Intel® Media Processor CE 3100

Thermal Design Guide

August, 2008

Revision 1.0

Reference Number: E51481-001

Legal Statements

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Revision History

Date	Revision	Reference #	Description
August, 2008	1.0	E51481-001	Initial public release.

Reference Documents

Document Title	Document #
Integrated Circuit Thermal Measurement Method-Electrical Test Method	EIA/JESD51-1
Integrated Circuits Thermal Test Method Environmental Conditions – Natural Convection (Still Air)	EIAJESD51-2

1 Introduction

This document describes the Intel® Media Processor CE 3100 thermal characteristics and suggested thermal solutions. This document should be used to properly design a thermal solution for systems implementing the Intel® Media Processor CE 3100.

Properly designed systems provide adequate cooling to maintain the Intel® Media Processor CE 3100 case temperature (Tcase) at or below the maximum specification.

Table 3. Ideally, this is accomplished by providing a low local ambient temperature, while the system is in operation, and creating a minimal thermal resistance to that local ambient temperature. By maintaining the Intel® Media Processor CE 3100 case temperature at or below the value recommended in this document, the Intel® Media Processor CE 3100 will function properly and reliably.

1.1 Intended Audience

The intended audience for this document is System Design Engineers using the Intel® Media Processor CE 3100. System designers are required to address component and system-level thermal challenges as the market continues to adopt products with higher-speeds and port densities. New designs may be required to provide better cooling solutions for silicon devices depending on the type of system and target operating environment.

1.2 Thermal Considerations

In a system environment, the temperature of a component is a function of the component, board, and system thermal characteristics. System-level thermal constraints consist of the local ambient temperature near the component, the airflow over the component and surrounding board, and the physical constraints at, above, and surrounding the component that may limit the size of a thermal enhancement (heat sink).

The component's case/die temperature depends on the following:

- component power dissipation
- size
- packaging materials (effective thermal conductivity)
- type of interconnection to the substrate and motherboard
- presence of a thermal cooling solution
- power density of the package, nearby components, and motherboard

Technology trends continue to push these parameters toward increased performance levels (higher operating speeds), I/O density (smaller packages), and power density (more transistors). As operating frequencies increase and packaging size decreases, the power density increases and the thermal cooling solution space and airflow become more constrained. The result is an increased emphasis on system design to reduce local ambient temperatures and ensure that thermal design requirements are met for each component in the system.

1.3 Importance of Thermal Management

The thermal management objective is to ensure that all system component temperatures are maintained within functional limits. The functional temperature limit is the range in which the electrical circuits are expected to meet specified performance requirements. Operation outside the functional limit can degrade system performance, cause logic errors, or cause component and/or system damage. Temperatures exceeding the maximum operating limits may result in irreversible changes in the device operating characteristics. Sustained operation at component maximum temperature limit may affect long-term device reliability.

1.4 About this Document

This document provides the following information:

- Section 2 “Packaging Terminology” provides definitions for package terminology used in this document.
- Section 3 “Thermal Specifications” provides The Intel® Media Processor CE 3100 case temperature specifications and explains where to find power requirements. This section also discusses thermal packaging techniques
- Section 4 “Thermal Attributes” provides The Intel® Media Processor CE 3100 thermal characteristic data, package mechanical attributes, and package thermal characteristic data. Use this section to determine your thermal solution requirements.
- Section 5 “Thermal Enhancements” discusses the use of heat sinks: heat sink attach methods, heat sink interfacing, and heat sink reliability.
- Section 6 “Measurements for Thermal Specifications” Provides instructions for measuring The Intel® Media Processor CE 3100 case temperature with and without a heat sink.

2 Packaging Terminology

Following is a list of packaging terminology used in this document.

Table 1. Packaging Terminology

Term	Definition
Ambient	Refers to local ambient temperature of the bulk air approaching the component. It can be measured by placing a thermocouple approximately 1 inch upstream from the component edge and ½ inch above board.
FCBGA Flip Chip Ball Grid Array	A surface mount package using a combination of flip chip and BGA structure whose PCB-interconnect method consists of a solder ball array on the interconnect side of the package. The die is flipped and connected to an organic build-up substrate with C4 bumps.
Junction	Refers to a P-N junction on the silicon. In this document, it is used as a temperature reference point (for example, ΘJA refers to the "junction" to ambient thermal resistance).
Tcase	Refers to the temperature measured at the top surface center of the package.
LFM	Linear Feet per Minute (airflow)
Printed Circuit Assembly (PCA)	An assembled PCB.
Thermal Design Power (TDP)	The estimated maximum possible/expected power generated in a component by a realistic application. Use Maximum power requirement numbers from Table 3.

3 Thermal Specifications

To ensure proper operation of the Intel® Media Processor CE 3100, the thermal solution must maintain a case temperature at or below the values specified in Table 3. System-level or component-level thermal enhancements are required to dissipate the generated heat if the case temperature exceeds the maximum temperatures listed in Table 3.

Analysis indicates that most applications are unlikely to cause The Intel® Media Processor CE 3100 to be at Tcase-max for sustained periods of time. Given that Tcase should reasonably be expected to be a distribution of temperatures, sustained operation at Tcase-max may be indicative that the given thermal solution will also result in situations where Tcase exceeds the specified maximum value. Such thermal designs may affect long-term reliability of the Intel® Media Processor CE 3100 and the system sustained performance at Tcase-max should be evaluated during the thermal design process and steps taken to further reduce the Tcase temperature.

Good system airflow is critical to dissipate the highest possible thermal power. The size and number of fans, vents, and/or ducts, and their placement in relation to components and airflow channels within the system determine airflow. Acoustic noise constraints may limit the size and types of fans, vents, and ducts that can be used in a particular design.

To develop a reliable, cost-effective thermal solution, all of the system variables must be considered. Use system-level thermal characteristics and simulations to account for individual component thermal requirements.

Table 2. Package Thermal Characteristics in a 60°C Environment[1]

Package	ΘCA (˚C /W)	ΨJT (˚C /W)
37.5 mm FCBGA	4.96	0.5

Table 3. Absolute Thermal Maximum Rating

Product	Est. TDP[2] (W)	Tcase Max-HS[3] (˚C)
800 MHz Processor	9.82	107.0

The thermal parameters defined above are based on simulated results of packages

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[1] Integrated Circuit Thermal Measurement Method-Electrical Test Method EIA/JESD51-1, Integrated Circuits Thermal Test Method Environmental Conditions - Natural Convection (Still Air), No heat sink attached, EIAJESD51-2.

[2] Power values shown in table are a combination of measurements and estimates based on silicon simulation. Maximum power, also known as Thermal Design Power (TDP), is a system design target associated with the maximum component operating temperature specifications. Maximum power values are determined based on typical DC electrical specifications and maximum ambient temperature for a worst-case realistic application running at maximum utilization.

[3] Tcase Max-hs is defined as the maximum case temperature with the Default Enhanced Thermal solution attached. This is not to exceed the maximum allowable case temperature.

assembled on standard multilayer 2s2p 1.0-oz Cu layer boards in a natural convection environment. The maximum case temperature is based on the maximum junction temperature and defined by the relationship, Tcase-max = Tjmax – (ΨJT x Power) where ΨJT is the junction-to-package top thermal characterization parameter. If the case temperature exceeds the specified Tcase max, thermal enhancements such as heat sinks or forced air will be required. ΘJA is the package junction-to-air thermal resistance.

4 Thermal Attributes

4.1 Designing for Thermal Performance

Appendix B: documents the PCB and system design recommendations required to achieve the Intel® Media Processor CE 3100 thermal performance documented in this application note.

4.2 Typical System Definition

A system with the following attributes is used to generate thermal characteristics data:

- The heat sink case assumes the default enhanced thermal solution (see Section 5.2 "Extruded Heat Sinks").
- The evaluation board is a four-layer 4 x 4 inch PCB.

