

LED Driver with Average-Mode Constant Current Control



General Description

The FP7182 is an average current mode control LED driver IC operating in a constant off-time mode. FP7182 does not produce a peak-to-average error, and therefore greatly improves accuracy, line and load regulation of the LED current without any need for loop compensation or high-side current sensing. The output LED current accuracy is $\pm 2\%$.

The FP7182 can be powered from an 8.0 - 100V supply. A PWM & Linear dimming input is provided that accepts an external control TTL compatible signal. The output current can be programmed by an internal 277mV reference.

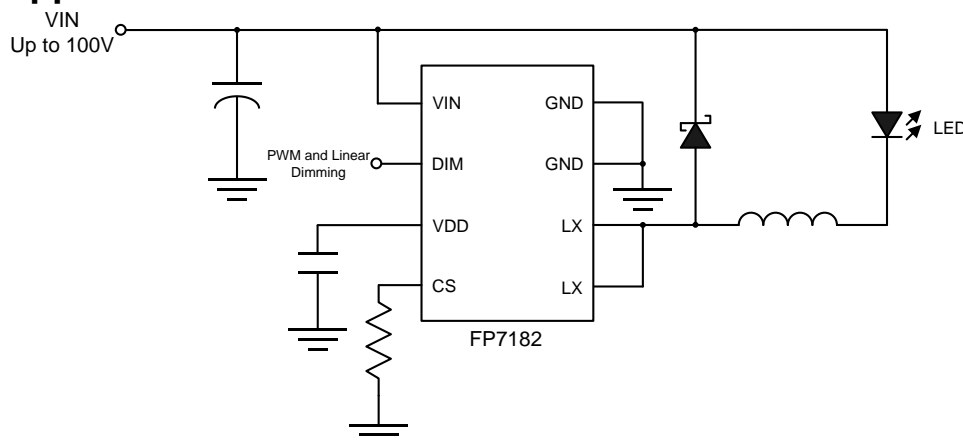
Features

- Fast Average Current Control
- Internal 8 to 100V Linear Regulator
- Linear and PWM Dimming Capability
- Output Short Circuit Protection with Skip Mode
- Requires Few External Components for Operation
- Internal 100V/1.5A N-MOSFET

Applications

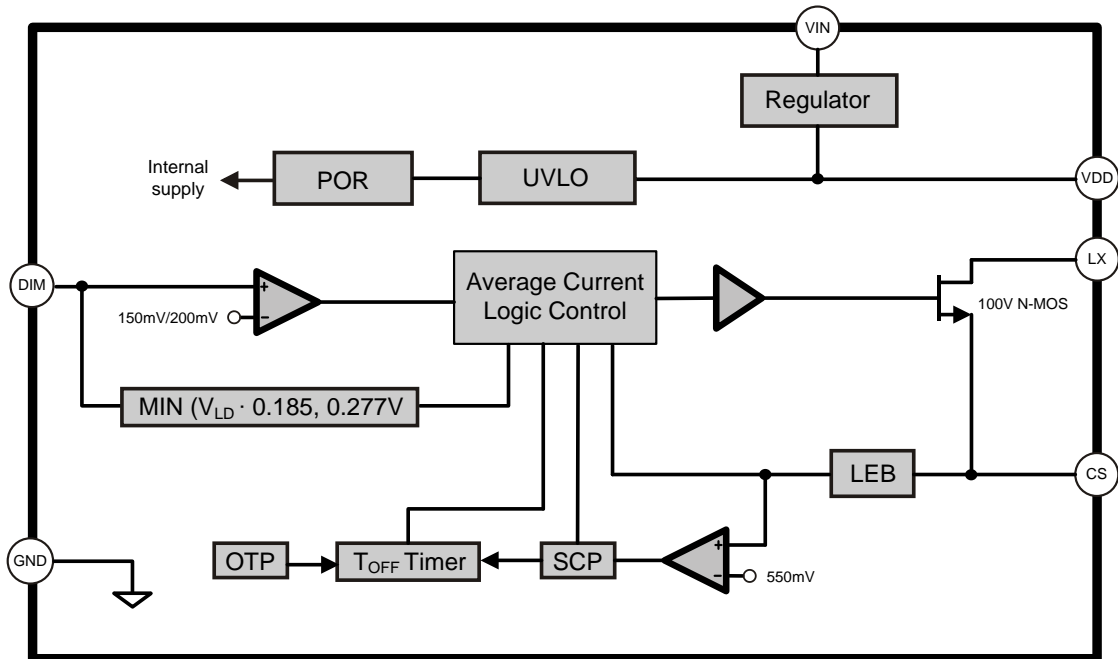
- DC/DC or AC/DC LED Driver Applications
- Back Lighting of Flat Panel Displays
- General Purpose Constant Current Source
- Signage and Decorative LED Lighting
- Chargers

