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IGBT / IPM failure
2014.9.29 version 1.0

- **1.electrical over stress (EOS)**
  - **1.1 over current**
    - 1.1.1 short circuit
    - 1.1.2 over continuous load current
    - 1.1.3 dynamic over load in switching process
  - **1.2 over voltage**
    - 1.2.1 gate and emitter
    - 1.2.2 collector and emitter
    - 1.2.3 isolation test
  - **1.3 over temperature**
    - 1.3.1 high Rth in design process
    - 1.3.2 high Rth in application
    - 1.3.3 high switching losses
    - 1.3.4 over temperature protection error
  - **1.4 end of life**
    - 1.4.1 delta T is too big
    - 1.4.2 average T is too big
    - 1.4.3 too many power cycling qty
    - 1.4.4 high short power cycle qty
- **2. Mechanical failure**
  - **2.1 DCB crack**
    - 2.1.1 high mechanical force in assembling
    - 2.1.2 high mechanical force in transportation
  - **2.2 decreased creepage distance**
    - 2.2.1 electrical material between potential
      - 2.2.1.1dust in silicon gel
      - 2.2.1.2 thermal paste go into silicon gel
    - 2.2.2 damage/miss isolation protection
      - 2.2.2.1 damaged isolation foil
      - 2.2.2.2miss silicon gel
    - 2.2.3 high altitude
    - 2.2.4 too many isolation test times
  - **2.3 high mechanical force on terminals**
    - 2.3.1 dimension problem
      - 2.3.1.1 hole diameter too small
      - 2.3.1.2 height on different terminals not the same
      - 2.3.1.3 too thick bar
      - 2.3.1.4 machining accuracy too low
    - 2.3.2 not symmetric design
    - 2.3.3 high torque
    - 2.3.4 no support pillar for bar
- **3.Enviroment**
  - **3.1 moisture**
    - 3.1.1 condensation
    - 3.1.2 high humidity
  - **3.2 dust**
    - 3.2.1 no filter in cabinet
    - 3.2.2 no maintenence of filter
    - 3.2.3 bad sealing of cabinet
  - **3.3 corrossion**
  - **3.4 cosmic ray**
    - 3.4.1 high altitude
    - 3.4.2 high Vdc
    - 3.4.3 low temperature
  - **3.5 shock and vibration**

