HE2208 Series
2μA IQ,0.5A Low Power LDO

Features

- Low voltage drop: 0.06V@100mA
- Input Voltage Range: 1.2V~6.5V
- Adjustable Output Voltage Available by Specific Application (1.2V~3.3V)
- Large Output Current: >0.5A
- Low Quiescent Current: 2.0uA
- Output voltage accuracy: tolerance ±2%
- Over-Temperature Protection
- Packages:SOT23-5
- PSRR=75dB@1KHz

Applications

- Battery-powered equipment
- Hand-Hold Equipment
- GRS Receivers
- Wireless LAN

General Description

The HE2208 series are highly precise, low noise, positive voltage LDO regulators manufactured using CMOS processes,The series achieves high ripple rejection and low dropout. the benefits of wide input voltage range from 1.2V to 6.5V,Adjustable Output Voltage Available by Specific Application within a range of 1.2V ~ 3.3V. The series is also compatible with low ESR ceramic capacitors which give added output stability.It provides up to 500mA of output current in miniaturized packaging.

Quiescent current of only 2μA makes these devices ideal for powering the battery-powered, always-on systems that require very little idle-state power dissipation to a longer service life. There is an option of shutdown mode by selecting the parts with the EN pin and pulling it low,The shutdown current in this mode goes down to only 0.1uA (typical). The other features include current limit function,Integrated Short-Circuit Protection,over temperature protection.

Selection Table

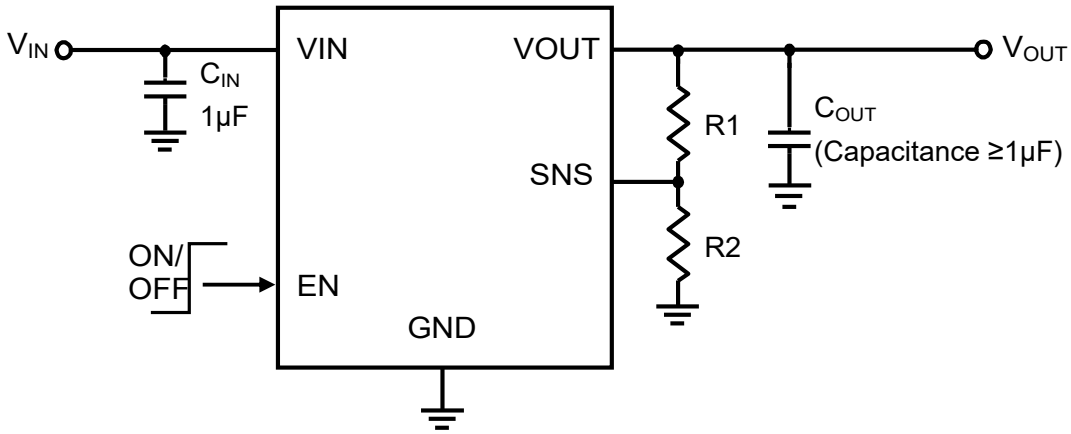
Part No.	Output Voltage	Package	Marking
HE2208	ADJ	SOT23-5	

Order Information

HE2208①②③④⑤

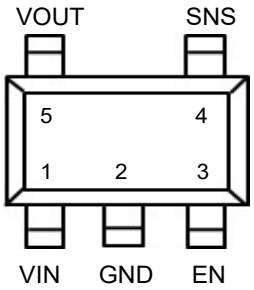
Designator	Symbol	Description
①	A	Standard
②	G	Output Voltage(ADJ)
③④	M5	Package:SOT23-5
⑤	R	RoHS / Pb Free
	G	Halogen Free

Application Circuits



Pin Assignment

SOT23-5



Pin No. SOT23-5	Pin Name	Pin Function
1	VIN	Supply voltage input.
2	GND	Ground.
3	EN	Chip Enable Control Input
4	SNS	Sense of Output Voltage
5	VOUT	Voltage Output.

