

IEEE Mechanical Standard for Conduction-Cooled and Air-Cooled 10 SU Modules

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Abstract: The mechanical design requirements for conduction-cooled and air-cooled modules of the 10 SU by 6.375 in (161.9 mm) format are established. The specification of dimensions and tolerances is intended to ensure the mechanical intermateability of modules within associated subracks. The basic dimensions, frames, PWBs, materials, assembly, and chassis interface of singlesided and double-sided modules are covered.

Keywords: conduction, convection, direct air impingement, heatsink, printed wiring board (PWB)

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Introduction

(This introduction is not a part of IEEE Std 1101.3-1993, IEEE Mechanical Standard for Conduction-Cooled and Air-Cooled 10 SU Modules.)

The purpose of this standard is to provide instructions to organizations with respect to the requirements to be considered during the design of modules. This standard pertains to conduction-cooled and air-cooled modules. The conduction-cooled module assembly consists of components and a printed wiring board (PWB) or PWBs bonded to a heatsink or frame that has features that provide for insertion, extraction, chassis alignment, and thermal and structural management. The heatsink is a three-dimensional part requiring fine tolerances to provide for surface mount or through-hole component leads. This standard does not require this particular implementation. Other implementations that meet the mechanical intermateability specifications are permitted. The air-cooled module assembly consists of components and a PWB with a front panel that has features that provide for insertion, extraction, chassis alignment, and structural management.

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1. Overview

This standard is divided into five clauses. Clause 1 describes the scope and purpose of this standard as well as describes the environmental performance level and terminology used. Clause 2 lists references to other standards that form a part of this standard. Clause 3 provides definitions of terms. Clause 4, which is the heart of this standard, lists the various requirements for conduction-cooled and air-cooled 10 SU modules. Clause 5 gives suggestions, which are not requirements, but rather are provided as guidance in the design process.

Throughout this standard please note that subclause titles that end with “(CC)” indicate a requirement for conduction-cooled modules. Subclause titles that end with “(AC)” indicate a requirement for direct-air-impingement-cooled modules. Conduction-cooled requirements are always listed before air-cooled requirements.

1.1 Scope

This standard establishes the mechanical design requirements for conduction-cooled and air-cooled modules of the 10 SU by 6.375 in [161.9 mm] format. This standard is intended for use in conjunction with other IEEE standards.

1.2 Purpose

The purpose of this standard is the specification of dimensions and tolerances that will ensure the mechanical interchangeability of modules within associated subracks. This standard covers the basic dimensions, frames, PWBs, materials, assembly, and chassis interface of single-sided and double-sided modules.

1.3 Environmental performance level

The module shall meet one or more of the environmental performance levels specified in IEEE Std 1156.1-1993.¹ The required environmental performance level shall be specified by the procurement activity. This standard is primarily intended for military applications using performance levels 1 and 2 of IEEE Std 1156.1-1993, but does not exclude other applications using other performance levels.

¹Information on references can be found in clause 2..

1.4 Terminology

The word *shall* indicates a mandatory requirement. For example, “Designers shall implement all such mandatory requirements to ensure interoperability with other IEEE Std 1101.3-1993 conformant products.”

The word *should* indicates flexibility of choice with a strongly preferred implementation. The phrase *it is recommended* is used interchangeably with the key word *should*.

The word *may* indicates flexibility of choice with no implied preference.

2. References

The following documents form a part of this standard to the extent referenced herein. In the event of conflict between the documents referenced herein and the contents of this standard, the contents of this standard will be considered a superseding requirement. Nothing in this standard, however, supersedes applicable laws and regulations, unless a specific exemption has been obtained.

ANSI/IPC D-275-1991, Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies.²

ANSI/IPC RB-276-1992, Qualification and Performance Specification for Rigid Printed Boards.

ANSIY 14.5M-1982 (R1988), Dimensioning and Tolerancing.

EIA PN-2933-1992, Miniaturized Two-Part Blade-and-Tuning Fork Connector for Printed Wiring Boards and Backplanes.³

IEC 50, Second edition, International Electrotechnical Vocabulary, Terms and definitions for electronic packaging.⁴

IEEE Std 1156.1-1993, IEEE Standard for Microcomputer Environmental Specifications for Computer Modules.⁵

IEEE Std 1301-1991, IEEE Standard for a Metric Equipment Practice for Microcomputers—Coordinating Document (ANSI).

