IPC-SMEMA-9851

Mechanical Equipment Interface Standard

February 2007

A standard developed by IPC

Supersedes SMEMA 1.2

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 mechanical equipment interface standard

Developed by the Assembly Equipment Mechanical Interface Subcommittee (5-42) of IPC

Supersedes: IPC-SMEMA 1.2

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Mechanical Equipment Interface Standard

1 EQUIPMENT INTERFACE

1.1 Introduction The SMEMA machine interface standards were developed to facilitate the interface of equipment used in the manufacture of surface-mounted printed circuit boards. This standard is for mechanical and electrical interfaces.

1.2 Purpose The purpose of this standard is to provide an equipment interface specification for board transfer manufacturing systems of surface-mounted printed circuit boards. This specification provides the minimum requirement that conveyor-to-conveyor equipment shall meet, and does not represent a complete specification for the equipment’s interface. Conformance to the standard may be achieved by the appropriate design of the equipment or by providing special adapters that enable the equipment to meet the standard.

1.3 Interpretation “Shall,” the emphatic form of the verb, is used throughout this specification whenever a requirement is intended to express a provision that is binding. The words “should” and “may” are used whenever it is necessary to express nonmandatory provisions. “Will” is used to express a declaration of purpose. To assist the reader, the word shall is presented in bold characters.

2 SINGLE LANE MECHANICAL INTERFACE REQUIREMENTS

The mechanical specifications that follow are for single board transfer systems with conveyor transports. These systems can be assembled next to each other without any interface hardware. The printed circuit board is assumed to move from left to right in the diagrams that follow; however, the same standard applies for systems when the board moves from right to left. An equipment manufacturer shall clearly state the direction of board movement.

2.1 Conveyor Height Each machine shall have the transport conveyor height adjustable from 940 to 965 mm [37 to 38 in] from the floor to the bottom of the PC board.

2.2 Fixed Rail For the purposes of this standard, the front rail is defined as the fixed rail.

2.3 Conveyor Width For equipment with an adjustable conveyor width, the front rail is fixed and the rear rail is adjustable. The range of adjustment will vary with the equipment manufacturer.

2.4 Edge Clearance The conveyor should require no more than 5 mm [0.197 in] of clear board space at the side edges.

2.5 Tooling Pins Tooling pins, if used, should be on the front edge of the board (next to the fixed transport rail). A recommended hole diameter is 4 mm [0.16 in]. Distance from the edge should be 7.6 mm [0.299 in].

2.6 Maximum Gap The maximum unsupported gap as defined by G in Figure 2-1 is 19 mm [0.748 in].

![Figure 2-1 Maximum Gap](IPC-9851-2-1)
2.7 Lead-in  The minimum lead-in on the track ends of the conveyor is 3 mm [0.118 in] and the angle shall not be greater than 30° as shown in Figure 2-2.

![Figure 2-2 Lead-In](image)

3 DUAL-LANE MECHANICAL INTERFACE REQUIREMENTS

The specifications that follow are for dual-lane transfer systems with conveyor transports. These systems can be assembled next to each other without any interface hardware. The printed circuit board is assumed to move from left to right in the diagrams; however, the same standard applies for systems when the board moves from right to left. An equipment manufacturer shall clearly state the direction of movement.

This standard provides for variations in dual-lane conveyor rail spacing configurations. The equipment documentation shall clearly state whether the conveyor rail spacing conforms to Configuration A, B or C, as defined in Table 3-1. For Configuration C, the conveyor rail spacing (rails 1 to 3) and minimum center lane spacing (rails 2 to 3) shall be specified on equipment documentation.

Rail 1 shall be fixed position, rails 2 and 4 shall be adjustable, and rail 3 may be fixed or adjustable. For the purposes of this standard, the rail closest to the front of the equipment is defined as fixed rail as shown in Figure 3-1 (1).

![Figure 3-1 Dual Lane Conveyor](image)

<table>
<thead>
<tr>
<th>Table 3-1 Dual-Lane Configurations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration Type</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
</tbody>
</table>

Note 1: Rail spacing is measured from transport edge to transport edge, see Figure 3-1 (7).
Note 2: See Figure 3-1 (8)

3.1 Conveyor Height  Each machine shall have the transport conveyor height adjustable from 940 to 965 mm [37 to 38 in] from the floor to the bottom of the PC board.

3.2 Conveyor Width Each Lane  Each conveyor shall be able to be independently adjusted for printed circuit boards as small as 50 mm [1.97 in] and at least as wide as 216 mm [8.5 in] wide boards (see Figure 3-1).

3.3 Asynchronous Control  Asynchronous control of the two lanes shall be available. Asynchronous control is defined as the ability to move and control each conveyor independent from the other.

