


Burroughs 

**AP 300  
Equipment  
(Data Communications  
Interface)**

REFERENCE MANUAL

PRICED ITEM

**AP 300**  
**Equipment**  
**(Data Communications**  
**Interface)**

REFERENCE MANUAL

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PRICED ITEM

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# INTRODUCTION

This manual describes the AP 310/AP 320 Journal Printers. It presents information on the function and general operation of basic and optional equipment, and is designed to be used as a reference tool by users who operate the system and by programmers responsible for programming host machines. The AP, as described here, is a free-standing printer. Functional descriptions and control codes are presented without reference to a host machine. Thus, the host programmer will need to consult appendices A and C in this manual, and appropriate manuals describing the host language and machine.

This manual is organized under the following major topics:

1. General Description.
2. Machine Capabilities.
3. Print Characters.
4. Printer Status.
5. Printer Code Definitions and Assignments.
6. Error Conditions and Associated Results.
7. The Data Communications Interfaces.

All information necessary for the basic, day-to-day operation of the machinery is contained in sections 1 and 2. Subheadings, as they appear in the table of contents, describe the contents of this manual to a sufficient level of detail to allow quick access to topics covered.



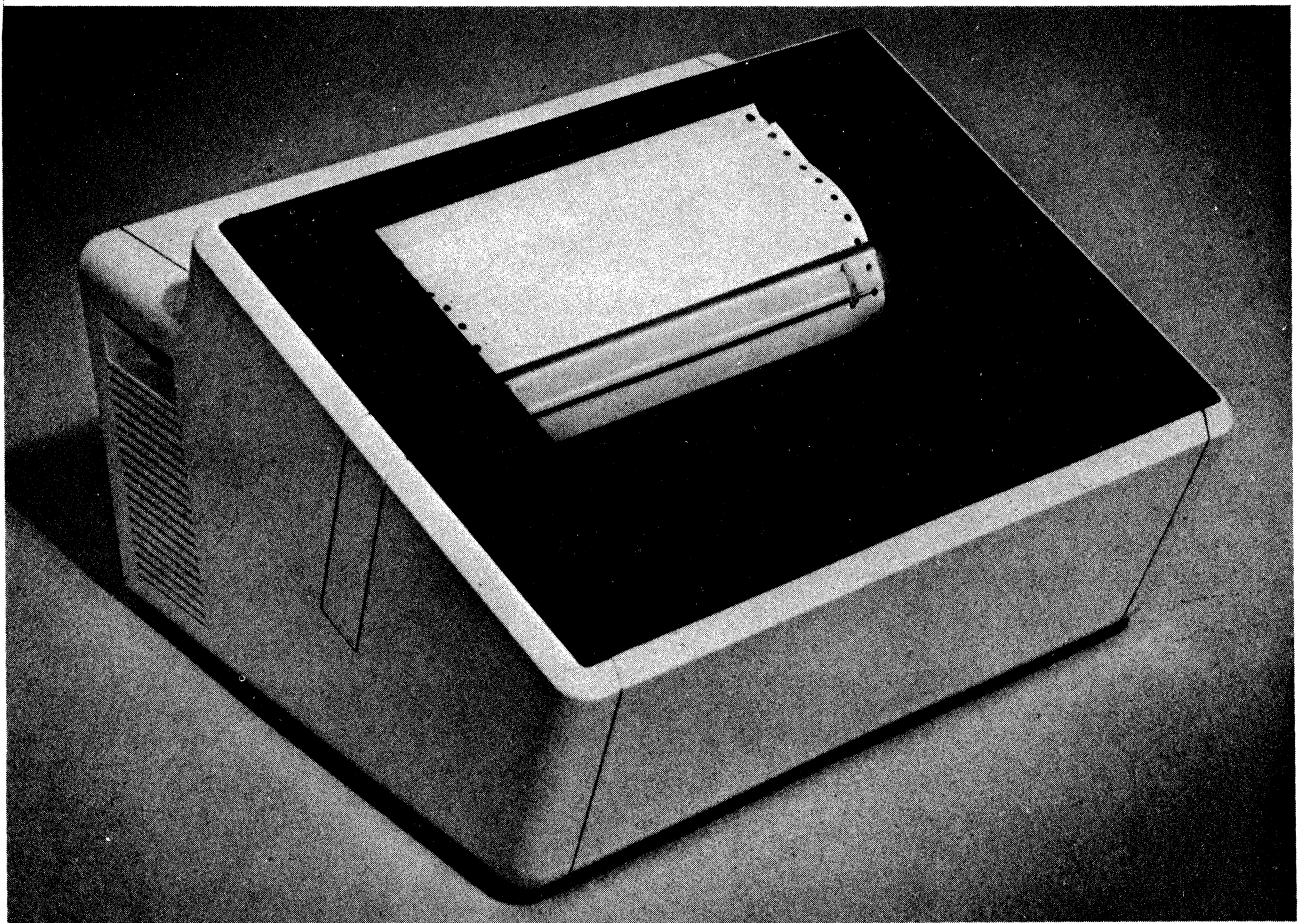
# SECTION 1

## GENERAL DESCRIPTION OF AP 300 SERIES DATA COMMUNICATIONS PRINTERS

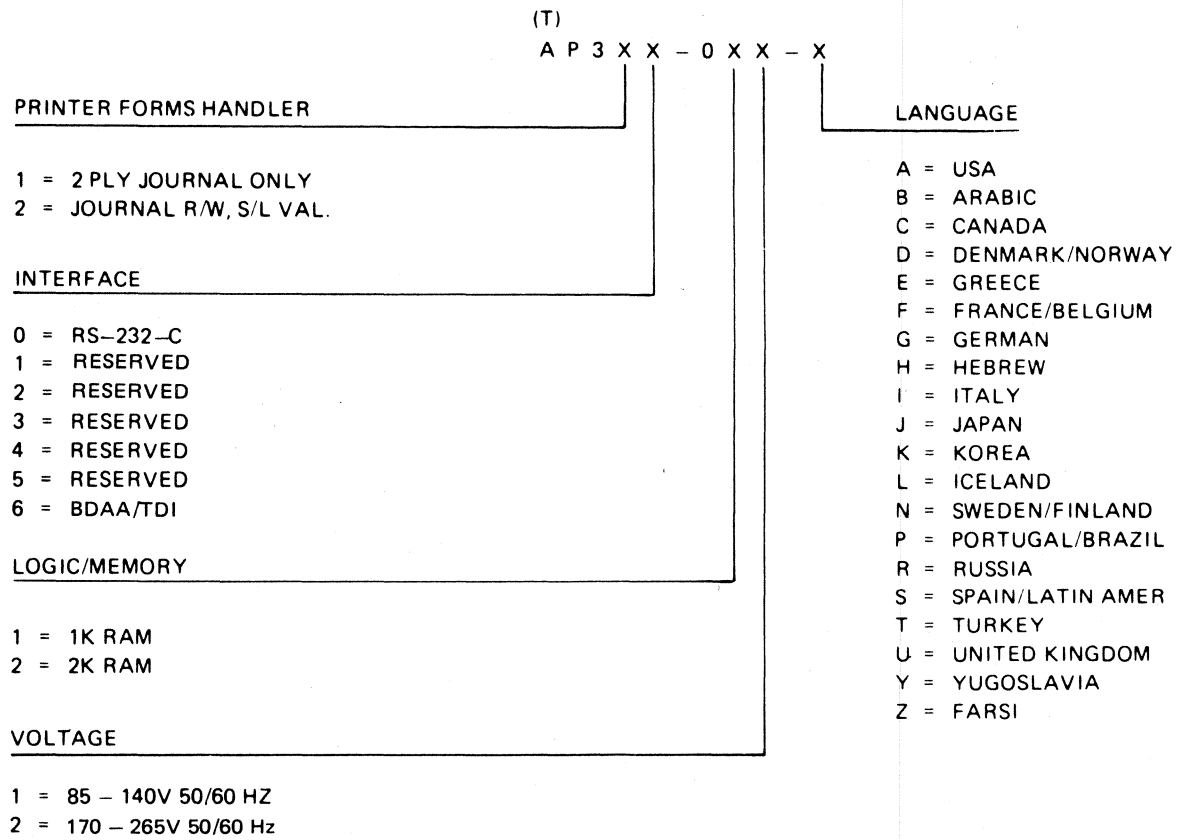
### GENERAL INFORMATION

The AP series Journal Printer is a free-standing matrix data communications printer (see figure 1-1)

capable of operating with host terminals using one of three optional data communications interfaces: RS-232-C, TDI or BDAA. See figure 1-2 for a configuration of the product numbering system.



**Figure 1-1. AP 3XX Free-Standing Printer**



**Figure 1-2. AP 3XX Configurator**

The AP 300 series printer is a 90 character per second (cps) printer. A 9-pin print head prints lines with a maximum length of 8.25 inches (209.6 mm). Printing may occur on both the forward and reverse strokes of the carrier. The AP 310 provides for printing on up to 2-ply, 8-inch (203.2 mm), pin-fed, journal paper. The AP 320 provides single line validation

and journal rewind for financial applications.

Printing begins when the printer receives a full message block from the host. If the message buffer is not full, further print data may be received during printing.

# SECTION 2

## MACHINE CAPABILITIES

### GENERAL INFORMATION

This section presents the functional subsystems, both optional and standard, that make up the AP series printer(see figure 2-1).

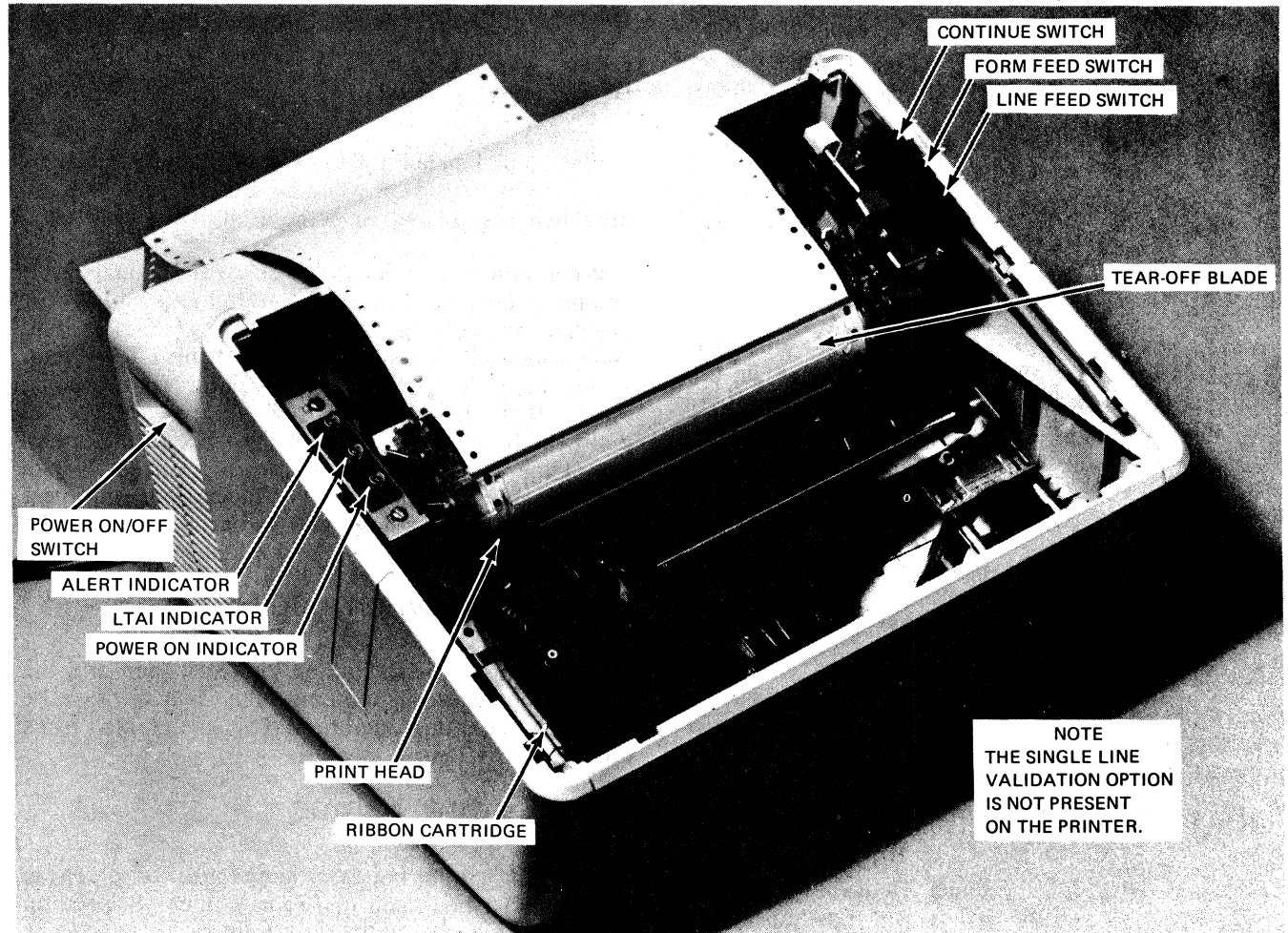


Figure 2-1. Printer Switches, Indicators, and Print Head Assembly

# SWITCHES AND INDICATORS

## POWER On Indicator

This indicator is lit when power to the printer is on. It is labeled POWER.

## ALERT Indicator

This indicator, labeled ALERT, blinks under the following conditions:

1. When the printer is out of paper. If the optional validation chute is used, it remains closed.
2. When a validation form requirement is not satisfied. In this instance, the validation chute is open while the indicator is blinking.
3. The ALERT indicator blinks once for every BEL control code (0-7) received. This indicator is steadily lit when the printer is not functioning properly.

## Audible Alert

An audible alert sounds in parallel with the ALERT indicator for all conditions except single line validation forms requirement alert. When an Error state occurs requiring the operator to remove a validation document, the audible alert sounds only once for 0.5 seconds (refer to the paragraph titled Single Line Validation Operation, section 2).

A volume control is provided so that the user may adjust the volume of the audible alert. This adjustment requires a small screwdriver.

## ON/OFF Switch

This is an alternating current (ac) power switch, provided for turning power on and off.

## FORM FEED Switch

Pressing the switch labeled FORM FEED advances the paper to the top-of-page position.

This control is not active while the printer is printing. Refer to the paragraph titled Paper Alignment, section 3, for instructions on setting the initial top-of-page position.

