

SEMI E23-1104 (Reapproved 0710) SPECIFICATION FOR CASSETTE TRANSFER PARALLEL I/O INTERFACE

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NOTICE: This Standard or Safety Guideline has an Inactive Status because the conditions to maintain Current Status have not been met. Inactive Standards or Safety Guidelines are available from SEMI and continue to be valid for use.

1 Purpose

1.1 Cassette transfer between process equipment and transport equipment is performed by means of a mechanical operation in the interactive area and requires quick response and reliable interlock signals.

1.2 The purpose of this Specification is to provide a cassette transfer parallel input/output (I/O) interface for control of the interface mechanism that supplements the SECS standard for material movement.

2 Scope

2.1 This Specification deals with the parallel I/O interface for the cassette transfer between two pieces of equipment, such as a piece of process equipment and a piece of transport equipment.

2.2 This Standard defines the wire-connected parallel I/O interface between two pieces of equipment and the photo-coupled parallel I/O interface between the process equipment and the transport equipment.

2.3 The application of the parallel I/O interface to the cassette transport is as follows.

2.4 Each piece of equipment is connected to the HOST at the SECS interface, and each of the two pieces of equipment between which the cassette transfer will be made is connected at the parallel I/O interface as shown in Figure 1.

2.5 The cassette transfer request, or load/unload command, is notified by the SECS-II message. The actual cassette transfer action is executed using the parallel I/O interface, interlocking each mechanism. (An example of a cassette transfer transaction using the parallel I/O interface is shown in Related Information 1.)

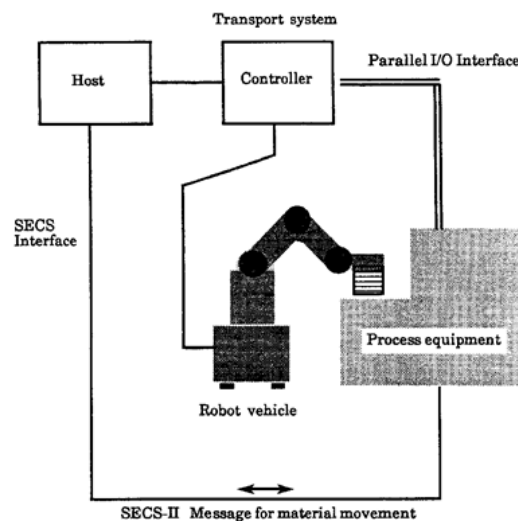


Figure 1
Application of Parallel I/O Interface to Cassette Transport

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 Referenced Standards and Documents

3.1 SEMI Standards and Safety Guidelines

SEMI E1 — Specification for Open Plastic and Metal Wafer Carriers

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)

3.2 ISO Standard¹

ISO 4902 — Information Technology – Data Communication – 37-pole DTE/DCE Interface Connector and Contact Number Assignments

3.3 JIS Standard²

JIS-X-5103 — The Interface Between Data Circuit Terminating Equipment (DCE) and Data Terminal Equipment (DTE) (37/9-Pin Interface)

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

4 Terminology

4.1 Definitions

4.1.1 *active equipment* — equipment that loads a cassette onto the cassette stage of another piece of equipment or unloads a cassette from the cassette stage of another piece of equipment.

4.1.2 *cassette* — a plastic or metal wafer carrier (as defined in SEMI E1).

4.1.3 *cassette stage* — a stage on a piece of equipment on which a cassette is placed or from which it is removed that allows the cassette transfer.

4.1.4 *cassette transfer robot* — a robot that transfers cassettes (see Figure 2).

4.1.5 *passive equipment* — equipment that is loaded or unloaded by the active equipment.

4.1.6 *photo-coupled interface* — a parallel I/O interface connected without contact by means of a photo-coupled device.

4.1.7 *process equipment* — fabrication equipment, inspection equipment, and cassette stage equipment used in semiconductor manufacturing.

4.1.8 *robot vehicle* — a piece of equipment having a cassette transfer robot on the vehicle that moves to another piece of equipment and transfers cassettes (see Figure 2).

4.1.9 *transfer* — to either load or unload.

4.1.10 *transport equipment* — a piece of equipment (or system) which transports or transfers cassettes. It mainly consists of a transport vehicle, a robot vehicle, and a cassette transfer robot.

4.1.11 *transport vehicle* — a vehicle which transports cassettes but which has no mechanism for cassette transfer (see Figure 2).

4.1.12 *wire-connected interface* — a parallel I/O interface connected by means of wire and a connector.