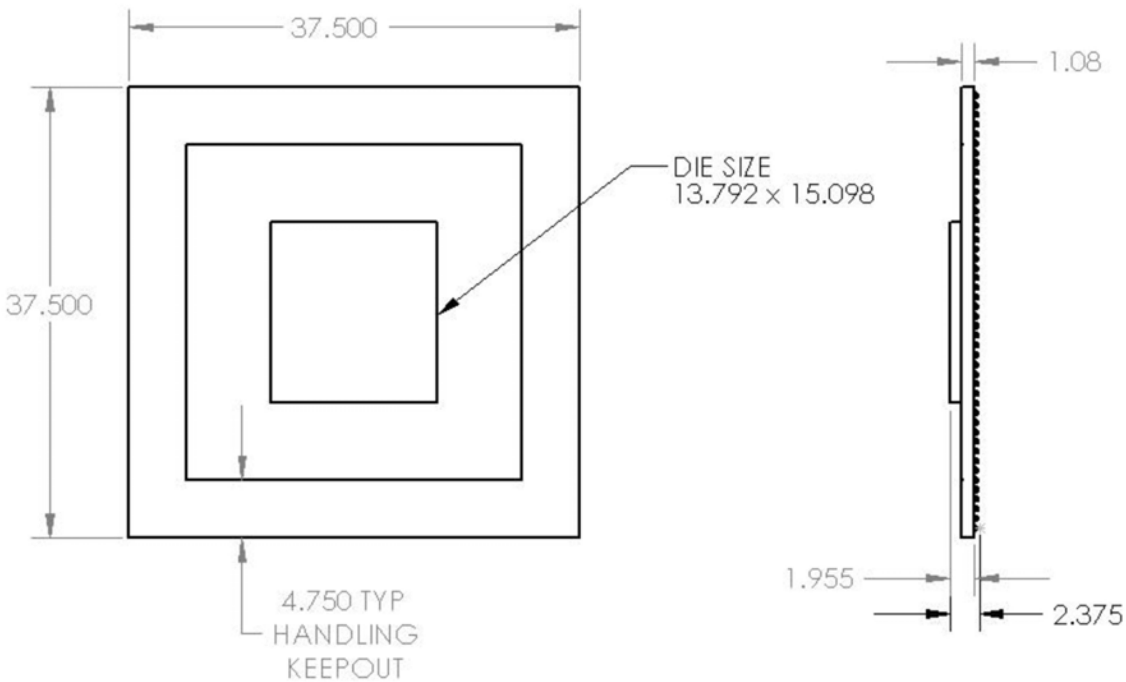
Note: Keep the following in mind when reviewing the following data:

- All data is preliminary and has not been validated against physical samples.
- Your system design may be significantly different.
- A smaller board with less than six copper layers will potentially affect the Intel® Media Processor CE 3100 product thermal performance. It is requested that the designer is recommended to do complete thermal analysis based on the physical system.

4.3 Thermal Attributes

4.3.1 Package Mechanical Attributes

Figure 1. 37 mm 1434 FCBGA Mechanical Drawing (Top View/Side)



The Intel® Media Processor CE 3100 is packaged in a 37.5 mm 1434 FCBGA. The mechanical drawing is shown in Figure 1.

4.3.2 Package Thermal Characteristics

Table 4 aids in determining the optimum airflow and heat sink combination for the Intel® Media Processor CE 3100. Table 4 shows the required local ambient temperature versus airflow for a typical Intel® Media Processor CE 3100 system (see Section 4.1 "Designing for Thermal Performance"). Typical System Definition

Table 4 shows Tcase as a function of airflow and ambient temperature at the Thermal Design Power (TDP) for a typical Intel® Media Processor CE 3100 system. Again, your system design may vary considerably from the typical system board environment used to generate Table 4.

A Flotherm* thermal model is available upon request. Contact your local Intel sales representative if you would like to receive an Intel® Media Processor CE 3100 thermal model. The default heat sink is described in Section 5.2. Table 4 shows the default TDP heat sink airflow vs Tcase. The shaded values indicate Tcase temperatures that exceed the Intel Tcase specification of 107˚C. Areas with no shading indicate the default heat sink is sufficient to meet the $T_{case-max}$.

Table 4. Expected Tcase (°C) with the default heat sink attached at 9.82W TDP

Tcase_center	Air Flow (LFM)				
Amb Temp (°C)	0	100	200	300	400
85	128	110	105	104	102
75	120	100	97	95	94
70	113	95	90	88	87
65	107	90	85	83	82
60	101	86	80	78	77
55	94	81	76	73	72
45	90	71	65	63	62
35	75	61	55	53	52
0	39	26	21	19	18

Example 1: If a system is designed for 0 LFM (natural circulation, no fan); and T_{amb} is less than or equal to 65°C, the default heat sink described in this design guide is sufficient enough to meet the $T_{case-max}$.

Example 2: If T_{amb} is 70°C, and system is designed for 0 LFM, the T the default will not be sufficient. The system and/or the heat sink will need to be redesigned to meet the $T_{case-max}$.specification.

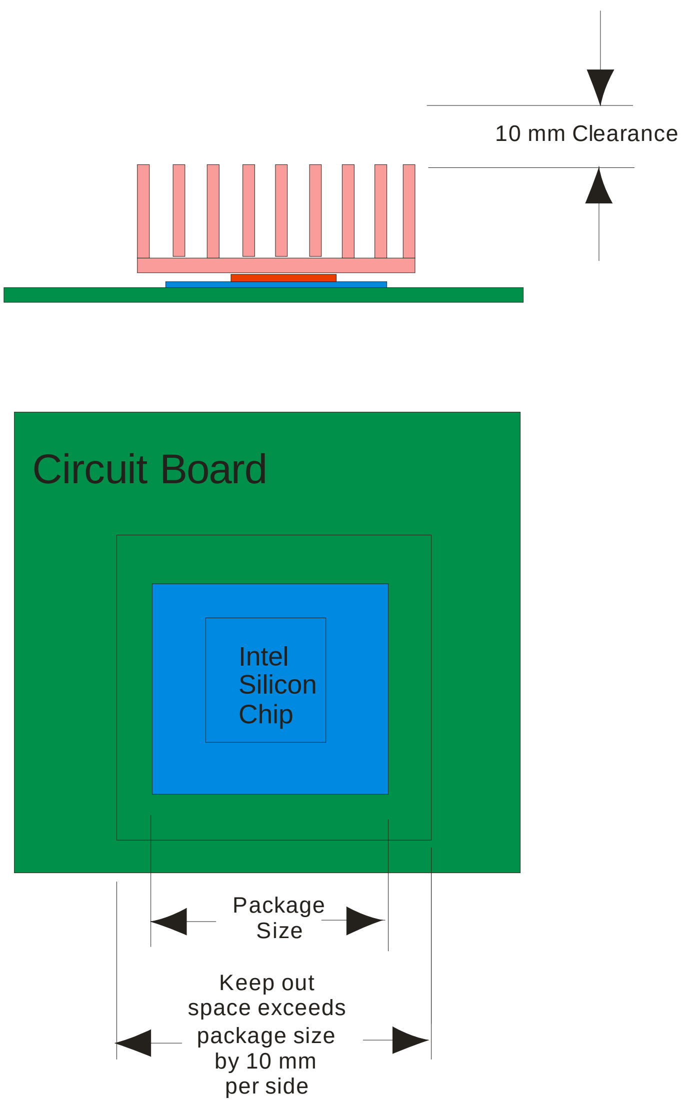
5 Thermal Enhancements

One method frequently used to improve thermal performance is to increase the component's surface area by attaching a metallic heat sink to the component top. Increasing the surface area of the heat sink reduces the thermal resistance from the heat sink to the air, increasing heat transfer.