MIL-A-8625E, Anodic Coatings for Aluminum and Aluminum Alloys.⁶

MIL-HDBK-217E, Reliability Prediction of Electronic Equipment.

MIL-I-46058C, Insulating Compound, Electrical (For Coating Printed Circuit Assemblies).

MIL-P-50884C, Printed Wiring, Flexible and Rigid-Flex.

MIL-STD-130G, Identification Marking of U.S. Military Property.

²ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

³EIA publications are available from Global Engineering, 1990 M Street NW, Suite 400, Washington, DC, 20036, USA.

⁴IEC publications are available from IEC Sales Department, Case Postale 131, 3 rue de Varembe, CH-1211, Genève 20, Switzerland/Suisse. IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

⁵IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

⁶MIL and NAVSEA publications are available from the Director, U.S. Navy Publications and Printing Service, Eastern Division, 700 Robbins Avenue, Philadelphia, PA 19111, USA.

MIL-STD-202F, Test Methods for Electronic and Electrical Component Parts.

MIL-STD-454M, Standard General Requirements for Electronic Equipment.

MIL-STD-889B, Dissimilar Metals.

MIL-STD-2000A, Standard Requirements for Soldered Electrical and Electronic Assemblies.

MIL-STD-2036, General Requirements for Electronic Equipment Specifications.

MIL-STD-5400, General Requirements for Electronic Equipment, Airborne.

NAVSEA TE000-AB-GTP-010-1991, Parts Application and Reliability Information Manual for Navy Electronic Equipment.

3. Definitions

3.1 alpha end: The end of the module nearest the lowest-numbered connector contact.

3.2 alpha key: The connector keying pin located at the alpha end of the module connector.

3.3 beta end: The end of the module farthest from the lowest-numbered connector contact.

3.4 beta key: The connector keying pin located at the beta end of the module connector.

3.5 chassis: A subrack that is in accordance with IEC 50 -.

3.6 frame: *See: heatsink.*

3.7 gravitational acceleration unit (g): A unit of acceleration that is approximately 32.2 ft/s² [9.8 m/s²].

3.8 gamma key: The connector keying pin located at the center of the module connector, next to the guide pin.

3.9 guide pin: A pin used for guidance of the connector during module insertion and extraction.

3.10 guide rib: A rib provided for initial module alignment at the time of installation into the chassis module slot. For conduction-cooled modules only, guide ribs form the heat transfer paths to the chassis and the mounting for the module retainers at the alpha and beta ends of the module heatsink.

3.11 header: A structure attached to or integral to the top of the heatsink used for structural performance and marking.

3.12 heatsink: A part, also referred to as a frame, that serves both as a structural support and the principal thermal conduction medium. The PWB is attached to the heatsink. The heatsink spreads and conducts the heat from the components to the guide ribs (for conduction-cooled modules only). *Syn: frame.*

3.13 insertion/extraction levers: Mechanical levers used to provide a mechanical advantage during the insertion and extraction of a module to allow operation without tools. The insertion/extraction levers shall be part of each module.

3.14 interface plane: An assigned plane on the bottom surface of the module connector from which the connector's electrical pins protrude, thus forming the mating surface. This surface is used as a reference for module dimensions.

3.15 key code: An alpha or alphanumeric designator used to identify the style and angular position of the keying pins.

3.16 module: A plug-in unit per IEC 50.

3.17 module retainer/expansion element: The device used to secure the module in the chassis and to hold module guide ribs against the chassis webs to attain a thermal interface (for conduction-cooled modules only).

3.18 pitch: The center-to-center spacing between adjacent chassis module slots.

3.19 profile: The thickness of the module.

3.20 printed wiring board (PWB): A generic form that includes other interconnection boards.

3.21 side A: By convention, the side of the module closest to the connector “A” row, and the same side as the keying pins.

3.22 side B: By convention, the side of the module farthest from the connector “A” row, and the opposite side from the keying pins.

