IEEE Standard for a Common Mezzanine Card (CMC) Family

Sponsor

Microprocessor & Microcomputer Standards Committee (MMSC)

of the

IEEE Computer Society

Approved 14 June 2001

IEEE-SA Standards Board

Abstract: The mechanics of a common mezzanine card (CMC) family are defined in this standard. Mezzanine cards, designed to this standard, can be used interchangeably on VME, VME64 and VME64x boards, CompactPCI® boards, Multibus® I and II boards, desktop computers, portable computers, servers, and other similar types of applications. Mezzanine cards can provide modular front panel I/O, backplane I/O or general function expansion or a combination for host computers. Single, wide mezzanine cards are 75 mm wide by 150 mm deep by 8.2 mm high.
Keywords: backplane I/O, bezel, board, card, CompactPCI, face plate, front panel I/O, host computer, I/O, local bus, metric, mezzanine, module, modular I/O, Multibus, PCI, VME, VME64, VME64x, VMEbus

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Introduction

[This introduction is not part of IEEE Std 1386-2001, IEEE Standard for a Common Mezzanine Card (CMC) Family.]

The primary goal of this standard is to provide the mechanics of a mezzanine card family that can be deployed on a variety of different host computer platforms. These mezzanine cards can be used to provide front panel I/O, rear panel I/O, additional local host functions, or a combination of all three. The mezzanine card's local bus can be PCI, SBus, or other local buses as they are developed in the future. The secondary goal of this standard is to have only one mezzanine card mechanical definition for a specific type of local bus, instead of multiple mechanical implementations as in the past. Multiple mechanical implementations fragment the market and destroy economies of scale for manufacturing, engineering, sales, and marketing. A single mechanical definition builds larger markets with many more unique functions for the multitude of user applications, and at a lower price. Both the suppliers and users win by enjoying the benefits of a larger unified market.

SBus Historical: In 1993 when the effort to develop a mezzanine card standard was started, there seemed to be a market need to shrink the SBus (IEEE 1496) mechanical form factor so that it would fit in a single VME board slot. (SBus cards are 20.32 mm high and take up a second VME slot when attached to a VME host board.) A SBus mezzanine card (SMC) draft child standard was developed and reached the sponsor ballot phase (see Section 1.5 for the definition of child standard). This draft standard, IEEE P1386.2, was titled "Draft Standard Physical and Environmental Layers for SBus: SMC." Due to the overwhelming popularity of the PCI local bus, no market interest developed for the single slot SBus version, SMC. IEEE P1386.2 was dropped as a proposed IEEE standard in the summer of 1996.

Futurebus® Historical: In 1993 most of the core Futurebus+ (IEEE 896.x) standards had been completed. At that time there seemed to be a reasonable market interest in the Futurebus+ architecture. The mechanics of placing mezzanine cards on Futurebus+ modules was included in the core IEEE P1386 Draft 2.0 mechanical definition. Unfortunately, the market for Futurebus+ never developed. During this standard's sponsor ballot phase, it was decided to remove all references to Futurebus+ in both the IEEE P1386 and IEEE P1386.1 draft standards. Since the extended CMC form factor (250 mm deep) version was specified mainly for the Futurebus+ applications, it was also dropped from both IEEE P1386 and IEEE P1386.1. As a result, only two CMC form factors are defined: single width and double width.

CompactPCI® Historical: After the first sponsor ballot in April 1995, a new bus architecture was introduced to the market that rapidly gained large market interest. CompactPCI transformed the PCI local bus into a backplane bus with a maximum of eight slots. CompactPCI board, backplane, and subrack mechanics are the same as VME64x, except for the backplane connectors. All the board and subrack mechanics defined for the VME64x architecture apply directly to CompactPCI. VME64x provides 205 user-defined I/O pins through the backplane, and CompactPCI provides 315 user-defined I/O pins through the backplane. The PCI Industrial Computers Manufacturers Group (PICMG) is responsible for the promotion and maintenance of the CompactPCI specifications.

Routing of PCI mezzanine cards (PMC) I/O to the rear of CompactPCI boards is defined and controlled by PICMG. Detailed specifications are available on the World Wide Web at the following URL: http://www.picmg.com.

Special thanks are due to Dave Moore, original Working Group Technical Editor of IEEE Std 1386-2001, for the generation of the many drafts; to Eike Waltz for the key mechanical designs of the CMC; and to Dave Rios on the connector design. Heinz Horstmeier, Cliff Lupien, Harry Parkinson, Rick Spratt, and Chau Pham are also to be thanked for their contribution to the development of this standard.

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Contents

IEEE Standard for a Common Mezzanine Card (CMC) Family

1. Overview

1.1 Scope

This standard defines the mechanics for a common set of slim mezzanine cards that can be used on VME, VME64 and VME64x boards, CompactPCI® boards, Multibus® I and II boards; desktop computers; portable computers; servers; and other similar computer applications. Mezzanine cards based on this standard can be used to provide modular front panel I/O, backplane I/O, or general function expansion for the host computer.

1.2 Purpose

The majority of the popular reduced instruction set computer (RISC) and complex instruction set computer (CISC) microprocessors use the same logical and electrical layer for their high-speed local bus. These same processors are being incorporated onto VME64x boards, CompactPCI boards, Multibus I and II boards, desktop computers, portable computers, servers, and other types of computer systems. There is a large market need for modular I/O and modular local function expansion via slim mezzanine cards mounted parallel above the host computer's board.

This standard defines the mezzanine card mechanics for these types of applications. This mechanical definition is based on IEEE Std 1301.4-1996.[1]

1.3 General arrangement

Mezzanine cards are intended to be used where slim parallel-card mounting is required as in embedded single-board computers, desktop computers, portable computers, and servers. Figure 1 illustrates a single-size and a double-size mezzanine card defined by this standard.

Typical single- and double-size common mezzanine cards (CMCs) on VME64x boards are illustrated in Figure 2. Implementation of CMCs on CompactPCI and Multibus II boards is similar to that of 6U VME64x boards except that Multibus II boards are 220 mm deep and CompactPCI boards use a 2 mm connector system. CMCs can also be used on 3U VME64x and CompactPCI boards.

[1]Information on references can be found in Clause 2.

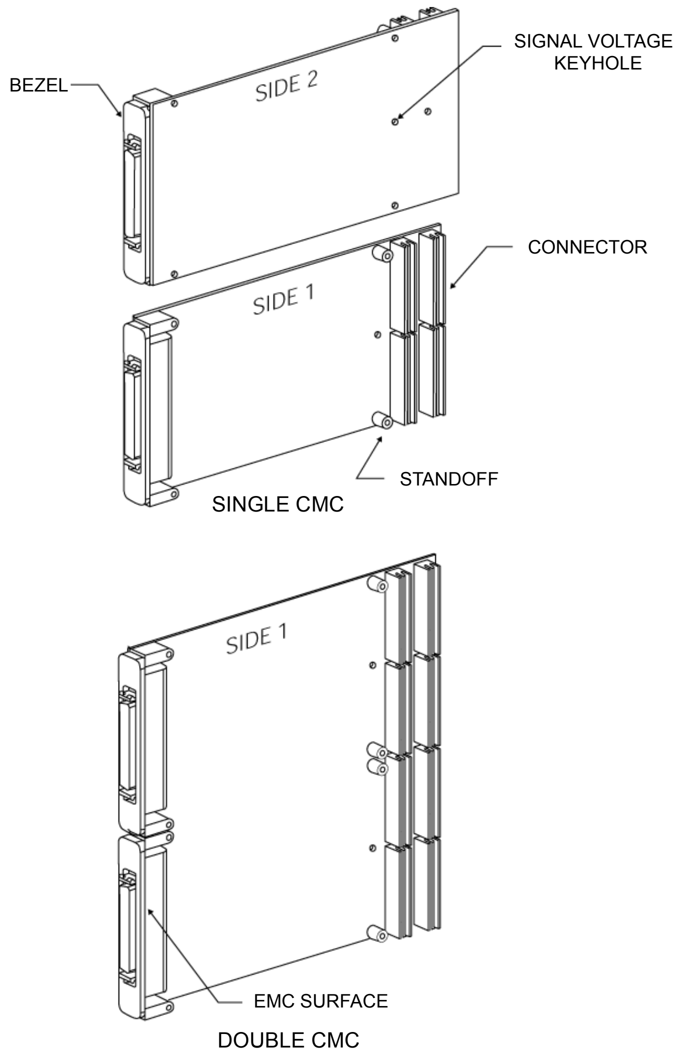

Figure 1—Typical single and double CMC

Multibus I boards do not use front panels. The I/O is via the top edge of the board. Figure 3 illustrates a single CMC and two single CMCs on a Multibus I board.

The size and shape of desktop computers, portable computers, servers, and other similar types of computers vary considerably, depending on specific target markets and associated needs. Figure 4 illustrates how a CMC could be mounted inside a desktop or portable computer host. The I/O panel arrangement would be similar to one already illustrated.

1.4 Theory and operation of usage

CMCs are designed to be plugged into a slot above the host's printed circuit board (PCB). The host may place low height components under the mezzanine card for additional functionality. The host is to provide one or more slot openings into which the mezzanine cards are plugged. The host slot opening provides mechanical support, as well as EMI shielding. For maximum utilization of component space, the mezzanine

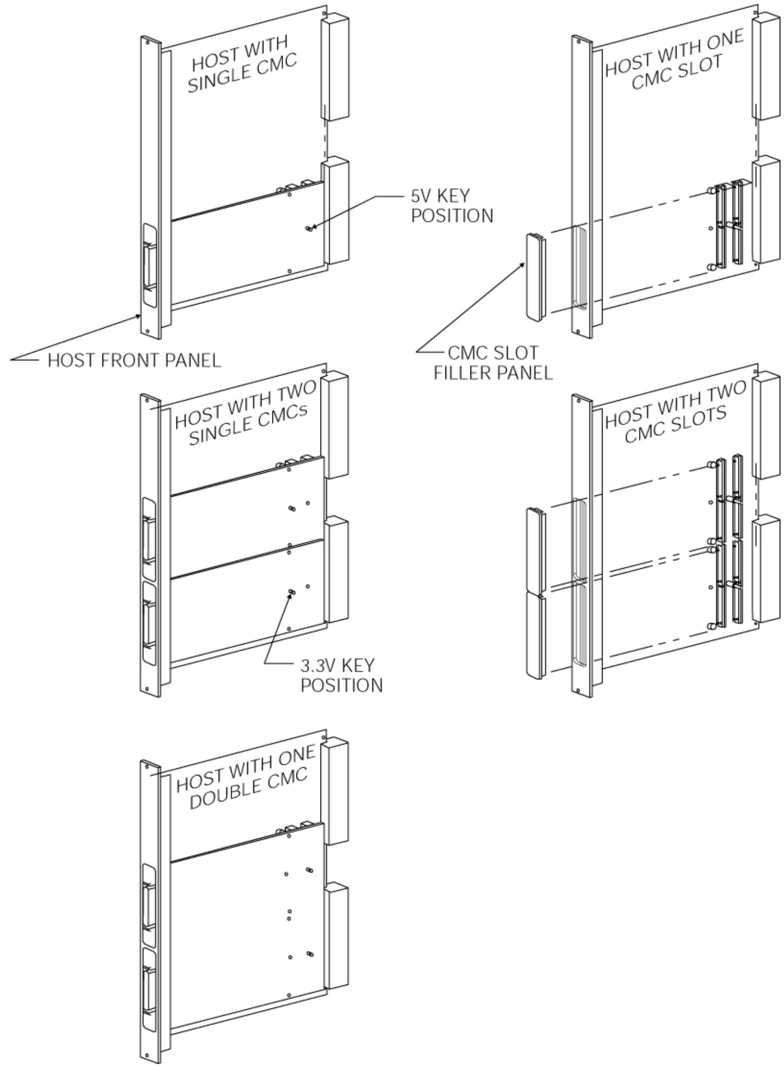

Figure 2—Typical single and double CMC on a 6U VME64x host

card is typically placed such that the major component side of the mezzanine card faces the major component side of the host computer's main board.

The local bus interface to the host computer is provided via one or more connectors between the mezzanine card and the host board. These connectors reside on the rear of the mezzanine card.

The I/O off the mezzanine card can be via the front panel (bezel) or via one or more of the mezzanine card connectors. If the I/O is through the mezzanine card connector, the I/O is generally routed to the host computer's backplane, as is commonly done on VME64x, CompactPCI, and Multibus I and II based computer systems.

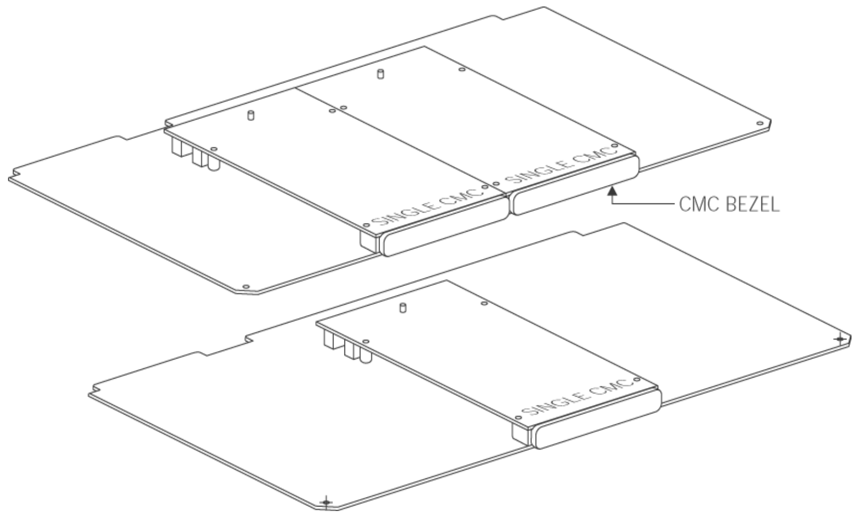

Figure 3—Typical one or two single CMCs on Multibus I host

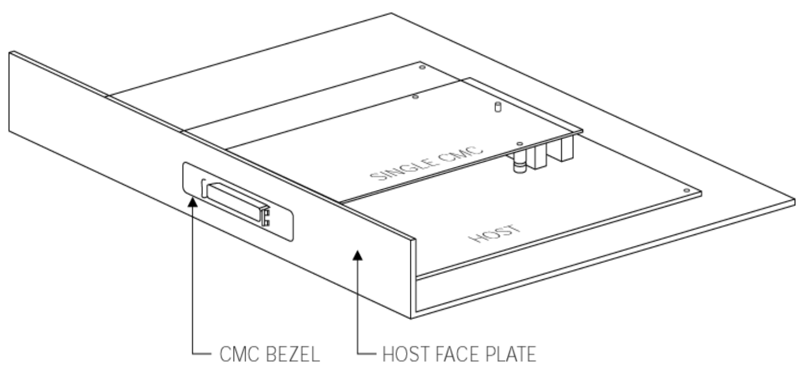

Figure 4—Typical CMC in a desktop or portable computer host

1.5 Parent-child standard

This standard acts as a parent standard to one or more child standards. At the time this standard was developed and approved, one child standard was developed and approved simultaneously, which is the IEEE Std 1386.1-2001. IEEE Std 1386.1-2001 provides the specific connector pin assignment of the PCI local bus, as it is routed onto the mezzanine card. In the future, additional child standards can be developed that use the basic mechanical definition (from this standard), but have different local buses.

Note that IEEE Std 1386.1-2001 references other standards or specifications for the definition of the local bus's logical and electrical layers.

1.6 Conformance

A vendor of mezzanine cards or host computers (or host peripherals) may claim compliance with this standard only when the complete mechanical interface is met.

1.7 Dimensions

All dimensions in this standard are in millimeters (mm) unless otherwise specified. Drawings are not to scale. First-angle projection has been used throughout this standard.

1.8 Coordinate dimensions

The coordinate dimensions define the actual dimensions of a 25 mm metric equipment practice. These actual dimensions are derived from coordination dimensions using the principle of boundary and axis references illustrated in IEEE Std 1301-1991 and IEC 60917-2-1-1993.

