

Two-Stage, Flickerless™ 0-10V Dimmable Digital Off-Line LED Driver with High PF and Low THD

1 Description

The iW3631 is a two-stage, high-performance AC/DC offline power supply controller for dimmable LED luminaires with an analog dimming interface. It controls the LED current based on an analog input voltage on the dimming pin. It has a built-in 0-10V dimming interface that works directly with 0-10V dimming systems, eliminating the need for a driver circuit and microcontroller. It can also be implemented to support wireless SSL applications without the need for auxiliary power supplies. The iW3631 uses Dialog's unique digital **Flickerless™** technology to virtually eliminate all flicker in the entire dimming range and to minimize low frequency output ripple current.

The two-stage approach allows the first-stage boost converter to convert the rectified AC voltage ($90V_{AC}$ to $277V_{AC}$) to an intermediate voltage while correcting for power factor. The second-stage flyback converter then provides the constant current regulation to the LEDs. The combination of an active start-up circuit and fast yet smooth soft-start for both boost and flyback stages results in a start-up time (AC plug-in to 90% of set LED current) of less than a half second and fast PF settling time.

The iW3631 operates in a quasi-resonant mode to provide high efficiency and uses Dialog's **PrimAccurate™** advanced primary-side sensing technology to achieve excellent line and load regulation without secondary feedback components. The digital control algorithms used by the iW3631 maintain stability over all operating conditions without the need for any external loop compensation components, minimizing the BOM cost.

2 Features

- Supports universal, $90V_{AC}$ - $277V_{AC}$ input voltage range and output power up to 90W
- Two-stage design (boost and flyback)
 - » High PF (> 0.95) and low THD ($< 10\%$) over entire input voltage range and 50%-100% load current
- Under 5% 100Hz/120Hz output current ripple
- Quasi-resonant control for both boost and flyback stages to achieve high efficiency
- Fast yet smooth boost start-up scheme to achieve short PF settling time
- Fast transient response ensures minimal bulk voltage overshoot within the capacitor safety limit
- Small size design
 - » Small size input bulk capacitor
 - » Small size output capacitor
 - » Small transformer
- Built-in 0-10V isolation transformer driver
- Wide dimming range from 1% to 100%
- **Flickerless** technology - removes virtually all flicker
- **PrimAccurate** primary-side sensing eliminates the need for optocoupler feedback and simplifies design
- Tight LED current regulation ($\pm 5\%$)
- Under 0.5s start-up time
- Hot-plug LED module support
- Multiple protection features:
 - » LED open and short circuit protection
 - » Single-fault protection
 - » Over-current protection
 - » Current sense-resistor-short-circuit protection
 - » Input over-voltage and brown-out protection
 - » Internal junction temperature-based over-temperature protection

3 Applications

- Dimmable LED ballast with analog input for dimming control
- Dimmable LED ballast with 0-10V interface for dimming control
- Wireless SSL lighting
- Output power up to 90W

Two-Stage, Flickerless™ 0-10V Dimmable Digital Off-Line LED Driver with High PF and Low THD

