Features

- High input voltage (up to 50V)
- Low Power Consumption: 2μA (Typ)
- Maximum Output Current: 400mA
- Voltage drop:350mV@100mA(3.3V)
- Good Transient Response
- Output voltage accuracy: tolerance ±2%
- SOT89-3，SOT23-3,SOT23-5 and SOT89-5 package
- PSRR:85dB@1KHz

Applications

- Portable, Battery Powered Equipmpm
- Microcontroller Applications
- Smoke detector and sensor
- Audio/Video equipment
- Weighting Scales
- Home Automation

General Description

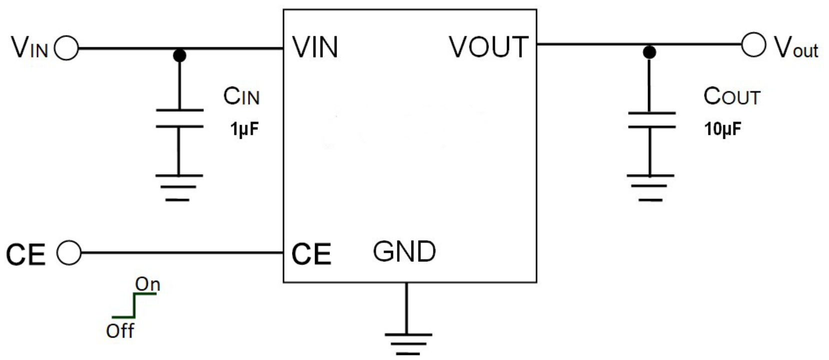
The HE2210 series is a high voltage，ultralow-power，low dropout voltage regulator. The device can deliver 400mA output current with a dropout voltage of 350mV and allows an input voltage as high as 50V. The typical quiescent current is only 2μA. The device is available in fixed output voltages of 2.5,2.8,3.0,3.3,3.6,5.0,6.0,9.0, and 12V.The device features integrated short-circuit and thermal shutdown protection.Although designed primarily as fixed voltage regulators, the device can be used with external components to obtain variable voltages.

Order Information

HE2210①②③④

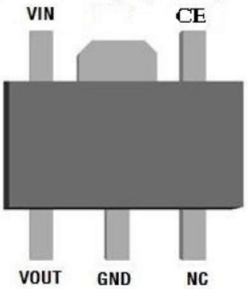
Designator	Symbol	Description
①	P	Package:SOT89-3
	PB	Package:SOT89B-3
	PC	Package:SOT89C-3
	P5	Package:SOT89-5
	M3	Package:SOT23-3
	M5	Package:SOT23-5
②③	Integer	Output Voltage(2.5~12V)
④	R	RoHS / Pb Free
	G	Halogen Free

Application Circuits

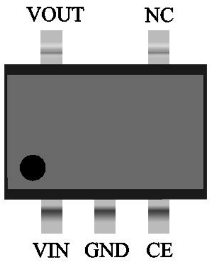


Pin Assignment

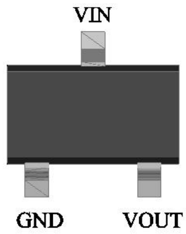
SOT89-5 (Top view)



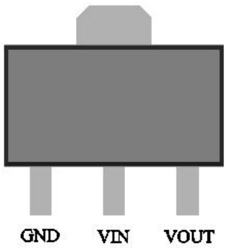
SOT23-5 (Top view)



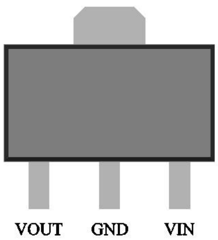
SOT23-3 (Top view)



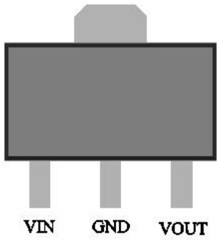
SOT89 (Top view)



SOT89B (TOP view)



SOT89C(TOP view)



Selection Table

Part No.	Output Voltage	Package	Marking
HE2210M530R	3.0V	SOT23-5	
HE2210M533R	3.3V	SOT23-5	
HE2210M550R	5.0V	SOT23-5	
HE2210P533R	3.3V	SOT89-5	
HE2210P550R	5.0V	SOT89-5	
HE2210P30R	3.0V	SOT89-3	
HE2210P33R	3.3V	SOT89-3	
HE2210P50R	5.0V	SOT89-3	
HE2210PB33R	3.3V	SOT89B-3	
HE2210PB50R	5.0V	SOT89B-3	
HE2210PC33R	3.3V	SOT89C-3	
HE2210PC50R	5.0V	SOT89C-3	
HE2210M333R	3.3V	SOT23-3	
HE2210M350R	5.0V	SOT23-3	

