3.1.8 *bi-directional bar code symbol* — a bar code symbol capable of being read successfully, either by scanning from right to left or from left to right.

3.1.9 *character — of a bar code* — a single group of bars and spaces that together represent an individual numeral, letter, punctuation mark, or other symbol.

3.1.10 *character set* — the complete range of characters available for encoding within a particular bar code symbology.

3.1.11 *check character — of a bar code symbol* — a character included within the symbol whose value is used for the purpose of mathematical verification of the accuracy of the read.

3.1.12 *continuous code* — a bar code symbol in which all spaces within the symbol are parts of characters so that there are no inter-character gaps.

3.1.13 *element — of a bar code symbol* — a single bar or space.

3.1.14 *module — of a bar code symbol* — narrowest element, bar, or space.

3.1.15 *nominal width — of a bar code element* — the average width of each size element.

3.1.16 *quiet zone — of a bar code symbol* — a clear background area that precedes the start character and follows the stop character of the symbol.

3.1.17 *self-checking bar code symbol* — a bar code symbol that uses a checking algorithm that can be applied against each character such that substitution errors can only occur if two or more "printing" defects appear within a single character.

3.1.18 *self-clocking bar code symbol* — a bar code symbol in which the number of modules, bars, and spaces is the same in each character.

3.1.19 *space — in a bar code symbol* — the more reflective element of the symbol, usually formed by the background between bars.

3.1.20 *start/stop character — in a bar code symbol* — special characters that provide initial timing references and direction-of-read information to the decoding logic.

3.1.21 *start/stop character pattern* — a special bar code character that provides the scanner with start and stop reading instructions as well as scanning direction. The start character is at the left end of a BC-412 symbol (position #2). The stop character is at the right end of the symbol (position #11).

3.1.22 *symbol* — a combination of characters, including start/stop characters, quiet zones, data characters, and check characters, required by a particular symbology, which form a complete scannable entity.

4 Method of Marking

4.1 The dot matrix laser method shall be used to write characters. The minimum bar matrix shall be 1 dot horizontal and 11 dots/mm vertical as shown in Table 1 and Figure 1. The minimum matrix for alphanumeric characters shall be as specified in SEMI M12. In either case, more dots may be used, up to and including a solid line.

5 BC-412 Code[1]

5.1 *Characteristics* — BC-412 is a presence-absence bar code symbology which uses an alphanumeric character set as outlined in Table 2. The name BC-412 is derived from the method used to encode data characters. Each data character is comprised of four single-width bars incremented within 12 modules. The code is a continuous code.

5.2 *Character Set* — The character set available for marking wafers consists of the ten digits (0−9) and all capital letters in the English alphabet except O as listed in Table 3. In addition, there is a start character and a stop character.

5.2.1 *Character Construction and Value* — The module sequence and value for use in calculating the check character are listed for each character in Table 3.

5.3 *Symbol Content* — All character count and content in the wafer marking symbol are user-definable and vary in number from 7 to 18. The checksum character position is fixed.

6 Optional Alphanumeric Code

6.1 The optional alphanumeric symbol is variable and user definable, and similar to existing SEMI standards M12 and M13 with respect to font style.

6.2 The characters may be oriented with the bottom or top of each character toward the primary fiducial user definable.

6.3 The characters in the optional alphanumeric symbol are those in position #3 through position # (n + 2) of the BC-412 symbol (see Table 4).

7 Code Field Locations

7.1 The code field locations for flatted and notched wafers are specified in Figures 3 and 4, respectively. Values of the dimensions for both cases are given in Table 5.

1 IBM Corporation, 2000 Purchase Street, Purchase, NY 10577, Director of Commercial Relations

7.2 The dimensions given in Table 5 are those found on the finished wafer, regardless of where in the process the wafer is marked.

7.3 These dimensions are derived with the assumption that both the bar code and the optional alphanumeric markings are placed on the wafer without realignment of the wafer.

7.4 The code field locations are defined by the limits of the bar code elements and the optional alphanumeric characters. Character dimensions are from centerline to centerline of the extreme features of the character.

8 Definition of the Error-Detecting Method

8.1 Define the following symbols:

$$\begin{aligned} CD &= \text{Check character} \\ i &= \text{Position of a data character within a string from left to right, } i \geq 1 \\ CV(i) &= \text{Character value of i (Table 4)} \\ F_o &= \text{Mod}_{35}\left(\sum CV(i)_{i=odd}\right) \\ F_e &= \text{Mod}_{35}\left(\sum CV(i)_{i=even}\right) \\ F &= \text{Mod}_{35}(F_o + 2F_e) \end{aligned}$$

8.2 Compute the check character:

8.2.1 Assign the value "0" to the check character (position #4, second character in string).

8.2.2 Calculate F_o and F_e.

8.2.3 Calculate F.

8.2.4 Calculate CD as $\text{Mod}_{35}(17 \times F)$.

8.3 *Verification*

8.3.1 Recalculate F_e and F_o with the value of CD found in Section 8.2.4 to the second character in the string (position #4).

8.3.2 Calculate F.

8.3.3 If F = 0, the check character is correct.

8.4 As an example, calculate the check character for A_Q45670 as follows:

8.4.1 Write the code as A0Q45670.

8.4.2 Calculate F_o, F_e, and F:

$$\begin{aligned} F_o &= \text{Mod}_{35}(A(i) + Q(i) + 5(i) + 7(i)) = \\ F_o &= \text{Mod}_{35}(7 + 18 + 33 + 21) = \text{Mod}_{35}(79) = 9 \\ F_o &= \text{Mod}_{35}(0 + 11 + 19 + 0) = \text{Mod}_{35}(30) = 30 \\ F &= \text{Mod}_{35}(9 + 60) = \text{Mod}_{35}(69) = 34 \end{aligned}$$

8.4.3 Calculate the value for CD:

$$CD = \text{Mod}_{35}(17 \times 34) = \text{Mod}_{35}(578) = 18$$

8.4.4 This corresponds to the character, Q, so the symbol is now AQQ45670.

8.4.5 Verify that the check character in AQQ45670 is correct as follows:

$$\begin{aligned} F_o &= \text{Mod}_{35}(A(i) + Q(i) + 5(i) + 7(i)) \\ &= \text{Mod}_{35}(7 + 18 + 33 + 21) = \text{Mod}_{35}(79) = 9 \\ F_e &= \text{Mod}_{35}(Q(i) + 4(i) + 6(i) + 0(i)) \\ &= \text{Mod}_{35}(18 + 11 + 19 + 0) = \text{Mod}_{35}(48) = 13 \\ F &= \text{Mod}_{35}(F_o + 2F_e) \\ &= \text{Mod}_{35}(9 + 26) = \text{Mod}_{35}(35) = 0 \end{aligned}$$

Table 1 Character Dimensions (see Figure 1)

Module Height (dot centerline to dot centerline)	2.000 mm ± 0.025 mm (0.0790" ± 0.0010")		
Bar Code Character Spacing (centerline to centerline, non-cumulative within the Symbol Length [see Table 2])	1.440 mm ± 0.025 mm (0.0570" ± 0.0010")		
Mark Width	0.110 mm ± 0.025 mm (0.0043" ± 0.0010")		
Module Spacing (centerline to centerline, non-cumulative within the Character Spacing [see above])	0.120 mm ± 0.025 mm (0.0047" ± 0.0010")		
Scribing Features:	Scribing Features:		
Density of dots along module length	11 dots/mm, minimum		
Number of dots per module width	1 dot per module width		
Character Construction:	*# of Bars*	*# of Spaces*	*Modules*
Data Character	4	8	12
Start Character	1	2	3
Start Character Dimension	0.360 mm ± 0.025 mm (0.0140" ± 0.0010")		
Stop Character	2	1	3
Stop Character Dimension	0.360 mm ± 0.025 mm (0.0140" ± 0.0010")		

Table 2 Characteristics of BC-412 Bar Code

Encodable Character Set	*Alphanumeric (except O) with No Non-Numeric or Non-Alphabetic Characters (see Table 3)*
Code Type	Continuous
Symbol Length	Variable: for this application, symbol can be formed from 13.200 mm ± 0.050 mm (0.5760" ± 0.020") including the Quiet Zones, to 29.040 mm ± 0.050 mm (1.1400" ± 0.0020") including the Quiet Zones.
Bi-Directional Decoding	Yes
Number of Check Characters	One
Character Self Checking	Yes
Character Self Clocking	Yes
Character Dimensions	See Table 1 and Figure 1.
Non-Data Overhead	Six Modules

Table 3 BC 412 Code — Character Construction and Values

Character	*Module Sequence*	*Check Character Value*	*Character*	*Module Sequence*	*Check Character Value*
0	|-|-|-|-----	00	I	|--|-|----|-	27
1	|-|-|--|----	15	J	|--|--|-|---	16
2	|-|-|---|---	17	K	|--|--|--|--	24
3	|-|-|----|--	29	L	|--|--|---|-	04
4	|-|-|-----|-	11	M	|--|---|-|--	34
5	|-|--|-|----	33	N	|--|---|--|-	12
6	|-|--|--|---	19	O		
7	|-|--|---|--	21	P	|--|----|-|-	32
8	|-|--|----|-	08	Q	|---|-|-|---	18
9	|-|---|-|---	02	R	|---|-|--|--	01
A	|-|---|--|--	07	S	|---|-|---|-	14
B	|-|---|---|-	25	T	|---|--|-|--	13
C	|-|----|-|--	20	U	|---|--|--|-	26
D	|-|----|--|-	22	V	|---|---|-|-	05
E	|-|-----|-|-	09	W	|----|-|-|--	31
F	|--|-|-|----	30	X	|----|-|--|-	28
G	|--|-|--|---	03	Y	|----|--|-|-	23
H	|--|-|---|--	06	Z	|-----|-|-|-	10
Start	|--		Stop	|-|	

Legend: |=one bar; -=one module blank (no bar)

Table 4 BC 412 Symbol Content for Wafer Marking

Position	*Description*	*Modules*
1	Leading Quiet Zone	10
2	Start Character	3
3	User Definable	12
4	Check Character	12
5 to (n + 2)	User Definable	12/character
(n + 2) + 1	Stop Character	3
(n + 2) + 2	Trailing Quiet Zone	10
Total Modules including Quiet Zones		f(n) = (12n) + (6) + (20)
Total Modules within Marking Area Only		f(n) = (12n) + (6)

n = Number of characters in the code as defined by the user, including check character, excluding Start and Stop characters.

Table 5 Code Field Location Dimensions (see Figures 3 and 4)

Dimension	*Flatted Wafer (Figure 3)*	*Flatted Wafer (Figure 3)*	*Notched Wafer (Figure 4)*	*Notched Wafer (Figure 4)*
	n = 7	n = 18	n = 7	n = 18
A	1.624 mm ± 0.025 mm	same	1.624 mm ± 0.025 mm	same
B[3]	4.666 mm ± 0.500 mm	12.476 mm ± 0.500 mm	4.666 mm ± 0.500 mm	12.476 mm ± 0.500 mm
C[3]	9.332 mm ± 0.030 mm	24.952 mm ± 0.050 mm	9.332 mm ± 0.030 mm	24.052 mm ± 0.050 mm
E[1]	3.350 mm ± 0.500 mm	same	7.400 mm ± 0.050 mm	same
F	0.700 mm ref.	same	0.700 mm ref.	same
G[3]	5.400 mm ± 0.500 mm	13.320 mm ± 0.500 mm	5.400 mm ± 0.500 mm	13.320 mm ± 0.500 mm
H[3]	10.800 mm ± 0.050 mm	26.640 mm ± 0.050 mm	10.800 mm ± 0.050 mm	26.640 mm ± 0.050 mm
J	2.000 mm ± 0.025 mm	same	2.000 mm ± 0.025 mm	same
L[3]	13.200 mm ± 0.050 mm	29.040 mm ± 0.050 mm	13.200 mm ± 0.050 mm	29.040 mm ± 0.050 mm
M[2]	1.260 mm min.	same	1.260 mm min.	same

[1] This dimension is the distance between the centerline of the bottom dot in the bar code and the edge of the finished wafer.
[2] This dimension is the distance between the centerline of the first module of the start character (or the last element of the stop character) and the outer edge of the Quiet Zone.
[3] n = 7 and n = 18 values represent the smallest to the largest extremes of the bar code symbology to be used.

The formulas for calculating all other values in between are as follows:

$$\text{Dimension (B) (Using SEMI M 12 Sizing)} = \frac{((n-1)\text{ Character Spacing}) + (\text{Character Width})}{2}$$

$$= \left[\frac{((n-1)\times 1.420) + 0.812}{2} \pm 0.500\right] \text{mm} = ((0.710n - 0.304) \pm 0.500) \text{ mm}$$

$$\text{Dimension (C)} = (((n-1)\times 1.420) + 0.812 \pm 0.050) \text{ mm} = ((1.420n - 0.608) \pm 0.050) \text{ mm}$$

$$\text{Dimension (G)} = \left[\frac{((12n)\times 0.120) + (6\times 0.120)}{2} \pm 0.500\right] \text{mm} = ((0.720n - 0.360) \pm 0.500) \text{ mm}$$

$$\text{Dimension (H)} = (((12n)\times 0.120) + (6\times 0.120) \pm 0.050) \text{ mm} = ((1.440n - 0.720) \pm 0.050) \text{ mm}$$

$$\text{Dimension (L)} = (((12n)\times 0.120) + (6\times 0.120) \pm (20\times 0.120) \pm 0.050 \text{ mm} = ((1.440n - 3.120) \pm 0.050) \text{ mm}$$

Tolerance for module spacing is non-cumulative (see Table 1).

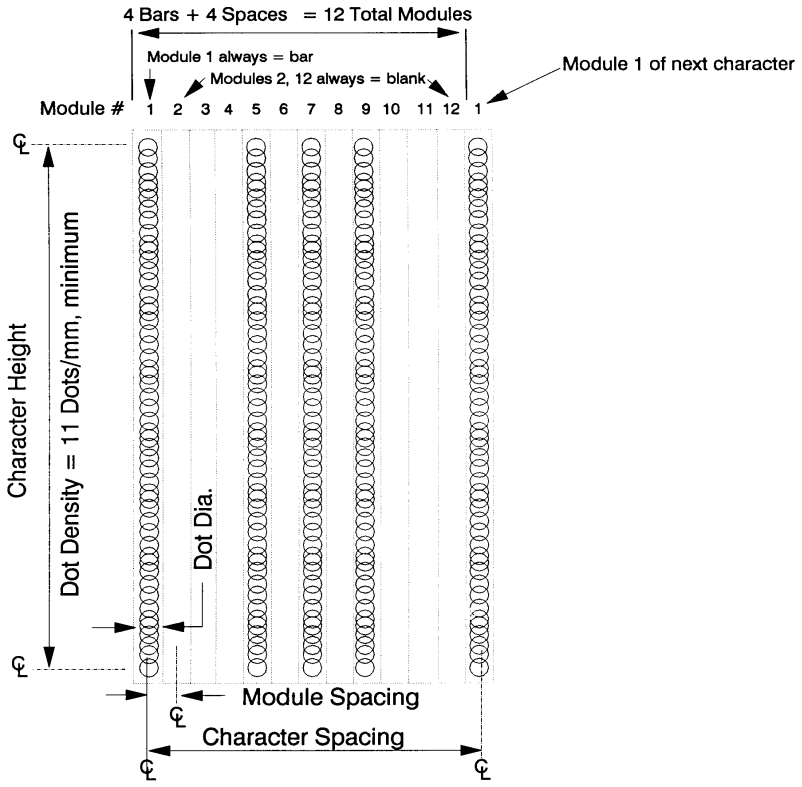

Figure 1
BC-412 Data Character Construction

NOTE 4: Each bar code character contains four bars and four spaces. A space is one or more contiguous blanks. Module 1 is always a bar; the other three bars are distributed among modules 3−11; modules 2 and 12 are always spaces. One or more blanks which comprise a space must occur between bars.

