Digital AC Direct Power Controller for Phase-Cut Dimmable LED Luminaires

1 Description

The iW3989 is a high performance AC direct power 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 iW3989 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 iW3989's cycle-by-cycle waveform analysis technology allows for fast dimmer transient response.

The iW3989 achieves excellent closed-loop LED current regulation under different AC line and LED forward voltages. It provides high efficiency that is close to switch-mode controllers, which solves the thermal challenges in most AC direct driven luminaires. By eliminating the inductive components, the iW3989 eliminates the audible noise when working with TRIAC dimmers, enabling a true incandescent-like lighting experience. The iW3989 also uses proprietary digital technology to enhance the immunity to line distortion, makes it a robust, flicker-free solution in harsh AC line environments.

The iW3989 minimizes the external components count by simplifying the EMI design with Dialog's ***EZ-EMI***® technology, and by integrating the LED current sink and V_{CC} charging circuit.

2 Features

- Non-isolated off-line 120V_{AC} LED driver
- Wide AC line frequency range (from 45Hz to 66Hz)
- High power factor > 0.7 or > 0.9
- Excellent dimmer compatibility
  - » Leading-edge dimmer
  - » Trailing-edge dimmer
  - » Digital smart dimmer
- Wide dimming range
- No external V_{CC} charging needed - reduces BOM cost
- Excellent immunity to AC line distortion
- Tight LED current regulation
- Fast start-up (< 0.5s without dimmer)
- Multiple protection features:
  - » LED open-circuit and short-circuit
  - » Current setting resistor open-circuit and short-circuit
  - » Over-temperature derating and thermal shutdown

3 Applications

- Dimmable LED retrofit lamps up to 15W (Note 1)
- Dimmable LED Luminaires up to 15W (Note 1)

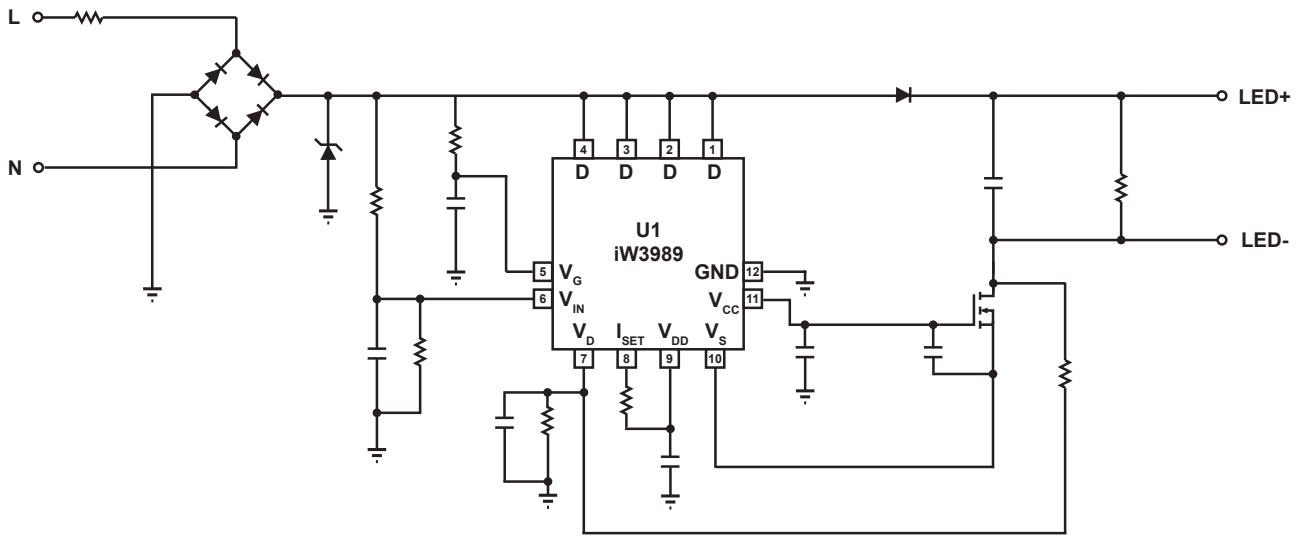

Figure 3.1 : iW3989 Typical Application Circuit

Note 1: For output power above 10W 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

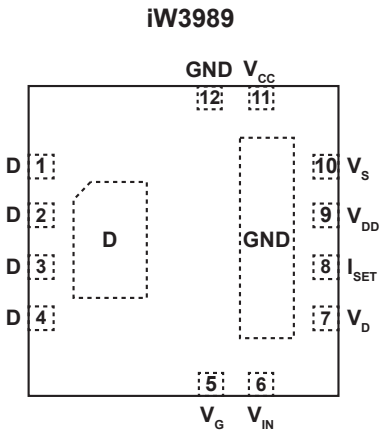

Figure 4.1 : 12-Lead QFN PackageTop View (Transparent)

Pin Number QFN-12	Pin Name	Type	Pin Description
1-4	D	Analog Input	Internal high voltage MOSFET drain.
5	V_G	Analog Input	Internal high voltage MOSFET gate.
6	V_{IN}	Analog Input	Rectified AC line voltage sense.
7	V_D	Analog Input	External MOSFET drain voltage sense.
8	I_{SET}	Analog Input	LED current setting.
9	V_{DD}	Power	Power supply for control logic.
10	V_S	Analog Input	External MOSFET source pin.
11	V_{CC}	Power	External MOSFET gate bias.
12	GND	Ground	Ground.

