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Systems

IBM 3270 Information Display System: 5926-BO3 Optical Scanner Reference Manual

RPQs 7B0215 and U42416

IBM

Preface

The IBM 5926-BO3 Optical Scanner is a hand-held device for reading printed bar-coded data. It is designed for attachment to the display stations of an IBM 3270 Information Display System.

This publication provides information for customer and IBM personnel concerned in operating, programming and physical planning for 5926-BO3 Optical Scanners. Readers should be familiar with the basic principles of the 3270 Information Display System.

The publication has six main sections.

Introduction: This section briefly describes the optical scanner, its operation, and the production of printed bar-codes suitable for scanning.

Operating Procedure: This section describes how an operator uses the optical scanner to read bar-coded data, and how the data is transmitted to a data processing system.

Program Considerations and Code Information: This section describes the programming support, data codes, and error checking involved in scanning and transmitting bar-coded data.

Preparation of Bar Codes: This section lists the allowed dimensions of bar-codes, describes the ways that data can be arranged on a document, and describes UCS character assignment for bar-code printing.

Paper and Print Quality Requirements: This section gives requirements and recommendations for setting up a printer, selecting the correct paper, and so on, for producing printed bar codes suitable for optical scanning.

5926-BO3 Characteristics and Installation Planning Information: This section lists the physical and (required) environmental characteristics of the optical scanner.

Appendix A describes the use of test documents.

Associated Publications

IBM 3270 Information Display System Component Description, GA27-2749.

An Introduction to the 3270 Information Display System, GA27-2739.

Operator's Guide for IBM 3270 Information Display Systems, GA27-2742.

Introduction to IBM 3705 Communications Controller, GA27-3051.

Second Edition (September, 1975)

This is a minor revision of GA19-5024-0, incorporating corrections to some publishing errors which appeared in the first edition.

Changes are periodically made to the information herein; any such changes will be reported in subsequent revisions or Technical Newsletters.

Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

A form for readers' comments is provided at the back of the manual. If the form has been removed, comments may be addressed to IBM Germany, Special Engineering, Dept. 3208, 7030 Boeblingen, Germany. Comments become the property of IBM.

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Contents

Introduction 1
Operating Summary 1
Bar-code Printing 1
Feature Restrictions 1

Operating Procedure 3

Programming Considerations and Code Information . . . 4
Programming Support 4
Delta-distance-A Code 4
Data Code 4
Data Format 4
Error Checking 5
Format Check 5
Modulus 10 Check 5
Version 1 (Specify Code 9470) 6
Version 2 (Specify Code 9471) 6
Check Digit 6
Example for Calculation of the Check Digit (X) If There Is an Odd Number of Data Digits 6

Preparation of Bar Codes 7
Bar-code Printing with IBM Printers 7
Characteristics of Bar Codes and Documents 8
Character and Bar Dimensions 8
Bar Code Area 8
Document Size and Contents 8
Document Layout 10
"Normal" Alphameric Printing 10
"Sideways" Alphameric Printing 10
UCS Character Assignment 10
UCS Buffer Loading 10
Modulus Checking Subroutine 10

Paper and Print Quality Requirements 14
Prerequisites 14
Paper Requirements 14
Reflectance 14
Paper Marks 14
Smoothness 14
Document Mutilation 14
Print Quality 15
General Requirements 15
Setting Up the Printer 15
Print Ribbons 15
Printed Bar Quality 15
Extraneous Ink and Marks 15
Print Contrast Signal Measurement 15

5926-BO3 Characteristics and Installation Planning Information 17
Physical Characteristics 17
Dimensions 17
Weight 17
Environmental Characteristics 17
Operating Temperature 17
Relative Humidity 17
Maximum Wet Bulb 17
Vibration and Shock 17
Power Requirements 17
Interface Cord 17
Connector 17

Appendix A. Optical Scanner Test Documents 18
Scanners with Version 1 Modulus Checking 18
Scanners with Version 2 Modulus Checking 18
Testing the Check Circuitry 18
Testing for Acceptable Mutilation 18

Illustrations

Figure	*Title*	*Page*
1	IBM 5926-BO3 Optical Scanner	vi
2	Optical Scanners in 3270 Information Display System	2
3	Using the "Windows" to Keep the Scanner Aligned	3
4	Delta-distance-A Code: Character "2"	4
5	Delta-distance-A Code and Hexadecimal Values	5
6	Typical Bar-coded Data String	5
7	Alphameric Character Orientation	7
8	Character and Bar Dimensions	8
9	Dimensions of Bar-code Area	8
10	Document Dimensions	9
11	Bar-coded Document with "Normal" Alphameric Printing	11
12	Bar-coded Document with "Sideways" Alphameric Printing	11
13	Code Assignment for UCS Printing	12
14	Definition of Data Set to be Loaded from Disk (Part 1)	13
15	Definition of Data Set to be Loaded from Disk (Part 2)	13
16	Sample Test Document (Pages 2, 4, 5)	19
17	Sample Test Document (Page 3)	20

Note: The illustrations in this manual have a code number to the right of the caption. This is a publishing control number and is unrelated to the subject matter.

Abbreviations

BOS	beginning of string
BTAM	basic telecommunications access method
CICS	customer information control system
CPU	central processing unit
DOS	disk operating system
EBCDIC	extended binary-coded-decimal interchange code
EOS	end of string
IMS	information management system
IQF	interactive query facility
OCR	optical character recognition
PCS	print contrast signal
RPQ	request for price quotation
TAPPI	Technical Association for the Pulp and Paper Industry
TCAM	telecommunications access method
TSO	time sharing option
UCS	universal character set
VIDEO	visual data entry online system
VTAM	virtual telecommunications access method

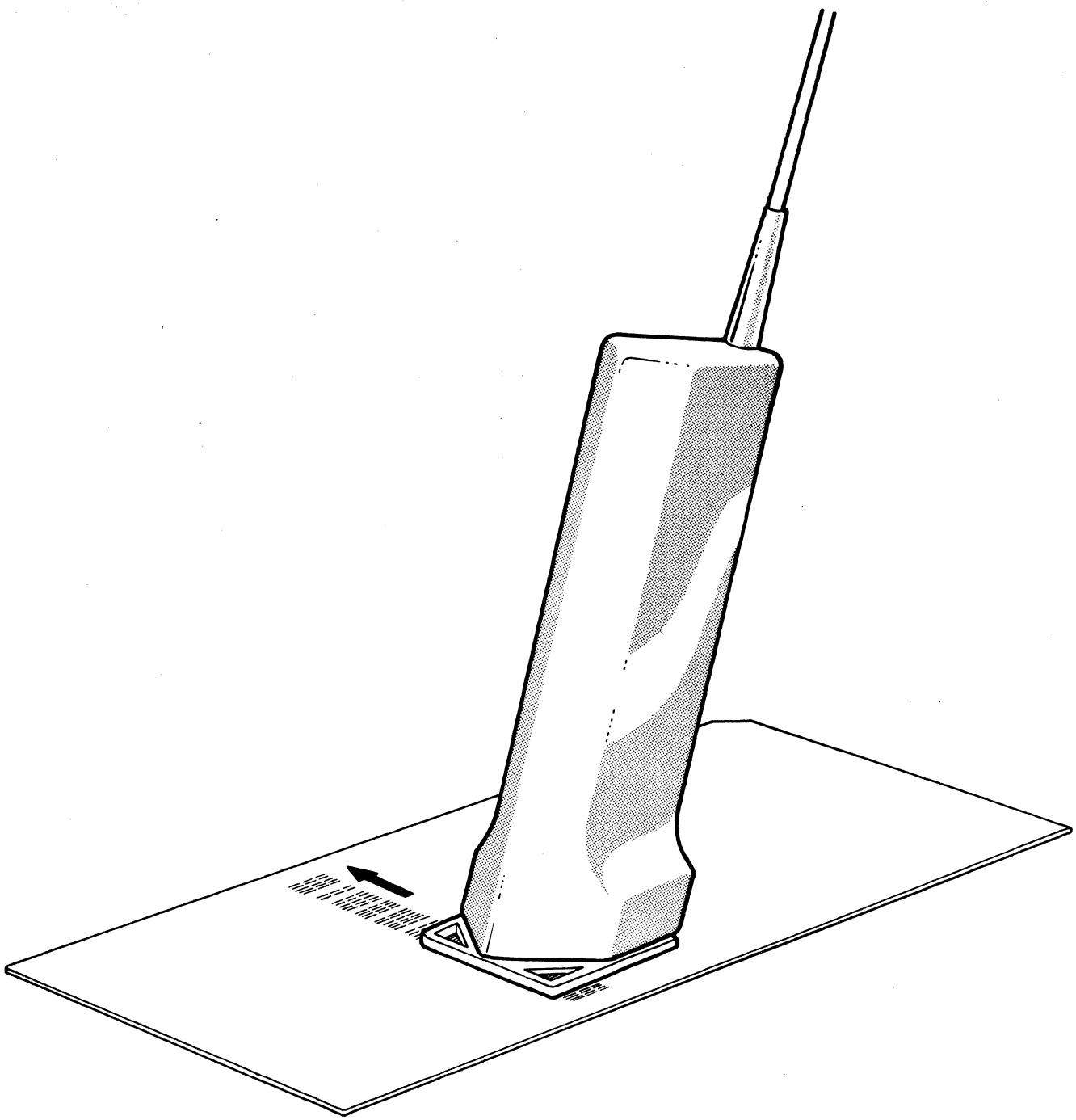


Figure 1. IBM 5926-BO3 Optical Scanner [19808]

