



Venture To Begin! 

White Paper

Continuous Power Testing of
the VTB Controller and Motor (AETOS & RGA)

Contents

1. Summary.....	1
2. Test Subject and Configuration.....	2
2.1 Special Configuration of the Testing Platform.....	2
2.2 Tested System	2
3. Test Methods and Conditions.....	3
3.1 Test Objectives.....	3
3.2 Test Conditions.....	3
4. Test Data and Results.....	4
4.1 Result Analysis.....	6
5. Conclusion	6
6. Appendices.....	7

1.Summary

The power retention capability and thermal management reliability of a powertrain under prolonged, high-load operating conditions are critical metrics for evaluating its overall performance.

This white paper presents a dedicated assessment of the output stability and thermal limits of the VTB controller and motor system under continuous load, through a rigorous laboratory bench test. A modified direct-drive test bench and independent DC power supply are employed in the test to minimize interference from battery state-of-charge degradation and focus on the inherent thermal behavior of the system.

Core Test Data

Under an ambient temperature of 21 °C and specified air-cooling conditions, the system maintained continuous output for 25 minutes. The temperature rise and power variation process are as follows:

- **35 kW Stable Output (7 minutes):** The system operated at a power of 35 kW (48 Ps). At the 7th minute, the controller temperature rose to 76°C (168.8°F), and the internal motor temperature rose to 135°C (275 °F).
- **Dynamic Power Reduction (11 minutes):** The power reduction strategy was triggered at the 7th minute, and the power decreased stepwise from 35 kW (48 Ps) to 18 kW (25 Ps) over 11 minutes. Upon completion of the power reduction phase, the controller temperature dropped to 72°C (161.6°F), and the internal motor temperature dropped to 141°C (285.8°F).
- **18 kW Stable Output (7 minutes):** Subsequently, the system maintained stable operation at 18 kW (25 Ps) for 7 minutes until the end of the test. At test completion, the controller temperature was 69 °C (156.2 °F), and the internal motor temperature was 133°C (271.4 °F).

Core Conclusions

Under continuous load, the VTB controller and motor demonstrate active power management capabilities based on precise temperature feedback. The system automatically performs smooth intervention and adjustment before the temperatures of critical components reach preset thresholds, ultimately maintaining a safe thermal equilibrium state suitable for long-term operation.

This verifies the hardware temperature resistance limits and the effectiveness of the control strategy. During this process, the temperature rise curves of the controller and motor show a converging trend, confirming the boundary constraints of the thermal management system under steady-state high-load conditions.

35 kW Stable Output
Duration: 7 minutes

Controller Temperature: 76.0°C
Internal Motor Temperature: 135°C

Dynamic Power Reudction.
Stepwise reduction from 35 kW
to 18 kW
Duration: 11 minutes

Controller Temperature: 72.0°C
Internal Motor Temperature: 141°C

18 kW Stable Output
Duration: 7 minutes

Controller Temperature: 69.0°C
Internal Motor Temperature: 133°C

2.Test Subject and Configuration

2.1 Special Configuration of the Testing Platform

To ensure the rigor of the testing process and to prevent any irreversible damage to the entire vehicle drivetrain, while also allowing for an accurate evaluation of the core performance of the VTB controller and motor, the VTB engineering team performed targeted modifications to the dynamometer:

The motor was directly coupled to the dynamometer roller shaft through a secondary drive chain & sprocket, and a laboratory-grade DC power supply was used to directly power the system.

2.2 Tested System

Table 2-1 Tested System Specifications

Components	Brand	Model	Key Specification
Motor	VTB	RGA81	Nominal Peak Power: 81 kW
Controller	VTB	V9600 GEN2 AETOS Max	Max Input Voltage: 109 V Max Bus Current: 800 V Max Phase Current: 960 A
DC Power Supply	Qingxi Yuanjin Electronics Factory	YJ-120KW-135V	Max Output Voltage: 135 V Max Output Current: 850 A
Infrared Camera	HIKMICRO	H16Pro	Max Temperature: 160 °C

