"DATASPEED*" 4540 REMOTE STATION ARRANGEMENTS

DESCRIPTION AND OPERATION

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1. GENERAL

1.01 This section describes DATASPEED 4540 remote clustered station arrangements and remote single display station arrangements, hereafter called clustered 4540 and4540 SDS. Some documents call the 4540 SDS a 4543. These station arrangements provide data communications with a line control unit (LCU) of a host computer and are designed for keyboard/display I/O applications, such as inquiry-response, data entry, and data retrieval.

1.02 This section is reissued to add the 4540 SDS and 45P106/AAA (for DATASPEED AP25) and 45AP201/AAA (for DATASPEED AP200) character printers. Hereafter, these printers are called AP25 and AP200.

Note: When ordering replaceable components, unless otherwise specified, prefix each part number with the letters "TP" (ie, TP410405).

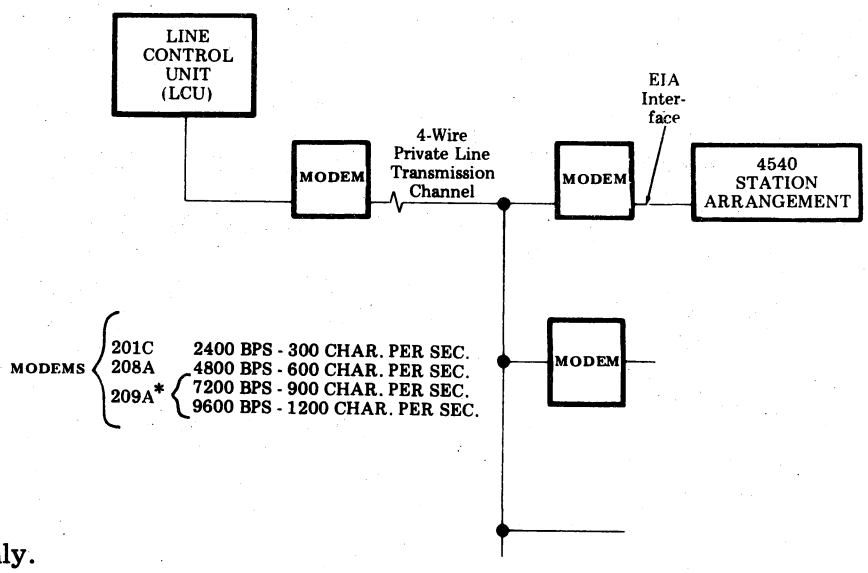
1.03 The BSC (binary synchronous communications) protocol used with 4540 conforms to American National Standards Institute (ANSI) standard X3.28-1971 sub 2.4 and, B2 plus RVI and WACK.

1.04 The BSC protocol described in this document allows the 4540 stations to operate on most systems that support IBM 3271 Model 2 control units, 3277 Model 2 display stations and 3284, 3286 or 3288 Model 2 printers.

1.05 The ADCCP protocol used with 4540 conforms to ANSI standard X3.66-1979. ADCCP (UN) is in turn compatible with UN (Unbalanced, Normal Response Mode) defined in HDLC (High Level Data Link Control), International Standards Organization (ISO) International Standards 3309, 4335, and 6159).

1.06 The ADCCP protocol described in this document allows 4540 stations to operate on most systems that support IBM 3271 Model 12 control units, 3277 Model 2 display stations, and 3284, 3286, or 3288 Model 2 printers.

1.07 Transmission rates between LCU and 4540 are at 2400, 4800, 7200 or 9600 bps. Transmission can occur over a 4-wire dedicated (private wire) voice grade or digital data network. Switched network (Direct Distance Dialing) circuits may also be employed to provide 4-wire backup facilities. The 4540 can be used with the following type of modems or equivalent: 201C, 208A, 209A or 500A as applicable. See Fig. 1.



*Point-to-point only.

Fig.1—Typical System

1.08 The clustered 4540 SCC operates as a BSC or ADCCP station depending on the 45FG110-type feature group circuit card used. All other hardware is the same. The 4540 SDS operates as a ADCCP station only.

1.09 At the heart of all 4540 terminal configurations is a multipurpose microprocessor based controller which connects the various components and defines the individual operating characteristics of each arrangement. The station cluster controller (SCC) of the clustered 4540 provides up to 32 SSI ports for device connection and the SDS provides an SSI port for connecting a keyboard and another for connecting a printer. An EIA RS232 port interfaces with transmission facilities. Field selectable options are selected from the keyboard.

1.10 The following hardware items are different from the DATASPEED 40/4 clustered station arrangement.

- 45C340 station cluster controller which permits up to 32 devices.
- 45D201 display for 4540 SDS includes controller which permits two SSI ports and one EIA RS232 port.
- 45D101 display which includes refresh and memory and permits SSI interconnection to the 45C340 controller and a keyboard.
- 45K301 keyboard which includes an external numeric cluster and an optional magnetic stripe reader (Operator I.D. badge reader) and/or keyboard lock.
- Furniture for printers, controller, and keyboard display mounting.

2. STATION CONFIGURATIONS

2.01 Each clustered 4540 station can be configured for up to 8, 16, or 32 devices, and must have a KD connected to controller port No. 1. A maximum of eight printers can be configured by the SCC (seven printers for 8-Device SCC). Device address is determined by selection of the SSI port at the SCC.

TABLE A

SDS KD
SDS PRINTER
SCC DEVICES

Port No.	Device No.	Device Address (BSC Only)	Device Cnfgrn
1	0	Space	8
2	1	A	
3	2	B	
4	3	C	
5	4	D	
6	5	E	
7	6	F	
8	7	G	
9	8	H	16
10	9	I	
11	10	[(¢)	
12	11	.	
13	12	<	
14	13	(	
15	14	+	
16	15	! (|)	
17	16	&	32
18	17	J	
19	18	K	
20	19	L	
21	20	M	
22	21	N	
23	22	O	
24	23	P	
25	24	Q	
26	25	R	
27	26	] (!)	
28	27	$	
29	28	*	
30	29	)	
31	30	;	
32	31	^ (¬)	

(Where 2 characters are shown, ASCII is at left, EBCDIC at right.)

Each 4540 SDS can be configured for one KD or one KD and one printer. The KD must be assigned as device 00 and when a printer is used it must be assigned as device 01.

2.02 The SCC device configuration determines the port numbers and device addresses available (eg, if 13 devices are to be handled, ports 1 through 16, and device addresses "space" through "!" would be available for use). See Table A.

2.03 Basic furniture arrangements for SCC and SDS are available as follows:

- Free-standing SCC, see Fig. 2.
- Attached SCC, see Fig. 2.
- SCC (only) under 4500-style wide table, see Fig. 2.
- Free-standing SDS, see Fig. 3.
- Attached SDS, see Fig. 3.

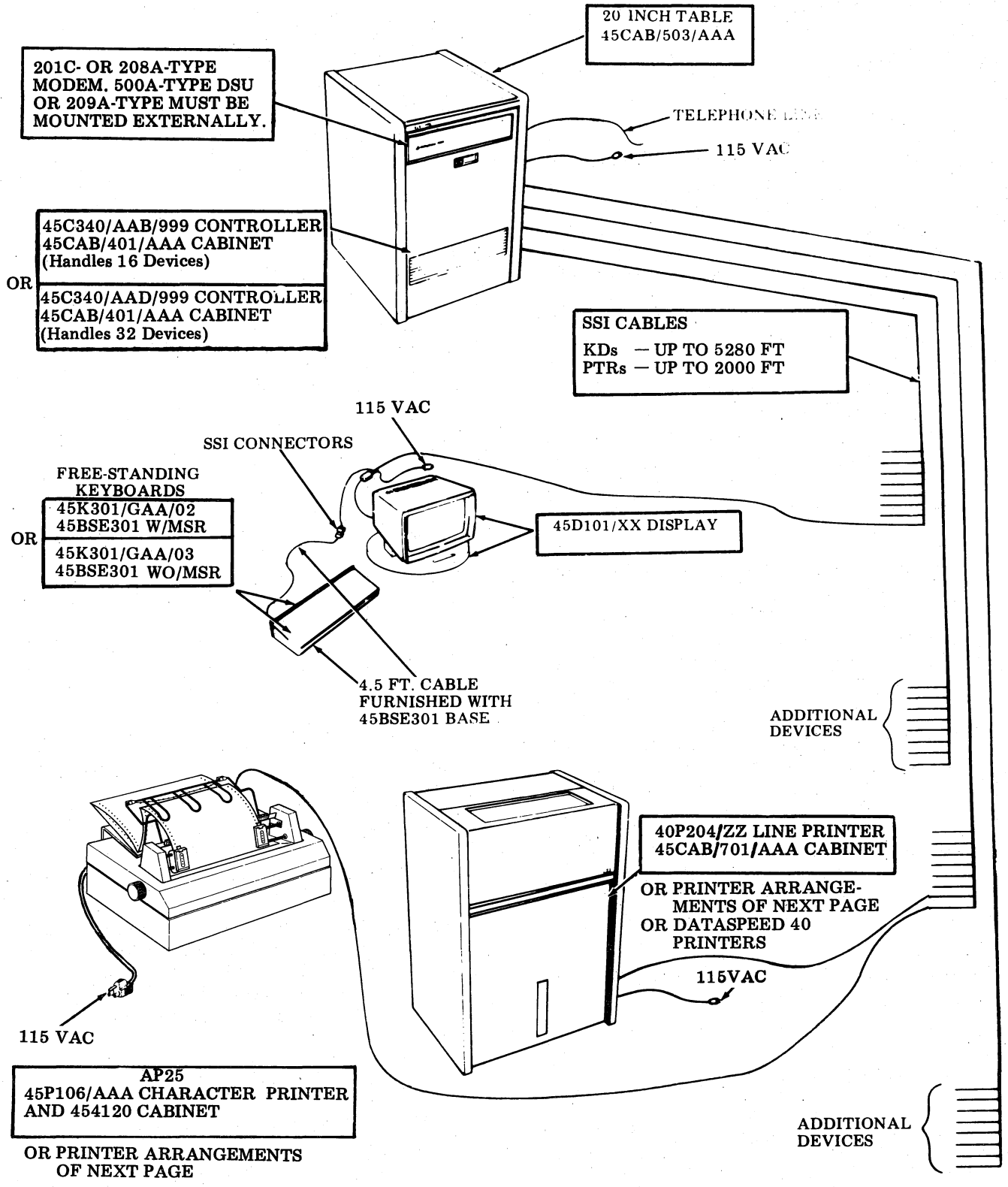


Fig. 2—Clustered 4540 Station
(Example of 16- or 32-Device Configuration With Free-Standing SCC)

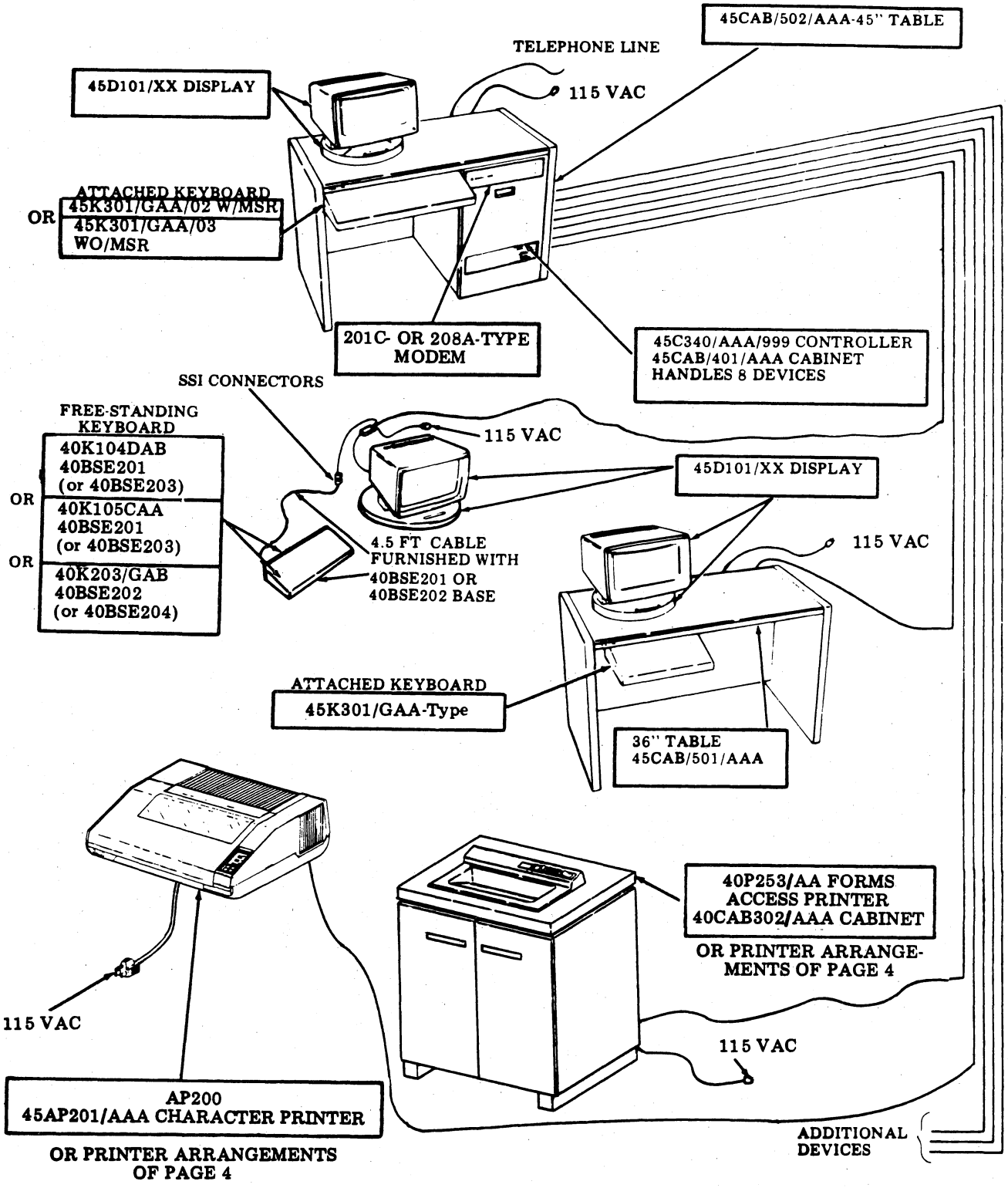


Fig. 2—Clustered 4540 Station (Contd)
(Example of 8-Device Configuration With SCC Under 4500-Style Wide Table)

Separately ordered EIA cable.

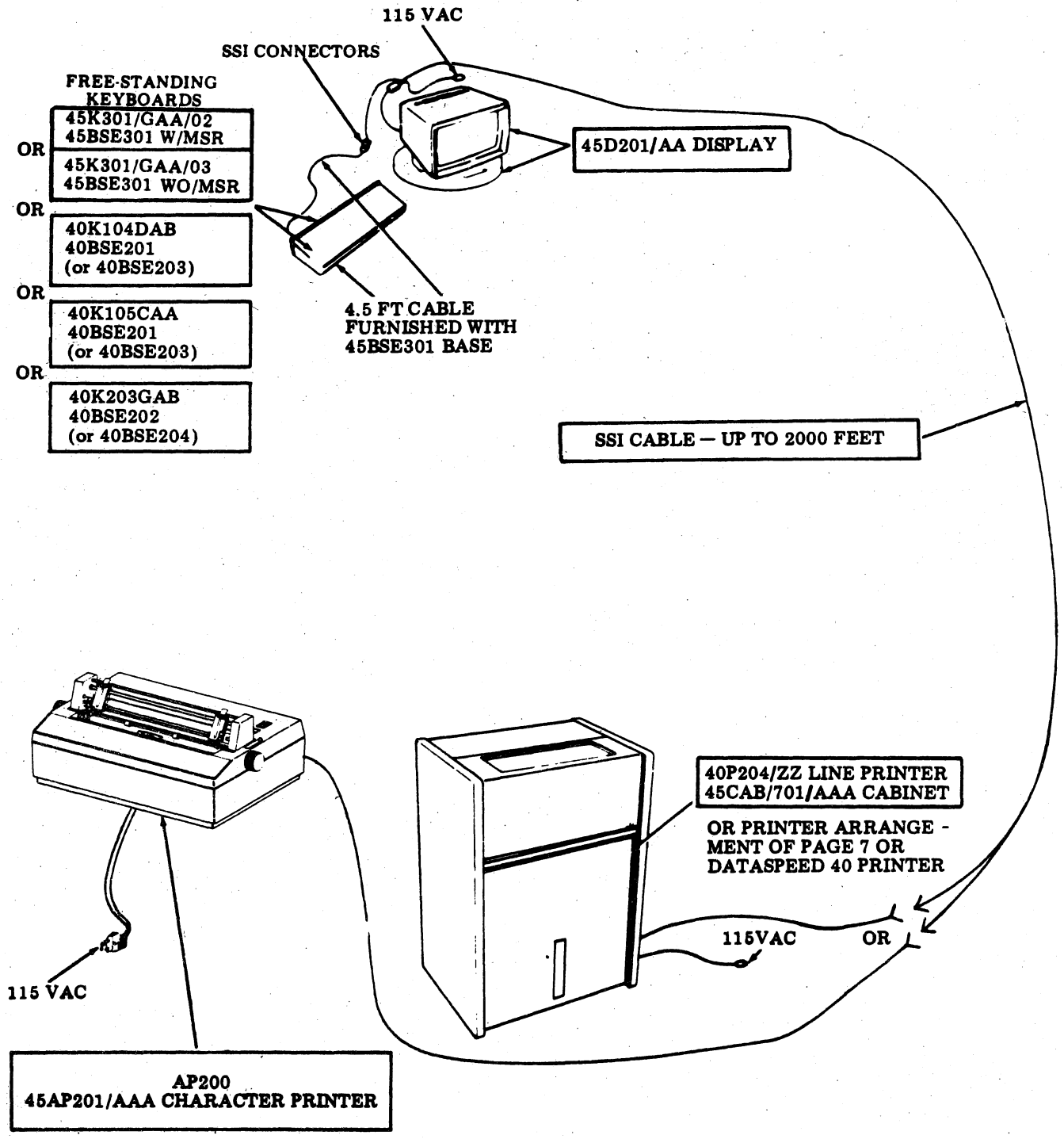


Fig. 3—4540 SDS
(Example of SDS With Free-Standing KD)

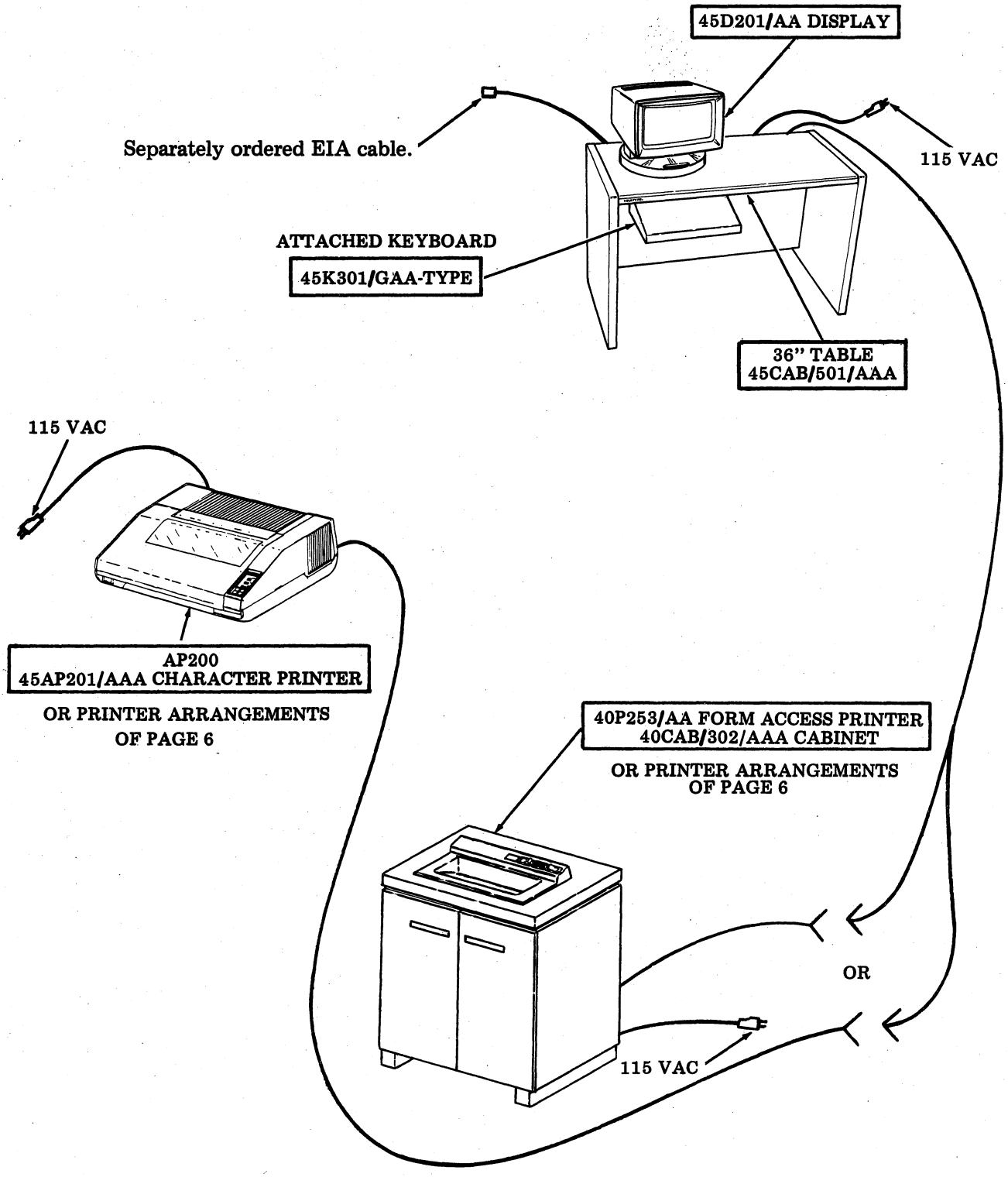


Fig. 3—4540 SDS (Contd)
(Example of SDS With Attached KD)

3. MAJOR COMPONENT DESCRIPTION

3.01 The clustered 4540 and 4540 single display station components (SCC, display base, monitor, keyboard, and printer)are described below. The SCC is only used in clustered 4540 stations.

STATION CLUSTER CONTROLLER (SCC)

3.02 The 45C340-type controller (SCC) is designed to meet the communications, data line and device interface requirements for clustering up to 32 SSI connected devices. See Fig. 4. All SCC controllers are housed in self-supporting modules, readily mounted in 4500-style cabinets (45CAB401/AAA) or to other mounting arrangements suitable to the customer. While providing for the controller, the 45CAB401/AAA cabinet, will also accommodate a 201C- or 208A-type modem.

3.03 SCC functions:

- Provides an EIA RS232C data set interface for connection to the modem and Standard Serial Interface (SSI) ports for connection to the devices.
- Manages the line protocol (polling, selecting, data transfer, and error recovery).
- Controls data flow between itself, data set, and devices.
- Controls the printer (printer buffers are located in SCC).
- Maintains status information on all devices.

3.04 The SCC consists of an eight bit, microprocessor based controller and power supply unit. The operating program is stored in 32K bytes of read-only memory (EPROM). An additional 4K bytes of EPROM store the controller self-test routines. The controller contains the circuit cards listed in Table B. See Fig. 5 for SCC block diagram.

- The 410311 circuit card contains the microprocessor, 32K bytes of read-write, RAM, EIA interface, a counter-timer, the self test firmware, and three DMA (Direct Memory Access) controllers. The read/write RAM utilizes dynamic MOS semiconductor devices which are automatically refreshed while the controller is executing a program. This card contains the controller self-testing hardware. The controller self test can be performed independently most other hardware (eg, SSI intercon cards, etc).
- One or two circuit cards provide the SSI interfaces (depending on the number of SSI interfaces required). 410314 provides up to 8 ports, while one 410313 provides up to 16 ports. Two 410313 circuit cards provide up to 32 ports. See Table B for controller arrangements.
- The feature group circuit card 45FG 10 type provides up to 32K bytes of EPROM (in sockets) containing the operating program. 256 bytes of read-write memory is included for field options. A rechargeable battery is associated with this memory so that set options are retained during power-down intervals. This battery is charged whenever the power switch to the controller is on. When fully charged, the battery provides option retention for power off interval of 17 days.
- One or more 410319 SSI intercon cards (that do not directly interconnect to the micro-processor bus) provide mounting for the transformers and connector of the SSI links. One 410319 and associated 452154 intercon cable is required for each eight SSI ports (See Fig. 6.). There are no active circuit components on the 410319 circuit card.
- The 410320 circuit card contains the EIA interface between the SCC and the data set. There are no active circuit components on the 410320 circuit card.

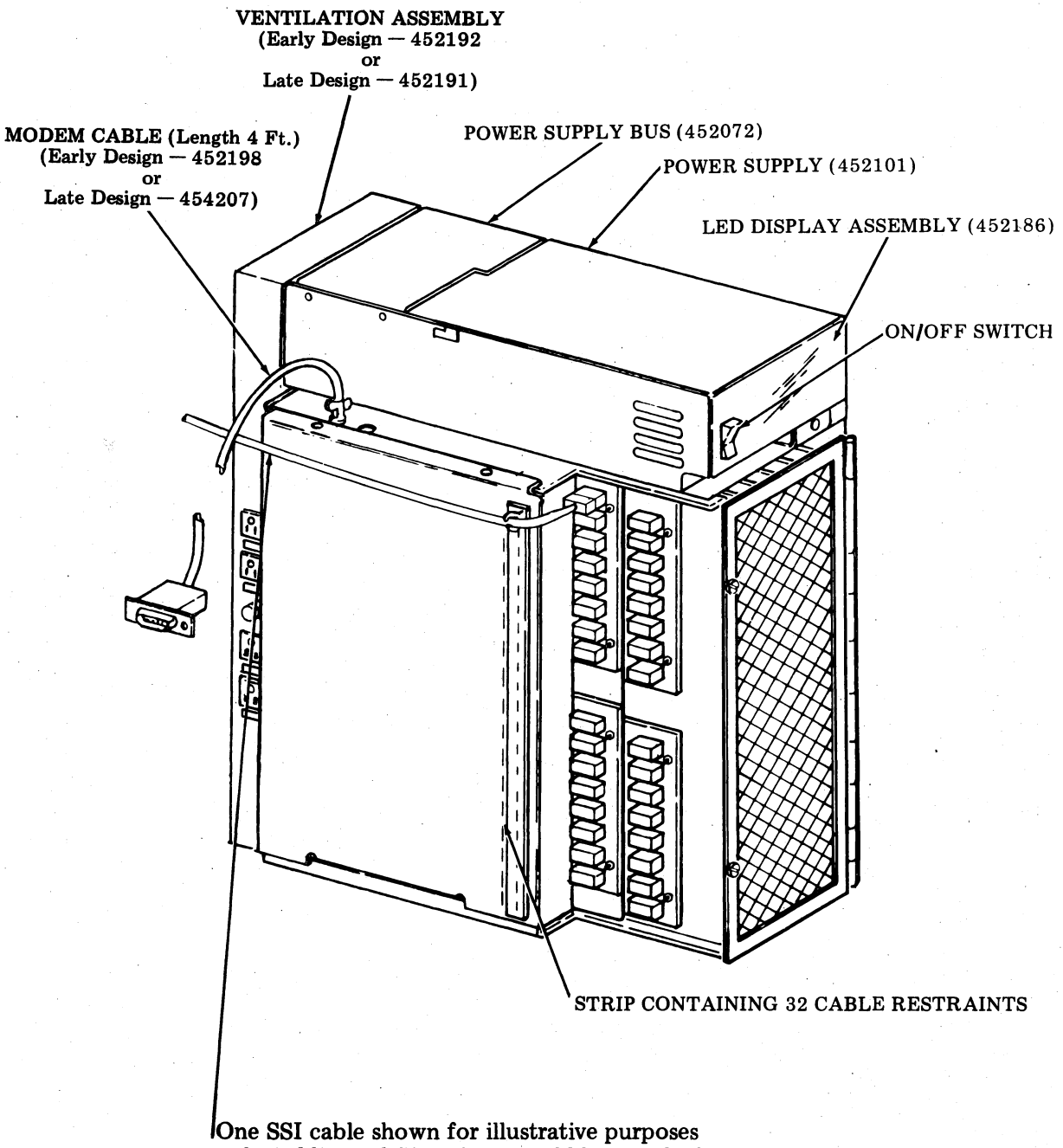


Fig. 4—32-Device 45C340 Controller

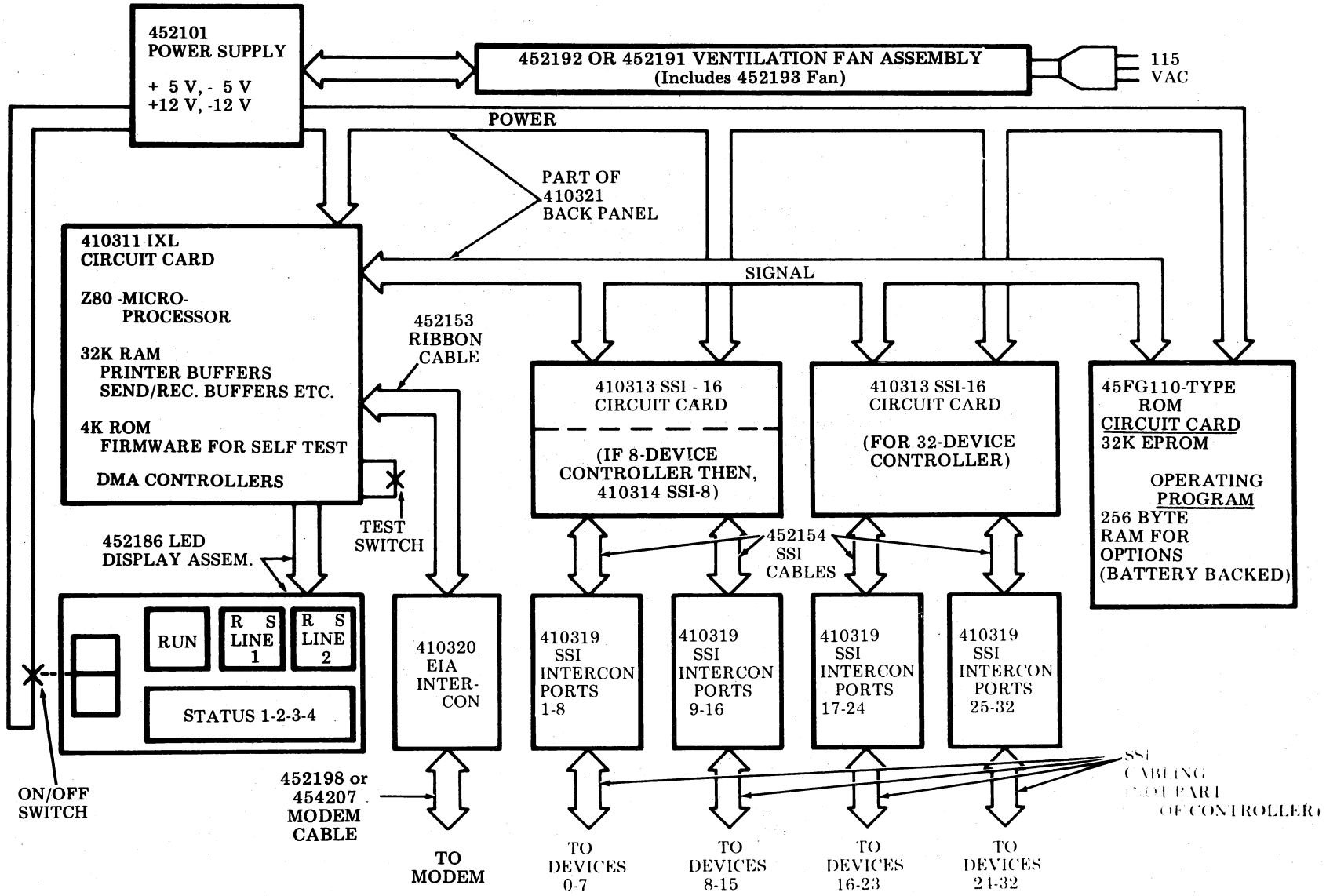
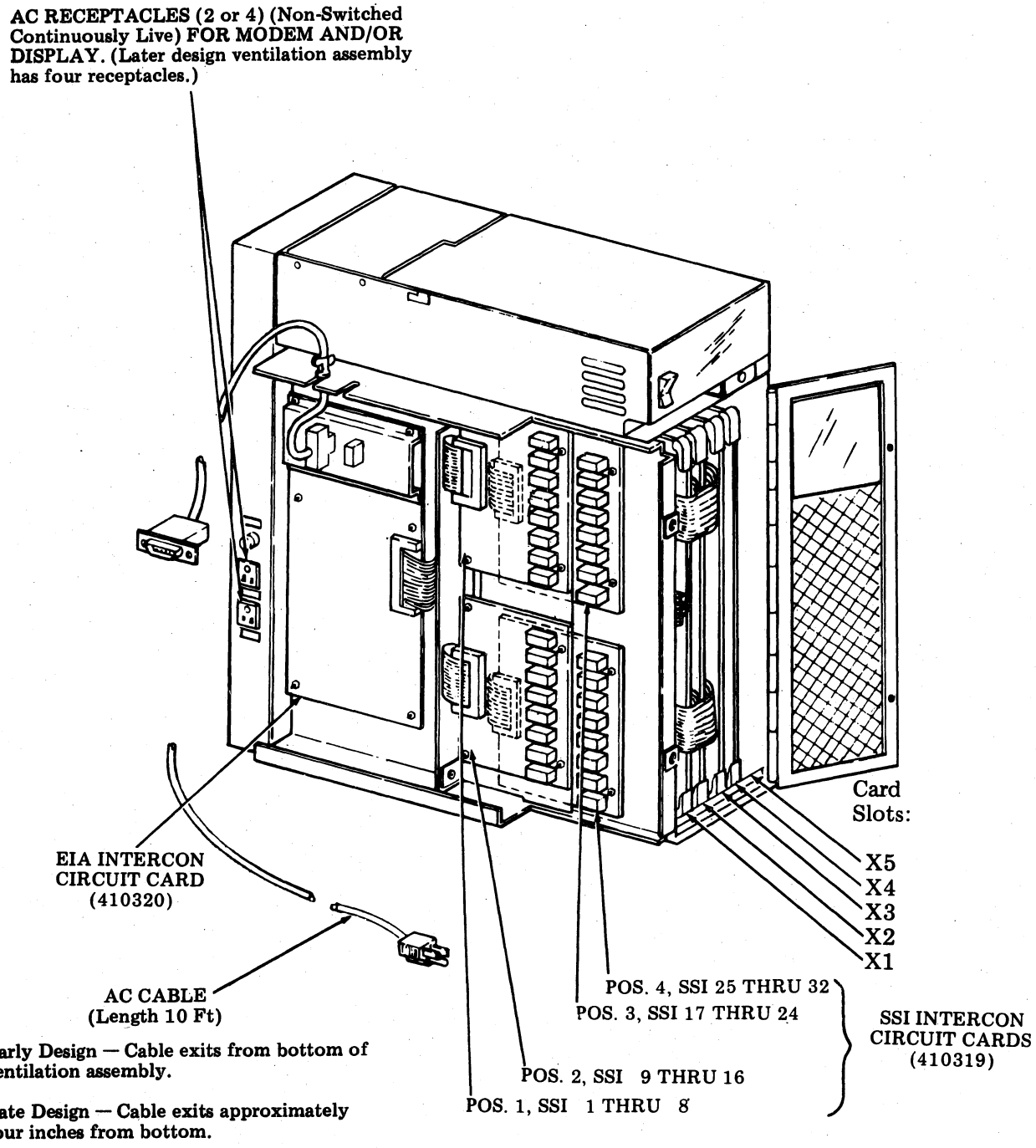


Fig. 5—45C340 Controller-Block Diagram



Note: Effective length to ac receptacle is 8 feet.

Fig. 6—32-Device 45C340 Controller
(Left side cover removed, door opened.)

TABLE B

CLUSTERED 4540 STATION

BASIC CONTROLLER ARRANGEMENTS

Handles Up To	Circuit Card Positions					45C340
	1	2	3	4	5	
8 Devices	410311	410314	45FG110 type	—	—	AAA/999
16 Devices	410311	410313	45FG110 type	—	—	AAB/999
32 Devices	410311	410313	410313	45FG110 type	—	AAD/999

410311 - IXL/32K RWM
410314 - SSI-8
410313 - SSI-16
45FG110-Type - Feature Group Card

3.05 The LED display assembly (452186) has 4-status LEDs, a run LED, and 2 LEDs to indicate the send and receive line condition of the data set interface. A cable connects the LED display assembly to the IXL card. A cut-out in the 4500 style controller cabinet provides external visibility of the display LEDs, plus access to the controller on/off switch.

3.06 The interface signal leads to the modem are shown in 5.10. These leads will interface 201-, 208- and 209-type modems in addition to Digital Service Units (DSU) operating up to 9600 baud.

3.07 The SCC Power Supply Unit (PSU) has the following output voltages: +5 V dc, -5 V dc, +12 V dc, -12 V dc, and 24 V dc. The 24 V dc is not used for this application. A LED indicator on the power supply indicates ("ON") when all voltages of the power supply are within tolerance.

3.08 The SCC also includes a self-test feature. The IXL circuit card includes the self-test switch which is accessible to installer/maintenance personnel.

DISPLAY BASE (CLUSTERED 4540)

3.09 The display base consists of an 8 bit microprocessor based controller and a power supply. The display base supports the 40MN101/AA (or 40MN201/AA) monitor and cable connections. See Fig. 7.

3.10 The display base uses Large Scale Integrated (LSI) circuit technology to provide a compact, low-cost unit. The unit is capable of local data entry and text editing functions. The display is connected via an SSI (up to 5,280 feet) connection to the SCC which manages the data link control protocol function. An error detection and retransmission scheme between each display base and the associated SCC is provided.

3.11 The display base functional program and character font is "downloaded" from the associated SCC. This feature gives the SCC the ability to vary the display base functional program or character font without any change to the display base hardware. The following conditions will cause the display to be "downloaded":

- When the display base ac power is turned on, it will request to be "downloaded" by transmitting (via SSI) a request to the SCC. Since this request is continuously transmitted, the SCC power may be turned on after power is turned on to the display.

- When an option(s) defining the display base functional program (ie, line code, type of keyboard, intensify or blink display, continuous or single alarm, numeric override, etc.) is initiated (system start up) or changed.

Upon either of the above conditions, the SCC will direct (via SSI) the display base to enter its load mode. The SCC operating program will then transmit the appropriate functional program and character font to the display base.

3.12 The major circuits of the display base are SSI ports, 4 k byte ROM, Address Multiplexer, 16 k byte RAM, Vicon, Font RAM, Video Circuitry, Microprocessor Logic, and Counter Timer Chip as described below.

- SSI Ports — Used for communication link between SCC and display base and between keyboard and display base.

- 4 k byte ROM — 2 k bytes contain memory for self-test, font loader and downloader. When power is switched on, the ROM directs the display base to request download from SCC. The remaining 2 k bytes are for future use.

- Address Multiplexer — Used to multiplex the address bits A0-A6 and A7-A13. Using a multiplexing scheme allows simplier circuit design so that there are less solder lands and fewer pins on IC chips.

- 16 k bytes RAM — Provides dynamic read/write memory for program control of SSI links. The RAM also provides display buffer memory and microprocessor scratch pad. The program is downloaded from the SCC.

- Vicon (Video Control) — Converts the contents of display buffer memory into dot information stored in the font RAM for the video circuitry.

- Font RAM — A static read/write memory containing 128 graphic symbols downloaded from SCC. Storing the character font in RAM allows changes in graphics without a hardware change in the display base.

- Video Circuitry — Converts the output of font RAM into 19.2 MHz serial dot signal. The video circuitry also adds half and double intensity, blink , and reverse video to the display signal.

- Microprocessor Logic — Controls the functions of the display base under program control.