The IBM 5926-BO3 Optical Scanner (Figure 1) is a hand-held device which reads printed bar-coded data for transmission to a data processing system. It is designed for attachment to the display stations of an IBM 3270 Information Display System, and provides fast and reliable data input in both local and remote applications (Figure 2). The optical scanning system consists of two "RPQ" (request for price quotation) products:

- RPQ 7B0215 – the 5926-BO3 Optical Scanner itself.
- RPQ U42416 – an electronics card which is plugged into an IBM 3275 or 3277 Display Station and enables an optical scanner to be attached to the display station.

The optical scanner is particularly suitable for applications where periodically-needed data or identification numbers have to be transmitted to the system. Instead of typing the information in at a keyboard, the operator simply moves the scanner across a line of printed bar codes. No special skill is required. This simple reading procedure can be an advantage for many types of non-batch-mode operations, such as large-scale public inquiry service, and in applications where members of the public may operate the terminal.

The optical bar code used is the Delta-Distance-A Code, which consists of groups of differently-spaced black bars printed on white paper. The character set comprises numerics 0 to 9 and six special characters, two of which are free for customer applications. Up to 16 numeric characters can be read in one scan.

OPERATING SUMMARY

When using the scanner for reading, the operator holds it in direct contact with a bar-coded document, and moves it from left to right across the bar codes. Two windows in the base of the scanner enable him to guide the scanner accurately. He can move the scanner at different speeds (within certain limits) with no effect on reading accuracy.

The scanned data is checked by the display station, and correct data appears in the data field of the display screen. In the case of incorrect reading, no data appears on the screen and the operator can immediately re-scan the bar codes.

Note: Use of the keyboard is inhibited during scanning. Before and after scans, however, the operator can make keyboard entries to supplement the scanned data.

The operator can make as many scans as there are free input data fields on the screen. Each input data field is 16 characters long (unless shorter fields are specified by the screen layout), and input starts at the location indicated by the cursor. If fewer than 16 characters are scanned, the remaining field is filled up with trailing blanks unless otherwise specified by the program. Read data can also be distributed to several fields, if specified by the program.

When the data appears on the screen, the operator presses the display station's ENTER key to transfer the data to the central processing unit (CPU) of the data processing system. The bar-code data is handled in the same way as keyed-in data, so no extra programming is needed.

BAR-CODE PRINTING

Delta-distance-A code characters may be printed by standard IBM train printers such as the IBM 1403 Printer Model N1, IBM 3203 Printer Model 2, and the IBM 5203 Printer Model 3. The printer must be equipped with a special train cartridge, such as RPQ U42427 (for 1403 or 3203 Printer) or RPQ X62141 (for 5203 Printer), which can print the 16 bar-code characters in addition to the normal character set. Both alphameric characters and bar codes may then be printed in the same print run. For print quality reasons the bar codes are printed from top to bottom but the alphameric characters are printed from left to right.

To make it easier for the operator to scan the bar codes, each character is printed three times side by side. The individual bars are thus about 7 mm in total width. Bar codes produced by printers other than the ones specified above can be read if the bar dimensions are the same and the same coding algorithm as the delta-distance-A code is used.

For information on programming for bar-code printing, see under "Preparation of Bar Codes". For printed bar-code specifications, see "Characteristics of Bar Codes and Documents" in the same section.

FEATURE RESTRICTIONS

When a 3275 or 3277 Display Station is modified for use with an optical scanner, the scanner attachment card is plugged into the position normally reserved for the Operator Identification Card Reader feature card. Therefore the operator identification card reader cannot be attached to the display station if an optical scanner is installed, and *vice versa.*

If a 3275 has an IBM 3284 Printer Model 3 attached, an optical scanner cannot be attached unless RPQ X35511 is installed for compatibility. With this RPQ installed, the Selector Light Pen feature cannot be installed.

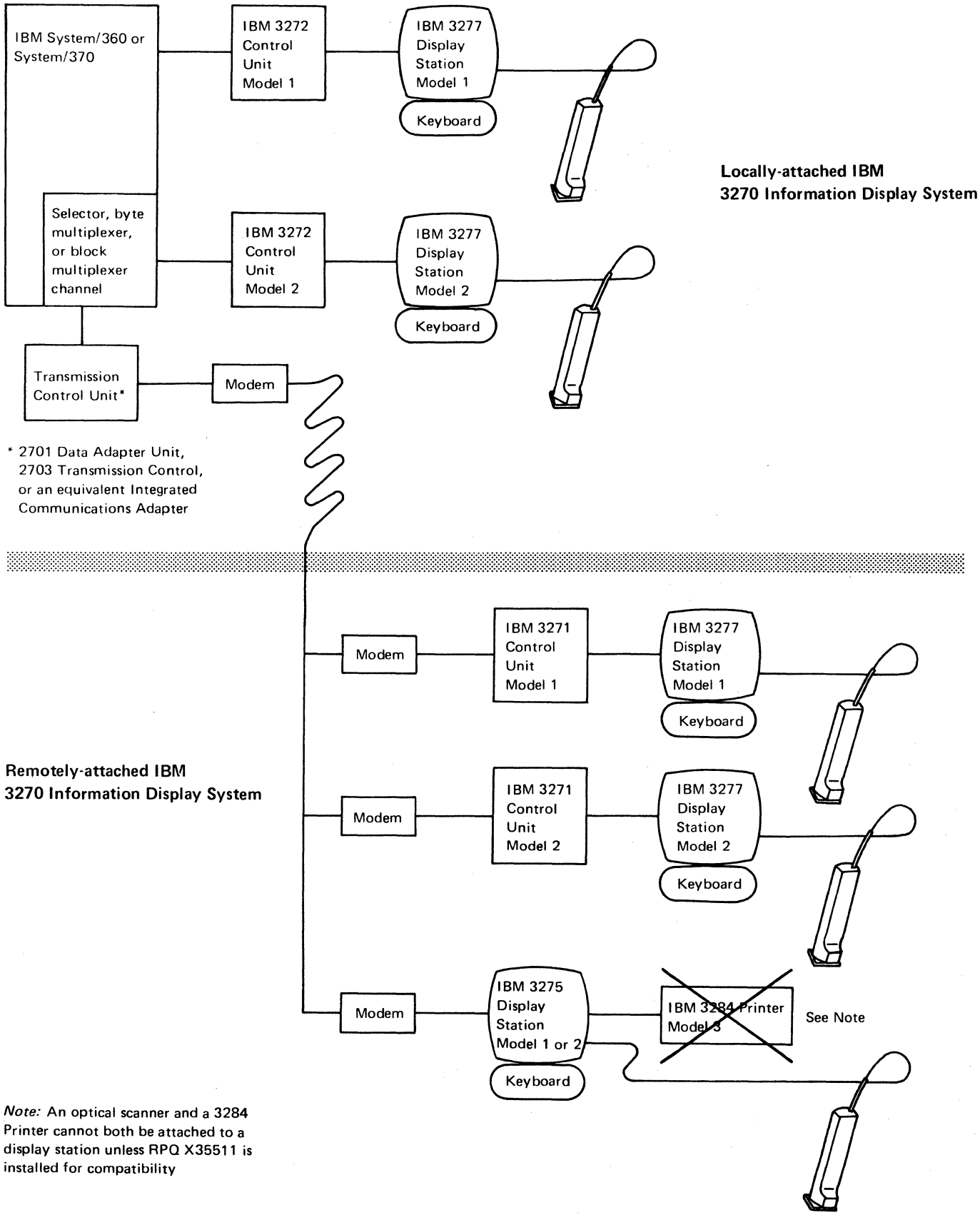


Figure 2. Optical Scanners in 3270 Information Display System [19809]

The indications that the optical scanner is ready for use are the same as those for the display station's keyboard: the station's SYSTEM AVAILABLE indicator must be lit and the cursor must be positioned at the beginning of the first input data field. Note, however, that during an actual scanning operation, use of the keyboard is inhibited.

