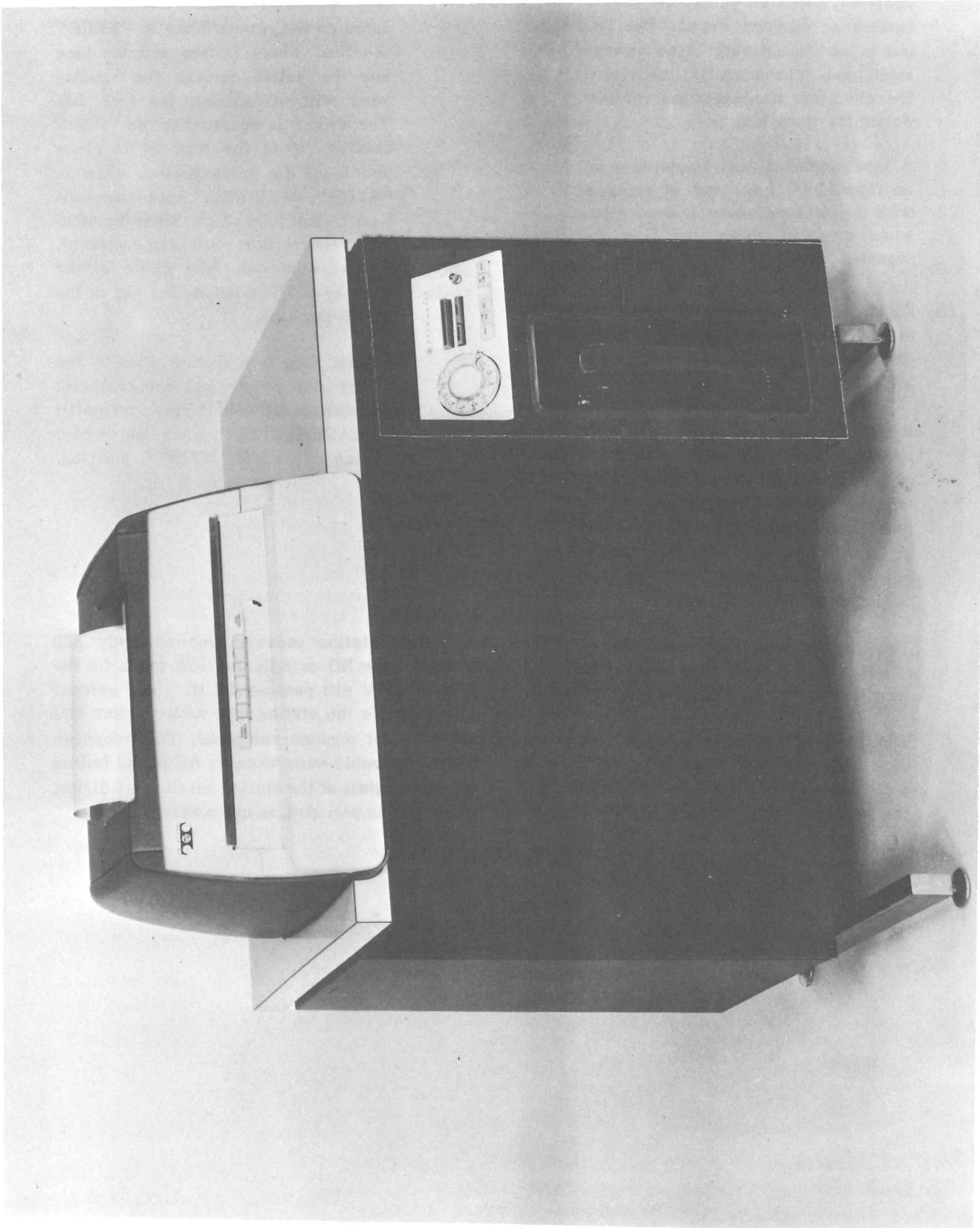
The taut tape sensor actuated by tight tape when the tape from the punch is a continuous piece to the reader, lights the lamp designated "TAPE ALARM."

A "RUN-STOP-FREE" switch is located on the reader. When in "FREE" the feed wheel is free and the tape may be pulled through the reading head without opening the tape lid. The switch is operated to the "RUN" position when the tape is in place and ready for transmission. When in "STOP" or "FREE" tape transmission cannot take place. When the automatic reader start feature is activated, transmission can take place in the RUN or STOP position but not in the FREE position.

