
Abstract: A generic standard that may be applied in all fields of electronics where equipment and installations are required to conform to the 482.6 mm (19 in) equipment practice based on IEEE 1101.1-1991, IEC 297-3 (1984), and IEC 297-4 (1995). Dimensions are provided that will ensure mechanical interchangeability of subracks and plug-in units.

Keywords: dimensions, mechanical interchangeability, plug-in units, subracks
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Introduction

(This introduction is not part of IEEE Std 1101.10-1996, IEEE Standard for Additional Mechanical Specifications for Microcomputers Using the IEEE Std 1101.1-1991 Equipment Practice.)

With the widespread acceptance of international (IEC) microcomputer architectures based on the Eurocard form factor, the IEEE Computer Society Technical Committee on Microcomputers and Microprocessors found it appropriate to form an IEEE standard to expand upon IEEE Std 1101.1-1991 and the IEC 297 series of standards, Dimensions of Mechanical Structures of the 482.6 mm (19 in) Series (IEC 297-1, IEC 297-3 and IEC 297-4).

This additional standard provides design engineers with the dimensions and tolerances necessary to ensure mechanical, electromagnetic compatibility (EMC), and electrostatic discharge (ESD) function compatibility. This additional standard will be in conformance with IEC Drafts 48D/1587-1 and 48D/1587-3.

This additional standard offers mechanical, EMC, and ESD system integration details. It offers advantages such as reduction in design and development time, manufacturing cost savings, and distinct marketing advantages.

This standard covers additional standardized dimensions of a range of EMC subracks and associated EMC plug-in units, injector, extractor and keying device handles for plug-in units and associated subracks, printed board backplane related dimensions for the IEC 603-2 Type C, 3-row and expanded 5-row connector series and a plug-in unit/subrack ESD protection concept.

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1. Overview

1.1 Scope

This generic standard may be applied in all fields of electronics where equipment and installations are required to conform to the 482.6 mm (19 in) equipment practice based on IEEE Std 1101.1-1991, IEC 297-3 (1984), and IEC 297-4 (1995).

1.1.1 Dimensions of electromagnetic compatibility (EMC) subracks and associated EMC plug-in units

This standard covers additional dimensions for a range of modular EMC subracks based on IEEE Std 1101.1-1991, IEC 297-3 (1984), and IEC 297-4 (1995) for mounting in equipment according to ANSI/EIA 310-D and IEC 297-1 (1988), together with the basic additional dimensions of a compatible range of EMC plug-in units. This standard covers additional requirements as proposed in IEC 48D /1587-3.

1.1.2 Dimensions for plug-in unit injector and extractor handles


1.1.3 Dimensions for plug-in unit keying


1 Information on references can be found in Clause 2.
1.1.4 Dimensions for electrostatic discharge (ESD) protection


1.1.5 Alignment pin


1.1.6 Protective solder side PB covers


1.1.7 Dimensions for printed boards and backplanes using IEC 603-2 (1995) Type C 3-row and expanded 5-row connectors


1.1.8 Dimensions for Printed Boards and Backplanes using center mounted connectors


1.2 Purpose


NOTE — IEEE Std 1101.1-1991, IEC 297-3 (1984), and IEC 297-4 (1995) subrack systems not complying with these additional standard requirements have limited compatibility.

2. References

The following publications should be used in conjunction with this standard. When a standard is superseded by an approved revision, the revision shall apply.

ANSI/EIA 310-D-1992, Racks, Panels and Associated Equipment.²

ANSI/VITA 1-1994 VME64 Specification


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

IEC 50, International Electrotechnical Vocabulary.³


IEC 297-3 (1984), Dimensions of mechanical structures of the 482.6 mm (19 in) series. Part 3: Subracks and associated Plug-In Units.


IEC 603-2 (1995), Connectors for frequencies below 3 MHz for use with printed boards—Part 2: Detail-specification for two-part connectors with assessed quality, for printed boards, for basic grid of 2.54 mm (0.1 in) with common mounting features.

IEC 821 (1991), VMEbus—Microprocessor system bus for 1 byte to 4 byte data


IEC 48D/1587-1, Mechanical aspects/climatic tests for Cabinets, Racks and Subracks for the IEC 917-… and the IEC 297-… Series.⁴

IEC 48D/1587-3, Electromagnetic shielding performance tests for Cabinets Racks and Subracks for the IEC 917-… and the IEC 297-… Series.⁵


IEEE P1386 (Draft 2, April 1995), Common Mezzanine Card Family: CMC.⁷

IEEE P1386.1 (Draft 2 April 1995), Physical/Environmental Layers for PCI Mezzanine Cards: PMC.

