

xTCA TM

**PICMG® Specification MTCA.4
R 1.0 Draft 0.9w**

Enhancements for Rear I/O and Precision Timing

21 January 2011



**Open Modular
Computing Specifications**

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1 Introduction

1.1 Objectives

The purpose of this document is to define an AMC and a corresponding μ RTM module set for rear I/O along with an appropriate μ TCA shelf. The document also contains a section on precision timing that was driven by needs in the physics accelerator control and experiment data collection electronics. The committee feels that although originally driven by the physics research community this specification has much wider general use.

1.1.1 Reference documents

The publications cited in this section are relevant to this specification. Most of the specifications referred to are subject to periodic and independent updates, and are the responsibility of their respective organizations. The reader is advised to check carefully the version or revision of the referenced specification that is to be used in conjunction with this document.

1.1.2 Reference specifications

All documents may be obtained from their respective organizations.

Document	Organization	Contact information
PICMG 3.0 R3.0	PICMG	
PICMG AMC.0 R2.0	PICMG	
PICMG IRTM.0 R1.0	PICMG	
PICMG IRTM.1 R1.0	PICMG	
PICMG MTCA.0 R1.0	PICMG	
PICMG MTCA.1 R1.0	PICMG	

1.1.3 Environment and regulatory documents

1.2 Contributors

The following companies and institutions contributed to the creation of this document:

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Elma Bustronic	N.A.T.	
Extrusion Tech (XTech)	National Instruments	
Fermi National Accelerator Laboratory	Pentair Technical Products	
Foxconn Electronics	Performance Technologies	
GE Intelligent Platforms	Positronic Industries	

1.3 Special word usage

In this specification the following key words (in **bold** text) will be used:

- may:** Indicates flexibility of choice with no implied preference.
- should:** Indicates flexibility of choice with a strongly preferred implementation. The use of **should not** (in **bold** text) indicates a flexibility of choice with a strong preference that the choice or implementation should be prohibited.
- shall:** Indicates a mandatory requirement. Designers **shall** implement such mandatory requirements to ensure interchangeability and to claim conformance with this specification. The use of **shall not** (in **bold** text) indicates an action or implementation that is prohibited.

Note: When not in bold text, the words “may,” “should,” and “shall” are being used in the traditional sense; that is, they do not adhere to the strict meanings described above.

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1.5 Signal naming conventions

All signals are active high unless denoted by a trailing # symbol. Differential signals are denoted by a trailing + (positive) or – (negative) symbol.

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1.7 Acronyms and definitions

The following terms and acronyms are used in specific ways throughout this document.

μRTM	The Micro Rear Transition Module that mates with an associated AMC Module. It is the analog of the RTM in ATCA.
RP##	Designator for the pin connector (male contacts) in the μRTM and also the μRTM alignment/key
Airflow Filler	An airflow impedance matching module used when a module is not present to prevent excessive cooling air from shunting around empty slots.

1.8 Revision history

Date	Revision	Changes
13 Aug 2009	D0.1	Introduction and major section headings
	D0.2	Outline complete at all header levels
	D0.3	
	D0.4	
	D0.5	
	D0.6	
	D0.7	
11 Jan 2011	D0.8	Ready for Final Subcommittee Review
13 Jan 2011	D0.9	Ready for Member Review
	RC1.0	Ready for Adoption Ballot
	R1.0	Adopted

2 Mechanical

2.1 Tolerances

- ¶ 1 A Root Sum Squared (RSS) tolerance was applied to all mechanical interfaces and test dimensions following ISO 1101 standards.

2.2 AMC Module→

2.2.1 Printed Circuit Board

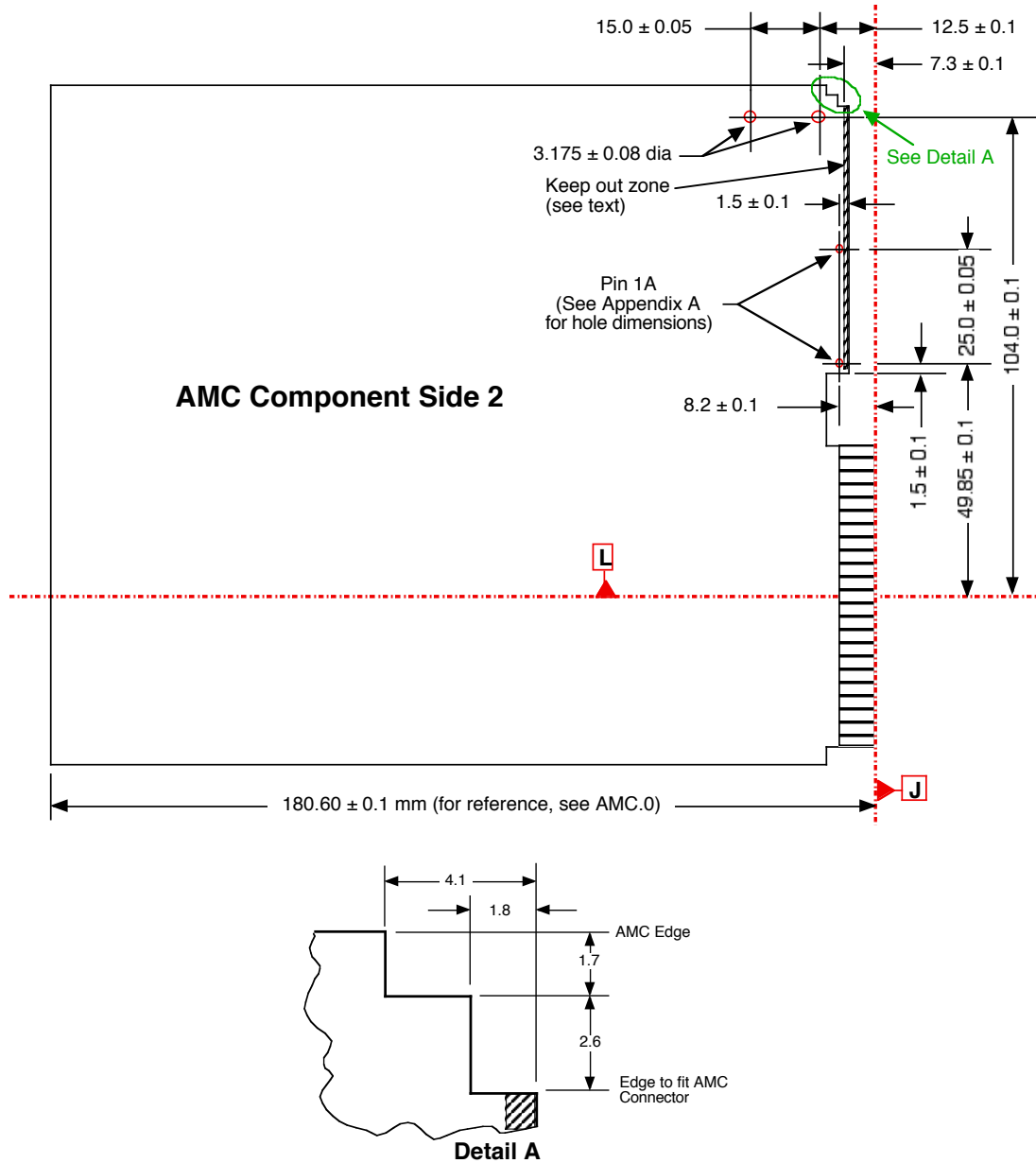


Figure 2-1: AMC Dimensions

Note: Figure 2-1 shows pin 1A locations for Zone 3 ADF connectors.

- REQ 2-1: The outline of the AMC with ADF connectors **shall** follow PICMG AMC.0 R2.0, Section 2.2.1.2 except as noted in Figure 2-1.
- REQ 2-2: Implementations using other connectors **may** have different positions for Pin 1 and different Zone 3 PCB edge details than those shown in Figure 2-1.
- ¶ 2 Unless otherwise noted, all dimensions conform to AMC.0 R2.0. Note that although the AMC outline is similar to AMC.0, Figure 2-5 the profile in the Zone 3 area is different. The profile in that area was specified for the case when there were two backplanes in a two-tier subrack. The outline insured that the PCB missed the upper backplane AMC connector. Since that area is now specified for attachment to a μ RTM the old outline dimensions have been changed. The reference 42.5 is now 48.35, 107.5 is now 110.05 maximum and the setback from Datum J that was 7.5 is now 6.7. The old outline was the start of another edge card connector but with the fingers removed and cut short.
- REQ 2-3: The inside and outside PCB corners in the Zone 3 area **shall** follow AMC.0 R2.0, Section 2.2.2, Figure 2-12 (Inside corners to be R1 and outside corners to be R0.5).
- ¶ 3 Detail A allows AMC's without Zone 3 connectors and the Guide/Key block to be inserted in shelves or carriers that have an AMC connector in the Zone 3, Connector 1 area (see MTCA.0 R1.0, Figure 2-100). The removal of PCB material in the notch area (detail A) will result in the Guide/Key block overhanging the PCB by about 0.5 mm. One should be aware that some of the AMC's original functionality could be lost in such a configuration.
- REQ 2-4: To be compatible with subracks and carriers that have the AMC connector in the Zone 3, Connector 1 area, other components **shall not** be in the keep out zone shown in Figure 2-1.
- REQ 2-5: The AMC board **shall** implement the ESD strip as detailed in AMC.0, Section 2.2.1.4.

2.2.2 Zone 3 Keying and Alignment

- ¶ 4 The keying mechanism used by modules adds protection from potentially damaging voltages being applied at the Zone 3 interface. In some cases system considerations may not allow gating of the voltages on the μ RTM to the Zone 3 connector possibly resulting in damage to circuitry on the front board.
- ¶ 5 The alignment mechanism adjusts the front and rear modules so the Zone 3 connectors are positioned for mating.
- REQ 2-6: The AMC Modules that mate with μ RTM Modules **shall** implement female key/alignment mechanics as specified in Appendix B-2.

2.2.2.1 Key Orientation

Table 2-1: Key Orientation

N	A = Orientation in Degrees
1	0
2	45
3	90
4	135
5	180
6	225
7	270
8	315

¶ 6 The Orientation details can be found in Appendix B-3.

REQ 2-7: N = 0 **should** be used for test fixtures or in cases where only alignment is necessary.

2.2.2.2 Module Keying when using ADF Connectors

REQ 2-8: AMC Modules using ADF connectors **shall** use the key definitions as described in Table 2-2.

Table 2-2: Data Connector Voltage Level Keying

N	Data Signal in Volts
1	LVDS
2	0 – ± 1
3	$>\pm 1$ – ± 3.3
4	$>\pm 3.3$ – ± 10
5	$>\pm 10$
6	Reserved
7	Reserved
8	Reserved

2.2.2.3 Module Keying when not using ADF Connectors

REQ 2-9: Key definitions for AMC Modules and μ RTMs that use connectors other than ADF connectors in Zone 3 **shall** be defined by the Module designer.

2.2.3 Connectors

2.2.3.1 Zone 1

REQ 2-10: The front board **should** use an add-on plug connector instead of edge card fingers.

¶ 7 The use of the add-on plug connector is similar to that specified for the MCH in MTCA.0 R1.0, Section 2.11.4. The versions of these connectors that have only Tongue 1 can be used here. These connectors have tighter tolerances and better overall mechanical properties than that obtainable with edge fingers. In addition the tight constraint on the PCB thickness is relaxed.

2.2.3.2 Zone 3 Connectors

¶ 8 The AMC Module uses connectors in the Zone 3 area to connect to the μ RTM. The following sections provide details on how to use specific connectors in Zone 3. Table 2-3 lists the necessary signals to be provided at the AMC and μ RTM interface.

Table 2-3: Power/Management Connections for AMC/ μ RTM Interface

Name	Description	Name	Description
μ RTM_PWR	+12 Volts (nom)	GND	Ground
μ RTM_PS#	μ RTM Present	μ RTM_MP	+3.3 Volts (nom)
μ RTM_SDA	I ² C Data	μ RTM_SCL	I ² C Clock
μ RTM_TCK	Optional JTAG TCK	μ RTM_TDI	Optional JTAG TDI
μ RTM_TDO	Optional JTAG TDO	μ RTM_TMS	Optional JTAG TMS

REQ 2-11: An ADF connector in J30 **shall** have a Short Pin in position J30-C1 for μ RTM_PS#.

¶ 9 The ADF connector Short Pin is defined in Appendix A.

REQ 2-12: Implementation of JTAG **shall** be optional (red names in Table 2-5).

REQ 2-13: If JTAG is implemented on the Front AMC and the μ RTM is not present the AMC **should** short the TDI and TDO lines that go to/from the μ RTM on the AMC.

- ¶ 10 The AMC can use the μ RTM_PS# line to activate the TDI to TDO connection to the μ RTM.
- REQ 2-14: If a μ RTM that does not implement JTAG is associated with an AMC that implements JTAG the μ RTM **shall** connect the TDO and TDI pins on the Zone 3 connector.
- REQ 2-15: When both a μ RTM and AMC that implement JTAG are connected the μ RTM **shall** be included in the AMCs JTAG signal chain.
- REQ 2-16: If an AMC that does not implement JTAG is connected to a μ RTM that does the user **should** make sure that the μ RTM JTAG signals are in a state that will not cause unintended JTAG operations.

2.2.3.2.1 Zone 3 ADF Connectors

- REQ 2-17: Front boards **may** use ADF connectors in Zone 3 for connection to the μ RTM.
- REQ 2-18: Front boards designed with Zone 3 ADF connectors **shall** comply with the requirements of this section.
- REQ 2-19: Front Board ADF receptacle connectors J30 and J31 **shall** be as defined in Appendix A.
- REQ 2-20: The 20 pair ADF connector **may** be used on Mid-size and Full-size Modules.
- REQ 2-21: The 30 pair ADF connector **may** be used on Mid-size and Full-size Modules.
- REQ 2-22: The 40 pair ADF connector **may** be used on Full-size Modules.

Table 2-4: ADF Connector Compatibility Table

	Compact	Mid-size	Full-size
ADF 20 Pair	no	yes	yes
ADF 30 Pair	no	yes	yes
ADF 40 Pair	no	no	yes

- ¶ 11 Columns E, F, G, H, GndF and GndH are not available in the 20 pair version and therefore JTAG cannot be implemented. Columns G, H and GndH are not available in the 30 pair version. The 20 and 30 pair ADF connectors are detailed in Appendix A. The 40 pair ADF male is detailed in PICMG3.0 and the female in PICMG 3.8. (See Table 2-5 and Table 2-6.)
- REQ 2-23: The ADF J30/RP30 connector **shall** have data, power and system management functions assigned to pins as shown in Table 2-5.

REQ 2-24: ADF connector J31 **may** be populated to afford extra data connectivity

¶ 12 Table 2-5 has the pin assignments for the J30/RP30 connectors. J31/RP31 are entirely user-defined (see Table 2-5). Both tables are for the 20, 30 and 40 pair ADF connectors.

REQ 2-25: Functions in rows 1 and 2 that are not used as shown **shall** be left unconnected

Table 2-5: J30/RP30 Pin Assignments

Col→ Row↓	GndH	H	G	GndF	F	E	GndD	D	C	GndB	B	A
10	GNDH10	H10	G10	GNDF10	F10	E10	GNDD10	D10	C10	GNDB10	B10	A10
9	GNDH9	H9	G9	GNDF9	F9	E9	GNDD9	D9	C9	GNDB9	B9	A9
8	GNDH8	H8	G8	GNDF8	F8	E8	GNDD8	D8	C8	GNDB8	B8	A8
7	GNDH7	H7	G7	GNDF7	F7	E7	GNDD7	D7	C7	GNDB7	B7	A7
6	GNDH6	H6	G6	GNDF6	F6	E6	GNDD6	D6	C6	GNDB6	B6	A6
5	GNDH5	H5	G5	GNDF5	F5	E5	GNDD5	D5	C5	GNDB5	B5	A5
4	GNDH4	H4	G4	GNDF4	F4	E4	GNDD4	D4	C4	GNDB4	B4	A4
3	GNDH3	H3	G3	GNDF3	F3	E3	GNDD3	D3	C3	GNDB3	B3	A3
2	GNDH2	H2	G2	GNDF2	TMS	TDI	GNDD2	SCL	MP	GNDB2	PWRB2	PWRA2
1	GNDH1	H1	G1	GNDF1	TDO	TCK	GNDD1	SDA	PS#	GNDB1	PWRB1	PWRA1
							20 Pair ADF Connector					
				30 Pair ADF Connector								
	40 Pair ADF Connector											

Notes: 1. The connector name prefix has been omitted in this table for readability. The JTAG, management and power pins have the μ RTM_ prefix omitted in the table.

2. PS# is a short pin for last mate and first break.

¶ 13 Connector designation and row/column number name the signal contacts. For example: J30-A5 would be the pin in the J30 connector, column A and row 5. Ground contacts are by row number and column where the column designator is the same as the adjacent signal column. RP31-GNDF6 would be the designator for connector RP31 grounds pin in ground column F row 6. For signals pins that have specific use the designator uses that signal name, *i.e.* J30-MP or RP30-PWRB2.

REQ 2-26: Each pair A/B, C/D, E/F and G/H **may** be used as a differential pair or as two individual single-ended signals.

REQ 2-27: If used as a differential signal pair A, C, E and G **shall** be assigned as positive/+ and B, D, F and H as negative/- signals.

¶ 14 The ground contacts, GNDx(n) of a row are connected together within the ADF connector. Unless referring to a specific ground pin in a connector this document uses the generic term GND. Note that in 20 pair ADF connectors only A, B, GndB, C, D, and GndD are in the connector. For the 30 pair ADF connectors A, B, GndB, C, D, GndD, E, F and Gnd F are in the connector.

REQ 2-28: All pins named ‘GND’ **shall not** be used for signals.

REQ 2-29: In the case of analog signals these GND contacts **may** be connected to a separate “analog ground” to control signal fidelity.

Table 2-6: J31/RP31 Pin Assignments

Col→ Row↓	GndH	H	G	GndF	F	E	GndD	D	C	GndB	B	A
10	GNDH10	H10	G10	GNDF10	F10	E10	GNDD10	D10	C10	GNDB10	B10	A10
9	GNDH9	H9	G9	GNDF9	F9	E9	GNDD9	D9	C9	GNDB9	B9	A9
8	GNDH8	H8	G8	GNDF8	F8	E8	GNDD8	D8	C8	GNDB8	B8	A8
7	GNDH7	H7	G7	GNDF7	F7	E7	GNDD7	D7	C7	GNDB7	B7	A7
6	GNDH6	H6	G6	GNDF6	F6	E6	GNDD6	D6	C6	GNDB6	B6	A6
5	GNDH5	H5	G5	GNDF5	F5	E5	GNDD5	D5	C5	GNDB5	B5	A5
4	GNDH4	H4	G4	GNDF4	F4	E4	GNDD4	D4	C4	GNDB4	B4	A4
3	GNDH3	H3	G3	GNDF3	F3	E3	GNDD3	D3	C3	GNDB3	B3	A3
2	GNDH2	H2	G2	GNDF2	F2	E2	GNDD2	D2	C2	GNDB2	B2	A2
1	GNDH1	H1	G1	GNDF1	F1	E1	GNDD1	D1	C1	GNDB1	B1	A1
							20 Pair ADF Connector					
				30 Pair ADF Connector								
	40 Pair ADF Connector											

Note: The connector name prefix has been omitted in this table for readability.

¶ 15: The 40 pair ADF connectors are defined in PICMG 3.0 (receptacle) and PICMG 3.8 (pin). The 20 and 30 pair ADF connectors are defined in this document.

2.2.3.2.2 Zone 3 Non ADF Connectors and Zone 3 Interface Repository

- REQ 2-30: Front AMCs **may** use connectors other than ADF connectors in Zone 3.
- REQ 2-31: Front AMC designers that use connectors other than ADF connectors in Zone 3 **should** submit a μ RTM Zone 3 Interface repository entry to PICMG.
- REQ 2-32: μ RTM Zone 3 Interface repository entries **shall** specify what connectors are used in Zone 3 by the Front AMC.
- REQ 2-33: μ RTM Zone 3 Interface repository entries **shall** include mechanical drawings with Zone 3 connector locations for the Front AMC.
- REQ 2-34: μ RTM Zone 3 Interface repository entries **shall** specify the key/guide position used by the Front AMC.
- REQ 2-35: μ RTM Zone 3 Interface repository entries **shall** specify the Front AMC's Zone 3 connector pinout for the required management functions listed in Table 2-3.
- ¶ 16 μ RTM_PS# in Table 2-3 is a short pin (see Section 2.2.3.2) and that last-mate/first-break function is necessary in a non-ADF connector for proper management operation.
- REQ 2-36: μ RTM Zone 3 Interface repository entries **shall** specify the electrical characteristics of other Zone 3 connector pins for the Front AMC.

2.2.4 AMC Face Plate

- REQ 2-37: AMC Modules **shall** have a faceplate, including the latch and retention device, as specified in MicroTCA.1 R1.0, Section 2.5.
- ¶ 17 See also PICMG Rugged MicroTCA.1 R1.0, Appendix B for implementations of the retention device.

2.2.5 AMC Mid-size Module Component Envelope

- ¶ 18 The AMC Modules in this specification have the component envelope similar to that shown in AMC.0 R2.0, Figure 2-15 except as modified in Figure 2-2 below. This outline eliminates the stair stepping and makes the Mid-size Module outline similar to the Compact and Full-size Module outlines.

