



SSL2108 series

GreenChip drivers for LED lighting

Rev. 4 — 8 May 2012

Product data sheet

1. General description

The SSL2108 series is a range of high-voltage Integrated Circuits (ICs) for driving LED lamps in general lighting applications.

The main benefits of the product family are:

- Small Printed-Circuit Board (PCB) footprint, and compact solution
- High efficiency (up to 95 %)
- Ease of integration
- Low electronic Bill Of Material (BOM)

The product family is made of ICs with a range of internal HV switches for easy power scaling.

The ICs work as boundary conduction mode converters, typically in buck configuration. 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. The IC consumes 1.3 mA of supply current with an internal clamp limiting the supply voltage.

The ICs provide accurate output current control with LED current accuracy within 5 %. The ICs can be operated using Pulse-Width Modulation (PWM) dimming and has many protection features including easy LED temperature feedback.

Remark: This data sheet covers the both the T and AT versions of the SSL21081, SSL21082, SSL21083 and SSL21084. Unless the version is explicitly stated, SSL2108XT refers to all T versions.

2. Features and benefits

- LED driver IC family driving strings of LEDs from a rectified mains supply
- High-efficiency switch mode buck driver product family:
 - ◆ Drivers with integrated 300 V (DC) (SSL21081 and SSL21082) or 600 V (DC) (SSL21083 and SSL21084) power switches
- Controller with power-efficient boundary conduction mode of operation with:
 - ◆ No reverse recovery losses in freewheel diode
 - ◆ Zero Current Switching (ZCS) for turn-on of switch
 - ◆ Zero voltage or valley switching for turn-on of switch
 - ◆ Minimal required inductance value and size



- Direct PWM dimming possible
- Fast transient response through cycle-by-cycle current control:
 - ◆ Negligible AC mains ripple at LED current and minimal total capacitor value
 - ◆ No over or undershoots in the LED current
- No binning on LED forward voltage required
- Internal Protections:
 - ◆ UnderVoltage LockOut (UVLO)
 - ◆ Leading-Edge Blanking (LEB)
 - ◆ OverCurrent Protection (OCP)
 - ◆ Short-Winding Protection (SWP) SSL2108XT only
 - ◆ Internal OverTemperature Protection (OTP)
 - ◆ Brownout protection
 - ◆ Output Short Protection (OSP)
- Low component count (see [Figure 4](#)) LED driver solution:
 - ◆ No Schottky diode required due to ZCS
 - ◆ No dim switch and high-side driver required for PWM dimming
 - ◆ Easy external temperature protection with a single NTC resistor
 - ◆ Option for soft-start function
 - ◆ Compatible with wall switches with built-in indication light during standby¹
- IC lifetime easily matches or surpasses LED lamp lifetime

3. Applications

SSL2108 series products are intended for compact LED lighting applications with accurate fixed current output for single mains input voltages. Mains input voltages include 100 V (AC), 120 V (AC) and 230 V (AC). The output signal can be modulated using a PWM signal.

1. The Hotaru switch is a well known wall switch with built-in light

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage	operating range	[1] 8	-	14	V
$R_{DS(on)}$	drain-source on-state resistance	SSL21083T/AT; SSL21084T/AT; $T_j = 25\text{ }^{\circ}\text{C}$	4	5	6	Ω
		SSL21083T/AT; SSL21084T/AT; $T_j = 125\text{ }^{\circ}\text{C}$	6	7.5	9	Ω
		SSL21081T/AT; SSL21082T/AT; $T_j = 25\text{ }^{\circ}\text{C}$	2.05	2.3	2.55	Ω
		SSL21081T/AT; SSL21082T/AT; $T_j = 125\text{ }^{\circ}\text{C}$	3.05	3.45	3.85	Ω
f_{conv}	conversion frequency		-	-	200	kHz
I_{DRAIN}	current on pin DRAIN	SSL21083T/AT; SSL21084T/AT	-1	-	1	A
		SSL21081T/AT; SSL21082T/AT	-2	-	2	A
V_{DRAIN}	voltage on pin DRAIN	SSL21083T/AT; SSL21084T/AT	-0.4	-	600	V
		SSL21081T/AT; SSL21082T/AT	-0.4	-	300	V

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

5. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
SSL21081T	SO8	plastic small package outline body; 8 leads; body width 3.9 mm	SOT96-1
SSL21083T			
SSL21081AT			
SSL21083AT			
SSL21082T	SO12	plastic small package outline body; 12 leads; body width 3.9 mm	SOT1196-1
SSL21084T			
SSL21082AT			
SSL21084AT			

5.1 Ordering options

Remark: All voltages are in V (AC) unless otherwise specified.

Table 3. Ordering options

SSL2108 series variants	Input voltage	Internal MOSFET characteristics	Package	Brownout protection selectable
SSL21081T	100 V; 120 V	300 V (DC); 2 Ω	SO8	no
SSL21081AT				
SSL21082T			SO12	yes
SSL21082AT				
SSL21083T	100 V; 120 V; 230 V	600 V (DC); 5 Ω	SO8	no
SSL21083AT				
SSL21084T			SO12	yes
SSL21084AT				

[1] The SO12 package variants have more so called fused leads than the SO8 variants and can be used when higher output power is required.

