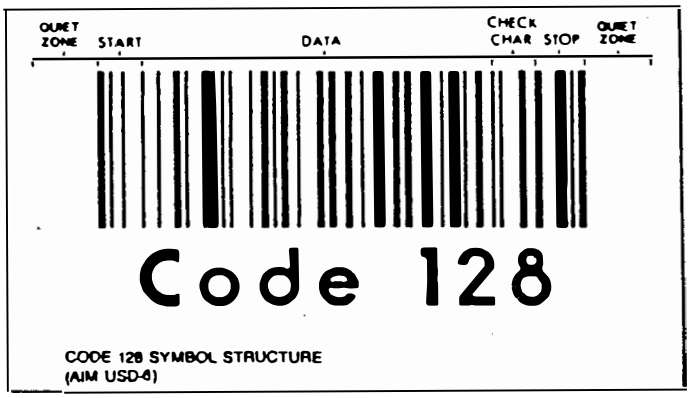


AN INTRODUCTION AND EXPLANATION

CODE 128 CHARACTER SET

(FROM USD-6)

Table I

CODE 128 (USD-6)

VALUE	CODE A	CODE B	CODE C	BAR PATTERN B	S	B	S	B	S
0	SP	SP	00	2	1	2	2	2	2
1	!	!	01	2	2	2	1	2	2
2	"	"	02	2	2	2	2	2	1
3	#	#	03	1	2	1	2	2	3
4	$	$	04	1	2	1	3	2	2
5	%	%	05	1	3	1	2	2	2
6	&	&	06	1	2	2	2	1	3
7	'	'	07	1	2	2	3	1	2
8	(	(	08	1	3	2	2	1	2
9	)	)	09	2	2	1	2	1	3
10	*	*	10	2	2	1	3	1	2
11	+	+	11	2	3	1	2	1	2
12	,	,	12	1	1	2	2	3	2
13	—	—	13	1	2	2	1	3	2
14	.	.	14	1	2	2	2	3	1
15	/	/	15	1	1	3	2	2	2
16	0	0	16	1	2	3	1	2	2
17	1	1	17	1	2	3	2	2	1
18	2	2	18	2	2	3	2	1	1
19	3	3	19	2	2	1	1	3	2
20	4	4	20	2	2	1	2	3	1
21	5	5	21	2	1	3	2	1	2
22	6	6	22	2	2	3	1	1	2
23	7	7	23	3	1	2	1	3	1
24	8	8	24	3	1	1	2	2	2
25	9	9	25	3	2	1	1	2	2
26	:	:	26	3	2	1	2	2	1
27	;	;	27	3	1	2	2	1	2
28	<	<	28	3	2	2	1	1	2
29	=	=	29	3	2	2	2	1	1
30	>	>	30	2	1	2	1	2	3
31	?	?	31	2	1	2	3	2	1
32	@	@	32	2	3	2	1	2	1
33	A	A	33	1	1	1	3	2	3
34	B	B	34	1	3	1	1	2	3
35	C	C	35	1	3	1	3	2	1
36	D	D	36	1	1	2	3	1	3
37	E	E	37	1	3	2	1	1	3
38	F	F	38	1	3	2	3	1	1
39	G	G	39	2	1	1	3	1	3
40	H	H	40	2	3	1	1	1	3
41	I	I	41	2	3	1	3	1	1
42	J	J	42	1	1	2	1	3	3
43	K	K	43	1	1	2	3	3	1
44	L	L	44	1	3	2	1	3	1
45	M	M	45	1	1	3	1	2	3
46	N	N	46	1	1	3	3	2	1
47	O	O	47	1	3	3	1	2	1
48	P	P	48	3	1	3	1	2	1
49	Q	Q	49	2	1	1	3	3	1
50	R	R	50	2	3	1	1	3	1
51	S	S	51	2	1	3	1	1	3
52	T	T	52	2	1	3	3	1	1
53	U	U	53	2	1	3	1	3	1
54	V	V	54	3	1	1	1	2	3
55	W	W	55	3	1	1	3	2	1
56	X	X	56	3	3	1	1	2	1
57	Y	Y	57	3	1	2	1	1	3
58	Z	Z	58	3	1	2	3	1	1
59	[	[	59	3	3	2	1	1	1

VALUE	CODE A	CODE B	CODE C	BAR PATTERN B	S	B	S	B	S
60	\	\	60	3	1	4	1	1	1
61	|	|	61	2	2	1	4	1	1
62	^	^	62	4	3	1	1	1	1
63			63	1	1	1	2	2	4
64	NUL	`	64	1	1	1	4	2	2
65	SOH	a	65	1	2	1	1	2	4
66	STX	b	66	1	2	1	4	2	1
67	ETX	c	67	1	4	1	1	2	2
68	EOT	d	68	1	4	1	2	2	1
69	ENQ	e	69	1	1	2	2	1	4
70	ACK	f	70	1	1	2	4	1	2
71	BEL	g	71	1	2	2	1	1	4
72	BS	h	72	1	2	2	4	1	1
73	HT	i	73	1	4	2	1	1	2
74	LF	j	74	1	4	2	2	1	1
75	VT	k	75	2	4	1	2	1	1
76	FF	l	76	2	2	1	1	1	4
77	CR	m	77	4	1	3	1	1	1
78	SO	n	78	2	4	1	1	1	2
79	SI	o	79	1	3	4	1	1	1
80	DLE	p	80	1	1	1	2	4	2
81	DC1	q	81	1	2	1	1	4	2
82	DC2	r	82	1	2	1	2	4	1
83	DC3	s	83	1	1	4	2	1	2
84	DC4	t	84	1	2	4	1	1	2
85	NAK	u	85	1	2	4	2	1	1
86	SYN	v	86	4	1	1	2	1	2
87	ETB	w	87	4	2	1	1	1	2
88	CAN	x	88	4	2	1	2	1	1
89	EM	y	89	2	1	2	1	4	1
90	SUB	z	90	2	1	4	1	2	1
91	ESC	{	91	4	1	2	1	2	1
92	FS	|	92	1	1	1	4	4	3
93	GS	}	93	1	1	1	3	4	1
94	RS	~	94	1	3	1	1	4	1
95	US	DEL	95	1	1	4	1	1	3
96	FNC 3	FNC 3	96	1	1	4	3	1	1
97	FNC 2	FNC 2	97	4	1	1	1	1	3
98	SHIFT	SHIFT	98	4	1	1	3	1	1
99	CODE C	CODE C	99	1	1	3	1	4	1
100	CODE B	FNC 4	CODE B	1	1	4	1	3	1
101	FNC 4	CODE A	CODE A	3	1	1	1	4	1
102	FNC 1	FNC 1	FNC 1	4	1	1	1	3	1

