BTTR robot update

F9 SIC LAB WEEKLY

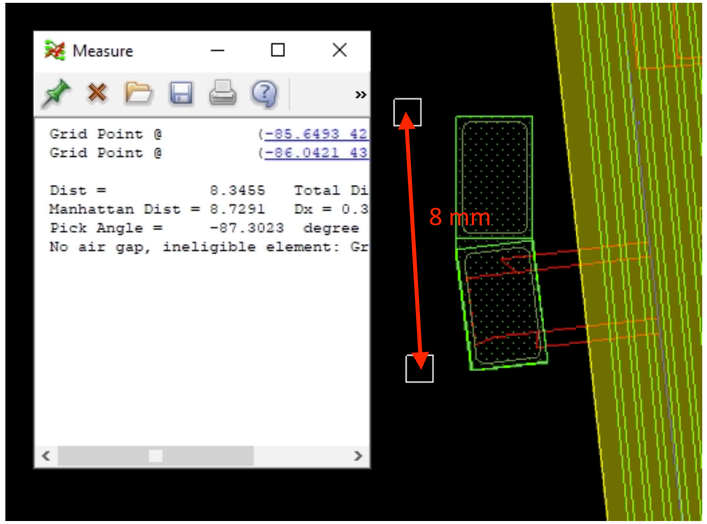
Configuration file changes & test length

- New JSON configuration files with added checks for short contacts between networks in TOP tape layer
    - Incorrectly set flag in the extraction code caused the extraction script to only include short checks to BOTTOM tape layer and then ignore all TOP layer checks
- Added HV line checks to the main robot program
- Electrical test time increased: 42 minutes -> **50 minutes**
    - One additional short measurement for each network + 2 x HV line check for each HV network
- Total test time with tape loading + fiducial measurements + electrical test: **60 minutes**

