

“DATASPEED*” 40/4 STATION ARRANGEMENTS

DESCRIPTION AND OPERATION

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SECTION 582-200-101

1. GENERAL

1.01 This practice describes DATASPEED 40/4 station arrangements. This includes Maxi-Cluster, Mini-Cluster, and Single Display Stations.

1.02 This section is reissued to add new features:

1. Switched network station arrangements and protocol.
2. 40C305 Controller.
3. Security lock feature.
4. Fractions graphics.
5. More detailed private-line bi-synch description.

Because this section is a general revision, marginal arrows have been omitted.

1.03 The 40/4 station arrangements provide data communications with a Line Control Unit (LCU). The 40/4 is designed for keyboard/display, I/O applications such as inquiry response, data entry, and data retrieval.

1.04 Transmission rates depend on station communication facilities, and data sets used. See Table A for details. The 40/4 uses an EIA RS-232C data set interface.

1.05 The 40/4 station operates synchronously with ASCII or EBCDIC character line codes. All stations on a given line must use the same code.

1.06 The 40/4 uses binary synchronous protocol for communications control. Maxi-clusters, mini-clusters and single display stations are designed to operate on most systems that support IBM 3271 Model 2 Control Units and 3277 Display Stations intended for private line application. The single display station with

switched network service is designed to operate with most systems that support 3275 Model 2 Control Units.

TABLE A
COMMUNICATION LINKS

Station Arrangement	Transmission Channel	Baud Rate	Data Set or Data Service Unit (DSU)
Maxi-Cluster	4-Wire Private Line Point-to-Point only	9600	209 48230 LADS 500A L1/4
Maxi-Cluster Mini-Cluster Single Display	4-Wire Private Line Multipoint, up to 32 stations on a given line	4800	208A-L1A 500A-L1/3 (DSU) 48230 LADS
		2400	201C-LID/2/4/5 251A1 (TDU) 48230 LADS 500A-L 1/2 (DSU)
Single Display	2-Wire Switched Network Point-to-Point	4800	208B
		2400	201C-LIC 201C-LIA/2/3/4
		1200	212A-L1, L1A

1.07 The single display with the switched network feature can be used for manual calling, manual or automatic answering, manual or automatic disconnect.

1.08 The hardware differences between the private line single display station and switched network single display station are one or two circuit cards in the controller and one keytop, DISC
Z on keyboard of the switched network single display station.

1.09 The private line stations operate in a polling and selection environment with 1 to 32 stations on a given circuit. The switched network single display station operates in a line contention environment on a point-to-point communication link.

2. STATION CONFIGURATIONS

Maxi-Cluster

2.01 A Maxi-Cluster Configuration, shown in Fig. 1, consists of: One Station Cluster Controller (SCC), one to six Device Cluster Controllers (DCC), and one to thirty-six devices (KDs and printers). Each DCC controls one to six devices with a minimum of one KD per DCC.

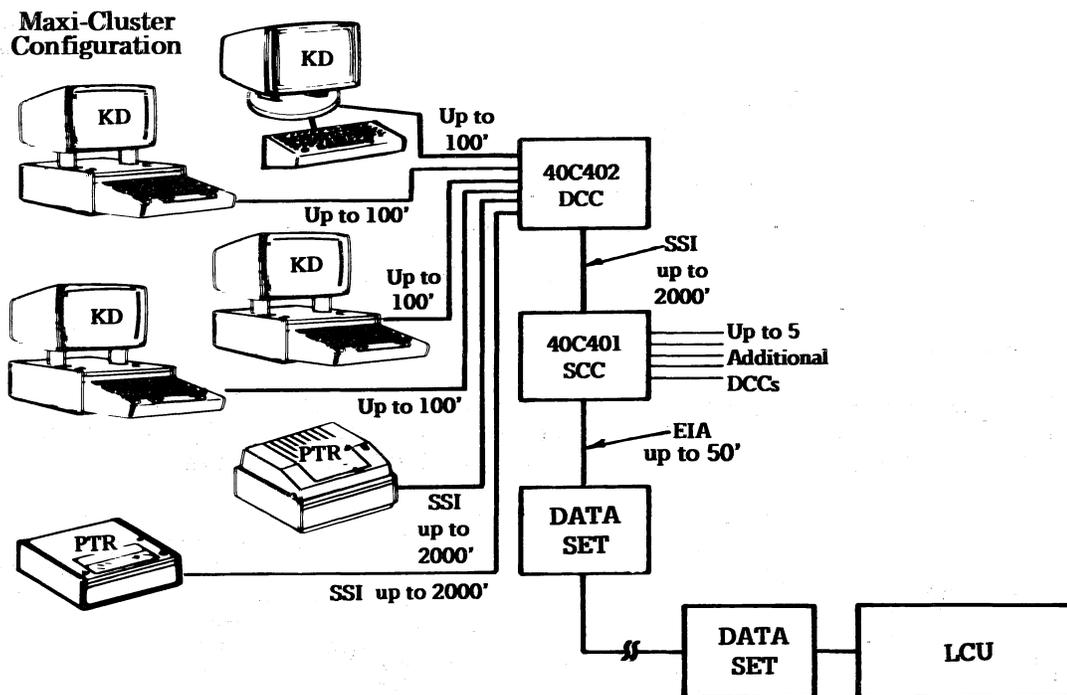


Fig. 1—Maxi-Cluster Configuration

Mini-Cluster

2.02 A Mini-Cluster Controller (MCC), shown in Fig. 2, is configured with one to three devices. The MCC must have one KD but not more than two KDs.

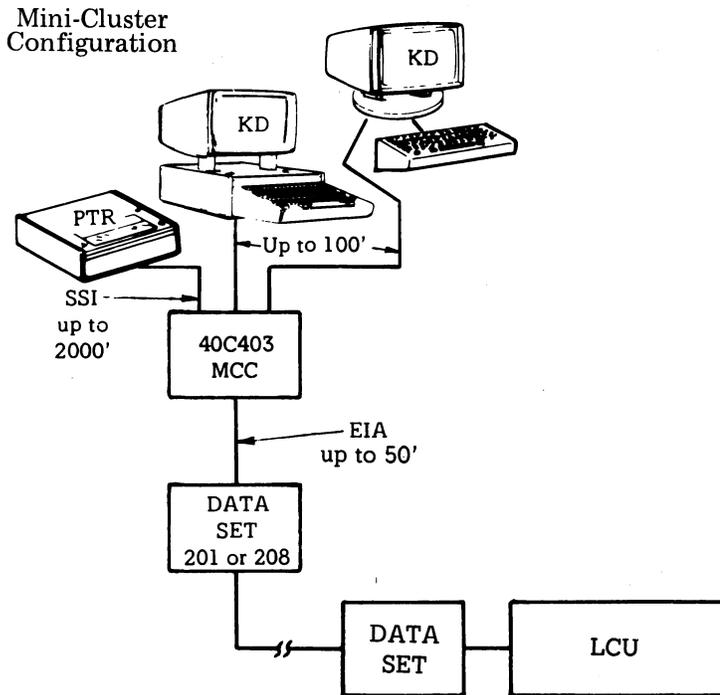


Fig. 2—Mini-Cluster Configuration

Single Display Station

2.03 A Single Display Station (SDS), shown in Fig. 3, is configured with one KD and an optional printer. The 40C304-type and 40C305-type controllers are electrically, physically, and operationally identical with the exception of the controller mounting hardware required for each application.

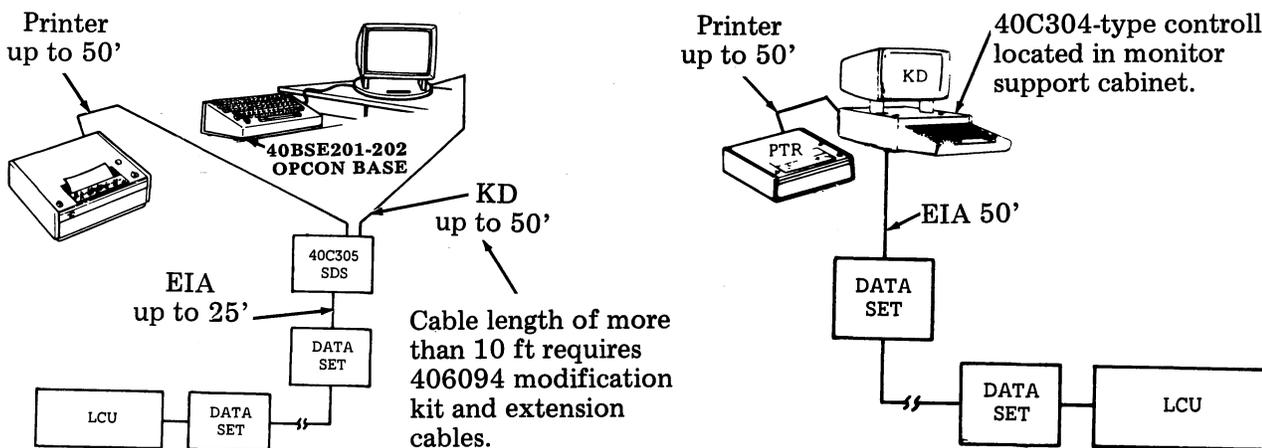


Fig. 3—Single Display Station Arrangements

2.04 The 40C304-type controller is designed to be installed in a 40CAB251-type cabinet. The 40C305-type controller is designed to be installed in a 40CAB901-type pedestal. The 40C305 can also be rack mounted in customer provided hardware.

3. COMPONENT DESCRIPTION

Monitor

3.01 The basic function of the monitor is to display data on a 5-1/4 by 11-1/4 screen. The display format for private line is 24 lines, 80 characters per line.

3.02 The switched network service has a 26 line mode. The 25th line is blank and the 26th line contains system status information.

3.03 The drive signals and ac power enter the display monitor through connectors located in the monitor support legs. See Section 582-213-100 for more information.

Keyboard

3.04 Three different keyboard styles can be used with 40/4 stations. See Section 582-200-500 for keytop layouts.

- 40K104/DAB typewriter style keyboards have keytop layouts similar to a typewriter.
- 40K203/GAB 40-wide 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.

3.05 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 controller (DCC, MCC or SDC).

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

3.07 The 40K105/CAA keyboard is only for use in a station using the EBCDIC line code, therefore, all station keyboards would need the EBCDIC keytop arrangements.

3.08 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 over-travel position. These keys can also cause cursor wraparound as indicated in Fig. 5. Except for the 40K104/DAB, all keyboards have two **CURSOR LEFT** keys for operator convenience.

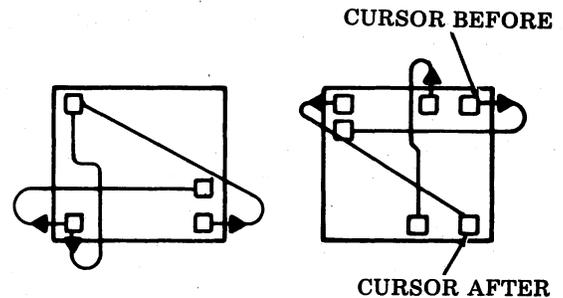


Fig. 4—Cursor Wraparound

- (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.

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(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 re-typing 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 40/4, 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 repetitious information in the same field for each document. This character is displayed as DL on an up-low KD and Ø on a monospace KD.

(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 character is displayed as FM on an up-low KD and < on a monospace KD.

(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 display buffer contents to the designated printer. The indicator lights on depression of the PRINT LOCAL key and extinguishes when the buffer transfer is complete. 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). Depression 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.

- INPUT INHIBIT indicator (40K105) — 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 moves 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 Feature — The L/TST 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 wrap-around.

- (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 nonnumeric 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.

Printer

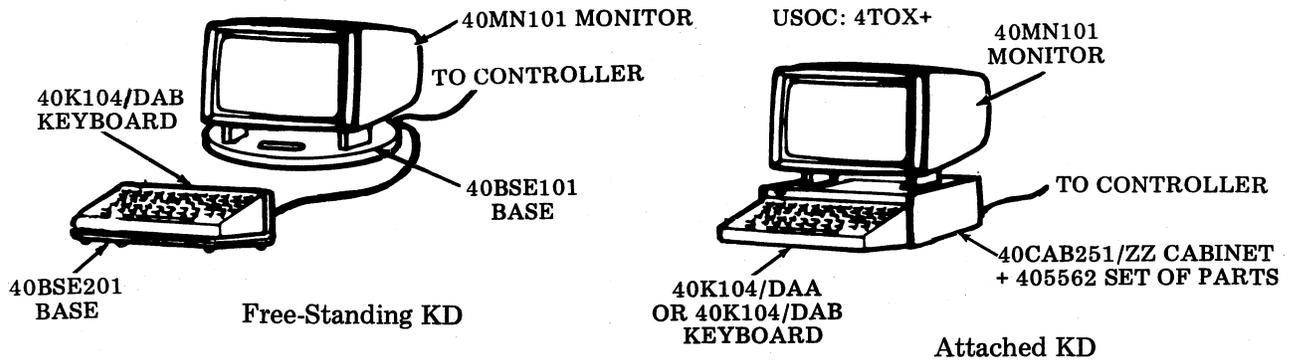
3.09 The Model 40 printers are electromechanical, impact printing devices capable of printing SSI (Standard Serial Interface) signals at speeds up to 5.2 lines per second. Printing is accomplished by print hammers impacting the paper and ribbon into type pallets in a carrier moving across the page at 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).

3.10 Printers can be 80-column friction, 80- or 132-column tractor, or 80-column forms access. See Section 582-210-100 for more information.

3.11 Print local operation transfers the KD buffer to the printer buffer for printing. This is a local function not involving the host.

Devices and Accessories

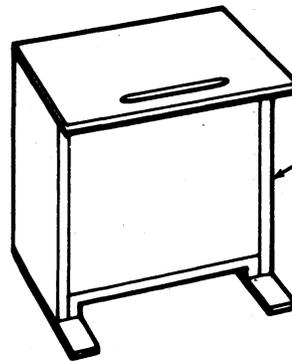
3.12 Devices and accessories used with 40/4 are shown in Fig. 5.



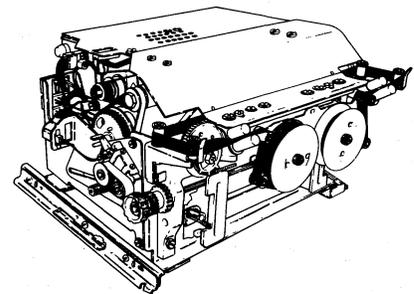
40/4 circuit cards may be carried in a 405900 carrying case.

