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AT&TCo Standard

DATA AUXILIARY SET 820B5
USED IN NO. 1 ELECTRONIC SWITCHING SYSTEM ADF
HALF-DUPLEX—150 WORD PER MINUTE DATA STATION
WITH CUSTOMER PROVIDED TERMINAL
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section describes the 4-row 150-word per minute (wpm) half-duplex (HDX) station employed in the No. 1 Electronic Switching System Arranged with Data Features (No. 1 ESS ADF) using the Data Auxiliary Set 820B5 for customer provided terminal application. Also described in this section is the associated Data Auxiliary Set 806C1. The purpose of this section is to provide information concerning the theory of operation and functional description of the station equipment.

A. Purpose of System

1.02 The 4-row 150-wpm HDX station with customer provided terminal is part of the No. 1 ESS ADF (hereafter called ADF). The ADF system is a message store-and-forward data switching system which employs time-shared control. The operation is controlled by the ADF which uses stored program in lieu of wired logic.

1.03 The use of ESS devices allows the system to operate at speeds much higher than the rate at which events associated with a single message can occur. This permits the control equipment to be time-shared by all the messages which the system handles.

1.04 The ADF adminsters teletype communication services for several types of station arrangements which includes 3- and 4-row teletypewriters and customer provided terminals operating both full and half duplex. Each 4-row type station has its own station controller to provide supervisory control functions and signal regeneration.

1.05 The 4-row 150-wpm HDX station with customer provided terminal utilizes a 10-bit character sequence consisting of one start bit, seven information bits, one parity bit, and one stop bit.

1.06 The block diagram in Fig. 1 shows the No. 1 ESS ADF system which consists of, in addition to the ADF, a control serving test center (CSTC), a number of serving test centers (STC), and a group of lines both single and multistation for each STC.

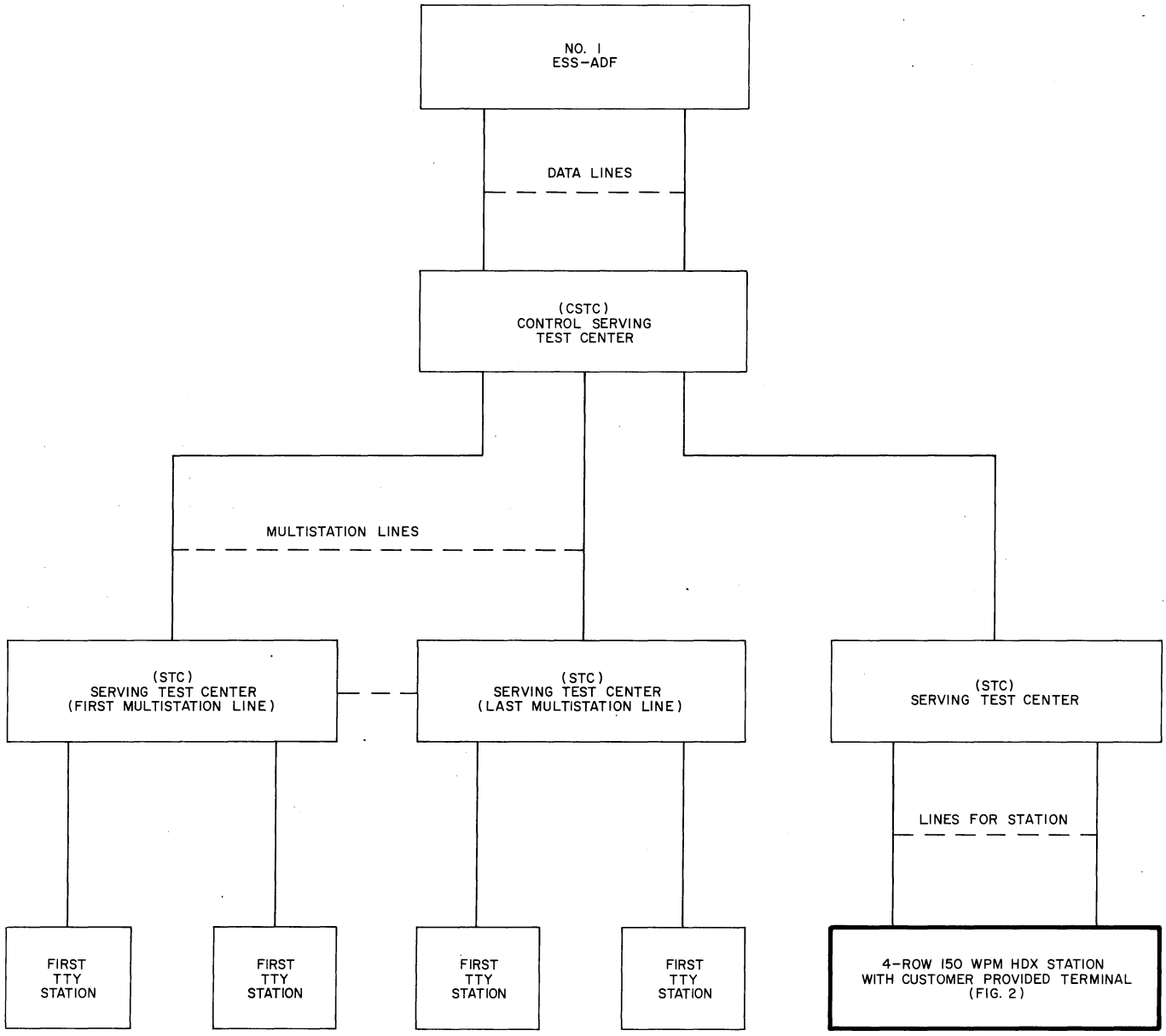


Fig. 1—No. 1 ESS ADF—Block Diagram

1.07 Messages can be automatically sent to and received from the ADF without attendant operation at the station. The ADF can provide data character code conversion, speed change, privacy, and error control. Messages can be routed by recognizing precedence, single address codes, multiple address codes, and group code addresses.

1.08 The CSTC provides connection between the ADF and multistation line groupings at the STC. The CSTC also provides a method of monitoring the service quality similar to that of the toll testboard in voice communications. The STC serves as a looping or grouping terminal for multistation 100-wpm and 150-wpm lines.

B. Purpose of Station

1.09 The No. 1 ESS ADF HDX data station used with the customer provided terminal provides low-speed (150 wpm) data service with other stations,

in the private network of which it is a part, under control of the No. 1 ESS ADF system.

C. Message Handling

Message Preparation

1.10 An interrogation scheme called polling is used by the ADF for recognition of station service requests. The ADF processor polls each station periodically for service requests.

1.11 When the customer provided terminal has a message prepared, it conditions the station controller to indicate that it has traffic available when the station is polled by the ADF. A message normally includes the heading (routing information), the text (content of message), and characters required for automatic administration of the message.

1.12 A station with traffic may be selected by the ADF to send the traffic it has, and the message information is stored temporarily in the ADF. The sending station will be restored to the idle condition when the complete transmission has been picked up.

D. Station Operation

1.13 The ADF interrogates each station individually in a continuous cyclic operation. The station replies and indicates the following:

(a) Whether or not the station is ready to receive

(b) Whether or not the station has traffic available to transmit

(c) Whether the traffic to be transmitted has regular or priority status.

This sequence is referred to as polling. If a bid to enter traffic is registered by a station, the ADF may select that station to transmit.

1.14 When the ADF elects to pick up traffic from a station that has entered a bid to transmit, the ADF will send an originating message number (if required) which may be followed by the time and date (if required) for the message pickup. On signal from the ADF, the station will now send the message heading to the ADF. The message heading should contain the addresses of the stations to receive the message. If any of the stations addressed in the heading are on the same line (intraline) as the selected sender, the ADF will select them as receivers. The ADF then signals the selected sender to transmit the text of the message. The message is copied by the intraline receivers and stored by the ADF for future delivery to the interline addressee(s).

1.15 Message delivery is administered on a selective call-in basis. Each station designated as an addressee in the heading of a message nominated for delivery is interrogated by the ADF to determine if it is ready to receive. If the station is not ready to receive, the ADF will store the message until, during one of the cyclic polling sequences, the ADF discovers that the station is ready to receive. If the station is ready to receive, it will be selected as a receiver and the message will be delivered. After the text of each message has been delivered, the ADF interrogates each receive station to determine if the message was received properly. This sequence is referred to as the "roll call." If a positive reply to roll call is received from a station, the ADF goes on to roll call the other selected receive stations; however, if a negative reply is received, the ADF will queue (intraline delivery) or requeue (interline delivery) the message for retransmission. After all the selected receive stations have been roll called, they are returned to idle by the ADF.

Message Delivery

1.16 At some later time, the ADF polls the negative responding receiving stations. If a station is available for receiving (ready-to-receive), the ADF calls in the station as a receiver and delivers the message. After the complete message has been delivered, a roll-call sequence initiated by the ADF determines if the message reception was satisfactory. After the roll call, the station will be restored to the idle condition by the ADF.

