Power Supply and TVT tests on DC/DC converter status report

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Summary

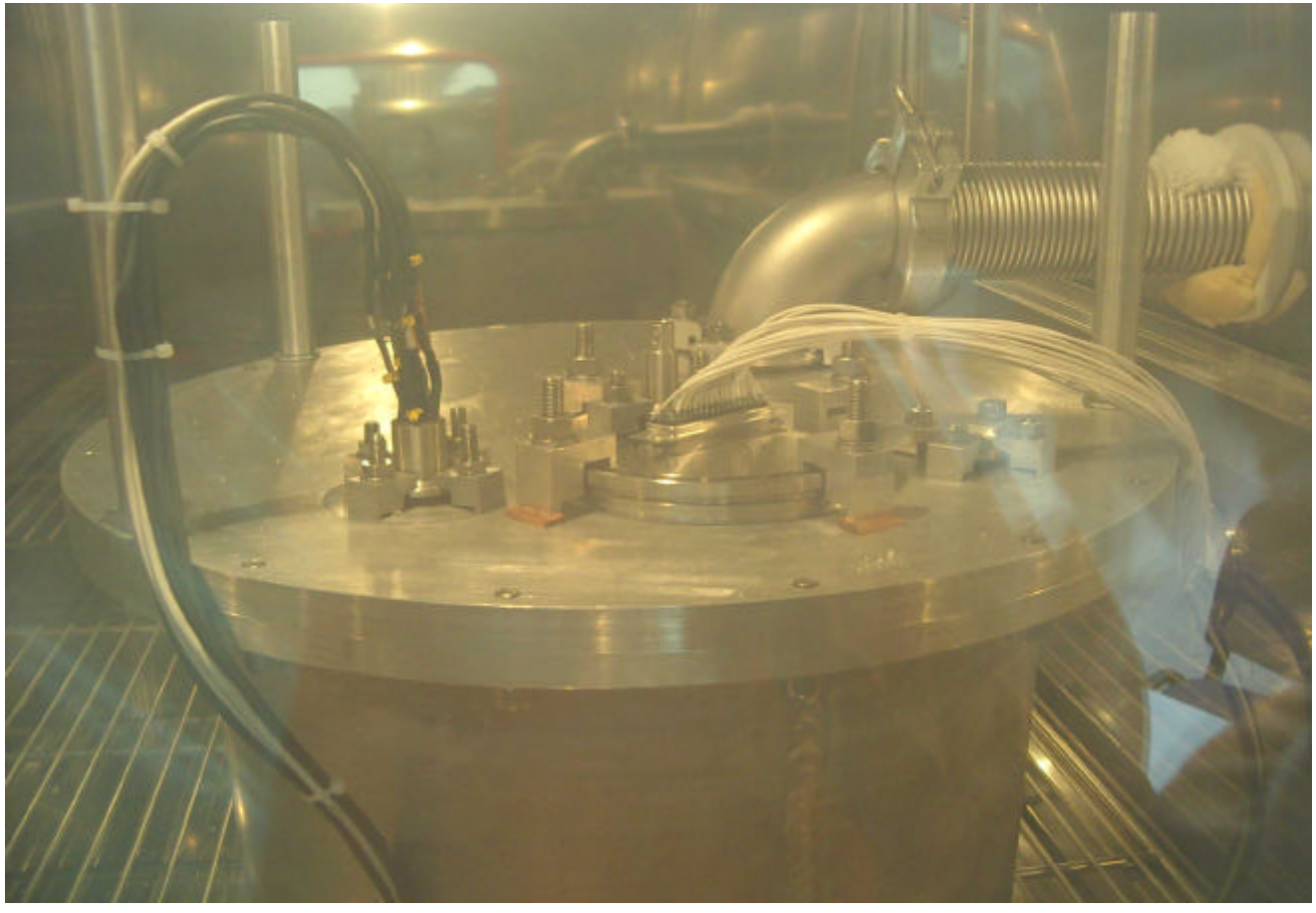
- TVT tests for DC/DC converters in Terni
- Production of ASI contract boards

Purpose of the TVT test at single board level

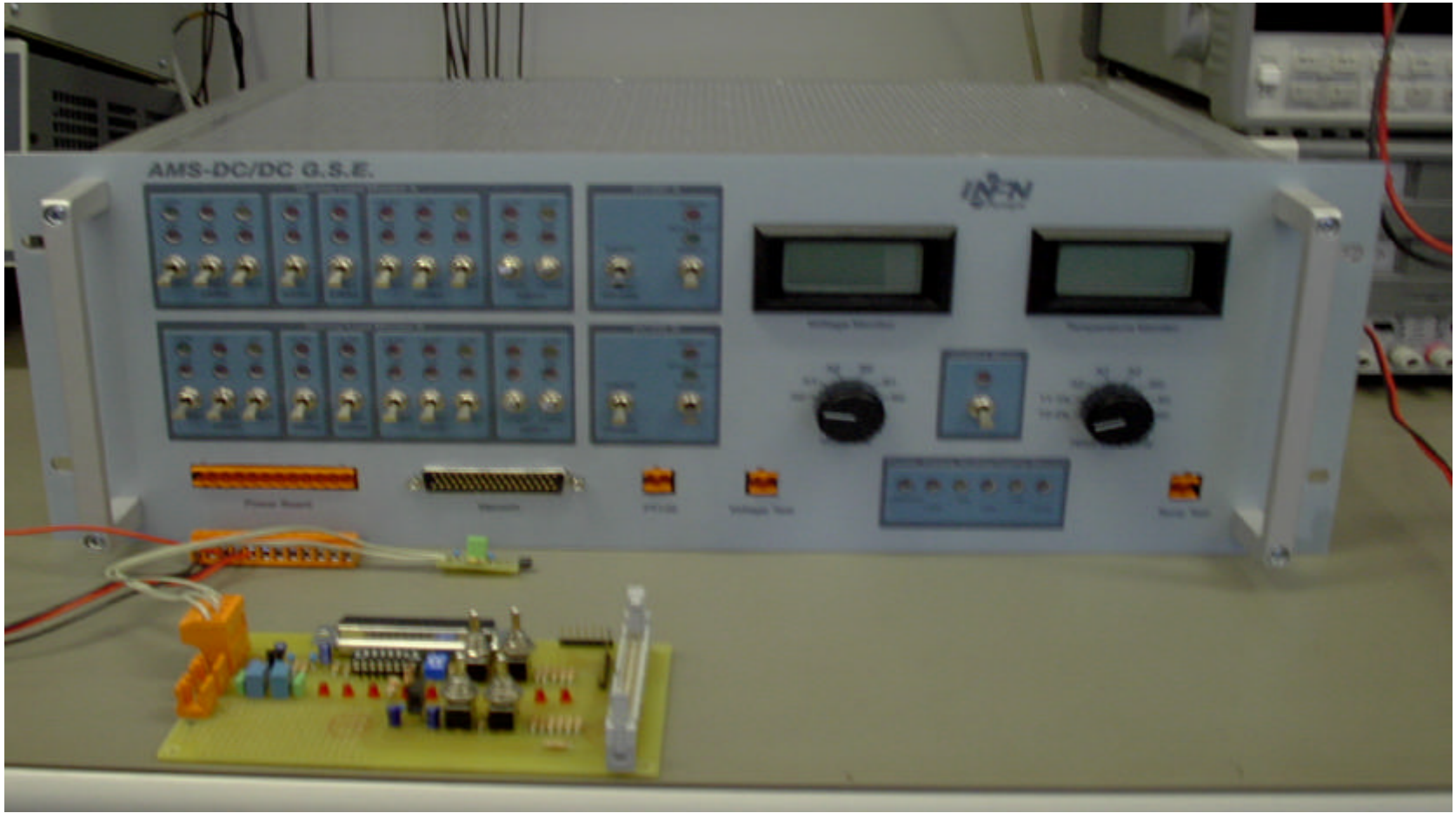
- Give a reasonable thermal stress in vacuum to the card.
- Understand the thermal gradients on the board.
- Converters are tested to their typical current output value which is generally higher than nominal AMS current output.

