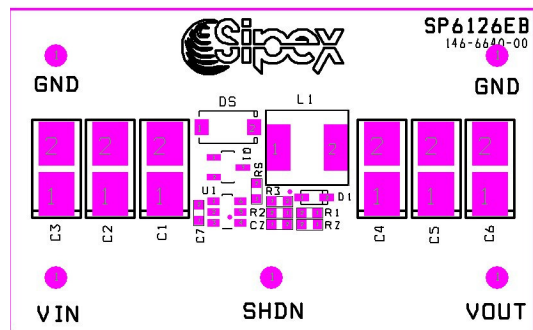


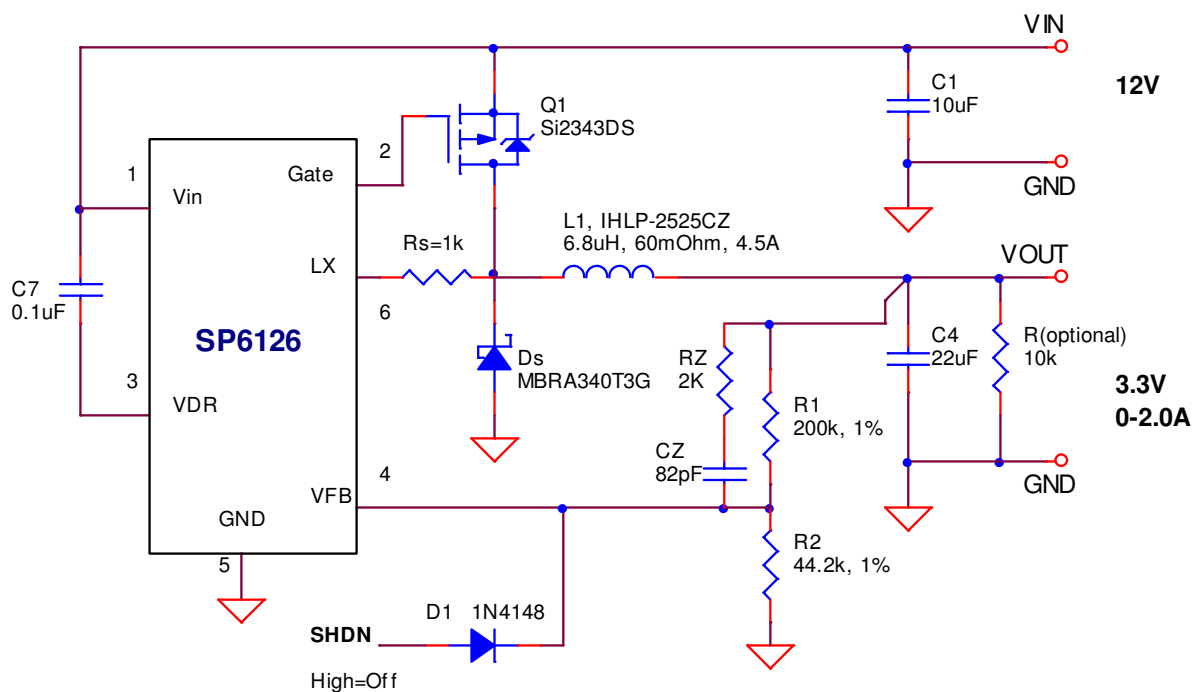


SP6126, 2A Evaluation Board Manual

- Easy Evaluation for the SP6126EK1 12V Input, 0 to 2A Output Non-Synchronous Buck Converter
- Precision $0.60V \pm 1\%$ High-Accuracy Reference.
- Small form factor
- Feature Rich: Single supply operation, Over-current protection with auto-restart, on/off function, Preset internal soft start, Type-II internal compensation



SP6126EB SCHEMATIC



* R(10k) is optional. It helps keep the output capacitor discharged under no-load condition.

USING THE EVALUATION BOARD

1) Powering Up the SP6126EB Circuit

Connect the SP6126 Evaluation Board to an external +12V power supply. Connect with short leads directly to the “VIN” and “GND” posts. Connect a Load between the “VOUT” and “GND” posts, again using short leads to minimize inductance and voltage drop.