Typical Application Circuit



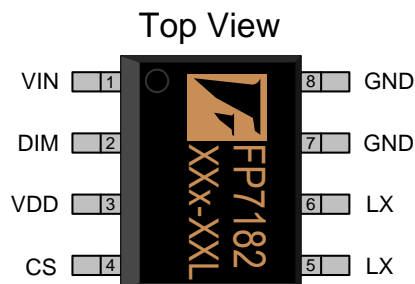
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Function Block Diagram



Pin Descriptions

SOP-8L

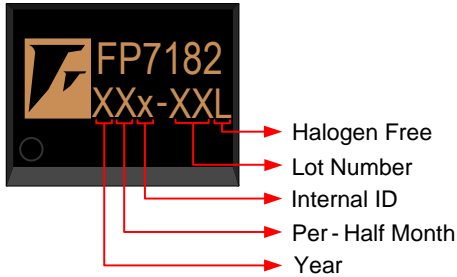


Name	No.	I / O	Description
VIN	1	I	This pin is the input of an 8 - 100V linear regulator.
DIM	2	I	This pin is the linear and PWM dimming input of the IC.
VDD	3	I	This is the power supply pin for all internal circuits.
CS	4	I	This pin is the current sense pin used to sense the FET current by means of an external sense resistor.
LX	5	O	Power switch
LX	6	O	Power switch
GND	7	P	Ground return for all internal circuitry.
GND	8	P	Ground return for all internal circuitry.

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Marking Information

SOP-8L



Halogen Free: Halogen free product indicator

Lot Number: Wafer lot number's last two digits

For Example → Lot : 123456 → XXx-56L

Internal ID: Internal Identification Code

Per-Half Month: Production period indicator in half month time unit

For Example : A → First Half Month of January

B → Second Half Month of January

C → First Half Month of February

D → Second Half Month of February

Year: Production year's last digit

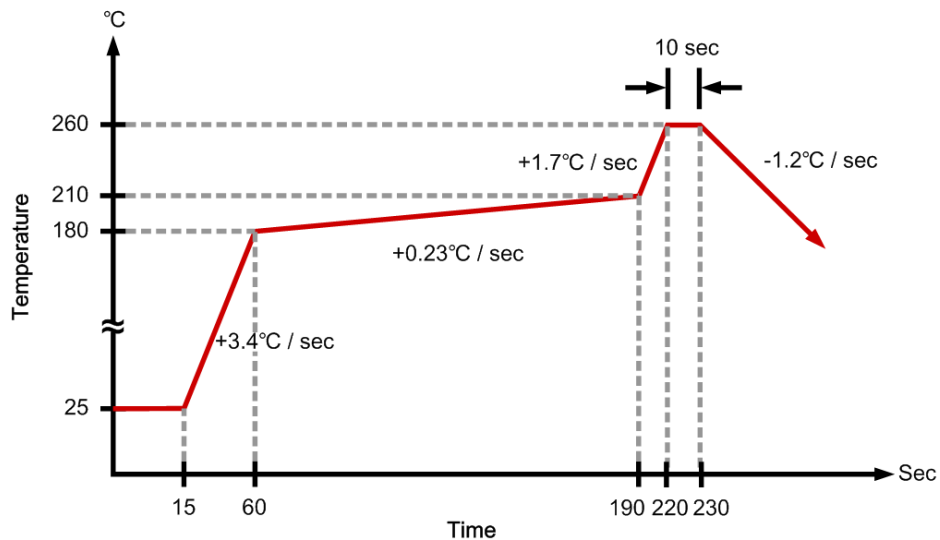
Ordering Information

Part Number	Operating Temperature	Package	MOQ	Description
FP7182DR-G1	-25°C ~ +85°C	SOP-8L	2500 EA	Tape & Reel

