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DATA SHEET
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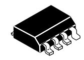
# H - o a Ha -B n Co o o LED L A a n o

# CL30059

MARKING DIAGRAM



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

- PSR Current Regulation ±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

**ORDERING INFORMATION**

| Device | Package | Shipping |
| --- | --- | --- |
| | | |

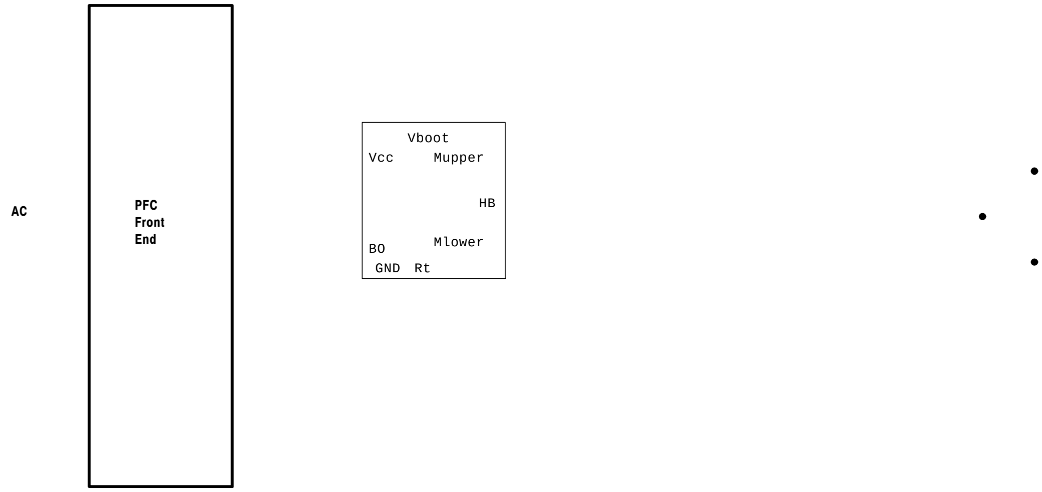



Figure 1. Typical LCC Application Example

## PIN FUNCTION DESCRIPTION

| Pin # | Pin Name | Function | Pin Description |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
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| | | | |
| | | | |

## MAXIMUM RATINGS TABLE

| Symbol | Rating | Value | Unit |
|---|---|---|---|
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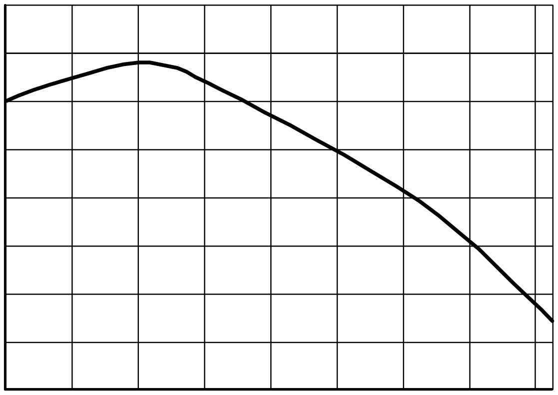
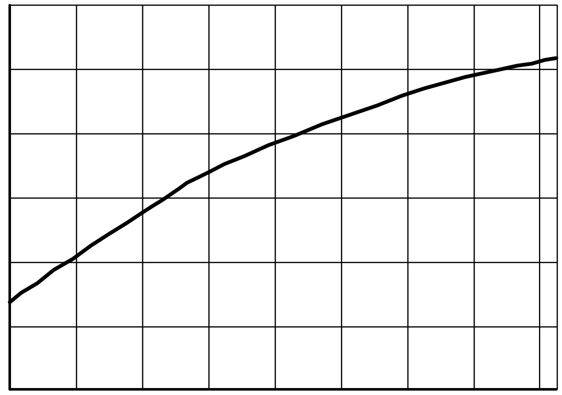
| | | | |
| | | | |
| | | | |
| | | ± | |
| | | | |
| | | | |
| | | | |
| θ | μ | | |
| θ | μ | | |
| | | | |
| | | | |
| | | | |

**ELECTRICAL CHARACTERISTICS**

| Characteristic | Pin | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **SUPPLY SECTION** | | | | | | |
| | | | | | | |
| | | | | | | |