Overall dimensions and internal subdivisions are determined by using different increments or mounting pitches (mp1 = 25 mm, mp2 = 5 mm, mp3 = 2.5 mm, mp4 = 0.5 mm, and mp5 = 0.05 mm). These mounting pitches have been used to derive the key dimensions given in this standard. They are also used when extending this standard with additional dimensions (where such extensions are permitted) and when alternative positions of piece parts are described (in such cases, it is obvious that the relationships between involved dimensions shall be maintained).

2. References

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

ANSI/IEEE Std 796-1983, IEEE Standard Microcomputer System Bus.[2]

ANSI/IEEE Std 1014-1987 IEEE Standard for A Versatile Backplane Bus: VMEbus.[3]

ANSI/VITA 1-1994 VME64 Standard.[4]

ANSI/VITA 1.1-1997 VME64x Standard.

Bellcore GR-1089-CORE 1999 Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunications Equipment.[5]

EIA-700 AAAB 1996, 1.0 Millimeter, Two-Part Connectors for Use with Parallel Printed Boards.[6]

EN50082-1-1998 Electromagnetic Compatibility Generic Immunity Standard Part 1: Residential, Commercial and Light Industry.[7]

EN55022-1998 Information Technology Equipment. Limits and Methods of Measurement of Radio Disturbance Characteristics.

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[2]ANSI/IEEE Std 796-1883 has been withdrawn; however, copies can be obtained from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (http://www.ansi.org/).

[3]ANSI/IEEE publications are available from the Institute of Electrical and Electronics Engineers (IEEE), Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-133, USA, (http://standards.ieee.org/).

[4]ANSI/VITA publications are available VITA, 78 E. Gelding Drive, #104 Scottsdale, AZ 85260, USA (http://www.vita.com/).

[5]Bellcore publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (http://www.global.ihs.com/).

[6]EIA publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (http://www.global.ihs.com/).

[7]EN publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (http://www.global.ihs.com/).

EN55024-1989 Information Technology Equipment. Immunity Characteristics. Limits and Methods of Measurement.

ETSI EN300 386-2 1997 Electromagnetic Compatibility and Radio Spectrum Matters (ERM) Telecommunication Network Equipment; Electromagnetic Compatibility (EMC) Requirements; Part 2: Product Family Standard.[8]

FCC Part 15 of the Federal Communication Commission (FCC) Rules.[9]

IEC 60917-2-1-1993, Modular Order for the Development of Mechanical Structures for Electronic Equipment Practices – Part 2: Sectional Specifications Interface Coordination Dimensions for the 25 mm Equipment Practice Section 1.[10]

IEC 61587-1:1999 Part 1: Mechanical Structures for Electronic Equiment—Tests for IEC 60917 and IEC 60297—Part 1: Climatic, Mechanical Tests and Safety Aspects for Cabinets, Racks, Subtracks and Chassis.

IEEE Std 1101.1-1998, Mechanical Core Specification for Microcomputers using IEC 603-2 Connectors.[11]

IEEE Std 1101.10-1996, Specifications for Additional Mechanical Specifications using the IEEE 1101.1 Equipment Practice.

IEEE Std 1156.1-1993, IEEE Standard for Microcomputer Environment Specification for Computer Modules.

IEEE Std 1301-1991 IEEE Standard for a Metric Equipment Practice for Microcomputers-Coordination Document.

IEEE Std 1301.4-1996 IEEE Standard for a Metric Equipment Practice for Microcomputers-Coordination Document for Mezzanine Cards.

IEEE Std 1386.1-2001 IEEE Standard Physical and Environmental Layers for PCI Mezzanine Cards.

PICMG 2.0, R3.0 CompactPCI Core Specification.[12]

ISO/IEC 10861:1994 [ANSI/IEEE Std 1296-1994 Edition] IEEE Standard for a High-Performance Synchronous 32-Bit Bus: MULTIBUS II.

2.1 Trademarks

The following names used within this standard are trademarked:

CompactPCI® and PICMG® are registered trademarks of the PCI Industrial Computers Manufacturers Group.

[8]ETSI EN publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (http://www.global.ihs.com/).
[9]FCC rules are available on the World Wide Web from the following URL: http://www.fcc.gov.
[10]IEC publications are available from the American National Standards Institute, Sales Dept., 11 West 42nd Street, 13th Floor, New York, NY 10036.
[11]IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (http://standards.ieee.org/).
[12]PICMG publications are available from PCI Industrial Computers Manufacturing Group (PICMG), c/o Virtual, Inc., 401 Edgewater Place, Suite 500, Wakefield, MA 01880, USA (http://www.picmg.com/).

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2.2 Relationship between VME, VMEbus, VME64, VME64x, and CompactPCI

The original VME specification is specified by IEEE Std 1014-1987. A second generation VME standard was developed that expanded VME to a 64-bit address and data width bus architecture. It was developed by the VITA Standards Organization (VSO) and is called ANSI/VITA 1-1994, VME64 Standard. All of the original IEEE VME standard definition was incorporated in the VME64 standard. A third generation VME standard was developed called ANSI/VITA 1.1-1997, VME64 Extensions (VME64x) Standard. The standard added a variety of additional features, including an expanded 160 pin connector, a center 95 pin 2 mm connector, an EMC U-shaped front panel, ESD protection, +3.3 V & 48 V power, front panel keying, and so on.

All the mechanical features defined in the VME64x standard are utilized in the PICMG 2.0 R3.0. Mechanical placement of the CMCs on VME64x and CompactPCI 3U and 6U boards is exactly the same. The only difference is routing of the CMC's I/O through the rear backplane connectors. CMCs can be used on VME and VME64 boards with flat, front panels. There is less mechanical flex strength in the flat, front panels versus U-shaped front panels. The preference should be to use the U-shaped front panels, in all Eurocard type applications.

The terms *VME* and *VMEbus* mean the same thing and are used interchangeably.

3. Definitions, abbreviations, and terminology

3.1 Special word usage

3.1.1 shall: A key word indicating a mandatory requirement. Designers shall implement such mandatory requirements to ensure interchangeably and to claim conformance with the specification. This key word is used interchangeably with the phrase *is required*.

3.1.2 should: A key word indicating flexibility of choice with a strongly preferred implementation. This key word is used interchangeably with the phrase *is recommended*.

3.1.3 may: A key word indicating flexibility of choice with no implied preference. This key word is used interchangeably with the phrase *is optional*.

3.2 Definitions

3.2.1 coordination dimension: A reference dimension used to coordinate mechanical interfaces. This is not a manufacturing dimension with a tolerance.

3.2.2 mezzanine card: An add-on printed circuit board (PCB), which is mounted parallel to a host computer board. Note that some applications use "module" instead of "board", although both have the same meaning.

3.2.3 reference plane: A theoretical plane, not having thickness or tolerance, used to separate space.

NOTE—See IEEE Std 1101.1-1998.

3.2.4 true position: Some point on a card's printed circuit board (PCB) that is used by the assembly equipment for the reference positioning of a set of components.

3.3 Abbreviations

The following abbreviations are used extensively in this standard:

CMC	Common Mezzanine Card
H	height nomenclature
I/O	input/output
Jn	Connector receptacle number
mm	millimeter
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect
Pn	Connector plug number

3.4 Dimensional nomenclature height, width, and depth

The following is a list identifying abbreviations and a description of height dimensional nomenclature used in this standard:

Nomenclature	Description
H1	CMC side 1 component height
H2	CMC side 2 component height
Hp	CMC plug seating plane height
Hs	CMC standoff height and reference plane height

There are no **width** and **depth** dimensional nomenclatures used in this standard.

4. Mezzanine card mechanics

This clause defines the mechanical dimensions for mezzanine cards. The host mezzanine card slot mechanics are defined in Clause 5.

4.1 CMC size designations and sizes

Two different mezzanine card sizes are defined. These two sizes are listed in Table 1. The designation of each card size is given in the first column.

NOTE—The CMC's envelope boundaries are designed on a grid structure, where the basic increment of the grid is 25 mm. The width increment of CMCs is 75 mm. When two CMCs are placed next to each other, there is a 1 mm gap between each CMC.

The depth of CMCs is 149 mm. Should other mezzanine cards be used in conjunction with one or more CMCs, there will be a 1 mm gap between the edges of two single CMCs.

For a better understanding of this grid structure and how it ties into the international metric measurement systems, please obtain a copy of IEEE Std 1301.4-1996.

Table 1—CMC PWB size designations and dimensions

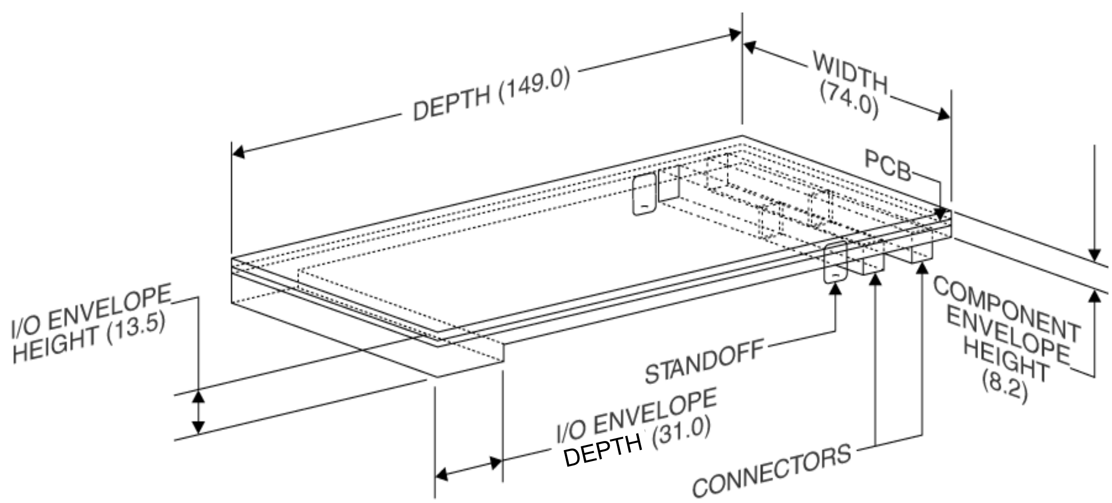
Designation	Width (mm)	Depth (mm)
Single	74.0	149.0
Double	149.0	149.0

4.2 EMC envelope

A key concept in this standard is the CMC envelope, which defines a space that may be occupied by the CMC PCB, associated electronic components, and required cooling gap. The total CMC envelope space is divided into two parts:

a) component envelope
b) I/O envelope

The envelope for a single CMC is shown in Figure 5. The component envelope maximum height shall be 8.2 mm and 13.5 mm for the I/O envelope. The maximum depth of the I/O envelope shall be 31.0 mm.



Note—Basic dimensions are to be true position within 0.15 mm of Datum A and Datum B.

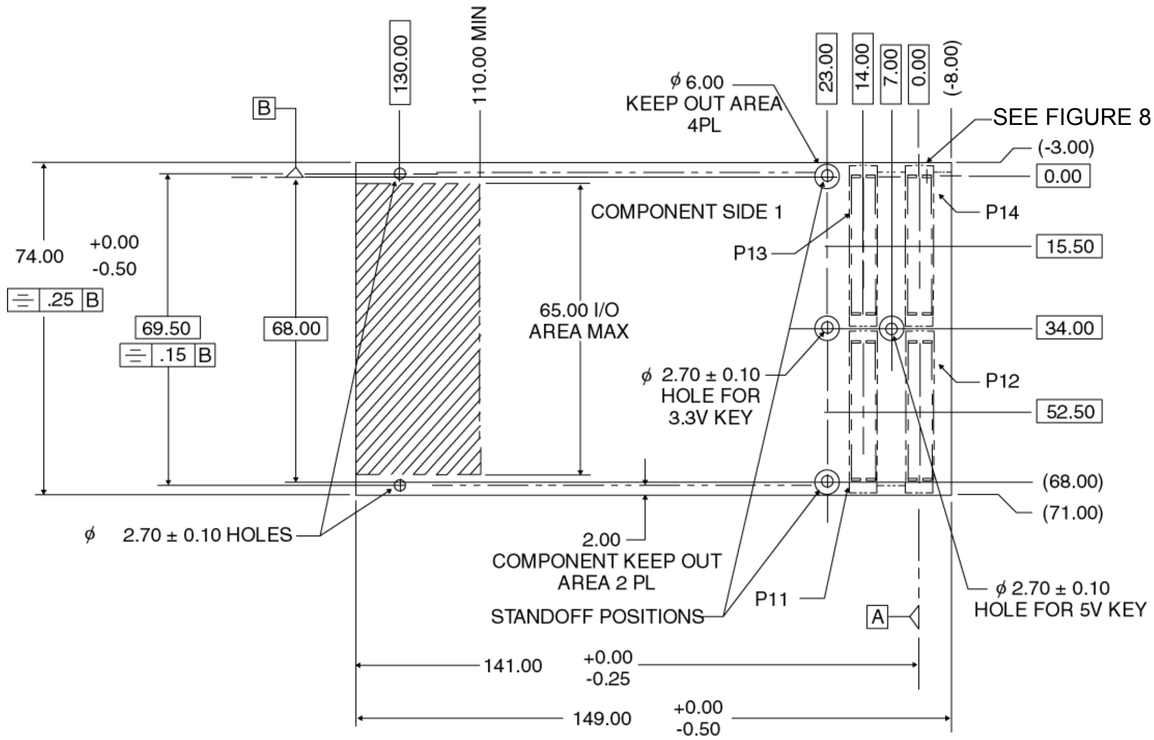
Figure 5—Single size CMC envelope (front panel not shown)

The component envelope is where electronic components (such as ICs, chips, devices, resistors, capacitors, and so on, plus the printed circuit board) may be placed. No component is allowed to protrude through this envelope, except the CMC connectors, standoffs, and bezel retention screws. PCB warpage during the manufacturing process shall be included for calculating and measuring maximum component heights so as to not protrude through this envelope.

The I/O envelope (area) shall be used for the mounting of I/O connectors on the CMC bezel. In some applications, no I/O connectors are used; therefore, this envelope may then be used for the mounting of components. Larger components may also be placed in this envelope. A connector or component of any kind shall not protrude outside this specified envelope. The only exception is the CMC bezel and I/O connectors mounted on the bezel, which protrude beyond the face of the bezel. No limit is defined for the length of this protrusion. See Figure 10 for further mechanical details on the I/O envelope of the mezzanine card.

4.3 CMC dimensions

Figure 6 and Figure 7 show the mechanical dimensions that shall be used for both CMC sizes. The rest of the mechanics are found on the single or double CMC dimensions. Note that the standoff hole size is not defined. The size of these holes depends on how the standoffs are permanently attached to the CMC during assembly.



Note—Basic dimensions are to be true position within 0.15 mm of Datum A and Datum B.

