



Client: Server Fortress

Date: 23rd February 2016

Site: Handcross, West Sussex.

Project Description/ Objectives:

**To prove the thermal capability of
The enhanced Server Fortress 19" cabinet
to a Heat load of 10kW.**



Server Fortress Installation

Project Description/ Objectives:

'Server Fortress – Enhanced' is an extension to the Server Fortress range of server safes. It has a heavier, triple layered, ventilated, front and rear door. The outer louvered door grid is of deeper construction, significantly increasing its strength and therefore its resistance to physical attack. The perforated sheet beneath the outer grill, designed to stop probes, remains unchanged. The final inner layer is a new large grid system to provide rigid support to both the perforated sheet and the outer louvered grill.

The objective of the thermal testing was to ensure that this thicker and stronger, triple layered, vented door panel did not adversely affect the thermal performance of 'Server Fortress – Enhanced' compared to the original 'Server Fortress' unit.





Contents

| | | |
|-----|-----------------------|----------|
| 1.0 | Management Summary | Pg 4-7 |
| 2.0 | Plan of Installation | Pg 8 |
| 3.0 | Equipment and Methods | Pg 9-13 |
| 4.0 | Detailed test Results | Pg 14 |
| 4.1 | 0kW | Pg 14-17 |
| 4.2 | 3kW | Pg 18-21 |
| 4.3 | 6kW | Pg 22-25 |
| 4.4 | 9kW | Pg 25-29 |
| 4.5 | 12kW | Pg 29-33 |
| 4.6 | Conclusion | Pg 33 |



1.0 Management Summary

Further to the recent development and manufacture of an updated Server Fortress Cabinet at Handcross West Sussex, testing took place on 23rd February 2016 to prove the thermal qualities of the enclosure.

The target was to prove that with a cold aisle temperature within ASHRAE limits, up to 10kW of heat could pass through the cabinet.

The team in attendance from E1E10 were as follows:

Stephen Ford – Project Manager

Chloe Anne Ladds - Project Assistant

Representation was also present from Server Fortress.

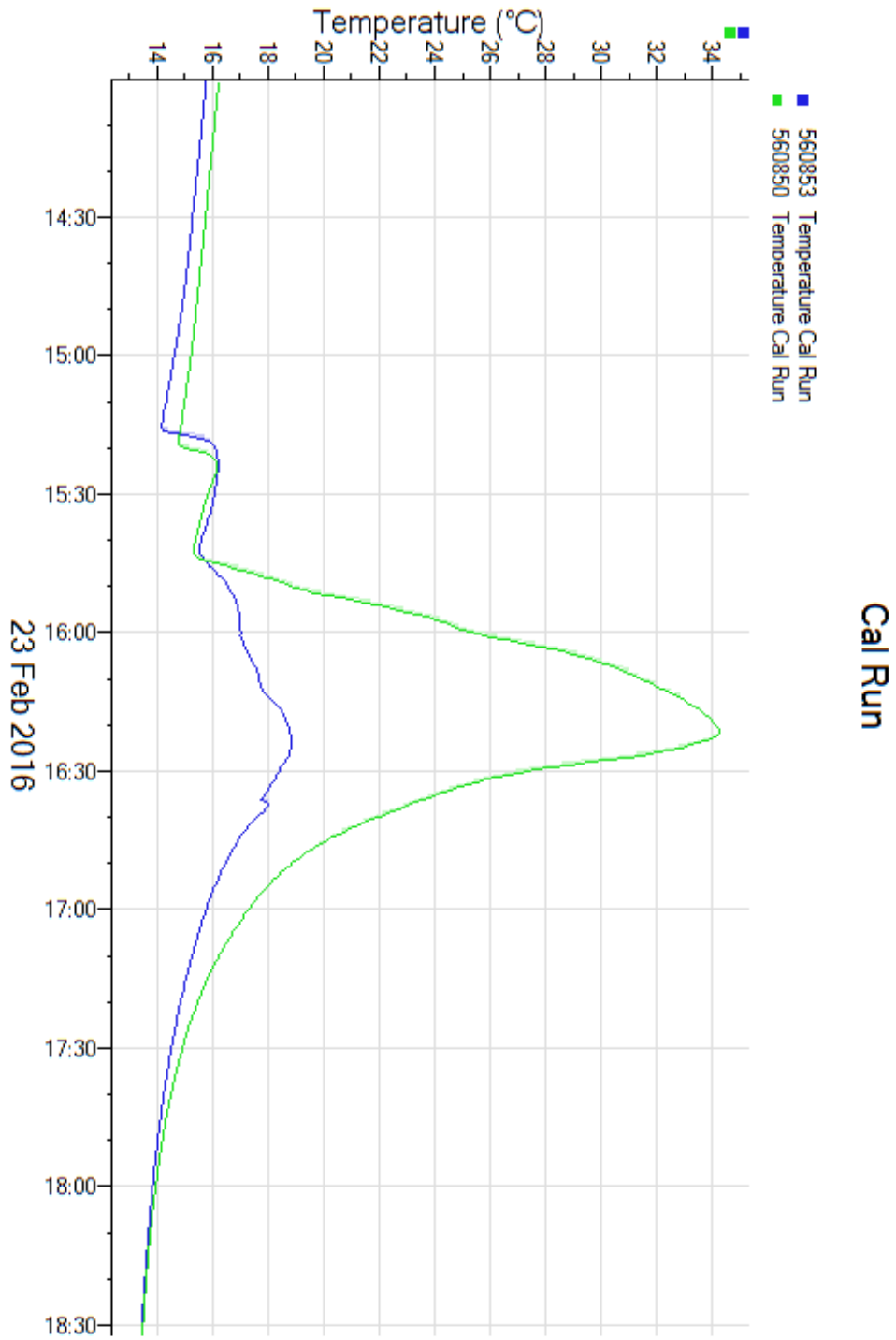
The testing consisted of the following stages:-

- Testing at 0 load
- Ramping up to 3kW load
- Ramping up to 6kW load
- Ramping up to 9kW Load
- Ramping up to 12kW load
- End of Test

From an operational point of view, we are pleased to report that the design performed equal to or better than the criteria set. Results in detail are provided within the remainder of the report.

The graphs below demonstrate the range of temperatures in the Cold and Hot aisle throughout the testing. All Cold aisle temperatures remained within ASHRAE guidelines and The Hot aisle temperatures maintained a healthy 12 to 15 degrees delta T.

Aisle temperatures

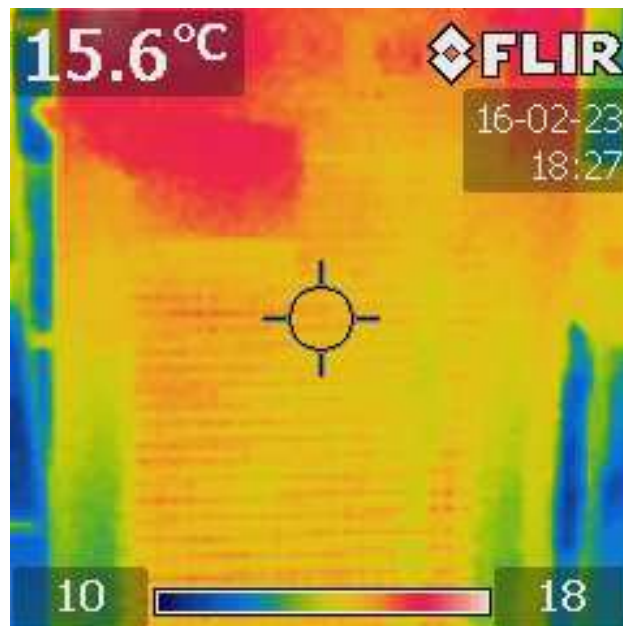


The graph above shows that the maximum delta T temperature is 15 degrees at worst, and therefore within limits.

Humidity and dew point readings are not relevant from this test as the environment did not have controls for this.

The position of the dataloggers are shown on the side elevation of the Server Fortress cabinet in the next section.

The thermal image below shows that the hot points were apparent as expected and would not be detrimental to the operation of servers, pdus and network cabling.



Testing Schedule: Completed



| POWER SETTING/ACTION | STAGE | TIME | Pass |
|------------------------|-------|---------|------|
| | | 23.2.16 | |
| 0 Kw | 1 | 15.30 | Y |
| Switch to 3kW | 2 | 15.40 | Y |
| Switch to 6kW | 3 | 15.50 | Y |
| Switch to 9kW | 4 | 16.00 | Y |
| Switch to 12kW | 5 | 16.11 | Y |
| Reduce load in reverse | 6 | 16.21 | Y |

Voltages were recorded between 232 V and 237 V, and therefore at 18amps, the target Kw levels were reached.

