

RHIC Run24 100 GeV Au

12x150A lead readiness review

First ramp test

F.Micolon – August 2024

Introduction

Why are we interested in the lead behaviors?

- The Aug 1st 2023 QLI event lead to extensive repairs and a 6 month RHIC shutdown. It was attributed to an electrical breakdown in the blue VB4 12x150 A superconducting lead – Review [link](#) for details
- The failure was attributed to structural fatigue of the lead due to large temperature variations in operation ([IPAC24 paper TUPR56](#))
- 100 GeV Au marks the return of RHIC high energy operation (the earlier Run24 was proton 100 GeV with only moderate currents)
- A test of the 100 GeV Au currents was done Aug 28st to review the leads readiness (dwell time was only ~5 min for each lead). A longer dwell time will be done when the ramp/shut down test is done by PSG. Will need a day to review all resistance circuit after shutdown test before handing over to MCR.

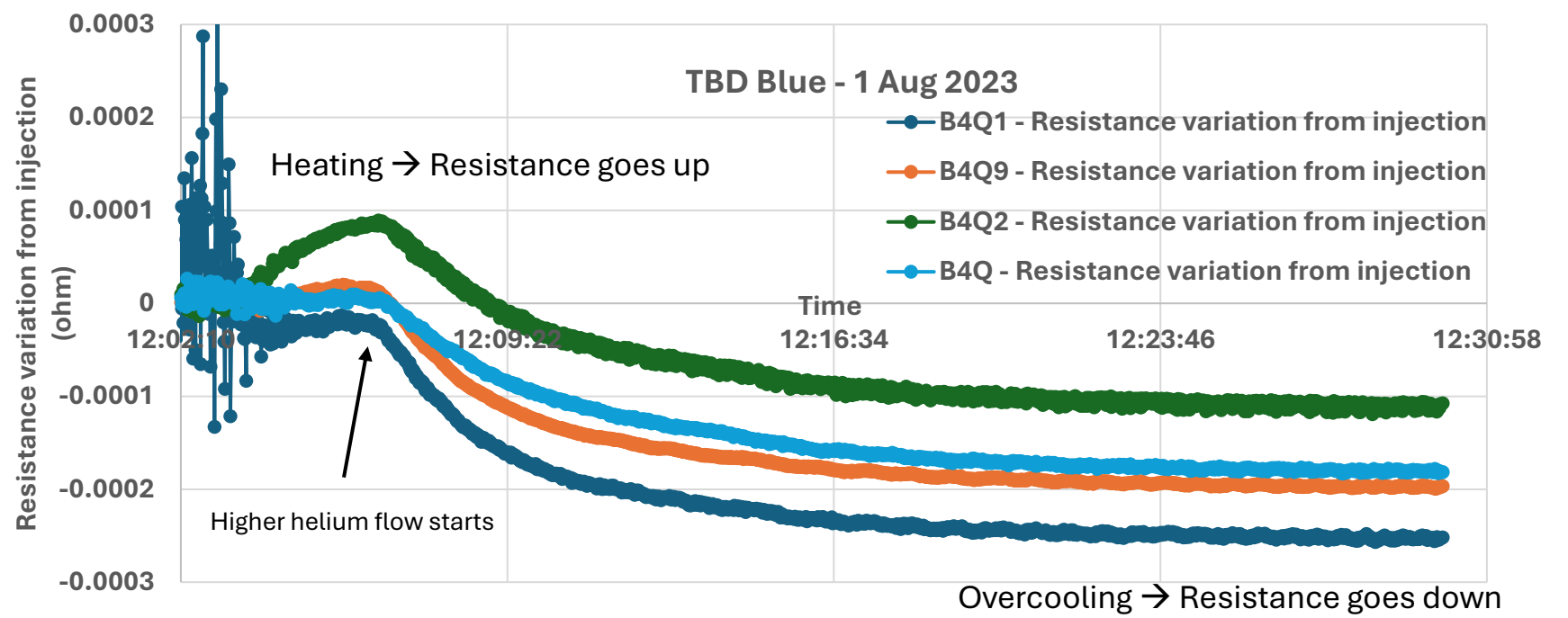
Outline

- 1004 valvebox : Blue lead TBD, TBB Yellow TBD TBB
- Problematic circuits identified and proposed course of action

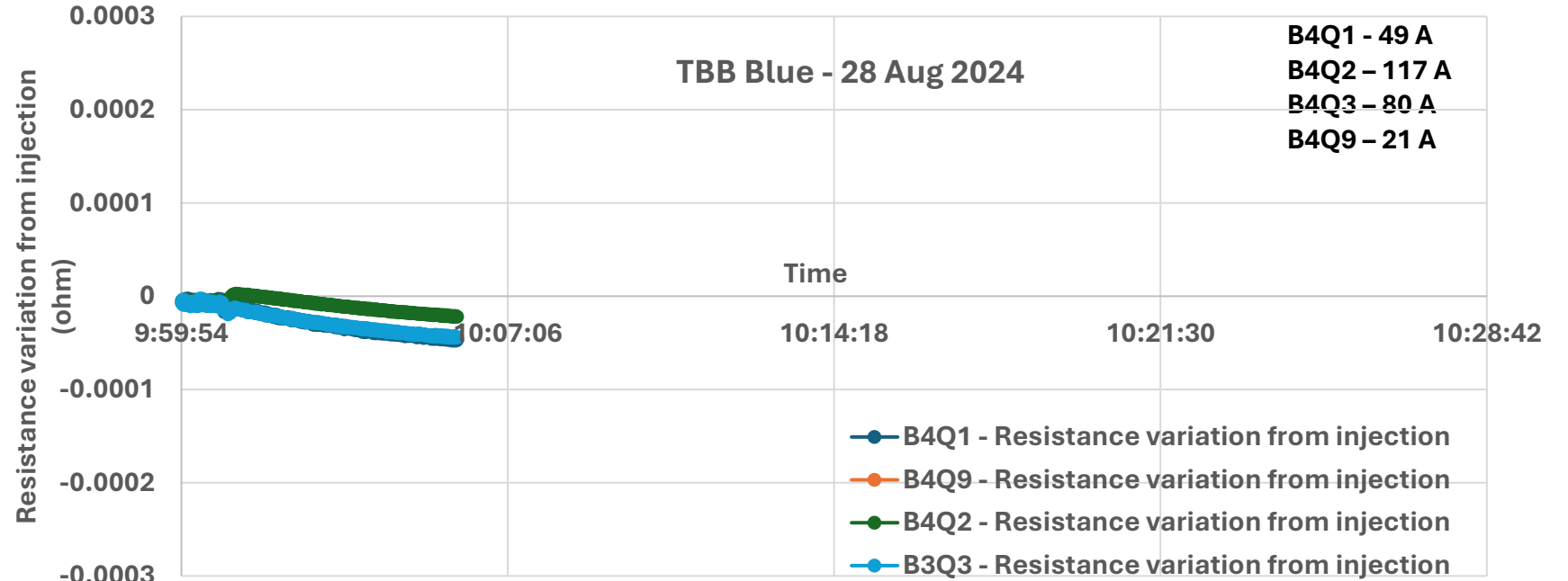
1004 valvebox – Blue Yellow TBDs TBBs

B4 TBD comparison

Before (1 Aug 2023)



