Second Preliminary   April 6, 1965

GENERAL ELECTRIC RECORDS COMMUNICATION NETWORK (RECOMM)

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1. GENERAL

1.01 This section describes the G.E.RECOMM Network and outlines procedures for preservice and trouble location tests. The network consists of a modified version of the 8A1 Selective Calling System for half duplex circuits and a modified version of the 8B1 Selective Calling System for full duplex circuits.

1.02 Two customer owned and maintained communication processors (referred to as a processor, hereafter) 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.

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 35ASR for send-receive stations and Model 35RO 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 (35ASR or 35RO) must be equipped for selective calling operation. The 35ASR's 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 35ASR (non-selective) and a Model 35RO equipped for selective calling operation over full-duplex facilities. Approximately 25 stations may be associated with each circuit. The 35RO is associated with the receive side of the circuit with the 35ASR associated with the send side. The keyboard, associated typing unit, and typing reperforator of the 35ASR 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 35RO, 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 35RO selective calling machine.

1.06 Several 35ROTR's are required for refile traffic (messages that are resent on a separate network.) These sets are associated with the 35RO's on full-duplex circuits and the 35ASR's or 35RO's 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 set is equipped with a station controller to interface a station with the loop facility. The stations are arranged to operate on 20 ma DC signals. Appropriate data sets are required to translate the DC signals into tone modulated AC signals. Type 130 subsets, using 43A1 DW carrier terminals or data carrier subsets, Stelma Type 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 and 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 35ASR and 35RO 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.

1.09 Data is transmitted at 100 words per minute (WPM) using the 8-level, American Standard Code for Information Interchange (ASCII). Transmission of this code requires facilities capable of transmitting shorter unit pulses than facilities used for 100 WPM, 5-level Baudot Code (28 line of 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 one second. Characteristics of commonly used teletypewriter signals are contained in Table A for comparison.

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

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

(a) 1 element – start pulse ––– always spacing

(b) 7 elements – intelligence or selecting pulses ––– marking or spacing

(c) 1 element – parity ––– marking or spacing (G.E.RECOMM always marking)

(d) 2 elements – stop pulse ––– always marking

X MARK   –(DASH) CHARACTER OBTAINED IN CONJUNCTION WITH "SHIFT" KEY.
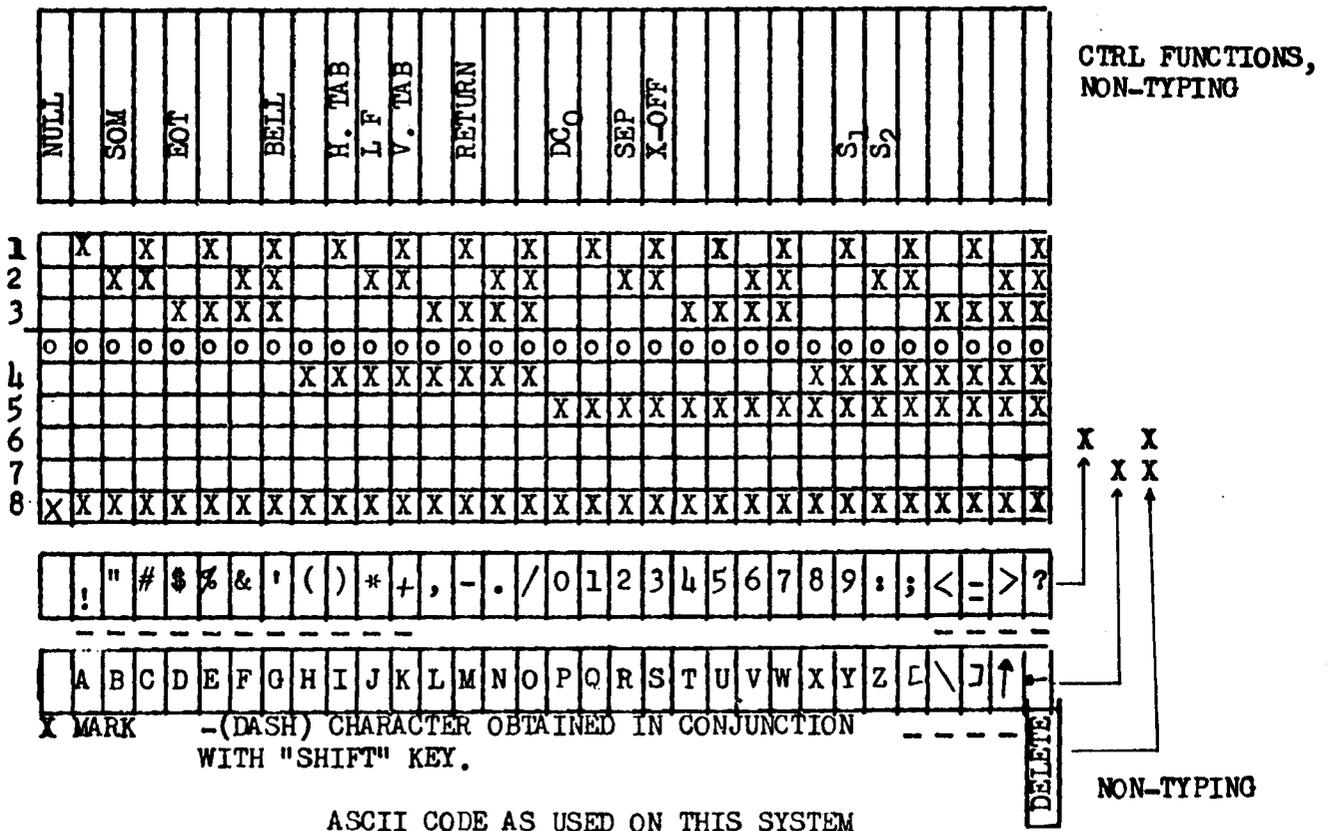
ASCII CODE AS USED ON THIS SYSTEM

FIG. 1

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 second character of the TSC, CDC and A/B codes 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, and etc.

