Bell System
TECHNICAL REFERENCE

MODEL 33, 35, AND 37
STATIONS
FOR POINT-TO-POINT
PRIVATE LINE SERVICE
AUGUST, 1971

326-553

Bell System Data Communications

TECHNICAL REFERENCE

●

MODELS 33, 35, AND 37 STATIONS

FOR

POINT - TO - POINT PRIVATE LINE SERVICE

●

AUGUST, 1971

●

ENGINEERING DIRECTOR - TRANSMISSION SERVICES

NOTICE

This Technical Reference is published by American Telephone and Telephone Company as a guide for the designers, manufacturers, consultants and suppliers of customer-provided systems and equipment which connect with Bell System communications systems or equipment. American Telephone and Telegraph Company reserves the right to revise this Technical Reference for any reason, including, but not limited to, conformity with standards promulgated by USASI, EIA, CCITT, or similar agencies, utilization of new advances in the state of the technical arts, or to reflect changes in the design of equipment or services described therein. The limits of responsibility and liability of the Bell System with respect to the use of customer-provided systems or equipment are set forth in the appropriate tariff regulations.

If further information is required, please contact:

Engineering Director — Transmission Services
American Telephone and Telegraph Company
195 Broadway
New York, New York 10007

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION

This Technical Reference describes Point-To-Point Private Line Service in which a Model 33, 35 or 37 Teletypewriter Station is connected to one or both points on a communication link. The arrangements described are composed of two interconnecting stations and their communications control capability. The teletypewriter provides keyboard or tape input and paper tape or page copy output.

The Model 33, 35 and 37 teletypewriter stations use Subcategories 2.3/A1 of ANSI Standard X3.3.4/212 dated September, 1970; "PROCEDURES FOR USE OF THE COMMUNICATION CONTROL CHARACTERS OF THE AMERICAN NATIONAL STANDARD CODE FOR INFORMATION INTERCHANGE IN SPECIFIED DATA COMMUNICATION LINKS." The specific Subcategory 2.3 is defined as "Two-Way Alternate; Non-Switched Point-To-Point"and Subcategory AI as "Message Oriented; Without Replies and Without Longitudinal Checking." This Technical Reference also describes optional procedures which may be used.

This Technical Reference does not provide a detailed description of the ASCII Code (X3.4-1968) or the Line Control Procedure Standard (X3.3.4/212).

2. TELETYPEWRITERS — MODELS 33, 35 AND 37

Model 33, 35 and 37 Teletypewriters 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 KSR (See Figure 1).
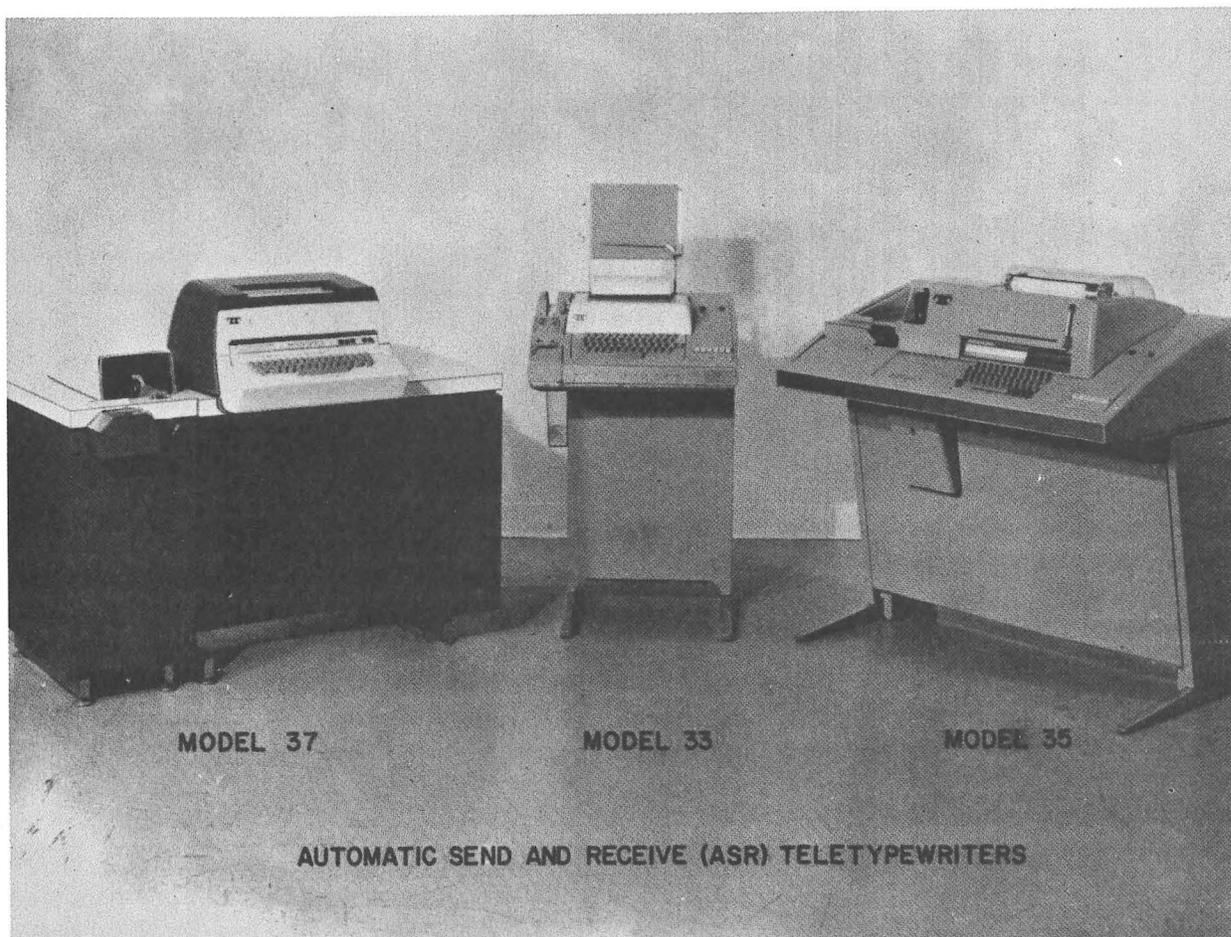

