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## ABSTRACT

This application note focuses on the design for power supply requirements of the C2000 F29 series (TI C2000 64-bit MCU with TPS65036x). The document explains how to use the TPS65036x and set power sequences for the F29 series. The C2000 F29 series requires high slope rate in power up and down. The C2000 series requires dedicated power sequence, reset timing, and so on. Discrete design with DC/DC buck converter, LDOs and VRS devices complicates the design to realize the F29 power supply requirements. The TPS65036x can support these requirements. The application note also explains how users can set the TPS65036x output using a GUI.

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## 1 Introduction

The TPS65036x family is an integrated power management IC. The family has a wide-Vin step-down converter, two Low-Vin step-down converters, and one low dropout (LDO) regulator. The C2000 F29 series requires VDDIO and VDDA, which are the 3.3V rail and VDD which is a 1.25V rail. Users can use additional voltage requirements for the application beside 3.3V and 1.25V rail of F29 requirements.

## 2 Overview for C2000, F29 Series Power Requirements

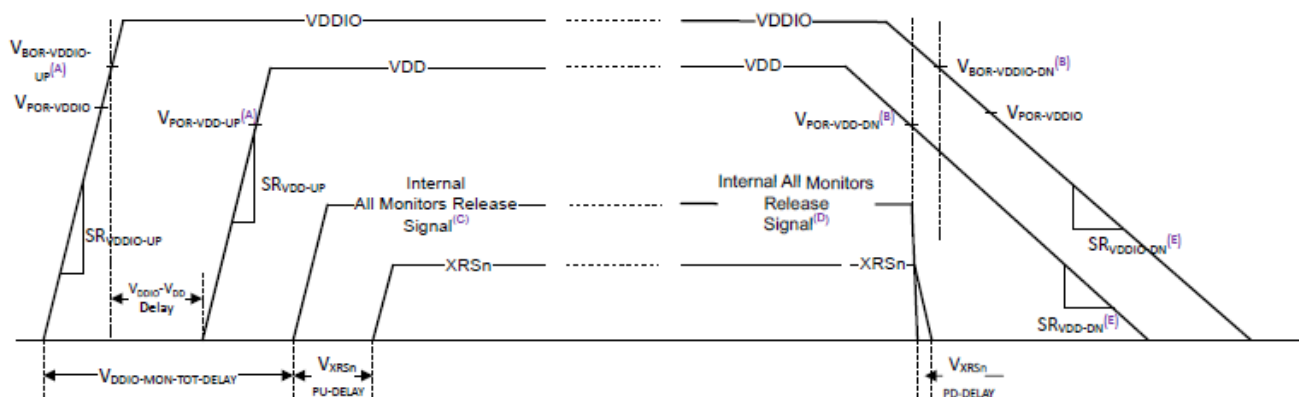
### 2.1 Power Supply Ramp Rate

The F29 series (F29H85X, F29P56x, and F29P32x) requires the 100mV/us as the power supply ramp rate listed in [Table 2-1](#). For the discrete design, there are a lot of DC/DC buck converters have the internal fixed soft-start timer with millisecond order. According to [Table 2-1](#), these DC/DC buck converters are difficult to meet the power supply slope requirements.

**Table 2-1. F29H85x and F29P85x Supply Ramp Rate Requirements**

PARAMETER		MIN	TYP	MAX	UNIT
SR <sub>VDD33</sub>	Supply Ramp Rate of 3.3V Rails (VDDIO, VDDA). Internal/External VREG	3		100	mV/us
SR <sub>VDD12</sub>	Supply Ramp Rate of 1.2V Rail (VDD)	2		100	mV/us

F29 series also require power up and down sequence with delay. [Figure 2-1](#) shows the F29H85x and the F29P85x external VREG power up sequence.



- This trip point is the trip point before XRSn releases. See the *Power Management Module Characteristics* table.
- This trip point is the trip point after XRSn releases. See the *Power Management Module Characteristics* table.
- During power up, the All Monitors Release Signal goes high after all POR and BOR monitors are released. See the *PMM Block Diagram*.
- During power down, the All Monitors Release Signal goes low if any of the POR or BOR monitors are tripped. See the *PMM Block Diagram*.