5.1 Clearances

To be effective, a heat sink should have a pocket of air around it that is free of obstructions. Though each design may have unique mechanical restrictions, the recommended clearances for a heat sink used with the Intel® Media Processor CE 3100 are shown in Figure 2.

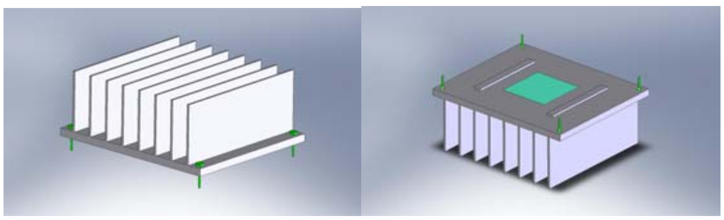
Figure 2. Heat Sink Volume Restrictions for the Default Heat Sink



5.2 Extruded Heat Sinks

The following extruded wave solder heat sink is the default (suggested) Intel® Media Processor CE 3100 thermal solution. CCI Technologies in Taiwan is a suggested vendor. Figure 3 shows the wave solder pins, which attach the default heat sink to the PCB. It also shows the pre attached phase change thermal interface material (TIM). Figure 4 shows the dimensions for the proposed heat sink. Other sources for thermal solutions are provided in Appendix Appendix A:.

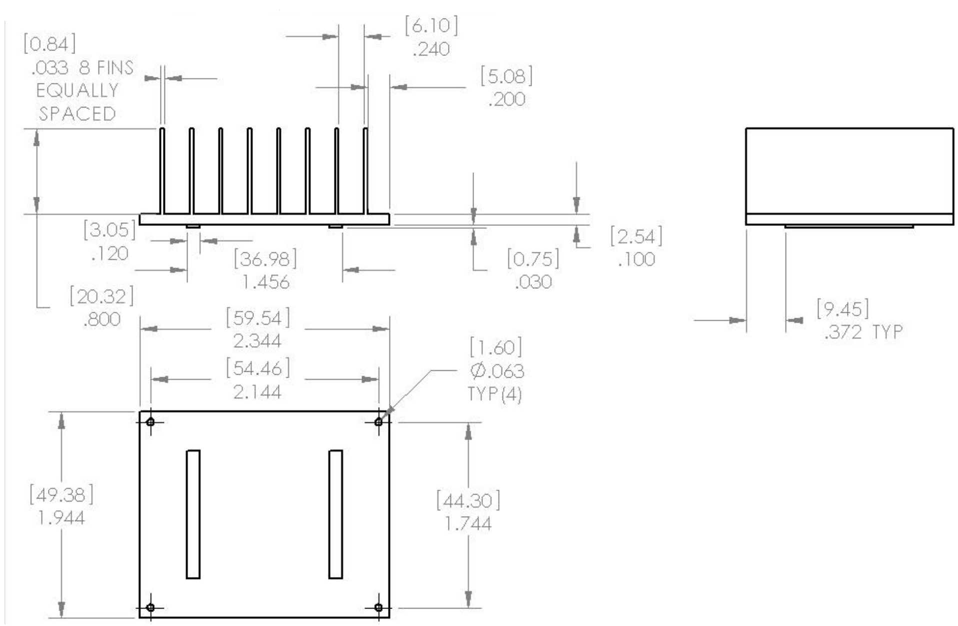
Figure 3. Intel® Media Processor CE 3100 Extruded Heat Sink



The standard mill finish wave solder heatsink is available for the 800 MHz package.

INTEL PART #	FINISH	PROCESSOR	VENDOR
E13671-002	MILL ALUMINUM	800 MHz	CCI

Figure 4. Dimensions of the Intel® Media Processor CE 3100 Heat Sink Solution



See drawings in Appendix Appendix C:.

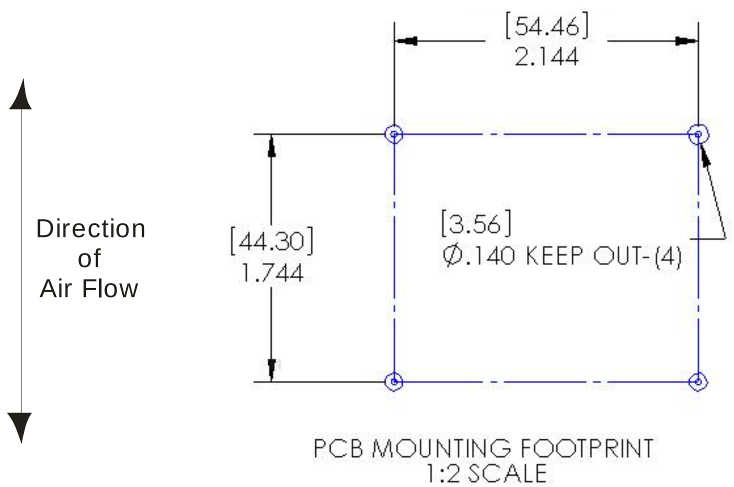
5.3 Attaching the Extruded Heat Sink

Several methods can be used to attach the heat sink to the PCB. This document will discuss two typical methods for high volume production.

5.3.1 Attaching the Default Wave Solder Heat Sink

The wave solder heat sink requires four PTH (plated through holes) in the PCB in the same locations as shown on the Plated Through Hole Drawing (Figure 5). The four heat sink attachment pins are inserted in the PTH holes and the board is then passed over the solder wave to attach the heat sink. Any heat sink attachment method must ensure complete surface contact between the top surface of the die and the bottom surface of the heat sink.

Figure 5. Plated Through Hole Drawing



Reference Board Holes for attaching
the default wave solder heatsink

5.3.2 Thermal Interface Material (PCM45HD)

The recommended thermal interface is PCM45HD from Honeywell. PCM45HD thermal interface pads are phase change materials suitable for high performance IC devices. These materials exhibit excellent wetting at interfaces during typical operating temperature range, resulting in very low surface contact resistance. In many cases, the thermal interface material (TIM) can be pre applied by the heat sink vendor, simplifying the manufacturing process.

Always follow the manufacturer's recommended attachment procedure for the recommended thermal interface. The steps below represent some of the typical steps to attach the phase change TIM.

1. Ensure that the component surface and heat sink are free from contamination. Using proper safety precautions clean the package top with a lint-free wipe and Isopropyl Alcohol.
2. Remove the PCM45HD liner and carefully position the TIM on the center of the heat sink.
3. Prior to assembly of the heat sink onto the heat dissipating component, it is recommended that the heat sink with the TIM is placed at room temperature between 21°-25°C (70°-77°F) for approximately 2 hrs.
4. Remove the taped liner and verify that the TIM is secured uniformly to heat sink.
5. Assemble heat sink to the package.

Dents and minor scratches in the material will not affect performance since the material is designed to flow at typical operating temperatures. PCM45HD pads can be removed for rework using a single-edged razor and then cleaning the surface with isopropyl (IPA) solvent.

Note: Each PCA, system and heat sink combination varies in attach strength. Carefully evaluate the reliability of tape/epoxy attaches prior to high-volume use (See Section 5.4 "Reliability").

Figure 6. PCM45 Phase Change Tape

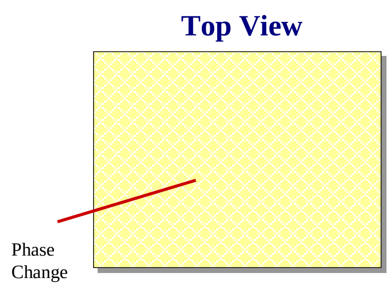
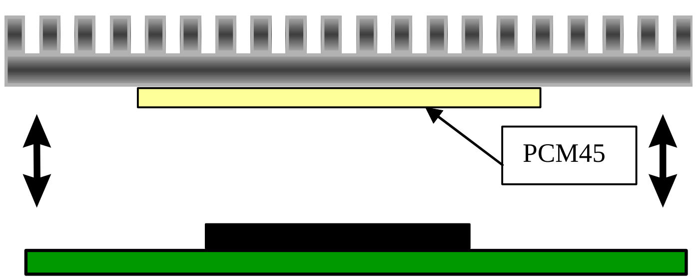


Figure 7. Completing the Attach Process



5.4 Reliability

Each PCA, system and heat sink combination varies in attach strength and long-term adhesive performance. Carefully evaluate the reliability of the completed assembly prior to high-volume use. Some reliability recommendations are shown in the following table.

