CMS Week 10-13 June 2002
HVBs Summary
M.De Giorgi

Aachen 6 -11 may 2002

- An excessive noise was settled by modifying the layout of HV connections inside the SLs. GND connections of SLs and inside the filter box of the power supply were also modified.

- The tripping time of the HV channels was changed from ~0 to to 100 seconds, allowing for the conditioning of the SLs.

- In these conditions reasonable data acquisition was possible with noise levels <100Hz/cell, and currents below the fixed limits were reached after a few hours of running at nominal HV voltages on a few SLs.

- On one SL , after several hours of quite HV operation a sudden step of Anode current of a few μA occured in correspondance of a group of 8 cells powered by one HVB; since then the current step was stable.

- Aachen colleagues reported to have replaced ~10 HVBs with this behaviour.

- Most of these boards were showing in lighter colour the fiberglas weave supporting the resin of the pre-preg noflow used to insulate the outer layers of the boards. This raised the suspicion that there might be a correlation between the visual aspect and the current problem, in spite of the fact that the boards passed the screening in Beijing (45 min @5 / 2.5 / -2.5 kV on pcbs, plus 2 hours @4.5 / 2.25 /-2.25 on mounted boards in gas).

CIEMAT

- 6 boards replaced in the SLs for variuos reasons (waiting for details) are being brought to CERN. No particular alarm was raised up to now.

LNL

- 10 HVB replaced for various reasons:
    ⇒ 7 because of scratched or poorly insulated anode-connection wires (glue), or missing (detached) anode-connection wire (manipulation)
    ⇒ 3 because of High currents (a few μA) after a few days operation: out of these 2 show the fiberglas weave, but also a dark coloured inclusion, where the application of 5kV shows a smal flash; 1 does not show the fiberglas weave, but has a local defect of etching in one of the outer layers.

ACTIONS

- In response to Aachen preliminary findings, a warning was sent out to the production sites, that in principle the HVBs showing the fiberglas weave, might go off with high currents after several days of normal operation. So the HVBs showing this aspect were selected by eye and put aside in the three Labs, waiting for more evidence. In LNL ~ 60% of the 1164 boards in store show, more or less evident, the weave pattern.

- 16 HVBs clearly showing the weave pattern were put in a test jig in gas for a long duration test run at ~220ppm O2.

  $\Rightarrow$ After a week one board went off to ~2μA. The board was taken away from the jig for inspection. A clear spot covering a W path and the near GND was visible, having two small dots around its center. By applying 5kV to the W paths via an HV insulation meter, a small flash was visible in correspondance to the spot.

  $\Rightarrow$ At a closer inspection with a microscope the two dots appeared to be scars as if produced by some sharp or pointed body.We will try to have a microscopic cross-sectional analysis of this. The residual 15 boards were kept under test in the jig for another week with quite operation (~0 currents).

- The 10 HVBs replaced by Aachen have been sent to Padova and put in the test jig as well. The test description follows:

Test of 10 replced HVBs at Aachen

A) The 10 boards were put in the Test Jig under HV in air:
1) #1475   OK (10÷20nA reached in 5 min.)
2) #1374   OK
3) #1474   OK
4) #1360   OK
5) #1373   OK
6) # 728   BAD (4÷5 microA)
7) # 2317   BAD
8)#1441   BAD
9) #1359   OK
10)#1529   BAD

B) The 4 BAD were taken out of the Jig and inspected: all 4 show a dark inclusion 2÷3 mm diameter across an HV path with a small bump in correspondance.
By means of an "insulation meter" 5kV were applied to that path and a small flash was visible in correspondance to the inclusion, spotting it as the weak point.
These failures do not seem to be correlated to what we provisionally called "bad polymerisation".

C) The remaining 6 were put in gas and while the O2 went down to ~1% #1475 and #1373 started to drawn ~100nA between W and C. the current went to 0 instantly as soon as the Jig Box was opened : the problem is external, related to some mounting defect.
Leaving the boards in gas (not powered) for one night made good because the Wire-Cathode currents went down to ~40 nA.
The two boards were taken out and cleaned with alcohol, without a significant improvement, but currents stay anyway at 0 in air. These boards will be more carefully inspected later.

D) Boards 2), 3), 4), 9) of the above list are kept under test as long as possible at ~40÷50 ppm of O2. They keep to show ~0 currents.
#1474 is slightly "noisy" showing occasional jumps to 40 nA .

E) Analysis of CIEMAT boards is necessary to get more information.

- **<u>HVB production quality</u>**

- A first production of ~500 boards was good and did not show significant rejection.

- Following batches showed an increase of the rejections in Beijing up to ~20%

- I finally correlated this rejection to a particular aspect of the outer layers (anodes) in correspondance of the gaps between paths and the diffused GND. The fiberglas weave supporting the resin of the pre-preg noflow, used to insulate the outer layers of the boards, was visible in lighter colour.

- Together with the producer the pressure-temperature cycle of fabrication was improved and the last batches are free from this defect.

- A few hundred boards previously rejected by aspect were re-worked with an improved cycle

- In Beijing they find the last two batches (3000 HVB) sent this year "very good" : 9 boards rejected over ~1000 up to now. Just received them in Padova, will be analysed asap.

