Fast Ultra High-PSRR, Low-Noise, 300mA CMOS Linear Regulator

General Description

The EMP8737 features ultra-high power supply rejection ratio, low output voltage noise, low dropout voltage, low quiescent current and fast transient response. It guarantees delivery of 300mA output current for V_{IN}=2.2V ~ 5.5V and supports preset output voltages ranging from 0.8V to 4.5V with 0.05V increment. It also guarantees delivery of 100mA output current for V_{IN} range lower from 1.75V ~ 2.1V.

Based on its low quiescent current consumption and its less than 1μA shutdown mode of logical operation, the EMP8737 is ideal for battery-powered applications. The high power supply rejection ratio of the EMP8737 holds well for low input voltages typically encountered in battery-operated systems. The regulator is stable with small ceramic capacitive loads (1μF typical). The EMP8737 is Available in miniature SOT-23-5 package.

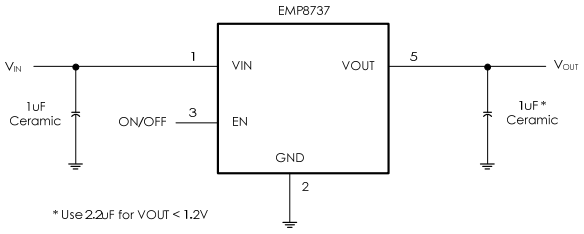
Features

- 2.2V to 5.5V input range for I_{OUT} 300mA operation
- 1.75V to 2.1V input range for I_{OUT} 100mA operation
- 62dB typical PSRR at 1kHz
- 110μV RMS output voltage noise (10Hz to 100kHz)
- 290mV typical dropout at 300mA
- 57μA typical quiescent current
- Less than 1μA typical shutdown mode
- Fast line and load transient response
- Auto-discharge during chip disable
- 80μs typical turn-on time
- Stable with small ceramic output capacitors
- Over temperature and over current protection
- ±2% output voltage tolerance

Applications

- Wireless handsets
- PCMCIA cards
- DSP core power
- Hand-held instruments
- Battery-powered systems
- Portable information appliances

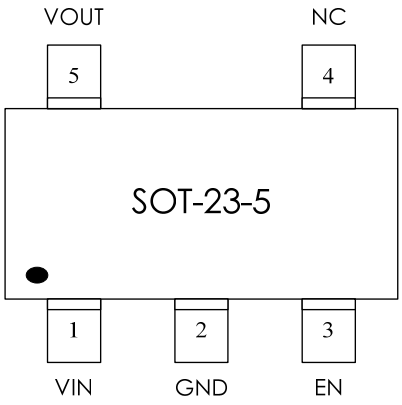
Typical Application



*Use 2.2μF for V_{OUT} < 1.2V

CONNECTION DIAGRAM

SOT-23-5(TOP View)



ORDER INFORMATION

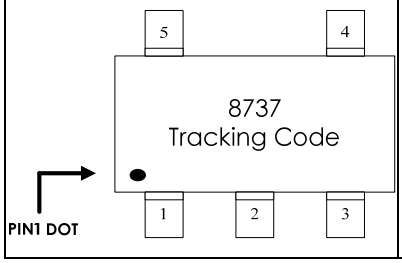
EMP8737-XXVF05GRR

XX	Output Voltage
VF05	SOT-23-5 Package
NRR	RoHS & Halogen free
	Commercial Grade Temperature
	Rating: -40 to 85°C
	Package in Tape & Reel

Pin Functions

Name	SOT-23-5	Function
VIN	**1**	**Supply Voltage Input**. Require a minimum input capacitor of close to 1μF to ensure stability and sufficient decoupling from the ground pin.
GND	**2**	**Ground Pin**.
EN	**3**	**Enable Input.** Enable the regulator by pulling the EN pin High. To keep the regulator on during normal operation, connect the EN pin to VIN. The EN pin must not exceed VIN + 0.5V under all operating conditions.
NC	**4**	**No Connection**
VOUT	**5**	**Output Voltage Feedback**.

