TELETYPEWRITER

GENERAL ELECTRIC RECORDS COMMUNICATION NETWORK

TESTROOM RESPONSIBILITIES AND PROCEDURES

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1. GENERAL

1.01 This section describes the General Electric records communication (GE RECOMM) network and outlines procedures for preservice and trouble location tests. The network consists of a modified version of the 8A1 data selective calling system for half-duplex circuits and a modified version of the 8B1 data selective calling system for full-duplex circuits.

1.02 Two customer-owned and maintained communication processors (hereafter referred to as a processor) are provided to control all traffic on the network. Some of the additional functions performed by the processor are:

(a) ***System Control:*** Polling and selection of stations on the line is accomplished under program control. Individual messages can be routed to more than one outlying station by proper coding.

(b) ***Message Accumulation:*** Messages are assembled, routed, and distributed under program control.

(c) ***Storage:*** Storage is provided for messages that cannot be transmitted for any reason. In addition, storage is provided for message queuing and message journals.

(d) ***Traffic Analysis and Accounting:*** The number of messages per line per station will be counted daily. Also, journal storage can be processed for network study.

(e) ***System Monitoring:*** Incomplete or improperly coded messages are rejected and a canned message is automatically transmitted to the originating station.

(f) ***Parity:*** All characters received by the processor must be even parity. The eighth level pulse, discussed in pgh 1.10 and 4.05 is used to keep all characters at even parity. If a character with odd parity is received, the processor will replace that character with an UP ARROW (↑) and continue with its processing.

1.03 All message transmission will be from the processor to the outlying station or vice versa. There will not be any direct transmission between stations.

1.04 The half-duplex circuits consist of model 35 ASR for send-receive stations and model 35 RO for receive-only stations with suitable interconnection facilities. Approximately 25 stations may be associated with each circuit; however, the number of stations is usually determined by traffic load conditions. All stations (35 ASR or 35 RO) must be equipped for selective calling operation. The 35 ASRs are switched from the line during tape perforation to permit a page copy to be printed of the message. No response can be received from the station under this condition. Page copy is not printed when the tape is transmitted to the line.

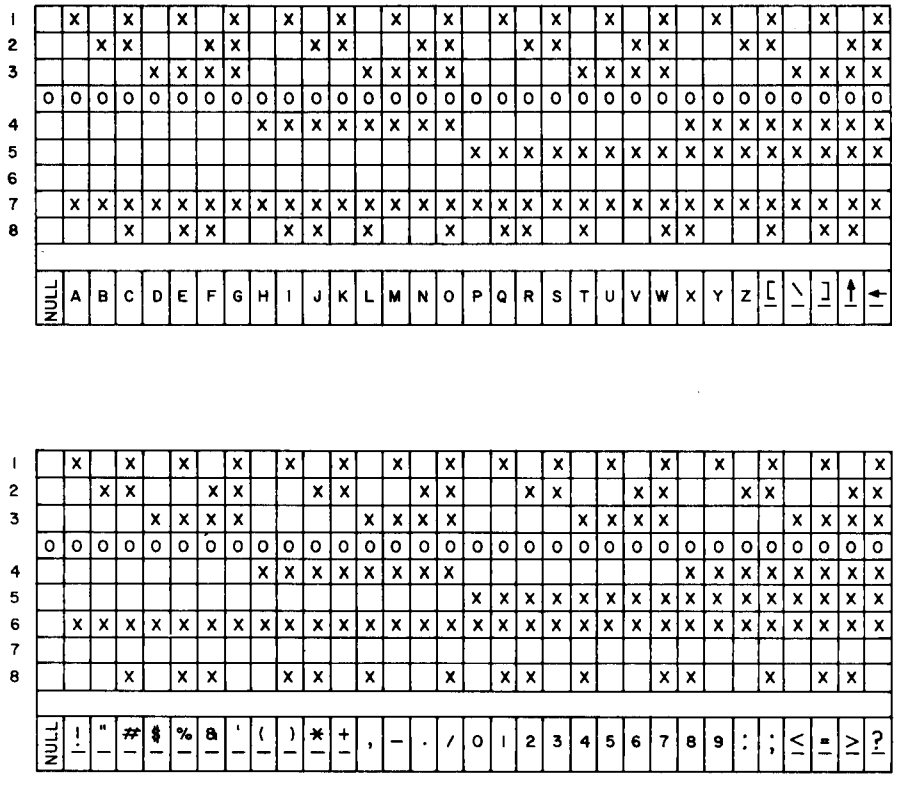
1.05 The full-duplex stations consist of a model 35 ASR (nonselective) and a model 35 RO equipped for selective calling operation over full-duplex facilities. Approximately 25 stations may be associated with each circuit. The 35 RO is associated with the receive side of the circuit while the 35 ASR is associated with the send side.

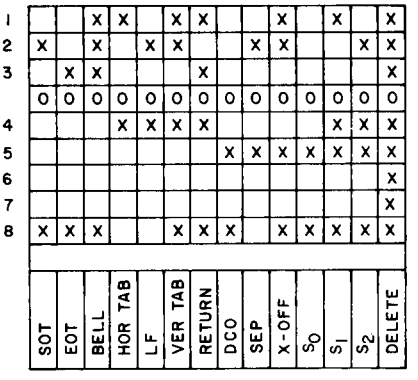
The keyboard, associated typing unit, and typing reperforator of the 35 ASR will always be off-line for perforation of tape. A page copy will be printed as the tape is perforated. The transmitter-distributor (TD) will be connected to the line under control of the 35 RO but may be removed for editing tapes. Page copy is not printed when the tape is transmitted to the line. In several cases, receive-only stations are provided on full-duplex circuits. These consist of a model 35 RO selective calling machine.

1.06 Several 35 ROTRs are required for refile traffic (messages that are resent on a separate network). These sets are associated with the 35 ROs on full-duplex circuits and the 35 ASRs or 35 ROs on half-duplex circuits. A single connect code is used to connect the teletypewriter and the receiving-only typing reperforator.

1.07 Each send-receive and receive-only station is equipped with a controller to perform switching operations and to interface the station with the loop facility. The teletypewriter sets are arranged to operate on 20-ma dc signals. Appropriate data sets are required to translate the dc signals into tone modulated ac signals and vice versa. Type 130 subsets, using 43A1 DW carrier terminals or data carrier subsets, Stelma 1B are provided for this purpose. With the exception of the receive-only stations using 130-type subsets, the subsets are contained in the teletypewriter station cabinet. The 130-type subsets are mounted on a separate floor stand at the receive-only locations.

1.08 Each station is equipped with an idle line motor control unit, model 202-2, which controls the ac power to the teletypewriter. If the line is steady marking or spacing for a period of 20 minutes, the power is removed. The first mark-to-space transition that appears on the line causes the motor control unit to connect power to the teletypewriter. On full-duplex circuits the power to the 35 ASR and 35 RO is controlled by one unit which is associated with the receive side of the circuit. A NORMAL BY-PASS switch is provided to permit manually connecting power during periods when the line is idle. This switch should be operated to the NORMAL position for automatic control of power to the machine.





CONTROL FUNCTIONS – NON-TYPING

NOTES:

1. CHARACTERS UNDERLINED OBTAINED IN CONJUNCTION WITH SHIFT KEY
2. (a). CONTROL FUNCTIONS DC_0, S_0, S_1, X-OFF GENERATED BY THE PROCESSOR.
   (b). CONTROL FUNCTION S_2 GENERATED BY ANSWER BACK EQUIPMENT.

Fig. 1 — ASCII Code as Used on the GE RECOMM Network

TABLE A

	WPM	BAUD	LEVEL	STOP ELEMENT	SIGNAL ELEMENT MILLISECONDS	LINE FREQUENCY
	60	45.5	5	1.42	22.0	22.7
	75	56.9	5	1.42	17.6	28.4
	100	74.2	5	1.42	13.5	37.1
ASCII	100	110.0	8	2.00	9.09	55.0

1.09 Data is transmitted at 100 words per minute (WPM) using the 8-level, American Standard Code for Information Interchange (ASCII). (See Fig. 1.) Transmission of this code requires facilities capable of transmitting shorter unit pulses than facilities used for 100-WPM, 5-level Baudot Code (model 28 teletypewriter equipment). Since services using these codes operate at 100 WPM but require different transmission rate, the term baud is used to specify the number of times the shortest unit pulse can be transmitted in 1 second. Characteristics of commonly used teletypewriter signals are contained in Table A for comparison.