- Counter Timer Circuit (CTC) — A programmable IC circuit which furnishes counting, timing, and interrupt functions.

3.13 A self-test capability permits verification of operability of the display base. The base run indicator is used to indicate the results.

This test is initiated by a switch in the display base, accessible by maintenance personnel. See Fig. 9.

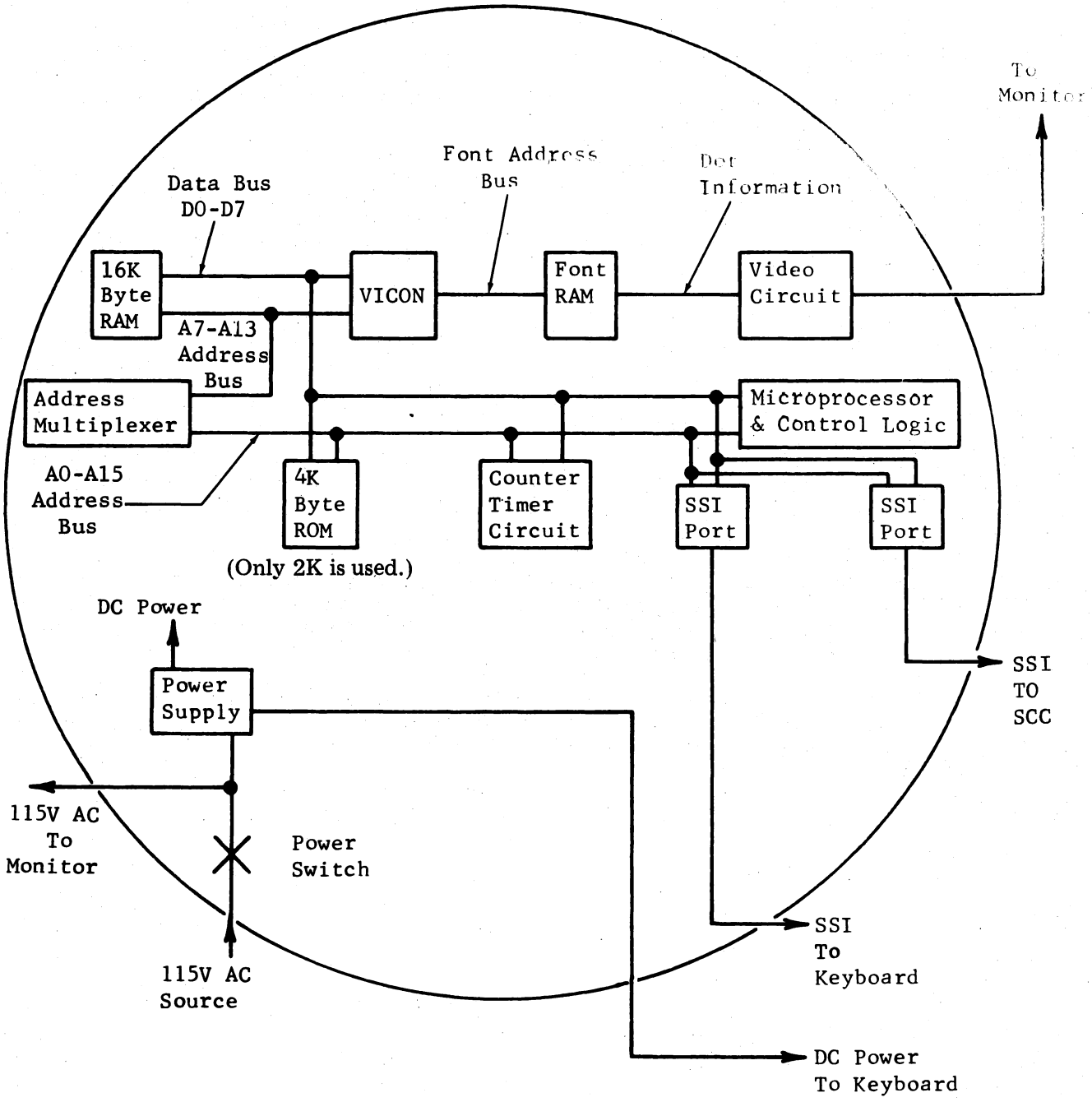


Fig. 7—Major Circuitry of Display Base For Clustered 4540

DISPLAY BASE (4540 SDS)

3.14 4540 display base functions:

- Provides an EIA RS-232-C data set interface for connection to the modem and Standard Serial Interface (SSI) ports for connection to a keyboard and printer.
- Manages the line protocol.
- Controls data flow between itself, data set, KD and printer.
- Controls the printer (printer buffer is located in the display base).
- Maintains status information on KD and printer.

3.15 The SDS display base consists of an eight bit microprocessor based controller and power supply. The controller and power supply are mounted on a circular circuit card which is locked inside a circular base (45C320). The operating program is stored in 28 k bytes of read only memory (EPROM). An additional 4 k bytes of ROM store the controller self-test routines. Also, a 16 k byte RAM provides for buffer memory for the devices, monitor, printer, etc, and short term storage for certain program functions. An Address Multiplex is used to interface 14 channels of the 16 channel address bus to the 7 channel inputs of the VICON and 16 k bytes buffer RAM. Using a battery backed 128 byte CMOS RAM memory, the options are retained for 16 days (fully charged battery) when the ac power is switched off. The controller contains the circuit cards shown in Fig. 8. Also, see Fig. 8 for SDS block diagram.

- The 45FG410/AF/01 circuit card set contains the stored program for the required logic functions. The initial offering consists of a two card set (EPROM). The two plug-in type circuit cards are labeled as follows: Card 1 of 2 (installed in Position 1), Card 2 of 2 (installed in Position 2). Each card has up to 14 k bytes of memory available for the station application program.
- The 410161 video card consists of three related circuits:

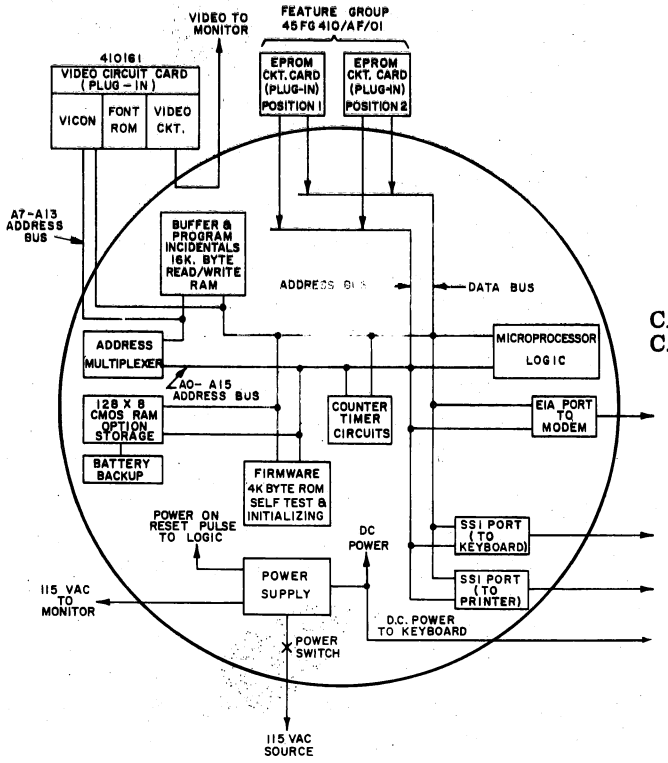
  VICON (Video Control) — Converts the contents of display buffer memory into dot information stored in the font ROM for the video circuitry.

  Font ROM — A static read/write memory containing 128 graphic symbols.

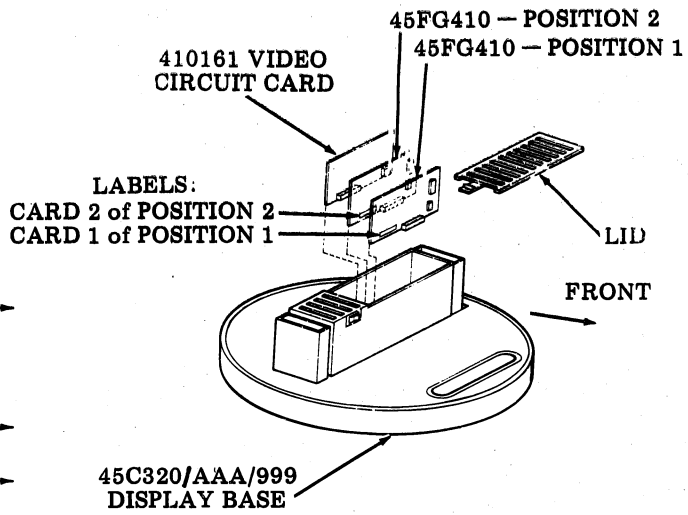
  Video Circuitry — Converts the output of font ROM into 19.2 MHz serial dot signal. The video circuitry also adds half and double intensity and blink to the display signal.

3.16 Five operator visible indicators, shown in Fig. 8, operate as follows:

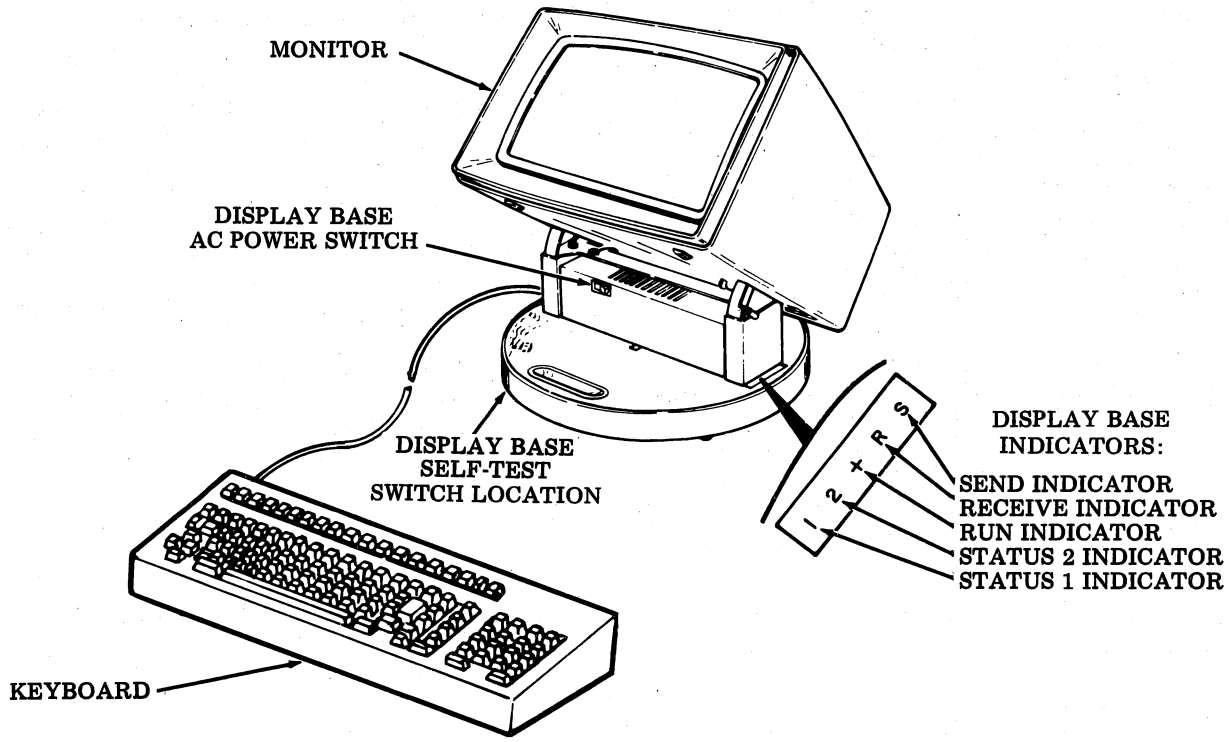
- Send Indicator — This indicator blinks when the station is transmitting.
- Receive Indicator — This indicator blinks when data signals are present on the telephone line receive channel.
- Run Indicator — This indicator is on when station power is applied. It is also used during display analysis by maintenance personel.
- Status 2 Indicator — This indicator is only used during display analysis by maintenance personnel.
- Status 1 Indicator — This indicator will light whenever SDS receives a valid frame for the station and the poll is set in the control byte. When a response is sent, the indicator turns off. This indicator is also used during display analysis by maintenance personnel.



SDS Display Base Block Diagram



SDS Display Base With Plug-In Cards Removed



SDS Display Switches and Indicators

Fig. 8—SDS Display

MONITOR

3.17 The basic function of the monitor is to display data on a 5-1/4 by 11-1/4 inch screen. The display format is 24 lines, 80 characters per line. The character font, "downloaded" from the SCC, is a full 96 character set. The 40MN101/AA monitor is used with standard 60 hertz alternating current. The 40MN201/AAA can be used with 50 or 60 hertz alternating current. The drive signals and ac power enter the display monitor through connectors located in the monitor suport legs. See Section 582-213-100 for more information.

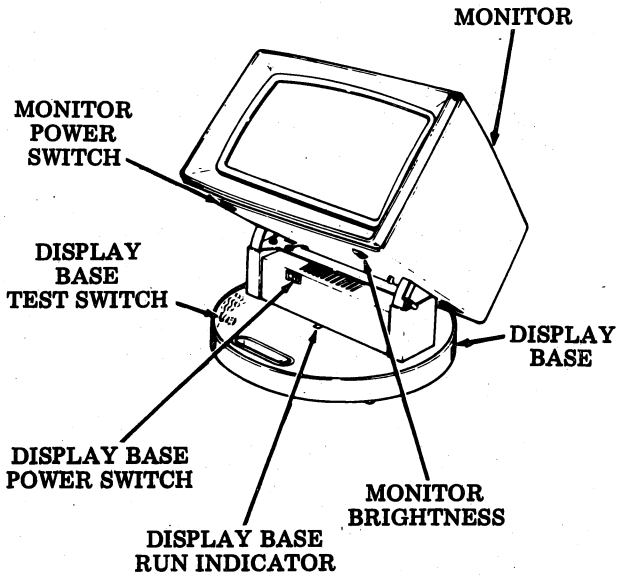


Fig. 9—Display Base (for Clustered 4540) and Monitor

KEYBOARDS

3.18 Four different keyboard styles can be used with 4540 stations, see Fig. 11.

- 45K301/GAA/XX typewriter-style keyboards provide an external numeric pad at the right. Optionally a magnetic stripe reader and/or keyboard disable switch can be provided.

- 40K104/DAB typewriter-style keyboards have keytop layouts similar to a typewriter.

- 40K203/GAB typewriter-style keyboards are similar to the 40K104 except for the external numeric pad included at the right.

- 40K105/CAA Internal Numeric Cluster (INC) keyboards permit easy entry of numeric data. Numeric keys are color contrasted in a convenient cluster which can be optioned to automatically shift in numeric fields.

3.19 All keyboards provide tactile and audible feedback when a keyswitch is depressed. System status and operator input is transmitted via an SSI link between the keyboard and the display base.

3.20 All keyboards have an audible alarm and an alarm volume control which can be adjusted by the operator.

3.21 The 45K301 keyboard can be:

(a) 45K301/GAA/02 — Includes a magnetic stripe reader (MSR) to the left of the keytop layout.

(b) 45K301/GAA/03 — Does not include the MSR. A blank filler panel is used to cover the area where MSR would be located, see Fig. 11.

3.22 All of the keyboards of 3.18 can be intermixed within a clustered 4540 station configuration. However, the 40K105/CAA keyboard is only for use in a station using the EBCDIC line code, therefore, all station keyboard would need the EBCDIC keytop arrangements.

3.23 Any keyboard of 3.18 can be used in a free-standing arrangement with a keyboard base in 4540 stations. Only the 45K301/GAA/XX can be attached to brackets on 4500 furniture (included with 36-inch and 45-inch tables).

3.24 Special key functions and features for keyboards are described below:

(a) Cursor Left, Cursor Right, Cursor Up, Cursor Down — Depression of these keys causes the cursor to move one position in the indicated direction. These keys are repeatable if depressed into the overtravel position. These keys can also cause cursor wraparound as indicated in Fig. 10. Except for the 40K104/DAB, all keyboards have two CURSOR LEFT keys for operator convenience.

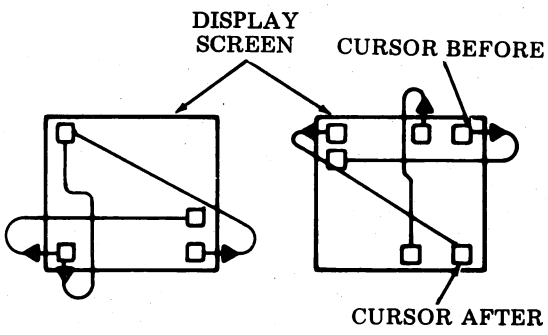


Fig. 10—Six Examples of Cursor Wraparound

(b) HOME — Moves cursor to the upper left-most position on the display of an unformatted display or to the first position of the first unprotected field relative to the upper left-most position of a formatted display.

(c) CURSOR RETURN — Moves cursor to the first character position of line that cursor is in. This key is not present on the internal numeric cluster keyboard (40K105).

(d) CURSOR TAB Key — Depression of this key will move the cursor to the first character location in the next unprotected field. If the display has no unprotected fields, or is totally protected, the cursor is homed (returned to the upper-left most character position.) This key can cause cursor wraparound.

(e) SKIP — This key is functionally the same as the cursor tab key and is only on the internal numeric cluster keyboard. It is provided in addition to the CURSOR TAB key for operator convenience.

(f) BACK TAB Key — Moves cursor to the first character location of the current or first preceding unprotected field dependent on cursor position. The cursor is homed if the display is unformatted or totally protected. This key can cause cursor wraparound.

(g) NEW LINE Key — When entered from the keyboard, the cursor will be moved to the first unprotected character location on the next line. No NL symbol will be displayed. (When the NL character is received by the display from the LCU, the symbol " ≡ " will be displayed, but the function is not performed.)

(h) CHARACTER INSERT/CHARACTER DELETE — Provided so that information in unprotected fields or unformatted displays may be changed or corrected without retyping the entire field.

- CHARACTER INSERT moves display data to right one position and inserts a space in the cursor location. Insert happens only if null or space exists at the end of field.

- CHARACTER DELETE erases character at cursor location and moves display data to the left one position. A null is inserted at the end of field.

(i) LINE INSERT/LINE DELETE — These keys are only operational when the display buffer is unformatted (no attributes present).

- LINE INSERT — Moves all data on the cursor line and below, down one line while inserting a line of nulls at the cursor line. The last line (line 24) must be all nulls for line insert to occur. Alarm will sound if operation cannot be performed. This function is nondestructive.

•LINE DELETE — Deletes the cursor line, moves all data below the cursor line up one line, and fills the last line with nulls.

(j) PF (PROGRAM FUNCTION) Keys (PF1 through PF12) — The depression of a PF key will cause the 4540, when polled, to transmit all modified data fields from the buffer preceded by a specific AID character denoting which PF key was depressed. This character instructs the LCU, dependent upon application programming, to perform a specific function. A typical example of program function key use would be the keyboarding of an account number onto the display followed by depression of a PF key. This PF key generates a code to the LCU which could send, to the requesting display, all information pertaining to that account number. The operator, upon receiving the account information, could update the information from the keyboard. A different PF key could send the modified information on the monitor plus a code which could cause the LCU to update the account. Program function keys PF6-12 are not provided on internal numeric cluster keyboards.

(k) PA (PROGRAM ACCESS) Keys (1,2,3) — These keys also cause a specific code to be sent instructing the LCU to perform a specific function. However, depression of a PA key does not result in data in the buffer being transmitted. A typical example of the use of a program access key can be drawn using an extension of the PF example. Assume, for instance, that the operator entered several account numbers prior to depressing the first PF key, and that the information regarding each account exceeds the 1920-character display capacity. Depressing the PA1 key causes a code to be sent which could cause the LCU to send successive pages of the same account. PA2 could cause the LCU to send the next account that was originally entered on the display by the operator. PA3 is not provided on the typewriter style keyboards.

(l) DUP (DUPLICATE) Key — Depression of this key causes a specific code to be inserted into the display buffer, indicating a duplication operation for the remainder of the field, after which a cursor tab function is performed. An example of DUP use would be repetitous information in the same field for each document. This character is displayed as DU for all character sets.

(m) FM (FIELD MARK) Key — Depression of this key causes a specific code to be inserted into the display buffer to indicate an end of field. This code displays an FM for all character sets.

(n) Mode Keys and Indicators — Mode keys with indicators are provided so that the operator may easily identify the operational mode of the terminal.

• S/R indicator and S/R (ENTER) Key — When S/R indicator is on, indicates a transmission or reception in progress. S/R blinks when sending or receiving function aborted. Depressing LOCAL will reset blinking S/R. Depression of S/R (ENTER) causes the device to send after the next poll from host.

• LOCAL indicator and LOCAL (RESET) Key — When ON, indicates that the keyboard is active and may be used for entering data on the display. This indicator lights upon LCU command or upon depression of the LOCAL (RESET) key. It extinguishes upon depression of the S/R (ENTER) key, a PF key, a PA key, PRINT LOCAL, R/TST, L/TST, or CLEAR.

• PRINT LOCAL Key and Indicator — This key allows hard copy of the 1920 character display buffer contents by a designated printer. The indicator lights on depression of the PRINT LOCAL key and extinguishes when the buffer transfer is complete. The S/R indicator lights while the buffer is being transferred. The data is printed in an 80-column format. No data lines are suppressed. Valid form feed characters are performed as they are encountered in the buffer. A blinking PRINT LOCAL indicator means the printer for local copy is not available (ie, turned off, cover open, out of paper, or does not exist). A blinking S/R with the PRINT LOCAL indicator on, indicates an unsuccessful buffer transfer. Depressions of the LOCAL (RESET) key will clear these conditions and return keyboard control to the operator. If the alarm sounds when the PRINT LOCAL key is depressed, then the LCU has locked the device buffer to prevent it from being copied.

Summary of indicator lights:

LOCAL	S/R	PRINT LOCAL	MODE
ON	OFF	OFF	Keyboard for local operation.
OFF	OFF	OFF	Send Bid pending or keyboard not restored after send/receive operation.
OFF	ON	OFF	Sending or receiving data from host or performing a copy command.
OFF	FLASH	OFF	Aborted transmission during data transfer from host or 4540.
OFF	OFF	ON	Print Local Bid pending.
OFF	ON	ON	Print Local Buffer transfer.
OFF	FLASH	ON	Print Local Buffer transfer aborted.
OFF	OFF	FLASH	Print Local Aborted (No printer or printer not available.)

- INPUT INHIBIT Indicator — This lamp is present only on the internal numeric cluster keyboard. It acts as an inverse LOCAL indicator. When lit, operator input is inhibited and depressing any key other than RESET will only cause the alarm to sound. If the S/R indicator is also lit, any key depressions will cause the alarm to sound.

- NUMERIC LOCK Key and Indicator — Only on the internal numeric cluster keyboard; this is an operator controlled key. It is used to enable an operator to enter a string of numeric characters into an unformatted display or into an alphanumeric field without having to keep the NUMERIC key depressed. Depressing the key once will light the indicator and set the numeric lock mode on. A second depression of the key extinguishes the indicator and clears the numeric lock mode. An operator can temporarily override the numeric lock mode to enter an alpha character by depressing and holding down the ALPHA key while depressing the desired key(s).

(o) CAPS LOCK, SHIFT, NUMERIC, ALPHA, REPEAT and CONTROL Keys

- CAPS-LOCK Key — This is a key found only on typewriter style keyboards. When depressed, restricts characters to upper case, digits, and unshifted graphics.

- SHIFT or NUMERIC Key — Depressing and holding down one of these keys and then depressing a character key causes the symbol shown on the upper half of the keytop to be generated.

- ALPHA Key — Present on the internal numeric cluster keyboard only. Depressing and holding down this key and then depressing a character key will cause the character or symbol shown on the lower half of the keytop to be generated.

- REPEAT Key — Depressing and holding down this key and then depressing any other key makes that key repeat its character. 40K104 typewriter style keyboards do not have this key.

- CONTROL Key — Depressing and holding down this key (found on typewriter style keyboards only) and then depressing either the A, S, J, or M keys will cause R/TST, L/TST, FM or DUP to be generated, respectively. All other controls on the ALPHA keys are nonfunctional.

(p) Erasing Controls

- CLEAR — Depression of this key resets all data (protected and unprotected) to nulls (nulls are not displayed), homes the cursor, primes the controller to generate a code to the LCU that the display has been cleared, and turns off the local indicator.

- ERASE INPUT — Depression of this key resets all unprotected data on the display to nulls (nulls are not displayed) and sends the cursor to the first unprotected character location on the display.

- TAB — Inserts nulls in all character locations from (and including) the cursor position, to the end of the unprotected field. The cursor moved to the first character location of the next unprotected field. If the cursor is on a field attribute character or in a protected field when the key is depressed, a cursor tab function is performed and no data is cleared. Tab can cause cursor wraparound.

(q) Test Features

R/TST — This key sends a request to the LCU for a test pattern to check proper display and display buffer operation. Many systems do not support this feature. Depression of R/TST on first KD has a maintenance function given in Section 582-300-500.

L/TST — This key will cause the initiating of the local test routine.

(r) Auto-Skip Function — Causes the cursor to automatically skip to the next unprotected field. Autoskip occurs only when operator enters data into the last character position of a field and the next field is defined as protected and numeric. This function can cause wraparound.

(s) Audible Alarm — The audible alarm is used to alert the operator. Circumstances that activate the alarm are: LCU generated code, attempted keyboarding in protected fields or on field attribute characters, attempted line insertion/deletion on a formatted display, attempted character insert or delete in a protected field, an attempted insertion of nonumeric characters in a numeric field, an attempt to request a print local on a locked buffer, depressing any key when the LOCAL indicator is not on, and depressing the LOCAL or RESET key when the S/R indicator is on.

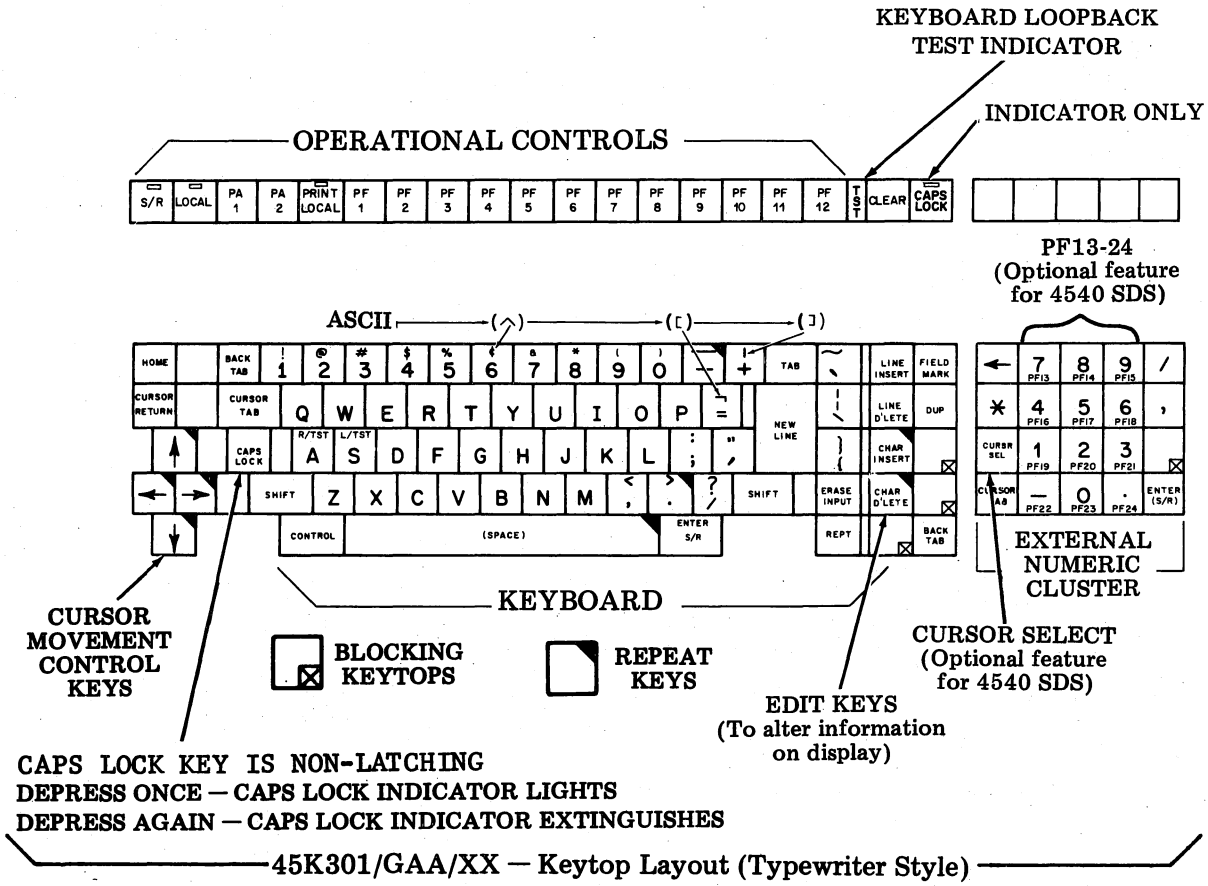
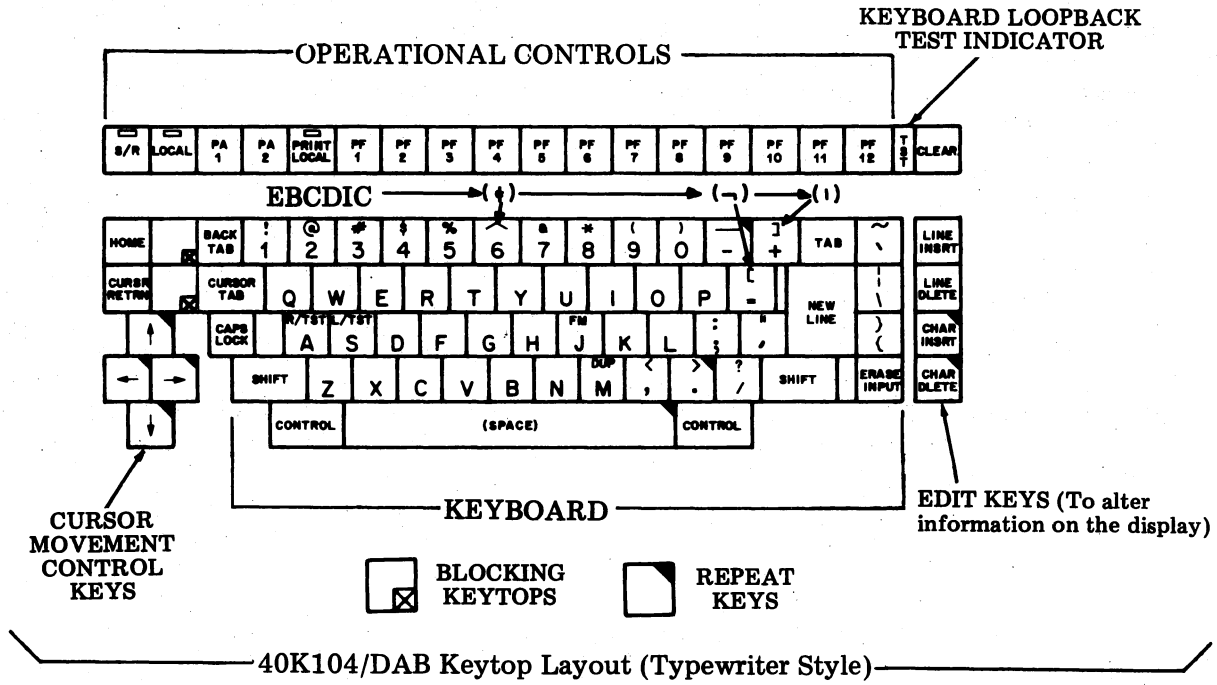
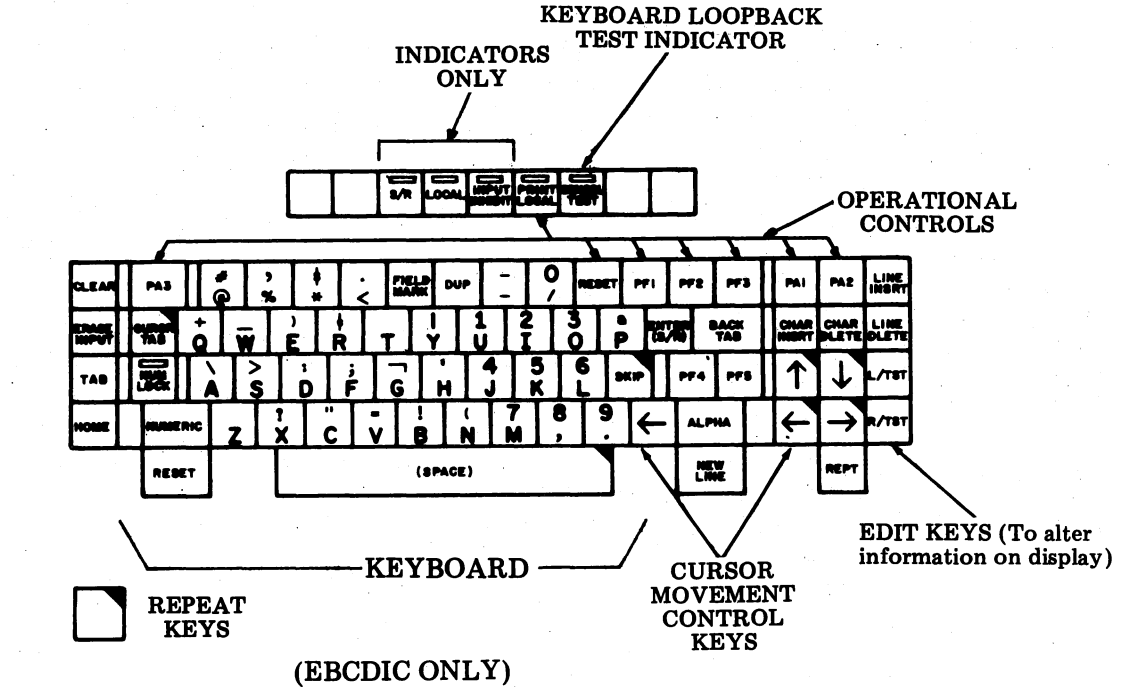


Fig. 11—Keyboard Keytop Layouts



40K104/DAB Keytop Layout (Typewriter Style)



40K105/CAA Keytop Layout (Internal Numeric Cluster Style)

Fig. 11—Keyboard Keytop Layouts (Contd)

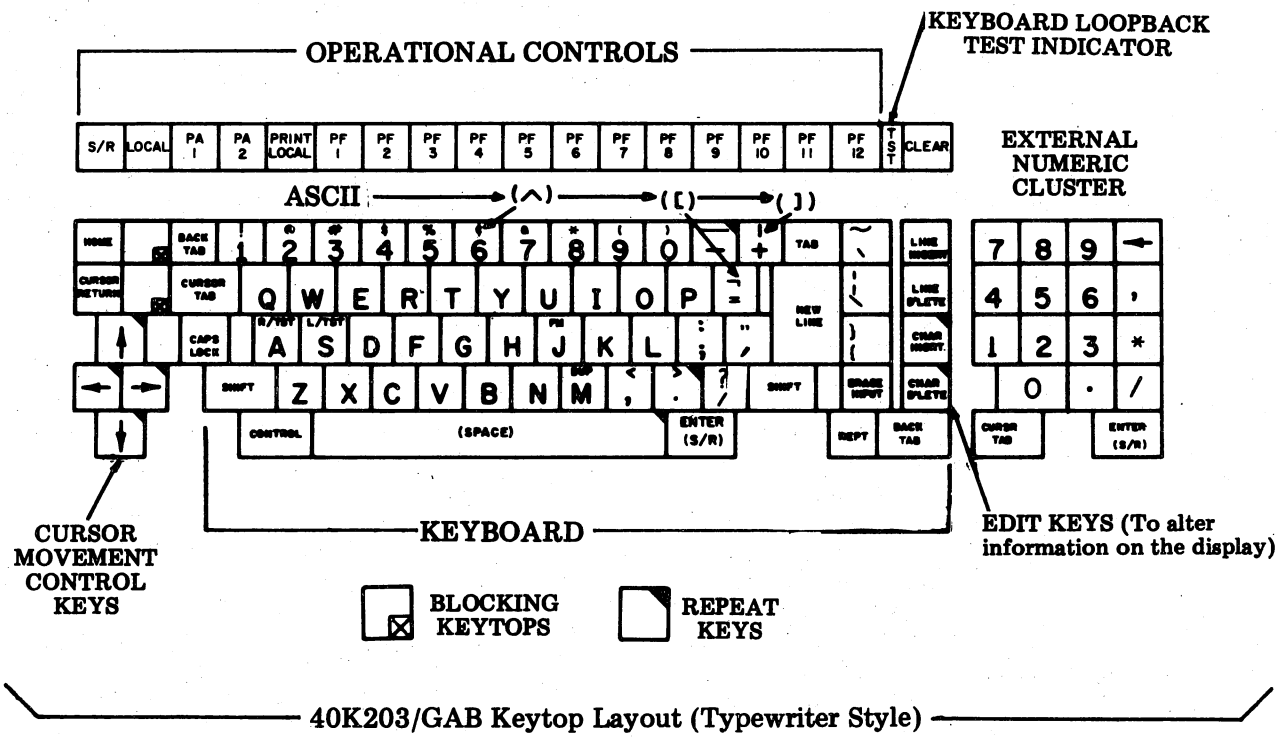


Fig. 11—Keyboard Keytop Layouts (Contd)

PRINTERS

3.25 The 40-type line printers (line-at-a-time) used with 4540, are electromechanical, impact printing devices capable of printing SSI (Standard Serial Interface) signals. Printing speed for line printers is expressed in lines per minute. Printers can print up to 300 lines per minute. The printing speed quoted is for the worst case of characters to be printed but the best case for other controller activities. Throughput is also affected by message length. Short messages will decrease throughput. Printing is done by print hammers impacting the paper and ribbon into type pallets in a carrier moving across the page at a constant speed. One print hammer mechanism is provided for each column. Printed characters are spaced horizontally at ten per inch and lines of printing are spaced vertically at six per inch (standard) or eight per inch (option on some printers).

3.26 A line printer can be 80-column friction, 80- or 132-column tractor, or 80-column forms access. See Section 582-210-100 for more information.

3.27 A 132-column line printer (40P204/ZZ) is available for use in a 4500-style cabinet (45CAB701/AAA). The printer is similar to the 40P202/ZZ printer described in existing documents, but also features a reinker and paper jam alarm. The reinker extends the density life of the ribbon to a minimum of 20,000,000 characters printed (under normal operating conditions). The paper jam alarm causes printing to stop and the cabinet paper alarm indicator to light if a paper feed malfunction occurs. A 40P202/ZZ printer with a 402920 paper jam alarm modification kit can also be used in the 45CAB701/AAA cabinet. The 4500-style noise reducing cabinet (see Fig. 12) features both a "forms advance" push button switch and a combination paper-out indicator/paper advance push button switch. In addition, this cabinet is completely enclosed so that a box of sprocket feed paper will be completely hidden and out of the way inside of the cabinet. A small window on the front access door acts as a visual indicator for the amount of accumulated paper in the cabinet. Printer paper accumulation is inside and to the rear of the cabinet and is accessible from the front.

3.28 Print local operation transfers the KD buffer to the associated printer buffer for printing. This is a local function not involving the computer.

3.29 The 45AP106/AAA character printer of the AP25 is an electromechanical impact printing device capable of printing SSI signals at 30 characters-per-second (throughput depends on controller activities). Printing is done by pins in a print head. Characters are formed in a 7 by 9 dot matrix. Printer is 132-column tractor feed.