MODEL 37   MODEL 33   MODEL 35

AUTOMATIC SEND AND RECEIVE (ASR) TELETYPEWRITERS

FIGURE 1

2.1 Power Requirements

The customer must provide a receptacle supplying continuous 115-volt, 60 Hertz ac power. The teletypewriter will properly operate over a frequency deviation of ±0.45 Hz and a voltage range of 103 to 127 volts. Power consumption, at nominal line voltage, in watts, for various teletypewriter arrangements is given in Table 1-A.

Table 1-A   Station Power Consumption (Watts)

Terminal	Model 33	Model 35	Model 37
KSR or RO	95	120	150
ASR	110	210	300

2.2 Code and Speed

The communication code used by the teletypewriters is the American National Standard Code (ASCII, X3.4-1968). Model 33 and Model 35 teletypewriters operate at 100 words per minute, 110-baud with an 11-unit code (1 start, 7 information, 1 even parity, and 2 stop). The Model 37 teletypewriter operates at 150 words per minute, 150-baud with a 10-unit code (1 start, 7 information, 1 even parity, and 1 stop).

2.3 Teletypewriter Features

a. Line Length — The printers generally accept 72 characters per line; however, other line lengths can be accommodated up to the maximum capability of a specific terminal.

b. Parity — All teletypewriters generate an even parity in the 8th bit. The Model 37 includes a parity detector which lights a lamp on receipt of a parity error. The Models 33 and 35 may be equipped with a Parity Error Alarm Modification on an optional basis.

c. Response — All teletypewriters are arranged to provide an ACK control character response to an ENQ control character bid for master status. Additionally, the Models 33 and 35 can provide up to a 15-character prefix to the character ACK by coding the drum of their electro-mechanical answer-back mechanism.

d. Interrupt (Break) — All teletypewriters interpret a spacing signal of 190 ms or greater as an Interrupt Signal. A spacing signal of less than 100 ms is not interpreted as an Interrupt Signal. All teletypewriters can generate a timed Interrupt Signal of 380 to 750 ms of space except Model 33 and 35 RO's which do not have the Interrupt generation capability.

e. Bell — All teletypewriters are arranged to ring the signal bell in response to the reception of the BEL character. Additionally, the Models 35 and 37 will indicate the reception of the character NAK by ringing the signal bell.

f. Back Space — The Model 37 printer is arranged to backspace one character position for each Back Space (BS) character received. The Models 33 and 35 printers do not respond to the BS character.

g. Full/Half Duplex — All teletypewriters are arranged to have separate Send and Receive circuits which are internally connected for half-duplex operation. Half-duplex operation is required when ANSI communication control procedures are used. Additionally, the Model 37 can be controlled by "On Line" character sequences; Escape followed by a Colon (:) to separate the send-receive data leads and provide "Full Duplex", Escape followed by a Semicolon (;) will cause it to return to "Half-Duplex" mode when received on the receive leg of the circuit.

h. Form Feed Option — The Models 33, 35 and 37 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.

i. Vertical Tab Option — The Models 35 and 37 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. With an additional option, the Model 37 provides "On Line" tab control which permits remote tab set and clear in response to Escape followed by Numeric 5 (Set) and

Escape followed by Numeric 6 (Clear) character sequences.

j. Horizontal Tab Option — The Models 35 and 37 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. With an additional option, the Model 37 provides "On Line" tab control which permits remote tab set and clear in response to an Escape followed by Numeric 1 (Set) and Escape followed by Numeric 2 (Clear) character sequences.

k. New Line — As an option, all teletypewriters may be arranged to provide the format effector, New Line, which controls the movement of the printing point to the first printing position on the next printing line. (See para. 2.4 C)

2.4 Timing Considerations

a. Motors — From the receipt of a start signal, a time interval of up to two seconds is required to assure that the teletypewriter motors are at operating speed.

b. Control Characters — All control characters that result in the control of a teletypewriter component (e.g. reader, punch) should be followed by a Delete character or a timing interval equal to a character in length.

c. Carriage Return or New Line — Two Delete characters or an equivalent time interval is required following the Carriage Return or New Line functions to assure the carriage return operation.

d. Vertical Tabulation and Form Feed — Model 33 and 35 printers form feed at the rate of 6 lines per character interval. The Model 37 printer form feeds at the rate of 3 lines per character interval. The Model 35 and 37 printers vertical tab at the rate of 6 lines per character interval and 3 lines per character interval, respectively.

e. Horizontal Tabulation — Models 35 and 37 printers horizontal tab at the rate of 3 spaces per character interval.

f. The Model 33/35 teletypewriters automatically generate the response

character ACK with an electro-mechanical answer- back mechanism. For system timing purposes the character ACK must be the last coded character on the answer-back drum. A Delete character after the response character ACK is not required for system timing.

g. The Model 35 teletypewriters require a timing interval equal to two characters in length to precede the response character ACK. This time interval may be generated by prefix characters or suitable buffering. The Model 33 and 37 teletypewriters do not require this timing interval.

