Synchronous Buck PWM and Linear Power Controller

FEATURE

- Controller operates from 5V and 12V
- Drives two N-channel MOSFETs for switching buck converter
- Drives an N-channel MOSFET on the linear output
- Fixed 600kHz constant switching frequency
- Full range 0~100% duty cycle
- Internal soft start
- Fast transient response
- UVP monitoring on both outputs
- Internal 0.8V reference voltage.

APPLICATIONS

- Graphics-GPU and memory supplies
- ASIC power supplies
- Embedded processor and I/O supplies
- Cable Modem, Set Top Box, and DSL Modems
- DSP and Core Communications Processor supplies

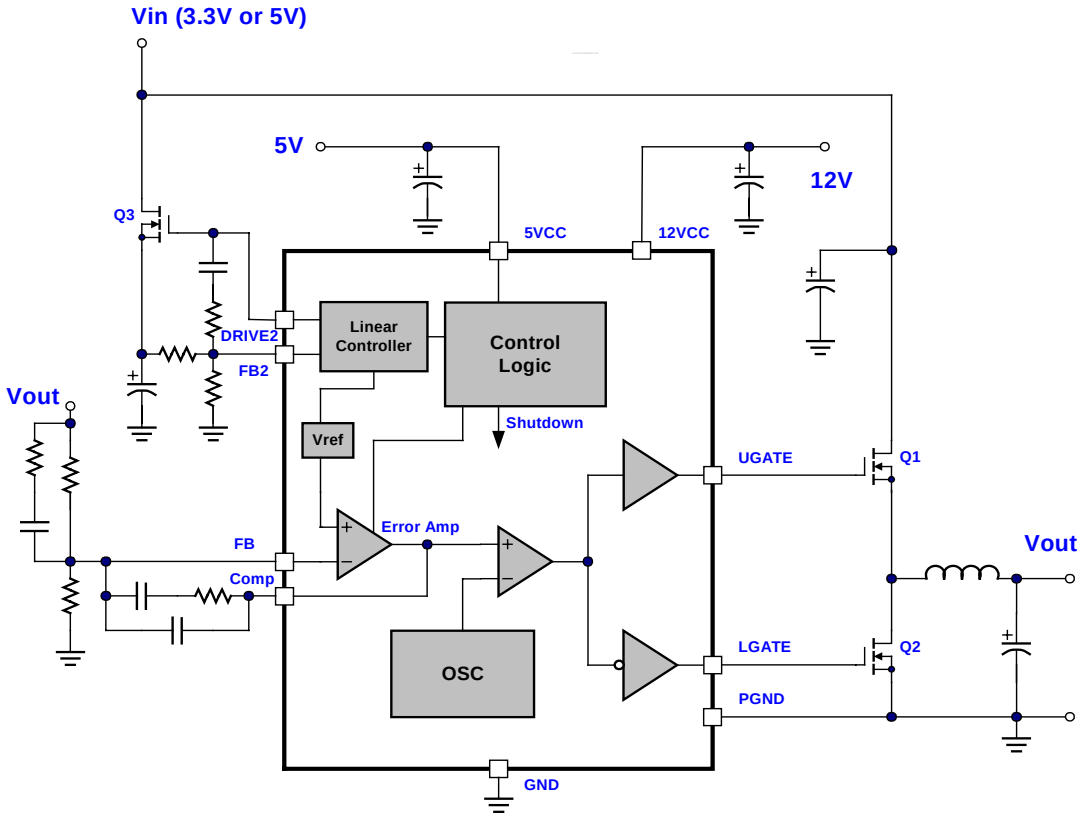
GENERAL DESCRIPTION

The SS7529 consists of a dual-output power controller and the protection circuits in a single SO-14 package for graphic cards and other applications.
The dual-output power controller provides regulation by driving two N-MOSFETs in a synchronous rectified buck converter, and one N-MOSFET in a linear configuration.

