Non-isolation High Power Factor LED Driver

Features

- Transition mode (TM) PFC control
- Non-isolation flyback topology
- Precision current regulation for LED
- Cycle-by-cycle over current protection
- VCC pin over voltage protection
- Output open protection
- Constant on time PWM control
- Programmable CT pin for PFC optimization

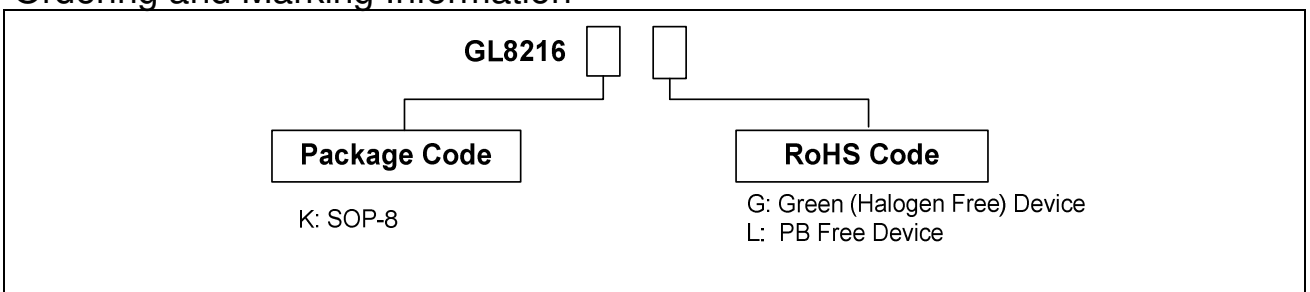
Application

- LED lighting

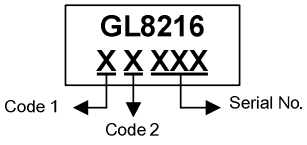
General Description

The GL8216 is a high performance non-isolation AC/DC off-line switching mode single stage PFC control IC for LED lighting. It's built-in an accuracy +/- 1% reference voltage for current regulation. The feedback control loop is easily compensated by connected a capacitor to COMP pin and ground. The application circuit for constant current is very simple without any OPAmp required. It's suitable for low cost LED driver with PFC requirement and accuracy LED current.

Ordering and Marking Information



SOP-8



Code 1	8	9	A	B	...	G	H	I	J
Year	2008	2009	2010	2011		2016	2017	2018	2019
Code 2	1	2	3	4		9	A	B	C
Month	Jan.	Feb.	Mar.	Apr.		Sep.	Oct.	Nov.	Dec.

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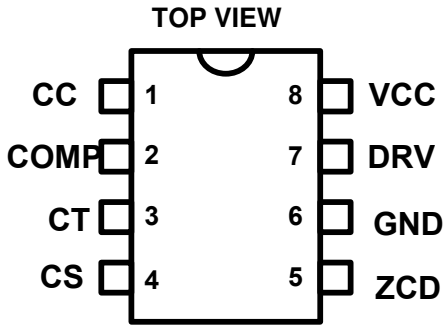
Pin Configuration



