

SEMI E147-0307

GUIDE FOR EQUIPMENT DATA ACQUISITION (EDA)

This standard was technically approved by the global Information & Control Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on November 21, 2006. It was available at www.semi.org in February 2007 and on CD-ROM in March 2007.

1 Purpose

1.1 This guide document provides additional information about the Equipment Data Acquisition (EDA) SEMI standards suite, explains the relationship among those standards, and presents basic concepts for implementation to ensure the EDA specifications are properly applied.

2 Scope

2.1 In-scope

2.1.1 This guide is applicable to semiconductor manufacturing equipment that implement the SEMI definition of the EDA interface for collecting equipment engineering data.

2.1.2 This guide includes the following:

- Overview of the EDA interface
- Overview of standards that make up the EDA interface
- Relationship among the EDA interface standards
- Guide for integrating and implementing the EDA standards

2.2 Out-of-scope

2.2.1 This guide standard does not describe or define any interface between systems outside the equipment.

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 Limitations

3.1 Guide Type Standard

3.1.1 This document is a “Guide Type Standard” defined in § 4, “STANDARDS DOCUMENT,” in the SEMI Standards Regulations.

3.1.2 “Guide Type Standard” is defined in the SEMI Standards Regulations as follows:

“Guide — A Sub-Type of Standard providing a series of options or instructions intended to increase the awareness of the user to available techniques in a given subject area and to provide information from which subsequent evaluations and standardization can be derived. Guides may or may not suggest a particular course of action.”

3.1.3 This guide does not define any requirements. The purpose of this document is to increase the user’s awareness of defined requirements and concepts related to the EDA interface.

3.2 Conceptual Description

3.2.1 This document describes the EDA interface at the conceptual level; it is based on the SEMI standards suite for EDA interfaces.

3.2.2 This guide may be revised for changes related to the technology defined in the related standards. Additional learning from implementation evaluation results may be added to this document.

4 Referenced Standards and Documents

4.1 SEMI Standards

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

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

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

SEMI E40 — Standard for Processing Management
SEMI E87 — Specification for Carrier Management (CMS)
SEMI E90 — Specification for Substrate Tracking
SEMI E94 — Specification for Control Job Management
SEMI E116 — Specification for Equipment Performance Tracking (EPT)
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 E138 — XML Semiconductor Common Components

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

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 ACL — Access Control List

5.1.2 MES — Manufacturing Execution System

5.2 Definitions

5.2.1 *Client* — an application that communicates with the equipment to access equipment resources, interact, or receive data from the equipment.

5.2.2 *Data Collection Plan (DCP)* — the plan to acquire necessary data from the equipment.

5.2.3 *Data consumer* — a software entity that manages data collection plans and collects data from the equipment through the EDA interface. In this document, the data consumer is the “client” for data collection and is used interchangeably.

5.2.4 *Equipment Data Acquisition (EDA)* — activity of acquiring data from the equipment by the data consumer.

5.2.5 *EDA interface* — the data communication interface between the data consumer or the EE client and the equipment to provide required capabilities for EDA.

5.2.6 *EE application* — the means of identifying equipment status to direct the equipment engineering. EE application may represent a computer application program for equipment engineering.

5.2.7 *EE client* — a synonym for “client” in this document.

5.2.8 *Equipment Engineering (EE)* — all activities for equipment availability improvement and performance maintenance inside and outside of the factory.

5.2.9 *Equipment Engineering Capability (EEC)* — an application that addresses a specific area of equipment engineering, such as fault detection, predictive maintenance, spare parts management, etc.

5.2.10 *Equipment Engineering Data (EE data)* — the data required to support equipment engineering capabilities. This includes data from the equipment and data from the factory.

5.2.11 *Equipment Engineering System (EES)* — the physical implementation of equipment engineering capabilities.

5.2.12 *Equipment metadata* — the data that describes the equipment physical structure and available data/information from the equipment.

5.2.13 *Equipment node* — an equipment component that is used to describe the equipment physical structure.

5.2.14 *Interface A* — a synonym for EDA interface.

5.2.15 *Metadata* — a synonym of equipment metadata in this document.

6 EDA Interface Overview

6.1 Equipment Engineering System and the EDA Interface

6.1.1 An Equipment Engineering System (EES) requires a wide variety and large amounts of equipment information. The overall health of the equipment, performance, and process monitoring are examples of data collected to improve Overall Equipment Efficiency (OEE). In equipment engineering systems these respective monitoring activities are called Equipment Engineering Capabilities (EEC).