E. Station Characteristics

1.17 The block diagram in Fig. 2 shows a 4-row 150-wpm HDX station. The station unit(s) connect with the port(s) of the customer provided terminal with an 11-lead interface (Table A). One or more station units may be provided in accordance with customer requirements.

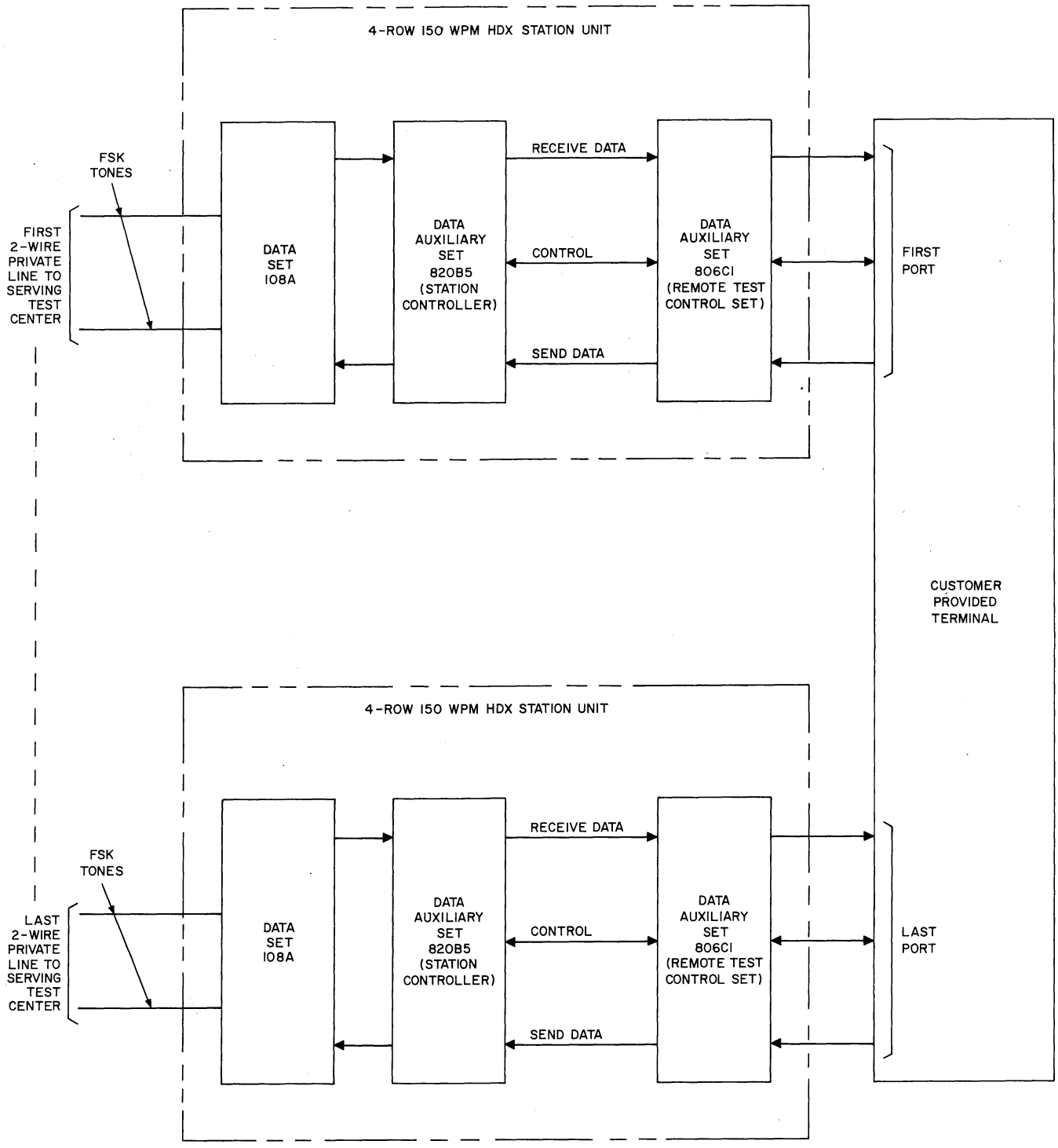


Fig. 2—4-Row 150-WPM HDX Station (With Customer Provided Terminal)—Block Diagram

TABLE A

INTERFACE BETWEEN CUSTOMER TERMINAL AND STATION CONTROLLER

EIA CIRCUIT DESIGNATION	EIA CIRCUIT DESCRIPTION	TO AND FROM CONTROLLER	DATA STATION DESIGNATION
AA	Protective Ground	—	PG
BA	Transmitted Data	To	TD
BB	Received Data	From	RD
CC	Data Set Ready	From	DSR
AB	Signal Ground	—	SG
CA	Request to Send Regular	To	RTSR
CB	Clear to Send	From	CTS
—	Request to Send Priority	To	RTSP
CD	Data Terminal Ready	To	DTR
CE	Call Indicator	From	CI
—	Service Message Indicator	From	SMI

1.18 The customer ports usually will be designated as ***sending and receiving, sending only,*** and ***receiving only.*** Station-to-station messages will not usually be routed to the send-only ports, however, occasional ADF originated service messages may be directed to the send-only ports. Therefore, the send-only ports should be arranged so that these ports are capable of receiving transmission from the ADF.

Station Controller

1.19 The Data Auxiliary Set 820B5 (hereafter called the station controller) enables the

terminal equipment to automatically send and/or receive messages as directed by the ADF. The station controller provides circuits for detection and recognition of control characters from two sources:

(a) Characters originated in the customer provided terminal.

(b) Characters received from the ADF.

The station controller also provides circuits for generation of two types of characters:

(a) Response and service request characters to be sent to the ADF.

(b) An underline (_) character which is used to replace characters with incorrect parity in the received message.

Data Set

1.20 The Data Set 108A provides a means of converting the dc characters to audio frequency shift keying tones for transmission over voice frequency telephone facilities. The audio tones received from the ADF are converted to dc signals for application to the station controller.

F. Maintenance Features

1.21 Two types of loop-back tests are provided in the station controller: automatic and manual. An automatic loop-back test for a given station may be selected by sending a loop-back code sequence from the STC. The automatic loop-back test facilitates the evaluation of line, data set, and control logic circuits.

1.22 A maintenance (manual loop-back) switch is provided at the station controller unit for data set loop-back testing. The manual loop-back test provides for performance testing of the data set and transmission facilities. The dc received data output signal from the data set is looped back to the dc data input terminals of the data set.

G. Station Power

1.23 The station equipment primarily operates from a 106 to 129 volts, 60 ±0.5 Hz power source. Each data station unit is fused for 1/2 ampere. The station controller and data set are supplied dc power by a 24A power unit mounted on the controller.

2. PHYSICAL DESCRIPTION

2.01 This part describes the physical appearance of the components of a No. 1 ESS ADF 150-wpm HDX data station used with customer provided terminal.

A. Station

2.02 The station is equipped with one or more station units. Each station unit consists of:

(a) Data Auxiliary Set 820B5

(b) Data Set 108A

(c) Data Auxiliary Set 806C1

2.03 A partial view of a typical station is shown in Fig. 3. The station units shown are mounted in a KS-20093 type cabinet which can typically accommodate a total of 16 working units and two spare units. Up to eight working units and one spare unit may be located in the front area of the cabinet. Eight additional working units plus the second spare unit may be located in the rear area of the cabinet. Only three station units are shown in the partial view (Fig. 3).

B. Station Unit

2.04 The data station unit is shown in Fig. 4. The station unit is mounted on a 7 by 25 inch panel which is part of Data Auxiliary Set (DAS) 806C1. The Auxiliary Set 820B5 (equipped with Data Set 108A) is located on the right side of the mounting.