3. DATA SETS AND COMMUNICATION CONTROL

The Private Line Station includes an appropriate Data Set as described in the Technical References on Private Line Service (See References). In these services permanent Carrier is established between the two stations and all line and control functions must be performed either by ASCII Control Characters or by other timed signals such as the Interrupt (Break) Signal.

4. STANDARD LINE CONTROL PROCEDURES

The ANSI Standard X3.3.4/212 dated September 30, 1970, describes the use of ASCII Control Characters to control Data Communications, and the station arrangements described in this document follow the standard in their operation. The Models 33, 35 and 37 follow identical line control procedures. The ANSI standard does not determine the techniques required for turning on motors and the resultant time delay inherent in such an operation. Consequently, special Model 33/35 and 37 procedures have been provided to care for this item supplementing the ANSI procedures (See Figures 2 thru 8).

4.1 Station Operation
4.1.1 Motor on

The teletypewriter motors may be started locally by a control switch or remotely by a wake-up signal. The circuit logic of the Models 33/35 and 37 are all arranged to recognize a spacing pulse as a wake-up signal for remote motor start. The Models 33/35 require spacing

signal of 9 ms (nominal) and the Model 37 requires a spacing signal of 25 ms (nominal). The ASCII characters recommended for this purpose are the character ENQ for the Model 37 and the character Delete (DEL) for the Models 33/35. For computer systems that can accommodate both 100 and 150 wpm transmission speeds, a spacing pulse of 25 ms (nominal) will satisfy the requirements for all teletypewriters. As noted in the timing section of this reference, a time interval of at least 2 seconds is then required to allow the motors to attain operating speed before transmission may be initiated.

4.1.2 Call Establishment

After the motors are at operating speed, the stations are in contention and available for call establishment. Either station may bid for master (send) status. A station bids for master status by transmitting the character ENQ, and acquires master status upon receipt of an ACK character response from the answering station. The answering station generates the ACK character and assumes slave status. Call establishment is completed with the master-slave relationship.

4.1.3 Message Transfer

Message transmission is one direction only. It can be a single message or a series of messages. Special headings and text separators within the messages are permitted since these control characters and procedures are independent of station operation and, therefore, are not acted upon by the station logic.

4.1.4 Call Termination

Transmission of the EOT character negates the master-slave relationship and causes the stations to return to the contention mode.

4.1.5 Motor Off

The teletypewriter motors may be manually turned off by a control switch or will turn off automatically after approximately five minutes of idle line.

4.2 Incomplete Call Attempt

A model 33, 35 and 37 station that is in a "Local", "Out of Service" or "Paper Alarm" condition will not respond (No Reply) to the receipt of the bid character ENQ, and a later attempt for call establishment will be necessary.

When two stations attempt to achieve master status simultaneously, the ENQ signals will usually be garbled and require retransmission.

A calling station that receives an invalid or NAK character reply should reattempt to establish the call. If the reply is the same, a later attempt for call establishment should be made.

The Models 35 and 37 are arranged to ring the teletypewriter bell upon the receipt of an NAK character response. The Model 33 does not have this feature.

An Interrupt signal can be generated from a receiving (slave) station and sent toward a sending (master) station to stop its sending. Upon recognition of the Interrupt signal by the sending station, all transmission is stopped and inhibited; the Model 37 stations revert to the contention mode and the Model 33/35 stations go into an Interrupt (Break) condition that must be manually reset.

5. OPTIONAL PROCEDURES FOR MODELS 33/35 AND 37

The Model 33/35 and 37 teletypewriters have additional operational features that are not required nor specified in the ANSI Standard for line control procedures. These features are provided to encompass a broad range of customer applications.

5.1 Models 33/35
5.1.1 Motor Off

The Models 33/35 have a wiring option which allows the teletypewriter motor to be automatically turned off upon the reception of the control character EOT instead of the station being placed in the contention mode.

5.1.2 Conversation Mode

The Models 33/35 can be placed in a conversational mode which permits alternate sending and receiving (chit-chat) without an intervening termination and establishment procedure as required utilizing ANSI Category 2.3 line control procedures.

In a teletypewriter-to-teletypewriter application, the conversation mode is initiated after the call establishment procedure (Par. 4.1.2) has been completed. The master station can place the slave station in the conversational mode by transmitting the character ACK to the slave station. The character ACK is generated from the keyboard or automatically by activation of the "Here Is" key which trips the answer-back response.

In teletypewriter-to-computer applications, the optional conversation mode is always available because the receive data lead of a station in the master (send) state is never blinded.

Recovery from the conversational mode may be brought about by turning the teletypewriter motor off manually, or by having it turn off automatically by idle line or EOT disconnect.

5.1.3 Tape Reader Control

The automatic reader associated with the Model 33/35 teletypewriters is controlled by local switches or by ASCII control characters. The control characters to start the reader are generated from a remote station and to stop the reader are generated locally.

The control characters are as follows:
DC1 Stop Local Reader
      Start Remote Reader*

DC3 Stop Local Reader
ENQ Stop Local Reader

EOT Stop Local Reader

ACK Start Remote Reader*

* Note: Reader will respond to these codes when it has tape, has been conditioned for auto reader operation, and the station is in the sending mode.

5.1.4 Tape Punch Control

The punch associated with the Model 33/35 teletypewriters is controlled by local switches or by ASCII control characters. The control characters to enable and disable punch operation are DC2 and DC4, respectively.

5.2 Model 37
5.2.1 Motor Off

The Model 37 motors turn off automatically upon receipt of the DLE-EOT character sequence. This character sequence transmitted at the end of a message causes automatic motor turn off at both the local and the distant station. The operation of the Clear switch when a Model 37 station is in the master or slave state turns local motors off and generates the DLE-EOT character sequence "on line" to turn distant station motors off.

