Systems

IBM 3203 Printer Model 5
Component Description
and Operator's Guide

IBM

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and Operator's Guide**

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Preface

This publication provides reference and operating information for users of the IBM 3203 Model 5 Printer. It is written mainly for system planners, programmers, and operators, but may also be of interest to system supervisors and engineers.

The publication provides a general introduction to the 3203 Model 5, its components and method of operation, and explains the various operating procedures. The "Programming Information" section describes the commands used to control the printer, the status and sense information returned to the system, and the error recovery procedures.

The reader should be familiar with the system to which the printer is attached. For system and programming information, refer to the publications listed in the bibliography for the using system.

Contents

Illustrations

Abbreviations

CCW	channel command word
COL	character outline limits
CSW	channel status word
DOS/VS	disk operating system/virtual storage
DUCT	dualing and uncomparable character table
EBCDIC	extended binary-coded-decimal interchange code
FCB	forms control buffer
lb	pound
lpi	lines per inch
lpm	lines per minute
mm	millimeter
OCR	optical character recognition
OMR	optical mark reading
PCS	preferred character set
SLI	suppress length indication
TIO	test input/output
UCS	universal character set
UCSB	universal character set buffer
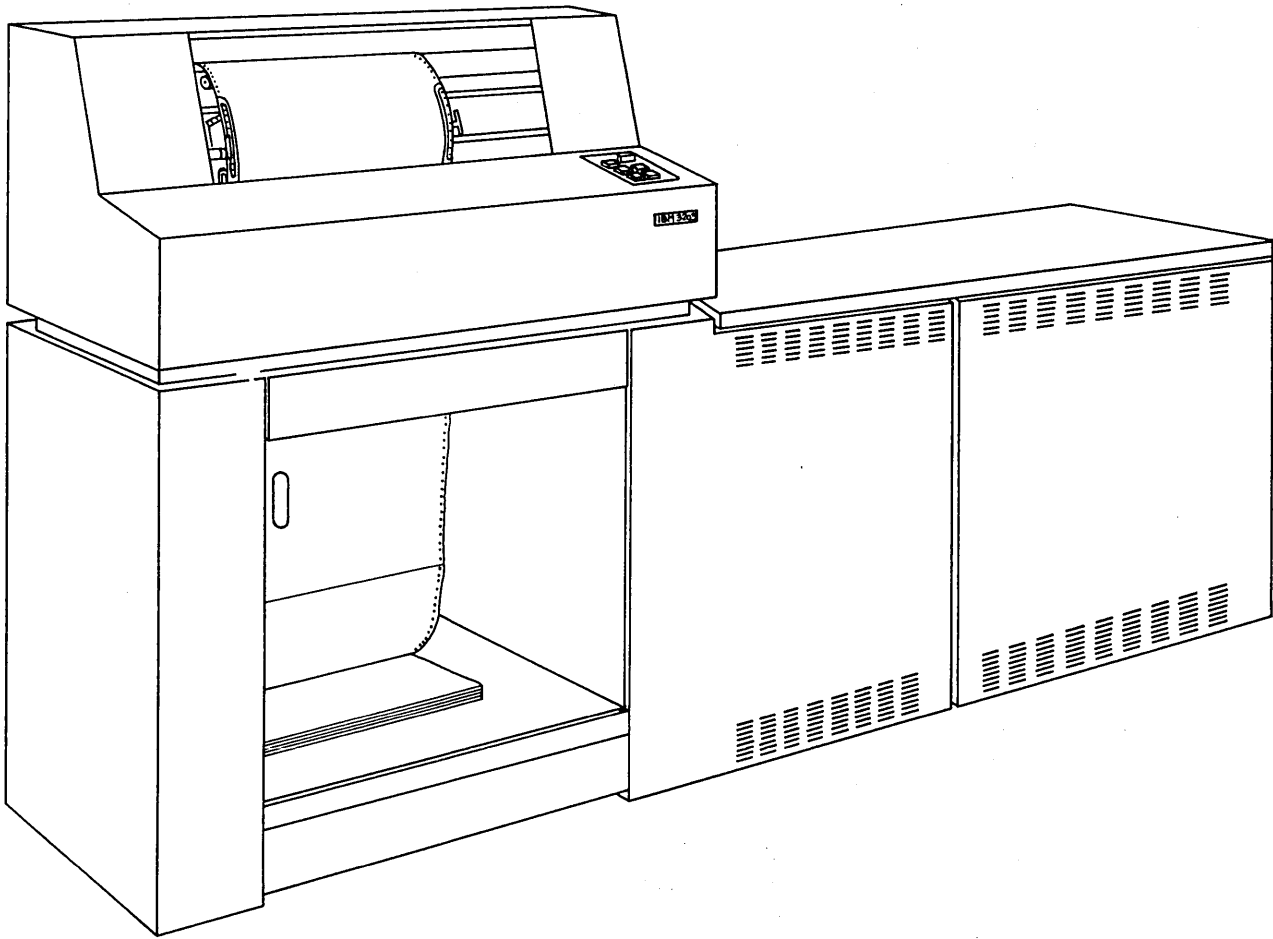
Frontispiece. IBM 3203 Printer Model 5

Introduction

The IBM 3203 Printer Model 5 (Frontispiece) produces printed records, controlled by a System/370 data channel, or an equivalent interface. A channel attachment located in the printer accepts the commands from the channel and controls printer operation. The 3203-5 is a line printer; that is, its unit of printing is the line.

The main elements of the 3203-5 Printer (Figure 1) are a print hammer unit, an interchangeable train cartridge containing 240 characters, and a tapeless carriage under program control.

The 3203-5 has a line length of 335.3 mm (13.2 inches), or 132 characters. It prints at six or eight lines per inch. If the 3203-5 is equipped with the 48-character set train cartridge, it prints at a nominal speed of 1200 lines per minute.

The 3203-5 uses the IBM 1416 Interchangeable Train Cartridge, which is also used on the IBM 1403 Printer Model N1. The universal character set (UCS) is a standard feature.
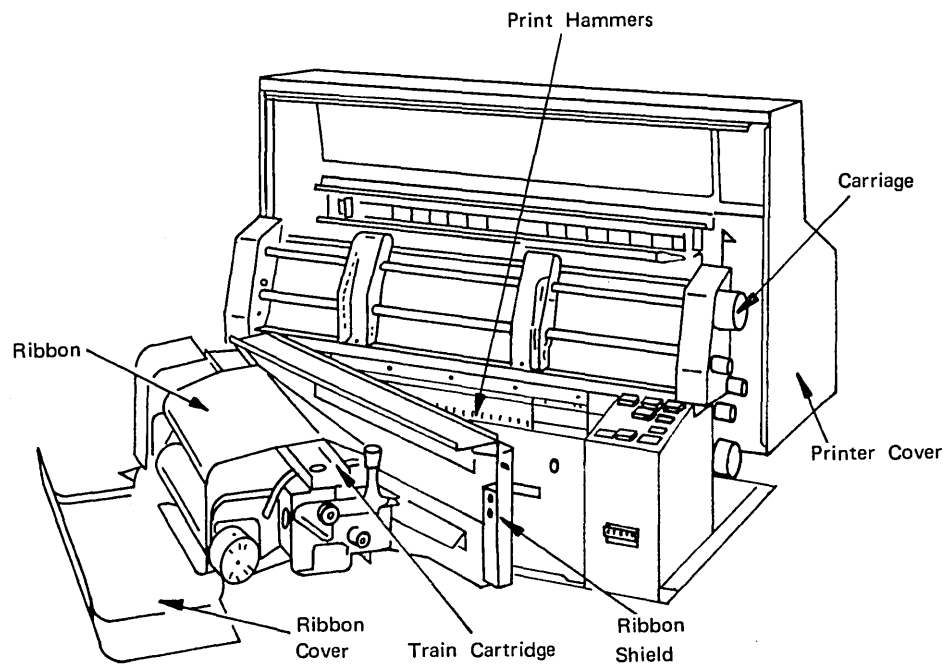
Figure 1. Main Elements of 3203 Printer

METHOD OF PRINTING

Characters are printed by the impact of hammers against the back of
the form, forcing the form and ribbon against the typeface to print
the characters. The printing method of the 3203-5 is shown in Figure
2.
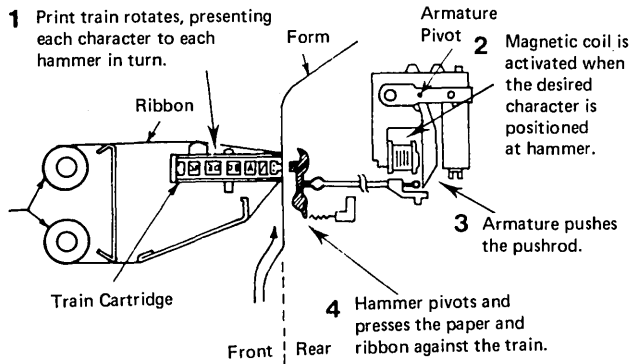
Figure 2. Printing Method of 3203 Printer

When a line has been printed the paper is transported under system and
program control. The paper passes through the printer as shown in
Figure 3.
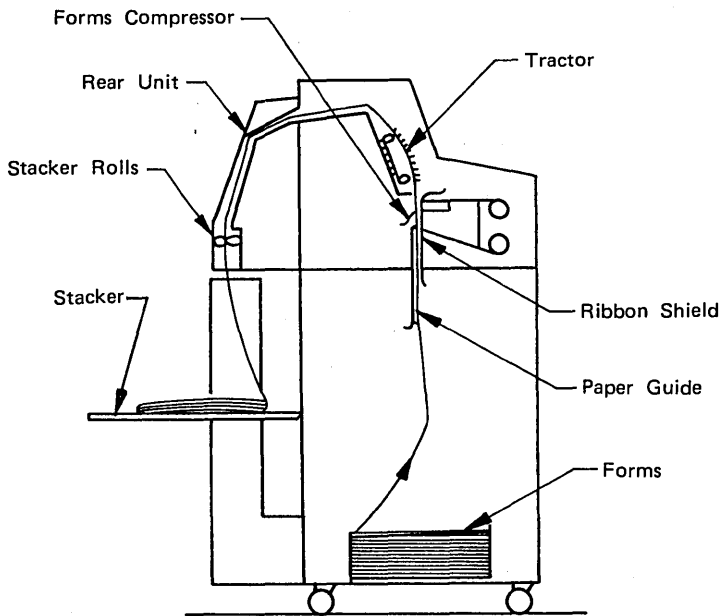
Figure 3. Paper Path through 3203

PRINTING SPEED

The printing speed is defined as the number of lines printed per minute (lpm). It depends upon several factors such as the number of identical characters on the print train, the line spacing, and the page format. Using a 48-character set print train, the 3203 can print at a nominal speed of 1200 lpm. Maximum print speed of 1580 lpm can be attained with a character set of 32 characters (see "Preferred Character Set"). Any character set with fewer than 32 characters will also print at 1580 lpm.

Figure 4 shows the formulas used for calculating the speed of continuous printing.

48-Character Set Mode	
Type arrangements:	$\text{nominal} = \dfrac{60,000}{\left(\dfrac{0.729 \times 240}{f}\right) + X + 0.200}$
General application - AN HN	
OCR application -	absolute
A font OAA ODA ONA	$\text{minimum} = \dfrac{60,000}{\left(\dfrac{0.736 \times 240}{f}\right) + X + 0.214}$
B font ONB	
Universal Character Set (UCS) Mode	$\text{nominal} = \dfrac{60,000}{\left(\dfrac{0.729 \times 240}{f}\right) + X + 0.929}$
Type arrangements: ALA GN PCS-AN	
PCS-HN PN QNC QN RN SN TN YN	
	absolute
	$\text{minimum} = \dfrac{60,000}{\left(\dfrac{0.736 \times 240}{f}\right) + X + 0.936}$

f = Number of times a given set of characters appear on the train, and $\dfrac{240}{f}$ must equal a whole number.

X = time factor for spacing or skipping (see Figure 5).

Figure 4. Formulas to Calculate Printing Speed

The formulas contain a variable for the immediate carriage movement that occurs when the print line is complete. The actual printing speeds can therefore vary from the nominal speeds given, and are often greater. Depending on whether single spacing or skipping operations are performed, the appropriate time factor (X in the formulas shown in Figure 4) must be added in the denominator of the formulas.

Figure 5 shows the time factors for the number of lines skipped. The times vary according to the number of lines, six or eight, printed per inch.

Lines skipped at 6 lpi (lines per inch)	Time in ms	
1	13.85	
2	22.40	
3	30.40	
4	38.30	
5	46.20	
6	54.10	
7	80.90	
8 - 16	84.52	plus 3.62 per additional line
17	132.40	
18 - 27	135.70	plus 3.30 per additional line
28	194.10	
29 - 66	197.13	plus 3.03 per additional line
67 and up	316.49	plus 7.25 per additional line

Lines skipped at 8 lpi (lines per inch)	Time in ms	
1	13.85	
2	18.40	
3	24.90	
4	31.40	
5	37.90	
6	44.40	
7	68.80	
8 - 16	71.86	plus 3.06 per additional line
17	112.50	
18 - 27	115.30	plus 2.80 per additional line
28	165.00	
29 - 88	167.56	plus 2.56 per additional line
89 and up	324.03	plus 5.43 per additional line

Figure 5. Time Factors for Line Spacing and Skipping

Example A

Calculation (by formula) for a 48-character AN train. The number of times the complete 48 AN configuration appears on the train is 5.

240/48 = 5 presentations of 48 AN set.

Therefore, f equals 5, and X (for continuous printing and single line spacing at 6 or 8 lpi) equals 13.850.

$$\text{Nominal speed (lpm)} = \frac{60,000}{(0.729 \times \frac{240}{5}) + 13.850 + 0.200} = 1223$$

Example B

Calculation for a 48 AN train, printing continuously with double
spacing at 6 lpi:

f = 5
X = 22.40

$$\text{Nominal speed (lpm)} = \frac{60{,}000}{(0.729 \times \frac{240}{5}) + 22.400 + 0.200} = 1041$$

The same configuration, but printing continuously with double spacing
at 8 lpi:

f = 5
X = 18.400

$$\text{Nominal speed (lpm)} = \frac{60{,}000}{(0.729 \times \frac{240}{5}) + 18.400 + 0.200} = 1119$$

ATTACHMENT TO SYSTEM

The 3203 Model 5 is designed for connection to a System/370 channel, or an equivalent interface. The channel attachment in the 3203-5 accepts channel command words and responds with channel status word contents as described later in this manual under "Programming Information".
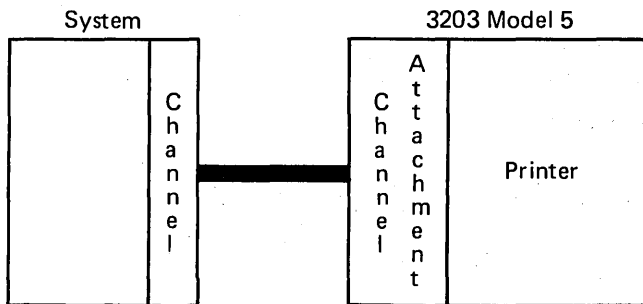
Figure 6. System Attachment

Buffers

The 3203 Model 5 has several buffers that control the operation of the printer.

* The print line buffer contains the 132 characters which form the line or data to be printed. The characters are stored in EBCDIC code (see Appendix A). The print data buffer is loaded when a 'Write' command is given to the 3203-5.

* The universal character set buffer contains an image in EBCDIC code of the 240 characters on the print train, and contains the 64 bytes of the dualing and uncomparable character table. The train buffer is loaded by the 'Load UCSB' command.

* The forms control buffer contains bytes of information for controlling the movement of the carriage. The forms control buffer is loaded by the 'Load FCB' command.

Forms and Ribbon

The 3203-5 prints on continuous forms consisting of one to four parts (copies). Forms consisting of more than four parts should be tested under operating conditions to determine acceptability. The forms are punched at the margins to fit onto the pin-feed carriage tractors. They can be designed to permit printing in almost any desired arrangement. Recommendations are given in the IBM publication Forms Design Reference Guide for Printers, GA24-3488.

The forms may be up to 610 mm (24 inches) long and 508 mm (20 inches) wide from edge to edge. A maximum width of 452 mm (17-25/32 inches) is recommended as this allows greater flexibility in the use of the print area.

Note: When a length greater than 432 mm (17 inches) is used, the door of the forms compartment must be kept open. When a length greater than 366 mm (14 inches) is used, the acoustic enclosure must be left open.

The minimum forms length is 76,2 mm (3 inches), and the minimum width is 89 mm (3-1/2 inches). Short forms should be grouped to improve stacking, the main folds being at intervals of between 203 mm (8 inches) and 304 mm (12 inches).

The operator may have to remain in attendance at the stacker if:

• Card stock is being printed.
• The relative humidity is more than 65% or less than 20%. (Below 8% relative humidity, forms feeding is not guaranteed.)
• The pile of forms on the stacker tray is higher than 304 mm (12 inches).

Paper suitable for optical character readers is specified in the publications listed in "OCR Paper Requirements" under "Printing for Optical Character Recognition (OCR)".

FORMS FASTENING

Fastening must prevent the copies from shifting without impairing the feeding or printing alignment of the forms. The fastening method is determined by the width and length of the forms and the number of parts.

Multiple-part forms should be fastened on both sides and only in the margin areas. Single-side fastening is not recommended. However, if this method is used, the fastening must be on the right-hand side. Carbons must also be fastened on the right-hand side.

The forms must not contain rigid staples in the print area. There must be no metal staples in the area of the cartridge and the hammer unit.

A leader is normally required for pre-numbered forms.

PAPER WEIGHT

The required paper weight depends on the number of parts to the forms, as follows:

Single-Part Forms

Paper weight   14 to 35 lbs (17x22-500)
(53 to 130 grams/square meter)

Maximum thickness 0.23 mm (0.009 inch)

Multiple-Part Forms

Maximum thickness 0.51 mm (0.020 inch)

Maximum variation 0.30 mm (0.012 inch)
of forms thickness within form

Four-part forms

Paper weight   11 to 13 lbs (17x22-500)
(41 to 49 grams/square meter)
Sulphide bond

Carbon paper   6 to 9 lbs (20x30-500)
weight   (14 to 21 grams/square meter)
Kraft medium carbon paper

Forms with more
than four parts

Paper weight   Approximately 11 lbs (17x22-500)
(41 grams/square meter)

Carbon paper   Approximately 6 lbs (20x30-500)
weight   (14 grams/square meter)

Smooth-surfaced papers usually produce better copies. The forms should be tested under operating conditions for trouble-free feeding and legibility.

Continuous Card Forms

```
Card weight        99 lbs (24x36-500)
                   (161 grams/square meter)
```

Marginally-punched long-grain card stock with 2, 3, or 4 cards per fold, in widths of 216 mm (8-1/2 inches), 378 mm (14-7/8 inches) and 403 mm (15-7/8 inches) is recommended. Result are better with long-grain stock than with short-grain stock.

RIBBON

The ribbon recommended for the 3203-5 is IBM P/N 457937 or an approved equivalent. The ribbon is 357 mm (14-1/16 inches) wide. For applications which require OCR print quality, see "Ribbon Recommendations" under "Printing for Optical Character Recognition (OCR)". If the ribbon protector described in the above section is installed, it must be retracted during operation with a standard ribbon.

IBM 1416 Interchangeable Train Cartridge

The 1416 Interchangeable Train Cartridge is used on the 3203-5. It contains 240 characters arranged on 80 type slugs with three characters per slug (Figure 7). The cartridge is mounted on the swing gate. When the train moves, it is continuously cleaned by a vacuum cleaning system.
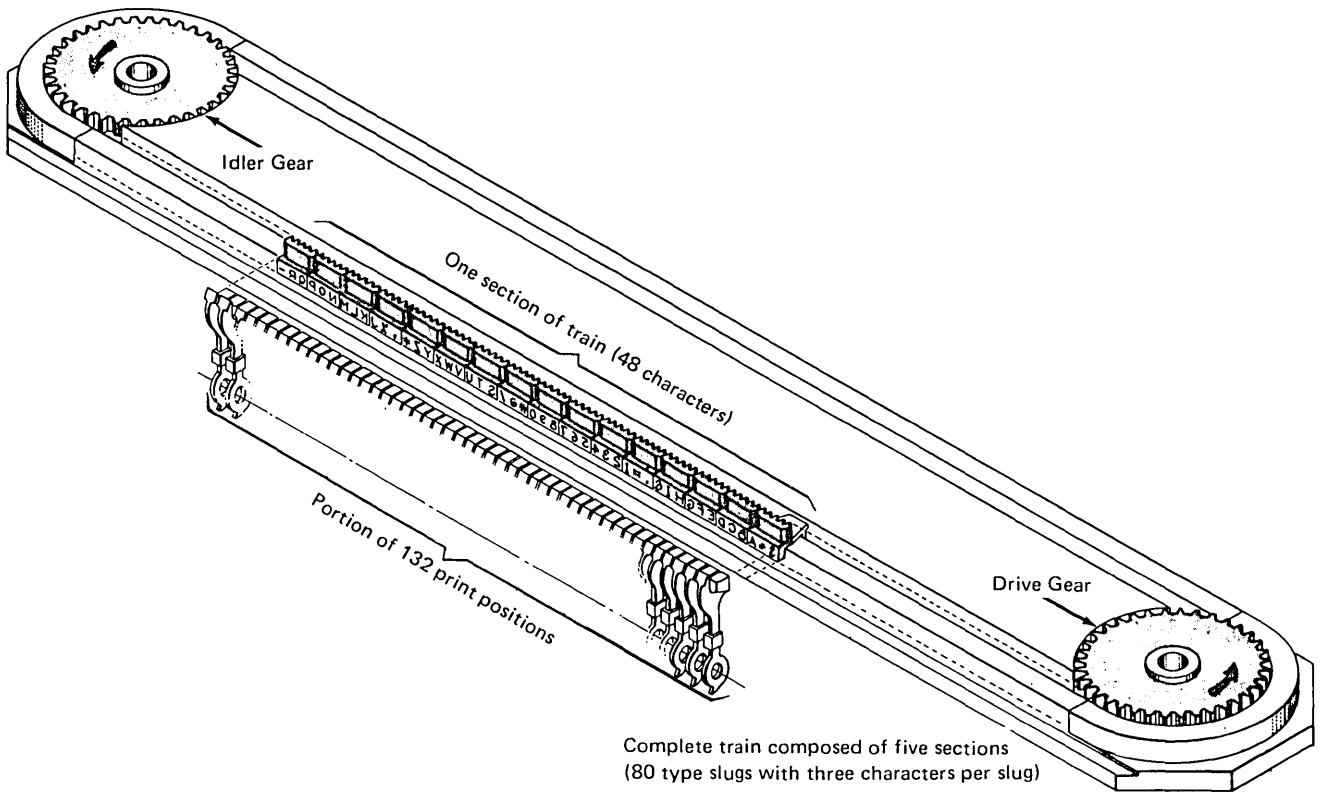
Figure 7. Schematic of Train Printing Mechanism

TYPE SIZE

The standard type is 2.413 mm (0.095 inch) high. Type styles with a nominal height of 2.007 mm (0.079 inch) are also available and should be used when printing at eight lines per inch. The horizontal spacing of characters on the form is 2.54 mm (0.1 inch) from center to center.