6. Block diagram

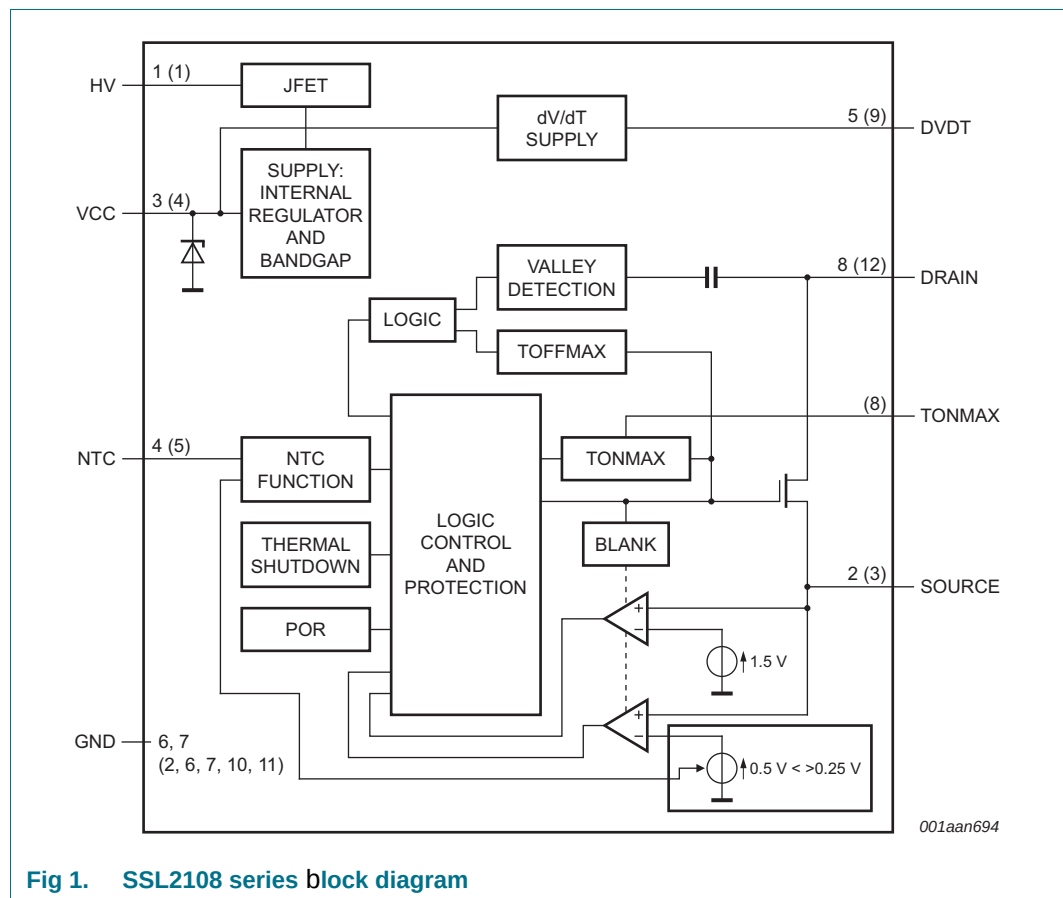
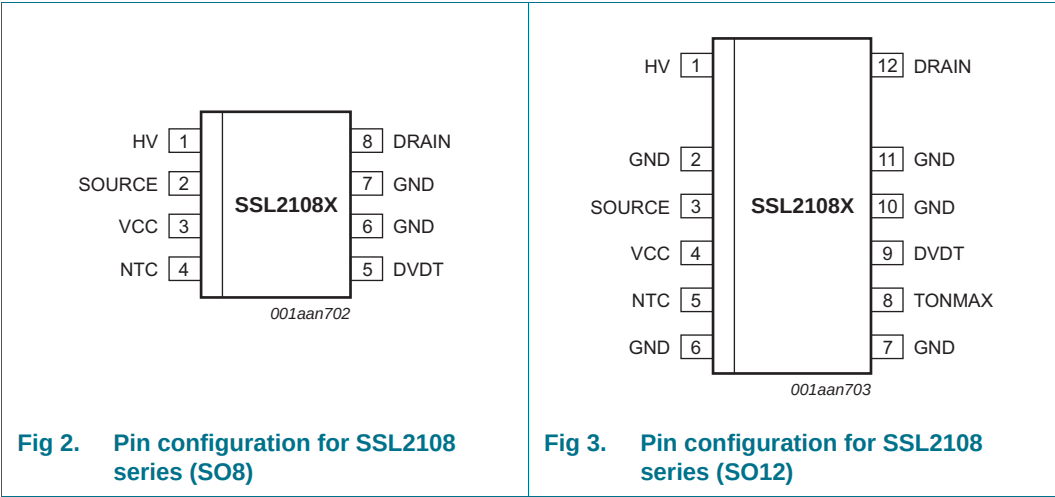


