SB9961	P.1
POWER LED DRIVER WITH AVERAGE-MODE CONSTANT CURRENT CONTROL	

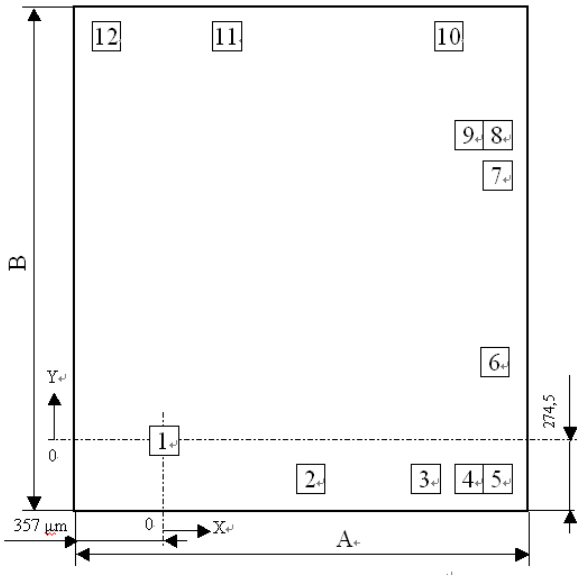
FEATURES

- 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 -40ºC to +125ºC
- Pin-compatible with the SB9910

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

PAD DIAGRAM



1. Chip size: A=1.80mm, B=1.97mm (without scribe line width).
2. Scribe line width: X=80µm, Y=80µm
3. Pad size: 100µm x 100µm
4. Substrate to GND
5. Wafer thickness: 460µm

DESCRIPTION

The SB9961 is an average current mode control LED driver IC operating in a constant off-time mode. Unlike SB9910, 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 ±3%.

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

The SB9961 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.

SB9961 is pin-to-pin compatible with SB9910 and it can be used as a drop-in replacement for many applications to improve the LED current accuracy and regulation.

TYPICAL APPLICATION CIRCUIT

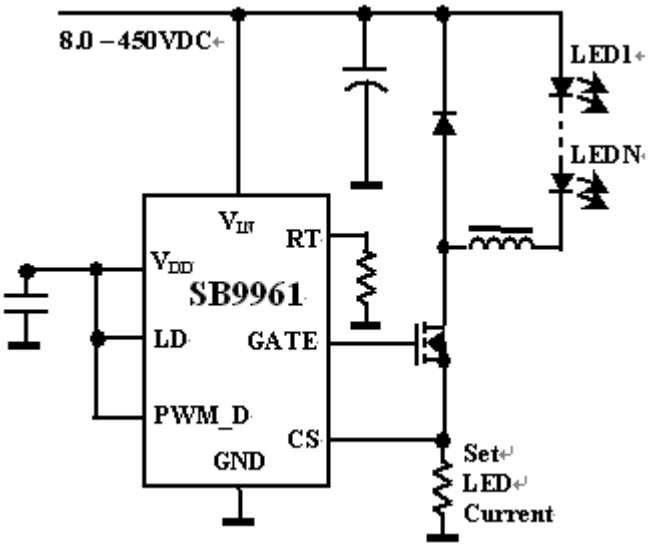
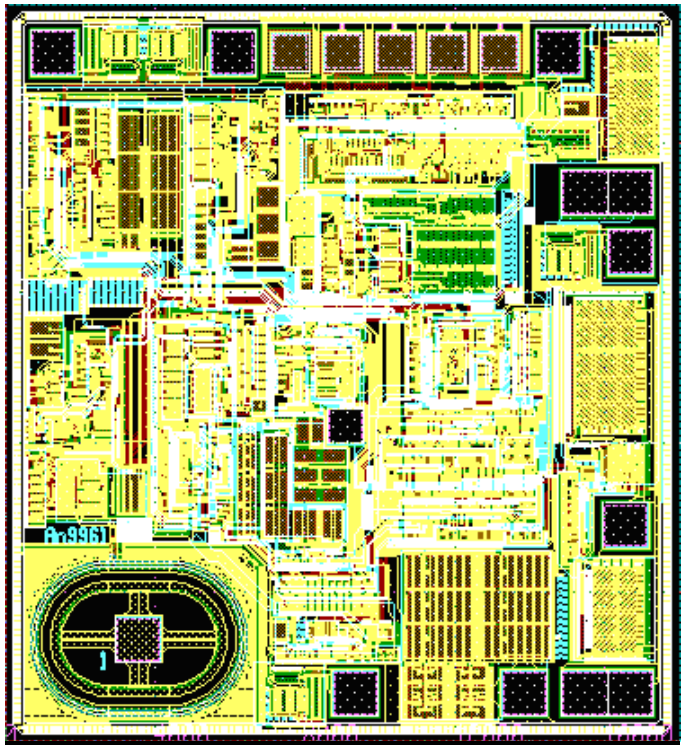