Table 5. Typical Reliability Validation

Test[4]	Requirement	Pass/Fail Criteria[5]
Mechanical Shock	50G trapezoidal, board level 11 ms, 3 shocks/axis	Visual & Electrical Check
Random Vibration	7.3G, board level 45 minutes/axis, 50 to 2000 Hz	Visual & Electrical Check
High-Temperature Life	85 °C 2000 hours total Checkpoints occur at 168, 500, 1000, and 2000 hours	Visual & Mechanical Check
Thermal Cycling	Per-Target Environment (for example: -40 °C to +85 °C) 500 Cycles	Visual & Mechanical Check
Humidity	85% relative humidity 85 °C, 1000 hours	Visual & Mechanical Check

5.5 Thermal Performance

5.5.1 Thermal Interface Management for Heat Sink Solutions

To optimize the Intel® Media Processor CE 3100 heat sink design, it is important to understand the interface between the top surface of the silicon and the heat sink base. Specifically, thermal conductivity effectiveness depends on the following:

- Bond line thickness
- Interface material area
- Interface material thermal conductivity

5.5.2 Bond Line Management

The gap between the top of the silicon and the heat sink base impacts heat sink solution performance. The larger the gap between the two surfaces, the greater the thermal resistance. The thickness of the gap is determined by the flatness of both the heat sink base and the silicon, plus the thickness of the thermal interface material (for example, PSA,

[4] Perform the above tests on a sample size of at least 12 assemblies from 3 lots of material (total = 36 assemblies).

[5] Additional Pass/Fail Criteria can be added at your discretion.

thermal grease, epoxy) used to join the two surfaces.

The planarity of the Intel® Media Processor CE 3100 package is 8 mils, maximum.

5.5.3 Interface Material Performance

The following two factors affect the performance of the interface material between the heat spreader and the heat sink base:

- Thermal resistance of the material
- Wetting/filling characteristics of the material

5.5.3.1 Thermal Resistance of the Material

Thermal resistance describes the ability of the thermal interface material to transfer heat from one surface to another. The higher the thermal resistance, the less efficient the heat transfer. The thermal resistance of the interface material has a significant impact on the thermal performance of the overall thermal solution. The higher the thermal resistance, the larger the temperature drop is required across the interface.

5.5.3.2 Wetting/Filling Characteristics of the Material

The wetting/filling characteristic of the thermal interface material is its ability to fill the gap between the heat spreader top surface and the heat sink. Since air is an extremely poor thermal conductor, the more completely the interface material fills the gaps, the lower the temperature-drop across the interface, increasing the efficiency of the thermal solution.

6 Measurements for Thermal Specifications

Determining the thermal properties of the system requires careful case temperature measurements. Guidelines for measuring the Intel® Media Processor CE 3100 case temperature are provided in Section 6.2.

6.1 Background

Intel has previously published 0-degree metrology guidelines to install thermocouples on the top surface of packages with an Integrated Heat Spreader (IHS), which do not have a heat sink installed on the package. There is also a 90-degree metrology guideline published to install thermocouples in heat sinks. Both of these techniques use thermal epoxy to fasten the thermocouple to the IHS or heat sink and require an oven to cure the epoxy. The Consumer Electronics Group (CEG) has developed an alternate 0-degree method, which can be used for either BGA packages with an IHS or FCBGA packages. This method is easy to implement, does not require an oven, and uses commonly available thermal grease with a high thermal conductivity.

CEG uses FCBGA (flip chip ball grid array) packages on virtually all of their platforms with heat sinks installed. This section describes the metrology to install thermocouples on those devices. In addition, the metrology described can be used to attach thermocouples to IHS packages, which have a heat sink installed. CEG recommends this thermocouple metrology to promote consistency in thermal testing of Set Top Box packages.

6.2 Case Temperature Measurements

Maintain the Intel® Media Processor CE 3100 Tcase at or below the maximum case temperatures listed in Table 3 to ensure functionality and reliability. Special care is required when measuring the case temperature to ensure an accurate temperature measurement. Use the following guidelines when making case measurements:

- Calibrate the thermocouples used to measure Tcase before making temperature measurements.
- Use 36-gauge (maximum) K-type thermocouples.
- Measure the surface temperature of the case in the geometric center of the case top.

Care must be taken to avoid introducing errors into the measurements when measuring a surface temperature that is a different temperature from the surrounding local ambient air. Measurement errors may be due to a poor thermal contact between the thermocouple junction and the surface of the package, heat loss by radiation, convection, conduction through thermocouple leads, and/or contact between the thermocouple cement and the heat-sink base (if used).

6.3 Thermocouple Installation

If a heat sink is installed on the top of the package, the thermocouple clearance groove for the thermocouple wire must be machined into the bottom of the heat sink, not cut in the top of the heat sink. The typical size of the machined groove in the heat sink is .032 x .032 in (.81 x .81 mm) deep. Case temperature is always measured on the top surface of the silicon die or heat sink and in the approximate center of the die.

6.3.1 Parts/Materials Required

- Fine point tweezers
- Exacto* Knife
- Thermocouples Omega part #5TC-K-TT-36-36
- 3M* Kapton* tape cut into strips (1/8” X ½”)
- Silicone O-Ring Cord Stock 1/16" Fractional Width, McMaster Carr part # 96505K21 or equivalent
- Heat sink – based on Platform requirements

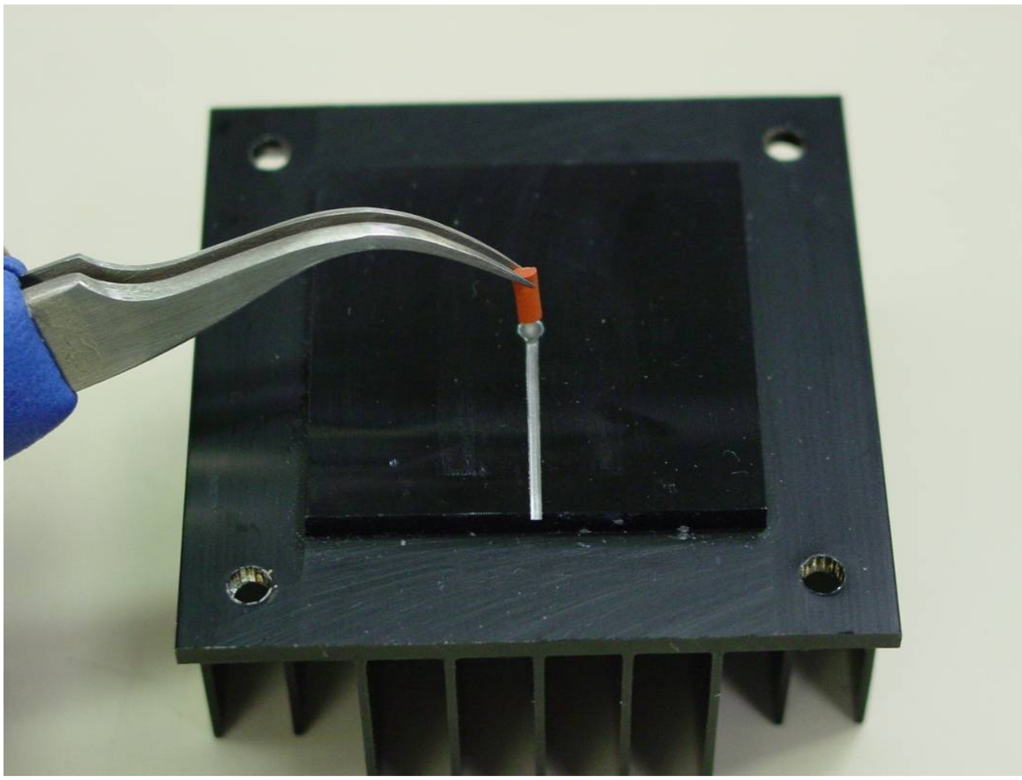
6.3.2 Heat Sink Preparation

1. Obtain the appropriate heat sink.
2. Assuming the heat sink is centered over the die, mill a 0.070 in diameter hole in the center or location coinciding with the center of the die, of the heat sink. The depth of the hole depends on heat sink base thickness. See Figure 8 for example only.
3. Machine a 0.03 in wide and 0.03 in deep groove in the heat sink from the edge of the heat sink to the hole. See Figure 8.