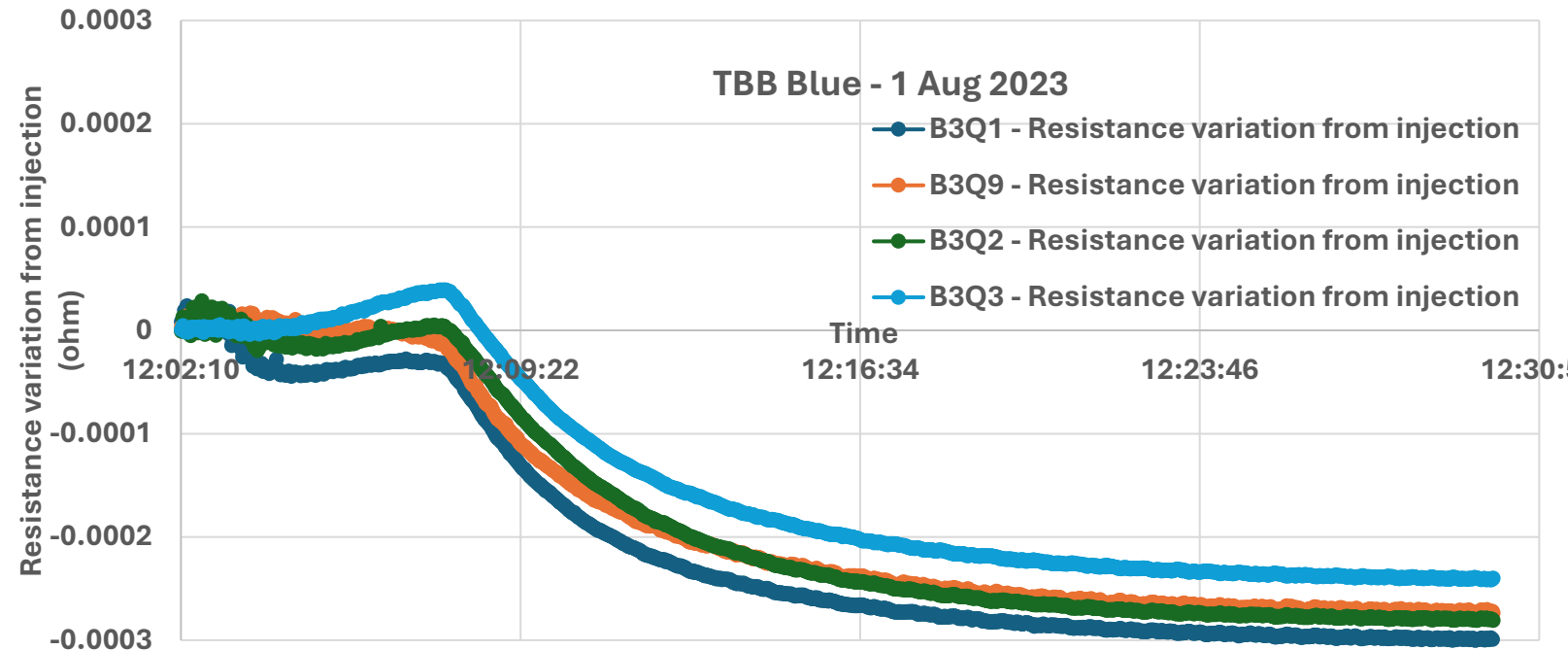
After (28 Aug 2023)
New helium flow law



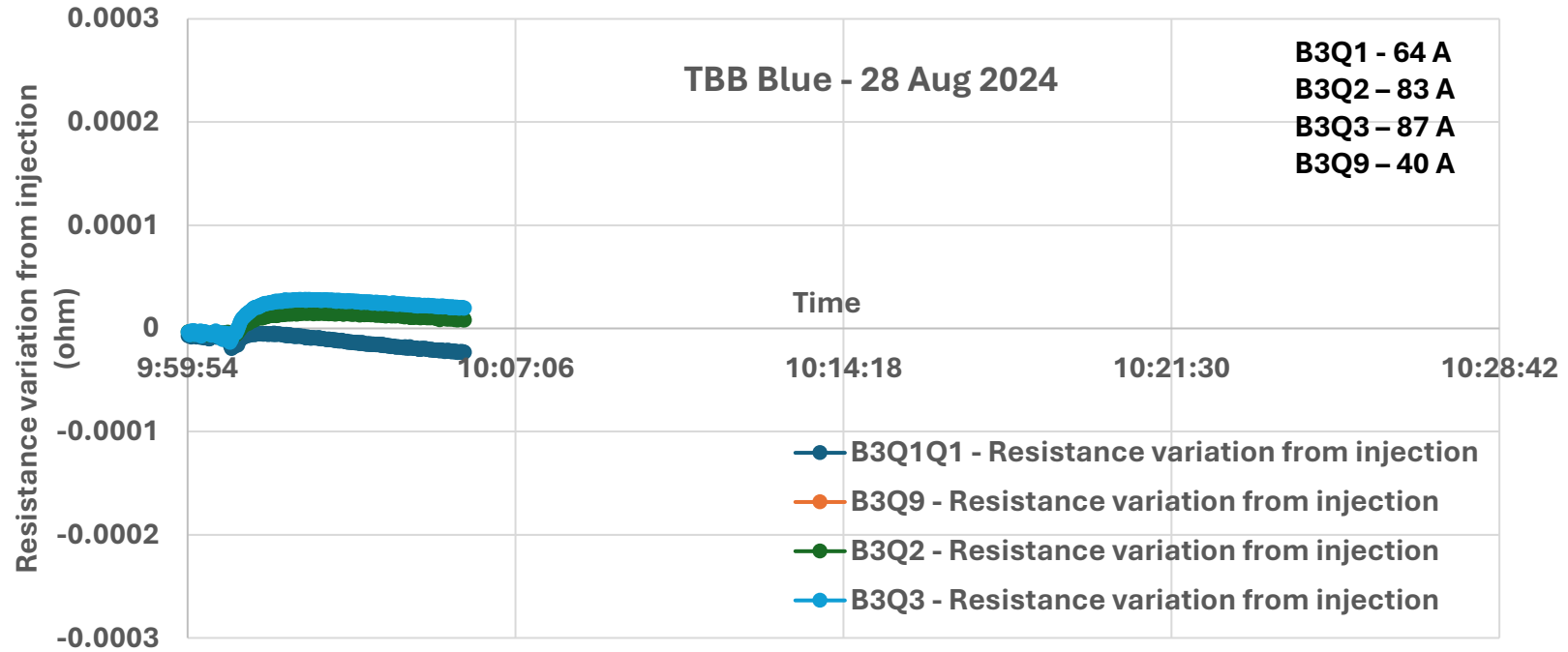
Looks much stabler than before.
General slow decrease.
Will need to review longer dwell time.

B3 TBB comparison

Before (1 Aug 2023)



