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MARKING DIAGRAM

CL30059

The NCL30059 is a self-oscillating high voltage MOSFET driver primarily tailored for LED driver applications using half-bridge topology. LLC and LCC configurations are supported with optimized wide range control offered by the latter for Constant Current (CC) applications. Due to its proprietary 600 V technology, the driver is useful for bulk voltages utilized in 277 VAC lighting applications. Operating frequency of the driver can be adjusted from 25 kHz to 250 kHz using a single resistor. Adjustable brown-out protection assures correct bulk voltage operating range. An internal 100 ms PFC delay timer ensures the converter is enabled after the bulk voltage is fully stabilized. The device provides fixed dead-time which helps to lower the shoot-through current.

Features C

ORDERING INFORMATION

Device	Package	Shipping [†]
NCL30059BDR2G	SOIC 8	2500 /
	(Pb Free)	Tape & Reel

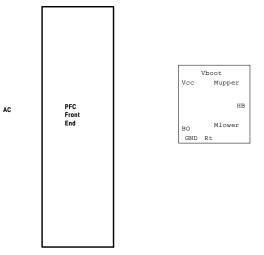
PSR Current Regulation $\pm 2\%$ Efficiency up to 92% SOIC-8 Package These are Pb-Free Devices

Typical Applications

Low Cost Resonant Converters Low Parts Count CV and CC LED Drivers Wide Output Voltage Range LCC Drivers Wallpack and Bollard LED Drivers High Bay and Streetlight LED Drivers

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PIN FUNCTION DESCRIPTION

Pin #	Pin Name	Function	Pin Description	
1	V _{CC}	Supplies the Driver	The driver accepts up to 16 V (given by internal zener clamp).	
2	Rt	Timing Resistor	Connecting a resistor between this pin and GND, sets the operating frequency	
3	BO	Brown Out	Detects low input voltage conditions. When brought above V_{latch} , it fully latches off the driver.	
4	GND	IC Ground		
5	M _{lower}	Low Side Driver Output	Drives the lower side MOSFET.	
6	HB	Half Bridge Connection	Connects to the half bridge output.	
7	M _{upper}	High Side Driver Output	Drives the higher side MOSFET.	
8	V _{boot}	Bootstrap Pin	The floating supply terminal for the upper stage.	

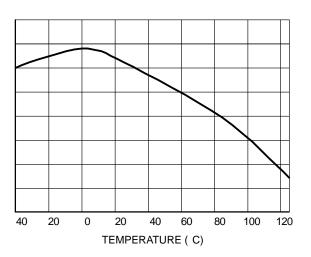
MAXIMUM RATINGS TABLE

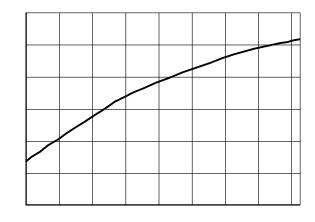
Symbol	Rating	Value	Unit V	
V _{bridge}	High Voltage Bridge Pin Pin 6	1 to +600		
Vboot Vbridge	Floating Supply Voltage	0 to 20	V	
VDRV_HI	High Side Output Voltage	Vbridge 0.3 to Vboot + 0.3	V	
VDRV_LO	Low Side Output Voltage	0.3 to V _{CC} +0.3	V	
dVbridge/dt	Allowable Output Slew Rate	±50	V/ns	
I _{CC}	Maximum Current that Can Flow into V_{CC} Pin (Pin 1), (Note 1)	20	mA	
V_Rt	Rt Pin Voltage	0.3 to 5	V	
	Maximum Voltage, All Pins (Except Pins 4 and 5)	0.3 to 10	V	
R_{\thetaJA}	Thermal Resistance Junction to Air, IC Soldered on 50 mm 2 Cooper 35 μm	178	C/W	
R_{\thetaJA}	Thermal Resistance Junction to Air, IC Soldered on 200 mm^2 Cooper 35 μm	147	C/W	
	Storage Temperature Range	60 to +150	С	
	ESD Capability, Human Body Model (All Pins Except Pins 1 , 6, 7 and 8)	2	kV	
	ESD Capability, Machine Model (All Pins Except Pins 1, 6, 7 and 8)	200	V	

