Test & Validation for QD Option Software

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The VersaLab

What it is:

a small cryogen -free cryocooler-based Vibrating Sample Magnetometer (VSM)

What it does:

Temp range: 50K to 400K

Magnetic range: -3 to 3 Tesla

Who uses it:

Universities, Industries, Laboratories, and other programs exploring what certain samples do at various temperatures and/or magnetic fields.

Option Software Testing on VersaLab

- VSM Errors
  - activation alarms - passed
  - VSM temperature control fails - passed
  - Final Test: Magnet - passed
  - Scan Temperature with No Overshoot - passed
- VSM Oven Errors
  - **No Overshoot (crash & overshooting) - passed**
  - Fast Temperature Rate causes Crash - passed

Software Testing

Objectives:

- Ensure that the customer will not run into any difficulties performing any of the predicted tasks
- Ensure that the results given are accurate and meaningful

Approaches:

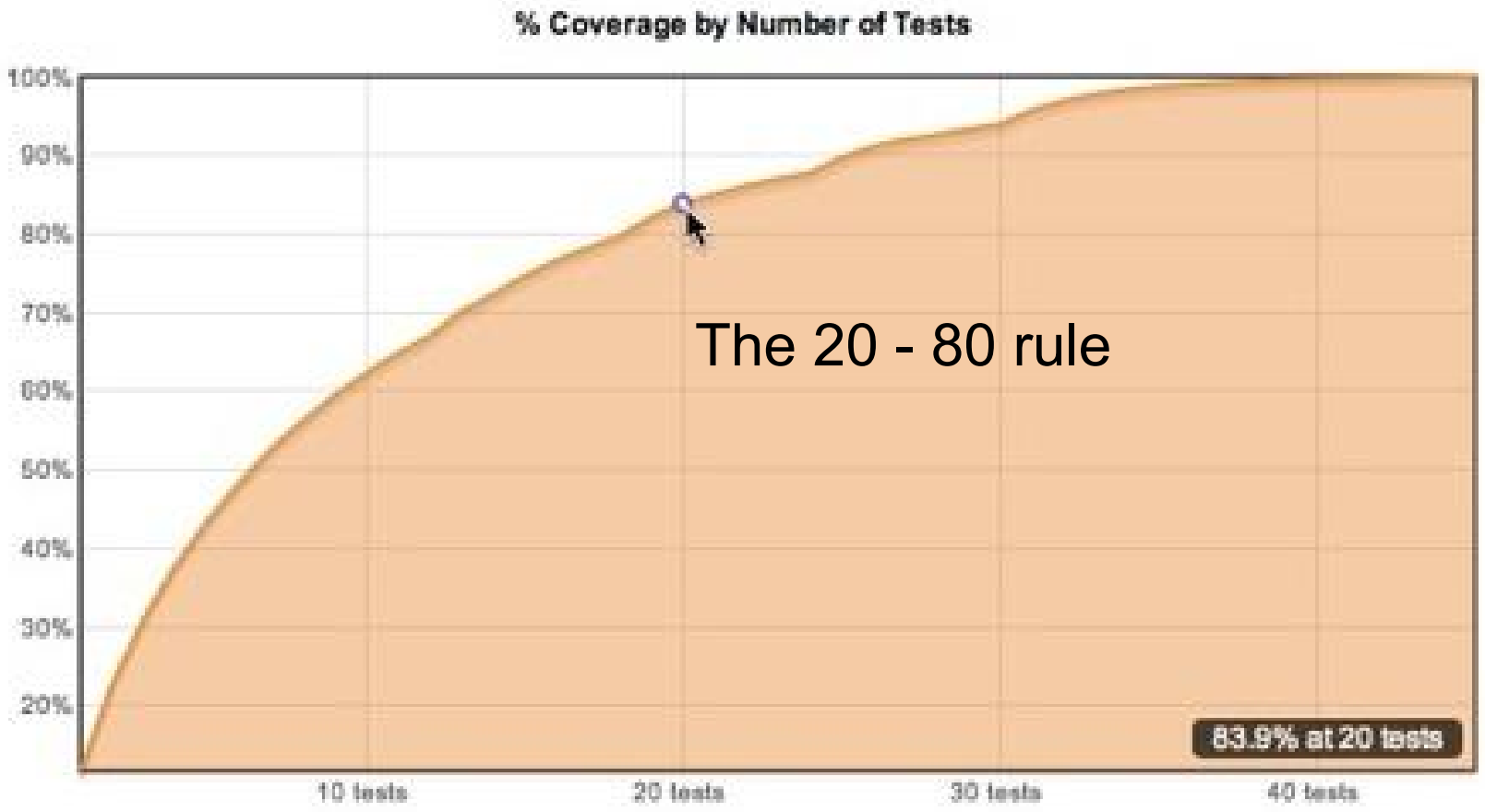
- Ad Hoc or Formal

- Graphical User Interface (GUI), MultiVu, Option Interface, or CAN Interface

The Test Process

http://www.sdlc.ws/software-testing-life-cycle-stlc-complete-tutorial/

Test Coverage



Test Coverage

- Glass Box- exercise all possible pathways (complete structure known)
- Black Box- exercise for functionality; “Can it do what it needs to?”
- Path Testing: coverage criteria
  - Line coverage: execution of every line once; **weakest**
  - Branch coverage: go down every path (true and false); complete coverage (but not complete testing); **50%**
  - Condition coverage: each possibility (true, false 1, false 2, false 3); **the best**

Defect Tracking

- **Progress Tracking:** new, in-progress, finished
- **Statistics:** accurate glimpse at state of product, allocating time & resources
- **Setting Milestones**
- **Accountability:** ownership of tickets and progress

Three Parts To Every Good Bug Report

And the Lord spake, saying, "First shalt thou take out the Holy Pin. Then, shalt thou count to three, no more, no less. Three shall be the number thou shalt count, and the number of the counting shalt be three. Four shalt thou not count, nor either count thou two, excepting that thou then proceed to three. Five is right out. Once the number three, being the third number, be reached, then lobbest thou thy Holy Hand Grenade of Antioch towards thou foe."

