

## High-PSRR Low-Noise RF LDO

" 'HM1157 Series

## CMOS Voltage Regulator With ON/OFF Switch

300mA

The HM1157 series is a low-noise LDO that can supply up to 300 mA output current. Designed to meet the requirements of RF and analog circuits, the HM1157 series device provides low noise, high PSRR, low quiescent current, and low line or load transient response figures. Using new innovative design techniques, the HM1157 series offers ultra-low noise performance without a noise bypass capacitor and the ability for remote output capacitor placement. response figures with a 1- $\mu$ F input and a 1- $\mu$ F output ceramic capacitor

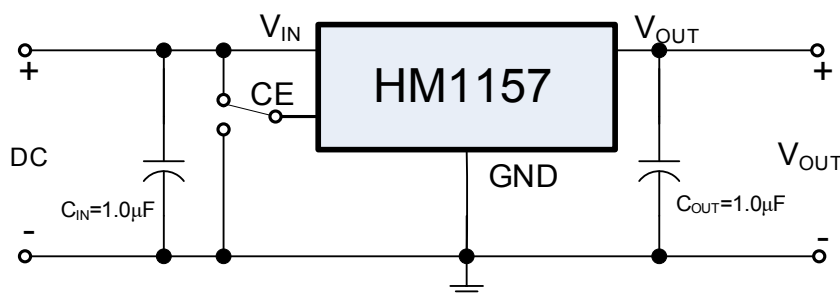
### ■ Features:

- Input Voltage Range: 2.2 V to 5.5 V
- Output Voltage Range: 1.2 V to 4.5 V
- Stable With 1- $\mu$ F Ceramic Input and Output Capacitors
- No Noise Bypass Capacitor Required
- Remote Output Capacitor Placement
- Current Limiter and Over Temperature Protection
- -40°C to 125°C Operating Junction Temperature
- Low Output Voltage Noise: 20 $\mu$ V<sub>RMS</sub>
- High PSRR: 90dB@1kHz
- Output Voltage Tolerance:  $\pm$ 2%
- Low quiescent Current: 20 $\mu$ A
- Low Dropout Voltage: 120mV@300mA

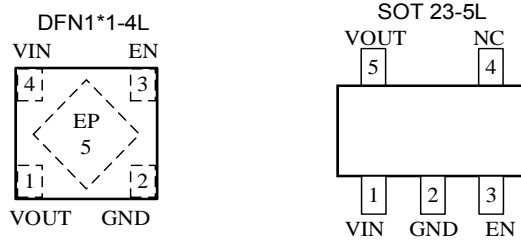
### ■ Applications:

- Mobile Phones, Tablets
- Digital Cameras and Audio Devices
- Portable and Battery-Powered Equipment
- Portable Medical Equipment
- Smart Meters and Field Transmitters
- RF, PLL, VCO, and Clock Power Supplies
- IP Cameras
- Drones

### ■ Typical Application:



■ Pin Configuration (Top View):



■ Product Selections:

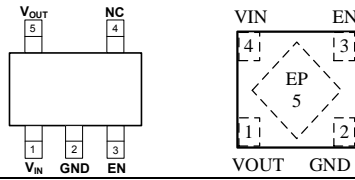
Product Name	V <sub>OUT</sub> (V)	Package	Ordering Name	Marking	Package Information
HM1157B12DR	1.2	DFN1*1-4L	HM1157B12DR	5712	Tape and Reel, 10000pcs
HM1157B15DR	1.5	DFN1*1-4L	HM1157B15DR	5715	
HM1157B18DR	1.8	DFN1*1-4L	HM1157B18DR	5718	
HM1157B21DR	2.1	DFN1*1-4L	HM1157B21DR	5721	
HM1157B25DR	2.5	DFN1*1-4L	HM1157B25DR	5725	
HM1157B28DR	2.8	DFN1*1-4L	HM1157B28DR	5728	
HM1157B30DR	3.0	DFN1*1-4L	HM1157B30DR	5730	
HM1157B33DR	3.3	DFN1*1-4L	HM1157B33DR	5733	
HM1157B36DR	3.6	DFN1*1-4L	HM1157B36DR	5736	Tape and Reel, 3000pcs
HM1157B12MR	1.2	SOT23-5L	HM1157B12MR	5712	
HM1157B15MR	1.5	SOT23-5L	HM1157B15MR	5715	
HM1157B18MR	1.8	SOT23-5L	HM1157B18MR	5718	
HM1157B21MR	2.1	SOT23-5L	HM1157B21MR	5721	
HM1157B25MR	2.5	SOT23-5L	HM1157B25MR	5725	
HM1157B28MR	2.8	SOT23-5L	HM1157B28MR	5728	
HM1157B30MR	3.0	SOT23-5L	HM1157B30MR	5730	
HM1157B33MR	3.3	SOT23-5L	HM1157B33MR	5733	
HM1157B36MR	3.6	SOT23-5L	HM1157B36MR	5736	

Notes:

- 1\* Customer can request to customize the output voltage ranged from 1.2V to 4. 5V if desired voltage is not found in the selections.
- 2\* Customer can request customization of package choice.
- 3\* Please pay attention to the MARKING of the product package type.