Figure 6—Single CMC

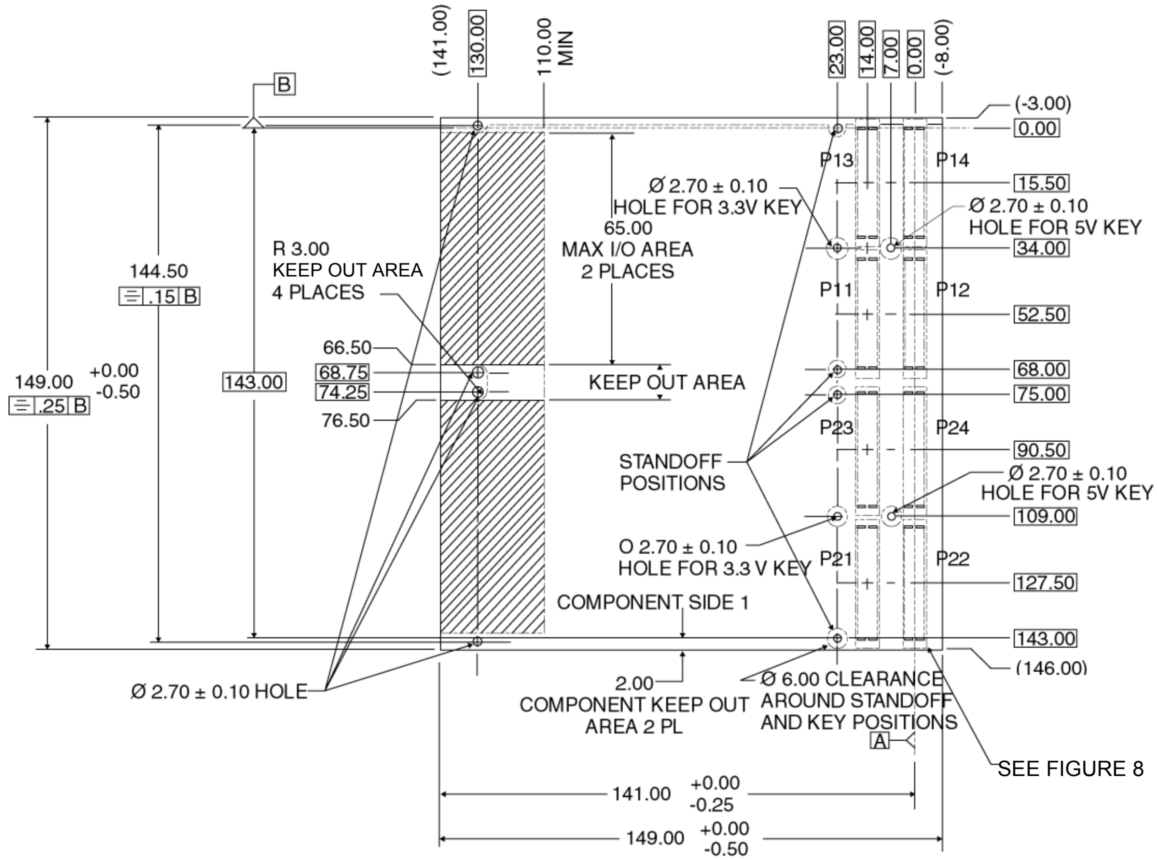
4.4 Voltage keying

Many of the new local buses can operate at one of two different voltage levels. For these types of applications, voltage keying holes are provided on the mezzanine cards. The two voltages are 5 V and 3.3 V. If the mezzanine card's local bus operates on the 5 V signaling level, it shall provide a 5 V keying hole. If the mezzanine card's local bus operates on the 3.3 V signaling level, it shall provide a 3.3 V keying hole. If both voltages can be supported, then both holes shall be provided. See Figure 6 and Figure 7 for the location of these holes. The associated keying pins are defined in Clause 5. The host is to provide the keys.

4.5 Connector pads and labeling

Figure 8 shows the connector pads layout that shall be used for each connector placed on a CMC. The labeling of each pin within each connector shall also follow the pin numbering scheme shown in Figure 8.

Depending on the functionality of the CMC, anywhere from one to four connectors may be used and in any combination. Recommendations as to which combinations should be used are found in the child standards, which use this parent standard for the mechanical card definition.



Note—Basic Dimensions are to be true position within 0.15 mm of Datum A and Datum B.

Figure 7—Double CMC

4.6 CMC connector

All CMC connectors shall use the EIA-700 AAAB connector as defined by EIA-700 AAAB 1996. These connectors shall be referred to as the plug, or “Pn” connector. For single wide CMCs, the connectors shall be labeled P11 through P14. When double wide CMCs are used, the connector numbers shall be P11 through P14 and P21 through P24 (see Figure 6 and Figure 7). If a CMC does not use all of the connectors, this space is open to be utilized by additional components. A special caution is noted as a CMC with connectors missing could be plugged in to a host with all connectors mounted, thereby making restricting component heights in the connector area mandatory. For CMCs that do place components, other than connectors in the connector area, these components shall not exceed a height of 4.0 mm.

4.7 CMC connector assembled on a CMC

Assembly of all the CMC connectors on a mezzanine card shall be within ±0.14 mm of true position.

The angular misalignment of any connector shall not exceed 1.5°, or shall not exceed 0.94 mm of perpendicular misplacement from one end of the connector to the other end of the connector (long dimension). The angular misalignment of any connector across the width (short dimension) shall not exceed 1.5°, or not exceed 0.16 mm of perpendicular misalignment.

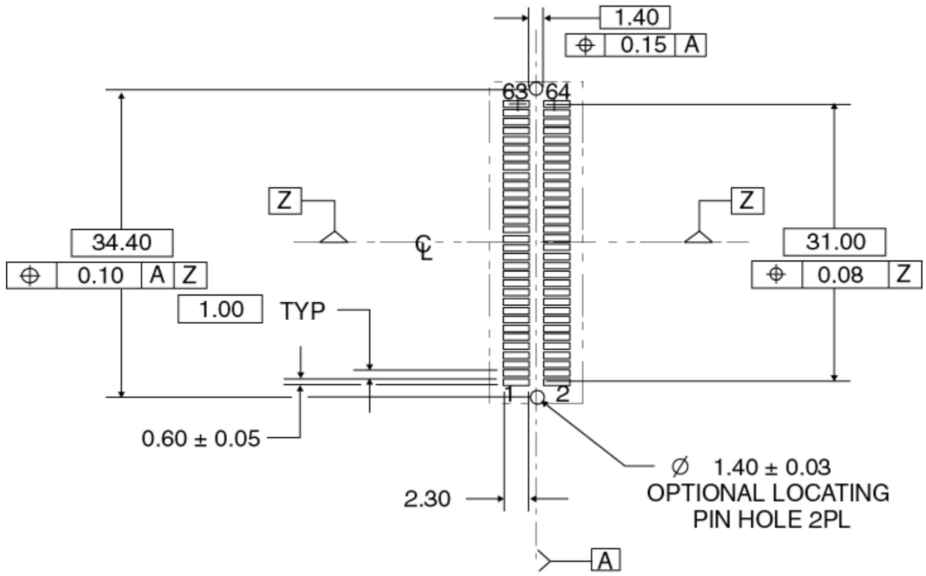


Figure 8—CMC “P” connector surface mount pad

The solder thickness variation between the connector contacts and the solder-coated surfaces on the mezzanine card shall not exceed 0.1 mm. Excessive buildup of solder under the connector contacts will cause the connector to be mounted too high such that, when assembled on a host computer, the plug and receptacle connector seating surface will touch and push against each other with excessive force.

4.8 CMC component heights

The referenced size CMC is designed to accommodate components up to 4.7 mm in height on side 1. On Side 2, the component height can be up to 3.5 mm minus the PCB thickness. See Figure 9 for a side view of the CMC component area.

Note that warpage of the PCB shall be included in the component height on both sides.

In some applications, it may be necessary to use taller or shorter components on a CMC. In these situations, more height is needed for the component vertical space.

The CMC is designed to provide for this flexibility. The CMC’s PCB may be moved up or down for this added height, depending on whether the added height is needed on side 1 or side 2. Table 2 shows the height relationship.

Designers must realize that if one side’s height is increased, the other side’s height is decreased accordingly, since the CMC envelope cannot be changed.

Note that special components, which are not electrically isolated (have conductive top surfaces) from the PCB’s power and ground planes, shall be shorter in height and shall not protrude through the special heights listed in Table 2. This additional margin is 0.7 mm. Conductive surface components are allowed in the designated I/O area because the host module provides a restricted area, which allows no conductive traces or vias.

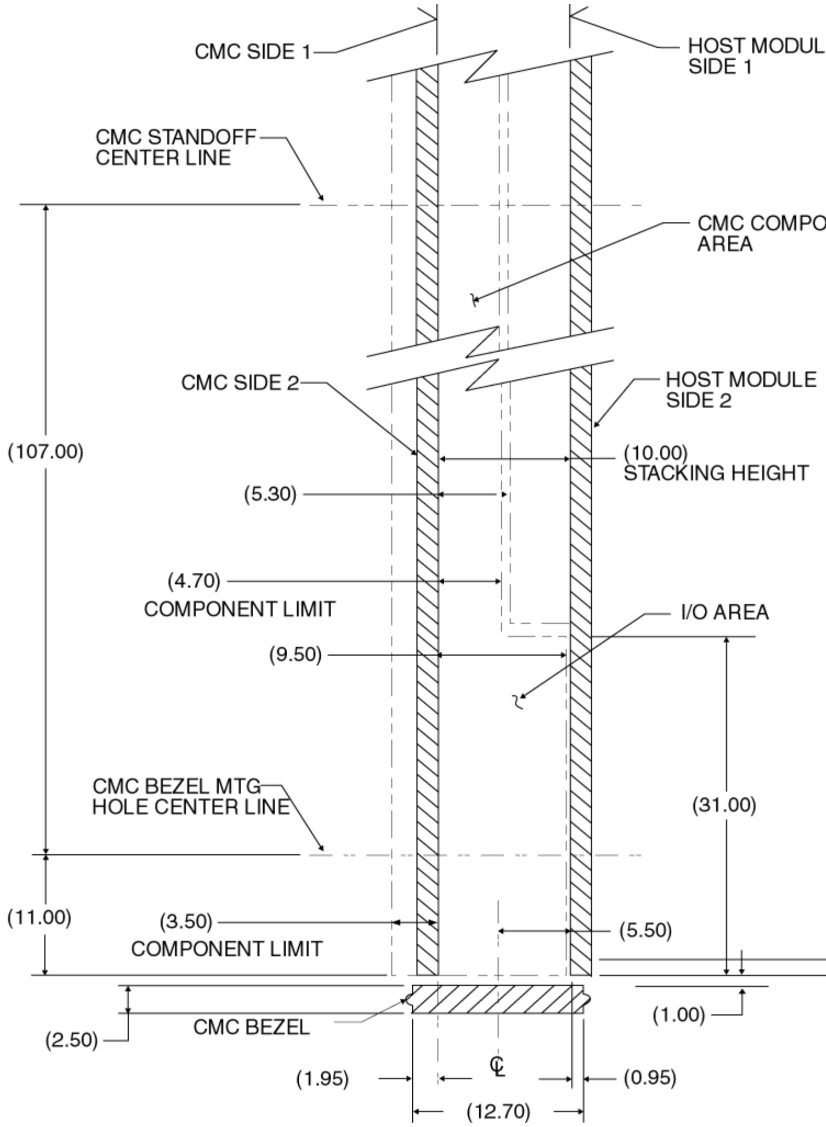


Figure 9—CMC I/O area and component area limits reference

Table 2—Relationship between stacking, standoff, component, and plug seating heights

Standoff and stacking height (Hs +/- 0.10) Figure 10 (mm)	Side 1 components area height (H1) Figure 9 (mm)	Side 2 components area height (H2) Figure 9 (mm)	Special[a] component height on Side 1 (mm)	Plug seating height (Hp) Figure 10 (mm)
8.00	2.70	5.50	2.00	2.30
9.00	3.70	4.50	3.00	3.30
10.00[b]	4.70[b]	3.50[b]	4.00[b]	4.30[b]
11.00	5.70	2.50	5.00	5.30

[a] Components with conductive top surfaces are limited to these component heights.
[b] CMC reference plane height used for the nominal mezzanine card height dimensions.

4.9 CMC connector and standoff heights

The referenced CMC side 1 surface (see Footnote b of Table 2) is designed to be placed 10 mm from the host side 1 surface. Standoffs are used to maintain the spacing between the CMC and the host, and to provide mechanical rigidity. The connectors are designed to be fully mated, but not bottoming at the seating surfaces when assembled to a host. See Figure 10 for the relationship between CMC connector and standoff.

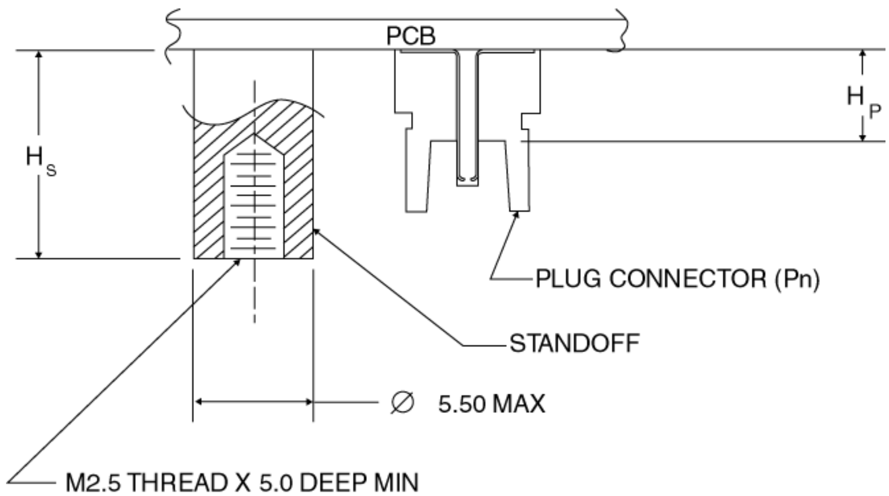


Figure 10—CMC connector and standoff relationship

Note that the CMC side 1 reference plane may be the top surface of the solder-coated surfaces for the connector contacts. It is recommended that solder-coated surfaces be used under the standoffs and CMC bezel for additional strength and consistency, and for maintaining proper spacing between the mezzanine card and the host.

Whenever the PCB's vertical position is changed, the corresponding standoff and connector's seating surface shall also be changed. The CMC envelope's position above the host shall remain fixed. Table 2 lists the relationship (change in dimensions) between the plug seating height and the standoff's height as the side 1 and side 2 component area heights are increased or decreased. Effectively, the CMC PCB is moved up or down, respectively. Figure 11 illustrates the CMC PCB height variation above the host.

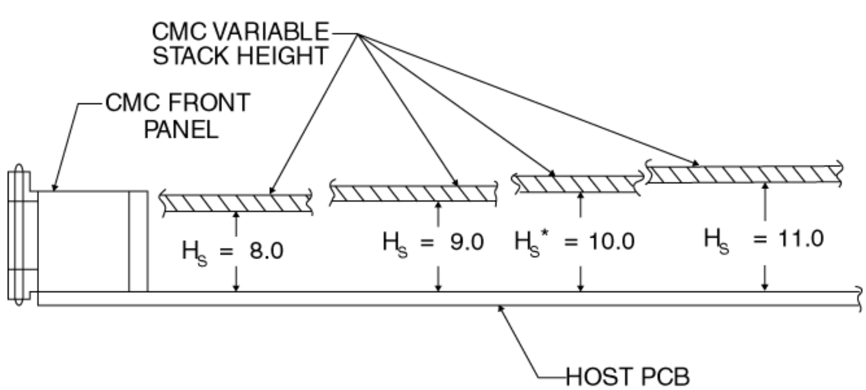


Figure 11—CMC PCB position within a mezzanine card envelope

The mezzanine standoff shall be an internal part that is permanently attached to the mezzanine card. The standoff shall also provide internal threads for a threaded fastener from the host side. The fasteners for the standoffs shall be provided by the CMC vendor. Standoff material is not defined by this specification.

The mezzanine card standoffs may be optionally soldered or riveted to the CMC PCB.

4.10 CMC bezel

The bezel of a CMC has two basic parts: the bezel and the EMC gasket.

Each CMC shall be designed to accommodate a bezel. The main function of the bezel is for the mounting of front panel I/O connectors and/or special indicators and switches. Since standard-size bezels are used, the CMC can fit into any host which provides a CMC slot. Figure 12 shows the mechanical design of the CMC bezel.

The two legs on the bezel also provide the standoffs for the front portion of the mezzanine card. The height of these legs shall be the same as the two standoffs used near the CMC connectors.

Should the CMC PCB be moved up or down within the CMC envelope, then the bezel leg height shall be adjusted accordingly. See Table 2 for this relationship.

The center horizontal line of the CMC bezel shall always be 5.5 mm above the host side 1 surface, for the 10 mm stacking height. See Figure 10 for this illustration. Note that if the CMC PCB is moved up or down, the CMC bezel's center line does not move. The bezel always maintains the same relationship with the host's side 1 surface and host front panel (face plate).

4.11 CMC test dimensions

It is very important that fully assembled CMCs be measured to ensure that when the CMC is plugged into a host's CMC slot, it will properly match. There are three critical dimensions that shall be measured to verify that a CMC will fit properly in a host computer's CMC slot.

The first critical dimension is the distance between rear connectors (0.00 reference) and the CMC bezel center line. When a CMC is plugged into the host computer's CMC slot, the CMC bezel should be aligned with the host computer's CMC slot opening. Due to tolerance buildup, this will not perfectly match. The actual mismatch may be as much as ±0.3 mm. See Figure 13.

The second critical dimension is the perpendicular center line of the CMC connector to the perpendicular center line of the CMC bezel. This is specified in Figure 13.