Figure 1. 8~450V Powered Driver for N White Power LEDs

PAD LOCATION

Pad	Pad Name	X (μm)	Y (μm)
1	V_{IN}	0	0
2	CS	578	-144.5
3	GND	1029	-144.5
4	GND	1189	-144.5
5	GND	1313	-144.5
6	GATE	1300	303
7	PWM_D	1313	1033
8	V_{DD}	1313	1193
9	V_{DD}	1189	1193
10	V_{DD}	1122	1565.5
11	LD	250	1565.5
12	RT(R_{OSC})	-227	1565.5

DIE PHOTO



ABSOLUTE MAXIMUM RATINGS

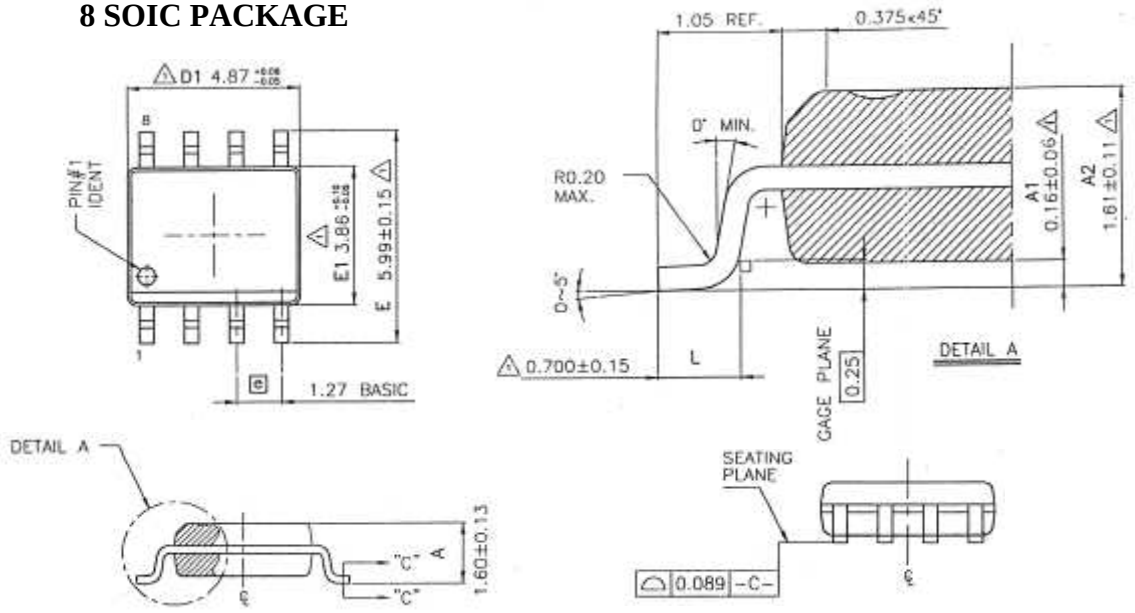
Parameter	Value
V_{IN} to GND	-0.5V to +470V
V_{DD} to GND	12V
CS, LD, PWMD, GATE, RT to GND	-0.3V to (V_{DD} +0.3V)
Junction temperature range	-40°C to+150°C
Storage temperature range	-65°C to+150°C
Continuous power dissipation *(T_A = +25°C)* 8-Lead SOIC	650mW