## LINE FEED Switch

Operation of the switch labeled LINE FEED, as a rule, advances the paper one line. When the print-

er is in the Forms Alignment mode (journal cover open), operating this switch advances the paper in steps of 1/24 inch (1 mm) increments.

If the LINE FEED switch is pressed for longer than one second, the paper advance enters a Slew mode. Paper continues to advance as long as the switch is pressed.

When the journal cover is open, operation of this switch resets the top-of-page position count.

The Line Feed control is not active while the printer is printing.

## Line Transmission Activity Indicator (LTAI)

The lamp labeled LTAI is used in all interfaces. The lamp is turned on when an EOT is received and off when responding to a the ENQ of a poll.

When communications between a functional printer and a host ceases, the operator can isolate the problem by pressing the CONT (CONTINUE) switch. When pressed, this switch turns off the LTAI lamp. If the lamp lights again, the printer is not being polled. If the lamp remains off, the host or data line is down. If the host and data lines seem functional, use of the four data comm lamps can further isolate the problem. If this point is reached, the problem may be caused by a nonfunctional printer and can be isolated by a Burroughs Field Engineer.

## Continue Switch (CONT)

If the single line validation chute is open and the ALERT indicator is blinking, this switch must be pressed to continue operation. This switch also turns off the LTAI lamp.

## Data Comm Lamps

Four data comm indicator lamps are active. These lamps are visible when the door is open. Each lamp is identified by a number, as follows:

Label	Function
DS4	Control Sent
DS5	Control Received
DS6	Send Data Ready
DS7	Data Received Complete

## Control Sent

This indicator is steadily lit when one of the following data characters is sent by the printer to the host:

1. EOT.
2. ACK.
3. NAK.

It is turned off when the printer starts to receive data from the host (SOH) or when the printer receives the final character of a control string. That character is ENQ for polls and selects; it is lower case "s" or "t" for fast selects and broadcast selects.

### NOTE

All lights are turned off when main power is turned off. All conditions must be re-established individually when power is turned on.

## Control Received

This indicator is lit when the printer has received a string of control characters from the host. It is turned on when the printer receives the final character of a control string. That character is ENQ for polls and selects; it is lower case "s" or "t" for Fast Selects and Broadcast Selects.

This indicator is turned off following the transmission of a control character (ACK, NAK, or EOT) to the host, or, when status is being sent to the host, following the transmission of the block check character.

## Send Data Ready

When this indicator is lit, the printer is transmit ready. This means that it responds to the next Poll or Group Poll by sending its status to the host.

If the printer is transmit ready, the indicator is turned on following the reception of an EOT. It is turned off when the printer receives the ACK sent by the host to indicate that it has successfully received the status of the printer.

## Data Received Complete

This indicator is lit when the printer is expecting data from the host.

It is turned on when the printer acknowledges a Select (ACK). It is turned off when the printer acknowledges the complete reception of the transmitted data (ACK), or when the printer receives a control string indicating that the host has aborted the Select.

## PRINT BUFFER

The print buffer consists of a constant data field buffer and a receive message buffer. The constant data field (CDF) of 132 print and control characters may be loaded and printed on receipt of a single control character. Repetition rates and overflow are controlled by the line protocol.

## PRINTER

### Ribbon Cartridge

The printer uses a continuous loop ribbon contained within a removable cartridge. The ribbon cartridge may be changed with the print head located in any position.

To change the ribbon, use the following procedure:

1. Open the journal cover (refer to step 1 under the paragraph titled Loading Paper, in this section); this disables printing.

2. With one hand, press the clip which holds the cartridge in place towards the print head (see

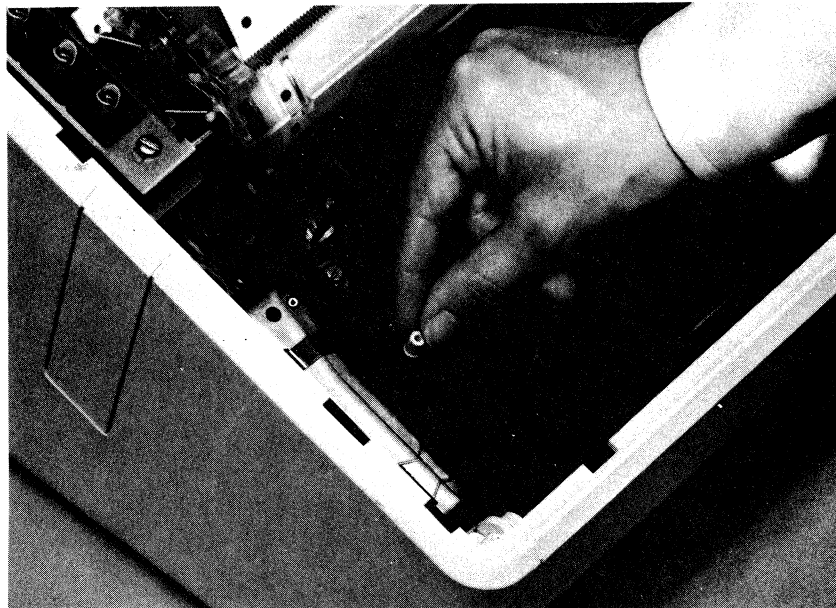
figure 2-2).



**Figure 2-2. Printer Cartridge Removal**

3. With the other hand, gently remove the old cartridge.
4. Place the new cartridge in the printer, making sure the ribbon is stretched firmly over the

print head, and that the cartridge is firmly in place. The ribbon may be tightened by turning the small knob on the cartridge (see figure 2-3).



**Figure 2-3. Adjusting Ribbon Tension**

## Character Set

The character set is determined by the character generator located in main memory. The character set is a factory option (see the last digit of the configurator, figure 1-2). Code assignments and character sets are specified in section 5 of this manual.

## Print Field Density

The standard print density is 12 characters per inch (cpi) (4.72 characters per cm.). The print density may be programmatically changed to 16 cpi (6.3 cpc), 8 cpi (3.15 cpc), or 6 cpi (2.36 cpc). The print density may be changed between two adjacent print characters within a line.

The maximum number of characters which may be printed on a line at each print density is as follows:

Print Density (Characters Per Inch)	Characters Per Line
16	132
12	99
8	66
6	49

## Print Speed

The nominal print speed is 90 characters per second, bidirectionally. The line speed varies depending on the length of the line printed and the efficiency of the turn-around allowed by the print format.

## Bidirectional Printing

The print head traverses the paper until all characters on that line are printed. At that point, the printer determines the most efficient route of travel to begin the next line of print. When printing is completed and a Go Idle control code is received, the print head moves to the home position (left margin).

## FORMS HANDLER

### Paper Requirements

The forms handler mechanism requires pin-feed,

fan-fold, and continuous paper. Single-ply, double-ply, or carbonless papers may be used.

Maximum paper width is 9.5 inches (241.3 mm). Width between the detachable edges is 8.5 inches (215.9 mm). Maximum usable print width is 8.25 inches (209.6 mm).

## Vertical Line Spacing

Under the default condition, paper is advanced in 1/6 inch (4.2 mm) steps ( $0.167 \pm 0.017$  inch [ $4.24 \pm 0.43$  mm]). Control codes exist which change the pitch of the vertical spacing to multiples of 1/24 inch (1.06 mm) steps (maximum line advance 99/24 inches [104.94 mm]).

When vertical line spacing is 1/8 inch (3.2 mm) or less, overlapping between lines may occur.

## Vertical Spacing Speed

The minimum vertical spacing speed is 6 inches (152.4 mm) per second. The time to advance one line at the standard 1/6 inch (4.2 mm) vertical spacing is typically 80 msec (milliseconds). The optional 1/8 inch (3.2 mm) spacing typically requires 70 msec; 1/4 inch (6.4 mm) spacing typically requires 90 msec.

## Length of Page

The length of page used by the Top-of-Page control is selectable via control codes. A host may select the page length by specifying the number of lines on a document. The default condition is 11 inches (279.4 mm) or, as a Burroughs field engineering selectable option, the length can be set at 5.5 inches (139.7 cm).

## Out of Paper Detection

When printing is approximately one inch (25.4 mm) from the bottom of the last sheet of paper, the Out-of-Paper signal halts printing on a line boundary. The ALERT indicator blinks, and the audible alert, if present, sounds. If the printer has a validation chute, it closes; opening the journal door turns off the indicators. When paper has been properly loaded, printing automatically continues.

## Loading Paper

Use the following procedure:

1. Open the journal cover by turning the knob or

key on the top, right corner of the cover. This turns the alarms off and disables printing (see figure 2-4).

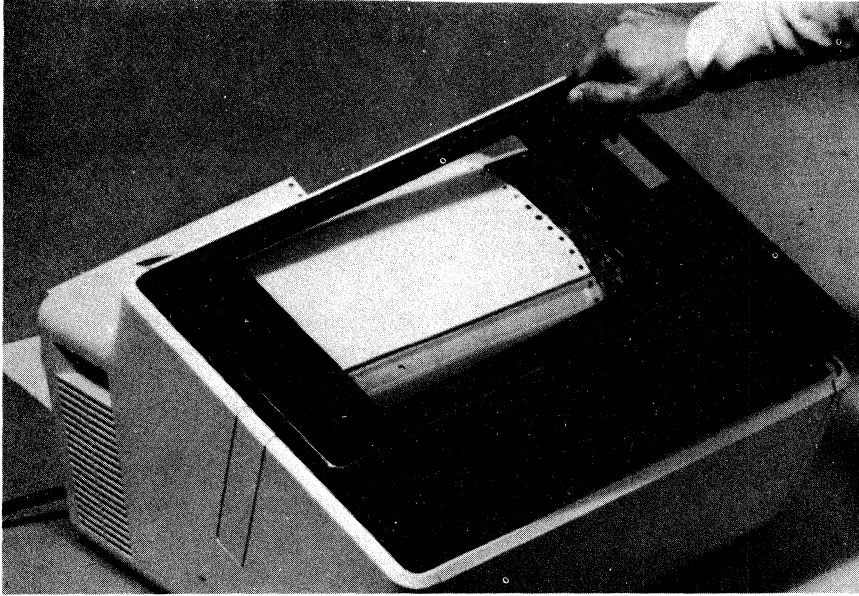


Figure 2-4. Removal of Printer Top Cover

2. Lift the tear-off blade. This retracts the feed pins so that paper may be inserted (see figure

2-5).

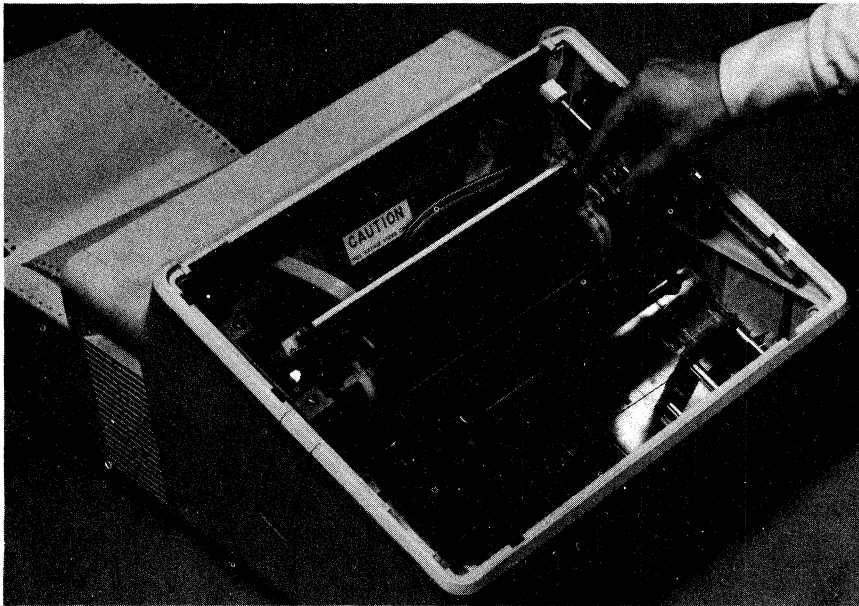
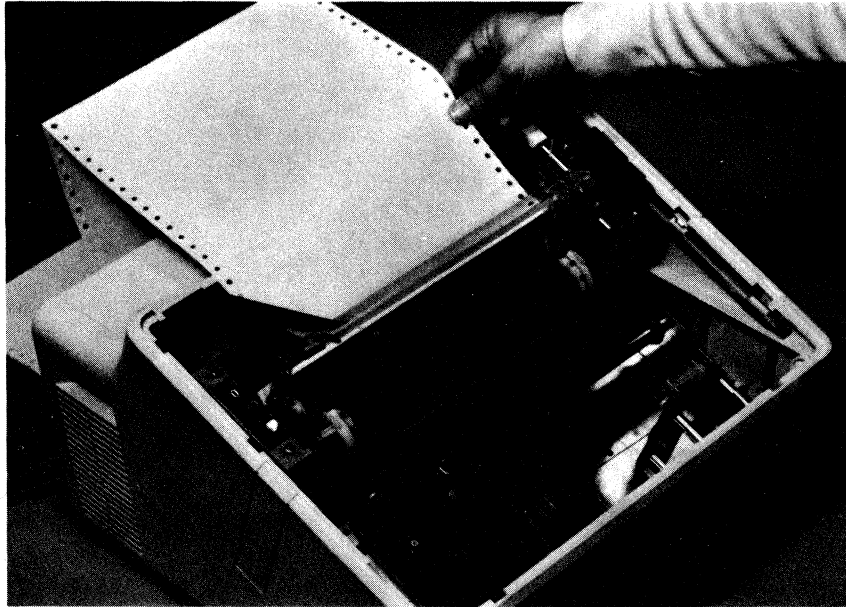