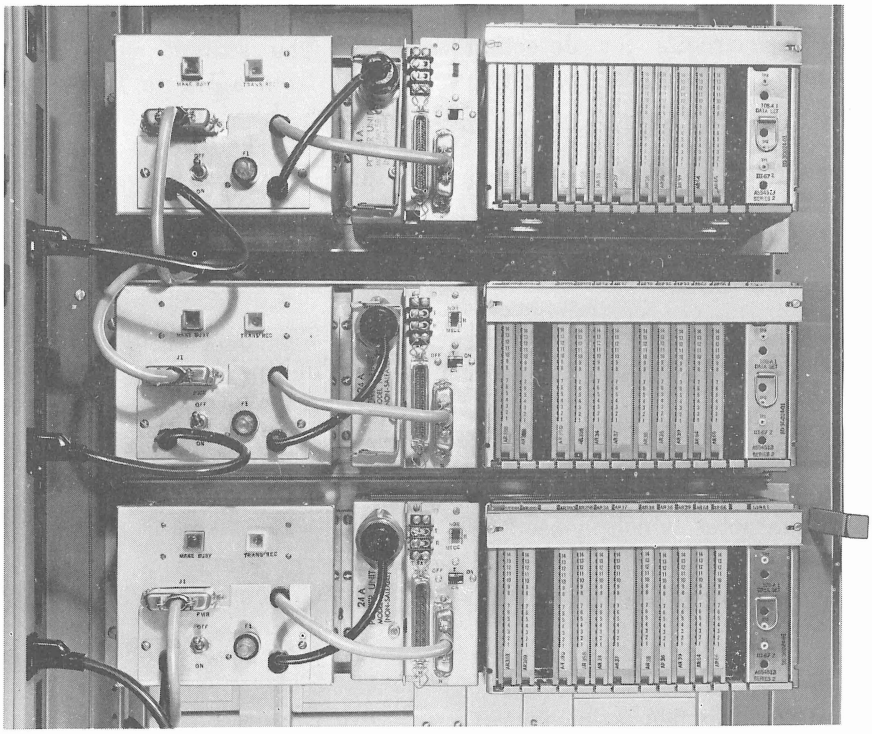


Fig. 3—Partial View of a Typical Station

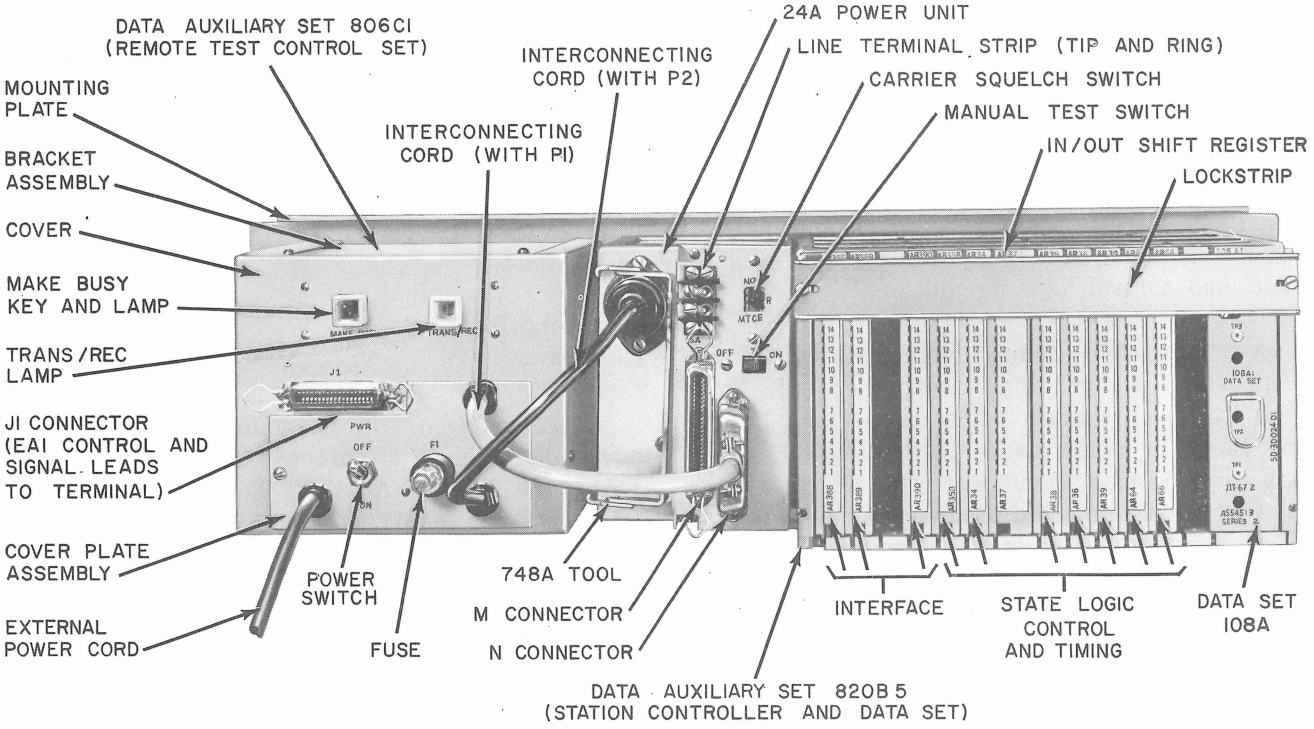


Fig. 4—Data Station Unit

2.05 The data station unit assembly weighs approximately 26 pounds with overall dimensions of approximately 25 inches wide by 7 inches high by 8-1/2 inches deep. The fully equipped KS-20093 cabinet described in 2.03 weighs approximately 800 pounds with overall dimensions of approximately 34 inches wide by 74-1/4 inches high by 30-1/2 inches deep. The data station unit may be mounted in any suitable type cabinet which provides an approximate width of 24.3 inches between mounting screw centers. Plug-in ac power should be available within reach of the 10-inch external power cord.

C. Station Controller

2.06 The station controller and data set unit (Fig. 4) are always mounted on the panel which is part of the Data Auxiliary Set 806C1. The station controller (Data Auxiliary Set 820B5) consists of eleven circuit packages beginning immediately to the right of the 24A power unit. Eight of the circuit packages (including the IN/OUT SHIFT REGISTER) are employed for the controller function and three circuit packages are for interface functions.

2.07 The 748A tool is used for extracting the circuit packages from the controller for maintenance purposes. Connectors and a terminal strip are provided for connection of power, the station line (tip and ring), and the EIA leads (via DAS 806C1). Switches are provided for control of modulator squelch and maintenance tests (manual loop-back).

2.08 The station controller and data set weigh approximately 18 pounds before installation on the mounting plate of the Data Auxiliary Set 806C1. Overall dimensions of the station controller are approximately 15-1/2 inches wide by 6 inches high by 8-1/2 inches deep.

D. Data Set

2.09 The Data Set 108A (Fig. 4) is the single circuit package located at the right end of the station controller and data set assembly. The data set is not supplied with the controller and must be ordered separately for installation with the controller.

E. Data Auxiliary Set 806C1

2.10 The Data Auxiliary Set 806C1 (Fig. 4) consists of a mounting plate, bracket assembly, cover, and cover plate assembly. The mounting plate measures approximately 25 inches wide by 7 inches high. The bracket assembly provides the top, bottom, and rear sides which protect the electrical components. The cover is removable and provides the left, front, and right sides which contain the electrical components. The cover plate assembly provides a separate mounting on the cover for the power portion of the electrical components.

2.11 ***The electrical components consist of the following:***

(a) External power cord with P3 connector, power switch, fuse, and interconnecting power cord with P2 connector.

(b) The MAKE BUSY key and lamp and the TRANS/REC lamp.

(c) An internal circuit board and relays which connect between the terminals of the external EIA signal connector J1 and the interconnecting cord with the P1 connector (to connector N on the station controller).

2.12 The assembled bracket, cover, and mounting plate with all electrical components (excluding the station controller unit) weighs approximately 8 pounds. The overall dimensions of the bracket assembly and cover are approximately 7 inches wide by 5-3/4 inches high by 6 inches deep.

3. FUNCTIONAL DESCRIPTION

3.01 This part describes the various components which make up the basic 150-wpm HDX station for use with a customer provided terminal.

A. Station Arrangement

3.02 In the descriptions which follow, it will be assumed that the station under consideration is a complete sending and receiving station. Message transmission will be covered separately from message reception so that the method of operation may be applied to terminate only situations.

3.03 Reference will be made to the ASCII code. Table B shows the ASCII code for bits one through seven. Seven bits provide message character information and an eighth bit is employed for parity checking purposes. Parity in this system

is even. Table C provides the definitions for the various station control code characters.

TABLE B

USA STANDARD CODE FOR INFORMATION INTERCHANGE

USAS X3.4 — 1967

BITS B_7 B_6 B_5	B_4	B_3	B_2	B_1	ROW / COLUMN	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
						0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
	0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC2	"	2	B	R	b	r
	0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
	0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
	0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
	0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
	0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
	1	0	0	0	8	BS	CAN	(	8	H	X	h	x
	1	0	0	1	9	HT	EM	)	9	I	Y	i	y
	1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
	1	0	1	1	11	VT	ESC	+	:	K	[	k	{
	1	1	0	0	12	FF	FS	,	<	L	/	l	|
	1	1	0	1	13	CR	GS	−	=	M	]	m	}
	1	1	1	0	14	SO	RS	.	>	N	^	n	~
	1	1	1	1	15	SI	US	/	?	O	—	o	DEL

TABLE C

CONTROL CHARACTER CODE DEFINITIONS

DESIGNATION	DEFINITION	DESIGNATION	DEFINITION
NUL	All spaces	DLE	Data Link Escape
SOH	Start of Heading	DC1	Device Control 1
STX	Start of Text	DC2	Device Control 2
ETX	End of Text	DC3	Device Control 3
EOT	End of Transmission	DC4	Device Control 4
ENQ	Enquiry	NAK	Negative Acknowledge
ACK	Acknowledge	SYN	Synchronous Idle
BEL	Bell or other signal	ETB	End Transmission Block
BS	Backspace	CAN	Cancel
HT	Horizontal Tabulate	EM	End of Medium
LF	Line Feed	SUB	Substitute
VT	Vertical Tabulate	ESC	Escape
FF	Form Feed	FS	File Separator
CR	Carriage Return	GS	Group Separator
SO	Shift Out	RS	Record Separator
SI	Shift In	US	Unit Separator
DEL	Delete All Marks	SP	Space

3.04 In accordance with customer requirements, the HDX station with customer provided terminal may be employed as a send and receive station, a send-only station, or a receive-only station.