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Start 27 May 02 **Stop 3 Jun 02**
08:00 **08:15**

#3307 ⇒ ~2 µA after 6.5 days
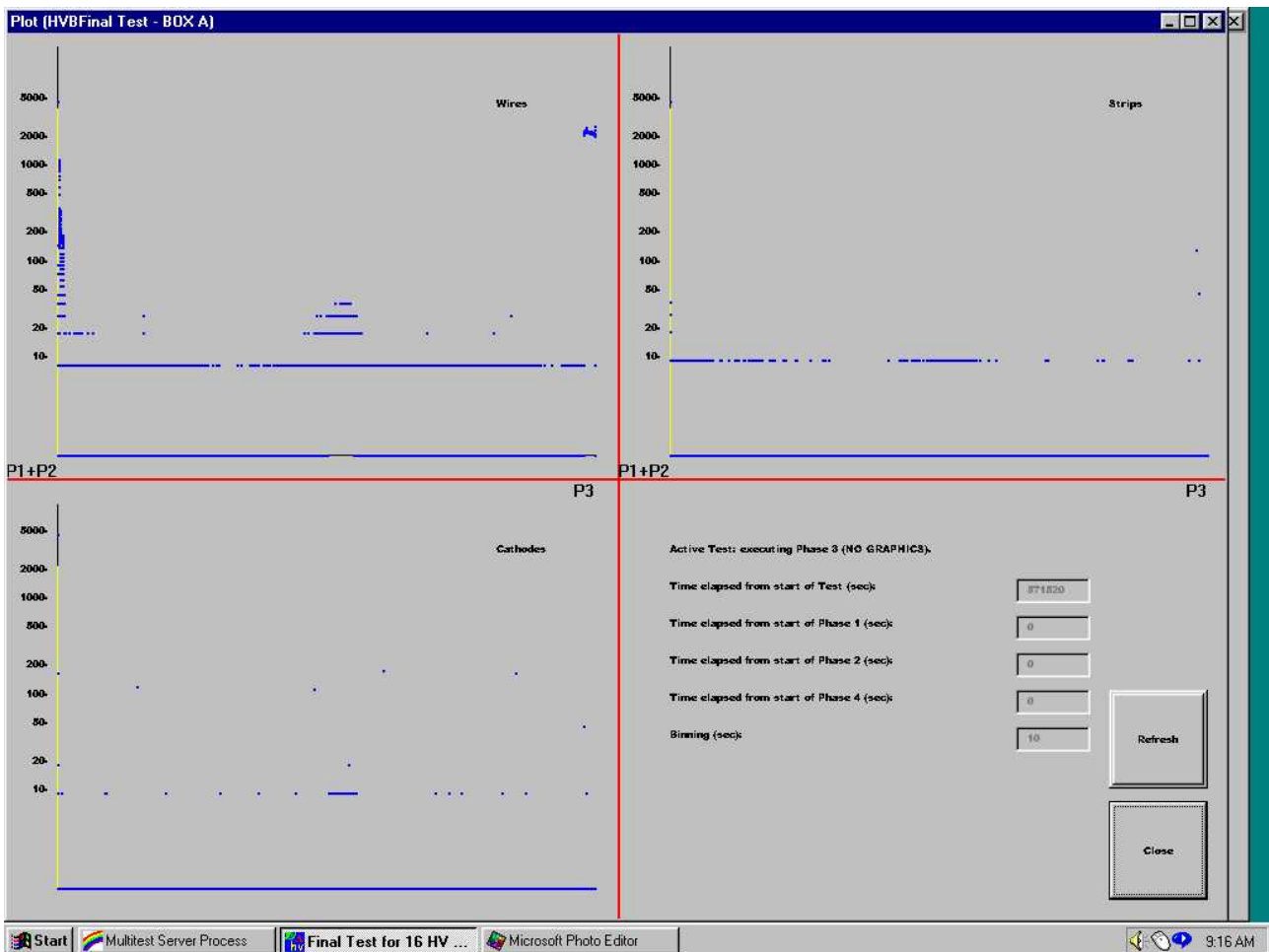
Start 30 May 02   **Stop 5 Jun 02**   **O2 = 200ppm**
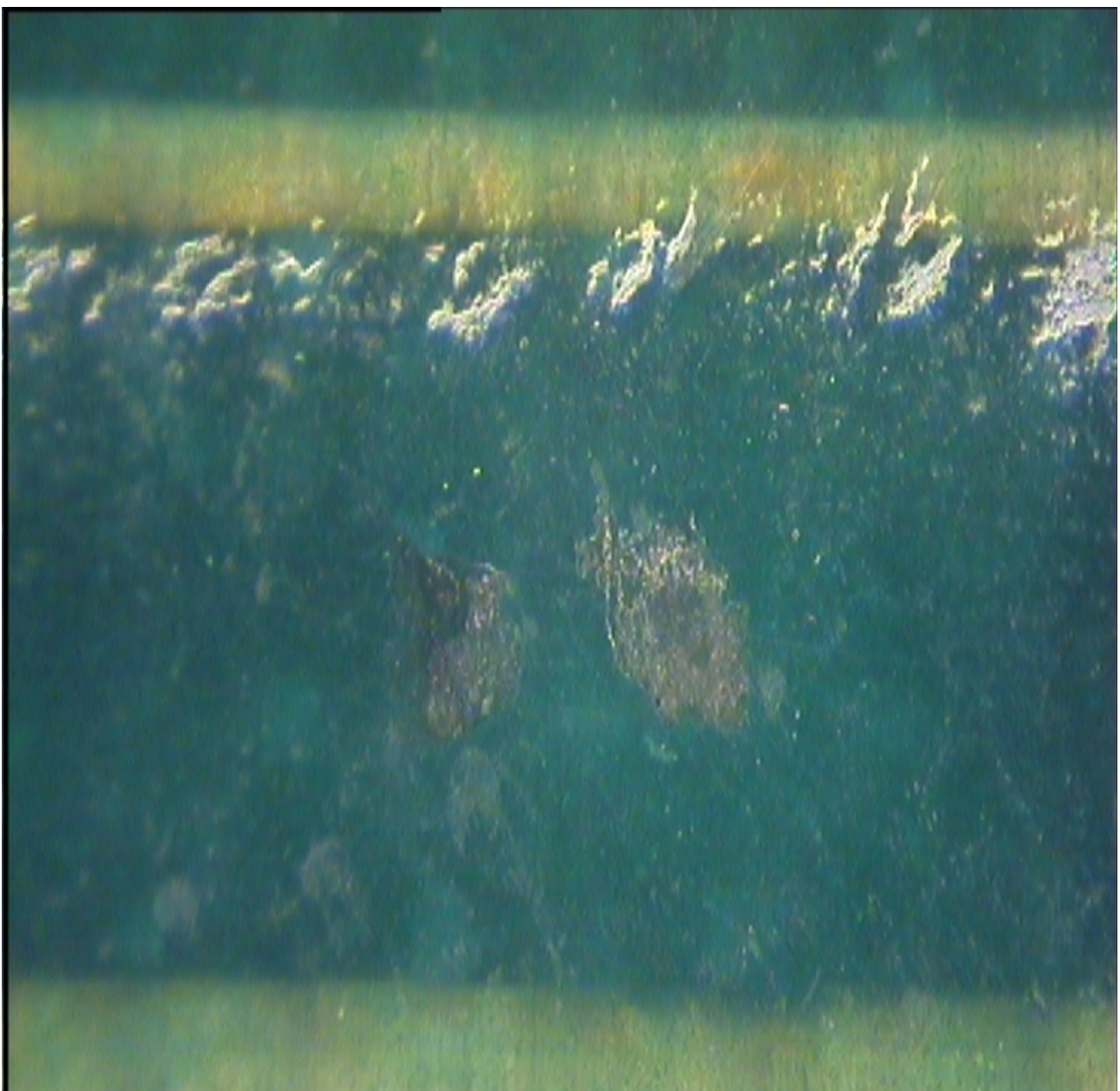**09:50**   **14:30**

