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(Revision of
IEEE Std 1101.1-1991)

IEEE Standard for Mechanical Core Specifications for Microcomputers Using IEC 60603-2 Connectors

Sponsor

Microprocessor and Microcomputer Standards Subcommittee of the IEEE Computer Society

Approved 28 September 1998

IEEE-SA Standards Board

Abstract: The basic dimensions of a range of modular subracks conforming to IEC 60297-3 (1984-01) and IEC 60297-4 (1995-03) for mounting in equipment according to IEC 60297-1 (1986-09) and ANSI/EIA 310-D-1992, together with the basic dimensions of a compatible range of plug-in units, printed boards, and backplanes, are covered. The dimensions and tolerances necessary to ensure mechanical function compatibility are provided. This standard offers total system integration guidelines with attendant advantages, such as reduction in design and development time, manufacturing cost savings, and distinct marketing advantages.
Keywords: compatibility, mechanical interchangeability, plug-in units, subracks

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Introduction

(This introduction is not a part of IEEE Std 1101.1-1998, IEEE Standard for Mechanical Core Specifications for Microcomputers Using IEC 60603-2 Connectors.)

With the introduction of international (IEC) microcomputer architectures based on the "Euroboard form factor," the IEEE Computer Society Technical Committee on Microprocessors and Microcomputers found it appropriate to form a separate IEEE standard to expand upon the IEC 60297 series of standards, Dimensions of mechanical structures of the 482.6 mm (19 in) series. (See Clause 3 of this standard.)

This standard provides design engineers with the dimensions and tolerances necessary to ensure mechanical function compatibility. This standard also provides environmental specifications as an addendum to IEC 60297-3 (1984-01).

This mechanical standard offers total system integration guidelines. It offers advantages such as reduction in design and development time, manufacturing cost savings, and distinct marketing advantages.

This standard covers standardized dimensions of a range of modular subracks and a compatible range of plug-in units, printed boards, backplanes, and connectors.

This standard was revised from IEEE Std 1101.1-1991.

At the time that the revision was completed, the P1101.1 Working Group had the following membership:

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IEEE Standard for Mechanical Core Specifications for Microcomputers Using IEC 60603-2 Connectors

1. Scope

1.1 Basic dimensions of subracks

This standard covers the basic dimensions of a range of modular subracks conforming to IEC 60297-3 (1984-01) and IEC 60297-4 (1995-03) for mounting in equipment according to IEC 60297-1 (1986-09) and ANSI/EIA 310-D-1992, together with the basic dimensions of a compatible range of plug-in units, printed boards, and backplanes.

1.2 Dimensions of plug-in units

This standard will give the dimensions of associated plug-in units and connector-mounting details together with applicable detail dimensions of the subrack.

1.3 Environmental requirements of subracks

This standard will state environmental requirements of subracks and their associated plug-in units.

2. Purpose

The purpose of this standard is the specification of dimensions that will ensure the mechanical interchangeability and environmental requirements of subracks and of plug-in units.

3. References

The following publications shall be used in conjunctions with this standard. When they are superseded by an approved revision, the revision shall apply.

ANSI/EIA 310-D-1992: Racks, Panels, and Associated Equipment.[1]

[1]ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (www.ansi.org/).

CFR (Code of Federal Regulations), Title 47: Telecommunications, Part 15J, published by Office of the Federal Register (FCC Rules and Regulations are contained within this document).[2]

IEC 60068-2-1 (1990-05), Environmental testing—Part 2: Tests. Tests A: Cold.[3]

IEC 60068-2-2 (1974-01), Environmental testing—Part 2: Tests. Test B: Dry Heat.

IEC 60068-2-6 (1995-03), Environmental testing—Part 2: Tests. Test Fc: Vibration (sinusoidal).

IEC 60068-2-11 (1981-01), Environmental testing—Part 2: Tests. Test Ka: Salt mist.

IEC 60068-2-27 (1987-06), Environmental testing—Part 2: Tests. Test Ea and guidance: Shock.

IEC 60097 (1991-05), Grid systems for printed circuits.

IEC 60249-2-1 (1985-01), Base materials for printed circuits. Part 2: Specifications. Specification No. 1: Phenolic cellulose paper copper-clad laminated sheet, high electrical quality.

IEC 60249-2-2 (1985-01), Base materials for printed circuits. Part 2: Specifications. Specification No. 2: Phenolic cellulose paper copper-clad laminated sheet, economic quality.

IEC 60249-2-3 (1987-04), Base materials for printed circuits. Part 2: Specifications. Specification No. 3: Epoxide cellulose paper copper-clad laminated sheet of defined flammability (vertical burning test).

IEC 60249-2-4 (1987-06), Base materials for printed circuits. Part 2: Specifications. Specification No. 4: Epoxide woven glass fabric copper-clad laminated sheet, general purpose grade.

IEC 60249-2-5 (1987-06), Base materials for printed circuits. Part 2: Specifications. Specification No. 5: Epoxide woven glass fabric copper-clad laminated sheet of defined flammability (vertical burning test).

IEC 60297-1 (1986-09), Dimensions of mechanical structures of the 482.6 mm (19 in) series. Part 1: Panels and racks.

IEC 60297-3 (1984-01), Dimensions of mechanical structures of the 482.6 mm (19 in) series. Part 3: Subracks and associated plug-in units.

IEC 60297-4 (1995-03), Mechanical structures of electronic equipment—Dimensions of mechanical structures of the 482.6 mm (19 in) series. Part 4: Subracks and associated plug-in units—Additional dimensions.

IEC 60603-2 (1995-09), 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 60651 (1979-01), Sound level meters.

IEC 60707 (1981-01), Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source.

IEC 61010-1 (1990-09), Safety requirements for electrical equipment for measurement, control, and laboratory use—Part 1: General requirements.[4]

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[2]CFR publications are available from the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20013-7082, USA.

[3]IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3, rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (www.iec.ch/). IEC publications are also available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (www.ansi.org/).

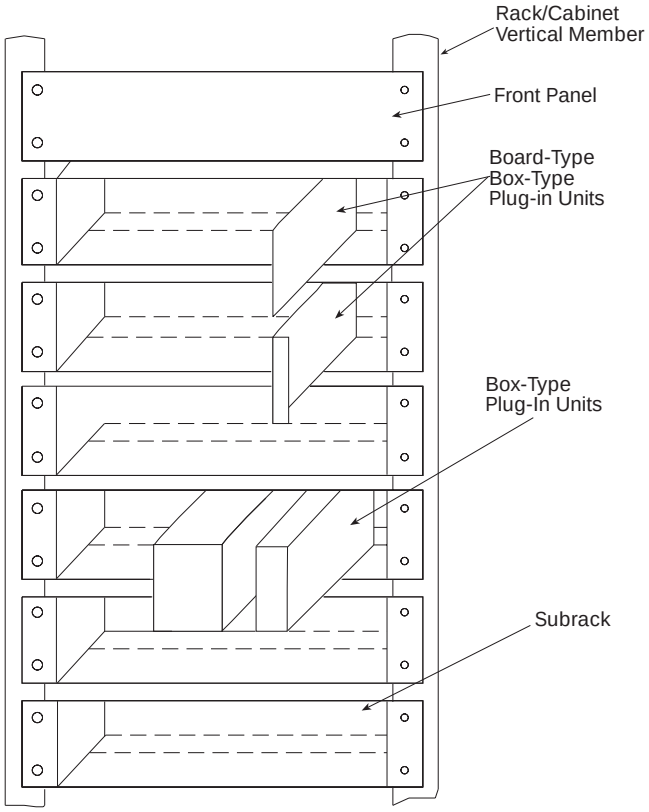
[4]IEC 61010-1 (1990-09) replaces withdrawn standard IEC 60348 (1978).

IEEE Std 1101.10-1996, IEEE Standard for Additional Mechanical Specifications for Microcomputers Using the IEEE 1101.1-1991 Equipment Practice.[5]

IEEE 1101.11-1998, IEEE Standard for Mechanical Rear Plug-in Units Specifications for Microcomputers Using the IEEE 1101.1 and the IEEE 1101.10 Equipment Practice.

4. General arrangement

Subracks may be mounted one above another or in combination with suitable instruments and panels in equipment complying with the rack and panel dimensions given in IEC 60297-1 (1986-09) and ANSI/EIA 310-D-1992. See Figure 1.



NOTES
1—Generally, subracks are equipped with printed board or rack-and-panel-type connectors at the rear side, and have guides for locating or supporting, or both, printed boards or plug-in units.
2—In principle, the connector is mounted on the right side of the printed board as viewed from the front of the subrack.
3—Table 5 defines the dimensions required for mechanical interchangeability of plug-in units.
4—The drawings in this standard are not intended to indicate details of design. All dimensions are given in millimeters (with inches in parentheses).
5—All drawings in this standard are shown in the first angle projection according to ISO 1101: 1983 [B3].
6—Terminology is as per IEC 60917-1 (1998-09) [B2] and IEC 60050 [B1].

Figure 1—General arrangement

[5]IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (www.standards.ieee.org/).

5. Euroboard matrix

See Figure 2.

All references to board heights in this document are in units of, and increments of, 3U (133.35 mm, or 5.25 in). A board commonly called single height can be housed in a 3U-high subrack or box-type plug-in unit and may have a single connector [see IEC 60603-2 (1995-09)] on its rear edge.

— A 3U-high subrack commonly houses a single-height board.
— A 6U-high subrack commonly houses a double-height board.
— A 9U-high subrack commonly houses a triple-height board.

NOTES
1— For 6U- and 9U-high configurations, the use of fixtures to mount the connectors will be required to guarantee intermateability.
2—Board heights may be incremented in units of 133.35 mm (5.25 in) after the initial 100 mm (3.937 in).

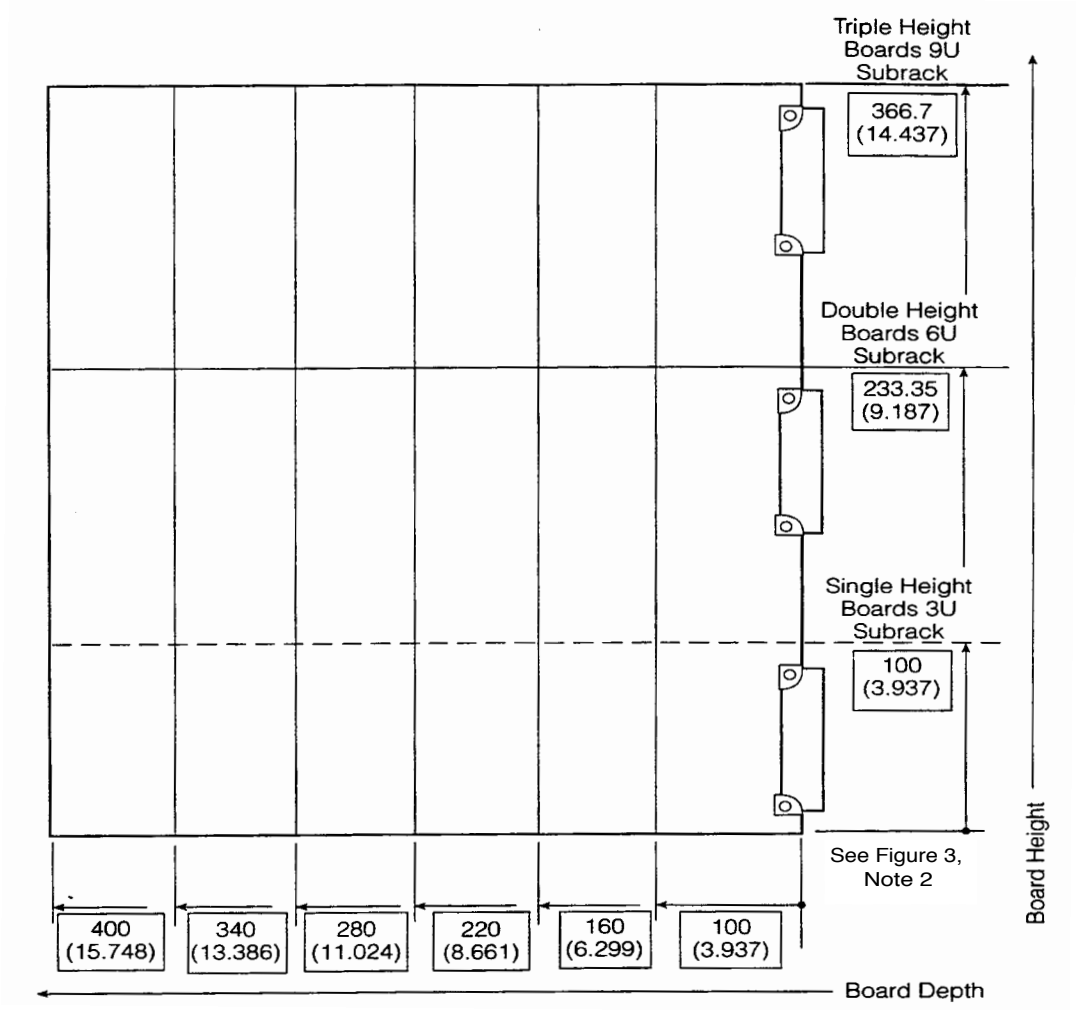


Figure 2—Euroboard matrix

6. Euroboard sizes

Table 1 and Table 2 show a selected range of Euroboard sizes from IEC 60297-3 (1984-01).

6.1 Euroboard height

Table 1—Euroboard height

Reference-U	3	6	9
Printed board height H_b +0/–0.3 (+0/–0.012) see Clause 5, Note 2	100.00 mm (3.937 in)	233.35 mm (9.187 in)	366.70 mm (14.437 in)

6.2 Euroboard depth

Table 2—Euroboard depth

Printed board depth D_b +0/–0.3 (+0/–0.012)	100 mm (3.937 in)	160 mm (6.299 in)	220 mm (8.661 in)	280 mm (11.024 in)	340 mm (13.386 in)	400 mm (15.748 in)
D_a ±0.1 (±0.004)	93.67 mm (3.688 in)	153.67 mm (6.050 in)	213.67 mm (8.412 in)	273.67 mm (10.774 in)	333.67 mm (13.137 in)	393.67 mm (15.499 in)

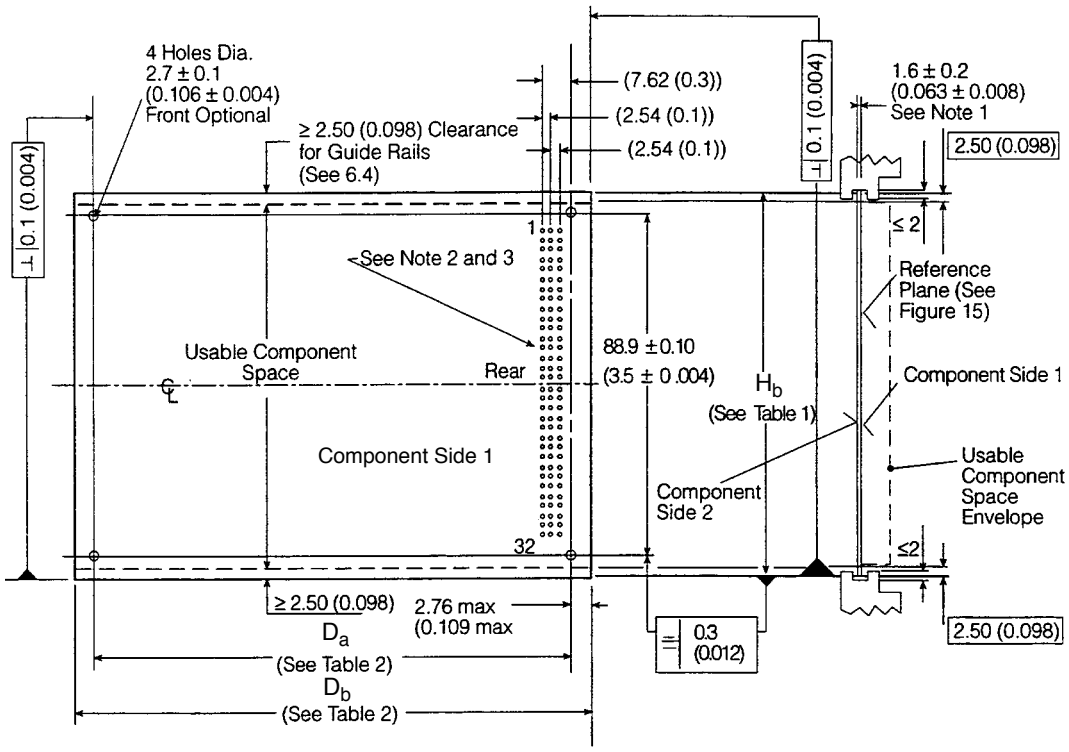
6.3 Euroboard thickness

The thickness of printed boards of plug-in units shall be 1.6 ± 0.2 mm (0.063 ± 0.008 in) in the area of the guide rails [clearance for guide rails ≥ 2.5 mm (0.098 in)]. (See Figure 3.) See the IEC 60249-2-series for other printed board thicknesses and tolerances.

6.4 Conductive elements and guide rails

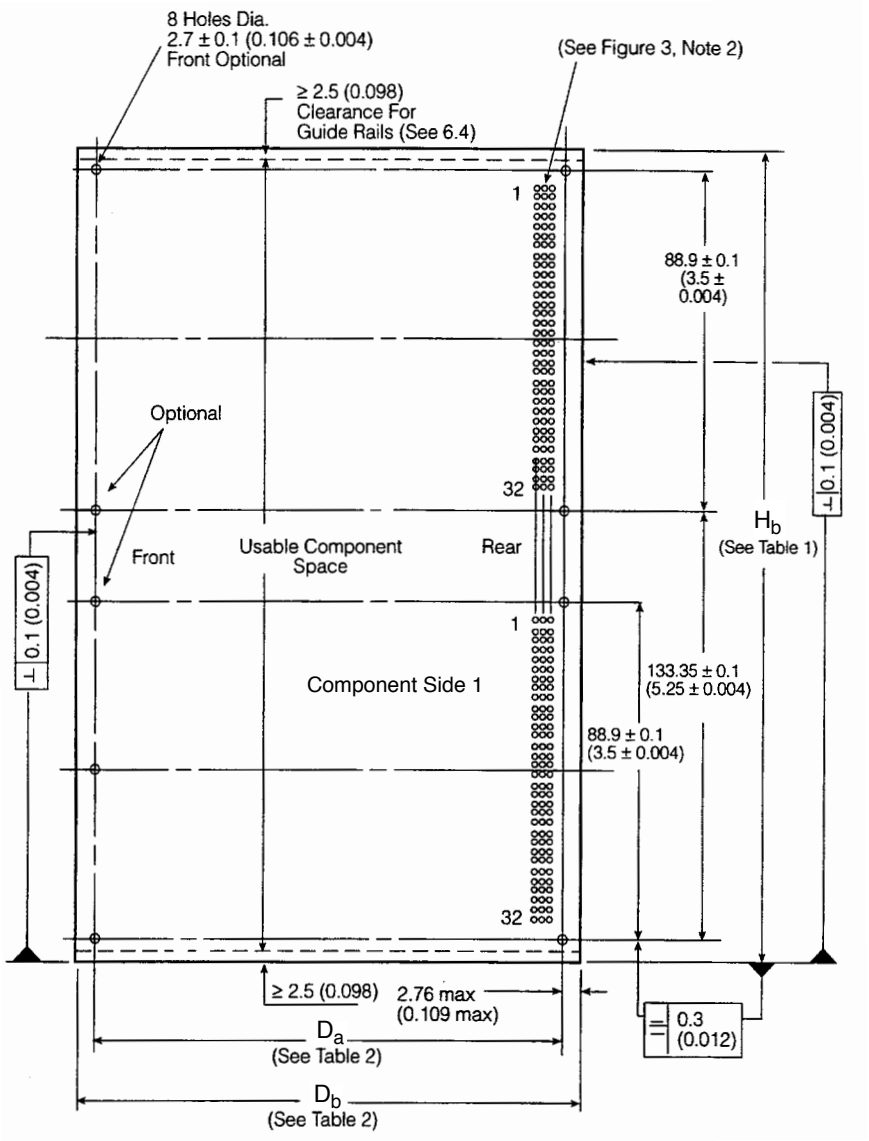
Conductive elements are not to extend beyond the usable component space on the outer planes. Printed circuits and components shall be placed on the board in accordance with their electrical features.

