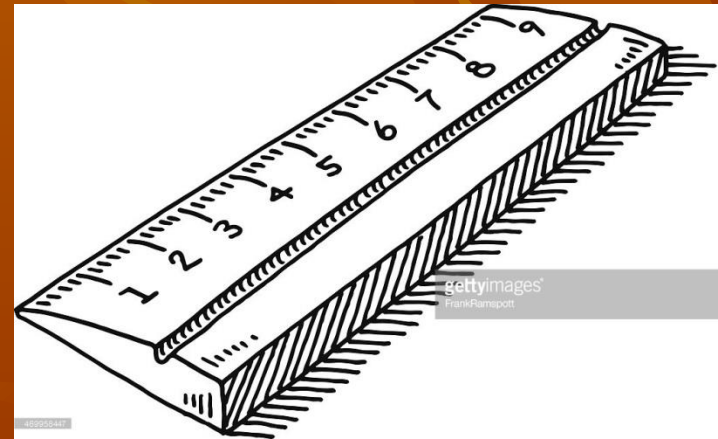


# PCB Design – Measurements

Tom Thoen

# Measurements

- OK – so we all know how to use a ruler, right?
  - A standard ruler is not a very effective tool in electronic design – why not? (Yes, this is a real question!)
  - At least three answers...

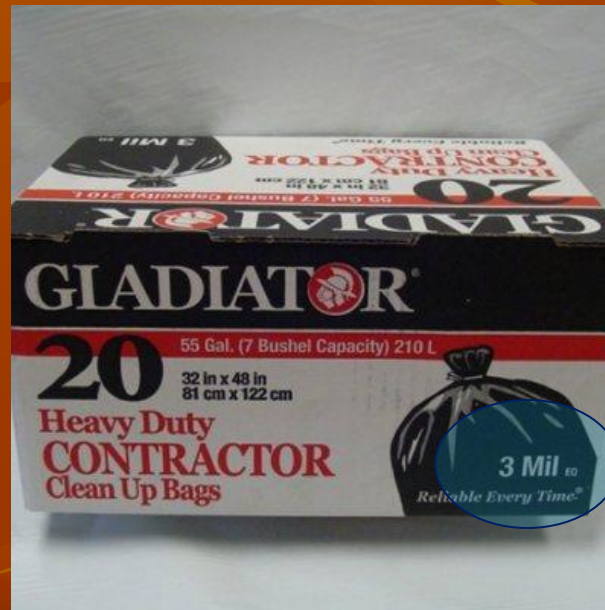


## Important terms:

- Scale of measurement – Electronic components are generally very small and require precision in measurement
- Resolution of measurement – we often need to measure in increments of 1/1000 inches!
- Units of measurement – Fractions are not typically used – for example 3/32”

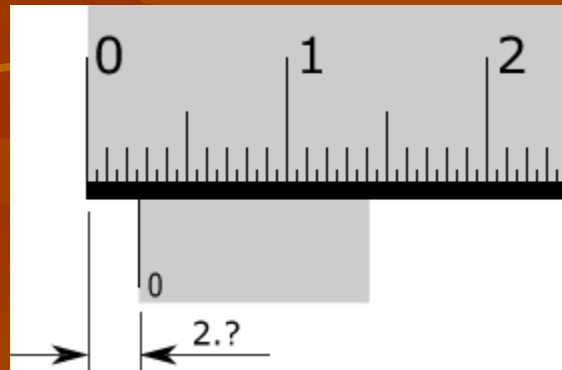
# Units used in the PCB world

- The most common unit is the “mil.”
- 1 mil = 0.001 inches; for example 20 mils = 0.020”
- Mil does NOT equal millionths!! Where else have we heard of mils?? 50 milliseconds = 0.05 seconds
- Trash bags...



# Inches and Millimeters

- Inches – when used, fractions are not typically used.
- Why not? Incredibly confusing!!
- Who wants to keep track of what  $5/16$ " equals?



# Inches continued

- Instead decimal values are used:
  - 3.25 inches, 4.05 inches, 0.025 inches.
- This is typical in CAD measurements based on Cartesian co-ordinate systems, and we'll see later how CAM (Computer Aided Manufacturing) files use these numbers.