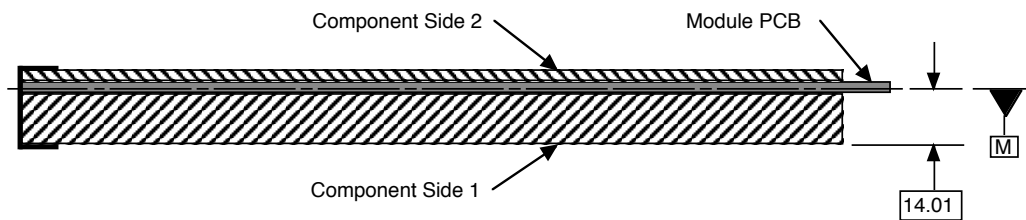


Figure 2-2: AMC Component Outline

2.2.6 AMC Test Dimensions

- ¶ 19 The test dimension for the depth of the assembly is the same as that in PICMG Rugged MicroTCA.1 R1.0. The projection of the Zone 3 ADF connector mating face beyond Datum J is an added dimension. The test dimensions from Datum L are to the edge of the ADF connector housing.

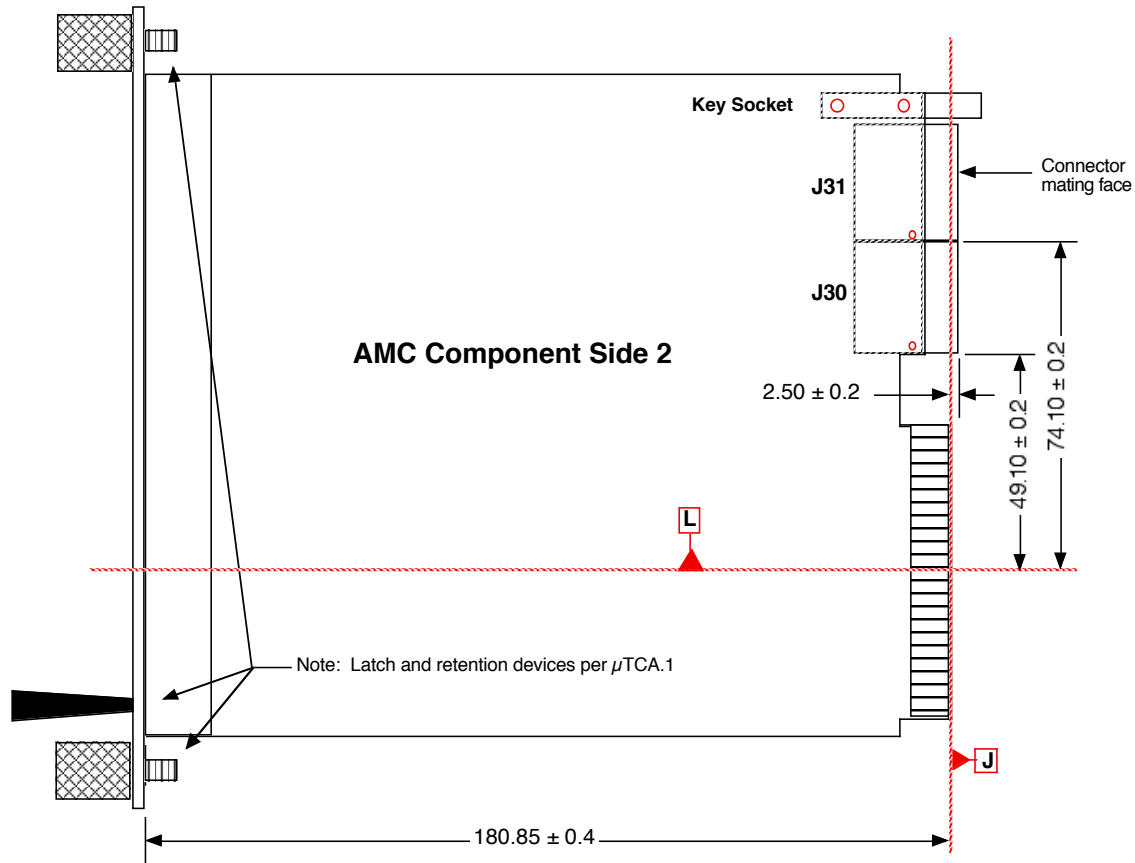


Figure 2-3: AMC Module Test Dimensions

2.3 μRTM Module

- ¶ 20 Construction of the μRTM is similar to the AMC in AMC.0 R2.0.
- REQ 2-38: The panel and other hardware **shall** be rotated 180° about an axis perpendicular to the PCB so as to be compatible with existing hardware.
- ¶ 21 The 180° rotation places the latch in the upper left of the μRTM Module. Other hardware is similarly repositioned. All drawings are shown from side two of the PCB.

2.3.1 Printed Circuit Board

¶ 22 The μ RTM is similar to the AMC front board in size. Figure 2-4 shows the board outline and the location of Zone 3 ADF connectors and the male alignment/key pin. As in the AMC specification there are reserved areas for hot swap switch, faceplate mounting hardware, and ESD zone along the top and bottom edge.

REQ 2-39 The PCB outline and pin 1 locations in Figure 2-4 **shall** be for μ RTMs using ADF connectors.

REQ 2-40: Implementations using other connectors **may** have different positions for Pin 1 and different Zone 3 PCB edge details than those shown in Figure 2-4.

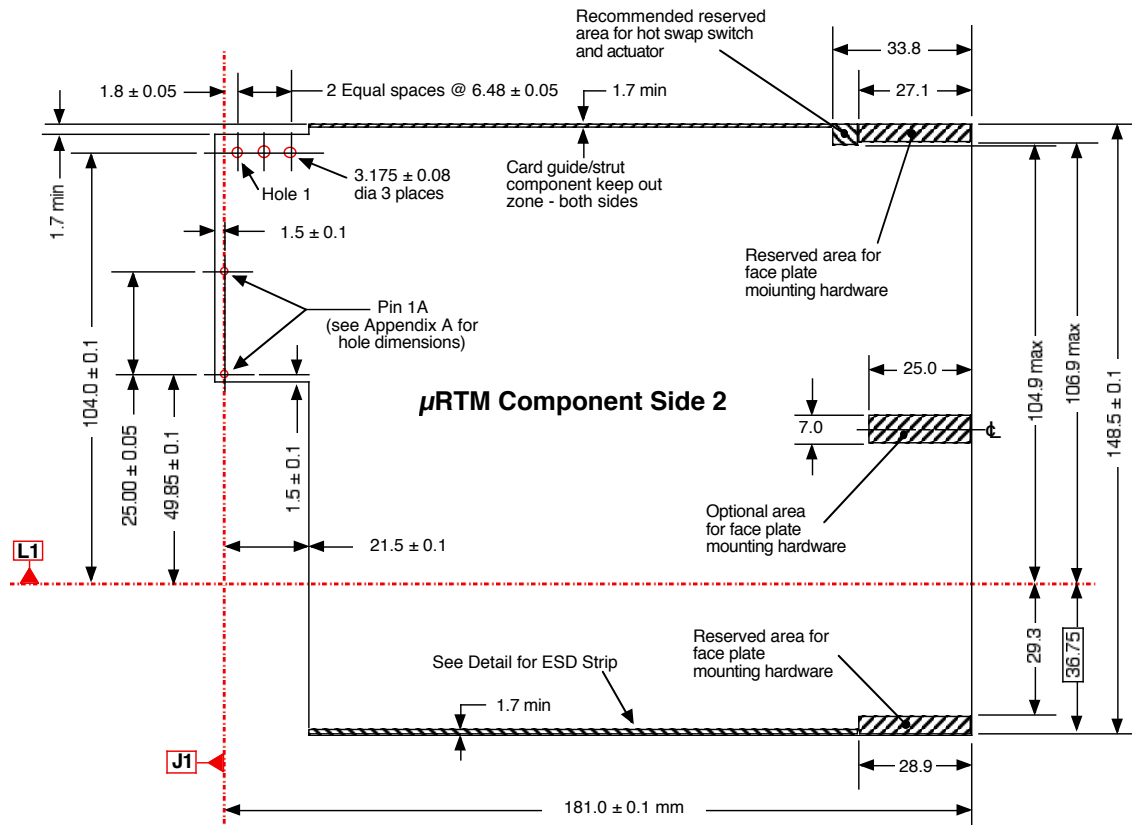


Figure 2-4: μ RTM PCB Dimensions

Note: Datum LI is collinear with Datum L in Figure 2-1 and Datum JI is parallel to Datum J in Figure 2-1.

§ 23 Dimensions for keep out and for mounting hardware are similar to AMC.0 R2.0, Figure 2-5 except for rotation of pattern from lower (upper) left to upper (lower) right.

§ 24 The ESD strip shown in Figure 2-5 is similar to that specified in AMC.0, Section 2.2.1.4. The ESD segments are located only on

component side 2 of the μ RTM. The difference is that the strip is at the bottom of the μ RTM rather than at the top as for the AMC Module.

REQ 2-41: The μ RTM **shall** have ESD protection as shown in Figure 2-5.

¶ 25 Figure 2-5 shows the general dimension of the ESD strip on the lower part of the μ RTM. Other dimensions of the PCB are in Figure 2-4. Segments 1, 2 and 3 are similar to those in AMC.0, Figure 2-8. More ESD data can be obtained from AMC.0, Section 2.2.1.4 and Section 4.4.

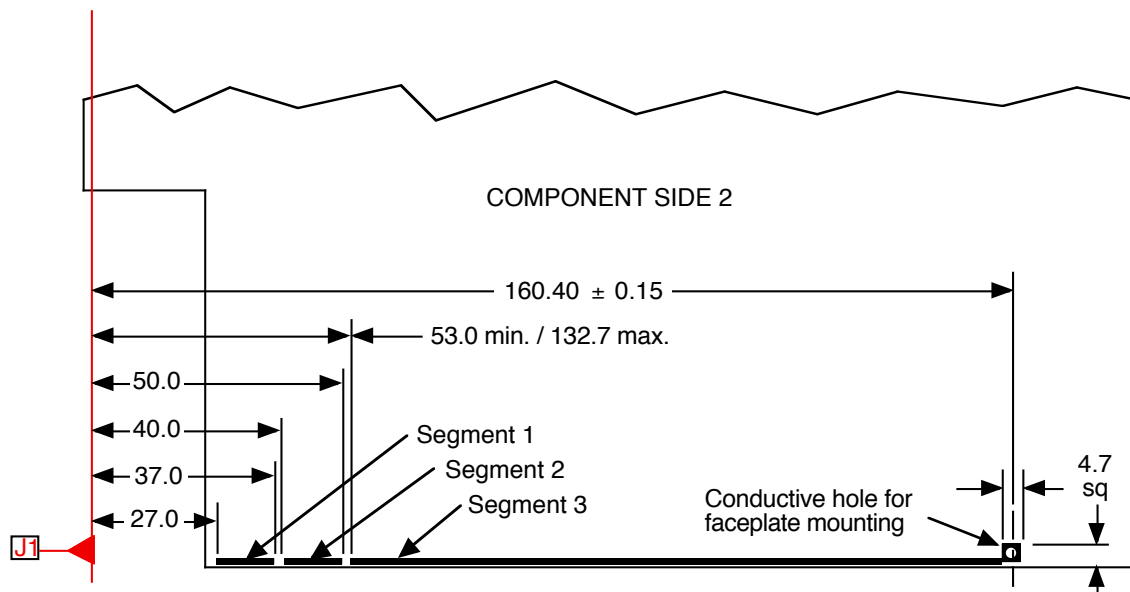


Figure 2-5: μ RTM ESD Strip Dimensions

2.3.2 Zone 3 Keying

¶ 26 See this document Section 2.2.2 and Appendix B for other Key Information.

REQ 2-42: The μ RTM Modules that mate with AMC Modules **shall** implement the male key/alignment mechanics as specified in Appendix B-1.

2.3.3 Zone 3 Connectors

2.3.3.1 ADF Connectors

REQ 2-43: The μ RTMs **shall** position the Zone 3 ADF connector(s) according to the pin 1 location for each connector as shown in Figure 2-4.

REQ 2-44: The mounting hole pattern on the μ RTM **shall** be as shown in Appendix A.

2.3.3.2 Non ADF Connectors and Zone 3 Interface Repository

- REQ 2-45: μ RTMs **may** use connectors other than ADF connectors in Zone 3.
- REQ 2-46: μ RTM designers that use connectors other than ADF connectors in Zone 3 **should** submit a μ RTM Zone 3 Interface repository entry to PICMG.
- REQ 2-47: μ RTM Zone 3 Interface repository entries **shall** specify what connectors are used in Zone 3 by the μ RTM.
- REQ 2-48: μ RTM Zone 3 Interface repository entries **shall** include mechanical drawings with Zone 3 connector locations for the μ RTM.
- REQ 2-49: μ RTM Zone 3 Interface repository entries **shall** specify the key/guide position used by the μ RTM.
- REQ 2-50: μ RTM Zone 3 Interface repository entries **shall** specify the μ RTMs Zone 3 connector pinout for the required management functions listed in Table 2-3.
- REQ 2-51: μ RTM Zone 3 Interface repository entries **shall** specify the electrical characteristics of other Zone 3 connector pins for the μ RTM.

2.3.4 μ RTM Face Plate

- REQ 2-52: μ RTM Modules **shall** have a faceplate, including the latch and retention device, as specified in MicroTCA.1 R1.0, Section 2.5.
- ¶ 27 See also PICMG Rugged MicroTCA.1 R1.0, Appendix B for implementations of the retention device. The hardware is the same as for the AMC.0 R2.0, however, the mounting is reversed top to bottom. Figure 2-6 shows the reversed mounting for the LEDs and handle. Bar code and vendor label area is the same as shown in AMC.0 R2.0, Figure 2-20.

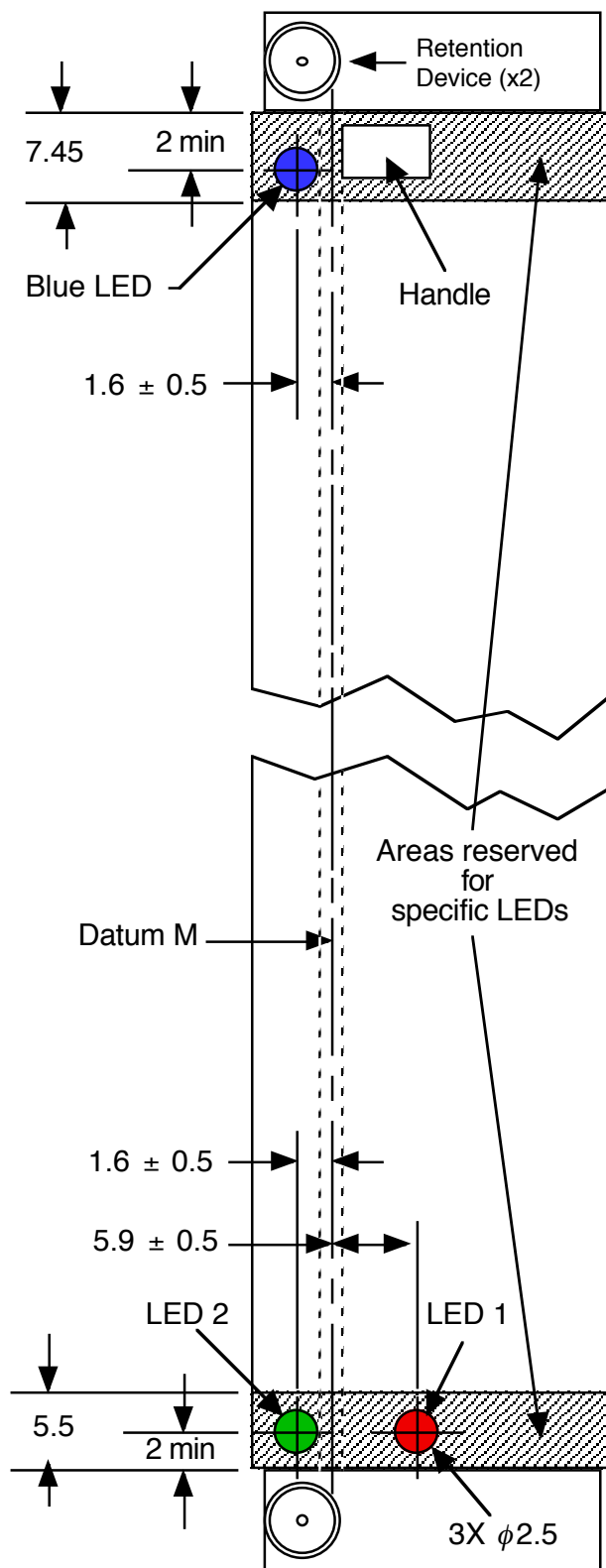


Figure 2-6: μ RTM Face Plate

Note: the color of LED1 and LED2 can vary per AMC.0 R2.0, Section 2.2.4.1.

2.3.5 μ RTM Module Component Envelope

REQ 2-53: μ RTM modules **shall** use the same component height outline as AMC.0 R2.0, Figure 2-14, Figure 2-16 and Figure 2-15 as modified by Figure 2-2 in this document.

¶ 28 The Figures cited in REQ 2-52 do not include the ADF connector outlines. The connector outlines can be determined from PICMG 3.0, PICMG 3.8 and this document Appendix A as appropriate for the use.

¶ 29 The male ADF connector plastic housing extends beyond the Module panel by a nominal 0.33 mm on component Side 2. Since there is no metallic contact possible this overhang has been deemed by the committee to be acceptable.

2.3.6 μ RTM Test Dimensions

REQ 2-54: μ RTMs that implement ADF connectors **shall** meet the test dimensions in Figure 2-7.

¶ 30 Test dimensions from Datum L1 are to the edge of the ADF connector housing.

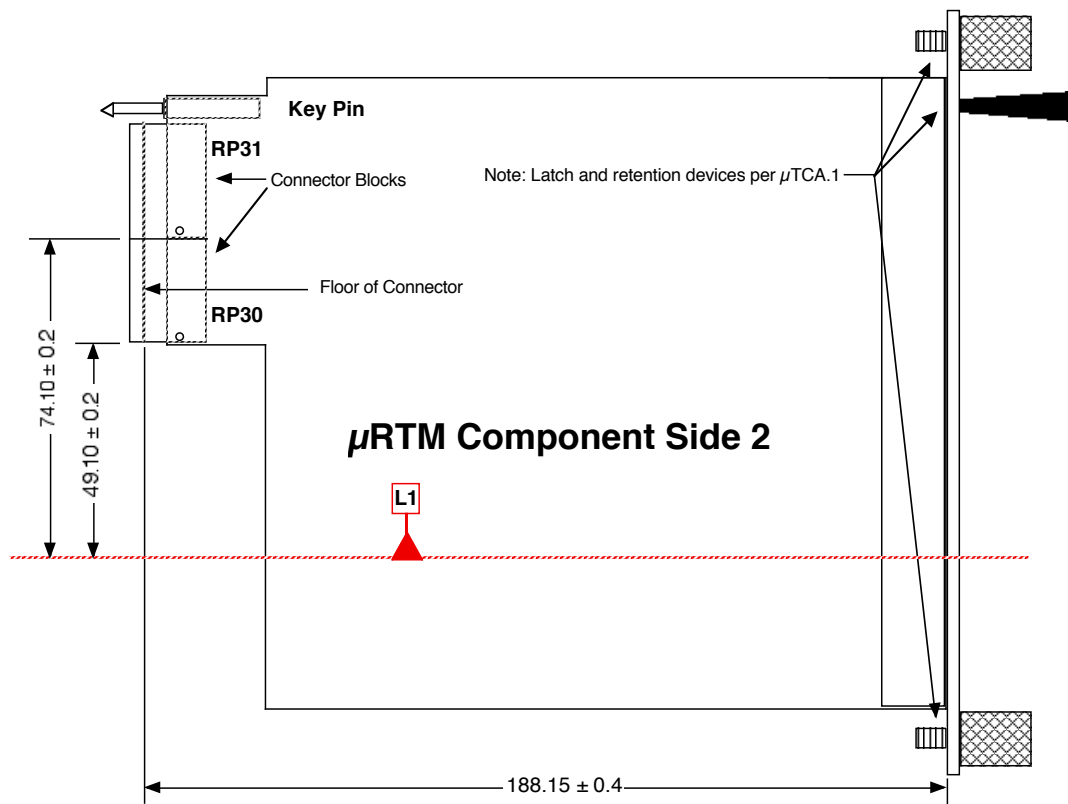


Figure 2-7: μ RTM Module Test Dimensions

2.4 μ TCA Subrack

- ¶ 31 In the broadest sense one can think of the μ TCA Subrack as two subracks mated back-to-back. Obviously there is more to the subrack but this gives the user a way of viewing this section of the document.

2.4.1 Subrack Dimensions

- ¶ 32 Subrack specifications follows the MTCA.0 R1.0 specification. The AMC Modules and the front part of the subrack are fully compatible with the Double Modules of this specification. The rear of the subrack accommodates μ RTM Modules specified in this document.

