

SEMI E54.11-0301

SPECIFIC DEVICE MODEL FOR ENDPOINT DEVICES

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1 Purpose

1.1 This specification is part of a suite of standards that specify the implementation of SEMI standards for the Sensor/Actuator Network. The specific purpose of this specification is to describe a network independent application model comprised of device objects that are common to all Endpoint Devices on a semiconductor equipment Sensor/Actuator communication network.

2 Scope

2.1 An Endpoint device (EPD) is a device that measures and monitors process characteristics to determine when a specific threshold or event has been obtained usually to signal the completion of a process or process step. These endpoint devices are, but not limited to, devices that may classify a process endpoint by determining the size and count of particles in the process environment, detecting and determining optical light from a sample region of the environment's space, or determining motor current of an equipment component.

2.2 This specification specifically addresses the minimum attributes, services and behavior an Endpoint (EPD) device must support to be interoperable on the Sensor/Actuator Network.

2.3 This specification is intended to ensure a high-degree of device interoperability on the Sensor/Actuator Network, while still allowing flexibility for product differentiation and technology evolution.

2.4 The model specified in this specification is used in conjunction with the Sensor/Actuator Network Common Device Model (CDM) to completely describe the Endpoint device (EPD) as it appears from the network interface.

2.5 This specification, together with the Sensor/Actuator Network Standard, the Sensor/Actuator Network Common Device Model, and a Sensor/Actuator Network Communication Specification, form a complete interoperability specification for the EPD.

2.6 To comply with this specification, a device must implement and support, at a minimum, the required attributes, services, and behavior identified in these documents. Support for optional attributes, services and

behavior is not required to be compliant to this specification. Optional attributes, services, and behavior are specified in these documents to promote further device interoperability as features evolve and are adopted by more manufacturers. If optional attributes, services, and behavior are implemented for this device they must be implemented as identified in this document.

2.7 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 health practices and determine the applicability or regulatory limitations prior to use

3 Limitations

3.1 This specification is a companion to a suite of specifications that together make up the Sensor/Actuator Network Communication standard. Therefore, using portions of this specification that relate to network communications necessarily requires an understanding of the associated network specification.

3.2 As this document is a specification for the Endpoint Device Model, it does not contain any definition of objects, attributes, services, or behavioral descriptions that are already defined in the Sensor/Actuator Network Common Device Model (CDM). Additional attributes, attribute assignments, services and/or service parameters that are Endpoint Device specific and/or implementation specific are contained in this specification.

3.3 While this specification is sufficient to completely describe the EPD as it appears from the network, it does not fully describe behavior of a specific endpoint device type which is not visible from the network. This allows flexibility in implementation techniques and product differentiation between manufacturers. Manufacturer specific objects may be defined by the manufacturer but are, by definition, outside the scope of this standard.

3.4 This specification is compatible, but not compliant with SEMI E39. This means that although this specification does not require compliance with SEMI E39, it is extensible such that implementations may be developed that are fully compliant with both standards. Note that the concepts and terminology of this specification are compatible with those of SEMI E39.

However, SEMI E39 has specific requirements that are intended for higher level applications and thus are not applied to the Endpoint Device Model.

3.5 Operation over the entire range specified for an attribute within a specific object is not a requisite for compliance with this specification.

4 Referenced Standards

NOTE 1: As listed or revised, all documents cited shall be the latest publications of adopted standards.

4.1 SEMI Standards

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

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *EP* — an EPD sensor named Endpoint.

5.2 Definitions

5.2.1 *Endpoint Device (EPD)* — a self-contained device, consisting of device specific signal-processing electronics, which is capable of monitoring and measuring the occurrence of a process endpoint.

5.2.2 *Endpoint Detection Event* — consists of the device operation of monitoring, measuring, analyzing, waiting, and reporting endpoint.

