IPC-2551

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International Standard for Digital Twins

An international standard developed by IPC

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Standard

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In May 1995 the IPC's Technical Activities Executive Committee (TAEC) adopted Principles of Standardization as a guiding principle of IPC's standardization efforts.

Standards Should:

- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

Standards Should Not:

- Inhibit innovation
- Increase time-to-market
- Keep people out
- Increase cycle time
- Tell you how to make something
- Contain anything that cannot be defended with data

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Thank you for your continued support.

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International Standard for Digital Twins

Developed by the Generic Requirements for Digital Twin Task Group (2-12a) of the Electronic Product Data Description Committee (2-10) of IPC

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

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International Standard for Digital Twins

1 SCOPE

This standard establishes the IPC Digital Twin, which is comprised of the Digital Twin Product, Digital Twin Manufacturing and Digital Twin Lifecycle frameworks. Within the Digital Twin Architecture, this standard stipulates and defines Digital Twin properties, types, complexities and readiness levels. The IPC Digital Twin includes historical information about a product, including the history of design in terms of revision and engineering changes, and manufacturing information, that may refer to as the Digital Thread.

This standard enables any manufacturer, design organization or solution provider to initiate application interoperability to create smart value chains, as well as the mechanism to assess their current IPC Digital Twin readiness level.

This standard provides the information and guidance necessary to understand a full IPC Digital Twin, Digital Twin Product, Digital Twin Manufacturing and Digital Twin Lifecycle. This standard also provides information and guidance on how organizations benefit from the IPC Digital Twin, how to assess IPC Digital Twin readiness level and how to prepare an organization of any size or production volume to implement a full IPC Digital Twin approach to its organization and/or products.

1.1 Purpose The purpose of the standard is to enable interoperability of all forms of processing of digital data related to a product, that precisely match and represents the physical capabilities. In this way, any manufacturer is able to create and utilize the IPC Digital Twin to represent every process and possible actions taken on a product within the manufacturing and lifecycle environment, for engineering, modelling, planning, quality and reliability analysis, simulations, etc. Critical decisions for product, process and material design can be optimized within the digital realm with the certainty that the expected performance and benefits will exist in the physical world. The effect is that physical prototypes of any description can be avoided, including trial and error, resulting in vastly reduced lead-time and costs, as well as elimination of mistakes.

1.2 Application of This Standard This standard is applicable to all aspects of the product lifecycle, from initial design concept, through the final end of life. All associated physical and transactional operations are included. There are no restrictions in terms of product classification sector, size of operation or location. SMT production is not required to be a part of the factory. Though intended to support all aspects of printed board production, the use of IPC CFX can be extended downstream to include, for example, mechanical assembly, personalization, packing and shipping, as well as up-stream to include, for example, electrical and mechanical subassembly.

1.3 Definition of Requirements The words **shall** or **shall not** are used in the text of this document wherever there is a requirement for materials, preparation, process control or acceptance.

The word ''should'' reflects recommendations and is used to reflect general industry practices and procedures for guidance only.

Line drawings and illustrations are depicted herein to assist in the interpretation of the written requirements of this Standard. The text takes precedence over the figures.

1.4 Order of Precedence The contract **shall** take precedence over this Standard, referenced standards and drawings.

In the event of conflict, the following order of precedence applies:

1. Procurement as agreed and documented between customer and supplier.
2. Master drawing reflecting the customer's detailed requirements.
3. When invoked by the customer or per contractual agreement, this standard.

When documents other than this standard are cited, the order of precedence **shall** be defined in the procurement documents.

The User has the opportunity to specify alternate acceptance criteria.