Ultra-Low Noise 800mA LDO Regulator

General Description

The iD9307 is an 800mA fixed output voltage, low dropout and low noise linear regulator with high ripple rejection ratio and fast turn-on time.

It includes a reference voltage source, an error amplifier, driver transistors and an internal current limiter. The current limiter's holdback circuit operates as a short protection.

The iD9307 works well with low ESR ceramic capacitors, suitable for portable RF and wireless battery-powered applications with stringent space requirements and demanding performance. It also offers ultra low noise output and has low quiescent current.

Ordering Information

iD9307 - □□ □□□ □

Taping
R: Tape and Reel

Package
A20:SOT-89-3
A21:SOT-89-3
A23:SOT-89-3
A30:SOT-23-3
A50:SOT-23-5
A72:SOT-223-F Type
A74:SOT-223-T Type
S80:SOP-8

Output Voltage	Voltage Code
1.0	10
1.2	12
1.5	15
1.8	18
2.5	25
2.6	26
2.8	28
3.3	33
Adjustable	AD

Features

- Ultra-Low-Noise application
- Wide 2.5V to 7V Operating Range
- Quick Start-Up
- Eight Fixed Voltage Options Available
- Current Limiting Protection
- Thermal Shutdown Protection
- High Ripple Rejection 50dB@1kHz
- Standby Current Less Than 0.1μA
- Auto Discharge

Applications

- Battery-Powered Equipment
- Portable Instruments
- Slim DVDs
- Digital Camera
- WLAN Communication
- Hand-Held Instruments

Marking Information

For marking information, please contact our sales representative directly or through an iDesyn distributor around your location.

Typical Application Circuit

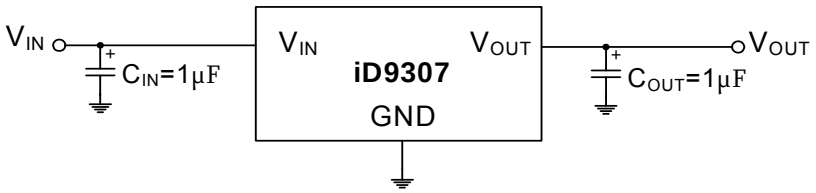
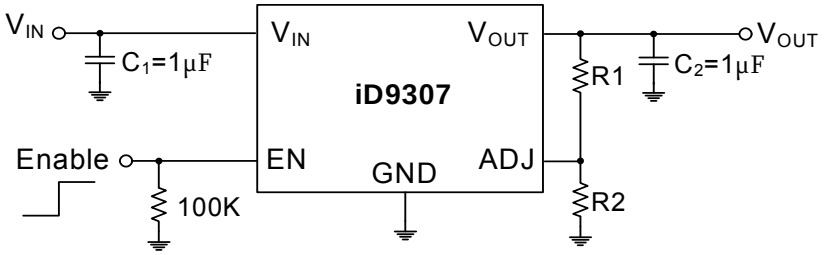


Figure 1. Fixed Voltage Version



$$V_{OUT} = 1.0 \times \left(1 + \frac{R_1}{R_2}\right) \text{Volts}$$

Figure 2. Adjustable Voltage Version

Absolute Maximum Ratings

Supply Voltage V_{IN}	8V
Power Dissipation, P_D @ T_A=25˚C	
SOT-89-3	570mW
SOT-223	1050mW
SOT-23-3 & SOT-23-5	400mW
SOP-8	625mW
Thermal Resistance, θja	
SOT-89-3	175˚C/W
SOT-223	95˚C/W
SOT-23-3 & SOT-23-5	250˚C/W
SOP-8	160˚C/W
Lead Temperature	260 ˚C
Storage Temperature	-65˚C to 150˚C
ESD Susceptibility	
HBM (Human Body Mode)	2kV
MM (Machine Mode)	200V

Recommended Operating Conditions

Input Voltage V_{IN}	2.5V to 7V
EN Input Voltage	0V to 7V
Junction Temperature	-40˚C to 125˚C
Ambient Operating Temperature	-40˚C to 85˚C

Electrical Characteristics (Unless otherwise specified V_{IN}=5V, T_A=25°C)