## ■ Ordering Information

HM1157 ①②③④ : e.g. HM1157B33MR

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	PIN Configuration	B	
②③	Output Voltage	18~	e.g. 1.8V → ②=1, ③=8
④	Packages Type	MR	SOT23-5L
		DR	DFN1*1-4L

## ■ Absolute Maximum Ratings:

(Unless otherwise indicated:  $T_a=25^{\circ}\text{C}$ )

PARAMETER	SYMBOL	RATINGS		UNITS
Input Voltage	V <sub>IN</sub>	-0.3 ~ 6.0		V
Output Voltage	V <sub>OUT</sub>	-0.3 ~ V <sub>IN</sub> +0.3V		
Power Dissipation	P <sub>D</sub>	SOT23-5L	250	mW
		DFN1*1-4L	200	
Thermal Resistance	R <sub>θJB</sub> <sup>(1)</sup>	SOT23-5L	180	°C/W
		DFN1*1-4L	160	
Operating Ambient Temperature	T <sub>opr</sub>	-40 ~ +85		°C
Storage Temperature	T <sub>stg</sub>	-40 ~ +125		
ESD Protection	ESD HBM	6000		V

**Note:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

<sup>(1)</sup> Mounted on JEDEC standard 4layer (2s2p) PCB test board

## ■ Notes on Use:

Input Capacitor ( $C_{IN}$ ): 1.0 $\mu\text{F}$  above

Output Capacitor ( $C_{OUT}$ ): 1.0 $\mu\text{F}$  above

## ■ Electrical Characteristics:

HM1157 Series

(Unless otherwise indicated:  $T_a=25^{\circ}\text{C}$ )

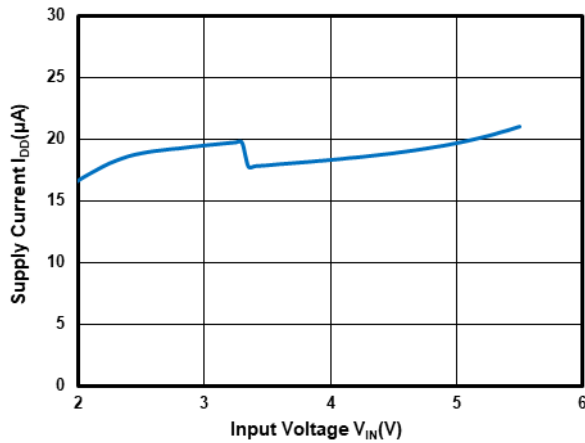
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	$V_{\text{OUT(S)}}$	$V_{\text{IN}}=V_{\text{OUT(S)}}+2.0\text{V}$ $I_{\text{OUT}}=1\text{mA}$ , $V_{\text{OUT(S)}}<2.0\text{V}$	$V_{\text{OUT(S)}}-0.03$	$V_{\text{OUT(S)}}$	$V_{\text{OUT(S)}}+0.03$	V
		$V_{\text{IN}}=V_{\text{OUT(S)}}+1.0\text{V}$ $I_{\text{OUT}}=1\text{mA}$ , $V_{\text{OUT(S)}}\geq 2.0\text{V}$	$V_{\text{OUT(S)}}\times 0.98$		$V_{\text{OUT(S)}}\times 1.02$	
Dropout Voltage*1	$V_{\text{DROP}}$	$V_{\text{EN}}=V_{\text{IN}}$ , $V_{\text{OUT}}<3\text{V}$ $I_{\text{OUT}}=300\text{mA}$		130		mV
		$V_{\text{EN}}=V_{\text{IN}}$ , $V_{\text{OUT}}\geq 3\text{V}$ $I_{\text{OUT}}=300\text{mA}$		120		
Line Regulation	$\frac{\Delta V_{\text{OUT}}}{\Delta V_{\text{IN}} \cdot V_{\text{OUT(S)}}}$	$V_{\text{OUT(S)}}+1.0\text{V}\leq V_{\text{IN}}=V_{\text{EN}}\leq 5.5\text{V}$ $I_{\text{OUT}}=10\text{mA}$		0.02	0.1	%/V
Line Transient	$\Delta V_{\text{OUT\_Line}}$	$V_{\text{IN}}=V_{\text{OUT}}+1\text{V}$ to $V_{\text{OUT}}+2\text{V}$ in 30 $\mu\text{s}$	-1			mV
		$V_{\text{IN}}=V_{\text{OUT}}+2\text{V}$ to $V_{\text{OUT}}+1\text{V}$ in 30 $\mu\text{s}$			1	
Load Regulation	$\Delta V_{\text{OUT2}}$	$V_{\text{IN}}=V_{\text{EN}}=V_{\text{OUT(S)}}+1.0\text{V}$ $1\text{mA}\leq I_{\text{OUT}}\leq 300\text{mA}$		10	20	mV
Load Transient	$\Delta V_{\text{OUT\_Load}}$	$I_{\text{OUT}}=1\text{mA}$ to $300\text{mA}$ in 10 $\mu\text{s}$	-40			mV
		$I_{\text{OUT}}=300\text{mA}$ to $1\text{mA}$ in 10 $\mu\text{s}$			40	
Temperature Stability	$\frac{\Delta V_{\text{OUT}}}{\Delta T_a \cdot V_{\text{OUT(S)}}}$	$V_{\text{IN}}=V_{\text{EN}}=V_{\text{OUT(S)}}+1.0\text{V}$ $I_{\text{OUT}}=1\text{mA}$ , $-40^{\circ}\text{C}\leq T_a\leq 125^{\circ}\text{C}$		$\pm 100$		ppm/ $^{\circ}\text{C}$
GND Current ( $V_{\text{EN}}=V_{\text{IN}}$ )	$I_{\text{GND}}$	no load		20	30	$\mu\text{A}$
		$I_{\text{OUT}}=300\text{mA}$		470		$\mu\text{A}$
Shutdown Current	$I_{\text{SHUT}}$	$V_{\text{IN}}=5.5\text{V}$ , $V_{\text{EN}}=0$		0.01	0.1	$\mu\text{A}$
Input Voltage	$V_{\text{IN}}$	---	2.2		5.5	V
Maximum Output Current	$I_{\text{OUTMAX}}$		250	300		mA
Current Limit*2	$I_{\text{LIM}}$	$V_{\text{IN}}=V_{\text{EN}}=V_{\text{OUT(S)}}+1.0\text{V}$ $V_{\text{OUT}}=0.95 \times V_{\text{OUT(S)}}$		500		mA
$C_{\text{OUT}}$ Auto Discharge	$R_{\text{DCHG}}$	$V_{\text{EN}}=0$ , $V_{\text{OUT}}=V_{\text{OUT(S)}}$		240		$\Omega$
Power Supply Rejection Ratio	PSRR	$f=1\text{kHz}$ , $I_{\text{OUT}}=20\text{mA}$		94		dB
		$f=10\text{kHz}$ , $I_{\text{OUT}}=20\text{mA}$		72		
		$f=100\text{kHz}$ , $I_{\text{OUT}}=20\text{mA}$		77		
		$f=1\text{MHz}$ , $I_{\text{OUT}}=20\text{mA}$		53		
Output noise voltage	$e_{\text{N}}$	$I_{\text{OUT}}=20\text{mA}$		20		$\mu\text{V}_{\text{RMS}}$
Start-Up Time	$T_{\text{START}}$	From $V_{\text{EN}}>V_{\text{ENH}}$ to $V_{\text{OUT}}=95\%$ of $V_{\text{OUT}}$		80	150	$\mu\text{s}$
Overshoot on Start-Up	$\Delta V_{\text{OUT\_Start-up}}$	Stated as a percentage of $V_{\text{OUT(S)}}$			5	%
EN 'H' Level Voltage	$V_{\text{ENH}}$	---	0.85		5.5	V
EN 'L' Level Voltage	$V_{\text{ENL}}$	---	0		0.35	
EN 'H' Level Current	$I_{\text{ENH}}$	$V_{\text{IN}}=5.5\text{V}$ , $V_{\text{EN}}=V_{\text{IN}}$	-0.1		0.1	$\mu\text{A}$
EN 'L' Level Current	$I_{\text{ENL}}$	$V_{\text{IN}}=5.5\text{V}$ , $V_{\text{EN}}=0$	-0.1		0.1	
Over Temperature Protection	OTP	$I_{\text{OUT}}=1\text{mA}$		155		$^{\circ}\text{C}$