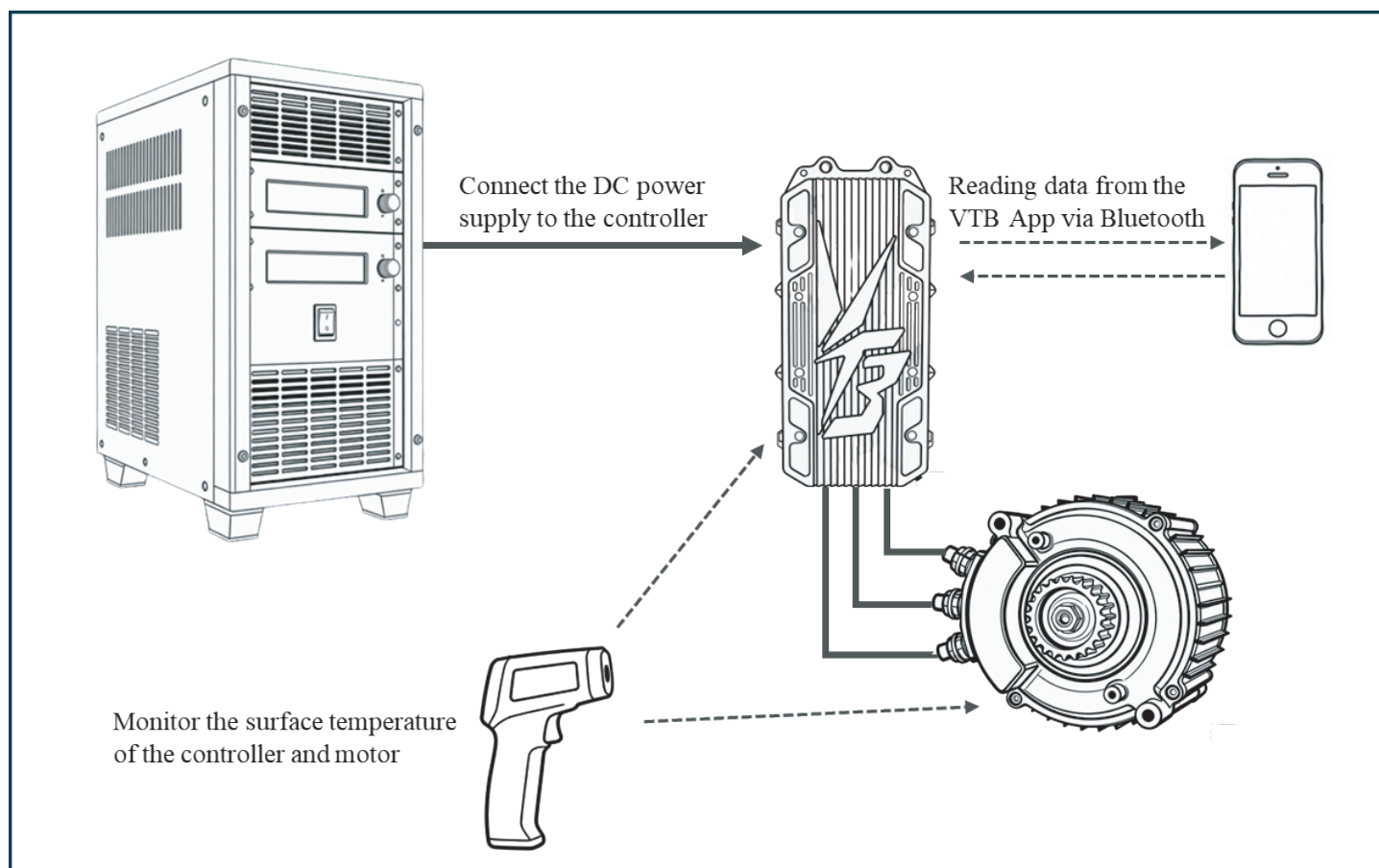


Figure 2-1 Connection Diagram

3. Test Methods and Conditions

3.1 Test Objectives

- To record the temperature rise data and duration for the controller and motor under continuous high load.
- To validate the trigger logic and regulation effectiveness of the system's thermal management control strategy.

3.2 Test Conditions

Test Date: 2026/1/27

Test Location: VTB Laboratory

Environmental Conditions:

- Temperature: 20°C
- Humidity: 68%

Cooling Conditions: Forced convection cooling applied to the motor and controller using a fixed-position blower.