The test setup I

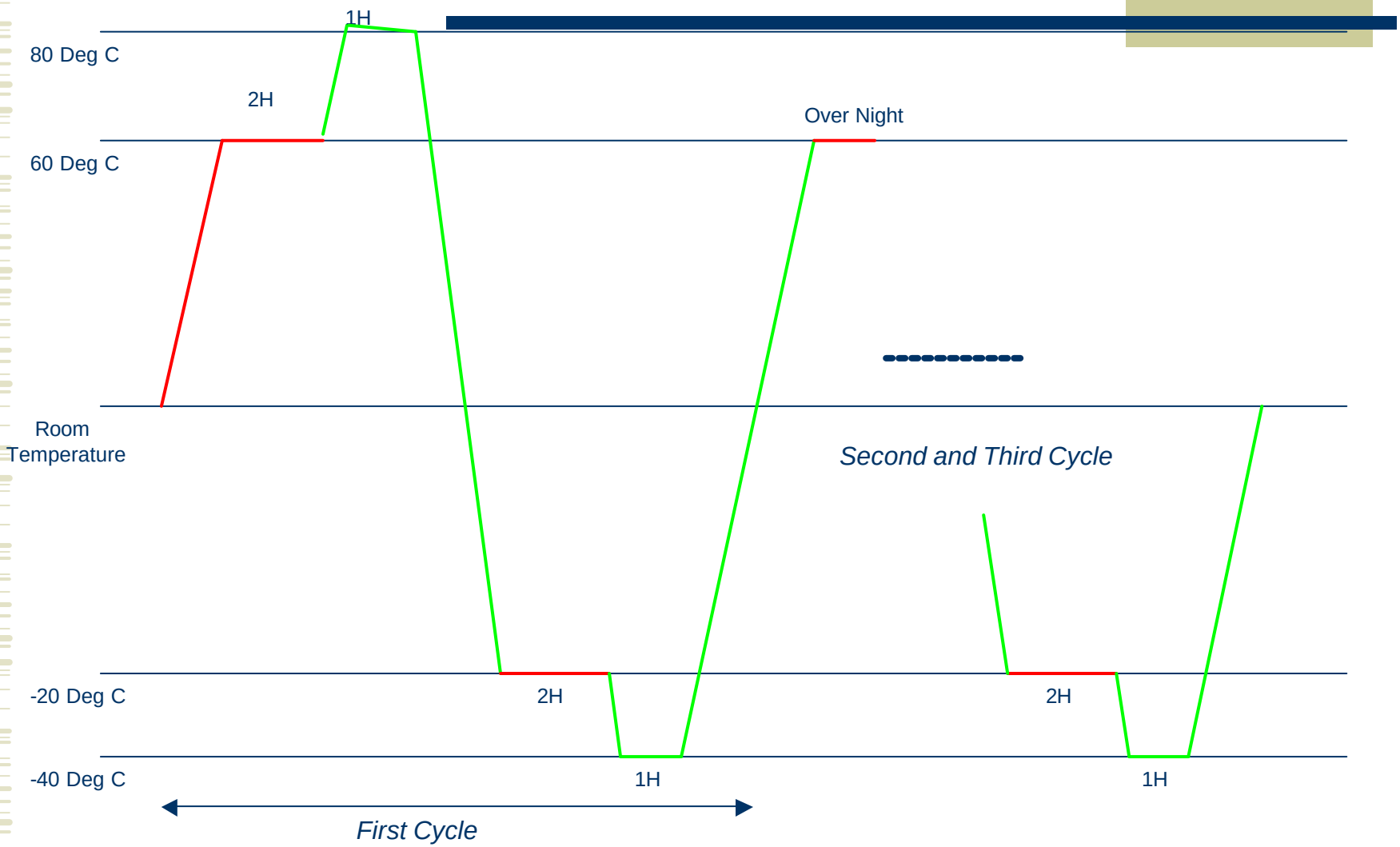
The test sutup II



The test setup III



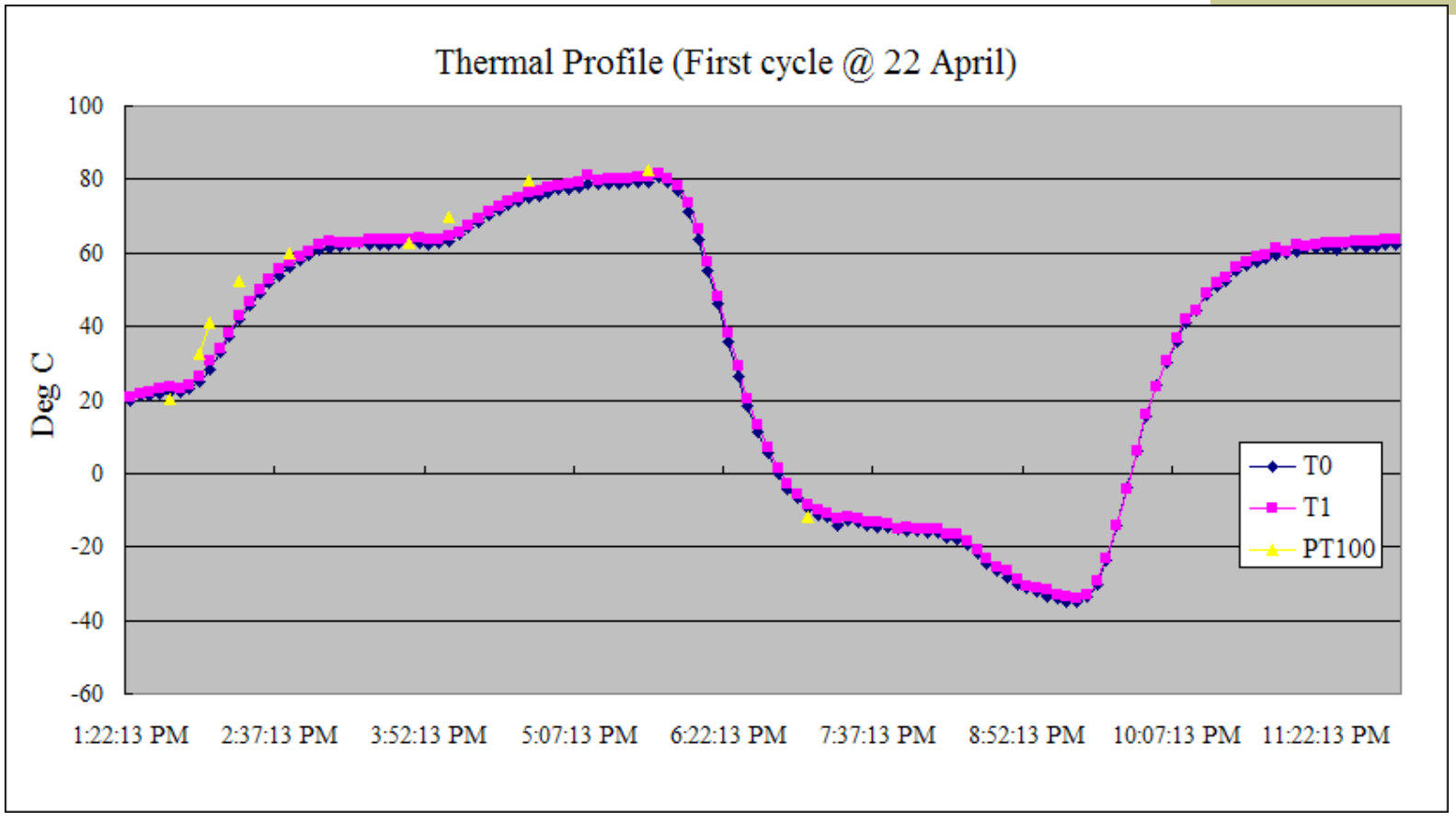
The TVT cycle



S9048 I

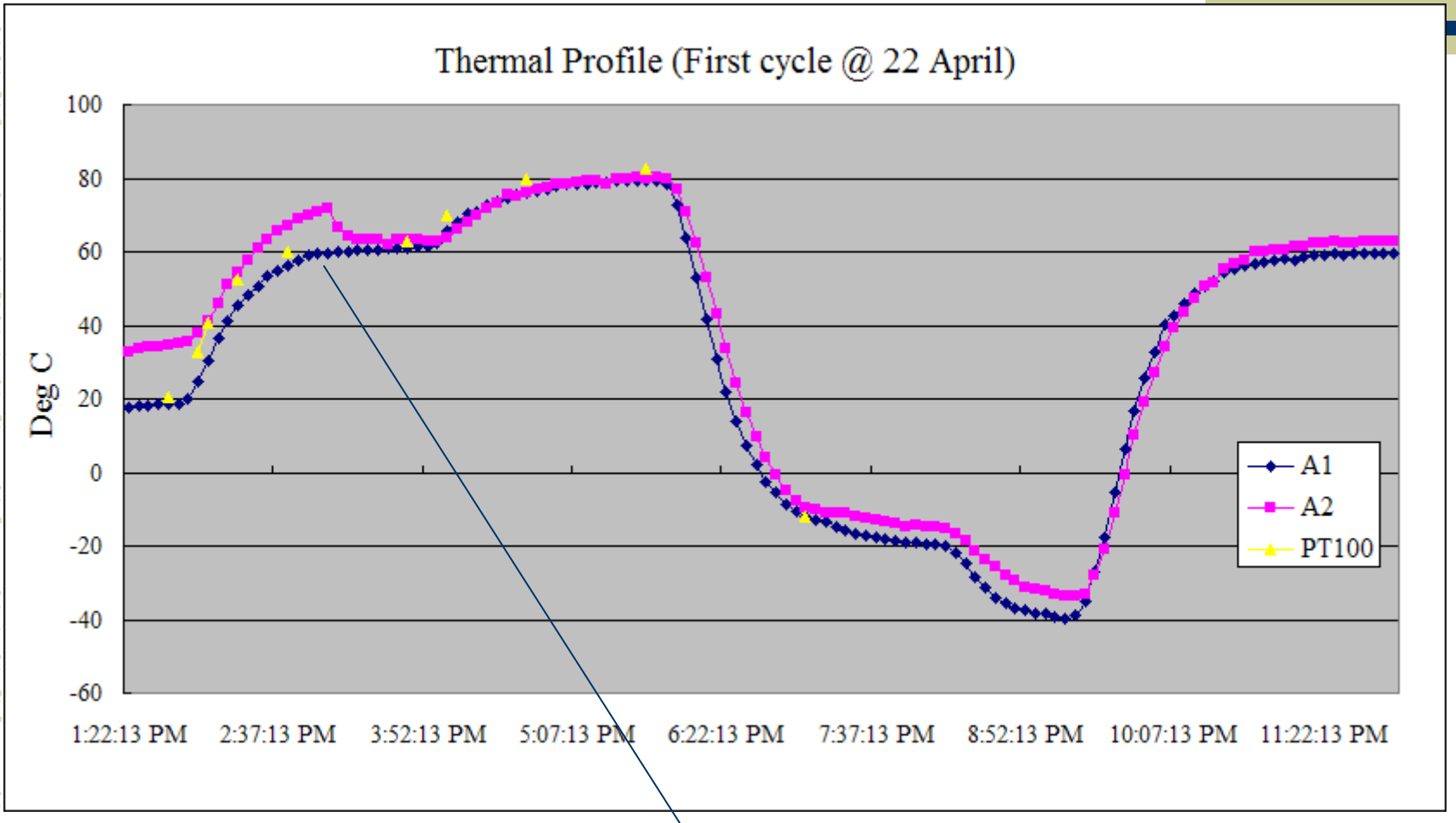
- First tested; procedure not strictly followed
- Side A on side B off
- Thermal sensors:
  - A0 Broken
  - A1 Switching MOSFET side B, lost during 2nd thermal cycle
  - A2 Rectifier MOSFET side B
  - B0 Tranformer side A
  - B1 Rectifier MOSFET side A
  - B2 Switching MOSFET side A