The following text describes a simple inquiry example. All other applications of the scanner would be handled in a similar way.

The operator takes the document to be read and (if possible) places it on a flat surface. He then moves the scanner from left to right across the bar codes, pressing lightly to keep the read head in direct contact with the document surface. The speed of the scanning movement can vary between 2 cm and 50 cm per second, corresponding to a data rate of between five and 120 characters per second. Acceleration and deceleration of the scanner are allowed, as long as the scanning speed does not change by more than 20 percent from one character to the next.

Two windows in the baseplate of the scanner enable the operator to move the read head accurately across the bar codes. As the scanner is moved across the bar codes, the bars should always be visible through the windows (Figure 3). The maximum acceptable deviation from an imaginary code centerline is ±3 mm. Skew from that centerline must not exceed ±6°. Scanning must start to the left of the beginning-of-string (BOS) character and must continue *past* the end-of-string (EOS) character.

As the document is scanned, the display station gives the character string a format check and a modulus 10 check. Correct data is transferred to the display buffer and then appears on the screen, starting at the location indicated by the cursor (note that only correct data will appear on the screen). The maximum number of characters that can be read in one scan and displayed is 16. For smaller numbers of characters, however, the programmer may have specified shorter fields on the screen. If the number of characters read is smaller than the specified field on the screen, the remaining positions in the field are blank. The program may

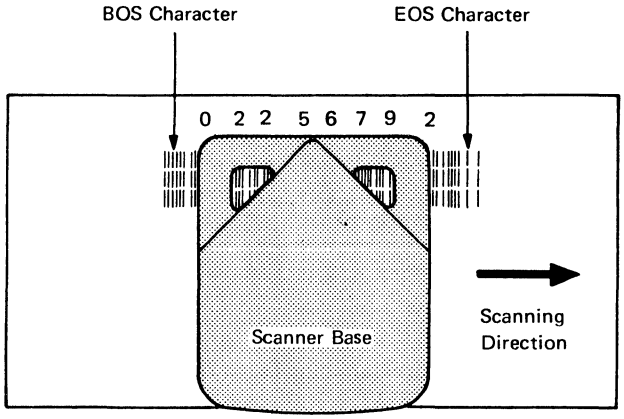


Figure 3. Using the "Windows" to Keep the Scanner Aligned [19810]

also specify that data read in one scan is distributed over several short fields on the screen.

When correct scanned data appears on the screen, the keyboard clicker also sounds. Thus a successful scanning operation is indicated in two ways: visually, when the data appears on the screen, and acoustically, by the clicker. The operater can then press the display station's ENTER key to transmit the displayed data to the data processing system.

If, after scanning, no data appears on the screen, the operator can immediately repeat the scan. The scanner must, however, be lifted from the document at the end of each scan. If several retries fail to provide displayed data, the operator can enter the data through the keyboard (assuming that the document was printed with alphameric characters in addition to the bar codes).

The operator should then try to discover why the bar-coded data was not transferred to the display screen. To help him do this, test documents are provided with every scanner. (For instructions on their use, see "Appendix A. Optical Scanner Test Documents".) If the test documents fail to provide displayed data, an IBM customer engineer should be called.

This section will mostly be of interest to programmers. It describes the programming support, code formats and error checking required for scanning printed bar codes. For programming considerations in the *printing* of bar codes, see the section "Preparation of Bar Codes".

PROGRAMMING SUPPORT

When an optical scanner is attached to a 3275 or 3277 Display Station, there is no need to change any of the programming support for the 3270 Information Display System. All existing programming (such as BTAM, TCAM, VTAM, VIDEO/370, DATA/360, IMS, IQF, CICS, and TSO) can be used. The scanner causes no conflict with these programs because the bar-coded data which it reads is treated by the system just as if it had been entered through a keyboard.

The display screens can be either formatted (divided into fields) or unformatted. The user can format the screen, according to his requirements, by the use of attribute characters. The application program divides the screen into fields and defines the type of information which each field will contain. The program will then "know" that a certain type of information will always be displayed in the same screen location, and will thus be able to process information from the screen much faster. The operator, too, is able to work more efficiently.

When defining the formatted fields, the programmer should be aware of the following points.

1. With one scan, a maximum of 16 data characters can be entered (not including the BOS and EOS characters).
2. The optical scanner input data field on the screen should be limited to the expected data length by the use of attribute characters.
3. When input data is less than 16 characters the input data field is filled with trailing blanks (to a maximum length of 16), unless an attribute character defines that the field is shorter.
4. Data read by one scan can be distributed to several fields on the screen, separated by attribute characters.

If the data string contains a modulus 10 check character, the application program can repeat the modulus 10 check. This increases data security and detects errors which might occur during the transmission of data to the data processing system.

DELTA-DISTANCE-A CODE

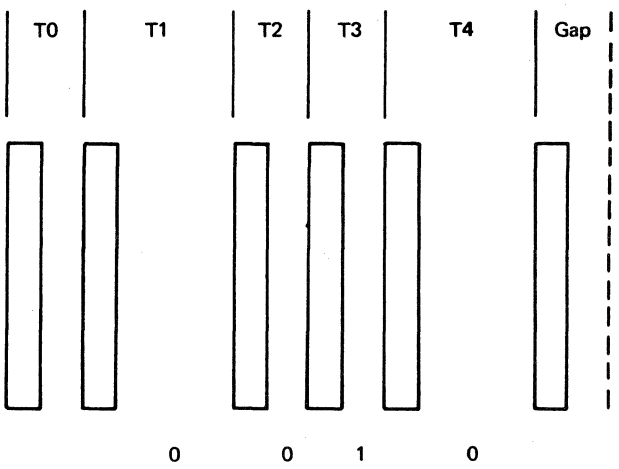


Figure 4. Delta-distance-A Code: Character "2" [19811]

The optical bar code used is the delta-distance-A code, with a density of six characters per inch (236 characters per metre). This two-level self-clocking code is specially suited for use as a printed bar code.

The delta-distance-A code carries information as a function of the space between adjacent bars. As the operator passes the scanner across the bar codes, the distances between the bars are measured and the data is decoded.

Each character is composed of six bars. The gaps between the bars can be of two different widths, and the disposition of the different gaps among the six bars determines the character represented.

DATA CODE

Figure 5 shows the assignments of the valid bar combinations.

DATA FORMAT

Each character string must have the following format:

BOS (beginning-of-string character)
Data (maximum of 16 characters)
EOS (end-of-string character)

Hex Value	Bit 8	4	2	1	Bar Code	Graphic/Data	1416 Slug Part Number
0	0	0	0	0	II II II	0	4 052 735
1	0	0	0	1	I II III	1	4 052 736
2	0	0	1	0	II III I	2	4 052 737
3	0	0	1	1	II IIII	3	4 052 738
4	0	1	0	0	I III II	4	4 052 739
5	0	1	0	1	II I III	5	4 052 740
6	0	1	1	0	I IIII I	6	4 052 741
7	0	1	1	1	I IIIII	7	4 052 742
8	1	0	0	0	III II I	8	4 052 743
9	1	0	0	1	III III	9	4 052 744
A	1	0	1	0	III I II	K (special)*	4 052 745
B	1	0	1	1	I I IIII	L (special)*	4 052 746
C	1	1	0	0	IIII II	M (special)*	4 052 747
D	1	1	0	1	IIII I I	EOS	4 052 748
E	1	1	1	0	IIIII I	O (reserved) *	4 052 749
F	1	1	1	1	IIIIII	BOS	4 052 750

* If these characters are scanned, K, L, M and O are displayed on the screen

Notes:
1. The special characters with hex values A and B may be assigned by the user.
2. Hex value C is used for version 2 modulus 10 checking.

Figure 5. Delta-distance-A Code and Hexadecimal Values [19812]

Figure 6 shows a typical character string in printed bar-code form. Note that the BOS and EOS characters are not counted as data.

A BOS and an EOS character must be included in every string for synchronization reasons. It is also recommended that a check digit is concatenated with the data to be transmitted (see "Modulus 10 Check" under "Error Checking").

Although a character string may contain up to 16 numeric characters, strings should preferably be shorter because of human factor and error checking considerations. (For example, the efficiency of modulus 10 check procedures decreases with longer character strings because the probability of undetected errors increases.)

Note: Blanks are not allowed within a character string.