### Notes:

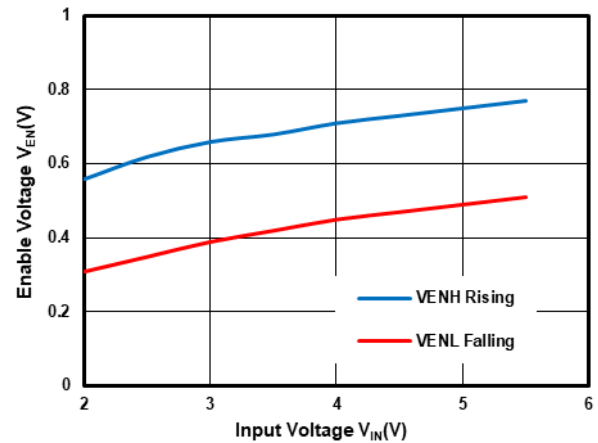
- $V_{\text{DROP}}=V_{\text{IN1}} - (V_{\text{OUT(S)}}\times 0.98)$  where  $V_{\text{IN1}}$  is the input voltage when  $V_{\text{OUT}}=V_{\text{OUT(S)}}\times 0.98$ .
- $I_{\text{LIM}}$ : Output current when  $V_{\text{IN}}=V_{\text{OUT(S)}}+1\text{V}$  and  $V_{\text{OUT}}=0.95\times V_{\text{OUT(S)}}$ .

### ■ Typical Performance Characteristics:

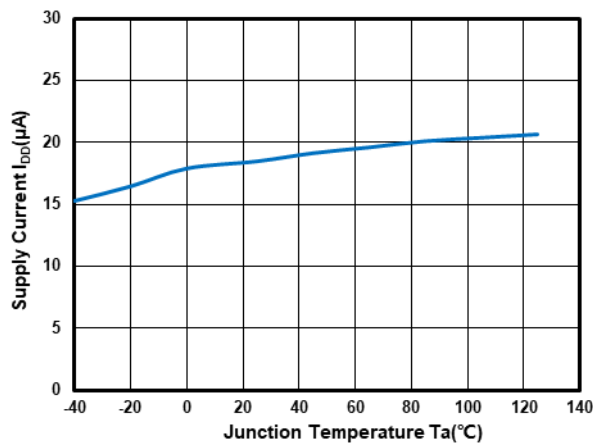
Test Conditions:  $V_{IN}=4.3V$ ,  $V_{OUT}=3.3V$ ,  $C_{IN}=1.0\mu F$ ,  $C_{OUT}=1.0\mu F$ ,  $T_a=25^\circ C$ , unless otherwise indicated.



