SEMI M21-0318 (Reapproved 0923)
GUIDE FOR ASSIGNING ADDRESSES TO RECTANGULAR ELEMENTS IN A CARTESIAN ARRAY

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1 Purpose

1.1 It is frequently very useful to have a standardized method for labeling elements in an array on a silicon wafer surface.

1.2 This Guide defines an element addressing convention for locating and uniquely identifying rectangular elements in a Cartesian array.

1.3 Such arrays are useful in locating sites for site flatness characterization, defect mapping, determination of parametric distributions, etc. on unpatterned semiconductor wafers.

2 Scope

2.1 This Guide covers procedures for assigning addresses that can be used to locate and identify rectangular elements in a Cartesian array. The array may be regular or tiled in one direction.

2.2 Relating the position of the array to the wafer surface is outside the scope of this Guide, but it may be established through use of the wafer coordinate system defined in SEMI M20.

2.3 This Guide covers procedures for assigning a unique identification (address) for each element in the array. An example of the results obtained by following this procedure are given in Related Information 1.

2.4 The element addressing convention in this Guide provides an orderly progression along perpendicular directions with addresses of adjacent elements in any direction differing by one. Consequently, distances may be calculated in a unified way.

2.5 For complex patterns, more than one array on a wafer may be defined and related to the same coordinate axes.

2.6 The element addressing convention in this Guide is consistent with that of the polar array specified in SEMI M17. In addition, element addresses can be readily transformed to addresses in other types of addressing conventions for Cartesian arrays as described in Related Information 2.

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3 Referenced Standards and Documents

3.1 *SEMI Standards and Safety Guidelines*

SEMI M17 — Guide for a Universal Wafer Grid

SEMI M20 — Practice for Establishing a Wafer Coordinate System

SEMI M59 — Terminology of Silicon Technology

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4 Terminology

4.1 Acronyms, terms, and symbols related to silicon technology, including those used in these practices, are listed and defined in SEMI M59.

5 Array Element Layout

5.1 The array is constructed from *m* vertical columns and *n* horizontal rows of identical elements of dimension a horizontally and b vertically. The number of elements in different rows and columns may vary to suit the application.

5.2 The address of an element is given by two numbers separated by a comma: (*i*,*j*). The first number, *i*, indicates the column and the second, *j*, the row.

5.3 The longest row and the longest column are used in identifying the Starting Element, which is assigned the address (0,0).

5.4 The array may have a tiled appearance, either with one or more rows offset relative to the row containing the Starting Element (row tiling) or with one or more columns offset relative to the column containing the Starting Element (column tiling).

5.4.1 For row tiling, the offset, *tr*, is a fraction (*pr/qr*) of the horizontal element dimension, *a*, where *pr* and *qr* are small whole numbers.

5.4.2 For column tiling, the offset, *tc*, is a fraction (*pc/qc*) of the vertical element dimension, *b*, where *pc* and *qc* are small whole numbers.

5.4.3 In either case, the offset may be constant or it may vary from row to row or column to column. When the offset is constant, the array pattern is repeated every *qr* rows or *qc* columns.

6 Element Addresses

6.1 Define the array center as the intersection of the vertical and horizontal array centerlines, found as follows:

6.1.1 If the array is regular (not tiled):

6.1.1.1 Count the number of elements, *m*, in the longest row.

6.1.1.2 If *m* is even, start at the leftmost element, count *m*/2 elements to the right, and construct a line along the right vertical boundary of this element. This line is the vertical array centerline (refer to Figure 1a).

6.1.1.3 If *m* is odd, start at the leftmost element, count (*m* +1)/2 elements to the right, and construct a line through the center of this element. This line is the vertical array centerline (refer to Figure 1b).

6.1.1.4 Count the number of elements, *n*, in the longest column.

6.1.1.5 If *n* is even, start at the topmost element, count down *n*/2 elements, and construct a line along the bottom horizontal boundary of this element. This line is the horizontal array centerline (refer to Figure 1c).

6.1.1.6 If *n* is odd, start at the topmost element, count down (*n* +1)/2 elements, and construct a line through the center of this element. This line is the horizontal array centerline (refer to Figure 1d).

6.1.2 If the columns of the array are tiled (refer to Figure 2a):

6.1.2.1 Count the number of columns, *m*, in the widest part of the array from left to right.

6.1.2.2 If *m* is even, start at the leftmost column, count *m*/2 columns to the right, and construct a line along the right vertical boundary of this column. This line is the vertical array centerline.

6.1.2.3 If *m* is odd, start at the leftmost column, count (*m* + 1)/2 columns to the right, and construct a line through the center of this column. This line is the vertical array centerline.

6.1.2.4 Count the number of elements, *n*′, in the column which contains or is immediately to the right of the vertical array centerline, depending on whether *m* is odd or even, respectively.

NOTE 1: The number, *n*′, is usually equal to but may be less than *n*.

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6.1.2.5 If n' is even, start at the topmost element, count down $n'/2$ elements, and construct a line along the bottom horizontal boundary of this element. This line is the horizontal array centerline.

6.1.2.6 If n' is odd, start at the topmost element, count down $(n' + 1)/2$ elements, and construct a line through the center of this element. This line is the horizontal array centerline.