	Character Set Print Mode	Print Speed (lpm)

"AN" (48 "A" GRAPHICS) 5 IDENTICAL ARRAYS

| 123 | 456 | 789 | O#∄ | /ST | UVW | XYZ | &.% | JKL | MNO | PQR | -$* | ABC | DEF | GHI | +.□ |

48 (see Note 1) 1215

"HN" (48 "H" GRAPHICS) 5 IDENTICAL ARRAYS

| 123 | 456 | 789 | O-' | /ST | UVW | XYZ | &.(| JKL | MNO | PQR | -$* | ABC | DEF | GHI | +.) |

48 (see Note 1) 1215

"OAA" (48 "OCR-A" FONT GRAPHICS) 5 IDENTICAL ARRAYS

| L1- | M.Q | /2Y | R9$ | O%G | F3J | S8# | B(@ | C6V | P7Z | D+& | K5* | E4X | NAW | IO, | HTU |

48 (see Note 1) 1215

"ODA" (48 GRAPHICS, 10 "OCR-A" NUMERICS) 5 IDENTICAL ARRAYS

| 123 | 456 | 789 | O#∂ | /ST | UVW | XYZ | &.X | JKL | MNO | PQR | -$* | ABC | DEF | GHI | +.□ |

48 (see Note 1) 1215

"ONA" (48 GRAPHICS, 10 + 3 "OCR-A" NUMERICS) 5 IDENTICAL ARRAYS

| 123 | 456 | 789 | O#∂ | /ST | UVW | XYZ | &.⊣ | JKL | MNO | PQR | -$* | ABC | DEF | GHI | Ψ.ʃ |

48 (see Note 1) 1215

"OAB" (48 GRAPHICS, 10 + 3 "OCR B" NUMERICS) 5 IDENTICAL ARRAYS (see Note 2)

| L 1 Y | N D K | I 2 / | R 9 G | T > H | F 3 V | S 8 & | < O U | C 6 ∗ | A W Z | . + Q | E 5 X | P 4 J | ' $ = | , 0 - | M B 7 |

48 1215

"OAB" (48 GRAPHICS, 10 + 3 "OCR B" NUMERICS) 5 IDENTICAL ARRAYS (WORLD TRADE ONLY) (see Note 3)

| L 1 Y | N . K | I 2 / | R 9 G | B > H | F 3 V | S 8 & | O < U | C 6 ∗ | A 7 Z | D + Q | E 5 X | P 4 J | ' $ = | , 0 - | M T W |

48 1215

"ONB" (48 GRAPHICS, 10 + 3 "OCR-B" NUMERICS) 5 IDENTICAL ARRAYS

| L 1 Y | N . K | I 2 / | R 9 G | B > H | F 3 V | S 8 ⅃ | O < U | C 6 ∗ | A 7 Z | D + Q | E 5 X | P 4 J | ' $ = | , 0 - | M T W |

48 (see Note 1) 1215

"ALA" (162 GRAPHICS 78 PREFERRED)

123	ABC	DEF	GHI	JKL	MNO	PQR	/ST	UVW	XYZ	ÆŒP	[ ] !	- " :	. , '	456	789	0\‡	· ? ʼ	ʼ ‾ ̃	ʼʼ	˘ ˙
abc	def	ghi	jkl	mno	pqr	?st	uvw	xyz	æœþ	αβγ	%±€	) (:	123	456	789	0-+	↵) (	̣ ̈ ̊	_ =
										DØ£	[ ]≠							\ ~̃	ʼ ̈ ̄	⌐ ˥
						=s t			d∈ž	⊛þ£	*⌼$		123	456	789	0-+	ʼ) (	> < +	˙ ˙ ~

120/240 585/315

"GN" (63 GRAPHICS - 57 PREFERRED)

123	456	789	OXY	/ST	UVW	I :	" , =	JKL	MNO	PQR	-Z (	ABC	DEF	GHI	+.)	%S*	#&@	< ⊣	'?>
																	\⊃⊏		
																	#&@		
																	\⊃⊏		

60/120 1020/585

"PCS-AN" (49 GRAPHICS), 3-LEVEL SET, 48 "A" GRAPHICS

123	456	789	0,-	PQR	≠$@	/ST	UVW	XYZ	□.∗	123	456	789	0,-	JKL	MNO	ABC	DEF	GHI	+.∗
					£$%														
					≠$@														
					£$%														

30/60/120 1560/1020/585

Notes:

1. These arrangements print in the "48 character set mode"; all others print in the "UCS mode". For details refer to section "Printing Speed" in the "Introduction".
2. A timing mark dash (graphic —) is available instead of the graphic > to print timing marks on documents for reading by the IBM 3886 Optical Character Reader.
3. The graphics ö or φ may be substituted for apostrophe graphic ' and Ä, Ñ, or Æ for the equals symbol =.

Figure 8. (Part 1 of 2) Train Arrangements (Printout Representation)

	Character Set Print Mode	Print Speed (lpm)

"PCS-HN" (49 GRAPHICS). 3-LEVEL SET. 48 "H" GRAPHICS

30/60/120 — 1560/1020/585

"PN" PL/I (60 GRAPHICS) 4 IDENTICAL ARRAYS

60 — 1020

"QN" PL/I (60 GRAPHICS · 45 PREFERRED) SCIENTIFICALLY PREFERRED

48/240 — 1195/315

"QNC" PL/I (60 GRAPHICS · 45 PREFERRED) COMMERCIALLY PREFERRED

48/240 — 1195/315

"RN" FORTRAN-COBOL- COMMERCIAL (52 GRAPHICS · 47 PREFERRED)

48/240 — 1195/315

"SN" TEXT PRINTING (84 GRAPHICS · 78 PREFERRED) COMMERCIAL

80/240 — 815/315

"TN" TEXT PRINTING (120 GRAPHICS) SCIENTIFIC 2 IDENTICAL ARRAYS

120 — 585

"YN" HIGH-SPEED ALPHAMERIC (42 GRAPHICS · 39 PREFERRED)

40/120 — 1355/585

Figure 8. (Part 2 of 2) Train Arrangements (Printout Representation)

STANDARD CHARACTER SETS

The train cartridge contains 240 characters which are arranged on type slugs in groups of three. The arrangement is usually five identical arrays of 48 characters. The basic character arrangements are "A" (Standard Binary Coded Decimal Interchange Code) or "H" (for FORTRAN or COBOL). Each of these character arrangements allow 48 different characters to be printed at each print position: 26 alphabetic, 10 numeric, and 12 special characters. Figure 8 shows a variety of these arrangements.

Dualing

The AN and HN trains are identical except for four character positions. On the AN train these four positions contain:
¤ % @ #

whereas the HN train has:

) (' =

This means, for example, that the HN train has the right-hand parenthesis graphic where the AN train has the lozenge. This right-hand parenthesis graphic is printed if the corresponding EBCDIC code hex 4C (see Figure 9) is sent to a printer equipped with the HN train. If hex 4C is sent to a printer equipped with the AN train the lozenge is printed. This relationship is called dualing (pairing). Dualing is a standard feature for the 48-character set. All possible combinations are shown in Figures 9 and 10.

Apart from the exception stated in Note 3 on Figure 10, the codes outside the bold lines of the Figure are considered to be undefined. Undefined codes generally cause an unspecified graphic to be printed. This graphic may be different from the one printed, displayed, or otherwise recorded by another output device. IBM reserves the right to change such undefined graphics printed by the 3203-5 from an undefined code.

EBCDIC Graphics	Hex	Binary	Stored Hex-value in Print Buffer	Printed Character AN-Chain	HN-Chain
¤	4C	0100 1100	4C	¤	)
)	5D	0101 1101			
%	6C	0110 1100	6C	%	(
(	4D	0100 1101			
@	7C	0111 1100	7C	@	'
'	7D	0111 1101			
#	7B	0111 1011	7B	#	=
=	7E	0111 1110			

Figure 9. EBCDIC Codes for Characters Dualed on the 3203

Bit Positions

4567 \ 23	00 00	00 01	00 10	00 11	01 00	01 01	01 10	01 11	10 00	10 01	10 10	10 11	11 00	11 01	11 10	11 11
0000					Blank	&	.						&	−		0
0001							/		a	j			A	J		1
0010									b	k	s		B	K	S	2
0011									c	l	t		C	L	T	3
0100									d	m	u		D	M	U	4
0101									e	n	v		E	N	V	5
0110									f	o	w		F	O	W	6
0111									g	p	x		G	P	X	7
1000									h	q	y		H	Q	Y	8
1001									i	r	z		I	R	Z	9
1010																
1011					.	$	,	#/= (A/H)								
1100					¤/) (A/H)	.	%/((A/H)	@/' (A/H)								
1101					(/% (H/A)	)/# (H/A)		'/@ (H/A)								
1110					+			=/# (H/A)								
1111																

Notes:

1. A and H refer to graphics printed from the 48 AN or 48 HN set, respectively.

2. Graphics enclosed in the heavy lines correspond to most commonly expected bit patterns.

3. The lower-case alphabetic graphics shown will print as the corresponding upper-case graphics on the 48 AN or 48 HN arrangements when a lower-case bit pattern is sent to a 3203 with a 48 AN or 48 HN arrangements.

Figure 10. EBCDIC Characters Printed by 48AN or 48HN Train

UNIVERSAL CHARACTER SET

The ability to print with a universal character set (UCS) is a
standard feature of the 3203-5. The feature can be operated when a UCS
print train is mounted.

The UCS feature allows sets of 240 graphics other than standard
character sets to be printed. The graphics can be arranged in any
order on the print train. Some existing UCS train arrangements are
shown in Figure 8. These arrangements cover the following needs:

* High-speed alphameric printing
* Programming language I (PL/I) character set
* Printing of commercial and scientific texts
* Commercial applications of FORTRAN and COBOL

The user can design UCS trains according to his needs (see "Preferred
Character Set").

PREFERRED CHARACTER SET

The preferred character set (PCS) train has 240 characters arranged on
the train so that the most common characters can be presented to the
hammer more frequently to give a maximum speed of 1580 lpm. The
preferred character set train contains eight arrays of 14 numeric and
special characters, four arrays of 26 alphabetic characters, four
arrays of four special characters, and two arrays of four less-common
special characters. Figure 11 shows, as an example, the sequence of
characters on the Preferred Character Set (PCS)-AN train.

```
*.+ IHG FED CBA ONM LKJ -,0 987 654 321 *.Ħ ZYX WVU TS/ @$# RQP -,0 987 654 321
*.+ IHG FED CBA ONM LKJ -,0 987 654 321 *.Ħ ZYX WVU TS/ %$& RQP -,0 987 654 321
*.+ IHG FED CBA ONM LKJ -,0 987 654 321 *.Ħ ZYX WVU TS/ @$# RQP -,0 987 654 321
*.+ IHG FED CBA ONM LKJ -,0 987 654 321 *.Ħ ZYX WVU TS/ %$& RQP -,0 987 654 321
```

Group # 1. 1 2 3 4 5 6 7 8 9 0 , - . *   (eight arrays)
Group # 2. A through Z $ / Ħ +   (four arrays)
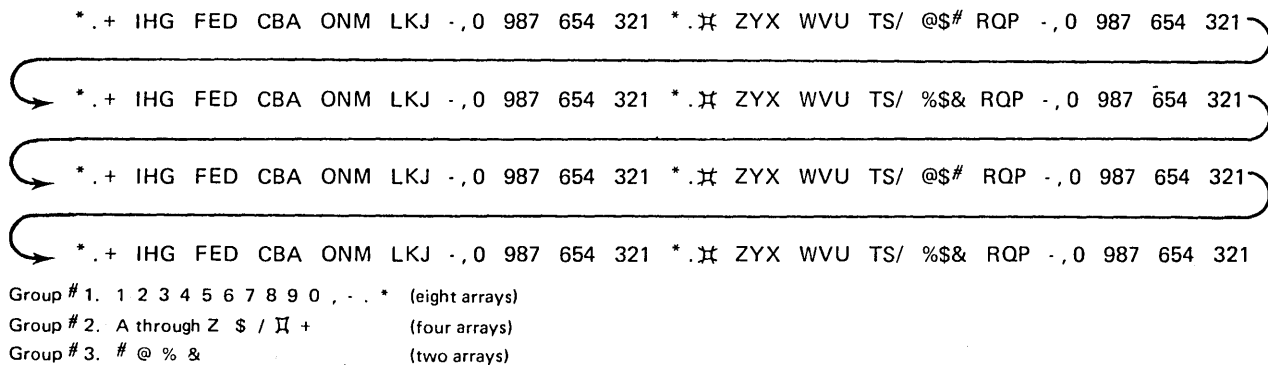Group # 3. # @ % &   (two arrays)

Figure 11. Preferred Character Set Sequences on AN Train

The actual speed attained depends upon the characters being printed
and the number of internal scans required to locate the proper
character on the train. For printing exclusively the characters
designated by group, the maximum speed is:

Group 1: 0 to 9.,-*   1580 lpm
Group 2: A to Z $/ ¤ +   1020 lpm
Group 3: # @ % &   585 lpm

Examples of PCS Timings

The examples of timings shown in Figure 12 apply to the PCS
arrangement on an AN train with a total of 240 characters. The timing
charts show the print-cycle time associated with the three different
character groups, and with the maximum printing speed.


```
|◄──── Max. print time ──►|◄─Forms ──►|◄─ Synch- ──►|
                             movement      ronous
                             time:         factor:

        Group 1 : 22.08 ms   13.85 ms      0.936 ms
        Group 2 : 44.20 ms
        Group 3 : 88.32 ms

|◄──────────── Total time : ────────────►|

        Group 1 : 36.866 ms   ( 1627 lpm )  1565 lpm
                               maximum applies
        Group 2 : 58.986 ms   1020 lpm
        Group 3 : 103.106 ms  585 lpm
```
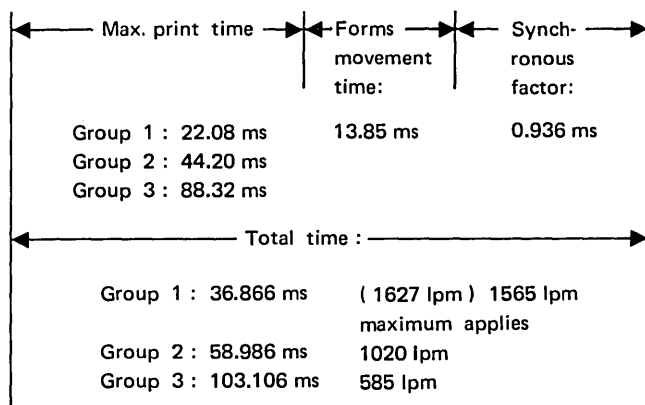
Figure 12. Printing Speed for Preferred Character Set

Group 1

Group 1 consists of 14 characters per array: 0 - 9 . , - *. Each
character appears eight times on the train. This equals a pseudo set
of 30 characters per array.

Note: The speed calculated from the formula given in Figure 4 exceeds
the maximum possible printer speed. These given maximum speeds apply.

Group 2

Group 2 consists of 30 characters per array: A to Z $ / ¤ +. Each
character appears four times on the train. This equals a pseudo set of
60 characters per array.

Group 3

Group 3 consists of four characters per array: # @ % &
Each character appears twice on the train. This equals a pseudo set of
120 characters per array.

Components

FORMS CARRIAGE

A tapeless carriage (Figure 13) transports the forms. The carriage is driven by a stepper motor under control of the printer attachment. Programmed movement of the carriage is by space and skip commands, as described later in this manual under "Programming Information". The carriage is controlled manually by the CARRIAGE SPACE and CARRIAGE RESTORE keys. (see "Operator Panel Switches, Keys, and Lights" under "Information for Operators").
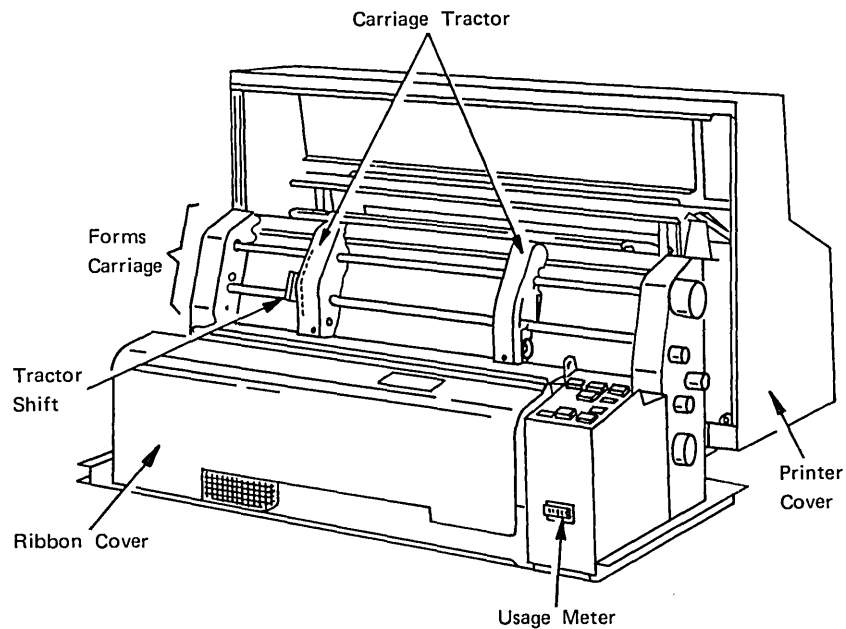
Figure 13. Forms Carriage

The carriage has two operating speeds. The maximum speed for up to six spaces is 609 mm/sec. (24 inches/sec.) and that for over six spaces is 1397 mm/sec. (55 inches/sec.).

In place of the conventional carriage tape, the 3203-5 has a forms control buffer and a line counter.

The forms are transported by two pin-feed tractors. Two tractor levers are provided for laterally adjusting the tractors so that the forms can be correctly positioned and tensioned. Forms varying in overall width from 89 to 452 mm (3-1/2 to 17-25/32 inches) can be inserted.

Carriage motion is monitored by photocells and any errors such as runaways or failure of the carriage to move are signaled to the attachment.

PAPER COMPARTMENT

The paper compartment is located in the front of the printer. The unprinted forms are fed from this compartment to the carriage for printing. The paper compartment is accessible from the front of the printer by a transparent sliding door (see Figure 3).

RIBBON DRIVE AND RIBBON SHIELD

The ribbon drive consists of two spools connected to two motors. The tension of the ribbon is controlled.

The ribbon shield (Figure 14) separates the forms from the ribbon to minimize soiling of the paper. It is equipped with a hammer position indicator (see Figure 24) and with a chad shield to stop chad from falling into the print area.

Ribbon

Ribbon
Cover

Train
Cartridge
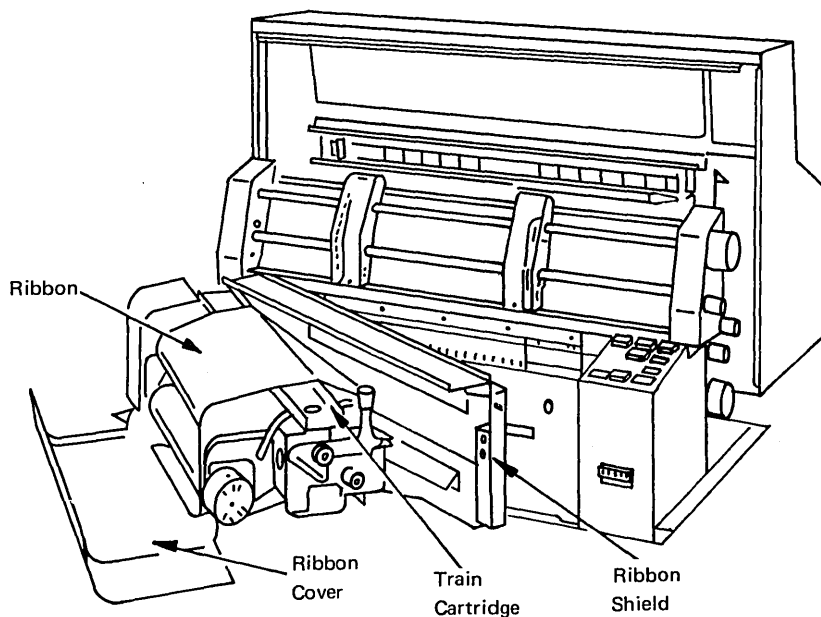
Ribbon
Shield

Figure 14. Ribbon

FORMS STACKER

The forms stacker (Figure 15) is located at the back of the printer, behind the paper compartment, and accepts the printed forms. An acoustic enclosure surrounds the stacker.

The forms stacker consists of a tray-shaped grid which gradually moves down to maintain a controlled distance between the paper stacker rolls and the top of the stacked paper. The STACKER DOWN key at the back of the machine operates a power mechanism which lowers the stacker so

that the operator can remove the printed forms. Manual adjustment is necessary before printing starts: the tray is pushed up by hand to its uppermost position. See "Adjustment of Power-Assisted Stacker" under "Information for Operators".
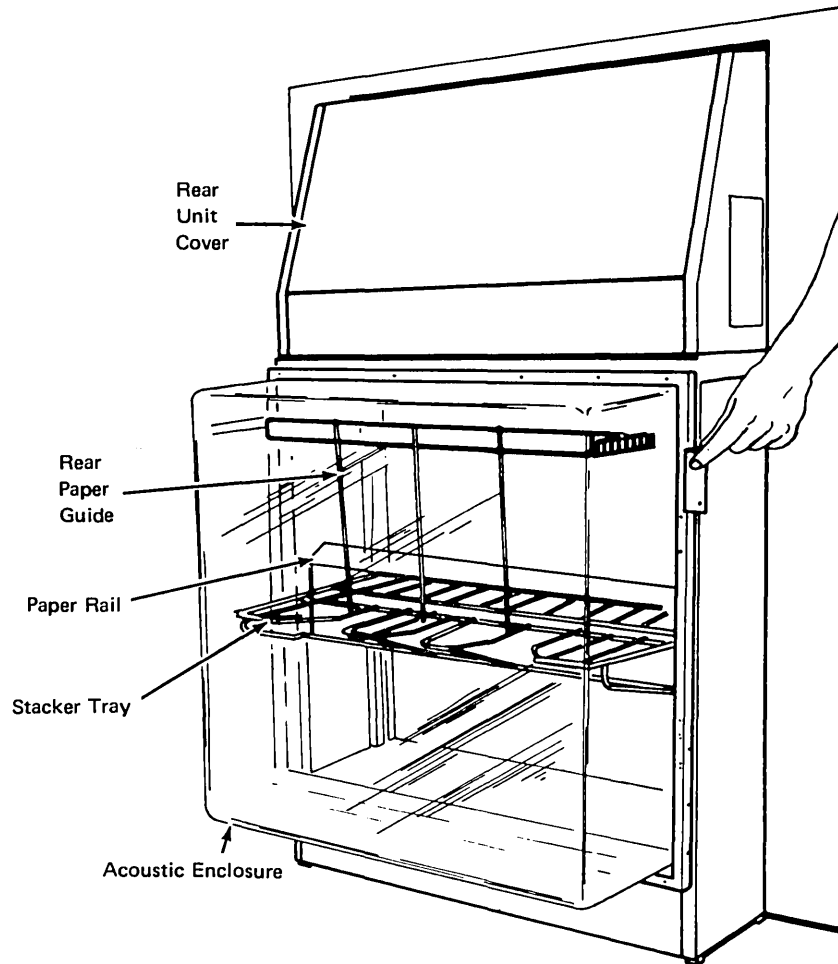

Figure 15. Rear Unit with Forms Stacker

Stacker Components

The stacker is equipped with two sets of paper guides, one set fitted in the acoustic enclosure and a second set at the back of the stacker area. The paper guides are manually adjusted to the length of the forms. An adjustable rail is fitted onto the stacker tray to ensure that the forms settle down in the correct fanned arrangement. The correct setting of the rail and the chute, installed below the rear unit cover, encourage proper stacking.

VACUUM CLEANING SYSTEM

The vacuum cleaner (Figure 16) is located behind the left side cover
of the printer. It consists of a motor-driven suction unit, a vacuum
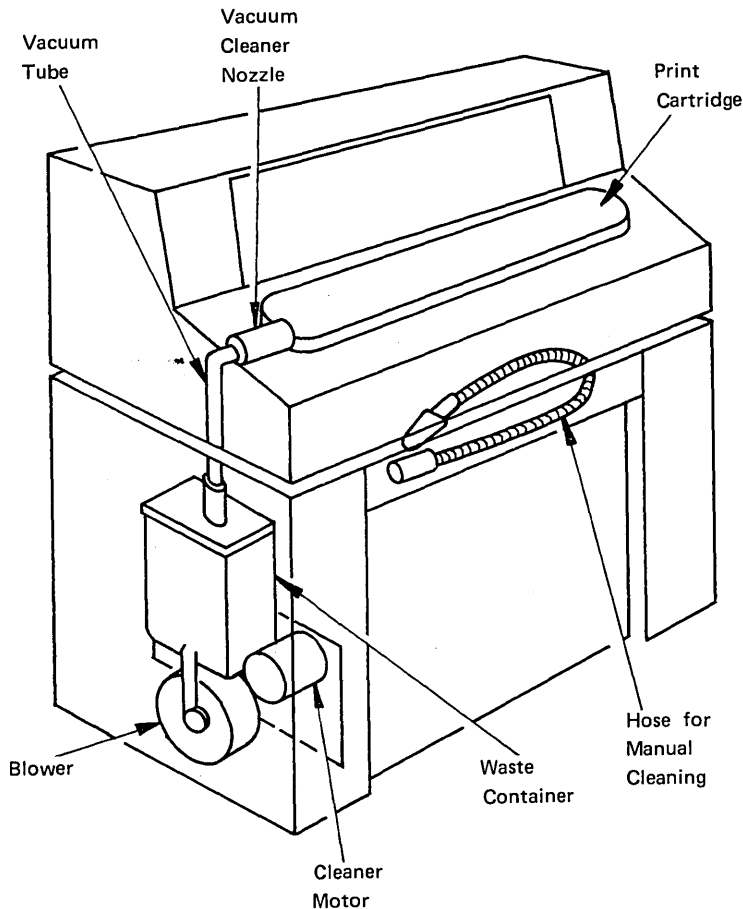tube and nozzle, and a waste container.