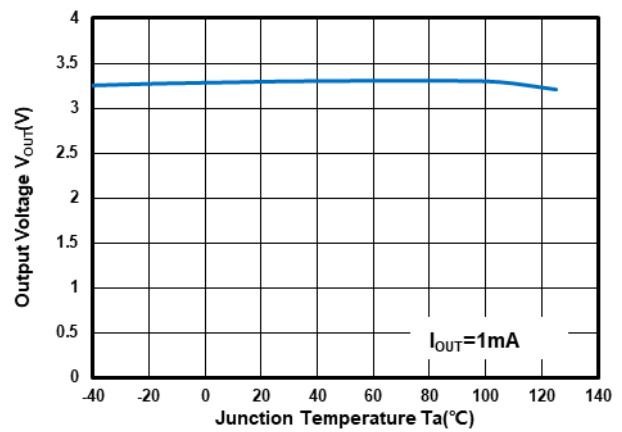
Supply Current vs. Input Voltage



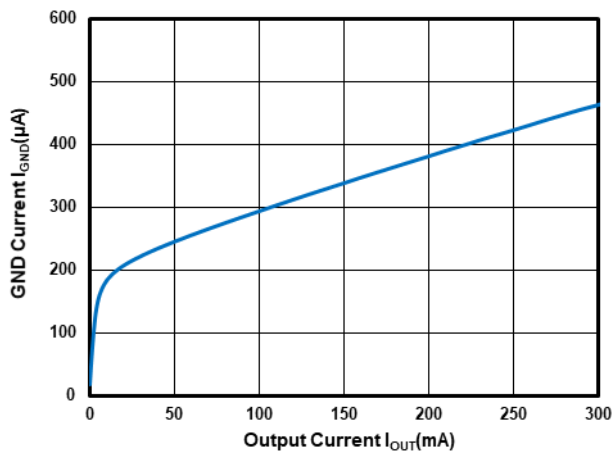
$V_{EN}$  Thresholds vs. Input Voltage



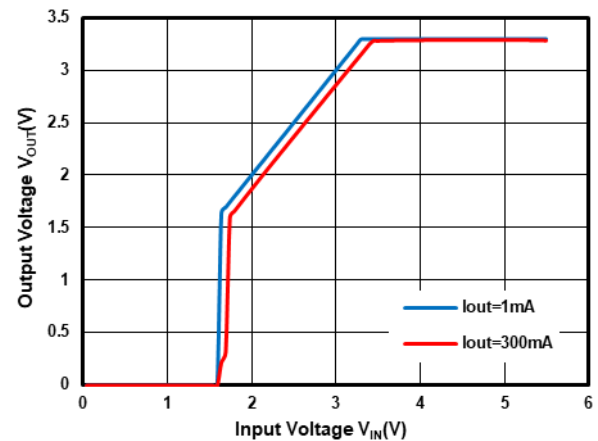
Supply Current vs. Temperature



Output Voltage vs. Temperature



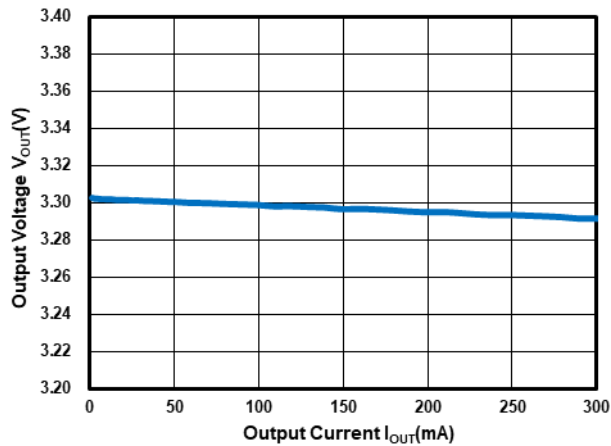
GND Current vs. Output Current



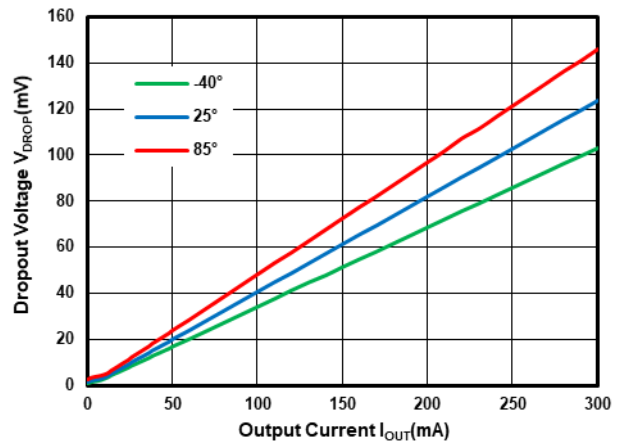
Output Voltage vs. Input Voltage

## ■ Typical Performance Characteristics (Continued):

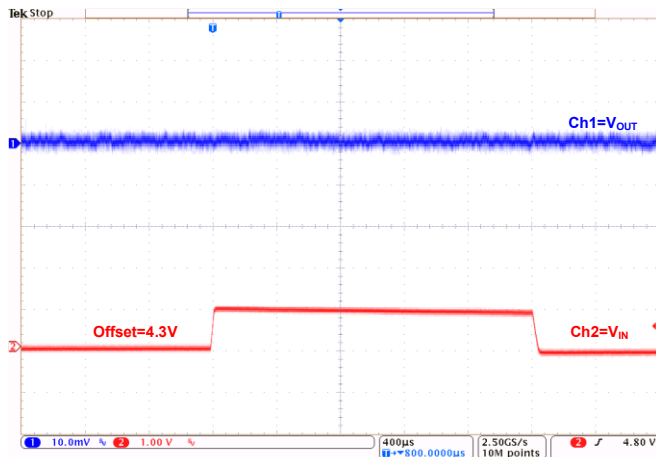
