



**1.2A HIGH OUTPUT CURRENT LDO REGULATOR**

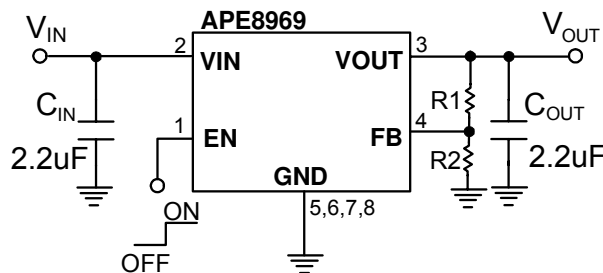
**FEATURES**

- Input Voltage Range : 2.6V~6.0V
- Adjustable Output Voltage form 0.8V to 5.5V
- Dropout Voltage is 380mV at 1A Output Current
- Guaranteed 1.2A Output Current
- Low Quiescent Current is 50µA (typ.)
- Maximum Supply Current in Shutdown Mode <1uA
- Fast Transient Response
- Under-Voltage Protection
- Current Limit and Thermal Shutdown Protection
- Short Circuit Current Fold-Back
- Available in the SO-8 and ESOP-8 Pb-Free Package

**DESCRIPTION**

The APE8969 is a low noise, high output current, low quiescent current and low dropout linear regulator. The Device includes pass element, error amplifier, band-gap, current-limit and thermal shutdown circuitry. The output current is up to 1.2A, The characteristics of low dropout voltage and less quiescent current make it good for some critical current application, for example, some battery powered devices. The typical quiescent current is approximately 50µA. In the shutdown mode, the maximum supply current is less than 1uA. Built-in current-limit, Short current protection and thermal-shutdown functions prevent any fault condition from IC damage.

**TYPICAL APPLICATION**

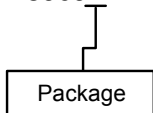


$$V_{OUT} = V_{FB} \times (1 + R1/R2), \quad V_{FB} = 0.8V$$

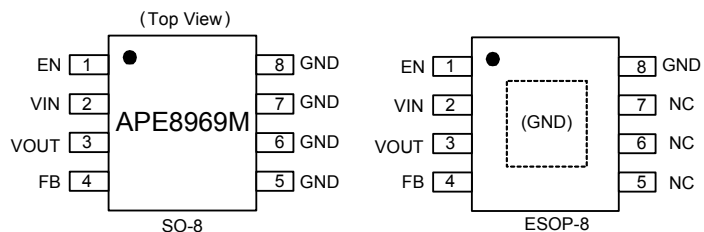
$$R2 \text{ range} = 50K \sim 300K$$

**ORDERING/PACKAGE INFORMATION**

**APE8969X**



M : SO-8  
MP : ESOP-8





**ABSOLUTE MAXIMUM RATINGS** (at  $T_A=25^\circ\text{C}$ )

VIN Pin Voltage( $V_{IN}$ )	-----	GND - 0.3V to GND + 6.5V
Output Voltage( $V_{OUT}$ )	-----	GND - 0.3V to VIN + 0.3V
EN Pin Voltage( $V_{EN}$ )	-----	GND - 0.3V to + 6.5V
FB Pin Voltage( $V_{FB}$ )	-----	GND - 0.3V to + 6.5V
Power Dissipation( $P_D$ )	-----	1.65W
Storage Temperature Range( $T_{ST}$ )	-----	-40°C to +150°C
Junction Temperature Range( $T_J$ )	-----	-40°C To 125°C
Operating Temperature Range ( $T_{OP}$ )	-----	-40°C to +85°C
Thermal Resistance from Junction to Case( $R_{th_{JC}}$ )		
	SO-8	20°C/W
	ESOP-8	15°C/W
Thermal Resistance from Junction to Ambient( $R_{th_{JA}}$ )		
	SO-8	60°C/W
	ESOP-8	40°C/W

Note:  $R_{th_{JA}}$  is measured with the PCB copper area of approximately 1 in<sup>2</sup>(Multi-layer). That need connect to GND pin.

