Programmer's Guide for the Series 70 Printer

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The purpose of this guide is to help programmers and system engineers program the IPI Series 70 Printer and integrate it into a system.

PRINTER INFORMATION

The IPI Series 70 Printer is a nine-pin impact printer designed for use in video lottery systems. It supports multiple-column printing in two character sets and graphics.

The information in this section describes the features and general characteristics of the printer.

Features

- Print Speed
  - 200 characters per second in normal mode
  - 100 characters per second in double wide mode
- Interface
  - Centronics Parallel
  - RS-232
- Character Sets
  - IBM Character Set I
  - IBM Character Set II
- Character Modes
  - Normal Mode
  - Double-Wide Mode
- Line Spacing
  - Eight lines per inch
- Automatic Knife Cutter
  - .002 to .007 inch ply thickness
  - Full cut only
- 2-Ply Receipt-Journal Printing
- Low Paper Sensor
- Mounting
  - Vertical
  - Horizontal

Graphics
Block graphics (characters from character set)
Dot addressable graphics

Dimensions

Depth
10.75 in.
273 mm

Width
6.062 in.
154 mm

Height
6.75 in.
171.5 mm

Paper Exit
4.72 in. from front of printer +/- .020 in.
from left to right 120 mm

Reliability

Mean Time Between Failures (MTBF)
25,000 hours

Mean Time To Repair (MTTR)
15 minutes

Printhead life
200 million characters Mean Cycles Between Failure (MCBF)

Ribbon Cassette
3 million characters

Knife
1 million cuts (life)
100,000 cuts Mean Time Between Failure (MTBF)

Power Requirements

Voltage
120 +/- 10% Vac

Amperage (draw)
.4 amps (maximum)

Frequency
60 +/- 2% Hz

Power (wattage)
37 W

Environmental Requirements

Operating Temperature
40 Degrees Fahrenheit to 105 Degrees Fahrenheit
5 Degrees Celsius to 40 Degrees Celsius

Operating Humidity
20% to 90% relative humidity (non-condensing)

Storage Temperature
40 Degrees Fahrenheit to 140 Degrees Fahrenheit
5 Degrees Celsius to 60 Degrees Celsius

Storage Humidity
5% to 95% relative humidity

Startup

When the printer receives power, the following sequence occurs:

Carriage moves slightly left
Carriage moves slightly right
Carriage homes to left side
Cutter blade cycles once
Interface sets to ready state

If there is a fault condition on startup, the LED on the board will flash, the interface will be set to not ready, and the printer will not come up.

Fault Conditions

The following fault conditions may occur:

- Printhead or Cutter Blade Jam
- Paper Low

When one of these occurs, the printer sends various signals to the host system to indicate what the fault condition is.

Printhead or Cutter Blade Jam

If the printhead or cutter blade is jammed, usually due to a paper jam, the following signals are sent from the printer to the host system:

Busy signal goes high
/Fault signal goes low
Select signal goes low
Printer is offline

Paper Low

When the paper low sensor is activated, the following signals are sent from the printer to the host system:

Select signal goes low
Paper End signal goes high
Busy signal goes high
/Fault signal goes low

The printer continues printing until it receives the Activate Cutter command or until it prints 21 inches of paper (allowing transactions to finish, especially longer ones such as an End-of-Day report).

COMMUNICATIONS

The IPI Series 70 Printer can be programmed using either the Centronics parallel interface or the RS-232 Interface. This section describes both interfaces as well as the commands supported by the printer.

Centronics Parallel Interface

This section describes the implementation of the Centronics Parallel Interface for the IPI Series 70 printer.

The following sections show the pin assignments, the communications sequence, and the timing diagram.

Pin Assignments

Data bit 8 is optional. It is connected to pin 16 through a jumper. The /ACK signal is also optional. It is coupled to pin 23 through a jumper.

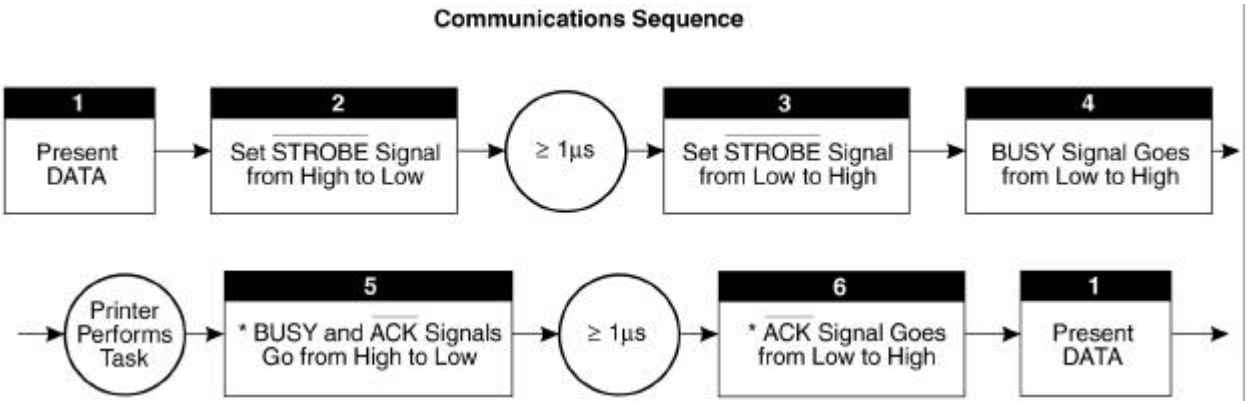
Pin #	Signal	Direction	Description
1	/STROBE	To Printer	STROBE pulse of read data in. Pulse width must be more than 0.5 microseconds at receiving terminal. The signal level is normally high; read-in of data is performed at the LOW level of this signal.
2	DATA 1	To Printer	Least Significant Bit High=Logical 1; Low=logical 0
3	DATA 2	To Printer	High=Logical 1; Low=Logical 0
4	DATA 3	To Printer	High=Logical 1; Low=Logical 0
5	DATA 4	To Printer	High=Logical 1; Low=Logical 0
6	DATA 5	To Printer	High=Logical 1; Low=Logical 0
7	DATA 6	To Printer	High=Logical 1; Low=Logical 0
8	DATA 7	To Printer	High=Logical 1; Low=Logical 0
9	DATA 8	To Printer	High=Logical 1; Low=Logical 0
10	/ACKNOWLEDGE	From Printer	Approximately 5 Microseconds LOW Pulse. LOW = Data Received, Printer Ready
11	BUSY	From Printer	Low = Printer Ready to Receive Data High = Printer NOT Ready to Receive Data