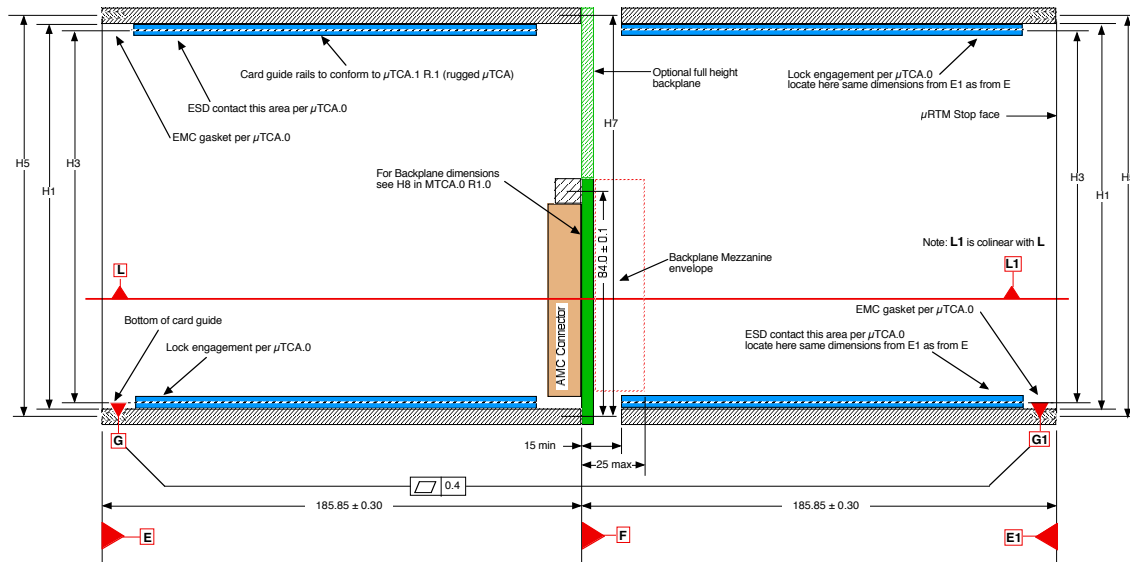


Figure 2-8: Side view of Subrack

Note: For missing dimensions see MTCA.0, Section 2.

- REQ 2-55: Figure 2-8 side view drawing **shall** serve as the basis for designing the μ TCA subrack.
- REQ 2-56: Other manifestations of the subrack such as Pico, half width rack mounted, *etc* **shall** conform to the dimensions of Figure 2-8.
- ¶ 33 Subracks that have the modules mounted horizontally rather than vertically have certain constraints imposed by the module retention requirements. Such Subracks are not described in this document and may prove difficult to manufacture.
- REQ 2-57: The backplane printed circuit board thickness **should** be 5 mm.
- ¶ 34 The height of the backplane is detailed in MTCA.0 R1, Table 2-10. The distance from L or L1 to the top of the backplane is one half of H8 for the single width entry in Table 2-10 when the AMC connects

directly to the μ RTM. The top support bar is included in the maximum backplane height for the single width case.

2.4.2 Insertion of Front and Rear Boards

REQ 2-58: When initially configuring modules in the μ TCA subrack the following sequence **shall** be followed:

1. Insert the Front AMC Module of the AMC/ μ RTM pair
2. Fasten the retention device on the AMC panel to the subrack
3. Insert μ RTM
4. Fasten the retention device on the μ RTM panel to the subrack

¶ 35 After the initial configuration sequence specified in REQ 2-58, the removal and reinsertion of either the AMC Module or the μ RTM Module will not require this sequence to be repeated.

REQ 2-59: If both the AMC and μ RTM are removed then the insertion sequence in REQ 2-58 **shall** be repeated.

2.4.3 Subrack Test Dimensions

REQ 2-60: Subracks that conform to this specification **shall** meet the test dimensions in Figure 2-9.

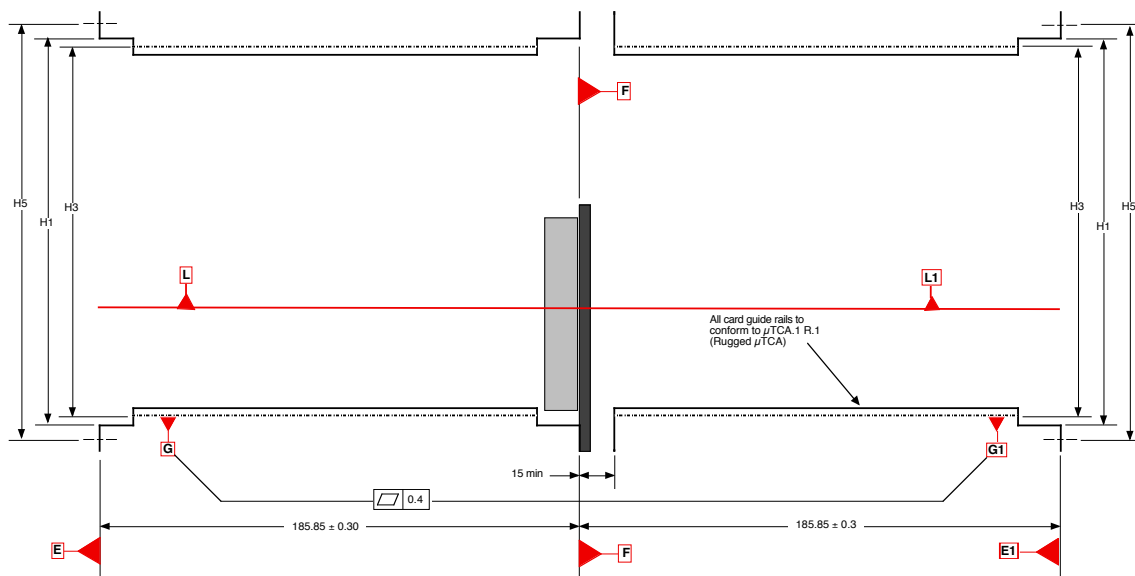


Figure 2-9: Test Dimensions for Subrack

¶ 36 Datum's L and L1 are collinear. For location of Datum L see MTCA.0, R1.0, Figure 2-29. The dimensions H1, H3 and H5 are defined in MTCA.0, R1.0, Section 2.7.1.

2.4.4 Subrack Cooling

Section 5.2 contains diagrams of airflow balancing modules that can be used when dealing with temporary, permanent or empty slots. The airflow requirements are also in Section 5.2.

2.4.5 Module sizes for subracks

- ¶ 37 Subracks can be constructed for any module size (Compact, Mid-size, or Full-size) or mixture of various sizes. Mid-size Modules can fit either the 2 or 3 row ADF connector in Zone 3. Full-size Modules can fit the 2, 3 or 4 row ADF connectors into Zone 3.
- REQ 2-61: Modules without Zone 3 connectors, if used, **shall** have a μ RTM Filler Module inserted in the rear of these units to block air flowing between the front and rear of the subrack.
- ¶ 38 It should be noted that there could be a slight interference between the adjacent modules gasket and the connector when inserting either the AMC or the μ RTM. This interference only occurs as the inserted module passes the adjacent front panel and does not impact the other hardware on either board. This has not been deemed to be a problem (see Section 2.3.5).

2.4.6 Zone 3 Backplane

- ¶ 39 The subrack and AMC Module with ADF connectors are defined such that a backplane could be mounted in Zone 3 without modifying the AMC Module. The ADF connectors on the AMC Module would mate correctly with the vertical male ADF backplane connector. If a μ RTM were also used with the Zone 3 backplane it would have to be modified.
- ¶ 40 MicroTCA.4 does not detail either the backplane or the μ RTM that would be compatible with such a backplane.

3 Management

3.1 Overview

- ¶ 41 MicroTCA.4 systems extend the functionality of the MicroTCA.0 specification. This section defines the hardware platform management extensions required by MicroTCA.4 systems. The requirements from AMC.0 and MicroTCA.0 apply to MicroTCA.4 systems unless explicitly superseded by this specification.

3.2 μ RTM Management Hardware

- ¶ 42 AMCs designed for MicroTCA.4 systems support a μ RTM via Zone 3 connectors (see Section 2.1.3.2 and Section 2.3.3). The μ RTM is managed by the MMC of the front AMC board. In order to detect a mismatched μ RTM, a standardized management interface between the AMC and the μ RTM is required.
- ¶ 43 The management interface between the AMC and the μ RTM includes the following:
- Ground (GND)
 - μ RTM-PS#
 - Management Power (μ RTM-MP)
 - I²C bus
 - Payload Power (μ RTM-PWR)
- ¶ 44 In addition to the signals through the Zone 3 Interface, there are additional circuitry requirements for the AMC and the μ RTM.
- ¶ 45 Figure 3-1 shows an example block diagram of the basic AMC and μ RTM management circuitry.

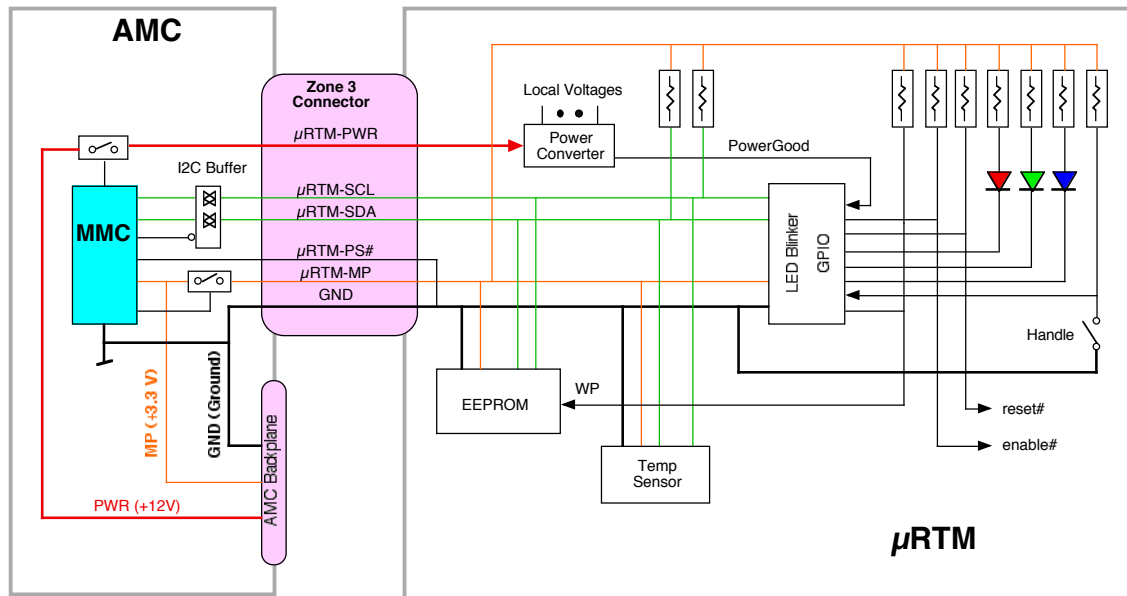


Figure 3-1: Example AMC/μRTM Management Block Diagram

3.2.1 μRTM-PS#

- ¶ 46 The μRTM-PS# signal is used to detect the presence of a μRTM.
- REQ 3-1: The Front AMC **shall** pull-up μRTM-PS# to management power.
- REQ 3-2: The μRTM **shall** connect μRTM-PS# to ground.
- REQ 3-3: The Front AMC's MMC **shall** monitor the μRTM-PS# signal.
- REQ 3-4: If the Zone 3 connectors do not guarantee μRTM-PS# to be a last mate contact, the MMC design **should** take precautions to ensure the μRTM is fully mated before considering the μRTM as present.
- ¶ 47 The precautions in REQ 3-4 about the lack of a short pin are design specific and are beyond the scope of this specification.

3.2.2 Management Power

- ¶ 48 Management Power (MP) is delivered to the μRTM through the Front AMC.
- REQ 3-5: The Front AMC's MMC **should** gate MP to the μRTM.

3.2.3 I²C Bus

- REQ 3-6: The MMC **shall** provide an I²C bus for connection to devices on the μ RTM.
- REQ 3-7: The AMC **should** provide a bi-directional buffer such as an LTC4307 or equivalent to isolate the μ RTM I²C bus from the AMC's I²C bus.
- REQ 3-8: The μ RTM **shall** provide an AT24C32A compatible serial EEPROM that contains the Platform Management FRU information of the μ RTM.
- REQ 3-9: This EEPROM **shall** be connected to the Front AMC MMC's I²C port.
- REQ 3-10: The address of the EEPROM **shall** be 50h.
- REQ 3-11: If a larger EEPROM is needed, devices up to 24C512 **may** be used, as they are software compatible with the 24C32.
- ¶ 49 Although SMBus is very similar to I²C, there are minor differences. Some SMBus devices might appear to work, but might occasionally cause errors. I²C compatibility is required.

3.2.4 Hot Swap Handle

- ¶ 50 A Hot Swap ejector handle switch is used to notify the MMC when the μ RTM can proceed from Hot Swap state M1 to M2 during an insertion and from Hot Swap state M4 to M5 during an extraction. Because incompatible μ RTMs do not proceed beyond the M1 state, a standardized interface for reading the hot swap ejector handle state is not needed.
- REQ 3-12: The μ RTM **shall** provide a Hot Swap ejector handle switch readable by a compatible AMC's MMC.

3.2.5 μ RTM LEDs

- ¶ 51 Like an AMC, the μ RTM provides a Blue Hot Swap LED, LED1 and optionally LED2.
- REQ 3-13: The μ RTM **shall** provide a Blue Hot Swap LED as defined in AMC.0.
- REQ 3-14: The Blue Hot Swap LED **shall** be powered from MP.
- REQ 3-15: The Blue Hot Swap LED **shall** power up in the on state.
- REQ 3-16: The Blue Hot Swap LED **shall** be controllable by a compatible AMC's MMC.
- REQ 3-17: The μ RTM **shall** provide LED1 as defined by AMC.0.
- REQ 3-18: LED1 **shall** be controllable by a compatible AMC's MMC.

- REQ 3-19: The μ RTM **should** provide LED2 as defined by AMC.0.
- REQ 3-20: LED2, if implemented, **shall** be controllable by a compatible AMC's MMC.
- ¶ 52 The hardware interface between the AMC's MMC and the μ RTM's LEDs is not defined in this specification. A design can choose to use dedicated pins in the Zone 3 interface or can provide an I²C-based interface. It should be noted, however, that many MMC firmware implementations cannot generate steady blink rates for LEDs connected to I²C-based GPIO devices. It is recommended that I²C-based designs use LED blinker devices rather than simple GPIO to drive the LEDs.
- REQ 3-21: μ RTMs that control the LEDs via I²C **should** use LED drivers with programmable blink rate and duty cycle.

3.2.6 Payload Power

- ¶ 53 Payload power is delivered to the μ RTM through the Front AMC.
- REQ 3-22: The Front AMC's MMC **shall** gate Payload Power to the μ RTM.
- REQ 3-23: The MMC **shall** only enable Payload Power to the μ RTM as defined in Section 3.5.
- ¶ 54 Payload Power is delivered to the μ RTM as PWR (nominally 12V) minus a small voltage drop due to the PWR switching on the AMC (see Section 4.2.2).
- REQ 3-24: If a μ RTM requires other voltages, the μ RTM **shall** provide any necessary voltage conversion circuitry.

3.2.7 μ RTM Reset

- ¶ 55 Some μ RTM designs require a reset signal. This can be implemented using a dedicated Zone 3 pin, an I²C-based implementation, or some other design-specific mechanism.

3.2.8 Zone 3 Interface Enable

- ¶ 56 Many μ RTM designs require a Zone 3 interface enable signal. This enable signal can be implemented using a dedicated Zone 3 pin, an I²C-based implementation, or some other design-specific mechanism.

3.2.9 μ RTM Temperature Sensor

- REQ 3-25: The μ RTM **shall** provide at least one temperature sensor readable by the Front AMC's MMC.
- REQ 3-26: The temperature sensor **should** monitor the most temperature critical component on the μ RTM.
- REQ 3-27: The temperature sensor **may** be connected to the I²C bus or **may** be connected using user I/O.

3.3 FRU Device IDs

- ¶ 57 The AMC.0 specification requires AMCs to implement a single FRU device ID of 0. Because the μ RTM needs to be managed as an independent FRU, this specification requires the MMC to implement two specific FRU device IDs.
- REQ 3-28: The MMC **shall** implement FRU Device ID 0 to represent the Front AMC.
- REQ 3-29: In MicroTCA.4 environments, the MMC **shall** implement FRU Device ID 1 to represent its μ RTM.
- REQ 3-30: In response to a Get PICMG Properties command, the MMC **shall** report a *Max FRU Device ID* of 1.
- REQ 3-31: The MMC **shall** provide a FRU Device Locator record in its SDRs for the μ RTM.
- REQ 3-32: This FRU Device Locator record **shall** report the μ RTM as having an Entity ID of PICMG Rear Transition Module (COh).
- REQ 3-33: The MMC **shall** implement the Get Device Locator Record ID command as defined in the AMC.0 specification.
- REQ 3-34: The Carrier Manager **shall** map each AMC's FRU Device ID 0 (Front AMC) to Carrier Manager relative FRU Device IDs 5-39 as defined in MicroTCA.0.
- REQ 3-35: The Carrier Manager **shall** map each AMC's FRU Device ID 1 (μ RTM) to Carrier Manager relative FRU Device IDs 90-124.

3.4 MicroTCA Carrier Information

- ¶ 58 The MicroTCA Carrier Information record includes a list of Slot Entries for each FRU in the MicroTCA Carrier. Each Slot Entry specifies the Site Type and Site Number as well as physical location coordinates.
- REQ 3-36: Slot Entries corresponding to μ RTMs **shall** have their *Site Type* field set to a value of 09h (Rear Transition Module as defined in the PICMG 3.0 specification).
- REQ 3-37: Slot Entries corresponding to μ RTMs **shall** have their *Site Number*, *Origin X*, and *Origin Y* fields set to the same values as the respective fields in the associated Front AMC's Slot Entry.
- ¶ 59 This means that the Origin X and Origin Y fields are relative to the lower left corner when viewed from the front of the Carrier and are relative to the lower right corner when viewed from the rear of the Carrier.

3.5 Operational State Management

- ¶ 60 Hot swap of μ RTMs is handled very similarly to hot swap of AMCs. The Front AMC's MMC implements two Module Hot Swap sensors, one for the Front AMC and one for the μ RTM. The Carrier Manager implements FRU Hot Swap sensors for each Front AMC and each μ RTM. Additionally, the Carrier Manager maps FRU IDs to the μ RTMs, maps sensors to μ RTM sensors, *etc.*
- ¶ 61 The following sections provide more details about operational state management for μ RTMs.

3.5.1 Typical μ RTM Insertion Process

- ¶ 62 The following sequence is recommended when inserting a μ RTM in a system.
- 1) The μ RTM is inserted and μ RTM-PS# is asserted.
 - 2) When the MMC detects μ RTM-PS# asserted by the μ RTM, it enables μ RTM-MP to the μ RTM and the μ RTM's management circuitry is powered.
 - 3) The μ RTM's Blue LED defaults to On.
 - 4) The MMC enables the Module Hot Swap sensor associated with the μ RTM, and generates a Module Hot Swap sensor (μ RTM Present) event.
 - 5) The Carrier Manager changes the Hot Swap state for the μ RTM from M0 to M1.

- 6) The MMC performs a compatibility check as described in Section 1 and generates a Module Hot Swap sensor (μ RTM Compatible or μ RTM Incompatible) event.
- 7) If the μ RTM was determined to be incompatible with the Front AMC, the insertion process is complete and the μ RTM is left in the M1 state. If the μ RTM was determined to be compatible with the Front AMC, the insertion process continues.
- 8) The user closes the μ RTM hot swap handle.
- 9) When the MMC detects the μ RTM's hot swap handle is closed, it generates a Module Hot Swap sensor (Handle Closed) event from the Module Hot Swap sensor associated with the μ RTM.
- 10) The Carrier Manager changes the Hot Swap state for the μ RTM from M1 to M2 and sends a Set FRU LED (Blue LED Long Blink) command to the MMC for FRU ID 1.
- 11) The MMC sets the μ RTM's Blue LED to long blink.
- 12) The MMC enables the remaining sensors associated with the μ RTM.
- 13) The Carrier Manager creates local sensors that map to each sensor associated with the μ RTM.
- 14) The Carrier Manager, Shelf Manager or System Manager sends a Set FRU Activation (Activate) command to the Carrier Manager.
- 15) The Carrier Manager changes the Hot Swap state for the μ RTM from M2 to M3.
- 16) The Carrier Manager sends a Set Power Level (Level=1) command to the MMC for FRU ID 1.
- 17) The MMC enables payload power to the μ RTM.
- 18) The Carrier Manager changes the Hot Swap state for the μ RTM from M3 to M4.
- 19) The MMC enables the μ RTM and AMC Zone 3 Interfaces.
- 20) The Carrier Manager sends a Set FRU LED (Blue LED Off) command to the MMC for FRU ID 1.
- 21) The MMC turns off the μ RTM's Blue LED.

3.5.2 Typical μ RTM Extraction Process

¶ 63

The following sequence is recommended when removing a μ RTM from a system.

- 1) The user opens the μ RTM hot swap handle
- 2) When the MMC detects the μ RTM's hot swap handle is open, it generates a Module Hot Swap sensor (Handle Open) event from the Module Hot Swap sensor associated with the μ RTM.
- 3) The Carrier Manager changes the Hot Swap state for the μ RTM from M4 to M5 and sends a Set FRU LED (Blue LED Short Blink) command to the MMC for FRU ID 1.
- 4) The MMC sets the Blue LED to short blink.
- 5) The System Manager, Shelf Manager or Carrier Manager sends a Set FRU Activation (Deactivate) command to the Carrier Manager
- 6) The Carrier Manager changes the Hot Swap state for the μ RTM from M5 to M6 and sends the FRU Control (Quiesce) command to the MMC for FRU ID 1.
- 7) The MMC takes any design specific action to quiesce the Zone 3 Interface. Refer to Section 1 for more details.
- 8) The MMC disables the μ RTM and AMC Zone 3 Interfaces and generates a Module Hot Swap sensor (Quiesced) event from the Module Hot Swap sensor associated with the μ RTM.
- 9) The Carrier Manager sends a Set Power Level (Level=0) command to the MMC for FRU ID 1.
- 10) The MMC disables payload power to the μ RTM.
- 11) The Carrier Manager changes the Hot Swap state from M6 to M1, and sends a Set FRU LED (Blue LED On) command to the MMC for FRU ID 1.
- 12) The MMC turns on the μ RTM's Blue LED.
- 13) The user extracts the μ RTM.
- 14) When the MMC detects μ RTM-PS# is de-asserted, the MMC disables all the sensors associated with the μ RTM except the Module Hot Swap sensor, disables the μ RTM's MP, generates a Module Hot Swap sensor (μ RTM Absent) event, and then disables the Module Hot Swap sensor associated with the μ RTM.
- 15) The Carrier Manager changes the Hot Swap state for the μ RTM from M1 to M0 and deletes all local sensors associated with the μ RTM.