The idle line timer has a standard time period of 5 minutes with optional time periods of 2, 10 and 20 minutes. The optional timing period must be implemented by the Telephone Company installer.

5.2.2 Conversation Mode

The Model 37 teletypewriter is equipped with a wiring option that provides a conversational mode permitting alternate sending and receiving between two stations without an intervening termination and establishment procedure. Upon detection of the EOT character, a station with master status becomes a slave while a station with slave status becomes a master. This procedure may be repeated any number of times until termination of transmission is initiated either through idle line time out or by the transmission of the character sequence DLE-EOT.

A second conversational mode wiring option is available that permits alternate transmission without using a control character. When this option is implemented, a slave station may gain master status by manually operating the send switch. When this type of operation is selected, both stations are always in the send mode and transmission must be conducted on an alternate basis.

5.2.3 Tape Reader Control

The Model 37 reader operation is the same as that described for the Models 33/35.

5.2.4 Tape Punch Control

The Model 37 punch operation is the same as that described for the Models 33/35.

| LOCAL STATION START-UP | | | DISTANT STATION START-UP | | | | ESTABLISHMENT PROCEDURE | | | | MESSAGE TRANSFER | TERMINATION PROCEDURE |

DEPRESS ON — MOTOR TURN ON DELAY — PROCEED LAMP ON — SEND DEL — PROCEED LAMP OFF — TIME DELAY — PROCEED LAMP ON — SEND ENQ — PROCEED LAMP OFF — RECEIVE (PREFIX) ACK — PROCEED LAMP ON — TRANSMIT DATA — SEND EOT — OFF

CONTENTION PROCEED LAMP ON

IDLE LINE TIME OUT — OFF

RECEIVE NON-ACK

DEPRESS ON

PROCEED LAMP ON

NO REPLY

DEPRESS ON

PROCEED LAMP ON

CONTENTION PROCEED LAMP ON

SEND EOT — OFF

FIGURE 2

X 3.3.4 OPERATING PROCEDURE (MASTER STATUS)