Pin #	Signal	Direction	Description
12	PAPER END	From Printer	High = Printer Paper Low
13	SELECT	From Printer	High = Printer Online
14	PULLED HIGH		
15	VACANT		
16	0V		Logic Ground
17	CHASSIS GROUND		Chassis Ground is Isolated from Logic Ground
18	+5V	From Printer	50mA Maximum
19-30	0V	Ground	Twisted Pair Return Signal Ground Level
31	/I-PRIME	To Printer	Clear/Reset/Initialize. Low Pulse
32	/FAULT	From Printer	Low = Paper Low Offline Error
33	0V		Logic Ground
34	VACANT		
35	VACANT		
36	Pulled High		

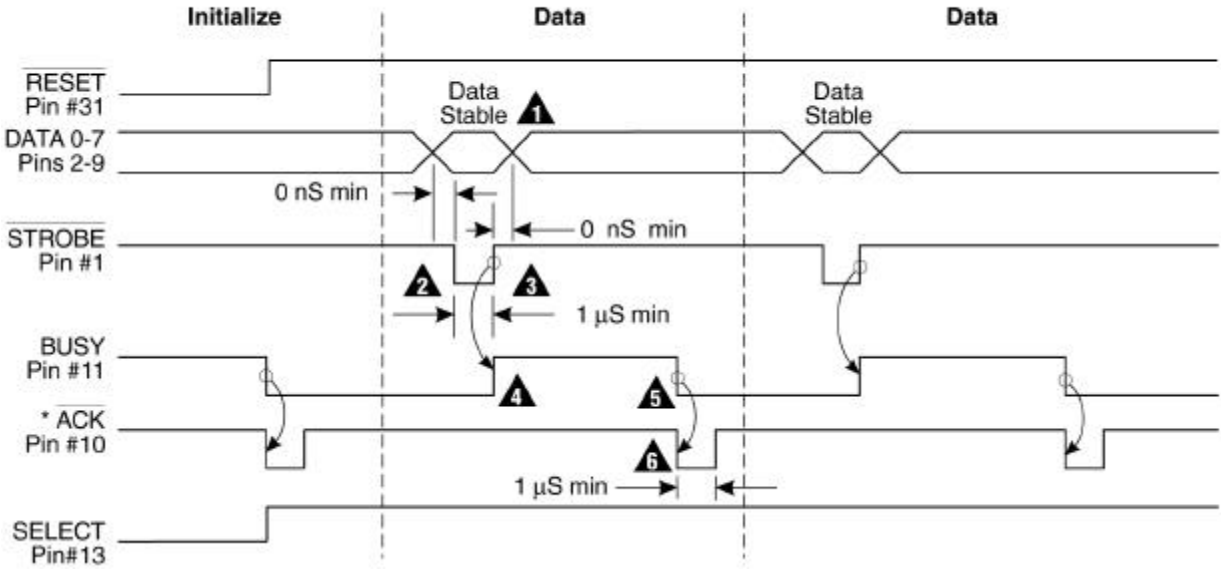
Protocol

Communications Sequence (see chart on page 8)

Timing Diagram (see chart on page 9)


Communications Sequence
1
Present DATA
2
Set STROBE Signal from High to Low
≥ 1µs
3
Set STROBE Signal from Low to High
4
BUSY Signal Goes from Low to High
Printer Performs Task
5
* BUSY and ACK Signals Go from High to Low
≥ 1µs
6
* ACK Signal Goes from Low to High
1
Present DATA

Timing Diagram



RS-232 Interface

This section describes the implementation of the RS-232 Interface for the IPI Series 70 printer.

The following sections provide information for these topics:

- Features
- Pin Assignments
- Switch Settings
- Protocol
- Diagnostic Tests

Features

- Up to 19.2K Baud
- 2K Buffer
- READY/BUSY or XON/XOFF Protocol
- Communications Diagnostic Mode
- Optional Firmware to Send Data From Printer

Pin Assignments

Pin #	Signal	Symbol	Direction	Description
1	PROTECTIVE GROUND	PG		Connected to the Printer Frame
2	TRANSMIT DATA	TD	From Printer	Transmits Serial Data in XON/OFF Protocol
3	RECEIVE DATA	RD	To Printer	Serial Data Received by Printer
4	REQUEST TO SEND	RTS	From Printer	Printer is NOT Ready to Receive Data in READY/BUSY Protocol
5	VACANT			
6	DATA SET READY	DSR	To Printer	Host is Ready to Send Data. Printer Receives Data After Confirming This Signal as High.
7	SIGNAL GROUND	SG		Ground
8-10	VACANT			
11	SUPERVISORY SEND DATA	SSD	From Printer	Printer is NOT Ready to Receive Data in READY/BUSY Protocol
12	VACANT			
13	SIGNAL GROUND	SG		Ground
14-19	VACANT			
20	DATA TERMINAL READY	DTR	From Printer	Printer is NOT Ready to Receive Data in READY/BUSY Protocol
21-25	VACANT			

Switch Settings

Factory Settings

- 9600 Baud
- 8 Data Bits
- No Parity
- READY/BUSY Protocol
- DTR (Pin 20)

SW 1

Switch	Function	On	Off
1	Parity Type	Odd	Even
2	Parity	* No Parity	Parity
3	Data Bits	* 8	7
4	Protocol	* READY/BUSY	XON/XOFF
5	Test Select	Circuit	Monitor
6	Mode	Printing	Testing

Switch	Function	Selection	Switch 7	Switch 8
7, 8	Busy Line	* DTR - (Pin 20)	On	On
		RTS - (Pin 4)	On	Off
		SSD - (Pin 11)	Off	On
		SSD + (Pin 11)	Off	Off

SW 2

Switch	Function	Selection			
1, 2, 3	Baud Rate	Rate (bps)	Switch 1	Switch 2	Switch 3
		19,200	On	On	On
		* 9,600	Off	On	On
		4,800	Off	Off	On
		2,400	Off	Off	On
		1,200	On	On	Off
		600	Off	On	Off
		300	On	Off	Off
		110	Off	Off	Off
* Factory Settings					