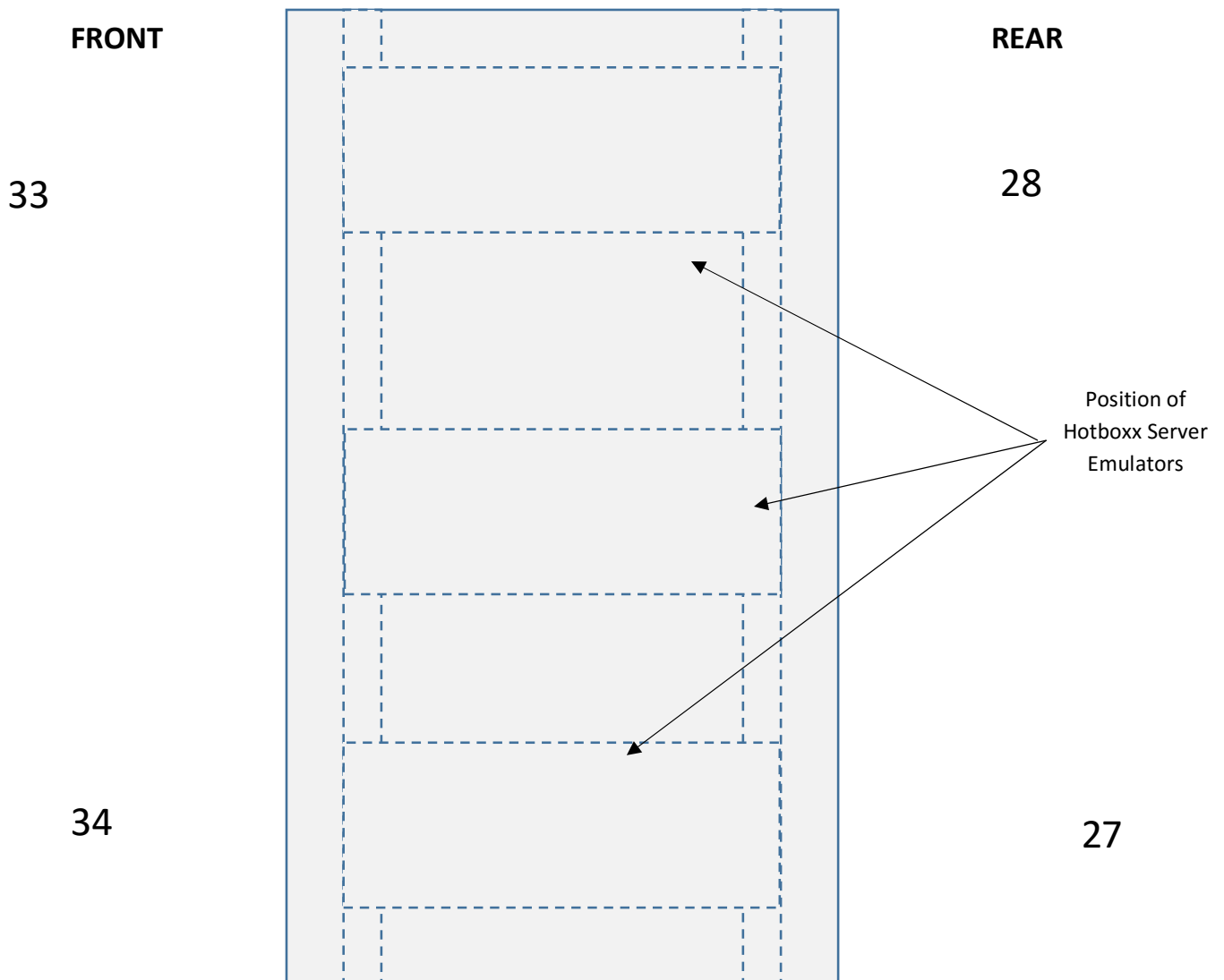
Each stage of the testing comprised of the following processes:

| |
|---|
| Continual Data logger readings for temperature (humidity optional) at pre agreed positions (see drawing). |
| Thermal images at front and rear of Cabinet. |
| There will be four humidity data loggers fitted. |
| Air flow readings at all data logger positions. |
| Power usage will be noted. |

As previously stated, the test proved successful within the facility provided, with the cabinet reaching and exceeding the design criteria.

2.0 Plan of Installation

Side elevation of Server Fortress Cabinet with position of Data loggers



N.B. Data loggers were positioned to inside surface of doors.

Air flow readings were taken at the same positions as above.

3.0 Equipment and Methods

The following equipment was used during the testing:

19" System test emulators



With the increasing heat generated from the latest server technology it has become imperative to estimate the environmental and power demand before either data centres are built or equipment installed in existing data centres.

To emulate, in so far as is possible, those demands there is a choice between a full software based examination or just placing fan heaters for a 'best guess' alternative.

HOTBOXX exists to fill that gap between expensive and subjective software for data centre heat dissipation assessment and the simple but inaccurate employment of space heaters to simulate possible hotspot scenarios.

Each 19" mounted HOTBOXX comes with dual stepped heater control and variable fan controls allowing for complete server environment simulation when and wherever required.



Specification

Based on its sister unit MTEH-2002 but with a greater variable Airflow to give blade server like performance.

The MTEH-2003H-V is supplied with:

- Variable power settings 1KW, 2KW, 3.0KW & 4.0KW (Accuracy: +5 / -10 % at 230V)
- NTC Temperature sensors and displays for air entry and exit temperatures. Rear sensor includes a 300mm lead for positioning within the cabinet. (Sensor accuracy +/- 2%)
- 2 x Temperature safety cut-out above heaters set at 85°C
- Dimensions: 6U x 680 deep
- Weight: 23KG
- Power Supply: Fused Dual IEC C14 male



Setting 1 was used for this test

| Setting | Air volume L/sec | Air volume m ³ /hr | Air Volume CFM | Temp Diff 3.1KW ΔT | Temp Diff 4.3KW ΔT |
|---------|---------------------|----------------------------------|-------------------|-----------------------|-----------------------|
| 1 | 199 | 715 | 421 | 13.6°C | 18.6°C |
| 2 | 201 | 722 | 425 | | |
| 3 | 202 | 725 | 427 | | |
| 4 | 208 | 747 | 440 | 14.0°C | 18.9°C |
| 5 | 224 | 805 | 474 | | |
| 6 | 239 | 858 | 505 | | |
| 7 | 254 | 912 | 537 | 11.7°C | 16.6°C |

NB based on Duct CSA 530 cm²

Flir thermal image camera

To verify temperature readings and observe behaviour of heat relative to air flow.

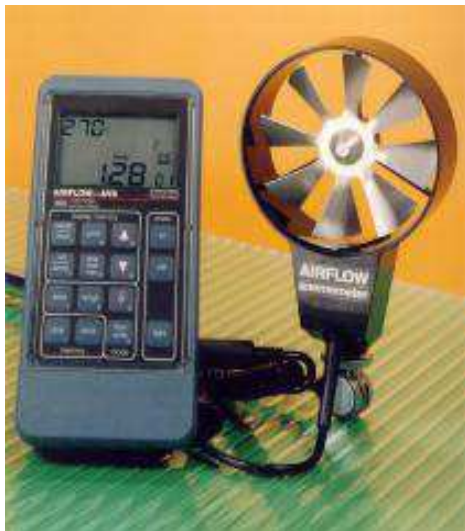


High accuracy of $\pm 2^{\circ}\text{C}$ or $\pm 2\%$ produces sensitive infrared images for general purpose maintenance analysis.

Measures temperatures up to $+250^{\circ}\text{C}$ and detects temperature differences as small as 0.10°C .

Measurement functions; spotmeter, correction for emissivity and reflected temperature, emissivity table

Anemometer to measure airflows



A battery operated digital handheld anemometer featuring a digital display.

The instrument indicates velocity, volumetric flow and temperature in imperial or metric units.

Unit has with a 100mm diameter vane head and telescopic handle.

Hand held temperature reader to verify temperatures from data loggers and to give real time readings