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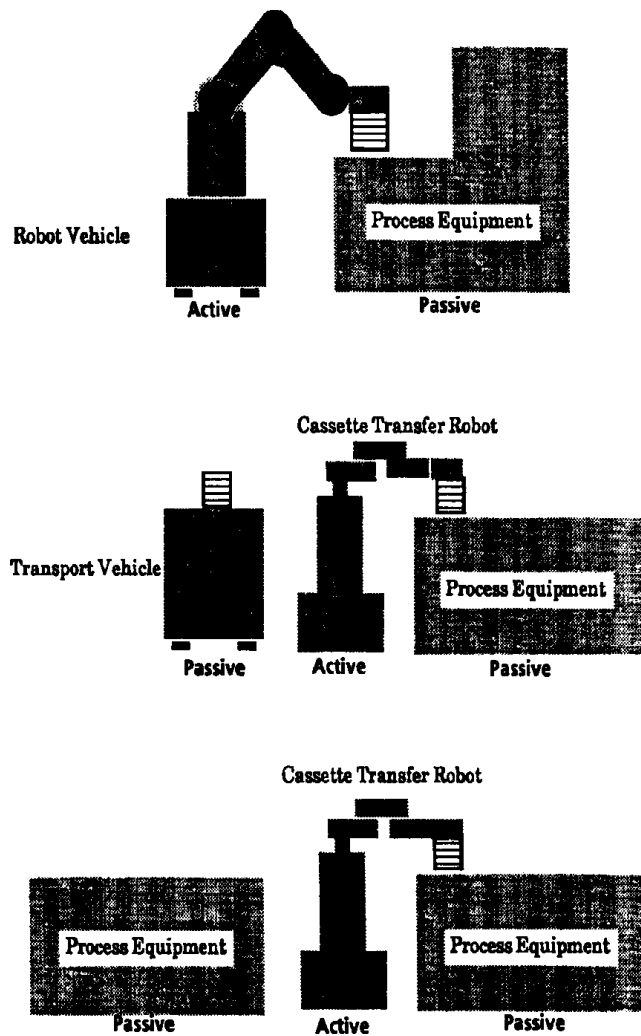


Figure 2
Cassette Transfer Between Active Equipment and Passive Equipment

5 Parallel I/O Interface Specification

5.1 This standard refers only to the cassette transfer between active and passive equipment.

5.2 *Wire-Connected Parallel I/O Interface Specification* — The equipment is to have a parallel I/O interface for the passive mode when it becomes passive, and the parallel I/O interface for the active mode when it becomes active.

5.2.1 *Signals for Each Cassette Stage* — The cassette stage is to have the input/output signal lines listed in Table 1.

Table 1 Signals for Each Cassette Stage (Wire-Connected Interface)

<i>Signal Type</i>	<i>P/A</i>	<i>Description</i>
L_REQ (LOAD REQUEST)	P->A	This signal means that the CS can be loaded. The signal turns OFF when the cassette is detected on the CS. (The CS is a cassette stage.)
U_REQ (UNLOAD REQUEST)	P->A	This signal means that the CS can be unloaded. The signal turns OFF when it is detected that the cassette has been removed from the CS.

Signal Type	P/A	Description
READY	P->A	This signal means that the CS is in a state where it can be accessed by the active equipment. It turns ON when the CS is in the READY state after the TR_REQ signal from the active turns ON. The signal turns OFF by handshakes with the COMPT signal.
TR_REQ (TRANSFER REQUEST)	A->P	This signal turns ON when the active equipment is going to start transferring the cassette. It turns OFF when the BUSY signal is OFF. (Active equipment starts transferring the cassette with the BUSY ON after recognizing the READY ON.)

5.2.2 *Common Signals* — The signals in Table 2 show the status of the cassette transfer action of the active equipment. The CSs are allowed to input these signals commonly from active equipment.

Table 2 Common Signals (Wire-Connected Interface)

Signal Type	P/A	Description
BUSY	A->P	This signal turns ON when the active equipment starts transferring the cassette to the CS while it is in READY and turns OFF after the robot has loaded or unloaded a cassette and has moved away from the interactive zone. The passive equipment does not perform any mechanical action in the interactive zone while this signal is ON.
COMPT (COMPLETE)	A->P	This signal means the active equipment has completed the transfer action. It turns OFF after handshaking with the READY signal.

#1 It is recommended that the BUSY signal turn OFF after the active equipment has confirmed L_REQ (or U_REQ) is OFF.

5.2.3 *Cassette Transfer Sequence* — Time charts for the cassette transfer sequence are shown in Figures 3 (a) and (b).