Figure 16. Vacuum Cleaning System

During printing, the vacuum cleaning system is always in operation.
The nozzle positioned immediately to the left of the train cartridge
continually draws paper fibers and ribbon lint from the type slugs
during printing.

The nozzle is mounted on the ribbon shield. When the swing gate and
ribbon shield are swung open, the nozzle is detached from the vacuum
tube, and the cleaner motor is then inactive. A separate hose is kept
on the storage shelf below the swing gate. When this hose is attached
by hand to the vacuum tube a switch is activated and the blower
starts. The print area can then be vacuum-cleaned by hand.

ACOUSTIC ENCLOSURE

A transparent acoustic enclosure is mounted around the forms stacker. Paper guides fitted inside at the top of the enclosure are manually adjustable to the length of the forms. When opened, the operator has free access to the forms stacker. When closed, the enclosure reduces noise during operation of the printer.

USAGE METER

The usage meter (location shown in Figure 13) registers the operating time chargeable to the customer. The meter starts recording when the first print command is received, and stops recording when a manual space or restore operation is executed. Recording is suspended anytime the using system's meter is stopped.
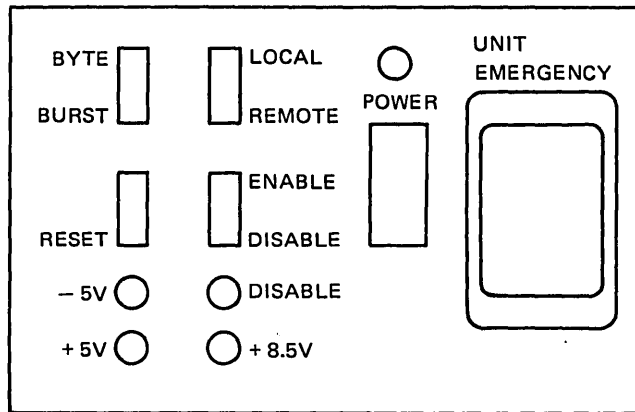
MACHINE COVERS AND SAFETY

The 3203-5 should not be run with the covers open to avoid needless exposures to hazards.

Some hazards such as electrical potentials and noise are less obvious than the danger from moving parts. To reduce these hazards IBM uses recommended grounding practices for all machines and fits covers which keep noise at a level that will not damage hearing.

Information for Operators

To operate the printer, you must understand the use of the keys and switches, and the meaning of the lights. You should also know the procedure for handling the forms, the ribbon, the print cartridge, the stacker, and the vacuum cleaning system.

```
┌─────────────────────────────────────────────────┐
│                                       UNIT        │
│  BYTE □    □ LOCAL      ○            EMERGENCY    │
│                        POWER                      │
│  BURST     □ REMOTE                               │
│                                                   │
│            □ ENABLE                               │
│  RESET □   □ DISABLE                              │
│                                                   │
│  - 5V ○    ○ DISABLE                              │
│                                                   │
│  + 5V ○    ○ + 8.5V                               │
└─────────────────────────────────────────────────┘
```

Auxiliary Operator's Panel

```
        ┌──────────┐
        │ Counter  │
        │          │
        │          │
        │  Reset   │
        └──────────┘
```

```
┌───────────────────────────────────┐   ┌──────────────┐
│  ┌────────┐ ┌────────┐ ┌────────┐ │   │  ┌────────┐  │
│  │ Single │ │ Power  │ │        │ │   │  │ Start  │  │
│  │ Cycle  │ │ On     │ │        │ │   │  └────────┘  │
│  └────────┘ └────────┘ └────────┘ │   │              │
│                                   │   │  ┌────────┐  │
│  ┌────────┐ ┌────────┐ ┌────────┐ │   │  │ Stop   │  │
│  │Carriage│ │Interlock│ │ Forms │ │   │  └────────┘  │
│  │Restore │ │        │ │        │ │   │              │
│  └────────┘ └────────┘ └────────┘ │   │  ┌────────┐  │
│                                   │   │  │Carriage│  │
│  ┌────────┐ ┌────────┐ ┌────────┐ │   │  │Restore │  │
│  │Carriage│ │Stacker │ │ Check  │ │   │  └────────┘  │
│  │Space   │ │        │ │        │ │   │              │
│  └────────┘ └────────┘ └────────┘ │   │  ┌────────┐  │
│                                   │   │  │   ▼    │  │
│  ┌────────┐ ┌────────┐ ┌────────┐ │   │  └────────┘  │
│  │ Start  │ │ Stop   │ │ Ready  │ │   │              │
│  └────────┘ └────────┘ └────────┘ │   │              │
└───────────────────────────────────┘   └──────────────┘
            Front Panel                     Rear Panel
```
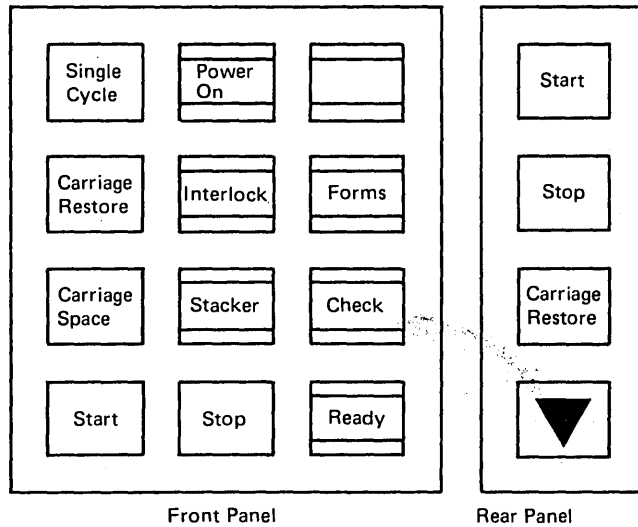
Figure 17. Operating Keys, Lights, and Switches

AUXILIARY OPERATOR PANEL

An auxiliary operator panel (Figure 17) located on the right-hand end
of the lower cabinet contains switches and lights used primarily by
maintenance personnel, as follows:

Enable/Disable Switch

When this switch is in the Enable position, the printer is connected
to the channel. When the switch is in the Disable position, the
printer is logically disconnected from the channel. The Disable light
turns on when the switch is in the Disable position.

Local/Remote Switch

When this switch is in the Remote position, the printer power can be
turned on and off by the attaching system. When the switch is in the
Local position, power to the printer can be turned on and off by the
Power On/Off switch.

Byte/Burst Mode Switch

The setting of this switch determines whether the printer's channel
attachment operates in byte mode (MPX channel only), or in burst mode.

Reset Switch

This momentary switch resets the channel attachment and printer,
causes the printer to become not ready, and resets any error
conditions. The forms control buffer and UCS buffer are loaded with
default data.

Default values are:
      Not ready condition
      AN train image loaded
      Allow Data Check
      Folding off
      6 lpi
      Check conditions are reset
      Last Log is cleared
      Forms Control Buffer loaded with channel 1 on first line
      and page length of 66
      Forms Control Buffer Pointer set to first line

Power On/Off Switch

This switch can be used to turn printer and channel attachment power
on and off if the Local/Remote switch is in the Local position.

Default values: see above under Reset Switch

Note: The switch has to be operated for about one second to assure
successful power on.

Unit Emergency Switch

This switch turns off AC power to the 3203-5 and is for use only in an emergency.

-5V, +5V, +8.5V Lights

These lights indicate presence of the DC voltages required by the printer controller.

Power On Light

This light indicates that 3203-5 power is on.

Disable Light

This light turns on when the Enable/Disable switch is placed in the Disable position.

OPERATOR PANEL SWITCHES, KEYS, AND LIGHTS

The keys (Figure 17) allow you to put the printer in and out of operation, and to manually control the carriage. The lights inform you of printer status and of conditions requiring your attention.

START Key

Pressing the START key places the printer into the ready state, with the printer READY light on. The printer can operate only in the ready state. Pressing the START key is ineffective when any previous error condition (indicated by the INTERLOCK, CHECK, FORMS and STACKER lights) has not been corrected. For convenience, another START key is located at the rear of the printer.

When the START key is pressed a check reset is also performed. If only this check reset (but not the ready state) is required, the 3203 STOP key should be held down and the START key pressed.

SINGLE CYCLE Key

The SINGLE CYCLE key is provided for printing single lines. Pressing the SINGLE CYCLE key makes the printer ready until one write command has been executed. After printing, the 3203-5 becomes 'not ready'. You can then print another single line by pressing the SINGLE CYCLE key again. Press START to return to normal operation.

Single cycle operation allows you to align the form properly at the
beginning of a print job. Also, you can print the last lines of the
final form, line by line, after end of forms has been signaled. Always
make sure, however, before pressing SINGLE CYCLE, that the end of the
forms has not already risen above the print line. Otherwise the 3203-5
may print without paper and a line of print will be lost.

STOP Key

When you press the STOP key, the printer completes the current
operation and stops. The printer is then in the 'not ready' state, a
prerequisite for manual operations (loading forms, adjustments, and so
on). Pressing the STOP key also activates the ribbon drive. For
convenience, another STOP key is located at the rear of the printer.

CARRIAGE RESTORE Key

Pressing the CARRIAGE RESTORE key causes the forms carriage to advance
to the print line defined by channel 1 in the forms control buffer. If
channel 1 is not defined in the forms control buffer, no carriage
movement occurs.

The CARRIAGE RESTORE key is operational only when the printer is in
the 'not ready' state. If the printer is ready, press the STOP key to
make CARRIAGE RESTORE effective. For convenience, another CARRIAGE
RESTORE key is located at the rear of the printer.

CARRIAGE SPACE Key

Pressing the CARRIAGE SPACE key causes the form to advance one space.
The CARRIAGE SPACE key is operational only when the printer is in the
'not ready' state. If the printer is ready, press the STOP key to make
CARRIAGE SPACE effective.

Reset Counter Switch

Operating the reset counter switch resets the forms control buffer to
address 1 without moving the forms. Address 1 of the forms control
buffer should correspond to the first possible print line of the form
directly under the forms perforation.

Note: Do not confuse address 1 of the forms control buffer with the
address of channel 1 code. The channel 1 code is not necessarily
located at buffer address 1.

When released, the switch automatically returns to the OFF position. The reset counter switch permits the forms and the counter to be synchronized before operation.

The reset counter switch is operational only when the printer is in the 'not ready' state. If the printer is ready, press the STOP key to make the reset counter switch effective.

For access to the reset counter switch, raise the top cover.

STACKER DOWN Key (Rear)

The STACKER DOWN key at the rear of the printer allows you to lower the stacker tray.

POWER ON Light

The POWER ON light turns on after the 3203-5 power-on sequence has successfully completed.

INTERLOCK Light

The INTERLOCK light turns on when the printer's swing gate is open. If the interlock condition occurs when the printer is not ready, the INTERLOCK light turns off when you close the swing gate. If the interlock condition occurs when the printer is ready, the INTERLOCK light turns off when you close the swing gate and press the START key.

FORMS Light

The FORMS light turns on when:

1. The end of the last form is about 76 mm (3 inches) below the print line, or
2. The forms have jammed, or are torn.

If the FORMS light was turned on because the end of forms was reached, it is turned off when new forms are inserted, the swing gate is closed and START is pressed. If the FORMS light was turned on by a forms jam, it is turned off when the jam is cleared and the START key is pressed. If the FORMS light turns on while the printer is not-ready, correcting the problem turns it off (without pressing the START key).

READY Light

The READY light turns on if the following conditions are fulfilled:

1. The START key (or SINGLE CYCLE key) is pressed.
2. The STOP key is not operated.
3. Any previous error condition is corrected (as indicated by the INTERLOCK, CHECK, FORMS, and STACKER lights).

The READY light turns off if any of the following conditions occurs:

1. The STOP key is pressed.
2. The FORMS light is on because the end of forms has been reached, and the last line has been printed on the last form.
3. The FORMS light turns on because the forms are jammed or torn.
4. The INTERLOCK light turns on.
5. The STACKER light turns on.
6. The CHECK light turns on for any reason except to indicate an equipment check only (see equipment check under "CHECK Light").

CHECK Light

The CHECK light turns on whenever an error condition or equipment check is detected. Unit check is indicated to the system. Detailed information on these conditions is available in the sense bytes.

Pressing the printer START key turns off the CHECK light if no hard error is present. If a coil protect check occurred, the CHECK light cannot be turned off for at least five seconds, otherwise the hammer coils may be damaged.

If the CHECK light indicates an equipment check only and the READY light is on, the CHECK light is turned off by any command other than no-operation and 'sense'.

STACKER Light

The STACKER light turns on when the stacker is full. It may also turn on if a stacker jam or other stacking error occurs.

The STACKER light turns off when the stacker has been emptied or the stacking error has been corrected and the START key is pressed.

MANUAL CONTROLS

Use the manual controls (Figure 18) to adjust the position of the forms in relation to the carriage and the hammer unit, and to make adjustments for print quality.
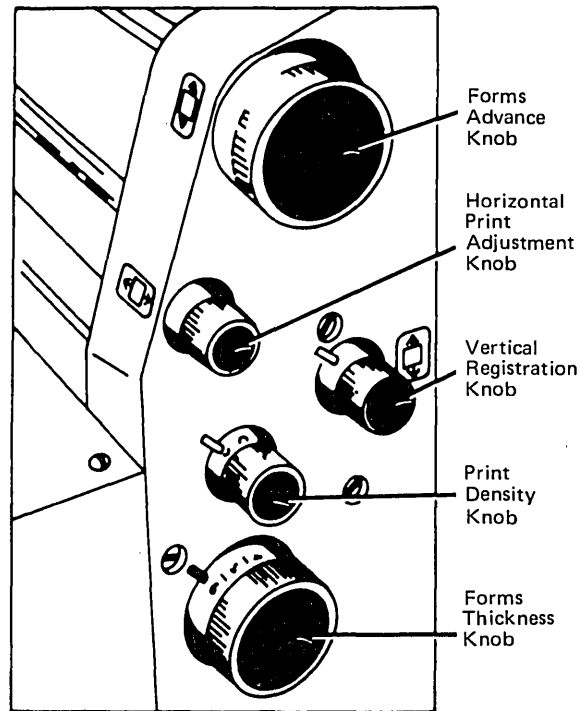
Figure 18. Manual Controls

Forms Advance Knob

Turn the forms advance knob to move the forms vertically. You can use this knob only when the printer is in the 'not ready' state. Do not attempt to force the knob.

Vertical Print Registration Knob

The vertical print registration knob allows a fine setting of the forms at the print line. The print line can be adjusted through approximately 3 mm (0.12 inch) during printing.

Horizontal Print Adjustment Knob

Turn the horizontal print adjustment knob for a fine adjustment of the forms in a lateral direction. A range of 12.7 mm (0.5 inch) is available.

The setting of the horizontal print adjustment knob can be seen from
the three rings on the adjustment shaft (Figure 19). When the middle
ring is just visible to the left of the housing, the midpoint of
adjustment is reached. The other two rings show the limits of left
and right adjustment.
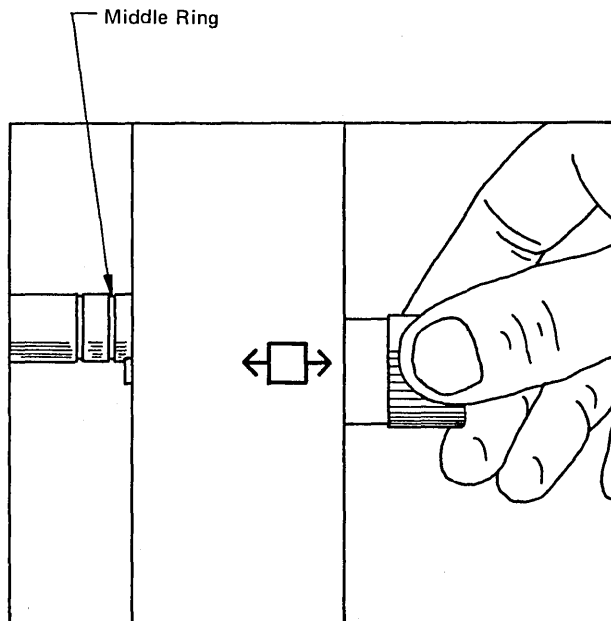
Figure 19. Fine Adjustment of Forms in Horizontal Direction

Print Density Knob

Use the print density knob to regulate the impact energy applied to
the paper. The knob is marked with a scale from "A" through "D". The
position "A" gives the highest print density recommended for thick
forms, and the position "D" gives the lowest print density,
recommended for thin forms. Refer also to the label on the ribbon
cover.

The print density knob is also used to compensate for various ribbon
conditions. Turn the knob towards "D" when the ribbon is new, towards
"A" when the ribbon is old.

    CAUTION
    Do not leave the knob at "A" after a new ribbon has been mounted. A
    permanent "A" setting keeps hammer impact needlessly high, thus
    causing early wear of the ribbon.

Forms Thickness Knob

The forms thickness knob allows you to adjust the gap between the print train and the hammers. The knob is marked from 1 through 6. A low setting is recommended for a single part form and a high setting for a multi-part form. Poor adjustment may cause the printed characters to be light at top or bottom. The settings are also shown on the ribbon cover label.

Paper Brake Adjustment Lever

The paper brake adjustment lever (Figure 20) allows you to adjust the paper drag according to the weight of the forms. The adjustment lever has three positions (1, 2, and 4), corresponding to the number of parts to the forms (see the label on the ribbon cover). For a single-part form, for example, select position 1. Special conditions or a particular type of form may make it advisable to choose a non-standard setting. Wrong adjustment of the paper brake may cause misregistration.
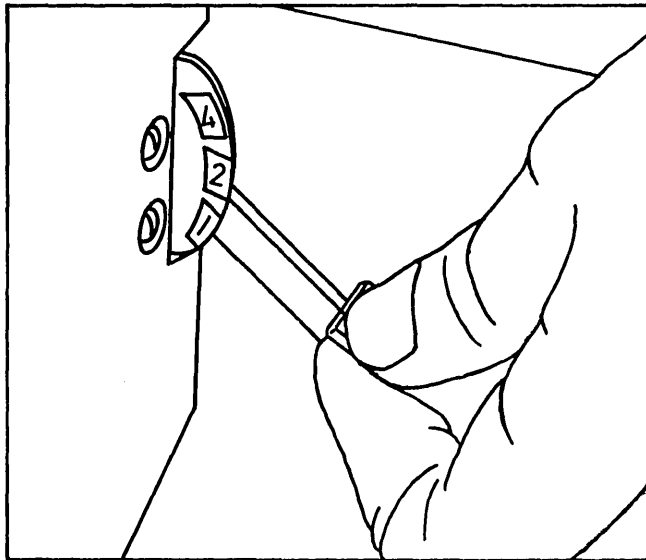
Figure 20. Paper Brake Adjustment Lever

OPERATING PROCEDURES

Forms Loading

There are two procedures for forms loading: one for initial loading into the empty printer, the other for reloading after an end-of-forms condition or when changing to a different type of forms. The principle is similar in both cases but the objectives are slightly different.

During initial forms loading, the aim is to synchronize and align the forms in the printer. When replenishing the forms supply during a job, you must retain this synchronism and alignment.

Initial Loading

1. Raise the printer cover. Pull the swing gate locking lever (Figure 21) toward you and open the swing gate.

   Note: Open the train gate only while the printer is in the not-ready state. Opening the gate while the printer is ready may cause unpredictable results, such as lost print lines and check conditions.
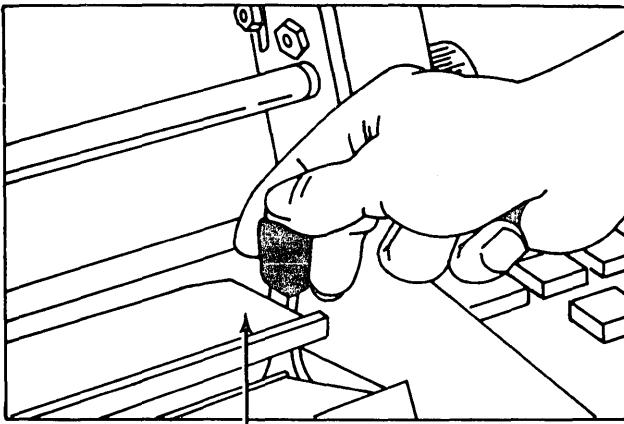
Swing Gate

Figure 21. Opening the Swing Gate

2. Position the left-hand tractor immediately to the left of the first print hammer. The tractor slides freely when you lift the tractor tab (Figure 22).

Tractor Tab
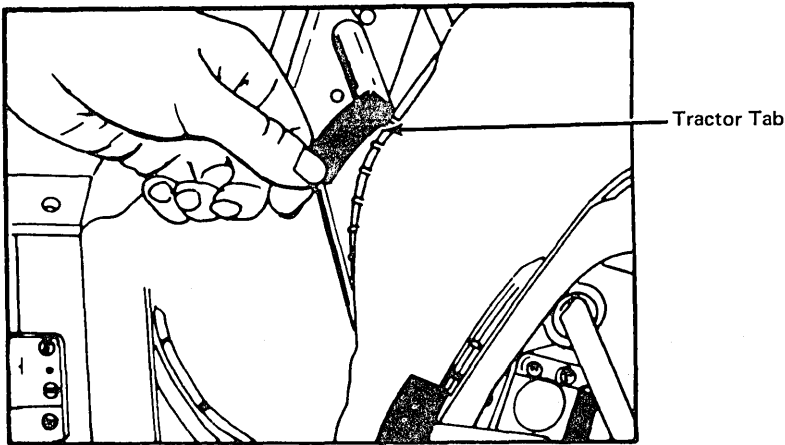
Figure 22. Positioning a Tractor

3. Lift up the covers of both tractors until they remain open. Place

the forms into the forms compartment, reach over the lower
structure and pull up the forms.
4. Place the left-hand margin of the first sheet over the feed pins
of the left-hand tractor and close the tractor cover (Figure 23).
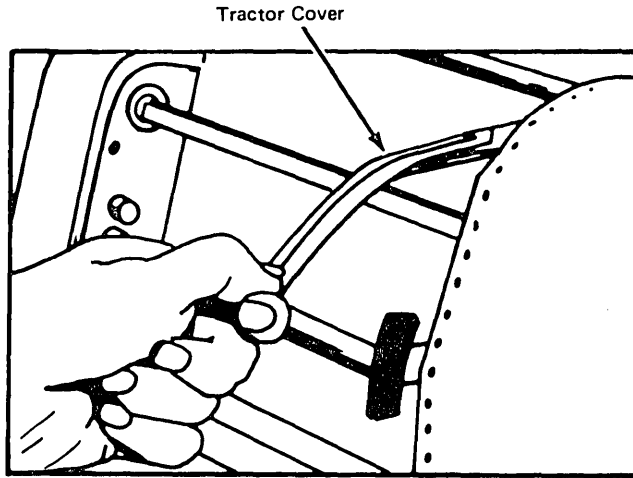
Tractor Cover

Figure 23. Closing a Tractor Cover

5. Slide the other tractor until its feed pins fit into the holes of
the sheet, then close the tractor cover. The form should be smooth
without being tightly stretched. Set the vertical print
registration knob to position 0, and turn the horizontal print
adjustment knob until the middle ring (see Figure 19) on the shaft
is just visible to the left of the housing.
6. Close the ribbon shield. Lift both tractor tabs and align the
forms horizontally against the hammer position indicator scale
(Figure 24) according to your instructions for the job. (For
preprinted forms, a given hammer position must normally be aligned
with a particular point on the form.) Turn the horizontal print
adjustment knob (see Figure 18) to move the forms exactly into
position.
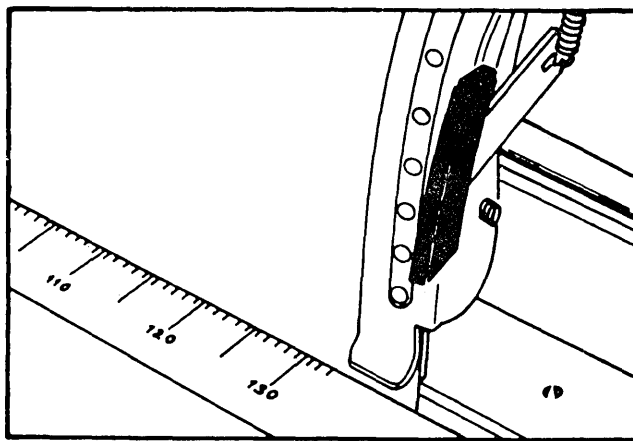
Figure 24. Hammer Position Indicator

7. Open the ribbon shield. Position the form vertically by turning

the forms advance knob (see Figure 18) until the perforation
between the first and second sheets is aligned with the top of the
scribed line on the printer (Figures 25 and 26). Set the paper
brake to position 1, 2, or 4, depending on the number of parts to
the forms. (With some forms, results can be improved by trying a
different setting.) Close the swing gate.
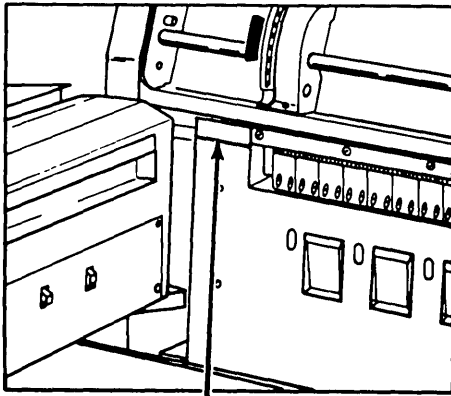
Scribed Line

Figure 25. Printing Area

Note: The second sheet is now correctly aligned for printing. The
first sheet is a dummy leader, especially when the forms are
sequence-numbered or have multiple parts.

