Status of the LVPS Transformer Problem

TileCal Maintenance Meeting

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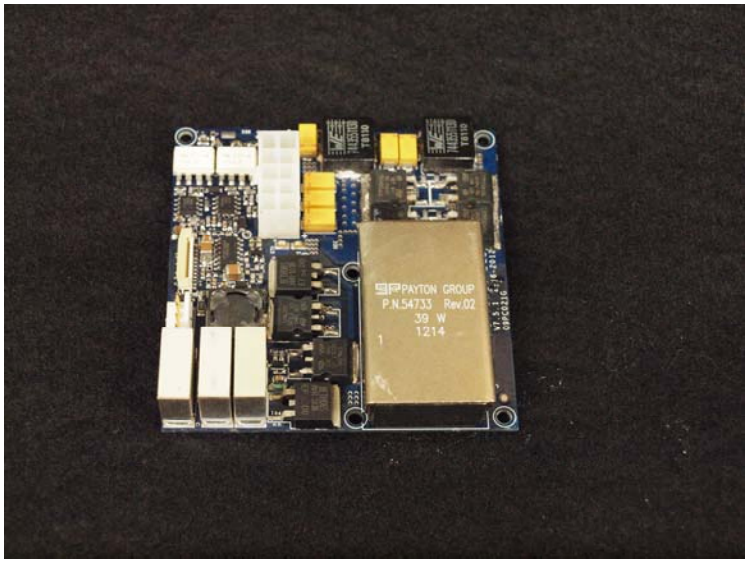
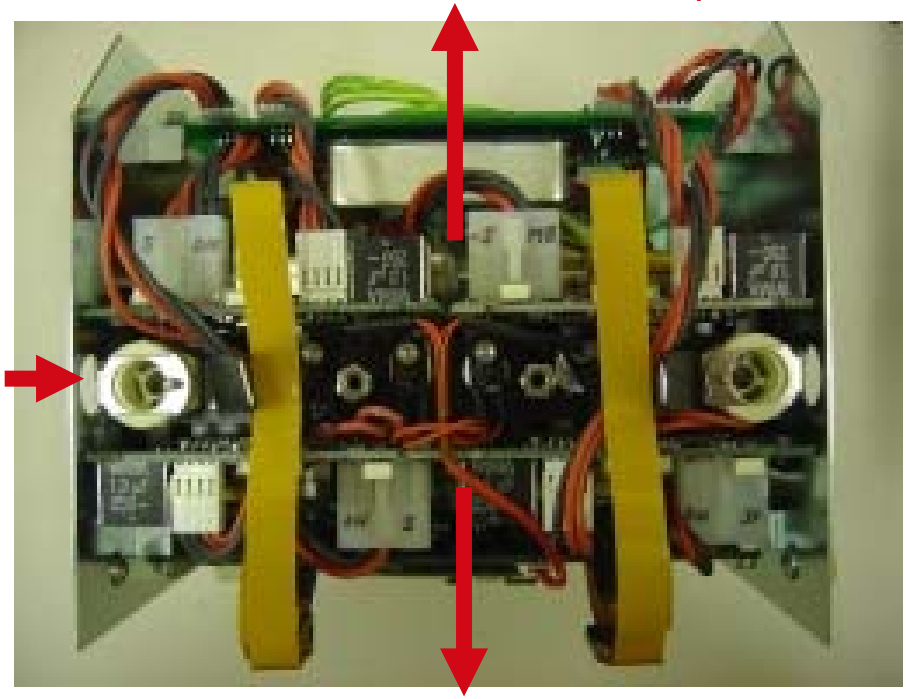
Summary of the Problem

- Covers on the transformers are coming off after installation in the detector
- Since bricks are installed back-to-back on the cold plate inside the LVPS box, loose covers can fall onto live circuitry…
- Boxes also have 360 degree orientation on the detector, so no box is “safe”…

