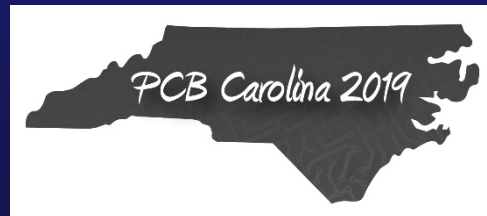




Creepage & Clearance Measurements

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Demonstration
for PCB Carolina 2019

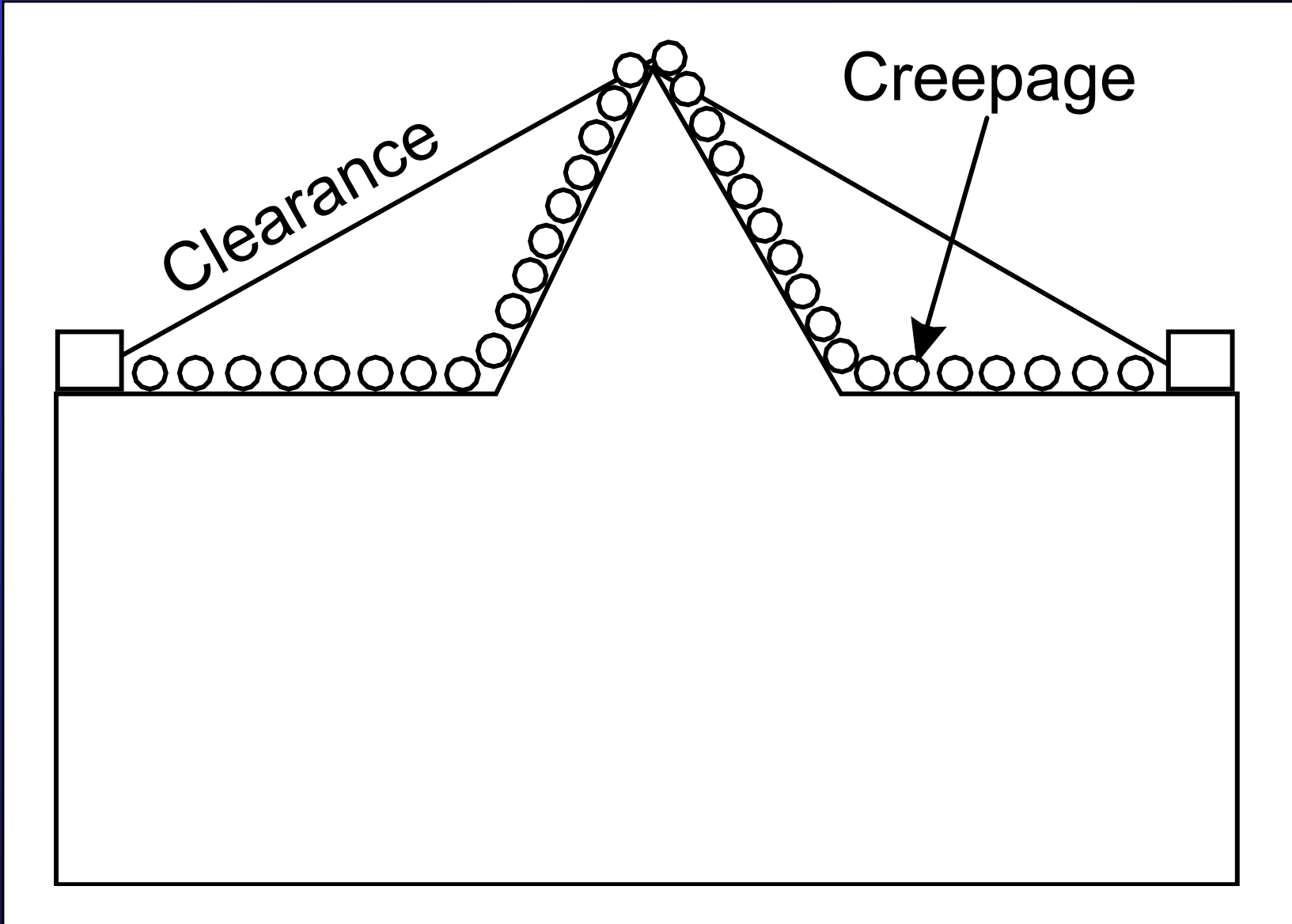


Creepage Distance

- The shortest distance over surface between two conductive parts

Clearance Distance

- The shortest distance through air between two conductive parts



Measurement Steps

- 1) Determine requirement
- 2) Sample & measurement prep
- 3) Verify compliance

Step 1: ID Requirement

- See Tables in the Safety Standards
- You must determine:
 - Operating Voltage,
 - Insulation Type = O, B, S, D, R
 - Installation Category,
 - Pollution Degree,
 - CTI rating