NOTE—The clearance area for guide rails may be used to provide conductivity between the subrack and the boards in order to reduce EMI/RFI emissions, provide electrostatic discharge (ESD) contact, or to provide heat sinking capability for the board.



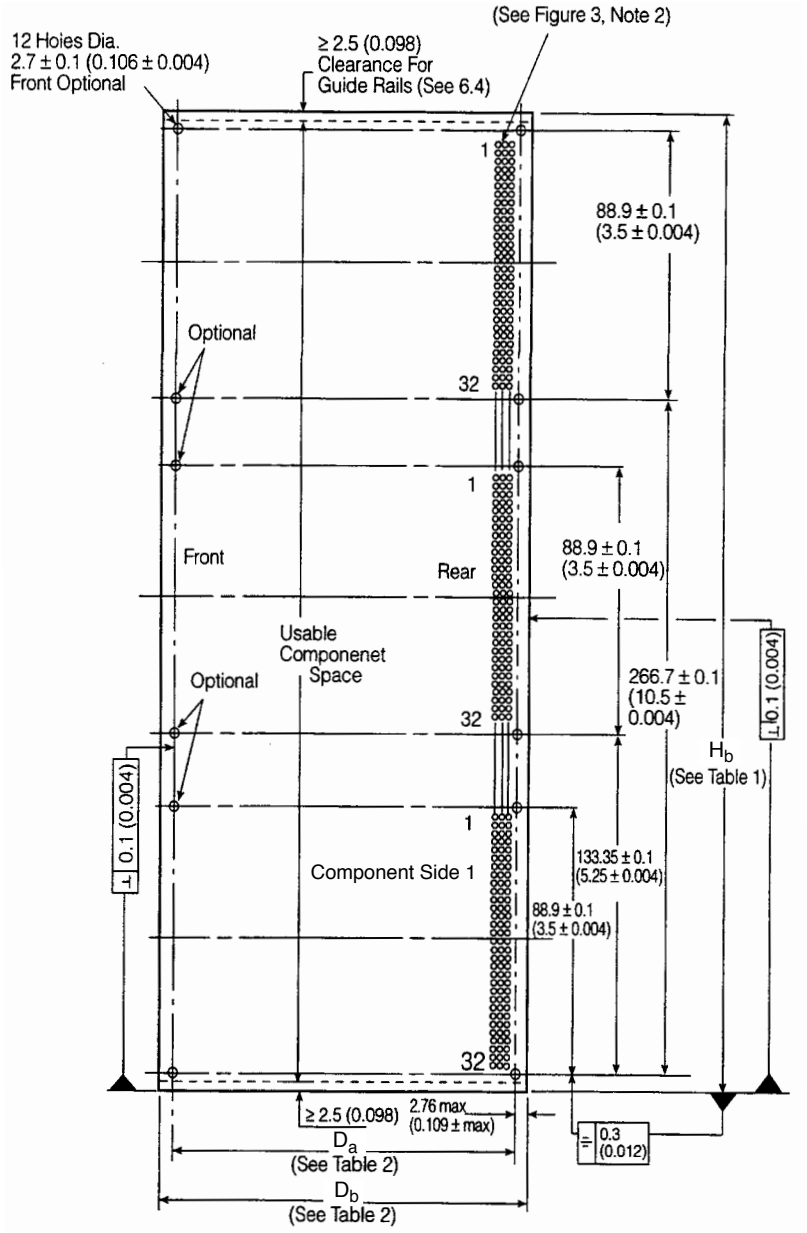
NOTES
1—For board thickness, see 6.3.
2—This connector pattern refers to Type C connectors as specified in IEC 60603-2 (1995-09), which does not indicate tolerance. Recommended IEEE 1101.1 tolerance is +0.05 mm (+0.002 in).
3—See IEC 60097 (1991-05).

Figure 3—Single-height boards, component side 1 view



NOTE—Use fixtures to mount connectors. For board thickness, see 6.3.

Figure 4—Double-height board, component side 1 view



NOTE—Use fixtures to mount connectors. For board thickness, see 6.3

Figure 5—Triple-height board, component side 1 view

7. Position of plug-in unit mounted connectors, board-type and box-type

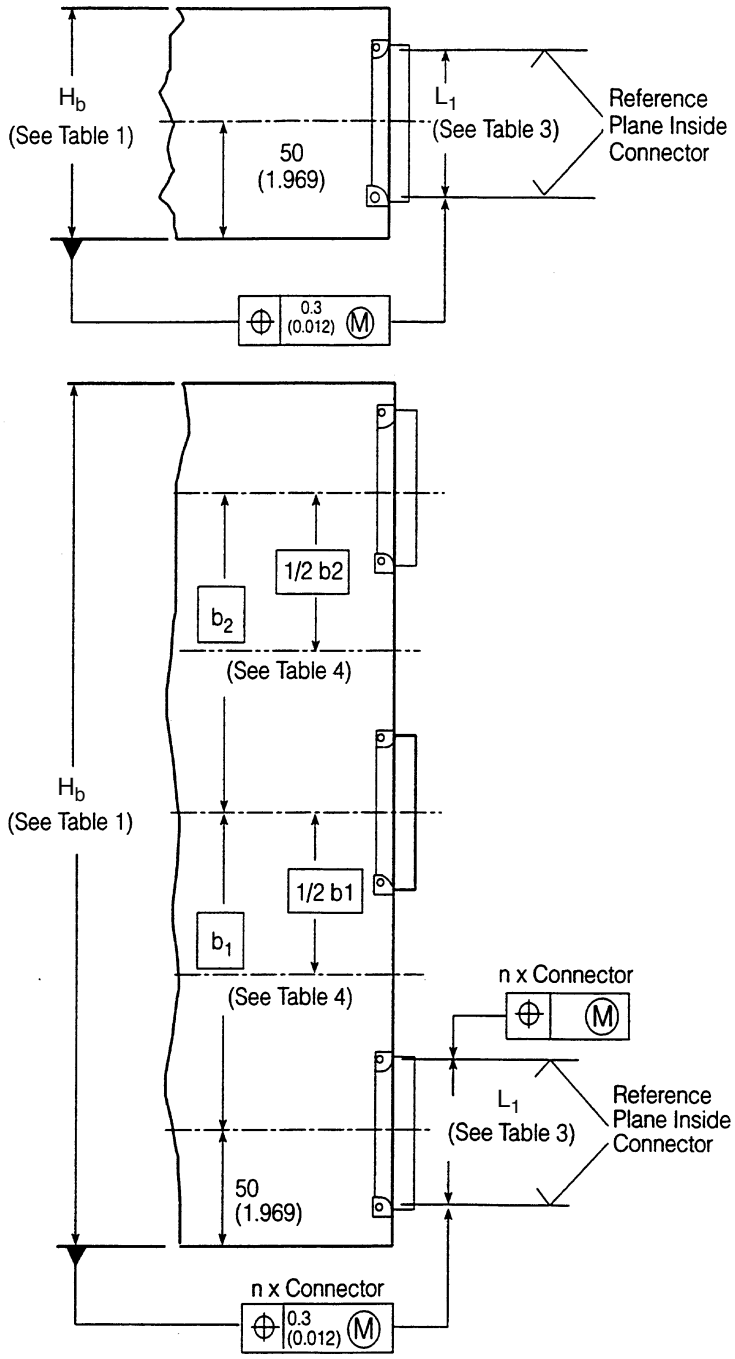
Table 3—Position of plug-in mounted connectors, board/box-type

Connector type [see IEC 60603-2 (1995-09)]	L_1	L_2
B + C (see Figure 6)	85.2 + 0.2 – 0 (3.354 + 0.008/–0)	—
Q + R (see Figure 7)	—	85.2 – 0.2/+0 (3.354 – 0.008/+0)

Table 4—Position of plug-in mounted unit connectors

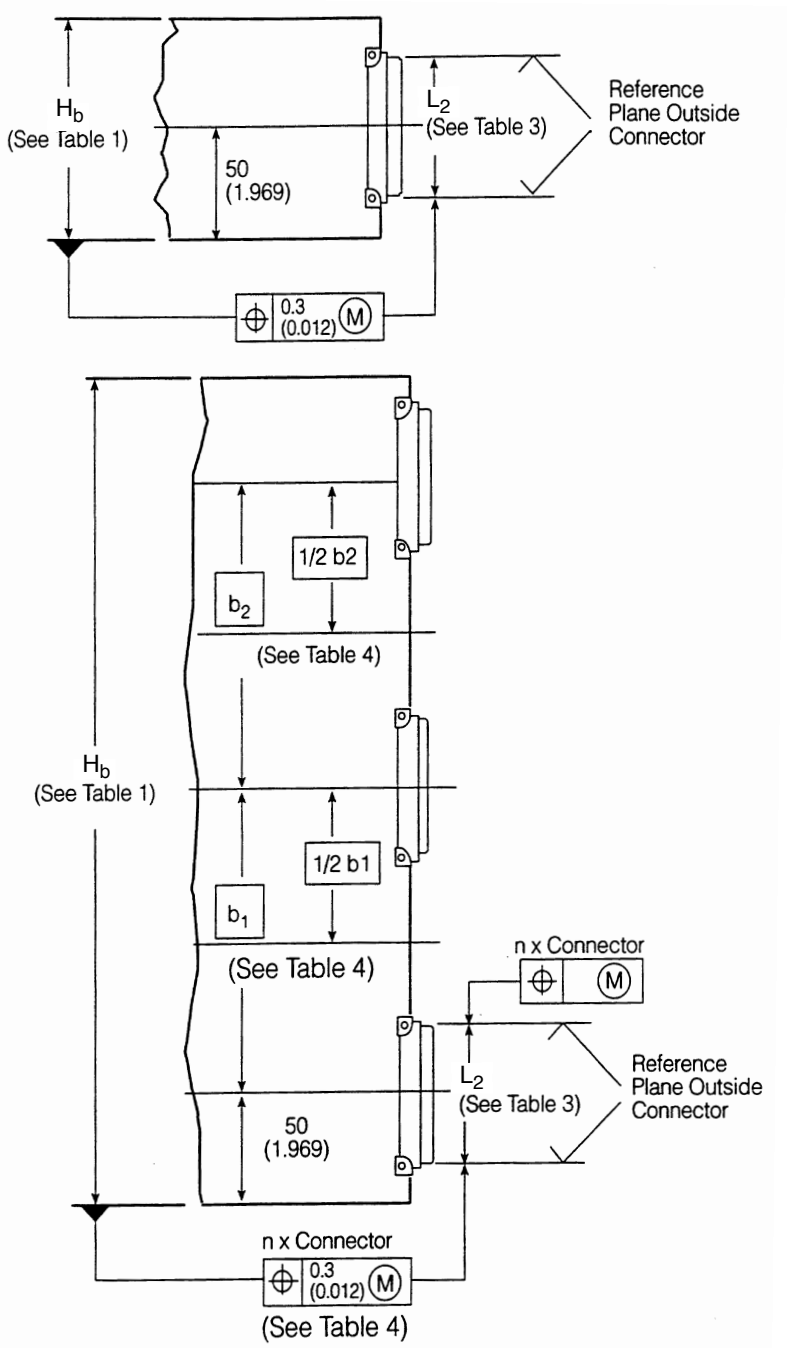
Reference-U[a]	**3**	**6**	**9**
b_1	—	133.35 mm (5.25 in)	133.35 mm (5.25 in)
b_2	—	—	133.35 mm (5.25 in)

[a]Subracks are dimensioned in height of U, 1U = 44.45 mm (1.75 in). See IEC 60297-1 (1986-09) and ANSI/EIA 310-D-1992.



NOTE—Fixtures are required when mounting connectors on double- and triple-height boards.

Figure 6—Position of connectors on plug-in units



NOTE—Fixtures are required when mounting connectors on double- and triple-height boards.

Figure 7—Position of inverse connectors on plug-in units

8. Plug-in unit description

A plug-in unit can be of various types, as is shown in Figure 1. It usually consists of a printed board assembly with connector(s) and, optionally, handle(s), ejector(s), front panel, rear panel, mounting rails, and covers.

A plug-in unit can itself house a plurality of different types of plug-in units. Box-type plug-in units may house board-type plug-in units or other subassemblies.

9. Plug-in unit dimensions

9.1 Board-type plug-in units

1) DT2 in Table 5 is the inspection dimension to ensure reliable connector mating.
2) For connector detail, see IEC 60603-2 (1995-09).
3) For a nominal 5.08 mm (0.2 in) width filler panel (see Figure 14), the 7.47 mm (0.294 in) dimension is reduced to 2.35 mm (0.093 in).
4) Maximum dimensions for location features for front panel alignment or screw retention, or both, are shown in Figures 13 and 14. The standard M2.5 screw mounting does not exclude other means of retention or quick-release fasteners (to be agreed upon by vendor and user). Slotted or plus-type screw heads are permitted.
5) Double-sided surface-mounted devices (SMD) mounting on plug-in boards may result in changes of the relationship of front panel, guide rail, and backplane positioning relative to the subrack (see Figure 15).
6) The injector/ejector design detail can be derived from Figures 8 and 9, and can be manufactured of various materials (see 12.6.2). This detail is restricted to individual boards plugged into the subrack, and is not suitable for front panel mounted boards or within a box-type plug-in unit (see Figure 19).
7) The dimension between the front attachment plane and the beginning of the board guide has been increased from ≥ 6 mm (0.236 in) as per IEC 60297-3 (1984-01) to ≥ 10 mm (0.393 in) as per IEC 60297-4 (see Figures 28 through 33) in order to allow for injector/ejector operation.
8) Board-type plug-in units with front panels may require handles. The details of handles and their positioning on the front panels are not specified in this standard.
9) The recommended plug-in unit front panel thickness is 2.5 mm (0.098 in).

9.2 Box-type, box/board-type plug-in units

1) DT2 is the inspection dimension to ensure reliable connector mating. For inspection dimensions, see Table 5.
2) For connector details, see IEC 60603-2 (1995-09).
3) Box-type plug-in units are designed to interface with the subrack, as specified in Clause 11, via a single board, as specified in Figures 3 through 5, with connectors attached. Additionally, the box-type plug-in units may be used to house large components.
4) Box/board-type plug-in units are designed to interface with the subrack, as specified in Clause 11, via one or more board-type plug-in unit(s), as specified in Figures 3 through 5 and 10 through 12, with connector(s) attached [see IEC 60603-2 (1995-09)]. Individual front panels can be replaced by single plug-in unit front panels, or in other combinations of N × 5.08 mm (0.2 in).
5) Box and box/board-type plug-in units may require handles [see 9.1, item 8)].

10. Backplane design and mounting positions

10.1 Rigidity

Backplane and subrack mounting positions must be sufficiently rigid to withstand the insertion and withdrawal forces of the connectors, as per IEC 60603-2 (1995-09).

10.2 Dimensions

The dimension 7.47 mm (0.294 in) is the minimum dimension to the first mounting hole. This dimension can be increased by increments of N × 5.08 mm (0.2 in).

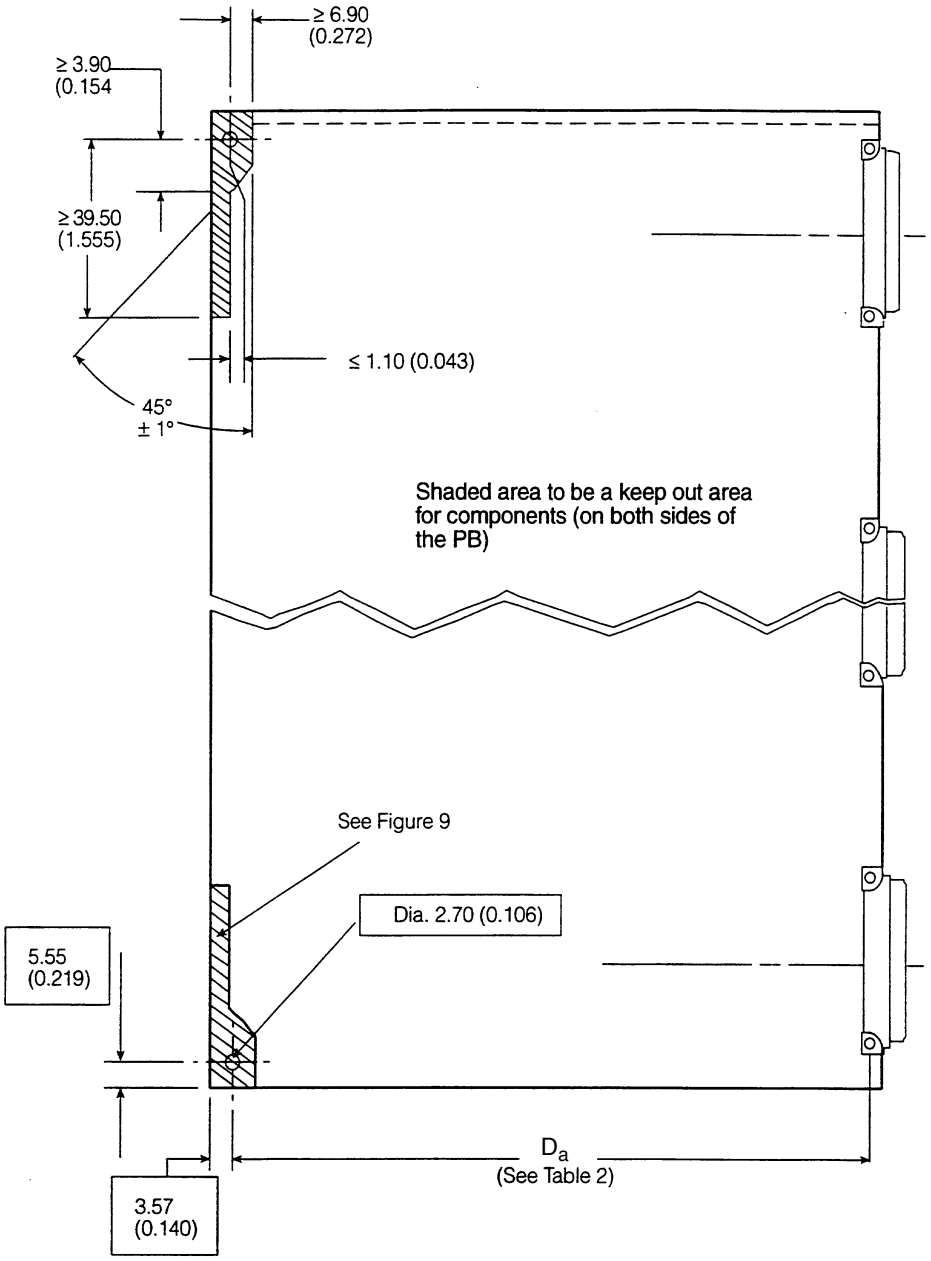
NOTE—For backplane, connector, board, and front panel relationships, see Figure 15.