6.1.2 Figure 1 shows an example of equipment communicating to an EES and the Manufacturing Execution System (MES). MES communication for production and EES communication for equipment engineering are not required to be physically separated. They may be implemented logically independently.

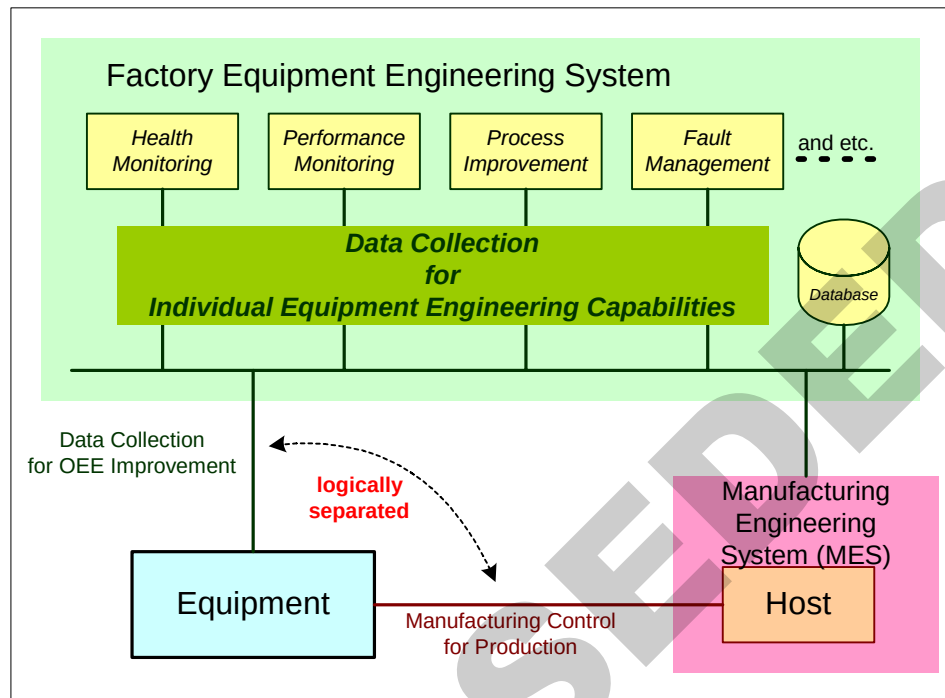


Figure 1
Conceptual View of Equipment Communications

6.1.3 Each Equipment Engineering Capability (EEC) has its own purpose and can obtain the necessary information from the equipment via the EDA interface. A specific application of an EEC could require large amounts of equipment information. Some of this information may be common to all EECs, while other information may relate to a specific engineering capability. A wide variety of equipment information may be required to satisfy these requirements. The interface that provides this equipment data and is used to collect data is the EDA interface.

6.2 EDA Interface and Related SEMI Standards

6.2.1 SEMI standards defined for the EDA interface can be classified as follows:

- Security for access to the equipment information, SEMI E132
- Data model (metadata) for the available data from the equipment, SEMI E125 and SEMI E120
- Mechanism for defining and enabling data acquisition from the equipment, SEMI E134

6.2.2 Figure 2 shows the relationship between the EDA interface standards for the client acting as an Equipment Engineering Application and the equipment. The SEMI EDA standards are used to implement the EDA interface.

6.2.3 SEMI E132 Role in Security

6.2.3.1 SEMI E132 — Specification for Equipment Client Authentication and Authorization, defines the mechanism to restrict access to the equipment resource using the concept of “Authentication” and “Authorization.” In an EES enabled factory, multiple equipment engineering applications co-exist. An equipment engineering application is represented as a client for the equipment. Not all clients are allowed to access the equipment information, in particular the metadata, or to request data from the equipment. Only client(s) allowed to access specific equipment in the factory are permitted to acquire the information from the equipment. SEMI E132 ensures this by an authentication and authorization mechanism.

6.2.3.2 EDA communication between a client and equipment is enabled by the session establishment defined in SEMI E132. All service messages defined in SEMI E125 and SEMI E134 are exchanged using authenticated

sessions as defined in SEMI E132. Clients allowed to access the equipment through the EDA interface may have different levels of access to the equipment-defined functionality. Authorization is the mechanism that ensures which equipment functionality the client is permitted to access.