5.3 This document inherits the terminology defined by SEMI E54.1

5.3.1 *Attribute*

5.3.2 *Behavior*

5.3.3 *Boolean (BOOL)*

5.3.4 *Byte*

5.3.5 *Character*

5.3.6 *Common Device Model (CDM)*

5.3.7 *Data Type*

5.3.8 *Data Units*

5.3.9 *Device*

5.3.10 *Device Manager (DM) Object*

5.3.11 *Device Model*

5.3.12 *Double Integer (DINT)*

5.3.13 *Enumerated Byte*

5.3.14 *Full Scale Range*

5.3.15 *Instance*

5.3.16 *Last Valid Value (LVV)*

5.3.17 *Long Integer (LINT)*

5.3.18 *Long Real (LREAL)*

5.3.19 *Manufacturer*

5.3.20 *Nibble*

5.3.21 *Null Character*

5.3.22 *Object*

5.3.23 *Real (REAL)*

5.3.24 *S, A, and C Objects*

5.3.25 *Sensor Actuator Controller (SAC) Object*

5.3.26 *Service*

5.3.27 *Signed Integer (INT)*

5.3.28 *Short Integer (SINT)*

5.3.29 *State Diagram*

5.3.30 *Test String*

5.3.31 *Unsigned Double Integer (UDINT)*

5.3.32 *Unsigned Double Long Integer (UDLINT)*

5.3.33 *Unsigned Integer (UINT)*

5.3.34 *Unsigned Long Integer (ULINT)*

5.3.35 *Unsigned Short Integer (USINT)*

6 Requirements and Specifications

6.1 In order to implement this standard in an Endpoint Device, it is necessary to also implement SEMI E54.1 and one of the Sensor/Actuator Network Communication Standards (SEMI E54.4–E54.9). See Section 3 for more information on a complete interoperability standard.

6.2 This specification also requires the implementation of a *Date_And_Time* data structure used to represent the current device Date and Time. Table 1 defines the format of the *Date_And_Time* data type.

Table 1 Date_And_Time Format

<i>Data Item</i>	<i>Description</i>	<i>Range</i>
1	Number of milliseconds since midnight	Unsigned Double Integer (UDINT)
2	Number of days since 1/1/72	Unsigned Integer (UINT)

7 Conventions

7.1 This document embraces the conventions and notations stated in section 6 of SEMI E54.1.

8 Device High Level Structure

8.1 General Description

8.1.1 The high-level object view of an Endpoint Device (EPD) profile is shown in Figure 1.

8.1.2 Note that the profile for an “EPD Device” object is depicted in Figure 1 only for the purposes of illustrating a high level view of the device and its component objects. In the context of this document, this object is not addressable, does not have addressable attributes, does not have accessible services and, does not exhibit any defined behavior.

8.1.3 In the remainder of this section, this document defines in detail the component objects unique to the EPD device. References, rather than definitions, are included for the DM, the SAC and other objects defined

in SEMI E54.1.

8.1.4 Many of the objects defined in this document inherit properties from other objects. The properties inherited include attribute, service and behavior definitions. These other objects are specified here or in SEMI E54.1.

8.1.5 This document provides for future extensions as well as manufacturer specific enhancements by reserving object attribute identifiers and object service identifiers. Specifically all object definitions in this document specify or reserve the first 64 attribute identifiers (A1 through A64) and the first 64 service identifiers (S1 through S64) allowing manufacturers to specify identifiers beyond these ranges. Additionally, byte enumerated attributes are specified or reserved from 0 to 63 allowing manufacturers to specify an enumeration beyond this range (64 to 255).

8.1.6 *Endpoint Device (EPD) Description* — An Endpoint device profile is composed of the component objects and object relationships shown in Figure 1.