3.30 The AP201/AAA high speed matrix tractor feed printer of the AP200 can operate at a maximum throughput of 275 characters-per-second, depending on line length and controller activities. The 7 by 7 dot matrix printing is done by pins in a print head. The printer is 132-column tractor feed. The printer can be installed on a customer provided table or a 45CAB403 pedestal

4500-STYLE TABLES

3.31 Four tables (see Fig. 12) are available:

- 20-Inch Wide — 45CAB503/AAA — This table provides a furniture-like appearance for the 45CAB401/AAA controller cabinet when it is desired that the controller cabinet be freestanding. The controller cabinet is slid under the table. The top of this table can be used for mounting of other equipment (eg. 209A-type modem, etc).
- 36-Inch Wide — 45CAB501AAA — This table accommodates an attached KD.
- 45-Inch Wide — 45CAB502/AAA — This table accommodates an attached KD and a 45CAB 401/AAA controller cabinet. The table is used for an attached KD only when a wider table is desired. The controller cabinet slides under and to the right of the table.
- 28-Inch Wide — 45CAB603/AAA — This table accommodates a 45P102/AAA character printer.

3.32 The tables of 3.31 are shipped unassembled. A table consists of a tabletop, two end panels, and a rear skirt. The 36-inch and 45-inch tables also include a keyboard bracket for mounting a 45K301-type keyboard. The 28-inch table includes a printer cover and related hardware. The tables are packed flat in a specially designed carton by the factory.

4. SPECIAL FEATURES

PRINTER "PRINT LOCAL" CAPABILITY

4.01 Printers can be connected to any SSI port on the SCC except the first port. The ports chosen determine which KDs can use the print local capability.

4.02 The Option 415 selection for each printer will determine its print local capability. 415B = print local enabled, 415A = print local disabled. Before a 45P106/AAA character printer of an AP25 is selected to have print local capability in BSC applications, it should be determined whether the computer can tolerate the approximately 60-second (minimum) print local time during which the printer will not respond to selects. Usually a computer will tolerate 21-seconds of no response. This contention can be avoided by using the copy command (instead of print local) for hard copy. In ADCCP applications, the printer will respond "device busy" during print local if a message is received for the printer so the no-response concern does not apply.

4.03 If one printer is used and Option 415b is chosen, any KD connected to a port numbered less than the printer port number can print local copy of its buffer. A KD connected to a port numbered greater than the printer port number cannot do a "Print Local" function.

4.04 When two printers are used, and Option 415b is chosen for both of them, the first printer will service all KDs connected to ports numbered less than the first printer port number, the second printer will service all KDs connected to ports numbered greater than the first printer port number and less than the second printer port number. Any KDs connected to ports numbered greater than the second port number cannot perform a "Print Local" function.

4.05 This example illustrates print-local qualifications:

Port Number	Device Type
1	KD1
2	KD2
3	Printer 1 (415a — "Print Local" capability disabled)
4	KD3
5	KD4
6	KD5
7	Printer 2 (415b — "Print Local" capability enabled)
8	KD6

Since Printer 1 has its "Print Local" capability disabled, KDs 1 and 2 will print local to the next higher printer, which is printer 2. KDs 3, 4, and 5 will also "Print Local" to printer 2, while KD6 cannot do a "Print Local" function. If the options for printer 1 and 2 were reversed, KDs 1 and 2 would "Print Local" to print 1, while KDs 3, 4, 5, and 6 could not do a "Print Local" function. When more than two printers are added to a cluster, the same rules apply.

4.06 When it is desired that only some of the KDs in a station not have the capability of performing a "Print Local" function, these KDs should either be connected to SCC ports higher than the highest printer port (with Option 415b) or have a blocking keytop (340701) installed in place of the "Print Local" keytop.

4.07 Printers for the on-line copy command must be on the same SCC.

FEATURE GROUP CIRCUIT CARDS

4.08 The 4540 uses different feature group cards to provide different services.

- 45G110/AA (manufacture discontinued) —Basic BSC operation for clustered 4540. Security lock in off position allows data to be sent to display. Will not support the MSR feature or character printers.

- 45FG110/AB/01 — As "AA" it replaces but adds: support for MSR, Locked Buffer Override (Option 414), PF1 to store options forces all KDs to download, (S/R works the same as "AA"), SCC status indicator 2 blinks whenever download occurs, SCC status indicator 3 blinks when SSI retransmission occurs, security lock in off position makes KD unavailable for sending and receiving data.
- 45FG110/AB/02 — As "AB/01" but station sends ENQs until host responds.
- 45FG110/AB/04 — As "AB/01" but adds PF13 — 24 capability (Shift is numeric pad).
- 45FG110/AB/05 — As "AB/01" but adds cursor select, continuous ENQ, displays £ not $.
- 45FG110/AC/01 (manufacture discontinued) — Basic 4540 ADCCP line protocol for clustered 4540.
- 45FG110/AE/01 — As "AB/01" it replaces but supports character printers and improves line printer throughput during heavy device use. More than one print local can occur at a time Contents of KD buffer transferred to printer buffer.
- 45FG110/AE/02 — As "AE/01" but adds cursor select, continuous ENQ, displays £ not $.
- 45FG110/AF/01 — As "AC/01" it replaces but supports character printers and improves line printer throughput during heavy device use. More than one print local can occur at a time. Contents of KD buffer transfered to printer buffer.
- 45FG410/AF/01 — Basic ADCCP line protocol for 4540 SDS. Supports a character printer or line printer.

OPTIONAL FEATURES

Magnetic Stripe Reader (MSR)

4.09 The magnetic stripe reader (MSR) of a 45K301/GAA/02 consists of a read-head assembly, amplifier circuit card, and card-in-place switch. It converts magnetic coded characters on the back of a "credit" card into electrical signals. The MSR can be used for security type applications (ie, restricting terminal access to authorized personnel only, permitting access to certain host software only, etc). The size of the card conforms to Spec ANSI X4.13 — 1971. The location of the magnetic stripe and encoding scheme conform to Spec ANSI X4.16 — 1976, Track 2 (ABA). Cards used in the MSR are not supplied by Teletype Corporation. A test card (406303) is available to test the MSR portion of the keyboard.

4.10 The operator inserts the card into the reader with the information stripe facing down and on the right hand side. Card motion must be continuous, ranging from 2 to 40 inches per second, until the card reaches the card stop.

4.11 For proper decoding, the KD must be in local, the cursor must be in an unprotected character position, a parity error must not be detected, and the LRC at the end of the message must be verified by the display base. With improper decoding, the keyboard alarm is sounded and the data is discarded.

4.12 Data is encoded at 75 bits per inch, 40 characters maximum including LRC character, binary coded decimal, with odd parity. Reception begins with start-of-record (SOR) character. After the data is sent, a switch on the card reader causes the status word (card in place) to be sent.

4.13 After valid data from MSR is received, the first character loaded into the display buffer, at the cursor position, is a protected, nondisplay, and modified field attribute character. The data from the MSR is then loaded. The cursor position is incremented after each character insertion and continues until the LRC character or another attribute character is encountered. When another attribute is encountered, any remaining data from MSR is discarded.

4.14 Once the input data from MSR is properly inserted into the display buffer, the 4540 will respond to a poll with a read modified message containing the AID of magnetic stripe reader (W).

4.15 An uncoded card will cause a status word (card in place) to be sent to the display base. No data will be changed in the display buffer, but the 4540 will respond to a poll with a read modified message.

4.16 The LCU is not automatically notified when the card is removed from MSR.

Security Lock

4.17 The 347300 modification kit provides a security lock feature which can only be used with the 45K301-type keyboard. The switch in the off position causes keyboard and MSR information to be inhibited. The display buffer is also unavailable to the host. The keyswitch must be in the off position to remove the key.

4.18 The 453970 modification kit provides a security lock feature which can only be used with a 40K104-, 40K105- or 40K203-type keyboard. The modification kit must be installed on a 40BSE203 (for use with a 40K104- or 40K105-type keyboard) or a 40BSE204 (for use with a 40K203-type keyboard). The keyswitch in the off position causes keyboard information to be inhibited. The display buffer is also unavailable to the host. The keyswitch must be in the off position to remove the key. The keyboard lock modification kits described in the 40-type documents are not applicable in the 4540 stations.

Cursor Select (45K301 Keyboard — SDS only)

4.19 The cursor select (CURSR SEL keytop, separately ordered) feature allows the user to select an item (or items) from a list or table displayed on the monitor screen. The user selected item (or items) can then be identified to the host.

To select an item, position the cursor within the desired selection field and depress the CURSR SEL key. A selection field is a field which contains an item preceded by a "?". Depressing a CURSR SEL will cause the "?" to change to a " > ". When the desired items have been selected, advance the cursor to a field designated as an attention field (a field preceded by a space or a null character (displayed as a blank or an "&"). With the cursor in the desired field depress CURSR SEL key, which causes a bid to be entered. When the KD is next polled the selected data will be sent to the host.

Note: When attention field is not present, first make the selection of the items desired and depress the S/R (or ENTER) key to send the selected data.

PF13 through PF24 (45K301 Keyboard — SDS only)

4.20 The program function PF13 through PF24 keytops are separately ordered. Depressing a PF key will cause modified data preceded by a code (associated with PF key depressed) to be sent when the KD is next polled. Depending on system programming the PF code sent witl instruct the computer to perform a specific function.

5. TECHNICAL DATA

ELECTRICAL REQUIREMENTS

5.01 Currents and power shown in Table C are maximum values based on power company supplied voltages within the limits of 115 Vac ±10 percent, 60 hz ±0.75 percent. When frequency varies more than 0.1 percent for extended periods, a cyclic displacement (waviness) of data on the monitor may be observed. This condition can be eliminated by use of the 40MN201 Monitor.

TABLE C

ELECTRICAL CURRENT AND POWER REQUIREMENTS

Device (or Controller)	Starting Current and Duration (MS = Milliseconds)	Running Current	Power (in Watts)	Power (in BTU/HR)
Clustered 4540:				
Display & Keyboard (See Notes)	13A (50 MS)	1.2A	106	364
SCC (8 device)	16A (50 MS)	.60A	64	220
(16 device)	16A (50 MS)	.70A	76	261
(32 device)	16A (50 MS)	1.10A	103	354
4540 SDS:				
Display & Keyboard	13A (50 MS)	1.2A	113	386
45C320	10A (50 MS)	.25A	38	139
Line Printer	10A (400 MS)	1.40A	160	550
Character Printer (45P104/AAA)	42A (100 MS)	.90A	80	275
AP200 Printer (Idle)	7.4A (250 MS)	1.31A	150	512
(Printing)	N.A.	2.40A	275	938

Note 1: Power consumption by a KD, when not in use, can be reduced by approximately 100 watts by turning off the monitor power switch. Turning off display base power switch when system is operating may result in system delay.

Note 2: The display base includes a circuit to limit the starting current for the monitor (included in the 13A) well below the starting current for the monitor in 40/4 applications.

ENVIRONMENTAL CONDITIONS

5.02 Environmental conditions should be within the limits listed in Table D to avoid damage and permit proper operation:

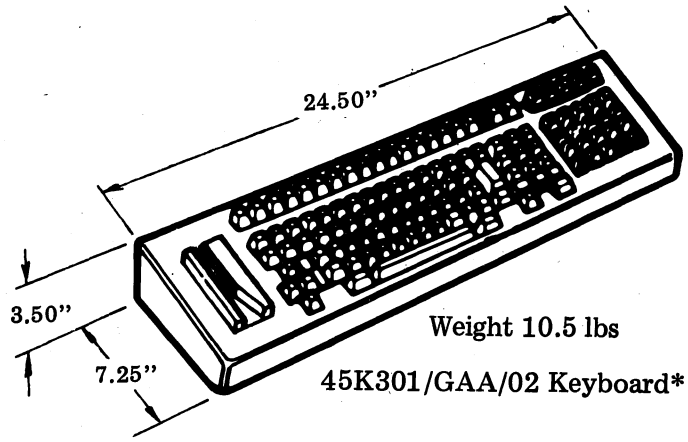
TABLE D

ENVIRONMENTAL CONDITIONS

Condition	Storage or Transport		Operating	
	Min	Max	Min	Max
Temperature	-40°F	+150°F	+40°F	+110°F
Relative Humidity	2%	95%	5%	95%
Altitude	Sea Level	50,000 Ft.	Sea Level	10,000 Ft.

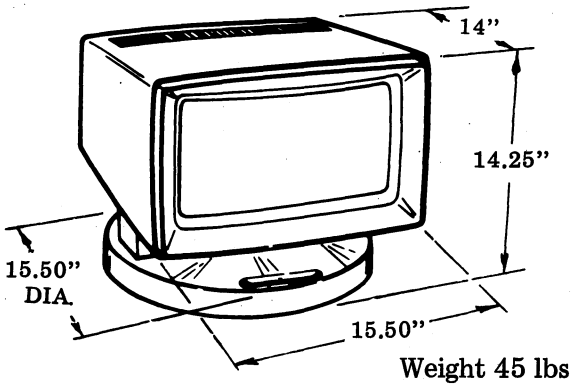
5.03 As with any device that can be damaged by water, exposure to sudden temperature changes that can cause condensation should be avoided. Example: A device stored in subzero temperature will collect moisture if immediately unpacked in a warm, humid area.

PHYSICAL DIMENSIONS AND WEIGHTS



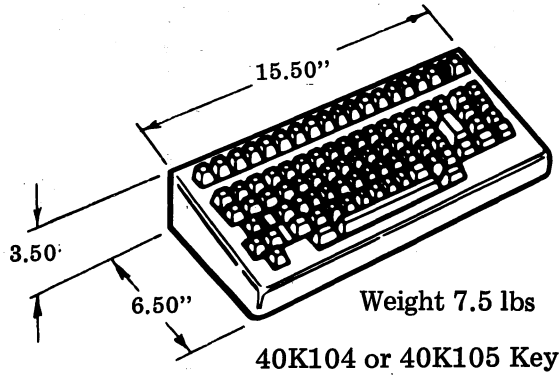
Weight 10.5 lbs

45K301/GAA/02 Keyboard*



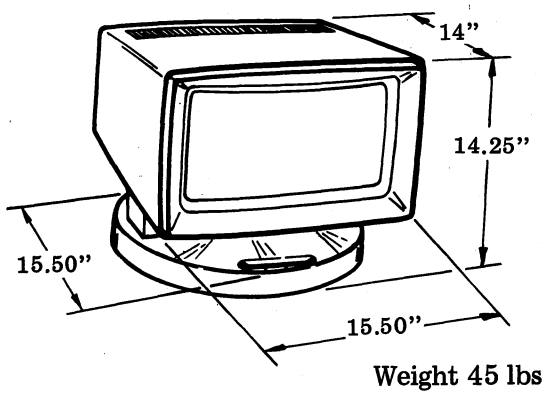
Weight 45 lbs

45D101/XX Display
(for 4540 clustered)



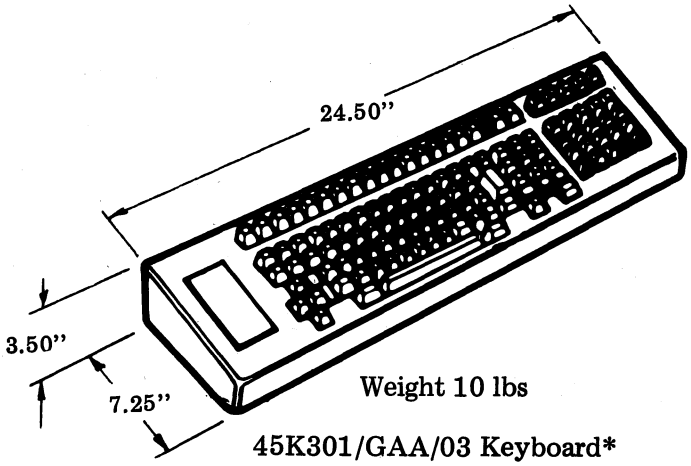
Weight 7.5 lbs

40K104 or 40K105 Keyboard*



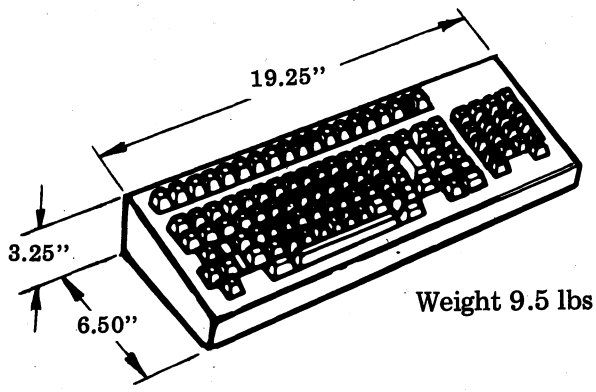
Weight 45 lbs

45D201/AA Display
(for 4540 SDS)



Weight 10 lbs

45K301/GAA/03 Keyboard*

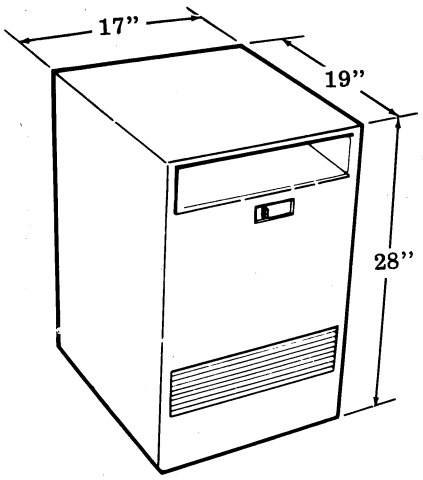


Weight 9.5 lbs

40K203 Keyboard*

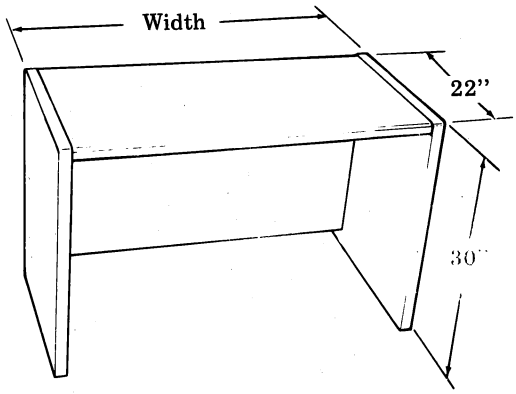
*If keyboard uses free standing base add 1/2 inch to height and 3/4 inch to depth of keyboard. Also add approximately 2.5 lbs. to weight of keyboard.

Fig. 12—Components — Physical Dimensions and Weights



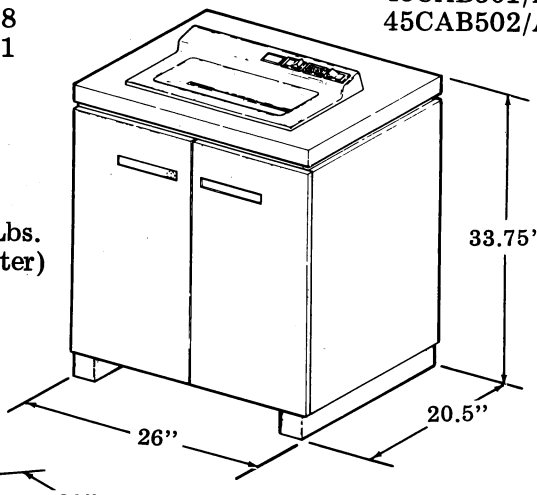
45CAB401/AAA Cabinet		lbs.
W/45C340/AAA/999	SCC	86
W/45C340/AAB/999	SCC	88
W/45C340/AAD/999	SCC	91

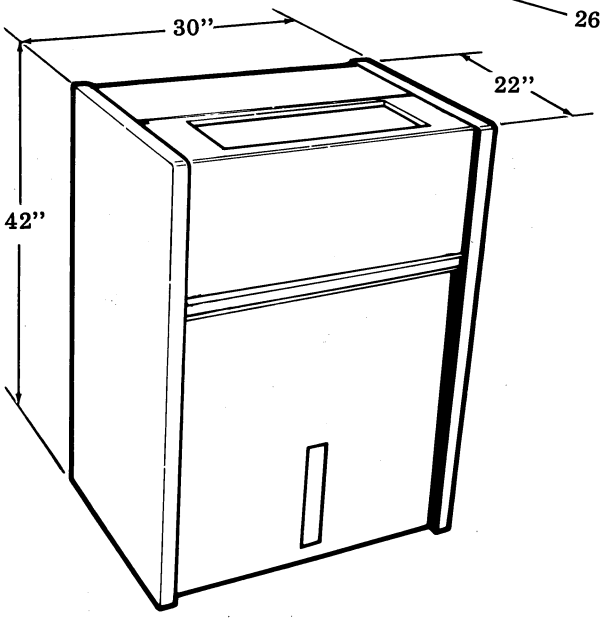
29-, 36- and 45-Wide Tables



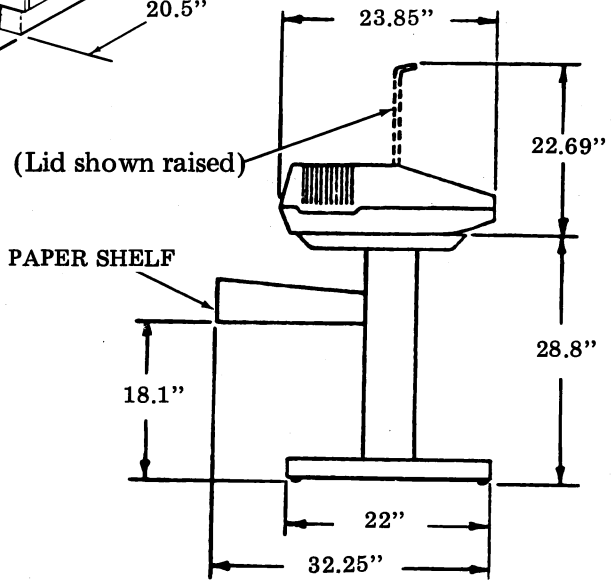
	Width	Weight
45CAB503/AAA	20"	47 lbs.
45CAB501/AAA	36"	85 lbs.
45CAB502/AAA	45"	96 lbs.

40CAB302/AAA — Weight 100 Lbs.
(146.5 Lbs With 40P253/AA Printer)





45CAB701/AAA Cabinet — Weight 155 Lbs.
(210 Lbs With 40P204/ZZ Printer)



45AP201/AAA Printer is shown installed.

45CAB403/AAA Pedestal — Weight 37 Lbs.

Fig. 12—Components — Physical Dimensions and Weights (Contd)

TERMINAL LAYOUTS AND DEVICE CABLING

5.04 The 4540 devices (terminals) should be located for convenient operation of the keyboard, viewing of display, and installing paper in the printer. The 4500-style furniture or customer supplied tables may be used, see caution below. Space for other office furniture (if used) for source data papers should also be considered.

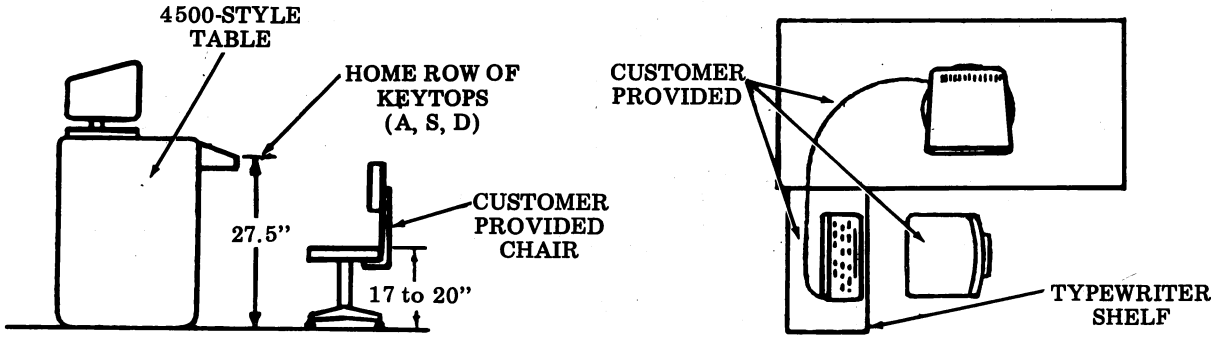


Fig. 13—KD Layout Examples

5.05 The attached style KD provides a fixed relationship between the keyboard and the display. The use of 4500-style furniture provides proper keyboard height for seated operators. Fig. 13 provides examples.

Caution: The only type of keyboard which can be attached to a 4500-style table is the 45K301/GAA type. If another type of keyboard is attached, improper operation may result.

5.06 On free-standing style KDs, the keyboard can be mounted at different levels and up to 4 feet away from the display. Table height can be chosen for seated or standing operation.

5.07 SSI cable termination at the SCC, printer or display is accomplished by crimping terminals to SSI leads with a crimping tool and inserting terminals into a connector with insertion tool (452206), and then connecting cable to a connector on the display cable junction box, printer or SCC. The exception is any display equipped with a new-style junction box (which terminates stripped SSI leads in a terminal block). Device cabling is shown in Fig. 14.

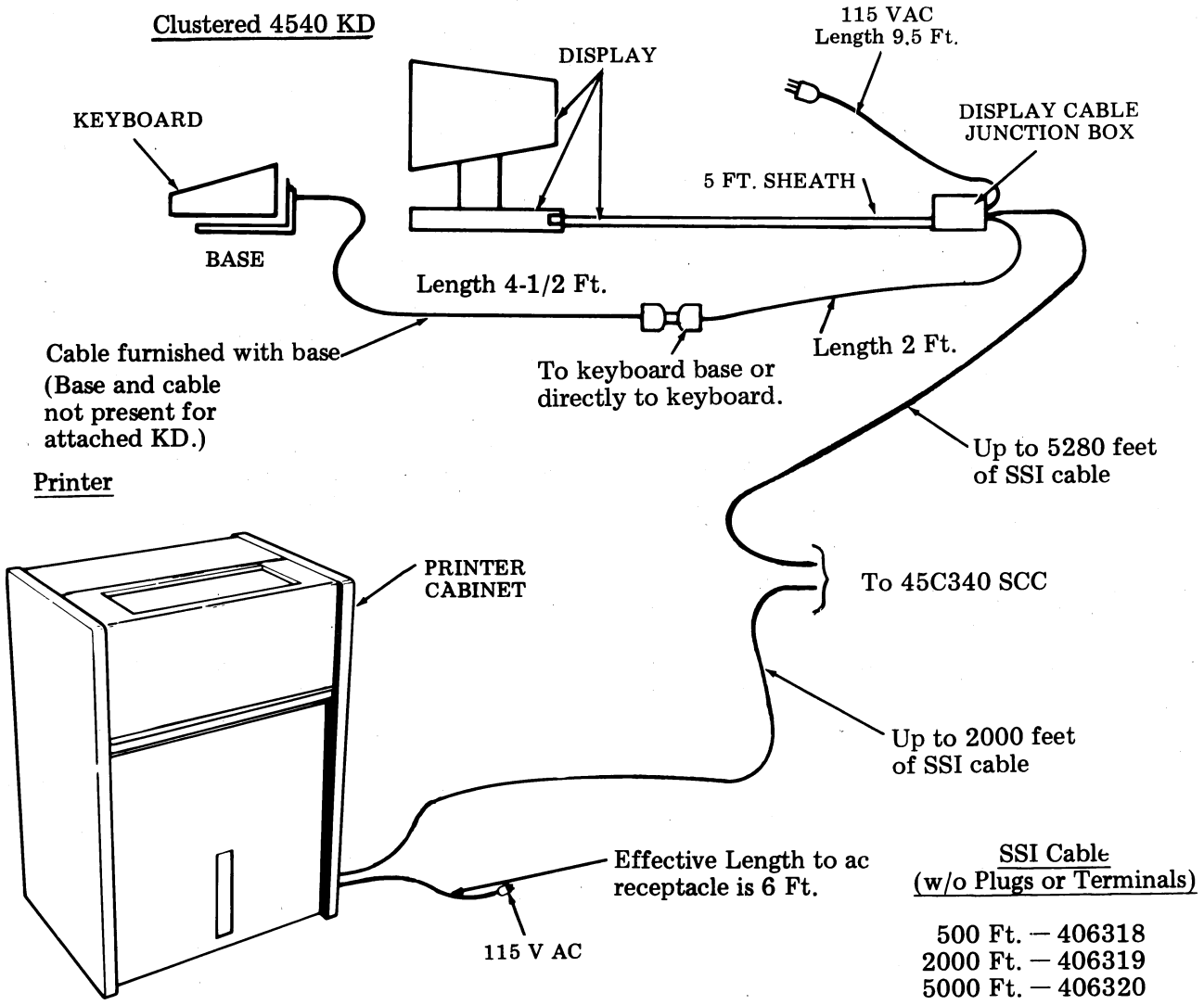


Fig. 14—Device Cabling

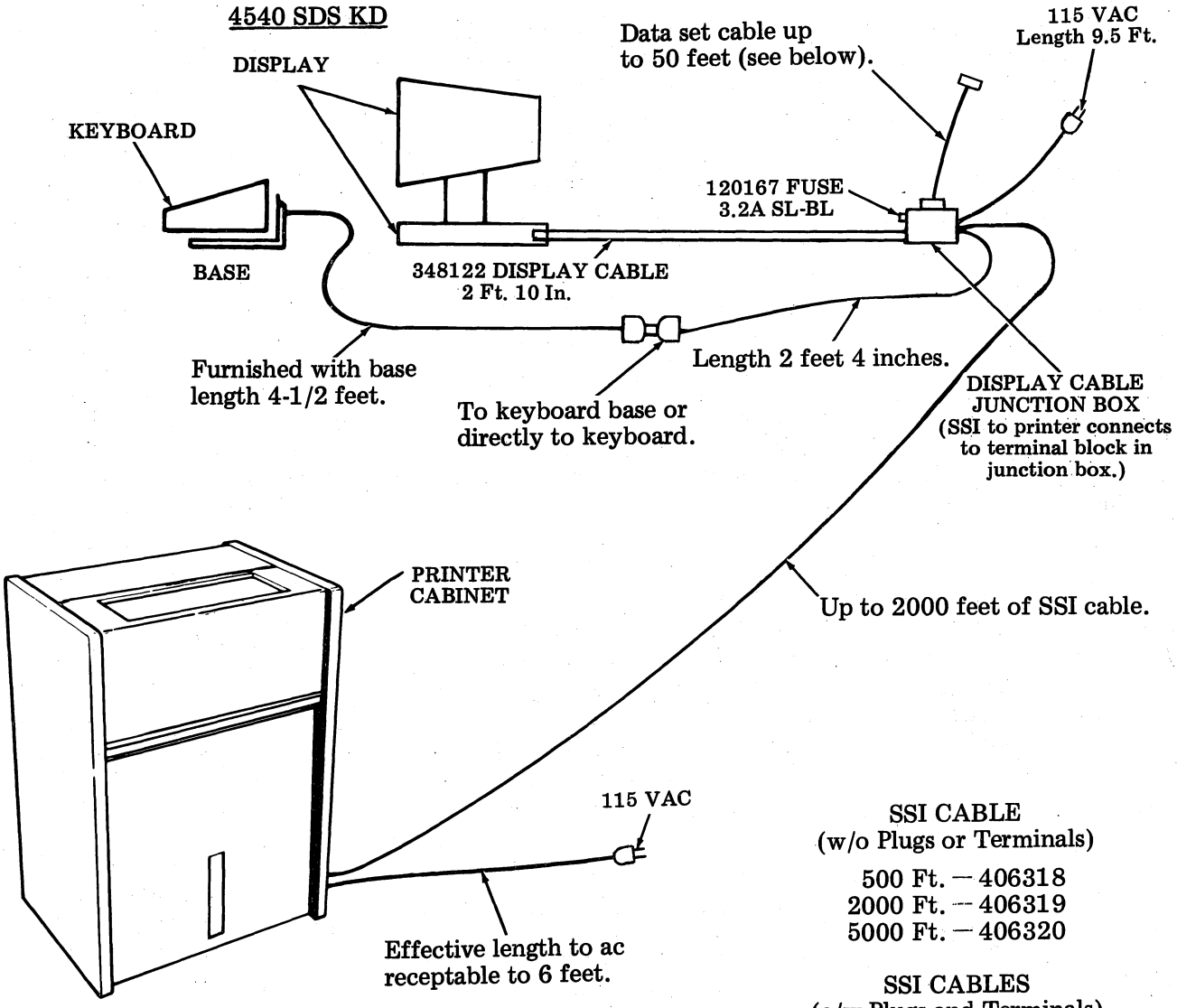


Fig. 14—Device Cabling (Contd)

SSI CABLE
(w/o Plugs or Terminals)

500 Ft. — 406318
2000 Ft. — 406319
5000 Ft. — 406320

SSI CABLES
(e/w Plugs and Terminals)

6 Ft. — 405306
10 Ft. — 348138
12 Ft. — 405307
25 Ft. — 405308
50 Ft. — 405309

DATA SET CABLES

7 Ft. — 408065
12 Ft. — 408066
25 Ft. — 408067
50 Ft. — 408068

5.08 As shown in Fig. 14 fixed lengths of SSI cable are available. These cables include an assembled plug and terminals at each end.

5.09 The clustered 4540 includes a modem cable (45198 or 454207) of 4 feet in length. This cable can be extended up to 50 feet by connecting one of the following cables to the four foot modem cable. See TABLE E which includes cables available for 4540 SDS.

TABLE E

MODEM EXTENSION CABLES

7 feet - 408065
12 feet - 408066
25 feet - 408067
50 feet - 408068

STATION INTERFACE

5.10 The 4540 interface to the station modem meets EIA standard RS-232C. Leads used in 4540 are indicated. The DSR lead is physically available, but is not used by the 4540. EIA leads are shown in Fig. 15.

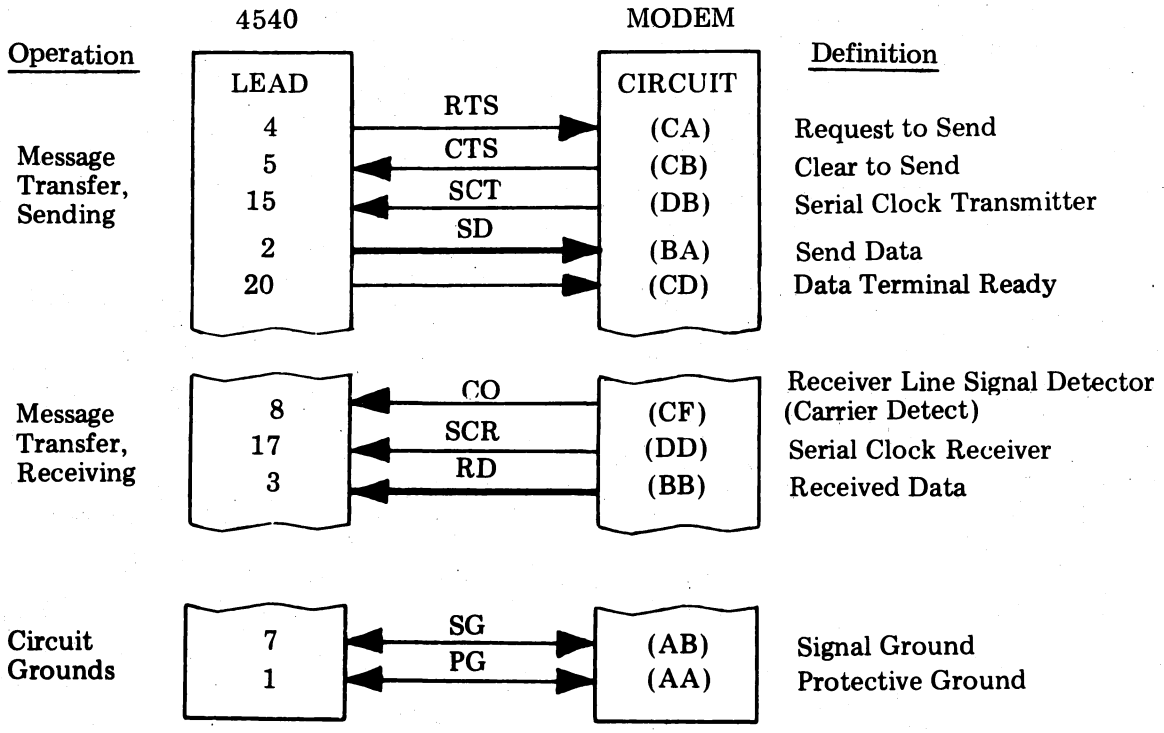


Fig. 15—EIA Leads

STATION AND DEVICE OPTIONS

5.11 Options for the station and each device associated with the station are initiated from the KD connected to Port 1 of the SCC (clustered 4540) or the KD (4540 SDS). Depressing the required keytops will result in a listing (option menu) appearing on the display. The required options are entered into this listing. For optioning information refer to Section 582-300-200 (clustered) or Section 582-300-205 (SDS). Of the options listed in Part 5, only two are related to the entire station — Option 401 — Control Unit Number, Option 408 — Line Code. All other options are related to the individual devices. Each device can have its own unique set of options.

512 Control Unit Number (Option 401) — Each station cohabiting a line must have its own unique Control Unit Number. BSC requires Control Unit Numbers from 00 to 31. ADCCP requires Control Unit Numbers from 01-FE.

5.13 Sound Continuous Alarm (Option 402) — If Option 402a is selected and the write control character has the sound alarm bit on, the alarm on the KD will sound at one second intervals until the LOCAL or RESET key is depressed. With Option 402b, the alarm is sounded only once.

5.14 Blink Intensified Fields (Option 403a,b)— With option 403a, fields designated as highlighted are intensified. With option 403b, fields designated as highlighted are blinked.

5.15 Blink Flagged Intensified Fields (Option 403c) — With this option, fields designated as blinked are blinked, fields designated as intensified are intensified. Intensified and blinked fields on the same display are blinked.

5.16 Numeric Override (Option 406) — The operator of a typewriter style keyboard will not be able to enter alpha data in a numeric field and the alarm will be sounded if it is tried (406b). Selecting 406a allows an operator of a typewriter style keyboard to enter alpha data in a numeric field, however, the audible alarm is sounded for each key stroke.

5.17 Numeric Special Feature (Option 407) — This option applies only to entering data into a numeric field when using an internal numeric cluster-style keyboard. Enabling this option (407a) limits the automatic upshift of keys to the digits 0 — 9, minus, DUP, and period. Disabling this option (407b) automatically upshifts all keys.

5.18 Line Code (Option 408) — For BSC, this option (ASCII 408a, EBCDIC 408b) must be entered for the entire station. For ADCCP, the line code is always EBCDIC.

5.19 Buffer Lock (Option 414) — With Option 414a, a protected alphanumeric attribute in the home position of the buffer will lock the buffer to copy command and print local. With Option 414b a print local is permitted. An attempted copy command with buffer locked will always give status and sense Buffer Locked (D, A).

5.20 Print "Print Local" Capability (Option 415) — Option 415b enables a printer to provide print local capability to KDs connected to certain ports. Option 415a disables a printer from providing print local capability. Selection of either 415a or 415b does not prevent the printer from being selected, nor does it affect any copy command functions involving the printer. See 4.01 through 4.06 for Printer "Print Local" capability.

5.21 Device Type (Option 416) — Device type Option 416 is used to define each device in the station. Option 416e applies to AP25 printers. Option 416f applies to 40P-type printers and AP200 printers.

416a — No device
416b — KD with 40K104 or 40K203 Keyboard
416c — KD with 40K105 Keyboard
416d — KD with 45K301 Keyboard
416e — Character Printer
416f — Line-at-a-time Printer

5.22 PF13 through PF24 (Option 420) — Option 420a disables the functions of PF13 through PF24. Option 420b enables the functions PF13 through PF24, providing the host supports the function. (This option is used with the 45K301 keyboard only and the 403141 modification kit keytops).

5.23 Cursor Select (Option 421) — This option applies to 4540 SDS only. Option 421a disables cursor select function. Option 421b enables cursor select providing a 45K301 keyboard is used and the host supports this function.

6. COMMUNICATION ACCESS

6.01 Part 6 describes the operation of 4540 stations interacting with a line control unit (LCU). The LCU controls one or more private lines; each line contains up to 32 station cluster controllers (SCCs) and 4540 SDS controllers. Communications on the line are entirely controlled by the LCU. No direct station-to-station message transfer can occur. Operating line speeds are 2400, 4800, 7200 or 9600 bits per second, synchronous transmission. Transmissions between the LCU and any of the stations are on a two-way half-duplex block oriented basis.