5 Absolute Maximum Ratings

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

Parameter	Symbol	Value	Units
D		500	V
V_G		-0.3 to 30	V
V_{IN}		-0.3 to 7	V
V_D		-0.3 to 7	V
V_{DD}		-0.3 to 7	V
I_{SET}		-0.3 to 7	V
V_S		-0.3 to 12	V
V_{CC}		-0.3 to 12	V
ESD Rating (HBM)		±2000	V
Storage temperature range		-65 to +150	°C
Maximum junction temperature		150	°C

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, so functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

6 Physical Dimensions

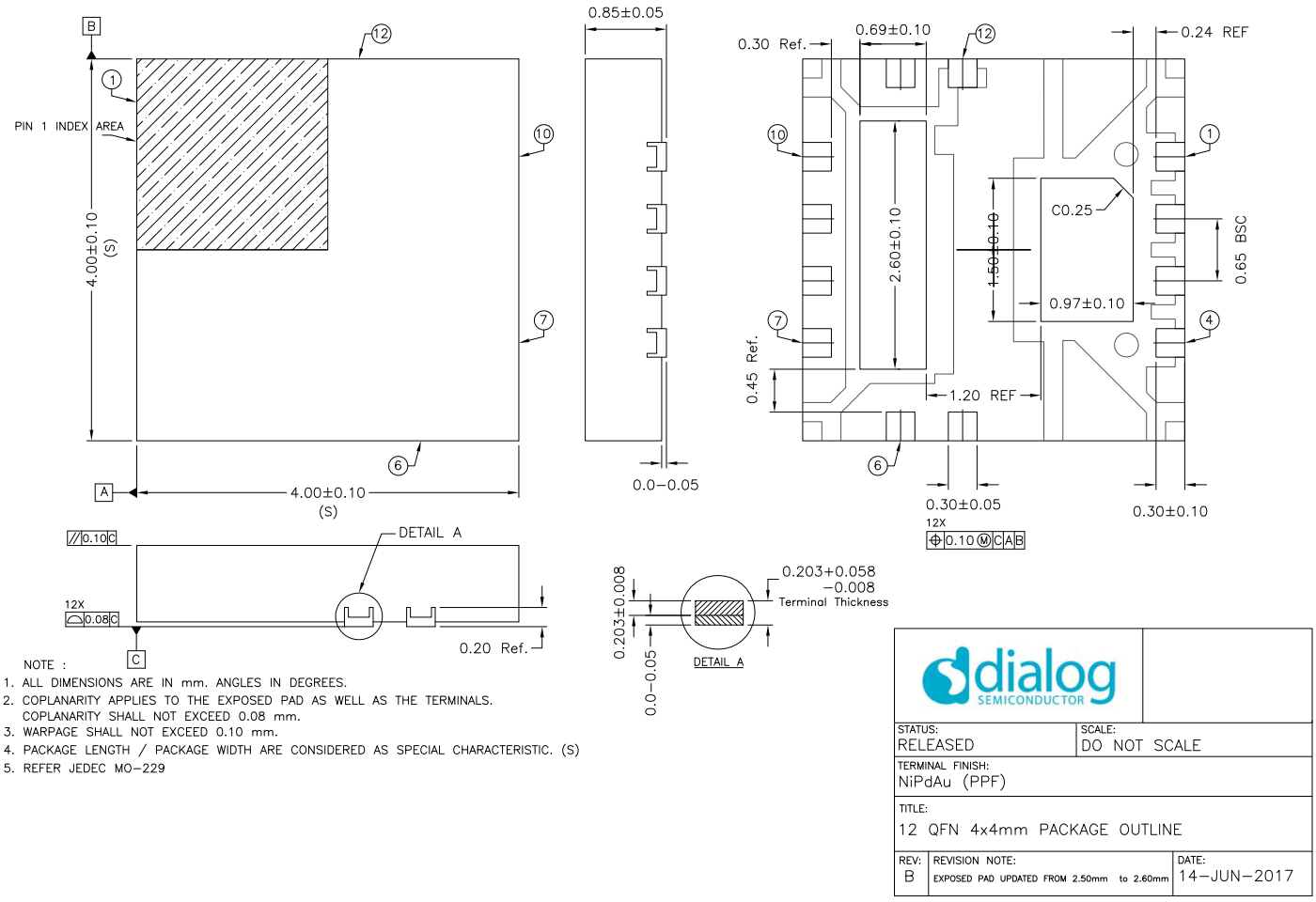

Figure 6.1 : Physical Dimension of QFN Package

7 Ordering Information

Part Number	Options		Package	Description
	Optimized Output Power Range	Power Factor		
iW3989-00	up to 10W	> 0.7	QFN-12	Tape & Reel[1]
iW3989-20	above 10W	> 0.9	QFN-12	Tape & Reel[1]
iW3989-30	above 10W	> 0.7	QFN-12	Tape & Reel[1]

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

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