Step 1: Example

- Mains to Earth = Basic
- Mains = 240 VAC
- Working Voltage = 50 VAC
- Pollution Degree 2
- CTI = 150
- Creepage ___ ; Clearance ___

Step 2: Preparation

- a) Proper Test Equipment
- b) Verification vs. Data
- c) Identify Measurement Points
- d) Pre-Measurement Sample Prep
- e) Measurement Methodology

Step 2A: Test Equipment

- 1) Rigid Finger (w/force gauge)
- 2) Creepage & Clearance gauges
- 3) Optical comparator
- 4) Digital calipers
- 5) Digital micrometer
- 6) Steel ruler

Rigid Finger Probe



Rigid Finger with Force



Creepage & Clearance Kit





Step 2B: Verify or Data?

Verifying Compliance

VS.

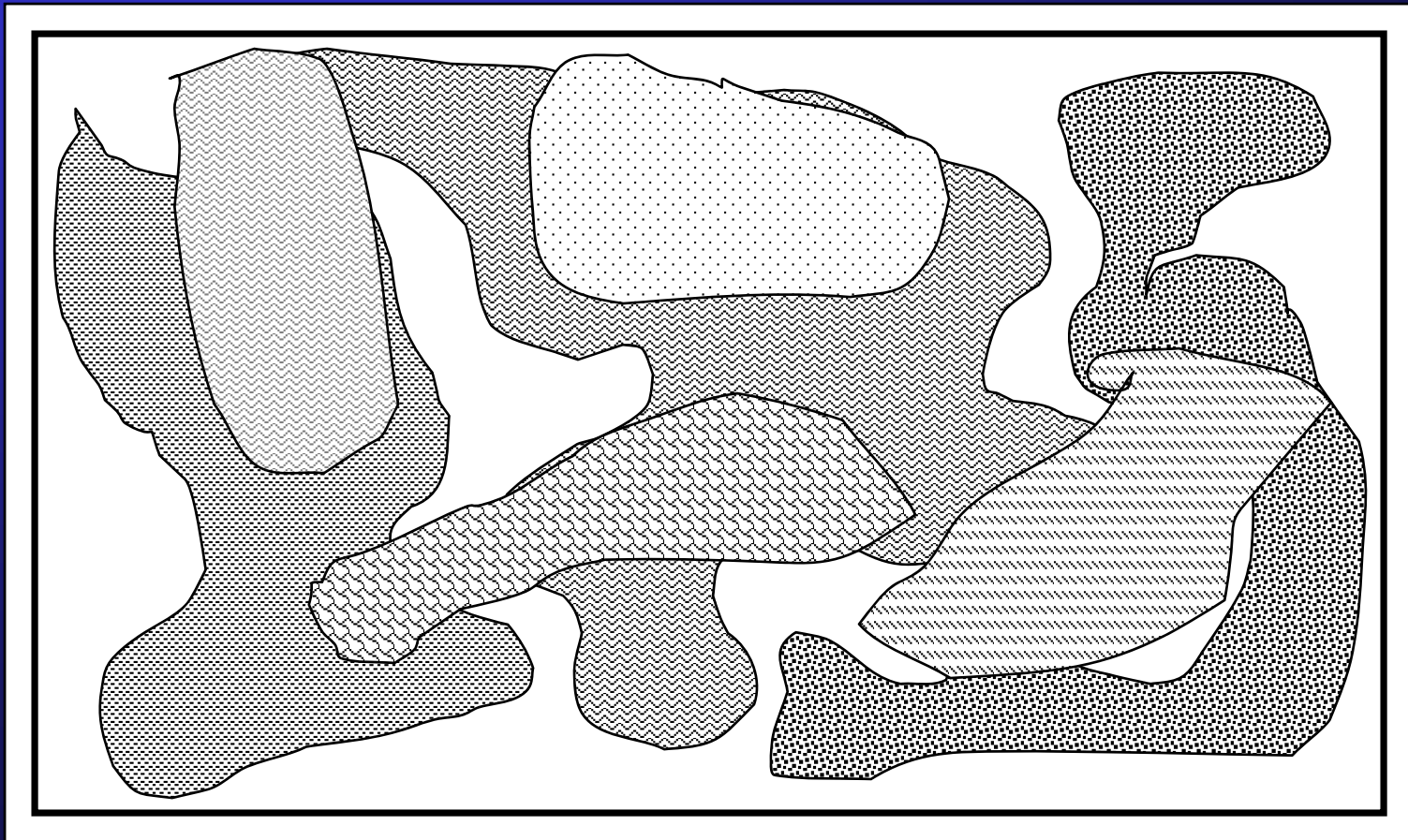
Measurement Data

Step 2C: Where?