Dynamometer: DynoCosber-500

Calibration Status: Load calibration completed (2026/1/9)

Data Synchronization: Post-test synchronized analysis was performed using data collected from the infrared camera and the VTB App.

Test Procedure:

1. Start the system at room temperature, and set the DC power supply to CV-96V and CC-800A.
2. Adjust the controller with a phase current of 610 A, field weakening disabled, and the motor power reduction temperature set to 150 °C (300 °F), the controller power reduction temperature set to 75 °C (167 °F).
3. Apply a constant high load to the dynamometer to enable the system to quickly enter and maintain a high-power output state.
4. Conduct the continuous operation test until all key temperature parameters no longer rise significantly and reach dynamic equilibrium.
5. Synchronously record all electrical parameters and temperature parameters throughout the entire process.

4.Test Data and Results

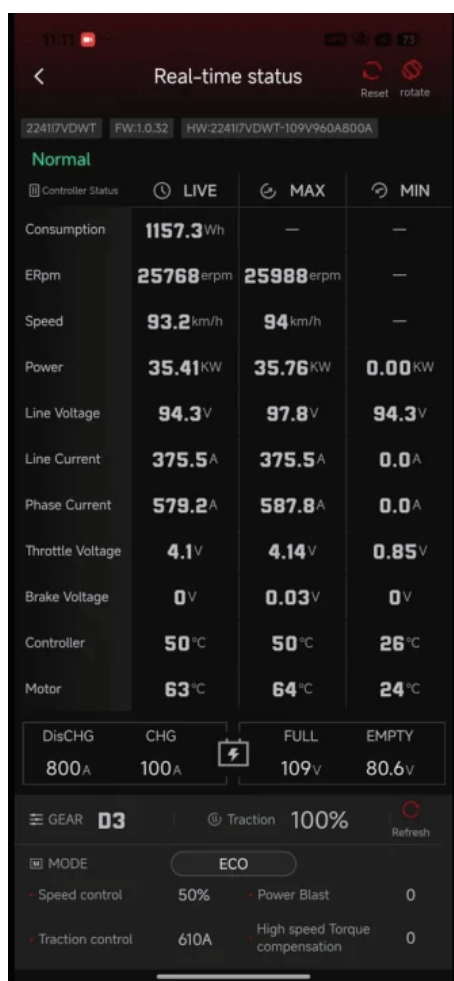


Figure 4-1 Screenshot from VTB App



Figure 4-2 Image of DC Power Supply

The full data table can be found in the Appendix.

The table below presents a summary of key data:

Table 4-1 Key Data Summary

Time (min)	Controller Internal Temperature °C (°F)	Motor Internal Temperature °C (°F)	Power kW (Ps)	Phase Current (A)	Status Description
0	26.00 (78.80)	24.00 (75.20)	0.00 (0.00)	0.00	Initial state
2	48.00 (118.40)	47.00 (116.60)	35.49 (48.27)	369.70	High-power output, rapid temperature rise
7	76.00 (168.80)	135.00 (275.00)	32.69 (44.43)	337.80	Key point: Motor temperature triggers the first power reduction
15	74.00 (165.20)	144.00 (291.20)	23.62 (32.12)	244.50	Dynamic adjustment period
25	69.00 (156.20)	133.00 (271.40)	18.12 (24.64)	184.50	Steady-state equilibrium