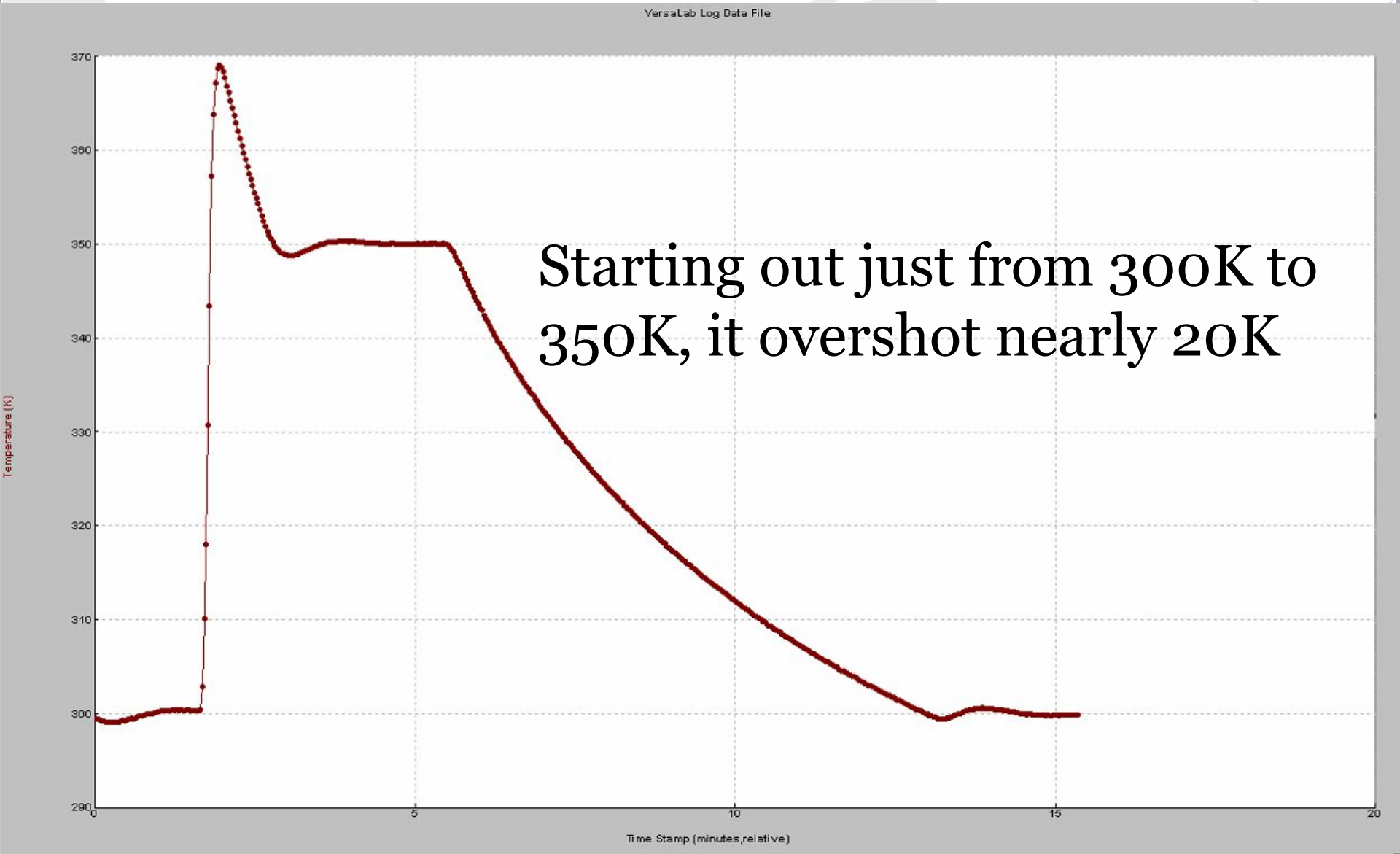
-- Monty Python and the Holy Grail

Every good bug report needs exactly three things.

1. Steps to reproduce
2. What you expected to see
3. What you saw instead

Joel Spolsky, “Painless Bug Tracking“ 2000

The No Overshoot Problem



Starting out just from 300K to 350K, it overshot nearly 20K

PID Calculations

Proportional - Integral - Differential Controller (PID)

Proportional Gain- proportional to current error value, adjusts stability.