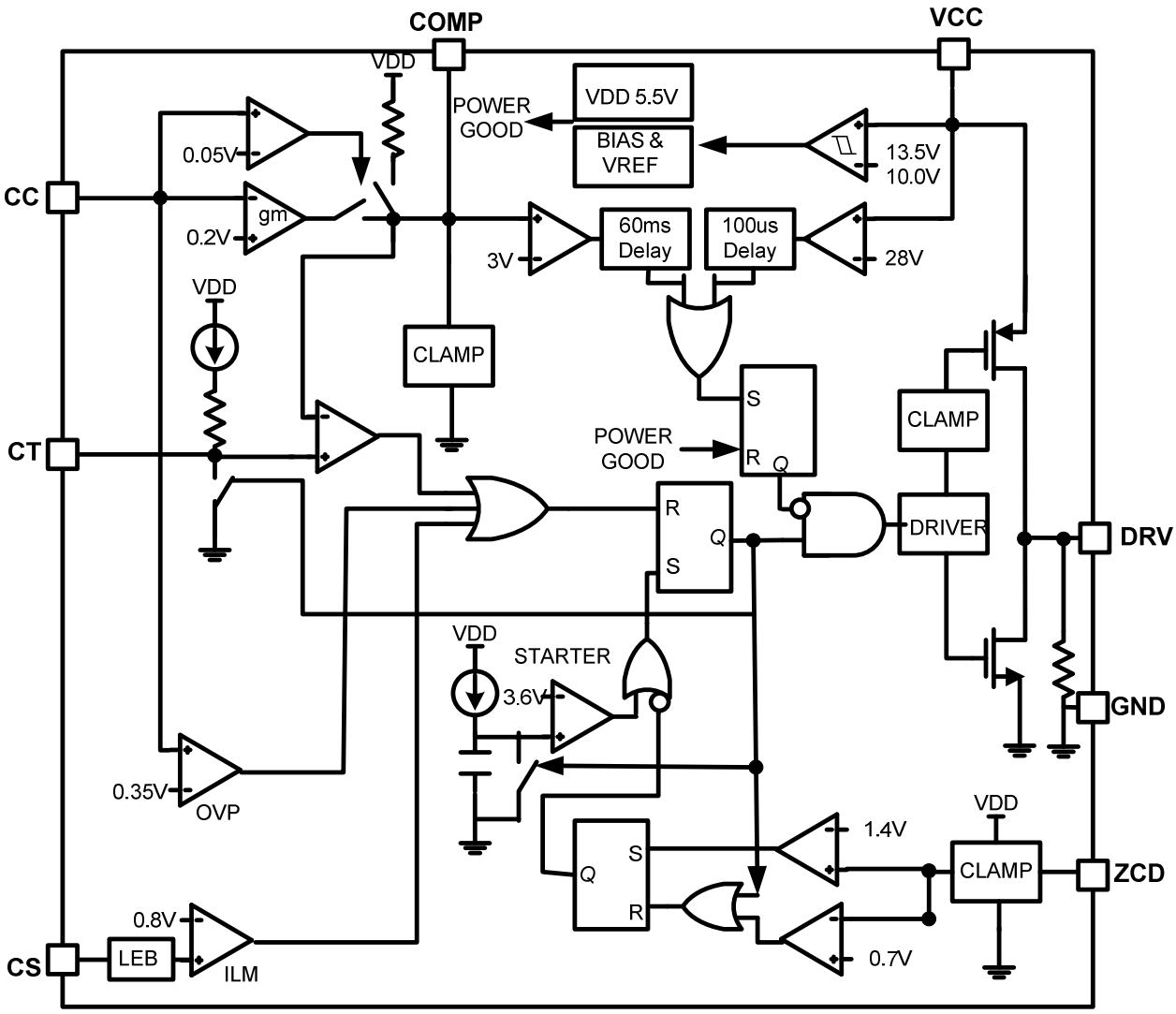
Pin Description

Pin No.	Name	Function
1	CC	The Constant Current pin is connected to the internal error amplifier.
2	COMP	The COMP pin is connected to the output of internal error amplifier. Adding compensation network to stabilize the control loop and get higher power factor.
3	CT	The CT pin is connected to the current source to charge the external capacitor and compare the COMP voltage to terminate the power switch.
4	CS	The Current Sense pin is connected to the input of OCP comparator, and terminates the power switch when the current sense voltage is beyond threshold.
5	ZCD	The Zero Current Detector Input, which is connected to an auxiliary winding to monitor the zero crossing current of the inductor. When the ZCD detects that the winding has been demagnetized, it will send the set signal to turn on the external MOSFET.
6	GND	The ground pin.
7	DRV	The DRV pin is connected to the totem pole gate driver to drive the external power switch.
8	VCC	Positive power supply pin.

