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# **Report on the Thermal Testing of the**

**RM Education\***  
**RM Tower 330\***

**Lab. Ref: Resea4977**

**Thermal Specification**

**(as per Intel Thermal Specifications)**



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## 1. INTRODUCTION

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### 1.1. Introduction

This document details the thermal test of the **RM Education RM Tower 330, Lab. Ref: Resea4977** to Intel Specifications.

The testing was carried out by INTEL CORPORATION (UK) LTD at their Engineering test facilities located at

Intel Corporation (UK) Ltd  
Pipers Way  
Swindon  
Wiltshire  
England  
SN3 1RJ

This report also details the configuration of the equipment under test, the test methods used and any relevant modifications where appropriate.

### 1.2. Documentation Review & Approval

**Date of Test Completion:** 1 October 2013

**Date of Report:** 3 October 2013

**Test Engineer**

A handwritten signature in black ink, appearing to read "Colin Lee". The signature is written in a cursive, flowing style.

Colin Lee



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## 2. Summary of Issues

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A summary of thermal related test issues is given below. A priority has been assigned to each problem to estimate the potential impact to users. Additionally, there may be some issues that are identified in this report as “FYI” (For Your Information) that may be of interest, but are not considered of high enough priority to be listed in the summary.

### 2.1. Test Result

The system **PASSES** tests to Intel Thermal Specifications in the supplied configuration using the **Intel® Core™ i7-4770 (8M Cache, up to 3.90 GHz)**.

### 2.2. Priority 1 Critical

- [Issues that must be corrected]
  - None

### 2.3. Priority 2 Important

- [Issues that should be considered for improvement, but not critical to the system passing]
  - None

### 2.4. Priority 3 Future Impact

- [Issues that have little impact now. Some may have future impact]
  - None

### 2.5. FYI Items

- [For Your Information. Miscellaneous information that may be of interest]
  - None

### 3. System Configuration

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This section lists the original configuration of the equipment under test. If any changes are required for the system to pass thermal test specification, these will be stated in section 6.1, and only the system in this configuration is recognized as a qualifying result.

#### 3.1. Equipment Under Test (EUT)



Figure 3-1 RM Tower 330

#### 3.2. Thermal Solution



Figure 3-2 EKL Processor Fan Heatsink



### 3.3. EUT Configuration

Component	Qty	Manufacturer	Model	AA/Serial Number	Description	Location
System	1	RM*	PC 330 Tower	T093182301	µATX Mini Tower System	N/A
Chassis	1	Chenbro*	PC31176-H02*13246	Not Known	µATX Mini Tower Chassis	N/A
Power Supply	1	AcBel*	PCB029	PCB02913250000102A	iPower 85 400	Top rear of chassis
Motherboard	1	Fujitsu*	D3222-B1	42204493	ATX Q87 Extended Lifecycle Mainboard	N/A
Processor	1	Intel®	Intel® Core™ i7-4770 CPU (8M Cache, up to 3.90GHz)	CM8064601464303	CPU	LGA1150 socket
Integrated Graphics	1	Intel®	Intel® HD Graphics 4600	N/A	N/A	N/A
Processor Thermal Solution	1	EKL*	DFr922512CM-010	N/A	DC 12V fan and heatsink	LGA1150 socket
SSD	1	Samsung*	Samsung SSD 840	S14GNEACC31555L	2.5" 840, 250 GB SSD	Side mounted bay
HDD	1	Toshiba*	DT01ACA1	830H4JENS	3.5" DT01ACA, 1000 GB, 7200 RPM HDD	Lower 3.5" bay
Optical Drive	2	TSSTcorp*	CDDVDW SH-224DB	R93E6YCD4071MZ R93E6YCD4071MY	Super Filemaster	5.25" bays
Memory	4	Elixir*	M2X8G64CB8HC5 N-DG	7722123F D815123E C11C123E 8B11123D	DIMM, DDR3, 8192 MB, 1600 MHz	DIMM A3 DIMM A1 DIMM B4 DIMM B2
Card Reader	1	Not known	Not known	130201724	Generic card reader	Upper 3.5" Bay
Front-Panel Daughterboard	1	Not known	Not Known	Not known	Generic USB front panel with 2x USB2, 2x USB3, Audio in and Audio out	Front panel



3.4. Additional information for fans, ferrites, etc fitted in the chassis

Component	Qty	Manufacturer	Model	Serial Number	Position in chassis
Chassis Fan	1	Top Motor*	DF128025SL-3	30H08002520402966 D6N0359	Rear exhaust vent

3.5. Software

BIOS Version	Manufacturer	Date	Comments
V4.6.5.4 R1.10.0	FUJITSU // American Megatrends Inc.*	09/16/2013	

Operating System	Manufacturer	Service Pack	32/64 Bit	Comments
Windows 7 Professional	Microsoft*	SP1	64Bit	





## 4. Test Methodology

### 4.1. Thermal Test Equipment

Some or all of this equipment may have been used during thermal testing.

Supplier	Description	Model/Part Number
Thermotron*	Walk-In Thermal Chamber	WP-499-THCM-705
Thermotron	Thermal Chamber	S-8SLE
National Instruments*	Compact DAQ chassis	NI cDAQ-9172
National Instruments	Thermocouple input module	NI 9211
Cambridge Accusense*	Airflow Monitoring Equipment	ATM-24 CAFS-220-5M
Testo*	Digital Anemometer	0560.4900
Anville Instruments*	Data Acquisition Unit	X-435
Fluke*	Hydra Data Logger	2625A
Fluke	Thermocouple Calibrators	51/52 & 714 Series
FLIR Systems*	Infra-Red Camera	Thermacam* S40
Omega*	Hot-Point Cell	CL950-220

Table 4-1

### 4.2. Tolerance/Accuracy

All thermal test equipment is maintained annually by traceable calibration.  
The accuracy of type T thermocouples is: -270 to +400°C, greater of 0.5°C or 0.4%.

