

Suggestions on non-5V tolerant pin input

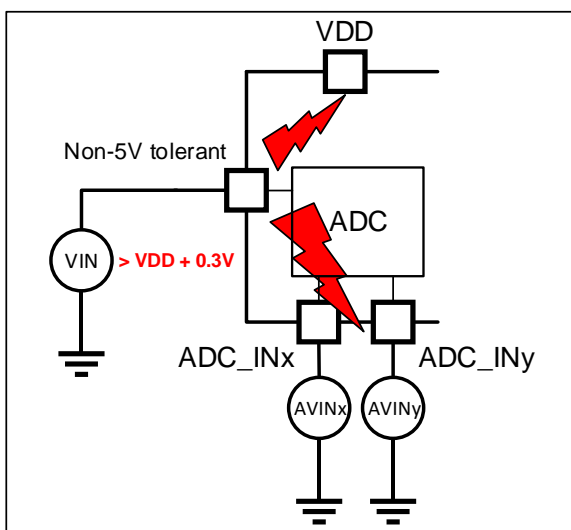
Questions:

What will happen if the input voltage of non-5V tolerant pin is greater than $VDD + 0.3V$?

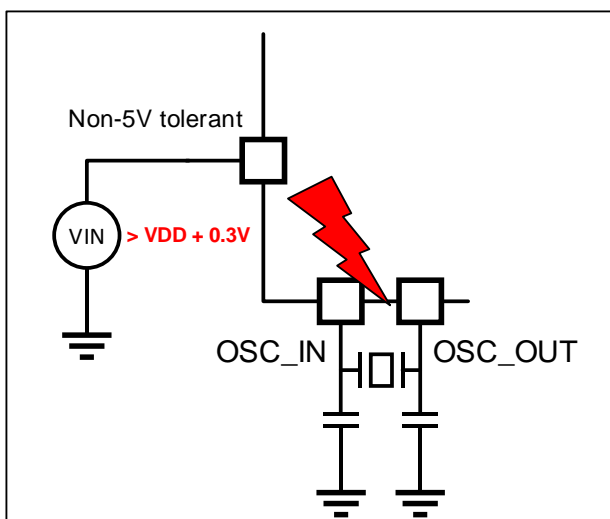
Answer:

There are two problems as follows:

1. Such high voltage will raise $VDD/VDDA$ via internal path of MCU. It also disturbs other ADC through ADC channels to input signal sources, resulting in inaccurate sampling results on any ADC channel.

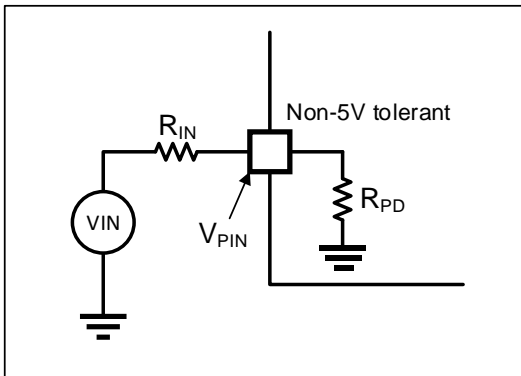


2. This high voltage will interfere with the HEXT in the 64-pin and 48-pin devices, causing it to fail to vibrate or stop again after vibrating.



Because of this, any external device whose output voltage exceeds $V_{DD}+0.3V$ cannot be directly connected to the non-5V tolerant pin. In this case, it is recommended that the output signal source of such device should be divided by a resistor divider circuit to below V_{DD} before connecting to non-5V tolerant pin, so as to avoid the issues mentioned.

For AT32 MCU, there is a pull-down resistor (RPD) on the pin. The signal source is connected to an external resistor (RIN) before connecting itself to the non-5V tolerant pin, plus the pull-down resistor enabled by software, forming the simplest resistor divider circuit.



Considering the possible differences in pull-down resistor values due to process variation, the following two conditions should be satisfied when selecting R_{IN} :

- (1) Calculated based on the maximum PRD, V_{PIN} needs to be lower than V_{DD} after voltage division;
- (2) Calculated based on the minimum PRD, V_{PIN} needs to be greater than the minimum V_{IN} after voltage division.

Symbol	Parameter	Min	Typical	Max	Unit
RPD	Weak pull-down equivalent resistor	70	90	120	kΩ
VIN	Standard I/O input high level voltage	$0.31 * V_{DD} + 0.8$	-	$V_{DD} + 0.3$	V

For example:

If $V_{DD}=3.3V$, $V_{IN}=3.8V$, $R_{IN}=30\text{ k}\Omega$ can be selected.

- (1) $3.8 \times 120 / (30+120) = 3.04V$, less than $3.3V$;
- (2) $3.8 \times 70 / (30+70) = 2.66V$, greater than $0.31 \times 3.3 + 0.8 = 1.823V$.

The above conditions should be followed to prevent the non-5V tolerant pin from withstanding voltage greater than $V_{DD}+0.3V$, and to make sure that the high level output of device, after being divided, can still be recognized by the pin as high.

Type: MCU

Applicable products: AT32 MCU family

Main function: GPIO

Minor function: None

Document revision history

Date	Revision	Changes
2022.2.16	2.0.0	Initial release

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