3.5.3 FRU Hot Swap and Module Hot Swap Sensors

¶ 64 The Carrier Manager manages the hot swap state for μ RTMs similarly to how it manages the hot swap state for AMCs.

REQ 3-38: The Carrier Manager **shall** implement a FRU Hot Swap sensor as defined in the PICMG 3.0 specification for each μ RTM.

¶ 65 μ RTMs are hosted by the MMC on the Front AMC.

REQ 3-39: The MMC **shall** implement a Module Hot Swap sensor for the μ RTM in addition to the Module Hot Swap sensor for the AMC.

REQ 3-40: The Module Hot Swap sensor associated with the μ RTM **shall** generate events as defined in Table 3-1.

REQ 3-41: The Module Hot Swap sensor associated with the μ RTM **shall** respond to Get Sensor Reading commands as defined in Table 3-2.

Table 3-1: Module Hot Swap Event Message

Data Type	Byte	Data Field
Request Data	1	<i>Event Message Rev</i> = 04h (IPMI specification)
Request Data	2	<i>Sensor Type</i> – F2h (Module Hot Swap)
Request Data	3	<i>Sensor Number</i> = xxh (Implementation specific)
Request Data	4	<i>Event Direction</i> (<i>bit 7</i>) = 0b (Assertion) Event Type [6:0] = 6Fh (Generic Availability)
Request Data	5	Event Data 1 [7:4] = 00h (unspecified Event Data 2 and 3) [3:0] = Current Event 0 = Module Handle Closed 1 = Module Handle Opened 2 = Quiesced 3 = Backend Power Failure 4 = Backend Power Shut Down 5 = μ RTM Present ¹ 6 = μ RTM Absent ¹ 7 = μ RTM Compatible ¹ 8 = μ RTM Incompatible ¹ 9-Fh = Reserved
Request Data	6	<i>Event Data 2</i> = FFh or not present
Request Data	7	<i>Event Data 3</i> = FFh or not present
Response Data	1	<i>Completion Code</i>

Note 1: Only applicable to Module Hot Swap sensors associated with μ RTMs or Module Hot Swap sensors associated with other module types, write as 0b and ignore on read.

Table 3-2: Get Sensor Reading (Module Hot Swap sensor)

Data Type	Byte	Data Field
Request Data	1	<i>Sensor Number</i> (FFh = reserved)
Response Data	1	<i>Completion Code</i>
Response Data	2	<i>Sensor Reading</i> [7:0] Not Used. Write as 00h.
Response Data	3	<i>Standard IPMI byte</i> (See “Get Sensor Reading” in the IPMI specification): [7] – 0b = All Event Messages disabled from this sensor [6] – 0b = Sensor scanning disabled [5] – 1b = Initial update in progress. This bit is set to indicate that a “Re-Arm Sensor Events” or “Set Event Receiver” command has been used to request an update of the sensor status, and that update has not occurred yet. Software should use this bit to avoid getting an incorrect status while the first sensor update is in progress. This bit is only required if it is possible for the MMC to receive and process a “Get Sensor Reading” or “Get Sensor Event Status” command for the sensor before the update has completed. This is most likely to be the case for sensors, such as fan RPM sensors, that may require seconds to accumulate the first reading after a re-arm. [4:0] Reserved. Ignore on read.
Response Data	4	<i>Current State Mask</i> [7] – 1b = μ RTM Compatible ¹ [6] – 1b = μ RTM Absent ¹ [5] – 1b = μ RTM Present ¹ [4] – 1b = Backend Power Shut Down [3] – 1b = Backend Power Failure [2] – 1b = Quiesced [1] – 1b = Module Handle Opened [0] – 1b = Module Handle Closed
Response Data	(5) ²	[7] – Reserved. Write as 1b. Ignore on read. [6:1] – Reserved. Write as 0b. Ignore on read. [0] – 1b = μ RTM Incompatible ¹

Note 1: Only applicable to Module Hot Swap sensors associated with μ RTMs. For Module Hot Swap sensors associated with other module types, write as 0b and ignore on read.

Note 2: Required for Module Hot Swap sensors associated with μ RTMs. This is optional for all other module types.

- REQ 3-42: The Front AMC's MMC **shall** enable and disable the Module Hot Swap sensor associated with the μ RTM as defined in Section 3.5.6.
- REQ 3-43: When the MMC detects that the μ RTM is present, after enabling the Module Hot Swap sensor associated with the μ RTM, the MMC **shall** generate a Module Hot Swap (μ RTM Present) event from the Module Hot Swap sensor associated with the μ RTM.
- REQ 3-44: When the MMC detects that the μ RTM is no longer present, before disabling the Module Hot Swap sensor associated with the μ RTM, the MMC **shall** generate a Module Hot Swap (μ RTM Absent) event from the Module Hot Swap sensor associated with the μ RTM.
- REQ 3-45: The MMC **shall** support μ RTM Compatible and μ RTM Incompatible states and events as defined in Section 3.5.5.
- REQ 3-46: The MMC **shall** support other Module Hot Swap sensor states and events as defined in the AMC.0 specification.

3.5.4 FRU Activation and Deactivation

- ¶ 66 The MicroTCA Carrier Activation and Current Descriptor record includes a MicroTCA Carrier Activation and Current Descriptor for each FRU connected to a Power Channel. The MicroTCA Carrier Activation and Current Descriptor specifies the current limitations of the Power Channel and whether the System Manager, Shelf Manager or Carrier Manager is responsible for activating and deactivation the corresponding FRU.
- REQ 3-47: μ RTMs **shall** be listed in the MicroTCA Carrier Activation and Current Descriptor record.
- REQ 3-48: MicroTCA Carrier Activation and Current Descriptors corresponding to μ RTMs **shall** have their *Site Type* field set to a value of 09h (Rear Transition Module as defined in the PICMG 3.0 specification).
- REQ 3-49: Because μ RTMs do not directly connect to Power Channels, MicroTCA Carrier Activation and Current Descriptors corresponding to μ RTMs **shall** have their *Power Channel* and *Maximum Channel Current* fields set to 0.
- REQ 3-50: Each MicroTCA Carrier Activation and Current Descriptor corresponding to a μ RTM **shall** be listed after the associated Front AMC's MicroTCA Carrier Activation and Current Descriptor in the MicroTCA Carrier Activation and Current Descriptor record.
- ¶ 67 It should be noted that μ RTMs receive their power via the Front AMC. If a Front AMC is deactivated, its Payload Power will be disabled; in this case, the μ RTM connected to that AMC will also have its Payload Power disabled.

REQ 3-51: A System Manager, Shelf Manager, or Carrier Manager **may** implement an activation/deactivation policy that activates Front AMCs prior to μ RTMs and deactivates μ RTMs prior to Front AMCs.

3.5.5 Compatibility Check

- ¶ 68 The Zone 3 Interface connecting the Front AMC and the μ RTM has a few standardized pins for basic management, but most of the pins are user defined. In order to help prevent damage if an AMC is connected to an incompatible μ RTM, a compatibility check is performed to determine if the AMC and μ RTM are compatible with each other.
- ¶ 69 The result of the compatibility check is reported via the μ RTM Compatible and μ RTM Incompatible state bits in the Module Hot Swap sensor. Additionally, incompatible μ RTMs are left in the M1 Hot Swap state so Payload Power and the Zone 3 Interface are never enabled unless the AMC and μ RTM are determined to be compatible.
- ¶ 70 The MMC performs the compatibility check by reading Zone 3 Interface Compatibility records from the AMC's FRU information and from the μ RTM's FRU information. If matching records are found, the AMC and μ RTM are considered as compatible. If matching records are not found, then the AMC and μ RTM are considered incompatible.

Table 3-3: Zone 3 Interface Compatibility record

Offset	Length	Field description
0	1	<i>Record Type ID</i> . Value C0h (OEM).
1	1	[7:7] End of list. Set to one for the last record. [6:4] Reserved, write as 0h. [3:0] Record format version (=2h for this definition).
2	1	<i>Record Length</i> .
3	1	<i>Record Checksum</i> . Holds the zero checksum of the record.
4	1	<i>Header Checksum</i> . Holds the zero checksum of the header.
5	3	<i>Manufacturer ID</i> . For this specification the value is 12634 (0x00315A, LSB first)
8	1	<i>PICMG Record ID</i> . Value 30h.
9	1	<i>Record Format Version</i> . Value 1h.
10	1	<i>Type of Interface Identifier</i> : 0h = PICMG IRTM.0 REP Number (see Table 3-4) 1h = Other PICMG Specification-defined Interface Identifier (see Table 3-5) 2h = Interface Identifier GUID (see Table 3-6) 3h = OEM interface identifier (see Table 3-7) 4h = PICMG MTCA.4 REP Number (see Table 3-8) 5h-FFh = Reserved
11	N	<i>Interface Identifier Body</i> (format depends on the type), terminated by the end of record.

¶ 71 An Interface identifier body of type 0 (PICMG IRTM.0 REP Number) is not applicable for an AMC/ μ RTM because μ RTMs are explicitly not IRTM.0 compliant. The PICMG IRTM.0 REP Number format in Table 3-4 is listed here only for completeness.

Table 3-4: PICMG IRTM.0 REP Number

Offset	Length	Field description
11	4	The IRTM.0 REP number, 32 bits, LS byte first

¶ 72 An Interface identifier body of type 1 (Other PICMG specification-defined interface identifier) has the format in Table 3-5:

Table 3-5: Other PICMG Specification-defined Interface Identifier

Offset	Length	Field description
11	4	The PICMG specification unique identifier, LS byte first (format TBD by other interface specs)
15	1	The PICMG specification major revision number
16	1	The PICMG specification minor revision number
17	M	The opaque interface identifier body

- ¶ 73 The interface Identifier Body of type 2 (Interface identifier GUID) has the format in Table 3-6.

Table 3-6: Interface identifier GUID

Offset	Length	Field description
11	16	Interface identifier GUID, LS byte first. Globally Unique Identifier generated in accordance with AMC.0.

- ¶ 74 An Interface Identifier Body of type 3 (OEM interface identifier) has the format in Table 3-7.

Table 3-7: Interface identifier OEM

Offset	Length	Field description
11	3	Manufacturer ID (IANA) of the OEM that owns the definition of this interface. LS Byte first.
14	4	OEM-defined interface designator, 32 bits, LS byte first.

- ¶ 75 An Interface identifier body of type 4 (PICMG MTCA.4 REP Number, see Table 3-3) is used for an AMC/ μ RTM that has a connector set defined in the PICMG μ RTM repository.

Table 3-8: PICMG MTCA.4 REP Number

Offset	Length	Field Description
11	4	The MTCA.4 REP Number, 32 bits, LS byte first

- REQ 3-52: AMCs and μ RTMs **shall** provide at least one Zone 3 Interface Compatibility record in their FRU information.
- REQ 3-53: When the MMC detects a μ RTM is present, the MMC **shall** perform a compatibility check.
- REQ 3-54: If any Zone 3 Interface Compatibility record in the μ RTM's FRU information matches any Zone 3 Interface Compatibility record in the AMC's FRU information, the AMC and μ RTM **shall** be considered compatible, otherwise the AMC and μ RTM **shall** be considered incompatible.
- REQ 3-55: Zone 3 Interface compatibility records **shall** be considered as matching if the records are the same length and are identical from Offset 9 through the end of the records, otherwise, the records **shall** be considered as not matching.
- REQ 3-56: After performing the compatibility check, the MMC **shall** generate a Module Hot Swap sensor event indicating the result of the compatibility check.

3.5.6 Sensor Management

- ¶ 76 μ RTM sensors are dynamically populated or depopulated on the MMC when the μ RTM is detected as present or absent. Similarly, the Carrier Manager dynamically populates and depopulates local sensor mapped to the μ RTM sensors when μ RTM presence or absence is reported via the Module Hot Swap sensor events.
- REQ 3-57: When the Front AMC's MMC detects that a μ RTM is present, the MMC **shall** enable the Module Hot Swap sensor for the μ RTM.
- REQ 3-58: When the MMC determines that the μ RTM is compatible with the Front AMC, the MMC **shall** enable any additional μ RTM sensors.
- REQ 3-59: When the MMC detects that the μ RTM is no longer present it **shall** disable all μ RTM sensors except for the Module Hot Swap sensor associated with the μ RTM.
- REQ 3-60: The MMC **shall** disable the Module Hot Swap sensor associated with the μ RTM after generating the Module Hot Swap (μ RTM Absent) event.
- REQ 3-61: The MMC **shall** provide an SDR for the Module Hot Swap sensor associated with the μ RTM.
- ¶ 77 This allows the MMC to provide a Module Hot Swap sensor for the μ RTM regardless of the result of the compatibility check. Although it is likely that the MMC also provides the SDRs for other μ RTM sensors, the exact implementation of μ RTM sensor SDRs is design-specific and is beyond the scope of this specification.
- REQ 3-62: The SDRs for sensors associated with the μ RTM **shall** use the PICMG Rear Transition Module entity ID COh and the AMC's site number + 60h as a device-relative entity instance number.

3.5.7 Quiesce Actions

- REQ 3-63: When the Front AMC's MMC receives a FRU Control (Quiesce) command with FRU Device ID set to 1, the MMC **shall** take appropriate action (implementation specific) to bring the Zone 3 interface to a quiesced state and generate a Module Hot Swap (Quiesced) event from the Module Hot Swap sensor associated with the μ RTM.
- REQ 3-64: If the μ RTM is determined to be compatible and the μ RTM supports a Zone 3 Interface enable mechanism, the MMC **shall** disable the Zone 3 Interface after it is quiesced, but before generating the Module Hot Swap sensor (Quiesced) event.
- ¶ 78 Because the Zone 3 Interface is mostly user defined pins, the actions needed to quiesce the Zone 3 Interface can vary greatly from one design to another. In the simplest cases, there might not be any

action required. In other cases some or all of the user defined pins may need to be isolated, and in some cases, all or part of the Front AMC might even need to be powered off under MMC control. The specific actions needed are design specific and are beyond the scope of this specification.

3.6 Power Management

- REQ 3-65: The Front AMC's Module Current Requirements record **shall** include the power required for any compatible μ RTM.
- REQ 3-66: If a μ RTM is determined to be incompatible, the MMC **shall not** enable Payload Power to the μ RTM.
- REQ 3-67: If a μ RTM is determined to be compatible, upon receipt of a Set Power Level (Level = 1, FRU Device ID = 1) command, the MMC **shall** enable Payload Power to the μ RTM.
- REQ 3-68: If the μ RTM supports a Zone 3 Interface enable mechanism, the MMC **shall** enable the Zone 3 Interface after enabling Payload Power to the μ RTM.
- REQ 3-69: Upon receipt of a Set Power Level (Level = 0, FRU Device ID = 1) command, the MMC **shall** disable Payload Power to the μ RTM.
- ¶ 79 Disabling the Zone 3 Interface happens as part of the quiesce actions as defined in Section 3.5.7.

3.7 Cooling Management

- REQ 3-70: Because μ RTMs have Carrier Manager FRU Device IDs, they **may** be listed as cooled FRUs in MicroTCA Fan Geography records.

3.8 E-Keying

- ¶ 80 Certain applications require special clock, trigger, and interlock connections between modules. For this reason, they use special backplanes with specific connections on AMC ports 12 through 15 and 17 through 20.
- REQ 3-71: Ports 12 through 15 are routed using point-to-point links and **shall** be E-Keyed using the standard E-Keying mechanisms defined in the AMC.0 specification.
- ¶ 81 These applications are likely to use custom protocols on ports 12 through 15.
- REQ 3-72: When using custom protocols, the corresponding Link Descriptors **shall** specify *Link Type* values of F0h – FEh (E-Keying OEM GUID definition as defined in the PICMG AMC.0 specification).
- ¶ 82 Ports 17 through 20 are routed in a multi-drop bus topology. This is incompatible with point-to-point E-Keying. A Carrier Bused

Connectivity record in the Carrier FRU information describes the bused connections.

Table 3-9: Carrier Based Connectivity Record

Offset	Length	Field description
0	1	<i>Record Type ID</i> . Value C0h (OEM).
1	1	[7:7] End of list. Set to one for the last record. [6:4] Reserved, write as 0h. [3:0] Record format version (=2h for this definition).
2	1	<i>Record Length</i> .
3	1	<i>Record Checksum</i> . Holds the zero checksum of the record.
4	1	<i>Header Checksum</i> . Holds the zero checksum of the header.
5	3	<i>Manufacturer ID</i> . For this specification 12634 (0x00315A, LSB first) shall be used for the <i>Manufacturer ID</i> .
8	1	<i>PICMG Record ID</i> . The value 31h shall be used for the <i>PICMG Record ID</i> .
9	1	<i>Record Format Version</i> . For this specification, the value 0h shall be used for the <i>Record Format Version</i> .
10	1	<i>Bused Connection Count</i> . Number of Bused Connection Descriptors (N) that follow.
11	Variable	<i>Bused Connection Descriptors</i> . This is a list of Bused Connection Descriptors. Each entry is formatted as defined in Table 3-10.

¶ 83 The Carrier Based Connectivity record includes a list of *Bused Connection Descriptors*. Each *Bused Connection Descriptor* describes a bused connection.

Table 3-10: Bused Connection Descriptor

Offset	Length	Field description
0	1	<i>Bused Device Count</i> . The number of devices (D) connected to the corresponding bus.
1	2 * D	<i>Bused Device Descriptors</i> . This is an array of D <i>Bused Device Descriptors</i> . Each <i>Bused Device Descriptor</i> is formatted as defined in Table 3-11.

¶ 84 Each *Bused Connection Descriptors* includes an array of *Bused Device Descriptors*. Each *Bused Device Descriptor* specifies a single port on a specific AMC or on-Carrier device that is connected to the bus.

Table 3-11: Bused Device Descriptor

Offset	Length	Field description
0	1	<i>Resource ID.</i> Indicates the AMC Slot ID or on-Carrier device. [7] Resource Type. 1 AMC, 0 indicates on-Carrier device ID [5:4] Reserved; write 0h [3:0] On-Carrier device ID or AMC Site Number
1	1	<i>Port.</i> Indicates the Port number within the AMC Slot or on-Carrier device.

REQ 3-73: MicroTCA Carriers implementing bused connections **shall** include a Carrier Bused Connectivity record in the Carrier FRU Information.

REQ 3-74: A Bused Connection Descriptor **shall** be provided for each bus.

REQ 3-75: A Bused Device Descriptor **shall** be provided for each port of each AMC Slot or on-Carrier Device that is connected to a bus.

REQ 3-76: During the E-Keying process, the Carrier Manager **shall** explicitly disable all Ports listed in both an AMC's AdvancedMC Point-to-Point Connectivity record and a Carrier Bused Connectivity record.

¶ 85 Use of an AMC that implements Point-to-Point Connectivity on Ports bused by the Carrier could result in damage to devices connected to the bus. Disabling the Port via E-Keying does not guarantee electrical compatibility in this case. It is the system integrator's responsibility to ensure that all AMCs used in a bused Carrier are electrically compatible with the bused implementation.

REQ 3-77: If an AMC provides an AdvancedMC Point-to-Point Connectivity record for a Channel that uses a Port listed in the Carrier Bused Connectivity record, the Carrier Manager **should** issue a warning to an appropriate user interface.

¶ 86 This warning is intended to alert a system integrator during development and testing that an electrical incompatibility might exist. Specifics of the warning and the user interface are design specific and are outside the scope of this specification.

¶ 87 Compatibility checking, enabling and disabling of bused ports, and arbitration of transmitters and receivers is application specific and is outside the scope of this specification.

3.9 Zone 3 Interface Documentation

¶ 88 FRU information can contain a variety of information about a FRU. It might be desirable to include information describing where to get documentation for the Zone 3 interface. Table 3-11 defines the Zone 3 Interface Documentation record. This record provides a Uniform Resource Locator (URL) that can be used to locate documentation for the Zone 3 Interface of the corresponding FRU.

Table 3-12: Zone 3 Interface Documentation record

Offset	Length	Field description
0	1	<i>Record Type ID</i> . Value C0h (OEM).
1	1	[7:7] End of list. Set to one for the last record. [6:4] Reserved, write as 0h. [3:0] Record format version (=2h for this definition).
2	1	<i>Record Length</i> . = N+4
3	1	<i>Record Checksum</i> . Holds the zero checksum of the record.
4	1	<i>Header Checksum</i> . Holds the zero checksum of the header.
5	3	<i>Manufacturer ID</i> . For this specification 12634 (0x00315A, LSB first) shall be used for the <i>Manufacturer ID</i> .
8	1	<i>PICMG Record ID</i> . The value 32h shall be used for the <i>PICMG Record ID</i> .
9	1	<i>Record Format Version</i> . For this specification, the value 0h shall be used for the <i>Record Format Version</i> .
10	N	<i>URL</i> . The Internet Uniform Resource Locator string that can be used through a World Wide Web browser to obtain documentation information about this Zone 3 interface. (e.g. “http://www.my_vendor.com:280?docu=my_board”)

REQ 3-78: AMCs and μ RTMs **may** provide a Zone 3 Interface Documentation record in their FRU information.