S9048 raw data PT100 T0-T1 (first cycle)



PT100: Sensor in the inner chamber
T0: Sensor 1, dissipation layer
T1: Sensor 2, dissipation layer

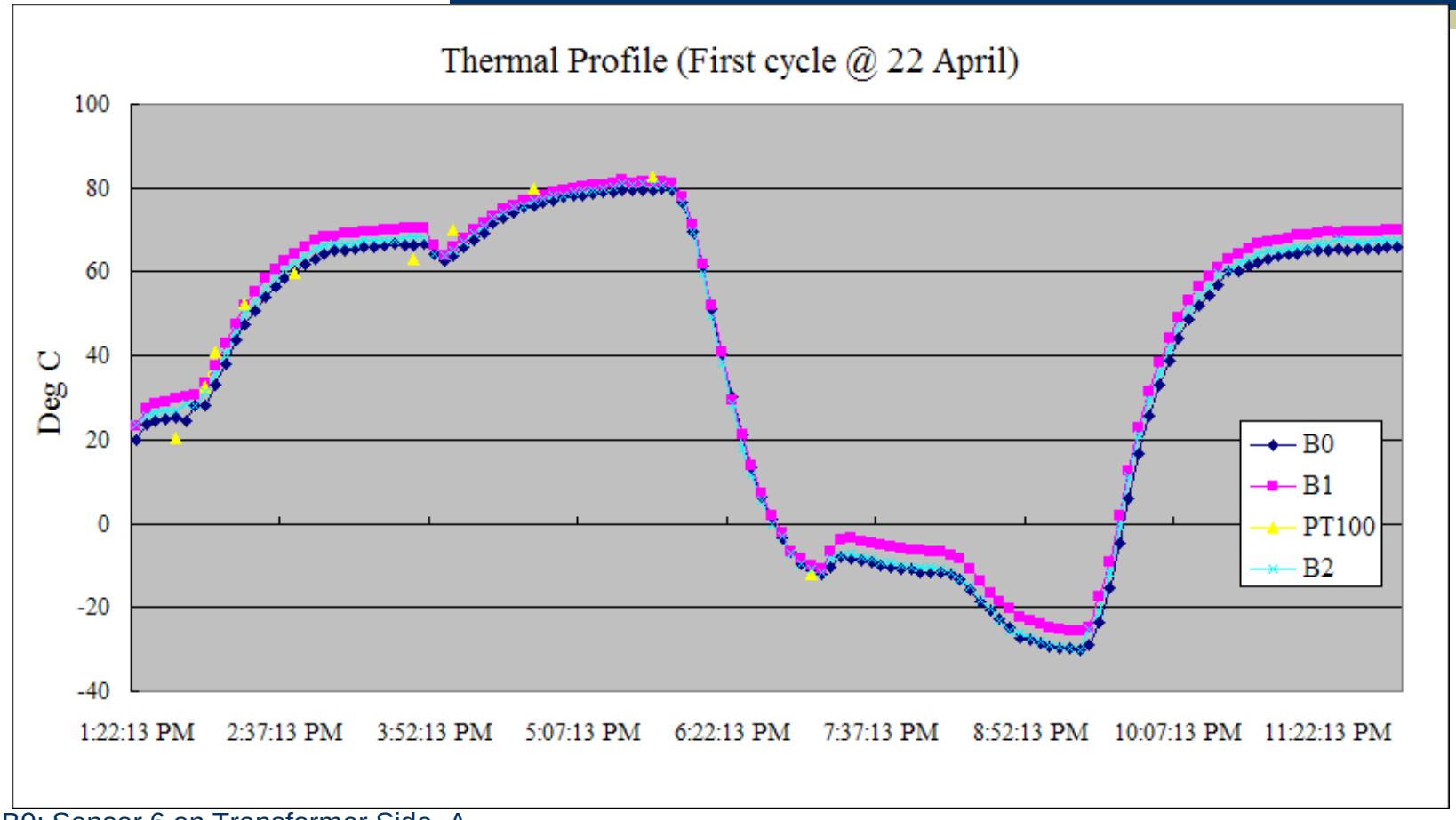
S9048 raw data PT100 A1 A2 (first cycle)



A1: Sensor 4 on MOS_Switch Side_B
A2: Sensor 5 on MOS_Rectfier Side_B

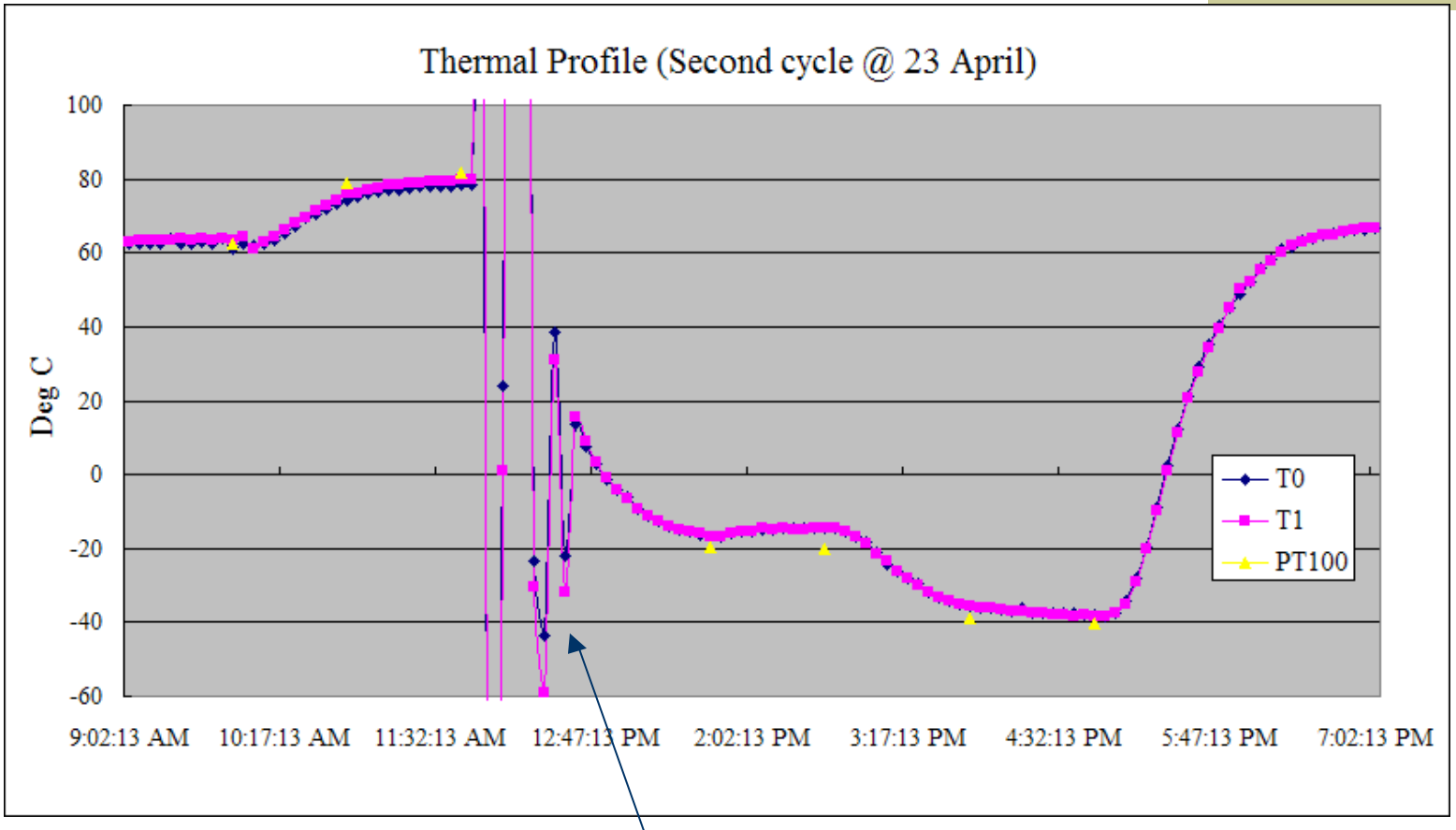
We did this wrong, we turn-on both side(A&B).
It should be turn-on only one side(A).