2.02 **Transmitter Start Codes:** The TSC is a two character code. The first character is DC_0, and the second is assigned one of the 26 alphabetic 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 these conditions may exist at the polled station.

(a) Traffic to be sent from tape — tape reader starts.

(b) No traffic — answer back automatically sent.

(c) No response, half-duplex only — station switched off line.

(d) Unable to respond — circuit or equipment trouble.

2.03 **Call Directing Codes:** The CDC is a two character code. The first character is S_1, and the second is limited to one of the 26 alphabetic characters. The CDC is sensed by all receivers but is recognized only where a stunt box is coded with that specific combination. A single CDC is assigned to each station. Group or broadcast codes are not used. For this type of transmission, each station is selected by the assigned CDC. All CDC's are originated by the processor. The outlying stations use mnemonic codes in place of CDC's when preparing tape. After a message is received by the processor, it translates the mnemonic code to the proper CDC's for the stations involved. When the processor transmits a CDC, one of these conditions may exist at the station.

(a) Station able to receive — sends answer back.

(b) Low paper — station sends BELL BELL.

(c) No response, half-duplex stations only — station switched off line.

(d) Unable to respond — circuit or equipment trouble.

2.04 **Answer Back:** The A/B code is a two character code. The first character is S_2 and the second is one of the 26 alphabetic 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. Failure to receive the A/B code may be caused by three conditions.

(a) Half-duplex circuit only — equipment switched off line.

(b) Low paper — A/B replaced with a BELL BELL response.

(c) Maintenance condition — circuit or equipment trouble.

2.05 Start of Transmission: The SOT code is a single character (Control B).
After the CDC's are sent from the processor and the A/B 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 non-select non-print condition. A receiving station will not print the
CDC's, 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 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 stunt box which stops the TD. In addition, the EOT restores all logic
on the circuit, except alarms, to the non-print 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 - So 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 non-print 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. 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, a So 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 a So 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. A So DELETE code received prior to a CDC will stop a station reader making the send leg idle. The So DELETE code will not appear on page copy or 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 a So DELETE TSC sequence in order to start a reader. The So DELETE places the receiver in a hold condition (non-print). The two 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 a So DELETE X-OFF sequence. Following the X-OFF, a TSC would start another reader and a susequent SOM would reactivate all receiving devices, if interrupted.

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 by-pass the station.

3.08 When sending multiple address messages, an EOT DELETE code is used after each address. This causes the processor to send a So DELETE X-OFF TSC sequence which stops the TD and immediately restarts it. A seperate 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 preforms 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 35ASR and a 35RO. The 35ASR 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 (Figure 2) contains the indicator lights, keys, and switches for operation. The functions and indications provided are:

(a) Power Switch - The power switch has three positions; OFF, ON-LINE and LCL. With the power switch in the OFF position, power is removed from the set. When the rotary power switch on the ASR is placed in the LCL (Local) position, the TD is switched from the line to an internal circuit to permit editing tapes. In this position, the answer back circuitry is still connected to the line and will respond to a CDC or TSC. This position of the switch is not used on the RO machine. With the switch on the ASR in the ON-LINE position, the TD will be connected to the line. If the switch on the RO is also in this position, power to both machines is under control of the Idle Line Motor Control Unit.

(b) Mode Switch - The three position mode switch 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 with the power switch.

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

(d) Alarm Quiet Normal Key - When an alarm condition is originated, the audible alarm (buzzer) may be silenced by operating the twist key to the Quiet position. After the alarm condition is corrected, the key should be restored to the Norm position.

(e) Alarm Lamp - The red alarm lamp 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 Normal position. The alarm lamp will continue to be lit 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 white Send Lamp is on when the reader is transmitting 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 (Figure 3) contains the indicator lights, keys and switches for the 35RO at a receive-only station. The keys used perform the same functions as previously outlined. Since the sending controls are not used at these stations, the BID, SEND and LCL positions of the power switch are not activated.

4.04 The keyboard arrangement is indicated in Figure 4. The control
functions, such as EOT, SOT, and 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 BSP
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 one 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 always marking.

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 (CDC's and TSC's) are
sent by the processor and preceded by an EOT code. The EOT code insures
that each station is in the select non-print condition.

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
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 non-print condition. 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 by-passes
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 lit during the time the station is switched off-line.

5.06 In tape preparation, mnemonic codes are used instead of CDC. The
processor converts these codes to the appropriate CDC's. 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 35ASR for a send-receive station or a 35RO for a receive-only station. In some cases a 35ROTR is provided under control of the 35ASR or 35RO.

6.02 The control panel is identical with the 35ASR shown in Figure 2. The function and indications provided are:

(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 LCL 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 (Par. 4.02).

7. PRE-SERVICE TESTS

7.01 Pre-service tests on the system should consist of individual station and overall system tests. The tests and requirements are indicated in Tables C through K. Test tapes required for overall tests should be prepared and checked locally prior to the scheduled test. The test outlined in Tables F and G are for FDX stations. Tables F and H apply to HDX station. These tests should be completed from the STC before overall tests are made. Overall tests are covered for FDX operation in Table I and HDX operation in Table J. 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 one day should be allowed for testing each individual station and up to three days or more for overall tests. The actual intervals should be agreed upon between the plant, engineering and sales 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 by-pass switch on the motor control unit to connect power.

8. TROUBLE LOCATION TESTS

8.01 The trouble report should first be associated with one of the following tables.

Table   - Sending Failures - Full-duplex Stations

Table   - Sending Failures - Half-duplex Stations

Table   - Receiving Failures - Full-duplex Stations

Table   - Receiving Failures - Half-duplex Stations

8.02 Some reports may use different words to describe the trouble or all conditions may not be covered in the step by step procedures. However, comparison of the reported trouble with the proper table will generally indicate which steps should be used to isolate the trouble. In some instances, application of the step by step procedures may be helpful in locating a trouble not specifically covered by the tables.

