**Abstract**

The harsh radiation conditions, including the ones expected for the operation with High-Luminosity LHC, require detailed and careful quality control of any gas detector from the very beginning stage of assembly. The existing probe methods for cathode boards QC are able to find shorts to ground, shorts between pads and breaks in the readout line at the initial stage of manufacturing. The cosmic test requires fully assembled detectors and reveals pads with absent or low amplitude analog signals associated with resistance in the readout trace line. In current work we propose the direct method for such defect recognition for both bare cathode boards and fully assembled detectors and demonstrate the examples of a successful cure.

**sTGC detectors**

- Operational gas: CO2 / n-pentane mixture, 55% / 45%
- Operational voltage: 2.9 kV
- Anode wires: 50 μm diameter gold plated tungsten
- Wire pitch: 1.8 mm
- Gap thickness: 1.4 mm
- Cathode plane: 100 or 200 FR4 with graphite-epoxy coating with R = 1000 or 2000 kΩ: (at the air on inner/outer layer, respectively)
- Electrodes: strips (precise tracking) and pads (triggering “3 of 4 in quad”)

**Experimental Setup**

- Scope (Tektronix MS056, Keysight DSOX3034A)
- Pulse generator (preferably, built-in)
- DAQ (Laptop+NI LabView 18)

**The method description**

- If the resistance in trace line inside STGC much less than R0 and the board is without graphite-epoxy coating the output signal is exponential
  \[ A(t) = \frac{1}{\tau C_p} e^{-t/\tau} \]
- The response for fully assembled detector is non-exponential but the parameters are meaningful anyway

**Defect search example**

- The next steps are:
  - Open the protection near via
  - Remove the honeycombs - the grounding - the prepreg
  - Measure trace line resistance by DVM

**Breakup localization**

- Point 1, near the adapter board
- Point 2, near via

**Option: input sine waveform**

- Amplitude and Phase measurement at point 1
- Amplitude and Phase measurement at point 2

**Defect location prediction**

- The method is suitable for check at every stage of mass-production:
  - Before the assembly (bare boards)
  - Singlets
  - Doublets
  - Quads+adapter boards

- The method is able to recognize:
  - Pads shorted to the ground
  - Disconnected pads (>10kΩ)
  - Trace line resistance (<10kΩ)
  - Interconnected pads

- It demonstrates a possibility for breakout localization and successful cure

**Conclusions**

- We measure Rise and Delay time
- Rise: \[ t_{rise} = \frac{R_0}{C_p} \ln 2 \]
- Delay: \[ t_{delay} = \frac{R_0}{C_p} \ln 2 \]
- The probe electrical scheme. \( C_p \) is pad capacitance

**References**

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