

LED Driver with Average-Mode Constant Current Control

Features

- ▶ Fast average current control
- ▶ Programmable constant off-time switching
- ▶ Linear dimming input
- ▶ PWM dimming input
- ▶ Output short circuit protection with skip mode
- ▶ Ambient operating temperature -40°C to $+125^{\circ}\text{C}$
- ▶ Pin-compatible with the HV9910B

Applications

- ▶ DC/DC or AC/DC LED driver applications
- ▶ LED backlight driver for LCD displays
- ▶ General purpose constant current source
- ▶ LED signage and displays
- ▶ Architectural and decorative LED lighting
- ▶ LED street lighting

General Description

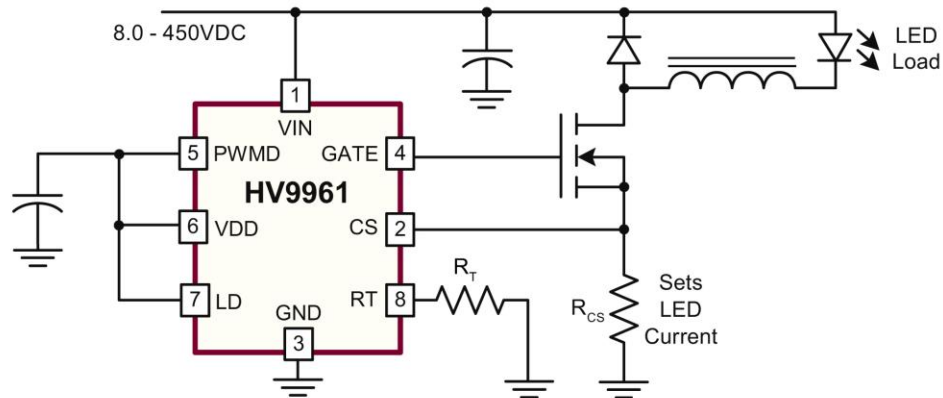
The HV9961 is an average current mode control LED driver IC operating in a constant off-time mode. Unlike HV9910B, this control IC does not produce a peak-to-average error, and therefore greatly improves accuracy, line and load regulation of the LED current without any need for loop compensation or high-side current sensing. The output LED current accuracy is $\pm 3\%$.

The IC is equipped with a current limit comparator for hiccup-mode output short circuit protection.

The HV9961 can be powered from an 8.0 - 450V supply. A PWM dimming input is provided that accepts an external control TTL compatible signal. The output current can be programmed by an internal 272mV reference, or controlled externally through a 0 - 1.5V dimming input.

HV9961 is pin-to-pin compatible with HV9910B and it can be used as a drop-in replacement for many applications to improve the LED current accuracy and regulation.

Typical Application Circuit



Electrical Characteristics (Specifications are at $T_A = 25^{\circ}\text{C}$. $V_{IN} = 12\text{V}$, $V_{LD} = V_{DD}$, $PWMD = V_{DD}$ unless otherwise noted)

Sym	Description	Min	Typ	Max	Units	Conditions
Input						
V_{INDC}	Input DC supply voltage range ¹	*	8.0	-	450	V DC input voltage
I_{INSD}	Shut-down mode supply current	*	-	0.5	1.0	mA Pin PWMD to GND

Notes:

1. Also limited by package power dissipation limit, whichever is lower.

* Denotes the specifications which apply over the full operating ambient temperature range of $-40^{\circ}\text{C} < T_A < +125^{\circ}\text{C}$.

Electrical Characteristics (Specifications are at $T_A = 25^\circ\text{C}$. $V_{IN} = 12\text{V}$, $V_{LD} = V_{DD}$, $\text{PWM} = V_{DD}$ unless otherwise noted)

Sym	Description	Min	Typ	Max	Units	Conditions
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Internal Regulator

V_{DD}	Internally regulated voltage	-	7.25	7.50	7.75	V	$V_{IN} = 8.0\text{V}$, $I_{DD(\text{ext})} = 0$, 500pF at GATE; $R_T = 226\text{k}\Omega$
$\Delta V_{DD, \text{line}}$	Line regulation of V_{DD}	-	0	-	1.0	V	$V_{IN} = 8.0 - 450\text{V}$, $I_{DD(\text{ext})} = 0$, 500pF at GATE; $R_T = 226\text{k}\Omega$
$\Delta V_{DD, \text{load}}$	Load regulation of V_{DD}	-	0	-	100	mV	$I_{DD(\text{ext})} = 0 - 1.0\text{mA}$, 500pF at GATE; $R_T = 226\text{k}\Omega$
UVLO	V_{DD} undervoltage lockout threshold	*	6.45	6.70	6.95	V	V_{IN} rising
ΔUVLO	V_{DD} undervoltage lockout hysteresis	-	-	500	-	mV	V_{IN} falling
$I_{IN, \text{MAX}}$	Maximum input current (limited by UVLO)	#	3.5	-	-	mA	$V_{IN} = 8.0\text{V}$, $T_A = 25^\circ\text{C}$
		#	1.5	-	-		$V_{IN} = 8.0\text{V}$, $T_A = 125^\circ\text{C}$

PWM Dimming

$V_{EN(\text{lo})}$	PWM input low voltage	*	-	-	0.8	V	$V_{IN} = 8.0 - 450\text{V}$
$V_{EN(\text{hi})}$	PWM input high voltage	*	2.2	-	-	V	$V_{IN} = 8.0 - 450\text{V}$
R_{EN}	Internal pull-down resistance at PWM	-	50	100	150	k Ω	$V_{\text{PWM}} = 5.0\text{V}$

Average Current Sense Logic

V_{CS}	Current sense reference voltage	-	264	-	280	mV	---
$A_{V(\text{LD})}$	LD-to-CS voltage ratio	-	0.176	-	0.187	-	---
$V_{\text{LD}(\text{OFF})}$	LD input voltage, shutdown	-	-	150	-	mV	V_{LD} falling
$\Delta V_{\text{LD}(\text{OFF})}$	LD input voltage, enable	-	-	200	-	mV	V_{LD} rising
T_{BLANK}	Current sense blanking interval	*	150	-	280	ns	---
$T_{\text{ON}(\text{min})}$	Minimum on-time	-	-	-	1000	ns	$\text{CS} = V_{CS} + 30\text{mV}$
D_{MAX}	Maximum steady-state duty cycle	-	75	-	-	%	Reduction in output LED current may occur beyond this duty cycle

Short Circuit Protection

V_{CS}	Hiccup threshold voltage	-	410	-	470	mV	---
T_{DELAY}	Current limit delay CS-to-GATE	-	-	-	150	ns	$\text{CS} = V_{CS} + 30\text{mV}$
T_{HICCUP}	Short circuit hiccup time	-	330	-	460	μs	---
$T_{\text{ON}(\text{min})}$	Minimum on-time (short circuit)	-	-	-	430	ns	$\text{CS} = V_{DD}$

Notes:

* Denotes the specifications which apply over the full operating ambient temperature range of $-40^\circ\text{C} < T_A < +125^\circ\text{C}$.

Guaranteed by design.