TELETYPEWRITER-TO-TELETYPEWRITER

MODEL 33 OR 35

LOCAL STATION
START-UP

ESTABLISHMENT
PROCEDURE

MESSAGE
TRANSFER

TERMINATION
PROCEDURE

DEPRESS
ON

MOTOR
TURN ON
DELAY

PROCEED
LAMP
ON

SEND
ENQ

PROCEED
LAMP
OFF

RECEIVE
(PREFIX)
ACK

PROCEED
LAMP
ON

TRANSMIT
DATA

SEND
EOT

OFF

CONTENTION
PROCEED LAMP
ON

IDLE LINE
TIME OUT

OFF

RECEIVE
NON-ACK

NO
REPLY

DEPRESS
ON

PROCEED
LAMP ON

CONTENTION
PROCEED LAMP
ON

SEND
EOT

OFF
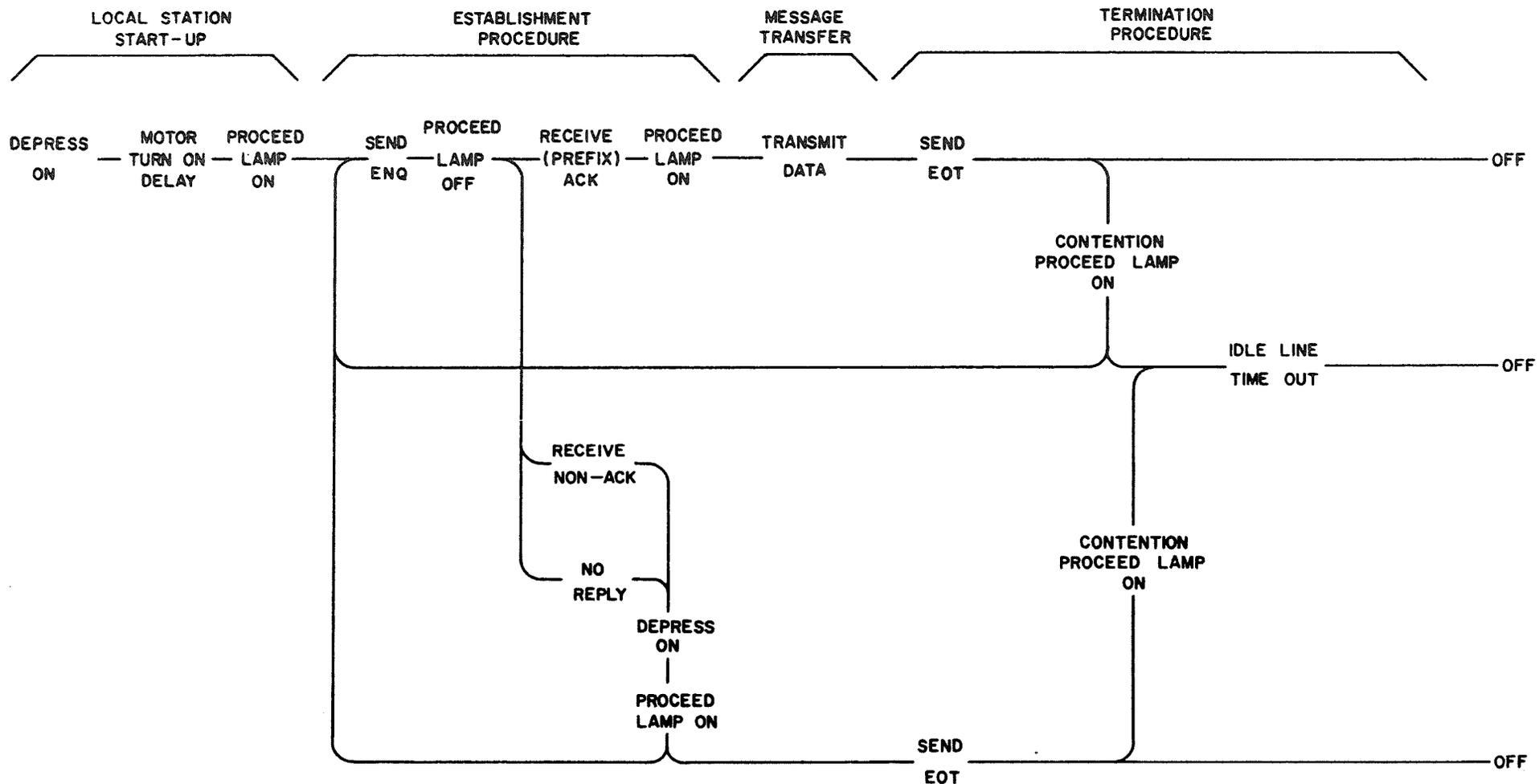
FIGURE 3

X 3.3.4. OPERATING PROCEDURE (MASTER STATUS)
TELETYPEWRITER-TO-COMPUTER
MODEL 33 OR 35

- 7 -

| START–UP PROCEDURE | ESTABLISHMENT PROCEDURES | MESSAGE TRANSFER | TERMINATION PROCEDURE |

RECEIVE *
DEL

MOTOR TURN ON DELAY

PROCEED LAMP ON

RECEIVE ENQ

PROCEED LAMP OFF

TRANSMIT (PREFIX) ACK

RECEIVE DATA

RECEIVE EOT

OFF

SLAVE MACHINE IN BREAK CONDITION

CONTENTION PROCEED LAMP ON

IDLE LINE TIME OUT

OFF

RECEIVE ENQ ——— NO REPLY **
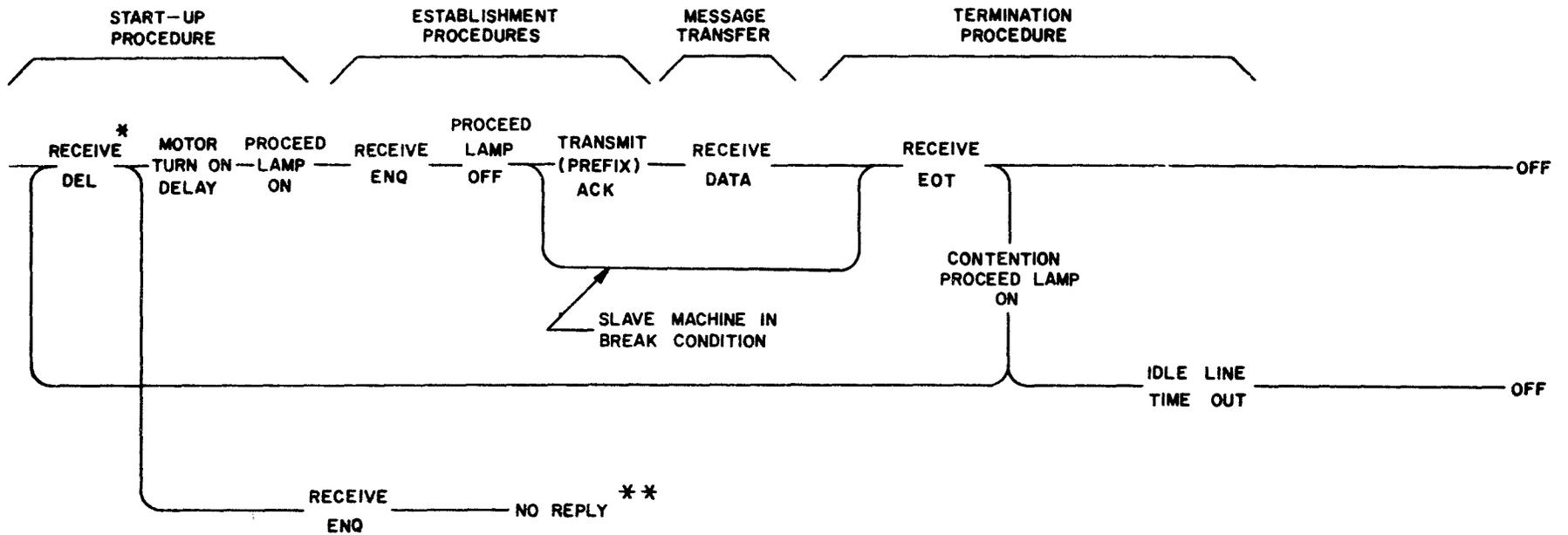
* IN THE CASE OF A COMPUTER ENQ SUBSTITUTED FOR DEL IN THE START–UP PROCEDURE.