Figure 8. Machining for the Thermocouple

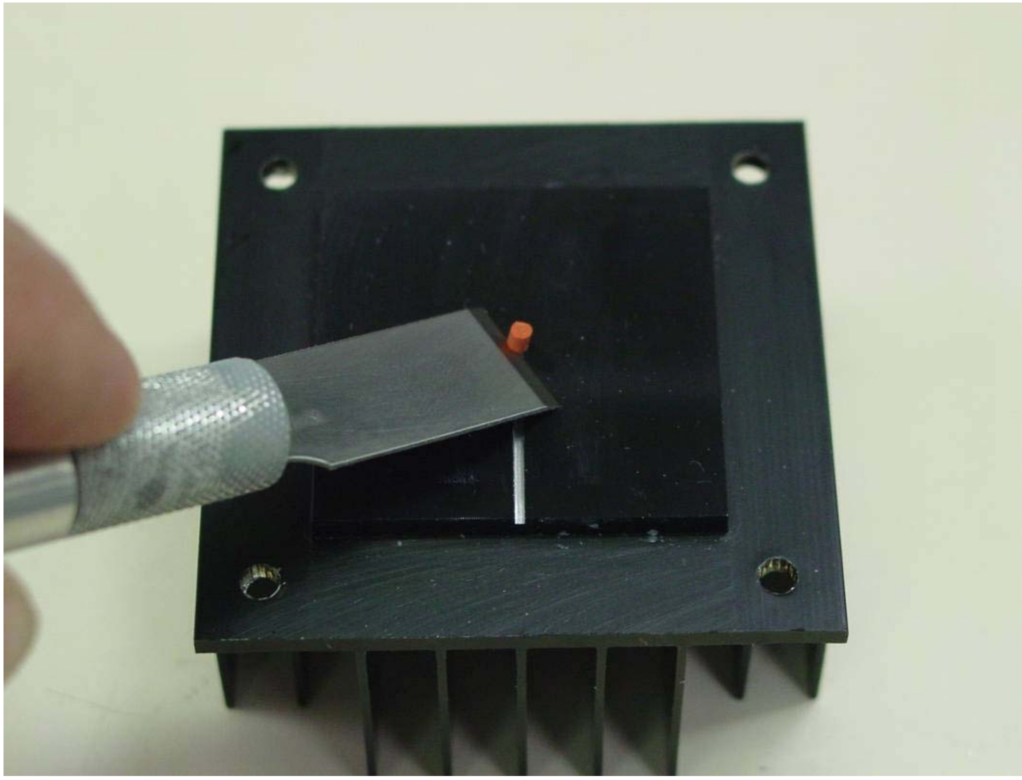
4. Cut a ¼ in long piece of the silicone O-ring cord using the Exacto knife to make sure the cut is clean and perpendicular.
5. Using tweezers press the ¼ in long O-ring cord into the 0.07 in diameter hole making sure the O-ring cord is inserted firmly against the bottom of the hole. See Figure 9.

Figure 9. Inserting the O-ring Cord



6. Use the Exacto knife to cut the remaining O-ring cord flush with the heat sink surface (be careful that you don't scratch the heat sink).

Figure 10. Cutting the O-ring Cord



6.3.3 Thermocouple Preparation

1. With the thermocouple in hand, find the beaded end and straighten the wire by hand so that the first 4-6 inches are reasonably straight. Use the fine point tweezers to make sure that the bead and the two wires coming out are straight and untwisted. Make sure that the second layer of insulation, sometimes clear, is not covering the bead.
2. Use the tweezers to grab slightly below the thermocouple bead while using the razor blade to make a sharp bend at approximately 70-80 degrees in the thermocouple wire. (Be careful to not cut or damage the thermocouple wire.) See Figures Figure 11, Figure 12, and Figure 13.

Figure 11. Thermocouple Preparation (1 of 3)

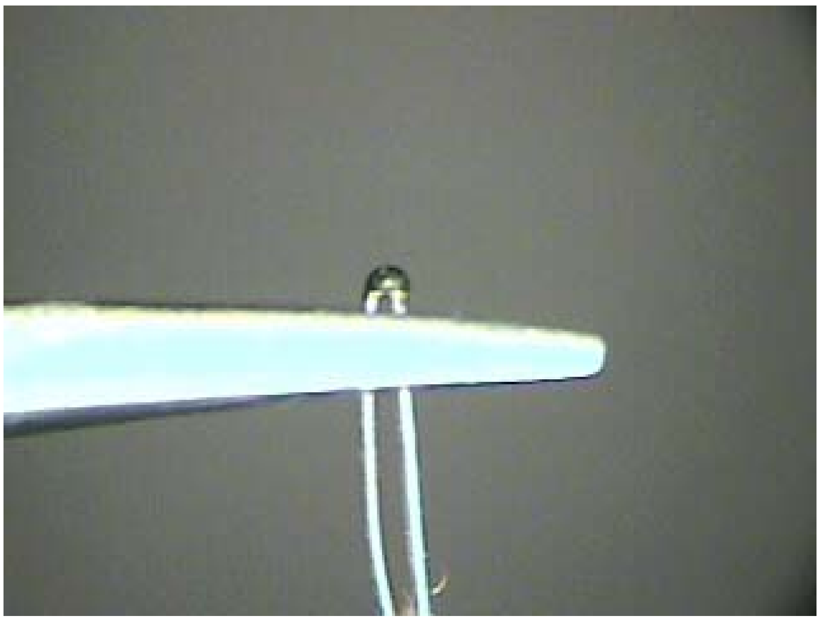


Figure 12. Thermocouple Preparation (2 of 3)