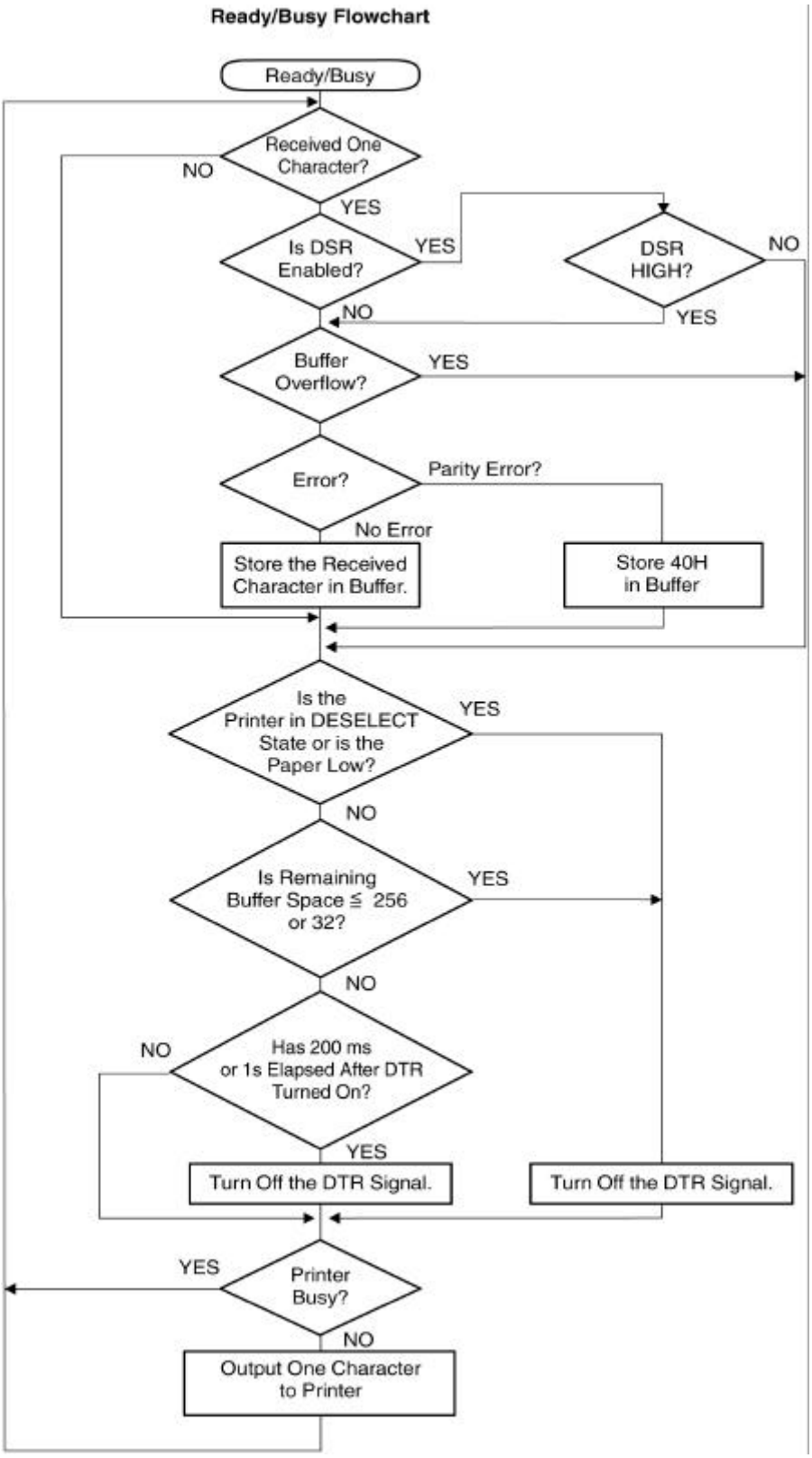
Switch	Function	Selection	
		On	Off
4	DSR	Active	Inactive
5	Buffer Threshold	* 32 Bytes	256 Bytes
6	Busy Signal Timing	* 200 ms	1 second
7	Not Used		
8	Not Used		
* Factory Settings			

Protocol

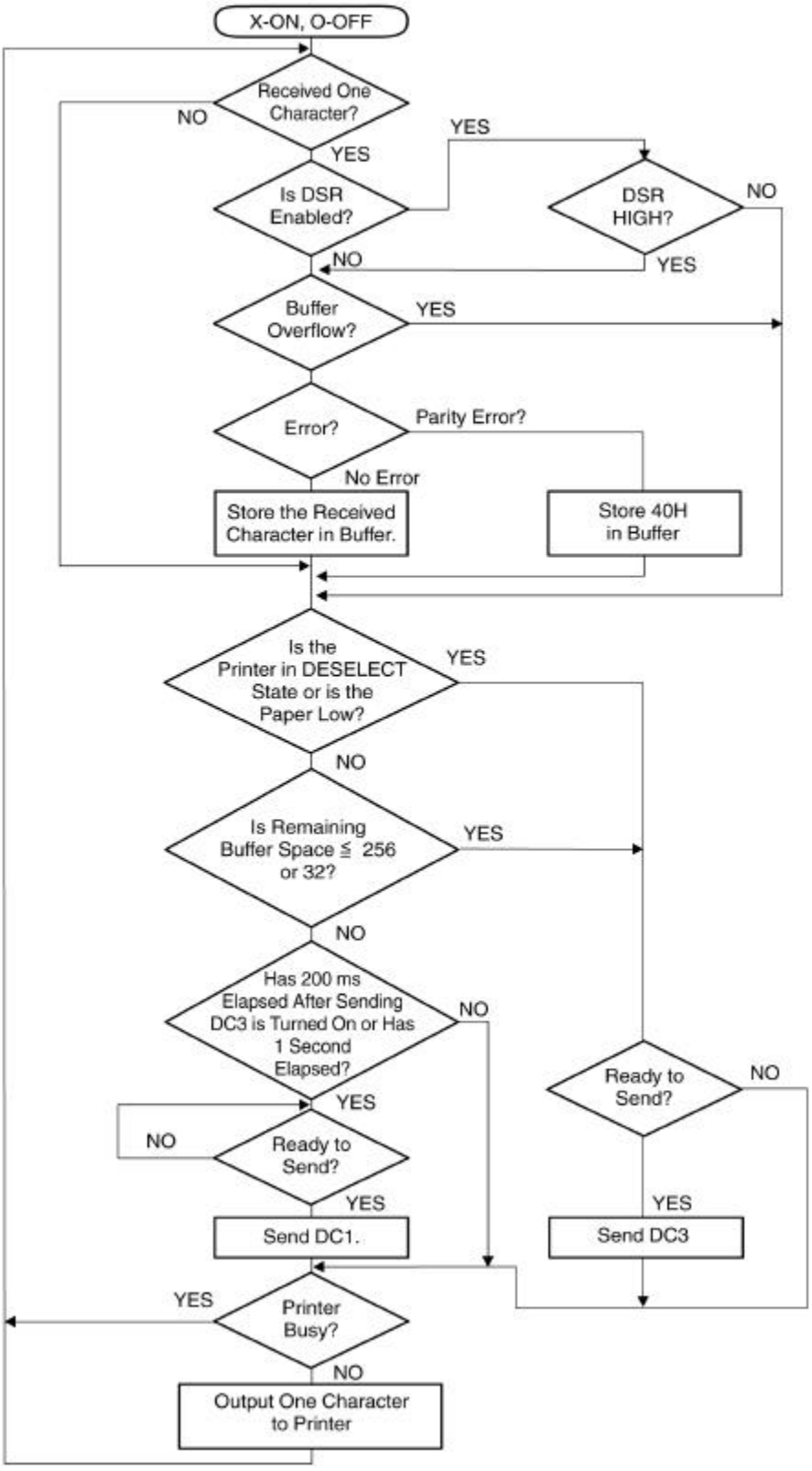
READY/BUSY Flowchart (see chart on page 14)