Part No.	Output Voltage	Package	Marking
HE2210P60R	6.0V	SOT89-3	
HE2210PB60R	6.0V	SOT89B-3	
HE2210P90R	9.0V	SOT89-3	
HE2210PB90R	9.0V	SOT89B-3	
HE2210PC0R	12V	SOT89-3	
HE2210PBC0R	12V	SOT89B-3	

Absolute Maximum Ratings [1] [2]

Parameter		Symbol	Maximum Rating	Unit
Input Voltage		V_{IN}	V_{SS} -0.3~V_{SS}+50.0	V
		V_{OUT}	~	V
Output Current		I_{OUT}	400	mA
Power Dissipation	SOT23-5,SOT23-3	Pd	400	mW
	SOT89-3,SOT89-5		500	
Thermal Resistance	SOT23-5,SOT23-3	$R_{\theta JA}$ [3]	250	℃/W
	SOT89-3,SOT89-5		200	℃/W
Operating Temperature		Topr	-40~85	℃
Storage Temperature		Tstg	-40~125	℃
Soldering Temperature & Time		Tsolder	260℃, 10s	

Note (1): Exceeding these ratings may damage the device.

Note (2): The device is not guaranteed to function outside of its operating conditions

Note (3): The package thermal impedance is calculated in accordance to JESD 51-7.

ESD Ratings

Item	Description	Value	Unit
$V_{(ESD-HBM)}$	Human Body Model (HBM) ANSI/ESDA/JEDEC JS-001-2014 Classification, Class: 2	±4000	V
$V_{(ESD-CDM)}$	Charged Device Mode (CDM) ANSI/ESDA/JEDEC JS-002-2014 Classification, Class: C0b	±200	V
$I_{LATCH-UP}$	JEDEC STANDARD NO.78E APRIL 2016 Temperature Classification, Class: I	±150	mA

ESD testing is performed according to the respective JESD22 JEDEC standard.The human body model is a 100 pF capacitor discharged through a 1.5kΩ resistor into each pin. The machine model is a 200pF capacitor discharged directly into each pin.

Recommended Operating Conditions

Parameter	MIN.	MAX.	Units
Supply voltage at V_{IN}	---	30	V
Operating junction temperature range, Tj	-40	125	°C
Operating free air temperature range, TA	-40	85	°C

Note : All limits specified at room temperature (TA = 25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

Electrical characteristics

（At T_A=25°C, C_{IN}=1uF, V_{IN}=V_{OUTNOM}+1.0V, C_{OUT}=10μF, unless otherwise noted）

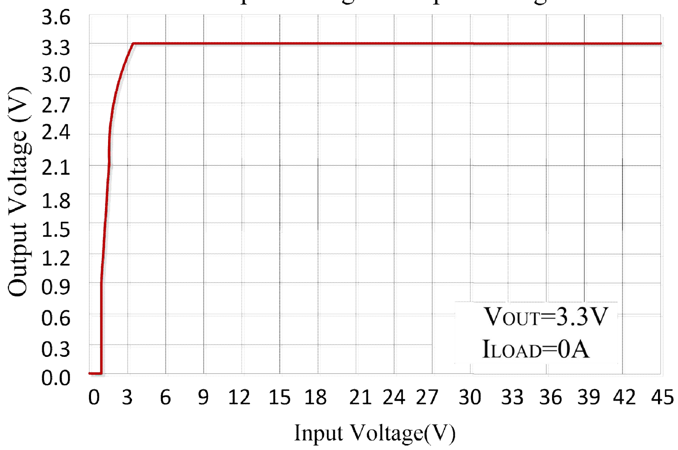
Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
V_{IN}	Input Voltage		3.0	—	50	V
I_Q	Quiescent Current	V_{IN}=12V No load	—	2.0	2.3	μA
V_{OUT}	Output Voltage	V_{IN}=12V I_{OUT} =10mA	-2.0		+2.0	%
I_{SD}	Shutdown Ground Current	V_{IN}=0V	—	—	0.1	μA
I_{LEAK}	V_{OUT} Shutdown Leakage Current	V_{OUT}= 0V	—	—	0.1	μA
I_{OUT_MAX}	Output Current		—	400	—	mA
V_{DROP}	Dropout Voltage(1)	I_{OUT} =10mA V_{IN} = V_{OUTNOM}-0.1V	—	35	—	mV
		I_{OUT} =100mA V_{IN} = V_{OUTNOM}-0.1V	—	350	—	mV
ΔLOAD	Load Regulation	V_{IN}= V_{OUT}+1V 1mA≤I_{OUT}≤100mA	—	40	—	mV
ΔLINE	Line Regulation	I_{OUT}=1mA, V_{OUTNOM}+0.5V≤V_{IN}≤50V	—	0.01	—	%/V
PSRR	Power Supply Rejection Ratio	V_{IN}=12V , I_{OUT} =10mA f=1KHz, V_{OUT}=3.3V	—	85	—	dB
V_{IH}	EN Threshold Voltage,Logic-High	V_{IN}=5.0V, I_{OUT}=1mA	1.0	—	—	V
V_{IL}	EN Threshold Voltage,Logic-Low	V_{IN}=5.0V	—	—	0.4	V
I_{LIMIT}	Current Limit	V_{IN}= V_{OUT}+1V		450	—	mA
I_{SHORT}	Short /Start Load Current	RL=1Ω		100		mA
e_{NO}	Output Noise Voltage	10Hz to 100kHz C_{OUT}=1μF	—	100	—	μV_{RMS}
T_{SD}	Thermal Shutdown Temperature		—	150	—	℃
$ΔT_{SD}$	Thermal Shutdown Hysteresis		—	20	—	℃

