

CLM3616

AC/DC Digital Power Controller for High Power Factor Dimmable LED Drivers

1. Description

The CLM3616 is a two-stage, high-performance AC/DC offline power supply controller for dimmable LED luminaires. It applies advanced digital control technology to detect the dimmer type and phase, which provides dynamic impedance to interface the dimmer and control the LED brightness at the same time. The CLM3616 uses unique digital technology to eliminate visible flicker in the entire dimming range and minimize low frequency output ripple current.

With advanced dimmer detection technology, the CLM3616 can operate with most wall dimmers including leading-edge dimmers (R-type or R-L type) and trailing-edge dimmers (R-C type). In addition, the CLM3616's cycle-by-cycle waveform analysis technology allows fast dimmer setting response. When no dimmer is on the line, the CLM3616 optimizes the power factor and minimizes the current harmonic distortion to the AC line.

The CLM3616 operates the main power converter that delivers constant current to the LED load in quasi-resonant mode to provide high power efficiency and minimize electro-magnetic interference (EMI). It uses patented 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 eliminating the need for an optocoupler.

The CLM3616 minimizes the external components count by simplifying the EMI filter with technology. The intelligent dimmer detection technology eliminates the need for a high-power bleeder. Additionally, the digital control loop of the CLM3616 maintains stable overall operating conditions without the need for loop compensation components.

2. Features

- Isolated/non-isolated offline 120V_{AC}/230V_{AC} LED driver up to 12W output power
- Wide line frequency ranges (from 45Hz to 66Hz)
- Meets IEC61000-3-2 requirement
- Total harmonic distortion < 15% with PF > 0.95
- Wide dimmer compatibility
 1. Leading-edge dimmer
 2. Trailing-edge dimmer
 3. Digital dimmer
 4. Occupancy sensors and timers
- Under 20% output ripple current
- Wide dimming range from 1% to 100%
- **Flickerless**[™] LED dimming
- Resonant control to achieve high efficiency (typical > 85% without dimmer)
- Over-temperature LED current foldback
- Small solution size
 5. Two-stage topology enables small-size input and output filter capacitors
 6. 200kHz maximum switching frequency enables small transformer
 7. Intelligent dimmer interface eliminates dedicated high-power bleeder
- primary-side sensing eliminates the need for optocoupler feedback
- Tight LED current regulation ($\pm 5\%$)
- Fast start-up (< 0.5s without dimmer)
- Supports hot-plug LED module (Zhaga)
- Compatible with NEMA SSL6 dimming curve
 8. standard
 9. x LED open-circuit and short-circuit protection
 10. x Over-current and over-temperature protection
 11. x Current sense resistor short-circuit protection x AC line over-voltage/-frequency protection

3. Applications

- Dimmable LED retrofit lamps up to 12W
- Dimmable LED ballast and luminaires up to 12W

目录

CLM3616	1
1. Description	1
2. Features	1
目录	2
缩写目录	3
4. Pinout Description	6
5. Absolute Maximum Ratings	7
6. Physical Dimensions	8
7. Ordering Information	8

缩写目录

ADR	Address 地址
AL	Application Layer 应用层
BD	Bidirectional 双向
BGA	Ball Grid Array 球阵列封装
BHE	Bus High Enable 总线高电平使能
CMD	Command 命令
CS	Chip Select 片选
DC	Distributed Clock 集成分布时钟
DL	Data Link Layer 数据链接层
EMC	Electromagnetic Compatibility 电磁兼容性
EMI	Electromagnetic Interference 电磁干扰
EOF	End of Frame 帧结尾
EEPROM	Electrically Erasable Programmable read only memory 带电可擦可编程只读存储器
FMMU	Fieldbus Memory Management Unit 现场总线内存管理单元
GPI	General Purpose Input 通用数字量输入引脚
GPO	General Purpose Output 通用数字量输出引脚
I	Input 输入
I/O	Input or Output 输入或者输出
I2C	Inter-Integrated Circuit 集成电路总线
IRQ	Interrupt Request 中断请求
LDO	Low Drop-Out regulator 低压差线性稳压器
LVDS	Low Voltage Differential Signaling 低压差分信号
LI-	LVDS RX- 低压差分信号负接收端
LI+	LVDS RX+ 低压差分信号正接收端
LO-	LVDS TX- 低压差分信号负发射端
LO+	LVDS TX+ 低压差分信号正发射端
LED	Light Emitting Diode 发光二极管
MAC	Media Access Controller 介质访问控制
MDIO	Management Data Input / Output 管理数据输入/输出
MI	(PHY) Management Interface 以太网物理层接口器件管理接口