** THIS IS WHERE THE RECEIVING TERMINAL IS IN OUT OF SERVICE, LOCAL OR PAPER ALARM.

FIGURE 4
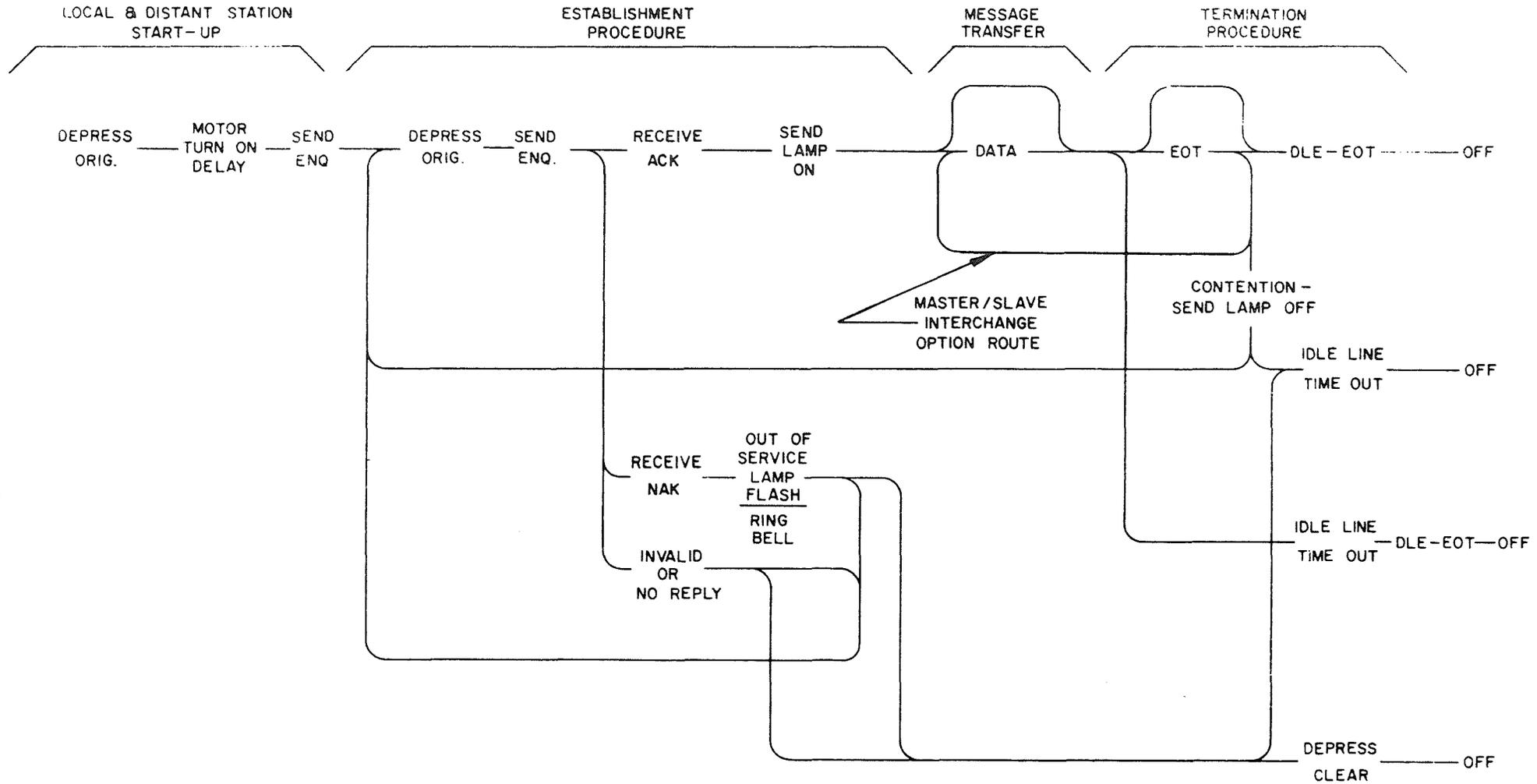
X 3.3.4 OPERATING PROCEDURE (SLAVE STATUS)

