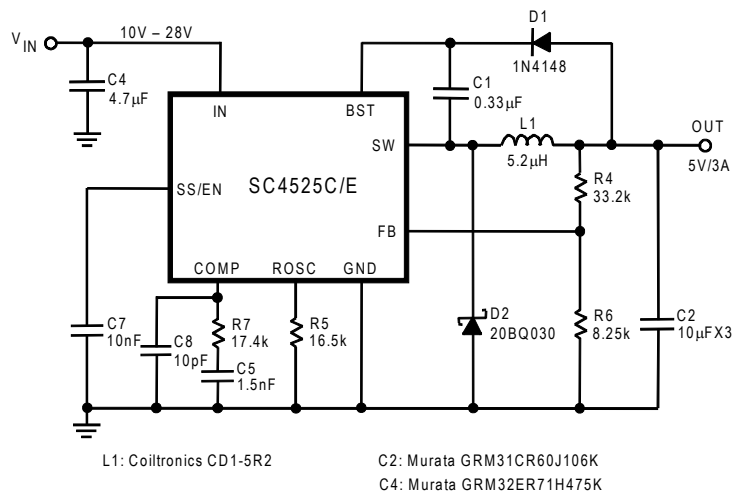
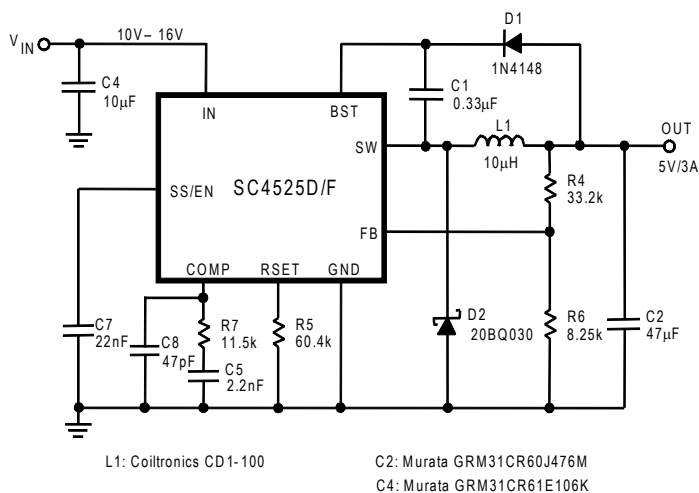


POWER MANAGEMENT

This application note services two purposes. First, it is intended to assist designers in the transition from Semtech's SC4525C and SC4525D step-down switching regulators to the SC4525E and SC4525F devices. Second, it provides a new external synchronization schematic for SC4525 product family. The SC4525E and SC4525F regulators share the identical footprint as the "C" and "D" versions, so existing customers will not need to make any PCB changes. There are no external component changes necessary to ensure the SC4525E and SC4525F perform identically to the SC4525C and SC4525D.



**Figure 1 — SC4525C/E Typical Application
Circuit Schematic**



**Figure 2 — SC4525D/F Typical Application
Circuit Schematic**

Bootstrapping the power transistor

For $V_{OUT} > 8V$ applications using the SC4525C/D a diode, D4 as shown in Figure 3, is required in parallel with the bootstrap capacitor. There is an improvement in the SC4525E/F circuits. There is no need of that extra diode for $V_{OUT} > 8V$ applications. This is shown in Figure 4.