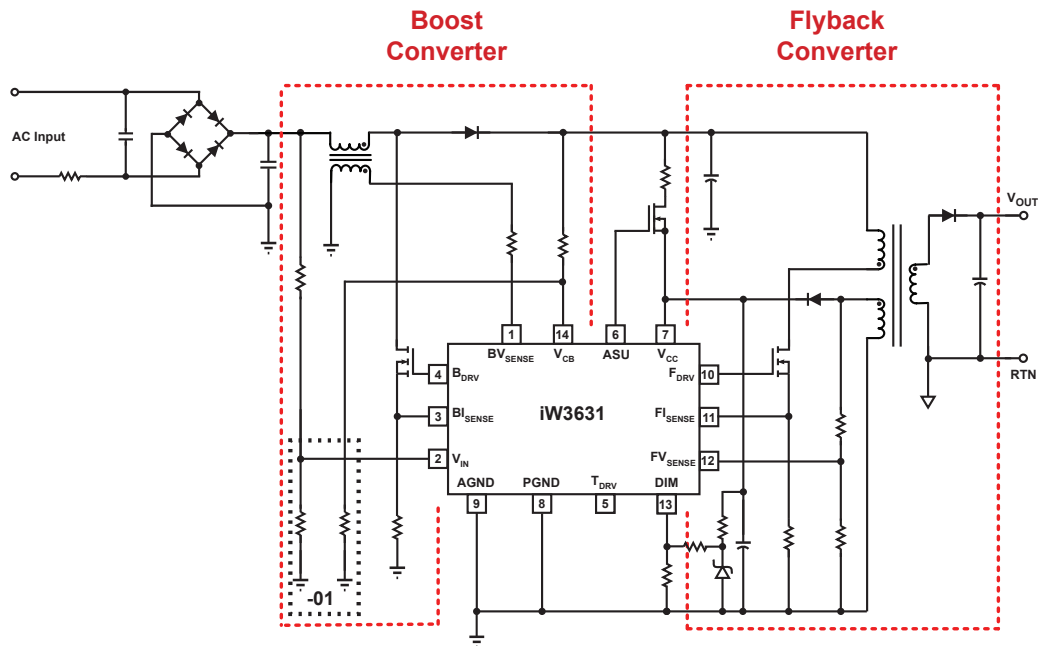


Figure 3.1 : iW3631 Analog Dimming Simplified Schematic with Internal (-00) or External (-01) Sensing

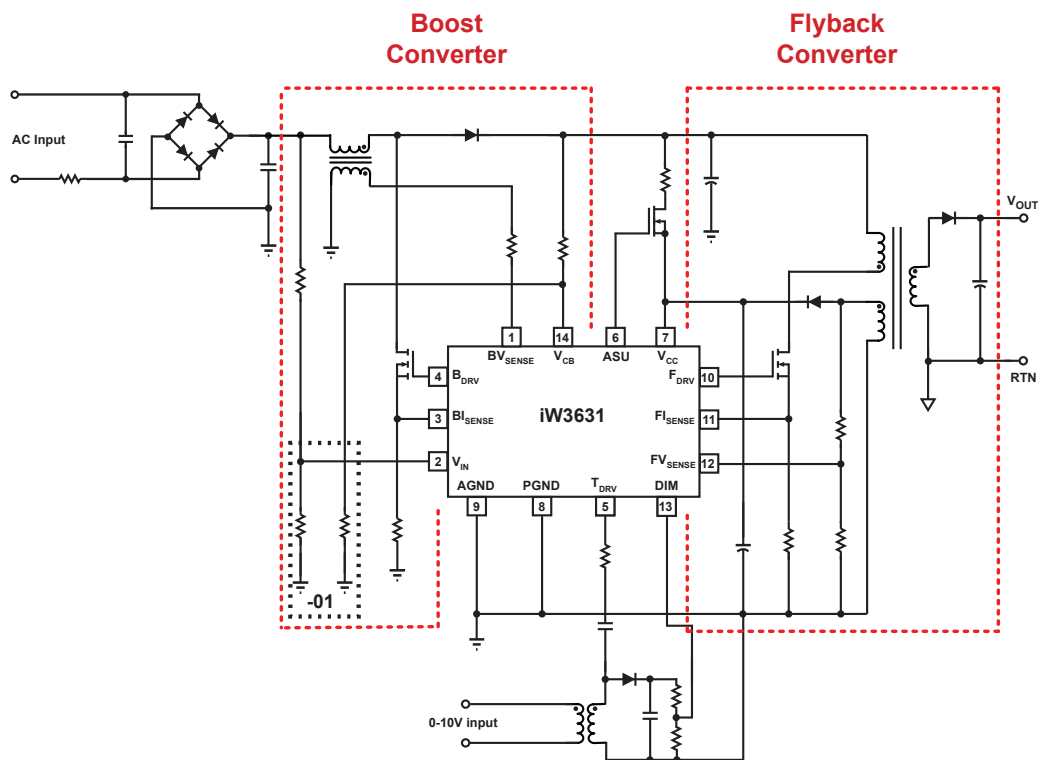


Figure 3.2 : iW3631 0-10V Dimming Simplified Schematic with Internal (-00) or External (-01) Sensing

