7.2 *BOLTS/Light Exclusion Volume* — Equipment or loadport unit compliant with this standard must provide a BOLTS/Light exclusion volume defined in this section. BOLTS/Light exclusion volume consists of multiple sub-volumes and spaces defined in this section. The box opener/loader compliant with this standard must be compatible with BOLTS/Light exclusion volume. Bolts/Light exclusion volume is shown in Figure 2.

7.2.1 *Loader Exclusion Volume* — Loader exclusion volume is an exclusion volume for the main part of box opener/loader that is defined by *x108, y101, y110, y111,* and *z107*. *y111* is intentionally shorter than SEMI E15.1 D dimension in order to allow the equipment integrators to place a safety door, a carrier ID reader/writer, and/or any other features required by the user. An additional removable cover can be mounted on the box opener/loader if it is to be supplied as a complete unit compliant with the SEMI E15.1 D dimension.

7.2.2 *Door Seal Exclusion Volume* — Door seal exclusion volume is an exclusion volume for the door seal portion of box opener/loader that is defined by the distance between the plane at the SEMI E15.1 D1 and *y101, x108,* and *z109.*

7.2.3 *BOLTS/Light Opening Exclusion Volume* — BOLTS/Light opening exclusion volume is an exclusion volume for the box opener/loader encroachment of equipment from BOLTS/Light plane at portion above the permanent reserved space. There should be an opening when the door is opened. Through this opening substrates may be moved between the box on the BOLTS/Light compliant box opener/loader and the equipment by a wafer handler in the equipment. BOLTS/Light opening exclusion volume is defined by *x102, y103, z103,* and *z108*.

7.2.4 *Permanent Reserved Space* — Space that is reserved permanently in the equipment defined by *x102, y102, z105,* and *z108*.

7.2.5 *Temporarily Reserved Space* — Space that is reserved temporarily during a door open/close motion is being done and when the door is closed. The temporarily reserved space during a door open/close is defined by *x102, y102, y103, z103,* and *z108*. The temporarily reserved space when a door is closed is defined by *x102, y103, y112, z103,* and *z108*.

7.2.6 *The Loader Bottom Flange Exclusion Volume* — The loader bottom flange exclusion volume is an exclusion volume for fixing the box opener/loader to bottom interface plane. Loader bottom flanges are located on the both bottom side of the box opener/loader and directly mounted on bottom interface plane. The loader bottom flange exclusion volume is defined by *x108, x109, y115, y116,* and *z113 measured* from the bottom end of *z107.*

NOTE 3: The spaces to access the fixing bolt should be reserved by equipment side. This document does not define these spaces.

7.3 *Side Interface Features* — This standard defines the equipment side of the side interface features. Side interface features are defined with respect to “Docked facial datum plane” instead of “Facial datum plane”. The box opener/loader should mate with these features to provide the seal to the equipment. The side interface features are shown in Figure 2.

7.3.1 *BOLTS/Light Plane* — The BOLTS/Light plane is defined to be parallel to and at a distance *y101* from the docked facial datum plane. The Seal Zone is on this plane.

7.3.2 *Cycle-to-Cycle Repeatability* — The cycle-to-cycle repeatability of *y101* must be within *y113.*

7.3.3 *Seal Zone* — The equipment side of the BOLTS/Light plane specified by *x101, x103, z101, z102, z104,* and *z106* must be a flat area for sealing between the equipment and the box opener/loader.

7.3.3.1 The flatness of the seal zone must be within *y114* and the perpendicularity of the seal zone to the facial and horizontal datum planes must be within $\sigma 1$.

7.3.3.2 This standard only defines the seal zone on the equipment side. The actual seal is not defined in this standard, but should be mounted on the box opener/loader.

7.3.4 *Wafer Position* — This standard defines a typical wafer position when the box opener/loader positions the wafers to the equipment. The facial datum plane of a docked carrier is defined by *y110* from the facial datum plane. This provides compatible wafer center positions from the facial datum plane.

NOTE 4: This means that this standard defines a specified typical docking stroke.

7.4 *Bottom Interface Features* — This standard defines mainly the equipment side of the bottom interface features. Bottom Interface Features are shown in Figure 3.

7.4.1 Regarding the box opener/loader, parallelism of the bottom interface feature and the horizontal datum plane must be within $\sigma 2$.

7.4.2 *Bottom Interface Planes* — The Bottom Interface Feature should have two Bottom Interface Planes defined by *x104, x105, y104, y105,* and *z107*. Nothing other than locating pins can protrude above these planes. During maintenance, the front end of the loading slider area should be open *z112* under the bottom interface planes.

7.4.3 *Loader Locating Pins* — Equipment must have two Loader locating pins to locate the box opener/loader so as to provide highly repeatable and quick attachment/detachment. Horizontal locations of the loader locating pins are defined by *x106* and *y106*. Height of the loader locating pins is defined by *z110*. Diameter of the loader locating pins is defined by *d1*. A box opener/loader compatible with this standard must refer these two Loader Locating pins.

7.4.3.1 *Positioning Pin* — Loader locating pin on the left side from operator is a positioning pin that is used to hold box opener/loader both in *x* and *y* directions.

7.4.3.2 *Anti-Rotation Pin* — Loader locating pin on the right side from operator is an anti-rotation pin that is used to hold box opener/loader in *y* direction only (see Figure 4).

7.4.4 *Locking Screws* — Four locking screws defined by *x106, y107,* and *y108* to tighten the box opener/loader.

7.4.4.1 The equipment should have M8-16 tapped holes at these locations.

7.4.5 *Control Connection Area* — Area used to pass connectors, wires, and tubes for electrical signals, power supply and other inlets/outlets.

7.4.5.1 The control connection area is defined at the same height as the the bottom interface planes by *x107* and *y109*.

NOTE 5: This standard only defines the connection area for the box opener/loader itself. It is recommended that connectors will be located above this area for quick maintainability.

7.4.5.2 Other connections which will possibly be located in this area for other functions are listed below and may be defined in separate standards:

- Carrier ID reader/writer head interface (automated units that read or write to an ID tag defined in SEMI E15.1)
- Manual operation panel
- Wafer mapper

7.5 *Panel Interface Height* — This standard defines an optional panel interface height so as to provide panel installation height to enclose box opener/loader in the equipment. Panel interface height is defined by *z111* from horizontal datum plane. In case this option is used, both equipment and the box opener/loader should have forklifts exclusion volume defined by SEMI E15.1 H0.

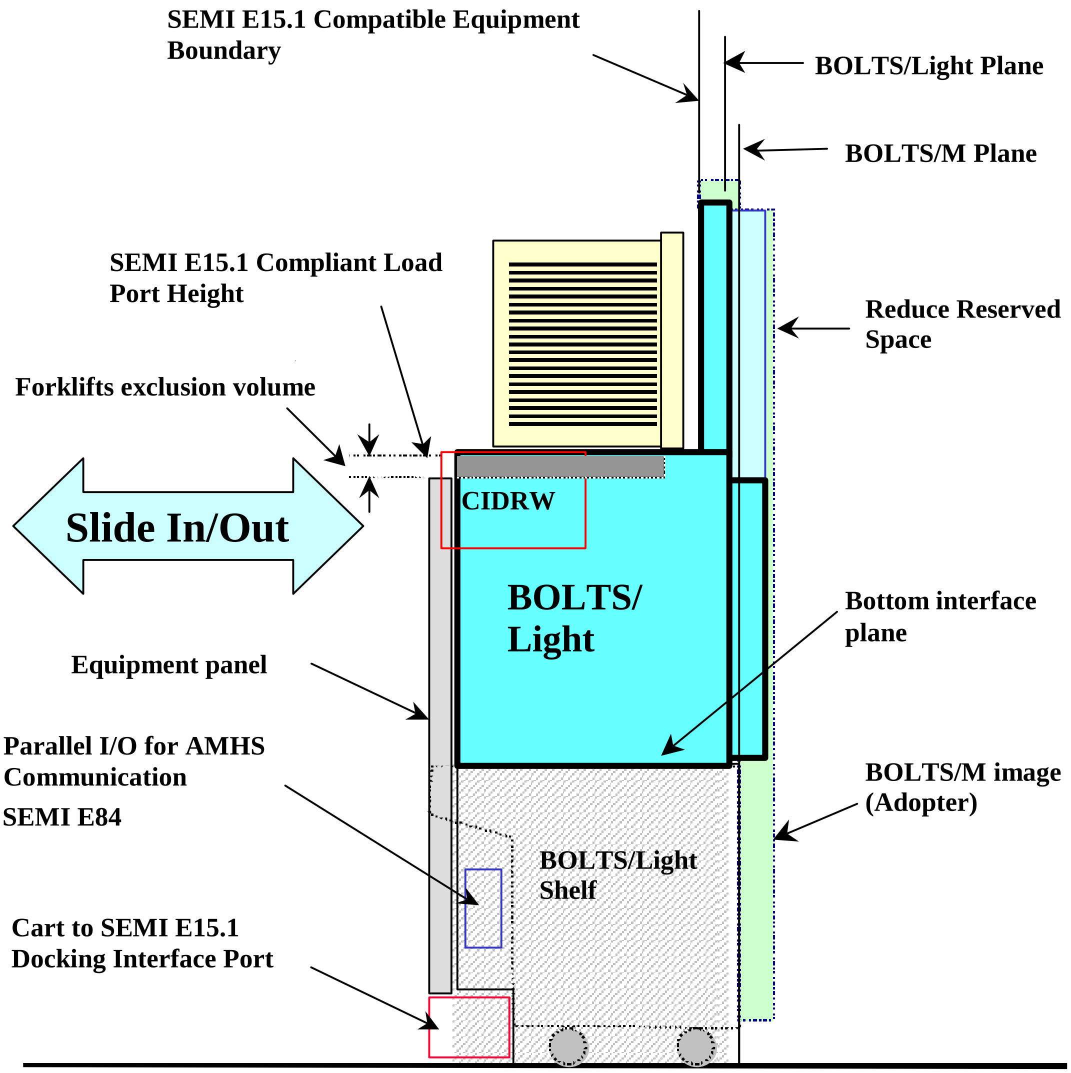

Figure 1
Diagram Concept of Light-Weight and Compact Box Opener/Loader and Tool-Interoperability Standard (BOLTS/Light)

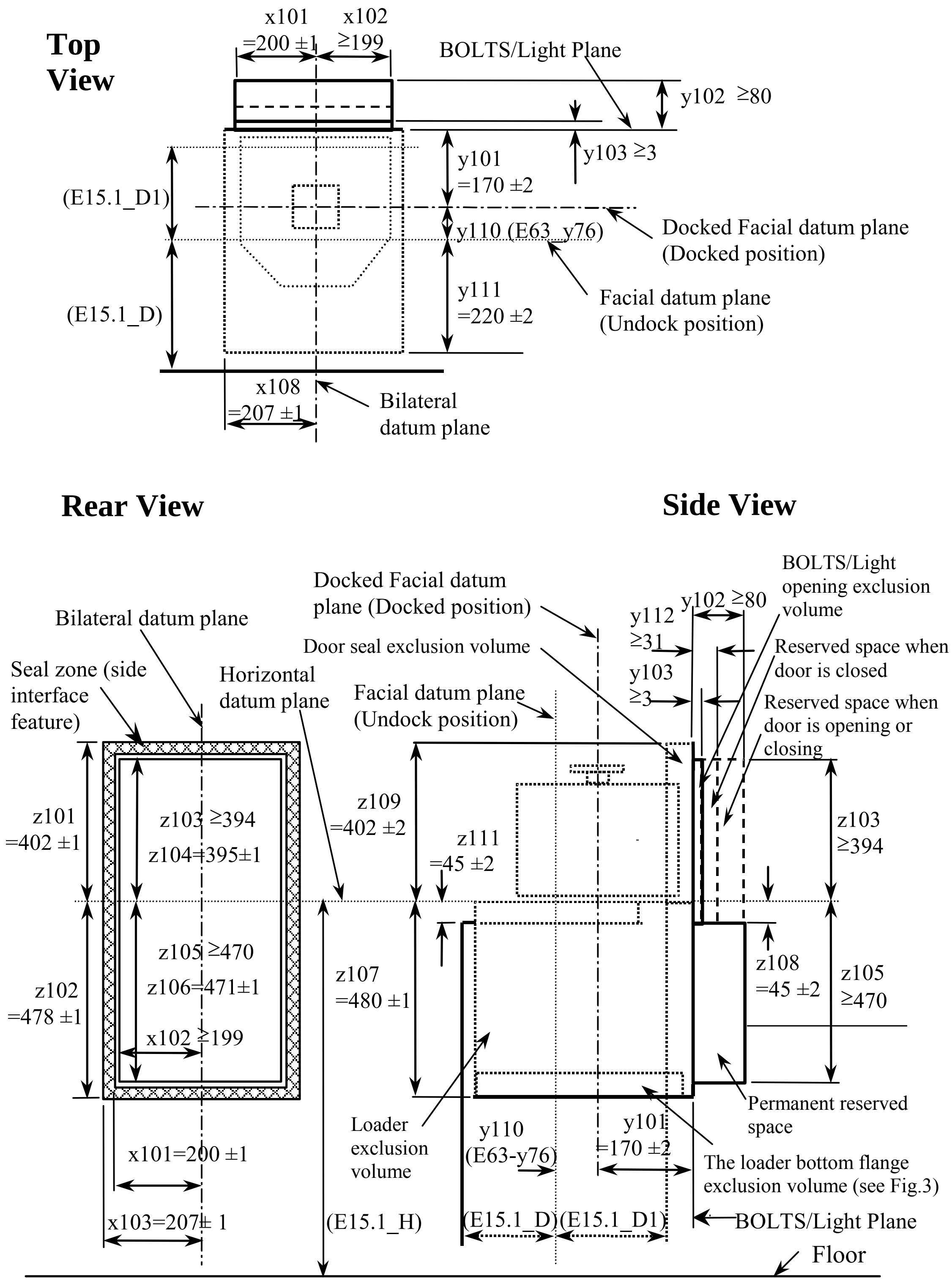

Figure 2
Top, Rear, and Side Views of BOLTS/Light Exclusion Volume and Equipment Side of the Side Interface Feature