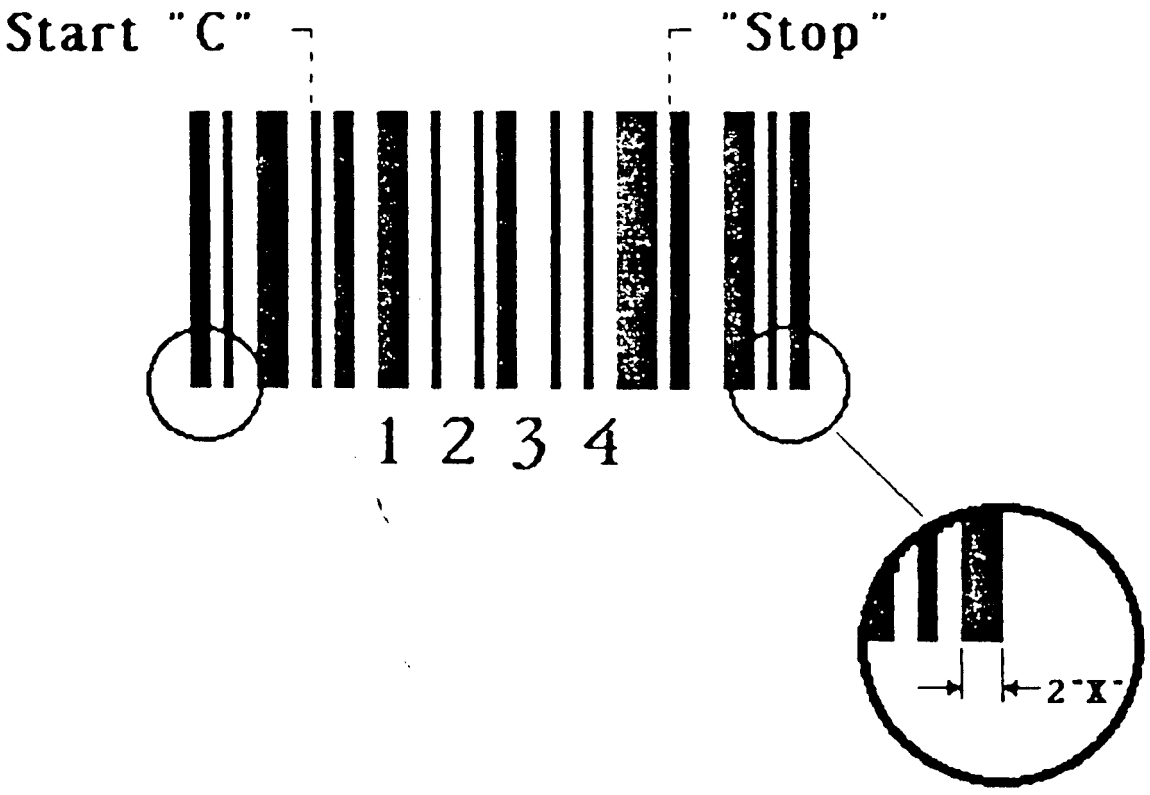
			B	S	B	S	B	S
103	START (CODE A)		2	1	1	4	1	2
104	START (CODE B)		2	1	1	2	1	4
105	START (CODE C)		2	1	1	2	3	2

		B	S	B	S	B	S	B
STOP		2	3	3	1	1	1	2

CODE 128 "START" & "STOP" CHARACTERS

The "Start and "Stop" character patterns of Code 128 are unique when scanned in either direction. The "Stop" character is 13 elements long, completely unique and contains no information data. The "Start" character does contain code subset information which defines the data information following in the bar code.

In addition, the "Start" and "Stop" characters utilize the same outside wide-narrow, black-white pattern seen by the scanner for the first four "X" elements. It is significant to note that the outside bars are always 2 "X" wide. This feature gives better scanning performance because most scanners set the "black" signal level, or contrast measurement, on the first bar scanned. The 2 "X" wide thickness provides assurance of an accurate "black" measurement even when the scanner resolution is not accurately matched to the single "X" dimension of the printed symbol.



THE RELATIVE LENGTHS OF ALPHANUMERIC BAR CODES

This chart illustrates the relative lengths of data characters, in terms of "X", among popular industrial alphanumeric bar codes. The comparison is based on the use of a dot matrix impact printer and any other printing process where USD-2 and 3 are printed in a 3:1 wide/narrow ratio. The "Overhead" column represents the number of "X" elements required to encode the start, stop and check digits for each code.

BAR CODE SYMBOLOGY	DATA CHARACTER "X" ELEMENTS	CODE OVERHEAD "X" ELEMENTS
USD-2&3 Code 3 of 9 A/N	16X	31X
Code 3 of 9 ASCII	16X, partial 32X	31X
USD-6 Code 128 A/N or ASCII	11X	35X
USD-6 Code 128 Numeric Only	5.5X	35X
USD-6 Code 128 Mixed Density	5.5X to 11X	35X plus 11X per shift
USD-7 Code 93 A/N	9X	36X
USD-7 Code 93 ASCII	9X, partial 18X	36X

To determine the overall length of a bar code symbol (L_c) in terms of "X", multiply (the number of characters) times (the data character element "Xs") and add (the code overhead).

Quiet zones at each of the bar codes must be added to length calculated above to develop the overall length of the label. Quiet zones must measure at least 10X on each end of the code after positioning, printing and cutting the label stock. Quiet zones should never be less than 1/8 inch in any case.

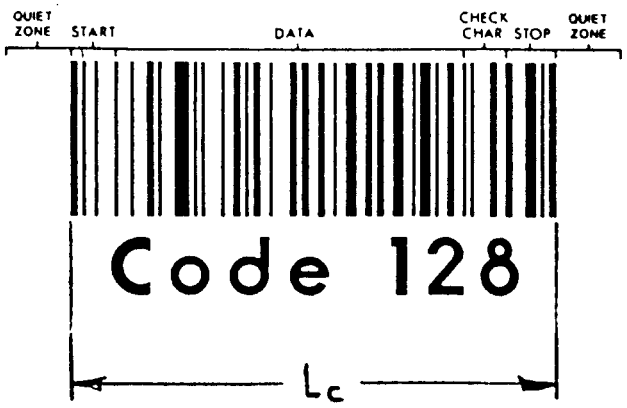


Figure 7

22 CHARACTER BAR CODE SYMBOL

Length of Code Vs. Printing Technology

	MECHANICAL IMPACT X=.0075"	MECHANICAL IMPACT X=.011"	THERMAL NON-IMPACT X=.008"	ELECTROSTATIC NON-IMPACT X=.010"	DOT MATRIX IMPACT (60 in) X=.0166"
Code 39 (9.4) A/N	2.468"	-	-	-	-
Code 39 A/N	-	4.213"	3.064"	3.83"	6.383"
Code 93 A/N	-	-	1.872"	2.34"	3.90"
Code 128 Numeric	-	-	1.336"	1.67"	2.78"
Code 128 A/N	-	-	2.128"	2.66"	4.433"
AN Mixed 50%	-	-	1.776"	2.22"	3.70"

NOTES:

1. The "Length of Code" listed does not include the required 10X quiet zones at each end of the symbol.
2. Photo plot composition produces symbols with "X" = .006 inches or larger.
3. Wet printing processes; offset, flexography, and letterpress produce symbols with "X" = .010 inches or larger.
4. Dot matrix impact printers range from "X" = .010 at 144 dots/inch, to the example above.
5. Corrugated containers require an "X" of .032 inches or larger.

Figure 9

IMPACT FOR THE USER OF 128

* Code 128 reduces the space required to encode long bar-coded messages. Data fields of 12 to 26 characters are now practical to encode and print on current printing equipment.

* Code 128 provides a method to shorten bar codes with long numeric fields to minimize the overall symbol length. In many cases, this permits the user to retain his full alphanumeric product numbering system without compromise.

* Code 128 can be freely intermixed with other bar codes in those applications, such as the National Stock Number (Logmars) program, where for example, Code 3 of 9 is required for standardized final product marking.

* Code 128 facilitates encoding work-in-process travelers when job number, part number, and operation number are required in bar code symbology for shop floor data collection.

* The "Function" characters of Code 128 permit concatenation of data fields thus minimizing data entry functions and supplemental key stroke activities.

  Product order books can employ order or vendor prefix symbols for a given page and short codes for actual item descriptions.

* Code 128 addresses the needs of current print technologies and will be compatible with future improvements.

* At the recommended minimum "X", specified in USD-6 of .010, a 32 digit numeric bar code can be encoded at a density of 15 characters/inch.

* Printed circuit board labels produced by photo composition technology with an "X" dimension of .006 provide 10 digit numeric encodation at a density of 18.5 characters per inch.

* A standard 60 dot per inch dot matrix impact printer can produce 32 digit numeric bar codes with a density of 9 characters per inch. At this density, these bar code labels can be comfortably read at a distance of 18" with a laser scanner.