2) Measuring Output Load Characteristics

It's best to GND reference scope and digital meters using the Star GND post near the output of the board. VOUT ripple can best be seen touching probe tip to the pad for COUT and scope GND collar touching Star GND post – avoid a GND lead on the scope which will increase noise pickup.

3) Using the Evaluation Board with Different Output Voltages

While the SP6126 Evaluation Board has been tested and delivered with the output set to 3.30V, by simply changing one resistor, R2, the SP6126 can be set to other output voltages. The relationship in the following formula is based on a voltage divider from the output to the feedback pin FB, which is set to an internal reference voltage of 0.60V. Standard 1% metal film resistors of surface mount size 0603 are recommended.

$$R2 = \frac{R1}{\left(\frac{V_{out}}{V_{ref}} - 1\right)}$$

Where R1 = 200kΩ. For Vout = 0.60V setting, simply remove R2 from the board.

Note that since the SP6126 Evaluation Board design was optimized for 12V down conversion to 3.30V, changes of output voltage and/or input voltage will alter performance from the data given in the Power Supply Data section.

Using the SHDN (ON/OFF function)

Feedback pin serves a dual role of ON/OFF control. The MOSFET driver is disabled when a voltage greater than 1V is applied at FB pin. Maximum voltage rating of this pin is 5.5V. The controlling signal should be applied through a small signal diode as shown on page 1. Under no-load condition an optional 10kOhm bleeding resistor across the output helps keep the output capacitor discharged.

POWER SUPPLY DATA

The SP6126EB is designed with an accurate 2% reference over line, load and temperature. Figure 1 data shows a typical SP6126 Evaluation Board efficiency plot, with efficiencies to 92% and output currents to 2.5A. SP6126 Load Regulation in Figure 2 shows no change in output voltage from no load to 2A load. Figures 3 and 4 show the transient response of the SP6126. Figures 5 and 6 show a controlled start-up with no load and 2A load when power is applied where the input current rises smoothly as the soft-start ramp increases. Figures 7 and 8 show the output ripple under no load and 2A load.