If, in certain applications, 16 characters are not sufficient, the operator is allowed to make additional scans. Before transmitting data to the data processing system, he can make as many scans as there are free input data fields provided on the display screen.

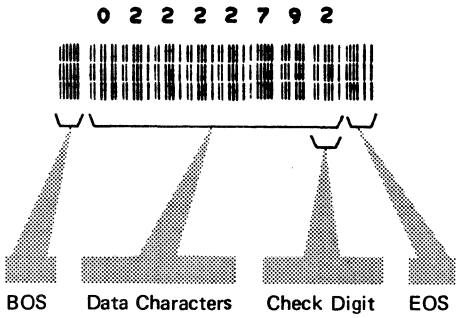


Figure 6. Typical Bar-coded Data String [19813]

ERROR CHECKING

The control logic of the optical scanner attachment performs two types of checking: format check, and modulus 10 check.

Format Check

The format check checks that the scanner reads the BOS and EOS characters, and that no additional bars follow EOS. Also, the total number of bars in the complete scanned character string must be a multiple of six. If one or several bars are missing, due to a misprint or to mutilation, the data is not accepted.

Modulus 10 Check

In addition to the format check the control logic can also perform a modulus 10 check, and it is recommended that

each data string should contain a check digit. There are two different methods of initiating the modulus 10 check. The two methods cannot be mixed, so the method to be used must be defined to customer engineering before the optical scanner is installed.

Version 1 (Specify Code 9470)

Each non-numeric character (including EOS) causes the preceding numeric data field to be modulus 10-checked. Therefore, all data fields are checked to give maximum data security.

The numeric data field must always contain an even number of digits, including the check digit. If required, a leading zero must be added.

Version 2 (Specify Code 9471)

In version 2, only special character M (hexadecimal C) initiates the modulus 10 check. This method allows the use of checked and unchecked data fields, where the application requires it. Data security, however, is greatly reduced for the unchecked fields.

With version 2 the numeric data field must contain an odd number of digits (including the check digit), when checked according to the modulus 10 rules.

Check Digit

To calculate the modulus 10 check digit, each digit of a given number is multiplied by weight factors and the total of the resulting product digits are generated. The check digit must always have the weight factor 1. The other digits from right to left have, alternatingly, 2 and 1 as weight factors. A check character is added to the sum of the product digits so that the result is a multiple of 10.

Example for Calculation of the Check Digit (X) If There Is an Odd Number of Data Digits

1 4 7 1 1 X	Number to be checked
2 1 2 1 2 1	Weight factors
2 4 14 1 2 X	Product number
	All product digits are added:

2 + 4 + 1 + 4 + 1 + 2 + X = next multiple of 10

The check digit X is the value which brings the calculated number to the next multiple of 10, therefore:

X = 6

In this example, the check digit is 6. The complete data field, including the check digit, is therefore:

1 4 7 1 1 6

To check a numeric data field (modulus 10), the following calculation is made:

1 4 7 1 1 6	Received number
2 1 2 1 2 1	Weight factors
2 4 14 1 2 6	Product number
	All product digits are added:

2 + 4 + 1 + 4 + 1 + 2 + 6 = 20

The sum must be a multiple of 10, if no error occurred.

If, for instance, the digits 4 and 7 are interchanged, this error will be detected because the sum cannot be divided by 10 without remainder. The following example shows the checking of an erroneous field:

1 7 4 1 1 6	Wrong number
2 1 2 1 2 1	Weight factors
2 7 8 1 2 6	Product number

All product digits are added:

2 + 7 + 8 + 1 + 2 + 6 = 26 ÷ 10 = 2

The remainder is 6. Detecting a wrong number always causes a modulus check error.

With an odd number of digits (data digits plus check digit) the calculating method is the same except that the weight factors start with 1 instead of 2 in the leftmost position.

Longer data strings may be blocked and each block can be modulus 10-checked if required.

Note: The bar-code printing program must include a subroutine which calculates the modulus 10 check digit for each data string to be printed.

The optical scanner is specially designed to read bar-codes printed by IBM train printers such as the 1403 Model N1, 3203 Model 2, and 5203 Model 3. This section outlines the method of producing bar codes with an IBM printer, then gives the allowed dimensions for printed bar codes and documents, and describes the different ways that bar codes and alphameric characters may be arranged on a document. It also describes UCS character assignment for bar-code printing.

BAR-CODE PRINTING WITH IBM PRINTERS

Due to the horizontal train movement on IBM line printers, only horizontally-arranged bars avoid shadow printing. Therefore, the bar code is printed rotated by 90° to normal (Figure 7). To ensure that the bars are long enough for the scanner to be used properly, each bar-code character is printed three times side by side. The standard line feeding provides a character spacing of six characters per inch. Bar codes and text are printed in a single run.

To prepare an IBM train printer for bar-code printing, it is necessary:

1. To ensure that the printer has the necessary features installed. See "Prerequisites" in the section "Paper and Print Quality Requirements".
2. To install a special interchangeable train cartridge fitted with bar code slugs (available as RPQ U42427 or RPQ X62141).
3. To set up the printer for optimum print quality: see "Setting Up the Printer" in the section "Paper and Print Quality Requirements".
4. To set the printer line spacing to six lines per inch.

Note: For label production, the above RPQs also provide alphameric characters turned through 90° in the train. This allows text (the alphameric characters which correspond to the bar codes) to be printed in the correct orientation (see Figure 7).

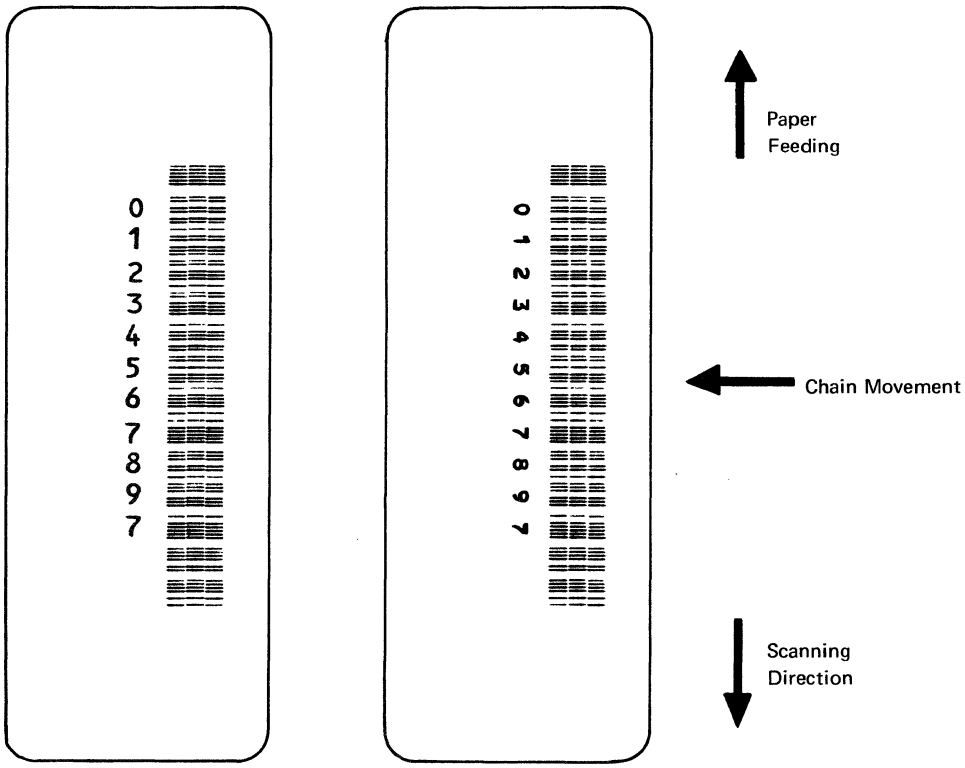


Figure 7. Alphameric Character Orientation [19814]

CHARACTERISTICS OF BAR CODES AND DOCUMENTS

The dimensions for bar codes and documents, described in the following paragraphs, are based on the capabilities of the 1416 Interchangeable Train Cartridge (and the interchangeable train cartridge for a 5203 Model 3). The dimensions are also valid for other printing methods if they are used as minimum values. Before using a printing method other than an IBM train printer, however, the proposed method should be discussed with IBM's International Document Evaluation Center*.