6.2.3.3 The definition of privileges by using ACL Entries as defined in SEMI E132 restricts client access to a range of equipment features for the authenticated client. The client accessing the equipment features through the authenticated session must have a privilege(s) assigned to it beforehand through an ACL Entry.

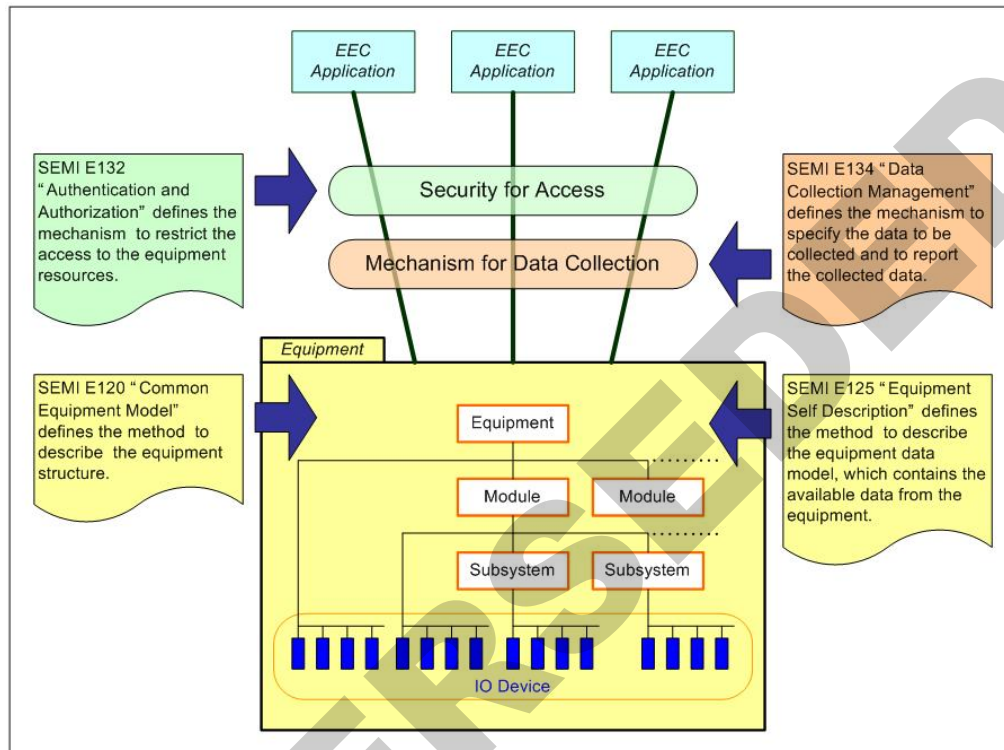


Figure 2
EDA Interface and Relative SEMI Standards

6.2.4 SEMI E132 Role in Security

6.2.4.1 SEMI E132 — Specification for Equipment Client Authentication and Authorization, defines the mechanism to restrict access to the equipment resource using the concept of “Authentication” and “Authorization.” In an EES enabled factory, multiple equipment engineering applications co-exist. An equipment engineering application is represented as a client for the equipment. Not all clients are allowed to access the equipment information, in particular the metadata, or to request data from the equipment. Only client(s) allowed to access specific equipment in the factory are permitted to acquire the information from the equipment. SEMI E132 ensures this by an authentication and authorization mechanism.

6.2.4.2 EDA communication between a client and equipment is enabled by the session establishment defined in SEMI E132. All service messages defined in SEMI E125 and SEMI E134 are exchanged using authenticated sessions as defined in SEMI E132. Clients allowed to access the equipment through the EDA interface may have different levels of access to the equipment-defined functionality. Authorization is the mechanism that ensures which equipment functionality the client is permitted to access.

6.2.4.3 The definition of privileges by using ACL Entries as defined in SEMI E132 restricts client access to a range of equipment features for the authenticated client. The client accessing the equipment features through the authenticated session must have a privilege(s) assigned to it beforehand through an ACL Entry.

6.2.5 SEMI E125 and SEMI E120 Role in Metadata Modeling and Retrieval

6.2.5.1 SEMI E125 — Equipment Self Description, defines the equipment data model that references the equipment structure model by using SEMI E120 — Common Equipment Model.