4 Electrical

4.1 General

- ¶ 89 This document uses the electrical specifications for AMC's and μ TCA shelves. This specification adds a connector in Zone 3 of a Double AMC and an associated μ RTM. Other than defining the Zone 3 connector, the μ RTM and the μ TCA subrack this specification relies on previous documents for most details.

4.2 Power

4.2.1 AMC and μ RTM Power

- REQ 4-1: Total power delivered to and used by AMC front board and its associated μ RTM **shall** conform to PICMG AMC.0 R2.0 except that the maximum Management Power current **shall** be increased from 150 mA to 180 mA.
- REQ 4-2: Of the 180 mA of MP the μ RTM **shall** be limited to 30 mA.
- ¶ 90 The current limit for the AMC remains at 150 mA.
- REQ 4-3: The Payload Power **shall** not be enabled to the μ RTM until system management has performed a compatibility check.

4.2.2 μ RTM Power

- ¶ 91 Two voltages are fed from the front board to the μ RTM. One is Payload Power (μ RTM-PWR) and the other is Management Power (μ RTM-MP).
- REQ 4-4: The MP current **shall** conform to AMC.0 R2.0, Section 4.2.2.
- REQ 4-5: The front board MMC **shall** control the switching of the PWR to the μ RTM.
- REQ 4-6: The designer **shall** consider the voltage drop that will be introduced if these voltages are switched by the AMC.
- REQ 4-7: The voltage drops introduced by the switching and contact resistance **shall not** exceed 50 mV for μ RTM-MP and 200 mV for μ RTM-PWR.
- REQ 4-8: For AMC's and associated μ RTM's following the specifications in Sections 2.1.3.2 and 2.2.3.1, the four power pins (PWRA1, PWRB1, PWRA2, PWRB2) on the J30/RP30 ADF connectors **shall** be connected together on both modules with impedances that do not differ by more than 20% to insure current flow is the same to 20%.
- REQ 4-9: For other connectors the power pins assigned **shall** conform to the specifications in this and other sections.

- REQ 4-10: The combined AMC and μ RTM MP surge current **shall** be limited to 270 mA for a maximum of 200 ms.
- REQ 4-11: The μ RTM-PWR current drawn by the μ RTM **shall not** exceed 3 amperes.
- ¶ 92 The voltages for the μ RTM's PWR and MP pins are the same as those defined in AMC.0 R2.0, Section 4.2 with the drop of the PWR switch taken into account by the module designer.
- REQ 4-12: The μ RTM **shall** be designed so that sudden power loss **shall not** cause permanent damage to the module.
- REQ 4-13: The average power calculation in AMC.0, REQ 4.4b **shall** include the μ RTM in the calculation.
- REQ 4-14: The μ RTM **should** provide an input capacitance of at least 0.5 μ F on Payload Power per W of its maximum Payload Power requirement.
- REQ 4-15: The voltage tolerances in AMC.0, Section 4.2.1.2 **shall** be applied to the μ RTM.
- REQ 4-16: The power and grounding in AMC.0, Section 4.2.2 and 4.2.3 **shall** be applied to the μ RTM.

4.2.3 Power Module

- REQ 4-17: The Power Modules **shall** be capable of providing 180 mA of continuous MP to each AMC slot.
- REQ 4-18: The Power Modules **shall** support MP inrush current up to 270 mA for 200 ms to each AMC slot.

4.3 Data

- REQ 4-19: ADF Zone 3 data connectors **shall** conform to PICMG 3.0 R3.0, Appendix A.4.
- REQ 4-20: The Zone 1 backplane connectors **shall** conform to PICMG MTCA.0 R1.0, Section 7.

4.4 Clocks

- ¶ 93 Clocks on the Zone 3 plug are not defined by this specification. User defined pins can be used for this purpose. Other clocks in the AMC connector follow MTCA.0 and Section 6 below.

4.5 Isolation

- ¶ 94 Input isolation is defined in PICMG MTCA.0 R1.0, Section 4.8.1.11. AC isolation is defined in PICMG MTCA.0 R1.0, Section 4.8.2.2.

4.6 ESD

- ¶ 95 See PICMG AMC.0 R2.0, Section 2.2.6.

4.7 Signal Levels

REQ 4-21: User specified signal levels in Zone 3 at the AMC/ μ RTM interface in Zone 3 **shall not** exceed the levels specified by the mechanical keying in Table 2-1.

5 Thermal

5.1 Thermal Requirements

- REQ 5-1: The cooling requirements for this specification **shall** be those in PICMG 3.0.
- REQ 5-2: The following documents **should** be used as a guide for thermal requirements for both the Front Board and the μ RTM.
- PICMG AMC.0 R2.0: Advanced Mezzanine Module specification, Section 5
 - PICMG MTCA.0 R1.0: μ TCA base specification, Section 5
 - PICMG MTCA.1 R1.0: Air Cooled Rugged μ TCA specification, Section 5

5.2 Subrack Cooling

- REQ 5-3: Empty slots in the front and rear of the subrack **shall** have airflow Impedance Matching Devices on the AMC and μ RTM Filler Modules to balance the cooling air in the shelf.
- REQ 5-4: All Filler Modules **shall** follow the construction method outlined in this document so units from different vendors will work together to properly control the cooling air flow.

5.2.1 AMC Filler Modules

- REQ 5-5: AMC Filler Modules **shall** have an Air Impedance Matching Device.
- ¶ 96 PICMG Rugged MicroTCA.1 R1.0, Section 5.4 can serve as a reference when designing this module.
- REQ 5-6: The AMC Filler Module Impedance Matching Device **should** be adjustable.
- ¶ 97 Figure 5-1 shows the Air Impedance Matching Device placed directly above the backplane AMC connector. This may be fixed or (preferably) adjustable. The exact details are left to the designer.

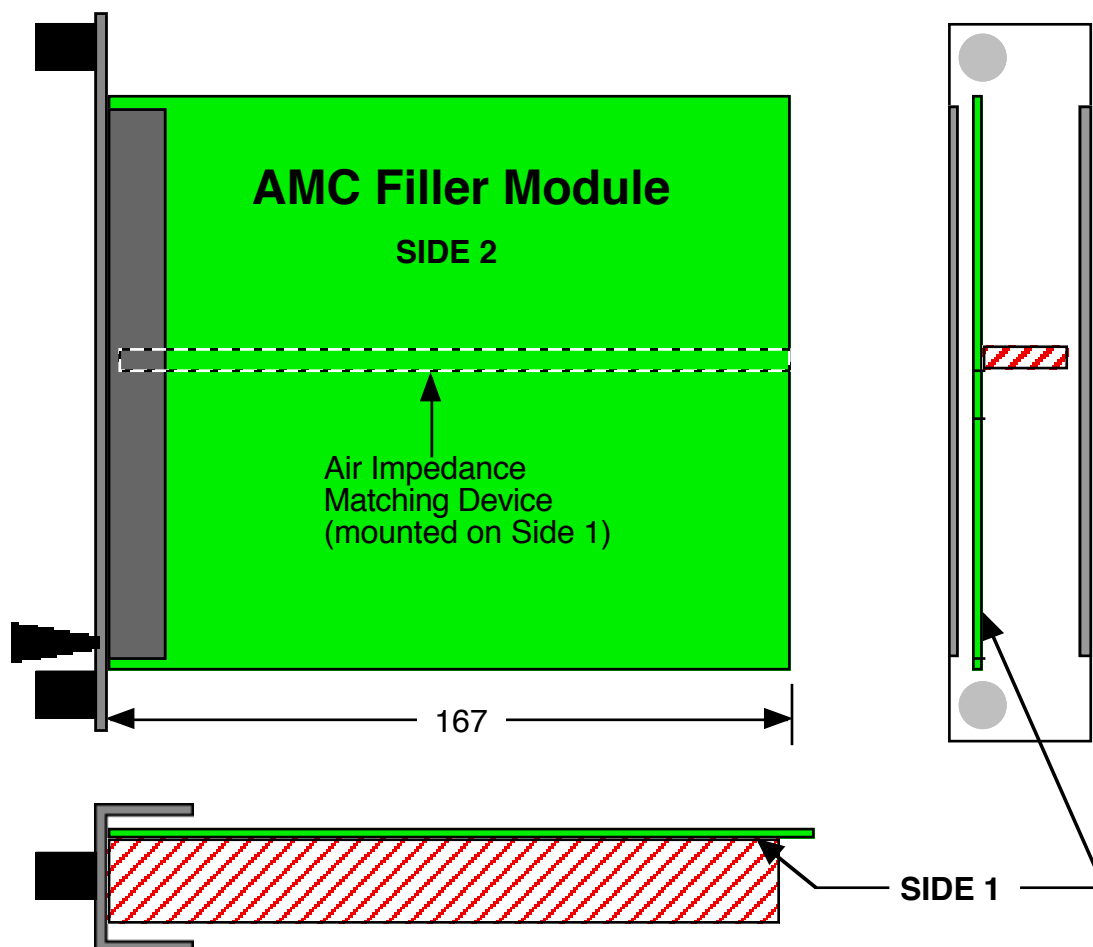


Figure 5-1: AMC Filler Module Assembly

5.2.2 μ RTM Modules

- REQ 5-7: μ RTM Modules **shall** block at least 85% of the Zone 3 area. The 85% includes the connector(s), key and, if necessary, a Connector Air Block (see Figure 5-2).
- REQ 5-8: The Backplane Air Block Plate shown in Figure 5-2 **should not** be used if electronics on the rear of the backplane requires cooling.
- ¶ 98 Figure 5-2 shows a μ RTM that connects to the front AMC. In this case the horizontal block may not be necessary since components on the PCB may provide the required air impedance. An air block plate may be necessary in Zone 3 if the connectors and key/alignment hardware to not block at least 85% of the air that can spill either direction between front and back.

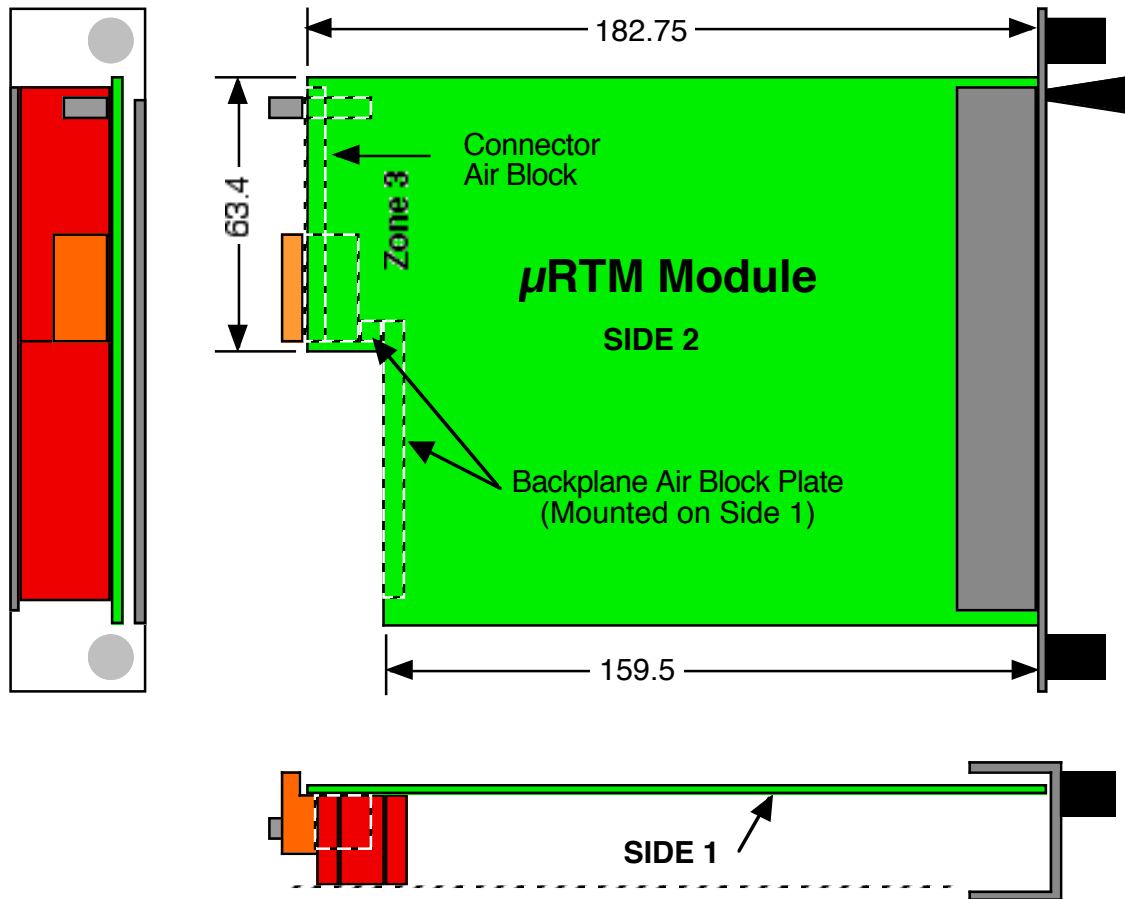


Figure 5-2: RTM Assembly with Air Block

5.2.3 μRTM Filler Modules

REQ 5-9: μRTM Filler Modules **shall** have an Air Impedance Matching Device.

§ 99 PICMG Rugged MicroTCA.1 R1.0, Section 5.4 can serve as a reference when designing this module.

REQ 5-10: The μRTM Filler Module Air Impedance Matching Device **should** be adjustable.

REQ 5-11: μRTM Filler Modules **shall** have an airflow blocking mechanism that fills a minimum of 85% of the Zone 3 area between the front and rear if AMC connections are present.

§ 100 The μRTM Filler Module shown in Figure 5-3 has more blocking plates than the AMC Filler Module to control the airflow behind the backplane. This area has a large open area for mounting a mezzanine on the rear of the backplane. The plates confine the airflow behind the backplane and also block Zone 3 to prevent air

flowing to/from the front of the subrack. This μ RTM Filler Module has a horizontal Air Impedance Matching Device that is preferably adjustable. The adjustment gives the system designer better control when balancing the cooling in the shelf.

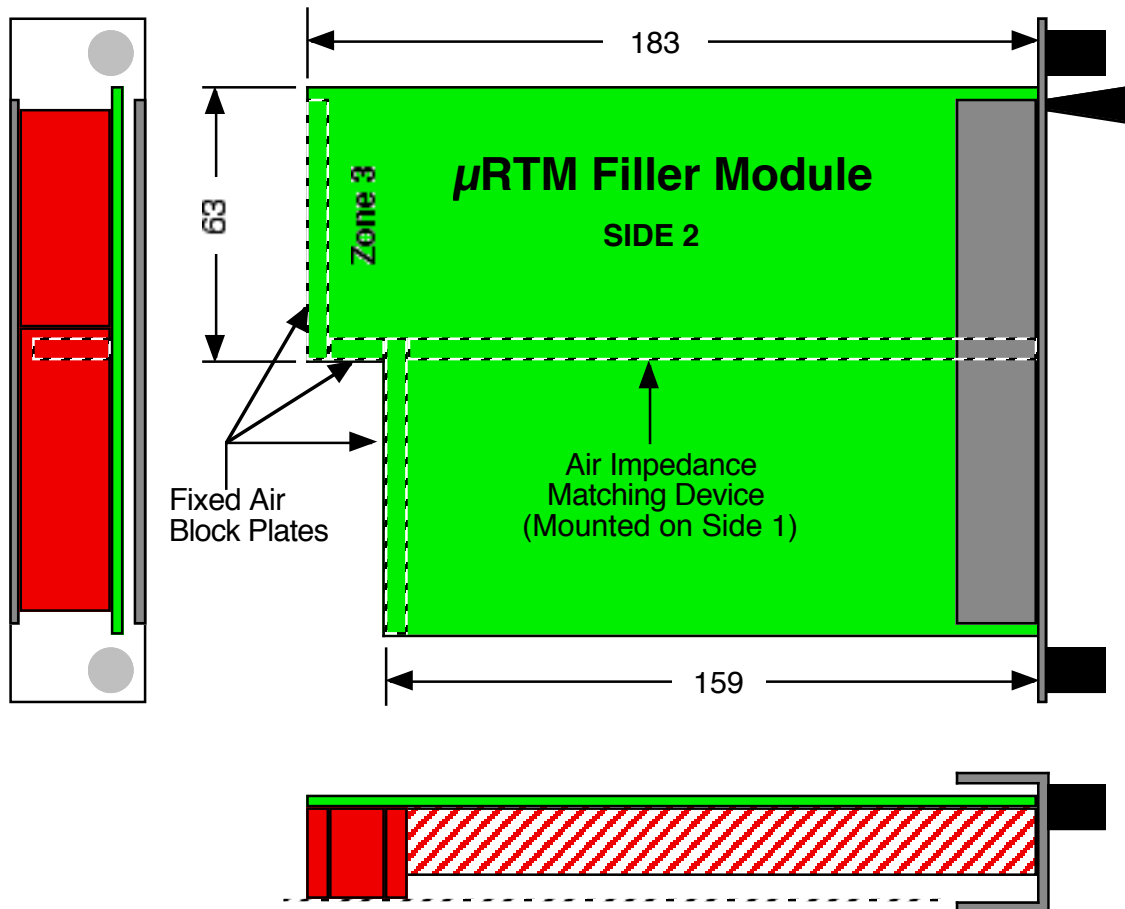


Figure 5-3: μ RTM Filler Module Assembly

5.2.4 Subrack Air Cooling

- ¶ 101 Cooling requirements are similar to AMC.0 R2.0 and MicroTCA.0 R1.0. In the μ TCA subrack specified in this document there is also the rear μ RTM area to cool. See Section 4.2 for power ratings on front AMC's and rear μ RTM's that will set the cooling requirements.
- REQ 5-12: The cooling air supplied to the front of the subrack **shall** meet the specifications in the AMC.0 and MicroTCA.0.
- REQ 5-13: The cooling air supplied to the rear of the subrack **shall** meet the specifications in the AMC.0 and MicroTCA.0 that has been scaled to the reduced maximum power allowed for the μ RTM.
- REQ 5-14: Monitoring of cooling for the front and rear of the subrack **shall** be integrated into the system management system.

5.2.5 Filler Module Configurations in Subracks

- ¶ 102 Figure 5-4 shows the subrack with both front and rear Filler Modules. The horizontal impedance plates (air block) balance the airflow both front and rear when functional modules are not in place. The fixed air block plates on the μ RTM keep the air from shunting around the module at the rear of the backplane. The fixed air block plates in the Zone 3 area takes the place of a backplane and confines the front and rear airflow in their respective channels.

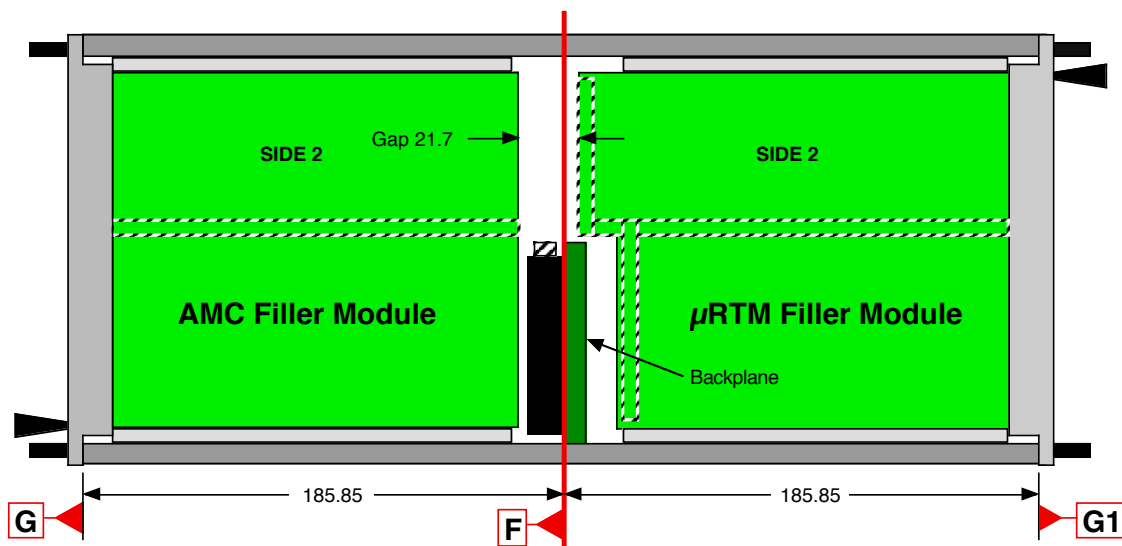


Figure 5-4: Subrack with Filler Panels

¶ 103

Figure 5-5 shows a subrack with a functional AMC Module but no Zone 3 connection to a μ RTM. The μ RTM Filler Module is necessary to constrain the airflow in the correct areas.