IMPACT FOR THE USER OF CODE 128

Let's look at the impact of Code 128 in two examples:

20 DIGIT NUMERIC DATA CODE EXAMPLES

* Beginning with Code 39 as a reference
* Interleaved 2 of 5
* Code 128 Start "C" the maximum density numeric code
* Note all examples have the same Bar/Space "X" dimension

The use of CODE 128 would provide a:

59% reduction of the Code 3 of 9 symbol length

23% reduction of the Interleaved 2 of 5 symbol length

18 DIGIT A/N DATA EXAMPLES

* Beginning with Code 39 as a reference
* Code 128, Start "A" provides 26.4% reduction
* Code 128 with shift character provides 44.% reduction
* Note that the narrow Bar/Space "X" dimension is the same for each example

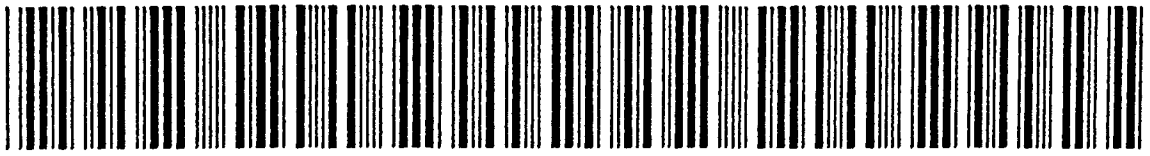
9 CHARACTER FULL ASCII EXAMPLES

*Beginning with a Code 39 example as a reference
* Code 128 illustrates a 58% reduction in overall code length
* Code 128 does provide all the ASCII control characters in single-symbol encodation, including upper and lower case alpha characters.

20 DIGIT NUMERIC DATA

Printing Ratio

CODE 39 — 5.85" — 1,1:3,3



100%

INTERLEAVED 2 OF 5 — 3.15" — 1,1:3,3

54%

CODE 128 START "C" — 2.42" — 1,2,3,4

41%

C – 128/C – 39.....58% Reduction
C – 128/I – 2 of 5 ...23% Reduction

18 ALPHA/NUMERIC CHARACTERS

Printing Ratio

CODE 39

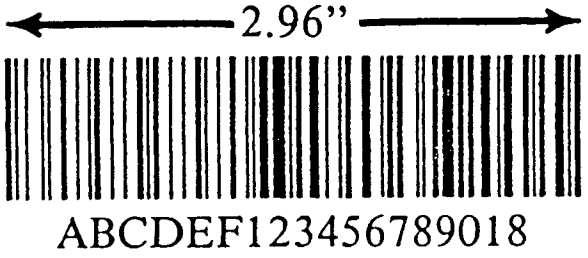
1,1:3, 3

CODE 128

1,2,3,4

27% Reduction

CODE 128
START "B"
SHF TO
CODE "C"



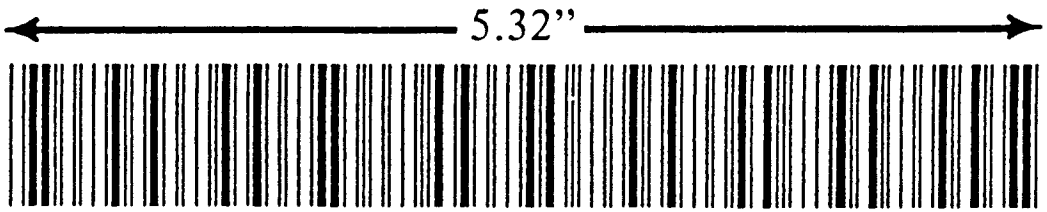
1,2,3,4

44% Reduction

FULL ASCII CHARACTER SET
9 CHARACTER EXAMPLES

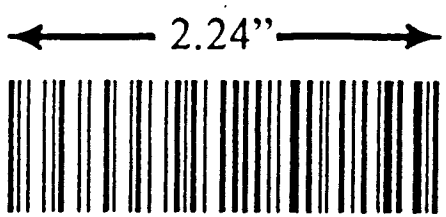
Printing Ratio

CODE 39



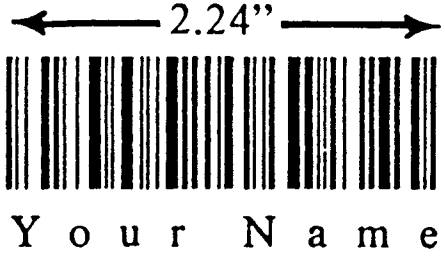
1,1:3,3

CODE 128



58% Reduction

CODE 128



58% Reduction

CODE 128 EXAMPLES

REGISTRATION CARD

Shown here is the 1984 New York Marathon Registration card which includes two bar codes containing 9 data fields with a total of 50 data characters. These fields include the runner's number, payment for a bus ticket, best previous finish time, predicted finish time, checkpoint splits and the runner's first and last name. The card is 8 1/2" wide.

For this application, only Code 128 provides a practical solution for the automated runner registration process. The alternative symbologies, when used for the same data, produced bar code lengths which were too long even when printed on the same laser printer.

This card served as a official notice of acceptance as well as an official runner's identification card to claim his or her official running bib.

The bib itself was produced, on demand, at the registration table and included a tear-off scoring bar code, a split-time prediction wristband, a bus ticket and clothing tag, as well as the large running number.

SHOP FLOOR DATA ENTRY MENU

This "menu" is typical of those used in shop floor data collection applications to reduce or eliminate the need for keyboard data entry. The codes shown here ilustrate the system function callups required to initiate a system-prompted dialogue between the computer and the worker. The actual data collection transaction typically includes scanning from the actual product or work-in-process "Travelers".

SHOP FLOOR WORK-IN-PROCESS TRAVELER

The shop floor work-in-process "Traveler" is a document which moves through a production facility along with the actual product or lot of material being worked on. The "Traveler" typically identifies the shop order number or product, its material, quantity to be produced, the operations sequence or routing, and the work center where operations will be performed. It also defines the logical points to report the job's location and progress. This Traveler has been enhanced with bar codes to enable keyless data entry of its progress through a manufacturing process directly from the location of each activity.

1984 NYC MARATHON OFFICIAL REGISTRATION CARD

207621Edith Jones

Your running number is ----› F762

3410904012014524032033000

Sex	Age	Bus?	Mag?	Team	Country
F	45	YES	NO	Millrose	U.S.A.

#22154
Jones, Edith
2[redacted] FIRST AVE
NEW YORK NY
100[redacted]

You must bring this card to pick up your running number at registration - NO EXCEPTIONS.
DO NOT FOLD this card. No registration Sunday, race day, 10/28/84

MTP DATA COLLECTION SYSTEM

SAMPLE WORK CENTER MENU

for the CULLINET Manufacturing System

This menu is typically used by an operator at a work center to select the function to be performed. Once the function has been selected, the terminal will prompt the operator for each data item needed. Once all data items have been supplied, the appropriate Cullinet screen will be called up, filled in, and sent back to the host. Any errors that result will be reported back to the operator.

