



### DESCRIPTION

The A9970 is a 40V Synchronous Constant Current Buck LED Driver, with 55mΩ High-Side and 20mΩ Low-Side MOSFETs Integrated, Minimal External Component Requirement and High Efficiency, Ideal for Car Lamp Applications.

Adjustable Output Current up to 3.5A with ±3% Accuracy. RISEN Resistor is used to set the Output Current. No External Compensation Component Needed. 135kHz switching Frequency with Jitter Function Improves EMI Performance.

Internal Thermal Regulation Prevents The Chip from Overheating Without Shutting Down The Output. Input Under Voltage Lock-Out Protection Disable The Chip When Input Voltage Lower Than 7V.

The A9970 is available in SOP8 package.

### ORDERING INFORMATION

Package Type	Part Number	
SOP8 SPQ: 4,000pcs/Reel	M8	A9970M8R
		A9970M8VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

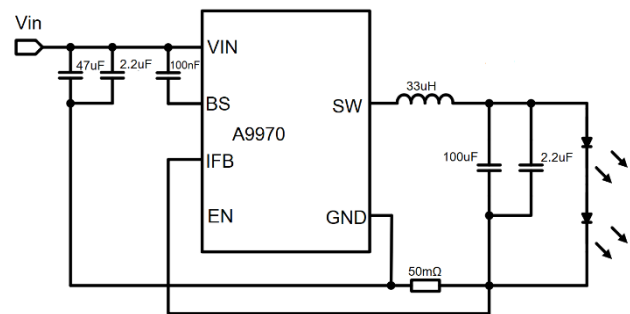
### FEATURES

- Build in Power MOSFETs
- Adjustable Output Current,  $I_{FB}=150mV$
- Constant Current Accuracy: ±3%
- No External Compensation Needed
- Internal Thermal Regulation
- Under Voltage Lock-Out
- Minimum External Components
- Available in SOP8 Package

### APPLICATION

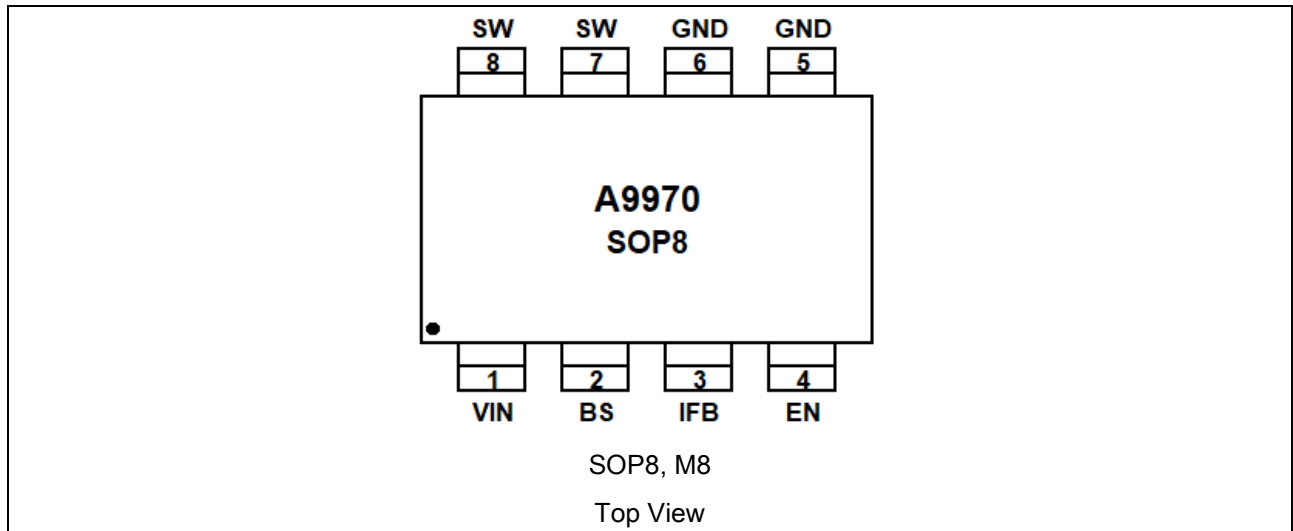
- LED lamp for automobile

### TYPICAL APPLICATION





### PIN DESCRIPTION



PIN#	Symbol	Function
1	VIN	Power supply Input. Place a 2.2 $\mu$ F ceramic Capacitor between VIN and GND as close as possible
2	BS	Power to the Internal High-Side MOSFET Gate Driver. Connect a 100nF Capacitor from BS to VIN
3	IFB	Feedback Pin
4	EN	Enable Input. Setting it to High Level 5V or NO Connection, When Setting it to Ground Level will Turn Off The Chip.
5, 6	GND	Ground
7, 8	SW	Power Switching Output Connect to External Inductor