The synchronous rectified buck converter provides simple, single feedback loop, voltage mode control with fast transient response, from an internal 0.8V temperature-compensated reference voltage. A fixed 600kHz frequency oscillator reduces design complexity, while balancing typical application cost and efficiency.

The internal soft-start function and the 12V direct drive on the switching output help to save the bootstrap circuit. Furthermore, the internal POR (power on reset) helps to prevent the system from sequencing issues during the startup and turn-off. Reacting to fault conditions, the SS7529 will shutdown both outputs when the voltage on either FB or FB2 pins drops below 51% of their nominal value.

TYPICAL APPLICATIONS



ORDERING INFORMATION

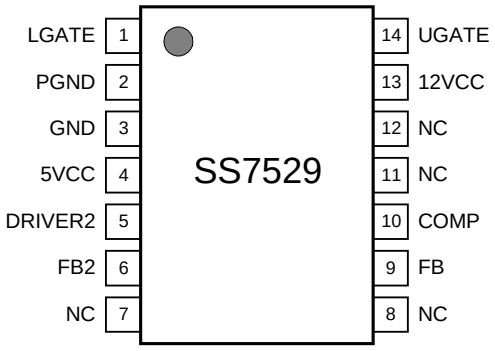
SS7529CSXX

- Packing:
  - TB: tubes
  - TR: tape and reel
- Package type:
  - S: small outline SO-14