Order, Mark & Packing Information

Marking	Vout	Product ID	Packing
	1.2	EMP8737-12VF05GRR	3K units Tape & Reel

Absolute Maximum Ratings (Notes 1, 2)

VIN, VOUT, VEN	-0.3V to 6.5V
Storage Temperature Range	-65°C to160°C
Junction Temperature (T_J)	150°C
Lead Temperature (10 sec.)	260°C
ESD Rating	
Human Body Model	2kV
MM	200V

Thermal Resistance (θ_{JA})	
SOT-23-5	250°C/W

Operating Ratings (Note 1, 2)

Temperature Range	-40°C to 85°C
Supply Voltage	2.2V to 5.5V

Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $V_{IN} = V_{OUT}$ +1V (Note 3), $V_{EN}=V_{IN}$, $C_{IN} = C_{OUT}$ = 2.2µF, T_A = 25°C.
Boldface & underline limits apply for the operating temperature extremes: -40°C and 85°C.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{IN}	Input Voltage	I_{OUT}= 300mA (max.)	**2.2**		**5.5**	V
V_{OUT}	Output Voltage		**0.8**		**4.5**	V
ΔV_{OTL}	Output Voltage Tolerance	I_{OUT} = 10mA (Note 3)	-2		+2	% of $V_{OUT (NOM)}$
			-3		**+3**	
I_{OUT}	Maximum Output Current	V_{IN}= 2.2V ~ 5.5V	**300**			mA
I_{LIMIT}	Output Current Limit		**300**	450		mA
I_Q	Supply Current	I_{OUT} = 0mA		57		µA
		I_{OUT} = 50mA		63		
		I_{OUT} = 150mA		88		
		I_{OUT} = 300mA		130		
	Shutdown Supply Current	V_{OUT} = 0V, EN = GND		0.001	1	
V_{DO}	Dropout Voltage (Note4)	I_{OUT} = 100mA		90		mV
		I_{OUT} = 300mA		290		
ΔV_{OUT}	Line Regulation	I_{OUT} = 1mA, (V_{OUT} + 1V) ≤ V_{IN} ≤ 5.5V (Note 3)	-0.1	0.01	0.1	%/V
	Load Regulation	1mA ≤ I_{OUT} ≤ 300mA		0.0008		%/mA
e_n	Output Voltage Noise	V_{OUT}=2.5V, I_{OUT} = 10mA, 10Hz ≤ f ≤ 100kHz		110		μV_{RMS}
T_{SD}	Thermal Shutdown Temperature			165		℃
	Thermal Shutdown Hysteresis			35		
V_{EN}	EN Input Threshold	V_{IH}, (V_{OUT} + 1V) ≤ V_{IN} ≤ 5.5V (Note 3)	**1.2**			V
		V_{IL}, (V_{OUT} + 1V) ≤ V_{IN} ≤ 5.5V (Note 3)			**0.4**	
I_{EN}	EN Input Bias Current	EN = GND or V_{IN}		0.1	100	nA
T_{ON}	Turn-On Time	V_{OUT} at 95% of Final Value		80		µs
T_{OFF}	Turn-Off Time	I_{OUT}=0mA (Note 5)		2.4		ms

Electrical Characteristics (cont.)

Unless otherwise specified, all limits guaranteed for $V_{EN}=V_{IN}$, $C_{IN} = C_{OUT} = 2.2\mu F$, $T_A = 25°C$.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{IN}	Input Voltage	I_{OUT}= 100mA (max.)	1.75		2.1	V
ΔV_{OTL}	Output Voltage Tolerance	1mA ≤ I_{OUT} ≤ 100mA, 1.75V ≤ V_{IN} ≤ 2.1V	-2		+2	% of $V_{OUT (NOM)}$
I_{OUT}	Maximum Output Current	V_{IN}= 1.75V ~ 2.1V	50		100	mA

Note 1: Absolute Maximum ratings indicate limits beyond which damage may occur. Electrical specifications do not apply when operating the device outside of its rated operating conditions.

Note 2: All voltages are with respect to the potential at the ground pin.

Note 3: Condition does not apply to input voltages below 2.2V since this is the minimum input operating voltage.

Note 4: Dropout voltage is measured by reducing V_{IN} until V_{OUT} drops 100mV from its nominal value at V_{IN} -V_{OUT} = 1V. Dropout voltage does not apply to the regulator versions with V_{OUT} less than 2.2V.