**ABSOLUTE MAXIMUM RATINGS**

VIN to GND	-0.3 to 42V
SW to GND	-0.3 to 42V
EN, I <sub>FB</sub> to GND	-0.3 to 6V
T <sub>J</sub> , Max operating Junction Temperature	150°C
T <sub>A</sub> , Operating Range	-40°C ~ +105°C
θ <sub>JC</sub> , Package Thermal Resistance	SOP8 45°C/W
T <sub>S</sub> , Storage Temperature	-40°C ~ +150°C
Lead temperature & time	260°C, 10S
ESD(HBM)	>2000V

\* Stresses above 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 Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**ELECTRICAL CHARACTERISTICS**

V<sub>in</sub>=12V, T<sub>A</sub>=25°C, unless otherwise stated

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input Voltage	V <sub>IN</sub>	-	7	-	40	V
UVLO Voltage	V <sub>UVLO</sub>	-	-	7	-	V
UVLO Hysteresis		-	-	1	-	V
Standby Frequency	I <sub>SB</sub>	-	-	1.6	4	mA
Switching Frequency	F <sub>SW</sub>	-	-	135	-	KHz
Reference Voltage of Constant Current	I <sub>FB</sub>	-	145.5	150	154.5	mV
Maximum Duty Cycle	D <sub>MAX</sub>	-	-	100	-	%
Minimum On-Time		-	-	250	-	ns
RDS <sub>ON</sub> of Power MOS	High Side	I <sub>OUT</sub> =1A	-	55	75	mΩ
	Low Side	I <sub>OUT</sub> =1A	-	17	22	
Thermal Shutdown Temperature	T <sub>SD</sub>	-	-	150	-	°C