9. MONITORING TELETYPEWRITERS

9.01 A 35KSR is being provided at all STC for maintenance and testing. This machine should be arranged for either HDX or FDX operation. To test FDX 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 35RO is provided in addition to the 35KSR to permit monitoring both sides of a FDX 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 non-printing) to be printed on the monitor. These codes will be printed out as indicated in Table B. 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 B

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

Type of Codes	Control Code	Printed on Monitoring TTY	Key Operated to Send Codes from Keyboard
TSC	DC_0*	O*	Control and P,*
CDC	S_1*	9*	Control and Y,*
A/B	S_2*	:*	Control and Z,*
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 & Stop TD	So	8	Control and X
Separate	Separate	2	Control and R

1. * Indicates second character of code assigned to the station.

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.

ASR CONTROLS FOR A HDX OR FDX STATION

RO CONTROLS FOR A FDX STATION

ALARM

KEY BOARD

ALARM QUIET

NORM

COPY ALL

NORM

KT T

K

MODE

SEND

BID

REPEAT   SINGLE

DISABLED

STRAPPED IN
REPEAT POSITION

LOCKED IN
KT POSITION

EOL

OFF

ON LINE   LCL

BREAK

DISABLED

LOC LF   LOC CR

OFF

ON LINE   LCL

BREAK

DISABLED
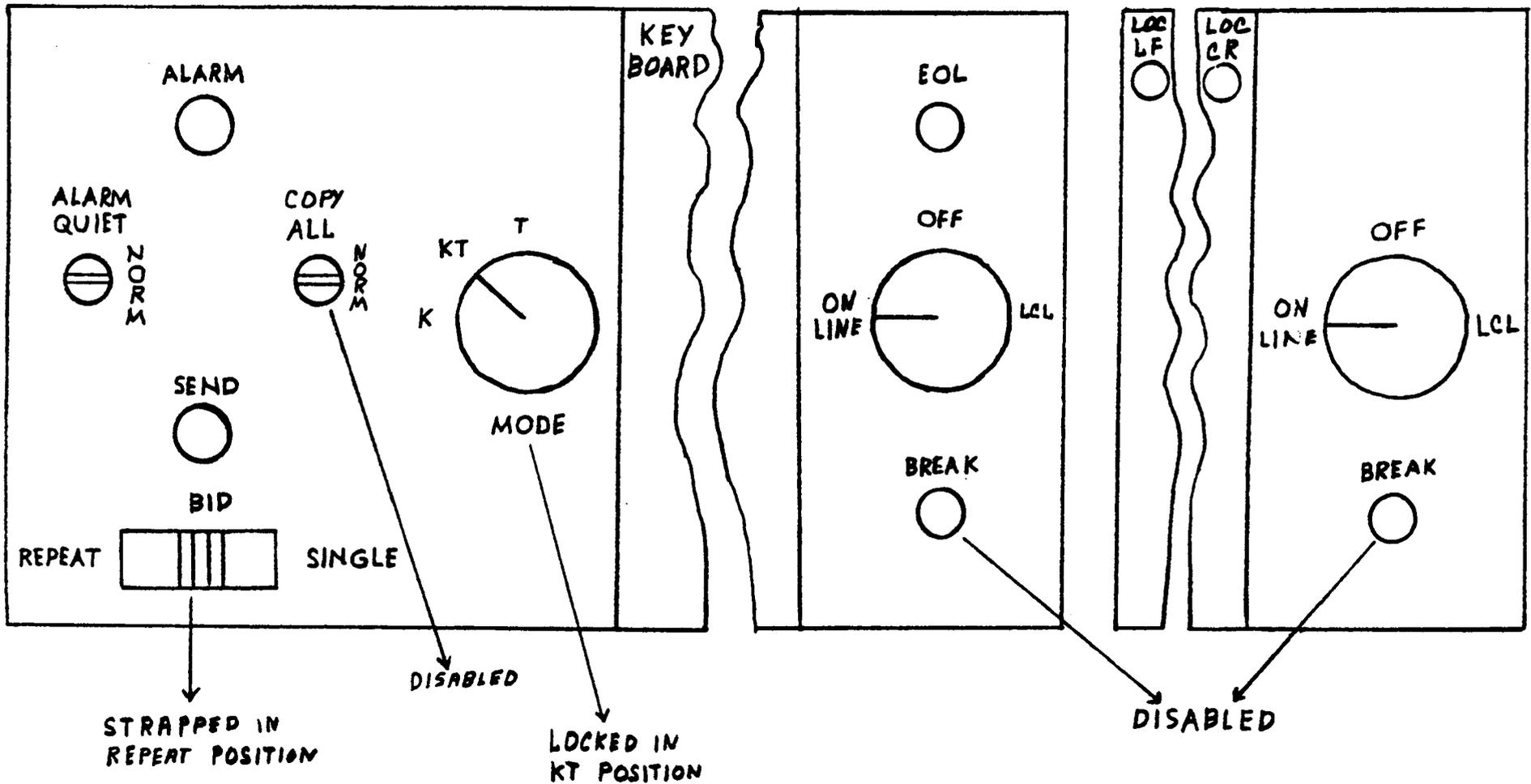
FIG. 2

RO CONTROLS FOR A
RECEIVE-ONLY STATION

ALARM

ALARM QUIET — NORM

COPY ALL — NORM

SEND

BID
REPEAT — SINGLE

DISABLED

LOC LF

LOC CR

OFF

ON LINE — LCL

BREAK

DISABLED

FIG. 3
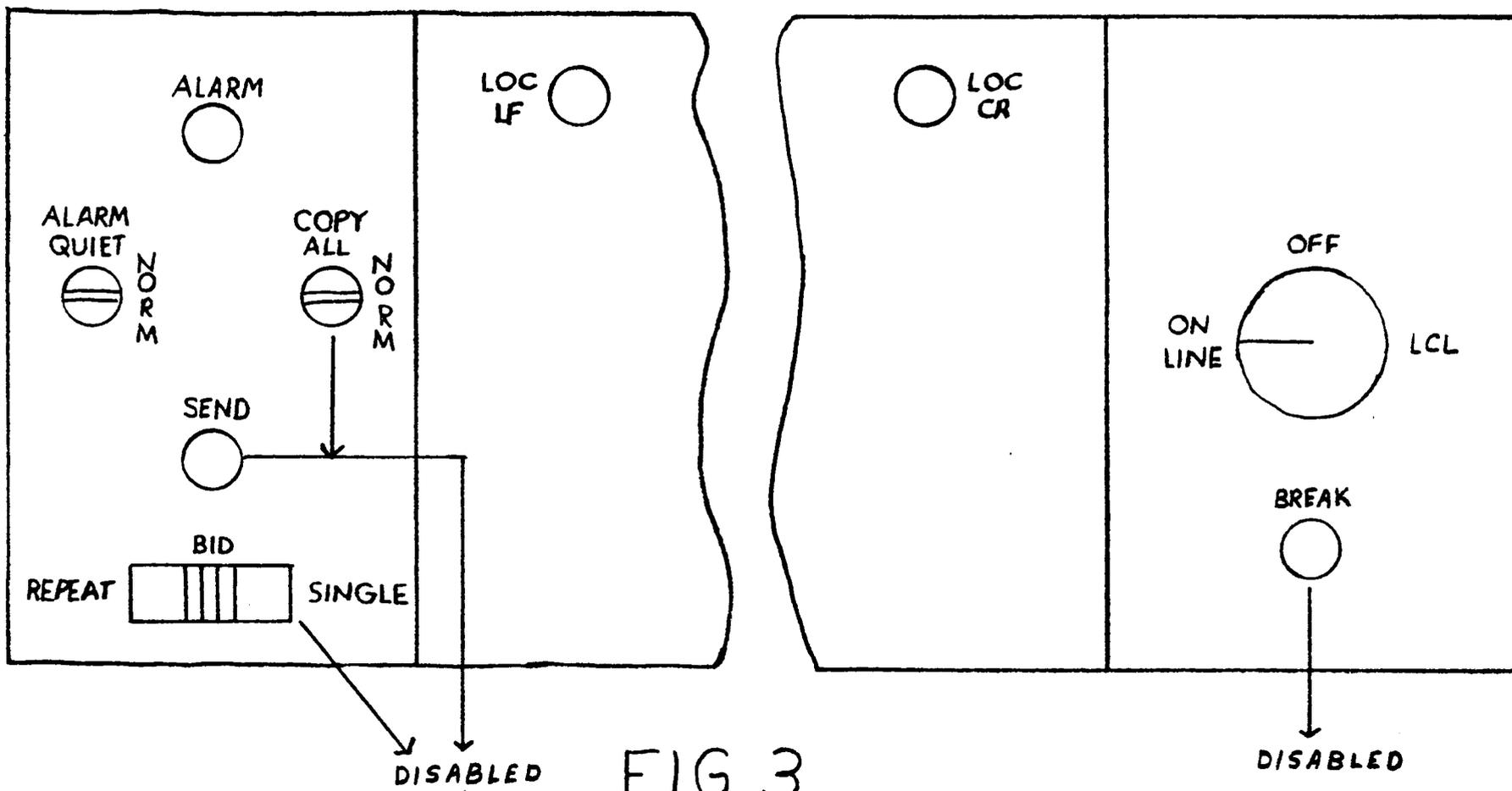
KEYBOARD LAYOUT
35 ASR
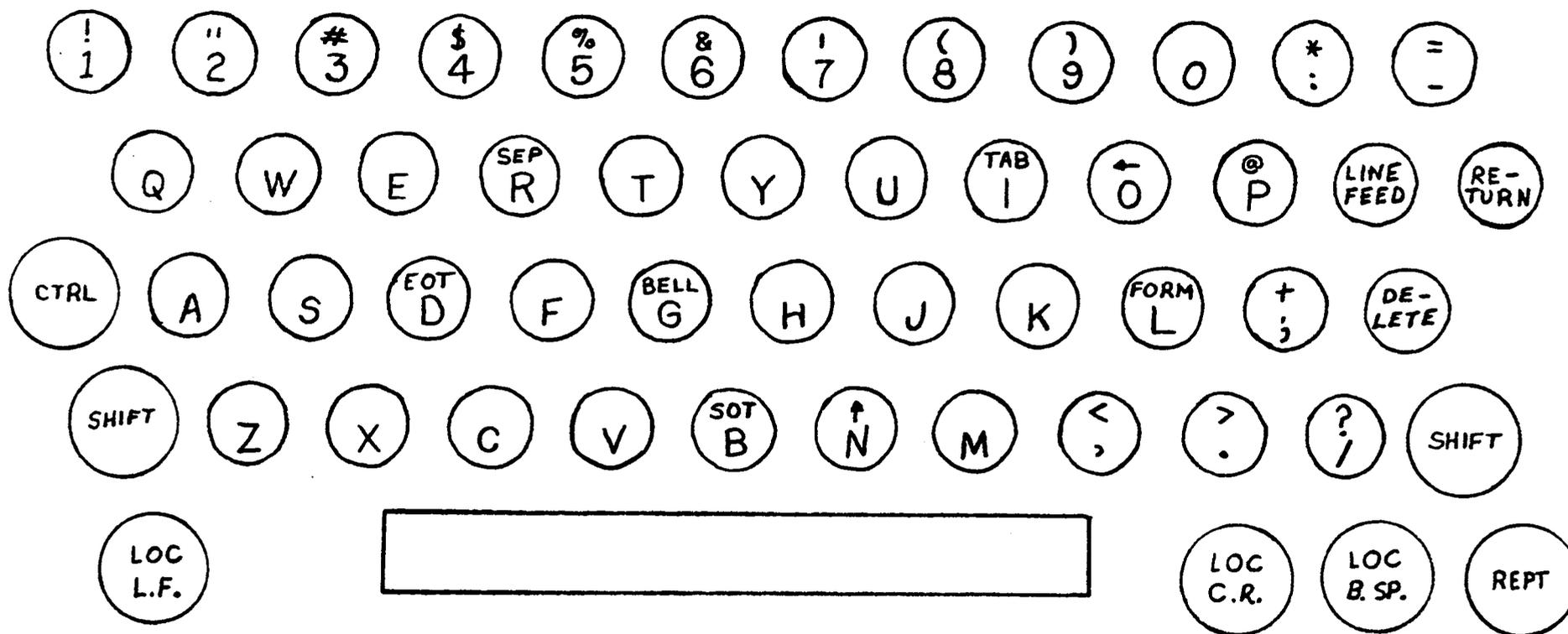
NOTE: GRAPHICS AND CONTROL CODES ON UPPER PORTION OF KEY CAPS
OBTAINED IN CONJUNCTION WITH "SHIFT" AND "CONTROL" KEYS,
RESPECTIVELY.