8. Operate the counter reset switch. The form is now initially
   synchronized, that is, set to the first printable line.
9. Align the forms stock in the compartment so that the forms lead
   straight up, then close the sliding door. Adjust the stacker as
   described in "Stacker Adjustment". If the stacker is set
   correctly, proceed to "Starting the First Print Job".
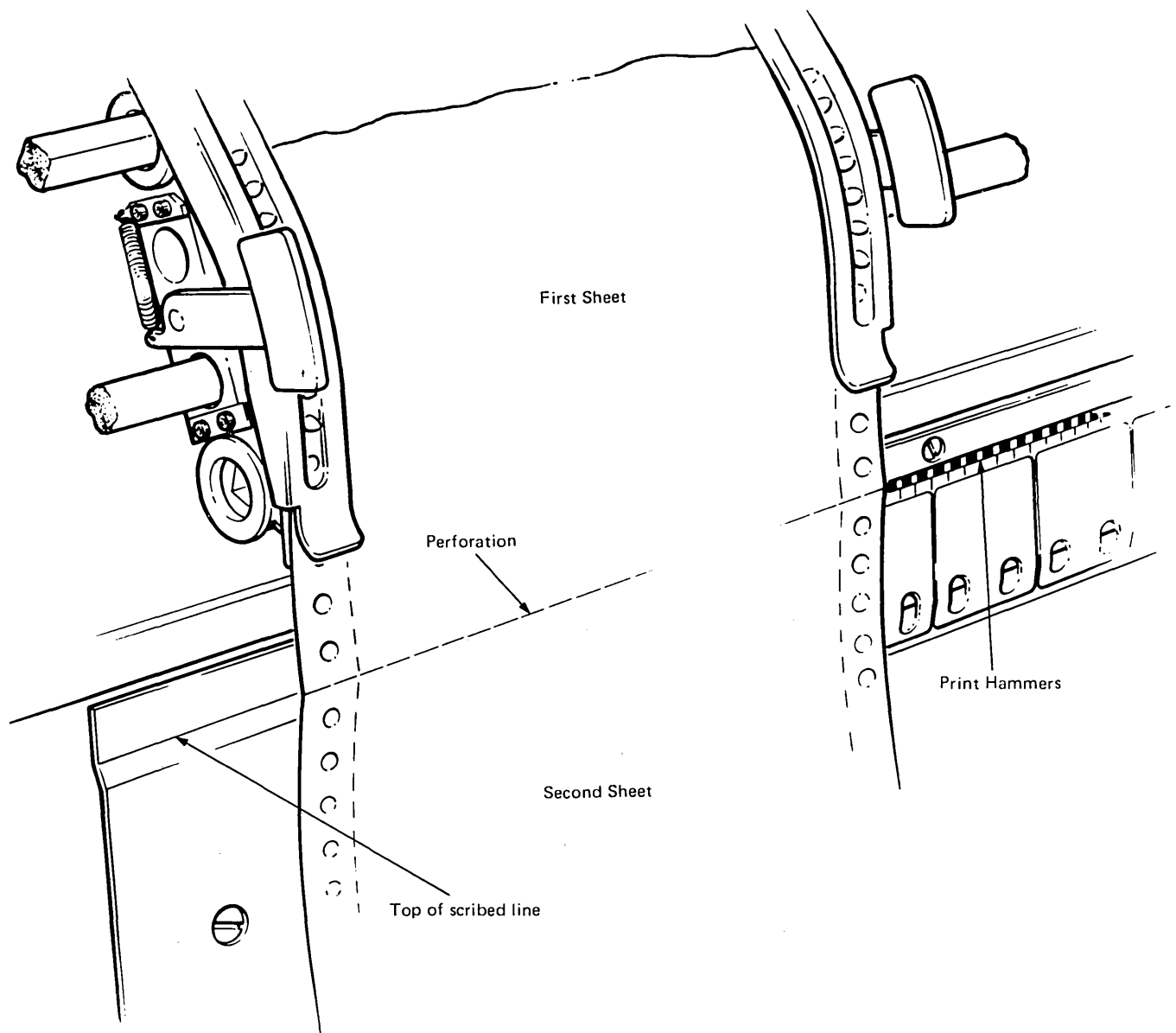
Figure 26. Initial Vertical Alignment of Forms

Forms Unloading

1. Press the printer STOP key.
2. If the end-of-forms switch has operated, the FORMS light turns on but printing continues until the printer attachment detects the end-of-sheet code in the forms control buffer. Thus the last form is completely printed. Go to step 3. If the end of forms has not been reached, go to step 4.
3. Press CARRIAGE RESTORE to unload forms. Go to step 7.
4. Move the forms upward until the end of the last printed sheet is just above the tractors. (Use CARRIAGE RESTORE or CARRIAGE SPACE, or both keys, depending on length of forms.)
5. Tear off the forms below the last printed sheet.
6. Press CARRIAGE SPACE to unload forms.
7. Remove the job from the stacker.

The procedure for reloading depends on whether the same type of form
or a different type of form is needed.

Note: Open the train gate only while the printer is in the not-ready
state. Opening the gate while the printer is ready may cause
unpredictable results, such as lost print lines and check conditions

To reload with identical forms, raise the printer cover, open the
swing gate and open both tractor covers. Place new forms over the
previous forms so that the perforations match exactly (Figure 27).
This overlapping ensures that synchronism remains unchanged. Do not
move any switches or knobs. Close the tractor covers and the swing
gate. Close the printer cover, and press the printer START key to
continue.
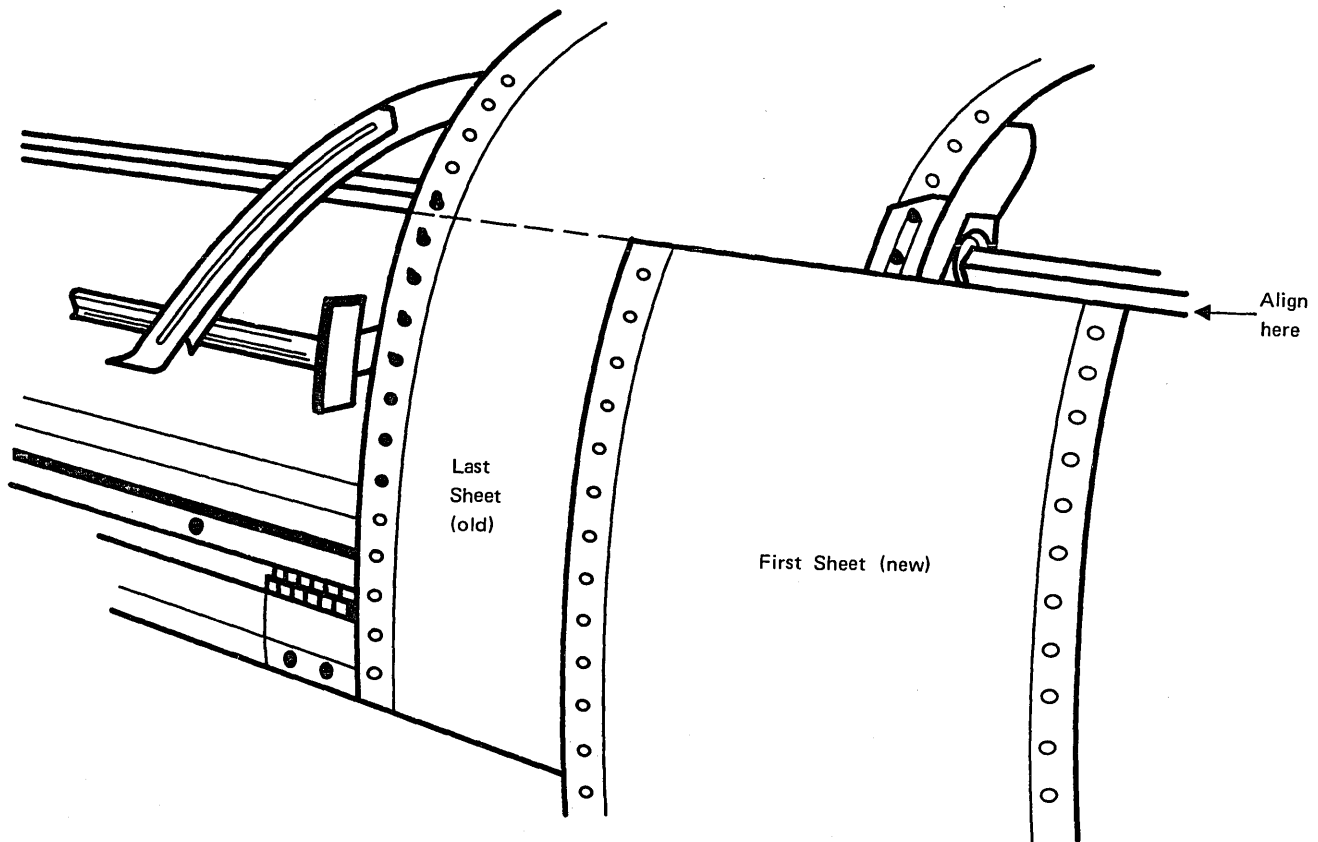
Figure 27. Positioning New Forms

To reload with a different type of forms, run out the old forms by
pressing the CARRIAGE RESTORE key several times. Then proceed as
described under "Initial Loading".

Power-Assisted Forms Stacker

Stacker Parts

The adjustable parts of the power-assisted stacker (Figure 28) are:
• Stacker tray
• Paper rail
• Paper guides
• Stacker chute
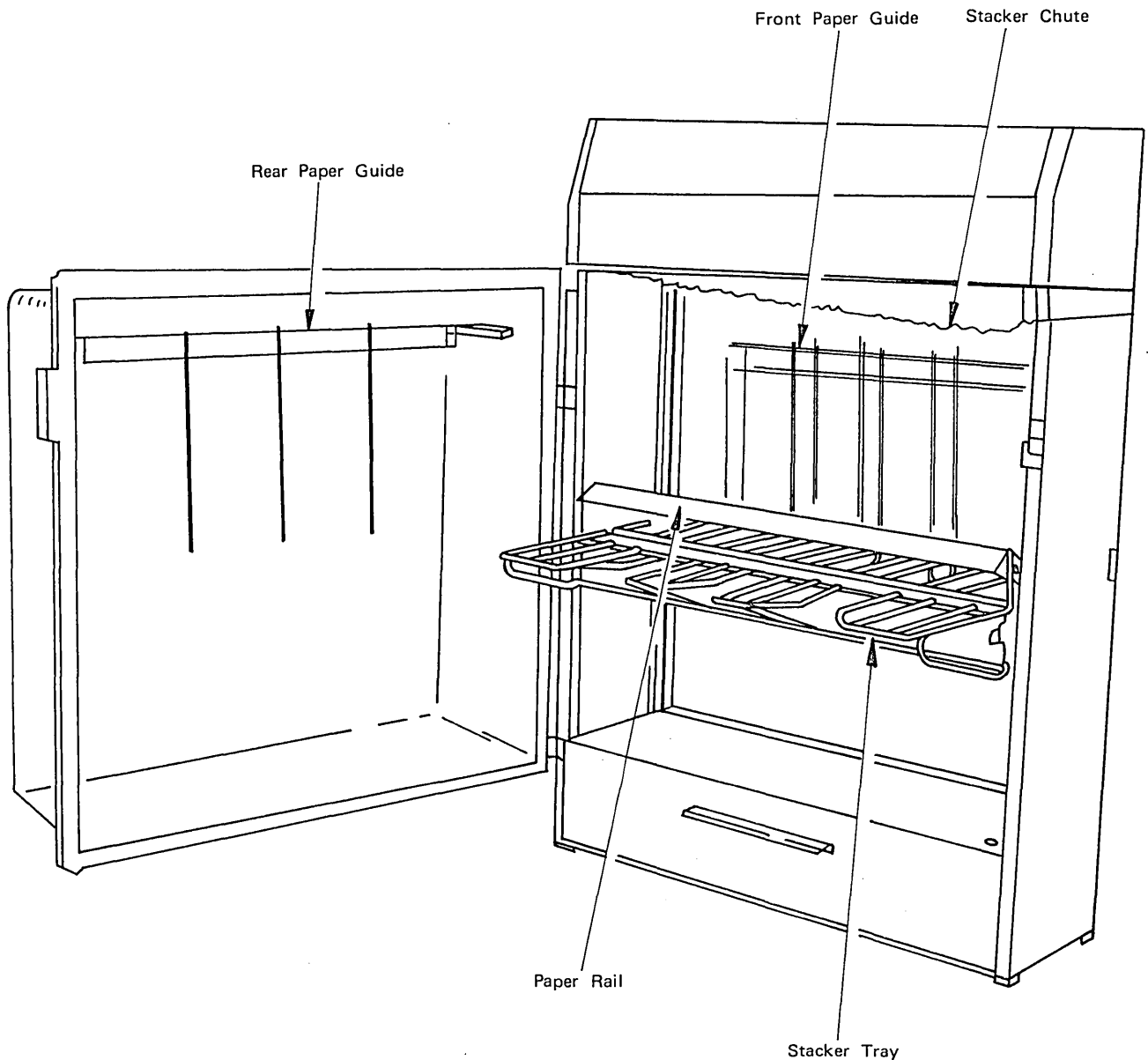
Figure 28. Adjustable Stacker Parts

Stacker Tray: This is a horizontal grid which holds the printed forms.
You raise the tray by hand (Figure 29) and lower the tray by pressing
the STACKER DOWN key. During printing, the tray moves down
automatically as the paper pile grows. The movement is controlled by a
sensing device (Figure 30), located on both sides of the stacker
housing.

CAUTION
Raise the stacker tray only when the printer READY light is off. If
the tray is raised during the printer ready state, the beams of the
sensing device may be broken, causing an automatic downward movement
of the tray.
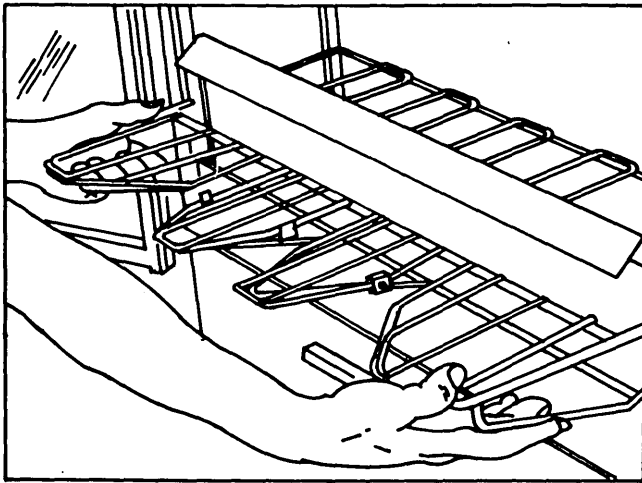
Figure 29. Raising the Stacker Tray
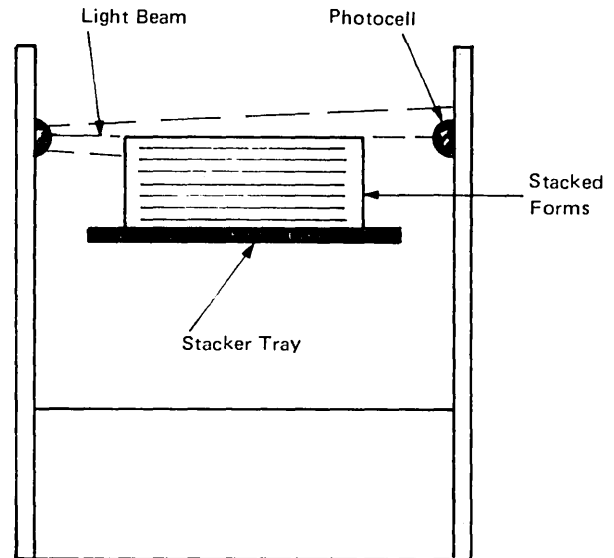
Figure 30. Paper Pile Sensing D evice

Paper Rail: This is a bar mounted over the stacker tray to improve
stacking.

1. Upward Adjustment. Raise the paper rail (Figure 31) and engage
   the notches in the holding rod.
2. Downward Adjustment. Disengage the rail from the holding rod and
   lower the rail into the stacker tray.
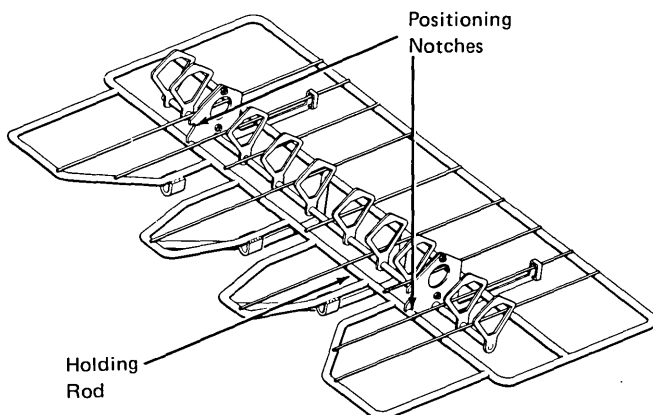
Figure 31. Hinged Paper Rail (Up Position)

Paper Guides: The paper guides (front and rear) are two vertical grids
which guide the printed forms onto the stacker tray. The guides (see
Figure 28) are suspended from pairs of numbered holes which you select
according to the length of the forms.

Stacker Chute: This is a metal plate mounted in the housing over the stacker tray. The chute helps to improve stacking, particularly of single forms. It can be set to three positions; up, middle, and down (Figure 32).
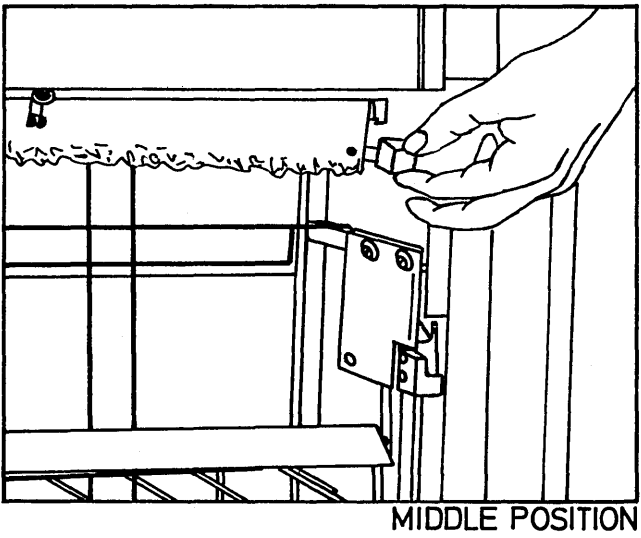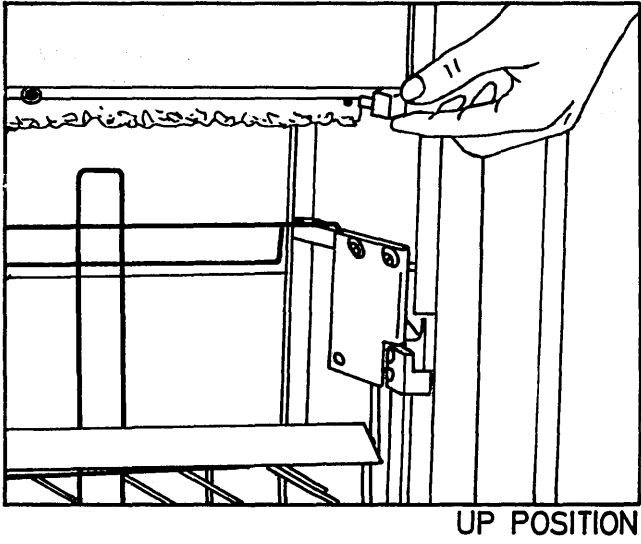
UP POSITION

MIDDLE POSITION

DOWN POSITION
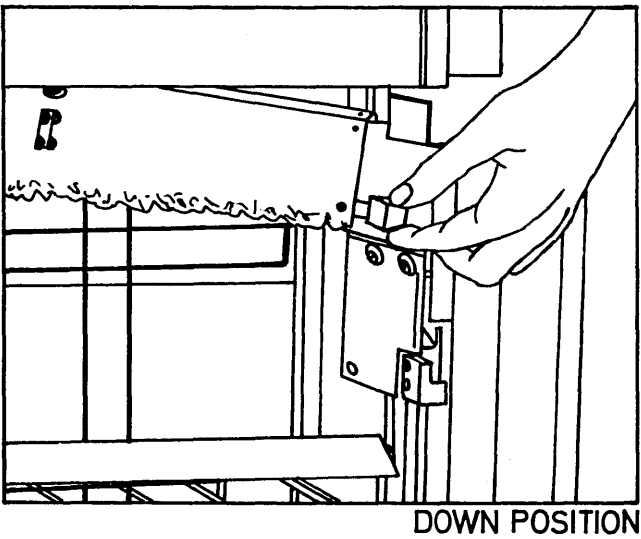
Figure 32. Stacker Chute

Adjustment of Power-Assisted Stacker

Set the adjustable parts of the stacker according to the length and stiffness of the forms as described in the following text.

Note: It may be possible to improve results by varying these settings on a basis of trial and error.

For Paper Forms up to 356 mm (14 Inches) Long:

1. Set the front and rear paper guides to the length of the forms. The minimum possible setting is 203 mm (8 inches), even if the forms are shorter.
2. Push the stacker tray to its top position.
3. Set the paper rail and chute to the levels shown in Figure 33.

Forms	Settings	
	Paper Rail	Chute
One-part	Down	Down
Two to four parts	Middle	Middle
More than four parts	Up	Up

Note: It may be possible to improve results by varying these settings on a basis of trial and error.

Figure 33. Recommended Settings of Paper Rail and Chute

For Paper Forms Over 356 mm (14 Inches) Long:

1. Remove the rear paper guide from inside the acoustic enclosure and slide it into the tubes in the stacker tray. This extends the stacker tray to support the longer forms.
2. Press STACKER DOWN until the stacker tray reaches the middle position. If stacking is untidy, lower the tray until it improves.
3. Set the paper rail and chute to the levels shown in Figure 33.
4. Leave the acoustic enclosure open during printing.

For Card Stock and Extra-Stiff Forms:

1. Set the front and rear paper guides to the length between the major folds of the card stock.
2. Press STACKER DOWN until the stacker tray reaches its lowest position.
3. Set the paper rail to the down position.
4. Set the stacker chute to the up position.

When a job starts, always guide the first few forms evenly onto the stacker tray by hand.

Note: If the relative humidity is more than 65% or less than 20% you may have to give your full attention to the stacking.

Starting the First Print Job

After you have loaded the forms and adjusted the stacker as previously described, the printer cover is still open. Proceed as follows:

1. Set the forms thickness and print density to suit the forms you have loaded (see decal on ribbon cover).
2. Make the printer ready by pressing the 3203 START key. The printer must be ready before the forms control buffer can be loaded.

   NOTE: DOS/VS will load the FCB automatically.

3. Make sure that the forms control buffer is correctly loaded.
4. If you suspect bad alignment, use the SINGLE CYCLE key to print a line, and check the registration.
5. Adjust registration, if necessary, then press the START key and guide the first few forms onto the stacker tray.

Print Cartridge Changing

1. Raise the printer cover.
2. Unlatch the swing gate and swing it open. Unlatch the ribbon shield and secure it against the forms.
3. Remove the top ribbon spool as described under "Ribbon Changing". Pivot the two handles on top of the cartridge to their upright position so that the cartridge is unlocked (Figure 34). Lift the cartridge free of the print unit by its handles and place the new cartridge on the locating studs.
4. Turn the drive knob (Figure 35) by hand until you hear the click of the drive key engaging in the slot in the drive gear. Lock the cartridge in place by returning the handles to the horizontal position.
5. Replace the ribbon spool.
6. Close and lock the swing gate and lower the printer cover.