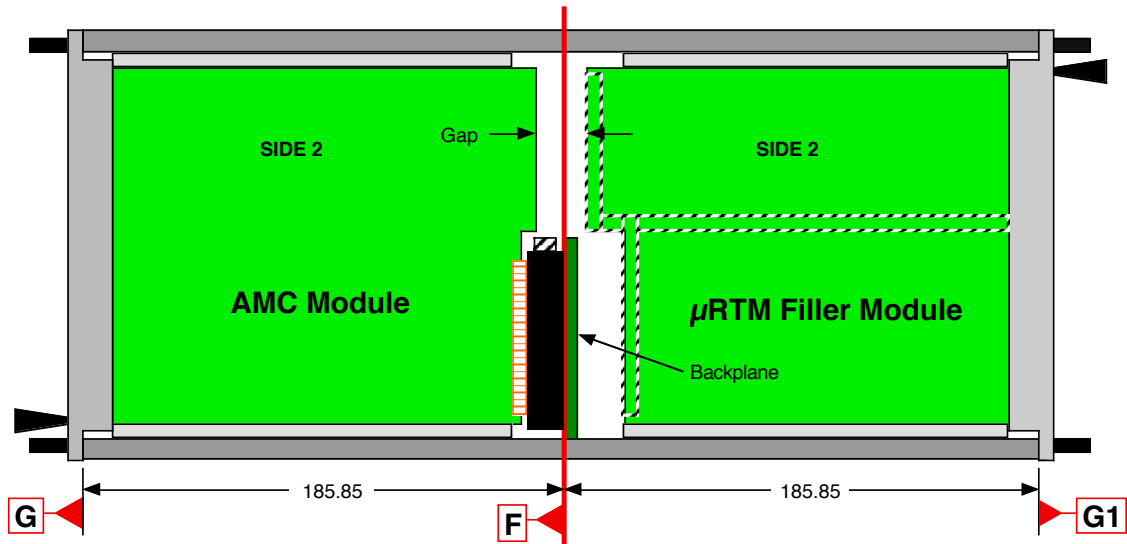


Figure 5-5: Subrack with AMC Module and μ RTM Filler Module

¶ 104

Figure 5-6 shows a subrack with an AMC Filler Module with a functional μ RTM with a Zone 3 connection. The AMC Filler Module is necessary to constrain the airflow in the correct areas. This is an unlikely configuration but can occur if the AMC is removed and the subrack cooling is required to function properly.

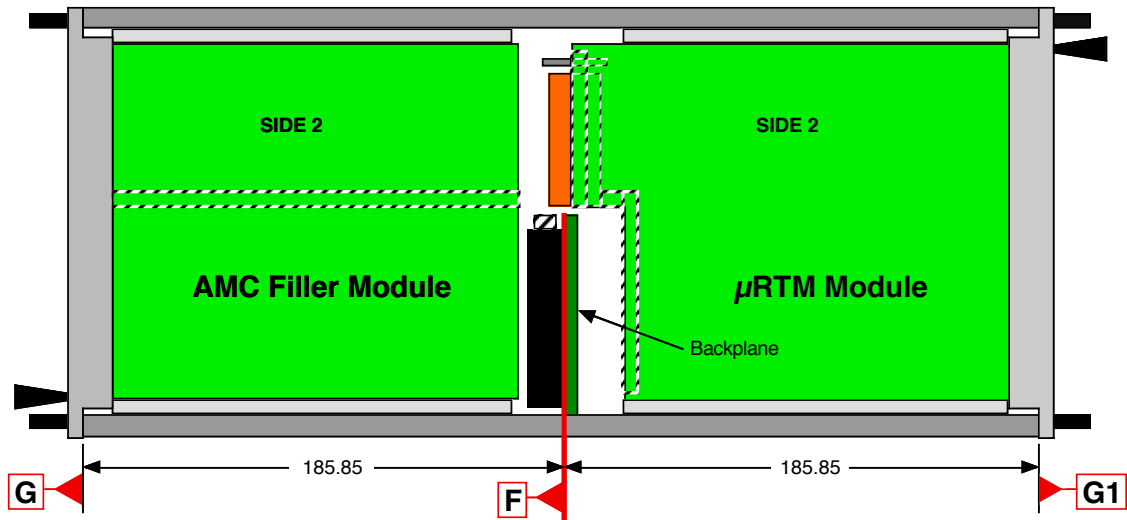


Figure 5-6: Subrack with AMC Filler Module and μ RTM Module

5.3 μ RTM power

REQ 5-15: The average power on the μ RTM **shall not** exceed 30 watts.

¶ 105 The power limit is calculated from the 3 A limit on the pins and the minimum of 10 V as given in AMC.0 R2.0, Section 4.2.

REQ 5-16: Since all power is supplied by the front AMC Module, the power used by the μ RTM **shall** be subtracted from that available to the AMC front board.

¶ 106 The maximum power available to the AMC/ μ RTM combination is 80 W.

6 Interconnect

6.1 Introduction

¶ 107 This section describes a backplane for use in MTCA.4 that has features to facilitate the data acquisition and control of accelerators, experiments. Uses of this backplane may be of use outside the area of research.

6.2 Fabric interface

¶ 108 Specific fabric technologies are outside the scope of this specification. Refer to the appropriate AMC.x specification for information related to specific fabric technologies.

6.3 MCH Specifications

¶ 109 The MCH interconnects are defined in the MicroTCA.0 specification.

6.4 Clocking

6.4.1 General clocking topology

¶ 110 Figure 6-1 shows the general concept of the clock, trigger and interlock signal connections. Two radial clocks as defined in AMC.0 are used to distribute low jitter, high quality clocks by radial links from all AMC slots to the MCH. FCLKA is reserved and provided for PCIe usage. Ports 17 to 20 (Rx17/Tx17 to Rx20/Tx20) are used as a bus for triggers, clocks and interlock signal distribution.

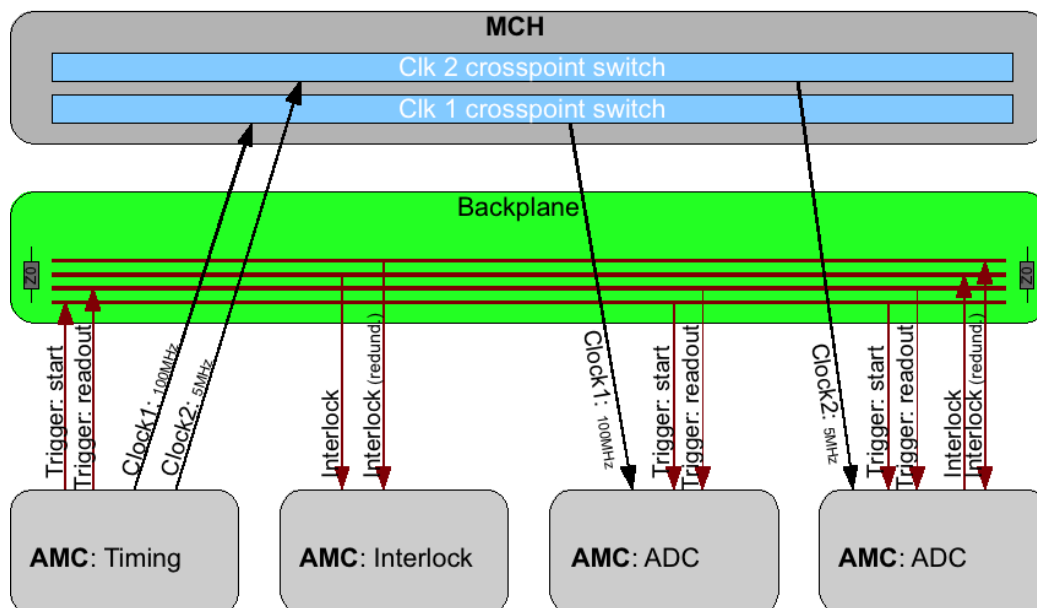


Figure 6-1: Example using radial clocks and bused triggers

6.4.2 Radial clock circuitry

¶ 111 Two point-to-point lines from all AMC Modules to the MCH implement the clocks as differential pairs (M-LVDS) as defined in AMC.0, Section 6.3.1. The lines are bidirectional. Any AMC can be the source or the receiver of clock TCLKA or TCLKB.

REQ 6-1: An AMC Module **may** implement a receiver or transmitter or both.

¶ 112 A 100 Ω line-termination is required on both ends of the transmission line. These terminations are in both the MCH and the AMC Module as shown in Figure 6-2. Long stubs in the PCB layout have to be avoided (see AMC.0, Section 6.3.1).

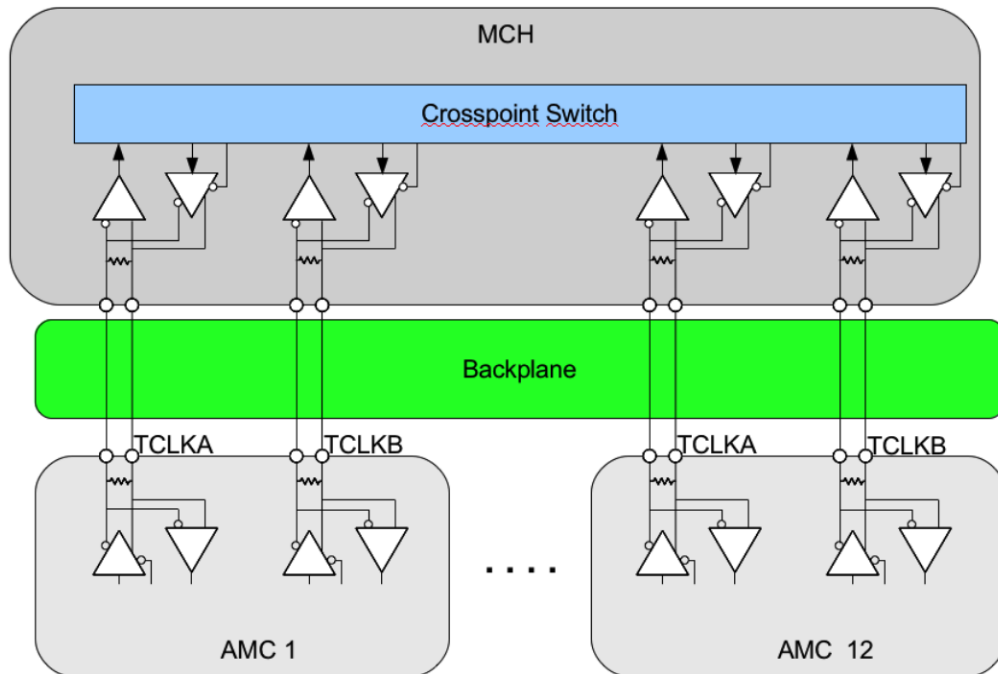


Figure 6-2: TCLKA and TCLKB are bidirectional example.

¶ 113 TCLKC and TCLKD are implemented in a similar manner to TCLKA and TCLKB except they are connected to the redundant MCH.

6.5 Bus lines general topology

¶ 114 In Figure 6-3 an example usage of the bus lines is given. The differential Receiver and Transmitter lines of the ports 17 to 20 of all AMC's are connected together on the backplane.

REQ 6-2: At both ends of the backplane these lines **shall** be terminated by 100 Ω .

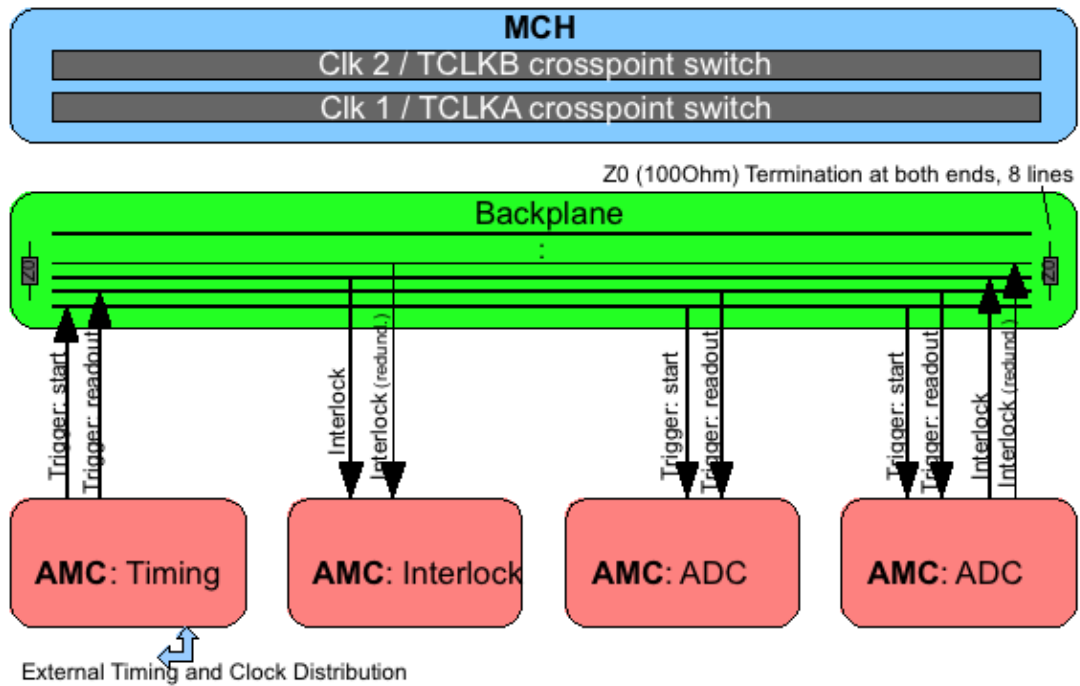


Figure 6-3: Example using the 8 bus lines

6.5.1 Ports 17 to 20 usage

REQ 6-3: The differential lines **shall** be driven by M-LVDS, according to EIA/TIA-899.

¶ 115 The AMC Modules may implement a receiver or a transmitter or both on every Rx and Tx pair of the ports 17 to 20.

REQ 6-4: The differential lines on AMC Modules (stubs) **should** be as short as possible and **shall** not exceed 30 mm.

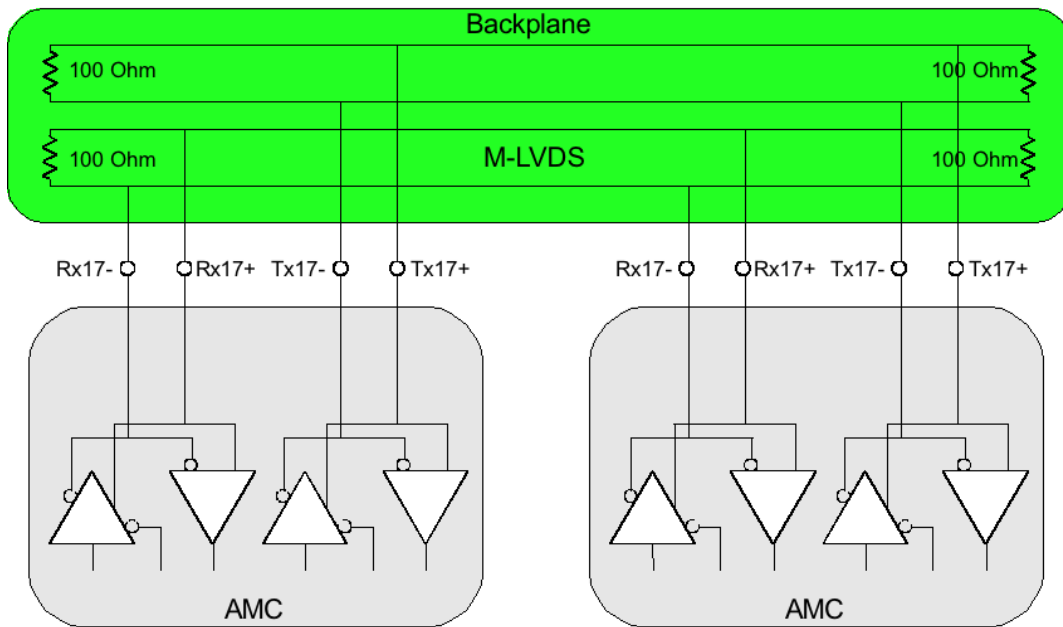


Figure 6-4: M-LVDS transceiver shown for port 17

¶ 116 The usages of the bus lines are application dependent. Table 6-1 indicates a possible usage.

Table 6-1: Example usage of the 8 bus lines for triggers, interlocks and clocks

AMC Port	Name	Description	Usage
Rx17	TrigStart	Start sampling data	Triggers
Tx17	TrigEnd	Stop sampling data	
Rx18	TrigReadOut	Start data transfer to CPU	
Tx18	ClkAux	Low performance clock	
Rx19	Reset	Reset of counter, dividers	
Tx19	Interlock 0	Interlock line 0	3 interlocks to provide 2 out of 3 redundancy
Rx20	Interlock 1	Interlock line 1	
Tx20	Interlock 2	Interlock line 2	

6.6 JTAG interface

¶ 117 See PICMG MTCA.0 R1.

6.7 μ TCA interface topologies

6.7.1 Backplane

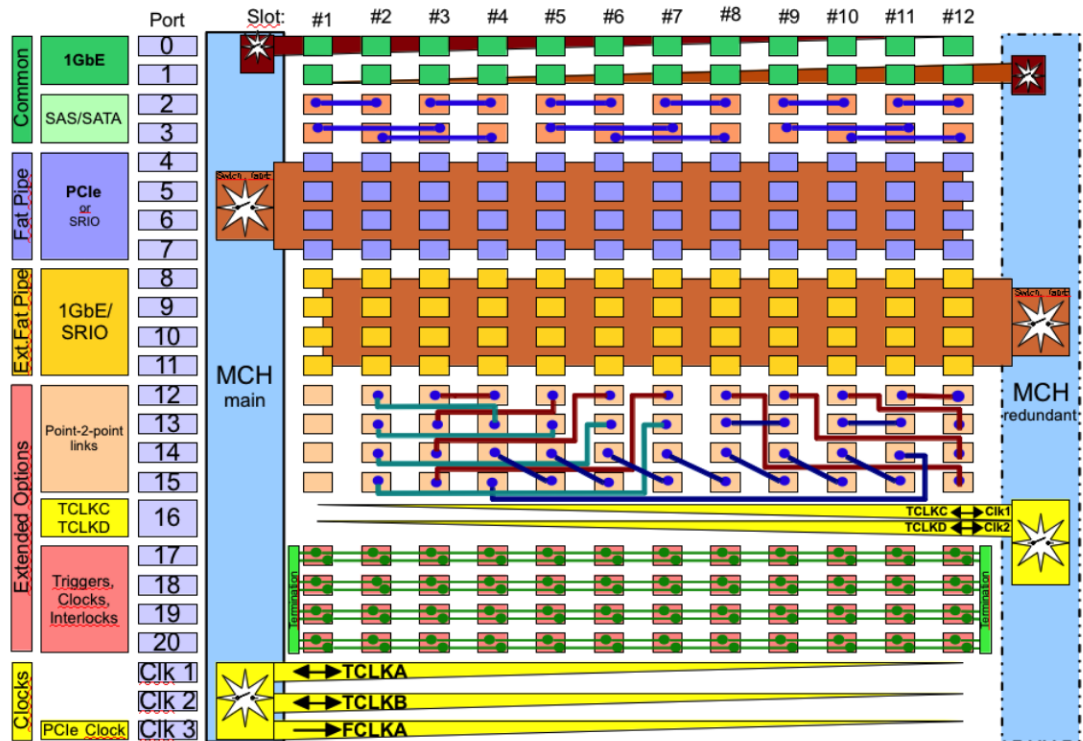


Figure 6-4: Example of a μ TCA backplane

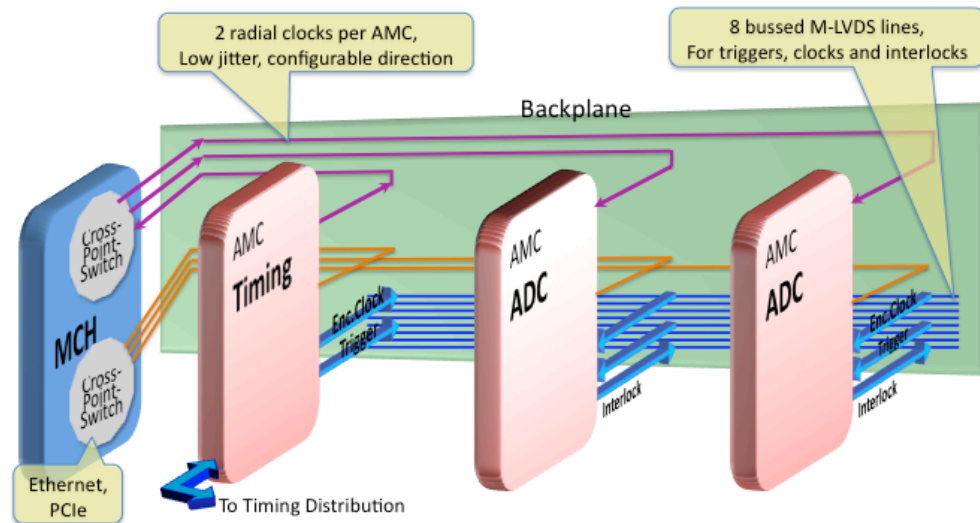
- ¶ 118 The following are the uses of the various Ports and Clocks for this backplane.
- REQ 6-5: Port 0 **should** be used for base Ethernet interface. Port 1 is connected to the optional (redundant) MCH.
- REQ 6-6: Port 4 to 7 **should** be used for PCIe.
- REQ 6-7: Port 12 to 15 **may** be used for application specific wire-ring.
- REQ 6-8: Ports 17 – 20 **should** be wired as a bus according Section 6.4.
- REQ 6-9: FCLKA (Clk3) **should** be used for PCIe clock distribution as defined in MTCA.0 R1.0
- REQ 6-10: TCLKA and TCLKB **should** be wired from the main MCH to all AMC slots.
- REQ 6-11: TCLKC and TCLKD **should** be wired from the redundant MCH to all AMC slots.

6.8 MCH Connector pin allocations

- ¶ 119 The MCH is connected according to MTCA.0.

