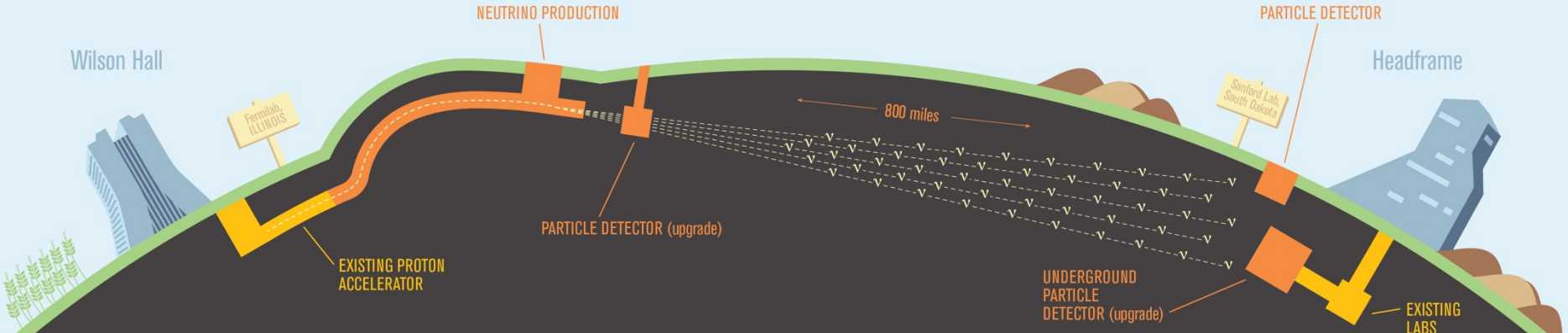
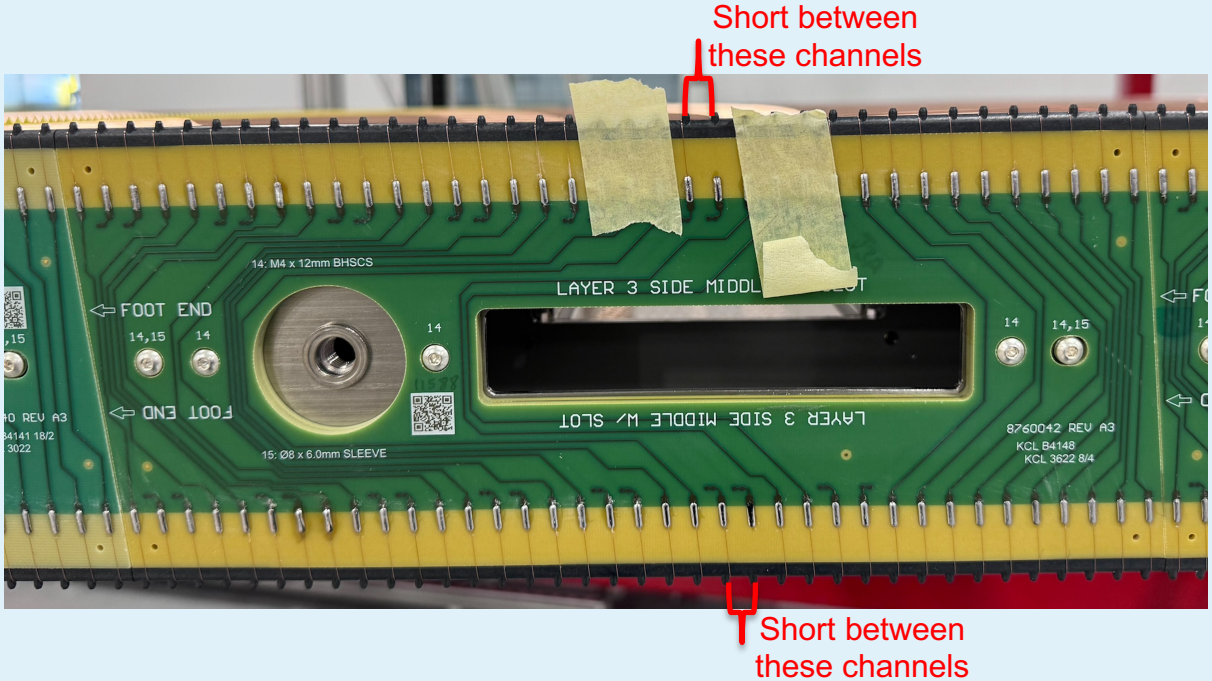
Short between U channels on APA 12