6.2.5.2 The Equipment Data Model describes the data available from the equipment. Through the data model, the equipment shares information about the available data defined in the equipment with the client. Since the equipment metadata or data model information shows the structure, behavior, and available information from the equipment, it is necessary to represent which component in the equipment generates what data. SEMI E125 defines the method to describe the available data from the physical equipment component. To understand the meaning of the available data from the respective component, the equipment component is associated with the equipment structure. SEMI E120 defines how to describe the physical equipment structure. Each equipment component used in SEMI E125 refers to a component in the equipment structure described according to SEMI E120. This way, the client knows which equipment component generates what equipment data or information.

6.2.5.3 The equipment data available through the EDA interface is described using the types and the classes as defined in SEMI E125. The equipment components are the data sources for the available equipment data and described in the form of the equipment structure as defined in SEMI E120. The description of the available data includes Parameters, Events, Exceptions, and SEMI object attributes available and implemented in the equipment.

6.2.6 SEMI E134 Role in Data Acquisition

6.2.6.1 SEMI E134 — Data Collection Management, defines the mechanism to specify the data to be collected and the form of the report for the collected data.

6.2.6.2 The client may require continuous data collection from the equipment. The client may also request temporary information about the equipment's condition or status. SEMI E134 provides two types of data collecting mechanisms for these purposes. One mechanism is based on the Data Collection Plan (DCP) request and the other is an ad-hoc data request. In DCP requests, the desired data are automatically collected based on the instructions defined by the DCP and reported in data collection reports. A DCP specifies the data set to be collected, the sampling method, the buffering, and persistence. An ad-hoc data request is the mechanism for on-demand data collection. The client obtains the necessary information for a data collection request by querying the metadata from the equipment as defined by SEMI E125 and SEMI E120. No interference is expected to continuous data collection due to ad-hoc data requests (on demand data collection). Data collection services are defined in SEMI E134.

6.3 The Relationship between SEMI EDA Standards

6.3.1 SEMI EDA Standards

6.3.1.1 Figure 3 shows the relationship among SEMI standards related to the EDA interface.

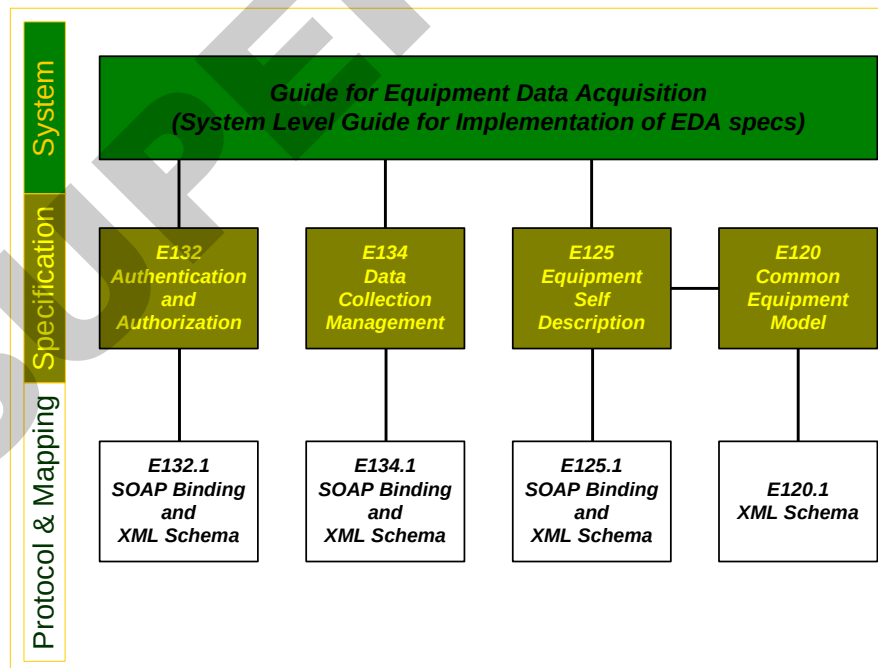


Figure 3
SEMI Standards for the EDA Interface

6.3.2 *Guide for Equipment Data Acquisition*

6.3.2.1 This document describes a system-level guide for applying the specifications of the EDA standards. It describes the specifications and their relationship to each other. It also provides examples in which the specifications are applied to introduce concepts.

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

6.3.3.1 SEMI E120 defines a general method of describing the physical equipment structure by using common attributes and terminology. The specification explains the equipment structure that identifies the data source.

