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Thermal Test Report for BFX-AT100

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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 2700+7708 DMM Data Acquisition, Data logging System
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	01S1	BFX-AT100	TBD	4.9.113

2.3 Environment

Table 3: Test environmental requirements²

Ambient temp. for testing	25°C & 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.

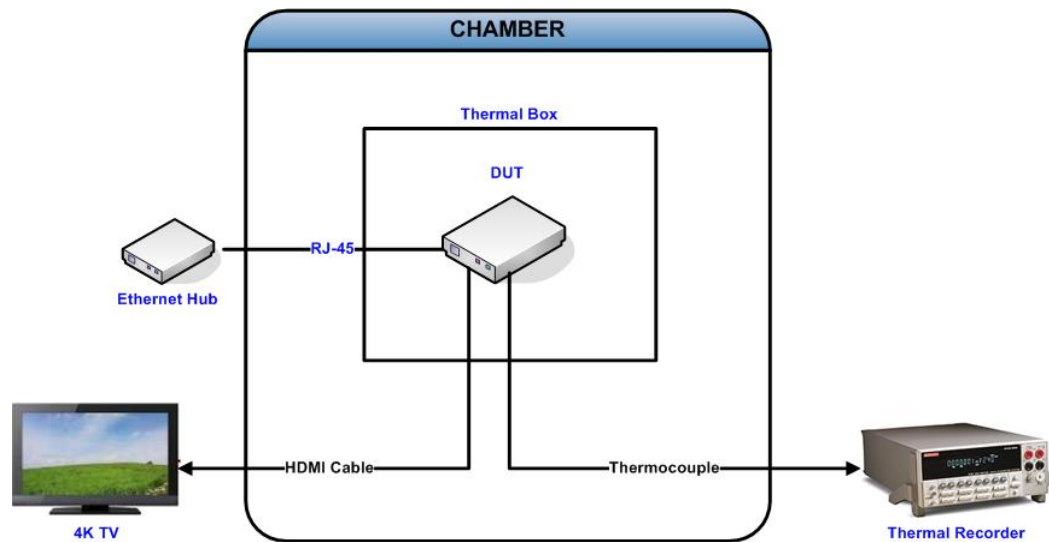
2.4 Power Consumption Measurement

The total power consumption: 3.3(W)

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).

2.5 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 recoded.
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 through Ethernet Hub and play the YouTube 4K video

4. Pass/Fail Criteria

Table 4: Pass/Fail Criteria

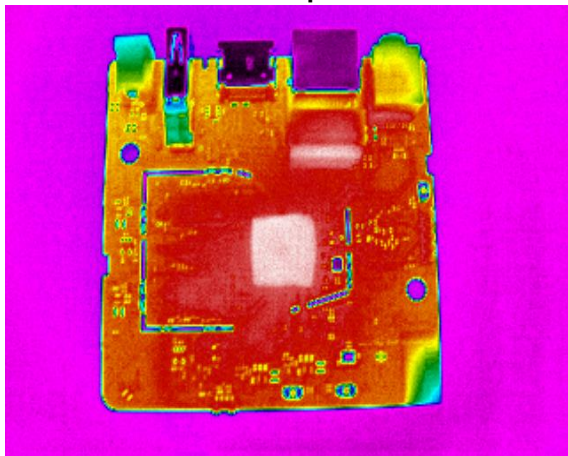
Ambient Temp.		Criteria
Condition 1	25°C & 50°C	1. The component surface temperature should meet component specification. 2. AL capacitor's lifetime > MTBF or product lifetime 3. IC chip's Temp.: Follow IC formula ($T_j = T_c + \theta_{jc} \cdot P$) and T_j has 90% de-rating for judgment. 4. Housing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