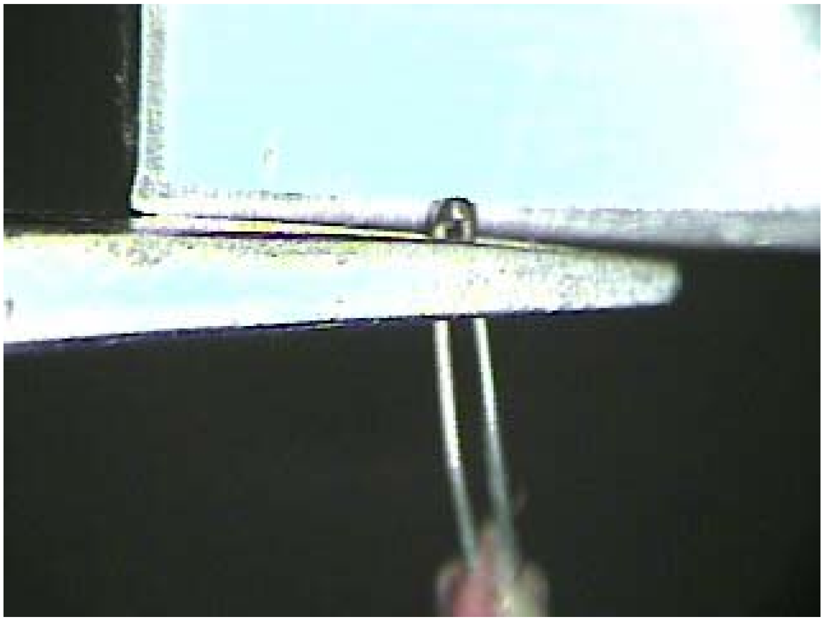
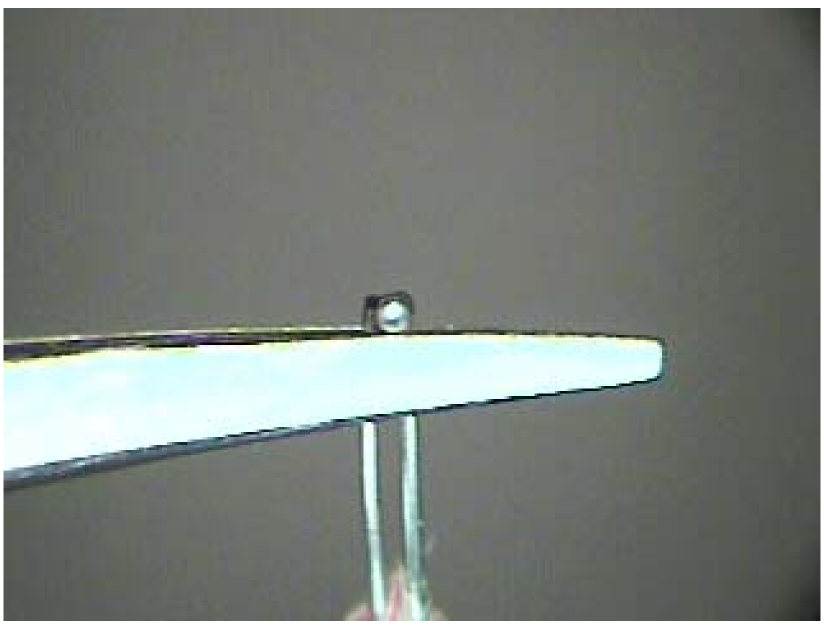


Figure 13. Thermocouple Preparation (3 of 3)



3. Look at the side view of the thermocouple and make sure the bend is as close to the thermocouple bead as possible. See Figure 14.

Figure 14. Thermocouple Side View

4. Place the thermocouple in the HS grove centering the bead over the silicone insert, hold the thermocouple with one hand and use tweezers to apply a piece of Kapton tape across the wire as close to the thermocouple tip as possible, but outside the surface that will be mating with the die surface. Press and rub the tape for a secure bond. Use multiple pieces of tape if necessary to keep the thermocouple from moving. See Figure 15 and Figure 16.

Figure 15. Installing the Kapton Tape (1 of 2)

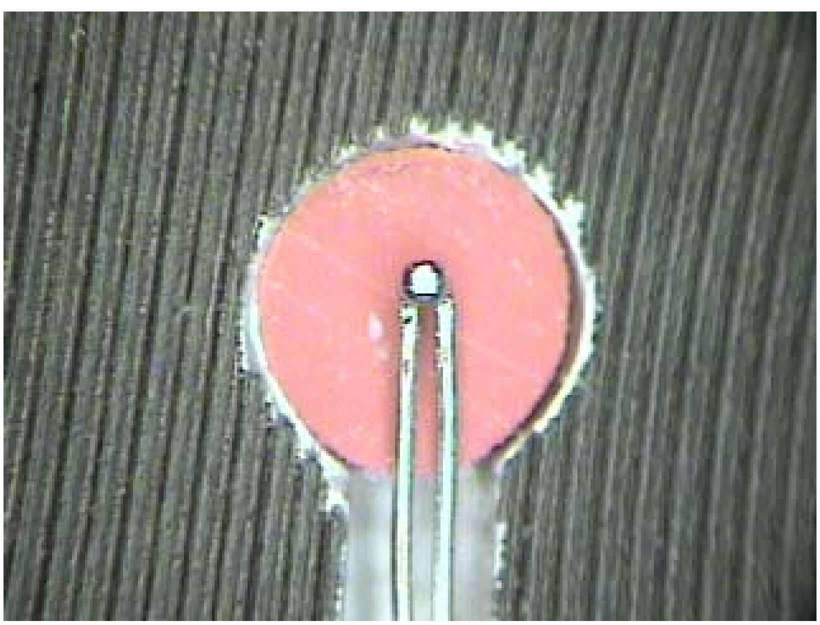
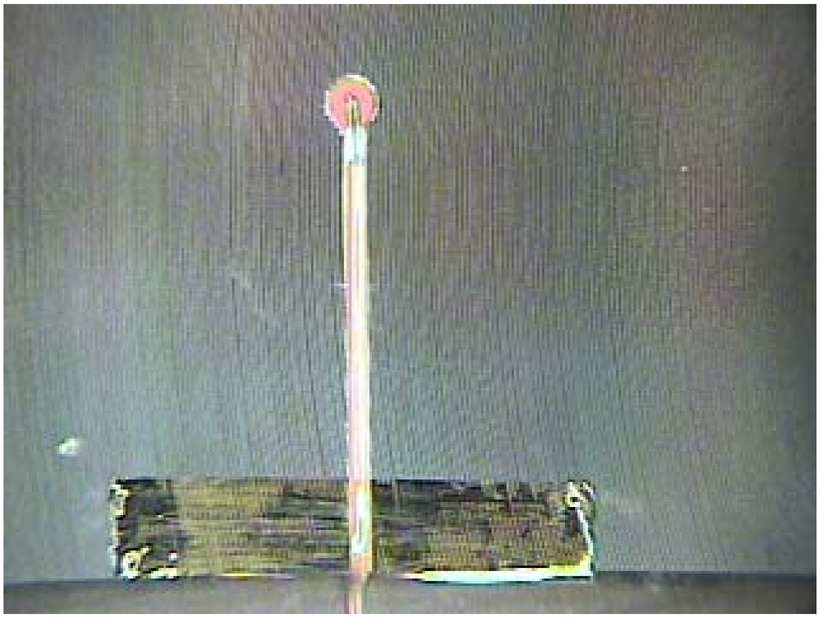


Figure 16. Installing the Kapton Tape (2 of 2)



6.3.4 Applying Thermal Grease or Thermal Interface Material of Choice to Unit or Die

Dispense a thin layer of TIM material on the top surface of the die (the amount varies depending on die size). Use an Exacto knife to spread an even layer of material completely over the surface of the die. (Be careful not to touch the die surface with the Exacto blade and potentially scratching or chipping the die.)

6.3.5 Attaching HS to the Board

1. Place the heat sink directly over the die such that the thermocouple bead is placed reasonably at the die center. Make sure not to slide the heat sink in either X or Y direction during assembly
2. Apply retention mechanism evenly over the surface of the heat sink. The objective is to have solid contact of the thermocouple bead with the top surface of the bare silicon.

6.4 Precautions

Use care in handling the system after the thermocouples are in place so they are not pulled loose. Check your temperature readings again before power-on to make sure all thermocouples are reading the correct room temperature. This metrology does not secure the thermocouple to the package as well as the epoxy method but it is an acceptable compromise if care is taken in handling the system until the test is completed. While not recommended, once testing is complete, the thermocouples can be removed before the thermal grease hardens, carefully cleaned, and reused to minimize the cost of testing. For thermocouple installation on packages without heat sinks, do not use this procedure. Refer to the previously published metrology, which uses thermal epoxy. Document # 251926-001 for 845PE/945GE Chipset contains a description of the metrology.