FIG. 4

TAPE FORMAT

1. Delete Characters - Tape Leader
2. SOT - Start of Transmission
3. Five character destination code from directory

    1. Character A or B - The processor that serves the called station
    2 & 3. Two character numeric (00 to 99) - The processor circuit number
        of called station
    4. Second character of the called station's CDC
    5. Check character

4. One character - Type of message (0-4)

    0 - Single address
    1 - Multiple address
    2 - Group code (not used)
    3 - Service message
    4 - Processor error

5. Five 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

    1. EOT
    2. Repeat Steps 1-11 for each successive address
    3. Follow each address with an EOT code
    4. 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)

FIGURE 5

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	So Del X-OFF Pau DCoA		DCoB		So Del X-OFF Pau DCoB	
Central Office TTY Monitor A Prints	8 ← 3 0 A		0 B		8 ← 3 0 B	
Outlying Station		S_2A				S_2B
Central Office TTY Monitor B Prints		;A				;B

Fig. 6 - Polling & "No Traffic Response" Format

Del - Delete character
Pau - Pause in transmission (100ms)
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 carrage return and linefeed on DCo plus one character.
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.

FDX CIRCUIT
PROCESSOR CONTINUES WITH TSC SEQUENCE FROM FIG. 5
OUTLYING STATION RESPONDS WITH TRAFFIC (SINGLE ADDRESS MESSAGE)
NO OUTGOING TRAFFIC FROM THE PROCESSOR

	TSC	Tape Leader	Start of TGM	Desti-nation	Type of Message	Originating Station	Message Number
Processor Output	DCoC						
Central Office TTY Monitor A Prints	O C						
Outlying Station		Del Chars	SOT	B16GA	O	AO6FA	47 CR LF Del
Central Office TTY Monitor B Prints		← ← ← ←	"	B16GA	O	AO6FA	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
	So Del X-OFF Pau DCoD
	8 ← 3 O D
CR LF LF LF LF LF LF EOT Del Chars	
$ ← ← ← ←	

Fig. 7

Processor Output	So Del X-OFF Pau DCoE	So Del Pau S_1G	SOT CR CR LF Del B16GA O
Central Office TTY Monitor A Prints	8 ← 3 O E	8 ← 9G	" ← B16GA O
Outlying Station		Del Chars SOT BO	S_2G 5EA 1 A26CA 35 CR
Central Office TTY Monitor B Prints		←← ← ← " BO	:G 5EA 1 A26CA 35

A06FA 47 CR LF Del Kansas City, Kansas 6-5-65	So Del X-OFF Pau DCoE SOT W.F.Snow Computer Pheonix
A06FA 47 ← Kansas City, Kansas 6-5-65	8 ← 3 O E W.E.Snow Computer Pheonix
LF Del 6-5-65 C.A.Rye Sales Atlanta CR LF Del EOT Del Chars	Del Chars SOT A21HA 1
←← 6-5-65 C.A.RYE Sales Atlanta ← $ ← ← ← ←	← ← ← ← " A21HA 1

CR LF Del T E X T T E X T T E X T T E	So Del X-OFF Pau DCoE SOT X T R.A.
← T E X T T E X T T E X T T E	8 ← 3 O E " X T R.A.
A26CA 35 CR LF Del 6-5-65 P.A.May Sales St. Louis CR LF Del EOT Del Chars	Del Chars Sep
A26CA 35 ← 6-5-65 P.A.May Sales St. Louis ← $ ← ← ← ←	← ← ← ← 2

Fig. 8

FDX CIRCUIT SEQUENCE

PROCESSOR

Send Leg   Receive Leg

S₂A ← ··············· So Del X-OFF DCoA   TSC Sequence

SOT → Garble or   DCoB   TSC
Preamble   Incorrect

Text → Steady   Service
         Mark, 1 Sec.   Message
                            to
EOT → Omitted or   Station   Idle
        Garbled

No Response ← ············ So Del X-OFF DCoC   TSC Sequence
or Garbled S₂

No Response ← ············ So Del X-OFF DCoC   TSC Sequence
or Garbled S₂   Repeated

S₂D ← ··················· So Del X-OFF DCoD   TSC Sequence

No Response or ← ········· EOT So Del S₁A   CDC Sequence
Garbled Response

S₂A ← ··················· So Del S₁A   CDC Sequence
                                                 Repeated

                          SOT
Idle ← ··················· Preamble
                          Text
                          EOT

Bell Bell ← ············· EOT So Del S₁B   Low Paper
                                                 Sequence

S₂C ← ··················· EOT So Del S₁C

S₂E ← ··················· So Del X-OFF DCoE   Select
                                                 Receiving
Message ← ················ DCoF   Unit and
                                                 Poll TD's
                          SOT
Message ← ················ Preamble
                          Text
                          EOT

S₂D ← ··················· EOT So Del S₁D   Interrupt TD &
                                                 Select Rec. Unit
                          SOT
Message Cont'd ← ········· Preamble
                          Text
EOT ← ···················