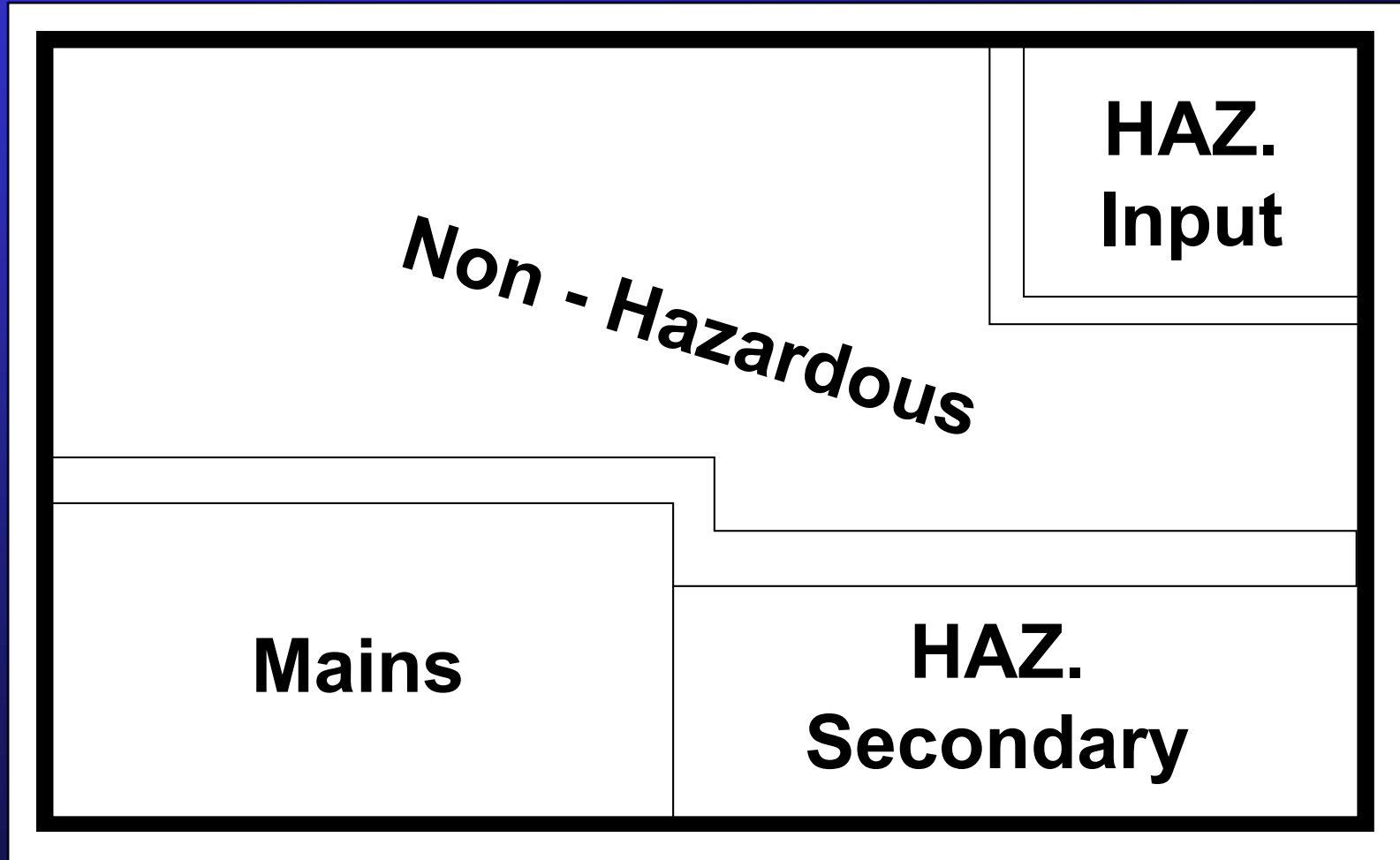
Identifying Measurement Points

- Isolation Devices
 - Transformers, optical isolators, relays
- Insulation based on type: B, S, D, R
 - Over surface = creepage = circuit boards, inside devices,
 - Thru air = clearance = between components

Avoid



Preferred



Step 2D: Preparation

- Documentation:
 - : Schematic Diagram
 - : Trace Diagrams & Layout Diagrams
- Apply force before measurement with rigid test finger:
 - : 10 N Internal parts
 - : 30 N Enclosures

Step 2E: Magnet Wire

Measurement Methodology #1:

- Magnet wire is considered an “uninsulated” live part

Step 2E: Mains Circuit

Measurement Methodology #2:

- Working voltage in the mains circuit is never less than the mains voltage.

Step 2E: Mains Circuit

Measurement Methodology #2:

- Working voltage in the mains circuit is never less than the mains voltage.

Step 2E: Creepage

Measurement Methodology #3:

- Insulation Coordination = Required Creepage distance cannot be less than the required clearance distance