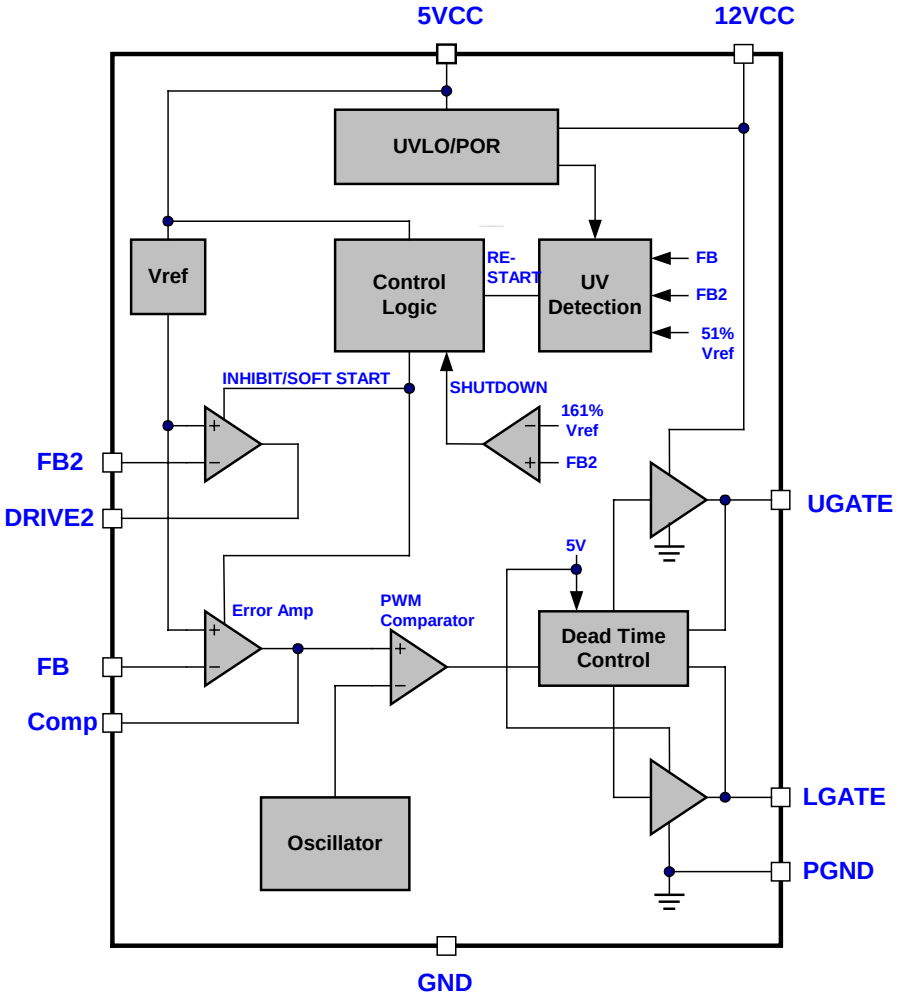
For example: SS7529CSTR

SS7529 in SO-14 shipped in tape and reel

PINOUT INFORMATION



BLOCK DIAGRAM



PIN DESCRIPTIONS

PIN	NAME	FUNCTION
1	LGATE	Connect LGATE pin to the PWM converter's lower MOSFET gate. This pin provides the gate drive for the lower MOSFET.
2	PGND	Power ground return
3	GND	Signal and power ground for the IC. All voltage levels are measured with respect to this pin.
4	5VCC	Connect this pin to 5V supply voltage. This pin provides the bias for the control circuitry. The voltage at this pin is monitored for Power-On Reset (POR) purposes.
5	DRIVE2	This pin is the output of the linear controller. Connect this pin to the gate of an external N-MOSFET to provide output power.
6	FB2	This pin is the inverting input of the internal error amplifier for the linear regulator output. Connect this pin to the output of the converter via an external resistor divider.
7	NC	Not connected
8	NC	Not connected
9	FB	This pin is the inverting input of the internal error amplifier for the switching buck converter. Connect this pin to the output of the converter via an external resistor divider.
10	COMP	Error amplifier output
11	NC	Not connected
12	NC	Not connected
13	12VCC	Connect this pin to the 12V supply voltage. This pin provides the bias for the driver circuitry. The voltage at this pin is monitored for Power-On Reset (POR) purposes.
14	UGATE	Connect the UGATE pin to the PWM converter's upper MOSFET gate. This pin provides the gate drive for the upper MOSFET.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage 5Vcc..... -0.3 ~ 7V
Supply Voltage 12Vcc ..... -0.3 ~ 14V
UGATE, LGATE, DRIVE2 ..... -0.3 ~12Vcc
FB, FB2, COMP ..... -0.3 ~ 5Vcc+0.3

Operating Temperature Range..... 0°C to 70°C
Storage Temperature Range..... –65°C to 150°C
Junction Temperature..... 0°C to 125°C
Package thermal resistance SO-14..... 68 °C/W
Lead temperature (Soldering, 10sec)..... 300 °C

Caution:

Stresses beyond the ratings specified in "Absolute Maximum ratings" may cause permanent damage to the device. This is a stress-only rating and the device should not be operated at these, or any other conditions above those indicated in the operational sections of this specification.

ELECTRICAL CHARACTERISTICS

(T_A = +25°C unless otherwise stated, Vcc=5.0V)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Vcc Supply Voltage					
12Vcc		10.8	12	13.2	V
5Vcc		4.5	5.0	5.5	V
Vcc Supply Current					
Nominal Supply Current 12Vcc	UGATE and LGATE open		1.3		mA
Nominal Supply Current 5Vcc	UGATE and LGATE open		1.0		mA

ELECTRICAL CHARACTERISTICS (cont.)

Power On Reset					
5Vcc Rising Threshold		4.15	4.35	4.55	V
5Vcc Falling Threshold		3.7	3.9	4.1	V
12Vcc Rising Threshold		9.6	10.3	10.8	V
12Vcc Falling Threshold		9.2	9.6	10.2	V
Oscillator					
Frequency		550	600	650	kHz
Ramp Amplitude			1.5		Vp-p
Soft-Start					
Soft-Start Interval			3.4		ms
Reference					
Reference Voltage Tolerance		-2		+2	%
Nominal Reference Voltage			0.8		V
PWM Error Amplifier					
DC gain			70		dB
Gain Bandwidth Product			10		MHz
Slew Rate			6		V/uS
FB Input Bias Current			20	150	nA
Comp High Output Voltage			5		V
Comp High Output Current (Source)			-7.3		mA
Comp Low Output Voltage			0.5	1	V
Comp Low Output Current (Sink)			5.6		mA
PWM Gate Drivers					
UGATE & LGATE Source Current			-1		A
UGATE & LGATE Sink Current			1		A
UGATE Maximum Voltage		11	12		V
LGATE Maximum Voltage		4	5		V
UGATE & LGATE Output Impedance			3.1	4.3	Ω
PWM Protection					
Under-Voltage Level (VFB/VREF)			51		%
Linear Regulator Error Amplifier					
DC gain			70		dB
Gain Bandwidth Product			10		MHz
Slew Rate			6		V/uS
FB2 Input Bias Current			20	150	nA
DRIVE2 High Output Voltage			12		V
DRIVE2 High Output Current			-14		mA
DRIVE2 Low Output Voltage			0	0.5	V
DRIVE2 Low Output Current			14		mA
Linear Regulator Protection					
Under-voltage Level (VFB2/VREF)			51		%
Over-voltage Level (VFB2/VREF)			161		%