TABLE TOPS

PART NO.	WIDTH	SLOT
401531	24"	None
401532	29"	None
401533	34"	None
401914	24"	11"
401912	31"	11"
401913	27-1/2"	17"
401915	39"	17"



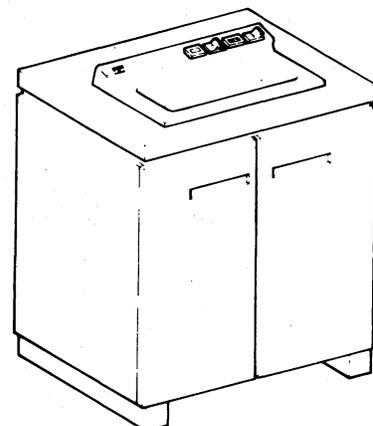
40CAB901/AJ PEDESTAL (With Power Facilities Plus Top and Legs)



40P250 Through 40P255 Forms Access Tractor Feed Printer (80-Column)

TYPE CARRIERS

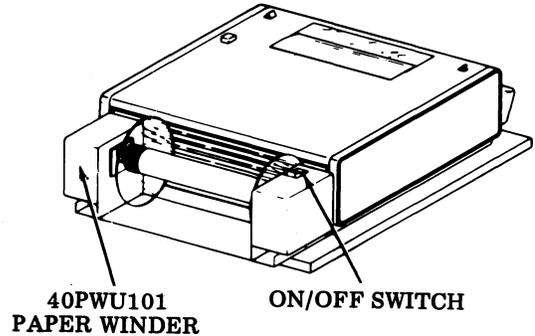
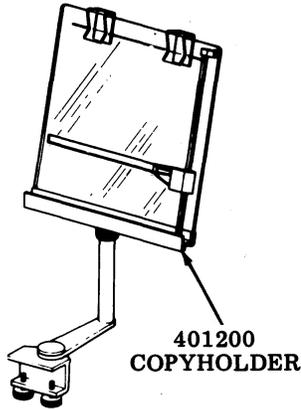
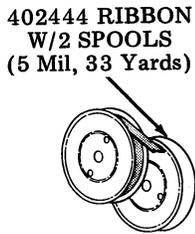
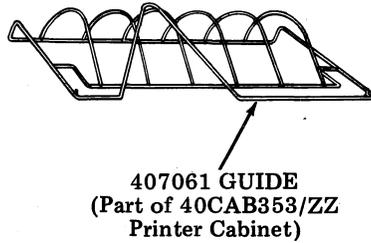
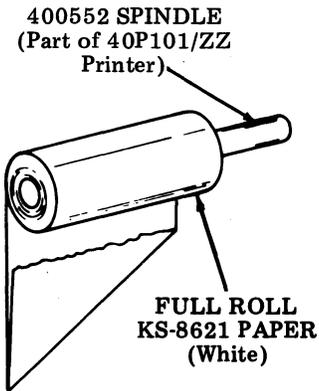
PART NO.	LINE CODE	TYPE	COLUMNS	FONT ID SYMBOL
400629	ASCII	Up-Low	80	A S
400645	ASCII	Monocase	80	A A
400775	ASCII	Line Drawing	80	A G
400777	ASCII	Up-Low	132	A S
400780	ASCII	Monocase	132	A J
400783	EBCDIC	Up-Low	132	A M
400784	EBCDIC	Up-Low	80	A M
400785	EBCDIC	Monocase	80	A O
400887	EBCDIC	Monocase	132	A S



40CAB302/AB Forms Access Printer

Fig. 5

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FORM-OUT BELT SELECTION

Form Selector Setting				Part No.	Color of Belt
4	3	2	1		
Length of Form, Inches					
3-1/3	2-1/2	5	10	402571	Amber
3-2/3	2-5/6*	5-1/2	11	402572	Blue
4	3	6	12	402573	Yellow
4-1/3	3-1/3*	6-1/2	13	402574	Brown
4-2/3	3-1/2	7	14	402575	Red
5	3-5/6*	7-1/2	15	402576	Pink
5-1/3	4	8	16	402577	Lt Green
5-2/3	4-1/3*	8-1/2	17	402578	Green
6	4-1/2	9	18	402579	Lt Blue
7-1/3	5-1/2	11	22	402580	White

*These lengths are not used in the Bell System.

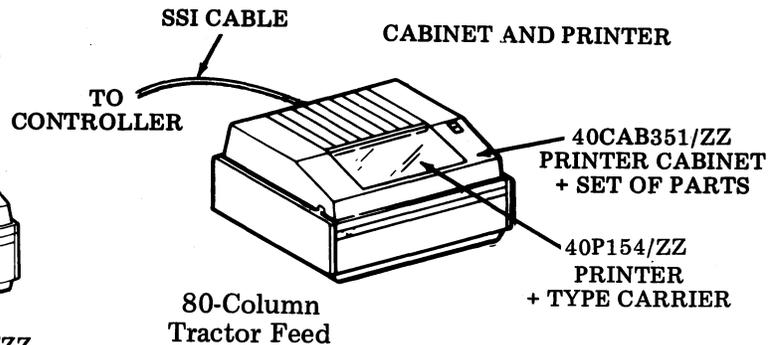
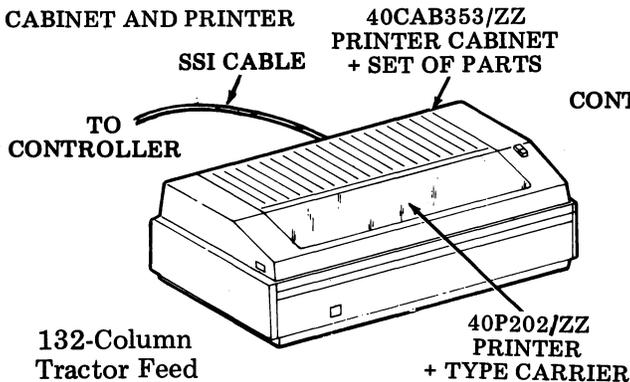
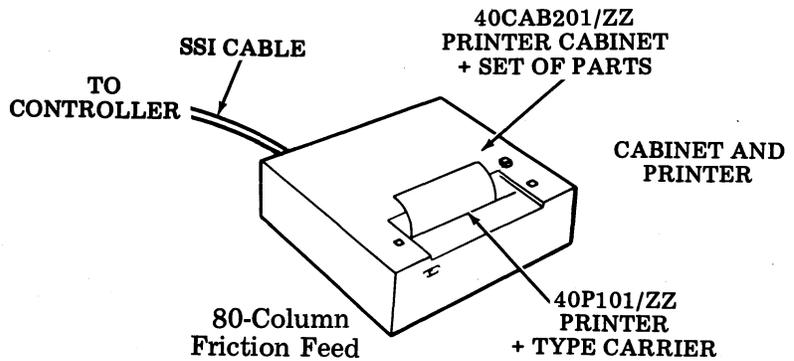


Fig. 5 (Cont)

4. SPECIAL FEATURES

Fractions

4.01 Fractions — The fractions feature for display and printing of fractions is available with SDS arrangements. The fractions included are $1/8$, $1/4$, $3/8$, $1/2$, $5/8$, $3/4$ and $7/8$.

4.02 A monospace 132-column type carrier is required to print fractions. Two ROM changes in the SDS and seven keytop changes on the keyboard are required for the display of fractions. See 50947S for more information.

Keyboard Display Amplifier

4.03 Keyboard Display Amplifier (KDA) — 40KDA101. A KDA extends the range

of the KD to 600 feet. It is required when a KD is more than 100 feet from its controller. The KDA can be used only with maxi- or mini-cluster station arrangements. See Section 582-200-212 for more information.

Security Lock

4.04 Security Lock — A key switch to disable an attached style KD is available. It is not available for SDS style stations. For more information see 50844S.

Line Drawing

4.05 Line Drawing — A special character font used for internal applications. The D I/O circuit card and/or type carrier, with line drawing capability, provide normal monospace characters plus display and printing of line drawing symbols.

5. TECHNICAL DATA

Electrical and Environmental Requirements

5.01 Currents and power shown in Fig. 6 are maximum values based on power company supplied voltages within the limits: 115 volts ac $\pm 10\%$, 60 Hz $\pm 0.75\%$. When the frequency varies more than 0.1% for extended periods, a cyclic displacement (wavyness) of data on the monitor may be observed. This condition can be eliminated by the use of the 40MN201 monitor.

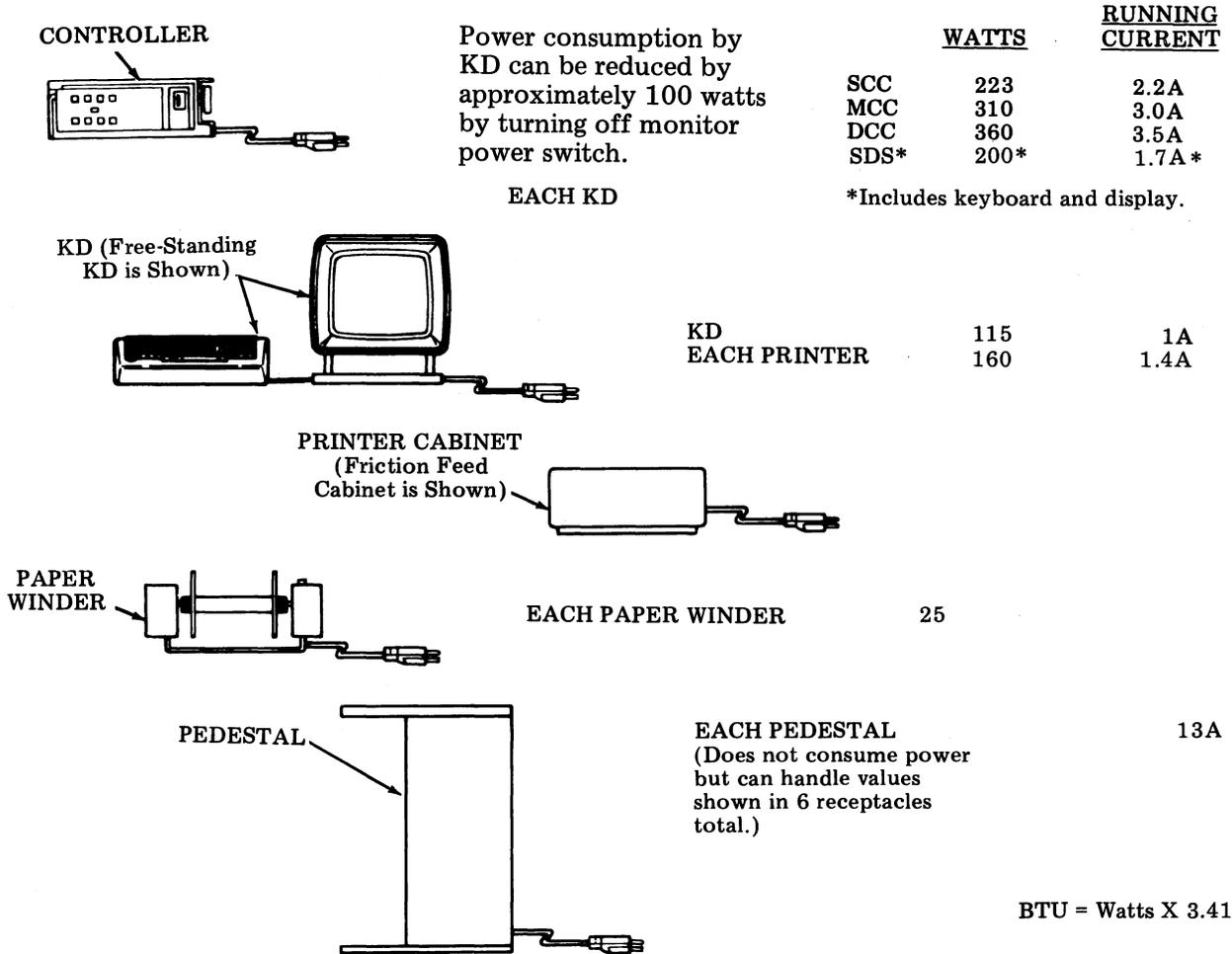


Fig. 6

Environmental conditions should be maintained within the following limits to avoid damage and provide proper operation.

<u>Environmental Condition</u>	<u>Storage or Transportation</u>		<u>Operation</u>	
	<u>Min</u>	<u>Max</u>	<u>Min</u>	<u>Max</u>
Temperature	-40°F	+150°F	+40°F	+110°F
Humidity	2%	95%	2%	95%
Altitude	Sea Level	50,000 ft	Sea Level	10,000 ft

Sudden temperature changes that can cause condensation should be avoided. A device stored in subzero temperatures will collect frost when unpacked in a warm room.

