SEMI E151-1211
GUIDE FOR UNDERSTANDING DATA QUALITY

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1 Purpose

1.1 The purpose of this Guide is to provide common terminology and definitions that can be used when addressing the quality of semiconductor equipment generated data. It establishes a set of common definitions that help specify, communicate, address, and discuss the quality of data produced by the production equipment.

2 Scope

2.1 This Guide contains the following component:

2.2 Background and description of an approach to understanding data quality and associated terminology.

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 Limitations

3.1 The term 'data,' as utilized in this Guide, is limited to data that is or can be collected from production equipment in the semiconductor industry via a SEMI standard communication interface.

3.2 This Guide does not define the protocol of messaging used to transport or communicate data values. That messaging infrastructure is covered in other SEMI Standards. The data quality definitions, attributes, and associated elements contained in this Guide are intended to apply specifically to the value content of equipment messages that report data.

3.3 This Guide does not specify how the quality of equipment generated and reported data may be improved or corrected. The quality of the messaging and communication infrastructure is outside the scope of this Guide.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI E5 — SEMI Equipment Communications Standard 2 Message Content (SECS-II)

SEMI E54 — Sensor/Actuator Network Standard

SEMI E120 — Specification for the Common Equipment Model (CEM)

SEMI E125 — Specification for Equipment Self Description (EqSD)

SEMI E132 — Specification for Equipment Client Authentication and Authorization

SEMI E134 — Specification for Data Collection Management (DCM)

SEMI E145 — Classification for Measurement Unit Symbols in XML

4.2 *IEEE Standard*[1]

IEEE 100-1988 — Standard Dictionary of Electrical and Electronics Terms (Fourth Edition, ANSI/IEEE)[2]

[1] Institute of Electrical and Electronics Engineers, 3 Park Avenue, 17th Floor, New York, NY 10016-5997, USA; Telephone: +1.212.419.7900, Fax: +1.212.752.4929, http://www.ieee.org

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4.3 *ISMI Documents*

Factory and Equipment Clock Synchronization and Time-stamping Guidelines: Version 2.0; http://ismi.sematech.org/docubase/abstracts/06094781B-ENG.htm[3]

ISMI Data Quality Guidelines Version 1; http://ismi.sematech.org/docubase/abstracts/07024843C-ENG.htm[4]

4.4 *NIST Documents*[5]

NIST Technical Note 1551; http://www.nist.gov/eeel/electromagnetics/rf_electronics/upload/NIST-TN-1551.pdf

http://tf.nist.gov/timefreq/general/glossary.htm

4.5 *Other References*

McGraw-Hill Dictionary of Scientific and Technical Terms 5th Edition[6]

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

5 Terminology

5.1 Terminology is defined as abbreviations, acronyms and definitions.

5.2 Definitions or descriptions of the following terms used in this Specification may be found in the SEMI International Standards: Compilation of Terms (available on the SEMI Web site; http://www.semi.org).

5.3 *Abbreviations and Acronyms* — The following abbreviations and acronyms are used in this Guide.

5.3.1 *APC* — advanced process control

5.3.2 *EDA* — equipment data acquisition

5.3.3 *GEM* — generic equipment model

5.3.4 *SECS-II* — SEMI Equipment Communications Standard 2 Message Content

5.3.5 *SML* — SECS message language

5.3.6 *XML* — eXtensible markup language

5.4 *Definitions*

5.4.1 *absolute accuracy* — accuracy as measured from a reference that must be specified. [IEEE]

5.4.2 *accuracy* — closeness of the agreement between the result of a measurement and a true value of the measurand.

5.4.3 *application* — software used to record, analyze, or visualize equipment data which in turn will be used to control the equipment processes. Examples of these applications are: Advance Process Control, maintenance, cell controllers, database, and storage software systems.

5.4.4 *application latency* — the interval of time between the time data is received and the time data results are applied by the application.

5.4.5 *bias* — a fixed deviation from the true value that remains constant over replicated measurements within the statistical precision of the measurement. [IEEE]

5.4.6 *cycle* — (1) a periodic movement in a time series. [IEEE] (2) a period of time in which a set of events is completed.

5.4.7 *drift* — a deviation in the output from a set value that is affected by physical or environmental conditions.