Character and Bar Dimensions

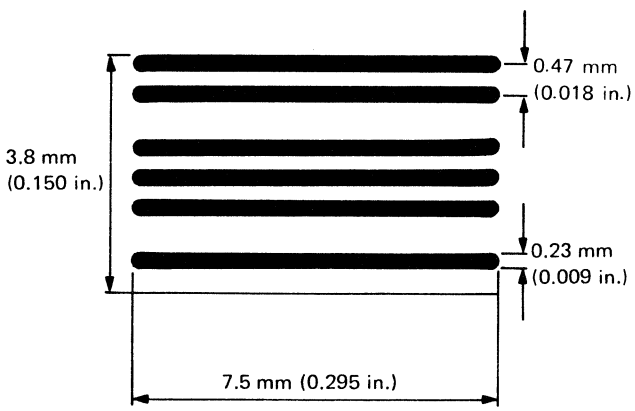


Figure 8. Character and Bar Dimensions [19815]

If the bar-code is to be printed using an IBM train printer, the allowed dimensions are as follows:

- Bar spacing is 0.47 ± 0.024 mm (0.018 in. ± 5%) or 0.94 ± 0.024 mm (0.037 in. ± 2.5%).
- Bar width is 0.23 ± 0.04 mm (0.009 in. ± 17%).
- Minimum bar length with three side-by-side printings is 7.2 mm (0.283 in.).

If the bar code is to be printed using any method other than an IBM train printer, the allowed dimensions are as follows:

- Bar spacing: minimum 0.45 mm (0.018 in.), maximum 1.0 mm (0.039 in.).
- Bar width: minimum 0.2 mm (0.008 in.), maximum 0.3 mm (0.012 in.).
- Bar length (minimum): 7.0 mm (0.276 in.).
- Tolerance in bar spacing centerline: ± 5%.

Bar-Code Area

The bar-code area (Figure 9) is the field the optical scanner reads. Within this area no signs, marks, or background printing other than the bar code are allowed.

The maximum length of all bars is 7.5 mm (minimum 7.2 mm), which is achieved with three character strokes on an IBM train printer.

Printing n data characters gives a code-length of $(n + 2) \times 4.2$ mm (0.165 in.). This is 50.4 mm (1.98 in.) for 10 data characters. It is recommended that the bar codes are preceded and followed by blank fields each of 15 mm (0.59 in.).

Document Size and Contents

To allow the scanner base-plate to be fully positioned on the document, a document must be at least the minimum size shown in Figure 10.

Each document should show the bar-coded data also in alphameric form, to allow the operator to enter data via the keyboard when it is impossible to read data with the scanner. To minimize the need for keyboard entry, the document can contain two bar-code fields, each printed

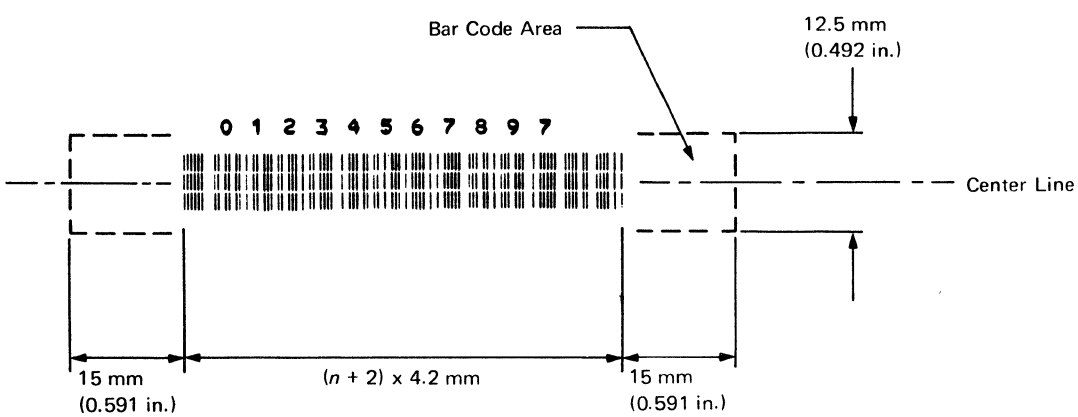
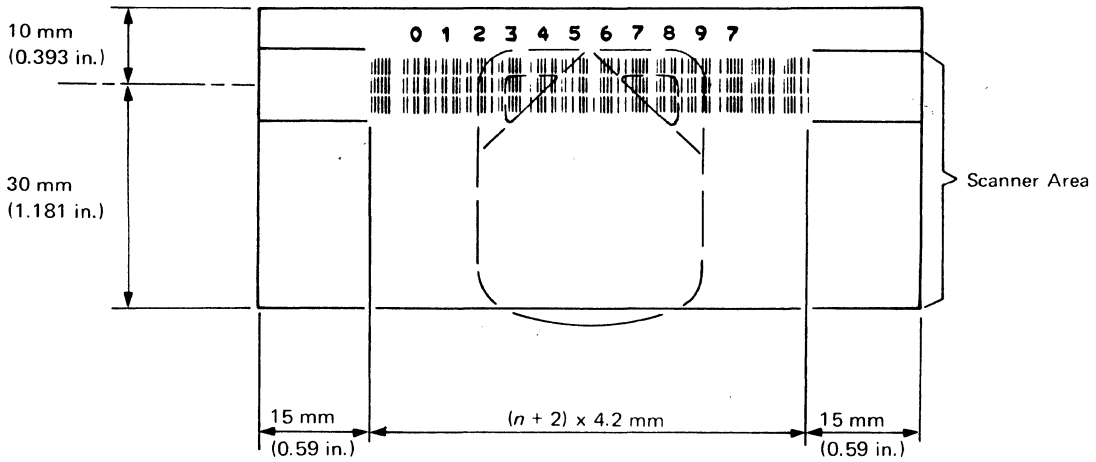


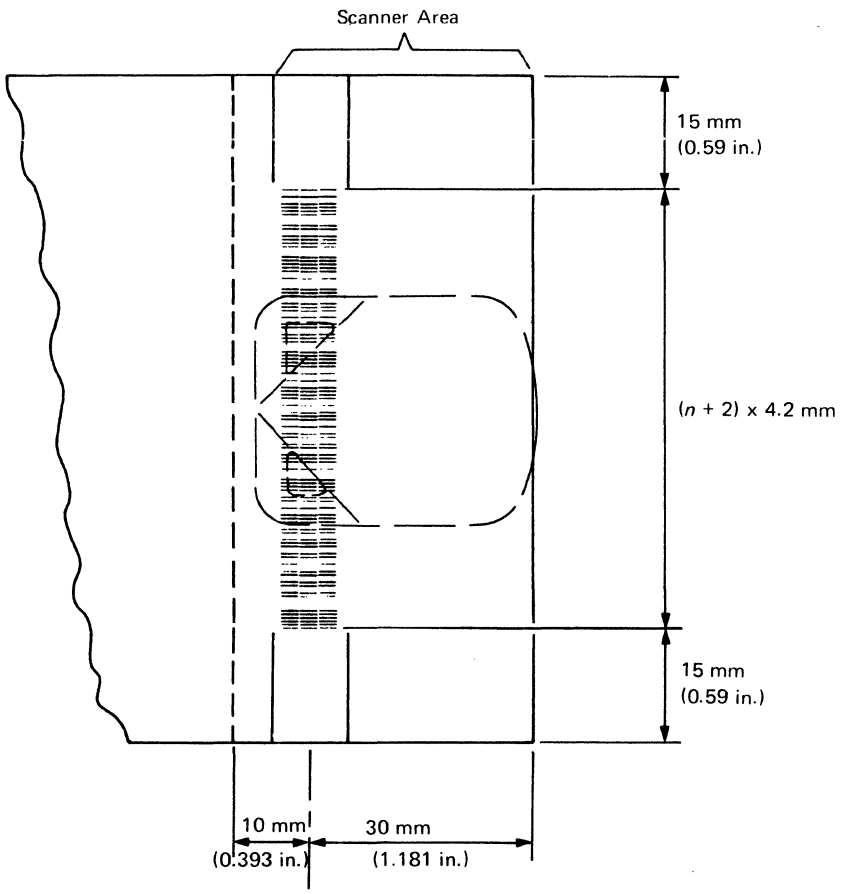
Figure 9. Dimensions of Bar-code Area [19816]

* IBM Deutschland, 7 Stuttgart, Vaihinger Strasse 124, Germany

Horizontal Scanning



Vertical Scanning



Note: The *minimum distance* between document edge and first or last character is 15 mm (0.59 in.).

Figure 10. Document Dimensions [19817]

with the same data. The operator can then try to scan the second field if scanning the first field was unsuccessful.

Document Layout

There are two different ways of arranging the bar codes and the alphameric characters on a document.

"Normal" Alphameric Printing

The alphameric characters on the document are printed normally: from left to right and from top to bottom. The bar-code line is printed from top to bottom in a predefined area (Figure 11).