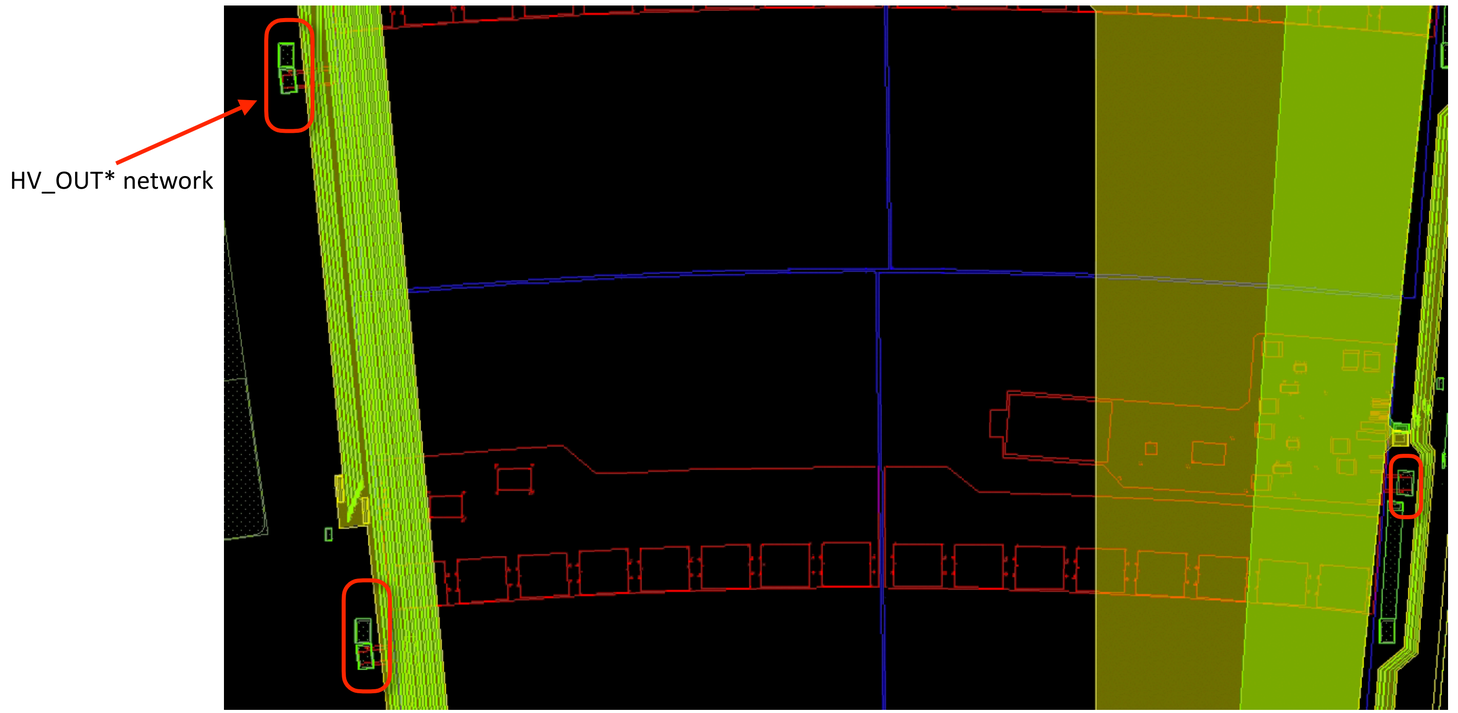
Networks & tests

- **Resistance measurements**:
  - Measure pads that are at least 15 mm apart. HV_OUT* network pads are too close together.
  - Measure primary (max X) and final pad in network, intermediate pads are measured if geometrically accessible. Most networks have all pads measured.

Example of HV_OUT network with total length of just 8 mm.



A total of 10 such HV_OUT networks that cannot be checked for continuity.

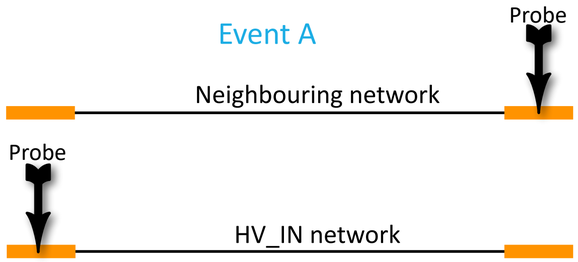


Networks & tests

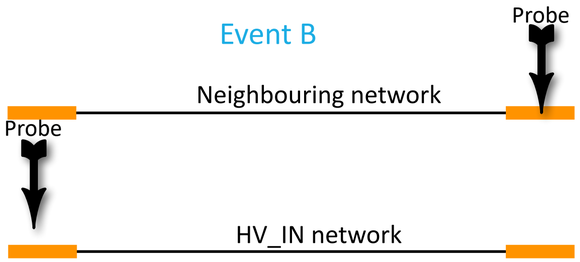
- **Resistance measurements**:
  - Measure pads that are at least 15 mm apart. HV_OUT* network pads are too close together.
  - Measure primary (max X) and final pad in network, intermediate pads are measured if geometrically accessible. Most networks have all pads measured.
- **Shorts measurements**:
  - Shorts check from primary pad to the closest neighbouring pad from other network. Both networks are in TOP layer.
  - Shorts check from primary pad to FASTSIGGND in BOT layer.
- **HV measurements**:
  - 1000 V applied for at least 15 seconds between HV network pad and neighbouring network pin.
  - HV_IN networks: Two measurements, one with neighbouring HV_IN in TOP layer and one with network in BOT layer.
  - HV_OUT networks: One measurement, to the nearest network in TOP layer.

HV line checks

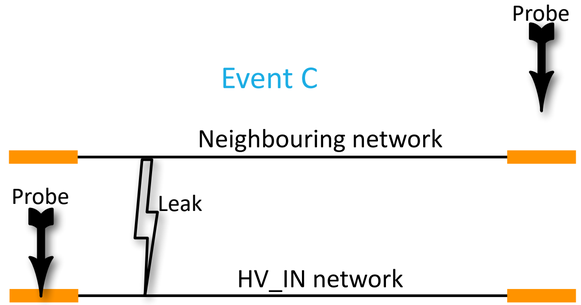
- Three theoretical scenarios all result in tape passing the HV test



Robot result: PASS
Actual result: PASS



Robot result: PASS
Actual result: ?



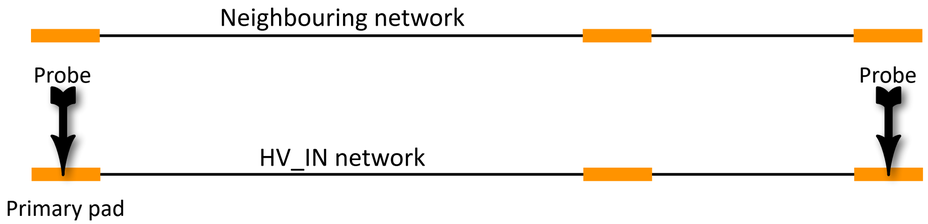
Robot result: PASS
Actual result: FAIL

- So far we didn't have any checks to verify the results are really from event A
- Have to implement HV line checks, to verify probes have good contact with the measuring pads