Test Conditions:  $V_{IN}=4.3V$ ,  $V_{OUT}=3.3V$ ,  $C_{IN}=1.0\mu F$ ,  $C_{OUT}=1.0\mu F$ ,  $T_a=25^\circ C$ , unless otherwise indicated.



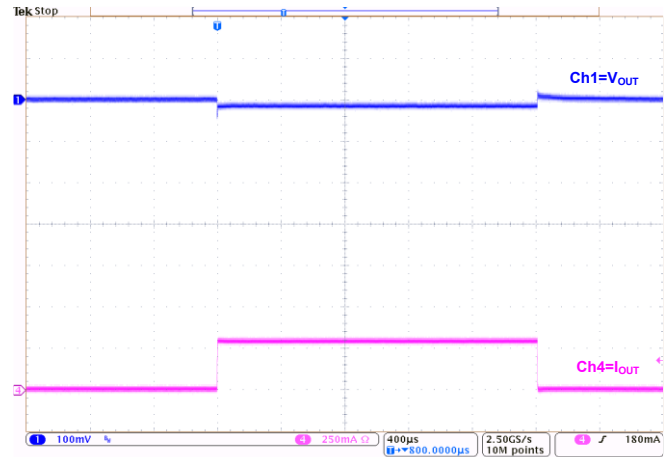
Output Voltage vs. Output Current



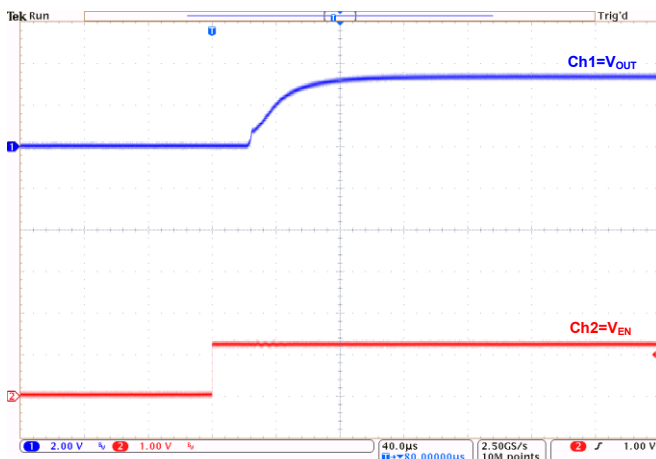
Dropout Voltage vs. Output Current



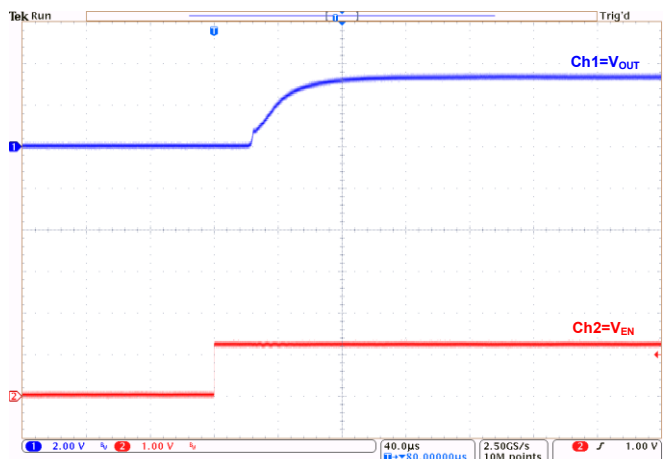
Line Transient:  
( $I_{OUT}=10mA$ )



Load Transient:  
( $I_{OUT}=0mA \sim 300mA \sim 0mA$ )