Justin Evans, Anthony Ezeribe, Brian Rebel, Sotiris Vlachos

29th April 2024



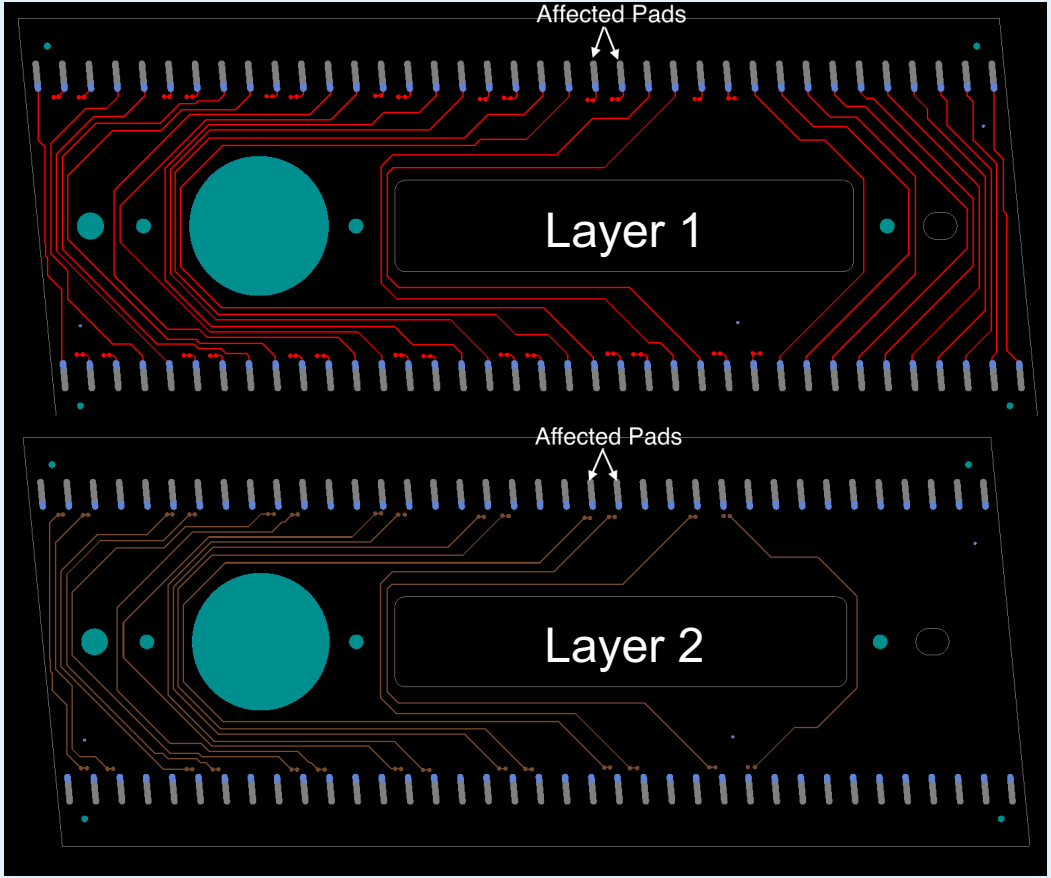
Short between U-layer channels



- These two channels show a physical connection within the U-layer wrap board shown

	Layer & side	Head board & pad	Cold channel	Offline channel
Channel 1:	BU	3-33	3-6-3	287
Channel 2:	BU	3-34	12-3-8	286

Short is on an inner layer



- The short is on the second layer of a multilayer board, hence this is very unlikely to be damage from a mishandling of the board
- No physical damage is visible on the board

Investigation with Merlin

Merlin PCB is the board manufacturer

- They have gone through their test record for us

This board came from a batch of 84 boards, produced from 21 panels

- Merlin perform automated optical inspection and an electronic bare-board test on all boards
- Of this batch, 1 board failed the electrical test and was not sent, but Merlin are certain that this board in question passed the tests
- Merlin's full route card for this batch of boards is included in the root cause document

Conclusion and recommendation

It is unknown how this short came about

Our investigations show that Merlin is doing the required QC on boards leaving their factory

- And this is a one-off failure across many hundreds of boards

We recommend that the U wires be kept in place on both these channels and the APA be completed with the short in place and recorded

APA experts agree that keeping the wires in place is the optimal decision

- Removing a wire would modify the drift field, which would reduce the physics performance of the APA
- The signals from these two shorted channels will still be useable

A full root cause document is available in EDMS

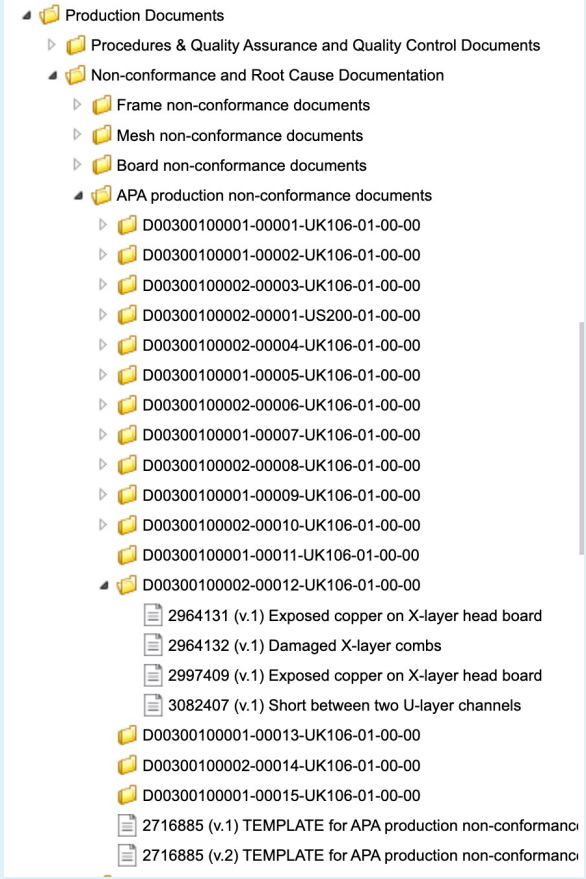
- https://edms.cern.ch/document/3082407/1
- Please take a look and send through any comments – if nothing significant is raised, we will approve this on Wednesday