Fig 1. SSL2108 series block diagram

7. Pinning information

7.1 Pinning



7.2 Pin description

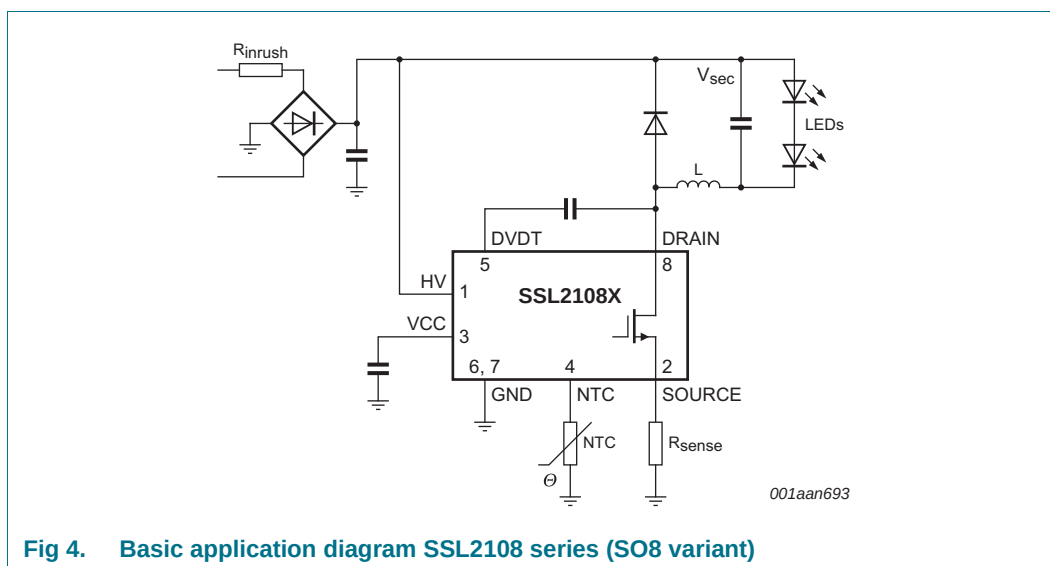
Table 4. Pin description

Symbol	Pin (SO8)	Pin (SO12)	Description
HV	1	1	high-voltage supply pin
SOURCE	2	3	low-side internal switch
VCC	3	4	supply voltage
NTC	4	5	LED temperature protection input
GND	6,7	2,6,7,10,11	ground
DVDT	5	9	AC supply pin
TONMAX	-	8	brownout protection timer input
DRAIN	8	12	high-side internal switch

8. Functional description

8.1 Converter operation

The converter in the SSL2108 series is a Boundary Conduction Mode (BCM), peak current controlled system. For the basic application diagram see [Figure 4](#), for the waveforms see [Figure 5](#). 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 internal MOSFET switch is switched on. Thereafter, the amplitude of the current build-up in L is proportional to $V_{IN} - V_{OUT}$ and the time that the internal MOSFET switch is on. When the internal MOSFET switch is switched off, the current continues to flow through the freewheel diode and the output capacitor. The current then falls at a rate proportional to the value of V_{OUT} . The LED current I_{LED} is almost equal to half the peak switch current. A new cycle is started, as soon as the inductor current I_L is zero.



8.2 Conversion frequency

The conversion frequency must be limited to below 200 kHz. Therefore, select an inductance value so that the conversion frequency is always within limits, given the supply voltage, LED voltage and component spread.

8.3 Valley detection

A new cycle is started when the primary switch is switched on (see [Figure 5](#)). Following time t_1 , when the peak current is detected on the SOURCE pin, the switch is turned off and the secondary stroke starts (3). When the secondary stroke is complete and the coil current at t_3 equals zero, the drain voltage starts to oscillate around the $V_{IN} - V_{OUT}$ level. The amplitude equals V_{OUT} . A special feature, called valley detection is an integrated part of the SSL2108 series 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 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. 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.

