Contactor’s Control Board

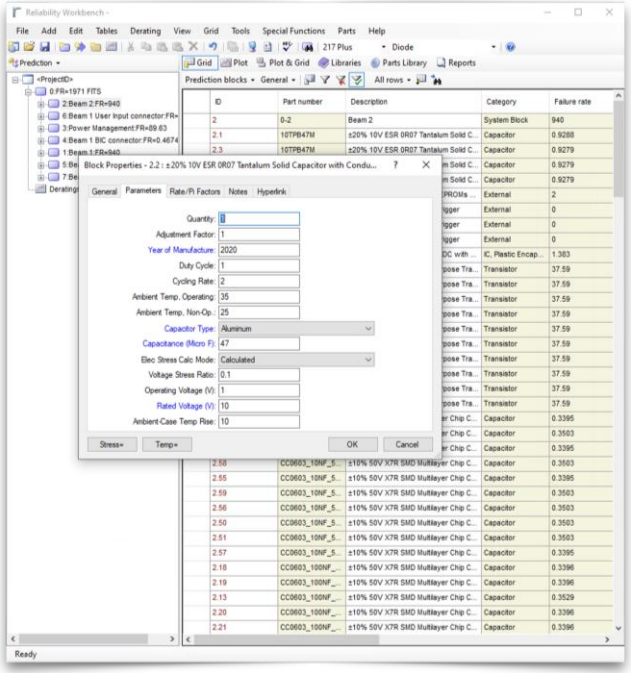
Reliability Study – kick-off meeting

Component-level FMECA
Failure rates, modes & end-effects

Component failure modelling

- Use library of component failure models, parametrized by mission profile and operating conditions

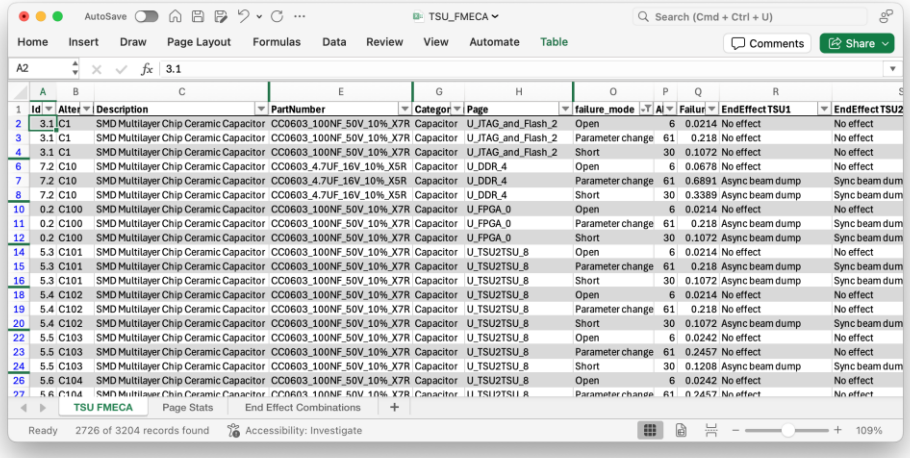
Outcomes:
Template of all component failure modes and estimation of their likelihood.



End-effects assignment

- Together with expert, assign system-level effect of each component failure mode