Figure 2
BC-412 Character Position and Module Content

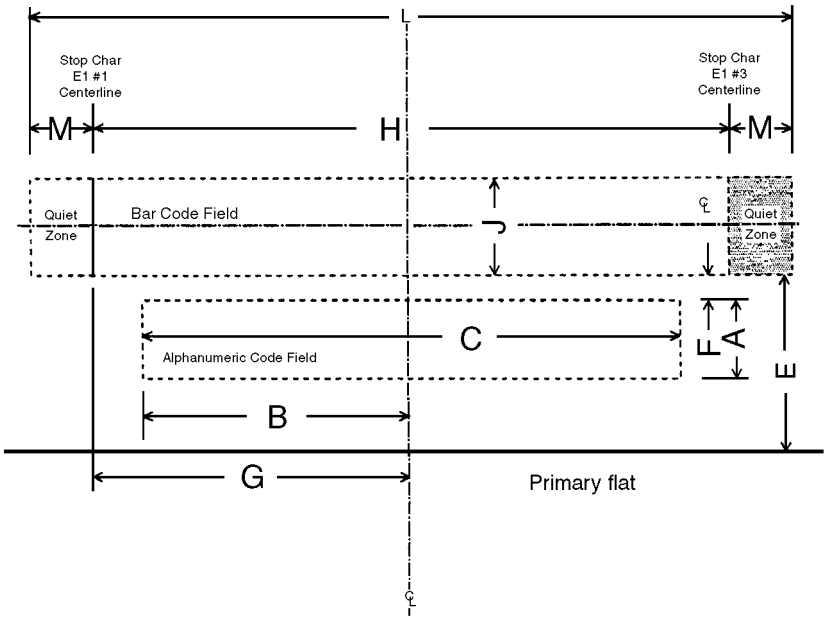

Figure 3
Code Field Locations for Flatted Wafers

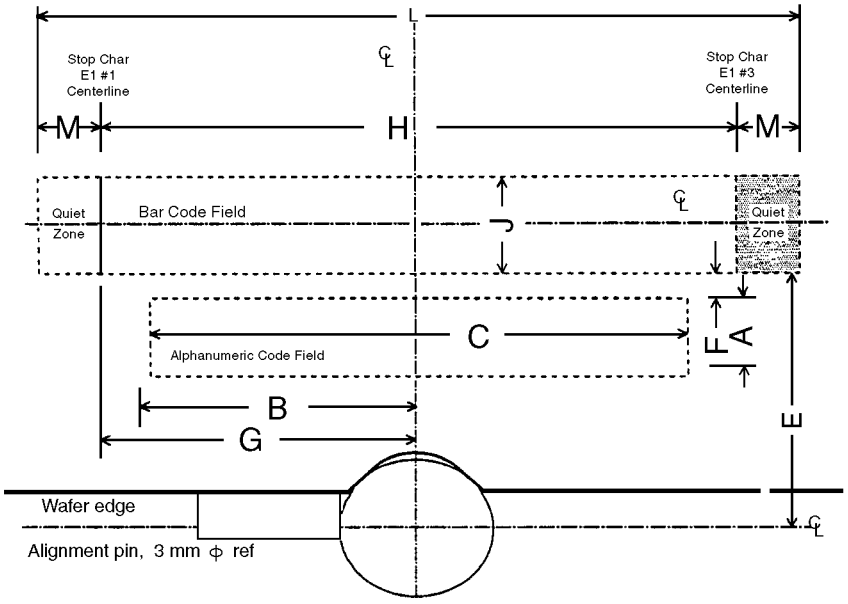

Figure 4
Code Field Locations for Notched Wafers

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RELATED INFORMATION 1
APPLICATION NOTES

NOTICE: This related information section is not an official part of SEMI T1 and is not intended to modify or supercede the official standard. Rather, this note is provided primarily as a source of information to aid in the application of the standard. As such, it is considered reference material only. The standard should be referred to in all cases.

R1-1 Center Reference Dimensions for Bar Code and Optional Alphanumeric Marks

R1-1.1 The following information is provided as a reference for equipment which employs center referencing to locate the bar code or optional alphanumeric marks. Dimensions for flatted wafers are given in Table R1-1 and dimensions for notched wafers are given in Table R1-2.

R1-2 Referenced Documents

R1-2.1 *SEMI Standards*

SEMI M1.7 — Standard for 125 mm Polished Monocrystalline Silicon Wafers

SEMI M1.8 — Standard for 150 mm Polished Monocrystalline Silicon Wafers

SEMI M1.9 — Standard for 200 mm Polished Monocrystalline Silicon Wafers (Notched)

SEMI M1.10 — Standard for 200 mm Polished Monocrystalline Silicon Wafers (Flatted)

SEMI M1.12 — Standard for 125 mm Polished Monocrystalline Silicon Wafers Without Secondary Flat

SEMI M1.13 — Standard for 150 mm Polished Monocrystalline Silicon Wafers Without Secondary Flat (625 µm Thickness)

Table R1-1 Mark Distances on Flatted Wafers (see Figure R1-1)

	Wafer Size and SEMI Standards				
	125 mm		*150 mm*		*200 mm*
Dim. in mm	*SEMI M1.7*	*SEMI M1.12*	*SEMI M1.13*	*SEMI M1.8*	*SEMI M1.10*
D	125 ± 0.5	125 ± 0.2	150 ± 0.2	150 ± 0.2	200 ± 0.2
FL	42.5 ± 2.5	475. ± 2.5	47.50 ± 2.5	57.50 ± 2.5	57.50 ± 2.5
Znom	58.83	58.83	71.19	69.32	95.83
Zmax	59.53	59.37	71.70	69.93	96.30
Zmin	58.09	58.25	70.66	68.68	95.34
R1nom	54.48	54.48	66.84	64.97	91.48
R1max	55.59	55.53	67.86	66.10	92.46
R1min	53.23	53.39	65.79	63.82	90.08
K1nom	1.03	1.03	1.03	1.03	1.03
K1max	1.55	1.55	1.55	1.55	1.55
K1min	0.05	0.50	0.50	0.50	0.50

D = Wafer Diameter
FL = Primary Flat Length

Table R1-2 Mark Distances on Notched Wafers (see Figure R1-2)

	Wafer Size and SEMI Standards		
Dim. in mm	*125 mm*	*150 mm*	*200 mm SEMI M1.9*
D	125 ± 0.5	150 ± 0.2	200 ± 0.2
Z1nom	0.80	0.80	0.80
Z1max	1.05	1.05	1.05
Z1min	0.30	0.30	0.30
R1nom	54.90	67.40	92.40
R1max	55.91	68.26	93.26
R1min	53.64	66.29	91.29
K1mon	3.28	3.28	3.28
K1max	4.05	4.05	4.05
K1min	2.50	2.50	2.50
Ynom	1.80	1.80	1.80
Y1max	2.05	2.05	2.05
Y1min	1.55	1.55	1.55

D = Wafer Diameter

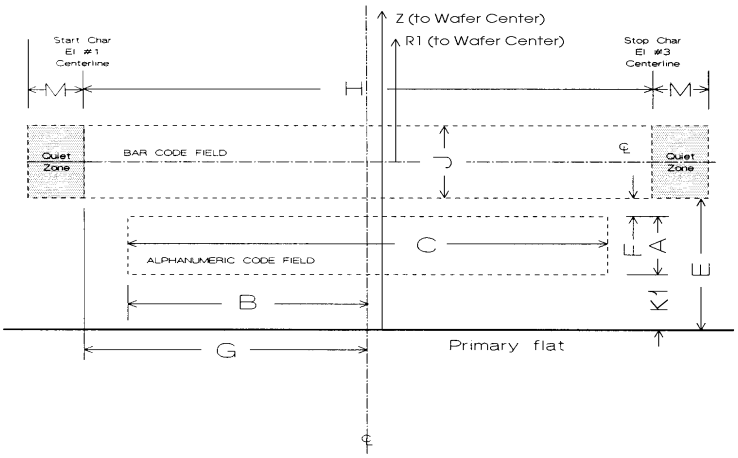

Figure R1-1
Code Field Locations for Flatted Wafers (See Tables R1-1 and 5.)

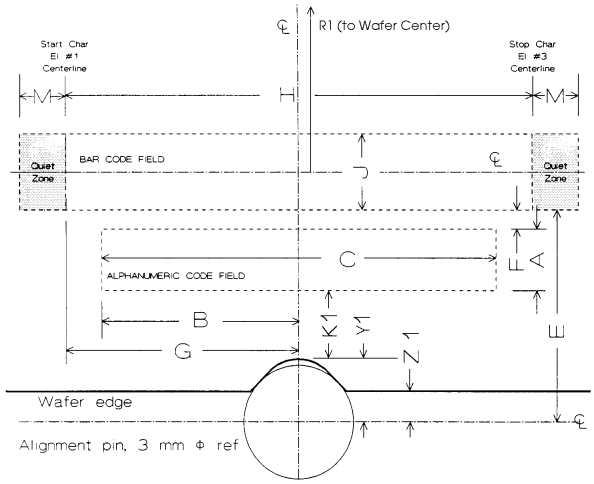

Figure R1-2
Code Field Locations for Notched Wafers (See Tables R1-2 and 5.)

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SEMI T2-0298 (Reapproved 1104)
SPECIFICATION FOR MARKING OF WAFERS WITH A TWO-DIMENSIONAL MATRIX CODE SYMBOL

This specification was technically approved by the Global Traceability Committee and is the direct responsibility of the North American Traceability Committee. Current edition approved by the North American Traceability Committee on July 11, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1993; last published February 1998.

1 Purpose

1.1 This specification is intended to provide a marking symbology that can be used to mark silicon wafers with minimum intrusion into the fixed quality area of the wafer.

2 Scope

2.1 This specification defines the geometric and spatial relationships and content (including the error checking and correcting code) of a two-dimensional (2-D), machine-readable, binary matrix code symbol for front surface marking of wafers of silicon which comply with SEMI M1, SEMI M2, or SEMI M11, and other materials with diameters of 125 to 200 mm. This specification allows for consistency of all wafer marking performed by wafer manufacturers. It may be used in conjunction with, or as an alternative to, the alphanumeric marking codes specified in SEMI M12 and SEMI M13 or a front surface bar code like that specified in SEMI T1.

2.2 Although this specification does not specify the marking techniques that may be employed when complying with its requirements, it is assumed that the symbol will be obtained by laser scribing individual dots.

2.3 The 2-D matrix code is applicable to a broad range of wafer products, including epitaxial wafers, SOI wafers, and unpatterned or patterned polished wafers. The format and algorithms of this code are based on the Data Matrix two-dimensional symbology specified in AIM International Symbology Specification - Data Matrix.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards

3.1 *SEMI Standards*

SEMI AUX001 — List of Vendor Identification Codes

SEMI M1 — Specifications for Polished Monocrystalline Silicon Wafers

SEMI M2 — Specification for Silicon Epitaxial Wafers for Discrete Device Applications

SEMI M11 — Specifications for Silicon Epitaxial Wafers for Integrated Circuit (IC) Applications

SEMI M12 — Specification for Serial Alphanumeric Marking of the Front Surface of Wafers

SEMI M13 — Specification for Alphanumeric Marking of Silicon Wafers

SEMI T1 — Specification for Back Surface Bar Code Marking of Silicon Wafers

3.2 *AIM International Technical Specification*[1]

AIM International Symbology Specification - Data Matrix

3.3 *ANSI Standard*[2]

ANSI X3.4 — American Standard Code for Information Interchange (ASCII)

NOTE 1: This standard is equivalent to ISO 646, Information Processing - ISO 7-bit Coded Character Set for Information Processing.

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

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2 American National Standards Institute, Headquarters: 1819 L Street, NW, Washington, DC 20036, USA. Telephone: 202.293.8020; Fax: 202.293.9287, New York Office: 11 West 42nd Street, New York, NY 10036, USA. Telephone: 212.642.4900; Fax: 212.398.002, Website: www.ansi.org

4 Terminology

4.1 *Definitions*

4.1.1 *binary values* — a dot in the wafer surface indicates the binary value 1. The absence of a dot, or a smooth surface surrounding a cell center point, indicates the binary value 0.

4.1.2 *border column* — the outermost column of a data matrix code symbol.

4.1.3 *border row* — the outermost row of a data matrix code symbol.

4.1.4 *cell center point, of an array* — the point at which the centerline of a row intersects the centerline of a column.

4.1.5 *cell spacing, of an array* — the (equal) vertical or horizontal distance between the cell center points of contiguous cells.

4.1.6 *cell, of a data matrix code symbol* — the area within which a dot may be placed to indicate a binary value.

4.1.7 *center line, of a row or column* — the line positioned parallel to, and spaced equally between, the boundary lines of the row or column.

4.1.8 *central area, of a cell* — the area enclosed by a circle centered at the cell center point; used by code readers to sense the binary value of the cell.

4.1.9 *data matrix code symbol* — a two-dimensional array of square cells arranged in contiguous rows and columns.

4.1.10 *dot* — a localized region with a reflectance which differs from that of the surrounding surface.

NOTE 2: To assure reading efficiency, a minimum contrast of 30% is required between the reflectance value of a dot and the surrounding wafer surface. Various densitometers can provide such measurements nondestructively.

4.1.11 *dot misalignment, within a cell* — the distance between the physical center point of a dot and the cell center point.

4.1.12 *reference point, of a data matrix code symbol* — the physical center point of a corner cell common to a border row and border column, used to identify the physical location of the symbol on the object being marked with the symbol.

NOTE 3: The reference point is at a fixed location on the object. Different cells may be chosen as the reference point, depending on the desired orientation of the symbol on the object and the size variability of the symbol. The particular cell to be used as the reference point must be specified for each application.

5 Ordering Information

5.1 Purchase orders for wafers furnished to this specification shall include the following items:

5.1.1 *Message Characters*

5.1.1.1 Quantity (10 to *nn*, where *nn* is 11–31 and depends on the character set to be encoded (see Table 1).

5.1.1.2 Content of Message Characters 11 and up, if present.

5.1.2 Cell Spacing (125 or 150 µm).

6 Requirements

6.1 *Shape and Size of the Matrix Code Symbol*

6.1.1 Each square matrix code symbol shall be composed of an equal even number (from 16 to 20) of rows and columns of equally spaced square cells. Cell spacing shall be either 125 or 150 µm (see Table 2, and Figures 1 and 2).

6.1.2 *Dot Size* — The nominal shape of the dot produced in the matrix may be circular or square. Its dia-meter or edge length (after polishing) shall be 100 ± 10 µm.

6.2 *Border Rows and Columns* (see Figure 3)

6.2.1 One border row and one border column shall contain a dot in each cell. These are identified as the primary border row and the primary border column. These are used by the code reader to determine the reference point and orientation of the matrix.

6.2.2 The opposing (secondary) border row and column shall contain dots in alternating cells.

6.2.3 The reference point of the symbol shall be the physical centerpoint of the cell common to the primary border row and the secondary border column.

6.2.4 The maximum dot misalignment within a cell is 20 µm. This ensures that a minimum size dot covers a cell central area of radius 25 µm (see Figure 4).

Table 1 Matrix Code Symbol Dimensions

Square Arrays for Use on 125 to 200 mm Wafers	*C_1, R_1 (µm)#1*			*C_2, R_2 (µm)#1*		
# of cells in row or column	16	18	20	16	18	20
125 µm spacing	1875	2125	2375	2000	2250	2500
150 µm	2250	2550	2850	2400	2700	3000

#1: See Figure 1 for pictorial representation of Dimensions C_1, C_2, R_1, and R_2.