The bar codes may be printed to be scanned either from the top downwards or from the bottom upwards (as shown in Figure 11). This depends on the UCS character assignments (see "UCS Character Assignment").

"Sideways" Alphameric Printing

For label printing, both the bar codes and the alphameric characters are printed from top to bottom. This is made possible by the sideways characters fitted on the special train cartridge (RPQ U42427 or RPQ X62141).

When the label is turned, it gives the impression that the bar codes and the text were printed in the conventional way (Figure 12).

UCS CHARACTER ASSIGNMENT

To print bar codes, the bar-code characters are assigned EBCDIC (extended binary-coded decimal interchange code) representations which do not interfere with the EBCDIC representations of standard print characters.

A special print method must be used to obtain the best print quality and character alignment. Assign hexadecimal print character codes 10 through 1F to print positions 1, 4, 7, and so on, print characters 20 through 2F to positions 2, 5, 8, and so on, and print characters 30 through 3F to positions 3, 6, 9 and so on, as shown in Figure 13.

The special bar-code slugs in the train are arranged so that the printed bar codes may be scanned from the top downwards, in the sequence:

0 1 2 3 4 5 6 7 8 9 A B C D E F.

If the bar codes are to be scanned from bottom upwards, the train is unchanged but the sequence is:

0 8 4 C 2 A 6 E 1 9 5 D 3 B 7 F.

The full UCS image is then defined as hexadecimal

10 20 30 11 21 . . . 2F 3F (top downwards), or as

10 20 30 18 28 38 14 . . . 2F 3F (bottom upwards),

as shown in Figures 14 and 15. These two figures define a data set to be loaded from disk.

UCS Buffer Loading

For information on UCS buffer loading, see the appropriate manual for the printer which is to be used for bar-code printing.

MODULUS-CHECKING SUBROUTINE

The bar-code print program must contain a subroutine which calculates the modulus 10 check digit for each data string to be printed.

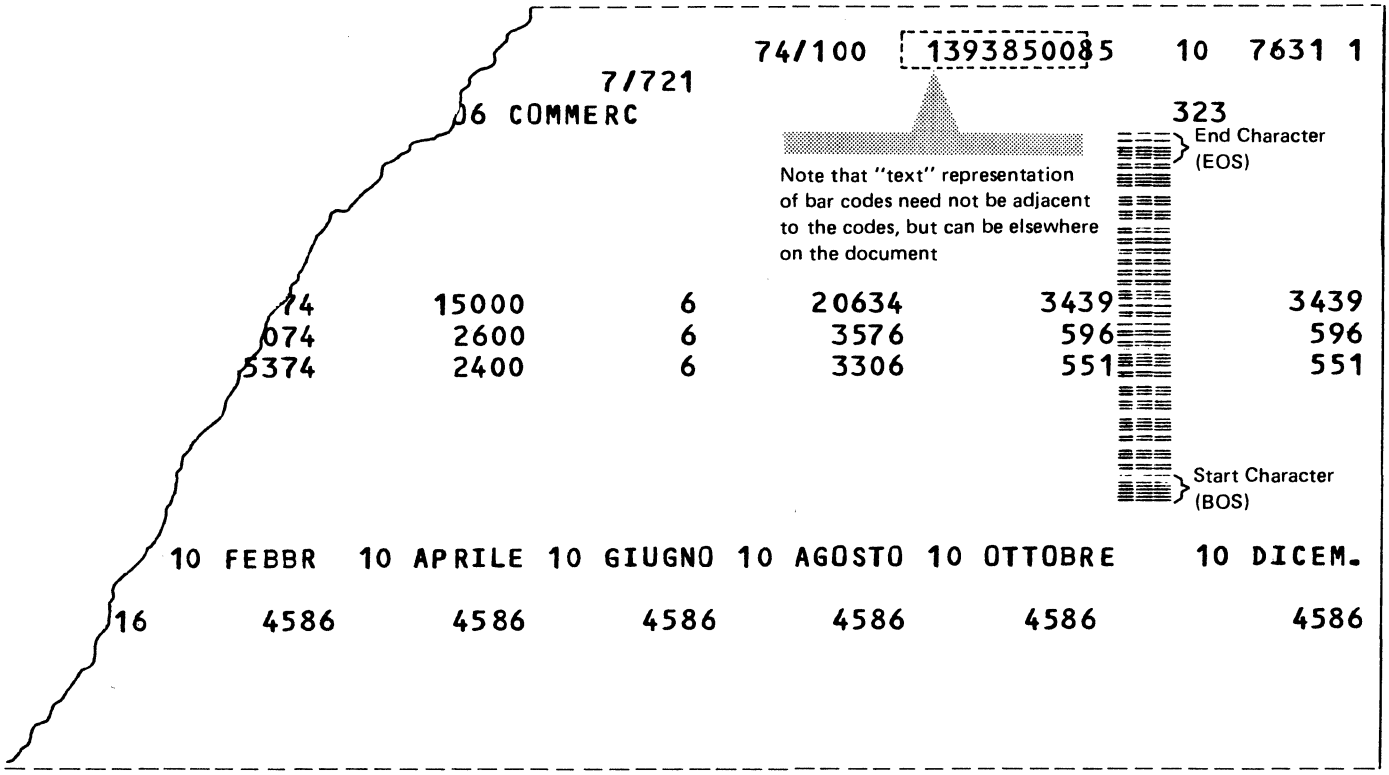


Figure 11. Bar-coded Document with "Normal" Alphameric Printing [19818]

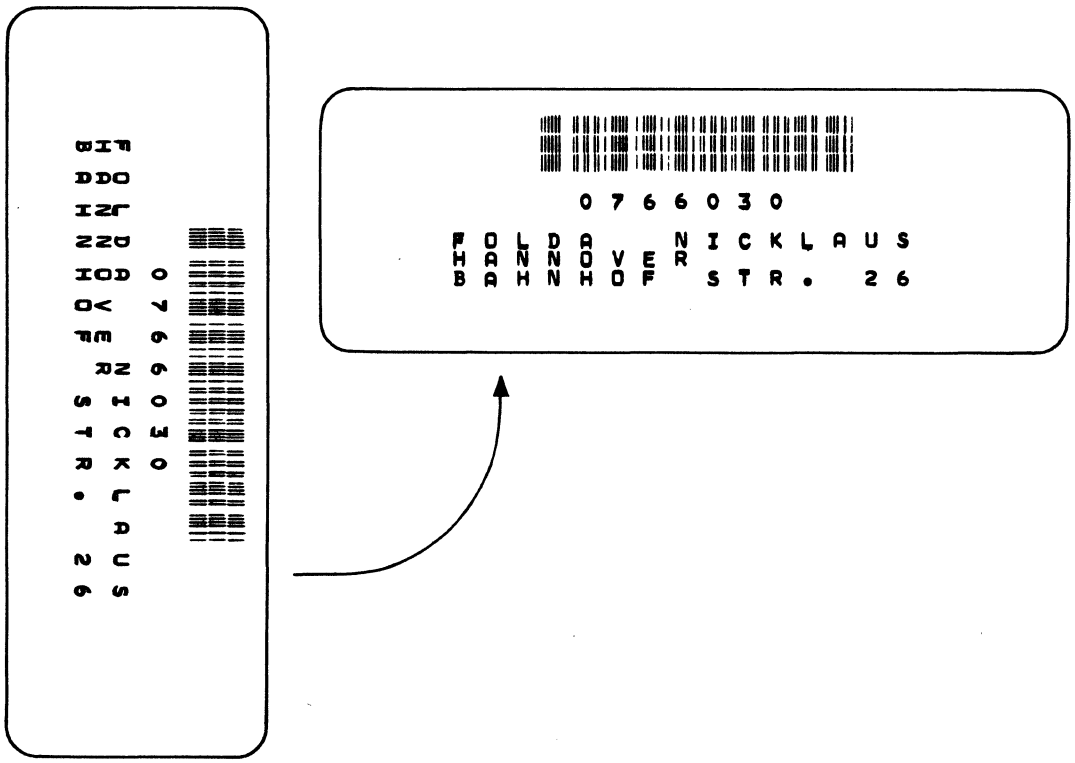
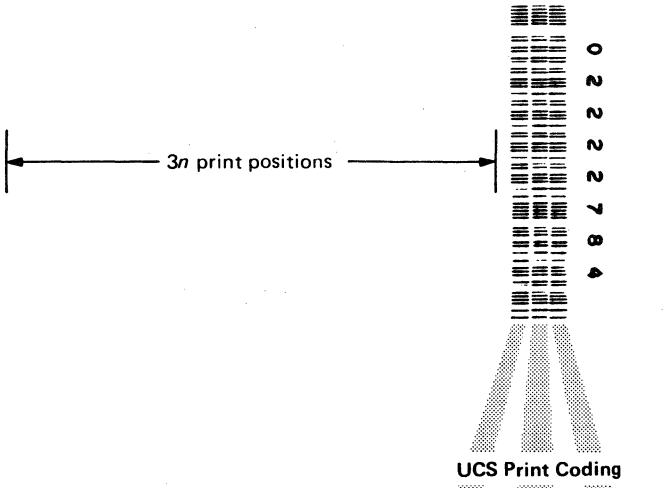


