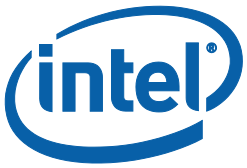


Intel® Xeon Phi™ Processor x205 Product Family

Thermal / Mechanical Specification and Design Guide (TMSDG)

December 2017

Revision 001

Document Number: 336852

Notice: This document contains information on products in the design phase of development. The information here is subject to change without notice. Do not finalize a design with this information.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software, or service activation. Learn more at intel.com, or from the OEM or retailer.

No computer system can be absolutely secure. Intel does not assume any liability for lost or stolen data or systems or any damages resulting from such losses.

You may not use or facilitate the use of this document in connection with any infringement or other legal analysis concerning Intel products described herein. You agree to grant Intel a non-exclusive, royalty-free license to any patent claim thereafter drafted which includes subject matter disclosed herein.

No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document.

The products described may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

This document contains information on products, services and/or processes in development. All information provided here is subject to change without notice. Contact your Intel representative to obtain the latest Intel product specifications and roadmaps.

Intel disclaims all express and implied warranties, including without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement, as well as any warranty arising from course of performance, course of dealing, or usage in trade.

Intel does not control or audit third-party benchmark data or the web sites referenced in this document. You should visit the referenced web site and confirm whether referenced data are accurate.

Copies of documents which have an order number and are referenced in this document may be obtained by calling 1-800-548-4725 or by visiting www.intel.com/design/literature.htm.

Intel, the Intel logo, and Xeon are trademarks of Intel Corporation in the U.S. and/or other countries.

*Other names and brands may be claimed as the property of others.

Contents

Figures

Tables

Revision History

Document Number	Revision Number	Description	Date
336852	001	• Initial release of the document.	December 2017

1 Overview

1.1 Introduction

This document provides processor thermal/mechanical specification and design guidelines for development of thermal and mechanical solutions for the Intel® Xeon Phi™ processor x205 product family.

The Intel® Xeon Phi™ processor x205 product family design is heavily leveraged from the Intel® Xeon Phi™ processor x200 product family.

This document identifies only the differences between those two processors. Refer to Table 1-1 for the document describing the Intel® Xeon Phi™ processor x200 product family.

Table 1-1. Related Documents

Document	Order Number
Intel® Xeon Phi™ Processor x200 Product Family Thermal/Mechanical Specifications and Design Guide	334785-002

2 Thermal Specification and Design Guidelines

2.1 Thermal Specification Overview

The thermal specifications for the 320W TDP and 250W TDP SKUs, were obtained using two different thermal solution options: (1) a 1U Liquid Assist Air Cooling (LAAC) thermal solution and (2) a 1U/2U Loop Heat Pipe (LHP) thermal solution as well. These two different thermal solutions are detailed in Appendix A. It is important to note that the T_{CASE} specs are based on "Time 0" thermal validation testing and specific to a unique reference system. The reference system is described in Table 2-1.

Table 2-1. Reference System Configuration used for determining T_{CASE} Specifications

System	
Processor:	Intel® Xeon Phi™ processor x205 product family
Motherboard:	Adams Pass Refresh
Chassis:	Enhanced Bobcat Peak
Cold Plate Material:	Copper
Heat Exchanger Material:	Aluminum
Tube Material:	EPDM
Thermal Interface Material (TIM):	Honeywell* PCM45F

2.2 Thermal Design Power (TDP) and T_{CASE} Specifications

Table 2-2 and Table 2-3 list the Thermal Design Power (TDP) and T_{CASE} values for the different processor SKUs.

Table 2-2. TDP and T_{CASE} Specifications – 250W SKU

	Processor	
Workload	**CPU Centric**	**Memory Centric**
CPU Power	209W	182W
Memory Power	41W	68W
Total Power	250W	
CPU Die Maximum T_{CASE} (see note 1)	72 °C	
DTS Maximum T_{DTS}	84 °C	
Minimum T_{CASE}[2]	5 °C	

NOTES:

1. These specifications were obtained using two different thermal solution options (i) 1U LAAC thermal solution at $T_{ambient}$ = 33 °C and (ii) 1U LHP thermal solution at $T_{ambient}$ = 35 °C , using Adams Pass Refresh Motherboard in a 1U Enhanced Bobcat Peak chassis.
2. ASHRAE thermal envelopes allow scenarios where the data center ambient temperature may drop below 5 °C, down to 0 °C. However, the processor silicon temperatures are expected to quickly rise above 5 °C once operational. Contact your Intel representative if you believe your data center implementation warrants further consideration of minimum operational temperatures down to 0 °C.