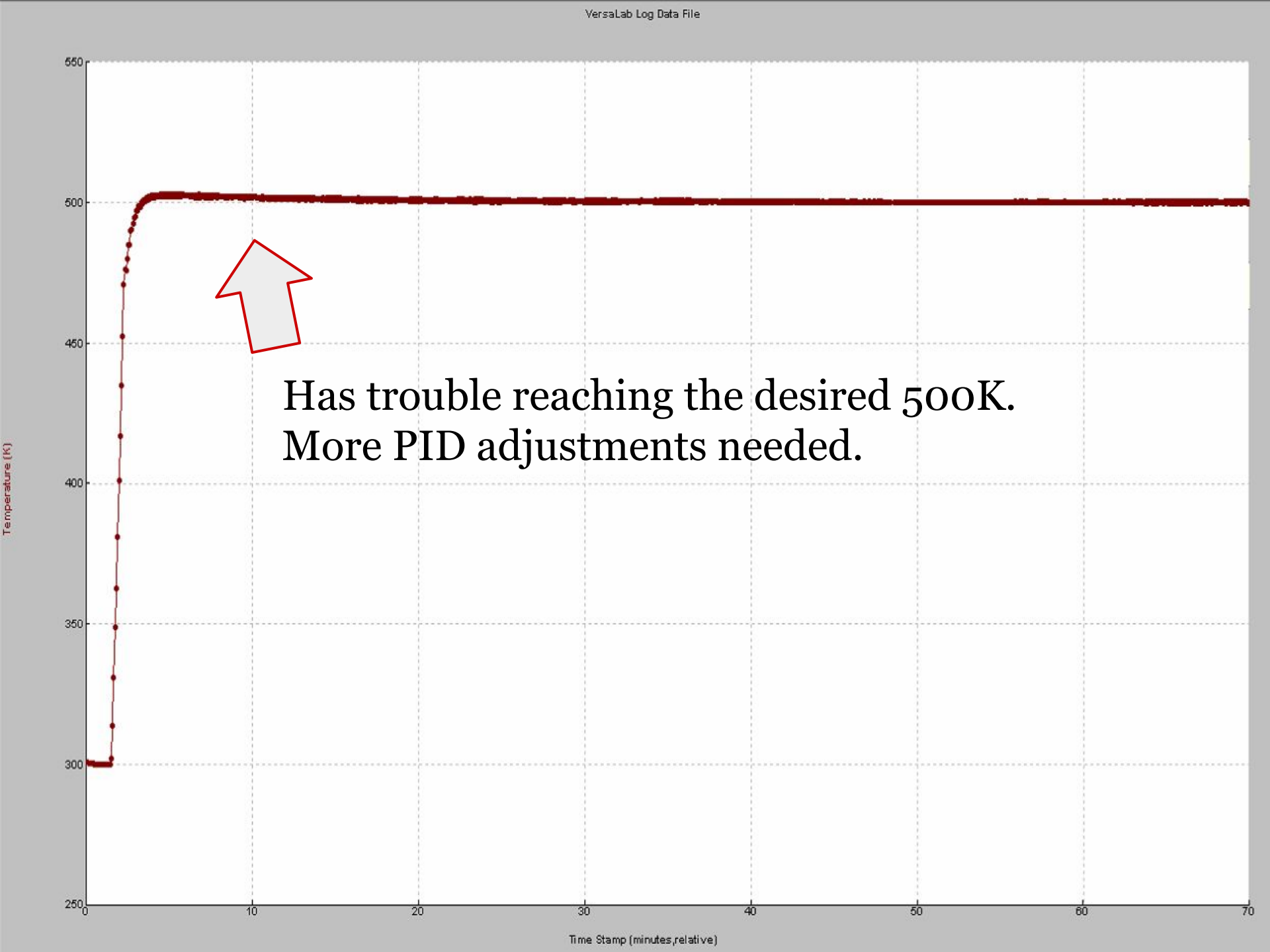
$$P_{\text{out}} = K_p\, e(t)$$

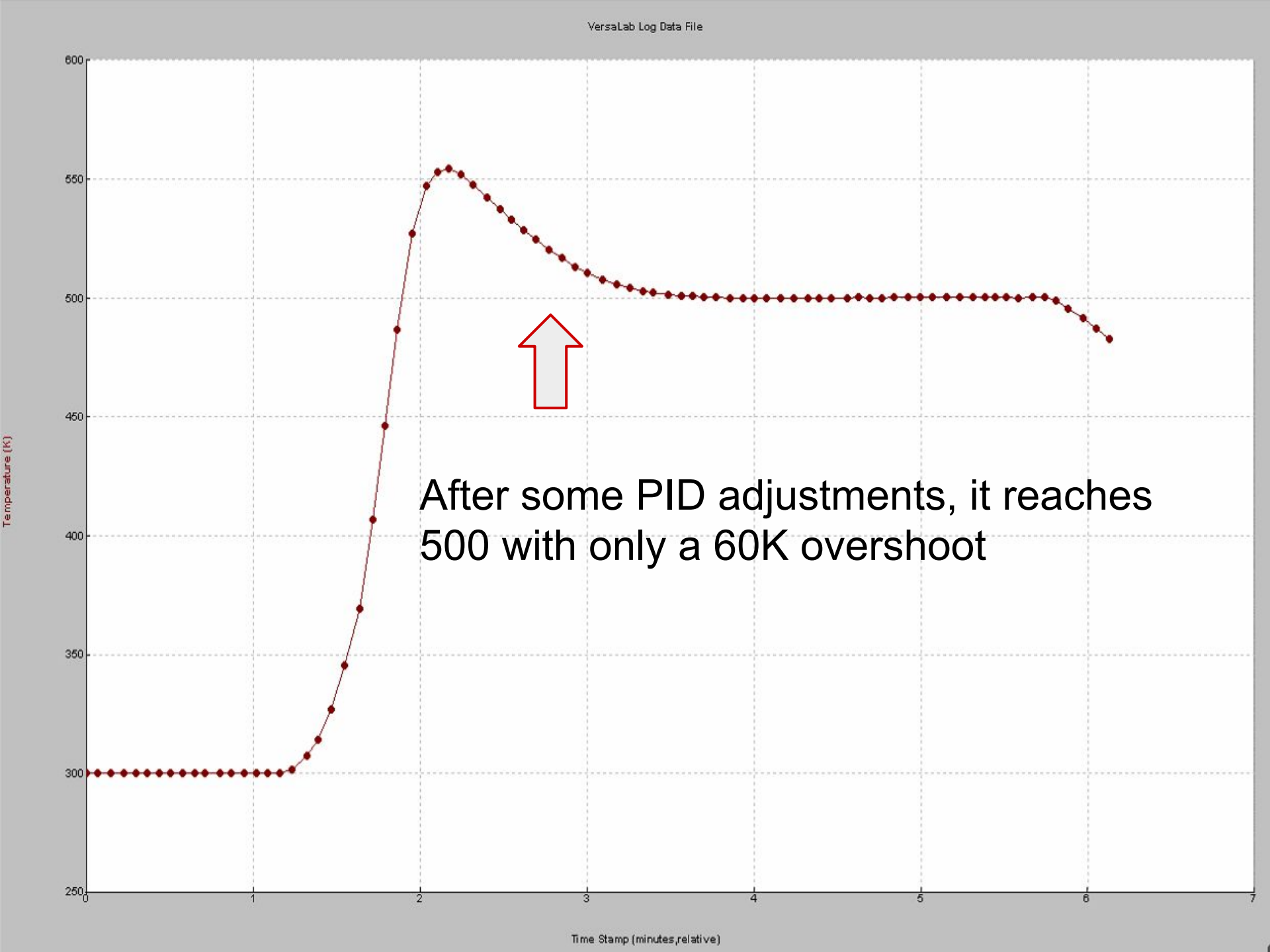
Integral Gain- proportional to current error magnitude and duration, reaches the set point.