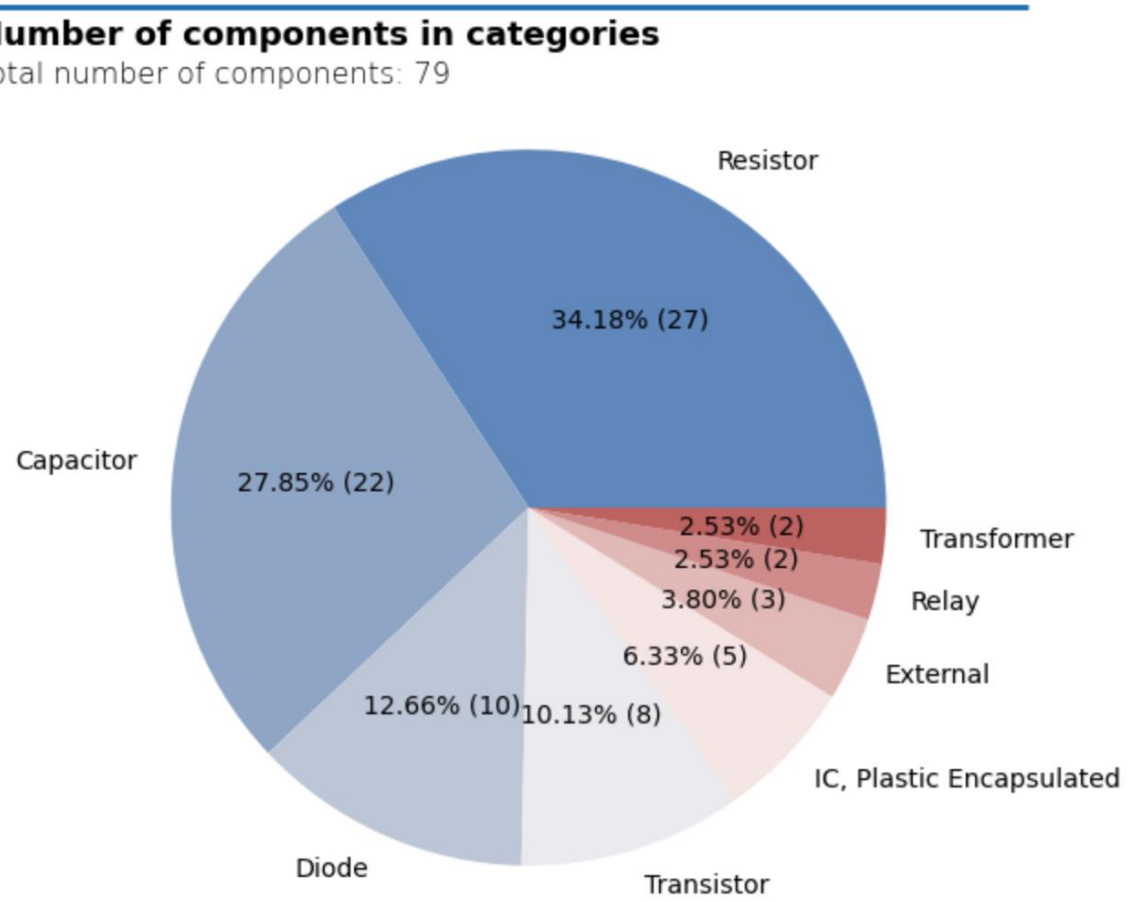
Outcomes:
Establishing probability for each failure end-effect (on system level).



This considers only the first order failures, components being used according to specifications and defined operating scenarios & during useful life.

General statistics

- Initial prediction of 891 FITS*
- Only two design pages:
  - Input, Driving and Feedback – 471 FITS
  - Powering – 420 FITS
- Total of 80 components
  - 62% are resistors and capacitors
  - 22% diodes, transistors
  - 5 ICs, 2 relays and 2 transformers
  - 3 uncategorized components
    - Fuse – 20 FITS each