Table 2-3. TDP and T_{CASE} Specifications – 320W SKU

	Processor	
Workload	**CPU Centric**	**Memory Centric**
CPU Power	276W	252W
Memory Power	44W	68W
Total Power	320W	
CPU Die Maximum T_{CASE} (see note 1)	77 °C	
DTS Maximum T_{DTS}	94 °C	
Minimum T_{CASE}[3]	5 °C	

NOTES:

1. These specifications were obtained using two different thermal solution options (i) 1U LAAC thermal solution at $T_{ambient}$ = 27 °C and (ii) 2U LHP thermal solution at $T_{ambient}$ = 35 °C , using Adams Pass Refresh Motherboard in a 1U Enhanced Bobcat Peak chassis.
2. ASHRAE thermal envelopes allow scenarios where the data center ambient temperature may drop below 5 °C, down to 0 °C. However, the processor silicon temperatures are expected to quickly rise above 5 °C once operational. Contact your Intel representative if you believe your data center implementation warrants further consideration of minimum operational temperatures down to 0 °C.

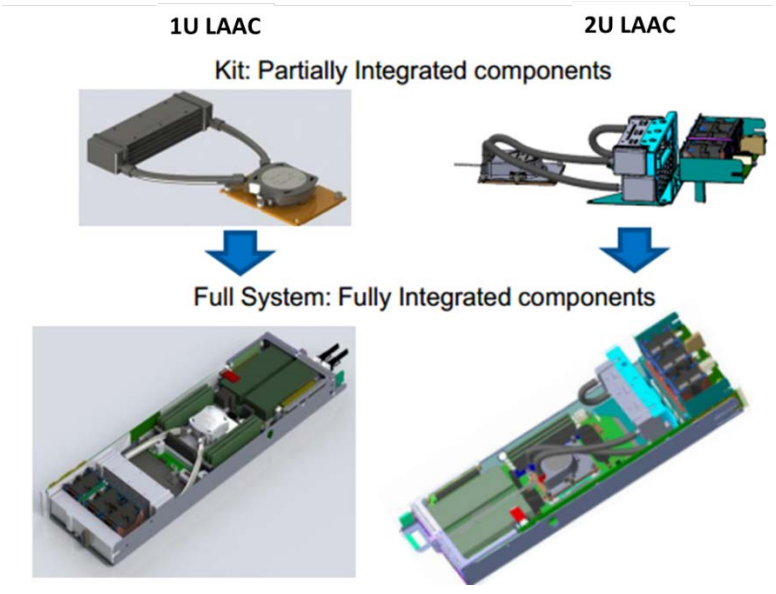
A Cooling Technologies for Intel® Xeon Phi™ Processor x205 Product Family

A.1 Liquid Assist Air Cooling (LAAC) Technology

Liquid Assist Air Cooling (LAAC) technology is an active thermal solution which dissipates higher heat load than existing passive, air-cooled, heat sinks within the equivalent keep out volumetric. It consists of a cold plate, heat exchanger and pump in closed loop as shown in Figure A-1. A liquid is pumped through the cold plates to remove the heat generated by the IHS. The heated liquid then flows through a liquid-to-air heat exchanger within the server chassis where the heat is dissipated to the ambient air from the chassis fans.

Power hooks are necessary on motherboards to power the pumps. Active BMC control algorithm is necessary for preventing/ identification of leaks and reliability issues.

