SSL2109 series

Compact non-dimmable LED controller IC

Rev. 4 — 26 October 2012 Product data sheet

1. General description

The SSL2109 series is a range of high-voltage Integrated Circuits (IC) for driving LED lamps in general lighting applications.

The main benefits of this IC include:

- Small Printed-Circuit Board (PCB) footprint and compact solution
- High efficiency (up to 95 %) for non-dimmable high power factor solutions
- High power factor >0.9 (application dependent)
- Ease of integration and many protection features
- Low electronic Bill Of Material (BOM)
- Highly flexible IC for use in buck, buck/boost and flyback modes
- Single inductor used for non-isolated configurations because of internal demagnetization detection and dV/dt supply

The IC is supplementary to the SSL21081/SSL21083 series but without an internal switch. The IC range has been designed to start up directly from the HV supply by an internal high-voltage current source. Thereafter, the dV/dt supply is used with capacitive coupling from the drain, or any other auxiliary supply. This functionality provides full flexibility in the application design. An internal clamp limits the supply voltage.

The IC provides accurate output current control to within 5 % LED current accuracy. The IC can be operated using Pulse-Width Modulation (PWM) current regulation and has many protection features including easy LED temperature feedback.

2. Features and benefits

- LED controller IC for driving strings of LEDs or high-voltage LED modules from a rectified mains supply
- Part of a high-efficiency switch mode flyback or buck product family.
  - Controller-only which can drive an external MOSFET
- Controller that has power-efficient boundary conduction mode of operation with:
  - No reverse recovery losses in freewheel diode
  - Zero Current Switching (ZCS) for switch turn-on
  - Zero voltage or valley switching for switch turn-off
  - Minimal required inductance value and size
- SL2109AT: suitable for high power factor (>0.9) applications
- Applicable in buck, buck/boost and flyback topologies

- Direct PWM current regulation possible
- Fast transient response through cycle-by-cycle current control:
  - Negligible AC mains ripple in LED current and minimal total capacitance in low ripple configurations
  - No over or undershoots in the LED current
- Simple high input power factor solution (>0.9)
- Internal Protection features:
  - UnderVoltage LockOut (UVLO)
  - Leading-Edge Blanking (LEB)
  - OverCurrent Protection (OCP)
  - Short-Winding Protection (SWP); SSL2109T only
  - Internal OverTemperature Protection (OTP)
  - Brownout protection
  - Output Short Protection (OSP)
- Low component count (see Figure 4) LED driver solution:
  - No dim switch and high-side driver required for PWM current regulation
  - Easy external temperature protection with a single NTC
  - Option for soft-start function
  - Compatible with wall switches with built-in indication light during standby
- IC lifetime easily matches or surpasses LED lamp lifetime

3. Applications

The SSL2109 is intended for compact LED lamps with accurate fixed current output for single mains input voltages. Mains input voltages include 100 V, 120 V and 230 V (AC). The output signal can be modulated using a PWM signal. The power range is determined by external components.

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	operating range	8	-	14	V
$I_{CC(INT)}$	internal supply current	normal operation	-	1.3	-	mA
V_{HV}	voltage on pin HV		-	-	600	V
V_{DRAIN}	voltage on pin DRAIN		–0.4	-	600	V
f_{conv}	conversion frequency		-	100	-	kHz
$V_{o(DRIVER)max}$	maximum output voltage on pin DRIVER	VCC > $V_{CC(startup)}$	9	10.5	12	V

5. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
SSL2109AT	SO8	plastic small package outline body; 8 leads; body width 3.9 mm	SOT96-1
SSL2109T			

