

Temperature Measurement

Colibri T20

Issued by:	Toradex	Document Type:	Measurement Report
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Purpose:	Learn more about the temperatures on the Colibri T20/Iris combo under full load
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Version:	0.5
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Revision History		
Date	Version	Remarks
24-08-11	0.1	Preliminary draft
25-08-11	0.2	Correct RAM configuration
28-12-12	0.3	Add Heat Sink Measurements
22-2-13	0.4	Add Clip on Heat Sink and Thermo Conductive Foam Measurements
30-04-13	0.5	Correct Clip on Heat Sink spec, correct spelling misstakes

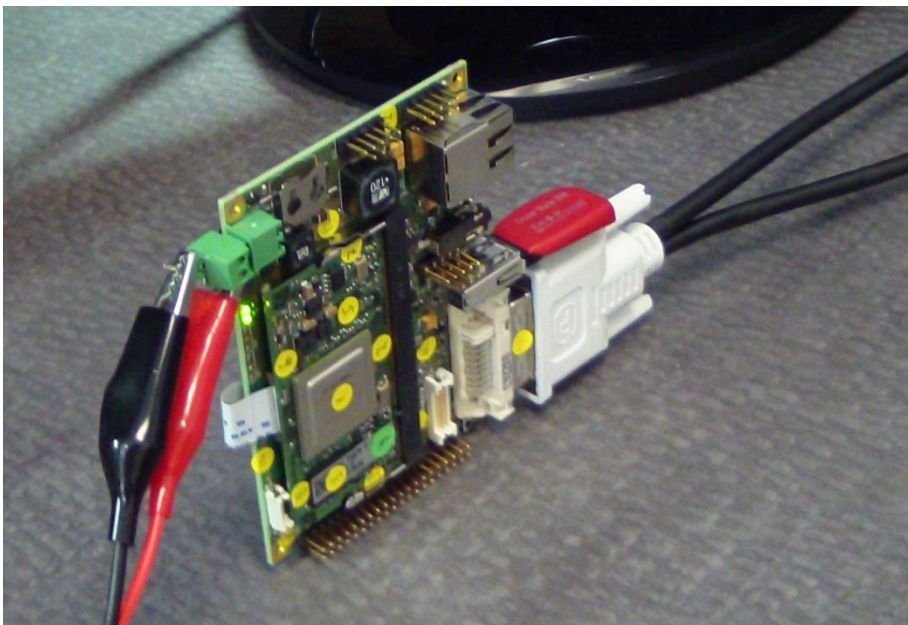
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1 Temperature Distribution with Iris Carrier board

