Application Note

Design Considerations for Better Performance Using TPS62810 in SSD Applications

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ABSTRACT

This application note introduces a practical application method for improving load transient response and efficiency, and this is achieved by dynamically switching the mode between Auto Mode and FPWM. The MODE or SYNC pin of the TPS62810 is controlled by the host or the SSD controller directly based on the system status. The core concept of this approach is to switch from Auto Mode to FPWM just before the system load increases to improve transient performance, and to switch from FPWM to Auto Mode when the system enters an idle state for better efficiency. This application note demonstrates how effectively this method meets goals and outlines key design considerations for enhancing overall system performance in SSD applications.

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1 Introduction

Better load transient performance and higher efficiency are always key design factors in portable applications, and the operation mode (FPWM or Auto Mode (PFM or PWM)) is selected based on system conditions. Generally, both FPWM and Auto Mode have pros and cons, and Auto Mode is widely used when high efficiency is required under light load conditions. However, Auto Mode has a relatively slow response compared to FPWM when the output load changes rapidly between light and heavy load conditions.

Figure 1-1 shows the typical application circuit of the TPS62810 configured to provide a 1.8V output from a 3.3V input. The MODE or SYNC pin is used for the mode selection, and the TPS62810 operates in FPWM since the MODE or SYNC pin is tied up to VIN. If the MODE or SYNC pin is pulled low (to GND), then the TPS62810 runs in Auto Mode.

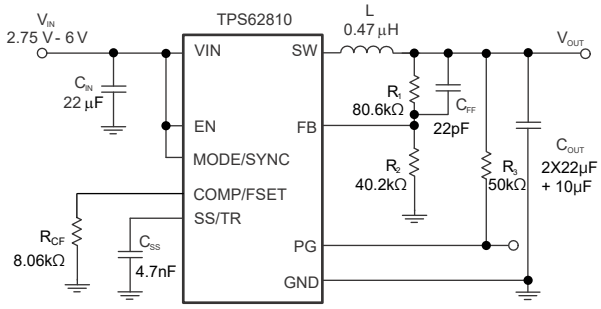


Figure 1-1. Typical Application Circuits of the TPS62810

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2 Proposed Application Method for Better System Performance

Figure 2-1 shows the proposed application method using the TPS62810 for better load transition performance and higher efficiency. The MODE or SYNC pin is not fixed to a single voltage level (high or low) in this case and is directly controlled by SSD controller based on the system load conditions. The goal is to operate in Auto Mode at light load condition for higher efficiency and immediately change to FPWM from Auto Mode before the load switches to heavy load from light load condition using the control signal from SSD controller.

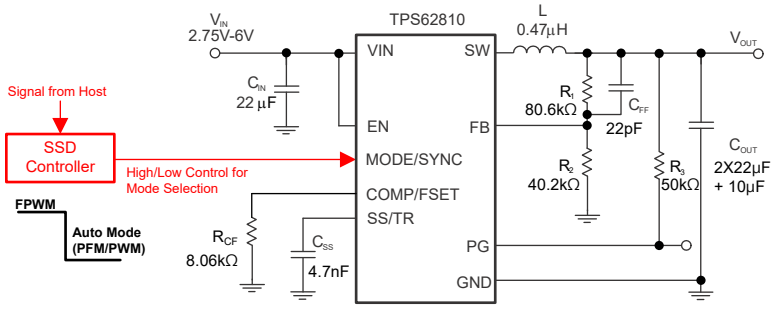


Figure 2-1. Proposed Application Method

Figure 2-2 shows a timing sequence from the host to the SSD controller, and the red line represents the wake-up signal from the host while the blue line indicates actual system load. As shown in Figure 2-2, actual system load starts to increasing 7ms later after receiving this wake-up signal from the host. The TPS62810 gets this wake-up signal from the SSD controller directly to control the MODE or SYNC pin of the TPS62810, and the TPS62810 operates in FPWM from Auto Mode at point A to have better load transient performance with lower output voltage ripple before the system load goes up at point B.

When the SSD system enters idle mode, the SSD controller receives a signal from the host at point C. The system then switches to idle mode 2ms later at point D. After point D, the TPS62810 switches from FPWM to Auto Mode to achieve better ripple performance and higher efficiency under light load conditions. All of these operations are triggered by a control signal directly from the SSD controller.