6.3.4 *SEMI E120.1 — XML Schema for the Common Equipment Model*

6.3.4.1 SEMI E120.1 provides an XML representation of the equipment structure based on SEMI E120 definitions.

6.3.5 *SEMI E125 — Specification for Equipment Self Description (EqSD)*

6.3.5.1 SEMI E125 defines the mechanism and interface that describe the available information, such as data items, events, and exceptions, for each equipment component in the physical equipment structure.

6.3.6 *SEMI E125.1 — Specification for SOAP Binding for Equipment Self Description*

6.3.6.1 SEMI E125.1 describes the services in the SEMI E125 specification as well as the XML schema and web service files.

6.3.7 *SEMI E132 — Specification for Equipment Client Authentication and Authorization (ECAA)*

6.3.7.1 SEMI E132 defines the method to establish an authenticated session between the client and the equipment for network security. SEMI E132 also defines the authorization method to restrict the client's access to specific EDA equipment-defined functionality.

6.3.8 *SEMI E132.1 — Specification for SOAP Binding for Equipment Client Authentication and Authorization*

6.3.8.1 SEMI E132.1 describes the services in the SEMI E132 specification as well as the XML schema and web service files.

6.3.9 *SEMI E134 — Specification for Data Collection Management (DCM)*

6.3.9.1 SEMI E134 defines the mechanism to collect the specified data and report the collected data.

6.3.10 *SEMI E134.1 — Specification for SOAP Binding of Data Collection Management (DCM)*

6.3.10.1 SEMI E134.1 describes the services in the SEMI E134 specification as well as the XML schema and web service files.

6.3.11 *SEMI E138 — XML Semiconductor Common Components*

6.3.11.1 SEMI E138 is a central location for definitions of common XML elements that are not specific to a single standard, but common across multiple standards.

6.4 *Use Case of Standard Capabilities*

6.4.1 Figure 4 shows the overview of EDA services. The actors in Figure 4 represent entities in UML that in turn map into software applications.

6.4.2 *Security Admin*

6.4.2.1 SEMI E132 provides a general mechanism to allow the factory to establish a Central Administration Model. A Central Administration Model can be used to issue client credentials, establish client authorizations, and possibly client credentials on the equipment. SEMI E132 defines the mechanism and interface for authentication with and without credentials and authorization by defining privileges. However, SEMI E132 does not provide any mechanism to exchange the credentials. SEMI E132 specifies that only the SecurityAdmin utilizes the operations defined in the Security Administration Interface. The equipment should support only one SecurityAdmin account concurrently. The equipment is also required to perform the SecurityAdmin capabilities on its equipment console. These capabilities allow initial credential-setting during equipment installation or troubleshooting. SecurityAdmin is not intended for use under normal operational conditions.

6.4.3 *Data Consumer or Client*

6.4.3.1 In SEMI E132, the client is defined as an application process that communicates with the equipment to access equipment resources. In SEMI E134, the data consumer is defined as any software entity that uses the DataCollectionManager interface to manage data collection on the equipment. Thus, the SEMI E134 data consumer is the application that processes or consumes the data sent by the equipment, i.e., the EE application.