**Figure 2-1. F29H85x, F29P56x, and F29P32x External VREG Power Up Sequence**

**Table 2-2. F29H85x, F29P56x, and F29P32x Delay Time for Power Management**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
VDD33-VDD12 Delay	Ramp Delay between VDD33 and VDD12		0			us

TPS65036x can release the XRSn pin after VDD33 and VDD12 are up. C2000 F29 releases the XRSn pin after VDDIO-MON-TOT-DELAY and VXRSN-PU-DELAY. TPS65036x features a reset read back function that must be disabled or adjusted to account for VDDIO-NON-TOT-DELAY and VXRSN-PU-DELAY.

## 2.2 Overvoltage and Undervoltage Threshold

The 1.25V and 3.3V rail of the C2000 F29 has minimum and maximum range requirements as shown in [Table 2-3](#). The TPS65036x has an internal voltage monitor that checks that each voltage rail is under overvoltage and undervoltage threshold. The OV and UV threshold range of the buck converter in TPS65036x are  $\pm 4\%$  to  $\pm 5.5\%$ . The OV threshold range of LDO is  $+4\%$  to  $+5.5\%$  and the UV threshold of LDO is  $-3.5\%$  to  $-5\%$ .

**Table 2-3. F29 Device Power Supply Voltage Range**

	MIN	TYP	MAX	UNIT
VDDIO, VDDA	2.8	3.3	3.63	V
VDD	1.1875	1.25	1.3125	V

The C2000 F29 VDDIO and VDDA 3.3V supply voltage requires 10% accuracy. The VDD (1.25V supply voltage) requires a  $\pm 5\%$  range. The TPS65036x has a high accuracy of the voltage monitor rather than the C2000 F29 requirements and the requirements help to realize functional safety.

### 3 TPS65036x Power Up Sequence Setup

Users can set the power up sequence and power supply ramp rate with the GUI. Click the [link](#) to access the GUI.