ISO 1101:1983, Technical drawings—Geometrical tolerancing—Tolerancing of form orientation, location and run-out—Generalities, definitions, symbols, indications on drawings.⁸

PICMG, CompactPCI Specification.⁹

VITA - 1X- 199X, VIPA Specifications¹⁰

VITA - 1.1-199X, VME64 Extensions Specifications.

³IEC publications are available from IEC Sales Department, Case Postale 131, 3, rue de Varembé, CH-1211, Geneève 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.

⁴Presently at the Draft stage. Contact the IEC for information on its current status.

⁵Presently at the Draft stage. Contact the IEC for information on its current status.

⁶IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

⁷Numbers preceded by P are IEEE authorized standards projects that were not approved by the IEEE Standards Board at the time this publication went to press. For information about obtaining drafts, contact the IEEE.

⁸ISO publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse. ISO 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.

⁹This document is available from Rogers Communications, 301 Edgewater place, Suite 220, Wakefield, MA 01880, USA.

¹⁰VITA publications are available from VFÉA International Trade Association, 7825 E. Gelding Dr., Suite 104, Scottsdale, AZ 85260, USA.
3. Terminology

3.1 Abbreviations

The following abbreviations are used in this standard:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>EMC</td>
<td>Electromagnetic Compatibility</td>
</tr>
<tr>
<td>ESD</td>
<td>Electrostatic Discharge</td>
</tr>
<tr>
<td>HP</td>
<td>Horizontal Pitch of 5.08 mm (See IEEE Std 1101.1-1991)</td>
</tr>
<tr>
<td>mm</td>
<td>Millimeter</td>
</tr>
<tr>
<td>n</td>
<td>N x 5.08 ± 0.1</td>
</tr>
<tr>
<td>N</td>
<td>Multiples of</td>
</tr>
<tr>
<td>PB</td>
<td>Printed Board (See IEC 50)</td>
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<tr>
<td>U</td>
<td>Units of 44.45 mm (1.75 in) [See ANSI/EIA-310D-1992 and IEC 297-1 (1986)]</td>
</tr>
<tr>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>I/O</td>
<td>Input/Output</td>
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</table>

3.2 Special word usage

*may:* A key word indicating flexibility of choice with no implied preference.

*shall:* A key word indicating a mandatory requirement. Designers shall implement such mandatory requirements to ensure interchangeability and to claim conformance with the specification.

*should:* A key word indicating flexibility of choice with a strongly preferred implementation.

*complementary:* A keyword indicating that there is no standard as yet defined but product is in design or is available and relate to the referred standard, yet may differ or expand mechanically and/or electrically in certain areas of the standard.
4. General arrangement

Generally, subracks featuring EMC, ESD, injector/extractor handle, plug-in unit, and keying compliance, are equipped with a range of compatible filler panels and/or compatible plug-in units.

NOTES

1—The drawings in this specification are not intended to indicate details of design. All dimensions are given in millimeters.

2—All drawings in this specification are shown in first angle projection according to ISO 1101. ( ) dimensions are for reference only.

3—Terminology is as per IEC 50 and IEC 916.

Figure 1—General arrangement

5. EMC

EMC subracks and plug-in units are designed to maintain an EMC environment compatible with IEC 48D /1587-3 Electromagnetic shielding performance tests for cabinets, racks and subracks for the IEC 917 -… and the IEC 297 -… series. See 5.1.
5.1 EMC subrack

EMC subrack dimensions are as illustrated in Figure 2. The following conditions shall be observed:

a) All gaskets, contacts, and contact surfaces shall be electrically conductive.
b) The mating surfaces of the EMC subrack and the EMC plug-in unit front panels and/or EMC filler panels shall be conductive.
c) Under worst condition performance, the mating contacts of the EMC and ESD plug-in units and subracks may be related to the application specific chosen connector performance requirements or specified in application-specific standards.
d) All subrack and plug-in unit contact surfaces shall be connected to a common subrack ground.

Figure 2—EMC subrack dimensions
5.2 EMC filler panels

EMC filler panels are as illustrated in Figure 3.

Figure 3—EMC filler panel dimensions
5.3 EMC plug-in unit front panels

EMC plug-in unit front panels are as illustrated in Figure 4. Plug-in unit injector/extractor handles (see Clause 8.) are not shown.

Figure 4—EMC plug-in unit front panel dimensions
5.4 EMC front panel/PB relationship

EMC front panel/PB relationship is as illustrated in Figure 5.