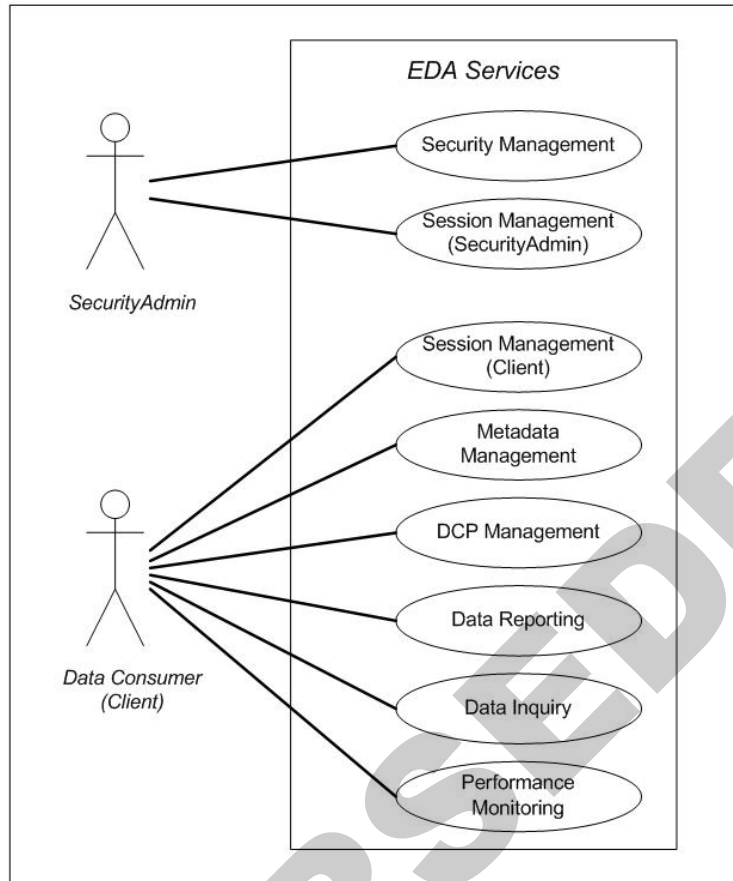


Figure 4
Overview of EDA Services

6.4.4 Security Management

6.4.4.1 SecurityAdmin defines the authorization information (i.e., the privilege(s) for each client) on the equipment by using the security administration interface. The privilege information is set as an ACL Entry. The ACL Entry links a client and a privilege(s) defined on the equipment. SEMI E132 does not define any specific privileges. For the EDA interface, the privileges that can be assigned to the potential client are defined in SEMI E134.

6.4.5 Session Management (SecurityAdmin)

6.4.5.1 SecurityAdmin manages the SEMI E132 session using the security administration interface. Note that the SEMI E132 session (or the authenticated session) is an application-level concept defined by SEMI E132 and is independent of any physical or logical connection or communication protocol “session” layer used in the actual exchange of messages.

6.4.6 Session Management (Client)

6.4.6.1 Through the session manager interface, clients can request the equipment to establish a SEMI E132 session to use functions defined for data collection by the EDA interface. Upon receiving the request, the equipment performs the authentication process for the requesting client. SEMI E132 defines the authentication process.

6.4.7 Metadata Management

6.4.7.1 Clients may request the equipment to send equipment metadata by using the equipment metadata manager interface defined in SEMI E125. Equipment metadata describes the equipment structure and the equipment information available from the equipment components. All changes to equipment metadata should be managed by the equipment.

6.4.8 Data Inquiry

6.4.8.1 A client may request the equipment to send specific data by using the data collection manager interface defined in SEMI E134. The on-demand data request is called an ad-hoc data request. The requested data may not be associated with a specific event or exception. The ad-hoc data request can not be used for trace data.

6.4.9 DCP Management

6.4.9.1 Clients may request the equipment to collect and report data automatically by using the data collection manager interface defined in SEMI E134. The data set to be collected and the sampling specifications are defined in the DCP on the equipment. This DCP is reusable. To collect equipment data, the client must activate a DCP by using the data collection manager interface. After the activation, data collection begins according to the definition in the data collection plan. For example, if the plan defines that a certain event initiates data collection, the data collection does not start until that event occurs.

6.4.10 Data Reporting

6.4.10.1 The equipment reports the collected data specified in the DCP to the client using the DCP consumer interface defined in SEMI E134.

6.4.11 Operational Performance Monitoring

6.4.11.1 Collecting large amounts of data may overload the equipment's computing resources, which may impede the intended process capabilities of the equipment. SEMI E134 requires the equipment to monitor performance and manage data collection such that it does not affect the processing ability of the equipment, including data collection through the EDA interface.

6.5 Example of High Level Scenario for Data Collection

6.5.1 Figure 5 shows an example of the high level interaction between the data collection client (Data Consumer) and the equipment. This scenario uses high level operation names, which differ from those defined in the related standard.