Physical Dimensions and Weights

5.02 Physical dimension and weights of 40/4 components are shown in Fig. 7.

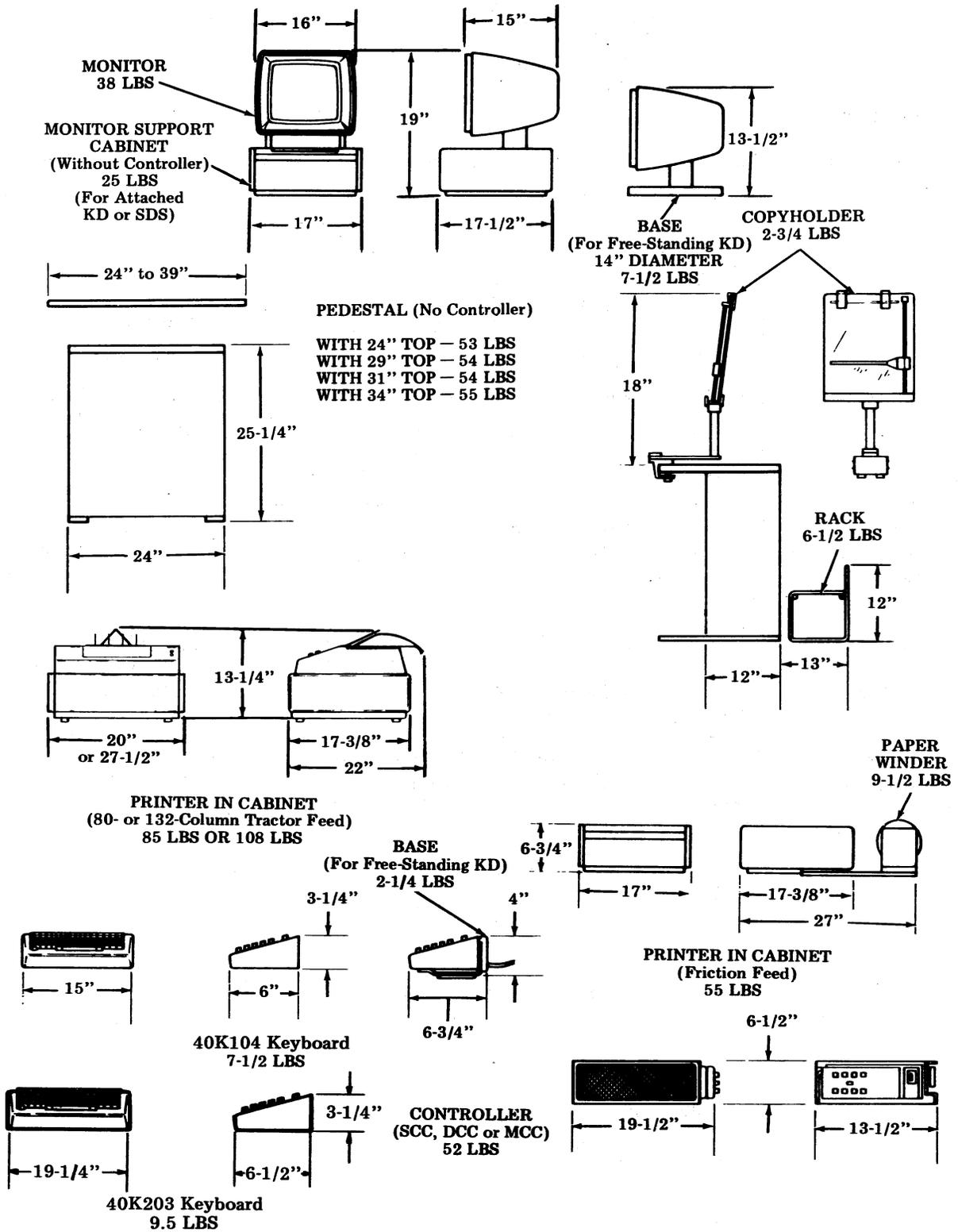


Fig. 7—Physical Dimensions and Weights

DATA SET EXTENSION CABLES

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

Station Interface

5.03 Interface to the station data set meets EIA standards RS-232C. Leads used in 40/4 are indicated in Fig. 8.

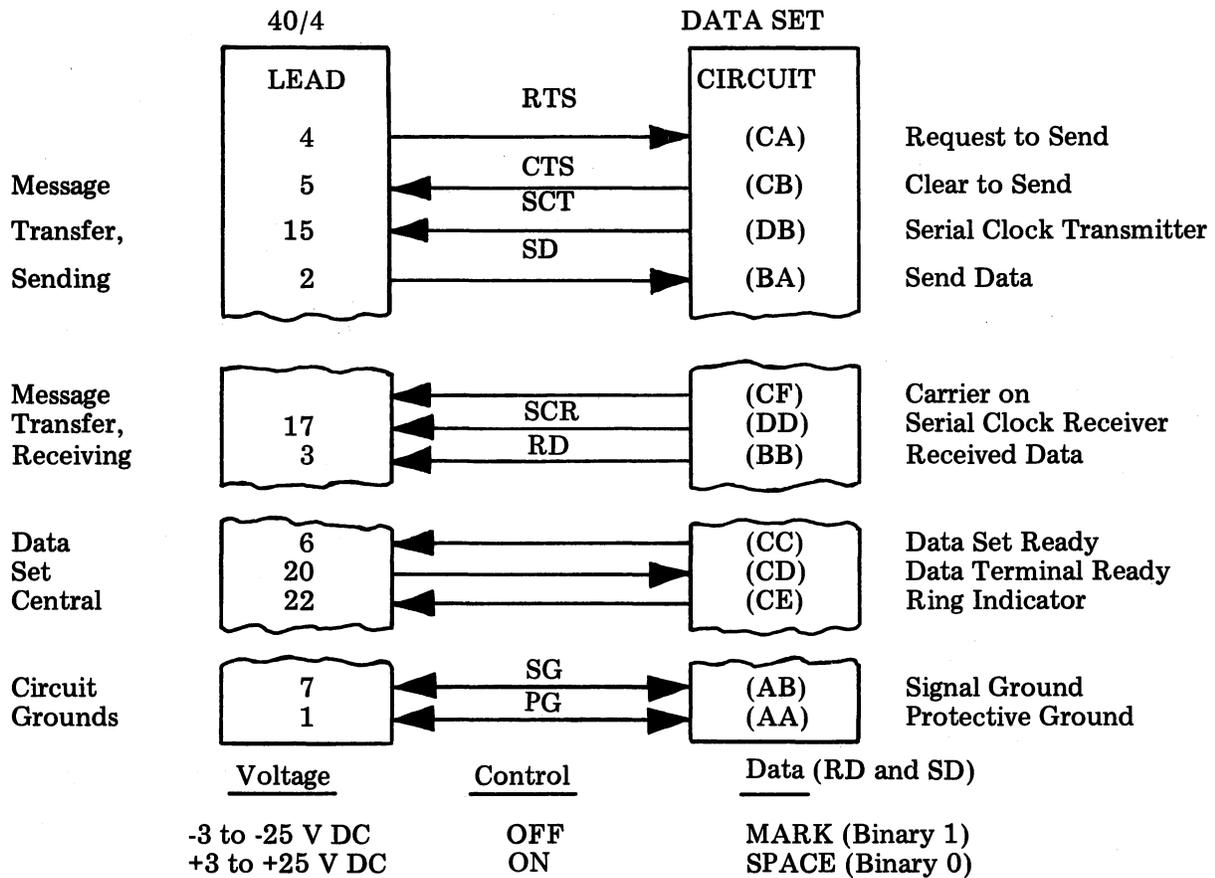


Fig. 8—EIA Leads

Station and Device Options

5.04 Description of station and device options are given in 5.05 through 5.18. The application of the options are shown in Table C. For more detailed information and actual optioning of the equipment, see appropriate installation BSP.

5.05 Station Poll (SPA) and Select (SSA) Address (Option 401) — One of the sets of SPAs and SSAs of Table B must be chosen for each private line station. Each station cohabiting a line must have its own unique SPA and SSA.

TABLE B

STATION POLL, STATION SELECT AND DEVICE ADDRESSING

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

ADDRESS CHART

Stn or Dvce No.	S P A	S S A	D A	Stn or Dvce No.	S P A	S S A	D A
0	SP	—	SP	18	K	2	K
1	A	/	A	19	L	3	L
2	B	S	B	20	M	4	M
3	C	T	C	21	N	5	N
4	D	U	D	22	O	6	O
5	E	V	E	23	P	7	P
6	F	W	F	24	Q	8	Q
7	G	X	G	25	R	9	R
8	H	Y	H	26] (!)	:] (!)
9	I	Z	I	27	\$	#	\$
10	[(+)	:	[(+)	28	*	@	*
11	.	,	.	29)	')
12	<	%	<	30	:	=	:
13	(	_	(	31	^(\square)	"	^(\square)
14	+	>	+	32			-
15	! (!)	?	! (!)	33			/
16	&	0	&	34			S
17	J	1	J	35			T

5.06 Type of Alarm with WCC (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. Option 402c provides alarm of one second intervals and the TAB Key erases to end of field, but no cursor movement. 402d provides single alarm and TAB Key erases to end of field but no cursor movement.

5.07 Highlight Field (Option 403) — With

Option 403a, fields designated as highlighted are intensified. With Option 403b, fields designated as highlighted are blinked. With Option 403c, fields designated as blinked are intensified, fields designated as intensified are intensified. Intensified and blinked fields on the same display are blinked. With Option 403d, all fields with highlight, protect, and alphanumeric bits on are blinked.

5.08 Type of Block Abort (Option 404) — With

Option 404a station sends ETX, when it abnormally stops sending on-line. With Option 404b, station sends SUB ENQ when it abnormally stops sending, this option is recommended for most applications.

5.09 Device Address (Option 405) — Each

device must have an unique address. Addresses for maxi-cluster controllers are determined by the port the cables are plugged into. For mini-cluster and single display controllers, an unique address for each device must be specified and optioned.

5.10 Numeric Override (Option 406) — With

Option 406b, 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. Selecting Option 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.

5.11 Numeric Special Feature (Option 407) —

An automatic upshift can only occur in a numeric field. Option 407a limits the automatic upshift of the internal numeric cluster keyboard to the numeric cluster (the digits 0-9, minus, DUP, and period). Option 407b automatically upshifts the entire keyboard.

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5.12 Line Code (Option 408) — This option (ASCII is 408a, EBCDIC is 408b) must be entered for each station. All stations on the same circuit must use the same code.

5.13 Font for KD (Option 409) — This option (up-low is 409a, monospace is 409b, line drawing is 409c) allows each KD to use the appropriate font.

5.14 Keyboard Style (Option 410) — Choose between keyboard styles, 410a for typewriter style and 410b for internal numeric style. Typewriter style includes 40K104-type and 40K203-type keyboards. The 40K105-type keyboard is for the internal numeric style.

5.15 Data Set (Option 411) — The private line SDS arrangement permits the use of an internal modem (251A1 TDU) with Option 411b. Option 411a permits the use of an external data set, it is used in all other arrangements. Option 411c is only used when the SDS is in loopback testing mode, see Section 582-200-505.

5.16 Station Identification Sequence (Option 412) — The switched network SDS allows for a four character station identification sequence. The first character is preset to "F" for ASCII and "f" for EBCDIC. The next three characters are specified as Options 412a, b, and c.

5.17 Automatic Disconnect Time (Option 413) — After the switched network station is in the data mode, a timer is initiated each time after the terminal transmits a valid header, text, response, or status transmission. The timer is reset each time the terminal receives data from the line. If the timer is not reset prior to the optioned time interval, a disconnect sequence of DLE EOT will be transmitted.

5.18 Buffer Lock (Option 414) — With Option 414a, a protected alphanumeric attribute in the home position of the buffer locks the buffer to PRINT LOCAL. With Option 414b, a print local is permitted. An attempted copy command with buffer locked, will always give status and sense of Device Not Available (D, A). For specific operation see Section 582-200-201 or 582-200-205.

TABLE C
OPTIONS

Option	Maxi-Cluster	Mini-Cluster	SDS (Private Line)	SDS (Switched Network)
401 Station Control Number				
(a) None	—	—	—	—
(b) Zero through 31 (Choose a number)	X	X	X	—
402 Type of Alarm with WCC				
(a) Alarm sounds at one second intervals	X	X	X	X
(b) Single Alarm	X	X	X	X
(c) Alarm sounds at one second intervals (and Erase to End of Field Feature)	—	—	X	X
(d) Single Alarm (and Erase to End of Field Feature)	—	—	X	X
403 Highlighted Fields				
(a) Intensify	X	X	X	X
(b) Blink	X	X	X	X
(c) Intensify or Blink	X	X	X	X
(d) Special Blink Field	—	—	X	X
404 Type of Block Abort				
(a) Terminate with ETX	X	X	—	—
(b) Terminate with Sub Enq	X	X	X	X
405 Device Identification (each device must have an unique address)				
(a) None	—	—	—	—
(b) 1st Device	(Determined by port connection)	X	X	—
(c) 2nd Device		X	X	—
(d) 3rd Device		X	—	—
406 Numeric Field Override (Typewriter Style Keyboards Only)				
(a) Enabled	X	X	X	X
(b) Disabled	X	X	X	X
407 Numeric Feature (Internal Numeric Keyboards Only)				
(a) Enabled	X	X	X	X
(b) Disabled	X	X	X	X
408 Line Code				
(a) ASCII	X	X	X	X
(b) EBCDIC	X	X	X	X

TABLE C
OPTIONS (Contd)

Option	Maxi-Cluster	Mini-Cluster	SDS (Private Line)	SDS (Switched Network)
409 Font for KD (a) Up-Low (b) Monocase (c) Line-Drawing	(Any of these styles can be used, not a switch option.)		X X —	X X —
410 Keyboard Style (a) Typewriter Style (b) Data Entry	(Either style can be used, not a switch option.)		X X	X X
411 Data Set (a) External (b) Internal (c) Loop-back (For Testing Only)	Required, not an option not available (Available another way, see Section 582-200-201)		X X X	X — X
412 Station Identification Sequence (a) 2nd Character (b) 3rd Character (c) 4th Character	—	—	—	X X X
413 Automatic Disconnect Timer a-o, 1 to 15 minutes (Choose number)	—	—	—	X
414 Buffer Lock (a) Enable (b) Disable	X X	X X	X X	X X

Legend:

X = Applies to indicated service.

— = Does not apply

6. COMMUNICATION ACCESS

Channel

Private line

6.01 A 4-wire dedicated communication channel with special conditioning as required by data sets is recommended. Up to 32 controllers on the same channel are allowed.

Switched network

6.02 A 2-wire communication channel used with a line contention type protocol is recommended. A new channel is established, by standard procedures, for each series of transmissions.

Operator Input

6.03 Operator input to the monitor is accomplished via a keyboard. The full 96 character ASCII or EBCDIC 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.

6.04 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.

7. PRIVATE LINE DATA LINK OPERATION

7.01 In a 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. The station does not take any action for control codes of other stations cohabiting its line, nor does it take action on invalid control codes.

7.03 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.

7.04 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.

Line Code

7.05 The station can be optioned to operate with either one of two character sets to the LCU. All stations and the LCU on the same line must use the same code. The choices are: the American National Standard Code for Information Interchange (ASCII) or the Extended Binary Coded Decimal Interchange Code (EBCDIC). See Table C for ASCII and Table D for EBCDIC.

7.06 Each character is transmitted in an 8-unit frame. In order of transmission, the units of each character frame represent:

<u>Unit</u>	<u>Assigned Representation</u>
For ASCII —	
Units 1 through 7	Bits 1 through 7 of ASCII character
Unit 8	Odd parity over all 8 units
For EBCDIC —	
Units 1 through 8	Bits 7 through 0 of EBCDIC character

TABLE D
ASCII LINE CODE

ASCII												
Controls		Characters										
NUL	DLE	SP	0	@	P	`	p	0	0	0		
SOH	DC1 (SBA)	!	1	A	Q	a	q	1	1			
STX	DC2 (EUA)	"	2	B	R	b	r	2	0	1	0	
ETX	DC3 (IC)	#	3	C	S	c	s	3	1			
EOT	DC4 (RA)	\$	4	D	T	d	t	4	0	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	
HT (PT)	EM	)	9	I	Y	i	y	9	1		
NL	SUB	*	:	J	Z	j	z	A	0	1	0	
VT	ESC	+	;	K	[	k	{	B	1		
FF	FS (DUP)	,	<	L	\	l	|	C	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 K and TABLE L

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

TABLE E
EBCDIC LINE CODE

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

7.07 The characters which are employed in link control are described in 7.08-7.54.

Block Check Sequence (BCS)

7.08 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.

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

7.10 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.

7.11 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.

7.12 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 Acknowledgements (ACK0/ACK1)

7.13 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

7.14 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.

Data Link Control Characters

7.15 The LCU or station uses a number of characters or character sequences to control data transfer. These are given in 7.16 through 7.33.

7.16 Four consecutive SYN (Synchronize) characters 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.

7.17 A trailing pad character (Hex FF) is sent immediately after any transmission by the SCC or LCU. This ensures that the carrier in the data set is on while the last (nonpad) character is being sent.

7.18 DLE is used as shown in Table E.

TABLE F

USES OF THE CHARACTER DLE

PURPOSE	ASCII	EBCDIC
Alternating acknowledgment (ACK0, ACK1)	D L E 0 D L E 1	D L E Hex 70 D L E /
Wait-Acknowledge (WACK)	D L E ;	D L E ,
Reverse Interrupt (RVI)	D L E <	D L E @

7.19 NAK (Negative Acknowledgement) 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 pads.

7.20 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.

7.21 The SCC sends ENQ (Enquiry) 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.

7.22 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.

7.23 The SCC sends WACK (Wait Acknowledgement) 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.

7.24 The SCC sends RVI (Reverse Interrupt) when it receives a selection sequence but has status and sense pending for the selected device. When SCC receives an RVI after sending status and sense, the status message is reset. When the SCC receives an 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.

7.25 The SCC sends SOH (Start of Heading) as the first character of the first block when a status and sense or a test request message is sent.

7.26 The SCC sends STX (Start of Text) as the first character of each block transmitted except for the case when SOH is sent.

7.27 ETB and ETX (End of Transmission Block and End of Text) — 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).

7.28 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). A received ETB is like an ETX, hence subsequent blocks 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.

7.29 The SCC sends EOT (End of Transmission) 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.

7.30 The SID (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 B for Station Poll, Station Select and Device Addresses.

7.31 The ITB (Intermediate Transmission Block) 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.

7.32 When the WCC indicates NL/EM control, all data in a printer buffer after EM (End of Medium) is held but not printed. When the WCC indicates fixed length lines, EM does not cause printing to stop.

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

Message Control Characters

7.34 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.

7.35 The control character ESC (Escape) is transmitted as the first character after STX in a message from the LCU to the SCC.

7.36 Command Codes — 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 G.

7.37 Device Commands — The commands listed in Table G 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.

7.38 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.

7.39 The copy command copies the specified field contents as determined by the CCC (see 6.42). 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 G
COMMANDS

COMMAND	
WRITE	E S 1 W C C
ERASE-WRITE	E S 5 W C C
ERASE ALL UNPROTECTED	E S ? C
COPY	E C D S 7 C A C C
READ MODIFIED	E S 6 C
READ ALL	E S 2 C

Legend:

WCC = Write Control Character
CCC = Copy Control Character
DA = Device Address

7.40 WCCs (Write Control Characters) are used in write and erase-write commands to the SCC. The WCC bit assignments and related functions are given in Table H. Characters other than those shown in Table H 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 H
WRITE CONTROL CHARACTERS

WCC							
Start Printer	Sound KD Alarm	Put KD in LOCAL	Reset ACs to Unmodified	Print			
				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
•		•		[Ç] !	!	:	
•		•	•	·	\$	·	#
•	•			<	*	%	@
•	•		•	()	-	'
•	•	•		+	;	>	=
•	•	•	•	! ^ _	?	"	

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.