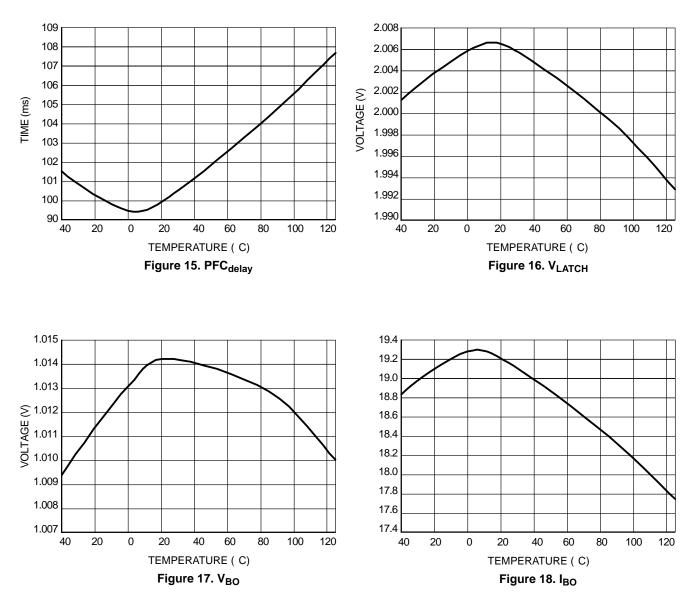
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
This device contains internal zener clamp connected between V_{CC} and GND terminals. Current flowing into the V_{CC} pin has to be limited by an external resistor when device is supplied from supply which voltage is higher than VCC_{clamp} (16 V typically). The I_{CC} parameter is respired for VPO. specified for VBO = 0 V.

ELECTRICAL CHARACTERISTICS (For typical values $T_J = 25$ C, for min/max values $T_J = 40$ C to +125 C, Max $T_J = 150$ C, $V_{CC} = 12$ V, unless otherwise noted)

Characteristic	Pin	Symbol	Min	Тур	Max	Unit
SUPPLY SECTION						
Turn On Threshold Level, V _{CC} Going Up	1	VCC _{ON}	10	11	12	V
Minimum Operating Voltage after Turn On	1					







APPLICATION INFORMATION

The NCL30059 is primarily intended to drive low cost half-bridge applications. It supports LLC and optimized LCC topologies offering wide output voltage range in constant current (CC) mode making it ideal for LED drivers. The IC includes several features that help the designer to cope with resonant SPMS design. All features are described thereafter:

Wide Operating Frequency Range: The internal current controlled oscillator is capable to operate over wide frequency range up to 250 kHz. Minimum frequency accuracy is $\pm 3\%$.

Fixed Dead–Time: Internal dead–time control is optimized to avoid cross conduction or shoot–through during transitions between low and high side conduction.

100 ms PFC Timer: Fixed delay is placed to IC operation whenever the driver restarts (VCC_{ON} or BO_OK detect events). This delay assures that the bulk voltage will be stabilized prior to switching operation. Another benefit of this delay is that the soft start capacitor will be fully discharged before any restart.

Brown–Out Detection: The BO input monitors bulk voltage level via resistor divider and thus assures that the application is working only for wanted bulk voltage band. The BO input sinks current of $18.2 \,\mu\text{A}$ until the Vref_{BO} threshold is reached. Designer can thus adjust the bulk voltage hysteresis according to the application needs.

Latched Input: The latched comparator input is connected in parallel to the BO terminal to allow the designer latch the IC if necessary – overvoltage or overtemperature shutdown can be implemented using this latch. The supply voltage has to be cycled down below VCC_{reset} threshold, or V_{BO} diminished under V_{BO} level to reset the latch and enable restart. **Internal V_{CC} Clamp**: The internal zener clamp offers a way to prepare passive voltage regulator to maintain V The internal timing capacitor Ct is charged by current which is proportional to the current flowing out from the Rt pin. The discharging current I_{DT} is applied when voltage on this capacitor reaches 2.5 V. The output drivers are disabled during discharge period so the dead time length is given by the discharge current sink capability. Discharge sink is disabled when voltage on the timing capacitor reaches zero and charging cycle starts again. The charging current and thus also whole oscillator is disabled during the PFC delay period to keep the IC consumption below 400 μ A.

This is valuable for applications that are supplied from auxiliary winding and V_{CC} capacitor is supposed to provide energy during PFC delay period.

For resonant LED driver applications it is necessary to adjust minimum operating frequency with high accuracy. The designer also needs to limit maximum operating and startup frequency. All these parameters can be adjusted

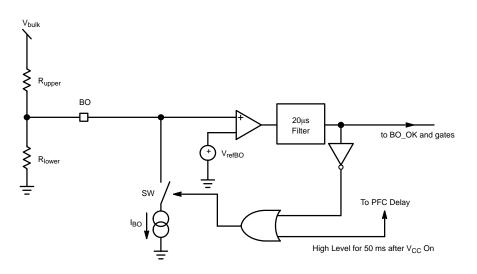


Figure 23. The internal Brown–Out Configuration with an Offset Current Sink

A resistive divider made of R_{upper} and R_{lower} , brings a portion of the HV rail on Pin 3. Below the turn–on level, the 18.2 μ A current sink (I_{BO}) is on. Therefore, the turn–on level is higher than the level given by the division ratio brought by the resistive divider. To the contrary, when the

internal BO_OK signal is high (PFC timer runs or Mlower and Mupper pulse), the I_{BO} sink is deactivated. As a result, it becomes possible to select the turn–on and turn–off levels via a few lines of algebra:

 $I_{\text{BO}} \text{ is ON}$

$$Vref_{BO} = V_{bulk1} \cdot \frac{R_{lower}}{R_{lower} + R_{upper}} - I_{BO} \cdot \left(\frac{R_{lower} \cdot R_{upper}}{R_{lower} + R_{upper}}\right)$$
(eq. 1)