UCS Cartridge Mounting

1. Turn the drive knob by hand until the cartridge is in the correct starting position, as follows:
   a. The drive key is aligned with the position marker on the cover.
   b. The indicators on the two windows are aligned with the position markers on the two gears. A maximum of five revolutions of the drive key may be required.
2. Rotate the print train counterclockwise until the first character of the color-coded slug is aligned with the arrow engraved on the cartridge.

3. Place the cartridge onto the locating studs. Move the drive knob slightly left or right until the drive key engages.
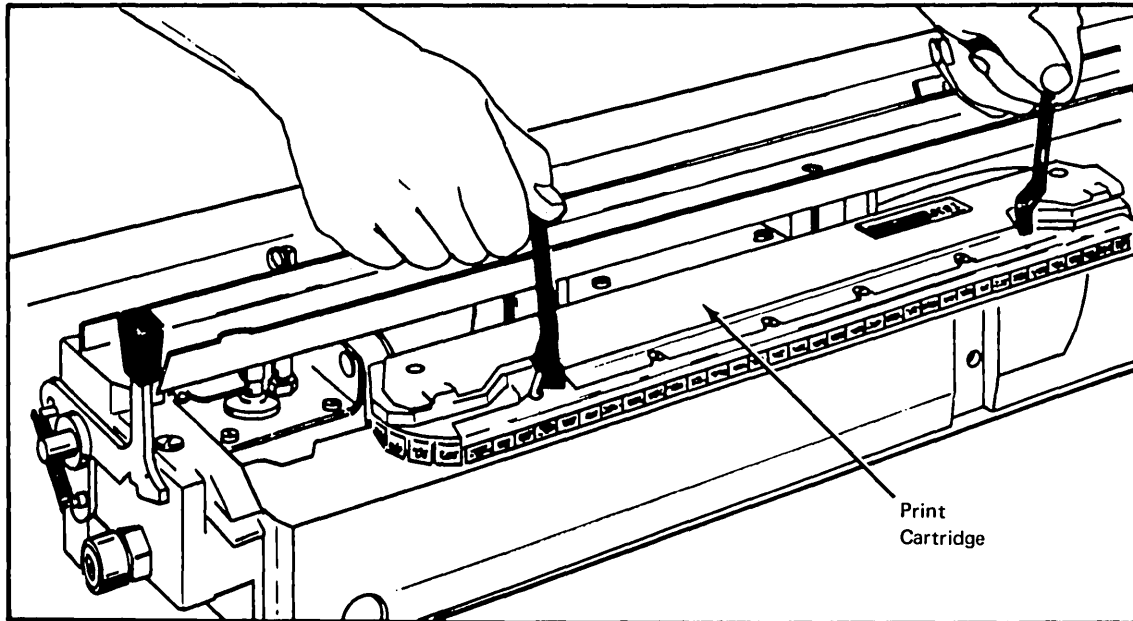4. Lock the cartridge in place by returning the handles to the horizontal position.
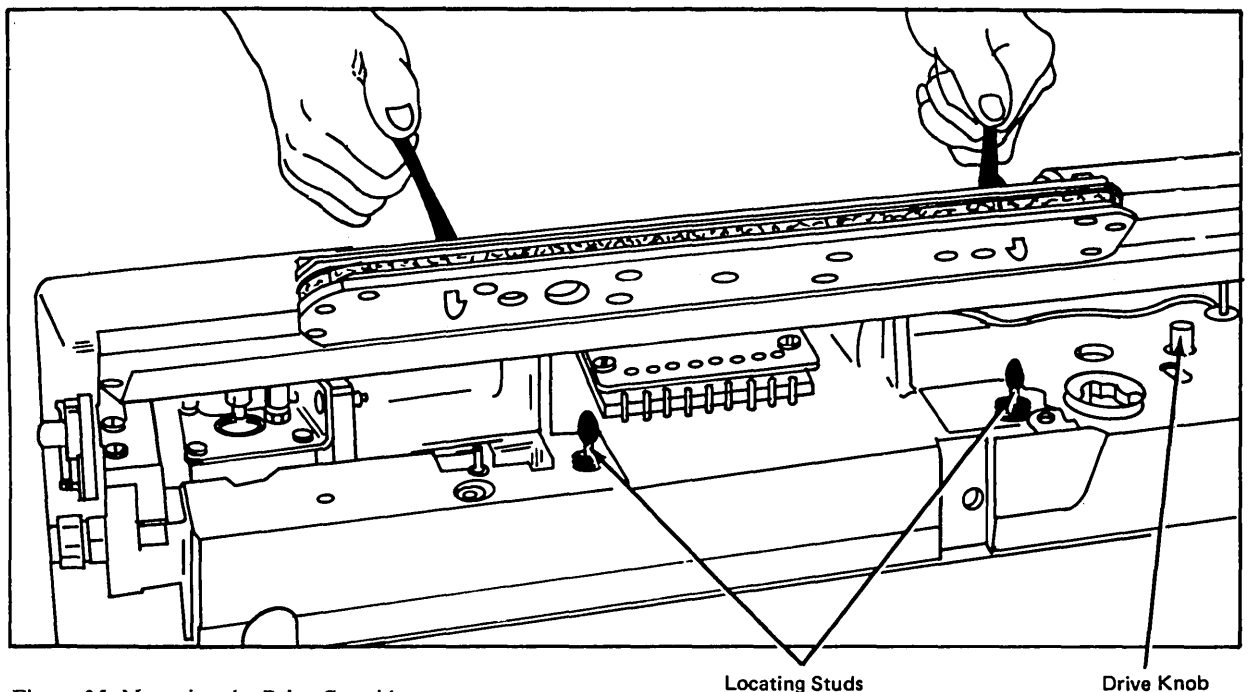

Figure 34. Removing the Print Cartridge

Figure 35. Mounting the Print Cartridge

Cleaning the Print Train

Smudged characters and extraneous ink are sometimes signs of a dirty print train. Run the train clean program with the approved cleaning paper (IBM part number 451529). If the condition continues, the train must be cleaned by hand: this is a task for qualified personnel and it must be performed by an IBM service representative only.

To clean the train:

1. Remove the paper and ribbon.
2. Insert cleaning paper (IBM part 451529 or equivalent).
3. Set forms thickness control to 2.
4. Set print density knob to A.
5. For DOS/VS, ASSIGN SYS000 to the printer and execute the program with the name CLEANER.
6. Follow the instructions that will appear on the logging device.

Ribbon Changing

1. Raise the printer cover. Unlatch the swing gate and swing it open.
2. Clean the area of the ribbon shield with the vacuum cleaner.
3. Unlatch the ribbon shield and swing it against the forms. Swing down the ribbon cover.
4. Push the top ribbon spool towards the hinged side of the front unit. Lift out the other end of the top ribbon spool, remove the spool from the drive and place it carefully on top of the swing gate. Remove the bottom spool in a similar way to the top spool.
5. Install the new ribbon in reverse order, bottom spool first. When positioning the top spool, make sure that the reversing bar of the ribbon (Figure 36) is not on the far side of the trip lever, otherwise the ribbon will be severely damaged when the ribbon drive starts.
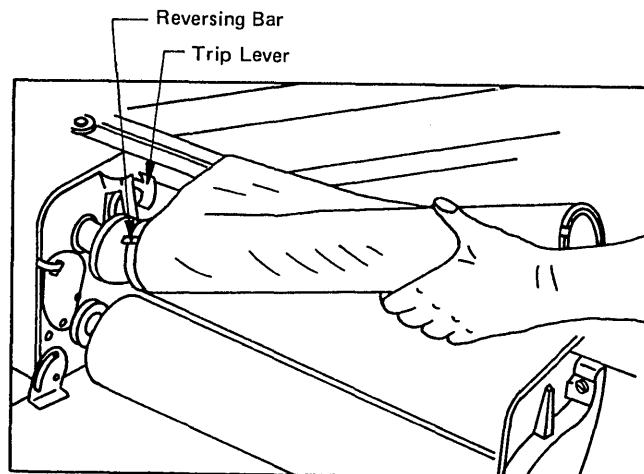

Figure 36. Installing the Ribbon

6. When the ribbon has been installed (Figure 36), tighten it by hand
   to remove slack from the printing area. (Press the STOP key to run
   the ribbon drive).

Note: The high energy of the 3203-5 print hammers improves the print
quality of copies when multiple-part forms are used, but it can also
cause the ribbon to wear out before the ink is used up. To lengthen
the life of the ribbon, use the following procedure. After installing
a new ribbon, set the print density knob to "D". When the print
density is too light, turn the print density knob one half-step or
more towards "A" until the quality becomes satisfactory. Do not turn
the knob further than is necessary for satisfactory density. For
example, a setting of "C" would be typical for most single-part forms.

Revaluate the print quality periodically. If a decline is detected
after several hundred thousand lines, turn the print density knob
another half-step towards "A". Repeat the procedure as often as
necessary.

Ribbon fabric life is reduced (independent of ink content) by:

1. Initial runs of new type faces (the first few months after
   installing a new cartridge).
2. Use of 2.01 mm (0.079 inch) type or text type which has a
   relatively small contact area and therefore increases ribbon
   stress.
3. By high usage of small-area characters (for example, on job
   delimiter pages), such as period, comma, hyphen, slash, and colon.

If a ribbon is used beyond its useful fabric life, print quality may
be adversly affected, data may be lost, and the machine may be
damaged. Use of a ribbon beyond its useful life is indicated by:

• Small holes appearing in the ribbon
• Frayed streaks on the fabric
• Foldover of the ribbon

When any of these conditions occur, replace the ribbon.

The plastic shield should be cleaned periodically with cleaning paper
or cleaning fluid.

Vacuum Cleaning

Vacuum clean the print area at the beginning of every shift as
follows:

1. Raise the printer cover. Unlatch the swing gate and swing it open.
   Remove the manual vacuum cleaner hose from its storage shelf below
   the swing gate.
2. Attach the hose to the vacuum tube at the left of the ribbon
   shield (Figure 37). The vacuum cleaner starts automatically.
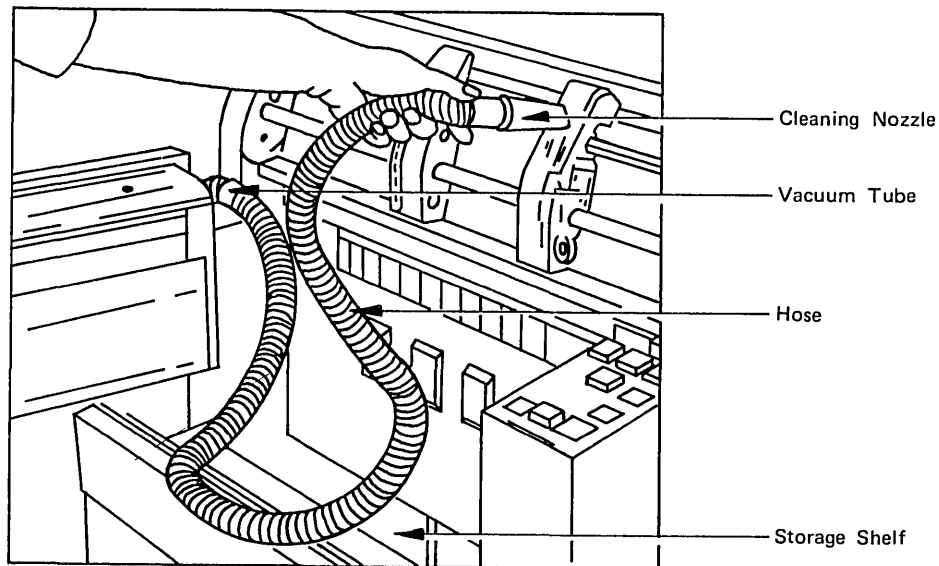3. Vacuum all lint and dirt from the print area.

Figure 37. Vacuum Cleaning by Hand

4. Disconnect the vacuum cleaner hose and stow it in its storage
   place.

   Note: Fold the hose into a U-shape and fit it into the storage
   shelf. The bend must be to the right; the open ends of the hose
   must be to the left. Tuck the bend up under the operator panel so
   that it does not interfere with the closing of the swing gate.
   Close the swing gate and lower the printer cover.

Regularly empty the waste container (Figure 38) which is located under
the left side cover of the printer. To replace the filter bag, follow
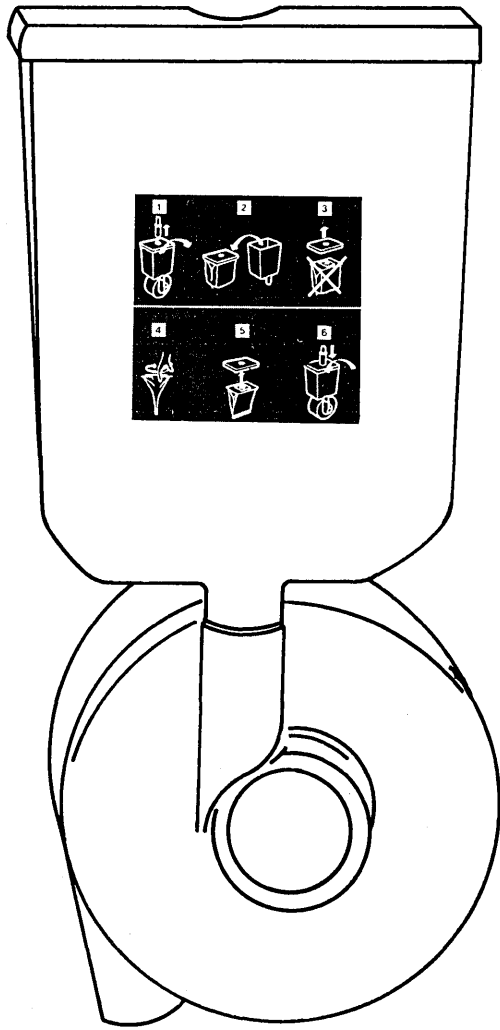the steps shown on the label on the waste container.

Figure 38. Vacuum Cleaning Waste Container

Programming Information

This section describes the commands acceptable by the 3203 Model 5, and the status and sense information returned to the attaching system by the 3203-5. Refer to IBM System/370 Principles of Operation, GA22-7000 for a description of System/370 I/O operations.

COMMANDS

The 3203 Model 5 responds to all commands with 0 (zero) initial status (condition code 0 on System/370), unless the channel or the 3203-5 is busy, the 3203-5 is not operational, or status is pending in the 3203-5 or the subchannel.

Incorrect length is posted for all commands that do not cause data transfer, unless the SLI bit is set in the CCW. It is recommended that the SLI bit be set in any CCW issued to the 3203-5. Note that since a CCW with a count of zero is invalid, the program cannot use the CCW count field to specify that no data be transferred to the I/O device (see System/370 Principles of Operation).

Write Commands

Write commands (Figure 39) cause data to be transferred from main storage to the print line buffer; the data transfer is followed by the print operation, including any carriage motion. Data transfer ends either when the print line buffer is filled or when the length count has been reduced to zero, whichever occurs first. If the number of data bytes transferred is less than the print line width, the remaining positions are filled with blanks (hex '40'). Channel end is indicated when the data transfer to the 3203-5 is completed. Device end is indicated when the mechanical print operation is complete and any carriage operation has positively started.

If a 'write and skip' command specifies a channel for which no code exists in the forms control buffer, the carriage does not move and the command ends with unit check set. A subsequent sense indicates data check and line position. If a 'write and skip' command orders the carriage to go to the channel at which it is presently located, the carriage moves until that channel is again detected.

Command Code		Command
CCW Bits	Hex	

0 1 2 3 4 5 6 7	Hex	Command
0 0 0 0 0 0 0 1	01	Write without spacing
0 0 0 0 1 0 0 1	09	Write and space 1
0 0 0 1 0 0 0 1	11	Write and space 2
0 0 0 1 1 0 0 1	19	Write and space 3
1 0 0 0 1 0 0 1	89	Write and skip to channel 1
1 0 0 1 0 0 0 1	91	Write and skip to channel 2
1 0 0 1 1 0 0 1	99	Write and skip to channel 3
1 0 1 0 0 0 0 1	A1	Write and skip to channel 4
1 0 1 0 1 0 0 1	A9	Write and skip to channel 5
1 0 1 1 0 0 0 1	B1	Write and skip to channel 6
1 0 1 1 1 0 0 1	B9	Write and skip to channel 7
1 1 0 0 0 0 0 1	C1	Write and skip to channel 8
1 1 0 0 1 0 0 1	C9	Write and skip to channel 9
1 1 0 1 0 0 0 1	D1	Write and skip to channel 10
1 1 0 1 1 0 0 1	D9	Write and skip to channel 11
1 1 1 0 0 0 0 1	E1	Write and skip to channel 12

Figure 39. Write Commands

Command Code		Command
CCW Bits	Hex	

0 1 2 3 4 5 6 7	Hex	Command
0 0 0 0 1 0 1 1	0B	Space 1
0 0 0 1 0 0 1 1	13	Space 2
0 0 0 1 1 0 1 1	1B	Space 3
1 0 0 0 1 0 1 1	8B	Skip to channel 1
1 0 0 1 0 0 1 1	93	Skip to channel 2
1 0 0 1 1 0 1 1	9B	Skip to channel 3
1 0 1 0 0 0 1 1	A3	Skip to channel 4
1 0 1 0 1 0 1 1	AB	Skip to channel 5
1 0 1 1 0 0 1 1	B3	Skip to channel 6
1 0 1 1 1 0 1 1	BB	Skip to channel 7
1 1 0 0 0 0 1 1	C3	Skip to channel 8
1 1 0 0 1 0 1 1	CB	Skip to channel 9
1 1 0 1 0 0 1 1	D3	Skip to channel 10
1 1 0 1 1 0 1 1	DB	Skip to channel 11
1 1 1 0 0 0 1 1	E3	Skip to channel 12

Notes: 1. If the carriage is at the channel, the command does not cause
any carriage motion unless the previous command was 'write
without spacing'.

2. These commands cause no data transfer, and the CCW SLI
bit should be set to prevent on incorrect length indication
in the CSW.

Figure 40. Carriage Control Commands

Carriage Control Commands

Carriage control commands (Figure 40) consist of space and skip commands without write. These commands cause no data transfer, and the CCW SLI bit should be set to prevent an incorrect length indication in the CSW.

The command code is transferred to the printer attachment, then channel end is indicated and the carriage operation is started. Device end is indicated when the mechanical operation is positively started in the printer. If a skip command orders the carriage to go to the channel at which it is presently located, the forms do not move and device end is set.

Initializing and Diagnostic Commands

The initializing and diagnostic commands (Figure 41) are given to set certain conditions in the printer attachment, and to control and diagnose errors in the printer subsystem. The commands cause no printing or carriage motion.

Command Code		Command
CCW Bits	Hex	
0 1 2 3 4 5 6 7		
0 0 0 0 0 1 0 0	04	Sense
0 0 0 0 0 0 1 1	03	No-op*
1 1 1 1 1 0 1 1	FB	Load UCS buffer
0 1 0 0 0 0 1 1	43	Fold*
0 0 1 0 0 0 1 1	23	Unfold*
0 1 1 0 0 0 1 1	63	Load forms control buffer
0 1 1 1 0 0 1 1	73	Block data check*
0 1 1 1 1 0 1 1	7B	Allow data check*
0 0 0 0 0 0 1 0	02	Read print line buffer
0 0 0 0 1 0 1 0	0A	Read UCS buffer
0 0 0 1 0 0 1 0	12	Read forms control buffer
0 0 0 0 0 1 1 0	06	Check read
0 1 1 0 1 0 1 1	6B	Raise cover*
0 0 0 0 0 1 1 1	07	Diagnostic gate*

* These commands cause no data transfer and the CCW SLI bit should be set to prevent an incorrect length indication in the CSW.

Figure 41. Initializing and Diagnostic Commands

Sense

The 'sense' command transfers 24 bytes of sense information to main storage. The 'sense' command is usually given when unit check has been set in the CSW and the reason is to be investigated. The sense bytes contain information about errors or unusual conditions in the printer or the channel attachment. The operating system analyses this information before taking appropriate recovery action.

The sense information is stored into the main storage location specified by CCW bits 8 to 31, in ascending order of address. The number of sense bytes to be transferred is specified in CCW bits 48 to 63. Channel end and device end are both set when the transfer of sense information to main storage is completed.

For details of information that can be obtained by use of the 'sense' command, see "Sense Information" in this section.

No-Op

The 'no-op' command performs no operation in the 3203-5. When this command is given, zero status (condition code 0) is returned. Then channel end, device end, and any other status conditions that exist at the time are indicated.

This command causes no data transfer, and the CCW SLI bit should be set to prevent an incorrect length indication in the CSW.

Load UCS Buffer

The 'load UCS buffer' command causes data to be transferred from main storage to the 304-byte UCS buffer. The buffer contains the 240-byte train image and the 64-byte dualing and uncomparable character table (DUCT). The format of the train image corresponds to the formats used for the 1416 train cartridge on the 1403 Printer or the 3203 Model 4. The format of the DUCT is explained later in this section under "Dualing and Uncomparable Character Table".

The data transfer begins at the main storage location specified in bits 8 to 31 of the CCW and proceeds in ascending order of address. If the length count is less than 304, unit check is posted and a subsequent sense indicates a load check. At the end of the data transfer, channel end and device end are both indicated. The UCS buffer remains loaded until it is reloaded or power goes off.

Note: Operating the RESET switch on the auxiliary operator panel loads default data into the UCS buffer and the forms control buffer.

Fold

The 'fold' command causes the printer controller to ignore bit positions 0 and 1 of the EBCDIC code when the character codes from the UCS and print line buffers are compared. This causes printing of uppercase characters only from either uppercase or lowercase data codes. When the 'fold' command is given, folding continues until the 'unfold' command is received, until power to the printer is turned off, or until the auxiliary operator panel RESET switch is operated.

This command causes no data transfer, and the CCW SLI bit should be set to prevent an incorrect length indication in the CSW.

Unfold

The 'unfold' command causes the controller to stop folding, and returns the printer to normal operation.

This command causes no data transfer, and the CCW SLI bit should be set to prevent an incorrect length indication in the CSW.

Load Forms Control Buffer

The 'load forms control buffer' command transfers data from main storage to the forms control buffer. The carriage line counter is reset. The maximum data transfer is 256 bytes (see "Programming the Forms Control Buffer" following in this section).

If no end of sheet flag is detected in the data transferred, if the load contains a channel number greater than 12, or if the total number of non-zero bytes (up to and including the end of sheet code, but excluding the indexing byte, if specified), exceeds 31, the operation terminates with unit check, and a subsequent sense indicates load check.

The forms control buffer remains unchanged until it is reloaded or until power is turned off.

Note: Operating the RESET switch on the auxiliary operator panel loads default data into the forms control buffer and the UCS buffer.

Block Data Check

The 'block data check' command blocks setting of data check conditions (sense byte 0, bit 4) that can occur if the print line buffer contains a character code that is not printable. 'Block data check' remains on until reset by an 'allow data check' command, a UCS buffer parity check, or until power is turned off.

This command causes no data transfer, and the CCW SLI bit should be set to prevent an incorrect length indication in the CSW.

Allow Data Check

The 'allow data check' command resets the block data check condition and allows the printer controller to set data check (bit 4 in sense byte 0) after an unprintable character is detected in the print line buffer.

This command causes no data transfer, and the CCW SLI bit should be set to prevent an incorrect length indication in the CSW.

Read Print Line Buffer

The 'read print line buffer' command tranfers the bytes in the print line buffer as they were received by the printer from a previous write command to main storage. The command is normally used for diagnosis. If dualing has been set, the 'AN' character codes are transferred for the dualable characters regardless of whether 'AN' or 'HN' characters were transferred with the previous print line.

Read Universal Character Set Buffer

The 'read universal character set buffer' command transfers the 304 bytes of the UCS buffer to main storage. The command is normally used for diagnosis.

Read Forms Control Buffer

The 'read forms control buffer' command transfers the carriage control bytes to main storage. The data transfer begins at the storage location designated by the data address (CCW bits 8 to 31) and proceeds in ascending order of address. The command is normally used for diagnosis.

Check Read

The 'check read' command transfers to main storage, the check information stored at each addressable position of the print line buffer. The command is normally used for diagnosing faults, or for isolating them to an individual print position. The check bits transferred have the following meanings:

```
Bit  Designation            Meaning

0    Enable      ⎫
1    Compare     ⎬        These bits are used to control the
2    Fired       ⎬        hammer driver 'on' time.
3    Handled     ⎭

4    Data check           The data check bit is set during a
                          write command if the DUCT field
                          indicates that a character at the
                          corresponding position is not in the
                          train image.

5    Hammer failure       The hammer failure bit is set during
                          printing if the corresponding hammer
                          driver fails to turn on when it should.

6    Hammer misfire       The hammer misfire bit is set if the
                          addressed hammer is on when it should
                          be off.

7    Parity check         The parity check bit is set when
                          invalid parity is detected for the nine
                          data bits in the corresponding
                          position of the print line buffer.
```

When the 'check read' command is given after a 'diagnostic gate' command, the eight bits of the FCB pointer indicating the position of the current line in the forms control buffer are transferred to the channel. The maximum data transfer length is 1. The value of the FCB pointer is encoded in the same way as the 3811, as follows:

- Internally, the FCB position is stored in 'zero origin' notation (the first line is line 0, the second line is line 1, etc..