Two-Stage, Flickerless™ 0-10V Dimmable Digital Off-Line LED Driver with High PF and Low THD

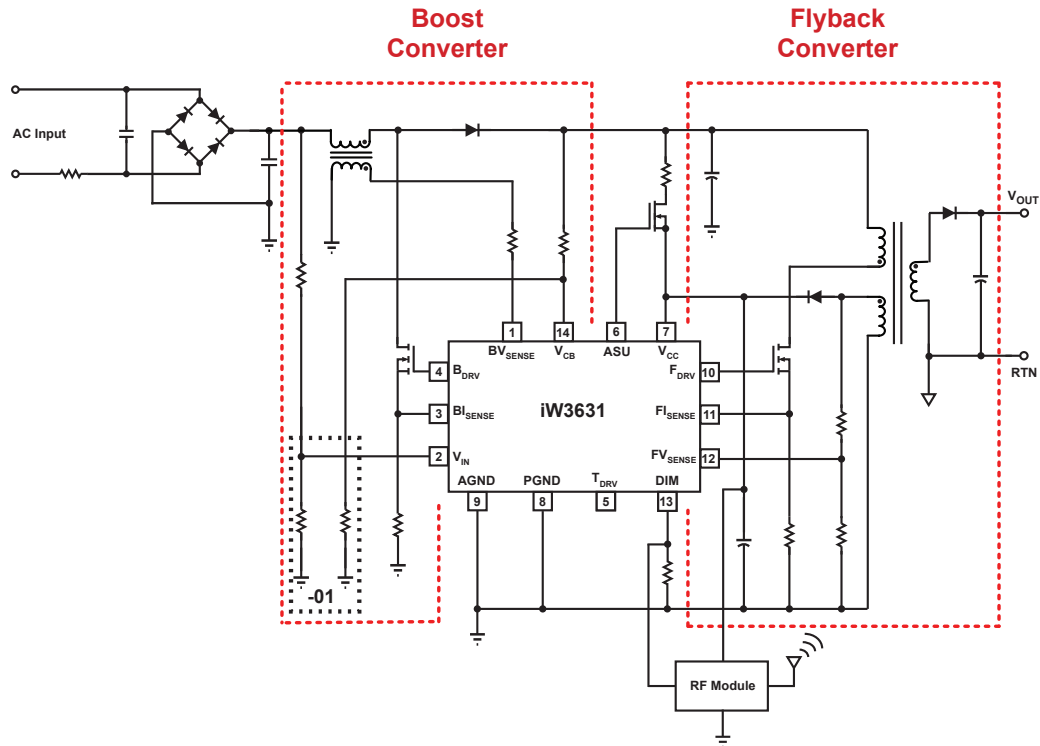


Figure 3.3 : iW3631 Wireless Dimming Simplified Schematic with Internal (-00) or External (-01) Sensing

Two-Stage, Flickerless™ 0-10V Dimmable Digital Off-Line LED Driver with High PF and Low THD