7 Conclusion

Increasingly complex systems require better power dissipation. Care must be taken to ensure that the additional power is properly dissipated. Heat can be dissipated using improved system cooling, selective use of ducting, passive, or active heat sinks, or any combination.

The simplest and most cost effective method is to improve the inherent system cooling characteristics through careful design and placement of fans, vents, and ducts. When additional cooling is required, thermal enhancements may be implemented in conjunction with enhanced system cooling. The size of the fan or heat sink can be varied to balance size and space constraints with acoustic noise.

This document has presented the conditions and requirements to properly design a cooling solution for Intel® Media Processor CE 3100-based systems. Properly designed solutions provide adequate cooling to maintain the Intel® Media Processor CE 3100 case temperature at or below those listed in Table 3. Ideally, this is accomplished by providing a low local ambient temperature and creating a minimal thermal resistance to that local ambient temperature. Alternatively, heat sinks may be required if case temperatures exceed those listed in Table 3.

By maintaining the Intel® Media Processor CE 3100 case temperature at or below those recommended in this document, the Intel® Media Processor CE 3100 will function properly and reliably.

Use this document to understand the Intel® Media Processor CE 3100 thermal characteristics and compare them to your system environment. Measure the Intel® Media Processor CE 3100 case temperatures to determine the best thermal solution for your design.

Appendix A: Heat Sink and Attach Suppliers

Table 6. Default Heat Sink and TIM Suppliers

Part	Part Number	Supplier	Contact
Extruded Al wave solder heat sink	Axxxxx unassigned	CCI Thermal Technologies	(714) 739-5797
PCM45XX		Honeywell	

See the following web site for information on the Honeywell PCM45HD Phase Change Thermal Interface:
http://www.electronicmaterials.com/products_services/packaging/pcm45_phas_chg_therm_int_mat.pdf

A.1 Heat Sink Attach Suppliers

CCI – Chaun Choung Technology Corp.
US: 2204 Forbes Drive, Suite 104
Austin, TX 78754
e-mail: eunice_chen@ccic.com.tw

APAC: F12, No. 123-1, Hsing-De Road
Sanchung City, Taipei, Taiwan
Tel: 886-2-29952666~8
e-mail: monica_chih@ccic.com.tw
Web: www.ccic.com.tw

Cooler Master Co., Ltd.
9F, No. 786, Chung Cheng Road,
Chung Ho city, Taipei, Taiwan, R.O.C.
Tel: +886-(0)2-32340050
Fax: +886-(0)2-32340051
e-mail: sales@coolermaster.com.tw
Web: www.coolermaster.com

Dynatron Corp.
41458 Christy Street
Fremont, CA 94538, USA
Tel: 510-498-8888
Fax: 510-498-8488
e-mail: info@dynatron-corp.com
Web: www.dynatron-corp.com

Vette Corporation
2 Wall Street, 4th Floor
Manchester, NH 03101 USA
Tel: 603-792-3460
Fax: 603-792-3461
e-mail: sales@vettecorp.com
Web: www.vettecorp.com

A.2 Thermal Interface Material Suppliers

Berquist Company
18930 W. 78th Street
Chanhassen, MN 55317 USA
Tel: 800-347-4572
Web: www.berquistcompany.com

Chomerics
77 Dragon Court
Woburn, MA 01888 USA
Tel: 781-935-4850
E-mail: chomailbox@parker.com
Web: www.chomerics.com

Honeywell International Inc.
101 Columbia Road
Morristown, NJ 07962 USA
Tel: 973-455-2000
Web: www.honeywell.com

Power Devices Inc.
26941 Cabot Road, Bldg 124
Laguna Hills, CA 92653 USA
Tel: 949-582-6712
e-mail: power.devices@loctite.com
Web: www.powerdevices.com

Shin-Etsu Micro Si. Inc.
10028 S. 51st St.
Phoenix, AZ 85044
(480) 893-8898
Web: www.microsi.com

Thermagon, Inc.
4707 Detroit Avenue
Cleveland, OH 44102 USA
Tel: 216-939-2300
e-mail: info@thermagon.com
Web: www.thermagon.com

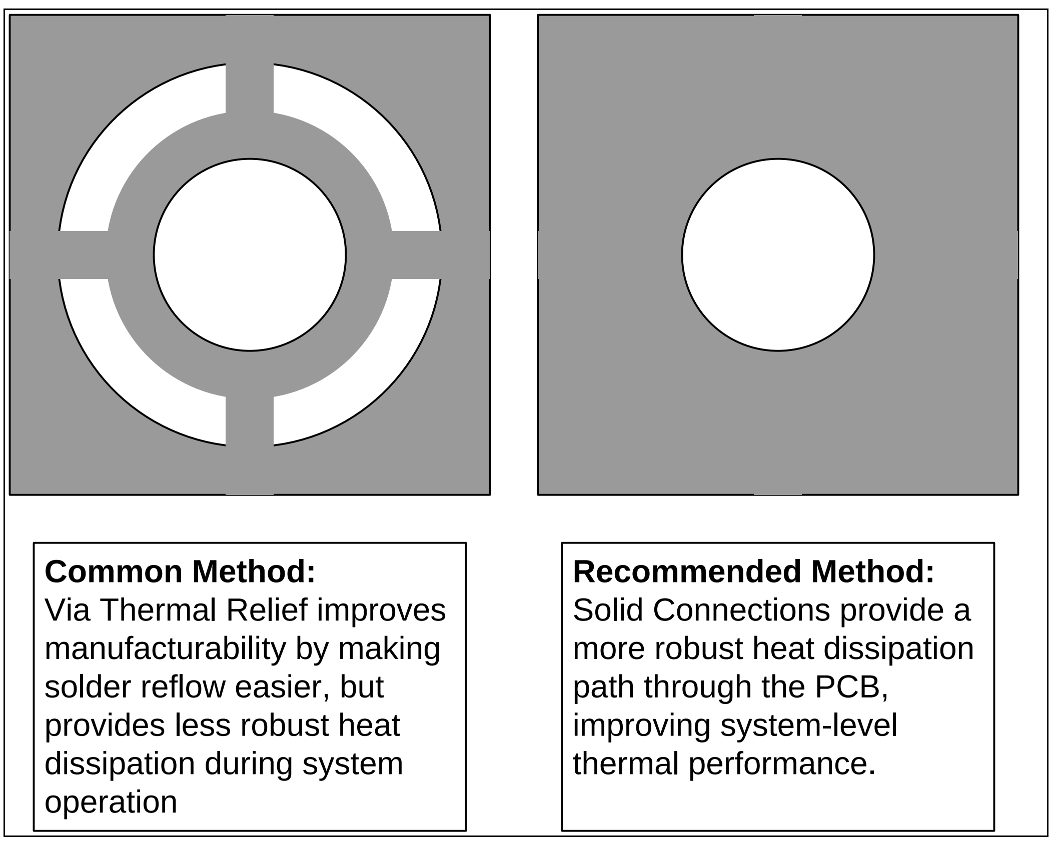
Appendix B: PCB Guidelines

The following general PCB design guidelines are recommended to maximize the thermal performance of FCBGA packages:

- When connecting ground (thermal) vias–to the ground planes, do not use thermal-relief patterns. Thermal-relief patterns are designed to limit heat transfer between the vias and the copper planes, thus constricting the heat flow path from the component to the ground planes in the PCB. See Figure 17.
- As board temperature also has an effect on the thermal performance of the package, avoid placing the Intel® Media Processor CE 3100 adjacent to high power dissipation devices.
- If airflow exists, locate the components in the mainstream of the airflow path for maximum thermal performance. Avoid placing the components downstream, behind larger devices or devices with heat sinks that obstruct the airflow or supply excessively heated air.

