AME, Inc.

AME8870 *Preliminary* **300mA CMOS LDO w/ Discharge**

■ General Description

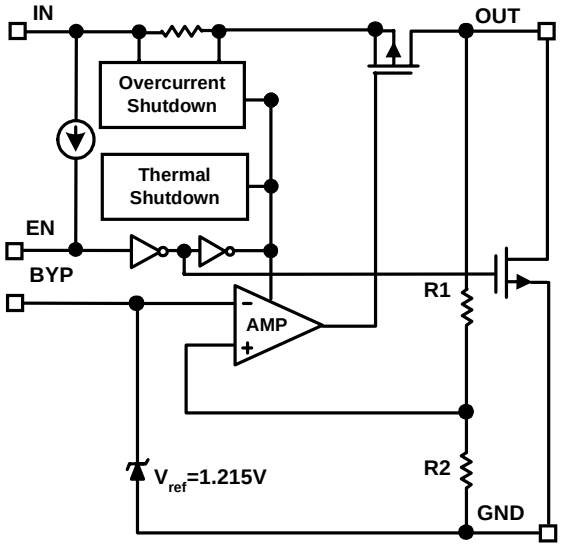
The AME8870 family of positive, linear regulators feature low quiescent current (30µA typ.) with low dropout voltage, making them ideal for battery applications. The space-saving SOT-23-5 package is attractive for "Pocket" and "Hand Held" applications.

These rugged devices have both Thermal Shutdown, and Current Fold-back to prevent device failure under the "Worst" of operating conditions.

In applications requiring a low noise, regulated supply, place a 1000 pF capacitor between Bypass and Ground.

The AME8870 is stable with an output capacitance of 2.2µF or greater.

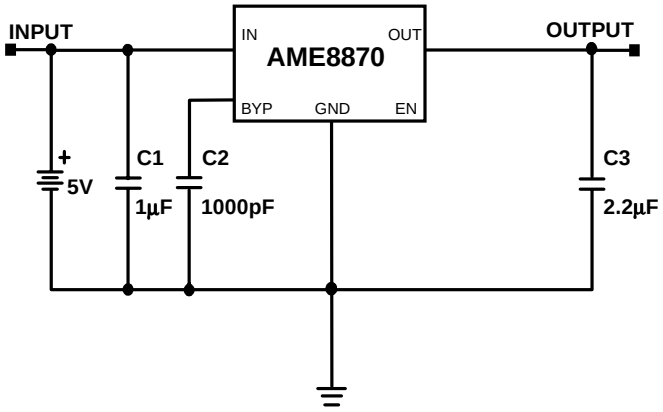
■ Functional Block Diagram



■ Features

- Very Low Dropout Voltage
- Guaranteed 300mA Output
- Accurate to within 1.5%
- 30µA Quiescent Current
- Over-Temperature Shutdown
- Current Limiting
- Short Circuit Current Fold-back
- Noise Reduction Bypass Capacitor
- Power-Saving Shutdown Mode
- Space-Saving SOT-25 Package
- Factory Pre-set Output Voltages
- Low Temperature Coefficient

■ Typical Application

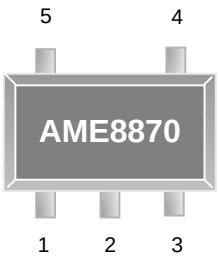


■ Applications

- Instrumentation
- Portable Electronics
- Wireless Devices
- Cordless Phones
- PC Peripherals
- Battery Powered Widgets
- Electronic Scales

■ Pin Configuration

SOT-25
Top View



AME8870AEEV

1. V_{IN}
2. GND
3. EN
4. BYP
5. OUT

■ Ordering Information

Part Number	Marking	Output Voltage	Package	Operating Temp. Range
AME8870AEEV350	AXJww	3.5V	SOT-25	- 40°C to + 85°C
AME8870AEEV360	AXIww	3.6V	SOT-25	- 40°C to + 85°C

■ Absolute Maximum Ratings

Parameter	Maximum	Unit
Input Voltage	8	V
Output Current	P_D / (V_{IN} - V_O)	mA
Output Voltage	GND - 0.3 to V_{IN} + 0.3	V
ESD Classification	B	

