SEMI T17-0706 (Reapproved 0923)
SPECIFICATION OF SUBSTRATE TRACEABILITY

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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.

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.

1 Purpose

1.1 The purpose of this Specification is to provide standard data representation and its communication of Die Trace Data for SEMI T13 Device Tracking Standard especially for substrate traceability. The final goal of this Standard is to realize the traceability of semiconductor, flat panel display (FPD), or MEMS devices as described in SEMI T13. This Standard clarifies a part of the traceability specific for substrate such as wafer or some other substrates defined in SEMI T13. This Standard applies SEMI T13 for substrates on equipment or Die Trace Machine, and specifies related things for the substrates.

2 Scope

2.1 This Standard specifies data representation, communication, and related things to make capability for tracing substrates on the machine compliant to SEMI T13. This Standard does not specify anything which major purposes are outside of traceability (e.g., manufacturing execution, marketing, or safety).

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 This Standard is written to be applied to production lines for semiconductor, FPD, or MEMS devices including manufacturing equipment in the lines. Applying this Specification to the other production lines such as print circuit board (PCB) assembly systems could be possible if some consideration specific to the system is provided. However, the original concept in this Standard doesn't fully take care of such systems other than the semiconductor, FPD, or MEMS device production system.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

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

SEMI E30 — Specification for the Generic Model for Communications and Control of Manufacturing Equipment (GEM)

SEMI E39 — Specification for Object Services: Concept, Behavior and Services (OSS)

SEMI E98 — Provisional Specification of Object Based Equipment Model (OBEM)

SEMI T7 — Specification for Back Surface Marking of Double-Side Polished Wafers with a Two-Dimensional Matrix Code Symbol

SEMI T12 — Specification for Tracing Jigs and Implements

SEMI T13 — Specification for Device Tracking: Concepts, Behavior and Services

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

5 Terminology

5.1 *Definitions*

5.1.1 *component* — decomposed unit of equipment. The unit here is replaceable or maintainable/manageable, and may be essential for the equipment or may be optional.

5.1.2 *consumable part* — such consumable as bonding wire held on equipment in container or magazine, or such repeatedly used consumable on equipment as chemicals. Familiar examples in home and office are ink/toner cartridges or dot-impact ink ribbons.

5.1.3 *jig* — an attachment which is used to support measurement or production of material on one or more equipment as defined in SEMI T12.

5.1.4 *part* — replaceable or maintainable unit, or a set of the units on equipment. From the point of traceability, this is the general name of jigs, components or consumable parts.

5.1.5 *substrate* — base layer material or board to mount semiconductor devices, or to fabricate semiconductor devices on it as defined in SEMI T13.

5.1.6 *substrate handler* — physical handling entity of substrate (e.g., end-effectors, robot arms, transfer modules, and hand-off slots/tables). It may or may not be identified as substrate traceability location.

5.1.7 *substrate holder* — physical entity to hold substrate a while (e.g., slots of substrate carrier, susceptors, chucking tables, and process modules). While it is usually identified as a substrate transfer location, substrate handler may or may not be identified as a substrate holder in this sense.

5.1.8 *substrate prescription* — prescription for substrate to be processed (e.g., process recipe and bin code map). It is usually instruction in specific language, parameter table, data array including image data or their combination. Sometimes it may be whole recipe of substrate for a piece of equipment or a part of it specific for a process module.

5.1.9 *substrate processor* — a kind of substrate holder which provides process on substrate there.

5.1.10 *substrate processor component* — subcomponent, jig or part of substrate processor, when it is chosen for processing and/or its preparation occasionally or intentionally.

5.1.11 *substrate processing material* — besides the substrate itself, any identifiable material used for processing of the substrate.

5.1.12 *substrate processing parameter* — adjusted, modified or substituted parameter in originally planned substrate prescription.

5.1.13 *substrate traceability location* — location which substrate has stayed in die trace machine or its managing area.

5.1.14 *substrate traceability location ID* — identification of substrate traceability location to distinguish in specific range. Usually it is a combination of substrate traceability location names and die tracers.

5.1.15 *substrate traceability location name* — name of substrate traceability location to identify physical location of a substrate uniquely.

NOTE 1: Refer to the SEMI International Standards: Compilation of Terms (COTs) for a list of the latest terms and their definitions.

6 Convention

6.1 This section defines the conventions followed by this Standard.

6.1.1 *Components of Complex Attributes* — The names of object attributes defined in tables are left-justified. The individual elements of complex attributes are right-justified in order of appearance below the complex attribute.

6.1.2 *Formal Name of an Object* — The text capitalizes formal object name references. Similar to the way capitalization is normally used when discussing entities. When describing something in the general (like cities) lower case is used, but when a specific entity is of interest (New York City), then first letters are capitalized.