Documentation reminder

Each APA has a folder of dedicated root cause / non-conformance documents

This should be one of the first ports of call for understanding details of any APA

- Especially missing/shorted wires



Documentation reminder

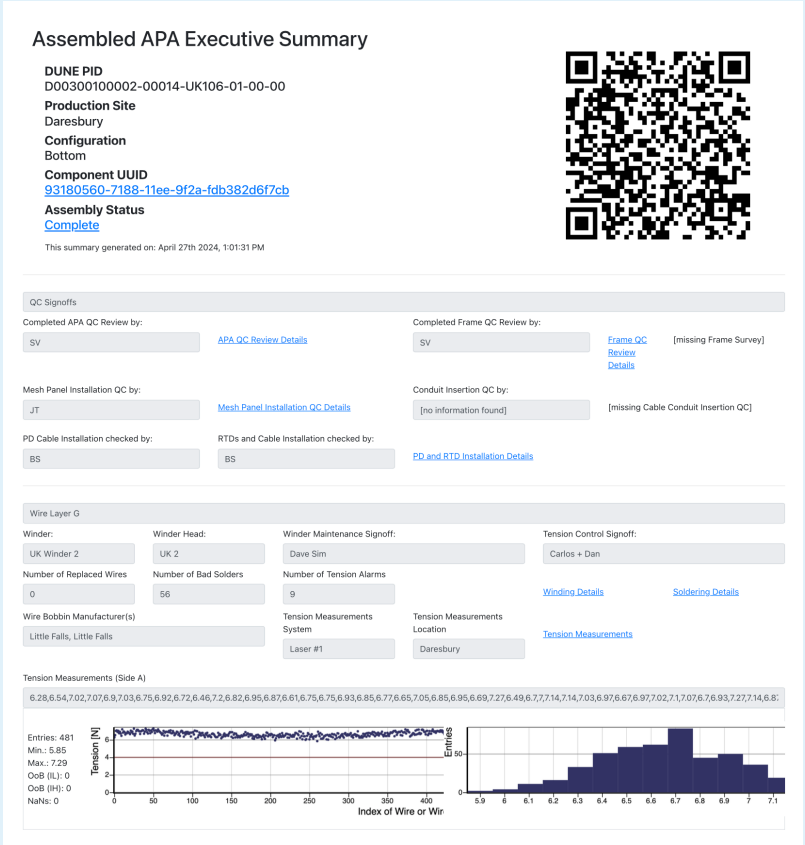
We also have a construction database

- https://apa.dunedb.org/

Pretty much everything you need to know is in here

- e.g. board-by-board QC data, APA travelers, etc

There is a summary page for each APA which will also show all key features of APAs such as missing channels



Assembled APA Executive Summary

DUNE PID
D00300100002-00014-UK106-01-00-00

Production Site
Daresbury

Configuration
Bottom

Component UUID
93180560-7188-11ee-9f2a-fdb382d6f7cb

Assembly Status
Complete

This summary generated on: April 27th 2024, 1:01:31 PM

QC Signoffs

Completed APA QC Review by: SV — APA QC Review Details
Completed Frame QC Review by: SV — Frame QC Review Details — [missing Frame Survey]
Mesh Panel Installation QC by: JT — Mesh Panel Installation QC Details
Conduit Insertion QC by: [no information found] — [missing Cable Conduit Insertion QC]
PD Cable Installation checked by: BS
RTDs and Cable Installation checked by: BS — PD and RTD Installation Details

Wire Layer G

Winder: UK Winder 2
Winder Head: UK 2
Winder Maintenance Signoff: Dave Sim
Tension Control Signoff: Carlos + Dan
Number of Replaced Wires: 0
Number of Bad Solders: 56
Number of Tension Alarms: 9
Winding Details — Soldering Details
Wire Bobbin Manufacturer(s): Little Falls, Little Falls
Tension Measurements System: Laser #1
Tension Measurements Location: Daresbury
Tension Measurements

Tension Measurements (Side A)

6.28,6.54,7.02,7.07,6.9,7.03,6.75,6.92,6.72,6.46,7.2,6.82,6.95,6.87,6.61,6.75,6.75,6.93,6.85,6.77,6.65,7.05,6.85,6.95,6.69,7.27,6.49,6.7,7.7,7.14,7.14,7.03,6.97,6.67,6.97,7.02,7.1,7.07,6.7,6.93,7.27,7.14,6.8:

Entries: 481
Min.: 5.85
Max.: 7.29
OoB (lL): 0
OoB (lH): 0
NaNs: 0

This is an example from APA 14