SEMI E54.2-0698 (Reapproved 0710)
GUIDE FOR WRITING SENSOR/ACTUATOR NETWORK (SAN) STANDARD BALLOTS

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1 Purpose

1.1 This guide recommends the method, form, and content for adding specific device models and associated Sensor Actuator Network Communications Standard (SANCS) extensions to the SEMI Sensor Actuator Network (SAN) standard. This guide facilitates consistency of these ballots, leading to better consistency and clarity of the resulting specifications and to easier development of SAN standard-conformant devices that achieve a high level of interoperability.

2 Scope

2.1 This guide provides written templates for ballots that will add either a specific device model (SDM), an SANCS ancillary standard, or SANCS extensions to support an SDM to the SEMI SAN Standards. The guide provides directions for using the templates.

2.2 Physical devices will not be compliant with this guide; they will be compliant to standards which are spawned from the templates specified herein.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards and Documents

3.1 *SEMI Standards*

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

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

SEMI E39 — Object Services Standard: Concepts, Behavior, and Services

SEMI E54 — Sensor/Actuator Network Standard

SEMI E54.1 — Standard for Sensor/Actuator Network Common Device Model

SEMI E54.3 — Standard for Sensor/Actuator Network Specific Device Model for Mass Flow Device

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

4 Terminology

4.1 *Abbreviations and Acronyms*

4.1.1 *A* — Actuator (a CDM class definition)

4.1.2 *AE* — Active Element (a CDM class definition)

4.1.3 *C* — Controller (a CDM class definition)

4.1.4 *CDM* — (SEMI) Common Device Model

4.1.5 *DM* — Device Manager (a CDM class definition)

4.1.6 *ISO-OSI* — International Organization for Standardization – Open Systems Interconnect (model)

4.1.7 *NCS* — Network Communications Standard

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4.1.8 *OMT* — Object Modeling Technique

4.1.9 *S* — Sensor (a CDM object)

4.1.10 *SAC* — Sensor/Actuator/Controller (a CDM class definition)

4.1.11 *SAN* — Sensor/Actuator Network (or Sensor Bus)

4.1.12 *SANCS* — Sensor/Actuator Network Communications Standard, frequently abbreviated to NCS

4.1.13 *SDM* — (SEMI) Specific Device Model

4.2 *Definitions*

4.2.1 *connection oriented* — a situation between communicating objects wherein they are connected in a mode analogous to a two-way phone conversation.

4.2.2 *specific device model (SDM)* — a model used to specify each type of device, such as a Mass Flow Controller or Thermocouple.

5 Background

5.1 The SEMI sensor bus (SAN) communications model consists of three components: a CDM, an SDM, and an SANCS (NCS). The following subsections provide a brief description of the specifications which define these components:

5.1.1 *Network Communications Standard Specification* — An NCS specification is required for each network technology. Each one consists of two major parts:

5.1.1.1 *Part 1: Enabling Protocol and CDM Object Presentation* — This part of an SANCS specification should achieve the following goals:

- provide an ISO-OSI layered specification of the protocol, specifying the protocol requirements at each layer,
- specify the object oriented communication environment, including object representation and addressing, attributes and services addressing, etc.,
- specify how CDM objects are represented and addressed to/from the network, and
- specify how AE class and subclass objects, defined in the CDM and the SDMs, are represented and addressed to/from the network.

5.1.1.2 *Part 2: Enabling Specific Device Models* — This part provides a mapping of SDM objects for the SANCS specification. There should be a section for each SDM which identifies specific objects that must be supported to enable the SDM and how the SDM structure fits into the protocol application layer foundation.

5.1.2 *Common Device Model* — Each device's functions on a network should comply with the specifications of the Common Device Model, SEMI E54.1. Three types or classes of objects may be combined to create models of real devices. The types are Active Element (AE) and its subclasses, Sensor/Actuator Controller (SAC) and its embedded objects, and the Device Manager (DM).

NOTE 1: The CDM specifies the relationship between these objects. It specifies some of the structure and behavior for the DM and SAC objects. The subclasses of the AE object provide capabilities which are useful to most devices.

5.2 Specific Device Model

5.2.1 Specific Device Models are defined in the SEMI SAN SDM (SEMI E54.3). Each SDM is added as a separate new section (similar to the way a new section is added to SEMI E5 when a new stream is added).

