

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

1 Description

The iW3689 is a single-stage, high-performance AC/DC off-line power supply controller for dimmable LED luminaires. It applies advanced digital control technology to detect the dimmer type, enabling it to provide dynamic impedance to interface with the dimmer and to control the LED brightness at the same time.

With advanced dimmer detection technology, the iW3689 can operate with most wall dimmers including leading-edge dimmers (R-type or R-L type), trailing-edge dimmers (R-C type), and smart dimmers. In addition, the iW3689's cycle-by-cycle waveform analysis technology allows for fast dimmer transient response.

In no-dimmer mode, the iW3689 operates the main power converter that delivers current to the LED load in quasi-resonant mode to provide high power efficiency and low electro-magnetic interference (EMI). When there is no dimmer on the line, the iW3689 optimizes the power factor and minimizes the current harmonic distortion to the AC line. The commonly utilized converter topologies for iW3689 are buck-boost and flyback.

The iW3689 uses 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 iW3689 minimizes the external components count by simplifying the EMI filter with Dialog's **EZ-EMI®** technology, and by integrating current sink, switching, and V_{CC} charging circuit. Additionally, the iW3689 does not require an auxiliary winding, which eliminates the need for a custom inductor. The digital control loop of the iW3689 maintains stability over all operating conditions without the need for loop compensation components.

The iW3689 maintains high performance wide-range dimming and achieves excellent dimmer compatibility with a simple application circuit.

2 Features

- Isolated/non-isolated off-line 120V_{AC}/230V_{AC} LED driver up to 25W (Note 1)
- Wide line frequency range (from 45Hz to 66Hz)
- Meets IEC61000-3-2 current harmonic requirement
- Total harmonic distortion < 20% with PF > 0.92
- Excellent dimmer compatibility
 - » Leading-edge dimmer
 - » Trailing-edge dimmer
 - » Digital smart dimmer
- Wide dimming range of 1% to 100%
- Intelligent digital control integrates current sink and V_{CC} maintenance function into power switching circuit
- Advanced IC power management and voltage sensing enables the use of off-the-shelf inductor
- Resonant control to achieve high efficiency (typical >85% without dimmer)
- Excellent AC line distortion immunity ensures quality of product under real-life circumstances
- Over-temperature LED current foldback and shutdown
- Tight LED current regulation ($\pm 5\%$)
- Fast start-up (< 0.5s without dimmer)
- Multiple protection features that include:
 - » LED open-circuit and short-circuit protection
 - » Current sensing resistor open circuit and short-circuit protection
 - » Over-current protection

3 Applications

- Dimmable LED retrofit lamps up to 25W (Note 1)
- Dimmable LED luminaires up to 25W (Note 1)

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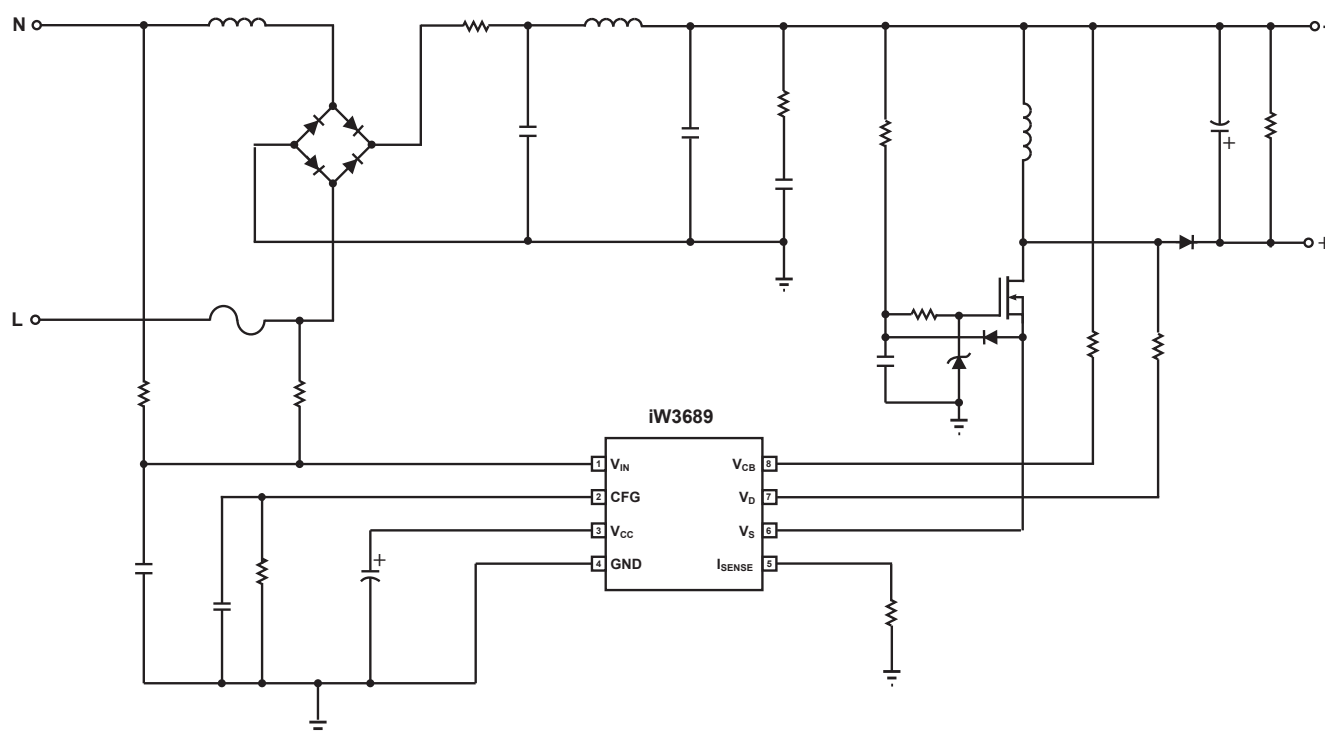