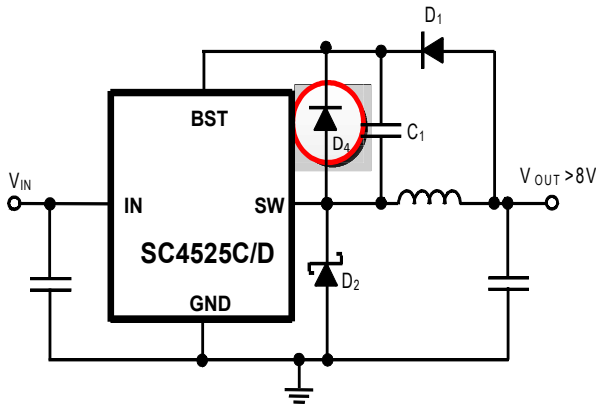


Figure 3 — SC4525C/D $V_{OUT} > 8V$ Application Circuit

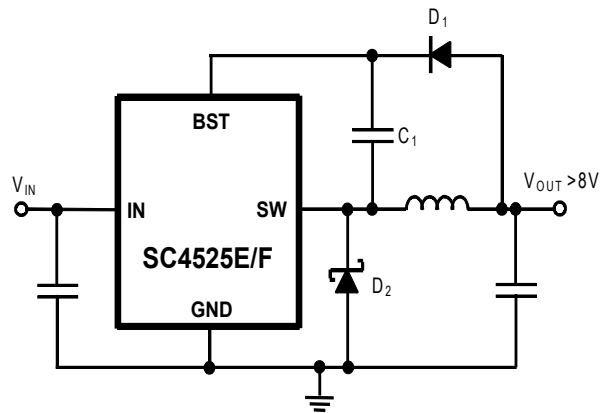


Figure 4 — SC4525E/F $V_{OUT} > 8V$ Application Circuit

Electrical Characteristics Changes

The specification differences between the SC4525C/D and SC4525E/F are minor and have minimal or no impact on the circuit performance. The comparison results are shown in Tables 4 and 5.

Table 4 — SC4525C and SC4525E Electrical Characteristic Comparison

Parameter	SC4525C			SC4525E		
	Minimum	Typical	Maximum	Minimum	Typical	Maximum
Minimum Switch On-time (ns)		150			150	250

Table 5 — SC4525D and SC4525F Electrical Characteristic Comparison

Parameter	SC4525D			SC4525F		
	Minimum	Typical	Maximum	Minimum	Typical	Maximum
Minimum Switch On-time (ns)		150			150	250

POWER MANAGEMENT

External Synchronization

There is no external clock buffer inside the SC4525E. However, the SC4525E may be synchronized to an external clock and synchronization actually works well for regulators running below 35% duty cycle.

To synchronize the SC4525E, the clock is fed into the ROSC pin through a coupling capacitor C_c [Figures 5(a) and 5(b)]. The falling edge of the clock injects a current pulse into the ROSC pin. This current pulse momentarily increases the internal oscillator capacitor charging current and trips the oscillator comparator, thus locking the clock onto the internal oscillator. C_c is typically between 4.7pF and 47pF. The clock logic level can be up to 5V. The magnitude of the injected current pulse is proportional to the transition rate of the clock falling edge. C_c can be 10pF if the clock swings from 0 to 5V with fall time less than 20ns. The ability to synchronize may depend on the clock duty cycle. The small Schottky diode BAT54 in Figure 5(b) reduces coupling from the clock rising edge to the ROSC pin. It not only extends the useful duty cycle range of the synchronizing clock but also reduces PWM (SW falling edge) jitters.

To allow for free-running frequency tolerances, the nominal free-running frequency should be set (using Table 1) to the synchronizing frequency:

$$f_{\text{FREE-RUN}} \approx f_{\text{SYNC}}$$

Synchronization Test

1. Set the SC4525E free-running frequency equal to the clock frequency f_{SYNC} .
2. Start with a single coupling capacitor [Figure 5(a)], test for synchronization with a 10pF coupling capacitor. If the clock cannot lock onto the internal oscillator, then increase C_c as needed. If the clock duty cycle can be adjusted, then set it in middle of its locking range.
3. Use the circuit in Figure 5(b) if a single coupling capacitor cannot result in synchronization or there are excessive PWM jitters.
4. Verify synchronization with $f_{\text{FREE-RUN}}$ programmed to $0.8f_{\text{SYNC}}$ and $1.2f_{\text{SYNC}}$. Adjust clock duty cycle if necessary. This ensures frequency locking under the worst-case free-running frequency tolerances.