Typical Performance Characteristics

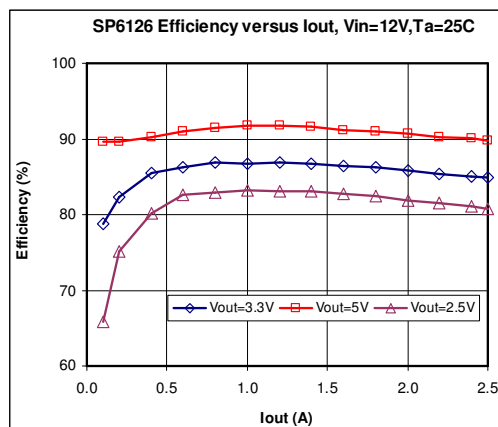


Figure 1- Step load 1-2A, ch1: Vin
ch2: Vout, ch3: Iout

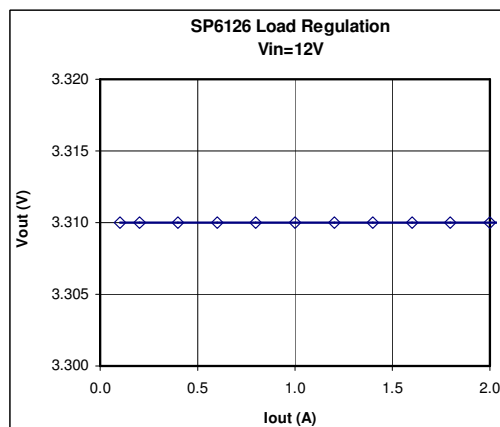


Figure 2- Step load 0.3-2A, ch1: Vin
ch2: Vout, ch3: Iout

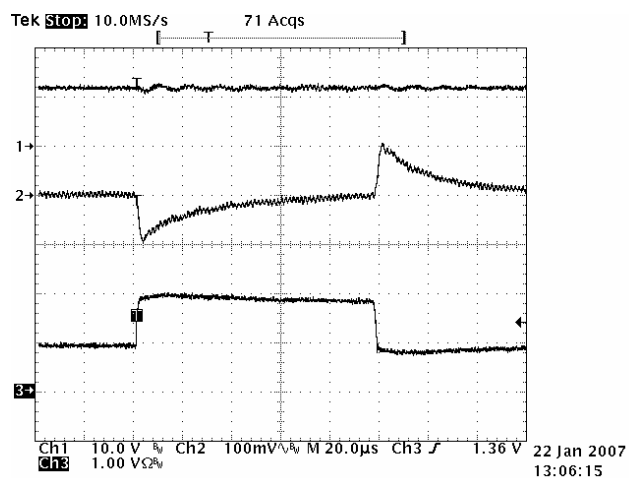


Figure 3- Step load 1-2A, ch1: Vin
ch2: Vout, ch3: Iout

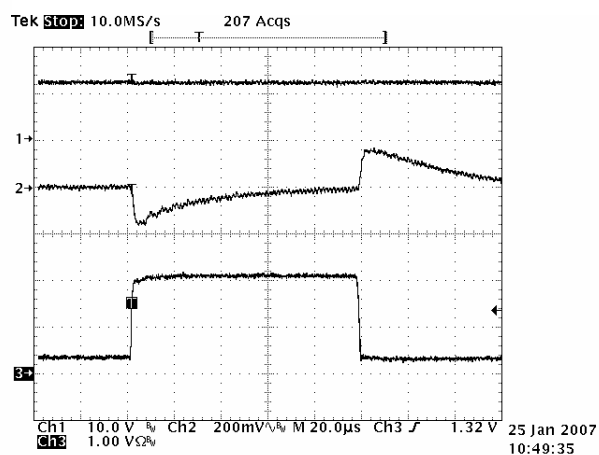


Figure 4- Step load 0.3-2A, ch1: Vin
ch2: Vout, ch3: Iout

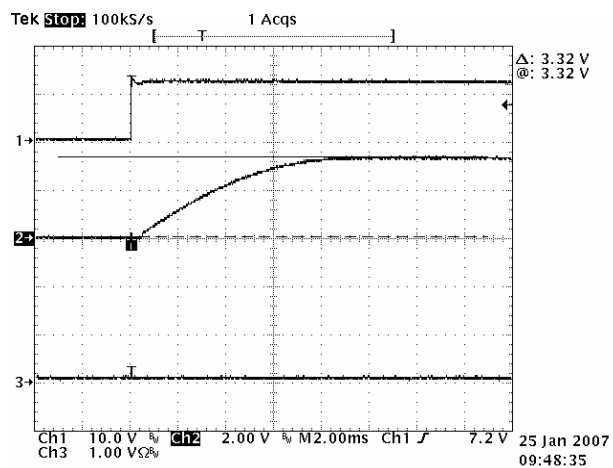


Figure 5- Startup no load, ch1: Vin
ch2: Vout, ch3: Iout

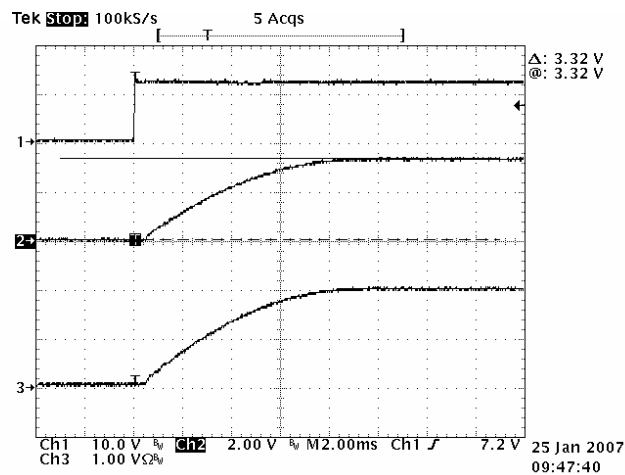


Figure 6- Start up 2A, ch1: Vin
ch2: Vout, ch3: Iout

Typical Performance Characteristics

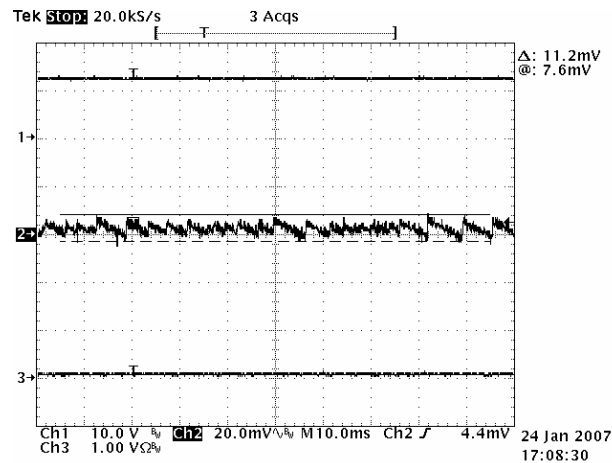


Figure 7- Output ripple at 0A is 11mV,
ch1: V_{in} , ch2: V_{out} , ch3: I_{out}

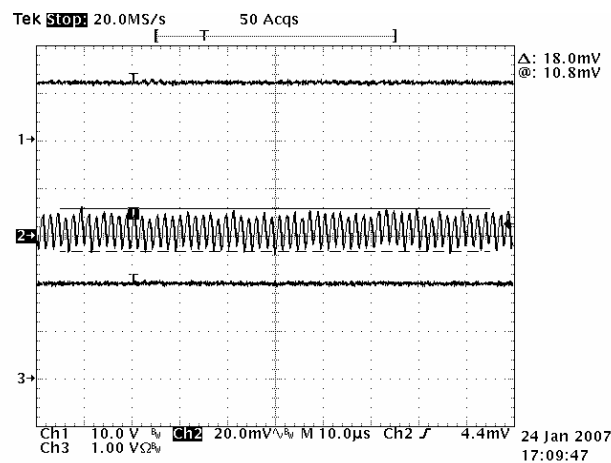


Figure 8- Output ripple at 2A is 18mV,
ch1: V_{in} , ch2: V_{out} , ch3: I_{out}

LOOP COMPENSATION

The SP6126 includes Type-II internal compensation components for loop compensation. External compensation components are not required for systems with tantalum or aluminum electrolytic output capacitors with sufficiently high ESR. Use the condition below as a guideline to determine whether or not the internal compensation is sufficient for your design.

