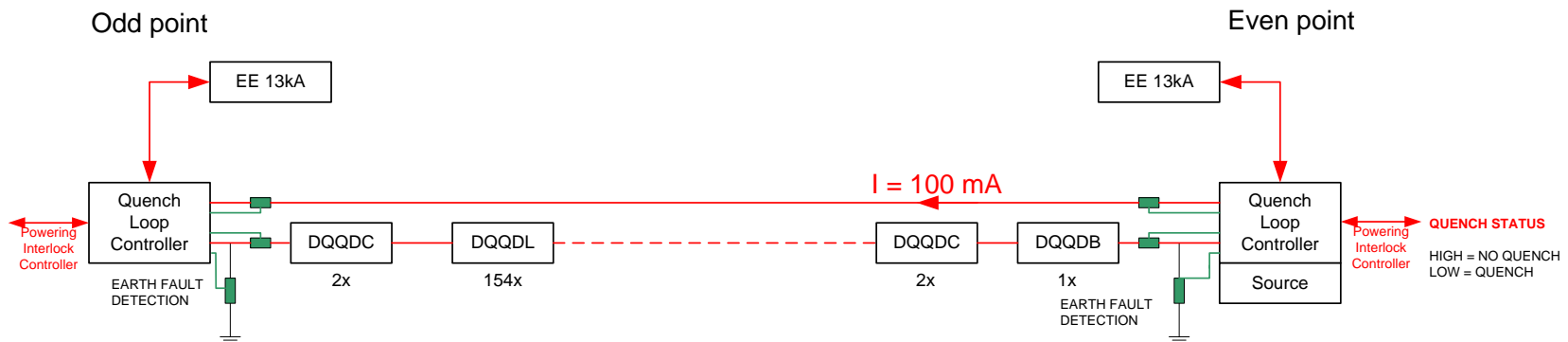→ 3 different detection systems involved

- Local quench detectors (trigger quench heater power supplies)

  - U_{TH} = 100 mV t_{DET} = 10.5 ms (fixed parameters)

- Main busbar protection system

  - U_{TH} = 1 V t_{DET} = 100 ms (programmable parameters)

- Protection system for HTS current leads

  - U_{TH} = 3 mV t_{DET} = 100 ms (programmable parameters)

→ In case of a quench the information is transmitted to the QPS quench loop controller via the QPS internal current loop

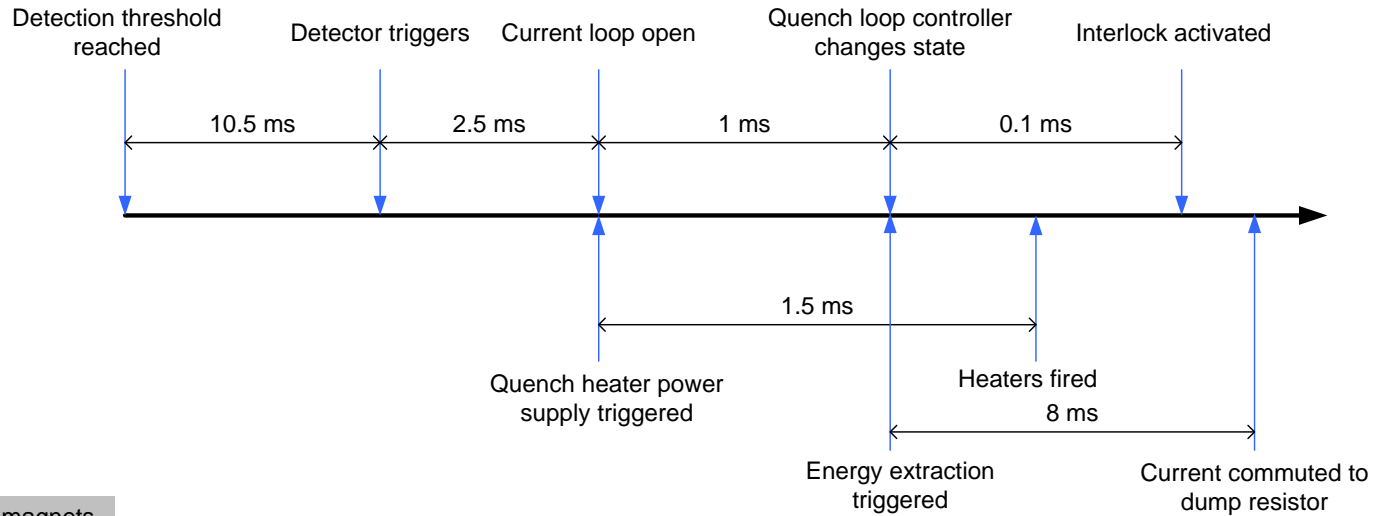→ The quench loop controller interfaces to the PIC via a type A interlock

→ Quench Loop Controller

– Level triggered 4 state micro-controller based detection system

• NO QUENCH, QUENCH, SHORTED LOOP, EARTH FAULT

– Controller includes voltage source (I_{LOOP} = 100 mA) in the even points

– Redundant detection system with 1 out of 2 evaluation scheme

– System is tested once per month (every detector)

Odd point

Even point

EE 13kA

EE 13kA

I = 100 mA

| Powering Interlock Controller | Quench Loop Controller | | DQQDC | DQQDL | | DQQDC | DQQDB | | Quench Loop Controller | Powering Interlock Controller | QUENCH STATUS |

Quench Loop Controller

EARTH FAULT DETECTION

DQQDC
2x

DQQDL
154x

DQQDC
2x

DQQDB
1x

EARTH FAULT DETECTION

Quench Loop Controller

Source

QUENCH STATUS

HIGH = NO QUENCH
LOW = QUENCH

→ 2 different detection systems involved

- Digital quench detectors of type DQQDI and DQQDT (trigger quench heater power supplies)

  - U_{TH} = 100 mV t_{DET} = 10 ms (programmable parameters)

- Protection system for HTS current leads (triggers quench heater power supplies)

  - U_{TH} = 3 mV t_{DET} = 100 ms (programmable parameters)

→ These systems are integrated in so-called Global Protection Units and interface directly to the PIC via an interlock type A or B

MB and MQ

| Detection threshold reached | | Detector triggers | | Current loop open | | Quench loop controller changes state | | Interlock activated |

10.5 ms — 2.5 ms — 1 ms — 0.1 ms

1.5 ms

Quench heater power supply triggered

Heaters fired

8 ms

Energy extraction triggered

Current commuted to dump resistor

Insertion region magnets and inner triplets

Detection threshold reached — Detector triggers — Interlock activated

10 ms — 0.1 ms

1.5 ms

Quench heater power supply triggered

Heaters fired

AT-MEL-PM, RD, 12-NOV-2004

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