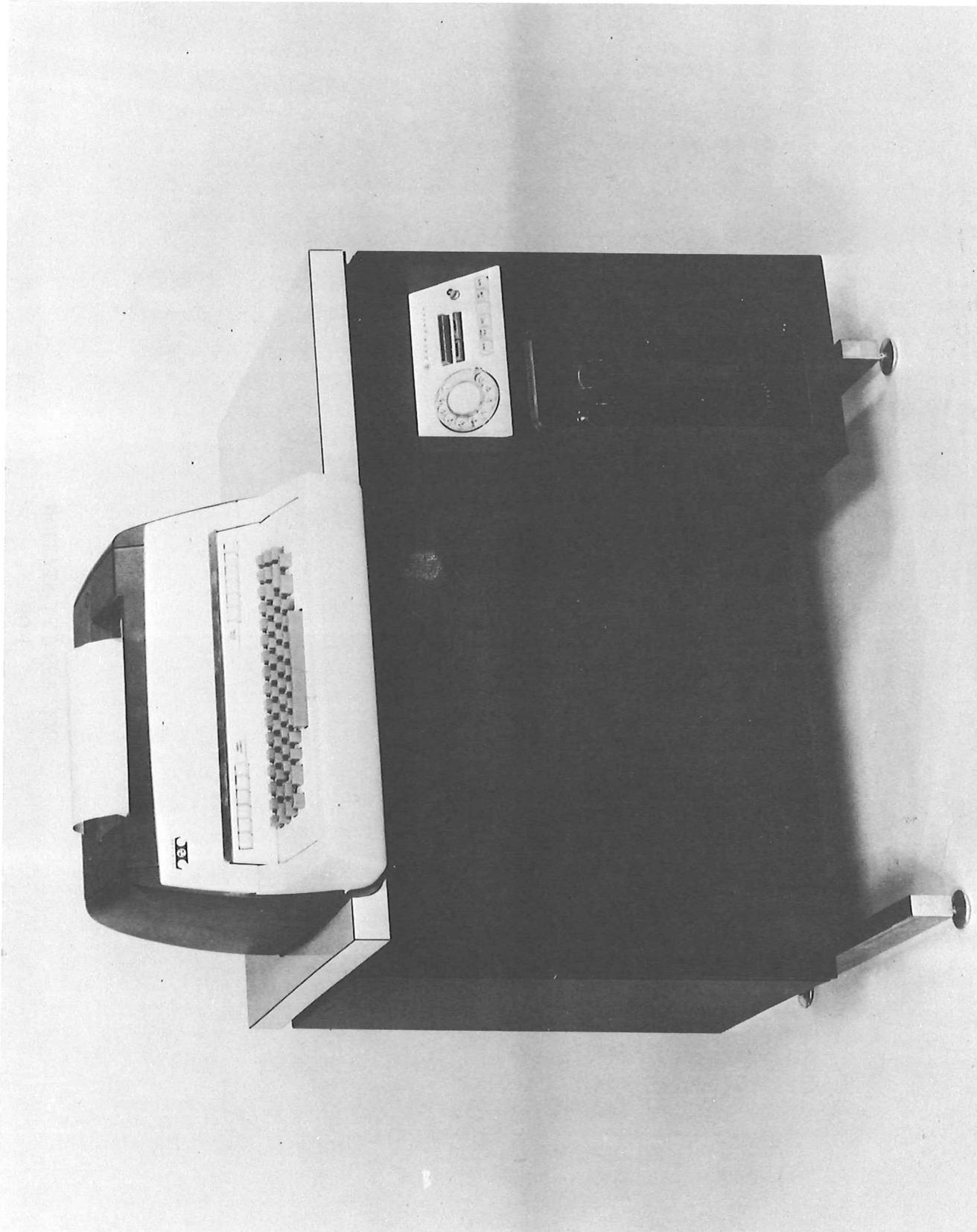
Reader Step is a feature whereby the reader may be stepped one character for each operation of the key designated "READER STEP" when the reader switch is in the "STOP" position.