S9048 raw data PT100 B0 B1 B2 (first cycle)



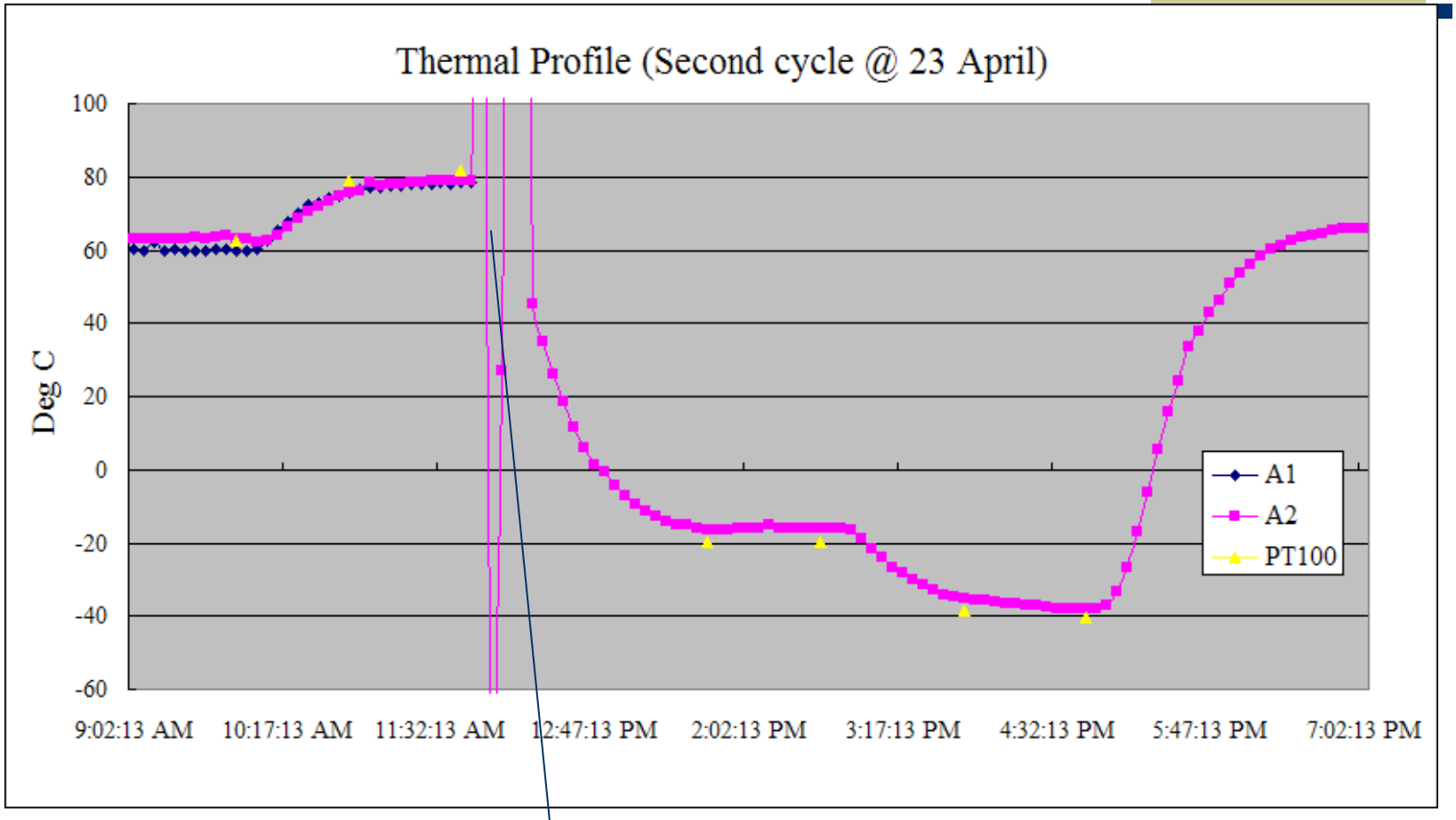
B0: Sensor 6 on Transformer Side_A
B1: Sensor 7 on MOS_Rectfier Side_A
B2: Sensor 8 on MOS_Switch Side_A

S9048 raw data PT100 T0-T1 (second cycle)



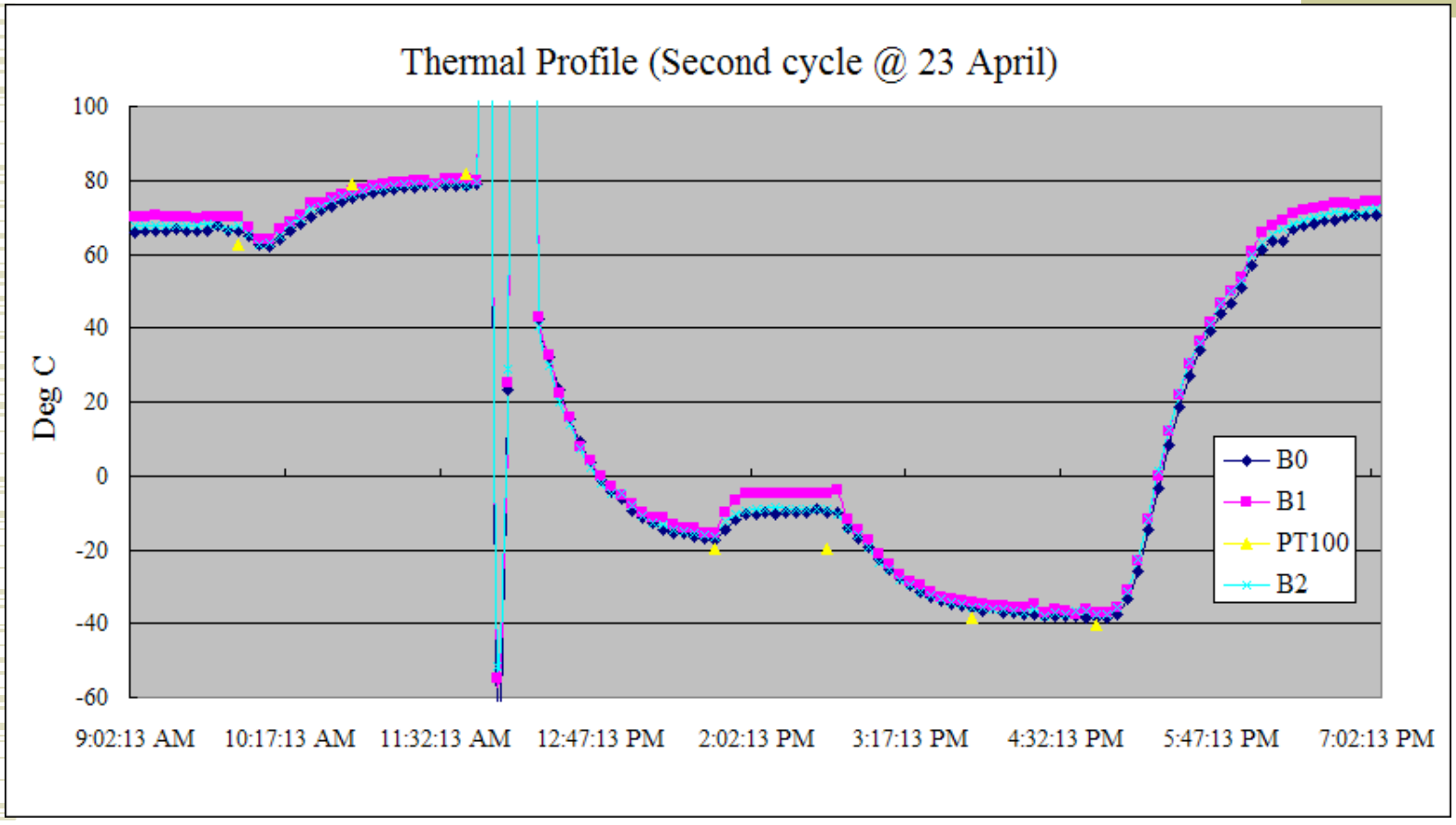
Temp Buffer(TL074) failed in this phase.