6. Block diagram

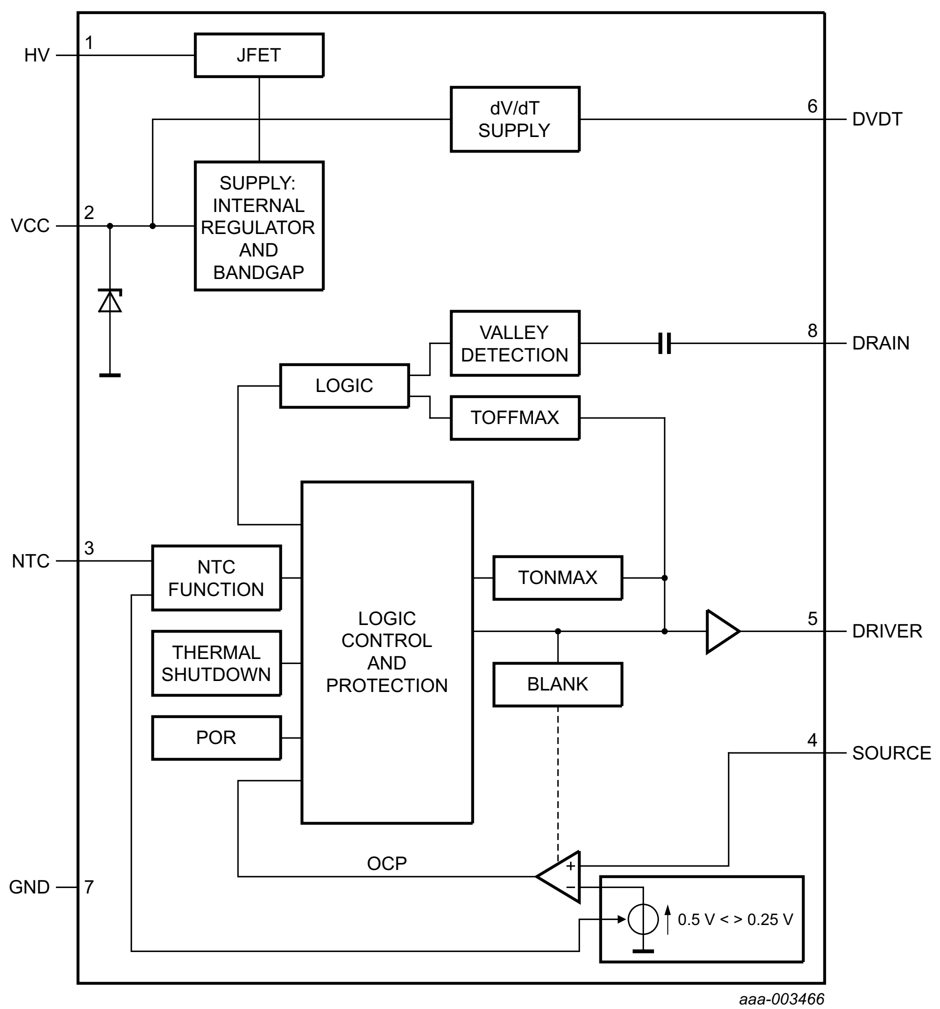


Fig 1. SSL2109AT block diagram

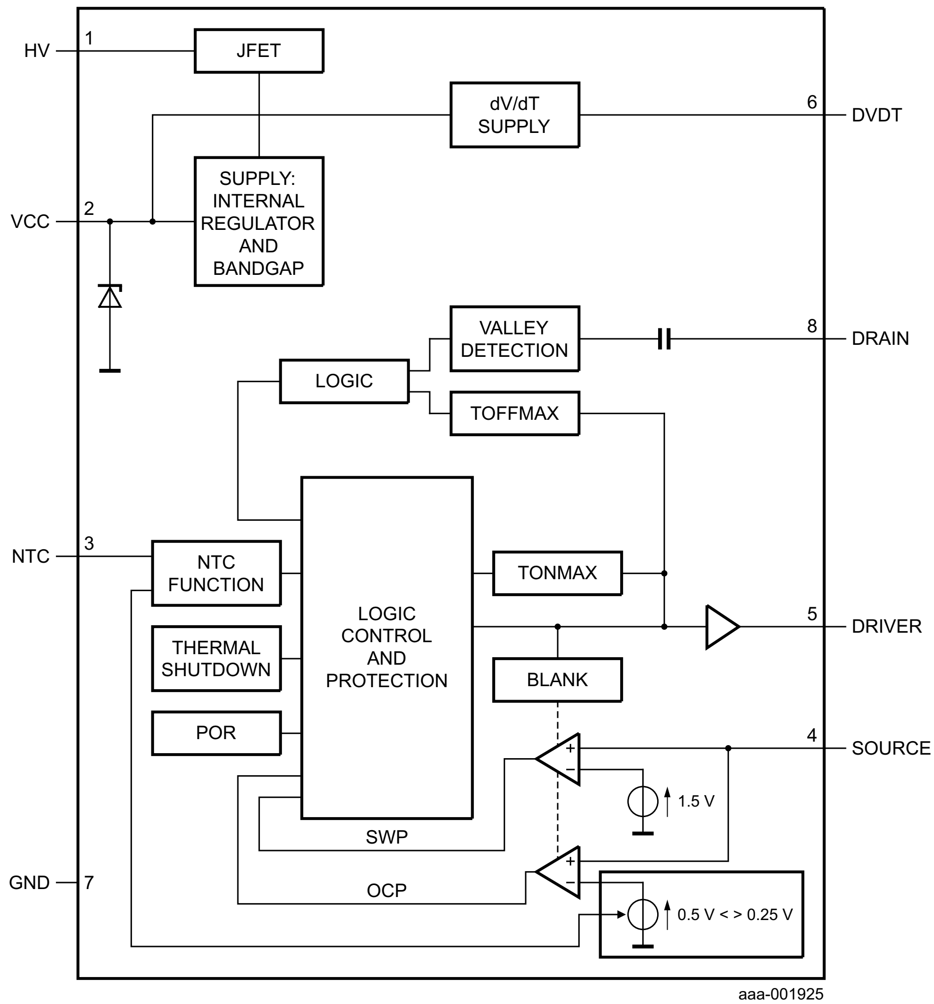


Fig 2. SSL2109T block diagram

7. Pinning information

7.1 Pinning

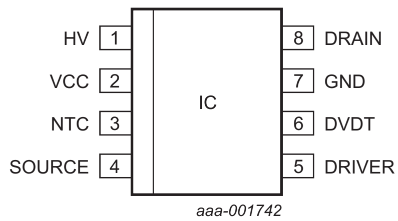


Fig 3. SSL2109 pin configuration

7.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
HV	1	high-voltage supply pin
VCC	2	supply voltage
NTC	3	temperature protection input
SOURCE	4	low-side external switch
DRIVER	5	driver output
DVDT	6	AC supply pin
GND	7	ground
DRAIN	8	high-side external switch

8. Functional description

8.1 Introduction

The SSL2109 is a range of products for small form factor retrofit SSL lamps and separate LED drivers.