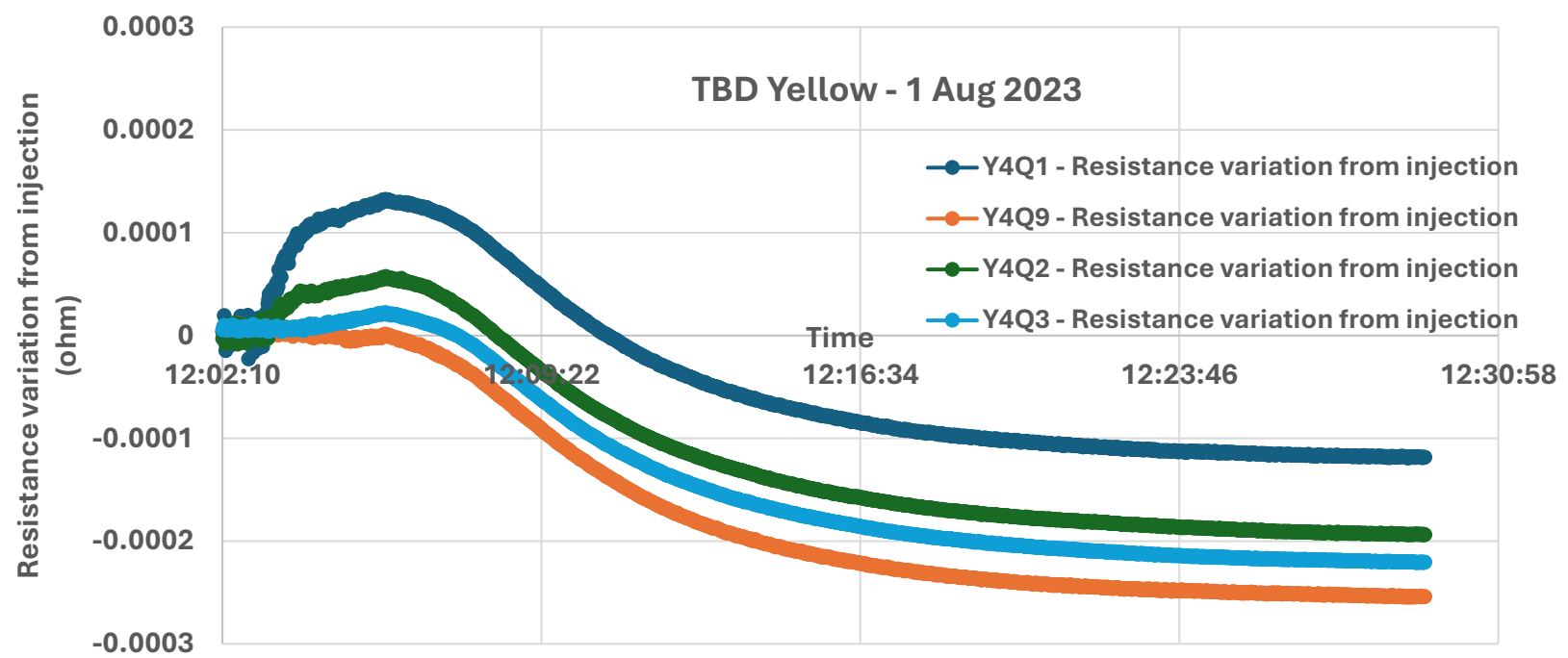
After (28 Aug 2023)
New helium flow



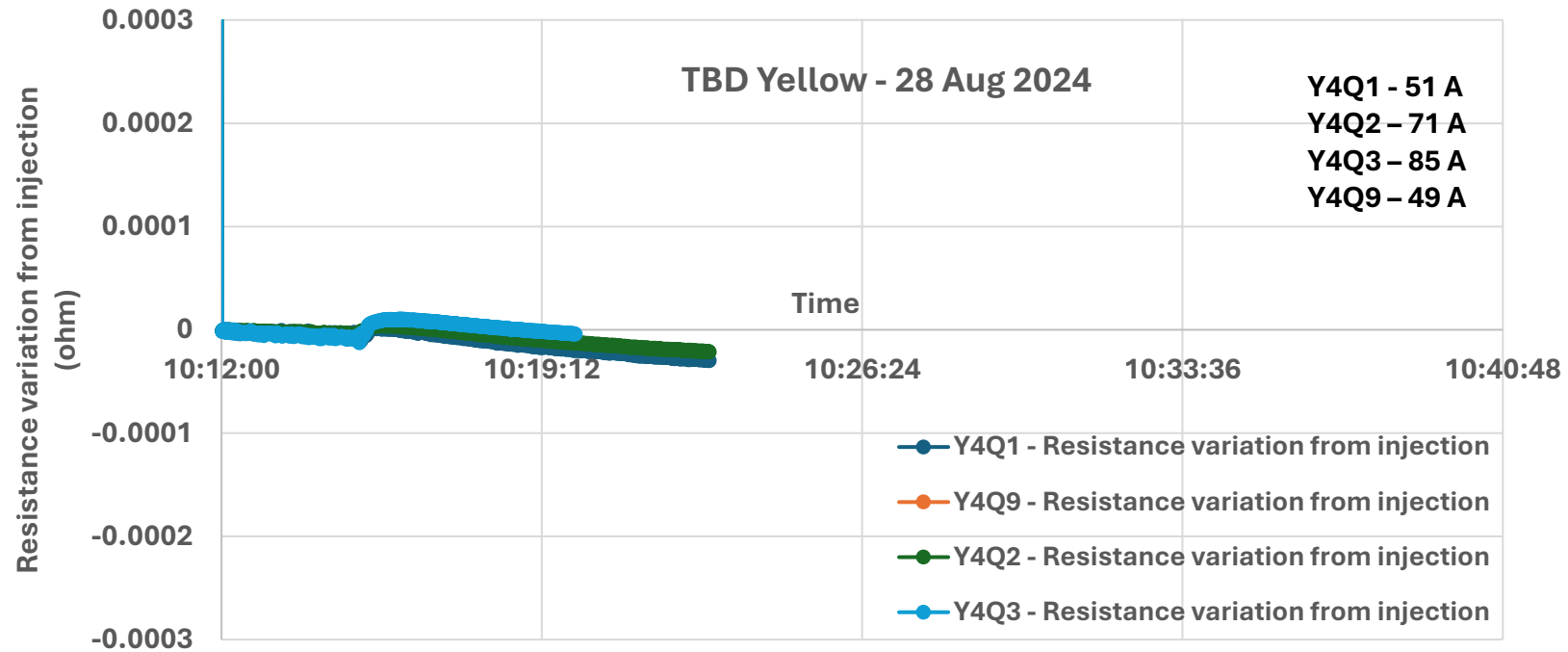
Looks much stabler than before.
B3Q1 slow decrease.
Will need to review longer dwell time.

Y4 TBD comparison

Before (1 Aug 2023)



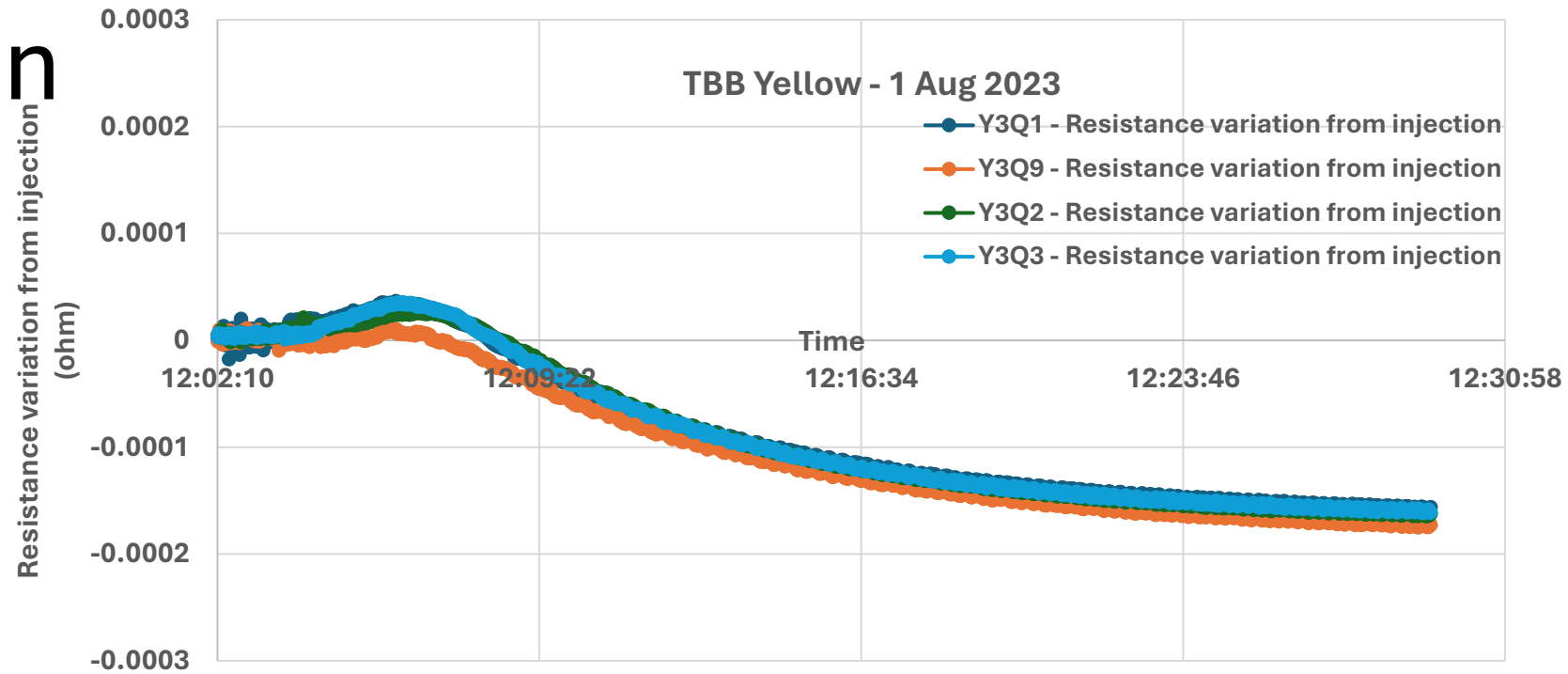
After (28 Aug 2023)
New helium flow



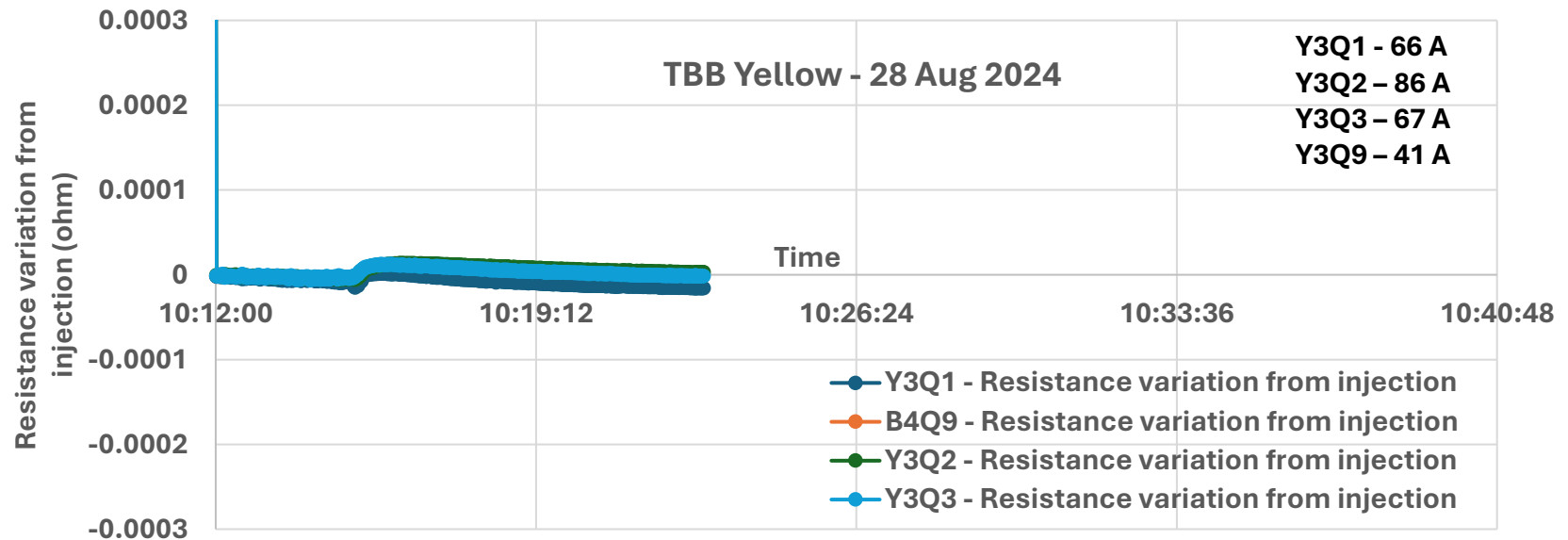
Looks much stabler than before.
Will need to review longer dwell time.

Y3 TBB comparison

Before (1 Aug 2023)



After (28 Aug 2023)
New helium flow



Looks much stabler than before.
Will need to review longer dwell time.

Provisional conclusion

- We need to review the longer dwell time ramp

Will need 1 day to review all circuit resistance before 100 GeV Au MCR handover

- As far as TBB/TBD the data collected look good. Thermal cycling was reduced by the new helium flow logic.

- “Are we at safe from breaking a 12x150A lead next year ?”

We can't know for sure unfortunately... Because we can't tell how bad the solder joints have been damaged by 20 years operation (structural fatigue is a statistical phenomenon...)

But the temperature variation has been largely reduced.

