

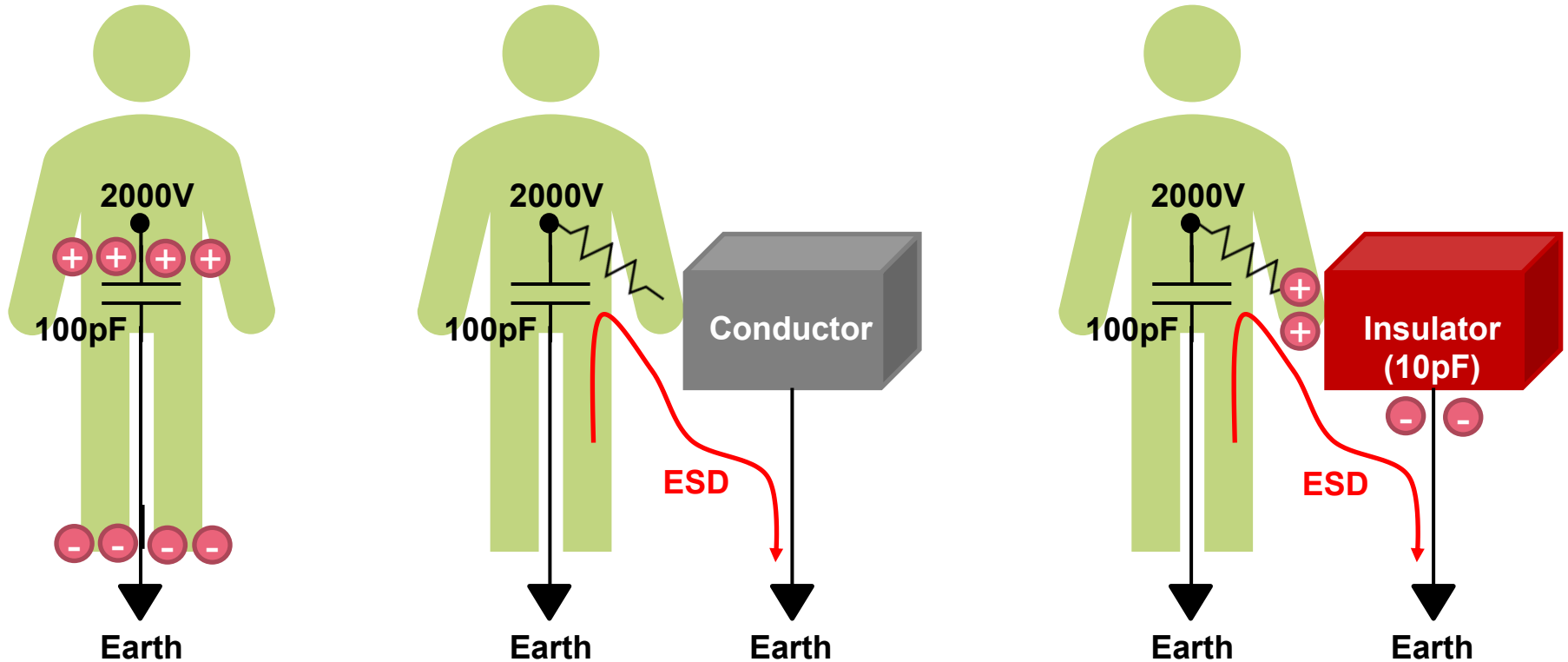
# ESD Basics

# Electrostatic Discharge

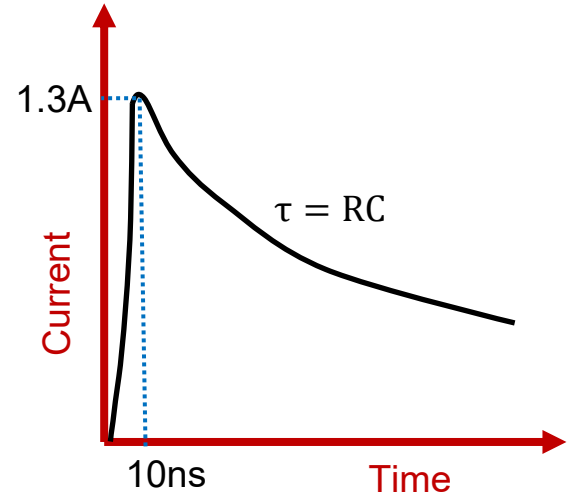
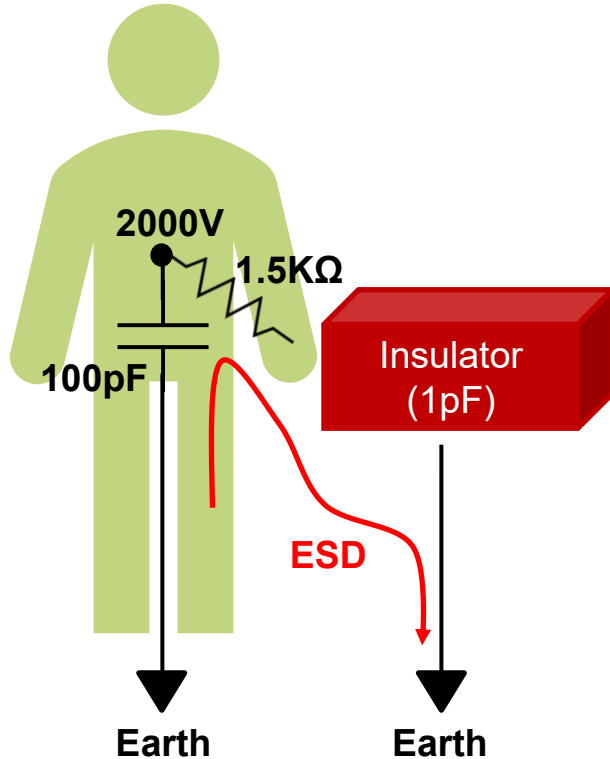


Image Courtesy - [https://hakkousa.com/whats-new/whatisesd\\_howcanyoupreventit.html](https://hakkousa.com/whats-new/whatisesd_howcanyoupreventit.html)