5. POWER

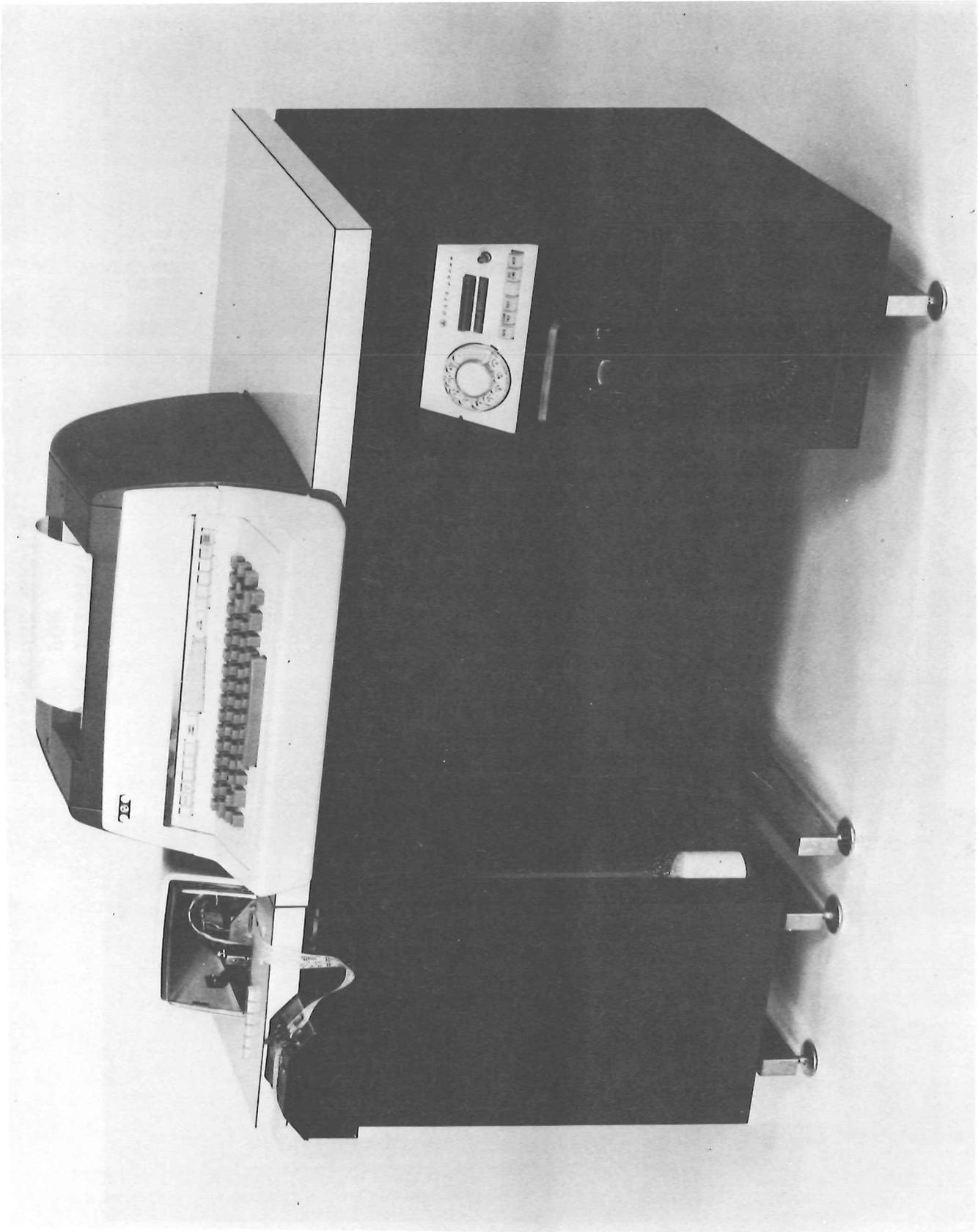
The station requires approximately 300 watts for the RO or KSR and 550 watts for the ASR of 117V ± 10 percent, 60 Hz ± 0.75 percent AC power. In the station idle mode (motors off) the data set remains energized. The telephone mode is useable even when an AC power failure situation exists at the station but the card dialer, where one is provided, is not operative.