Where two characters are shown, ASCII is on left, EBCDIC on right.
AC - Attribute Character

7.41 CCCs (Copy Control Characters) are used in the copy-from command to the SCC. The CCC bit assignments and related functions are shown in Table H. Characters other than those shown in Table H 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 I
COPY CONTROL CHARACTERS

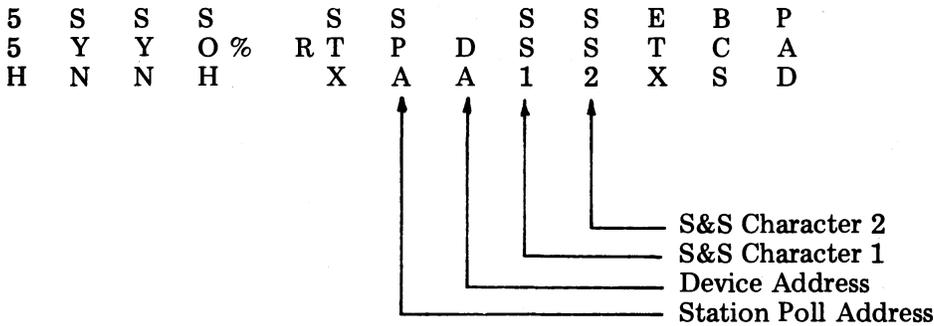
CCC								
Start Printer	Sound KD Tone	Copy			Print			
		ACs	Protected Data	Unprotected Data	NL char/line	40 char/line	64 char/line	80 char/line
		•			SP	&	-	0
		•		•	A	J	/	1
		•	•		B	K	S	2
		•	•	•	C	L	T	3
	•	•			D	M	U	4
	•	•		•	E	N	V	5
	•	•	•		F	O	W	6
	•	•	•	•	G	P	X	7
•		•			H	Q	Y	8
•		•		•	I	R	Z	9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

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.

Where two characters are shown, ASCII is on left, EBCDIC on right.
AC = Attribute Character

7.42 Certain alarm conditions detected by the SCC are recorded as S&S (Status and Sense) 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. This message takes the form shown in Table J.

TABLE J
STATUS AND SENSE



CONDITIONS	S S 1	S S 2	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.

7.43 The various S&S conditions and their representations are shown in Table J.

7.44 Status and sense bit assignments are shown in Table K.

TABLE K
S&S BIT ASSIGNMENTS

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	Data Check (DC)
6	Device End (DE)	6	Control Check (CC)
7	Always a 0	7	Operation Check (OC)

7.45 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 L 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 L

AIDs

Key Depressed	A I D	Message Response to Poll
S/R	^	READ MODIFIED
PA1	%	SHORT
PA2	>	SHORT
PA3	,	SHORT
R/TST	0	READ MODIFIED
PF1	1	READ MODIFIED
PF2	2	READ MODIFIED
PF3	3	READ MODIFIED
PF4	4	READ MODIFIED
PF5	5	READ MODIFIED
PF6	6	READ MODIFIED
PF7	7	READ MODIFIED
PF8	8	READ MODIFIED
PF9	9	READ MODIFIED
PF10	:	READ MODIFIED
PF11	#	READ MODIFIED
PF12	@	READ MODIFIED
CLEAR	—	SHORT
none, KD	-	RESPONSE TO READ
none, P	Y	COMMAND ONLY

7.46 Buffer Address and Cursor Address (BA1, BA2, CA1, CA2) — A device buffer contains 1920 character positions. Each position has a pair of graphic characters (BA1, BA2) specifying a unique position in the buffer. Characters denoted CA1 and CA2 are used to identify the cursor location.

Device Orders

7.47 Device orders can be used by the LCU to format the message. See Table M.

- (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 unprotected 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 M
DEVICE ORDERS

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

7.48 Attribute characters shown in Table N are sent from the LCU as the first character following SF. Characters other than those shown in Table N 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 N
ATTRIBUTE CHARACTERS

Specify Field as					A C option 403a or b*			
Protected†	Numeric	Hidden	Highlighted*	Modified	SP	D	B	F
					•	A	E	C
					•	H	[¢
					•		.	
					•	<	+	
					•	(!	
					•	&	M	K
					•	J	N	L
					•	Q	|	!
					•	R	\$	
					•	*	;	
					•)	^	~
					•	-	U	S
					•	/	V	T
					•	Y	|	
					•	Z	,	
					•	%	>	
					•	-	?	
					•	0	4	2
					•	1	5	3
					•	8	:	
					•	9	#	
					•	@	=	
					•	,	"	

Specify Field as					A C option 403c†			
Protected†	Numeric	Hidden	Highlighted†	Intensified†	Modified	SP	D	B
						•	A	E
						•	H	
						•	[¢
						•	.	
						•	<	+
						•	(!
						•	&	M
						•	J	N
						•	Q	|
						•	R	\$
						•		!
						•	\$	
						•	*	;
						•)	^
						•	-	U
						•	/	V
						•	Y	|
						•	Z	,
						•	%	>
						•	-	?
						•	0	4
						•	1	5
						•	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 BA₁ BA₂ = 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.

7.49 Attribute bit assignments are shown in Table O.

TABLE O
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

7.50 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 double 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

7.51 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.

7.52 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.

7.53 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.

7.54 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.

8. PRIVATE LINE DATA LINK CONTROL PROCEDURES

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 Part 8 describes binary synchronous protocol for private line. Figs. 10 through 12 show the typical information flow. Charts 1 through 14 show more detailed operation.

8.03 Figs. 10, 11, and 12 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 categories:

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

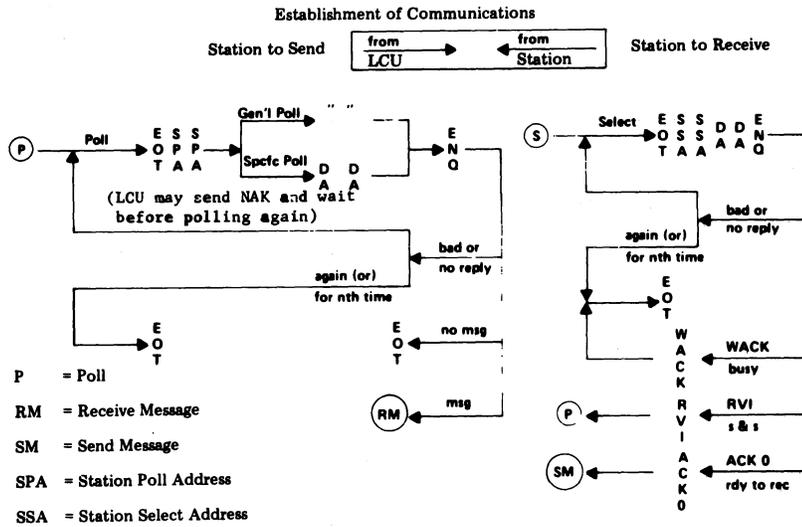


Fig. 9—System Flow Diagram

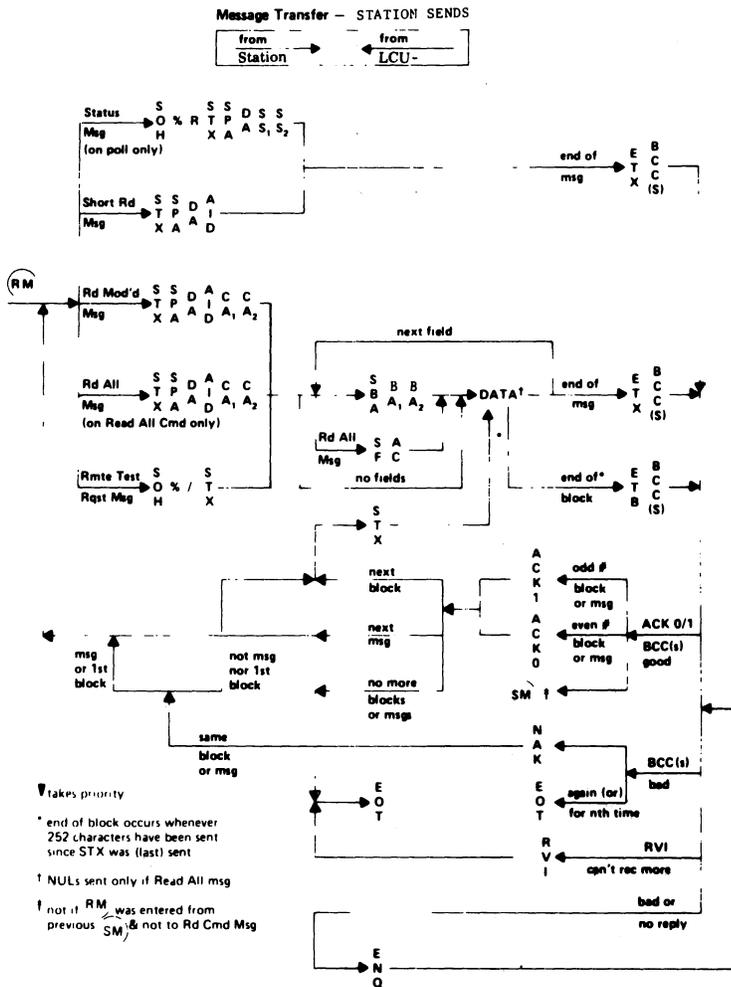


Fig. 10—System Flow Diagram (Contd)

Message Transfer — Station Receives

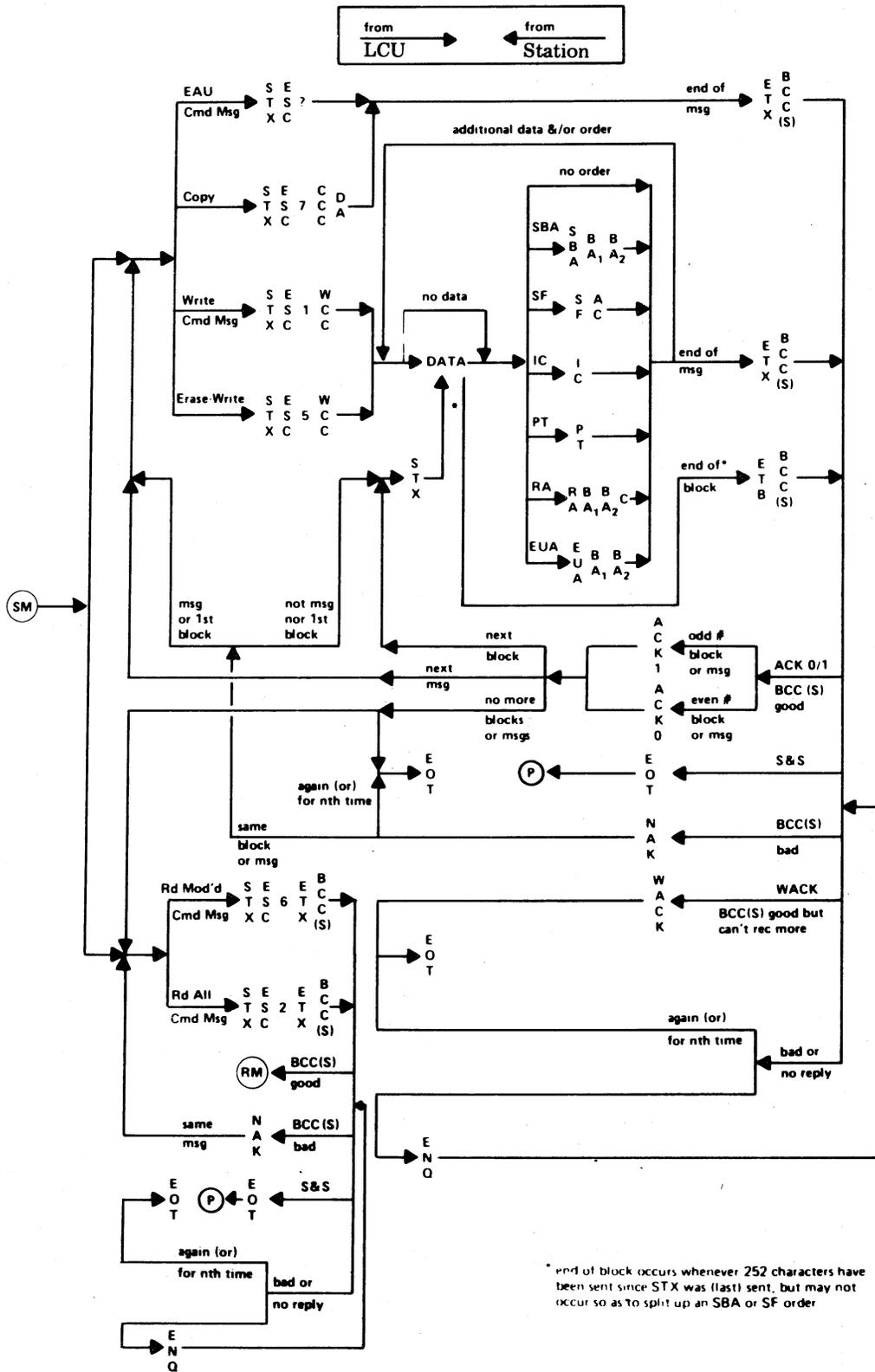


Fig. 11—System Flow Diagram (Contd)

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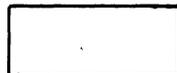
8.04 The following list identifies the major groupings of the charts that provide more detailed operation.

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 SELECTION	CHARTS 4 & 5
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

Note: Charts 1 through 14 use "SCC" instead of "40/4". "SCC" in the charts refer to 40/4 SCC, MCC, or SDC.

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

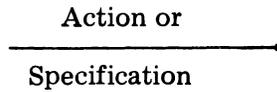
- LCU or SCC does operation in box:



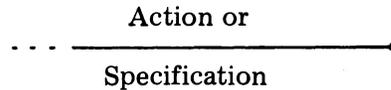
- Additional information is given in this shape:



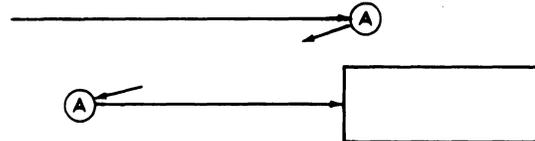
- An action or specification is written along a line from a box to another box:



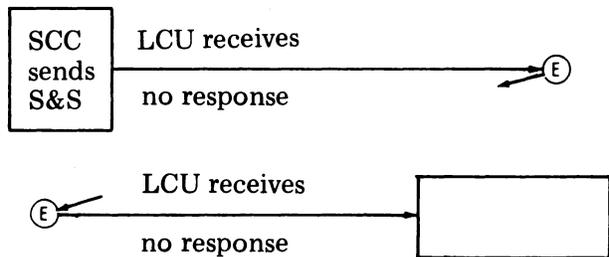
- An action or specification can come from any box provided. The action or specification applies when three dots precede the line:



- 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:



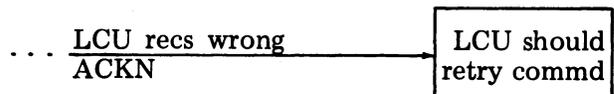
Example 1:



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.