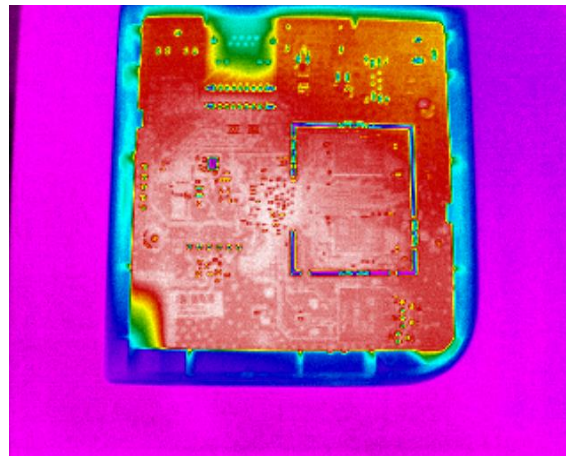
5. Test Results

5.1 IR image report

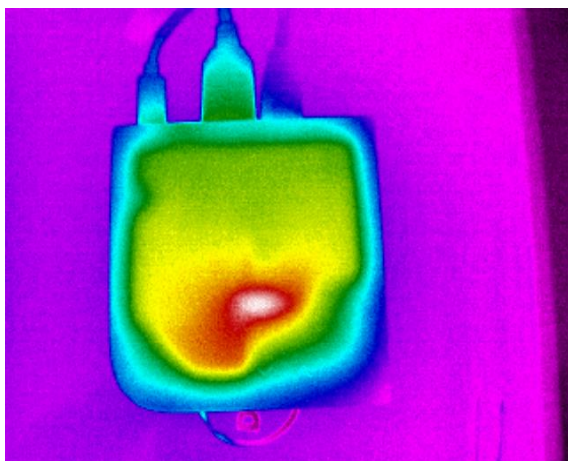
PCB Top



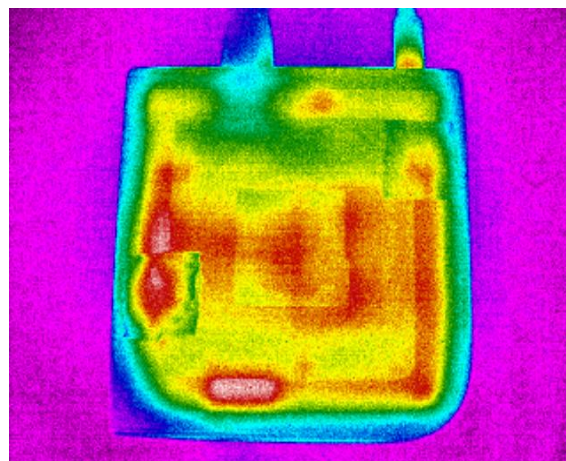
PCB Bottom



Housing Top



Housing Bottom



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.

