SEMI A3-0819
SPECIFICATION FOR PRINTED CIRCUIT BOARD EQUIPMENT COMMUNICATION INTERFACES (PCBECI)

This Standard was technically approved by the Automation Technology Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on May 7, 2019. Available at www.semiviews.org and www.semi.org in August 2019.

1 Purpose

1.1 The purpose of this Specification is to define the equipment communication interface for printed circuit board (PCB) manufacturing. A robust and comprehensive shop-floor communication standard would specify detailed, bidirectional communication has been needed to improve productivity and reduce the costs to develop the equipment interface in PCB manufacturing.

1.2 This Document is designed for software engineers implementing communication interfaces especially for PCB manufacturing to establish a robust and expandable framework for the integration of equipment. A collection of SEMI and other standards have been referenced.

2 Scope

2.1 This Specification aims to provide a common interface especially for the equipment used in PCB manufacturing. It is independent of the base technology used. It is mainly intended to be applied to exposure process, drilling process or plating process—however it is not limited to these areas of application.

2.2 This Specification is used for the purpose of standardizing the host/equipment interfaces within factory automation systems only.

2.3 This Specification is developed for both of the inline equipment and batch equipment. A piece of manufacturing equipment is a mechanical and physical entity in shop-floor which plays a role in the manufacturing process. It can be used to transport, store or process material and can have a modular structure. A host is a computer or a network of computers which exchange information with the equipment in order to fulfill manufacturing tasks.

2.4 This Specification intends to lay the foundation for a reliable and extensible IT integration framework for PCB manufacturing based on proven standards using a multi-layered approach. As far as possible the Specification references existing SEMI Standards to realize these layers. The resulting framework is referred to as printed circuit board equipment communication interface (PCBECI).

2.4.1 This Specification defines a physical layer/data link layer based on Ethernet and RS-232-C.

2.4.2 Message exchanges between equipment and host are based on SEMI E37/SEMI E37.1/SEMI E4 for message transfer.

2.4.3 This Specification defines a message and data item set based on SEMI E5.

2.4.4 This Specification defines the behavior of PCB equipment as seen through a SEMI E30 based communications link.

2.5 As far as possible the SEMI Standards named before are used as known from semiconductor industry. However, a small set of restrictions has been defined to simplify their application in PCB industry and thereby to improve the level of acceptance. This Specification contains one subsection for each layer that describes the restrictions that apply for PCB manufacturing. Nevertheless, it should be easy to adjust interface implementations developed for semiconductor industry to fulfill these restrictions.

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 Specification is not an all-inclusive list of applicable standards. Additional standards may be used as needed.

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3.2 When referring to other SEMI Standards used in this Document the reader should allow for some editorial exceptions in order to apply these standards to PCB equipment. For example, if another SEMI Standard uses the term wafer, the reader can assume that this also applies to substrates of printed circuit board. These minor differences do not impact the interpretation or usage of those standards in PCB manufacturing.

3.3 The PCBECI Specification does not intend to express requirements for data preprocessing (computation of mean-values, etc.).

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI E4 — Specification for SEMI Equipment Communications Standard 1 Message Transfer (SECS-I)

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 E37 — Specification for High-Speed SECS Message Services (HSMS) Generic Services

SEMI E37.1 — Specification for High-Speed SECS Message Services Single Selected-Session Mode (HSMS-SS)

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

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *GEM* — Generic Model for Communications and Control of Manufacturing Equipment

5.1.2 *HSMS* — high speed SECS message service

5.1.3 *SECS* — SEMI Equipment Communication Standard

5.1.4 *PCB* — printed circuit board

5.1.5 *PCBECI* — printed circuit board equipment communication interface

5.2 *Definitions*

5.2.1 *printed circuit board equipment communication interface (PCBECI)* — the PCBECI is a SECS-II compliant interface. Messages are recommended to be transmitted via an Ethernet network using HSMS protocol but RS-232-C using SECS-I protocol also applicable for small amount and simple data transmittal. The functionality is based on SEMI E30 with the restrictions and additions defined in this Document.

6 Conventions

6.1 *Requirements Identification*

6.1.1 The following notation specifies the structure of requirement identifiers (see Table 1).

6.1.1.1 The following requirements prefix format shall be used at the beginning of the requirement text:

- [A003.00-RQ-nnnnn-nn]

6.1.1.2 To mark the end of the requirement text the following suffix format must be used:

- [/RQ]

6.1.2 Requirement IDs apply across the row (left to right) of a table unless otherwise specified.

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Table 1 **Requirement Identifiers**

Format Notation	*Purpose*
Esss.ss	SEMI Standards Specification Identifier. Examples: E087.00, E087.01, E134.00.
RQ	Indicates this is a requirement identifier.
Nnnnn	Unique five digit number within this Specification. 90000–99999 are reserved for use by SEMI.
-nn	Two-digit number that indicates version level of the requirement (-00 is used for the first version of a requirement).
/RQ	Indicates the end of a requirement.

7 Physical Layer

7.1 [A003.00-RQ-00001-00] PCB equipment shall provide an Ethernet (per IEEE 802®) port or EIA RS-232-C port that allows the equipment to connect to the factory network. PCB equipment shall support state of the art communication data rates. The capabilities of the PCBECI described in this Specification shall be exposed through this port. [/RQ]

8 Application Layer

8.1 [A003.00-RQ-00002-00] PCB equipment shall provide an implementation of the application layer compliant to SEMI E37.1 (HSMS-SS). For some simple PCB equipment to transfer small amount of data purpose, PCB equipment may provide an implementation of the application layer compliant to SEMI E4 (SECS-I) only. [/RQ]

9 Behavior of PCB Equipment as Seen Through the PCBECI

9.1 [A003.00-RQ-00003-00] PCB equipment shall comply with the fundamental GEM requirements and additional capabilities as defined in SEMI E30 except the Limits Monitoring capability and the Spooling capability. PCB equipment supplier shall provide the GEM Compliance Statement (SEMI E30, Table 11). [/RQ]

9.2 [A003.00-RQ-00004-00] In order to comply with this Specification, PCB equipment shall provide a PCBECI as defined by SEMI E30 with the restrictions and additions outlined in the following sections. [/RQ]

9.3 *PCBECI Documentation Requirements*

9.3.1 Besides other criteria, the effort for equipment integration is highly dependent on an equipment supplier's documentation quality. The following requirements are defined in addition to the SEMI E30, GEM documentation requirements.

9.3.2 *Format*

9.3.2.1 [A003.00-RQ-00005-00] The documentation shall be electronically readable and shall allow for copy/paste actions. This is especially relevant for lists of variable data items, parameters, events and alarms. [/RQ]

9.3.2.2 [A003.00-RQ-00006-00] Variable Data Items, Alarms, Events, including description and characteristics, shall be provided in electronic format (comma separated values, XML or any standard office format) in a data dictionary. [/RQ]

9.3.3 *Content*

9.3.3.1 [A003.00-RQ-00007-00] The supplier shall document when data values (DVVALs) are current and valid. A comma-separated list of DVNAMEs is required for each CEID to show what DVVALs are current and valid at the occurrence of the event. [/RQ]

9.4 *Alarm Management*

9.4.1 [A003.00-RQ-00008-00] One generic event 'AlarmDetected' and one generic event 'AlarmCleared' is required for all alarms. [/RQ]

9.4.2 Software packages, which provide the 'AlarmDetected' and 'AlarmCleared' events for each single alarm are acceptable as long as they also provide the generic 'AlarmDetected' and 'AlarmCleared' events for all alarms.

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