8.2 Converter operation

The converter in the SSL2129 is a Boundary Conduction Mode (BCM), peak current controlled system. See Figure 4 for the basic application diagram. See Figure 5 for the waveforms.

This converter type operates at the boundary between continuous and discontinuous mode. Energy is stored in inductor L each period that the switch is on. The inductor current I_L is zero when the MOSFET is switched on. The amplitude of the current build-up in L is proportional to the voltage drop over the inductor and the time that the MOSFET switch is on. When the MOSFET is switched off, the energy in the inductor is released towards the output. The current then falls at a rate proportional to the value of V_{OUT}. The LED current I_{LED} depends on the peak current through the inductor (SSL2109 controlled) and on the HV bus voltage while it is optimized for a high power factor. A new cycle is started once the inductor current I_L is zero. This quasi-resonant operation results in higher efficiency.

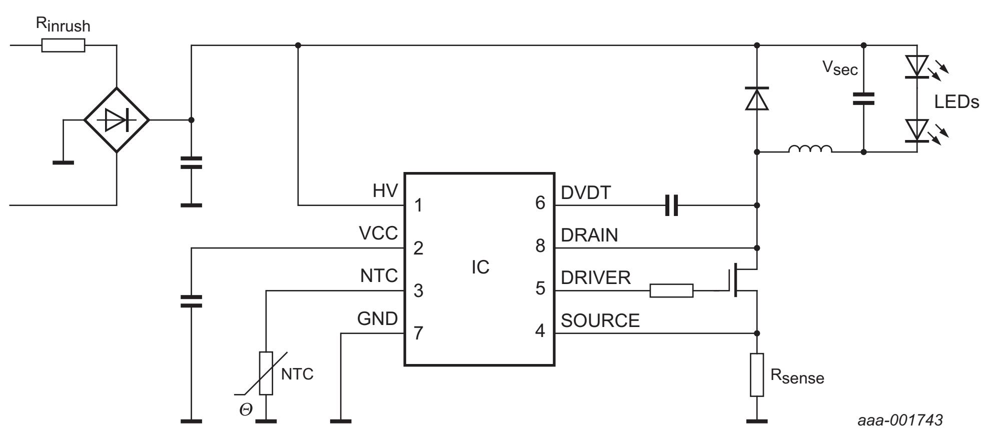


Fig 4. SSL2109AT basic low ripple buck application diagram

8.3 Driver pin

The SSL2109 is equipped with an internal driver that can control an external switch. The voltage on the driver output pin is increased towards $V_{o(DRIVER)max}$ to open the switch during the first cycle (t_0 to t_1). The voltage on the driver output pin is pulled down towards a low level from the start of the secondary stroke until the next cycle starts (t_0 to t_{00}). During transition from low to high and back, there is a controlled switching slope steepness. This controlled condition limits the high frequency radiation from the circuit to the surrounding area.

At the lowest VCC voltage ($V_{CC(stop)}$), the voltage of the driver is $V_{O(DRIVER)min}$.

8.4 Valley detection

A new cycle is started when the primary switch is switched on (see Figure 5). In the following sections, “on” represents the conductive state and off the non-conductive state.

Following time t_1, when the peak current is detected on the SOURCE pin, the switch is turned off and the secondary stroke starts at t_2. When the secondary stroke is completed with the coil current at t_3 equaling zero, the drain voltage starts to oscillate at approximately $V_{IN} - V_{OUT}$ level. The peak to peak amplitude equals $2 \times V_{OUT}$. A special feature, called valley detection is an integrated part of the SSL2109 circuitry. Dedicated built-in circuitry connected to the DRAIN pin, senses when the voltage on the drain of the switch has reached its lowest value. The next cycle is then started at t_{00} and as a result the capacitive switching losses are reduced. A valley is detected and accepted if both the frequency of the oscillations and the voltage swing are within the range specified (f_{ring} and $\Delta V_{vrec(min)}$) for detection. $\Delta V_{vrec(min)}$ is the voltage differential between the HV (pin) in and the DRAIN pin. If a valid valley is not detected, the secondary stroke is continued until the maximum off-time ($t_{off(high)}$) is reached, then the next cycle is started.

A series resistance can be included at the drain sensing pin for flyback mode to remove the high-frequency ringing caused by the transformer leakage inductance.

