

AC/DC Digital Power Controller for Single-Stage High Power Factor Dimmable LED Drivers

1 Description

The iW3609 is a single-stage, high-performance AC/DC offline power supply controller for dimmable LED luminaires. It applies advanced digital control technology to detect the dimmer type, which provides dynamic impedance to interface with the dimmer and control the LED brightness at the same time.

With advanced dimmer detection technology, the iW3609 can operate with most wall dimmers including leading-edge dimmers (R-type or R-L type) and trailing-edge dimmers (R-C type). In addition, the iW3609's cycle-by-cycle waveform analysis technology allows for fast dimmer setting response. When no dimmer is on the line, the iW3609 optimizes the power factor and minimizes the current harmonic distortion to the AC line. Furthermore, in no dimmer condition, output current is regulated at nominal output current value over a wide input voltage range.

The iW3609 operates the main power converter that delivers current to the LED load in quasi-resonant mode to provide high power efficiency and minimize electro-magnetic interference (EMI). The commonly utilized converter topologies for iW3609 are buck-boost and flyback. It uses Dialog's patented **PrimAccurate™** primary-side sensing technology to achieve excellent LED current regulation under different AC line and LED load voltages, without using a secondary-side feedback circuit and thus eliminating the need for an opto-coupler.

The iW3609 minimizes the external components count by simplifying the EMI filter with Dialog's **EZ-EMI®** technology. The intelligent dimmer detection technology minimizes the bleeding power loss. Additionally, the digital control loop of the iW3609 maintains stable overall operating conditions without the need for loop compensation components.

2 Features

- Isolated/non-isolated offline 120V_{AC}/230V_{AC} LED driver up to 15W output power
- Wide line frequency range (from 45Hz to 66Hz)
- Meets IEC61000-3-2 Current Harmonic requirement
- Total harmonic distortion < 20% with PF > 0.92
- Wide dimmer compatibility
 - » Leading-edge dimmer
 - » Trailing-edge dimmer
- Selectable dimming range of 1% to 100% or 10% to 100%
- Resonant control to achieve high efficiency (typical > 82% without dimmer)
- Over-temperature LED current foldback
- Small solution size
 - » Single-stage topology reduces part counts
 - » 90kHz maximum switching frequency enables the use of a small transformer
- **PrimAccurate** primary-side sensing eliminates the need for opto-isolator feedback
- Tight LED current regulation ($\pm 5\%$)
- Fast start-up (< 0.5s without dimmer)
- Compatible with NEMA SSL6 dimming curve standard
- Multiple protection features that include:
 - » LED open-circuit and short-circuit protection
 - » Over-current protection
 - » Over-temperature protection
 - » Current sense resistor short-circuit protection
 - » AC line over-voltage protection
- Optional proprietary input current shaping

3 Applications

- Dimmable LED retrofit lamps up to 15W
- Dimmable LED luminaires up to 15W



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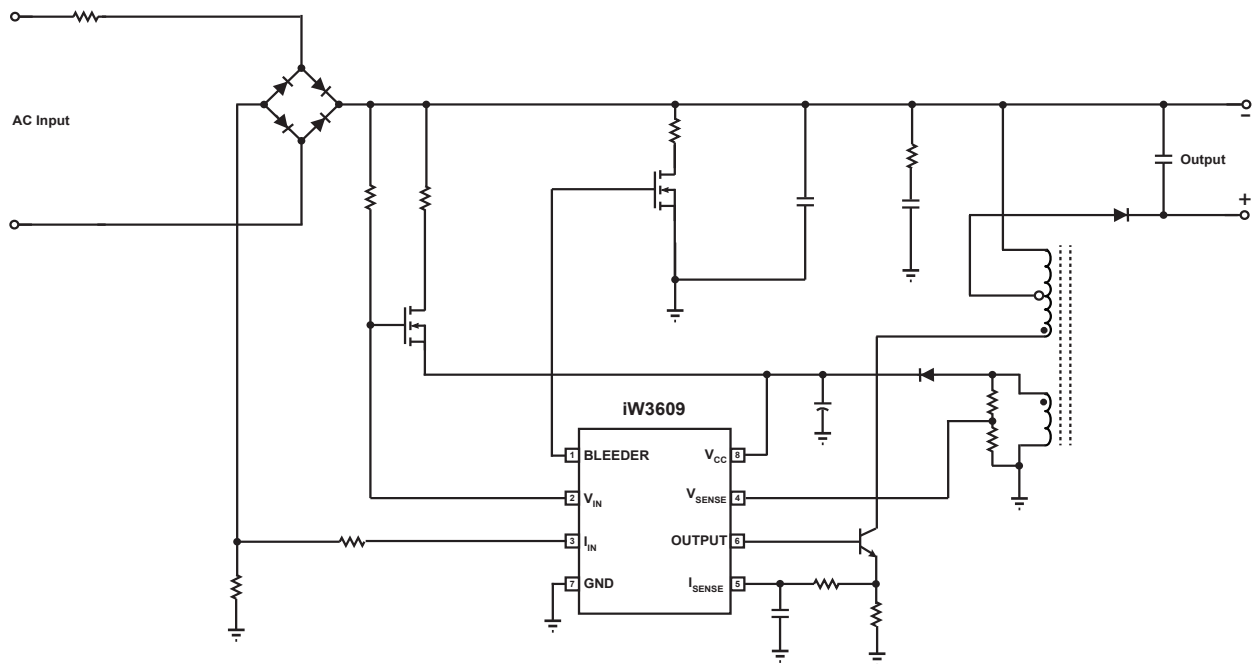