1.10 The ASCII code contains 11 equal elements; element breakdown is as follows:

One element — start pulse — always spacing.
Seven elements — intelligence or selecting pulses — marking or spacing.
One element — parity — marking or spacing
Two elements — stop pulse — always marking.

2. CONTROL CODES

2.01 All control codes are monitored by the processor and each station on the circuit. No outlying station can transmit without being selected by the processor. When a station is polled, the message transmitted must conform with the format programmed into the processor. The message format is shown in Fig. 2. Polling and response sequences are shown in Fig. 3, 4, and 5. Figure 3 shows stations A and B sending no-traffic response while Fig. 4 shows station C responding with a signal address message. Figure 5 shows station E responding with a multiple address message. The second character of the transmitter start code, (TSC), call directing code (CDC), and answer back (A/B) code is the same character. For example, station A would have a TSC of DC_0A, a CDC of S_1A, and an A/B code of S_2A. The second character for station B would be B in each case, etc.

1. DELETE characters — Tape leader
2. SOT — Start of transmission
3. 5-character destination code from directory made up of:
   (a) Character A or B — The processor that serves the called station.
   (b) and (c) 2-character numeral (00 to 99)—The processor circuit number of called station.
   (d) Second character of the called station's CDC
   (e) Check character
4. One character — Type of message (0 to 4)
   0 — Single address
   1 — Multiple address
   2 — Group code (not used)
   3 — Service message
   4 — Processor error
5. 5-character originating station code (See Item 3.)
6. Message number
7. CR LF Del
8. Originating city and state
9. Date
10. Name to
11. Destination department and city

11A. Multiple address messages only
   (a) EOT
   (b) Repeat Steps 1 to 11 for each successive address
   (c) Follow each address with an EOT code
   (d) Precede text with a separate code

12. Text
13. Signature
14. Component name
15. EOT — End of transmission
16. Tape trailer (approximately 12 DELETE characters)

Fig. 2 — Message Format

FDX CIRCUIT
PROCESSOR TRANSMITS TSC SEQUENCE
OUTLYING STATION SENDS NO TRAFFIC RESPONSE (ANSWER BACK)

	TSC SEQUENCE	A/B	TSC	NO RESPONSE OR S_2 GARBLED	REPEAT COMPLETE TSC SEQUENCE FOR STATION	A/B
Processor Output	S_0 Del X-OFF Pau DC_0A		DC_0B		S_0 Del X-OFF Pau DC_0B	
Central Office TTY Monitor A Prints	8 ← 3 O A		O B		8 ← 3 O B	
Outlying Station		S_2A				S_2B
Central Office TTY Monitor B Prints		:A				:B

Note 1: Del — Delete character.
Pau — Pause in transmission (100 ms).

Note 2: The second character of the TSC is printed below and into the first character. This is caused by the teletypewriter being equipped with a combined carriage return and line feed on DC_0 plus one character.

Note 3: The processor checks during the TSC sequence for a S_2 (first character of the A/B code) or an SOT (start-of-transmission code). If no response is received or the S_2 character is garbled, the station is polled a second time with the complete TSC sequence. A message with a missing or garbled SOT code is an incomplete message to the processor. The message will be disregarded and a canned message sent to the station that originated the message.

Fig. 3 — Polling and No Traffic Response Format

2.02 ***Transmitter Start Code:*** The TSC is a 2-character code. The first character is DC_0, and the second one is assigned from the 26 alphabetical characters. When a TSC is generated by the processor, all stations sense the code but only the station to which the code is assigned will respond. One of the following conditions may exist at the polled station.

- Traffic to be sent from tape — tape reader starts.
- No traffic — answer back automatically sent.
- No response, half-duplex only — station switched off-line.
- Unable to respond — circuit or equipment trouble.

2.03 ***Call Directing Code:*** The CDC is a 2-character code. The first character is S_1, and the second is limited to one of the 26 alphabetical characters. The CDC is sensed by all receivers, but is recognized only where a stuntbox is coded with that specific combination. A single CDC is assigned to each station. Group codes are used in some cases. For this type of transmission, each station is selected by the assigned CDC. All CDCs are originated by the processor. The outlying stations use mnemonic codes in place of CDCs when preparing tape. After a message is received by the processor, it translates the mnemonic code to the proper CDCs for the stations involved. When the processor transmits a CDC, one of the following conditions may exist at the station.

- Station able to receive — sends answer back.
- Low paper — station sends BELL BELL.
- No response, half-duplex stations only — station switched off-line.

FDX CIRCUIT
PROCESSOR CONTINUES WITH TSG SEQUENCE FROM FIG. 3
OUTLYING STATION RESPONDS WITH TRAFFIC (SINGLE ADDRESS MESSAGE)
NO OUTGOING TRAFFIC FROM THE PROCESSOR

	TSC	TAPE LEADER	START OF TRMSN	DESTINATION	TYPE OF MESSAGE	ORIGINATING STATION	MESSAGE NUMBER
Processor Output	DC_0C						
Central Office TTY Monitor A Prints	O C						
Outlying Station		Del Chars	SOT	B16GA	O	A06FA	47 CR LF Del
Central Office TTY Monitor B Prints		←←←←	"	B16GA	O	A06FA	47 ←

ORIGINATING CITY & STATE	DATE	NAME TO	DEPT. & DESTINATION	TEXT	SIGNATURE
Kansas City, Kansas	6-5-65	W. F. Snow	Computer Pheonix CR LF Del	TEXT	R. A. George
Kansas City, Kansas	6-5-65	W. F. Snow	Computer Pheonix CR LF Del	TEXT	R. A. George

END OF MESSAGE	TSC SEQUENCE
	S_0 Del X-OFF Pau DC_0D
	8← 3 O D
CR LF LF LF LF LF LF EOT Del Chars	
$ ←←←←	

Fig. 4 — Polling and Traffic Response Format, Example 1

- Unable to respond — circuit or equipment trouble.

2.04 ***Answer Back Code:*** The A/B code is a 2-character code. The first character is S_2 and the second is one of the 26 alphabetical characters. This code is returned to the processor after each CDC is sent to indicate the station is ready to receive traffic. It is also returned after a TSC is sent if the station has no traffic. The eighth level must be marking to be recognized by the processor as a valid response. Failure to receive the A/B code may be caused by three conditions.

- Half-duplex circuit only — equipment switched off-line.
- Low paper — A/B replaced with a BELL BELL response.
- Maintenance condition — circuit or equipment trouble.

FDX CIRCUIT
OUTLYING STATION RESPONDS TO A TSC SEQUENCE WITH A MULTIPLE ADDRESS MESSAGE
PROCESSOR SENDS MESSAGE RECEIVED IN FIG. 4