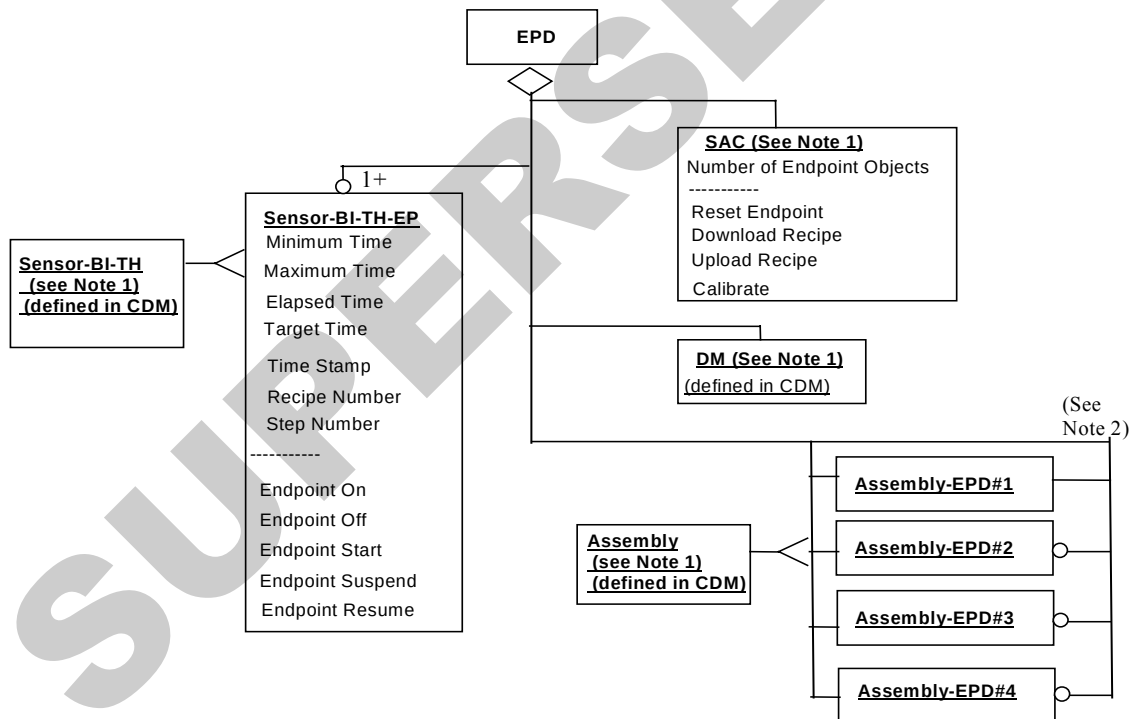


Figure 1
Endpoint Device High Level Structure

NOTE 1: The Sensor-BI-TH, DM, SAC, and Assembly are defined in the CDM. Additional attributes and services are added to support the EPD.

NOTE 2: Assembly-EPD #1 object is required. Other Assembly-EPD objects are optional.

8.1.7 General Requirements

8.1.7.1 *Device Objects* — All objects are defined in terms of their object name and Class/Object identifier. Identifiers for all objects described in this document are summarized in Table 2.

Table 2 Endpoint Device Objects

<i>Referenced Document Section</i>	<i>Object Name</i>	<i>Class/Object Identifier</i>	<i>Minimum #</i>	<i>Maximum #</i>
8.2	Device Manager (DM)	EPD1	1	1
8.3	Sensor Actuator Controller (SAC)	EPD2	1	1
8.5	Sensor-BI-TH-EP	EPD3	1	1024
8.6	Assembly-EPD#1	EPD4	1	1
8.6	Assembly-EPD#2	EPD5	0	1
8.6	Assembly-EPD#3	EPD6	0	1
8.6	Assembly-EPD#4	EPD7	0	1
—	Reserved	EPD7 – EPD63	-	—
—	Manufacturer Specified	> EPD64	-	—

8.1.7.2 *Object Services* — Not all object services listed in this document can necessarily be requested over the network. They are included in this document because their behavior may generate network activity.

8.1.7.3 *Object Behavior* — A network specific service error response is generated for all service requests received over the network that are not supported by the object, or contain a parameter value which is beyond the supported range, or which is otherwise invalid.

8.2 *Device Manager Object (DM)* — The Device Manager object is the device component responsible for managing and consolidating the device operation as specified in SEMI E54.1. The following sections specify the components of the DM object that are not specified in the Common Device Model or require further definition than specified in SEMI E54.1.

8.2.1 *Device Manager Object Attributes* — Required and optional DM object attributes are listed in Table 3.

Table 3 DM Object Attributes

<i>Attribute Name</i>	<i>Attribute Identifier</i>	<i>Access Network</i>	<i>Required</i>	<i>Form</i>
Device Type	A1	R	Yes	Refer to SEMI E54.1.
Exception Detail Alarm	A13	R	No	Refer to SEMI E54.1.
Exception Detail Warning	A14	R	No	Refer to SEMI E54.1.
Reserved	A33-A64	—	—	Reserved for SDM future expansion
Manufacturer Specified	> A64	—	—	Manufacturer Specific attributes

8.2.1.1 *Device Type* — An attribute that uniquely identifies the type of the device on the network. The device type attribute is assigned as follows:

Endpoint Device = “EPD”

NOTE 2: If the “Endpoint Device” functionality is implemented by another Sensor/Actuator Network Specific Device Model, the ‘Device Type’ attribute value may be specified by the manufacturer to identify the other Specific Device Model.

8.2.1.2 *Exception Detail Alarm (Optional)* — An attribute that identifies the detailed alarm status of the device. Table 4 defines the bit assignments associated with the alarm exception detail.

Table 4 Exception Detail Alarm Bit Assignments

Bit	Device Specific Alarm[0]
0	Unexpected Conditions Detected
1	Reserved
2	Sensor Not Detected
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Endpoint Failure

8.2.1.3 *Exception Detail Warning (Optional)* — An attribute that identifies the detailed warning status of the device. Table 5 defines the bit assignments associated with the warning exception detail.

