Application Report
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Using the TPS54X80 Tracking SWIFT™ dc/dc Converters for Simultaneous Tracking of the Input Supply

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ABSTRACT

High-performance signal processing devices, such as FPGAs and DSPs, require multiple power supply voltages for operation. The order and timing in which these supply outputs power up and down is usually specified. A design example using the TPS54380 is shown for the case where the power supply to be tracked is also the input voltage to the TPS54380. Information is provided for adjusting the start-up timing characteristics. For higher output currents, appropriate devices are recommended.

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1 INTRODUCTION

High-performance, signal processing devices, such as FPGAs and DSPs, require multiple power supplies that generate different voltages for the core and I/O voltages. The order in which the supply outputs power up and down is critical to device operation and long-term reliability. The TPS54X80 family of dc/dc converters is designed for applications that have critical power supply sequencing requirements. The device has a TRACKIN pin to implement different sequencing methods. The TRACKIN pin has an analog multiplexer that compares the 0.891-V internal voltage reference to the voltage on the TRACKIN pin and connects the lower of the voltages to the noninverting node of the error amplifier. When the TRACKIN pin voltage is lower than the internal voltage reference, the TRACKIN pin voltage is effectively the reference for the power supply, forcing the output to be equal to the TRACKIN voltage.

Once the voltage at the TRACKIN pin rises above the internal reference level, the output voltage will remain at its preset level. For the TPS54X80 to accurately track a voltage on start-up, the device must be both powered on and enabled; that is, the input voltage must be greater than the UVLO threshold, and the ENA pin must not be held low. If the sequencing requirements of the design require that the output of the TPS54X80 track the same voltage rail that is used to power the device, a different technique must be used.

SWIFT is a trademark of Texas Instruments.

2 TPS54380 DESIGN EXAMPLE

Consider a design with two voltage rails, V1 = 3.3 V at 1.5 A and V2 = 1.8 V at 3 A. At turnon, the V2 output must track the V1 output simultaneously until V2 reaches 1.8 V. If the V1 voltage is used to power a TPS54380, to allow the TPS54380 to receive input power while the remainder of the V1 bus is powered down, a distribution switch may be used as shown in the schematic of Figure 1. When VIN is initially applied to the circuit, the ~ENABLE signal is held low, preventing the 3.3 V from appearing on the V1 voltage bus. The ENA line of the TPS54380 is tied to the VIN voltage rail, so that when the VIN voltage exceeds the UVLO threshold of 2.95 V, the device is ready to track the V1 voltage when it is present. Alternately, a second enable signal can be used to independently activate the TPS54380 if that level of control is required.