RECEIVE JOB AT OPERATION. . . . . 
RECVJOB

START JOB AT OPERATION. . . . . 
STARTJOB

COMPLETE JOB OPERATION. . . . . 
COMPLJOB

TRANSFER JOB TO OPERATION. . . . . 
TRANSJOB

CLOSE JOB. . . . . 
CLSJBQTY

RECEIVE IN WAREHOUSE. . . . . 
PRODRCPT

LOG OFF TERMINAL. . . . . 
LOGOFF

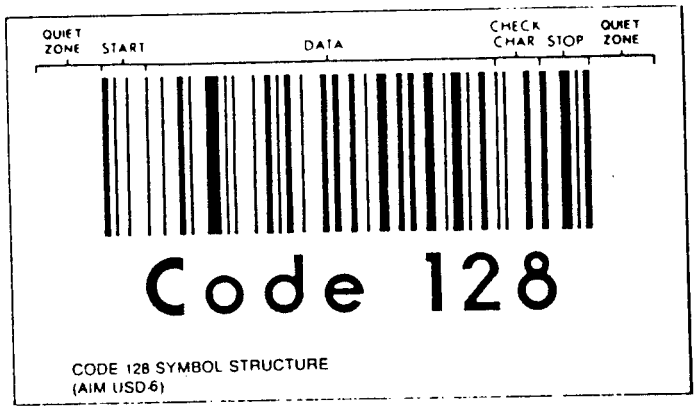
RUB OUT/CORRECTION. . . . . 
*

TIME. . . . . 
TIME

computer identics
corporation
5 SHAWMUT RD. CANTON MA. 02021 (617) 821-0830

CODE 128

AN INTRODUCTION AND EXPLANATION



Prepared by:

Charles E. Mara
Computer Identics Corporation
5 Shawmut Road
Canton, MA 02021

20 Nov 84

CODE 128; AN INTRODUCTION AND EXPLANATION

Universal Symbol Description 6 (USD-6)

Code 128 was introduced in the fall of 1981 in response to the need for a compact alphanumeric code symbol that could be used to encode complex product identification systems. The fundamental requirement called for a symbology capable of being printed by existing data processing printers which daily produce work in process travelers, job tickets and product traceability documents. Identification messages of 10 to 32 characters long, printed on existing forms and labels, was deemed the bench mark.

Code 128 uniquely addresses this need with the most compact, complete, alphanumeric symbology available. In addition, Code 128 has been designed with geometric features to improve scanner reading performance, to be self checking and to provide data message management function codes. Code 128 is destinctive from other traditional symbologies now in use and may be used in combination with Interleaved 2 of 5 (USD-1) or Code 3 of 9 (USD-2 and 3), when automatically descriminating code readers are employed.

Code 128 symbology is freely available and in the public domain. The specification for Code 128, titled "Universal Symbol Description-6", is available through the Automatic Identification Manufacturers, Inc. (AIM), a trade association affiliated with the Material Handling Institute.

CODE 128	EXAMPLES	
Subset A		Upper Case A/N & ASCII Control Characters
Subset B		Upper & Lower Case Characters A/N
Subset C		Double Density Numerics (8.3 Characters/inch shown here)

Figure 1

ATTRIBUTES OF CODE 128

1. COMPACT, ALPHANUMERIC: Code 128 encodes the complete 128 character ASCII character set without the compromise of adding extra symbol elements.

2. VARIABLE LENGTH: Code 128 is designed to be a variable length symbology and has the built-in ability to link one message to another for composite message transmission.

3. DOUBLE DENSITY NUMERIC: In symbols representing fields of numeric data, Code 128 provides the encodation of pairs of numeric digits in place of alphanumeric characters. This cuts the required space in half. Where four or more digits of numeric data exist in a message, the encodation can be shifted to compress strings of numerics into double density characters. This technique is illustrated in Figure 2, below.

4. RELIABILITY: Code 128 is properly decoded and checked at two levels, first at the individual character level using character self-check parity and, second, as a complete message using the calculated, end-of-message, check digit.

5. IGNORES SYSTEMATIC INK SPREAD: Code 128 is designed to be "edge to similar edge" decodable. By using the power of today's microprocessors, a series of measurements are utilized to measure the bars and spaces to determine a character symbol pattern rather than using the wide/narrow logic of the past. The result is a symbology that takes advantage of the dot matrix printer "over lap" and ignores the spread of wet inks on paper. Spread or shrinkage up to 50% of the nominal "X" dimension is permissable.

6. ENCODABLE FUNCTION SYMBOLS: Code 128 permits system designers to compress or expand messages, shift character sets, and assign their own functional response, all with a given printed bar code message.

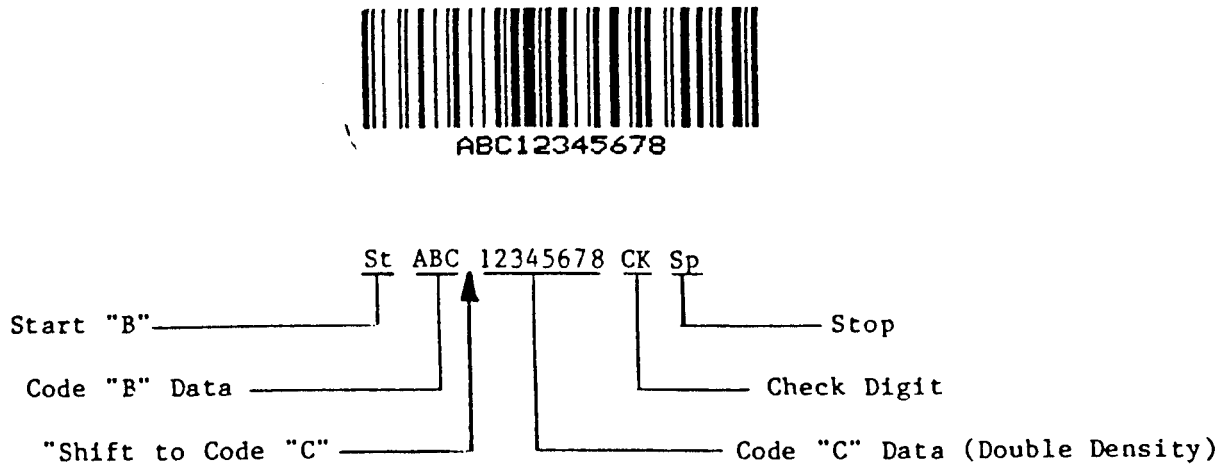


Figure 2

DECODING CODE 128

Code 128 is designed to be character decoded with a multi-step algorithm using edge to edge decoding and error detection derived from the even/odd bar/space character parity. Using this algorithm, all ink spread, bar shrinkage, dot matrix overlap or systematic edge sensing errors up to +/- 1.5X per character are totally removed from the decoding. These errors are usually the largest component of decoding measurement errors. After these are removed, all residual non-systematic errors up to .5X per bar or space are corrected. All errors up to 1.5X per bar or space are detected, and most errors over 1.5X are also detected at the character decode level.

An additional error check is made at the symbol decode level using a built-in modulo 103 prime check character. This check character is used to detect all single character errors which were not detected at the character decode level. It is also used to detect over 99% of all multi-character errors.

Code 128 does not use the traditional wide/narrow, black/white decoding logic of earlier industrial bar codes. Code 128 takes advantage of the power of today's microprocessors and utilizes an edge to similar edge decoding process which permits each "X" element of print to be used as a logic element in the symbol. The result is a shorter printed bar code symbol.

As illustrated in Figure 3, decoding Code 128 is a four step process:

1. The bars and spaces are digitized.

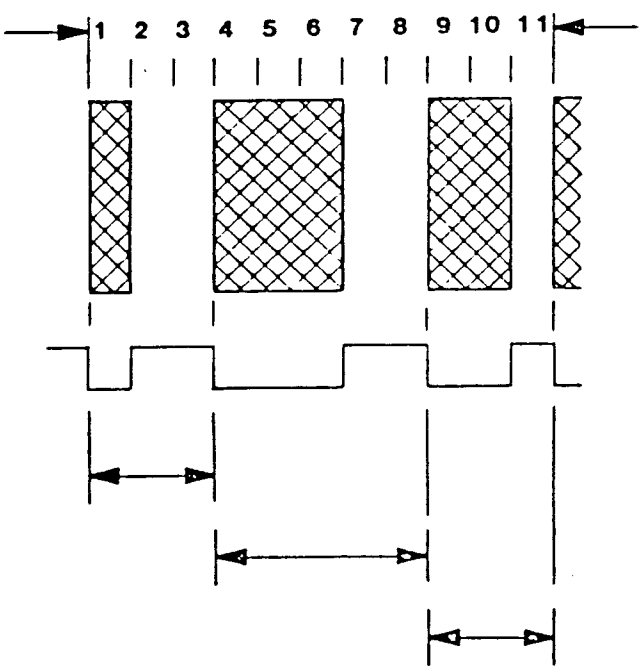
2. Five similar edge to similar edge measurements are made on both the black bars and the white spaces of each character. The individual characters are then decoded on the basis of their measured black and white patterns.

