

IEEE Recommended Practices for the Implementation of a Metric Equipment Practice (IEEE Std 1301-1991)

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Abstract: Recommendations provide guidance in the implementation of the generic standard, IEEE Std 1301-1991, and the connector-related standards, such as IEEE Std 1301.1-1991 and IEEE Std 1301.3-1992. This recommended practice may be applied in all fields of electronics where equipment and installations are required to conform to a metric modular order. The IEEE 1301 metric equipment practices are in accordance with IEC 917 (1988) and IEC 917-0 (1989), including cabinet, rack, subracks, printed boards, and common connector-dependent dimensions for connector pitches of 2.5, 2.0, 1.5, 1.0, and 0.5 mm.

Keywords: backplane, cabinet, interchangeability, metric, microcomputer component dimensions, plug-in unit, printed board, rack, subrack

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Dedication

The members of the IEEE 1301 Working Group were saddened by the death of our chairman, Hans Karlsson, who passed away before the final publication of this standard. This publication is dedicated to his memory. Under his able leadership, the IEEE 1301 Metric Equipment Practices were conceived, written, and published in record time. This accomplishment was a direct result of the dedication, organizational abilities, and friendly persuasive powers of Hans Karlsson, who will be remembered always as the father of the IEEE Metric Equipment Practices.

Introduction

[This introduction is not a part of IEEE Std 1301.2-1993, IEEE Recommended Practices for the Implementation of a Metric Equipment Practice (IEEE Std 1301-1991).]

The Metric Equipment Practice Specifications, IEEE Std 1301-1991 and IEEE Std 1301.1-1991, have been used in several projects to solve packaging problems. Many questions have been generated by design engineers concerning the interpretations and use of various parameters specified in these documents. IEEE Std 1301.2-1993 answers many of the questions raised and also details interoperability with inch-based equipment practices.

Several individuals contributed in an outstanding way and deserve special mention. During the initial phases, Frank Hom, Elwood Parsons, Michael Thompson, and Joe Trainor were active participants. Valuable technical input was provided by Nobuaki Sugiura and Eike Waltz. Stan Evans, Jim Koser, David Moore, Peter Odell, and Gene Schramm contributed extensively both technically and editorially throughout the project.

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IEEE Recommended Practices for the Implementation of a Metric Equipment Practice (IEEE Std 1301-1991)

1. Overview

1.1 Scope and purpose

The purpose of this recommended practice is to give guidance in the implementation of the generic standard, IEEE Std 1301-1991,¹ and the connector-related standards, such as IEEE Std 1301.1-1991 and IEEE Std 1301.3-1992. This recommended practice may be applied in all fields of electronics where equipment and installations are required to conform to a metric modular order.

The IEEE 1301 metric equipment practices are in accordance with IEC 917 (1988) and IEC 917-0 (1989), including cabinet, rack, subracks, printed boards, and common connector-dependent dimensions for connector pitches of 2.5, 2.0, 1.5, 1.0, and 0.5 mm. The coordination dimensions given in IEEE Std 1301-1991, for heights, widths, and depths for a mechanical structure lie within a homogeneous, metric, modular, three-dimensional grid as specified in IEC 917 (1988). Applications of different connector families with pitches of 2.5, 2.0, 1.5, 1.0, and 0.5 mm developed from IEEE Std 1301-1991 must all accept the same backplane grid of 0.5 mm in order to standardize manufacturing and test equipment and allow the mixing of different connector families on the same backplane. Optimum conditions are thereby created for the application of computer-assisted methods throughout design and manufacturing, such as computer-assisted planning, development, manufacturing, testing, and installation.

1.2 Background

The need for a metric evolution to the IEC 297 and the IEEE 1101 equipment practices came from the desire to improve economical design and manufacture by using computer systems. Computer-aided engineering (CAE) systems operate to best advantage when dealing with a constant, three-dimensional grid. Both IEC 297 and IEEE Std 1101 use mixed units of inches and millimeters; hence, there is no common grid system.

IEC 917 (1988) was developed by the international electronics community specifically to take advantage of CAE systems. It uses a three-dimensional single grid system based on a smallest increment of 0.5 mm in accordance with

¹Information on references can be found in clause 2.

ISO 1000:1981. The metric system has been adopted by the majority of countries worldwide, including the USA (US Trade Law, Omnibus Trade Act, 1988). IEC 917 (1988) and IEC 917-0 (1989) form the generic standard from which all standards, such as IEEE Std 1301-1991, IEEE Std 1301.1-1991, and IEEE Std 1301.3-1992 are derived.