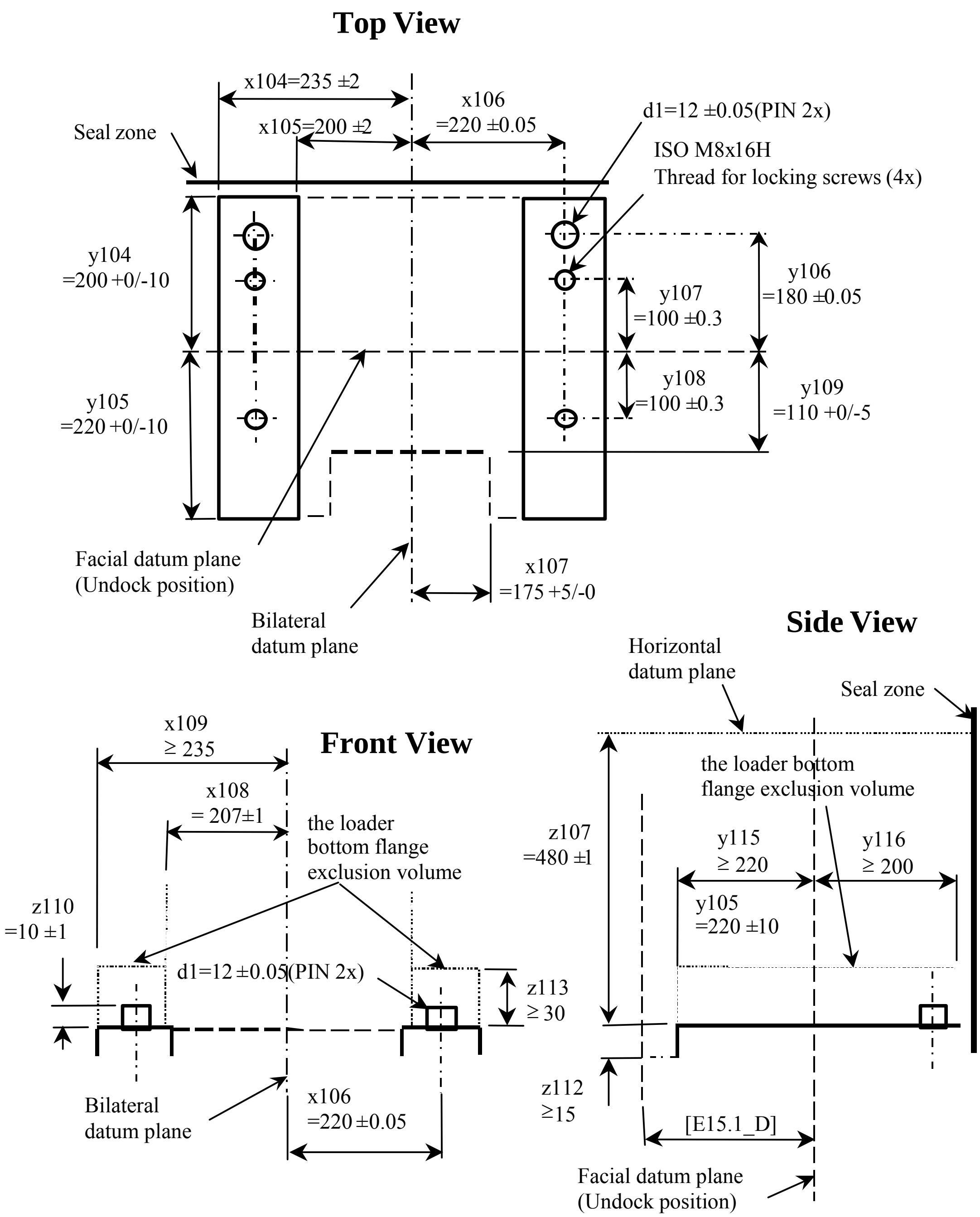

Figure 3
Equipment Side of the Bottom Interface Feature

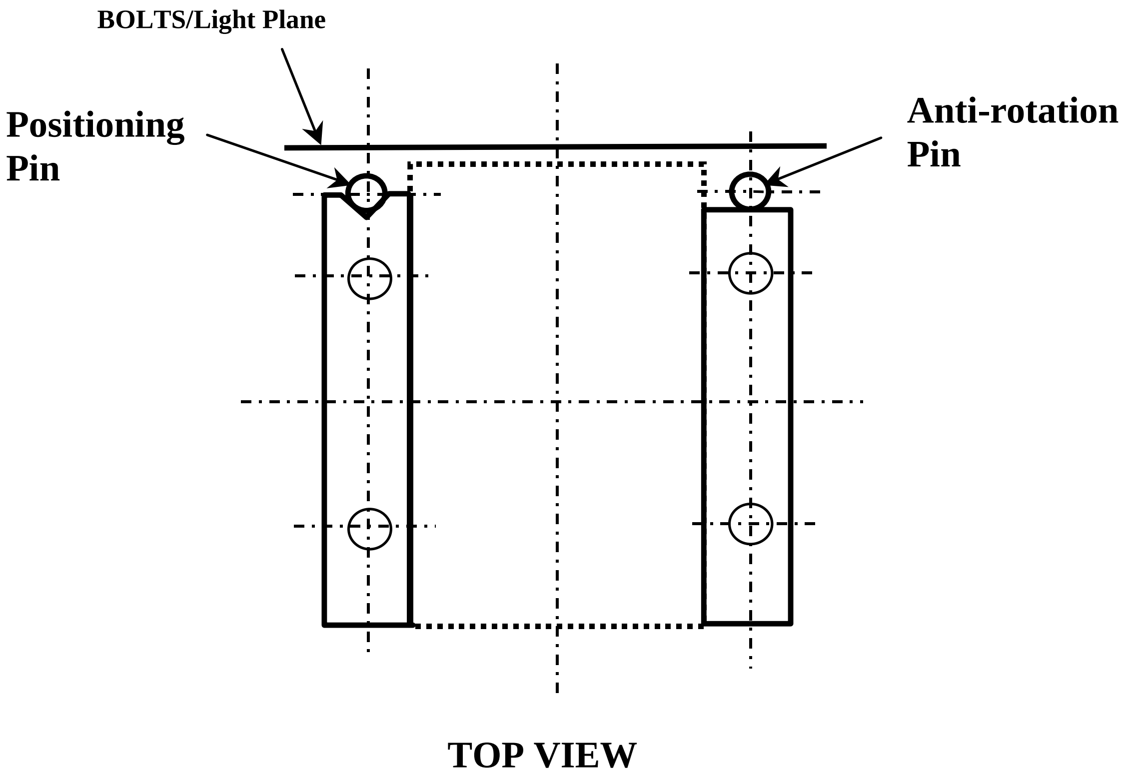

Figure 4
Usage of Loader Locating Pins

Table 1 Dimensions for Light-Weight and Compact Box Opener/Loader to Tool Standard (BOLTS/Light) Interface

Symbol	*Value Specified*	*Datum Measured from*	*Feature Measured to*
σ1	0 ± 0.1°	Facial and horizontal datum planes	Perpendicularity of seal zone.
σ2	0 ± 0.1°	Horizontal datum plane	Parallelism of bottom interface plane.
d1	12 ± 0.05 mm	-	Loader locating pin diameter.
r100	1 mm maximum	not applicable	All concave features. (radius)
r101	2 mm maximum	not applicable	All required convex features. (radius)
x101	200 ± 1 mm	Bilateral datum plane	Edge of hole opening and inside edge of seal zone.
x102	199 mm minimum	Bilateral datum plane	Encroachment of equipment on the sides of the reserved spaces inside the equipment.
x103	207 ± 1 mm	Bilateral datum plane	Outside edge of seal zone.
x104	235 ± 2 mm	Bilateral datum plane	Outside edge of bottom interface plane.
x105	200 ± 2 mm	Bilateral datum plane	Inside edge of bottom interface plane.
x106	220 ± 0.05 mm	Bilateral datum plane	Center of positioning pin location and tightening locking screw location.
x107	175 +5/-0 mm	Bilateral datum plane	Outside edge of control connection area.

Symbol	*Value Specified*	*Datum Measured from*	*Feature Measured to*
x108	207 ± 1 mm	Bilateral datum plane	Width of the door seal exclusion volume. Width of the loader exclusion volume. Width of the loader bottom flange exclusion volume. (Inside)
x109	235 mm minimum	Bilateral datum plane	Width of the loader bottom flange exclusion volume. (Outside)
y101	170 ± 2 mm	Docked Facial datum plane	BOLTS/Light plane. Seal surface on equipment.
y102	80 mm minimum	BOLTS/Light plane	Encroachment of equipment on the permanent reserved space and on the reserved space when the door is opening or closing.
y103	3 mm minimum	BOLTS/Light plane	Encroachment of equipment.
y104	200 + 0/-10 mm	Facial datum plane	Rear edge of bottom interface plane.
y105	220 + 0/-10 mm	Facial datum plane	Front edge of bottom interface plane.
y106	180 ± 0.05 mm	Facial datum plane	Positioning pin location.
y107	100 ± 0.3 mm	Facial datum plane	Front locking screw location.
y108	100 ± 0.3 mm	Facial datum plane	Rear locking screw location.
y109	110 + 0/-5 mm	Facial datum plane	Rear edge of control connection area.
y110	[E63]	Facial datum plane	Docked-facial datum plane.
y111	220 ± 2 mm	Facial datum plane	Front end of the loader exclusion volume.
y112	31 mm minimum	BOLTS/Light plane	Encroachment of equipment on the reserved space when the door is closed.
y113	± 0.5 mm	-	Cycle-to-cycle repeatability of y101.
y114	± 1 mm	-	Flatness of seal zone.
y115	220 mm minimum	Facial datum plane	Front face of the loader bottom flange exclusion volume.
y116	200 mm minimum	Facial datum plane	Rear face of the loader bottom flange exclusion volume.
z101	402 ± 1 mm	Horizontal datum plane	Outside edge of seal zone on top.
z102	478 ± 1 mm	Horizontal datum plane	Outside edge of seal zone on bottom.
z103	394 mm minimum	Horizontal datum plane	Encroachment of equipment on the top of the permanent reserved space inside the equipment.
z104	395 ± 1 mm	Horizontal datum plane	Top edge of hole opening and inside edge of seal zone.
z105	470 mm minimum	Horizontal datum plane	Encroachment of equipment on the bottom of the permanent reserved space inside the equipment.
z106	471 ± 1 mm	Horizontal datum plane	Bottom edge of hole opening and inside edge of seal zone.
z107	480 ± 1 mm	Horizontal datum plane	Height of the bottom interface planes.
z108	45 ± 2 mm	Horizontal datum plane	Encroachment of equipment on the top of the permanent reserved space inside the equipment.
z109	402 ± 2 mm	Horizontal datum plane	Encroachment of equipment on the top of the box opener/ loader between the BOLTS/Light plane and the SEMI E15.1_D1 plane.
z110	10 ± 1 mm	Bottom end of z107	locating pins height.
z111	45 ± 2 mm	Horizontal datum plane	Panel Interface Height.
z112	15 mm minimum	Bottom end of z107	Docking space to bottom interface plane during maintenance.
z113	30 mm minimum	Bottom end of z107	Height of loader bottom flange exclusion volume.

APPENDIX 1
APPLICATION NOTES

NOTE: The material in this appendix is an official part of SEMI E92 and was approved by full letter ballot procedures on December 3, 1999 by the Japanese Regional Standards Committee.

A1-1 NOTICE: Usage of Loader Locating Pins

A1-1.1 In order to provide quick interchangeability with accurate repeatability, it is recommended to use V shaped groove to couple with the positioning pin and use flat plane to couple with the anti-rotation pin as shown in Figure 4.

A1-2 NOTICE: BOLTS/Light Shelf

A1-2.1 BOLTS/Light Shelf may be used in order to keep compatibility with BOLTS/M interface. In this case, BOLTS/M interface provides backward compatibility of equipment interface and BOLTS/Light interface provides standardized precise quick attachment/ detachment interface. BOLTS/Light shelf is shown in Figure A-1.

A1-3 NOTICE: Box Opener/Loader Compatibility

A1-3.1 It is recommended that equipment suppliers design their process equipment to be capable of accepting box opener/loaders that interface with either a BOLTS/M interface or a BOLTS/Light interface. This standard has been structured to make the BOLTS/Light interface a component capable of being attached to a BOLTS/M interface. (It is not physically feasible to make the BOLTS/M interface an optional component capable of being attached to a BOLTS/Light interface).

A1-3.2 If an equipment supplier provides a BOLTS/M interface, their process equipment can be modularly configured to interface with either type of box/opener loader. This type of approach allows "two-way compatibility":

- Process equipment with a BOLTS/M interface can attach a BOLTS/Light interface. This enables the process equipment to now accept a box opener/loader with a BOLTS/Light interface.
- Process equipment with a BOLTS/Light interface can remove the BOLTS/Light interface to expose a BOLTS/M interface. This enables the process equipment to now accept a box opener/loader with a BOLTS/M interface.

Equipment suppliers may provide only a BOLTS/Light interface at their discretion. However, it should be understood that process equipment designed in this manner can not be modularly configured to accept a box/opener loader with a BOLTS/M interface.

A1-4 NOTICE: Docking Stroke Variation for Backward Compatibility

A1-4.1 In order to provide the "Backward compatibility" requested in I300I/J300 GJG[1], vendors who want to use this standard to put BOLTS/Light unit in their existing BOLTS/M compliant loadport unit may vary docking stroke as their option to accommodate their existing designs. The unit that has a different docking stroke is no more a BOLTS/Light-Full-Compliant unit, but could be called as BOLTS/Light-Quasi-Compatible unit.

A1-5 NOTICE: Sliding Mechanism

A1-5.1 Actual design of the sliding mechanism is left to the box opener/loader and/or equipment designer. The equipment provides bottom interface planes as the loading slider areas.

A1-5.1.1 This implies several types of bottom interface planes are acceptable by the equipment; e.g., roller guided, plastic material based, etc.

A1-6 NOTICE: Maintenance Cart

A1-6.1 If the box opener/loader is too heavy to attach/detach manually by maintainer, this standard provides for the possibility/capability of cart-based maintenance.

A1-6.2 The cart may use the same cart to equipment docking mechanism as the cart for FOUP delivery.

A1-6.3 The maintenance cart may also use a connection with the bottom interface planes that are defined in this standard. Specification of how to make the carts is outside the scope of this standard.

A1-7 NOTICE: Finger Pinch Sensor

A1-7.1 This document does not define or specify a finger pinch sensor. Considering finger pinching with edges, the following approach may be recommended.

- Finger pinching with edges is more serious than it is with flat surfaces. So, it is recommended not to place the box flange seal in a narrow tunnel structure which have sharp edges but place it on a flat surface (or in a dimple that has chamfered edges).

1 I300I/J300 GJG — I300I/J300 Global Joint Guidance for 300 mm Semiconductor Factories. SEMATECH, 2706 Montopolis Drive, Austin, TX, 78741. http://www.sematech.org

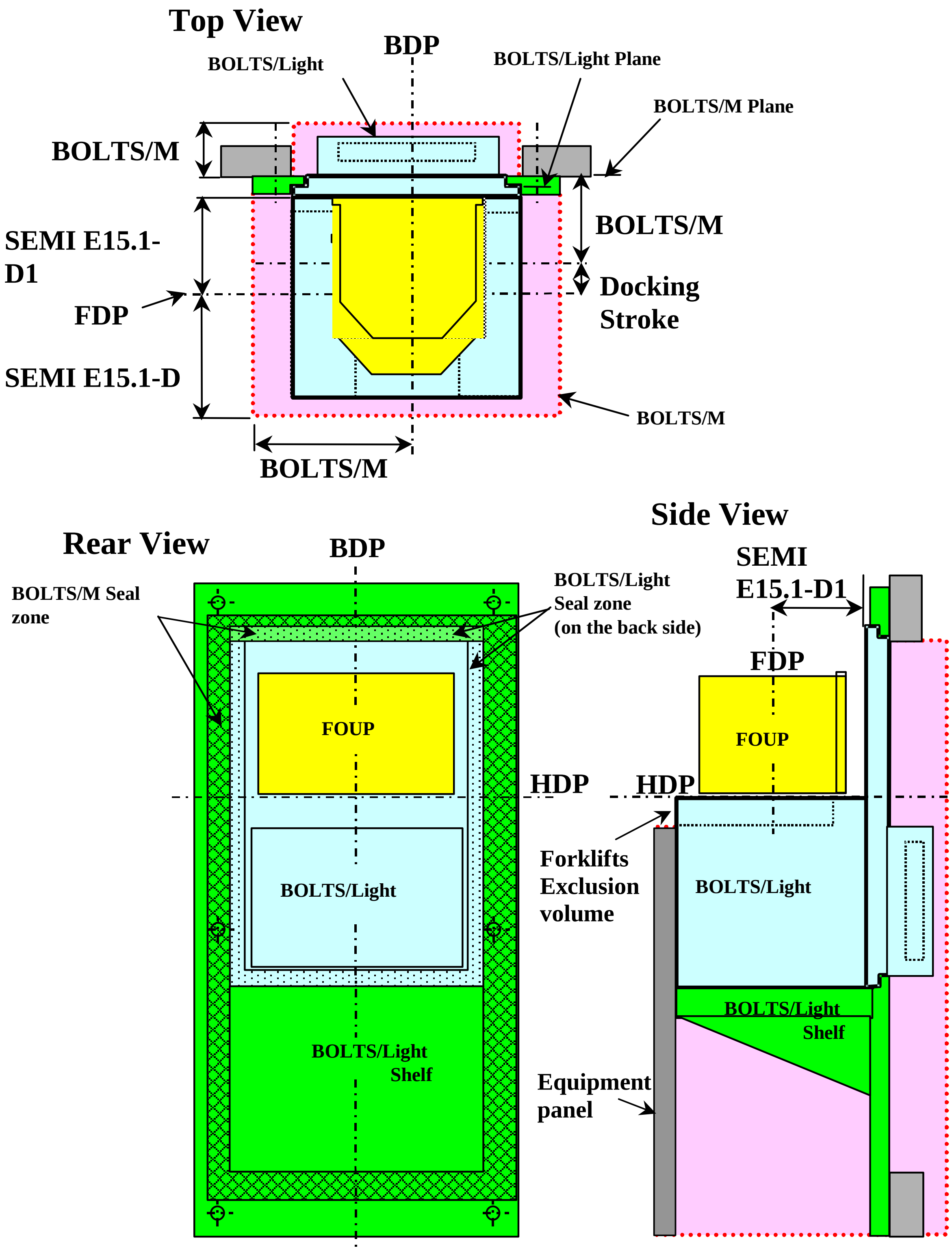

Figure A-1
Usage of BOLTS Shelf (Adopter)

- Placement of a finger pinch sensor in the approximately 11 mm space behind SEMI E15.1 D1 is recommended.

A1-8 NOTICE: Adjustment of BOLTS/Light Unit

A1-8.1 In order to maintain quick interchangeability and interoperability and quick attachment/detachment, adjustment capability should be provided separately by the box opener/loader and equipment to ensure the port is positioned correctly with respect to the wafer handling robot.

A1-8.2 As a result, adjustment means will be necessary on both the box opener/loader and the equipment. The box opener/loader may have a capability to calibrate its critical dimensions in advance, for example, the parallelism between bottom interface surface and HDP. In this case, it is not necessary to adjust the box opener/loader after installation. The equipment should have a capability to adjust bottom interface plane with respect to the wafer-handling robot. In case of changing the box opener/loader in the field, adjustment might then not be necessary on both the box opener/loader and the equipment side.