6.02 The communications channel used for this access arrangement is a 4-wire dedicated (private line) facility with special conditioning as required by the modems. With 4-wire transmission facilities, two independent signaling paths are provided. One signaling path is directed from the LCU transmitter to the receive portions of each of the stations. The other signaling path links the transmitting portions of each of the stations to the LCU receiver.

MODEMS

6.03 Several types of modems are prescribed for this access arrangement. The same modem (or equivalent) must be used by all stations on a particular link. The modem internal clock option is required. The LCU modem is usually optioned for constant carrier. Switched carrier operation at the LCU (very unusual and not recommended) may require each connected clustered 4540 station to be equipped with a 45FG110/AE/01 or 45FG110/AF/01 or later. The following modems, or equivalent, may be used.

(a) When a 201-type modem is employed, the station operates at 2400 bits per second (300 characters per second). Bit and character synchronous operation are employed.

(b) When a 208A-type modem is employed, the station operates at 4800 bits per second (600 characters per second). Bit and character synchronous operation are employed. For clustered 4540, a 451340 modification kit is required when used inside of a 45CAB401/AAA cabinet. Some manufacturer's 208-type modems will not fit. A Western Electric 208-type modem will fit.

(c) A 209-type modem may be employed for operation at 7200 bits per second (900 characters per second) or 9600 bits per second (1200 characters per second). Bit and character synchronization are employed.

(d) The 4540 can also operate on a digital data network using a 2400 DSU at 2400 bps, a 4800 DSU at 4800 bps or a 9600 DSU at 9600 bps.

OPERATOR INPUT

6.04 Operator input to the monitor is accomplished via a keyboard. The full 96 character set can be displayed on the standard 40 monitor. Data entered on the monitor may be unformatted or formatted into fields defined by the LCU. Possible field choices include: protected or unprotected; numeric or alphanumeric; intensified, blinking, or normal intensity; displayed or non-displayed; or any combination thereof. Fields designated as protected by the remote LCU are inaccessible to the terminal operator.

6.05 A typical application could consist of an operator's request for a specific form which the LCU could enter on the monitor in protected fields. The operator then could enter all the variable data in the unprotected fields to fill out the form. Dependent on program control, all operator input can be displayed at a higher than normal intensity (intensified) to visually distinguish between operator input and LCU input. Although it is possible to transmit the entire contents of the display buffer, system efficiency is enhanced by the transmission of only those fields which have been modified by the operator.

LINE CODE

6.06 All stations and the LCU on the same line must use the same line code. BSC can be optioned for American National Standard Code for Information Interchange (ASCII) or Extended Binary Coded Decimal Interchange Code (EBCDIC). ADCCP requires the EBCDIC Line Code. See Table F and Table G.

TABLE F

ASCII LINE CODE

ASCII															
Controls		Characters													
NUL	DLE	SP	0	@	P	`	p	0	0	0	0	0			
SOH	DC1 (SBA)	!	1	A	Q	a	q	1	1						
STX	DC2 (EUA)	"	2	B	R	b	r	2	0	1					
ETX	DC3 (IC)	#	3	C	S	c	s	3	1						
EOT	DC4 (RA)	$	4	D	T	d	t	4	0	0	1				0
ENQ	NAK	%	5	E	U	e	u	5	1						
ACK	SYN	&	6	F	V	f	v	6	0	1					
BEL	ETB	'	7	G	W	g	w	7	1						
BS	CAN	(	8	H	X	h	x	8	0	0	0	1			
HT (PT)	EM	)	9	I	Y	i	y	9	1						
NL	SUB	*	:	J	Z	j	z	A	0	1					
VT	ESC	+	;	K	[	k	{	B	1						
FF	FS (DUP)	,	<	L	\	l	|	C	0	0	1			
CR	GS (SF)	-	=	M	]	m	}	D	1						
SO	RS (FM)	.	>	N	^	n	~	E	0	1					
SI	US (ITB)	/	?	O	_	o	DEL	F	1						
0	1	2	3	4	5	6	7	HEX	1	2	3	4			
0	1	0	1	0	1	0	1	5	BITS						
0		1		0		1		6							
0				1				7							

Key for TABLE F and TABLE G

ACK - Acknowledge
BEL - Bell
BS - Backspace
CAN - Cancel
CR - Carriage Return
DC1 - Device Control 1
DC2 - Device Control 2
DC3 - Device Control 3
DC4 - Device Control 4
DEL - Delete
DLE - Data Link Escape
DUP - Duplicate
EM - End of Medium
ENQ - Enquiry
EOT - End of Transmission
ESC - Escape
ETB - End of Transmission Block
ETX - End of Text
EUA - Erase Unprotected to Address
FF - Form Feed
FM - Field Mark
FS - File Separator
GS - Group Separator
HT - Horizontal Tabulation
IC - Insert Cursor
ITB - End of Intermediate Transmission Block
NAK - Negative Acknowledge
NL - New Line
NUL - Null
PT - Program Tab
RA - Repeat to Address
RS - Record Separator
SBA - Set Buffer Address
SF - Start Field
SI - Shift In
SO - Shift Out
SOH - Start of Heading
SP - Space
STX - Start of Text
SUB - Substitute
SYN - Synchronous Idle
US - Unit Separator
VT - Vertical Tabulation

TABLE G

EBCDIC LINE CODE

EBCDIC					Controls				Characters											
BITS				0	0				0				1							
				1	0				1				0				1			
				2	0		1		0		1		0		1		0		1	
				3	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
4	5	6	7	HEX 0 1	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	0	0	0	NUL	DLE			SP	&	-						{	}	\	0
			1	1	SOH	SBA					/		a	j	~		A	J		1
		1	0	2	STX	EUA		SYN					b	k	s		B	K	S	2
			1	3	ETX	IC							c	l	t		C	L	T	3
	1	0	0	4									d	m	u		D	M	U	4
			1	5	PT	NL							e	n	v		E	N	V	5
		1	0	6			ETB						f	o	w		F	O	W	6
			1	7			ESC	EOT					g	p	x		G	P	X	7
1	0	0	0	8									h	q	y		H	Q	Y	8
			1	9		EM						`	i	r	z		I	R	Z	9
		1	0	A					¢	!	¦	:								
			1	B					.	$	,	#								
	1	0	0	C	FF	DUP		RA	<	*	%	@								
			1	D		SF	ENQ	NAK	(	)	_	'								
		1	0	E		FM			+	;	>	=								
			1	F		ITB		SUB	|	¬	?	"								

6.07 Each character is transmitted in an 8 bit frame. ASCII characters are sent bit 1 first. The 8th bit is used as odd parity for bits 1-7. EBCDIC characters are sent bit 7 first, bit 0 last. No parity is used with EBCDIC.

7. BSC INTRODUCTION (Clustered 4540 only)

7.01 In a multipoint private line environment, the station is either in a control mode, or in a text mode.

7.02 The station enters the control mode whenever it transmits or receives a valid EOT sequence. While in the control mode, the station monitors the communications line for its selection or poll addressing sequence.

7.03 The station does not take any action for control codes of other stations on the same line, nor does it take action on invalid control codes.

7.04 Once a station is successfully selected or polled, it enters the text mode. In the text mode, the station is either a master station or a slave station. This status depends on the operation being performed. The station that is transmitting a message is called the master station, whereas the station that is receiving and acknowledging the message is called the slave station.

7.05 The station becomes the master station (and the Line Control Unit or LCU, the slave station) once it sends SOH or STX to the LCU while executing a response to a read command or a poll operation. As the master station, it can (1) transmit text messages and (2) transmit ENQ to request a reply or retransmission from the LCU. When message transmission is completed, the station will normally return to control mode by sending EOT. The station becomes the slave station (and the LCU the master station) when performing a write or control command. As a slave station, it responds appropriately to the master station (LCU) transmissions.

Block Check Sequence (BCS)

7.06 A redundancy check is performed on the following communications line data:

- Command-sequence characters (including the write data of a write or erase/write command) addressed to the station.
- Data transmitted to the LCU in response to a read type command or to a polling sequence.

7.07 The block check sequence (BCS) is accumulated for each block of data at both the LCU and the station.

7.08 When using ASCII, a Longitudinal Redundancy Check (LRC) is generated from the sent characters. Additional error checking is done by a vertical parity check on all characters. The derived LRC is sent after each block and compared at the receiver.

7.09 When using EBCDIC, a Cyclic Redundancy Check (CRC) (2 character sequence) is generated from the sent characters in a more complex scheme than LRC. At the transmitter, the information bits are subjected to an encoding process equivalent to a division by the generator polynomial. The resulting remainder is transmitted to the line immediately after the information bits as delimited by ITB, ETB, or ETX-commencing with the highest order bits. At the receiver, the incoming block is subjected to a decoding process equivalent to a division by the generator polynomial which, in the absence of errors, will result in a zero remainder. If the division results in other than a zero remainder, errors are indicated.

7.10 BCS accumulation is initiated by, but does not include, the first STX or SOH framing character. An STX embedded in a block beginning with SOH is included in the BCS. All characters (except SYN, and the character(s) following ITB) following the first STX or SOH, including the end-of-block character (ETB or ETX), are part of the accumulation. Following the ETB or ETX character, the transmitting unit transmits its BCS character(s). The receiving unit then compares this character(s) with the BCS it has accumulated. If the redundancy accumulations are different, a transmission error has occurred. When the Station receives an errored block, it responds to the transmission by sending NAK. BCS characters are neither displayed nor printed.

Alternating Acknowledgments (ACK0/ACK1)

7.11 To ensure against loss of an entire block of data (eg, synchronization not attained), alternating acknowledgments (ACK0/ACK1) are employed in response to successive valid blocks. ACK0 is generated for selects and all even numbered blocks. ACK1 is generated for all odd numbered blocks. ACKN is used in this document to indicate the general case.

Limited Conversational Mode

7.12 This mode provides for transmitting text data in reply to a complete message. A conversational reply can be sent only in place of an "ACKN" to a text block, S & S message, or complete text message that ended with ETX. The conversational block must begin with STX. The STX character is interpreted as the affirmative reply. Upon receipt of the STX, the transmitting station relinquishes master status and reverts to the receive mode with slave status. The LCU can send a conversational reply to any data from the SCC other than the first block of text sent in response to a read or read modified command. The LCU is not permitted to transmit another conversational reply in response to a conversational reply. If the LCU does send a conversational reply to the first block of text sent by the station in response to a read or read modified command (violation of the definition of limited conversational mode), the station will respond ACK0 if the block check sequence is valid.

DATA LINK CHARACTERS

7.13 The LCU or station uses a number of characters or character sequences to control data transfer. These are given in 7.14 through 7.31.

SYN (Synchronize) and Leading Pad

7.14 Two consecutive SYN characters preceded by a leading pad character (Hex "55") are generated by the station before any transmission. Received SYN characters are not included in the BCS and are not passed by the SCC to any device. The station requires two consecutive SYN characters before any line information is accepted. While SYN characters may generally be used in transmission without adverse effect, the sequences ETX-BCS, ETB-BCS, ACK0, ACK1, SF AC, RVI and WACK are always transmitted contiguously with no SYN characters inserted in the sequence. BSC requires that two SYN characters per second be inserted during transmission.

Trailing Pad

7.15 A trailing pad character (Hex FF) is sent immediately after any transmission by the SCC or LCU. This ensures that the carrier in the modem is on while the last (nonpad) character is being sent. The SCC can receive up to 200 contiguous PADs in text. For ASCII applications, a pad (Hex FF) in text will cause a vertical parity error, however, a Hex 7F in text will not cause a vertical parity error. Any amount greater than 200 will cause the SCC to transmit NAK and enter control mode.

DLE (Data Link Escape)

7.16 DLE is used as shown in Table H.

TABLE H

DATA LINK ESCAPE

PURPOSE	ASCII	EBCDIC
Alternating acknowledgment (ACKO, ACK1)	DLE 0 DLE 1	DLE Hex 70 DLE /
Wait-Acknowledge (WACK)	DLE ;	DLE ,
Reverse Interrupt (RVI)	DLE <	DLE @

NAK (Negative Acknowledgment)

7.17 NAK is sent by the SCC when:

- it receives a block containing a parity error (ASCII only).
- it receives a block having an invalid BCS.
- it receives a block terminating in or containing ENQ (after an STX has been received).
- it receives a block containing more than 200 contiguous pads.

7.18 When the SCC receives a NAK from the LCU it should repeat its previous block. The use of NAK does not alter the sequence of alternating positive acknowledgements.

ENQ (Enquiry)

7.19 The SCC sends ENQ if it does not receive a response within 3 seconds of transmitting a block or if it receives an invalid response to a block (eg, other than EOT, NAK, ACKN, RVI, STX). The SCC also sends ENQ to abort a transmitted block if the device fails to send a complete block to the SCC.

7.20 Upon receipt of ENQ, the SCC:

- repeats its previous reply, if in receive text mode.
- replies NAK if the received ENQ aborted a block.
- prepares to send or receive if the ENQ was part of a valid poll or selection sequence.

WACK (Wait Acknowledgment)

7.21 The SCC sends WACK if the device, in response to a selection or block from the LCU, is busy. The SCC sends ENQ upon receipt of WACK from the LCU.

RVI (Reverse Interrupt)

7.22 The SCC sends RVI when it receives a selection sequence but has status and sense pending for the selected device. When SCC receives a RVI after sending status and sense, the status message is reset. When the SCC receives a RVI in response to text, the SCC sends EOT and resets alarm flags. If RVI is sent to message ending in ETB, the SCC blinks the S/R lamp on the sending keyboard. SCC always responds to RVI with EOT.

SOH (Start of Heading)

7.23 The SCC sends SOH as the first character of the first block when a status and sense or a test request message is sent.

STX (Start of Text)

7.24 The SCC sends STX as the first character of each block transmitted except for the case when SOH is sent.

ETB and ETX (End of Transmission Block and End of Text)

7.25 The SCC sends blocks containing a maximum 256 characters including STX, the station ID (first block only), text characters, buffer and cursor addresses, attribute characters, and ETB or ETX. The normal text block will be 254 characters long. A block whose 253rd character is a start field or a set buffer address will be 255 or 256 characters respectively. This is done to prevent splitting these sequences by block boundaries. The only blocks that can be shorter than 254 characters are:

- Status and Sense responses.
- Last block of a text message.
- First text block (if message is less than 254 characters).

7.26 All blocks, except the last block of a message, end with ETB BCS. The last block of multiblock messages, and all one-block messages, end with ETX BCS. The receipt of ETB or ETX causes the SCC to expect the BCS as the next character(s). Subsequent blocks, if needed, must contain an ESC command code following the STX. In multiblock messages to the printer, only the Write Control Character (WCC) of the last block should have the start printer bit set.

EOT (End of Transmission)

7.27 The SCC sends EOT when:

- It has no blocks to send, indicating a no traffic response.
- It is in an abnormal state and cannot continue sending additional message blocks.
- In place of an ACKN to a received message if the message caused a status and sense message to be primed.

Upon sending (or receiving) of EOT, the SCC returns to the control mode.

SID (Station Identity)

7.28 The SID, or station identity, is a two character identifier associated with each KD or printer and is unique for any private line. The SID is employed in polling, selection, and in the first response block to a poll or read. Each character of the SID is repeated on polling and selection by the LCU, as BCS checking of supervisory sequences is not employed in this system. See Table J for Station Poll and Station Select Addresses.

ITB (Intermediate Transmission Block)

7.29 The ITB character is sent by the LCU to inform the SCC that the next character(s) is a BCS. A BCS error after ITB will cause a NAK response to be sent to the LCU. The SCC never transmits ITB.

EM (End Medium)

7.30 When the WCC indicates NL/EM control, all data in a printer buffer after EM is held but not printed. When the WCC indicates fixed length lines, EM is converted to a space and does not cause printing to stop. A received EM will occupy a position in the printer buffer.

TTD (Temporary Text Delay)

7.31 The SCC will respond to a TTD (STX.... ENQ) from the LCU by sending NAK and awaiting the next sequence from the LCU.

MESSAGE CONTROL CHARACTERS

7.32 Both the SCC and LCU employ a number of message control characters which improve message transfer efficiency. These characters are either control characters (other than the control characters used for link control), or graphics whose location in a stream of information causes a special interpretation.

ESC (Escape)

7.33 The control character ESC is transmitted as the first character after STX in a message from the LCU to the SCC.

Command Codes

7.34 One of the graphics, 1, 2, 5, 6, 7, or ?, is transmitted as the character following ESC in LCU commands to the SCC. See Table I.

Device Commands

7.35 The commands listed in Table I are decoded by the addressed device and the following action is taken:

- Write — Write received data into buffer (will overwrite previously entered data). Text need not be present in a write or erase write Command.
- Erase/Write — Clear buffer and then write received data in buffer.
- Read Modified — Transmit data fields flagged as modified from buffer.
- Read All — Transmit contents of buffer, including nulls.
- Erase all Unprotected — Clear all unprotected fields in the buffer.
- Copy — Transfer specified contents of the buffer of a specified device into the buffer of the selected device on the same SCC. No text is transferred to or from the LCU.

7.36 When a write or erase/write command is executed, the buffer is written from an address determined as follows:

— Location 0, if erase/write is executed and no DC1 (SBA) is present.

— At the address following DC1 (SBA), if present.

— At the address of the cursor, if the write follows a COPY, selection, or a response to a polled message transfer.

— At the current buffer address when the write command follows a read command or another write command.

7.37 The copy command copies the specified field contents as determined by the CCC. Other locations in the "To" device buffer are set to NULLS. The cursor shall be located in the same position in the "To" device as in the "From" device. The "from" and "to" device addresses can be the same. This capability may be used to cause selective erasure of the buffer.

TABLE I

COMMANDS

COMMAND		TEXT PERMITTED
WRITE	E* W S 1 C C (F1) C	YES
ERASE–WRITE	E* W S 5 C C (F5) C	YES
ERASE ALL UNPROTECTED	E* S ? C (6F)	NO
COPY	E* C D S 7 C C (F7) C A	NO
READ MODIFIED	E* S 6 C (F6)	NO
READ ALL	E* S 2 C (F2)	NO
CLEAR	A1	NO
PSEUDO BID	F8	NO

Legend:

WCC = Write Control Character (see 7.38)
CCC = Copy Control Character (see 7.39)
DA = Device Address (see Table A)

(Hex for EBCDIC added in parenthesis).

*ADCCP does not use ESC in commands.

Write Control Characters (WCC)

7.38 WCCs are used in write and erase-write commands to the SCC. The WCC bit assignments and related functions are given in Table J. Characters other than those shown in Table J can be used since the SCC uses only the low order six bits (bits 7-2) of the EBCDIC character. When ASCII line code is used, the characters are first translated in the SCC to EBCDIC. The communications control characters SYN, ITB, ENQ, ETB and ETX are not allowed, and will be acted upon as control characters.

TABLE J

WRITE CONTROL CHARACTERS

WCC (SP, A, etc)							
				Print			
Start Printer	Sound KD Alarm	Put KD in LOCAL	Reset ACs to Unmodified	NL char/line	40 char/line	64 char/line	80 char/line
				SP	&	-	0
			●	A	J	/	1
		●		B	K	S	2
		●	●	C	L	T	3
	●			D	M	U	4
	●		●	E	N	V	5
	●	●		F	O	W	6
	●	●	●	G	P	X	7
●				H	Q	Y	8
●			●	I	R	Z	9
●		●		[¢	] !	¦ ¦	:
●		●	●	.	$	,	#
●	●			<	*	%	@
●	●		●	(	)	_	'
●	●	●		+	;	>	=
●	●	●	●	¦ ¦	^ ¬	?	"

Where two characters are shown, ASCII is on left, EBCDIC on right.

AC — Attribute Character

Bit(s)	Function
0-1	Value of these bits determined by bits 2-7.
2-3	Printer Format 00 - NL/EM characters honored 01 - 40 character print line 10 - 64 character print line 11 - 80 character print line
4	Start Printer 0 - Do not start printer operation at completion of write. 1 - Start printer operation at completion of write.
5	Sound KD Alarm 0 - Do not sound alarm at completion of write. 1 - Sound KD alarm at completion of write.
6	Restore KD to Local 0 - Do not restore KD to Local at completion of write. 1 - Restore KD to Local at completion of write.
7	Reset ACs to Unmodified 0 - Do not reset ACs to Unmodified prior to writing data or executing orders. 1 - Reset ACs to Unmodified prior to writing data or executing orders.

Copy Control Character (CCC)

7.39 CCCs are used in the copy-from command to the SCC. The CCC bit assignments and related functions are shown in Table K. Characters other than those shown in Table K can be used since the SCC uses only the low order six bits (bits 7-2) of the EBCDIC character. (When ASCII line code is used, the characters are first translated in the SCC to EBCDIC.) However, the communications control characters SYN, ITB, ENQ, ETB, and ETX are not allowed, and will be acted upon as control characters.

TABLE K

COPY CONTROL CHARACTERS

CCC								
		Copy			Print			
Start Printer	Sound KD Tone	ACs	Protected Data	Unprotected Data	NL char/line	40 char/line	64 char/line	80 char/line
		•			SP	&	-	0
		•		•	A	J	/	1
		•	•		B	K	S	2
		•	•	•	C	L	T	3
	•	•			D	M	U	4
	•	•		•	E	N	V	5
	•	•	•		F	O	W	6
	•	•	•	•	G	P	X	7
•		•			H	Q	Y	8
•		•		•	I	R	Z	9
•		•	•		[¢	] !	¦	:
•		•	•	•	.	$	,	#
•	•	•			<	*	%	@
•	•	•		•	(	)	_	'
•	•	•	•		+	;	>	=
•	•	•	•	•	! |	^¬	?	"

Where two characters are shown, ASCII is on left, EBCDIC on right.

AC — Attribute Character

Bit(s)	Function
0-1	Value of these bits determined by bits 2-7.
2-3	Printer Format 00 - NL/EM Characters honored 01 - 40 Character print line 10 - 64 character print line 11 - 80 character print line
4	Start Printer 0 - Do not start printer at completion of copy. 1 - Start printer at completion of copy.
5	Sound KD alarm 0 - Do not sound KD alarm at completion of copy. 1 - Sound KD alarm at completion of copy.
6-7	Type of data to be copied 00 - Copy ACs only 01 - Copy ACs and unprotected data 10 - Copy ACs and protected data 11 - Copy ACs, unprotected and protected data.

Buffer Address And Cursor Address (BA1, BA2; CA1, CA2)

7.40 A device buffer contains 1920 character positions. Each position has a pair of graphic characters (BA2, BA2) specifying a unique position in the buffer. Characters denoted CA1 and CA2 are used to identify the cursor location.

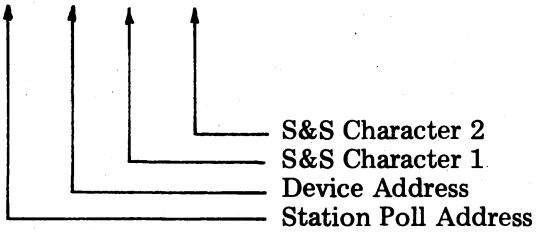
STATUS AND SENSE (S&S)

7.41 Certain alarm conditions detected by the SCC are recorded as S&S characters. These characters are transmitted in alarm status messages to the LCU. If the SCC is selected, and certain S&S bits are set, the SCC will respond RVI to indicate a request for a specific poll. The message takes the form shown in Table L.

TABLE L

STATUS AND SENSE FOR BSC

5	S	S	S		S	S		S	S	E	B	P
5	Y	Y	O	%	R T	P	D	S	S	T	C	A
H	N	N	H		X	A	A	1	2	X	S	D



CONDITIONS	SS1	SS2	TYPE OF POLL	TYPE OF ALARM
Invalid Command	SP	A	Spec†	Operational Check
Device Unavailable‡	SP	&	Spec†	Intervention Required
Command Not Valid for Device	SP	_	Spec†	Command Reject
Device Busy	H	SP	Spec†	Busy
"From" Device Busy	H	A	Spec†	Operational Check and Busy
"From" Device Unavailable	SP	J	Spec†	Intervention Required Operational Check
"From" Device Buffer is Locked to Prevent Copy	D	A	Spec†	Operational Check, Specify Unit
Device No Longer Busy	B	SP	Gen or Spec	Device End (End of Being Busy)
Printer Out of Paper	B	&	Spec§	Intervention, Device End
Block Aborted	SP	D	Spec	Data Check
Internal Timing Error	SP	B	Spec§	Control Check, Operational Check
" FROM "Device Internal Timing Error	SP	C	Spec†	Control Check, Operational Check

†No alarm response to a general poll.

‡Device unavailable is set if the addressed device is unavailable or has no SSI clock at the time a poll or select is received or a display fails to respond to a GO SEND or GO RECEIVE directive.

§Also sent in response to General Poll when printer fails a print out.

7.42 Status and sense bit assignments are shown in Table M.

TABLE M

S&S BIT ASSIGNMENTS FOR BSC

S&S Character 1		S&S Character 2	
Bit	Description	Bit	Description
0	Value dependent on bits 2-7	0	Value dependent on bits 2-7
1	Always a 1	1	Always a 1
2	Always a 0	2	Command Reject (CR)
3	Always a 0	3	Intervention Required (IR)
4	Device Busy (DB)	4	Always a 0
5	Unit Specify (US)	5	Device Check (DC)
6	Device End (DE)	6	Control Check (CC)
7	Always a 0	7	Operation Check (OC)

7.43 The following status and sense conditions are stored in the SCC until reset by an LCU response of RVI, ACK or conversational response. The 45FG110/AE/01 will also reset pending S&S of types not sent to GP when sequence EOT, GP is received.

Invalid Command - OC - (Space A)

Set if:

- The second character in received text is other than ESC or ENQ.
- ETX does not follow the erase all unprotected, read or read modified command.
- ETX does not follow the "FROM" device address in a copy command.
- The "FROM" device address is invalid.
- The buffer address is invalid.
- ETB or ETX embedded in an order.
- ETB or ETX as WCC or CCC (unless 45FG110/AE/01 or later is installed).
- Message sent to a printer with the WCC start printer bit on and ETB as an ending character.

Device Unavailable - IR - (Space &)

Set if:

- The addressed device is unavailable, has its keyboard disconnected, has its security keylock in the OFF position, or has no SSI clock at the time a specific poll or select is received.
- Printer power is turned off while printing a message (unusual occurence). This applies to 45FG110/AE/01 (or later) only.

Command Not Valid For This Device - CR - (Space -)

Set if:

- The third character in received text is not valid, the command sequence is then invalid.

Device Busy - DB - (H Space)

Set if:

- The printer is busy when its specific poll is received.

"FROM" Device Busy - DB,OC - (H A)

Set if:

- "FROM" device address is valid, but device is busy.

"FROM" Device Unavailable - IR,OC - (Space J)

Set if:

- "FROM" device address is valid, but device is unavailable.

Device No Longer Busy - DE - (B Space)

Set by:

- The SCC when an unavailable, "FROM" device unavailable, busy, or "FROM" device busy condition clears itself; or when printer has replaced paper or closed lid.
- The SCC for all devices that are available when SCC is powered up.

Printer Out of Paper - DE,IR - (B&)

Set if:

- The printer is out of paper, has its lid open, or is disabled when a select or specific poll is received.
- During the printing of a LCU initiated printout if the printer runs out of paper, has its lid opened, or is disabled.

Internal Timing Error - CC - (Space B)

Set if:

- The station cluster's receive buffer overflows.
- The device fails to return a block received status to the station cluster while unloading the receive text buffer.
- The "To" device in a copy function fails to return a block received status to the SCC while unloading the receive text buffer within 20 milliseconds.
- The device fails to go into the receive mode during a select or conversational response.
- The "To" device in a copy function fails to ackowledge that it is ready to receive a buffer.

Locked Buffer - OC, US - (DA)

Set if:

- The "FROM" device in a copy command has locked its buffer to prevent it from being copied.

Block Forward Abort - DC - (Space D)

- The device fails to send a block of data to a send next block directive within 20 milliseconds (caused by an SSI link failure).

Message being sent during time of error is terminated with SUB ENQ.

"FROM" Device Internal Timing Error - CC, OC - (Space C)

Set if:

- The "FROM" device in a copy between devices fails to completely transfer its buffer to the SCC.
- The "FROM" device in a copy function sends its buffer to the "To" device with errors. One retry is attempted before the error is set.

SPECIAL FUNCTION KEYS (AID)

7.44 The Attention Identification Device (AID) character is the first character after the device address in all text responses by the SCC except for Status & Sense messages. The AID is set by an operator when one of the keyboard keys of Table N is depressed. The AIDs sent in response to a read-all or read-modified command are "Y" for a printer or "-" for a KD.

TABLE N

AIDs

Key Depressed	AID	HEX EBCDIC	Message Response to Poll
S/R	'	7D	READ MODIFIED
PA1	%	6C	SHORT READ
PA2	>	6E	SHORT READ
PA3	,	6B	SHORT READ
R/TST	0	F0	READ MODIFIED
PF1	1	F1	READ MODIFIED
PF2	2	F2	READ MODIFIED
PF3	3	F3	READ MODIFIED
PF4	4	F4	READ MODIFIED
PF5	5	F5	READ MODIFIED
PF6	6	F6	READ MODIFIED
PF7	7	F7	READ MODIFIED
PF8	8	F8	READ MODIFIED
PF9	9	F9	READ MODIFIED
PF10	:	7A	READ MODIFIED
PF11	#	7B	READ MODIFIED
PF12	@	7C	READ MODIFIED
CLEAR	_	6D	SHORT READ
none, KD	-	6O	RESPONSE TO READ COMMAND ONLY
none, P	Y	E8	RESPONSE TO READ COMMAND ONLY
Mag Stripe Reader	W	E6	READ MODIFIED

AID for R/TST is sent only in a read-type command.

DEVICE ORDERS

7.45 Device orders can be used by the LCU to format the message. See Table O.

(a) Set Buffer Address (SBA) defines the buffer address at which operations are to begin or continue.

(b) Start Field (SF) indicates the beginning of a new field ie, protected, numeric, etc.

(c) Insert Cursor (IC) causes the cursor to be placed at the current buffer address.

(d) Program Tab (PT) advances the buffer pointer to the next unprotecetd field. If the pointer is currently on an attribute of an unprotected field, it is advanced one position. If the PT is received when the pointer is within a field and follows either text data or another PT, the rest of the field is replaced by nulls; otherwise, the field is left unmodified. The search for the next unprotected field stops at the end of the buffer. The buffer pointer is then reset to the start of the buffer.

(e) Repeat to Address (RA) stores a specified character in all locations up to but excluding the specified buffer address. The RA function will wrap in buffer memory. If the address specified is the current buffer address, all locations will be set to the specified character

(f) Erase Unprotected to Address (EUA) stores nulls in all unprotected locations up to (but excluding) the specified address. The EUA function will wrap in memory. If the address specified is the current address, all unprotected locations will be set to nulls.

TABLE O

DEVICE ORDERS

ORDER		CHARACTERS	
		EBCDIC	ASCII
SBA (11)	SET BUFFER ADDRESS	S B B B A A A 1 2	D B B C A A 1 1 2
SF (1D)	START FIELD	S A F C	G A S C
IC (13)	INSERT CURSOR	I C	D C 3
PT (05)	PROGRAM TAB	P T	H T
RA (3C)	REPEAT TO ADDRESS	R B B A A A C 1 2	D B B C A A C 4 1 2
EUA (12)	ERASE UNPROTECTED TO ADDRESS	E B B U A A A 1 2	D B B C A A 2 1 2

EBCDIC Hex added in parenthesis.

Attribute Characters (AC)

7.46 Attribute characters shown in Table P are sent from the LCU as the first character following SF. Characters other than those shown in Table P can be used since the SCC uses only the lower order six bits of the EBCDIC character. When ASCII line code is used, the characters are first translated in the SCC to EBCDIC. However, the communications control characters SYN, ETB, ENQ, ITB and ETX are not allowed, and will be acted upon as control characters.

TABLE P

ATTRIBUTE CHARACTERS

Specify Field as					AC option 403a or b*			
Protected†	Numeric	Hidden	Highlighted*	Modified				
					SP	D	B	F
				•	A	E	C	G
			•		H	[¢		
			•	•	I	.		
		•			<	+		
		•		•	(	! |		
	•				&	M	K	O
	•			•	J	N	L	P
	•		•		Q	] !		
	•		•	•	R	$		
	•	•			*	;		
	•	•		•	)	^ ¬		
•					-	U	S	W
•				•	/	V	T	X
•			•		Y	¦		
•			•	•	Z	,		
•		•			%	>		
•		•		•	_	?		
•	•				0	4	2	6
•	•			•	1	5	3	7
•	•		•		8	:		
•	•		•	•	9	#		
•	•	•			@	=		
•	•	•		•	'	"		

Specify Field as						AC option 403c†			
Protected†	Numeric	Hidden	Highlighted: Blinked†	Highlighted: Intensified†	Modified				
						SP	D	B	F
					•	A	E	C	G
				•		H			
				•	•	I			
			•			[¢			
			•		•	.			
		•				<	+		
		•			•	(	! |		
	•					&	M	K	O
	•				•	J	N	L	P
	•			•		Q			
	•			•	•	R			
	•		•			] !			
	•		•		•	$			
	•	•				*	;		
	•	•			•	)	^ ¬		
•						-	U	S	W
•					•	/	V	T	X
•				•		Y			
•				•	•	Z			
•			•			¦			
•			•		•	,			
•		•				%	>		
•		•			•	_	?		
•	•					0	4	2	6
•	•				•	1	5	3	7
•	•			•		8			
•	•			•	•	9			
•	•		•			:			
•	•		•		•	#			
•	•	•				@	=		
•	•	•			•	'	"		

* Highlighted fields are intensified or blinked, according to whether option 403a or 403b is elected respectively.

† Fields specified as blinked cause fields specified as intensified to be blinked if displayed at the same time on the same display.

† A protected alphanumeric AC at BA_1 BA_2 = SP SP (home) location prevents both PRINT LOCAL & copy command print-out.

Where 2 characters are shown, character at left is ASCII, character at right is EBCDIC.

7.47 Attribute bit assignments are shown in Table Q.

TABLE Q

ATTRIBUTE BIT ASSIGNMENTS

Bit(s)	Function
0-1	Value of these bits determined by bits 2-7
2-3	Specify field as: 00 - Unprotected and alphanumeric 01 - Unprotected and numeric 10 - Protected and alphanumeric 11 - Protected and numeric
4-5	Display field intensity 00 - Normal intensity 01 - Normal intensity 10 - Intensified or blinked (dependent on option 403) 11 - Hidden
6	Blink intensified fields (only if bits 4 and 5 are 1 0) 0 - Do not blink intensified field 1 - Blink intensified field
7	Specify field as: 0 - Not modified 1 - Modified

Field Definitions

7.48 The device buffers have field characteristics and locations designed by the remote LCU. Each field begins with a field attribute character which denotes the properties of the field. The field attribute character occupies a protected character position in the device buffer and is displayed or printed as a space.

Field definitions are:

- Protected — Protected fields are accessible only by the remote LCU (ie, terminal operators cannot enter or alter data in fields designated as protected).

- Unprotected — Unprotected fields are accessible to the operator or the LCU. In these fields, terminal operators may enter, alter, edit and update information.

- Numeric — Allows only numeric data (digits 0-9, minus, DUP and period characters) to be entered into the field. Numeric override option is available.

- Alphanumeric — Any data can be entered into these fields.

- Intensified — Characters entered into fields designated as intensified are displayed at a higher than normal intensity on the display.

- Blink — Characters entered into fields designated as blink are displayed with intensity that alternates between half and normal intensity.

- Hidden — Data in these fields is stored in the display buffer, but is not displayed on the monitor or printed on the printer. The terminal operator may enter data in such fields (if they are also defined as unprotected), but the data will not be displayed.

- Modified — Fields in which the data has been altered by the operator are designated as modified. Higher throughput can be achieved by transmitting only data fields defined as modified. Modified fields may also be sent from the LCU.

CONTROL CHARACTERS RECEIVED IN TEXT

7.49 The Control Characters ETX, ENQ, SYN, ETB and ITB (US) are always decoded as communications control characters and cannot be embedded in text for other than communication control purposes.

7.50 The control characters PT (HT), SBA (DC1), EUA (DC2), IC (DC3), RA (DC4), and SF (GS) are defined as device order codes and may appear anywhere in text. However, if an order code is embedded in an order (ie, the SF in the sequence SBA A SF), the embedded order is ignored and only the low six bits (bits 2-7) of the EBCDIC character value is used with the initial order.

7.51 The control characters NL, EM, FF, DUP (FS), FM and NULL (RS), are defined buffer functions or data characters and can appear anywhere in text. However, if they are embedded in an order, the function is ignored and only the low six bits (bits 2-7) of the EBCDIC character value is used with the order.

7.52 The rest of the ASCII and EBCDIC control characters and all the undefined EBCDIC characters may appear in received text. Undefined characters are stored in the device buffer as delete (ASCII HEX '7F', EBCDIC HEX '07'). These characters are displayed as ⁄ and will be sent back to the LCU as a delete.

AIDS TO DECODING BSC DATA STREAMS

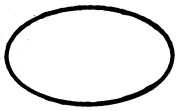
7.53 The following list identifies the major groupings of the charts that provide more detailed operation.

GENERAL POLL	CHARTS 1 & 2
SPECIFIC POLL	CHART 3
LED DISPLAY	CHART 3
SCC RESPONSE TO POLL	CHART 3
DATA LINK CONTROL NOTES	CHART 4
CONDITIONS THAT CAUSE STATUS AND SENSE	CHARTS 4 & 5
SELECTION	CHART 6
WRITE COMMANDS	CHARTS 7 & 8
LIMITED CONVERSATIONAL RESPONSE FROM LCU	CHART 8
READ COMMANDS	CHARTS 9 & 10
COPY COMMAND	CHART 11
ERASE ALL UNPROTECTED COMMAND	CHART 12
DEVICE ORDERS	CHART 12
TEXT TO PRINTER	CHART 13
ACTUAL SCC RESPONSES	CHART 14

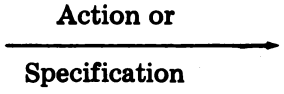
7.54 The following symbols are used in Charts 1 through 14.