Message ← ················ So Del X-OFF DCoG SOT

Message ← ················ Text Cont'd

HDX CIRCUIT SENDING SEQUENCE

```
                        ┌─────────────────────────────┐
                        │ So Del X-OFF EOT Del DCoA    │
                        └─────────────────────────────┘
                   ┌───────────────┐
        ┌──────────┤ EOT Del DCoA  │
        │          └───────────────┘
        │          ┌───────────────┐
        │          │ First No Response │
        │          └───────────────┘
        │                             ┌──────────────┴──────────────┐
        │                             ▼                             ▼
        │                           A/B                            SOT
        │                             │                             │
        │                             ▼                             ▼
        │                        EOT Del DCoB              Preamble ── Garble or
        │                             │                                  Incorrect
        │                             ▼                             ▼
  Second No Response                 A/B                        Text ──── Steady Mark
        │                             │                                   1 sec
        │                             ▼                             ▼
        │                    ┌─────────────────┐               EOT ──── Garble or     Service
        │                    │  EOT Del DCoC   │                         Omitted      Message
        │                    └─────────────────┘                                      to Station
        │          ┌───────────────────────────────────────┐
        └──────────┤ So Del X-OFF EOT Del DCoB              │◄─────────────────
                   └───────────────────────────────────────┘
```
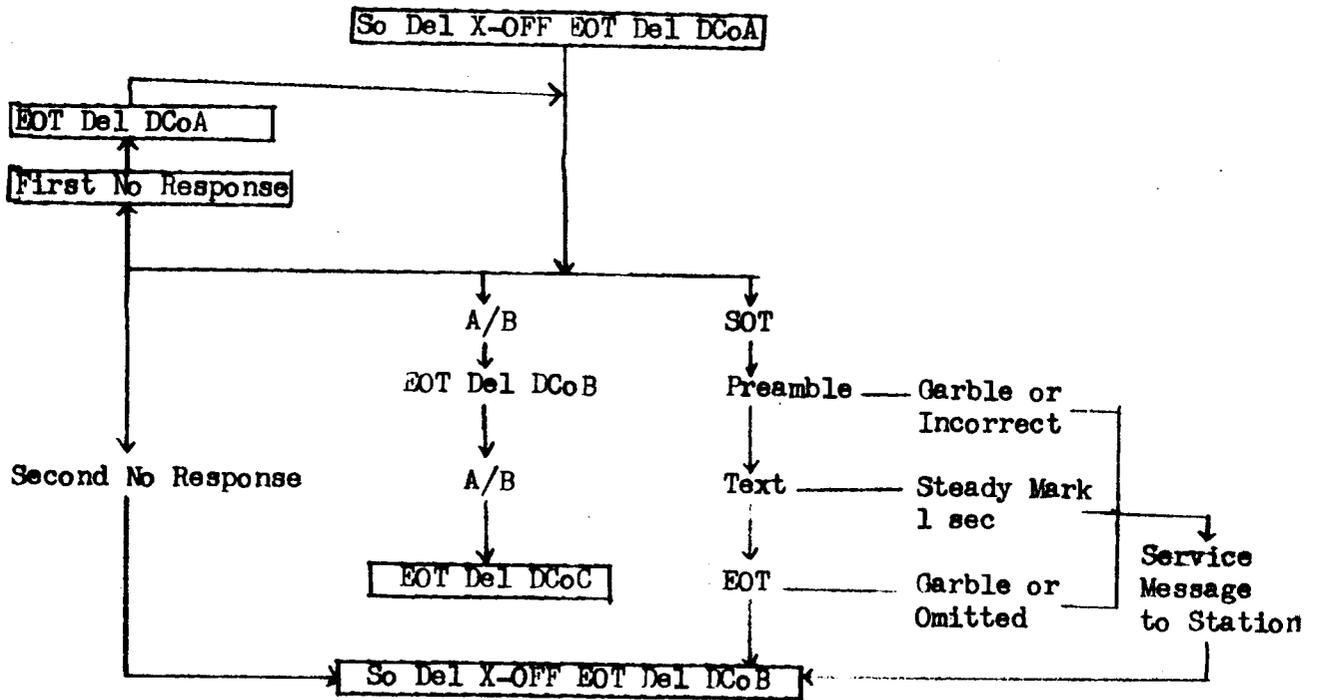
HDX CIRCUIT RECEIVING SEQUENCE

```
                        ┌─────────────────┐
                        │  EOT Del S₁A    │
                        └─────────────────┘
          ┌──────────────────┬────────────────┬──────────────────────┐
          ▼                  ▼                                        ▼
    First No            First                                        A/B
    Response          BELL BELL                                       │
          │                  │                                        ▼
          ▼                  ▼                                       SOT
    Second No           Second                                        │
    Response          BELL BELL                                       ▼
          │                  │                                     Message
          │          ┌─────────────────┐                             │
          └──────────┤  EOT Del S₁B    │◄────────────────────────────┘
                     └─────────────────┘
```
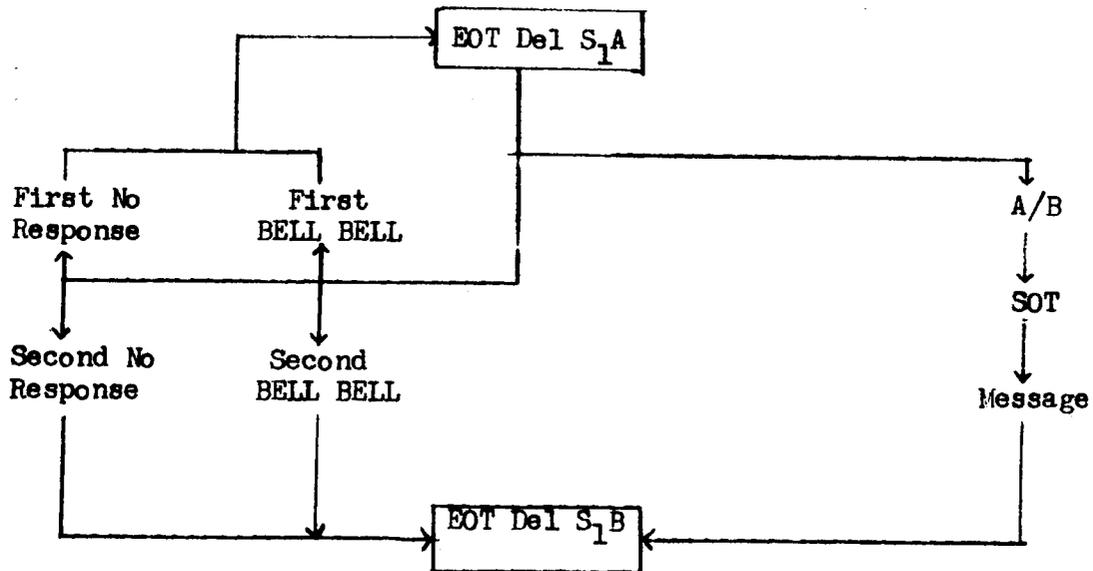
Fig. 10