A1-8.3 A fixture may help facilitate this adjustment.

A1-8.4 If fine adjustment is needed after reattaching the box opener/loader (due to deficient adjustment of the box opener/loader or equipment side), it may be done on the equipment side by means of adjusting screws or other mechanism at bottom interface plane.

A1-9 NOTICE: Control Connection Area

A1-9.1 Connection should be completed after sliding in the box opener/loader. Disconnection should be completed before sliding out the box opener/loader.

SEMI E99-1104^E

THE CARRIER ID READER/WRITER FUNCTIONAL STANDARD: SPECIFICATION OF CONCEPTS, BEHAVIOR, AND SERVICES

This specification was technically approved by the Global Information and Control Committee and is the direct responsibility of the Japanese Information and Control Committee. Current edition approved by the North American Regional Standards Committee on January 10, 2003. Initially available at www.semi.org January 2003; to be published March 2003. Originally published February 2000; previously published March 2003.

E This standard was editorially modified in September 2004 to correct an error. Change was made to Section R4.1.1.3.

NOTICE: The designation of SEMI E99 was updated during the 1104 publishing cycle to reflect changes to SEMI E99.1.

1 Purpose

1.1 The purpose of the Carrier ID Reader/Writer Functional Standard effort is to provide a common specification for concepts, behavior, and services (functions) provided by a Carrier ID Reader and a Carrier ID Reader/Writer to an upstream controller. A standard interface will increase interchangeability of Carrier ID Reader/Writers so that users and equipment suppliers have a wider range of choices.

2 Scope

2.1 The Carrier ID Reader/Writer Interface Standard addresses the functional requirements for a generic Carrier ID Reader/Writer interface with an upstream controller.

2.2 The specification includes required behavior and required communications for both a Carrier ID Reader and a Carrier ID Reader/Writer.

2.3 This specification does not require, define, or prohibit asynchronous messages sent by the Carrier ID Reader or Reader/Writer.

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 This standard does not define the specific protocol to be used for the Carrier ID Reader/Writer. Supplements to this standard are required to describe how the functions of the Carrier ID Reader/Writer are implemented for specific protocols.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E1.9 — Mechanical Specification for Cassettes Used to Transport and Store 300 mm Wafers

SEMI E15 — Specification for Tool Load Port

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

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

SEMI E47.1 — Provisional Mechanical Specification for Boxes and Pods Used to Transport and Store 300 mm Wafers

SEMI E62 — Provisional Specification for 300 mm Front-Opening Interface Mechanical Standard (FIMS)

SEMI E87 — Specification for Carrier Management (CMS)

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

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *CIDRW* — represents both the Carrier ID Reader and the Carrier ID Reader/Writer

5.1.2 *FOUP* — Front Opening Unified Pod

5.2 *Definitions*

5.2.1 *attribute* — information about or associated with some entity or object.

5.2.2 *carrier* — 1. a container, such as a FOUP or open cassette, with one or more positions for holding substrates (SEMI E87). 2. any cassette, box, pod, or boat that contains wafers.

5.2.3 *carrier ID* — an identifier for a carrier. A value that uniquely identifies a given carrier in a factory. The identifier may be represented physically with any one of various technologies. For electronic tags with read/

write capability, in some cases the user may designate a portion of the data to be used as a carrier ID.

5.2.4 *carrier ID reader* — a unit (subsystem) that detects and decodes data from the ID tag.

5.2.5 *carrier ID reader/writer* — a unit (subsystem) with the functionality of both a carrier ID reader and a carrier ID writer.

5.2.6 *carrier ID tag (tag, ID tag)* — a physical device for storing Carrier ID and other information. There are two basic types of tags, read-only tags and read/write tags.

5.2.7 *carrier ID writer* — a unit which encodes data for and writes it to the carrier ID tag.

5.2.8 *cassette* — an open structure that holds one or more substrates.

5.2.9 *controller* — a system that provides control (performs required operations when certain conditions occur or when interpreting and acting upon instructions) and communicates with a higher level manager. Controllers exist at all levels within a factory. Examples of controllers include the Multiple ID Reader/Writer Controller, the Equipment Controller, and the Load Port Controller.

5.2.10 *front-opening unified pod (FOUP)* — a box (that complies with SEMI E47.1) with a non-removable cassette (so that its interior complies with SEMI E1.9) and with a front-opening interface (that mates with a FIMS port that complies with SEMI E62).

5.2.11 *fundamental requirements* — the requirements for information and behavior that must be satisfied for compliance to a standard. Fundamental requirements apply to specific areas of application, objects, or services.

NOTE 1: All portions of the carrier ID reader/writer specification are considered to be fundamental requirements unless explicitly described as optional. See also optional requirement.

5.2.12 *load port* — the interface location on a tool where wafer carriers are delivered. It is possible that wafers are not removed from, or inserted into, the carrier at this location.

5.2.13 *message interleaving* — the practice of sending a new message request before receiving the reply to an earlier request.

5.2.14 *multiple ID reader/writer controller* — a unit controlling the Reader/Writer function of one or multiple ID Reader/Writer Heads, communicates the command/data with the equipment controller or the equivalent controller such as Load port Controller in the equipment configuration.

5.2.15 *optional capability* — a specification that is not required for an implementation to be compliant to a standard. The supplier developing the CIDWR has the option to provide these additional capabilities or not depending on supplier's product configuration. See also fundamental requirement.

5.2.16 *reader/writer head* — a structured portion which functions to detect the ID code and/or to write the ID code. The ID reader/writer unifying a head function inside its body can be placed as a head. The ID reader/writer not unifying a head function will be located separately from the head.

5.2.17 *tag fault* — any condition that causes errors when reading or writing to the tag, including power faults and tag damage.

5.2.18 *upstream controller* — a controller that directs the Carrier ID Reader/Writer through the communication interface.

5.3 *Data Types*

5.3.1 *enumerated* — may take on one of a limited set of possible values. These values may be given logical names, but they may be represented by any single-item data type.

5.3.2 *form* — type of data: positive integer, unsigned integer, integer, floating point (float), enumerated, boolean, text, formatted text, structure, list, ordered list.

5.3.3 *integer* — may take on the value of any negative or unsigned integer. Messaging protocol may impose a limit on the range of possible values.

5.3.4 *structure* — a specific set of items, of possibly mixed data types, in a specified arrangement.

5.3.5 *text* — a character string. Messaging protocol may impose restrictions, such as length or ASCII representation.

5.3.6 *unsigned integer* — may take on the value of any positive integer or zero. Messaging protocol may impose a limit on the range of possible values.

6 Conventions

6.1 *State Model Methodology*

6.1.1 This document uses the Harel state chart convention for describing dynamic operation of defined objects. The outline of this convention is described in an attachment of SEMI E30. The official definition of this convention is described in "State Charts: A Visual Formalism for Complex Systems" written by D. Harel in Science of Computer Programming 8, 1987[1].

1 Elsevier Science, P.O. Box 945, New York, NY 10159-0945, http://www.elsevier.nl/homepage/browse.htt

6.1.2 Transition tables are provided in conjunction with the state diagrams to explicitly describe the nature of each state transition. A transition table contains columns for Transition number, Previous State, Trigger, New State, Actions, and Comments. The "trigger" (column 3) for the transition occurs while in the "previous" state. The "actions" (column 5) includes a combination of:

- Actions taken upon exit of the previous state.
- Actions taken upon entry of the new state.
- Actions taken which are most closely associated with the transition.

6.1.2.1 No differentiation is made between these cases.

6.2 *Object Notation*

6.2.1 The object models in Related Information 2 use the Object Modeling Technique (OMT) developed by Rumbaugh, James, et al, in Object-Oriented Modeling and Design.[2] An overview of this notation is provided in SEMI E39, Object Services Standard: Concepts, Behavior, and Services.

Num	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*

6.3 *Service Message Representation*

6.3.1 Services are functions or methods that may be provided by either the equipment or the host. A service message may be either a request message, which always requires a response, or a notification message, that does not require a response.

6.3.2 *Service Definition*

6.3.2.1 A service definition table defines the specific set of messages for a given service resource, as shown in the following table:

Message Service Name	*Type*	*Description*

Type can be either "N" = Notification or "R" = Request & Response.

6.3.2.2 Notification type messages are initiated by the service provider (e.g., the equipment) and the provider does not expect to get a response from the service user. Request messages are initiated by a service user (e.g., the host). Request messages ask for data or an activity from the provider. Request messages expect a specific response message (no presumption on the message content).

6.3.3 *Service Parameter Dictionary*

6.3.3.1 A service parameter dictionary table defines the description, format and its possible value for parameters used by services, as shown in the following table:

Parameter Name	*Description*	*Format: Possible Value*

6.3.3.2 A row is provided in the table for each parameter of a service.

2 James Rumbaugh, Michael Blaha, William Premerlani, Frederick Eddy, William Lorensen, Object-Oriented Modeling and Design, Englewood Cliffs, New Jersey: Prentice-Hall, 1991.

6.3.4 *Service Message Definition*

6.3.4.1 A service message definition table defines the parameters used in a service, as shown in the following table:

Parameter	*Req/Ind*	*Rsp/Cnf*	*Comment*

6.3.4.2 The columns labeled REQ/IND and RSP/CNF link the parameters to the direction of the message. The message sent by the initiator is called the "Request". The receiver terms this message the "Indication" or the request. The receiver may then send a "Response" which the original sender terms the "Confirmation".

6.3.4.3 The following codes appear in the REQ/IND and RSP/CNF columns and are used in the definition of the parameters (e.g., how each parameter is used in each direction):

Code	*Description*
M	Mandatory Parameter — Must be given a valid value.
C	Conditional Parameter — May be defined in some circumstances and undefined in others. Whether a value is given may be completely optional or may depend on the value of the other parameter.
U	User-Defined Parameter.
-	The parameter is not used.
=	(For response only.) Indicates that the value of this parameter in the response must match that in the primary (if defined).

7 Overview

7.1 The Carrier ID Reader/Writer Model defines the behavior and services (functions) for both Carrier ID Readers and Carrier ID Reader/Writers. The Carrier ID Reader/Writer is a small intelligent system, typically used as a subsystem within equipment.

7.1.1 The primary functionality of the Carrier ID Reader/Writer is to read the identifier of the carrier (Carrier ID) from the Carrier ID tag. Various technologies may be used to encode the Carrier ID and to read it. Some technologies do not allow data to be written.

7.1.2 The acronym CIDRW is used to refer to both the Carrier ID Reader and the Carrier ID Reader/Writer. The requirements for the Carrier ID Reader are a subset of the requirements for the Carrier ID Reader/Writer.

7.1.3 An object model for the CIDRW is provided in Related Information 2 – Object Model.

7.2 *Number of Heads*

7.2.1 A Reader/Writer Head is a device that is positioned on a load port for reading or reading/writing information from a Carrier ID tag. A Carrier ID Reader/Writer provides one or more ID Reader/Writer Heads and is connected to an upstream controller by a single interface. This allows the upstream controller to control either one head or multiple heads using the same interface specification.

7.2.2 *Single Head Configuration*

7.2.2.1 In the case of a single head, the head may be presented as an integrated part of the CIDRW.

7.2.3 *Multiple Head Configuration*

7.2.3.1 In the case of multiple heads, some services are logically performed by the CIDRW, and the individual heads logically perform others. The individual heads are numbered sequentially and may be referenced individually by the upstream controller. Note that the upstream controller does not communicate directly with the heads. All communications are between the upstream controller and the CIDRW unit.

7.2.3.2 In the multi-head case, the CIDRW shall allow independent control of the heads. Multiple transactions invoking services performed by the individual heads may be open at the same time. For example, when a read command is sent to one head, the host can send additional commands such as a read command and a status confirmation command to another head before the first head sends the response to the first command.

7.3 *Upstream Controller*

7.3.1 The CIDRW provides certain services when requested by the upstream controller. The upstream controller sends a message requesting the specified service, and the CIDRW sends a message with the response.

7.3.2 This standard assumes that an upstream controller initiates each service message to the CIDRW, and the CIDRW sends its response to the upstream controller. The upstream controller must watch the response time to monitor the communication timeout. This standard will define the recommended method for handling exceptions caused by timeouts.

7.3.3 In addition, some CIDRW may provide asynchronous notification to the upstream controller. Examples of this include, but are not limited to, the detection of a fault condition resulting in an alarm. Asynchronous notification is not required for compliance to this standard.

8 Attributes

8.1 An attribute is an item of information about an entity that is maintained and is available by request. There is certain information concerning the CIDRW that is of potential interest to the upstream controller, including the manufacturer, the model, and the serial number of the device. This information is considered as attributes of the CIDRW and is available on request.

8.2 *CIDRW Attribute Definition Table*

8.2.1 Table 1 defines the attributes of the Carrier ID Reader/Writer subsystem.

Table 1 CIDRW Attribute Definitions

Attribute Name	*Description*	*Access*	*Reqd*	*Form*
Fundamental				
Configuration	Number of heads.	RO	Y	Text
Alarm Status	Current CIDRW substate of ALARM STATUS.	RO	Y	Enumerated: 0 = NO ALARMS 1 = ALARMS
Operational Status	Current CIDRW substate of OPERATIONAL.	RO	Y	Enumerated: IDLE BUSY MAINTENANCE
SoftwareRevisionLevel	Revision (version) of software.	RO	Y	Text
Optional				
CarrierIDOffset	Offset position of the first byte for Carrier ID in the Electric Tag.	RW	N	00-15
CarrierIDLength	Length byte of the Carrier ID. If non-visible ASCII character exists in this string, CIDRW shall send out an error to the upstream controller.	RW	N	01–16
DateInstalled	Date the subsystem was installed.	RO	N	Protocol dependent.
Device Type	Identifiers subsystem as either a Carrier ID Reader or a Carrier ID Reader/Writer.	RO	N	Text
HardwareRevisionLevel	Revision number of the hardware.	RO	N	Text
MaintenanceData	Supplier dependent.	RO	N	Text
Manufacturer	The name or identifier of the manufacturer.	RO	N	Protocol dependent.
ModelNumber	The manufacturers model designation.	RO	N	Text
SerialNumber	Subsystem serial number assigned by manufacturer.	RO	N	Protocol dependent.

8.3 *Read/Write Head Attributes*

8.3.1 Table 2 defines the attributes for the Read/Write Head.

NOTE 2: In the case of an integrated single head, the attributes in Table 2 are regarded as an extension of Table 1.

8.3.2 In the case of multiple heads, it must be possible to distinguish between the attributes of different heads.

Table 2 Read/Write Head Attribute Definitions

Attribute Name	*Description*	*Access*	*Reqd*	*Form*
Fundamental				
HeadStatus	The current state.	RO	Y	Enumerated: IDLE, BUSY, NOT OPERATING
HeadID	Head number 0–31	RO	Y if multi-head	Text. 2 digits.
Optional				
Cycles	Number of read and write operations performed.	RO	N	Unsigned integer
HeadCondition	The current Maintenance status.	RO	N	Enumerated: No alarms Needs Maintenance Read/Write fault Read/Write rate fault No power.
HeadDateInstalled	Date this head was installed.	RO	N	Protocol dependent.
HeadMaintenance-Data	Supplier dependent	RO	N	Text

9 State Models

9.1 To facilitate independent control of the individual heads, this section defines two separate state models, one for CIDRW subsystem and one to be applied to each of the individual heads.

9.2 *CIDRW State Model*

9.2.1 This section defines the state model for the CIDRW subsystem. Figure 1 shows the diagram for this model.

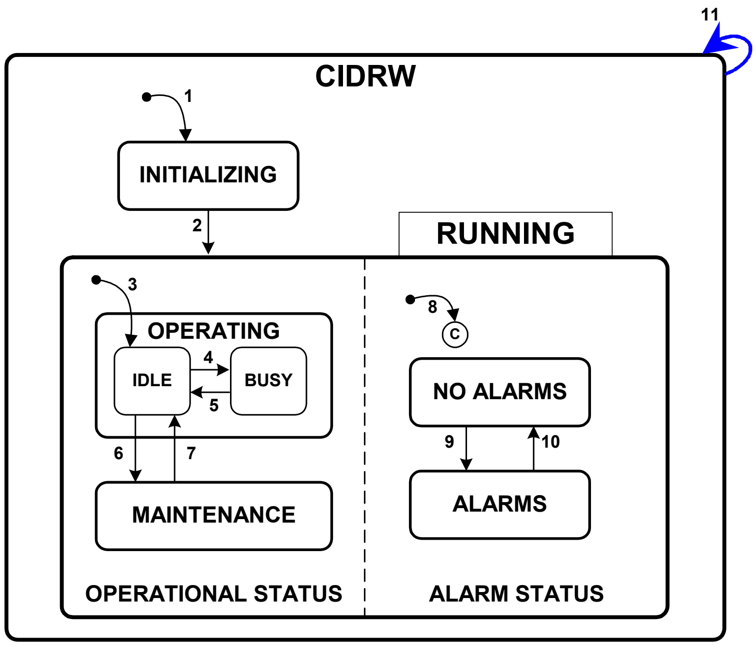

Figure 1
CIDRW State Model Diagram

9.2.2 Table 3 defines the states of the CIDRW. Definitions are in alphabetical order.

Table 3 CIDRW Subsystem State Definitions

State	*Definition*
ALARM STATUS	Shows the presence or absence of alarms.
ALARMS	An alarm condition exists.
BUSY	A service is being performed that affects the state of the hardware.
CIDRW	Superstate of CIDRW State Model. Always active when CIDRW powered on.
IDLE	No service is being performed. All heads are idle.
INITIALIZING	CIDRW is performing initialization and self diagnostics. Presence or absence of alarms is initially determined in this state.
NO ALARMS	No alarm conditions exist.
OPERATING	Normal operational states where reading and/or writing operations can be performed.
OPERATIONAL STATUS	The CIDRW is fully capable of performing all services that it supports.
RUNNING	The CIDRW is operational and able to communicate.
MAINTENANCE	Internal setup and maintenance activities.