The key point is that the SSD controller receives a signal from the host prior to any actual system load transition between light and heavy states, which can be utilized to trigger a mode change in the TPS62810.

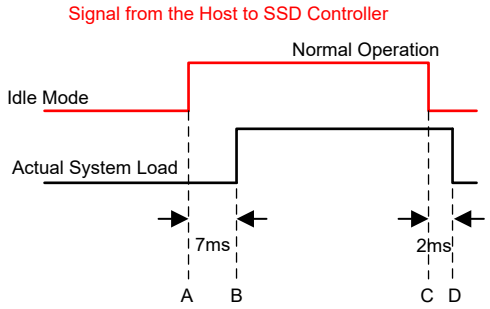


Figure 2-2. Timing Sequence from the Host to SSD Controller

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3 Experimental Results

Figure 3-1 through Figure 3-1 show experimental results (VSW: Ch1 in blue with 2V/div, VOUT: Ch2 in light blue with 100mV/div (1.8V offset), MODE/SYNC Voltage: Ch3 in red with 2V/div, IOUT: Ch4 in green with 1A/div) with the critical waveforms to verify the operation and performance of the proposed application method. The input and output voltages are 3.3V and 1.8V respectively, and the output current corresponds to the system load in this SSD application.

Figure 3-1 shows the load transient response with auto mode, and the output peak-to-peak voltage ripple is about 26mV when the load switches to heavy load from light load condition.

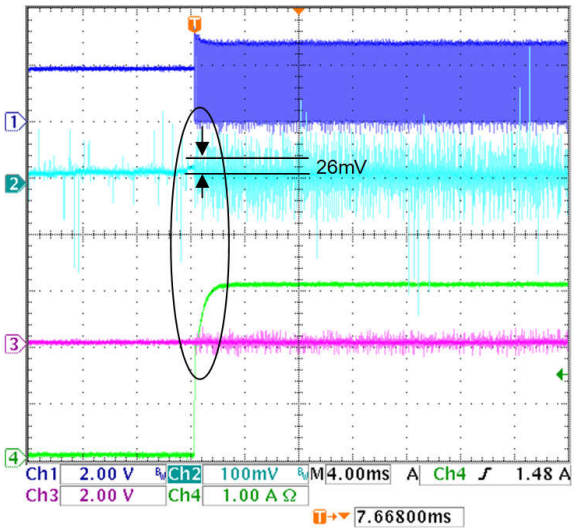


Figure 3-1. Load Transient Result with Auto Mode (Light to Heavy Load)

Figure 3-2 shows the load transient performance when the mode is changed to FPWM from Auto Mode before the system load goes up. As shown in Figure 3-2, FPWM has better load transient performance compared to Auto Mode under the same system load condition, transitioning from idle to heavy load.

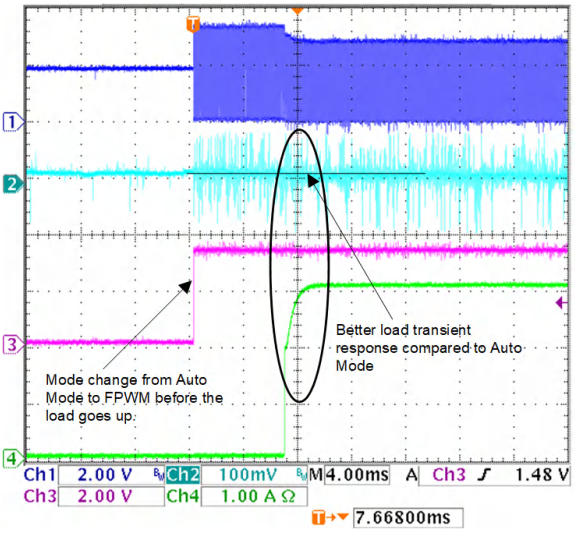


Figure 3-2. Load Transient Result with FPWM (Light to Heavy Load)

Figure 3-3 shows the output voltage ripple when the mode is changed to Auto Mode from FPWM before the system actually goes to the idle state. As shown in Figure 3-3, the ripple voltage is about 50mV during the load transient, and Auto Mode shows higher ripple voltage compared to FPWM due to slower response in this case.