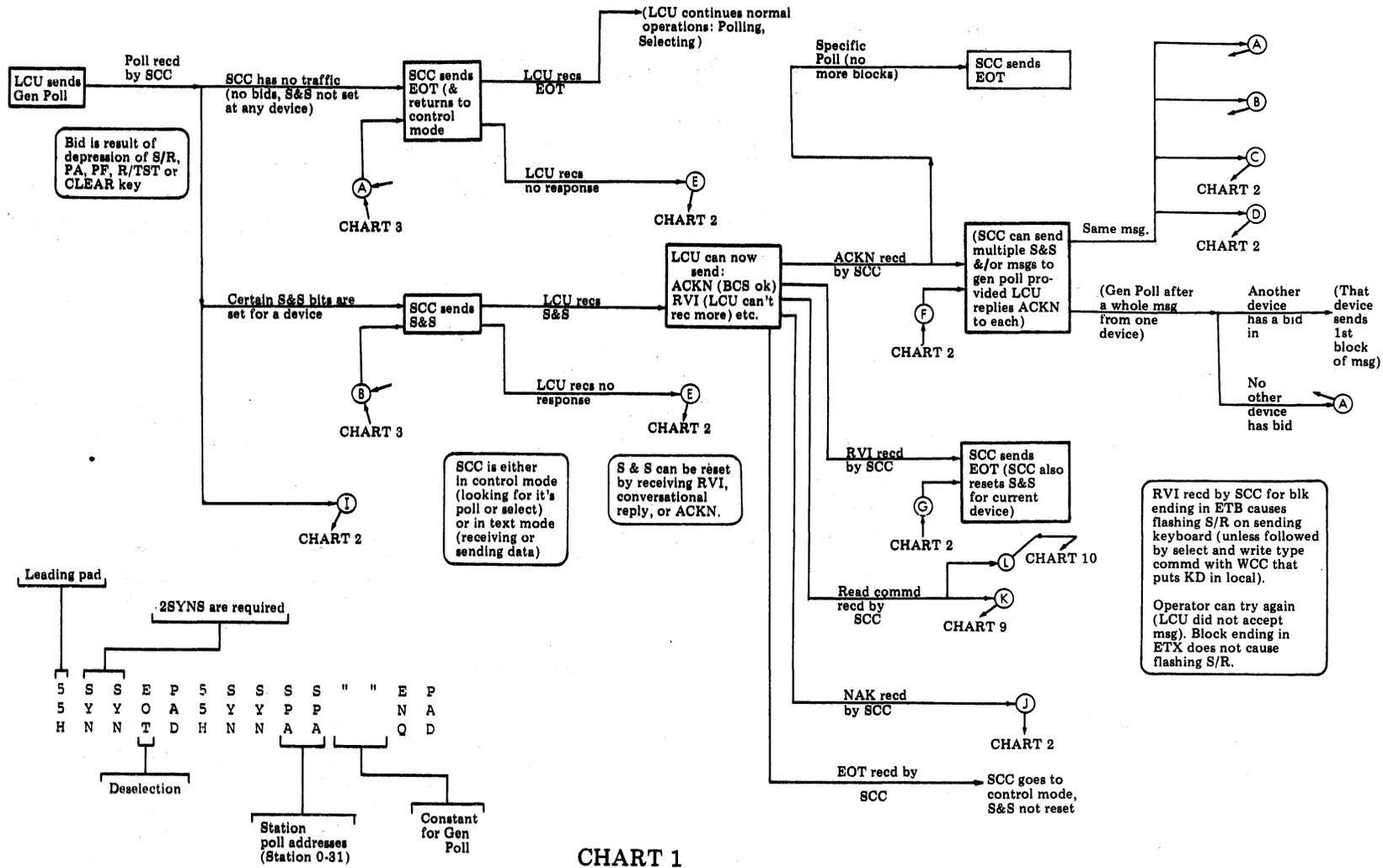
Example 2:



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

40/4 Bisynch Protocol



Specific Poll

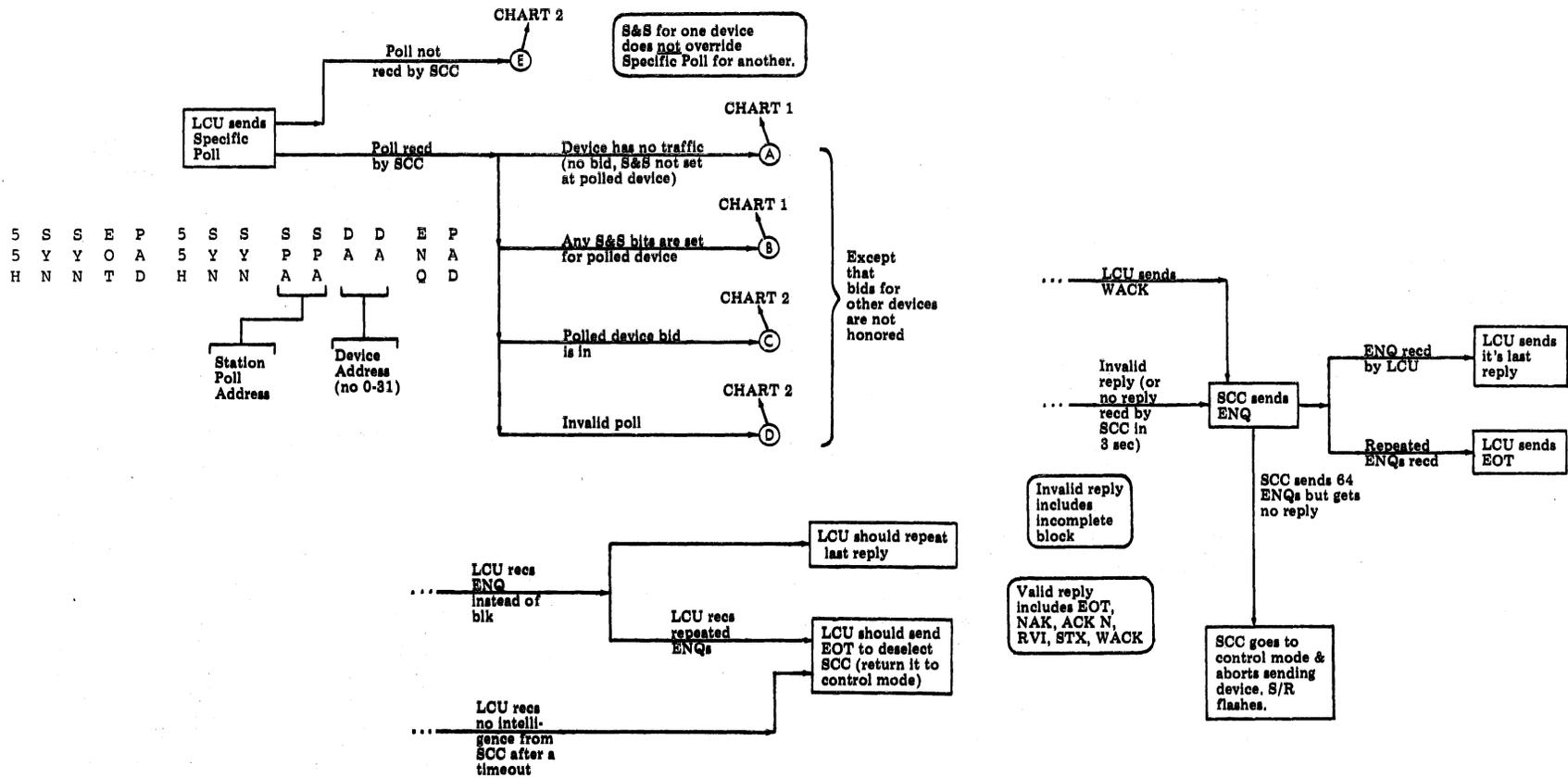
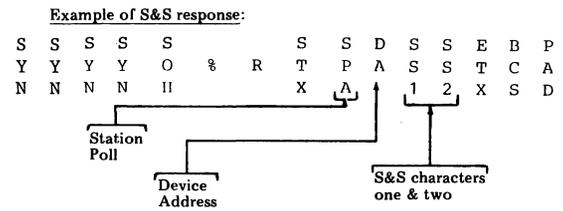
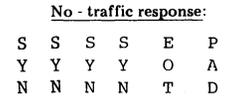
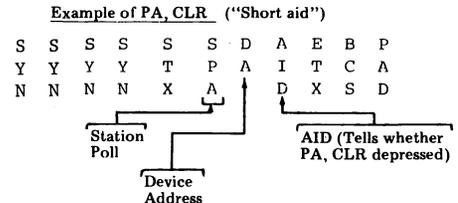
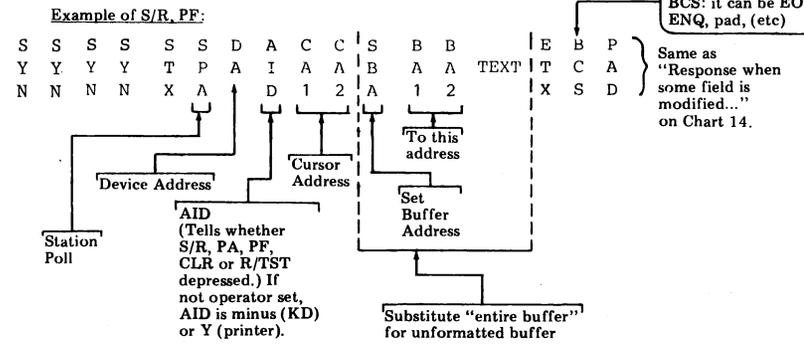


CHART 3

SCC Response To Poll (Also see Chart 14.)



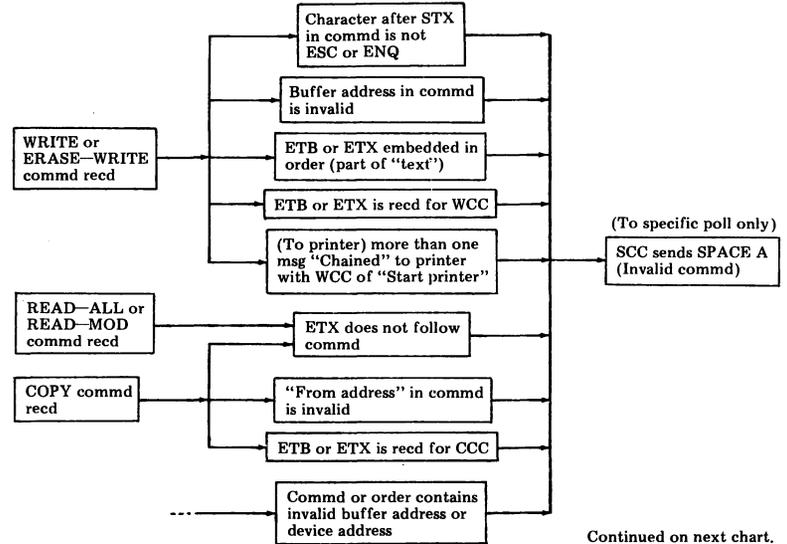
Test request msg (R/TST) also applies, see Chart 14

Data Link Control Notes

- SYN - No SYNs allowed in middle of ETX-BCS, ETB-BSC, ITB-BCS ACK N, SF"X", RVI, WACK.
- 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.
- SYNS in text or the two characters following ITB are not accumulated in BCS.

Conditions that cause S&S to be sent

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

Conditions that cause S & S (Contd)

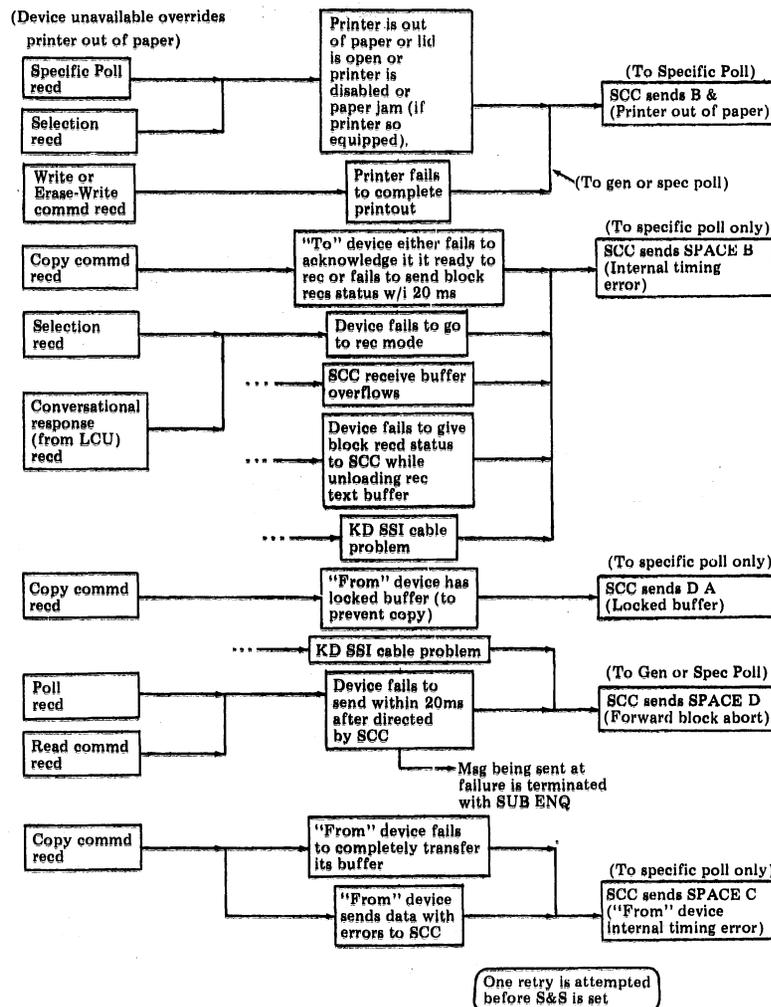
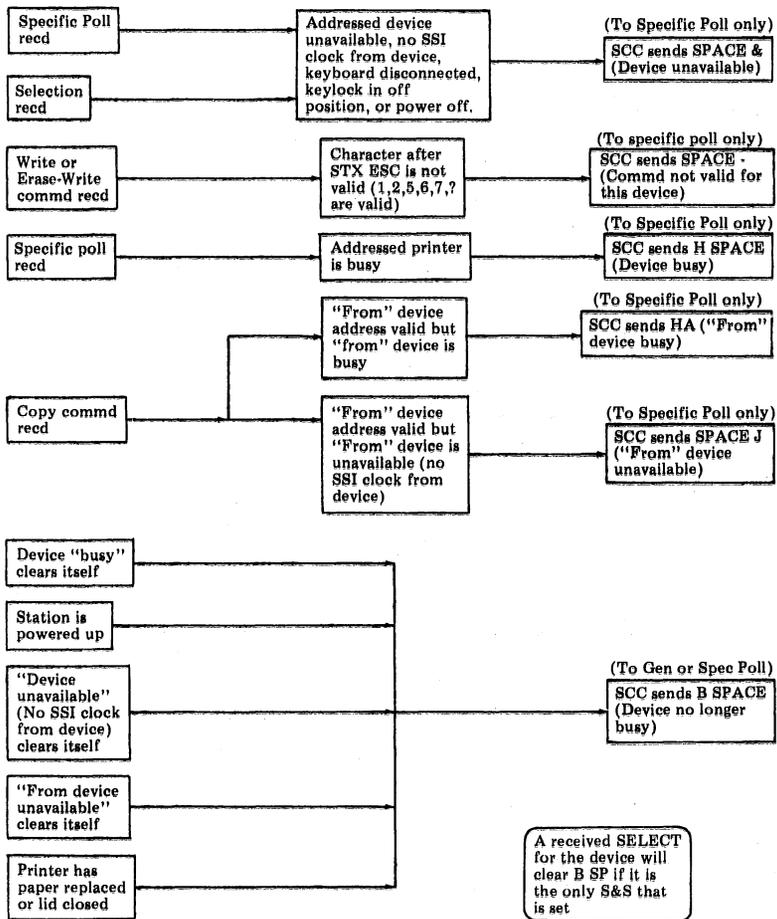


