

## 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 power factor (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.

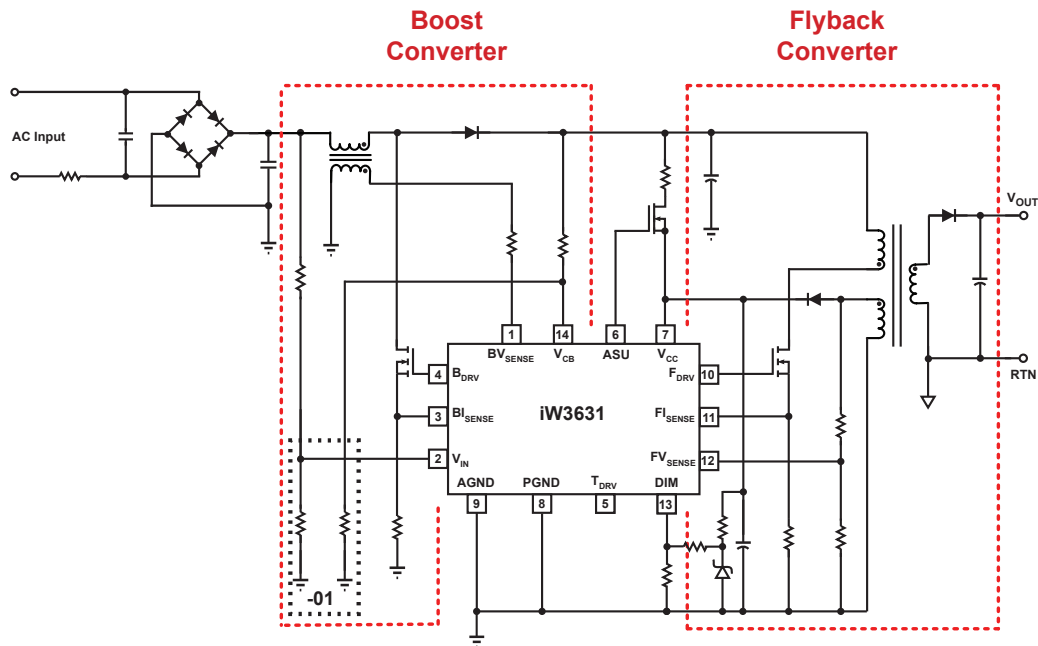
### 2 Features

- Supports universal,  $90V_{AC}$ - $277V_{AC}$  input voltage range and output power up to 120W or above
- 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