9.2.3 Table 4 defines the transitions of the CIDRW State Model.

Table 4 CIDRW State Transitions

#	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*
1	(Any)	Powerup or reset	INITIALIZING	Initialize hardware and software components.	Default entry on powerup.

#	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*
2	INITIALIZING	Initialization is complete.	RUNNING	None	The CIDRW is now able to communicate.
3	INITIALIZING	Default entry into OPERATING.	IDLE	None	Internal
4	IDLE	A service request to read or write or perform diagnostics is received.	BUSY	None	
5	BUSY	All service requests that affect the state of the hardware are completed.	IDLE	None	
6	IDLE	A user selects the MAINTENANCE state and all heads are idle.	MAINTENANCE	None	The upstream controller may send a request or the operator may set a switch to select the OPERATING or the MAINTENANCE state. Maintenance and setup activities may now be performed.
7	MAINTENANCE	A user selects the OPERATING state and all heads are idle.	IDLE	None	The upstream controller may send a request or the operator may set a switch to select the OPERATING or the MAINTENANCE state. Normal operating activities may now be performed.
8	INITIALIZING	Default entry into ALARM STATUS.	ALARMS or NO ALARMS	None	
9	NO ALARMS	An alarm condition is detected.	ALARMS	None	
10	ALARMS	All alarm conditions have cleared.	NO ALARMS	None	
11	Any	A reset service request is received.	CIDRW	None	

9.3 *Read (Write) Head State Model*

9.3.1 For a CIDRW with multiple heads, this state model shall be provided for each Read/Write Head.

9.3.2 For the single head case, these states are covered in the CIDRW state model and no additional state model for the head is required. IDLE and BUSY correspond to substates of the same names in the CIDRW state model. If any head is NOT OPERATING, then the active substate of ALARM STATUS in the CIDRW state model is ALARMS.

9.3.3 The NOT OPERATING state is not required, if it is not possible to detect alarms related to the head. Note also that some alarm conditions are fatal (so that the head cannot operate with full functionality) while others may not be fatal.

9.3.4 Figure 2 shows the diagram for the Read (Write) Head State Model.

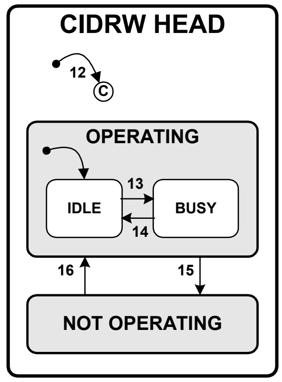

Figure 2
Read (Write) Head State Model

9.3.5 Table 5 defines the states for the Read (Write) Head.

Table 5 Read (Write) Head State Definitions

State	*Definition*
NOT OPERATING	Head is in a non-operational state or has reduced functionality. Maintenance is required.
OPERATING	Head is active and fully functional.
IDLE	Head is not performing a service.
BUSY	Head is performing a service.

9.3.6 Table 6 defines the transitions of the Read (Write) Head State Model.

Table 6 Read (Write) Head State Transitions

#	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*
12	(unknown)	Initialization on powerup or reset.	Either NOT OPERATING or OPERATING	None	Default entry on power-up.
13	IDLE	Request to perform a service.	BUSY	None	
14	BUSY	Completion of service.	IDLE	None	
15	OPERATING	An alarm condition is detected.	NOT OPERATING	None	
16	NOT OPERATING	Self-Diagnostic Service	OPERATING	None	All alarm conditions are clear.

10 Alarm Conditions

10.1 An alarm condition exists whenever one or more faults or exceptions that interfere with normal read/write operations is detected. A maintenance condition exists when the CIDRW determines the need for either maintenance (repair) or preventive maintenance activities.

10.2 The CIDRW is able to detect and report alarm conditions through its status attributes (when queried by the upstream controller). It may additionally report changes in alarm conditions asynchronously through alarm or event reports.

11 Services

11.1 To be compliant with this standard, the CIDRW shall support all services that are indicated as required. In addition, if the CIDRW provides other services that have the same or similar functionality as services defined in this document, then compliance to this standard requires they shall satisfy the requirements of the service as defined.

11.2 *List of Services*

11.2.1 Table 7 lists the services defined by this standard and indicates which are optional and which are required.

Table 7 List of Services

Service Name	*Description*
Fundamental Requirements	
Get Attributes	Get specified information about the CIDRW.
Get Status	Get the current status of the CIDRW.
Read ID	Read ID.
Requirement for Reader/Writer	
Read Data	Read back data written previously (not applicable to read-only devices).
Write Data	Write data (not applicable to read-only devices).
Optional Capabilities	
ChangeState	Change to MAINTENANCE state or to OPERATING state. This is required if the device supports the optional WriteID service.
Perform Diagnostics	Perform diagnostic tests.
Reset	Reset CIDRW hardware and software.
Set Attributes	Write specified information.
Write ID	Write ID field (device must also support ChangeState service).

11.3 *Parameter Definitions*

11.3.1 Table 8 defines the parameters that are used in one or more services, including individual items within parameter structures. Parameters are listed in alphabetical order.

Table 8 Parameter Definitions

Parameter	*Form*	*Description*
Action	Protocol-specific.	Specifies diagnostic action to perform.
Attribute ID	Text	Attribute identifier. Name of attribute.
Attribute Value	Varies with attribute.	Attribute value.
Carrier ID	Text	User data.
Data	Text	User data.
DataSeg	Protocol-specific.	Indicates specific section of data to read or write.
DataSize	Unsigned integer	Indicates the number of bytes of data to read or write.
Head ID	Number 0–31	Identifies either an individual head (non-zero) or the CIDRW subsystem itself (zero).
PM Information	Enumerated: -Normal execution -Maintenance required	Preventive Maintenance Information
Result Status	Enumerated: -Normal operation -Execution Error -Communication Error -Hardware Error -Tag Fault	Result information on the status of the request concerning the service request. *Execution Error*: cannot read Tag data. Cannot Read ID sequence. But equipment is normal. *Communication Error*: syntax error of Message or Message format or Value. *Hardware Error*: ID reader/writer head fault, ID reader/writer head is powered off. Tag Fault: power fault, exceeded retry limit

Parameter	Form	Description
Status	Structure	Information about the status of the CIDRW. Consists of PM Information and the current values of the CIDRW attributes AlarmStatus, OperationalStatus, and HeadStatus.

11.4 *Service Definitions*

11.4.1 This section defines the parameters used for each CIDRW service.

11.4.2 *ChangeState*

11.4.2.1 ChangeState is an optional service that requests the CIDRW to change its operational substate to MAINTENANCE or to OPERATING. Table 9 defines the parameters used for the ChangeState service.

Table 9 ChangeState Service Definition

Parameter	Req/Ind	Rsp/Conf	Description
StateRequest	M	-	Specifies either MAINTENANCE or OPERATING substate.
Result Status	-	M	Result information on the status of the request.
Status	-	M	Status information

11.4.3 *Get Attributes*

11.4.3.1 Get Attributes is a required service used to request the attributes of the CIDRW.

Table 10 Get Attributes Service Definition

Parameter	Req/Ind	Rsp/Conf	Description
Head ID	M	M	Specifies Head or Subsystem.
(list of) Attribute ID	M	-	Identifiers of one or more attributes.
(list of) Attribute Value	-	M	Attribute Values in order as requested.
Result Status	-	M	Result information on the status of the request.

11.4.4 *Get Status*

11.4.4.1 Get Status is a required service used to get the current status of the CIDRW. The upstream controller may request current status at any time.

Table 11 Get Status Service Definition

Parameter	Req/Ind	Rsp/Conf	Description
Head ID	M	M	Specifies Head or Subsystem.
Result Status	-	M	Result information on the status of the request.
Status	-	M	Status information

11.4.5 *Perform Diagnostics*

11.4.5.1 Perform Diagnostics is an optional service used to request the CIDRW perform its internal diagnostics. The supplier shall document the specific diagnostics performed.

Table 12 Perform Diagnostics Service Definition

Parameter	Req/Ind	Rsp/Conf	Description
Head ID	M	M	Specifies Head or Subsystem.
Action	C		Specifies diagnostic action to perform.
Result Status	-	M	Result information on the status of the request.
Status	-	M	Status information

11.4.6 *Read Data*

11.4.6.1 Read Data is used to request a generic block of data by an ID Reader/Writer Head. This service is required for the Carrier ID Reader/Writer type and is optional otherwise. The Carrier ID Reader/Writer is not required to understand the content of the data.

Table 13 Read Data Service Definition

Parameter	*Req/Ind*	*Rsp/Conf*	*Description*
Head ID	M	M	Specifies Head.
DataSeg	C	-	Indicates specific section of data.
DataSize	C	-	Indicates number of bytes to read.
Data	-	M	Data Read from Head.
Result Status	-	M	Result information on the status of the request.
Status	-	M	Status information

11.4.7 *Read ID*

11.4.7.1 Read ID is used to request the Carrier ID be read by an ID Reader/Writer Head. This service is a fundamental requirement.

Table 14 Read ID Service Message Parameter Definition

Parameter	*Req/Ind*	*Rsp/Conf*	*Description*
Head ID	M	M	Specifies Head.
Carrier ID	-	M	Carrier ID
Result Status	-	M	Result information on the status of the request.
Status	-	M	Status information

11.4.8 *Reset*

11.4.8.1 Reset is an optional service used to re-initialize the CIDRW.

Table 15 Reset Service Definition

Parameter	*Req/Ind*	*Rsp/Conf*	*Description*
Result Status	-	M	Result information on the status of the request

11.4.9 *Set Attributes*

11.4.9.1 Set Attributes is used to set attributes of the CIDRW that have read/write (R/W) access. This is an optional service. Attempts to set attributes with read-only (RO) access shall be denied. Attribute values returned are those as read following the set operation.

Table 16 Set Attributes Service Definition

Parameter	*Req/Ind*	*Rsp/Conf*	*Description*
Head ID	M	M	Specifies Head or Subsystem.
Attributes ID	M	-	Attribute Ids
Attribute Values	M	-	Attribute Values
Result Status	-	M	Result information on the status of the request.
Status	-	M	Status information

11.4.10 *Write Data*

11.4.10.1 Write Data is used to request a generic block of data to an ID Reader/Writer Head. This service is required for the Carrier ID Reader/Writer type and is optional otherwise. The Carrier ID Reader/Writer is not required to understand the content of the data.

Table 17 Write Data Service Definition

Parameter	*Req/Ind*	*Rsp/Conf*	*Description*
Head ID	M	M	Specifies Head.
DataSeg	C	-	Indicates specific section of data.
DataSize	C	-	Indicates number of bytes to read.
Data	M	-	Write Data (from Host).
Result Status	-	M	Result information on the status of the request.
Status	-	M	Status information

11.4.11 *Write ID*

11.4.11.1 Write ID is used to set the field for Carrier ID to an ID Reader/Writer Head. This service is optional. This shall be a protected operation that can be performed only in the MAINTENANCE state to prevent accidental overwriting of the ID field.

Table 18 Write ID Service Definition

Parameter	*Req/Ind*	*Rsp/Conf*	*Description*
Head ID	M	M	Specifies Head.
Data (ID)	M	-	Write ID Data.
Result Status	-	M	Result information on the status of the request
Status	-	M	Status information

11.4.11.2 The field for the Carrier ID shall be located from the first byte to the maximum byte of Carrier ID in the memory for electric tag.

11.4.12 *Service Operability*

11.4.13 Some services are performed by the CIDRW and others are logically performed by the individual heads. It is expected that the CIDRW will support multiple interleaved transactions to the various independent logical units. Table 19 shows which of the various services can be performed by the CIDRW when the CIDRW and its heads are in various individual states. Note that when in the initializing state after powerup or the reset service, the CIDRW may not be able to communicate.

Table 19 Valid Services per State

	Service									
	Write ID	*Write Data*	*Set Attributes*	*Reset*	*Read ID*	*Read Data*	*Perform Diagnostics*	*Get Status*	*Get Attributes*	*ChangeState*
CIDRW State										
INITIALIZING										
OPERATING		X	X	**X**	**X**	**X**	**X**	**X**	**X**	**X**
MAINTENANCE	X		X	**X**	**X** (See NOTE 1.)		**X**	**X**	**X**	**X**
Head State										
NOT OPERATING									**X**	
IDLE									**X**	
BUSY									**X**	

NOTE 1: May not be supported by all Readers.

12 Event Notifications

12.1 Event Notification is an optional capability where the CIDRW is able to detect events and report state and status changes independently of a service request from the upstream controller.

RELATED INFORMATION 1
SCENARIOS

NOTICE: This related information is not an official part of SEMI E99. This related information was approved for publication by full letter ballot procedures on September 3, 1999.

R1-1 This section provides examples of typical scenarios for a CIDRW with two read heads.

Table R1-1 Reset Scenario

Controller	*CIDRW*			*Head 1*		*Head 2*	
Msg.	Msg.	Action	State	Action	State	Action	State
Reset→		Perform Reset	Init State		NORMAL		NORMAL
	←Reset Reply		Operating or Maintenance		Idle or NORMAL		Idle or NORMAL

Table R1-2 Get Status Scenario

Controller	*CIDRW*			*Head 1*		*Head 2*	
Msg.	Msg.	Action	State	Action	State	Action	State
Get Status 0→		Determine Status	Operating or Maintenance		Any		Any
	←Status Reply		Same		Any		Any

Table R1-3 Scenario for Interleaved Read ID from Both Heads

Controller	*CIDRW*			*Head 1*		*Head 2*	
Msg.	Msg.	Action	State	Action	State	Action	State
Read ID 01→			Operating	Start Read	Busy		Idle
Read ID 02→			Operating		Busy	Start Read	Busy
	←Read ID Reply 01		Operating		Idle		Busy
	←Read ID Reply 02		Operating		Idle		Idle

Table R1-4 Read Data from Both Heads

Controller	*CIDRW*			*Head 1*		*Head 2*	
Msg.	Msg.	Action	State	Action	State	Action	State
Read Data 01→			Operating	Start Read	Busy		Idle
Read Data 02→			Operating		Busy	Start Read	Busy
	←Read Data Reply 01		Operating		Idle		Busy
	←Read Data Reply 02		Operating		Idle		Idle

Table R1-5 Scenario to Write Data to Both Heads

Controller	*CIDRW*			*Head 1*		*Head 2*	
Msg.	Msg.	Action	State	Action	State	Action	State
Write Data 01→			Operating	Start Write	Busy		Idle
Write Data 02→			Operating		Busy	Start Write	Busy
	← Write Data Reply 01		Operating		Idle		Busy
	← Write Data Reply 02		Operating		Idle		Idle

RELATED INFORMATION 2
OBJECT MODEL

NOTICE: This related information is not an official part of SEMI E99. This related information was approved for publication by full letter ballot procedures on August 28, 2000.

R2-1 Object models provide a graphic representation of entities. The models in this section use the Object Modeling Technique (OMT) described in Object-Oriented Modeling and Design. Object types are represented by rectangles with one, two, or three sections. The name of the object type is in the first, or only section. Attributes, information about the object, are shown in the second section. Operations or services are shown in a third section. Lines between objects represent relationships.

R2-2 Three models are shown for purposes of illustration. The general multi-head case is shown first with only the required attributes and services. Next, the full model for the multi-head case is shown with all attributes and services defined in this standard. Finally, the full model for the integrated single-head case is shown.

R2-3 Note that the Upstream Controller sends all service requests to the CIDRW controller, including services shown for the individual heads. Services shown on these models for CIDRW are those with a Head ID service parameter value of zero while services shown for the Head are those with a Head ID service parameter value between one and thirty-one.