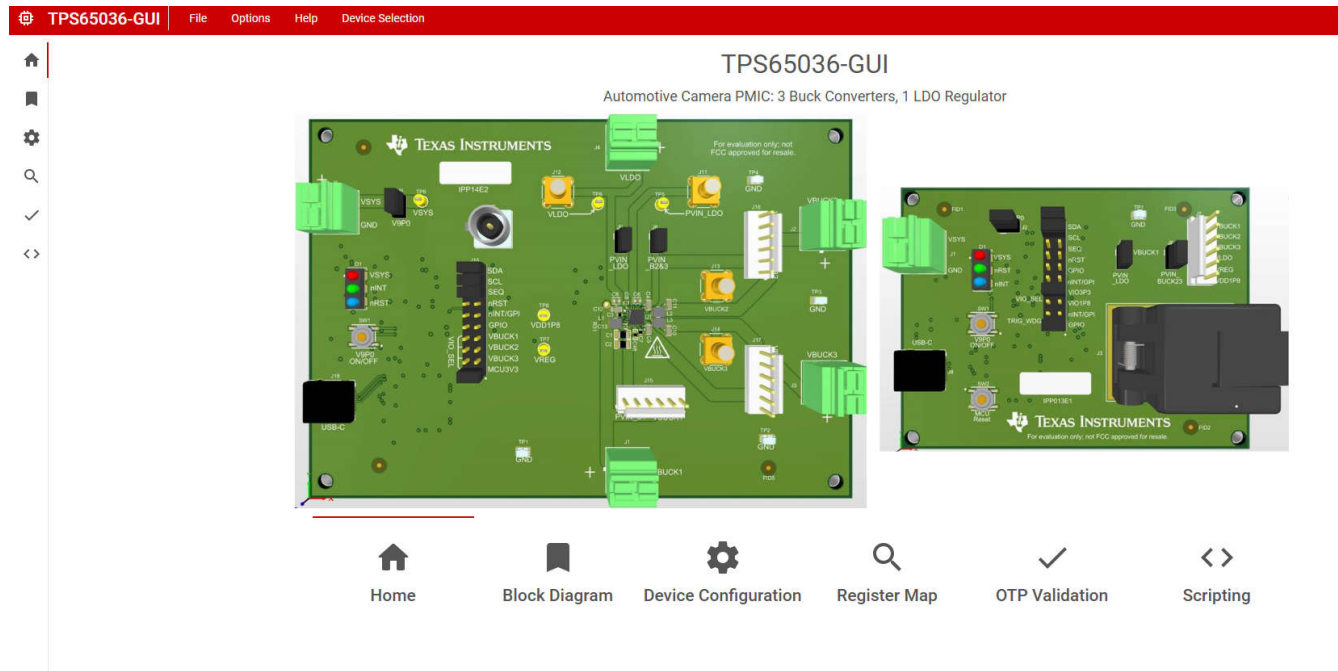


Figure 3-1. TPS65036x GUI Top Page

#### 3.1 TPS65036x GUI Setup: Configuration

By selecting the device configuration in the top page, there are five configuration pages: *Bucks and LDO Config*, *Additional Config*, *Sequencing Overview*, *Watchdog*, *Interrupt and Fault Config* and *Monitor Interrupt and Fault Status*. This application note focuses on how to set parameter and explains the buck and LDO setting and power up sequence for the C2000 F29 series. Users can set the enable, output voltage, slew rate, over- and undervoltage threshold and internal current limit in bucks and LDO configuration as [Figure 3-2](#) shows.

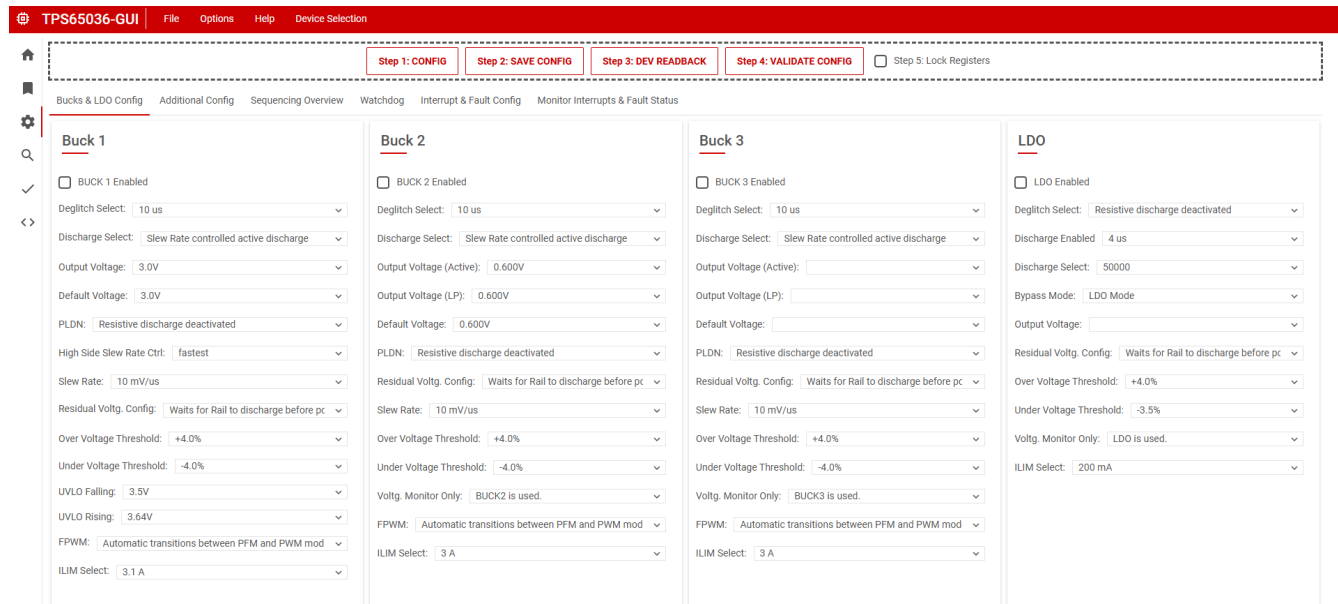
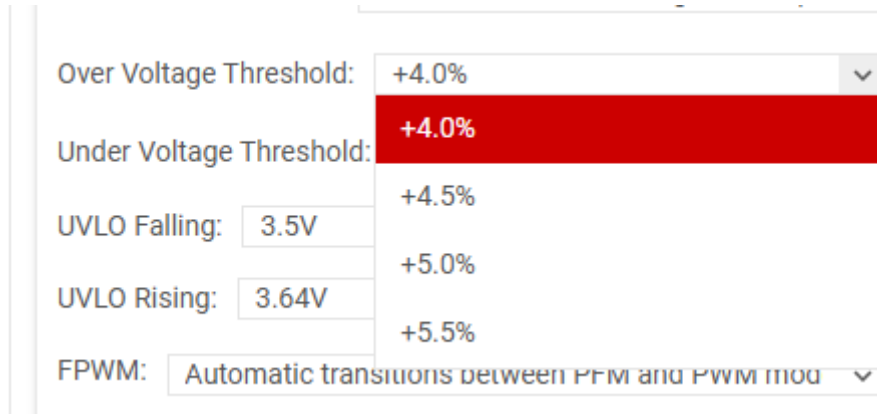