In the development of the IEEE 1301 series of standards, consideration has been given to the need for the following:

- a) Economic use of space; i.e., ability to achieve high-density packaging of electronics.
- b) Thermal engineering (cooling).
- c) EMC requirements.
- d) SMD on both sides of printed boards.
- e) Fewer restrictions on connector type; e.g., connector families with pin pitches based on increments of 0.5 mm, such as 1.0 mm, 1.5 mm, 2.0 mm, and 2.5 mm all can be used in the same equipment practice.
- f) Modular connector construction to give high pin counts. (Connector body modules of various lengths can be assembled together on a board edge to yield total pin counts in the hundreds.)
- g) Injector/ejectors to facilitate installation and removal of plug-in units with high pin counts.
- h) Interchangeability at the major interface level, e.g., plug-in units into subracks or subracks into racks or cabinets.
- i) Forward adaptation; e.g., the metric printed boards are larger than the inch-based system, hence, inch-based layouts can be adapted to a metric system with a minimum of rework.

1.3 Implementation

IEEE Std 1301-1991 specifies a number of equipment practice implementations. It contains all of the common detail information for cabinets and racks, rack front panels, subracks, backplanes, plug-in units, and plug-in unit injector/ejectors. This standard does not contain dimensions that are connector-related. These dimensions can be found in the detail standard pertaining to the particular connector family. For example, the combination of IEEE Std 1301-1991 and IEEE Std 1301.1-1991, with relevant connector details from EIA IS-64 (1991), are used for a complete equipment practice from the cabinet down to a 2 mm pitch connector. Note, however, that even at this level of detail specific products have not been fully defined.

Further implementations of IEEE Std 1301-1991, in combination with IEEE Std 1301.X and future connector specifications, will be used to create equipment practices for connectors having pitches of, for example, 2.5 mm, 1.5 mm, or 1 mm.

This standard is intended to give assistance to engineers using the existing IEEE Std 1301-1991, IEEE Std 1301.1-1991, and EIA IS-64 (1991) documents to generate products/profiles. This standard, IEEE Std 1301.2-1993, will also support future teams in developing detail standards for alternative connector families.

Note that the equipment practices specified in IEEE Std 1301-1991 are based on IEC 917 (1988), with a chosen coordination dimension of 25 mm. IEC 917 (1988) gives guidance on a selection of preferred sizes for equipment implementation.

Whenever practical in the implementation of these metric standards, dimensional details should reference the original document, i.e., either the latest version of IEEE Std 1301 or of IEEE Std 1301.X. When dimensions from the original documents are repeated, for clarity, in a profile or application document, a dimension should be made that they are for reference only and the origin should be defined, e.g., "Dimensional details shall be taken from IEEE 1301-1991."

1.4 Dimensions

All dimensions in this document are in millimeters in accordance with ISO 1000:1981 and ISO 31-1:1978 unless otherwise specified.

1.5 Coordination dimensions

IEEE Std 1301-1991 defines the actual dimensions of a 25 mm metric equipment practice. These actual dimensions are derived from coordination dimensions using the principles of boundary and axis references illustrated in IEEE Std 1301-1991 and IEC 917 (1988).

Overall dimensions and internal subdivisions are determined by using different increments or mounting pitches ($mp_1 = 25$ mm, $mp_2 = 5$ mm, $mp_3 = 2.5$ mm, and $mp_4 = 0.5$ mm).

The purpose of these standards is the specification of dimensions that will ensure mechanical interchangeability.

1.5.1 Dimensions of cabinets and racks

IEEE Std 1301-1991 covers a selection of coordination dimensions for a range of cabinets and racks conforming to IEC 917-2 (1992).

1.5.2 Dimensions of subracks and front panels

IEEE Std 1301-1991 covers a selection of coordination dimensions for a range of subracks and front panels conforming to IEC 917-2 (1992) for mounting in cabinets and racks.

1.5.3 Dimensions of plug-in units and printed boards

IEEE Std 1301-1991 covers a selection of coordination dimensions of plug-in units and printed boards conforming to IEC 917 (1988) for mounting in subracks.

1.5.4 Standardized dimensions

The sizes selected in the IEEE 1301 series of standards were derived by consensus of both manufacturers and end users in the working group.

1.6 Connector-related parameters

Connector-related parameters will be found in the relevant detail standard for a particular connector family; e.g., IEEE Std 1301.1-1991 defines the connector-related parameters for product interfaces for 2 mm pitch connectors, while IEEE Std 1301.3-1992 performs the same function for the 2.5 mm connectors.

1.7 Environmental requirements

It is not the intention of this specification to dictate design criteria to meet individual environmental requirements. It is the system designer's responsibility to ensure the selection of materials and construction methods adequate to meet the product requirements.

In the case of EMC, some guidance on the plug-in unit front panel design is given in IEEE Std 1301-1991. Again, material selection and detail design are left to the designer.

Performance levels and test criteria can be found in P1156.1, which lists the requirements for environmental stresses such as temperature, humidity, shock, vibration, flammability, ESD, fungus, etc. The majority of the tests are based on IEC Publication 68, which is a multipart document covering aspects of environmental testing.