3.05 When power is first applied to the station, an initializer circuit in the controller applies a momentary positive voltage to all critical state logic memory elements and places the controller in the idle mode.

B. Message Format

3.06 The first message from a terminal consists of the message heading, an STX, the text of the message, and an ETX. If a second message is prepared for one continuous transmission, it should follow the ETX of the first message, and must begin with an SOH. A third message may follow the ETX of the second, etc, in the same manner as the second message. Each message after the first must follow the same format, ie,

SOH heading STX text ETX.

After the last message, ETX of the last message must be followed by EOT.

C. Polling (Fig. 5)

3.07 All stations are periodically polled by the ADF. Fig. 5 is a sequence chart of the polling routine. The ADF sends a DLE character followed by the unique station polling code (SPC)

identification for the station. The response generated by the station controller of the HDX station depends upon the sending and receiving status at the station being polled. The station polling responses are listed in Table D.

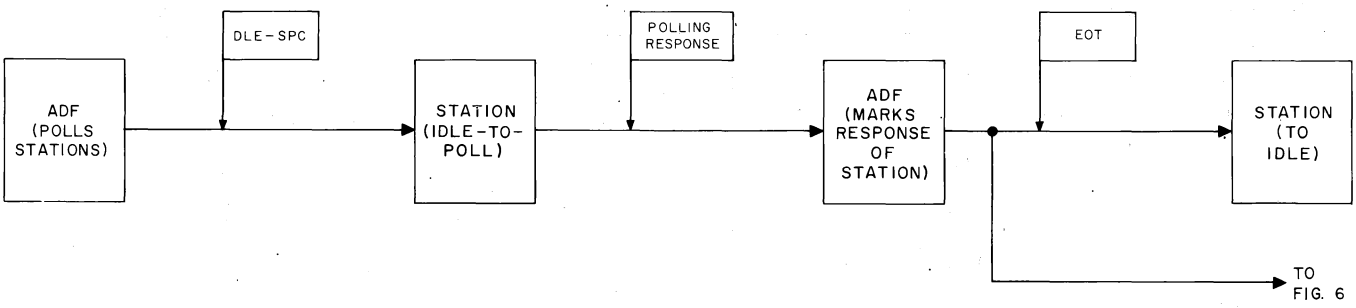


Fig. 5—Station Polling Sequence Chart

TABLE D

STATION POLLING RESPONSES

RESPONSE	STATE OF SENDING TERMINAL	STATE OF RECEIVING STATION
CAN	No Traffic To Send	Ready to Receive
R-ACK	Regular Traffic to Send	Ready to Receive
P-ACK	Priority Traffic to Send	Ready to Receive
R-NAK	Regular Traffic to Send	Not Ready to Receive
P-NAK	Priority Traffic to Send	Not Ready to Receive
NAK	No Traffic to Send	Not Ready to Receive

Note: A station is ***READY*** to receive if it is not made busy and the DTR lead is activated.

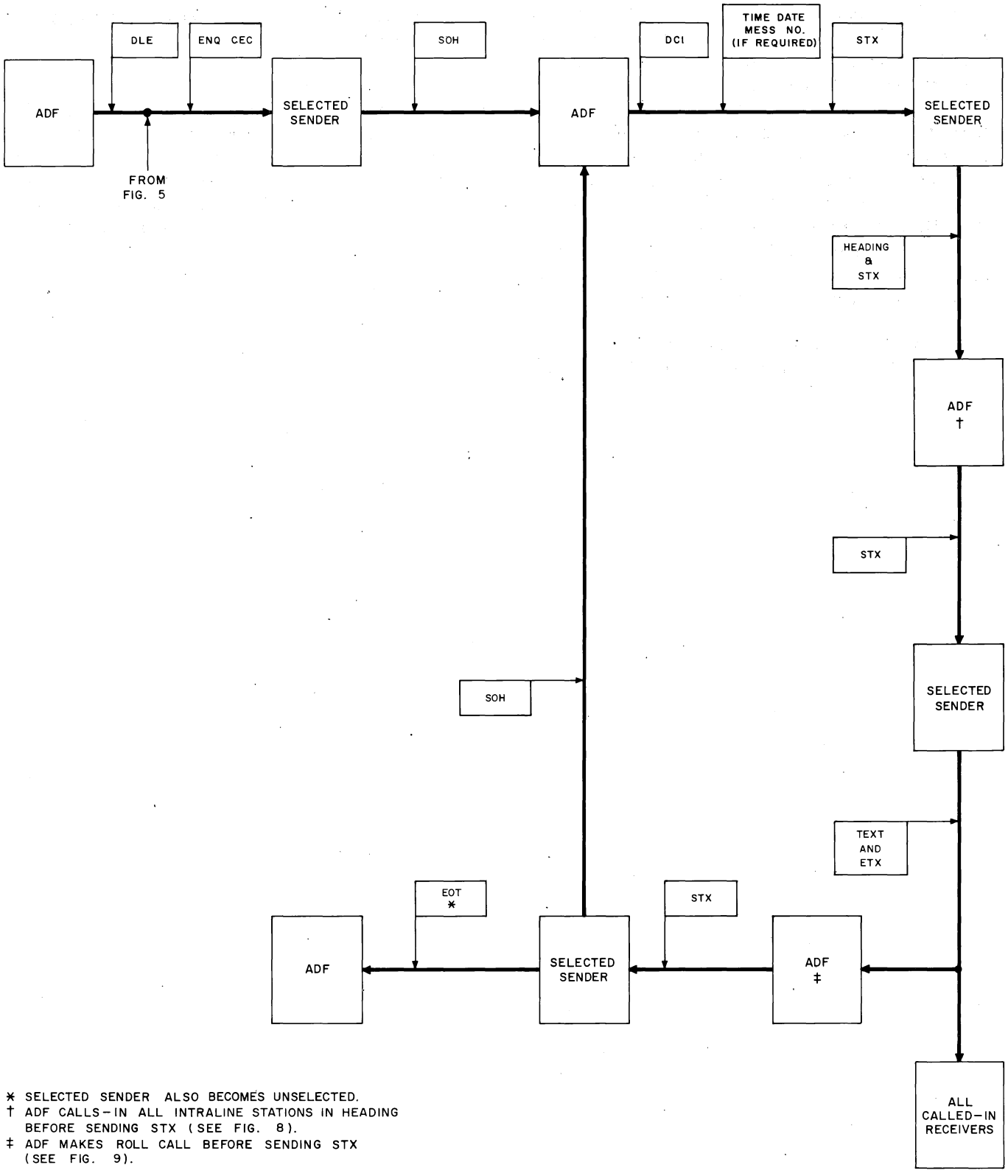
D. Sending the Message (Fig. 6)

3.08 Once the station has been polled and traffic is available, the ADF may elect to pick up the message regardless of the status of the station receiver, otherwise, the ADF sends EOT and the station is restored to idle. The ADF transmits ENQ followed by the unique call enquiry code (CEC) of the station, and, if traffic is still available, the station transmits SOH and is selected as a sender (TRANS/REC lamp lighted). The ADF now sends DC1. Detection of DC1 by the selected station causes the station RD lead to be unblinded. The ADF may now send an originating message number and originating date and time (when required) which are passed on to the terminal. Note that this information may be lost if the terminal is not ready to receive at this time. STX is now transmitted by the ADF causing the CTS lead to be activated. The station transmits the message heading and STX originated by the terminal. The controller detects the outgoing STX and deactivates the CTS lead. The ADF now checks heading validity and proceeds to call in any intraline station which is included in the heading. If required, the ADF sends personal address information and delivery number to the called-in receive station and then proceeds to call in any other addressed intraline stations. The ADF sends ENQ DC2, the date, time of generation, originating number (if required) and complete heading to all of the called-in receivers. The ADF now sends STX to the

selected transmit station, again activating the CTS lead. The terminal then transmits the text followed by ETX. The controller detects the outgoing ETX and deactivates the CTS lead. The called-in receive stations receive the message, including ETX, directly from the selected sender and the ADF stores the message for later transmission to the interline addressees. The ADF now "roll calls" the called-in receivers to determine if the message has been received properly. After roll call is completed, the ADF sends EOT to return the selected receivers to idle, and sends STX to the selected transmit station causing the CTS lead to be deactivated. At this time, one of the following may occur:

(a) If the station has additional messages to transmit, the terminal transmits an SOH. The station remains a selected sender, and ADF now sends DC1, as before, and the pickup process is repeated.