#3307 taken away
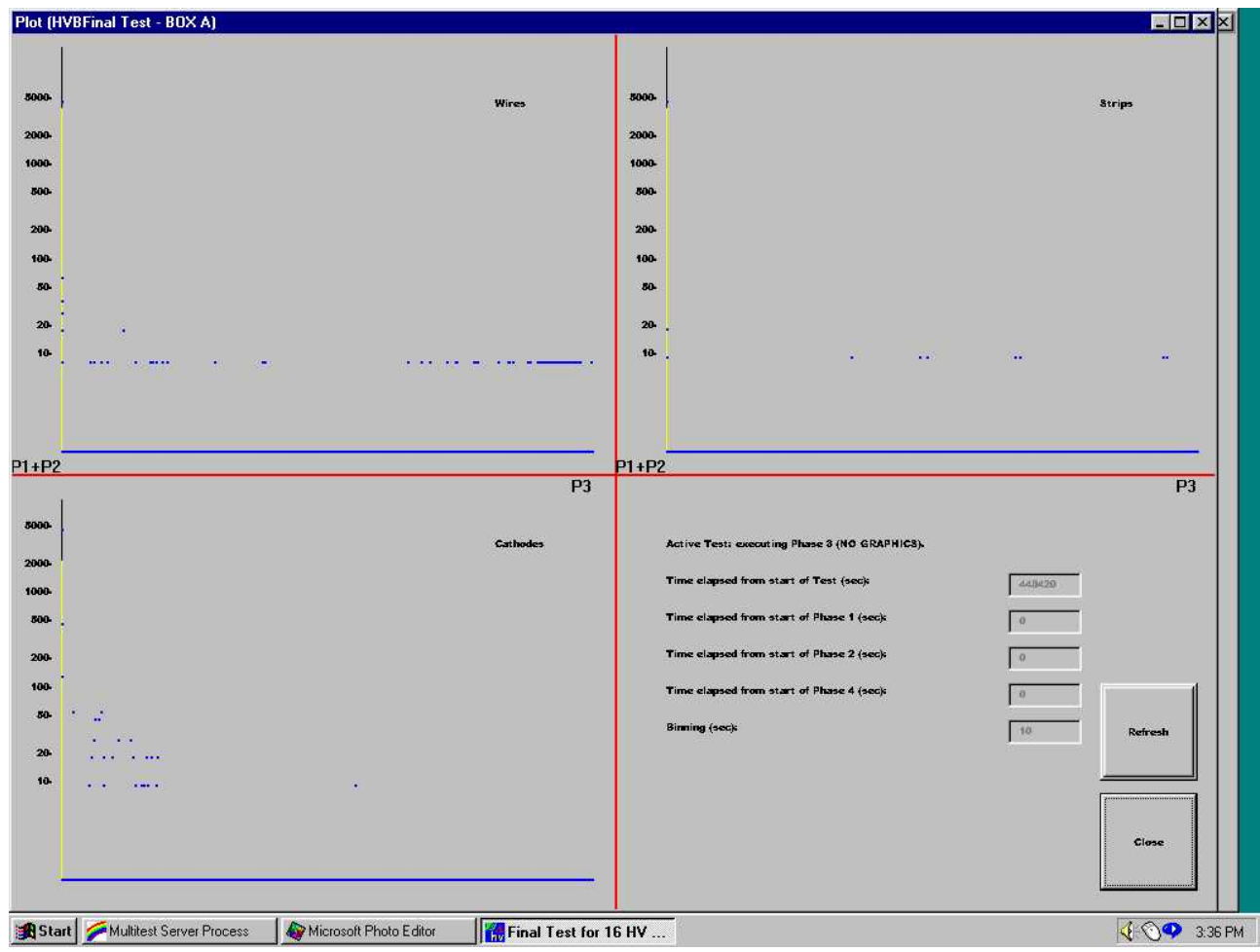
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