Table 5—Inspection dimensions, Figures 10–12

Reference Board Depth D_b	100	160	220	280	340	400
DT2 ± 0.4 mm (±0.016 in)	109.93 mm (4.328 in)	169.93 mm (6.690 in)	229.93 mm (9.052 in)	289.93 mm (11.415 in)	349.93 mm (13.777 in)	409.93 mm (16.139 in)

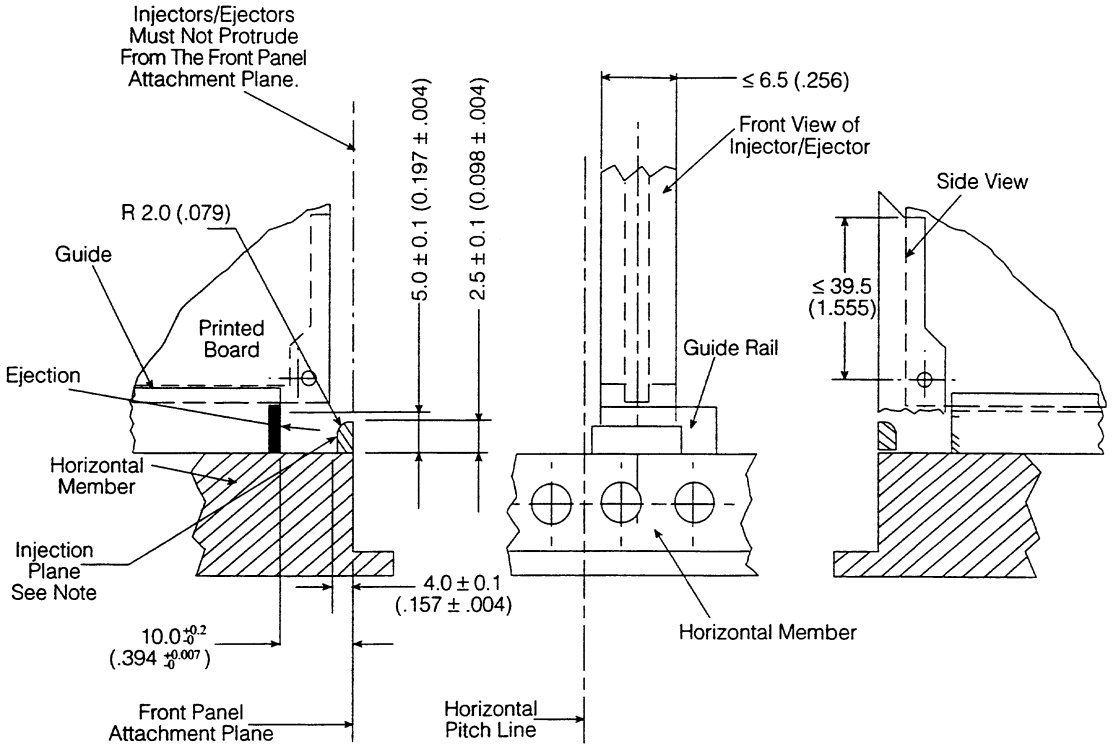
Table 6—Front panel dimensions, Figures 13, 14, 17, 19, 20–23; Backplane dimensions, Figures 24–26

Reference Subrack Heights U	3	6	9
G+0/–0.3 mm (+0/–012 in)	128.7 mm (5.067 in)	262.05 mm (10.317 in)	395.40 mm (15.567 in)
F_1 ± 0.2 mm (±0.008 in)	122.5 mm (4.823 in)	—	—
F_2 ± 0.2 mm (±0.008 in)	—	255.85 mm (10.073 in)	—
F_3 ± 0.2 mm (±0.008 in)	—	—	389.20 mm (15.323 in)



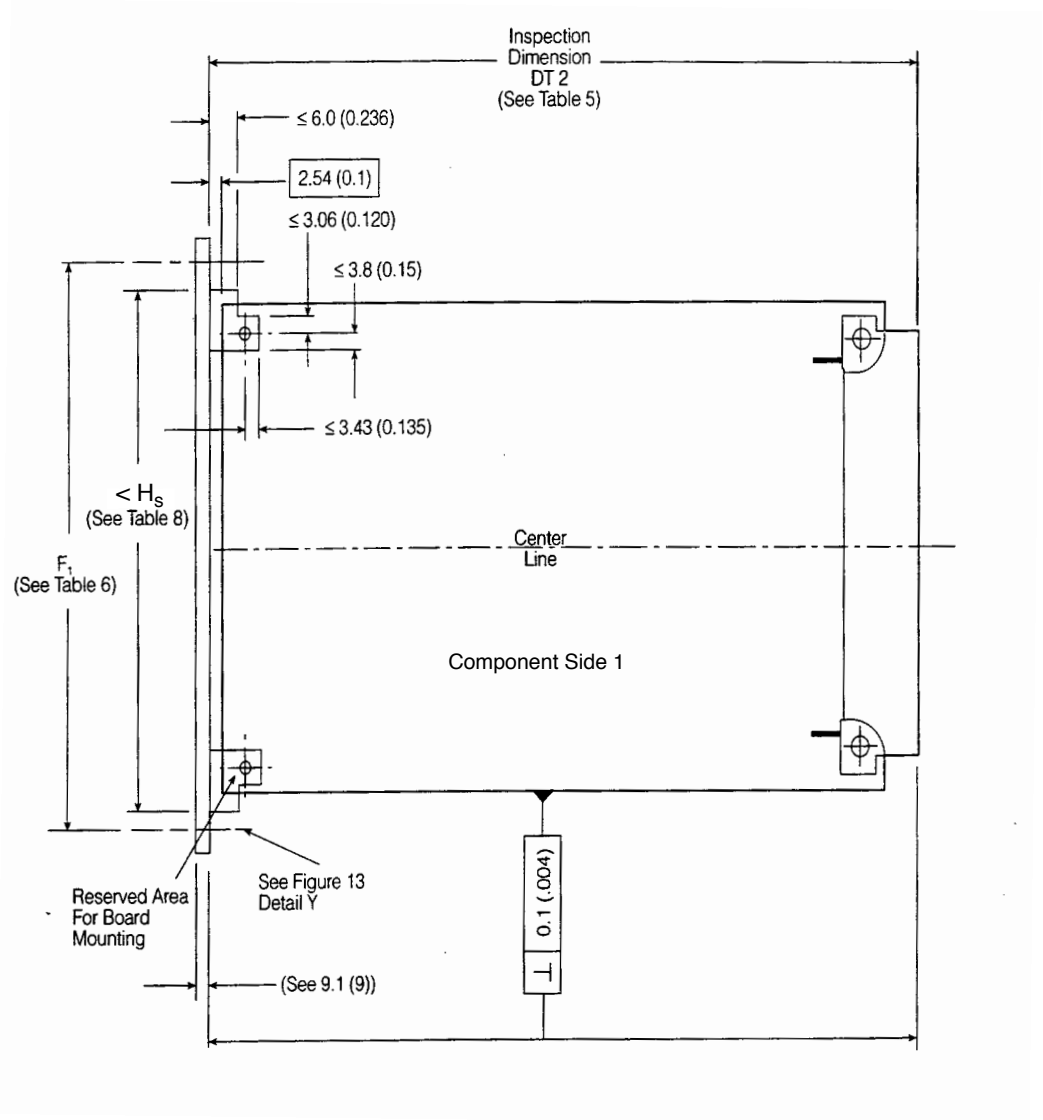
NOTES
1—Single-height boards may either use one or two injectors/ejectors. Double- and triple-height boards require two injectors/ejectors.
2—If metallic injectors/ejectors are used, printed circuits and components must be placed in accordance with their electrical features [see 9.1, item 6)].

Figure 8—Injector/ejector mounting positions for printed boards without front panels



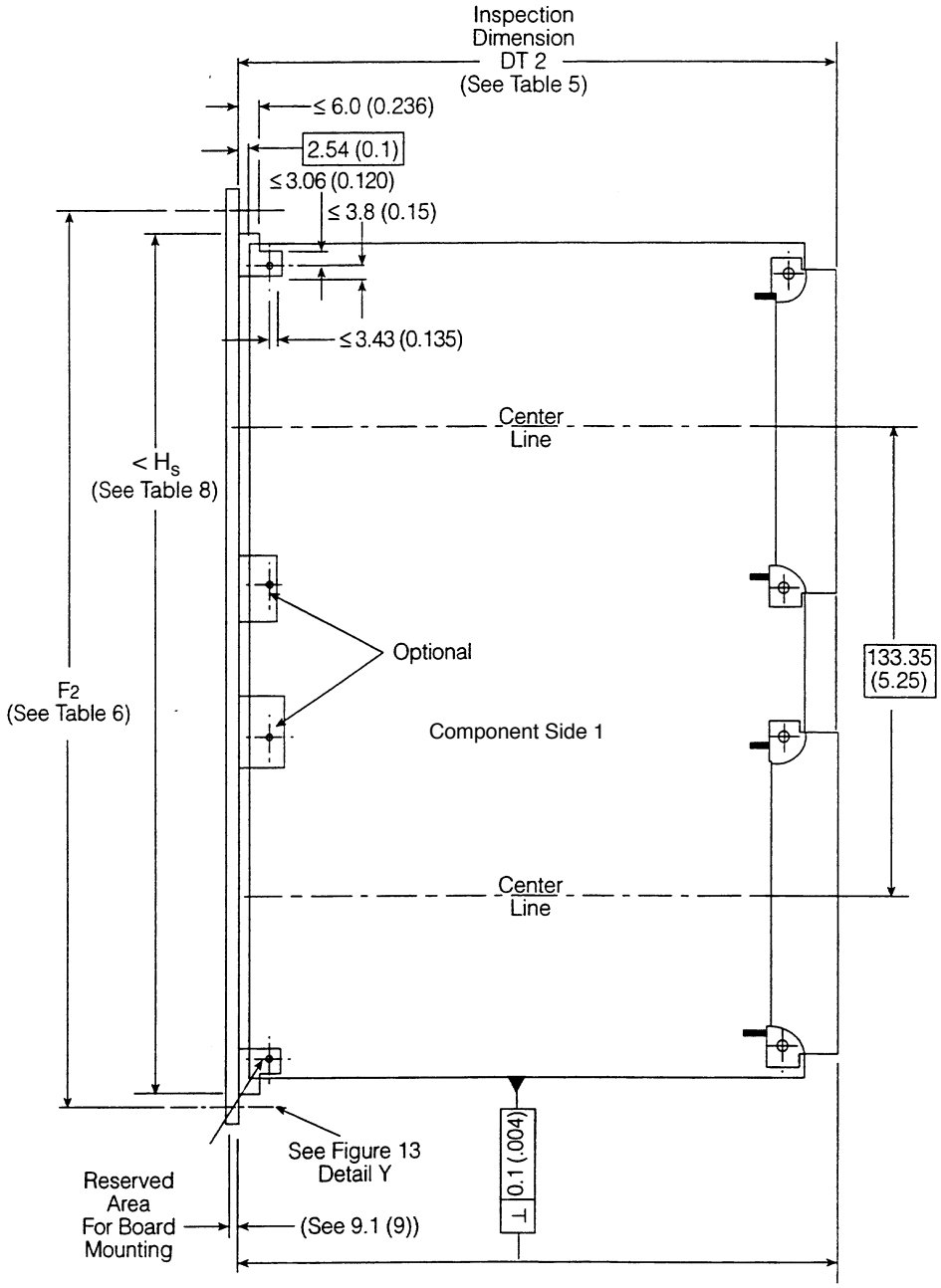
NOTE—To be an optional and removable part, if in compliance with IEC 60297-3 (1984-01). The injection plane can be of full width design if agreed between vendor and user [see 9.1, items 6) and 7)].

Figure 9—Injector/ejector detail for use of printed boards without attached front panels



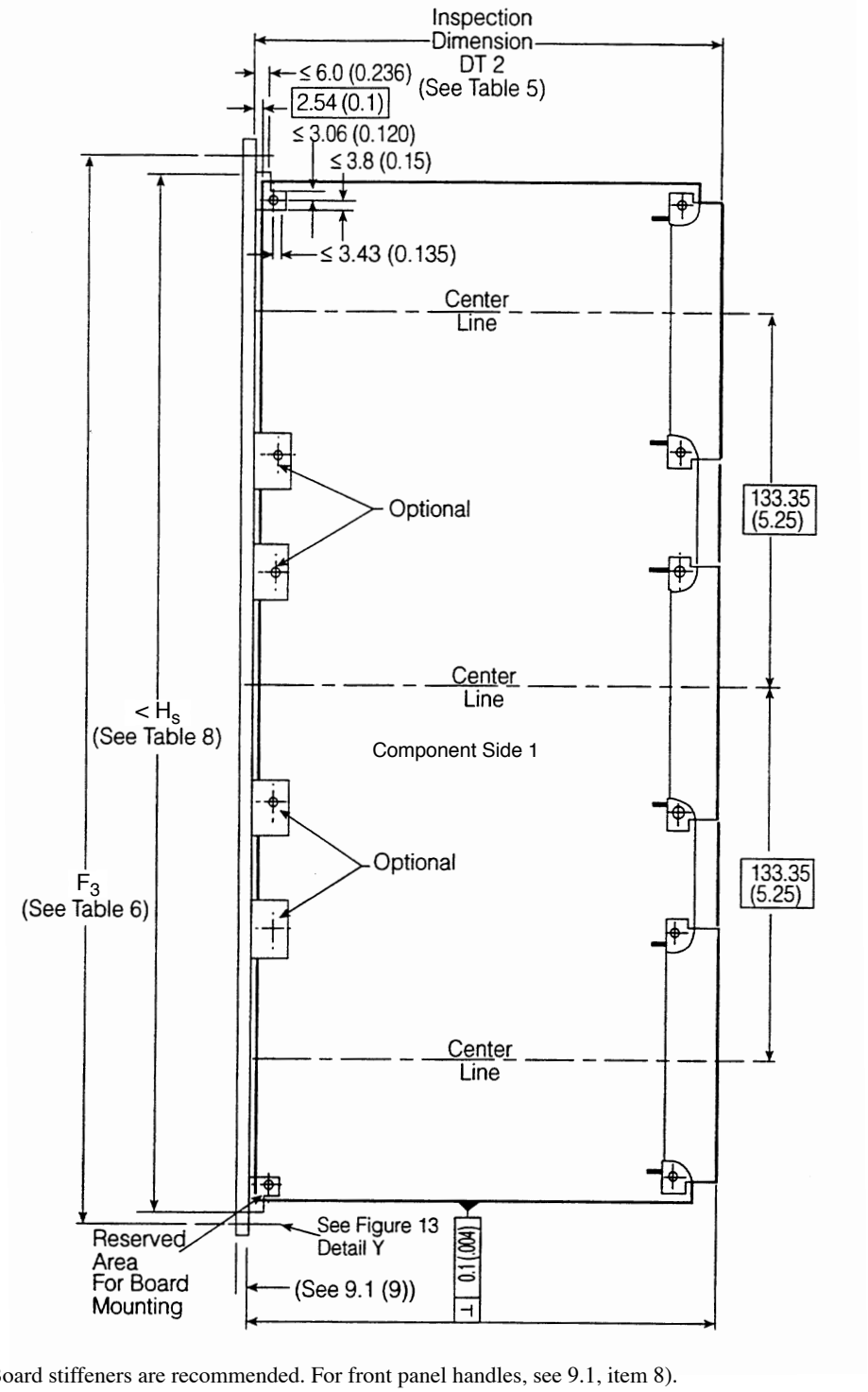
NOTE—For front panel handles, see 9.1, item 8).

Figure 10—Single-height board-type plug-in unit



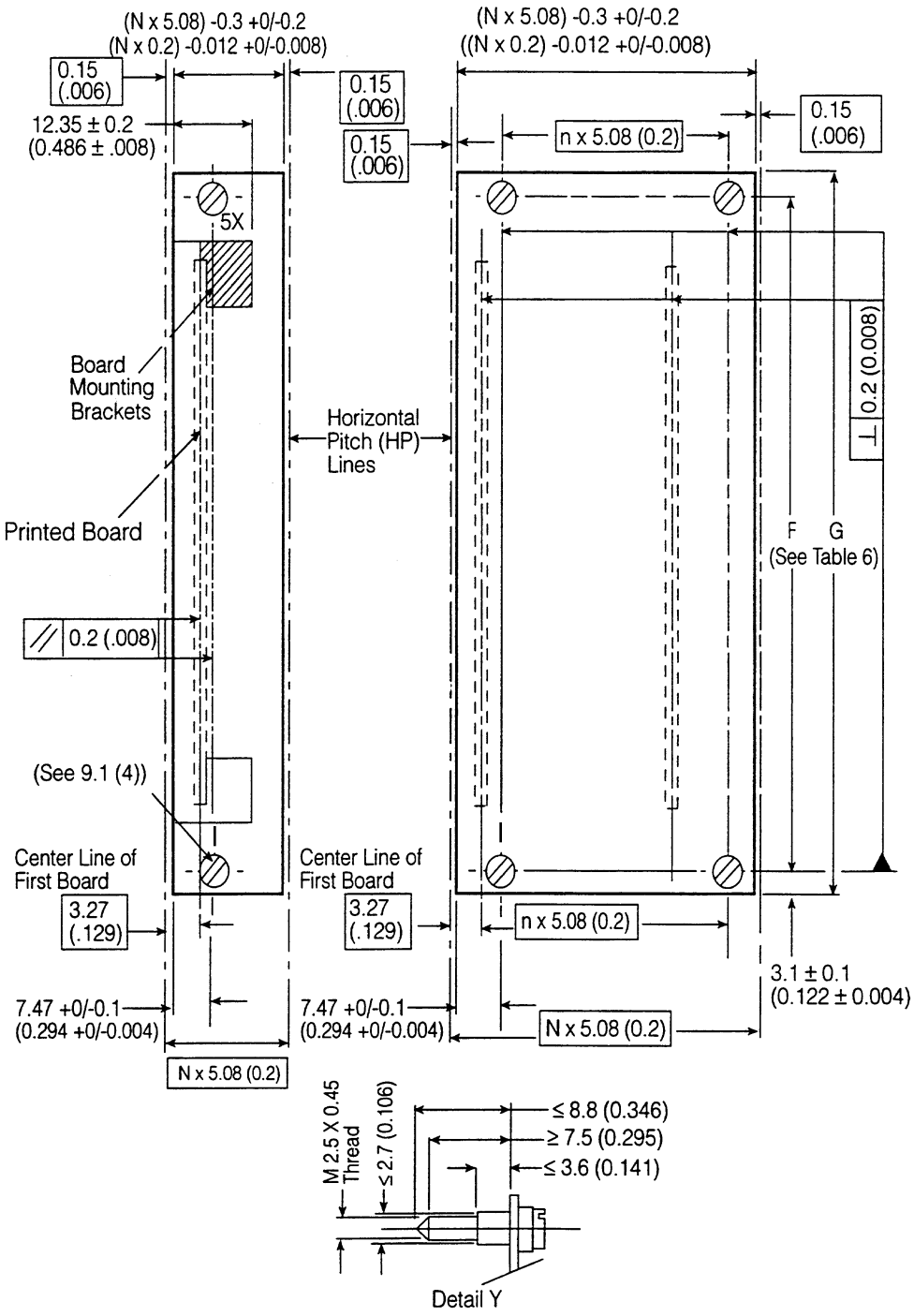
NOTE—For front panel handles, see 9.1, item 8).