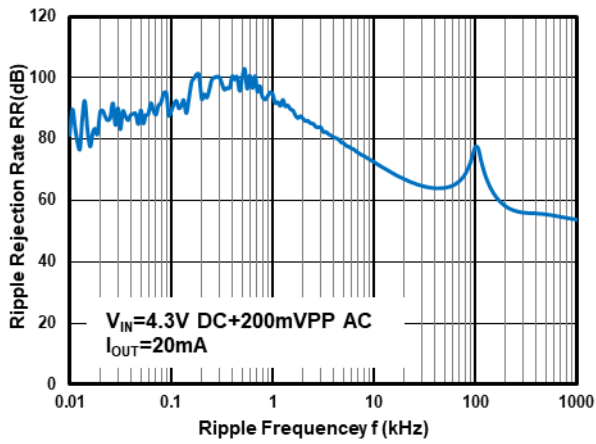
EN Enable:  
( $I_{OUT}=0mA$ )



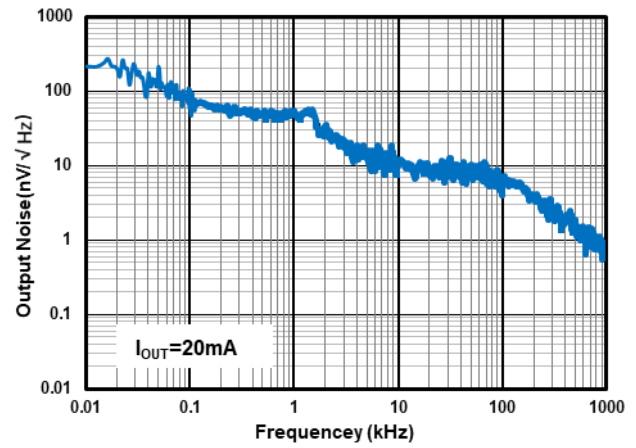
EN Enable:  
( $I_{OUT}=300mA$ )

## ■ Typical Performance Characteristics (Continued):

Test Conditions:  $V_{IN}=4.3V$ ,  $V_{OUT}=3.3V$ ,  $C_{IN}=1.0\mu F$ ,  $C_{OUT}=1.0\mu F$ ,  $T_a=25^\circ C$ , unless otherwise indicated.



Power Supply Rejection Ratio



Noise Density Test

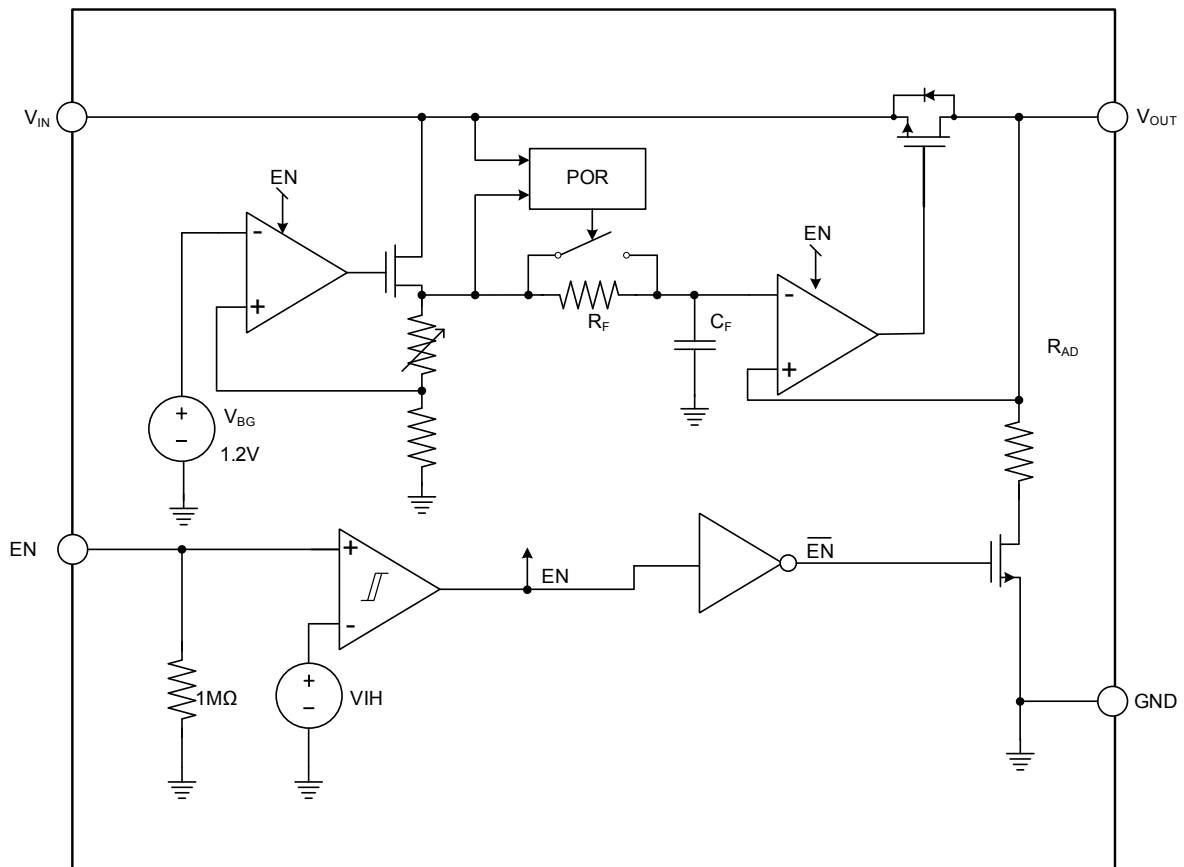
## ■ Detailed Description:

### 1. Overview

Using new innovative design techniques, the HM1157 series offers ultra-low noise performance without the need for a separate noise filter capacitor.