R2-4 Fundamental Requirements Example Object Models

R2-4.1 The object model in Figure R2-1 shows objects for the general (multi-head) CIDRW satisfying fundamental requirements only. It shows the CIDRW subsystem as made up of one or more heads. It also illustrates the required attributes and services provided by the CIDRW and its relationships with its upstream controller and with its heads.

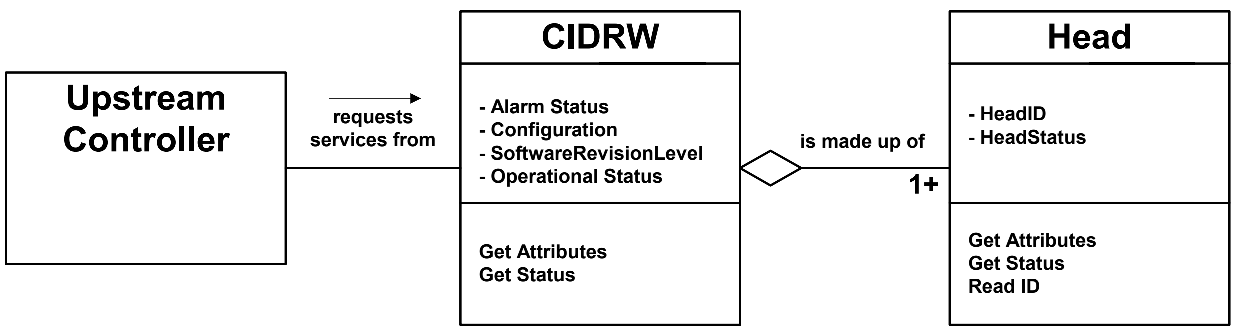

Figure R2-1
Object Model for Fundamental Requirements

R2-5 Full Capabilities

R2-5.1 Figure R2-2 shows the object model for a CIDRW with full capabilities, so that all optional attributes and services are supported.

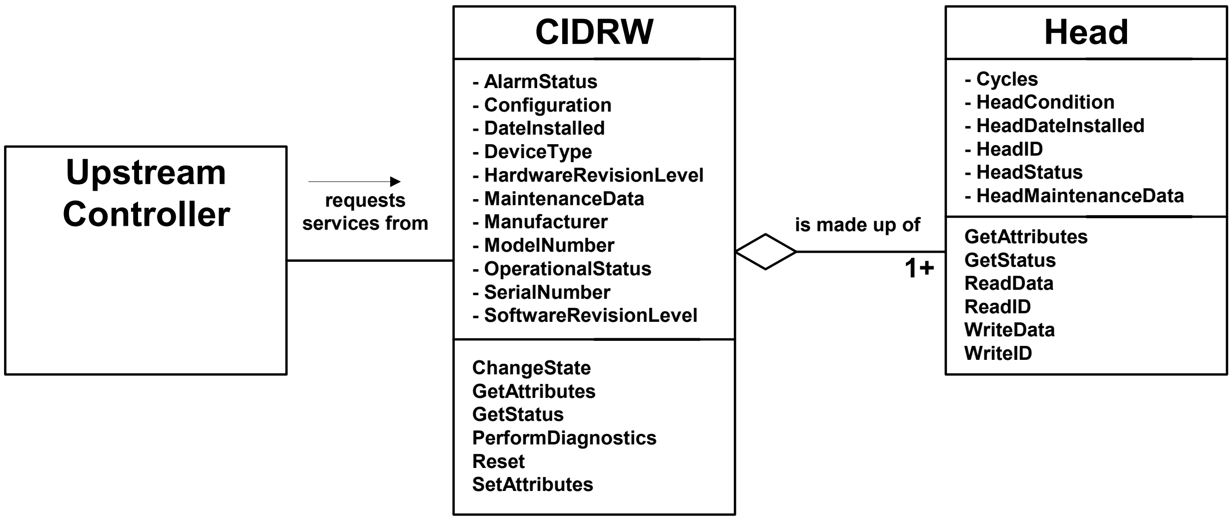

Figure R2-2
Object Model for Full Capabilities

R2-6 Integrated Model

R2-6.1 Figure R2-3 shows the object model for a CIDRW with full capabilities and a single integrated head. The head is not shown as a separate component in this case, and the head attributes and services have become part of the CIDRW subsystem itself.

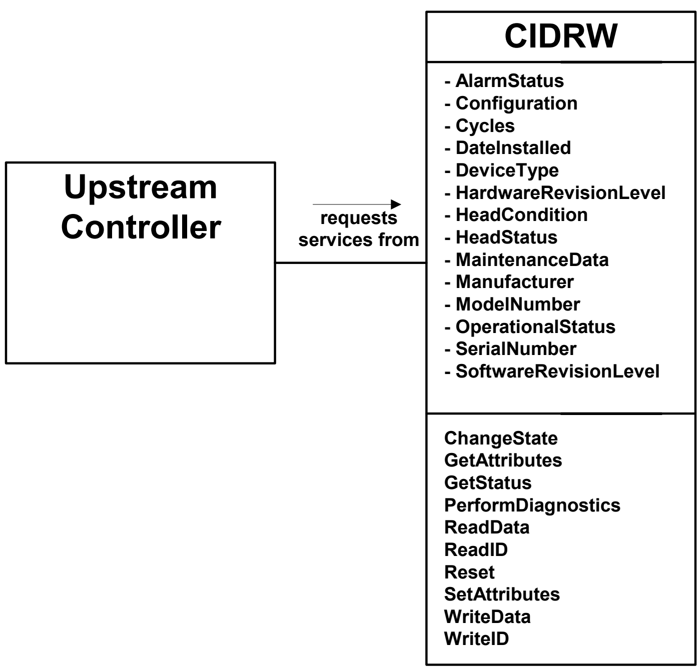

Figure R2-3
Integrated Model with Full Capabilities

RELATED INFORMATION 3
APPLICATION NOTES

NOTICE: This related information is not an official part of SEMI E99. This related information was approved for publication by full letter ballot procedures on September 3, 1999.

R3-1 Combined State Model

R3-1.1 The following figure, R3-1 shows the combined state model for the CIDRW unit with nn heads, from HEAD01 TO HEADnn. The CIDRW is considered as IDLE when and only when it is in OPERATING and all of its heads are IDLE.

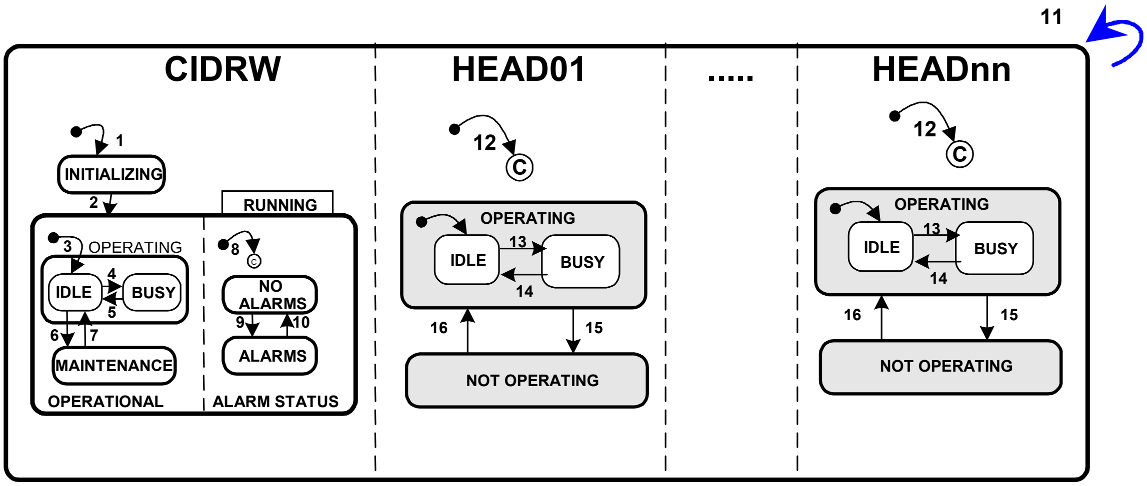

Figure R3-1
Combined State Model

RELATED INFORMATION 4

NOTICE: This related information is not an official part of SEMI E99 and was derived from the Japanese Information and Control Committee. This related information was approved for publication by full letter ballot on January 10, 2003.

R4-1 Application of RF Tag as Carrier ID Tag

R4-1.1 In case that RF Tag is utilized as Carrier Tag for SEMI E99 application, to secure the interoperability among the CIDRW units for writing / reading the Carrier ID into / out of the RF Tag, some basic consideration should be taken as follows:

R4-1.1.1 *Coincidence of Carrier ID Written and Read in Tag Memory* — Fundamentally Carrier ID, which is read out, should be quite same as written, with no addition.

R4-1.1.2 *Caution for Carrier ID Contents Applied to Object ID* — Carrier ID as Material ID can be used as Object ID. But the Space Character (20_{16}) should not be used as the first or the last character of Carrier ID. SEMI E39 restricts these.

R4-1.1.3 *Non-Visible Character in Carrier ID* — If non-visible ASCII character is found within the specified tag area, CIDRW shall send out an error (i.e. Execution error) to the upstream controller when "Read ID" service was executed. The contents of Carrier ID issued by host/upstream controller should be compliant with visible Character.

R4-1.1.4 *Location of Carrier ID Field (CID Field)* — Carrier ID field shall be located from the first byte to the maximum byte of Carrier ID in the memory of the Electric Tag. The relation of Carrier ID Offset and Carrier ID length are shown bellow:

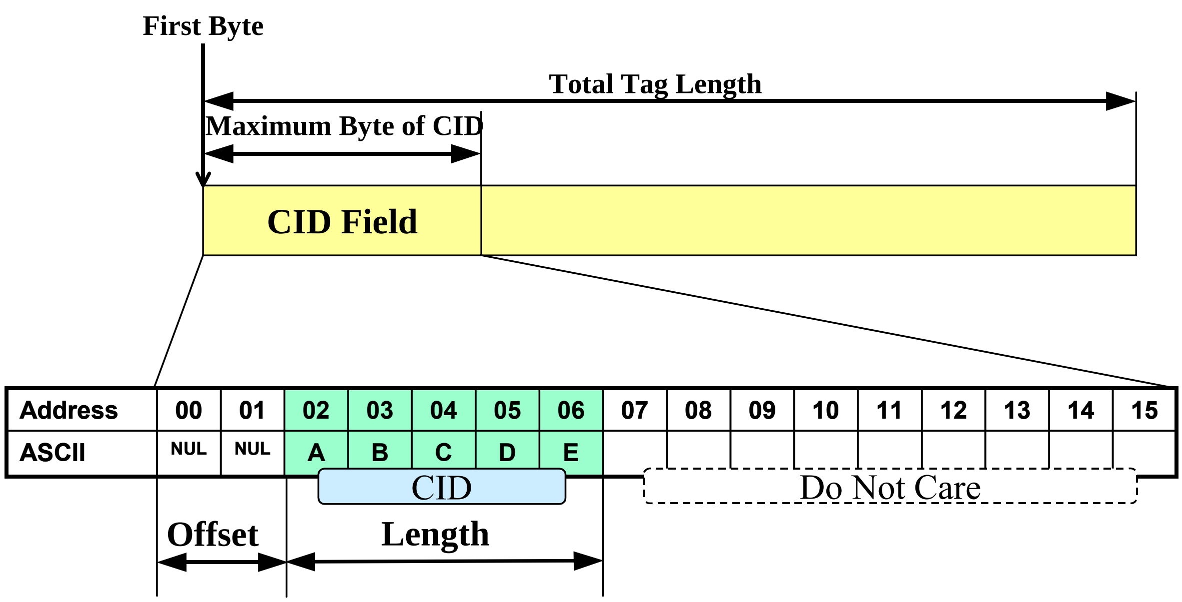

Figure R4-1
Example of Carrier ID in Tag ("CID = ABCDE")

R4-1.1.5 *Condition of CarrierIDOffset and CarrierIDLength* — By setting the condition of CarrierIDOffset and CarrierIDLength, CIDRW can correspond to CarrierID Tag characteristic to device makers already existing, if they are compliant with the reinforced specification for RF Tag in SEMI E99.

R4-1.1.5.1 The information of the Offset value and Length of Carrier ID should be stored as the CIDRW Attribute.

R4-1.1.5.2 When a CIDRW is installed in the equipment, it needs to set up a condition of CarrirIDOffset and CarrierIDLength as per user requirement once at least.

SEMI E99.1-1104
SPECIFICATION FOR SECS-I AND SECS-II PROTOCOL FOR CARRIER ID READER/WRITER FUNCTIONAL STANDARD

This specification was technically approved by the Global Information and Control Committee and is the direct responsibility of the Japanese Information and Control Committee. Current edition approved by the Japanese Regional Standards Committee on July 23, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published June 2000; previously published November 2003.

1 Purpose

1.1 This document maps the services and data of the Carrier ID Reader/Writer (CIDRW) standard to SECS-II streams and functions and data definitions.

2 Scope

2.1 This document applies to all implementations of CIDRW that use the SECS-II message protocol (SEMI E5).

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

3.1 *SEMI Standards*

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

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

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

4 Terminology

4.1 *Abbreviations and Acronyms*

4.1.1 *CIDRW* — Carrier ID Reader/Writer; represents both the Reader and the Read/Writer.

4.1.2 *SECS* — SEMI Equipment Communications Standard

5 Physical Requirements

5.1 The CIDRW using the SECS-I protocol shall use a 9-pin female connector.

6 Service Message Mapping

6.1 Table 1 shows the specific SECS-II streams and functions that shall be used for SECS-II implementations of the service messages defined in SEMI E99.

6.2 Request and notification messages are mapped to primary (odd-numbered) SECS-II functions and response messages are mapped to secondary (even-numbered) SECS-II functions.

6.3 In some cases, a common set of parameters allows more than one service to be mapped to the same stream and function, with an additional SECS-II data item used to differentiate between the two services.

Table 1 Services Mapped to SECS-II Messages

Message Name	*Stream,Function*	*SECS-II Name*
ChangeState	S18,F13/F14	Subsystem Command Request/Acknowlege
Get Attributes	S18,F1/F2	Read Attribute Request/Data
Get Status	S18,F13/F14	Subsystem Command Request/Acknowledge
Perform Diagnostics	S18,F13/F14	Subsystem Command Request/Acknowledge
Read Data	S18,F5/F6	Read Request/Data
Read ID	S18,F9/F10	Read ID Request/Data
Reset	S18,F13/F14	Subsystem Command Request/Acknowledge
Set Attributes	S18,F3/F4	Write Attribute Request/Acknowledge
Write Data	S18,F7/F8	Write Request/Acknowledge
Write ID	S18,F11/F12	Write ID Request/Acknowledge

7 Service Parameter to Data Item Mapping

7.1 Table 2 shows the mapping between message parameters defined by CIDRW and data items defined by SECS-II. For parameters specified in the definitions of a CIDRW service, either the parameters themselves, or individual elements of complex parameters, map to a specific data item.