3.4 Edge Clearance  The conveyors should require no more than 5 mm [0.197 in] of clear board space at the side edges.

3.5 Maximum Gap  The maximum unsupported gap as defined by G in Figure 2-1 is 19 mm [0.748 in].
3.6 Lead-in  The minimum lead-in on the track ends of the conveyor is 3 mm [0.118 in] and the angle shall not be greater than 30° as shown in Figure 2-2.

3.7 Electrical Interface  Each lane shall have independent transfer interface control. Each lane shall have independent connectors for input and output control (total of 4) (see 4 Electrical Interface Requirements).

4 ELECTRICAL INTERFACE REQUIREMENTS

A machine-to-machine electrical interface is required to insure proper sequencing of PC boards. The interface is used for “Local” control and shall operate independently of the cell controller.

These requirements are applicable to single and dual lane systems.

4.1 Inter-Machine Control  To sequence boards properly from machine-to-machine, the “Board Available” and “Machine Ready” signal lines will be used and “Board Pass/Fail” signal line is optional.

4.2 Inter-Machine Connections  See Figure 4-1 and Table 4-1.

4.2.1 Connectors  All interface connectors on a machine shall be female. Figures 4-2 and 4-3 provide interface connector information.

4.2.2 Cable  Each machine shall include the downstream/output signal cable and mating connectors. Wire color code needs to comply with established standards specific to the country of manufacture such as NFPA 79, EN60204-1 or as otherwise defined in the procurement documentation.

4.3 Interface Signal Logic  The electrical interface signal sequence is shown in Figure 4-4, and may be obtained using an optical isolator or a relay. The minimum requirements are to switch 30 Vdc, 10 mA. At 10 mA, the output “LOW” shall not exceed 0.8 Vdc. The logic for normal board transfer is described in Tables 4-2 and 4-3 and is shown in Figure 4-4.

A similar timing diagram applies to boards passed under the Board Fail Option. In such cases, the “Board Available” signal described in Table 4-3 is REPLACED by the “Failed Board Available” signal. The “Board Available” signal shall be off (contacts open) during transfers of failed boards as shown in the logic diagram in Figure 4-5.
### Figure 4-1 Electrical Interface Schematic

### Table 4-1 Electrical Interface Connector/Cable Functional Description

<table>
<thead>
<tr>
<th>Connector/Cable</th>
<th>Function</th>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1-2 (Note 1)</td>
<td>Machine Ready to Receive</td>
<td>Contacts Closed (Notes 2,3)</td>
<td>Machine is ready to receive next board.</td>
</tr>
<tr>
<td>Pair 3-4 (Note 1)</td>
<td>Board Available</td>
<td>Contacts Closed (Notes 2,3)</td>
<td>Machine has a good board ready to send. All boards are considered to be &quot;good&quot; if the Board Fail option is not being used.</td>
</tr>
<tr>
<td>Pair 5-6</td>
<td>Auxiliary Interface Power (optional)</td>
<td>Available; user to document purpose and operating parameters.</td>
<td></td>
</tr>
<tr>
<td>Pair 7-8 (Note 1)</td>
<td>Failed Board Available (Optional)</td>
<td>Contacts Closed (Notes 2,3)</td>
<td>Default (no connection or, if used, contacts are open) is that the incoming board is good and suitable for use. Optional use is to provide closed contacts when it has been determined that the board should stop transfer or be diverted. In such cases, these contacts shall be closed in lieu of (and not in addition to) the normal Good Board Available contacts.</td>
</tr>
<tr>
<td>Pair 9-10</td>
<td>Not defined</td>
<td>Available; user to document purpose and operating parameters.</td>
<td></td>
</tr>
<tr>
<td>Pair 11-12</td>
<td>Not defined</td>
<td>Available; user to document purpose and operating parameters.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Not used</td>
<td>Not used</td>
<td>Not used.</td>
</tr>
<tr>
<td>14</td>
<td>Cable shield (Optional)</td>
<td>Cable shield attachment if required; follow good engineering practices (connect at only one end).</td>
<td></td>
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</table>

**Note 1:** Minimum requirements are to switch 30 Vdc, 10 mA.

**Note 2:** At 10 mA, the output "LOW" or contact closure shall not exceed 0.8 Vdc.

**Note 3:** Assure proper polarity if using optional optical isolator.

**Note 4:** Existing equipment not built to this standard may require modified pin-out on the connector and/or the interface cable.
**Figure 4-2** Square Flange Receptable, Accepts Multimate Sockets

**Note 1:** These are manufacturers drawings and do not reflect metric dimensions.

**Note 2:** All connectors shown are manufactured by AMP®. The following are AMP part numbers.
- 14 position, square flange, receptacle; P/N 206043-1
- Cable Clamp; P/N 206070-1
- Socket; P/N 66594-1