6.9 System examples

- ¶ 120 This section describes examples of applications in science. The same principles can be used in industrial or medical systems as well. Applications in these fields usually collect a lot of different analog signals, slow and high-speed digital data, and often control actuators in the field. Single or multiple CPU's, FPGA's or DSP's are within the shelf to execute slow and fast feedbacks and to provide the data to other processes and the users.



**Figure 6-5: A 'typical' analog front-end.
CPU and further AMC's are not shown**

¶ 121

Figure 6-5 shows the distribution of clocks and triggers within a shelf. Some high-speed ADC's require precise clocks: radial clock lines switch in the MCH are provided for these applications. Less demanding clocks and triggers are distributed via the eight bussed M-LVDS lines. Clock frequencies around 100 MHz are foreseen on the 100 Ω impedance matched bus. Triggers can be used to arm data recording of the ADC's or to trigger readout processes in CPU's. Figure 6-6 is an example of a fast digitizer with a FPGA controlling the processing of data. A radial distributed clock is used for the ADC's. Data acquisition is triggered from the M-LVDS bus. And the board is able to compare ADC readings with a threshold to generate interlock signals. Those are distributed within the shelf on the bussed lines.

¶ 122

PCIe accomplishes data transfer between the ADC, FPGA and the CPU. The μ TCA system provides more then 400 MB/sec transfer speed over 4 lanes available in each AMC. Further lines of ports 12 to 15 of the backplane (see Figure 6-4) can be used to combine ADC data of several boards via Giga-bit links of the controlling FPGA's. An example from accelerators is the calculation of a vector sum of 32 cavities. Four ADC AMC's are collecting the data; a fifth AMC implements a feedback controller. Such a complex system does not need external clock trigger or fast link lines since the backplane can distribute the required signals.

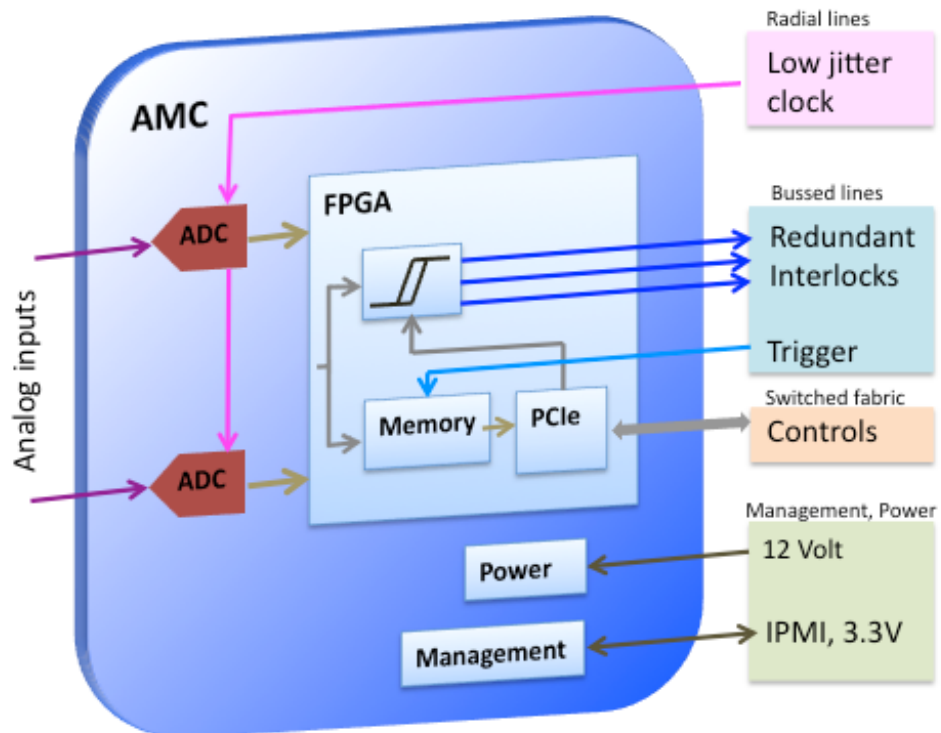

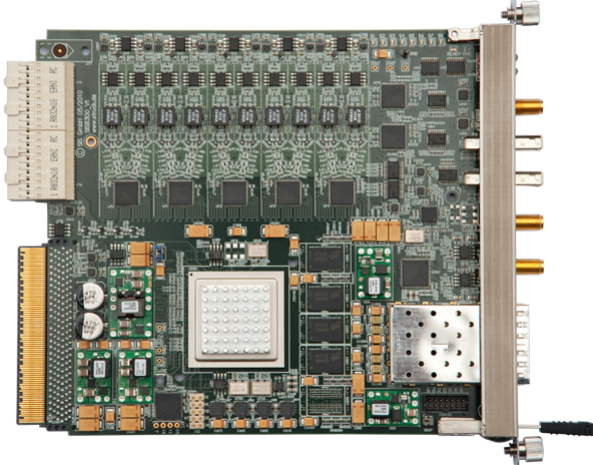


Figure 6-6: An example of a fast front-end (ADC AMC0)

- ¶ 123 Sufficient space for connectors is a further requirement for front-end electronics. And ADC's often need complex signal conditioning. Double size AMC's and the same PCB size on the μ RTM provide enough space for digital and analog electronics. Sensitive analog parts of the signal chain needs to be well separated and shielded from power converters and noisy digital lines. The layout of the AMC- μ RTM connections is designed to support critical analog designs.
- ¶ 124 The equal space on the AMC and μ RTM allows flexible combinations to design modular systems. An AMC with a FPGA requires many PCB layers and high-speed strip-line designs. This is time consuming development. It is an advantage to use these complex boards in multiple applications by providing μ RTM's as the adapter. μ RTM's can be implemented with 4 to 6 layers and more designers are able to do this. In other applications an expert RF designer is required to create high frequency RF front-end. The front and rear division of the task is convenient since one can partition the tasks to different skilled designers.

Table 6-2: Examples of AMC's with different μ RTM to adapt to different applications

μ RTM	AMC
	
<ol style="list-style-type: none"> 1. Down-converter as RF front-end 2. Fiber-optic receiver 3. Pulse shaper to stretch photo diode signals 	Multi channel ADC
<ol style="list-style-type: none"> 1. 20 MHz ADCs and signal conditioning 2. Stepper controller and position read-back 3. Interlock systems (analog and digital inputs) 	FPGA with memory, fast links, FMC
Disks and peripheral connections	CPU

A. Twenty and Thirty Pair Advanced Differential Fabric connector definitions

- ¶ 125 The information in this Appendix is similar to that in PICMG 3.0 except that it delineates 20 and 30 pair versions of the Advanced Differential Fabric (ADF) connector.
- ¶ 126 The user of this section should note that the row and column designations used in this document are consistent with those used in other PICMG xTCA documents. These designations are the opposite of the way connector manufacturers label their products.

A.1 General data

A.1.1 Objective of this document

- ¶ 127 See PICMG 3.0 R3.0

A.1.2 Scope

- ¶ 128 See PICMG 3.0 R3.0

A.1.3 Intended method of mounting

- ¶ 129 See PICMG 3.0 R3.0

A.1.4 Ratings and characteristics.

- ¶ 130 See PICMG 3.0 R3.0

A.1.5 Normative references

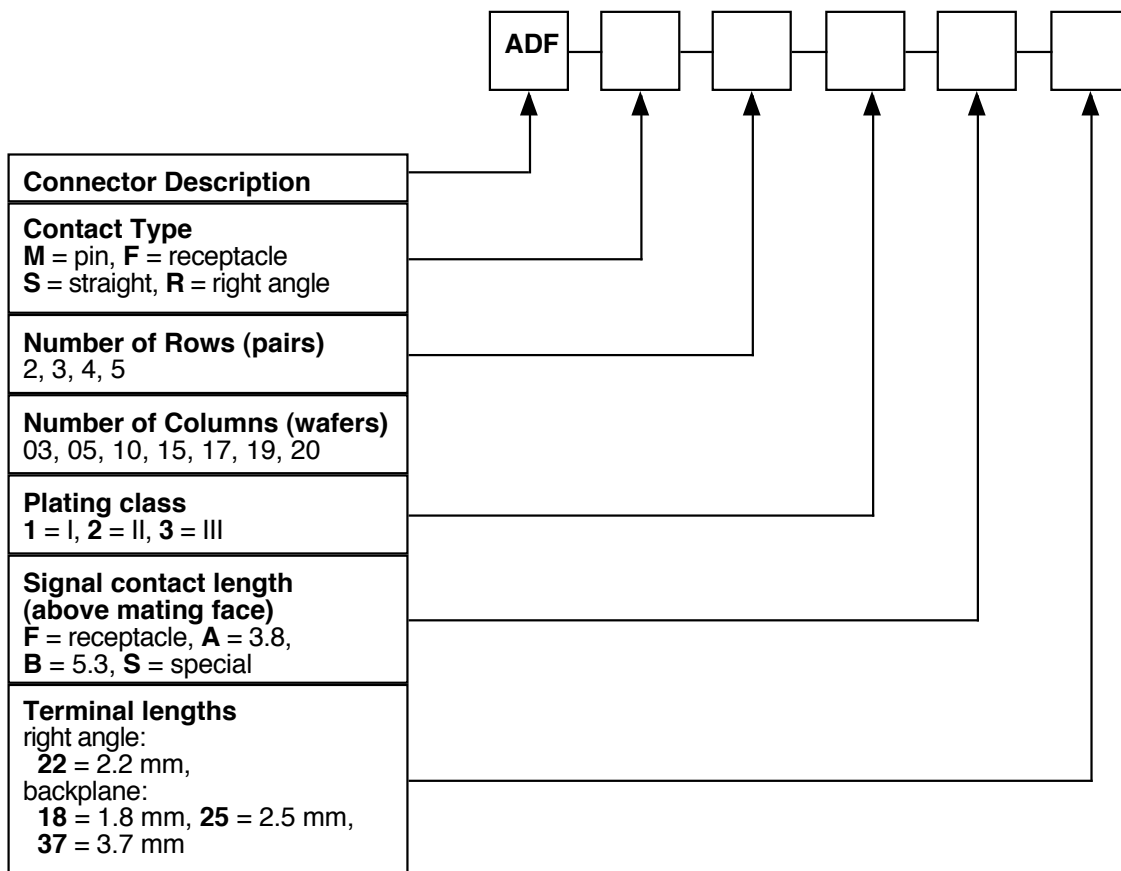
- ¶ 131 See PICMG 3.0 R3.0

A.1.6 Markings

- ¶ 132 See PICMG 3.0 R3.0

A.1.7 Type designation

Table A-1: ADF part number designator



¶ 133

Using this nomenclature a receptacle 30 pair ADF receptacle connector in Zone 3 of the AMC would be designated:

ADF-FR-3-10-2-F-22

The mating connector on the μ RTM would be designated:

ADF-MR-3-10-2-B-22

Note that for the male right angle a Short Pin is available and designated as “S”. The user is responsible for indicating which pin lengths are in which positions. This connector would be designated as:

ADF-MR-3-10-2-S-22

Typically the “S” designator would be used in the RP30 position.

A.2 Technical information

A.2.1 Definitions

A.2.1.1 Contacts and terminations

¶ 134 See PICMG 3.0 R3.0 except on line 37 and change “Front Board” to “Front Board and μ RTM”.