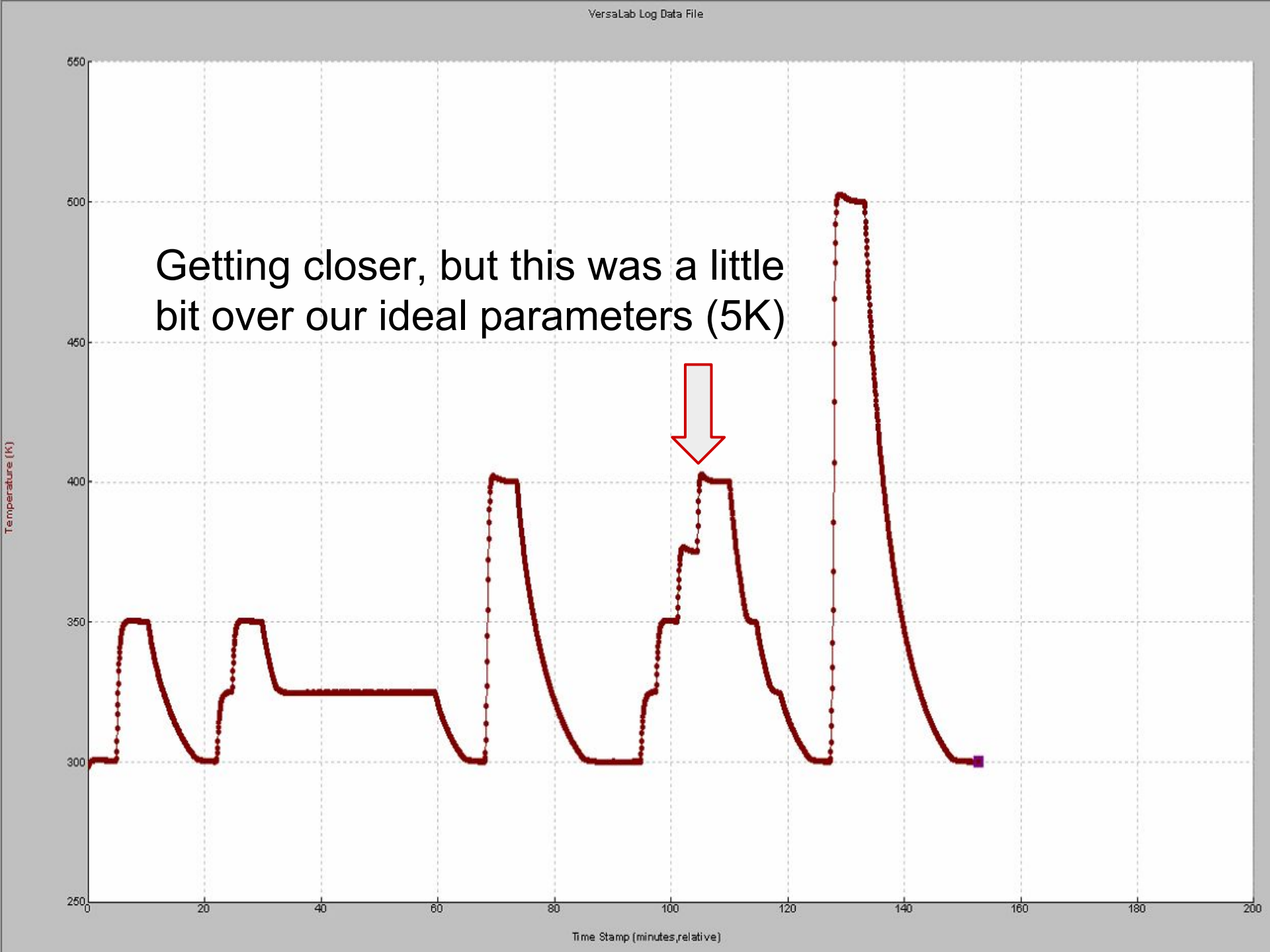
$$I_{\text{out}} = K_i \int_0^t e(\tau)\, d\tau$$