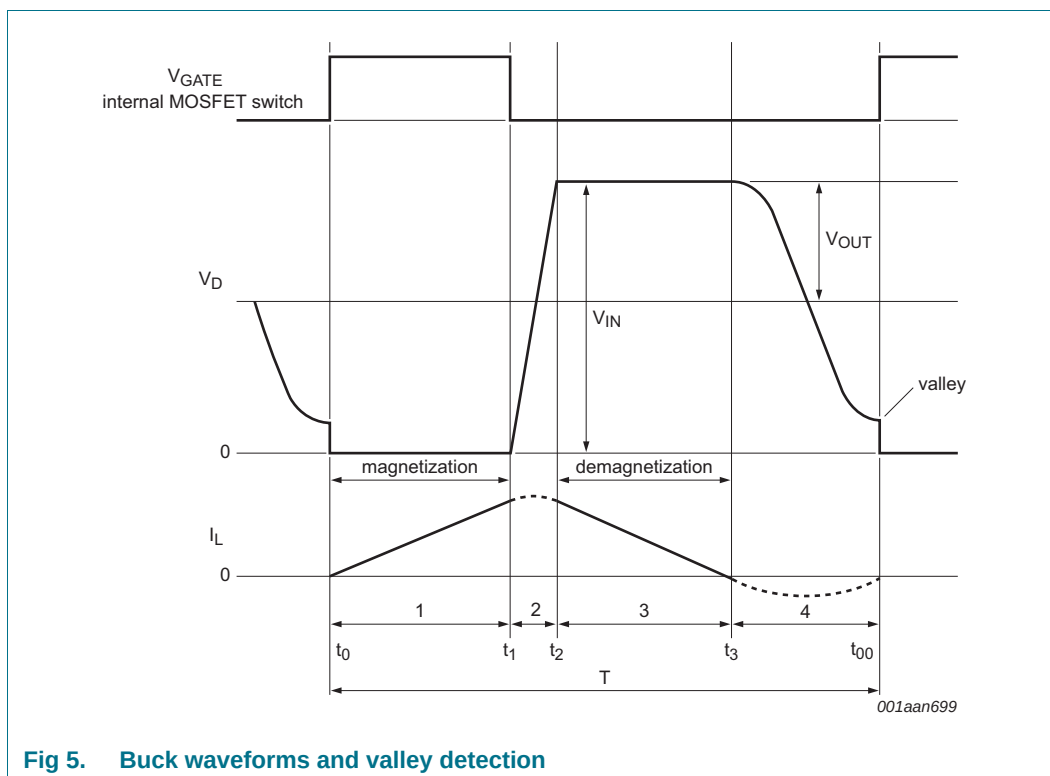


Fig 5. Buck waveforms and valley detection

8.4 Protective features

The IC has the following protective features:

- UnderVoltage LockOut (UVLO)
- Leading-Edge Blanking (LEB)
- OverCurrent Protection (OCP)
- Internal OverTemperature Protection (OTP)
- Brownout protection
- Short-Winding Protection (SWP) SSL2108XT 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. The IC halts, causing V_{CC} to fall lower than $V_{CC(stop)}$, and instigates start-up. Switching starts only when no fault condition exists.

8.4.1 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.

8.4.2 Leading-Edge Blanking (LEB)

To prevent false detection of the short-winding or overcurrent, a blanking time following switch-on is implemented. When the internal 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.

8.4.3 OverCurrent Protection (OCP)

The SSL2108 series 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 by the resistor in series to the SOURCE pin.

8.4.4 OverTemperature Protection (OTP)

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

8.4.5 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 SSL2108 series, there is a maximum limit on the on-time of the 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.

Using the SO12 package, the $t_{on(high)}$ can be lowered by connecting a capacitor to the TONMAX pin. The external capacitor is charged during the primary stroke with I_{TONMAX} . If V_{TONMAX} level is reached before the $t_{on(high)}$ time, the switch is turned off and the secondary stroke starts. When no capacitor is connected to the pin, V_{TONMAX} is reached quickly, shorter than the minimum limit of one microsecond. In this case, or in case the TONMAX pin is grounded, the internal time constant, $t_{on(high)}$ determines the maximum on-time.

8.4.6 Short-Winding Protection (SWP) SSL2108XT only

SWP activates if there is a steep rising current through the MOSFET and thus through the external resistor connected to the SOURCE pin. 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.

8.4.7 Output Short Protection (OSP)

During the second stroke (switch-off time), if a valley is not detected within the off-time limit ($t_{\text{off(high)}}$), 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. A timer is started when $t_{\text{off(high)}}$ is detected, and is stopped only if a valid valley-detection occurs in one of the subsequent cycles. If no valley is detected for $t_{\text{det(sc)}}$, it is concluded that a real short-circuit exists and not start-up. The IC enters latched protection. If V_{CC} drops lower than $V_{\text{CC(rst)}}$, the IC resets the latched protection mode. During PWM dimming, the OSP timer is paused during the off-cycle of the PWM signal.

8.5 VCC supply

The SSL2108 series 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 $V_{\text{CC(startup)}}$. The IC locks out (stops switching) when the voltage at the VCC pin is lower than $V_{\text{CC(stop)}}$. 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 SSL2108 series 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} . 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 maximum value of I_{DD} no external Zener diode is needed in the dV/dt supply circuit.

8.6 DVDT 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.

8.7 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 $V_{\text{CC(swon)reg}}$ level, another regulator with a current capability of up to $I_{\text{sup(high)HV}}$ is started. The job of the regulator is to fill in the required supply current, which the DVDT supply does not deliver, thus preventing the IC going into UVLO. When the VCC voltage is higher than $V_{\text{CC(swon)reg}}$ level, the regulator is turned off.

8.8 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 $I_{\text{offset(NTC)}}$. 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 6](#).