Figure 2-5. Lifting Paper Tear-Off Blade

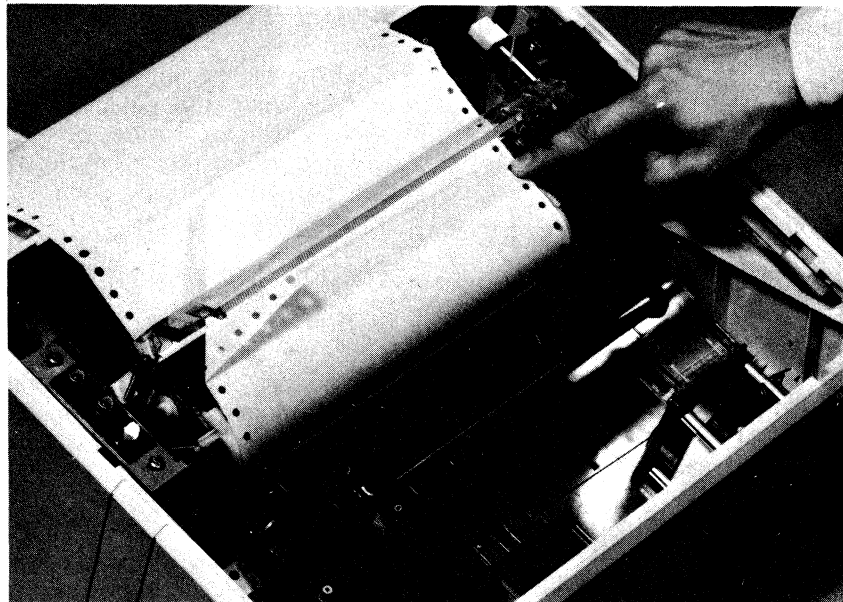


3. Fold corner of paper so that it slides easily under the print head. Insert the paper (see figure 2-6).



**Figure 2-6. Inserting Paper**

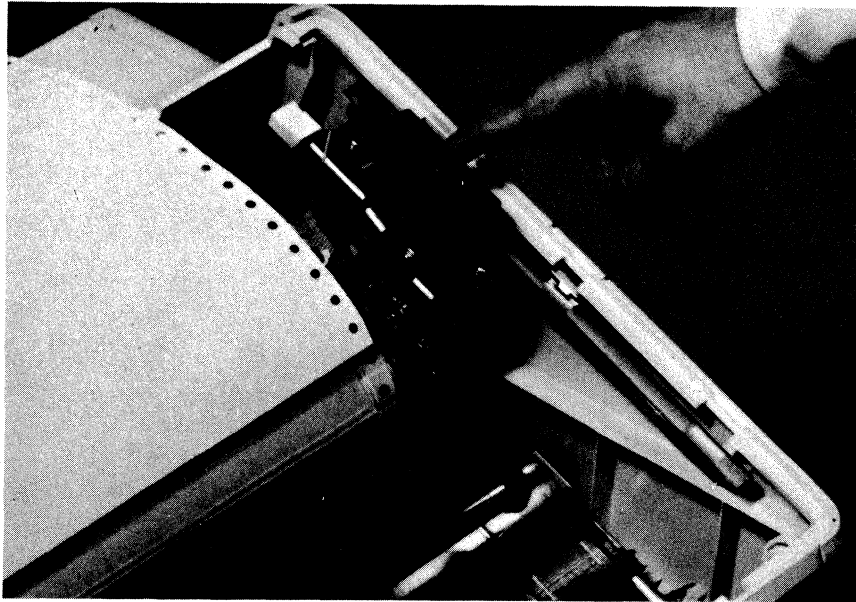
4. Align pin feed holes in the paper with the pins, and drop the tear-off blade. This engages the paper (see figure 2-7).



**Figure 2-7. Aligning Paper Pin Feed Holes**

5. Finally, align the top of the paper (refer to the following paragraph, titled Paper Alignment).

(See figure 2-8.)



**Figure 2-8. Aligning the Paper to the Top-of-Page Position**

## Paper Alignment

The journal cover must be open when aligning paper for a new or initial top-of-page position. When the journal cover is open, pressing the LINE FEED switch resets the top-of-page positioning count.

To align the paper:

1. Open journal door.
2. Position paper to desired location using LINE FEED.
3. Close journal door.

The LINE FEED switch must be held for one second before the printer enters the Slew mode. When the journal cover is open, pressing the LINE FEED switch advances the paper in 1/24 inch (1.06 mm) increments as follows:

- 1/4 inch (6.4 mm) line = 6 increments/line.
- 1/6 inch (4.2 mm) line = 4 increments/line.
- 1/8 inch (3.2 mm) line = 3 increments/line.

When the top edge of the paper is aligned with the

tear-off blade, the line of print is 1.55 inches (39.37 mm) below the top edge of the page.

## Journal Cover

Whenever the journal cover is opened, printing ceases. When the cover is closed, the print head moves to the home position before printing automatically continues at the proper location. While the journal cover is open, the printer status is Operator Attention.

## Single Line Validation Mechanism (Optional)

The single line validation chute must be opened before a document can be inserted or removed. The chute opens only when the print head is driven into the end of travel (cammed) position.

The single line validation document sensor is active only when the print head is not in the cammed position; thus, it does not indicate that the operator has actually inserted or removed the form.

## Single Line Validation Operation

Receipt of the Form Required control code causes the print head to move into the cammed position, thus opening the chute for a document. The ALERT indicator operates continuously in Blinking mode until the operator inserts the document and presses the CONT switch. The chute then closes and forms presence is checked before operation continues. If the form is not inserted at this time, the Form Required operator is executed again. Printing occurs until a Release Form control code is received. The chute is then opened by driving the print head into the cammed position. Again, the ALERT indicator operates continuously in Blinking mode until the op-

erator presses the CONT switch, whereupon the chute closes and the printer resumes operation.

The optional audible alert sounds only once for 0.5 seconds for each Forms Action operation.

## Depth of Single Line Validation Chute

The distance from the base of the print line to the bottom edge of the document can be adjusted from 3/8 inch (9.5 mm) to 2-1/4 inches (57.2 mm). Depth must be adjusted by a Burroughs Field Engineer. A minimum margin of one inch (25.4 mm) is required above the print line.

# SECTION 3

## PRINT CHARACTERS

### CHARACTER GENERATION

Character fonts are generated by the combination of a basic ROM pattern and print control algorithms. The algorithms are initiated by control characters.

A representative font for each character in the standard printer is shown in the following figures:

- Figure 3-1. 7-Pin Alphanumeric (Upper and Lower Case)
- Figure 3-2. 7-Pin Symbols
- Figure 3-3. Expanded-Protected Numeric Symbols
- Figure 3-4. Expanded-Protected Alphabetic (Upper Case Only)
- Figure 3-5. Expanded Characters (Samples Only)
- Figure 3-6. International Characters
- Figure 3-7. 9-Pin Alphanumeric (Upper Case Only)

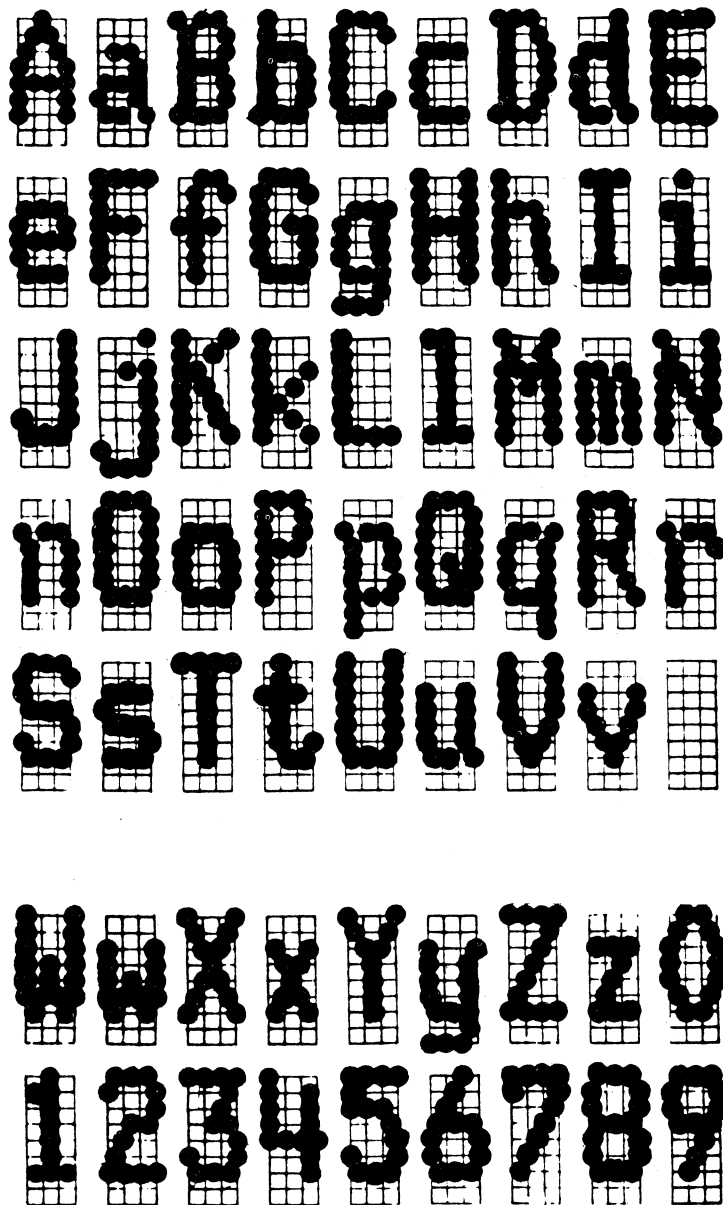


Figure 3-1. 7-Pin Alphanumeric (Upper and Lower Case)

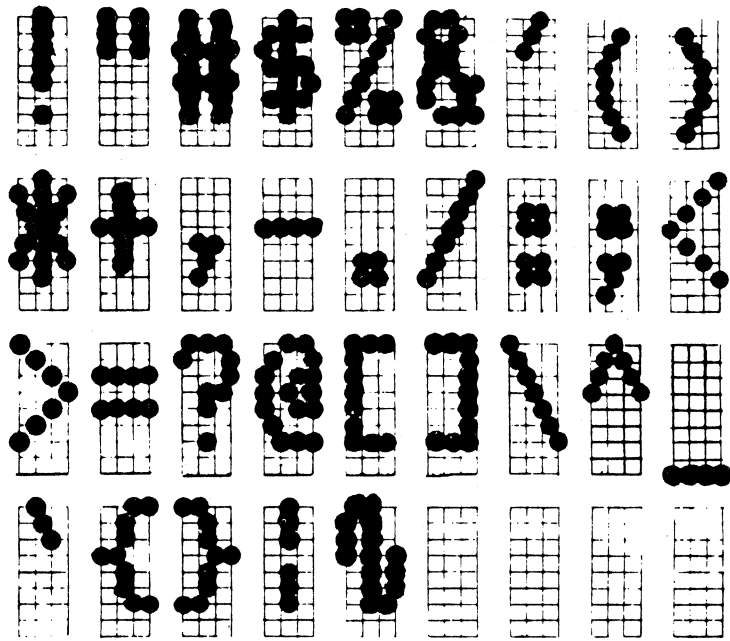


Figure 3-2. 7-Pin Symbols

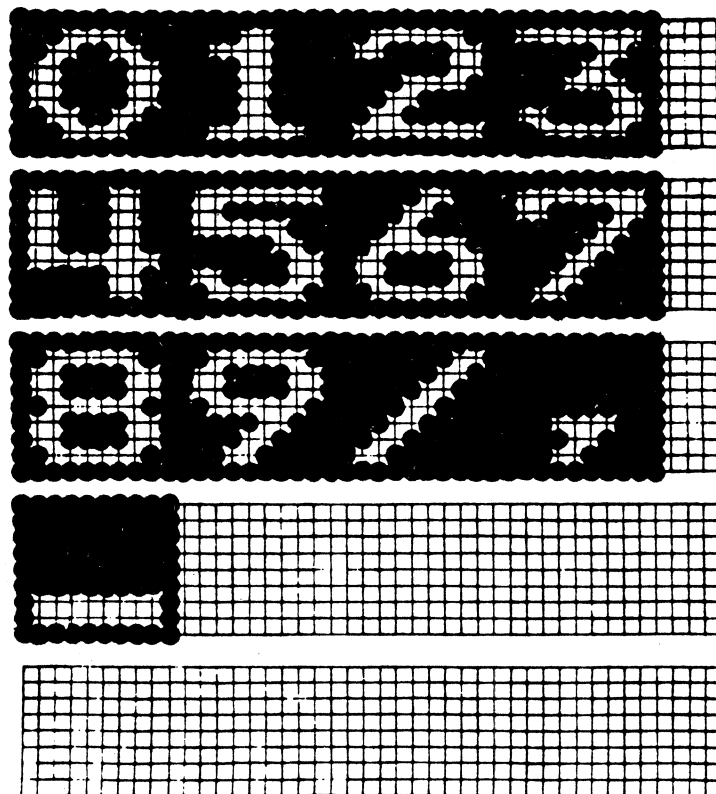


Figure 3-3. Expanded-Protected Numeric Symbols

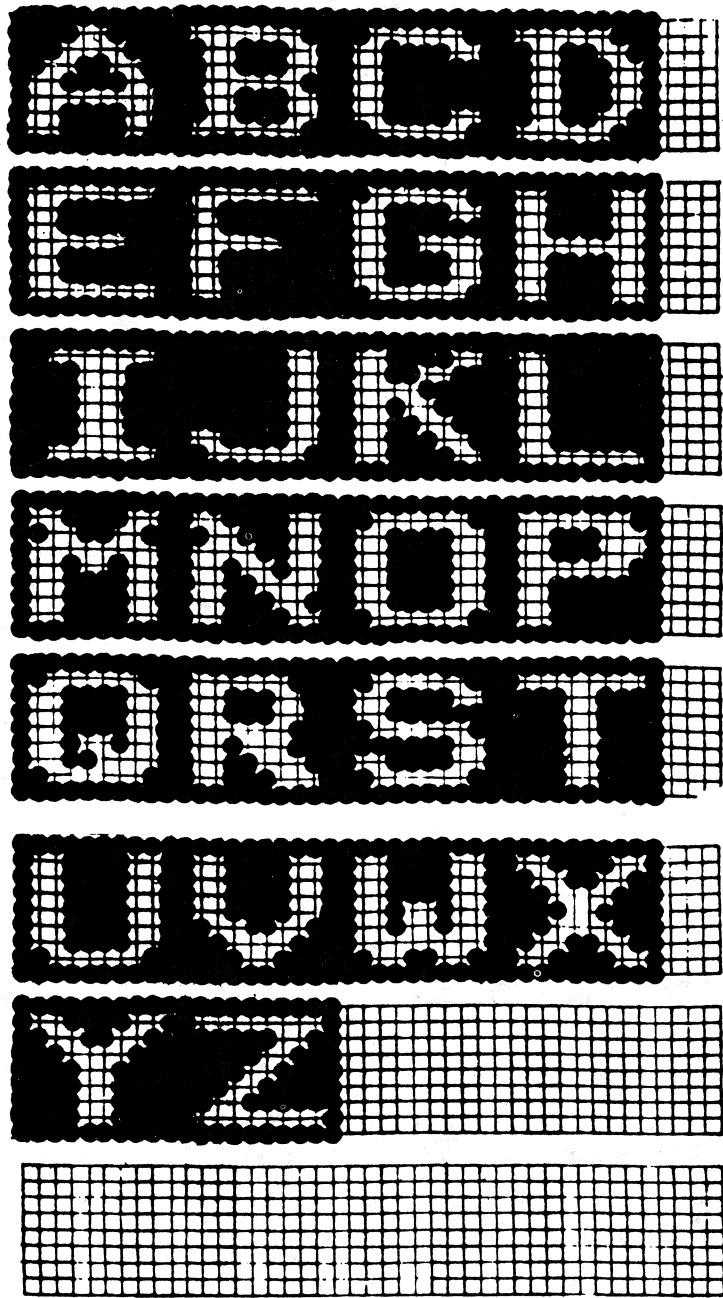


Figure 3-4. Expanded-Protected Alphabetic (Upper Case Only)