(b) If no additional messages are to be transmitted within the in-progress transmission, then the concluding message is followed by EOT. The EOT is detected, the station becomes unselected as a transmitter (TRANS/REC lamp extinguished), and the traffic available state is cancelled.



* SELECTED SENDER ALSO BECOMES UNSELECTED.
† ADF CALLS-IN ALL INTRALINE STATIONS IN HEADING BEFORE SENDING STX (SEE FIG. 8).
‡ ADF MAKES ROLL CALL BEFORE SENDING STX (SEE FIG. 9).

Fig. 6—Sender Selection Sequence Chart

Emergency Stop—Interrupting a Selected Sender (Fig. 7)

3.09 There are situations which make it necessary for the ADF to interrupt a selected sender. In order to interrupt a transmitting station, the ADF transmits a break consisting of a minimum of 0.5-sec space followed by 0.6-sec mark. The break is detected by the controller and the CTS lead is deactivated. The ADF now transmits DLE DC1 which activates the service message indicator (SMI) lead, unselects the station as a sender, and clears the "traffic available" state. Option Z is provided to activate the CI lead whenever the SMI lead is activated if required by the terminal. The ADF may now transmit a service message followed by EOT and restores the station to the idle state.

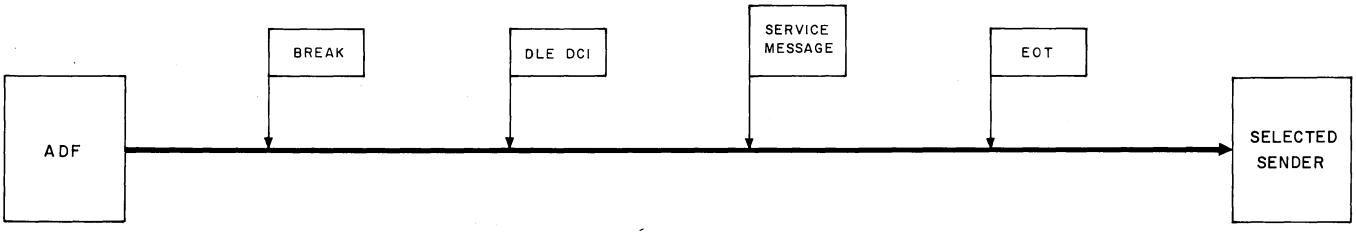


Fig. 7—Emergency Stop Sequence Chart

E. Receiving the Message

Call In (Fig. 8)

3.10 If the ADF has a station marked "ready to receive," it can call in that station as a receiver. To call in the station, the ADF transmits ENQ followed by the unique CEC of the station. The station responds with its unique station identity code (SIC) followed by either ACK if it is ready to receive, or NAK if it is not ready. If the station replies NAK, the ADF sends EOT to restore the station to idle. The station as a result of this response, is marked "not ready" by the ADF. Further call-in attempts will not be made. The station can be marked "ready" during the polling cycle only.

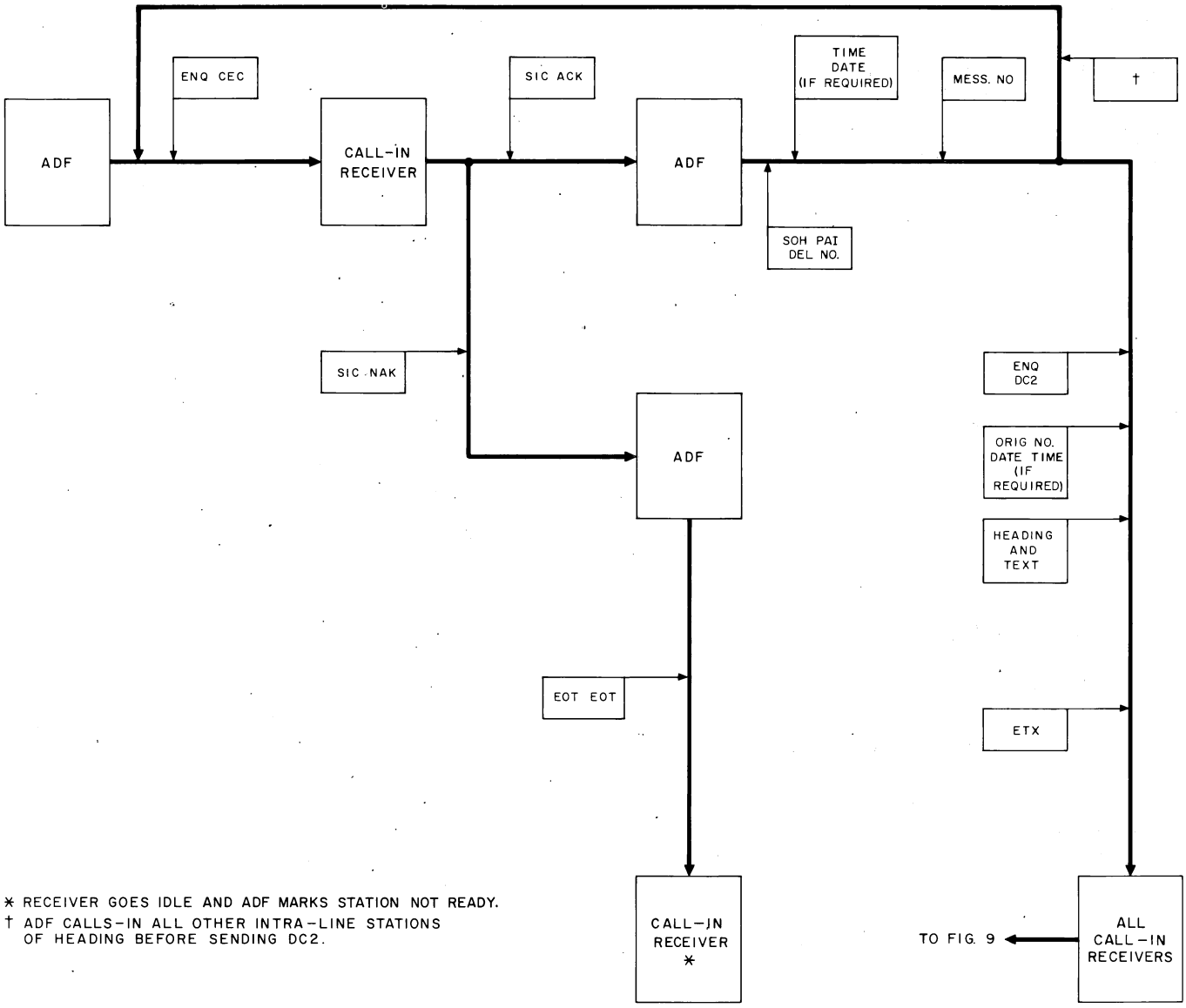


Fig. 8—Receiver Call-In Sequence Chart

3.11 A station is not ready to receive if any of the following conditions exists:

(a) The station is out of service (made busy).

Note: The station cannot be placed out of service if it is selected as a receiver or sender.

(b) The controller is in the process of initialization.

(c) The DTR lead is deactivated.

3.12 If the station response is SIC ACK, the TRANS/REC lamp is lighted, which signifies that the station is selected as a receiver, and the CI lead is activated. The ADF now transmits personal address information (if required) and the message delivery number to the station. If additional stations are to be called in, the process just described is repeated. The ADF now transmits ENQ DC2. The ADF transmits delivery time, date, originating number (when available), and message heading followed by STX. The message text followed by ETX is now transmitted by the ADF.

Parity Error

3.13 The eighth bit of the ASCII code is used to provide even-bit parity. That is, the eighth bit of each ASCII code character is chosen (mark or space) so that the character contains an even number of marking and spacing information bits. The controller monitors the number of spacing information bits of each received character. If the count is odd indicating a parity error, the incorrect character is changed to an underline (_) by the controller.

Roll Call (Fig. 9)

3.14 After the text and ETX have been transmitted, the ADF initiates roll call by sending ENQ followed by the station CEC. When the controller receives the ENQ, the station responds by transmitting its SIC followed by CAN if the message was received properly, or by NAK if it was not received properly. The NAK response is generated if any of the following occurs during the interval between the time the station was selected to receive and roll call.

(a) The DTR lead became deactivated, even momentarily.

(b) The controller detected a parity error on a received character.

When roll call is completed, EOT restores all called-in receivers to idle state.