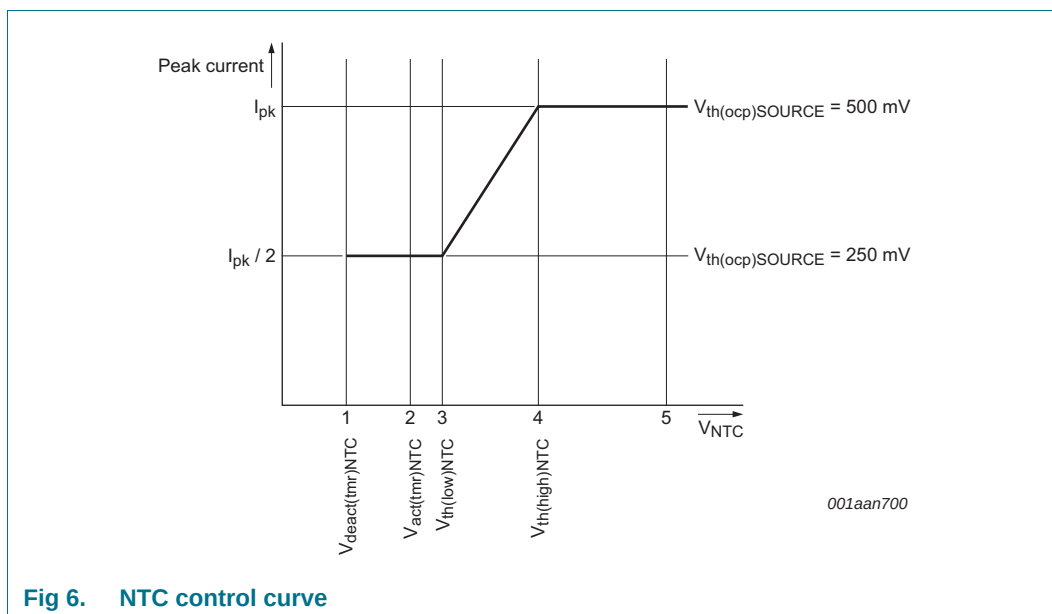


Fig 6. NTC control curve

When the voltage on the NTC pin is higher than $V_{\text{th(high)NTC}}$ see [Figure 6](#) (4), the converter delivers nominal output current. When the voltage is lower than this level, the peak current is gradually reduced until $V_{\text{th(low)NTC}}$ is reached, see [Figure 6](#) (3). The peak current is now half the peak current of nominal operation. When $V_{\text{act(tmr)NTC}}$ is passed, see [Figure 6](#) (2) a timer starts to run to distinguish between the following situations:

- If the low-level $V_{\text{deact(tmr)NTC}}$ is not reached within time $t_{\text{to(deact)NTC}}$, [Figure 6](#) (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 $V_{\text{th(high)NTC}}$, see [Figure 6](#) (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 $V_{\text{deact(tmr)NTC}}$ is reached within the time $t_{\text{to(deact)NTC}}$, [Figure 6](#) (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 $V_{\text{deact(tmr)NTC}}$.

8.8.1 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 $V_{\text{th(low)NTC}}$ [Figure 6](#) (3), the convertor starts with half of the maximum current. The output current slowly increases to maximum when $V_{\text{th(high)NTC}}$ [Figure 6](#) (4) is reached.

8.9 Heat sink

For SSL2108 series applications, the copper of the PCB acts as the heat sink. The SSL2108 series (SO12) uses thermal leads (pins 2, 6, 10 and 11) for enhanced heat transfer from die to the PCB copper heat sink. The thermal lead connection can drastically reduce thermal resistance.

[Equation 1](#) shows the relation between the maximum allowable power dissipation P and the thermal resistance from junction to ambient.

$$R_{th(j-a)} = (T_{j(max)} - T_{amb}) / P \quad (1)$$

Where:

$R_{th(j-a)}$ = thermal resistance from junction to ambient

$T_{j(max)}$ = maximum junction temperature

T_{amb} = ambient temperature

P = power dissipation

9. Limiting values

Table 5. 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
f _{conv}	conversion frequency		-	200	kHz
P _{tot}	total power dissipation	SO8 package	-	0.6	W
		SO12 package	-	1	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 (DC) version	−0.4	+600	V
		300 V (DC) version	−0.4	+300	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
V _{TONMAX}	voltage on pin TONMAX	current limited	−0.4	+5.2	V
Currents					
I _{DD}	supply current	at pin VCC	[1] -	20	mA
I _{DRAIN}	current on pin DRAIN	600 V (DC) version	−1	+1	A
		300 V (DC) version	−2	+2	A
I _{SOURCE}	current on pin SOURCE	600 V (DC) version	−1	+1	A
		300 V (DC) version	−2	+2	A
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 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air; SO8 package; PCB: 2 cm × 3 cm, 2-layer, 35 μm Cu per layer	142	K/W
		in free air; SO12 package; PCB: 2 cm × 3 cm, 2-layer, 35 μm Cu per layer	121	K/W
		in free air; SO8 package; PCB: JEDEC 2s2p	72	K/W
		in free air; SO12 package; PCB: JEDEC 2s2p	53	K/W
Ψ_{j-top}	thermal resistance from junction to top	top package temperature measured at the warmest point on top of the case; SO8 package	3.4	K/W
		top package temperature measured at the warmest point on top of the case; SO12 package	4.7	K/W

11. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
High-voltage						
I _{leak(DRAIN)}	leakage current on pin DRAIN	V _{DRAIN} = 600 V (DC)	-	-	10	μA
		V _{DRAIN} = 300 V (DC)	-	-	10	μA
I _{leak(HV)}	leakage current on pin HV	V _{HV} = 600 V (DC)	-	-	30	μA
		V _{HV} = 300 V (DC)	-	-	30	μA
Supply						
V _{CC}	supply voltage	operating range	11 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	-	-	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}	supply current	normal operation	-	1.3	-	mA

