How to use VSEL function of TPS63070

Changing the output voltage of a DC/DC converter during operation can be a useful feature in battery operated applications to increase the battery lifetime. In applications that include processors, a lower system voltage reduces the leakage currents. In addition, it typically reduces the operating frequency as well. Both effects lower the power consumption and increase the battery lifetime.

Other examples include environment controllers for building automation where a higher operating voltage is needed to supply a particle sensor, or that is, in wireless network cameras where the forward voltage of a LED shortly increases to create a flash.

The TPS63070 dynamic voltage scaling feature uses the VSEL pin to change the output voltage during operation. Through an internal MOSFET an additional external resistor is pulled to GND (VSEL=high) or left floating (VSEL=low). If pulled to GND the resistor is connected in parallel to the bottom feedback resistor which then enables a higher output voltage.

The needed output voltages can be calculated with the following formulas:

\[ V_{O1} = (V_{FB} \times \frac{R1+R2}{R2}) \]  
\[ V_{O2} = (V_{FB} \times \frac{R1+(R2 || R3)}{R2 || R3}) \]

where:

\[ R2 || R3 = \frac{R2 \times R3}{R2 + R3} \]  

R3 can be calculated with this formula:

\[ R3 = \frac{V_{FB}}{(V_{O2} - V_{O1})} \times R1, \text{ for } V_{O2} > V_{O1} \]

This excel calculator can be used: VSEL Calculator.

TPS63070 dynamic voltage scaling feature can be used during operation. Figure 2 shows a dynamic output voltage change from 5 V to 3.3 V with a slow signal ramp on the VSEL pin. The VSEL pin has an inbuilt hysteresis of typically 30 mV preventing Vo oscillations.
The maximum switching frequency depends on the operating mode, output current, voltage step and output capacitor.

If the device operates in forced-PWM or PWM mode the maximum switching frequency is 10 kHz. Higher frequencies result in the output voltage not reaching the lower value. The discharge is dependent on the negative current limit and the output capacitance.

In power save mode (PSM) the output capacitor discharge is determined by the output current. Higher output current results in faster output voltage changes. Figure 5 and Figure 6 show two different output current both with 1 kHz switching frequency.

1 References

VSEL Calculator

TPS63070 Datasheet

2 Trademarks

All trademarks are the property of their respective owners.
IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI’s Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2019, Texas Instruments Incorporated