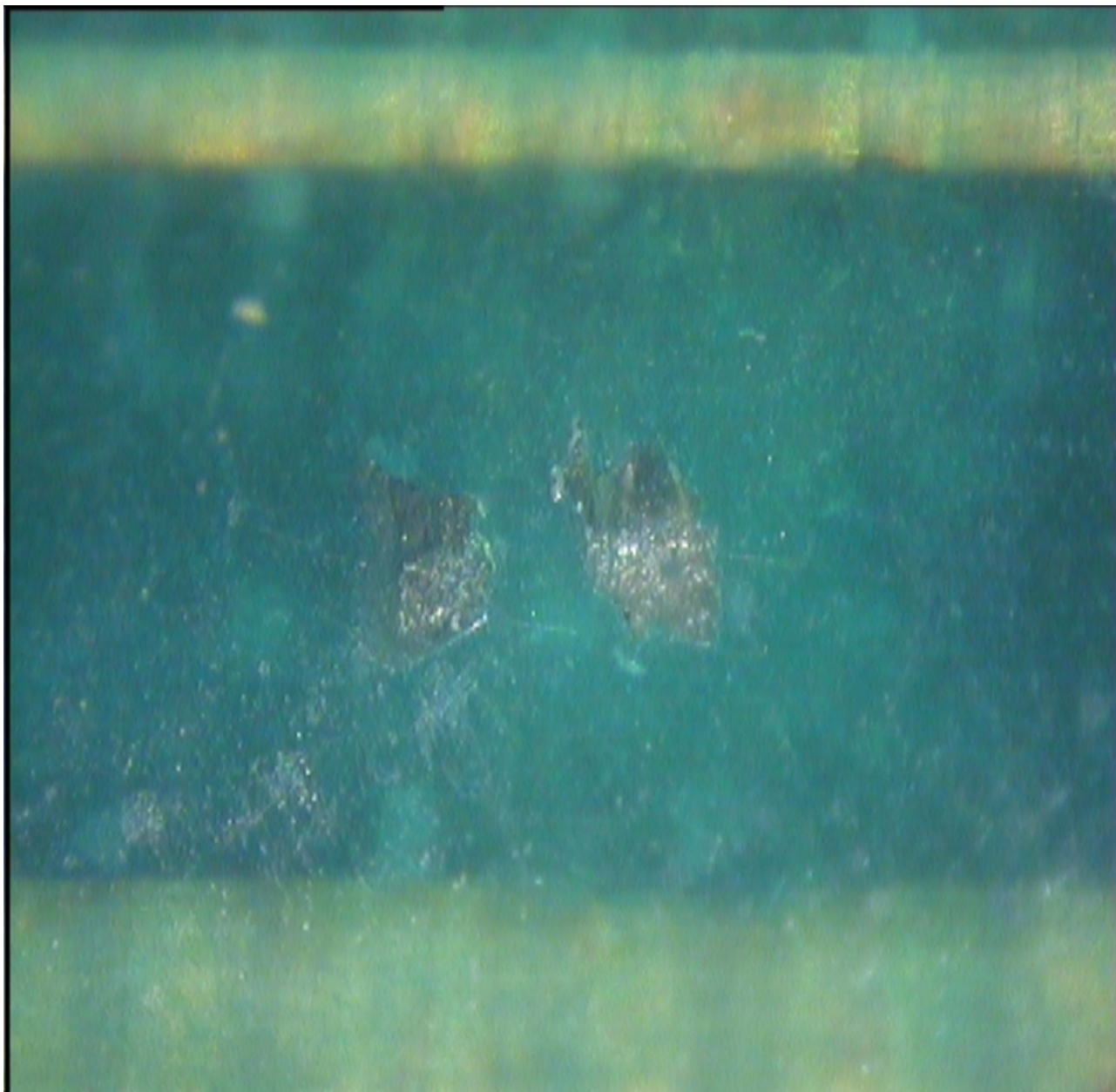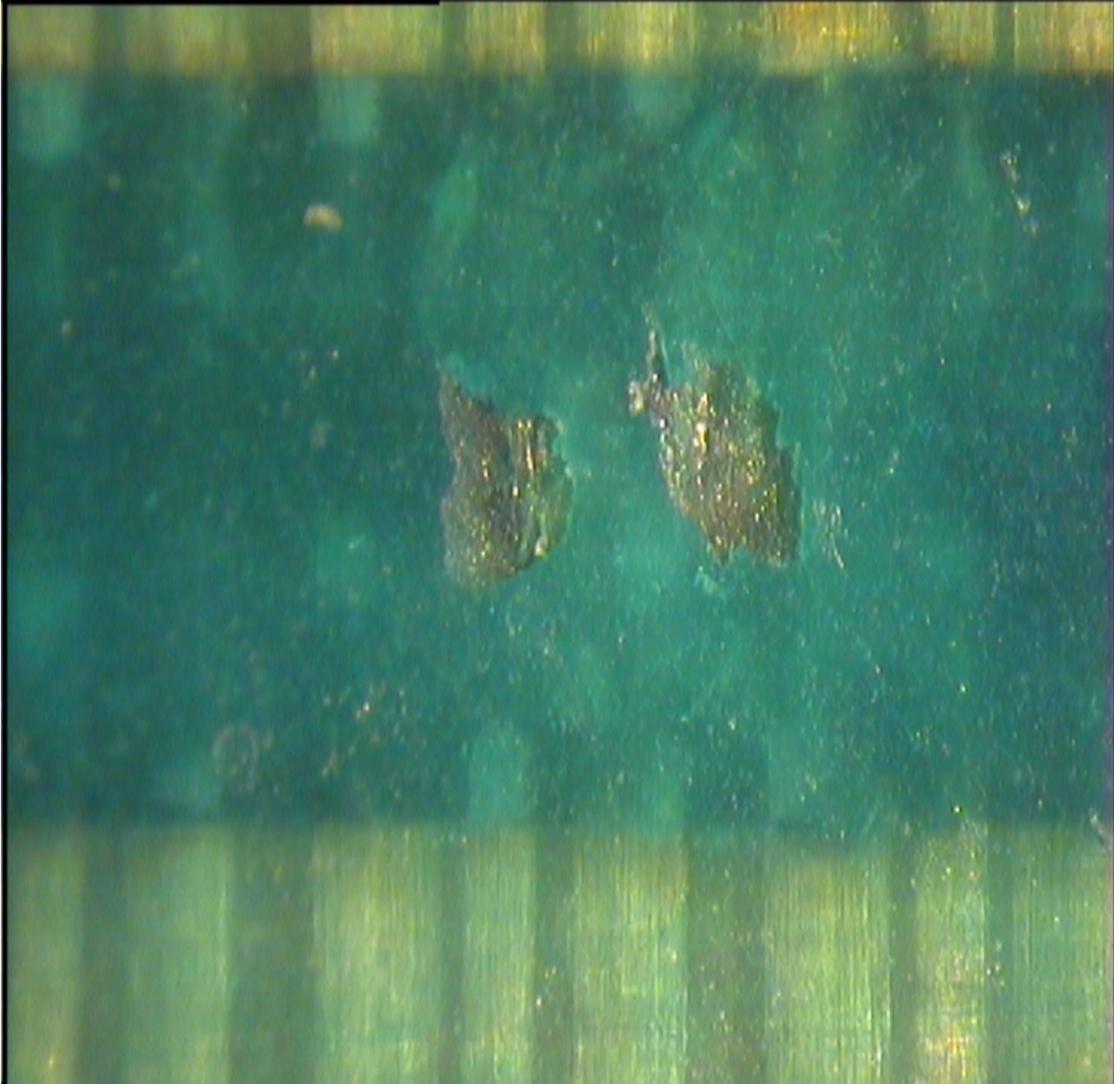