The third critical dimension is the vertical height of the CMC bezel and standoffs off the CMC reference plane. The center of the bezel shall be within the tolerance specified in Figure 10 and the standoffs with the numbers given in Table 2.

4.12 I/O capability

The I/O capability may be via the CMC front panel, backplane I/O via host, or both.

For I/O through the host's backplane, such as VME64x, CompactPCI, Multibus I, or Multibus II, one or more of the CMC connectors may be assigned for this capability. See Clause 6 of this standard for the required mappings.

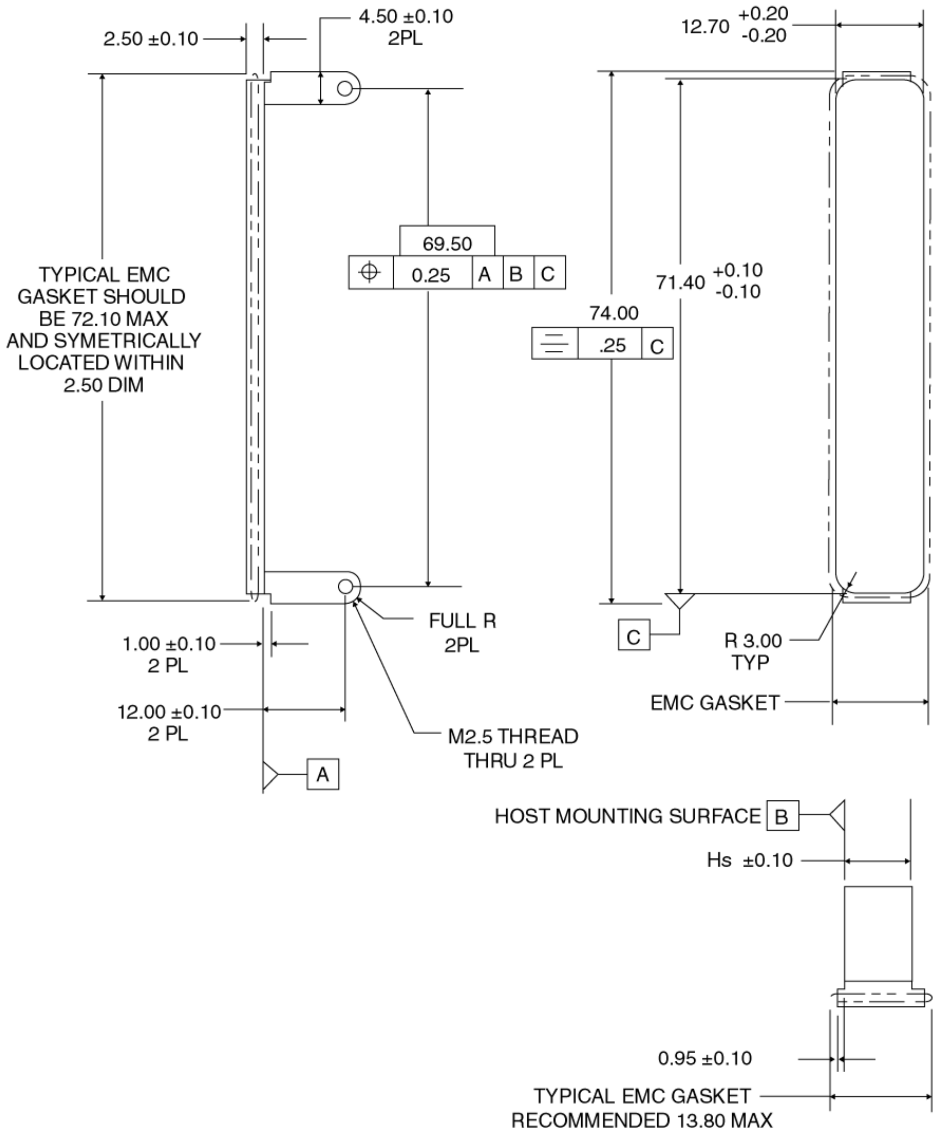


Figure 12—CMC bezel detail

4.13 Power consumption and dissipation

The power drawn from the host by each mezzanine card, as well as heat dissipated by the facing host computer's board, shall have a maximum limit. Host computer designers then can design for the worst case in both power draw, as well as the removal of heat generated by the mezzanine card. Table 3 lists the maximum power consumption and dissipation for each of the mezzanine card sizes. Since the mezzanine card side 1 faces the host, the power dissipated on side 1 is also limited to minimize heat buildup between the host and the mezzanine card.

Manufacturers that supply mezzanine cards to the open market shall provide the following information on each mezzanine card:

— 5 V current drawn, peak and average
— 3.3 V current drawn, peak and average

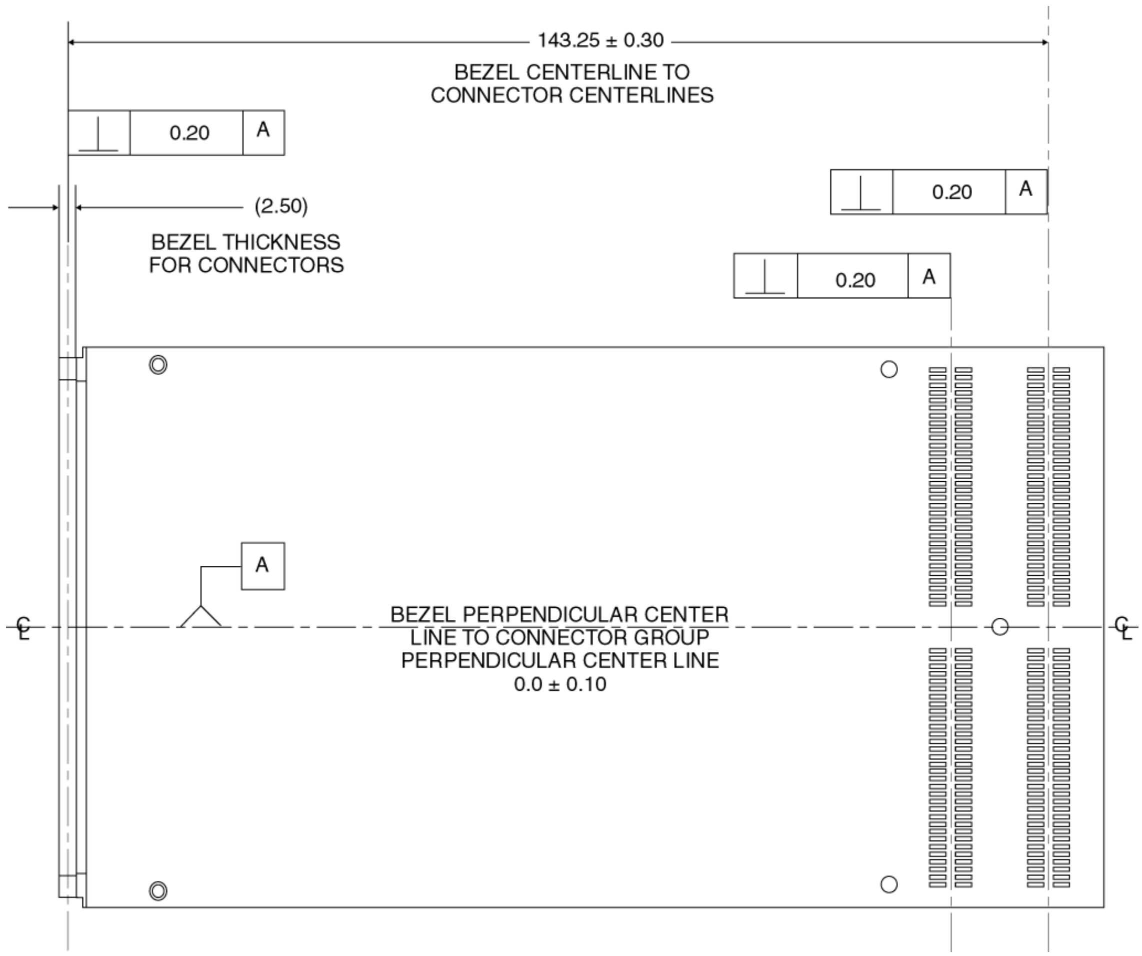


Figure 13—Bezel to connector test dimensions

Table 3—CMC maximum power consumption and heat dissipation

Side(s)	Single (in watts)	Double (in watts)
Side 1	6.0	12.0
Side 1 + Side 2	7.5	15.0

— Average power dissipated on side 1
— Average power dissipated on side 2
— Percent of side 1 area, side view, that is not occupied by components
— Percent of side 2 area, side view, that is not occupied by components

For some applications, users may need to calculate the amount of airflow that can flow across a mezzanine card for proper cooling purposes.

Note that the VME International Trade Association (VITA) had defined an extended specification for processors CMC and PMCs.[13]

4.14 Ground connections

The CMC front panel bezel shall be electrically isolated from the mezzanine card circuit ground to prevent ground loop problems. Boards should provide a minimum of 50 V dc and 100 kΩ of isolation between the CMC front panel bezel. More isolation may be required depending on system requirements.

The required standoffs, which are attached to the mezzanine card near the P11 and P13 connectors, shall be tied to the mezzanine card's circuit ground so that they do not float and create unwanted antennas. All keying holes shall remain electrically isolated from the mezzanine card's circuit ground.

4.15 Electromagnetic compatibility

CMC boards shall meet the standards of the latest harmonized versions of the following specifications. CMC boards should meet class B emissions and a minimum of performance criteria B for immunity where referenced in the following specifications. For Information Technology Equipment (ITE), use EN50022-1998; for radiation emissions and for radiation immunity, use EN55024 and EN50082-1. For products used in the United States, refer to FCC Part 15 for emission requirements above 1GHz. For telecom applications, use ETSI EN300 386-2 1997 and Bellcore GR-1089-CORE 1999.

Functional mezzanine cards with I/O off the front panel may be designed and manufactured to meet the higher EMC performance levels, as well as meet other national and international EMC standards, such as those specific to telecommunications, so long as the minimum requirements specified in this standard are met.

It is recommended that mezzanine card vendors list any EMC standards, and to which level(s) that are met in the product specifications. It is also recommended that any test results should be published in the same product specifications.

4.16 Shock and vibration

All mezzanine cards installed in a host shall at a minimum meet performance level V.2 of the shock and vibration requirements specified in IEC 48D (Secretariat) 76.

Mezzanine card suppliers may design and manufacture mezzanine cards to meet higher shock and vibration performance levels, as well as meet other national and international shock and vibration standards, so long as the minimum requirements specified in this standard are met.

It is recommended that mezzanine card vendors list the shock and vibration standards, and to which level(s) that are met in the product specifications. It is also recommended that any test results should be published in the same product specifications.

4.17 Environmental

Mezzanine cards may be designed and manufactured to meet the higher environmental levels as specified in 4.17.1 and 4.17.2, as well as meet other national and international environmental standards, such as those specific to telecommunications, so long as the minimum requirements specified in this standard are met.

[13]For further details, visit www.vita.com.

It is recommended that mezzanine card vendors list the environmental standards, and to which level(s) that are met in the product specifications. It is also recommended that any test results should be published in the same product specifications.

4.17.1 Mechanical requirements

All mezzanine cards shall at a minimum meet performance level C.1 of the climatic requirements specified in IEC 48D (Secretariat) 76, but at 85% air humidity. They shall also, at a minimum, meet performance level I.1 of the industrial atmosphere requirements specified in IEC 48D (Secretariat) 76.

4.17.2 Electronic components

The electronic components on all mezzanine cards shall, at a minimum, meet performance level 4 as specified in IEC 48D (Secretariat) 76. This reference specifies the temperature, humidity, and other environmental requirements.

4.18 MTBF

Mezzanine card vendors should state the expected mean-time-between-failures (MTBF) of each mezzanine card for a specific operating environment, and shall state what method was used to calculate the MTBF number(s).

4.19 ESD design

Providing for electrostatic discharge (ESD) protection may be difficult in some of the mezzanine card's electronic design. Standoffs are required to be tied to the mezzanine card's circuit ground. It is recommended that mezzanine card handlers (the person who installs a CMC into a host) first touch one of the standoffs to bleed off any electrical static energy, should it be present. Placing a small ground trace around the perimeter of the mezzanine card may also be used to bleed off any potential static energy, if the handler first touches the mezzanine card's edge when picking it up.

4.20 ESD kit

It is recommended that mezzanine card vendors supply an ESD kit with each mezzanine card. This kit is essentially a grounding strap and a wire that connects the mezzanine card handler to the host's chassis ground prior to installing a mezzanine card into the host. Should any static electricity be present, it will be discharged and thereby prevent any possible static discharge damage to the host and/or mezzanine card.

5. Host CMC slot mechanics

This clause defines the mechanical dimensions for the mezzanine card host. The mezzanine card mechanics are defined in Clause 4.

The mechanics for CMC slots on VME64x, CompactPCI, Multibus I, and Multibus II are defined in this clause. The mechanics for desktop computers, portable computers, servers, and other similar types of computers are not defined, since these designs vary from computer to computer and manufacturer to manufacturer. Enough information is presented in this chapter, as well as in the previous chapter, for mechanical designers of these types of computers to be able to design hosts with one or more CMC slots.

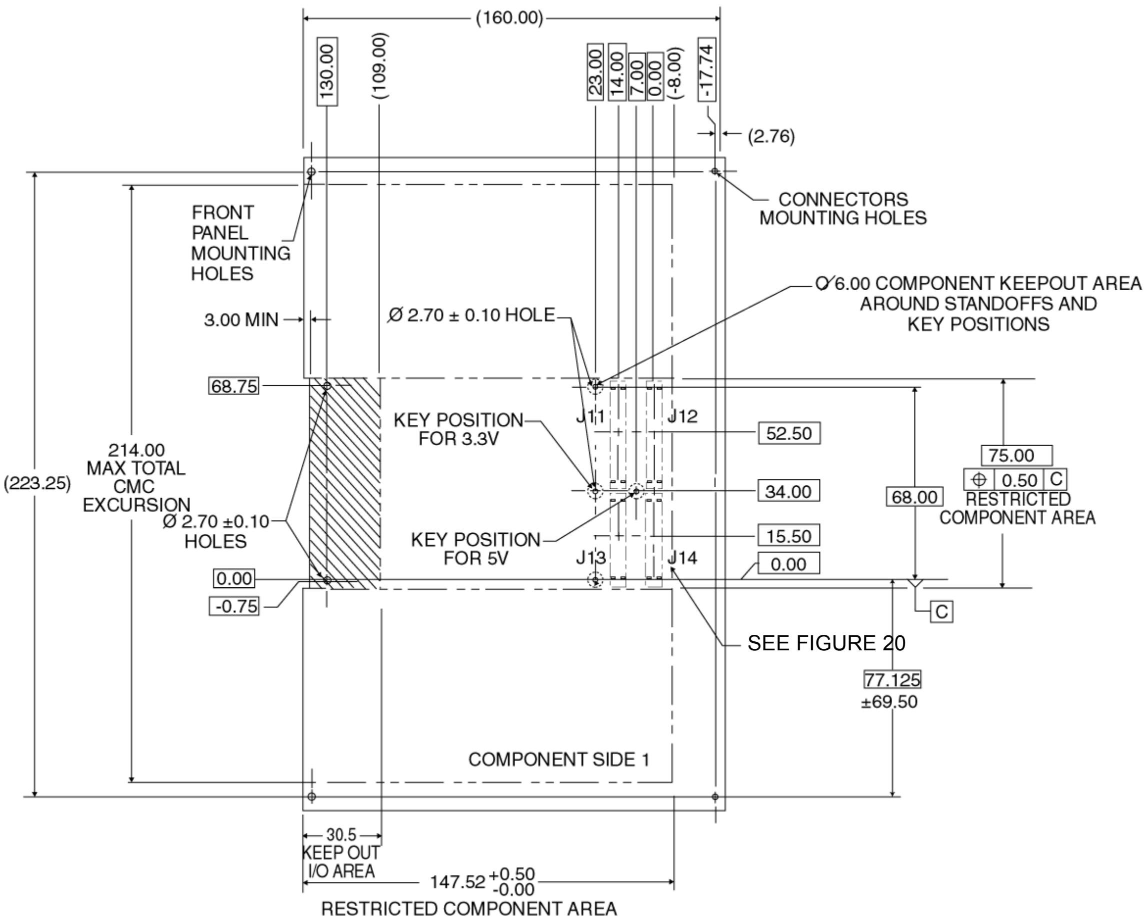


Figure 14—VME64x or CompactPCI host for single CMC

5.1 Stacking height above the host PCB

The mezzanine card mechanics are designed to be placed within the single slot envelope of VME64x, CompactPCI, and Multibus II boards. Usage of these mezzanine cards does not force the host board combined with a mezzanine card to take up two slots. For VME64x, CompactPCI, Multibus I and Multibus II, the referenced stacking height is 10 mm from the host PCB to the mezzanine card PCB. For applications that require more vertical space above the host side 1 surface, a 13 mm stacking height is also defined. Taller components can be used underneath the mezzanine card area when a 13 mm stacking height is used.