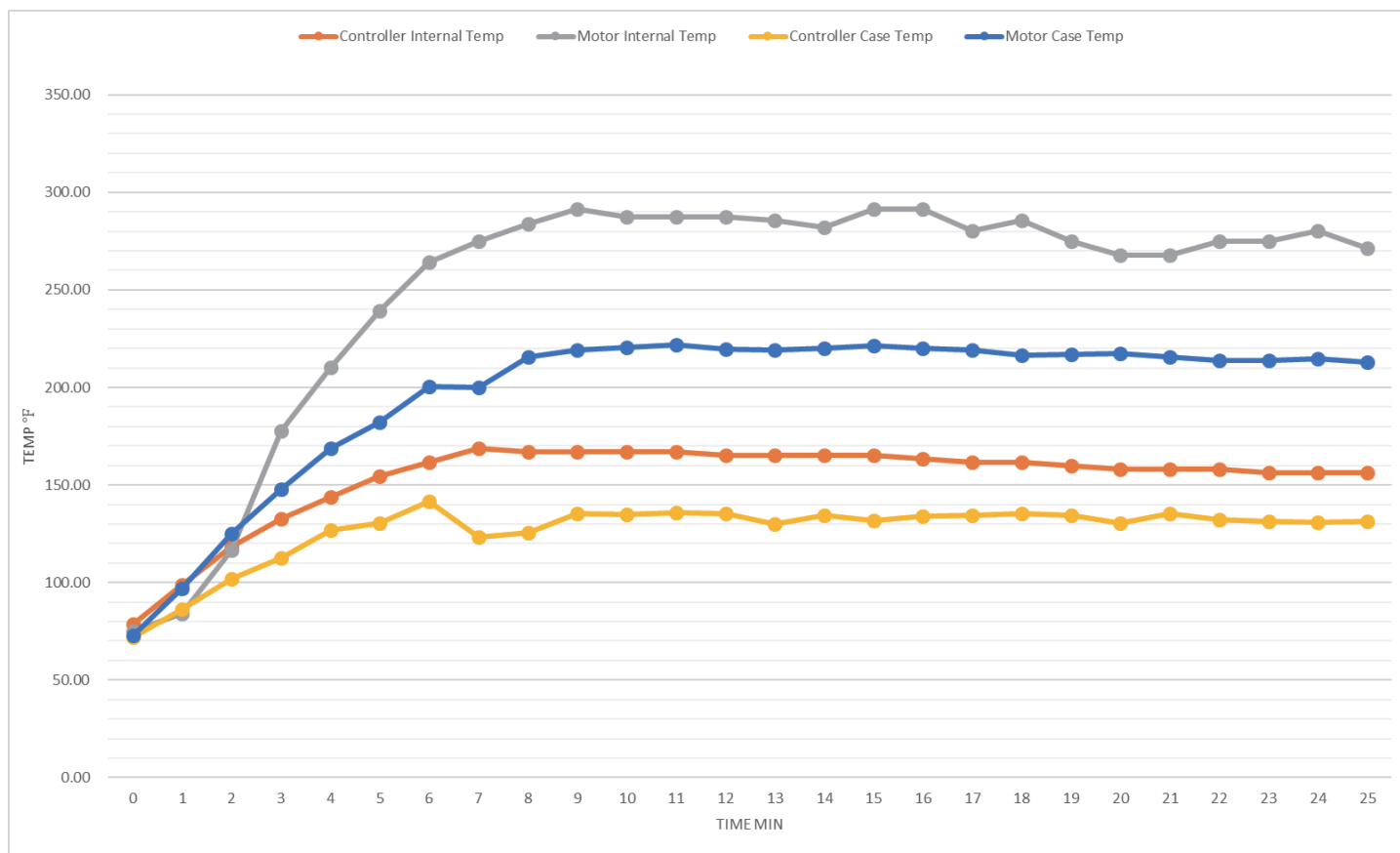


Figure 4-3 Time-Temperature Curve

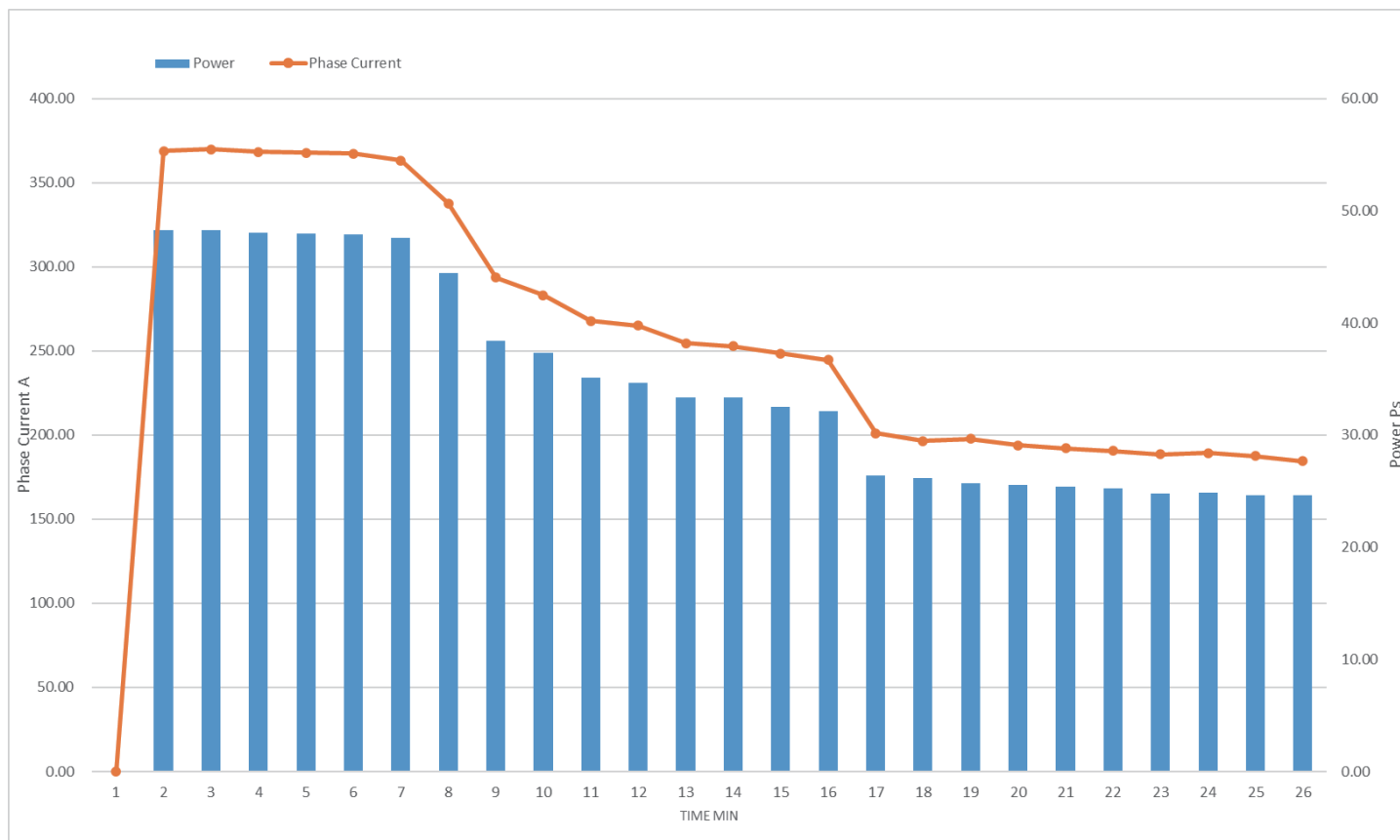


Figure 4-4 Power-Phase Current Curve

4.1 Result Analysis

Phase 1: 0–7 minutes

After system startup, it quickly enters a high-power output state of 35 kW. The temperature rise rate of the motor is significantly higher than that of the controller, indicating that the motor windings are the primary heat source under the current load conditions.

Phase 2: 7–18 minutes

At the 7th minute, the internal controller temperature approaches the preset threshold near 75 °C (167 °F). At the 9th minute, the internal motor temperature approaches the preset threshold near 150 °C (300 °F).

According to the control strategy, the output power is gradually reduced from 35 kW (48 Ps) to 18 kW (25 Ps), effectively suppressing the temperature rise rate.

Phase 3: 18–25 minutes

Following dynamic adjustment, the system reaches a thermal equilibrium state. The power output stabilizes around 18 kW (25 Ps) with minor fluctuations.

In summary, under the current cooling conditions, the system can sustain an output of 35 kW (48 Ps) for 7 minutes. The continuous output capability corresponding to the system's thermal equilibrium point is 18 kW (25 Ps). The power reduction strategy intervenes accurately when the internal controller temperature reaches 75 °C (167 °F), ensuring the safe operating boundary of the hardware.

5. Conclusion

A continuous power boundary verification was conducted on the powertrain consisting of the VTB controller and motor under constant load mode. The data shows that under a constant high load of 35 kW (48 Ps), the system can maintain stable output for 7–8 minutes until the core controller temperature reaches the thermal saturation threshold of 75 °C (167 °F).

Upon triggering thermal protection and power derating, at an output of 18 kW (25 Ps), the motor heat generation and heat dissipation reach equilibrium, and temperatures cease to rise, achieving a safe transition from "peak output" to "sustainable operation".