Problematic circuits

The resistance measured is across the cold conductor and some length of warm cabling. Total resistance warm+cold is generally ~ 1 mohm. Resistance lot subtract warm cable R value (at RTemp)

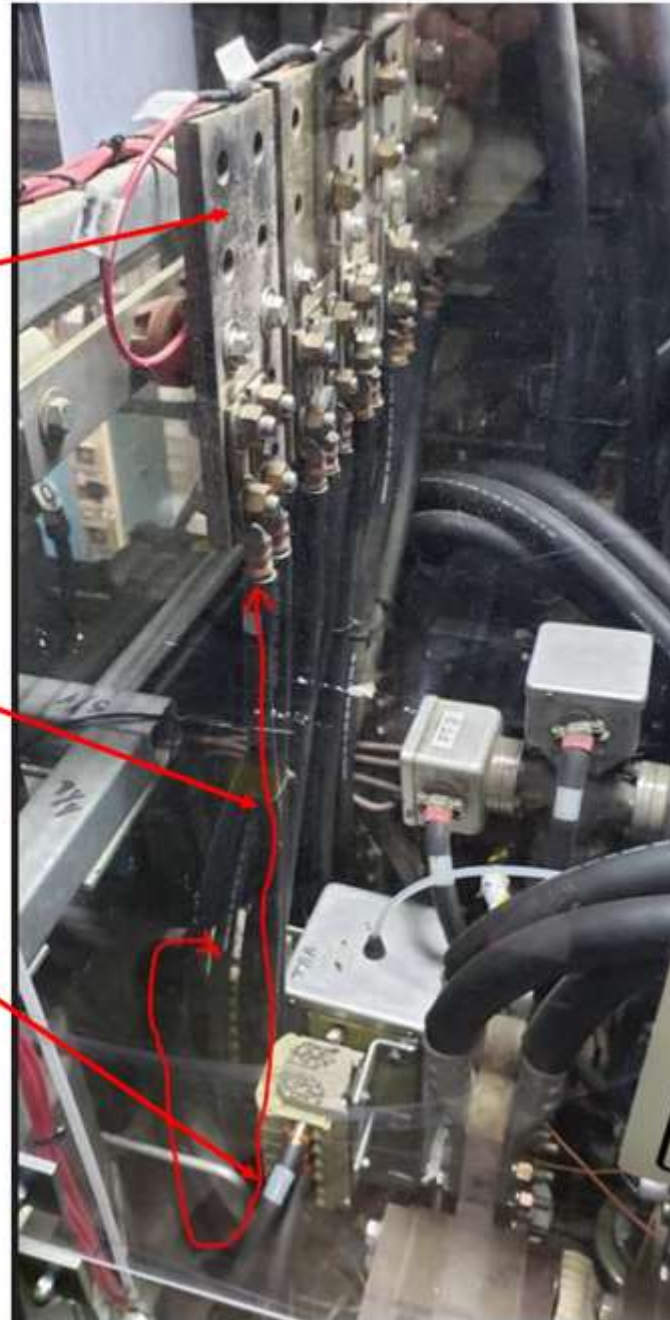
Typical patterns :

- A resistance increase that tends slow down and stabilize would point more to warm cabling heating.
- A resistance that increases more and more and goes out of bounds exponentially would point to the thermal runaway of the cold conductor.

Warm voltage tap

3 – 9 ft of AWG 00 copper cable

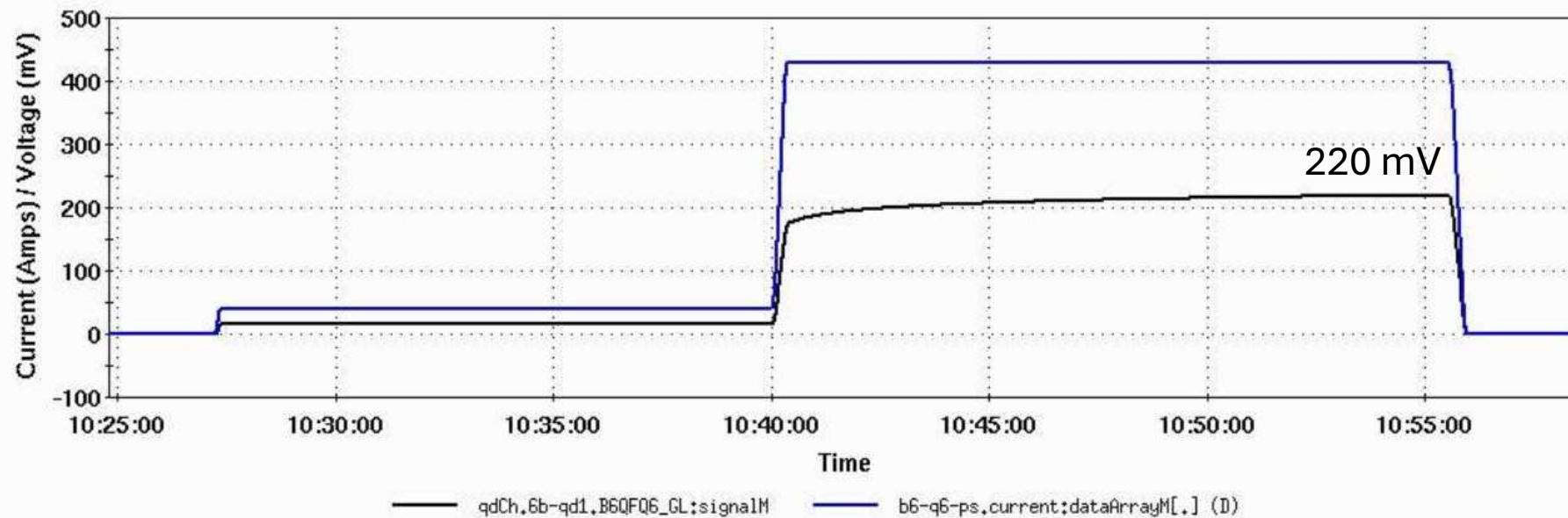
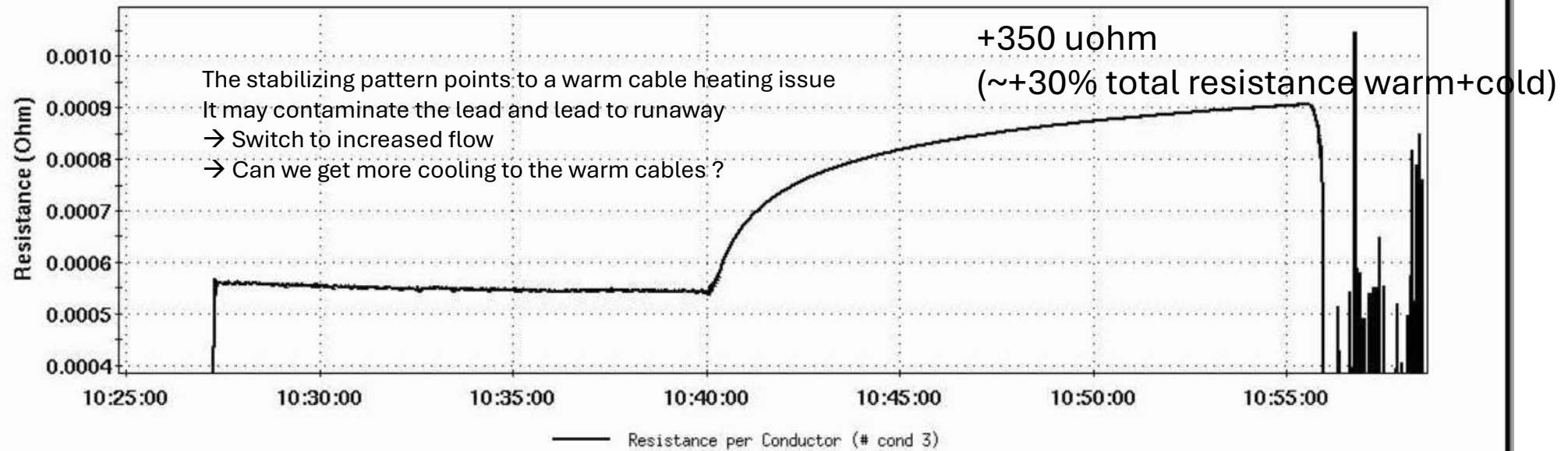
Top of the 12x150 A lead



