



## Si9165 Demonstration Board

### FEATURES

- Voltage Mode Control
- Fully Integrated MOSFET Switches
- 600-mA Load Capability
- 2.7- to 6-V Input Voltage Range for  $V_{DD}$  and  $V_S$
- Programmable PWM/PSM Control
- Up to 2-MHz Switching Frequency in PWM
- Synchronous Rectification in PWM
- Less than 200- $\mu$ A  $I_{DD}$  in PSM
- Integrated UVLO and POR
- Integrated Soft-Start
- Synchronization
- Shutdown Current  $< 1 \mu$ A
- Wide Bandwidth Feedback Amplifier
- Single-Cell Li+ and 3-Cell NiCd or NiMH Operation

### DESCRIPTION

The Si9165 controller offers one of the most compact synchronous buck or boost converter with 2.7- to 6-V input voltage. The integrated MOSFETs and 2-MHz operating frequency help shrinking the converter size dramatically.

There are two different version of demo boards (DB), buck and boost converters, because the Si9165 can be easily configured to buck or boost modes. The demo board has been configured to generate 2.7-V regulated output for buck DB while for boost DB is 3.6 V. The output voltage set point can be easily adjusted by changing the value of  $R_2$  (See Figure 1) using the formula

$$R_2 = \frac{R_1}{\frac{V_{OUT}}{V_{REF}} - 1} \quad (1)$$

The typical value of  $V_{REF}$  is 1.3 V. It is recommended not to change  $R_1$  since that would alter the control loop compensation.

The PWM/PSM pin can be used to program the controller to operate in PWM or PSM mode. PWM is normal pulse width modulation to keep output regulated through out the load range, while the PSM mode offers better efficiency at light load to conserve power by skipping switching pulses. Notice the PSM only gain efficiency advantage at light load and can only deliver certain load current (about 150 mA) before output drops out of regulation.

Included in this document are schematics (Figure 1 and Figure 2), demo board sample waveform (Figure 3 through 6), PCB layout (Figure 7 through 12), and Bill Of Material (Table 1 and 2).

*The demonstration board layout is available in Gerber file format. Please contact your Vishay Siliconix sales representative or distributor for a copy.*

### ORDERING INFORMATION: PART NUMBER

**Si9165DB-K (BUCK CONVERTER)**  
**Si9165DB-S (BOOST CONVERTER)**

### TEST SETUP AND OPERATION

1. Visually inspect demo board and make sure that Jumper 1 is set to Enable and Jumper 2 is set to PWM.
2. Attach an electronic load set to either resistive or current mode to the output pins (P3 and P4) on the demo board. Set the load current to 200 mA or equivalent resistor value. After the converter is powered up, output load current can be adjusted.
3. Attach a dc power supply, with at least 3-A current capability, to the input pins (P1 and P2) on the demo board. The input voltage can be adjusted between 2.7 and 3.6 V for boost DB or 2.7 to 6 V for buck DB.
4. Put an oscilloscope ground on the input ground, and the Ch1 probe on the output and connect Ch2 probe on pin 20 of Si9165 (COIL pin). The waveform for buck and boost DB should appear approximately as shown in Figure 3 and 4, respectively.
5. To test your DB in PSM, adjust the load to 20 mA. Then change Jumper 2 setting to PSM. Notice the reduction of the input current. With the same probe setup mentioned above, the waveform for buck and boost DB should appear approximately as shown in Figure 5 and 6, respectively.

