



Design Considerations, Common Failures, and Debug Techniques

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Radiated Emissions

Radiated Emissions Considerations

- Failures during testing phase are more expensive
- Cost and time to market are prime motivators
- Circuit designers unaware of EMI considerations
- Whether to quell or contain
- Pre-compliance testing is your best ally

Radiated Emissions and Cabinets

- How close to a stainless steel canister
- Presence and position of slits
- Extent of dielectric surfaces on metallic enclosures
- Seams and doors
- Cables carry more than just data

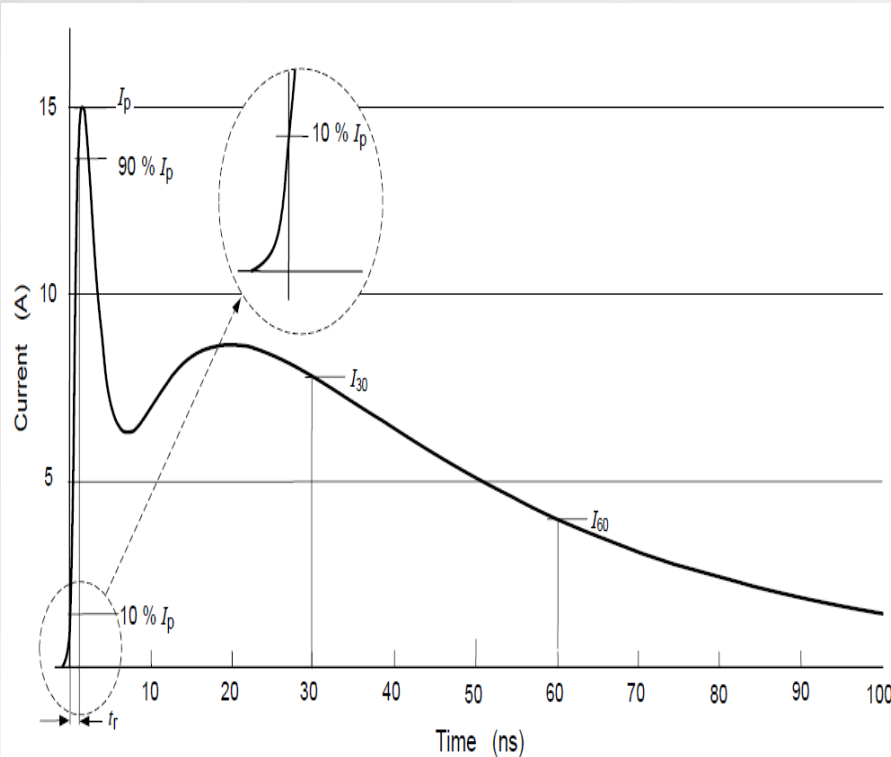
Radiated Emissions and Circuit Boards

- Ground planes, traces, and bypass capacitors
- The greatest disturber of the peace – switching power supplies
- Know your (second) sources
- Be wary of off-the-shelf boards
- Spread Spectrum oscillators

Electrostatic Discharge

ESD Waveform

- Energy contained in the ESD event is small – approximately 1uJ



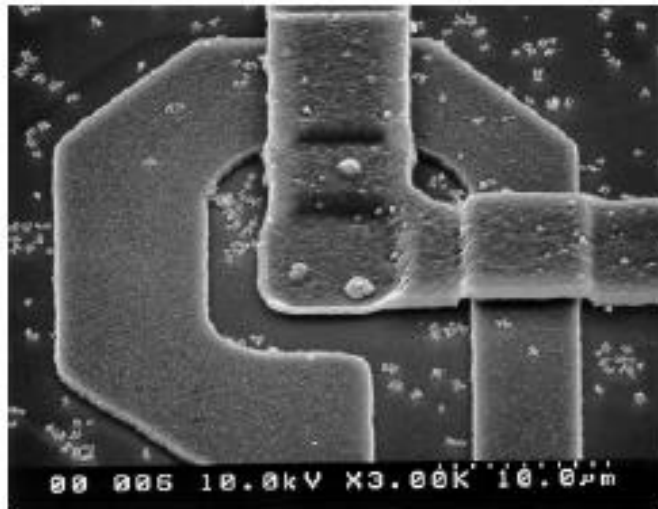
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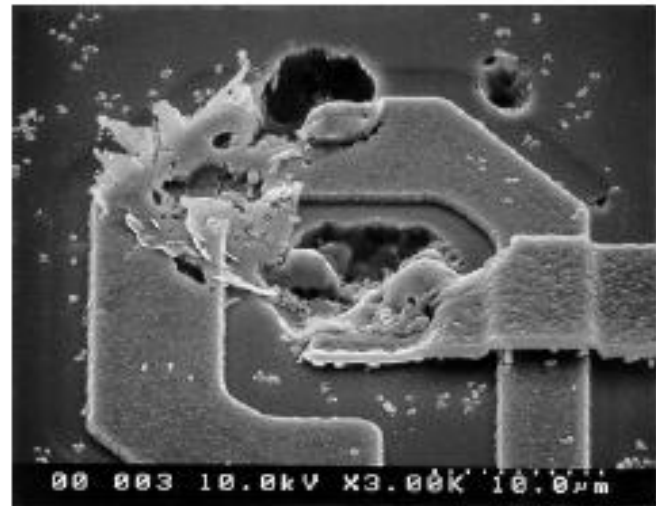
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ESD Damage