Table 2 Message Character Count in Square Arrays for Use on 125 to 200 mm Wafers

# of Cells in a Row or Column		*16*	*18*	*20*
Maximum # of Message Characters	8-bit	10	16	20
	Mostly upper-case	16	25	31

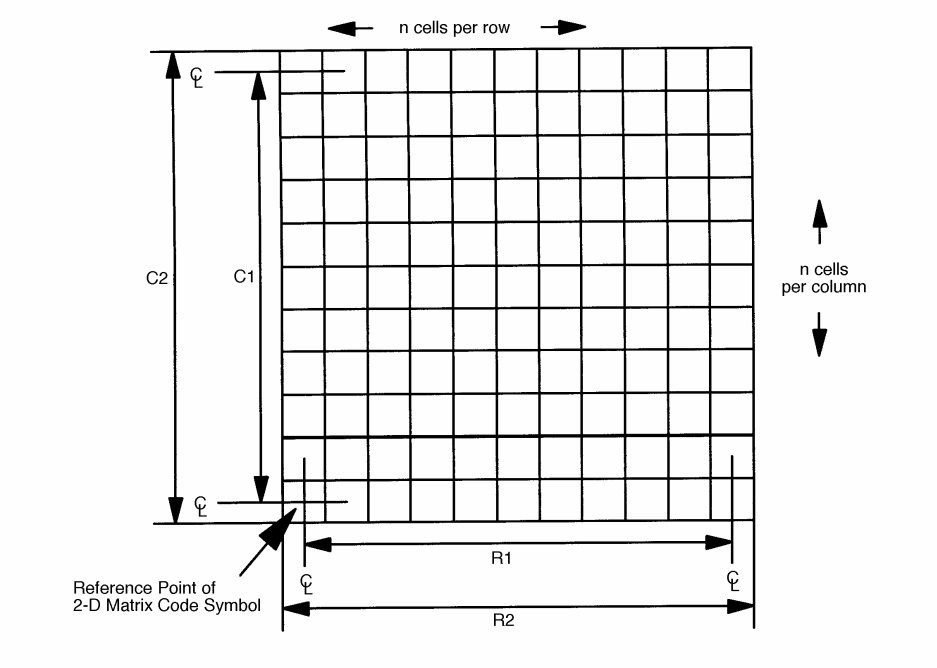

Figure 1
Data Matrix Field Dimensions

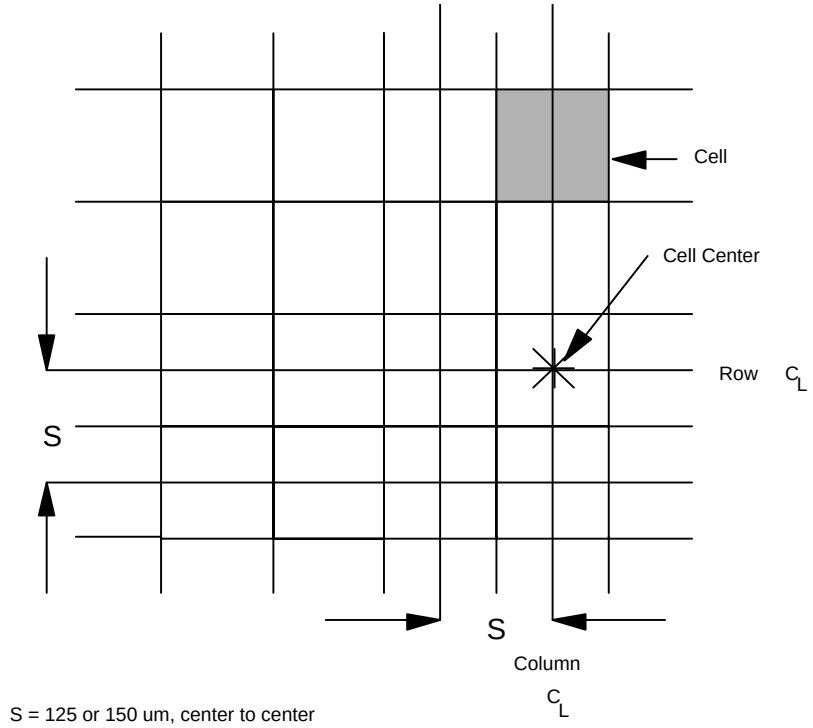

Figure 2
Data Matrix Cell Spacing

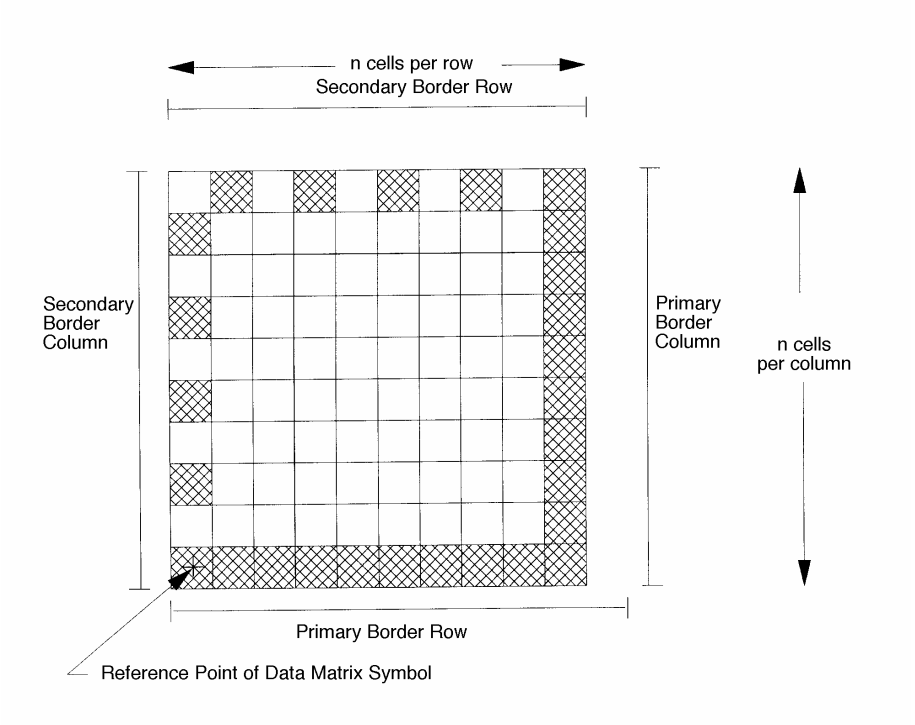

Figure 3
Border Rows and Columns: ECC200

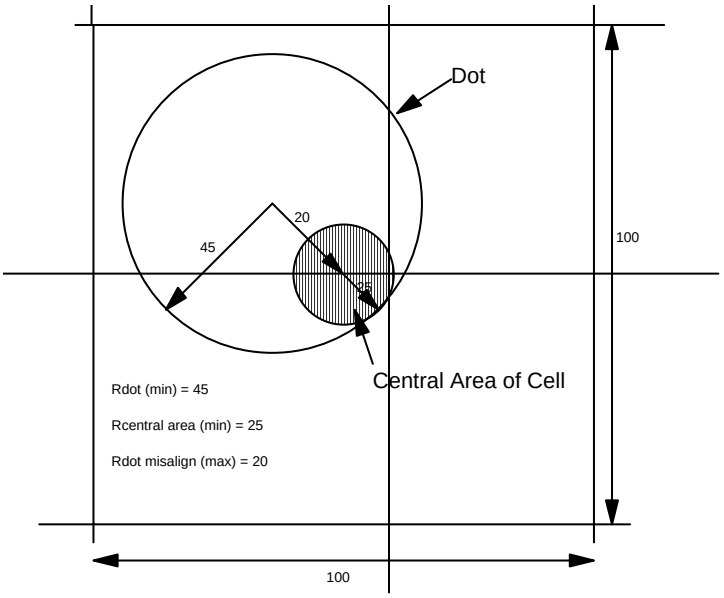

Figure 4
Minimum Size Dot with Maximum Dot Misalignments (all Dimensions in µm)

6.3 *Content of the Matrix Code Symbol*

6.3.1 Each square matrix code symbol shall contain between 10 and 23 message characters encoded in accordance with AIM ISS Data Matrix, including the characters associated with error checking and correcting (ECC200), as also defined in AIM ISS Data Matrix.

6.3.2 The message characters may include any of those designated as “mostly uppercase” in Table 5 and Annex J of AIM ISS - Data Matrix. The first 10 message characters shall contain two elements:

- a vendor-assigned 8-character wafer identification code, followed by
- a 2-character vendor identification code as defined in SEMI AUX001.

6.3.2.1 The remaining message characters, if any, shall contain information as agreed between the vendor and user.

6.3.3 The total number of message characters available depends on the row/column count and on the encoded character set (see Table 2).

6.4 *Location of the Matrix Code Symbol*

6.4.1 With the wafer positioned front surface up and with the primary fiducial toward the operator, the reference point of the matrix code symbol shall be located as specified in Table 3.

6.4.2 The square matrix code symbol used on 125 to 200 mm diameter wafers shall be oriented with the border columns parallel with the primary fiducial bisector and the border rows perpendicular to the primary fiducial bisector. The secondary border column shall be toward the primary fiducial bisector, and the primary border row shall be toward the edge of the wafer.

6.4.3 The nominal position of the reference point of the matrix code symbol is 1 mm to the right of the closest alphanumeric code field. A 3º skew toward the alphanumeric field, which is the maximum skew allowed by SEMI M12 and SEMI M13, does not cause the matrix code symbol to impinge on the alphanumeric code fields, even if the symbol is placed only 15.5 mm from the primary fiducial bi-sector. Consequently, this matrix code symbol position permits the simultaneous use of front surface alphanumeric marking as specified in SEMI M12 or M13, on 125 to 200 mm wafers with either flatted or notched primary fiducials.

6.4.4 Because the matrix code symbol is located in the same place with respect to the primary fiducial bisector on all wafer diameters from 125 to 200 mm, the use of both marking and reading equipment is simplified.

6.4.5 The distance from the edge of the data matrix code symbol to the diameter perpendicular to the primary fiducial bisector varies according to the actual size of the wafer and the placement of the symbol within its tolerance range. Minimum distances from the edge of the code symbol to the wafer center-line are given in Table 4 for both 16 × 16, 125 µm and 20 × 20, 150 µm matrix code symbols.

Table 3 Location of Matrix Code Symbol — Wafer Polished Side Up, Primary Fiducial toward the Operator

Type of Array	*Wafer Fiducial*	*Reference Point Cell*	*Location of Symbol Reference Point*
Square (used on 125, 150, and 200 mm wafers)	Flat	Common cell of primary border row and secondary border column	16.0 ± 0.5 mm to the right of the fiducial bisection, and 2.5 ± 0.5 mm above the edge of the flat
	Notch		160 ± 0.5 mm to the right of the fiducial bisector, and 5.3 ± 0.5 mm above the notch pin center

Table 4 Minimum Distances from Edge of Matrix Code Symbol to the Wafer Centerline

SEMI Standard	*M1.7*	*M1.8*	*M1.12*	*M1.13*	*M1.10*			*M1.9*
Nominal Wafer Diameter, mm	125	150	125	150	200	125	150	200
Flat or Notch	Flat	Flat	Flat	Flat	Flat	Notch	Notch	Notch
Distance from 20 × 20 Matrix with 150 µm Cell Spacing, mm	52.17	62.76	52.33	64.73	89.28	53.98	66.48	91.48
Distance from 16 × 16 Matrix with 125 µm Cell Spacing, mm	53.14	63.73	53.30	65.74	90.25	54.95	67.45	92.45

APPENDIX 1
SIMULTANEOUS MARKING WITH SQUARE DATA MATRIX AND ALPHANUMERIC CODES

NOTICE: The material in this appendix is an official part of SEMI T2 and was approved by full letter ballot procedures.

A1-1 The relative positions of alphanumeric and data matrix markings are shown in Figure A1-1. This figure also shows the relationship between the data matrix code symbol and the edge of the polished area of the front surface of the wafer. Wafer peripheries in the figure are the edges of the polished area of wafers with maximum intrusion of the edge contour, minimum diameter, and maximum flat diameter (minimum flat length), or distance between the notch pin centerline and the wafer edge, as specified in SEMI M1. For all wafer diameters, SEMI M1 allows the edge contour to extend inward from the edge up to 508 µm (Dimension B in Figure 4 of SEMI M1). The distance between the notch pin centerline and the wafer periphery may vary from 0.30 to 0.80 mm as indicated in Figure 6 of SEMI M1. Other dimensions and tolerances are specified in the appropriate polished wafer specification in SEMI M1.

A1-2 Alphanumeric code field locations are shown for all cases except the SEMI M13 code field for flatted wafers, which lies entirely to the left of the primary fiducial bisector. Note that alphanumeric code field locations are not specified for 125 mm diameter notched wafers in either SEMI M12 or SEMI M13.

A1-3 The nominal position of the reference point of the data matrix code symbol is marked by a +; this position is 1 mm to the right of the closest alphanumeric code field. Because of the tolerances on the position of the reference point, the largest data matrix code symbol (20 × 20, 150 µm cell spacing) may lie anywhere within the dotted square. The effect of a 3º skew toward the alphanumeric field is also shown. Although the skew does not affect readability of the data matrix code symbol, too great a skew may cause the data matrix symbol code to impinge on occupied areas of the wafer surface. The 3º skew, which is the maximum allowed by SEMI M12 and SEMI M13, does not cause the data matrix code symbol to impinge on the alphanumeric code fields.

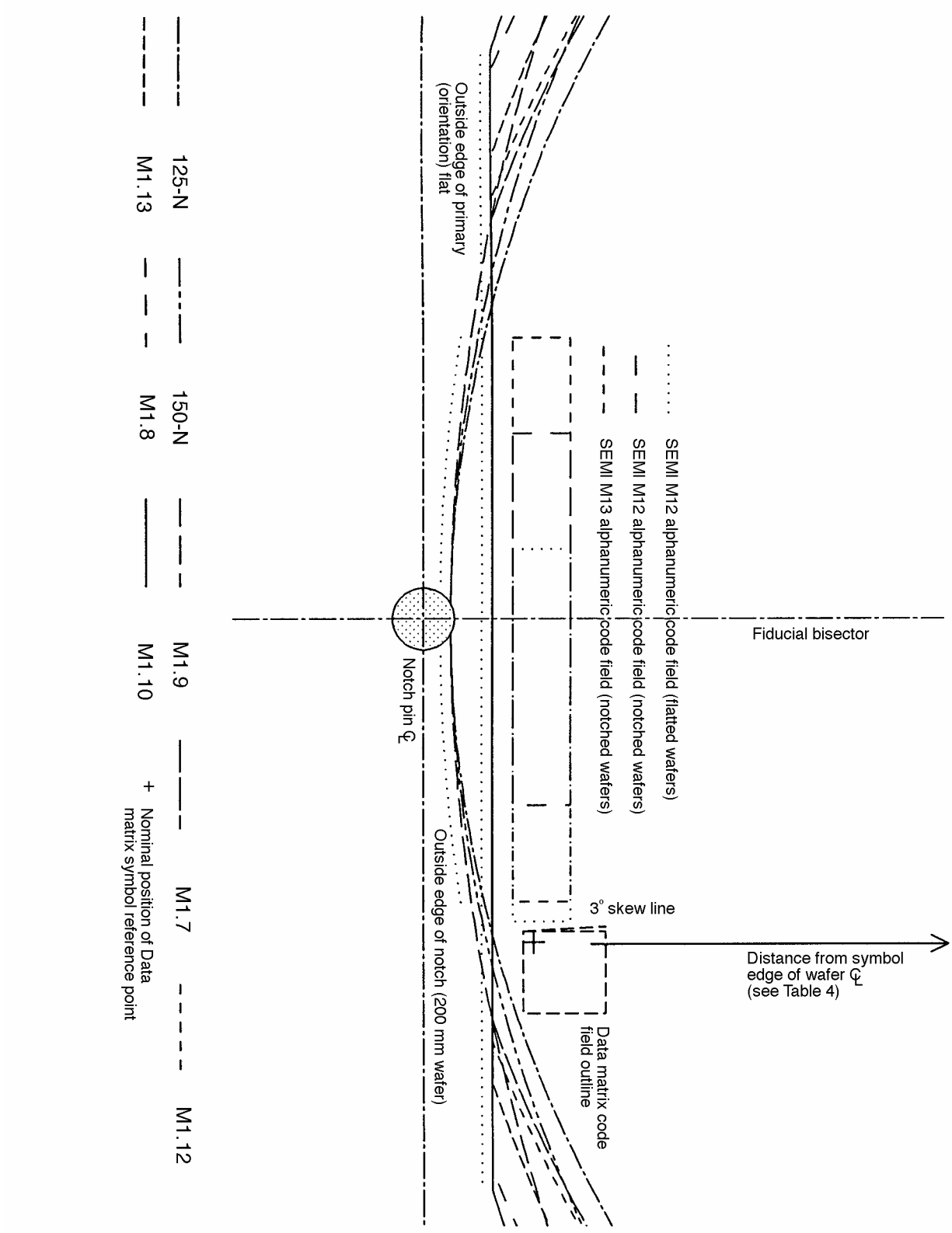

Figure A1-1
Relationship Between the Maximum Size Matrix Code Symbol, Alphanumeric Fields, and the Edges of the Polished Front Surface of Minimum Size Wafers

NOTICE: SEMI makes no warranties or representations as to the suitability of the standards set forth herein for any particular application. The determination of the suitability of the standard is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature, respecting any materials or equipment mentioned herein. These standards are subject to change without notice.

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SEMI T3-0302
SPECIFICATION FOR WAFER BOX LABELS

This specification was technically approved by the Global Traceability Committee and is the direct responsibility of the North American Traceability Committee. Current edition approved by the North American Regional Standards Committee on November 27, 2001. Initially available at www.semi.org February 2002; to be published March 2002.

NOTE: This document was entirely rewritten for publication in 2002.

1 Purpose

1.1 This specification provides a common format, content, size, and location for printed, machine-readable labels on wafer boxes to facilitate communication of data essential for advanced traceability and electronic data exchange systems. These labels differ from those used in common commercial practice in that they provide less detailed information about parametric properties of the wafer. Such information is now readily stored in advanced traceability systems.

1.2 This specification covers labels that contain two bar code symbols and their associated human-readable interpretation.

1.3 This specification also covers a two-dimensional Data Matrix code symbol that can accommodate substantially more information than can the bar code symbols. This symbol is included to provide for a smooth transition from existing traceability and labeling procedures to the comprehensive, unified system envisioned for the future in which common reading equipment can be used throughout the plant. If the Data Matrix symbol is used without the bar code symbols, provision is made for an associated human readable interpretation.

1.4 Labels provided in accordance with this specification satisfy the special requirements of 300 mm Wafer Shipping Systems, detailed in SEMI M45, for both front opening shipping box (FOSB) labels and bag labels.

2 Scope

2.1 This specification covers size, message content and symbology requirements of labels for wafer boxes used for storage and transport of silicon wafers 100 mm in diameter and larger.

2.2 For wafer boxes used with 100 to 200 mm diameter wafers, this specification provides for two similar labels in order that the contents of the wafer box can be identified when the wafer box is stored in either of two positions: with the side of the wafer box parallel with the front of the storage shelf or with the end of the wafer box parallel with the front of the storage shelf. Because wafer boxes are routinely stacked for storage, placement of box labels on the top or bottom of the box is not recommended.

2.3 For FOSBs used with 300 mm wafers, this specification provides for two identical labels, one to be placed on the FOSB and the other to be placed on the outer bag. These requirements are consistent with the requirements of SEMI M45. SEMI M31 specifies FOSB dimensions.

2.4 The message content and locations of the symbols used on the labels covered by this specification are designed to fit in a space consistent with size of the available flat area on wafer boxes investigated. If a larger flat area is available on the wafer boxes to be used, the label size may be increased and additional message content included.

2.5 This specification includes descriptions of the characteristics of the code formats to be employed.

2.6 The labels covered by this specification may be applied on the box itself, and on the box wrap portion of the wafer package, but not on the transport package (outer shipping carton) used for commercial transportation of wafer packages.

NOTE 1: Specifications for transaction labels, which are intended for use on the outer shipping carton, are given in ANSI/EIA 556-B.

2.6.1 The format of the barcode is based on Code 39, as specified in ISO/IEC 16388.

2.6.2 The format of the Data Matrix Code is specified in ISO/IEC 16022.

2.7 Wafer box labels are intended to be applied in a cleanroom environment concurrent with the completion of production of the wafers. Although it is recognized that the materials of construction and the adhesives used to apply the label must be selected with this use in mind, their specification is beyond the scope of this document.

2.8 The dimensions in this specification are applicable to labels printed with printers that have nominal resolution of 203 dots per inch (dpi). Printers with higher resolution may be used, but many of the dimensions may differ from those in this specification and the code fields may or may not fit within the specified label size and format. In such cases, the user

of this specification must ensure that the label is of a size that fits the box to be employed.

2.9 This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety health practices and determine the applicability or regulatory limitations prior to use.