S9048 raw data PT100 A1 A2 (second cycle)



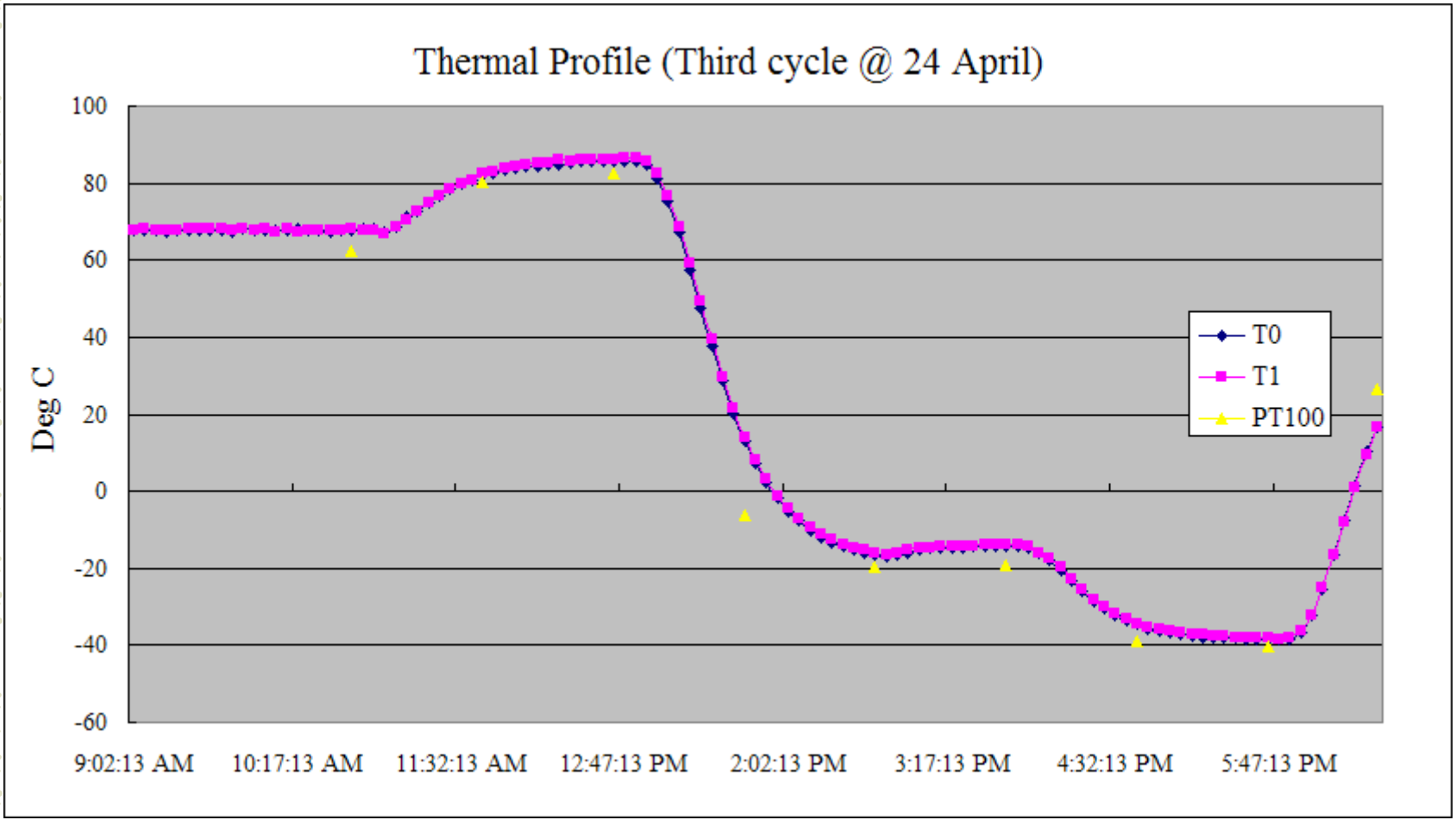
Lost A1 read-out after Temp. Buffer failed.

S9048 raw data PT100 B0 B1 B2 (second cycle)

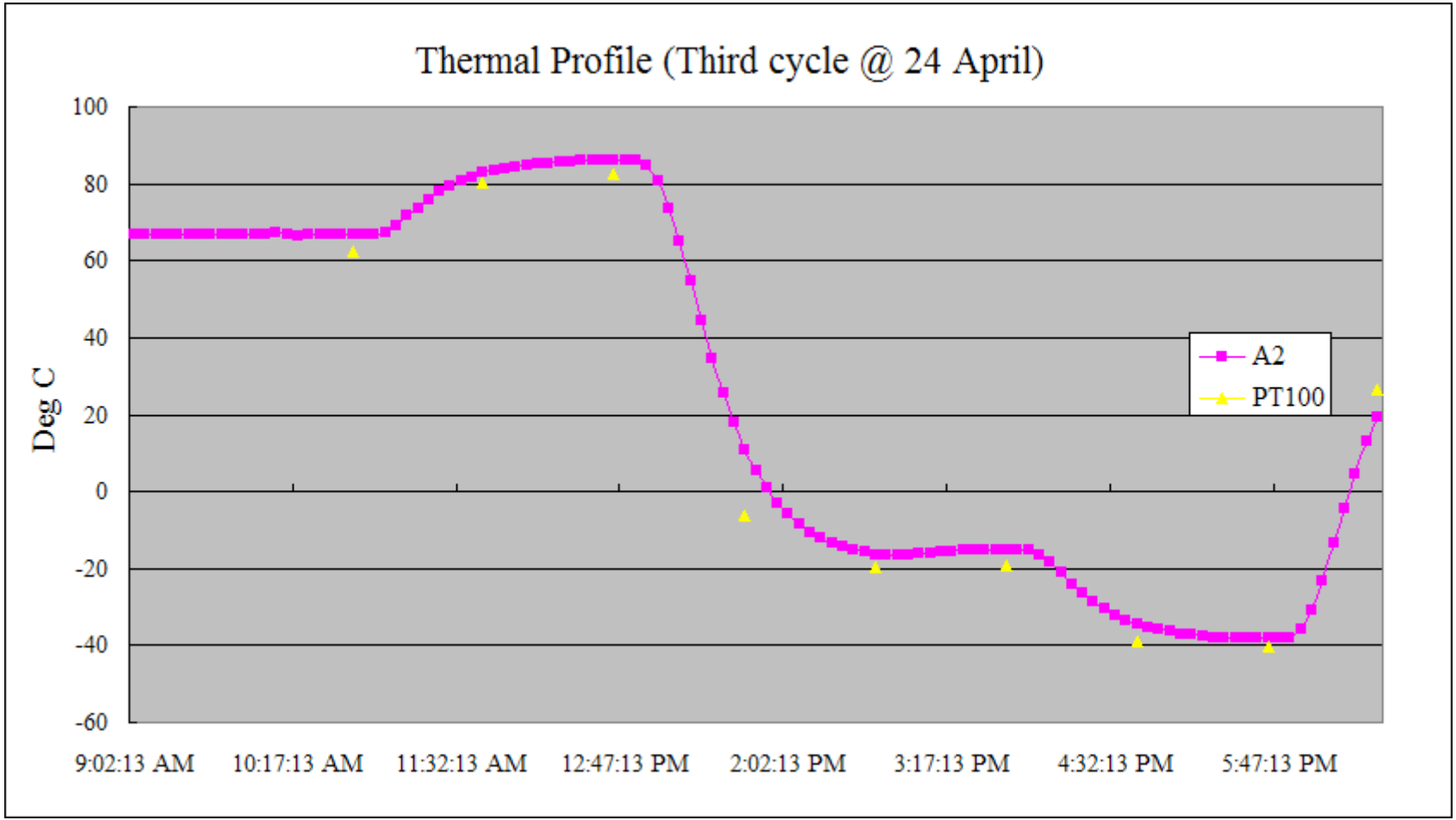


B0: Sensor 6 on Transformer Side_A
B1: Sensor 7 on MOS_Rectfier Side_A
B2: Sensor 8 on MOS_Switch Side_A

