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

1 Description

The iW3688 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 iW3688 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 iW3688's cycle-by-cycle waveform analysis technology allows for fast dimmer transient response.

In no-dimmer mode, the iW3688 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 iW3688 optimizes the power factor and minimizes the current harmonic distortion to the AC line. The commonly utilized converter topologies for iW3688 are buck-boost and flyback.

The iW3688 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 optocoupler.

The iW3688 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 iW3688 does not require an auxiliary winding, which eliminates the need for a custom inductor. The digital control loop of the iW3688 maintains stability over all operating conditions without the need for loop compensation components.

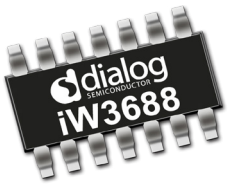
The iW3688 maintains high performance wide-range dimming and achieves excellent dimmer compatibility with a simple application circuit.

2 Features

- Isolated/non-isolated off-line $120V_{AC}$/$230V_{AC}$ LED driver up to 20W 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
- Excellent dimmer compatibility
  - » Leading-edge dimmer
  - » Trailing-edge dimmer
  - » Digital smart dimmer
- Wide dimming range of 1% to 100%
- Intelligent digital control integrating current sink 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
  - » AC line over-voltage protection
  - » Over-current protection

3 Applications

- Dimmable LED retrofit lamps up to 20W
- Dimmable LED luminaires up to 20W



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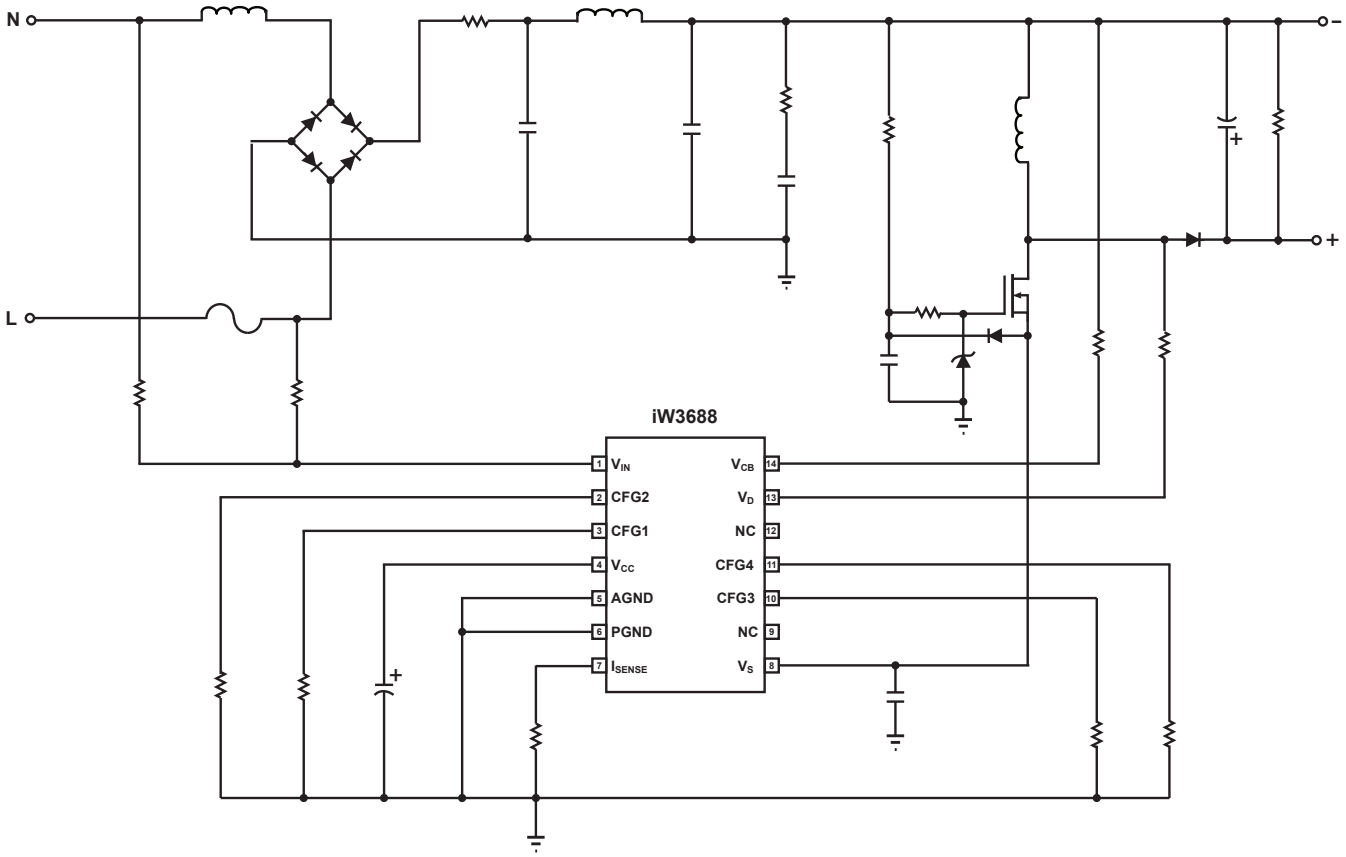