MII	Media Independent Interface 介质无关接口
MISO	Master In – Slave Out 主站输入-从站输出
MOSI	Master Out – Slave In 主站输出-从站输入
n.a.	not available 未使用
n.c.	not connected 未连接
O	Output 输出
PD	Pull-down 下拉
PDI	Process Data Interface 过程数据接口 Physical Device Interface 物理设备接口
PLL	Phase Locked Loop 锁相回路
PU	Pull-up 上拉
PHY	Physical 以太网物理层器件
QFN	Quad Flat package No leads 方形扁平无引脚封装
RD	Read 读
SII	Slave Information Interface 从站信息接口
SM	SyncManager 同步管理器
SOF	Start of Frame 帧起始
SPI	Serial Peripheral Interface 串行外设接口
TA	Transfer Acknowledge 传输应答
TFBGA	Thin-profile Fine-pitch BGA 薄型球栅阵列封装
TS	Transfer Start 传输周期启动
UI	Unused Input (PDI: PD, 其它: GND)未使用的输入引脚
WD	Watchdog 看门狗
WPD	Weak Pull-down 弱下拉, 只够配置信号
WPU	Weak Pull-up 弱上拉, 只够配置信号
WR	Write 写

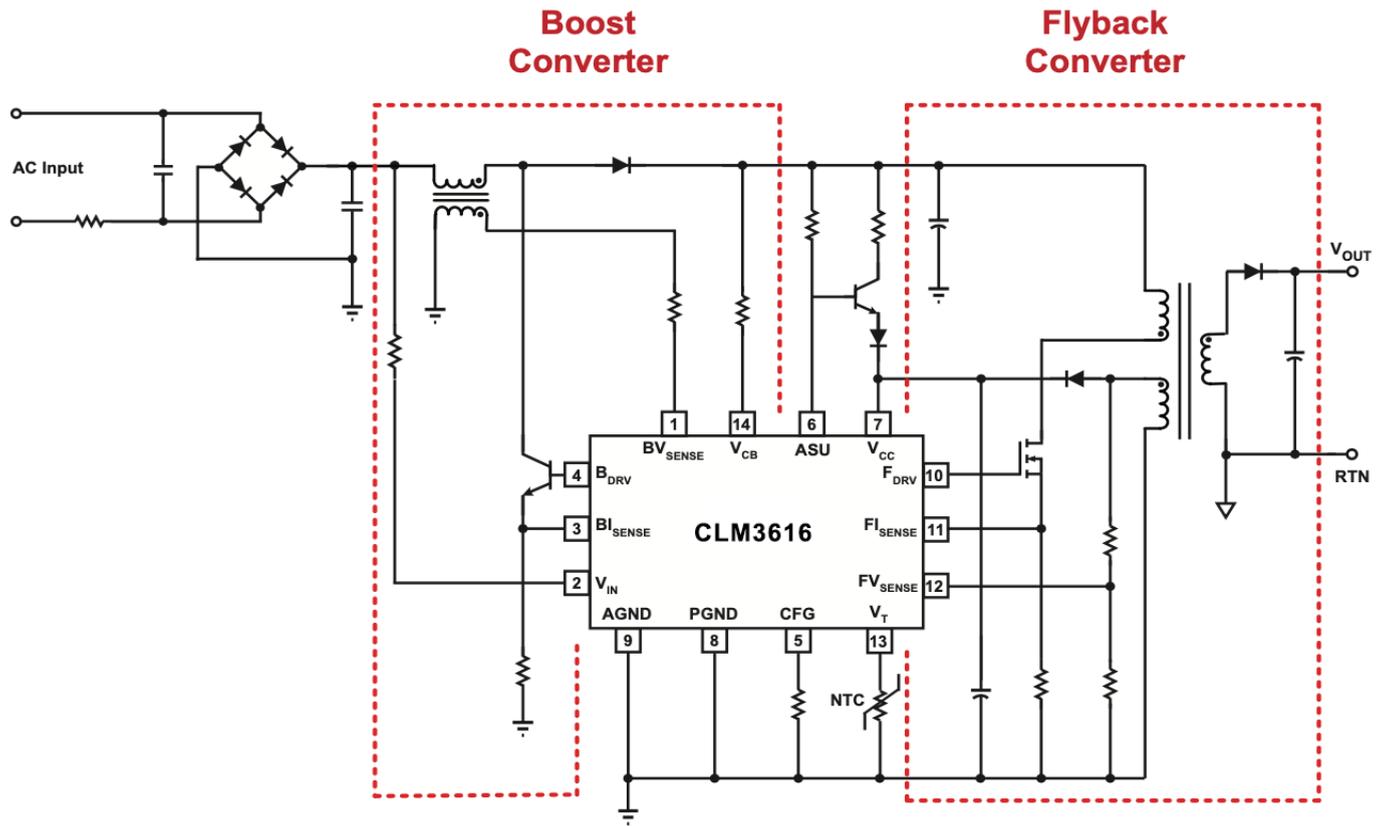


Figure 3.1 : CLM3616 Simplified Schematic

4. Pinout Description

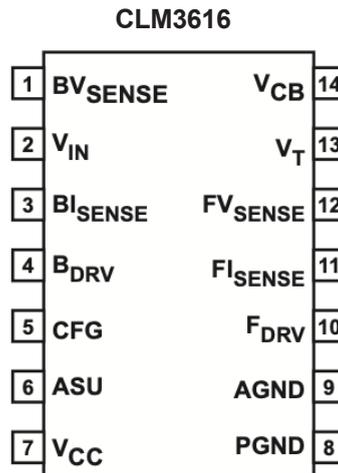


Figure 4.1 : 14-Lead SOIC Package

Pin Number	Pin Name	Type	Pin Description
1	BV _{SENSE}	Analog Input	Boost inductor voltage feedback input
2	V _{IN}	Analog Input	Rectified AC line voltage input
3	BI _{SENSE}	Analog Input	Boost current sense input
4	B _{DRV}	Output	Base drive output for boost BJT
5	CFG	Analog In/Out	Driver parameter configuration pin and auxiliary driver
6	ASU	Output	Active start-up and bleeder control