**ELECTRICAL SPECIFICATIONS**

( $T_A=25^\circ\text{C}$  unless otherwise specified)

Parameter	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS	
Input Voltage	$V_{IN}$	(Note1)	2.6	-	6	V	
FB Voltage	$V_{FB}$	$V_{IN}=2.6\text{V to }6\text{V}, I_{OUT}=1\text{mA}$	0.784	0.8	0.816	V	
FB Input Leakage Current	$I_{FB}$	$V_{FB}=0.8\text{V}$	-100	-	100	nA	
Adjustable Output Voltage Range	$V_{OUT}$		$V_{FB}$	-	5.5	V	
Quiescent Current	$I_Q$	$I_{OUT}=0\text{mA}, V_{IN}=5\text{V}$	-	50	-	$\mu\text{A}$	
Shutdown Current	$I_{SD}$	$I_{OUT}=0\text{mA}, V_{EN}=0\text{V}$	-	-	1	$\mu\text{A}$	
Dropout Voltage	$V_{DROPO}$	$I_{OUT}=1.0\text{A}$	$V_{OUT}=1.50\text{V}$	-	1.1	1.3	V
			$V_{OUT}=1.80\text{V}$	-	0.8	1	
			$V_{OUT}=2.50\text{V}$	-	0.57	0.7	
			$V_{OUT}=3.30\text{V}$	-	0.38	0.6	
Current Limit (Note 2)	$I_{LIMIT}$		1.3	1.5	-	A	
Short Circuit Current	$I_{short}$	$V_{FB}<0.3\text{V}$	-	300	-	mA	
Load Regulation (Note 3)	$\Delta V_{LOAD}$	$I_{OUT}=10\text{m}\sim 1.2\text{A}$	-	0.4	1	%	
Ripple Rejection	PSRR	$C_{IN}=2.2\mu\text{F}, C_O=2.2\mu\text{F}, I_{OUT}=10\text{mA}$	F=120Hz	-	65	-	dB
			F=1KHz	-	55	-	
Enable Input Threshold	$V_{ENH}$	Regulator Enable	2	-	-	V	
	$V_{ENL}$	Regulator Shutdown	-	-	0.8		
Enable Pin Current	$I_{ENH}$	$V_{EN}=V_{IN}$	-	0.003	0.1	$\mu\text{A}$	
	$I_{ENL}$	$V_{EN}=0\text{V}$	-	0.35	1		
Temperature Shutdown	TS		-	140	-	°C	
Temperature Shutdown Hysteresis	TSH		-	30	-	°C	

**Note 1.** Minimum  $V_{IN}$  voltage is defined by output adds a dropout voltage.

**Note 2.** Current limit is measured at constant junction temperature by using pulsed testing with a low ON time.

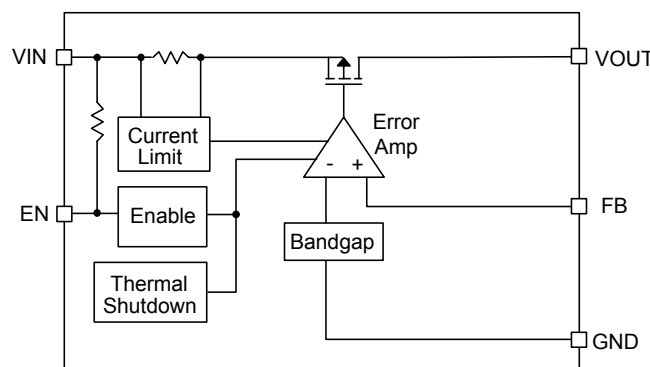
**Note 3.** Regulation is measured at constant junction temperature by using pulsed testing with a low ON time.



**PIN DESCRIPTIONS**

PIN SYMBOL	PIN DESCRIPTION
VIN	Input voltage
GND	Ground
EN	Active-Low Shutdown Input. A logic low reduces the supply current to less than 1µA. Connect to VIN or Floating for normal operation.
VOUT	Regulator Output Voltage. Adjustable from 0.8V to 5.5V.
FB	Feedback Input for Setting the Output Voltage. Connect to an external resistor divider for adjustable output operation.

**BLOCK DIAGRAM**



**FUNCTION PIN DESCRIPTION**

A minimum of 2.2µF capacitor must be connected from VOUT to ground to insure stability. Typically a large storage capacitor is connected from VIN to ground to ensure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be dropout voltage higher than VOUT in order for the device to regulate properly.

