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IPC-SMEMA-9851

Mechanical Equipment Interface Standard

IPC-SMEMA-9851

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:
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Users of this publication are encouraged to participate in the development of future revisions.

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Acknowledgment

Any Standard involving a complex technology draws material from a vast number of sources. While the principal members of the Assembly Equipment Mechanical Interface Subcommittee (5-42) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

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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].

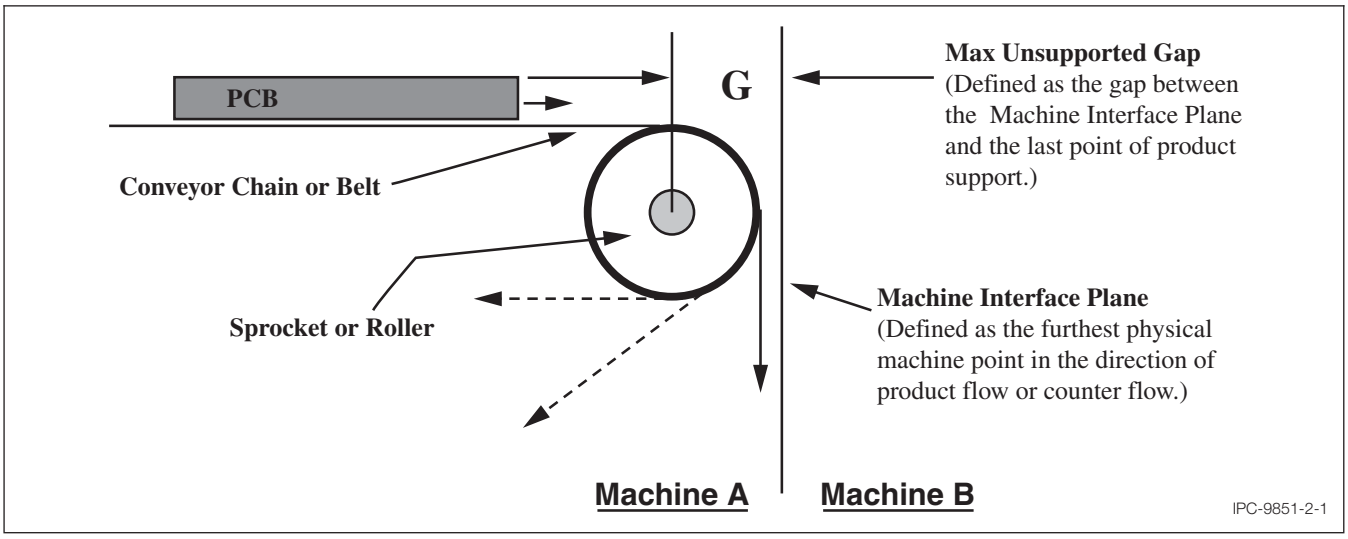

Figure 2-1 Maximum Gap

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.

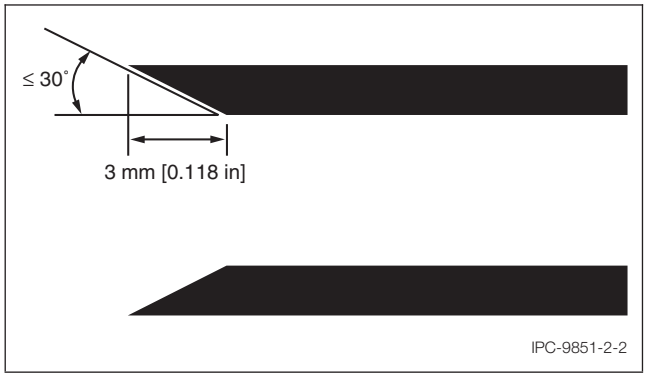

Figure 2-2 Lead-In

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).

Table 3-1 Dual-Lane Configurations

Configuration Type	Conveyor Rail Spacing Rails 1 to 3[1]	Minimum Center Lane Spacing Rails 2 to 3[2]
A	251 mm [9.88 in]	35 mm [1.38 in]
B	266 mm [10.47 in]	50 mm [1.97 in]
C	As defined in equipment manufacturer's documentation	

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].