Caution: Stress above the listed absolute maximum rating may cause permanent damage to the device

■ Recommended Operating Conditions

Parameter	Rating	Unit
Ambient Temperature Range	- 40 to + 85	^oC
Junction Temperature	- 40 to + 125	^oC

■ Thermal Information

Parameter		Maximum	Unit
Thermal Resistance (θ_{ja})	SOT-25	260	^oC / W
Internal Power Dissipation (P_D) (DT = 100^oC)	SOT-25	380	mW
Maximum Junction Temperature		150	^oC

■ Electrical Specifications

TA = 25°C unless otherwise noted

Parameter	Symbol	Test Condition		Min	Typ	Max	Units
Input Voltage	V_{IN}			Note 1		7	V
Output Voltage Accuracy	V_O	I_O=1mA		-1.5		1.5	%
Dropout Voltage	$V_{DROPOUT}$	I_O=300mA V_O=$V_{O(NOM)}$ -2.0%	1.2V<$V_{O(NOM)}$<=2.0V		See chart	1300	mV
			2.0V<$V_{O(NOM)}$<=2.8V			400	
			2.8V<$V_{O(NOM)}$			300	
Output Current	I_O	V_O>1.2V		300			mA
Current Limit	I_{LIM}	V_O>1.2V		300	450		mA
Short Circuit Current, Note2	I_{SC}	V_O<0.8V			150	300	mA
Quiescent Current	I_Q	I_O=0mA			30	50	µA
Ground Pin Current	I_{GND}	I_O=1mA to 300mA			35		µA
Line Regulation	REG_{LINE}	I_O=1mA V_{IN}=V_O+1 to V_O+2	V_O < 4.0V	-0.2		0.2	%
			Vo >= 4.0V	-0.4		0.4	
Load Regulation	REG_{LOAD}	I_O=1mA to 300mA		-1	0.2	1	%
Over Temerature Shutdown	OTS				150		°C
Over Temerature Hysterisis	OTH				30		°C
V_O Temperature Coefficient	TC				30		ppm/°C
Power Supply Rejection	PSRR	I_O=100mA C_O=2.2µF	f=1kHz		50		
			f=10kHz		20		dB
			f=100kHz		15		
Output Voltage Noise	eN	f=10Hz to 100kHz I_O=10mA	Co=2.2µF		30		µVrms
EN Input Threshold	V_{EH}	V_{IN}=2.7V to 7V		2.0		Vin	V
	V_{EL}	V_{IN}=2.7V to 7V		0		0.4	V
EN Input Bias Current	I_{EH}	V_{EN}=V_{IN}, V_{IN}=2.7V to 7V				0.1	µA
	I_{EL}	V_{EN}=0V, V_{IN}=2.7V to 7V				0.5	µA
Shutdown Supply Current	I_{SD}	V_{IN}=5V, V_O=0V, V_{EN}<V_{EL}			0.5	1	µA
Shutdown Output Voltage	$V_{O,SD}$	I_O=0.4mA, V_{EN}<V_{EL}		0		0.4	V

Note1: $V_{IN(MIN)}$=V_{OUT}+$V_{DROPOUT}$

Note2: To prevent the Short Circuit Current protection feature from being prematurely activated, the input voltage must be applied before a current source load is applied.

■ Detailed Description

The AME8870 family of CMOS regulators contain a PMOS pass transistor, voltage reference, error amplifier, over-current protection, and thermal shutdown.

The P-channel pass transistor receives data from the error amplifier, over-current shutdown, and thermal protection circuits. During normal operation, the error amplifier compares the output voltage to a precision reference. Over-current and Thermal shutdown circuits become active when the junction temperature exceeds 150^{o}C, or the current exceeds 300mA. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 120^{o}C.

The AME8870 switches from voltage mode to current mode when the load exceeds the rated output current. This prevents over-stress. The AME8870 also incorporates current foldback to reduce power dissipation when the output is short circuited. This feature becomes active when the output drops below 0.8volts, and reduces the current flow by 65%. Full current is restored when the voltage exceeds 0.8 volts.