Figure 12. Bar-coded Document with "Sideways" Alphameric Printing [19819]



Hex Value	Bar Code	EBCDIC Value	*1st*	*2nd*	*3rd*
0	II II II	F0	10	20	30
1	I II III	F1	11	21	31
2	II III I	F2	12	22	32
3	II IIII	F3	13	23	33
4	I III II	F4	14	24	34
5	II I III	F5	15	25	35
6	I IIII I	F6	16	26	36
7	I IIIII	F7	17	27	37
8	III II I	F8	18	28	38
9	III III	F9	19	29	39
A	III I II	D2	1A	2A	3A
B	I I IIII	D3	1B	2B	3B
C	IIII II	D4	1C	2C	3C
D	IIII I I		1D	2D	3D
E	IIIII I	(D6)	1E	2E	3E
F	IIIIII		1F	2F	3F

Figure 13. Code Assignment for UCS Printing [19820]

```
//  JOB UCSIMAGE FOR 1403 PRINTER

//  OPTION CATAL, NOSYM, NOXREF, NODECK
    PHASE UCSDA,+0, NOAUTO
//  EXEC ASSEMBLY
          PRINT ON,DATA
      START  0
          DC X'102030112131122232132333142434152535162636172737'          BARCODE1
          DC X'1828381929391A2A3A1B2B3B1C2C3C1D2D3D1E2E3E1F2F3F'          BARCODE2
      DC C'L1YNDKI2/R9GT>HF3VS8&&<OUC6*AWZ.+QE5XP4J''¢=,0-MB7'            OCRB
      DC C'L1YNDKI2/R9GT>HF3VS8&&<OUC6*AWZ.+QE5XP4J''¢=,0-MB7'            OCRB
         DC X'102030112131122232132333142434152535162636172737'           BARCODE1
         DC X'1828381929391A2A3A1B2B3B1C2C3C1D2D3D1E2E3E1F2F3F'           BARCODE2
     DC C'L1YNDKI2/R9GT>HF3VS8&&<OUC6*AWZ.+QE5XP4J''¢=,0-MB7'             OCRB
DC CL80'TRAIN PRINTS BARCODE TO BE SCANNED FROM TOP DOWNWARDS + OCR-B'
 END
/*
```

Figure 14. Definition of Data Set to be Loaded from Disk (Part 1) [19821]

```
//  JOB UCSIMAGE FOR 1403 PRINTER

//  OPTION CATAL,NOSYM,NOXREF,NODECK
    PHASE UCSDA,+0,NOAUTO
//  EXEC ASSEMBLY
          PRINT ON,DATA
     START  0
          DC X'102030182838142434 1C2C3C1222231A2A3A1626361E2E3E'         BARCODE1
          DC X'112131192939152535 1D2D3D1323331B2B3B1727371F2F3F'         BARCODE2
     DC C'L1YNDKI2/R9GT>HF3VS8&&<OUC6*AWZ.+QE5XP4J''¢=,0-MB7'            OCRB
     DC C'L1YNDKI2/R9GT>HF3VS8&&<OUC6*AWZ.+QE5XP4J''¢=,0-MB7'            OCRB
          DC X'102030182838142434 1C2C3C1222321A2A3A1626361E2E3E'         BARCODE1
          DC X'112131192939152535 1D2D3D1323331B2B3B1727371F2F3F'         BARCODE2
     DC C'L1YNDKI2/R9GT>HF3VS8&&<OUC6*AWZ.+QE5XP4J''¢=,0-MB7'            OCRB
DC CL80'TRAIN PRINTS BARCODE TO BE SCANNED FROM BOTTOM UPWARDS + OCRB'
 END
/*
```

Figure 15. Definition of Data Set to be Loaded from Disk (Part 2) [19822]

Bar codes suitable for reading by the optical scanner can be printed by a 1403 Printer Model N1, a 3203 Printer Model 2, or a 5203 Printer Model 3. To ensure good quality printed bar codes from any of these printers, follow the recommendations and requirements listed in the following paragraphs.

Note: Any other method of producing printed bar codes should be discussed with the IBM International Document Evaluation Center.

PREREQUISITES

- The IBM train printer must be equipped with the appropriate special train cartridge for printing bar codes (RPQ U42427 or RPQ X62141). The user may specify different text fonts via RPQ, if required.
- A 1403 Model N1 must be equipped with the Universal Character Set feature and extra-wide hammers (available as RPQ W15658). The extra-wide hammers do not interfere with other printing applications.
- A 5203 Model 3 must be equipped with the universal character set feature.
  Note: Universal character set and extra-wide hammers are standard on the 3203 Model 2.
- Paper and print ribbon must be suitable for bar-code printing, as described later in this section.
- The operator should be trained to set the printer up for the best bar-code printing quality. He should pay particular attention to correct adjustment of the print force lever and the paper thickness lever.

PAPER REQUIREMENTS

The paper used for printing bar codes should comply to IBM specifications for optical character recognition (OCR) quality. Paper weights between 80 grams per square meter (g/m^2) and 160 g/m^2 are suitable. Paper must be fabricated of chemical woodpulp. Carbon-backed and carbonless image papers are unacceptable. Card stock and multiple-ply forms should not be used. The document must not be surface-treated.

Reflectance

Paper used for optical scanning must reflect at least 68 percent as much light as magnesium oxide at all wavelengths between 850 and 950 nanometers (nm). This range is beyond the 700 nm upper extremity of normal human vision and in the near-infrared region. The measurement should be made using one thickness of the sample with a matte black backing. Measurements are to be made in accordance with TAPPI * standard T425.

Paper Marks

Paper used for optical scanning must have a mark count lower than 250 marks/m^2 (150 marks/1,000 in.^{2}), where a mark is defined as a visible imperfection greater than 0.1 mm (0.004 in.) in any dimension and where the print contrast signal (PCS) value of the paper value exceeds 0.2. (For instructions on PCS measurement, see "Print Contrast Signal Measurement" in this section.) Marks present in the material are often produced in the process of manufacturing. These marks may be "seen" by the optical scanner and may interfere with data recognition.

Smoothness

Characters printed on smooth paper have fewer voids and better edge definition than those printed on rough paper. Excessively smooth paper, however, should not be used. The smoother the surface of the paper, the more likely it becomes that ink or carbon will smear.

The paper stock (as measured with a Sheffield Tester) should ideally have a smoothness of between 100 and 150 Sheffield, although between 80 and 200 is acceptable.

Document Mutilation

- Surface mutilations caused by staples, clips, adhesive tapes and so on are not acceptable.
- Materials that change the reflectance of the base paper (gum, wax, grease, glue, dirt, spilled liquids, and so on) are not acceptable in the data area.
- Folded, creased, or warped documents are acceptable, after reconditioning, if each document lies within 0.2 mm (0.008 in.) of being flat under a pressure of 0.1 newtons per square centimetre.
- 1. A tear that has removed paper must not extend into the scanner area.
  2. No tear must extend into the bar-code area.

---

* Technical Association for the Pulp and Paper Industry, 360 Lexington Avenue, New York, N.Y., U.S.A.

PRINT QUALITY

General Requirements

- Bar codes should be printed three times, side-by-side, to give the required bar length.
- Use print positions 1, 2, 3 or 4, 5, 6 or 7, 8, 9 or 130, 131, 132. Do not use positions 2, 3, 4 or 3, 4, 5 and so on.
- Do not print any other text in the same position as the bar codes.
- Use the standard characters for alphameric printing wherever possible. The smaller sideways characters reduce print ribbon life.

Setting Up the Printer

The following text lists the actions which the operator should take before every bar-code printing job, to ensure optimum print quality.

- Set the line-feeding adjustment to six characters per inch, for correct bar-code spacing.
- Set the paper thickness lever to obtain a uniform print image. To ensure that the print train and the hammer unit are parallel, use the following procedure during ripple printing:
  1. Adjust the lever to a value at which the top and bottom of a character in the leftmost positions (print positions 1 to 12) are printed with the same density. Use the bar-coded character 6 for this adjustment: the upper and lower bars must have the same density.
- Clean the ribbon shield whenever you change ribbons.
- At the beginning of every shift of bar-code printing, clean the type slugs with type cleaner.