- LCU or SCC does operation in box:

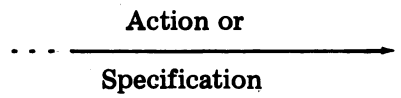
- Additional information is given in this shape:



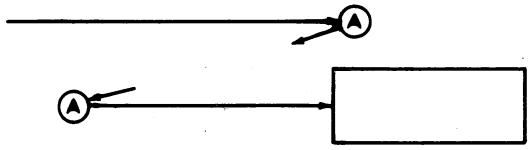
- An action or specification is written along a line from a box to another box:



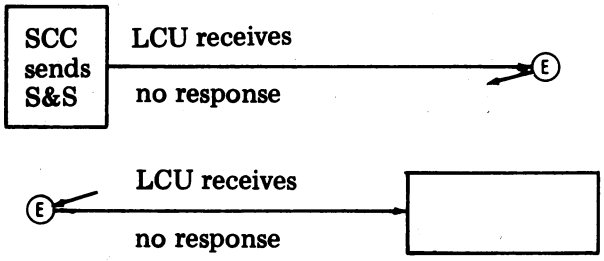
- An action or specification can come from any box provided. The action or specification applies when three dots precede the line:



- When a line is not drawn directly to a box, it is drawn to a circled letter, the pigtail on the circle indicates the direction to continue:



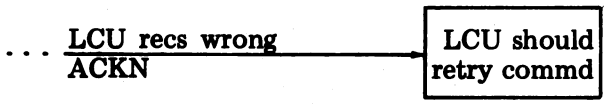
Example 1:



Explanation of example 1:

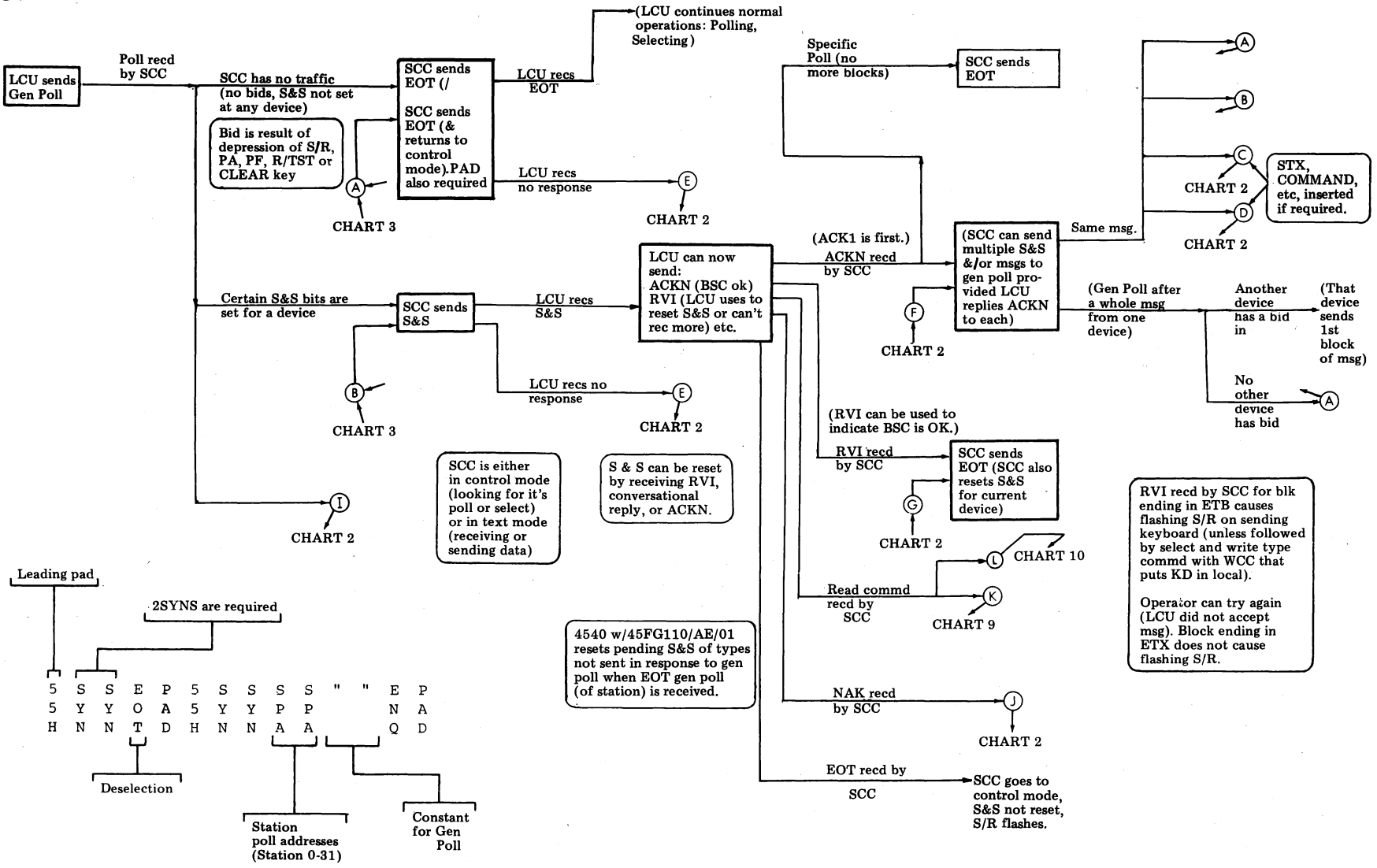
The SCC sends S&S if the LCU receives no response; follow the line to "E", then the pigtail to the lower "E", then the line to the unlabeled box.

Example 2:



Explanation of example 2: If the SCC sends wrong ACKN, then the line "LCU receives wrong ACKN" applies. The LCU should retry the command (as indicated in the box).

General Poll



4540 Binary Synchronous Communication (BSC) Protocol

CHART 1 — BSC

General Poll (Contd)

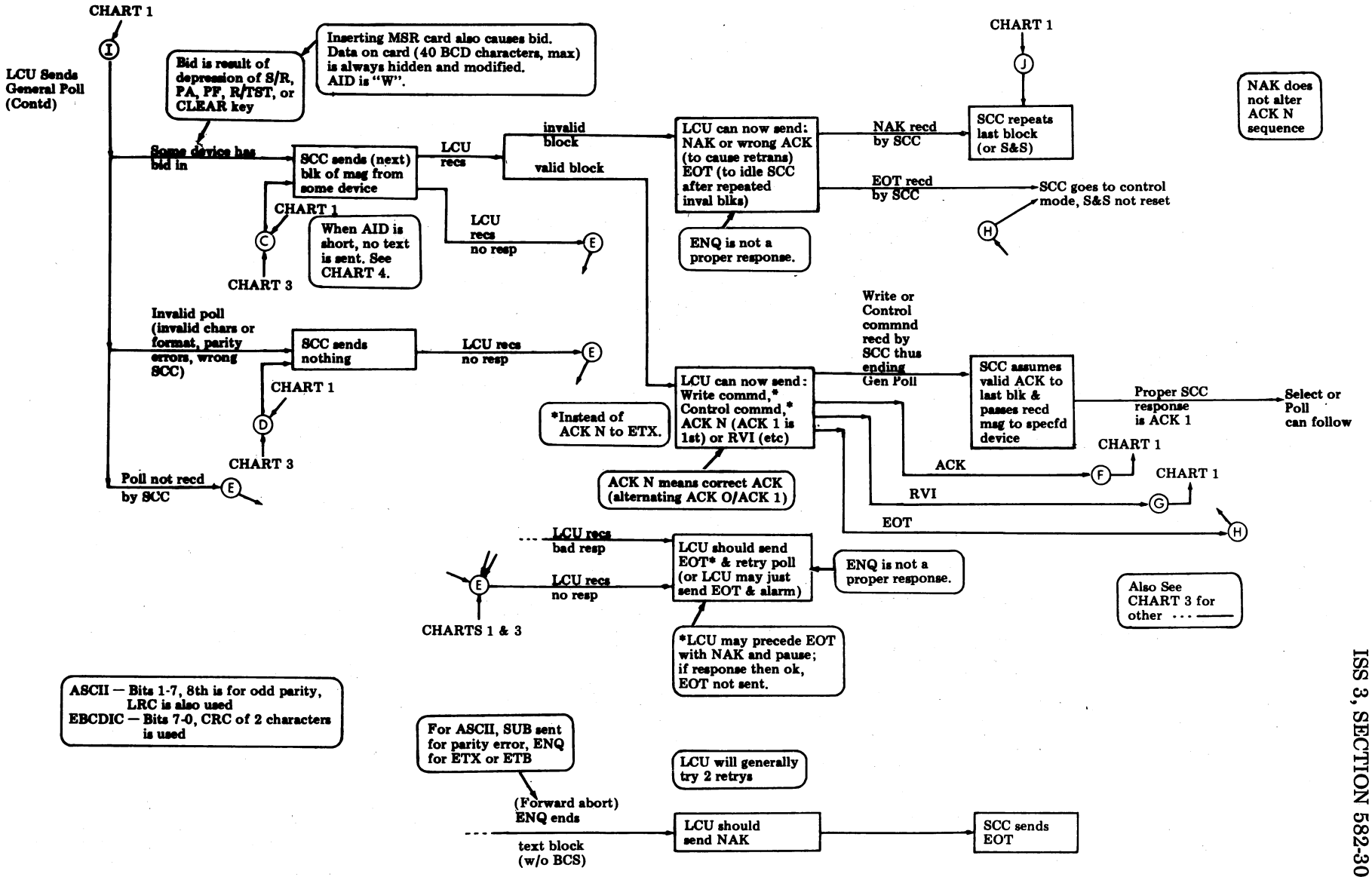
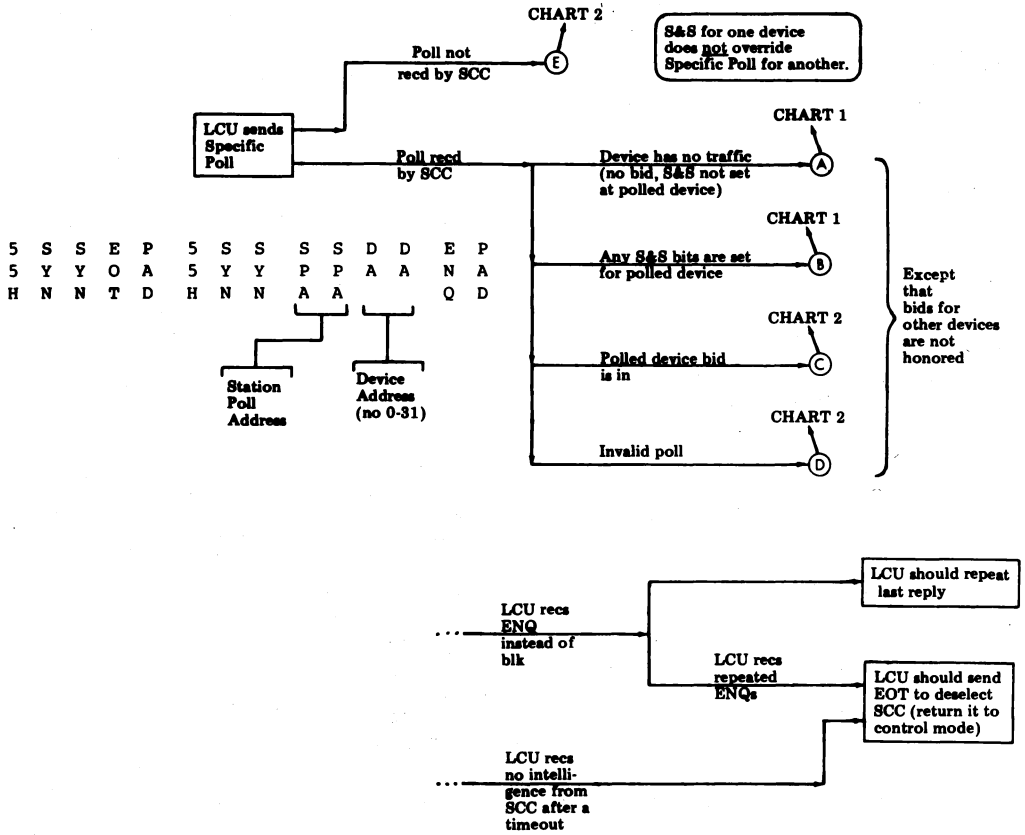


CHART 2 — BSC

Specific Poll
4540 responds to 1-32 device addresses only.



LED Display for 4540

R S		R S	
Line 1		Line 2	
1	2	3	4

R of Line 1 lights when any data is on the receive line.
S of Line 1 lights when SCC is sending.

1. Lights when station receives its own poll.
*2. Lights when there is a download to any KD.
*3. Lights when there is a SSI retransmission.
4. Lights in loopback test when the message is sent from controller to EIA interface.

*Not available with 45FG110AA.

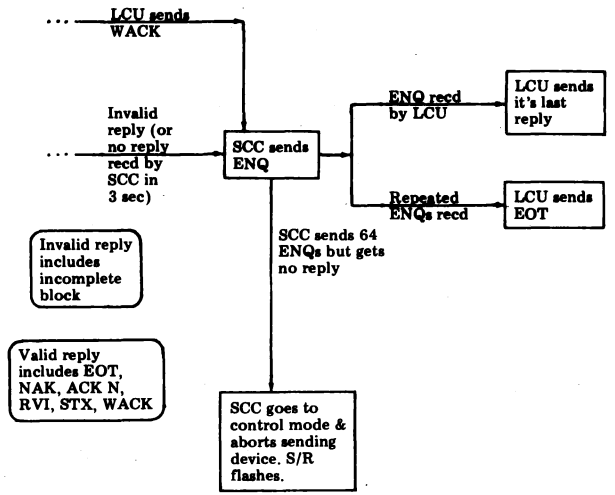
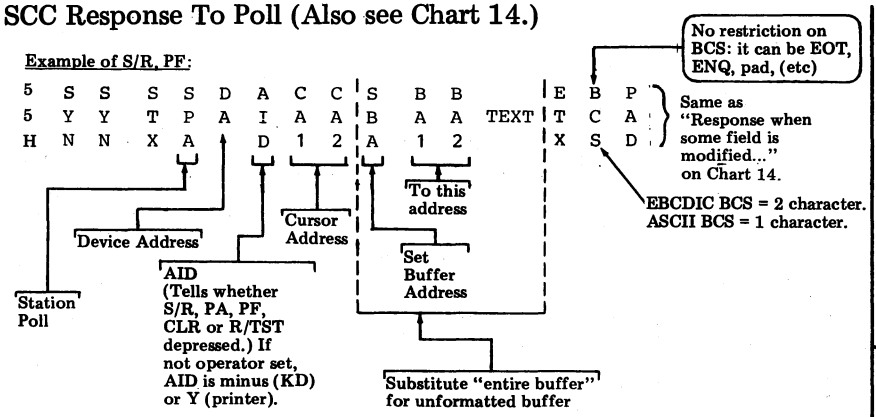


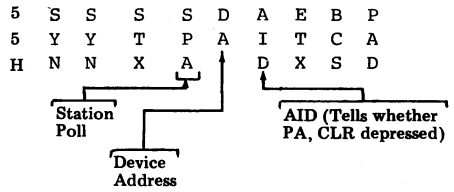
CHART 3 — BSC

SCC Response To Poll (Also see Chart 14.)

Example of S/R, PF:

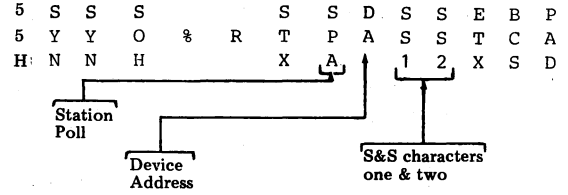


Example of PA, CLR ("Short aid")



No - traffic response:

Example of S&S response:



Test request msg (R/TST) also applies, see Chart 14

Data Link Control Notes

SYN - No SYNs allowed in middle of ETX-BCS, ETB-BSC, ITB-BCS ACK N, SF"X", RVI, WACK.

Sometimes called leading pad.

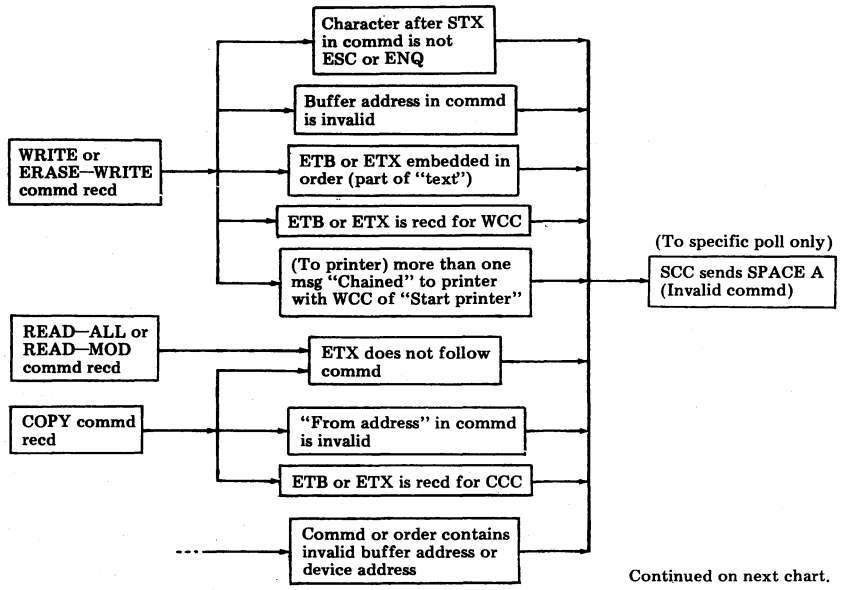
PAD - (Hex FF) Must be sent immediately after any transmission. SCC requires only that the 1st 4 bits be marking. FF insures modem carrier is not dropped during character prior to FF.

Leading pad "(Hex 55)" character that precedes transmissions.

SYNS in text or the two characters following ITB are not accumulated in BCS. BCS is generated and detected in the SCC.

Conditions that causes S&S to be sent to a Poll

If device is selected and S&S is pending, SCC sends RVI (expecting a specific poll to pick up S&S). Exceptions: B SPACE, SPACE D, SPACE B, (and B &, if there was a prior select).



Continued on next chart.

CHART 4 — BSC

Conditions That Cause S&S to be Sent to a Poll (Contd)

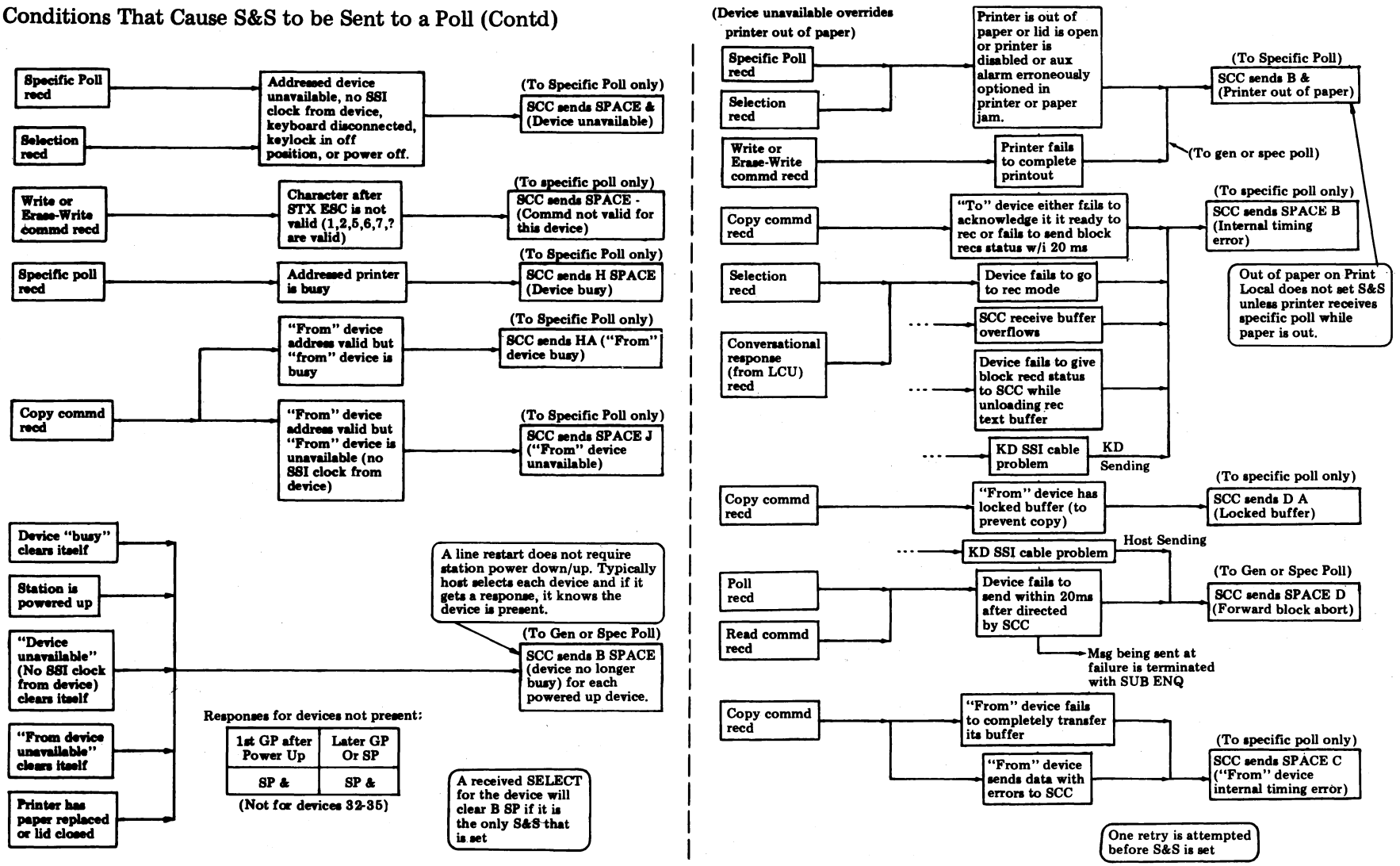


CHART 5 — BSC

Selection — A communication initiated by LCU to prepare a device to receive a command.

A select will override an abort (S/R flashing), it will also override a pending bid. The bid is lost.

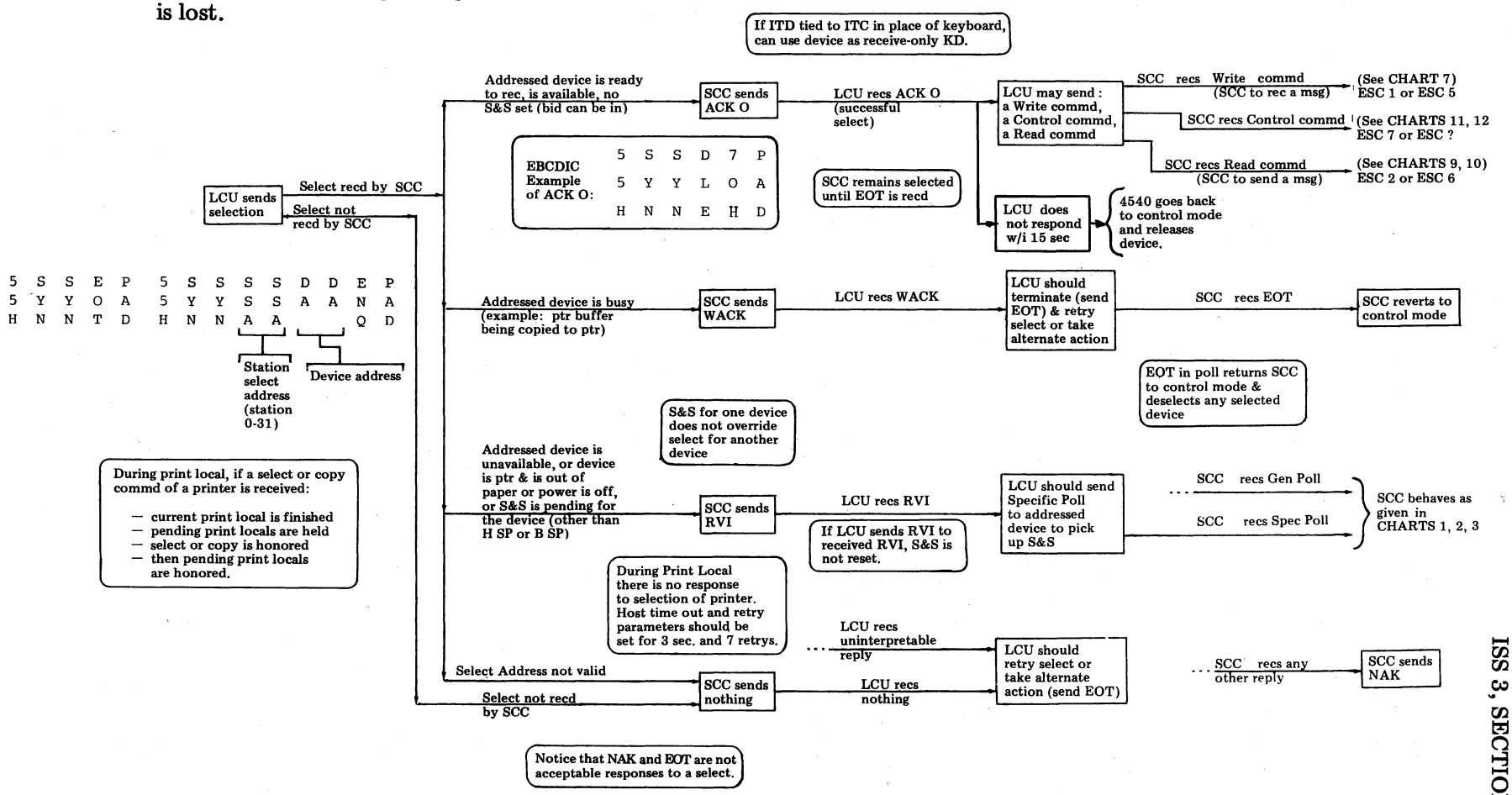


CHART 6 — BSC

Write Commands (SCC to rec)

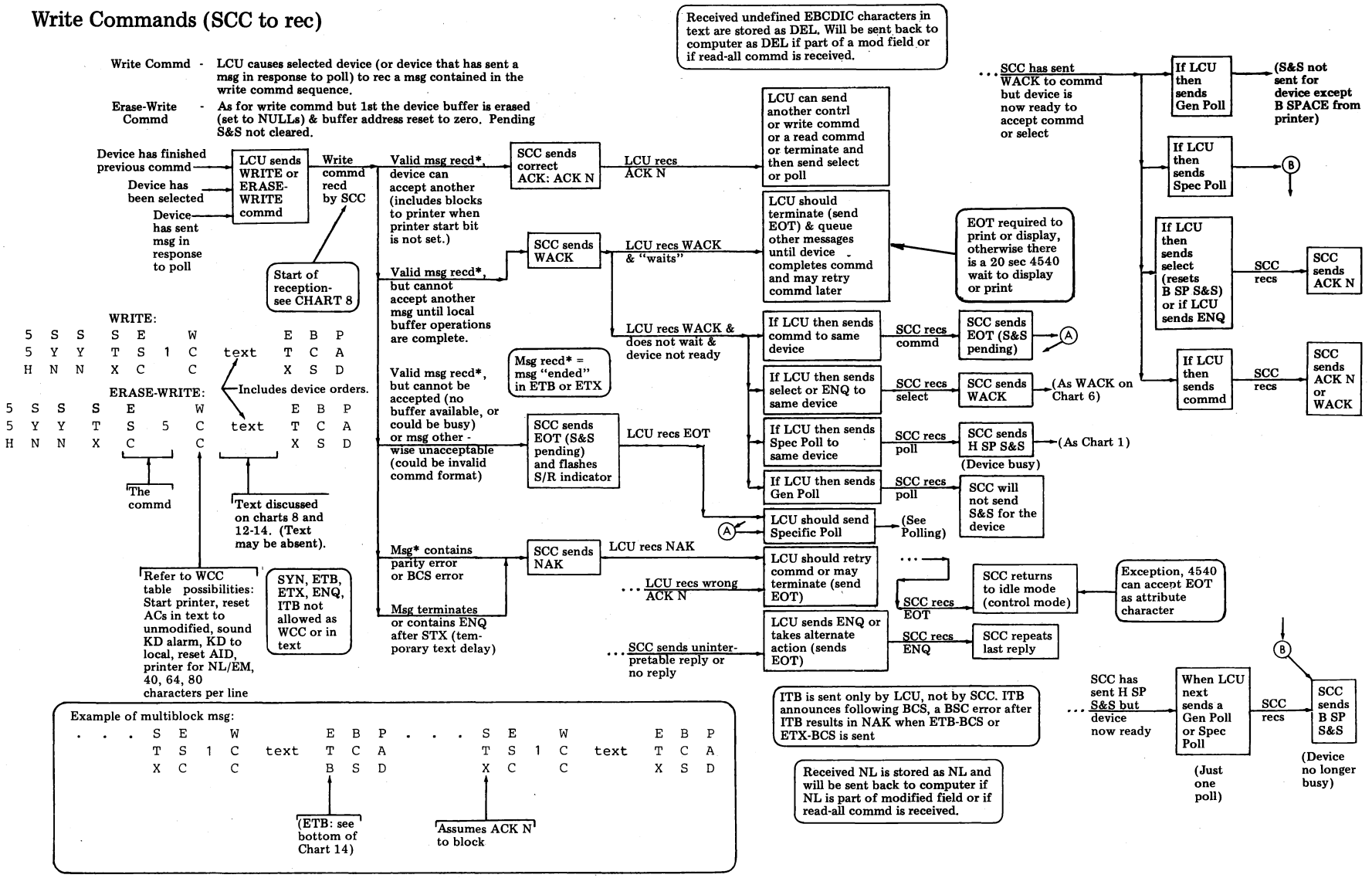
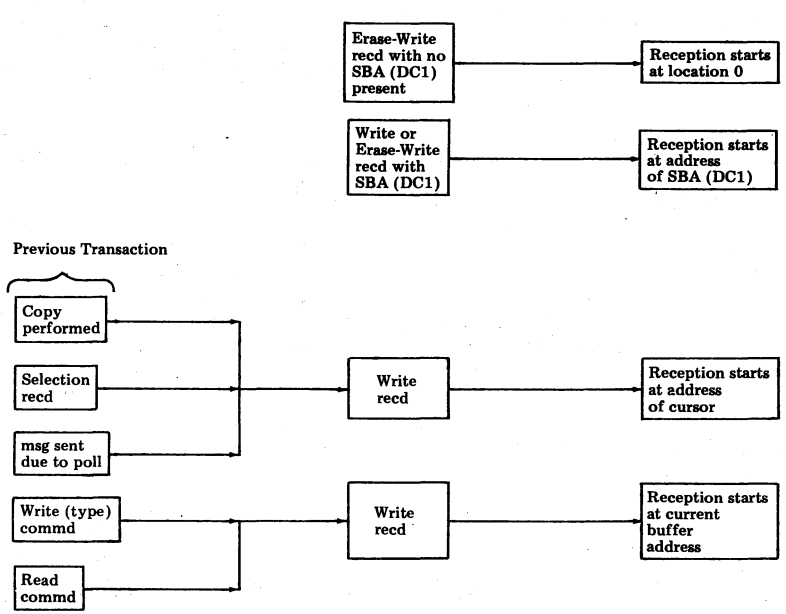
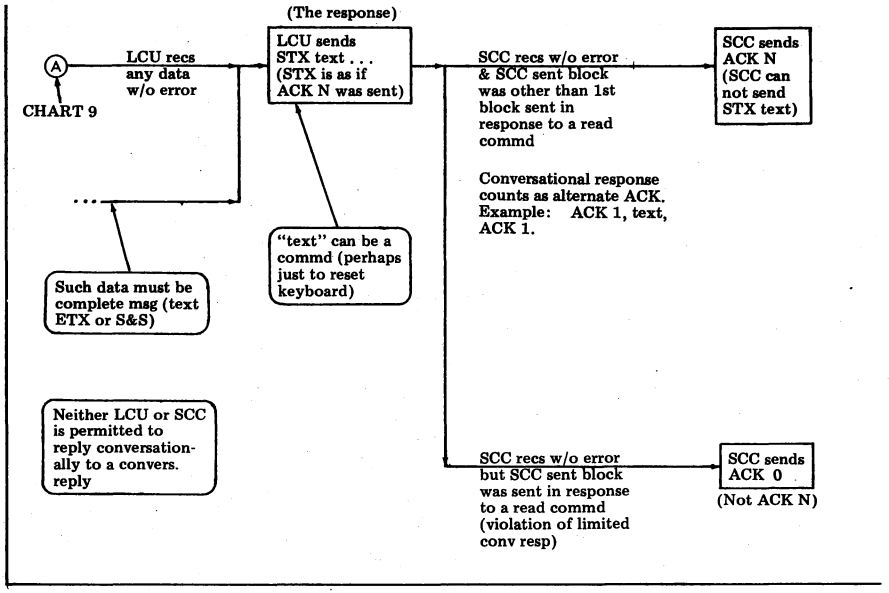


CHART 7 — BSC

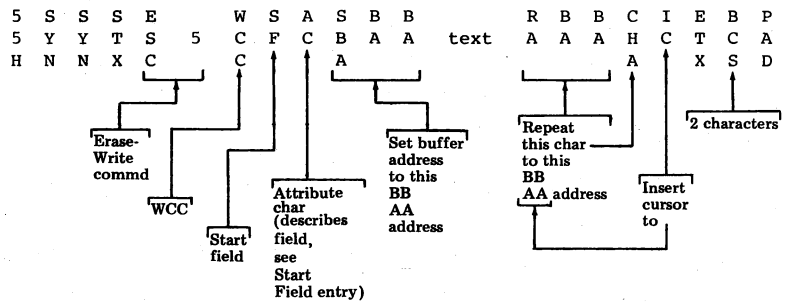
Start of reception of text due to Write or Erase-Write:



Limited Conversational Response From LCU



Example of LCU Write Response to SCC Acknowledgement of Select:



Read Commands (SCC to Send)

Read-All Commd — LCU commands selected device to send entire device buffer, including NULLs.

Read-Modified Commd — LCU commands selected device to send only modified fields.

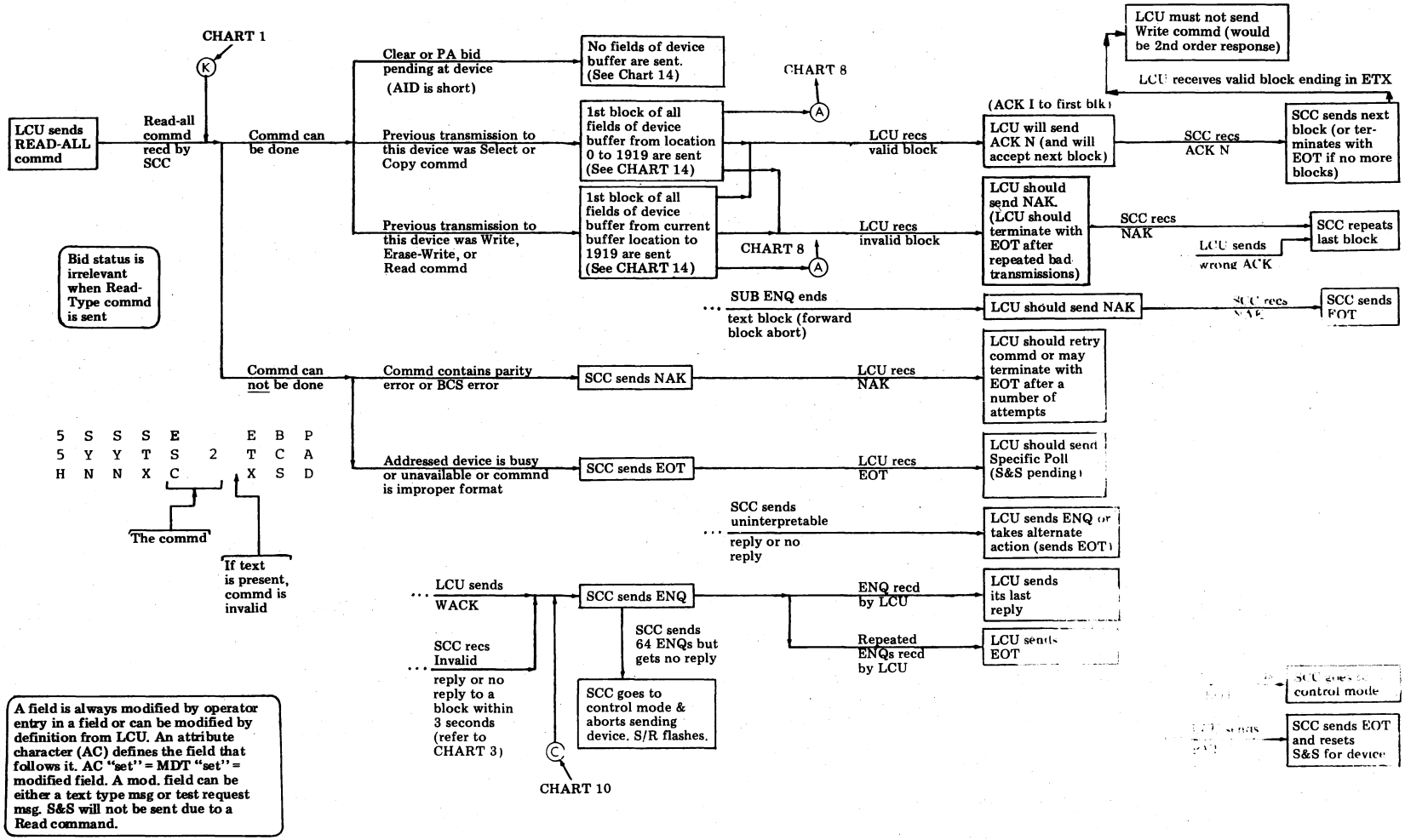


CHART 9 — BSC

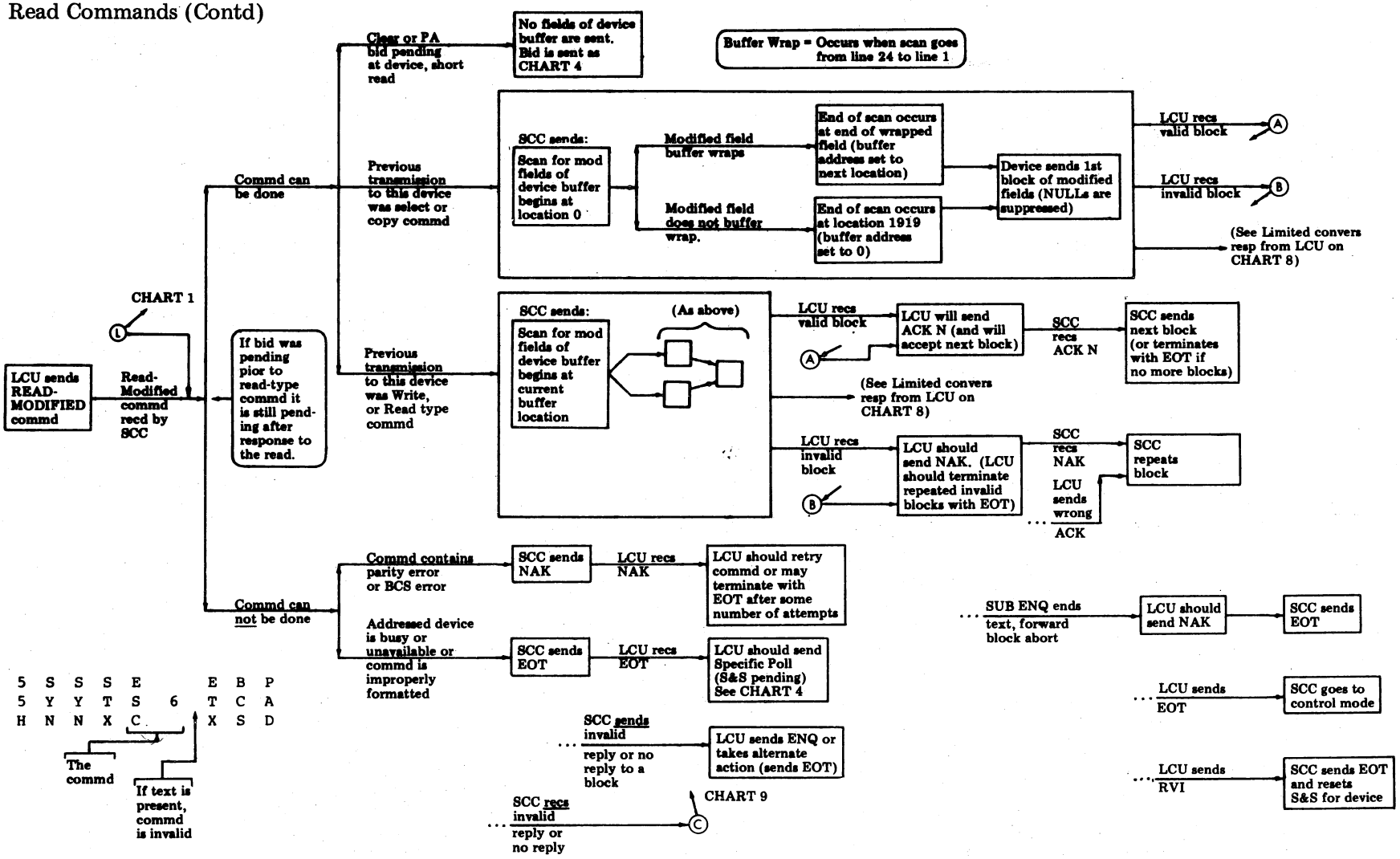


CHART 1
LCU sends READ-MODIFIED commd
Read-Modified commd recd by SCC
If bid was pending pior to read-type commd it is still pending after response to the read.
Commd can be done
Commd can not be done
Clear or PA bid pending at device, short read
No fields of device buffer are sent. Bid is sent as CHART 4
Buffer Wrap = Occurs when scan goes from line 24 to line 1
Previous transmission to this device was select or copy commd
SCC sends:
Scan for mod fields of device buffer begins at location 0
Modified field buffer wraps
Modified field does not buffer wrap.
End of scan occurs at end of wrapped field (buffer address set to next location)
End of scan occurs at location 1919 (buffer address set to 0)
Device sends 1st block of modified fields (NULLs are suppressed)
LCU recs valid block
LCU recs invalid block
(See Limited convers resp from LCU on CHART 8)
Previous transmission to this device was Write, or Read type commd
SCC sends:
Scan for mod fields of device buffer begins at current buffer location
(As above)
LCU recs valid block
LCU will send ACK N (and will accept next block)
SCC recs ACK N
SCC sends next block (or terminates with EOT if no more blocks)
(See Limited convers resp from LCU on CHART 8)
LCU recs invalid block
LCU should send NAK. (LCU should terminate repeated invalid blocks with EOT)
SCC recs NAK
LCU sends wrong ACK
SCC repeats block
Commd contains parity error or BCS error
SCC sends NAK
LCU recs NAK
LCU should retry commd or may terminate with EOT after some number of attempts
Addressed device is busy or unavailable or commd is improperly formatted
SCC sends EOT
LCU recs EOT
LCU should send Specific Poll (S&S pending) See CHART 4
SUB ENQ ends text, forward block abort
LCU should send NAK
SCC sends EOT
LCU sends EOT
SCC goes to control mode
LCU sends RVI
SCC sends EOT and resets S&S for device
SCC sends invalid reply or no reply to a block
LCU sends ENQ or takes alternate action (sends EOT)
SCC recs invalid reply or no reply
CHART 9
5 5 H
S Y N
S Y N
S T X
E S C
6
E T X
B C S
P A D
The commd
If text is present, commd is invalid

CHART 10 — BSC

Copy Command - LCU causes current active device to copy from some device buffer on same SCC. Copy for a device can be from itself. Use of CCC allows selective modification of a device buffer contents. Data is copied as defined in CCC, all other locations in the "to device" buffer are set to NULL, however all attribute characters are copied. LCU can prevent copy by putting a protected alphanumeric attribute in 1st buffer position (but refer to Option 414b). A locked buffer can not be printed by print-local. Cursor of "to" is set by "from" device position.