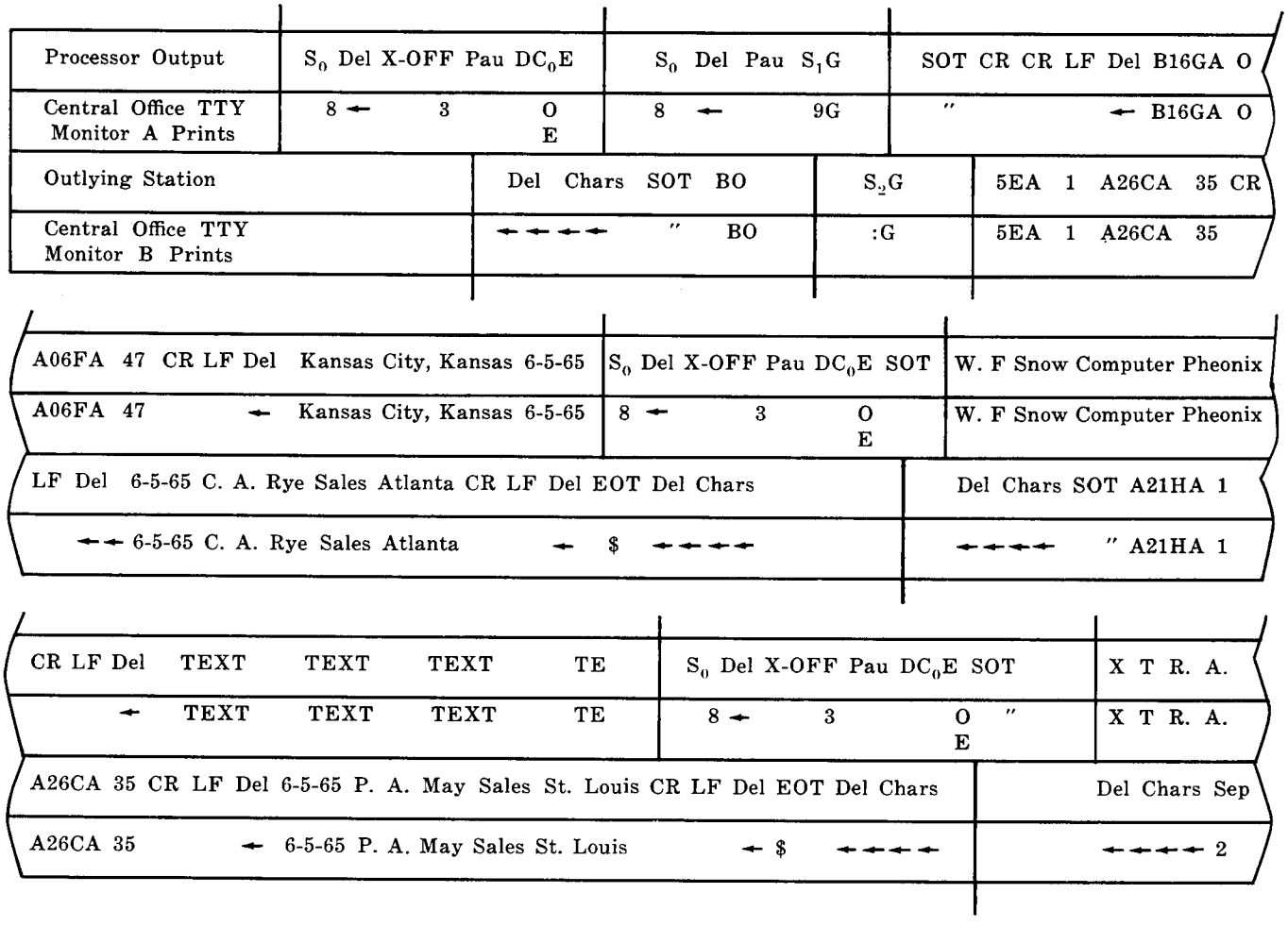


Fig. 5 — Polling and Traffic Response Format, Example 2

2.05 ***Start-of-Transmission Code:*** The start-of-transmission (SOT) code is a single character (control B). After the CDCs are sent from the processor and the A/B code returned from each station, the processor sends SOT. This code will condition all selected receivers to the non select print condition and all unselected receivers to the nonselect, nonprint condition. A receiving station will not print the CDCs, A/B, or SOT codes. This code is also used as the first control character in tapes transmitted to the processor.

2.06 ***End-of-Transmission Code:*** The end-of-transmission (EOT) code is a single character (control D). On a half-duplex circuit, it is used as a disconnect code and is recognized by the stuntbox which stops the TD. In addition, the EOT restores all teletypewriters on the circuit to the nonprint select condition. When associated with a full-duplex circuit, the sending machine has no means of detecting the code. The code is detected by the processor and a X-OFF code is sent by the processor on the receive side of the circuit to stop the TD. The EOT code also follows each address of a multiple address message. The TD is stopped in this case but is immediately restarted by its TSC from the processor.

2.07 ***Interrupt Code — S_0 DELETE:*** This code is generated only by the processor and is used on full-duplex circuits. It precedes a CDC

or TSC sent from the processor. In the case of a CDC the TD sending will be stopped to permit an A/B from the station on the send side of the circuit. When preceding a TSC, any selected receivers will be placed in a nonprint condition to prevent copying the TSC.

2.08 ***X-OFF:*** This code is generated by the processor and is used on full-duplex circuits. It is sent on the receive side of the circuit to stop a station TD after the EOT code is received at the processor.

2.09 ***BELL BELL:*** This code is generated on half- and full-duplex circuits and is sent after receiving the CDC for the station if the paper supply is low. Under this condition, the CDC will not select the station.

2.10 ***Separate Code:*** This code (control R) is used on multiple address messages after the last address. It indicates to the processor that all addresses have been transmitted and text of message will follow.

3. DESCRIPTION — FULL-DUPLEX

3.01 The send and receive legs in full-duplex operation are electrically independent of each other. Traffic on one leg does not appear on the other. It is significant to note that each sending station has a common receiver, the processor as shown in Fig. 6. Transmission to the processor is on the send leg. All receiving stations have a common transmitter, the processor. Messages are relayed from the processor to the receivers on the receive leg.

3.02 The tape reader is operated from the send logic in the station control circuit, which responds to a TSC generated by the processor on the receive leg; however, an S_0 or X-OFF code received on the receive leg will also control the reader. Once the reader is started, transmission will continue until the tape clears the reading head unless an S_0 or X-OFF code is received on the receive leg.

3.03 Since the computer is the only receiving device on the send leg, there is no need to stop the reader for an A/B. Messages sent from a station will not be printed on the sending machine. Also, the reader disregards but transmits the EOT disconnect code. When the EOT code is received by the processor, it sends an X-OFF code on the receive leg which stops the TD. Since time is required to complete this sequence, an adequate trailer must be perforated in the tape between messages when continuous tape operation is used.

3.04 The processor will transmit a CDC to a station-receiving device on the receive leg and wait as the station controller generates an A/B code on the send leg. It is necessary, therefore, to stop the reader, if sending, before a CDC is received so that an A/B response can be transmitted on the send leg without conflicting with reader message transmission. This is accomplished by strict conformance with the full-duplex receive leg preamble format. An S_0 DELETE code received prior to a CDC will stop a station reader making the send leg idle. The S_0 DELETE code will not appear on page copy but will appear in tape if a reperforator is the receiving device. An SOT code following the CDC will restart the reader and place the receiver in the print or reperforate condition.

3.05 If transmission from a reader is terminated, the processor may have to break into the receive leg traffic in order to start another reader. This is accomplished by the processor interrupting the receive leg traffic with an S_0 DELETE TSC sequence in order to start a reader. The S_0 DELETE places the receiver in a hold condition (nonprint). The 2-character TSC polls a station reader. If no traffic is available, the station controller will respond with an A/B. The processor then advances to the next station by sending a subsequent TSC. If traffic is available, the reader will start an uninterrupted transmission of message preamble and text to the processor on the send leg. Meanwhile, the computer generates an SOT code to reactivate the holding receivers and then resumes message transmission to the selected receivers.

3.06 A reader may be stopped at any time so that a TSC will be required to restart it. This is accomplished by an S_0 DELETE X-OFF sequence. Following the X-OFF, a TSC would start another reader and a subsequent SOM would reactivate all receiving devices, if interrupted.