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.

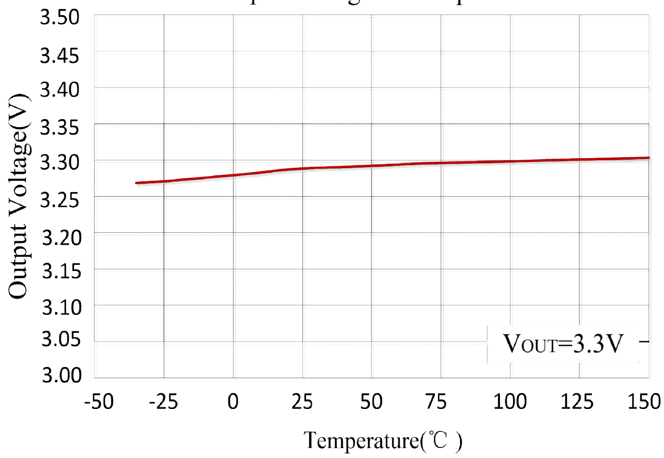
Typical Performance Characteristics:

Test Condition: TA=25°C,Iout=1mA, COUT=10uF, unless otherwise noted

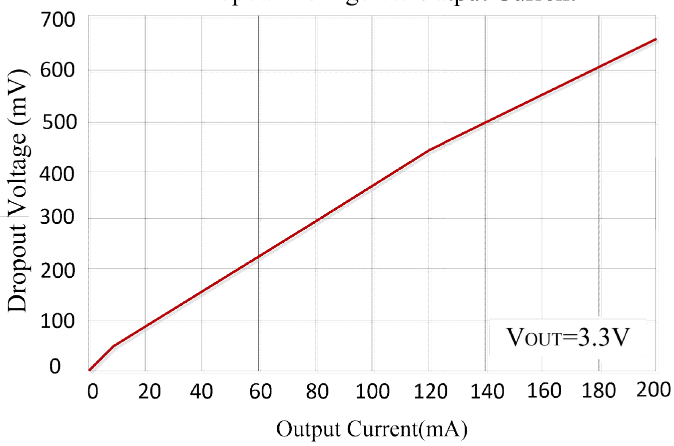
Output Voltage vs. Input Voltage



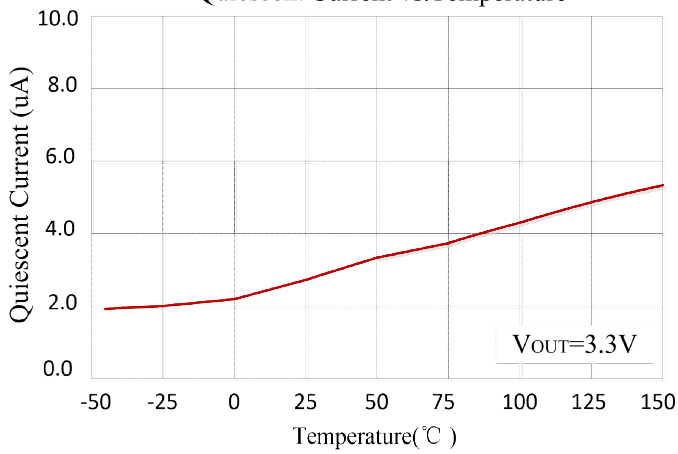
Output Voltage vs.Temperature



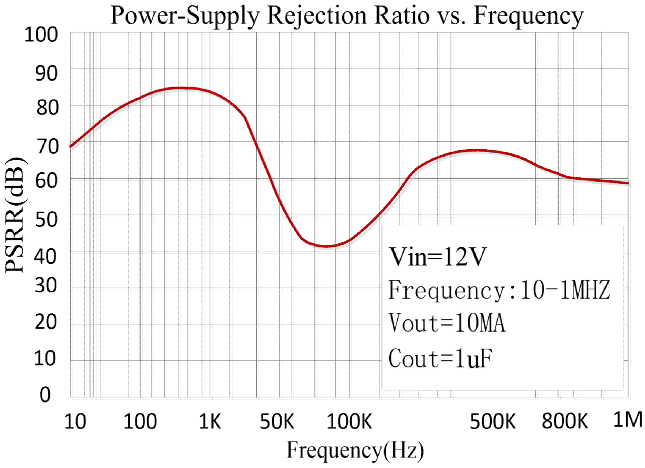
Dropout Voltage vs. Output Current