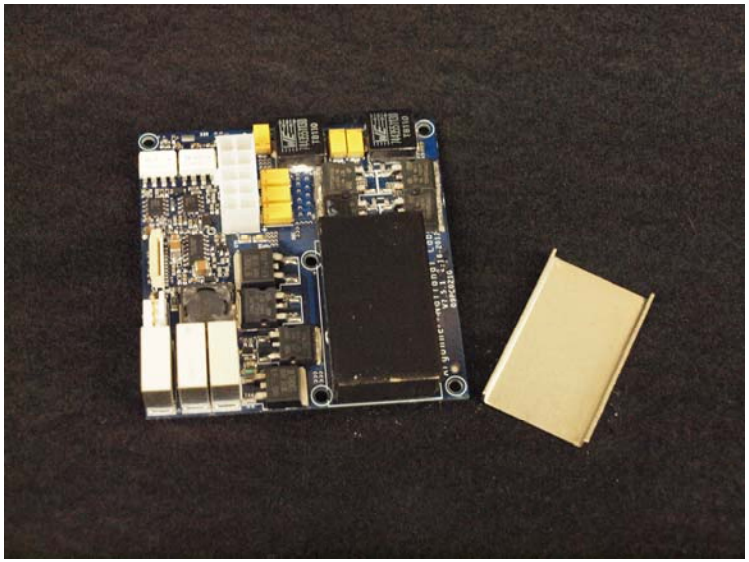


Transformer covers face up



Cold Plate

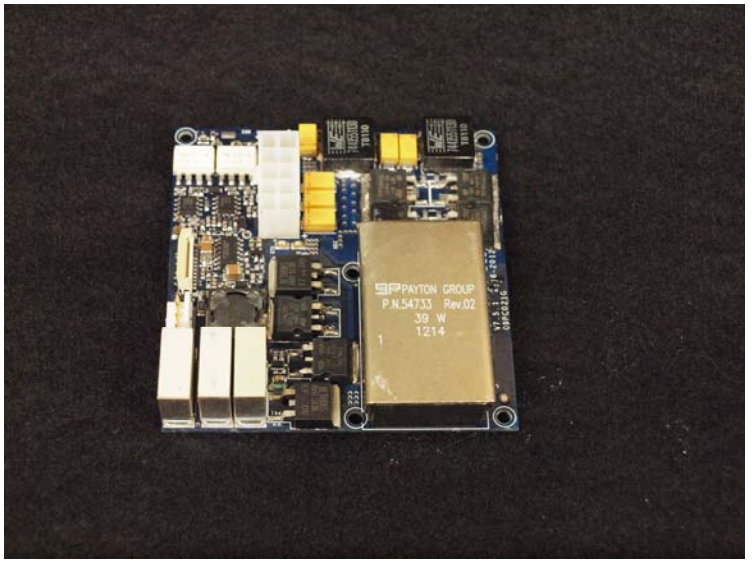
Transformer covers face down



Summary of the Problem (Cont.)

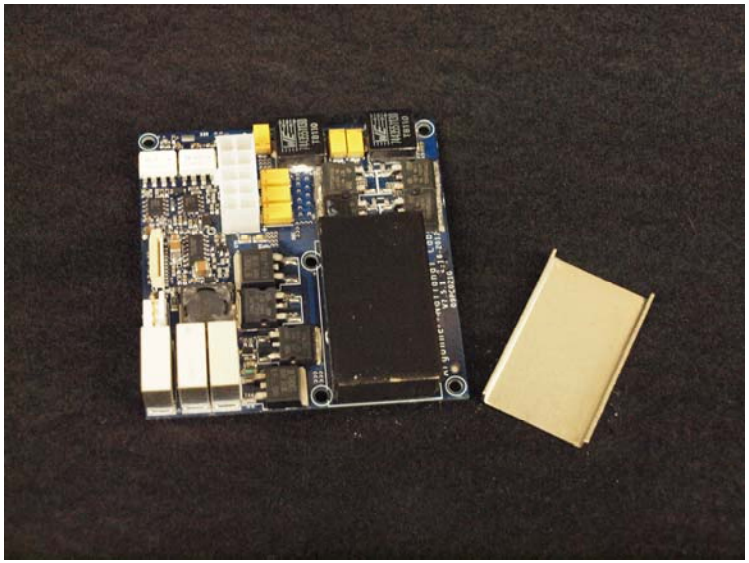
- **What is known from the checkout:**
  - **"A few" loose covers were noted during checkout at Argonne**
    - These were glued back on with RTV
  - **"Approximately 10" loose covers were noted during QA at CERN**