**SCHEMATIC DIAGRAMS**

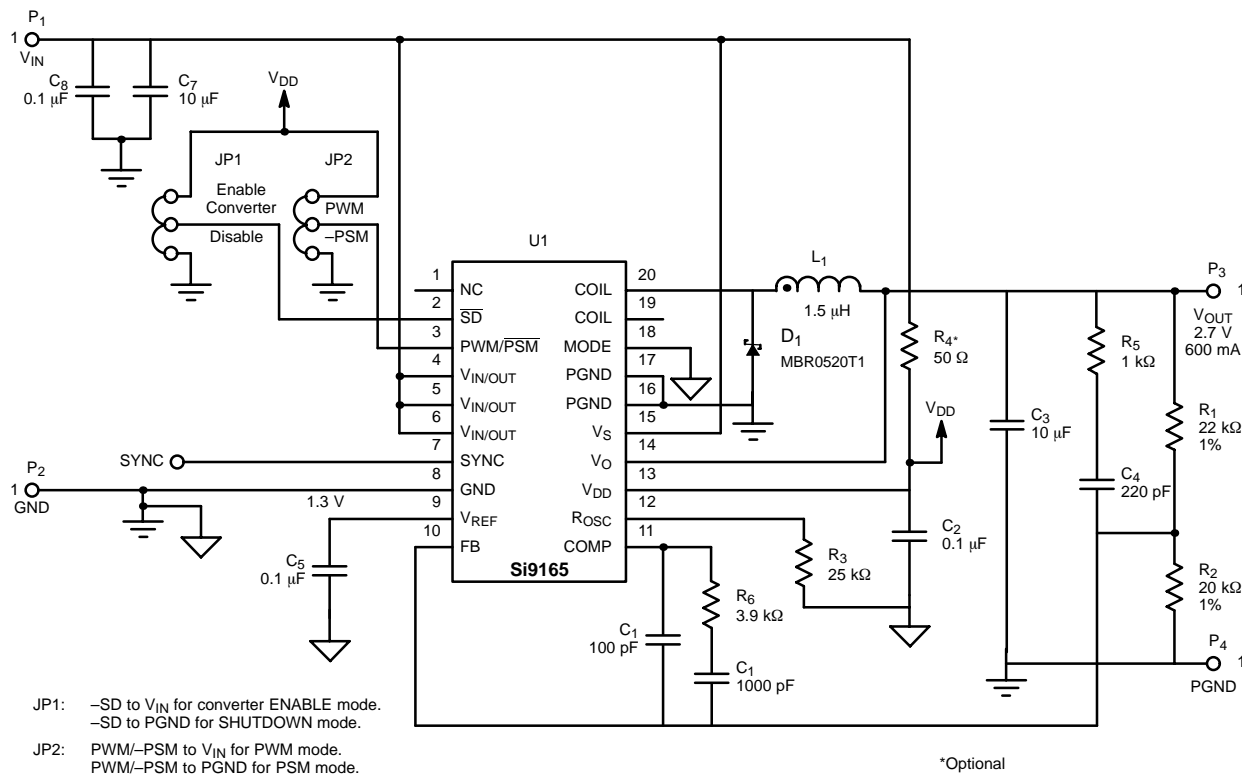


FIGURE 1. Schematics of Si9165 Buck

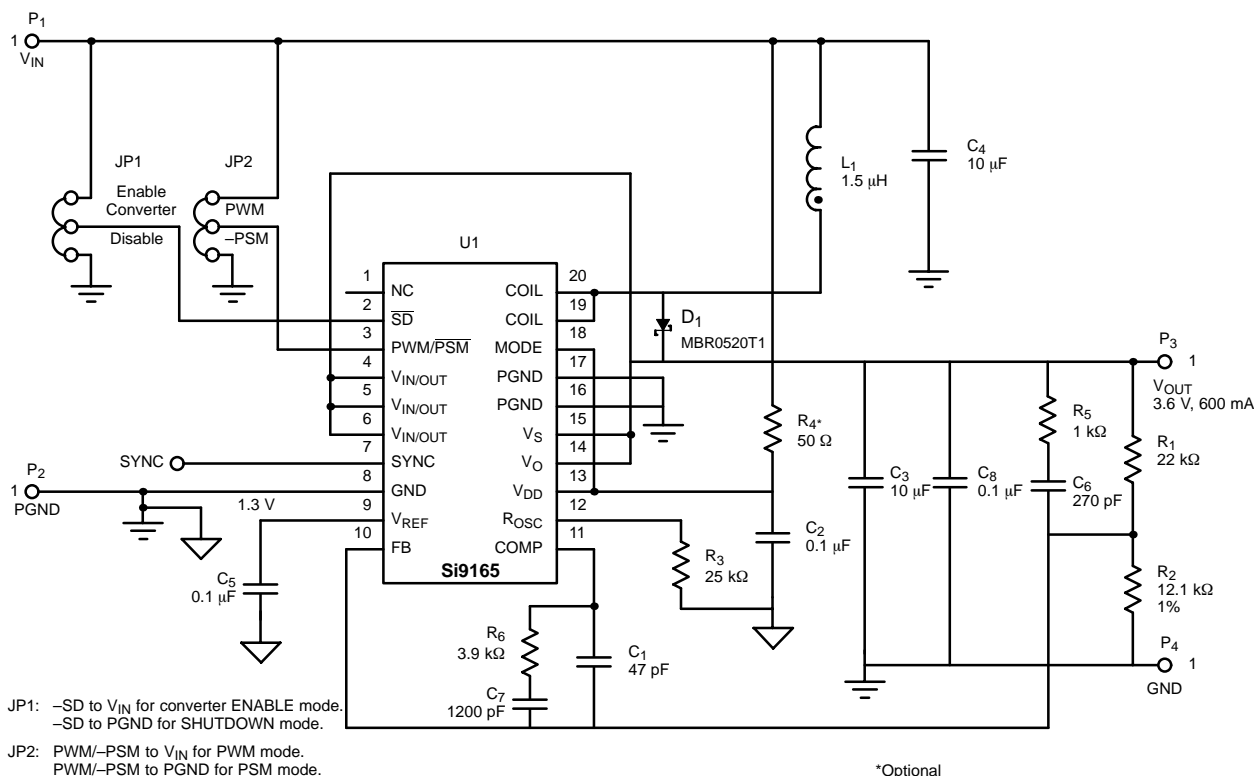
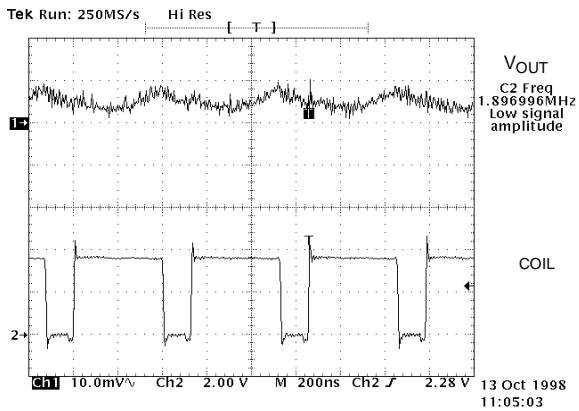