7	V _{CC}	Power	Power supply for control logic and voltage sense for power-on reset circuit. 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. It should be connected to the power ground on PCB.
10	F _{DRV}	Output	Gate drive output for flyback MOSFET
11	FI _{SENSE}	Analog Input	Flyback current sense (used for cycle-by-cycle peak current control and limit)
12	FV _{SENSE}	Analog Input	Flyback voltage sense (used for primary-side regulation and ZVS)
13	V _T	Analog Input	External power limit shutdown control and external over-temperature power derating
14	V _{CB}	Analog Input	Boost output voltage feedback input

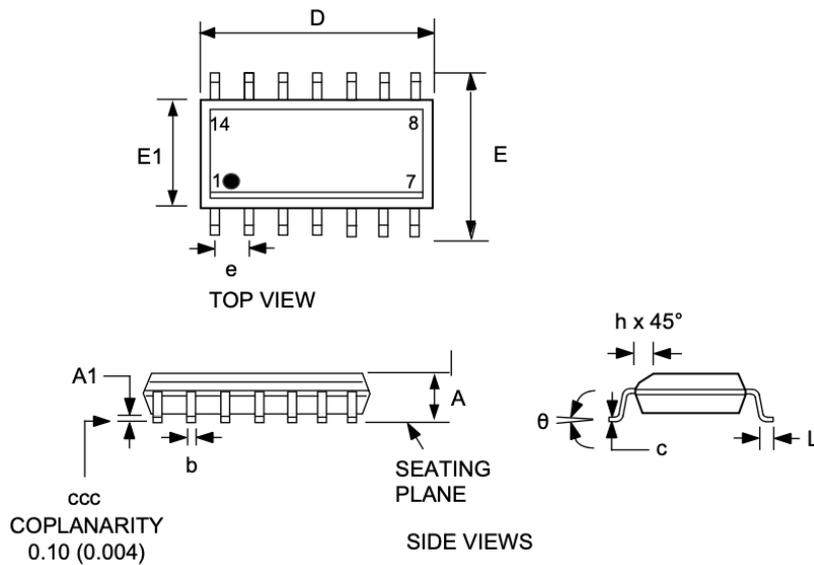
5. Absolute Maximum Ratings

Absolute maximum ratings are the parameter values or ranges which can cause permanent damage if exceeded. For maximum safe operating conditions, refer to Electrical Characteristics in Section 6.

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 4.0	V
CFG input (pin 5)		-0.3 to 4.0	V
CFG output (pin 5)		-0.3 to 18	V
FV _{SENSE} input (pin 12, I ≤ 10mA)		-0.7 to 4.0	V
BV _{SENSE} input (pin 1, I ≤ 3mA)		-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
V _T 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		±2,000	V
Latch-up test per JESD78A		±100	mA

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
CLM3616-00	120V _{AC} Input	SOIC-14	Tape & Reel ¹
CLM3616-01	230V _{AC} Input	SOIC-14	Tape & Reel ¹

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