XON/XOFF Flowchart (see chart on page 15)

Ready/Busy Flowchart



X-ON/X-OFF Flowchart



Diagnostic Tests

Run the circuit test and the monitor mode test to check that the serial cable is sending and receiving the correct signals.

Running the Circuit Test

Before running the circuit test, you may want to purchase or make a turnaround cable with the pin assignments shown in the illustration on page 17.

Be sure to shut off power to the printer when disconnecting the serial cable and connecting the turnaround cable.

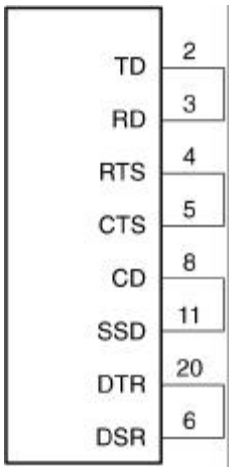
The circuit test checks the serial interface to ensure that the proper signals are sent across the active lines. The printer will print a message indicating whether the test was successful or not.

Follow the instructions in the flow chart on page 18 to run the circuit test.

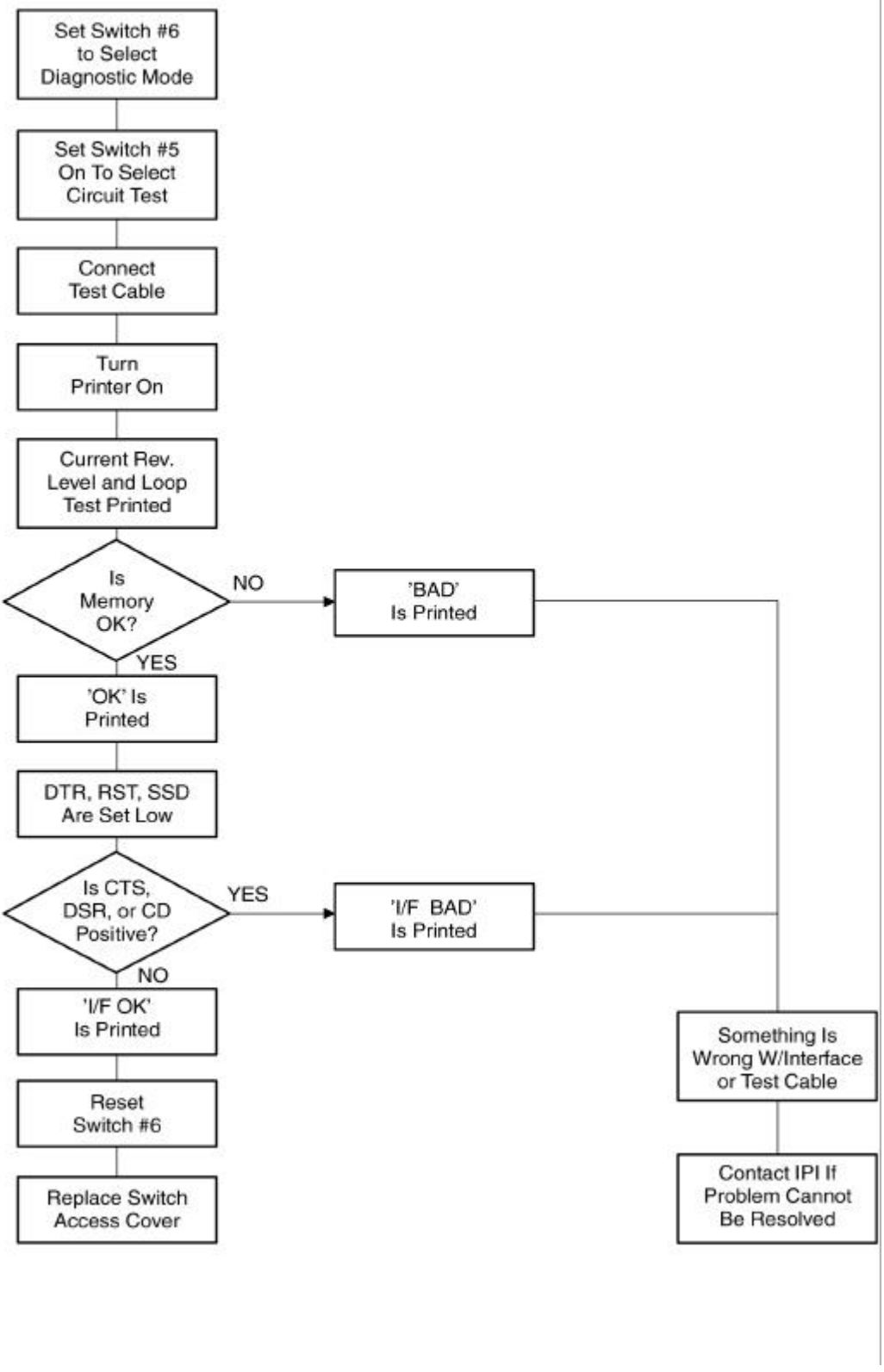
Running the Monitor Mode Test

The monitor mode test verifies that the data sent to the printer is set at the proper baud rade, parity, and number of data bits. This test is a feature of the high speed interface board.