Figure 11—Double-height board-type plug-in unit



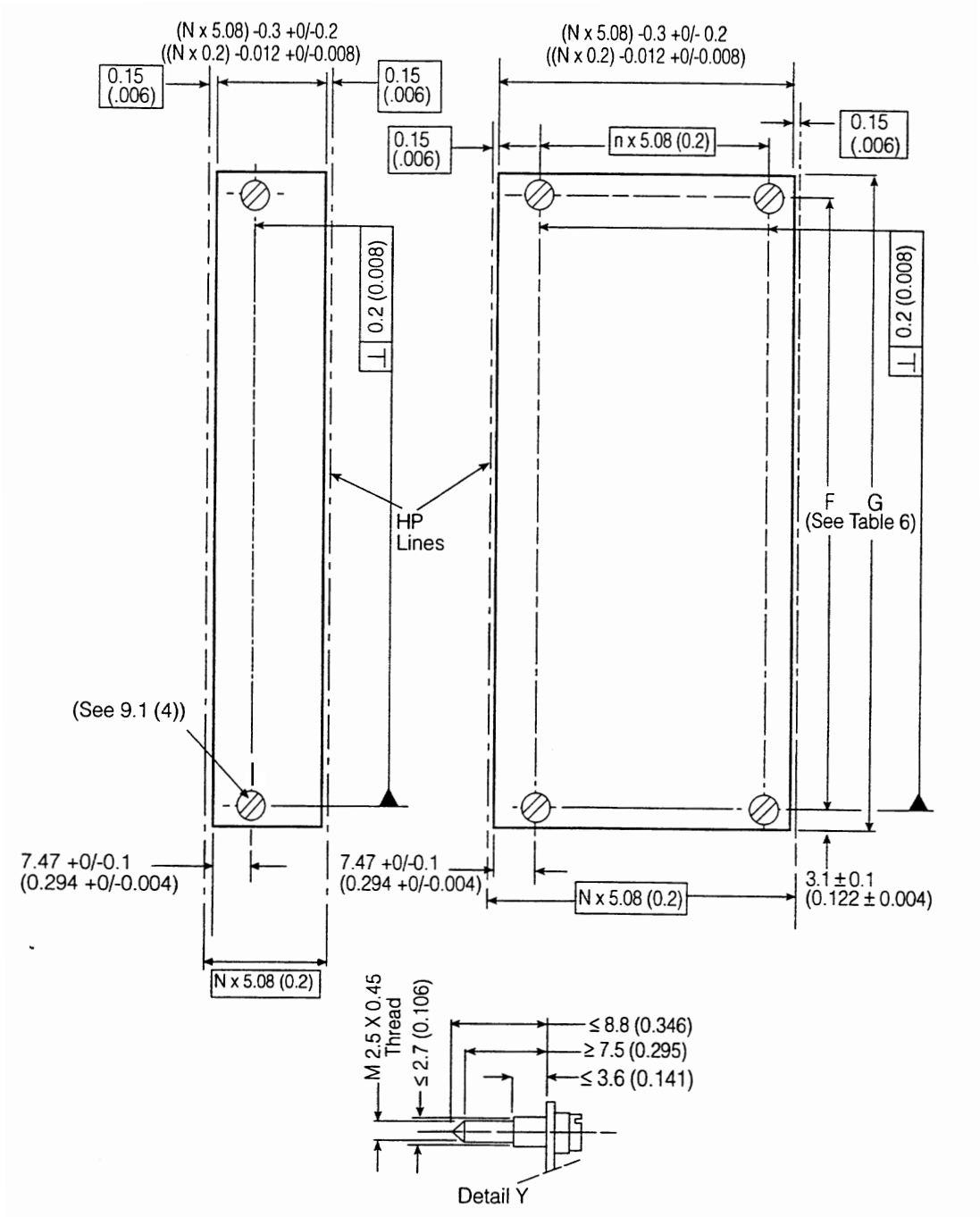
NOTE—Board stiffeners are recommended. For front panel handles, see 9.1, item 8).

Figure 12—Triple-height board-type plug-in unit



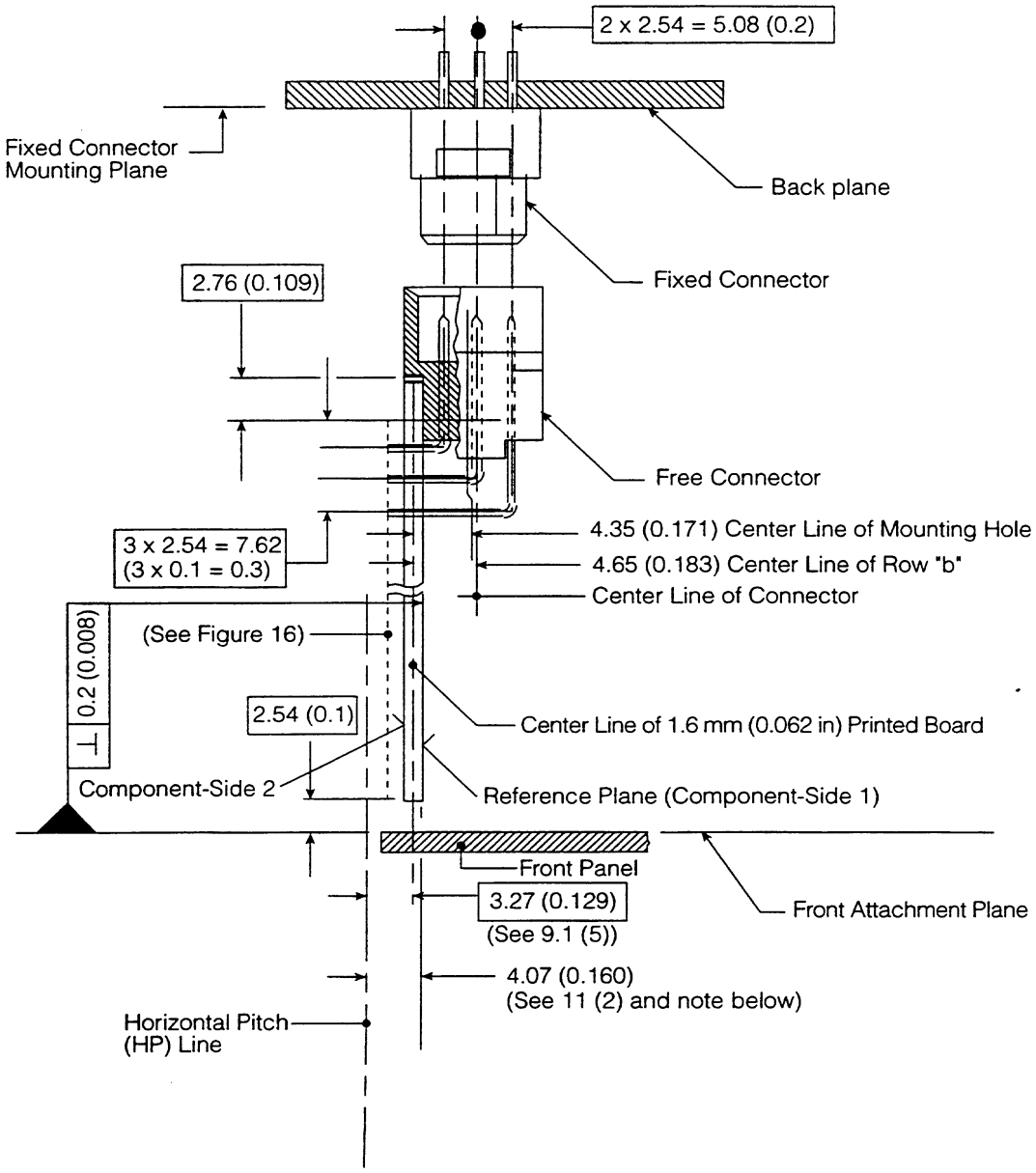
NOTE—n = N × 5.08 ± 0.1 (0.2 ± 0.004)

Figure 13—Board-type plug-in unit front panel



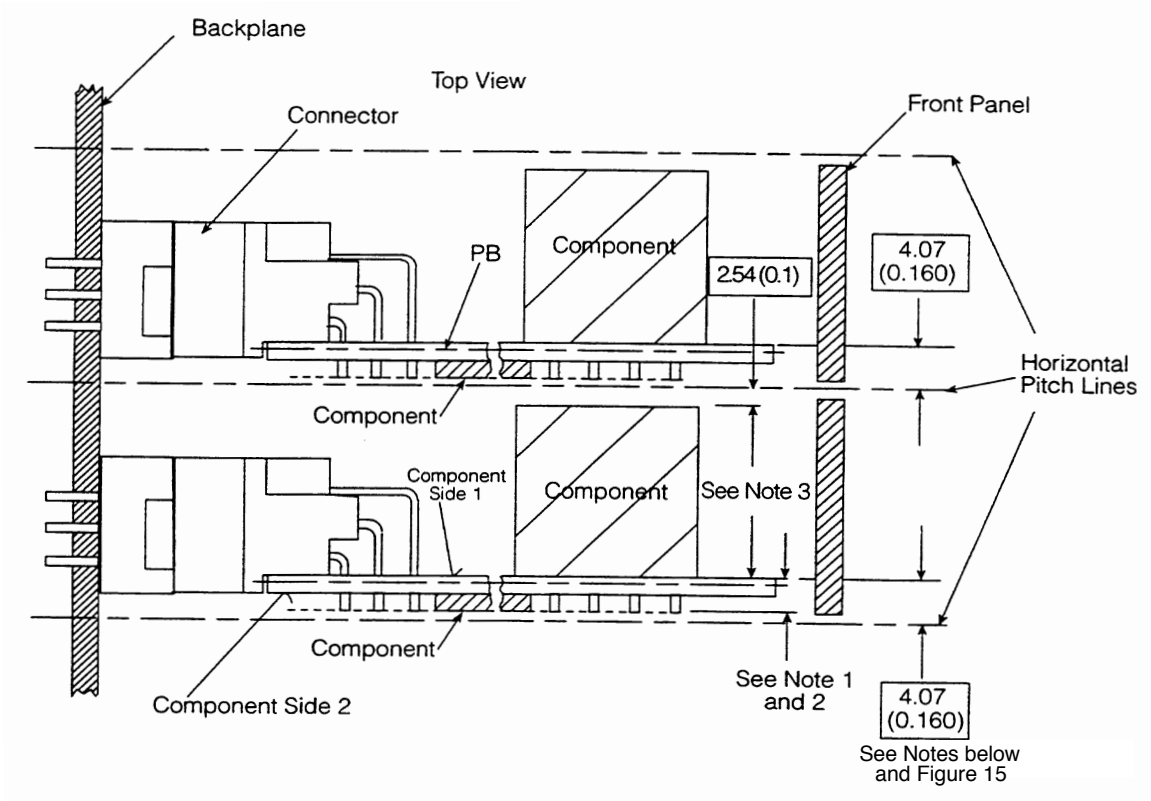
NOTE—n = N × 5.08 ± 0.1 (0.2 ± 0.004)

Figure 14—Filler panels



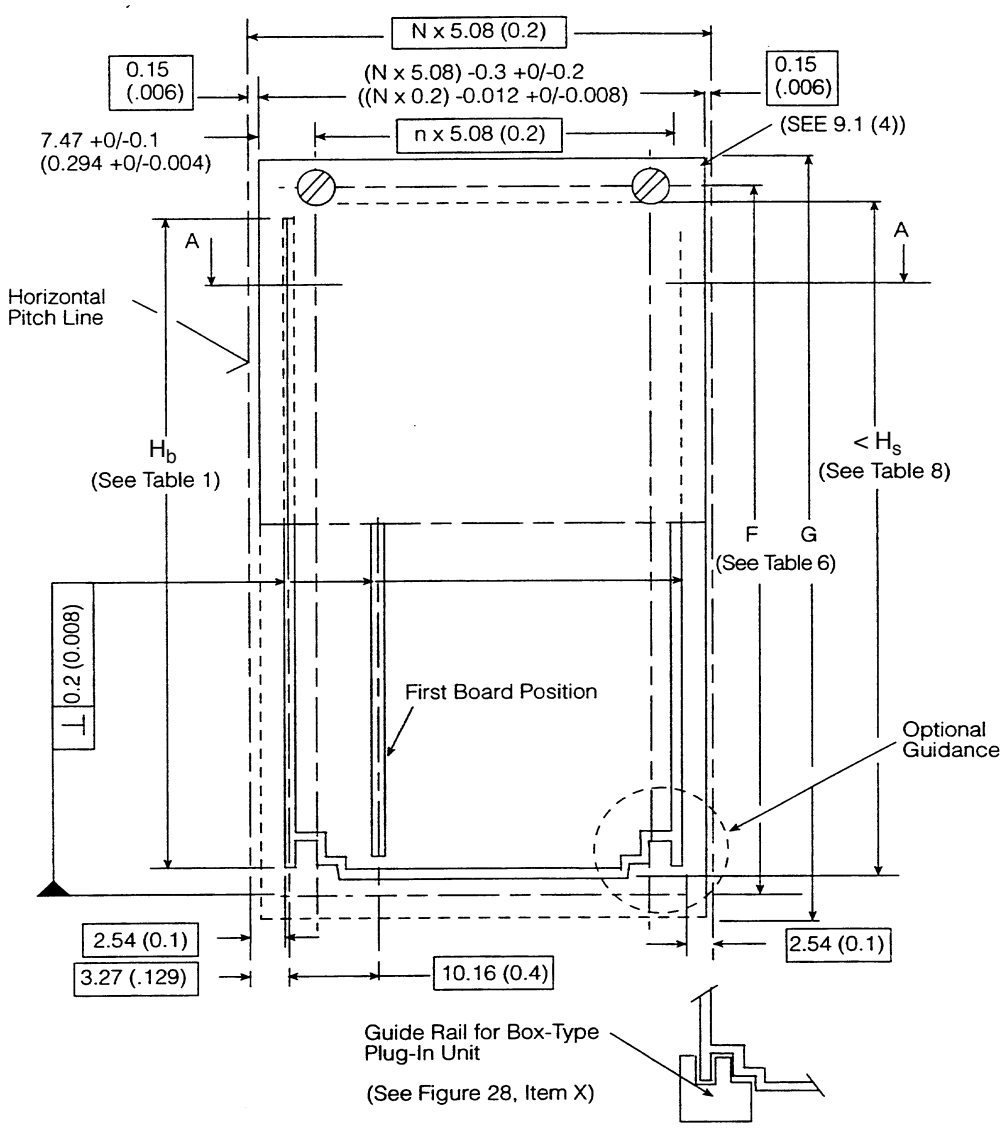
NOTE—The dimension 4.07 mm (0.160 in) represents the first board position for conventional component mounting (on component side 1). For double-sided surface-mounted devices (SMD) boards (component side 1 and 2) the dimension of 4.07 mm (0.160 in) may be increased to 9.15 mm (0.360 in) = 4.07 + 5.08 (0.160 + 0.200). For board thickness, see 6.3. Thicker boards shall grow towards the component side 2 and may have to be routed in the guide area.

Figure 15—Front panel, board, connector, backplane relationship



NOTES
1—3.70 mm (0.145 in): Maximum recommended pin length and component height. See Clause 7 of IEEE Std 1101.10-1996.
2—Solder pins of components and solder-side mounted components shall not protrude into the horizontal pitch line.
3—Components shall not protrude into the 2.54 mm (0.10 in) zone below the horizontal pitch line. Component height restrictions will vary depending on the manufacturer's ability to control board warp and thickness, measured on installed boards.

