SEMI T9-1110 (Reapproved 0216)
SPECIFICATION FOR MARKING OF METAL LEAD-FRAME STRIPS WITH A TWO-DIMENSIONAL DATA MATRIX CODE SYMBOL

This Standard was technically approved by the Traceability Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 4, 2015. Available at www.semiviews.org and www.semi.org in February 2016; originally published in 1998; previously published November 2010.

1 Purpose

1.1 This Specification provides a marking symbology that can be used to mark metal lead-frame strips.

2 Scope

2.1 This Specification defines the geometric and spatial relationships and content (including the error checking and correcting code) of rectangular two-dimensional (2D), machine-readable, binary Data Matrix symbology for front-surface marking of metal lead-frame strips (also called 'strips'). It may be used in conjunction with the alphanumeric marking codes specified in SEMI M12 and SEMI M13.

2.2 This Specification defines a 22-character default message that is included in all marks, and option for up to 50 additional characters, for a total of 72 message characters. An optional shorter message contains 12 to 16 message characters; the resulting square field is narrower but taller than the 22-character rectangular one.

2.3 This Specification provides a suggested location for the code symbol. It also provides guidelines for specifying other code locations when the suggested location is not suitable for an application.

2.4 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.

NOTE 1: A mark survivability experiment is being conducted by the SEMI North American Traceability Committee. A report is available from SEMI: request 'Leadframe Mark Survivability Report' dated February, 1999.

2.5 Data Matrix symbology is applicable to a broad range of lead-frame materials including copper and Alloy 42 in both bare and plated conditions. The format and algorithms of this code are based on two-dimensional symbology specified in ISO/IEC 16022.

2.6 This Specification supports EIA Package Marking Specification by enabling individual die tracking in the manufacturing steps between die attach and device packaging marking.

NOTE 2: Marking of each die, while in wafer form, prior to dicing, could also accomplish this end.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards and Documents

3.1 *SEMI Standards and Safety Guidelines*

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

SEMI M13 — Specification for Alphanumeric Marking of Silicon Wafers

3.2 *ANSI Standards*[1]

ANSI/FACT-1 — Data Application Identifier Standard

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

[1] American National Standards Institute, 25 West 43rd Street, New York, NY 10036, USA; Telephone: +1.212.642.4900, Fax: +1.212.398.0023, http://www.ansi.org

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NOTE 3: This standard is equivalent to ISO 646, Information Processing – ISO 7-bit Coded Character Set for Information Exchange.[2]

ANSI MH10.8.2 — Data Application Identifier Standard

3.3 *ISO/IEC Standard*[2]

ISO/IEC 16022 — Information Technology – Automatic Identification and Data Capture Techniques – Data Matrix Bar Code Symbology Specification

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

4 Terminology

4.1 *Definitions*

4.1.1 *alignment bar, of a data matrix code symbol* — a solid line of contiguous filled cells abutting a line of alternatively filled and empty cells. [ISO/IEC 16022]

4.1.2 *binary values* — a dot in the substrate 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.

4.1.3 *border column* — the outermost column of a data matrix code symbol. This column is a portion of the finder pattern.

4.1.4 *border row* — the outermost row of a data matrix code symbol. This row is a portion of the finder pattern.

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

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

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

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

4.1.9 *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.

4.1.10 *data matrix code symbol* — a two-dimensional array of square cells arranged in contiguous rows and columns. In certain ECC200 symbols, data regions are separated by alignment patterns. The data region is surrounded by a finder pattern. [ISO/IEC 16022]

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

NOTE 4: To assure reading efficiency, a minimum contrast of 30% is required between the reflectance value of a dot and the surrounding substrate surface. Various densitometers can provide such measurements nondestructively.

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

4.1.13 *finder pattern, of a data matrix code symbol* — a perimeter to the data region. Two adjacent sides contain dots in every cell; these are used primarily to define physical size, orientation, and symbol distortion. The two opposite sides are made up of cells containing dots in alternate cells. [ISO/IEC 16022]

4.1.14 *orientation corner, of a lead-frame strip* — the strip corner used to assure correct die assembly orientation. It is denoted by an identification mark.

4.1.15 *quiet zone* — an unmarked background area that surrounds the entire code symbol.

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

[2] International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland; Telephone: +41.22.749.01.11, http://www.iso.org

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NOTE 5: 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 on 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 lead-frame strips furnished to this specification shall include the following items:

5.1.1 *Message Characters*

5.1.1.1 Quantity (12 to *mm*, where *mm* = 13 to 16; or 22 to *nn*, where *nn* is 23 to 72).

5.1.1.2 Content of Message Characters 13 to 16, or 23 and up, if present.

5.1.2 Location of Mark, if different from § 6.3

6 Requirements

6.1 *Shape and Size of the Data Matrix Code Symbol*

6.1.1 *Data Matrix Code Symbol Dimensions*

6.1.1.1 Each rectangular matrix code symbol shall be composed of an array of 12–16 rows and 26–48 columns as defined in ISO/IEC 16022.

6.1.1.2 Each square matrix code symbol shall be composed of an array 16 rows and 16 columns.

6.1.1.3 Table 1 defines the field dimensions and maximum number of message characters for each of the five available combinations of rows and columns.

Table 1 2-D Data Matrix Code Symbol Dimensions

Cell Spacing (µm)	*# of Cells in Row*	*# of Cells in Column*	*C1*	*R1*	*C2*	*R2*	*# of Message Characters, Maximum*
			(mm)				
100	12	26	1.10	2.50	1.20	2.60	22
	12	36	1.10	3.50	1.20	3.60	31
	16	36	1.50	3.50	1.60	3.60	46
	16	48	1.50	4.50	1.60	4.80	72
	16	16	1.50	1.50	1.60	1.60	16

6.1.1.4 Cell spacing shall be 100 µm, center to center.

6.1.2 *Dot Size* — The nominal shape of the dot produced in the matrix may be circular or square. Its diameter or edge length shall be 100 ± 10 µm.

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

6.1.3.1 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 orientation of the matrix.

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

6.1.3.3 For these rectangular and square matrix code symbols, the reference point of the symbol shall be the physical centerpoint of the cell common to the primary border row and the primary border column.

6.1.4 The maximum allowable dot misalignment within a cell is 20 µm. This ensures that a minimum size dot covers a cell central area of radius 25 µm.

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