3 Referenced Documents

3.1 *SEMI Standards*

AUX1 — List of Vendor Identification Codes

SEMI M1.15 — Standard for 300 mm Polished Monocrystalline Silicon Wafers (Notched)

SEMI M12 — Specification for Serial Alphanumeric Marking of the Front Surface of Wafers

SEMI M13 — Specification for Alphanumeric Marking of Silicon Wafers

SEMI M31 — Provisional Specification for Front-Opening Shipping Box Used to Transport and Ship 300 mm Wafers

SEMI M45 — Provisional Standard for 300 mm Wafer Shipping System

SEMI T1 — Specification for Back Surface Bar Code Marking of Silicon Wafers

SEMI T2 — Specification for Marking of Wafers with a Two-Dimensional Matrix Code Symbol

SEMI T7 — Specification for Back-surface Marking of Double-side Polished Wafers with a Two-dimensional Data Matrix Code Symbol

3.2 *ANSI Standards*[1]

ANSI/ASC X3.182 — Bar Code Print Quality - Guideline

ANSI MH10.8.2 — Data Application Identifier Standard

3.3 *EIA Standards*[2]

ANSI/EIA-556-B — Outer Shipping Container Label Standard

ANSI/EIA 706 — Component Marking Standard

3.4 *ISO/IEC Standards*[3]

ISO/IEC 15417 — Automatic Identification and Data Capture Technique Symbology Specification – Code 128

ISO/IEC 16022 — International Symoblogy Specification – Data Matrix

ISO/IEC 16388 — Automatic Identification and Data Capture Technique Symbology Specification – Code 39

4 Terminology

4.1 Definitions of terms relating to wafer boxes (see Figure 1) are as follows:

4.1.1 *bar end, of a wafer box base* — the end of the box base that is next to the first pocket of the cassette inside the base or the first pocket of the base itself.

4.1.2 *base, of a wafer box* — the open-top container into which wafers are placed, either in cassettes or into integrally molded pockets.

4.1.3 *box wrap* — the wrapping or bagging applied over the wafer box to comprise the product package.

NOTE 2: The box wrap is usually sealed under clean room conditions.

4.1.4 *cover, of a wafer shipping box* — the portion of the box which closes the top of the base.

4.1.5 *wafer box* — a sealable container consisting of a base and a cover, used for storing or transporting wafers. Compare with *transport package* in ANSI/EIA-556-B.

4.1.6 *wafer box label* — the label on the wafer box identifying the product and its manufacturer.

4.1.7 *wafer package* — the combination of a wafer box and box wrap.

4.1.8 *wall end, of a wafer shipping box* — the end of the shipping box that is opposite the bar end.

4.2 Terms relating to FOSBs are defined in SEMI M31.

4.3 Terms relating to bar code characteristics are defined in SEMI T1. Definitions for additional terms relating to the product package, product package label, and bar code format and characteristics can be found in ANSI/EIA-556-B, Appendix A.

1 American National Standards Institute, New York Office: 11 West 42nd Street, New York, NY 10036, USA. Telephone: 212.642.4900; Fax: 212.398.0023 Website: www.ansi.org

2 Electronic Industries Alliance, EIA Engineering Department, Standards Sales Office, 2001 Eye Street, NW, Washington, D.C. 20006, USA. Website: www.eia.org

3 International Organization for Standardization, ISO Central Secretariat, 1, rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland. Telephone: 41.22.749.01.11; Fax: 41.22.733.34.30 Website: www.iso.ch

4.4 Terms relating to the data matrix code symbol characteristics are defined in SEMI T2 and ISO/IEC 16022.

4.5 Definitions of terms relating to code content are as follows:

4.5.1 *customer information field* — a 35-character field containing the customer product ID and, if desired, other customer assigned information.

4.5.2 *customer product ID* — a unique combination of alphanumeric characters assigned by a customer or purchaser to identify a product, sometimes called customer part number.

4.5.3 *data field* — a specific portion or area of a label designated to contain a human readable interpretation, a bar code symbol, or a two-dimensional matrix code symbol.

4.5.4 *data identifier* — a specified character or character string that defines the category or intended use of data that follows.

4.5.5 *encrypted data* — data entered by the vendor, usually to facilitate traceability, that may or may not be shared with the customer.

4.5.6 *human readable interpretation (hri)* — the interpretation of all or a portion of a bar or matrix code symbols presented in a type font which can be read by persons.

4.5.7 *message character* — a character that contains data, encoded into a bar or matrix code symbol.

NOTE 3: Data identifiers and concatenation characters are considered to be message characters, but start/stop characters are not.

4.5.8 *message length* — the number of message characters contained in a single encoded message.

4.5.9 *traceability number, of a wafer box label* — a string of 35 message characters comprising a lot number, vendor code (including manufacturing location, if desired), and date of labeling together with the appropriate data identifier and concatenation characters.

5 Ordering Information

5.1 Purchase orders for the wafers furnished with wafer box labels in conformance with this specification shall include the following:

5.1.1 Statement that the wafer box label conforms to SEMI Specification T3.

5.1.2 Content of message characters for customer information field.

5.1.3 Label type (see Section 7.1) or, if additional space is available on the box, dimensions of labels and placement of fields thereon.

5.2 In addition, the following optional items may be specified:

5.2.1 If a two-dimensional matrix code symbol is included on the label:

5.2.1.1 Inclusion or exclusion of wafer identification information.

5.2.1.2 User-specified data, if required, and requirement, if any, for sharing of code for encrypted data.

5.2.2 Label locations on the wafer box, if different from the recommended locations.

6 Content and Characteristics of Data Fields

6.1 *Bar Code Symbols*

6.1.1 The label shall contain two data fields for bar code symbols, when such symbols are specified. Each bar code symbol shall contain 35 message characters in addition to the start/stop characters.

6.1.2 A non-printed message header is normally encoded when encoding multiple, concatenated data fields. However, this header is not encoded in the bar code fields to conserve space. The absence of this message header requires appropriate software in bar code reading systems, to separate the data fields.

6.1.3 The upper bar code data field, the customer information field (see Table 1 and Figure 2a), shall contain the customer product ID preceded by a "P," the data identifier for this item as specified in ANSI MH10.8.2.

6.1.3.1 Optionally, if the customer product ID occupies less than 34 characters, the customer identification field may also contain one or more of the subfields listed below, up to the limit of 35 characters total. Each optional subfield shall be preceded by the concatenator symbol "+" and the data identifier(s) below, in accordance with ANSI MH 10.8.2.

6.1.3.2 Field Identifier for *customer part number revision*: 2P

6.1.3.3 Field Identifier for *customer specification number*: 20P

6.1.3.4 Field Identifier for *customer specification revision*: 21P

6.1.3.5 Field Identifier for *customer drawing number*: 12P

6.1.3.6 Field Identifier for *customer drawing revision*: 22P

6.1.4 The lower bar code data field (see Table 2 and Figure 2b) shall contain the 35-message character traceability number. This field is divided into four subfields, each separated from the adjacent field by the concatenation symbol "+ ." The first subfield contains the lot number of 16 characters, preceded by the data identifier "1T." The second subfield contains the 2-character SEMI vendor identification code, preceded by the data identifier "1V. " The third subfield contains the labeling date (YYMMDD), preceded by the data identifier "D. " The fourth subfield contains the quantity, preceded by the data identifier "Q. " The quantity indicated on the label shall be the number of wafers in the wafer box to which the label is affixed; the unit of measure is understood as each (EA). The message characters in this symbol are distributed as shown in Table 2.

Table 1 Content of Bar Code Symbol in Upper Bar Code Data Field (Customer Information Field)

Number of characters	*Symbol Content*	*Notes*
Required Subfield		
First 1	Data Identifier	"P"
message dependent	Customer Product ID (e.g. part number)	(Customer-specified)
Optional Subfields		
3	Concatenator + Data Indentifier	"+ 2P"
message-dependent	Customer Part Number Revision	(Customer-specified)
4	Concatenator + Data Indentifier	"+ 20P"
message-dependent	Customer Specification Number	(Customer-specified)
4	Concatenator + Data Indentifier	"+ 21P"
message-dependent	Customer Specification Number Revision	(Customer-specified)
4	Concatenator + Data Indentifier	"+ 12P"
message-dependent	Customer Drawing Number	(Customer-specified)
4	Concatenator + Data Indentifier	"+ 22P"
message-dependent	Customer Drawing Revision	(Customer-specified)

NOTE 1: The total number of characters in the field shall not exceed 35; any character location not filled with data shall contain a dash.

Table 2 Content of Bar Code Symbol in Lower Bar Code Data Field (Traceability Number)

Character Location	*Symbol Content (All required fields)*	*Notes*
1–2	Data Identifier	"1T"
3–18	Lot Number	(Supplier assigned)
19–21	Concatenation Symbol and Data Identifier	"+ 1V"
22–23	Vendor Identification Code	(SEMI) (See Note 1)
24–25	Concatenation Symbol and Data Identifier	"+ D"
26–31	Labeling Date	(YYMMDD) (See Related Information 1)
32–33	Concatenation Symbol and Data	"+ Q"
34–35	Quantity (unit, EA, implied)	(numeric)

NOTE 1: The SEMI vendor identification code may contain information on manufacturing location. AUX1 contains multiple codes indicating manufacturing location for some, but not all, wafer suppliers. If desired, suppliers whose codes do not now include manufacturing location identification can request additional codes for each location from SEMI, following the procedure in AUX1.

6.1.5 All bar code symbols shall use the Code 39 bar code as specified in ISO/IEC 16388, unless an optional bar code is selected (see Section 6.1.9). Code 39 is a variable length, discrete, self-checking, bi-directional bar code. Each character is composed of nine elements: Five bars and four spaces. Three of the nine elements are wide and six elements are narrow.

6.1.6 *Character Set* — The Code 39 character set consists of 43 characters: 0-9, A-Z,+ ,-,.,$,/,%, and space. In addition, an asterisk (*) is used only for both the start and stop characters; it cannot be used as a message character. No other characters shall be encoded in the bar code symbols of labels covered by this specification. In the absence of a character at any assigned location, a dash (-) shall be used.

6.1.7 *Print Quality* — The Code 39 print quality shall be B/03/630 or better in accordance with ANSI X3.182. To assure reading efficiency, the minimum reflectance of the quiet zones shall be 60%, the minimum reflectance of spaces shall be 51%, and the maximum reflectance of bars shall be 10%.

6.1.8 *Symbol Dimensions* — Bar code symbol dimensions shall be as listed in Table 3.

6.1.9 *Other Bar Code Symbology* — Code 128 may be used in lieu of Code 39. Users must verify that this code fits within the available label space.

6.2 *Human-Readable Interpretation Symbols*

6.2.1 Each bar code symbol data field on the label shall have an associated human-readable data field either immediately above or immediately below it. The symbol in each of the human-readable data fields shall contain all the message characters contained in the associated bar code data field. Start and stop characters shall not be included, but the data field identifiers and concatenation symbols shall be included.

6.2.2 The nominal height of the human-readable characters shall be 2.0 mm (0.08 in.).

6.2.3 There shall be a clear space of 0.5 mm (0.02 in.) above and below each human-readable symbol.

6.3 *Data Matrix Code Symbol*

6.3.1 The label may contain up to two identical square two-dimensional matrix code symbols each with up to 682 message characters when six-bit characters are encoded using the EDIFACT encodation scheme described in Annexe J3 of ISO/IEC 16022 (see also Table 11 in ISO/IEC 16022).

6.3.2 The first six characters shall contain the message header, in accordance with EIA 706; this header identifies a message that contains data identifiers that are in accordance with ANSI MH10.8.2. The header content is not printed.

6.3.3 The next 71 characters in the matrix code symbol shall contain the information included in the two bar code symbols on the label, together with additional concatenation symbols, as summarized in Table 4. In the absence of a character at any assigned location, a dash (-) shall be used. This information shall also be included if the bar codes are not printed.

Table 3 Nominal Dimensions of Bar Code 39 Symbols

Symbol	*Dimension*	*Metric (SI) Value*	*U.S. Customary Value*
-	number of message characters	35	35
X	width of narrow bar	0.125 mm	0.00493 in.
N	ratio of wide to narrow bar width	2.0	2.0
I	nominal intercharacter gap	0.1251 mm	0.00493 in.
H	bar height (See Note 1.)	9.0 mm	0.35 in.
L'	bar code symbol length (excl. quiet zones)	60.06 mm	2.365 in.
-	bar code density (excl. quiet zones)	0.583 cpmm	14.80 cpi
Q	width of quiet zone (See Note 1.)	6.35 mm	0.25 in.
L	total length of bar code symbol	72.76 mm	2.865 in.

NOTE 1: The metric (SI) and U.S. Customary values of this dimension are not exact equivalents; the dimension has been rounded to obtain rational values in both systems.

6.3.4 For boxes to be used for wafers between 100 and 200 mm in diameter, the content of the remainder of the data matrix code symbol is optional, as agreed between the customer and supplier. However, it is recommended that the remaining message characters in the Data Matrix code symbol include the following 500-character wafer identification information. For labels to be used on 300 mm FOSBs, the wafer identification information is required, in accordance with SEMI M45.

6.3.4.1 These next 500 characters identify the slot number and individual wafer identification of each wafer in the box, with a string of 25 twenty-character fields. Each of these fields contains:

a. The concatenation character ("+ ") and Data Identifier for the slot ID ("31T") and a two-digit number of the slot, and

b. the concatenation character ("+ ") and Data Identifier for the ID of the wafer in that slot ("32T") and the ten-character wafer ID including the two-character vendor identification code. The wafer ID number is comprised of

i) the first ten characters of the marking codes specified in SEMI M12, SEMI M13, or SEMI T2, or

ii) all ten characters of the marking code specified in SEMI T7.

NOTE 4: The content of the marking code specified in SEMI T1 is not specified. This standard may not be suitable for use with wafers marked with the marking code specified in SEMI T1.

6.3.4.2 The cassette/box slot sequence assumes slot 01 at the bar end and slot 25 at the other end of the box. Data matrix code symbols on labels on boxes or cassettes with less than 25 slots shall have one field for each slot.

Table 4 Message Character Content of Matrix Code Symbols

Character		*Symbol Content*	*Notes*
Location	*Count*		
General Information			
1–6	6	Message Header	<d237>
7	1	Data Identifier	"P"
8–41	34	Customer Information (see Table 2)	(Customer-assigned)
42–44	3	Concatenation Symbol and Data Identifier	"+ 1T"
45–60	16	Lot Number	(Supplier-assigned)
61–63	3	Concatenation Symbol and Data Identifier	"+ 1V"
64–65	2	Vendor Identification Code	(SEMI)
66–67	2	Concatenation Symbol and Data Identifier	"+ D"
68–73	6	Labeling Date	(YYMMDD) (See Related Information 1)
74–75	2	Concatenation Symbol and Data Identifier	"+ Q"
76–7	2	Quantity (unit, EA, implied)	(numeric)
	77	Subtotal for general information	
Wafer Information (Optional, see 6.3.4 and 6.3.4.1)			
78–81	4	Concatenation Symbol and Data Identifier	"+ 31T"(See Note 8)
82–83	2	Slot Number	(numeric, 01-25)
84–87	4	Concatenation Symbol and Data Identifier	"+ 32T"
88–97	10	Wafer Identification Number	
	20	Subtotal for one wafer	
98–577	480	Subtotal for next 24 wafers	
	500	Subtotal for wafer information	
	577	Total for General + Wafer Information	
Encrypted or Customer-specific Data (Optional)			
577–682	up to 105	As needed	Otherwise unused character locations (See Note 9)

NOTE 1: If wafer identification data are not available or are not desired for a particular application, additional supplier-specified and/or customer-specified data fields may be included in these character locations as agreed upon between customer and supplier. Begin each supplier-specified field with a data identifier from the series 31T to 34T and each customer-specified field with a data identifier from the series 20T to 24T. Separate adjacent fields with the concatenation symbol (+).

NOTE 2: These unused character locations are available for encrypted or unencrypted supplier-specified information or for customer-specified information. These characters do not appear in the bar code symbol, but only in the Data Matrix Code Symbol. Begin the field with the concatenation symbol ("+ ") followed by an appropriate data identifier as defined in Note 1; in the unlikely event that more than one field is included, begin each field with an appropriate identifier and separate adjacent fields with the concatenation symbol. If the field is not filled completely with characters it is not necessary to pad with dashes; the encoding software will pad it automatically.

6.3.4.3 All slots shall be represented in the Data Matrix code. The first identification number shall be that of the wafer in slot 01 at the bar end; the second, that of the wafer in slot 02; and so on. An empty slot shall be designated

by dashes. For shipping boxes containing 100 to 200 mm diameter wafers, slot 01 is at the bar end of the box. For 300 mm FOSBs, slot 1 is specified by SEMI M31 to be at the bottom of the FOSB.

6.3.5 Any character locations not otherwise used may contain information whose content shall be agreed to between supplier and customer. These characters may consist of customer-specified data or supplier-specified data (which may be encrypted) or both.

6.3.6 The data matrix code shall be a square field, constructed in accordance with ISO/IEC 16022, using error correction code ECC200.

6.3.7 *Dot Size* — The nominal shape of the dot produced in the matrix may be circular or square, depending on the printing technique. It is recommended that each " cell" of the data matrix symbol be composed of at least four dots (a cell with two dots per edge). When printed at 203 dpi, the dot diameter or edge length is 0.125 mm (0.00985 in.).

6.3.8 *Symbol Dimensions* — Each matrix code symbol shall be composed of 80 rows and 80 columns of cells spaced equally with cell spacing *S* (see Figure 3). The nominal outside dimensions of the matrix (C2 and R2 in Figure 4), printed with 4 dots per cell at 203 dpi is 20 mm.