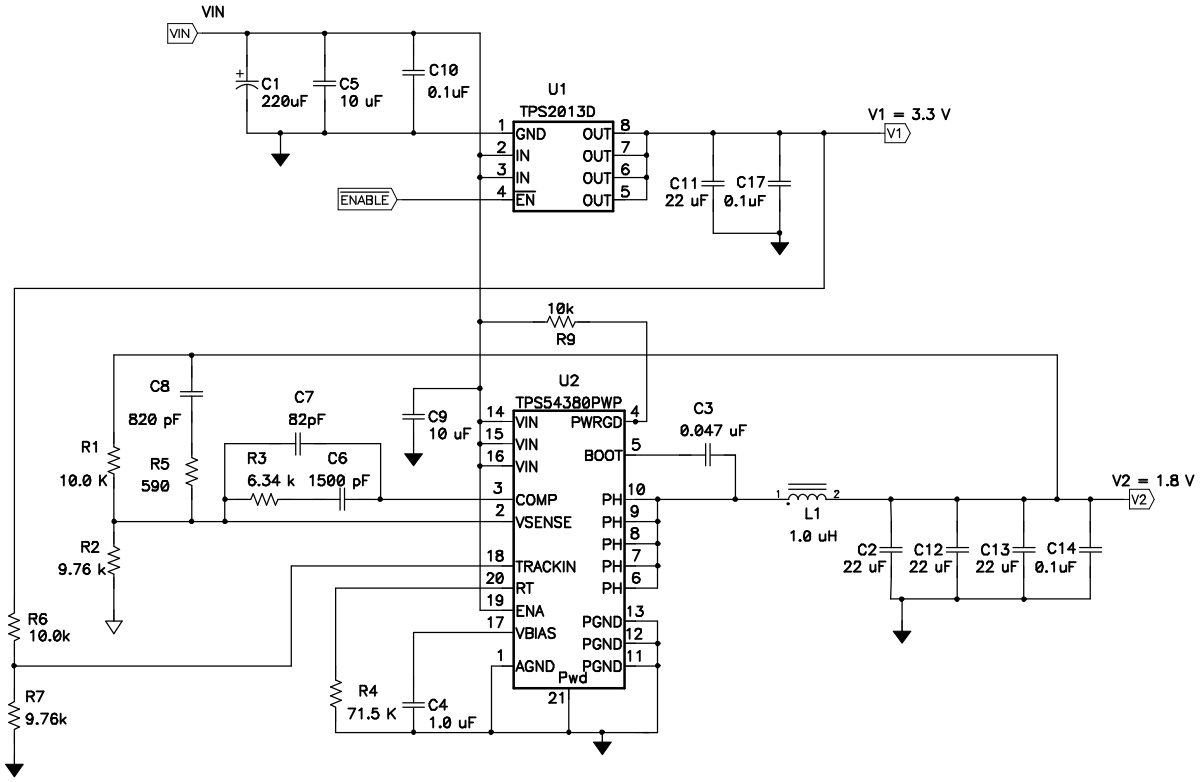

Figure 1. TPS54380 With TPS2013 Distribution Switch

For simultaneous tracking, the resistor divider network of R6 and R7 that feeds the TRACKIN pin of the TPS54380 is set to the same values as the R1 and R2 divider network that sets the V2 output voltage of 1.8 V. When the ~ENABLE signal is pulled low, the V1 voltage rail starts to ramp up towards 3.3 V, and the V2 voltage tracks it as shown in Figure 2.

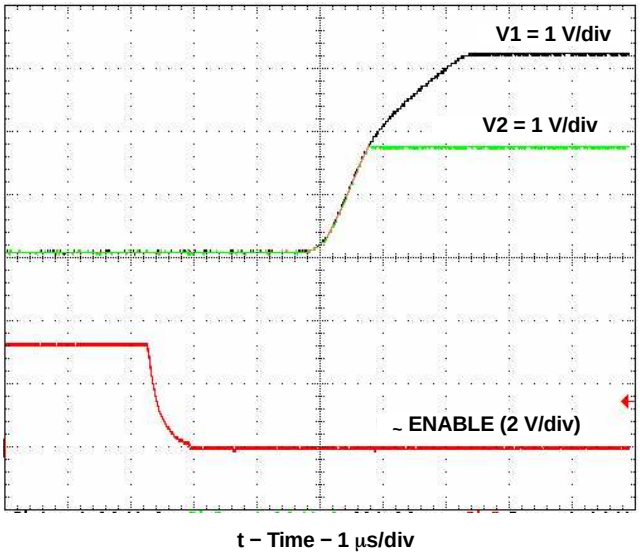

Figure 2. Power-Up Waveform With Simultaneous Tracking

3 ADJUSTING THE RAMP TIMING

Figure 3 shows the generalized timing relationship for simultaneous sequencing, with the R1/R2 divider ratio equal to the R6/R7 ratio. The V2 voltage tracks the V1 voltage at start-up until V2 reaches its output set point.

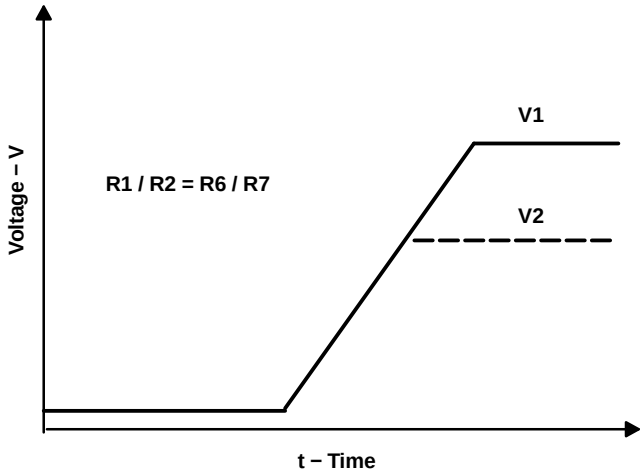

Figure 3. Simultaneous Tracking Relationship

The power-on timing can be adjusted so that V2 rises faster or slower than V1. This type of sequencing is ratiometric. Making the ratio of R6/R7 less than R1/R2 causes the V2 voltage to rise faster than V1 as shown in Figure 4. As the ratio of R6/R7 is decreased relative to R1/R2, the slope of the V2 start-up waveform increases in the direction shown by the arrow.