**EN**

The APE8969 features an LDO regulator enable/disable function. To assure the LDO regulator will switch on; the EN turn on control level must be greater than 2.0 volts. The LDO regulator will go into the shutdown mode when the voltage on the EN pin falls below 0.8 volts. For to protecting the system, the APE8969 have a quick-discharge function. If the enable function is not needed in a specific application, it may be tied to VIN to keep the LDO regulator in a continuously on state.

**FB**

The output is an adjustable version, the FB voltage is 0.8V. The output voltage can be set by outside resistances. The output voltage, VOUT, is then given by the following equation:

$$V_{OUT} = 0.8 \times (1 + R1/R2)$$

For the reasons of reducing power dissipation and loop stability, R2 is recommending to choose 50K~300KΩ.



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## APPLICATION INFORMATION

Like any low-dropout regulator, the APE8969 requires input and output decoupling capacitors. The device is specifically designed for portable applications requiring minimum board space and smallest components. These capacitors must be correctly selected for good performance (see Capacitor Characteristics Section). Please note that linear regulators with a low dropout voltage have high internal loop gains which require care in guarding against oscillation caused by insufficient decoupling capacitance.

### Capacitor Selection

Normally, use a 2.2 $\mu$ F capacitor on the input and a 2.2 $\mu$ F capacitor on the output of the APE8969. Larger input capacitor values and lower ESR (X5R, X7R) provide better supply-noise rejection and transient response. A higher- value output capacitor (4.7 $\mu$ F) may be necessary if large, fast transients are anticipated and the device is located several inches from the power source.

### Input-Output (Dropout) Voltage

A regulator's minimum input-to-output voltage differential (dropout voltage) determines the lowest usable supply voltage. In battery-powered systems, this determines the useful end-of-life battery voltage. Because the device uses a PMOS, its dropout voltage is a function of drain-to source on-resistance,  $R_{DS(ON)}$ , multiplied by the load current:

$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

### Current Limit and Short-Circuit Protection

The APE8969 used a current sense-resistor to monitor the output current. A portion of the PMOS output transistor's current is mirrored to a resistor such that the voltage across this resistor is proportional to the output current. Once the output current exceeds limit threshold, APE8969 would be protected with a limited output current. Further more, when the output is short to ground, the output current would be folded-back to a less limit.

### Thermal Considerations

The APE8969 series can deliver a current of up to 1.2A over the full operating junction temperature range. However, the maximum output current must be dated at higher ambient temperature to ensure the junction temperature does not exceed 125°C. With all possible conditions, the junction temperature must be within the range specified under operating conditions. Power dissipation can be calculated based on the output current and the voltage drop across regulator.

$$P_D = (V_{IN} - V_{OUT}) I_{OUT}$$

The final operating junction temperature for any set of conditions can be estimated by the following thermal equation:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / R_{th_{ja}}$$

Where  $T_{J(MAX)}$  is the maximum junction temperature of the die (125°C) and  $T_A$  is the maximum ambient temperature. The junction to ambient thermal resistance ( $R_{th_{ja}}$ ) for SO-8 package at recommended minimum footprint is 60°C/W. Visit our website in which "Recommended Footprints for Soldering Surface Mount Packages" for detail.



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**APPLICATION INFORMATION**

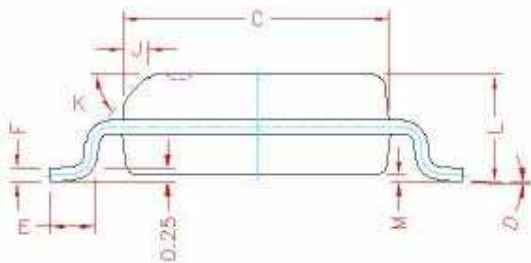
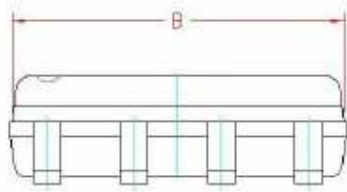
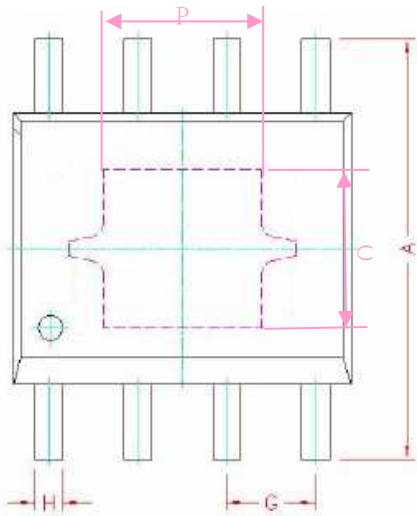
**PCB Layout**