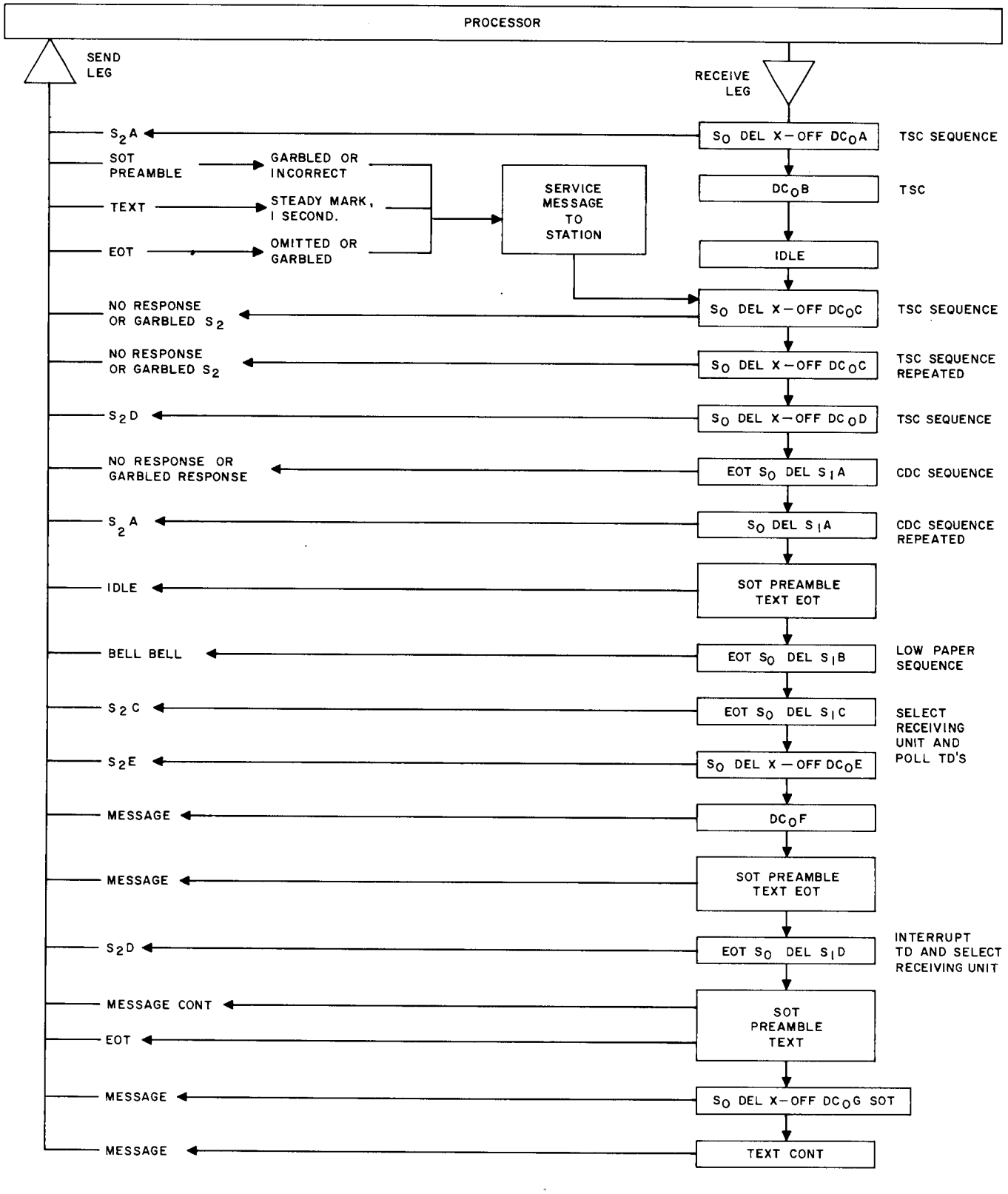


Fig. 6 — Full-Duplex Circuit — Sending Sequence

3.07 The receiving devices will cause the station controller to generate a BELL BELL code sequence after receipt of a CDC if the typing unit is low on paper. Under this condition the station is not selected and the processor will bypass the station.

3.08 When sending multiple address messages, an EOT DELETE code is used after each address. This causes the processor to send an S_0 DELETE X-OFF TSC sequence which stops the TD and immediately restarts it. A separate code is used between the last address and the message text to indicate to the processor that all addresses have been received. The separate code also performs the same function as the SOT code.

4. STATION EQUIPMENT — FULL-DUPLEX

4.01 The station equipment on a full-duplex circuit consists of a modified 35 ASR and a 35 RO. The 35 ASR is associated with the sending side of the circuit with the TD on the line except when switched to an internal circuit for editing tapes; then the typing unit, keyboard, and perforator are off-line. Messages are prepared with a home copy printed as the tape is perforated. With the TD on-line messages may be transmitted at the same time tape is being prepared.

4.02 The control panel (see Fig. 7) contains the indicator lights, keys, and switches, for operation. The functions and indications provided are:

(a) ***Power Control:*** The 35 ASR and the 35 RO each have a 3-position (OFF-ON LINE-LOC) rotary power switch. With the power switch in the OFF position, power is removed from the set. When the power switch on the ASR is in the LOC (local) position, its TD is switched from the line to an internal auxiliary circuit to permit editing tapes. While in this condition, the answer-back feature (in the full-duplex circuit only) will still respond to a CDC or TSC, providing the RO's power switch remains in the ON LINE position. (The LOC position is not used on the RO.) When the power switch of the ASR is in the ON LINE position, its TD will be connected to the line. Power to both machines is under control of the idle line motor control unit when the switches are operated to the ON LINE or LOC position.

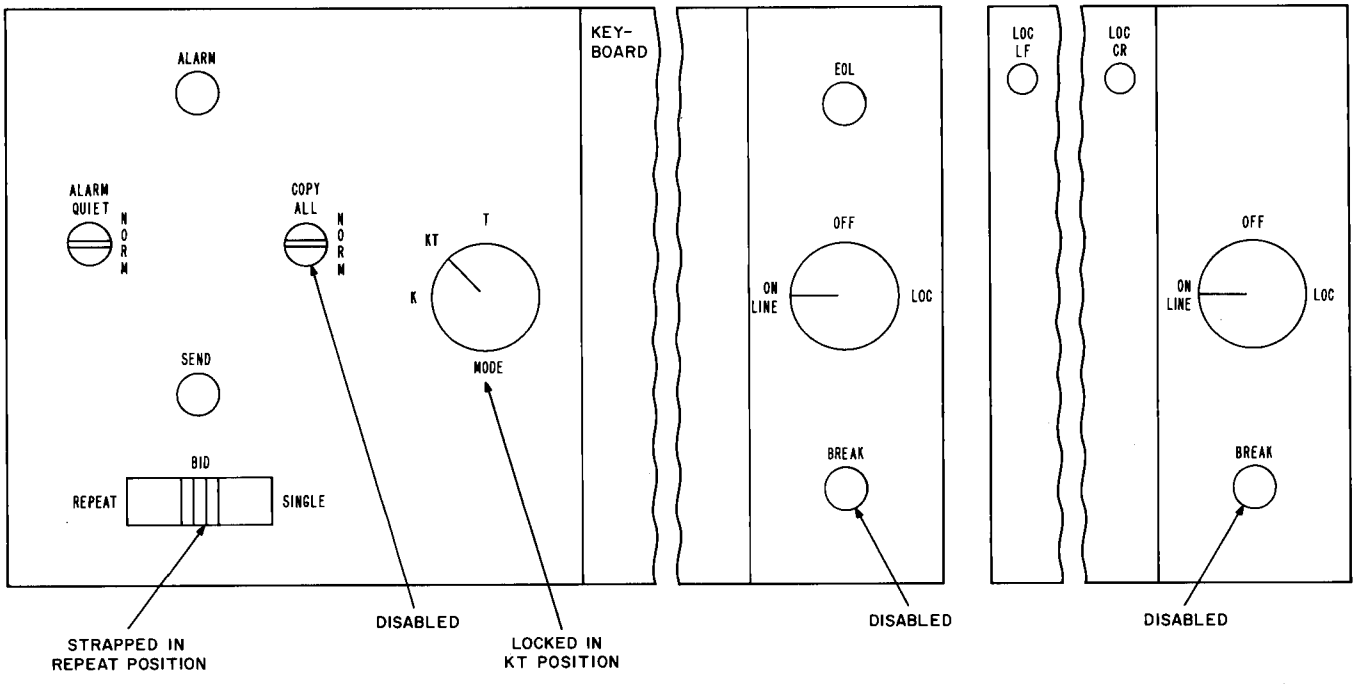


Fig. 7 — ASR and RO Controls

(b) ***Mode Switch:*** The 3-position mode switch on the ASR is locked in the KT position. This provides a local circuit for the keyboard, typing unit, and reperforator. The TD may be switched into this circuit by operating its power switch to LOC.

(c) ***Copy All Normal Switch:*** This switch is disabled.

