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 (±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)

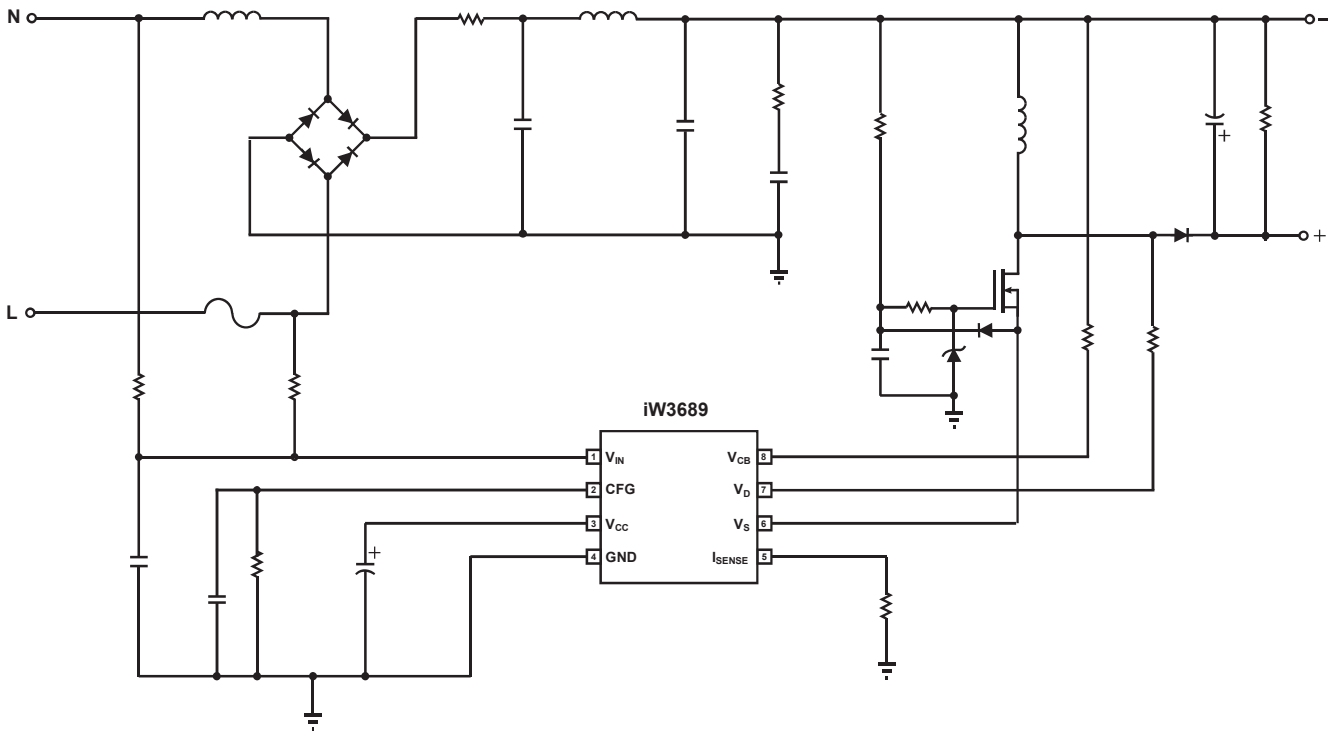

Figure 3.1 : iW3689 Typical Application Circuit

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

4 Pinout Description

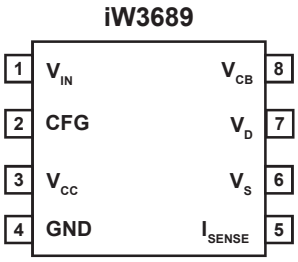

Figure 4.1 : 8-Lead SOIC-8 Package

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.

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	°C
Operating junction temperature	T_{JOPT}	-40 to 150	°C
Storage temperature	T_{STG}	-65 to 150	°C
Thermal resistance junction-to-PCB [gnd lead]	Ψ_{JB}	75	°C/W
ESD rating per JEDEC JS-001-2017		±2,000	V
Latch-up test per JESD78E		±100	mA