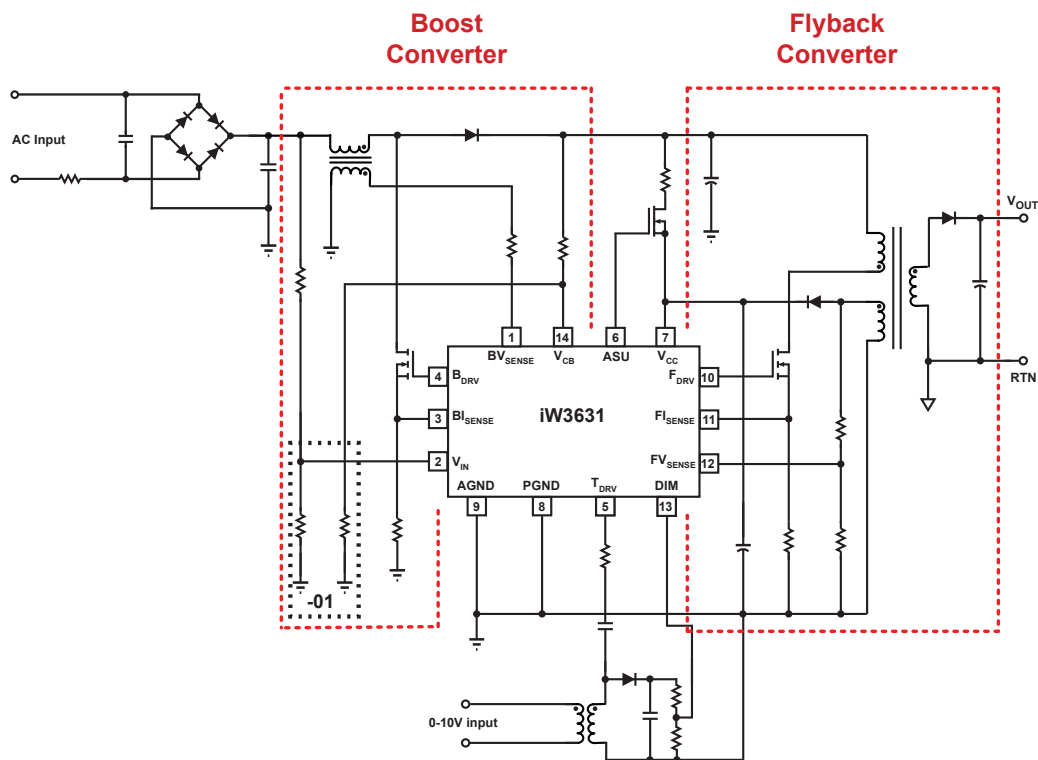
### 3 Applications

- 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 120W or above

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**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**

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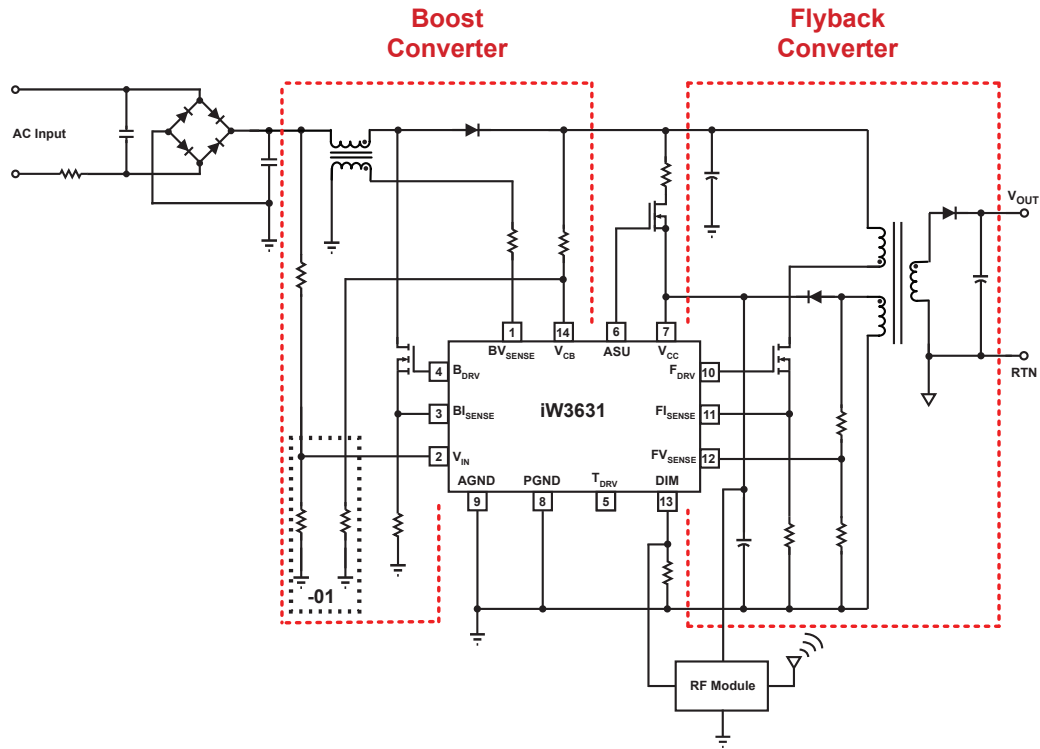


Figure 3.3 : iW3631 Wireless Dimming Simplified Schematic with Internal (-00) or External (-01) Sensing