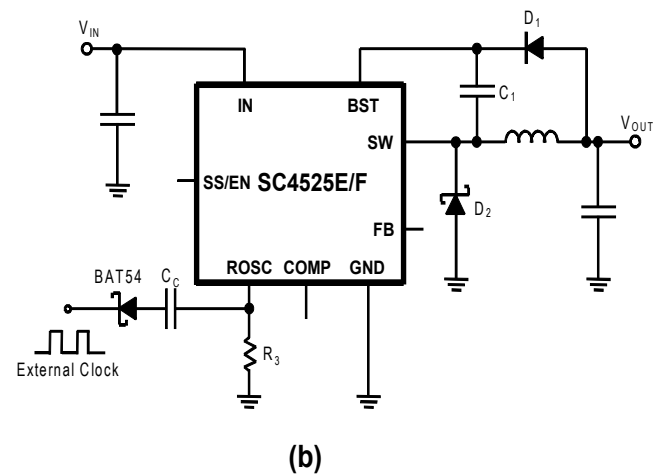
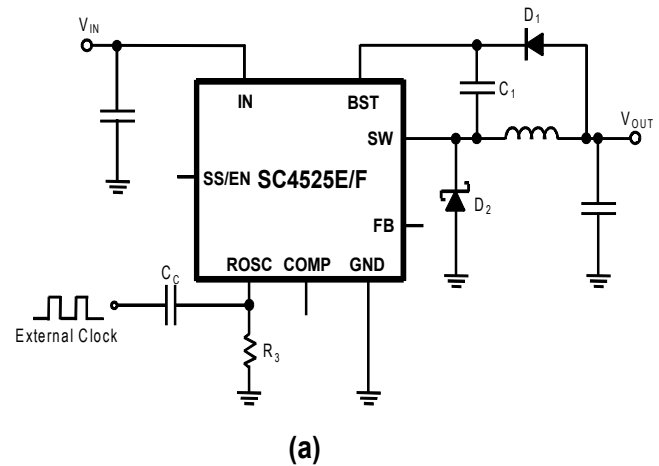


Figure 5. Methods of Synchronizing the SC4525E.

- (a) A Single Ceramic Coupling Capacitor
- (b) A Coupling Capacitor in Series with a Schottky Diode.

Table 1: Resistor for Typical Switching Frequency

Freq. (k)	R _{osc} (k)	Freq. (k)	R _{osc} (k)	Freq. (k)	R _{osc} (k)
200	110	700	25.5	1400	9.76
250	84.5	800	21.5	1500	8.87
300	69.8	900	18.2	1600	8.06
350	57.6	1000	15.8	1700	7.15
400	49.9	1100	14.0	1800	6.34
500	38.3	1200	12.4	1900	5.62
600	30.9	1300	11.0	2000	5.23

POWER MANAGEMENT

Frequently Asked Questions

Q1. Does my oscillator resistor value need to change?

A. No.

The switching frequency of SC4525E/F is set with an external resistor from the ROOSC pin to ground. The oscillator frequency setting resistor values of the SC4525C/D and SC4525E/F are same. When converting from the SC4525C/D to SC4525E/F, no change of the oscillator resistor is needed.

Q2. Do I need to change my compensation network component values?

A. No.

The switching regulators in the SC4525C/D and SC4525E/F require a simple Type-2 compensation network for stable operation. The correct calculation of these component values (R7, C5 and C8) is very important to maintain the stability of the circuit. It is essential to verify loop compensation by checking regulator load transient response. With the largest load step pertinent to the application applied, the regulator output voltage and the load current were observed. These transient waveforms should not show any ringing or excessive overshoot. It is required to adjust the component values until we get a stable operation. While verifying the load transient response of SC4525E/F, no excessive ringing or overshoot was noticed. So no component change is needed while converting SC4525C/D to SC4525E/F.

Q3. If I change SC4525C/D with SC4525E/F, will it impact the efficiency?

A. Efficiency is more or less same with both parts.

Q4. Do I need to change feedback resistor?

A. No, same feedback resistor can be used for both the parts.

Q5. Do I need to change feedback resistor?

A. No, same feedback resistor can be used for both the parts.



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