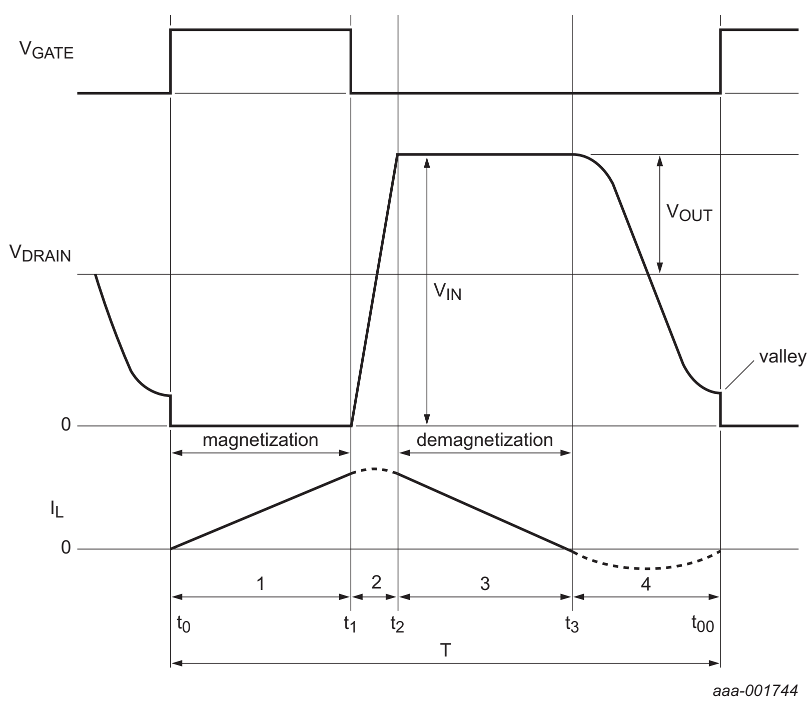


Fig 5. Buck waveforms and valley detection

8.5 Protective features

The IC has the following protections:

- UnderVoltage LockOut (UVLO)
- Leading-Edge Blanking (LEB)
- OverCurrent Protection (OCP)
- Internal OverTemperature Protection (OTP)
- Brownout protection
- Short-Winding Protection (SWP) SSL2109T only
- Output Short Protection (OSP)
- LED overtemperature control and protection

The SWP and the OSP are latched protections. These protections cause the IC to halt until a reset (a result of power cycling) is executed. When V_{CC} drops lower than $V_{CC(rst)}$, the IC resets the latch protection mode. The internal OTP and LED over temperature protections are safe-restart protections. When V_{CC} drops lower than $V_{CC(rst)}$, the IC resets the latch protection mode. If V_{CC} drops below $V_{CC(stop)}$, the IC halts. Switching starts only when no fault condition exists.

8.5.1 UnderVoltage LockOut (UVLO)

When the voltage on the VCC pin drops lower than $V_{CC(stop)}$, the IC stops switching. An attempt is then made to restart by supplying V_{CC} from the HV pin voltage.

8.5.2 Leading-Edge Blanking (LEB)

To prevent false detection of the short-winding or overcurrent, a blanking time following switch-on is implemented. When the MOSFET switch turns on there can be a short current spike due to capacitive discharge of voltage over the drain and source. During the LEB time (t_{leb}), the spike is disregarded.

8.5.3 OverCurrent Protection (OCP)

The SSL2109 contains a highly accurate peak current detector. It triggers when the voltage at the SOURCE pin reaches the peak-level $V_{th(ocp)SOURCE}$. The current through the switch is sensed using a resistor connected to the SOURCE pin. The sense circuit is activated following LEB time t_{leb}. As the LED current is half the peak current (by design), it automatically provides protection for maximum LED current during operation. There is a propagation delay between overcurrent detection and the actual closure of the switch $t_{d(ocp-swoff)}$. Due to the delay, the actual peak current is slightly higher than the OCP level set using the resistor in series to the SOURCE pin.

8.5.4 OverTemperature Protection (OTP)

When the internal OTP function is triggered at a certain IC temperature ($T_{th(act)otp}$), the converter stops operating. The OTP safe-restart protection and the IC restarts again with switching resuming when the IC temperature drops lower than $T_{th(rel)otp}$.

8.5.5 Brownout protection

Brownout protection is designed to limit the lamp power when the input voltage drops close to the output voltage level. Since the input power has to remain constant, the input current would otherwise increase to a level that is too large for the input circuitry. For the SSL2109, there is a maximum limit on the on-time of switch $t_{on(high)}$.

The rate of current rise in the coil during the on-phase is proportional to the difference between input voltage and output voltage. Therefore, the peak current cannot be reached before $t_{on(high)}$ and as a result the average output current to the LEDs is reduced.

8.5.6 Short-Winding Protection (SWP); SSL2109T only

SWP activates if there is a steep rising current through the MOSFET. The voltage across the external resistor connected to the SOURCE pin increases. This current can occur when there is a short from the freewheel diode. Additionally, it occurs due to a small/shorted inductor between the input voltage and the DRAIN pin. If the voltage on the SOURCE pin is greater than 1.5 V, latched protection is triggered following LEB time t_{leb}. In addition, if V_{CC} drops lower than $V_{CC(rst)}$ the IC resets the latched protection mode.

8.5.7 Output Short-circuit Protection (OSP)

During the second stroke (switch-off time), if a valley is not detected within the off-time limit ($t_{off(high)}$), then typically the output voltage is less than the minimum limit allowed in the application. This condition can occur either during starting up or due to a short-circuit. A timer $t_{det(sc)}$ is started when $t_{off(high)}$ is detected. Timer $t_{det(sc)}$ is stopped when a valid valley detection occurs in one of the subsequent cycles.