Type-II internal compensation is sufficient if the following condition is met:

$$f_{ESRZERO} < f_{DBPOLE} \quad \dots\dots\dots (1)$$

where:

$$f_{ESRZERO} = \frac{1}{2\pi \cdot R_{ESR} \cdot C_{OUT}} \quad \dots\dots\dots (2)$$

$$f_{DBPOLE} = \frac{1}{2\pi \cdot \sqrt{L \cdot C_{OUT}}} \quad \dots\dots\dots (3)$$

Creating a Type-III compensation Network

The above condition requires the ESR zero to be at a lower frequency than the double-pole from the LC filter. If this condition is not met, Type-III compensation should be used and can be accomplished by placing a series RC combination in parallel with R1 as shown below. The value of CZ can be calculated as follows and RZ selected from table 1.

$$CZ = \frac{\sqrt{L \cdot C}}{R1} \quad \dots\dots\dots (4)$$

$f_{ESRZERO}/f_{DBPOLE}$	RZ
1X	50K
2X	40K
3X	30K
5X	10K
>= 10X	2K

Table1- Selection of RZ

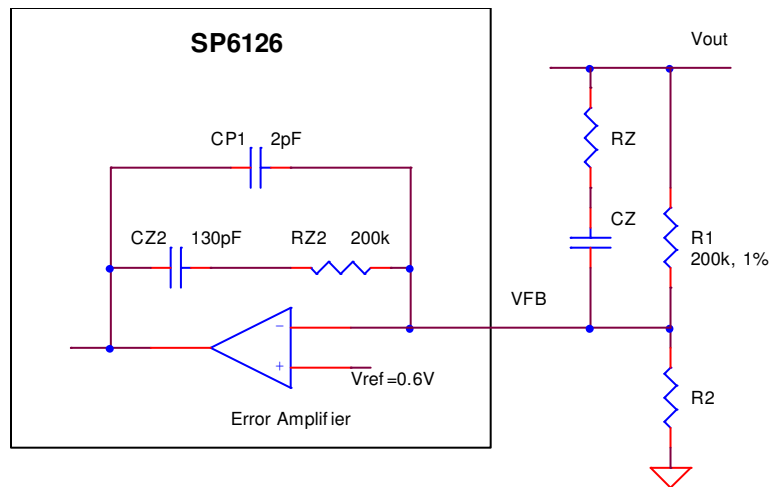


Figure 9- RZ and CZ in conjunction with internal compensation components form a Type-III compensation