Before ESD

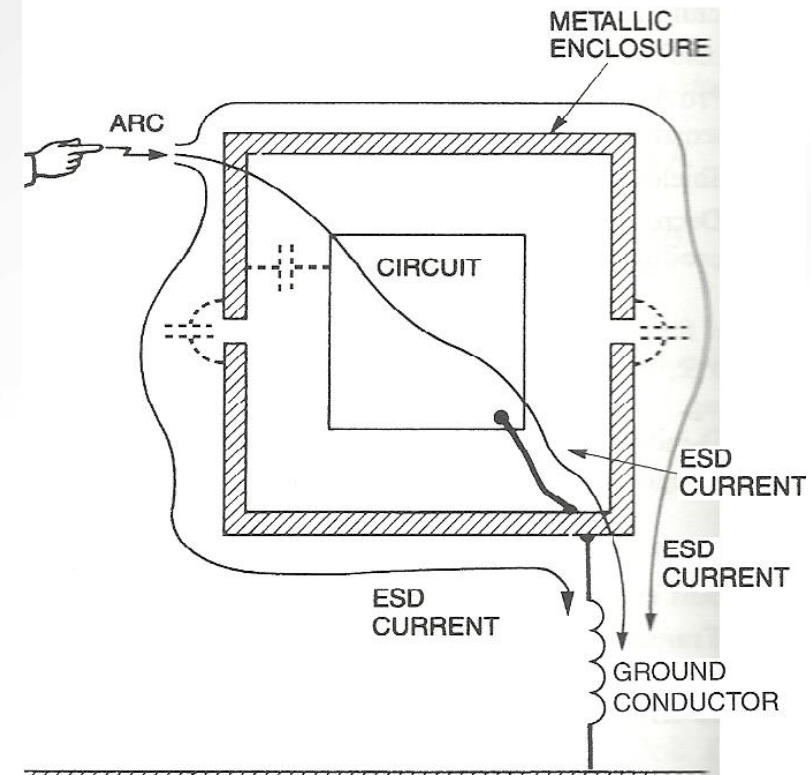


After ESD



ESD Mitigation

- ESD current flows through the path of least resistance – ground should be low inductance
- Guard rail around PCB
- Locate sensitive components away from the edge of PCB
- Minimize loop areas of circuitry to minimize ESD-generated E-field coupling
- Minimize seams and apertures





Thank you!

Are there any questions?

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OSHA NRTL Nationally Recognized Testing Laboratory

A2LA-Accredited to ISO/IEC 17025:2005
(Baltimore: #0591-01, Union City: #0591-02)

FCC TCB Telecommunications Certification Body

SCC CB Standards Council of Canada Certification Body

IECEE NCB National Certification Body

NVLAP-Accredited NIST CAB Conformity Assessment Body

Verizon ITL Independent Testing Laboratory

DSCC-Accredited for Designated MIL-STD Testing

EPCglobal Inc, Official Test Lab for RFID Hardware Certification Program

EPA- Recognized for ENERGY STAR® Testing & Certification

VCCI - Voluntary Council for Control of Interference (Japan)

ISTA Transit Tested Program Member - International Safe Transit Association

ACIL Member - American Council of Independent Laboratories

Measurement Canada Recognized Test Facility for electricity meters

What's Next?

ENERGY STAR® Update