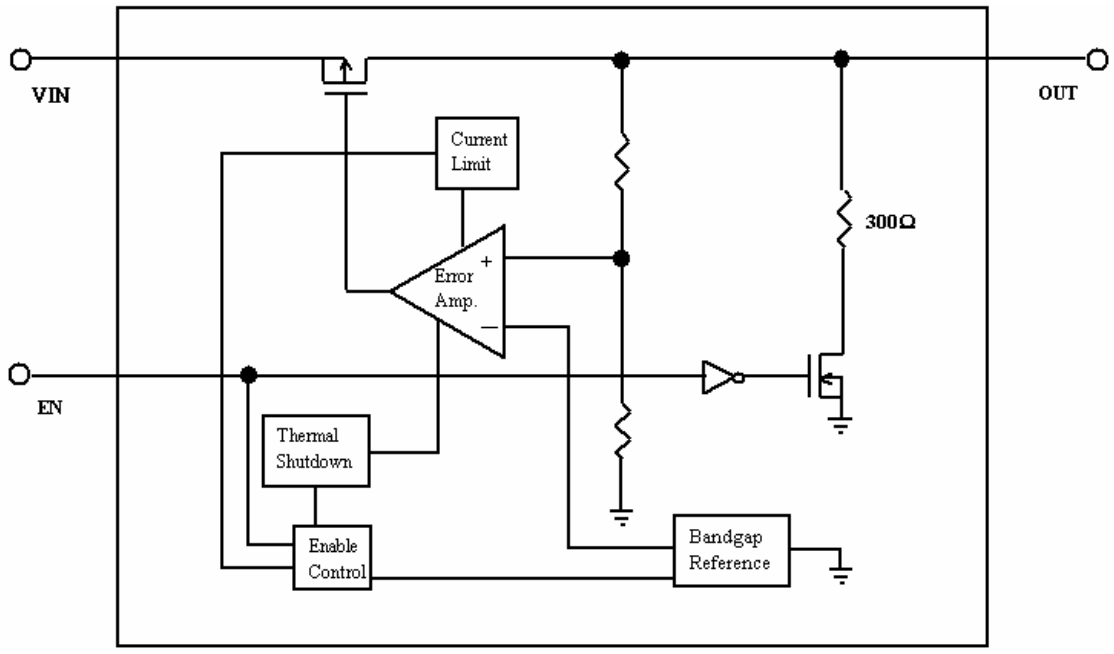
Note 5: Turn-off time is time measured between the enable input just decreasing below V_{IL} and the output voltage just decreasing to 10% of its nominal value.

Note 6: Maximum Power dissipation for the device is calculated using the following equations:

$$P_D = \frac{T_{J(MAX)} - T_A}{\theta_{JA}}$$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction-to-ambient thermal resistance. E.g. for the SOT-23-5 package θ_{JA} = 250°C/W, $T_{J(MAX)}$ = 150°C and using T_A = 25°C, the maximum power dissipation is found to be 500mW. The derating factor (-1/θ_{JA}) = -4mW/°C, thus below 25°C the power dissipation figure can be increased by 4mW per degree, and similarity decreased by this factor for temperatures above 25°C.

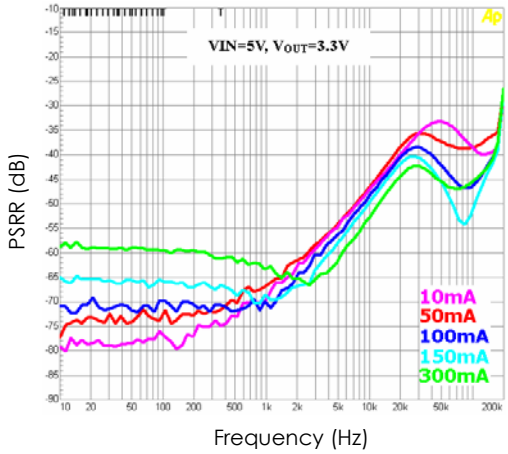
Functional Block Diagram



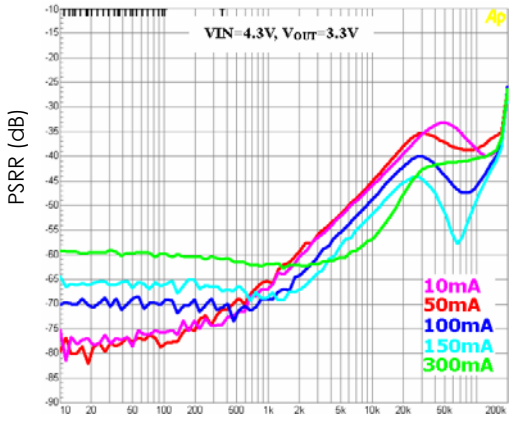
Typical Performance Characteristics

Unless otherwise specified, VIN = $V_{OUT\ (NOM)}$ + 1V, V_{EN}=V_{IN}, C_{IN} = C_{OUT} = 2.2μF, T_A = 25°C.