[3] SEMATECH, 257 Fuller Road, Suite 2200, Albany, NY 12203, USA; Telephone: +1.518.649.1000, http://www.sematech.org

[4] Institute of Electrical and Electronics Engineers, 3 Park Avenue, 17th Floor, New York, NY 10016-5997, USA; Telephone: +1.212.419.7900, Fax: +1.212.752.4929, http://www.ieee.org

[5] National Institute of Standards and Technology, 100 Bureau Drive, Stop 3460, Gaithersburg, MD 20899-3460, USA; Telephone: +1.301.975.6478, http://www.nist.gov

[6] Referenced definitions reprinted, with permission. McGraw-Hill Education, Two Penn Plaza, New York, NY 10121-2298, USA. Telephone: +1.212.904.2574, Fax: +1.212.904.6285; http://www.mheducation.com

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5.4.8 *end-to-end latency* — with respect to the reporting of data from equipment to a requesting application, the total sum of tool data latency, network data latency, and the time it takes the signal at a receiving node to reach the application from which the latency is being measured.

5.4.9 *error band* — a range of deviation or percentage from an ideal, targeted, or otherwise specified value or set of values.

5.4.10 *full scale* — the maximum (max) value.

5.4.11 *hysteresis* — phenomenon seen in the elastic and electromagnetic behavior of materials, in which a lag occurs between the application or removal of a force or field and its effect.

5.4.12 *jitter* — the unwanted variations of one or more signal characteristics, such as the time interval between successive pulses, the amplitude of successive cycles, or the frequency or phase of successive cycles.

5.4.13 *max* — the maximum; i.e., the greatest value something assumes. [IEEE]

5.4.14 *min* — the minimum; i.e., the smallest value something assumes. [IEEE]

5.4.15 *network latency* — the amount of time taken by a signal or message to travel from the equipment to its destination through the factory network.

5.4.16 *offset* — a component of error that is constant and independent of the input, often used to denote bias. [IEEE]

5.4.17 *range* — a scalar value that is the difference between the maximum (max) and minimum (min) value. Range can also refer to a set of values between the max and the min.

5.4.18 *repeatability* — closeness of the agreement between the results of successive measurements of the same measurand carried out under the same conditions of measurement. [NIST]

5.4.19 *reporting rate* — the number of messages per unit of time reported through an interface.

5.4.20 *reproducibility* — measurement with the same result under a set of conditions of measurement, that includes different locations, operators, measuring systems, and replicate measurements on the same or similar objects.

5.4.21 *resolution* — smallest difference between values of a measurand that can be meaningfully distinguished. [NIST]

5.4.22 *rules* — a set of instructions or behavior that results from an operation, request, or command.

5.4.23 *sampling rate* — defines the number of samples per second (or per other time unit) taken from a continuous signal to make a discrete signal.

5.4.24 *sensitivity* — (1) the ratio of the response or change induced in the output to a stimulus or change in the input [McGraw-Hill]. (2) the change in the response of a measuring device divided by the corresponding change in the stimulus. [NIST]

5.4.25 *settling time* — the time elapsed from the application of an input to the time at which the output has reached and remained within a specified tolerance of its final, targeted, or otherwise specified value.

5.4.26 *stability* — the ability to maintain a value, remain unchanged, or stay within a set of limits or parameters.

5.4.27 *standard communication interface* — any SEMI standard communication port in the equipment used for the purpose of controlling, collection and reporting data. Examples of these interfaces are SECS-II, EDA, and Sensor Bus.

5.4.28 *tool latency* — the interval of time required for a signal to travel inside the equipment from its source and be available to an external user for retrieval. It is influenced by sampling time, reaction time, retrieval time, time constants, indirect measurement factors, processing, encoding, decoding, and packaging.

5.4.29 *transient response* — (1) a change in the steady-state condition of a parameter. (2) that part of a change in a variable, such as current, voltage, or speed which may be initiated by a change in steady-state conditions or an outside influence that decays or disappears following its appearance. [IEEE]

6 Data Quality Guide Graphical Constructs

6.1 This section describes a particular convention to help the reader of this Guide understand the data quality approach used in this document and to aid in the interpretation of the identified aspects, attributes, and elements that impact data

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