

SEMI T1-95 (Withdrawn 0709) SPECIFICATION FOR BACK SURFACE BAR CODE MARKING OF SILICON WAFERS

This standard was technically approved by the global Traceability Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on May 13, 2009. It was available at www.semi.org in June 2009 and on CD-ROM in July 2009. Originally published in 1993; previously published March 2003.

NOTICE: This document was balloted and approved for withdrawal in 2009.

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1 Scope

1.1 This specification defines the content and location of a back surface bar code marking for silicon wafers. The code is variable in length from 7 to 18 characters which are user-definable. A character position is held constant for the checksum character, but all else is variable. No other information is encrypted into the code. This allows the performance requirements of related bar code reading equipment to be simplified. In addition, provision is made for an optional alphanumeric marking of the size specified in SEMI M12 to enable operator identification of wafers. This alphanumeric code is not intended to be machine readable.

NOTE 1: The example as described in Table 1 and Figure 1 pertains to a hard mark applied by the silicon wafer manufacturer.

1.2 This specification applies to flatted or notched silicon wafers of nominal diameter 125 mm and larger, as specified in SEMI M1.

1.3 The bar code can be read bi-directionally without impairing its decodability.

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.

2 Referenced Standards and Documents

2.1 SEMI Standards

SEMI M1 — Specifications for Polished Single Crystal Silicon Wafers

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.

3 Terminology

3.1 Definitions

3.2 *background, of a bar code symbol* — the uniform lighter or more reflective region, including quiet zones, that provides contrast for the darker bars.

3.2.1 *bar, in a bar code symbol* — the darker or less reflective element of the symbol.

3.2.2 *bar code density* — the number of characters, exclusive of quiet zones, that can be represented in a linear unit of measure.

NOTE 2: Bar code density can be expressed in characters per inch (cpi) or characters per millimeter (cpmm).

3.2.3 *bar code symbol* — an array of rectangular bars and spaces that are arranged in a predetermined pattern following specific rules to represent elements of data that are referred to as characters.

NOTE 3: The symbol is comprised of message characters and start/stop characters, check characters, and quiet zones as required by a particular symbology to form a complete scannable entity.

3.2.4 *bar code character* — a single group of bars and spaces which represent an individual number, letter, punctuation mark, or other symbol.

3.2.5 *bar height, of a bar code symbol* — the bar dimension perpendicular to the bar width.

3.2.6 *bar width, of a bar code symbol* — the perpendicular distance across a bar between the points on opposite edges that have a reflectance that is midway between the background and bar reflectance.

3.2.7 *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.

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

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

3.2.10 *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.

3.2.11 *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.

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

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

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

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

3.2.16 *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.

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

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

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

3.2.20 *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).

3.2.21 *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 Code¹

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 standards SEMI M12 and SEMI 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.

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.

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

8 Definition of the Error-Detecting Method

8.1 Define the following symbols:

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

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 ¶ 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 :

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

8.4.3 Calculate the value for CD:

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

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