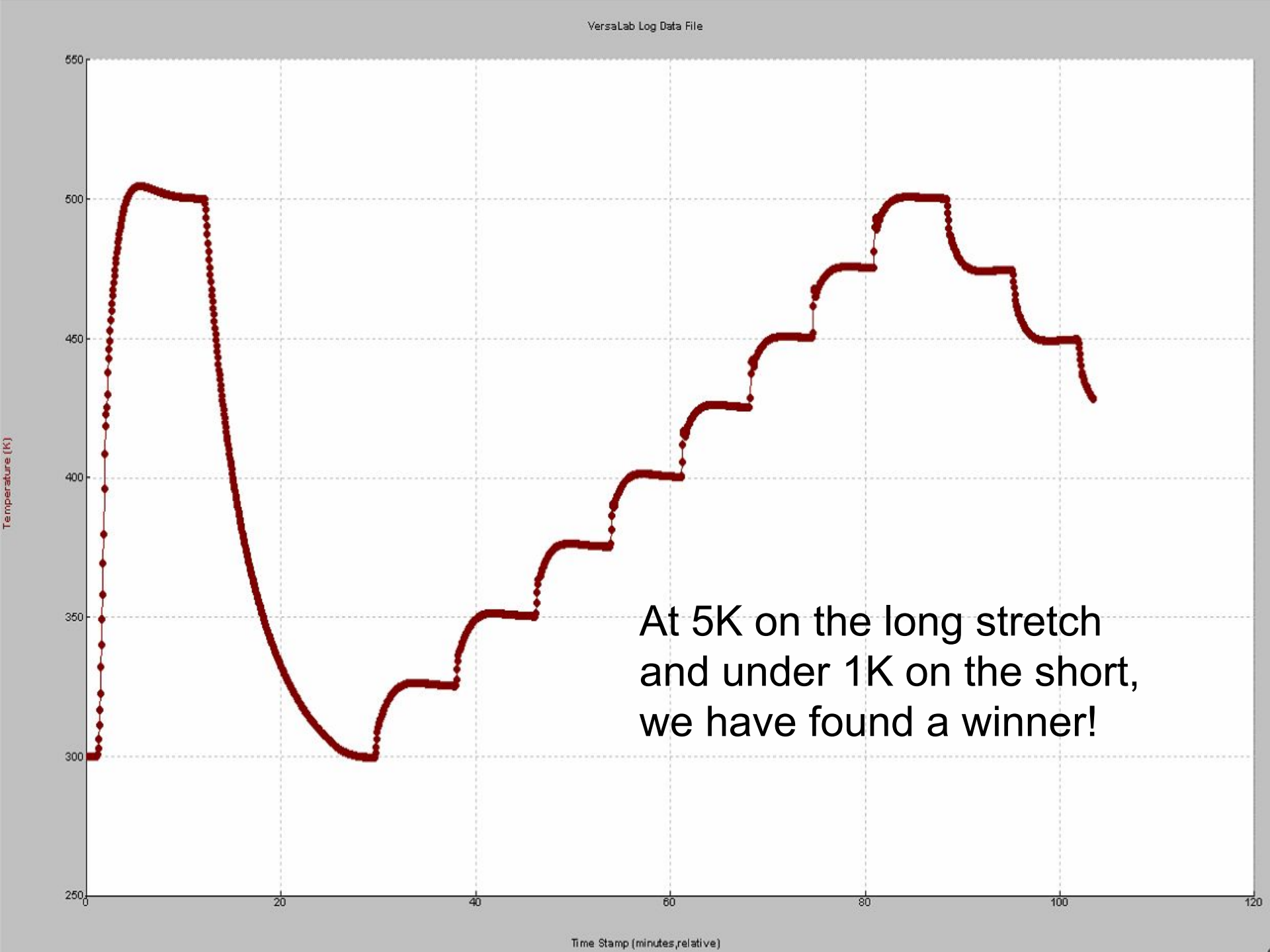
Differential Gain- proportional to error's slope.

$$D_{\text{out}} = K_d \frac{d}{dt} e(t)$$


VersaLab Log Data File
550
500
450
400
350
300
250
Temperature (K)
0
10
20
30
40
50
60
70
Time Stamp (minutes,relative)
Has trouble reaching the desired 500K.
More PID adjustments needed.