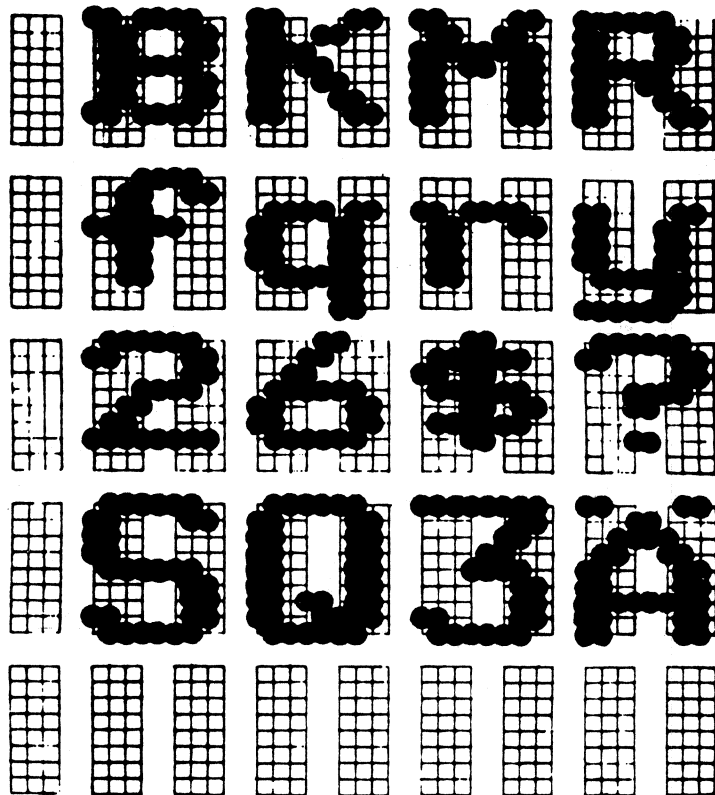


Figure 3-5. Expanded Characters (Samples Only)

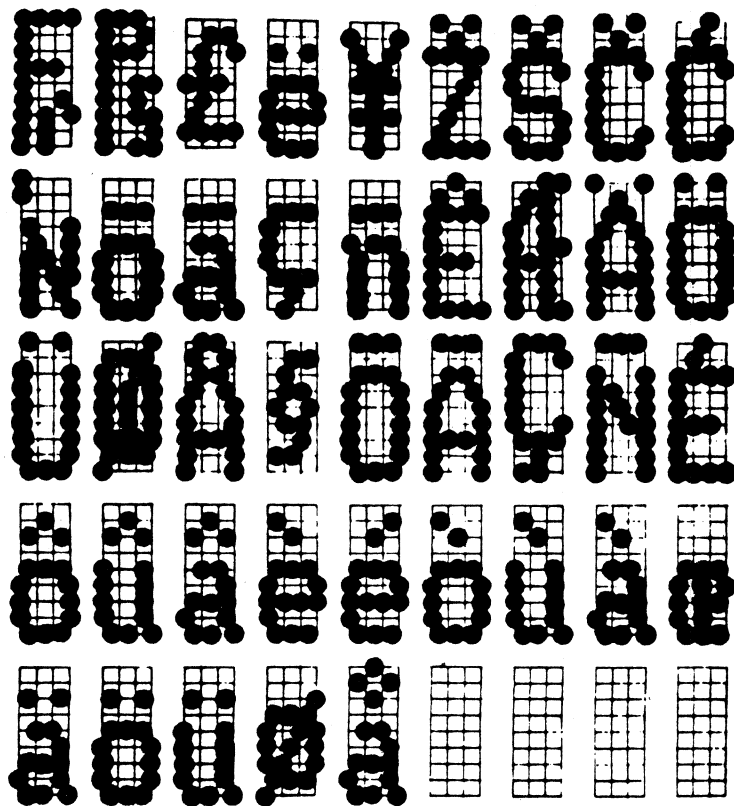


Figure 3-6. International Characters

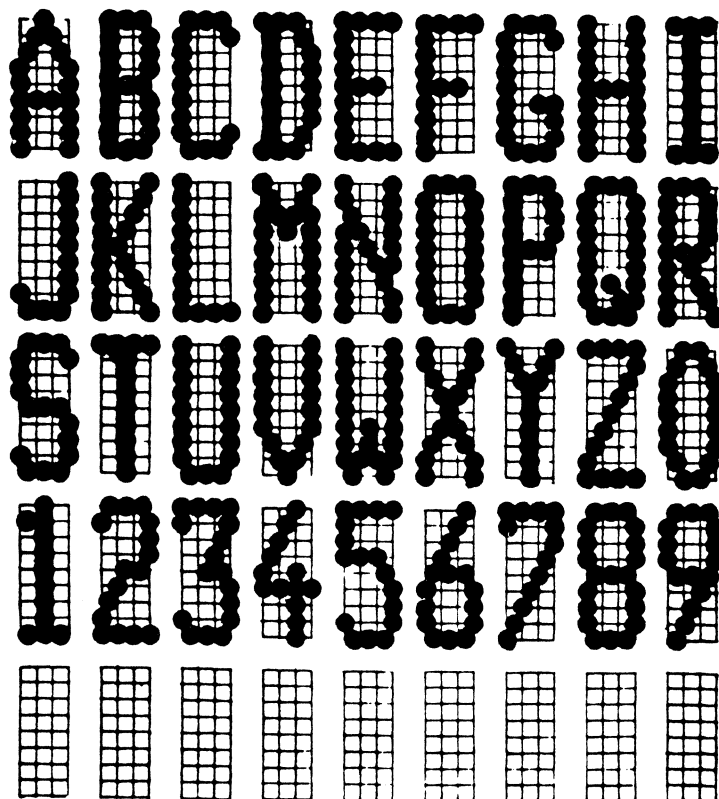


Figure 3-7. 9-Pin Alphanumeric (Upper Case Only)



# CHARACTER SET ORGANIZATION AND CODE ASSIGNMENTS

All fonts are selected by a 2-character control string. Once selected, these fonts are always used until a new selection is made. Receipt of any print code specified in figures 3-8 through 3-15 causes the

associated character to be printed. It is not necessary to revert to the basic character set before changing one optional set to another by means of a further escape sequence.

	2	3	4	5	6	7
0	SP	0	@	P	\	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	#	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	/	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	[	k	{
12	,	<	L	\	l	
13	-	=	M	]	m	}
14	.	>	N	^	n	/
15	—	?	O	_	o	

	2	3	4	5	6	7
0	SP	0	@	P	\	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	£	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	'	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	[	k	{
12	,	<	L	\	l	
13	-	=	M	]	m	}
14	.	>	N	^	n	—
15	/	?	O	_	o	DEL

Figure 3-8. Standard Print Codes (Canada and U.S.)

Figure 3-9. United Kingdom, France/Belgium, Italy Optional Print Codes

International character sets are selected by a specific ROM and a switch configuration which may be modified by a Field Engineer. Figures 3-10 through

3-15 illustrate these character sets and present associated control codes.

	2	3	4	5	6	7
0	SP	0	@	P	ø	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	#	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	'	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	[	k	{
12	,	<	L	Ñ	l	ñ
13	-	=	M	]	m	}
14	.	>	N	^	n	ˉ
15	/	?	O	_	o	DEL

Figure 3-10. Spain/Latin American Print Codes

	2	3	4	5	6	7
0	SP	0	ø	P	`	p
1	!	1	A	Q	a	q
2	"	2	ß	R	b	r
3	£	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	'	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	Ä	k	ä
12	,	<	L	Ö	l	ö
13	-	=	M	Ü	m	ü
14	.	>	N	^	n	β
15	/	?	O	_	o	

Figure 3-11. Germany/Austria/Switzerland  
Optional Print Codes

	2	3	4	5	6	7
0	SP	0	@	P	\	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	#	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	/	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	Ö	k	ö
12	,	<	L	ç	l	ç
13	-	=	M	Ä	m	ä
14	-	>	N	^	n	^
15	/	?	O	_	o	DEL

	2	3	4	5	6	7
0	SP	0	Ö	P	ö	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	£	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	'	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	Á	k	á
12	,	<	L	Ø	l	ø
13	-	=	M	Å	m	å
14	-	>	N	Ü	n	ü
15	/	?	O	Ä	o	ä

Figure 3-12. Portugal/Brazil Optional Print Codes

Figure 3-13. Denmark/Norway Optional Print Codes

	2	3	4	5	6	7
0	SP	0	É	P	é	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	£	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	'	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	þ	k	þ
12	,	<	L	Á	l	á
13	-	=	M	Ð	m	ð
14	.	>	N	Ö	n	ö
15	/	?	O	Ó	o	ó

Figure 3-14. Iceland Optional Print Codes

	2	3	4	5	6	7
0	SP	0	@	P	\	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	£	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	'	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
10	*	:	J	Z	j	z
11	+	;	K	Ä	k	ä
12	,	<	L	Ö	l	ö
13	-	=	M	Å	m	å
14	.	>	N	Ü	n	ü
15	/	?	O	-	o	

Figure 3-15. Sweden/Finland Optional Print Codes

## NINE - PIN FONT

When the 9-pin font has been selected, 9-pin versions of the numbers and upper-case letters are printed. The 7-pin versions of the special characters are used, but they are shifted down by two dots so that they are aligned with the 9-pin characters.

Because realigning the lower-case letters would truncate the bottom two rows from the lower-case "g", "j", "p", "q", and "y", the 7-pin upper-case letters are aligned and printed in place of the lower-case letters. This is illustrated in figure 3-7.

## Expanded Characters

When an expanded character set has been selected characters are modified to a font illustrated by samples in figure 3-5. This option modifies the print density from 12 cpi (4.72 cpc) to 6 cpi (2.36 cpc), or from 16 cpi (6.3 cpc) to 8 cpi (3.15 cpc). (Print speed is reduced to 45 cps.)

## Protected Characters

When the protected character set has been selected, all following data characters are printed in expanded, white-on-black form. This algorithm is only intended for use with characters which use the upper seven pins in the dot matrix. Any data in the eighth or ninth rows is truncated, thus distorting the character. Refer to figures 3-3 and 3-4 for print fonts.

The following should not be sent when the protected subset is selected if legibility is to be main-

tained: lower-case "g", "j", "p", "q", "y", or underline.

Print speed for protected characters is 15 cps at 6 cpi (2.36 cpc) or 20 cps at 8 cpi (3.15 cpc).

## Underline

When the control code which puts the printer in the Underline mode is received, all character fonts are modified by an unconditional printing of alternate ninth row dots. The algorithm also prints ninth row dots between characters, forming a continuous underline.

This feature degrades the legibility of any characters using the eighth or ninth dot positions, including 9-pin character sets. It does not, however, affect the appearance of protected character sets.

This feature does not affect the normal print speed. However, because of the heavy demands it makes on the printer hardware, it should be used sparingly. It is recommended that underline be used on only one out of four successive full lines of print.

# SECTION 4

## PRINTER STATUS

### STATUS WORD

An 8-bit status word indicates the status of the printer. The lower digit identifies the state of the message and buffer; the upper digit contains flags that continuously monitor various printer conditions:

Status Word → Upper Digit	Lower Digit
B7 B6 B5 B4	B3 B2 B1 B0
Condition Flags	Message Buffer Status

The status and the auxiliary status word (refer to description of the Operator Attention condition, in this section) are transmitted together. Each status word is broken into two separate digits and transmitted as ASCII column-3-type characters. The 4-character status message is transmitted in response to a POL whenever the host has requested the status by sending a Send Status control word. The following text format is used:

3-A, 3-B, 3-C, 3-D

where:

- A is the condition flags (status word, upper-digit).
- B is the message buffer status (status word, lower digit).
- C is the system failure description (auxiliary status word, upper digit).

D is the operator attention description (auxiliary status word, lower digit).

#### NOTE

When an Operator Attention state first occurs, the printer responds to the next POL or Group POL, without requiring a Send Status command from the host. The same applies when a transmission number mismatch occurs.

The primary status conditions are identified in table 4-1.

### PRINTER STATES

#### Idle

The Idle state indicates that all transactions in the printer are completed and that any host may initiate a print message or load the constant data field. The printer enters the Idle state only after a power up condition, or receipt of a Go Idle or Cancel control code.

#### Available

The Available state indicates that the print buffer contains data that is terminated on a line boundary.

**Table 4-1. Printer Status**

Lower Digit	Status
1	Idle
2	Available
4	Busy
5	Error
0, 3, 6-F	Undefined
Upper Digit	
B4 = 1	If printer options must be loaded.
B4 = 0	If printer options are valid.
B5 = 1	If operation attention is required.
B5 = 0	If operation attention is not required.
B6 = 1	If constant data field is loaded.
B6 = 0	If CDF is reset (contains invalid data).
B7 = 1	If printer error has occurred and is ready for reporting.
B7 = 0	If no printer failure has occurred.

The printer is capable of receiving more print data; however, no Load CDF data is accepted. The printer remains in this state until a Go Idle control code is received.

If the host requires a form to be inserted by the operator, the printer remains in the Available state until a Forms Release command has been received and the form has been removed from the printer.

## Busy

The Busy state indicates that all printer buffers are full. In a data comm environment, the printer transmits a NAK code in response to further messages (when there is not room for 256 characters in the print buffer).

## Error

The Error state indicates that the last message received contains print format errors. The host must send a Cancel command. All other commands are ignored.

## Reload Printer

If set, this flag (B4) indicates that the power in the printer has been initialized or interrupted, and that any data loaded by the host should be reloaded. The flag is reset following the first Poll or Group Poll to which the printer responds.