Absolute Maximum Ratings

Supply Voltage .....2.0V to 9V

Storage Temperature .....-40℃ to 125℃

Operating Temperature .....-40℃ to 85℃

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

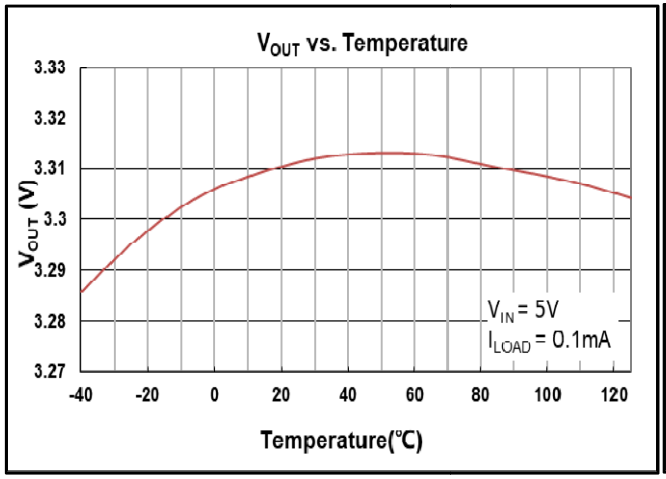
Electrical Characteristics

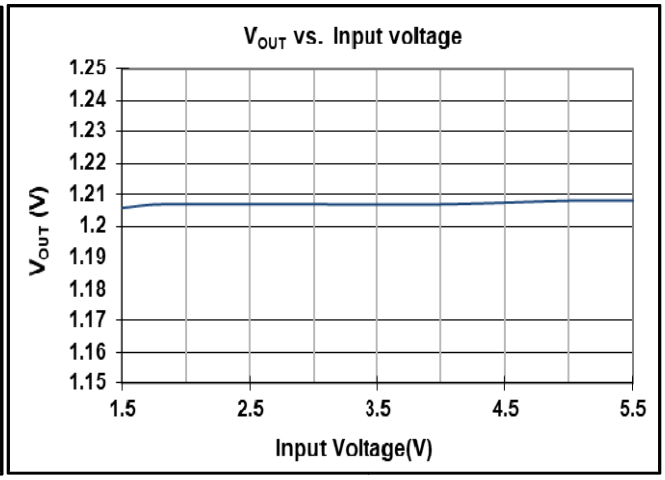
(TestConditions:VIN= VEN=5V ,CIN=1uF, COUT=1uF,TA=25℃, unless otherwise specified.)

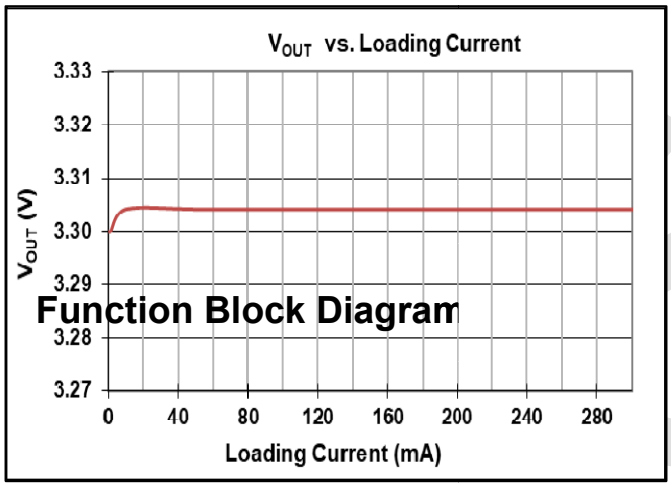
Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage	VIN		1.5	—	6.5	V
Ground Current	IQ	ILOAD=0mA	—	2	—	uA
Shutdown Ground Current	ISD	VEN = 0V, VOUT = 0V	—	0.01	—	uA
VOUT Shutdown Leakage Current	ILEAK		—	0.01	—	uA
SNS Input Current	ISNS	SNS = VOUT	—	0.7	—	uA
DC Output Voltage Accuracy	VSNS	ILOAD =0.1mA	1.176	1.20	1.244	V
Current Limit	ILIMIT			550	—	mA
Dropout Voltage	VOUT=3.3V	IOUT=100mA	—	130	—	mV
	VOUT=2.5V	IOUT=100mA	—	350	—	
	VOUT=1.5V	IOUT=100mA	—	550	—	
	VOUT=0.9V	IOUT=100mA	—	700	—	
Line Regulation	ΔLINE	ILOAD=30mA 1.5V≦VIN≦5.5V or (VOUT+0.2V)≦VIN≦5.5V	—	0.2	—	%/V
Load Regulation	ΔLOAD	10mA≦LOAD≦300mA	—	0.2	—	%/V
Power Supply Rejection Rate LOAD=5mA	PSRR	VIN=3.0V, VOUT=0.8V, f=1KHz	—	75	—	dB
		VIN=3.0V, VOUT=0.8V, f=100KHz	—	80	—	dB
EN Threshold Voltage	VIL	EN Falling	0.6	—	—	V
	VIH	EN Rising	—	—	2.0	V
EN Input Current	IEN	VEN = 5V	—	10	100	nA
Output Voltage Noise BW = 100Hz~10kHz	eNO	VIN=3.5V,ILOAD=100mA, Vout=0.8V	—	40	—	uVRMS
Output Voltage Temperature Coefficient	ΔVOUT/ ΔT•VOUT	IOUT=30mA	—	±100	—	ppm/℃
Thermal Shutdown Temperature	TSD	ILOAD=10mA	—	160	—	℃
Thermal Shutdown Hysteresis	ΔTSD		—	20	—	℃
Discharge Resistance		EN = 0V , VOUT = 0.1V	—	100	—	Ω