1.1 Test Setup

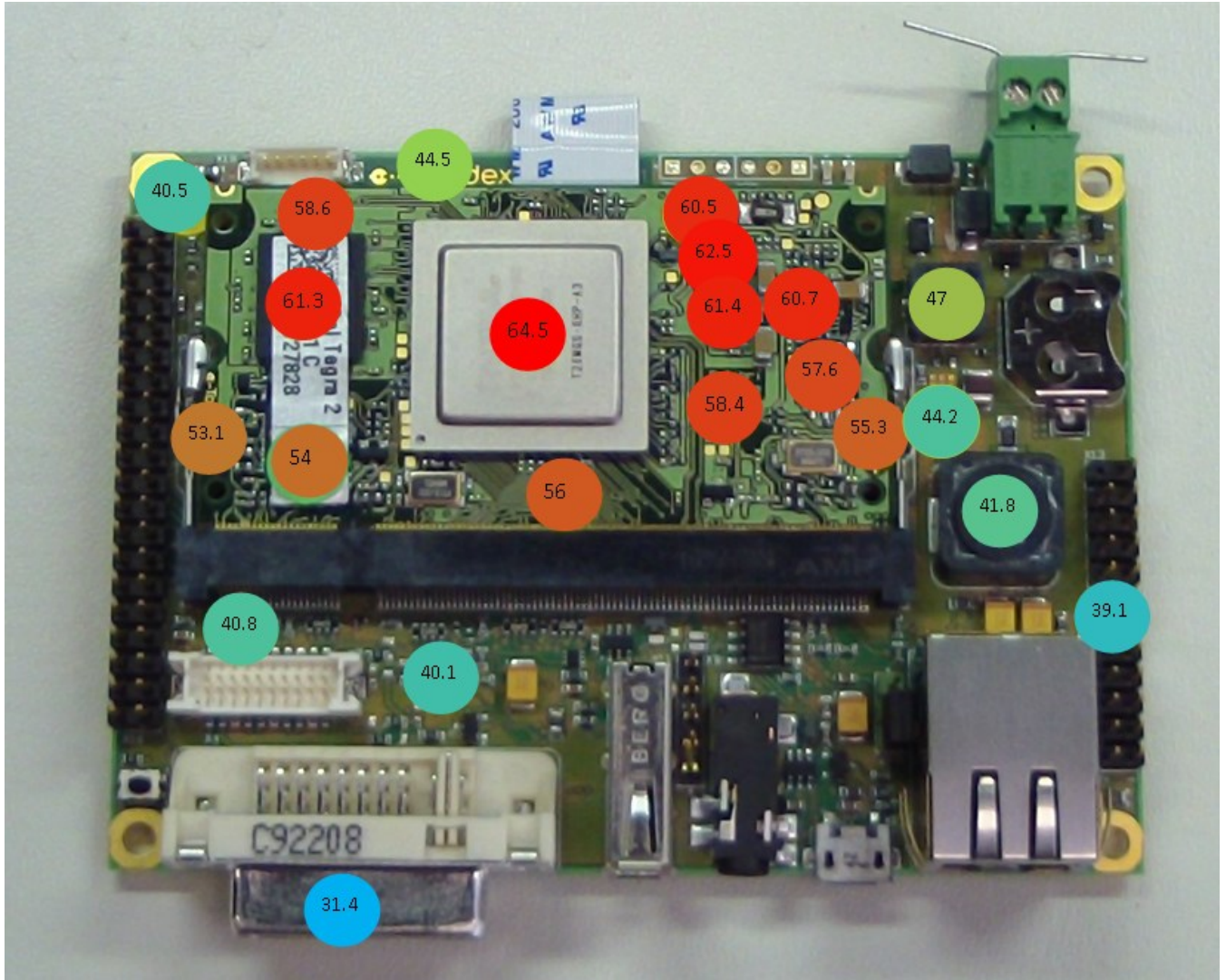
- Colibri T20 V1.1c 512MB RAM 1GB Flash (Test Version)
- Iris V1.1 A
- Windows Compact 7 version 0.1beta5
- Dynamically Voltage/Frequency switching deactivated, fix at 1GHz.
- Both CPU cores 100% load (Noldle Program)
- Playing 1080p movie from a direct connected USB Stick. (No Hub)
- Dual Screen setup 2x1080p connected via splitter cable on the DVI-I connector
- Iris Board vertical
- No forced air circulation
- System was running for about 1 hour with constant power consumption
- Measurement Device ThermoWorks Close Focus IR (Target Diameter 0.1")