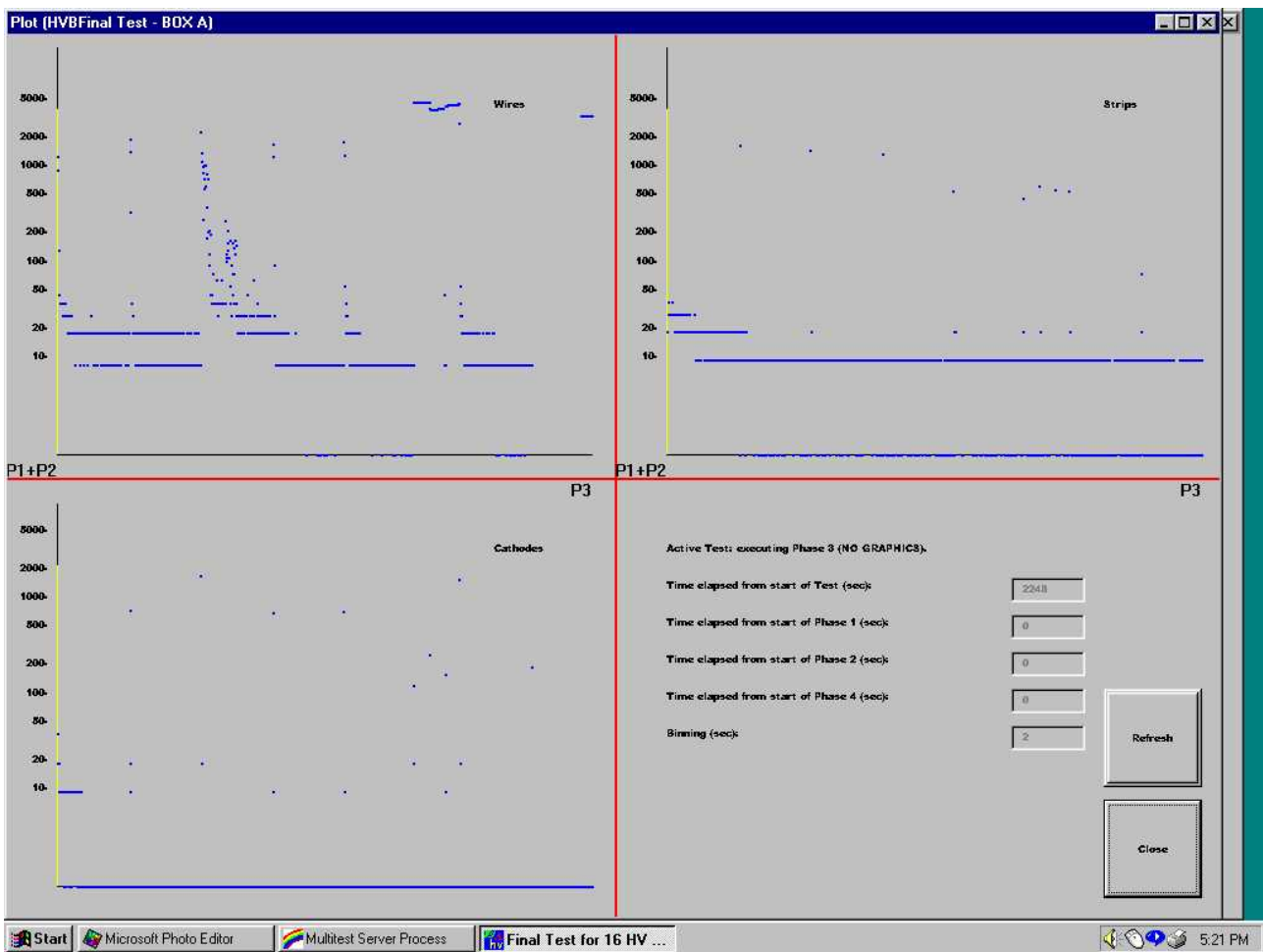**LNL – HVB # 3307**   **a) View of leaking point**