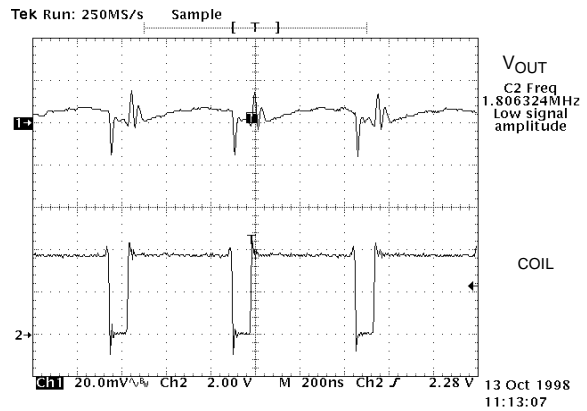
FIGURE 2. Schematics of Si9165 Boost

**CHANNEL LINEUP FOR FIGURES 3 THROUGH 6**

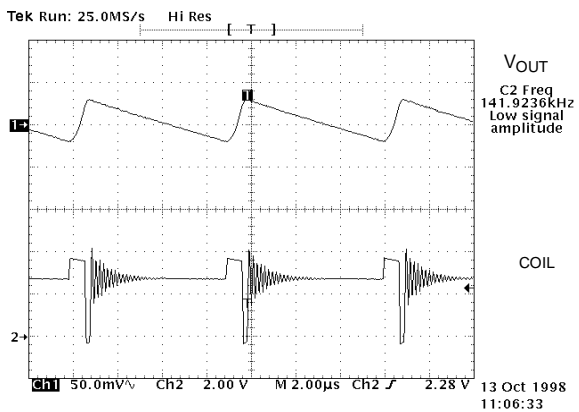
Ch1: Output Voltage  
Ch2: COIL Pin (pin 20 of IC) Voltage



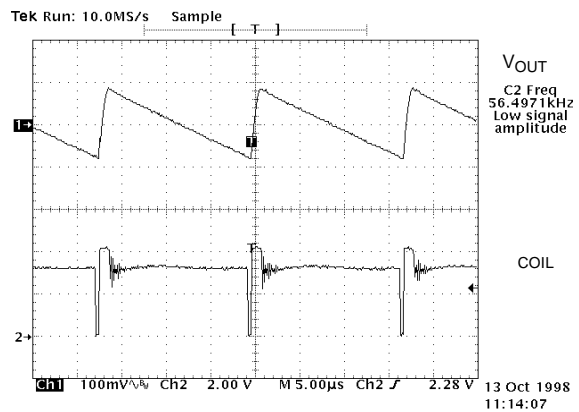
**FIGURE 3.** Buck DB PWM Mode:  $V_{IN} = 3.6\text{ V}$ ,  $V_{OUT} = 2.7\text{ V}$ , Load = 200 mA