M37 RO TTY STATION
FOR
DATA-PHONE SERVICE
FIGURE 1



M37 KSR TTY STATION
FOR
DATA-PHONE SERVICE
FIGURE 2



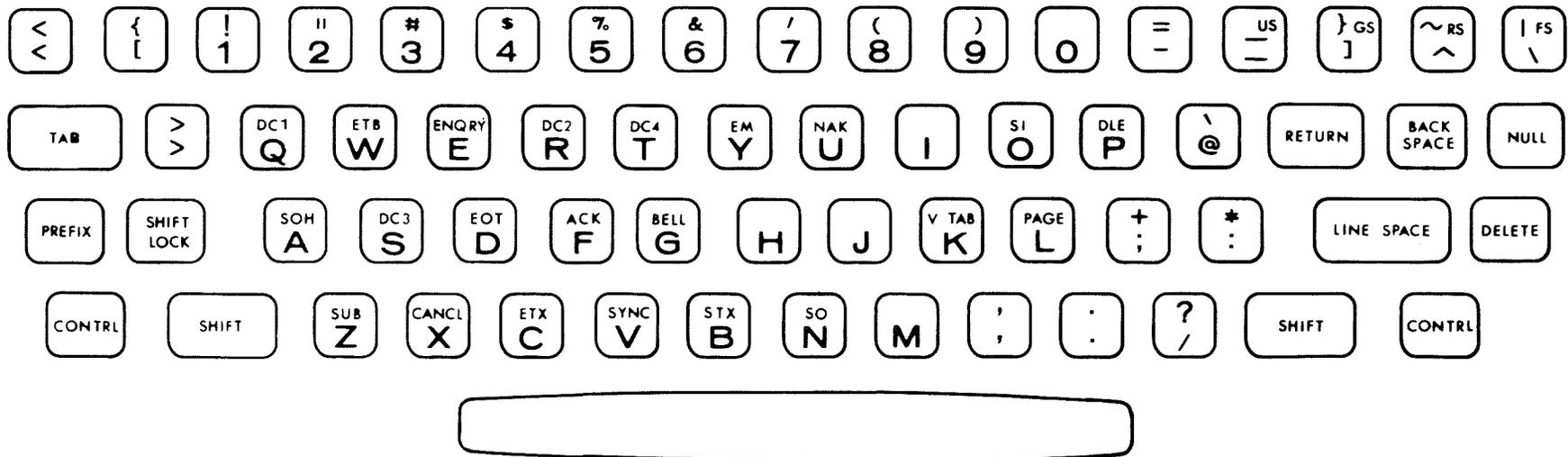
M37 ASR TTY STATION
FOR
DATA-PHONE SERVICE
FIGURE 3

USA STANDARD CODE FOR
INFORMATION INTERCHANGE
USAS X3.4 - 1967

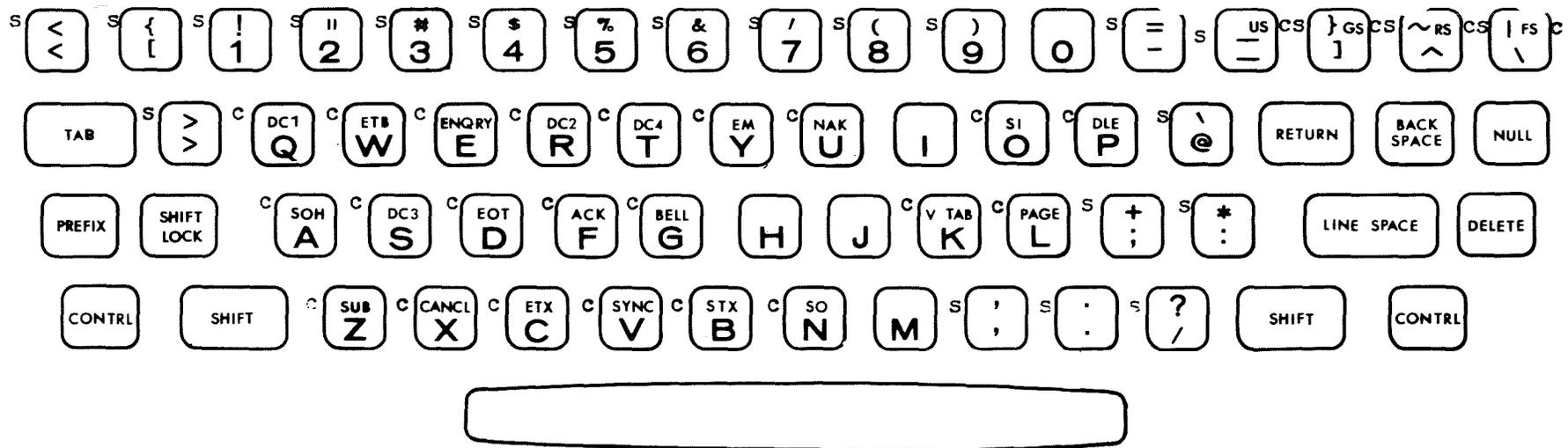
Bits					0	0	0	0	1	1	1	1				
					0	0	1	1	0	0	1	1				
b ₇	b ₆	b ₅	b ₄	b ₃	b ₂	b ₁	Column	Row	0	1	* 2	* 3	* 4	* 5	* 6	* 7
0	0	0	0	0	0	0	NUL	DLE	SP	0	@	P	\	p		
0	0	0	1	1	1	1	SOH	DC1	!	1	A	Q	a	q		
0	0	1	0	2	2	2	STX	DC2	"	2	B	R	b	r		
0	0	1	1	3	3	3	ETX	DC3	#	3	C	S	c	s		
0	1	0	0	4	4	4	EOT	DC4	\$	4	D	T	d	t		
0	1	0	1	5	5	5	ENQ	NAK	%	5	E	U	e	u		
0	1	1	0	6	6	6	ACK	SYN	&	6	F	V	f	v		
0	1	1	1	7	7	7	BEL	ETB	⌘	7	G	W	g	w		
1	0	0	0	8	8	8	BS	CAN	(	8	H	X	h	x		
1	0	0	1	9	9	9	HT	EM	)	9	I	Y	i	y		
1	0	1	0	10	10	10	LF	SUB	*	:	J	Z	j	z		
1	0	1	1	11	11	11	VT	ESC	+	;	K	[	K	{		