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Aachen-10 preliminary test in Air

5 June 02   16:30
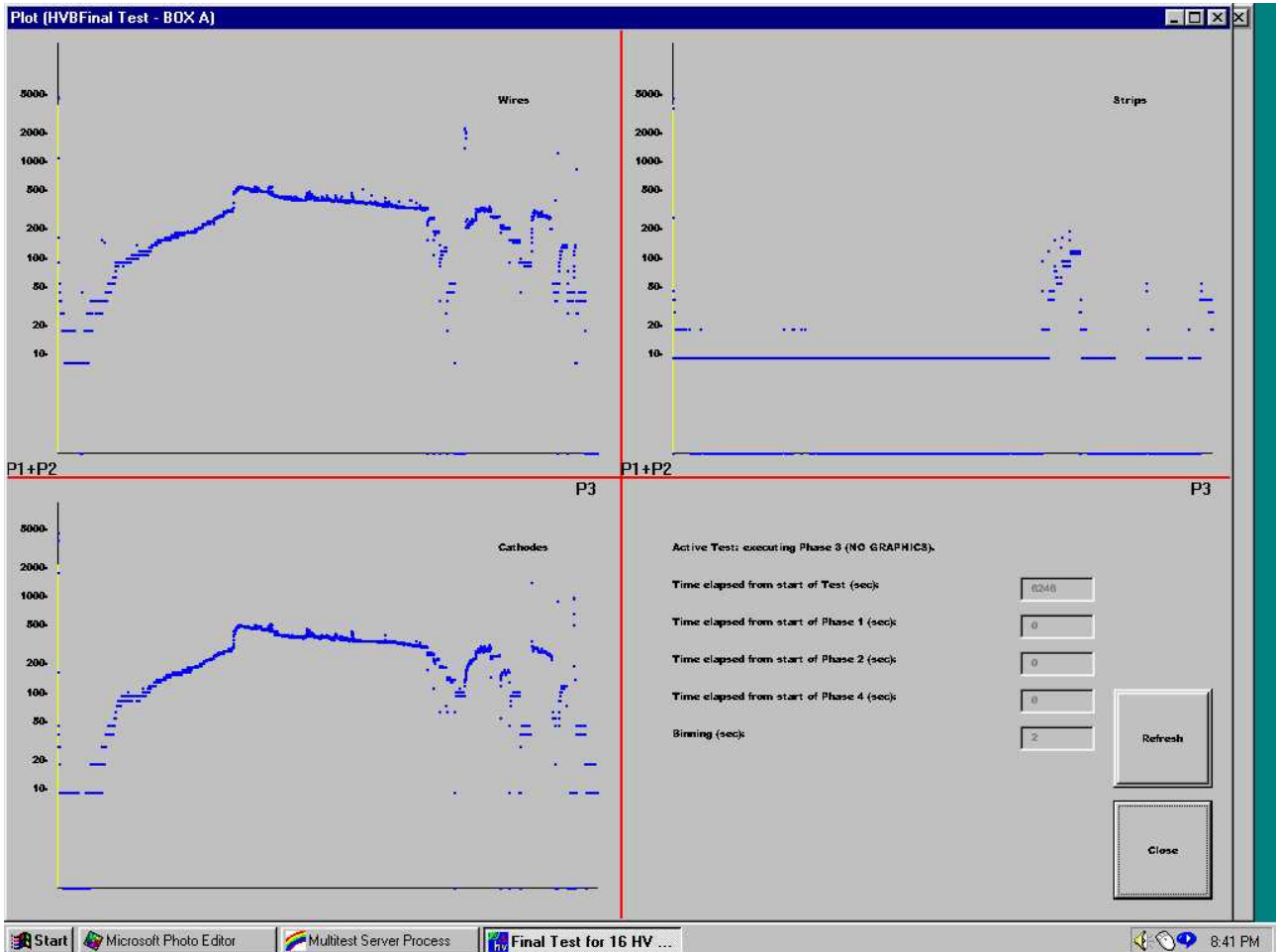
Aachen-6　　　　　　**test in Gas**　　　**O2 $\Rightarrow$ 75ppm**　　　　**~1.5.hours**