Figure 3.1 : iW3688 Simplified Application Circuit

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4 Pinout Description

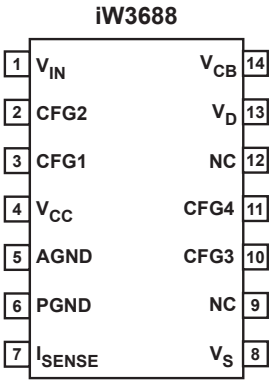


Figure 4.1 : 14-Lead SOIC-14 Package

Pin Number	Pin Name	Type	Pin Description
1	V_{IN}	Analog Input	Rectified AC line voltage input.
2	CFG2	Analog Input	Used for dimming mode configuration. See the applications section for additional information.
3	CFG1	Analog Input	Configures OTP threshold on start-up. See the applications section for configuration information.
4	V_{CC}	Power	Power supply for control logic.
5	AGND	Ground	Signal ground. It should be connected to the power ground on PCB.
6	PGND	Ground	Power ground.
7	I_{SENSE}	Analog Input	Current sense.
8	V_S	Analog Input	Source voltage of MOSFET.
9	NC	No Connection	Not internally connected.
10	CFG3	Analog Input	Used for dimming mode confirguration. See the applications section for additional information.
11	CFG4	Analog Input	Used for dimming mode confirguration. See the applications section for additional information.
12	NC	No Connection	Not internally connected.
13	V_D	Analog Input	Drain voltage of MOSFET.
14	V_{CB}	Analog Input	Input capacitor voltage after EMI filter.

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5 Absolute Maximum Ratings

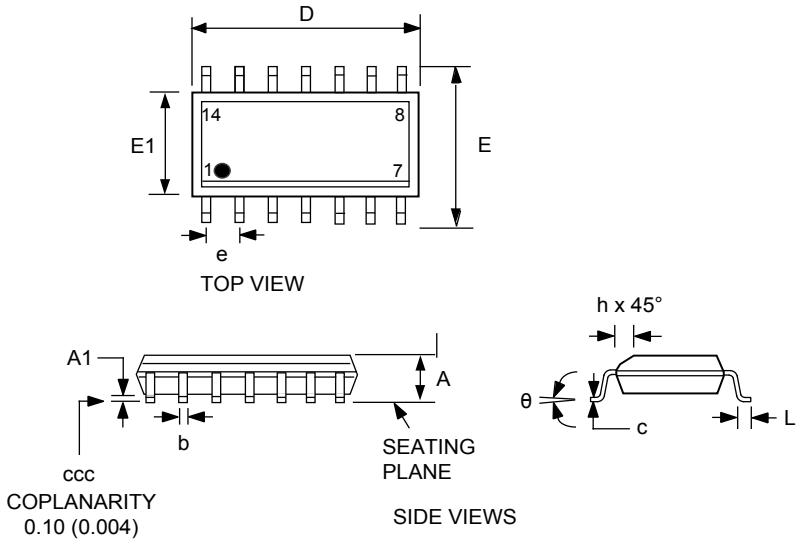
Absolute maximum ratings are the parameter values or ranges which can cause permanent damage if exceeded.

Parameter	Symbol	Value	Units
DC supply voltage range (pin 4)	V_{CC}	-0.3 to 6	V
V_{IN} input (pin 1)		-0.3 to 6	V
CFG1 input (pin 3)		-0.3 to 6	V
CFG2 input (pin 2)		-0.3 to 20	V
I_{SENSE} input (pin 7)		-0.3 to 6	V
V_S input (pin 8)		-0.3 to 20	V
CFG3 input (pin 10)		-0.3 to 6	V
CFG4 input (pin 11)		-0.3 to 20	V
V_D input voltage (pin 13)		-0.3 to 6	V
V_{CB} input voltage (pin 14)		-0.3 to 6	V
Maximum V_D input current (pin 13)	$I_{IN(VD)}$	750	µA
Maximum V_{CB} input current (pin 14)	$I_{IN(VCB)}$	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}	45	°C/W
ESD rating per JEDEC JESD22-A114		±1,000	V
Latch-up test per JESD78A		±100	mA

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6 Physical Dimensions

14-Lead SOIC Package



Symbol	Inches		Millimeters	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
b	0.013	0.020	0.33	0.51
c	0.007	0.010	0.19	0.25
D	0.337	0.344	8.55	8.75
E1	0.150	0.157	3.80	4.00
E	0.228	0.244	5.80	6.20
e	0.050 BSC		1.27 BSC	
L	0.016	0.050	0.40	1.27
h	0.010	0.020	0.25	0.50
θ	0°	8°	0°	8°
ccc	0.004		0.10	

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 E 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 E 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.

Figure 6.1 : 14-Lead SOIC Package

7 Ordering Information

Part No.	Options	Package	Description
iW3688-00	120V_{AC} Input for up to 14W	SOIC-14	Tape & Reel[1]
iW3688-01	230V_{AC} Input for up to 14W	SOIC-14	Tape & Reel[1]
iW3688-01-CA	230V_{AC} Input with lighting chopping enable for thermal improvement up to 20W	SOIC-14	Tape & Reel[1]
iW3688-10	120V_{AC} Input with light chopping enabled for thermal improvement up to 20W	SOIC-14	Tape & Reel[1]
iW3688-20	120V_{AC} Input for 15W – 20W	SOIC-14	Tape & Reel[1]
iW3688-21	230V_{AC} Input for 15W – 20W	SOIC-14	Tape & Reel[1]
iW3688-30	Universal Input for up to 14W	SOIC-14	Tape & Reel[1]

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

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