6.1.3 If the rows of the array are tiled (refer to Figure 2b):

6.1.3.1 Count the number of rows, n, in the widest part of the array from top to bottom.

6.1.3.2 If n is even, start at the topmost row, count down $n/2$ rows, and construct a line along the bottom horizontal boundary of this row. This line is the horizontal array centerline (refer to Figure 1c).

6.1.3.3 If n is odd, start at the topmost row, count down $(n + 1)/2$ rows, and construct a line through the center of this row. This line is the horizontal array centerline (refer to Figure 1d).

6.1.3.4 Count the number of elements, m', in the row which contains or is immediately above the vertical array centerline, depending on whether n is odd or even, respectively.

NOTE 2: The number, m', is usually equal to but may be less than m.

6.1.3.5 If m' is even, start at the leftmost element, count $m'/2$ elements to the right, and construct a line along the right vertical boundary of this element. This line is the vertical array centerline.

6.1.3.6 If m' is odd, start at the leftmost element, count $(m' + 1)/2$ elements to the right, and construct a line through the center of this element. This line is the vertical array centerline.

6.2 Locate the Starting Element (0,0) as follows:

6.2.1 If the array center falls within an element, designate that element as the Starting Element (refer to Figure 3a).

6.2.2 If the array is regular and the array center lies at an element corner, designate the element to the right and immediately above the array center as the Starting Element (refer to Figure 3b).

6.2.3 If the array is regular and the array center lies on a vertical element boundary, designate as the Starting Element that element which contains the horizontal array centerline and is immediately to the right of the vertical array centerline (refer to Figure 3c).

6.2.4 If the array is regular and the array center lies on a horizontal element boundary, designate as the Starting Element that element which contains the vertical array centerline and is immediately above the horizontal array centerline (refer to Figure 3d).

6.2.5 If columns of the array are tiled and the array center lies on a vertical boundary between columns, designate that element immediately to the right of the vertical centerline and containing the horizontal array centerline as the Starting Element. If the horizontal array centerline also falls on an element boundary in the column immediately to the right of the vertical array centerline, designate the element in this column and immediately above the horizontal array centerline as the Starting Element (refer to Figure 4a).

6.2.6 If rows of the array are tiled and the array center lies on a horizontal boundary between rows, designate that element immediately above the horizontal array centerline and containing the vertical array centerline as the Starting Element. If the vertical array centerline also falls on an element boundary in the row immediately above the horizontal array centerline, designate the element in this row and immediately to the right of the vertical array centerline as the Starting Element (refer to Figure 4b).

6.3 Assign addresses to the array elements as follows:

6.3.1 Elements along the horizontal array centerline:

6.3.1.1 If the horizontal array centerline passes through an element, assign that element the address $(i,0)$, where i is the column number. The first column to the right of the vertical array centerline is numbered 1, the next column to the right is numbered 2, the next column to the right is numbered 3, etc. Similarly, the first column to the left of the vertical array centerline is numbered -1, the next column to the left is numbered -2, the next column to the left is numbered -3, etc. (refer to Figure 3a).

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6.3.1.2 If the horizontal array centerline falls along an element boundary in any column, *i*, assign the address (*i*,0) to the element in that column which lies immediately above the horizontal array centerline (refer to Figure 3b).

6.3.2 Elements along the vertical array centerline:

6.3.2.1 If the vertical array centerline passes through an element, assign that element the address (0,*j*), where *j* is the row number. The first row above the horizontal array centerline is numbered 1, the next row up is numbered 2, the next row up is numbered 3, etc. Similarly, the first row below the horizontal array centerline is numbered -1, the next row down is numbered -2, the next row down is numbered -3, etc. (refer to Figure 3a).

6.3.2.2 If the vertical array centerline falls along an element boundary in any row, *j*, assign the address (0,*j*) to the element in that row which lies immediately to the right of the vertical array centerline (refer to Figure 3b).

6.3.3 Remaining elements:

6.3.3.1 Assign addresses (*i*,*j*) to the remaining elements based on their position relative to the elements along the horizontal and vertical array centerlines. For example the address of the element immediately above (1,0) is (1,1) and the element immediately below (1,0) is (1,-1) (refer to Figure 5).

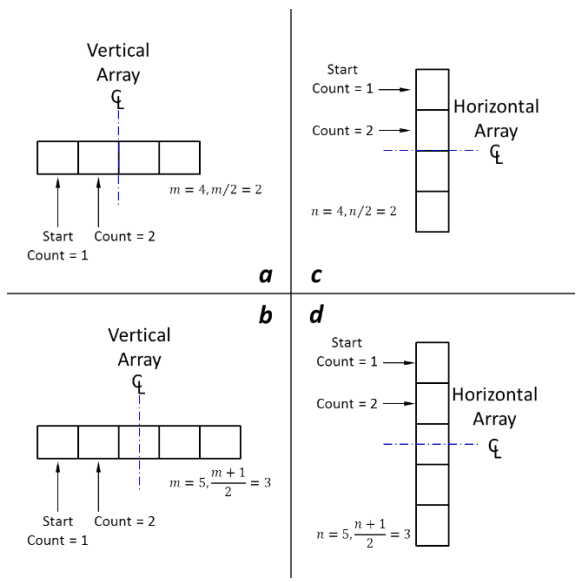

Figure 1
Array Centerlines

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