VersaLab Log Data File
600
550
500
450
400
350
300
250
Temperature (K)
0
1
2
3
4
5
6
7
Time Stamp (minutes,relative)
After some PID adjustments, it reaches 500 with only a 60K overshoot

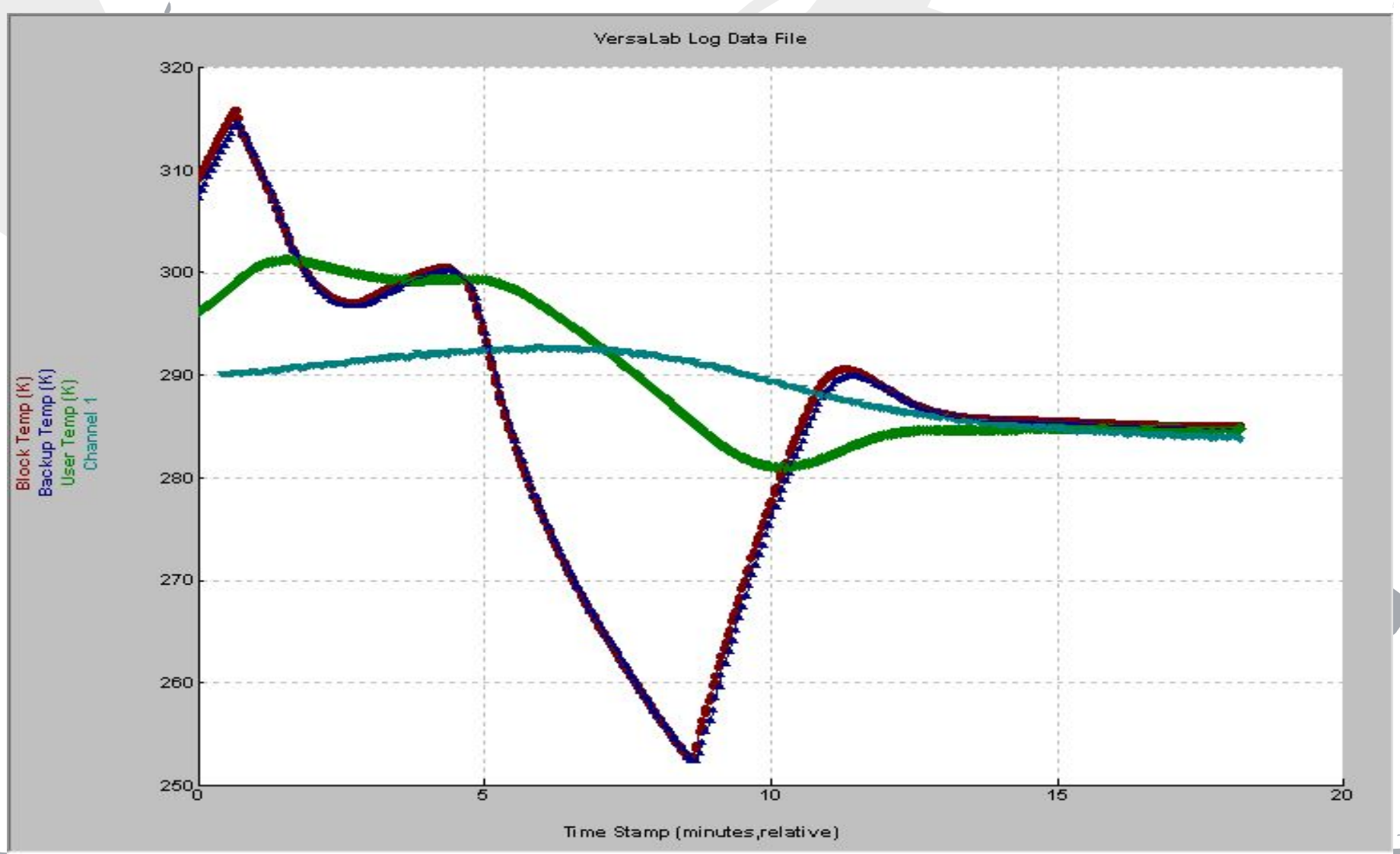

VersaLab Log Data File
Getting closer, but this was a little bit over our ideal parameters (5K)
Temperature (K)
550
500
450
400
350
300
250
0
20
40
60
80
100
120
140
160
180
200
Time Stamp (minutes,relative)