**FIGURE 4.** Boost DB PWM Mode:  $V_{IN} = 3\text{ V}$ ,  $V_{OUT} = 3.6\text{ V}$ , Load = 200 mA



**FIGURE 5.** Buck DB PSM Mode:  $V_{IN} = 3.6\text{ V}$ ,  $V_{OUT} = 2.7\text{ V}$ , Load = 20 mA



**FIGURE 6.** Boost DB PSM Mode:  $V_{IN} = 3\text{ V}$ ,  $V_{OUT} = 3.6\text{ V}$ , Load = 20 mA

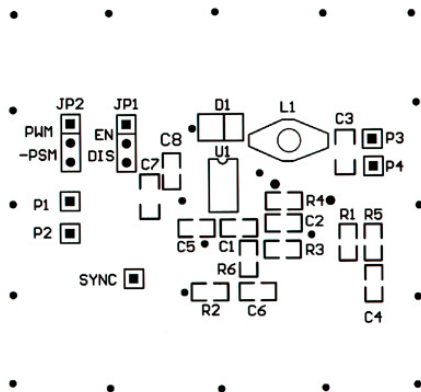


FIGURE 7. Buck—Top Silk Screen

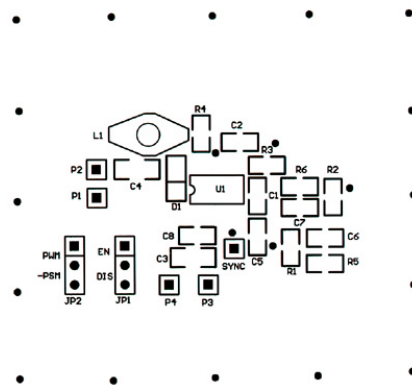


FIGURE 10. Boost—Top Silk Screen

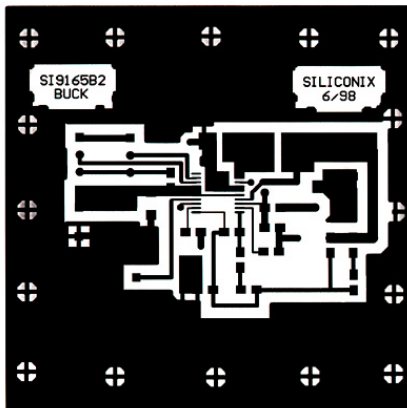


FIGURE 8. Buck—Top Layer

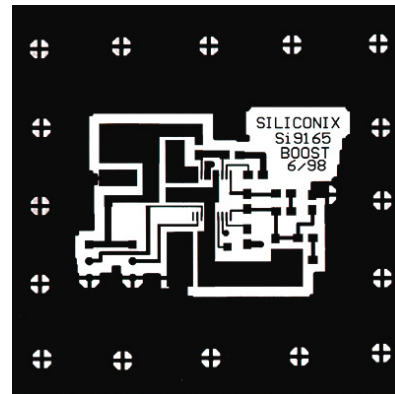


FIGURE 11. Boost—Top Layer

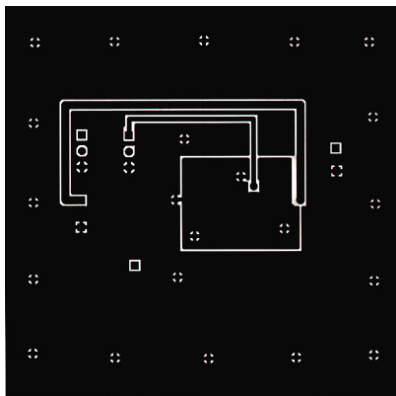


FIGURE 9. Buck—Bottom Layer

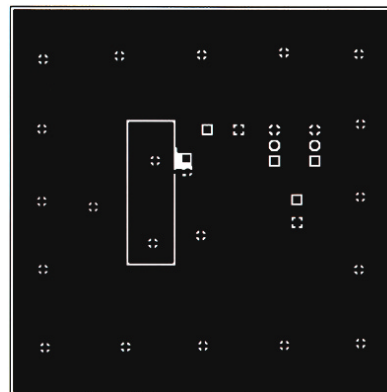


FIGURE 12. Boost—Bottom Layer



**TABLE 1. BUCK DEMO BOARD BILL-OF-MATERIAL**

Item	Qty	Designator	Part Type	Description	Footprint	Part Number	Manufacturer
1	1	R <sub>1</sub>	22 k	Resistor, 1%, 1/8 W	0805	CRCW08052202FRT1	Vishay Dale
2	1	R <sub>2</sub>	20 k	Resistor, 1%, 1/8 W	0805	CRCW08052002FRT1	Vishay Dale
3	1	R <sub>3</sub>	25 k	Resistor, 1%, 1/8 W	0805	CRCW08052502FRT1	Vishay Dale
4	1	R <sub>4</sub>	50	Resistor, 5%, 1/8 W	0805	CRCW0805500JRT1	Vishay Dale
5	1	R <sub>5</sub>	1 k	Resistor, 1%, 1/8 W	0805	CRCW08051001FRT1	Vishay Dale
6	1	R <sub>6</sub>	3.9 k	Resistor, 1%, 1/8 W	0805	CRCW08053901FRT1	Vishay Dale
7	1	C <sub>1</sub>	100 pF	Capacitor, Ceramic	0805	VJ0805101KXXAT	Vishay Vitramon
8	3	C <sub>2</sub> , C <sub>5</sub> , C <sub>8</sub>	0.1 μF	Capacitor, Ceramic	0805	VJ0805104KXXAT	Vishay Vitramon
9	2	C <sub>3</sub> , C <sub>7</sub>	10 μF	Capacitor, Ceramic	1206	GRM42-2X5R106K16	Murata
10	1	C <sub>4</sub>	220 pF	Capacitor, Ceramic	0805	VJ0805221KXXAT	Vishay Vitramon
11	1	C <sub>6</sub>	1000 pF	Capacitor, Ceramic	0805	VJ0805102KXXAT	Vishay Vitramon