Temperature and Humidity data loggers



Features

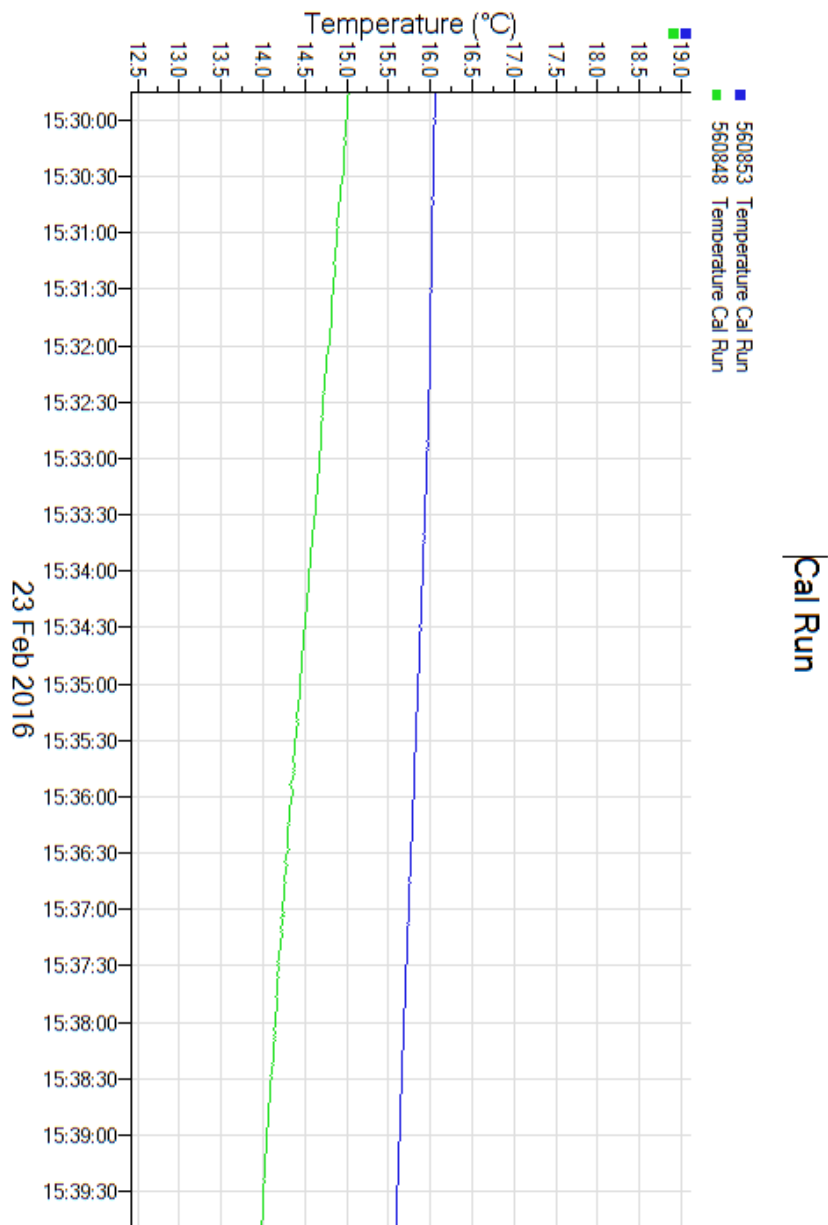
- Temperature recorder
- 16,000 reading capacity
- High Accuracy
- High Reading Resolution
- Fast Data Offload
- 2 user-programmable alarms
- Low battery monitor

4.0 Detailed Test Results

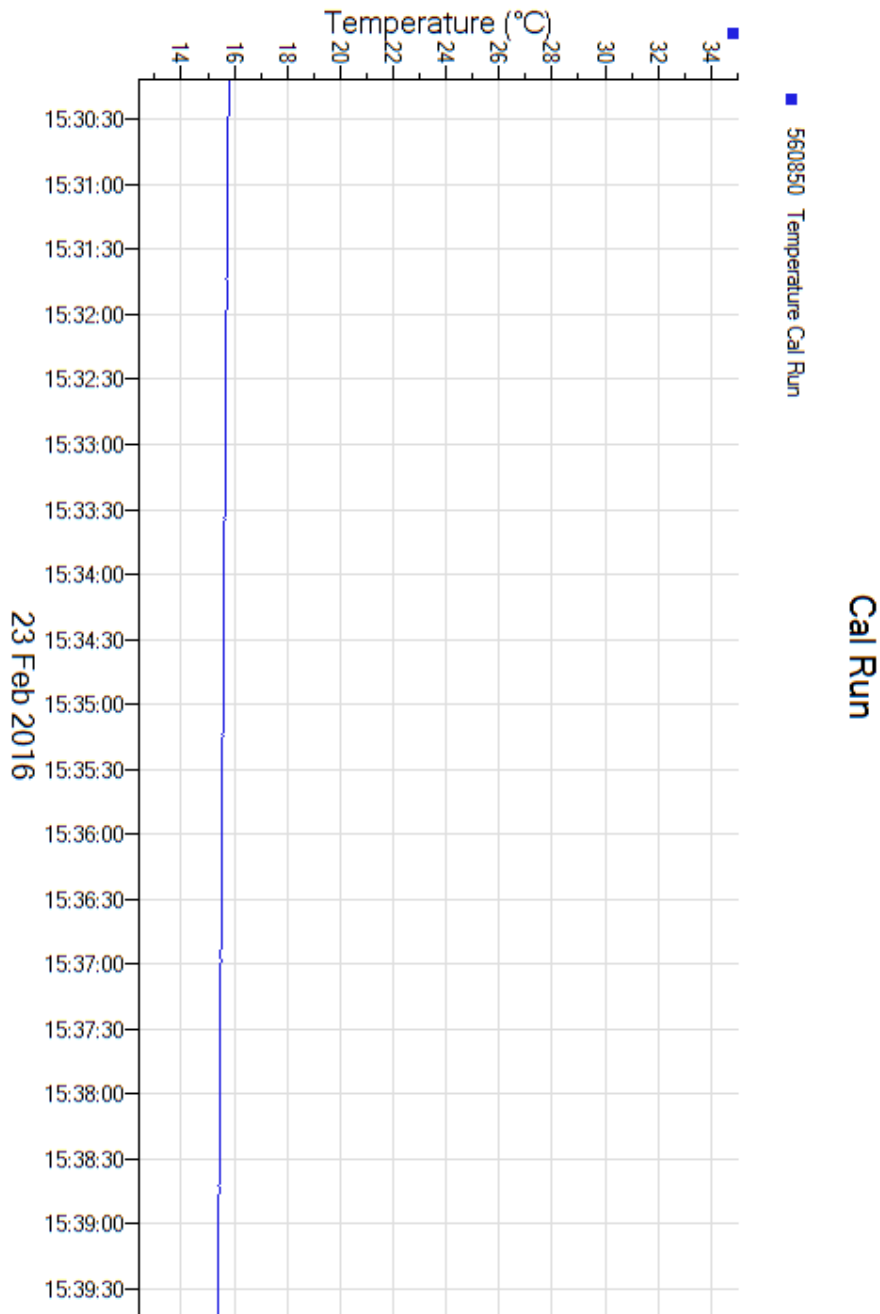
4.1 Test with 0kW load.

At 15.30 on 23rd February 2016, readings were taken as follows with cabinet installed with zero load.

Cold aisle temperatures:

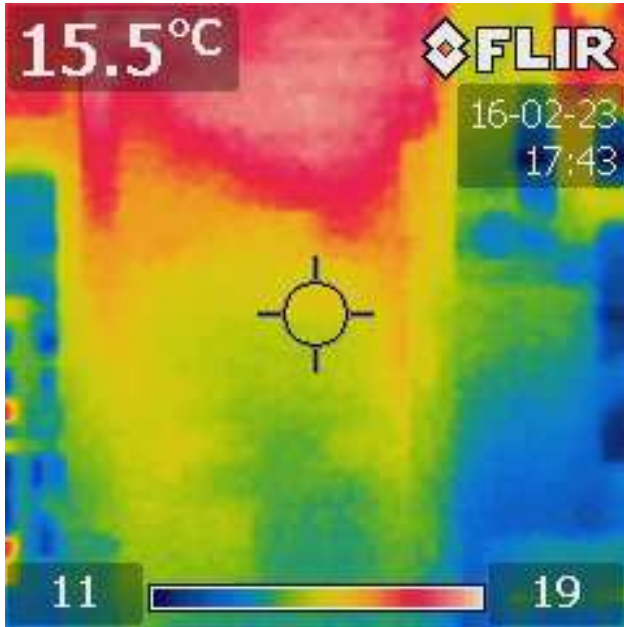


Hot aisle temperatures:

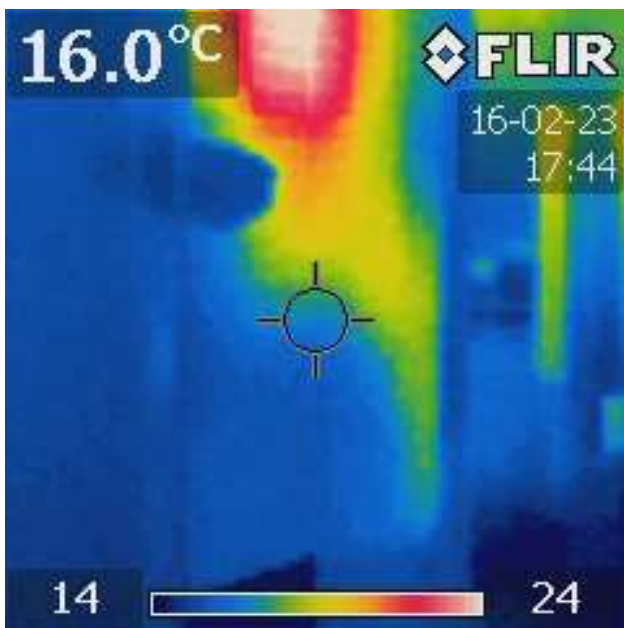


Thermal Images

Front of Cabinet



Rear of Cabinet





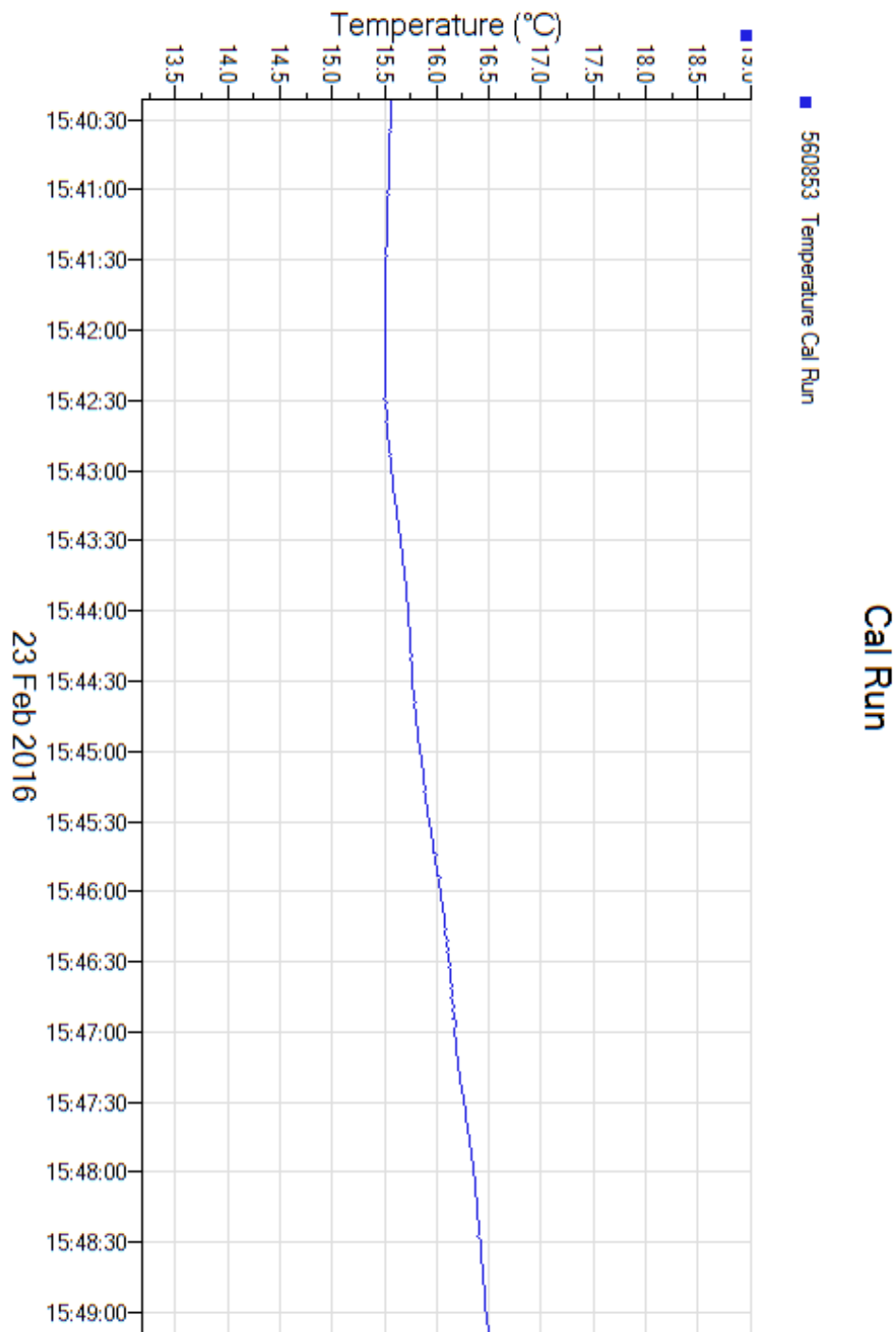
Air flow Readings

| Position (See layout) | Air flow reading |
|-----------------------|------------------|
| Top Front | 32.5 L/S |
| Bottom Front | 0 L/S |
| Top Rear | 0 L/S |
| Bottom Rear | 0 L/S |

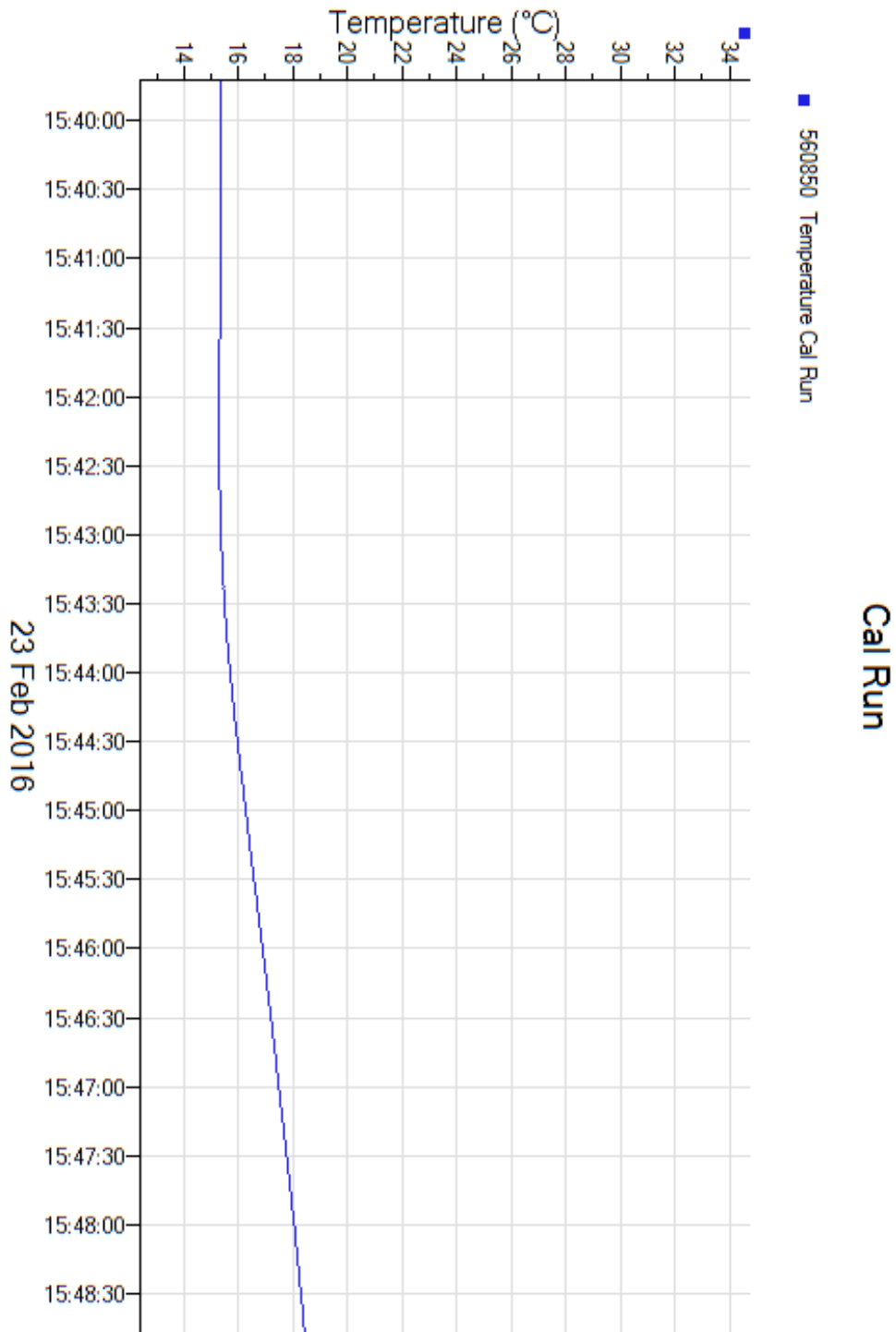
4.2 Test with 3kW load.

At 15.40 on 23rd February 2016, readings were taken as follows with cabinet installed with 3kW load.

Cold aisle temperatures:

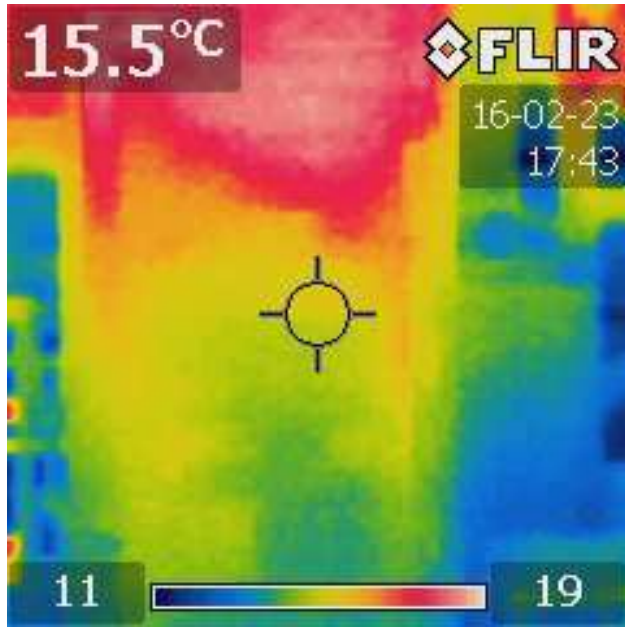


Hot aisle temperatures:

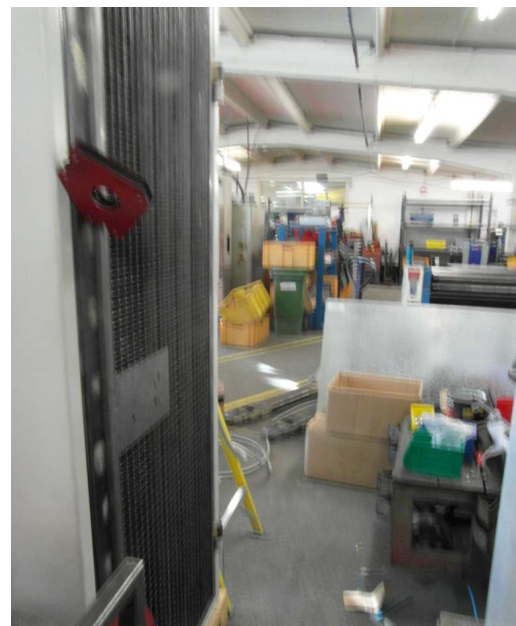
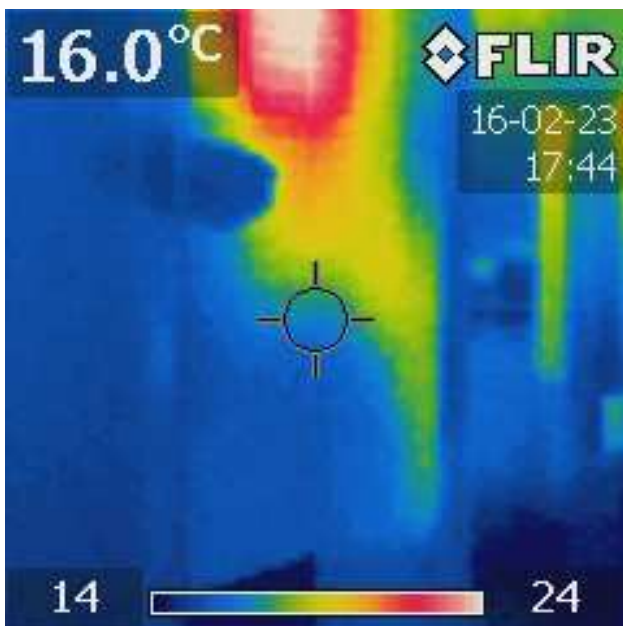


Thermal Images

Front of Cabinet



Rear of Cabinet





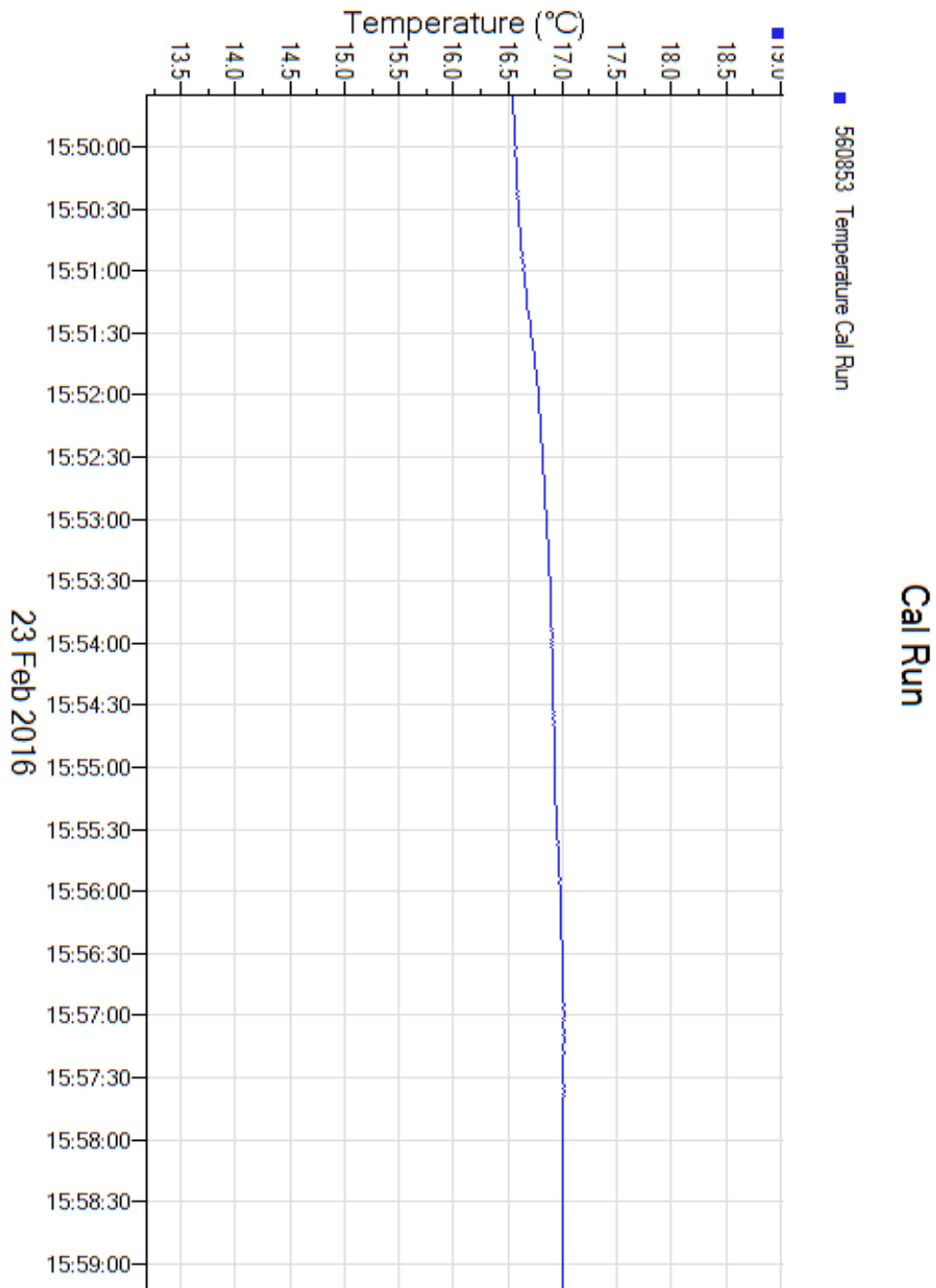
Air flow Readings

| Position (See layout) | Air flow reading |
|-----------------------|------------------|
| Top Front | 2.2m/s |
| Bottom Front | 2.8m/s |
| Top Rear | 2.7m/s |
| Bottom Rear | 5.4m/s |

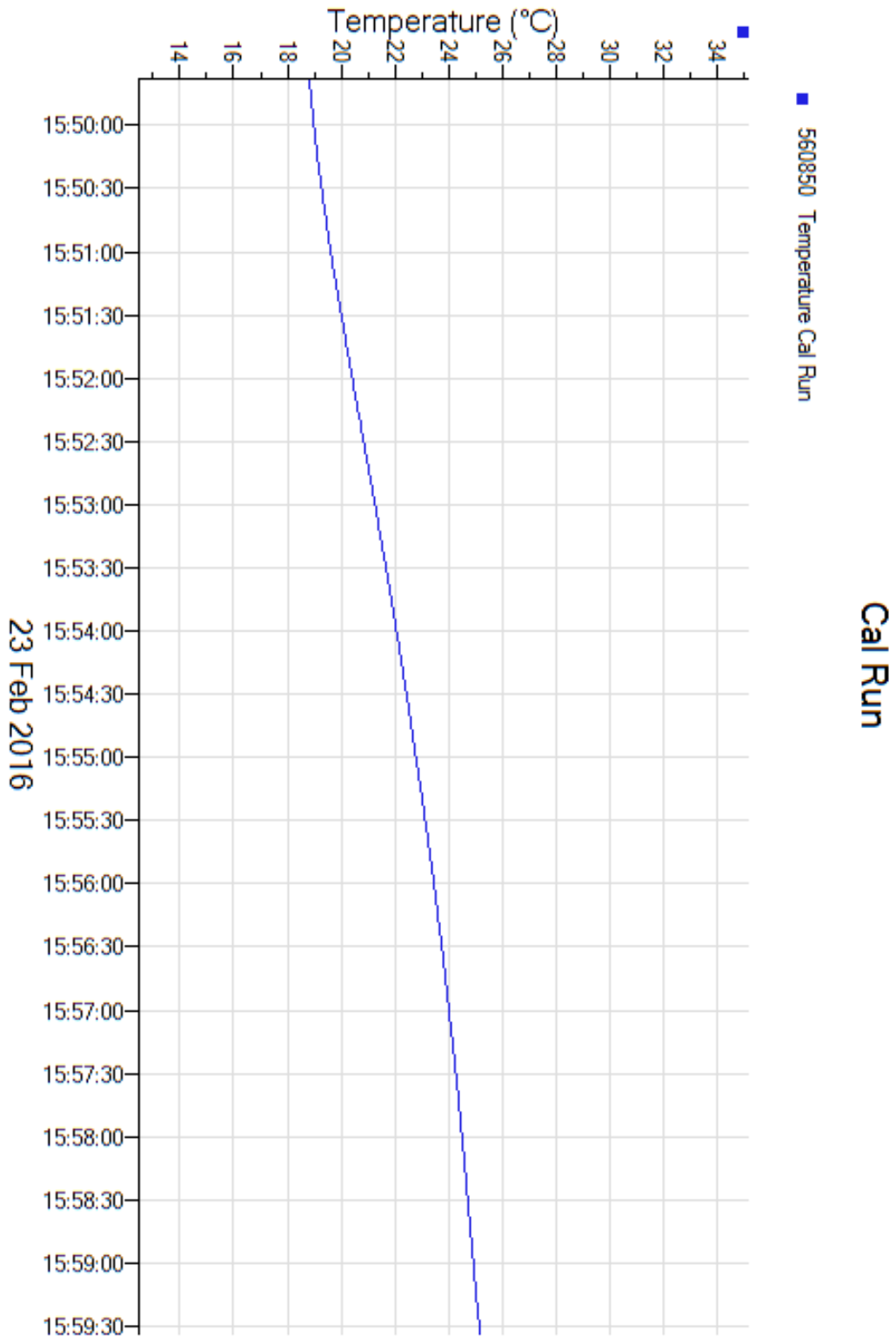
4.3 Test with 6kW load.