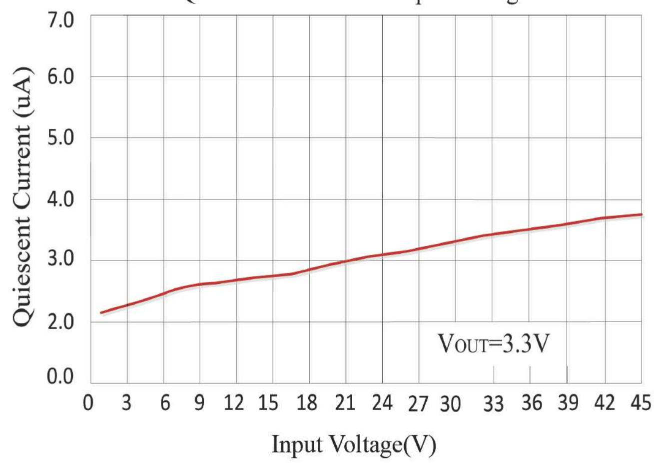
Quiescent Current vs.Temperature



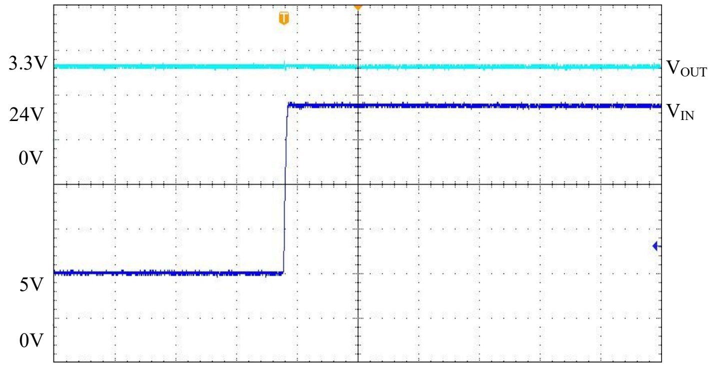
Power-Supply Rejection Ratio vs. Frequency



Quiescent Current vs. Input Voltage

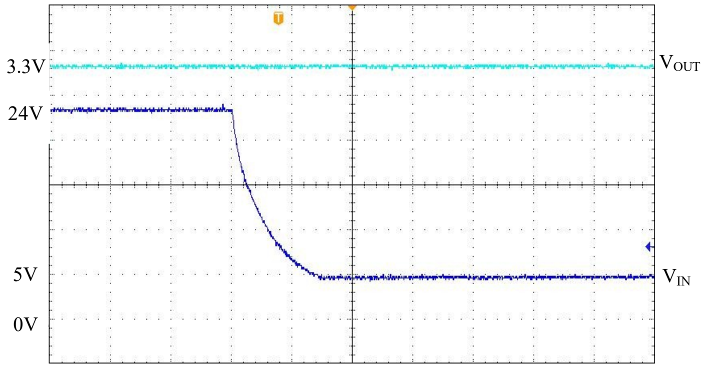


Line Transient Response (V_{IN}=5 to 24V V_{OUT}=3.3V)



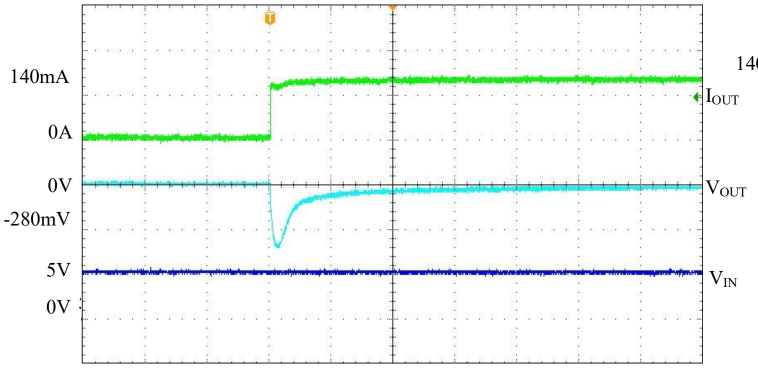
Time(4us/div)

Line Transient Response (V_{IN}=24 to 5V V_{OUT}=3.3V)