⇨ ***No "red flags" raised at the time, but maybe there should have been…***



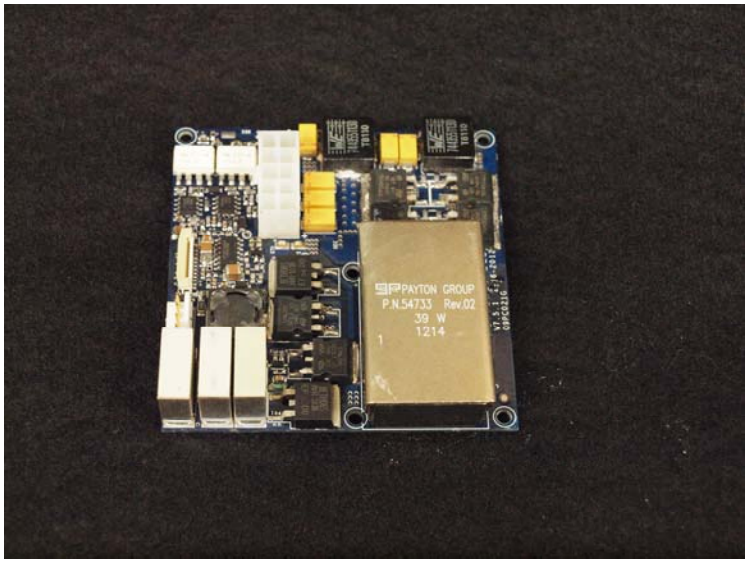
  - **Spot check of ~30 bricks currently at Argonne found 0 loose covers**

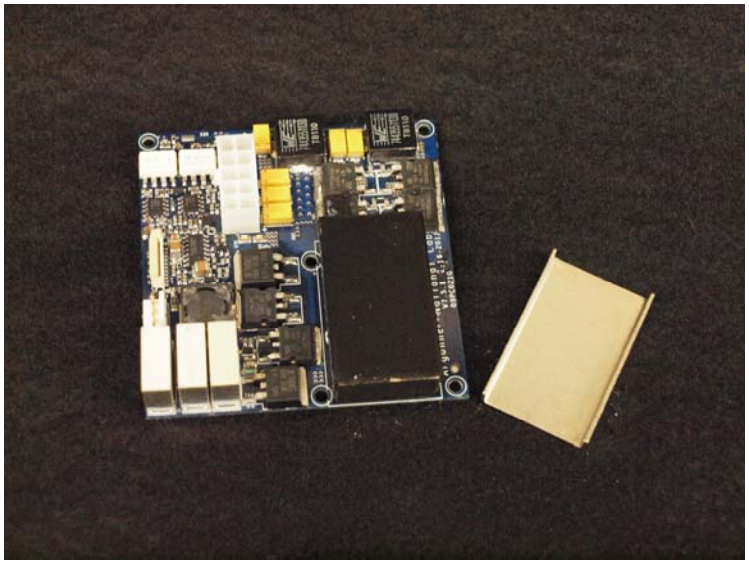
⇨ ***This is a subtle problem***
⇨ ***Problem not present in all bricks at t=0***
⇨ ***Problem may develop in time…***



Summary of the Problem (Cont.)

- **What is known from the experiment:**
  - **First occurrence of loose covers occurred only recently**
    - 3 boxes failed to start after planned power outage
    - Inspection after removal from detector found covers that had fallen off (See Stan's talk)
    - These boxes have been on the detector for a while…
  - **(As far as I know) No loose covers were observed in the (5) V7.3 boxes that have been operating on the detector for ~2 years**
  - **(As far as I know) No loose covers were observed in the (40) V7.5 boxes that have been operating on the detector for ~1 year**

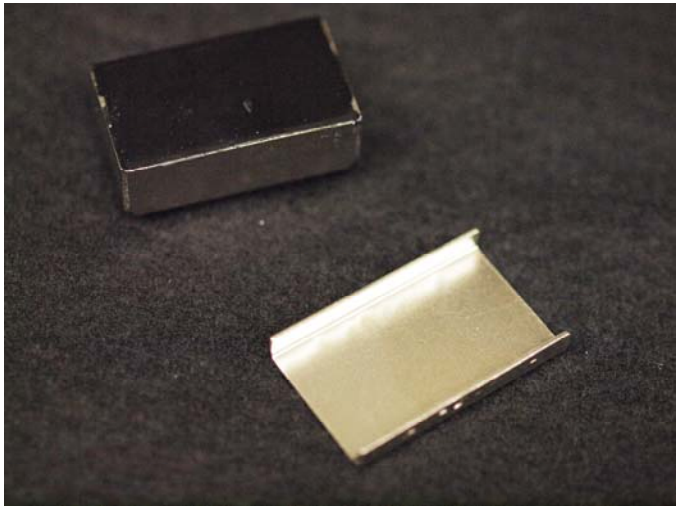




⇨ ***Conclusion: Problem likely to be batch-dependent***
⇨ ***Indications of dependence on thermal cycling….***

Summary of the Problem (Cont.)