## Constant Data Field (CDF) Loaded

If set, the CDF flag (B6) indicates that the CDF contains valid data. The flag is reset whenever data in the CDF has been destroyed. The host should monitor this flag to be sure that the constant data field is loaded with a valid message before sending an Insert CDF command.

## Operator Attention

If set, this flag (B5) indicates that the printer is awaiting operator action and is unable to perform any further print tasks. Further print data may be sent to the printer if allowed by the associated status bits.

The type of operator attention required is indicated by the lower digit of the auxiliary status word:

Auxiliary Status Word →				Lower Digit			
Upper Digit				Lower Digit			
B7	B6	B5	B4	B3	B2	B1	B0
Printer Failure Code				Operator Attention Code			

The auxiliary status word is divided into two separate digits, each transmitted as an ASCII column 3 character.

The following types of operator attention are identified in the printer:

Lower Digit	Operator Action
0	Operational (no operation required).
1	Insert form.
2	Remove form.
3	Close cover.
4	Clear transport jam.
5	Load paper.
6	Transmission number error; duplicate message ignored.
7	Transmission number error; messages lost.
8 - F	Undefined.

## Printer Failure

If set, this flag indicates that a printer failure has been detected. If an error log is being maintained by the host, it should read the printer failure data. The type of system failure is indicated by the upper digit of the auxiliary status word.

This condition can only be cleared by powering the printer off and on.

The following types of Operator Attention are identified in the upper digit of the auxiliary status word:

Upper Digit	Problem
0	No errors have occurred since last query.
2	Memory parity error.
4	RAM test failed during confidence test.
5	ROM hash check failed during confidence test.
6	Timer-counter chip defective during confidence test.
7	Transport jam or print mechanism failure.
8 - F	Undefined.

# SECTION 5

## PRINTER CODE DEFINITIONS AND ASSIGNMENTS

### PRINTER CONTROLS

The following paragraphs describe the characters used to control the printer. These control characters are not printed, and unless otherwise indicated, are

not stored in the print buffer. Refer to figure 5-1 for control code assignments. Refer to appendices A through C for samples and programmer aids.

BASIC CONTROLS				ESCAPED (ESC) CONTROLS	
	0	1	7	7	3
0	NUL	DLE	POLL	S7	SEND STATUS
1	SOH	*	SEL	E7	*
2	*	*	*	P7	GO IDLE
3	EXT	*	FSL	S9	*
4	EOT	*	BSL	E9	*
5	ENQ	NAK	*	*	LOAD CDF
6	ACK	SYN	*	FORM REQUIRED	INSERT CDF
7	BEL/CON	*	*	RELEASE FORM	SET UNDERSCORE
8	*	CAN	*	*	RESET UNDERSCORE
9	HT	*	*	*	LEFT JUSTIFY (H-L)
A	NL	*	*	FORM LENGTH	RIGHT JUSTIFY (H-R)
B	VT	ESC	*	*	*
C	FF	*	*	*	CPI-16
D	CR	*	*	*	CPI-12
E	SO	*	*	*	LINE ADV. INCREMENT
F	SI	*	*	*	*

\* RESERVED

**Figure 5-1. Printer Control Code Assignments**



## Insert Constant Data Field (CDF) 1-B, 3-6

If the Insert CDF control code is in a print message, the printer replaces it with the contents of the CDF. This code may be positioned anywhere in the print message where normal text data is allowed. It is stored in the print buffer and may be inserted in multiple locations, if desired. If the CDF is reset, and thus contains no valid data, this code is ignored.

The CDF data format is controlled by the positioning codes in the CDF. If positioning information is not included, the first character in the CDF buffer prints immediately after the last character preceding the Insert CDF code. Each Insert CDF code in a message counts as one character space in the print buffer.

## Load Constant Data Field (CDF) 1-B, 3-5

A message that loads the CDF may only be initiated when the printer is in the Idle state. If it is received at any other time, the printer enters the Error state.

This message is initiated and terminated by Load CDF codes. All data between the first and second Load CDF codes is inserted into the CDF. This includes the print positioning codes. All data in the CDF is inserted into the print message as indicated by each individual message.

The terminating Load CDF must be part of the same message as the initial Load CDF. If an ETX is encountered while the code is being loaded, then a terminating Load CDF is assumed.

The Load CDF data may be sent as part of a message to be printed if it is the first data field transmitted. This CDF data is used if the associated message contains an Insert CDF code.

The CDF is reset whenever the Load CDF code is immediately followed by another Load CDF code. The CDF can also be reset under certain transmission error conditions.

Whenever power is turned off or lost, the CDF is reset and must be reloaded before further use. See appendix C for an example of how the CDF is loaded.

## Cancel 1-8

This code is provided as a means of resetting all

data and conditions within the printer. It should be used sparingly and with complete knowledge of the printer conditions. Its effect is similar to a power-on condition.

This code halts printing and resets the print buffer, CDF, and flags within the printer. The host has no way of determining if printing is totally aborted, partially aborted, or not affected. Following this code, the printer will be in the Idle state.

## Bell (BEL) 0-7

If this code appears in the same line of data as other characters, the ALERT indicator (and optional audible alert) is turned on for 0.5 seconds for each Bell code in the line. These alerts take place prior to the printing of characters. Only the first 15 Bell codes in a line are used; subsequent ones are ignored. This code may be sent in the message anywhere normal text data is allowed.

## Escape (ESC) 1-B

This code must precede any of the control codes designated as escaped controls in figure 5-1. This code is stored in the print buffer if the associated control code is also stored in the print buffer.

## Send Status 1-B, 3-0

Receipt of this code causes the printer to respond to the next POL message by transmitting both the status and auxiliary status words. A total of four status characters are sent.

Status conditions and bit assignments are specified in section 4, titled Printer Status.

## Form Required 1-B, 7-6

If the single-line validation option is in operation, receipt of the Form Required control code causes the printer to check the form sensors to determine if the required form is present. Printing does not commence unless this form has been inserted. This control code is stored in the message buffer until processed. It is ignored if single-line validation is not implemented.

If this code follows a partial line of data in the message buffer, it causes this line to print before the printer requests the form. Subsequent data is left-justified to position zero.

## Release Form 1-B, 7-7

If single-line validation is in operation, receipt of

this control code causes the printer to require that the CONT switch be pressed before the printer resumes operation. The printer remains in the Available state until the CONT switch is pressed. This control code is stored in the message buffer until processed. It is ignored if single-line validation is not implemented.

If this code follows a partial line of data in the message buffer, it causes this line to print before the printer releases the form. Subsequent data is left-justified to position zero.

## Go Idle 1-B, 3-2

Receipt of this control code causes the printer to stop processing received data, to print all data received prior to the GO IDLE, to enter the IDLE state, and to cause the printer status to be made available to the host system.

## Form Length 1-B, 7-A

Receipt of this control string specifies the form length. The Top-Of-Page command or FORM FEED switch advances the paper by the amount specified by this instruction less the number of lines already printed on the page. If this control string is not sent to the printer, the printer utilizes a default condition of 11 inches (279.4 mm).

This control string is stored in the message buffer. After all characters preceding the control string are processed, the new form length definition is implemented.

The control string must be followed by three characters from ASCII column 3. The lower digits of these characters specify the number of 1/24 inch (1 mm) lines on the page. Leading zeroes must be inserted; thus, a one inch form would be specified by 024. There are 24 lines per inch (25.4 mm); thus, 264 would specify an 11-inch (279.4 mm) form.

Example (for 11-inch [279.4 mm] format):

1-B, 7-A, 3-2, 3-6, 3-4

The maximum form length which may be specified is 999/24 inches or 41.625 inches.

## Test Printer 1-B, 3-3

This control code, operative only when the printer is in the Idle mode, causes the printer to execute the confidence test. The printer memory and system registers are reset as in power up and must be reinitialized.

## DATA FORMATTING

Messages received may contain the print formatting information described in the following paragraphs.

The basic format of the messages is:

1. Send Interrupt control code (optional).
2. Insert Form control code (if validation option is implemented).
3. Print message and Print control codes.
4. Remove Form control code (if validation option is implemented).
5. Go Idle control code (optional).

## Initiate Printing

Printing commences when a full message block of data is received.

Printing may also be initiated when valid data has been terminated by an End-of-Line control code or when a full line of data has been received. After printing a full line, a new line control is automatically inserted.

End-of-Line control codes are:

Carriage Return	Go Idle
Vertical Tab	Form Requested
New Line	Form Released
Form Feed	

## Line Advance Increment 1-B, 3-E, 3-m, 3-n

Receipt of this control code specifies the distance the paper advances for each line advance. The default line advance increment is 1/6 inch (4.2 mm). The control code is stored in the message buffer. After all preceding characters are processed, the line advance size is updated.

The control string to define the line advance is:

1-B, 3-E, 3-m, 3-n

Where m and n are the second digits of ASCII decimal column-3-type digits which define the size of the advance in 1/24 inch (1 mm) increments according to the following table:

m and n		Line Advance Distance	
0	1	1/24 inch	(1 mm)
0	2	1/12 inch	(2.1 mm)
0	3	1/8 inch	(3.2 mm)
0	4	1/6 inch	(4.2 mm)
0	5	5/24 inch	(5.3 mm)
0	6	1/4 inch	(6.4 mm)
0	7	7/24 inch	(7.4 mm)
0	8	1/3 inch	(8.5 mm)
0	9	3/8 inch	(9.5 mm)
1	0	5/12 inch	(10.6 mm)
1	1	11/24 inch	(11.7 mm)
1	2	1/2 inch	(12.7 mm)
1	3	13/24 inch	(13.8 mm)
1	4	7/12 inch	(14.8 mm)
1	5	15/24 inch	(15.9 mm)
1	6	2/3 inch	(16.9 mm)

Leading zeros must be specified. The line advance increment can range from zero to 99/24 inches.

### Carriage Return (CR) 0-D

The Carriage Return control code causes all preceding data to be printed. All data following this code is left-justified to position zero. Since no line feed occurs, overprinting may result.

### New Line (NL) 0-A

Any data preceding this control code is printed. After printing, the forms handler vertical spaces one line. Data immediately following this code is left-justified to position zero.

### Forms Feed (FF) 0-C

Any data preceding this code is printed. The paper advances to the top of the next page. Any data following this code is left-justified to position zero.

### Vertical Tab (VT) 0-B

Any data preceding this control code is printed. The paper then vertically spaces as described below. All data immediately following this code is left-justified to position zero.

The Vertical Tab instruction consists of three characters. The first character is the Vertical Tab code. The next two ASCII decimal digits specify the number of vertical line spaces to be executed (relative to the present position).

Each line increment is that defined by the Line Advance Increment control (default 1/6 inch [4.2 mm]). The data format is: <VT> <high order character> <low order character>. Thus, to advance the paper 25 lines would require:

0-B, 3-2, 3-5

A Vertical Tab 0 code performs no operation.

### CPI-16 1-B, 3-C

This control code specifies that all following data is to be printed at a density of 16 characters per inch (6.3 cpc). A print line at this density may contain a maximum of 132 characters.

### CPI-12 1-B, 3-D

This control code specifies that all data following

is to be printed at a density of 12 characters per inch (4.72 cpc). Since this density is the default state of the printer, this code is required only when it is necessary to return to 12 cpi (4.72 cpc) after printing at 16 cpi (6.3 cpc). A print line at this density may contain a maximum of 99 characters.

### Set Underscore 1-B, 3-7

Receipt of this control code causes all following characters to be underlined until a Reset Underscore control code is received.

### Reset Underscore 1-B, 3-8

Receipt of this control code causes underlining of subsequent data characters to be stopped.

### Horizontal Positioning

An absolute horizontal position is indicated by four code characters. The first character is the horizontal position code. It may be either a horizontal position and left-justified data field (H-L), or a horizontal position and right-justified data field (H-R) code. The next three characters are ASCII decimal digits which specify the absolute data field position. The first print position is designated 0.

### Left-Justify Data 1-B, 3-9

1-B, 3-9 <Horizontal position at which extreme left character prints> <Data to be printed>

The left-justified, horizontal position code (H-L) and the associated positioning data characters designate the horizontal position at which the extreme left character in the data field prints. All following characters appear to the right of this character.

Example:

1-B, 3-9, 3-0, 3-1, 3-5, 3-9, 3-8, 3-7, 3-6

The print field starts at position 15 and prints "9876" with the 9 in position 15 and the 6 in position 18. When a left-justified field crosses the End-of-Line boundary, the data is broken at the boundary and the data field continues at position 0 on the next line.

Example (16 cpi):

1-B, 3-9, 3-1, 3-2, 3-5 PRINTTHIS

POSITION 0 1 2 3 . . . 125 126 127 128 129 130 131  
P R I N T T H

I S

## Right-Justify Data 1-B, 3-A

1-B, 3-A <Horizontal position at which extreme right character prints>

The right-justified, horizontal position control code (H-R) and the associated positioning characters indicate the position where the extreme right character in the data field prints. All following characters appear to the left of this position.

Example:

1-B, 3-A, 3-0, 3-4, 3-1, 3-5, 3-4, 3-3, 3-2

The print field terminates at position 41 and prints "5432". The 5 is printed in position 38, and the 2 in position 41. Further position codes or control codes are field delimiters.

## CHARACTER SET DEFINITION

The following paragraphs list character sets and related control code strings. Refer to section 3 for font details.

### Standard Character Set (S 7)

Receipt of the control code string "1-B, 7-0" selects the standard font.

Because this control string is the printer default condition, it is only used if another font has been previously selected.

### Expanded Character Set (E 7)

Receipt of the control code string "1-B, 7-1" selects a double-width character font.

### Protected Character Set (P 7)

Receipt of the control code string "1-B, 7-2" selects a white-on-black character font.

### Nine-Pin Font (S 9)

Receipt of the control code string "1-B, 7-3" selects the 9-pin font.

### Expanded Nine-Pin Font (E 9)

Receipt of the control code string "1-B, 7-4" selects the expanded 9-pin font.

# SECTION 6

## ERROR CONDITIONS AND ASSOCIATED RESULTS

### PRINT CHARACTERS

The printer attempts to print all print characters received. The character printed is determined by the character generator. Column 0 or 1 codes are not printed; these codes are processed as control characters or are ignored as specified in figure 5-1.

### ERRORS IN CONTROL MESSAGES

#### Horizontal Position Error

The printer enters the Error state if the associated tab positioning code indicates that printing should begin outside the boundary of the print line. The printer also enters the Error state if the data associated with a Horizontal-tab, Right-justify command is large enough to exceed the left margin. A Cancel command must be sent to reset the printer. These print lines must be re-sent to the printer using the proper positioning codes or a smaller data field.