(d) ***Alarm Quiet Normal Key:*** When an alarm condition occurs, the audible alarm (buzzer) may be silenced by operating the twist key to the ALARM QUIET position. After the alarm condition is corrected, the key should be restored to the NORM position.

(e) ***Alarm Lamp:*** The ALARM lamp (red) is a visual indication of alarm conditions. It is not affected by operation of the twist key to the ALARM QUIET position but will automatically restore after the alarm condition has been corrected and the alarm quiet-normal key returned to the NORM position. The alarm lamp will continue to be lighted after the alarm condition has been cleared if the key is in the ALARM QUIET position. All alarms have been disabled except the low paper alarm.

(f) ***Bid Lamp and Key:*** This key has been internally strapped to the repeat position so that it is not necessary to operate the key. The REPEAT lamp (amber) will light when the contacts of the TD ninth pin, the taut tape arm, and the run position of the RUN-STOP-FREE TD switch are made simultaneously. This lamp indicates a bid for the line has been entered.

(g) ***Send Lamp:*** The SEND lamp (white) on the ASR will light when the reader transmits to the line.

(h) ***BREAK:*** This key has been disabled.

(i) ***Guard Lamp:*** A red guard lamp is mounted in the left rear of the message tray of all ASR machines. It will light when the TD is switched off-line on full-duplex stations, or when the machine is switched off-line on half-duplex stations.

4.03 The control panel (see Fig. 8) contains the indicator lights, keys, and switches for the 35 RO at a receive-only station. The keys used perform the same functions as outlined in 4.02(a) through (i). Since the sending controls are not

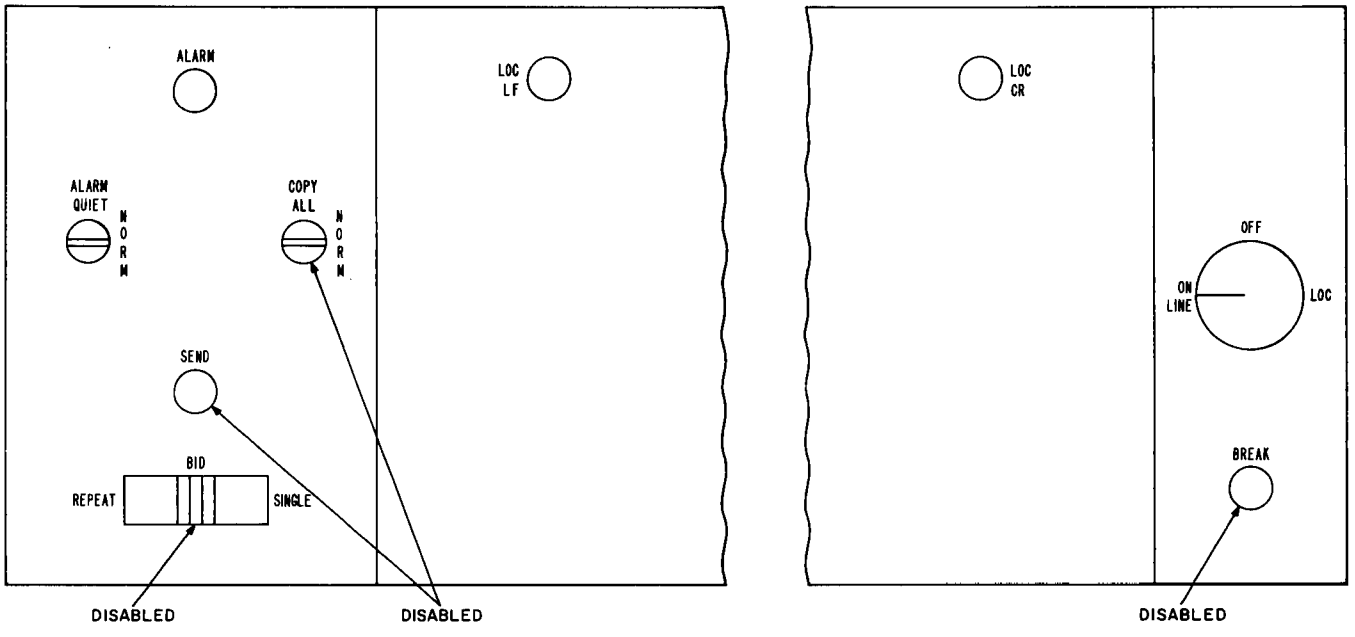


Fig. 8 — RO Controls for a Receive-Only Station

used at these stations, the BID key, SEND lamp and LOC position of the power switch are not activated.

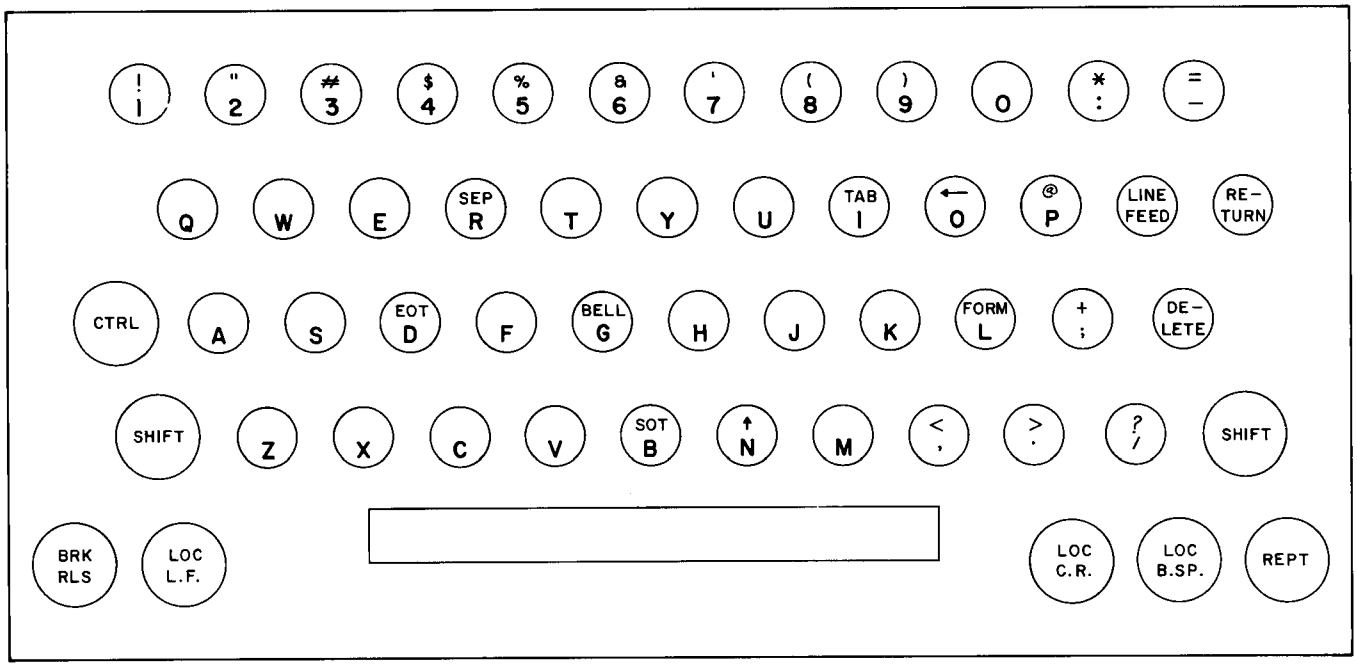
4.04 The keyboard arrangement is indicated in Fig. 9. The control functions, such as EOT, SOT, etc., are obtained by operating the CTRL (control) key and the desired function key simultaneously. The graphic symbols in the upper half of the key tops are obtained by operating the SHIFT key and the appropriate key simultaneously. Depressing the LOC B. SP. key allows the tape to be backspaced one character for each operation of the key. Simultaneous operation of the REPT key and any other key associated with a character will result in the character being repeated. The remaining keys are self-explanatory.

4.05 The ASR uses a tape 1 inch in width with eight information levels. The feed hole appears between the third and fourth information levels. The first seven are selecting pulses with the eighth level a "swing" or "parity" pulse to make all characters even parity.