Figure 3-2. TPS65036x GUI: BUCK1-4 and LDO Config

TPS65036x supports the 1.25mV/us, 2.5mV/us, 5mV/us and 10mV/us options. The C2000 F29 power supply requires from 2mV/us as a minimum to 100mV/us as a maximum as listed in [Table 2-1](#). The user can select from 2.5mV/us to 10mV/us from the options.

### 3.2 TPS65036x GUI Setup: Undervoltage and Overvoltage Threshold

The power supply for 1.25V and 3.3V of C2000 F29 is shown in [Table 2-3](#). Users can set the overvoltage (OV) and undervoltage (UV) threshold at the GUI. The OV and UV threshold range of buck converters is from +/-4% to +/- 5.5% with a 0.5% step. OV threshold range of LDO is from +4% to +5.5% and UV threshold range is from -3.5% to -4% with a 0.5% step.



**Figure 3-3. TPS65036x GUI: Overvoltage and Undervoltage Threshold Setting**

In parts-to-parts variations, users must consider additional +1% variations for each threshold. [Table 3-1](#) shows an example for supporting the over- and undervoltage requirement of F29 series.

**Table 3-1. F29 Power Rail Example**

	ITEM	THRESHOLD PARAMETER	VALIDATIONS	TOTAL	UNIT
Buck (1.25V)	Overvoltage	+4	+1.	+5	%
	Undervoltage	-4	-1	-5	%
LDO (3.3V)	Overvoltage	+5.5	+1	+6.5	%
	Undervoltage	-5	-1	-6	%

[Table 3-1](#) shows one of buck converter use for 1.25V VDD supply and LDO used for 3.3V VDDIO, VDDA power supply. The total in [Table 3-1](#) has total validation. This shows minimum and maximum validations as listed in [Table 3-2](#). This value is the output voltage range from TPS65036x and the value meets the F29 voltage range listed in [Table 2-3](#).

**Table 3-2. Buck and LDO Output Voltage Range**

F29 Power Rail	MIN (V)	MAX (V)	UNIT
1.25V	1.1875	1.3125	V
3.3V	3.102	3.5145	V

### 3.3 TPS65036x GUI Setup: Sequence

By selecting *Sequencing Overview*, users set the power up and down sequence as shown in [Figure 3-4](#). The check mark next to the GUI means *Disabled*. For example, Buck2 triggers the Buck1 power good and LDO power good signal to run. The power up sequence shown in [Figure 3-3](#) is: Wait 0.5ms → Run Buck1 → Wait 1ms → Run LDO → Wait 1ms → Run Buck2 → Wait 1ms → nRST

When the output voltage of Buck2 is 1.25V for F29 VDD and LDO is 3.3V for F29 VDDIO/VDDA, the previous sequence meets the F29 requirements. Buck1 is useful for additional power output for applications besides MCU.