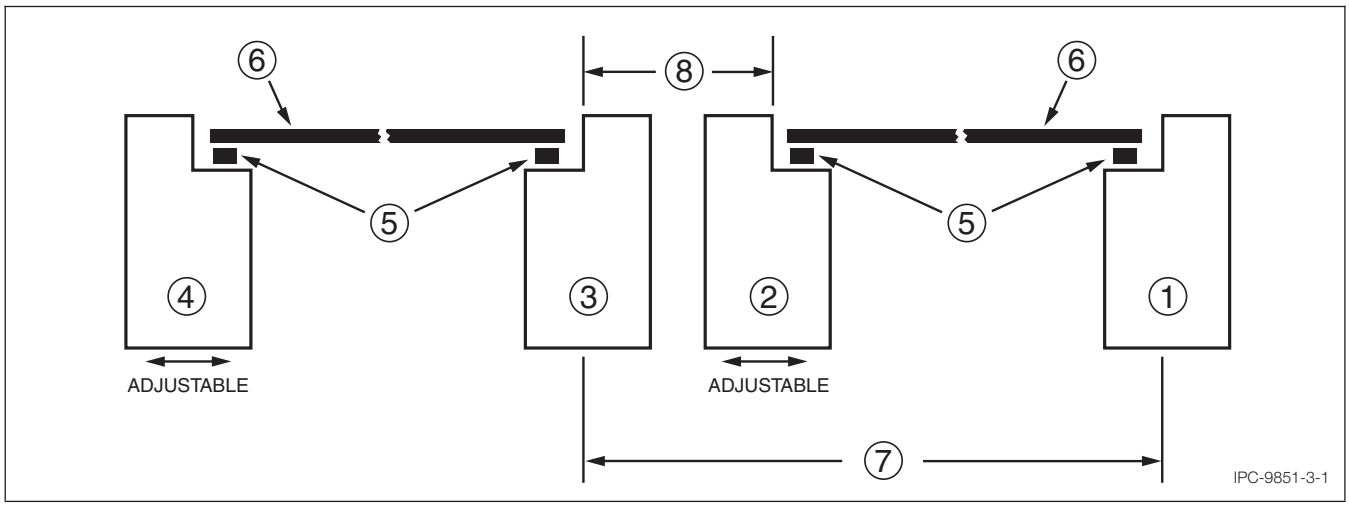

Figure 3-1 Dual Lane Conveyor

1. Rail 1, fixed in position
2. Rail 2, adjustable
3. Rail 3, may be fixed or adjustable
4. Rail 4, adjustable
5. Conveyor system
6. Circuit board/assembly
7. Rail 1 to Rail 3 spacing
8. Center lane spacing

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.