5. DESCRIPTION — HALF-DUPLEX

5.01 All transmission is from the station to the processor or vice versa. No transmission is permitted directly between stations. All traffic is under control of the processor. The control codes (CDCs and TSCs) are sent by the processor and preceded by an EOT code. The EOT code ensures that each station is in the select nonprint condition. Sending and receiving sequences are shown in Fig. 10.

5.02 The tape reader is operated from the logic in the station control circuit, which responds to a TSC generated by the processor. If a bid has not been entered by the station polled, the station will respond with an A/B code if it is on-line. After a bid has been entered, a TSC



NOTE:
GRAPHICS AND CONTROL CODES ON UPPER PORTION OF KEY CAPS OBTAINED IN CONJUNCTION WITH SHIFT AND CONTROL KEYS, RESPECTIVELY.

Fig. 9 — Keyboard Layout — 35 ASR

will cause the reader to start uninterrupted transmission until an EOT code is detected by the station control circuit which stops the reader. ***Local copy is not obtained.*** With the exception of an emergency stop (400-ms break), no provision has been made in the processor for stopping a reader.

5.03 Each station can be connected by a CDC. Group or broadcast codes are not used. When a station is selected, it transmits an A/B signal to indicate to the processor that the station is connected and ready to receive traffic. The EOT code which follows the message text restores all stations to the select nonprint condi-

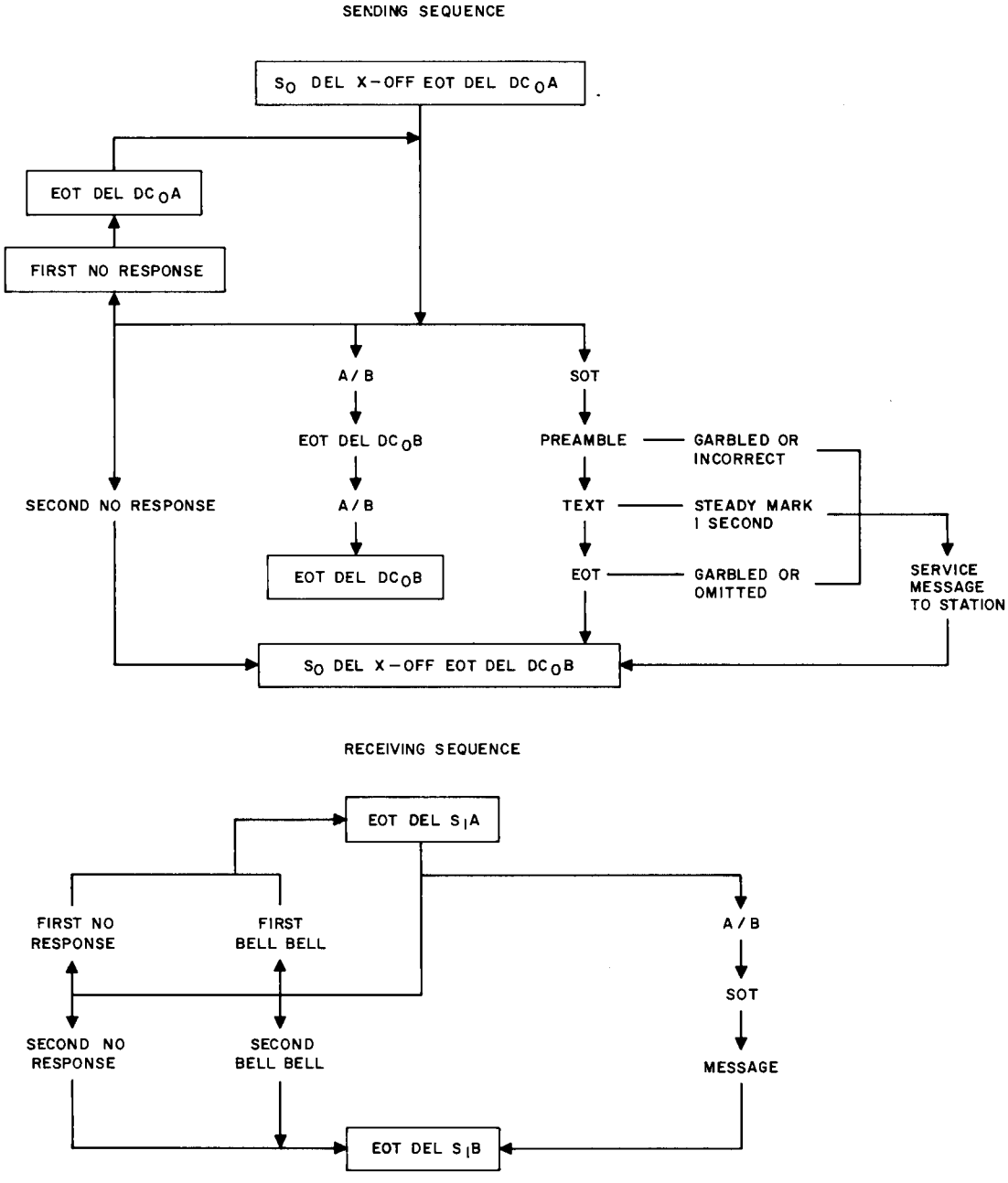


Fig. 10 — Half-Duplex Circuit — Sending and Receiving Sequences

tion. If a low paper condition exists at a station when the CDC is received, a BELL BELL is returned to the processor. In this condition the station does not connect and the processor bypasses the station.

5.04 A transmission path for both send and receive must be provided to a receive-only location. This is required because the receive-only station generates an A/B which must be transmitted to the processor.

5.05 For tape preparation the station is switched off-line. During this condition, messages cannot be sent or received. There will be no response from the station if the processor sends a TSC or CDC. A red guard light is lighted during the time the station is switched off-line.

5.06 In tape preparation, mnemonic codes are used instead of the CDC. The processor converts these codes to the appropriate CDCs. In addition, the processor checks the message preamble for proper format and checks for an EOT code. If all of these are not correctly received, it automatically sends a service message to the station informing the attendant that the message should be resent.

6. STATION EQUIPMENT — HALF-DUPLEX

6.01 The station equipment consists of a modified 35 ASR for a send-receive station or a 35 RO for a receive-only station. In some cases a 35 ROTR is provided under control of the 35 ASR or 35 RO.

6.02 The control panel is identical with the 35 ASR shown in Fig. 7 or the RO shown in Fig. 8. The function and indications provided are as follows:

(a) ***Power Switch:*** In the OFF position, the power is removed. The typing unit and reader are connected to the line in the ON LINE position. Tape cannot be prepared in this position. For tape preparation and editing, the LOC position is used. This position switches the station off-line and provides a local circuit for the typing unit, keyboard, reperforator, and TD.

(b) ***Mode Switch:*** This switch is locked in the KT position.

(c) The remaining switches and lamps operate the same as described under full-duplex. (See 4.02.)

7. PRESERVICE TESTS

7.01 Preservice tests on the system should consist of individual station tests. The tests and requirements are indicated in Tables B through H. Test tapes required for tests should be prepared and checked locally prior to the scheduled test. The tests outlined in Tables E and F are for full-duplex stations. Tables E and G apply to half-duplex stations. These tests should be completed from the STC. Stations equipped with an ROTR are tested as part of regular test sequence.

7.02 Testing intervals will depend upon the number of stations assigned to a circuit. A minimum of 1 day should be allowed for testing each individual station. The actual intervals should be agreed upon between the Plant Engineering, and Sales or Marketing groups involved.

7.03 All tests assume that station power is turned on and that loop facilities are properly adjusted and terminated. Since the stations are equipped with an idle line motor control unit, it may be necessary to send a short break to the station or operate the bypass switch on the motor control unit to connect power.

7.04 All perforators at sending stations should be set to use the eighth level as a "swing" or "parity" pulse. All characters must have an even number of mark pulses. Preservice tests should include a sample transmission from each tape perforator and be received by a reperforator. These sample tapes should be checked for even parity. A 911 test set, if available, can be used to check parity in place of using a reperforator.

8. TROUBLE LOCATION TESTS

8.01 The tables provided for preservice tests are arranged to test each feature of the machines. When trouble is not isolated by normal telegraph testing techniques, complete tests per the appropriate tables should be made.