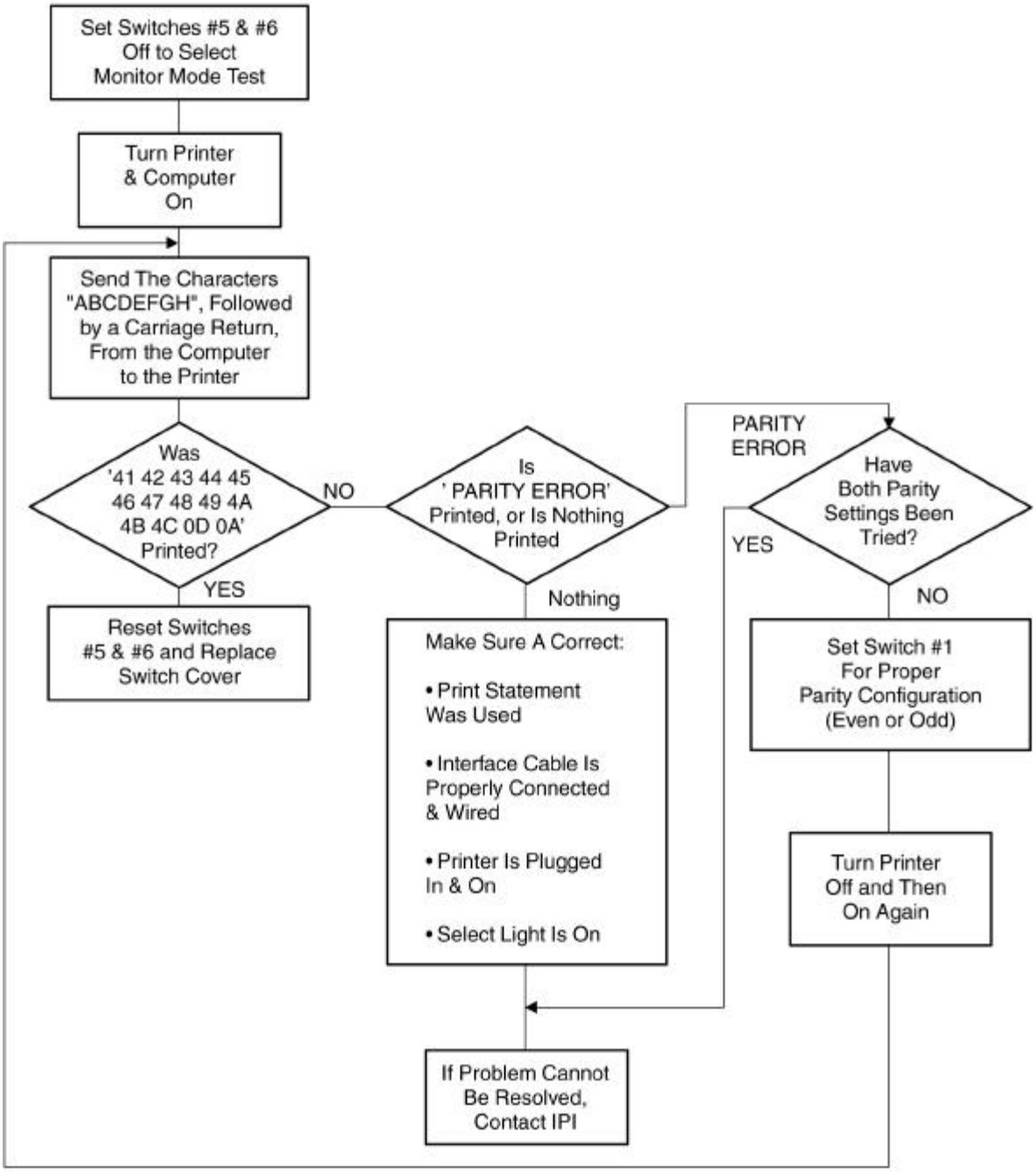
Follow the instructions in the flow chart on page 19 to run the monitor mode test.


TD
RD
RTS
CTS
CD
SSD
DTR
DSR
2
3
4
5
8
11
20
6

Performing the Circuit Test



Performing the Monitor Mode Test



Command Set

The IPI Series 70 printer supports commands in the following formats:

ASCII
Decimal
Hexadecimal
IPCL

IPCL Commands

IPCL is an alternate command set consisting of printable character strings which perform all of the printer's functions. Because some systems are unable to send certain sequences, such as escape sequences or HEX codes lower than 20, IPCL allows these systems to communicate with the printer.

IPCL commands consist of a string of four characters in this format: &%XX.

The first two characters, &%, are fixed and identify the command as an IPCL string.

The last two characters, XX, are alphanumeric and define the function to be performed. If the last two characters are undefined or incorrect, the string will be treated as printable data.

Command Reference Chart

The chart on the following page lists the various codes for each command, the default value (where applicable), and the page number where a detailed description of the command can be found.

Command	ASCII	Decimal	Hex	IPCL	Page Number
Carriage and Line Spacing Commands					
Carriage Return	CR	13	0D	&%CR	
Set Fine Line Spacing n/216" n = 1 to 255	ESC 3 n	27 51 n	1B 33 n	&%SV n	
Set Line Spacing at 8 Lines per Inch	ESC 0	27 48	1B 30	&%ST	
Set Line Spacing at 21/216"	ESC 1	27 49	1B 31	&%SG	
Line Feed, Default = 8 Lines per Inch	LF	10	0A	&%LF	
Perform Fine Line Feed n = 1 to 255	ESC J n	27 74 n	1B 4A n	&%LV n	
Print Characteristics Commands					
Begin 17 CPI Print Mode (Default Print Mode)	SI	15	0F	&%F1	
Begin 12 CPI Print Mode	ESC :	27 58	1B 3A	&%F2	
Begin 10 CPI Print Mode	DC2	18	12	&%F3	
Begin One Line Double Wide	SO	14	0E	&%MW	
End One Line Double Wide	DC4	20	14	&%MN	
Begin Multi Line Double Wide	ESC W 1	27 87 1	1B 57 01	&%FW1	
End Multi Line Double Wide	ESC W 0	27 87 0	1B 57 0	&%FW0	
Select IBM Character Set I	ESC 7	27 55	1B 37	&%C1	
Select IBM Character Set II (Default Character Set)	ESC 6	27 54	1B 36	&%C2	
Knife Commands					
Advance to Cut Position	VT	11	0B	&%VT	
Activate Cutter	EM	25	19	&%FC	
Buffer Commands					
Clear Print Buffer, Restore Defaults	CAN	24	18	&%RP	
Interface Busy Until Buffer Empty	EOT	4	04	None	
Miscellaneous Commands					
Print Interleaved 2 of 5 Bar Code	None	None	None	&%25	
Initiate Self Test	None	None	None	&%IT	