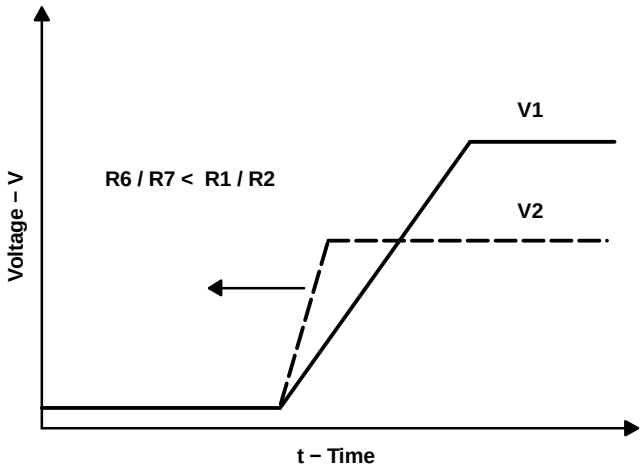

Figure 4. Ratiometric Sequencing With V2 Rising Before V1

To make V1 rise faster than V2, change the resistor divider R6/R7 to be greater than R1/R2. Figure 5 shows the result of increasing the R6/R7 ratio relative to R1/R2. Increasing the R6/R7 ratio further decreases the slope of V2 in the direction of the arrow.

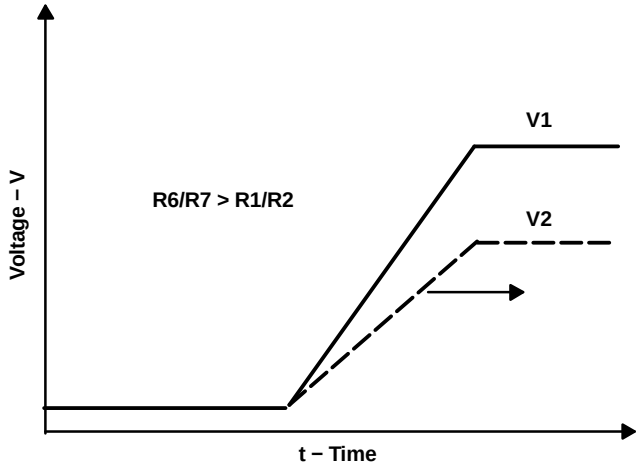

Figure 5. Ratiometric Sequencing With V1 Rising Before V2

It is important to note that R6 or R7 must be used to change the relative resistor divider ratios. Altering the R1/R2 divider also changes the regulated output value of V2.

4 HIGHER OUTPUT CURRENTS

The TPS54X80 family of tracking regulators is also available in a wide range of output current ratings:

DEVICE	MAXIMUM OUTPUT CURRENT (A)	INPUT VOLTAGE RANGE (V)
TPS54380	3	3 to 6
TPS54680	6	3 to 6
TPS54880	8	4 to 6
TPS54980	9	3 to 4

The TPS2013 distribution switch is limited to 1.5-A continuous output current. For higher V1 current requirements, consider the TPS2024 distribution switch (2 A continuous) or use a hot-swap controller such as the UCC3918. This device features an integrated FET and requires only a timing capacitor, two programming resistors, and bypass capacitors on the input and output for operation. The UCC3918 is rated for continuous output currents up to 4 A. For higher currents, an external FET device such as the TPS2330 is required.

5 RELATED DOCUMENTS

1. *TPS54380, 3-V to 6-V Input, Output Tracking Synchronous Buck PWM Switcher with Integrated FETs (SWIFT™) for Sequencing* data sheet (SLVS454)
2. *TPS54680, 3-V to 6-V Input, 6-A Output Tracking Synchronous Buck PWM Switcher with Integrated FETs (SWIFT™) for Sequencing* data sheet (SLVS429)
3. *TPS54880, 4-V to 6-V Input, 8-A Output Tracking Synchronous Buck PWM Switcher with Integrated FETs (SWIFT™) for Sequencing* data sheet (SLVS450)
4. *TPS54980, 3-V to 4-V Input, 9-A Output Tracking Synchronous Buck PWM Switcher with Integrated FETs (SWIFT™) for Sequencing* data sheet (SLVS452)
5. *Sequencing With TPS54x80 and TPS54x73 SWIFT DC/DC Converters* application report (SLVA007)
6. *TPS54380EVM-001 3-Amp DC/DC Converter EVM* user's guide (SLVU087)
7. *TPS54680EVM-228 6-Amp, TPS54880EVM-228 8-Amp DC/DC Converter EVM* user's guide (SLVU077)
8. *TPS54980EVM-022 9-Amp Swift Regulator Evaluation Module* user's guide (SLVU090)

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