Loop Compensation for the SP6126EB

$L = 6.8\mu\text{H}$, $C = 22\mu\text{F}/5\text{m}\Omega$ ceramic capacitor

From equation (2) $f_{\text{ESRZERO}} = 1.45\text{MHz}$. From equation (3) $f_{\text{DBPOLE}} = 13\text{kHz}$. Since the condition specified in (1) is not met, Type-III compensation has to be used by adding external components RZ and CZ. Using equation (4) CZ is calculated 61.2pF. After bench tests a 82uf was selected for optimum performance. Following the guideline given in table 1, a 2kOhm RZ was used.

PCB LAYOUT DRAWINGS

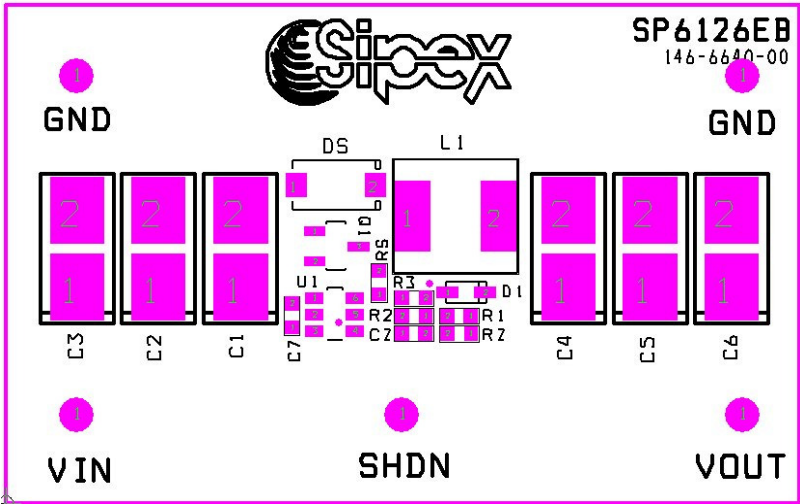


Figure 10. SP6126EB Component Placement

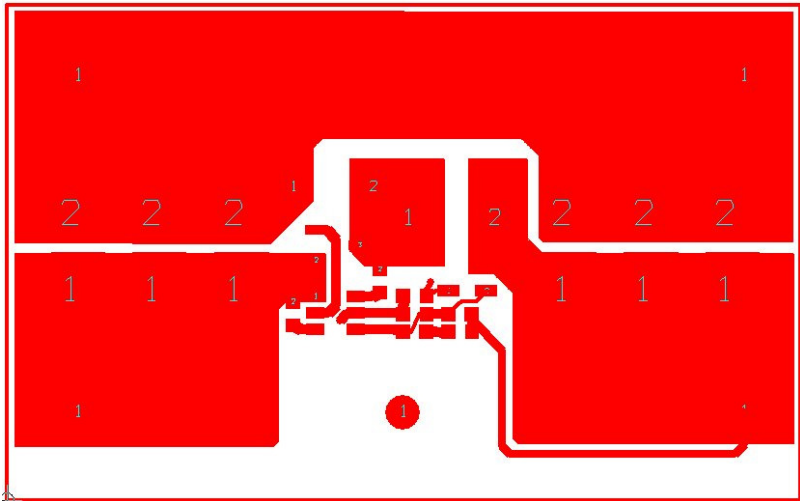


Figure 11. SP6126EB PCB Layout Top Side

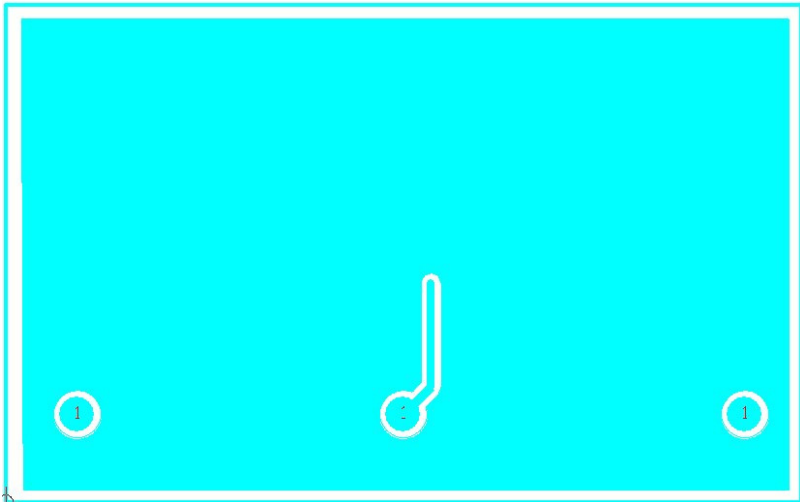


Figure 12. SP6126EB PCB Layout Bottom Side

Line No.	Ref. Des.	Qty.	Manuf.	Manuf. Part Number	Layout Size	Component	Vendor Phone Number
1	PCB	1	Sipex	146-6613-00	1.175"x1.934"	SP6126EB	408-934-7500
2	U1	1	Sipex	SP6126EK1	TSOT-6	Non-synchronous Buck Controller	408-934-7500
3	Q1	1	Vishay Semi	Si2343DS	SOT-23	PFET, 30V, 86mOhm	402-563-6866
4	DS	1	On Semi	MBRA340T3	SMA	Schotkky, 40V, 3A	602-244-6600
5	L1	1	Vishay	IHLP2525CZ	6.86x6.47mm	6.8uH Coil 8A 60mOhm	914-347-2474
6	D1	1	MCC	1N4148WX	SOD323	Fast Switching Diode 500mW	818-701-4933
7	C1	1	MURATA	GRM21BR61C106K	0805	10 uF Ceramic X5R 16V	770-436-1300
8	C6	1	MURATA	GRM21BR60J226M	0805	22uF Ceramic X5R 6.3V	770-436-1300
9	C7	1	MURATA	GRM18ER61E104K	0603	0.1uF Ceramic X5R	770-436-1300