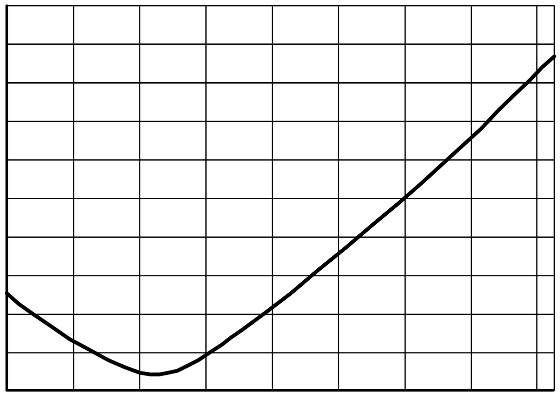


Figure 15. $PFC_{delay}$

Figure 16. $V_{LATCH}$

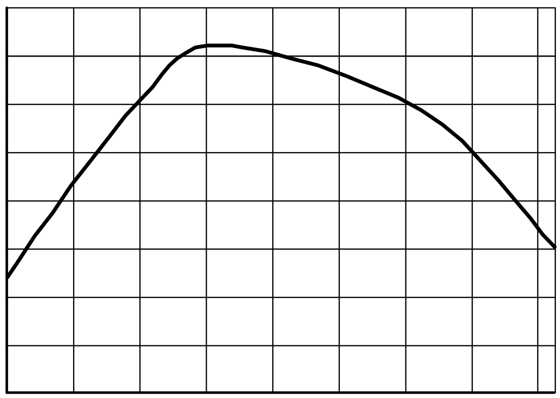


Figure 17. $V_{BO}$

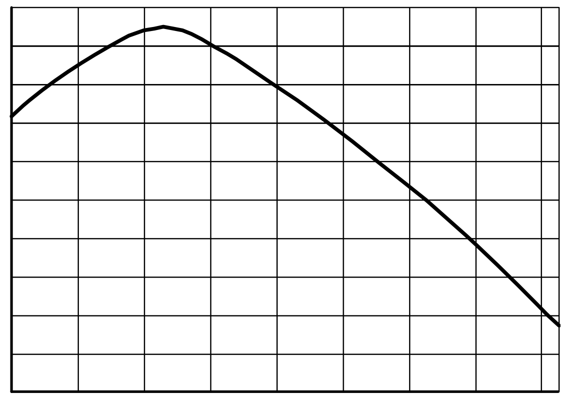


Figure 18. $I_{BO}$

## 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 ±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 μA 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 μA. 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

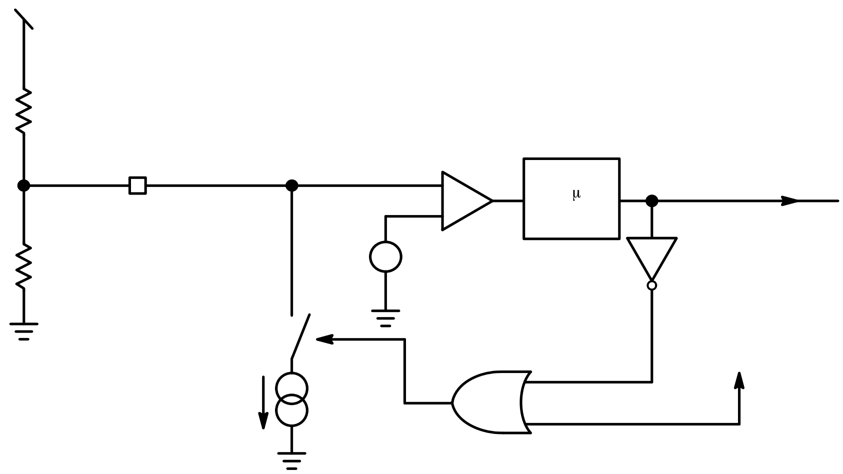



**Figure 23. The internal Brown−Out Configuration with an Offset Current Sink**

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 μA 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:

**$I_{BO}$ is ON**

$$= \cdot \frac{\quad}{+} - \cdot \left( \frac{\cdot}{+} \right)$$

**$I_{BO}$ is OFF**

$$= \cdot \frac{\quad}{+}$$

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

$$= \cdot \frac{-}{\cdot}$$

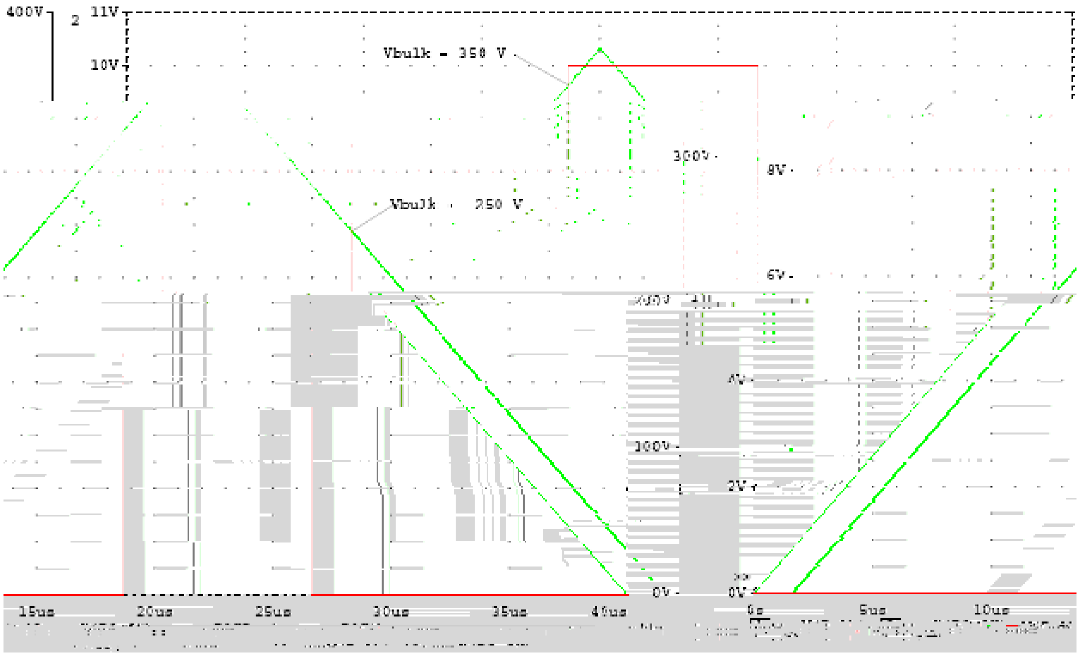



Figure 24. Simulation Results for 350/250 ON/OFF Brown−Out Levels