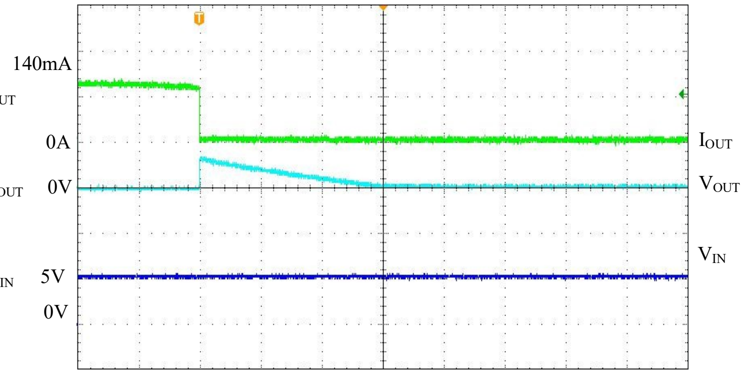
Time(4us/div)

Load Transient Response （V_{IN}=5V V_{OUT}=0V I_{OUT}=140mA）



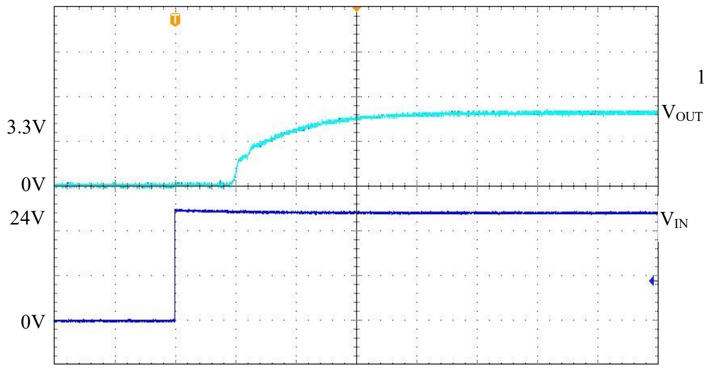
Time(20us/div)

Load Transient Response （V_{IN}=5V V_{OUT}=0V I_{OUT}=140-0mA）



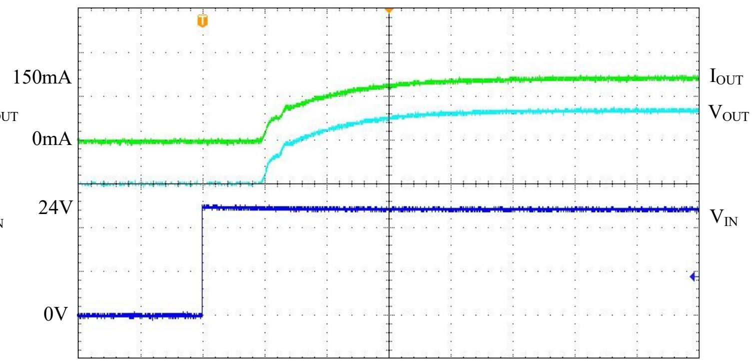
Time(20us/div)

Start Up （V_{IN}=24V V_{OUT}=3.3V）



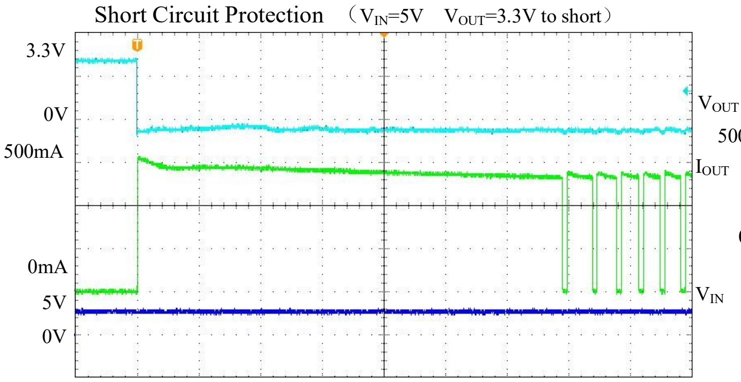
Time(100us/div)

Start Up （V_{IN}=24V V_{OUT}=3.3V I_{OUT}=150mA）



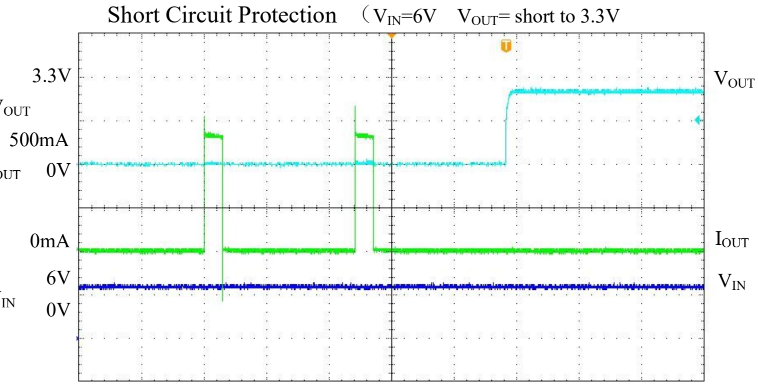
Time(100us/div)

Short Circuit Protection （V_{IN}=5V V_{OUT}=3.3V to short）



Time(20ms/div)

Short Circuit Protection （V_{IN}=6V V_{OUT}= short to 3.3V



Time(20ms/div)

Application Guideline

Input Capacitor

A 10μF ceramic capacitor is recommended to connect between V_{DD} and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both VIN and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is 10μF, ceramic capacitor is recommended, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to VOUT and GND pins.