- A value of two is added to the 'zero origin' notation.

- The hexadecimal notation of the resultant one-byte value is reversed (bits 7, 6, 5, 4, 3, 2, 1, 0 become bits 0, 1, 2, 3, 4, 5, 6, 7 respectively).

For example, FCB pointer value hex '40' is encoded for the first line of the form; hex 'C0' is encoded for the second line, etc..

Raise Cover

For compatibility with the 3211 Printer, the 'raise cover' command is accepted by the 3203-5 but no operation is carried out.

This command causes no data transfer, and the CCW SLI bit should be set to prevent an incorrect length indication in the CSW.

Diagnostic Gate

The 'diagnostic gate' command is treated as a no-operation unless it precedes the 'check read' command in a command chain. (See "Check Read" earlier in this section.)

This command causes no data transfer, and the CCW SLI bit should be set to prevent an incorrect length indication in the CSW.

DUALING AND UNCOMPARABLE CHARACTER TABLE

The 64-byte DUCT (UCS buffer addresses 240 to 303) is used to check in advance if a character code presented for printing:

* Is available in the train image buffer, or
* Must be translated for dualing, or
* Must be considered invalid.

Checking by the DUCT

Each character code presented to the print line buffer is treated with the DUCT table for validity. For this test, the character code is considered as two fields. Field 1 (bits 2 to 7) is used as an address which is added to the DUCT start address (UCS buffer address 240) for entry to the DUCT. Field 2 (bits 0 and 1) is considered as a decimal number 0, 1, 2, or 3 depending on whether it contains 00, 01, 10, or 11. This number points to the corresponding bit position at the DUCT address selected by bits 2 to 7. If the selected DUCT bit is found on, the character code is valid. If the DUCT bit is found off, the character code is unprintable.

Example

Graphic "A" (EBCDIC code 1100 0001) is to be tested by DUCT.

1. Field 1 of the EBCDIC code, consisting of bits 2 to 7 (00 0001), is selected for addressing a control byte in the DUCT.
2. Field 1 (decimal 1) is added to the DUCT start address (240) to address the DUCT control byte 241.
3. Field 2 of the EBCDIC code, consisting of bits 0 and 1 (11), is used in decimal form (3) to select a specific bit position of the DUCT control byte. In this case position three is selected.
4. If bit 3 of the DUCT control byte is found to be on, the graphic "A" is printable. If bit 3 is found off, graphic "A" is not printable.

Dualing

Dualing of a character code is controlled by bit 1 of the
corresponding DUCT byte. If bit 1 is on, dualing-translation is
carried out, provided bit 4, 5, 6, or 7 is also set, as shown in the
following table.

Character code (hex)	Graphic	DUCT bit on	Translated to (hex)	Graphic
4D	(	6	6C	%
5D	)	7	4C	¤
7D	'	5	7C	@
7E	=	4	7B	#

How to Program the DUCT

Set the 64 DUCT bytes (UCS buffer addresses 240 to 303) for printable
graphics as follows.

- For each DUCT address, look across the columns in Figure 42 and
  pick out the graphics (or the codes assigned to nonstandard
  graphics) used on the train.
- For each printable graphic or assigned code, set the DUCT bit
  indicated at the bottom of the relevant column in Figure 42.
- For dualing, set DUCT bits for both "A" and "H" graphics, plus the
  bits stated for the four addresses in the following table.

Address	Bit	Dualed Graphics "AN"	"HN"
253	6	%	(
269	7	¤	)
301	5	@	'
302	4	#	=

- At each address, turn off the remaining bits of the byte,
- At address 240, set bits 0 and 1 (null and space) to indicate that
  the respective codes are acceptable although they are not
  associated with a printable graphic.

Note: The first four bit positions (0 to 3) of the 64 DUCT bytes
provide control bits for null, space, and 254 graphics definable by
the eight-bit EBCDIC code.

Address of DUCT byte in UCS buffer	EBCDIC Table							
	Hex	Graphic and Control Symbols	Hex	Graphic and Control Symbols	Hex	Graphic and Control Symbols	Hex	Graphic and Control Symbols
240	00	NUL	40	SP	80		C0	.'
241	01		41		81	a	C1	A
242	02		42		82	b	C2	B
243	03		43		83	c	C3	C
244	04	PF	44		84	d	C4	D
245	05	HT	45		85	e	C5	E
246	06	LC	46		86	f	C6	F
247	07	DEL	47		87	g	C7	G
248	08		48		88	h	C8	H
249	09		49		89	i	C9	I
250	0A		4A	¢	8A		CA	
251	0B		4B	.	8B	{	CB	
252	0C		4C	<	8C	<	CC	∫
253	0D		4D	(	8D	(	CD	
254	0E		4E	+	8E	+	CE	Ч
255	0F	CU1	4F	|	8F		CF	.
256	10		50	&	90		D0	
257	11		51		91	j	D1	J
258	12		52		92	k	D2	K
259	13		53		93	l	D3	L
260	14	RES	54		94	m	D4	M
261	15	NL	55		95	n	D5	N
262	16	BS	56		96	o	D6	O
263	17	IL	57		97	p	D7	P
264	18		58		98	q	D8	Q
265	19		59		99	r	D9	R
266	1A	CC	5A	!	9A	}	DA	
267	1B		5B	$	9B	}	DB	
268	1C		5C	*	9C	¤	DC	
269	1D		5D	)	9D	)	DD	
270	1E		5E	;	9E	±	DE	
271	1F	CU2	5F	¬	9F	■	DF	
272	20		60	-	A0	-	E0	
273	21		61	/	A1	°	E1	
274	22		62		A2	s	E2	S
275	23		63		A3	t	E3	T
276	24	BYP	64		A4	u	E4	U
277	25	LF	65		A5	v	E5	V
278	26	EOB	66		A6	w	E6	W
279	27	PRE	67		A7	x	E7	X
280	28		68		A8	y	E8	Y
281	29		69		A9	z	E9	Z
282	2A	SM	6A		AA		EA	
283	2B		6B	,	AB	L	EB	
284	2C		6C	%	AC	Γ	EC	⊣
285	2D		6D	_	AD	[	ED,	
286	2E		6E	>	AE	≥	EE	
287	2F	CU3	6F	?	AF	•	EF	
288	30		70		B0	°	F0	0
289	31		71		B1	1	F1	1
290	32		72		B2	2	F2	2
291	33		73		B3	3	F3	3
292	34	PN	74		B4	4	F4	4
293	35	RS	75		B5	5	F5	5
294	36	UC	76		B6	6	F6	6
295	37	EOT	77		B7	7	F7	7
296	38		78		B8	8	F8	8
297	39		79		B9	9	F9	9
298	3A		7A	:	BA		FA	
299	3B		7B	#	BB	⌐	FB	
300	3C		7C	@	BC	¬	FC	
301	3D		7D	'	BD	]	FD	
302	3E		7E	=	BE	≠	FE	
303	3F		7F	"	BF	-	FF	

Set DUCT bit 0   Set DUCT bit 1   Set DUCT bit 2   Set DUCT bit 3

Figure 42. Setting DUCT Bits for Printable Graphics

Example

DUCT bits are to be set for a train containing only a lowercase "a" and uppercase "B" and a nonstandard character assigned to the hexadecimal code '41'. The control bytes loaded into addresses 240 to 242 would be:

	Control bytes	
DUCT address	Binary	Hexadecimal
240	1100 0000	C0
241	0110 0000	60
242	0001 0000	10

Bits 0 and 1 at address 240 are set for null and space. Bit 1 at address 241 is set for the nonstandard character with code assignment hexadecimal '41'. Bit 2 is set for lowercase "a". Bit 3 at address 242 is set for uppercase "B". The remaining bits at these three addresses and all bits at addresses 243 through 303 are turned off because no other graphics are printable and dualing is not specified.

PROGRAMMING THE FORMS CONTROL BUFFER

The forms control buffer can hold 256 bytes of carriage control information, of which 255 bytes only are usable positions. For compatibility with the 3211 Printer, the optional indexing byte is accepted but ignored by the 3203-5 (see "Indexing Byte" following in this section). If more or less than 256 bytes are specified in the CCW length count, and the SLI flag is off, an incorrect length indication is set in the CSW, and the residual count in the CSW is the difference between the length count and 256.

Each of the 255 usable positions of the forms control buffer corresponds to a line of the form. The buffer bytes are loaded with channel codes (Figure 43) which, in conjunction with the skip commands (see Figure 40), permit a programmed carriage advance to a specific line of the form. For example, a 'skip to channel 4' command would advance the carriage to print line 20 if byte 20 of the buffer were loaded with the channel 4 code.

Channel	Hex	Binary								(Position)
		0	1	2	3	4	5	6	7	
		–	–	–	F	8	4	2	1	(Value)
Channel 1	01	0	0	0	0	0	0	0	1	
Channel 2	02	0	0	0	0	0	0	1	0	
Channel 3	03	0	0	0	0	0	0	1	1	
Channel 4	04	0	0	0	0	0	1	0	0	
Channel 5	05	0	0	0	0	0	1	0	1	
Channel 6	06	0	0	0	0	0	1	1	0	
Channel 7	07	0	0	0	0	0	1	1	1	
Channel 8	08	0	0	0	0	1	0	0	0	
Channel 9	09	0	0	0	0	1	0	0	1	
Channel 10	0A	0	0	0	0	1	0	1	0	
Channel 11	0B	0	0	0	0	1	0	1	1	
Channel 12	0C	0	0	0	0	1	1	0	0	

Figure 43. Forms Control Buffer Codes

A maximum of 30 channel codes can be specified if the end of sheet is
not coded in the same byte as a channel code; a maximum of 31 channel
codes can be specified if the end of sheet code is coded in the same
byte as a channel code. If this number of channel codes is exceeded,
the 'load FCB' command is terminated with unit check set. A subsequent
sense indicates load check.

The bits in the buffer bytes have the following meaning.

• Bits 0 to 2 are not used, and should be zero.
• Bit 3 acts as a flag bit when located in the byte at buffer address
  1, or in the last byte used as carriage control information.
  - Bit 3 set at buffer address 1 selects spacing at 8 lines per
    inch.
  - Bit 3 not set at buffer address 1 selects spacing at 6 lines per
    inch.
  - Bit 3 set at any address other than 1 flags the byte stored
    there as the last byte of the carriage control information.
• Bits 4 to 7 contain one of twelve possible channel codes,
  hexadecimal 1 to C (see Figure 43), corresponding to the channel
  codes in skip commands. Bits 4 to 7 being all zeros indicate that
  no channel code is assigned to that line.

If bit 0, 1, or 2 is set, or if channel code 'OD', 'OE', or 'OF' is
present, the 'load FCB' command terminates with unit check set. A
subsequent sense indicates load check. These conditions apply,
however, only to a buffer data byte and not to the indexing byte
which is accepted for reasons of compatibility with the 3811 (see
"Indexing Byte" following in this section).

If the end of sheet code is not specified in positions 2 through 255
of the forms control buffer (not counting the indexing byte), the
'load FCB' command terminates with unit check. A subsequent sense
indicates load check.

For good stacking, the buffer load should match the fold-to-fold size of the form. For example, a three-per-fold form needs three single-form images in the buffer. The end-of-forms flag (bit 3) would be set in the last significant byte of the third image.

Indexing Byte

The indexing byte, optionally usable on the 3811, serves no purpose on the 3203-5. However, for compatibility reasons, the indexing byte causes no error when specified in the 3203's carriage control information.

The indexing byte is described in IBM 3211 Printer, 3216 Interchangeable Train Cartridge, and 3811 Printer Control Unit Component Description and Operator's Guide, GA24-3543.

Example

Assume the following:

- A form of 20 lines
- Channel 1 at line 3
- Spacing of eight lines per inch
- A skip to line 7 using channel code 5
- A skip to line 15 using channel code 7
- Channel 12 at line 18

The contents of the forms control buffer should be:

Buffer Byte	Buffer Address Decimal
10 (8 lpi)	01
00	02
01 (channel 1)	03
00	04
00	05
00	06
05 (channel 5)	07
00	08
00	09
00	10
00	11
00	12
00	13
00	14
07 (channel 7)	15
00	16
00	17
0C (channel 12)	18
00	19
10 (last address used)	20

Carriage Programming Options

An important consideration in programming the forms control buffer is the coordination between:

- The channel codes stored in the buffer,
- The buffer addresses and the print lines on the form, and
- The initial positioning of the forms in the carriage by the operator.

Recommended Technique

To achieve this coordination, the recommended practice is as follows.

- Assign buffer address 1 to the first physical line of the form.
- Assign channel 1 to the first line to be printed (Figure 44).
- Set up the forms initially so that the perforation aligns with the scribed line of the printer.
- Reset the line counter to 1.

Printing is preceded by a skip to channel 1.

Loaded Form	Forms Control Buffer	Line Counter

Scribed line

Address

1 First physical line
2
3
4 Printing starts here

1
2
3
4 Channel 1 code

Line 1 is set by a buffer load operation or by operating the reset counter switch

72 Last print line

72 End of sheet code

Wraps around at line 72 + 1
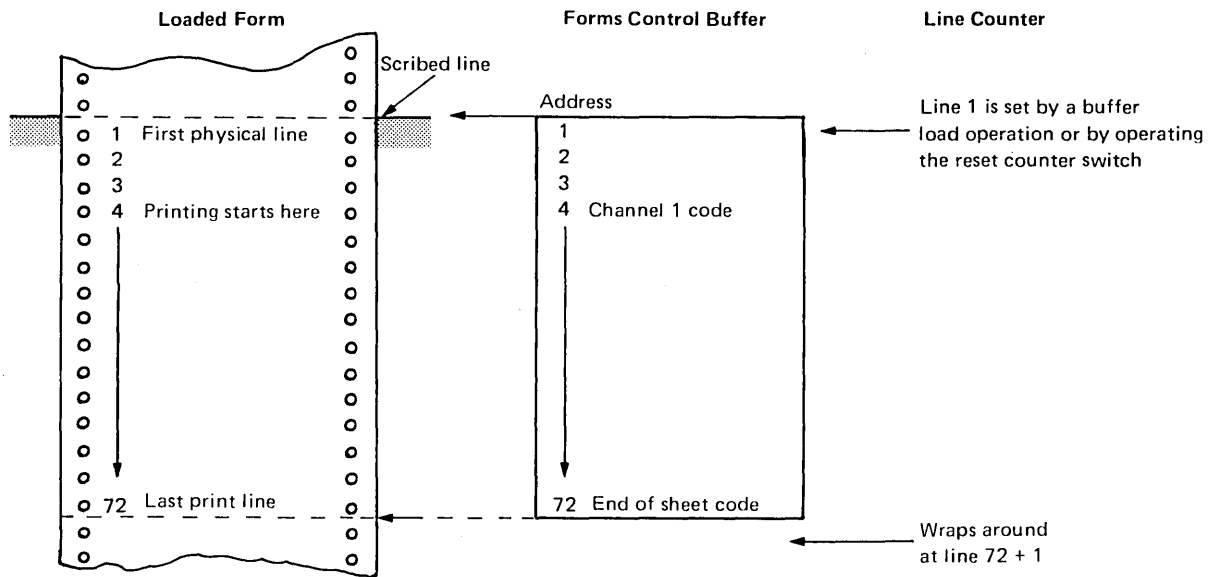
- Operator aligns form at perforation
- Printing is preceded by a skip to channel 1

Figure 44. Recommended Carriage Control

If required for compatibility with the 3211, one of the following alternative techniques can be used.

1. Assign buffer address 1 to the first line to be printed and store the channel 1 code at this address (Figure 45). The first print line is not the first physical line of the form. In this technique the operator must align the forms at the first line to be printed, not at the perforation. Therefore the operator must know exactly where printing is to start.
2. Assign buffer address 1 to the first physical line of the form and store the channel 1 code at this address (Figure 46). The first print line is not the first physical line of the form, because printing is preceded by a skip to channel X. The operator must initially set up the forms so that the perforation aligns with the scribed line of the printer.

Loaded Form		Forms Control Buffer	Line Counter

Scribed line

Address

1 Channel 1 code
2
3
4

72 End of sheet code

1 First physical line
2
3
4 Printing starts here

72 Last print line
1
2
3
4 Printing starts here

Line 1 is set by a buffer load operation or by operating the reset counter switch

Wraps around at line 72 + 1
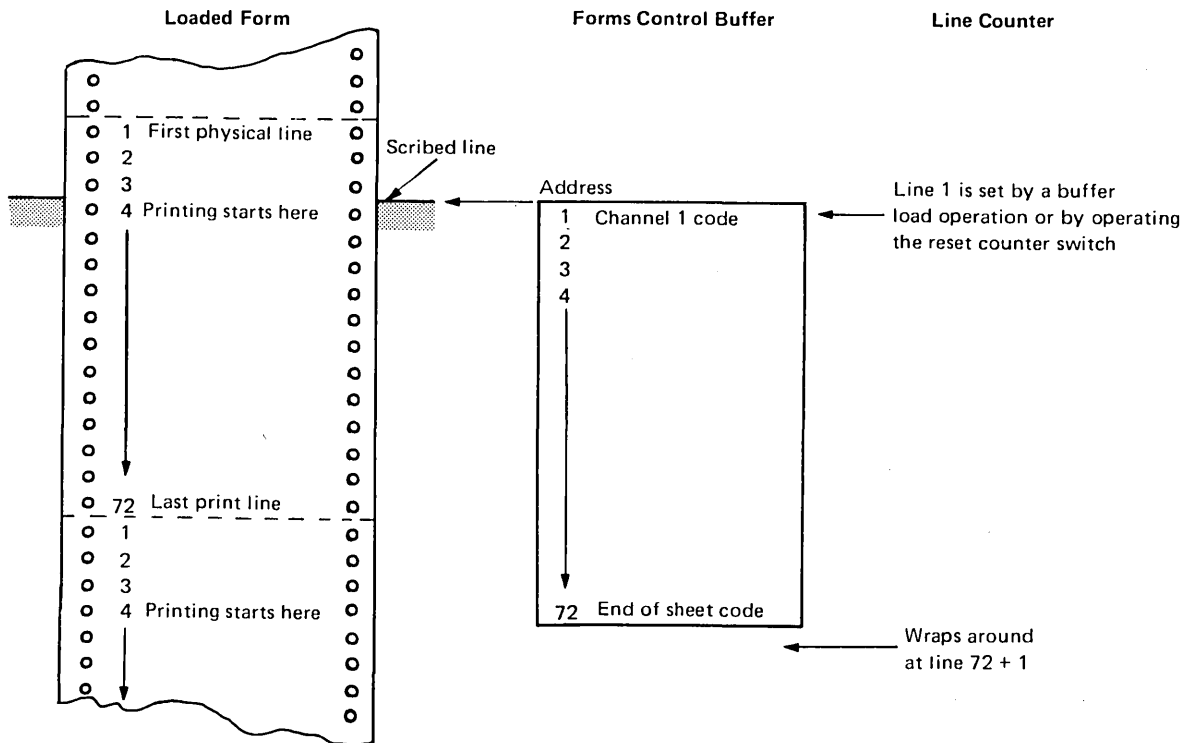
• Operator aligns form at first line to be printed

Figure 45. Alternative Carriage Control (1)

Loaded Form **Forms Control Buffer** **Line Counter**

Scribed line

Address

1 First physical line	1 Channel 1 code
2	2
3	3
4 Printing starts here	4 Channel X code

Line 1 is set by a buffer
load operation or by operating
the reset counter switch

72 Last print line   72 End of sheet code

Wraps around
at line 72 + 1
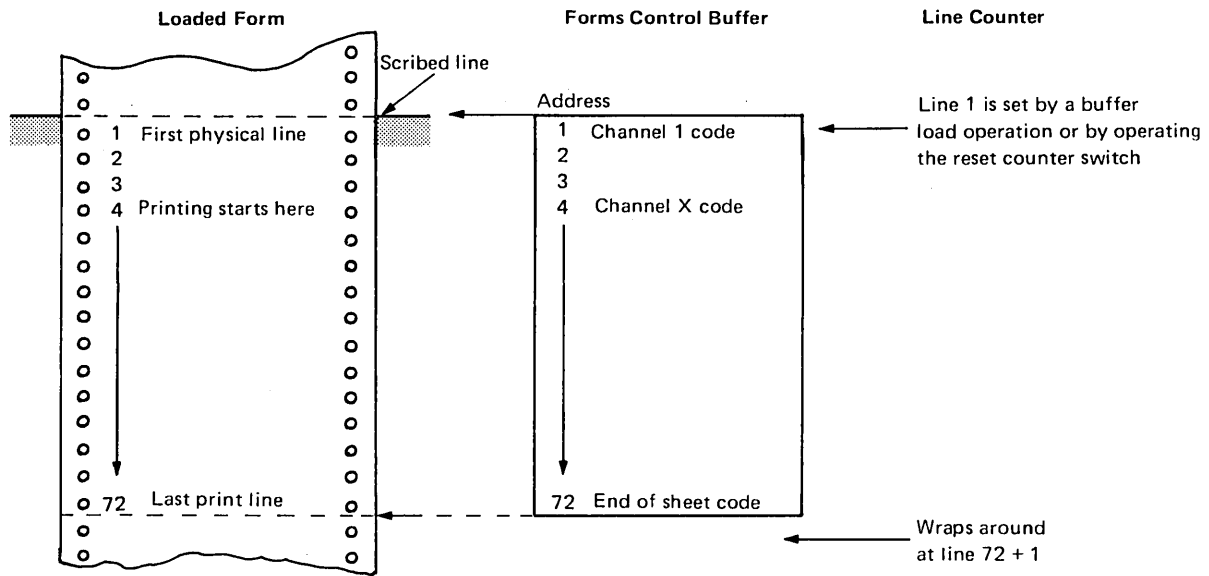
- Operator aligns form at perforation
- Printing is preceded by a skip to channel X

Figure 46. Alternative Carriage Control (2)

STATUS INFORMATION

The following text gives the meaning of the status indications that are given in response to 3203-5 commands.

Unit Status

The unit status is indicated in bits 32 to 39 of the CSW. The unit status is directly related to a command that has been given to, completed by, or terminated by the 3203-5. The bits are assigned the following meanings:

Bit   Designation

32   Attention (not used)
33   Status modifier
34   Control unit end
35   Busy
36   Channel end
37   Device end
38   Unit check
39   Unit exception

Except for control unit end, busy, unit check, and unit exception, the unit status bits have the same functions for the 3203 Model 5 as for any other device. For a detailed description of the unit status bits, see IBM System/370 Principles of Operation, GA22-7000.

Control Unit End (Bit 34)

Control unit end signals the end of a control unit busy period.

Busy (Bit 35)

The 3203-5 responds with control unit busy (busy, bit 35 and status modifier, bit 33) under the following conditions:

• While executing a channel command (from acceptance of the CCW, with zero status, until device end is posted)
• While responding to TIO
• While presenting unsolicited device end
• While performing functions not related to execution of a command

The time period of the control unit busy response does not exceed the maximum time required for execution of a CCW.

Unit Check (Bit 38)

The unit check bit is set for various errors or other unusual conditions that may have occurred in the printer and/or its control logic. Because the setting of unit check does not define the error condition, a 'sense' command should be issued. The contents of the sense bytes will show the reason why unit check was set.

For details of the conditions that can cause a unit check, see "Sense Information" in this section. The setting of unit check breaks command chaining.

Unit Exception (Bit 39)

The unit exception bit is set with device end when a 'space' or a 'write and space' command crosses or spaces to a channel 12 code in the forms control buffer.

Channel Status

The channel status information is recorded in bits 40 to 47 of the CSW. The bits have the following meanings:

Bit	Designation
40	Program-controlled interruption
41	Incorrect length
42	Program check
43	Protection check
44	Channel data check
45	Channel control check
46	Interface control check
47	Chaining check

The channel status bits have the same standard functions for the 3203 Model 5 as for any other device. For a detailed description of the channel status bits, see IBM System/370 Principles of Operation, GA22-7000.

SENSE INFORMATION

The sense bytes from the 3203 Model 5 are the same as those from the 3203 Model 4, except for bus-out check (byte 0, bit 2), which is used by the Model 5 because it is channel-attached. Figure 47 shows the basis of the sense bytes for the 3203 Model 5.