Table 2 Service Parameters to Data Item Mapping

Parameter Name	*SECS-II Data Item*	*Format*	*Values*
Attribute ID	ATTRID	20	Name of attribute
Attribute Value	ATTRVAL	20	
Carrier ID	MID	20	20_{16} - $7E_{16}$ (Visible ASCII)
Data	DATA	20	All characters 00H-0FFH
DataSize	DATALENGTH	52	
DataSeg	DATASEG	20	
HeadID	TARGETID	20	“00”-“31” Identifies either an individual head (“01”-“31”) or the CIDRW subsystem itself (“00").
PM Information	STATUS	20	“NE” = Normal execution, “MR” = Maintenance required
Result Status	SSACK	20	“NO” = Normal operation; “EE” = Execution error; “CE” = Communication error; “HE” = Hardware error; “TE” = Tag error
Status	List of STATUS	L,4 1. <PMInformation> 2. <AlarmStatus> 3. <OperationalStatus> 4. <HeadStatus>	Current values of PM Information with the corresponding attributes for CIDRW and Head (if applicable). See Tables 4 and 5.
StateRequest	CPVAL	20	“OP”,“MT”

NOTE 1: There are also data items used in SECS-II messages that do not map to specific services parameters. Services with the same set of parameters are mapped to the same SECS-II message by adding an additional data item to differentiate between the services. Table 3 contains the SECS-II data items that have not a corresponding CIDRW service parameter:

Table 3 Additional Data Requirements Table

SECS-II Data Item	*Function*	*Value*
SSCMD	Used to differentiate between different subsystem commands indicated.	“ChangeState” “GetStatus” “Perform Diagnostics” “Reset”

8 Data

8.1 *CIDRW Attributes*

8.1.1 Table 4 specifies the values for the CIDRW attribute identifiers and limitations on values.

Table 4 CIDRW Attribute Definitions

Attribute Name	*Description*	*Access*	*Format*	*Value*
Fundamental				
“Configuration”	Number of heads.	RO	20	“01”–“31”

Attribute Name	Description	Access	Format	Value
“AlarmStatus”	Current CIDRW substate of ALARM STATUS	RO	20	“0” = NO ALARMS “1” = ALARMS
“OperationalStatus”	Current CIDRW substate of OPERATIONAL	RO	20	“IDLE”, “BUSY”, “MANT”
“SoftwareRevisionLevel”	Revision (version) of software	RO	20	8 byte maximum
Optional				
CarrierIDLength	Length byte of the Carrier ID. If non-visible ASCII character exists in this string, CIDRW shall send out an error to the upstream controller.	RW	52	01–16
CarrierIDOffset	Offset position of the first byte for Carrier ID in the Electric Tag.	RW	52	00–15
“DateInstalled”	Date the subsystem was installed	RO	20	“YYYYMMDD” format
“DeviceType”	Identifies subsystem as either a Carrier ID Reader or a Carrier ID Reader/Writer.	RO	20	“CIDR_” or “CIDRW”
“HardwareRevisionLevel”	Revision number of the hardware	RO	20	8 byte maximum
“MaintenanceData”	Supplier dependent	RO	20	80 byte maximum
“Manufacturer”	The name or identifier of the manufacturer	RO	20	20 byte maximum
“ModelNumber”	The manufacturers model designation	RO	20	20 byte maximum
“SerialNumber”	Subsystem serial number assigned by manufacturer.	RO	20	20 byte maximum

8.2 *Read (Write) Head Attributes*

8.2.1 Table 5 shows the format and values for the Read (Write) Head.

Table 5 Read (Write) Head Attribute Definitions

Attribute Name	Description	Access	Format	Value
Fundamental				
“HeadStatus”	The current state.	RO	20	“IDLE”, “BUSY”, “NOOP”
“HeadID”	Head number 0–31	RO	20	2 digits, “00” through “31”.
Optional				
“Cycles”	Number of read and write operations performed.	RO	54	
“HeadCondition”	The current Maintenance status	RO	20	“NO” = No alarms “NM” = Needs Maintenance “NP” = No power “RT” = Read/Write rate fault “RW” = Read/Write fault.
“HeadDateInstalled”	Date this head was installed	RO	20	“YYYYMMDD” format
“HeadMaintenanceData”	Supplier dependent	RO	20	Text

RELATED INFORMATION 1
SCENARIOS

NOTICE: This related information is not an official part of SEMI E99.1. This related information was approved for publication by full letter ballot procedures on January 14, 2000.

This section provides examples of typical scenarios for a Carrier ID Reader/Writer.

R1-1 Read ID

R1-1.1 The upstream controller sends a Read ID Request message to the CIDRW for Head 1. The CIDRW Head 1 reads the ID, and the CIDRW returns the ID to the upstream controller.

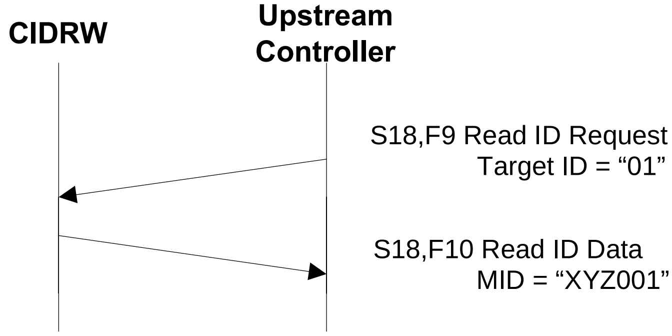

Figure R1-1
Read ID Scenario

R1-2 Read Data

R1-2.1 The upstream controller sends a Read Data Request message to the CIDRW for Head 1 and DataSeg 1. The CIDRW Head 1 reads the data, and the CIDRW returns the data to the upstream controller.

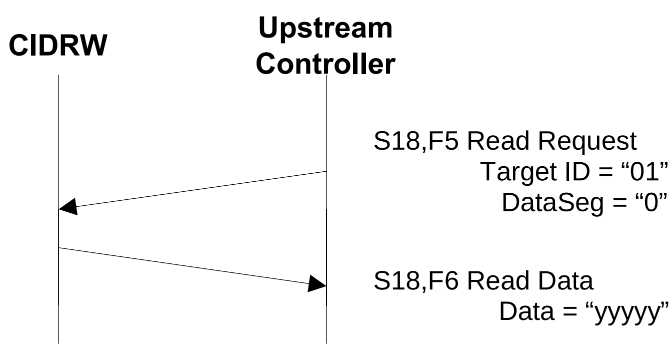

Figure R1-2
Read Data Scenario

R1-3 Write ID

R1-3.1 The CIDRW is in IDLE. The upstream controller requests the CIDRW change its operational status to MAINTENANCE.

R1-3.2 The CIDRW changes to MAINTENANCE and replies that it has changed state.

R1-3.3 The upstream controller sends a Write ID Request message to the CIDRW for Head 1. The CIDRW Head 1 reads the ID, and the CIDRW returns the ID to the upstream controller.

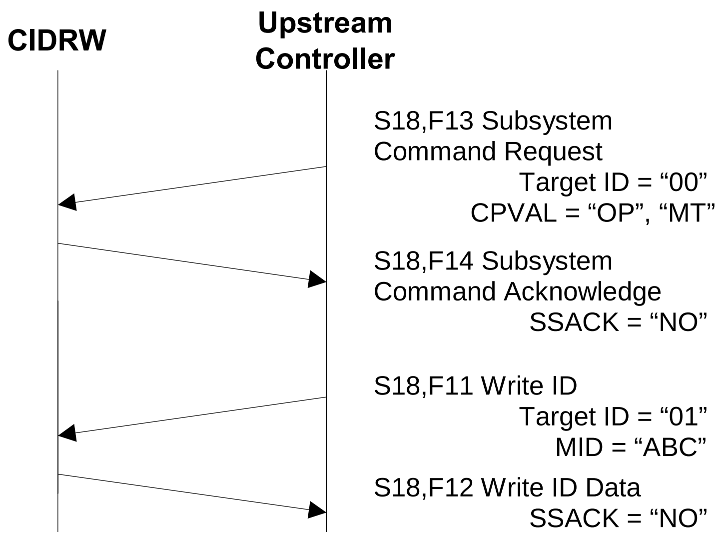

Figure R1-3
Write ID Data Scenario

R1-4 Write Data

R1-4.1 The upstream controller sends a Write Data Request message to the CIDRW for Head 1 and DataSeg 1. The CIDRW Head 1 writes the data, and the CIDRW returns the results to the upstream controller.

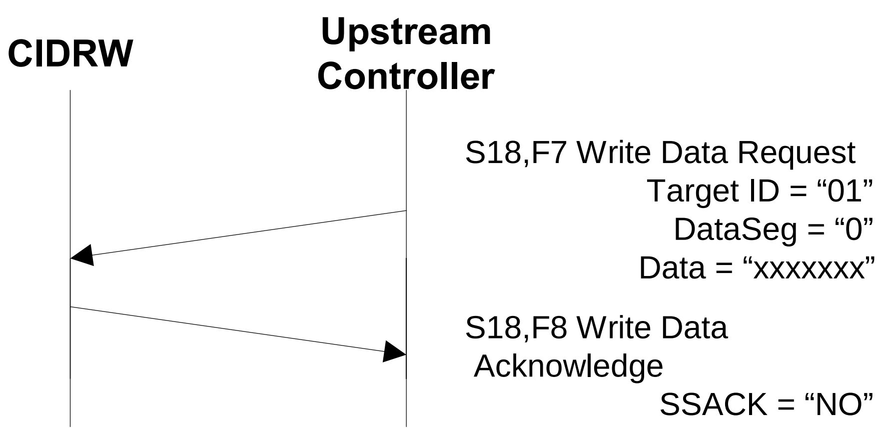

Figure R1-4
Write Data Scenario

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SEMI E100-1104
SPECIFICATION FOR A RETICLE SMIF POD (RSP) USED TO TRANSPORT AND STORE 6 INCH OR 230 mm RETICLES

This specification was technically approved by the Global Physical Interfaces and Carriers Committee and is the direct responsibility of the North American Physical Interfaces and Carriers Committee. Current edition approved by the North American Regional Standards Committee on August 16, 2004. Initially available at www.semi.org September 2004; to be published November 2004. Originally published February 2000, previously published March 2002.

1 Purpose

1.1 This standard specifies the Reticle SMIF Pod (RSP) used to transport and store 6 inch or 230 mm reticles in a reticle (photomask) or integrated circuit (IC) manufacturing facility.

2 Scope

2.1 This standard is intended to set an appropriate level of specification that places minimal limits on innovation while ensuring modularity and interchangeability at all mechanical interfaces. Most of the requirements given in this specification are in the form of maximum or minimum dimensions with very few required surfaces. Only the physical interfaces for the RSP are specified; no materials requirements or micro-contamination limits are given in this specification.

2.2 The pellicle exclusion volumes of this specification accommodate pellicles which extend the full length of the reticles. The pellicle exclusion volume widths are limited to 151 mm for 230 mm reticles, and 129 mm for 6 inch reticles.

2.3 The RSP has the following components, sub-components, and other features. A "●" symbol indicates components or features which are *required* and a "◊" symbol indicates components or features which are *optional*.

- Top
  - ◊ robotic handling flange (optional)
- Interior
  - supports for one 6 inch or 230 mm reticle
  - reticle capture mechanism
  - end-effector exclusion volume
  - 2 safety rail exclusion volumes
  - pellicle exclusion volume
  - transverse pellicle exclusion volume
- Sides
  - ◊ 2 side handling flanges on the sides parallel to the bi-lateral reference plane (optional)
  - 1 carrier ID exclusion volume on the rear side
  - ◊ 2 side handling exclusion volumes
- Bottom
  - door compatible with SMIF as defined in SEMI E19.4
  - pod latch-pin holes
  - features which mate with kinematic coupling pins
  - carrier sensing pads as defined in SEMI E1.9
  - 4 info pads
  - ◊ 4 bottom conveyor rails

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

3.1 *SEMI Standards*

SEMI E1.9 — Mechanical Specification for Cassettes Used to Transport and Store 300 mm Wafers

SEMI E19.4 — 200 mm Standard Mechanical Interface (SMIF)

SEMI E30.1 — Inspection and Review Specific Equipment Model (ISEM)

SEMI E47.1 — Provisional Mechanical Specification for Boxes and Pods Used to Transport and Store 300 mm Wafers

SEMI E57 — Mechanical Specification for Kinematic Couplings Used to Align and Support 300 mm Wafer Carriers

SEMI P5 — Specification for Pellicles

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

4 Terminology

4.1 *Definitions*

4.1.1 *bilateral reference plane* — a vertical plane that bisects the reticle and is perpendicular to both the horizontal and facial reference planes. The bilateral reference plane is coplanar with the bilateral datum plane defined in SEMI E57.

4.1.2 *facial reference plane* — a vertical plane which bisects the reticle and is parallel to the front side of the pod (where reticles are removed or inserted). The facial reference plane passes through the center of the 200 mm SMIF as defined in SEMI E19.4. The facial reference plane is coplanar with the facial datum plane defined in SEMI E57.

4.1.3 *horizontal reference plane* — a horizontal plane coplanar with the top surface of the port door as defined in SEMI E19.4. The horizontal reference plane is coplanar with the horizontal datum plane defined in SEMI E57.

4.1.4 *minienvironment* — a localized environment created by an enclosure to isolate the product from contamination and people.

4.1.5 *nominal reticle center line* — the line that is defined by the intersection of the two vertical reference planes (facial and bilateral) and passes through the nominal center of the seated reticle (which must be horizontal when the carrier is placed on the SMIF as defined in SEMI E19.4).

4.1.6 *pellicle* — as defined in SEMI P5.

4.1.7 *reticle* — as defined in SEMI E30.1.

4.1.8 *Reticle SMIF Pod* (RSP) — a minienvironment compatible carrier capable of holding one 6 inch or one 230 mm reticle in a horizontal orientation during transport and storage and is compatible with a Standard Mechanical Interface (SMIF) per SEMI E19.4.

4.1.9 *robotic handling flanges* — horizontal projections on the top of the box for lifting and rotating the box (as defined in SEMI E47.1).

4.1.10 *side handling flanges* — horizontal projections on the sides of the pod (sides parallel to the bilateral reference plane) for manual or automated lifting, transportation or positioning of the pod.

5 Ordering Information

5.1 *Intended Use* — This standard is intended to specify reticle carriers over a reasonable lifetime of use, not just those in new condition. For this reason, the purchaser needs to specify a time period and the number and type of uses to which the carriers will be put. It is under these conditions that the carriers must remain in compliance with the requirements listed in Section 6.

5.2 *Reticle Size and Thickness* — The purchaser needs to specify the reticle size and thickness to be accommodated in the RSP.

5.3 *Optional Features* — The purchaser needs to specify whether optional components (identified in Section 2) are required.

5.4 *Temperature Ranges* — The purchaser needs to specify two sets of temperatures to which the RSPs might be exposed. An operating temperature range is the set of environmental temperatures in which the RSPs will remain in compliance with the requirements listed in Section 6. A temporary temperature range is the set of environmental temperatures to which the pods can be exposed such that when the RSPs return to the operating temperature range, the RSPs will be in compliance with the requirements listed in Section 6. Limits on exposure times to elevated temperatures should be specified.

5.5 *Electrostatic Dissipation* — The end user may require a continuous path to ground from the reticle to the carrier registration and handling features. The purchaser needs to specify whether electrostatic dissipation is required.

5.6 *Contamination Requirements* — The purchaser needs to specify their contamination requirements.

6 Requirements

6.1 *Symmetry* — Most of the dimensions of the RSP are determined with respect to the three orthogonal reference planes defined in this document: the facial reference plane, the horizontal reference plane and the bilateral reference plane. All dimensions are symmetric about the bilateral reference plane except the latch features. All dimensions are symmetric about the facial reference plane except the registration features, carrier sensing pads, info pads, and latch features.

6.2 *Door* — The pod door, and its frame on the bottom of the pod, must be compatible with a port which conforms to SEMI E19.4.

6.3 *Reticle Centering and Capture* — When the carrier is closed, the reticle must be secured in all degrees of freedom within the carrier to prevent movement during transport and must be centered with respect to the SMIF defined in SEMI E19.4. A bisecting plane through the reticle, parallel to the bilateral reference plane must be within x114 of the bilateral reference plane of the load port when the reticle is seated in the carrier. A bisecting plane through the reticle, parallel to the facial reference plane must be within *y*133 of the facial reference plane of the load port when the reticle is seated in the carrier. When the carrier is open, it must provide a horizontal reticle capture range of *x*135 and *y*135. This capture range must be provided at *z*162 above the horizontal reference plane.

6.4 *Exclusion Volumes* — The interior of the RSP must never intrude into the pellicle exclusion volumes, and must not intrude into the end-effector exclusion volumes or safety rail exclusion volumes when the carrier is open. Where the exclusion volumes overlap, the end-effector exclusion volume is reduced by the pellicle exclusion volume when handling pellicilized or chrome-down reticles.

6.4.1 *End-Effector Exclusion Volumes* — Volumes in an opened pod which must be free for the end-effector to enter and handle the reticle as defined by *x*116, *x*132, *y*136, *x*144, *x*146, *y*144, *z*159, and *z*160 for a 230 mm RSP, and by *x*118, *x*143, *x*145, *y*143, *z*159, and *z*160 for a 6 inch RSP. No obstructions should exist in the end-effector exclusion volume which extends in the direction normal to the facial reference plane.

6.4.2 *Pellicle Exclusion Volumes* — Volumes in the pod below the reticle which must remain free from intrusion to accommodate the pellicle mounted on the reticle. No obstructions should exist in the pellicle exclusion volume which extends in the direction normal to the facial reference plane as defined by *x*115, *z*159 and *z*161 for a 230 mm RSP, and by *x*119, *z*159 and *z*161 for a 6 inch RSP. No obstructions should exist in the transverse pellicle exclusion volume which extends in the direction normal to the bilateral reference plane as defined by *y*129, *z*159 and *z*163 for a 230 mm RSP, and by *y*130, *z*159 and *z*163 for a 6 inch RSP.

NOTE 1: The transverse pellicle exclusion volume is only intended to specify where the reticle supports in the pod cannot exist. Reticles with the pellicles transverse are typically handled with end-effectors which grip from above the reticle.

6.4.3 *Safety Rail Exclusion Volumes* — Volumes in an opened pod which must remain free from intrusion to accommodate safety rails which may be used on end-effectors to protect the edge of the reticle during handling. No obstructions should exist in the safety rail exclusion volumes which extend in the direction normal to the facial reference plane as defined by *x*137 and *z*167 for a 230 mm, and by *x*138 and *z*167 for a 6 inch RSP.

6.5 *External Dimensions* — Figures 1, 2 and 3 show, respectively, the external top view, a detail and the front view of the RSP. Table 2 defines all of the external dimensions of the RSP (equivalent for both the 6 inch and the 230 mm versions).