The timer can also be stopped if the maximum limit on the on-time of the switch ($t_{on(high)}$) is reached, which is usually the case at start-up (brownout protection). If no valley is detected and ($t_{on(high)}$) is not reached before $t_{det(sc)}$, then it is concluded that a real short-circuit exists. The IC enters latched protection. If V_{CC} drops lower than $V_{CC(rst)}$, the IC resets the latched protection mode (see Figure 6). During PWM dimming, the OSP timer is paused during the off cycle.

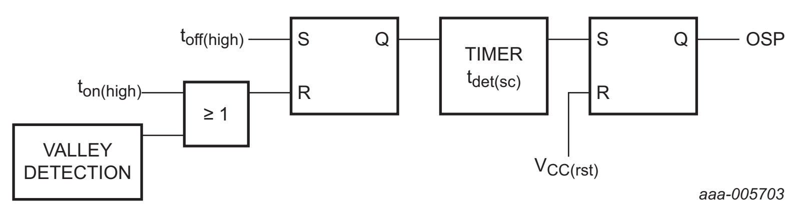


Fig 6. OPS logic diagram

8.6 VCC supply

The SSL2109 can be supplied using three methods:

- Under normal operation, the voltage swing on the DVDT pin is rectified within the IC providing current towards the VCC pin
- At start-up, there is an internal current source connected to the HV pin. The current source provides internal power until either the dV/dt supply or an external current on the VCC pin provides the supply

- An external voltage source can be connected to the VCC pin

The IC starts up when the voltage at the VCC pin is higher than $V_{CC(startup)}$. The IC locks out (stops switching) when the voltage at the VCC pin is lower than $V_{CC(stop)}$. The hysteresis between the start and stop levels allows the IC to be supplied by a buffer capacitor until the dV/dt supply is settled. The SSL2109 has an internal V_{CC} clamp, which is an internal active Zener (or shunt regulator). This internal active Zener limits the voltage on the supply VCC pin to the maximum value of V_{CC}. An external Zener diode is not needed in the supply circuit, if the maximum current of the dV/dt supply minus the current consumption of the IC (determined by the load on the gate drivers) is lower than the I_{DD} maximum value.

8.7 DVDT pin supply

The DVDT pin is connected to an internal single-sided rectification stage. When an alternating voltage with sufficient amplitude is supplied to the pin, the IC can be powered without any other external power connection. This solution provides an effective method to prevent the additional high-power losses, which would result if a regulator were used for continuously powering the IC. Unlike an auxiliary supply, additional inductor windings are not needed.

8.8 VCC regulator

During supply dips, the input voltage can drop too low to supply the required IC current through the DVDT pin. Under these conditions, if the VCC voltage drops lower than $V_{CC(swon)reg}$ level, another regulator with a current capability of up to $I_{HVhigh(oper)}$ is started. The job of the regulator is to fill in the required supply current, which the DVDT supply does not deliver preventing the IC going into UVLO. When the VCC voltage is higher than $V_{CC(swon)reg}$ level, the regulator is turned off.

8.9 NTC functionality and PWM dimming

The NTC pin can be used as a control method for LED thermal protection. Alternatively, the pin can be used as an input to disable/enable light output using a digital signal (PWM dimming). The pin has an internal current source that generates the current of $I_{offset(NTC)}$. An NTC resistor to monitor the LED temperature can be directly connected to the NTC pin. Depending on the resistance value and the corresponding voltage on the NTC pin, the converter reacts as shown in Figure 7.

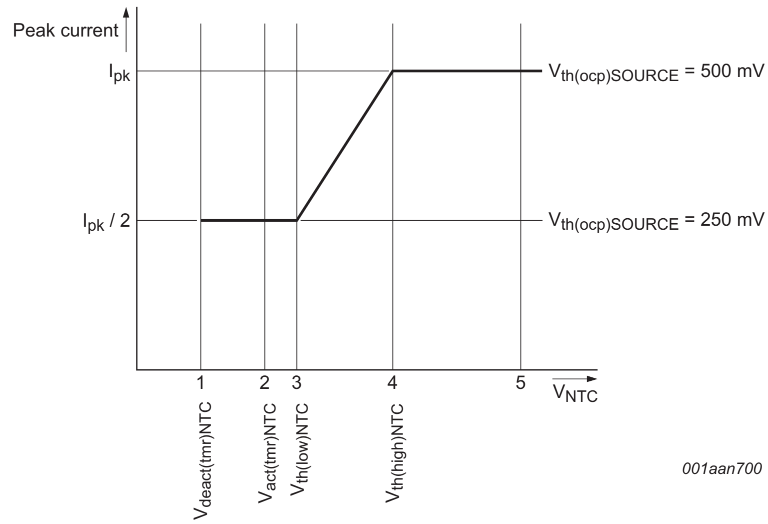


Fig 7. NTC control curve

When the voltage on the NTC pin is higher than $V_{th(high)NTC}$ see Figure 7 (4), the converter delivers nominal output current. When the voltage is lower than this level, the peak current is gradually reduced until $V_{th(low)NTC}$ is reached, see Figure 7 (3). The peak current is now half the peak current of nominal operation. When $V_{act(tmr)NTC}$ is passed, see Figure 7 (2) a timer starts to run to distinguish between the following situations:

- If the low-level $V_{deact(tmr)NTC}$ is not reached within time $t_{to(deact)NTC}$, Figure 7 (1) LED overtemperature is detected. The IC stops switching and attempts to restart from the HV pin voltage. Restart takes place when the voltage on NTC pin is higher than $V_{th(high)NTC}$, see Figure 7 (4). It is assumed that the reduction in peak current did not result in a lower NTC temperature and LED OTP is activated.
- If the low-level $V_{deact(tmr)NTC}$ is reached within the time $t_{to(deact)NTC}$, Figure 7 (1) it is assumed that the pin is pulled down externally. The restart function is not triggered. Instead, the output current is reduced to zero. PWM dimming can be implemented this way. The output current rises again when the voltage is higher than $V_{deact(tmr)NTC}$.

8.9.1 Soft-start function

The NTC pin can be used to make a soft start function. During switch-on, the level on the NTC pin is low. By connecting a capacitor (in parallel with the NTC resistor), a time constant can be defined. The time constant causes the level on the NTC pin to increase slowly. When passing level $V_{th(low)NTC}$ Figure 7 (3), the convertor starts with half of the maximum current. The output current slowly increases to maximum when $V_{th(high)NTC}$ Figure 7 (4) is reached.

9. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
General						
SR	slew rate	on pin DRAIN		–5	+5	V/ns
P_{tot}	total power dissipation	SO8 package		-	0.6	W
T_{amb}	ambient temperature			–40	+125	°C
T_j	junction temperature			–40	+150	°C
T_{stg}	storage temperature			–55	+150	°C
Voltages						
V_{CC}	supply voltage	continuous [1]		–0.4	+14	V
V_{DRAIN}	voltage on pin DRAIN	600 V version		–0.4	+600	V
V_{HV}	voltage on pin HV	current limited		–0.4	+600	V
V_{SOURCE}	voltage on pin SOURCE	current limited		–0.4	+5.2	V
V_{NTC}	voltage on pin NTC	current limited		–0.4	+5.2	V
Currents						
I_{DD}	supply current	at pin VCC		-	20	mA
I_{DVDT}	current on pin DVDT	duration 20 µs maximum		-	1.3	A
V_{ESD}	electrostatic discharge voltage	human body model; (for all pins except DRAIN and HV)	[2]	–2	+2	kV
		human body model for DRAIN and HV		–1	+1	kV
		charged device	[3]	–500	+500	V

[1] An internal clamp sets the supply voltage and current limits.

[2] Human body model: equivalent to discharging a 100 pF capacitor through a 1.5 kΩ series resistor.

[3] Charged device model: equivalent to charging the IC up to 1 kV and the subsequent discharging of each pin down to 0 V over a 1 Ω resistor.

10. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air; PCB: 2 cm × 3 cm; 2-layer; 35 µm Cu per layer	159	K/W
		in free air; PCB: JEDEC 2s2p	89	K/W
$\Psi_{j\text{-}top}$	thermal resistance from junction to top	top package temperature measured at the warmest point on top of the case	0.49	K/W

11. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
f_{conv}	conversion frequency			-	100	-	kHz
High-voltage							
$I_{leak(DRAIN)}$	leakage current on pin DRAIN	V_{DRAIN} = 600 V		-	-	10	µA
$I_{leak(HV)}$	leakage current on pin HV	V_{HV} = 600 V		-	-	30	µA
Supply							
V_{CC}	supply voltage	operating range	[1]	8	-	14	V
$V_{CC(startup)}$	start-up supply voltage			11	12	13	V
$V_{CC(stop)}$	stop supply voltage			8	9	10	V
$V_{CC(hys)}$	hysteresis of supply voltage	between $V_{CC(startup)}$ and $V_{CC(stop)}$		2	-	4.5	V
$V_{CC(rst)}$	reset supply voltage			4.5	5	5.5	V
$V_{CC(swon)reg}$	regulator switch-on supply voltage	insufficient dV/dt supply		8.75	9.25	9.75	V
$V_{CC(swoff)reg}$	regulator switch-off supply voltage	insufficient dV/dt supply		9.5	10	10.5	V
$V_{CC(reg)hys}$	regulator supply voltage hysteresis	$V_{CC(swoff)reg} - V_{CC(swon)reg}$		0.3	-	-	V
$V_{CC(regswon-stop)}$	supply voltage difference between regulator switch-on and stop	$V_{CC(swon)reg} - V_{CC(stop)}$		0.3	-	-	V
Consumption							
$I_{stb(HV)}$	standby current on pin HV	during start-up or in protection; V_{HV} = 100 V		300	350	400	µA
$I_{CC(INT)}$	internal supply current	normal operation		-	1.3	-	mA
Capability							
$I_{sup(high)HV}$	high supply current on pin HV	Standby: V_{HV} = 40 V; VCC < $V_{CC(stop)}$		1	1.3	1.6	mA
		Regulator On: V_{HV} = 40 V; VCC < $V_{CC(swon)reg}$ after start-up		2	2.3	2.6	mA
Current and SWP							
$V_{th(ocp)SOURCE}$	overcurrent protection threshold voltage on pin SOURCE	ΔV/Δt = 0.1 V/µs		480	500	520	mV
		ΔV/Δt = 0.1 V/µs; V_{NTC} = 0.325 V		230	250	270	mV
$t_{d(ocp-swoff)}$	delay time from overcurrent protection to switch-off	ΔV/Δt = 0.1 V/µs		-	75	100	ns
t_{leb}	leading edge blanking time	overcurrent protection		260	300	340	ns
		short-winding protection		210	250	290	ns
Δt_{leb}	leading edge blanking time difference	between t_{leb} for overcurrent protection and short-winding protection		30	50	-	ns
$V_{th(swp)SOURCE}$	short-winding protection threshold voltage on pin SOURCE	SSL2109T only		1.4	1.5	1.6	V