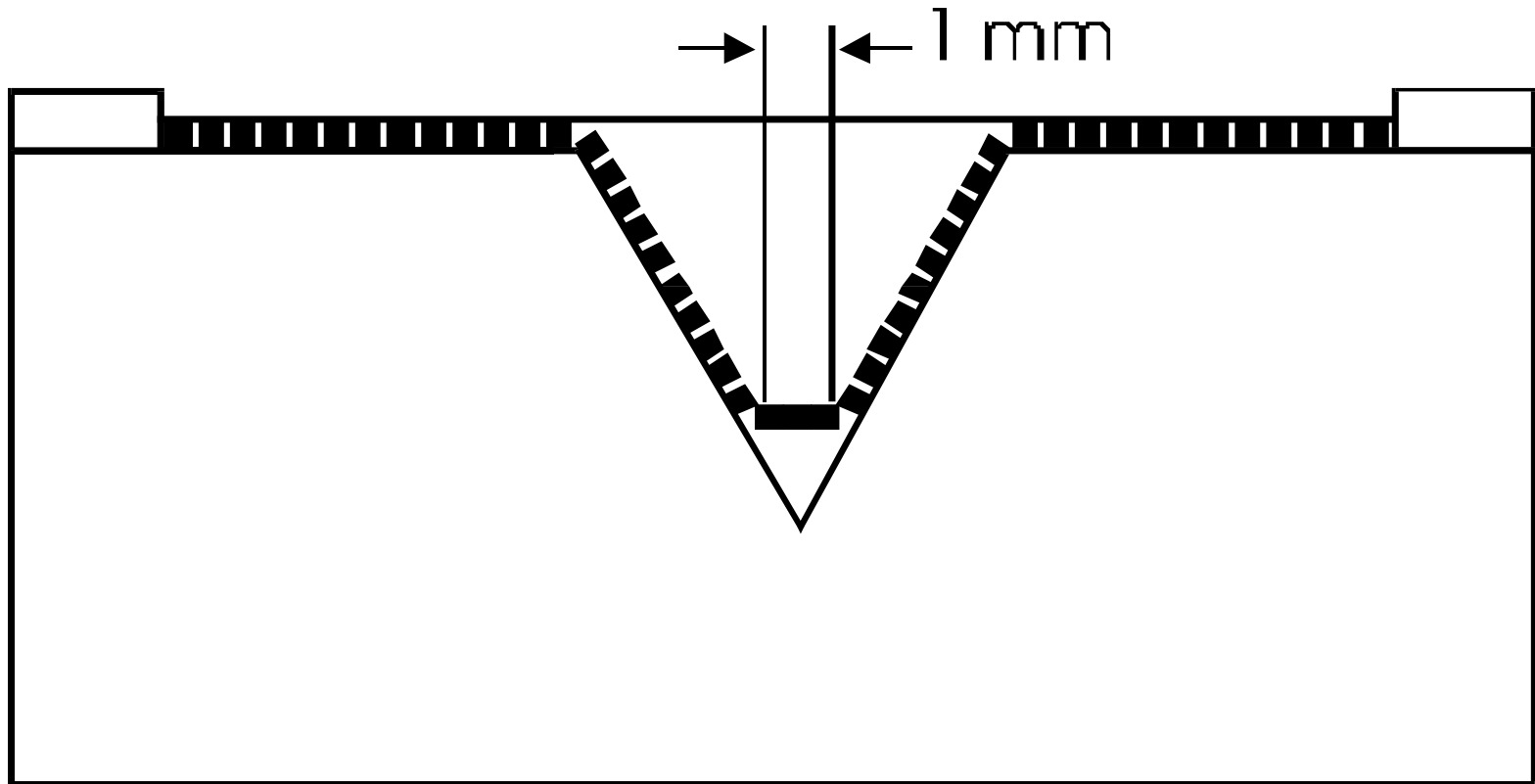
Step 2E: Creepage