MODEL 33 OR 35

LOCAL & DISTANT STATION START-UP	ESTABLISHMENT PROCEDURE	MESSAGE TRANSFER	TERMINATION PROCEDURE

DEPRESS ORIG. — MOTOR TURN ON DELAY — SEND ENQ

DEPRESS ORIG. — SEND ENQ. — RECEIVE ACK — SEND LAMP ON — DATA — EOT — DLE—EOT ———— OFF

MASTER/SLAVE INTERCHANGE OPTION ROUTE

CONTENTION — SEND LAMP OFF

IDLE LINE TIME OUT — OFF

RECEIVE NAK

OUT OF SERVICE LAMP FLASH

RING BELL

INVALID OR NO REPLY

IDLE LINE TIME OUT — DLE—EOT—OFF

DEPRESS CLEAR ———— OFF

FIGURE 5

X 3.3.4 OPERATING PROCEDURE (MASTER STATUS)
TELETYPEWRITER — TO — TELETYPEWRITER
MODEL 37
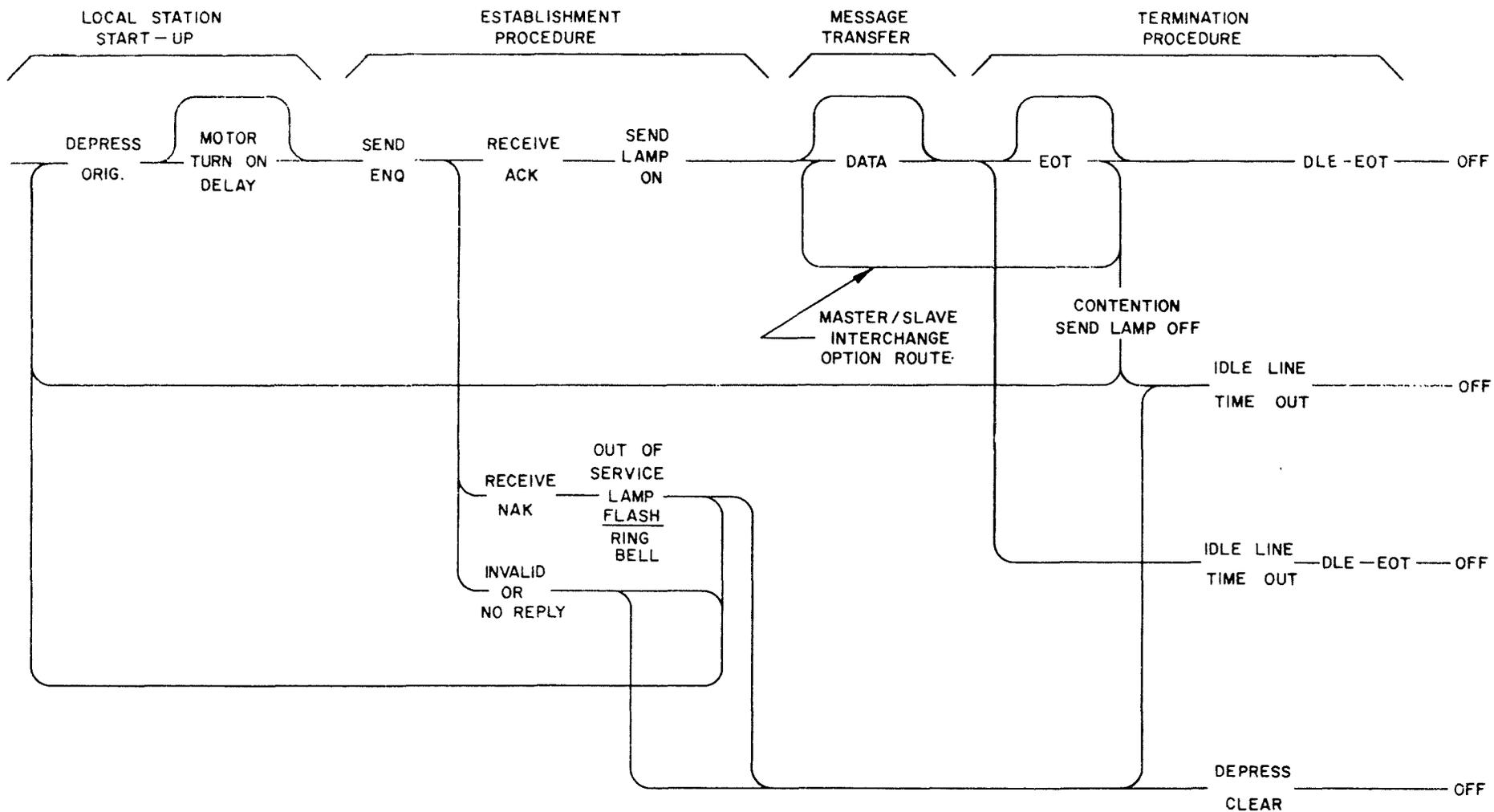
FIGURE 6

X 3.3.4 OPERATING PROCEDURE (MASTER STATUS)

TELETYPEWRITER—TO—COMPUTER

MODEL 37

START UP
PROCEDURE

ESTABLISHMENT
PROCEDURE

MESSAGE
TRANSFER

TERMINATION
PROCEDURE

RECEIVE
ENQ

MOTOR
TURN ON
DELAY

RECEIVE
ENQ

RECEIVE
LAMP
ON

SEND
ACK

DATA

EOT

DLE—EOT ——— OFF

MASTER / SLAVE
INTERCHANGE
OPTION ROUTE

CONTENTION —
RECEIVE LAMP OFF

IDLE LINE
TIME OUT

OFF

NO REPLY **

IDLE LINE
TIME OUT

DLE—EOT ——— OFF
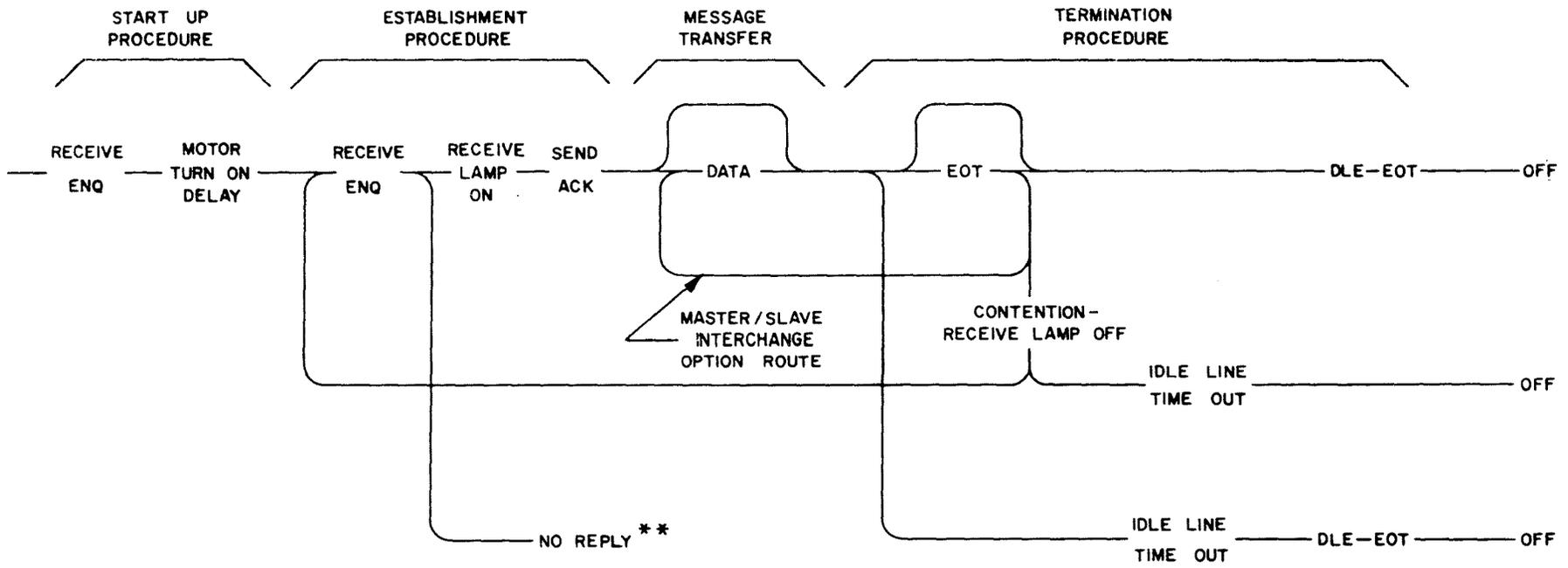
** THIS IS WHERE THE RECEIVING TERMINAL IS IN OUT SERVICE, LOCAL OR PAPER ALARM.