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power Supply Voltage	V_{IN}	V_{IN} to GND			100	V
	V_{DD}	V_{DD} to GND			8	V
CS, DIM			-0.3		$V_{DD}-0.3V$	V
Internal MOS V_{DS} Breakdown Voltage	V_{DS}			110		V
Allowable Power Dissipation	P_D	SOP-8L $T_A \leq +25^\circ C$			630	mW
Junction to Ambient Thermal Resistance	θ_{JA}			128		$^\circ C / W$
Operating Temperature			-25		+85	$^\circ C$
Storage Temperature	T_S	SOP-8L	-40		+150	$^\circ C$
SOP-8L Lead Temperature		(soldering, 10 sec)			+260	$^\circ C$

IR Re-flow Soldering Curve



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Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	V _{IN}		8.5		100	V
Operating Temperature			-25		85	°C

DC Electrical Characteristics (V_{IN}=12V, T_A = 25°C, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Internal Regulator						
Internally regulated voltage	V _{DD}	V _{IN} = 8V, I _{DD(ext)} = 0, 500pF at GATE; DIM = VDD	7.25	7.5	7.75	V
Line regulation of VDD	ΔV _{DD,line}	V _{IN} = 8 – 100V, I _{DD(ext)} = 0	0	-	1.0	V
Load regulation of VDD	ΔV _{DD,load}	I _{DD(ext)} = 0 – 0.6mA, DIM = VDD	0		100	mV
V _{DD} undervoltage lockout threshold	UVLO	V _{DD} rising	5.75	6	6.25	V
V _{DD} undervoltage lockout hysteresis	ΔUVLO	V _{DD} falling		500		mV
Average Current Sense Logic						
Current sense reference voltage	V _{CS}		271		283	mV
DIM-to-CS voltage ratio	A _{V(DIM)}		0.182		0.188	
DIM-to-CS voltage offset	A _{V(DIM)} (OFFSET)	Offset = V _{CS} – A _{V(DIM)} • V _{DIM} V _{DIM} = 1.2V	0		15	mV
CS threshold temp regulation					5	mV
DIM input voltage, shutdown	V _{DIM(OFF)}			150		mV
DIM input voltage, enable	Δ V _{DIM(ON)}			200		mV
Current sense blanking interval	T _{BLANK}		150		320	ns
Minimum steady-state duty cycle	T _{ON(min)}	CS = V _{CS} + 30mV			1000	ns
Short Circuit Protection						
Hiccup threshold voltage	V _{CS}		495	550	605	mV
Current limit delay CS – GATE	T _{DELAY}	CS = V _{CS} + 30mV			150	ns
Short circuit hiccup time	T _{HICCUP}		450	550	650	us
Minimum on-time (short circuit)	T _{ON(min)}	CS = V _{DD}			600	ns
OFF-Time						
Maximum off-time limit	T _{OFF(MAX)}			60		us

Notes:

$$T_{OFF} = \frac{0.6 \times L \times I_{LED(AVG)}}{V_{LED(MAX)}}$$

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Function Description

Input Voltage Regulator

The FP7182 can be powered directly from its VIN pin and can work from 8.5 - 100VDC at its VIN pin. When a voltage is applied at the VIN pin, the FP7182 maintains a constant 7.5V at the VDD pin. This voltage is used to power the IC and any external resistor dividers needed to control the IC. The VDD pin must be bypassed by a low ESR capacitor to provide a low impedance path for the high frequency current of the internal driver.

The FP7182 can also be operated by supplying a voltage at the VDD pin greater than the internally regulated voltage. This will turn off the internal linear regulator of the IC and the FP7182 will operate directly off the voltage supplied at the VDD pin. Please note that this external voltage at the VDD pin should not exceed 8.5V.