Note：(1) Dropout Voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value.

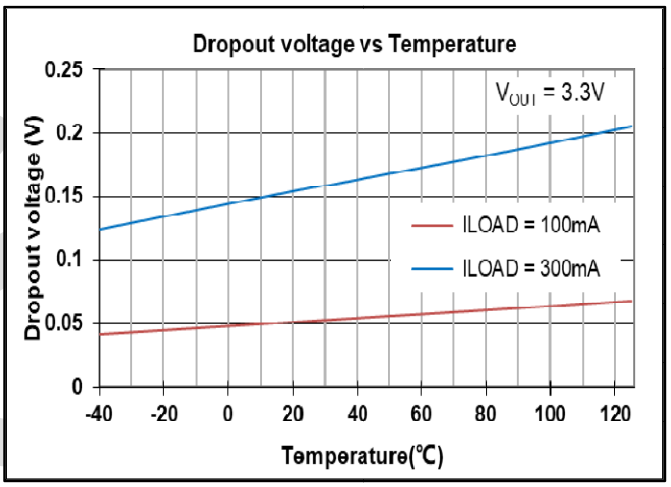
Typical Performance Characteristics

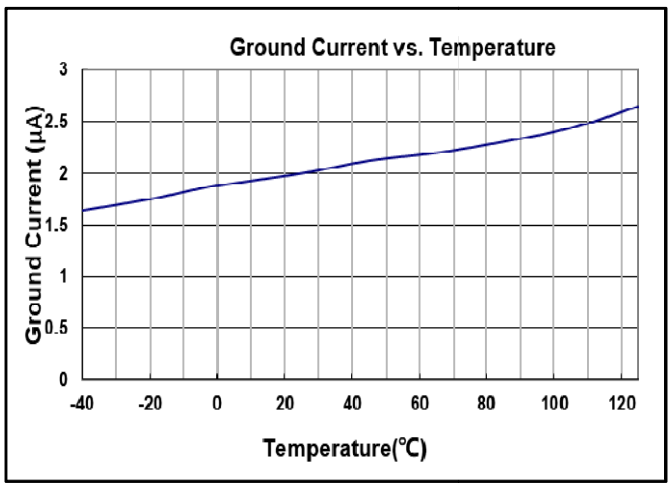


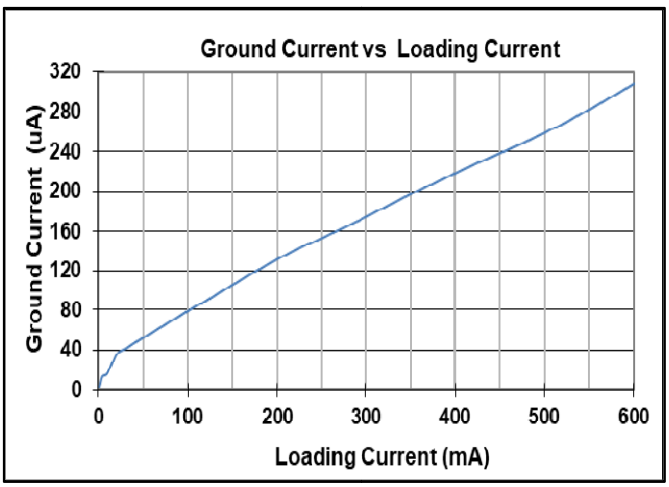


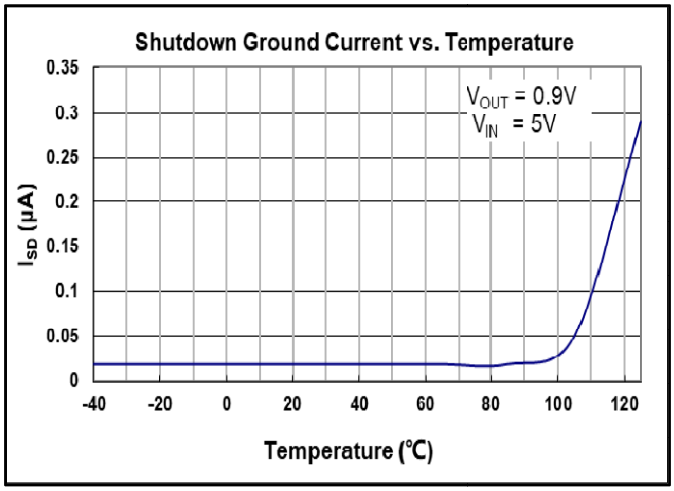


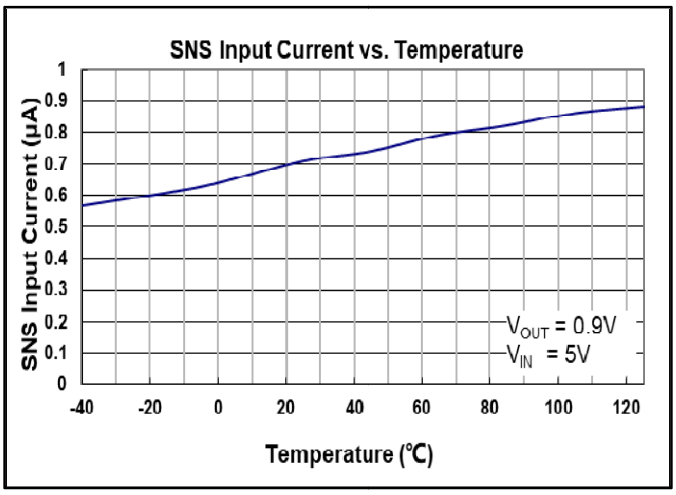
Function Block Diagram