Table 5 Exception Detail Warning Bit Assignments

Bit	Device Specific Warning[0]
0	Unexpected Conditions Detected
1	Reserved
2	0
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Endpoint Warning

8.2.1.4 *Manufacturer Exception Detail Size (Optional)* — An attribute that specifies the number of exception detail bytes included in the alarm or warning details.

Table 7 SAC Object Attributes

Attribute Name	Attribute Identifier	Access Network	Required	Form
Number of Endpoint Objects	SacA65	R	No	UINT

8.2.1.5 Initial and Default Values

Table 6 DM Object Attribute Initial and Default Values

Attribute	Initial Value	Default Value	Comment
Device Type	EPD	EPD	EPD = Endpoint Device
Exception Detail Alarm	0	0	
Exception Detail Warning	0	0	

8.2.2 *Device Manager Object Services* — The services provided by the Device Manager object are defined in SEMI E54.1. There are no additional services required for the Device Manager object.

8.2.3 *Device Manager Object Behavior* — The behavior exhibited by the Device Manager object is defined in SEMI E54.1. There is no additional behavior specified for the Device Manager object.

8.3 *Sensor Actuator Controller Object (SAC)* — The Sensor Actuator Controller object is the device component responsible for coordinating the interaction of the EPD device with the sensory/actuation/control environment as specified in SEMI E54.1. The following sections specify the components of the SAC object that are not specified in the Common Device Model or require further definition than specified in the Common Device Model.

8.3.1 *Sensor Actuator Controller Object Attributes* — The attributes provided by the Sensor Actuator Controller object are defined in SEMI E54.1. Table 7 contains the additional attributes required for the Sensor Actuator Controller object.

8.3.1.1 *Number of Endpoint Objects* — An attribute that specifies the number of endpoint objects in the device. This value represents the number of Sensor-BI-TH-EP objects in the device. If this attribute is not supported then the default value of 1 Endpoint object is supported.

8.3.1.2 *Initial and Default Values*

Table 8 SAC Object Attributes Initial and Default Values

Attribute	Initial Value	Default Value	Comment
Number of Endpoint Objects	Manufacturer Specified	Manufacturer Specified	There must be at least one Endpoint object.

8.3.2 *Sensor Actuator Controller Object Services* — The services provided by the Sensor Actuator Controller object are defined in SEMI E54.1. Table 9 contains the additional services required for the Sensor Actuator Controller object.

Table 9 SAC Object Services

Service	Service Identifier	Type	Description
Reset Endpoint	S33	R	Used to 'Reset' all of the Sensor-BI-TH-EP sensor objects.
Download Recipe	S34	R	Used to download the Sensor-BI-TH-EP sensor objects with manufacturer specific recipe data.
Upload Recipe	S35	R	Used to upload, from the device, manufacturer specific recipe data.
Calibrate	S36	R	Used to execute a device manufacture specific calibration procedure.
Reserved	S37–S64	—	Reserved for future expansion
Manufacturer Specified	> S64	—	Manufacturer Specific services

8.3.2.1 *Reset Endpoint (Optional)* — This service is used to instruct all of the Sensor-BI-TH-EP objects to perform a 'Reset' of their endpoint monitoring and measuring events. A one-time reset of their respective Sensor-BI-TH-EP attributes is performed. There are no parameters required for this service.

8.3.2.2 *Download Recipe (Optional)* — This service is used to set the recipe parameters associated with the endpoint sensor or a specific Sensor-BI-TH-EP object. The format and type of data comprising recipe data and the mechanism implemented to interrupt recipe data and distribute its contents to the appropriate Sensor-BI-TH-EP object is manufacturer specific. The parameter 'Recipe Data' may be a formatted data structure or a list of individual data items. The following table describes the parameters specified for this service.

Table 10 Download Recipe Service Parameter Definitions

Parameter	Request/Indication	Response/Confirmation	Data Type	Description
Recipe Data #1	M	U	Manufacturer Specific	The recipe parameter format is manufacturer specific. The implementation behavior required to support this service is also manufacturer specific.
Recipe Data #2	M	U	Manufacturer Specific	The recipe parameter format is manufacturer specific. The implementation behavior required to support this service is also manufacturer specific.
Recipe Data #3 through Recipe Data #N-1	M	U	Manufacturer Specific	The recipe parameter format is manufacturer specific. The implementation behavior required to support this service is also manufacturer specific.
Recipe Data #N	M	U	Manufacturer Specific	The recipe parameter format is manufacturer specific. The implementation behavior required to support this service is also manufacturer specific.