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Thermal Test Report for BFX-AT100 (TIANMAI Thermal Pad)

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Revision Change History

Revision	Description of Change	Date
1.0	Initial Release	10/04/2019
2.0	2nd Source	12/30/2020
3.0	2nd Source	08/12/2022

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1. Purpose and Scope

The scope of this test is to measure the thermal profile of BFX-AT100. The test purpose is to demonstrate that the temperature of key components and housing when system operates in required ambient temperatures. The temperature of all measurement points should not be over the thermal specification.

2. Test Setup

2.1 Equipment

Though any equipment with high level of accuracy can be used, it is recommended that the following be used for consistency in results. Include the model and calibration date and the following information:

Table 1: Setup Information¹

Item	Equipment Name	Description
1	Thermocouple	T-type
2	Thermocouple attachment	Thermal glue: LOCTITE 384 Accelerator: LOCTITE 7387
3	Data acquisition unit	Keithley K2700
4	Infrared thermal images	FLUKE Ti32
5	Environmental chamber	TERCHY MHF-408L

2.2 Configuration

Table 2: Information of DUT in thermal test

	Items	HW Version	Part Number	Serial Number	Software Version
1	Main Board	06C	T99X171	YWQ10XL	523r06_SD_fac- 20220126

2.3 Environment

Table 3: Test environmental requirements²

Ambient temp. for testing	Condition: 25 & 50°C
Place mode	Horizontal stand
Air flow inside chamber	Put the DUT inside the baffle box to simulating actual environment at higher temperature setting in stationary air flow environment. The baffle box is to prevent chamber airflow influence.

2.4 Power Consumption Measurement

The total DC power consumption: 2.9 (W)

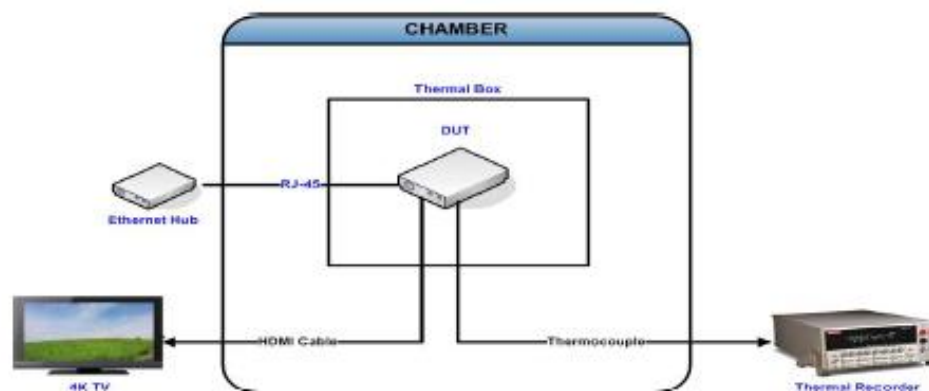
2.5 Second Source

1. Remove Top & Bottom Shielding Cover.
2. Change Thermal Pad to TIANMAI, K= 3W.

¹ Include this table in this test report. Be sure to report any deviation from this table in the test report.

² Add multiple 'Environmental Requirements' tables into the Test Report if necessary. Record the set conditions for each test completed (i.e. External ambient temp, relative humidity range, and mounting method).

2.6 Thermal Test Setup



3. Test Procedure

1. Ensure the DUT can operate continuously for up to 6 hours without failures or errors.
2. Photograph the test setup and the location of the thermocouples.
3. DUT powered down and cooled to ambient conditions, and then start recording temperature readings.
4. All readings must be the same, within the range of 2°C reading accuracy.
5. Power on and confirm that the DUT is functioning properly.
6. Apply thermal load as documented in 2.5 *Test Setup*. Record power consumptions of DUT with loading. If the CPU utilization and memory usage information is applicable, also must be recorded.
7. Monitor the temperature readings until steady-state³ has been reached for both components and chamber temperature.
8. Record temperature readings.
9. Functional exercising during thermal test:
 - a). HDMI connected to 4K TV and play the video.
 - b). LAN continue to run packet between Ethernet and PC, throughput 50Mbps.