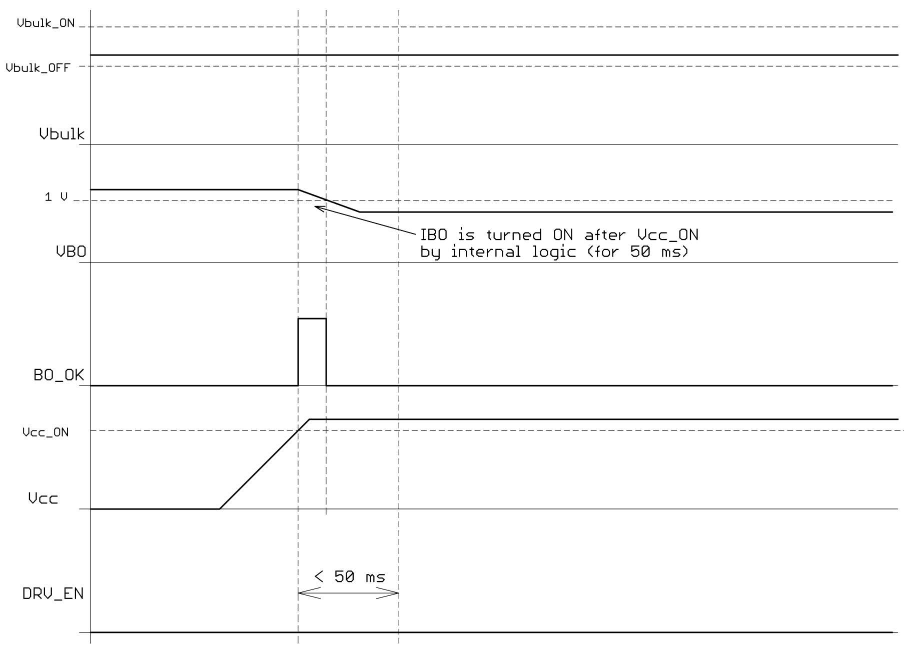



Figure 25. BO Input Functionality − $V_{bulk2} < V_{bulk} < V_{bulk1}$

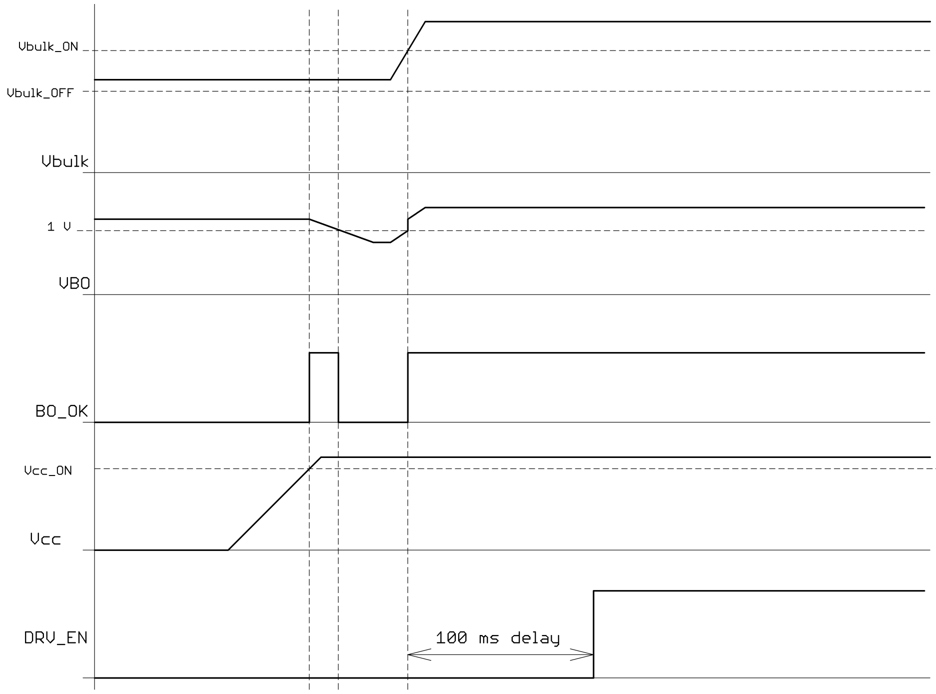



**Figure 26. BO Input Functionality −$V_{bulk2}$ < $V_{bulk}$ < $V_{bulk1}$, PFC Start Follows**

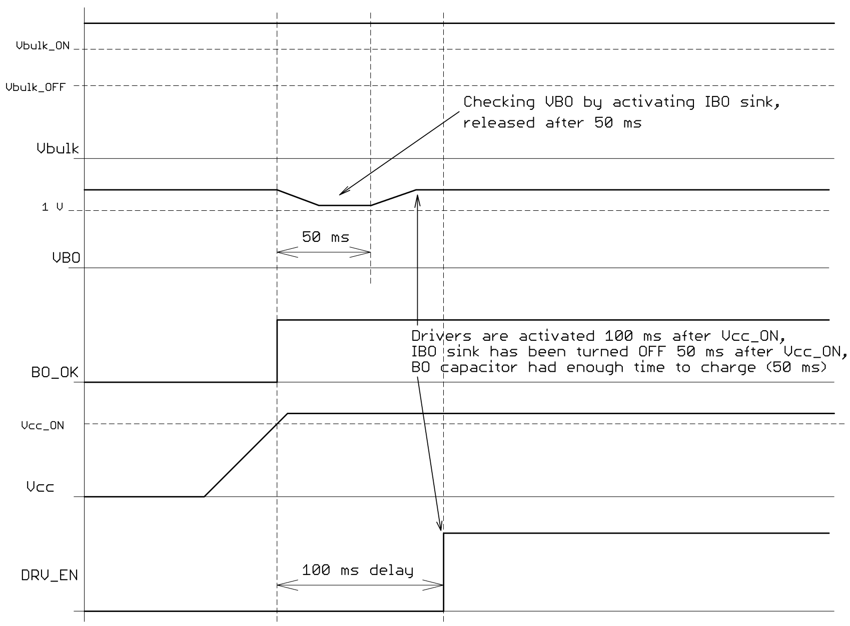