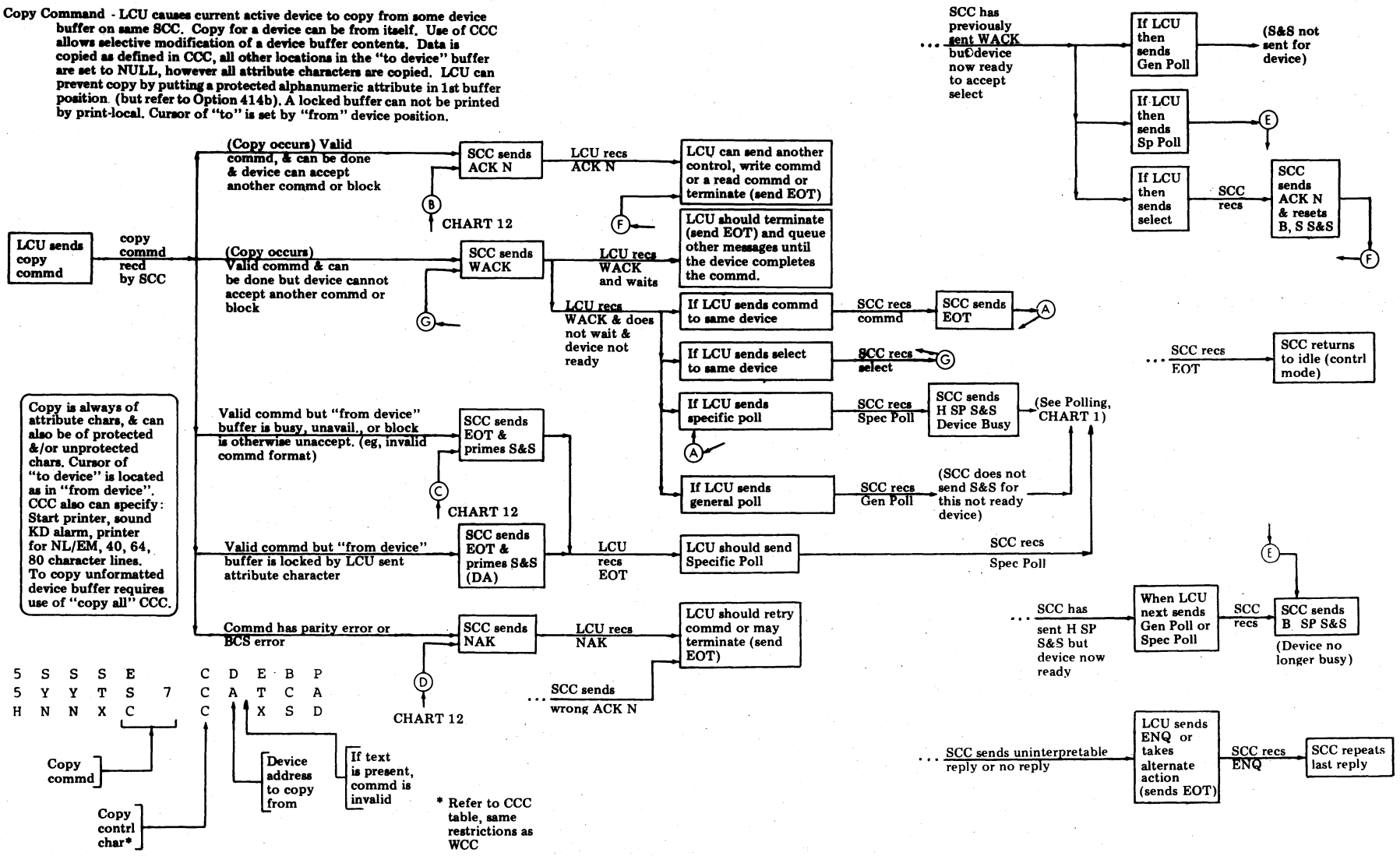
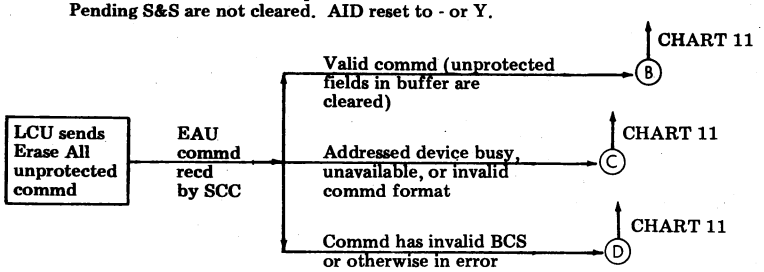
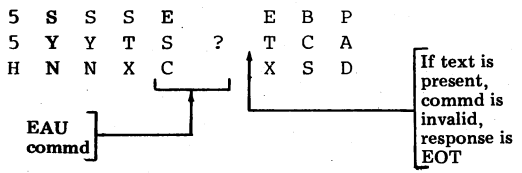


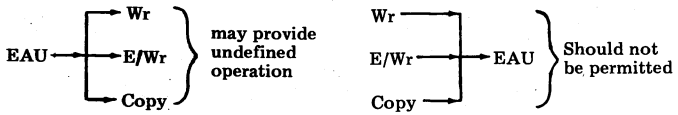
CHART 11 — BSC

Erase All Unprotected Command - LCU caused selective buffer erasure of addressed device. Unprotected buffer locations are set to NULL. Attribute characters (ACs or MDTs) are reset to unmodified. Cursor is set to 1st character location in 1st unprotected field in buffer. KD is set to local. Pending S&S are not cleared. AID reset to - or Y.





Restriction for Chaining Commands.



DEVICE ORDERS (part of text)

Device orders are sometimes called buffer orders.

Orders — Characters in data stream used to position, define, and format data. See 6.49.

Orders embedded in other orders are ignored.

The control characters ETX, ENQ, SYN, ETB and ITB (US) are control characters and cannot be used in text or orders other than for communication control purposes.

Set Buffer Address DC1 (SBA)

Used in form "$^{S}_{B}$ $^{B}_{A}$ $^{B}_{A}$" where $^{B}_{A}$ $^{B}_{A}$ defines buffer address
$_{A}$ $_{1}$ $_{2}$ $_{1}$ $_{2}$

where operations are to begin or continue. There can be many SBAs in a msg. ETB should not be embedded in the order. SBA can be sent by 4540 during read operations.

Start Field GS (SF) (Not used with unformatted messages)

SF can be sent by 4540 during read-all but not to poll or read-modified.

Used in form "$^{S}_{F}$ $^{A}_{C}$" where $^{A}_{C}$ defines the field that follows.

$^{A}_{C}$ is displayed as space on KD, $^{S}_{F}$ does not occupy a space. $^{A}_{C}$ has same restrictions as WCC.

$^{A}_{C=}$ Attribute character that defines field as one or more of the following: { protected, numeric, hidden, highlighted, modified }

ETB should not be embedded.

When no fields are defined then the buffer is considered unformatted.

Repeat to Address DC4 (RA)

Used in form "$^{R}_{A}$ $^{B}_{A}$ $^{B}_{A}$ C" where "$^{B}_{A}$ $^{B}_{A}$" defines a buffer address.
$_{1}$ $_{2}$ $_{1}$ $_{2}$

Repeated "C" (some character) is repeated up to (but excluding) the address. RA will wrap in the buffer. If address specified is the current address, all buffer locations will be set to the specified character.

Erase Unprotected to Address DC2 (EUA)

Used in form "$^{E}_{A}$ $^{B}_{A}$ $^{B}_{A}$" where "$^{B}_{A}$ $^{B}_{A}$" defines a buffer address.
$_{1}$ $_{2}$ $_{1}$ $_{2}$

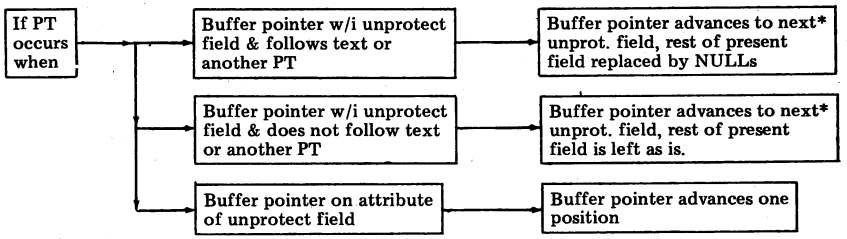
NULLs are stored in unprotected addresses up to (but excluding) the specified address. EUA will wrap in the buffer. If address specified is the current buffer address, all unprotected addresses (locations) will be set to NULLs.

Insert Cursor DC3 (IC)

Used in form "$^{I}_{C}$", places cursor at current buffer address. There is generally only one IC in a msg (the last one always applies).

Program Tab HT (PT)

Used in form "$^{P}_{T}$", performs a tab function:



*Search stops at end of buffer, if no attribute found, buffer pointer is reset to start of buffer

Text to Printer (also see 7.49 — 7.52)

1. When text is sent to a printer, the format specified by the write or copy control character can have a print length of 40, 64, 80 or new line (NL). NL is not LF.

2. When fixed line length is specified, space is substituted for NL to printer (no NL occurs). A line of spaces will cause NL.

3. When print format is NL/EM, but NL is not in data stream, line length is set by printer (generally 80 or 132).

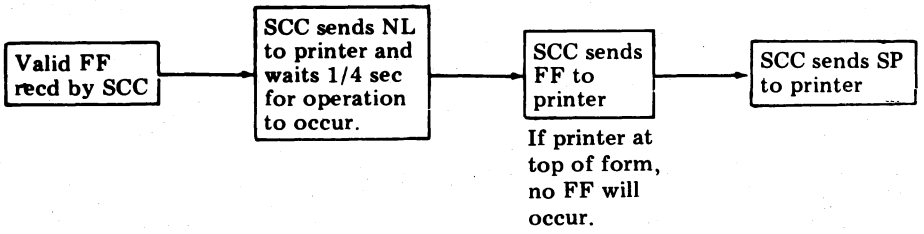
4. Print local generates 1920 characters of data (a complete buffer) with a fixed length of 80 characters/line.

5. Space is substituted for NULL, DUP, FM, DEL, $\frac{A}{C}$, and data in fields specified as hidden. Hidden NLs are not performed.

6. When using a fixed line length, lines of all NULLs, ACs and hidden fields are suppressed and no NL is performed. If not all characters on a line are suppressed then NULL, AC, non-print are treated as spaces. When using NL/EM or print local these lines are not suppressed.

7. FFs must be in first position of line to be valid (Space is substituted for invalid FF). With NL/EM format, valid FFs are determined to be either after a NL or as a 132 char/line. An FF in a totally suppressed line is not performed.

8. Form Feed sequence:



9. EM (End Medium) used with NL/EM WCC (NL/EM print format), causes printing to terminate (data after EM in printable field is not printed). If no EM is present, printing continues to end of buffer. EM has no effect with fixed line WCC and is printed as a SP.

10. Print termination procedure:

Last Character Recd by SCC	SCC sends to printer
NL	NL, ETX
Valid FF	NL, 1/4 td, FF, SP, CR
Valid FF, SP	NL, 1/4 td, FF, SP, CR
Valid FF, character(s)	NL, 1/4 td, FF char(s), NL
Any other valid char.	Char. NL ETX (omit char if in hidden field)

NL/EM format:

text EM, ETX → text NL 1/4 td ETX (NL is inserted)
text NL EM ETX → text NL 1/4 td ETX (no NL inserted)

td = time delay in seconds

11. After last character is sent, a minimum of 5.5 sec. time out occurs before printer motor turns off.

12. Print local in progress cause SCC to ignore a select to that printer. Write, copy, or EAU command in progress supercede print local.

13. Start printer WCC should be only in the last or only block sent to printer.

14. A NL is automatically generated by printer (NL/EM print format) if next character exceeds right margin. If next character is NL, only the printer generated NL will be performed

15. During print local, there is no response to selection of printer, however, there is a response to a specific poll.

CHART 13 — BSC

Actual SCC response sequences to mags & commds (Also see CHART 4)

No traffic response (EOT)

```
5  S  S  E  P
5  Y  Y  O  A
H  N  N  T  D
```

Entire buffer response for unformatted display (to Read-All commd)

```
5  S  S  S  S  D  A  C  C     Field contents     E  B  P
5  Y  Y  T  P  A  I  A  A        (text)          T  C  A
H  N  N  X  A     D  1  2     including NULLs    X  S  D
```

- No key depressed (-= KD) (Y = ptr)
- Cursor address (present cursor location)
- no SF or AC

Entire buffer response for formatted display (to Read-All commd)

```
5  S  S  S  S  D  A  C  C  S  A     field contents     E  B  P
5  Y  Y  T  P  A  I  A  A  F  C   including NULLs      T  C  A
H  N  N  X  A     D  1  2                             X  S  D
```

- STX is 1st character of each block
- No key depressed (-=KD) (Y=ptr)
- Cursor address
- Repeated for other mod fields (ETBs may be sent)

No key was depressed

Response when aid is "short"-PA or CLR

```
5  S  S  S  S  D  A  E  B  P
5  Y  Y  T  P  A  I  T  C  A
H  N  N  X  A     D  X  S  D
```

Response when some field is modified (or for unformatted buffer) and AID is not short — S/R, PF or to Read-Modified Commd

```
5  S  S  S  S  D  A  C  C  S  B  B    mod field     E  B  P
5  Y  Y  T  P  A  I  A  A  B  A  A    (NULLs        T  C  A
H  N  N  X  A     D  1  2  A  1  2    suppressed)   X  S  D
```

- Cursor address
- Repeated for other mod fields (ETBs may be present)
- (Omit for unformatted buffer)
- Unformatted buffer: Substitute "entire Buffer" for "mod field"

BA1, BA2 sent even for BA1, BA2 = O, O

SBA = DC1
SF = GS

S/R, PA, PF, CLEAR key was depressed or badge inserted in mag stripe reader

Response when no field is mod in formatted display but AID is Read Modified S/R, PF, or to Read-Modified commd

```
5  S  S  S  S  D  A  C  C  E  B  P
5  Y  Y  T  P  A  I  A  A  T  C  A
H  N  N  X  A     D  1  2  X  S  D
```

- Cursor address
- S/R, PF was depressed or badge inserted into Mag Stripe Reader

Response when R/TST is depressed (AID is O)

```
5  S  S  S        S  S  B  B
5  Y  Y  O  %  /  T  B  A  A   (field contents w/NULLs suppressed)   E  B  P
H  N  N  H        X  A  1  2                                        T  C  A
                                                                    X  S  D
```

- SOH used for R/TST and S&S only
- Omit for unformatted buffer
- Repeated for all modified fields (ETBs may be sent)
- For unformatted buffer, entire buffer contents are sent
- R/TST was depressed

S&S response sequences (Only to Poll)

```
5  S  S  S        S  S  D  S  S  E  B  P
5  Y  Y  O  %  R  T  P  A  S  S  T  C  A
H  N  N  H        X  A     1  2  X  S  D
```

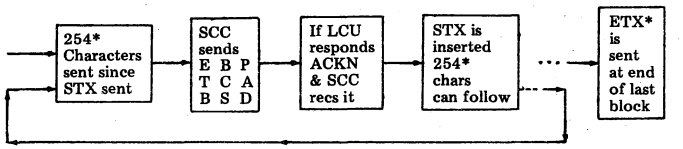
No key required to be depressed to send status

Cursor Address (Part of text)

```
C  C
A  A
1  2
```

A pair of characters (same 1920 pairs of graphic characters as 40/4) are sent by the SCC following the AID character (exception: when PA or CLEAR is depressed) to tell the LCU where the cursor is.

When SCC inserts ETB in msg (to Poll or Read):



*Blocks are typically 254 characters except when an order starts on the 254 character then the block will be 255 or 256 characters to complete the order. The last or only block can contain less than 254 characters. The block length sent by LCU is determined by LCU.

8. BSC DATA LINK EXAMPLES

8.01 Data link control procedures provide systematic programmed methods for establishing, maintaining, and termination of communication links. All communications are under the control of the LCU. Messages to the LCU can only be sent when allowed by the LCU. With the exception of "Print Local" operation, only the LCU can send messages to a device. Device buffer operations, as well as on-line message transfer are controlled by the polling, selection, and command sequences sent by the LCU.

8.02 The remainder of Part 8 describes BSC protocol. Fig. 16, 17 and 18 show the typical information flow. Charts 1 through 14 show more detailed operation.

8.03 Fig. 16, 17 and 18 show both the communications capabilities and the character sequences (SYNs and PADs are not shown) for polling and selection for most message formats and replies. System operation is divided into the following three categories:

- Establishment of Communication to Send and Station to Receive
- Message Transfer — Station Sends
- Message Transfer — Station Receives

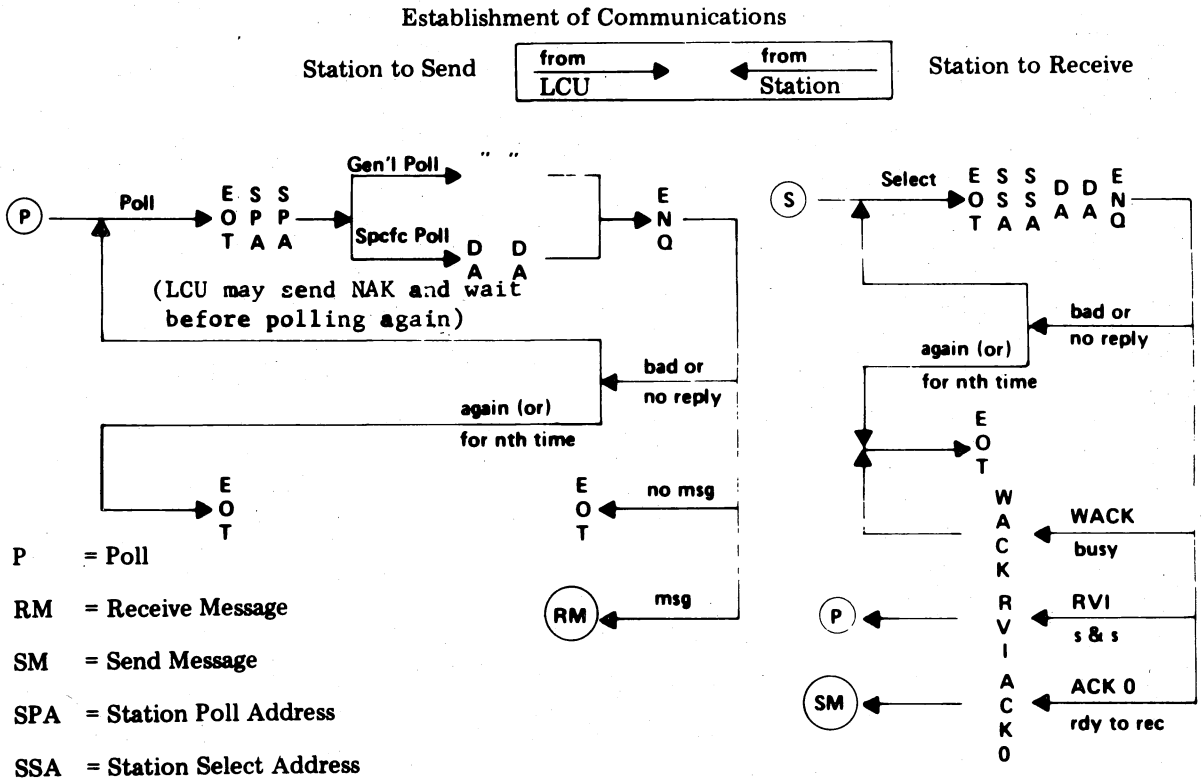


Fig. 16—System Flow Diagram For BSC

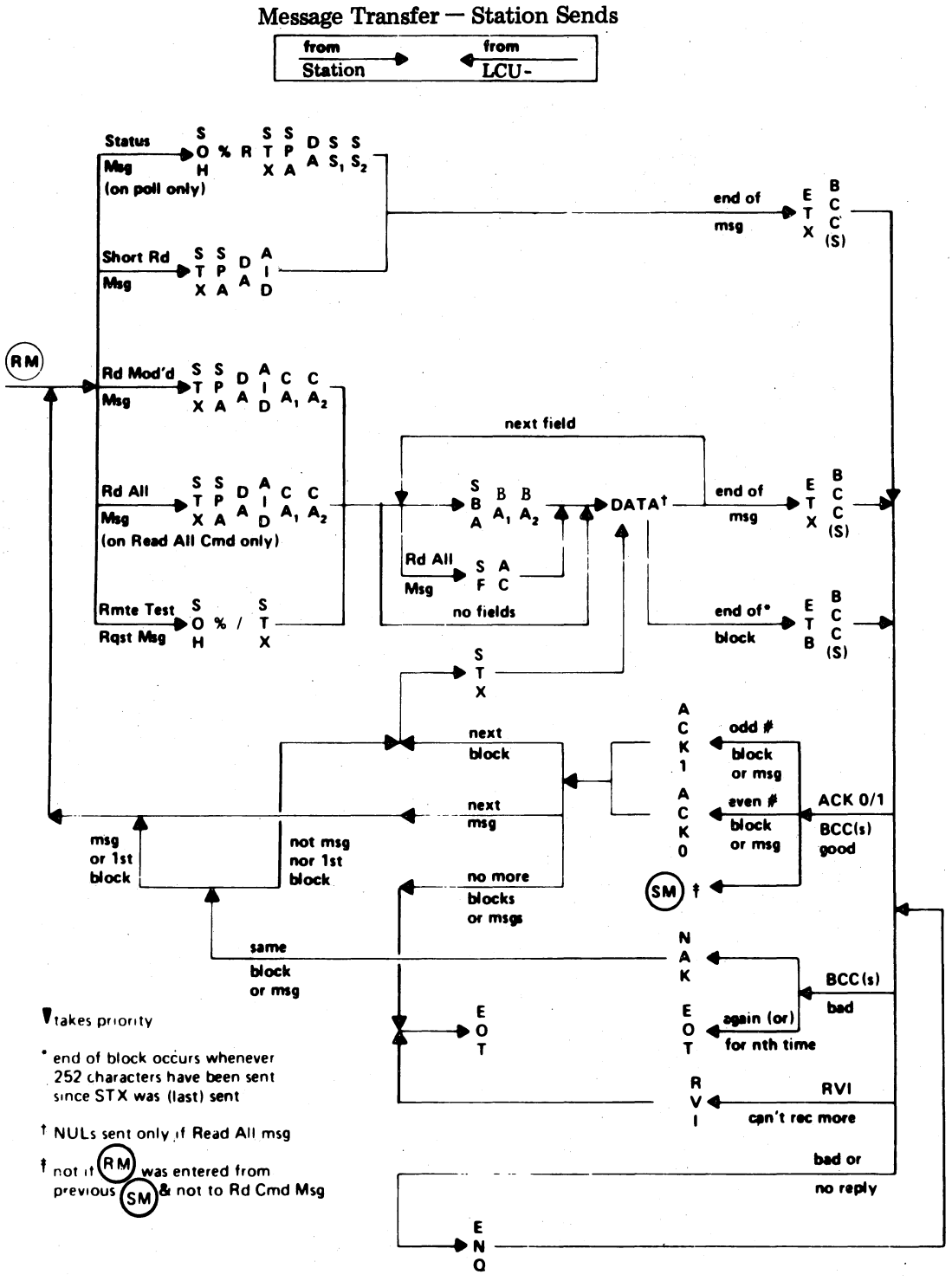


Fig. 17—System Flow Diagram for BSC (Contd)

Message Transfer — Station Receives

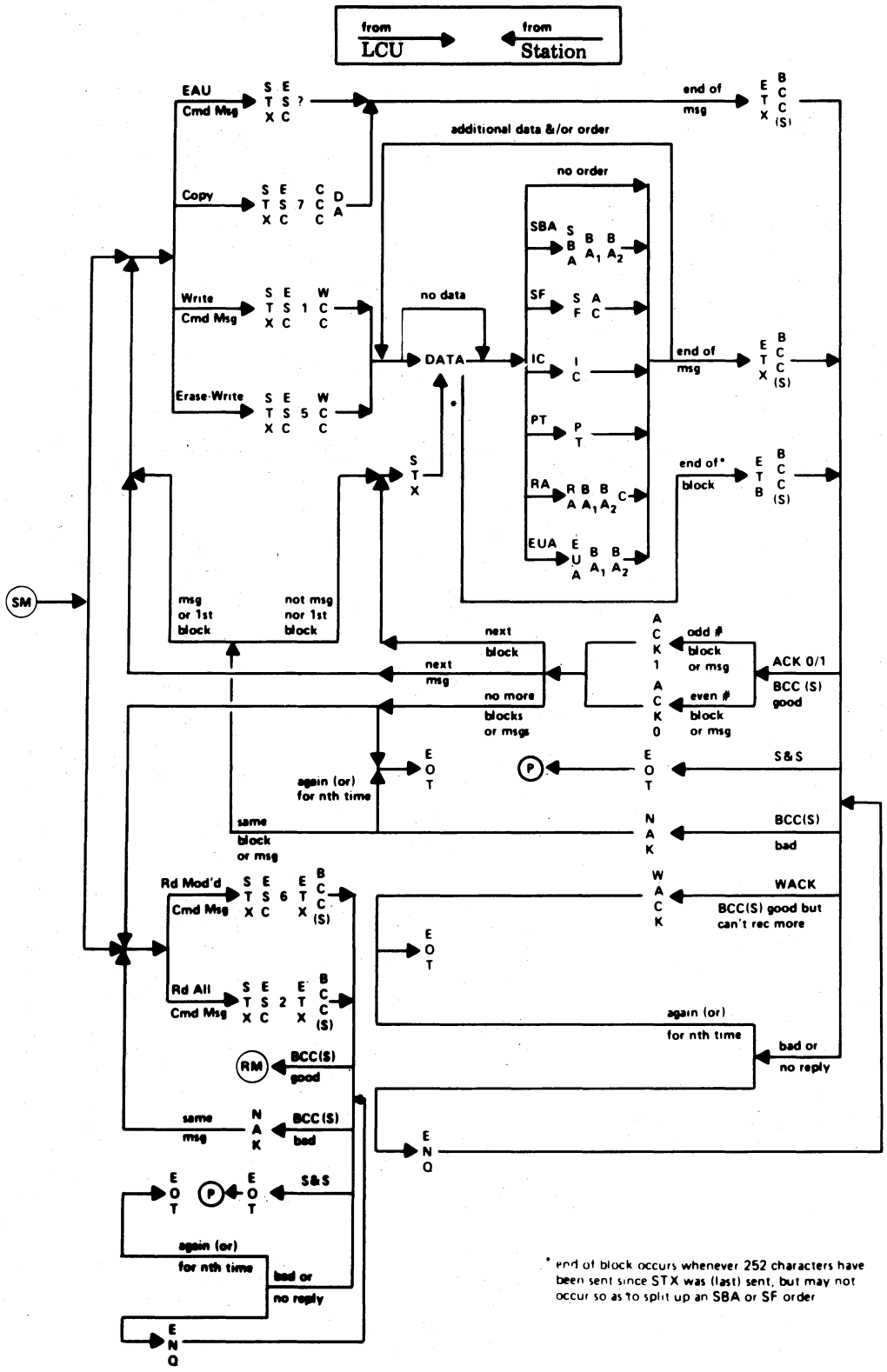


Fig. 18—System Flow Diagram for BSC (Contd)

9. ADCCP INTRODUCTION

9.01 The 4540 SDS or ADCCP version of clustered 4540 (hereafter called 4540 ADCCP) uses a bit oriented communications protocol that was designed to be compatible with SDLC (Synchronous Data Link Control) as it is used in SNA (Systems Network Architecture) networks defined in paragraph 9.04.

9.02 Data is encoded for transmission using the direct or NRZ (Non Return to Zero) method as opposed to the NRZI (Non Return to Zero, Inverted) method. Data encoded using NRZ changes state when the bit changes state. Data encoded using NRZI changes state only when sending binary 0 (see Fig. 19). Zero insertion (see Page 74) automatically provides change of state when transmitting binary 1s. Changes of state are only important when a modem does not provide clock to the receiver. The 4540 ADCCP can share the same communication line with other ADCCP and SDLC stations, provided that all use the direct method of data encoding (NRZ).

9.03 The 4540 ADCCP operates in an Unbalanced (UN) Normal Response Mode. "Unbalanced" means that one station on a shared communication line is designated as the primary station while the other stations on the line are designated as secondary stations. The function of maintaining an orderly flow of data is assigned to the primary station. "Normal Response Mode" means that the secondary station may initiate transmission to the primary station only when the primary station has given its permission. In a computer-based communications system, the host computer system (computer) is the primary station. The 4540 ADCCP always operates as a secondary station and uses EBCDIC line code. The bits are sent in 7 through 0 order.

9.04 The 4540 ADCCP is designed to operate as a terminal node in a SNA network. The host software support is compatible with the following SNA concepts:

- Physical Unit Type 1
- Format Identifier 3 (FID 3)
- Boundary Network Node Support for SDLC 3270
- Logical Unit Type 0
- Function Management Profile 2
- Transmission Services Profile 2

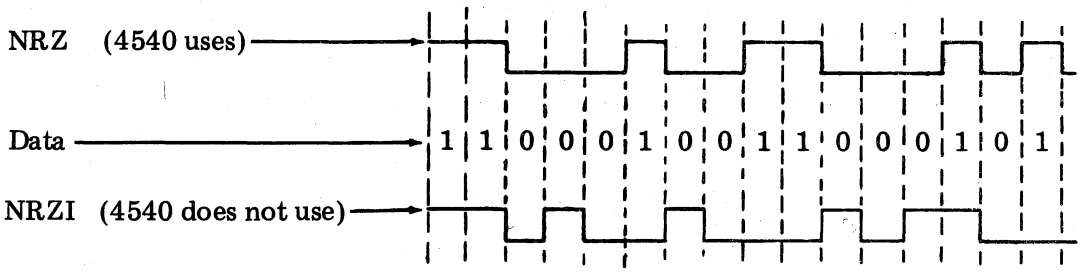


Fig. 19—Transmission of Data Using NRZ or NRZI

FRAME FORMATS

9.05 **All transmissions on an ADCCP communication line are made in groups of data bytes (eight bits per byte) called frames. The structure of each frame is the same: a beginning Flag byte (F) followed by an Address byte (A), a Control field byte (C), an optional Information field composed of a varying number of bytes (I), a two-byte Frame Check Sequence (FCS), and an ending Flag byte (F). An ADCCP (SDLC) frame thus contains a minimum of six** bytes (F, A, C, FCS, F). See Fig. 20. A maximum of seven frames can be transmitted before an acknowledgement specifying Nr is required from the receiving station (see Table R).

9.06 Each frame begins and ends with a "Flag" (F) byte. The beginning Flag is used to indicate the start of a frame. The end flag terminates the transmission and indicates to the receiver that the 16 bits preceding the end Flag contain the "Frame Check Sequence" (FCS). One flag can be both an ending flag and beginning flag. Charts 15 — 18, which follow Page 85, are provided as a ADCCP decoding aid. The remainder of Part 9 provides additional details.

9.07 The 4540 has two basic modes of operation. Disconnect Mode and Normal Response Mode. The station is initially powered up in the disconnect mode. In this mode, the 4540 is only capable of accepting mode setting commands from the computer. Any information to the 4540 is disregarded. When in the Normal Response Mode, the 4540 can receive information frames or mode setting commands from the computer and may initiate, if computer permits, information frames to computer.

9.08 The mode of the 4540 can be switched by commands listed in paragraph 9.24.

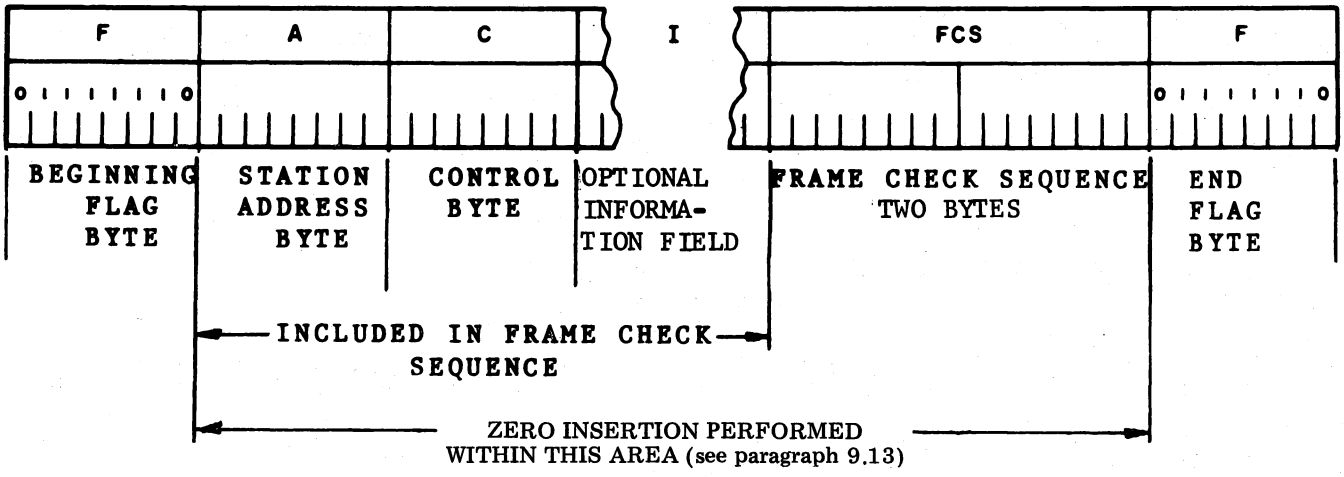


Fig. 20—ADCCP Frame

9.09 The "Address" (A) byte consists of the secondary station address. The primary station is never identified by an address. The Address byte may be any hexadecimal (hex) address from hex '01' to hex 'FE' inclusive. An all 1's (H'FF') address is recognized by the secondary station, as a "broadcast" address. An all 0's (H'00') is not recommended for a station address.

9.10 The Control byte controls the data link. There are three formats for the Control byte, see paragraph 9.15.

9.11 The Information field contains up to 261 bytes which includes up to 5 bytes of Systems Network Architecture (SNA) headers and up to 256 bytes of message text. The SNA headers are positioned at the begining of the Information field. These headers consist of Transmission Headers (TH) and Request/Response Headers (RH). See Fig. 21.

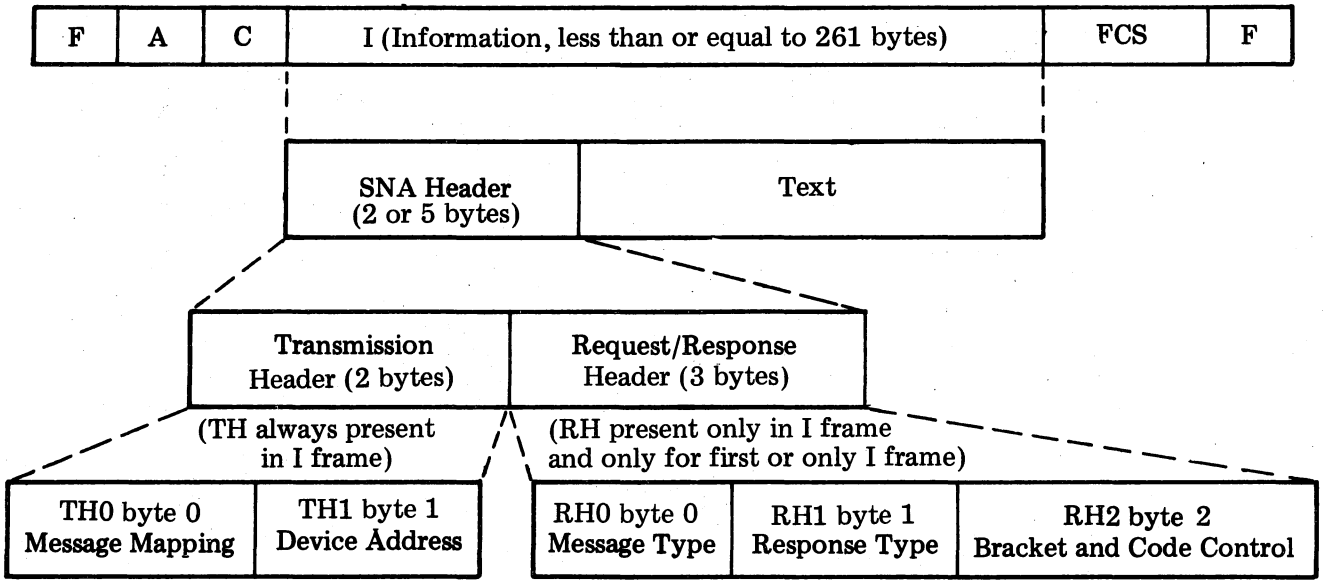


Fig. 21—Format of Information Field in I Frame

9.12 The Frame Check Sequence (FCS) contains two bytes (16 bits) used for error checking. The method of error checking is similar to the CRC used in BSC (Binary Synchronous Communications). All frames in ADCCP are error checked.

9.13 The end Flag signifies the end of the frame. Zero insertion is done between flags to prevent a byte being incorrectly detected as a flag (binary 01111110) or an abort (seven contiguous binary 1's). Zero insertion occurs when the sending station inserts a binary 0 after transmitting a succession of five contiguous 1's. The receiving station then deletes any 0 which follows a succession of five contiguous 1's. See Fig. 22.