10	CZ	1	MURATA	GRM18ER61H820K	0603	82pF Ceramic C0G 50V	770-436-1300
11	R1	1	VISHAY/DALE	CRCW0603200K	0603	200k	402-563-6866
12	R2	1	VISHAY/DALE	CRCW060344K2	0603	44.2K	402-563-6866
13	RZ	1	VISHAY/DALE	CRCW06037K15	0603	2.00K	402-563-6866
14	R	1	ROHM	MCR18EZPF1002	1206	10.0K	800-344-4539
15	VIN, VOUT, GND, GND, SHDN	5	Vector Electronic	K24C/M	.042 Dia	Test Point Post	800-344-4539

Table 2- SP6126EB List of Materials

INDUCTORS - SURFACE MOUNT								
Inductance (uH)	Manufacturer/Part No.	Inductor Specification					Inductor Type	Manufacturer Website
		DCR mOhms	Isat (A)	Size LxW(mm) Ht.(mm)				
6.8	VISHAY	60.0	8.00	6.47x6.86	3.00		Shielded	www.vishay.com
CAPACITORS - SURFACE MOUNT								
Capacitance (uF)	Manufacturer/Part No.	Capacitor Specification					Capacitor Type	Manufacturer Website
		ESR ohms (max)	Ripple Current (A) @5C Delta	Size LxW(mm) Ht.(mm)		Voltage (V)		
10	AVX 1206YD106MAT2A	0.005	3.00	3.20x1.60	1.60	16.0	X5R Ceramic	www.avx.com
22	AVX 08056D226MAT2A	0.005	260	2.00x1.25	1.25	6.3	X5R Ceramic	www.avx.com
MOSFETS - SURFACE MOUNT								
MOSFET	Manufacturer/Part No.	MOSFET Specification					Foot Print	Manufacturer Website
		RDS(on) ohms (max)	ID Current (A)	Qg nC (Typ) nC (Max)		Voltage (V)		
P-Ch	VISHAY Si2343DS	86.00	3.1	14.0	21.0	30.0	SOT-23	www.vishay.com

Table 3- SP6126EB Suggested Components and Vendor Lists

ORDERING INFORMATION

Model	Temperature Range	Package Type
SP6126EB	- 40°C to +85°C.....	SP6126 Evaluation Board
SP6126EK1.....	- 40°C to +85°C.....	6-pin TSOT-6