Figure 16—Board-to-board relationship



NOTES
1—See 6.4 and 9.2, items 3) and 5).
2—n = N × 5.08 ± 0.1 (0.2 ± 0.004)

Figure 17—Box-type plug-in unit, front view

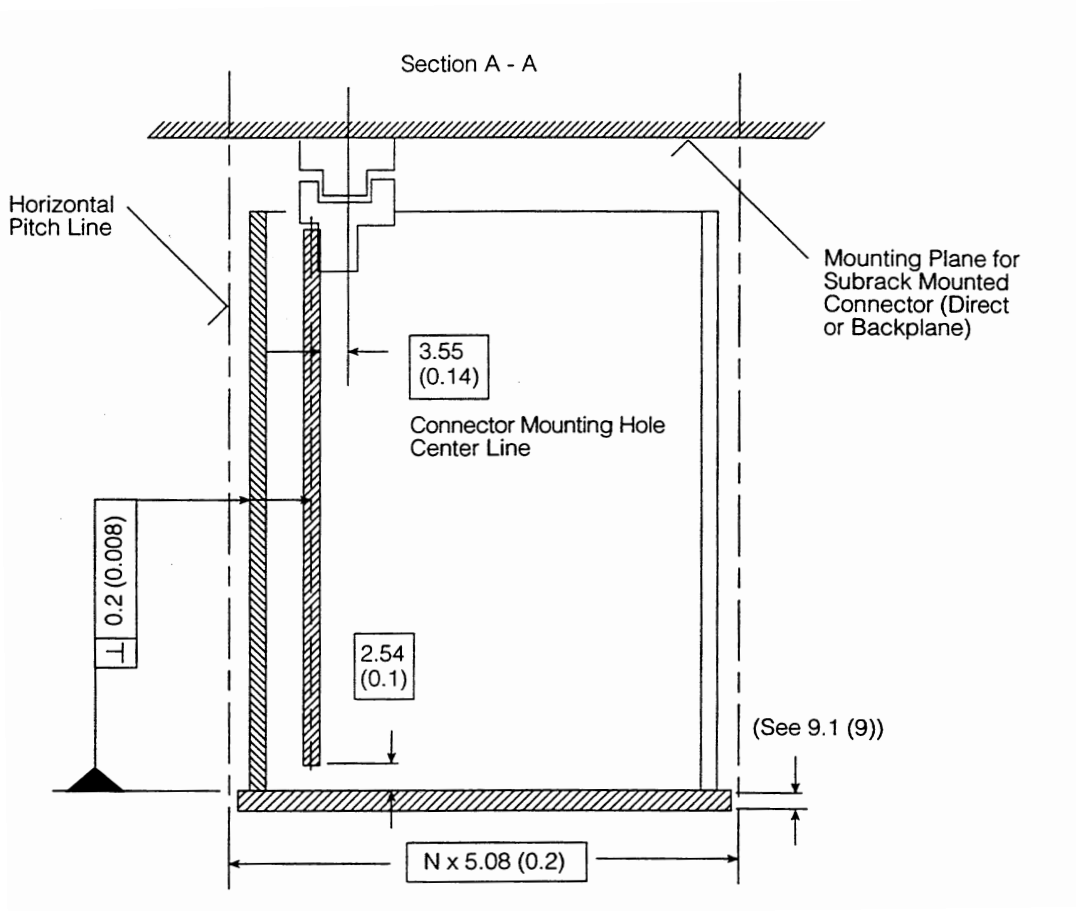
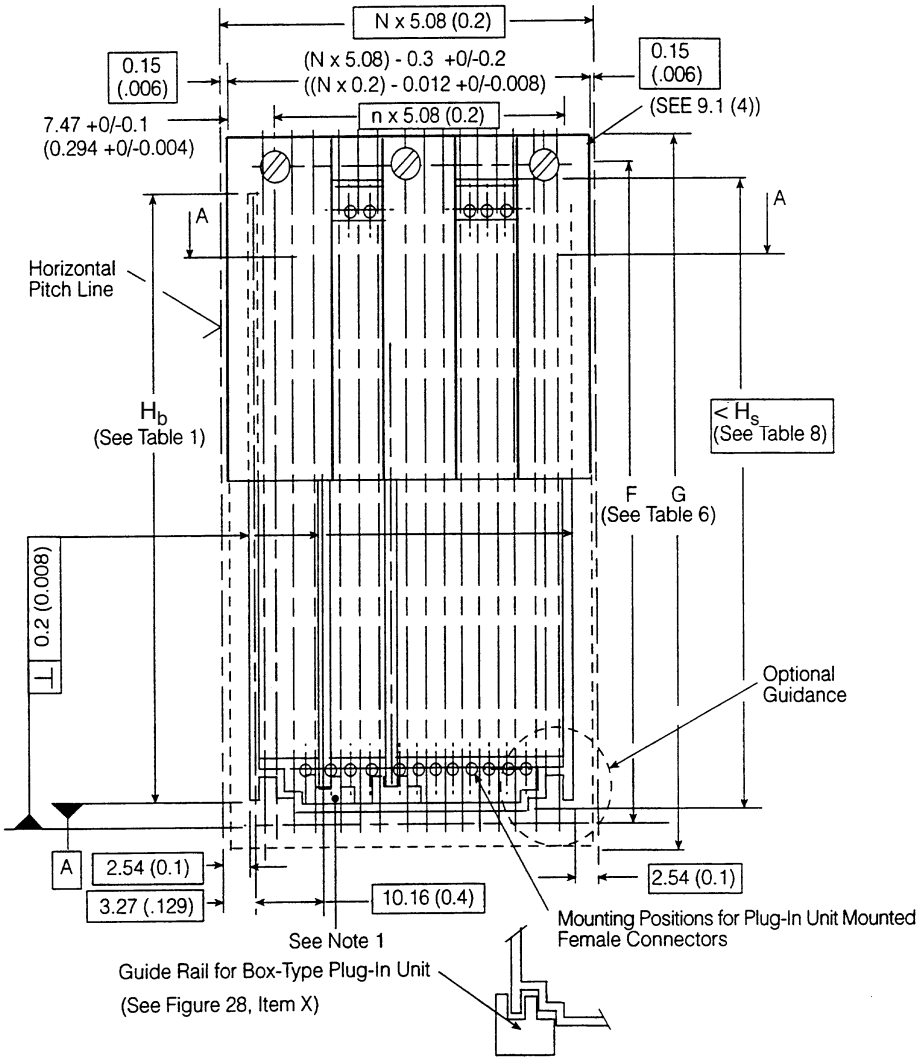
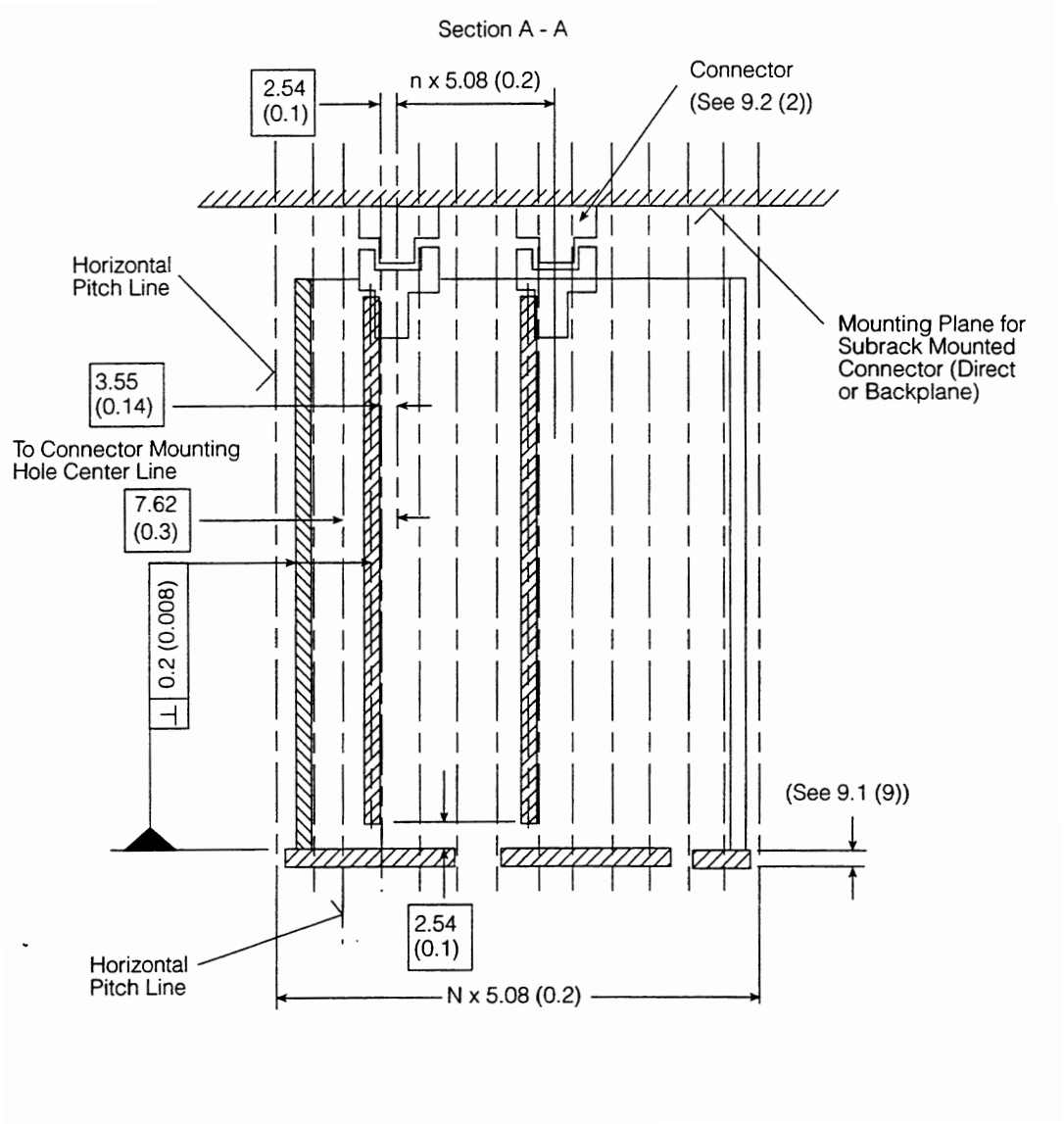


Figure 18—Box-type plug-in unit, plan view section A-A



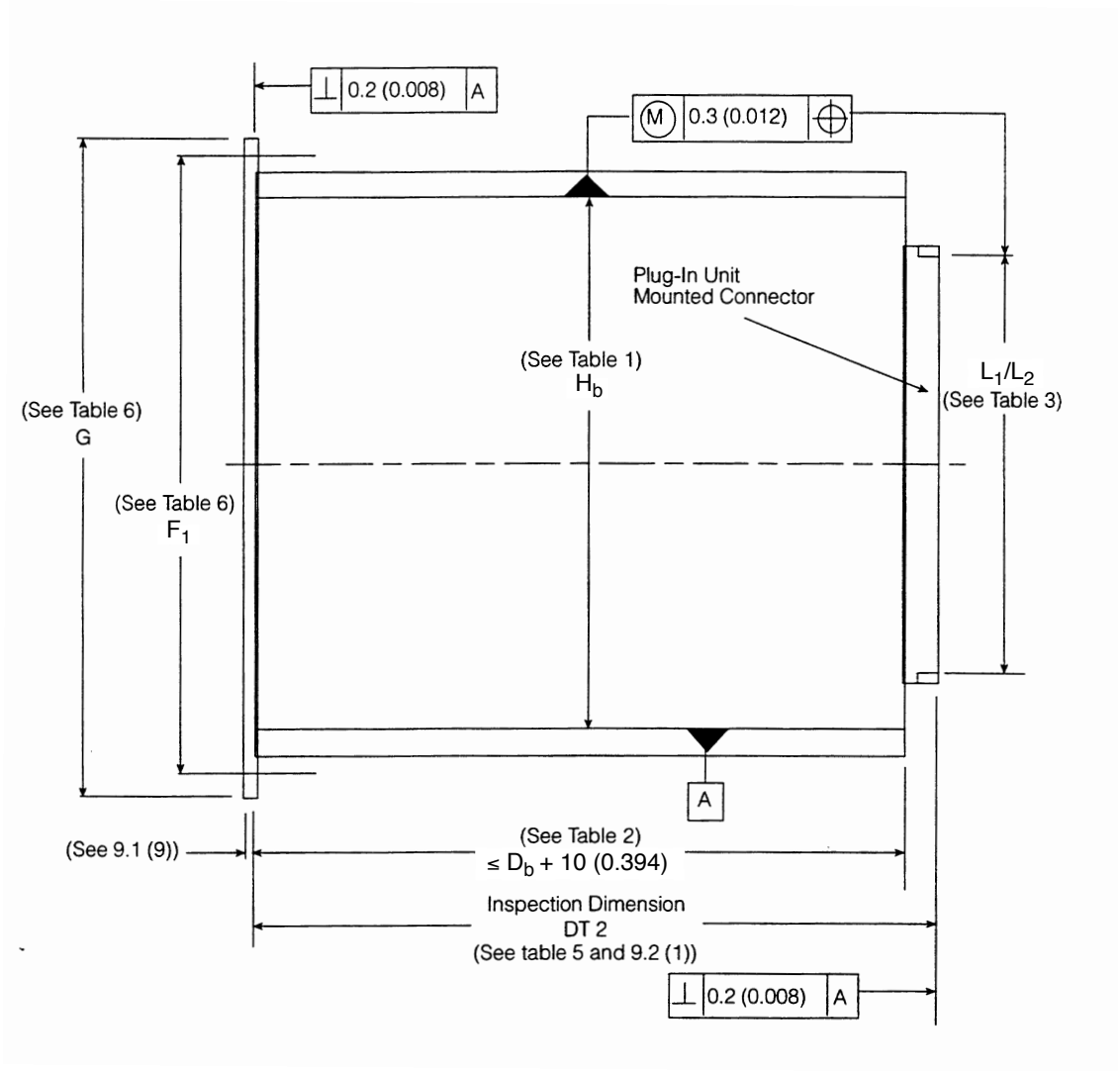
NOTES
1—Internal guides have the same board slot feature as shown in Figure 28, item X. See 6.4 and 9.2, items 4) and 5).
2—n = N × 5.08 ± 0.1 (0.2 ± 0.004)

Figure 19—Box/board-type plug-in, front view



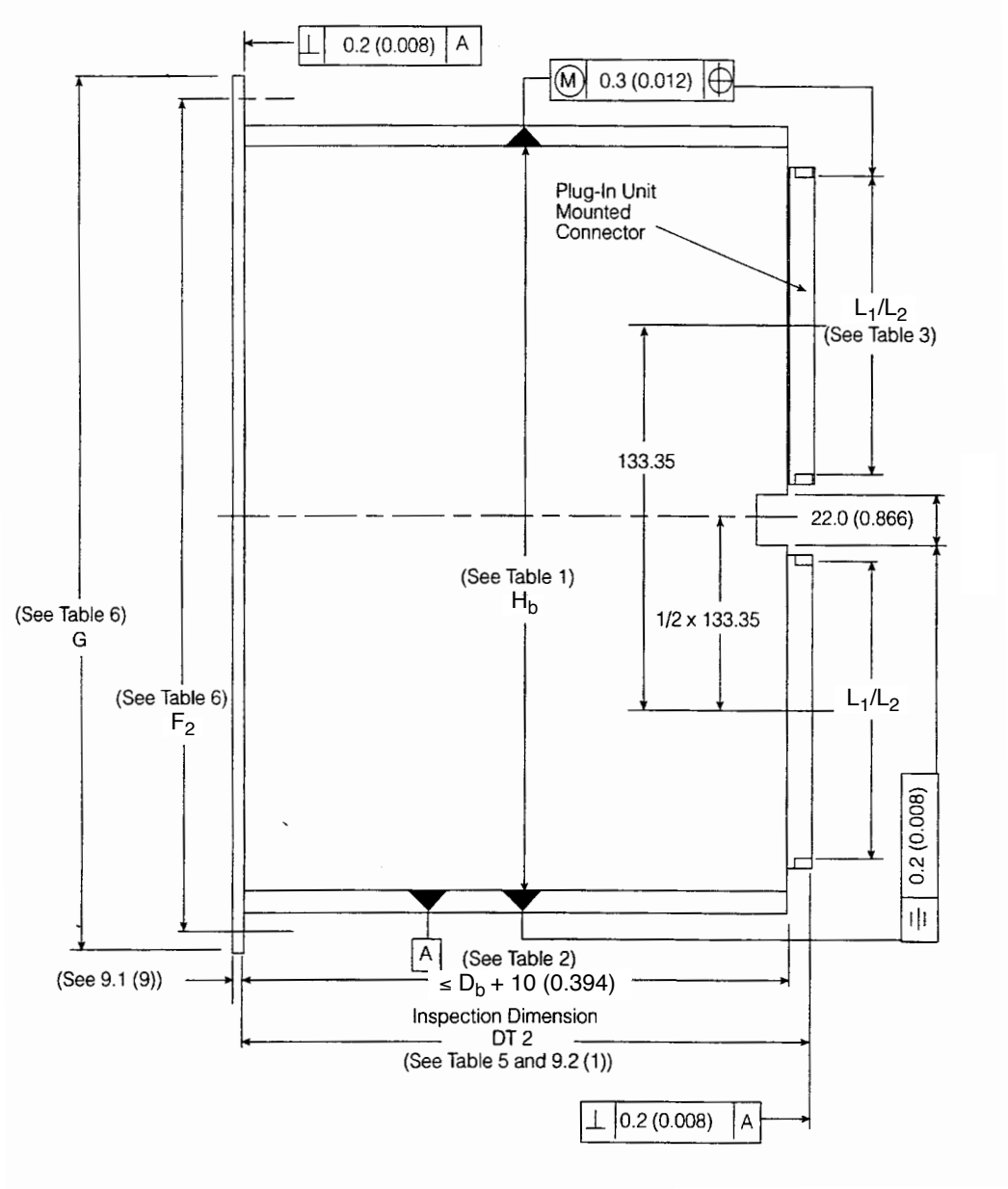
NOTE—n = N × 5.08 ± 0.1 (0.2 ± 0.004)

Figure 20—Box/board-type plug-in unit, plan view section A-A



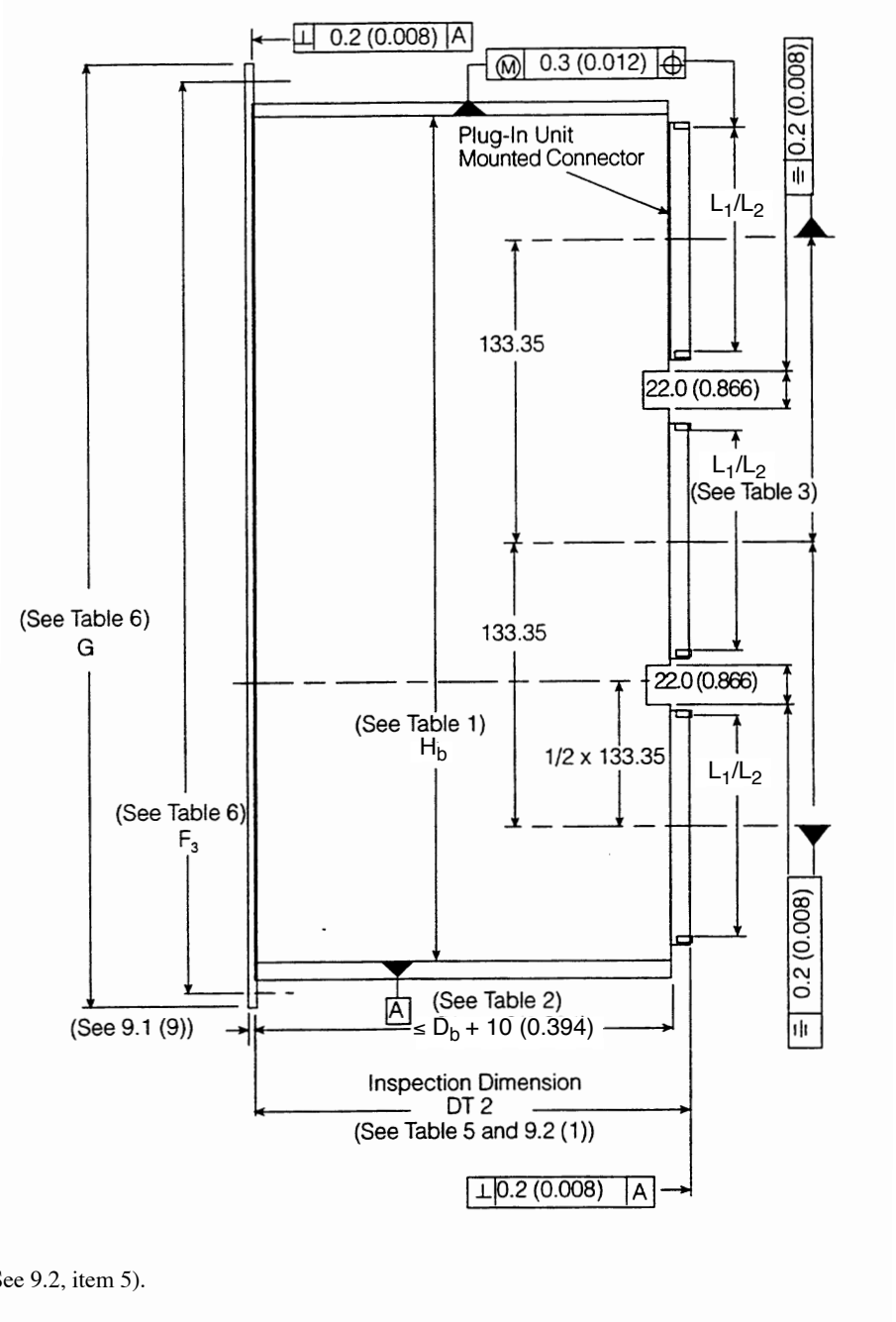
NOTE—See 9.2, item 5).