■ External Capacitors

The AME8870 is stable with an output capacitor to ground of 2.2µF or greater. Ceramic capacitors have the lowest ESR, and will offer the best AC performance. Conversely, Aluminum Electrolytic capacitors exhibit the highest ESR, resulting in the poorest AC response. Unfortunately, large value ceramic capacitors are comparatively expensive. One option is to parallel a 0.1µF ceramic capacitor with a 10µF Aluminum Electrolytic. The benefit is low ESR, high capacitance, and low overall cost.

A second capacitor is recommended between the input and ground to stabilize Vin. The input capacitor should be at least 0.1µF to have a beneficial effect.

A third capacitor can be connected between the BYPASS pin and GND. This capacitor can be a low cost Polyester Film variety between the value of 0.001 ~ 0.01µF. A larger capacitor improves the AC ripple rejection, but also makes the output come up slowly. This "Soft" turn-on is desirable in some applications to limit turn-on surges.

All capacitors should be placed in close proximity to the pins. A "Quiet" ground termination is desirable. This can be achieved with a "Star" connection.

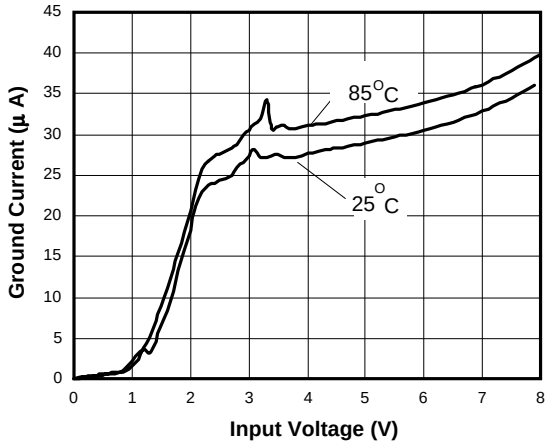
■ Enable

The Enable pin normally floats high. When actively, pulled low, the PMOS pass transistor shuts off, and all internal circuits are powered down. In this state, the quiescent current is less than 1µA. This pin behaves much like an electronic switch.

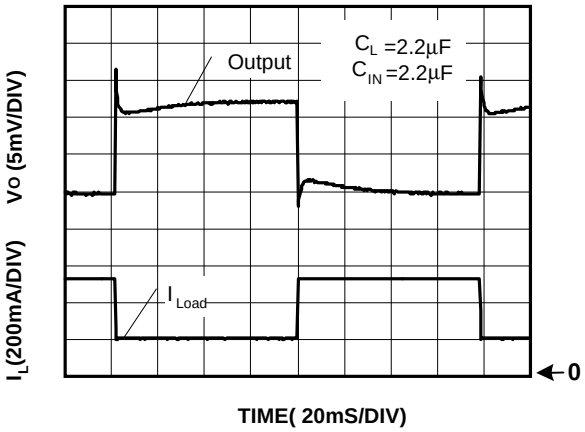
■ Auto-Discharge/No-Discharge

V_{OUT} has an internal 100- Ω (typ.) discharge path to ground when the EN pin is low.

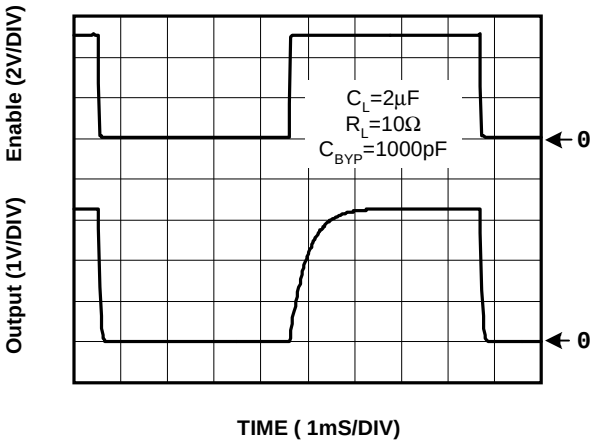
Ground Current vs. Input Voltage



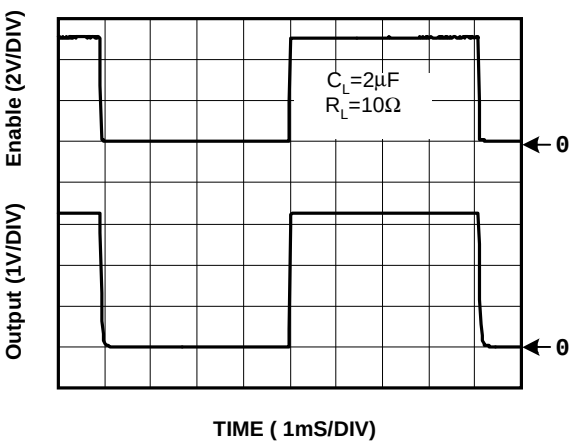
Load Step (1mA-300mA)



