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## Thermal Test Report for BFX-AT100 (Vender E 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 |

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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 Information<sup>1</sup>

| Item | Equipment Name          | Description                                                     |
|------|-------------------------|-----------------------------------------------------------------|
| 1    | Thermocouple            | T-type                                                          |
| 2    | Thermocouple attachment | Thermal glue: LOCTITE 384<br>Accelerator: LOCTITE 7387          |
| 3    | Data acquisition unit   | KEITHLEY 2700+7708 DMM<br>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 | 04L1C      | T99X171     | YUU07QD       | BFX_AT100-userdebug 9 PI<br>15.520.8-20200731<br>release-keys |

### 2.3 Environment

Table 3: Test environmental requirements<sup>2</sup>

|                           |                                                                                                                                                                                              |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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: 2.9(W)

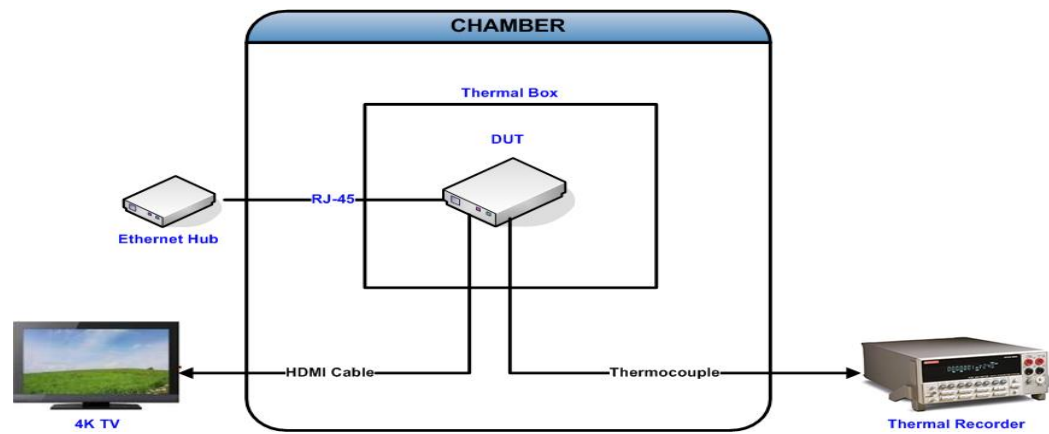
### 2.5 Second Source

For new thermal pad 480.01350.005 (THERMAL PAD 14\*14\*2mm) and 480.01351.005 (THERMAL PAD 13\*13\*1.5mm) of Vender E.

<sup>1</sup> Include this table in this test report. Be sure to report any deviation from this table in the test report.

<sup>2</sup> 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-state<sup>3</sup> 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