6.6 *Internal Dimensions* — Figures 4 through 8 show internal dimensions for the 6 inch and 230 mm versions of the RSP. Table 2 defines all internal dimensions which are common to the 6 inch and 230 mm RSP. Table 3 defines the internal dimensions which apply only to the 230 mm RSP. Table 4 defines the internal dimensions which apply only to the 6 inch RSP. The maximum height of the features which support the reticle are given by *z*164 for a 230 mm RSP and *z*165 for a 6 inch RSP.

NOTE 2: The maximum height of the reticle supports, plus the clearance between the reticle supports and reticle (chosen by the tool supplier) determine the height the reticle must be lifted before being extracted from, or inserted into the RSP.

6.7 *Robotic Handling Flange* — On the top of the pod is an optional handling flange for automated manipulation of the RSP. Figures 1, 3, and 5 show dimensions for the robotic handling flange. Table 2 defines the dimensions for the robotic handling flange.

6.8 *Side Handling Flanges* — On the sides of the pod parallel to the bilateral reference plane are optional handling flanges for automated manipulation of the RSP. Figures 1, 2, and 3 show dimensions for the side handling flanges. Table 2 defines the dimensions for the side handling flanges. No obstructions may exist in the side handling exclusion volumes which extend in the direction normal to the facial reference plane as defined by *x*136 and *z*166 when the side handling flanges are present.

6.9 *Kinematic Coupling* — The RSP door must have the capability of registering on the kinematic pins defined in SEMI E57. The features that mate with the pins must provide a lead-in capability that corrects an RSP misalignment no greater than *r*19 in any horizontal direction. However, it is recommended that robots placing RSPs on kinematic couplings use as little of this lead-in capability as possible to avoid wear.

6.10 *Carrier Sensing Pads* — The RSP door must have carrier sensing pads as defined in SEMI E1.9.

6.11 *Info Pads* — When the RSP is placed on a port, the info pads A, B, C, and D communicate information about the RSP configuration. Figures 6 and 8 show the dimensions of the info pads. Table 2 defines the info pad dimensions. A pad in the up position must be *z*26 above the horizontal reference plane. A pad in the down position must be *z*2 above the horizontal reference plane. Info pad assignments are shown in Table 1. Info pads that are "not defined" can be at either the up or down position unless specified by the end user. RSP configurations "to be assigned" may be assigned by the end user.

Table 1 Info Pad Assignments

RSP Configuration	*Info Pad*			
	A	*B*	*C*	*D*
230 mm reticle	not defined	not defined	up	down
6 inch reticle	not defined	not defined	down	down
to be assigned	not defined	not defined	up	up
to be assigned	not defined	not defined	down	up

6.12 *Inner and Outer Radii* — All required concave features may have a radius of up to *r*65 to allow cleaning and to prevent contaminant build-up. All required convex features may also have a radius of up to *r*66 to prevent small contact patches with large stresses that might cause wear and particles. Note that these limits on the radius of all required features are specified as a maximum (not a minimum) to ensure that the required features are not rounded off too much. The lower bound on the radius is up to the carrier supplier. Note also that this radius applies to every required feature unless another radius is called out specifically. Here a required feature is an area on the surface of the carrier specified by a dimension (or intersections of dimensions) that has a tolerance and not just a maximum or minimum (such as the edges of the robotic handling flange).

6.13 *Carrier ID Exclusion Volume* — Volume external to the pod which must remain free from intrusion to accommodate a carrier ID label or tag mounted on the pod. No obstructions should exist in the carrier ID exclusion volume as defined by *x*147, *y*137, *y*138, *z*180, and *z*181. Figures 1 and 3 show dimensions for the carrier ID exclusion volume. Table 2 defines the dimensions for the carrier ID exclusion volume. If a label is used, its surface must be at *y*139.

6.14 *Conveyor Rails* — Optional surfaces on the bottom for transporting the RSP on roller conveyors. The conveyor rail surfaces are bounded by *x*140, *x*141, *x*142, *y*140, *y*141 and *y*142 as shown in Figure 9. The height of the conveyor rail surface is defined by *z*171. Table 2 defines the dimensions for the conveyor rails.

7 Related Documents

7.1 *SEMI Standards*

SEMI E15 — Specification for Tool Load Port

SEMI P1 — Specification for Hard Surface Photomask Substrates

SEMI P33 — Provisional Specification for Developmental 230 mm Square Hard Surface Photomask Substrates