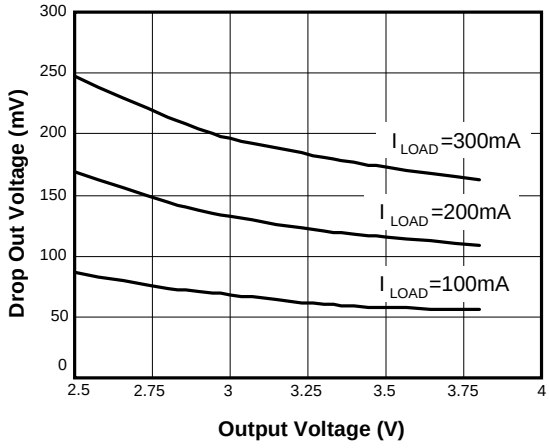
Chip Enable Transient Response



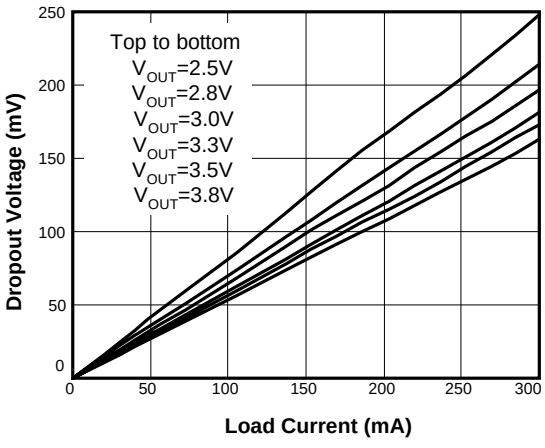
Chip Enable Transient Response



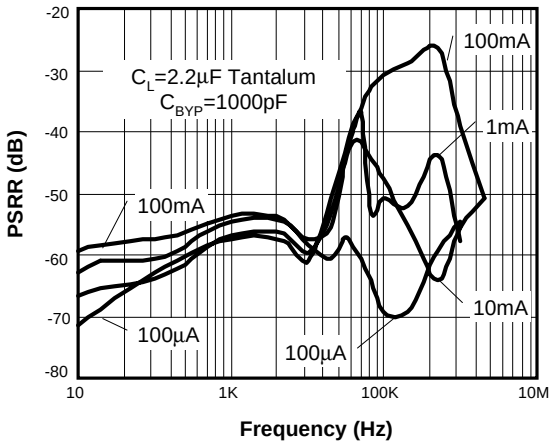
Drop Out Voltage vs. Output Voltage



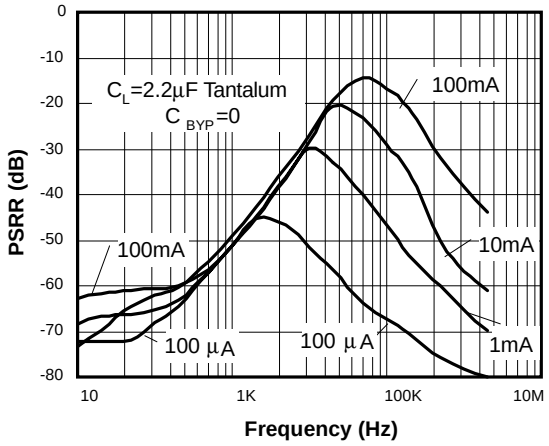
Drop Out Voltage vs. Load Current



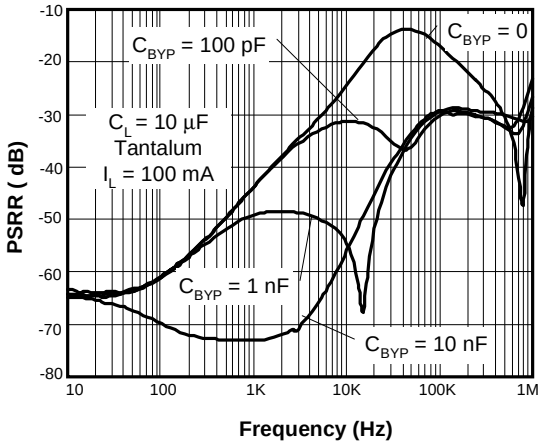