Other stacking heights can be used as well, as long as all the associated connector and shoulders are increased by the same height. Any incremental height changes shall always be in 1 mm steps.

5.2 Host PCB mechanics

The VME64x and CompactPCI host boards can support either one or two CMC slots. The mechanics of these 6U PCBs shall be per Figure 14 and Figure 15 for one or two slots, respectively. Multibus II host boards can also support one or two CMC slots, which shall be per Figure 16 and Figure 17, respectively. The Multibus I mechanics shall be per Figure 18 and Figure 19.

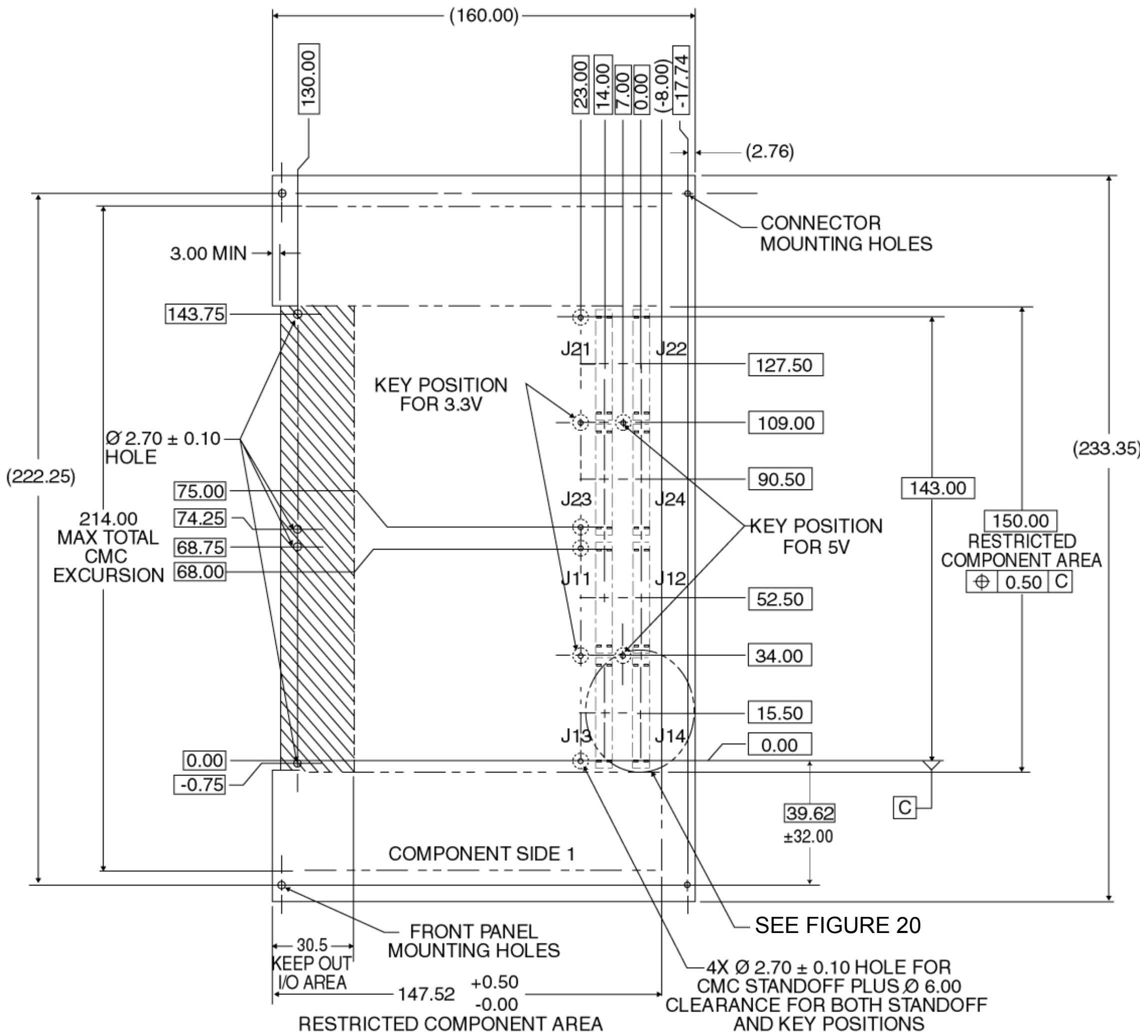


Figure 15—VME64x or CompactPCI host for double or two single CMCs

Whenever two slots are provided on the host computer, they shall be adjacent to one another as defined in the respective figures. This will allow for double-sized CMCs to be plugged into those slots.

The position of each mezzanine slot, with respect to the front edge of the host computer’s PCB, is fixed. The vertical position is variable and left open to the designer as to the exact position. The position shown is for reference only and is not a recommendation. This position shall remain within the boundary defined in the referenced figures.

5.2.1 Other host PCB mechanics

It is possible to place a single CMC slot on 3U VME64x or CompactPCI boards. It shall fit between both the top and bottom handles. There is no room left for other host front panel switches and indicators.

No drawing is provided for 3U and 9U VME64x or for 3U CompactPCI boards. The design easily can be derived from the 6U mechanical drawings and IEEE Std 1101.1-1998. IEEE Std 1101.1-1998 defines the mechanics of the 9U form factor. Should boards be designed for the 9U height, up to four CMC slots can be provided.

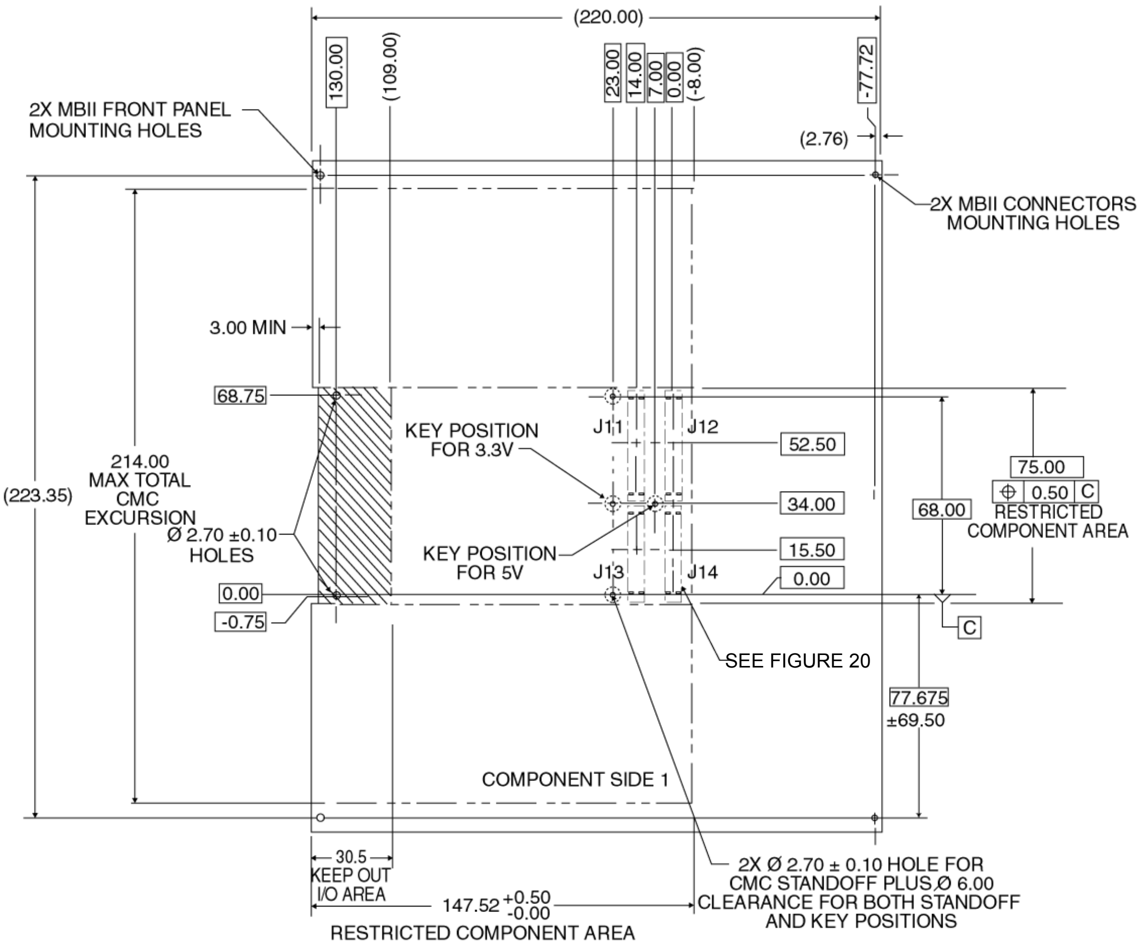


Figure 16—Multibus II host for single CMC

5.3 Connector pads and labeling

Figure 20 shows the connector pad layout that shall be used for each connector placed on the host PCB. The labeling of each pin within each connector shall also follow the pin numbering scheme shown in Figure 20.

Depending on the functionality of the host, anywhere from one to four connectors may be used, and in any combination. Recommendations as to which combinations should be used are found in the child standards that use this parent standard for their mechanical card definition.

5.4 CMC connectors

All host CMC connectors shall use the EIA-700 AAAB connector as defined by EIA-700 AAAB 1996. These connectors shall be referred to as the “receptacle” or “Jn” connector. For single slot hosts, the connectors shall be labeled J11 through J14. For two slot hosts, the connector numbers shall be J11 through J14 and J21 through J24. Should three slot hosts be used, the third set of connectors shall be labeled J31 through J34. Note that there are only single- and double-slot mezzanine cards.

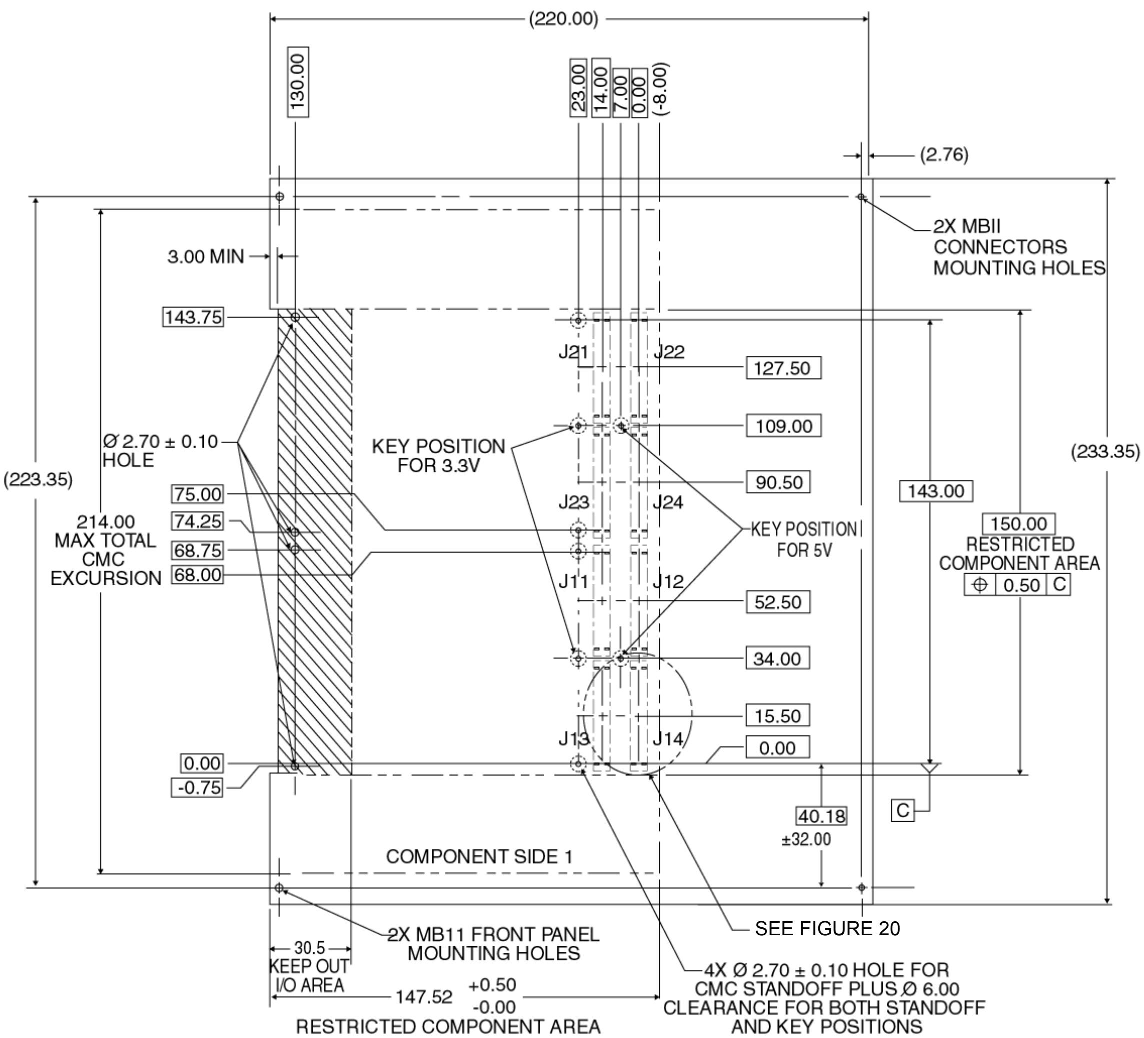


Figure 17—Multibus II host for double or two single CMCs

For hosts that support the 10.0 mm stacking height between the host and the mezzanine card, the 5.3 mm connector shall be used. The 8.3 mm connector height shall be used for hosts that support the 13.0 mm stacking height. See Figure 21 and Table 4 for point of reference.

Not all applications will need all the connectors. It is optional as to which combination of connectors are used.

If a host computer does not use all of the connectors, this space is open to be utilized by additional components. A mezzanine card with all connectors mounted could be plugged into such a host making restricting component heights mandatory. For host computers that do place components, other than connectors in the connector area, these components shall not exceed a height of 1.0 mm for 10.0 mm stacking heights. If a 13.0 mm stacking height is used, the component height shall not exceed 4.0 mm.