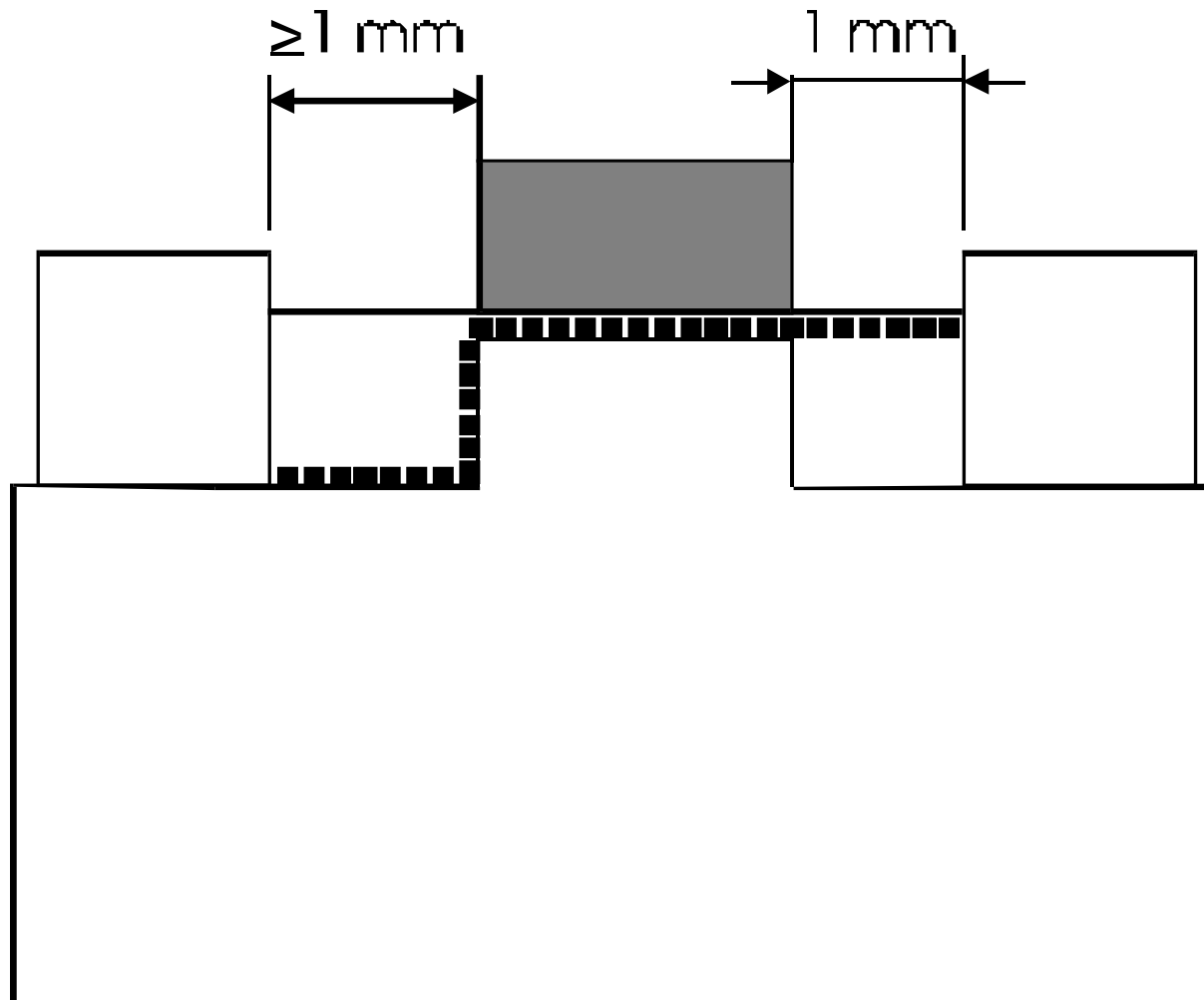
Measurement Methodology #4:

- Gaps, grooves, ridges

< 1 mm

≥ 1 mm





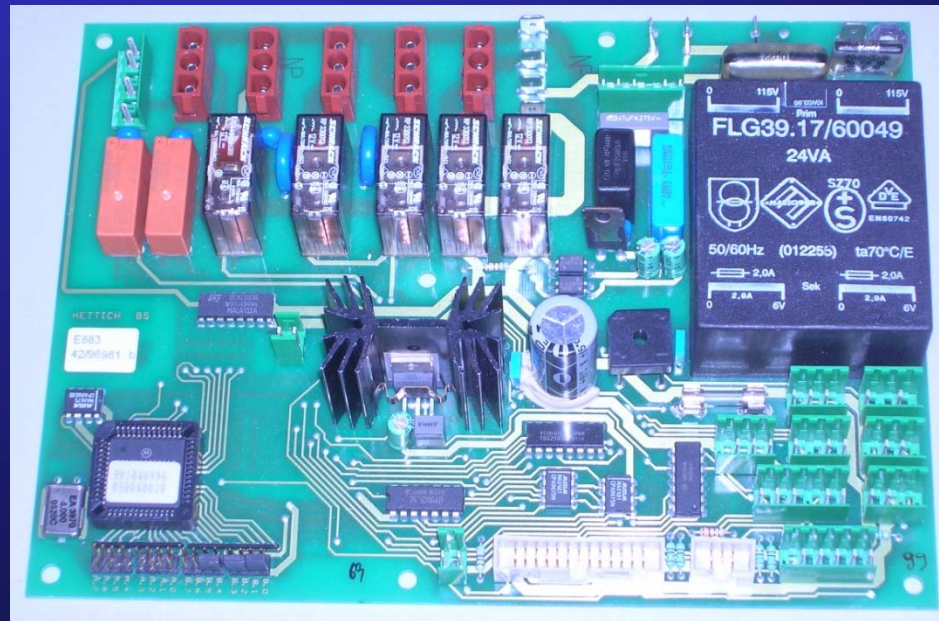


Measurement Demo

A Few Products
&
Components

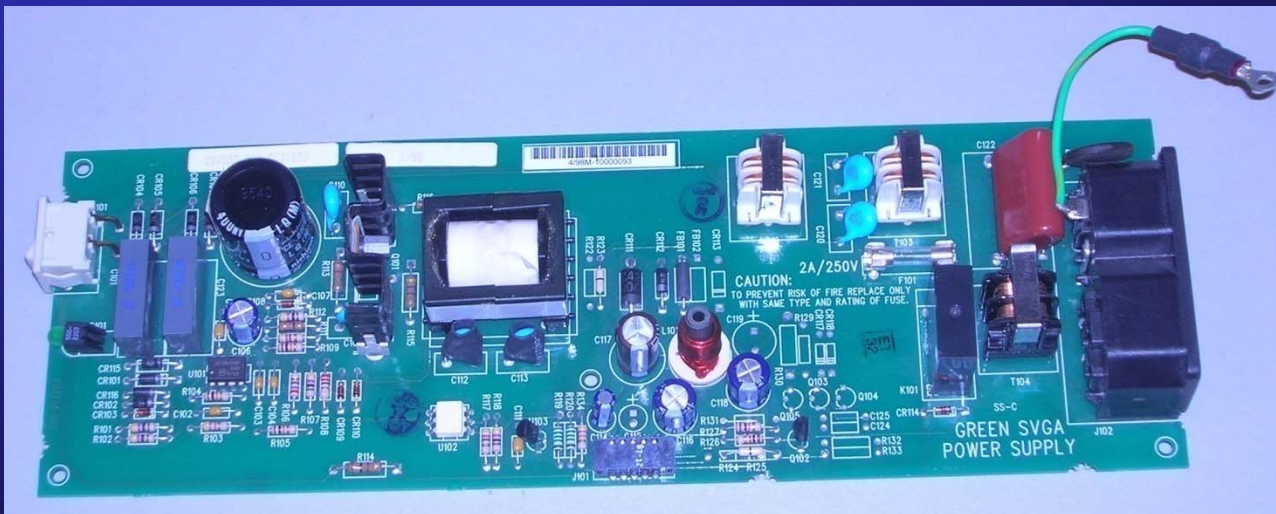
Measurement Demo

Populated Circuit Boards - Clearance



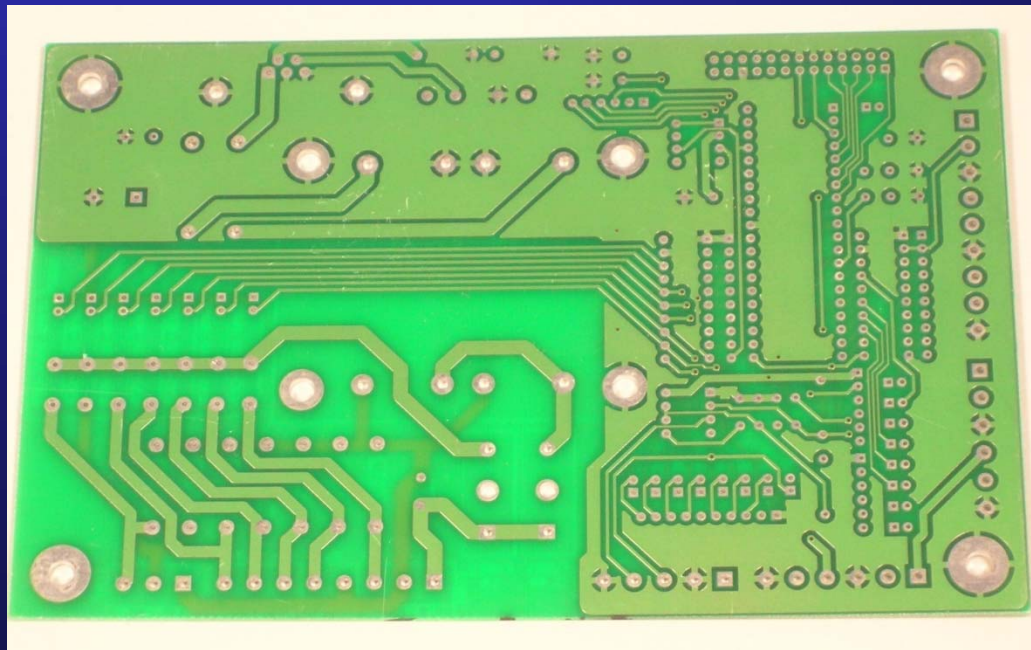
Measurement Demo

Populated Circuit Boards - Clearance



Measurement Demo

Bare Circuit Boards – Creepage
Trace Side



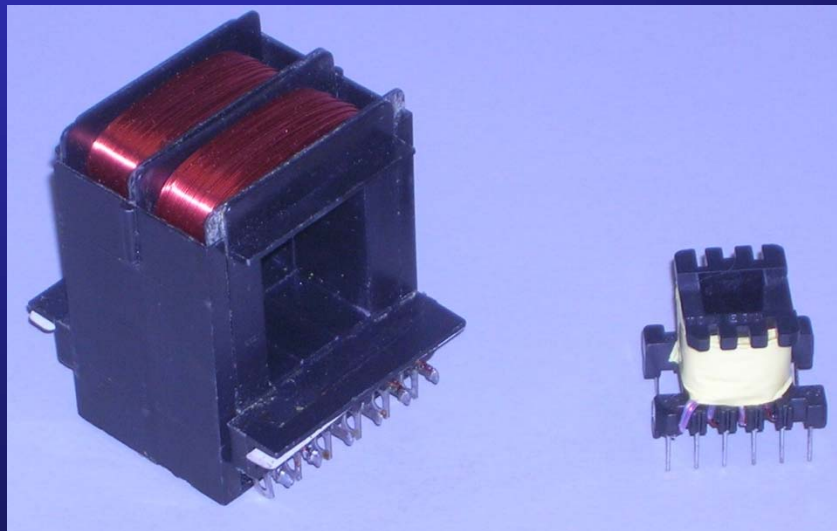
Measurement Demo