Power Supply Rejection Ratio



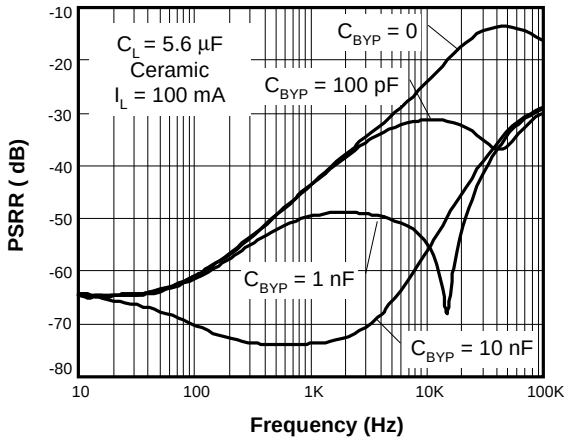
Power Supply Rejection Ratio



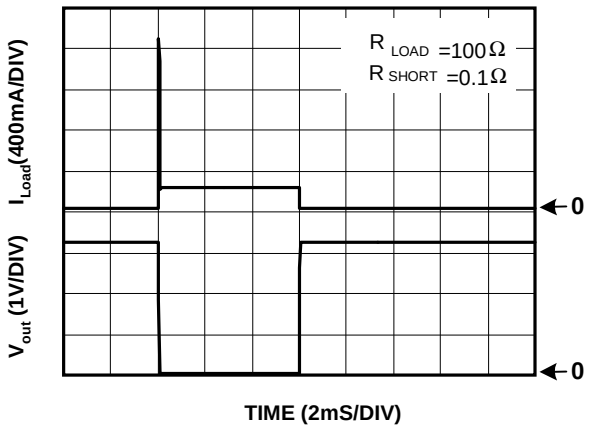
Power Supply Rejection Ratio



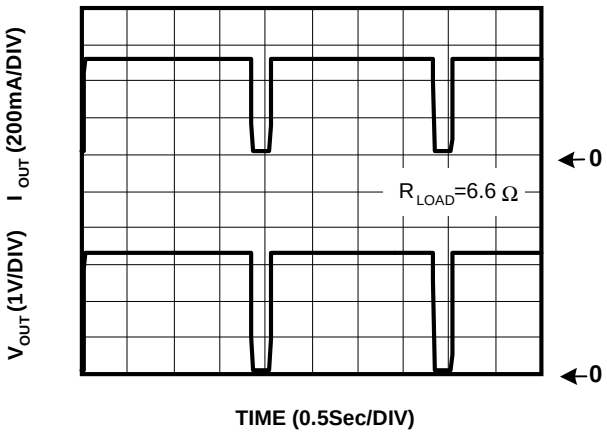
Power Supply Rejection Ratio



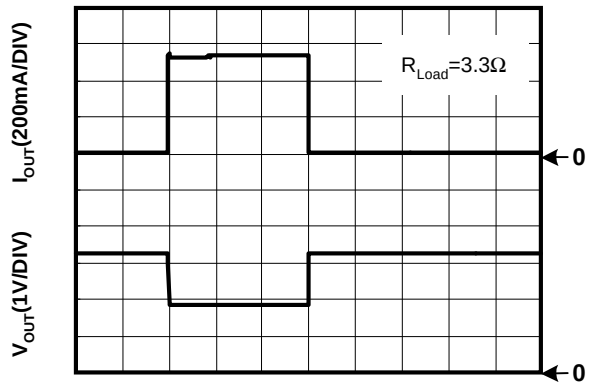
Short Circuit Response