3.23 system unit (SU): The equipment reference increment mounting pitch equal to 25 mm. See IEEE Std 1301-1993 for module dimensioning definition.

3.24 through-board: This refers to the implementation of dual-in-line packages, axial-leaded devices, etc., into plated through-holes in a PWB. *Syn:* **through-hole.**

3.25 through-hole: *See:* **through-board.**

3.26 web: That portion of the chassis cold wall that extends between modules forming the module slot and providing a heat transfer path (for conduction-cooled modules only).

4. Requirements

4.1 General requirements

All figures shall be interpreted in accordance with ANSI Y14.5M-1982. All dimensions are in inches, with metric equivalents in millimeters shown in brackets []. Headers, crossovers, covers, frames, and test points are optional on modules, but shall fit within the overall module profile.

Table 1 lists the general requirements of conduction-cooled modules to air-cooled modules.

Table 1— General requirements for conduction-cooled and air-cooled modules

Requirement	Conduction-cooled module (CC)	Air-cooled module (AC)
<i>Mechanical characteristics</i>	This standard defines dimensions, connector and module slot requirements for single-sided and double-sided conduction-cooled modules of the nominal 10 SU by 6.375 in [161.9 mm] format. The conduction-cooled module consists of a PWB with retainers mounted to side B in the guide rib area, insertion levers mounted at the top of the module, and a connector mounted at the bottom of the module. The recommended implementation of this module uses a frame on which to mount the PWB(s). Note that this standard does not preclude other implementations that meet the interface requirements specified herein.	The standard defines dimensions, connector and module slot requirements for air-cooled modules of the nominal 10 SU by 6.375 in [161.9 mm] format (measured from the front panel/chassis mating surface to the module interface plane).
<i>Environmental</i>	The modules shall meet the environmental requirements of IEEE Std 1156.1-1993.	The modules shall meet the environmental requirements of IEEE Std 1156.1-1993.
<i>Electrical</i>	Connector pin-out assignments shall be specified by the appropriate application document. The use of fiber optic termini or coaxial contacts is allowed, but will reduce the electrical pin count.	Connector pin-out assignments shall be specified by the appropriate application document. The use of fiber optic termini or coaxial contacts is allowed, but will reduce the electrical pin count.
<i>Module retention</i>	This standard assumes the use of expansion elements, one each on the alpha and beta ends of the module, for retention in the chassis.	Modules shall use the front panel and associated hardware for module retention.
<i>Weight</i>	In general, module weight is limited by avionics applications and, to a lesser extent, by center of buoyancy requirements for surface ship and submarine packaging. In shore-based equipment, it may be a consideration for the center of gravity of the enclosures. Module weight should be consistent with the requirements of the program implementation and the environmental requirements herein and in IEEE Std 1156.1-1993.	In general, module weight is limited by avionics applications and to a lesser extent, by center of buoyancy requirements for surface ship and submarine packaging. In shore-based equipment, it may be a consideration for the center of gravity of the enclosures. Module weight should be consistent with the requirements of the program implementation and the environmental requirements herein and in IEEE Std 1156.1-1993.
<i>Thermal conduction cooling</i>	Modules shall be designed to be conduction cooled through the guide ribs and shall be capable of being cooled by the guide ribs with no other heat loss path. The expansion elements shall maintain a pressure consistent with the requirements stated herein to ensure a thermal path between the guide ribs and the chassis webs.	N/A
<i>Direct air-impingement cooling</i>	N/A	Modules shall be designed for cooling using air flow over the components from either the alpha end to the beta end or the beta end to the alpha end with no other heat loss path. Flow mass and pressure drop across the module(s) are to be evaluated for the performance level specified by the procurement activity.
<i>Module pitch</i>	This standard permits modules to be placed on a minimum pitch of 0.787 in [20 mm] center to center. This spacing accommodates the maximum module profile and provides additional space for module displacements during vibration and shock.	This standard permits air-cooled modules to be placed on a minimum pitch of 1.181 in [30 mm] center to center. This spacing accommodates the maximum module profile and provides additional space for module displacements during vibration and shock.