Graphics Commands					
Single Density Graphics: 60 DPI	ESC K n1 n2	27 75 n1 n2	1B 4B n1 n2	&%GS n1 n2	
Full Speed Double Density Graphics: 120 DPI	ESC Y n1 n2	27 89 n1 n2	1B 59 n1 n2	&%GF n1 n2	
Half Speed Double Density Graphics: 120 DPI	ESC L n1 n2	27 76 n1 n2	1B 4C n1 n2	&%GD n1 n2	
Quadruple Density Graphics: 240 DPI	ESC Z n1 n2	27 90 n1 n2	1B 5A n1 n2	&%GO n1 n2	

Command Descriptions (Organized by Function)

This section describes each command (organized by function) and lists the codes in ASCII, Decimal, Hexadecimal, and IPCL.

Carriage and Line Spacing Commands

The default for the line spacing is 8 lines per inch.

Carriage Return

Prints the contents of the print buffer. This is a logical carriage return. The carriage remains in place until the next line to be printed is sent. The printer will then decide which is the most efficient direction to print the next line: from left to right (forward), or from right to left (backward).

If switch 3 on the main board is set to ON, the printer advances the paper one line following the carriage return. The spacing of the line feed is determined by the default (8 lines per inch) or the current value of the Line Spacing commands.

```
ASCII:          CR
Decimal:        13
Hexadecimal:    0D
IPCL:      &%CR
```

Set Fine Line Spacing n/216"

Changes the current value for line spacing (n/216") used by the Line Feed comand. This command does not advance the paper.

n = 1 to 255

```
ASCII:          ESC 3 n
Decimal:        27 51 n
Hexadecimal:    1B 33 n
IPCL:      &%SV n
```

Set Line Spacing at 8 Lines per Inch

Changes the current value for line spacing (n/216") used by the Line Feed command to 27/216". This is equal to 8 lines per inch which is the default value for line spacing.

ASCII: ESC 0
Decimal: 27 48
Hexadecimal: 1B 30
IPCL: &%ST

Set Line Spacing at 21/216"

Changes the current value for line spacing (n/216") used by the Line Feed command to 21/216" (approximately 10 lines per inch). This setting eliminates the space between consecutive lines of print. It is normally used in the Block graphics mode to make two blocks solid.

ASCII: ESC 1
Decimal: 27 49
Hexadecimal: 1B 31
IPCL: &%SG

Line Feed

Advances the paper one line. The default value is 8 lines per inch. The spacing of the line feed is determined by the default or the current value of the Line Spacing commands (in n/216" increments).

ASCII: LF
Decimal: 10
Hexadecimal: 0A
IPCL: &%LF

Perform Fine Line Feed

Advances the paper in n/216" increments. This command does not affect the default spacing or the current value of the Line Spacing commands.

n = 1 to 255

```
ASCII:          ESC J n
Decimal:        27 74 n
Hexadecimal:    1B 4A n
IPCL:      &%LV n
```

Print Characteristics Commands

The default for the print mode is 17 characters per inch. The default for the character width is normal mode (single-wide). The default for the character set is IBM character set II.

Begin 17 CPI Print Mode

Prints 17 characters per inch in normal mode (102 dots per inch). The maximum number of characters is 40 per line. If double-wide mode is turned on, 20 characters are printed per line. This mode may be mixed with 12 and 10 CPI on the same line. This is the default print mode.

```
ASCII:          SI
Decimal:        15
Hexadecimal:    0F
IPCL:      &%F1
```

Begin 12 CPI Print Mode

Prints 12 characters per inch (72 dots per inch). The maximum number of characters is 28 per line. If double-wide mode is turned on, 14 characters are printed per line. This mode may be mixed with 17 and 10 CPI on the same line.

```
ASCII:          ESC :
Decimal:        27 58
Hexadecimal:    1B 3A
IPCL:      &%F2
```

Begin 10 CPI Print Mode

Prints 10 characters per inch (60 dots per inch). The maximum number of characters is 24 per line. If double-wide mode is turned on, 12 characters are printed per line. This mode may be mixed with 17 and 12 CPI on the same line.

ASCII: DC2
Decimal: 18
Hexadecimal: 12
IPCL: &%F3

Begin One Line Double Wide

Prints one full line of the currently selected print mode (17, 12, or 10 CPI) in double width characters. The number of characters per inch is half of the selected print mode. For example, 12 CPI becomes 6 CPI. After the line is printed, the printer automatically reverts to the currently selected print mode unless a new print mode is selected.

ASCII: SO
Decimal: 14
Hexadecimal: 0E
IPCL: &%MW

End One Line Double Wide

Ends the Double Wide print command before the end of the line to be printed. The printer reverts to the currently selected print mode unless a new print mode is selected.

ASCII: DC4
Decimal: 20
Hexadecimal: 14
IPCL: &%MN

Begin Multi Line Double Wide

Prints multiple lines of the currently selected print mode (17, 12, or 10 CPI) in double width characters. The number of characters per inch is half of the selected print mode. For example, 12 CPI becomes 6 CPI. This command remains in effect until cancelled by the command, End Multi Line Double Wide.

```
ASCII:          ESC W 1
Decimal:        27 87 1
Hexadecimal:    1B 57 01
IPCL:           &%FW1
```

End Multi Line Double Wide

Ends the Multi Line Double Wide print mode. The printer reverts to the currently selected print mode unless a new print mode is selected.

```
ASCII:          ESC W 0
Decimal:        27 87 0
Hexadecimal:    1B 57 00
IPCL:      &%FW0
```

Select IBM Character Set I

Selects the IBM Character Set I including all special characters. See the section, Character Sets under the heading Print Capabilities, for a list of the characters.

```
ASCII:          ESC 7
Decimal:        27 55
Hexadecimal:    1B 37
IPCL:      &%C1
```

Select IBM Character Set II

Selects the IBM Character Set II including all special characters. See the section, Character Sets under the heading Print Capabilities, for a list of the characters. This is the default character set.

ASCII: ESC 6
Decimal: 27 54
Hexadecimal: 1B 36
IPCL: &%C2

Knife Commands

Advance to Cut Position

Positions the last print line beyond the knife before the paper is to be cut. This command does not cut the paper.