Table C

Preservice Tests – Local Loops – 2 Wire

STEP	STC	STATION
1	Check the cable pair for opens, shorts, grounds and battery.	
2	Measure the 1000 cycle tone at the VF line board as equivalent and record as reference level. Requirement level specified on the CLRC I2DB.	Send 1000 cycles at the level specified by the CLRC on the send loop.
3	Measure and record the levels Requirements Ref. ± 3DB Ref. ± 3DB Ref. ± 3DB Ref. ± 3DB Ref. ± 5DB	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 NMS as equivalent at the VF line board. Requirement, 52DBRMC. 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 voice-band 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.

Table D

Preservice Tests - Local Loops - 4 Wire

Step	STC	STATION
1	Check the cable pair for opens, shorts, grounds and battery.	
2	Measure the 1000 cycle tone at the receive VF line board jacks or equivalent and record as reference level. Requirement, level specified on the CLRC I2DB.	Send 1000 cycles on the send loop at the level specified by the CLRC.
3	Measure and record requirements as follows: Ref. ± 3DB Ref. ± 3DB Ref. ± 3DB Ref. ± 3DB Ref. ± 5DB	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 VF line board 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 I2DB.
5.	Send the following at the level specified on the CLRC. 500 Cycles 1500 Cycles 2000 Cycles 2500 Cycles 3000 Cycles	Measure and record, requirements as follows: Ref. ± 3DB Ref. ± 3DB Ref. ± 3DB Ref. ± 3DB Ref. ± 5DB
6	Send 1000 cycles at the send VF line board jacks or equivalent and measure the tone at the receive VF line board jacks or equivalent. Compute the level to the station and return from the CLRC. Requirement, computed level I4DB.	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 VF line jacks or equivalent and measure the steady state noise with the 3A NMS or equivalent. Requirement, 52DBRNC. This is a direct switch setting without any connection.	

TABLE D (CONT'D)

STEP	STC	STATION
8	Measure the impulse noise using the 6A impulse counter with voice-band 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 minutes the REF LEV DBRN switch set at 54.	
9	Remove test set and restore regular.	Connect the send and receive loops to the subset.

TABLE E

Preservice Tests - Check List of Line-up between the STC and Station

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

TABLE F

PRESERVICE TESTS - FDX, HDX, AND RO STATIONS

Step	Send from STC to Station	Condition at Station	RESPONSE FROM STATION Code or Message	RESPONSE FROM STATION Test Room TTY Prints	REMARKS
					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 non-print	A/B	:*	Repeat 3 times. Check Distortion with TMS. Requirement 8% or less. CDC does not print.
2	Send SOT 30% SWC Fox	Non-select print Fox printed	– –	– –	Make distortion tolerance tests. Set range arm and copy 20 perfect lines.
3	Remove Fox Send CDC	Non-select 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. ~~Audible and visual alarms should activate. Silence the audible alarm by turning the ALARM key to the QUIET position. The ALARM lamp stays on.~~
5	Send Fox	Fox prints with low paper alarm activated.	–	–	Station should copy Fox.

PRESERVICE TESTS - FDX, HDX, AND RO STATIONS

Step	Send from STC to Station	Condition at Station	RESPONSE FROM STATION		REMARKS
			Code or Message	Test Room TTY Prints	
6	Remove Fox Send CDC	Low paper alarm	-	-	No response from the station. Station copies second character of CDC.
7	Send EOT CDC	Select non-print	BELL BELL	' '	Repeat 3 times. Check Distortion. Requirement 8% or less.
8	Send TSC	Select non-print	A/B	: *	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 reperferator tape, no alarms should be activated.
10	Send EOT CDC	Select non-print	A/B	: *	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 non-print	BELL BELL	' '	Skip this step if an auxiliary ROTR is not provided. Replace tape and clear alarms.
12	Send So Del. CDC Sep Del. ABC	Select print	A/B	: *	Station should print ABC.
13	Send EOT followed by all CDC's on the circuit except the assigned CDC for the stn.	Select non-print	-	-	No response from stn.

PRESERVICE TESTS – FDX, HDX, AND RO STATIONS

Step	Send from STC to Station	Condition at Station	RESPONSE FROM STATION Code or Message	Test Room TTY Prints	REMARKS
14	Send SOT Fox	Non-select non-print	–	–	Operate COPY ALL–NORM switch to the ALL pos. TTY should not copy.
15	Send EOT CDC	Select non-print	A/B	:*	
16	Send SOT Fox	Non-select print	–	–	Fox printed.
17	Remove Fox Send Break	Non-select print	–	–	Machine should run open. No alarms are activated.
18	Send Fox	Non-select print	–	–	Fox printed.
19	Remove Fox Send EOT	Select non-print	–	–	
20	Idle	Select non-print	–	–	With Idle Line Motor Control switch in the NORM pos., power should be removed from the machines in 20 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.

1. * Second character of the assigned station code.