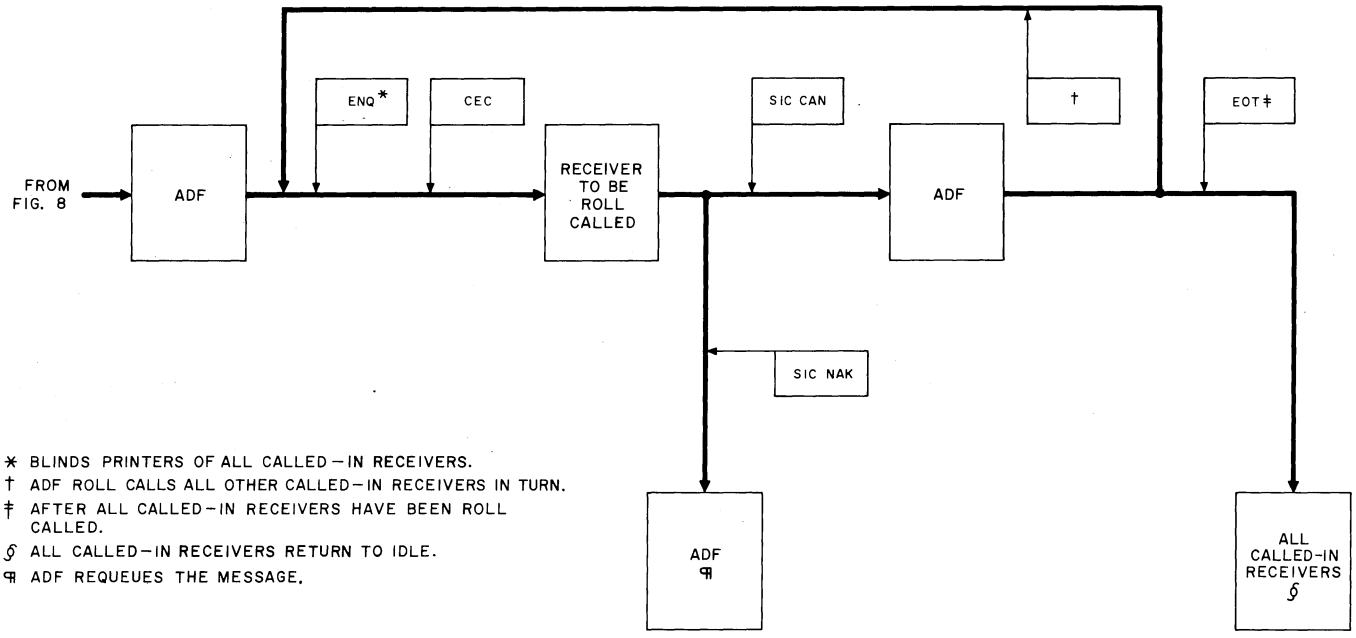


Fig. 9—Roll Call Sequence Chart

Service Message

3.15 There are situations under which ADF will send service messages at the beginning or end of a call-in sequence. Some of these service messages will be preceded by DLE, DC1. Option Y is provided to activate the SMI lead at this time if required by the terminal.

F. Station Functional Description (Fig. 10)

3.16 During the transmit sequence, the terminal produces voltage signals which conform to Electronic Industries Association (EIA) Specification RS-232-B and presents them to the controller. In the controller, the voltage signals are regenerated and sent to the data set. The data set converts

these voltage signals into voice-frequency data tones and then transmits them to the line.

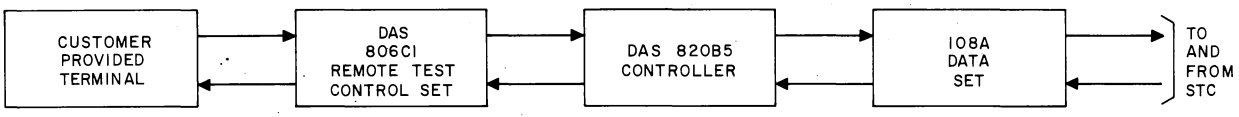


Fig. 10—Block Diagram of 150-WPM HDX Station

3.17 During the receive sequence, the data set converts the voice-frequency data tones from the line to EIA voltage signals which are presented to the controller. The EIA voltage signals are regenerated and sent to the terminal. During the automatic loop-back sequence, the control and data leads to the terminal are deactivated and the EIA signal generators are looped back to the EIA signal receivers within the station.

G. Common Control Functions

Out of Service

3.18 The station is placed in the out-of-service mode by operating the MAKE BUSY key on the attendant unit. If the MAKE BUSY key is operated when the station is either selected as a sender or receiver, the station will not go out of service until it is unselected. In the out-of-service mode the controller is conditioned to the not ready state and the traffic available state is inhibited, and all control signals to the terminal are deactivated. When the station is in the out-of-service mode, the MAKE BUSY lamp is lighted, however, the converse is not always true (see 3.19 and 3.20).

Maintenance Features

3.19 ***Automatic Loop-Back:*** Automatic loop-back tests may be performed remotely from the STC. The controller will be conditioned to the loop-back mode when it receives DLE, +. In this mode the control signals to the terminal are all deactivated and the EIA signal generators are looped back to the EIA signal receivers in the station controller. Data leads between the station unit and the terminal are deactivated. The terminal can neither generate nor receive traffic for the duration of the test. This mode allows the test center to make an on-line test of the transmission path and station as shown in Table E.

TABLE E

AUTOMATIC LOOP-BACK TESTS

TEST NO.	CONTROLLER RECEIVES	CONTROLLER SENDS	FUNCTION TESTED
1	DLE, DC1, EOT, ENQ, DC1	Nothing	Prove that station is not in loop-back
2	EOT, DLE, +	Nothing	DLE and + detection (places station in loop-back)
3	SPC	CAN	SPC detector and first CAN generator
4	ENQ, CEC	NAK	ENQ and CEC detectors and first NAK generator
5	DC1, ENQ, CEC	SIC, NAK	SIC and second NAK generator and DC1 detector
6	DLE, SPC	R, NAK	R and third NAK generator and DSR and RTSR interface circuits
7	ENQ, CEC	SOH	SOH generator
8	DC1, Note 1, STX, Note 2	Note 1, Note 2	DC1 unblinding, received STX detector and CTS, RTSP, RD, and TD interface circuits
9	SOH, Note 1	SOH	SOH detection
10	DC1, STX, Note 1, STX, Note 2	Note 1, STX	Transmitted STX detector
11	STX, Note 1, ETX, DLE, SPC	Note 1, ETX, P, NAK	ETX detector and P generator
12	ENQ, SPC, SPC	R, NAK	Priority reset
13	DC1, STX, U, O, G, C, A	U, up to "Break"	Break detector and SMI interface circuit
14	ENQ, DC1	SIC, ACK	ACK generator and the C1 and DTR interface circuits
15	SOH, ENQ	SOH	Heading unblinding
16	DC2, Note 1, DC1	Note 1	Message unblinding
17	ENQ, CEC	DC1, SIC, CAN	Roll call and second CAN generator
18	ENQ, DC2, Note 3, ENQ	Note 4	Parity error detection and underline generator
19	$\overline{\text{CEC}}$ (Note 5)	Nothing	False CEC detection
20	ENQ, CEC	SIC, NAK	Fourth NAK generator
21	EOT, ENQ, DC1	Nothing	EOT detector

Note 1: Any sequence of printing characters.

Note 2: Any sequence of printing characters differing from those used in Note 1.

Note 3: A sequence in which some characters which are supposed to contain the parity bit, but do not, and which some characters are supposed to contain the parity bit, but do.

Note 4: The same sequence of characters as used in Note 3 but with all bad parity characters replaced by underline characters.

Note 5: $\overline{\text{CEC}}$ denotes "not CEC" (any other character).

3.20 ***Manual Loop-Back:*** The R switch located on the controller disconnects the data set from the remainder of the station and connects the transmitted data lead to the received data lead of the data set. This isolates the station equipment which allows tests of the transmission facility and data set to be performed from the test center. In the manual loop-back mode, the MAKE BUSY lamp is lighted, and the control signals to the terminal are all deactivated.

Carrier Fail

3.21 When the carrier fail indication is received from the data set, all data and control signals to the terminal are deactivated.

Out of Synchronism Error

3.22 In TTY systems, a synchronous character timing is employed. Specifically, a mode of operation known as start-stop is used. A fixed time pattern is used for the group of bits representing a character, but each group is preceded by a signal transition which serves to denote when the fixed pattern is to start. In this system, the beginning of a character is identified by a mark-to-space transition. The start interval is spacing and is one-bit interval long. The stop interval is marking and is one-bit interval long for 150-wpm operation.

3.23 Normally the local clock, used for sampling and timing the information bits, is started on the mark-to-space transition of the start interval. The clock is arranged to run for a fixed number of cycles and stop during the stop interval of the incoming character. If the local clock is falsely started, or if the character is mutilated, there may be no marking interval on which to stop at the end of the normal sampling cycle. In this case, the timing circuit is arranged to stop after the normal timing interval and to wait for the next mark-to-space transition before recycling. The receiver usually regains synchronization quickly unless some repeated combination is transmitted which causes the selector to synchronize on a mark-to-space transition other than the normal start.