Figure A-1. Liquid Assist Air Cooling Technology (LAAC)

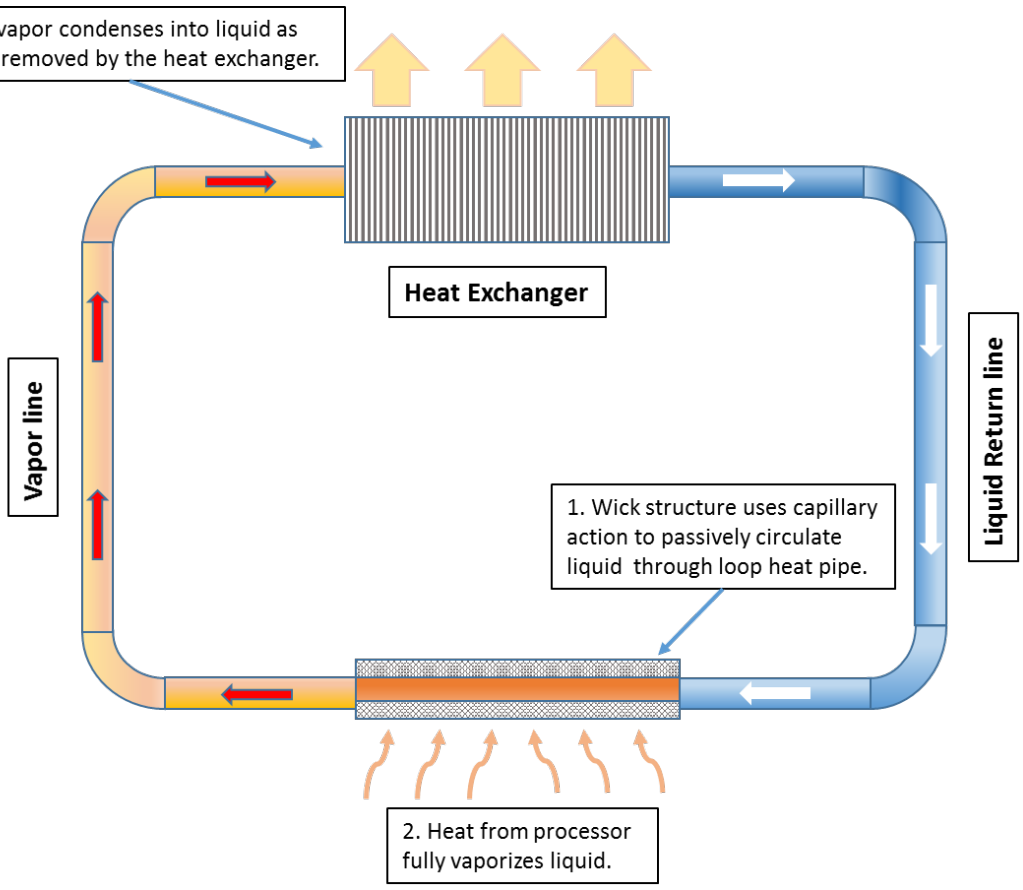


Courtesy: Asetek, Inc.*

A.2 Loop Heat Pipe (LHP) Technology

Loop heat pipe (LHP) technology is a passive thermal solution (no pumps) that dissipates higher heat load than existing passive, air-cooled, heat sinks within the equivalent keep out volumetric. It is optimized for performance in the horizontal orientation. The LHP utilizes a two-phase dielectric refrigerant. The heat from the IHS is absorbed by the liquid refrigerant flowing through the evaporator and changes phase into vapor. This vapor then travels to condenser area where heat is dissipated to ambient air and changes phase into liquid and returns to evaporator as shown in Figure A-2.

Figure A-2. Loop Heat Pipe Technology Operating Principle



B Supplier Listing

This chapter contains supplier information for LAAC and LHP vendors.

- Supplier content is provided by Intel as a convenience to its customers. Intel does not make any representations or warranties whatsoever regarding the quality, reliability, functionality, or compatibility of these devices.
- Only “Time 0” thermal validation testing specific to a unique reference system was done by Intel as detailed in Section 2.1. The thermal solutions have not been verified to meet performance targets or quality and reliability requirements.
- Supplier information provided in the table was deemed accurate when this document was released.
- Customers planning on using these thermal solution design should contact the suppliers for the latest information on their product(s).
- Customers must evaluate performance against their own product requirements.

Table B-1. Intel® Xeon Phi™ Processor x205 Product Family Thermal Solution Supplier Information

Component	Description	Supplier Contact Info
LAAC	1U and 2U Liquid Assisted Air Cooling System	http://www.asetek.com/company/support/contact-us/ Contact: Dipak Rao, dra@asetek.com
LHP	1U and 2U Loop Heat Pipe	http://www.calyos-tm.com/ Contact: Olivier De Laet, Olivier.de.laet@calyos-tm.com