#### Conflicts Between Right and Left-Justified Data

An error is declared when a left-justified horizontal position is followed by a right-justified horizontal position which would cause overprinting. The printer enters the Error state. The print line must be cleared and the data re-sent in such a way that the two data fields do not overlap.

#### CDF Buffer Overflow

The printer enters the Error state if an attempt is made to load the printer with more than 132 characters. If this occurs, the printer must be reset with a Cancel command.

#### Loading CDF While Printer Status is Not Idle

The printer enters the Error state if a Load CDF control code is received when the printer is not in the Idle state. A Cancel command is required to re-

set the Error state. The data associated with the Load CDF command is ignored.

The host should ensure that the printer is in the Idle state by sending a Go Idle control code before sending the Load CDF message.

#### Memory Parity Error

Any memory parity error causes the system error log flag in the status word to be set. The system error should be read by the host. The operator ALERT indicator is lit and the system must be repaired.

On all interfaces, the printer attempts to bring the carrier motors and forms movement to an orderly stop before halting.

#### Test Printer Command Received While Printer Not Idle

The printer enters the Error state upon receipt of the Test Printer control code if the printer is not Idle. This command is ignored and a Cancel command is required to reset the Error state. The host should ensure that the printer is in the Idle state before sending the Test Printer command by first sending a Go Idle command.

#### Transport Jam

A transport jam is considered a catastrophic failure. Power is removed from the carrier and forms motors and the ALERT indicator is turned on. The printer must be powered down, the jam cleared, and the printer powered on before printing can resume.

The printer enters the Error state and the report system error status flag is set and operates normally. The Error state cannot be cleared by command of host.

#### Transmission Parity Error

Transmission parity errors are handled by the protocol.

# SECTION 7

## THE DATA COMMUNICATIONS INTERFACES

### GENERAL DESCRIPTION

The printer is available with the following interfaces:

1. RS-232-C Asynchronous and Synchronous Interfaces.
2. TDI Interface.
3. BDAA Interface.

### RS-232-C ASYNCHRONOUS AND SYNCHRONOUS INTERFACES

#### Data Communications Features

The following paragraphs describe the character coding, message formatting, and error detection used by the printer in communicating with the host.

#### Modes of Operation

Data received by the printer is stored in a ring buffer. This means that as printing progresses, the available buffer area increases. When printing is complete, the entire buffer is available. The printer is defined to be busy whenever the available buffer area will not hold 255 characters. The printer goes to the Available state when printing has progressed to the point where more than 256 characters are available in the buffer.

While busy, the printer NAK's any Select, Fast Select and Broadcast Select can be performed while the printer is busy; however, if the transmitted text does not fit in the buffer (is over 256 characters), then the message is ignored and NAK'd (unless the printer is one of the non-addressed printers in a Broadcast Select).

The printer transmits its status to the host under two conditions:

1. It has received a Send Status code.
2. Operator attention is required, or the printer enters the Error state.

When one of these conditions occurs, the printer responds to the next poll or group poll.

### Character Coding

Character coding is formatted as defined in figures 3-8 and 5-1.

### Communications Control Characters

The following communications control characters directly affect the transmission or receipt of data by the printer:

Character	Code	Definition
NUL	0-0	Time Fill.
SOH	0-1	Start of Heading.
STX	0-2	Start of Text.
ETX	0-3	End of Text.
EOT	0-4	End of Transmission.
ENQ	0-5	Enquiry.
ACK	0-6	Acknowledge.
CON	0-7	Contention (same as BEL).
NAK	1-5	Negative Acknowledge.
SYN	1-6	Synchronous Idle.
POL	7-0	Poll.
SEL	7-1	Select.
FSL	7-3	Fast Select.
BSL	7-4	Broadcast Select.
RVI	1-0, 3-C	Reverse Interrupt.

### Illegal Characters

An *illegal character* is defined as a character having incorrect parity, or a control character appearing incorrectly in a predefined sequence. The printer tests each character received for correct parity and accepts control characters only in the sequence defined for the communications procedure being employed.

### Data Error Checking

Upon receipt of a message, the printer employs two types of error checking. The first is a character parity check using the eighth bit of each received

character as the parity bit. The second is a longitudinal binary sum (without carry) of each of the seven data bits of the received characters following the SOH code, up to and including the ETX code. This sum is contained in the Block Check Character (BCC) which also contains a character parity bit. If the tests for character parity within the text of the message and the BCC are correct, the printer responds with an ACK character. If either error check fails, the printer responds with a NAK character.

## Printer Address

The printer address (AD1, AD2) is set by the Field Engineer via internal switches.

The Group Poll address (GP1, GP2) is also set by the Field Engineer via internal switches. It is independent of the individual address of the printer.

## Transmission Numbers (XMT#)

Three options exist for transmission numbers: no transmission numbers, transmission numbers alternating between ASCII characters 0 and 1, or transmission numbers cycling through the ASCII characters 0, 1, 2....9.

If no transmission numbers are used, then a single ASCII digit transmission number is tolerated and ignored in received messages. No transmission numbers are included in the headers of messages to the host. No transmission number checking is performed on Broadcast Select.

If transmission numbers are used, then the transmission number initially expected is "0" for regular and Fast Select. Every message received has its transmission number compared to the expected transmission number. If the values match, then the message is accepted. If the expected transmission

number is the successor of the received transmission number, then the message is ignored, and the operator is informed through the auxiliary status byte that a duplicate message has been received. Any other non-match causes the message to be ignored and the operator to be informed through the auxiliary status byte that a message has been lost.

After every Select or Fast Select, the expected transmission number is set to the successor of the received transmission number of the message. If the received transmission number is not a digit, then the appropriate expected transmission number is set to "0".

The send transmission number is initialized to "0".

## Communications Procedures

The printer can use any of the following multipoint communications procedures for transmitting and receiving data:

- Poll
- Group Poll
- Select
- Fast Select
- Broadcast Select (Modified)

Multipoint Contention may be used on a line which has one or more printers located on it. The printers will ignore the protocol and will never contend for service.

### Poll (POL)

The polling procedure is used to transmit status to the host. The polling procedure and its associated notes are illustrated in figure 7-1.

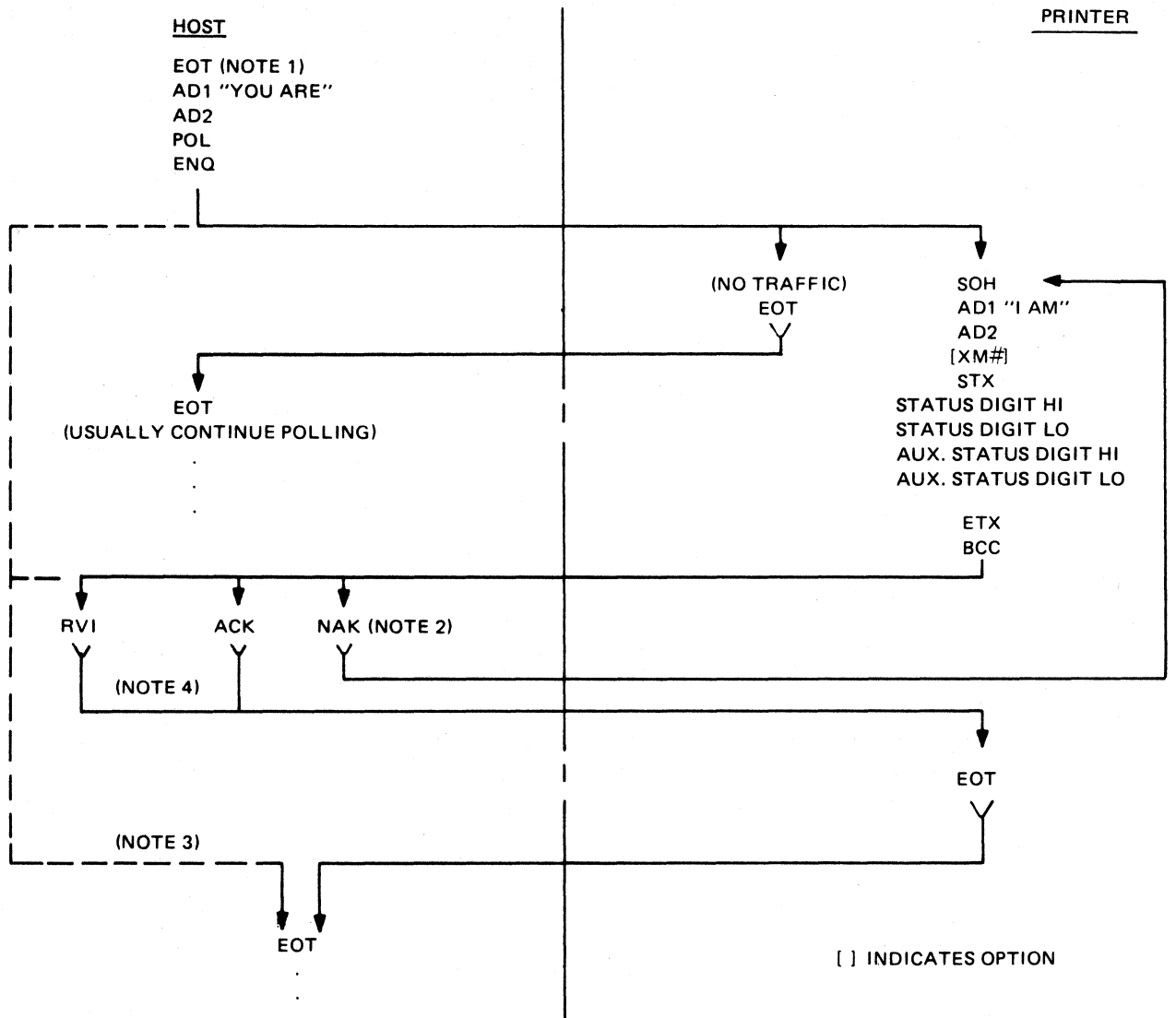


Figure 7-1. POL

Notes to figure 7-1:

1. This EOT may have been the termination for a previous transmission sequence. To minimize the effect of noise, the polling sequence may follow immediately.
2. If the host receives a message for which the character parity or block check tests fail, the NAK character is transmitted, calling for repeat of the transmission. This action can be repeated n times (n may be equal to zero) at which time, if the test fails, an error is recorded by the host and an EOT character is transmitted, terminating the transmission sequence.

- The printer transmits the same message when next polled.
3. If the printer does not receive an ACK, NAK, or EOT character, it may retain its message and remain inactive. The host times out and transmits an EOT character, thereby terminating the transmission sequence. The printer transmits the same message when next polled.
4. Reverse Interrupt (RVI) may be used by the host only after reception of a valid message which would result in a positive acknowledgement. Instead of sending ACK, the host sends Reverse Interrupt (1-0, 3-C).



# Group Poll (GPL)

The GPL procedure is an option of the standard

multipoint procedure. The GPL procedure and its associated notes are illustrated in figure 7-2.

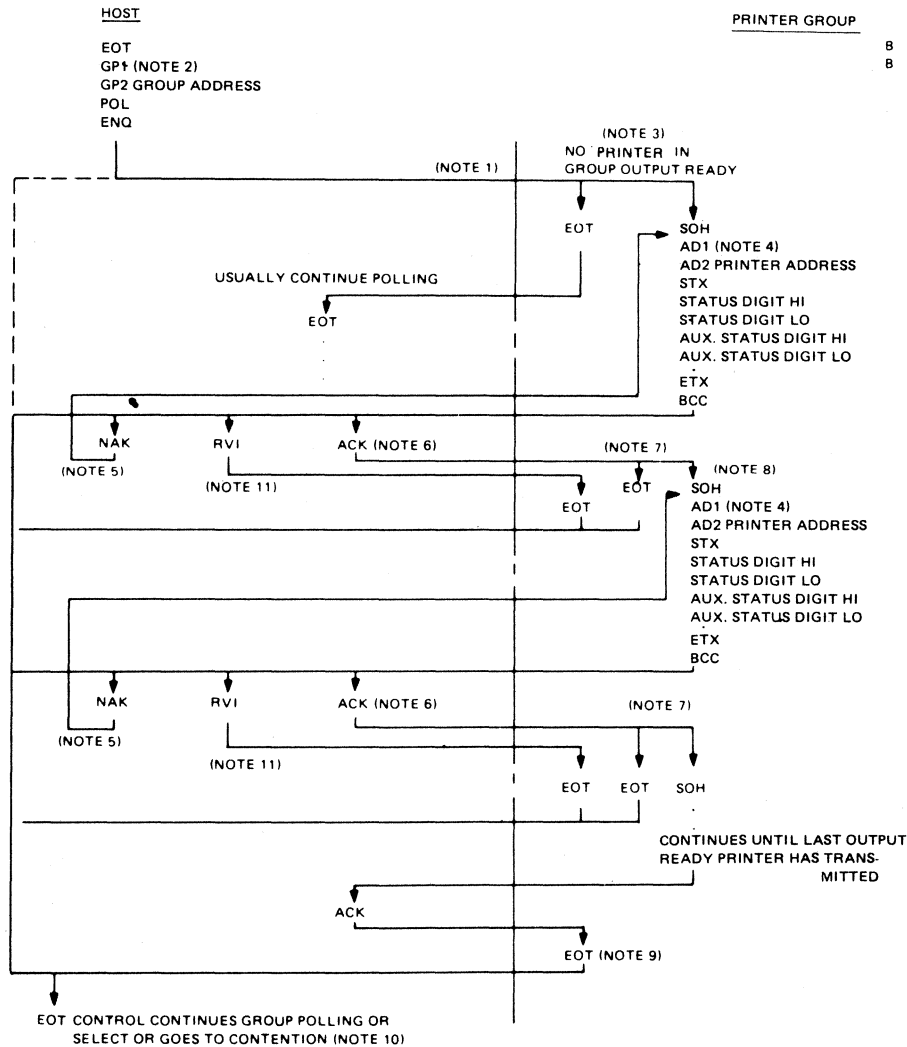


Figure 7-2. Group Polling

Notes for figure 7-2:

1. This procedure is used to reduce the overhead in a network of printers where several are located at one location on a communications line. The receipt of one Group Poll, if no printers are output ready, results in one response from the group. Thus, control can pass to the next group. In periods of low activity, the control is able to go through the polling list determining the output status of all printers with only one Poll to each location, not each printer. If multiple printers are output-ready at a location, they are allowed to transmit in sequence, in response to one Poll. Select, Broadcast, Fast Select, etc., are not affected by this polling procedure.
2. In this procedure, the polling sequence follows the same format as a normal Poll and uses the normal Poll character. Group Poll is controlled by the printer address and configuration set-up.
3. When the Poll is received by the group addressed, the output ready printer closest to the host or modem is the first to respond.
4. Each message sent in response to a Group Poll contains the individual responding address of the printer.
5. If the host detects an error in the message received in re-

- sponse to a Group Poll, normal polling error recovery is used.
6. Under this procedure, the host must be sure when it replies ACK to a message that buffer space exists, or is available for the next message that could result from another output-ready printer.
7. As soon as ACK is received from the host, the next output-ready printer transmits.
8. When ACK is received from the host and no printers remain output-ready, it is the responsibility of the last printer in the concatenation string to transmit the final EOT.
9. If the printer does not receive an ACK, NAK, or RVI character, it retains its message and remains inactive. The host times out and transmits EOT, thereby terminating the transmission sequence. The message is retransmitted when next polled.
10. The same error recovery procedure described in figure 7-1 is used with this procedure.
11. Reverse interrupt (RVI) may be used by the host only after reception of a valid message which would result in a positive acknowledgement. Instead of sending ACK, the host sends RVI.