# Millimeters – God’s gift to the engineering world

- Millimeters are convenient as the unit is small enough that often we can express measurements directly in integer units (no fractions required).
- Some common conversion values to remember (that means MEMORIZE!!):
  - 1 inch = 25.4mm
  - 1 mm = ~0.04 inches

# So, how big is a millimeter?

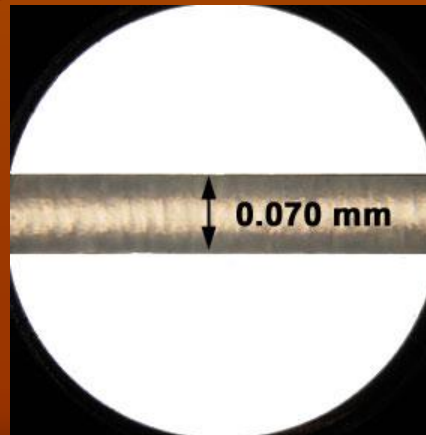
- Take a look at your pencil lead...
- If  $1\text{mm} = 0.04$  inches,  
 $0.5\text{mm} = 0.02$  inches
- How many mils is that??
- Use this to start to visualize  
how big a millimeter is!





# Scale of measurements

- In the PCB world, we measure small things...
- Let's start with something we are familiar with: human hair (typically 0.070mm)
- Convert to inches:  $0.070\text{mm} \div 25.4\text{mm}$
- = 0.00275 inches  
or 2.75 mils



# Practice time!!

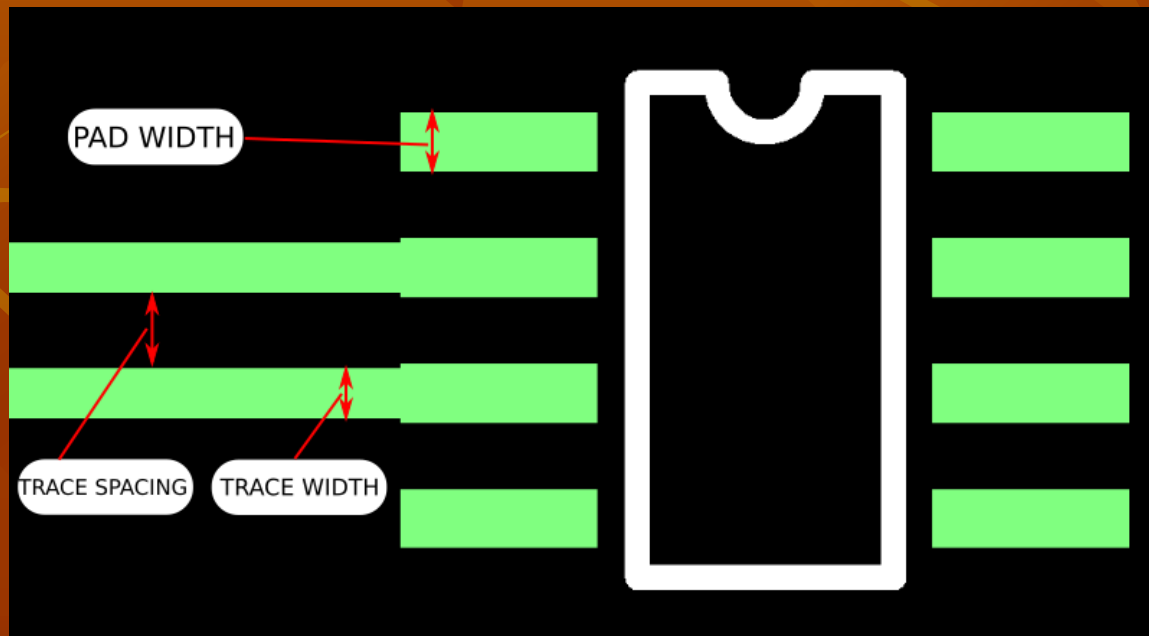
- Convert the following units:
  - 0.025 inches into millimeters and mils
  - 70 mils into inches and millimeters
  - $1/16$  inch into inches and mils (only fraction we'll use!)
  - 3.81mm into inches
  - 3.5mm into inches
  - 0.2 inches into millimeters

The background of the slide features a warm, orange-brown color palette. It is decorated with several large, stylized leaf silhouettes in a slightly lighter shade of orange, scattered across the frame. The overall aesthetic is autumnal and soft.