### 4.3. Test Method

Thermal testing will be performed in a thermal chamber with a controlled ambient temperature of 35°C. Temperature measurements are taken at 20 second intervals until thermal equilibrium (steady state) is reached. Steady state is reached when the difference between the current reading and the previous reading is less than 0.5%. Data will be collected for 5 minutes past the time determined to be steady state. The last data point is recorded in the test report with no averaging.

#### 4.4. Thermocouple Calibration Check

It is important to ensure that the thermocouples used for ambient and case temperature measurements are calibrated. A Hot-Point\* Calibration Cell is used to check the accuracy of thermocouples prior to any thermocouple being used for testing – each thermocouple is placed in the cell and then set to 0°C and 100°C. The thermocouple reading should be within +/-0.5°C of the set point.

#### 4.5. Thermocouple Placement

To record the processor ambient air temperature ( $T_a$ ) measurements, place 4 thermocouples equally spaced 2.54mm (0.1") above the fan hub vertically, halfway between the fan hub and housing horizontally (See Figure 4-1).

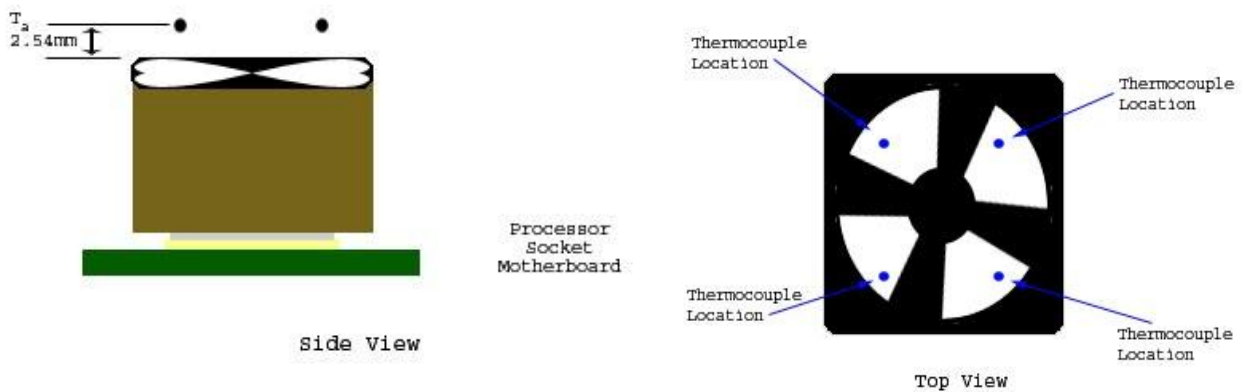


Figure 4-1 Thermocouple placement for determination of ambient temperature ( $T_a$ )

Additional thermocouples are placed to monitor PSU in/out and other system temperatures as required and will be detailed in section 5.

#### 4.6. Test Procedure

The BIOS of the system under test is reset to default settings where appropriate and all power saving features and system management functions are disabled. The system is then booted into the relevant Operating System and test software installed.

The application used for thermal testing is the Intel® Power Thermal Utility (PTU). This is activated to stress the processor to its Thermal Design Point and at no point during the test should the processor activate its thermal control circuit.

The thermocouple temperatures throughout the system are logged by the chamber control software over a period as stated in section 4.3.

CPU core temperatures are monitored using the TPU and maximum DTS value is recorded.



## 5. Thermal Test Results

All pass results are within the accuracy of the test equipment (see section 4.2).

### 5.1. Test Specifications & Limits

The information in this section is taken from the relevant processor Electrical, Mechanical & Thermal Specification document (EMTS).

#### 5.1.1. Intel® Core™ i7-4770 (8M Cache, up to 3.90 GHz) Thermal Specifications

Criteria	Specification	Note
Processor TCC Activation	100 °C	DTS temperature
Processor T <sub>A</sub>	40 °C	

### 5.2. Additional Monitor Points

Thermocouples were attached to the system to monitor memory ambient, SSD & HDD temperatures.

Location	Specification	Note
Memory	85 °C	Operating temp
Solid State Drive	70 °C	Operating temp
Hard disk	55 °C	Operating temp



## 6. Test Results

### 6.1. Test Equipment/Test Deviations

The thermal solution received with the system was found to be damaged, a replacement unit was fitted.

### 6.2. Thermal Stress Test Results

	Temp °C	Notes
CPU DTS <sub>MAX</sub>	89	
CPU T <sub>A</sub>	40.6	
PSU <sub>IN</sub>	41.9	
PSU <sub>OUT</sub>	42.6	
Memory (ambient)	48.8	
Memory (ambient)	48.0	
SSD (ambient)	43.2	
Hard disk (ambient)	43.0	

Table 6-1 Thermal Test Results – Intel PTU



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## 7. Conclusion

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The system **PASSES** tests to Intel Thermal Specifications in the supplied configuration using the **Intel® Core™ i7-4770 Processor**.



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## 8. References

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### 8.1. Thermal Support Documentation

Refer to the following documentation for more information.

Relevant Intel Processor Electrical, Mechanical & Thermal Specification (EMTS)
Relevant Intel Processor Thermal Design Guidelines.
ATX, $\mu$ ATX, BTX and $\mu$ BTX specifications [ <a href="http://www.formfactors.org">http://www.formfactors.org</a> ]

Table 8-1