

TLE985x overload current behavior

For the general-purpose I/O ports

About this document

Scope and purpose

This application note proposes additional information regarding the overload behavior of the general-purpose I/O ports (GPIO).

Intended audience

This document is intended for customers who are using the GPIOs in an application case where an overload condition can occur.

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Table of contents

Table of contents

About this document..... 1

Table of contents..... 2

1 Introduction 3

2 Feature definition of overload current..... 5

Revision history..... 6

Introduction

1 Introduction

An overload current occurs if the input voltage of V_{in} is higher than V_{DDP} or lower than ground. Typically, this can happen in case a switch to supply voltage has to be read in (digital or analog). The overload current can occur over the full lifetime of the product.

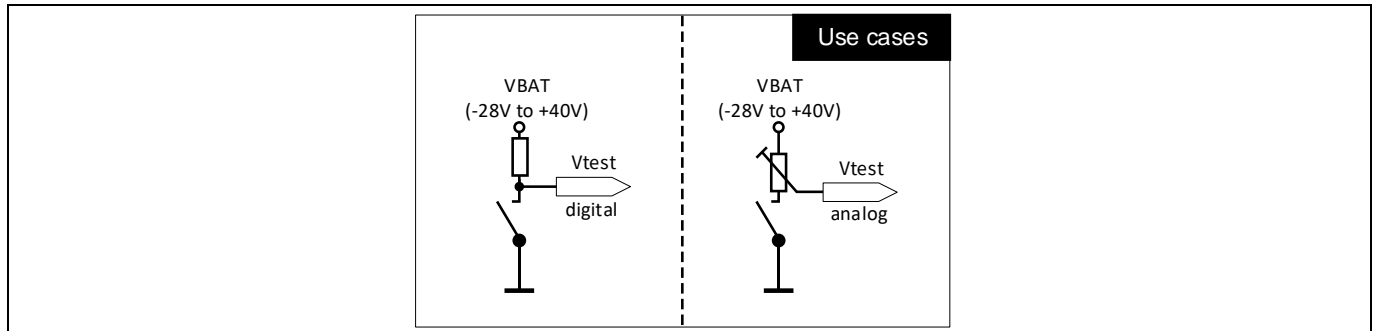


Figure 1 Typical use case

Depending on the external voltage at the respective pin, overload current can have following effects:

1. Stress on ESD diodes inside the pad structure. Therefore, the current has to be limited.
2. The overload current can couple as leakage current to an adjacent pin, which can influence the ADC measurement (KOVAN, KOVAP).

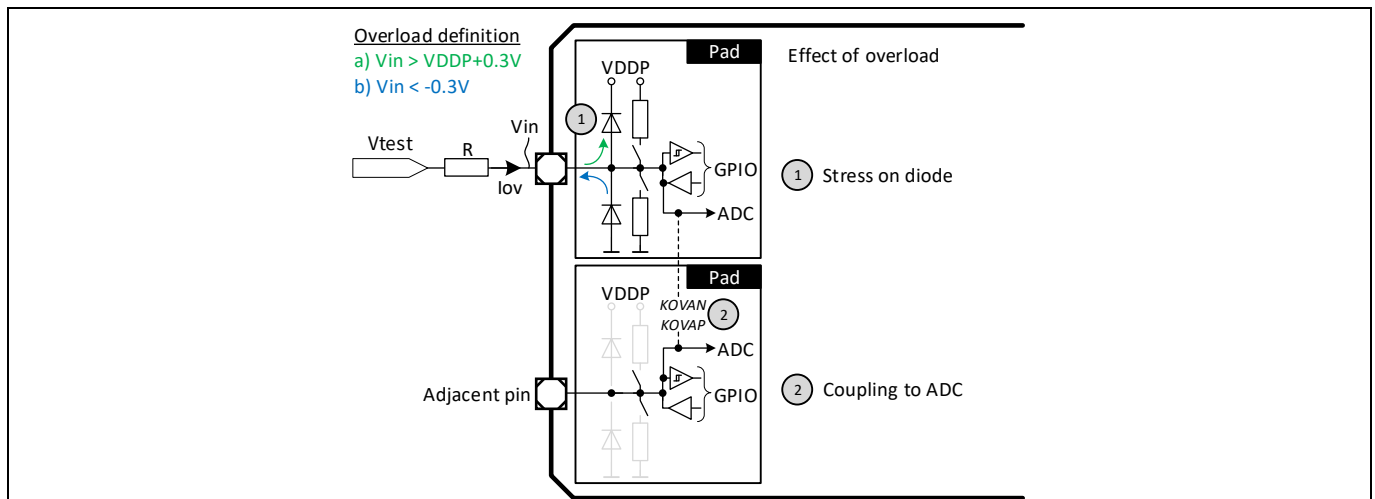


Figure 2 Definition of overload current (stress and coupling)

3. The sum of the overload current has to be sinked by the V_{DDP} regulator's pulldown in Sleep mode otherwise the wake behavior is influenced. In addition, the startup behavior (I_{ov} when unpowered) can be affected. In Stop mode, overload current is not allowed.
4. The sum of overload current must be small compared to the device's active current consumption.