1.2 Test Results

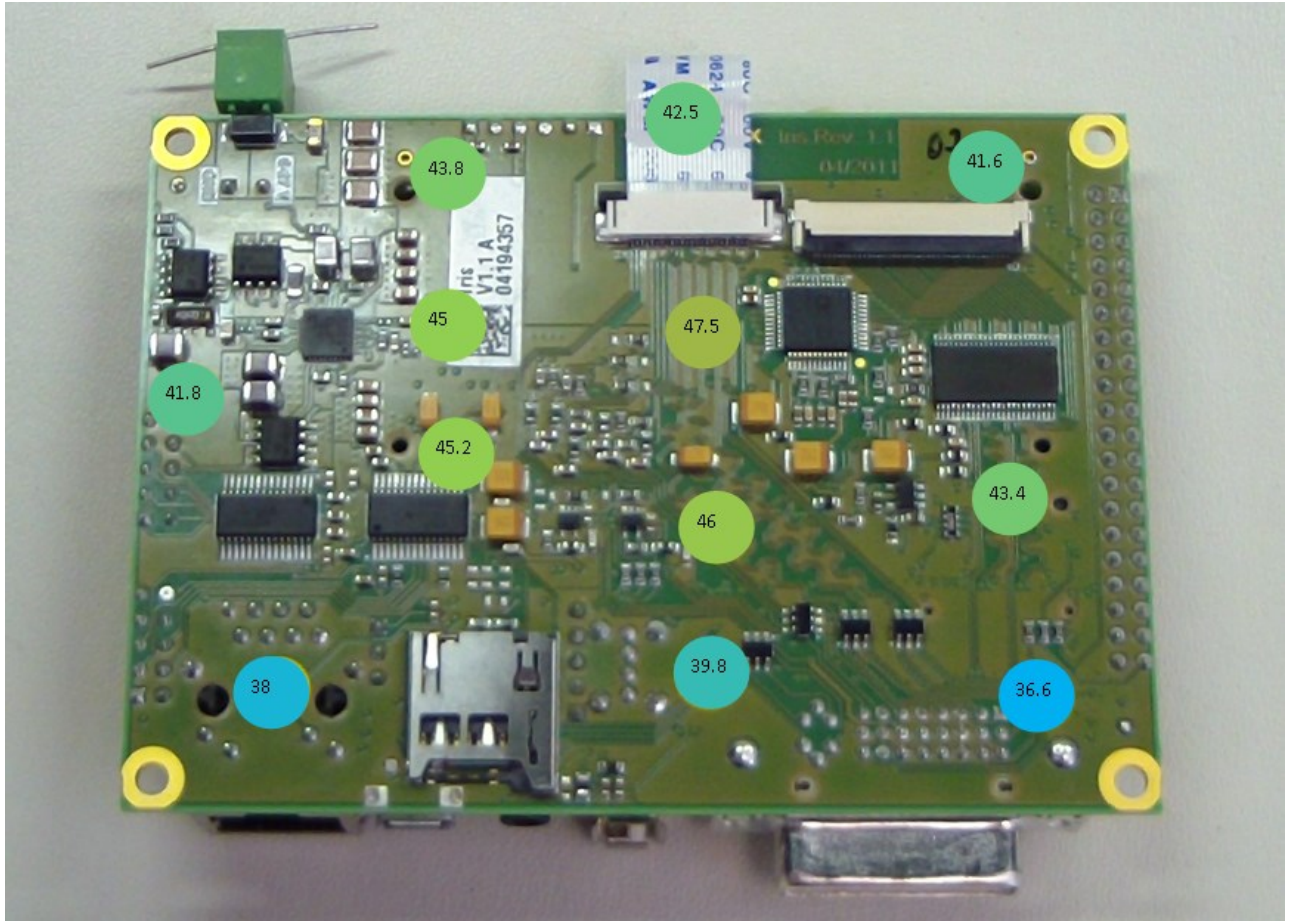


- Ambient temperature: 27.9 Grad Celsius
- CPU temperature 69 Grad Celsius
- Power Consumption of the whole system: 350mA @ 10V
- All temperatures in Grad Celsius

1.2.1 Front



1.2.2 Back



2 Heat Sink Test

2.1 Test Setup

- Colibri T20 V1.2 512MB RAM 1GB Flash (04754064)
- Iris V1.1 A
- Windows Compact 7 version 1.0 PerfKit
- Dynamically Voltage/Frequency switching deactivated, all frequencies to max (CPU 1GHz)
- Both CPU cores 100% load (Noldle Program)
- Playing 1080p movie from a USB Stick. (via Hub)
- Playing UI Composer Demo Cluster V5beta1
- Dual Screen setup 2x1080p connected via splitter cable on the DVI-I connector
- Iris Board flat on table
- No forced air circulation
- System was running for at least 1 hour with constant power consumption (with case more than 3h)
- Measurement Device ThermoWorks Close Focus IR (Target Diameter 0.1")
- CPU Junction measured via internal Thermal Diode