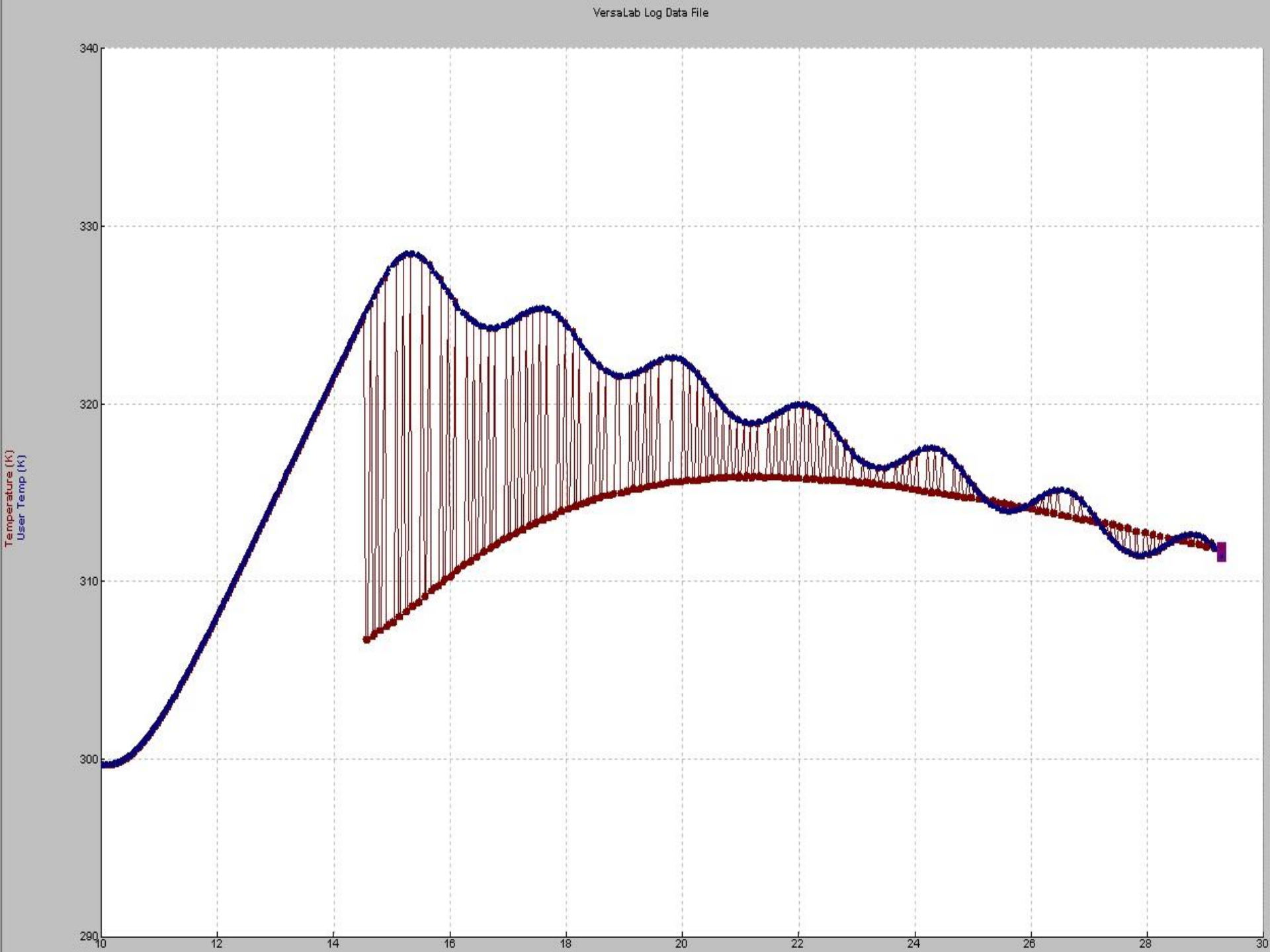

VersaLab Log Data File
550
500
450
400
350
300
250
Temperature (K)
0
20
40
60
80
100
120
Time Stamp (minutes,relative)
At 5K on the long stretch
and under 1K on the short,
we have found a winner!

Thank you all for coming!

And a special thanks to Petar, Tofik, and Mark W. for their work, patience, and support this summer.

A Bizarre Assortment of (2) Unreproducible Occurrences




VersaLab Log Data File
Temperature (K)
User Temp (K)
340
330
320
310
300
290
10
12
14
16
18
20
22
24
26
28
30