CHART 5

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

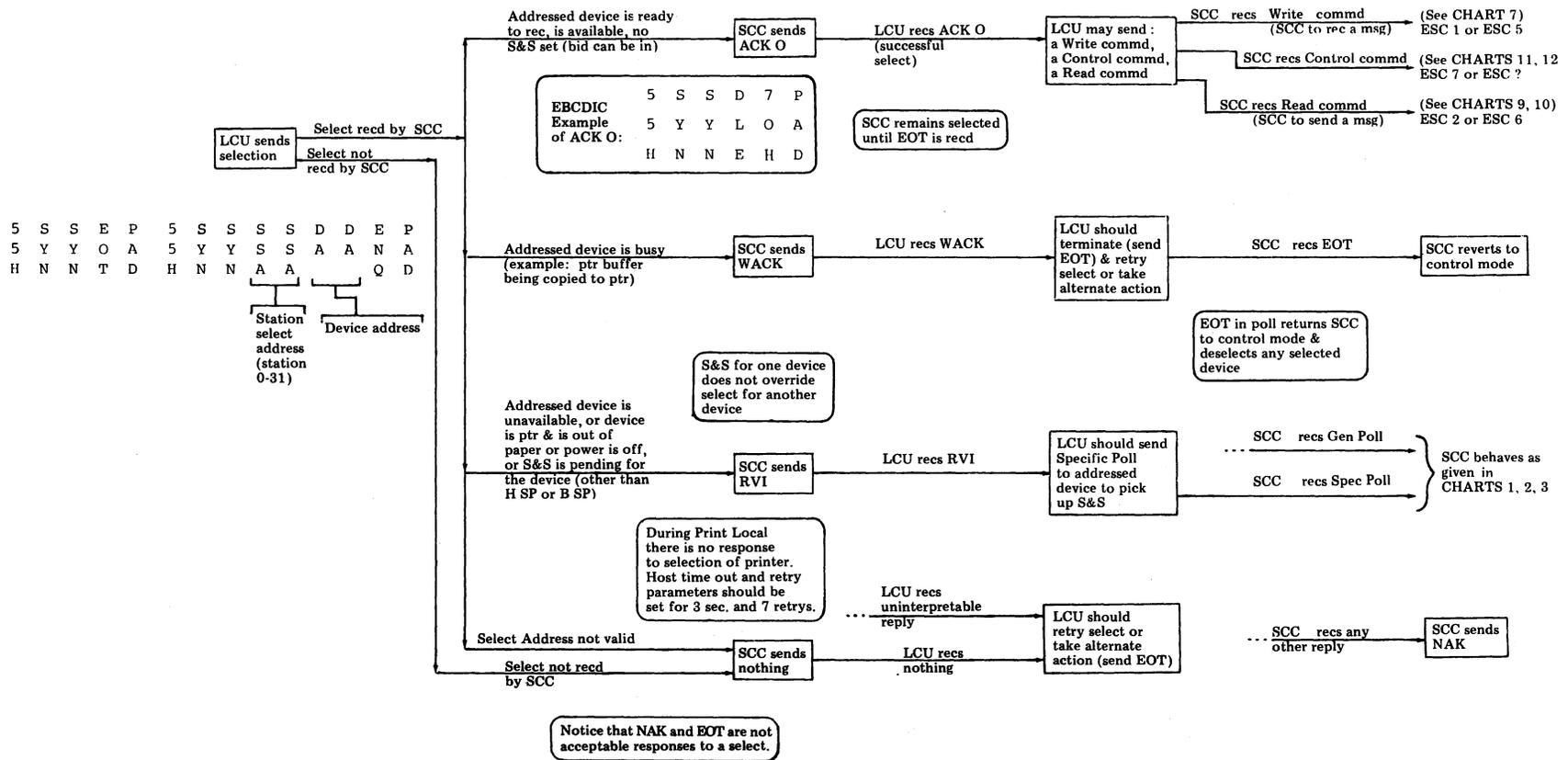


CHART 6

Write Commands (SCC to rec)

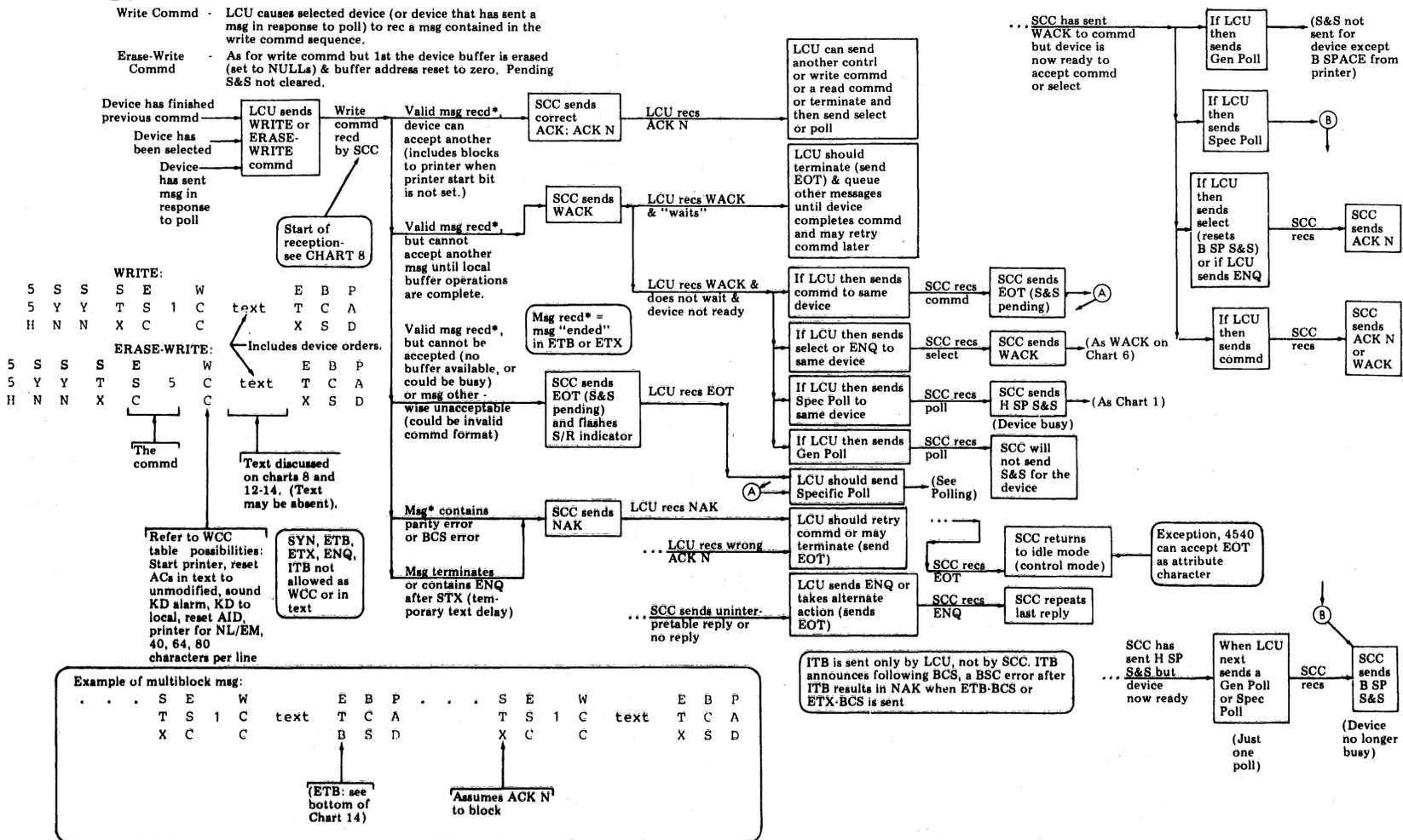
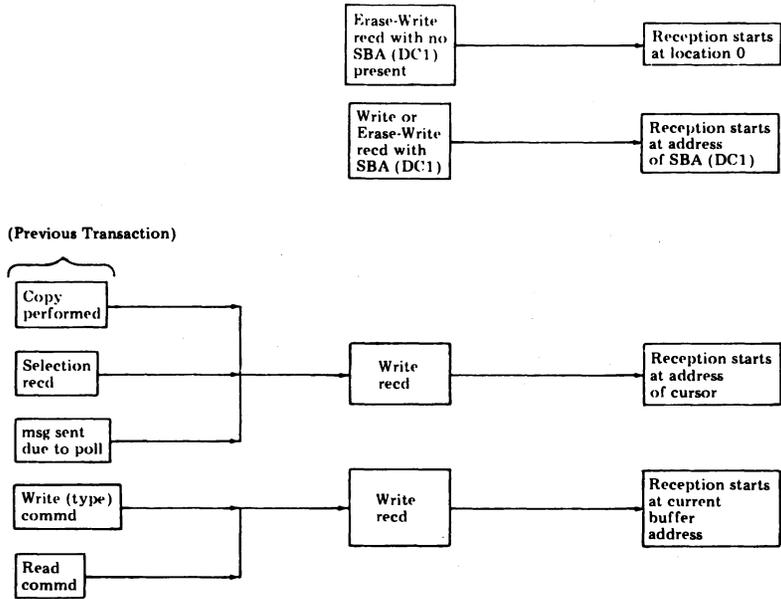
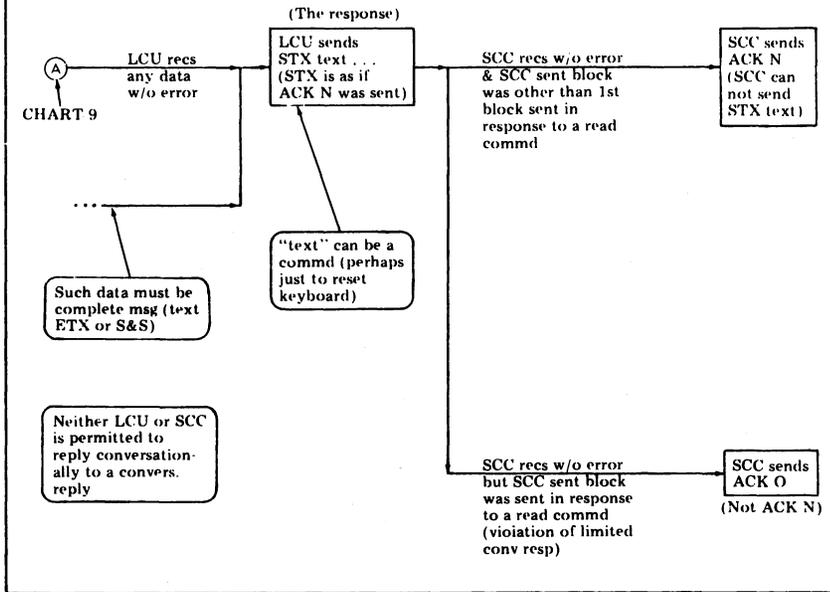


CHART 7

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:

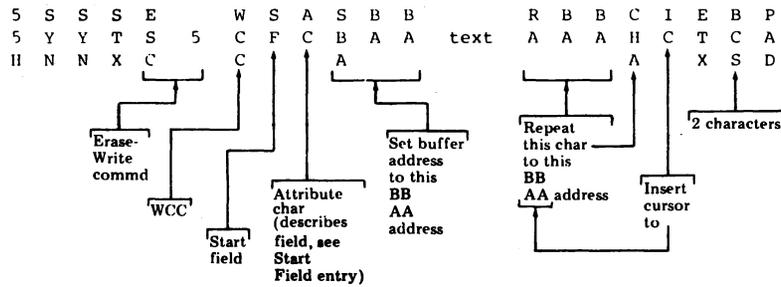


CHART 8

Read Commands (SCC to send)

READ-ALL COMMD - LCU commands device to send entire device buffer, including NULLs

READ-MODIFIED COMMD - LCU commands device to send only modified fields.

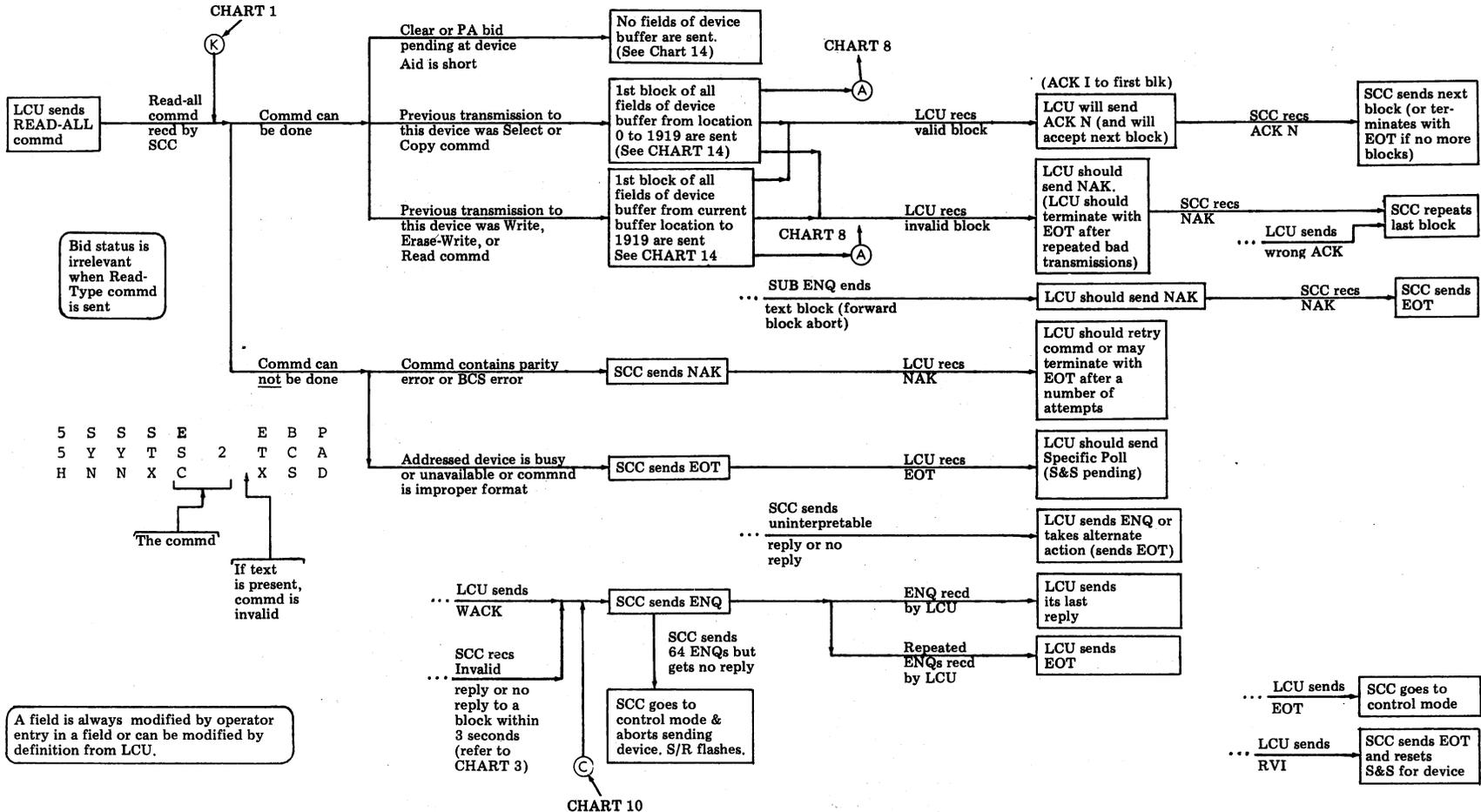


CHART 9

Read Commands (Cont)