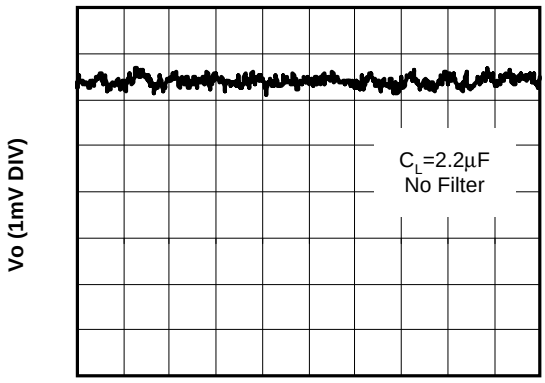
Overtemperature Shutdown



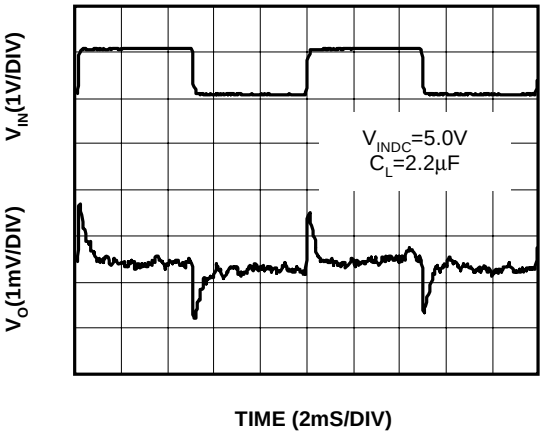
Current Limit Response



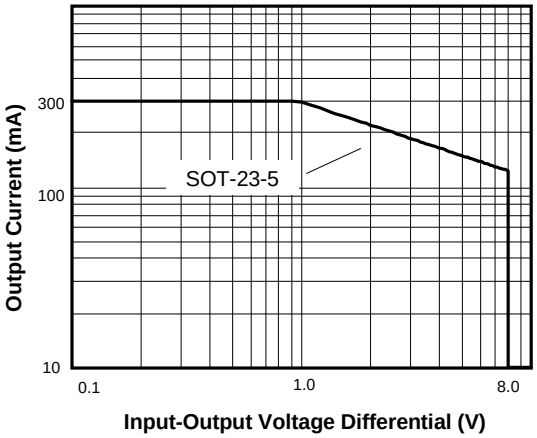
Noise Measurement



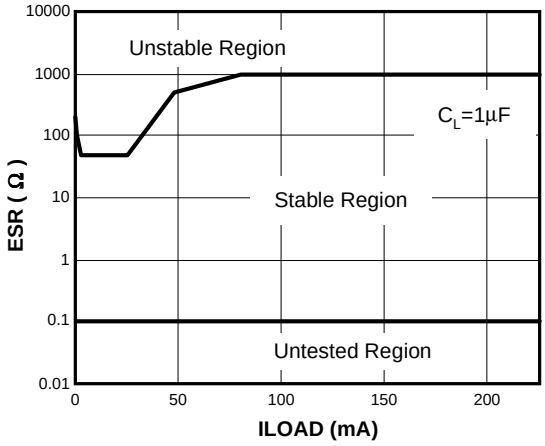
Line Transient Response



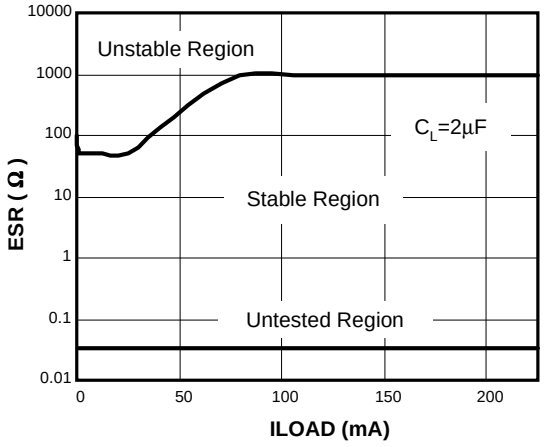
Safe Operating Area



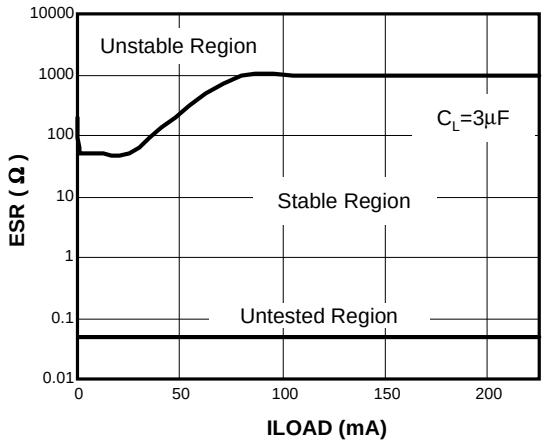