Sense Byte	Class of Information Provided	Origin or Purpose
0	Summary	In accordance with *IBM System/370 Principles of Operation,* GA 22-7000
1 2 3	Programming Mechanical Electrical	Similar to 3211 Printer
4	Device identification	Identifies the sense information as specific 3203
5 to 19	Maintenance	Provided for service personnel only
20 to 22	−	Not used
23	Device identification	Indentifies printer as 3203

Figure 47. Basis of Sense Bytes

Sense Byte 0: Summary

The bits in sense byte 0 have the following meanings:

Bit   Designation

0   Command reject
1   Intervention required
2   Bus-out check
3   Equipment check
4   Data check
5   Buffer parity check
6   Load check
7   Channel 9

Command Reject (Bit 0)

The command reject bit, when set, indicates that the current command was rejected because it was not valid for the 3203-5. When a command is rejected, zero status (condition code 0) is presented at initial selection. Then channel end, device end, and unit check are presented.

Intervention Required (Bit 1)

The intervention required bit, when set, indicates that operator intervention is necessary because the printer has lost the ready state. The ready state is lost in the following situations:

1. When the STOP key is pressed.
2. When the train gate is open (cartridge not properly seated) or the locking lever is not closed. The INTERLOCK light is on.
3. When a forms jam occurs or the supply of forms runs out. The FORMS light is on and bit 4 in sense byte 1, bit 5 in sense byte 2, are set.
4. When the stacker is full or a stacker jam occurs. The STACKER light is on.
5. When variations in train speed are likely to damage the motor. Bit 7 is set in sense byte 2.

The setting of the intervention required condition causes 'write', 'load', and control commands to terminate with channel end and unit check. Device end is presented thereafter. Intervention required is reset when the printer is restored to the ready state.

Bus Out Check (Bit 2)

The bus out check bit is set when wrong parity is detected on the channel bus to the 3203-5.

Equipment Check (Bit 3)

The equipment check bit is set when some condition in the equipment affects the operation in process. The condition is further defined by bits set in sense bytes 1, 2, or 3 as follows:

1. Print check (sense byte 1, bit 1). One or more of the following bits may also be set:
   a. Coil protect (sense byte 3, bit 3)
   b. Hammer fire check (sense byte 3, bit 4)
   c. Sync check (sense byte 3, bit 6)
2. Line position check (sense byte 1, bit 3)
   a. Carriage failed to move (sense byte 2, bit 0)
   b. Carriage motion check (sense byte 2, bit 1)
3. Controller check (sense byte 1, bit 6)

Data Check (Bit 4)

The data check bit is set when:

1. Print check (sense byte 1, bit 1) is set by a mismatch between a character in the print line buffer and the UCS buffer at a time when no 'block data check' command has been given.
2. A line position check (sense byte 1, bit 3) shows that a skip command contains a channel code which is not available in the forms control buffer. (A previous 'block data check' command would not block this error.)

Buffer Parity Check (Bit 5)

The buffer parity check bit is set by a parity check in the UCS buffer, forms control buffer, or print line buffer. The condition is further defined when the line position bit (sense byte 1, bit 3) is set; this indicates a parity check in the forms control buffer during a carriage operation.

When the buffer parity check bit is set and all bits in sense byte 1 are zeros, the condition is further defined by one of the following bits:

1. UCS buffer parity check (sense byte 3, bit 0). This means that faulty code did not prevent a write operation from being completed because the code in error appeared more than once in the UCS buffer, or that a parity error was detected during a UCS buffer read operation.
2. Print line buffer parity (sense byte 3, bit 1). This means that the bad parity was detected during a print line buffer read operation.

Load Check (Bit 6)

The load check bit is set when, during the execution of a 'load forms control buffer' or 'load UCSB' command, one of the following errors occurs:

1. An invalid channel code is received for the forms control buffer.
2. The flag bit (bit 3), that indicates end of sheet is not specified in positions 2 through 255 of the forms control buffer (excluding the indexing byte) during the 'load FCB' command.
3. A 'load UCSB' command transfers less than 304 bytes.
4. The FCB image transferred by a 'load FCB' command specifies more than 31 non-zero bytes.

Channel 9 (bit 7)

The channel 9 bit, when set, indicates that a channel 9 code was crossed or spaced to in the forms control buffer during the execution of a 'space' command or a 'write and space' command. The same situation, when caused by a manual space or any of the skip commands, does not set the channel 9 bit. The setting of the channel 9 bit causes unit check to be set at device end time.

Sense Byte 1: Programming Information

The bits in sense byte 1 have the following meanings:

Bit   Designation

0   Command retry (not used)
1   Print check
2   (Not used)
3   Line position check
4   Forms check
5   Command suppress
6   Controller check
7   (Not used)

Command Retry (Bit 0)

The command retry bit is always off (zero).

Print Check (Bit 1)

The print check bit is set when the print line in process contains one or more print errors. The error is defined by the setting of any of the following bits:

1. Coil protect (sense byte 3, bit 3)
2. Hammer fire check (sense byte 3, bit 4)
3. Sync check (sense byte 3, bit 6)
4. Data check (sense byte 0, bit 4). A write operation is incomplete because a code from the print line buffer was not found in the UCS buffer.

Line Position Check (Bit 3)

The line position check bit is set by any of the following conditions:

1. Carriage failed to move (sense byte 2, bit 0).
2. Carriage motion check (sense byte 2, bit 1).
3. Parity error in the forms control buffer.
4. A skip command specifies a channel for which no code is stored in the forms control buffer.

Forms Check (Bit 4)

The forms check bit is set by any of the following conditions:

1. Forms check (sense byte 2, bit 5).
2. When the last form has moved beyond the printstation or the stacker is full.

Command Suppress (Bit 5)

The command suppress bit is set when the interface is disconnected before channel end has been signaled. There is no carriage movement or printing. The interface is disconnected by the channel through a 'halt I/O' instruction or an error detected by the channel.

Controller Check (Bit 6)

The controller check bit is set if any of a number of error conditions, such as a parity error or interrupt error, occurs in the controller.

Sense Byte 2: Mechanical

The bits in sense byte 2 have the folloiwng meanings:

Bit   Designation

0   Carriage failed to move
1   Carriage motion check
2   (Not used)
3   (Not used)
4   (Not used)
5   Forms check
6   (Not used)
7   Train velocity check

Carriage Failed to Move (Bit 0)

This bit is set when the specified carriage movement is not sensed
within the prescribed time. This condition indicates improper movement
of forms and misalignment with the forms control buffer.

Carriage Motion Check (Bit 1)

The carriage motion check bit, when set, indicates improper movement
of the carriage and misalignment of the forms with the forms control
buffer.

Forms Check (Bit 5)

The forms check bit is set when the forms are not correctly
transported through a tractor. The cause may be a forms jam, a torn
form, or a separation of forms.

Train Velocity Check (Bit 7)

This bit is set by a variation in train velocity. To prevent damage
the train is stopped, causing the printer to lose the ready state.

Sense Byte 3: Electrical

The bits in sense byte 3 have the following meanings:

Bit   Meaning

0   UCS buffer parity
1   Print line buffer parity
2   (Not used)
3   Coil protect
4   Hammer fire check
5   (Not used)
6   Sync check
7   (Not used)

UCS Buffer Parity (Bit 0)

This bit is set when a code in the UCS buffer has incorrect parity.

Print Line Buffer Parity (Bit 1)

This bit is set when a code in the print line buffer has incorrect parity. The print line is not completed, and carriage motion is suppressed.

Coil Protect (Bit 3)

The coil protect bit is set when a print hammer is not reset.

Hammer Fire Check (Bit 4)

The hammer fire check bit is set by a malfunction of the print hammer circuits.

Sync Check (Bit 6)

The sync check bit is set when synchronism is lost between the print train and the address register of the UCS buffer.

Sense Byte 4: Device Identification

Bits 0-7 of sense byte 4 are always set to hexadecimal '84' in order to distinguish the 3203 from the 3211 Printer.

Sense Bytes 5 to 19: Maintenance

Sense bytes 5 to 19 contain information for service personnel only.

Sense Bytes 20 to 22: Unassigned

Sense bytes 20 to 22 are zero.

Sense Byte 23: Device Identification

Sense byte 23 is set to hex '00' to identify the printer as a 3203 Model 5 (also set to hex '00' for 3203 Model 4).

ERROR RECOVERY

The following text describes the minimum action the operating system should take to deal with errors or other unusual conditions. Such conditions are usually indicated by the setting of unit check or any of the other status bits (except an end condition or busy) in the CSW.

Unit Check in CSW

When a command ends with unit check set in the CSW, the operating system should issue a 'sense' command and subsequently inspect at least sense bytes 0 to 3 to find the reason for the unit check. The following text describes the suggested error recovery procedures for errors shown by bits set in sense bytes 0 to 3.

Note: Refer to "Sense Information" for a description of the causes of the following conditions.

Command Reject Set (Sense Byte 0, Bit 0)

When the command reject bit is set, the operating system should provide a message (information only) to the operator and indicate a permanent error.

Intervention Required Set (Sense Byte 0, Bit 1)

If the intervention required bit is set, the printer has lost its ready state and manual intervention is required. The operating system should analyze sense bytes 1, 2, and 3 because these bytes contain error information which is not necessarily indicated by the printer's indicator lights. Action should then be taken according to the setting of the sense bytes, as described in the following text.

With No Bits Set in Sense Bytes 1, 2, and 3: Probable causes are that the swing gate is open, the STOP key was pressed or a write command was given after a single cycle operation. A message should be provided for the operator to refer to the relevant paragraph of "Information for Operators" in this manual. After carrying out the procedure described there, the operator should make the printer ready, or, if this cannot be done, report a permanent error.

With Forms Check Set (Sense Byte 1, Bit 4): Probable causes are that the end of forms has been reached, or the stacker is full or jammed. The operator should reload forms or clear the jam as described in "Information for Operators" in this manual. To continue, START should be pressed. If the READY light does not come on, a permanent error must be indicated.

With Both Forms Check Bits Set (Sense Byte 1, Bit 4 and Sense Byte 2, Bit 5): The forms are probably torn, or jammed at the carriage. The operator should be referred by a message to the forms jam procedure under "Information for Operators" in this manual. START should then be pressed, but if the READY light does not come on a permanent error must be indicated.

With Train Velocity Check (Sense Byte 2, Bit 7) and Equipment Check (Sense Byte 0, Bit 3): The probable cause is a variation in train velocity caused by dirt or missing motor pulses. The operator should be advised to press START and continue operation, or, if the ready status cannot be restored, to report a permanent error.

Equipment Check Set (Sense Byte 0, Bit 3)

This bit is set if some condition in the equipment interferes with the current operation. Further information may be available in sense bytes 1, 2, and 3, described in the following text.

With Print Check (Sense Byte 1, Bit 1) and Print Line Buffer Parity Check (Sense Byte 3, Bit 1) Set: The probable cause is a print line buffer parity check. A message should be provided for the operator to

press the STOP key and then the START key to continue, or to report a permanent I/O error if the condition persists.

With Print Check (Sense Byte 1, Bit 1) and Hammer Fire Check (Sense Byte 3, Bit 4) Set: A hammer failure, hammer misfire, open coil check, or error in the print line buffer check byte can cause this condition. The operator should be advised to press the STOP key and then the START key to continue, or to report a permanent I/O error if the condition persists.

With Print Check (Sense Byte 1, Bit 1) and Coil Protect (Sense Byte 3, Bit 3) Set: The probable cause is that a print hammer is not reset. The operator should receive a message to press the STOP key and then the START key to continue, or to report a permanent I/O error if the condition persists.

With Print Check (Sense Byte 1, Bit 1) and Sync Check 1 (Sense Byte 3, Bit 6) Set: This condition is caused by lost synchronism. Pressing the STOP key, then the START key, may make it possible to continue operation, otherwise the error is permanent.

With Line Position (Sense Byte 1, Bit 3) and Carriage Failed to Move (Sense Byte 2, Bit 0) Set: The most likely cause of this condition is that the carriage failed to respond to a space or skip command. Recovery from this error is sometimes possible if the operator presses the STOP key and then the START key.

With Line Position (Sense Byte 1, Bit 3) and Carriage Motion Check (Sense Byte 2, Bit 1) Set: The probable causes are that the carriage accelerates too slowly, that there are extra or missing carriage feedback pulses, or a carriage step check 1 or 2. The operator should receive a message to press the STOP key and then the START key to continue, or to report a permanent error if the condition persists.

With Controller Check (Sense Byte 1, Bit 6) Set: This condition can be caused by a variety of errors in the controller such as parity and interrupt errors, timeouts, and invalid commands or requests. An appropriate message (information only) should be provided for the operator and a permanent error should be indicated.

Data Check Set (Sense Byte 0, Bit 4)

With Print Check (Sense Byte 1, Bit 1) Set: The probable causes are an unprintable character, or a controller timeout during printing. A message (information only) should be provided for the operator and a permanent error should be indicated.

With Line Position (Sense Byte 1, Bit 3) Set: This condition arises when a 'skip' or 'write and skip' command is given without the corresponding channel code being stored in the forms control buffer. A message (information only) should be provided for the operator and a permanent error should be indicated. To find out the current status of the forms control buffer, issue a 'check read' command preceded by a 'diagnostic gate' command. Then issue a 'read forms control buffer' command.

Buffer Parity Check Set (Sense Byte 0, Bit 5)

With UCS Buffer Parity (Sense Byte 3, Bit 0) Set: This condition can occur during a 'write' or 'read UCS buffer' operation. The probable cause is a parity error in the train image buffer or in the DUCT. The operating system should provide a message (information only) for the operator and indicate a permanent error.

With Print Line Buffer Parity (Sense Byte 3, Bit 1) Set: A parity error in the print line buffer can cause this condition during a 'read print line buffer' operation. A unit check record should be made for diagnostic and measurement recording before the operation is continued. For statistical recording, issue the 'check read' and 'read print line buffer' commands.

Load Check Set (Sense Byte 0, Bit 6)

The probable cause is that a 'load UCS buffer' command has a count not equal to 304 bytes, or a 'load forms control buffer' command has one of the following errors:

- No end-of-sheet flag in the load
- Bit 2 is set in the first byte
- Bit 0, 1, or 2 is set in any byte from the second through the last
- A channel number greater than 12 was specified in the load
- More than 30 (or 31) channel codes were specified in the load (see "Programming the Forms Control Buffer" preceding in this section)

A message (information only) should be provided for the operator and a permanent error should be indicated.

Channel 9 Set (Sense Byte 0, Bit 7)

This is a normal occurrence requiring no recovery action.

With Command Suppress (Sense Byte 1, Bit 5) Set: The probable cause is interface disconnection before channel end has been signaled. The operator should retry once. If this retry is unsuccessful a permanent error must be indicated.

Printing for Optical Character Recognition (OCR)

When the IBM 3203 Model 5 is used to produce input for an OCR system, the quality of the printing becomes of prime importance. Other factors can affect document readability, but print quality is the key to machine readability and also to overall system performance. Because print quality affects both total process time and error recovery effort, it must be carefully controlled.

OCR CHARACTER SETS

For OCR printing, the "ODA", "ONA", "OAA", "ONB", and "OAB" train arrangements are used (see Figure 8). The "ONB" arrangement is available only in countries served by IBM World Trade Corporation.

OCR PAPER REQUIREMENTS

For OCR paper specifications, see:
IBM System/360 and System/370 Component Description and Operating Procedures: IBM 1287 Optical Reader, GA21-9064.
IBM System/360 and System/370 Component Description and Operating Procedures: IBM 1288 Optical Page Reader, Model 1, GA21-9081.
Paper and Print Quality Requirements for IBM 1270 and 1275 Optical Reader Sorters, GA19-0036.
IBM System/360 Component Description: IBM 1270 Optical Reader Sorter, GA19-0035.
IBM Ssytem/360 Component Description: IBM 1275 Optical Reader Sorter, GA19-0034.
IBM 3881 Optical Mark Reader Models 1 and 2, Reference Manual and Operator's Guide, GA21-9143.
IBM 3886 Optical Character Reader, Input Document Design Guide and Specifications, GA21-9148.

RIBBON RECOMMENDATIONS

For applications in which OCR print quality is required, IBM ribbon P/N 1136430, or equivalent, is recommended.

When an OCR ribbon is used for OCR printing or for other applications, the ribbon protector (Figure 48) should be in operation. If the protector is not on the printer, a request should be made through the local IBM sales representative to have it installed. The ribbon protector is a no-charge feature with the code 9488. The ribbon protector should be cleaned frequently during use.
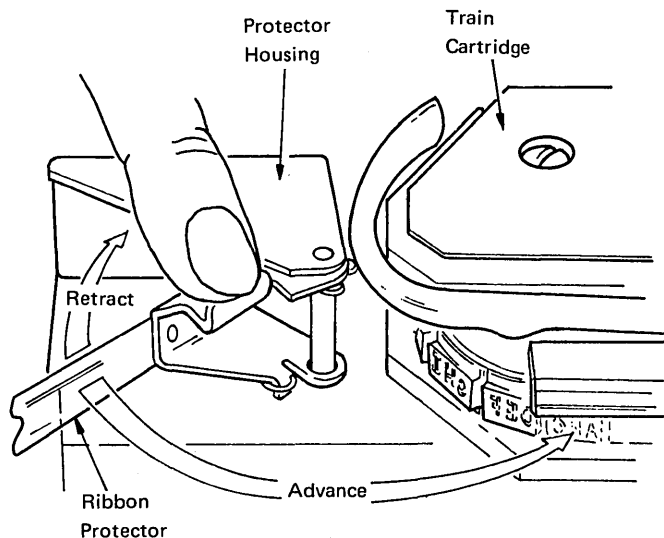
Figure 48. Ribbon Protector for OCR Printing

Ribbons must be replaced before print quality falls below the minimum requirements (see "Quality Control During Printing"). Ribbons should not be stored under extreme environmental conditions.

RECOMMENDATIONS AND CONSIDERATIONS

When OCR input documents are printed on the IBM 3203-5 the following recommendations and considerations for high speed OCR printing apply:

* A service representative should check that the printer is in satisfactory operating condition for OCR printing.

* Operators of the printer must be well trained. The training covers (1) setting of the operator controls and operation of the printer, and (2) knowledge of the features of each printer application. The user should provide a guide to enable the operator to refer to a setup procedure for each application.

* The forms must be aligned well in the printer. One method of assisting and monitoring alignment is to have either H's or boxes preprinted somewhere on the form and have the program overprint them on each form (see "Print Quality Control").

* The selection of the type font, paper, and ribbon is very important. Ribbon wear and print density should be frequently monitored. As print quality falls, adjustments should be made with the print density control.

* Because the ribbon is still usable for non-OCR printing, keep it when its OCR life is over (refer to "Quality Control During Printing").

* A method of increasing ribbon life is to design the printed form so that only half of the ribbon width is used. When the ribbon is worn, reversing it will double ribbon life. If printed data can be

placed in adjacent fields rather than on separate lines, ribbon life can be further extended. The problem of variable or uneven ribbon wear is eliminated if names, addresses, etc., are printed in columns over a portion of the print line. Also, narrow forms may be printed two or more across, which in addition to evenly spreading ribbon wear, also increases printing throughput.

* To ensure acceptance of the output, print a series of documents before a major printing run (see "Print Quality Control Procedure"). Check these documents and eliminate any problems before the remainder of the print run is started. This facility should be built into the program for use when newly-received forms are to be run.

* Adherence to preventive maintenance procedures is important when producing OCR input documents. Scheduled preventive maintenance should never be delayed or bypassed. After each full shift of OCR printing, run the ripple print program with the special cleaning paper (IBM P/N 451529) to clean the print train.

* Single-part forms only are recommended.

CHARACTER PRINT QUALITY

Character print quality is important to the operation of an OCR system. The reading performance of the machine and the recognition of the printed characters depend on how closely the printing and its immediate surroundings conform to the standards outlined in the following text. These standards are not readily apparent to the human eye and, therefore, OCR printing usually requires more care than normal printing. The standards given in the ISO Recommendation No. 1831 are obtainable by any IBM 3203 that is maintained and operated according to the procedures for OCR use.

The recommendations in the following text do not necessarily show the limits of OCR systems, but they do give limits which should not be exceeded. They also indicate to the operator when to adjust the printer, when to change the ribbon, and when to notify a service representative.

Character Outline Limits

Many of the following parameters for the printed character image are measured with the aid of the minimum/maximum character outline limits (COL), after alignment for best fit (Figure 49). The COL limits are determined with a commercially available magnifying glass equipped with the proper reticule.

Character Stroke Width

The character stroke width is the distance between the two edges of
the character stroke (line). The stroke width should be 0.35 mm (0.014
inch) plus or minus 0.15 mm (0.006 inch). Extremes are shown in Figure
49.
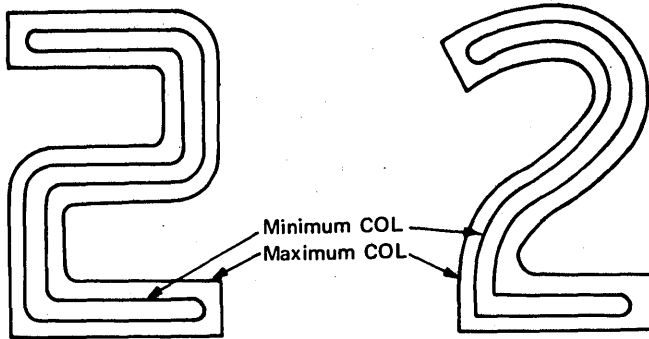
Figure 49. Use of Minimum/Maximum COLs (Best Fit)

Voids

Voids (Figure 50) are low-contrast areas (print contrast below 0.3)
inside the minimum COL. Voids are allowed if:

1. They can be contained entirely within a circle of 0.2 mm (0.008
   inch) diameter, provided the center-to-center distance to the next
   void is at least 1.0 mm (0.040 inch).
2. They cover less than one-third of the area of a 0.2 mm (0.008
   inch) diameter circle, without further restriction.

O 0.008 in. (0.2 mm) spot/void   0.04 in. (1.0 mm)
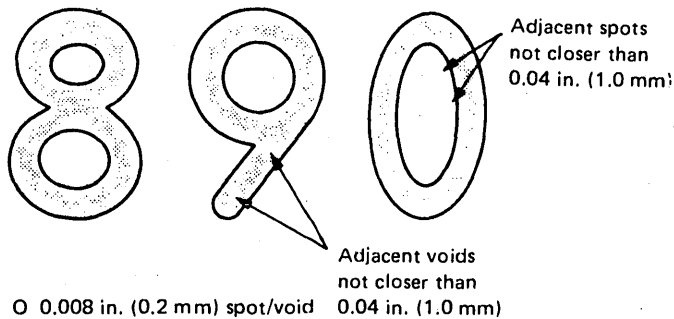
Figure 50. Spots and Voids

Character Spacing

Character spacing is the horizontal distance between the geometric
centers of adjacent characters. Character separation is the width
of the blank spaces between adjacent characters. The separation
should not be less than 0.35 mm (0.014 inch).

Character Misalignment

Character misalignment is the vertical shift of one character relative to another. The ISO printing specifications allow a maximum adjacent character misalignment of 0.66 mm (0.026 inch) and a maximum misalignment of 1.37 mm (0.054 inch) within a field.

HIGH SPEED PRINT QUALITY

Printing that is readable by people does not necessarily meet the requirements for machine reading. Figure 51 shows various deviations from OCR acceptable print quality.

Examples of printing in OCR-A or OCR-B font are given in Figures 52 through 59. Correction procedures for the print quality problems are included within the figures.