Print Ribbons

Only carbon print ribbons manufactured by the solvent process are suitable for printing bar codes for optical scanner reading. The part numbers of suitable ribbons are as follows:

For 1403 Model N1: Part No. 1136917
For 3203 Model 2: Part No. 1136633
For 5203 Model 3: Part No. 1136989

To control usage of the print ribbon, all printed bar-code lines should be counted. The ribbon should be changed when 100,000 lines have been printed.

Printed Bar Quality

The reflectance of the printed bars must be low enough to give a PCS value of 0.8. An average PCS value of 0.4 must be obtainable for stroke elements of 1.6 mm X 0.23 mm (0.063 in. X 0.009 in.) measured against the actual background paper of each code bar. (For instructions on PCS measurement, see "Print Contrast Signal Measurement" in this section.) The PCS value at the middle of a bar must never be lower than at the bar edges.

Extraneous Ink and Marks

Extraneous ink, spots around characters, erasures, paper imperfections, smudges, and any other unwanted source of

where a single-sheet sample is measured with a matte black backing of not more than six percent reflectance. BaS04 is the 100 percent reflectance reference material.

R_b = (b: black) the reflectance at a point p on the printed bar using the matte black backing.

Reflectance measurements must be made in the diffuse mode and in the spectral wavelength band of 850–950 nm. For advice on suitable measuring instruments, consult the IBM International Document Evaluation Center.

PHYSICAL CHARACTERISTICS

Dimensions: 33 X 20 X 110 mm (1.23 X 0.79 X 4.33 in.). (The dimensions of the attachment card are of no interest here because it is housed within the 3275 or 3277 Display Station.)

Weight: Approximately 50g (1.77 oz).

ENVIRONMENTAL CHARACTERISTICS

Operating Temperature: 10° – 40.6°C (50° – 105°F)

Relative Humidity: 8% – 80%

Maximum Wet Bulb: 26.7°C (80°F)

VIBRATION AND SHOCK

The optical scanner is designed to withstand the vibration and shock to which it might normally be subjected in a business environment.

POWER REQUIREMENTS

The optical scanner is powered, through its interface cord, by the 3275 or 3277. No additional power is needed.

INTERFACE CORD

A 1.5m (approximately 5 ft) interface cord is provided with the shipping group.

Connector: A multiple-pin connector for attachment to the display station.

Appendix A. Optical Scanner Test Documents

The test documents (Figures 16 and 17), Part No. 1890727, are shipped with each IBM 5926-BO3 Optical Scanner, to help the operator and the IBM customer engineer to determine whether or not the scanner operates correctly. Whenever normal bar-coded documents cannot be scanned successfully, the operator should scan the test documents before calling for a customer engineer.

Scanners with Version 1 Modulus Checking

A scanner adjusted to read even numbers of digits (modulus 10 check initiated by each non-numeric character) must be able to read correctly samples 1, 2, 3, 7, 8 and 9 on pages 2, 4 and 5 of the test documents.

Scanners with Version 2 Modulus Checking

A scanner adjusted to read odd numbers of digits (modulus 10 check only in the case of a check command character) must be able to read correctly samples 4 to 9 on pages 2, 4 and 5 of the test documents.

Testing the Check Circuitry

Samples 10 to 17 on page 3 of the test documents are designed to test the check circuitry. All of these samples contain errors and should not be readable, but sample 17 moves the cursor.

Testing for Acceptable Mutilation

Pages 4 and 5 of the test documents show the same samples as page 2, but with different backgrounds. Pages 4 and 5 are designed to allow the operator to determine acceptable mutilation or bleaching. The version 1/2 samples on pages 4 and 5 should be readable within three attempts.

The 3275 or 3277 displays these data after scanning the bar code.
The rest of the field is filled with blanks.

1

M 1 0 2 3 5 4 6 7 8 9

2

1 2 3 0 K 4 5 6 4 L 7 8 9 8 M

3

K L M

4

0 1 2 3 4 5 6 7 8 9 7 M

5

1 2 5 M 0 M 7 8 2 6 3 3 2 M

6

K L O M

7

1 0 2 3 5 4 6 7 8 9

8

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 7

9

K L O

4 Bit Delta Distance A- Code

1890727-2-3-4-5

Figure 16. Sample Test Document (Pages 2, 4, 5) [19823]

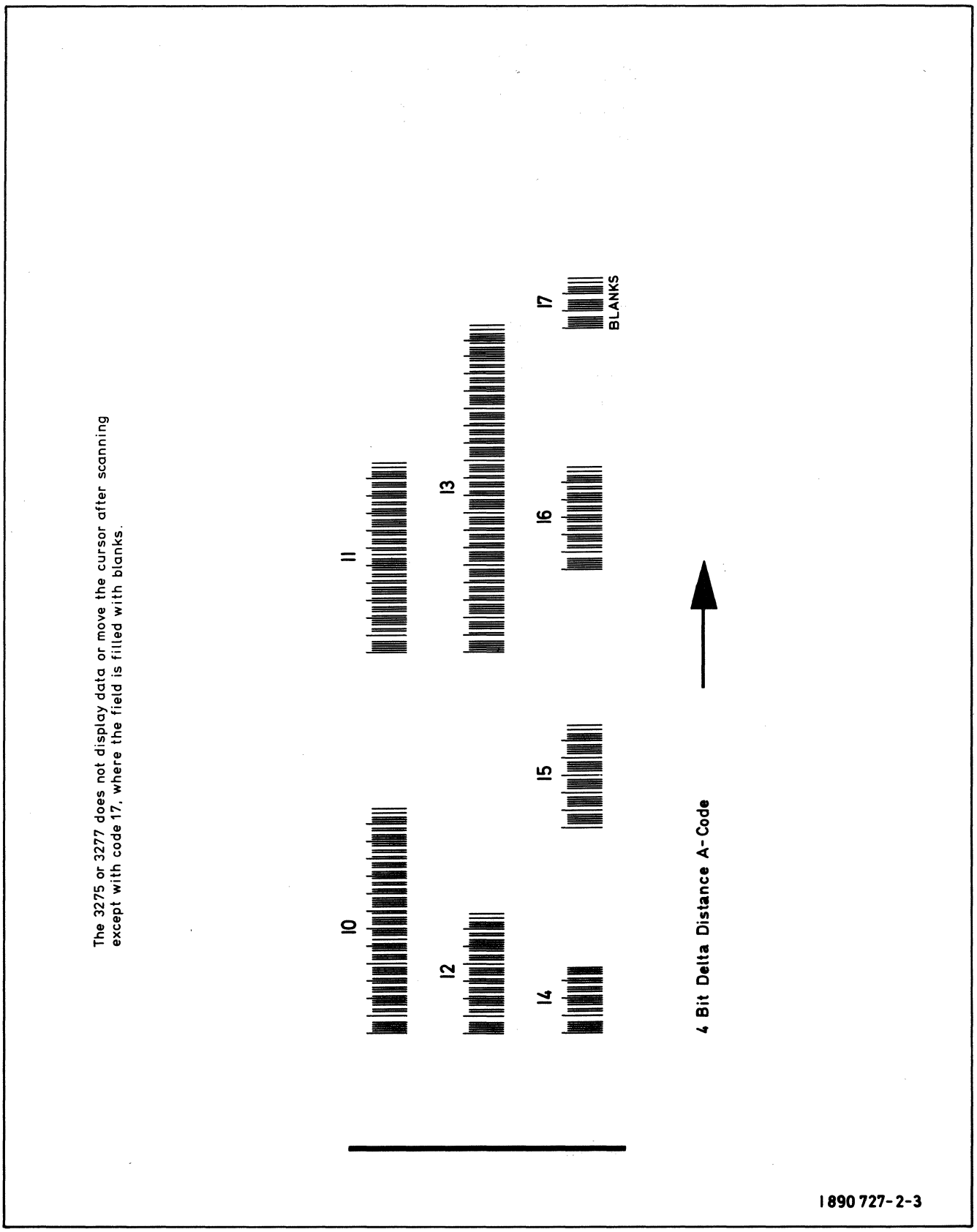


Figure 17. Sample Test Document (Page 3) [19824]

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5926-BO3 Optical Scanner Reference Manual

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This Technical Newsletter provides replacement pages for the subject publication. Pages to be replaced are:

15, 16

The change to the text is indicated by a vertical line to the left of the change.

Summary of Amendments

The part number for the carbon print ribbon for the 5203 Model 3 has been corrected.

Note: *Please file this cover letter at the back of the manual to provide a record of changes.*

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