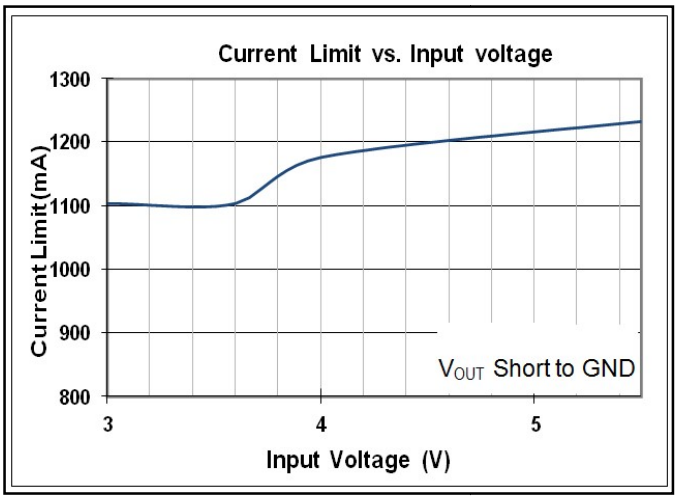


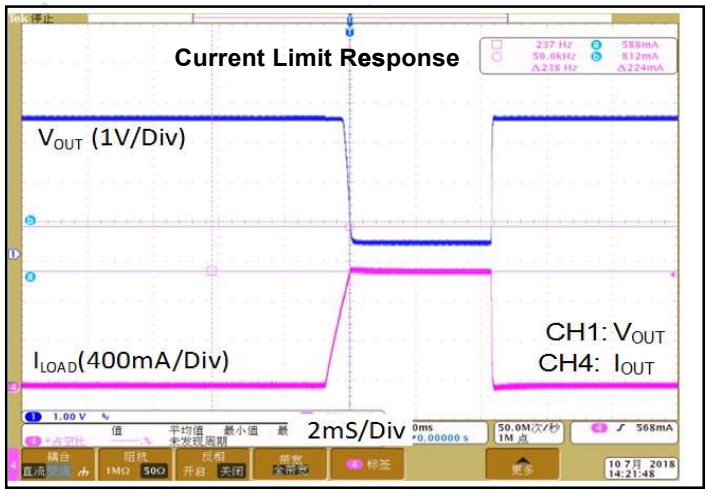


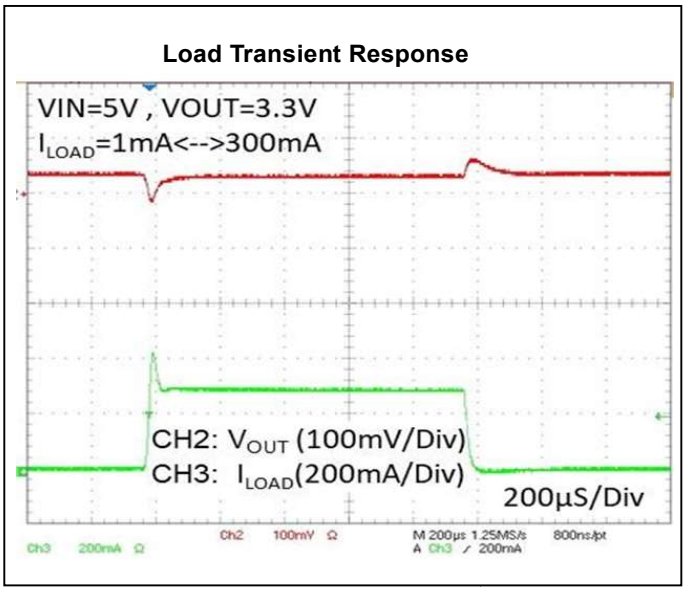


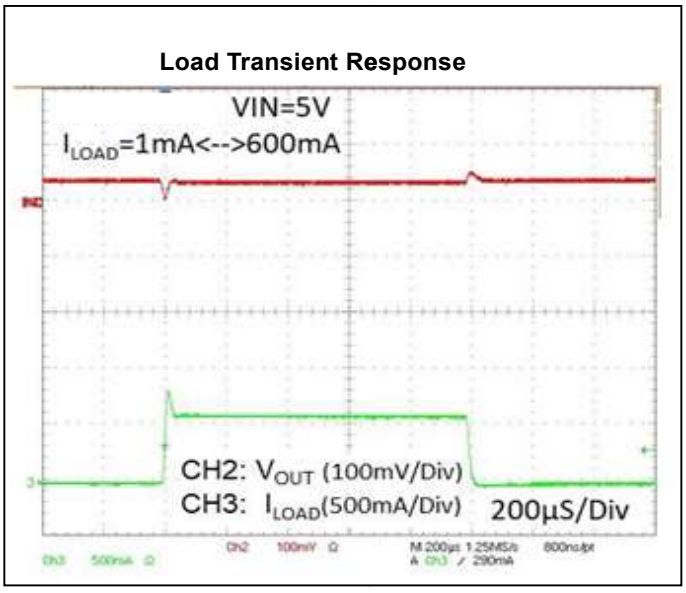

Shutdown Ground Current vs. Temperature
V_{OUT} = 0.9V
V_{IN} = 5V
I_{SD} (μA)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-40 -20 0 20 40 60 80 100 120
Temperature (℃)