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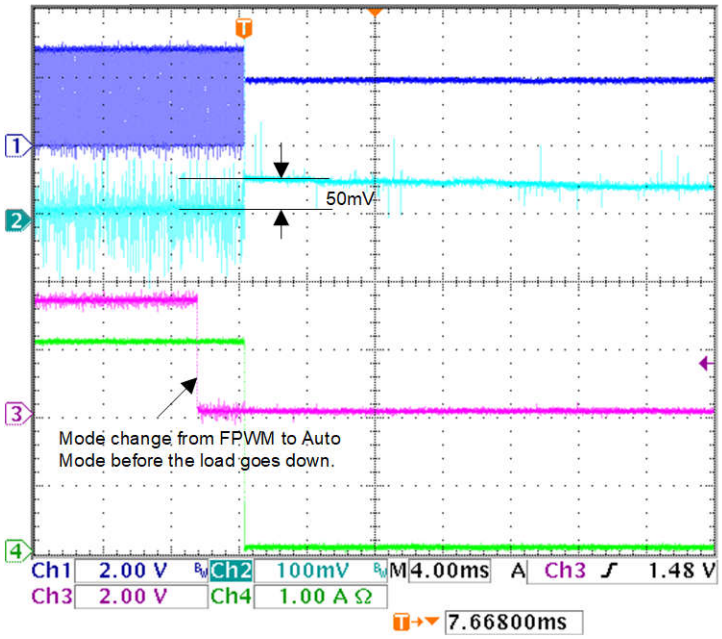


Figure 3-3. Load Transient Result with Auto Mode (Heavy to Light Load)

Figure 3-4 shows the output voltage ripple performance under the same load condition when the TPS62810 operates in FPWM keeping the MODE or SYNC pin high state. As shown in Figure 3-4, there is no voltage overshoot on the output, unlike Auto Mode, which exhibits a 50mV ripple when the system actually enters the idle state.

Once the system goes to the idle state, the TPS62810 operates in Auto Mode from FPWM controlled by SSD controller after point D as is shown in Figure 3-1 and this transition is critical for better efficiency.

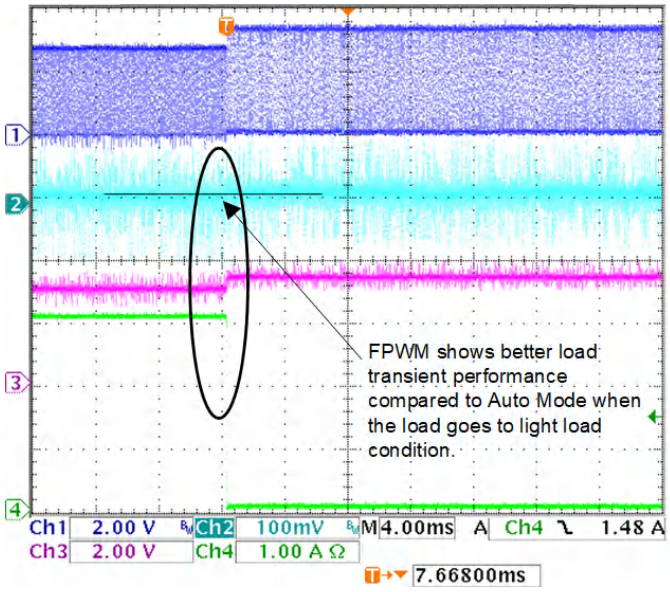


Figure 3-4. Load Transient Result with FPWM (Heavy to Light Load)

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4 Summary

A practical approach to achieving better load transient performance and higher efficiency is proposed in this application note. As the design has been confirmed with the actual application case in SSD, the design operates properly and delivers improved performance in terms of load transient response and efficiency compared to using a fixed mode (either Auto Mode or FPWM). The key point is that the SSD controller receives a signal from the host prior to any actual system load transition between light and heavy load states, which can be utilized to trigger a mode change in the TPS62810 using the MODE or SYNC pin. The signal from the SSD controller helps achieve design targets outlined in this document, and this makes the design an excellent choice.

5 References

- Texas Instruments, TPS6281xM, Extended Temperature, 2.75V to 6V Adjustable-Frequency Step-Down DC/DC Converter, data sheet
- Texas Instruments, TPS6281x-EP Enhanced Product, 6V, 1A, 2A, 3A, and 4A Step-Down DC/DC Converter Family With Adjustable Frequency, data sheet
- Texas Instruments, TPS6281x-Q1 2.75V to 6V Adjustable-Frequency Step-Down Converter, data sheet
- Texas Instruments, TPS62810EVM-015 Evaluation Module, user's guide

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