**Don't worry. That's about the most math we'll do in this class!**

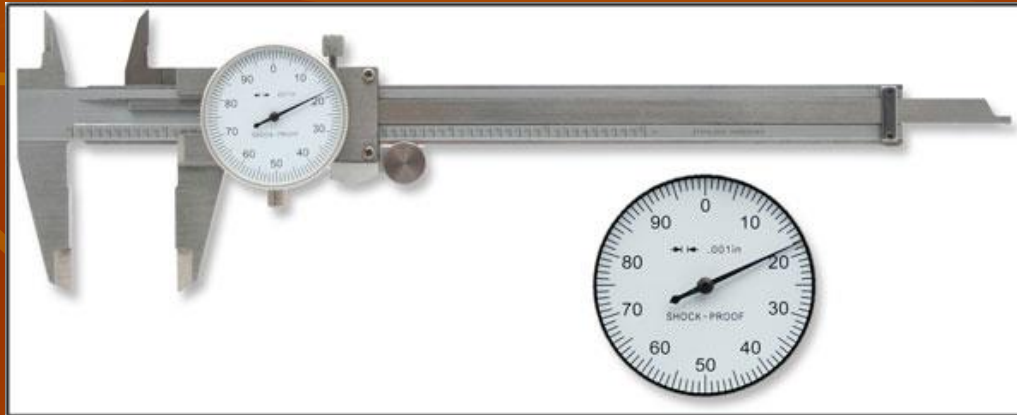
# Scale of measurements

- 2.75 mils may seem pretty small...
- However, a PCB trace width can be 5 mils or smaller:

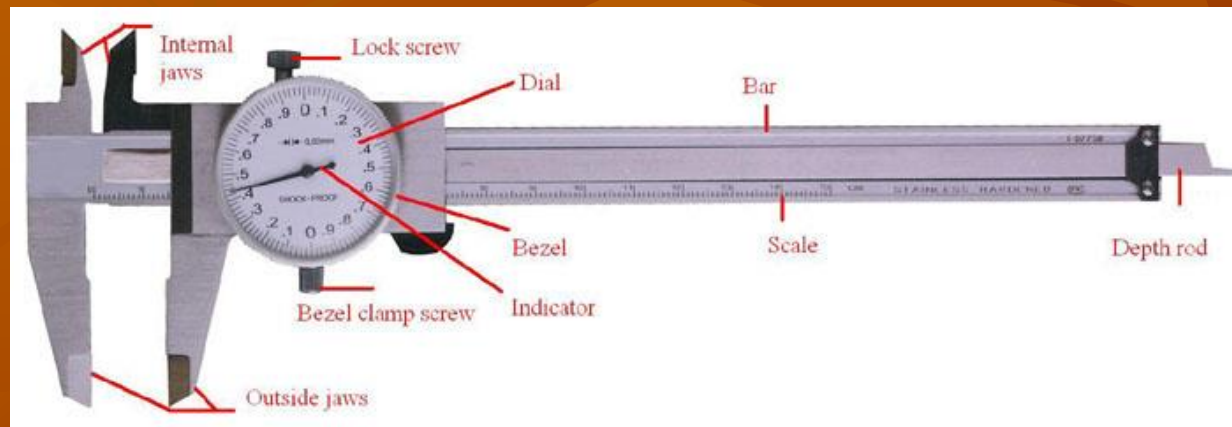


# So, how do we make these small measurements accurately?

- Most common tool: Dial and Digital Calipers



# Two most common types: (we'll practice today)





# Web references

- [www.gettyimages.com](http://www.gettyimages.com)
- [www.popscreen.com](http://www.popscreen.com)
- [www.lavergnebsa.org](http://www.lavergnebsa.org)
- [www.reallycutehairstyles.com](http://www.reallycutehairstyles.com)
- [www.oshlun.com](http://www.oshlun.com)
- [www.northerntool.com](http://www.northerntool.com)