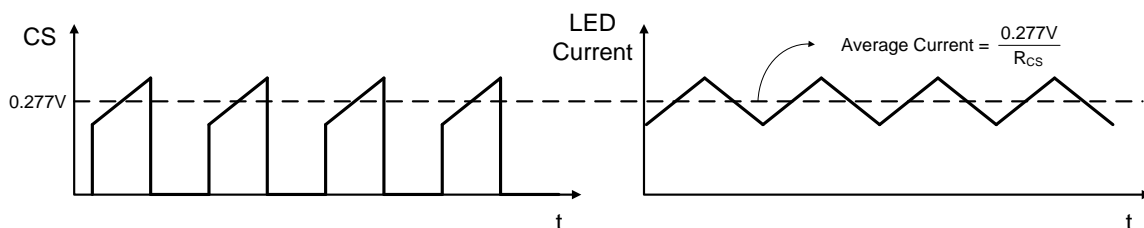
Average Current Control

The LED current is detected using a sense resistor at the CS pin. The feedback operates in a fast open-loop mode. No compensation is required. When the voltage at the DIM input $V_{DIM} \geq 1.5V$, output current is programmed simply as:

$$I_{LED} (A) = \frac{0.277V}{R_{CS} (\Omega)}$$

Otherwise:

$$I_{LED} (A) = \frac{V_{DIM} (V) \times 0.185}{R_{CS} (\Omega)}$$



The above equations are only valid for continuous conduction of the output inductor. It is a good practice to design the inductor such that the switching ripple current in it is 30~40% of its average peak-to-peak, full load, DC current. Hence, the recommended inductance can be calculated as:

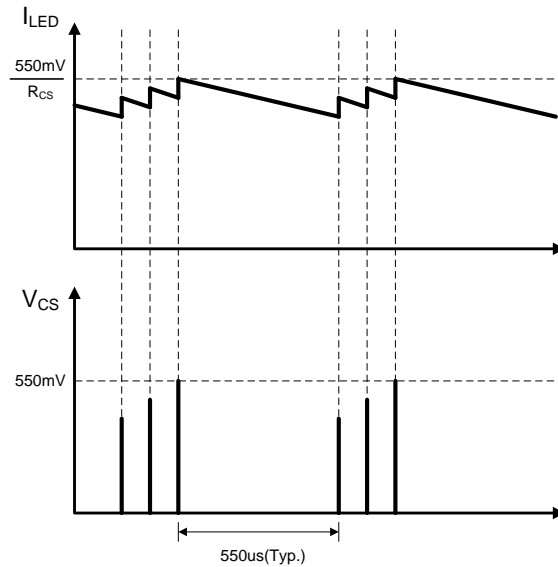
$$L = \frac{V_{IN(DC)} \times V_{LED} - V_{LED}^2}{0.6 \times I_{LED} \times V_{IN(DC)} \times f}$$

Note: f=switch frequency

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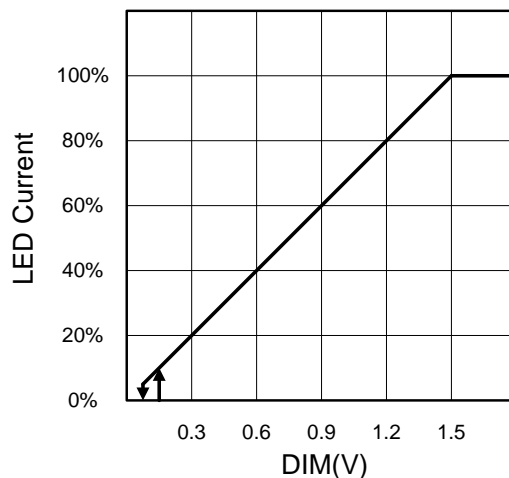
Output Short Circuit Protection

The short circuit protection comparator trips when the voltage at CS exceeds 0.55V. When this occurs, the GATE off-time $T_{HICCUP} = 550\mu s$ is generated to prevent stair-casing of the inductor current and potentially its saturation due to insufficient output voltage.