ASCII: VT
Decimal: 11
Hexadecimal: 0B
IPCL: &%VT

Activate Cutter

Cycles the cutter blade one time.

ASCII: EM
Decimal: 25
Hexadecimal: 19
IPCL: &%FC

Buffer Commands

Clear Print Buffer, Restore Defaults

Clears the print buffer of all data and loads the command default values.

ASCII: CAN
Decimal: 24
Hexadecimal: 18
IPCL: &%RP

Interface Busy Until Buffer Empty

Sets the interface status lines to Busy. The printer will remain busy until it has processed all data in the communications buffer. If this command is sent to the printer at the end of a transaction, the host can monitor the Busy signal to determine when the printer has completed the transaction.

ASCII: EOT
Decimal: 4

Hexadecimal: 04
IPCL: None

Miscellaneous Commands

Print Interleaved 2 of 5 Bar Code

This command is followed by the numeric data to be printed (up to 14 characters). The bar code is printed when either a carriage return is detected or more than 14 characters are entered. If the total number of digits is odd, the printer will add a leading 0 to conform to the I 2 of 5 bar code standard.

ASCII: None
Decimal: None
Hexadecimal: None
IPCL: &%25

Initiate Self Test

Runs internal diagnostics. Upon successful completion of the diagnostics, the printer prints a test pattern of a sample ticket, feeds the paper, and cycles the cutter blade (cutting the paper).

If the diagnostics fail, the LED on the board flashes

ASCII: None
Decimal: None
Hexadecimal: None
IPCL: &%IT

Graphics Commands

All graphics modes conform to IBM PC graphics standards.

Graphics are printed one column at a time, consisting of either full dots or half dots. Just as characters are generated in a cell of full and half dot columns, graphics are also created using columns of full and half dots, depending on the graphic mode selected. See the discussion on "Character Generation" in the section, "Characters" for more information.

The values n1 and n2 in each of the graphics commands tell the printer how many columns are to be printed. Each byte following the command sequence corresponds to a column to be printed. Each column of data consists of eight bits with each bit corresponding to a pin on the printhead.

The most significant bit is at the top and the least significant bit is at the bottom. A 1 in any bit position corresponds to a dot, and a zero in any bit position corresponds to a space.

When the number of graphics bytes received by the printer equals the value (n1 x 256 + n2), the printer will print the line of graphics from left to right and exit graphics mode. Any of the line spacing commands may be used to advance the paper.

The number of graphics columns available is determined by the graphics mode selected:

Single density--144 columns
Double density--288 columns
Quadruple density--576 columns

There are four graphics modes based on the density of the dots. All modes print full dot columns and most allow both full and half dots.

Single Density Graphics--60 dpi
Half Speed Double Density Graphics--120 dpi
Full Speed Double Density Graphics--120 dpi
Quadruple Density Graphics--240 dpi

Single Density Graphics--60 dpi

Prints full dot columns only.

```
ASCII:          ESC K n1 n2
Decimal:        27 75 n1 n2
Hexadecimal:    1B 4B n1 n2
IPCL:      &%GS n1 n2
```

Full Speed Double Density Graphics--120 dpi

Prints both full and half dot columns. Does not allow a half dot column to be printed after a full dot column.

```
ASCII:          ESC Y n1 n2
Decimal:        27 89 n1 n2
Hexadecimal:    1B 59 n1 n2
IPCL:      &%GF n1 n2
```

Half Speed Double Density Graphics--120 dpi

Prints both full and half dot columns. Allows both columns to be printed adjacent.

```
ASCII:          ESC L n1 n2
Decimal:        27 76 n1 n2
Hexadecimal:    1B 4C n1 n2
IPCL:      &%GD n1 n2
```

Quadruple Density Graphics--240 dpi

Prints both full and half dot columns. Allows both columns to be printed adjacent.

```
ASCII:          ESC Z n1 n2
Decimal:        27 90 n1 n2
Hexadecimal:    1B 5A n1 n2
IPCL:      &%GQ n1 n2
```

CHARACTERS

The IPI Series 70 Printer prints two character sets, each set in two modes (normal and double-wide). Additional character widths allow for a variety of print styles. The following sections discuss and show examples of these characteristics.

Character Sets

The following character sets are supported: IBM Character Set I and IBM Character Set II. IBM Character Set II allows for block graphics. It is also the default character set.

The following lists show representations of the two character sets. They are not reproduced here in their true dot pattern.

IBM Character Set 1 (see the chart on page 34)

IBM Character Set 2 (see the chart on page 35)

Hex.	Dec.	Character Set I	Character Set II
00	0	NUL	
01	1	SOH	
02	2	STX	
03	3	ETX	♥
04	4	EOT	♦
05	5	ENQ	♣
06	6	ACL	♠
07	7	BEL	
08	8	BS	
09	9	HT	
0A	10	LF	
0B	11	VT	
0C	13	CR	♪
0E	14	SO	
0F	15	SI	
10	16	DLE	
11	17	DC1	
12	18	DC2	
13	19	DC4	
14	20	DC4	
15	21	NAK	§
16	22	SYN	
17	23	ETB	
18	24	CAN	
19	25	EM	
1A	26	SUB	
1B	27	ESC	
1C	28	FS	
1D	29	GS	
1E	30	RS	
1F	31	US	
20	32	(Space)	
21	33	!	
22	23	"	
23	35	#	
24	36	$	
25	37	%	
26	38	&	
27	39	'	
28	40	(	
29	41	)	
2A	42	*	
2B	43	+	
2C	44	,	
2D	45	-	
2E	46	.	
2F	47	/	
30	48	0	
31	49	1	
32	50	2	
33	51	3	
34	52	4	
35	53	5	
36	54	6	
37	55	7	
38	56	8	
39	57	9	
3A	58	:	
3B	59	;	
3C	60	<	
3D	61	=	
3E	62	>	
3F	63	?	
40	64	@	
41	65	A	
42	66	B	
43	67	C	
44	68	D	
45	69	E	
46	70	F	
47	71	G	
48	72	H	
49	73	I	
4A	74	J	
4B	75	K	
4C	76	L	
4D	77	M	
4E	78	N	
4F	79	O	
50	80	P	
51	81	Q	
52	82	R	
53	83	S	
54	84	T	
55	85	U	
56	86	V	
57	87	W	
58	88	X	
59	89	Y	
5A	90	Z	
5B	91	[	
5C	92	\	
5D	93	]	
5E	94	^	
5F	95	_	
60	96	`	
61	97	a	
62	98	b	
63	99	c	
64	100	d	
65	101	e	
66	102	f	
67	103	g	
68	104	h	
69	105	i	
6A	106	j	
6B	107	k	
6C	108	l	
6D	109	m	
6E	110	n	
6F	111	o	
70	112	p	
71	113	q	
72	114	r	
73	115	s	
74	116	t	
75	117	u	
76	118	v	
77	119	w	
78	120	x	
79	121	y	
7A	122	z	
7B	123	{	
7C	124	|	
7D	125	}	
7E	126	~	
7E	127	(DEL)	
80	128		Ç
81	129		ü
82	130		é
83	131		â
84	132		ä

