SEMI T8-0698
SPECIFICATION FOR MARKING OF GLASS FLAT PANEL DISPLAY SUBSTRATES WITH A TWO-DIMENSIONAL MATRIX CODE SYMBOL

1 Purpose

1.1 This specification is intended to provide a marking symbology that can be used to mark glass flat panel display (FPD) substrates within the fixed quality area of the edge exclusion area of the substrate.

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 or back-surface marking of glass FPD substrates (sometimes called "motherglass" substrates) which comply with the edge specifications of SEMI D12. 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 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. A survivability experiment executed by the United States Display Consortium found such marks suitable.

NOTE: Other techniques could include resist exposure and grit blasting.

2.3 Data Matrix symbology is applicable to a broad range of FPD products including virgin substrates, processed and patterned substrates, panel assemblies, and displays. An application note describes the application of Data Matrix symbology to individual panel sections contained within a multi-panel motherglass substrate. The format and algorithms of this code are based on two-dimensional symbology specified in AIM International Symbology Specification - Data Matrix.

3 Referenced Documents

3.1 *SEMI Standards*

SEMI D4 — Method for Referencing Flat Panel Display Substrates

SEMI D12 — Specification for Edge Condition of Flat Panel Display (FPD) Substrates

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 Standard*[2]

ANSI MH10.8.2 — Data Application Identifier Standard

3.4 *Uniform Commercial Council Standard*[3]

Manufacturer Identification Codes

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.

---

1 AIM International, Inc., 634 Alpha Drive, Pittsburgh, PA 15238-2802, tel 412.963.8588, fax 412.938.8753

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

3 Uniform Code Council, 8163 Old Yankee Road, Dayton, Ohio 45458

Documents Document Sharing Hub

Full document details: SEMI T8-0698

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 1: 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 non-destructively.

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 *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 2: 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 substrates furnished to this specification shall include the following items:

5.1.1 *Message Characters*

5.1.1.1 Quantity (15 to *nn*, where *nn* is 16–46, and depends on the character set to be encoded [see Table 2]).

5.1.1.2 Content of Message Characters 16 and up, if present.

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 8 to 16 rows and 32 to 46 columns (see Table 1 and Figure 1) as defined in AIM International Symbology Specification - Data Matrix. It may contain an alignment bar.

6.1.1.2 Cell spacing shall be 125 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 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 rectangular matrix code symbol shall contain between 15 and 46 message characters, together with the error checking and correcting (ECC) 200 code characters, encoded in accordance with AIM International Symbology Specification - Data Marix.

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 Marix. 8-bit characters may also be encoded with reduced field capacity (see Table 3). The first 15 message characters shall contain two elements:

a. a vendor-assigned 8-character substrate identification code, followed by

b. a 7-character vendor identification code as defined by UCC. These are a six-digit company identification, preceded by a zero (0).

Documents
Document Sharing Hub
Full document details: SEMI T8-0698

6.2.2.1 The remaining message characters, if any, shall contain information as agreed between the vendor and user. This may require field identifiers and field concatenators (see ANSI MH10.8.2).

6.3 *Location of the Data Matrix Code Symbol*

6.3.1 With the substrate positioned front surface up and with the orientation corner toward the operator and to the operator's left, the reference point of the data matrix code symbol shall be placed toward the orientation corner as specified in Table 3.

6.3.2 The 12 row × 26 column rectangular 2-D matrix code symbol shall be placed entirely outside the fixed quality area (FQA) and within a nominal edge exclusion area of 10 mm. Large symbols will extend toward the substrate center and perpendicular to the substrate edges. (See Table 1 for field dimensions.)

6.3.3 The primary row of the symbol shall be parallel to the adjacent edge of the substrate ± 10.0°. The primary column of the symbol shall be nominally perpendicular to the same edge. The symbol shall lie between these two edges and the FQA (see Figures 4 and 5). The reference point of the symbol shall be located 4.0 ± 1.0 mm from the adjacent edge of the substrate.

Table 1 2-D Data Matrix Code Symbol Dimensions

Rectangular Array Spacing	*# of Cells in Row*	*# of Cells in Column*	*C_1 (mm)*	*R_1 (mm)*	*C_2 (mm)*	*R_2 (mm)*
125 µm	12	26	1.375	3.125	1.500	3.250
	12	32	1.375	4.375	1.500	4.500
	16	36	1.875	4.375	2.000	4.500

Table 2 Message Character Count in Rectangular Arrays for Use on FPD Substrates

# of Cells in Row and Column		*12 Rows × 26 Columns*	*12 Rows × 36 Columns*	*16 Rows × 36 Columns*
Maximum # of Message Characters	8-bit	N/A	20	30
	Mostly upper-case	22	31	46

Table 3 Location of 2-D Matrix Code Symbol Substrate Back Surface Up, Orientation Corner Toward the Operator and Toward the Operator's Left

Type of Array	*Reference Point*	*Location of Reference Point*
Rectangular	Common cell of primary border row and column	*4.0 ± 1.0 mm from the nominal edge of the substrate and toward the substrate orientation corner.

* The rows of the rectangular 2-D matrix code symbol are parallel to the X-edge of a substrate whose orientation corner is in the *1,1,1* orientation or the *2*, *-1*, *0* orientation as described in SEMI D4.

SEMI T8-0698 © SEMI 1998

Documents Document Sharing Hub

Full document details: SEMI T8-0698