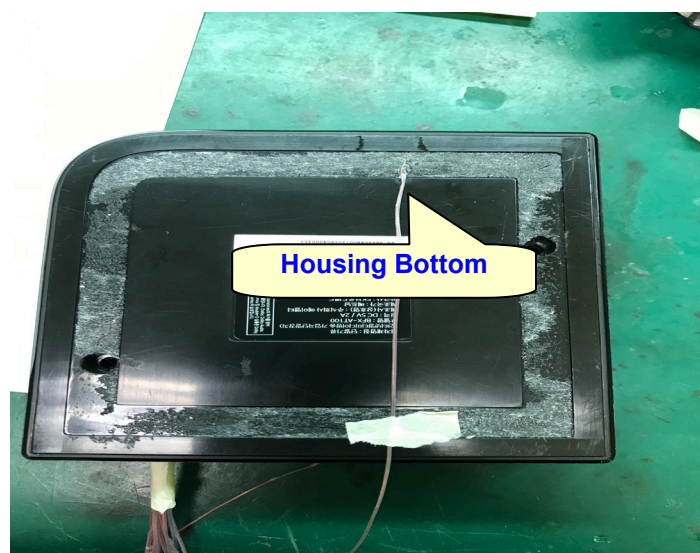
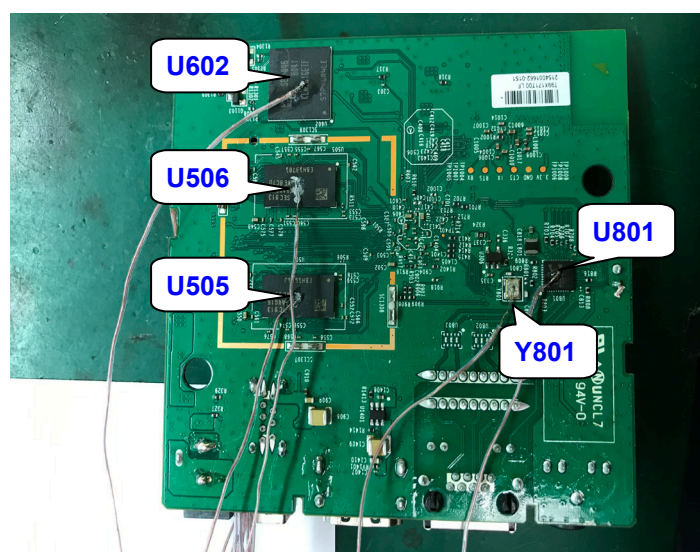
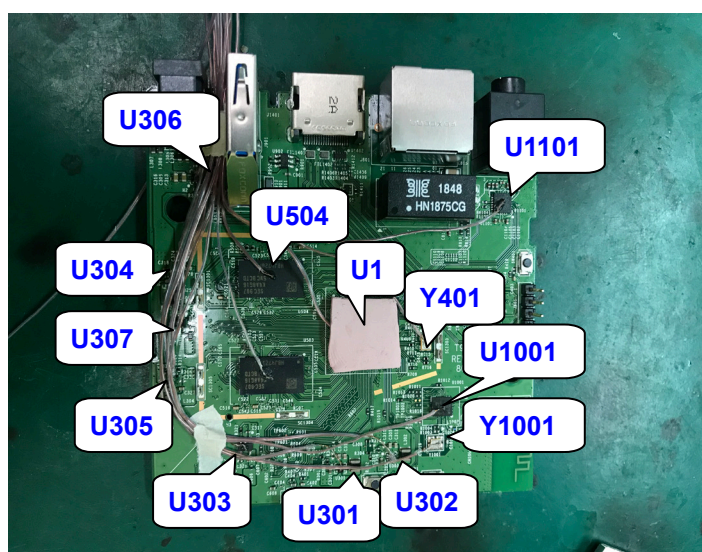
5.2 Thermal profile measurement

No.	Location	Description	25°C	50°C	Pass Criterion	Result @50°C
1	U301	IC DC-DC 2.5~5.5V SMD SOT5*3-6 GP TLV62569DRLR	47.41	70.96	$T_j < 135^{\circ}\text{C}$	Pass $T_j = T_c + \theta_{jc} * P$ $= 70.96 + 51 * 0.191$ $= 80.7 < 135$ $(T_j * 90\%, 150 * 90\%)$
2	U302	IC DC-DC 2.5~5.5V SMD SOT5*3-6 GP TLV62569DRLR	48.31	71.90	$T_j < 135^{\circ}\text{C}$	Pass $T_j = T_c + \theta_{jc} * P$ $= 71.9 + 51 * 0.191$ $= 81.64 < 135$ $(T_j * 90\%, 150 * 90\%)$
3	U305	IC DC-DC 2.5~5.5V SMD SOT5*3-6 GP TLV62569DRLR	46.27	70.01	$T_j < 135^{\circ}\text{C}$	Pass $T_j = T_c + \theta_{jc} * P$ $= 70.01 + 51 * 0.191$