3. Each character is then evaluated for correct black and white parity. To detect all single "X" module code errors within a character, a second algorithm must be employed that compares the measured sum of the bars and the spaces with the predicted sums required by the decoded character. In Code 128, all single "X" module errors will result in a 3X discrepancy in both the bar sum and space sum. This difference is easily detected even with large amounts of ink spread or bar dimension shrinkage.

   This second algorithm is possible exclusively with Code 128, because of its character internal parity scheme, and cannot be applied to the other edge-to-edge, decodable symbols (UPC, EAN or Code 93) because of their geometric construction.

4. The final step is to calculate and compare the encoded end-of-message, check character.

DECODING CODE 128



1. Digitize

2. Similar Edge
   To Similar Edge
   Measurements

3. Evaluate Character Parity Of The Predicted Character
   Single "X" Errors Result In "3 X" Discrepancy

4. At End Of Complete Symbol, Calculate And Compare The Check Digit

FIGURE 3

FORMAT A CONSTRUCTION FEATURES

Code 128 follows the general bar code format rules of Quite Zone, Start Code, Data, Check Digit, Stop Code and Quiet Zone. The "X" dimension can be selected to suit either the capability of the printer used or the optical requirements of the scanner.

As illustrated in Figure 4, each character of Code 128 is composed of eleven "X" elements, comprising three bars and three spaces. Character parity is defined by the sum of the printed "X" elements being "even", and the sum of the white "X" elements being "odd".

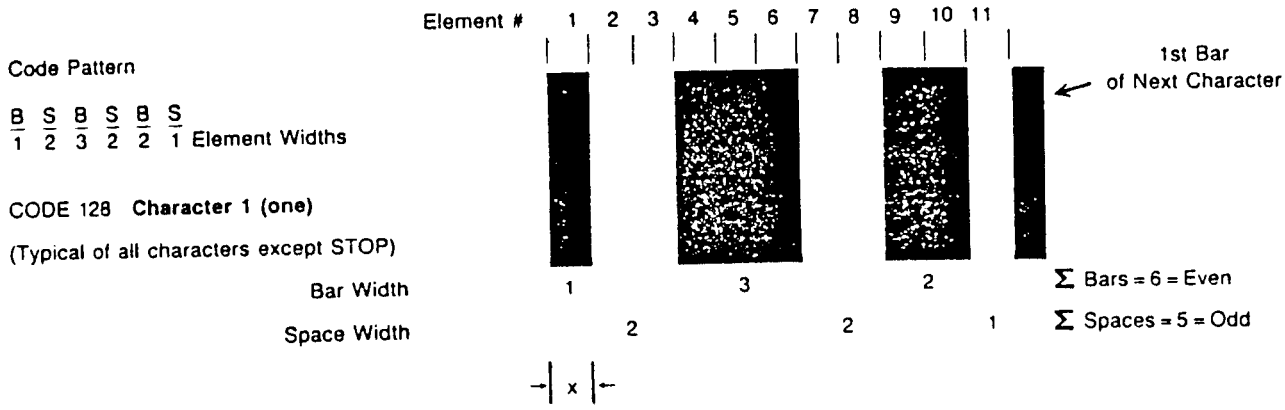


Figure 4

Within the set of 103 different characters there are 3 complete code subsets available to the user providing the full 128 ASCII characters: (Figure 1, Page 2)

* Using "Start A"; Upper Case Alphanumeric plus ASCII Control Characters
* Using "Start B"; Upper and Lower Case Alphanumeric Characters
* Using "Start C"; Double density numeric characters in pairs from 00 to 99

As shown in Figures 2, 5 and 6, shifting from one subset of characters to another is permissable within the printing of individual symbols. In these examples, a printed alphanumeric message can be shortened by shifting to double density numeric encodation when 4 or more numeric characters are in sequence.

In addition to the ASCII characters, Code 128 provides four function codes to provide special instructions to the reading unit. For example:

* Function 1 has been employed to PREFIX all the following label information with "this information".
* Function 2 has been defined to APPEND one bar code label to the next before transmitting.

TYPICAL ALPHA-NUMERIC BAR CODE

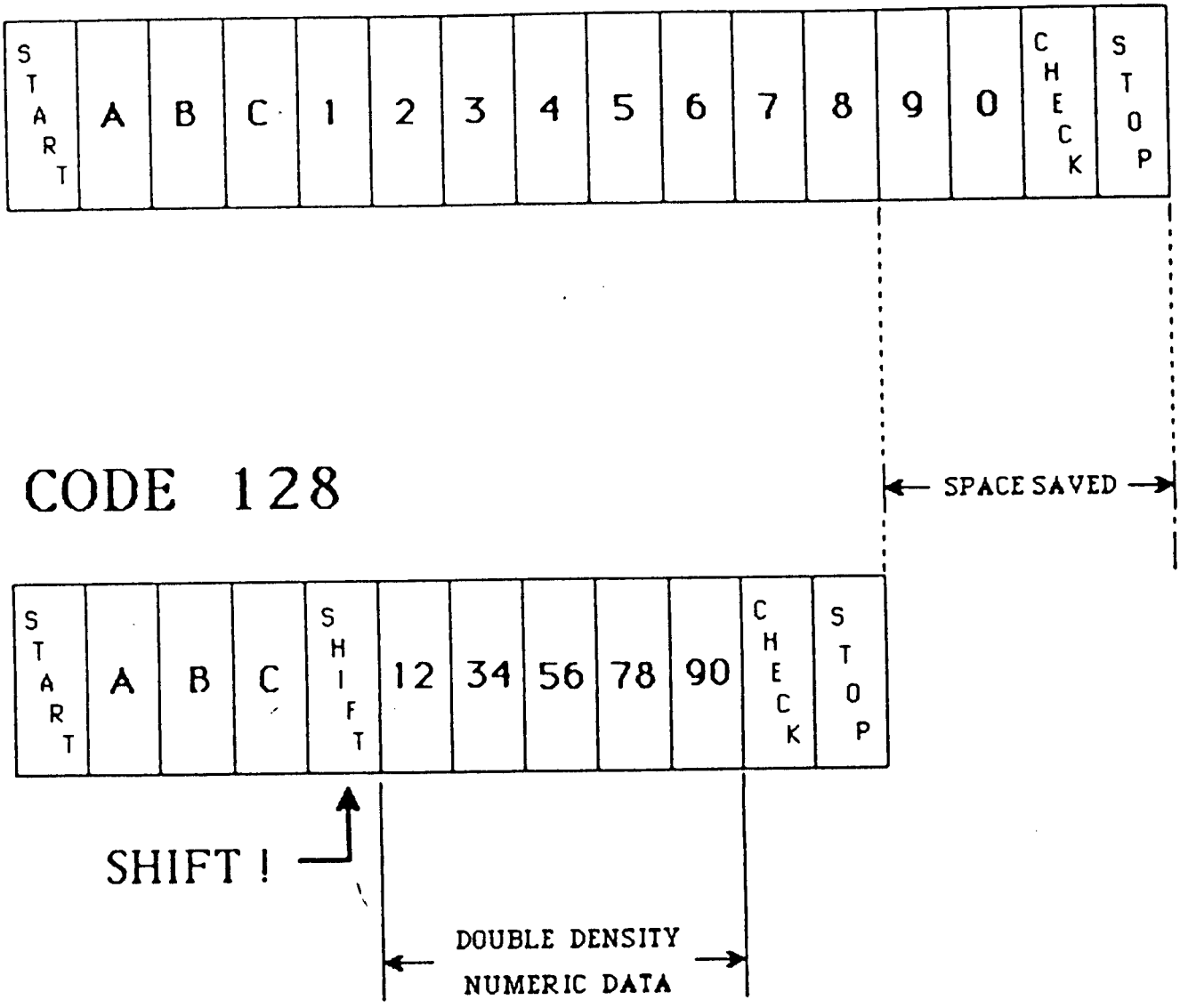


FIGURE 5

Figure 6 illustrates Code 128 symbols printed under the control of a program designed to minimize the overall length of the symbol. This control program always begins by thinking it will produce Code Subset "B" symbols unless it can minimize the length by shifting in and out of Code Subset "C".