Hex.	Dec.	Character Set I	Character Set II
85	133		à
86	134		â
87	135		ç
88	136	BS	ê
89	137	HT	ë
8A	138	LF	è
8B	139	VT	ï
8C	140	FF	î
8D	141	CR	ì
8E	142	SO	Ä
8F	143	SI	Å
90	144		É
91	145	DC1	æ
92	146	DC2	Æ
93	147	DC3	ô
94	148	DC4	ö
95	149		ò

Hex.	Dec.
B1	177
B2	178
B3	179
B4	180
B5	181
B6	182
B7	183
B8	184
B9	185
BA	186
BB	187
BC	188
BD	189
BE	190
BF	191
C0	192
C1	193

Character Modes

Two character modes are supported: normal (or single-wide) and double-wide, with three variations of character width in each mode.

Normal Mode

Characters in normal mode are available in three widths, depending on which print mode is selected (see the "Print Characteristics Commands" in the "Command Descriptions" section). The three widths are listed below with their widths provided in characters per inch (CPI), characters per line, and dots per inch.

17 characters per inch (default)
- 40 characters per line
- 102 dots per inch

12 characters per inch
- 28 characters per line
- 72 dots per inch

10 characters per inch
- 24 characters per line
- 60 dots per inch

These three modes are based on the same character cell (dot pattern). The dot-to-dot spacing is reduced for the smaller character width.

Double-Wide Mode

The double-wide mode doubles the width of the characters in the currently selected normal mode (see the "Print Characteristics Commands" in the "Command Descriptions" section).

The number of characters per inch or line in the double-wide mode is half that of the normal mode. 17 characters per inch becomes 8 1/2 characters per inch; 12 characters per inch becomes 6 characters per inch; 10 characters per inch becomes 5 characters per inch. However, the number of dots per inch remains the same in both modes.

The three double-wide modes are based on the same character cell (dot pattern). The dot-to-dot spacing is reduced for the

smaller character width.

Character Generation

All the character sets and modes are based on the same character cell, except the double-wide mode, which is twice the width of the normal mode. This section describes the character cell of the normal mode and shows examples of the dot patterns that make up the characters.

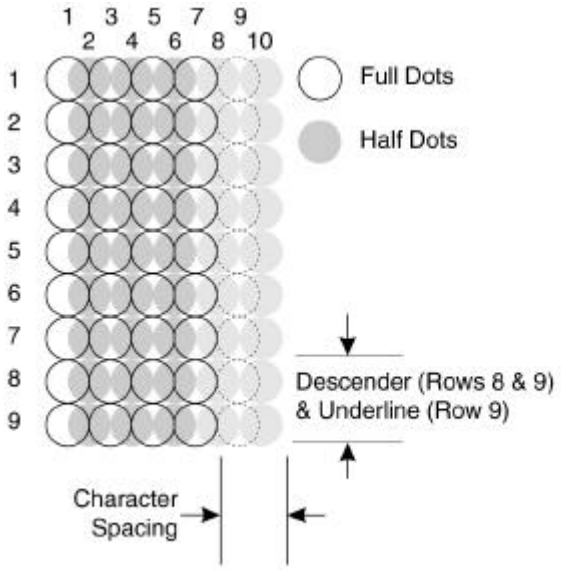
The character cell consists of five full dots and five half dots horizontally by nine full dots vertically as shown in the example on page 38 (double-wide mode is 10 full dots horizontally; half dots are not used).

The examples show the full dots as adjacent to each other in the character cell. This is a true representation for the 12 CPI print mode. In the 17 CPI print mode, the full dots overlap. In the 10 CPI print mode, the full dots are separated by a small amount of space.

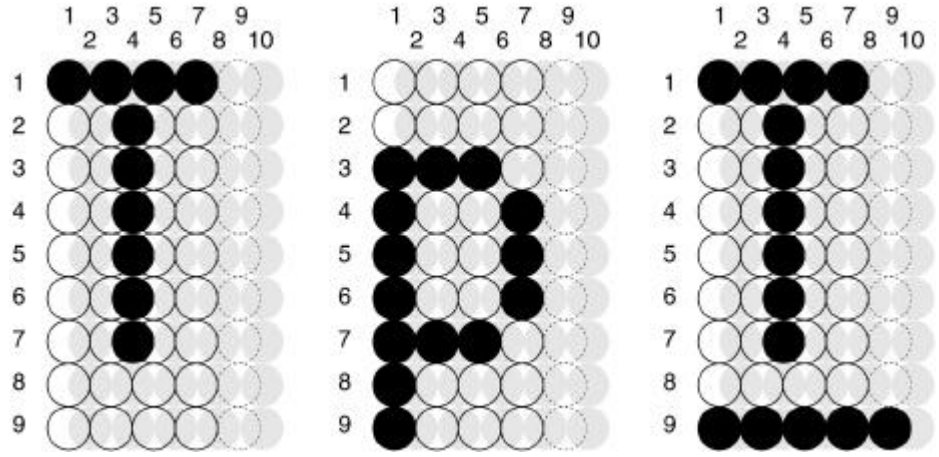
Each character is justified to the left of the cell and uses the first four columns of full dots and the first three columns of half dots. The last column of full dots and the last two columns of half dots are used for character spacing. The code actually treats each horizontal full and half dot as a column. The character cell is thus ten columns wide (five full dots and five half dots).

NOTE: Full and half dots cannot be printed adjacent to each other (that is, on the same row). Some of the graphics modes allow this. See "Graphics Commands" in the "Command Descriptions" section.

Characters use the full nine rows of vertical dots in the cell. The eighth and ninth rows are used for character descenders. The ninth vertical dot row is also used for underlining (the last full dot is printed). See the examples on page 39.



Sample: Normal character (12 characters per inch, 28 characters per line)


1 3 5 7 9
2 4 6 8 10
1
2
3
4
5
6
7
8
9