Linear Dimming

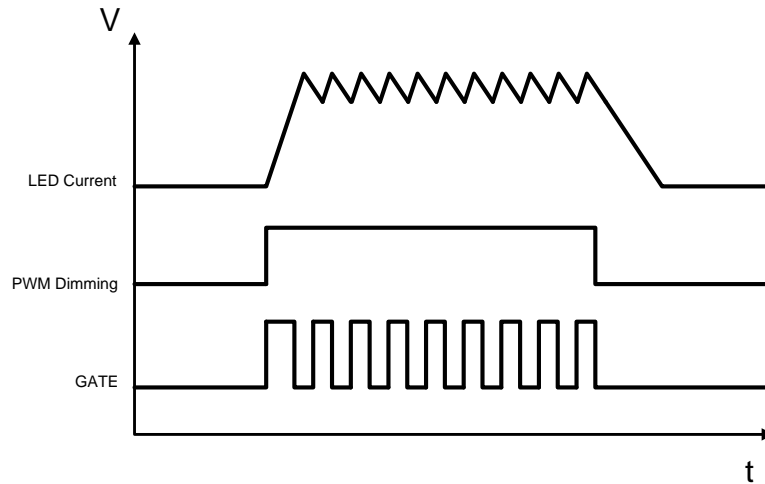
When the voltage at DIM falls below 1.5V, the internal 277mV reference to the constant-current feedback becomes overridden by $V_{DIM} \cdot 0.185$. As long as the current in the inductor remains continuous, the LED current is given by the equation above. However, when V_{DIM} falls below 200mV, the internal MOSFET output becomes disabled. The internal MOSFET signal recovers, when V_{DIM} exceeds 250mV. This is required in some applications to be able to shut the LED lamp off with the same signal input that controls the brightness.



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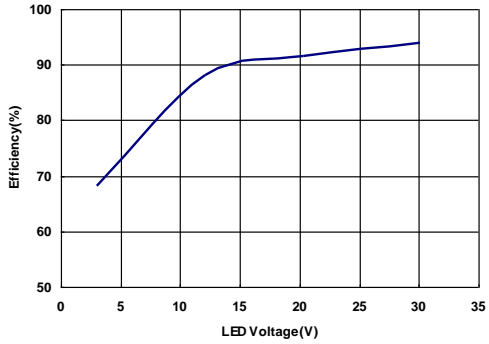
PWM Dimming

Due to the fast open-loop response of the average-current control loop of the FP7182, its PWM dimming performance nearly matches that of the FP7171.

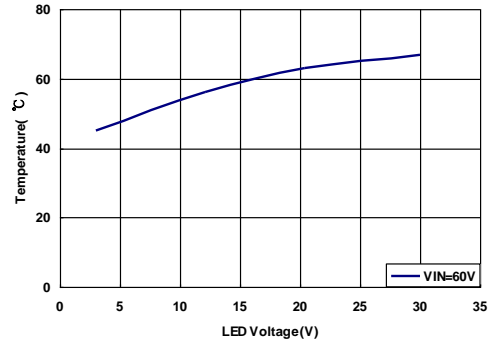


The rising and falling edges are limited by the current slew rate in the inductor. The first switching cycle is terminated upon reaching the 277mV ($V_{DIM} \cdot 0.185$) level at CS. The circuit is further reaching its steady-state within 1 switching cycles regardless of the switching frequency.