5.2.3.1 The TR_REQ from the active equipment initiates the cassette transfer sequence. The active equipment starts carrying out the transfer action with the BUSY ON as soon as it recognizes that the READY signal of the passive equipment is ON. The handshake is finished after the cassette transfer action has been completed.

5.3 *Photo-Coupled Parallel I/O Interface Specification* — This interface is concerned only with the cassette transfer between the process equipment and the transport robot vehicle. The robot vehicle is active and the process equipment is passive.

5.3.1 This interface is defined between the robot and the cassette stages to which the robot can transfer a cassette at the same stopping position.

5.3.2 *Signals* — The signals for the photo-coupled parallel I/O interface are listed in Table 3. The CS_0, CS_1, and CS_2 signals specifying the CS to or from which the active equipment transfers and the VALID signal indicating effectiveness of the data of CS_0~CS_2, are newly added to the signals defined in the wire-connected parallel I/O interface.

Table 3 Signals for the Photo-Coupled Parallel I/O Interface

Signal Type	P/A	Description
VALID	A->P	This signal remains high (ON) while the data of CS_0, CS_1, CS_2 is effective. (The data of CS_0, CS_1, CS_2 is not effective when VALID signal is OFF.)
CS_0 (LSB) CS_1 CS_2 (MSB)	A->P	The 3-bit signals specify the cassette stage number (0~7) of the passive equipment, to or from which the active equipment (robot vehicle) is going to transfer a cassette. They are set before the VALID signal turns ON. VALID and CS_0~CS_2 signal.
TR_REQ	A->P	This is the same in the wire-connected parallel I/O specification and is valid for the specified CS.

Signal Type	P/A	Description
L_REQ	P->A	This is the same in the wire-connected parallel I/O specification and is valid for the specified CS.
U_REQ	P->A	This is the same in the wire-connected parallel I/O specification and is valid for the specified CS.
READY	P->A	This is the same in the wire-connected parallel I/O specification and is valid for the specified CS.
BUSY	A->P	This is the same in the wire-connected parallel I/O specification.
COMPT	A->P	This is the same in the wire-connected parallel I/O specification.

5.3.3 Cassette Transfer Sequence — Time charts for the cassette transfer sequence in the case of the photo-coupled interface are shown in Figure 4 (a) and (b). After the active equipment (robot vehicle) reaches the process equipment, it sets the CS_0, CS_1, CS_2 3-bit-signals to specify the CS number of the passive equipment, to or from which the active equipment (robot vehicle) is going to transfer a cassette. Then the robot vehicle turns the VALID signal ON, which shows the date of the CS_0, CS_1, CS_2 signal is effective. After the cassette stage is specified, cassette transfer sequence is the same as in the wire-connected parallel I/O specification. TR_REQ, L_REQ, U_REQ, READY signals show the data for the specified CS while the VALID signal is ON, and the CS_0, CS_1, CS_2 signals are inhibited to change their data while the VALID signal is ON.

5.4 Error Detection and Recovery — The cassette transfer using this interface in the practical manufacturing lines will need handshake time interval control, cassette misalignment detection, and report of alarm or error to find an error or abnormal termination in the cassette transfer. An error recovery procedure with appropriate assist by human operators will be also required. This Standard, however, does not define the specifications related to the error detection and recovery because of difference in process time, failure mode, and error recovery procedure of individual equipment and system.

5.4.1 The recommendation for basic error detection is that the active equipment should control handshake time intervals, and at least the interval time T between the beginning of the cassette transfer and the end of the transfer should be controlled—see the time chart of the cassette transfer sequence shown in Figures 3(a), 3(b), 4(a), and 4(b), describing the time chart of the cassette transfer sequence.

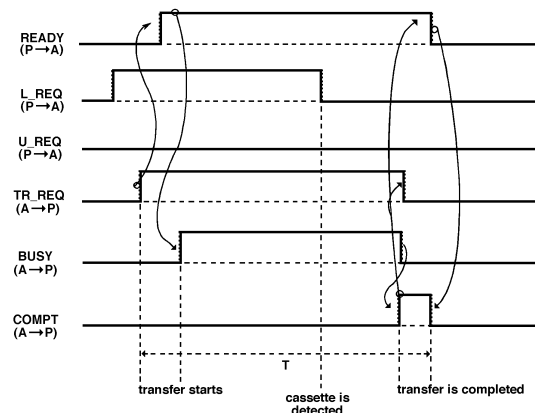


Figure 3A
Cassette Load Sequence
(Wire-Connected Interface)