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### 4 Pinout Description

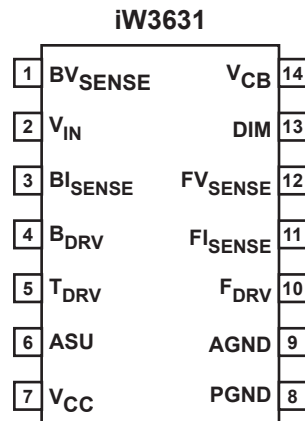


Figure 4.1 : 14-Lead SOIC-14 Package

Pin Number	Pin Name	Type	Pin Description
1	BV <sub>SENSE</sub>	Analog Input	Boost inductor voltage feedback used for valley mode switching.
2	V <sub>IN</sub>	Analog Input	Rectified AC line voltage feedback. -00 uses internal resistor (15kΩ typically) to sense line voltage; -01 needs an external resistor connected from this pin to GND.
3	BI <sub>SENSE</sub>	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 <sub>DRV</sub>	Output	Gate drive for boost MOSFET.
5	T <sub>DRV</sub>	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. If not using active start-up device, leave this pin floating.
7	V <sub>CC</sub>	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 <sub>CC</sub> pin and GND.
8	PGND	Ground	Power ground.
9	AGND	Ground	Signal ground.
10	F <sub>DRV</sub>	Output	Gate drive for flyback MOSFET.
11	FI <sub>SENSE</sub>	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 <sub>SENSE</sub>	Analog Input	Auxiliary voltage sense (used for primary-side regulation and valley mode switching).
13	DIM	Analog Input	Dimming level control input.
14	V <sub>CB</sub>	Analog Input	Boost output voltage feedback. -00 uses internal resistor (15kΩ typically) to sense line voltage; -01 needs an external resistor connected from this pin to GND.

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### 5 Absolute Maximum Ratings

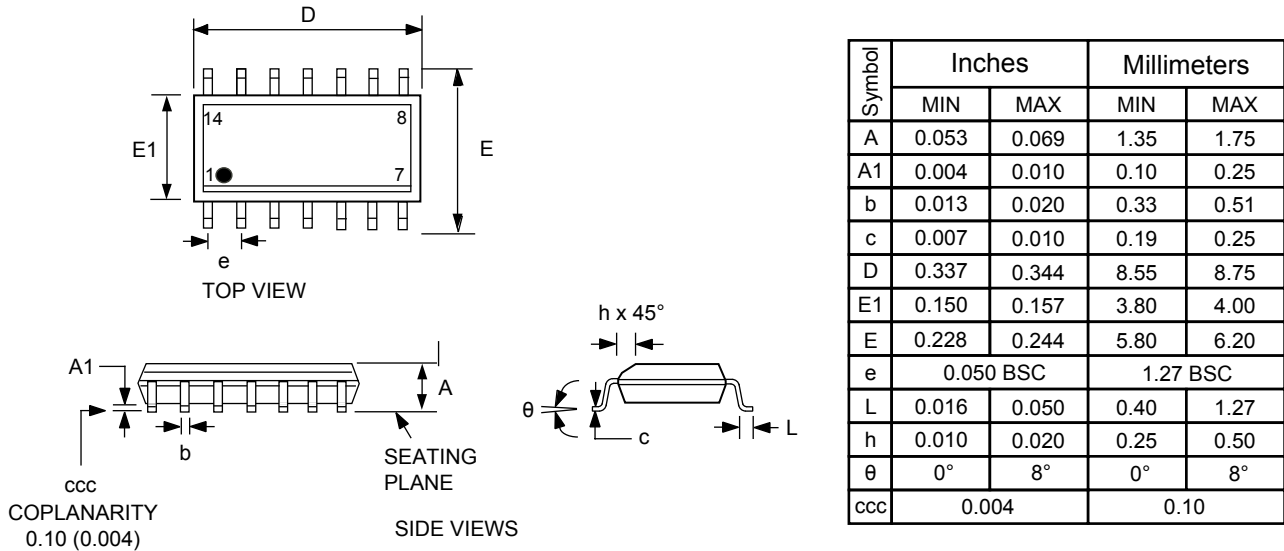
Absolute maximum ratings are the parameter values or ranges which can cause permanent damage if exceeded.

Parameter	Symbol	Value	Units
DC supply voltage range (pin 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
$Fl_{SENSE}$ input (pin 11)		-0.3 to 4.0	V
$Bl_{SENSE}$ 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	$\Psi_{JB}$	45	°C/W
ESD rating per JEDEC JESD22-A114		±2,000	V

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**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 <sup>1</sup>
iW3631-01	External sensing for $V_{IN}$ and $V_{CB}$	SOIC-14	Tape & Reel <sup>1</sup>

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

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