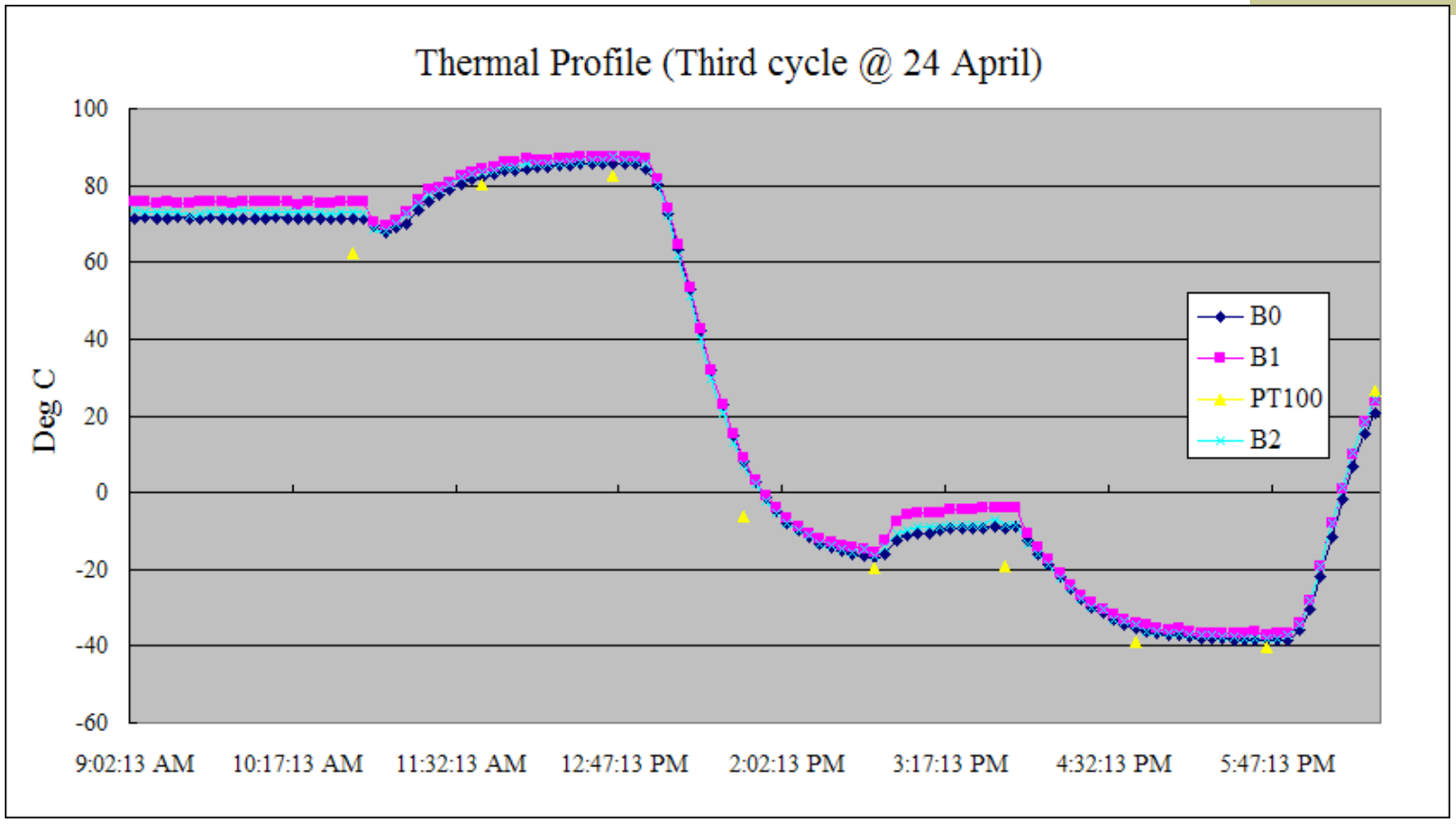
S9048 raw data PT100 T0-T1 (third cycle)



S9048 raw data PT100 A1 A2 (third cycle)



S9048 raw data PT100 B0 B1 B2 (third cycle)

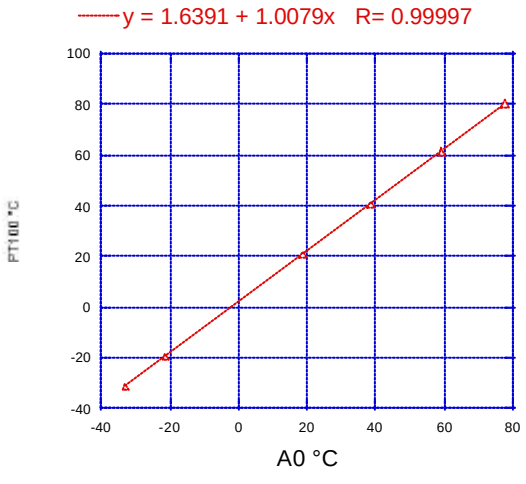


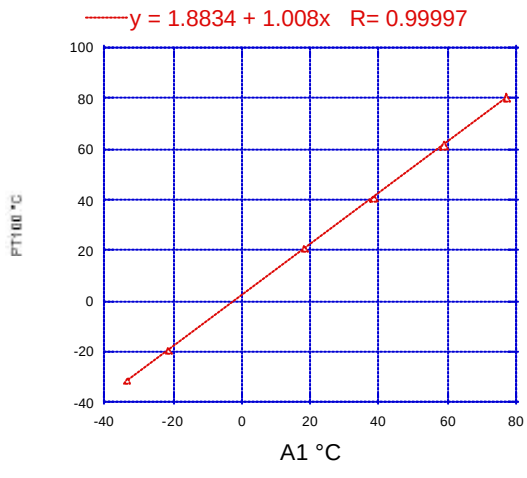
B0: Sensor 6 on Transformer Side_A
B1: Sensor 7 on MOS_Rectfier Side_A
B2: Sensor 8 on MOS_Switch Side_A

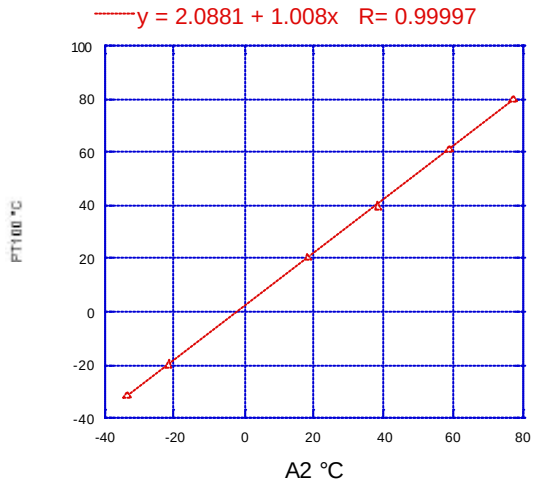
Interlude: The necessity of the calibration

- LM35 sensor should be calibrated versus PT100
- Systematic current effect.