Figure 3.1 : iW3689 Typical Application Circuit

Note 1 : For output power above 12W designs, care should be taken to verify the thermal and reliability constraints on the IC. IC temperature below 120°C is recommended for proper IC operation.

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4 Pinout Description

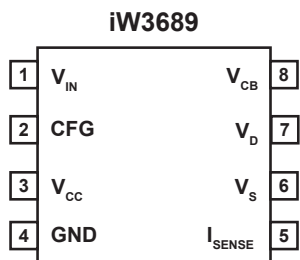


Figure 4.1 : 8-Lead SOIC-8 Package

Pin Number	Pin Name	Type	Pin Description
1	V _{IN}	Analog Input	Rectified AC line voltage input.
2	CFG	Analog Input	OTP threshold and dimmer mode configuration on start-up.
3	V _{CC}	Power	Power supply for control logic.
4	GND	Ground	Ground.
5	I _{SENSE}	Analog Input	Current sense.
6	V _S	Analog Input	Source voltage of MOSFET.
7	V _D	Analog Input	Drain voltage of MOSFET.
8	V _{CB}	Analog Input	Input capacitor voltage after EMI filter.

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5 Absolute Maximum Ratings

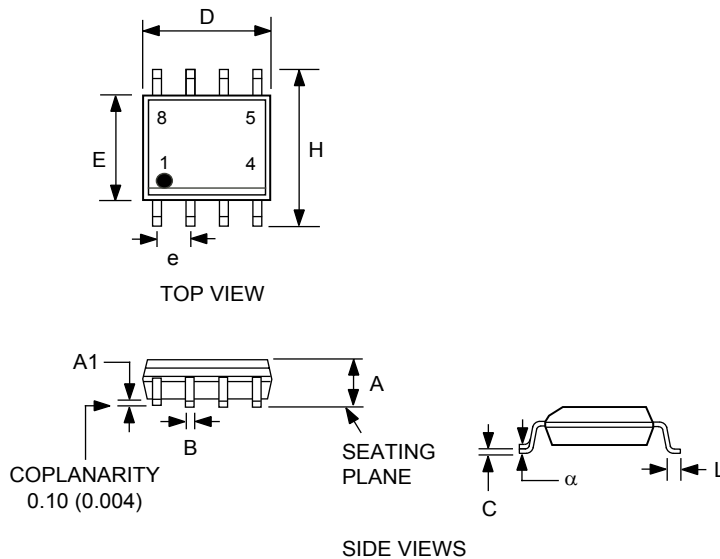
Absolute maximum ratings are the parameter values or ranges which can cause permanent damage if exceeded.

Parameter	Symbol	Value	Unit
DC supply voltage range (pin 3)	V_{CC}	-0.3 to 6	V
V_{IN} input (pin 1)		-0.3 to 6	V
CFG input (pin 2)		-0.3 to 6	V
I_{SENSE} input (pin 5)		-0.3 to 6	V
V_S input (pin 6)		-0.3 to 24	V
V_D input voltage (pin 7)		-0.3 to 6	V
V_{CB} input voltage (pin 8)		-0.3 to 6	V
V_D input current (pin 7)		750	μA
V_{CB} input current (pin 8)		750	μA
Maximum junction temperature	T_{JMAX}	150	$^{\circ}C$
Operating junction temperature	T_{JOPT}	-40 to 150	$^{\circ}C$
Storage temperature	T_{STG}	-65 to 150	$^{\circ}C$
Thermal resistance junction-to-PCB [gnd lead]	Ψ_{JB}	75	$^{\circ}C/W$
ESD rating per JEDEC JS-001-2017		$\pm 2,000$	V
Latch-up test per JESD78E		± 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 Ordering Information

Part Number	Options	Package	Description
iW3689-00	120V _{AC} Input	SOIC-8	Tape & Reel ²
iW3689-01	230V _{AC} Input, Optimized for Higher Power Applications	SOIC-8	Tape & Reel ²
iW3689-11	230V _{AC} Input, Optimized for Lower Power Applications	SOIC-8	Tape & Reel ²
iW3689-21	230V _{AC} Input, Optimized for External LED Driver Applications	SOIC-8	Tape & Reel ²
iW3689-31	230V _{AC} Input, Optimized for Compact Size Applications	SOIC-8	Tape & Reel ²

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

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(Rev.1.0 Mar 2020)

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