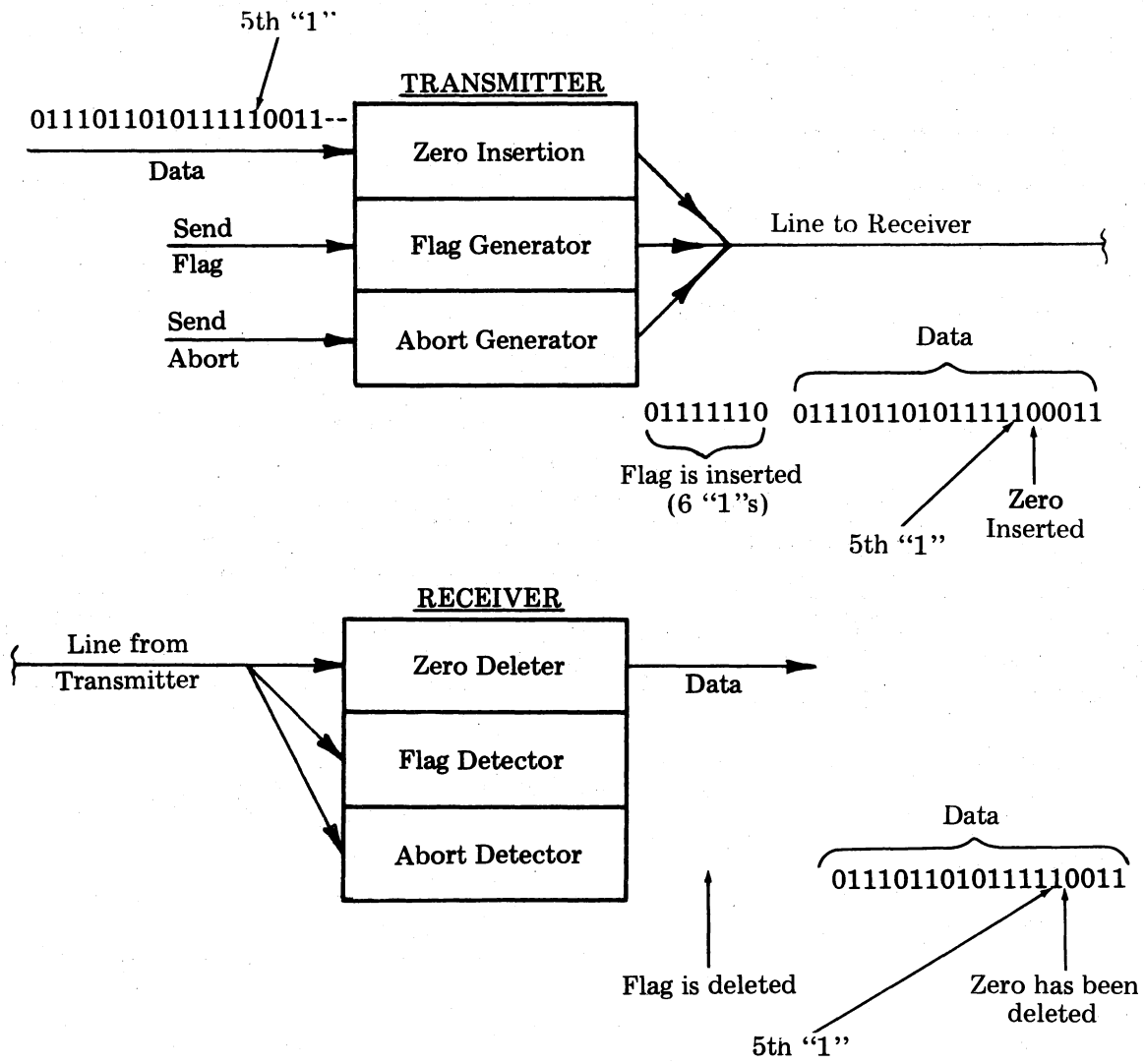


Fig. 22—Zero Insertion and Deletion

9.14 To abort a frame, the transmitter sends seven contiguous 1's. The primary station retains control after any abort. The link is in the idle state after 15 contiguous 1's are transmitted. The line is in the active state while a station is transmitting a frame. A series of flags are sent during interframe time fill.

TABLE R

CONTROL BYTE FORMATS

FORMAT TYPE	HEX	BIT CONFIGURATION 0, 1, 2,	3,	4, 5, 6,	7	NAME	ABBREVIATION	
Information	Variable	Nr	P/F	Ns	0	Information	I	
Supervisory	Variable	Nr	P/F	0 0 0	1	Receiver Ready	RR	
	Variable	Nr	P/F	0 1 0	1	Receiver Not Ready	RNR	
Unnumbered	93*	1 0 0	P	0 0 1	1	Set Normal Response Mode	SNRM	COMMANDS
	53*	0 1 0	P	0 0 1	1	Disconnect	DISC	
	73	0 1 1	F=1	0 0 1	1	Unnumbered Acknowledgement	UA	
	1F	0 0 0	F=1	1 1 1	1	Disconnect Mode	DM	
	97	1 0 0	F=1	0 1 1	1	Frame Reject	FRMR	
	F3*	1 1 1	P/F=1	0 0 1	1	Link Test (F always 1)	TST	

Where: Ns is number of frame sent,
Nr is number of next frame expected to be received,
* Hex applies only when P = 1.

CONTROL FIELD FORMATS

9.15 The Control byte contains three types of formats. The three formats are Information, Supervisory, and Unnumbered. The bit configuration, format type, and different names for commands and responses are listed in Table R.

9.16 All Control bytes contain the "Poll/Final" (P/F) bit. This bit is called the "Poll" bit when sent by the primary station or the "Final" bit when sent by the secondary station. When the poll bit is sent as a '1', it indicates that a response is required from the secondary station. When the Final bit is sent as a '1', it indicates the end of transmission from the secondary station.

9.17 The Information format is required whenever higher level data, contained in the information field, is transmitted between primary and secondary stations.

9.18 The control byte may contain up to two sequence numbers. Ns is used to indicate the sequence number of the data being sent. Nr is used to indicate to the sending station the number of the next information frame expected and indicates acknowledgement of the received frames.

9.19 Both Ns and Nr are set to 0 initially by SNRM command. Pending DR, EX, Pc (of RH1) and S&S responses from the 4540 are <u>not</u> reset by SNRM. If the sending station sends one frame, the receiving station sequence numbers are Ns = 0 and Nr = 1. After the second frame is sent, the receiving station has Ns = 0 and Nr = 2. Both counters are modulo 8 counters (0 — 7).

9.20 The Nr will not increment after an error is detected in a FCS. The errored frame and all remaining frames are discarded. The computer gains control and retransmission may be attempted. See Table S which shows an example where frames 0 — 6 are transmitted and then the receiving station responds with an I or S frame. A maximum of seven frames can be transmitted before an acknowledgement is necessary by the receiving station.

TABLE S

EXAMPLES OF ERROR RECOVERY WHEN FRAMES 0 — 6 ARE SENT

IF ERROR OCCURED IN FRAME	RECEIVER WILL RESPOND WITH Nr =	SENDER SHOULD RETRANSMIT FRAMES	SENDER MAY CONTINUE WITH FRAMES
0	0	0, 1, 2, 3, 4, 5, 6	
1	1	1, 2, 3, 4, 5, 6	7
2	2	2, 3, 4, 5, 6	7, 0
3	3	3, 4, 5, 6	7, 0, 1
4	4	4, 5, 6	7, 0, 1, 2
5	5	5, 6	7, 0, 1, 2, 3
6	6	6	7, 0, 1, 2, 3, 4
NONE	7	NONE	7, 0, 1, 2, 3, 4, 5

9.21 The Supervisory format is used to indicate to the receiving station that the sending station is Ready To Receive (Receiver Ready - RR) or Not Ready To Receive (Receiver - Not Ready - RNR). Since Nr is included in this format, it is also used to acknowledge received frames. The Supervisory format prohibits including an information field.

9.22 The computer can send RR with P bit to 1 to solicit a response (poll for information) from the 4540. The 4540 will send an RR response with the F bit set to 1 if it has no information to send.

9.23 The computer can send RNR with P bit set to 1 to probe link status of 4540 (RR, RNR, no response). This insures that the 4540 will not respond with I frames.

9.24 Unnumbered formats are used for special or infrequent control functions. Six commands are used with unnumbered formats: SNRM, DISC, UA, DM, FRMR and TST. The unnumbered format prohibits including an information field with two exceptions: TST (Link Test) and FRMR (Frame Reject). The following page gives the restrictions on the information field for TST and FRMR.

- Set Normal Response Mode (SNRM) — Sent by the computer to set the 4540 in the Normal Response Mode. When the SCC accepts the command, both Nr and Ns counters are reset and any pending FRMRs are also reset. Any unacknowledged frames that were transmitted before the SNRM remain unacknowledged. If the P bit is set to 1, the 4540 will respond with UA.

- Disconnect Command (DISC) — Sent by the computer to place the addressed 4540 in the Disconnect Mode. If the P bit is set to 1, the 4540 will respond with UA.

- Unnumbered Acknowledge (UA) — Sent by the 4540 to acknowledge the receipt and acceptance of SNRM or DISC Command provided the P bit is set to 1.

- Disconnect Mode Response (DM) — Sent by the 4540 to any valid frame (except (SNRM and TST) provided P bit is 1 and 4540 is in a Disconnect Mode.

- Frame Reject (FRMR) — Sent by the 4540 to report link level errors that cannot be recovered by retransmission. This response frame has a control byte containing the FRMR code followed by 3 bytes:

  1. The first byte contains the value of the rejected control byte.

  2. The second byte contains the current values of Ns and Nr at the 4540. Bits 0 — 2 are for Nr, bits 4 — 6 are for Ns, bits 3 and 7 = 0.

  3. The third byte describes the error. The last byte uses bits 7, 6, 5 and 4 designated WXYZ to report the following errors:

     W (bit 7) set to 1 indicates the received control byte was invalid or not implemented.

     W and X (bits 7 and 6) set to 1 indicates the received frame contained an information field which is not permitted based on the received control byte.

     Y (bit 5) set to 1 indicates the information field received exceeded 261 bytes.

     Z (bit 4) set to 1 indicates that the received control byte contained an invalid Nr (ie, the Nr had been acknowledged or is not the next sequential expected frame).

     Bits 0 — 3 of the third byte are not used.

  Once a FRMR has been sent, the 4540 will continue to send FRMR to all response opportunities until the condition is reset by the receipt of a SNRM or DISC command.

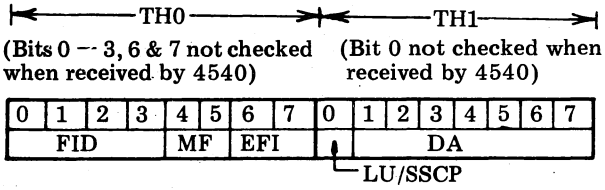
- Link Test (TST) — This command/response is used as a basic test of the communications link. The test is initiated by the computer when it sends a link test frame to an addressed 4540. The frame may contain an information field. Upon receipt and acceptance of the command frame, the 4540 will respond (if the P bit = 1) with a link test response frame containing no information field. The 4540 can accept this command in Normal Response Mode or Disconnect Mode. Link test is different from remote test (R/TST bid).

SNA HEADERS

9.25 The transmission header is used to define the format, including identification of which part of the message is in the frame and the device address at the secondary station. The transmission header is always present when an information field is transmitted to or from the 4540. The Transmission Header consists of two bytes as shown in Table T.

TABLE T

TRANSMISSION HEADER (TH)



9.26 The FID (Format Identifier Field) of TH0 is used to indicate the size and structure of headers being used. The 4540 ADCCP always uses a FID Type 3 (0011) which is consistent with operation of 4540 ADCCP as a Physical Unit Type 1. The 4540 does not check received FID bits.

9.27 The MF (Mapping Field) indicates to the receiving station the part(s) of the message contained in the frame. Even though 7 frames can be sent without a reply, the entire message (from the computer) may be many frames long. To preserve message integrity, (a responsibility of the sender) not more than 1920 text characters should be included prior to the end of the "last" frame (MF = 01). Message integrity can be lost by buffer wrap or orders that overwrite data already in the buffer.

11 — Indicates the frame contains the entire message. the computer must allow the 4540 to respond (P = 1) before sending another Information frame.

10 — Indicates the frame is the first in the message.

00 — Indicates the frame is an intermediate frame within the message.

01 — Indicates the frame is the last frame of the message. The computer must allow the 4540 to respond (P = 1) before sending another Information frame.

9.28 Any violation of Mapping Field will cause the 4540 to send Status and Sense, path error. A MF of 00 in the first frame is an example that would cause Status and Sense to be primed.

9.29 The EFI (Expedited Flow Indicator) contains two bits. Bit 6 is sent by 4540 as a 1 when the frame is in response to a request from the computer as required in RH1. Bit 6 is sent as a 0 in all other cases (ie, text sent due to bid). Bit 7 is always sent to the computer as a 0 except when the frame is sent in response to a clear command, in which case it is sent as a 1. The 4540 does not check received EFI bits.

9.30 The LU/SSCP (Logical Unit/System Services Control Point) bit of TH1 is sent as 0 when message from 4540 is caused by remote test (R/TST bid at 4540 KD). In all other messages generated by bid from the operator, the bit is sent as 1. The bit is sent to the computer as it was received whenever the frame is in response to a request from the computer as required in RH1. The 4540 does not check the received LU/SSCP bit.

9.31 The DA (Device Address) identifies the intended device (number) when received by 4540. When sent from 4540, it identifies the device which initiated the transmission. See Table U where DA is specified by TH1, bits 1 -- 7 and the hex for the TH1 byte is given for bit 0 = 0 or 1.

TABLE U

DEVICE ADDRESSING — TH1 (of TH0, TH1)

For 4540 SDS, KD is always device 0, printer is always device 1.

DEVICE NUMBER	HEX IF bit 0=1	HEX IF bit 0=0	TH1 Bits 1 — 7						
			1	2	3	4	5	6	7
0	C0	40	1	0	0	0	0	0	0
1	C1	41	1	0	0	0	0	0	1
2	C2	42	1	0	0	0	0	1	0
3	C3	43	1	0	0	0	0	1	1
4	C4	44	1	0	0	0	1	0	0
5	C5	45	1	0	0	0	1	0	1
6	C6	46	1	0	0	0	1	1	0
7	C7	47	1	0	0	0	1	1	1
8	C8	48	1	0	0	1	0	0	0
9	C9	49	1	0	0	1	0	0	1
10	CA	4A	1	0	0	1	0	1	0
11	CB	4B	1	0	0	1	0	1	1
12	CC	4C	1	0	0	1	1	0	0
13	CD	4D	1	0	0	1	1	0	1
14	CE	4E	1	0	0	1	1	1	0
15	CF	4F	1	0	0	1	1	1	1
16	D0	50	1	0	1	0	0	0	0
17	D1	51	1	0	1	0	0	0	1
18	D2	52	1	0	1	0	0	1	0
19	D3	53	1	0	1	0	0	1	1
20	D4	54	1	0	1	0	1	0	0
21	D5	55	1	0	1	0	1	0	1
22	D6	56	1	0	1	0	1	1	0
23	D7	57	1	0	1	0	1	1	1
24	D8	58	1	0	1	1	0	0	0
25	D9	59	1	0	1	1	0	0	1
26	DA	5A	1	0	1	1	0	1	0
27	DB	5B	1	0	1	1	0	1	1
28	DC	5C	1	0	1	1	1	0	0
29	DD	5D	1	0	1	1	1	0	1
30	DE	5E	1	0	1	1	1	1	0
31	DF	5F	1	0	1	1	1	1	1

To decode TH1 with bit 0 = 1 for device 0:

TH1 = 11 00 00 00 (binary)
or
TH1 = C0 (Hex).

Bit 0 is the LU/SSCP bit.

If bits 1 and 2 are not 1, 0 then Status and Sense is primed (Table Z).

9.32 The Request/Response header (RH) consists of three bytes used for routing of transmissions within the network. The RH is also used to indicate the type of response required from the 4540. A RH is only present when a message contains one Information frame or with the first Information frame when the message contains two or more frames. See Tables V, W and X.

TABLE V

REQUEST/RESPONSE HEADER — BYTE 0

(RH0)

BIT NUMBER	0	1	2	3	4	5	6	7
BIT NAME	R/R	RU	SCI	0	FI	SSDI	1	1

(RH0 not checked when received by 4540.)

9.33 R/R (Request/Response) is sent by 4540 as 0 in response to a poll (text or status) or read type command and sent as 1 when the frame is in response to a request specified in RH1 from the computer. This bit is not checked when received by the 4540.

9.34 The Request/Response Unit (RU) and the Subsystem Control Indicator (SCI) bits are normally sent by the 4540 as 0, 0 to indicate Function Management data. When sending a Clear response or Pseudo Bid response, these bits are sent as received. These bits are not checked when received by the 4540.

9.35 FI (Format Identifier) is normally sent to the computer as 0 except when the frame is in response to a request specified in RH1 from the computer. The FI bit is then sent as received. This bit is not checked when received by the 4540.

9.36 SSDI (Status and Sense Data Included) is sent as 1 by 4540 when Status and Sense information is included in the frame. At all other times this bit is sent as 0. This bit is not checked when received by the 4540.

9.37 Bit 3, 6, 7 of byte 0 is not used by 4540 ADCCP. When sent by the 4540, bit 3 is sent as 0 and bits 6 and 7 as 1. These bits are not checked when received by the 4540.

TABLE W

REQUEST/RESPONSE HEADER — BYTE 1

(RH1)

BIT NUMBER	0	1	2	3	4	5	6	7
BIT NAME	DR	0	0	EX	0	0	0	Pc

(Bits 1, 2, 4, 5 and 6 not used or checked by 4540 when received. Always sent by 4540 as 0's.)

9.38 Request/Response Header — Byte 1 contains DR (Definite Response), EX (Exception Response), and Pc (Pacing) bits. These bits are used to determine what kind of response, if any, is required by the computer. DR = 1 (with EX = 0) from the computer will cause a 4540 response that includes an RH response. EX = 1 (therefore DR = 1) from the computer will cause 4540 response that includes an RH response only if an error occurred, however if Pc = 1 then it will cause a response regardless of errors. Pc = 1 from the computer will cause a 4540 response after the indicated action (usually printing) is complete (or was attempted). The S&S response of "B space" (as used in BSC) to indicate the completion of printing is not used in ADCCP. See Table X.

9.39 When information frames are intended for printer, the DR, EX and Pc bits are ignored and a definite response with Pacing (DR = 1, EX = 0, Pc = 1) is assumed. The response by the 4540 is sent when the message is completed, or an error (paper out or lid open) is detected. These important printer responses can be seen in the first entry of Table X and also (specifically) in the next to the last entry of Table X.

TABLE X

DR, EX, and Pc BITS of RH1

(Chart 17 can be used to identify DR, EX, Pc status from Hex number of RH1)

TYPE	MESSAGE To 4540 DR EX Pc	RESPONSE FROM 4540 DR EX Pc	EXPLANATION
Definite Response With Pacing	1 0 1	1 0 1	Indicates successful completion of command.
		1 1 1	Indicates that an error occured. Includes status and sense. Frame has SSDI = 1.
Exception Response With Pacing	1 1 1	0 0 1	Indicates successful completion of command.
		1 1 1	Indicates that an error occured. Includes status and sense. Frame has SSDI = 1.
No Response With Pacing	0 0 1	0 0 1	Indicates only that command is completed (errors may have occured).
Definite Response No Pacing	1 0 0	1 0 0	Indicates successful completion of command.
		1 1 0	Indicates that an error occured. Includes status and sense. Frame has SSDI = 1.
Exception Response No Pacing	1 1 0	—	No response will be sent if successful.
		1 1 0	Indicates that an error occured. Includes status and sense. Frame has SSDI = 1.
No Response No Pacing	0 0 0	—	No response frame is sent regardless of how the command is completed.
Printer Responds regardless of how the bits are received.		1 0 1	Indicates successful completion of command.
		1 1 1	Indicates that an error occurred. Response includes status and sense. Frame has SSDI = 1.
4540 response when RR control byte is received with P = 1.	—	0 0 0	Bid key depressed.

Pending responses can be cleared by clear command

9.40 A response from 4540, when required by computer, contains only TH and RH in the I field, unless an error occurred. Four bytes containing Status and Sense are added when an error occurs.

TABLE Y

REQUEST/RESPONSE HEADER — BYTE 2

(RH 2)

BIT NUMBER	0	1	2	3	4	5	6	7
BIT NAME	BB	*0	0	0	*CSI	0	0	0

*(Bits 1 and 4 not checked by 4540 when received. Bits 1 and 4 always sent as 0 by 4540.)

9.41 The BB (Begin Brackets) is always sent by 4540 as 0. When the BB bit is set to 1 in a received message, the 4540 decrements its internal poll counter if the count is greater than zero. The BB is used with the Pseudo Bid command. See paragraph 9.47.

9.42 The CSI (Code Selection Indicator) is used to indicate the line code. The 4540 ADCCP always sends 0 indicating EBCDIC. CSI is not checked when received by the 4540.

9.43 Bits 1, 2, 3, 5, 6 and 7 are not used by the 4540. These bits are sent by the 4540 as 0's.

COMMANDS, AIDS AND ORDERS

9.44 A command from the computer is located in the first byte following the RH in the first (or only) frame of a message. There are two kinds of commands, SNA commands and Device commands. These are discussed below. An AID character from the 4540 is located in the first byte following RH in the first (or only) frame of a message. See Table N.

9.45 The 4540 ADCCP uses two SNA commands: Clear and Pseudo Bid. The rest of the commands are Device commands, such as Write or Read Modified, and are also used in BSC and are described in Part 7 and listed in Table I. Do not confuse Clear command with CLEAR key on keyboard.

9.46 The Clear command (Hex A1) is sent by the computer to cancel any pending responses (DR, EX, or Pc) from the 4540. This may be done by the computer as the first step in data traffic recovery after a catastrophic error has occurred. The Clear command format is an information frame containing a TH and RH followed by the Clear command byte (HEX A1). No information is allowed following Clear command byte. The 4540 responds to a Clear command as requested in the received RH, and includes the Clear command byte following the RH in the response.

9.47 The Pseudo Bid command (HEX F8) is sent by the computer to force the 4540 to perform a specific poll on the addressed device to determine if it has a bid pending. If the operator of that device has already entered a bid, the 4540 will reject the Pseudo Bid by responding with an exception response which includes sense bytes indicating a request reject (see Table Z). If the addressed device does not have a bid pending, the 4540 will increment its internal poll counter; then send a postive response as requested in the RH of the Pseudo Bid frame. The computer will then typically send a I frame with BB = 1 to the same device also specified in TH1 of the Pseudo Bid frame. The Pseudo Bid command frame contains a TH and RH followed by the Pseudo Bid command byte (HEX F8). No information is allowed following the Pseudo Bid command byte. The Pseudo Bid is used with the internal poll counter and Begin Brackets, see paragraphs 9.48 and 9.41.

9.48 An internal poll counter in the 4540 keeps track of outstanding Psuedo Bids. A successful Psuedo Bid (no bid pending at addressed device) increments the poll counter by 1 while a BB = 1 in the RH decrements the counter by 1. Typically, a successful Psuedo Bid frame is followed by a frame containing a BB = 1 to decrement the counter back to 0. However, it is possible for the host to send Psuedo Bids to more than one device without sending BB = 1 for earlier transmitted Psuedo Bids. This type of operation will result with the poll counter being incremented by one for each received successful Psuedo Bid. To decrement the counter back to 0 a frame with BB = 1 be issued for each outstanding Psuedo Bid. It is not necessary that the device address in TH1 of the frame containing BB = 1 be that of a device that was addressed in an earlier Psuedo Bid. When the poll counter does not equal zero, the 4540 will inhibit the sending of all bid information and asynchronous type of responses (printer responses, and initial device and status). Pending responses (previously requested) or retransmissions may be sent while the poll counter does not equal zero. See examples 6 and 7 in Part 10.

9.49 Orders are also used in BSC and are described in Part 7. ADCCP permits an order to be in any frame of a message, an order sequence can even be split between frames.

STATUS AND SENSE

9.50 When Status and Sense (S&S) are sent, it is sent in an information frame containing a TH, RH and four S&S bytes. The first two S&S bytes are used for SNA level errors and the last two bytes are used for device status similar to BSC. See Fig. 23.

Information Field								
Transmission Header (TH)		Request/Response Header (RH)			Status & Sense (S&S)			
					SNA S&S		Device S&S	
TH0	TH1	RH0	RH1	RH2	S&S0	S&S1	S&S2	S&S3

RH0 bit 5 = 1 means frame contains SSDI (Status & Sense Data Included).

Fig. 23—I Field When Status and Sense is Included in Frame

9.51 A S&S message may be sent only if the DR bit of RH1 from the computer is set to 1, otherwise the 4540 controller will not treat the error as a condition to cause S&S to be sent. The exception is DE S&S which is sent for the first occurrence of device power-up after 4540 controller power-up or for a previously indicated busy (or unavailable) device which is now ready or after 4540 controller option modification provided the 4540 is in the normal response mode and receives a frame from the computer with the P bit set to 1. A S&S message is used to recover from errors which cannot be recovered at the link level. An error such as out-of-paper which occurs during print local will not cause S&S to be sent except in response to an I frame from the computer for that device. Pending S&S is reset by a computer response which includes the proper Nr response to the S&S frame.

9.52 The first S&S byte (S&S0) indicates the general class of SNA error. See Table Z. The second byte (S&S1) called a modifier, indicates more specifically the cause of the error. SNA Status and Sense conditions indicate an error in the received TH or RH. The S&S may contain both SNA and device information (as given in Table Z). Table AA provides the bit configuration for SNA S&S. Table AB provides the bit configuration for device S&S. Device Status and Sense conditions indicate an error in the text of the message or during execution of a command or a hardware failure.

TABLE Z

STATUS AND SENSE (S&S)

Name	Type of Error and Description	S&S 0	S&S 1	S&S 2	S&S 3	
PE	Path Error. Incomplete TH.	80	00	00	00	SNA Error (Reference: 9.53)
PE,ME	Path Error with Map Error Modifier. Wrong MF in TH.	80	07	00	00	
PE, IR	Path Error with Intervention Required. Invalid DA in TH (bits 1, 2 in TH1 are not 1, 0).	80	00	00	10	
RR error	Request Reject. Pseudo Bid rejected (device specified in TH of Pseudo Bid has bid pending).	08	13	00	00	
RE,CR	Request Error and Command Reject. Invalid command.	10	00	00	20	
RHE,RU	Request Header Error with Incomplete RU modifier. Response unit too short (can occur when write command not followed by WCC).	40	05	00	00	
OC	Operational Check. Invalid buffer address or more than one byte in Read Command erase all unprotected, CLEAR or Pseudo Bid RU.	00	00	00	01	Device Error (Reference: 9.60)
DB, OC	Device Busy and Operational Check. From-device in copy command is busy.	00	00	08	01	
DB	Device Busy. Printer busy printing or KD busy processing previous request.	00	00	08	00	
DE	Device End (Device Available). Busy or unavailble device becomes available. Not sent when printer becomes available after printing. See Table X.	00	00	02	00	
OC, US	Operational Check and Unit Specify. From-device in copy command has locked buffer.	00	00	04	01	
IR, OC	Intervention Required and Operation Check. "From" device unavailable for copy or "from" device in copy command is out of range.	00	00	00	11	
IR	Intervention Required. Device has power off, is out of paper, cover open, keyboard locked or is disconnected.	00	00	00	10	
CC, OC	Control Check and Operation Check. Data transfer abort during copy command.	00	00	00	03	
DC	Device Check. Data transfer abort when available device fails to send data to controller.	00	00	00	04	
CC	Control Check. Data transfer abort when a device fails to accept data from controller.	00	00	00	02	

4 Bytes
Expressed in HEX

THE NEXT TWO PAGES PROVIDE MORE DETAIL.

9.53 SNA Status and Sense conditions indicate an error in the received TH or RH:

- Path Error (PE) — An error in the received TH. The frame received by the 4540 did not contain two TH bytes (information frame length was less than eight bytes including flags and FCS).
- Path Error with Map Error modifier (PE, ME) — An error in mapping field of the TH.
- Path Error with Intervention Required (PE, IR) — The device address in the TH is invalid because bits 1 and 2 of TH1 are not 1,0.
- Request Reject (RR error) — The addressed device specified by the TH of a Pseudo command has a bid pending and therefore the Pseudo bid is unsuccessful.
- Request Error and Command Reject (RE, CR) — The command byte was not performed because command is not valid for 4540.
- Request Header Error with Incomplete RU modifier (RHE, RU) — Response Unit (RU) is too short. An example would be when an Erase Write command is not followed by a WCC character (ie, command, 2 bytes FCS, flag).

TABLE AA

BIT ASSIGNMENTS FOR SNA S&S

BIT	S&S0 DESCRIPTION		S&S1 DESCRIPTION	
		1st Hex		1st Hex
0	PE Path Error	8	0	8
1		4	0	4
2	0	2	0	2
3	RE Request Error	1	0 (1 for RR of S&S0)	1
		2nd Hex		2nd Hex
4	RR Request Reject	8	0	8
5	0	4	0 (1 for RU, Incomplete RU modifier or for ME, Map Error)	4
6	0	2	0 (1 for RR of S&S0 or for ME, Map Error)	2
7	0	1	0 (1 for RR of S&S0 or for RU, Incomplete RU modifier or for ME, Map Error)	1

9.54 Device Status and Sense conditions indicate an error in the text of the message or during execution of a command or a hardware failure:

- Operational Check (OC) — Either the buffer address after an order is out of range (or missing as when the last frame of message ends before entire address is received) or text follows a Read command, Erase All Unprotected, Pseudo Bid or Clear command byte.
- Device Busy and Operation Check (DB, OC) — The from-device specified in a copy command is busy as for DB.
- Device Busy (DB) — The device addressed in previous request cannot accept the command due to a busy condition (KD or printer still processing or printing a previous request). Includes busy due to print local.
- Device End (DE) — A device previously indicated as busy or unavailable is now ready. When controller is powered on (or options changed) this S&S is sent for each device (including printer) as it becomes available. This S&S is not sent following a successful printout, refer to Table X. This is the only device S&S that is sent asynchronously (e.g. without address of device specified in the prior computer transmission).
- Operation Check with Unit Specify (OC, US) — The from-device in a copy command has a locked buffer (buffer location 0 contains an attribute that specifies a protected alphanumeric field).
- Intervention Required with Operation Check (IR, OS) — From-device in copy command is out of range or from-device is unavailable.
- Intervention Required (IR) — A message is addressed to device which is posted as unavailable (due to power off, out of paper, lid open, keyboard locked or disconnect). When unavailable device becomes available, DE status and sense will be sent.
- Control Check with Operation Check (CC, OC) —The from-device in a copy command fails to respond or sends an invalid response to the controller.
- Device Check (DC) — Error occurs when 4540 prepares to send due to a read command or poll. Error may be caused by device which is posted as available but fails to respond, or failure of device to transfer as block of information to the controller (one retry is allowed before DC is posted).
- Control Check (CC) — Device fails to respond to controller or device gives invalid response during Write (or Erase/Write) command or device fails as the to-device on a copy command. Controller may be at fault.

TABLE AB

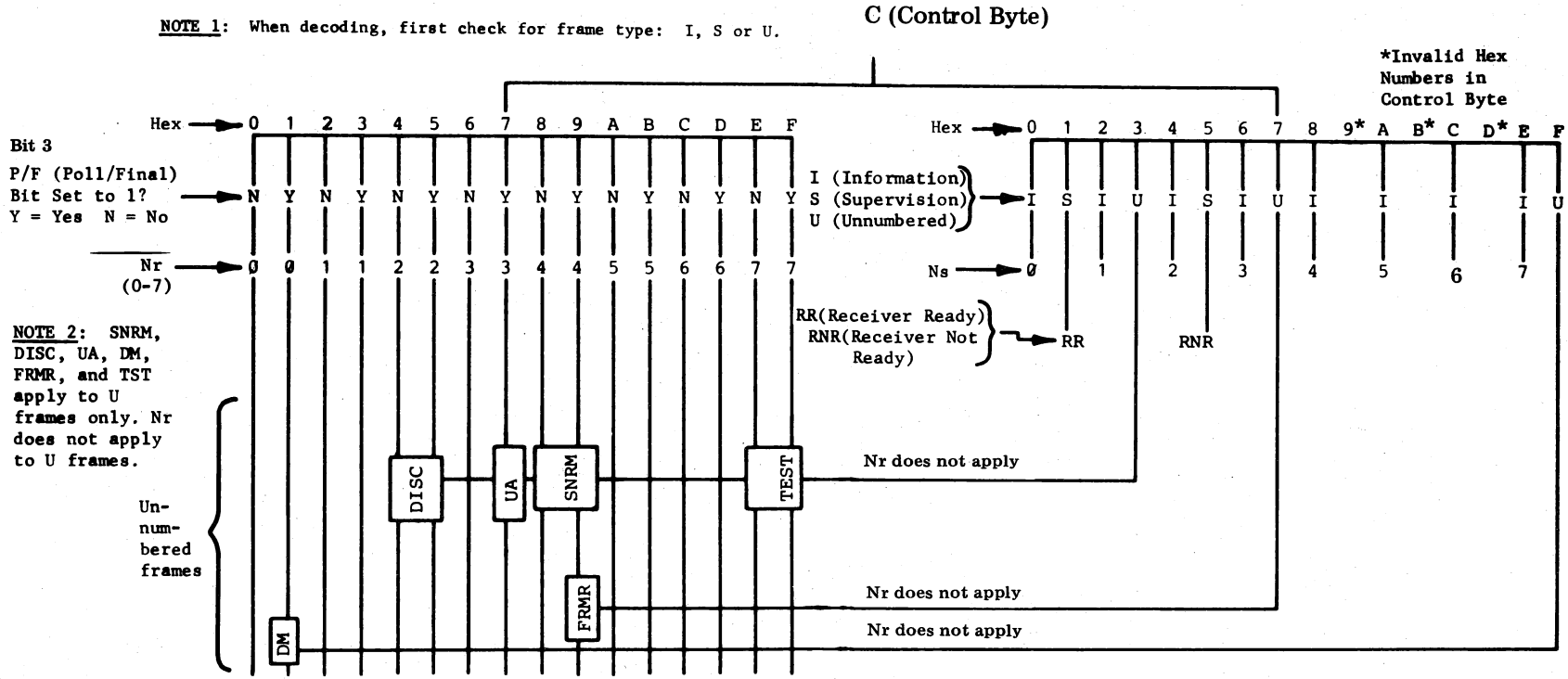
BIT ASSIGNMENTS FOR DEVICE S&S

BIT	S&S2 DESCRIPTION			S&S3 DESCRIPTION		
			1st Hex			1st Hex
0	0		8	0		8
1	0		4	0		4
2	0		2	CR	Command Reject	2
3	0		1	IR	Intervention Required	1
			2nd Hex			2nd Hex
4	DB	Device Busy	8	0		8
5	US	Unit Specify	4	DC	Device Check	4
6	DE	Device End	2	CC	Control Check	2
7	0		1	OC	Operational Check	1

Example of relation of Table Z to Table AB:
CC, OC, (00 00 00 03) of Table Z corresponds to S&S2 of Hex 00 and Hex 03 of S&S3 where 03 is 1 + 2 in 2nd Hex digit.

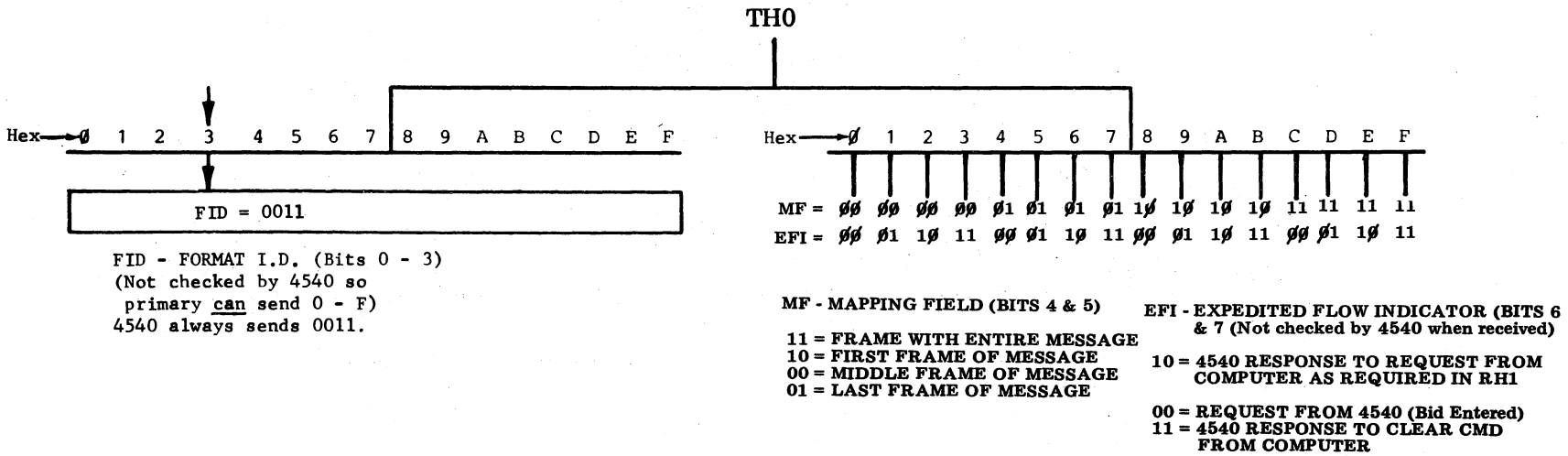
AIDS TO DECODING ADCCP DATA STREAMS

9.55 The following charts are provided as an aid to decoding ADCCP data streams. Examples of ADCCP data streams are given in Part 10.



TYPE OF CONTROL BYTES

CHART 15 — ADCCP



FID - FORMAT I.D. (Bits 0 - 3)
(Not checked by 4540 so primary can send 0 - F)
4540 always sends 0011.

MF - MAPPING FIELD (BITS 4 & 5)

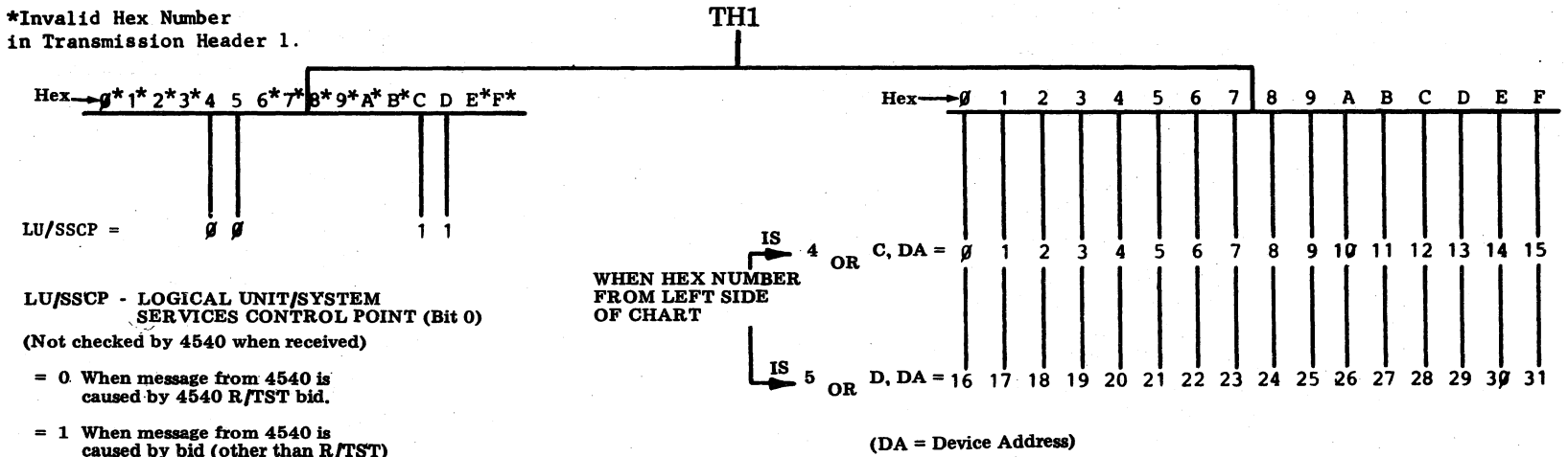
11 = FRAME WITH ENTIRE MESSAGE
10 = FIRST FRAME OF MESSAGE
00 = MIDDLE FRAME OF MESSAGE
01 = LAST FRAME OF MESSAGE

EFI - EXPEDITED FLOW INDICATOR (BITS 6 & 7 (Not checked by 4540 when received)

10 = 4540 RESPONSE TO REQUEST FROM COMPUTER AS REQUIRED IN RH1

00 = REQUEST FROM 4540 (Bid Entered)
11 = 4540 RESPONSE TO CLEAR CMD FROM COMPUTER

*Invalid Hex Number in Transmission Header 1.