### TYPICAL PERFORMANCE CHARACTERISTICS

Fig 1. Efficiency vs. Vin

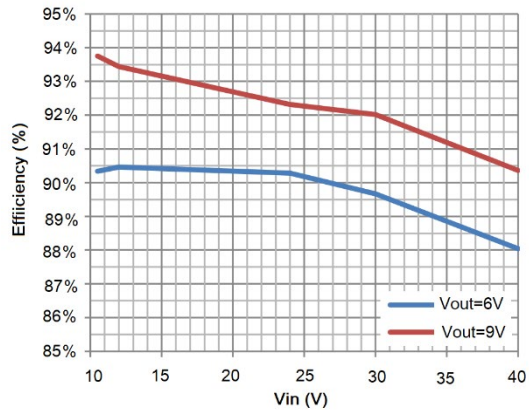


Fig 2. Switch Frequency vs. Input Voltage

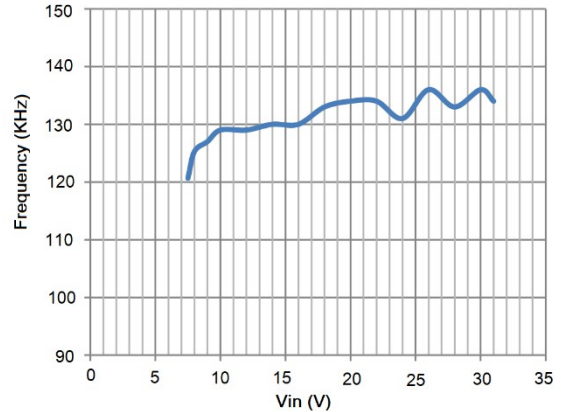


Fig 3. Temperature vs. I<sub>FB</sub>

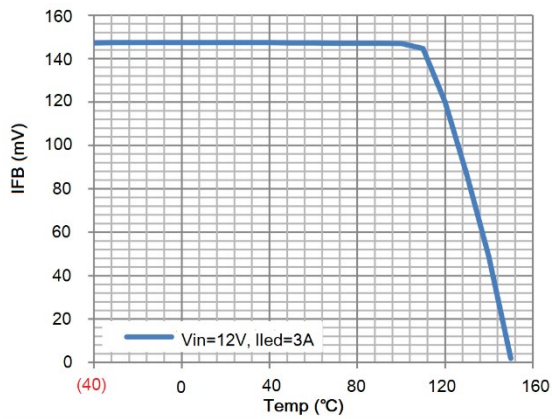


Fig 4. Temperature vs. I<sub>FB</sub>

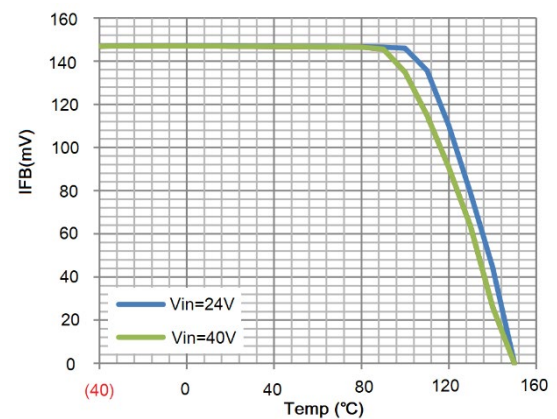


Fig 5. Power On

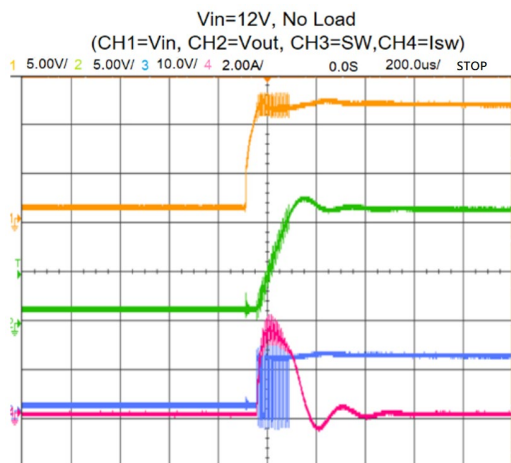


Fig 6. Power On

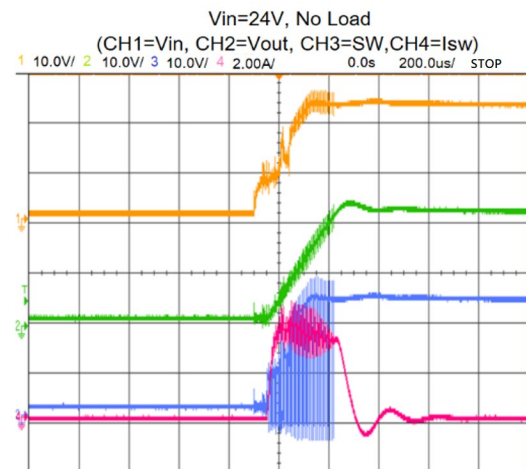