1	1	0	0	12	12	12	FF	FS	,	<	L	\	l	|		
1	1	0	1	13	13	13	CR	GS	-	=	M	]	m	}		
1	1	1	0	14	14	14	SO	RS	.	>	N	^	n	~		
1	1	1	1	15	15	15	SI	US	/	?	O	-	o	DEL		

*Only columns 2 to 7 are normally printed with the exception of SP (space) and DEL (delete).

FIGURE 4



ASCII M37 KEYBOARD
FIGURE 5



ASCII M37 KEYBOARD CODE GENERATION DISPLAY
Figure 6

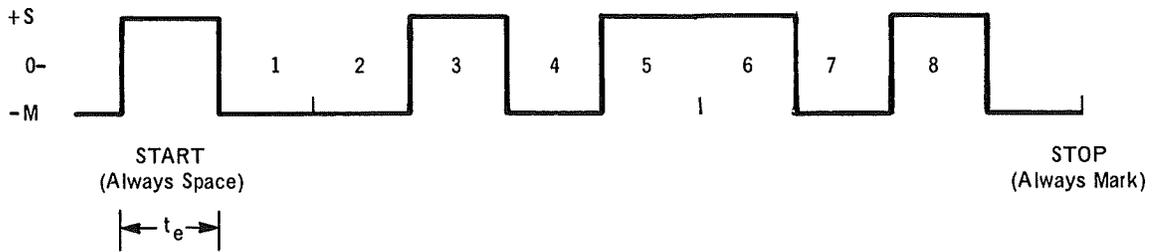
The lower keytop designations are primary and are generated when the key is depressed. For the alphabet the lower case is generated. Capital letters require the use of the shift key and the respective letter.

Other codes are generated as indicated using the shift key S or control key C with a particular key for the code desired. The ESC code is generated by depressing the key designated PREFIX.

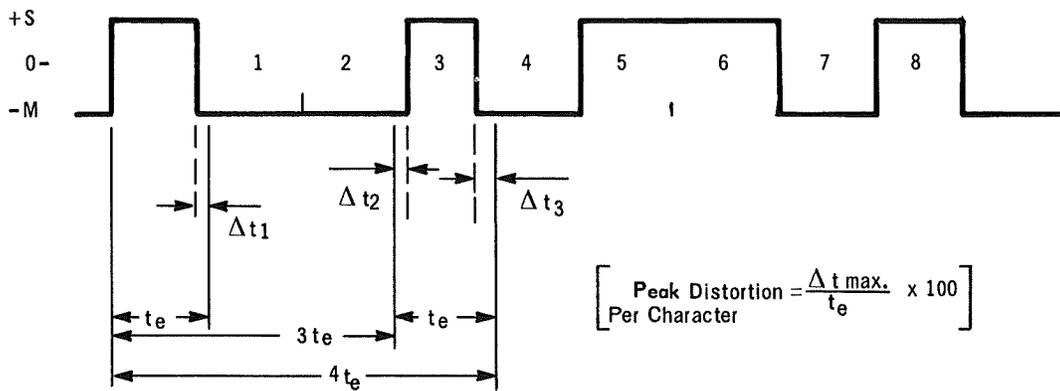
Shift S inverts the 5 and 8 or 6 and 8 bits.