TYPICAL PERFORMANCE CHARACTERISTICS

Figure 1. POWER ON

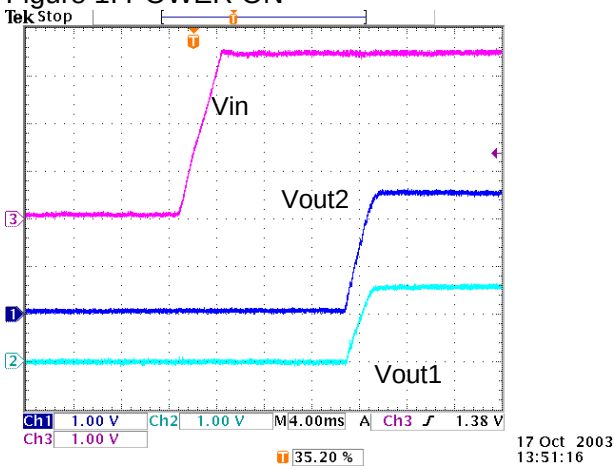


Figure 2. POWER OFF

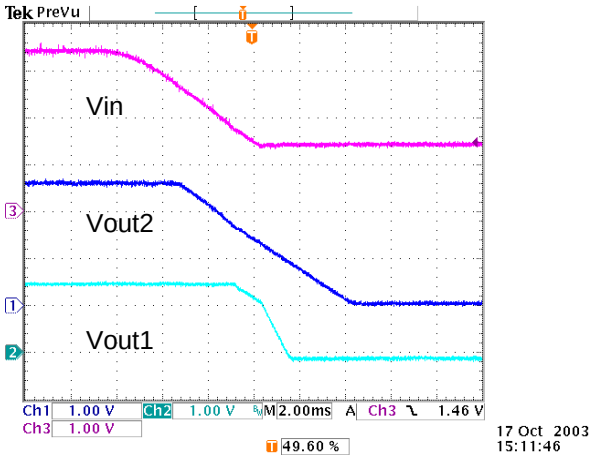


Figure 3. Dead time

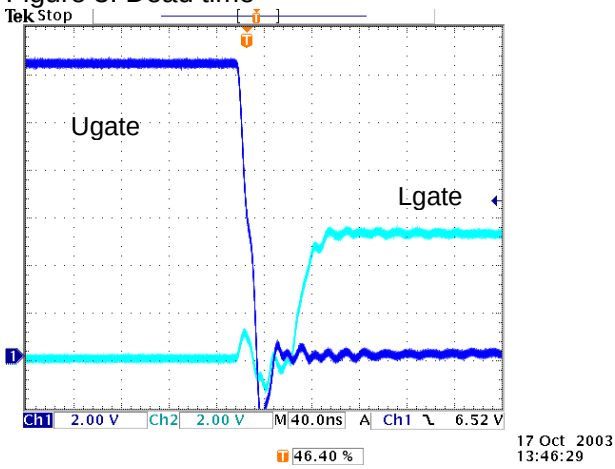


Figure 4. Dead time

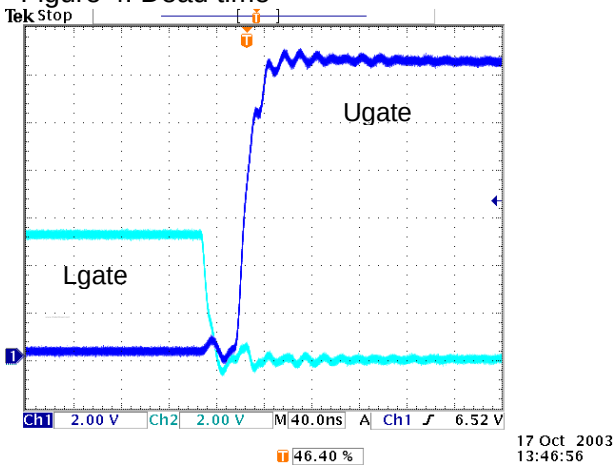


Figure 5. Load Off Transient Response

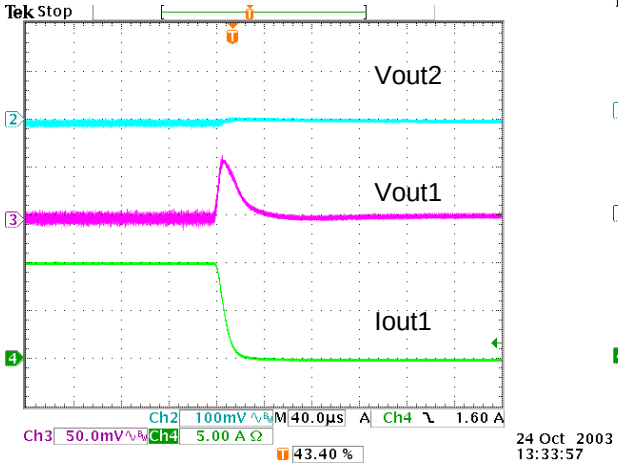
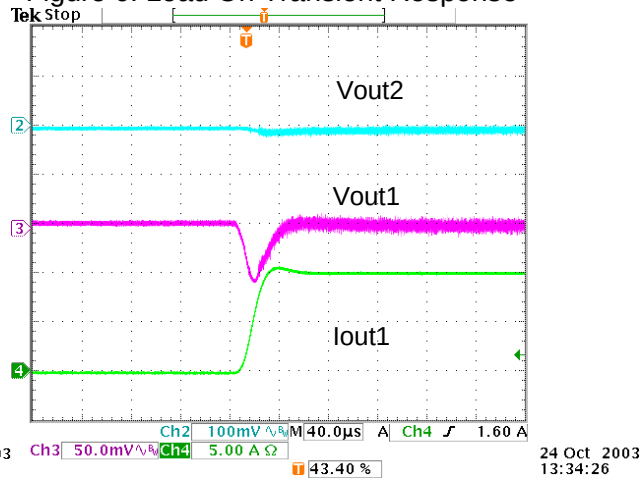


Figure 6. Load On Transient Response



FUNCTIONAL DESCRIPTION

Operation Overview

As graphic-card power design is getting more and more complicated, engineers need a smart solution to reduce not only the design effort, but to further reduce the development time. The SS7529 is targeted at providing application to provide an easy and cost effective solution. The SS7529 control circuit is supplied by 5v and the high-side MOSFET driver is supplied by 12V to eliminate the bootstrap circuit.
The SS7529 integrates a synchronous-rectified buck controller and a linear power controller to control the supply of both the high-current requirement of the GPU and the low current requirement of memory. To address fault conditions, UVP (Under-Voltage Protection) is implemented on both outputs and OVP (Over-Voltage Protection) on the linear controller.
The high switching frequency (600kHz) helps to reduce component sizes and the output ripple.

Initialization

There is a smart power-on-reset (POR) circuit to monitor both 5Vcc and 12Vcc to identify if controller has started operation or not. This is to prevent fault conditions from undesirable power sequencing. With this, users can easily implement circuits without worrying about the power sequencing.