LU/SSCP - LOGICAL UNIT/SYSTEM SERVICES CONTROL POINT (Bit 0)
(Not checked by 4540 when received)

= 0 When message from 4540 is caused by 4540 R/TST bid.

= 1 When message from 4540 is caused by bid (other than R/TST) at 4540 or 4540 reports S&S.

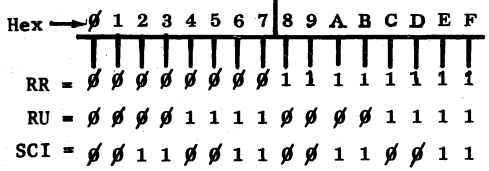
= As received when 4540 sends response to request from computer as required in RH1.

(DA = Device Address)

TRANSMISSION HEADERS

CHART 16 -- ADCCP

RH0 (4540 does not check RH0 when received)



RR – REQUEST/RESPONSE (BIT 0)

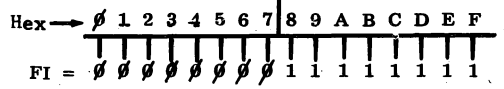
Ø = 4540 response to poll for text or S&S or Read command.

1 = 4540 response to request as required in RH1 from host.

RU – REQUEST/RESPONSE UNIT (BIT 1)

SCI – SUBSYSTEM CONTROL INDICATOR (BIT 2)

} Normally 4540 sends as 0,0. For Pseudo bid or CLEAR, 4540 sends as received.



FI – FORMAT IDENTIFIER (BIT 4)

Ø = Request from 4540 (Bid Entered)

1 = As received when 4540 sends responds to request from host as required in RH1.

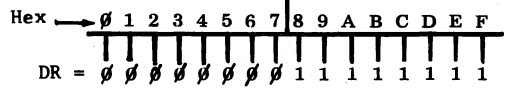
SSDI – STATUS/SENSE DATA INDICATOR (BIT 5)

Ø = S/S not included.

1 = S/S included.

(4540 always sends Bit 3 = 0, Bit 6 = 1, Bit 7 = 1. Bits 3, 6 and 7 are not used.)

RH1

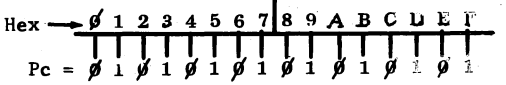


DR – DEFINITE RESPONSE (BIT Ø)

EX – EXCEPTION RESPONSE (BIT 3)

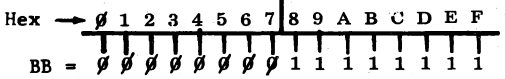
Use Table X to decode DR, EX and Pc

(Bits 1, 2, 4, 5 and 6 are not used 4540 sends these bits as 0's.)



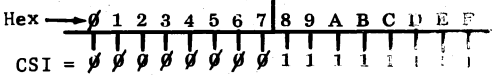
Pc – PACING (BIT 7)

RH2



BB – BEGIN BRACKET (Bit 0)
(4540 always sends BB as Ø)
BB used with Psuedo Bid --
See 9.41, 9.47 and 9.48.

(Bits 1, 2, 3, 6, 7 and 8 are not used 4540 sends these bits as 0's.)

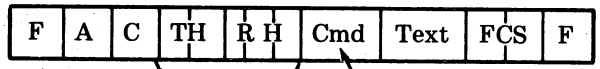


CSI – CODE SELECTION INDICATOR (BIT 4)
0 = EBCDIC
(CSI always sent by 4540 as 0)
(4540 does not check CSI)

REQUEST HEADERS

CHART 17 — ADCCP

First or Only Text I (Information) Frame:



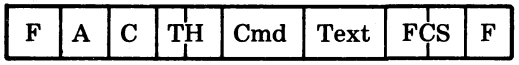
SNA Headers

Is AID for 4540 to computer.

I Field

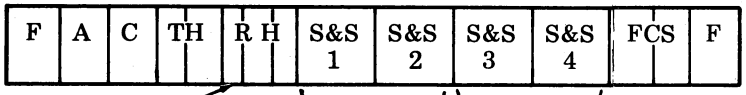
— ESC and ETX not used as in BSC.

Later (Intermediate or Final) Text I Frame:



— RH not present.

Status & Sense I Frame:



SSDI = 1

SNA S&S

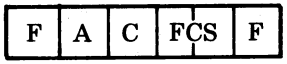
DEVICE S&S

(F bit always on)

Supervisory Frame:

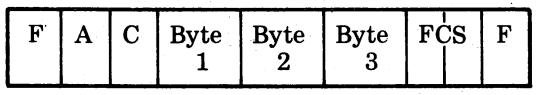
— Includes RR or RNR information.

Unnumbered Frame (Except Frame Reject and Link Test):



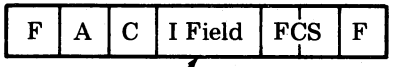
— I field prohibited.

Frame Reject (an unnumbered frame):



(F bit always on)

Link Test (TST) (an unnumbered frame):



Possible from computer, not from 4540.

— No relation to R/TST bid from 4540.

Clear Command Frame:

CLEAR command byte is hex A1.

— No information allowed after A1.

— Sent by computer, response of 4540 includes A1 following RH and has F bit on.

Psuedo Bid Command Frame:

Pseudo bid byte is hex F8.

— No information allowed after F8.

— Response of 4540 is either an exception resp w/S&S (08130000) or positive resp as requested in RH of Pseudo Bid frame.

SUMMARY OF FRAMES

CHART 18 — ADCCP

10. ADCCP ERROR RECOVERY

10.01 The 4540 first analyzes the Address byte. If the address matches the address optioned in 4540, the frame is stored in the receive buffer for further processing. If the address does not match, the receiver is blinded until another flag is received.

10.02 After the address match is successful, the 4540 then checks the received FCS against the calculated FCS. If the frame fails the FCS check, the 4540 discards the frame and does not increment the Nr count.

10.03 The Control byte is processed next. Errors detected in the control byte cause Frame Reject to be sent.

10.04 If the frame contains TH and RH headers they are processed next. Commands (eg. erase-write, read modified) are also checked. A Status and Sense message with the SNA error is sent if there is an error (provided P bit is on).

10.05 After SNA headers are processed and no errors are detected, the 4540 response to the message depends on the DR, EX, and Pc bits in RH1. Device errors (printer runs out of paper etc.) result in Status and Sense messages only if requested by RH1.

10.06 Error recovery is the responsibility of the computer. After a series of unsuccessful transmission retries, the computer should proceed with a higher level of recovery. The computer may send a clear command frame to reset pending responses (DR, EX, Pc), or send a SNRM frame to reset 4540 Nr and Ns to zero, or post a message to the system operator to take further action.

10.07 It is recommended that the computer attempt recovery from a no-response condition within approximately 3 seconds. When there is no 4540 response, the computer may send an RR frame to the station to invite a response or may send the unanswered frames again (to get the Nr expected). The ENQ process of BSC does not apply.

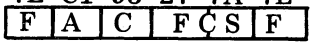
11. 4540 ADCCP DATA STREAM EXAMPLES

11.01 Several examples are included here to provide typical sequences of data transfer. Refer to Charts 15 through 18 to decode Hex numbers of Control Bytes. Transmission Headers, and Request/Response Headers.

ADCCP Example 1 — System Start Message

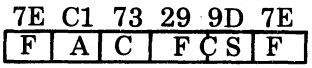
From Computer — Sends SNRM

Where 4540 address = C1



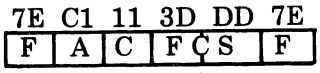
Control Byte indicates the following: Unnumbered Frame, Poll Bit On, SNRM (Set Normal Response Mode). Nr is not specified.

From 4540 — Sends UA



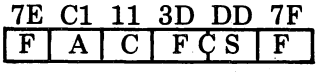
Control Byte: Unnumbered Frame, Final Bit On, UA (Unnumbered Acknowledge), Nr is not specified.

From Computer — Poll



Control Byte: Supervisory Frame, Poll Bit On, Nr = 0, Receiver Ready (RR).

From 4540 — Reports RR; no bids pending



Control Byte: Supervisory Frame, Poll Bit On, Nr = 0, RR.

ADCCP Example 2 — Device End Status

From Computer — Poll

7E	C1	11	3D	DD	7E
F	A	C	FCS		F

Control Byte: Supervisory Frame, Poll Bit On
Nr = 0, RR

From 4540 — Device 1 reports status

7E	C1	10	3C	C1	07	00	00	00	00	02	00	8F	4E	7E
F	A	C	TH0	TH1	RH0	RH1	RH2	S&S0	S&S1	S&S2	S&S3	FCS		F

Control Byte: Information Frame
Nr = 0, Final Bit On,
Ns = 0

THO: FID = 3
MF = 11 (Frame with entire message)
EFI = 00

TH1: LU/SSCP = 1
Device Address = 1

RH0: RR & RU & SCI = 0
FI = 0, SSDI = 1
Status information included.

RH1: DR & EX & Pc = 0

RH2: BB & CSI = 0

S&S = Device End for Device 1.

From Computer — Reports Nr and Polls 4540

7E	C1	31	3F	FC	7E
F	A	C	FCS		F

Control Byte: Supervisory Frame, Poll Bit On, Nr = 1, RR

From 4540 — Device 2 Reports Status

7E	C1	12	3C	C2	07	00	00	00	00	02	00	11	96	7E
F	A	C	TH0	TH1	RH0	RH1	RH2	S&S0	S&S1	S&S2	S&S3	FCS		F

Same as last transmission from 4540 except: Nr = 0, Ns = 1, and Device is 2. S&S = Device End for Device 2.

From Computer — Reports Nr and Polls

7E	C1	51	39	9F	7E
F	A	C	FCS		F

Control Byte: Supervisory Frame, Poll Bit On, Nr = 2, RR

ADCCP Example 3 — 4540 Has No Bids Pending and No Pending S&S

From Computer

7E	C1	11	3D	DD	7E
F	A	C	FCS		F

Control Byte: Supervisory Frame, Poll Bit On, Nr = 0
(next I Frame from 4540 should have Ns = 0), RR.

From 4540 — In Normal Response Mode With No Bids Pending

7E	C1	71	3B	BE	7E
F	A	C	FCS		F

Control Byte: Supervisory Frame, Final Bit On, Nr = 3, RR.

ADCCP Example 4 — 4540 Sends Bid and Then Receives Information

From Computer — Poll

7E	C1	51	39	9F	7E
F	A	C	FCS		F

Control Byte: Supervisory Frame, Poll Bit On, Nr = 2, RR.

From 4540 — PF 2 key depressed prior to poll (bid is pending)

7E	C1	54	3C	C0	03	00	00	F2	40	C1	C2	56	06	7E
F	A	C	TH0	TH1	RH0	RH1	RH2	AID	CA1	CA2	Text	FCS		F

Text

Control Byte: Information Frame, Nr = 2, Final Bit On, Ns = 2

TH0: FID = 3
MF = 11 (Frame with entire message).
EFI = 00 (Bid from 4540).

TH1: LU/SSCP = 1, 4540 initiated bid.
Device 0 is device that bid.

RH0: RR & RU & SCI =0
FI & SSDI = 0
Status and Sense data is not included.

RH1: DR & EX & Pc = 0
(4540 bid)

RH2: BB & CSI = 0

AID = Hex F2 translates to the aid for PF2 key depressed.

CA1, CA2 = Hex 40, C1 the present cursor position is Row 1, Column 2.

Text = Hex C2 (character B) is the only text in the buffer (unformatted).

From Computer -- Reports Nr and RR

7E	C1	71	3B	BE	7E
F	A	C	FCS		F

Control Byte: Supervisory Frame, Poll Bit On, Nr = 3, RR.

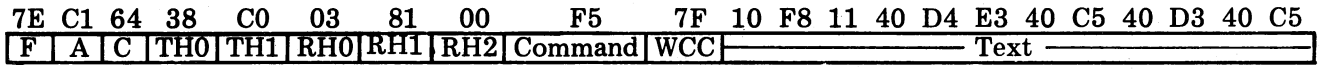
From 4540 -- Reports Nr and RR

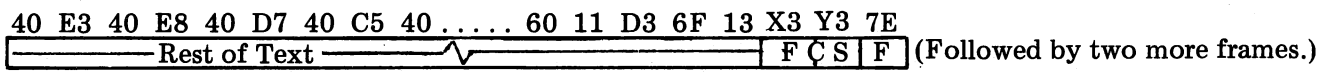
7E	C1	51	39	9F	7E
F	A	C	FCS		F

Control Byte: Supervisory Frame, Final Bit On, Nr = 2, RR.

ADCCP Example 4 — (Contd)

From Computer — Sends three frames of text and waits for 4540 reply.





(Followed by two more frames.)

Control Byte: Information Frame
Nr = 3
Poll Bit Off
Ns = 2 (happens to be 2)

TH0: FID = 3
MF = 10 (First frame of message).
EFI = 00

TH1: LU/SSCP = 1
Device Addressed = 0

RH0: RR & RU & SCI = 0
FI & SSDI = 0

RH1: DR = 1, EX = 0, Pc = 1
(Definite Response with Pacing)

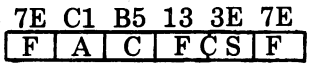
RH2: BB & CSI = 0

Command = Erase/Write, WCC (Write Control Character) of hex 7F is "quotes".

Text: Contains formatted buffer information.
FCS: X3 and Y3 are fictitious.

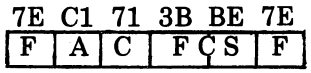
Two more frames are sent in this example.

From 4540 — Reports Nr and RNR



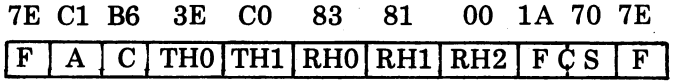
Control Byte: Supervisory Frame, Final Bit On, Nr = 5, RNR. The LCU cannot send an I frame with RNR set at 4540. Last message from computer had 3 I frames. Nr = 2 was the previous 4540 report in this example.

From Computer — Reports Nr and RR



Control Byte: Supervisory Frame, Poll Bit On, Nr = 3, RR.

From 4540 — Reports RH1 as received earlier.



Control Byte: Information frame
Nr = 5, Final Bit On
Ns = 3

TH0: FID = 3
MF = 11 (Frame with entire message).
EFI = 10 (Response to LCU).

TH1: LU/SSCP = 1
Device Address = 0

RH0: RR = 1, RU & SCI = 0
FI & SSDI = 0

RH1: DR = 1, EX = 0, Rc = 1
Sent as requested earlier.

RH2: BB & CSI = 0

ADCCP Example 5 — Computer Sends Multi-Frame Message To Printer of 4540

From 4540 — Response to a frame with P bit on when 4540 is in normal response mode.

7E	C1	11	3B BE	7E
F	A	C	FCS	F

A supervisory frame indicating RR;
Nr of 4540 happens to be 0.

(An Information frame indicating F = 1 and MF = 11 or 01 could have been used in the example.)

From Computer

7E	C1	00	38	41	03	81	00
F	A	C	TH0	TH1	RH0	RH1	RH2

F5	C8 ..... Text Part 1	X1 Y1	7E
	Text	FCS	F

WRITE CONTROL CHARACTER (H)

ERASE/WRITE COMMAND

The remainder of this example uses fictitious frame check characters.

An Information frame with Ns = 0, P = 0;
Nr of computer (for this station) happens to be 0.
MF = 10, EFI = 00. Device 1 is a printer in this example.
Write control character of H specifies start printer and NL/EM format.

From Computer

7E	C1	02	30	41	Text Part 2	X2 Y2	7E
F	A	C	TH0	TH1	Text w/o Command	FCS	F

Where Ns = 1, P = 0, MF = 00

From Computer

7E	C1	04	30	41	Text Part 3	X3 Y3	7E
F	A	C	TH0	TH1	Text w/o Command	FCS	F

Ns = 2, P = 0, MF = 00

From Computer
From Computer
From Computer

(3 more intermediate frames which are not shown. These frames have P = 0.)

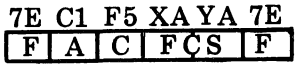
From Computer

7E	C1	1C	30	41	Text Part 7	X7 Y7	7E
F	A	C	TH0	TH1	Text w/o Command	FCS	7E

Ns = 6, P = 1, and MF = 00
(Total text character is less than 1920.)

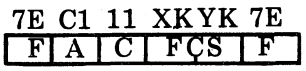
ADCCP Example 5 — (Contd)

From 4540



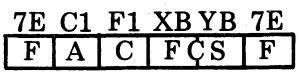
4540 reports Nr = 7 (all frames accepted) but unable to receive more data because 4540 is still processing the previous frame.

From Computer



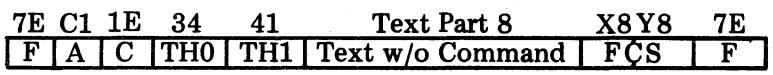
Computer reports Nr still 0 and invites response from any device at 4540.

From 4540



4540 is now able to receive more data for Device 1.

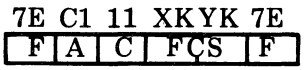
From Computer



Ns = 7, P = 1, MF = 01. The printer begins to print.

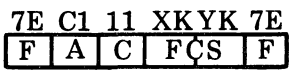
Notice that a WCC (with printer start bit on) is not present in this last frame, but is present in the first frame. This is different from BSC.

From 4540



4540 reports Nr = 0 (frame 7 was accepted).

From Computer



Computer invites response. (RR response.)

ADCCP Example 5 — (Contd)

From 4540

7E	C1	11	XK	YK	7E
F	A	C	FCS		F

4540 is able to receive but has no traffic or response to send.

⋮ (After a few more "RR" responses back and forth, 4540 responds as given below.)

From 4540 — (To Computer, RR Response)

7E	C1	30	3E	41	C3	81	00	XL	YL	7E
F	A	C	TH0	TH1	RH0	RH1	RH2	FCS		F

MF = 11, EFI = 10, and printer completed printout prior to computer RR response. (Pc bit on indicates printout complete.)

Notice that one of the uses for the Pc bit is to indicate printout is complete. This is different than the Device End S&S indication in BSC.

ADCCP Example 6 — 4540 Accepts Pseudo Bid

From Computer — Command to respond to Pseudo bid for addressed device.

7E	C1	74	3C	C7	03	80	00	F8	X1 Y1	7E
F	A	C	TH0	TH1	RH0	RH1	RH2	Text	FCS	F

Control Byte: Information Frame, Nr = 3, Poll Bit On, Ns = 2

TH0: FID = 3, MF = 11, EFI = 00

TH1: LU/SSCP = 1, Device is 7

RH0: RR & RU & SCI = 0, FI & SSDI = 0

RH1: DR = 1, EX & Pc = 0 (could be otherwise)

RH2: BB & CSI = 0

Text is only F8 which is the Pseudo bid command.
(This example uses fictitious FCS characters)

From 4540 — Response to Pseudo bid (accepted) and increment poll counter and thus inhibit sending bids or S&S.

7E	C1	76	3E	C7	83	80	00	X2 Y2	7E
F	A	C	TH0	TH1	RH0	RH1	RH2	FCS	F

Control Byte: Information Frame, Nr = 3, Final Bit On, Ns = 3

TH0: FID = 3, MF = 11, EFI = 10

TH1: LU/SSCP = 1, Device is 7

RH0: RR = 1, RU, SCI, FI & SSDI = 0

RH1: DR = 1, EX & Pc = 0

RH2: BB & CSI = 0 (No text follows RH2.)

From Computer — One frame message for Device 7 (BB did not have to be 1).

7E	C1	96	3C	47	03	80	80	C6.....D9	X3 Y3	7E
F	A	C	TH0	TH1	RH0	RH1	RH2	Text	FCS	F

Control Byte: Information Frame, Nr = 4, Poll Bit On, Ns = 3

TH0: FID = 3, MF = 11, EFI = 00

TH1: LU/SSCP = 0, Device is 7

RH0: RR & RU & SCI = 0, FI & SSDI = 0

RH1: DR = 1, EX & Pc = 0

RH2: BB = 1, CSI = 0 (BB = 1 causes poll counter to decrement to 0 to allow 4540 to send bids and S&S.)

ADCCP Example 7 — 4540 Rejects Pseudo Bid

From Computer — Command to respond to Pseudo bid.

7E	C1	74	3C	C7	03	80	00	F8	X1 Y1	7E
F	A	C	TH0	TH1	RH0	RH1	RH2	Text	FCS	F

Control Byte: Information Frame, Nr = 3, Poll Bit On, Ns = 2

TH0: FID = 3, MF = 11, EFI = 00

TH1: LU/SSCP = 1, Device is 7

RH0: RR & RU & SCI = 0, FI & SSDI = 0

RH1: DR = 1, EX & Pc = 0 (could be otherwise)

RH2: BB & CSI = 0

Text is only F8 which is the Psuedo bid command.
(This example uses fictitious FCS characters)

From 4540 — Response to Pseudo bid (rejected) and does not increment poll counter because a 4540 bid is pending for the device.

7E	C1	76	3E	C7	87	90	00	08	13	00	00	XZ YZ	7E
F	A	C	TH0	TH1	RH0	RH1	RH2	S&S0	S&S1	S&S2	S&S3	FCS	F

Control Byte: Information Frame, Nr = 3, Final Bit On, Ns = 3

TH0: FID = 3, MF = 11, EFI = 00

TH1: LU/SSCP = 1, Device is 7

RH0: RR & SSDI = 1, RU, SCI & FI = 0

RH1: DR = 1, EX = 1 & Pc = 0 (exception response)

RH2: BB & CSI = 0

S&S = Request Reject, device has bid pending

Computer should invite 4540 to send so that device 7 bid is accepted. Computer could then attempt Pseudo bid again.

12. STATION AND COMPONENT TESTING

12.01 Diagnostic capabilities built into each 4540 component permit individual component testing as well as station testing. For more information see Section 582-300-500 (clustered 4540) or Section 582-300-505 (4540 SDS).

12.02 Diagnostics and tests include:

Printer Self-Test
45C340 Controller Self-Test
Power Supply Analysis
45C310 Display Base Self-Test
45C320 Display Base Self-Test
Monitor Analysis
Display Base Self-Test
Keyboard Self-Test
Local test from KD
Analog Loopback Test
Digital Loopback Test

13. GLOSSARY, REFERENCES, AND ABBREVIATIONS

13.01 Glossary:

Acknowledge — An affirmative response to a message indicating the message was received without error.

Address — A specified location in a buffer or for a specified device, etc.

Advanced Data Communication Control Procedures (ADCCP) — A line protocol that conforms to ANSI standard X3.66 - 1979.

Alarm Message — Status and sense message sent by SCC notifying host of special conditions (eg. paper out, device not available).

Alphanumeric Field — An LCU defined field, into which Alpha and/or Numeric data can be entered.

Attached KD — Keyboard mounted to 4500 style furniture bracket.

Attention Identification (AID) — One of a group of characters generated by special keys on the keyboard and used for program attention,

Attribute Character — Character following Start Field (SF) character that designates the characteristics of characters in a field. Displayed and printed as a SPACE.

Binary Synchronous Protocol (Bisynch) — A Line protocol that conforms to ANSI standard X3.28 - 1971 sub 2.4 and sub B2 plus RVI and WACK. Bisynch is some times called BSC.

Blink — An optional feature that allows highlighted fields to be varied between normal and half intensity on the monitor.

Block — a group of characters usually designated with a beginning and ending control character. Most data blocks in 4540 are limited to 256 characters.

Buffer Address — Any of 1920 locations (0-1919) in the buffer.

Byte — As used in 4540, 8 bits.

Communications Access — The actual communication links including data sets.

Communications Control Characters — Characters used to control the data link in order to establish, change direction, signify alarm status of, or terminate communication.

Command Codes — Character sequences (ESC) 1, 2, 5, 6, 7, ? initiated by LCU to effect message transfer, write, read or control operations. (ESC) used in bisynch only.

Controller — For clustered 4540, a control unit (SCC) used to interface with data set and devices. Contains an inter-connecting frame, power supply, cooling fan, I/O ports, and various arrangements of circuit cards. For 4540 SDS, control unit (45C320 controller) used to interface with data sets and up to one printer. 45C320 contains power supply, I/O ports and various arrangement of circuit cards. The 45C320 is a display base.

Control Characters — Characters generated by the LCU or by combined use of the CONTROL and special keys on the keyboard.

Copy — The transfer of data from one device to another device on the same station.

Copy Control Character — Character following (ESC) 7 command that determines the type of data to be copied, sounding of alarm, printing and line length. (ESC) used in bisynch only.

Central Processing Unit (CPU) — Provides system host program and control via the LCU to the remote stations.

Command — Directs the addressed device to erase, write, copy, or read etc.

Cursor — A white rectangular indicator on the display. In local operation, the cursor is located at the address where the next operation will take place. Characters already in memory at the cursor location will be displayed within the cursor form.

Cursor Address (CA) — Character pairs indicating address of cursor.

Cursor Select — (4540 SDS only) allows selection of item in list or table displayed and identifies this item to the computer.

Cursor Wrap-Around Feature — Depressing a cursor positioning key always results in cursor movement. Example: "cursor right" at end of a line will result in cursor going to the next line, column one.

Cyclic Redundancy Check (CRC) — Type of block check sequence. Used only in bisynch EBCDIC stations.

Data Link Control — The procedures for controlling the link between communication devices.

Data Service Unit (DSU) — A device used to connect communications equipment to Digital Data Network.

Data Set — A device used to interface between communication controller and phone lines. Also called a modem.

Device — A keyboard display or printer.

Device Busy — A status condition sent if device is busy.

Device Unavailable — A status condition sent indicating the unavailability of a device to the LCU.

Display — A CRT (Cathode Ray Tube) capable of displaying characters; also called Monitor. A module consisting of base, cable and monitor.

Download — An operating program from the SCC is sent downstream to a KD. This gives more flexibility for configuring a station.

End Medium — EM character, if present, defines the last buffer location which will be preinted when fixed lengths are not specified in the WCC or CCC message control characters.

EPROM (Erasable, Programmable, Read-Only Memory) — An IC which can be programmed, erased, and reprogrammed.

Erase — A part of Erase-Write Command function that replaces characters stored in the Buffer with Nulls.

Erase All Unprotected — A command causing all unprotected characters in the buffer to be erased.

Erase Unprotected to Address — An order causing all unprotected characters in the buffer up to (but not including) a specified address to be erased by nulls.

Erase/Write — A command causing a buffer to be erased to nulls. The command may be followed by a message to be printed or displayed under control of a write control character.

Field — An area on a formatted display defined by one attribute character to have certain display characteristics starting at the sequential address following the attribute character and ending one character before the next attribute character.

Font — A complete set of characters in one style and size.

Formatted Display — Device buffer containing at least one attribute character.

Frame Check Sequence (FCS) — Type of block check sequence. Used in ADCCP.

Free-Standing KD — Keyboard and display are each mounted on a separate free-standing base.

Home Position — The first buffer location. Upper left corner of display (Row 1, Column 1).

Insert Cursor — An order to place cursor at the current buffer address.

Intensified Field — Any characters displayed in such a field appear at a higher than normal intensity.

Invalid Reply — A replay that is inappropriate or contains a wrong command.

Invalid Command — Incorrect character in command sequence.

Keyboard — Unit containing alphanumeric, control, and editing keys. Also referred to as an operator console.

Leading Pad — A HEX "55" Character generated by the station before any transmission. May also be generated by the LCU.

Line Control Unit (LCU) — A unit generally at the side of the host processor, used to control the flow data between the CPU and remote stations.

Link — A connection between two or more communication devices.

Longitudinal Redundancy Check (LRC) — A character derived from binary accumulation of bits during a block. Used only with ASCII stations.

Message Control Character — Characters within a data stream that control message transfer.

Master Station — Station that is sending a data block.

Modified Data Tag (MDT) — Bits set in attribute character used to indicate that data in a field has either been modified by control of CPU or by the operator when any data is entered in a field or changed.

Modified Field — Field defined as modified by LCU or by operator entry.

New Line (NL) — Control character, if present, defines the end of a line on a printer when fixed field lengths are not specified in the WCC or CCC message control characters.

Non-Intensified Field — Field in which characters are displayed at normal intensity.

Non-Displayed Field — Field in which data is present, but not displayed. (Also called hidden field).

Null — Character used to replace data in buffer. Printed or displayed as space.

Numeric Field — Field which only accepts digits, minus, DUP, and period characters.

Orders — Characters in data stream used to position, define and format data.

Poll — General or Specific. Used to initiate communication and request a message from a 4540.

Primary Station — The station (usually the computer) responsible for maintaining an orderly flow of data. Term is used with ADCCP.

Program Attention — Characters used to alert the program at the host CPU for special action.

PROM — Programmable Read Only Memory allows a program to be burned in but not changed like an EPROM.

Program Access — PA1, 2 and 3 — Special keys on keyboard. PA3 only on 40K105.

Program Function — PF1 through 12 — Special keys on keyboard. PF6 through 12 not on 40K105. PF13 through 24 can be on 45K301-type keyboard of 4540 SDS.

Program Tab — Order causing buffer address to be moved to the next unprotected field. Details in Chart 12.

Protected Character — Any character in field with "protect" attribute. Attempts to locally enter or change data in such a field will only result in an audible alarm.

Random Access Memory (RAM) — Temporary read/write memory. Data stored can be changed (data is lost when power is turned off).

Read — Buffer function in which data in 4540 storage for the device is transmitted.

Read All — Command that causes entire buffer contents to be transmitted.

Read Modified — Command that causes only modified data in buffer to be transmitted.

Read Command — Either "read all" or "read modified".

Repeat to Address — Order which causes all locations in a buffer up to (but not including) a specified address, to be replaced by a specified character.

Reset MDT — Buffer, or field(s) in buffer, which has been reset to unmodified by use of WCC or Attribute Character.

Read Only Memory — Permanent memory. Instructions are stored permanently and can be read out repeatedly.

Secondary Station — This station can only initiate transmission to the primary station when given permission by primary station. Term is used with ADCCP.

Self-Test Switch — A switch in the SCC, display base or printer used to initiate an internal test.

Set Buffer Address — An order causing operation to begin or continue at a buffer location specified.

Specific Poll — A communication initiated by the LCU requesting a message from a specific device or a station.

Standard Serial Interface — (SSI) Teletype Standard used for communication between a device and controller.

Start Field — An order which indicates that the following character is an attribute character.

Station Cluster Controller (SCC) — See "controller".

Station — A remote data communications facility that has a unique address or identity. Includes data set, controller, and devices.

Status and Sense — A character sequence indicating alarm status to the LCU.

SYN — Character preceding all transmissions. Used to get Sender and Receiver in step. May also be within text.

Text — The principal information being sent as distinguished from control codes. Formatting is part of text but commands are not.

Trailing Pad — A HEX "FF" character generated by the station or LCU after any transmission.

Unformatted Display — A display buffer which contains no attributes.

Uninterpretable Reply — A reply that has no recongizable character format.

Unprotected Field — Field into which data can be entered or changed.

Write — Write received data into station buffer.

Write Control Character (WCC) — Character following (ESC) 1 to 5 write commands that determines if message is to be printed, alarm sounded, keyboard and AID reset, MDT reset, and length of print line, (ESC) used in bisynch only..

13.02 References used with 4540:

SECTION	CONTENTS
582-300-150	Description And Operation
582-300-200	Installation (Clustered 4540)
582-300-205	Installation (4540 SDS)
582-300-400	Wiring (Clustered 4540)
582-300-405	Wiring (4540 SDS)
582-300-500	Testing And Troubleshooting (Clustered 4540)
582-300-501	On-Line BSC Test Using 921A Data Test Set
582-300-505	Testing And Troubleshooting (4540 SDS)
582-300-700	Disassembly/Reassembly And Parts (Clustered 4540)
582-300-705	Disassembly/Reassembly And Parts (4540 SDS)
582-300-750	Routine Maintenance (Clustered 4540 and SDS)
999-300-140	How To Operate - Clustered 4540 With Typewriter Style Keyboard
999-300-141	How To Operate - 4540 With Internal Numeric Style Keyboard
999-300-142	4500 Line Printer
999-300-143	Station's Manager's Manual (Clustered 4540)
999-300-144	How To Operate — AP25 Printer
999-300-145	How To Operate — 4540 SDS Keyboard Display
999-300-146	How To Operate — AP200 Printer
999-301-121	How To Operate — 40Line Printer
999-301-123	How To Operate — 201C
999-302-123	How To Operate — 208A
668-125-503	Test Center Test Procedures
668-125-508	Digitech Pacer Test Procedures
668-125-510	4540 ADCCP Test Program For Pacer M103-LB1/2
668-125-511	Synchronous DATASPEED 40/4 — 4540 Bi-Sync Test Procedures (/4ATC3 and /4ETC3) Testing Using Pacer — 103, LB1/2 Data Line Monitor/Simulator
W-4C800	Wiring Plan (Clustered 4540)
W-4DMOO	Wiring Plan (4540 SDS)

13.03 The following documents can also be obtained through Teletype Corporation.

SD 4540-401 General Technical Reference

SD 4540-402 Pocket Reference

SD 4540-404 4540 Data Communications Terminal (ADCCP) System Planning Guide

Wiring Diagram Package:

Remote Station Cluster Controller (45C340)	WDP 564
SDS Controller (45C320)	WDP 567
Display Base for Clustered 4540	WDP 538
Monitor	WDP 400
40K104 Keyboard	WDP 449
40K105 Keyboard	WDP 477
45K301 Keyboard	WDP 531
40K203 Keyboard	WDP 511

13.04 Abbreviations for communication control characters, orders and message controls as used in this document are listed in Tables AC through AH.

TABLE AC

BSC SEQUENCES

ABB	NAME	ASCII	EBCDIC
ACKO	Acknowledge 0	DLE zero	DLE Hex 70
ACK1	Acknowledge 1	DLE one	DLE Slash (/)
ACKN	Correct Acknowledge	DLE zero (or) DLE one	DLE Hex 70 (or) DLE Slash (/)
$\overline{\text{ACKN}}$	Incorrect Acknowledge	DLE zero for DLE one (or) DLE one for DLE zero	DLE Hex 70 for DLE Slash (or) DLE Slash for DLE Hex 70
CRC	Cyclic Redundancy Check	(does not apply)	(2 characters dependent on text)
RVI	Reverse Interrupt	DLE LESS THAN (<)	DLE AT SIGN (@)
TTD	Temporary Text Delay	STX ENQ	STX ENQ
WACK	Wait Acknowledge	DLE SEMICOLON (;)	DLE COMMA (,)
LRC	Longitudinal Redundancy Check (part of block check character)	(character dependent on Text)	(Does not apply)
PAD	8 Marking Bits (usually)	DEL (even parity)	Hex FF

TABLE AD

CONTROL CHARACTERS RECEIVED FROM LCU

ABB	NAME	ASCII	EBCDIC	PRINTS AS	DISPLAYED AS
DEL	Delete	DEL	DEL	Space	//
DUP	Duplicate	FS	DUP	Space	DU
EM	End Medium	EM	EM	Space	EM
FF	Form Feed	FF	FF	Space	FF
FM	Field Mark	RS	FM	Space	FM
NL	New Line	NL	NL	Space	=
NUL	Null	NUL	NUL	Space	Space

TABLE AE

ORDERS

ABB	NAME	ASCII	EBCDIC (Hex)
EUA	Erase Unprotected to Address	DC2	EUA (12)
IC	Insert Cursor	DC3	IC (13)
PT	Program Tab	HT	PT (05)
RA	Repeat to Address	DC4	RA (3C)
SBA	Set Buffer Address	DC1	SBA (11)
SF	Start Field	GS	SF (1D)

TABLE AF

MESSAGE CONTROL CHARACTERS

AC	- Attribute Character
AID	- Attention Identifier
BA	- Buffer Address
CA	- Cursor Address
CC	- Command Code
CCC	- Copy Control Character
ESC	- Prefix to Command (BSC only)
S&S	- Status and Sense
WCC	- Write Control Character

TABLE AG

ADCCP ABBREVIATIONS

A	Address byte
ADCCP	Advanced Data Communication Control Procedures
BB	Begin Bracket
C	Control byte
CSI	Code Selection Indicator
CR	Command Reject
DISC	Disconnect
DA	Device Address
DM	Disconnect Mode
DR	Definate Response
EB	End Bracket
EFI	Expedited Flow Indicator
EX	Exception Response
F	Flag byte
F bit	Final bit (Sometimes F), See P/F
FCS	Frame Check Sequence
FI	Format Identifier
FID	Format Identifier Field
FRMR	Frame Reject
HDLC	High Level Data Link Control
I	Information field
LU/SCCP	Logical Unit/System Services Control Point
MF	Mapping Field
ME	Map Error
NRZ	Non Return to Zero
NRIZ	Non Return to Zero, Inverted
Pc	Pacing (Sometimes P) See P/F
P bit	Poll bit
P/F	Poll/Final bit
PE	Path Error
RE	Request Error
RH	Request/Response Header
RHE	Request Header Error
RHE,RU	Request Header Error with Incomplete RU modifier
RR	Receiver Ready
RR error	Request Reject error
R/R	Request/Response
RNR	Receiver Not Ready
RU	Request/Response Unit
SCI	Subsytem Control Indicator
SDLC	Synchronous Data Link Control
SNA	System Network Architecture
SNRM	Set Normal Response Mode
SSDI	Status and Sense Data Included
TH	Transmission Header
TST	Test
UA	Unnumbered Acknowledgement
UN	Unbalanced
WXYZ	Four bits used with the Frame Reject command

TABLE AH

MISCELLANEOUS ABBREVIATIONS

AC	Attribute Character
ACK	Acknowledgement
ACU	Automatic Calling Unit
ADTS	Automatic Data Test System
AF	Alarm Flag
AID	Attention Identification Device
ANSI	American National Standards Institute
ASCII	American National Standard Code for Information Interchange
BA	Buffer Address
BSE	Base
BCC	Block Check Character
CA	Cursor Address
CAB	Cabinet
CC	Control Check
CID	Computer Identification
CIU	Communications Interface Unit
CLR	Clear
CR	Command Reject
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
DA	Device Address
DB	Device Busy
DC	Device Check
DE	Device End
D I/O	Display Input/Output
DISCN	Disconnect
DLE	Data Link Escape
DMA	Direct Memory Access
DSR	Data Set Ready
DSU	Data Service Unit
DTR	Data Terminal Ready
EAU	Erase All Unprotected
EBCDIC	Extended Binary Coded Decimal Interchange Code
EIA	Electronics Industries Association
EM	End of Medium
ENQ	Enquiry
EOT	End of Transmission
EPROM	Erasable Programmable Read Only Memory
ESC	Escape
ETB	End of Trasmission Block
ETX	End of Text
FF	Form Feed
ID	Identification
INC	Internal Numeric Cluster Keyboard
I/O	Input/Output
IR	Intervention Required
ITB	Intermediate Transmission Block
IXL	Instruction Execution Logic
K	1024
KD	Keyboard Display
LCL	Local
LCU	Line Control Unit
LED	Light Emitting Diode
LF	Line Feed (Not same as NL)
LSI	Large Scale Integration
MDT	Modified Data Tag
MOS	Metal Oxide Semiconductor
MSR	Magnetic Stripe Reader
NAK	Negative Acknowledgement
NL	New Line (not same as Line Feed)
OC	Operation Check
PA	Program Attention
PF	Program Function
PSU	Power Supply Unit
PTR	Printer
RAM	Random Access Memory
ROM	Read Only Memory
RTS	Request to Send
RVI	Reverse Interrupt
SCC	Station Cluster Controller
SOH	Start of Heading
SPA	Station Poll Address
SSA	Station Select Address
SSI	Standard Serial Interface
S/R	Send/Receive
STX	Start of Text
SYN	Sync
TTD	Temporary Transmission Delay
US	Unit Specify
WACK	Wait Acknowledgement
WCC	Write Control Character