2.2 Test Results

Test	Description	Ambient [°C]	CPU Junction [°C]	Other Temperature [°C]	
1	No Heat Sink	21.8	73		
2	No Heat Sink in Case	21.6	80	Top of Case Central	36.1
3	Large Black Heat Sink	22.4	55	Side Fin Central	48.3
4	Large Black Heat Sink Vertical	22.7	52	Side Fin Central	46.7
5	Small Black Heat Sink	21.9	63	Top of Heat Sink Central	58.7
6	Small Black Heat Sink in Case	21.8	58	Top of Case Central	36.5
7	Small Blue Heat Sink	21.8	65	Top of Heat Sink Central	62.1
8	Small Blue Heat Sink in Case	22.5	74	Top of Case Central	36.8
9	Clip on Heat Sink	22.4	63	Top of Heat Sink Central	55.4

2.2.1 Test 1, No Heat Sink

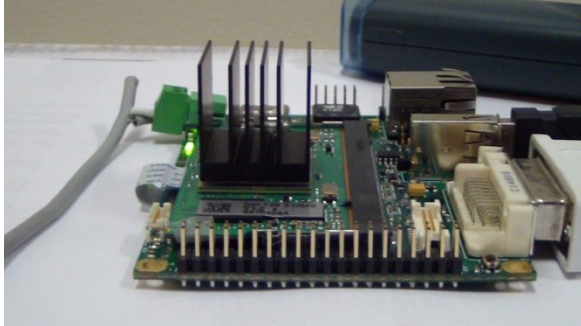


2.2.2 Test 2, No Heat Sink in Case



Heavy Cast Aluminum Case

2.2.3 Test 3, Large Black Heat Sink



ATS-54230W-C2-R0

<http://www.digikey.com/product-detail/en/ATS-54230W-C2-R0/ATS1250-ND/1284964>

The weight of the Heat sink is considerable high, additional mechanical fixation of the Colibri is recommended. For example use the mounting wholes on the Colibri and the Iris.

2.2.4 Test 4, Large Black Heat Sink Vertical



ATS-54230W-C2-R0

<http://www.digikey.com/product-detail/en/ATS-54230W-C2-R0/ATS1250-ND/1284964>

In this position most probably more heat is transfer via the bottom of the PCB.

The weight of the Heat sink is considerable high, additional mechanical fixation of the Colibri is recommended. For example use the mounting wholes on the Colibri and the Iris.

2.2.5 Test 5, Small Black Heat Sink



BDN09-3CB/A01

<http://www.digikey.com/product-detail/en/BDN09-3CB%2FA01/294-1097-ND/272735>

2.2.6 Test 6, Small Black Heat Sink in Case



Same heat sink than in test 5, but mounted inside the cast aluminum case form test 2. The top of the heat sink touches the case with some pressure. Be careful if you apply pressure to the module, deformation of the Colibri PCB can stress the solder joints and can lead to defects. Such failure may happen only after months or/and after many temperature cycles.

2.2.7 Test 7, Small Blue Heat Sink



ATS-60000-C2-R0

<http://www.digikey.com/product-detail/en/ATS-60000-C2-R0/ATS1376-ND/1285090>

2.2.8 Test 8, Small Blue Heat Sink in Case

Same heat sink than in test 7, but mounted inside the cast aluminum case form test 2. The heat sink does not touch the case directly.