SNS Input Current vs. Temperature
SNS Input Current (μA)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
V_{OUT} = 0.9V
V_{IN} = 5V
-40 -20 0 20 40 60 80 100 120
Temperature (℃)

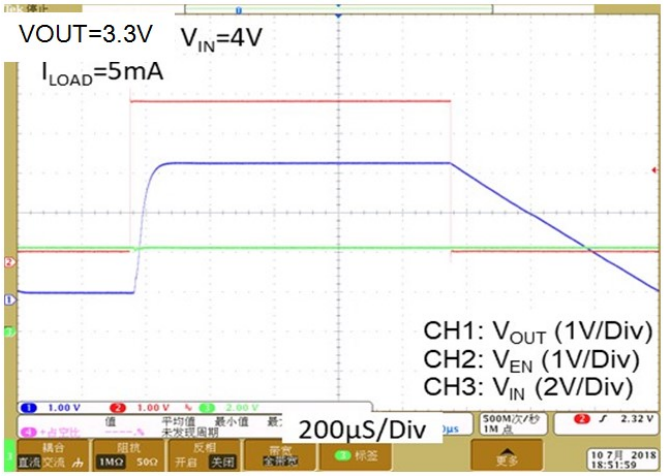

Current Limit vs. Input voltage
Current Limit (mA)
1300
1200
1100
1000
900
800
V_{OUT} Short to GND
3 4 5
Input Voltage (V)