Control C deletes 6 and 7 or deletes 7 and inverts 8.

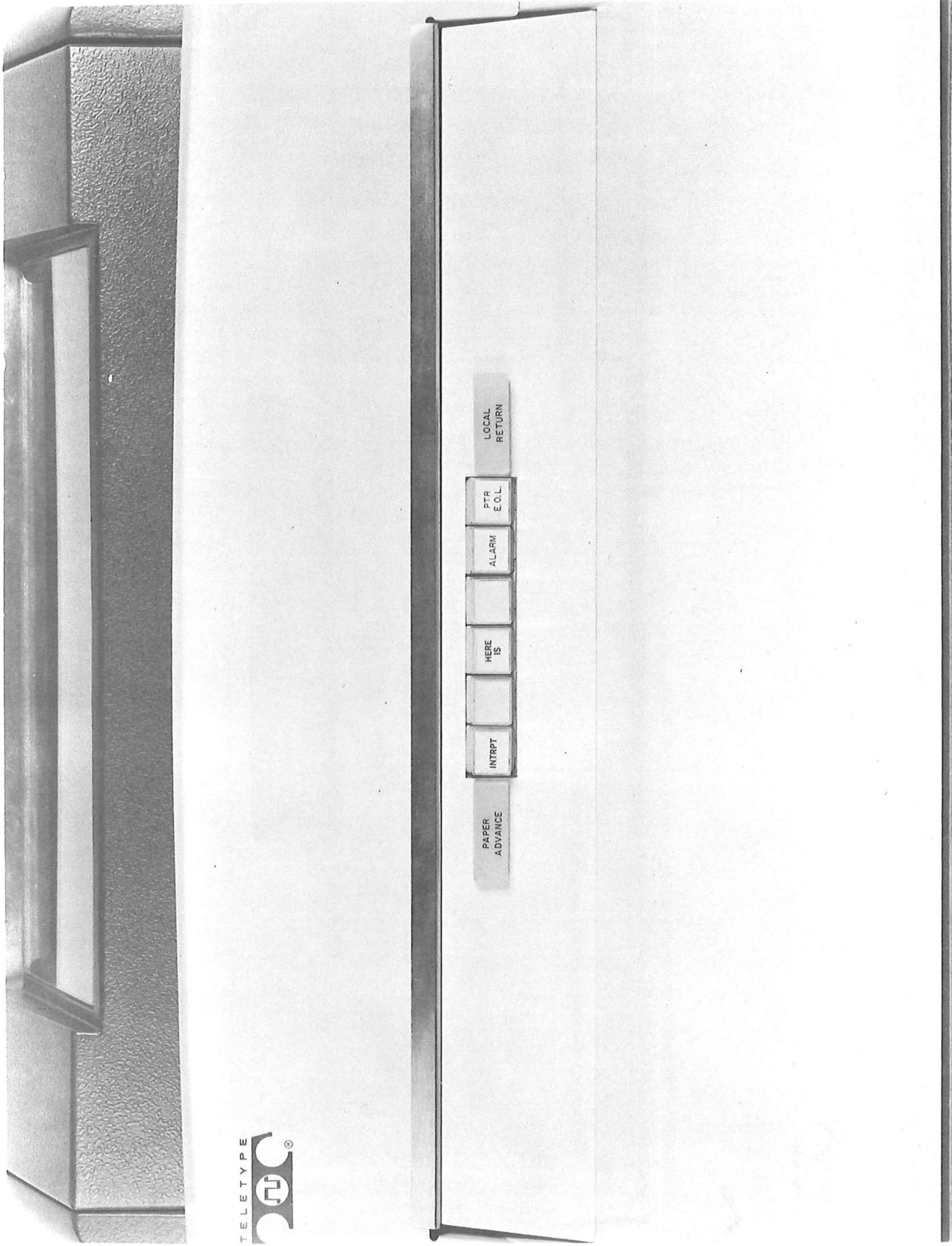
Eighth bit is parity and is marking or spacing to produce an even number of marking and/or an even number of spacing bits in a character.