2.2.9 Test 9, Clip On Heat Sink

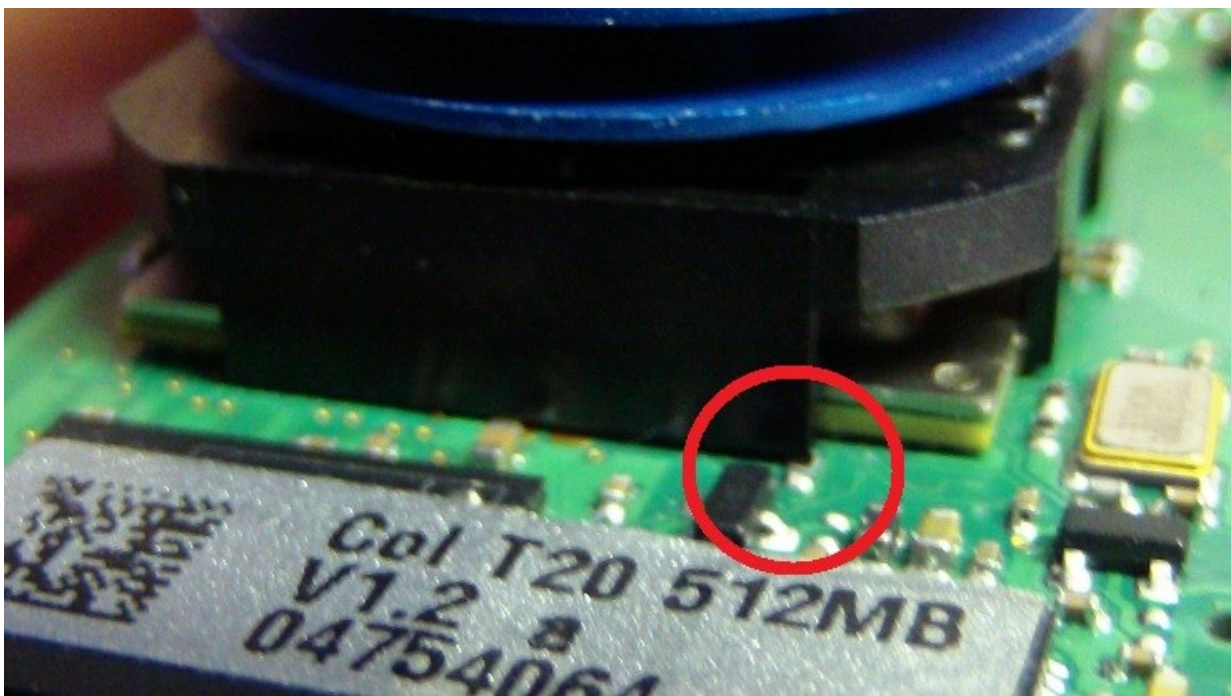


Clip on Heat Sink from cooliance. CGTT23-0014 (4 Fin 1.0 Dia).

http://www.cooliance.com/radial_fin.php

It looks like that was the only one which worked off the shelf. The design seem be optimized for forced airflow which we do not have. Also the plastic clip interference slightly with one component placed very close the Tegra chip.

Otherwise this is an attractive solutions, easy to mount and good connection with some contact pressure. If you decide to use a larger heat sink it is recommended to use the additional holes for fixation.



Plastic Clip touches component.

3 Thermal Conductive Foam below Module

Same basic Test setup than in Chapter 2.

Test	Description	Ambient [°C]	CPU Junction [°C]	Other Temperature [°C]	
1	No Foam Iris	21.8	73		
2	Yellow Foam Iris Flat	22.1	68	Back of Iris below CPU	53.6
3	Gray Foam Iris Flat	22.2	67	Back of Iris below CPU	54.4
4	Evaluation Board Flat	22.2	63	Back of Evalboard below CPU	36.5
5	Evaluation Board Gray Foam Flat	21.7	56	Back of Evalboard below CPU	40.8

The foam was placed between the bottom of the module and the carrier board. It was used some presser to slightly compress the foam. Be careful doing this, even slightly bending the module can damage the components.

Yellow Foam L37-3-48-23-4.5 1.7 W/m-K 1 Pad 23.00mm x 48.00mm

<http://www.digikey.com/product-detail/en/L37-3-48-23-4.5/1168-1668-ND/3300326>

Grey Foam H48-6G-20-20-4-1A 6.0 W/m-K 3 Pads 20.00mm x 20.00mm

<http://www.digikey.com/scripts/dksearch/dksus.dll?vendor=0&keywords=1168-1677-ND>