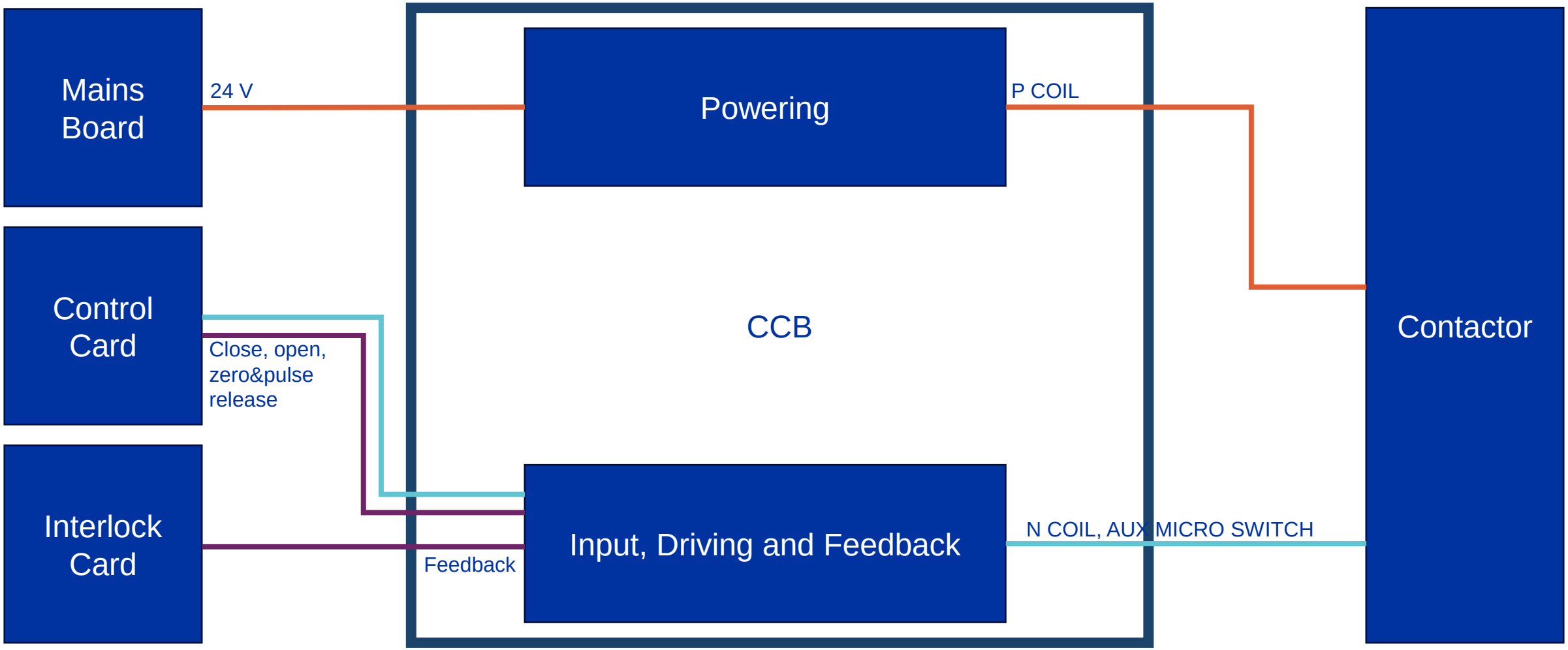


* FITS – number of failures in 10^9 hours.

Mission profile & other assumptions

- **Operating temperature: 35℃.**
- **Non-operating temperature: 25℃.**
- **Default component parameters:**
  - Year of manufacture: 2020
  - Ambient case rise (where applicable): 10℃.
  - Duty cycle: 1 (i.e., always on).
  - Cycling rate 2 (i.e., two power cycles in a year).
- **Relative humidity:** 0.5
- Parts assumed to be used within their ratings, no modifications made to quality and process factors (217Plus standard assumed).

Functional Context

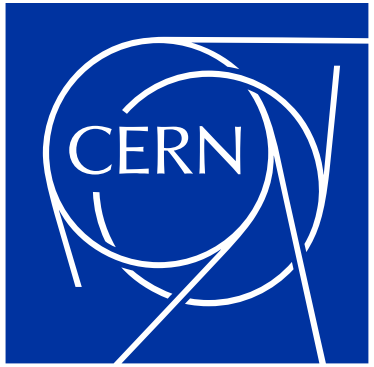


Special components

- Miniature High Capacity Relays, SPST – 80 FITS
- Gate Driver – Transistor?
- NPN/PNP General Purpose transistors vs OptiMOS Power MOSFET and PNP Complementary Silicon Power Transistor
- Two analog optocouplers
- Power Metal Strip, High Power
- Professional MELF Resistor
- Aluminium Electrolytic Capacitor, High Reliability for Switching Power Supplies
- Encapsulated Transformer and Moulded Transformer

Other problems

- **How many instances of the CCB will be deployed? What is the criticallity of a single contactor not opening?**
  - There seems to be three contactor relays in series – can it be considered triple redundancy?
- **End-effects assignment**



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Other problems

- **Galvanic isolation:**
  - matters of insulation degradation, thermal stress and other environmental factors,
  - mitigation: through design (creepage, clearance, layout), materials, inspections; also conformal coatings, sealing
    - How to Meet the Higher Isolation Creepage & Clearance Needs in Automotive Applications
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- **End-effects assignment**