Figure 21—Box-type, box/board-type plug-in unit, single-height side view



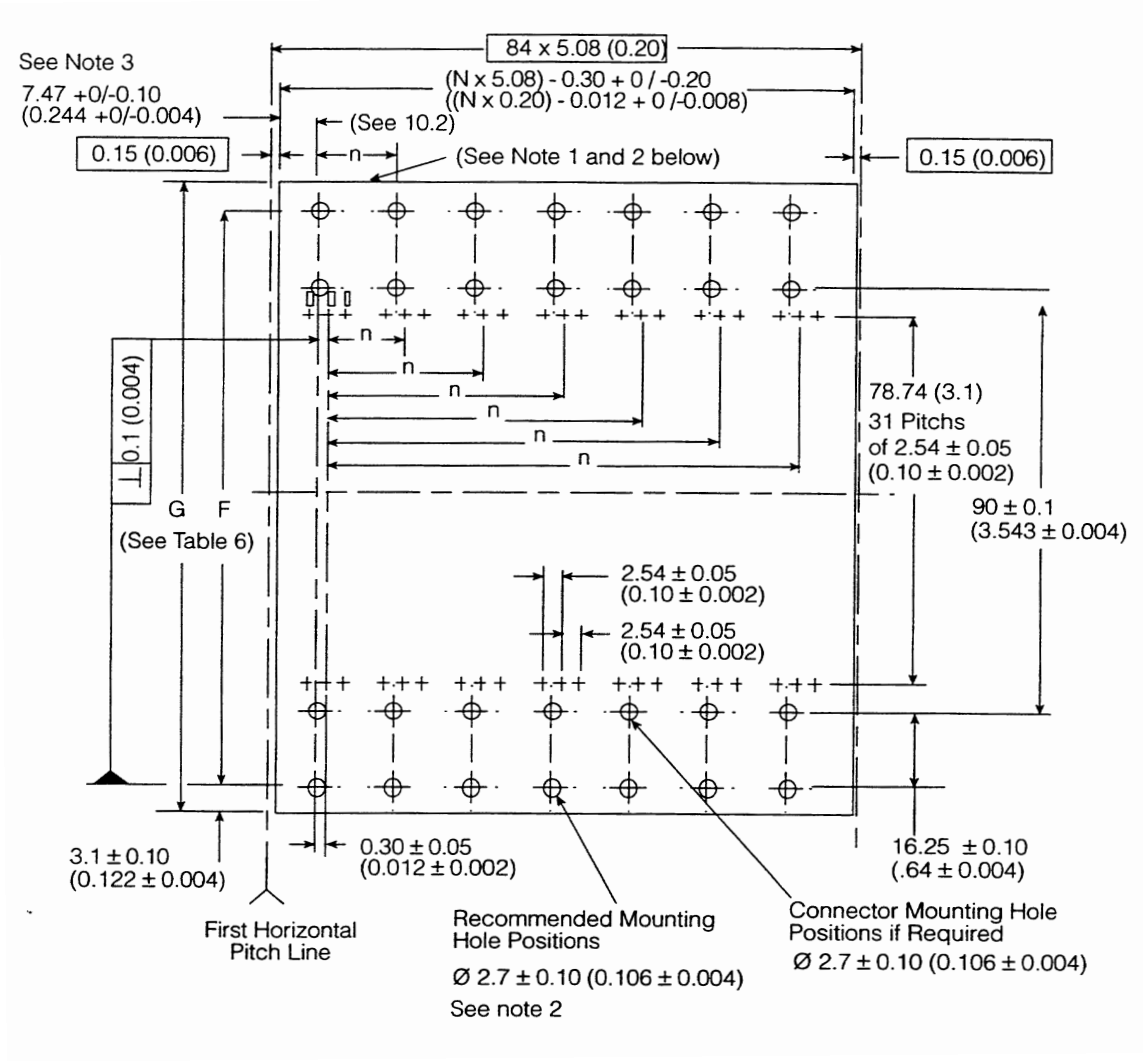
NOTE—See 9.2, item 5).

Figure 22—Box-type, box/board-type plug-in unit, double-height side view



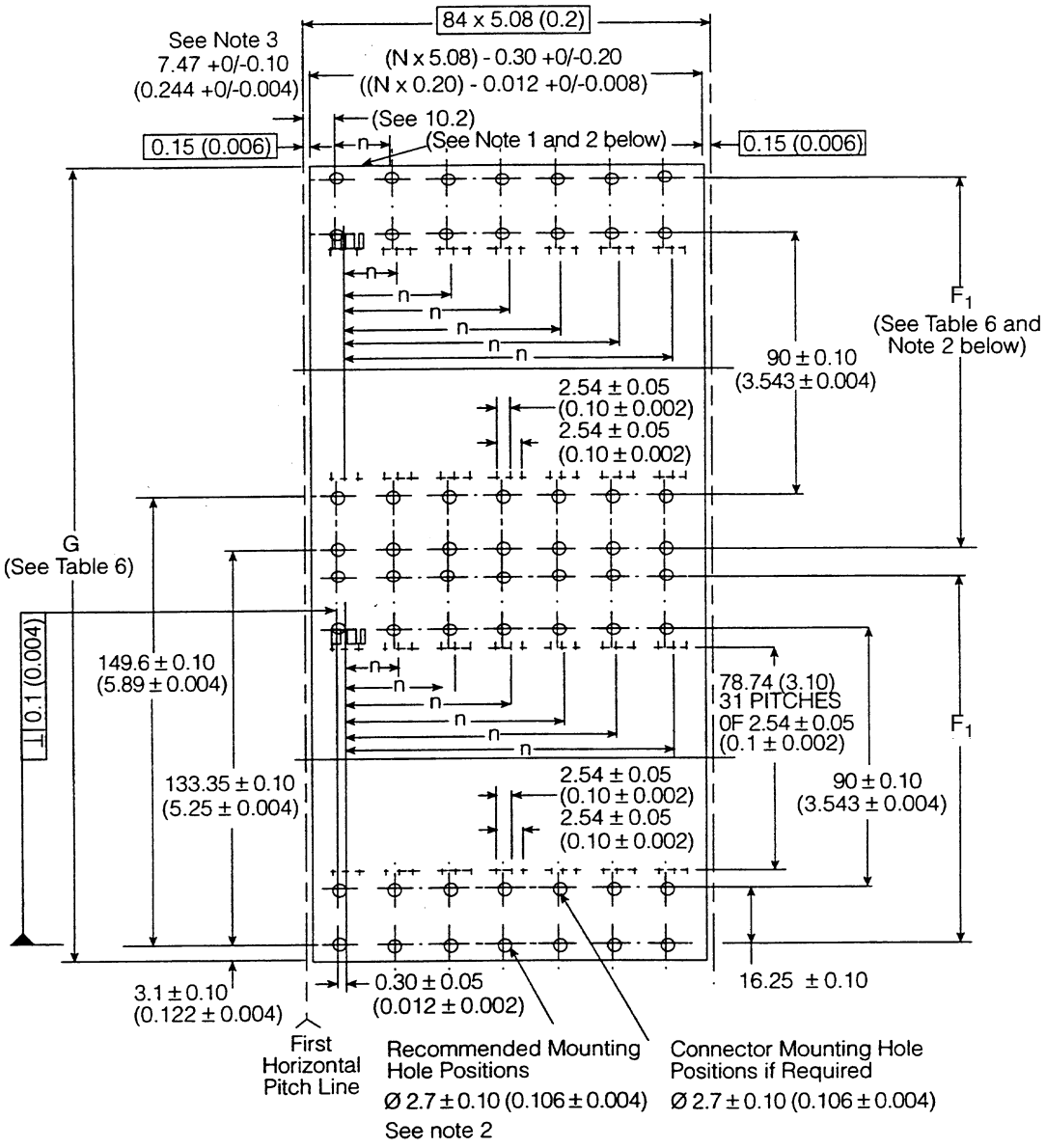
NOTE—See 9.2, item 5).

Figure 23—Box-type, box/board-type plug-in unit, triple-height side view



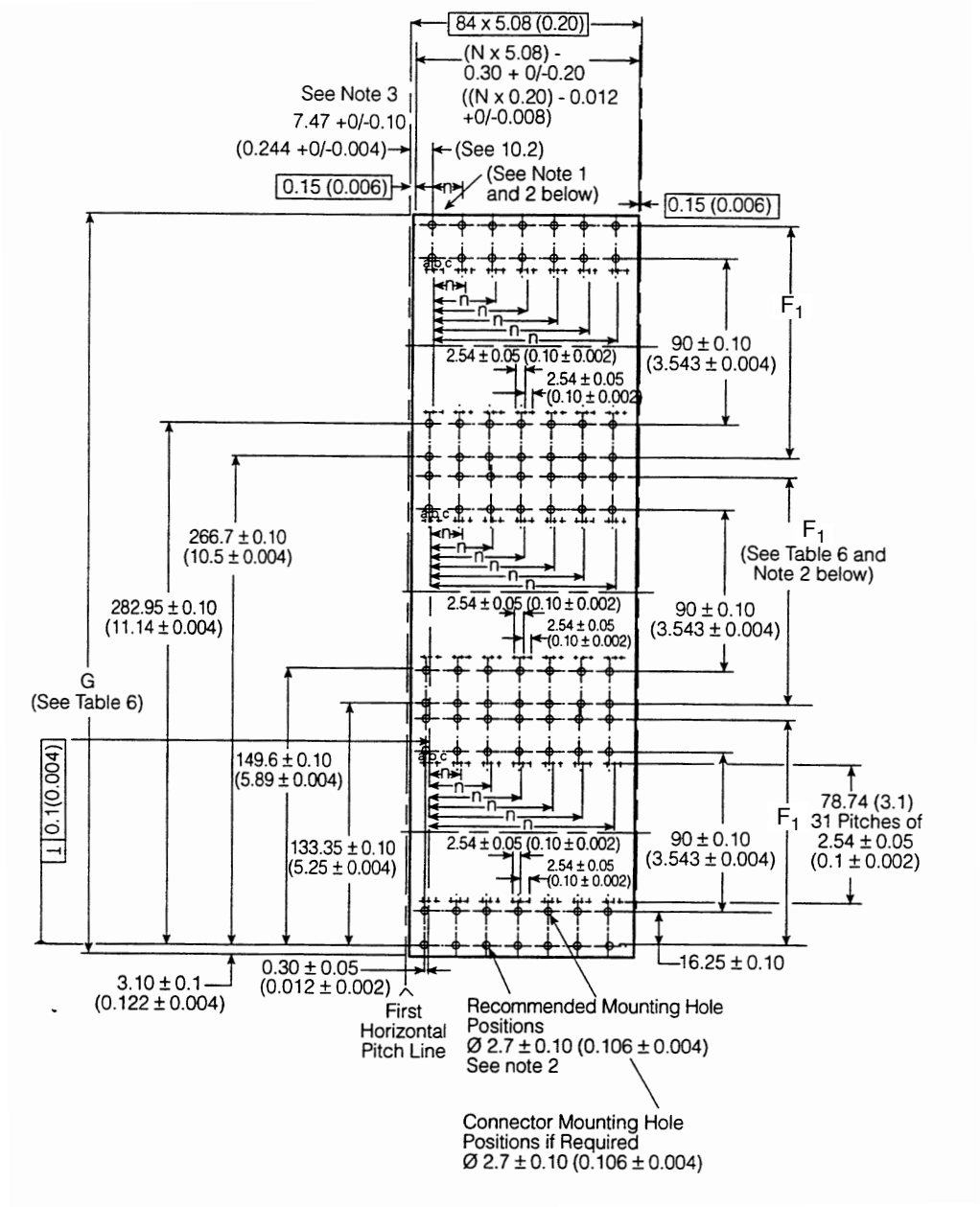
NOTES
1—n = N × 5.08 ± 0.1 (0.2 ± 0.004)
2—The distance between the subrack mounting holes has to be chosen to give adequate support to the backplane.
3—The dimension 7.47 mm (0.294 in) indicates the first specified mounting position of the backplane to the subrack and the connector to the backplane. Other dimensions are also possible and may be defined by other relevant standards or are to be agreed upon by vendor and user.

Figure 24—Single-height backplane



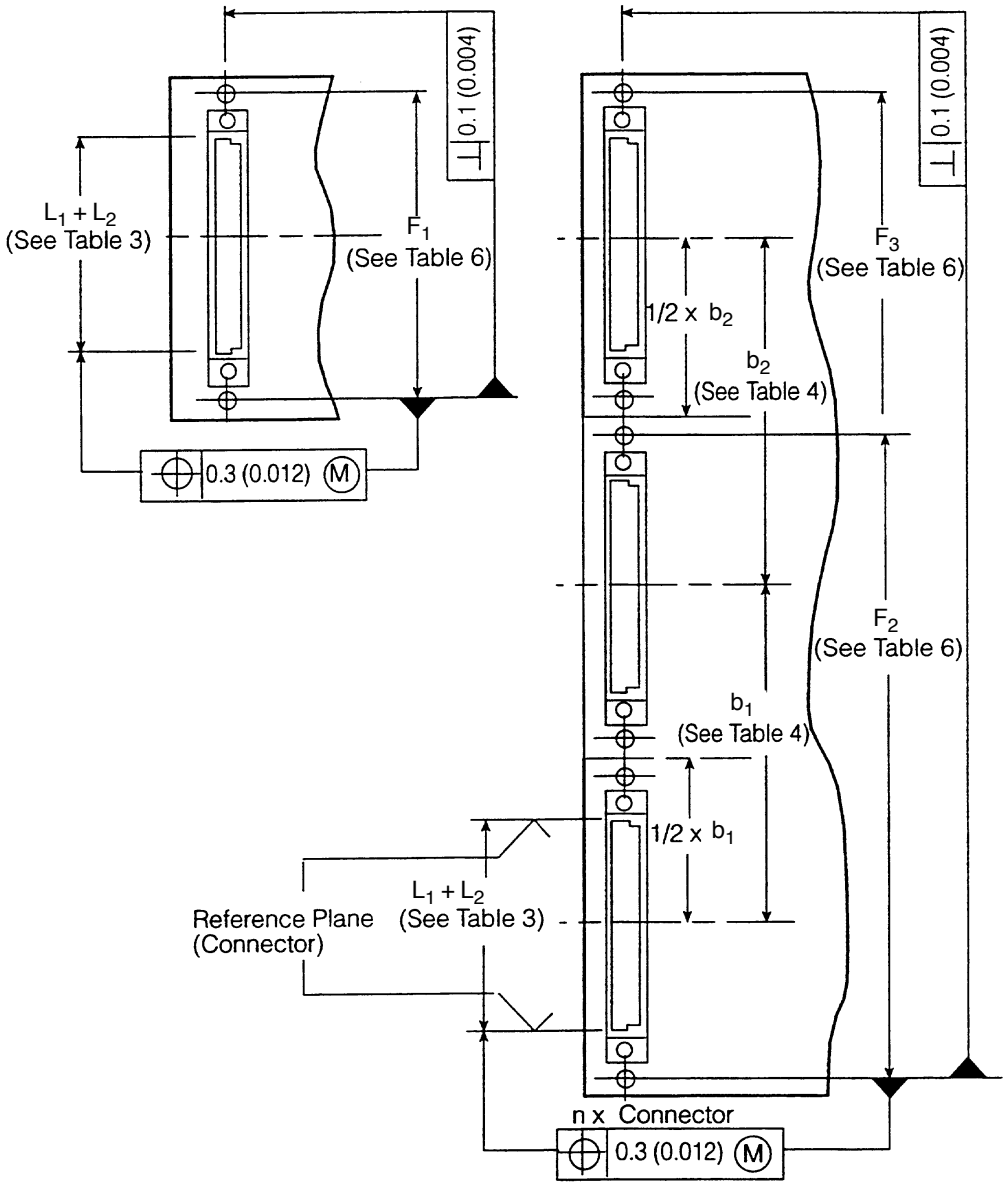
NOTES
1—n = N × 5.08 ± 0.1 (0.2 ± 0.004)
2—The distance between the subrack mounting holes has to be chosen to give adequate support to the backplane.
3—The dimension 7.47 mm (0.294 in) indicates the first specified mounting position of the backplane to the subrack and the connector to the backplane. Other dimensions are also possible and may be defined by other relevant standards or are to be agreed upon by vendor and user.

Figure 25—Double-height backplane



NOTES
1—n = N × 5.08 ± 0.1 (0.2 ± 0.004)
2—The distance between the subrack mounting holes has to be chosen to give adequate support to the backplane.
3—The dimension 7.47 mm (0.294 in) indicates the first specified mounting position of the backplane to the subrack and the connector to the backplane. Other dimensions are also possible and may be defined by other relevant standards or are to be agreed upon by vendor and user.

Figure 26—Triple-height backplane



NOTE—Fixtures are required when mounting connectors on double- and triple-height backplanes, and when backplanes are mounted to the subrack. For backplane flatness/bow see Clause 11, item 8).

Figure 27—Position of connectors on backplane

11. Subracks

For the purposes of this standard, a typical subrack is considered as being comprised of horizontal members secured between two side plates. The side plates have right-angled flanges equivalent to the extremities of the panels shown in IEC 60297-1 (1986-09) and ANSI/EIA 310-D-1992, and may be integral with the side plate, or may be a separate item bolted to the side plate of subracks having a working aperture of 84 HP (horizontal pitches) in conformity with IEC 60297-3 (1984-01). Other widths (non-nineteen inch) must be integer increments of 1 HP = 5.08 mm (0.2 in).