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

3. This completes the test of a RO station. Continue with Table G for a FDX station and Table H for a HDX station.

TABLE G

PRESERVICE TESTS - FDX STATIONS

Step	Send from STC to Station	Condition at Station	RESPONSE FROM STATION Code or Message	RESPONSE FROM STATION Test Room TTY Prints	REMARKS
1	Send So Del X-OFF TSC	TD selected	A/B	:*	No tape in TD. Repeat 3 times. Check dist. Requirement 8% or less.
2	-	-	-	-	Insert test tape #1 in TD. Do not operate bid key, bid lamp should be on.
3	Send TSC	TD starts	Message	Message	Check distortion. Requirement 14% or less. Adjust to min. distortion. In most cases this will be less than 8%. No copy on stn. TTY. TD should stop when tape runs out releasing the ninth pin. No alarms should be activated. Repeat 3 times.
4	-	-	-	-	Operate power switch to LOC.
5	Send So Del	TD off line	A/B	:*	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 CBC SOT Send Fox	Non-select print Fox printed	A/B -	:* -	- -
7	Remove Fox Send So Del X-OFF TSc	Non-print with TD selected	A/B	:*	No tape in TD.
8	Send SOT Fox	Non-select print	-	-	Fox copied. No control codes printed. Insert tape in TD. BID lamp on.
9	Remove Fox Send characters AB So Del X-OFF TSC Sep Del. CD.	Print, non-print TD starts, print CD.	Message	Message	Station machine should print ABCD. Tape should stop when tape releases the ninth pin. No alarms. Reset tape.

TABLE G (CONT'D)

PRESERVICE TESTS - FDX STATIONS

Step	Send from STC to Station	Condition at Station	Response from station Code or Message	Test Room TTY Prints	REMARKS
10	Send EOT TSC SOT So Del X-OFF SOT	TD selected and stopped	Message	Message	The TD should start on the TSC and stop on the So code. No alarms and no copy on station machine. Reset tape to beginning.
11	Send EOT TSC So Del	TD selected and stopped	Message	Message	The TD starts on the TSC and stops on the So code. No alarms.
12	Send CDC	Select non-print	A/B	:*	-
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 FDX station.

TABLE H

PRESERVICE TESTS – HDX STATIONS

Step	Send from STC to Station	Condition at Station	Response from Station		REMARKS
			Code or Message	Test Room TTY Prints	
1	Send So Del X-OFF EOT Del TSC	TD selected	A/B	:*	No tape in TD. Repeat 3 times. Check distortion. Requirement 8% or less.
2	–	–	–	–	Insert test tape #1 in TD. Do not operate BID key. BID lamp should be on.
3	Send EOT Del TSC	TD starts	Message	Message	Check distortion. Requirment 8% or less. 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 TSC	–	–	–	Do not operate any keys at the station. No audible alarm. TD should start and send remainder 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.

* Second character of the assigned code.

TABLE I

OVERALL PRESERVICE TESTS - FDX CIRCUITS

Step	Control Office	Station	REMARKS
1	Check facility lineup to end offices.	-	Check transmission and copy with end offices. Fox on both directions, simultaneously.
2	Send EOT and CDC's for all stations.	-	Check distortion of A/B from each station. Repeat 3 times for each station.
3	Send message (see Test Tape #2) to all stations scheduled for tests.	Receive message and insert test tape. Check BID lamp.	Keep record of all trouble conditions, garbles, alarms, and etc., at each station for later transmission.
4.	Send So TSC for each station.	Reinsert tape after it has been transmitted for second pickup.	Check copy and distortion from each station.
5	Send So TSC for each station. After tape starts, send So DELETE, CDC, SOT, EOT.	-	Check that TD stops on So, A/B received after CDC, and TD starts on SOT. Copy from TD must be error free when A/B code is disregarded.
6	Before end of tape send So DELETE, X-OFF, SOT, So DELETE, EOT, TSC, SOT.	-	Check that TD stops on So and starts on TSC and continues to the end of tape.
7	Send EOT and CDC's for all stations. Send Test Tape #1.	Test Tape #1 received by all stations.	-
8	Send EOT and CDC's for all stations. Send SOT, Del AB So Del. , TSC's for all stations, SOT, Del CD	No tape in TD. Station should print A B C D.	Check distortion of the A/B from each station.
9	Send EOT and CDC's for all stations. Send Test Tape #3 followed by 100 lines of Fox.	Receive Test Tape #3; prepare and insert Test Tape #4 in TD.	-
10	Send EOT, SOT, and CDC's for all stations.	-	No A/B should be received.
11	Send So, Del, TSC for each station.	Test Tape #4 transmitted as TSC received.	Investigate all trouble conditions indicated by Test Tape #4.

TABLE J

OVERALL PRESERVICE TESTS - HDX CIRCUITS

Step	Control Office	Station	REMARKS
1	Check facility lineup to end offices.	-	Check both directions of transmission.
2	Send EOT and CDC's for each station.	-	Check distortion of A/B from each station. Repeat 3 times.
3	Send message (see Test Tape #2) to all stations scheduled for tests.	Receive message and insert test tape. Check BID lamp.	Keep record of all trouble conditions, garbles, alarms, and etc., at each station for later transmission.
4	Send EOT, TSC for each station.	Reinsert tape after it has transmitted for second pickup.	Check copy and distortion from each station.
5	Send EOT, TSC for each station.	-	Check copy and distortion.
6	Send EOT and CDC's for all stations. Send Test Tape #1.	Test Tape #1 received by all stations.	-
7	Send EOT, TSC's for all stations.	-	Check distortion of A/B from each station.
8	Send EOT, CDC's for all stations. Send Test Tape #3 followed by 100 lines of fox.	Receive Test Tape #3; prepare and insert Test Tape # 4 in TD.	-
9	Send EOT, SOT, and CDC's for all stations.	-	No A/B should be received.
10	Send EOT, TSC for each station.	Test Tape #4 transmitted as TSC received.	Investigate all trouble conditions indicated by Test Tape #4.

TABLE K

TEST TAPE NO. 1

Ten (10) Delete characters 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 (10) lines of FOX CR LF Del
EOT (6) DELETE characters

TYPICAL TEST TAPE NO. 2

Ten (10) 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 F or G, as appropriate) of BSP 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
No. (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 Results 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