- **What is known from the vendor:**
  - **The transformers were ordered in 3 batches:**
    - 20 first prototypes
    - 400 for 40-box production
    - 2200 for 260-box production
  - **"It is likely" that the large quantity was manufactured at a different time than the smaller quantities (vendor still checking)**
  - **The transformers for the large production were potted with a silicone compound (not sure about the small production – still checking)**
  - **Intended method for holding the covers on was the adhesive properties of the silicone**
  - **Method requires covers to be cleaned before gluing to ensure good adhesion**
  - **Vendor is now going through production records to try to find answers**

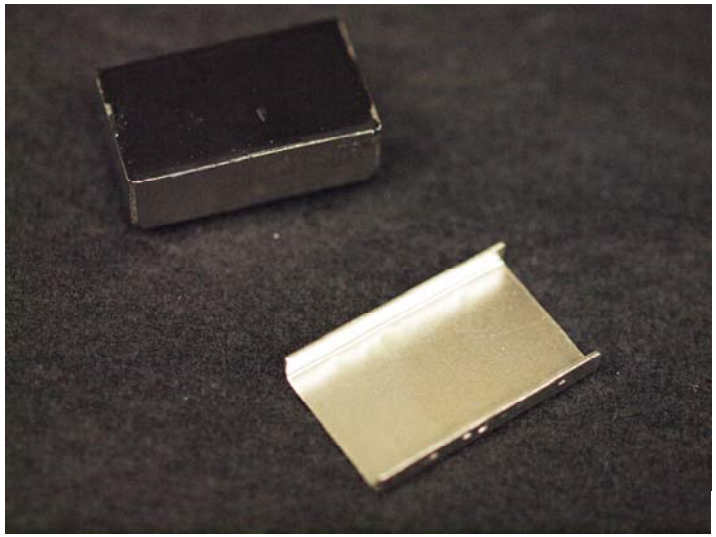


- **Theories being investigated:**
  - **Large production batch was done differently**
  - **Covers not cleaned properly**
  - **Thermal-cycling may be loosening adhesion of silicone**
  - **Covers manufactured with looser tolerance in large production**

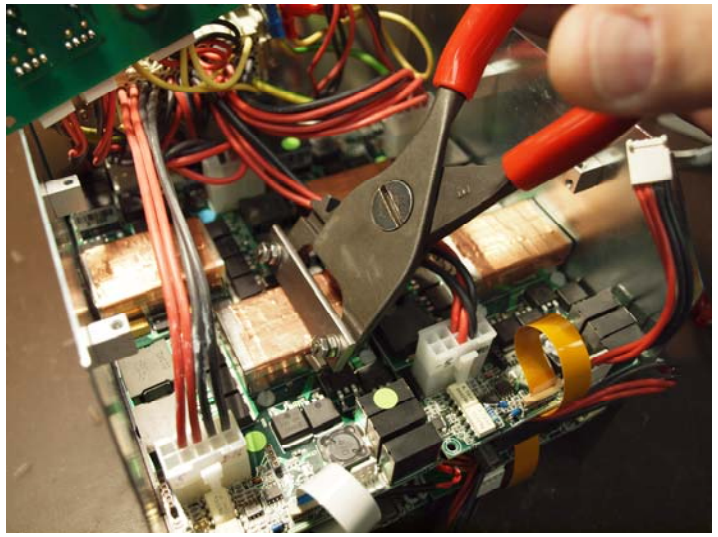
⇨ ***While cause is interesting, effect is devastating, and a solution is needed…***

Solution being Pursued

- Since number of potentially loose covers is not known, it is prudent to apply a fix to ALL bricks
  - ~150 boxes in Bldg. 175 currently
    – These are the "easy" ones
  - ~150 boxes currently installed on the detector, which would have to be removed.



