SEMI T9-0200
SPECIFICATION FOR MARKING OF METAL LEAD-FRAME STRIPS WITH A TWO-DIMENSIONAL DATA MATRIX CODE SYMBOL

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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 (2-D), 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 or the bar code specified in SEMI T1.

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 AIM International Symbology Specification - Data Matrix.

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.

2.7 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 Referenced Standards

3.1 *SEMI Standards*

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 Specifications*[1]

AIM International Symbology Specification — Data Matrix

3.3 *ANSI Standards*[2]

ANSI/FACT-1 — Data Application Identifier Standard

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

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

ANSI MH10.8.2 — Data Application Identifier Standard

NOTE 4: As listed or revised, all documents cited shall be the latest publications of adopted standards.

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2 American National Standards Institute, 11 West 42nd Street, New York, NY 10036, phone 212.642.4900, fax 212.398.0023

3 ISO, 1 rue de Varembe, Case Postale 56, CH-01211 Geneva 20, Switzerland

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4 Terminology

4.1 *alignment bar, of a data matrix code symbol* — a solid line of contiguous filled cells abutting a line of alternatively filled and empty cells [AIM International Symbology Specification - Data Matrix].

4.2 *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.

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

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

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

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

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

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

4.9 *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.

4.10 *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 [AIM International Symbology Specification - Data Matrix].

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

NOTE 5: 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.

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

4.13 *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 [AIM International Symbology Specification - Data Matrix].

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

4.15 *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.

NOTE 6: 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.

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

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–up, if present.

5.1.2 Location of Mark, if different from Section 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 to 16 rows and 26 to 48 columns as defined in AIM International Symbology Specification - Data Matrix.

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.

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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.

6.2 *Content of the Data Matrix Code Symbol*

6.2.1 Each matrix code symbol shall contain between 12 and 72 message characters, together with the error checking and correcting (ECC) 200 code characters, encoded in accordance with AIM International Symbology Specification - Data Matrix.

6.2.2 The message characters may include any of those designated as "mostly upper case" in Table 5 and Annex K of AIM International Symbology Specification - Data Matrix. The message characters are contained in a single field that contains multiple sub-fields (see Table 2). In the absence of a character at any assigned location, a dash ('-') shall be used.

6.2.2.1 The standard message code shall contain 22 or more characters. The first 22 characters shall be contained in sub-fields 1 through 6 whose content is listed in Table 2. The number of message characters in each of these sub-fields is fixed. Other sub-fields may be added to the message subject to Section 6.2.2.2. To save space or for other reasons, a condensed message code may be used as an alternative. Refer to Section 6.2.2.3.

6.2.2.2 Characters 23–up, if present, shall contain information as agreed upon between supplier and user. This may require field identifiers and field concatenators (see ANSI MH10.8.2).

6.2.2.3 The condensed message code shall contain 12 to 16 characters. The first 12 characters shall be contained in sub-fields 1 through 3, as listed in Table 3. The number of message characters in each of these sub-fields is fixed. Content of sub-field(s) for characters 13 through 16, if present, are to be agreed upon between supplier and user.

6.2.3 Sub-fields 2 and 3 in Table 2 and Table 3 are intended to provide a unique identification number for each strip from a given supplier.

Table 2 Sub-Field Message Characters in Rectangular Arrays for Use on Lead-Frame Strips (Standard Message Code)

Sub-Field Content		*Character Symbols*	*Number of Characters*
#	*Symbol Content*		
1	Field Identifier	IT (See NOTE 1.)	2
2	Traceability Number: Coil S/N	vendor assigned (See NOTE 2.)	3
3	Traceability Number: Strip ID	vendor assigned (See NOTE 2.)	7
4	Concatenation Symbol	+	1
5	Field Identifier	3V (See NOTE 1.)	2
6	Supplier ID	UCC/EAN coding	7
7	Optional Information	Vendor-user agreed	0 to 50
	Total		22 to 72

NOTE 1: These field identifiers are described in ANSI-FACT-1.

NOTE 2: Lead-frame strip suppliers

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