HV line checks: primary line

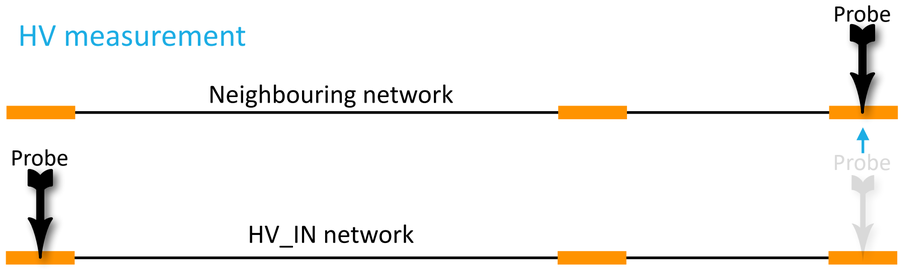
- Idea is to check if probe contacts with pads are good by measuring the network continuity
- Different scenarios, sometimes HV line check can’t be done:
  - Line already checked: Already measured resistance in this network -> contact on primary pad is good ✓
  - Cannot check primary line: cannot measure due to network geometry, would have to move probe from primary -> no point in doing that ✓
  - Checked primary line: measure resistance R < 500 ohm between primary pad and some other pad in HV network ✓
  - Failed check: Measured R > 500 ohm between pads
    - Debug probe positions until resistance measurement is good ✓
    - No debugging or R>500 ohm after debugging: Failed line check ❌

Primary line check



Measure resistance in HV network.

HV measurement

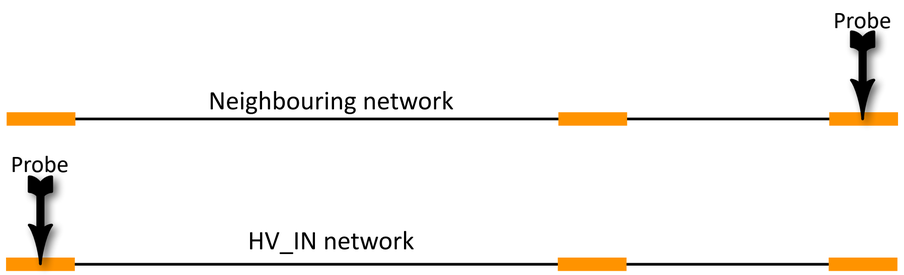


Probe on primary pad doesn’t move, secondary probe moves to the pad in the neighbouring network. Start HV measurement.

HV line checks: secondary line

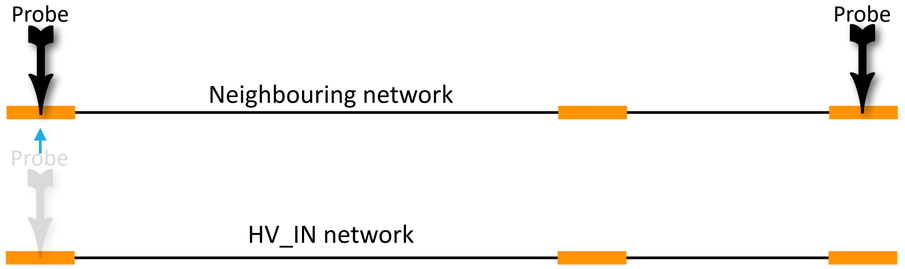
- After HV measurement is done, move probe from primary pad in HV network to some pad in the neighbouring network without moving the secondary probe. Measure resistance.
- Different scenarios, sometimes HV line check can’t be done:
  - Cannot check secondary line: cannot measure due to network geometry, would have to move secondary probe to different pad -> no point in doing that ✓
  - Checked secondary line: measure resistance R < 500 ohm between secondary probe pad and some other pad in neighbouring network ✓
  - Failed check: Measured R > 500 ohm between pads
    - Debug probe positions until resistance measurement is good -> repeat HV measurement ✓ (do not repeat primary line debugging, this would undo the secondary line correction)
    - No debugging or R>500 ohm after debugging: Failed line check ❌

HV measurement



HV measurement between neighbouring networks.

Secondary line check



Probe on secondary doesn’t move, move probe from primary pad in HV network to some other pad in neighbouring network. Measure resistance.

HV line checks: report

- Number of failed line check and where they happened is included in the final report:

RESISTANCE & CURRENT ANALYSIS

Number of networks with large resistance deviations: 1

Gaussian fit for narrow-lines distribution: R/L_0=0.01736 ohr

Gaussian fit for medium-lines distribution: R/L_0=0.0142 ohr

Gaussian fit for wide-lines distribution: R/L_0=0.00736 ohm/

Average current at 1000 V: 4.285 nA

Number of current measurements over 20 nA at 1000 V: 0

Number of failed HV line checks: 3

HV measurements with failed line checks:

HV_OUT1_R3

Failed HV line check for this net!

Pin	I [nA]	U [V]
D_R2H1_N_HVT	6.47	1000

HV_OUT1_R4

Failed HV line check for this net!

Pin	I [nA]	U [V]
D_R3H3_N_HVT	7.35	1000

- Should a failed HV line check cause the tape to FAIL in HV measurements?

Next steps

- Implement a better line checking algorithm, which will be able to check the currently unaccessible configurations
- Include failed HV line checks in the DB data
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