Absolute Maximum Ratings

Supply voltage VCC	30V
Junction temperature	150℃
Operating ambient temperature	-20℃ ~ 85℃
Storage temperature range	-65℃ ~ 150℃
SOP-8 package thermal resistance	160℃/W
Power dissipation (SOP-8, at ambient temperature = 85℃)	400mW
Lead temperature (All Pb free packages, soldering, 10sec)	260℃
ESD voltage protection, human body model	2KV
ESD voltage protection, machine model	200V

Block Diagram



Electrical Characteristics (V_{CC} = 15V, T_A = 25℃, unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
SUPPLY SECTION						
VCC turn-on threshold (UVLO on)	$UVLO_{ON}$		12.5	13.5	14.5	V
VCC turn-off threshold (UVLO off)	$UVLO_{OFF}$		9	10	11	V
VCC UVLO on/off hysteresis	$UVLO_{HYST}$			3.5		V
Operation current	I_{VCC}	C_{LOAD} = 1nF, f_{sw}=70kHz		2.5	3.2	mA
		C_{LOAD} = 0F, f_{sw}=70kHz		1.6	2.5	mA
Startup current	$I_{VCCSTART}$	VCC= $UVLO_{ON}$ - 0.5V		21	50	uA
VCC over voltage protection	VCC_{OVP}		26	28	30	V
ZERO CURRENT DETECTOR SECTION						
Upper clamp voltage	V_{ZCDH}	I_{ZCD} = 2.5mA	4.3	4.8	5.3	V
Lower clamp voltage	V_{ZCDL}	I_{ZCD} = -2.5mA	-0.4	-0.2	0	V
Arming voltage (positive-going edge)	V_{ZCDA}		1.2	1.4	1.6	V
Arming voltage (negative-going edge)	V_{ZCDT}		0.5	0.7	0.9	V
Input bias current	V_{ZCDB}		1	1.5	2	uA
PROTECTION SENSE SECTION						
Over load protection Vcomp threshold	V_{OLP}		2.6	3.0		V
Output over voltage protection	V_{OVP}			0.35		V
INTERNAL VOLTAGE REFERENCE SECTION						
Reference voltage	V_{REF}	T_A = 25°C	198	200	202	mV
Line regulation	ΔV_{REG}	13V < VCC < 20V		2	5	mV
Temp. stability	T_{STAB}	-40°C ≦ T_{AMB} ≦ 125°C		0.5	1	%
Total variation	ΔV_{TOT}	Over VCC and Tj ranges		2.5		mV
VOLTAGE ERROR AMPLIFIER SECTION						
Transconductance	g_m	Vin=0.1 to 0.3V	100	120	140	uS
Source current	I_{SOURCE}	CC=0.1V	-10	-12	-14	uA
Sink current	I_{SINK}	CC=0.3V	10	12	14	uA
Effective V_{COMP} voltage	$V_{COMP\ EFF}$		3.2	3.5	3.8	V
Input bias current	I_{IB}	CC= 0.2V -25°C ≦ T_{AMB} ≦ 125°C	-0.25		-1.25	uA
Sourcing current	I_{COMP}	CC=0V	-0.5	-1	-2	mA
CURRENT LIMIT SECTION						
Peak current limit protection (I_{PKLMT}) I_{SNS} voltage threshold	V_{ISNS}		0.7	0.8	0.9	V
Leading edge blanking time	t_{LEB}		350	450	550	ns
Delay to output	t_{TD}			130	220	ns

GATE DRIVER SECTION

Output low level	V_{OL}	Io = 20mA			1	V
Output high level	V_{OH}	Io = -20mA	8			V
Rising Time	t_r	C_{LOAD} = 1nF, VCC= 15V		280	500	ns
Falling Time	t_f	C_{LOAD} = 1nF, VCC= 15V		80	150	ns
Gate clamp voltage	V_{DRV}	VCC=20V	10		15	V

RAMP CONTROL SECTION

CT charge current	I_{CT}	V_{CT}=0V	-80	-100	-120	uA
Start timer period	t_{ST}		75	160	300	us