Current Limit Response
V_{OUT} (1V/Div)
I_{LOAD}(400mA/Div)
CH1: V_{OUT}
CH4: I_{OUT}
2mS/Div

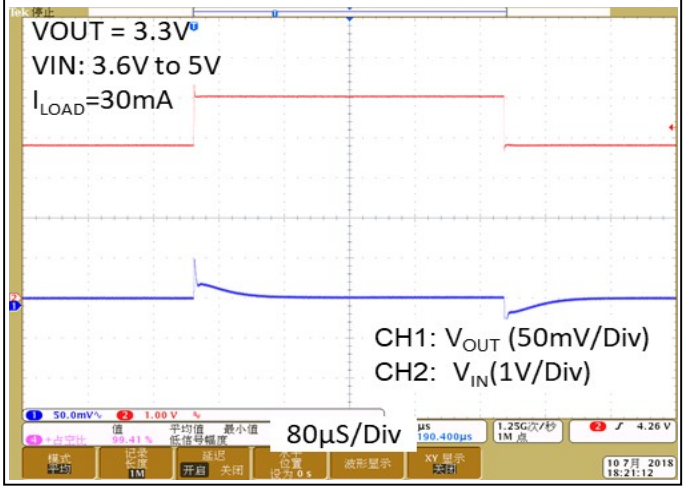

Load Transient Response
VIN=5V , VOUT=3.3V
I_{LOAD}=1mA<-->300mA
CH2: V_{OUT} (100mV/Div)
CH3: I_{LOAD}(200mA/Div)
200μS/Div


Load Transient Response
VIN=5V
I_{LOAD}=1mA<-->600mA
CH2: V_{OUT} (100mV/Div)
CH3: I_{LOAD}(500mA/Div)
200μS/Div