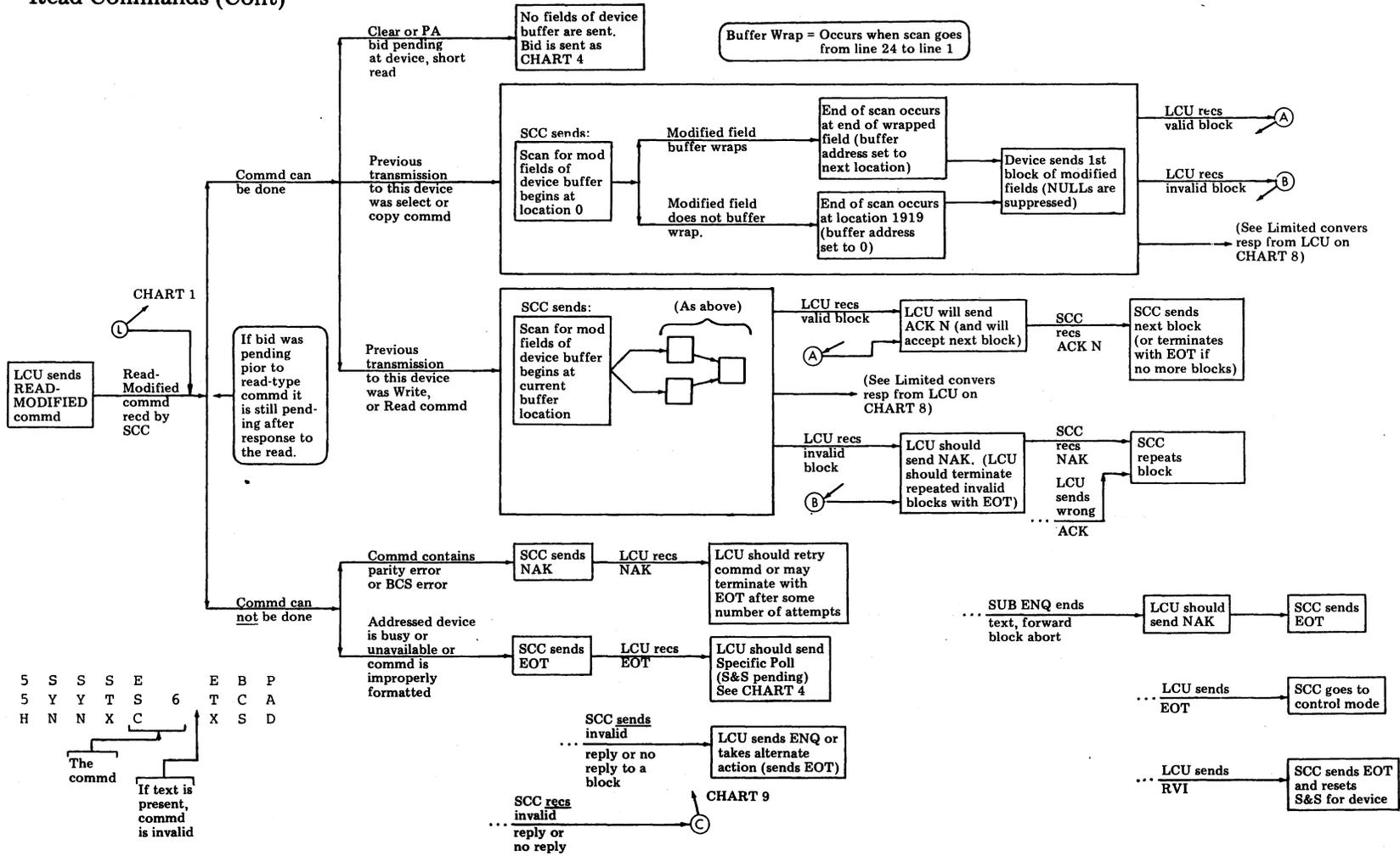
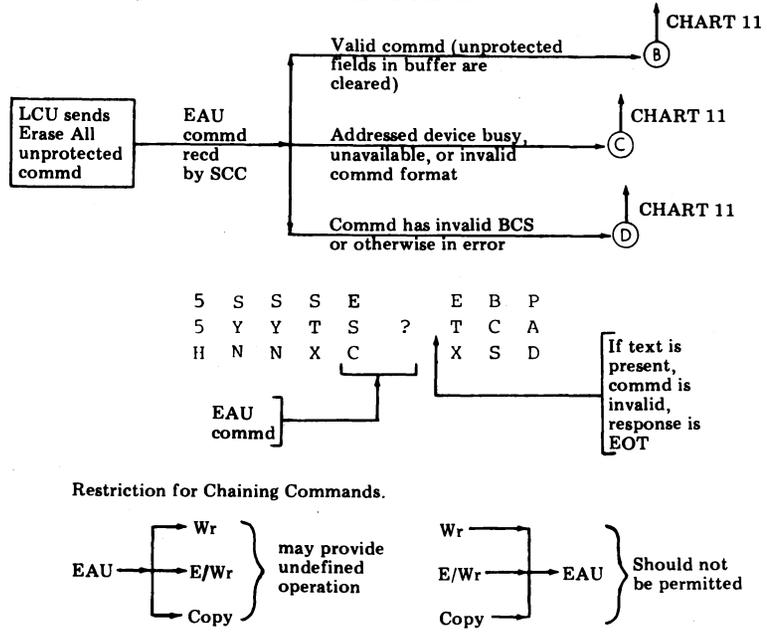


CHART 10

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.



Device Orders (Part of Text)

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

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 B B A A" where A A defines buffer address
A' 1 2 1 2

where operations are to begin or continue. There can be many SBAs in a msg.

CHART 12

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

Used in form "S A F 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 Attribute character that defines C= field as one or more of the following:
 { protected
 numeric
 hidden
 highlighted
 modified

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

Repeat to Address DC4 (RA)

Used in form "R B B B B A A C" where A 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 B B B B A A A" where A A defines a buffer address.
A 1 2 1 2

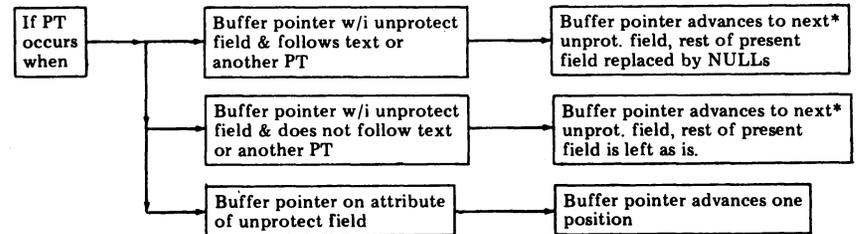
NULLs are stored in unprotected addresses up to (but excluding) the specified address. EUA will wrap in the buffer. If address specified is the current buffer address, all unprotected addresses (locations) will be set to NULLs.

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

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).
2. When fixed line length is specified, space is substituted for NL to printer (no NL occurs).
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, ^A, and _C data in fields specified as hidden.
6. When using a fixed line length, lines of all NULLs, ACs and hidden fields are suppressed. 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.

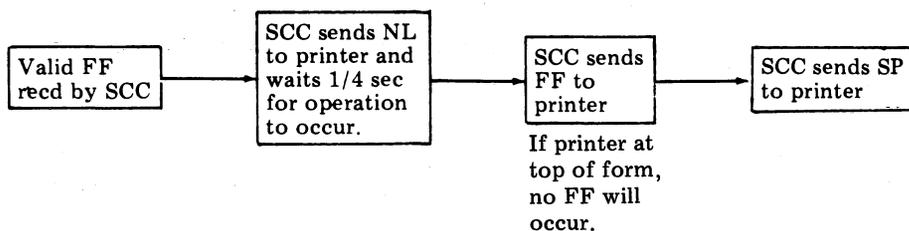


CHART 13

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

NL/EM format

text EM, ETX → text NL 1/4 td ETX
 text NL EM ETX → text NL 1/4 td ETX

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 by host.

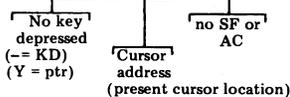
Actual SCC response sequences to mags & commds
(Also see CHART 4)

No traffic response (EOT)

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

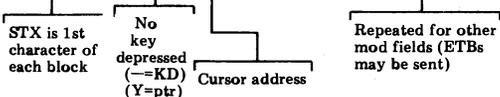
Entire buffer response for unformatted display (to Read-All commd)

```
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
```



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

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

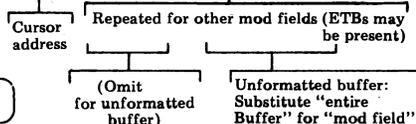


Response when aid is "short"-PA or CLR

```
S S S S S S D A E B P
Y Y Y Y T P A I T C A
N N 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 Commg

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



BA1, BA2 sent even for BA1, BA2 = O, O
SBA = DC1
SF = GS

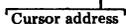
No key was depressed

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

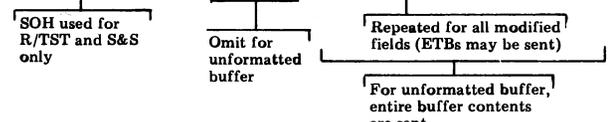
```
S S S S S S D A C C E B P
Y Y Y Y T P A I A A T C A
N N N N X A D 1 2 X S D
```

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



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

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



R/TST was depressed

S&S response sequences (Only to Poll)

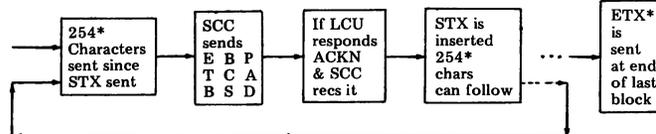
```
S S S S S S S S D S S E B P
Y Y Y Y O % R T P A S S T C A
N N N N H X A 1 2 X S D
```

No key required to be depressed to send status

Cursor Address 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.

CHART 14

9. SWITCHED NETWORK DATA LINK OPERATION

9.01 A 40/4 SDS can operate on most systems that support 3275 Model 2 Control Units.

9.02 Establishment of a line

- Call is placed.
- Receive station's data set ring indicator lead turns on.
- Receive station answers goes data (DTR must be on).
- Calling station goes data (DTR must be on) within 15 seconds.

Either station can now bid for line.

9.03 Manual calling, manual or automatic answering, manual or automatic disconnect is provided by SDS arrangement.

Bid Sequence of SDS

9.04 The initial bid sequence from the SDS is made up of four ID characters followed by the character ENQ. Subsequent bids by the SDS during the same call connection consist of only the ENQ character. After a bid has been acknowledged by the LCU, the SDS has control of the line and may start transmitting the text message.

Bid Sequence of LCU

9.05 The LCU bids for the line by sending an initial computer ID sequence followed by the character ENQ. (The computer ID sequence of 0 to 15 characters is not decoded by the 40/4 station). Subsequent bids by the LCU during the same call connection consist of only the ENQ character. If the initial bid by the LCU finds the SDS busy because of a printer or keyboard operation in process, the SDS will respond with WACK. The LCU might then respond with a disconnecting sequence "DLE EOT" or enter an ENQ/WACK loop waiting for the busy condition to end as indicated by an SDS ID followed by ACK response. If the WACK is received by the LCU in response to a bid during a maintained connection rather than from an initial bid, the LCU has a third option of responding with just EOT. If the LCU responds with EOT, the SDS will bid for the line and send the device end status when the busy causing operation ends.

SDS Identification

9.06 The SDS identification sequence consists of four characters programmed into each SDS with the dial feature. The first character is always "f" for EBCDIC terminals and "F" for ASCII terminals. The remaining three characters are assigned by the customer at the customer's location. All SDSs dialing the same phone number to communicate with the LCU location should use a different identification sequence. The 2nd, 3rd, and 4th ID characters will appear at the lower left corner of the display, when performing the "LOCAL" test.

Maintained Connection

9.07 After a bid has been acknowledged by the LCU, the SDS has control of the line and may start transmitting the text message. After receiving a positive acknowledgement to a text message, the SDS replies with an EOT character. The words "SYSTEM AVAILABLE" indicates to the operator that the SDS's message has been successfully transmitted. The operator can then depress the LOCAL (or RESET) key, enabling the keyboard for preparing another message, as desired.

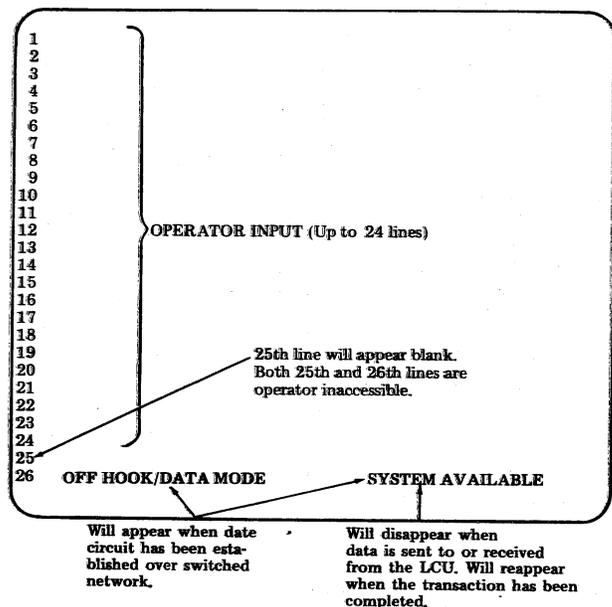


Fig. 12—Display When Station is On-Line

9.08 Disconnect

(a) Manual Disconnect — There are two ways to manually disconnect. The station attendant can force a manual disconnect by transferring to the talk mode, and then placing the handset on hook. This method of disconnecting overrides all others, and works for both the originating or answering station. The answering data set aborts (goes on hook) if a carrier is not detected within approximately 18 seconds after the data set is placed in the data mode. The other way to cause a manual disconnect is for an attendant to cause the SDS to transmit DLE EOT (initiated in local mode by pressing Control “Z” when using a typewriter style keyboard and Numeric “Z” when using the internal numeric cluster keyboard). However, only an SDS that is equipped with auto-answer has the ability to disconnect automatically.

(b) Automatic Disconnect — There are three ways to automatically disconnect. All require the auto-answer feature of the SDS data set to be optioned. Automatic disconnect can be accomplished in the following ways:

1. By receipt of the disconnect sequence DLE EOT.
2. By a 15 second time-out which is enabled when a ring indication is received by the SDS from the calling LCU and no subsequent carrier indication is received. This is sometimes called abort at call-up. It provides wrong phone number protection.
3. After the line has been established, an optional 1 to 15 minutes time-out (See Option 413) is initiated each time the SDS transmits a valid header, text, response, or status transmission. The timer is reset each time the SDS receives two sync characters from the line. If the timer is not reset prior to the time-out, a disconnect sequence of DLE EOT will be transmitted causing the telephone set to go on hook.

9.09 ENQ — The Enquiry character (ENQ) is transmitted by the SDS (or LCU) to bid for the line anytime after it has transmitted or received EOT. The SDC sends ENQ (1) if it does not receive a response after 2-1/2 seconds of transmitting a block, or (2) if it receives an invalid response to a block.

Upon receipt of ENQ the SDC:

- replies NAK if the received ENQ aborted a block.
- prepares to receive if the ENQ was part of a valid bid sequence from the LCU.

9.10 EOT — The SDC sends EOT when:

- it has no further blocks to send and its last block has been acknowledged. Either the SDS or LCU is free to bid for the line following the EOT character.
- it receives a block which does not terminate in ETX or ETB.
- it detects a BCC error during receipt of data.
- it detects a pad character in text that is received.
- in place of an ACK \emptyset /ACK1 to a received message, if the message caused a status and sense message to be primed due to format errors.

9.11 DLE EOT — DLE EOT is the disconnect sequence. Any SDS with the dial feature can transmit DLE EOT (initiated by activating the disconnect key). However, only an SDS equipped with auto-answer has the ability to disconnect automatically.

9.12 Write Control Character (WCC) — If the WCC “start printer” bit is set “on”, and a printer is part of the SDS, the associated message will be printed on the printer and displayed on the monitor. If the WCC “start printer” bit is set “off”, the associated message will only be displayed on the monitor. A message sent to the SDS can never be printed without also being displayed. If the SDS receives a WCC with the “start printer” bit on and a printer is not part of the SDS, the SDS will respond with EOT and prime the “Device Unavailable” status message.

9.13 The following message control sequences are the same for private line and switched network.

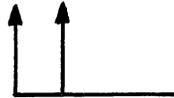
Line Code	Commands**
Device Orders	Cursor Address and Buffer Address Characters
Attribute Characters	Alternating Acknowledgements.
Field Definitions	Block Check Sequence
Message Blocking	Synchronization

**Copy Command is not used.

9.14 Status and sense messages are sent using the following format.