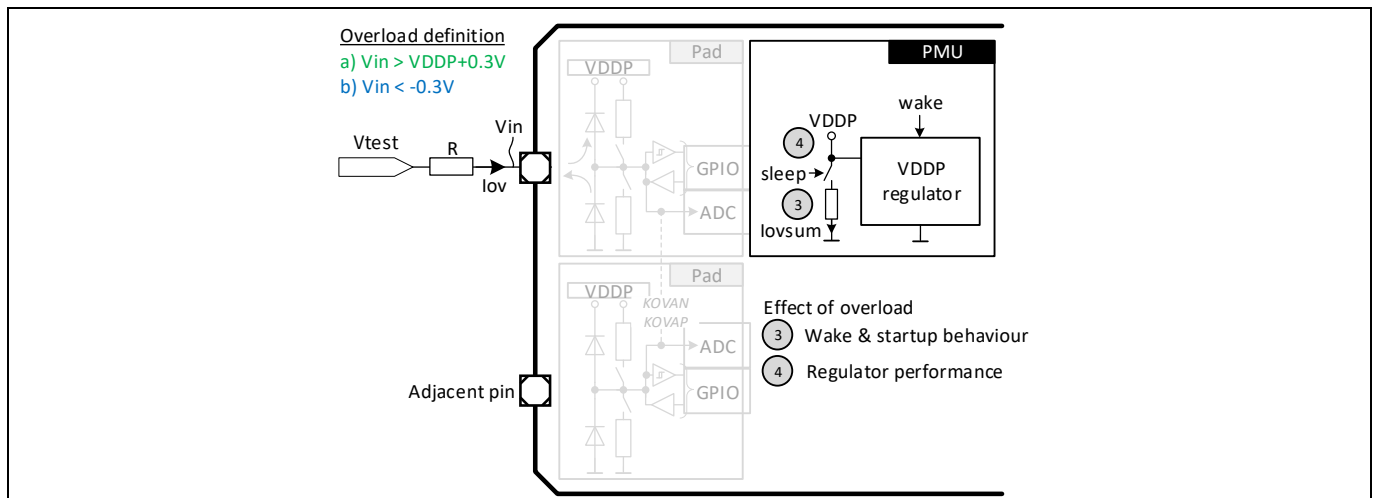


Figure 3 Definition of overload current (wake and startup, regulator performance)

2 Feature definition of overload current

In order to prevent the unwanted effects, the application shall operate within the condition described in Table 1.

Note: These data were determined by design review and laboratory characterization.

Table 1 Overload current

$V_s = 5.5 \text{ V}$ to 28 V , $T_j = -40^\circ\text{C}$ to $+150^\circ\text{C}$, all voltages with respect to ground, positive current flowing into pin (unless otherwise specified).

Parameter	Symbol	Values			Unit	Note
		Min.	Typ.	Max.		
Overload current on pins P0.x, P1.x, P2.x (except P2.0 and P2.2)	I_{ov}	-2		2	mA	^{1), 3)} overload current must be limited, e.g. via series resistor
Sum of overload currents	I_{ovsum}	-4		4	mA	^{1), 3)} the number of pins with overload must be limited to maximum 4
Overload negative current coupling factor for analog inputs	KOVAN			0.00015		^{2), 3)}
Overload positive current coupling factor for analog inputs	KOVAP			0.00015		^{2), 3)}

1) Overload conditions occur, if the standard operating conditions are exceeded, i.e. the input voltage V_{in} at the pin exceeds the specified range: $V_{in} > V_{DDP} + 0.3 \text{ V}$ ($I_{ov} > 0$) or $V_{in} < -0.3 \text{ V}$ ($I_{ov} < 0$).

2) An overload current through a pin injects an error current into the adjacent pins. This error current adds to that pin's leakage current (I_{oz}). The value of the error current depends on the analog input's overload current.

3) Overload condition is allowed when device is unpowered or in active and Sleep mode. It is not allowed in Stop mode.

Revision history

Document version	Date of release	Description of changes
1.0	2020-03-13	Initial release

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