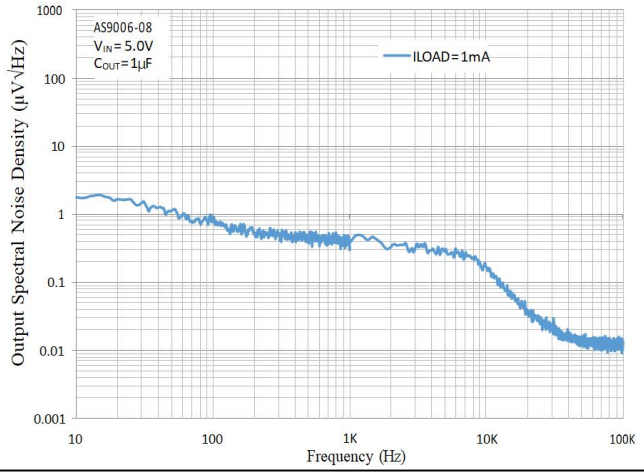
VOUT Turn ON/OFF by EN



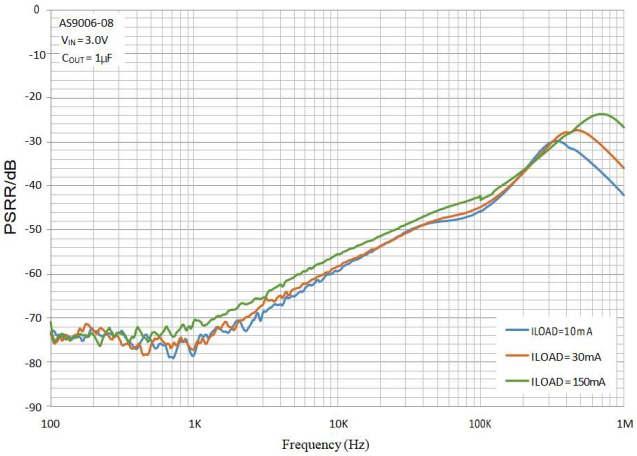
line Transient Response



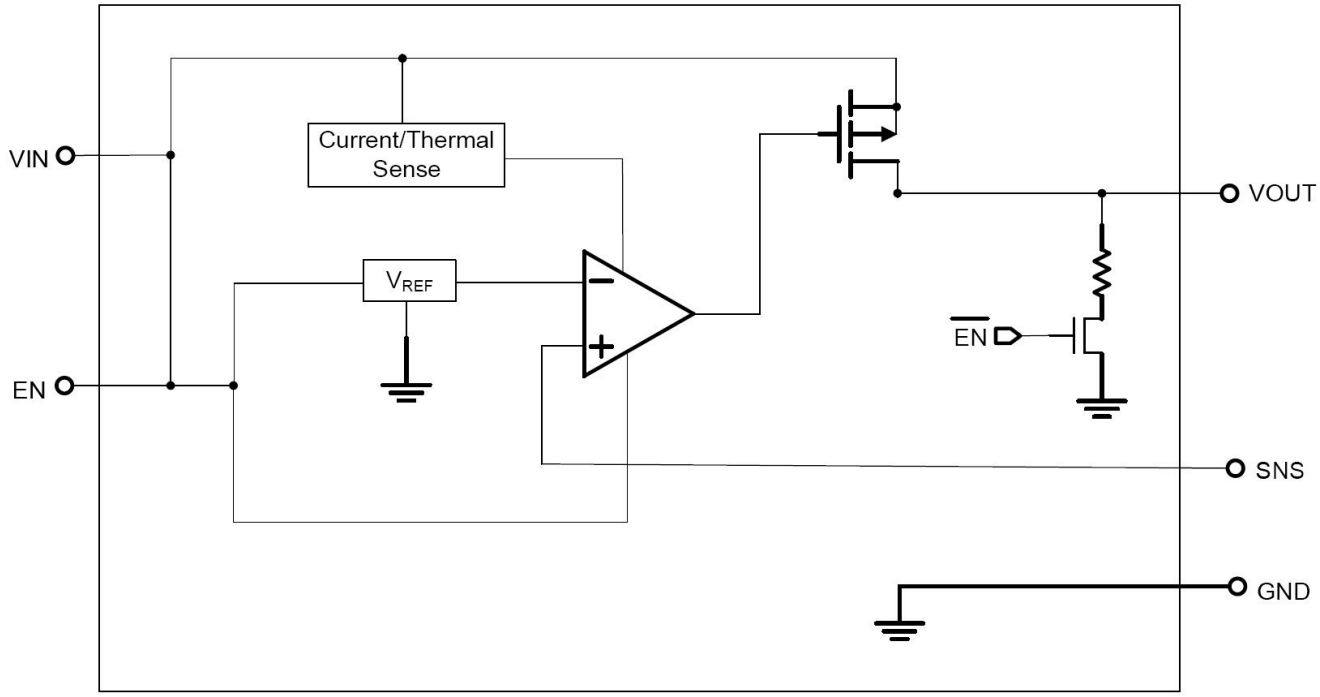
Noise Density Spectrum



PSRR vs. Frequency



Function Block Diagram



Application Guideline

Input and Output Capacitor Requirements

The external input and output capacitors of HE2208 series must be properly selected for stability and performance. Use a 1μF or larger input capacitor and place it close to the IC's VIN and GND pins. Any output capacitor meeting the minimum 1mΩ ESR (Equivalent Series Resistance) and effective capacitance between 1μF and 22μF requirement may be used. Place the output capacitor close to the IC's VOUT and GND pins. Increasing capacitance and decreasing ESR can improve the circuit's PSRR and line transient response.

Current Limit

The HE2208 series contain the current limiter of output power transistor, which monitors and controls the transistor, limiting the output current to 1100mA (typical).

The output can be shorted to ground indefinitely without damaging the part.

Dropout Voltage

The HE2208 series use a PMOS pass transistor to achieve low dropout. When (VIN – VOUT) is less than the dropout voltage (VDROP), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the RDS(ON) of the PMOS pass element. VDROP scales approximately with the output current because the PMOS device behaves as a resistor in dropout condition.

As any linear regulator,PSRR and transient response are degraded as(VIN – VOUT)approaches dropout condition.

Adjustable Output Voltage Application

The HE2208 by SNS pin also can work as an adjustable output voltage LDO. Figure 1 gives the connections for the adjustable output voltage application. The resistor divider from VOUT to SNS sets the output voltage when in regulation.

The voltage on the SNS pin sets the output voltage and is determined by the values of R1 and R2. To keep a good temperature coefficient of output voltage, the values of R1 and R2 should be selected carefully to ignore the temperature effect of input current at the SNS pin. A current greater than 50μA in the resistor divider is recommended to meet the above requirement. The adjustable output voltage can be calculated using the formula given in equation:

$$V_{OUT} = \frac{R1+R2}{R2} \times V_{SNS} \qquad (V_{SNS}=1.2V)$$

Where VSNS is determined by the output voltage selections in the ordering information of HE2208

The minimum recommended 50μA in the resistor divider makes the application no longer a 2μA low quiescent LDO.