Fig 7. Output Voltage Ripple

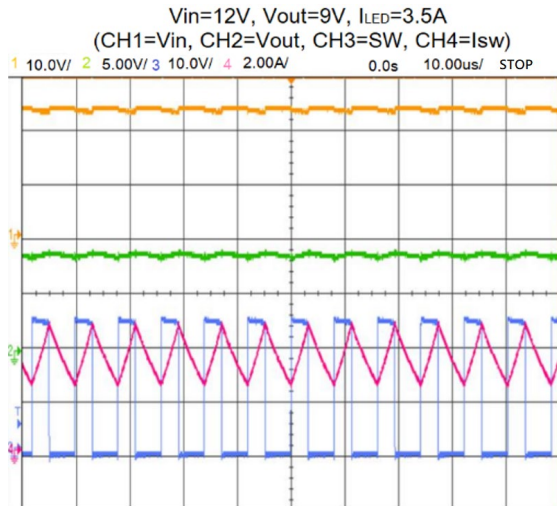
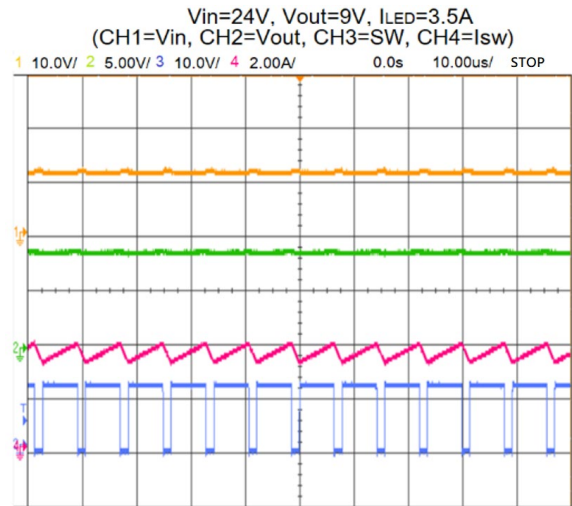
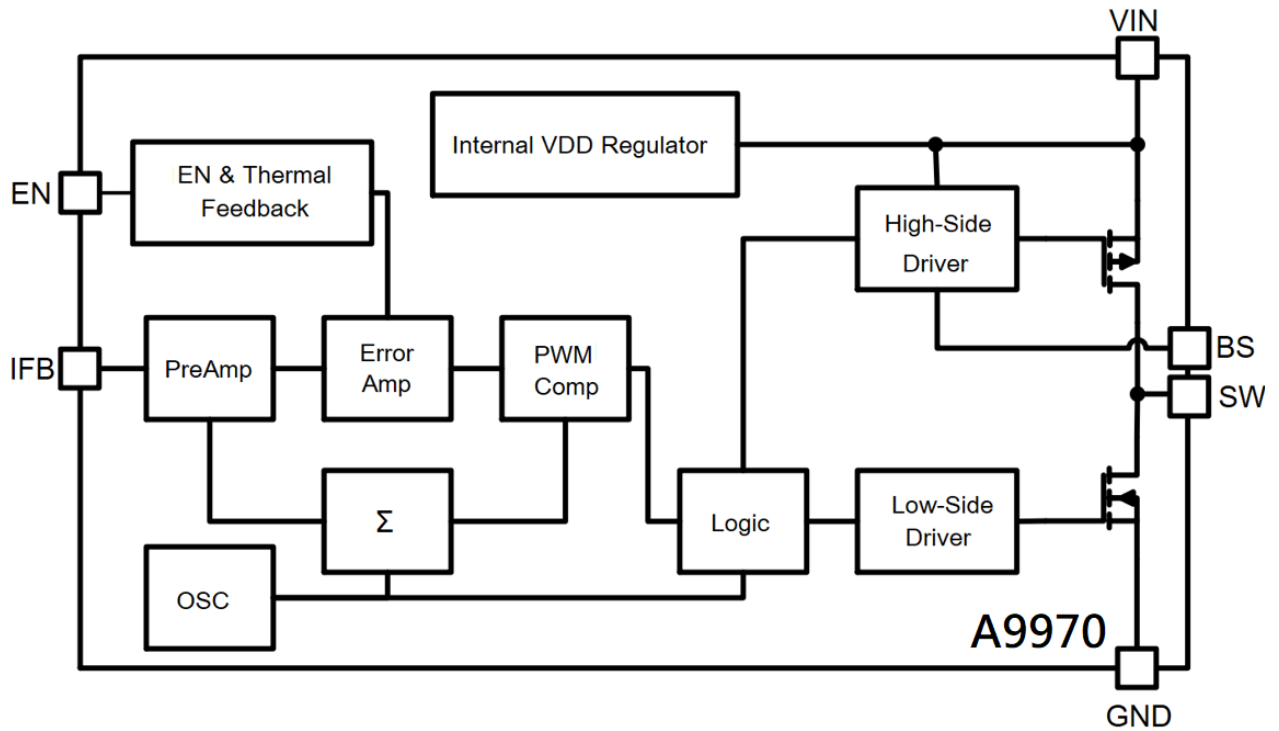


Fig 8. Output Voltage Ripple



BLOCK DIAGRAM





## DETAILED INFORMATION

### Input Under Voltage Protection

A9970 provides an input voltage up to 40V and operates from an input voltage range of 7V to 40V. If VIN drops below 6V, the UVLO circuit inhibits switching. Once VIN rises above 7V, the UVLO clears, and the chip activates.