12	1	D <sub>1</sub>	MBR0520T1	Schottky Diode	SOD-123	MBR0520T1	Motorola
13	1	L <sub>1</sub>	1.5 μH	IHLP Low Profile Inductor	2525	IHLP2525-1-5	Vishay Dale
14	1	U <sub>1</sub>	Converter	Power IC	TSSOP-20	Si9165	Vishay Siliconix
15	2	JP <sub>1</sub> , JP <sub>2</sub>	Jumper	3-Pin Jumper	SIP-3	SIP-3	Multi-Source
16	4	P <sub>1</sub> to P <sub>4</sub>	Header	1-Pin Header	TP	TP	Multi-Source

**TABLE 2. BOOST DEMO BOARD BILL-OF-MATERIAL**

Item	Qty	Designator	Part Type	Description	Footprint	Part Number	Manufacturer
1	1	R <sub>1</sub>	22 k	Resistor, 1%, 1/8 W	0805	CRCW08052202FRT1	Vishay Dale
2	1	R <sub>2</sub>	12.1 k	Resistor, 1%, 1/8 W	0805	CRCW08051212FRT1	Vishay Dale
3	1	R <sub>3</sub>	25 k	Resistor, 1%, 1/8 W	0805	CRCW08052502FRT1	Vishay Dale
4	1	R <sub>4</sub>	50	Resistor, 5%, 1/8 W	0805	CRCW0805500JRT1	Vishay Dale
5	1	R <sub>5</sub>	1 k	Resistor, 1%, 1/8 W	0805	CRCW08051001FRT1	Vishay Dale
6	1	R <sub>6</sub>	3.9 k	Resistor, 1%, 1/8 W	0805	CRCW08053901FRT1	Vishay Dale
7	1	C <sub>1</sub>	47 pF	Capacitor, Ceramic	0805	VJ0805470KXXAT	Vishay Vitramon
8	3	C <sub>2</sub> , C <sub>5</sub> , C <sub>8</sub>	0.1 μF	Capacitor, Ceramic	0805	VJ0805104KXXAT	Vishay Vitramon
9	2	C <sub>3</sub> , C <sub>7</sub>	10 μF	Capacitor, Ceramic	1206	GRM42-2X5R106K16	Murata
10	1	C <sub>4</sub>	270 pF	Capacitor, Ceramic	0805	VJ0805271KXXAT	Vishay Vitramon
11	1	C <sub>6</sub>	1200 pF	Capacitor, Ceramic	0805	VJ0805122KXXAT	Vishay Vitramon
12	1	D <sub>1</sub>	MBR0520T1	Schottky Diode	SOD-123	MBR0520T1	Motorola
13	1	L <sub>1</sub>	1.5 μH	IHLP Low Profile Inductor	2525	IHLP2525-1-5	Vishay Dale
14	1	U <sub>1</sub>	Converter	Power IC	TSSOP-20	Si9165	Vishay Siliconix
15	2	JP <sub>1</sub> , JP <sub>2</sub>	Jumper	3-Pin Jumper	SIP-3	SIP-3	Multi-Source
16	4	P <sub>1</sub> to P <sub>4</sub>	Header	1-Pin Header	TP	TP	Multi-Source