						$=79.75 < 135$ (Tj *90%, 150*90%)
4	U304	IC DC-DC 2.5~5.5V SMD SOT5*3-6 GP TLV62569DRLR	45.42	69.43	Tj < 135°C	Pass Tj = Tc+θjc*P =69.43+130*0.191 =94.26 < 135 (Tj *90%, 150*90%)
5	U303	IC REG 1.8V 500mA SMD SOT23-5 GP TLV75518PDBVR	46.27	69.82	Tj < 135°C	Pass Tj = Tc+θjc*P =69.82+130*0.191 =94.65 < 135 (Tj *90%, 150*90%)
6	U306	IC REG 1.8V 500mA SMD SOT23-5 GP TLV75518PDBVR	41.01	65.01	Tj < 135°C	Pass Tj = Tc+θjc*P =65.01+130*0.191 =89.84 < 135 (Tj *90%, 150*90%)
7	U307	IC REG 2.5V 500mA SMD SOT23-5 GP TLV75525PDBVR	45.64	69.40	Tj < 135°C	Pass Tj = Tc+θjc*P =69.4+130*0.191 =94.23 < 135 (Tj *90%, 150*90%)
8	U1	IC PER 1.8/3.3V SMD FCBGA393 GP ARM S905X2-B	53.29	76.55	Tj < 94.5°C	Pass Tj = Tc+θjc*P =76.55+5.36*0.5821 =79.67 < 94.5 (Tj *90%, 105*90%)
9	U504	IC DDR4 SDRAM 8Gb 1.2/2.5V 0.75nS SMD FBGA96 GP/HF K4A8G165WC-BCTD	48.60	72.37	Tc < 95°C	Pass
10	U506	IC DDR4 SDRAM 4Gb 1.2V 0.75nS SMD FBGA96 GP K4A4G165WE-BCTD	47.01	70.80	Tc < 95°C	Pass
11	U503	IC DDR4 SDRAM 8Gb 1.2/2.5V 0.75nS SMD FBGA96 GP/HF K4A8G165WC-BCTD	50.71	74.28	Tc < 95°C	Pass
12	U505	IC DDR4 SDRAM 4Gb 1.2V 0.75nS SMD FBGA96 GP K4A4G165WE-BCTD	45.51	69.46	Tc < 95°C	Pass
13	U602	IC eMMC 8GB 2.7~3.6V 5nS SMD FBGA153 GP KLM8G1GETF-B041	46.09	69.73	Tj < 112.5°C	Pass Tj = Tc+θjc*P =69.73+2*0.2802 =70.30 < 112.5 (Tj *90%, 125*90%)
14	U1001	IC MPU 3.3V SMD FCBGA49 2.4GHz GP/HF CYW20704UA2KFFB1G CYPRESS	47.80	71.25	Tj < 92.7°C	Pass Tj = Tc+θjc*P =71.25+61.21*0.0002 =71.27 < 92.7 (Tj *90%, 103*90%)
15	Y1001	XTAL 20MHz 20ppm 8pF 50ohm SMD GP/HF 2.5*2mm -30~+105DegC	47.17	70.64	Tc < 105°C	Pass
16	U801	IC PER 1.5/1.8/2.5/3.3V SMD QFN40 GP ETHERNET TRANSCEIVER RTL8211F-CG	49.99	73.47	Tj < 112.5°C	Pass Tj = Tc+θjc*P =73.47+100*0.0438 =77.85 < 112.5 (Tj *90%, 125*90%)
17	Y401	XTAL 24MHz 10ppm 12pF 30ohm SMD GP 3.2*2.5mm -40~+105DegC	49.60	72.96	Tc < 105°C	Pass

18	Y801	XTAL 25MHz 7ppm 12pF 50ohm SMD GP/HF 3.2*2.5mm -40~+105DegC	47.64	71.12	$T_c < 105^{\circ}\text{C}$	Pass
19	U1101	IC DSP 3.6V SMD QFN24 GP TLV320ADC3101IRGER	44.55	68.07	$T_j < 94.5^{\circ}\text{C}$	Pass $T_j = T_c + \theta_{jc} \cdot P$ $= 68.07 + 34.1 \cdot 0.1$ $= 71.48 < 94.5$ $(T_j * 90\%, 105^{\circ} 90\%)$
20	Housing Top		37.68	61.63	$< 65^{\circ}\text{C} @ 50^{\circ}\text{C}$ $< \Delta t \ 15^{\circ}\text{C}$	Pass
21	Reference Box		25.00	50.00		

5.3 Test photographs



6. Test Result Conclusions

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