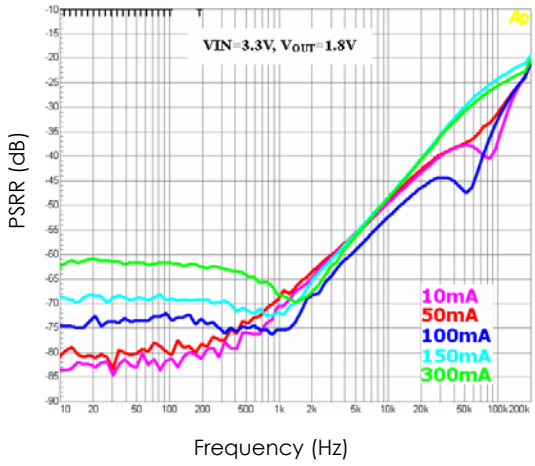
PSRR vs. Frequency



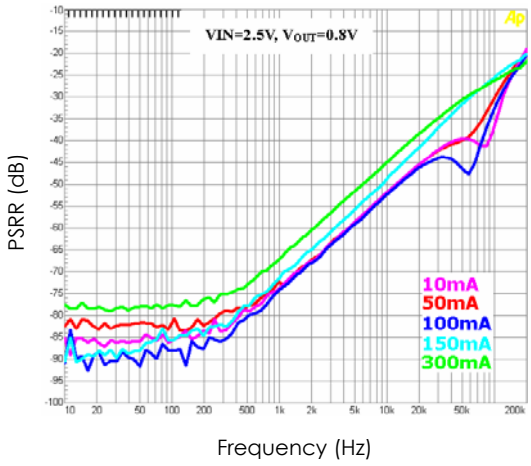
PSRR vs. Frequency



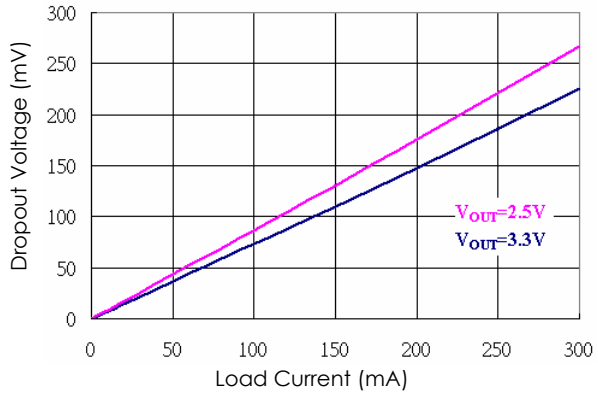
PSRR vs. Frequency



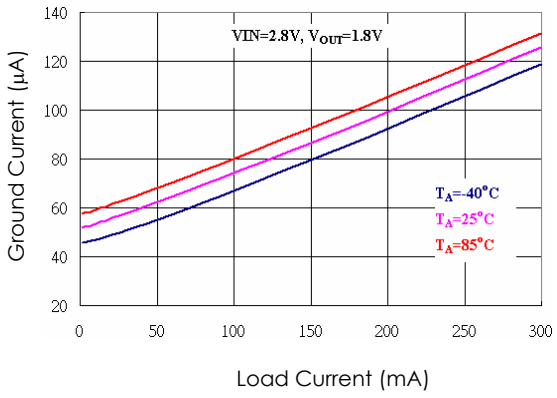
PSRR vs. Frequency



Dropout Voltage vs. Load Current



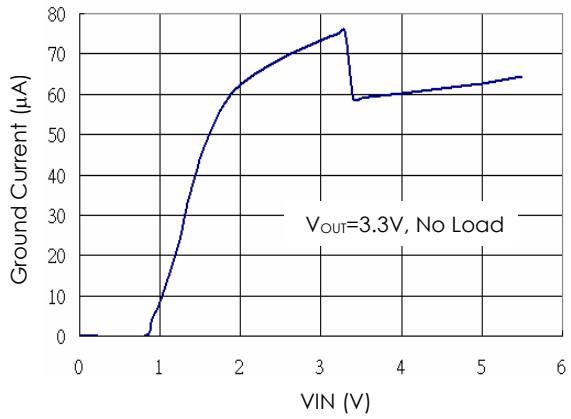
Ground Current vs. Load Current



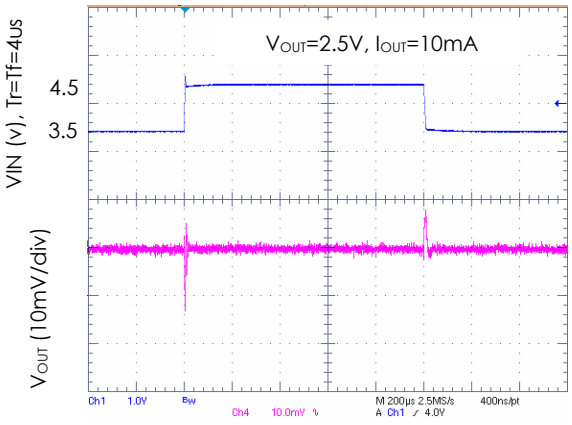
Typical Performance Characteristics

Unless otherwise specified, VIN = $V_{OUT\ (NOM)}$ + 1V, V_{EN}=V_{IN}, C_{IN} = C_{OUT} = 2.2μF, T_A = 25°C. (Continued)