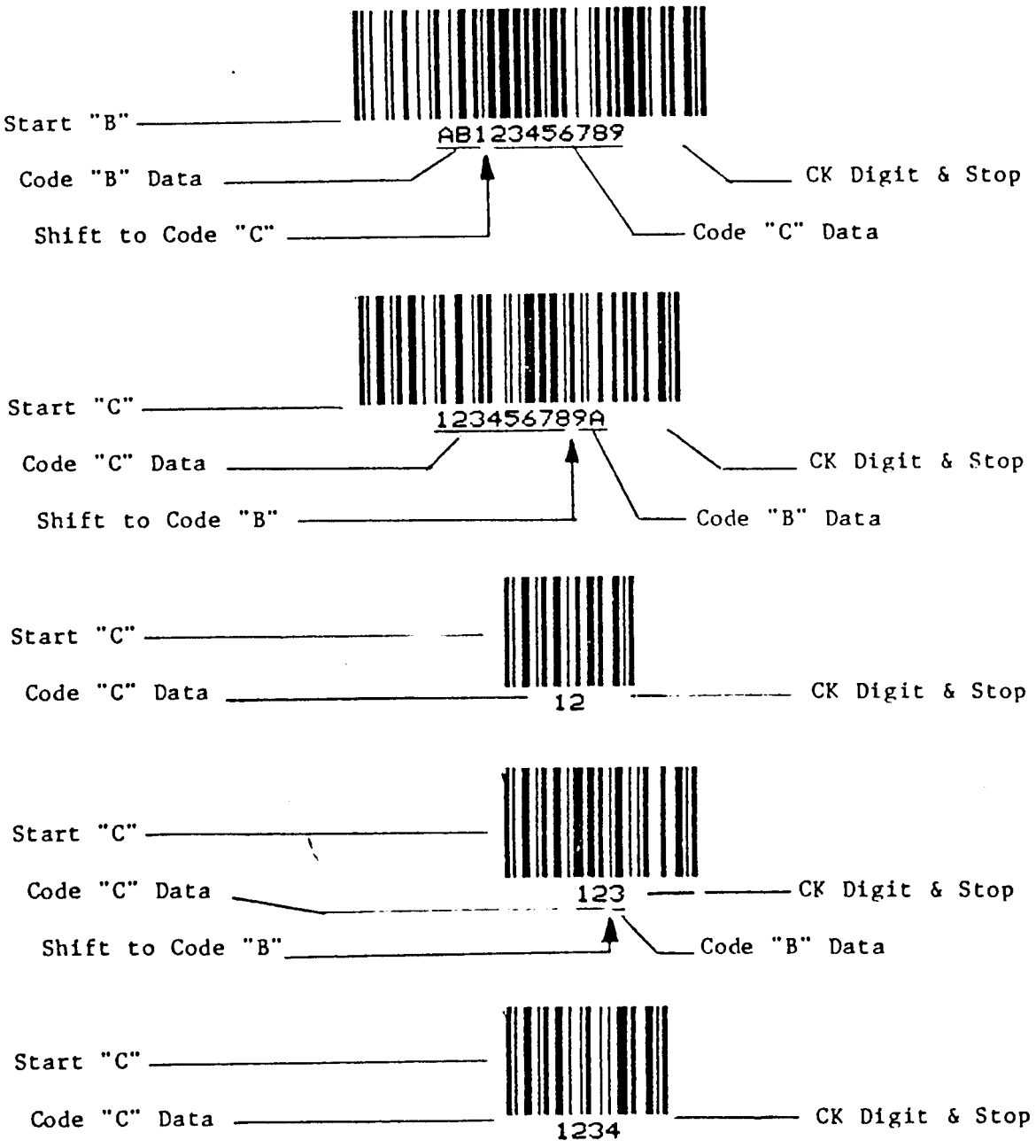


Figure 6

computer identics

FACSIMILE MESSAGE

TO FAX # 713 522-1134

DATE: 2/24/88

TO: DOUG LYCINGER - BONNER & MOORE COMP.

FROM: RICK O'BRYAN - C.I. Page 1 of 5

SUBJECT: Code 128 - Modulus 103 Checksum

DOUG,

SEE Attached

4 Sheets.

Thank You,

RICK O'BRYAN

HIGH PRIORITY DELIVER ASAP _____ PLEASE REPLY _____

CONFIDENTIAL - ADDRESSEE ONLY ✓

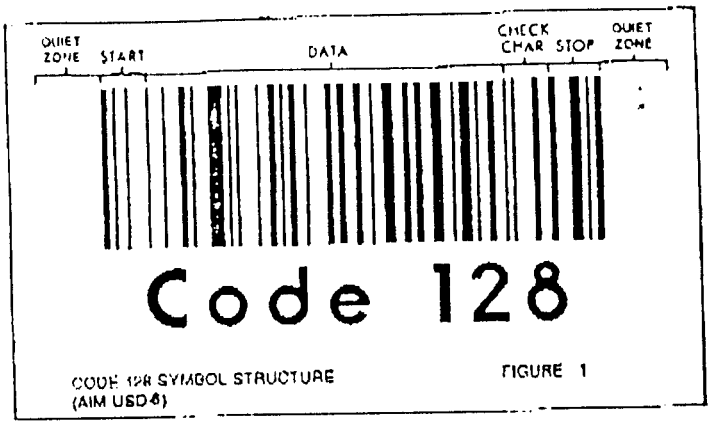
CI FAX #617-828-8942

5 Shawmut Road
Canton, Massachusetts 02021
Telephone (617) 821-0830 TWX 710-348-0828

AUTOMATIC IDENTIFICATION MANUFACTURERS UNIFORM SYMBOL DESCRIPTION—6 CODE 128

1.0 Introduction

CODE 128 (USD-6) is a bar code symbol whose name defines its capability of encoding the full ASCII 128 character set. CODE 128 is evolutionary in its ability to encode all the characters currently encodable in the various code formats existing today. The symbol is also revolutionary in its ability to encode those characters using fewer code elements per character resulting in a more compact code. It features unique start and stop characters for bidirectional and variable length decoding, both bar and space character parity for character integrity, a check character for symbol integrity, a function character for symbol linking, and spare function characters for unique application definition and/or future expansion.



CODE 128 SYMBOL STRUCTURE (AIM USD-6) FIGURE 1

CODE 128 is easily printed by conventional methods and its character assembly by discrete elements makes it especially suitable for computer plotted artwork and the latest computer controlled printing techniques by dot matrix, ink jet, and laser.

2.0 Symbol Encodation

2.1 Symbol Structure (Figure 1)

Each CODE 128 Symbol consists of a series of bar coded characters framed by non-printed areas called Quiet Zones. The bar coded character series begins with a unique start character, followed by the data characters with the most significant adjacent to the start character, then the check character, and finally the unique stop character. Human-readable information may be printed anywhere outside of the symbol area.