Stability vs. ESR vs. I_{Load}



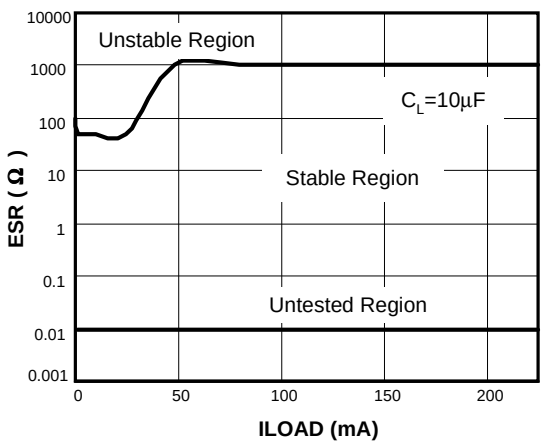
Stability vs. ESR vs. I_{Load}



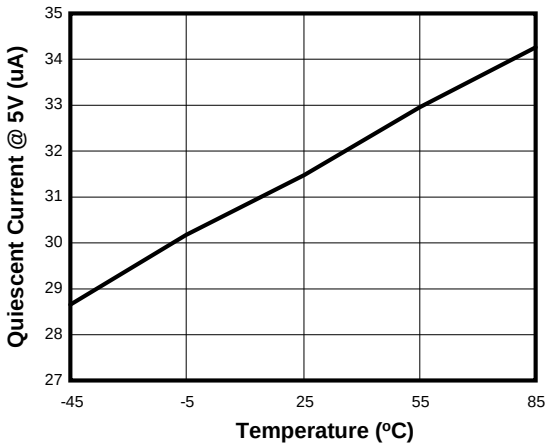
Stability vs. ESR vs. I_{Load}



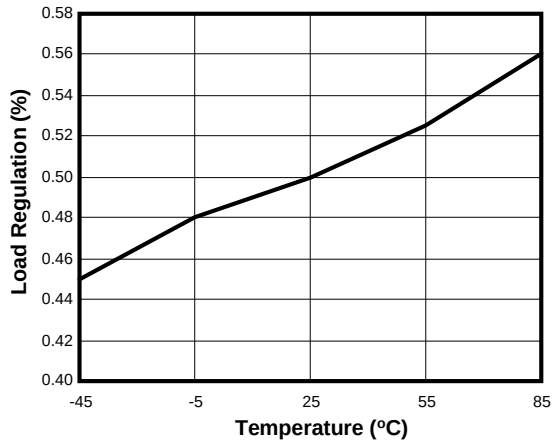
Stability vs. ESR vs. I_{Load}



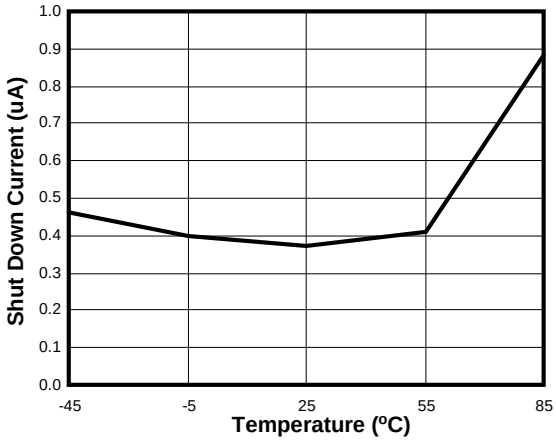
Quiescent Current vs. Temp.