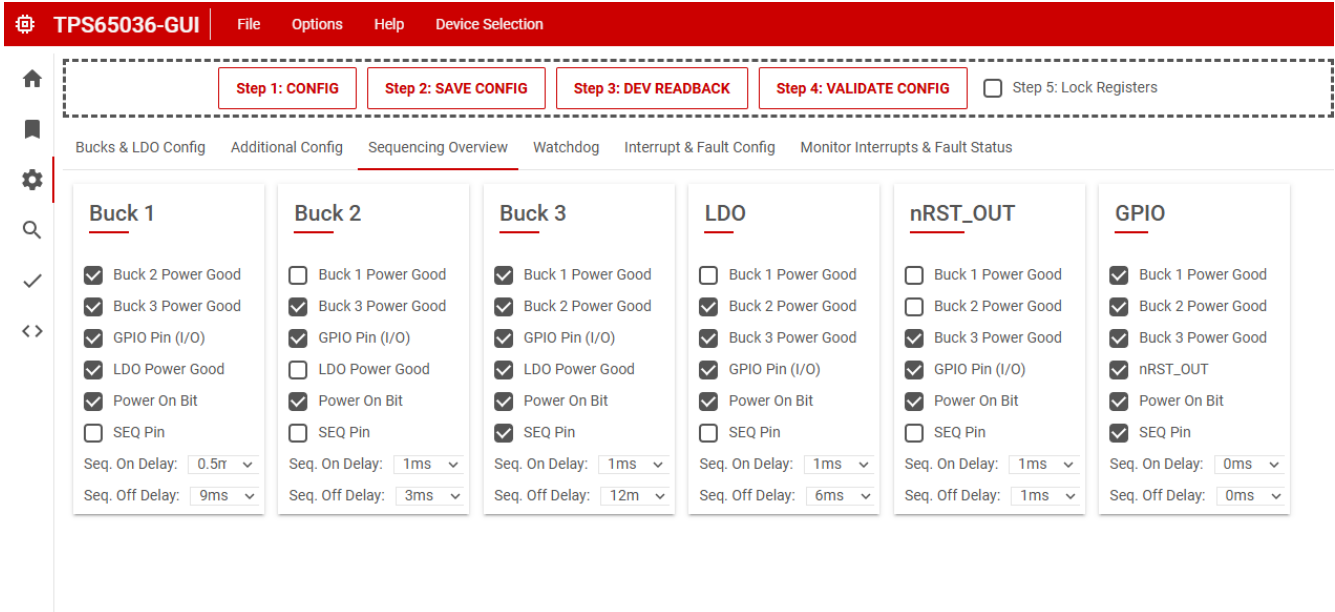


Figure 3-4. TPS65036x Sequencing Overview

### 3.4 TPS65036x GUI Setup: OTP Program

User can confirm the setting values in Register Map and program the value to OTP in TPS65036x by selecting *Write all* in GUI screen as shown in [TPS65036x GUI: Register Map](#).