Table 7. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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	SSL2108XT only	1.4	1.5	1.6	V
Valley detection						
(ΔV/Δt) _{vrec}	valley recognition voltage change with time	on pin DRAIN	−30	−20	−10	V/μs
f _{ring}	ringing frequency		[2] 200	550	1000	kHz
ΔV _{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						
V _{th(TONMAX)}	threshold voltage on pin TONMAX		3.75	4	4.25	V
I _{offset(TONMAX)}	offset current on pin TONMAX		−37	−43	−48	μA
t _{on(high)}	high on-time		12.5	15	17.5	μs
MOSFET output stage						
V _{BR(DRAIN)}	breakdown voltage on pin DRAIN	600 V (DC) version; T _j > 0 °C	600	-	-	V
		300 V (DC) version; T _j > 0 °C	300	-	-	V
R _{DSon}	drain-source on-state resistance	600 V (DC) version; T _j = 25 °C	4	5	6	Ω
		600 V (DC) version; T _j = 125 °C	6	7.5	9	Ω
		300 V (DC) version; T _j = 25 °C	2.05	2.3	2.55	Ω
		300 V (DC) version; T _j = 125 °C	3.05	3.45	3.85	Ω
(dV/dt) _{f(DRAIN)}	fall rate of change of voltage on pin DRAIN	300 V (DC) version; C _{DRAIN} = 150 pF, R _{SOURCE} = 2.2 Ω	[2] -	1.2	-	V/ns
		600 V (DC) version; C _{DRAIN} = 75 pF; R _{SOURCE} = 1.2 Ω	-	1.5	-	V/ns

Table 7. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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	0.29	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 protections						
$T_{th(act)otp}$	overtemperature protection activation threshold temperature		160	170	180	$^{\circ}C$
$T_{th(rel)otp}$	overtemperature protection release threshold temperature		90	100	110	$^{\circ}C$