At 15.50 on 23rd February 2016, readings were taken as follows with cabinet installed with 6kW load.

Cold aisle temperatures:

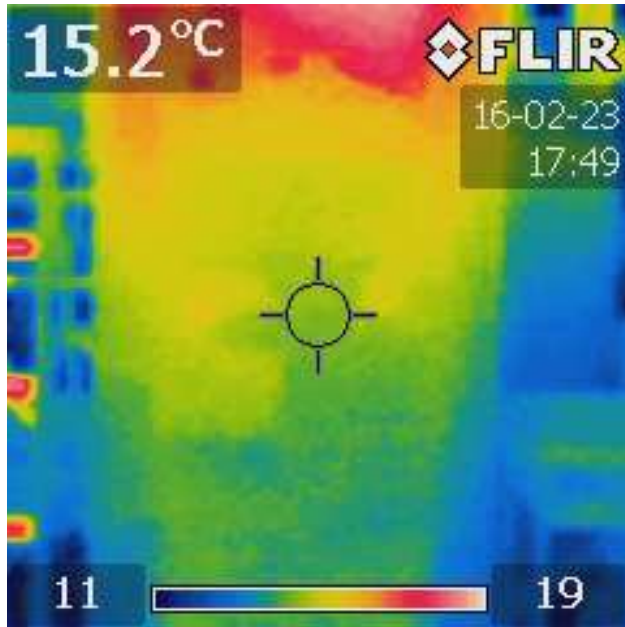


Hot aisle temperatures:

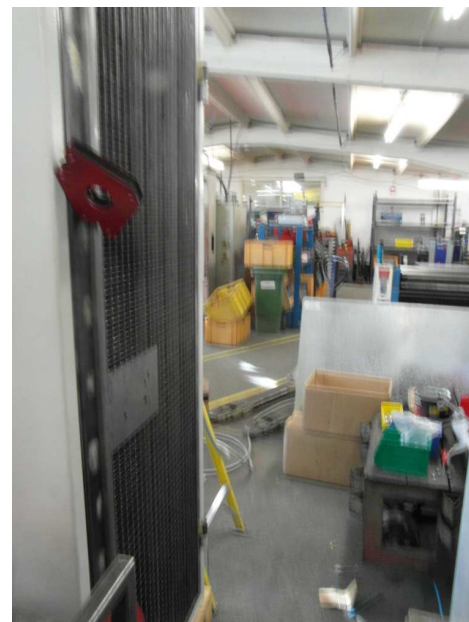
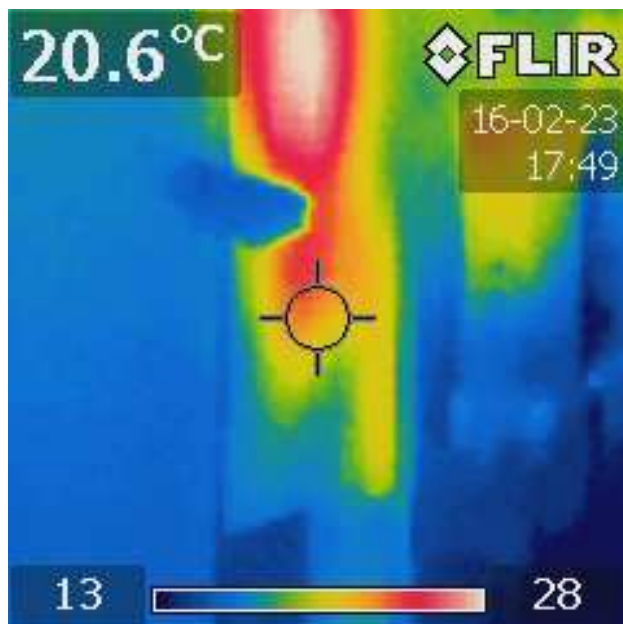


Thermal Images

Front of Cabinet



Rear of Cabinet





Air flow Readings:

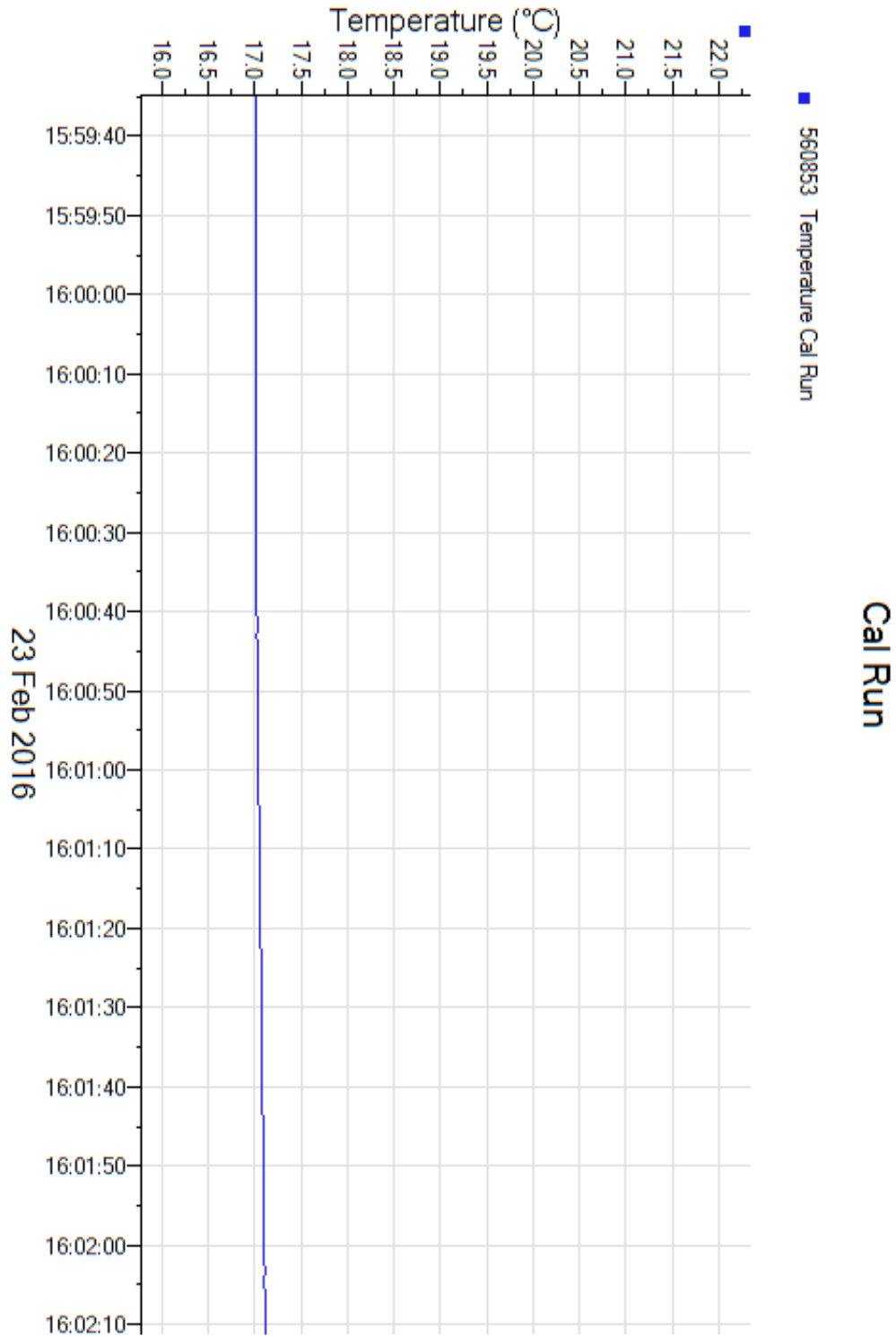
| Position (See layout) | Air flow reading |
|-----------------------|------------------|
| Top Front | 2.3m/s |
| Bottom Front | 2.9m/s |
| Top Rear | 3.1m/s |
| Bottom Rear | 5.5m/s |