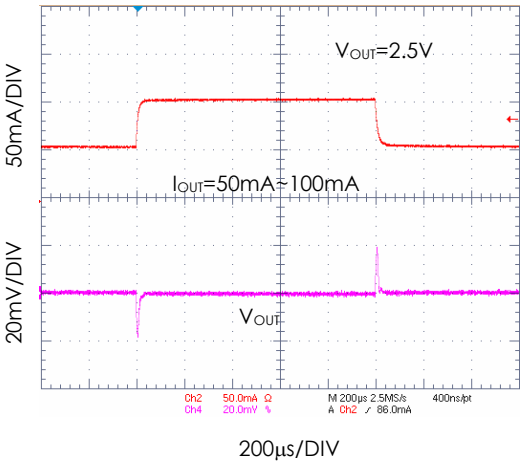
Ground Current vs. VIN



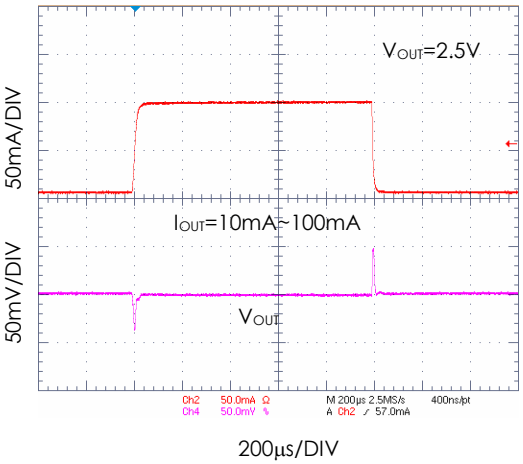
Line Transient



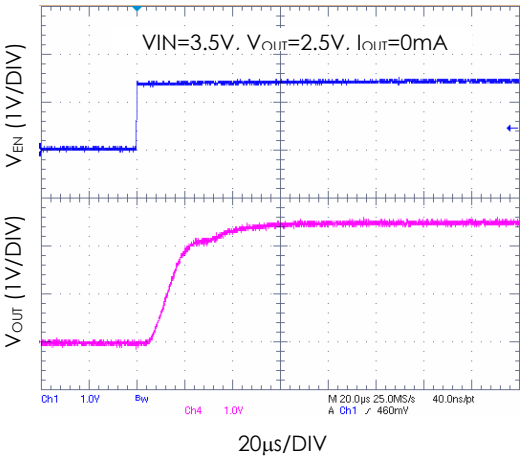
Load Transient



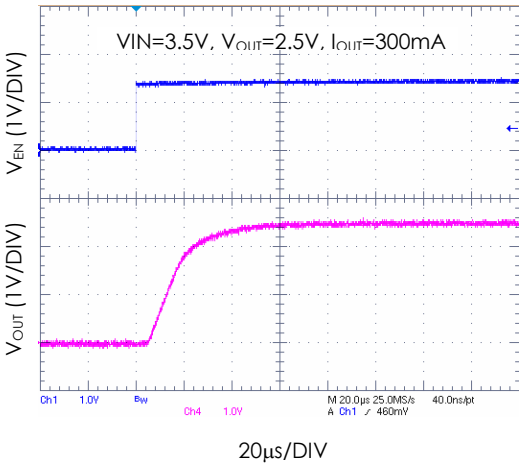
Load Transient



Enable Response



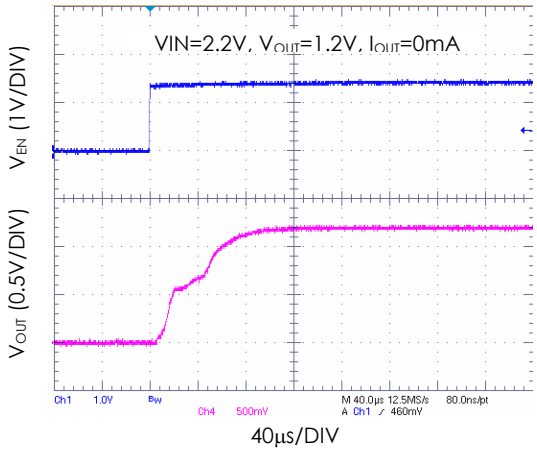
Enable Response



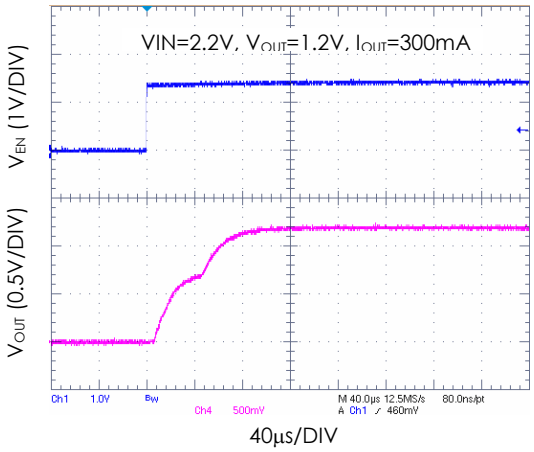
Typical Performance Characteristics

Unless otherwise specified, VIN = $V_{OUT\ (NOM)}$ + 1V, V_{EN}=V_{IN}, C_{IN} = C_{OUT} = 2.2µF, T_A = 25°C. (Continued)