TABLE B

PRESERVICE TESTS — LOCAL LOOPS — TWO WIRE

STEP	STC	STATION
1	Check the cable pair for opens, shorts, grounds, and battery.	
2	Measure the 1000-cycle tone at the voice-frequency lineboard or equivalent and record as reference level. ***Requirement:*** Level specified on the CLRC ±2 db.	Send 1000 cycles at the level specified by the CLRC on the send loop.
3	Measure and record the levels. Requirements: Ref. ±3 db (Note) Ref. ±3 db Ref. ±3 db Ref. ±3 db Ref. ±5 db (Note)	Send the following at the level specified by the CLRC. 500 Cycles 1500 Cycles 2000 Cycles 2500 Cycles 3000 Cycles
4	Measure the steady state noise using the 3A noise measuring set or equivalent at the voice-frequency lineboard. ***Requirement:*** 52 dbrnC. This is a direct switch setting without any correction.	Terminate the loop in the subset. Operate the OSC switch to OFF for the 130-type or remove the ac power if a Stelma subset is provided.
5	Measure the impulse noise using the 6A impulse counter with voiceband weighting. The limit is a direct setting of the counter without any correction. ***Requirement:*** The number of counts within 30 minutes should not exceed 90 with the REF LEV DBRN switch set at 54.	
6	Remove test set and restore regular.	Turn OSC switch to ON or connect ac power.

Note: These requirements do not apply if the assigned frequencies are between 1000 and 2500 cycles.

TABLE C

PRESERVICE TESTS — LOCAL LOOPS — FOUR WIRE

STEP	STC	STATION
1	Check the cable pair for opens, shorts, grounds, and battery.	
2	Measure the 1000-cycle tone at the receive voice-frequency lineboard jacks or equivalent and record as reference level. ***Requirement:*** Level specified on the CLRC ±2 db.	Send 1000 cycles on the send loop at the level specified by the CLRC.
3	Measure and record requirements as follows: Ref. ±3 db (Note) Ref. ±3 db Ref. ±3 db Ref. ±3 db Ref. ±5 db (Note)	Send the following at the level specified by the CLRC. 500 Cycles 1500 Cycles 2000 Cycles 2500 Cycles 3000 Cycles
4	Send 1000 cycles at the send voice-frequency lineboard jacks or equivalent at the level specified by the CLRC.	Measure the 1000-cycle tone on the receive loop and record as reference level. ***Requirement:*** Level specified on the CLRC ±2 db.
5	Send the following at the level specified on the CLRC. 500 Cycles (Note) 1500 Cycles 2000 Cycles 2500 Cycles 3000 Cycles (Note)	Measure and record requirements as follows: Ref. ±3 db Ref. ±3 db Ref. ±3 db Ref. ±3 db Ref. ±5 db
6	Send 1000 cycles at the send voice-frequency lineboard jacks or equivalent and measure the tone at the receive voice-frequency lineboard jacks or equivalent. Compute the level to the station and return from the CLRC. ***Requirement:*** Computed level ±4 db.	Connect the receive loop to the send loop, to provide a transmission path from the central office to the station and back to the control office.
7	Terminate the send voice-frequency line jacks or equivalent and measure the steady state noise with the 3A NMS or equivalent. ***Requirement:*** 52 dbrnC. This is a direct switch setting without any correction.	

TABLE C (Cont)

PRESERVICE TESTS — LOCAL LOOPS — FOUR WIRE

STEP	STC	STATION
8	Measure the impulse noise using the 6A impulse counter with voiceband weighting. The limit is a direct setting of the counter without any correction. ***Requirement:*** The number of counts within 30 minutes should not exceed 90 with the REF LEV DBRN switch set at 54.	
9	Remove test set and restore regular.	Connect the send and receive loops to the subset.

Note: These requirements do not apply if the assigned frequencies are between 1000 and 2500 cycles.

TABLE D

PRESERVICE TESTS — CHECK LIST OF LINE-UP

BETWEEN THE STC AND STATION

STC	STATION
43A1 Terminal 1. Check filament voltage. 2. Check networks. 3. Adjust send level per CLRC. 4. Adjust current and balance if neutral terminal. 5. Adjust receive gain. 6. Adjust receive bias.	130-type Subset 1. Remove V6. 2. Adjust filament voltage and +130 volts if an L6 rectifier is provided. Check +130 volts if an L8 rectifier is provided. 3. Check networks. 4. Adjust send level per CLRC. 5. Adjust receive gain potentiometer. 6. Adjust current (20 ma) and balance. 7. Adjust send bias. 8. Adjust receive bias.

TABLE E

PRESERVICE TESTS — FULL-DUPLEX, HALF-DUPLEX, AND RECEIVE-ONLY STATIONS

STEP	SEND FROM STC TO STATION	CONDITION AT STATION	RESPONSE FROM STATION		REMARKS
			CODE OR MESSAGE	TESTROOM TTY PRINTS	
					Post the correct trouble reporting information. Check that the mode switch is locked in the KT position. Check that the BREAK key is disabled
1	Send EOT Del X-OFF CDC	Select nonprint	A/B	: (Note 1)	Repeat three times. Check distortion with transmission measuring set, and check parity. ***Requirement:*** 8% or less. CDC does not print. Must be even parity.
2	Send SOT 30% SWC Fox	Nonselect print Fox printed	— —	— —	Make distortion tolerance tests. Set range arm and copy 20 perfect lines.
3	Remove Fox Send CDC	Nonselect print	—	—	The station should not respond with an A/B. The second character of the CDC should print.
4	—	Low paper alarm	—	—	Remove roll of paper permitting the low paper contacts to make.
5	Send Fox	Fox prints with low paper contacts activated.	—	—	Station should copy Fox.
6	Remove Fox Send CDC	Select print	—	—	No response from the station. Station copies second character of CDC.
7	Send EOT CDC	Select nonprint	BELL	BELL "	Repeat three times. Check distortion and parity. ***Requirement:*** 8% or less Alarm should activate. Must be even parity.

TABLE E (Cont)

PRESERVICE TESTS — FULL-DUPLEX, HALF-DUPLEX, AND RECEIVE-ONLY STATIONS

STEP	SEND FROM STC TO STATION	CONDITION AT STATION	RESPONSE FROM STATION		REMARKS
			CODE OR MESSAGE	TESTROOM TTY PRINTS	
8	Send TSC	Select nonprint	A/B	: (Note 1)	Station should respond with the A/B code, not BELL BELL. Clear alarm condition and restore the ALARM key to the NORM position.
9	—	—	—	—	HDX stations only. Remove reperforator tape; no alarms should be activated.
10	Send EOT CDC	Select nonprint	A/B	: (Note 1)	Station A/B should be received. Replace tape if removed. If an auxiliary ROTR is provided, remove tape. Station alarms should be activated.
11	Send CDC	Select nonprint	BELL BELL	"	Skip this step if an auxiliary ROTR is not provided. Replace tape and clear alarms.
12	Send S_0 Del. DC Sep Del. ABC	Select print	A/B	: (Note 1)	Station should print ABC.
13	Send EOT followed by all CDCs on the circuit except the assigned CDC for the station.	Select nonprint	—	—	No response from station.
14	Send SOT Fox	Nonselect nonprint	—	—	Operate COPY ALL-NORM switch to the ALL position; TTY should not copy.
15	Send EOT CDC	Select nonprint	A/B	: (Note 1)	
16	Send SOT Fox	Nonselect print	—	—	Fox printed.

TABLE E (Cont)

PRESERVICE TESTS — FULL-DUPLEX, HALF-DUPLEX, AND RECEIVE-ONLY STATIONS

STEP	SEND FROM STC TO STATION	CONDITION AT STATION	RESPONSE FROM STATION		REMARKS
			CODE OR MESSAGE	TESTROOM TTY PRINTS	
17	Remove Fox Send Break	Nonselect print	—	—	Machine should run open. No alarms are activated.
18	Send Fox	Nonselect print	—	—	Fox printed.
19	Remove Fox Send EOT	Select nonprint	—	—	
20	Idle	Select nonprint	—	—	With idle line motor control switch in the NORM position, power should be removed from the machines in 2 minutes. After power is removed, check 130-type subset. Power should be on.
21	Send DELETE	Power off	—	—	Power should be reconnected to the machine.

