# MSP MCU Capacitive Touch Design Considerations

Line vs. Battery Powered Applications

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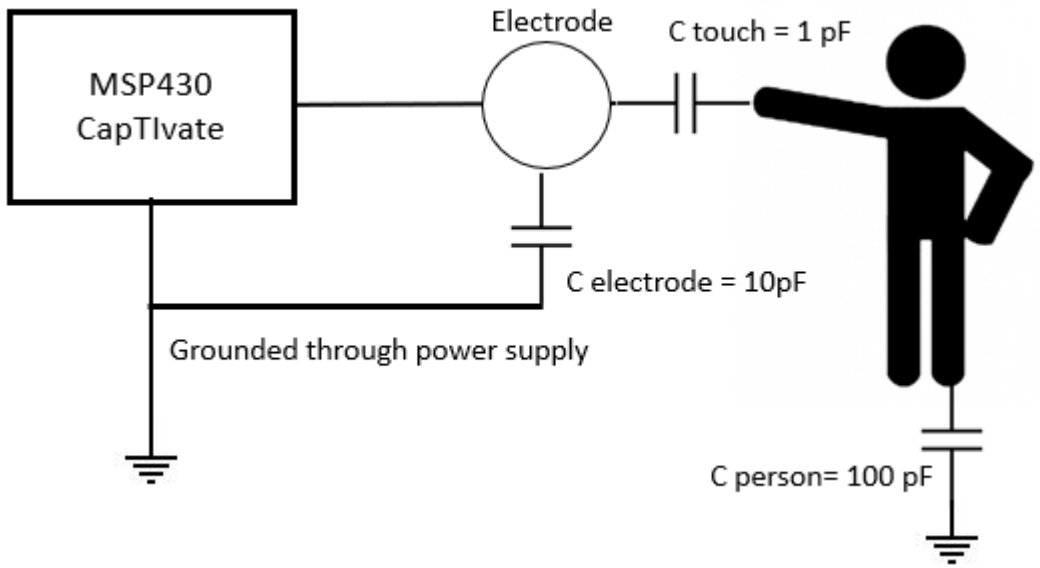
# Overview

- Line powered devices are strongly coupled to common (earth) ground
- Battery powered devices are weakly coupled
- Stronger coupling increases sensitivity to touch
- Stronger coupling decreases susceptiblity to environmental changes
- Examples
  - Wall thermostats
  - Elocks
  - Hotel door card reader

# Grounded Power Supply

- Strong coupling to ground
- Best sensitivity
  - Example ~10%




$$Sensitivity\ Line\ Powered = \frac{\frac{1}{\frac{1}{C\ touch} + \frac{1}{C\ person}}}{C\ electrode} = \frac{\frac{1}{\frac{1}{1pF} + \frac{1}{100pF}}}{10pF} = \frac{0.99pF}{10pF} = \frac{\sim 1pF}{10pF}$$

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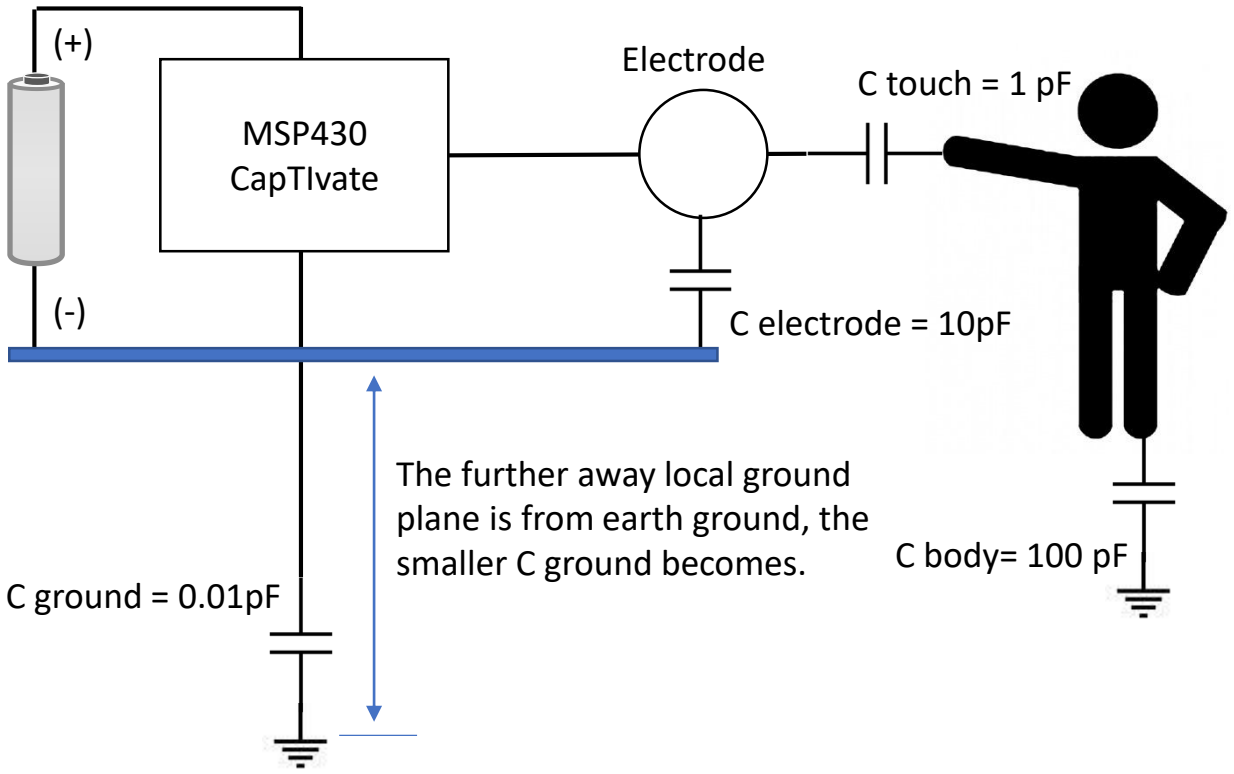
# Battery Powered