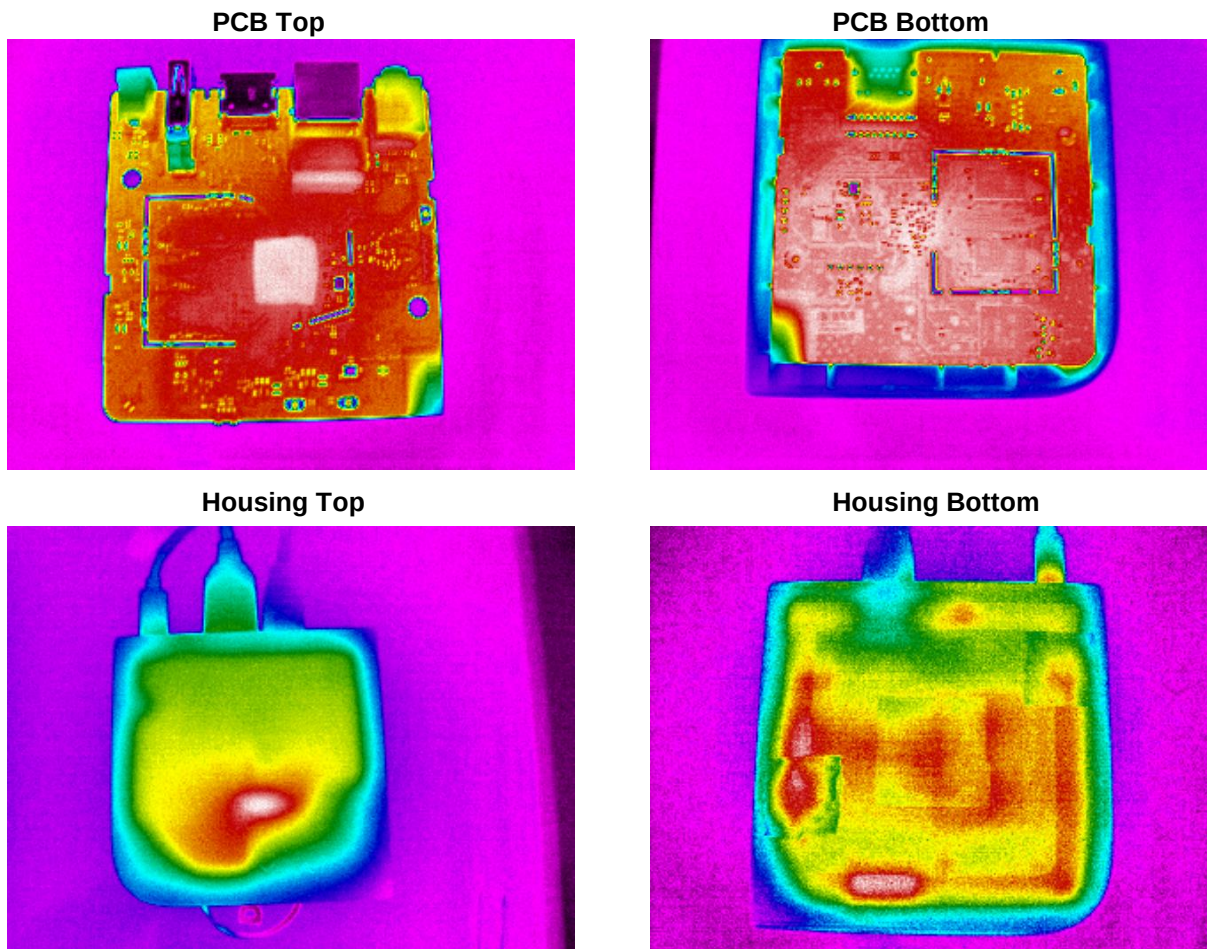
Table 4: Pass/Fail Criteria

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

<sup>3</sup> 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



#### 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.

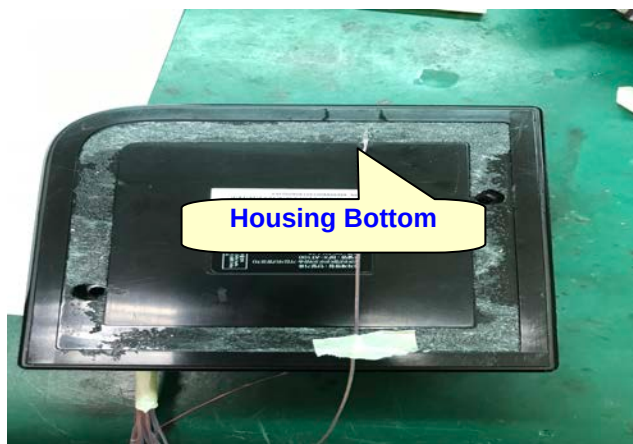
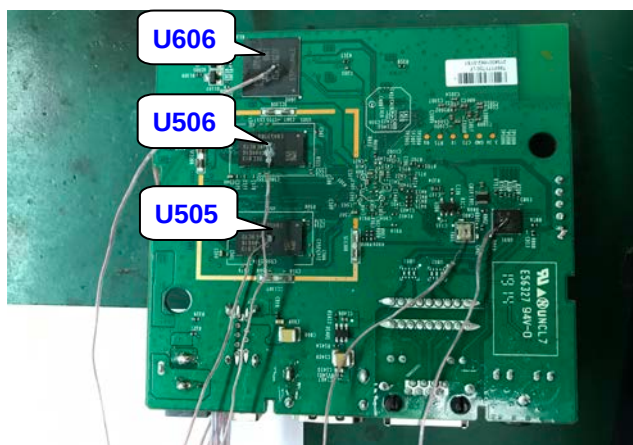
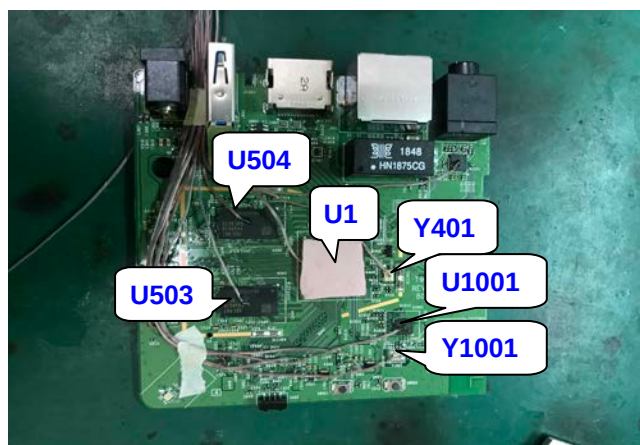
### 5.2 Thermal profile measurement