4.4 Test with 9kW load.

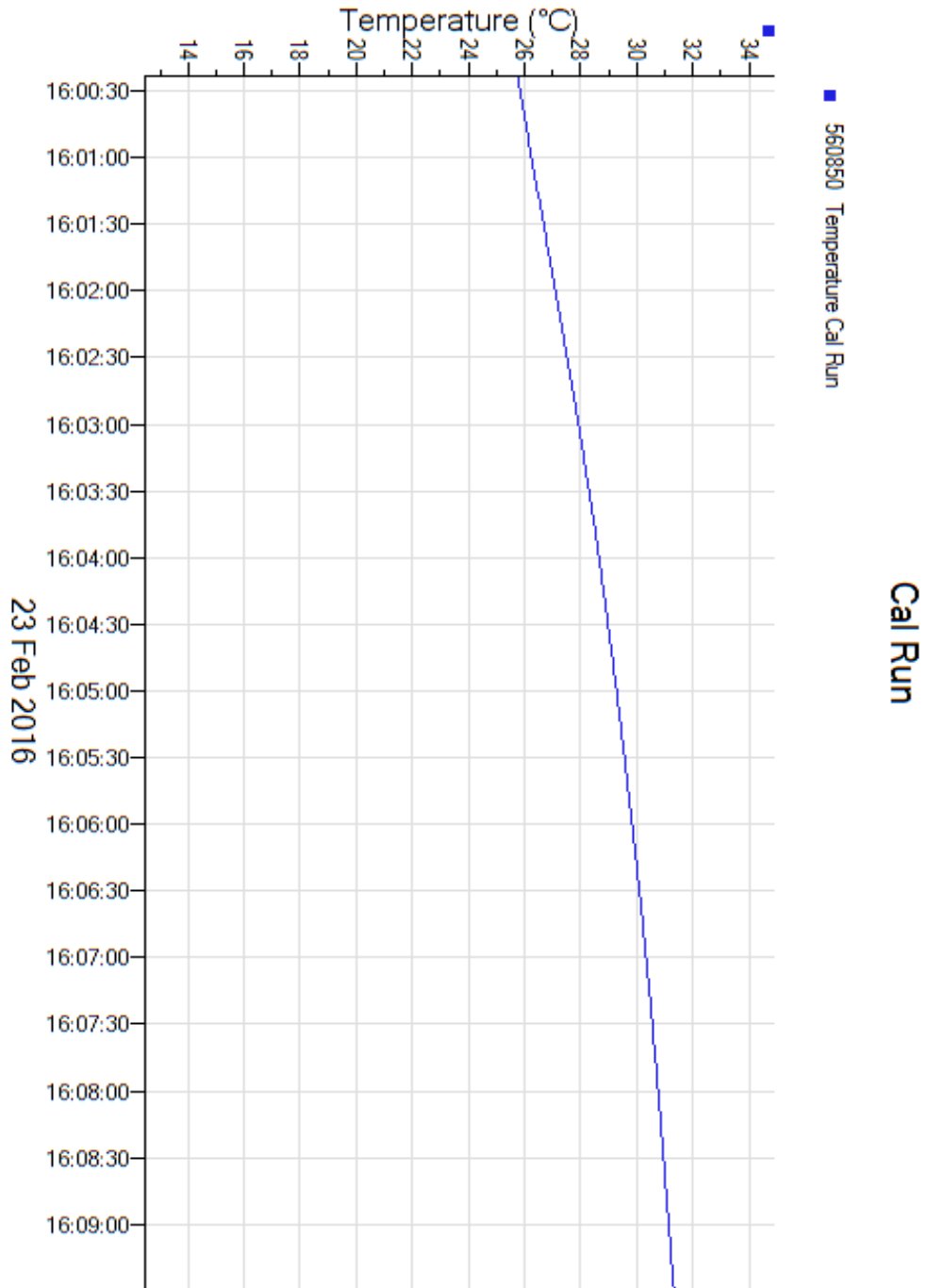
At 16.00 on 23rd February 2016, readings were taken as follows with cabinet installed with 9kW load.

The original plan was to test the cabinet at 10kW, and indeed the Server Emulators were set at 10kW. On checking the output of the pdus, we discovered the load was actually 11.2kW. The cabinet was coping well with this and therefore the testing continued at 11.2kW.

Cold aisle temperatures:

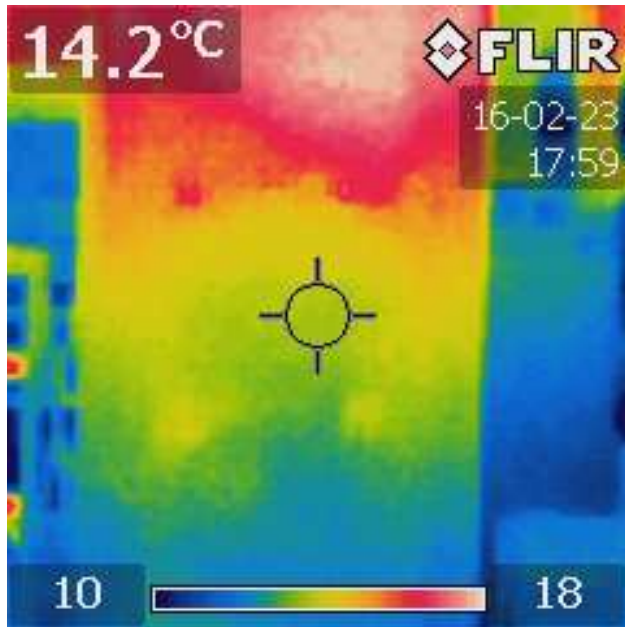


Hot aisle temperatures:

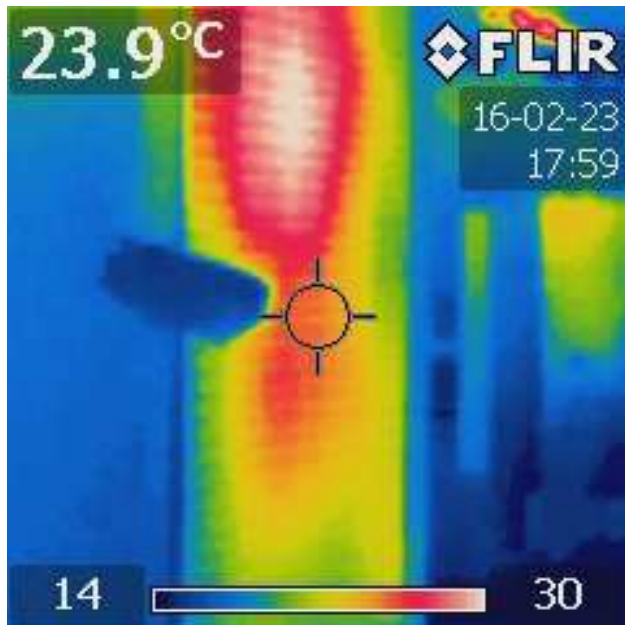


Thermal Images

Front of Cabinet



Rear of Cabinet





Air flow Readings

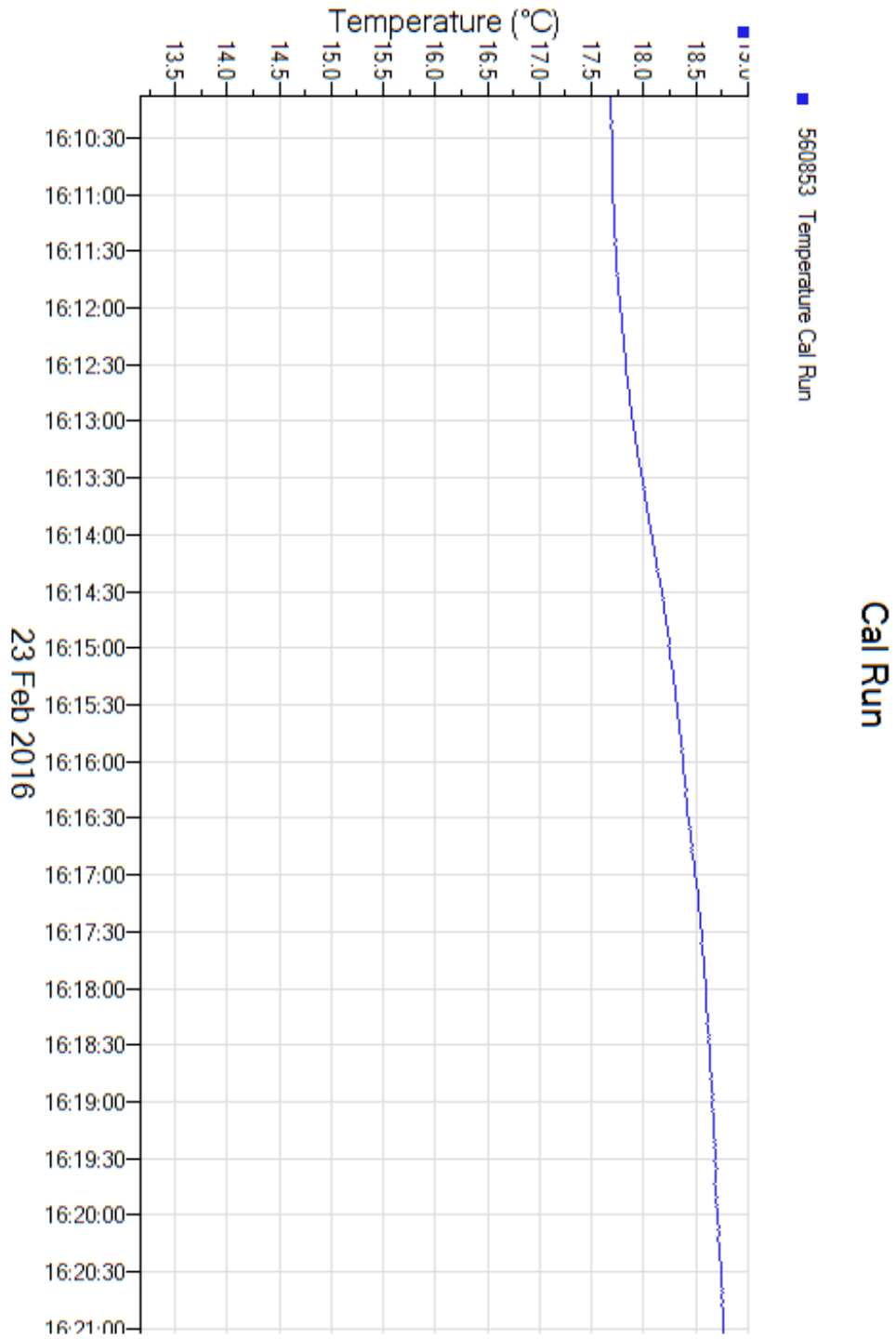
| Position (See layout) | Air flow reading |
|-----------------------|------------------|
| Top Front | 2.15m/s |
| Bottom Front | 2.7m/s |
| Top Rear | 2.6m/s |
| Bottom Rear | 5.6m/s |