The HM1157 series is designed to perform with a single 1- $\mu$ F input capacitor and a single 1- $\mu$ F ceramic output capacitor. With a reasonable PCB layout, the single 1- $\mu$ F ceramic output capacitor can be placed up to 10 cm away from the HM1157 series device.

### 2. Functional Block Diagram





## ■ Feature Description

### 1. Enable (EN)

The HM1157 series EN pin is internally held low by a 1-M $\Omega$  resistor to GND. The EN pin voltage must be higher than the  $V_{ENH}$  threshold to ensure that the device is fully enabled under all operating conditions. The EN pin voltage must be lower than the  $V_{ENL}$  threshold to ensure that the device is fully disabled and the automatic output discharge is activated.

### 2. Low Output Noise

Any internal noise at the HM1157 series reference voltage is reduced by a first order low-pass RC filter before it is passed to the output buffer stage. The low-pass RC filter has a -3 dB cut-off frequency of approximately 0.1 Hz.

### 3. Output Automatic Discharge

The HM1157 series output employs an internal 240- $\Omega$  (typical) pulldown resistance to discharge the output when the EN pin is low, and the device is disabled

### 4. Remote Output Capacitor Placement

The HM1157 series requires at least a 1- $\mu$ F capacitor at the OUT pin, but there are no strict requirements about the location of the capacitor in regards the OUT pin. In practical designs, the output capacitor may be located up to 10 cm away from the LDO.

### 5. Over Temperature Protection (OTP)

Over temperature protection disables the output when the junction temperature rises to approximately 160°C which allows the device to cool. When the junction temperature cools to approximately 135°C, the output circuitry enables. Based on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This thermal cycling limits the dissipation of the regulator and protects it from damage as a result of overheating.

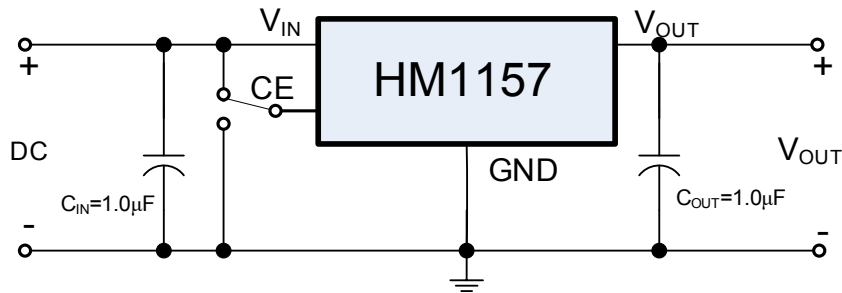
The over temperature protection circuitry of the HM1157 series has been designed to protect against temporary thermal overload conditions. The OTP circuitry was not intended to replace proper heat-sinking. Continuously running the HM1157 series device into thermal shutdown may degrade device reliability.

## ■ Application and Implementation

The HM1157 series is designed to meet the requirements of RF and analog circuits, by providing low noise, high PSRR, low quiescent current, and low line or load transient response figures. The device offers excellent noise performance without the need for a noise bypass capacitor and is stable with input and output capacitors with a value of 1  $\mu$ F. The HM1157 series delivers this performance in industry standard packages such as SOT23-5, for this device, are specified with an operating junction temperature ( $T_J$ ) of  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .

### 1. Typical Application

As the figure shows the typical application circuit for the HM1157 series. Input and output capacitances may need to be increased above the 1  $\mu$ F minimum for some applications.