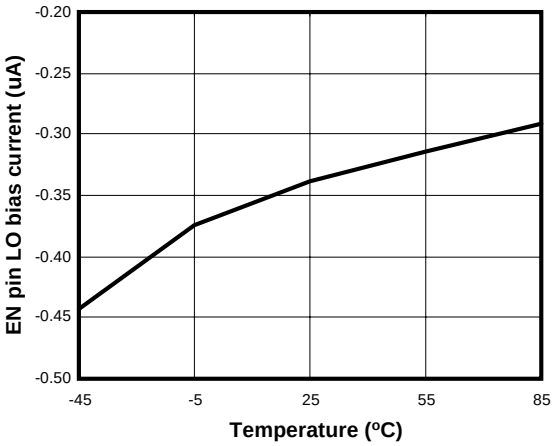
Load Regulation vs. Temp.

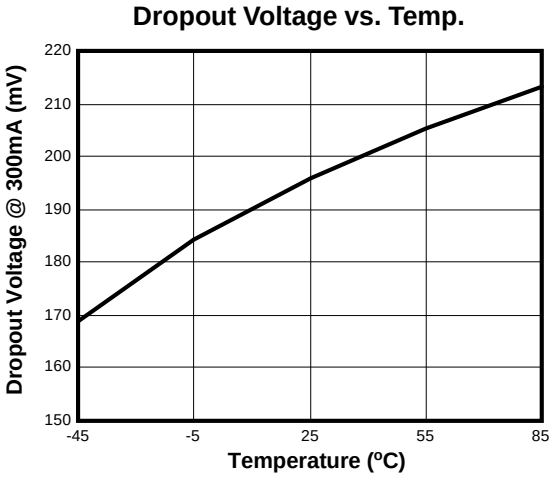


Shut Down Current vs. Temp.



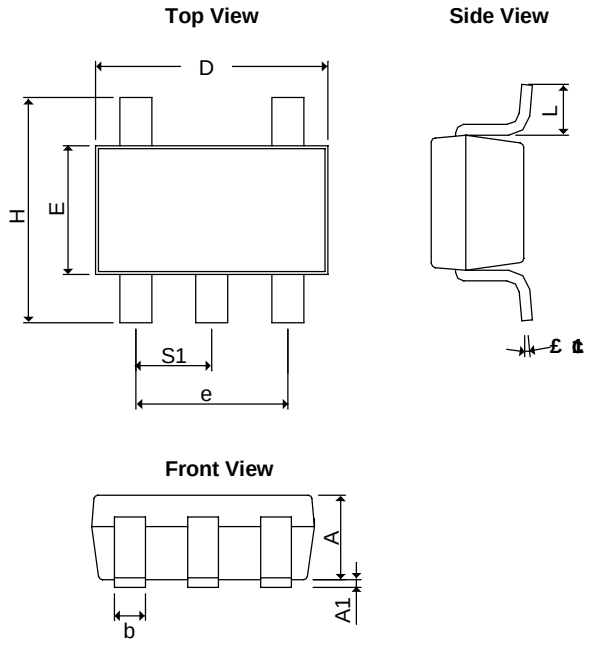
EN pin LO bias Current vs. Temp.




Dropout Voltage vs. Temp.
Dropout Voltage @ 300mA (mV)
220
210
200
190
180
170
160
150
-45
-5
25
55
85
Temperature (°C)

■ Package Dimension

SOT-25



SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.20REF		0.0472REF	
A_1	0.00	0.15	0.0000	0.0059
b	0.30	0.55	0.0118	0.0217
D	2.70	3.10	0.1063	0.1220
E	1.40	1.80	0.0551	0.0709
e	1.90 BSC		0.07480 BSC	
H	2.60	3.00	0.10236	0.11811
L	0.37BSC		0.0146BSC	
θ1	0^o	10^o	0^o	10^o
S_1	0.95BSC		0.0374BSC	

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E-Mail: sales@ame.com.tw

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Corporate Headquarter
AME, Inc.
2F, 189 Kang-Chien Road, Nei-Hu District
Taipei 114, Taiwan, R.O.C.
Tel：886 2 2627-8687
Fax: 886 2 2659-2989

U.S.A. (Subsidiary)
Analog Microelectronic, Inc.
3100 De La Cruz Blvd., Suite 201
Santa Clara, CA. 95054-2046
Tel：(408)988-2388
Fax：(408)988-2489