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

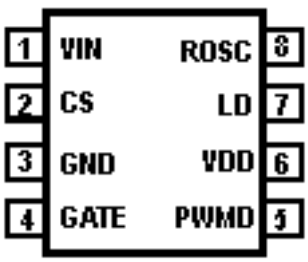
THERMAL RESISTANCE

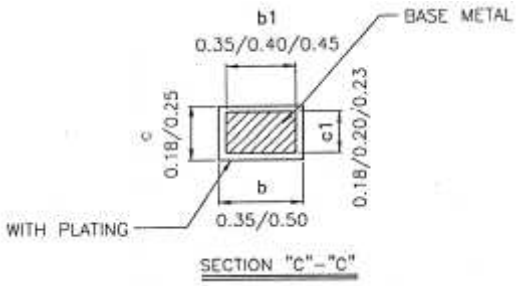
Package	θ_{JA}
8-Lead SOIC	128ºC/W

8 SOIC PACKAGE



PIN DESCRIPTION





ELECTRICAL CHARACTERISTICS

(T_A=25℃, V_{IN} = 12V, V_{LD} = V_{DD}, PWMD = V_{DD} unless otherwise noted.

Symbol	Parameter		Min	Typ	Max	Units	Condition
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	PWMD connected to GND
Internal Regulator							
V_{DD}	Internally regulated voltage	-	7.25	7.50	7.75	V	V_{IN}=8.0, $I_{DD(EXT)}$=0, 500pF at GATE, R_T= 226KΩ
$\Delta V_{DD,line}$	Line regulation of V_{DD}	-	0	-	1.0	V	V_{IN}=8.0-450V, $I_{DD(ext)}$=0, 500pF at GATE, F_{RT}= 226kΩ,
$\Delta V_{DD,load}$	Load regulation of V_{DD}	-	0	-	100	mV	$I_{DD(ext)}$=0-1.0mA, 500pF at GATE, F_{RT}= 226kΩ,
UVLO	V_{DD} under voltage lockout threshold	*	6.45	6.70	6.95	V	V_{IN} rising
ΔUVLO	V_{DD} undervoltage lockout hysteresis	-	-	500	-	mV	V_{IN} falling
$I_{IN,MAX}$	Maximum input current (limited by UVLO)	#	3.5	-	-		V_{IN}=8.0V, T_A=25^{0}C
		#	1.5	-	-		V_{IN}=8.0V, T_A=125^{0}C
PWM Dimming							
$V_{EN(lo)}$	PWMD input low voltage	*	-	-	0.8	V	V_{IN} = 8.0 - 450V
$V_{EN(hi)}$	PWMD input high voltage	*	2.0	-	-	V	V_{IN} = 8.0 - 450V
R_{EN}	Internal pull-down resistance at PWMD	-	50	100	150	kΩ	R_{PWMD} = 5.0V
Average Current Sense Logic							
V_{CS}	Current sense reference voltage	-	264	-	280	mV	---
$A_{V(LD)}$	LD-to-CS voltage ratio	-	0.176	-	0.187	-	---
$V_{LD(OFF)}$	LD input voltage, shutdown	-	-	150	-	mV	V_{LD} falling
$\Delta V_{LD(OFF)}$	LD input voltage, enable	-	-	200	-	mV	V_{LD} rising
T_{BLANK}	Current sense blanking interval	*	150	-	280	ns	---
$T_{ON(min)}$	Minimum on-time	-	-	-	1000	ns	CS = V_{CS} +30mV
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	CS = V_{CS} +30mV
T_{HICCUP}	Short circuit hiccup time	-	330	-	460	μs	---
$T_{ON(min)}$	Minimum on-time (short circuit)	-	-	-	430	ns	CS= V_{DD}

T_{OFF} Timer

T_{OFF}	Off time	-	32	40	48	μs	R_T=1.00MΩ
		-	8.0	10	12		R_T=226kΩ

GATE Driver

I_{SOURCE}	GATE sourcing current	-	0.165	-	-	A	V_{GATE} =0V, V_{DD}=7.5V
I_{SINK}	GATE sinking current	-	0.165	-	-	A	V_{GATE} = V_{DD}, V_{DD}=7.5V
t_{RISE}	GATE output rise time	-	-	30	50	ns	C_{GATE} = 500pF, V_{DD}=7.5V
t_{FALL}	GATE output fall time	-	-	30	50	ns	C_{GATE} = 500pF, V_{DD}=7.5V

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° C<TA< +125°C

\# Guaranteed by design.

FUNCTIONAL BLOCK DIAGRAM