Basic subrack dimensions are as follows:

1) Clearance for printed board ejectors, etc.
2) The position of the component side of the first printed board is 4.07 mm (0.160 in), and increments of 5.08 mm (0.2 in) thereafter. The component side surface remains static when using thicker boards. See 6.3.
3) Side plates may be extended beyond the rear attachment plane. A dimension of 60 mm (2.362 in) generally provides adequate connector pin protection. The rear edge of a non-extended side plate need not coincide with the rear attachment plane.
4) The detail shown in Figure 28, item Z for recessed panels is preferred and should be considered when designing the horizontal member.
5) Tolerance is as per IEC 60603-2 (1995-09).
6) See IEC 60297-1 (1986-09) and ANSI/EIA 310-D-1992 for subrack mounting details.
7) Dimension from component side to the connector mounting hole.
8) When calculating static and dynamic backplane bow, the tolerances of D are applicable.
9) IEC 60297-3 (1984-01) and IEEE Std 1101.1-1991 show a D_c dimension of 175.24 mm (for example) and a tolerance of +0.86 mm (+0.034 in) and –0.14 mm (–0.006 in). This unsymmetrical tolerance was of historical nature with no explanation. The dimensions and tolerances have been symmetrically redistributed. See IEEE Std 1101.11-1998.

Table 7—Subrack rear attachment plane and connector mounting plane

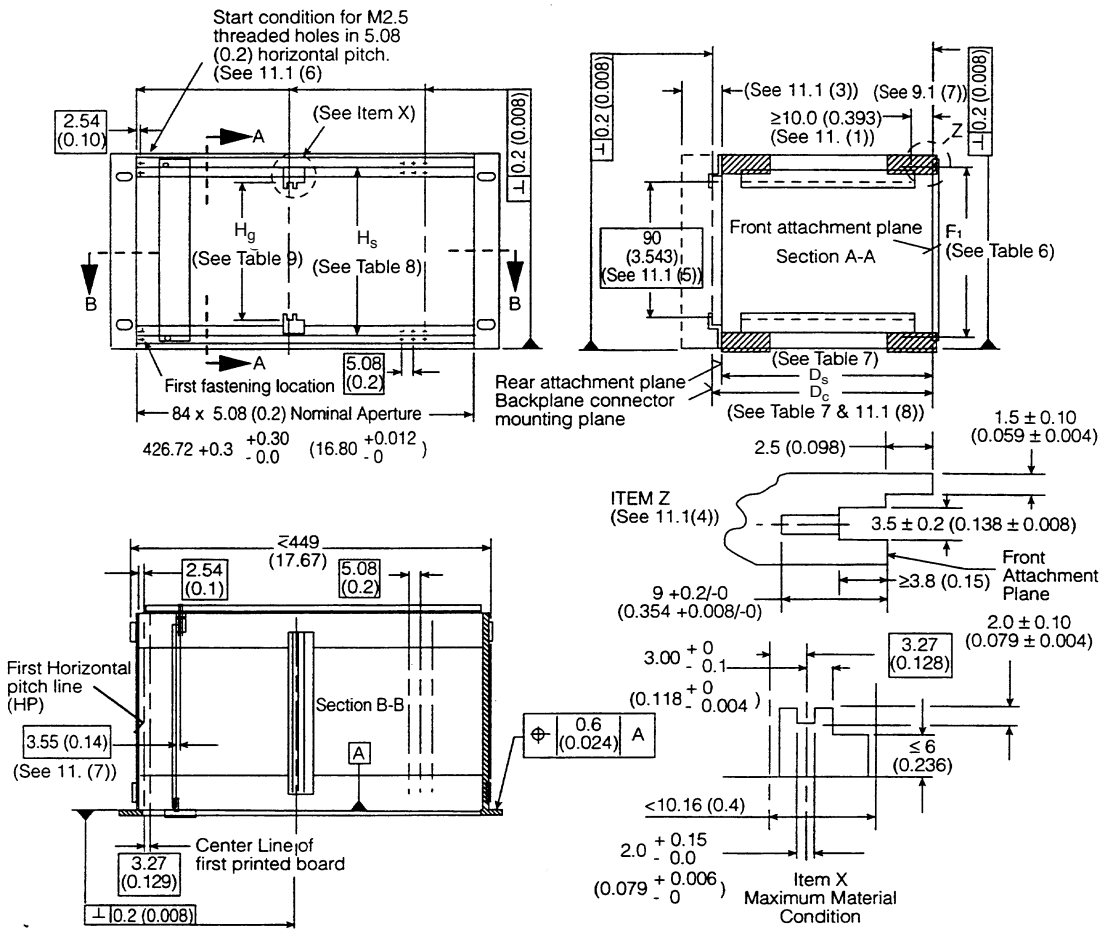
Reference Board Depth –D_b	100	160	220	280	340	400
D_s ± 0.5 mm (0.02 in)	112.24 mm	172.24 mm	232.24 mm	292.24 mm	352.24 mm	412.24 mm
	(4.419 in)	(6.781 in)	(9.143 in)	(11.506 in)	(13.868 in)	(16.230 in)
D_c ± 0.5 mm (0.02 in) See Clause 11, item 9)	115.60 mm	175.60 mm	235.60 mm	295.60 mm	355.60 mm	415.60 mm
	(4.551 in)	(6.913 in)	(9.275 in)	(11.637 in)	(14.000 in)	(16.362 in)

Table 8—Subrack amperture height

Reference Subrack Height-U	3	6	9
H_s IEC 60297-3 (1984-01)]	112.00 mm	245.35 mm	378.70 mm
	(4.409 in)	(9.659 in)	(14.909 in)

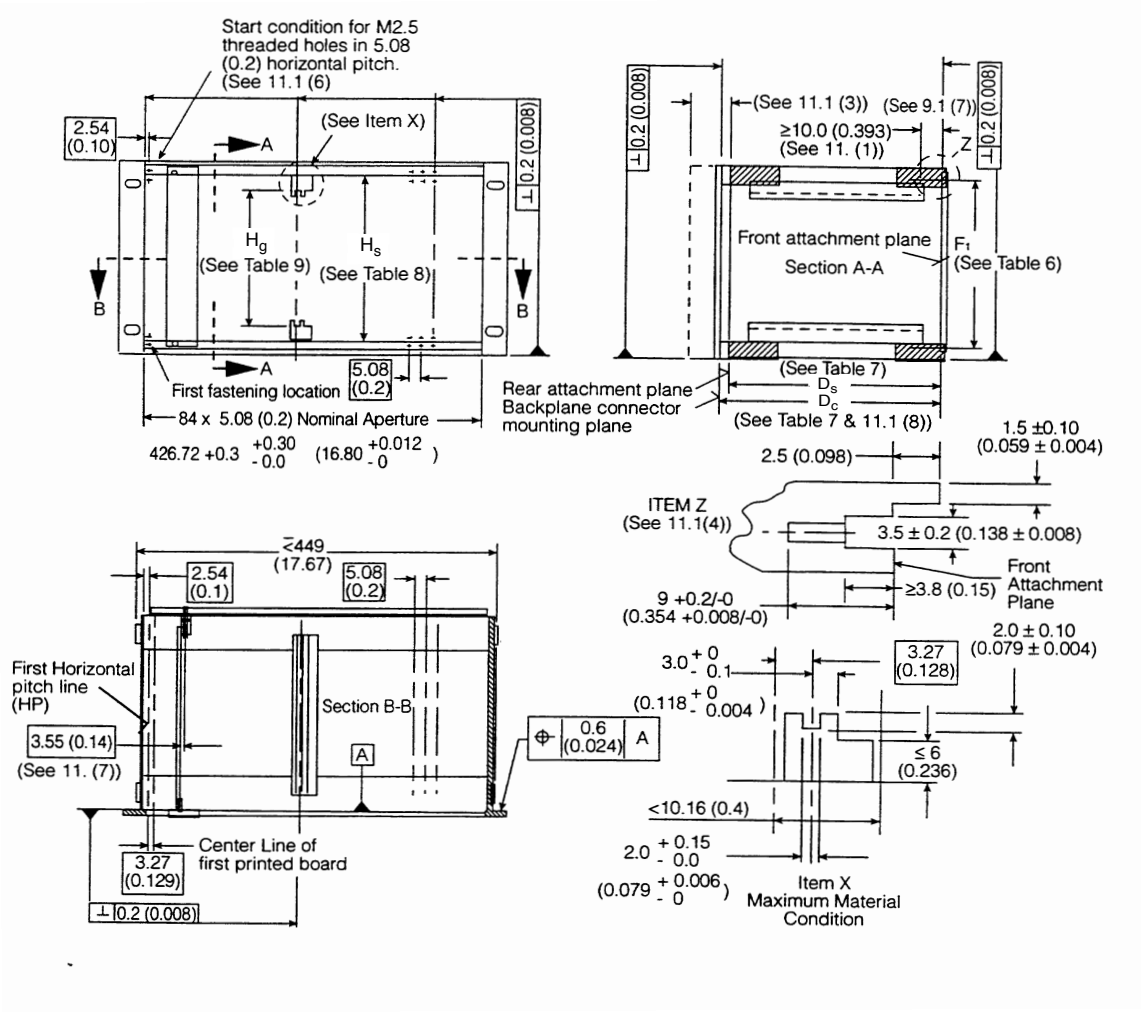
Table 9—Subrack board guidance height

Reference Subrack Height-U	3	6	9	12
H_g + 0.4 mm (0.016 in) –0(0)	100.2 mm	233.55 mm	366.9 mm	500.25 mm
	(3.945 in)	(9.195 in)	(14.445 in)	(19.695 in)



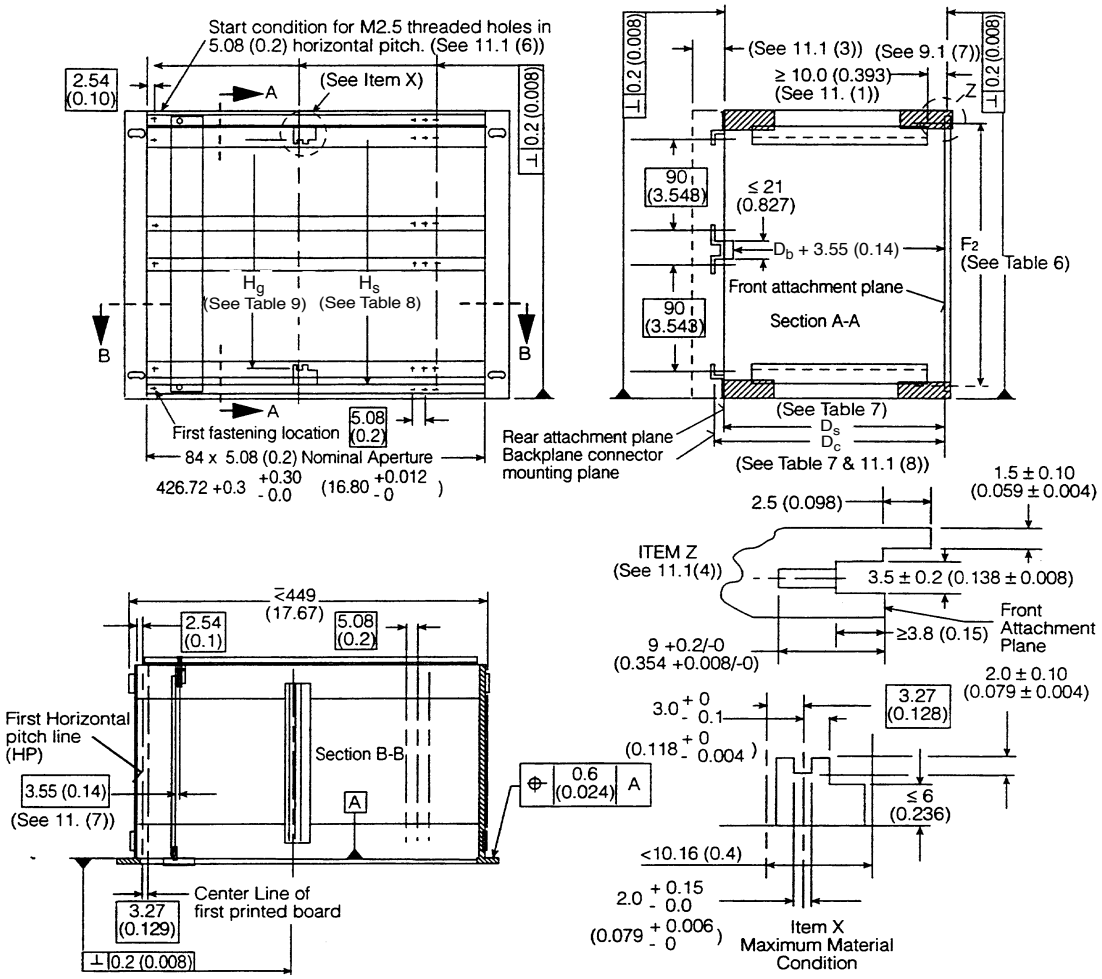
NOTE—See Clause 4, Note 5.

Figure 28—Single-height subrack individual connector mounting



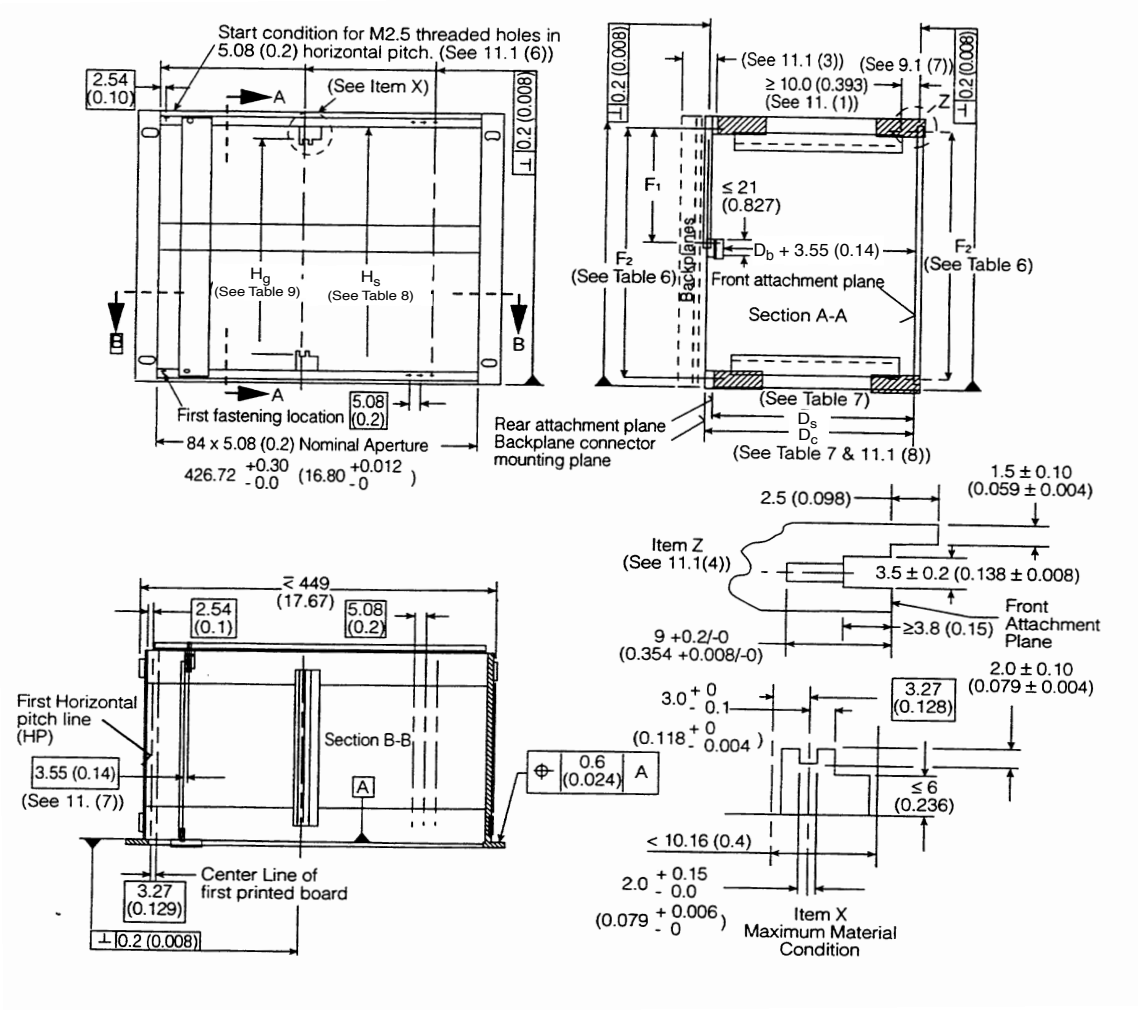
NOTE—See Clause 4, Note 5.

Figure 29—Single-height subrack individual connector mounting



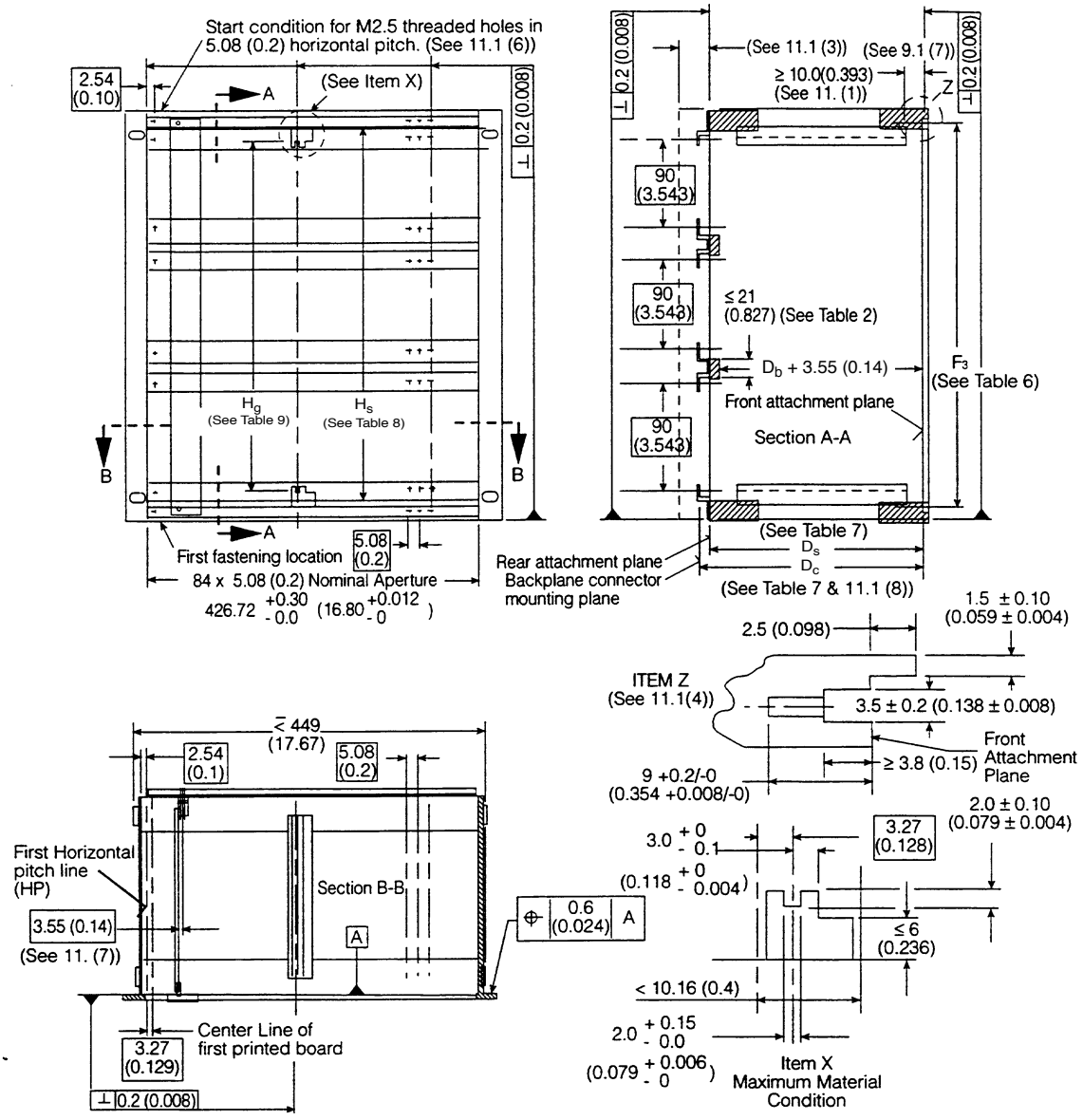
NOTE—See Clause 4, Note 5.