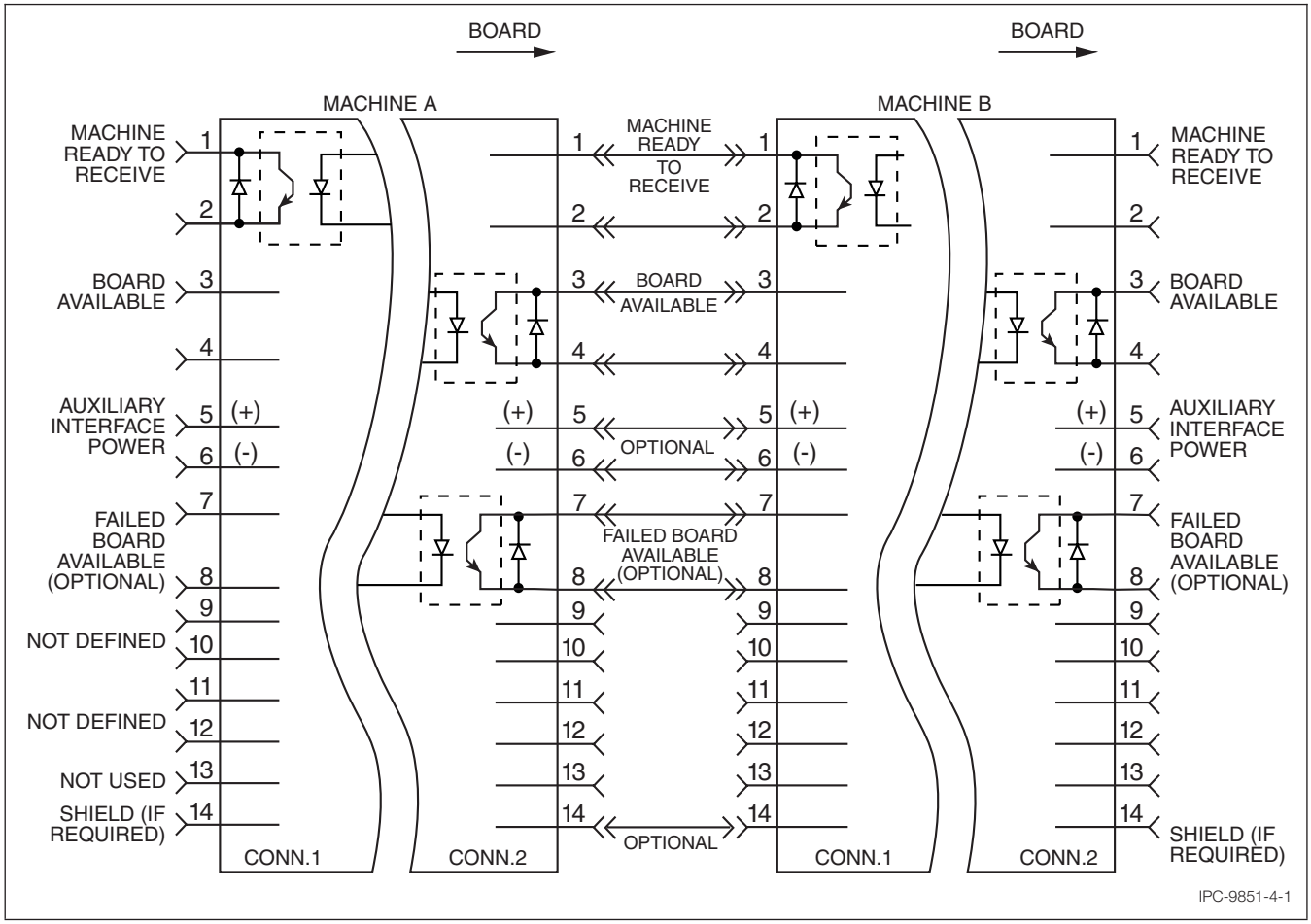

Figure 4-1 Electrical Interface Schematic

Table 4-1 Electrical Interface Connector/Cable Functional Description

Connector/Cable	Function	Condition	Description
Pair 1-2 (Note 1)	Machine Ready to Receive	Contacts Closed (Notes 2,3)	Machine is ready to receive next board.
Pair 3-4 (Note 1)	Board Available	Contacts Closed (Notes 2,3)	Machine has a good board ready to send. All boards are considered to be "good" if the Board Fail option is not being used.
Pair 5-6	Auxiliary Interface Power (optional)		Available; user to document purpose and operating parameters.
Pair 7-8 (Note 1)	Failed Board Available (Optional)	Contacts Closed (Notes 2,3)	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.
Pair 9-10	Not defined		Available; user to document purpose and operating parameters.
Pair 11-12	Not defined		Available; user to document purpose and operating parameters.
13	Not used	Not used	Not used.
14	Cable shield (Optional)		Cable shield attachment if required; follow good engineering practices (connect at only one end).

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.