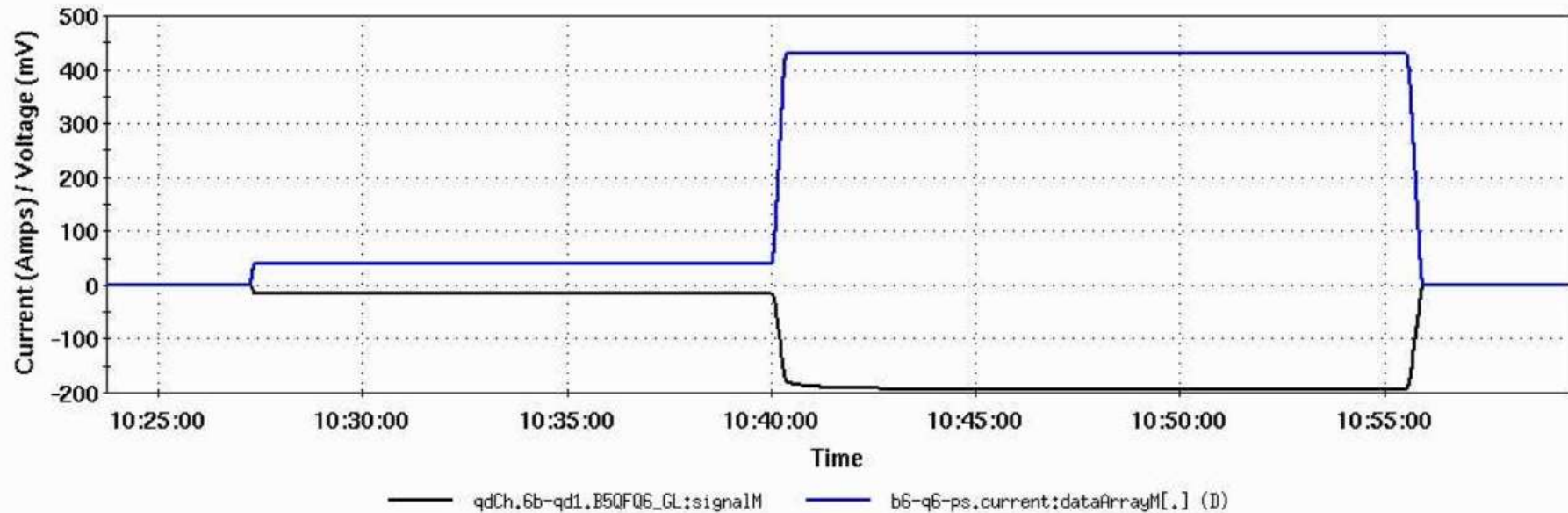
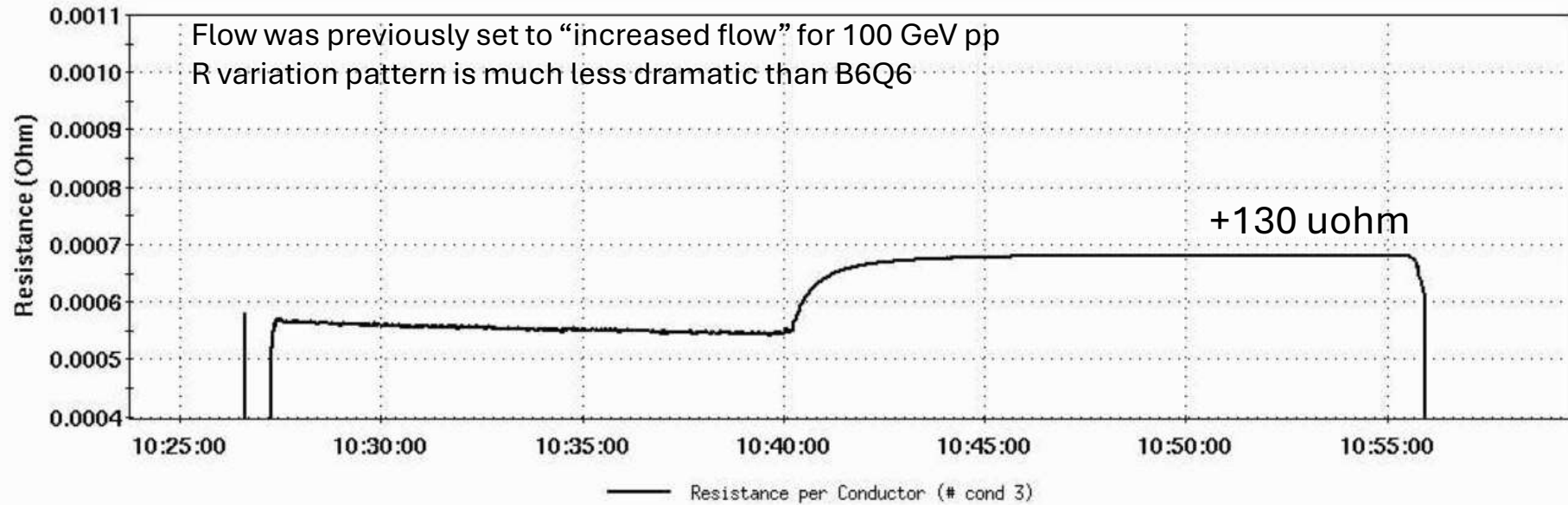
And this is a relatively neat and tidy looking valvebox. Others are much more tightly bundled... Warm cables cannot “breathe”

Problematic circuits	Pattern	Other conductors see the heat ?	Is the interlock protecting ?	Course of action ?
Y8TQ4	Increase stab +50uohm	No	-228 mV @ +50uohm Will trip at +200 mohm total increase (250 mV) Protection OK	Review next ramp
B6Q6	Large increase +350 uohm	Possibly	175mV @ +0uohm Will trip at +500uohm total increase Protection Ok	<ul style="list-style-type: none"> • Increase flow to high • Work with PS group to rearrange warm cabling during shutdown • Review next ramp
B6TQ4	Large increase +170 uohm	Possibly	190mV @ +0uohm Will trip at +450uohm total increase (132A) Protection Ok	<ul style="list-style-type: none"> • Increase flow to high • Work with PS group to rearrange warm cabling during shutdown • Review next ramp
B5TQ4	Large increase +180 uohm	Possibly	195mV @ +0uohm Will trip at +390uohm total increase (140A) Protection Ok	<ul style="list-style-type: none"> • Increase flow to high • Work with PS group to rearrange warm cabling during shutdown • Review next ramp
Y5TQ4	Large increase +100 uohm	No	175mV @ +0uohm Will trip at +550uohm total increase (138A) Protection Ok	Review next ramp

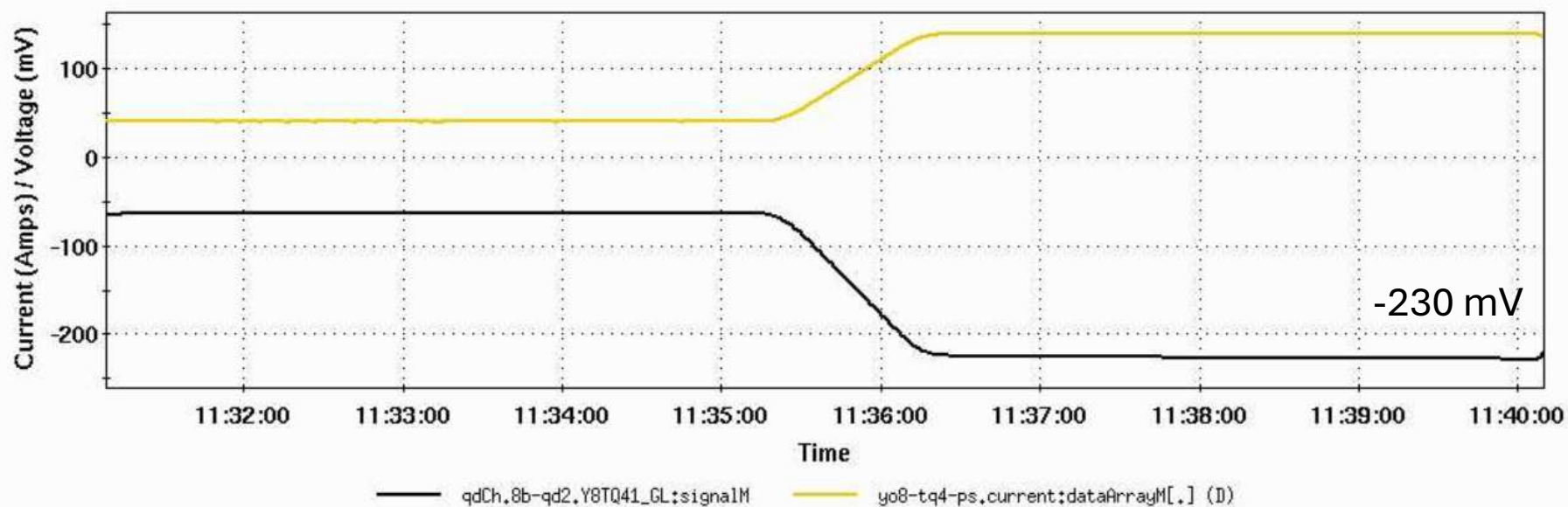
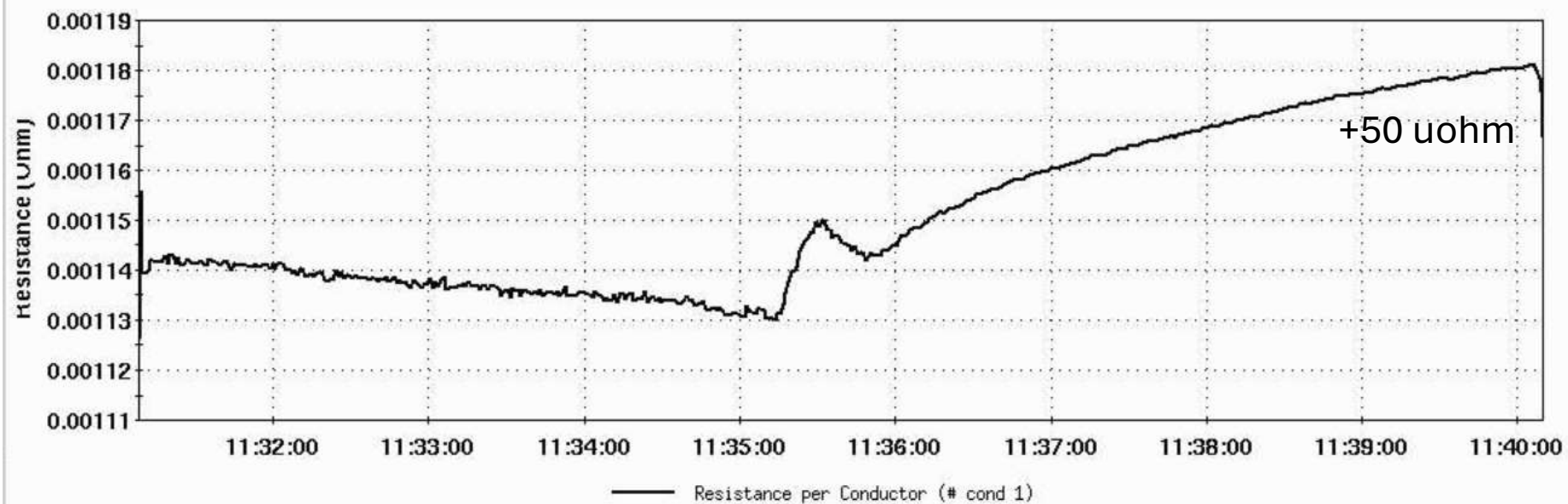
Problematic circuits	Pattern	Other conductors see the heat ?	Is the interlock protecting ?	Course of action ?
Y6TQ4	Large increase +100 uohm	No	175mV @ +0uohm Will trip at +550uohm total increase (138A) Protection Ok	Review next ramp
Y4Q8	Big increase +100 uohm and then stab	No they have large decrease	155mV @ +0uohm Will trip at +650uohm total increase (145A) Protection Ok	Consider switching back to low flow to alleviate the other conductor abrupt cool down
Y12Q8	Big increase +120 uohm and then stab	No they slightly decrease	170mV @ +0uohm Will trip at +550uohm total increase (146A) Protection Ok	Review next ramp