5.2.2 The Specific Device Models (SDM's) should be a specialization of the CDM and may extend the attributes, services, and behavior of any of the Sensor, Actuator, or Controller (subclasses of the AE class) objects of which they are made. SDM's may add to the attributes, services, and behavior of the SAC object.

6 Ballot Preparation

6.1 *The Cover Letter* — All ballots are submitted with a cover letter. The cover letter sets the context for the ballot. The Ballot Cover Letter Template provides guidance to prepare the cover letter.

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6.2 *Specific Device Model Ballots* — A ballot to add an ancillary specification for a new SDM should be prepared as defined in the template in the section titled Template for SDM Ballot Proposals.

6.2.1 SEMI E39 is the basis for the tables and figures called out in the template. Refer to SEMI E39 for clarifications on using and defining object models. General instructions for using the template are contained in the subsections of this section. Specific instructions are included within the templates.

6.2.2 Device application models should be presented using Rumbaugh's Object Modeling Technology notation for information models. (See SEMI E39 for details on using object notation for defining standards.)

6.2.3 The behavior of objects should be defined using Harel State charts, state definition tables, and state transition tables. A discussion of the notation may be found in Appendix A.5 of SEMI E30. An alternative table, Object Behavior State Transition Matrix, may be used in place of the more traditional (State) Transition Table. Cells in the Transition Matrix indicate the transition action which is taken for an event for any of the states in which it can be detected. This can be particularly useful for describing the variation in device response depending on a sub-state when the parent state detects an event.

6.2.4 The set of tables which define the device's interfaces are the only testable parts of the specification for the application models. The interface for each device model should be defined in a series of tables, as follows:

6.2.4.1 *Attribute Tables* — For each object defined as an element of a device, a table which defines its network visible attributes should be specified. Each attribute is named and tagged. Its network access type (read only or read/write) and storage class (volatile, non-volatile, or constant) are also specified. The table should also indicate which attributes have standardized values and which are device supplier reserved. The definition or description of an attribute can either be included in the table or else should immediately follow the table. The "Required" column indicates if the attribute must be supported for a device to be SDM-compliant. Use the letter "Y" to indicate yes and the letter "N" to indicate no. The form field is used to indicate the data type of the attribute, such as integer, floating point, array of characters, etc. Actual format of these data types is network-dependent.

6.2.4.2 *Optional Service Parameter Table* — If this table is included in the specification of an SDM, the parameters, which are used by the device's services, are defined in it, including the data type and length.

6.2.4.3 *Service Definition Table* — Each service and its parameters are defined in a table. If the optional parameter table is not used in the SDM specification, then the form field should be included in the service definition table.

6.3 *SANCS Ballots* — A ballot to add an ancillary specification for a new SANCS should be prepared as defined by the template in the section titled Template for Part 1 of an SANCS Ancillary Standard.

6.3.1 When a new SDM is added to the SAN standard, an update to Part 2 of the ancillary SANCS specifications is needed. A ballot should be prepared as defined in the template in the section titled Template for an SANCS ballot to support an SDM.

6.3.2 The nature of the Template for an SANCS ballot to support an SDM is that it adds SDM information to only one SANCS specification at a time. Additions and changes to support each new SDM are balloted separately for each SANCS specification.

6.3.3 *Coordination with Industry User Groups* — Most of the network technologies are supported by an industry user group or association. These groups are responsible for the assignment (i.e., mapping) of identifiers to the variables or attributes, parameters, and messages/services that will be managed by their protocol. When the SEMI SAN standards require new identifiers, they should be requested from the appropriate industry group.

6.3.3.1 *Technical Notes* — SEMI will make technical notes available, for each protocol supported by the SEMI SAN standards, that list the protocol's identifiers.

6.4 *Template Conventions*

6.4.1 Instructions or text that is meant to be replaced with ballot-specific information are included within the templates in italics. Non-italicized text and tables are intended to be included in the ballot as depicted in the template.

6.4.2 Section, figure, and table numbers specified using letters are meant to indicate structure and format. Specific numbers should be generated by the ballot author. Ballots which require adding to or modifying existing SAN standards will be edited by SEMI for consistency with the existing standard where necessary.

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