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

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

12. SSL2108 series buck configuration

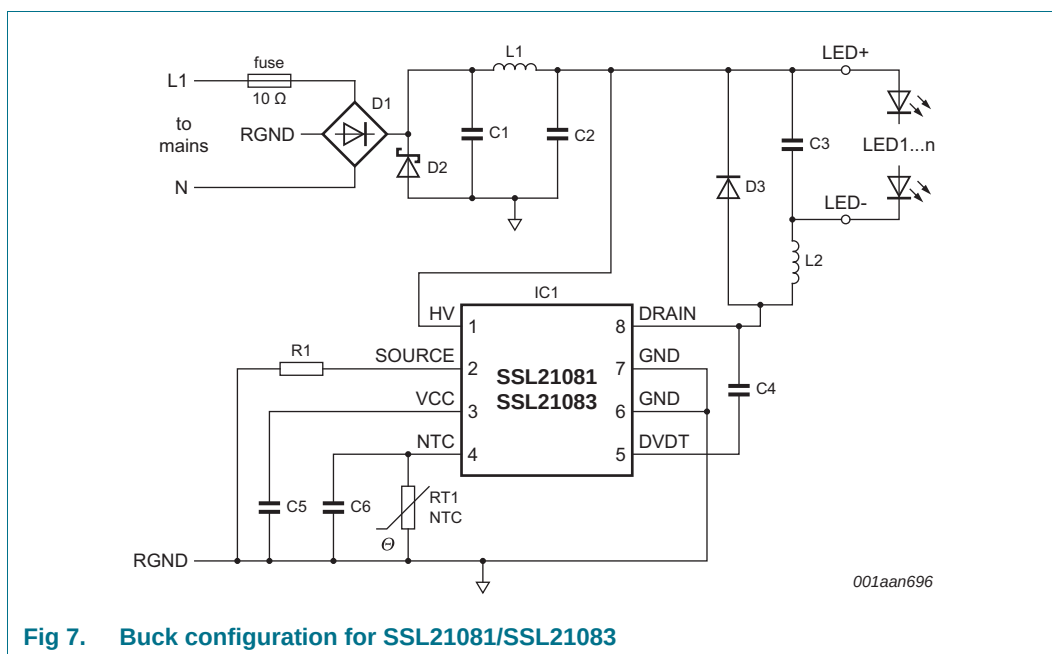


Fig 7. Buck configuration for SSL21081/SSL21083

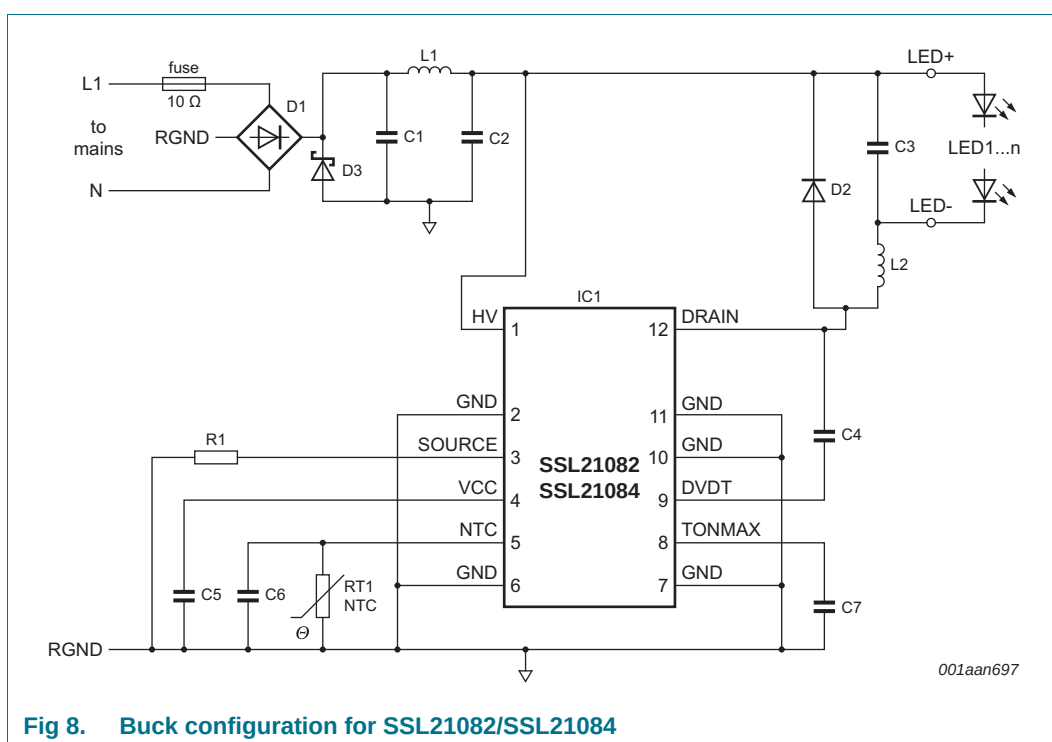


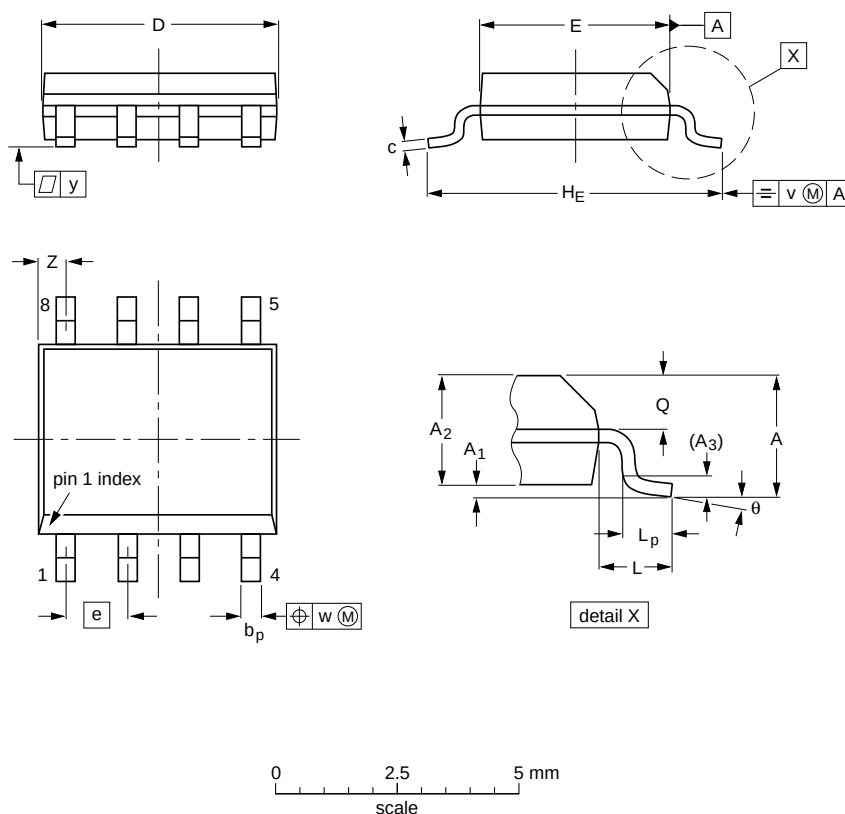
Fig 8. Buck configuration for SSL21082/SSL21084

Further application information can be found in the *SSL2108 series application note*.