**Figure 4-3** Cable Connector

**Note 1.** All connectors shown are manufactured by AMP®. The following are AMP part numbers.
- 14 position, plug; P/N 206044-1
- Cable Clamp; P/N 206070-1
- Pin; P/N 66593-1
Table 4-2 Signal Logic

<table>
<thead>
<tr>
<th>Time</th>
<th>Action/Condition</th>
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<tbody>
<tr>
<td>T0</td>
<td>Up-line board not available; down-line machine not ready to receive.</td>
</tr>
<tr>
<td>T1</td>
<td>Up-line machine has a board available to send; down-line machine not ready to receive.</td>
</tr>
<tr>
<td>T2</td>
<td>Up-line machine has a board available to send; down-line machine ready to receive, transfer starts.</td>
</tr>
<tr>
<td>T3</td>
<td>Board has completely left control of up-line machine; still moving into down-line machine.</td>
</tr>
<tr>
<td>T4</td>
<td>Transfer complete; down-line machine is completely in control of board. Board not available, down-line machine not ready to receive.</td>
</tr>
<tr>
<td>T5</td>
<td>Up-line board not available, down-line machine ready to receive.</td>
</tr>
<tr>
<td>T6</td>
<td>Up-line machine has a board available to send, down-line machine ready to receive, transfer starts.</td>
</tr>
<tr>
<td>T7</td>
<td>Board has completely left control of up-line machine; still moving into down-line machine.</td>
</tr>
<tr>
<td>T8</td>
<td>Transfer complete; down-line machine is completely in control of board. Board not available, down-line machine not ready to receive.</td>
</tr>
<tr>
<td>T9</td>
<td>Up-line board not available, down-line machine ready to receive.</td>
</tr>
<tr>
<td>T10</td>
<td>Up-line machine has a board available to send, down-line ready to receive, transfer starts.</td>
</tr>
</tbody>
</table>

Optional: Once both Machine A and Machine B signals are closed, and the board has neither left A nor arrived at B, an error message will be generated (to be defined by users).
Figure 4-4  Timing Logic Diagram for Normal Transfer

Figure 4-5  Timing Logic Diagram for Failed Board Option
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  What is your company’s primary product line?

- **Industry Suppliers**
  This facility supplies raw materials, machinery, equipment or services used in the manufacture or assembly of electronic interconnection products.

  What products do you supply?

- **Government Agencies/Academic Technical Liaisons**
  We are representatives of a government agency, university, college, technical institute who are directly concerned with design, research, and utilization of electronic interconnection devices. (Must be a non-profit or not-for-profit organization.)
Application for Site Membership

Site Information:

Company Name

Street Address

City State Zip/Postal Code Country

Main Switchboard Phone No. Main Fax

Name of Primary Contact

Title Mail Stop

Phone Fax e-mail

Company e-mail address W

Please Check One:

☐ $1,000.00 Annual dues for Primary Site Membership (Twelve months of IPC membership begins from the time the application and payment are received)

☐ $800.00 Annual dues for Additional Facility Membership: Additional membership for a site within an organization where another site is considered to be the primary IPC member.

☐ $600.00** Annual dues for an independent PCB/PWA fabricator or independent EMSI provider with annual sales of less than $1,000,000.00. **Please provide proof of annual sales.

☐ $250.00 Annual dues for Government Agency/not-for-profit organization

TMRC Membership ☐ Please send me information about membership in the Technology Market Research Council (TMRC)

Payment Information:

Enclosed is our check for $________________

Please bill my credit card: (circle one) MC AMEX VISA DINERS

Card No.___________________________________________________________Exp date_______________

Authorized Signature

Mail application with check or money order to:

IPC
3491 Eagle Way
Chicago, IL 60678-1349

Fax/Mail application with credit card payment to:

IPC
3000 Lakeside Drive, Suite 309 S
Bannockburn, IL 60015-1249
Tel: 847-615-7100
Fax: 847-615-7105

http://www.ipc.org

Please attach business card of primary contact here
Standard Improvement Form

The purpose of this form is to provide the Technical Committee of IPC with input from the industry regarding usage of the subject standard. Individuals or companies are invited to submit comments to IPC. All comments will be collected and dispersed to the appropriate committee(s).

If you can provide input, please complete this form and return to:
IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, IL 60015-1249
Fax 847-615-7105
E-mail: answers@ipc.org

1. I recommend changes to the following:
   ___ Requirement, paragraph number ________
   ___ Test Method number ________, paragraph number ________

   The referenced paragraph number has proven to be:
   ___ Unclear   ___ Too Rigid   ___ In Error
   ___ Other ________

2. Recommendations for correction:
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________

3. Other suggestions for document improvement:
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________

Submitted by:

Name

Telephone

Company

E-mail

Address

City/State/Zip

Date