Dropout Voltage

The dropout voltage refers to the voltage difference between the VIN and VOUT pins while operating at specific output current. The dropout voltage VDROP also can be expressed as the voltage drop on the pass-FET at specific output current (IRATED) while the pass-FET is fully operating at ohmic region and the pass-FET can be characterized asan resistance RDS(ON). Thus the dropout voltage can bedefined as (VDROP = VIN − VOUT = RDS(ON) x IRATED). Fornormal operation, the suggested LDO operating range is (VIN > VOUT + VDROP) for good transient response and PSRR ability. Vice versa, while operating at the ohmic region will degrade the performance severely.

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, PCB,

The max PD= (125°C − 25°C) / (Thermal Resistance °C/W)

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:

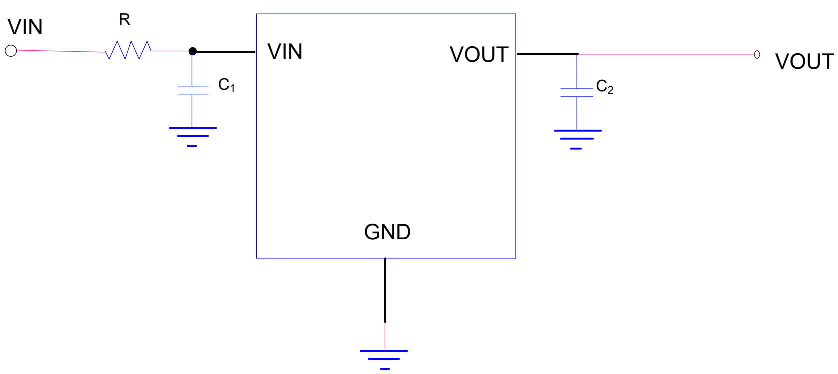
PD = (VIN – VOUT) × IOUT

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 HE2210 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.

IN - RUSH CURRENT AND VOLTAGE

The following figure shows a typical application circuit for the HE2210 devices. Please keep in mind that in-rush current can push up the Vin overshoot by as much as 50%. For example, when Vin=30V, the in-rush caused spike voltage can be as high as 45V. Therefore the voltage rating of Cin needs to be higher than 50% of the application.



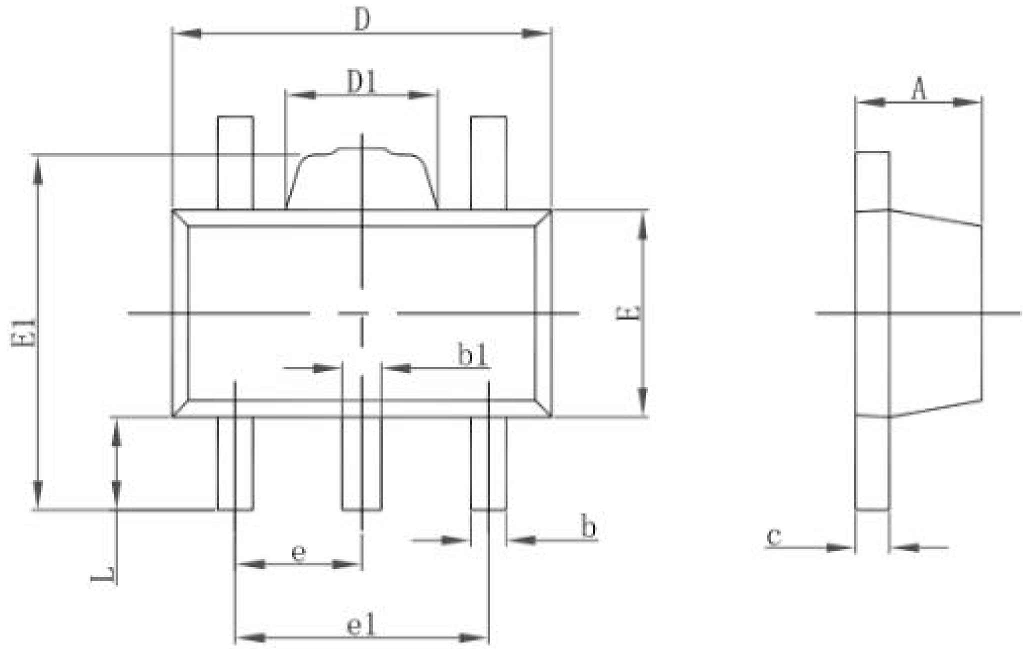
In live insertion application, it is suggested that R, C1 are selected as following:

1.C1=10μF ~ 100μF ceramic or electrolytic capacitor with maximum voltage greater than 50V, R=0

2.If the average current is known, for example a t 10mA, then for an input voltage of 20V, the C1 =1μF ~ 10μF ceramic or electrolytic with maxim um voltage greater than 40V and R=1KΩ in the type of 1206 at 1/4W rating can be selected.