3.24 In order to reduce the number of incorrect characters which are printed when the receiver is recovering synchronization, the controller samples the received character at the end of the timing interval. If this sample is found to be a space, the incorrect character is changed to an underline (_) by the controller.

Carrier Squelch

3.25 The T switch located on the controller provides the option of squelching the data set 108A transmitter carrier whenever the data set detects the loss of received carrier.

H. Data Auxiliary Set 820B5 (Fig. 11)

3.26 A block diagram of the controller (DAS 820B5) is shown in Fig. 11. The heavy lines represent the data transmission paths and the light lines the control signal paths.

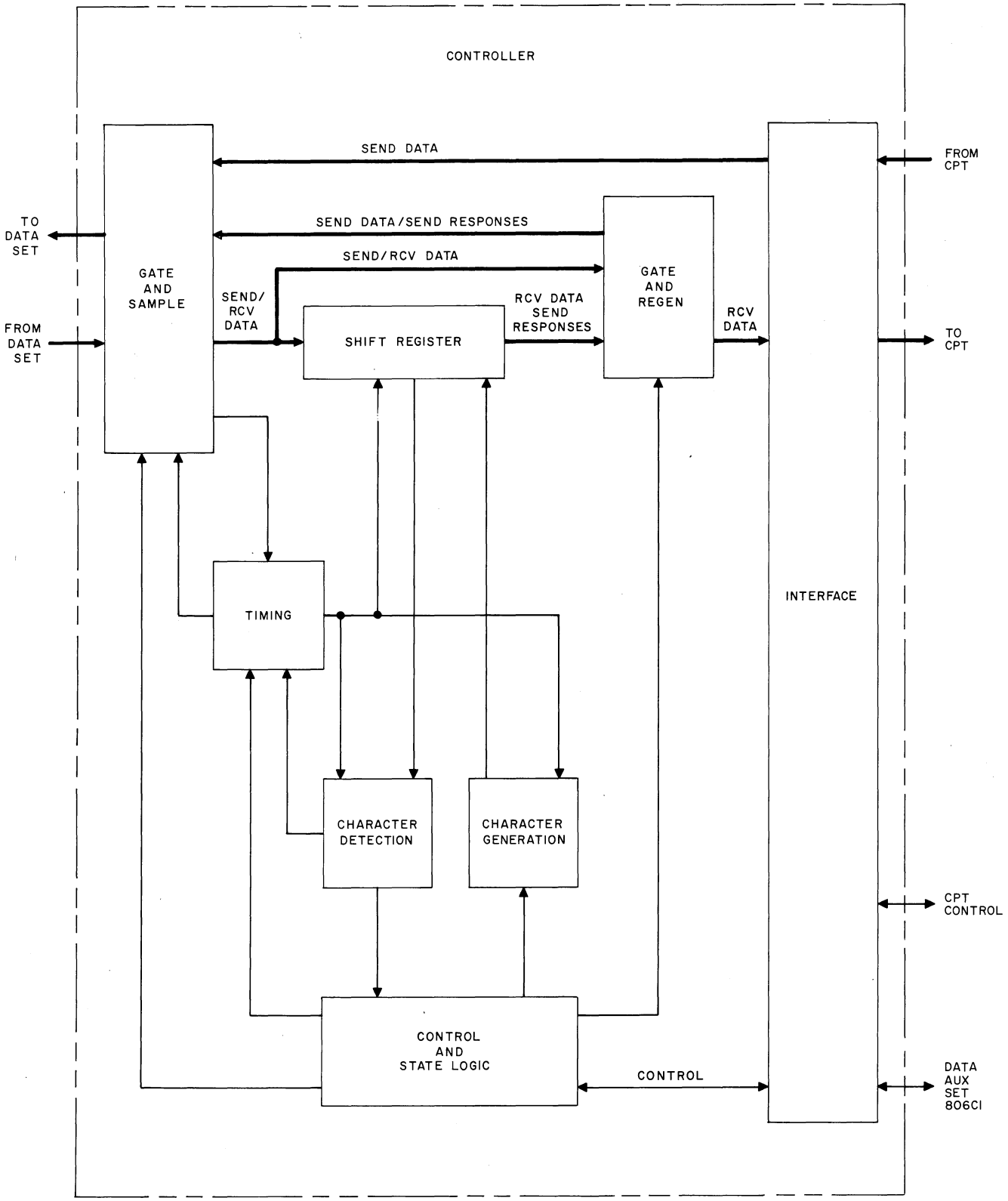


Fig. 11—Block Diagram of Station Controller for use With Customer Provided Terminal

Receive Mode

3.27 Characters are received serially from the data set under control of the gate and sample circuit. The start of each character triggers the local clock in the timing circuit and the clock runs for the duration of the character. The local clock is used to sample each bit of the received character and serially shift it into the shift register. Each character is monitored, as it is shifted into the shift register, by the character detection circuit. This is done in order to detect specific receive control characters. These characters are ENQ, CEC, ETX, EOT, DC2, DC1, DLE, STX, +, and SPC.

3.28 When a receive control character is detected, the character detection circuit signals the control and state logic circuit in order to sequence the controller through the various receive modes. Signals from the character detection circuit also trigger the clock circuit in order to provide timing for responses generated by the controller.

3.29 Each succeeding incoming character initiates a new timing cycle and the previous character is shifted out of the shift register and regenerated. After regeneration, the received characters are gated and applied to the customer provided terminal.

Generation of Responses

3.30 The responses generated by the controller are ACK, NAK, CAN, SIC, SOH, P, and R. Which of these characters are generated as a response is governed by the control and state logic circuit which monitors the status of the station equipment. The character is written into the shift register from the character generation circuit in a parallel fashion. The character is then serially shifted out of the register by the local clock, regenerated, and then gated to the data set for transmission to the line.

Send Mode

3.31 Characters from the customer provided terminal are applied serially, via the interface circuit, to the gate and sample circuit under the direction of the control and state logic circuit. Timing for the send characters is developed in the same manner as it was for the receive characters. After sampling, the send characters are regenerated and gated to the data set.

3.32 At the same time, the send characters are also serially inserted into the shift register. Each character is monitored, as it is shifted into the shift register, by the character detection circuit. This is done in order to detect specific transmit control characters. These characters are SOH, STX, ETX, and EOT. When a transmit control character is detected, the character detection circuit signals the control and state logic circuit in order to sequence the controller through various transmit modes.

Interface Circuits

3.33 The interface circuits control and monitor the station signals between the controller and the customer provided terminal. Some of the more important functions of the interface circuits are:

(a) Data signal exchange.

(b) Control signal exchange.

(c) Noise filtering.

I. Data Auxiliary Set 806C1

3.34 The Data Auxiliary Set 806C1 functions as a remote test control set used with Data Auxiliary Set 820B5. Data Auxiliary Set 806C1 provides the following:

- Mounting plate for Data Auxiliary Set 820B5
- Fuse protection and power switch for Data Auxiliary Set 820B5
- Keys and lamps required for maintenance of the data station
- Relays for loop-back test control

3.35 The mounting plate provides no electrical function and is described in Part 2, the physical description of this section.

3.36 The ac power circuit of each data station unit is protected by a 1/2 ampere fuse. A power OFF-ON switch is provided for removal of power when necessary during maintenance.

3.37 A MAKE BUSY key and lamp are provided to switch the controller out of service during

maintenance tests. The controller does not go out of service while selected by the ADF to send or receive. A TRANS/REC lamp is provided to indicate when the station is selected by the ADF for transmission or reception of traffic.

3.38 Two relays are provided for loop-back control. When the relays are activated, the EIA signal generators are looped back to the EIA signal receivers and all the data and control leads to the terminal are deactivated.

J. Data Set 108A

3.39 The Data Set 108A-type provides low-speed, full-duplex, serial data communications over 2-wire voiceband transmission facilities. The Data Set 108A communicates only with a Data Set 108B.

3.40 The data sets employ frequency-shift-keyed modulation and the transmit and receive frequencies are fixed. Therefore, two data sets of the same type cannot communicate with each other. Table F lists the line frequencies for the data set.

TABLE F

LINE FREQUENCIES FOR THE DATA SETS

DATA SET	FREQ BAND	MARK FREQ	SPACE FREQ
108A	Transmit	2225 Hz	2025 Hz
	Receive	1270 Hz	1070 Hz
108B	Transmit	1270 Hz	1070 Hz
	Receive	2225 Hz	2025 Hz

3.41 The block diagram in Fig. 12 shows Data Set 108A which consists of a sender, or transmitter, a receiver, and a carrier fail circuit. A hybrid provides a 2-wire to 4-wire connection for the send and receive circuits.