**Figure 27. BO Input Functionality − $V_{bulk}$ > $V_{bulk1}$**

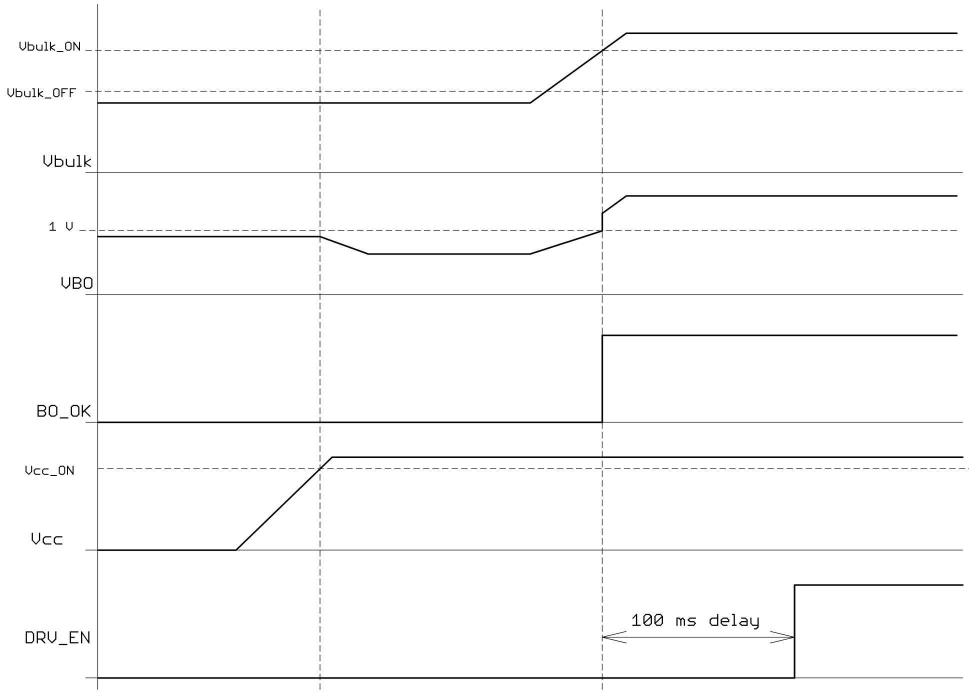
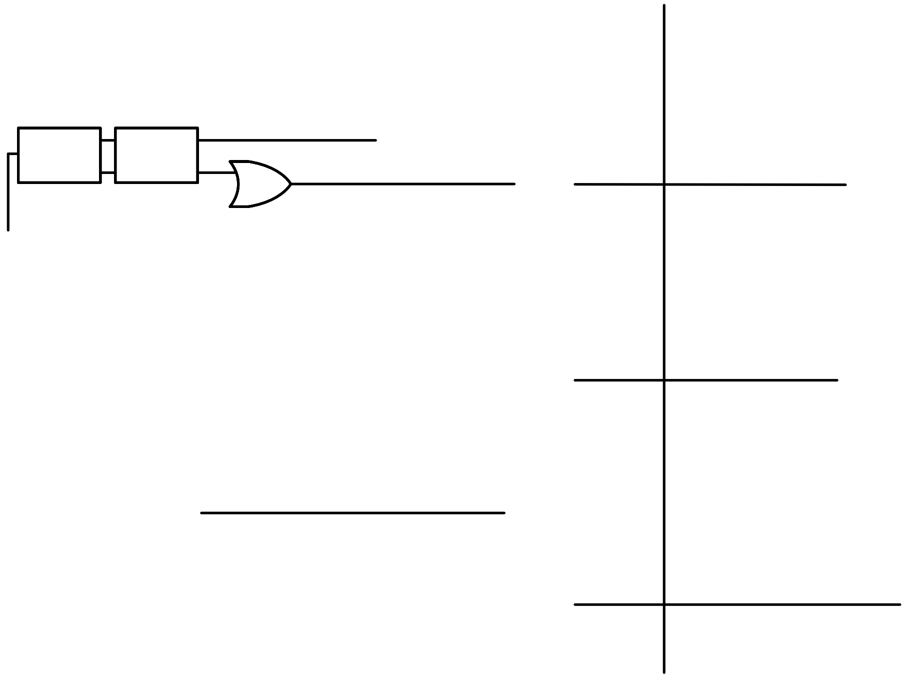



**Figure 28. BO Input Functionality − $V_{bulk}$ < $V_{bulk2}$, PFC Start Follows**

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



**SOIC 8 NB**
CASE 751–07
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