6.3.9 *Border Rows and Columns (see Figure 4)*

6.3.9.1 The leftmost border row and the bottom border column shall contain dots in each cell. These are identified as the primary border row and the primary border column.

6.3.9.2 The opposing (secondary) border row and column shall contain dots in every other cell.

6.3.9.3 These border rows and columns are used by the code reader to determine the origin, size, and orientation of the matrix.

6.3.9.4 The origin of the matrix code symbol shall be the physical center point of the cell common to the primary border row and the primary border column.

NOTE 5: This origin location differs from that used in SEMI T2.

6.3.10 *Message Characters* — The matrix code symbol contains 682 8-bit message characters.

Table 5 Nominal Dimensions of Wafer Box Labels and All Data Fields

Dimension	*Metric (SI) Value*	*U.S. Customary Value*
A (see Note 11)	25 mm	1 in.
B (see Note 11)	0.75 mm	0.04 in.
C (see Note 11)	1.0 mm	0.04 in.
D (see Note 11)	0.50 mm	0.02 in.
E (see Note 11)	2.0 mm	0.08 in.
F (see Note 11)	24.24 mm	0.95 in.
H (see Note 11)	9.0 mm	0.35 in.
J	2.0 mm	0.08 in.
K (see Note 12)	20.0 mm	0.788 in.
L´	60.06 mm	2.365 in.
L	72.76 mm	2.865 in.
P	119.0 mm	4.69 in.
Q	6.35 mm	0.25 in.
S (see Note 11)	30.0 mm	1.19 in.
T (see Note 11)	24.0 mm	0.95 in.
U (see Note 11)	2.5 mm	0.106 in.

NOTE 1: The Metric (SI) and U.S. Customary values of this dimension are not exact equivalents; the dimension has been rounded to obtain rational values in both systems.
NOTE 2: Printed at 4 dots/cell and 203 dpi.

6.3.10.1 The initial six characters are a non-printed message header. The next 570 characters are restricted to the Code 39 Character Set (see 6.1.6) using the six-bit EDIFACT encodation scheme described in Annexe J3 of ISO/IEC 16022. The remaining 105 message characters may be any character in the EDIFACT Encodation Character Set, including unprinted ones. These 105 characters are available for encrypted or unencrypted information, as negotiated between supplier and customer.

6.3.11 *Print Quality* — To assure reading efficiency, a minimum contrast of 30% is required between the reflectance value of a dot and the surrounding label surface. Various densitometers can provide such measurements nondestructively.

7 Label Types, Label Dimensions, and Placement of Data Fields on Labels

7.1 *Label Types (see Figure 5 for examples)*

7.1.1 *Type 1* — Company Field + Data Matrix Field with hri fields

7.1.2 *Type 2* — Company Field + Bar Code Field with hri fields

7.1.3 *Type 3* — Company Field + Data Matrix Field + Bar Code Field with hri fields. Two of this type of label are required for use on 300 mm FOSBs.

NOTE 6: The space reserved on the FOSB rear surface accepts labels as large as 120 mm by 120 mm. This permits the use of labels wider than is specified in this standard. Such labels may contain additional information as arranged by agreement between customer and supplier.

7.1.4 *Type 4* — Company Field + Data Matrix Field1 + Bar Code Field with hri fields + Data Matrix Field2 with hri fields

7.1.5 *Type 5* — Company Field + two Data Matrix Fields, both with hri fields

7.2 Each label shall contain an area containing Company Information and one or more areas containing bar codes, data matrix codes, and related human-readable information.

7.2.1 The Company Information area may contain supplier-related information in human-readable alpha-numeric format and other information as agreed to between customer and supplier.

7.2.2 The other fields that contain bar code, human-readable, and two-dimensional matrix code data fields, may be arranged as indicated in the examples shown in Figure 5.

7.2.3 The human-readable (hri) data fields can be placed either above or below their associated bar code data fields. The examples in Figure 5 show the configuration with the hri fields above the bar code data fields.

7.3 Approximate overall dimensions of the five label types shown in Figure 5 are tabulated in Table 6.

7.4 Dimensions of individual fields, label height, and label length for a type 4 label are given in Table 5 and Figure 6. Label types 4 and 5 may use perforated label material so that the sections may be separated after printing.

Table 6 Overall Dimensions of Box Labels

Label Type	*Length*			*Width*		
	Symbol	*mm*	*in.*	*Symbol*	*mm*	*in.*
1	F+ S	54.2	2.1	A	25.0	1.0
2	F+ L	97.0	3.8	A	25.0	1.0
3	P=F+ T+ L	119.0	4.7	A	25.0	1.0
4	P+ S	149.0	5.9	A	25.0	1.0
5	F+ 2S	84.2	3.3	A	25.0	1.0

NOTE 1: For meaning of the symbols, see Table 5.

8 Label Locations on Wafer Box

8.1 For boxes containing wafers from 100 to 200 mm in diameter, the following recommendations apply.

8.1.1 It is recommended that label type 4 or label type 5 be used for these boxes. These label types may be printed on perforated label material so that the sections may be separated after printing.

8.1.2 The recommended location for the larger label is the center (both vertically and horizontally) of the side of the cover of the wafer box facing the operator with the bar end to the left and the wall end to the right (see Figure 7). Alternatively, this label may be placed in the center of the same side of the base of the wafer box.

8.1.3 The recommended location for the smaller label is the center (both vertically and horizontally) of the wall end of the base of the wafer box (see Figure 7). Alternatively, this label may be placed at the center of the wall end of the cover of the wafer box.

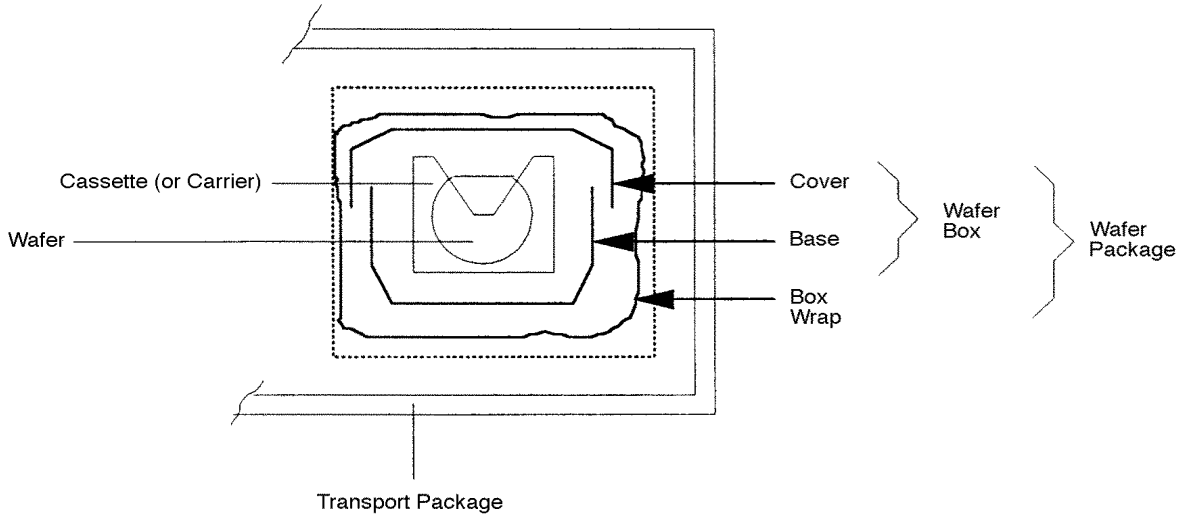
8.1.4 It is recommended that the wafer box cover and the wafer box base each contain a label, so that each will have a label after they have been separated. However, in some cases, space limitations may require that both labels be placed on the same part of the wafer box.

8.2 For FOSBs containing 300 mm wafers, the following requirements apply.

8.2.1 Use two identical Type 3 labels.

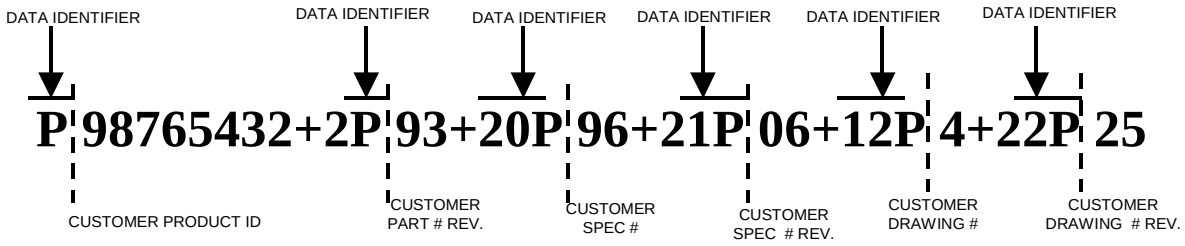
8.2.2 Place one label on the center of the rear surface of the FOSB with the long axis of the label perpendicular to the FOSB base (see Figure 8a).

8.2.3 Place the other, identical, label on the outer wrap bag, which is specified in SEMI M31, at the center of the side adjacent to the FOSB door (see Figure 8b).



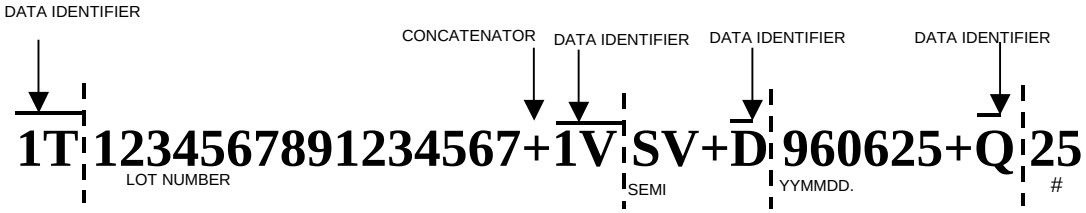
NOTE 1: This specification covers only labels for the wafer package, including the wafer boxes and the wafer box wrap; labels for transport packages are specified in EAI 556-B.

Figure 1
Wafer Box, Wafer Package and Transport Package



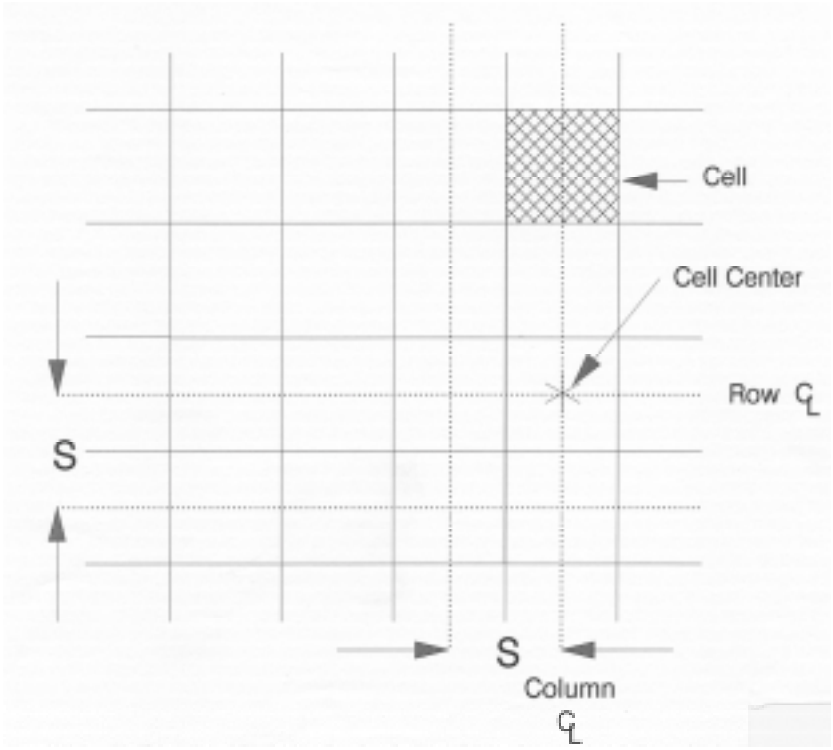
NOTE 1: In this figure, vertical dashed lines separate subfields; the concatenation and field identifiers are to the left of these dashed lines. The CUSTOMER PRODUCT ID is a required field whose content is specified by the customer. The PART # REVISION, SPECIFICATION #, SPECIFICATION # REVISION, DRAWING NUMBER and DRAWING NUMBER REVISION are optional fields; these are also assigned by the customer up to a maximum character count of 35, including all concatenation and field identifier characters. All unused character locations are filled with a dash (-).

Figure 2a
Example of Customer Information Field



NOTE 1: In this figure, vertical dashed lines separate subfields; the concatenation and field identifiers are to the left of these dashed lines. LOT NUMBER is assigned by the supplier. SEMI represents the two-character vendor code that is maintained by SEMI. YYMMDD represents the year, month and day of packaging and # is a two-digit number indicating the quantity of wafers in the box.

Figure 2b
Example of Traceability Number



NOTE 1: S = 0.25 mm (at 203 dpi and 4 dots per cell)