Due to cooling constraints, the continuous power measured in laboratory testing is theoretically lower than real-world performance. Greater continuous power can be achieved with water-cooling suppression.

This test aims to identify the thermophysical boundaries and protection mechanisms of the hardware. During testing, the controller and motor operated under extreme high temperatures for an extended period, far exceeding normal operating conditions. Sustaining the system near the thermal protection threshold for long or frequent periods may accelerate the aging of electronic components and insulation materials. This shall not be regarded as the recommended operating condition over the full life cycle of the system.

6.Appendices

Appendix A: Complete Raw Data Video

https://specification.ventusbikes.cn/white-paper/Controller_Motor_Continuous_Power_Dynamometer_Testing.mp4

4



Figure B-1 Test Site

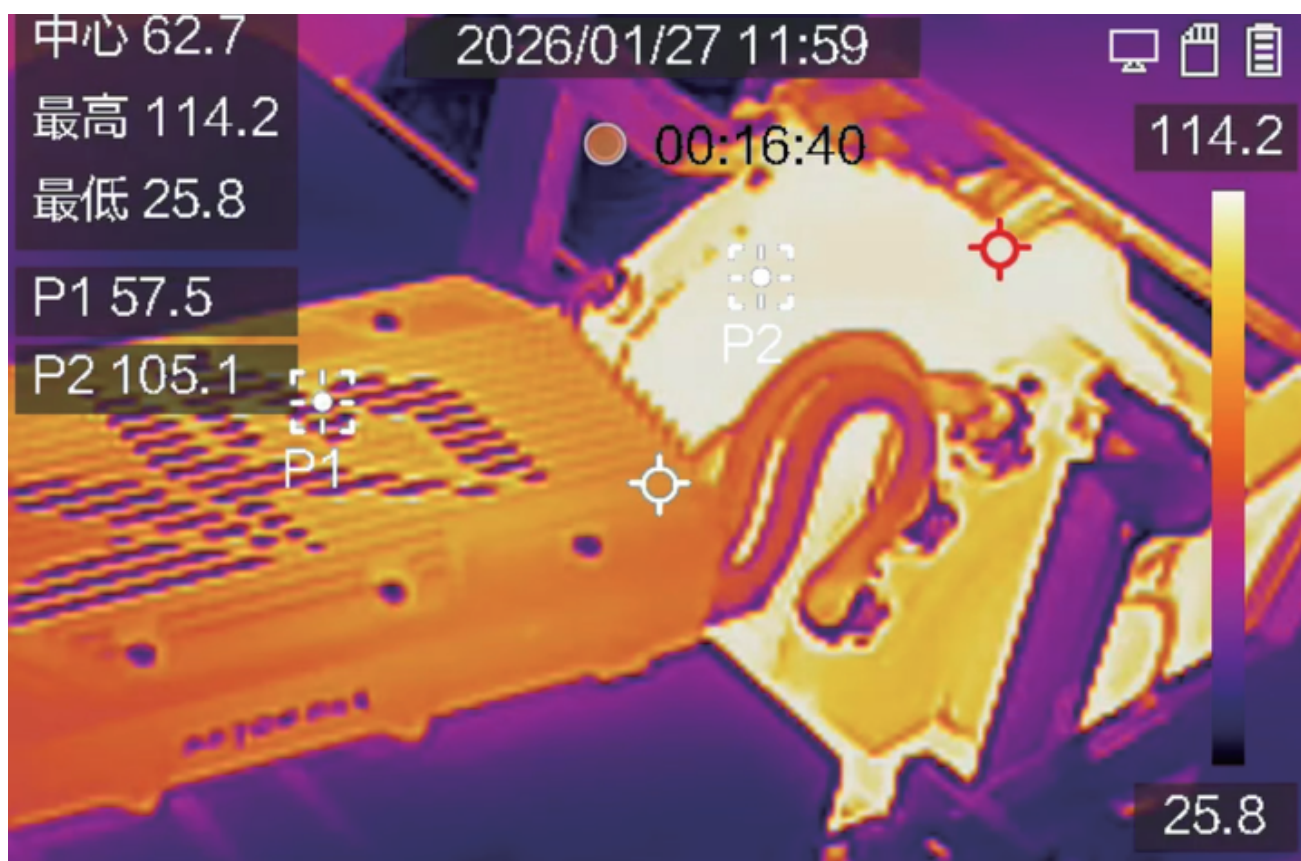


Figure B-2 Infrared Camera Image (P1: Controller, P2: Motor)