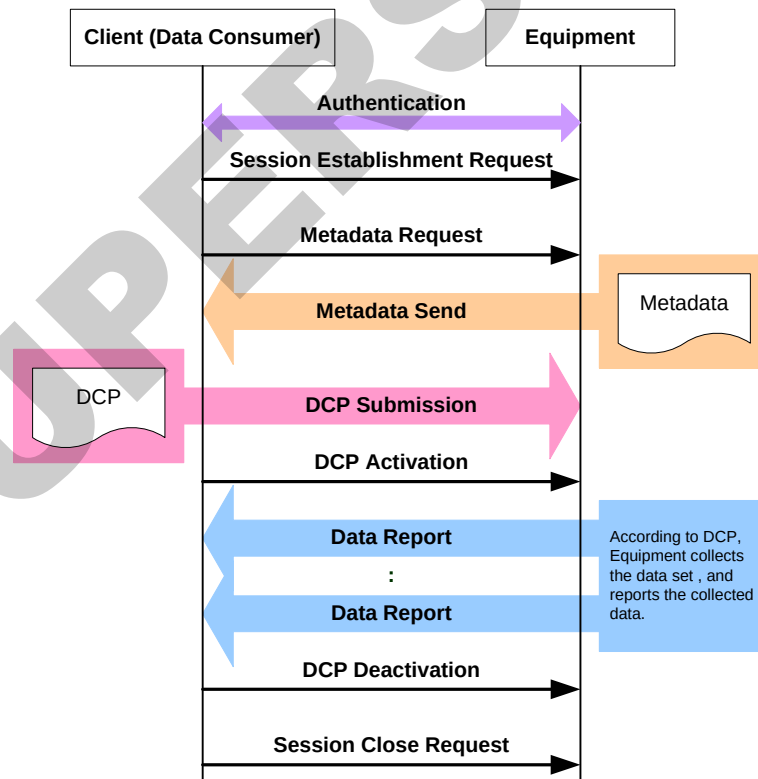


Figure 5
Example of a High Level Scenario

Table 1 Description of a High Level Scenario

No.	Client	Operation	Equipment	Comment
1	The client requests the equipment to establish SEMI E132 session.	Session Establishment Request (SEMI E132) →	The equipment establishes a SEMI E132 session if the client is authenticated and is authorized.	This high level scenario does not describe authentication process because it depends on the technology applied. SEMI E132 does not require a specific technology or protocol for authentication.
2	The client requests the metadata of the equipment.	Metadata Request (SEMI E125) →	Equipment receives a set of requests to retrieve the metadata.	
3	The client gets the equipment metadata.	← Metadata Send (SEMI E125)	The equipment sends its metadata.	The client identifies the available data from the equipment with the equipment metadata.
4	The client creates a Data Collection Plan.			The Data Collection Plan (DCP) specifies the data to be collected and the sampling timing.
5	The client submits the Data Collection Plan to the equipment.	DCP Submission (SEMI E134) →	The equipment validates and defines the DCP locally.	The submitted DCP is defined on the equipment after successful validation.
6	The client requests the equipment to activate the DCP.	DCP Activation (SEMI E134) →	The equipment activates the DCP.	The requested DCP is activated after successful validation. It depends on DCP definition if data collection begins immediately after activation.
7			The equipment initiates data collection.	The equipment initiates data collection and reports the collected data as specified in the DCP.
8	The client receives the collected data.	← Data Report (SEMI E134)	The equipment reports the collected data.	The amount of data reporting depends on the DCP definition.
9	The client requests the equipment to finish the data collection.	DCP Deactivation (SEMI E134) →	The equipment deactivates the DCP to finish data collection.	It depends on the DCP definition when the data collection ends.
10	The client requests the equipment to close the SEMI E132 session.	Session close Request (SEMI E132) →	The equipment closes this SEMI E132 session.	

7 Guide for Equipment Metadata

7.1 Equipment Example

7.1.1 Figure 6 shows an example of a simplified equipment structure.

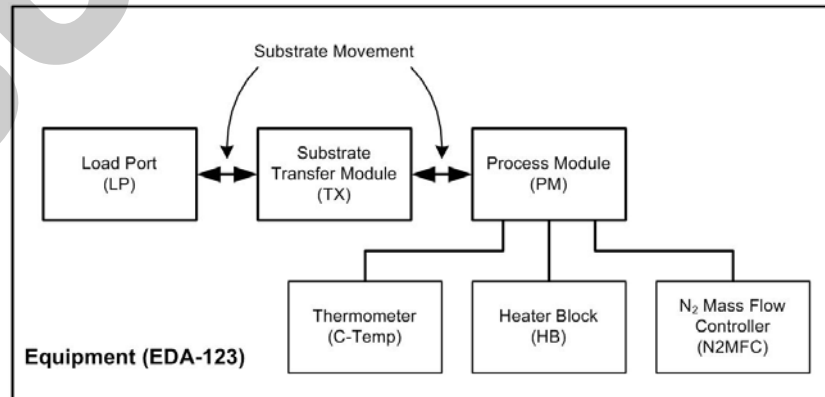


Figure 6
Example of an Equipment Structure