Typical Performance Characteristics

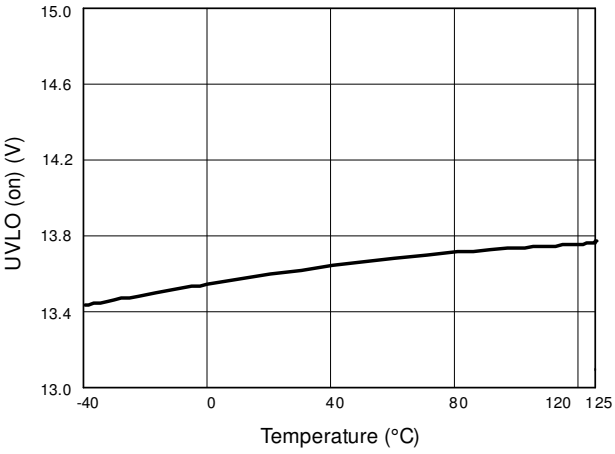


Fig. 1 UVLO (on) vs. Temperature

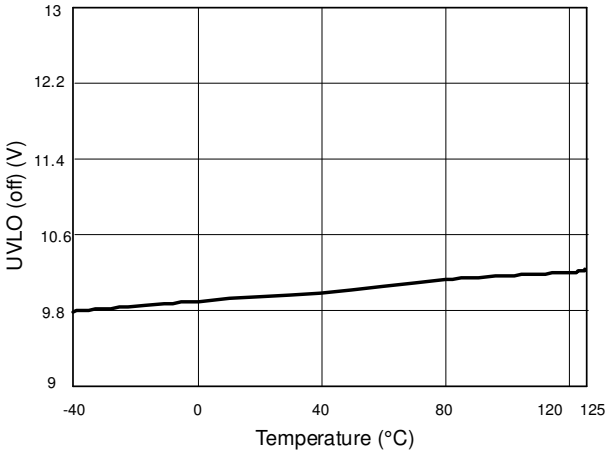


Fig. 2 UVLO (off) vs. Temperature

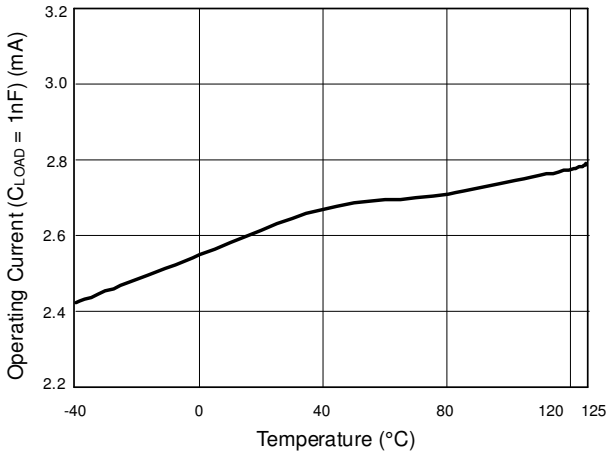


Fig. 3 Operating Current (C_{LOAD} = 1nF) vs. Temperature

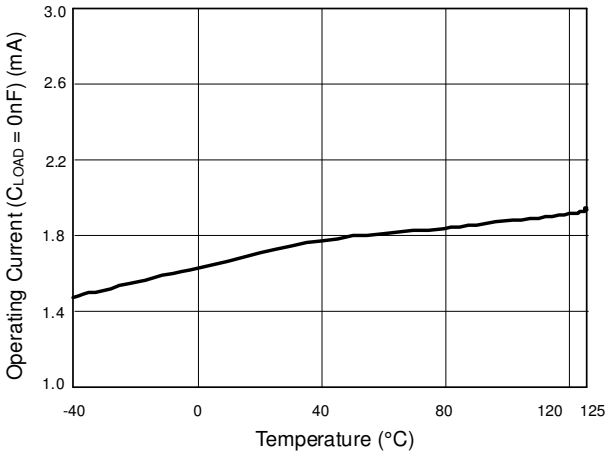


Fig. 4 Operating Current (C_{LOAD} = 0nF) vs. Temperature

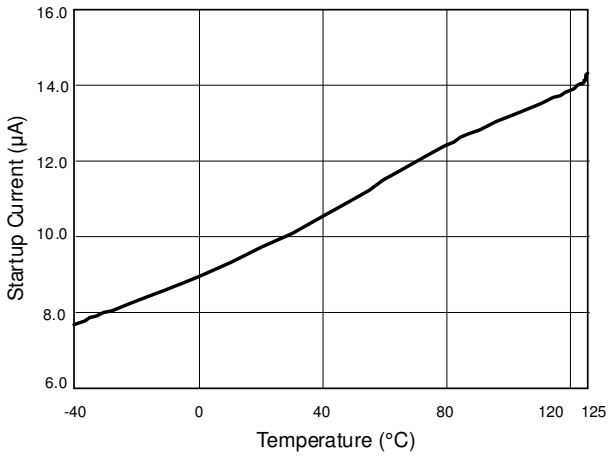


Fig. 5 Startup Current vs. Temperature

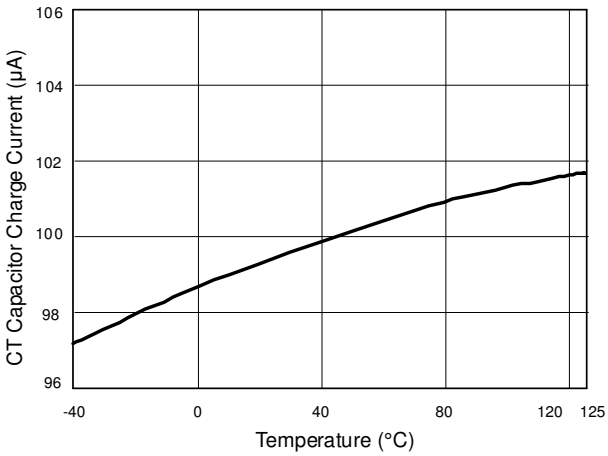


Fig. 6 CT Capacitor Charge Current vs. Temperature

Typical Performance Characteristics(Cont.)

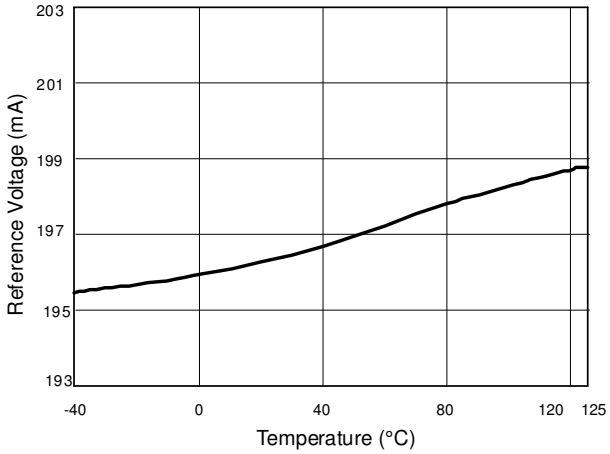


Fig. 7 Reference Voltage vs. Temperature

Application Information

Overview

The GL8216 contains a programmable timer, a transconductance error amplifier used in a feedback loop, an over current comparator, a current sense comparator, a zero current detector, a PWM and logic circuit, a totem pole MOSFET driver, an internal voltage reference, a restart timer and under voltage lockout circuit. It achieves the PFC function by using constant on time and voltage mode control.

Constant On time

The on time of pulse width to drive MOSFET is determined by the input CT pin and the error amplifier output COMP pin. The input CT pin provides the saw tooth waveform to compare with the COMP pin signal. The driver turned off when CT pin voltage reaches to COMP pin voltage. Due to the boundary mode operation of the transformer, the PFC function is implemented naturally by constant on time mode control.