# ESD Theory

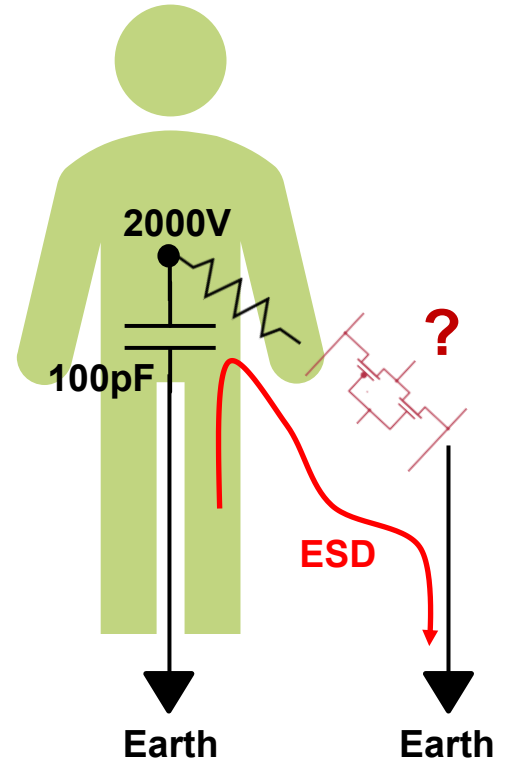
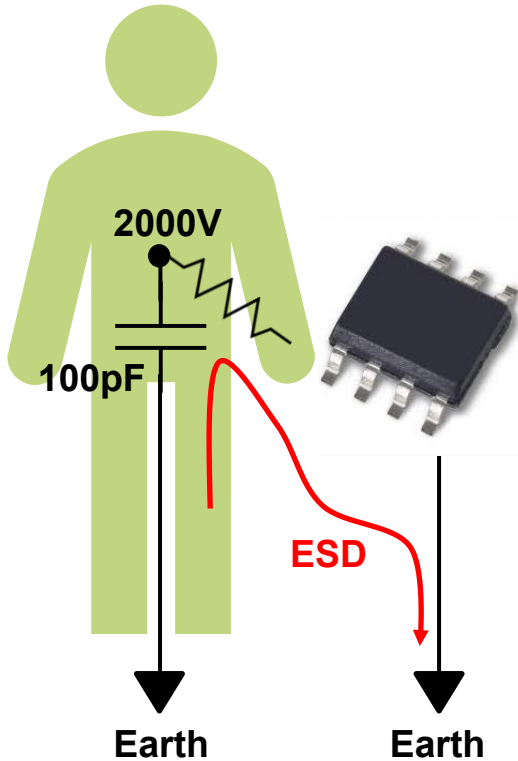
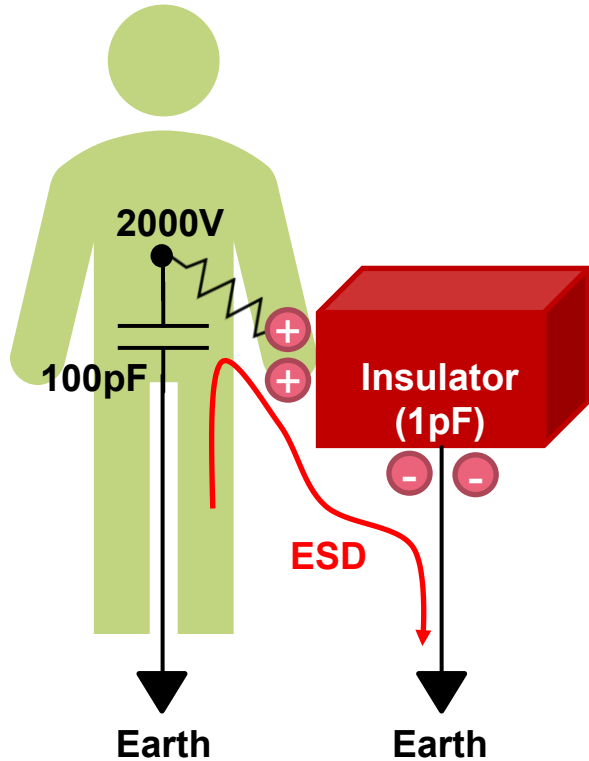