Appendix C: Full Time-Series Data Table for Continuous Power

Time (min)	Controller Temp °C (°F)	Motor Temp °C (°F)	Controller Case °C (°F)	Motor Case °C (°F)	Power kW (Ps)	Phase Current (A)
0	26.00 (78.80)	24.00 (75.20)	22.20 (71.96)	22.60 (72.68)	0.00 (0.00)	0.00
1	37.00 (98.60)	29.00 (84.20)	30.20 (86.36)	36.20 (97.16)	35.47 (48.24)	368.70
2	48.0 (118.40)	47.00 (116.60)	38.80 (101.84)	51.70 (125.06)	35.49 (48.27)	369.70
3	56.00 (132.80)	81.00 (177.80)	44.70 (112.46)	64.40 (147.92)	35.30 (48.01)	368.40
4	62.00 (143.60)	99.00 (210.20)	52.70 (126.86)	76.00 (168.80)	35.24 (47.93)	367.80
5	68.00 (154.40)	115.00 (239.00)	54.70 (130.46)	83.50 (182.30)	35.22 (47.90)	367.20
6	72.00 (161.60)	129.00 (264.20)	60.80 (141.44)	93.60 (200.48)	34.99 (47.59)	363.30
7	76.00 (168.80)	135.00 (375.00)	50.80 (123.44)	93.30 (199.94)	32.67 (44.43)	337.80
8	75.00 (167.00)	140.00 (284.00)	51.90 (125.42)	101.90 (215.42)	28.21 (38.37)	293.50
9	75.00 (167.00)	144.00 (291.20)	57.30 (135.14)	103.90 (219.02)	27.42 (37.29)	283.20
10	75.00 (167.00)	142.00 (287.60)	57.10 (134.78)	104.80 (220.64)	25.79 (35.07)	267.70
11	75.00 (167.00)	142.00 (287.60)	57.60 (135.68)	105.50 (221.90)	25.48 (34.65)	265.10
12	74.00 (165.20)	142.00 (287.60)	57.30 (135.14)	104.20 (219.56)	24.50 (33.32)	254.60
13	74.00 (165.20)	141.00 (285.80)	54.50 (130.10)	104.00 (219.20)	24.52 (33.35)	252.80
14	74.00 (165.20)	139.00 (282.20)	56.80 (134.24)	104.50 (220.10)	23.90 (32.50)	248.40
15	74.00 (165.20)	144.00 (291.20)	55.50 (131.90)	105.30 (221.54)	23.62 (32.14)	244.50
16	73.00 (163.40)	144.00 (291.20)	56.70 (134.06)	104.40 (219.92)	19.39 (26.37)	200.90
17	72.00 (161.60)	138.00 (280.40)	56.90 (134.42)	103.90 (219.02)	19.26 (26.19)	196.50
18	72.00 (161.60)	141.00 (285.80)	57.30 (135.14)	102.60 (216.68)	18.88 (25.68)	197.70
19	71.00 (159.80)	135.00 (275.00)	56.90 (134.42)	102.80 (217.04)	18.78 (25.54)	193.80
20	70.00 (158.00)	131.00 (267.80)	54.60 (130.28)	102.90 (217.22)	18.65 (25.36)	192.10
21	70.00 (158.00)	131.00 (267.80)	57.30 (135.14)	102.00 (215.60)	18.55 (25.23)	190.60
22	70.00 (158.00)	135.00 (275.00)	55.70 (132.26)	100.90 (213.62)	18.23 (24.80)	188.60
23	69.00 (156.20)	135.00 (275.00)	55.20 (131.36)	101.10 (213.98)	18.27 (24.85)	189.40
24	69.00 (156.20)	138.00 (280.40)	54.90 (130.82)	101.40 (214.52)	18.10 (24.62)	187.50
25	69.00 (156.20)	133.00 (271.40)	55.20 (131.36)	100.50 (212.90)	18.12 (24.64)	184.50