4 Pinout Description

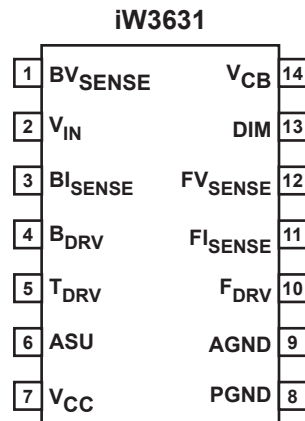


Figure 4.1 : 14-Lead SOIC-14 Package

Pin Number	Pin Name	Type	Pin Description
1	BV _{SENSE}	Analog Input	Boost inductor voltage feedback used for ZVS.
2	V _{IN}	Analog Input	Rectified AC line voltage feedback.
3	BI _{SENSE}	Analog Input	Boost current sense (only used for cycle-by-cycle peak current limit). Connect an approximately 1kΩ resistor to the source of the boost MOSFET switch to improve noise immunity.
4	B _{DRV}	Output	Gate drive for boost MOSFET.
5	T _{DRV}	Output	0-10V isolation transformer drive output.
6	ASU	Output	Control signal for active start-up device. This signal is pulled low after start-up is finished to cut off the active device.
7	V _{CC}	Power	Power supply for control logic and voltage sense for power-on reset circuitry. A decoupling capacitor of 0.1μF or so should be connected between the V _{CC} pin and GND.
8	PGND	Ground	Power ground.
9	AGND	Ground	Signal ground.
10	F _{DRV}	Output	Gate drive for flyback MOSFET.
11	FI _{SENSE}	Analog Input	Primary current sense (used for cycle-by-cycle peak current control and limit). Connect an approximately 1kΩ resistor to the source of the flyback MOSFET switch to improve noise immunity.
12	FV _{SENSE}	Analog Input	Auxiliary voltage sense (used for primary-side regulation and ZVS).
13	DIM	Analog Input	Dimming level control input.
14	V _{CB}	Analog Input	Boost output voltage feedback

Two-Stage, Flickerless™ 0-10V Dimmable Digital Off-Line LED Driver with High PF and Low THD

5 Absolute Maximum Ratings

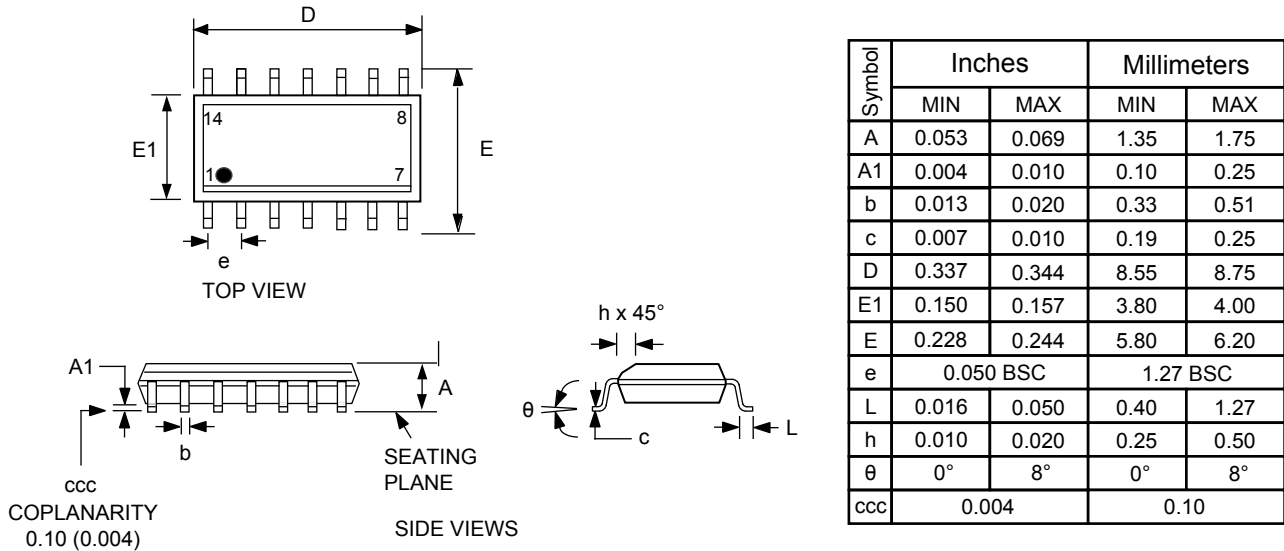
Absolute maximum ratings are the parameter values or ranges which can cause permanent damage if exceeded.