Trnascondutance Error Amplifier

With an external capacitor between the pins COMP and GND, the transconductance error amplifier forms an active low pass filter. The low pass filter monitors the average output current over several line cycles. Typically the filter's bandwidth is set below 10Hz in order to suppress the 100Hz line ripple of the output current. The non-inverting input is biased internally at an accuracy reference voltage 0.2V. The inverting input CC pin is directly connected to the sense resistor series with LED. The gate drive is disabled when CC voltage is more than 0.35V.

Over current Comparator

Because of the feedback loop with low bandwidth, the fast changes of the output current can't be regulated within an adequate time. Fast output changes occur during initial start-up. During this fast changes, a peak current is flowing through the external sense resistor series to LED. If this current exceeds an internal defined margin the over current comparator shut down the gate driver to reduce the output current.

Current Sense Comparator

An external sense resistor connected to the MOSFET source and ground transfers the source current of the MOSFET into a sense voltage. The signal is compared with internal reference voltage 0.8V. The switch-on peak current of the MOSFET is blanked out via a leading edge blanking circuit with a blanking time of typically 450ns.

Zero Current Detector

The zero current detector senses the inductor current via an auxiliary winding and ensures that the next on-time of the MOSFET is initiated immediately when the inductor current has reached zero. This diminishes the reverse recovery losses of the flyback converter diode. The MOSFET is switched off when the voltage of the CT pin reaches the voltage level of the error amplifier output. So the inductor current waveform has a triangular shape and there are no dead-time gaps between the cycles. This leads to an AC line current proportional to line voltage. To prevent false tripping the zero current detector is designed as a Schmitt-Trigger with a hysteresis of 0.7V. An internal 4.8V clamp protects the input from overvoltage breakdown. An external resistor has to be used in series with the auxiliary winding to limit the current through the clamps.