Transformers – Bobbin type



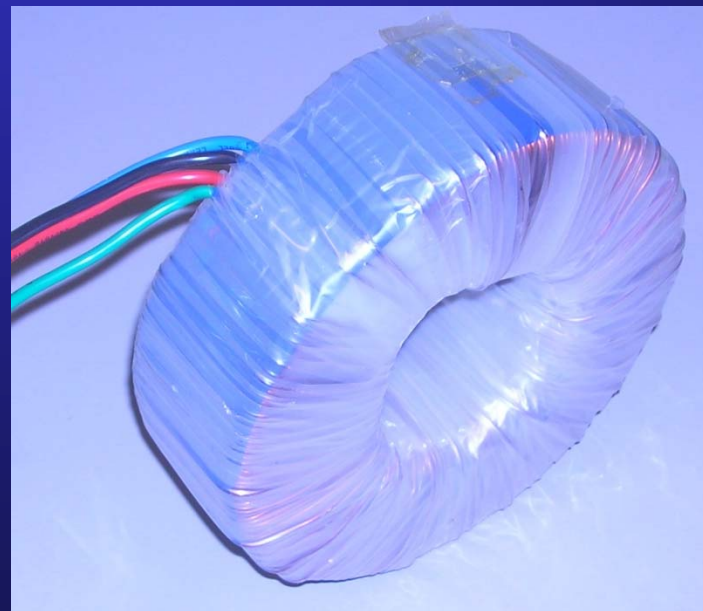
Measurement Demo

Transformer Bobbins/Windings



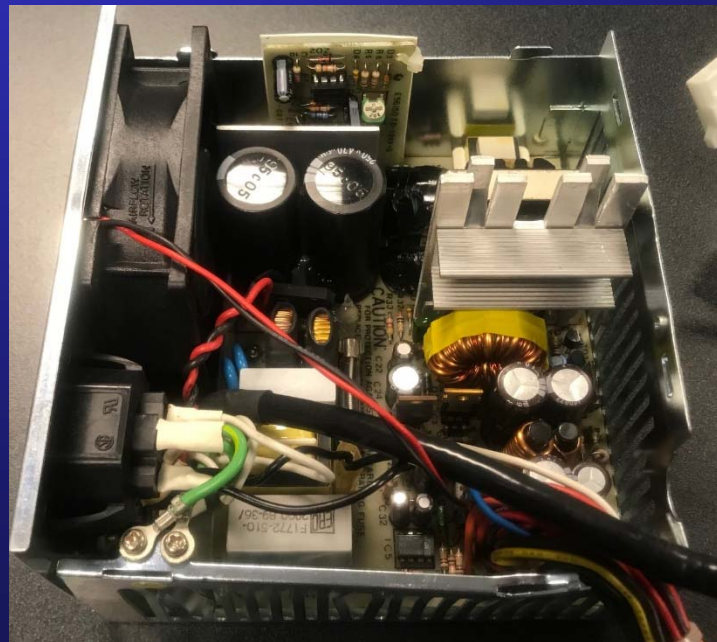
Measurement Demo

Transformers – Torroid



Measurement Demo

Switching Power Supply



Repairing Problems

- Reduce pollution degree
- Increase CTI
- Reduce Installation Category
- Use a conformal coating
- Add insulating tubing
- Cut a slot in the board
- Add barrier – earthed barrier
- Tie-wraps – fixing of wiring

Measurement Summary

1) Determine Requirement

- Establish the knowns - see tables in Standards

2) Sample & Measurement Prep

- Measurement tools & product documents
- Force with rigid probe
- Measurement points & methodology

3) Verify Compliance

- Verification vs. Measurement - different tools



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Product Test & Certification Laboratory

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