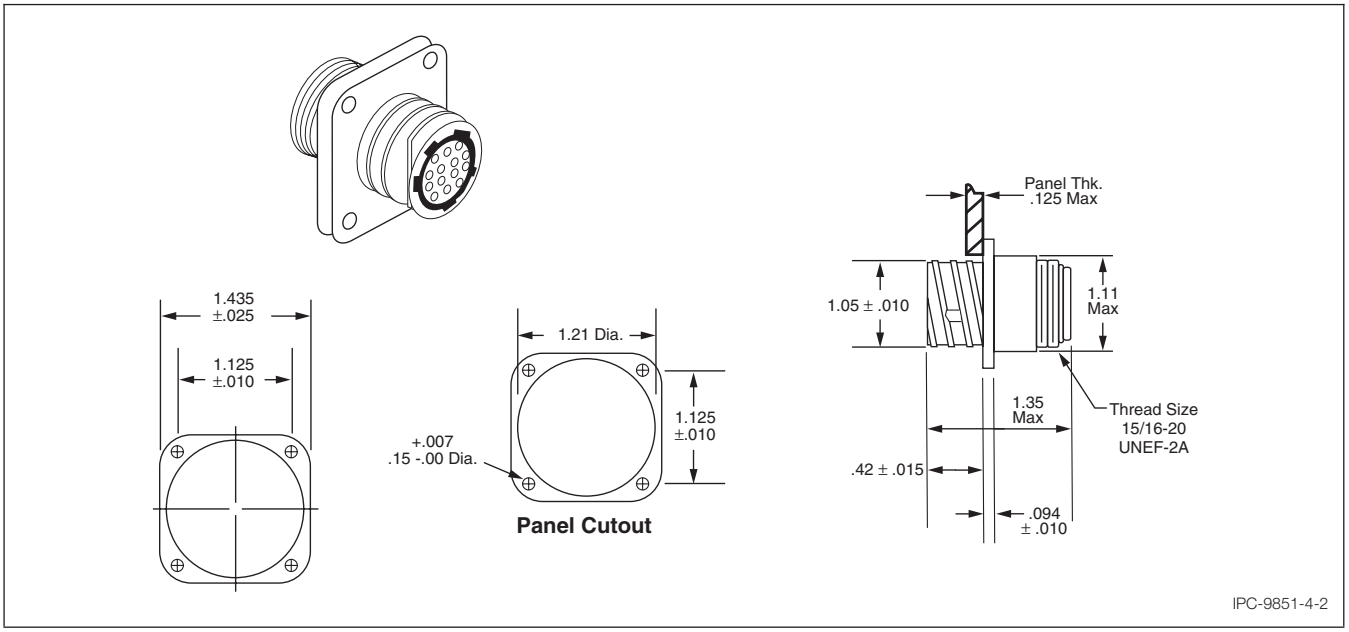

Figure 4-2 Square Flange Receptable, Accepts Multimate Sockets

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

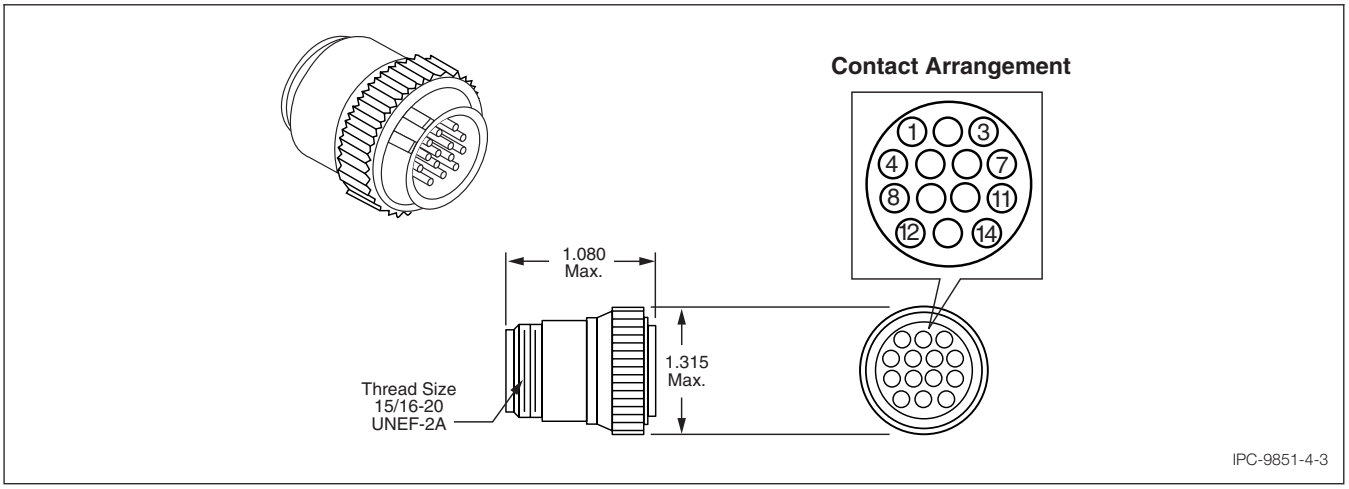

Figure 4-3 Cable Connector[1]

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

Board transfer occurs when Machine A has a BOARD AVAILABLE (contact closed), and Machine B is MACHINE READY TO RECEIVE (contact closed).
The signals can occur at any time, but board transfer does not occur until both contacts are closed.
The BOARD AVAILABLE signal from Machine A will remain closed until the board has left Machine A.
The MACHINE READY TO RECEIVE signal will remain closed until Machine B has positive control of the board.
Board transfer cannot occur again until each signal opens for at least 50 ms.
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).