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

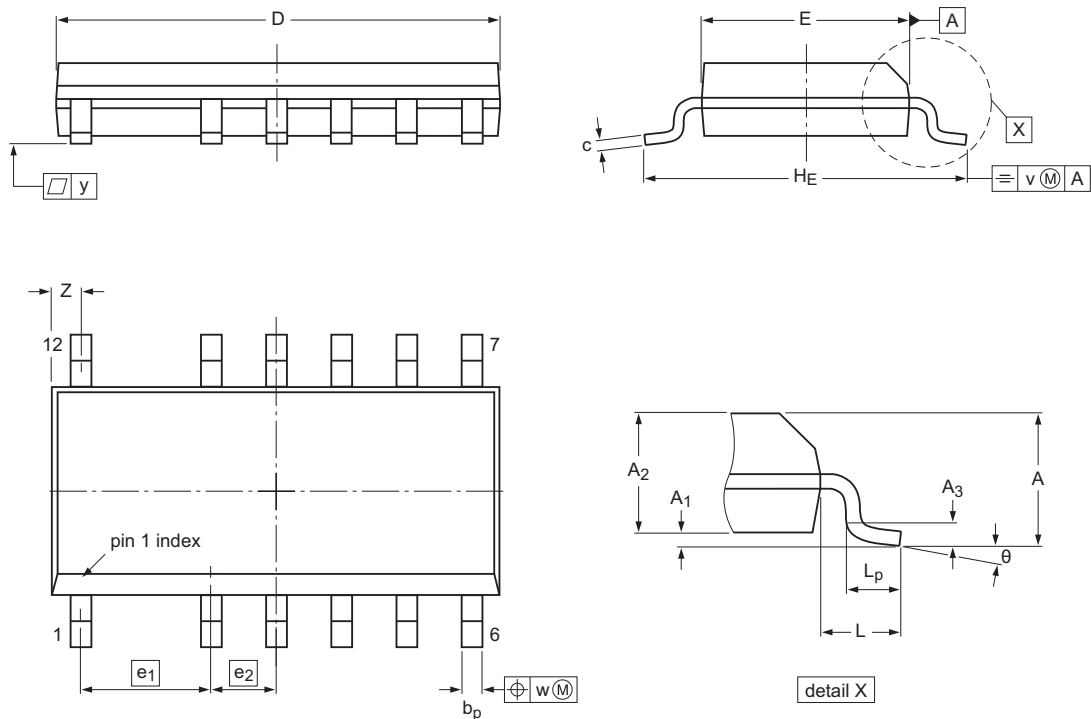
1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

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)

SO12: plastic small outline package; 12 leads; body width 3.9 mm

SOT1196-1



Dimensions

Unit	A	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e ₁	e ₂	H _E	L	L _p	Q	v	w	y	Z ⁽²⁾	θ
max	1.75	0.25	1.45		0.49	0.25	8.75	4.0			6.2		1.0	0.70				0.7	8°
nom		0.18	1.35	0.25	0.43	0.22	8.65	3.9	2.54	1.27	6.0	1.05	0.7	0.65	0.25	0.25	0.1	0.5	4°
min		0.10	1.25		0.36	0.10	8.55	3.8			5.8		0.4	0.60				0.3	0°

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

sot1196-1_po

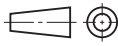
Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1196-1	---	MS-012 Compliant	---			11-02-15 11-02-16

Fig 10. Package outline SOT1196-1 (SOT12)

14. Abbreviations

Table 8. Abbreviations

Acronym	Description
BCM	Boundary Conduction Mode
BOM	Bill Of Materials
LED	Light Emitting Diode
LEB	Leading-Edge Blanking
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. References

- [1] **AN11040** — Drivers for LED lighting - application note

16. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
SSL2108_SER v.4	20120508	Product data sheet	-	SSL21081T_2T_3T_4T v.3.1
Modifications:	• SSL21081AT, SSL21082AT, SSL21083AT and SSL21084AT added. • Minor text changes throughout the data sheet.			
SSL21081T_2T_3T_4T v.3.1	20120222	Product data sheet	-	SSL21081T_2T_3T_4T v.3
SSL21081T_2T_3T_4T v.3	20120214	Product data sheet	-	SSL21081T_2T_3T_4T v.2
SSL21081T_2T_3T_4T v.2	20111206	Preliminary data sheet	-	SSL2108X v.1
SSL2108X v.1	20110909	Preliminary data sheet	-	-

17. Legal information

17.1 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>.

17.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

17.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Non-automotive qualified products — Unless this data sheet expressly states that this specific NXP Semiconductors product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NXP Semiconductors accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NXP Semiconductors' warranty of the

product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

17.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

GreenChip — is a trademark of NXP B.V.

18. Contact information

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: salesaddresses@nxp.com

19. Contents

1	General description	1
2	Features and benefits	1
3	Applications	2
4	Quick reference data	3
5	Ordering information	3
5.1	Ordering options	4
6	Block diagram	4
7	Pinning information	5
7.1	Pinning	5
7.2	Pin description	5
8	Functional description	6
8.1	Converter operation	6
8.2	Conversion frequency	6
8.3	Valley detection	6
8.4	Protective features	7
8.4.1	UnderVoltage LockOut (UVLO)	8
8.4.2	Leading-Edge Blanking (LEB)	8
8.4.3	OverCurrent Protection (OCP)	8
8.4.4	OverTemperature Protection (OTP)	8
8.4.5	Brownout protection	8
8.4.6	Short-Winding Protection (SWP) SSL2108XT only	8
8.4.7	Output Short Protection (OSP)	9
8.5	VCC supply	9
8.6	DVDT supply	9
8.7	VCC regulator	9
8.8	NTC functionality and PWM dimming	10
8.8.1	Soft-start function	10
8.9	Heat sink	11
9	Limiting values	12
10	Thermal characteristics	13
11	Characteristics	13
12	SSL2108 series buck configuration	16
13	Package outline	17
14	Abbreviations	19
15	References	19
16	Revision history	20
17	Legal information	21
17.1	Data sheet status	21
17.2	Definitions	21
17.3	Disclaimers	21
17.4	Trademarks	22
18	Contact information	22
19	Contents	23

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

© NXP B.V. 2012.

All rights reserved.

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 8 May 2012

Document identifier: SSL2108_SER