

SEMI P18-92 (Reapproved 1104)^E

SPECIFICATION FOR OVERLAY CAPABILITIES OF WAFER STEPPERS

This Standard was technically approved by the Micropatterning Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on August 16, 2004. Available at www.semi.org in November 2004; originally published in 1992.

^E This Standard was editorially modified in February 2019 to correct a publishing error. A correction was made to Equation 1.

NOTICE: This Standard or Safety Guideline has an Inactive Status because the conditions to maintain Current Status have not been met. Inactive Standards or Safety Guidelines are available from SEMI and continue to be valid for use.

NOTICE: Paragraphs entitled ‘NOTE:’ are not an official part of this Standard or Safety Guideline and are not intended to modify or supersede the official Standard or Safety Guideline. These have been supplied by the global technical committee to enhance the usage of the Standard or Safety Guideline.

NOTICE: The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONs, lists) therein. The paragraph symbol (§) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§ and §§§) the symbols are used to reference more than one section or paragraph, respectively.

1 Scope

1.1 Definitions for the overlay capabilities of wafer steppers are established, consistent with the primary application of wafer stepper (i.e., the manufacturing of very large-scale integrated circuits). Also included are definitions for associated parameters: registration, exposure field, good fields, and alignment.

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.

2 Referenced Standards

2.1 Statistical methods shall be used in accordance with the procedures in NBS Handbook #91 (Experimental Statistics, by M.G. Natrella) and ASTM STD 15D (Manual on the presentation of data and control chart analysis).

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

3 Terminology

3.1 Definitions

3.1.1 *overlay* — a vector quantity defined at every point on the wafer. It is the difference, O , between the vector position, P_1 , of a substrate geometry, and the vector position of the corresponding point, P_2 , in an overlaying pattern, which may consist of photoresist:

$$O = P_2 - P_1 \quad (1)$$

3.1.2 *interfield overlay (also referred to as field-to-field overlay)* — The center of the lens is chosen to be a reference point. The overlay at the reference point in each exposure field is the interfield overlay.

3.1.3 *exposure field* — the area of a wafer covered by a single exposure.

3.1.4 *intrafield overlay (also referred to as within-a-field overlay)* — the overlay within an exposure field, relative to the overlay at the center of the lens reference location.

NOTE 1: From these definitions, it follows that the overlay at any point on the wafer is the vector sum of interfield and intrafield overlays.

3.1.5 *registration* — a vector quantity defined at every point on the wafer. It is the difference, R , between the vector position, P_1 , of a substrate geometry, and vector position of the corresponding point, P_0 , in a reference grid:

$$R = P_1 - P_0 \quad (2)$$

3.1.5.1 The reference grid must be clearly specified in any specification of registration.

3.1.5.2 Interfield and intrafield registration are defined in a manner similar to interfield and intrafield overlay.

3.1.5.3 Overlay may be computed from registration measurements if the same reference standard is used on all systems for determining registration.

3.1.6 *alignment* — the mechanical positioning of reference points on the wafers (“alignment targets”) to the corresponding points on the reticles. The measure of alignment is the overlay at the position on the wafer where the alignment targets are placed.

3.1.7 Registration and overlay vectors shall be decomposed into orthogonal components, X and Y , along the directions of the stepper stage motion.

3.1.8 *good fields* — exposure fields in which the magnitude of the overlay at every point within the field is less than a specified value, V , in both the X and Y directions, exclusive of contributions to overlay from the reticles and non-linear deformations of the wafers during non-stepper processing.

NOTE 2: It should be recognized that contributions from reticles are non-statistical in nature, and that a particular reticle will make the same contributions to overlay and registration in every exposure field in which it is imaged.

3.1.9 *fraction of good field* — the overlay capabilities of wafer steppers shall be quantified in terms of the fraction of good fields, F , out of the total number of fields on the wafer:

$$F = \frac{\text{Number of good fields}}{\text{Number of total fields}} \quad (3)$$

Good fields may also be quantified as a percentage ($100 \times F\%$).

3.1.10 Any specification of overlay must define the applicable exposure field size and the stepping patterns on the wafers over which the specification applies. From ¶¶ 3.1.8 and 3.1.9 it follows that the specification of the overlay capability of wafer steppers consists of at least two additional numbers, the overlay value, V , and the fraction of good fields, F . It is consistent to characterize stepper overlay capability for multiple overlay values, $V_1, V_2, \dots$ with corresponding multiple fractions of good fields, $F_1, F_2, \dots$

NOTICE: SEMI makes no warranties or representations as to the suitability of the Standards and Safety Guidelines set forth herein for any particular application. The determination of the suitability of the Standard or Safety Guideline is solely the responsibility of the user. Users are cautioned to refer to manufacturer’s instructions, product labels, product data sheets, and other relevant literature, respecting any materials or equipment mentioned herein. Standards and Safety Guidelines are subject to change without notice.

By publication of this Standard or Safety Guideline, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any items mentioned in this Standard or Safety Guideline. Users of this Standard or Safety Guideline are expressly advised that determination of any such patent rights or copyrights and the risk of infringement of such rights are entirely their own responsibility.