- Weak coupling due to:
  - Distance to earth ground too far
  - Local ground plane area too small
- Reduced Sensitivity
  - Example ~0.1%




$$Battery\ Powered = \frac{\frac{1}{\frac{1}{C\ touch} + \frac{1}{C\ person} + \frac{1}{C\ ground}}}{C\ electrode} = \frac{\frac{1}{\frac{1}{1pF} + \frac{1}{100pF} + \frac{1}{0.01pF}}}{10pF} = \frac{0.0099pF}{10pF}$$

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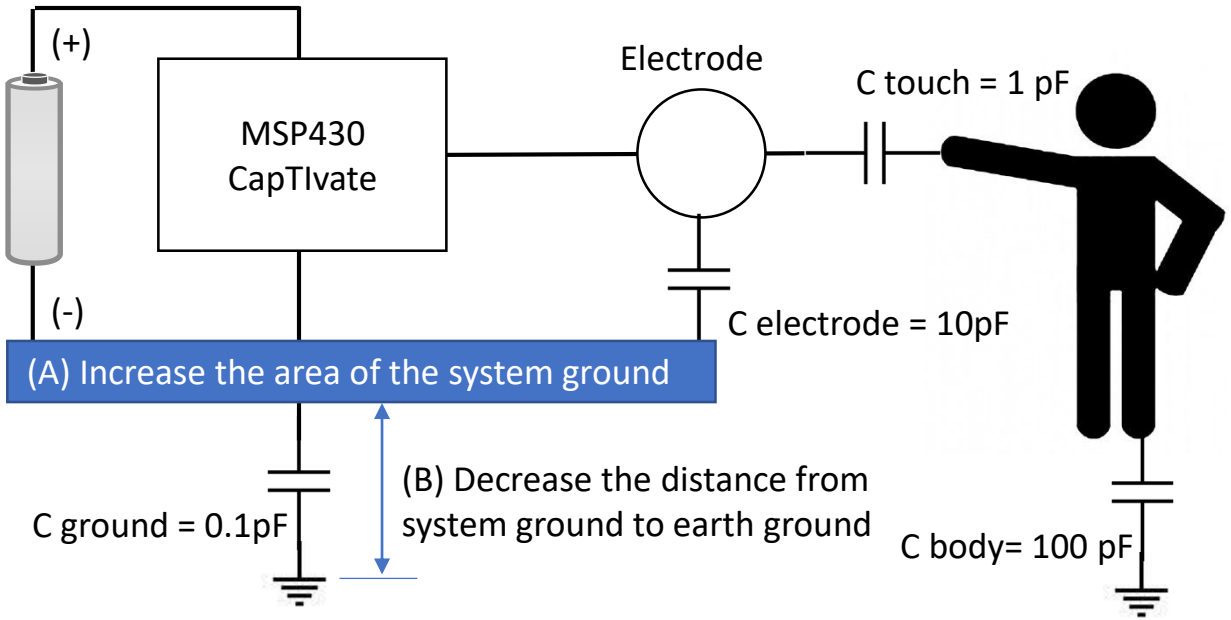
# Battery Powered (Improvements)

- Reduce distance
- Enlarge local ground area
- Improves sensitivity
  - Example ~1%




**Improve system coupling to earth ground by A, B or both.**

$$Improved\ Battery\ Powered = \frac{\frac{1}{\frac{1}{C\ touch}+\frac{1}{C\ person}+\frac{1}{C\ ground}}}{C\ electrode} = \frac{\frac{1}{\frac{1}{1pF}+\frac{1}{100pF}+\frac{1}{0.1pF}}}{10pF} = \frac{0.0908pF}{10pF} = 0.908\%$$

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# Design References

- CapTIvate Technology guide, Design Section, Battery powered devices
- SN0A952 - Ground Shifting in Capacitive Sensing Applications