# Transient Response

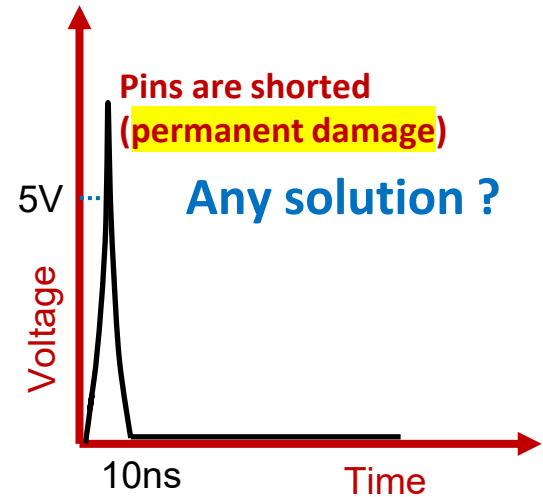
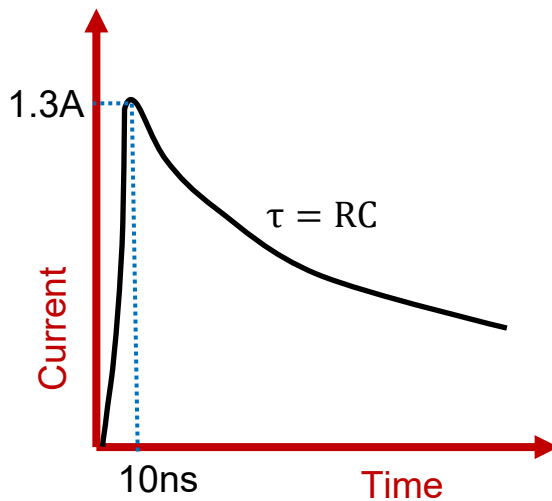
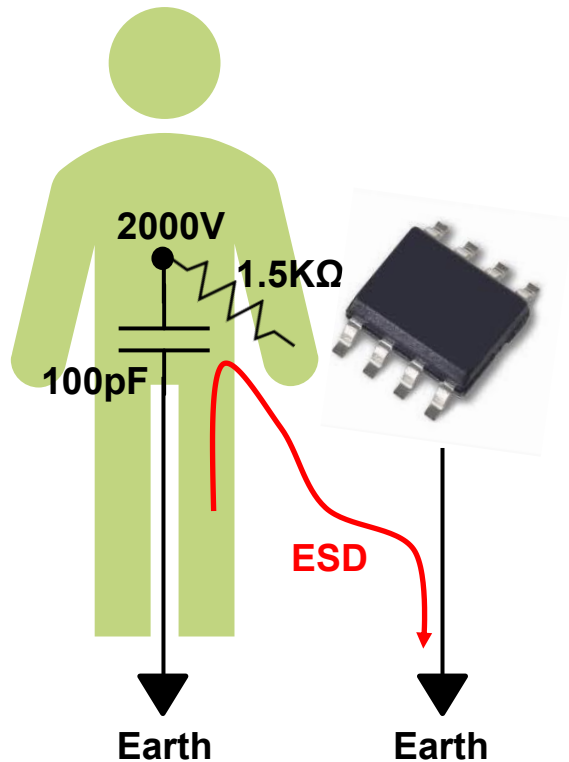


- What constitute the 10ns delay ?
- Voltage vs Time ?

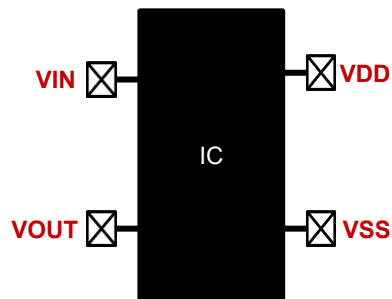
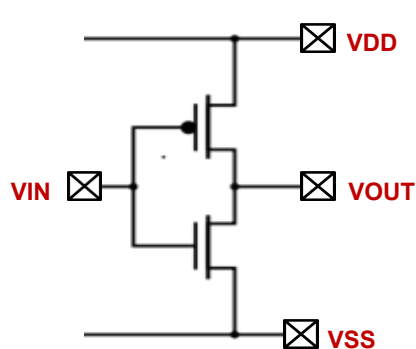
# Impact on IC