Figure 3
Data Matrix Cell Spacing

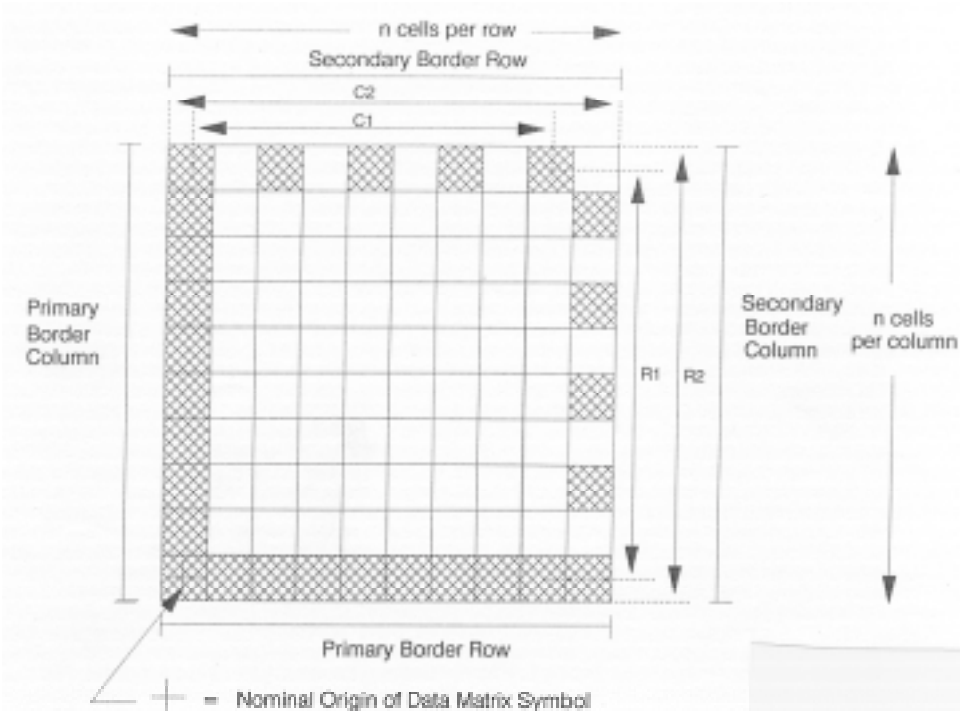


Figure 4
Border Rows, Border Columns and Dimensions of Data Matrix Symbol

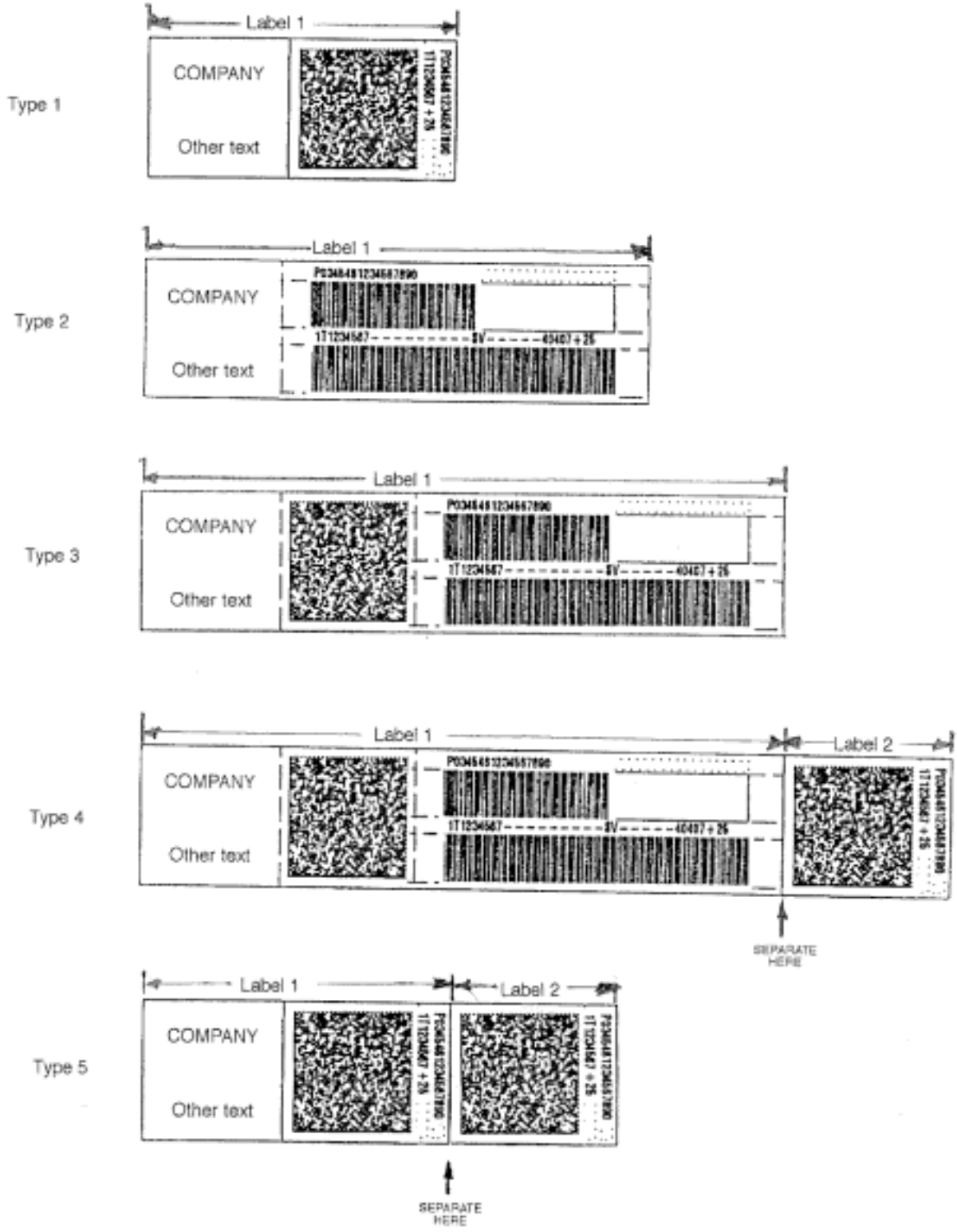


Figure 5
Examples of Box Label Layout Types

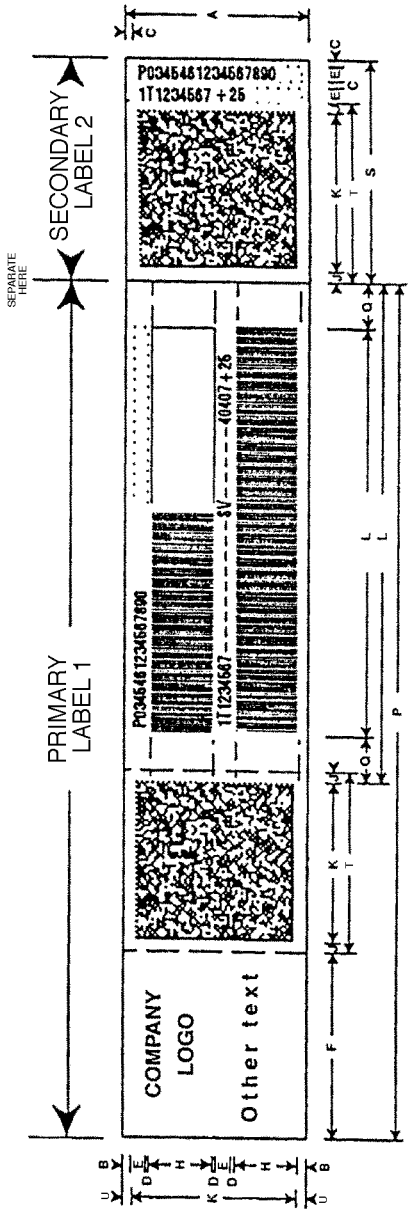


Figure 6
Labels with Bar Code, Human-Readable and Matrix Code Data Fields

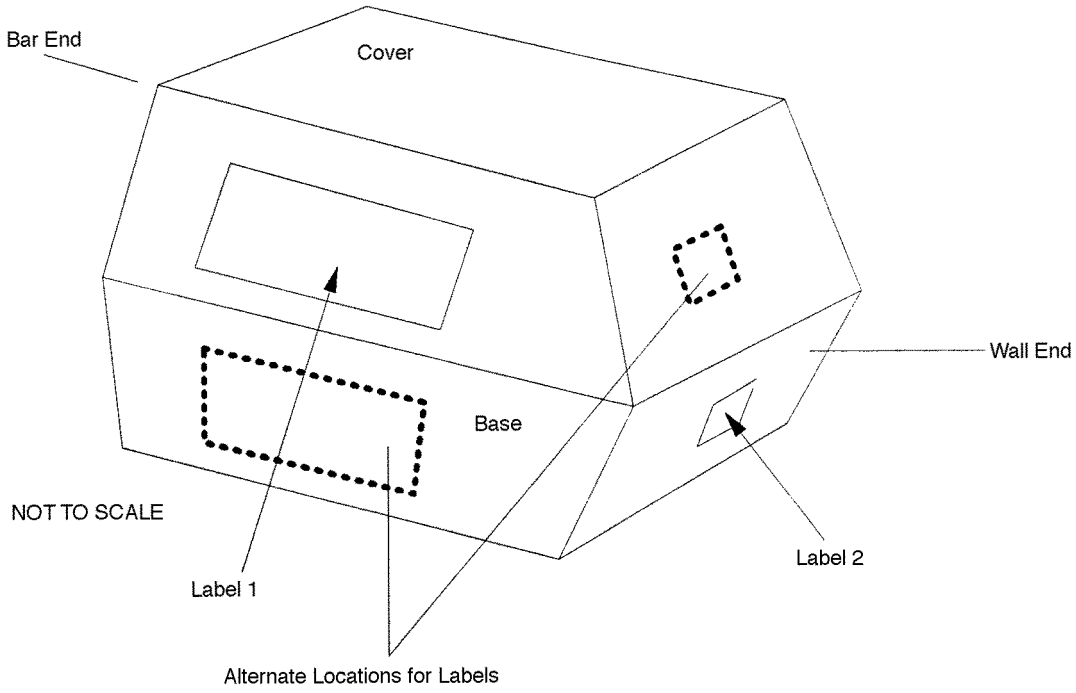


Figure 7
Recommended and Alternative Locations for Labels on Wafer Boxes for Use with Wafers of 100 to 200 mm Diameter

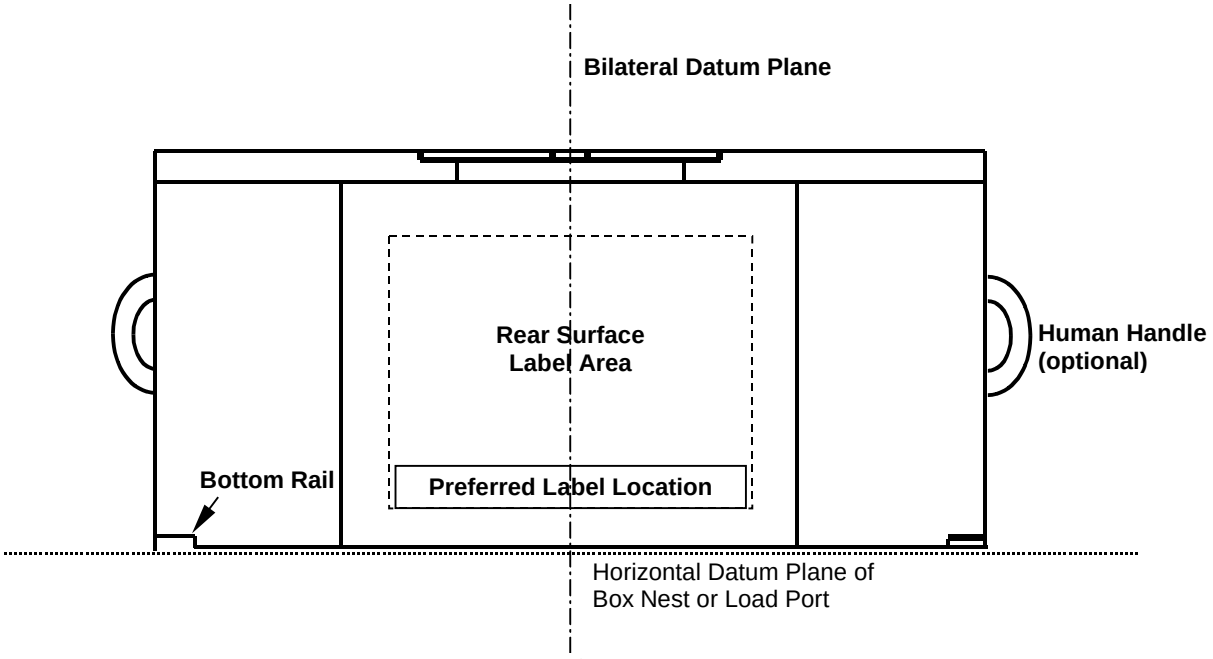


Figure 8a
300 mm FOSB Rear Surface Label Locations

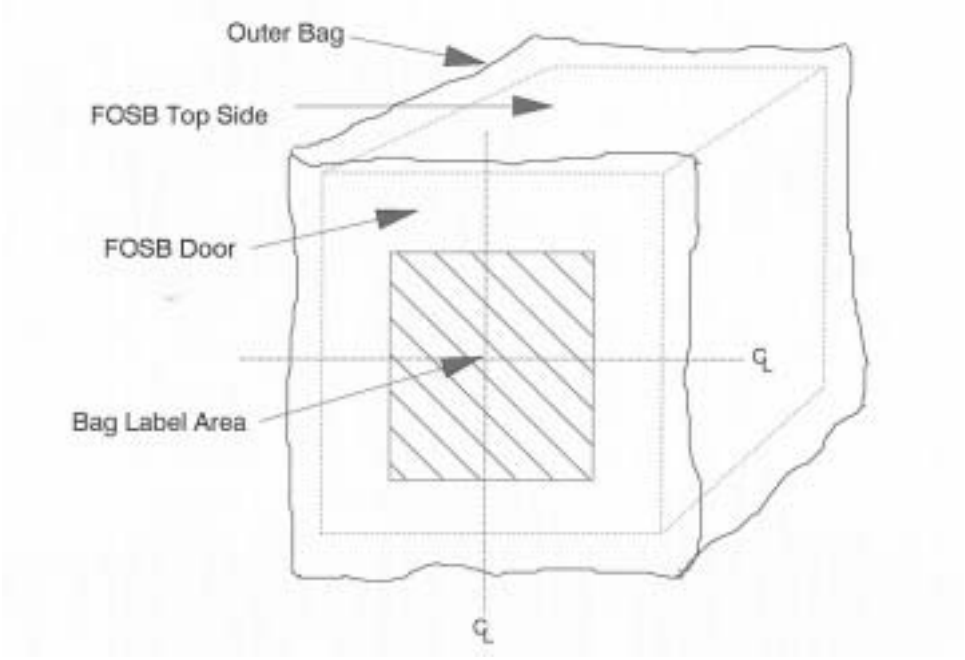


Figure 8b
FOSB Associated Outer Bag Label Location

RELATED INFORMATION 1
MODIFIED DATE FORMAT

NOTE: This related information is not an official part of SEMI T3 and was derived from information developed by the T3 Revision task force of the N.A. Traceability committee during revision of the standard. This related information was approved for publication in June 1997 after full letter ballot and approval by the NA Regional Standards Committee.

R1-1 Alternative Labeling Date Format

R1-1.1 By agreement between supplier and customer, the labeling date may be in the format of YYYYMMDD. The data identifier "6D" should be used when the year is indicated by four characters. This adds three characters to the information printed on the label, two additional date characters and the second character in the data identifier. There is space available on the minimum size label when using the two-dimensional data matrix symbol or the optional Code 128 bar code. Three additional characters added to the Code 39 bar code will not fit on the minimum size label unless the Lot Number is reduced to 13 characters.

SEMI T4-0301
SPECIFICATION FOR 150 mm AND 200 mm POD IDENTIFICATION DIMENSIONS

This specification was technically approved by the Global Physical Interfaces & Carriers Committee and is the direct responsibility of the European Equipment Automation Committee. Current edition approved by the European Regional Standards Committee on December 20, 2000. Initially available at www.semi.org February 2001; to be published March 2001. Originally published in 1995.

1 Purpose

1.1 The purpose of this specification is to ensure dimensional compatibility when mounting pod identification tags and tag identification devices.

2 Scope

2.1 The scope of this specification is to define:

- free space at a pod to allow the mounting of a pod identification tag, and
- free space to allow data transmission.

2.2 This specification is applicable to 150 mm and 200 mm Standard Mechanical Interfaces (SEMI E19). The space required for pod handling per SEMI E47 is considered.

2.3 This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

3 Limitations

3.1 This specification applies to pod identification only.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E15 — Specification for Tool Load Port

SEMI E19 — Standard Mechanical Interface (SMIF)

SEMI E47 — Specification for 150 mm/200 mm Pod Handles

NOTE 1: As listed or revised, all documents cited shall be the latest publications of adopted standards.

5 Terminology

5.1 *pod* — a box having a Standard Mechanical Interface (SMIF) per SEMI E19.

5.2 *Pod Identification Tag* — information carrier mounted to a pod.

5.3 *Standard Mechanical Interface (SMIF)* — interface plane between pod and another minienvironment per SEMI E19.

5.4 *Tag Identification Device* — device for transferring information from/to a pod identification tag.

6 Requirements

6.1 The defined free space for a pod identification tag (see Figure 1) may not be used by any other device than the pod identification tag and its supports.

6.1.1 The pod identification tag and its supports may not exceed the outline of the defined free space for a pod identification tag (see Related Information Section R1-1).

6.2 The defined free space for data transmission (see Figure 1) may only be used by the tag identification device if necessary (see Related Information Section R1-2).

Table 1 Dimensions of Defined Free Space

Dimension	*150 mm SMIF*	*200 mm SMIF*
A1	130 mm	167.5 mm
A2	160 mm min. 180 mm recommended	207.5 mm min. 227.5 mm recommended
A3	70 mm	70 mm
B1	36 mm	36 mm
B2	43 mm	43 mm
B3	120 mm	120 mm

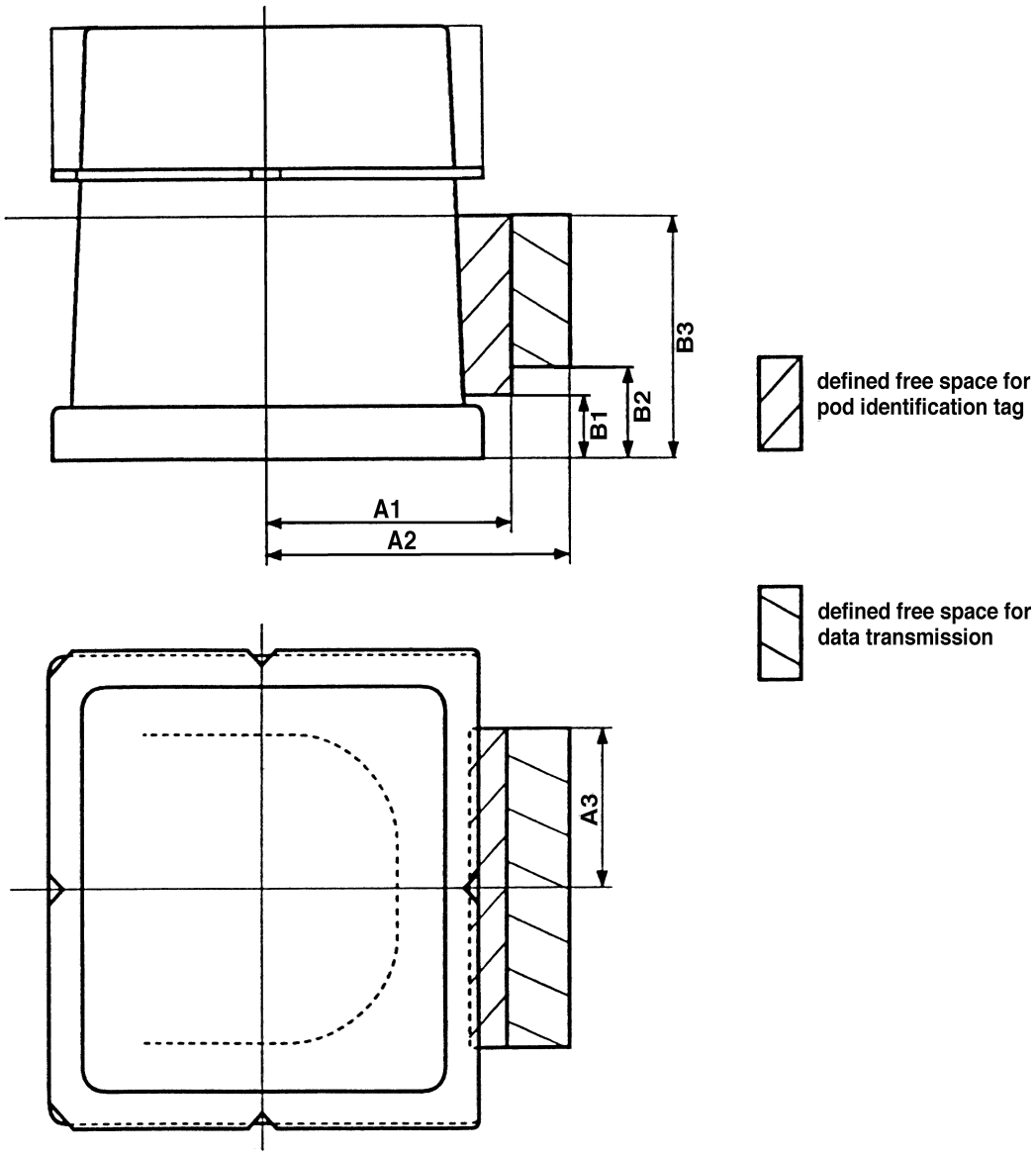


Figure 1

NOTICE: SEMI makes no warranties or representations as to the suitability of the standards set forth herein for any particular application. The determination of the suitability of the standard is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature respecting any materials or equipment mentioned herein. These standards are subject to change without notice.