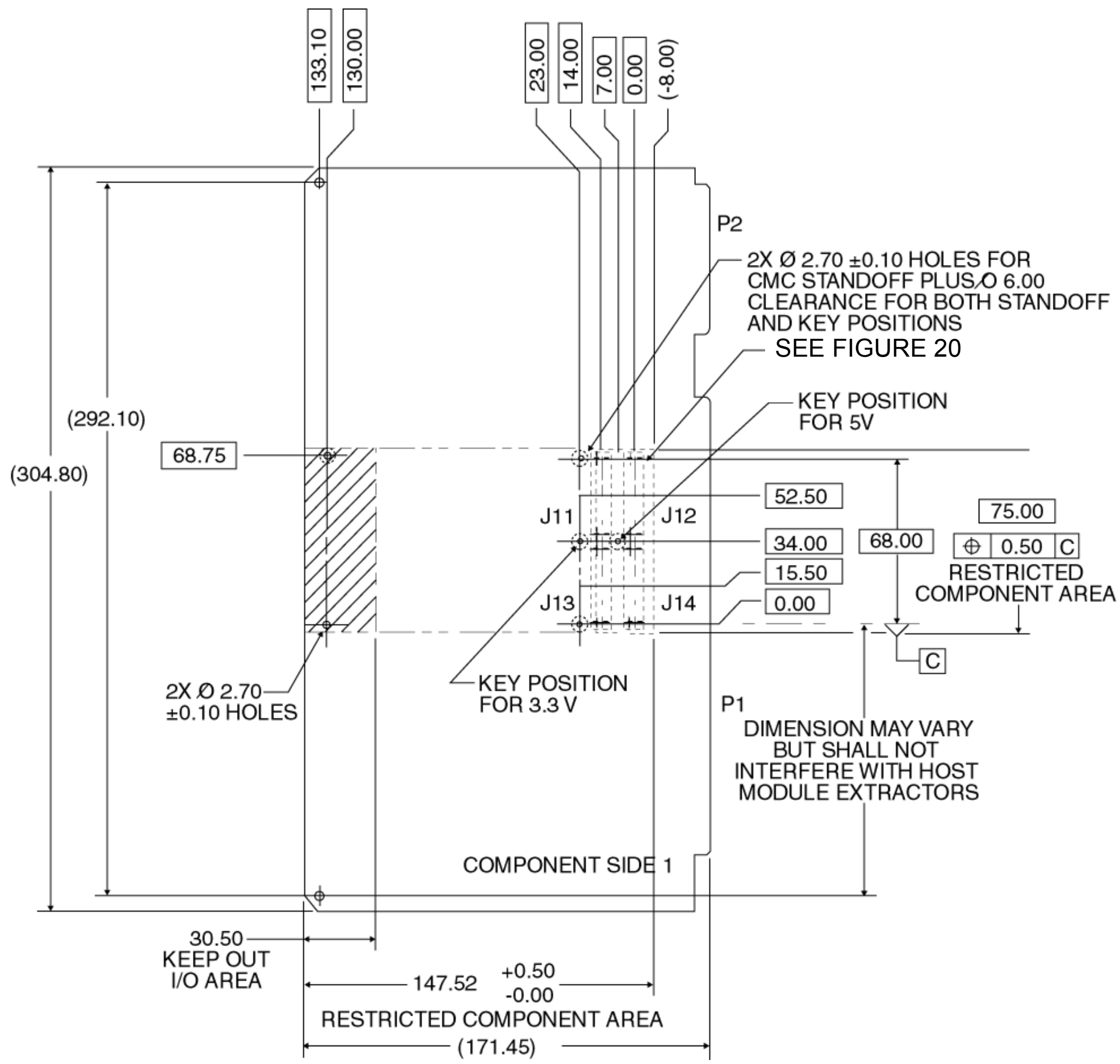


Figure 18—Multibus I host for single CMC

5.5 CMC connector assembled on a host

Assembly of all the CMC connectors on a host PCB shall be within ±0.14 mm of true position (TP). TP is defined as some point on a host's PCB, near the connector, that is used by the assembly equipment for positioning of the connector(s) prior to soldering.

The angular misalignment of any connector shall not exceed 1.5°, and shall not exceed 0.07 mm of perpendicular misplacement from one end of the connector to the other end of the connector.

The solder thickness variation between the connector contacts and the solder coated surfaces on the mezzanine card shall not exceed 0.1 mm. Excessive buildup of solder under the connector contacts will cause the connector to be mounted too high such that when a mezzanine card is plugged into the host's slot, the plug and receptacle connector seating surface will touch and push against each other with excessive force.

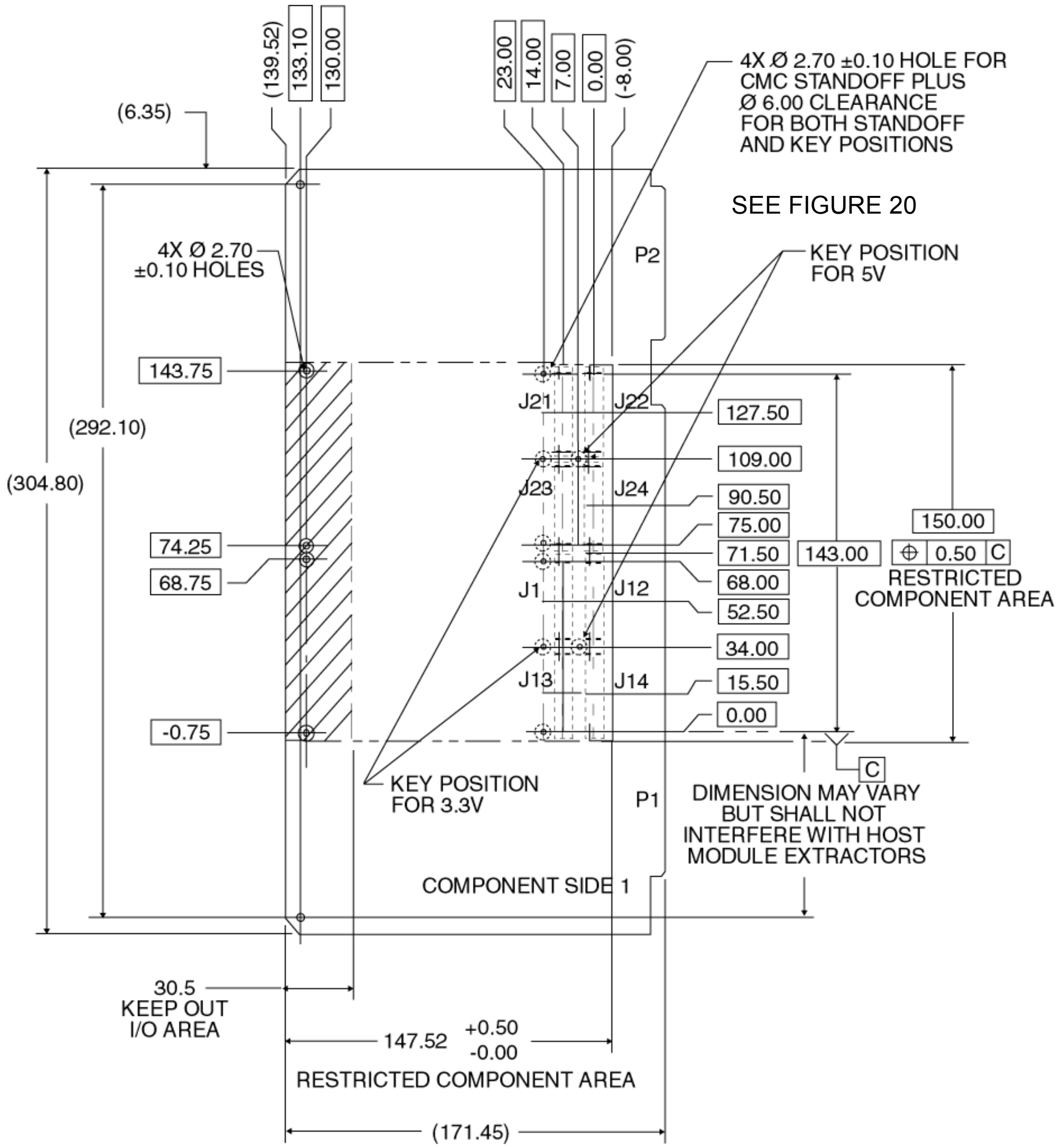


Figure 19—Multibus I host for double or two single CMCs

5.6 Host board side 1 component height

Host designers are allowed to place components under the mezzanine card slot. The maximum height of this area depends on whether the reference plane of the mezzanine card is 10 mm or 13 mm above the host. Table 4 lists these heights that shall be used.

No components shall be placed in the I/O area when the CMC is placed 10 mm above the host. When traces or vias are used in this I/O area, they shall be insulated to prevent shorting, should the mezzanine I/O area touch the host PCB in this area.

When the CMC is placed 13 mm above the host, the host component height under this area shall not exceed 2 mm. The reason for the extra 1 mm of space is for electrical clearance and airflow.

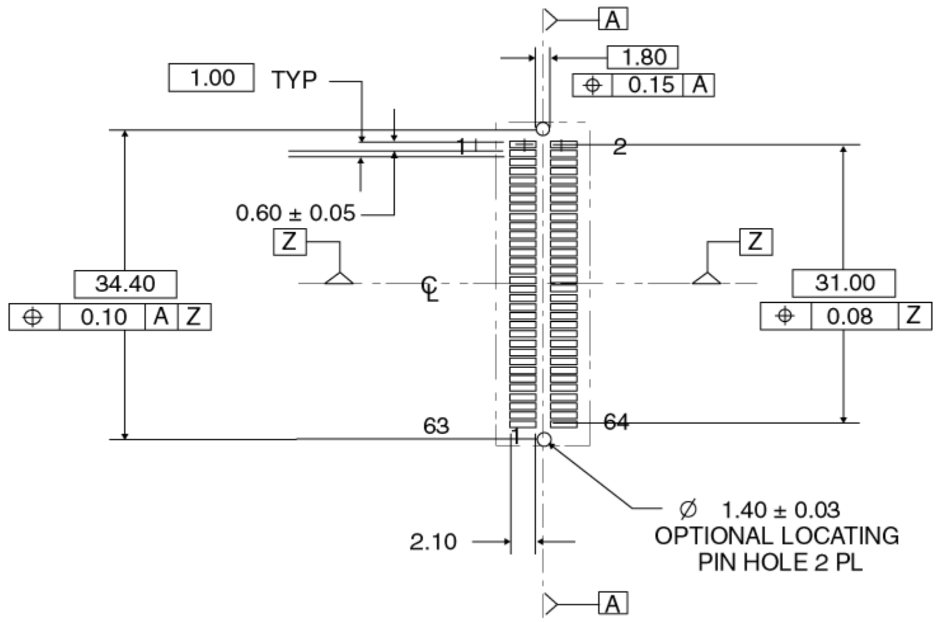


Figure 20—Host "J" connector surface mount pad layout

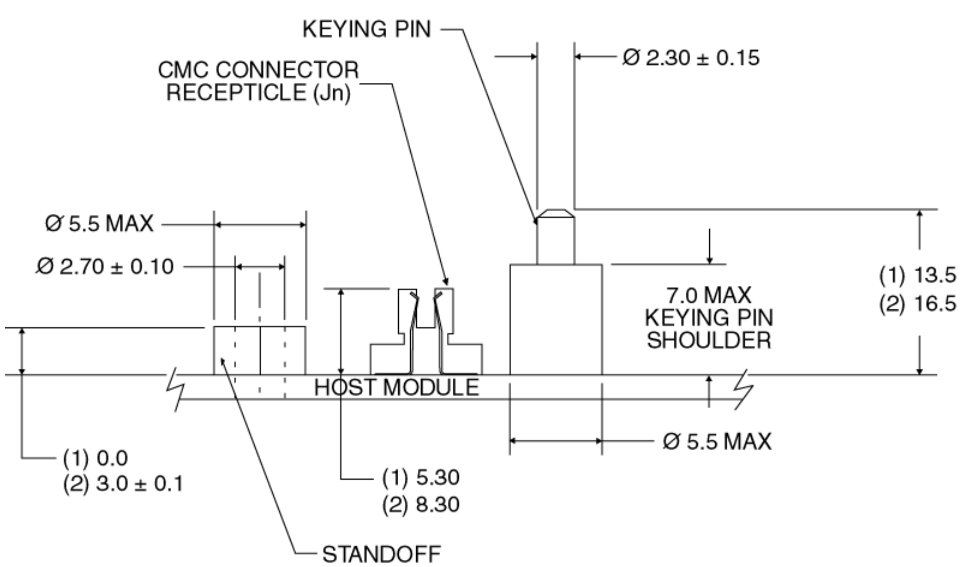


Figure 21—Host side view of standoff, receptacle, and keying pin

5.7 Extra shoulder for 13 mm hosts

For hosts, which support the 13 mm stacking height between the host side 1 and the mezzanine card side 1 reference plane, a 3.0 mm shoulder is needed underneath each of the standoff locations and the bezel legs. See Figure 21 for reference. Not shown is the spacer for the CMC bezel.

.

Table 4—Host component height limits

CMC reference place stacking height (mm)	Receptacle height (mm) Figure 21	Components under CMC component area (mm) Figure 25	Components under CMC I/0 area (mm) Figure 25
10	5.30	4.70	0.00
13	8.30	7.70	2.00

This shoulder should be attached to the host and must present a clear hole that allows a fastener from the host side to be threaded into the mezzanine standoff. Whenever a shoulder is needed, the shoulder on the host module shall provide a 2.7 mm clearance hole to allow for assembly to the mezzanine card and will have a height that is dependent on the height of the connector receptacle used on the host board.

In the event a different stacking height of 10 mm or 13 mm is used, the shoulder and host receptacle connector heights shall all be increased by the same height. As stated in 4.1, the incremental height shall be in 1 mm steps.

5.8 Voltage keying pins

Many of the new local buses can operate at one of two different voltage levels. Voltage keying pins are required on all host implementations in order to safeguard all installations utilizing the CMC.

The two bus signaling voltages are 5 V and 3.3 V. If the host’s local bus operates on the 5V signaling level, it shall connect 5V to the V(I/O) pins of the connector and provide a 5V keying pin near the connectors. If the host's local bus operates on the 3.3V signaling level, it shall connect 3.3V to the V(I/O) pins of the connector and provide a 3.3V keying pin near the connectors. See Figure 14 through Figure 19 for location of these keying pin positions and Table 6 for the V(I/O) pin assignment.

The mechanics of each voltage keying pin is defined in Figure 21. Note that two different length voltage keying pins are defined, one for 10 mm spacing and one for 13 mm spacing. See 5.1 for other increments.

The associated voltage keying holes for mezzanine cards are defined in Clause 4.

5.9 Host front panel or host face plate opening

The size and placement of one or two CMC slot openings for VME64x and CompactPCI boards shall be per Figure 22 (a) and (b). Multibus II front panel openings mechanics shall be per Figure 23 (a) and (b).

The horizontal center line of each slot shall be aligned with the center of each CMC connector group. See Figure 24.

Note that Multibus I boards do not have front panels. For desktop computers, portable computers, servers and other types of computers with face plates, the mechanics of the CMC slot opening can be derived from the mechanics in Figure 22 (a) and (b) through Figure 23 (a) and (b).

5.10 Filler panels

It is recommended that host computers prepared for shipment without a mezzanine card plugged into a slot should be shipped with an EMC-compatible filler panel in the vacant slot opening.

