Supply Voltage Considerations: VCC_IO in TMC50*xx* Designs

Valid for TMC5031

This application note describes how to connect VCC_IO in a way that guarantees a minimum supply voltage of 1.5V at the end of a chip-internal reset condition. A well-defined VCC_IO supply avoids wrong power up behavior of the TMC50*xx*, which is mandatory for the successful operation of the IC.

This application note shows a schematic for supplying the IO supply voltage in a 3.3V TMC50xx design.

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1 Requirements on IO Supply

The I/O supply voltage for the TMC50*xx* must not remain at 0V after the end of the chip internal reset. This is, because the I/O supply voltage is not monitored by the internal reset circuitry. During the phase where VCC_IO is below 1.5V the input levels cannot be determined by the chip and wrong power up behavior can result. This is not an issue if the internal 5V regulator is used for direct supply of the I/O voltage.

When using an external voltage regulator, most switching regulators and many newer linear regulators show a delayed boot up.

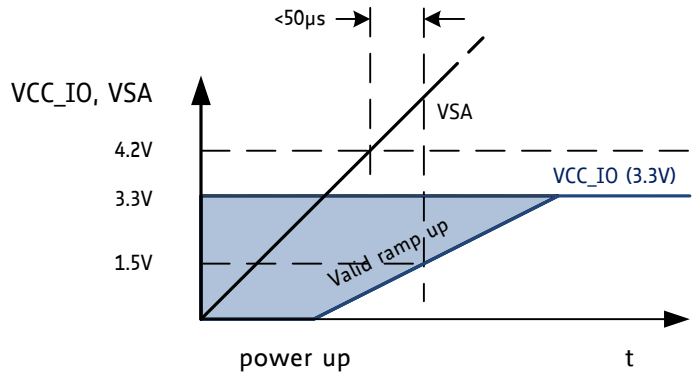

Figure 1.1 Safe supply ramp up with external (3.3V) VCC_IO source

For a reliable start-up it is essential that VCC_IO comes up to a minimum of 1.5V before the TMC50*xx* leaves the reset condition. This is ensured when using 5VOUT to supply VCC_IO, or when using an external low drop regulator supplied from 5VOUT or from the same source as VSA. The reset condition ends earliest 50µs after the time when VSA exceeds its undervoltage threshold of typically 4.2V, or when 5VOUT exceeds its undervoltage threshold of typically 3.5V, whichever comes last.

2 Sample Schematics

When using an external voltage regulator to supply the VCC_IO, please refer the power-up timing of the manufacturer as most regulators start up delayed. We found the following standard devices to operate reliably in this application (refer to Figure 2.1).

EXAMPLES FOR EXTERNAL REGULATORS	
TS3480CX33	This regulator can be used within the full supply voltage range when tied to the motor supply voltage.
LD1117-3.3	This regulator can be used to supply VCC_IO from 5VOUT, or from a supply voltage of up to 15V.

In case, other circuitry is supplied by the VCC_IO power source, make sure that the power dissipation limits and current limits of the regulators do not become exceeded.

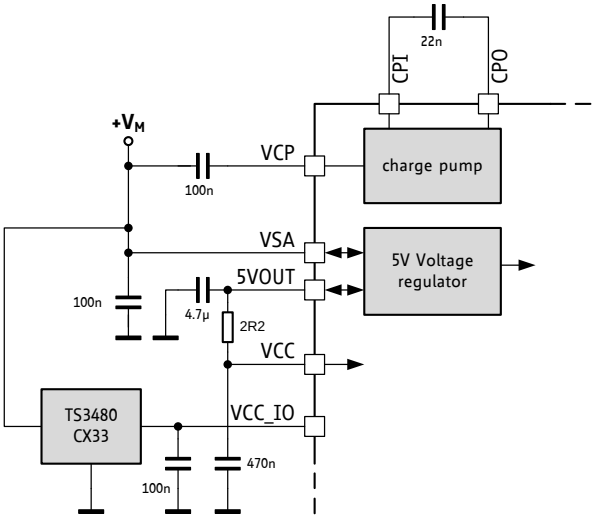

Figure 2.1 Using an external linear regulator to supply 3.3V VCC_IO

A second possibility is to supply VCC_IO from 5VOUT until the external regulator comes up (see Figure 2.2). In this schematic, a voltage divider supplies 3.3V to VCC_IO for start-up. In a 5V environment, the 2K resistor can be left away.

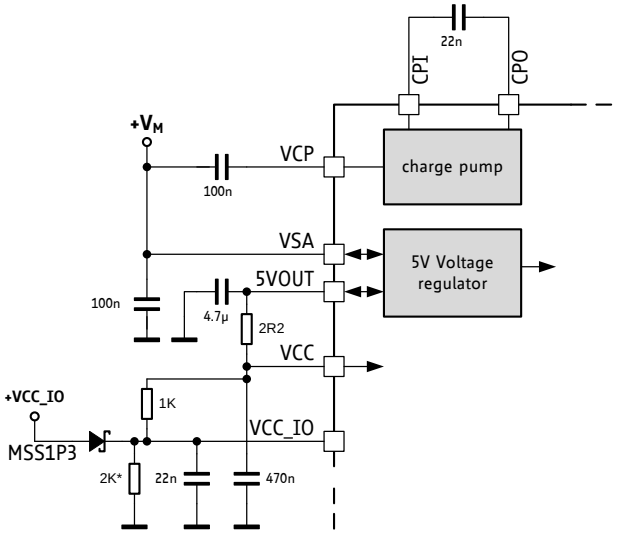

Figure 2.2 Using a Schottky diode to supply VCC_IO from external (delayed start-up) regulator

3 Disclaimer

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4 Revision History

4.1 Document Revision

Version	Date	Author LL – Lars Larsson SD – Sonja Dwersteg	Description
0.9	2013-FEB-07	BD	Initial version
1.00	2013-APR-24	SD	New design

5 References

TMC5031 datasheet, www.trinamic.com