Note 1: Second character of the assigned station code.

Note 2: At locations equipped with an ROTR; copy obtained on the teletypewriter should also be perforated in the tape.

Note 3: This completes the test of a RO station. Continue with Table G for a full-duplex station and Table H for a half-duplex station.

TABLE F

PRESERVICE TESTS — FULL-DUPLEX STATIONS

STEP	SEND FROM STC TO STATION	CONDITION AT STATION	RESPONSE FROM STATION		REMARKS
			CODE OR MESSAGE	TESTROOM TTY PRINTS	
1	Send S_0 Del X-OFF TSC	TD selected	A/B	: (Note)	No tape in TD. Repeat three times. Check distortion and parity. ***Requirement:*** 8% or less and even parity.
2	—	—	—	—	Insert test tape No. 1 in TD. Do not operate BID key; BID lamp should be lighted.
3	Send TSC	TD starts	Message	Message	Check distortion and parity. ***Requirement:*** 14% or less and even parity. Adjust to minimum distortion. In most cases this will be less than 8%. No copy on station TTY. TD should stop when tape runs out releasing the ninth pin. No alarms should be activated. Repeat three times.
4	—	—	—	—	Operate power switch to LOC.
5	Send S_0 Del TSC	TD off-line	A/B	: (Note)	A/B should be received with TD off-line. Insert tape locally. No copy is received at the STC. Operate power switch to ON LINE.
6	Send EOT CDC SOT	Nonselect print	A/B	: (Note)	—
	Send Fox	Fox printed	—	—	—
7	Remove Fox Send S_0 Del X-OFF TSC	Nonprint with TD selected	A/B	: (Note)	No tape in TD.

TABLE F (Cont)

PRESERVICE TESTS — FULL-DUPLEX STATIONS

STEP	SEND FROM STC TO STATION	CONDITION AT STATION	RESPONSE FROM STATION		REMARKS
			CODE OR MESSAGE	TESTROOM TTY PRINTS	
8	Send SOT Fox	Nonselect print	—	—	Fox copied. No control codes printed. Insert tape in TD. BID lamp lighted.
9	Remove Fox Send characters AB S_0 Del X-OFF TSC Sep Del CD	Print, nonprint TD starts, print	Message	Message	Station machine should print ABCD. Tape should stop when tape releases the ninth pin. No alarms. Reset tape.
10	Send EOT TSC SOT S_0 Del X-OFF SOT	TD selected and stopped	Message	Message	The TD should start on the TSC and stop on the S_0 code. No alarms and no copy on station machine. Reset tape to beginning.
11	Send EOT TSC S_0 Del	TD selected and stopped	Message	Message	The TD starts on the TSC and stops on the S_0 code. No alarms.
12	Send CDC	Select nonprint	A/B	: (Note)	—
13	Send SOT Del ABCD	Select print	Message	Message	Station prints ABCD. TD starts on SOT code.
14	Send Break	Select print	Message	Message	Before the tape runs out, send a break. The TD should continue to run.
15	Send EOT	—	—	—	This completes the test sequence for a full-duplex station.

Note: Second character of the assigned station code.

TABLE G

PRESERVICE TESTS — HALF-DUPLEX STATIONS

STEP	SEND FROM STC TO STATION	CONDITION AT STATION	RESPONSE FROM STATION		REMARKS
			CODE OR MESSAGE	TESTROOM TTY PRINTS	
1	Send S_0 Del X-OFF EOT Del TSC	TD selected	A/B	: (Note)	No tape in TD. Repeat three times. Check distortion and parity. ***Requirement:*** 8% or less and even parity.
2	—	—	—	—	Insert test tape No. 1 in TD. Do not operate BID key. BID lamp should be lighted.
3	Send EOT Del TSC	TD starts	Message	Message	Check distortion and parity. ***Requirement:*** 8% or less and even parity. No copy on station machine. TD should stop on EOT code in tape. Reinsert tape.
4	Send EOT Del TSC	TD starts	Message	Message	After TD starts, send a BREAK signal to the station. TD should stop.
5	Send EOT Del	—	—	—	Do not operate any keys at the station. No audible alarm. TD should start and send remainer of tape. Operate power switch to the LOC position.
6	Send EOT TSC	Off-line	—	—	No response from station The TD should be under local control for editing tapes. Local copy should be obtained from the TD. Operate power switch to ON LINE.

Note: Second character of the assigned code.

TABLE H

TYPICAL TEST TAPE NO. 1

Ten DELETE character SOT DELETE CR LF LF LF LF LF
This is test tape No. 1 from (insert station and location) CR LF Del
Remove tape from TD CR LF Del
Ten lines of FOX CR LF Del
EOT (6) DELETE characters

TYPICAL TEST TAPE NO. 2

Ten DELETE characters SOT DELETE CR LF Del
Good morning to all stations from your control office at Albany. The test schedule will follow Table (insert E or F, as appropriate) of Section 312-110-900 LL.
Your cooperation toward making these tests as rapidly and completely as possible will be appreciated.

Please make notes of any trouble conditions as they occur for later investigation. You will be requested to prepare a tape reporting the results of these tests with any trouble conditions encountered.

Insert test tape No. 1 and check BID lamp. You may contact us at telephone number (insert number) if the need arises. Thanks.

EOT (6) DELETE characters

TYPICAL TEST TAPE NO. 3

Ten (10) DELETE characters SOT DELETE CR LF LF LF LF Del

Albany to all stations
Our tests are nearing completion, we will follow this message with approximately 100 lines of Fox. While the Fox is being received, please prepare test tape No. 4 indicating the results of the tests at your location.

You are released 30 minutes after pickup of your tape unless instructed otherwise. Leave your station under control of the idle line motor control unit. Thanks again for your help.

EOT (6) DELETE characters

TYPICAL TEST TAPE NO. 4
(Indicate the result of tests at your station.)

Ten (10) DELETE characters SOT DELETE CR LF LF LF LF LF
This is test tape No. 4 from (insert station and location) CR LF
Garble was received in four lines of test tape No. 1 with all other tests completed without trouble.

EOT (6) DELETE characters

9. MONITORING TELETYPEWRITER

9.01 A 35 KSR is being provided at all STCs for maintenance and testing. This machine should be arranged for either half-or full-duplex operation. To test full-duplex stations the keyboard must be connected to the station receive leg with the typing unit connected to the station send leg.

9.02 At some locations a 35 RO is provided in addition to the 35 KSR to permit monitoring both sides of a full-duplex circuit simultaneously.

9.03 The key caps have been arranged to agree with the station equipment. Also, the print suppression has been disabled which permits the control codes (normally nonprinting) to be printed on the monitor. These codes will be printed out as indicated in Table I. When monitoring the circuit, care must be exercised to accurately differentiate between characters appearing in the message text or preamble and the control codes used on the circuit.

TABLE I

CHARACTERS PRINTED ON MONITORING TELETYPEWRITER CORRESPONDING TO CONTROL CODES AND PROCEDURE FOR SENDING CONTROL CODES

TYPE OF CODES	CONTROL CODE	PRINTED ON MONITORING TELETYPEWRITER	KEY OPERATED TO SEND CODES FROM KEYBOARD
TSC	DC_0 (Note 1)	0 (Note 1)	Control and P (Note 1)
CDC	S_1 (Note 1)	9 (Note 1)	Control and Y (Note 1)
A/B	S_2 (Note 1)	: (Note 1)	Control and Z (Note 1)
STOP TD	X-OFF	3	Control and S
Start of Transmission	SOT	"	Control and B
End of Transmission	EOT	$	Control and D
Low Paper	BELL BELL	"	Control and G
Delete	Timing Only		Delete
Blind Typing Unit and Stop TD	S_0	8	Control and X
Separate	Separate	2	Control and R

Note 1: Indicates second character of code assigned to the station.

Note 2: The control key or control and shift keys must be held depressed until the character key is operated. For example, a TSC of DC_0A would be sent by holding the control key depressed, operating key P, releasing the control key, and operating key A.