Table 6. Characteristics *…continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Valley detection						
$(\Delta V/\Delta t)_{vrec}$	valley recognition voltage change with time	on pin DRAIN	–30	–20	–10	V/µs
f_{ring}	ringing frequency	[2]	200	550	1000	kHz
$\Delta V_{vrec(min)}$	minimum valley recognition voltage difference	voltage drop on pin DRAIN	15	20	25	V
$t_{d(vrec-swon)}$	valley recognition to switch-on delay time		-	100	-	ns
Brownout detection						
$t_{on(high)}$	high on-time		12.5	15	17.5	µs
Driver (pin DRIVER)						
$I_{source(DRIVER)}$	source current on pin DRIVER	1.5 ms maximum; V_{DRIVER} = 2 V	-	–0.195	-	A
$I_{sink(DRIVER)}$	sink current on pin DRIVER	20 µs maximum; V_{DRIVER} = 2 V	-	0.28	-	A
		20 µs maximum; V_{DRIVER} = 10 V	-	0.46	-	A
$V_{o(DRIVER)max}$	maximum output voltage on pin DRIVER	VCC > $V_{CC(startup)}$	9	10.5	12	V
$V_{o(DRIVER)min}$	minimum output voltage on pin DRIVER	VCC = $V_{CC(stop)}$	6.5	7.5	8.5	V
NTC functionality						
$V_{th(high)NTC}$	high threshold voltage on pin NTC		0.47	0.5	0.53	V
$V_{th(low)NTC}$	low threshold voltage on pin NTC		0.325	0.35	0.375	V
$V_{act(tmr)NTC}$	timer activation voltage on pin NTC		0.26	0.3	0.325	V
$V_{deact(tmr)NTC}$	timer deactivation voltage on pin NTC		0.17	0.2	0.23	V
$t_{to(deact)NTC}$	deactivation time-out time on pin NTC		33	46	59	µs
$I_{offset(NTC)}$	offset current on pin NTC		-	–47	-	µA
OSP						
$t_{det(sc)}$	short-circuit detection time		16	20	24	ms
$t_{off(high)}$	high off-time		30	36	42	µs
Temperature protection						
$T_{th(act)otp}$	overtemperature protection activation threshold temperature		160	170	180	°C
$T_{th(rel)otp}$	overtemperature protection release threshold temperature		90	100	110	°C

[1] The maximum operating voltage at VCC can exceed 14 V when determined by the IC using the dV/dt supply.

[2] This parameter is not tested during production, by design it is guaranteed

12. Application information

A LED driver with the SSL2109 can be a buck, tapped buck or flyback converter operating in BCM. Figure 8 shows a buck solution in a low ripple configuration using a minimum of components.

Capacitor C3 buffers the IC supply voltage, which is powered via the HV pin at start-up and via C5 during normal operation. Sense resistors R4 and R5 converts the current through MOSFET Q1 into a voltage on pin Source. The value of these resistors defines the maximum primary peak current on MOSFET Q1, and thus the LED current. Resistor R6 reduces the reverse current into the DRIVER pin. The DRAIN pin is connected with the drain of Q1 for valley detection.

In the example shown in Figure 8, the NTC pin is used for temperature protection. The temperature level is set by Negative Temperature Coefficient (NTC) resistor R3 and capacitor C4 reduces noise on the NTC pin. Further information can be found in the SSL2109 application note.