OTP (Over Temperature Protection)

The over temperature protection function of HE2208 series will turn off the P-MOSFET when the junction temperature exceeds 155°C (typ.). Once the junction temperature cools down by approximately 15°C, the regulator will automatically resume operation.

Thermal Application

For continuous operation, do not exceed the absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated as below:TA=25°C, DS-Tech PCB,

The max PD (Max) = (125°C − 25°C) / (200°C/W) =0.5W for SOT-23-5 package.

Power dissipation (PD) is equal to the product of the output current and the voltage drop across the output pass element, as shown in the equation below:

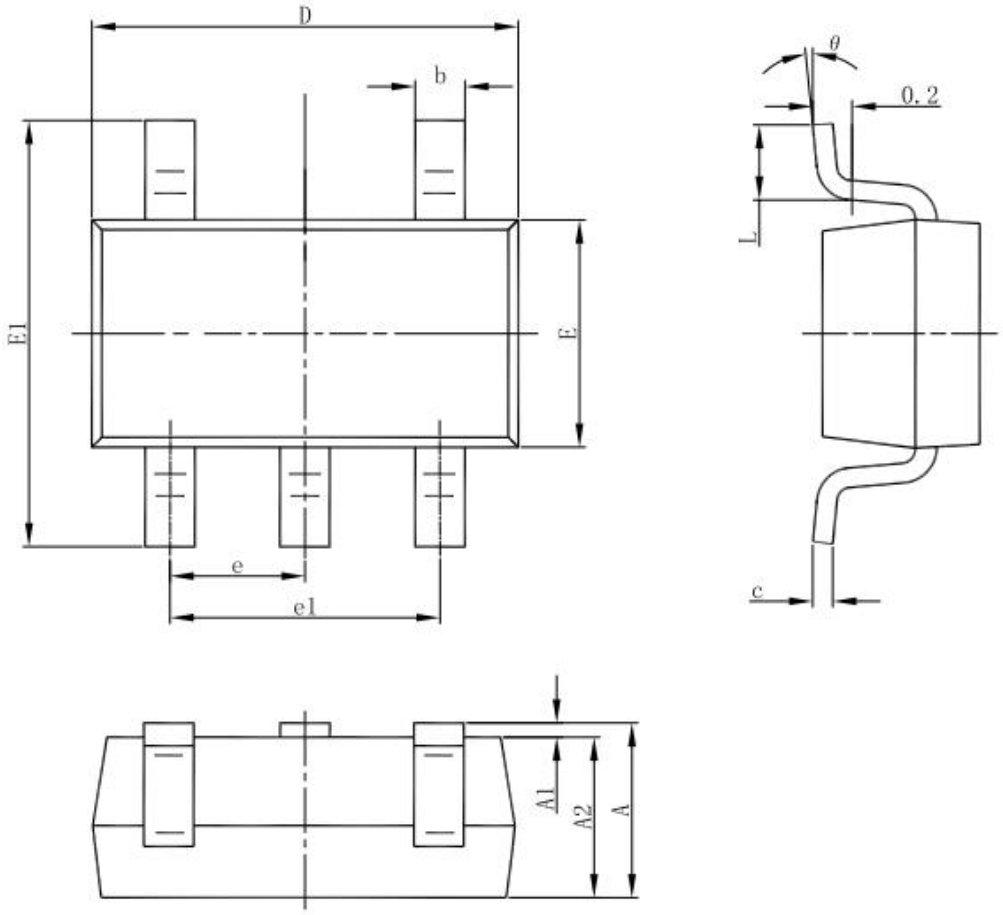
PD = (VIN – VOUT) × IOUT

Layout Consideration

By placing input and output capacitors on the same side of the PCB as the LDO, and placing them as close as is practical to the package can achieve the best performance. The ground connections for input and output capacitors must be back to the HE2208 ground pin using as wide and as short of a copper trace as is practical.Connections using long trace lengths, narrow trace widths, and/or connections through via must be avoided. These add parasitic inductances and resistance that results in worse performance especially during transient conditions

Packaging Information

SOT23-5 Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°