5 June 02　19:40　　　**Boards: 1,2,3,4,5,9**

　　　O2 = 0.2%　　**playing with HV**

Aachen-4   **test in Gas**   **O2 $\Rightarrow$ 75ppm**   **~12 hours**

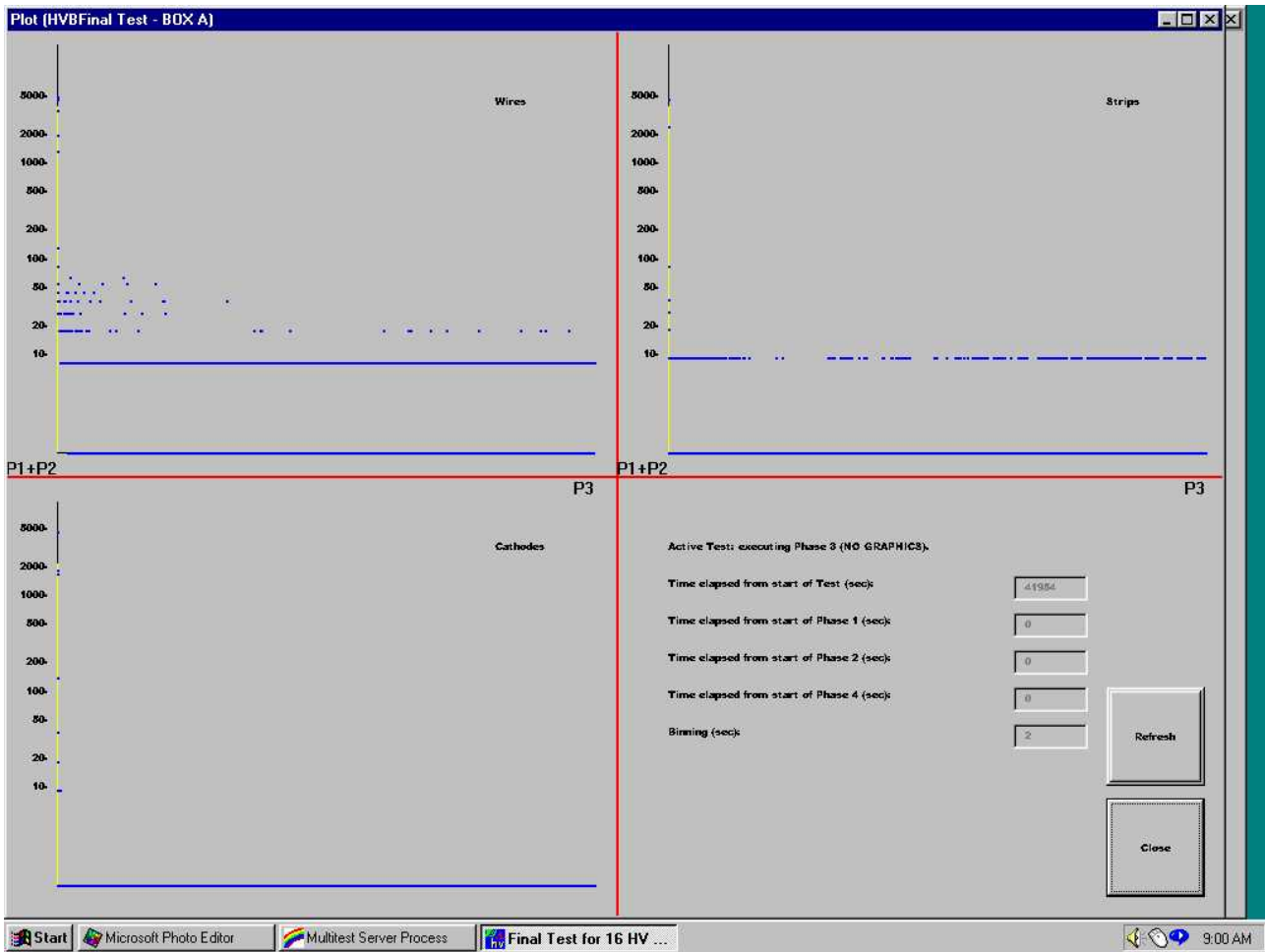**6 June 02   08:00   Boards: 2,3,4,9**

Aachen-1475-1   **test in Gas**   **O2 ⇒ 75ppm**   **~1 hour**