4.5 Test with 12kW load.

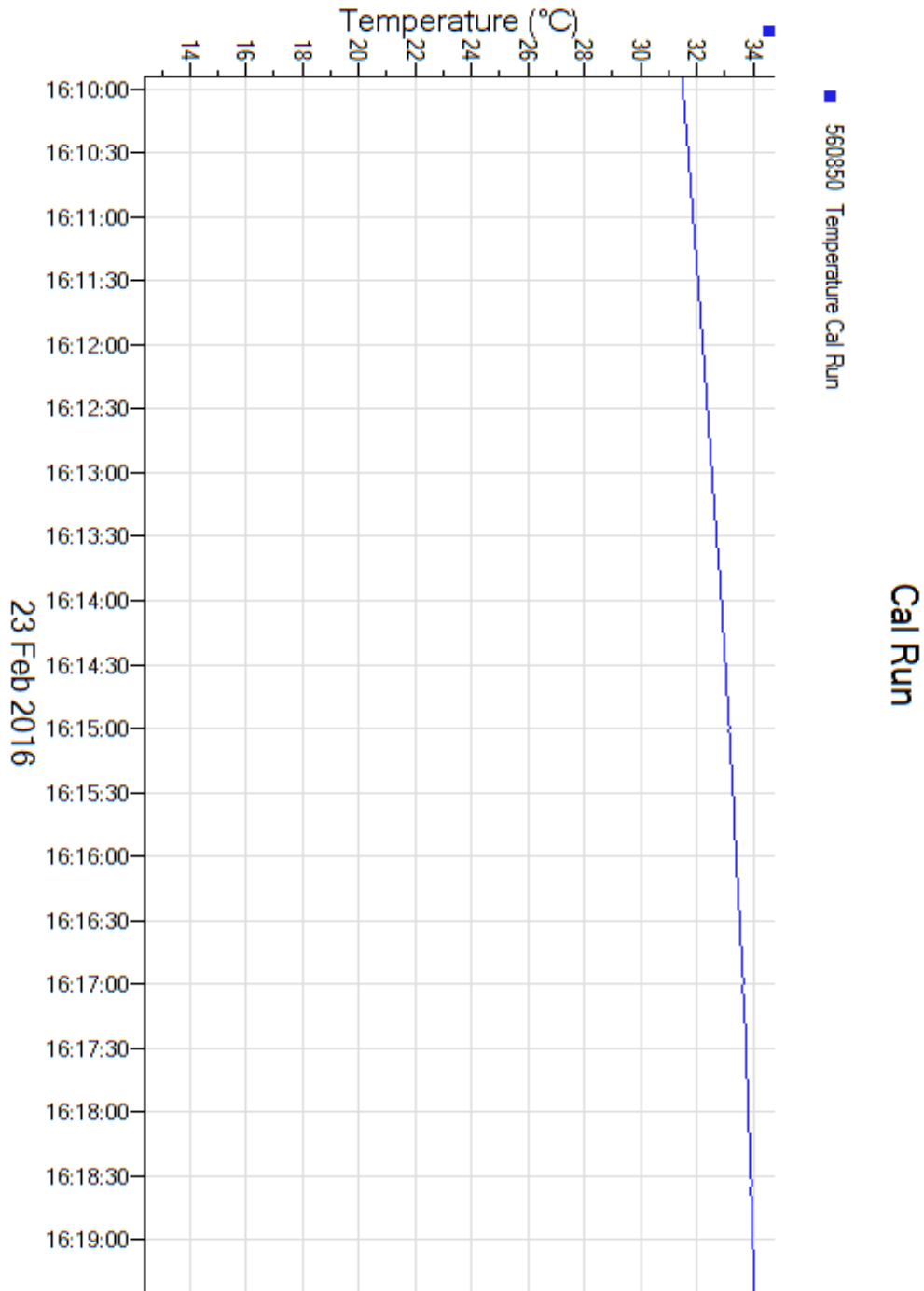
At 16.11 on 23rd February 2016, readings were taken as follows with cabinet installed with 12kW load.

The Server Fortress product is rated at 10kW, however the product was tested to 12kW and passed with flying colours as detailed below.

Cold aisle temperatures

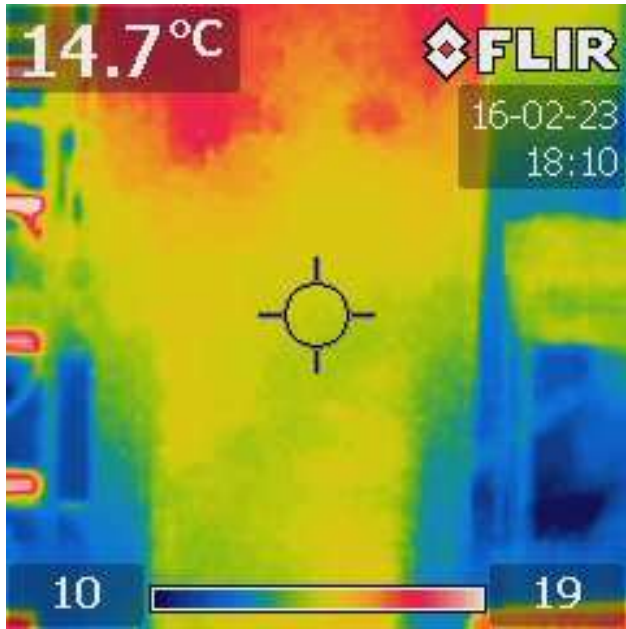


Hot aisle temperatures

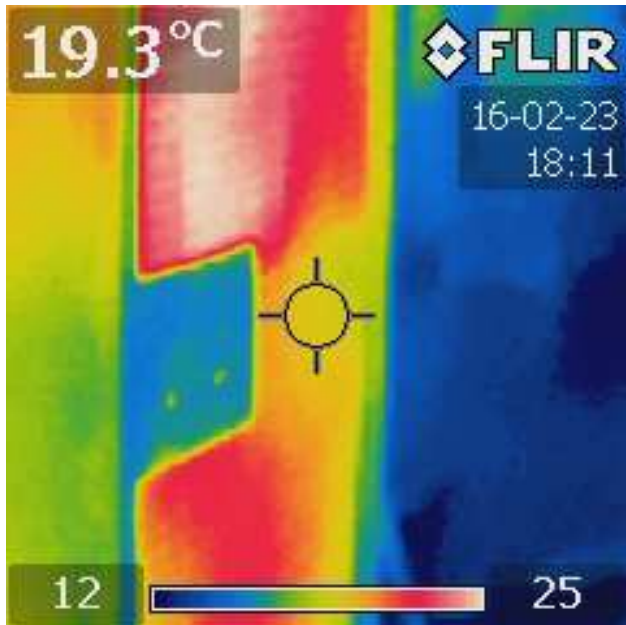


Thermal Images

Front of Cabinet



Rear of Cabinet



Air flow Readings

| Position (See layout) | Air flow reading |
|-----------------------|------------------|
| Top Front | 2.2m/s |
| Bottom Front | 2.6m/s |
| Top Rear | 2.5m/s |
| Bottom Rear | 5.9m/s |

4.6 Conclusion

We are pleased to conclude that The Server Fortress cabinet passed and exceeded the design specification for heat load.

The results detailed within this report demonstrate that the cabinet successfully handled a heat load of at least up to 12 kW.

Stephen D Ford

Stephen.ford@e1e10.com

Tel. +44 (0) 1223 421838

Fax. +44 (0)1223 420844

Mob. +44 (0)7740 795359