The user's attention is called to the possibility that compliance with this standard may require use of copyrighted material or of an invention covered by patent rights. By publication of this standard, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of any such patent rights or copyrights, and the risk of infringement of such rights, are entirely their own responsibility.

RELATED INFORMATION 1

NOTE: This related information is not an official part of SEMI T4, but was approved for publication by full letter ballot procedures in 1995.

R1-1 As the outline of the pod sidewall is not standardized, the available space for the pod identification tag may vary between different pod types.

R1-2 The defined free space for data transmission should not be obstructed for the following reasons:

- data transmission
- loading/unloading
- SEMI E15 (multiple row applications)

NOTICE: SEMI makes no warranties or representations as to the suitability of the standards set forth herein for any particular application. The determination of the suitability of the standard is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature respecting any materials or equipment mentioned herein. These standards are subject to change without notice.

The user's attention is called to the possibility that compliance with this standard may require use of copyrighted material or of an invention covered by patent rights. By publication of this standard, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of any such patent rights or copyrights, and the risk of infringement of such rights, are entirely their own responsibility.

SEMI T5-96 (Reapproved 1104)
SPECIFICATION FOR ALPHANUMERIC MARKING OF ROUND GALLIUM ARSENIDE WAFERS

This specification was technically approved by the Global Traceability Committee and is the direct responsibility of the North American Traceability Committee. Current edition approved by the North American Traceability Committee on July 11, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1996; previously published in 1999.

1 Purpose

1.1 The purpose of this document is to define standard criteria for the alphanumeric marking of round gallium arsenide wafers, in order to improve the consistency of wafer marking and allow simplification of the performance requirement of automatic optical character recognition (OCR) equipment.

2 Scope

2.1 This specification defines the geometric and spatial limits of the alphanumeric code, specifically for nominally round, flatted gallium arsenide wafers. It also defines the basic code used to characterize the individual wafer, thereby providing practical operator interpretation. This document does NOT address the marking techniques that may be employed when complying with this standard nor does it address any health issues associated with those techniques.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards

3.1 *SEMI Standards*

SEMI AUX001 — List of Vendor Identification Codes

SEMI M12 — Specification for Serial Alphanumeric Marking of the Front Surface of Wafers

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

4.1 *Definitions*

4.1.1 *adjacent character misalignment* — the vertical distance, *r*, between the character baselines of two adjacent characters on the same line (see Figure 6).

4.1.2 *character height* — the vertical distance between the lowest and the highest centerpoints of a character.

4.1.3 *character separation* — the horizontal distance between the adjacent boundaries of any characters (see Figure 1).

4.1.4 *character skew* — the angle between the character baseline and a line parallel with the bottom of the character window (see Figure 5).

4.1.5 *character spacing* — the horizontal distance between the character spacing reference lines of the adjacent characters (see Figure 1).

4.1.6 *character width* — the horizontal distance between the most left and the most right centerpoint of a character.

4.1.7 *code field (also known as character window)* — the rectangular window within which all characters must be contained (see Figure 4).

4.1.8 *front surface of the wafer* — the surface upon which active semiconductor devices have been, or will be, fabricated.

NOTE 1: This can be either the V-Groove or Dovetail side of the GaAs wafer.

4.1.9 *line character misalignment* — the vertical distance, *R*, between the character baselines of any two characters on the same line (see Figure 7).

5 Shape and Size of Marking

5.1 Dot matrix method shall be used to write characters. The minimum matrix shall be 5 dots horizontal and 9 dots vertical as shown in Figure 1. More dots may be used.

NOTE 2: The 5 × 9 dot matrix shown in Figure 1 is the minimum number of dots allowed. More dots may be used, up to and including a solid line. A solid line is not recommended, since it may increase wafer breakage.

5.2 *Character Dimensions and Spacing* — See Table 1, Table 2, and Figure 1.

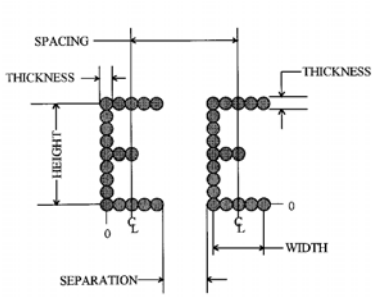


Figure 1
Character Outline

Table 1 Character Dimensions and Spacing — Configuration A — 3", 100 mm, 125 mm, 150 mm

Character	*(mm)*
Height	1.624 ± 0.025
Width	0.812 ± 0.025
Thickness	0.200 + 0.050 – 0.150
Spacing	1.420 ± 0.025
Minimum Separation	0.400

Table 2 Configuration B — 2", Option for 3" Wafers

Character	*(mm)*
Height	0.812 ± 0.025
Width	0.406 ± 0.025
Thickness	0.100 ± 0.050
Spacing	0.710 ± 0.025
Minimum Separation	0.104

NOTE 3: The thickness of the diagonal in the letter "N" is 0.138 ± 0.05 mm for single density dot matrix.

5.3 *SEMI OCR Standard Character Set* — See Figure 2 and Appendix 1.

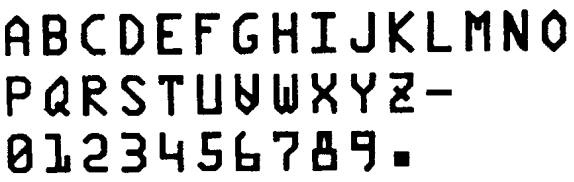


Figure 2
Standard Character Set

6 Alphanumeric Code

6.1 *Code* — Limited to one line of 20 characters maximum (see Figure 3 and Table 3 for an example using 15 characters). The first five to ten characters are an identification number which is unique to the ingot for a given supplier. This is followed by a dash, which is followed by three digits which indicate the wafer number, as numbered starting from the seed end of the ingot. The next two alpha characters identify the vendor according to SEMI AUX001. The last optional characters are specified by the vendor or customer. For example, these characters could be used to differentiate specifications, orientation, or doping. The character string (using a five character ingot as example) is constructed as follows:

Table 3 Vendor identification code

Character #	*Character Style*	*Parameter*	*Definition*
1 - 5	Alphanumeric	Ingot number	Supplier-assigned
6	Alpha	dash	a spacer
7 - 9	Numeric	Wafer number	Number of wafer in ingot
10 - 11	Alpha only	Vendor Identification Code	See SEMI AUX001
12 - 15	Alphanumeric	Optional: characters to identify specification(s)	Supplier- or customer-specified

6.2 If the optional special code characters are used to indicate doping, surface orientation, the symbols shown in Table 4 will be employed.

Table 4 Special Code Characters

Parameter	*Code*	*Definition*
Device surface orientationand flat location	V	V - Groove
	D	Dovetail
Dopant	U	Undoped
	C	Carbon
	R	Chromium
	T	Tellurium
	I	Indium
	S	Silicon
	L	Sulfur
	Z	Zinc
	E	Selenium
Front Surface Orientation	0	100
	A, B	111 A or B
	2	100 (2°off)
	3	100 (other off orientation)
	4	other orientation
	5	other flats

6.3 An example of the code is given in Figure 3.

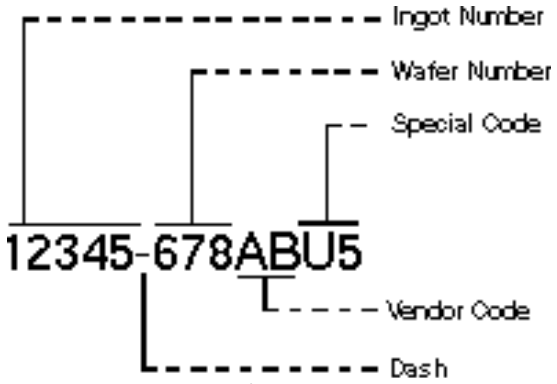


Figure 3
Example of Code for 3" Wafer

7 Code Field Location

7.1 Code field shall be located on the polished front surface of wafers or on the polished or etched back surface of wafers as shown in Table 5.

7.2 Code field is located as shown in Figure 4 and Table 6.

7.3 All characters must be contained within the code field along the major flat. The top of the characters is toward the side of the code field nearest the flat, see Figure 4.

7.4 *Dimensions* — See Figure 4 and Table 6.

7.5 In the standard specification, the first character of the code line is located toward the left side of the code field.

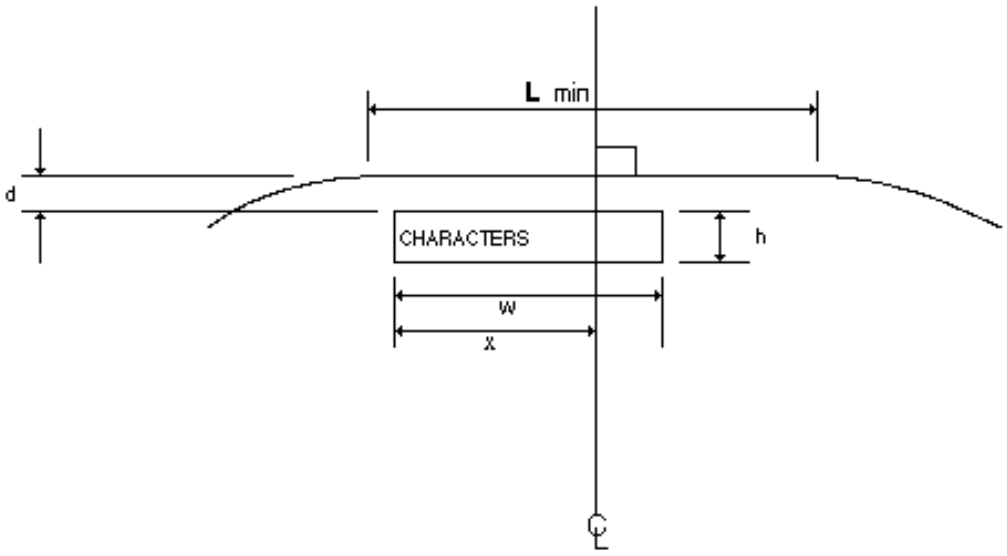


Figure 4
Code Field Location for Flatted Wafers

Table 5 Location of Code Field

Wafer Diameter	*Location of Code Field*
2"	Front (standard); Back surface (alternate)
3"	Front (standard); Back surface (alternate)
100 mm	Front surface
125 mm	Front surface
150 mm	Front surface

Table 6 Code Field Location and Dimensions

Parameter (mm)	*2"*	*3"*	*3"*	*100 mm*	*125 mm*	*150 mm*
Configuration Character Dimension(See Tables 1 and 2)	*B*	*B*	*A*[#1]	*A*	*A*	*A*
L min	14.23	19.05	19.05	30.0	40.0	55.0
x	7.1	9.5	9.5	15.0	20.0	27.5
w	14.0	14.0	19.0	27.0	27.0	27.0
d	1.0	1.0	1.0	1.0	1.0	1.0
h	1.4	1.4	2.4	2.4	2.4	2.4

#1: For 3" wafers, only 13 characters are allowed due to limitations on the size of the code field.

8 Character Alignment

8.1 *Character Skew* — 3 degrees maximum allowable (see Figure 5).

8.2 Maximum character misalignment (see Figures 6 and 7).

8.2.1 Maximum adjacent character misalignment allowable is 0.230 mm.

8.2.2 Maximum line character misalignment allowable is 0.460 mm.

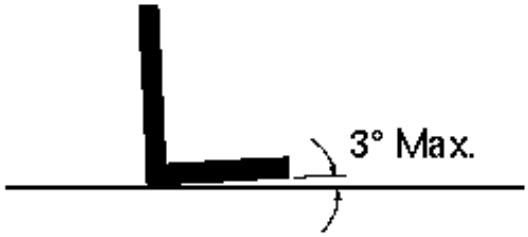


Figure 5
Character Skew

Figure 6
Adjacent Character Misalignment

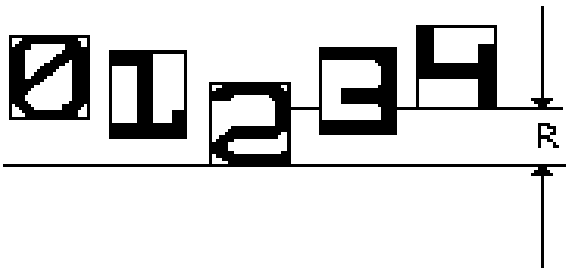
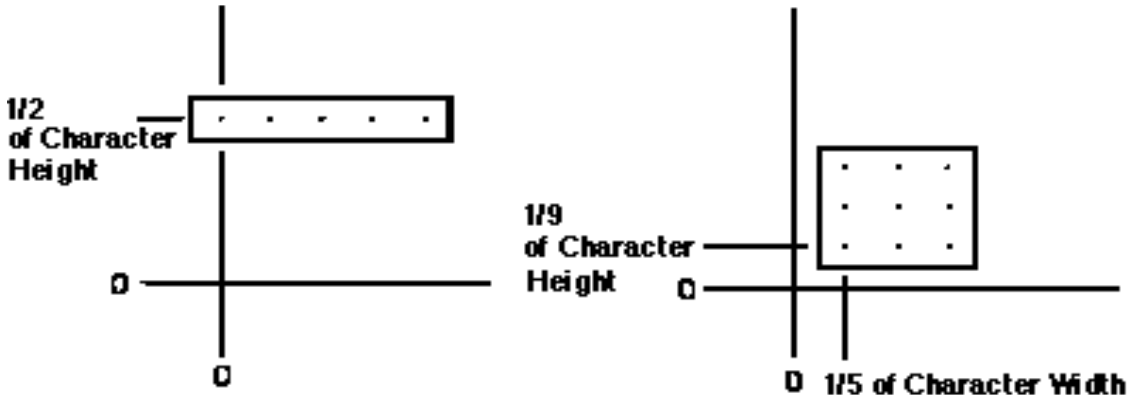
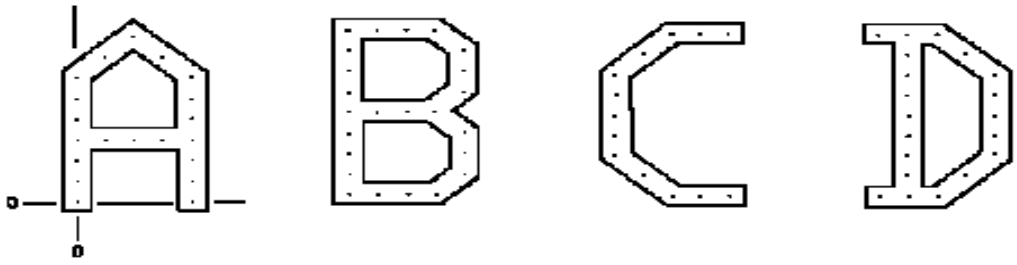