2.2 Character Structure (Figure 2)

Each CODE 128 character consists of eleven elements. Each element, whose width is a dimension called "x", can be either printed as a bar or part of a bar, or not printed and therefore a space or part of a space. Each character is comprised of three bars and three spaces, with each bar or space containing one to four elements. Character parity is defined by the sum of the printed elements in any character being even and the sum of the non-printed elements in any character being odd. This description applies to all CODE 128 characters except the STOP character, which differs with thirteen elements comprised of four bars and three spaces.

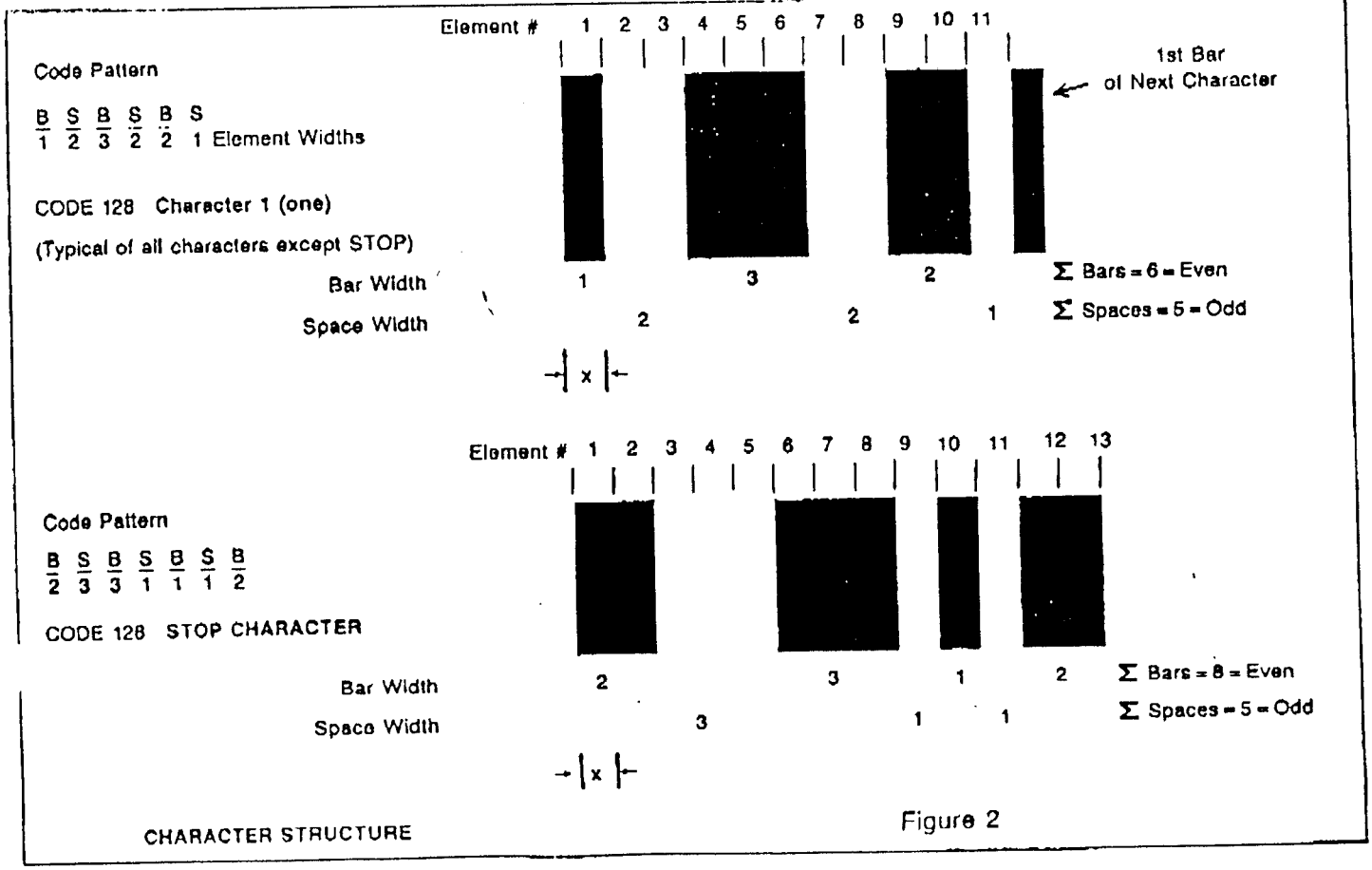


Figure 2

2.3 Code Structure (Table I)
CODE 128 has three unique Subsets shown in Table I as Code A, B, and C. The Bar and Space patterns shown are applicable to their equivalent characters listed under columns for Code A, B, or C, depending on which of the three unique Start Characters is used. If the symbol begins with Start Character A, then Code A Subset is defined. Code B or C Subsets are similarly defined by beginning the Symbol with Start Character B or C.

2.3.1 Code Subset A includes all of the standard alphanumeric keyboard characters plus control and special characters.

2.3.2 Code Subset B includes all of the standard alphanumeric keyboard characters plus lower case alpha and special characters.

2.3.3 Code Subset C includes a set of 100 digit pairs from 00 to 99 inclusive, allowing definition of double density numeric digits per character, plus special characters.

2.3.4 Special Characters
The last seven characters of Code Subsets A and B and the last three characters of Code Subset C are special characters that define special operations to the code reading device.

Within a symbol, it is possible to change from one Code Subset to another. The CODE and SHIFT special characters allow this type of change. The CODE Characters allow a Code Subset shift for all characters following it in the symbol. The SHIFT character allows a Code Subset shift for one character only. FNC or Function Characters define instructions to the Code Reading Device to allow for special operations, special applications, and/or future definitions.

2.3.4.1 CODE Characters
CODE A, B, or C Characters change the Symbol Code Subset from the Subset defined previously to the new Code Subset defined by the special Code Character. This change is applicable for all characters following that special Code Character until either the end of the symbol or the next special CODE A, B, or C Character is encountered.

2.3.4.2 SHIFT Character
The SHIFT Character changes the Code Subset from A to B or B to A for the single character following the SHIFT Character only.

2.3.4.3 FNC Characters
FNC 1—Reserved for future or special application
FNC 2—Special Instruction for Code Reader to temporarily store data from the symbol containing the FNC 2 character and transmit it with the next symbol data
FNC 3—Reserved for Code Reader initialization and other Code Reader specific operations
FNC 4—Reserved for future or special application

2.3.4.4 Note that none of the special characters (CODE, SHIFT, or FNC) as well as the Start, Stop or Check Characters, are to be displayed or transmitted by the Code Reader.

2.3.5 Value
Each character has associated with it a value listed in Table I. This value is used in calculating the Check Character for each symbol.

3.0 Quiet Zone (Figure 1)
The Quiet Zone is an area that is clear and free of all printing preceding the Start Character and following the Stop Character. The minimum Quiet Zone dimension is ten times (10X) the nominal element x.

4.0 Wide to Narrow Ratio
Not Applicable

5.0 Intercharacter Gap
Not Applicable

6.0 Check Character (Figure 1)
The character immediately preceding the STOP Character is the Check Character. The Check Character is a Modulus 103 Checksum that can be calculated by summing the start code value plus the products of each character position (most significant character position = 1) and the character value of that position. Divide the sum of the start code value and the products by 103. The remainder of the answer is the Check Character, expressed as the value of the encoded Check Character.

$$\frac{\text{Start Code Value} + \sum_{\text{Position}=1}^{n} (\text{Position})(\text{Position Value})}{103} = \begin{matrix}\text{Answer + Remainder,}\\ \text{Remainder = Check Character Value}\end{matrix}$$

Every encoded character is included in the calculation with the exception of the Stop and Check Characters.