4. Pass/Fail Criteria

Table 4: Pass/Fail Criteria

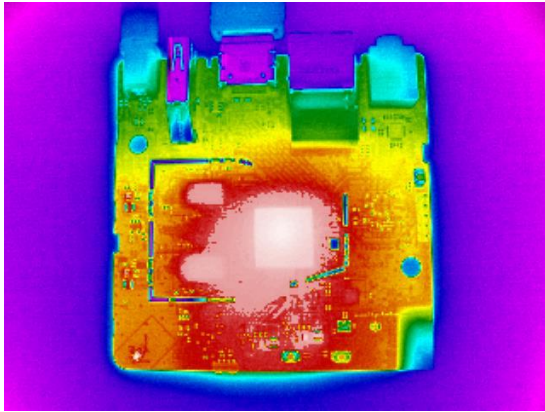
Ambient Temp.		Criteria
Condition	25 & 50°C	1. The component surface temperature should meet component specification. 2. AL capacitor's lifetime > MTBF or product lifetime. 3. IC chip's Temp.: Follow IC formula ($T_j = T_c + \theta_{jc} \cdot P$) and T_j has 90% de-rating for judgment. 4. Housing Top < Reference Box + 15°C 5. Housing Bottom < Reference Box + 20°C

³ Recommended definition of Steady-State: Three consecutive temperature readings for each thermocouple with less than a 1°C temperature rise. Each of these three consecutive temperature readings must be 15 minutes apart. This is a guideline and since some chamber temperatures can fluctuate more than 1°C, this must be taken into consideration.

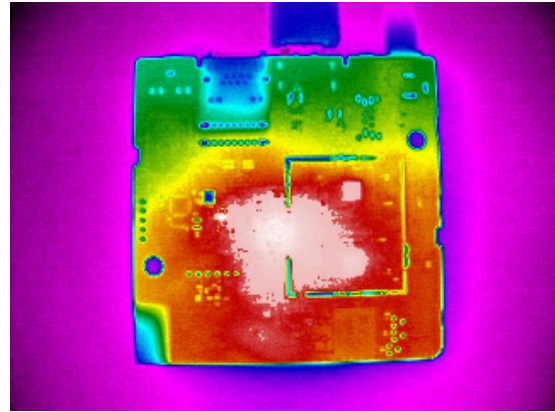
5. Test Results

5.1 IR image report

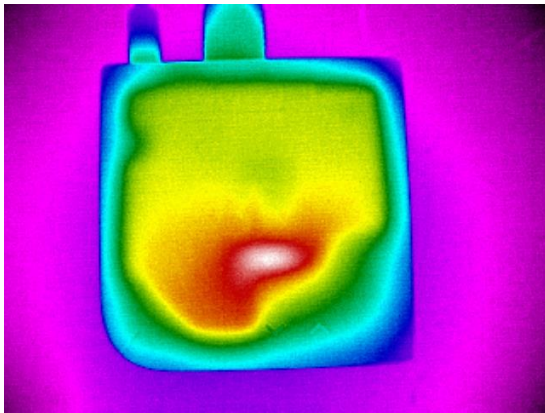
PCB Top



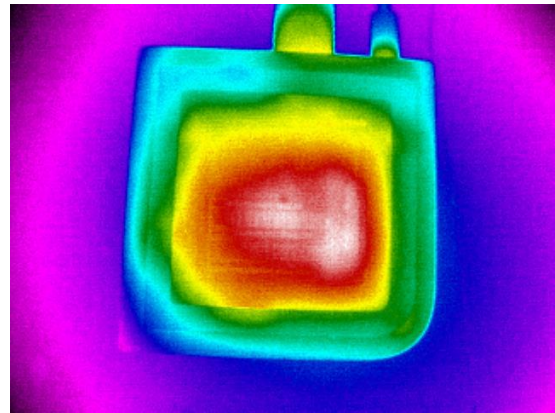
PCB Bottom



Housing Top side



Housing Bottom side



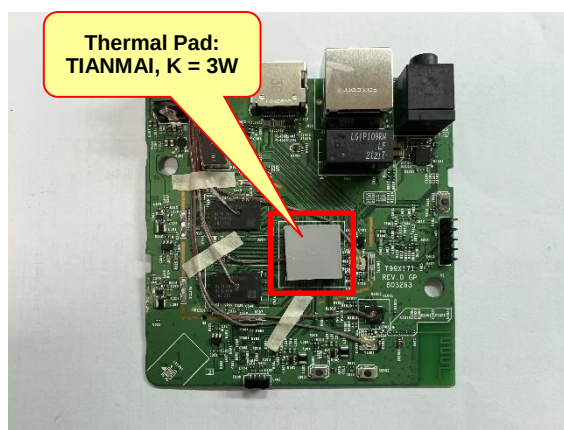
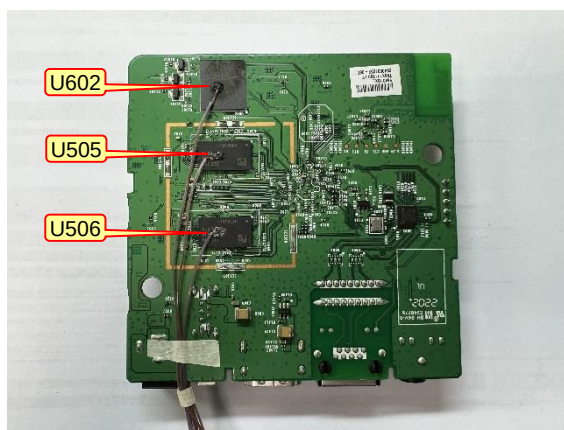
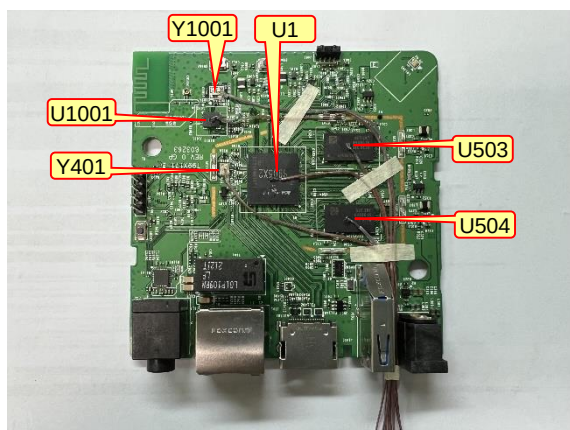
Remark:

1. Scan angle, direction, index are the impacting factors of IR images.
2. Above IR image, only for temperature relative scale reference only.
3. Please check the actual tested temperature by test result.

5.2 Thermal profile measurement

TIANMAI, K = 3W Thermal Pad Test						
No.	Location	Description	25°C	50°C	Pass Criterion	Result @50°C
1	U506	IC DDR4 SDRAM 4Gb 1.2V 0.75nS SMD FBGA96 GP K4A4G165WE-BCTD	50.2	75.1	$T_c < 95^{\circ}\text{C}$	Pass
2	U505	IC DDR4 SDRAM 4Gb 1.2V 0.75nS SMD FBGA96 GP K4A4G165WE-BCTD	51.7	76.4	$T_c < 95^{\circ}\text{C}$	Pass
3	U602	IC eMMC 8GB 2.7~3.6V 5nS SMD FBGA153 GP KLM8G1GETF-B041	49.1	73.9	$T_j < 112.5^{\circ}\text{C}$	Pass $T_j = T_c + \theta_{jc} \cdot P$ $= 73.9 + 2 \cdot 0.2802$ $= 74.46 < 112.5$ $(T_j \cdot 90\%, 125 \cdot 90\%)$
4	U1	IC PER 1.8/3.3V SMD FCBGA393 GP ARM S905X2-B	55.7	80.6	$T_j < 94.5^{\circ}\text{C}$	Pass $T_c + \theta_{jc} \cdot P$ $= 80.6 + 5.36 \cdot 0.5821$ $= 83.72 < 94.5$ $(T_j \cdot 90\%, 105 \cdot 90\%)$
5	Y401	XTAL 24MHz 10ppm 12pF 30ohm SMD GP 3.2*2.5mm -40~+105DegC	50.7	76.6	$T_c < 105^{\circ}\text{C}$	Pass
6	U503	IC DDR4 SDRAM 8Gb 1.2/2.5V 0.75nS SMD FBGA96 GP/HF K4A8G165WC-BCTD	51.6	76.6	$T_c < 95^{\circ}\text{C}$	Pass
7	U504	IC DDR4 SDRAM 8Gb 1.2/2.5V 0.75nS SMD FBGA96 GP/HF K4A8G165WC-BCTD	49.7	74.7	$T_c < 95^{\circ}\text{C}$	Pass
8	U1001	IC MPU 3.3V SMD FCBGA49 2.4GHz GP/HF CYW20704UA2KFFB1G CYPRESS	49.7	75.3	$T_j < 92.7^{\circ}\text{C}$	Pass $T_j = T_c + \theta_{jc} \cdot P$ $= 75.3 + 61.21 \cdot 0.0002$ $= 75.31 < 92.7$ $(T_j \cdot 90\%, 103 \cdot 90\%)$
9	Y1001	XTAL 20MHz 20ppm 8pF 50ohm SMD GP/HF 2.5*2mm -30~+105DegC	49.4	74.9	$T_c < 105^{\circ}\text{C}$	Pass
10	Housing Top	NA	39.1	63.4	$< 65^{\circ}\text{C}@50^{\circ}\text{C}$ $< \Delta t \ 15^{\circ}\text{C}$	Pass
11	Housing Bottom	NA	40.6	65.8	$< 70^{\circ}\text{C}@50^{\circ}\text{C}$ $< \Delta t \ 20^{\circ}\text{C}$	Pass
12	Reference Box	NA	25.0	50.0	NA	NA

5.3 Test photographs



6. Test Result Conclusions

The thermal test result was passed by horizontal mode of 25°C & 50°C.