Soft-Start

The POR function initiates the soft-start function after the 5Vcc and 12Vcc reach their threshold voltage. The built-in soft-start function is to prevent inrush current and output voltage overshoot during power on. An internal digital counter controls the soft-start voltage. It clamps the ramping of reference voltage at the input of the error amplifier and increases the pulse width of the output driver slowly. The typical soft-start duration is 3.4mS.

Under-Voltage Protection

The under-voltage protection (UVP) of the SS7529 is implemented by monitoring the feedback signal at FB and FB2 pins. Whenever one of these two signals drops below 51% of the internal reference, the UVP will be triggered and then both outputs will be quickly shut down. Unless the fault condition is removed, both outputs will keep in hiccup mode operation.

Output Voltage Setting

Both SS7529 outputs achieve regulation by feedback from the voltage dividers. Therefore, the output voltage can be easily programmed by the resistor values in the following equation.

For switching output (figure 7),

$$V_{OUT1} \times \frac{R_4}{R_1 + R_4} = V_{Ref} = 0.8V$$

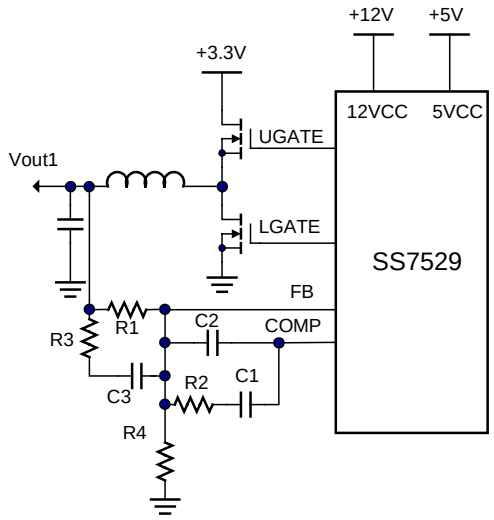


Figure 7. OUTPUT VOLTAGE SELECTION OF THE PWM OUTPUT

For linear output (figure 8),

$$V_{OUT2} \times \frac{R_6}{R_5 + R_6} = 0.8V$$

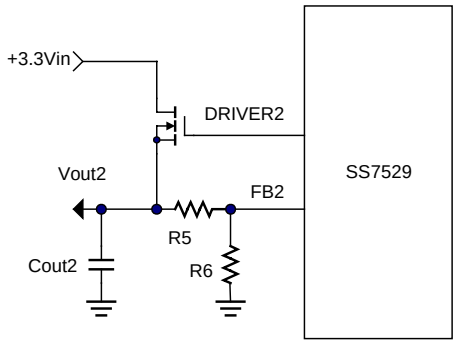


Figure 8. OUTPUT VOLTAGE SELECTION OF THE LINEAR OUTPUT

Converter Shutdown

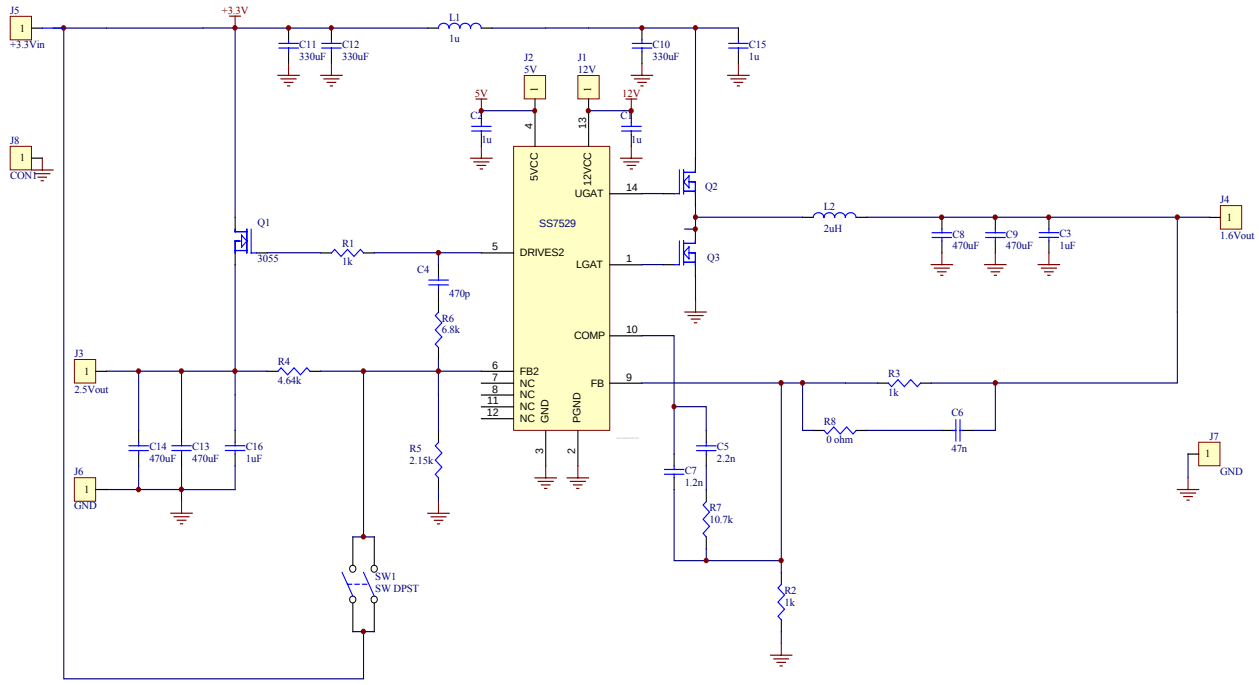