- Investigations & discussions at CERN & ANL have converged on the following fix:
  - Open the boxes & remove the ELMB and the fuse board, and the flat cables to the bricks
  - Apply a crimp to the transformer covers to provide more friction to hold them in place
  - Apply high-heat aluminum tape to the sides of the covers, to hold them onto the body of the transformer
  - Reassemble
  - Perform "quick" QA check



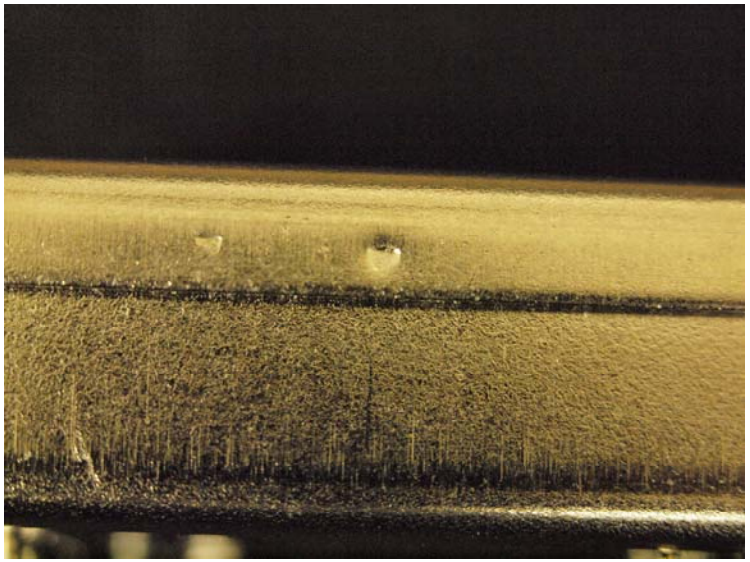
⇨ *Work can be done without removing bricks from box*

⇨ *Fix is "easy"; Hard part is disassembly and re-assembly of cables and top & bottom boards*

Solution being Pursued (Cont.)

- Two-pronged solution:
  - Crimp transformer covers
  - Use high-heat tape

  ⇨ *Intend for 0 chance of recurrence*
- For crimping, we have built a tool that applies a dimple crimp to the cover
  - Applies just the right amount of pressure
  - Works great
  - Crimp adds dimple to cover, but does not deform transformer case
  - We have made two tools that we will bring to CERN
- Logistics
  - Work will be performed in Bldg. 175
    - QA stand is there
    - Bench space is there
  - Can work on first 150 boxes now
  - As boxes are repaired, swap them in with the ones on the detector
  - My estimate: 0.5 hrs. per box for repair (goal)



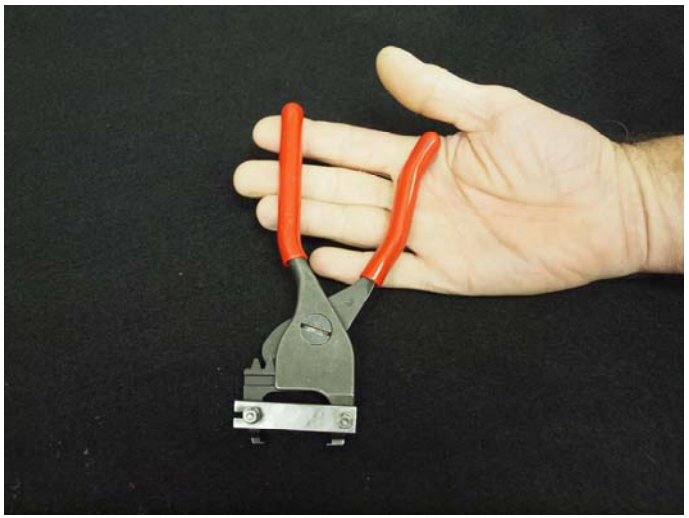
Remediation Plan

- ANL will send 1 person to CERN beginning Nov. 11 for 2 weeks
  (I will be there for the 1st week)
- With help from Anna, try to complete remediation on 150 boxes currently in Bldg. 175
- Stan's team: perform QA & bookkeeping
- Irakli's team: Swap repaired boxes into the detector as they become available

  ⇨ *Goal: Repair 1st 150 boxes in November before Thanksgiving*

- ANL will send another person to CERN for 2-3 more weeks after Thanksgiving

  ⇨ *Goal: Repair 2nd 150 boxes in December before Christmas shutdown*



⇨ *Main Goal: Fix this problem before the end of the calendar year 2013*

⇨ *As bad as this is, we have two things in our favor:*

⇨ *The fix is "easy" (no soldering, no parts replacement, no design changes)*

⇨ *Problem was discovered early, and we have the time to get the repairs done*