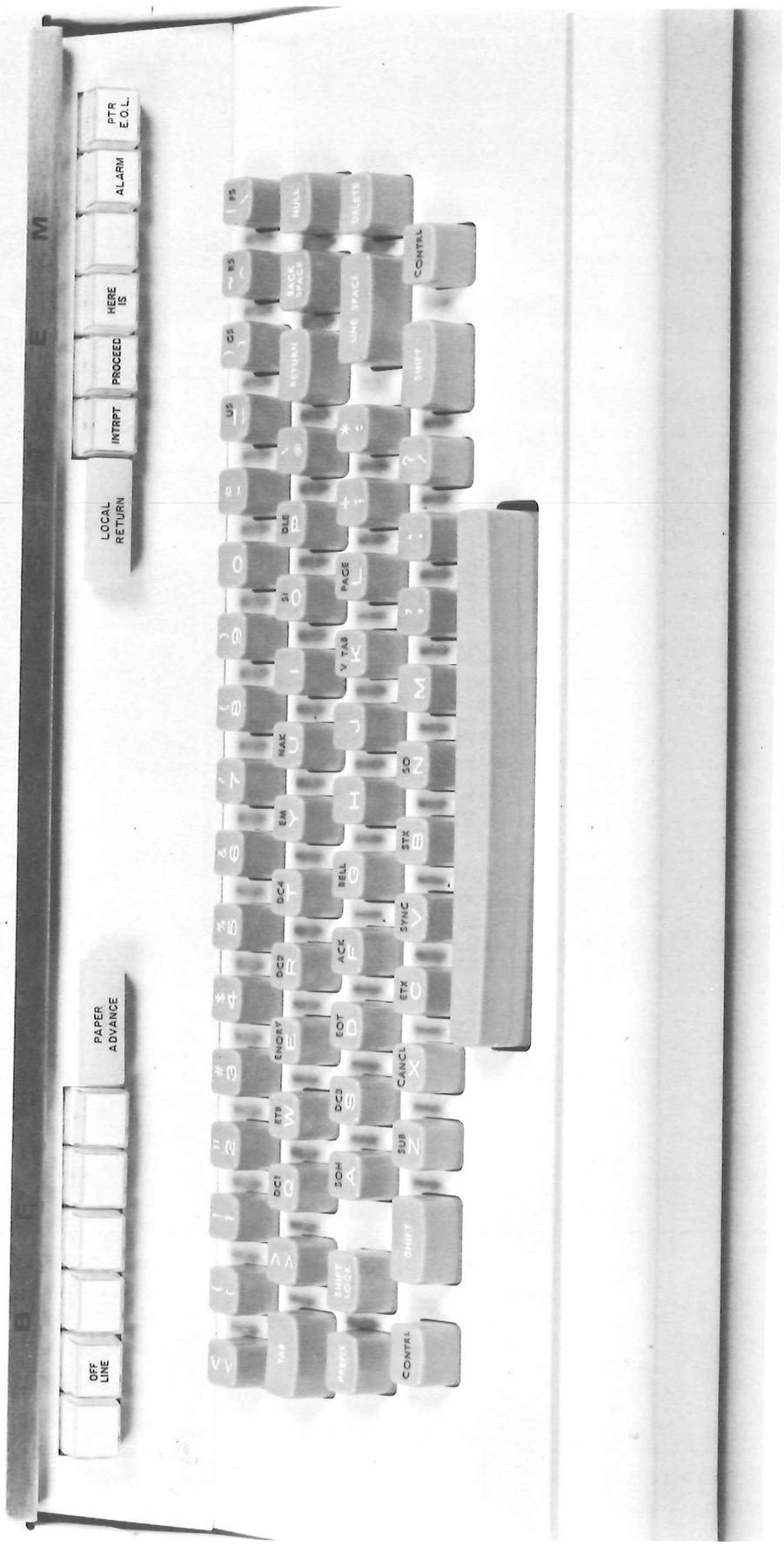
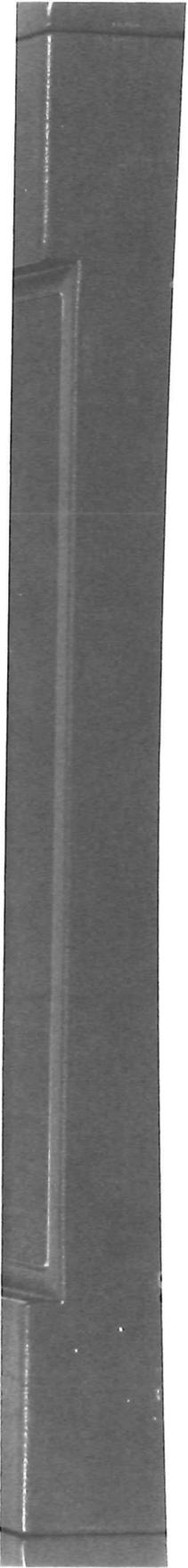
Typical Undistorted Eight Element
Start-Stop Signal
Figure 7