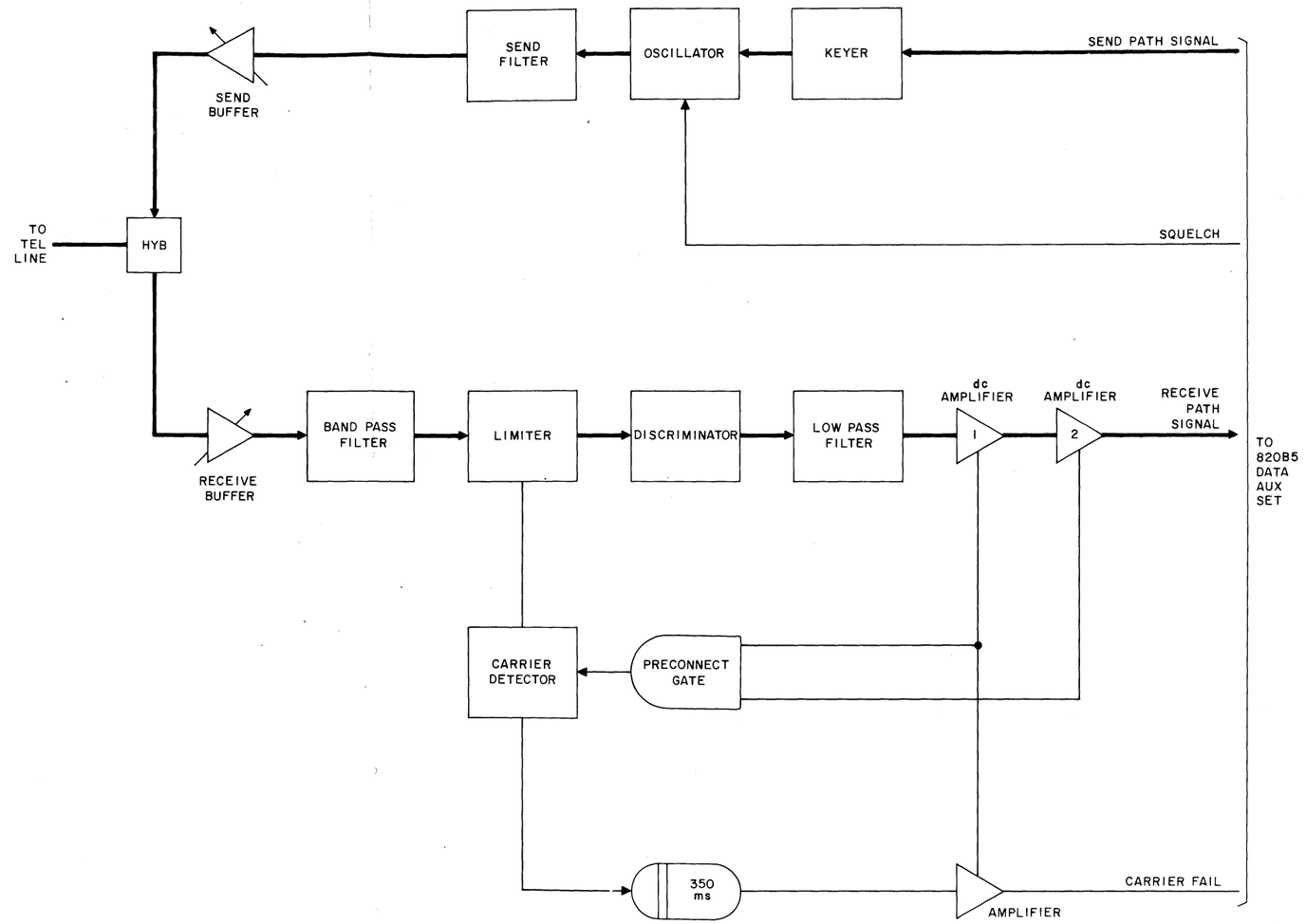


Fig. 12—Data Set 108A—Block Diagram

Send Circuit

3.42 The transmitter consists of an oscillator, a keyer, a filter, and a buffer amplifier. In the idle or marking condition, the keyer is conditioned to cause the oscillator to generate a steady mark signal tone (2225 Hz). The output of the oscillator is filtered and applied to the send buffer amplifier.

3.43 The send buffer amplifier, in addition to isolating the send filter impedance from the hybrid, is an adjustable gain amplifier with an output level range of 0 dBm down to 14 dBm. The output of the send buffer ampjifier is applied to the hybrid and then to the line.

Receive Circuit

3.44 The receive circuit consists of a buffer amplifier, bandpass filter, limiter, discriminator, low-pass filter, and dc amplifiers. The received signal from the hybrid is applied to the receive buffer amplifier. The receive buffer amplifier isolates the hybrid from the bandpass filter. The gain of the amplifier is adjusted in two 4-dB steps by means of screw-switches.

3.45 The output of the receive buffer amplifier passes through the bandpass filter to the limiter. The limiter amplifies and limits to provide an output with a constant amplitude, which is applied to the discriminator and the carrier detector. The discriminator detects, rectifies, and produces a voltage signal that is proportional to frequency. The output of the discriminator passes through the low-pass filter. The low-pass filter removes any ripple in the rectified signal from the discriminator.

3.46 The dc voltage output from the low-pass filter passes through the dc amplifiers and then to the controller.

Carrier Fail Circuit

3.47 The data sets incorporate loss-of-carrier detection (carrier fail circuit) which permits recognition of transmission interruptions caused by signal fading, line opens, etc. The carrier fail circuit consists of a carrier detector, a time-out gating circuit, an amplifier, and a preconnect gate. The carrier detector monitors the output of the limiter for the presence of an acceptable level of the carrier. The carrier detector circuit is activated when the received carrier power level falls below –40, –36, or –32 dBm (dependent on the setting of the D switch) for approximately 110 to 250 milliseconds. The carrier fail signal also clamps the receive data to a mark (ie, mark hold condition). After carrier fails, the data set will assume a preconnect mode. In this mode, the data set is not restored to normal until a marking carrier at normal power persists for approximately one-half second.

> ***Note:*** Some service applications using Data Set 108-type with Data Auxiliary Set 820B5 will use carrier squelch on data carrier failure option. When this option is provided, the amplifier will also condition the squelch amplifier to connect a ground to the oscillator, thereby turning off transmitted carrier to the distant data station.

3.48 When the two conditions have been met for 200 to 400 milliseconds, the carrier detector circuit removes the signal to the amplifier. The amplifier removes the clamp on the received path signals lead, turns on the data carrier detector lead to notify the terminal equipment that carrier has been restored, and, if the squelch option is provided, removes the ground to the oscillator.

4. OPERATION

4.01 Operation of the data station unit, in the normal sense, is autonomous. When ac power is applied to the station unit, the controller circuits will be initialized.

4.02 Outgoing messages are originated by the terminal. Incoming messages are generated by the calling data station.

4.03 Operational features provided by the Data Auxiliary Set 806C1 are primarily for the performance of maintenance and tests prescribed in Sections 598-046-310 and 598-046-510.

4.04 The Data Auxiliary Set 806C1 provides the following:

- MAKE BUSY key and lamp
- TRANS/REC lamp
- Power switch and fuse

A. MAKE BUSY Key and Lamp

4.05 The MAKE BUSY key is a push-push type key which provides alternate action type operation. Operation of the key consists of two cycles:

- When the MAKE BUSY key is depressed the first time:

  (1) If the station unit is unselected, when the key is operated, the station is placed in the out-of-service mode.

  (2) If the station unit is selected by the ADF for sending or receiving, operation of the key enables the out-of-service mode when the station becomes unselected.

- When the key is depressed the second time, the data station is restored to service and can be selected by the ADF.

4.06 The MAKE BUSY lamp lights when the MAKE BUSY key is operated to place the station unit in the out-of-service mode.

B. TRANS/REC Lamp

4.07 The TRANS/REC lamp lights when the station unit becomes selected by the ADF.

C. Power Switch and Fuse

4.08 The power switch may be employed to remove power from the station unit when circuit cards are to be removed or when removal of power is required by maintenance and test procedures.

Note: Except in emergency conditions, the power switch should never be turned OFF until after the MAKE BUSY key has been operated to remove the data station unit from service (TRANS/REC lamp is extinguished and the MAKE BUSY lamp lights).

4.09 If the MAKE BUSY lamp does not light when the MAKE BUSY key is operated, check fuse F1.

4.10 Momentary interruption of the ac power by operation of the power switch to the OFF position (when the station unit is in the out-of-service mode) will initialize all the logic circuits of the applicable station controller.

5. REFERENCES

5.01 The schematic drawing and circuit description pertaining to DAS 820B5 and 806C1 is SD- & CD-1D156-01 Data Auxiliary Set 820B5 with Data Auxiliary Set 806C1.