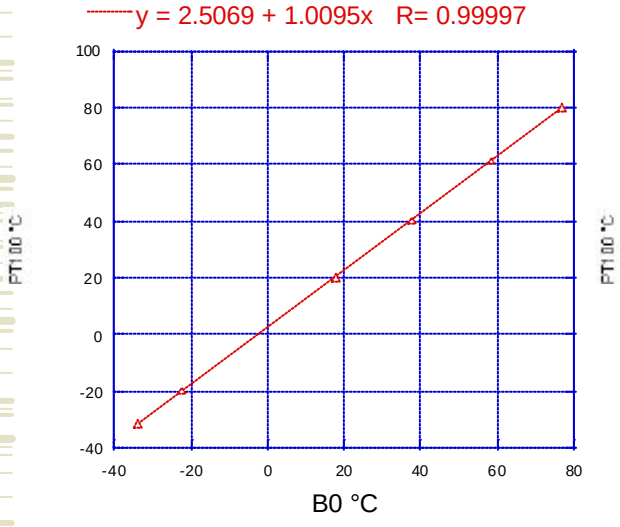
PT100-A0,A1,A2 first tests

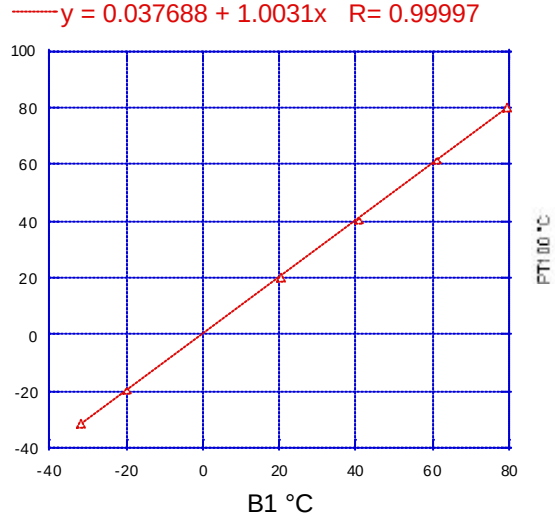


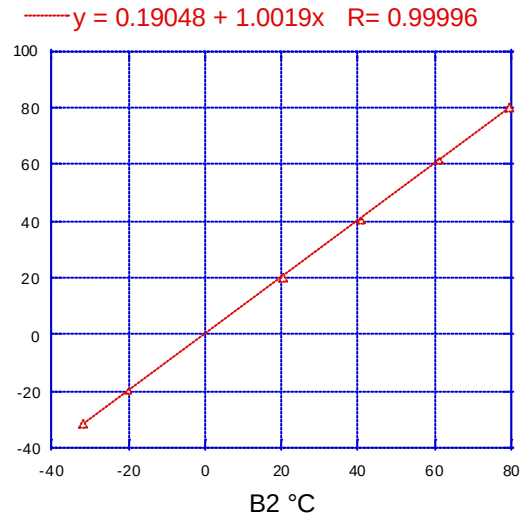




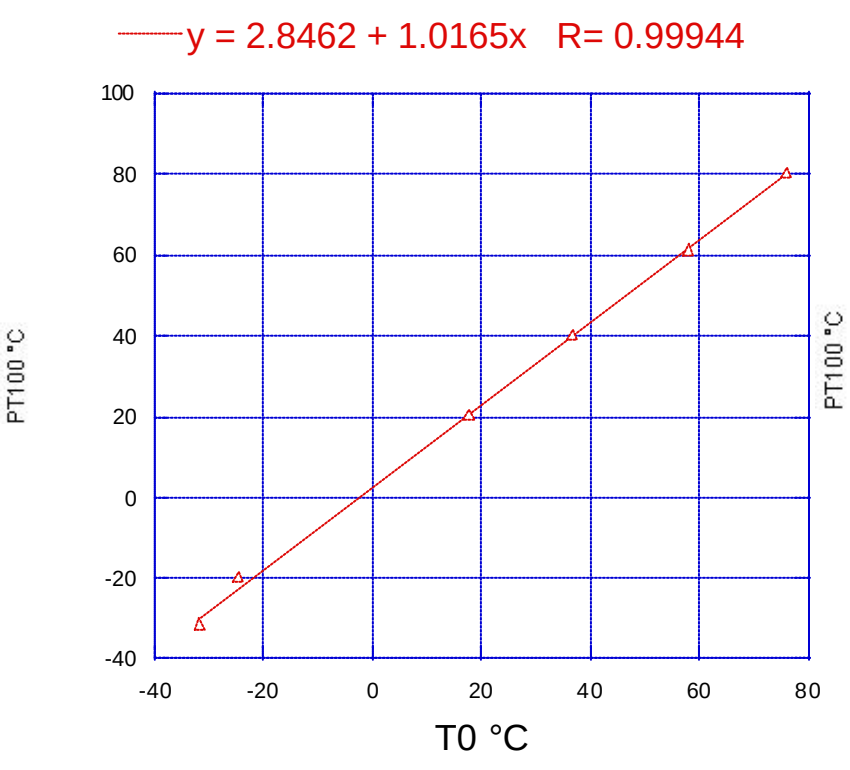
PT100-B0,B1,B2 first tests

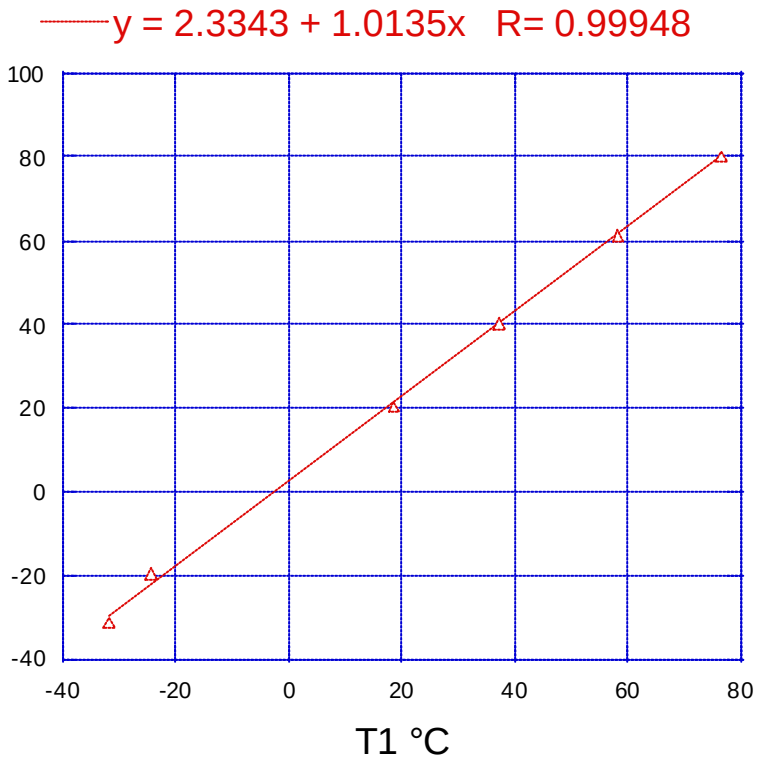




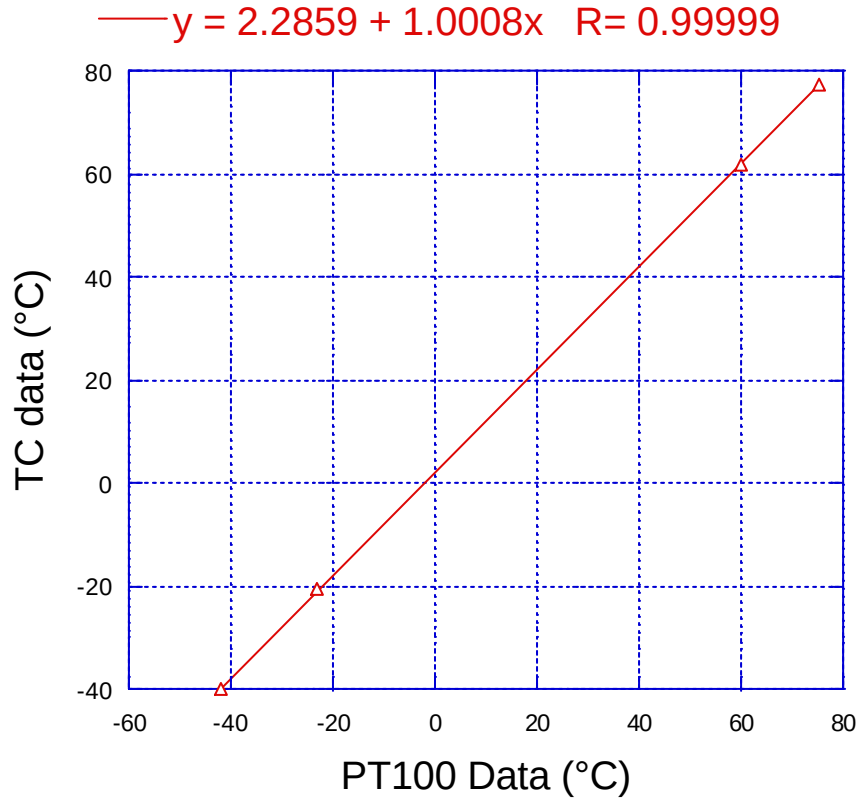


PT100-T0,T1 first tests

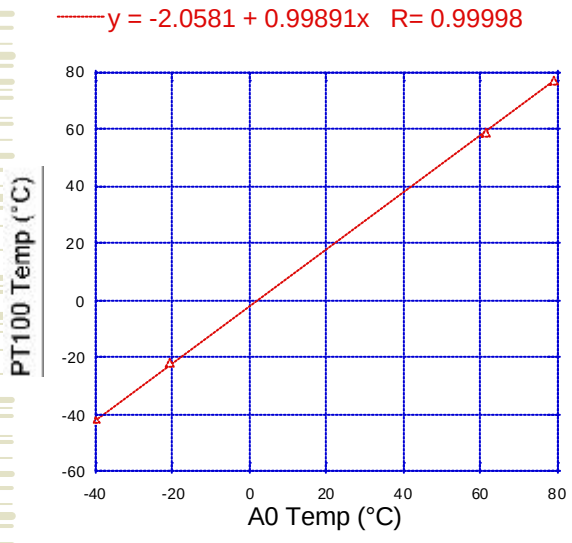


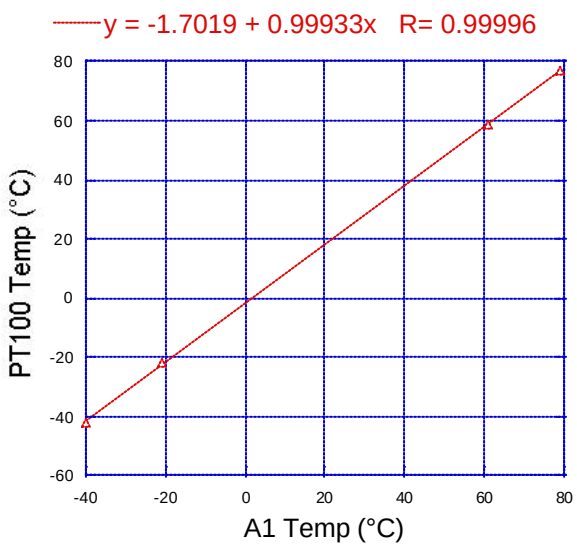


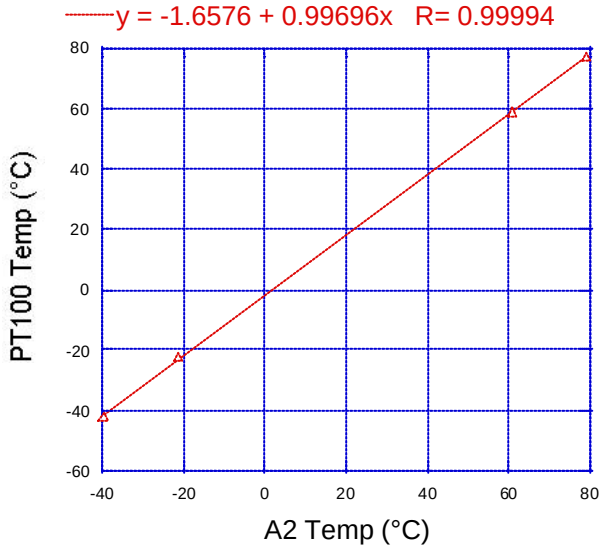
New PT100 TC test



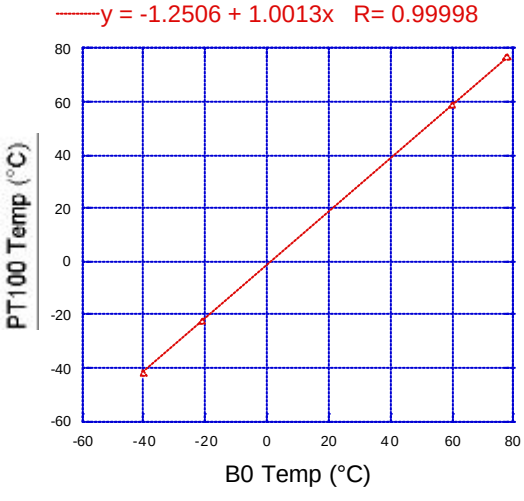
PT100-A0,A1,A2 second test

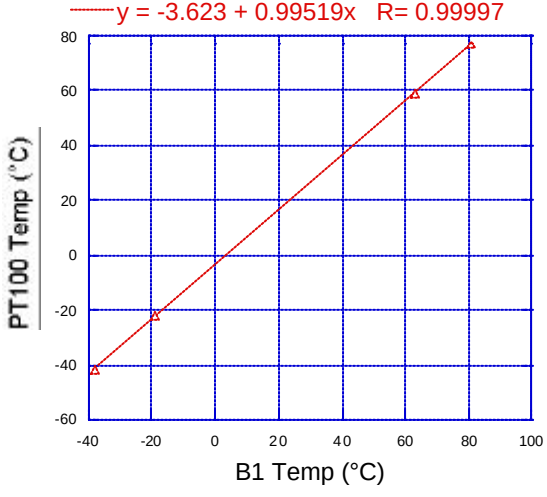


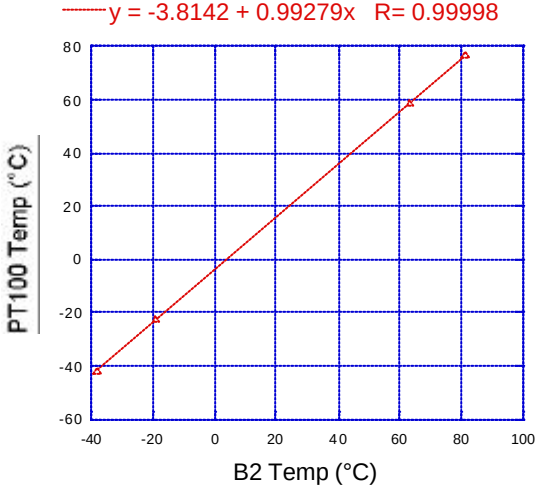




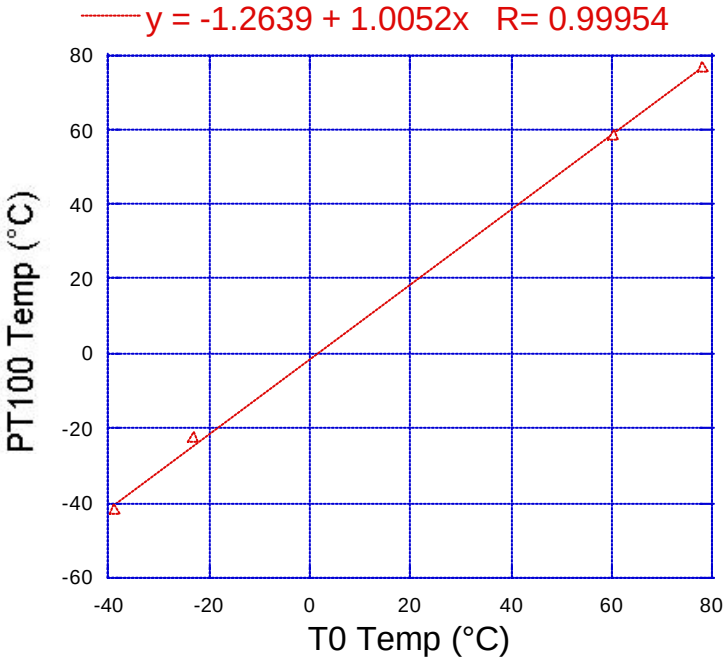
PT100-B0,B1,B2 second test

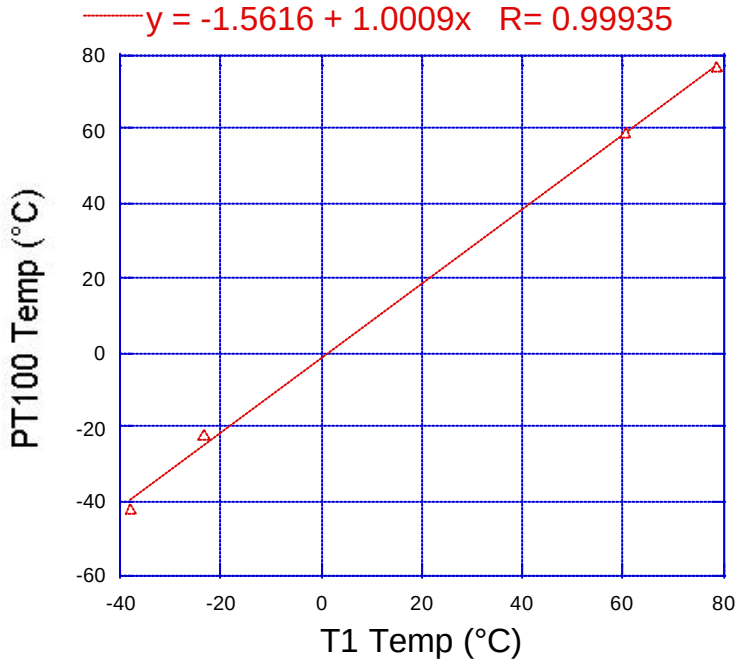






PT100-T0,T1 second test





Systematic current effect

- Due to current flowing on the ground on high current converters we noted a shift in the temperature measurement just after we turn off and on a converter.
- In order to avoid this we used temperature measurement before/after turn on or off to evaluate this effect.

Results on S9048

- S9048 had not functional problems during the test.
- We notice higher temperature on the transformer compared with the average value on the heat dissipation bar (Δ t=5.1°C at 60 °C and Δ t=7.1°C at –20 °C).
- We notice a small temperature increase on the rectifier MOSFET (Δ t=2.1°C at 60 °C and Δ t=3.2 °C at –20 °C).
- We notice negligible increase on the off side on the switchimg MOSFET.

S9051 tests

- Both converters on
- Thermal sensors:
  - A0 Switching MOSFET side A
  - A1 Transormer side A
  - A2 Rectifier MOSFET side A
  - B0 Switching MOSFET side B
  - B1 Transormer side B
  - B2 Rectifier MOSFET side B

Results on the S9051

- S9051 had not functional problems during the test.
- Switching MOSFET temperature rise not very homogeneus (Δ t= 3.9 °C at 60 °C on side A and Δ t= 2.0 °C at 60 °C on side B, at –20 °C Δ t= 6.9 °C on side A and Δ t= 3.8 °C on side B)
- Tranformer temperature rise more homogeneous (Δ t= 3.5 °C at 60 °C on side A and Δ t= 3.7 °C at 60 °C on side B, at –20 °C Δ t= 6.7 °C on side A and Δ t= 4.8 °C on side B)