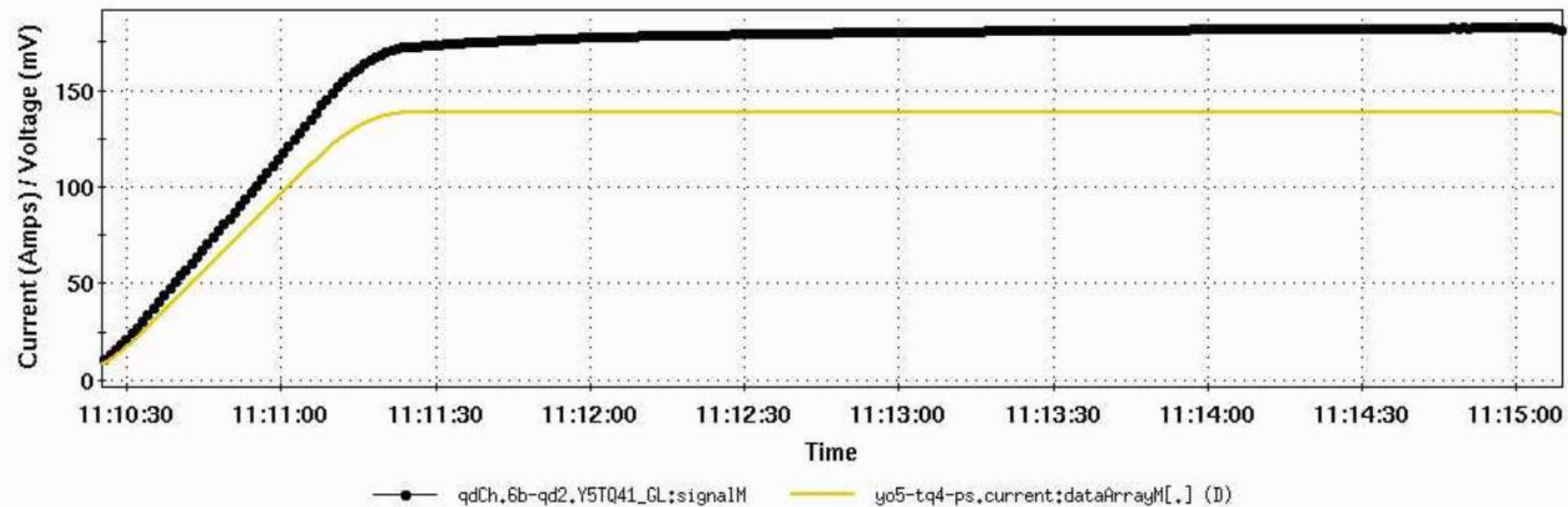
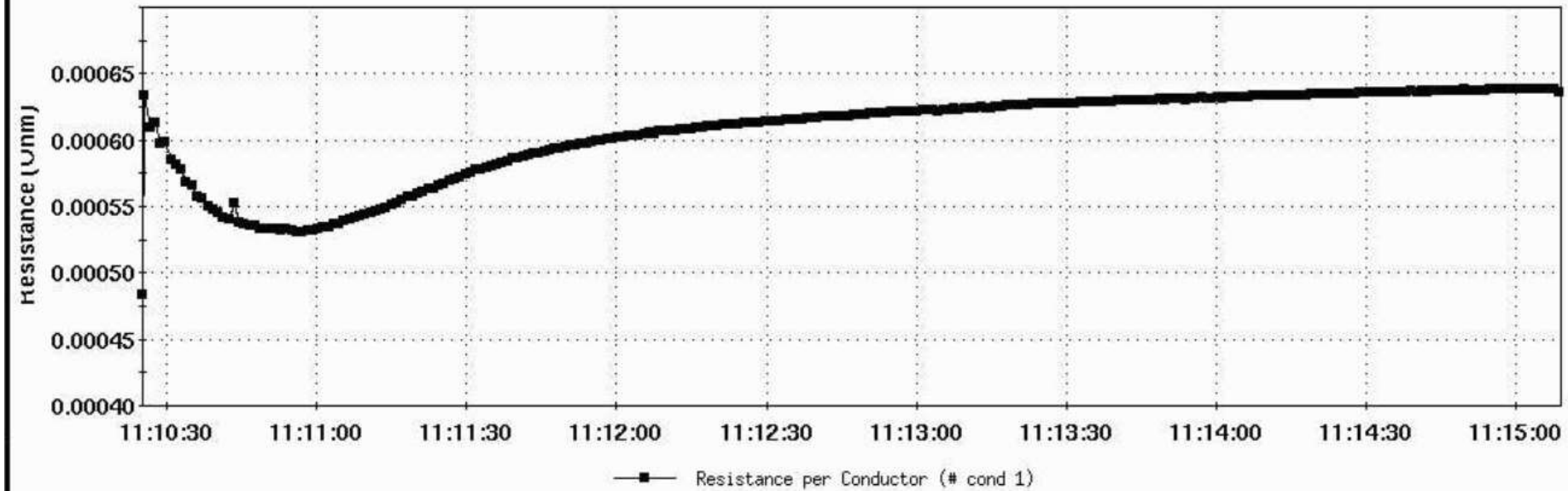
File Window Markers Analysis