A.3 30 Pair ADF Connectors

A.3.1 General isometric view and common features

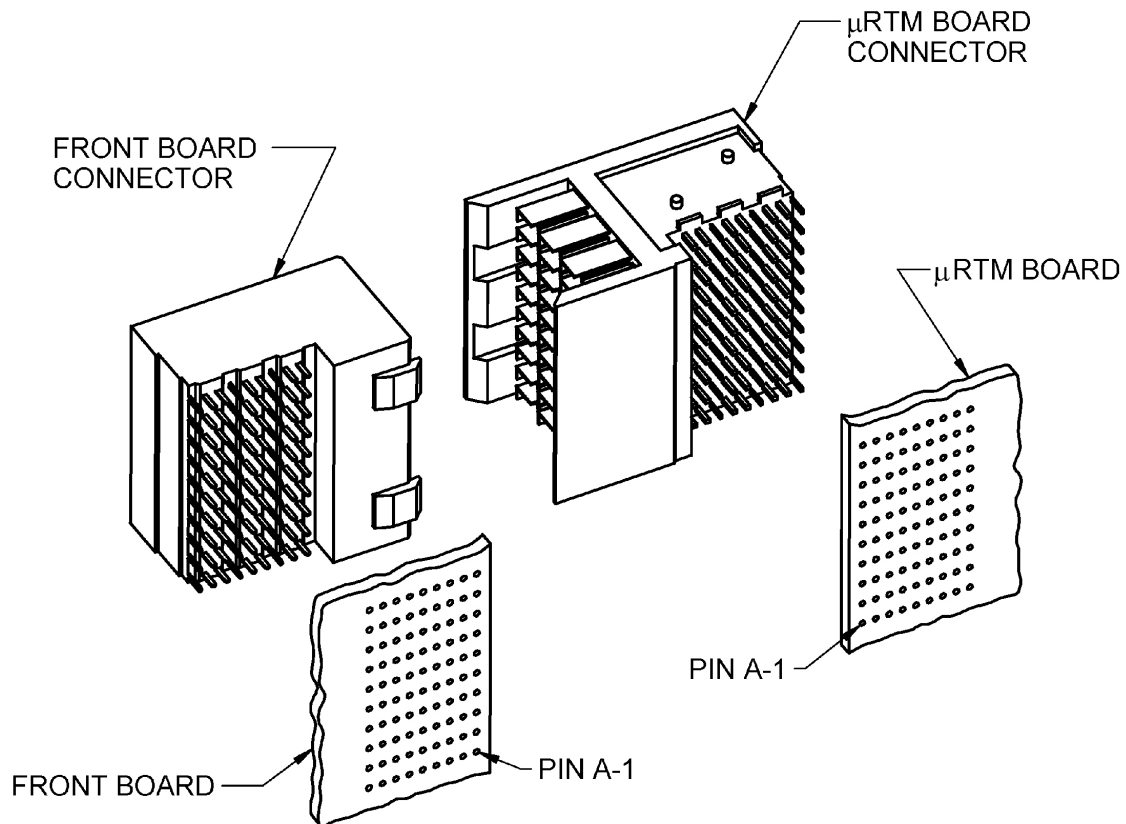


Figure A-1: Zone 3 front board and μ RTM mating illustration

A.3.2.2 Right Angle Pin Connector

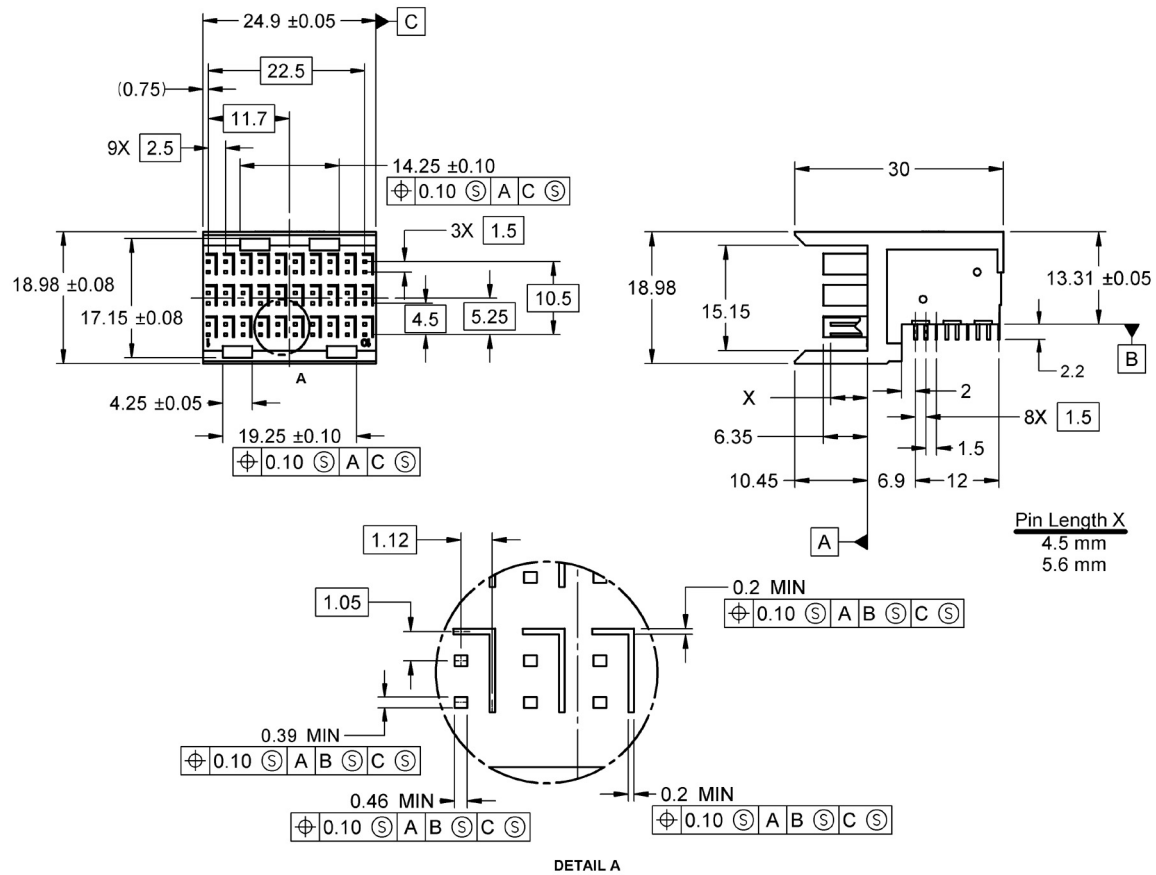


Figure A-3: Three row ADF male connector dimensions

A.3.2.2.1 Contacts

¶ 136 See PICMG 3.0, Section A.3.3.2

A.3.2.2.2 Contacts tip geometry

¶ 137 See PICMG 3.0, Section A.3.3.3

A.3.2.2.3 Terminations

¶ 138 See PICMG 3.0, Section A.3.3.4

A.4 Dimensional information for 20 Pair Connectors

A.4.1 General isometric view and common features

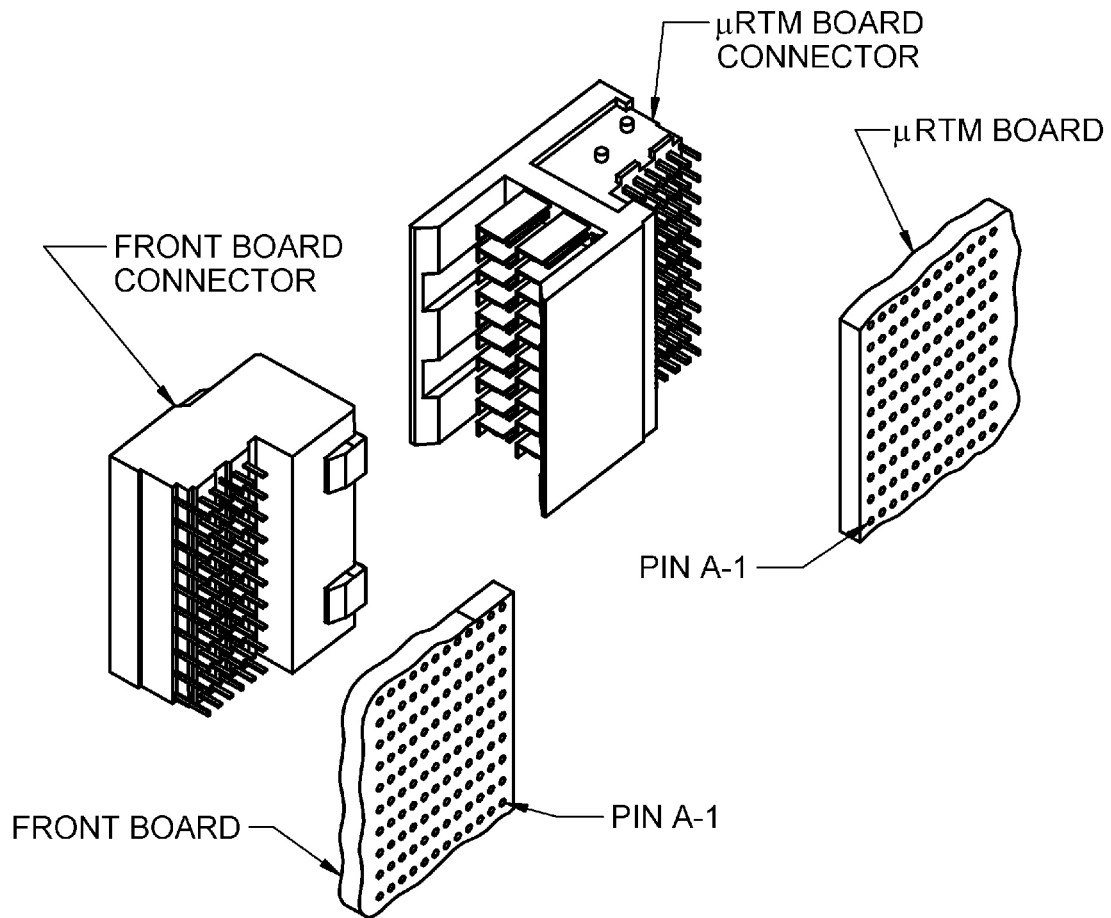


Figure A-4: Zone 3 front board and μ RTM mating illustration

A.4.2 Dimensional Information

A.4.2.1 Right Angle Receptacle Connector

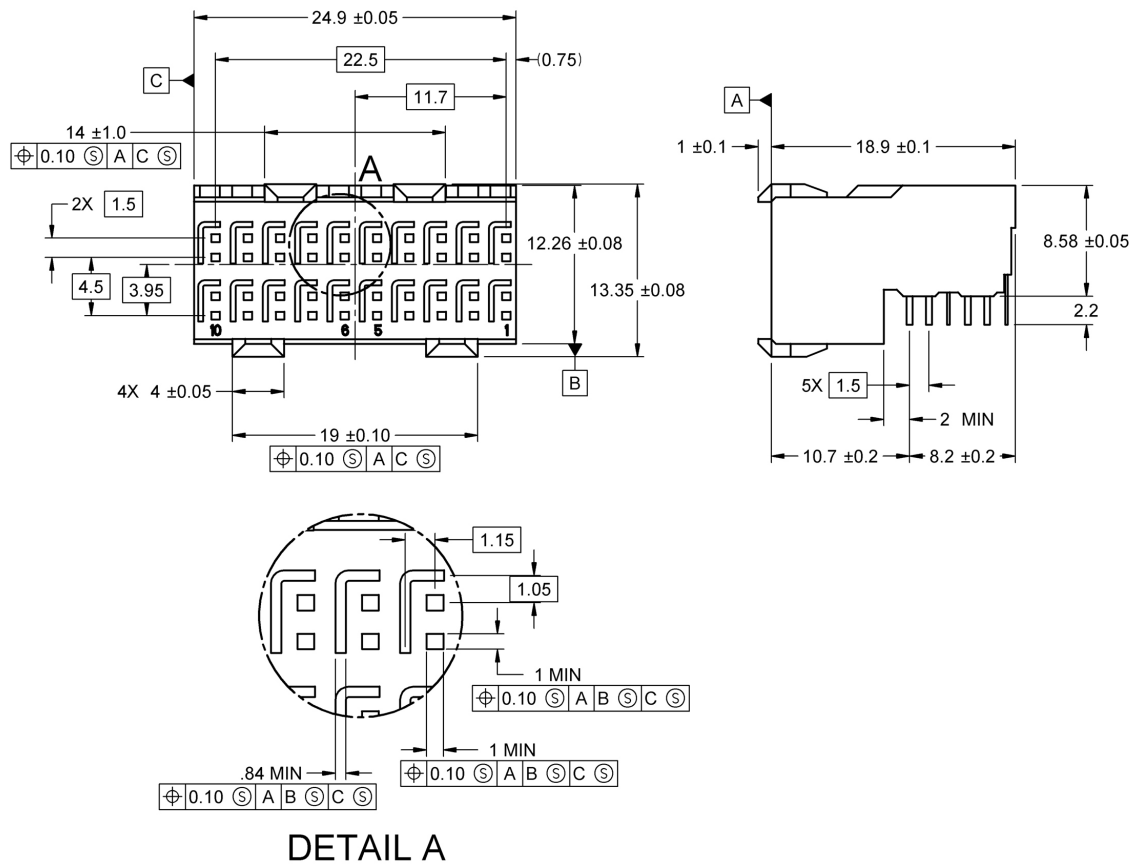


Figure A-5: Two row ADF female connector dimensions

A.4.2.1.1 Terminations

¶ 139 See PICMG 3.0, Section A.3.4.2

A.4.2.1 Right Angle Pin Connector

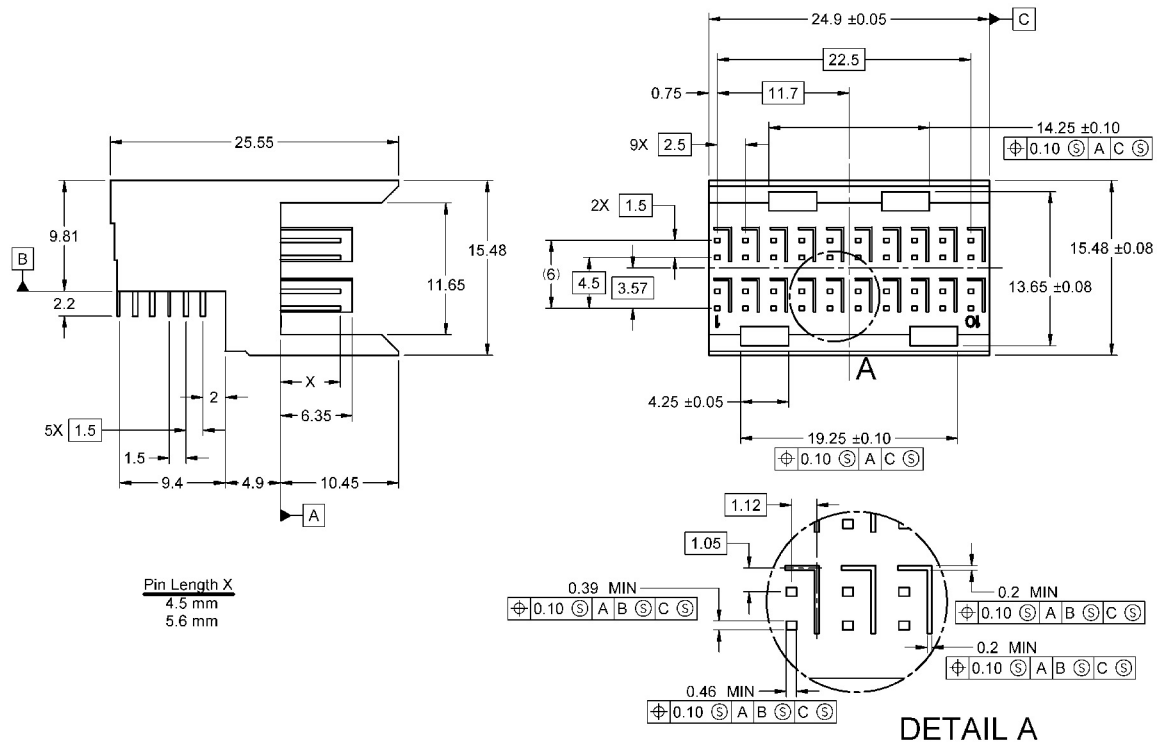


Figure A-6: Two row ADF male connector dimensions

A.4.2.2.1 Contacts

¶ 140 See PICMG 3.0, Section A.3.3.2

A.4.2.2.2 Contacts tip geometry

¶ 141 See PICMG 3.0, Section A.3.3.3

A.4.2.4 Terminations

¶ 142 See PICMG 3.0, Section A.3.3.4

A.5 Engagement information

A.5.1 Electrical engagement length

- ¶ 143 Three levels of mating are supported in mating pin and receptacle right angle connectors. The first contact to mate is the ground blade. The second to mate is Signal Level 2. The third is the 4.5 mm “Short Pin”. In the right angle pin connector there is no Level 1 (3.8 mm) pin as in the backplane male connector.

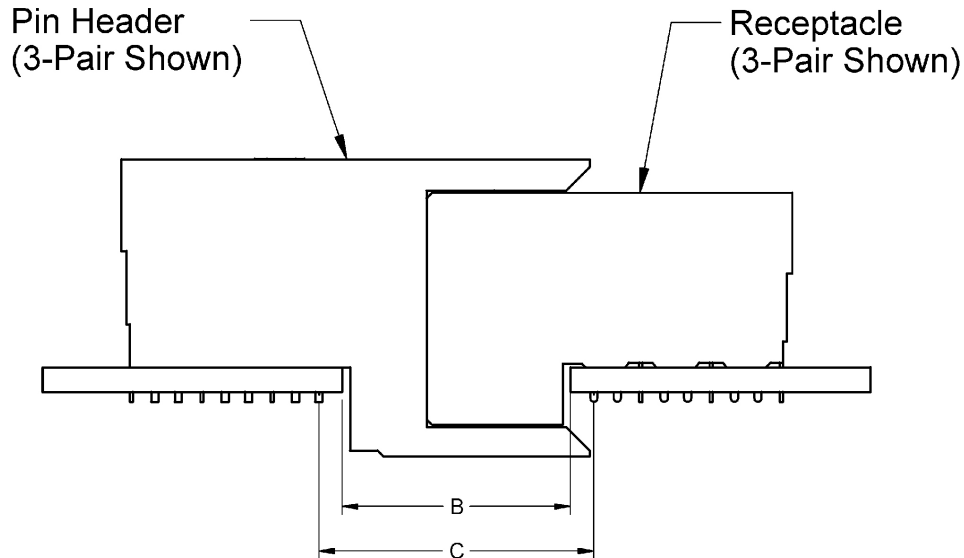


Figure A-7: Right Angle – Right Angle Connector Mating

Note: The dimensions for mating are the same for the 20 and 40 pair connectors.

Table A-2: Connector Mating Sequence

Product Family	Dim B (mm) fully mated	Contact	Dim C (mm) min	
			Reliable mate	Fully mated
ADF	14.8	Ground Shield	22.08	17.8
		Signal Level 2 5.3 mm	20.71	17.8
		Short Pin 4.5 mm	19.91	17.8

A.5.2 Perpendicular to engagement direction

¶ 144 See PICMG 3.0, Section A.3.2.3

A.5.4 Inclination

¶ 145 See PICMG 3.0, Section A.3.2.4

A.6 PCB Layout for Connectors

A.6.1 PCB Layout for AMC Zone 3 ADF connectors

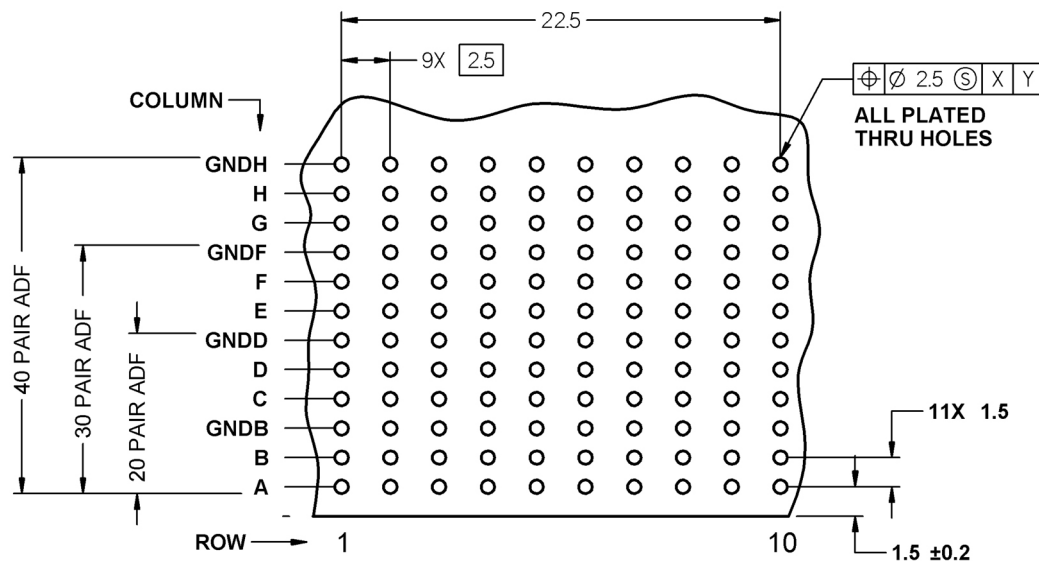


Figure A-8: ADF connector PCB hole layout

Note: View from component side 2.

REQ A-1: The ADF right angle receptacle connector **shall** use the hole pattern in Figure A-8 sized appropriately.

¶ 146 The position of hole A1 on the AMC PCB is shown in Figure 2-1.

A.6.2 PCB Layout for μ RTM Zone 3 ADF connectors

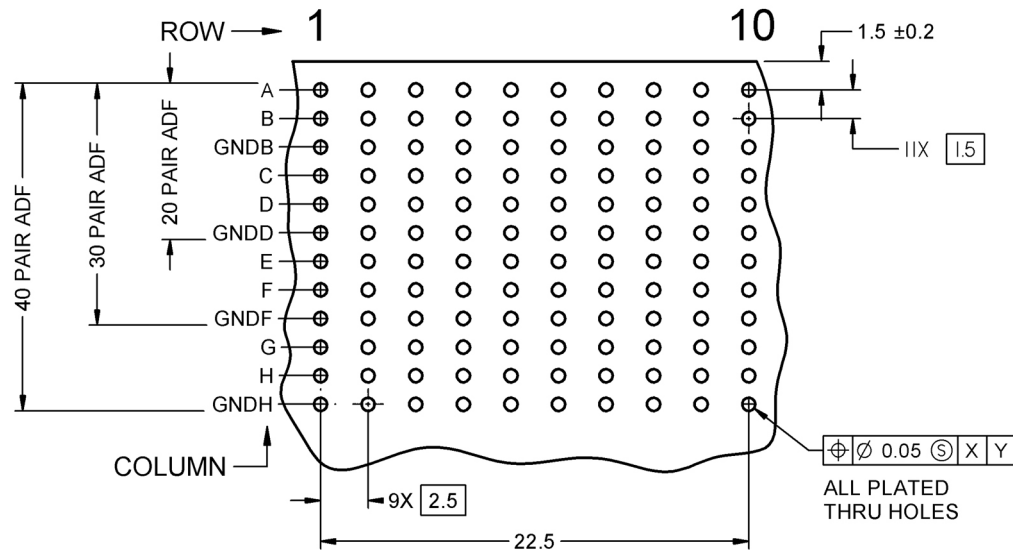


Figure A-9: ADF connector μ RTM PCB hole layout

Note: View from component side 2.

REQ A-2: The ADF right angle pin connector **shall** use the hole pattern in Figure A-9 sized appropriately.

¶ 147 The position of hole A1 on the μ RTM PCB is shown in Figure 2-4.

A.7 Characteristics

§ 148 Section A-7 is the same as PICMG 3.0 R3.0, Appendix A.4 except as noted in the following sections.

A.7.1 Propagation Delay

§ 149 Remove G and H Pins from PICMG 3.0 R3.0 Table A-9 for three connectors and E, F, G, and H for the two-row connector. After the appropriate modification the table in PICMG 3.0 R3.0 can be used.

B. Keys

B.1 Male Key Dimensions

REQ B-1: The male key/alignment pin in Figure B-1 **shall** be used on the μ RTM module. Orientation codes are in Table B-1.

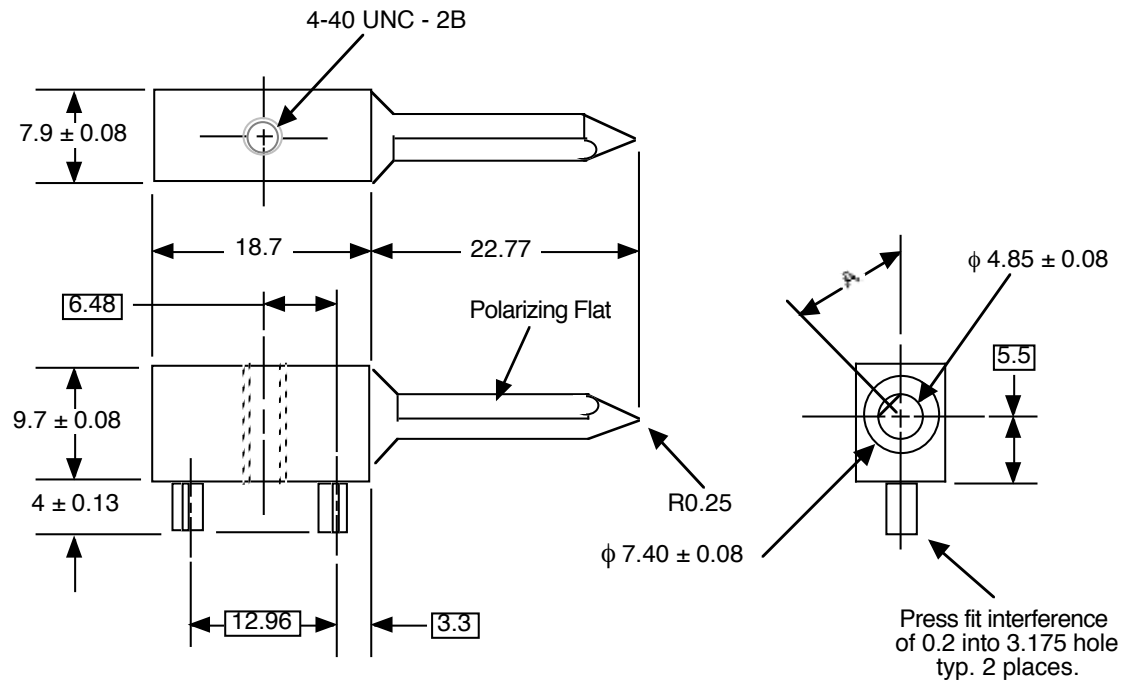


Figure B-1: Male key

B.2 Female Key Dimensions

REQ B-2: The female key/alignment pin in Figure B-1 **shall** be used on the AMC module. Orientation codes are in Table B-1.

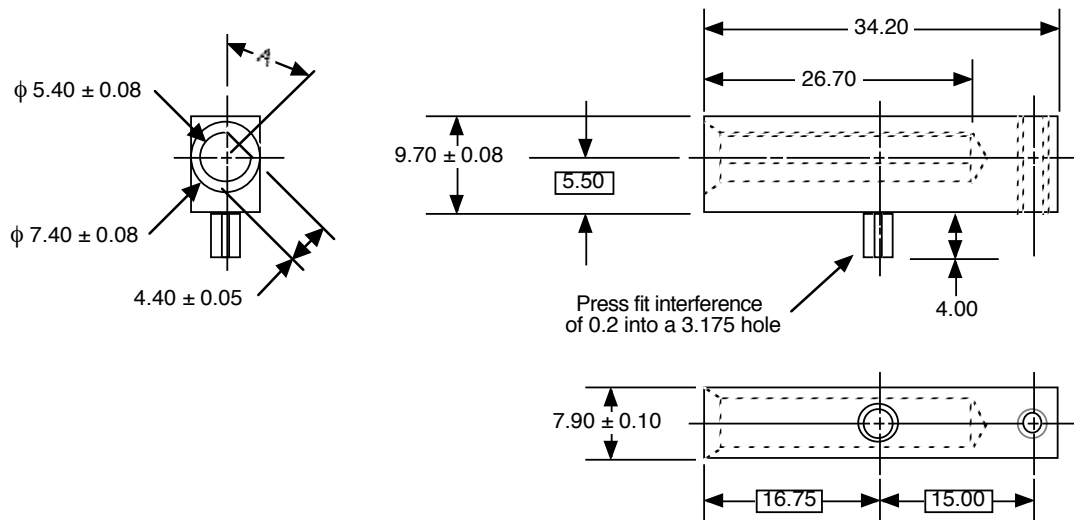


Figure B-2: Female key




























¶ 150

For cases where keying is not used (e.g. some test equipment) an un-keyed version of the female block is available. The un-keyed version is value 0 in Table B-1.

B.3 Key Orientation

¶ 151 Table B-1 indicates the orientation of the male and female keys. The meaning of the values is contained in Table 2-1 of this document.

Table B-1: Key positions (standard orientation)

N	A Rotation in degrees	View from front of Subrack		View from rear of Front Board
		Receptacle	Post	Receptacle
1	0			
2	45			
3	90			
4	135			
5	180			
6	225			
7	270			
8	315			
0	NA			

¶ 152 N = 0 has a unique position in the table. If the receptacle does not have a flat any post will fit into it. The receptacle might serves as an alignment mechanism. This feature might be of use in test fixtures. The user should be aware of the following:

- a) N = 0 posts cannot be inserted into N ≠ 0 receptacles.
- b) N ≠ 0 posts can be inserted into N = 0 receptacles.

Table of Requirements

REQ 2-1: The outline of the AMC with ADF connectors shall follow PICMG AMC.0 R2.0, Section 2.2.1.2 except as noted in Figure 2-1.	15
REQ 2-2 Implementations using other connectors may have different positions for Pin 1 and different Zone 3 PCB edge details than those shown in Figure 2-1.	15
REQ 2-3: The inside and outside PCB corners in the Zone 3 area shall follow AMC.0 R2.0, Section 2.2.2, Figure 2-12 (Inside corners to be R1 and outside corners to be R0.5).	15
REQ 2-4: To be compatible with subracks and carriers that have the AMC connector in the Zone 3, Connector 1 area, other components shall not be in the keep out zone shown in Figure 2-1.	15
REQ 2-5: The AMC board shall implement the ESD strip as detailed in AMC.0, Section 2.2.1.4.	15
REQ 2-6: The AMC Modules that mate with μ RTM Modules shall implement female key/alignment mechanics as specified in Appendix B-2.	15
REQ 2-7: $N = 0$ should be used for test fixtures or in cases where only alignment is necessary.	16
REQ 2-8: AMC Modules using ADF connectors shall use the key definitions as described in Table 2-2.	16
REQ 2-9: Key definitions for AMC Modules and μ RTMs that use connectors other than ADF connectors in Zone 3 shall be defined by the Module designer.	17
REQ 2-10: The front board should use an add-on plug connector instead of edge card fingers.	17
REQ 2-11: An ADF connector in J30 shall have a short pin in position J30-C1 for μ RTM_PS#.	17
REQ 2-12: Implementation of JTAG shall be optional (red names in Table 2-5).	17
REQ 2-13: If JTAG is implemented on the Front AMC and the μ RTM is not present the AMC should short the TDI and TDO lines that go to/from the μ RTM on the AMC.	17
REQ 2-14: If a μ RTM that does not implement JTAG is associated with an AMC that implements JTAG the μ RTM shall connect the TDO and TDI pins on the Zone 3 connector.	18
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