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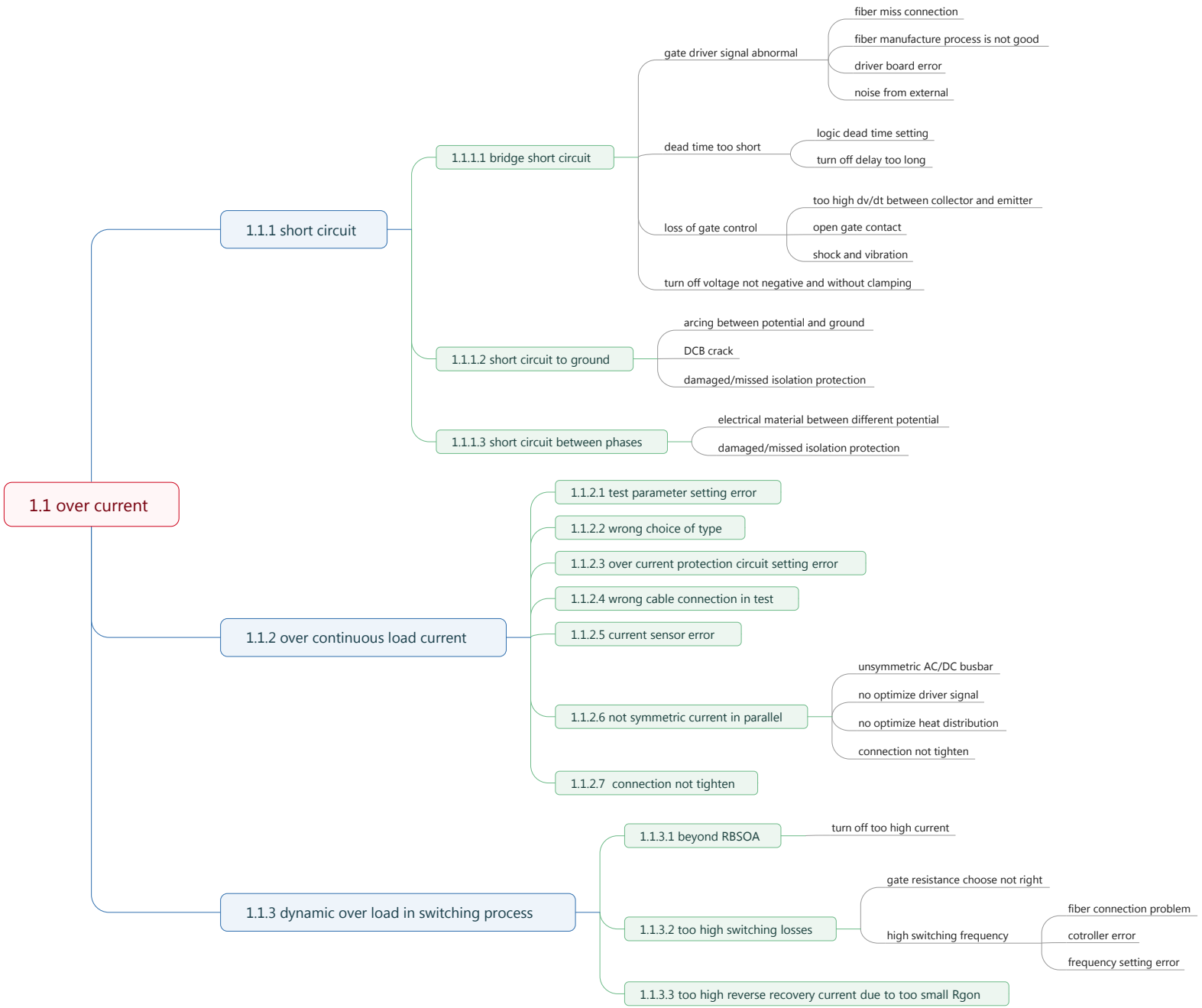

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1.2 over voltage

- 1.2.1 gate and emitter
  - 1.2.1.1 input voltage above specification
  - 1.2.1.2 input voltage with spike
  - 1.2.1.3 noise
    - power cable too close to driver cable
    - driver immunity design not good
  - 1.2.1.4 gate wire too long or not twisted
  - 1.2.1.5 ESD
    - wrong handling in assembling process
    - miss/wrong protection
  - 1.2.1.6 gate driver power supply stability
  - 1.2.1.7 dv/dt
    - short circuit or too high current in turn off process
- 1.2.2 collector and emitter
  - 1.2.2.1 input voltage with spike
  - 1.2.2.2 high stray inductance
    - wrong DC bus mechanical design
    - wrong capacitor bank position
    - wrong snubber capacitor choose
  - 1.2.2.3 high di/dt
    - wrong gate resistance choose
    - short circuit
    - too low temperature
    - no soft turn off or active clamp function in driver
  - 1.2.2.4 DC-bus voltage setting error
  - 1.2.2.5 mechanical reason
    - snnuber capacitors not tighten
    - capacitor bank not tighten
- 1.2.3 isolation test
  - 1.2.3.1 voltage out of specification
  - 1.2.3.2 no short circuit of all pins