SEMI S8 — Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment

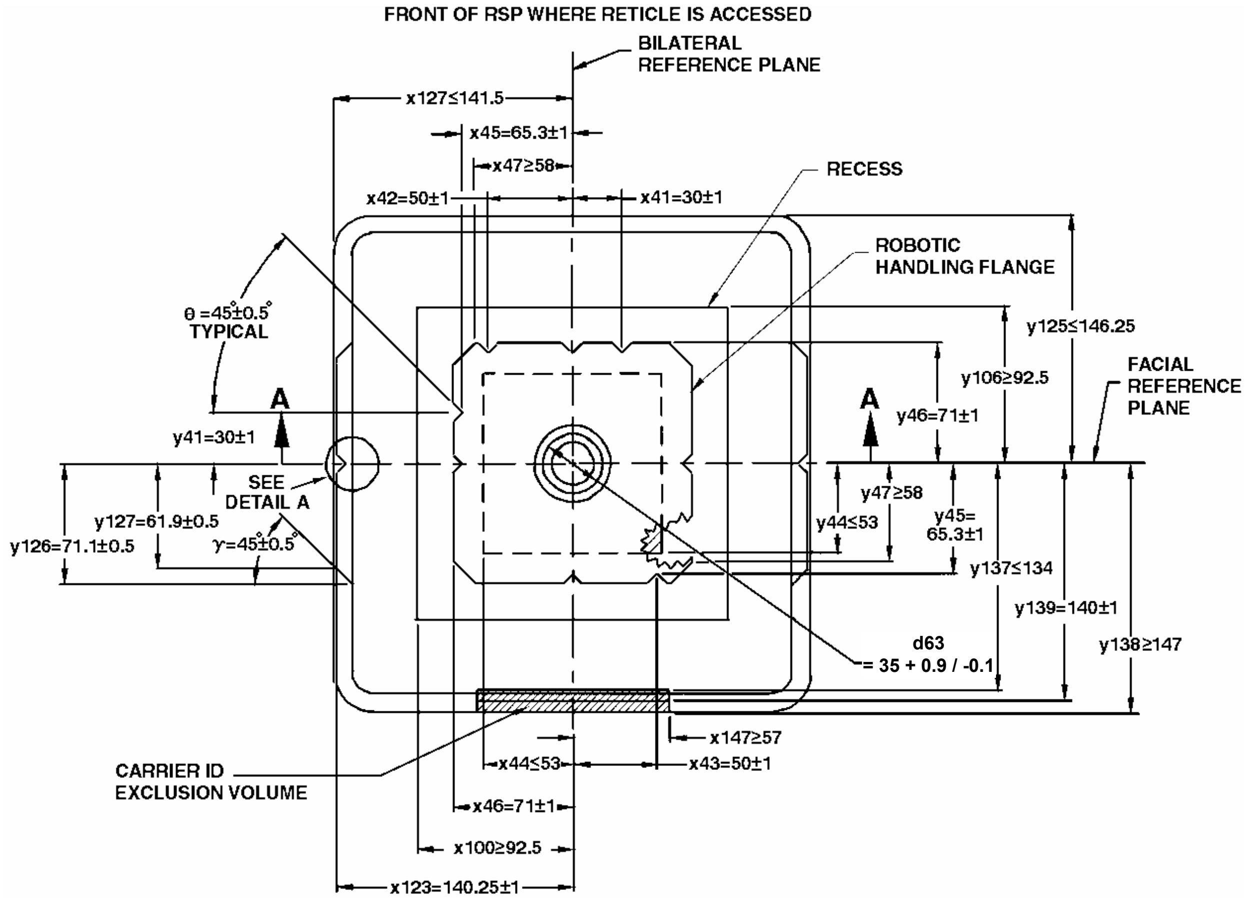

Figure 1
External Top View of 230 mm and 6 inch RSP

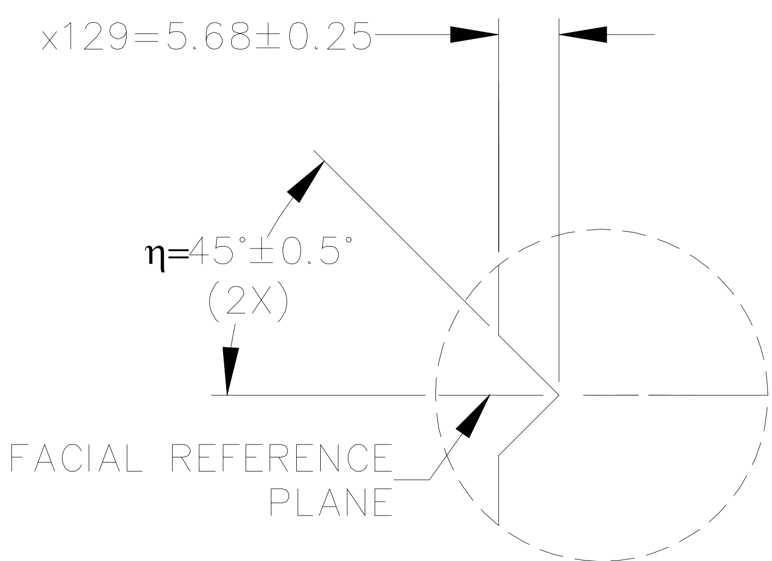

Figure 2
Detail A: External Top View of Side Handling Flange Alignment Hole

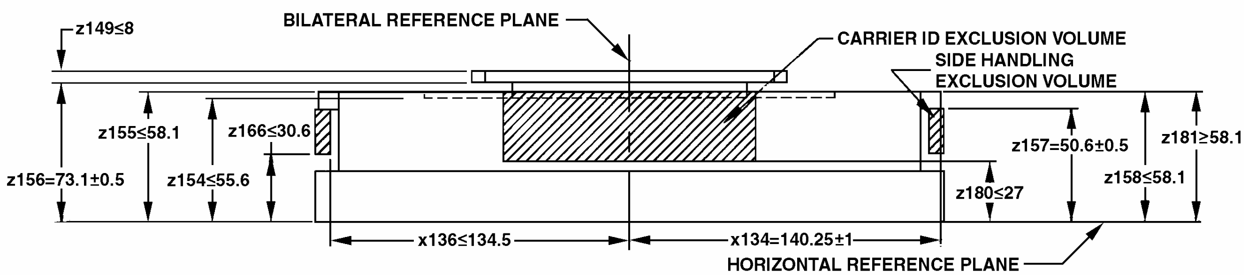

Figure 3
External Front View of 230 mm and 6 inch RSP

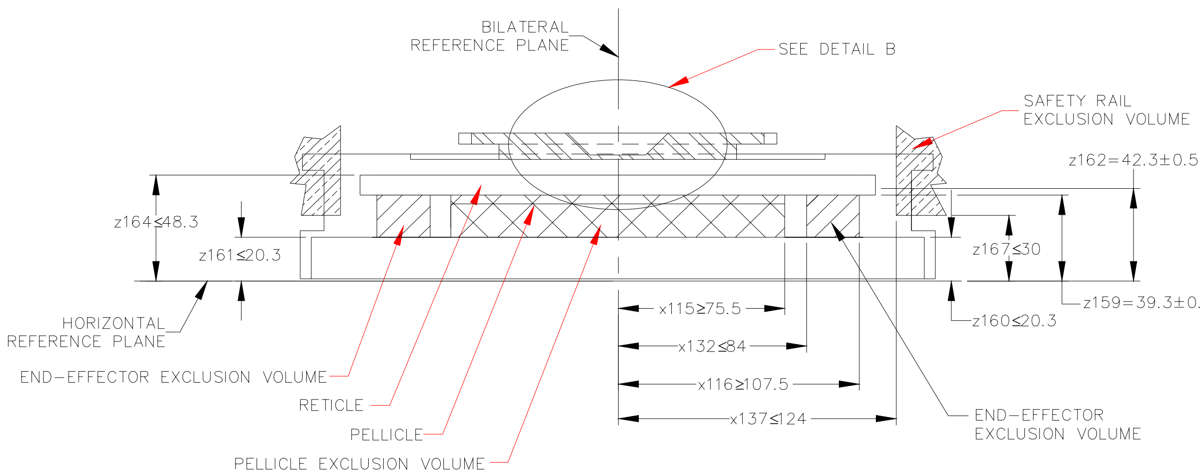

Figure 4
Section A-A: Internal Front View of 230 mm RSP

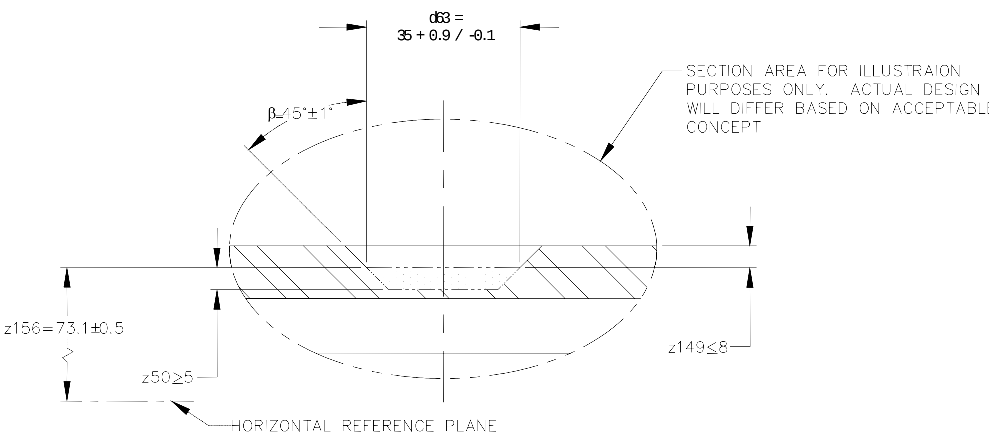

Figure 5
Detail B: Top Robotic Handling Flange Hole Feature

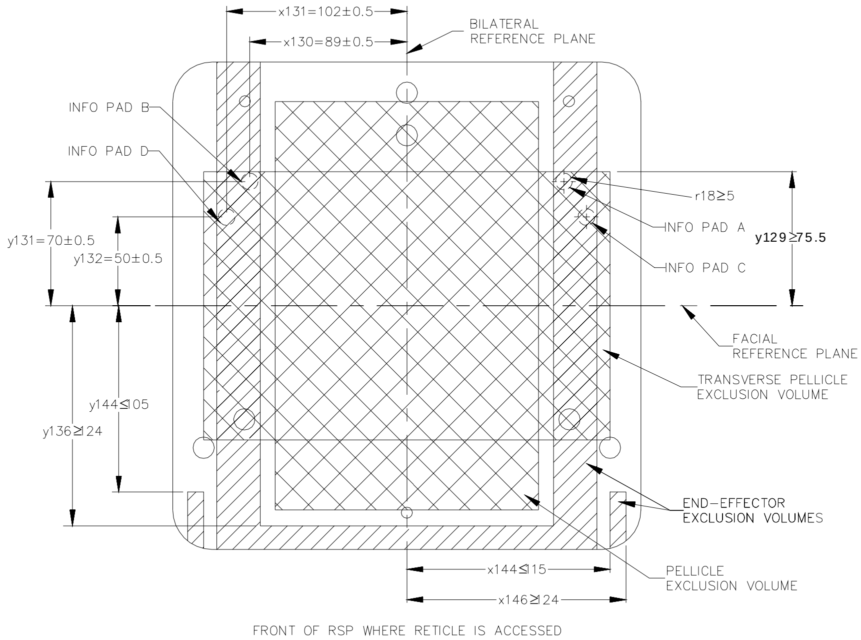

Figure 6
Door Only Top View of 230 mm RSP

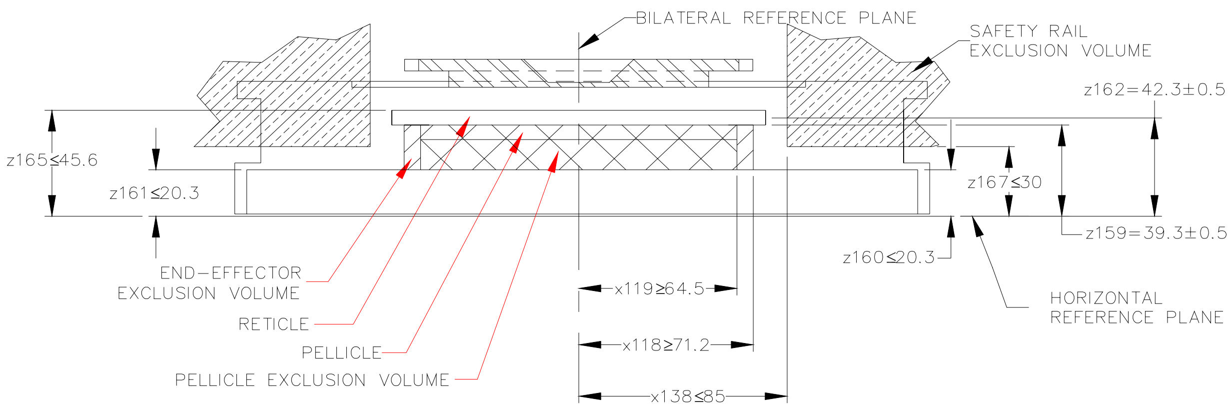

Figure 7
Section A-A: Internal Front View of 6 inch RSP

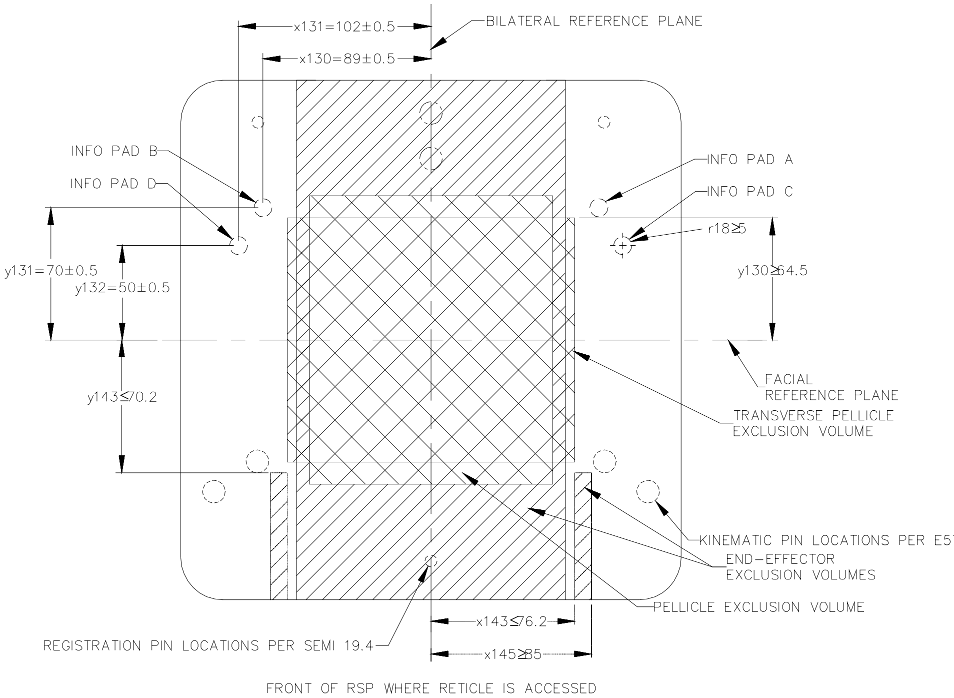

Figure 8
Door Only Top View of 6 inch RSP

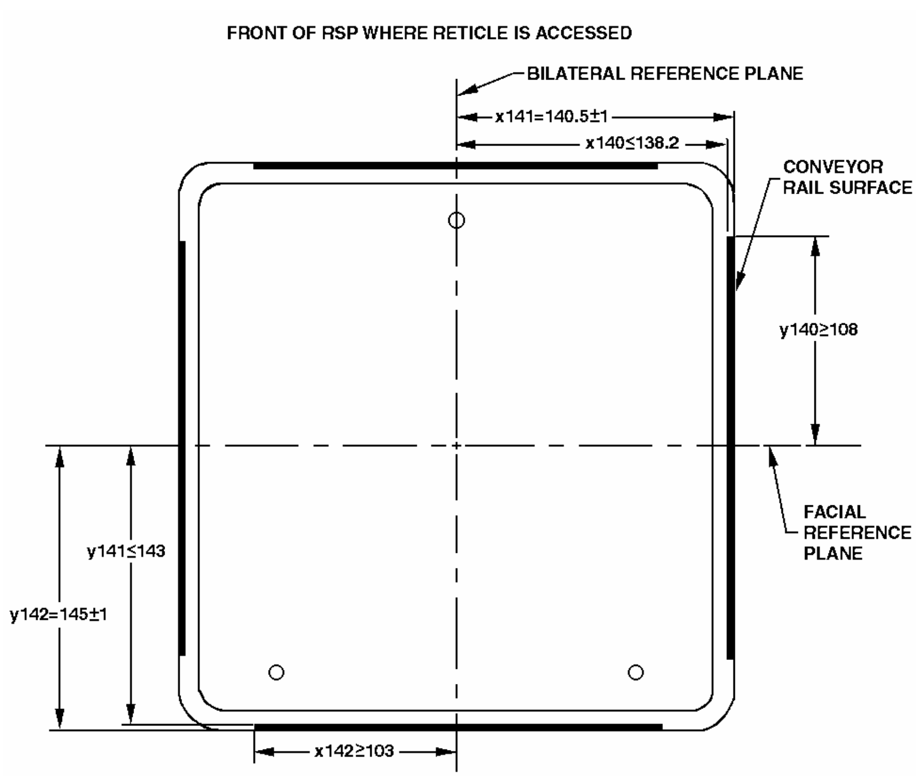

Figure 9
Exterior Bottom View of 6 inch and 230 mm RSP

Table 2 External Dimensions and Common Internal Dimensions for 6 inch and 230 mm RSP

Symbol Used	*Figure*	*Value Specified*	*Reference Measured From*	*Feature Measured To*
θ	1	45° ± 0.5°	facial reference plane	sides of orientation notches
γ	1	45° ± 0.5°	facial reference plane	edge of side handling flange chamfer
η	2	45° ± 0.5°	facial reference plane	sides of side handling flange orientation notches
β	5	45° ± 1°	bilateral and facial plane intersection	surface of the center hole in the top robotic handling flange
*r*65	n/a	1 mm (0.039 in.) maximum	not applicable	all required concave features (radius)
*r*66	n/a	2 mm (0.079 in.) maximum	not applicable	all required convex features (radius)
*r*18	6, 8	5 mm (0.197 in.) minimum	info pad center	perimeter of info pad
*r*19	None	10 mm (0.394 in.) minimum	not applicable	correctable RSP misalignment in any horizontal direction
*d*63	5	35.0 + 0.9 / - 0.1 mm (1.378 + 0.035 / - 0.004 in.)	centered on bilateral and facial plane intersection	top robotic handling flange hole design feature
*x*41	1	30 ± 1 mm (1.181 ± 0.039 in.)	bilateral reference plane	orientation notch center
*x*42	1	50 ± 1 mm (1.969 ± 0.039 in.)	bilateral reference plane	orientation notch center
*x*43	1	50 ± 1 mm (1.969 ± 0.039 in.)	bilateral reference plane	orientation notch center
*x*44	1	53 mm (2.087 in.) maximum	bilateral reference plane	side of robotic handling flange column
*x*45	1	65.3 ± 1 mm (2.571 ± 0.039 in.)	bilateral reference plane	orientation notch tip
*x*46	1	71 ± 1 mm (2.795 ± 0.039 in.)	bilateral reference plane	edge of robotic handling flange
*x*47	1	58 mm (2.283 in.) minimum	bilateral reference plane	edge of robotic handling flange corner beveling
*x*100	1	92.5 mm (3.642 in.) minimum	bilateral reference plane	edge of recess
*x*114	None	0 ± 1 mm (0 ± 0.039 in.)	bilateral reference plane	bisecting plane through reticle
*x*123	1	140.25 ± 1 mm (5.522 ± 0.039 in.)	bilateral reference plane	side edge of side handling flange
*x*127	1	141.5 mm (5.571 in.) maximum	bilateral reference plane	side of pod
*x*129	2	5.68 ± 0.25 mm (0.224 ± 0.010 in.)	side edge of side handling flange	vertex of side handling flange alignment notch
*x*130	6, 8	89 ± 0.5 mm (3.504 ± 0.020 in.)	bilateral reference plane	center of info pads A and B

Symbol Used	*Figure*	*Value Specified*	*Reference Measured From*	*Feature Measured To*
*x*131	6, 8	102 ± 0.5 mm (4.016 ± 0.020 in.)	bilateral reference plane	center of info pads C and D
*x*134	3	140.25 ± 1 mm (5.522 ± 0.039 in.)	bilateral reference plane	bottom edge of side handling flange
*x*135	None	0 ± 3 mm (0 ± 0.118 in.)	bilateral reference plane	bisecting plane through reticle
*x*136	3	134.5 mm (5.295 in.) maximum	bilateral reference plane	edge of side handling exclusion volume
*x*140	9	138.2 mm (5.441 in.) maximum	bilateral reference plane	edge of conveyor rail surface
*x*141	9	140.5 ± 1 mm (5.531 ± 0.039 in.)	bilateral reference plane	edge of conveyor rail surface
*x*142	9	103 mm (4.055 in.) minimum	bilateral reference plane	end of conveyor rail surface
*x*147	1	57 mm (2.244 in.) minimum	bilateral reference plane	edge of carrier ID exclusion volume
*y*41	1	30 ± 1 mm (1.181 ± 0.039 in.)	facial reference plane	center of orientation notch
*y*44	1	53 mm (2.087 in.) maximum	facial reference plane	edge of robotic handling flange column
*y*45	1	65.3 ± 1 mm (2.571 ± 0.039 in.)	facial reference plane	orientation notch tip
*y*46	1	71 ± 1 mm (2.795 ± 0.039 in.)	facial reference plane	edge of robotic handling flange
*y*47	1	58 mm (2.283 in.) minimum	facial reference plane	edge of robotic handling flange corner beveling
*y*106	1	92.5 mm (3.642 in.) minimum	facial reference plane	edge of recess
*y*125	1	146.25 mm (5.758 in.) maximum	facial reference plane	side of pod
*y*126	1	71.1 ± 0.5 mm (2.799 ± 0.020 in.)	facial reference plane	depth of side handles
*y*127	1	61.9 ± 0.5 mm (2.437 ± 0.020 in.)	facial reference plane	side handle chamfers
*y*131	6, 8	70 ± 0.5 mm (2.756 ± 0.020 in.)	facial reference plane	center of info pads A and B
*y*132	6, 8	50 ± 0.5 mm (1.969 ± 0.020 in.)	facial reference plane	center of info pads C and D
*y*133	None	0 ± 1 mm (0 ± 0.039 in.)	facial reference plane	bisecting plane through reticle
*y*135	None	0 ± 3 mm (0 ± 0.118 in.)	facial reference plane	bisecting plane through reticle
*y*137	1	134 mm (5.276 in.) maximum	facial reference plane	edge of carrier ID exclusion volume
*y*138	1	147 mm (5.787 in.) minimum	facial reference plane	edge of carrier ID exclusion volume

Symbol Used	*Figure*	*Value Specified*	*Reference Measured From*	*Feature Measured To*
*y*139	1	140 ± 1 mm (5.512 ± 0.039 in.)	facial reference plane	surface of ID label
*y*140	9	108 mm (4.252 in.) minimum	facial reference plane	end of conveyor rail surface
*y*141	9	143 mm (5.630 in.) maximum	facial reference plane	edge of conveyor rail surface
*y*142	9	145.5 ± 1 mm (5.728 ± 0.039 in.)	facial reference plane	edge of conveyor rail surface
*z*2	None	2 mm (0.079 in.) maximum	horizontal reference plane	surface of info pads (when down)
*z*26	None	9 mm (0.354 in.) minimum	horizontal reference plane	surface of info pads (when up)
*z*50	5	5 mm (0.197 in.) minimum	bottom of circular recess	midpoint of circular recess
*z*149	3, 5	8 mm (0.315 in.) maximum	bottom surface of robotic handling flange	height of robotic handling flange
*z*154	3	55.6 mm (2.189 in.) maximum	horizontal reference plane	top surface of dome recess
*z*155	3	58.1 mm (2.287 in.) maximum	horizontal reference plane	top surface of dome
*z*156	3, 5	73.1 ± 0.5 mm (2.878 ± 0.020 in.)	horizontal reference plane	bottom surface of robotic handling flange
*z*157	3	50.6 ± 0.5 mm (1.992 ± 0.020 in.)	horizontal reference plane	bottom edge of side handles
*z*158	3	58.1 mm (2.287 in.) maximum	horizontal reference plane	top surface of side handles
*z*159	4, 7	39.3 ± 0.5 mm (1.547 ± 0.020 in.)	horizontal reference plane	bottom surface of reticle
*z*160	4, 7	20.3 mm (0.799 in.) maximum	horizontal reference plane	edge of end-effector exclusion volume
*z*161	4, 7	20.3 mm (0.799 in.) maximum	horizontal reference plane	edge of pellicle exclusion volume
*z*162	4, 7	42.3 ± 0.5 mm (1.665 ± 0.020 in.)	horizontal reference plane	reticle capture height
*z*163	None	20.3 mm (0.799 in.) minimum	horizontal reference plane	edge of transverse pellicle exclusion volume
*z*166	3	30.6 mm (1.205 in.) maximum	horizontal reference plane	edge of side handling exclusion volume
*z*167	4, 7	30 mm (1.181 in.) maximum	horizontal reference plane	edge of safety rail exclusion volume
*z*171	None	0.5 mm (0.020 in.) maximum	horizontal datum plane	conveyor rail surface
*z*180	3	27 mm (1.063 in.) maximum	horizontal reference plane	bottom edge of carrier ID exclusion volume
*z*181	3	58.1 mm (2.287 in.) minimum	horizontal reference plane	top edge of carrier ID exclusion volume

Table 3 Internal Dimensions Unique to the 230 mm RSP

Symbol Used	*Figure*	*Value Specified*	*Reference Measured From*	*Feature Measured To*
*x*115	4	75.5 mm (2.972 in.) minimum	bilateral reference plane	edge of pellicle exclusion volume
*x*116	4	107.5 mm (4.232 in.) minimum	bilateral reference plane	edge of end-effector exclusion volume
*x*132	4	84 mm (3.307 in.) maximum	bilateral reference plane	edge of end-effector exclusion volume
*x*137	4	124 mm (4.882 in.) maximum	bilateral reference plane	edge of safety rail exclusion volume
*x*144	4, 6	115 mm (4.528 in.) maximum	facial reference plane	edge of end-effector exclusion volume
*x*146	4, 6	124 mm (4.881 in.) minimum	facial reference plane	edge of end-effector exclusion volume
*y*129	6	75.5 mm (2.972 in.) minimum	facial reference plane	edge of transverse pellicle exclusion volume
*y*136	6	124 mm (4.882 in.) minimum	facial reference plane	edge of end effector exclusion volume
*y*144	6	105 mm (4.134 in.) maximum	facial reference plane	edge of end-effector exclusion volume
*z*164	4	48.3 mm (1.902 in.) maximum	horizontal reference plane	top of reticle supports

Table 4 Internal Dimensions Unique to the 6 inch RSP

Symbol Used	*Figure*	*Value Specified*	*Reference Measured From*	*Feature Measured To*
*x*118	7	71.2 mm (2.803 in.) minimum	bilateral reference plane	edge of end-effector exclusion volume
*x*119	7	64.5 mm (2.539 in.) minimum	bilateral reference plane	edge of pellicle exclusion volume
*x*138	7	85 mm (3.346 in.) maximum	bilateral reference plane	edge of safety rail exclusion volume
*x*143	7, 8	76.2 mm (3.000 in.) maximum	facial reference plane	edge of end-effector exclusion volume
*x*145	7, 8	85 mm (3.346 in.) minimum	facial reference plane	edge of end-effector exclusion volume
*y*130	8	64.5 mm (2.539 in.) minimum	facial reference plane	edge of transverse pellicle exclusion volume
*y*143	8	70.2 mm (2.764 in.) maximum	facial reference plane	edge of end-effector exclusion volume
*z*165	7	45.6 mm (1.795 in.) maximum	horizontal reference plane	top of reticle supports

APPENDIX 1
APPLICATION NOTES

NOTICE: The material in this appendix is an official part of SEMI E100 and was approved by full letter ballot procedures on September 3 and December 15, 1999 by the North American Regional Standards Committee, but the recommendations in this appendix are optional and are not required to conform to this standard.

A1-1 Edge contact only with the photomask is preferred when handling, transporting, or storing.

A1-2 Skewness, warp, rock, and stiffness are implicitly defined in the geometric tolerances.

A1-3 A 6 inch reticle with a 140 mm wide pellicle can be accommodated in the RSP, but may require automation which approaches from above the reticle.

A1-4 Features on the RSP which enable stacking may be required by end users. It is preferred that these features allowing stacking in only one orientation.

A1-5 Features on the RSP which provide visual orientation of the RSP top and RSP door may be required by end users.

A1-6 In order to permit end-effectors, which can handle both 230 mm and 6 inch reticles, it is recommended to include the 230 mm end-effector exclusion volumes in RSPs configured for 6 inch reticles.