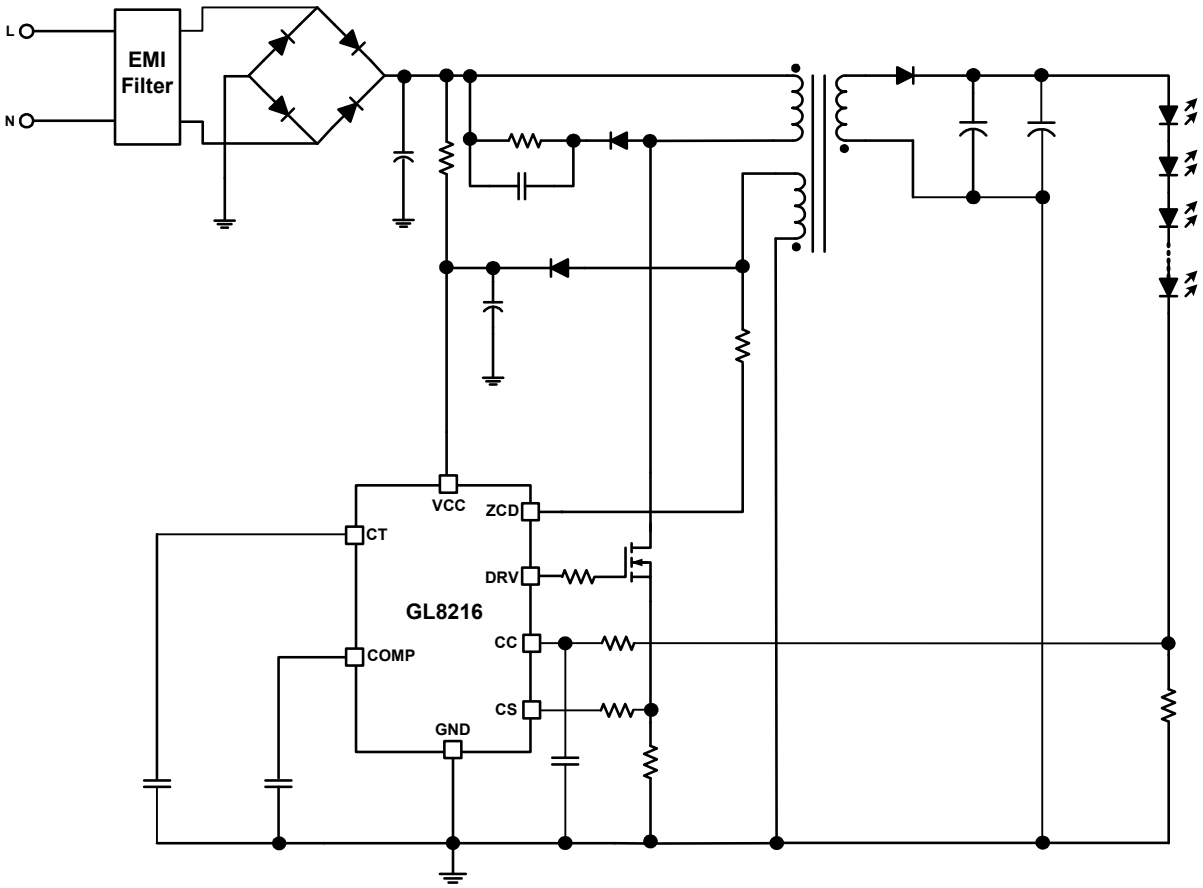
Restart Timer

The restart timer function eliminates the need of a oscillator. The timer starts or restarts the GL8216 when the drive output has been off for more than 160us after the inductor current reaches zero.

Under-voltage Lockout

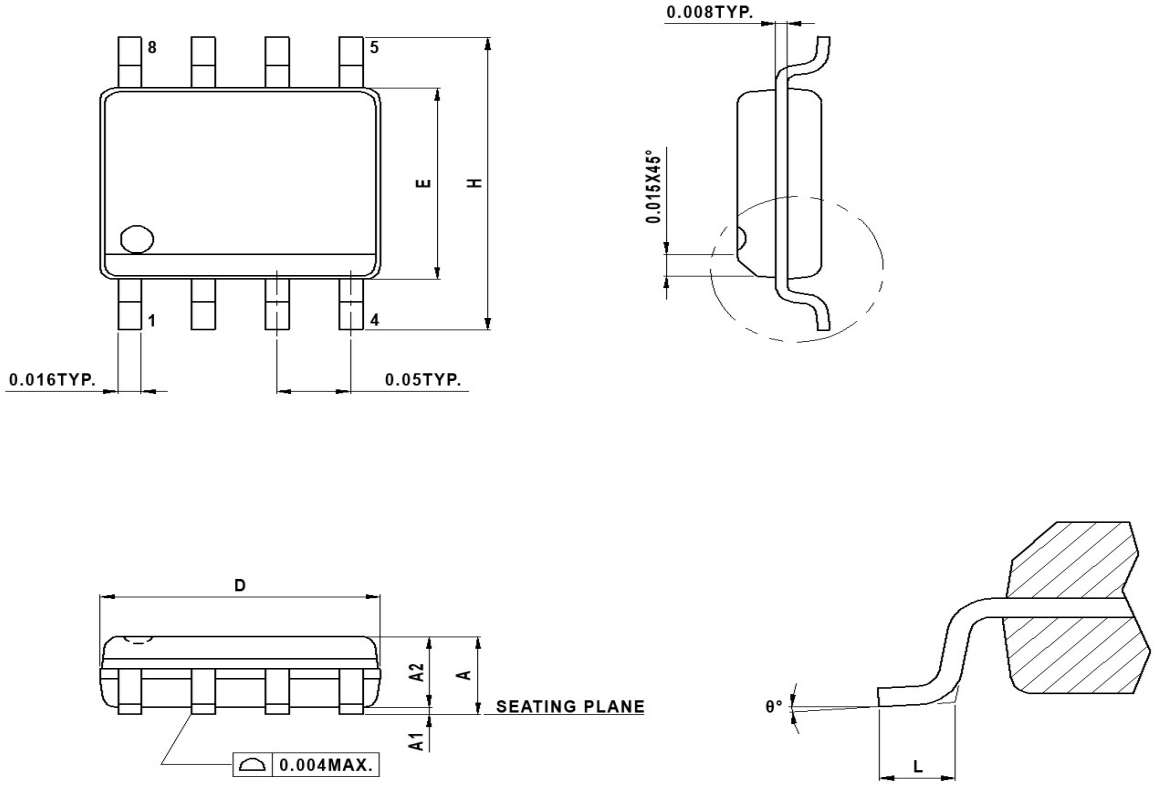
An under voltage lockout circuit switches the IC on when Vcc reaches the UVLO(ON) threshold and switches the IC off when Vcc is falling below the UVLO(OFF) threshold. During star up the supply current is less than 50uA. An internal voltage clamp has been added to protect the IC from Vcc overvoltage.