HHHH	Cutoff (Left)
HHHH	Cutoff (Right)
HHHH	End- to - End Density
HHHH	Single - Position Density
HHHH	Dark Legs or Strokes
HHHH	Extraneous Ink
H HHH	Horizontal Registration
HHHH	Light Bottoms
HHHH	Lights Tops
1413	Phantom Printing
HHHH	Shadow Printing
HHHH	Slur
H HHH	Stroke Width (Narrow and Wide)
H HHH	Vertical Registration
HHHH	Voids
H HHH HH HH H HHH	Wigglers

Figure 51. Print Deviations
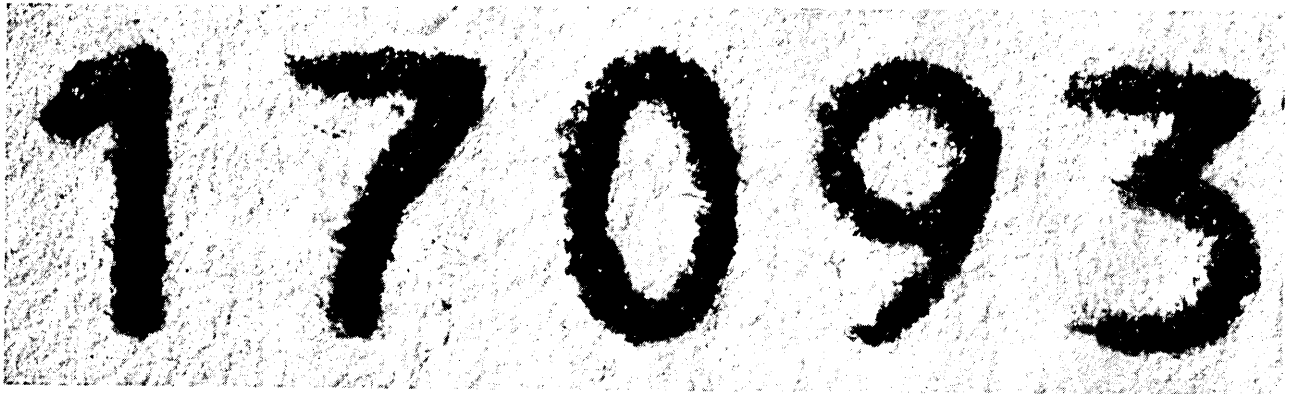
Figure 52. Acceptable Printing
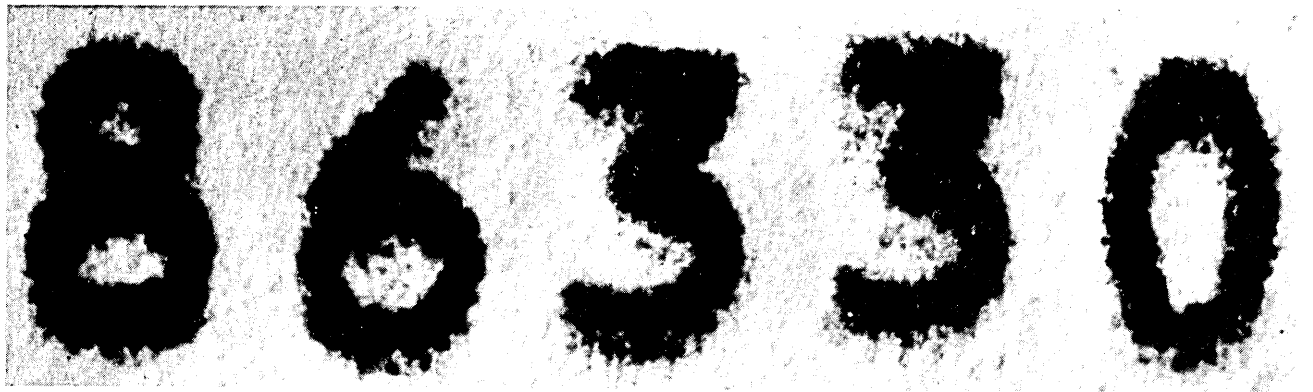
Correction: Turn impression control knob toward ,'D'

Figure 53. Heavy Printing
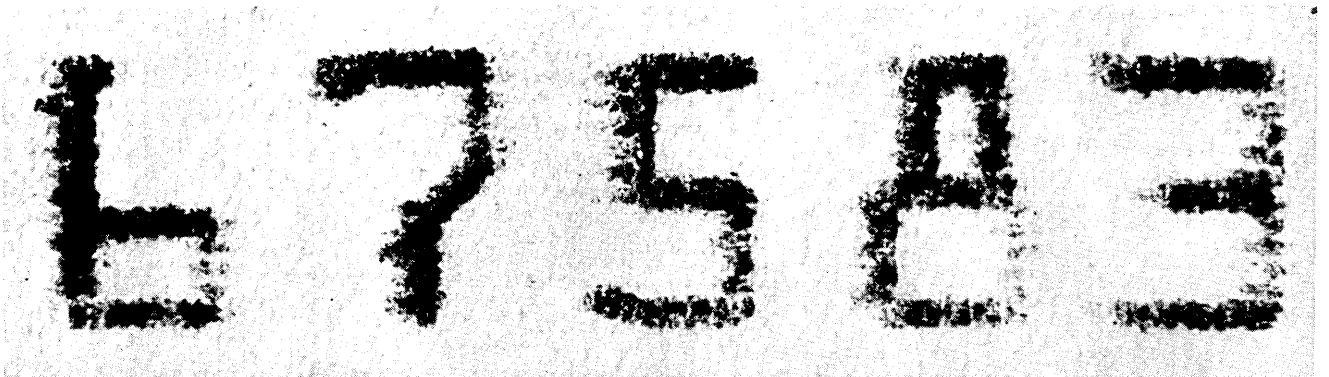
Correction: Turn impression control knob toward 'A' or replace the ribbon. If neither action corrects the problem, call a service representative.

Figure 54. Weak Printing
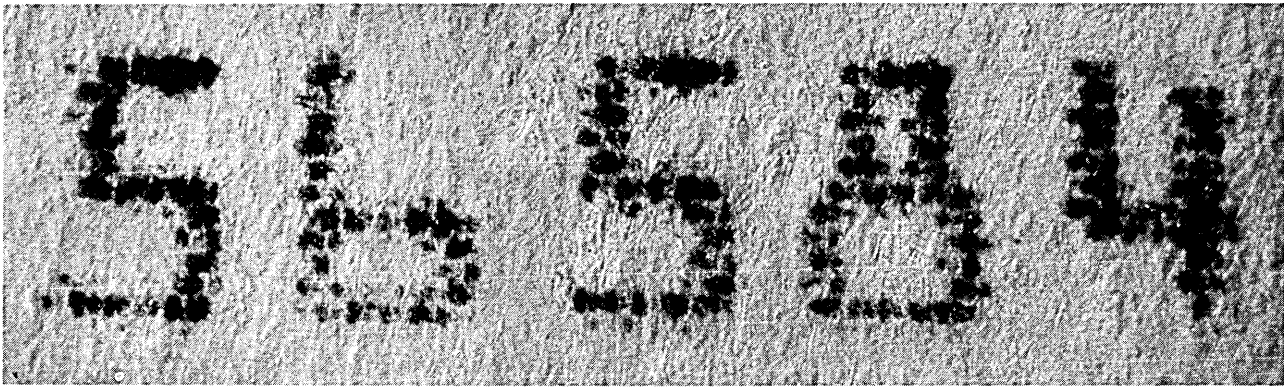
Correction: Check whether the correct OCR ribbon is installed.

Figure 55. Printing from a Coarse Ribbon
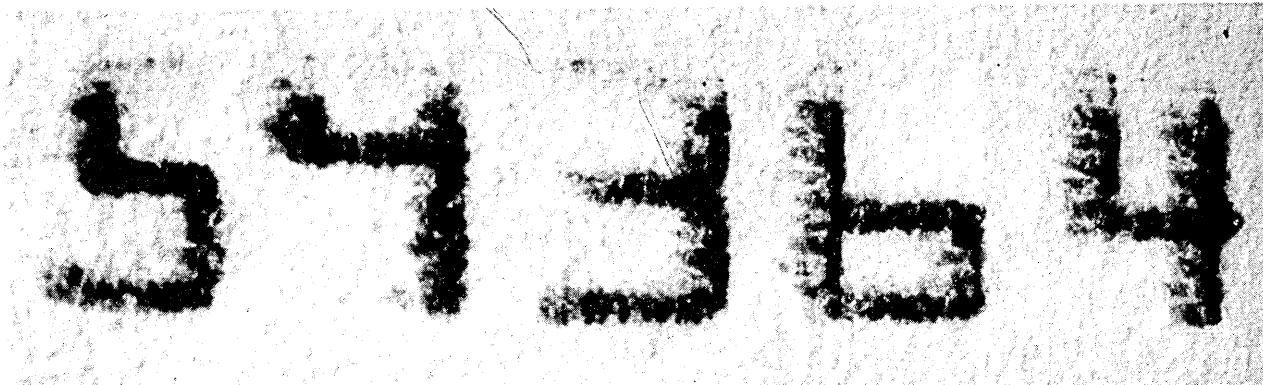
Correction: Turn the forms thickness knob toward '6'.

Figure 56. Light Tops to Characters
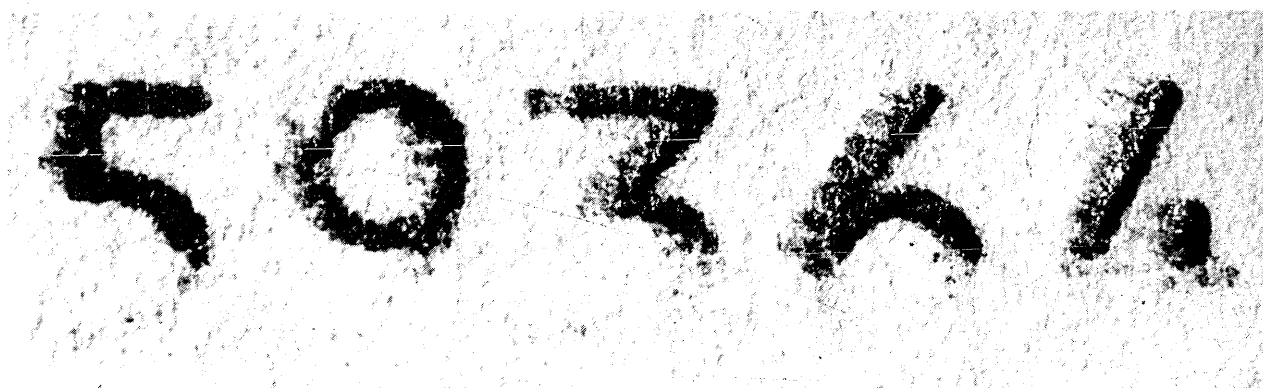
Correction: Turn the forms thickness knob toward '1'.

Figure 57. Light Bottoms to Characters
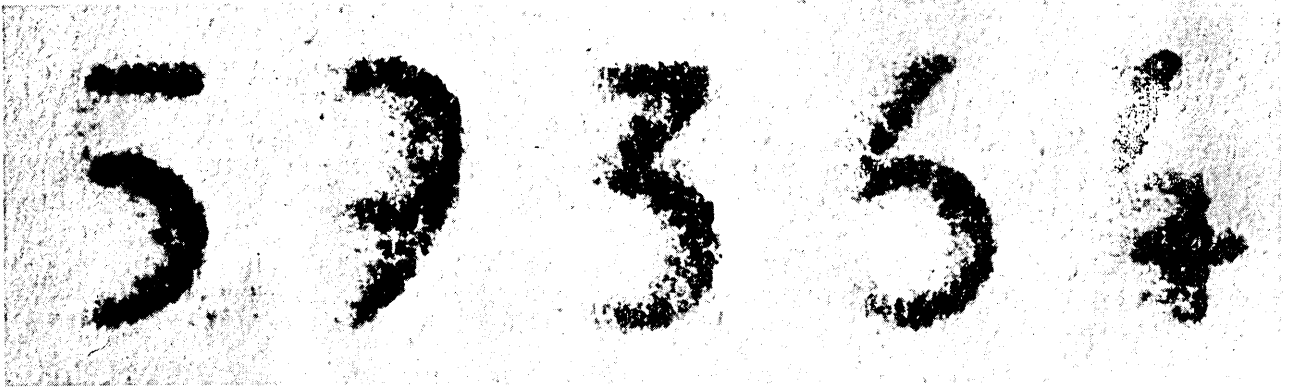
Correction: Contact a service representative.

Figure 58. Left Character Cutoff
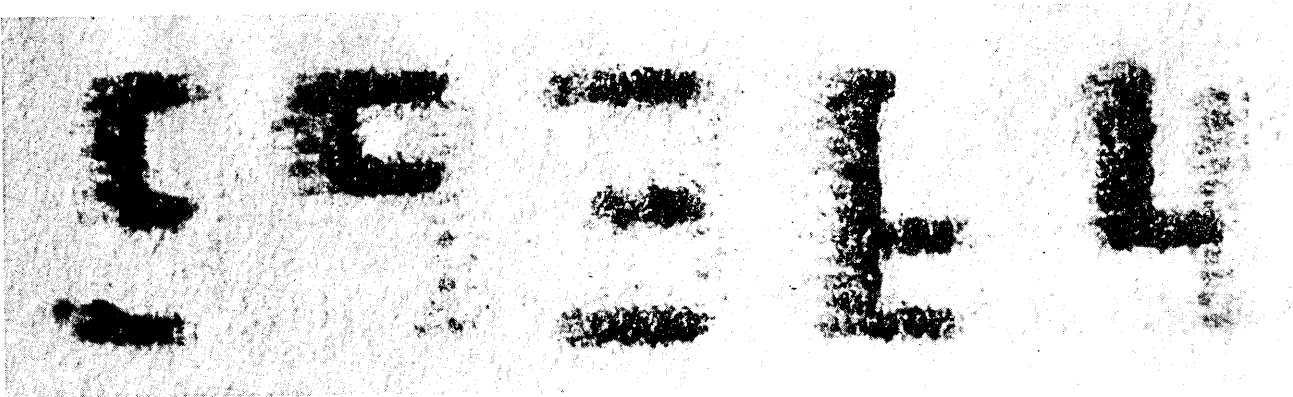
Correction: Contact a service representative.

Figure 59. Right Character Cutoff

Print Quality Control

The following print quality test and optimization procedures should be performed before printing OCR documents. To maintain OCR quality during printing, follow the procedure given under "Quality Control during Printing".

Print Quality Test and Optimization

The purpose of this procedure is to detect any maladjustments of the 3203 and to determine the optimum settings for the print density and forms thickness controls. Any detected maladjustment should be corrected by a service representative before you print OCR documents. Refer to "High Speed Print Quality" for examples of printing.

1. Install the correct ribbon for OCR printing (IBM P/N 1136430) and the desired OCR character set. For the test, it is better to use a ribbon nearing the end of its life because this makes deviations in characters easier to recognize.

2. Insert the forms in the forms feeding mechanism (see "Forms Loading"). If the forms have a design that makes it difficult to read the printed information, reverse them before printing. Adjust the forms tractors to hold the forms taut without bursting or tearing them.

3. Set the print density control to position "D" and print several lines of E's, O's, H's, U's, J's, X's and V's:
   EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
   OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
   HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
   UUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUU
   JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   VVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVV

4. If the tops of the E's or O's are lighter than the bottoms, turn the forms thickness control toward position 6. If the bottoms of the E's are lighter than the tops, turn the forms thickness control toward position 1. Refer to Figure 61. The forms thickness control setting is optimized when the horizontal stroke elements of the E's are of uniform thickness.

5. Check the printed lines and determine:

   • That the width of the vertical strokes in the H's are uniform. If the stroke widths vary across the print line (shown as INCORRECT in Figure 60), notify a service representative.

   • That the characters do not fade across the print line (characters blacker on one side of the print line than on the

Quality Control During Printing

Print quality must be revaluated periodically to maintain the optimum print density setting throughout the life of the ribbon. The procedure is as follows:

1. Look for a consistent trend of decreasing print quality, especially of inadequate density or narrow stroke width.

2. When such a trend is detected, turn the print density control one-half letter increment toward the A position. A magnifying glass can be helpful (especially during the early training of operators) in determining the trend.

3. Repeat steps 1 and 2 until about 250,000 lines for OCR, or 150,000 lines for OMR, have been printed.

4. It is important to make the first and second print density settings by closely examining the quality. The second setting must be found by constant supervision to determine if the ink in the ribbon is maintaining satisfactory print density (blackness).

Appendix A. Extended Binary-Coded-Decimal Interchange Code (EBCDIC)

In Figure A1, the 256-position table (outlined by the heavy black lines) shows the graphic characters and control character representations for EBCDIC. The bit-position numbers, bit patterns, hexadecimal representations, and card hole patterns for these and other possible EBCDIC characters are also shown in Figure A1.

To find the card hole patterns for most characters, partition the 256-position table into four blocks as shown in Figure A2.

Sixteen positions in the table are exceptions to this arrangement. These positions are indicated by small numbers in the upper right corners of their boxes in the table. The card hole patterns for these positions are given at the bottom of the table. Bit-position numbers, bit patterns, and hexadecimal representations for these positions are found in the usual manner.

Figure A3 shows some examples of the use of the EBCDIC chart.

EBCDIC Chart

0000	0	8-1	00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	8-1
			00				01				10				11				Bit Positions 0, 1
			00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	Bit Positions 2, 3
			0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	First Hexadecimal Digit
			9	9	9	9	9	9	9	9									
			12				12	12		12	12	12		12	12				Zone Punches
				11				11	11	11			11	11	11		11		
					0		0		0	0	0		0	0			0		Digit Punches
0000	0	8-1	NUL①	DLE②	DS③	④	SP⑤	&⑥	.⑦	⑧					⑨	⑩	\⑪	0⑫	8-1
0001	1	1	SOH	DC1	SOS				/⑬	.	a	j			A	J	⑭	1	1
0010	2	2	STX	DC2	FS	SYN					b	k	s		B	K	S	2	2
0011	3	3	ETX	TM							c	l	t		C	L	T	3	3
0100	4	4	PF	RES	BYP	PN					d	m	u		D	M	U	4	4
0101	5	5	HT	NL	LF	RS					e	n	v		E	N	V	5	5
0110	6	6	LC	BS	EOB	UC					f	o	w		F	O	W	6	6
0111	7	7	DEL	IL	PRE	EOT					g	p	x		G	P	X	7	7
1000	8	8		CAN							h	q	y		H	Q	Y	8	8
1001	9	8-1		EM							i	r	z		I	R	Z	9	9
1010	A	8-2	SMM	CC	SM		¢ |	!]	⑮	:									8-2
1011	B	8-3	VT	CU1	CU2	CU3	.	$	,	#									8-3
1100	C	8-4	FF	IFS		DC4	< ⑯	*	%	@					∫		◁		8-4
1101	D	8-5	CR	IGS	ENQ	NAK	(	)	−	'									8-5
1110	E	8-6	SO	IRS	ACK		+	;	>	=					Ψ				8-6
1111	F	8-7	SI	IUS	BEL	SUB	, |	∧ ¬	?	"									8-7
			9	9	9	9									9	9	9	9	
			12				12				12	12		12	12	12		12	Zone Punches
				11				11				11	11	11		11	11	11	
					0		0				0		0	0	0		0	0	

Bit Positions 4, 5, 6, 7

Second Hexadecimal Digit

Digit Punches

Card Hole Patterns

① 12-0-9-8-1
② 12-11-9-8-1
③ 11-0-9-8-1
④ 12-11-0-9-8-1
⑤ No Punches
⑥ 12
⑦ 11
⑧ 12-11-0
⑨ 12-0
⑩ 11-0
⑪ 0-8-2
⑫ 0
⑬ 0-1
⑭ 11-0-9-1
⑮ 12-11
⑯ On same train configurations, the lozenge (⊡) is printed for this bit pattern, but this is nonstandard.

Control Character Representation

ACK	Acknowledge	EOT	End of Transmission	RES	Restore
BEL	Bell	ESC	Escape	RS	Reader Stop
BS	Backspace	ETB	End of Transmission Block	SI	Shift In
BYP	Bypass	ETC	End of Text	SM	Set Mode
CAN	Cancel	FF	Form Feed	SMM	Start of Manual Message
CC	Cursor Control	FS	Field Separator	SO	Shift Out
CR	Carriage Return	HT	Horizontal Tab	SOH	Start of Heading
CU1	Customer Use 1	IFS	Interchange File Separator	SOS	Start of Significance
CU 2	Customer Use 2	IGS	Interchange Group Separator	SP	Space
CU 3	Customer Use 3	IL	Idle	STX	Start of Text
DC 1	Device Control 1	IRS	Interchange Record Separator	SUB	Substitute
DC 2	Device Control 2	IUS	Interchange Unit Separator	SYN	Synchronous Idle
DC 3	Device Control 3	LC	Lower Case	TM	Tape Mark
DC 4	Device Control 4	LF	Line Feed	UC	Upper Case
DEL	Delete	NAK	Negative Acknowledge	VT	Vertical Tab
DLE	Data Link Escape	NL	New Line		
DS	Digit Select	NUL	Null		
EM	End of Medium	PF	Punch Off		
ENQ	Enquiry	PN	Punch On		

Special Graphic Characters

¢	Cent Sign	-	Minus Sign, Hyphen
.	Period, Decimal Point	/	Slash
<	Less-than Sign	,	Comma
(	Left Parenthesis	%	Percent
+	Plus Sign	−	Underscore
|	Logical OR, Absolute	>	Greater-than Sign
&	Ampersand	?	Question Mark
!	Exclamation Point	:	Colon
$	Dollar Sign	#	Number Sign
*	Asterisk	@	At Sign
)	Right Parenthesis	'	Prime, Apostrophe
;	Semicolon	=	Equal Sign
¬	Logical NOT	"	Quotation Mark
[	Left Bracket	\	Backslash
]	Right Bracket	∧	Circumflex
		∫	Hook
		Ψ	Fork
		◁	Chair

Figure A1. EBCDIC Chart

				Block 1:	Zone punches at top of table; digit punches at left
1		3		Block 2:	Zone punches at bottom of table; digit punches at left
2		4		Block 3:	Zone punches at top of table; digit punches at right
				Block 4:	Zone punches at bottom of table; digit punches at right
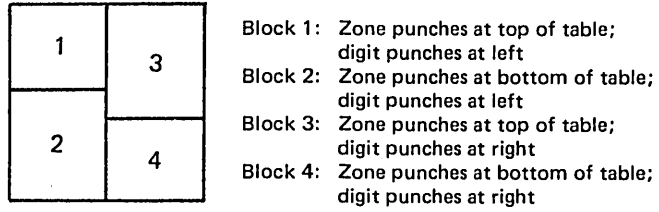
Figure A2. Chart Quadrants

Character	Type	Bit Pattern	Hex	Hole Pattern	
				Zone Punches	Digit Punches
PF	Control Character	00 00 0100	04	12-9	-4
%	Special Graphic	01 10 1100	6C	0	-8-4
R	Upper Case	11 01 1001	D9	11	-9
a	Lower Case	10 00 0001	81	12-0	-1
	Control Character, function not yet assigned	00 11 0000	30	12-11-0-9	-8-1

Bit Positions
01 23 4567

Figure A3. Examples of Chart Usage

Appendix B. 3203 Model 5 Sense Byte Summary

Byte 0: Summary Information

```
Bit     Designation

0       Command reject
1       Intervention required
2       Bus out check
3       Equipment check
4       Data check
5       Buffer parity check
6       Load Check (Load FCB, UCS Buffer)
7       Channel 9
```

Byte 1: Programming Information

```
Bit     Designation

0       Command retry
1       Print check
2       (Not used)
3       Line position check
4       Forms check
5       Command suppress
6       Controller check
7       (Not used)
```

Byte 2: Mechanical Information

```
Bit     Designation

0       Carriage failed to move
1       Carriage motion check
2       (Not used)
3       (Not used)
4       (Not used)
5       Forms check
6       (Not used)
7       Train velocity check
```

Byte 3: Electrical Information

```
Bit     Designation

0       UCS buffer parity
1       Print line buffer parity
2       (Not used)
3       Coil protect
4       Hammer fire check
5       (Not used)
6       Sync check
7       (Not used)
```

Byte 4: Device Identification

```
      Bits      Meaning

      0 to 7    Set to hexadecimal '84' to identify
                the device as a printer other than
                a 3211.
```

Bytes 5 to 19: Maintenance Information

```
      This information is for service
      personnel only.
```

Bytes 20 to 22: Unassigned

```
      These bytes are not used, and always
      contain zeros.
```

Byte 23: Device Identification

```
      This byte contains hex '00' to identify
      the printer as a 3203 Model 5 (also set
      to hex '00' for 3203 Model 4).
```

Appendix C. 3203-5 Programming Notes

Programs written for other printers may have to be changed to run with the 3203-5. This section describes differences between the 3203-5 and other printers.

LOAD FCB COMMAND

The 3203-5 expects a length count of 256 bytes for the FCB. Incorrect length is set in the CSW if more or less than 256 bytes are specified in the CCW length count, unless the CCW SLI bit is on. Therefore, the 'load FCB' CCW SLI bit should always be set on. The 3203-4 and 3211 printers do not set incorrect length on 'load FCB'

CONTROL COMMANDS

The 3203-5 implements all control commands as non-immediate commands. Because no data is transferred with these commands and the CCW data count must not be zero, incorrect length will be indicated in the CSW unless the CCW SLI bit is on. Therefore, the CCW SLI bit should be set on for all control commands (including the NOP command). All other printers implement these commands as immediate commands and thus do not cause incorrect length to be set.

ERROR CONDITION POSTING

The 3203-5 posts the following error conditions with channel end:

- Intervention Required (if the printer is not ready)
- Bus Out Check
- Equipment Check with Controller Check (Byte 1 Bit 6) and Bytes 5 through 23 set to zero

The 3203-5 posts all other error conditions (including Data Check, Buffer Parity Check, and Load Check) with device end only, whereas other printers may post some of these errors with channel end. Therefore, complete error testing must be done at device end.

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Component Description and Operator's Guide

GA 33-1529-0

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