7.0 Characters per Symbol
Variable length symbols may be encoded.

Table I

CODE 128 (USD-6)

VALUE	CODE A	CODE B	CODE C	BAR PATTERN B	S	B	S	B	S
0	SP	SP	00	2	1	2	2	2	2
1	!	!	01	2	2	2	1	2	2
2	"	"	02	2	2	2	2	2	1
3	#	#	03	1	2	1	2	2	3
4	$	$	04	1	2	1	3	2	2
5	%	%	05	1	3	1	2	2	2
6	&	&	06	1	2	2	2	1	3
7	'	'	07	1	2	2	3	1	2
8	(	(	08	1	3	2	2	1	2
9	)	)	09	2	2	1	2	1	3
10	*	*	10	2	2	1	3	1	2
11	+	+	11	2	3	1	2	1	2
12	,	,	12	1	1	2	2	3	2
13	—	—	13	1	2	2	1	3	2
14	.	.	14	1	2	2	2	3	1
15	/	/	15	1	1	3	2	2	2
16	0	0	16	1	2	3	1	2	2
17	1	1	17	1	2	3	2	2	1
18	2	2	18	2	2	3	2	1	1
19	3	3	19	2	2	1	1	3	2
20	4	4	20	2	2	1	2	3	1
21	5	5	21	2	1	3	2	1	2
22	6	6	22	2	2	3	1	1	2
23	7	7	23	3	1	2	1	3	1
24	8	8	24	3	1	1	2	2	2
25	9	9	25	3	2	1	1	2	2
26	:	:	26	3	2	1	2	2	1
27	;	;	27	3	1	2	2	1	2
28	<	<	28	3	2	2	1	1	2
29	=	=	29	3	2	2	2	1	1
30	>	>	30	2	1	2	1	2	3
31	?	?	31	2	1	2	3	2	1
32	@	@	32	2	3	2	1	2	1
33	A	A	33	1	1	1	3	2	3
34	B	B	34	1	3	1	1	2	3
35	C	C	35	1	3	1	3	2	1
36	D	D	36	1	1	2	3	1	3
37	E	E	37	1	3	2	1	1	3
38	F	F	38	1	3	2	3	1	1
39	G	G	39	2	1	1	3	1	3
40	H	H	40	2	3	1	1	1	3
41	I	I	41	2	3	1	3	1	1
42	J	J	42	1	1	2	1	3	3
43	K	K	43	1	1	2	3	3	1
44	L	L	44	1	3	2	1	3	1
45	M	M	45	1	1	3	1	2	3
46	N	N	46	1	1	3	3	2	1
47	O	O	47	1	3	3	1	2	1
48	P	P	48	3	1	3	1	2	1
49	Q	Q	49	2	1	1	3	3	1
50	R	R	50	2	3	1	1	3	1
51	S	S	51	2	1	3	1	1	3
52	T	T	52	2	1	3	3	1	1
53	U	U	53	2	1	3	1	3	1
54	V	V	54	3	1	1	1	2	3
55	W	W	55	3	1	1	3	2	1
56	X	X	56	3	3	1	1	2	1
57	Y	Y	57	3	1	2	1	1	3
58	Z	Z	58	3	1	2	3	1	1
59	[	[	59	3	3	2	1	1	1
60	\	\	60	3	1	4	1	1	1
61	]	]	61	2	2	1	4	1	1
62	^	^	62	4	3	1	1	1	1
63	—	—	63	1	1	1	2	2	4
64	NUL	`	64	1	1	1	4	2	2
65	SOH	a	65	1	2	1	1	2	4
66	STX	b	66	1	2	1	4	2	1
67	ETX	c	67	1	4	1	1	2	2
68	EOT	d	68	1	4	1	2	2	1
69	ENQ	e	69	1	1	2	2	1	4
70	ACK	f	70	1	1	2	4	1	2
71	BEL	g	71	1	2	2	1	1	4
72	BS	h	72	1	2	2	4	1	1
73	HT	i	73	1	4	2	1	1	2
74	LF	j	74	1	4	2	2	1	1
75	VT	k	75	2	4	1	2	1	1
76	FF	l	76	2	2	1	1	1	4
77	CR	m	77	4	1	3	1	1	1
78	SO	n	78	2	4	1	1	1	2
79	SI	o	79	1	3	4	1	1	2
80	DLE	p	80	1	1	1	2	4	1
81	DC1	q	81	1	2	1	1	4	1
82	DC2	r	82	1	2	1	2	4	1
83	DC3	s	83	1	1	4	2	1	1
84	DC4	t	84	1	2	4	1	1	1
85	NAK	u	85	1	2	4	2	1	1
86	SYN	v	86	4	1	1	2	1	1
87	ETB	w	87	4	2	1	1	1	1
88	CAN	x	88	4	2	1	2	1	1
89	EM	y	89	2	1	2	1	4	1
90	SUB	z	90	2	1	4	1	2	1
91	ESC	{	91	4	1	2	1	2	1
92	FS	|	92	1	1	1	4	2	1
93	GS	}	93	1	1	1	3	4	1
94	RS	~	94	1	3	1	1	4	1
95	US	DEL	95	1	1	4	1	1	1
96	FNC 3	FNC 3	96	1	1	4	3	1	1
97	FNC 2	FNC 2	97	4	1	1	1	1	1
98	SHIFT	SHIFT	98	4	1	1	3	1	1
99	CODE C	CODE C	99	1	1	3	1	4	1
100	CODE B	FNC 4	CODE B	1	1	4	1	3	1
101	FNC 4	CODE A	CODE A	3	1	1	1	4	1
102	FNC 1	FNC 1	FNC 1	4	1	1	1	3	1

			B	S	B	S	B	S
103	START (CODE A)		2	1	1	4	1	1
104	START (CODE B)		2	1	1	2	1	1
105	START (CODE C)		2	1	1	2	3	1

		B	S	B	S	B	S	B
STOP		2	3	3	1	1	1	2

8.0 Dimensional Specifications

CODE 128 is independent of absolute dimensions beyond those required by the printing and reading devices chosen to print and read the symbols in any given application. The CODE is tolerant of ink spread and similar consistent dimensional errors normally encountered during the printing process.

Table II defines the acceptable printed symbol dimensional tolerances based on an absolute minimum bar or space dimension of 0.009 inches. A symbol meeting these tolerances can be printed and read by most currently available technologies. Larger minimum printed dimensions may be required for certain applications.

In Table II, the "x" dimension shown is the nominal dimension of one code bar or space element.

The Bar or Space tolerance, "b", is the maximum amount any Bar or Space width may vary from its nominal dimension.

The Edge to Edge Tolerance, "e" is the maximum amount any dimension measured from the leading edge of one bar to the leading edge of the following bar, or the trailing edge of one bar to the trailing edge of the following bar, may vary from its nominal dimension.

The Character to Character Pitch Tolerance, "p", is the maximum amount any dimension measured from the leading edge of the first bar of any character to the leading edge of the first bar of the following character may vary from its nominal dimension.

Table II

"X" Dimension	0.001 Inches		
	Bar or Space Tolerance ± "b"	Edge to Edge ± "e"	Character to Character ± "p"
10	1.00	1.44	2.90
11	2.00	1.60	3.19
12	3.00	1.76	3.48
13	3.97	1.91	3.77
14	4.42	2.06	4.06
15	4.89	2.20	4.35
16	5.36	2.35	4.64
17	5.83	2.50	4.93
18	6.30	2.64	5.22
19	6.77	2.79	5.51
20	7.24	2.94	5.80
21	7.71	3.09	6.09
22	8.18	3.23	6.38
23	8.65	3.38	6.67
24	9.12	3.53	6.96
25	9.59	3.67	7.25
26	10.06	3.82	7.54
30	11.70	4.41	8.70
40	15.60	5.88	11.60
50	19.50	7.35	14.50