Forcing the FB2 pin to be higher than a threshold of 1.28V will shutdown both regulators. When the applied voltage is removed, the regulators will return to the re-start cycle and begin the soft-start process.

Layout Hints

There are some principles which should be followed when designing with the SS7529:

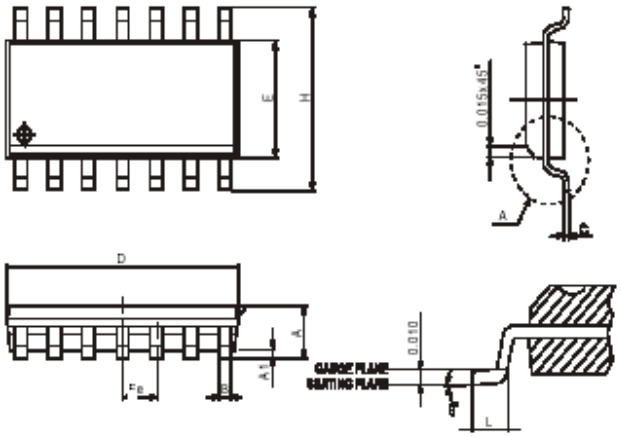
1. Keep the bypass capacitors of 5VCC and 12VCC very close to IC.
2. Keep output voltage feed back network, FB pin and FB2 pin related components (small signal components) very close to IC.
3. Signal ground plane of FB and FB2 pin (small signal components) should be connected to the power ground plane with a via or only one point to minimizes the effect of power ground currents.
4. Switching node such as UGATE and LGATE should be kept as small as possible and routed away from FB, FB2, and other linear circuit.
5. The PCB traces carrying discontinuous currents and any high current path should be made as short and wide as possible.
6. If possible, a multi-layer PCB is recommended. Please refer to the EV kit of SS7529 for a PCB layout example.

Typical Application Circuit



Packaging Information

Package: SOP-14



Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.477	1.732	0.058	0.068
A1	0.102	0.255	0.004	0.010
B	0.331	0.509	0.013	0.020
C	0.191	0.2496	0.0075	0.0098
D	8.558	8.762	0.336	0.344
E	3.82	3.999	0.150	0.157
e	1.274		0.050	
H	5.808	6.215	0.228	0.244
L	0.382	1.274	0.015	0.050
θ°	0°	8°	0°	8°