Parameter	Symbol	Value	Units
DC supply voltage range (pin 7)	V_{CC}	-0.3 to 18	V
F_{DRV} output (pin 10)		-0.3 to 18	V
B_{DRV} output (pin 4)		-0.3 to 18	V
T_{DRV} output (pin 5)		-0.3 to 18	V
FV_{SENSE} input (pin 12, $I \leq 10\text{mA}$)		-0.7 to 4.0	V
BV_{SENSE} input (pin 1, $I \leq 3\text{mA}$)		-0.7 to 4.0	V
V_{IN} input (pin 2)		-0.3 to 18	V
V_{CB} input (pin 14)		-0.3 to 18	V
FI_{SENSE} input (pin 11)		-0.3 to 4.0	V
BI_{SENSE} input (pin 3)		-0.3 to 4.0	V
ASU output (pin 6)		-0.3 to 18	V
DIM input (pin 13)		-0.3 to 4.0	V
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 Board Surface Temperature	ψ_{JB}	45	°C/W
ESD rating per JEDEC JESD22-A114		$\pm 2,000$	V
Latch-up test per JESD78A		± 100	mA

Two-Stage, Flickerless™ 0-10V Dimmable Digital Off-Line LED Driver with High PF and Low THD

6 Physical Dimensions

14-Lead SOIC Package



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 : Physical Dimensions of 14-Pin SOIC Package

7 Ordering Information

Part Number	Options	Package	Description
iW3631-00	Internal sensing for V_{IN} and V_{CB} ; $Z_{IN} = 15k\Omega$ and $Z_{CB} = 15k\Omega$	SOIC-14	Tape & Reel ¹
iW3631-01	External sensing for V_{IN} and V_{CB}	SOIC-14	Tape & Reel ¹

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

Two-Stage, Flickerless™ 0-10V Dimmable Digital Off-Line LED Driver with High PF and Low THD

Disclaimer

Information in this document is believed to be accurate and reliable. However, Dialog Semiconductor does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information. Dialog Semiconductor furthermore takes no responsibility whatsoever for the content in this document if provided by any information source outside of Dialog Semiconductor.

Dialog Semiconductor reserves the right to change without notice the information published in this document, including without limitation the specification and the design of the related semiconductor products, software and applications.

Applications, software, and semiconductor products described in this document are for illustrative purposes only. Dialog Semiconductor makes no representation or warranty that such applications, software and semiconductor products will be suitable for the specified use without further testing or modification. Unless otherwise agreed in writing, such testing or modification is the sole responsibility of the customer and Dialog Semiconductor excludes all liability in this respect.

Customer notes that nothing in this document may be construed as a license for customer to use the Dialog Semiconductor products, software and applications referred to in this document. Such license must be separately sought by customer with Dialog Semiconductor.

All use of Dialog Semiconductor products, software and applications referred to in this document are subject to Dialog Semiconductor's [Standard Terms and Conditions of Sale](#), unless otherwise stated.

© Dialog Semiconductor. All rights reserved.

RoHS Compliance

Dialog Semiconductor complies to European Directive 2001/95/EC and from 2 January 2013 onwards to European Directive 2011/65/EU concerning Restriction of Hazardous Substances (RoHS/RoHS2).

Dialog Semiconductor's statement on RoHS can be found on the customer portal <https://support.diasemi.com/>. RoHS certificates from our suppliers are available on request.

Contacting Dialog Semiconductor

United Kingdom

Dialog Semiconductor (UK) Ltd
Phone: +44 1793 757700

Germany

Dialog Semiconductor GmbH
Phone: +49 7021 805-0

The Netherlands

Dialog Semiconductor B.V.
Phone: +31 73 640 88 22

Email

info_pcbg@diasemi.com

North America

Dialog Semiconductor Inc.
Phone: +1 408 845 8500

Japan

Dialog Semiconductor K. K.
Phone: +81 3 5425 4567

Taiwan

Dialog Semiconductor Taiwan
Phone: +886 281 786 222

Web site:

www.dialog-semiconductor.com

Singapore

Dialog Semiconductor Singapore
Phone: +65 648 499 29

Hong Kong

Dialog Semiconductor Hong Kong
Phone: +852 2607 4271

Korea

Dialog Semiconductor Korea
Phone: +82 2 3469 8200

China

Dialog Semiconductor (Shenzhen)
Phone: +86 755 2981 3669

Dialog Semiconductor (Shanghai)

Phone: +86 21 5424 9058