#### Vender E Thermal Pad Test

| No. | Location | Description                                                       | 25°C  | 50°C  | Pass Criterion                | Result @50°C                                                                                                                               |
|-----|----------|-------------------------------------------------------------------|-------|-------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | U506     | IC DDR4 SDRAM 4Gb 1.2V<br>0.75nS SMD FBGA96 GP<br>K4A4G165WE-BCTD | 44.60 | 69.35 | $T_c < 95^{\circ}\text{C}$    | Pass                                                                                                                                       |
| 2   | U505     | IC DDR4 SDRAM 4Gb 1.2V<br>0.75nS SMD FBGA96 GP<br>K4A4G165WE-BCTD | 46.38 | 71.07 | $T_c < 95^{\circ}\text{C}$    | Pass                                                                                                                                       |
| 3   | U602     | IC eMMC 8GB 2.7~3.6V 5nS<br>SMD FBGA153 GP<br>KLM8G1GETF-B041     | 43.81 | 68.52 | $T_j < 112.5^{\circ}\text{C}$ | Pass<br>$T_j = T_c + \theta_{jc} \cdot P$<br>$= 68.52 + 2 \cdot 0.2802$<br>$= 69.08 < 112.5$<br>$(T_j * 90\%, 125^{\circ}\text{C} * 90\%)$ |
| 4   | U1       | IC PER 1.8/3.3V SMD<br>FCBGA393 GP ARM<br>S905X2-B                | 47.47 | 72.18 | $T_j < 94.5^{\circ}\text{C}$  | Pass<br>$T_j = T_c + \theta_{jc} \cdot P$<br>$= 72.18 + 5.36 \cdot 0.5821$<br>$= 75.3 < 94.5$                                              |

|    |                |                                                                             |       |       |                                                                                  | (Tj *90%, 105*90%)                                                                                            |
|----|----------------|-----------------------------------------------------------------------------|-------|-------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| 5  | Y401           | XTAL 24MHz 10ppm 12pF<br>30ohm SMD GP 3.2*2.5mm<br>-40~+105DegC             | 46.35 | 71.10 | $T_c < 105^{\circ}\text{C}$                                                      | Pass                                                                                                          |
| 6  | U503           | IC DDR4 SDRAM 8Gb<br>1.2/2.5V 0.75nS SMD<br>FBGA96 GP/HF<br>K4A8G165WC-BCTD | 47.39 | 71.86 | $T_c < 95^{\circ}\text{C}$                                                       | Pass                                                                                                          |
| 7  | U504           | IC DDR4 SDRAM 8Gb<br>1.2/2.5V 0.75nS SMD<br>FBGA96 GP/HF<br>K4A8G165WC-BCTD | 45.78 | 70.43 | $T_c < 95^{\circ}\text{C}$                                                       | Pass                                                                                                          |
| 8  | U1001          | IC MPU 3.3V SMD FCBGA49<br>2.4GHz GP/HF<br>CYW20704UA2KFFB1G<br>CYPRESS     | 45.53 | 70.26 | $T_j < 92.7^{\circ}\text{C}$                                                     | Pass<br>$T_j = T_c + \theta_{jc} * P$<br>$= 70.26 + 61.21 * 0.0002$<br>$= 70.27 < 92.7$<br>(Tj *90%, 103*90%) |
| 9  | Y1001          | XTAL 20MHz 20ppm 8pF<br>50ohm SMD GP/HF 2.5*2mm<br>-30~+105DegC             | 44.63 | 69.38 | $T_c < 105^{\circ}\text{C}$                                                      | Pass                                                                                                          |
| 10 | Housing Top    |                                                                             | 32.23 | 56.85 | $< 65^{\circ}\text{C} @ 50^{\circ}\text{C}$<br>$< \Delta t \ 15^{\circ}\text{C}$ | Pass                                                                                                          |
| 11 | Housing Bottom |                                                                             | 34.21 | 59.33 | $< 70^{\circ}\text{C} @ 50^{\circ}\text{C}$<br>$< \Delta t \ 20^{\circ}\text{C}$ | Pass                                                                                                          |
| 12 | Reference Box  |                                                                             | 25.00 | 50.00 |                                                                                  | Pass                                                                                                          |

### 5.3 Test photographs



## 6. Test Result Conclusions

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