- Rectifier MOSFET: Δ t= 3.4 °C at 60 °C on side A and Δ t= 2.1 °C at 60 °C on side B, at –20 °C Δ t= 7.1 °C on side A and Δ t= 4.3 °C on side B.

Tests on s9053

- One side on (B side) one side off
- Thermal sensors:
  - A0 Transformer side A
  - A1 output inductor side B
  - A2 MOSFET and freewheeling diode side A
  - B0 output inductor side A
  - B1 Transformer side B
  - B2 MOSFET and freewheeling diode side B

Results on s9053

- S9053 had not functional problems during the test.
- Output inductor hottest point: (Δ t = 6.0 °C compared to the thermal bar at 60 °C Δ t = 11.9 °C at –20 °C)
- Transformer: Δ t = 3.3 °C at 60 °C Δ t = 7.6 °C at –20 °C
- MOSFET and freewheeling diode: Δ t = 3.9 °C at 60 °C and Δ t = 9.2 °C at –20 °C
- Other sensors at the same level or slightly below thermal bar temperature

Tests on s9055

- One side on (A side) one side off
- Thermal sensor
  - A0 Trasformer side A
  - A1 MOSFET side A
  - A2 vacuum case
  - B0 Trasformer side B
  - B1 MOSFET side B
  - B2 vacuum case

Results on S9055

- S9055 had not functional problems during test
- Trasformer: $\Delta t = 0.9$ °C @ 60 °C, $\Delta t = 1.8$ °C @ -20 °C
- MOSFET: $\Delta t = 2.6$ °C @ 60 °C, $\Delta t = 4.5$ °C @ -20 °C
- Other sensors at the same level or slightly below thermal bar temperature

Test of S9054

- No converter failed during this test
- Data not yet available for this presentation

Conclusions on TVT test

- No converter failed during test.
- The results are reproducible in terms of cycles at level < 1 °C
- The results are not the same for A and B
- The measured values of Δt are not the same at the two test temperature (60 °C and –20 °C).
- The temperature mapping information we obtained are not too accurate but give reasonable results

ASI contract board production

- TPD controller: PCB under preparation at the moment CAEN has no component. Ready by mid-october (?).
- TPD filter: design finished PCB ready by mid-october. Ready by end October.
- TPSFE: Master ready PCB finished by early september.Ready by end October
- TBS: design starts at september. Ready by december.
- TBP: ready