 I_{BO} is OFF

$$Vref_{BO} = V_{bulk2} \cdot \frac{R_{lower}}{R_{lower} + R_{upper}}$$
(eq. 2)

We can extract R_{lower} from Equation 2 and plug it into Equation 1, then solve for R_{upper}:

$$\mathsf{R}_{\mathsf{lower}} = \mathsf{Vref}_{\mathsf{BO}} \cdot \frac{\mathsf{V}_{\mathsf{bulk1}} - \mathsf{V}_{\mathsf{bulk2}}}{\mathsf{I}_{\mathsf{BO}}} \, .$$

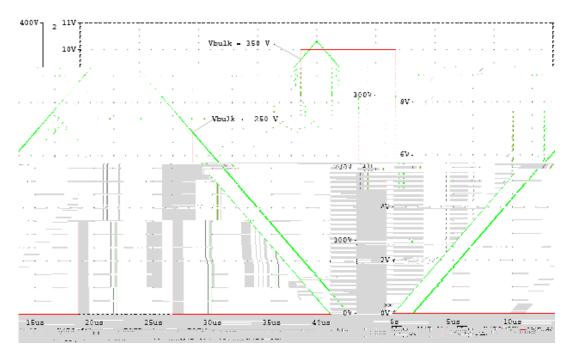
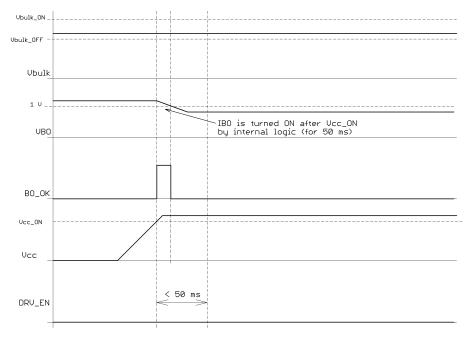


Figure 24. Simulation Results for 350/250 ON/OFF Brown-Out Levels





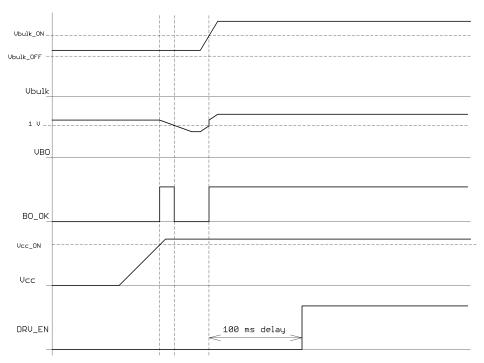
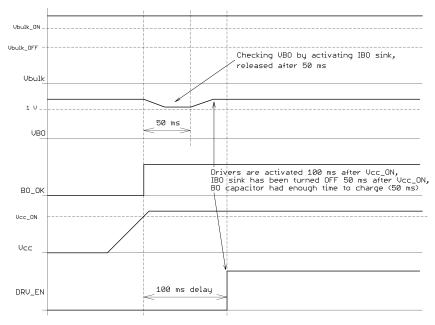


Figure 26. BO Input Functionality $-V_{bulk2} < V_{bulk} < V_{bulk1}$, PFC Start Follows





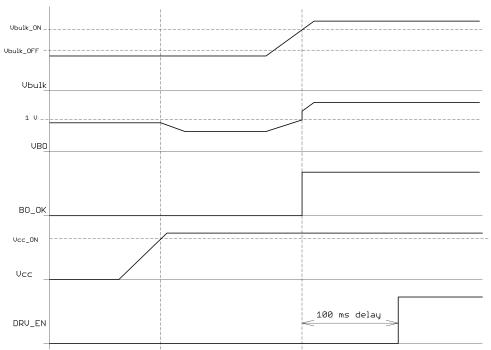
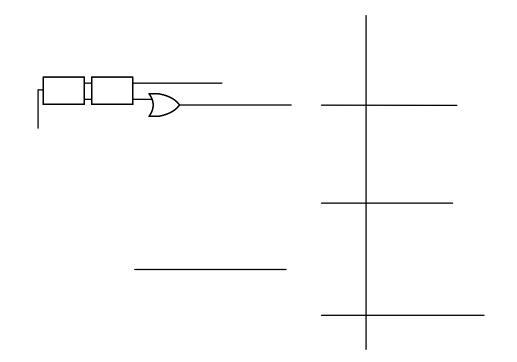


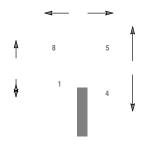
Figure 28. BO Input Functionality – V_{bulk} < V_{bulk2}, PFC Start Follows

The I_{BO} current sink is turned ON for 50 ms after any controller restart to let the BO input voltage stabilize (there can be connected big capacitor to the BO input and the I_{BO} is only 18.2 μA so it will take some time to discharge). Once the 50 ms one shoot pulse ends the BO comparator is supposed to either hold the I_{BO} sink turned ON (if the bulk voltage





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SEATING PLANE



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