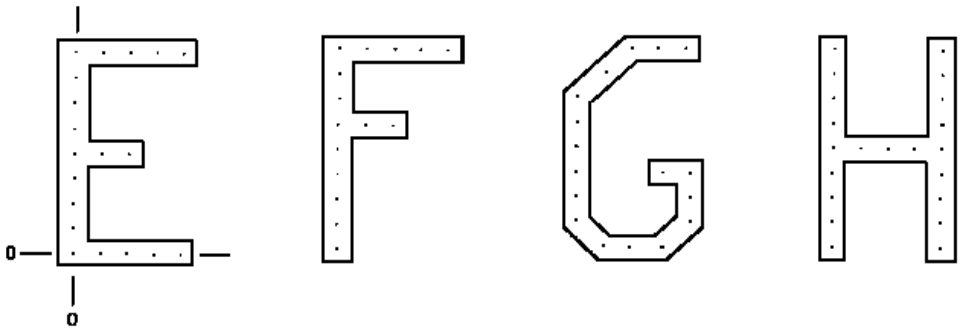
Figure 7
Line Character Misalignment

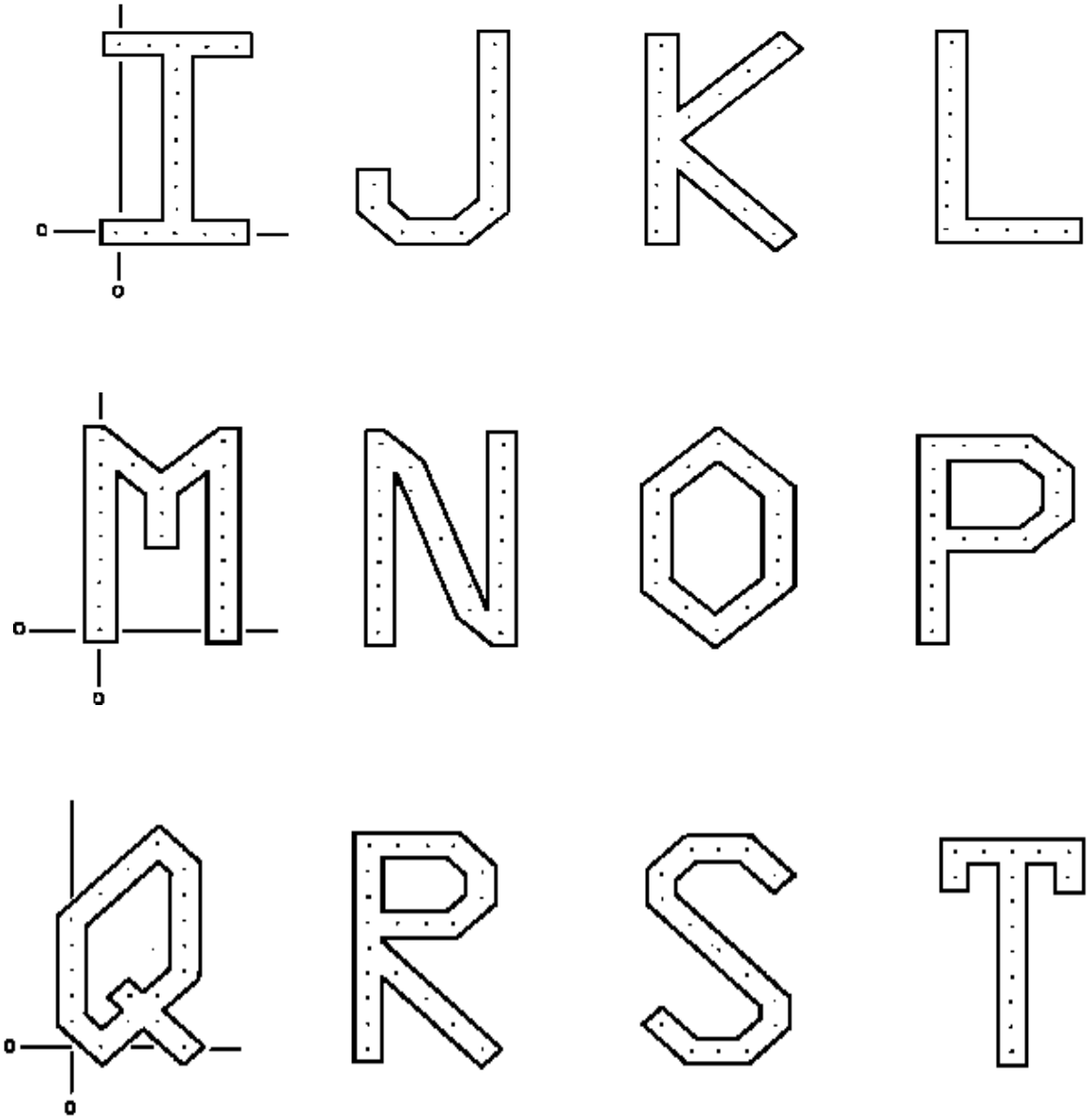
APPENDIX 1
SEMI OCR CHARACTER OUTLINES

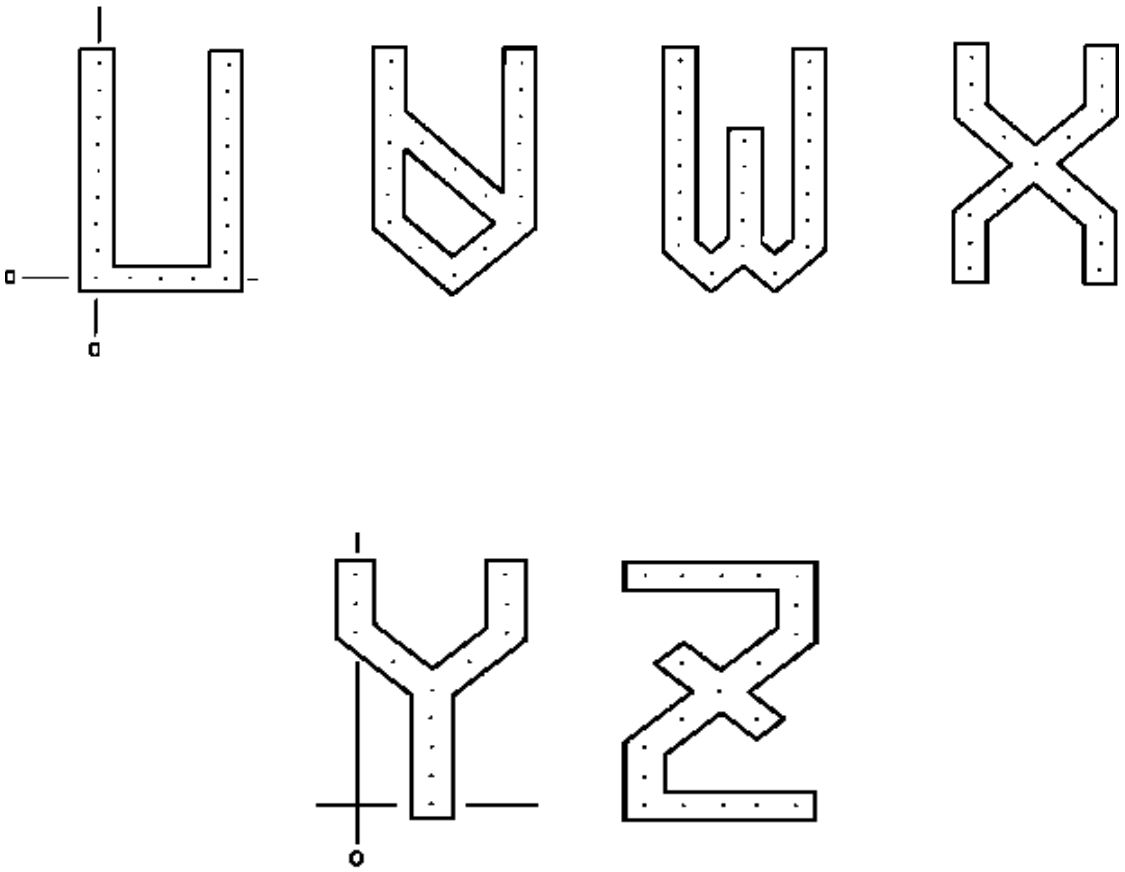
NOTICE: The material in this appendix is an official part of SEMI T5 and was approved by full letter ballot procedures.

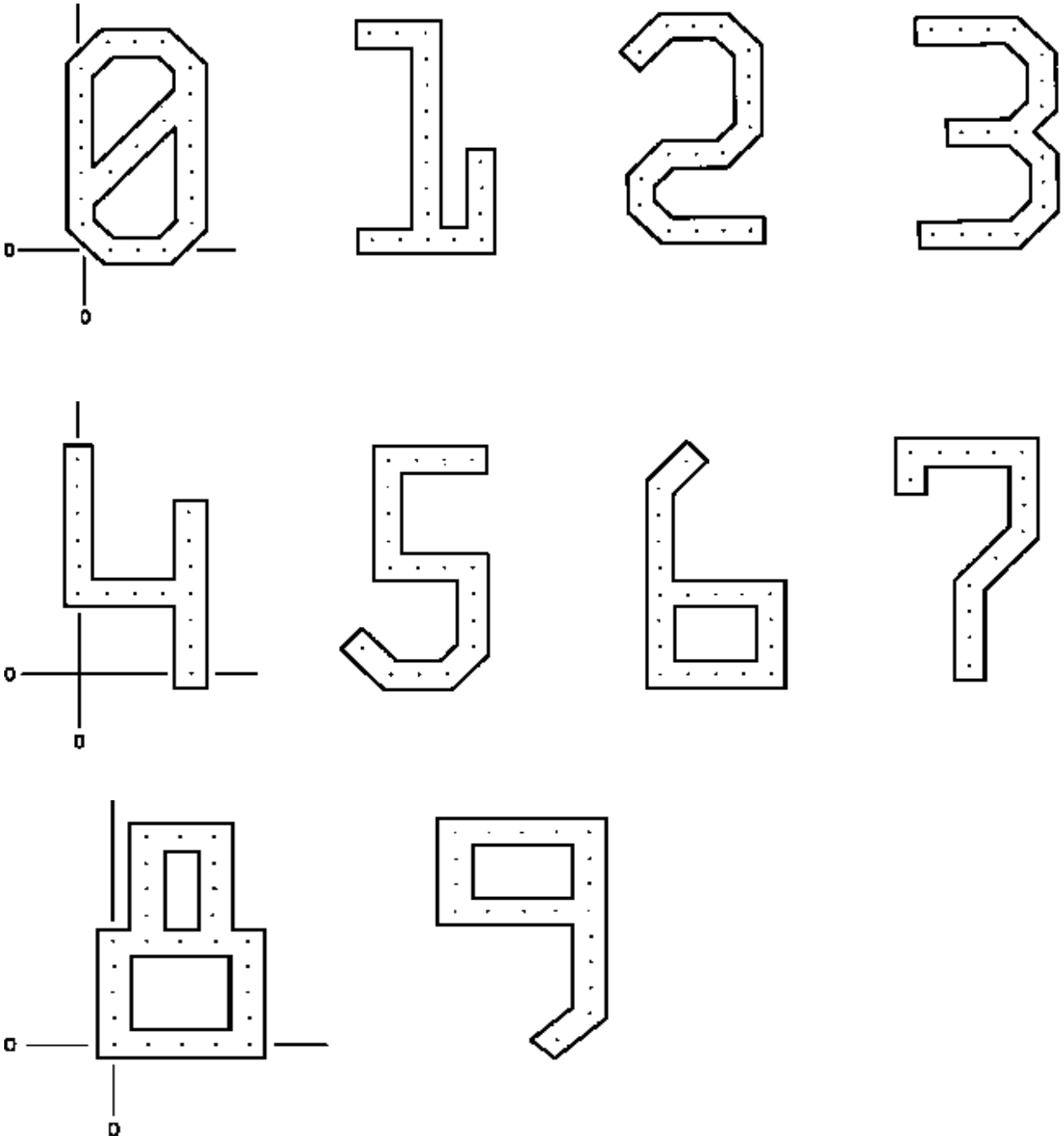












RELATED INFORMATION 1

NOTICE: This related information is not an official part of SEMI T5. This related information was approved for publication by full letter ballot procedures.

R1-1 Considerations for Reliable Automatic Reading of the Marking

R1-1.1 The following suggestions are offered to assist in assuring the most reliable automatic reading of the alphanumeric marking.

R1-1.2 *Character Stroke Thickness* — If a 5 × 9 dot matrix is chosen for marking, it is recommended that the minimum dot size be 0.100 mm. Double or higher density dot matrix is recommended; when used, smaller dot diameters may be employed. Stroke thickness should be constant withing 20% over the entire character set so that the reader settings may be optimized for the specific wafer run.

R1-1.3 *Contrast* — The character should have sufficient contrast to be legible. Contrast may be affected by depth and other conditions.

R1-1.4 *Clear Zone* — It is recommended that the area immediately beneath and a minimum of 0.500 mm around the marking characters be of uniform reflectivity and free of any lithography and process overlay edges.

R1-2 Considerations for the Use of Front Surface Markings

R1-2.1 Marks can impinge upon areas where devices may be printed. Since mask geometries are varied, considerations of the mark area should be made in mask design and also when applying the mark specifications to existing mask designs.

R1-2.2 When the mark is applied prior to epitaxial deposition, a crown or epi may grow along the mark edge. The height of this crown will depend upon the epi thickness and the deposition process.

SEMI T6-0697 (Reapproved 1104)
PROCEDURE AND FORMAT FOR REPORTING OF TEST RESULTS BY ELECTRONIC DATA INTERCHANGE (EDI)

This procedure was technically approved by the Global Traceability Committee and is the direct responsibility of the North American Traceability Committee. Current edition approved by the North American Traceability Committee on July 11, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published in 1997; previously published in 1999.

1 Purpose

1.1 To facilitate the electronic transfer of quality and test data between users and suppliers.

2 Scope

2.1 This document describes a procedure and format using ANSI ASC X12 "*863 Report of Test Results*" for electronic data interchange (EDI). The ANSI standard provides a basic structure and codes for transmitting messages. This is supplemented by SEMI-generated codes to describe product parameters and test methods specific to the semiconductor industry. For a description of the EDI business applications, see Appendices 1 and 2.

2.2 This standard may be used to report test results for all products used in the semiconductor industry when the applicable codes are included in a SEMI standard. It is intended to provide a consistent method for transmit-ting test results throughout the industry. Any implemen-tation of this document shall be agreed upon between trading partners.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards

3.1 *SEMI Standards*

SEMI AUX001 — List of Vendor Identification Codes

SEMI M12 — Specification for Serial Alphanumeric Marking of the Front Surface of Wafers

SEMI M18 — Format for Silicon Wafer Specification Form for Order Entry

3.2 *ANSI Standards*[1]

ASC X12 — 863 Report of Test Results, version 003 release 050

ASC X12 — Data Dictionary

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Terminology

4.1 *Abbreviations and Acronyms*

4.1.1 *ANSI* — American National Standards Institute

4.1.2 *ASC X12 (Accredited Standards Committee X12)* — Comprised of industry members for the purpose of creating EDI standards for submission to ANSI for subsequent approval and dissemination.

4.1.3 *EDI (Electronic Data Interchange)* — The computer-to-computer exchange of information which has tradi-tionally been communicated using paper documents.

4.2 *Definitions*

4.2.1 *certificate of analysis EDI message* — one message containing measurement or statistical data for one shipment, from one supplier site to one user site, of one user part number against one user purchase order shipped. Multiple lot numbers may be included in the shipment. (See Appendix 5.)

4.2.2 *codes* — a recognized set of abbreviations or conventions for representing specific elements of data.

4.2.3 *EDI translation* — the conversion of application data to and from the ASC X12 standard format.

4.2.4 *manufacturing lot* — a generic description for a group of parts that have a relationship as defined by the party establishing the identification (e.g., batch, shipment, production run, qualification/test run, individual product). (See Application Notes.)

1 American National Standards Institute, Headquarters: 1819 L Street, NW, Washington, DC 20036, USA. Telephone: 202.293.8020; Fax: 202.293.9287, New York Office: 11 West 42nd Street, New York, NY 10036, USA. Telephone: 212.642.4900; Fax: 212.398.0023, Website: www.ansi.org

4.2.5 *mapping* — the process of identifying the standards data element relationship to application data elements.

4.2.6 *message* — entire data stream including the outer envelope.

4.2.7 *statistical results EDI message* — one message containing measurement or statistical data for defined parameters for a stated period of time (see Appendix 5).

4.2.8 *test results EDI message* — used to designate data provided by special request (e.g., engineering, qualifications). This message contains specific measurement or statistical data for one request, from one trading partner to another trading partner, of one part number against one purchase order. Multiple lot numbers may be included (see Appendix 5).

4.2.9 *trading partner* — all members within the channels of distribution within an industry (suppliers, carriers, users, and intermediaries)[2] . This includes buyers and sellers which represent SEMI terms of user and supplier as well.

5 Requirements

5.1 An implementation model shall be agreed upon by trading partners. It is the intent of this document to make interpretation of the models used for transmitting electronic messages more consistent, so that implementations are based upon common practices.

5.1.1 Select one of the report types in Table 1 using the business model (Appendix 1) and the definitions found in Section 4.

Table 1 Report Types

Code	*Type of EDI Message*
CA	Certificate of Analysis
RT	Test Results
SR	Statistical Results

5.1.2 Define data requirements representing the requested measurements and statistics that are recorded for reporting electronically. (See Appendix 2.)

5.1.3 Select codes for parameters, units of measure, and statistical terms. Appendix 4 is a guideline to assist in modeling the EDI message. It uses codes selected from the ANSI Data Dictionary as well as codes created by SEMI for the semiconductor industry.

5.1.4 Data is electronically reformatted from the application where it resides into a format suitable for EDI transmission. This usually requires the use of translation software and the development of application interface programs.

5.2 Thorough piloting, testing, and educating is required for successful implementation.

6 Procedures

6.1 See Appendix 4.

7 Application Notes

7.1 Pending ANSI approval, SEMI is an authorized agency to maintain the tables of codes.

7.2 The material contained in Appendix 4 was created by using an EDI simulator referencing the ASC X12 "*863 Report of Test Reports*", version 003 release 050.

7.3 In using Appendix 4, refer to the column "SEMI Use" (far-left) to determine if data element usage is mandatory, conditional, or optional. SEMI mandatory elements include all ASC X12 863 mandatory elements, as well as selected other elements that are optional or conditional within ASC X12 863.

7.4 In Appendix 5, the example messages in this appendix were simplified by showing only a portion of what they can do. In practice, all of the transaction types (CA, RT, and SR) can use any combination of the statistical codes in Appendix 4, the new statistical codes in Appendix 4, or raw measurement data.

7.5 Additional statistical codes are defined in Appendix 3. These codes are pending ANSI approval.

7.6 This procedure will accommodate date/time considerations for the turn of the century. There are many options found in the data transmission segments in this document. The end result for which option is utilized will be agreed upon by the trading partners. The message is itself part of the ANSI standard, and any revisions to this standard will be incorporated.

7.6.1 In the data element type, DT is a standard ANSI definition and is being addressed by ASC X12 Committee.

7.6.2 In the BTR segment, used to identify the date of the actual transmission, BTR06 may be used as a century reference number.

7.6.3 In the DTM segments, used to identify the date for the actual data, the DTM05 data element of CC represents a two-digit century code (e.g., 19 for 1999, 20 for 2000).

2 The term "Trading Partner" is referenced from the Global Electronics Guidelines (DRAFT) for Bar Code & 2D Symbol Marking of Products and Packages in Conjunction with EDI.

7.7 Multiple levels of lot definitions (i.e., Lots and Sub-lots) may be handled through nesting within the LIN loop.

8 Listing of Appendices

8.1 *Appendix 1* — EDI Business Model

8.2 *Appendix 2* — EDI Transmission Flowchart

8.3 *Appendix 3* — New EDI Statistics (Definitions)

8.4 *Appendix 4* — EDI Transmission Components (863 Report of Test Results)

8.5 *Appendix 5* — Examples of EDI Transmissions