### Constant Current Output

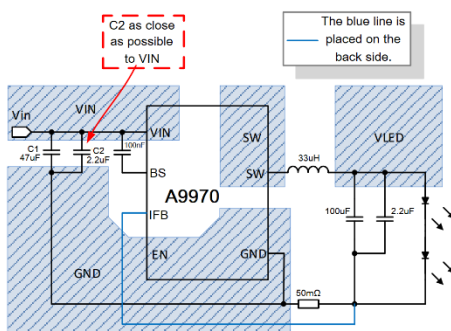
A9970 presets the IFB voltage to 150mV. An internal compensated loop will provide enough gain and stability to ensure this voltage under the right conditions. When the internal loop works normally, the external output capacitor must be parallel to the LED load. The Output Current can be set by an external resistor using the following equation:  $I_{OUT} = 150mV/R_{ISEN}$

Note that this equation only stands when the junction temperature is lower than the threshold value of thermal regulation, for which please read the following section.

### Thermal Regulation

The junction temperature of the IC is monitored internally. If the junction temperature exceeds the threshold value (typically 140°C), the converter reduces the voltage of IFB according to the temperature rise, thus to reduce the output current accordingly (i.e. when the junction temperature reaches to 145°C, the current will be drop to 75% of the original current; when reaches to 150°C, the current will be 50%). For a 30% current drop will cause a 51% heat drop generated by MOSFETs' RDS(ON) due to  $P=I^2R$ , and since the DC power loss makes the most contribution to heat generation, normally, this method can stabilize the temperature at between 140°C and 150°C without turning off the output when the power dissipation condition is insufficient (i.e. when the ventilation fan stops). But if external temperature continues to rise, the chip will completely shut down. This is non-latch protection. Once the junction temperature drops, the IFB voltage will rise again and the chip will resume to work.

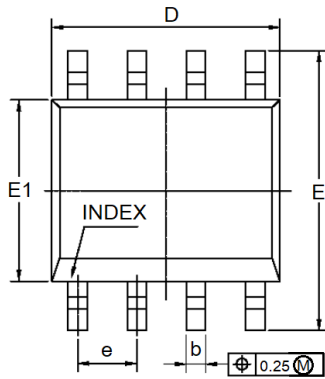
### Layout Guidelines



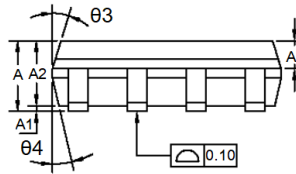


**PACKAGE INFORMATION**

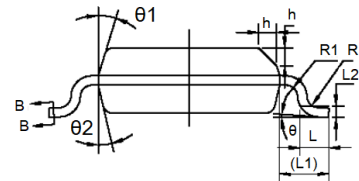
Dimension in SOP8 (Unit: mm)



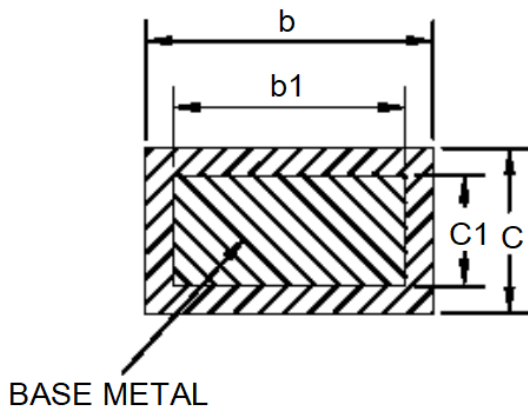
TOP VIEW



BOTTOM VIEW



SIDE VIEW



SECTION B-B

Symbol	Millimeters	
	Min	Max
A	1.350	1.750
A1	0.010	0.250
A2	1.250	1.650
A3	0.500	0.700
b	0.380	0.510
b1	0.370	0.470
c	0.170	0.250
c1	0.170	0.230
D	4.800	5.000
E	5.800	6.200
E1	3.800	4.000
e	1.270 BSC	
L	0.450	0.800
L1	1.040REF	
L2	0.250BSC	
R	0.070	-
R1	0.070	-
h	0.300	0.500
θ	0°	8°
θ1	15°	19°
θ2	11°	15°
θ3	15°	19°
θ4	11°	15°



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