1. All printers within the same group address must be on the same concatenation.
2. A printer with data to transmit blocks propagation of the request-to-send and clear-to-send signals over the data set interface lines until released by a successful transmission to the host (receipt of ACK or EOT characters from host). The host may terminate a Group Poll sequence at any time by transmitting EOT or RVI instead of ACK.
3. The EOT character is not transmitted by a printer detecting a request-to-send signal sent by any other printer more remote from the data set in the concatenation.
4. No printer transmits until it receives, in response to its request-to-send signal, a clear-to-send signal from a printer closer to the data set in the concatenation.

Data received by the host in response to a Group Poll is in order from the group member closest to the host in the concatenation string, and ends with an EOT from the group member farthest from the host in the concatenation. Each message contains the individual address characters (AD1, AD2) of the printer. Upon receipt of a NAK character from the host, the terminal retransmits its message. Concatenated printers with the same group address for group polling must be similar in their characteristics for the request-to-send/clear-to-send response time. The printers remaining in the group do not attempt to transmit and retain their message until the next Poll.

### Select (SEL)

The Select procedure is used for receiving data from the host. This procedure, along with associated notes, is illustrated in figure 7-3.

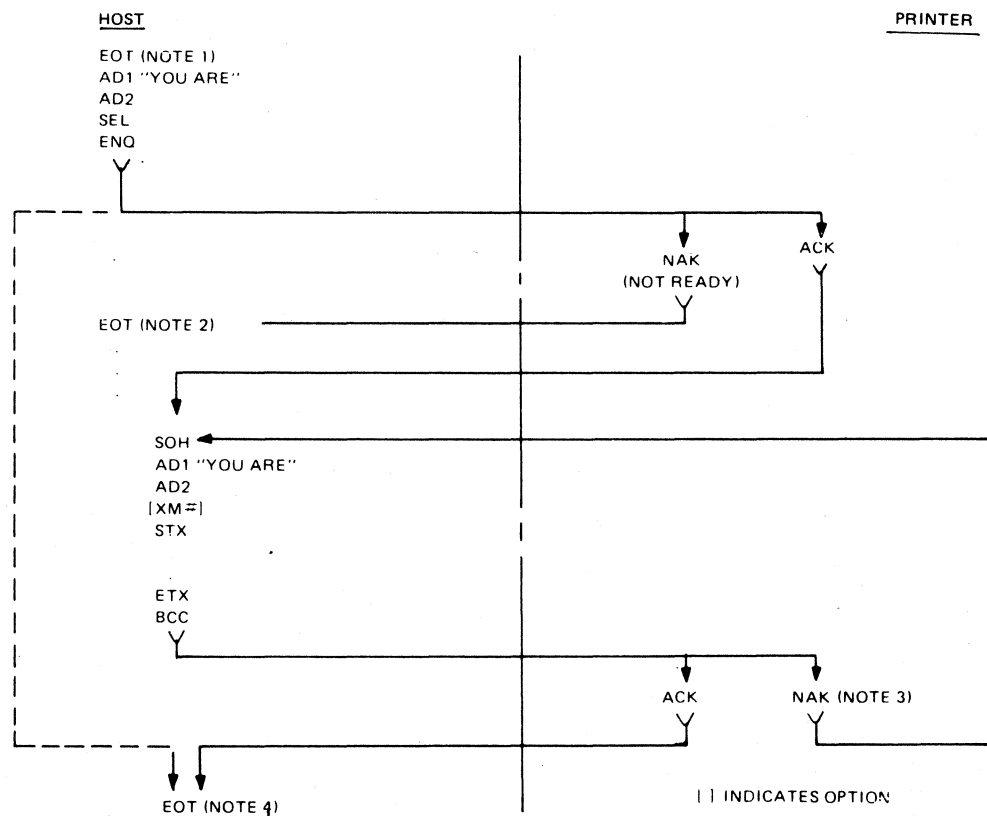


Figure 7-3. Select

#### Notes for figure 7-3:

1. This EOT may have been the termination of a previous transmission sequence. To minimize the effect of noise, the selection sequences may follow immediately.
2. If the printer is not ready to receive (as indicated by the transmission of NAK) the host normally retries the selection sequence in the proper order for the printer; however, for some installations it may be desired to repeat a selection sequence immediately.
3. If character parity or block check are not validated by the printer, or if a buffer overflow occurs, the printer transmits NAK. In this case, the host retransmits the message n times

- (n may equal zero). If the printer still does not acknowledge the message, the host terminates the sequence with an EOT character after recording the error. The host retains the message for transmission on the next selection to this printer.
4. If the host does not receive a response (ACK or NAK) to its message, it may time out and retransmit the block n times (n may equal zero). If there is still no response received, the host times out and terminates the selection sequence by transmitting EOT after recording the error. The host retains the message for transmission on the next selection sequence to this printer.



## Broadcast Select (BSL)

The BSL procedure enables the host to perform a fast selection of all multipoint network printers which contain the BSL option. The BSL procedure (and associated notes) is illustrated in figure 7-5. The address characters (AD1, AD2) are selected to represent the address of the printer that responds to the host transmission with ACK or NAK. Any printer

(other than the addressed printer) that is not ready to receive (non-Idle mode) ignores a Broadcast Select from the host.

By configuring a jumpered printer option, the printer can be forced to ignore Broadcast Selects.

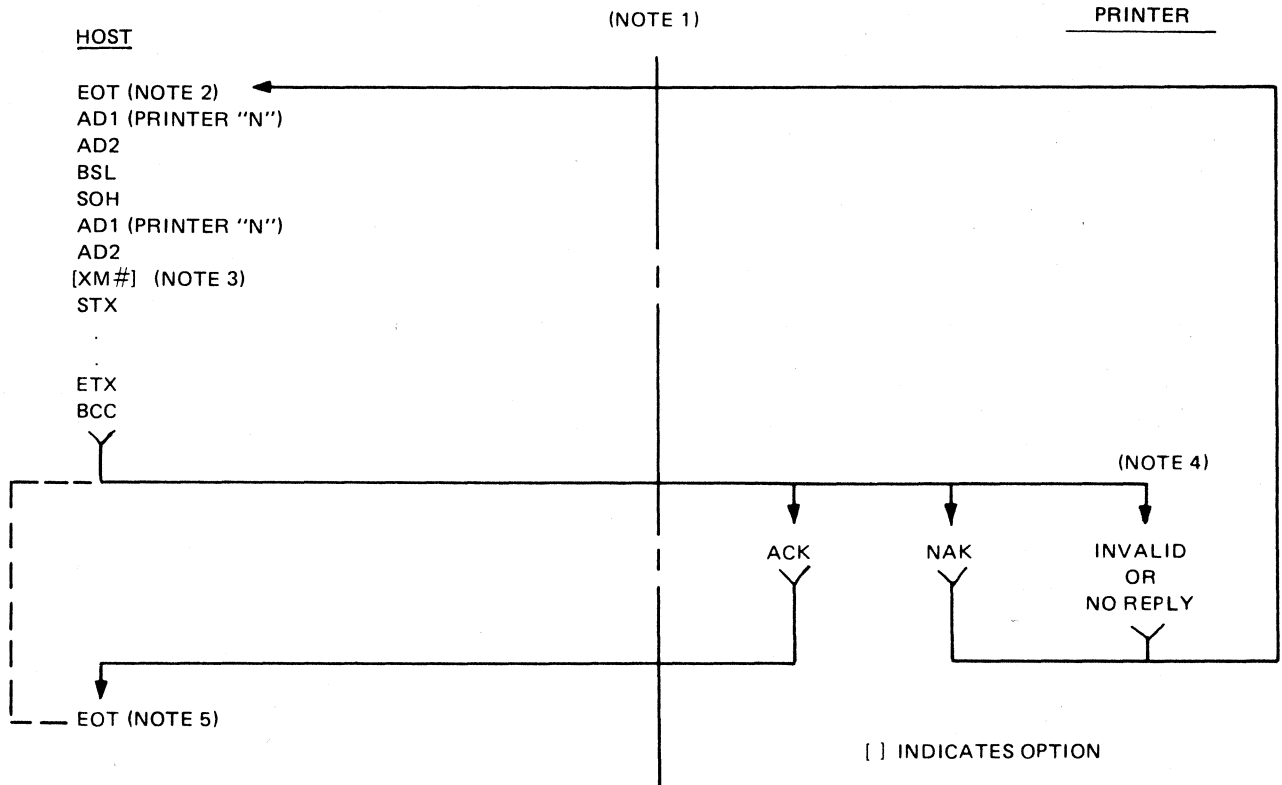


Figure 7-5. Broadcast Select

Notes for figure 7-5:

1. Broadcast Select is a fast selection of all printers. AD1 and AD2 are selected to represent a printer which acknowledges receipt of the message.
2. This EOT may have been the termination of a previous transmission sequence. To minimize the effect of noise, the Broadcast Select sequence may follow immediately.
3. Transmission numbers are ignored by the printer when used by the host except during the calculation of BCC.

4. If the addressed printer does not receive a valid message, (there is a parity, or block check error, or the printer is in a non-receive mode), that printer responds with a NAK character.
5. If the host does not receive a response (ACK or NAK) to its Broadcast Select, it may time out and rebroadcast the message n times (n may equal zero). If no response is received, the host terminates the Broadcast mode by transmitting EOT after recording the error.

## Character Format

The printer is capable of operating with either asynchronous or synchronous character format.

### Asynchronous Data Communications

For asynchronous data communications, each transmitted character uses ten nominally equal time intervals represented by a start bit, eight bits of information, and a stop bit. The start bit is a binary zero (Space) and is followed by seven bits of character code, transmitted with the least-significant bit first. The ninth transmitted bit is an even parity bit which is selected to make the total of binary one, or Mark bits, even (excluding the start and stop bits). The stop bit is a binary one (Mark).

### Synchronous Data Communications

For synchronous data communications, each transmitted character uses eight nominally equal time intervals represented by eight bits of information. The first seven represent the 7-bit character code which is transmitted with the least-significant bit first. The eighth bit is an odd parity bit (selected to make the number of binary one, or Mark bits of the 8-bit group, odd).

### Synchronous Idle Character (SYN)

The SYN character is used in the synchronous data communications mode to provide a signal for establishing and retaining synchronization in the absence of any other character. When initiating a synchronous transmission, the host sends out four SYN characters prior to the transmission of any other character to permit the receiving station to acquire synchronization. The printer purges the SYN character from recognition in the normal character sequence and does not include the SYN character in the BCC calculations.

The printer establishes character synchronization upon detection of two contiguous SYN characters and maintains this character synchronization unless it receives two consecutive characters with bad (even) parity. This condition is fulfilled when the data signal drops to the binary one (Mark) state, or when 16 bits of pad characters have been received. When character synchronization is lost, the printer re-establishes character synchronization upon receipt of the next two contiguous SYN characters.

### International Applications

The printer conforms to the interface circuit requirements defined by CCITT recommendation V24

and operates with the following data sets or equivalents in international applications.

1. V21 data set - the printer operates in a compatible interface with the V21 data set or equivalent, including the GPO Datel 2. Operation is asynchronous half-duplex at a data rate of 150 or 200 bps. Circuit 126 selects the transmit frequency for the data set. A positive voltage is used to select frequency number 1; a negative voltage is used to select frequency number 2. This adjustment is made by a Field Engineer.
2. V23 data set - the printer operates in a compatible interface with the V23 data set or equivalent, including the GPO Datel 1 and Burroughs TA 1201. Operation is asynchronous half-duplex at data rates of 600/1200 bps. A positive voltage is used to select 1200 bps operation; a negative voltage is used to select 600 bps operation. The Datel 1 normally operates on a 4-wire connection, but has the capability of being switched to 2-wire standby connection. The request-to-send delay in 2-wire operation is 200 milliseconds (msec). This delay is provided internally by the printer for both 600 and 1200 bps data sets.
3. V26 data set - the printer operates in a compatible interface with the V26 data set or equivalent, including the GPO Datel 7. The mode of operation is synchronous. Using the facility 3 form of the data set, operation is at a data rate of 2400 bps on a 4-wire line with alternate channel data rate of 1200 bps in either direction (not simultaneously) on a 2-wire line. CCITT circuit 111 (data signal rate selector) selects which of the alternative data rates are used.

### Concatenation Connection

A means is available for connecting multiple printers to a single data set in an asynchronous or synchronous multipoint network through concatenation (series chaining) of the printers. Disconnecting or removing power from any printer in the chain disables all printers beyond that printer.

### Synthesis of Clear-to-Send

When a concatenated printer chain includes certain non-printing devices, these devices possibly may not propagate the clear-to-send signal. It is also possible that these devices may loop the request-to-send signal directly back as clear-to-send, thereby eliminating any delay. A printer located beyond these devices does not receive clear-to-send from the data

set and, as a result, does not properly transmit its data. To overcome this difficulty, the printer contains within its concatenation circuitry a delay circuit which synthesizes the clear-to-send signal when activated by the request-to-send signal.

## Concatenation Cabling Limitations

No more than 15 printers can be concatenated in a chain composed solely of printers. In asynchronous operation, the maximum printer-to-printer concatenated cable length may not exceed 100 feet (30.48 meters). The maximum cumulative cable length may not exceed 1000 feet (304.8 meters). In synchronous operation, the maximum cumulative concatenation cable length may not exceed 1000 feet (304.8 meters).

