Over Voltage Stress considerations using TI MSP430 Microcontrollers

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Keep the maximum ratings in mind!

5.1 Absolute Maximum Ratings[1]

over operating free-air temperature range (unless otherwise noted)

	MIN	MAX	UNIT
Voltage applied at DVCC and AVCC pins to V_{SS}	–0.3	4.1	V
Voltage difference between DVCC and AVCC pins[2]		±0.3	V
Voltage applied to any pin [3]	–0.3	V_{CC} + 0.3 V (4.1 Max)	V
Diode current at any device pin		±2	mA
Storage temperature, T_{stg}[4]	–40	125	°C

(1) Stresses beyond those listed under *absolute maximum ratings*may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions*is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±1000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101[2]	±250	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Pins listed as ±1000 V may actually have higher performance.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process. Pins listed as ±250 V may actually have higher performance.

Consequences of violation

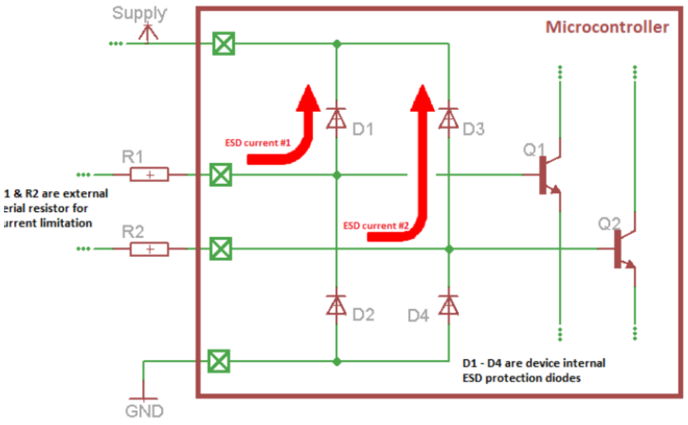
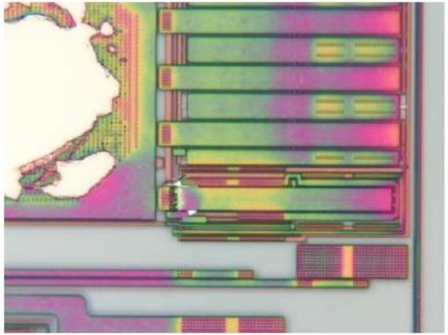


Figure 3. Principle Schematic of an I/O

1. Functional but out of spec

2. Not functional but not physically damaged

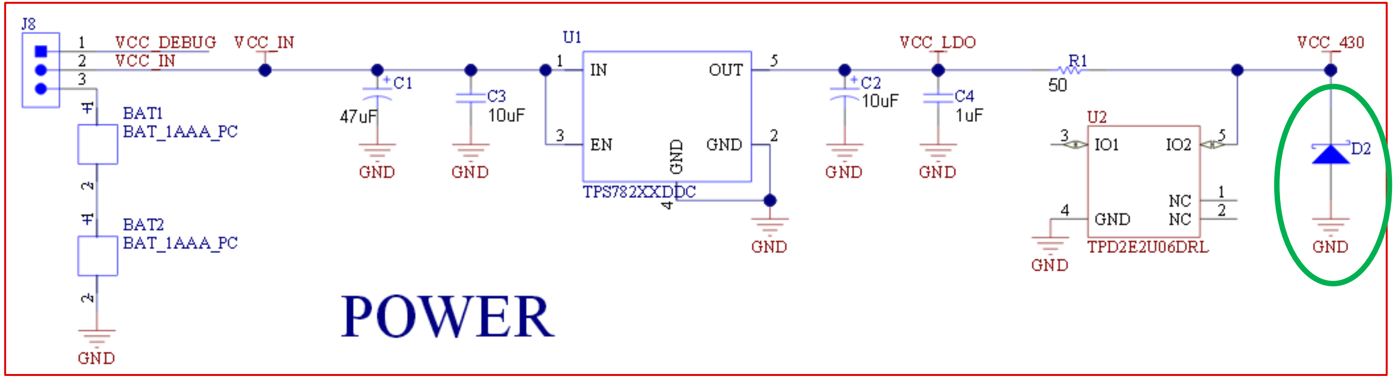
3. Electrical induced physical damage



TEXAS INSTRUMENTS

Possible application solutions

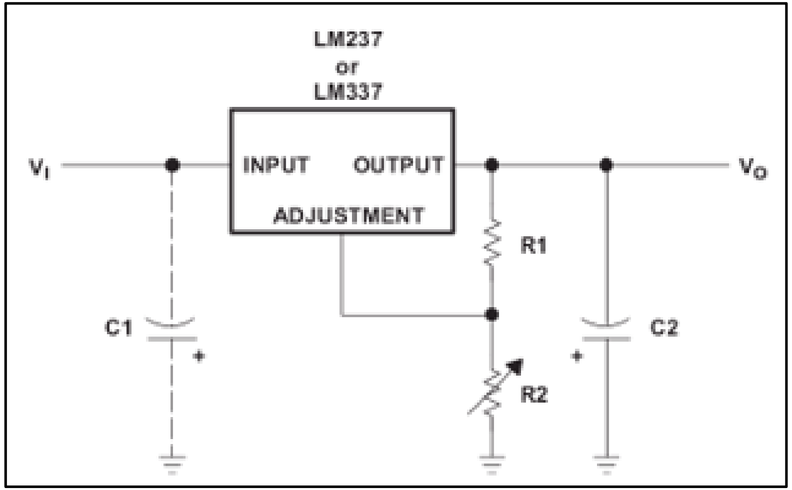
- Common solution is the use of a Zener diode connected to the supply
- Used to dissipate the additional energy introduced by the MSP MCU internal ESD diodes and clamps the voltage to the desired domain



- Selection of the right Zener diode depends on the application
- Characteristics like overall power consumption, power dissipation and overall clamping behavior needs to be considered

Possible application solutions

- Power supplies with good current-sinking capability
  - Example of a power supply with good current sink capability in case the ESD diodes will raise the supply voltage via the 2mA path



Consumes power

THEREFORE!
Prevent overvoltage on IO pins

  - main reason for the good sinking property of this circuit is the relatively high feedback current drawn by the R1/R2 combination for this specific regulator

Wrap Up

1. Keep the recommended and absolute maximum ratings from the component datasheet in mind during whole application development process!

2. Prevent overvoltage on supply and IO pins wherever possible by proper power supply sequence, good application design and external protection.

3. Keep in mind external protection external protection comes with drawbacks like overall consumption increase.
   → Therefore upfront prevention has priority!

Referenc

- Troubleshooting Guidelines for MSP Devices
- ESD Diode Current Specification
- MSP430™ System-Level ESD Considerations
- MSP430™ System-Level ESD Troubleshooting Guide