Figure 30—Double-height subrack individual connector mounting



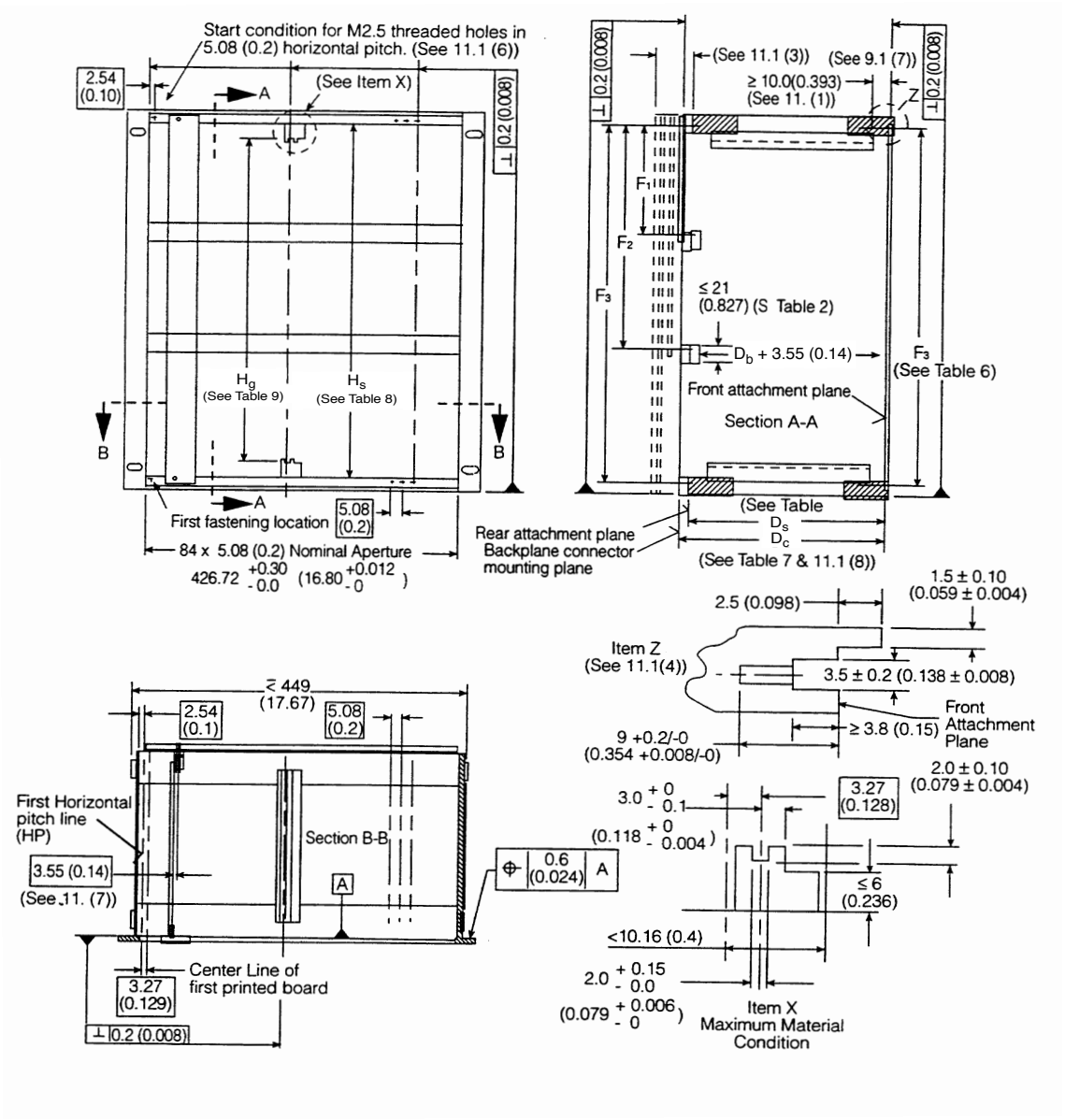
NOTE—See Clause 4, Note 5.

Figure 31—Double-height subrack backplane mounting



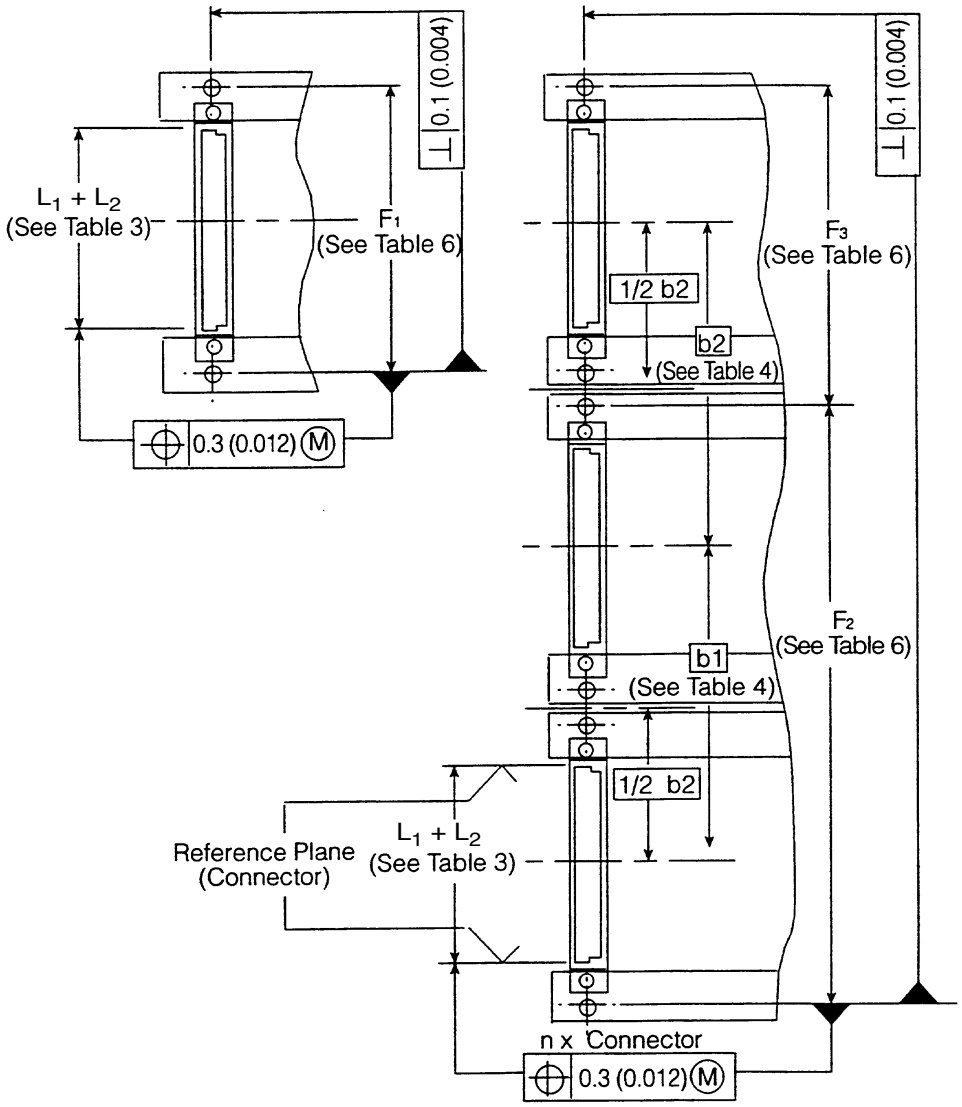
NOTE—See Clause 4, Note 5.

Figure 32—Triple-height subrack individual connector mounting



NOTE—See Clause 4, Note 5.

Figure 33—Triple-height subrack backplane mounting



NOTE—Fixtures are required when mounting connectors on double- and triple-height backplanes.

Figure 34—Position of connectors on subracks (without backplane)

12. Environmental specifications

12.1 Introduction

It is the purpose of this standard to ensure a minimum level of physical integrity and environmental performance in mechanical subracks, plug-in units, and backplanes, while taking into account the need for different levels of performance in different applications.

To provide a consistent and repeatable method for ensuring a minimum level of integrity and environmental performance during storage, handling, and transport, this clause details a standard test sequence that all subracks, plug-in units, and backplanes specified in this standard shall be capable of passing.

In order to provide maximum compatibility with existing IEC standards, this standard refers to the IEC 60068, Environmental Testing Procedures series of documents. Where differences exist between this standard and the IEC 60068 publications, this standard shall take precedence.

It is the system designer's responsibility to evaluate the correspondence between the system's plug-in units and subracks, and the system's environment.

12.2 Climatic tests

These tests are to be undertaken under non-operating conditions.

12.2.1 Steady cold

This test is in accordance with IEC 60068-2-1 (1990-05); –40 °C for 72 hours.

12.2.2 Steady dry heat

This test is in accordance with IEC 60068-2-2 (1974-01); +70 °C for 96 hours.

12.2.3 Cyclic damp heat

This test should be run varying from +25 °C to +40 °C at 95% relative humidity for 21 days.

12.2.4 Salt mist

This test is in accordance with IEC 60068-2-11 (1981-01); 5% for 96 hours (crevice corrosion testing).

12.3 Mechanical load

Test condition.

12.3.1 Load per 1 HP (84 HP available)

See Table 10.

NOTE—Filler panels and plug-in unit front panels shall be bolted onto the subrack.

Table 10—Mechanical loading per 1 hp

Subrack U × D_c	Board size H_b × D_b	Load/HP = N
3 × 175.60	100 × 160	1.0
6 × 175.60	233.35 × 160	1.0
9 × 175.60	366.70 × 160	1.0

12.3.2 Mounting configuration and axis

Test condition. (See Figure 35.)

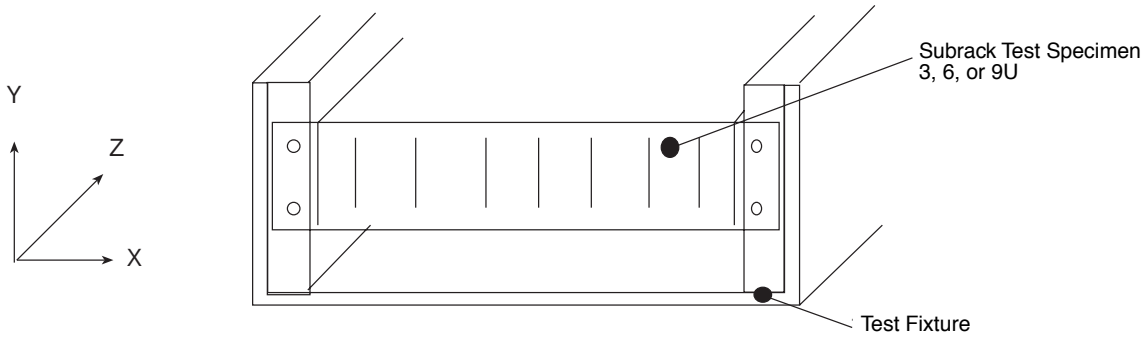
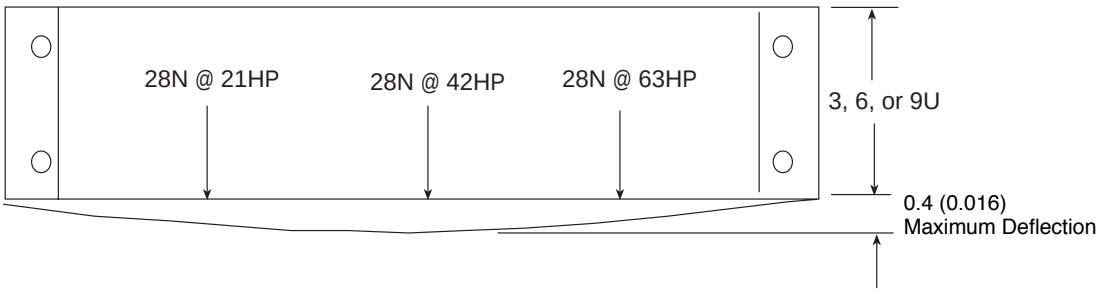


Figure 35—Mounting configuration and axis

12.3.3 Load distribution

Test condition. (See Figure 36.)



NOTE—Subracks deeper than D_c = 175.60 mm (D_b = 160 mm) and with an acceleration above 3 g may have to be additionally supported.

Figure 36—Load distribution

12.4 Vibration

1) Tests for sinusoidal vibration are per IEC 60068-2-6 (1995-03).
2) Initial resonance search: X, Y, and Z directions.
3) Endurance condition by sweeping: 10-55 Hz, 0.15 mm, 2 9.8 m/s^2 as a minimum, for sweeps 17.9 m/s^2 is suitable for applications such as placement next to rotating machineries, etc.
4) Endurance condition at resonance frequency: 10 min each direction.

12.5 Shock

Tests of shock is as per IEC 60068-2-27 (1987-06), 100 m/s^2 at 11 ms at 3 × 1000 shocks.

12.6 Safety tests

12.6.1 Earth resistance

See IEC 61010-1 (1990-09). There must be electrical continuity between all metallic elements of the subrack. The resistance of the connection between the protective earthing terminal or earthing contact and parts required to be earthed shall be less than 0.1 Ω. Front panels of subracks and plug-in units may optionally be continuous with the subrack, depending on application.

12.6.2 Flammability of plastic materials

See IEC 60707 (1981-01). Materials shall have a flammability classification of FV2 or better. [See Test 9 of IEC 60707 (1981-01).]

12.6.3 Transport recommendation

Transport test parameters for a subrack mounted in a 19 in cabinet [tests based on IEC 60068-2-27 (1987-06)] are shown in Table 11.

Table 11—Transport test parameters

Test	Mass	Frequency	Maximum Amplitude	Maximum Acceleration
Transport	30 kg	10–150 Hz	0.35 mm	50 m/s^2
Transport	30–100 kg	10–55 Hz	0.15 mm	17.9 m/s^2

12.6.4 Mass >30 kg

In practice, transport occurs mostly in systems with a total mass of >30 kg. As lower mechanical forces at this mass can be expected, less stringent tests are required (10–55 Hz, 0.15 mm).

12.6.5 Mass <30 kg

For objects with a mass of <30 kg, when mounted in a standard 19 in cabinet, additional supports are required. Mechanical vibration tests (50 m/s^2, 0.35 mm) have to be carried out.

12.6.6 Electromagnetic interference/radio-frequency interference (EMI/RFI)

Subracks as specified in this standard are of open construction, and by their nature offer no protection against incoming and transmitting interferences. Plug-in unit metal front panels and metal filler panels offer only limited protection when the subrack is mounted in a case or cabinet without a door. Three places that the system's designer can provide features that will reduce RFI emissions to allow the system to meet standard requirements (such as those specified in CFR Title 47, Part 15J) are the circuit board, the subrack, and the system enclosure.

RFI reduction techniques are usually a combination of grounding and shielding. The system designer must provide sufficient reduction to pass inspection, but must also stay within a cost budget. In order to intelligently apply the techniques at his or her disposal, the system designer needs to know the sources of radiation, its magnitude, and specific frequencies involved.

— *Recommendation 1:* The subrack should be made of metal so that the chassis ground is conveyed to all frame components.

— *Recommendation 2:* Clarify board specifications to allow and designate areas on the board outline that would provide connection to the chassis on three edges of the board. A board that has grounding only on one edge can act as a quarter-wave antenna when it is radiating. A board that is grounded at two opposite edges would radiate as a half-wave antenna, tuned to twice the frequency of the quarter wave mode. The mounting pads that attach the front panels can be used as grounding points. The edges of the board that go into the board guide could be used as additional grounding points. The circuit board manufacturer may either directly connect logic ground to chassis ground, or may connect it through a capacitor, which would allow a dc potential between ground and logic ground.

— *Recommendation 3:* The FCC or UL only requires certification of systems, not individual boards or components of the system. However, if board manufacturers publish the radiation characteristics of their boards, then the system designer would know the total sum of the individual components and a reasonable estimate of the required RFI reduction could be made.

— *Recommendation 4:* For subracks without bus bars for power and potential distribution it is recommended to distribute the potential in "star" routing to the supply source or the dedicated potential position of the case or cabinet in which the subrack is housed. All metallic parts of the mechanical/metal system should be electrically continuous. Connector cross sections must be of adequate thickness. Conductor cross sections should only be reduced from the source in the direction of the consumer.

12.6.7 Cooling

Subracks and plug-in units should be constructed in such a manner that obstructions to the airflow are avoided where possible.

High-density packaging does not necessarily save space or cost, as space consuming and costly forced cooling/ventilation systems are often required, and may consist of the following:

1) Natural convection
2) Forced air circulation
3) Forced fresh air intake/circulation
4) Heat exchangers suitable for sealed cabinets
5) Air conditioners suitable for sealed cabinets

The appropriate cooling method has to be chosen and calculated pending system construction, system application, and ambient air temperature.

The following typical noise levels are given as examples of various environments, and should be used as a guide when designing-in air moving equipment:

55 dB (A)—Concentration environment
70 dB (A)—Office environment
85 dB (A)—Industrial working environment

Blowers transmit a mix of frequencies, and these individual frequencies show different amplitudes. [See IEC 60651 (1979-01)].

Annex A

(informative)

Bibliography

[B1] IEC 60050, International Electrotechnical Vocabulary.

[B2] IEC 60917-1 (1998-09), Modular order for the development if mechanical structures for electronic equipment practices—Part 1: Generic standard.

[B3] ISO 1101:1983, Technical drawings—Geometric tolerancing—Tolerancing of form, orientation, location and run-out—Generalities, definitions, symbols, indications on drawings.[6]

[6]ISO 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.