An input capacitance of  $\cong 2.2\mu\text{F}$  is required between the APE8969 input pin and ground (the amount of the capacitance may be increased without limit), this capacitor must be located a distance of not more than 1cm from the input and return to a clean analog ground. Input capacitor can filter out the input voltage spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire. Otherwise, the actual voltage at the VIN pin may exceed the absolute maximum rating. The output capacitor also must be located a distance of not more than 1cm from output to a clean analog ground. Because it can filter out the output spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing



## ADVANCED POWER ELECTRONICS CORP.

### Package Outline : ESOP-8

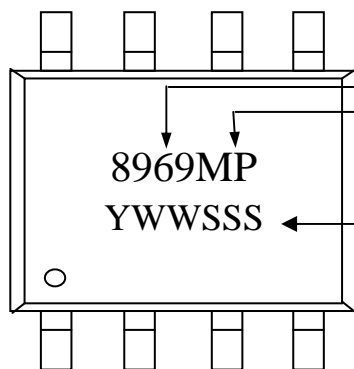


SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	5.80	6.00	6.20
B	4.80	4.90	5.00
C	3.80	3.90	4.00
D	0°	4°	8°
E	0.40	0.65	0.90
F	0.19	0.22	0.25
M	0.00	0.08	0.15
H	0.35	0.42	0.49
L	1.35	1.55	1.75
J	0.375 REF.		
K	45°		
G	1.27 TYP.		
P	2.15	2.25	2.35
Q	2.15	2.25	2.35

1. All Dimension Are In Millimeters.

2. Dimension Does Not Include Mold Protrusions.

### Part Marking Information & Packing : ESOP-8



Part Number

Package Code

8969MP  
YWWSSS

Date Code (YWWSSS)

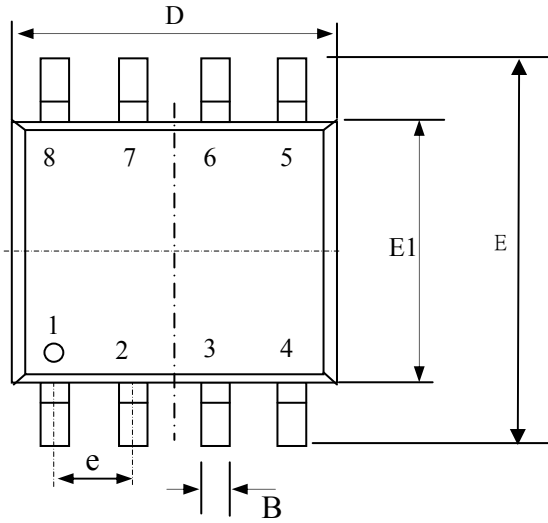
Y : Last Digit Of The Year

WW : Week

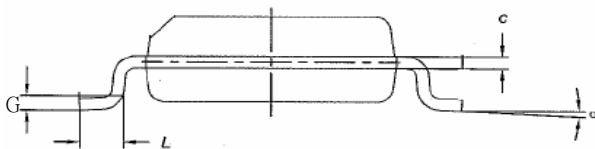
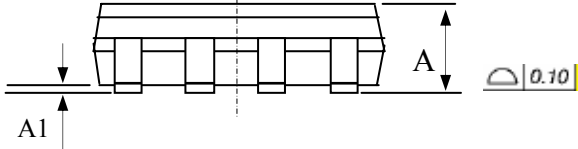
SSS : Sequence



Package Outline : SO-8



SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.18	0.25
B	0.33	0.41	0.51
c	0.19	0.22	0.25
D	4.80	4.90	5.00
E	5.80	6.15	6.50
E1	3.80	3.90	4.00
e	1.27 TYP		
G	0.254 TYP		
L	0.38	—	0.90
$\alpha$	0.00	4.00	8.00



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Part Marking Information & Packing : SO-8