Figure 3.1 : iW3609 Simplified Application Circuit

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4 Pinout Description

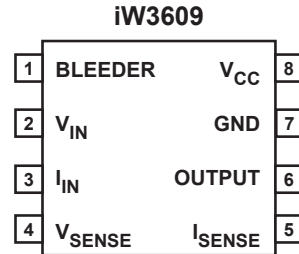


Figure 4.1 : 8 Lead SOIC Package

| Pin No. | Pin Name | Type | Pin Description |
|---------|-------------|--------------|---------------------------------|
| 1 | BLEEDER | Output | Gate drive for Bleeder switch |
| 2 | V_{IN} | Analog Input | Rectified AC line voltage sense |
| 3 | I_{IN} | Analog Input | Rectified AC line current sense |
| 4 | V_{SENSE} | Analog Input | Auxiliary winding voltage sense |
| 5 | I_{SENSE} | Analog Input | Primary side current sense |
| 6 | OUTPUT | Output | Base drive for main BJT switch |
| 7 | GND | Ground | Ground |
| 8 | V_{CC} | Power | Power supply for control logic |

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5 Absolute Maximum Ratings

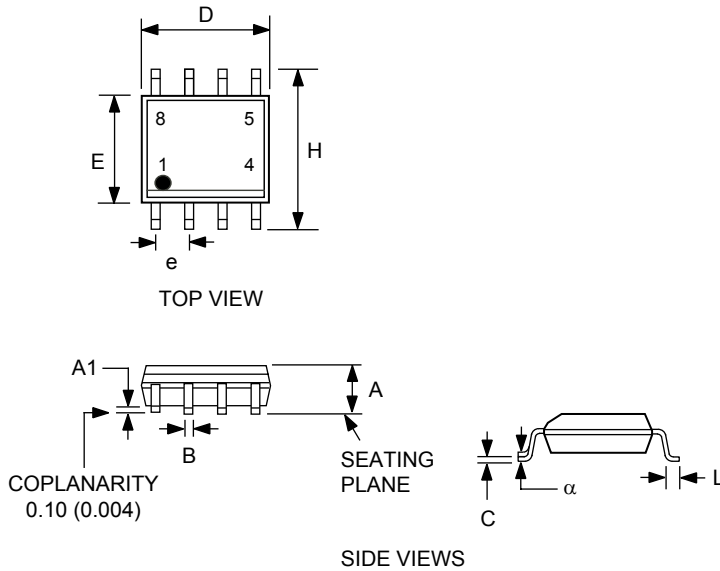
Absolute maximum ratings are the parameter values or ranges which can cause permanent damage if exceeded.

| Parameter | Symbol | Value | Units |
|--|------------------------|------------------|-------|
| DC supply voltage range (pin 8) | V_{CC} | -0.3 to 18 | V |
| OUTPUT (pin 6) | | -0.3 to 4.0 | V |
| BLEEDER output (pin 1) | | -0.3 to V_{CC} | V |
| V_{SENSE} input (pin 4, $I \leq 10\text{mA}$) | | -0.7 to 4.0 | V |
| V_{IN} input (pin 2) | | -0.3 to 18 | V |
| I_{SENSE} input (pin 5) | | -0.3 to 4.0 | V |
| I_{IN} input (pin 3) | | -0.7 to 4.0 | V |
| Maximum junction temperature | T_{JMAX} | 150 | °C |
| Storage temperature | T_{STG} | -65 to 150 | °C |
| Thermal Resistance Junction-to-Ambient [Still Air] | θ_{JA} (Note 1) | 160 | °C/W |
| ESD rating per JEDEC JESD22-A114 | | $\pm 2,000$ | V |
| Latch-up test per JESD78A | | ± 100 | mA |

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6 Physical Dimensions

8-Lead Small Outline (SOIC) Package



| Symbol | Inches | | Millimeters | |
|----------|-----------|-------|-------------|------|
| | MIN | MAX | MIN | MAX |
| A | 0.053 | 0.069 | 1.35 | 1.75 |
| A1 | 0.0040 | 0.010 | 0.10 | 0.25 |
| B | 0.014 | 0.019 | 0.35 | 0.49 |
| C | 0.007 | 0.010 | 0.19 | 0.25 |
| D | 0.189 | 0.197 | 4.80 | 5.00 |
| E | 0.150 | 0.157 | 3.80 | 4.00 |
| e | 0.050 BSC | | 1.27 BSC | |
| H | 0.228 | 0.244 | 5.80 | 6.20 |
| L | 0.016 | 0.049 | 0.40 | 1.25 |
| α | 0° | 8° | | |

Compliant to JEDEC Standard MS12F

Controlling dimensions are in inches; millimeter dimensions are for reference only

This product is RoHS compliant and Halide free.

Soldering Temperature Resistance:

[a] Package is IPC/JEDEC Std 020D moisture sensitivity level 1

[b] Package exceeds JEDEC Std No. 22-A111 for solder immersion resistance; package can withstand 10 s immersion < 260°C

Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25 mm per side.

The package top may be smaller than the package bottom. Dimensions D and E1 are determined at the outermost extremes of the plastic body exclusive of mold flash, tie bar burrs, gate burrs and interlead flash, but including any mismatch between the top and bottom of the plastic body.

7 Physical Dimensions

| Part no. | Options | Package | Description |
|-----------|--|---------|--------------------------|
| iW3609-00 | 120V _{AC} input, with current shaping | SOIC-8 | Tape & Reel ¹ |
| iW3609-01 | 230V _{AC} input, without current shaping | SOIC-8 | Tape & Reel ¹ |
| iW3609-04 | 230V _{AC} input, lower bleeder loss options | SOIC-8 | Tape & Reel ¹ |
| iW3609-10 | 120V _{AC} input, without current shaping | SOIC-8 | Tape & Reel ¹ |

Note 1: Tape and reel packing quantity is 2,500/reel. Minimum ordering quantity is 2,500.

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