```

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



Status and Sense (S&S) For Switched Network 40/4

TABLE P
Status and Sense (S&S)
For Switched Network 40/4

Name	Set if	S&S Characters
Device Busy	Device is busy when LCU bids for line	H, SPACE
Device No Longer Busy	Unavailable or busy condition clears itself or printer has replaced paper or closed lid	B, SPACE
Printer Out of Paper	Printer out of paper or lid open or printer disabled or fails to complete printing a block	B, &
Internal Timing Error	Receive buffer overflow	SPACE, B
Invalid Command	2nd character in received text is other than ESC or ENQ or ETX does not follow a Read Command or buffer address invalid	SPACE, A
Device Unavailable	Device is unavailable	SPACE, &
Command not valid for this Device	3rd character in received text is not valid command	SPACE, -
BCC Error	BCC error detected during receipt of data	A, SPACE

10. SWITCHED NETWORK DATA LINK CONTROL PROCEDURES

10.01 The following diagrams show both the communications capabilities and the character sequences (exclusive of SYN and PADs are not shown) for computer and station bids and for all types of message formats and replies once a

line connection is established. The charts are divided into the following categories:

- Bid from computer (CB)
- Bid from SDS (SB)
- Message transfer — SDS sends (SM)
- Message transfer — SDS receives (RM)

SWITCHED NETWORK 40/4 SYSTEM OPERATION
(Point-to-point Line Contention Protocol)

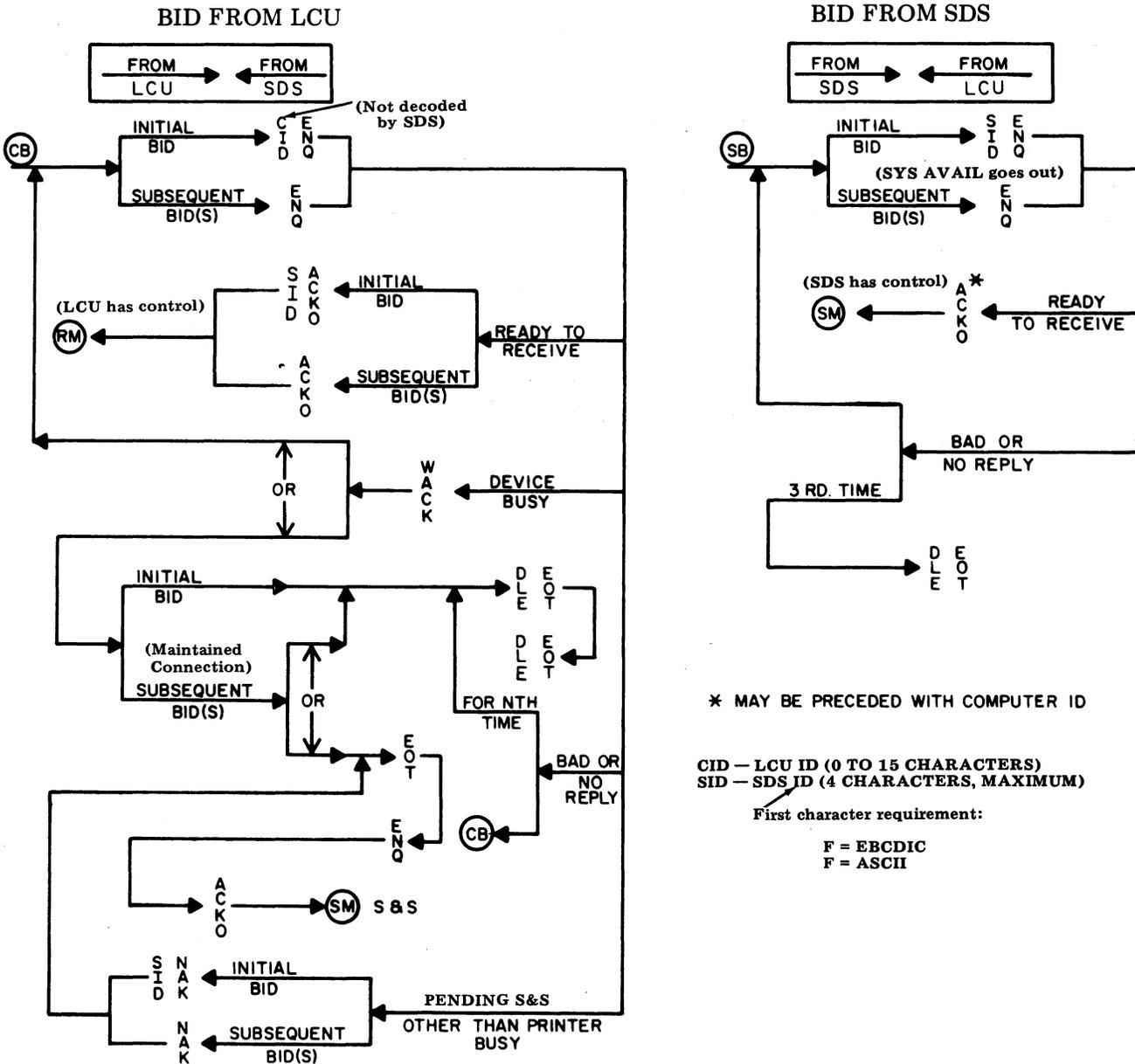


Fig. 13

Switched Network Message Transfer — SDS Receives

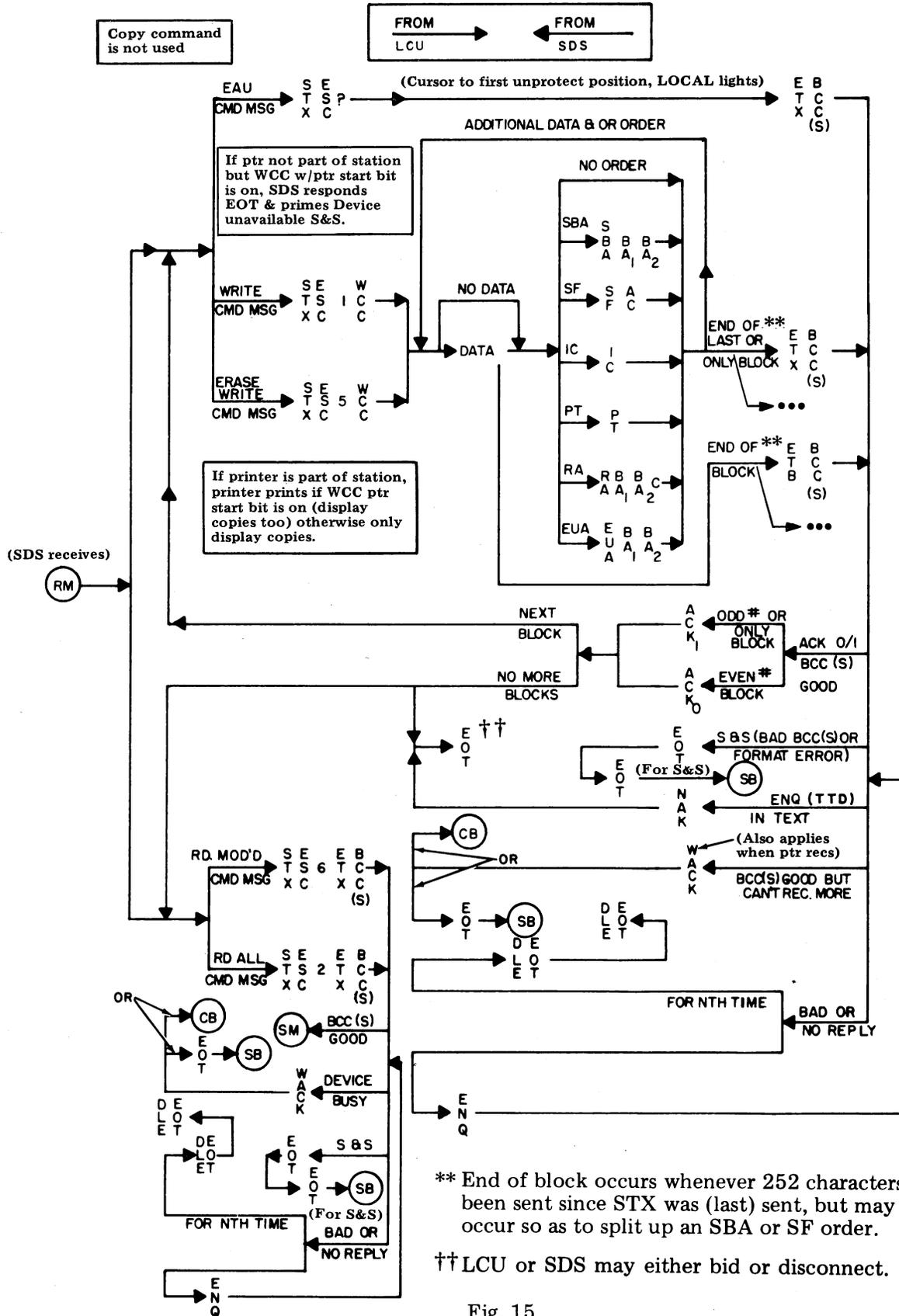


Fig. 15

11. GLOSSARY, REFERENCES, AND ABBREVIATIONS

11.01 Glossary:

Acknowledge — An affirmative response to a message.

Address — A Buffer location represented by two characters.

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 monitor support cabinet.

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.

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

Binary Synchronous — Transmission of data consisting of Bi-state (mark or space) bit characters using identical clocks to maintain synchronism between sender and receiver.

Bit — Binary 1 or 0.

Block — A group of up to 256 characters starting with STX or SOH and ending with ETB or ETX and followed by a Longitudinal Redundancy Check (LRC) in ASCII stations or Cyclic Redundancy Check (CRC) in EBCDIC stations.

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

Byte — A unit of 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.

Controller — A 40/4 Control Unit used to interface with data sets and devices. Contains an inter-connecting frame, power supply, cooling fan, I/O ports, and various arrangements of circuit cards.

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

Copy — The transfer to 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.

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 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 EBCDIC stations.

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

Device — A keyboard display or printer.

Device Busy — A status condition sent if printer is busy when its specific poll is received (if doing a Print Local Operation, EOT is sent).

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.

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

End of Text (ETX) — Character sent from station as last character of last block.

End of Transmission (EOT) — Character sent to terminate transmission.

End Transmitted Block (ETB) — Character sent from station as last character of a block when additional blocks follow.

Enquiry (ENQ) — Character sent, as part of poll or select sequence, or when sender does not receive a response.

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.

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

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

General Poll — A communication initiated by the LCU requesting a message from any device on a station.

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 — Reply to a poll, selection, or command that has a parity error (ASCII only) or wrong block check character (ASCII or EBCDIC).

Invalid Command — Incorrect character in command sequence.

Intermediate Transmission Block (ITB) — Character sent within test from LCU indicating that following character(s) is the block check sequence; more text follows the BCS.

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

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).

Not Acknowledged (NAK) — A negative response to a message.

Null — Character used to replace data in buffer. Printer 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.

Opcon — Acronym for operator console, also referred to as a keyboard.

Poll — General or Specific. Used to initiate communication and request a message from a 40/4.

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

Program Access — PA 1, 2, and 3 — Special keys on keyboard. PA3 only on 40K105.

Program Function — PF 1 through 12 — Special keys on keyboard. PF 6 through 12 not on 40K105.

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 40/4 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.

Reverse Interrupt (RVI) — A communications control sequence.

Selection — A communication initiated by the LCU to prepare a device on a station to accept a command.

Self-Test Switch — A switch in the SCC or display 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 Corporation 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 two-character sequence indicating alarm status to the LCU.

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

Temporary Text Delay (TTD) — A communications control character sequence.

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 — No reply that has no recognizable character format.

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

Wait Acknowledge (WACK) — Communication Control Character sequence.

Write — Write received data into station buffer.

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

11.02 References

40/4 BSP Sections

582-200-150	DATASPEED 40/4 Circuit Card, Modification Kit, and Compatability Information for Single Display, Maxi-Cluster, and Mini-Cluster Station Arrangements
582-200-201	DATASPEED 40/4 Maxi- or Mini-Cluster — Installation
582-200-205	DATASPEED 40/4 Single Display — Installation
582-200-212	DATASPEED 40 Keyboard Display Amplifier (KDA)
582-200-300	DATASPEED 40/4 Maxi-Cluster and Mini-Cluster Station Arrangements — Maintenance Controller Arrangements
582-200-401	DATASPEED 40/4 Maxi- or Mini-Cluster — Wiring Program
582-200-405	DATASPEED 40/4 Single Display — Wiring Diagram
582-200-501	DATASPEED 40/4 Maxi- or Mini-Cluster — Testing and Troubleshooting
582-200-505	DATASPEED 40/4 Single Display — Testing and Troubleshooting
582-200-701	DATASPEED 40/4 Maxi- or Mini-Cluster — Disassembly/Reassembly and Parts
582-200-705	DATASPEED 40/4 Single Display — Disassembly/Reassembly and Parts
582-200-751	DATASPEED 40/4 Routine Maintenance
582-211-210	Keyboard Disable Lock for DATASPEED 40/4 Attached Keyboard Display — Feature

40/4 How to Operate (HTO)

999-300-123	Basic (KD)
999-303-123	Internal Numeric Cluster Keyboard
999-301-121	Printer Operation and Maintenance
999-301-123	Data Set 201C (Private Line)
999-302-123	Data Set 208A (Private Line)
999-302-124	Data Set 212A (Switched Network — Single Display)
999-303-124	Data Set 201C (Switched Network — Single Display)
999-304-124	Data Set 208B (Switched Network — Single Display)
999-305-121	Forms Access Printer

40/4 Miscellaneous

668-125-503	Test Center Test Procedures
668-125-508	Digitech Pacer Tester Procedures
50927S	Instructions for Installing Synchronous Model 40/4 Single Display Station Arrangements Equipped with a 40C305 Type Controller, Includes Installation of 406094 Modification Kit
50859S	Synchronous Model 40/4 Mini-Cluster, Maxi-Cluster Station Cabling

ABBREVIATIONS

1.08 Abbreviations for communication control characters, orders and message controls as used in this document are listed in Tables Q through U.

TABLE Q
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 (/)
ACK \bar{N}	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 R
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 S

ORDERS

ABB	NAME	ASCII	EBCDIC
EUA	Erase Unprotected to Address	DC2	EUA
IC	Insert Cursor	DC3	IC
PT	Program Tab	HT	PT
RA	Repeat to Address	DC4	RA
SBA	Set Buffer Address	DC1	SBA
SF	Start Field	GS	SF

TABLE T

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
S&S	- Status and Sense
WCC	- Write Control Character

TABLE U

OTHER ABBREVIATIONS

AC	— Attribute Character
ACK	— Acknowledge
ACU	— Automatic Calling Unit
ADTS	— Automatic Data Test System
AF	— Alarm Flag (refer to Status and Sense)
AID	— Attention Identification Device
ASCII	— American National Standard Code for Information Interchange
BA	— Buffer Address
BSE	— Base
BCC	— Block Check Character
CA	— Cursor Address
CAB	— Cabinet
CID	— Computer Identification
CIU	— Communications Interface Unit
CLR	— Clear
CRC	— Cyclic Redundancy Check
CRT	— Cathode Ray Tube
DA	— Device Address
DCC	— Device Cluster Controller
D I/O	— Display Input/Output
DISCN	— Disconnect
DLE	— Data Link Escape

Continued on next page

TABLE U (Contd)

OTHER ABBREVIATIONS

DSR	— Data Set Ready
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 Transmission Block
ETX	— End of Text
FF	— Form Feed
ID	— Identification
INC	— Internal Numeric Cluster Keyboard
I/O	— Input/Output
ITB	— Intermediate Transmission Block
IXL	— Instruction Execution Logic
K	— 1024
KD	— Keyboard Display
LCL	— Local
LCU	— Line Control Unit
LF	— Line Feed
LSI	— Large Scale Integration
MCC	— Mini Cluster Controller
MDT	— Modified Data Tag
NAK	— Negative Acknowledgement
PA	— Program Attention
PF	— Program Function
PTR	— Printer
RAM	— Random Access Memory
ROM	— Read Only Memory
RTS	— Request to Send
RVI	— Reverse Interrupt
SCC	— Station Cluster Controller
SDS	— Single Display Station
SID	— Station Identification
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
USOC	— Universal Service Order Code
WACK	— Wait Acknowledgement
WCC	— Write Control Character