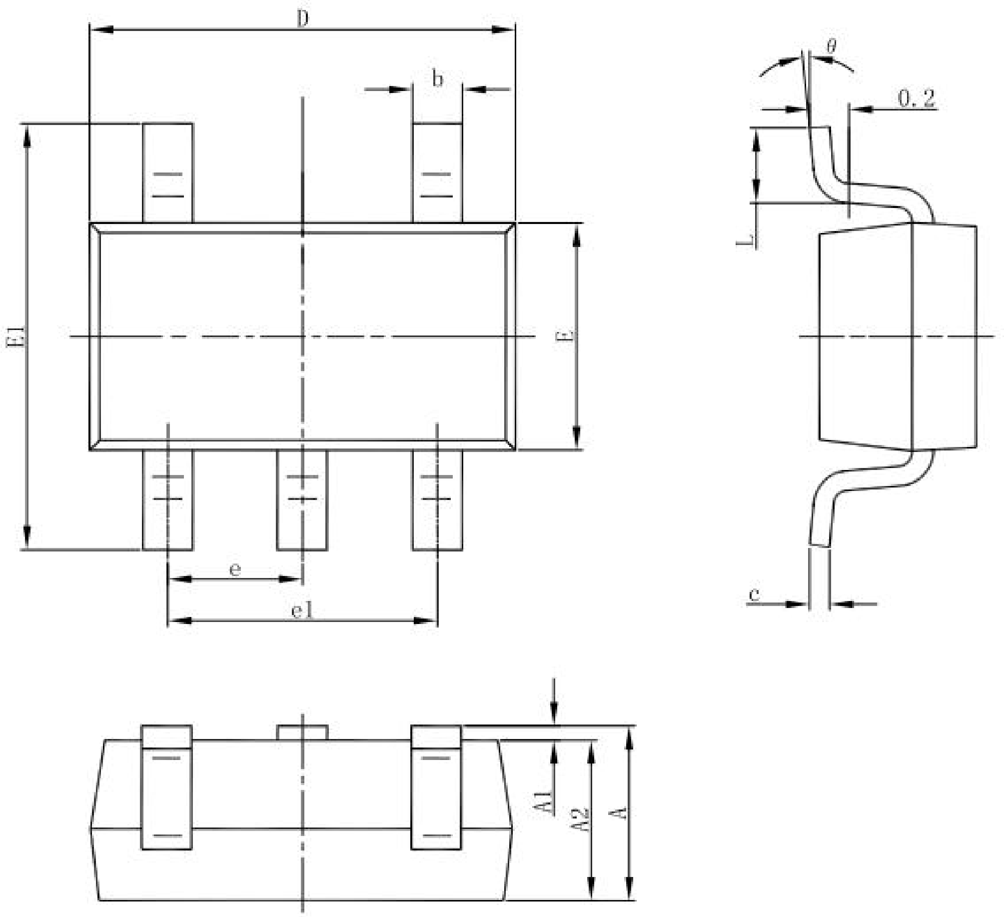
Package Information

SOT89-5 Outline Dimensions



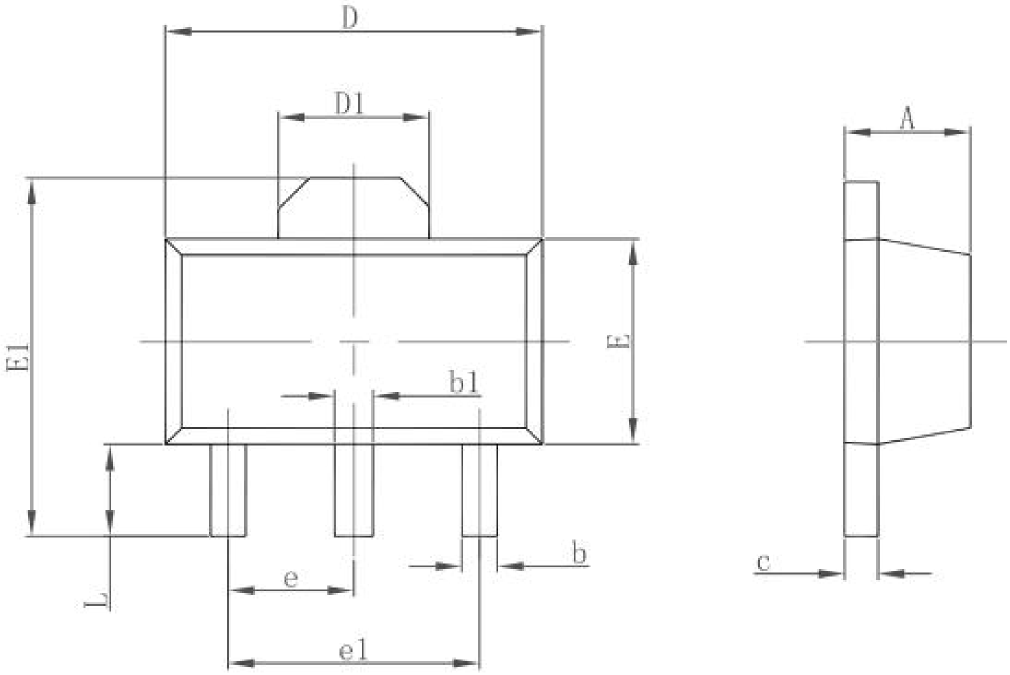
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.360	0.560	0.014	0.022
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.400	1.800	0.055	0.071
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500TYP.		0.060TYP.	
e1	2.900	3.100	0.114	0.122