# Permanent Damage



# ESD Protection



## IC Protection using ESD Diodes and Power Clamp

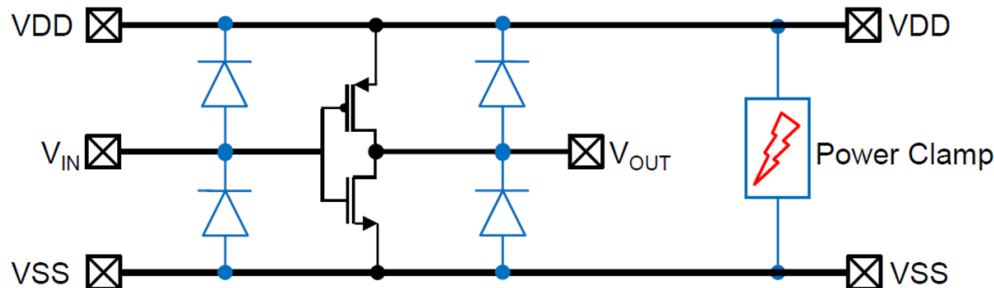
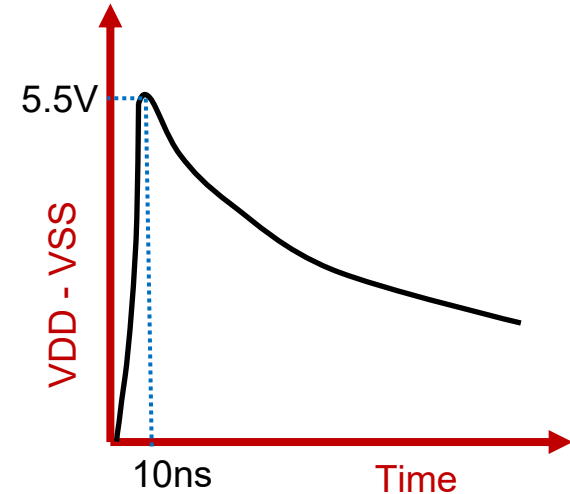
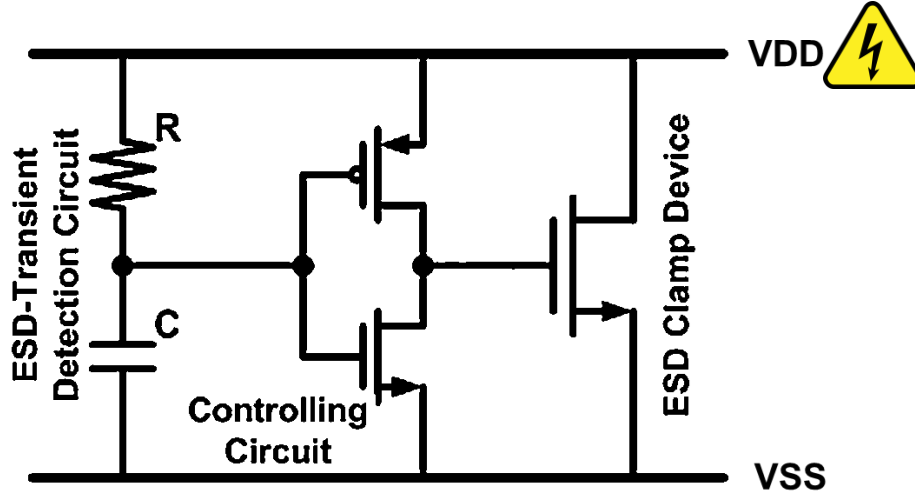


Image Courtesy – Prof. Mayank Shrivastava

**Power-clamp Offers A Low-Resistance Path Between  $V_{DD}$  And  $V_{SS}$  During an ESD Event**

**Objective –  $V_{DD}$  should not rise above  $V_{DD_{MAX}}$  (e.g., 5.5V) during an ESD event which injects 1.3A current.**