Figure 5—EMC plug-in unit 4 HP front panel and printed board relationship
6. Keying and alignment pin

Keying and alignment are closely related, yet can be separated (3 HP provides only for keying, 4 HP provides for keying and alignment).

This keying feature is designed for board type plug-in units with a minimum width of 4 HP:

(20.32 mm = 4 \times 5.08 = 4 \times 0.2 \text{ in}). This keying feature is suitable for 3U, 6U, and 9U subrack heights.

This keying feature provides four keying combinations when keys are used.

This keying feature provides for a standardized designation of keying combinations.

This keying feature can be an integral part of the subrack front member or separate guide rail. The counterpart in the board type plug-in unit can be an integral part of the board type plug-in unit or an add-on part to the board type plug-in unit.

The purpose of the alignment pin is as follows:

a) To “lift” the PB to ensure parallel connector mating prior to connector engagement;

b) To provide solid/protected keying;

c) To provide for a front panel ESD contact (optional);

d) To ensure EMC front panel alignment.
6.1 General arrangement with keying and alignment

General arrangement with keying and alignment is as illustrated in Figure 6.

Figure 6—Board type plug-in unit keying concept
6.2 Keying and alignment pin—dimensional relationship

The keying and alignment pin's dimensional relationship is as illustrated in Figure 7.

Figure 7— Alignment pin and keying chambers for board type plug-in units
6.3 Keying dimensions—receptacles

Key position dimensions for subrack and plug-in unit are as shown in Figures 8 and 9.

![Figure 8 — Key in Subrack without Plug-In Unit](image)

![Figure 9 — Key in plug-in unit and subrack assembly](image)
6.4 Key dimensions

The purpose of these keys is that they are removable, replaceable, and user programmable, as illustrated in Figure 10.

Figure 10—Programming key
6.5 Programming of keys

This keying concept permits a total of 4096 programming possibilities at six keying chambers, as illustrated in Figure 11.
6.6 Alignment pin test dimensions

Alignment pin test dimensions are as illustrated in Figure 12.

Figure 12—Subrack and board type plug-in unit alignment pin and keying chamber test dimensions
7. Protective solder side cover

Protective solder side covers may be required when inserting an EMC plug-in unit into an EMC subrack. The cover is used to prevent accidental contact of conductive components or solder leads with neighboring plug-in units. Note that the EMC gaskets of the board type plug-in units are permitted to overlay the pitch line by 1 mm. The solder side cover is also protecting the EMC gasket, as is illustrated in Figure 13.

![Figure 13— Protective solder side cover](image-url)
8. Plug-in unit injector/ejector handles

Both the plug-in unit and the corresponding subrack detail require compatible dimensioning. This injector/ejector specification is suitable to inject/extract plug-in unit's connectors with a force up to 700 N.

8.1 Subrack dimensions

Subrack dimensions are as illustrated in Figure 14.

![Figure 14 — Subrack dimensions suitable for plug-in units with injector / extractor handles](image)
8.2 Injector and extractor handle detail

Injector and extractor handle detail is as illustrated in Figure 15.
8.3 Plug-in unit injector/ejector handle front panel component space

The minimum width of this injector/ejector handle may be 3 HP (if no alignment pin is required), 4 HP (with alignment pin, see Figure 7), as is illustrated in Figure 16. The usable component space is defined in IEEE Std 1101.1-1991.

Figure 16—Usable component space on 3U/6U/9U plug-in unit front panels with injector and extractor handles
9. ESD protection

An electrostatic discharge clip shall be embedded inside and close to the front of the guide rails, for making early as possible contact with a discharge strip on one or both, the upper and/or lower edge of the Plug-in Unit Printed Board (see Note). The discharge clip in the guide rail shall be connected to the Subrack GND. The discharge clips and the corresponding discharge strips on the Plug-in Unit Printed Board shall provide for a continuous contact until the Plug-in Unit is fully engaged into the Subrack mounted connector.

Pending application the discharge clips and the discharge strips shall maintain ESD contact while the connector is engaged or shall break ESD contact before the connector is engaged. A resistor may be required between the ESD discharge strips and the Plug-in Unit power return to limit the discharge current (0 Vdc). See NOTES under 5.1.

NOTE — The guide rail discharge clips shall make ESD contact to discharge strips which are on the component side of the PB, either top or bottom of the PB or both.

9.1 Electrostatic discharge design requirements

9.1.1 Maintaining ESD contact during connector engagement

Maintaining ESD contact during connector engagement is as illustrated in Figure 17.

![Figure 17— ESD plug-in unit dimensions maintaining ESD contact during connector engagement](image-url)
9.1.2 Breaking ESD contact before connector engagement

Breaking ESD contact before connector engagement is as illustrated in Figure 18.