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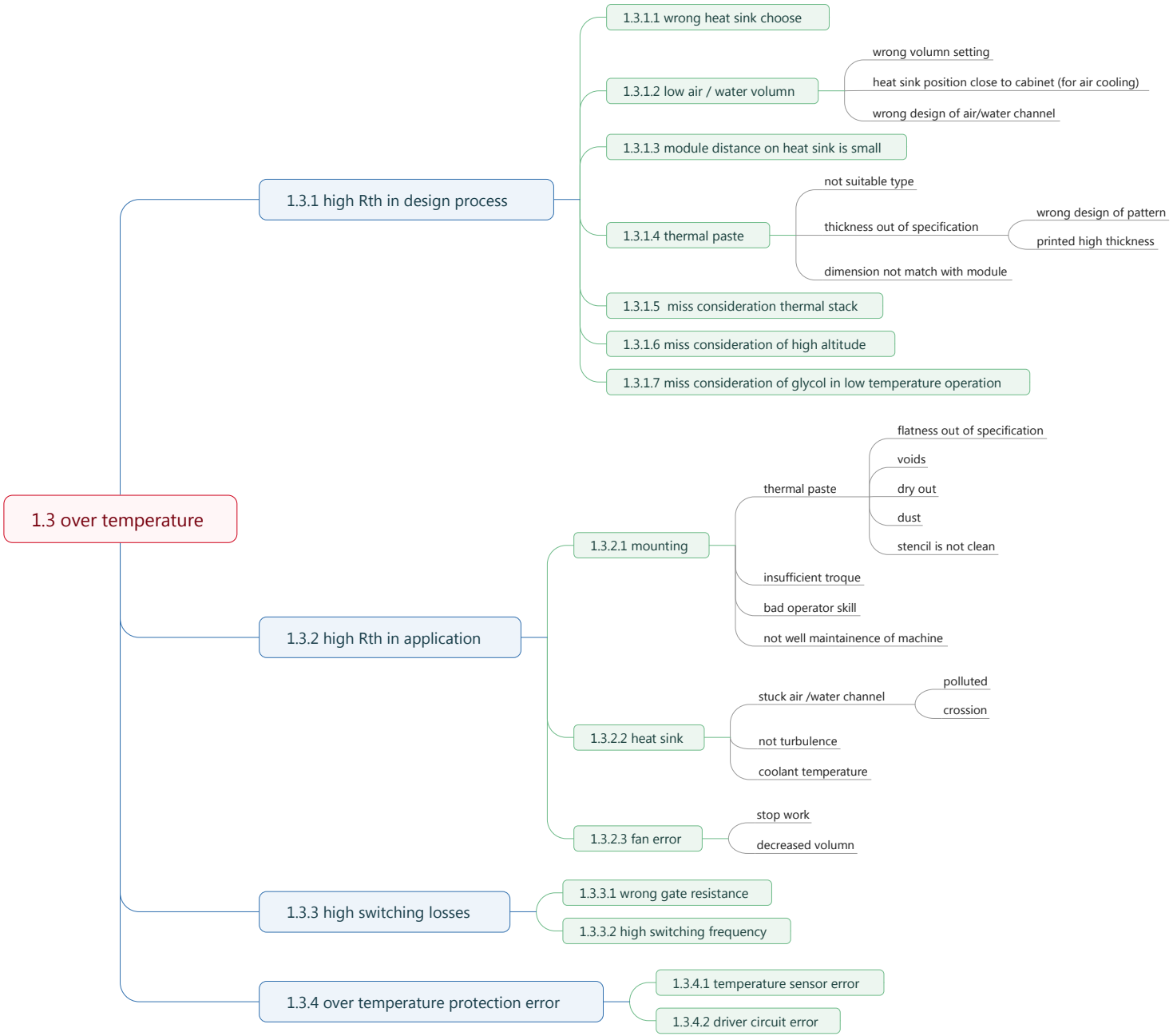

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- 2.1 DCB crack
  - 2.1.1 high mechanical force in assembling
    - 2.1.1.1 thermal paste
      - too thick
      - high density
      - not all printed area
      - particle
      - dimension area do not match with module
    - 2.1.1.2 assembling way
      - no pre-tighten
      - re-tighten after fixed
      - not according to suggested sequence
      - shift DCB and housing
        - fixture design not match with module
        - bad operator skills
    - 2.1.1.3 heat sink
      - flatness out of specification
      - roughness out of specification
      - particle
      - assebling hole do not match module dimension
    - 2.1.1.4 screw type not match with heat sink /module
    - 2.1.1.5 screw driver
      - wrong type
      - high torque out of specification
      - high RPM out of specification
      - not calibrated
  - 2.1.2 high mechanical force in transportation
    - 2.1.2.1 hard DC/AC bus
    - 2.1.2.2 bad transportation condition
      - shock
      - vibration