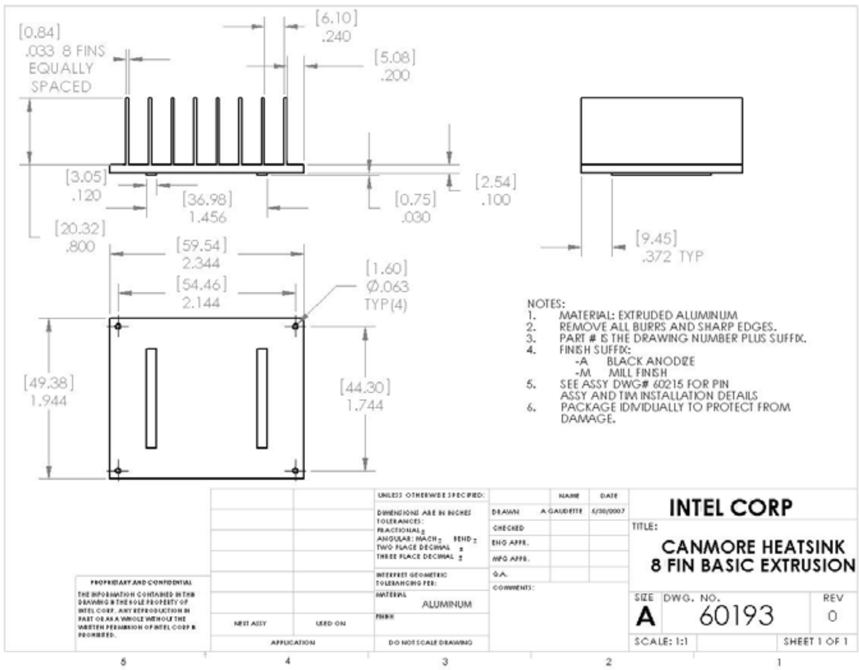
Note: The above guidelines are not all-inclusive and are defined to give you known, good design practices to maximize the thermal performance of the components.

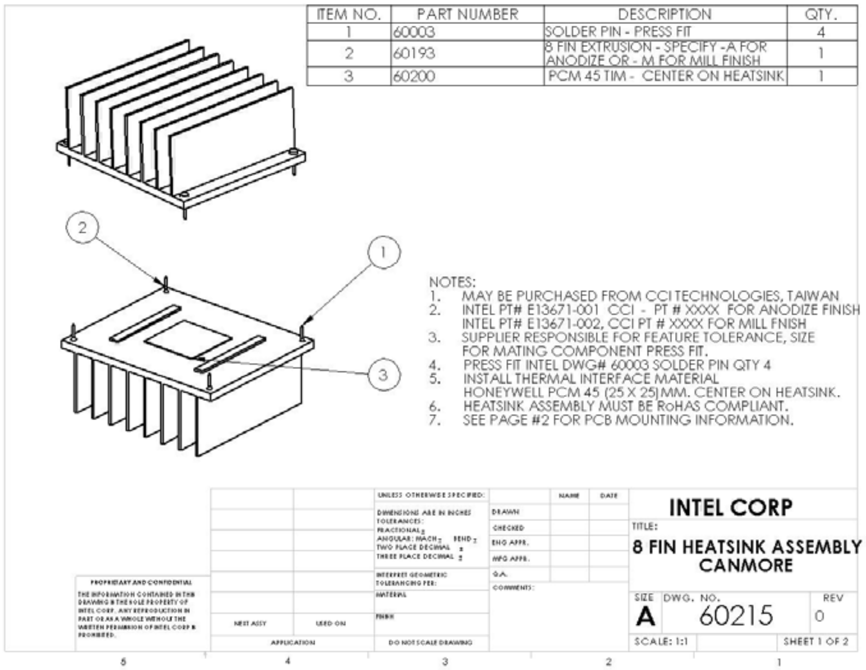
Figure 17. Top View of the Vias with Thermal Relief and Solid Connections

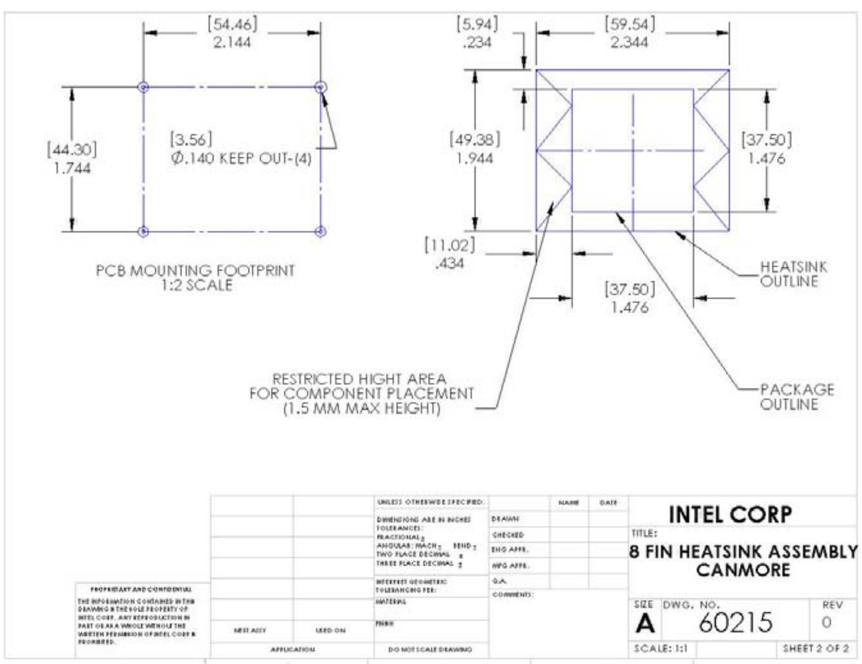


Appendix C: Heat Sink Drawings

Heat sink assembly drawings are provided in the following pages.




ITEM NO. | PART NUMBER | DESCRIPTION | QTY.
1 | 60003 | SOLDER PIN - PRESS FIT | 4
2 | 60193 | 8 FIN EXTRUSION - SPECIFY -A FOR ANODIZE OR - M FOR MILL FINISH | 1
3 | 60200 | PCM 45 TIM - CENTER ON HEATSINK | 1
NOTES:
1. MAY BE PURCHASED FROM CCI TECHNOLOGIES, TAIWAN
2. INTEL PT# E13671-001 CCI - PT # XXXX FOR ANODIZE FINISH
INTEL PT# E13671-002, CCI PT # XXXX FOR MILL FNISH
3. SUPPLIER RESPONSIBLE FOR FEATURE TOLERANCE, SIZE FOR MATING COMPONENT PRESS FIT.
4. PRESS FIT INTEL DWG# 60003 SOLDER PIN QTY 4
5. INSTALL THERMAL INTERFACE MATERIAL HONEYWELL PCM 45 (25 X 25)MM. CENTER ON HEATSINK.
6. HEATSINK ASSEMBLY MUST BE RoHAS COMPLIANT.
7. SEE PAGE #2 FOR PCB MOUNTING INFORMATION.
INTEL CORP
TITLE:
8 FIN HEATSINK ASSEMBLY
CANMORE
SIZE A
DWG. NO. 60215
REV 0
SCALE: 1:1
SHEET 1 OF 2


[54.46]
2.144
[44.30]
1.744
[3.56]
Ø.140 KEEP OUT-(4)
PCB MOUNTING FOOTPRINT
1:2 SCALE
[5.94]
.234
[59.54]
2.344
[49.38]
1.944
[37.50]
1.476
[11.02]
.434
HEATSINK OUTLINE
RESTRICTED HIGHT AREA
FOR COMPONENT PLACEMENT
(1.5 MM MAX HEIGHT)
PACKAGE OUTLINE
INTEL CORP
TITLE:
8 FIN HEATSINK ASSEMBLY
CANMORE
SIZE A
DWG. NO. 60215
REV 0
SCALE: 1:1
SHEET 2 OF 2