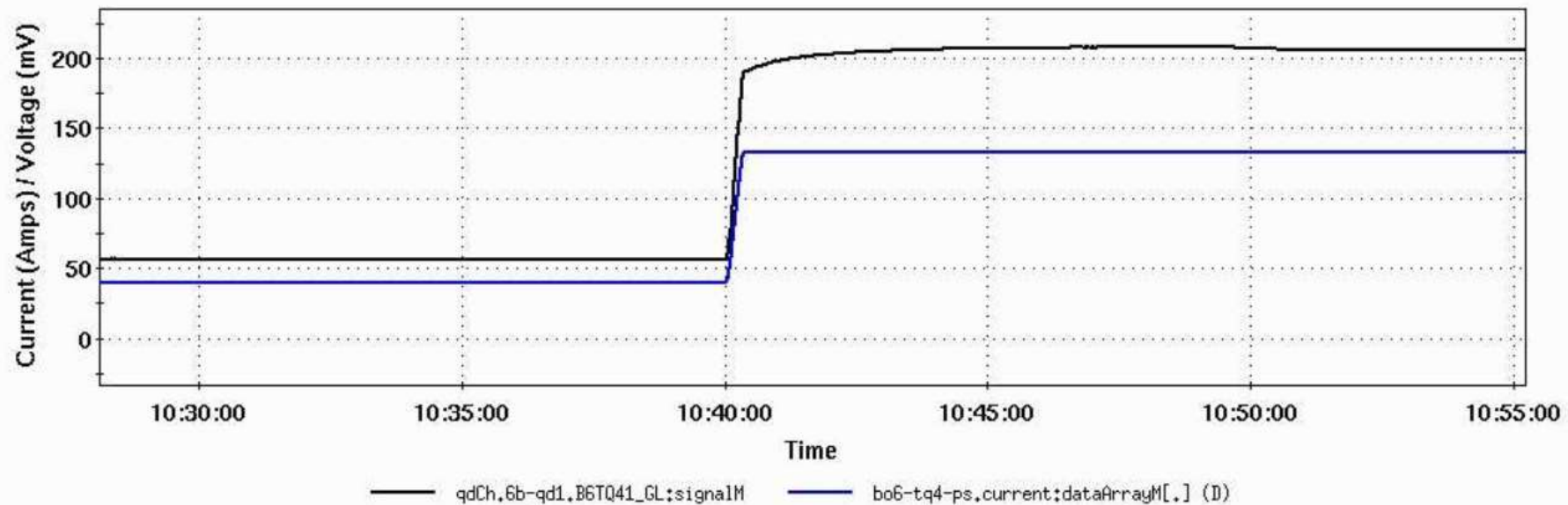
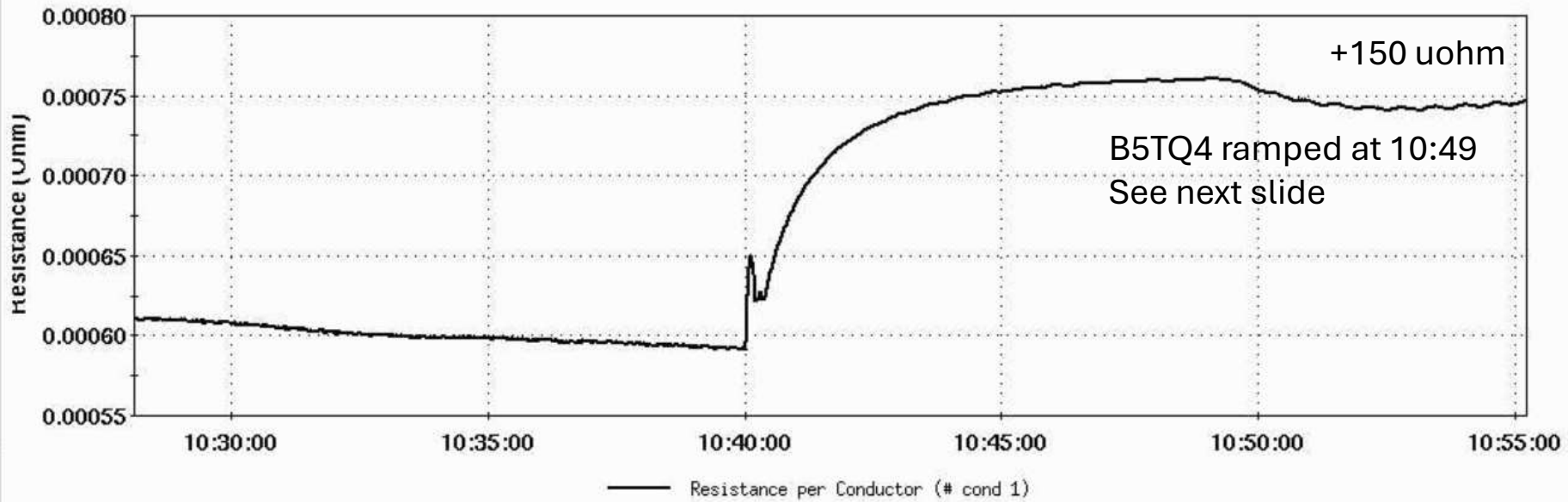
File Window Markers Analysis



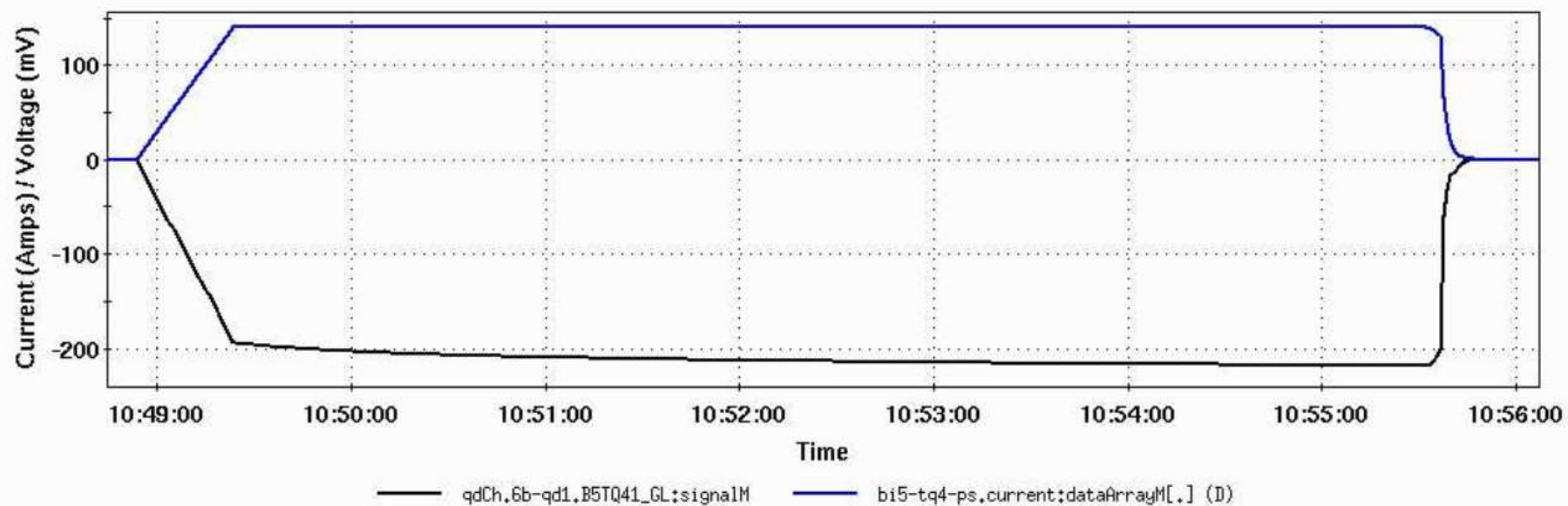
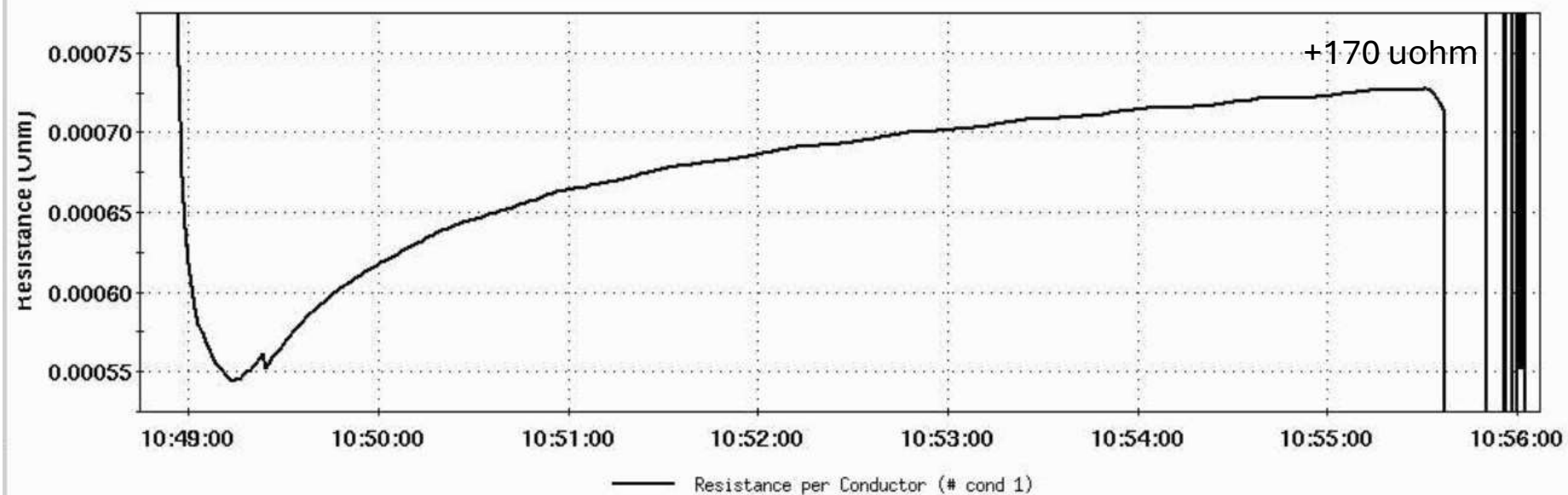
File Window Markers Analysis