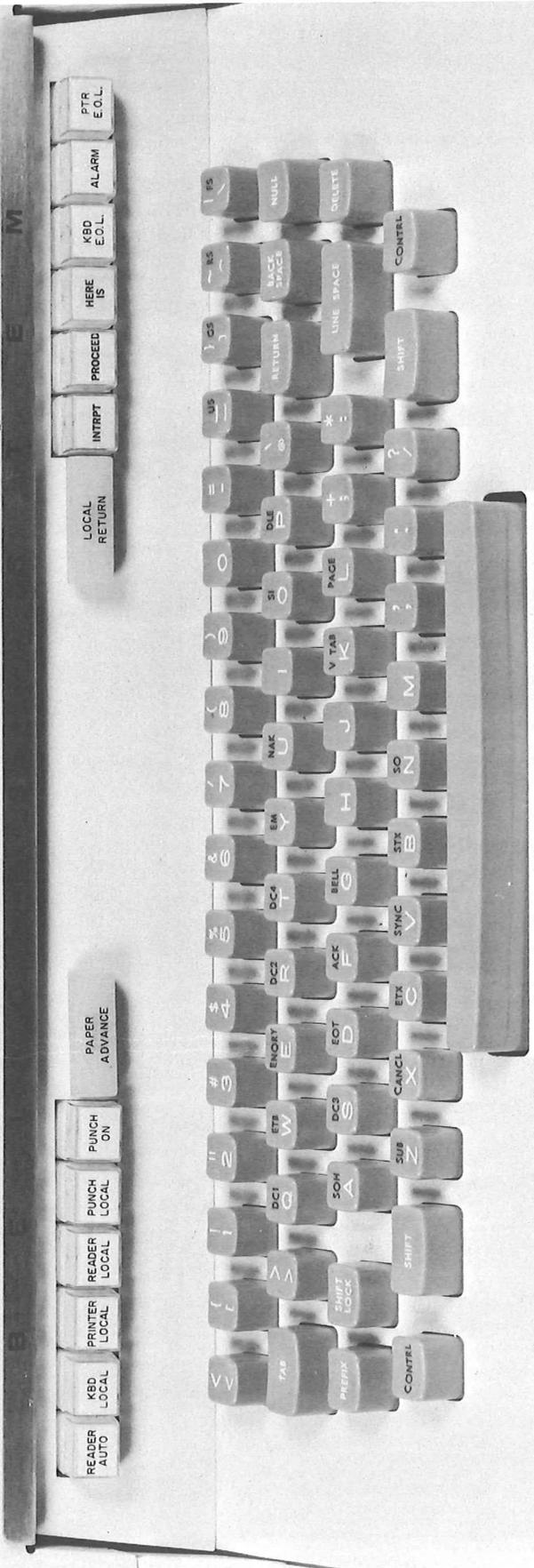
Distorted Eight Element
Start-Stop Signal
Figure 8



M37 RO
CONTROL PANEL
FIGURE 9



M37 KSR KEYBOARD
AND CONTROL PANEL
FIG. 10



M37 ASR KEYBOARD
AND CONTROL PANEL
FIGURE 11



ATTENDANT SET CONTROL PANEL

FIGURE 12