L	0.900	1.100	0.035	0.043

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°

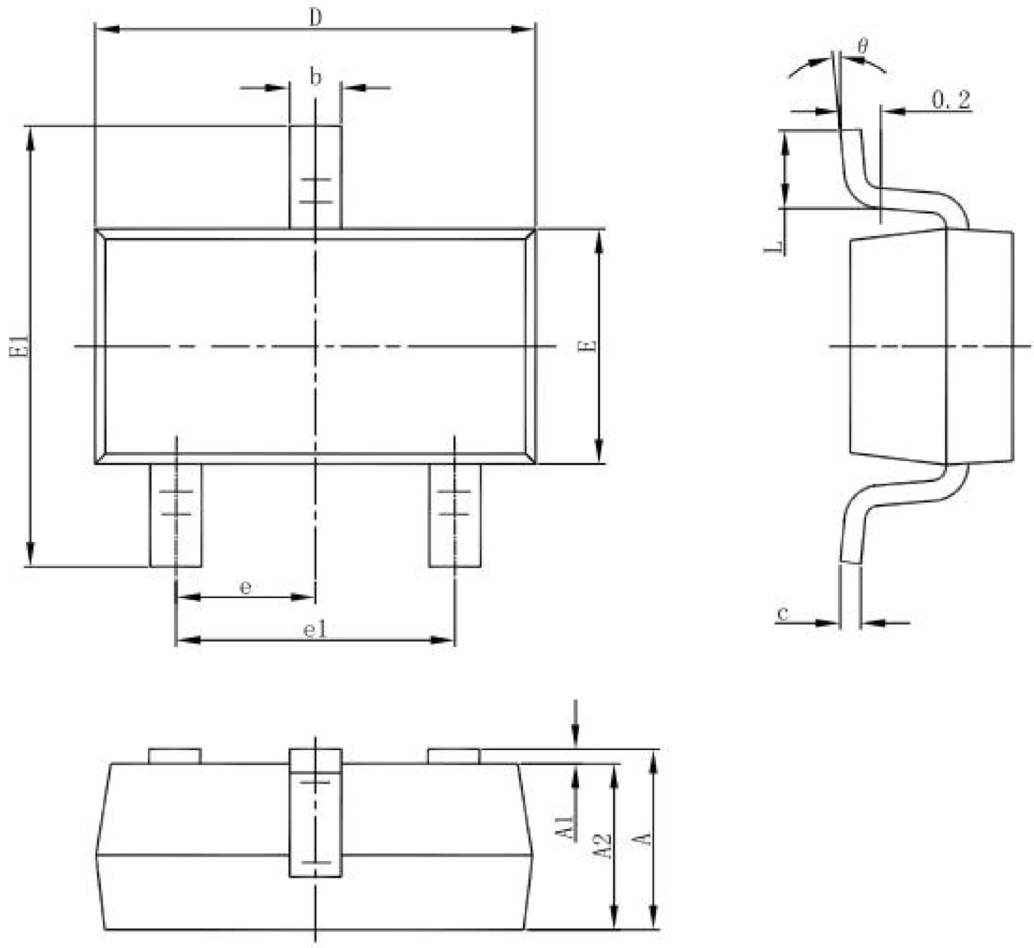
3-pin SOT89 Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF.		0.061 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060 TYP.	
e1	3.000 TYP.		0.118 TYP.	
L	0.900	1.200	0.035	0.047

Package Information

3-pin SOT23-3 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°