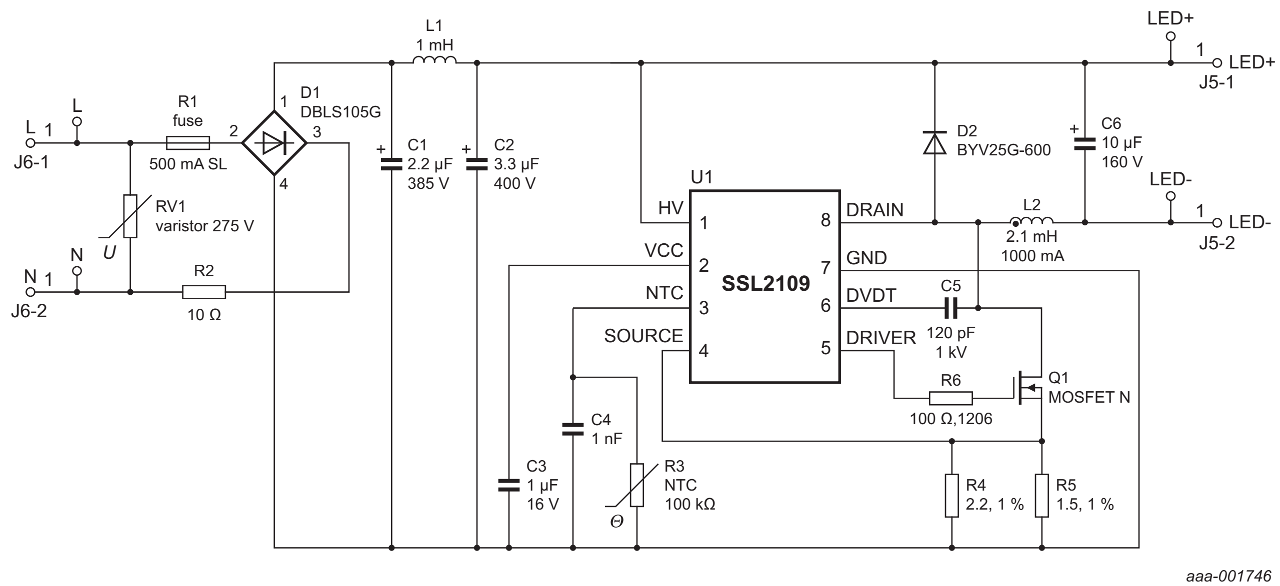
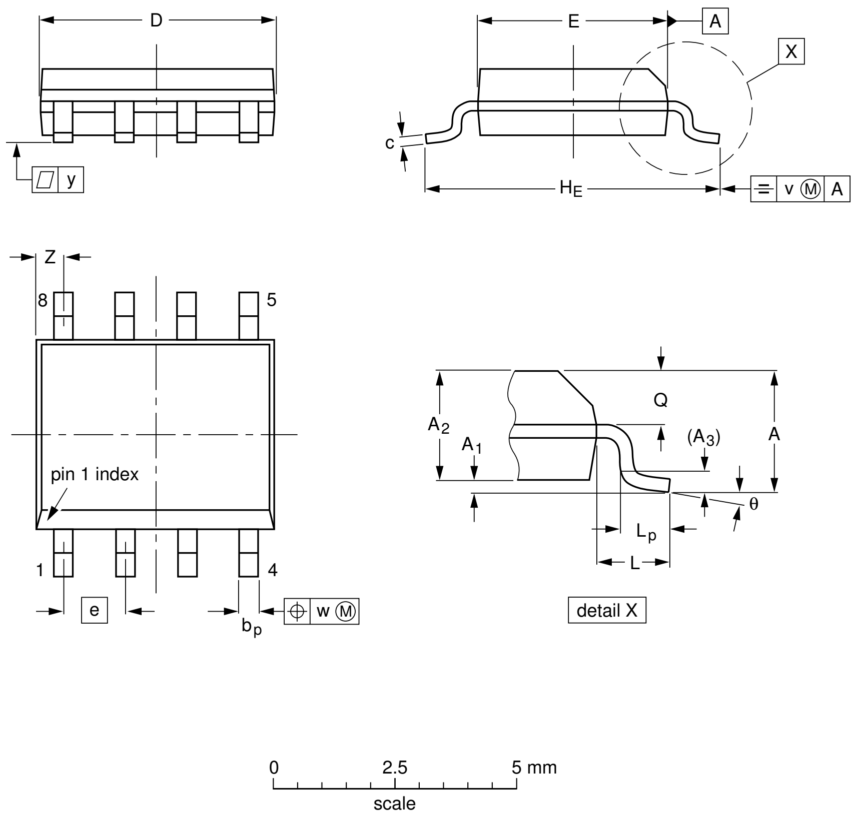


Fig 8. A typical SSL2109 buck low ripple application

13. Package outline

SO8: plastic small outline package; 8 leads; body width 3.9 mm **SOT96-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D(1)	E(2)	e	H_E	L	L_p	Q	v	w	y	Z(1)	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Notes

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT96-1	076E03	MS-012				~~99-12-27~~ 03-02-18

Fig 9. Package outline SOT96-1 (SOT8)

14. Abbreviations

Table 7. Abbreviations

Acronym	Description
BCM	Boundary Conduction Mode
BOM	Bill Of Materials
LEB	Leading-Edge Blanking
LED	Light Emitting Diode
MOSFET	Metal-Oxide Semiconductor Field-Effect Transistor
OCP	OverCurrent Protection
OSP	Output Short Protection
OTP	OverTemperature Protection
PCB	Printed-Circuit Board
PWM	Pulse-Width Modulation
SWP	Short-Winding Protection
UVLO	UnderVoltage LockOut
ZCS	Zero-Current Switching

15. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
SSL2109_SER v.4	20121026	Product data sheet	-	SSL2109T v.3
SSL2109_SER v.3	20120604	Product data sheet	-	SSL2109T v.2
SSL2109T v.2	20120426	Product data sheet	-	SSL2109 v.1.1
SSL2109 v.1.1	20120410	Preliminary data sheet	-	SSL2109 v.1
SSL2109 v.1	20120330	Preliminary data sheet	-	-

16. Legal information

16.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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18. Contents

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