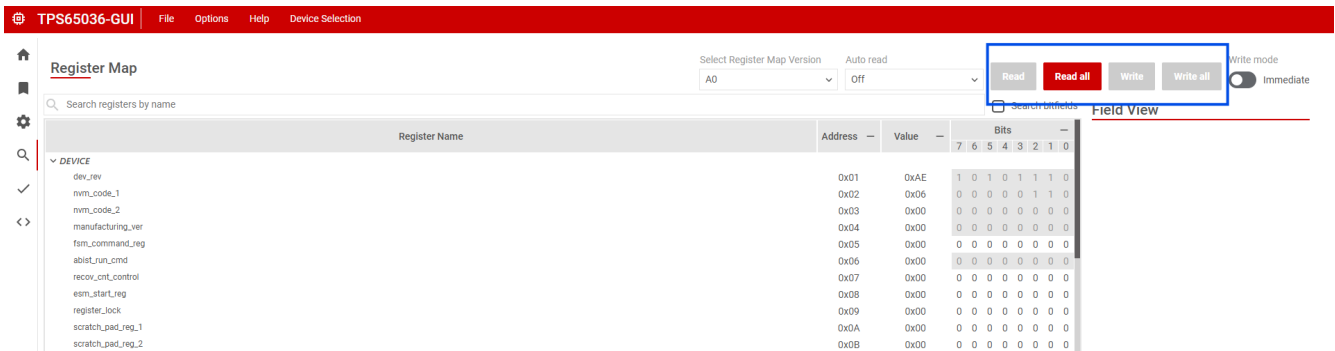
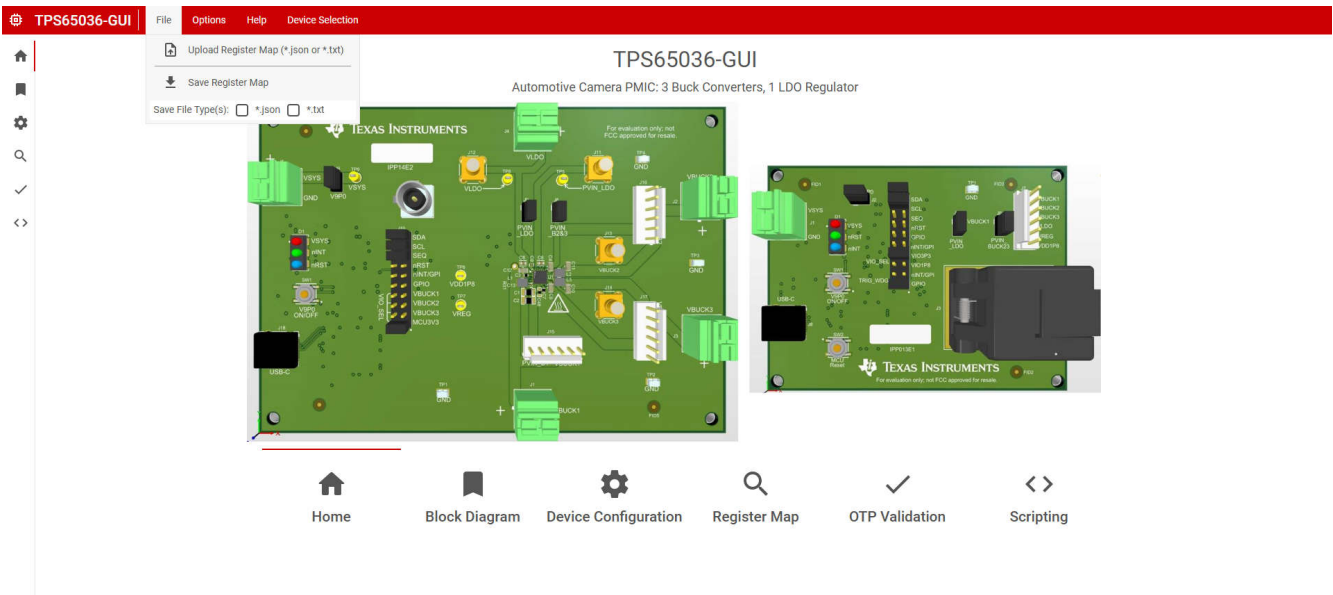


Figure 3-5. TPS65036x GUI: Register Map

### 3.5 TPS65036x GUI Setup: Save

Once the register value is fixed, the user can save the value from File at menu var and select *Save Register Map*.



**Figure 3-6. TPS65036x GUI: Save Register Setting**

## 4 Summary

The C2000 F29 power system design using TPS65036x helps users to set up over voltage, ramp rate and sequences. In addition, TPS65036x features four buck converters and one LDO. Besides supporting the F29 power rail, TPS65036x can support additional power rails in user application systems.

## 5 References

- Texas Instruments, [F29H85x, F29P58x, and F29P32x Real-Time Microcontrollers](#), data sheet.
- Texas Instruments, [TPS65036x-Q1 Automotive Camera, Radar, and MCU PMIC](#), data sheet.
- Texas Instruments, [TPS650360 Evaluation Module](#), EVM user's guide.

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