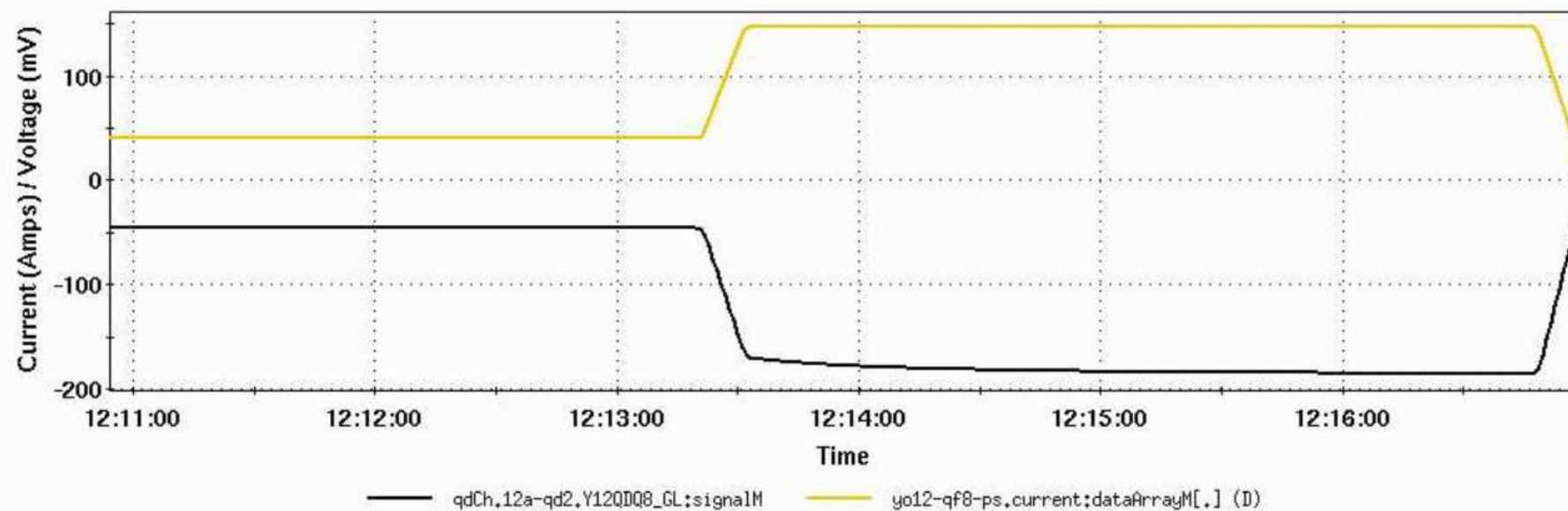
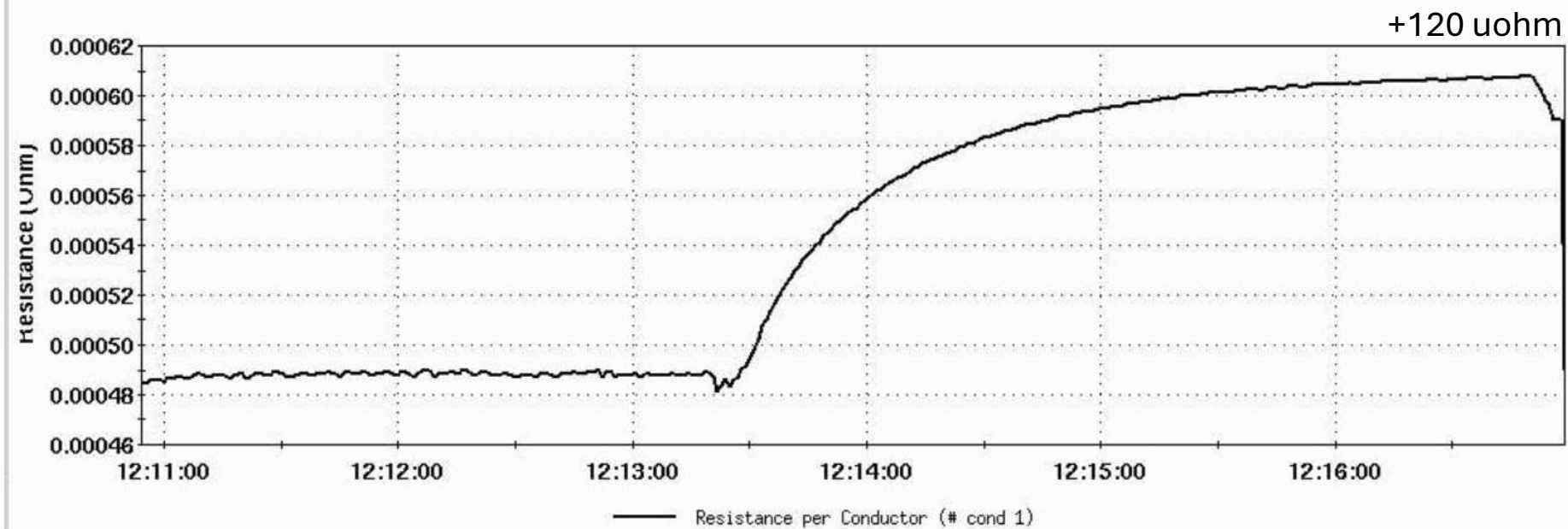
File Window Markers Analysis



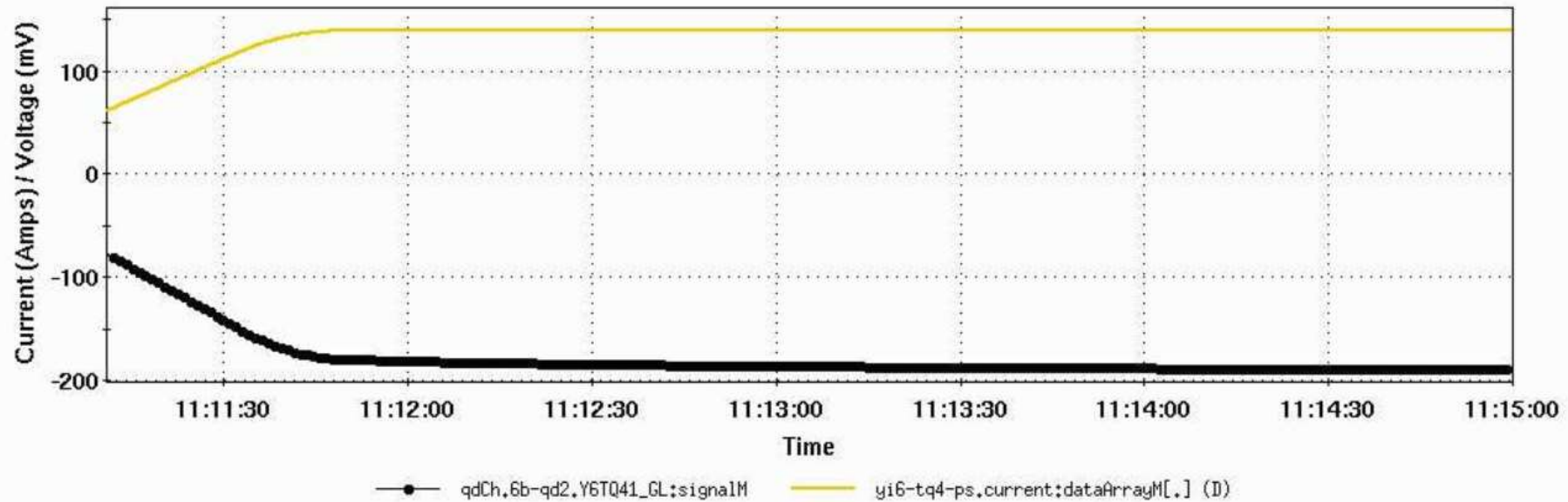
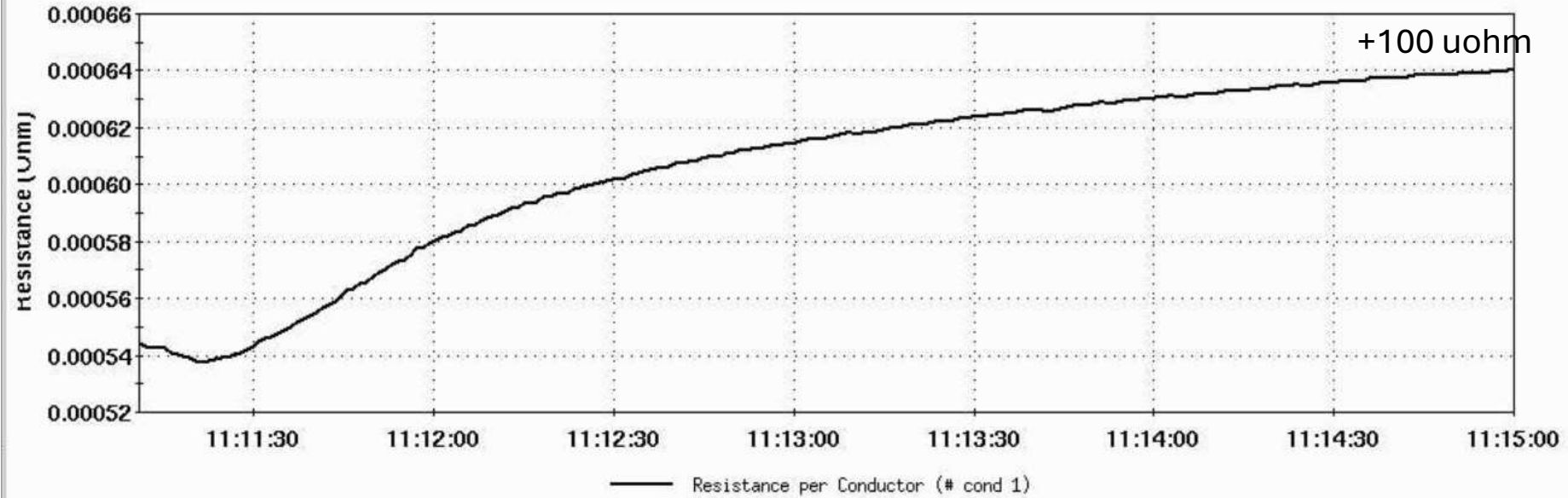
File Window Markers Analysis



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File Window Markers Analysis



File Window Markers Analysis