Table 4-3 Timing

Time	Action/Condition
T_0	Up-line **board not available**; down-line **machine not ready to receive**.
T_1	Up-line machine has a **board available to send**; down-line **machine not ready to receive**.
T_2	Up-line machine has a **board available to send**; down-line **machine ready to receive, transfer** starts.
T_3 (variable)	Board has completely left control of up-line machine; still moving into down-line machine.
T_4	Transfer complete; down-line machine is completely in control of board. **Board not available**, down-line **machine not ready to receive**.
T_5	Up-line **board not available**, down-line **machine ready to receive**.
T_6	Up-line machine has a **board available to send**, down-line **machine ready to receive, transfer** starts.
T_7 (variable)	Board has completely left control of up-line machine; still moving into down-line machine.
T_8	Transfer complete; down-line machine is completely in control of board. **Board not available**, down-line **machine not ready to receive**.
T_9	Up-line **board not available**, down-line **machine ready to receive**.
T_{10}	Up-line machine has a **board available to send**, down-line **ready to receive, transfer** starts.

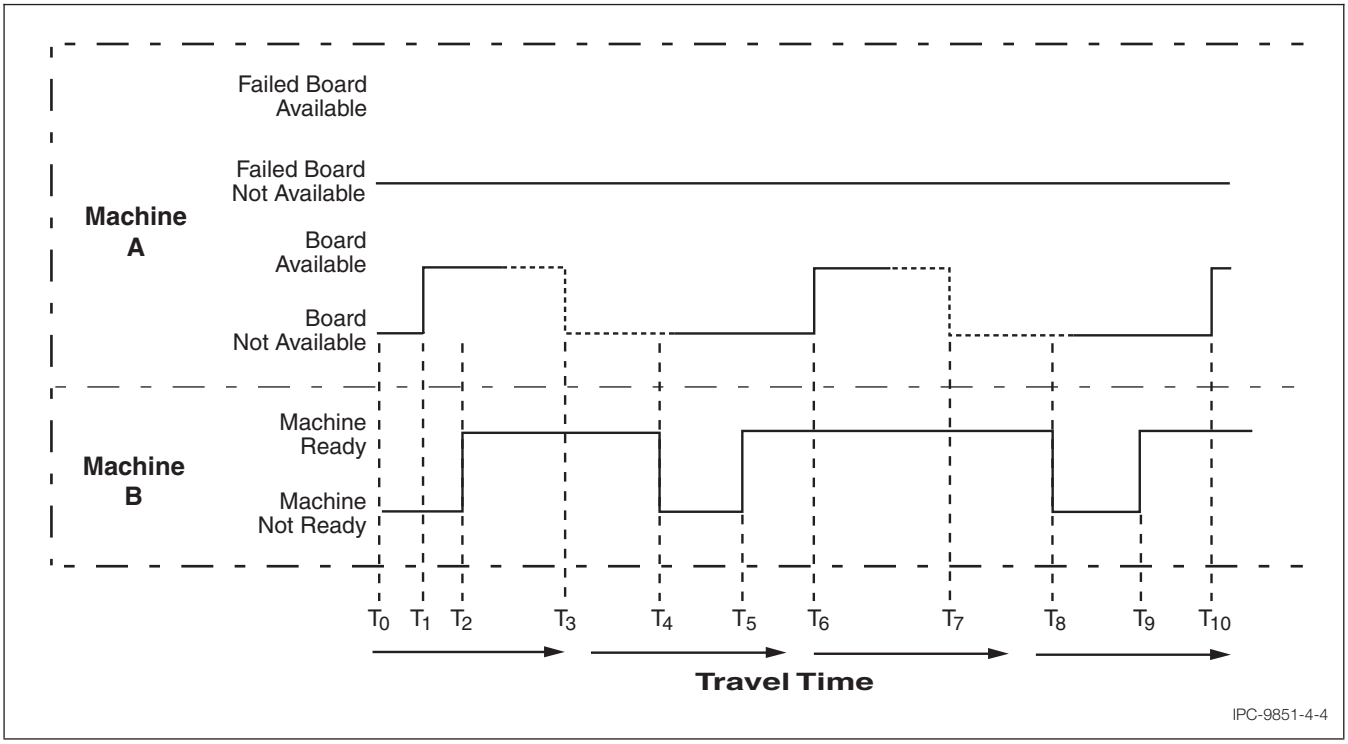

Figure 4-4 Timing Logic Diagram for Normal Transfer

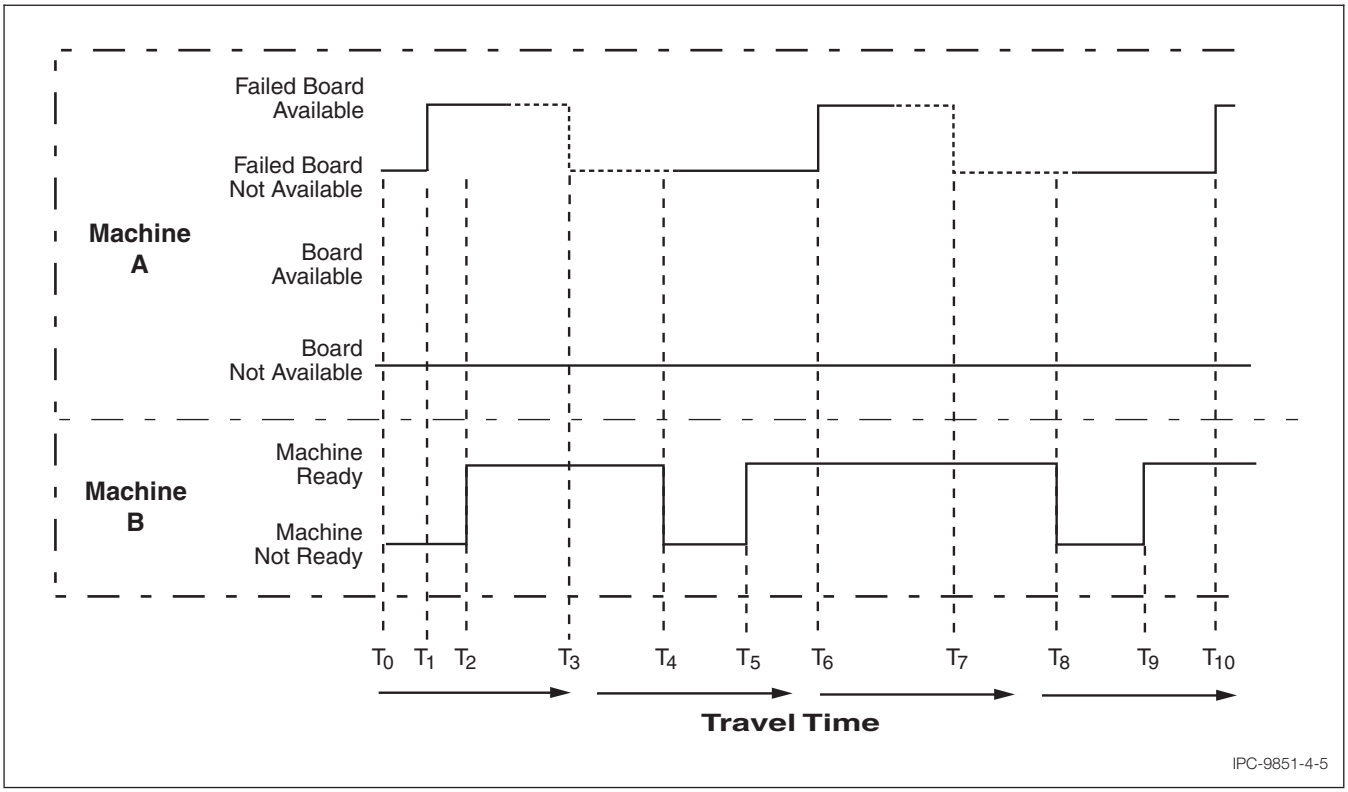

Figure 4-5 Timing Logic Diagram for Failed Board Option