Typical Application Circuit



Package Information

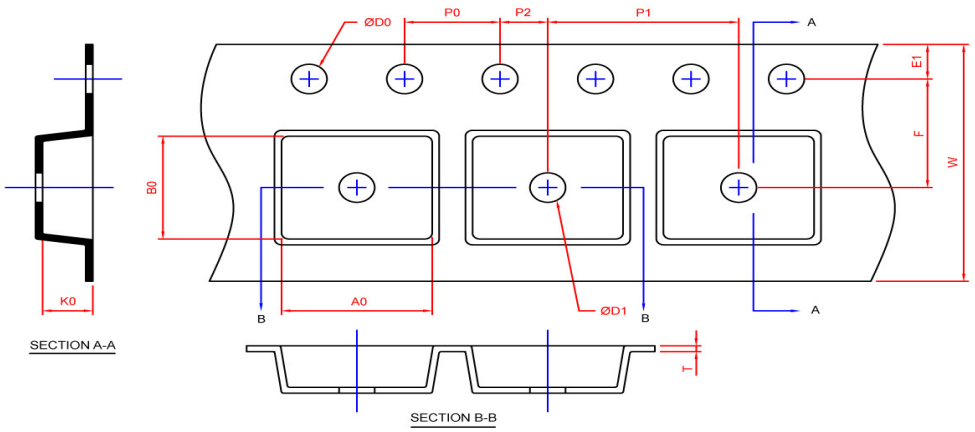
SOP-8

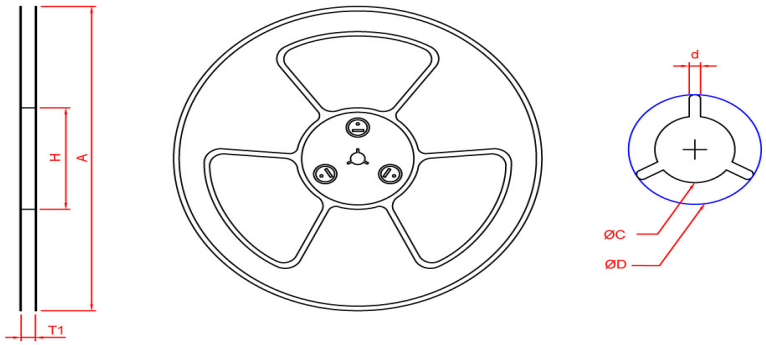


SYMBOL	INCHES	
	MIN.	MAX.
A	0.057	0.069
A1	0.004	0.010
A2	0.053	0.059
D	0.189	0.196
E	0.150	0.157
H	0.228	0.244
L	0.016	0.050
θ °	0	8

Carrier Tape & Reel Dimensions

SOP- 8





Application	A	H	T1	C	d	D	W	E1	F
SOP-8	330.0±2.0	50 MIN.	12.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.0±0.30	1.75±0.10	5.5±0.05
	P0	**P1**	**P2**	**D0**	**D1**	**T**	**A0**	**B0**	**K0**
	4.0±0.10	8.0±0.10	2.0±0.05	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	6.40±0.20	5.20±0.20	2.10±0.20

(mm)

Devices Per Unit

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOP- 8	12	-	2500