FIGURE 7
X 3.3.4 OPERATING PROCEDURE (SLAVE STATUS)
MODEL 37

— 11 —

ESTABLISHMENT
PROCEDURE

MESSAGE
TRANSFER
PROCEDURE

TERMINATION
PROCEDURE

```
 S                      S              E
 O — HEADING ——     —T— —TEXT— — T
 H                      X              X
```
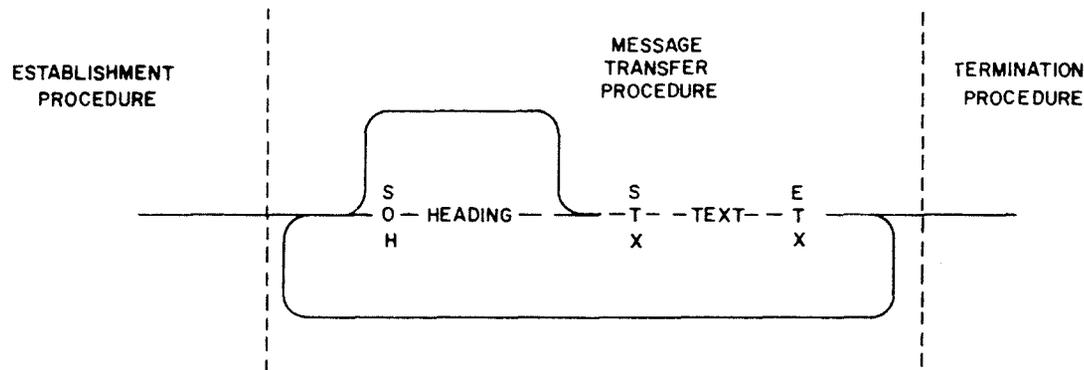
SUBCATEGORY Al: MESSAGE ORIENTED, WITHOUT REPLIES AND WITHOUT LONGITUDINAL CHECKING.

    THE MESSAGE TRANSFER PROCEDURE IS BASED ON ONE-WAY TRANSMISSION OF DATA FROM THE MASTER TERMINAL TO THE SLAVE TERMINAL. MESSAGE TRANSFER IS INITIATED BY THE MASTER TERMINAL AFTER THE ESTABLISHMENT PROCEDURE (SUBCATEGORY 2.3). IF THE MESSAGE HAS A HEADING, THE MASTER TERMINAL BEGINS THE TRANSMISSION WITH SOH. IF THE MESSAGE HAS NO HEADING, THE MASTER TERMINAL BEGINS THE TRANSMISSION WITH STX. THE ENTIRE MESSAGE IS SENT, TERMINATING WITH ETX. THE MASTER TERMINAL MAY REPEAT THIS OPERATION UNTIL ALL MESSAGES FOR THE SLAVE TERMINAL HAVE BEEN SENT. THE MASTER TERMINAL THEN PROCEEDS WITH THE TERMINATION PROCEDURE.

FIGURE 8

X 3.3.4 MESSAGE TRANSFER PROCEDURE

MODELS 33/35 OR 37

REFERENCES

1. Technical Reference — Model 37 Teletypewriter for DATA-PHONE Service — PUB41706.

2. Technical Reference — 150 Baud Private Line Channels — Interface Specification — PUB41002

3. Standard — ANSI X3.3.4/212 dated September, 1970*

4. Standard — American National Standard Code for Interchange (X3.4-1968) — ASCII

    *Superseded by ANSI X3.28 — 1971

GLOSSARY

CONTENTION
— An operational condition on a data communication link in which no station is designated a Master Station. In contention, each station on the link must monitor the signals on the link and wait for a quiescent condition before initiating a bid for Master Status.

MASTER STATION
— A station which has control of the data communication link at a given instant.

SLAVE STATION
— A station which has been selected to receive a transmission from the Master station.

PREFIX
— A sequence of characters (other than communication control characters) used in a supervisory sequence to define or qualify the meaning of the supervisory sequence.

CONVERSATION MODE
— "Chit-Chat" or back and forth communication without an intervening termination and establishment procedure.

POINT-TO-POINT LINK
— A data communication link connecting only two stations.

ENQ — ENQUIRY
— A communication control character used in data communication systems as a request for a response from a remote station.

ACK — ACKNOWLEDGEMENT
— A communication control character transmitted by a receiver as an affirmative response to a sender.

EOT —
END OF TRANSMISSION
— A communication control character used to indicate the conclusion of a transmission, which may have contained one or more texts and any associated headings.

NAK —
NEGATIVE ACKNOWLEDGE
— A communication control character transmitted by a receiver as a negative response to the sender.

DLE — EOT
— A communication control sequence used to indicate the conclusion of a transmission, which may have contained one or more texts and any associated headings.