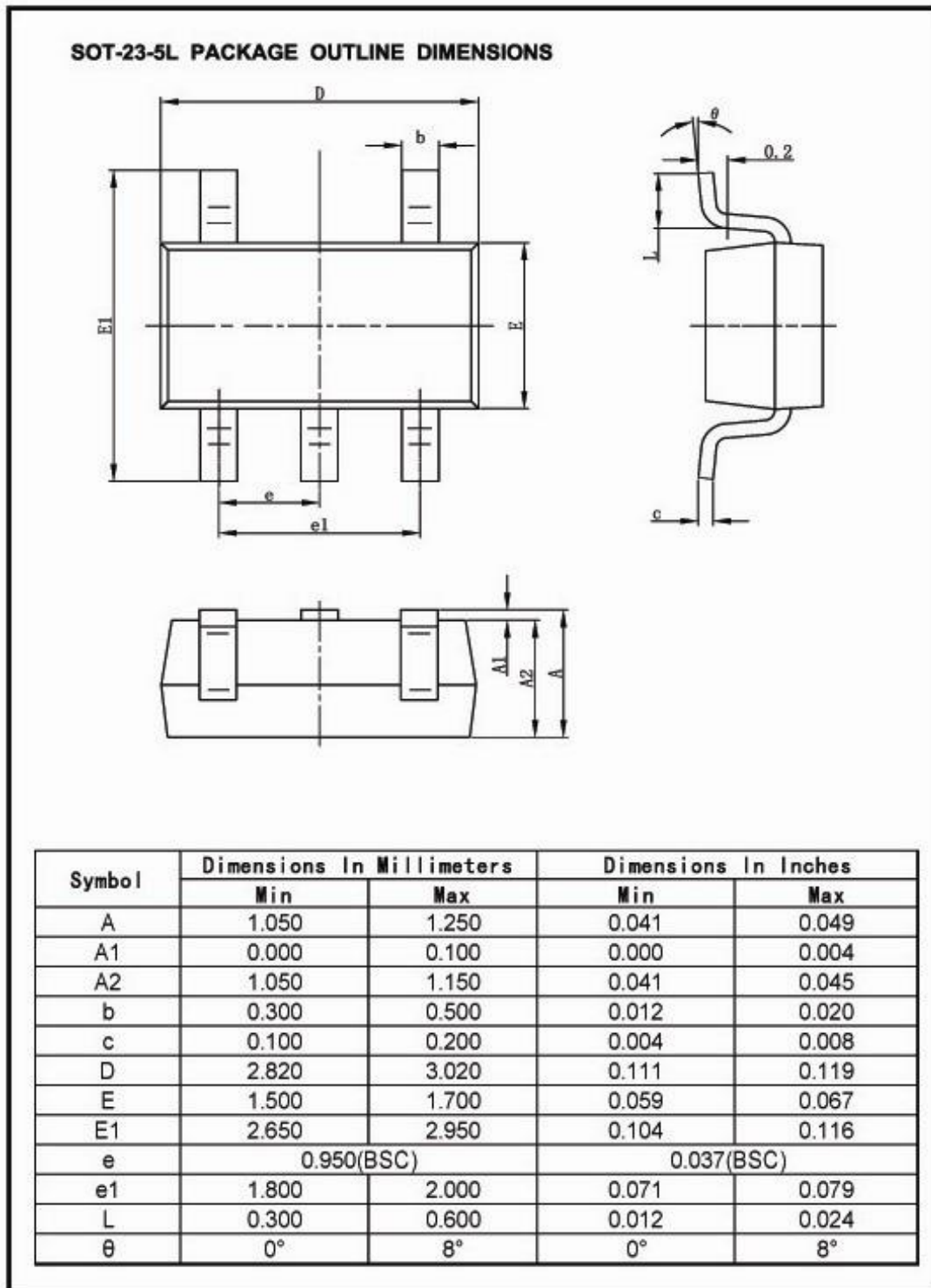
### 2. Design Requirements

DESIGN PARAMETER	EXAMPLE VALUE
Input voltage range	2.2 V to 5.5 V
Output voltage	1.8 V
Output current	300 mA
Output capacitor range	1 $\mu$ F to 10 $\mu$ F
Input/Output capacitor ESR range	5 to 500 m $\Omega$

#### Notes:

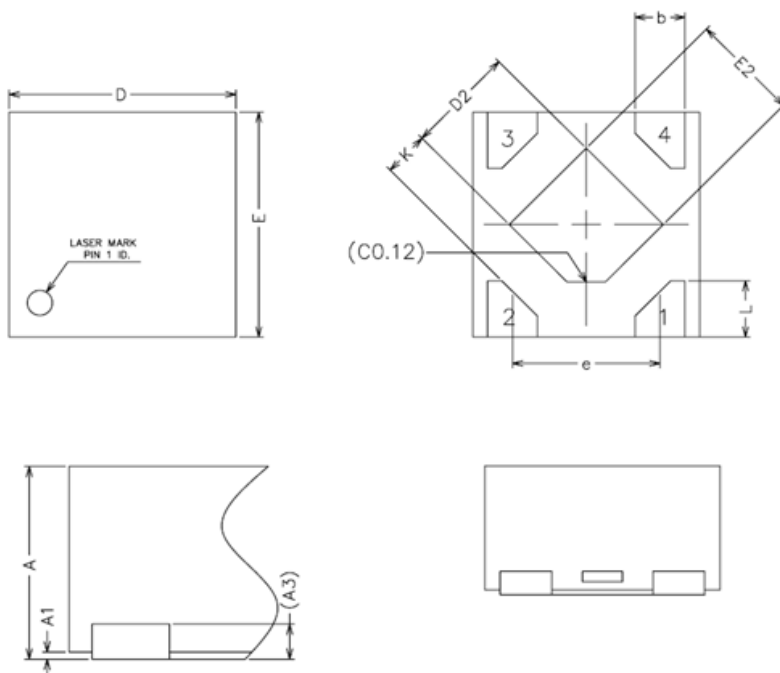
1. If the impedance of the power supply is high, which is caused by forgetting installing input capacitor or installing too small value capacitor, the oscillation may occur.
2. Pay attention to the operation conditions of input and output voltage and load current, such that the power consumption in the IC should not exceed the allowable power consumption of the package even though the chip has short circuit protection.
3. IC has a built-in anti-static protection (ESD) circuit, but please do not add excessive stress to the IC.

■ Packaging Information



■ Packaging Information (Continued)

DFN(1\*1)-4L PACKAGE OUTLINE DIMENSIONS



COMMON DIMENSIONS  
 (UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
A3	0.100REF		
b	0.17	0.22	0.27
D	0.95	1.00	1.05
E	0.95	1.00	1.05
D2	0.43	0.48	0.53
E2	0.43	0.48	0.53
L	0.20	0.25	0.30
e	0.60	0.65	0.70
K	0.15	—	—