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6.1.3 *Object Conventions* — This Standard conforms to the conventions for objects established by SEMI E39, including object diagrams, object terminology and requirements for standardized objects. Accordingly, notation is based on Unified Modeling Language (UML).[1]

6.2 *State Model Conventions*

6.2.1 This Standard uses the Harel state chart convention for describing dynamic operation of defined objects. The outline of this convention is described in an attachment of SEMI E30. The official definition of this convention is described in "State charts: A Visual Formalism for Complex Systems".[2]

6.2.2 The Harel convention does not have the concept of state models of 'creation' and 'extinction' for expressing a temporary entity. Transient object is such an entity, and a copy of the same state model is used for an independent job newly created. As the notation of Statechart Diagram in UML convention, a circle with a black circle inside is used for expressing extinction of an entity. A filled black circle denotes the entry to the state model (the entity creation).

6.2.3 Transition tables are provided in conjunction with the state diagrams to explicitly describe the nature of each state transition. A transition table contains columns for Transition number, Previous State, Trigger, New State, Actions, and Comments. The 'trigger' (column 3) for the transition occurs while in the 'previous' state. The 'actions' (column 5) includes a combination of:

- Actions taken upon exit of the previous state.
- Actions taken upon entry of the new state.
- Actions taken which are most closely associated with the transition.
- No differentiation is made between these cases.

Num	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*

6.2.4 *Service Message Representation* — Services are functions or methods that may be provided by either the equipment or the host. A service message may be either a request message, which always requires a response, or a notification message, that does not require a response.

6.3 *Service Definition*

6.3.1 A service definition table defines the specific set of messages for a given service resource, as shown in the following table:

Message Service Name	*Type*	*Description*

6.3.2 Type can be either 'N' = Notification or 'R' = Request & Response.

6.3.3 Notification type messages are initiated by the service provider (e.g., the equipment) and the provider does not expect to get a response from the service user. Request messages are initiated by a service user (e.g., the host). Request messages ask for data or an activity from the provider. Request messages expect a specific response message (no presumption on the message content).

[1] Unified Modeling Language (UML) "OMG Unified Modeling Language Specification" Version 1.4, 2001; http://www.omg.org

[2] D. Harel, "State charts: A Visual Formalism for Complex Systems", Science of Computer Programming 8, 1987.

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6.4 *Service Parameter Dictionary*

6.4.1 A service parameter dictionary table defines the description, format, and its possible value for parameters used by services, as shown in the following table:

Parameter Name	*Description*	*Format: Possible Value*

6.4.2 A row is provided in the table for each parameter of a service.

6.5 *Service Message Definition*

6.5.1 A service message definition table defines the parameters used in a service, as shown in the following table:

Parameter	*Req/Ind*	*Res/Cnf*	*Comment*

6.5.2 The columns labeled Req/Ind and Rsp/Cnf link the parameters to the direction of the message. The message sent by the initiator is called the 'Request'. The receiver terms this message the 'Indication' or the request. The receiver may then send a 'Response' which the original sender terms the 'Confirmation'.

6.5.3 The following codes appear in the Req/Ind and Rsp/Cnf columns and are used in the definition of the parameters (e.g., how each parameter is used in each direction):

M	Mandatory Parameter — Must be given a valid value.
C	Conditional Parameter — May be defined in some circumstances and undefined in others. Whether a value is given may be completely optional or may depend on the value of the other parameter.
U	User-Defined Parameter.
-	The parameter is not used.
=	(For response only.) Indicates that the value of this parameter in the response must match that in the primary (if defined).

7 General Requirements

7.1 *Means to Confirm Installation* — Equipment has to confirm the points where anticipated parts are installed physically and logically on the equipment. Also it has to identify logical functionality the parts what general role they are expected on it. To confirm and identify, the reference model of the equipment shall be SEMI E98 (Object Based Equipment Model).

7.2 *Means to Identify* — Equipment has to have any means to identify the parts. They may be physical readers for radio frequency tag or bar code, known architectural/composition configuration data on equipment, instruction by its management system, suggestion/selection by its operator, etc.

7.3 *Means to Communicate* — Each piece of equipment and its managing system for the purpose of this Standard has to have an electric communication means to transact each other.

8 Overview

8.1 *Substrates on Semiconductor Manufacturing Systems* — Electronics element devices are manufactured on such semiconductor material as silicon substrates which are often referred to as wafers; types of the substrates are dependent on device types (e.g., glass plates for flat panel display devices). Until they are separated into dice, production processes including metrology, inspection and test processes are carried out on the substrates. All tracking devices on production line results in tracing substrates. To collect or inquire their traceability information it is better to define

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