NOTE—The guide rail discharge clips shall make ESD contact to discharge strips that are on the component side of the PB, either top or bottom of the PB, or both.

Figure 18—ESD plug-in unit dimensions breaking ESD contact before connector engagement
9.1.3 Subrack ESD contact position

Subrack ESD contact position is as illustrated in Figure 19.

NOTE—The guide rail discharge clips shall make ESD contact to discharge strips that are on the component side of the PB, either top or bottom of the PB, or both.

Figure 19—Guide rail ESD clip contact area
10. Plug-in unit printed boards and backplanes using IEC 603-2 Type C, 3-row and expanded 5-row connectors

10.1 Printed board dimensions

Printed board dimensions are as illustrated in Figures 20-22.

![Diagram](image_url)

**NOTES**

1—This connector pattern refers to IEC 603-2 (1995-09) Type C, 3-row and expanded 5-row connectors, but these standards do not indicate tolerances for PCBs.

2—Use fixtures to mount connectors if required.

**Figure 20—3U plug-in unit printed board with typical IEC 603-2 Type C, 3-row and expanded 5-row connector pin layout**
Figure 21—6U plug-in unit printed board with typical IEC 603-2 Type C, 3-row and expanded 5-row connector pin layout

NOTES

1—This connector pattern refers to IEC 603-2 (1995-09) Type C, 3-row and expanded 5-row connectors, but these standards do not indicate tolerances for PCBs.

2—Use fixtures to mount connectors if required.
Figure 22—9U plug-in unit printed board with typical IEC 603-2 (1995-09) Type C, 3-row and expanded 5-row connector pin layout

NOTES

1—This connector pattern refers to IEC 603-2 (1995-09) Type C, 3-row and expanded 5-row connectors, but these standards do not indicate tolerances for PCBs.

2—Use fixtures to mount connectors if required.
10.2 Backplane dimensions

Backplane dimensions are as illustrated in Figures 23-25.

Figure 23—3U backplane with typical IEC 603-2 (1995-09) Type C, 3-row and expanded 5-row connector pin layout
NOTES
1—Use fixtures to mount connectors if required.
2—For backplane flatness, bow, and rigidity, the tolerances of dc as specified in IEEE Std 1101.1-1991, IEC 297-3 (1984), and IEC 297-4 (1995) apply for both static and dynamic calculations.

Figure 24—6U backplane with typical IEC 603-2 Type C, 3-row and expanded 5-row connector pin layout
NOTES

1—Use fixtures to mount connectors if required.

2—For backplane flatness, bow, and rigidity, the tolerances of dc as specified in IEEE Std 1101.1-1991, IEC 297-3 (1984), and IEC 297-4 (1995) apply for both static and dynamic calculations.

Figure 25—9U backplane with typical IEC 603-2 Type C, 3-row and expanded 5-row connector pin layout
11. Plug-in unit boards and subrack backplanes using center connectors compatible to IEC 603-2 Type C, 3-row and expanded 5-row connector

11.1 Printed board dimensions

Printed board dimensions are as illustrated in Figures 26 and 27.

NOTES

1—This connector pattern refers to IEC 603-2 (1995-09) Type C, 3-row and expanded 5-row connectors, but these standards do not indicate tolerances for PCBs.

2—Use fixtures to mount connectors if required.

Figure 26—6U plug-in unit printed board pin layout for a center-mounted connector compatible to IEC 603-2 Type C, 3-row and expanded 5-row
Figure 27—9U plug-in unit printed board pin layout for a center-mounted connector compatible to IEC 603-2 (1995-09) Type C, 3-row and expanded 5-row connectors.
11.2 Backplane dimensions

Backplane dimensions are as illustrated in Figures 28 and 29.

Figure 28— 6U backplane pin layout for a center-mounted connector compatible to IEC 603-2 (1995-09) Type C, 3-row and expanded 5-row

NOTES
1—Use fixtures to mount connectors if required.
2—For backplane flatness, bow, and rigidity, the tolerances of dc as specified in IEEE Std 1101.1-1991 IEC 297-3 (1984), and IEC 297-4 (1995) apply for both static and dynamic calculations.
NOTES

1—Use fixtures to mount connectors if required.

2—For backplane flatness, bow, and rigidity, the tolerances of dc as specified in IEEE Std 1101.1-1991, IEC 297-3 (1984), and IEC 297-4 (1995) apply for both static and dynamic calculations.

Figure 29—9U backplane pin layout for a center mounted connector compatible to IEC 603-2 (1995-09) Type C, 3-row expanded 5-row connector