6 June 02   11:56   Board #1475

O2   0.15%   140ppm
↓   ↓
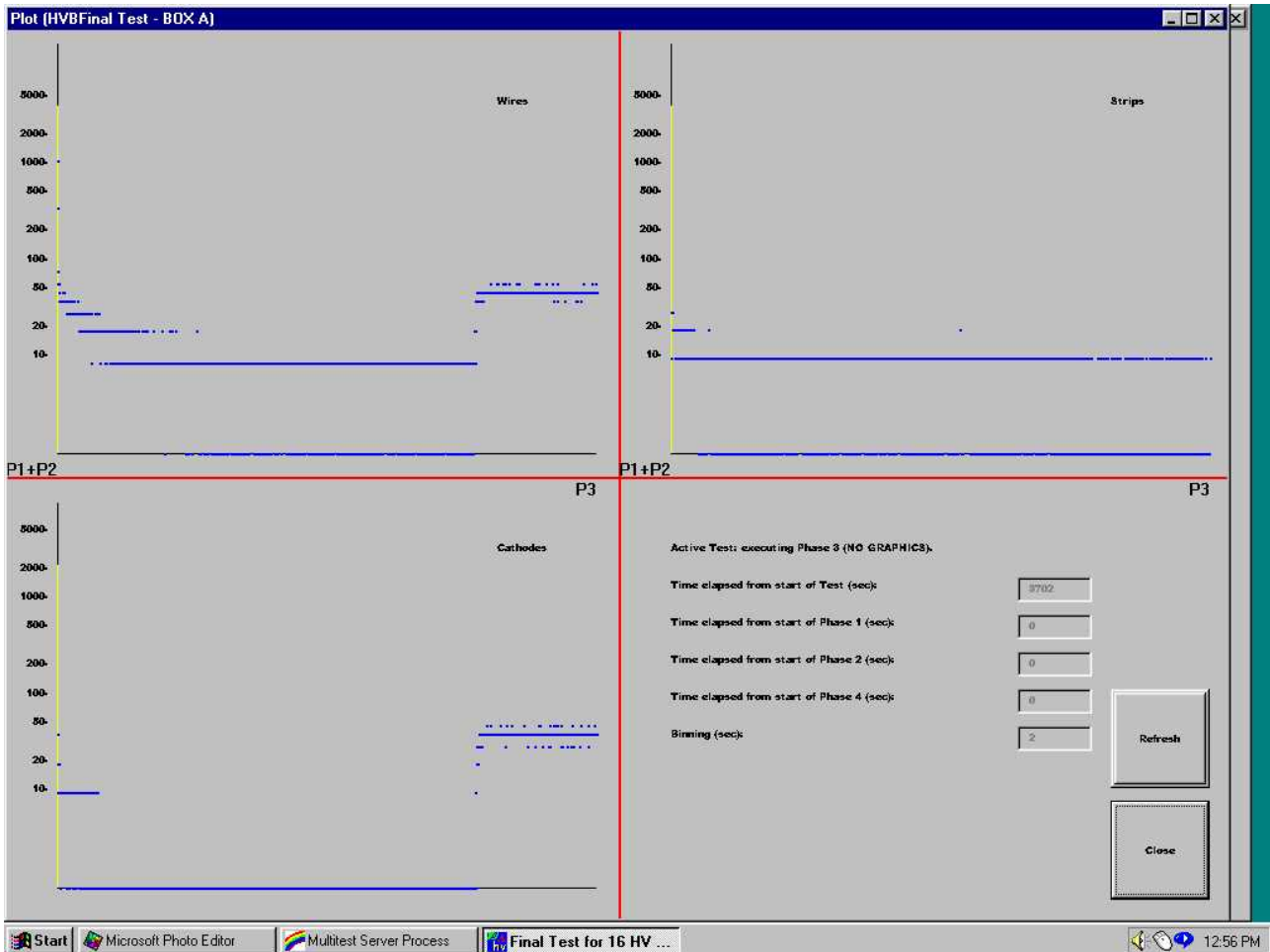
Aachen-13735-1   **test in Gas**   **O2 $\Rightarrow$ 75ppm**   **~1 hour**

6 June 02   12:58   **Board #1373**

Jig Box opened I$_W$ = 0
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