# RC Power Clamp

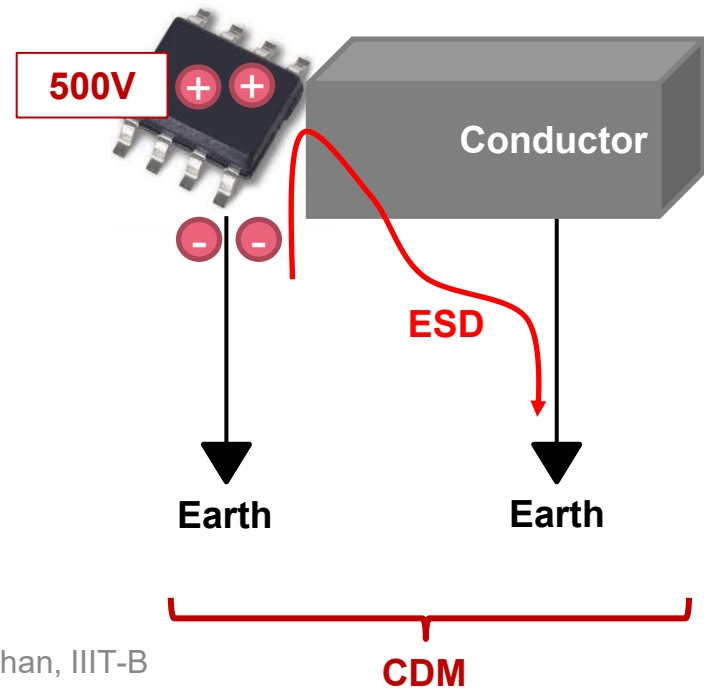
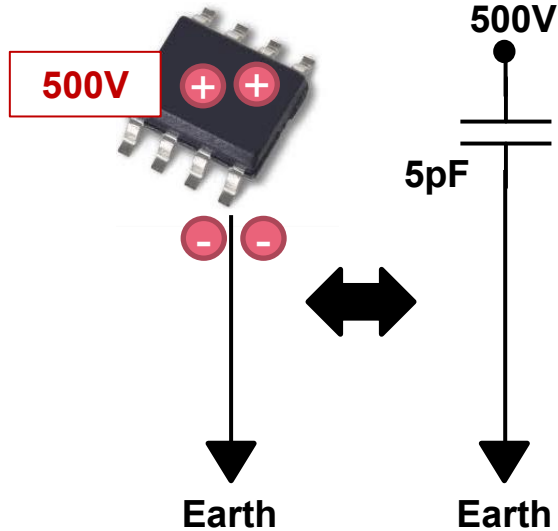
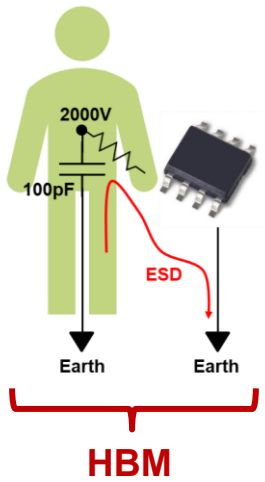


Yeh, Chih-Ting, Yung-Chih Liang, and Ming-Dou Ker. "Design of power-rail ESD clamp circuit with adjustable holding voltage against mis-trigger or transient-induced latch-on events." In *2011 IEEE International Symposium of Circuits and Systems (ISCAS)*, pp. 1403-1406. IEEE, 2011.

Design of RC ?

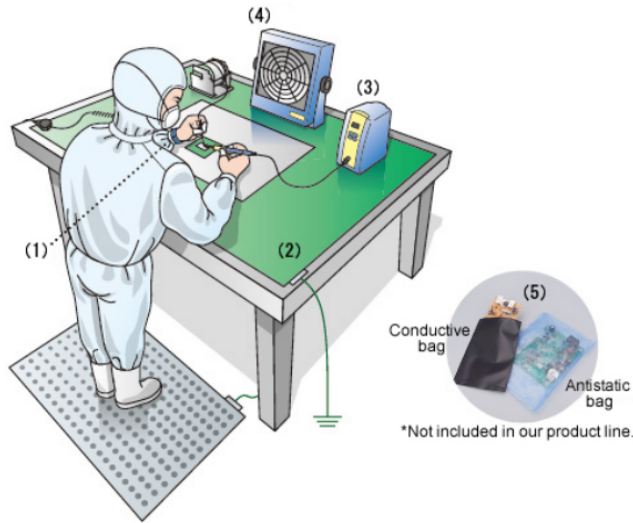


# ESD Models



# Precautions

ESD Control Procedures basically involves the following 5 steps.



<https://www.hakko.com/english/seidenki/pages/>

## 01 Ground the worker.

Wear an antistatic wrist strap.

## 02 Ground the surface of the work bench, the tools and other apparatus.

Lay the ESD protective mat on the work bench to ground it.

## 03 Remove from the area all materials (static producing materials) which tend to cause static electricity problems.

Use the ESD protective tools.

## 04 Use ionizer or the like for neutralization, if it is not possible to remove electrostatic by grounding.

Use the static eliminator (ionizer).

## 05 Place sensitive items in appropriate protective packaging when transporting or moving to storage from controlled areas described in the above.

Store in antistatic bags.