## Interface Data Rates and Data Sets

The printer is capable of operating with both domestic and international data rates and data sets. All data rates are field-engineering selectable (refer to section 2 of this manual).

### Data Rates

The standard data rate is 1800 bps, but the following rates may be selected by switches within the printer:

9600, 4800, 2400, 1800, 1200, 600, 300, 200, and 150 bps.

### Back-Up Rate Switch

The Back-up Rate switch is a 2-position switch mounted on the rear of the printer. Switch positions are labeled (1 = NORMAL; 2 = LOW). When the switch is in the NORMAL position, the printer transmits at the normal rate.

When the switch is in the LOW position, the printer transmits at the lower rate and delays are changed from 4-wire to 2-wire delays. Remote activation of the data rate selector circuit is equivalent to having the Back-up Rate switch set to the LOW position. If either the switch is set to LOW, or the rate selector circuit is active, then the back-up rate is selected. In a concatenated printer system, the data rate must be set identically for all printers. The Back-up Rate switch can provide rate-pairs of 1800 - 1200 bps or 1200 - 600 bps.



## TWO-WIRE DIRECT INTERFACE (TDI) COMMUNICATIONS

The printer is capable of TDI. The following factors are considered:

1. Character format is 10 bits (asynchronous).
2. Data transmission rates for asynchronous data is as follows:  
150, 200, 300, 600, 1200, 1800, 2400, 4800, or 9600 bps.
3. The connector for TDI uses pin 2 for data and pin 7 for signal ground.
4. The characters of a message sequence are in accordance with the following multipoint communications procedures as described elsewhere in this manual: POL, SEL, FSL, and BSL (Group Poll is excluded).
5. The cable used for the TDI connection is twisted 2-wire cable with a maximum length of 1000 feet (304.8 meters). This cable is a single cable with multiple drops along its length. The number of printers in a TDI installation is limited to a maximum of nine on a 1000-foot (304.8 meters) cable.

## BURROUGHS DIRECT ASYNCHRONOUS ACCESS (BDAA)

The printer is capable of meeting the requirements of BDAA as defined in the following paragraphs. Data rates include 1200, 1800, 2400, 4800, and 9600 bps at a maximum cable length of 6000 feet (1524 meters). The combination of the parameters of data rate, maximum installed cable length, and cable wire gauge provides the limits which govern each BDAA installation. The number of printers in a BDAA installation containing a single multipoint line is limited to a maximum of 20.

Character format is ten bits (asynchronous). The characters of a message should be in accordance with the following printer multipoint communications procedures: POL, SEL, FSL, and BSL. Group Poll is excluded.

## CLEAR-TO-SEND (CTS) DELAYS

The printer can accept externally generated (data set) clear-to-send delays, or can provide internal (self-generated) clear-to-send delays. Selection of in-

ternal/external CTS delay is accomplished by a Burroughs Field Engineer.

## External Delays

When configured for external delays, the printer requires no more than one millisecond to recognize the externally-generated CTS signal.

## Internal Delays

When configured for internal CTS delays, the printer has the following options:

- For TDI/BDAA: 0, 4, 17, or 50 msec.
- For RS-232-C: 0, 25, 50, or 200 msec.

## Other Delays

The printer provides a field-engineering selectable transmit-to-receive delay. Four options are available. Each option provides one of two values depending on whether 2-wire or 4-wire operation is called for:

Transmit-To-Receive Delays (msec)			
	2-Wire	or	4-Wire
Options:	12.5	or	0
	25	or	12.5
	50	or	25
	100	or	50

## FIELD-SELECTABLE OPTIONS

### Asynchronous/Synchronous Selector Switch

When this switch is in the OFF position, the printer operates in the asynchronous mode. This mode uses the following conditions:

1. Word length equals seven bit characters.
2. One stop bit.
3. Even parity.

When BDAA/TDI is selected, this switch must be in the OFF position so that the printer operates in the asynchronous mode.

When the switch is in the ON position, the printer operates in the synchronous mode. This mode uses the following conditions:

1. Word length equals seven bit characters.

2. Two SYN characters are required to re-establish synchronization.
3. Odd parity.

When BDAA is selected, this switch must be in the OFF position so that the printer operates in the asynchronous mode.

### Transmission Number Enable/Disable

When this switch is in the ON position, no transmission numbers are used. When it is in the OFF position, either cyclic (0 through 9) or alternating (0/1) transmission numbers are used, depending on the jumper selected (refer to the paragraph titled Transmission Number Type Select, in this section).

### Transmission Number Type Select

This jumper has no function unless the transmission number Enable/Disable switch is in the Enable (OFF) position; in that case, if this jumper is open, then cyclic transmission numbers are used. If the jumper is closed, then alternating transmission numbers are used.

### CTS Delay Time

Two switches are used to configure the CTS delays as described in the paragraph titled Clear-to-Send Delays, this section.

### Transmit to Receive Delay Time

Two switches are used to configure the transmit-to-receive delay time as described in the paragraphs following the heading Clear-to-Send Delays, in this section.

### 2-Wire/4-Wire Switch

When this switch is ON, the printer selects 2-wire operation. When this switch is OFF, the printer selects 4-wire operation unless either the Back-up Rate Select switch is in the LOW position, or the data rate selector circuit is active. In the latter cases, 2-wire operation is used.

The choice between 2-wire and 4-wire operation affects the transmit-to-receive delays as described in the paragraphs following the heading Clear-to-Send Delays, in this section.

For BDAA/TDI operations, the switch should always be in the ON position.

## Monitor Mode Enable

When this switch is turned to OFF, the printer enters the Monitor mode. This mode provides a soft monitor of data comm line activity by causing received control characters and certain text characters to be printed. As a security measure, only text char-

acters which are destined for the monitoring printer are printed. Characters with bad parity or pad characters are not printed.

Upon entering the Monitor mode, the carrier initializes; all buffered data is lost. Each character to be printed is translated into two ASCII characters according to the table below. For characters in ASCII columns:

0	1	2 thru 7
Character Printed	Character Printed	
NULL = Nu	DLE = Dl	All ASCII characters in columns 2 through 7 are printed as a space followed by that ASCII character.
SOH = Sh	DC1 = D1	
STX = Sx	DC2 = D2	
ETX = Ex	DC3 = D3	
EOT = Es	DC4 = D4	
ENQ = Eq	NAK = Nk	
ACK = Ak	SYN = Sy	
BEL = Bl	ETB = Eb	
BS = Bs	CAB = Cb	
HT = Ht	EM = Em	
LF = Lf	SUB = Sb	
VT = Vt	ESC = Ec	
FF = Ff	FS = Fs	
CR = Cr	GS = Gs	
SO = So	RS = Rs	
SI = Si	US = Us	

Monitoring continues until a buffer overflow occurs. At that time, printing ceases until the monitor is exited (by turning the switch to the ON position).

## Address Switches

Four sets of 8-bit switches are provided to select the address of the printer. Two of these sets of switches provide the printer with its individual (AD1/AD2) address; the other two sets of switches provide

the printer with its Group Poll (GP1/GP2) address. When one of the switches is ON, the corresponding address bit is 0.

## Broadcast Select Enable/Disable Jumper

When open, the printer responds to Broadcast Selects. When jumpered, the printer ignores Broadcast Selects.



# APPENDIX A

## HOST PROGRAMMER NOTES FOR THE AP 300

Programming for the AP 300 simply involves transmitting appropriate control codes as defined in figure 5-1.

Escaped codes are transmitted by sending, first, the escape code (1-B), then the control code as defined in the Escaped Controls chart (figure 5-1). For example; in order to specify form length, the sequence "1-B, 7-A" would be transmitted to the printer.

Typically, the programmer must:

1. Specify general formatting by moving appropriate control codes into the buffer (Form Length, Line Advance Increment, etc.).
2. Designate a font as specified in this manual. If other fonts are desired, they must be specified in the program. The codes for these desired fonts should be moved into the buffer.

Programmers should remember that the AP does not print any data until a whole message has been received. Messages should be no longer than 500 characters.

### STATUS WORDS

It is recommended that each program check the printer status at the beginning of the program. Before transmitting a message, the program should transmit the Send Status control code in order to determine the availability of the printer. Refer to section 4 of this manual for an explanation of printer states and a breakdown of the status word. When the status word is received by the host, it is the function of the program to test the bit pattern in order to determine the status of the printer and whether the printer is ready to receive a message.

# APPENDIX B

## AP 300 SERIES COMMANDS

Command	Function
1. Send Status	1-B, 3-0 (Note) Printer status returned. Status and auxiliary status words sent to host on next POL.
2. Insert CDF	1-B, 3-6 Contents of CDF printed.
3. Load CDF	1-B, 3-5 Loads all data and controls bracketed by Load CDF commands into CDF buffer.
4. Cancel	1-8 Resets all data and condition flags. Resets CDF buffer. Stops printing.
5. BEL	0-7 Lights ALERT indicator for 1/2 second; audible alert sounds for 1/2 second.
6. Form Required	1-B, 7-6 Checks validator form sensor. Stops printing if no form. NO-OP in AP 310.
7. Release Form	1-B, 7-7 Requires pressing of CONT switch to resume printing. NO-OP in AP 310.
8. Go Idle	1-B, 3-2 Printer enters Idle state after printing up to that point.
9. Forms Length	1-B, 7-A 3-K, 3-Y, 3-Z Sets forms length in 1/24 inch increments. Maximum length is 999 x 1/24 inch = 41.625 inches. Default length is 11 inches.
10. Test Printer	XYZ = 000 to 999 1-B, 3-3 Printer executes confidence test. Memory and system registers are reset.
11. Line Advance Increment	1-B, 3-E, 3-m, 3-n Advances paper; m,n = number of 1/2 inch increments.

where n defines the line advance distance as follows:

Line advance distance =  $n/24$  ( $1 \leq n \leq F$ ).

3-0 increments the line 2/3 inch.

12. Vertical Tab	0-B, 3-X, 3-Y Advances paper. X,Y = Max. no. of 1/24 in. increments (ASCII decimal). Sets printer to 16 cpi.
13. CPI-16	1-B, 3-C Sets printer to 12 cpi.
14. CPI-12	1-B, 3-D Unconditionally prints ninth pin.
15. Set Underscore	1-B, 3-7 Inhibits printing underscore.
16. Reset Underscore	1-B, 3-8 H-L: Prints extreme left character in field at indicated position.
17. Horizontal Positioning	1-B, 3-9/A, 3-X, 3-Y, 3-Z 3-9 = H-L, Left-Justify 3-A = H-R, Right-Justify H-R: Indicates position of extreme right character of that field. X, Y, Z = ASCII decimal, positioning - number of spaces from left margin.
18. Shift Out	0-E Selects G1 character set.
19. Shift In	0-F Selects G0 character set
20. New Line	0-A Prints all data preceding code, then vertical spaces one line and left-justifies to position zero.
21. Forms Feed	0-C Advances paper to top of next page.
22. Carriage Return	0-D Causes all preceding data to be printed. No line feed occurs.

Note:

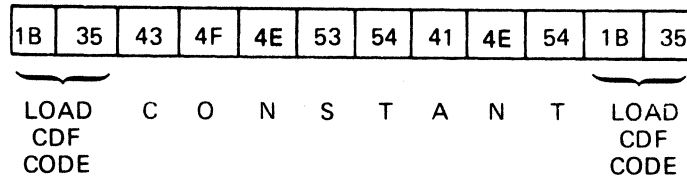
The 1-B code is an ESC character.

# APPENDIX C

## BUILDING A TRANSMIT BUFFER IN THE HOST: SOME EXAMPLES

### EXAMPLE 1: LOADING THE CONSTANT DATA FIELD (CDF)

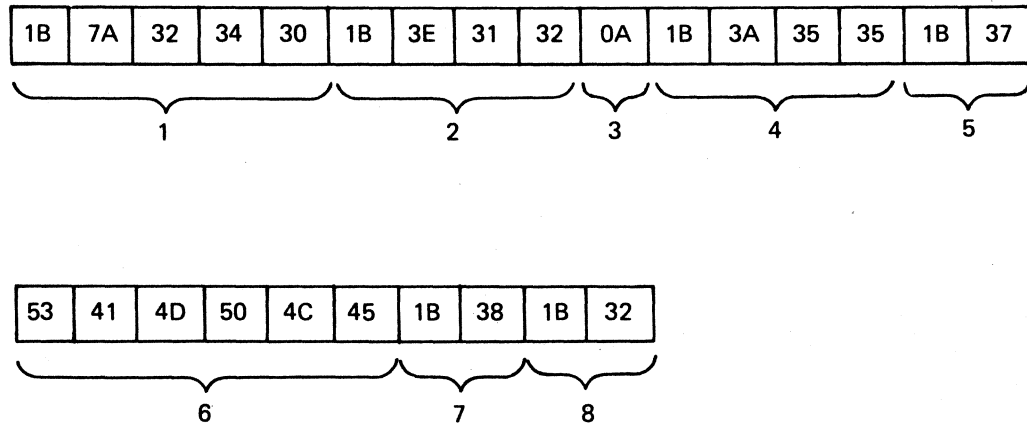
Because the printer must be in the Idle state when the CDF is loaded, the host should check the status of the printer. After ensuring that the printer is in the Idle state, the host transmits the following message which loads the CDF with the message, CONSTANT:



### EXAMPLE 2: PRINTING A SAMPLE MESSAGE

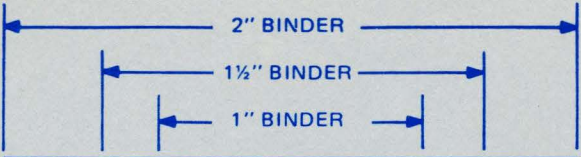
Code sequence 1 of the following example defines forms length to be 10 inches. Sequence 2 defines a line advance increment of one half inch.

The host then, in this message, sends one line of right-justified, partially underlined data by sending the New Line code (3), Right-Justified Horizontal positioning code (4), Set Underscore code (5), the word SAMPLE (6), Reset Underscore code (7). The host ends the message by sending the Go Idle control code (8).



Notes to the above diagram:

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>1. Forms Length.</li> <li>2. Line Advance Increment.</li> <li>3. New Line.</li> <li>4. Right-Justified Horizontal Positioning.</li> </ul> | <ul style="list-style-type: none"> <li>5. Set Underscore.</li> <li>6. SAMPLE.</li> <li>7. Reset Underscore.</li> <li>8. Go Idle.</li> </ul> |
|--|---|



**AP 300 Equipment**  
**(Data Communications Interface)**  
REFERENCE MANUAL

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