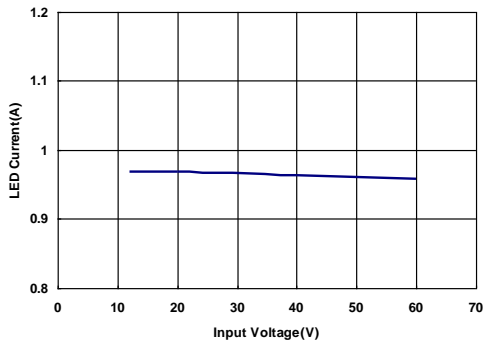
Efficiency



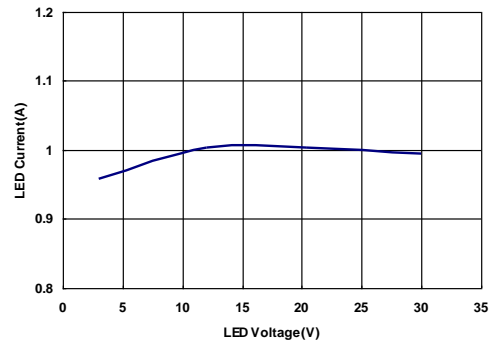
LED Voltage VS Temperature



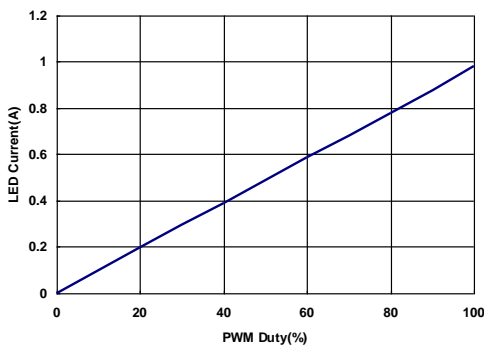
Line Regulation



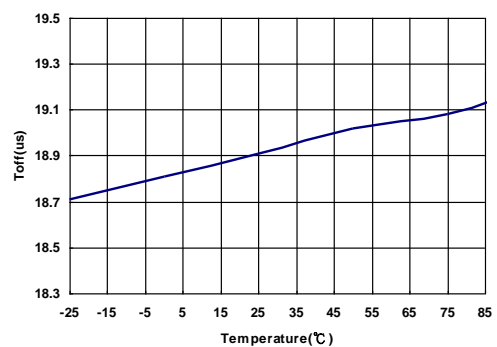
Load Regulation



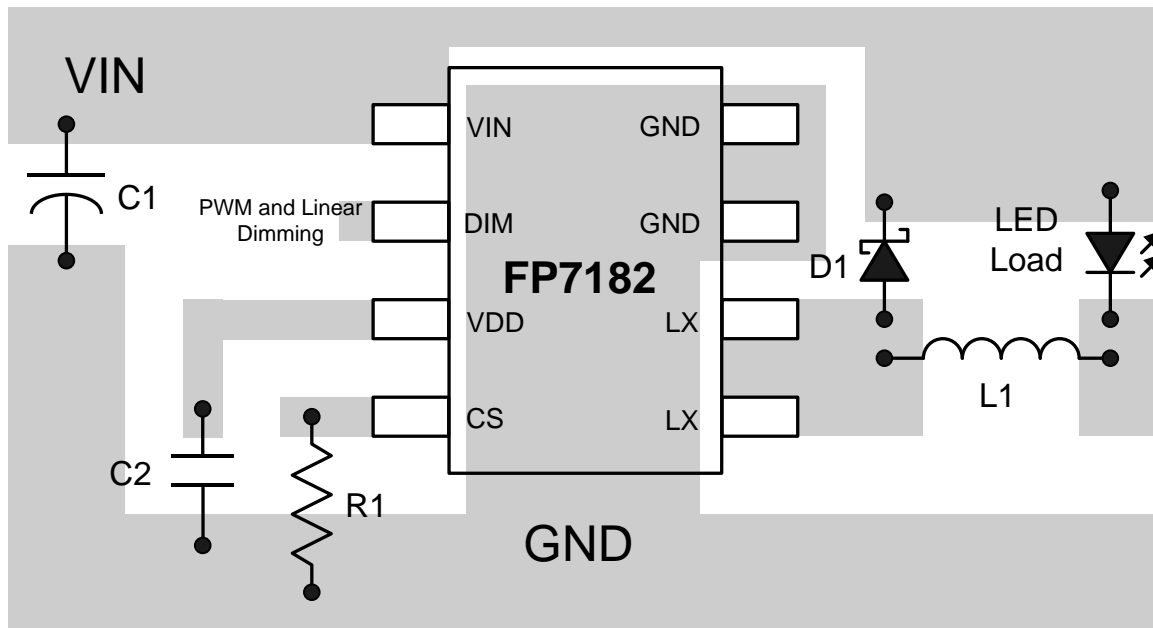
PWM Duty VS LED Current



Temperature VS Toff

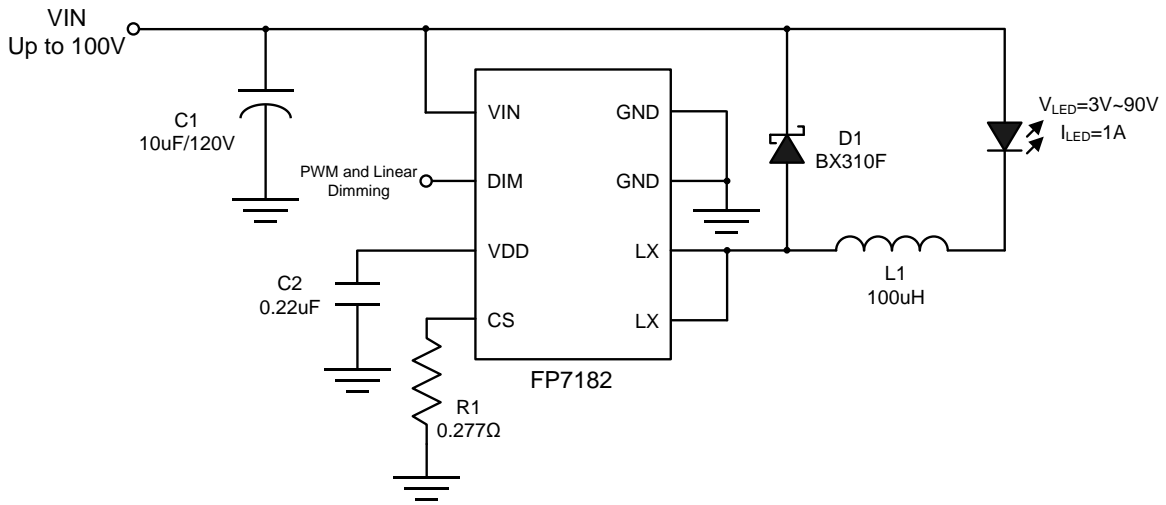


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Suggested Layout

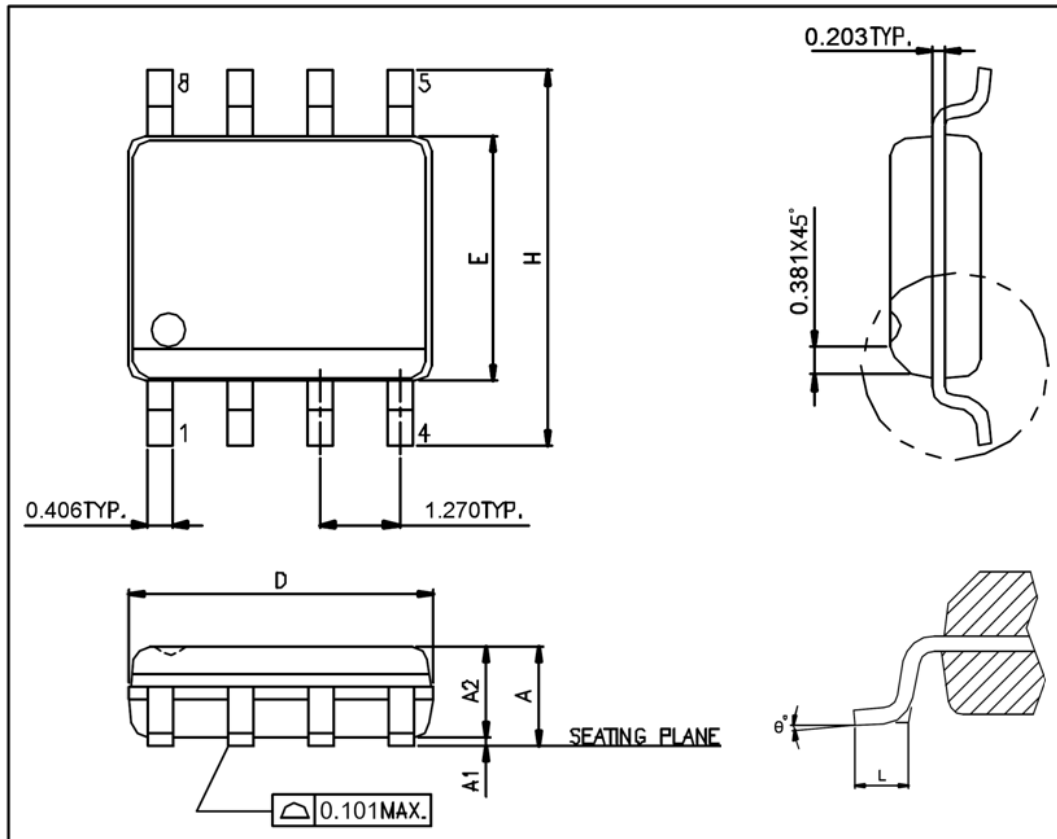
Typical Application Circuit



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Package Outline

SOP-8L



UNIT: mm

Symbols	Min. (mm)	Max. (mm)
A	1.346	1.752
A1	0.101	0.254
A2		1.498
D	4.800	4.978
E	3.810	3.987
H	5.791	6.197
L	0.406	1.270
θ°	0°	8°

Note:

1. Package dimensions are in compliance with JEDEC Outline: MS-012 AA.
2. Dimension "D" does not include molding flash, protrusions or gate burrs.
3. Dimension "E" does not include inter-lead flash, or protrusions.

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