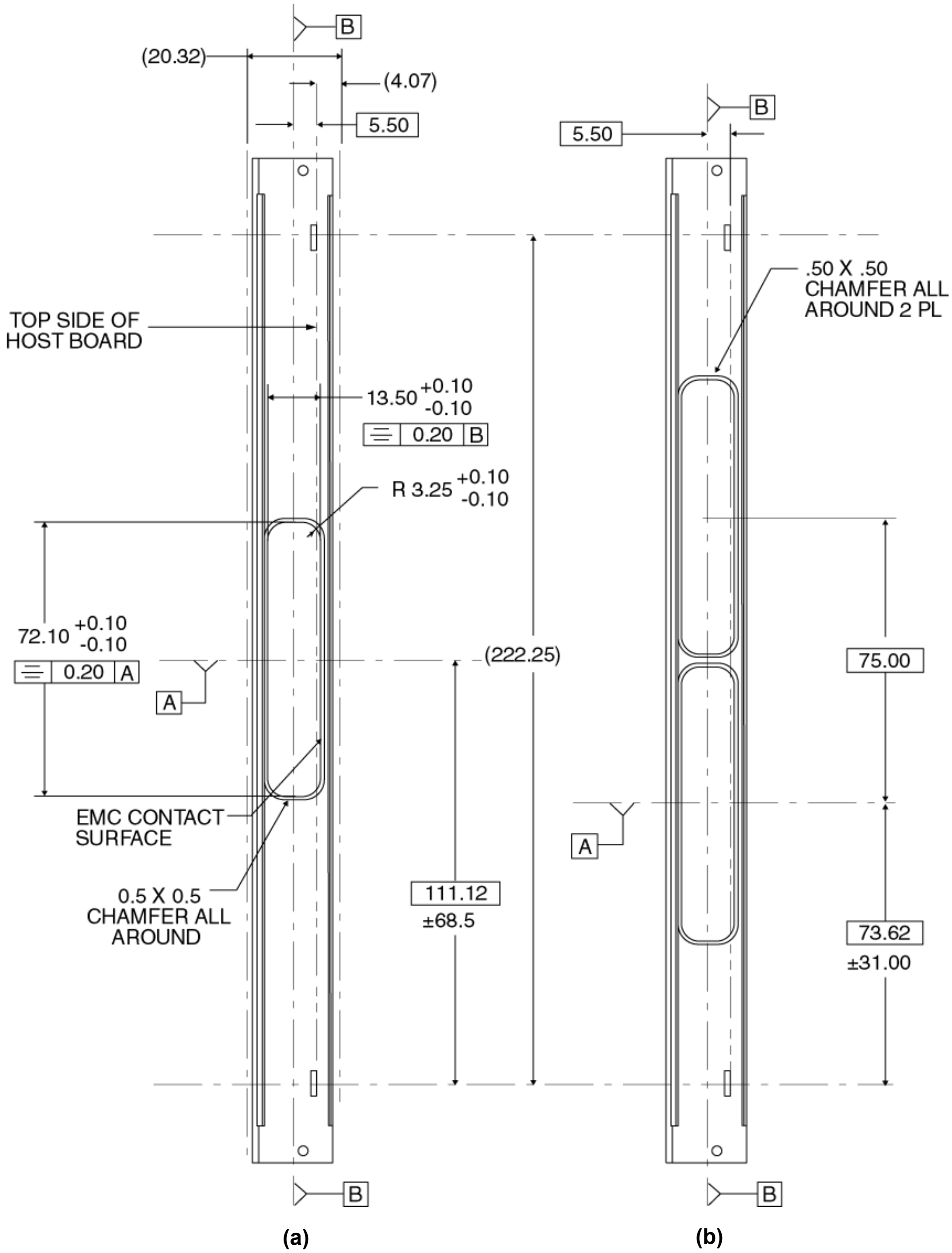


Figure 22—(a) VME64x or CompactPCI front panel with single slot CMC, rear view; (b) VME64x or CompactPCI front panel with double slot CMC, rear view

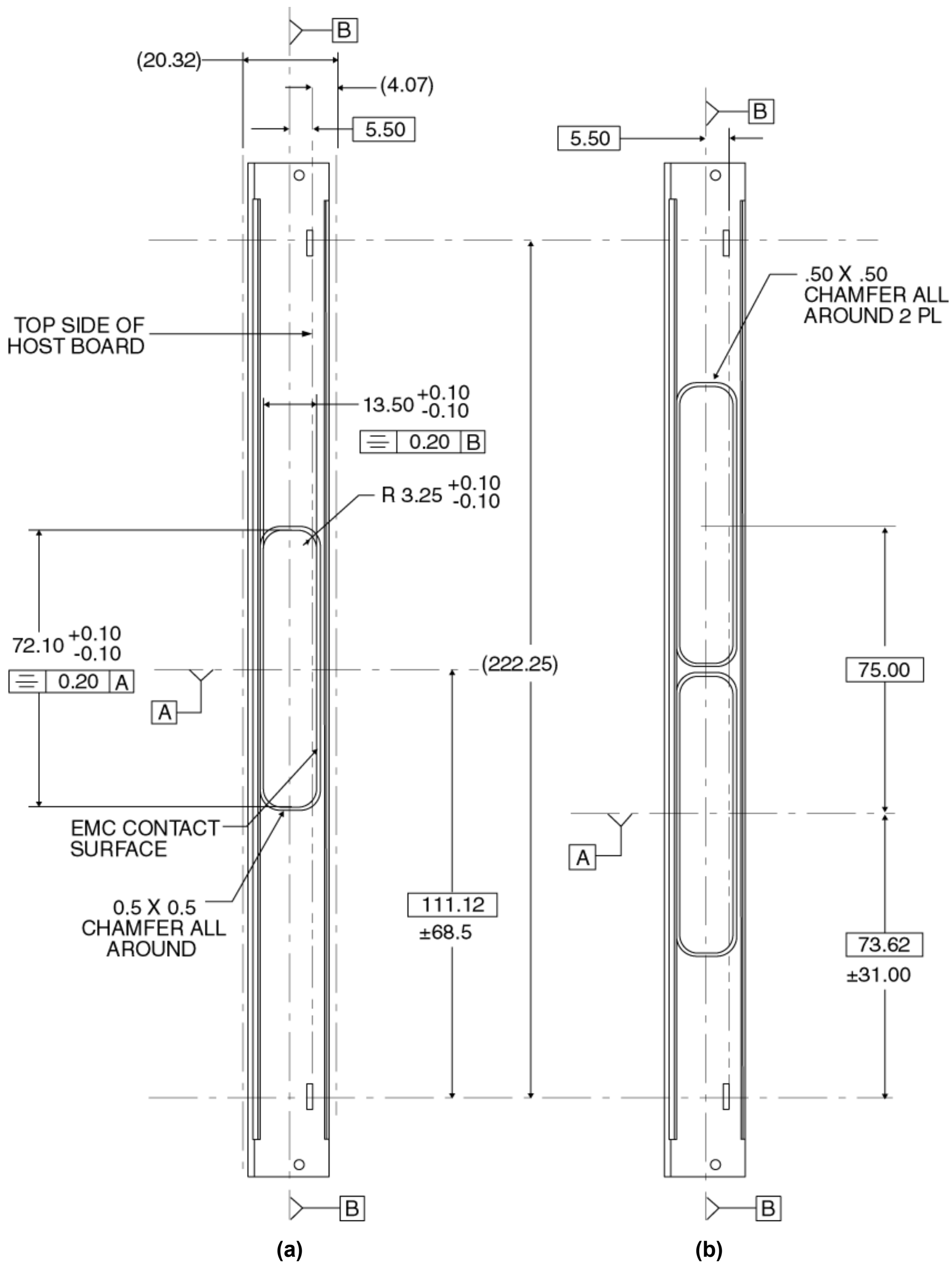


Figure 23—(a) Multibus II front panel with CMC slot, rear view; (b) Multibus II front panel with two CMC slots, rear view

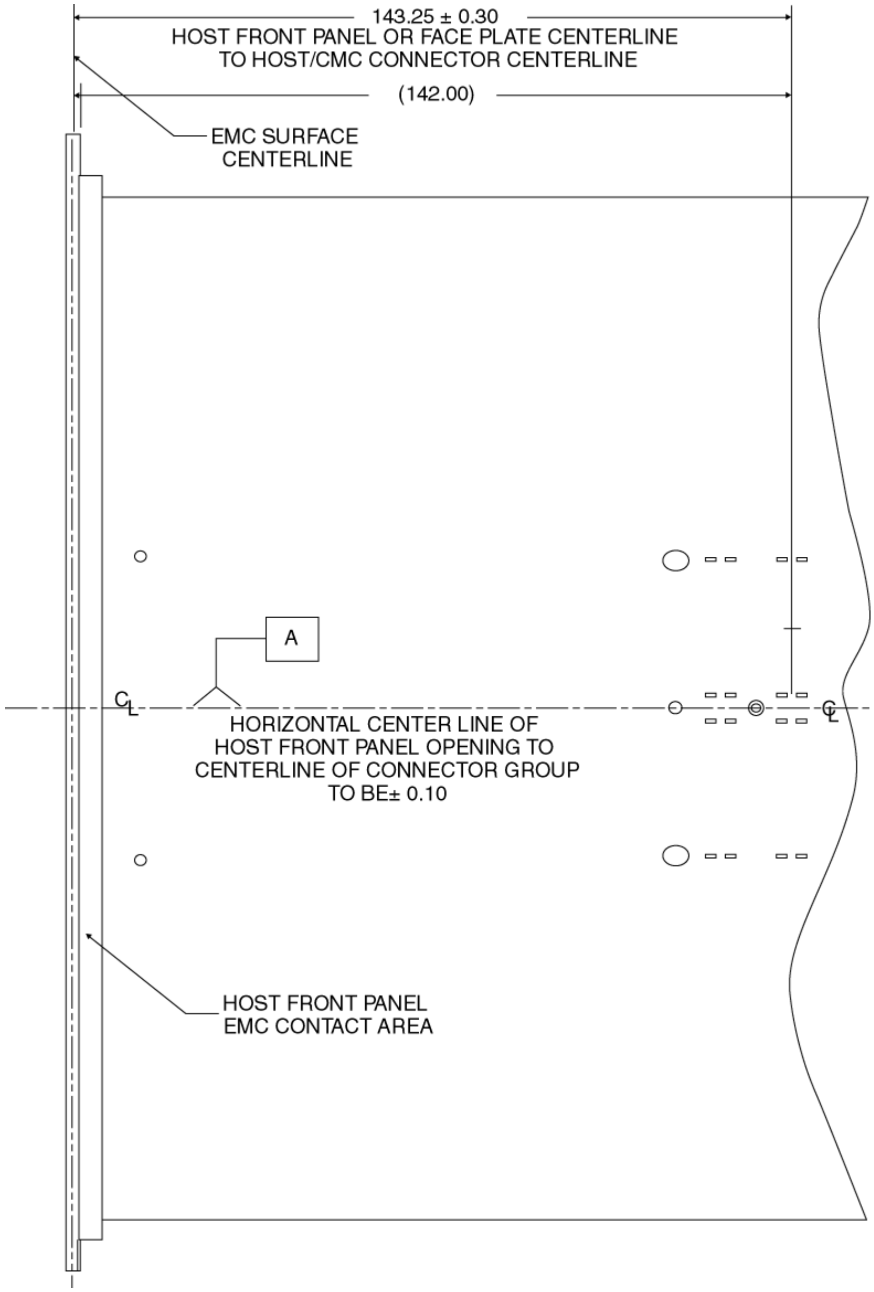


Figure 24—EMC host contact area

5.11 Host test dimensions

It is very important that fully assembled hosts be measured to ensure that when a CMC is plugged into a host's CMC slot, it will comply. Therefore, once the host is assembled, there are three critical dimensions that shall be measured to ensure that generic CMCs are in compliance:

a) The depth distance between rear connectors (0.00 reference) and the center line of the host front panel EMC contact area. See Figure 24.

b) The horizontal center line dimension, where the center of the front panel opening shall be centered with the CMC connector group. See Figure 24.

c) The height of the CMC slot opening's center line above the host's PCB, side 1. This will vary depending on whether a 10 mm or 13 mm spacing is used. See Figure 25 for this dimension.

When a CMC is plugged into the host's CMC slot, the CMC's bezel should be aligned with the host computer CMC slot opening. Due to tolerance buildup, this will not perfectly match. The actual mismatch may be as much as ±0.3 mm.

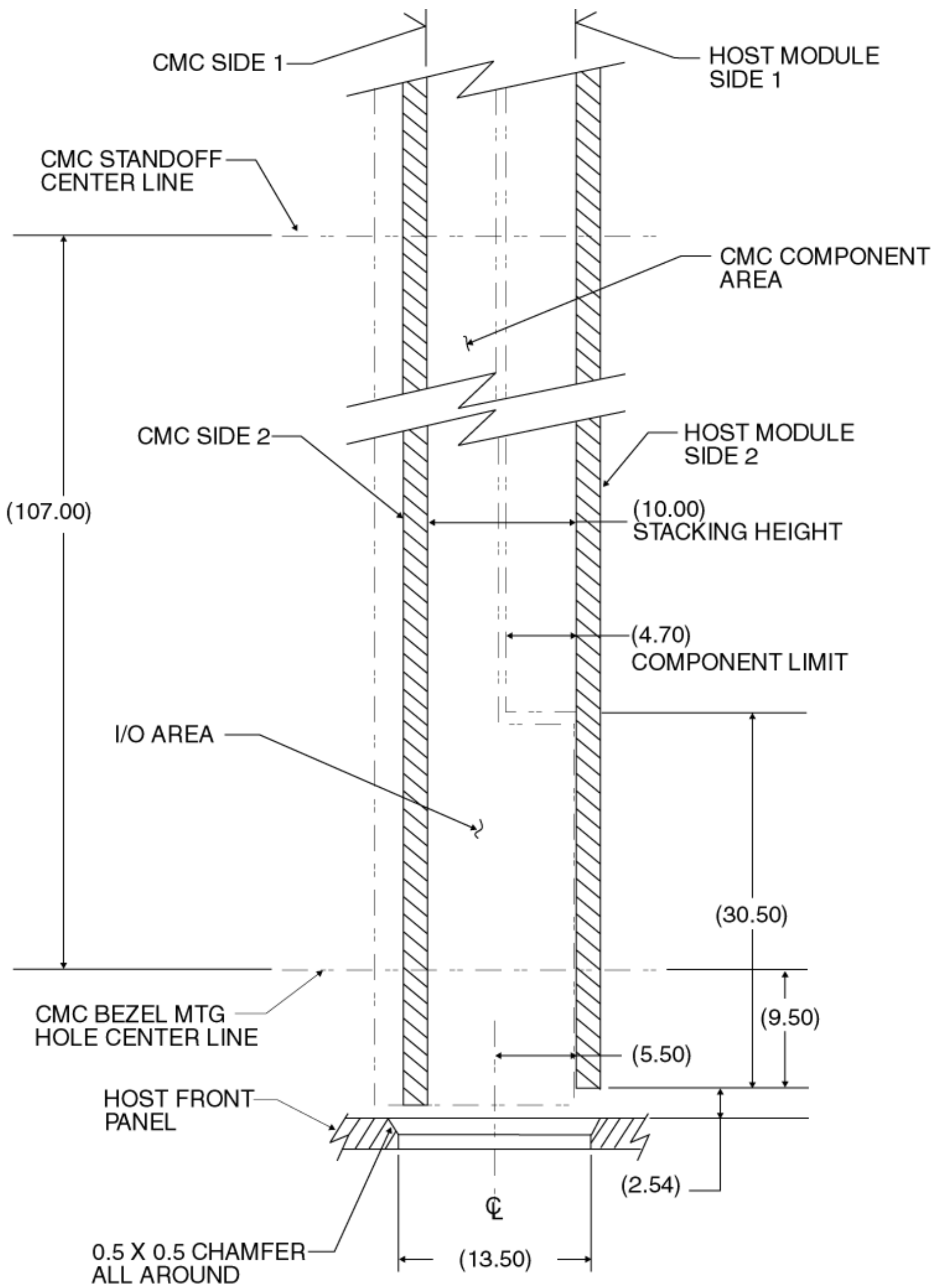


Figure 25—Host component limits reference (for IEEE 1101.1 compatible PCBs)

5.12 I/O capability

The I/O capability may be through the bezel opening or via the backplanes user-defined pins (if available). Depending on the host's application, either or both may be used.

For I/O through the host's backplane, such as VME64x, CompactPCI, Multibus I or Multibus II, one or more of the CMC connectors may be assigned for this capability. See Clause 6 of this standard for required signal pin mappings.

5.13 Power dissipation

The maximum power provided by the host for each mezzanine card slot, as well as the heat a host computer must remove from within the host's chassis (box, cabinet, and so on) should be clearly defined. Host computer designers then can design for the worst case in both power draw as well as removal of heat generated by the mezzanine card. See Table 3 in 4.13 for the recommended power consumption and dissipation for each of the mezzanine card sizes.

Since the mezzanine card side 1 faces the host side 1, the power dissipated underneath the mezzanine card should be limited to prevent excessive heat buildup in the area between the two. See Table 5 for the recommended maximum heat dissipation levels on side 1 of the host of the area where CMC is placed.

Table 5—Host side 1 maximum heat dissipation

Stacking height (mm)	Maximum heat dissipation (watts)
10.0	4.0
13.0	6.0

5.14 Grounding connections

Mezzanine cards shall be designed to minimize potential ground loop and EMC problems. CMC bezels shall be electrically isolated from the mezzanine card's signal ground plane and shall meet the minimum requirements in 4.14. For CMCs with I/O cables exiting the system chassis, the CMC's bezel should be attached to the host board chassis ground. For CMCs with no I/O cables exiting the system chassis, the CMC's bezel may be grounded to the host board chassis ground or be left floating as required by the application. All mezzanine card standoffs (those standoffs near P11 and P13) should be tied to the circuit ground at both the mezzanine card and the host board to avoid any "antenna" effects and to minimize the ground difference between the host and mezzanine card. (Early drafts of this standard did not recommend connecting the mezzanine circuit ground to host circuit ground via the standoffs, but later design experience recommends the opposite.)

All keying pins shall be tied to the host's circuit ground, since the keying hole in the mezzanine card is to be electrically isolated from the rest of the mezzanine card's circuits.