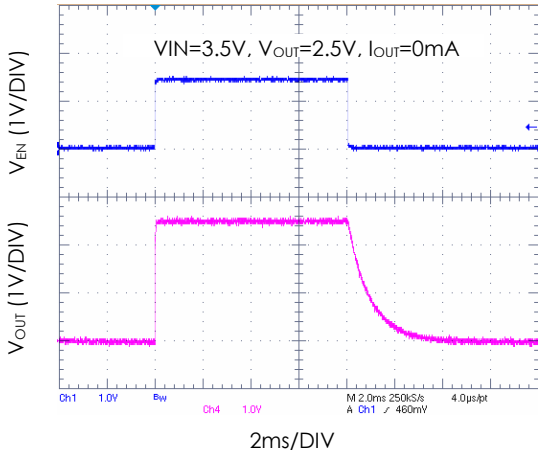
Enable Response



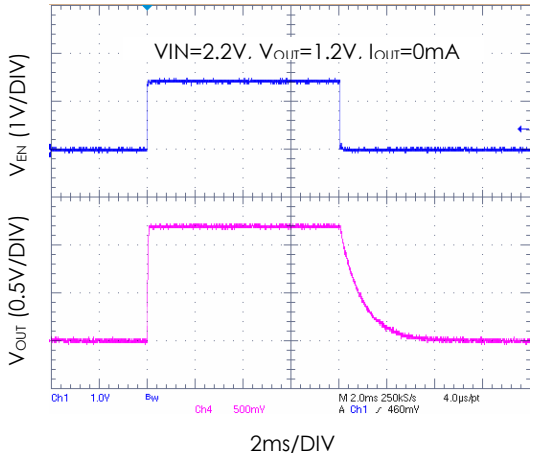
Enable Response



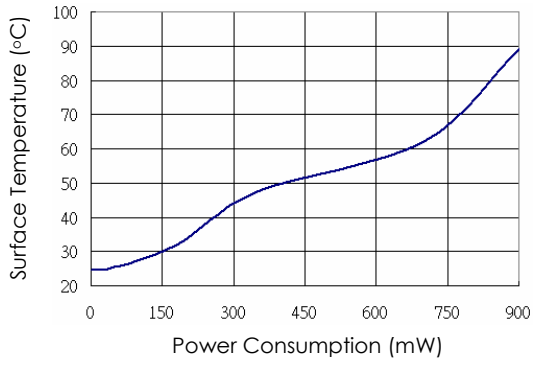
Disable Response



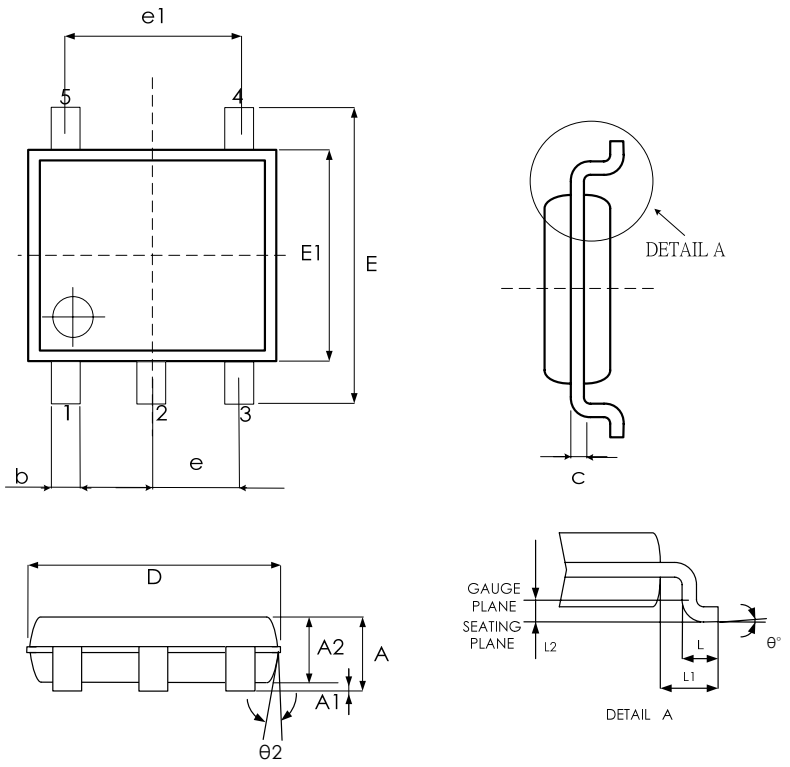
Disable Response



Power Derating (SOT-25)



SOT-23-5



SYMBPLS	MIN.	NOM.	MAX.
A	1.05	1.20	1.35
A1	0.05	0.10	0.15
A2	1.00	1.10	1.20
b	0.30	—	0.50
c	0.08	—	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.95 BSC		
e1	1.90 BSC		
L	0.30	0.45	0.55
L1	0.60 REF		
L2	0.25 REF		
θ°	0	5	10
θ2°	6	8	10

UNIT: MM

Revision History

Revision	Date	Description
1.0	2011.05.28	Original version
1.1	2011.05.28	EN pin must not exceed VIN + 0.5V under all operating conditions
1.2	2011.07.04	Modify Output Voltage Tolerance

Important Notice

All rights reserved.

No part of this document may be reproduced or duplicated in any form or by any means without the prior permission of ESMT.

The contents contained in this document are believed to be accurate at the time of publication. ESMT assumes no responsibility for any error in this document, and reserves the right to change the products or specification in this document without notice.

The information contained herein is presented only as a guide or examples for the application of our products. No responsibility is assumed by ESMT for any infringement of patents, copyrights, or other intellectual property rights of third parties which may result from its use. No license, either express , implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of ESMT or others.

Any semiconductor devices may have inherently a certain rate of failure. To minimize risks associated with customer's application, adequate design and operating safeguards against injury, damage, or loss from such failure, should be provided by the customer when making application designs.

ESMT's products are not authorized for use in critical applications such as, but not limited to, life support devices or system, where failure or abnormal operation may directly affect human lives or cause physical injury or property damage. If products described here are to be used for such kinds of application, purchaser must do its own quality assurance testing appropriate to such applications.