5.15 Electromagnetic compatibility

The electromagnetic compatibility (EMC) for host computers is not specified in this standard. It is recommended that host computer vendors clearly specify to what EMC standards and to which levels the computer has been designed and tested. Host designers should study the mezzanine card requirements in Clause 4 to understand what each mezzanine card is required to support, and then determine what is the most appropriate design for the host computer.

5.16 Environmental

The temperature, humidity, and other climatic environmental requirements are not specified in this standard, since these requirements are application dependent. It is recommended that host computer vendors clearly specify to what environmental level the computer can operate and to which national and international environmental standards the computer was designed and tested.

6. Electrical and logical layers

6.1 Connector utilization

The CMC connector pin assignments are based on specific signal integrity rules, as well as power considerations. The CMC standard allows +5 V, +3.3 V, and ±12 V. Which of these voltages shall be provided is defined in the specific bus standard; however, if used, the voltages shall be provided on the pins specified. The +5 V pins are assigned to Pn1 connector, the +3.3 V pins are assigned to the Pn2 connector, and the V(I/O) (signaling voltage) to Pn1 and Pn3 connector. All signal pins are surrounded by either voltage or ground pins. Pn1-13 is surrounded by three ground pins, and it is recommended for critical signals such as the clock signal.

The Pn4 connector is for user defined functions such as I/O. Routing of I/O traces on the host shall follow the I/O mapping as specified in 6.3.3.

6.2 CMC connector pin assignments

Table 6 provides all common pin assignments and signal names for the CMC application.

6.3 Rear I/O mapping

This section defines the recommended mapping of the CMC's Jn4 I/O connector to the rear I/O connectors on VME64, VME64x, Multibus I, and Multibus II boards. These rear I/O connectors attached to the respective backplanes, thereby providing I/O on the rear side of the backplane.

All the tables in this section are organized in the same top view (component side) physical connector pin hole orientation, as the rear I/O connectors are attached to the respective printed circuit board. Entries in each table are of the CMC's Jn4 connector pin number. See Figure 20 for the CMC Jn4 connectors' physical orientation and pin numbering sequence. All I/O signal mappings are done with none to a minimum of crossovers.

6.3.1 I/O mappings for VME, VME64, and VME64x boards

The I/O mapping for VME, VME64, and VME64x 3U and 6U boards is controlled and specified by VITA.[14]

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[14]I/O mappings are available on VITA's website at the following URL: http://www.vita.com..

Table 6—CMC connectors pin assignments

Pn1/Jn1				Pn2/Jn2				Pn3/Jn3				Pn4/Jn4			
Pin #	**Signal name**	**Signal name**	**Pin #**	**Pin #**	**Signal name**	**Signal name**	**Pin #**	**Pin #**	**Signal name**	**Signal name**	**Pin #**	**Pin #**	**Signal name**	**Signal name**	**Pin #**
1	Signal	−12V	2	1	+12V	Signal	2	1	Signal	Ground	2	1	I/O	I/O	2
3	Ground	Signal	4	3	Signal	Signal	4	3	Ground	Signal	4	3	I/O	I/O	4
5	Signal	Signal	6	5	Signal	Ground	6	5	Signal	Signal	6	5	I/O	I/O	6
7	BUSMODE1#	+5V	8	7	Ground	Signal	8	7	Signal	Ground	8	7	I/O	I/O	8
9	Signal	Signal	10	9	Signal	Signal	10	9	V (I/O)	Signal	10	9	I/O	I/O	10
11	Ground	Signal	12	11	BUSMODE2#	+3.3V	12	11	Signal	Signal	12	11	I/O	I/O	12
13	Signal	Ground	14	13	Signal	BUSMODE3#	14	13	Signal	Ground	14	13	I/O	I/O	14
15	Ground	Signal	16	15	+3.3V	BUSMODE4#	16	15	Ground	Signal	16	15	I/O	I/O	16
17	Signal	+5V	18	17	Signal	Ground	18	17	Signal	Signal	18	17	I/O	I/O	18
19	V (I/O)	Signal	20	19	Signal	Signal	20	19	Signal	Ground	20	19	I/O	I/O	20
21	Signal	Signal	22	21	Ground	Signal	22	21	V (I/O)	Signal	22	21	I/O	I/O	22
23	Signal	Ground	24	23	Signal	+3.3V	24	23	Signal	Signal	24	23	I/O	I/O	24
25	Ground	Signal	26	25	Signal	Signal	26	25	Signal	Ground	26	25	I/O	I/O	26
27	Signal	Signal	28	27	+3.3V	Signal	28	27	Ground	Signal	28	27	I/O	I/O	28
29	Signal	+5V	30	29	Signal	Ground	30	29	Signal	Signal	30	29	I/O	I/O	30
31	V (I/O)	Signal	32	31	Signal	Signal	32	31	Signal	Ground	32	31	I/O	I/O	32
33	Signal	Ground	34	33	Ground	Signal	34	33	Ground	Signal	34	33	I/O	I/O	34
35	Ground	Signal	36	35	Signal	+3.3V	36	35	Signal	Signal	36	35	I/O	I/O	36
37	Signal	+5V	38	37	Ground	Signal	38	37	Signal	Ground	38	37	I/O	I/O	38
39	Ground	Signal	40	39	Signal	Ground	40	39	V (I/O)	Signal	40	39	I/O	I/O	40
41	Signal	Signal	42	41	+3.3V	Signal	42	41	Signal	Signal	42	41	I/O	I/O	42
43	Signal	Ground	44	43	Signal	Ground	44	43	Signal	Ground	44	43	I/O	I/O	44
45	V (I/O)	Signal	46	45	Signal	Signal	46	45	Ground	Signal	46	45	I/O	I/O	46
47	Signal	Signal	48	47	Ground or Signal	Signal	48	47	Signal	Signal	48	47	I/O	I/O	48
49	Signal	+5V	50	49	Signal	+3.3V	50	49	Signal	Ground	50	49	I/O	I/O	50
51	Ground	Signal	52	51	Signal	Signal	52	51	Ground	Signal	52	51	I/O	I/O	52
53	Signal	Signal	54	53	+3.3V	Signal	54	53	Signal	Signal	54	53	I/O	I/O	54
55	Signal	Ground	56	55	Signal	Ground	56	55	Signal	Ground	56	55	I/O	I/O	56
57	V (I/O)	Signal	58	57	Signal	Signal	58	57	V (I/O)	Signal	58	57	I/O	I/O	58
59	Signal	Signal	60	59	Ground	Signal	60	59	Signal	Signal	60	59	I/O	I/O	60
61	Signal	+5V	62	61	Signal	+3.3V	62	61	Signal	Ground	62	61	I/O	I/O	62
63	Ground	Signal	64	63	Ground	Signal	64	63	Ground	Signal	64	62	I/O	I/O	64

6.3.2 I/O mappings for CompactPCI boards

The I/O mapping for CompactPCI 3U and 6U boards is controlled and specified by PCI Industrial Computers Manufacturers Group (PICMG). [15]

6.3.3 I/O mapping for Multibus II boards

Multibus II boards provide the whole P2 connector, 96 pins (rows a, b, and c) for user defined I/O. For CMC type applications, only connector rows a and c are used for CMC I/O.

Two different I/O mapping schemes are defined for Multibus II host boards: one CMC slot and two CMC slots.

a) When one CMC slot is provided on Multibus II host boards, all 64 pins of the CMC's J14 connector may be mapped to the P2 connector as shown in Table 7.
b) When two CMC slots are provided on Multibus II host boards, half of each CMC's Jn4 connector's I/O signal lines may be mapped to the P2 connector as shown in Table 8.

Note that a two CMC slot host has the option of only mapping one of its CMC Jn4 connector pins to the P2 connector and leaving the second CMC Jn4 connector unmapped. In this configuration, it is recommended that lower CMC slot's host be mapped to the P2 connector and the upper CMC slot's host be unmapped.

6.3.4 I/O mapping for Multibus I boards

There are 40 nonbussed pins available on the Multibus I P2 auxiliary connector. For a Multibus I using one CMC position mapped to P2, 32 backplane I/Os shall be mapped to the P14 connector of the CMC position using the pattern shown in Table 9. The second CMC position is not mapped due to limited pins available on P2.

NOTE—When CMC cards use 32 or less I/O leads, these I/Os shall be assigned to the lower 32 pins.

6.4 BUSMODE signals

The use of the 4 BUSMODE signals allows:

a) Detecting a CMC card plugged into the host module
b) Determining the logical protocol that the CMC card is capable of handling
c) Selecting a common logical protocol for all CMC cards and host to use

The four BUSMODE signals used by each CMC card are broken up into two groups. The first group is a set of three signals (BUSMODE[4:2]#), which are bussed to all card slots and the host logic. The second group is a separate return signal (BUSMODE1#) from each CMC card slot to the host logic. The BUSMODE[4:2]# signals are driven by the host module to all CMC slots, where they are used to determine the mode of the bus to be used by the CMC cards. Each CMC card will receive these signals and use the information to both set the logical protocol it uses on the bus and indicate back to the host module its presence, if it can support that logical protocol. The BUSMODE1# signal is driven independently by each CMC card to indicate to the host both the presence of a card in that slot and the capability of performing a given logical protocol. The host module then uses a read register to sense all the BUSMODE1# signals from each of the CMC slots to determine the presence of CMC cards.

[15] I/O mappings are available on PICMG's website at the following URL: http://www.picmg.com.

Table 7—One CMC slot's Jn4 connector mapped to the Multibus II P2 connector

P2 pin position	P2 row c	P2 row a
1	1	2
2	3	4
3	5	6
4	7	8
5	9	10
6	11	12
7	13	14
8	15	16
9	17	18
10	19	20
11	21	22
12	23	24
13	25	26
14	27	28
15	29	30
16	31	32
17	33	34
18	35	36
19	37	38
20	39	40
21	41	42
22	43	44
23	45	46
24	47	48
25	49	50
26	51	52
27	53	54
28	55	56
29	57	58
30	59	60
31	61	62
32	63	64

Table 8—Two CMC slot's J14 and J24 connectors mapped to the Multibus II P2 connector

P2 pin position	Row c	Row a
1	J24-1	J24-2
2	J24-3	J24-4
3	J24-5	J24-6
4	J24-7	J24-8
5	J24-9	J24-10
6	J24-11	J24-12
7	J24-13	J24-14
8	J24-15	J24-16
9	J24-17	J24-18
10	J24-19	J24-20
11	J24-21	J24-22
12	J24-23	J24-24
13	J24-25	J24-26
14	J24-27	J24-28
15	J24-29	J24-30
16	J24-31	J24-32
17	J14-1	J14-2
18	J14-3	J14-4
19	J14-5	J14-6
20	J14-7	J14-8
21	J14-9	J14-10
22	J14-11	J14-12
23	J14-13	J14-14
24	J14-15	J14-16
25	J14-17	J14-18
26	J14-19	J14-20
27	J14-21	J14-22
28	J14-23	J14-24
29	J14-25	J14-26
30	J14-27	J14-28
31	J14-29	J14-30
32	J14-31	J14-32

Table 9—One CMC slot on Multibus I

Host J14	Multibus I P2
33	32
34	31
35	30
36	29
37	28
38	27
39	26
40	25
41	24
42	23
43	22
44	21
45	20
46	19
47	18
48	17
49	16
50	15
51	14
52	13
53	12
54	11
55	10
56	9
57	8
58	7
59	6
60	5
61	4
62	3
63	2
64	1

Note that a low logic level “L” has a voltage that is lower (less than) than the high logic level “H”.

6.4.1 BUSMODE[4:2]# signals

The BUSMODE[4:2]# signals are used to determine the presence of cards plugged into the host module and to set the logical protocol of the CMC bus. These signals are bussed across all the CMC slots and are driven by the host module logic. The host module logic is the only logic that shall drive these signals. All CMC slots shall receive these signals as input-only signals. The logic levels used by these signals shall be the same as that used by the other bussed CMC signals. The logic level of these signals is determined by the V(I/O) pins and keying on the CMC card. Table 10 indicates the encoding of the various bus modules on the BUSMODE[4:2]# signals. The values in the table are taken relative to the signal levels presented on the bussed signals.

Table 10—BUSMODE[4:2]# mode encoding

BUSMODE4#	BUSMODE3#	BUSMODE2#	Mode
L	L	L	Card Present Test: “Card Present” only if a card is plugged into the slot; no bus protocol should be used
L	L	H	Return “Card Present” if PCI capable and uses PCI protocol
L	H	L	Reserved
L	H	H	Reserved
H	L	L	Reserved
H	L	H	Reserved
H	H	L	Reserved
H	H	H	No host present

The BUSMODE[4:2]# signals allows the host module to:

a) Detect if a card is plugged into each of the slots by using the “0” mode where CMCs assert the BUSMODE1# signal if they are plugged in regardless of the protocols they support.

b) Sense which protocols each of the cards can handle by using the defined modes (“1” at this time), since a card shall assert a BUSMODE1# signal only if it is capable of that mode.

c) Select in which mode the bus shall operate. Once the host has determined which modes the CMC cards can support, it sets the mode of operation to which all the cards are capable of supporting. If the host module is incapable of supporting any of the modules, it can then report this as an unsupported bus system.

6.4.2 BUSMODE1# signal

The BUSMODE1# signal is used by the CMC to indicate its presence in the system. One BUSMODE1# signal is used per CMC connector set. A CMC shall drive the BUSMODE1# signal and the host module shall only receive the signal. The logic levels used by this signal shall be the same as that used by the other bussed CMC signals, as determined by the V(I/O) pins and keying on the CMC cards. The BUSMODE1# signal shall be asserted by the CMC card within 10 bus clock cycles in response to the mode driven on the BUSMODE[4:2]# signals by the host module per Table 11. If a selected mode is not supported by a CMC card, then it shall disconnect itself from the bus, i.e., not drive any bus signals and deassert the BUSMODE1# signal.

As can be seen from Table 11 the BUSMODE1# signal allows the CMC card to:

a) Indicate its presence in the system through the assertion of BUSMODE1# ("Card Present Mode")
b) Indicate its ability to perform a given logical protocol

Table 11—CMC presents to system

BUSMODE[4:2]#	CMC capabilities	BUSMODE1#
L L L	Independent of CMC	L
L L H	Capable of performing PCI protocol	L
L L H	Incapable of performing PCI protocol	H
L H L	Capable of performing "reserved" protocol	L
L H L	Incapable of performing "reserved" protocol	H
LHH→HHL	Independent of CMC	H
H H H	Independent of CMC	H

6.4.3 Host module logic

The host module needs a 3-bit programmable register to drive the BUSMODE[4:2]# signals and a 1-bit read only register to sense the BUSMODE1# signals from each CMC slot. The register used by the Host module to drive BUSMODE[4:2]# should be a read/write register so the system has the ability to read the current mode of the bus. The register used to sense the BUSMODE1# signals from each slot should be synchronized to the system clock. Software (or firmware) on the host module shall ensure that an adequate period of time lapses between changing the BUSMODE[4:2]# signals and reading the BUSMODE1# signals. This minimum time period shall be 10 bus clock cycles long. If the host module is only capable of a single logical protocol, then it may "hardwire" or drive that BUSMODE[4:2]# encoding all the time. The host module shall not change the BUSMODE[4:2]# signals to an unsupported mode any time during a bus reset pulse.

6.4.4 CMC card logic

The CMC card logic receives the state of the BUSMODE[4:2]# signals and then, using knowledge of its capabilities, drives its BUSMODE1# signal. This logic should be combinatorial in nature as there is a minimum time of 10 bus clock cycles, in which to respond to a change in the BUSMODE[4:2]#signals. This logic also needs knowledge about the capabilities of the CMC card. This can either be programmed into the logic, selected by various jumpers (not recommended), or some low-level CMC card software (or firmware) interrogation of the CMC card interface logic. With this information, the CMC card logic behind the driver for the BUSMODE1# signal looks at the BUSMODE[4:2]# signals and drives the output in accordance to Table 11. At a minimum, the CMC card logic shall decode the "Card Present Test" mode and one of the logical protocol modes from the BUSMODE[4:2]# signal encodings table. The CMC card shall inhibit its bus interface at all times, except when a supported BUSMODE[4:2] mode is presented to it.