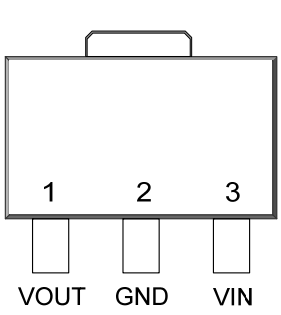
Parameters		Symbol	Condition		Min	Typ	Max	Units
Operating Voltage Range		V_{IN}					7	V
Shutdown Supply Current		I_{SBY}	V_{EN} = GND,Shutdown			0.01	1	μA
Reference Voltage Tolerance		V_{REF}			0.98	1	1.02	V
Supply Current Limit		I_{LIMIT}	R_{LOAD} = 1Ω		800	1000		mA
Quiescent Current		I_Q	V_{EN} ≧ 1.2V, I_{OUT} = 0mA			90	150	μA
Dropout Voltage (Note 3)		V_{DROP}	I_{OUT} = 800mA	V_{OUT} = 1.0V		1400	2000	mV
				V_{OUT} = 1.2V		1100	1800	
				V_{OUT} = 1.5V		850	1500	
				V_{OUT} = 1.8V		650	1200	
				V_{OUT} = 2.5V		450	800	
				V_{OUT} = 2.8V		400	600	
				V_{OUT} = 3.3V		300	500	
Line regulation		ΔV_{LINE}	V_{IN} = (V_{OUT} +1V) to 6V I_{OUT} = 1mA				6	mV/V
Load Regulation		ΔV_{LOAD}	1mA < I_{OUT} < 800mA				55	mV
Fast Discharge N-MOSFET Turn On Resistance		$R_{DISCHARGE}$	V_{IN} = 4V, V_{EN} = 0V			35		Ω
Output Noise Voltage		eNO	10Hz to 100kHz I_{OUT} = 200mA C_{OUT} = 1μF				100	μV_{RMS}
Thermal Shutdown Temperature		T_{SD}				165		°C
Thermal Shutdown Temperature Hysteresis		ΔT_{SD}				30		°C
Output Voltage Accuracy		ΔV_{OUT}	V_{OUT}<1.5V, I_{OUT} =1mA		-2.5		+2.5	%
			V_{OUT}>1.5V, I_{OUT} =1mA		-2		+2	
EN Threshold	Logic-Low V	V_{IL}	V_{IN} = 2.5V to 7V,Shutdown				0.4	V
	Logic-High V	V_{IH}	V_{IN} = 2.5V to 6V,Start-Up		1.6			
Power Supply Rejection Rate	f = 100Hz	PSRR	C_{OUT} = 1μF, I_{OUT} = 10mA			-60		dB
	f = 10kHz					-50		

Note 1: Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

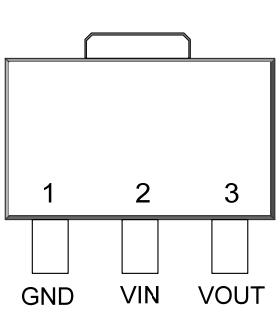
Note 2: $V_{IN(MIN)}$=V_{OUT}+$V_{DROPOUT}$

Note 3: The dropout voltage is defined as (V_{IN}-V_{OUT}) when V_{OUT} is 100mV below the target value of V_{OUT}.

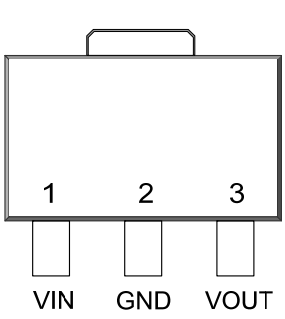
Pin Configurations (Top View)



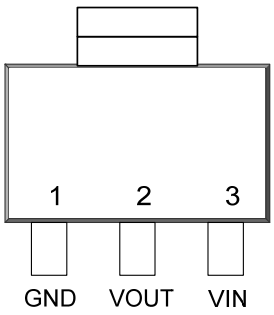
SOT-89-3 (A20)



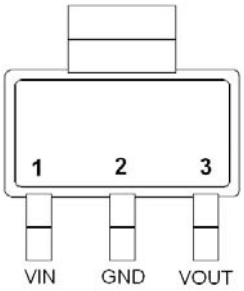
SOT-89-3 (A21)



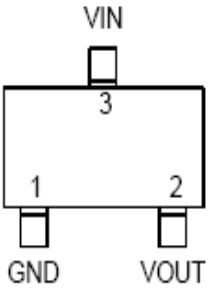
SOT-89-3 (A23)



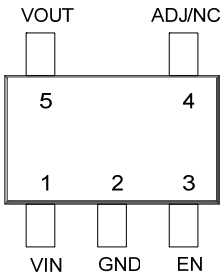
SOT-223 (F Type)



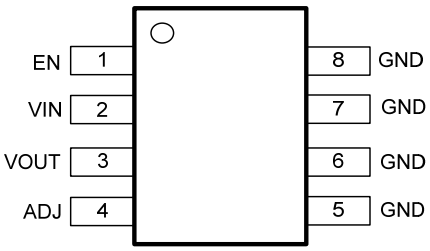
SOT-223 (T Type)



SOT-23-3



SOT-23-5

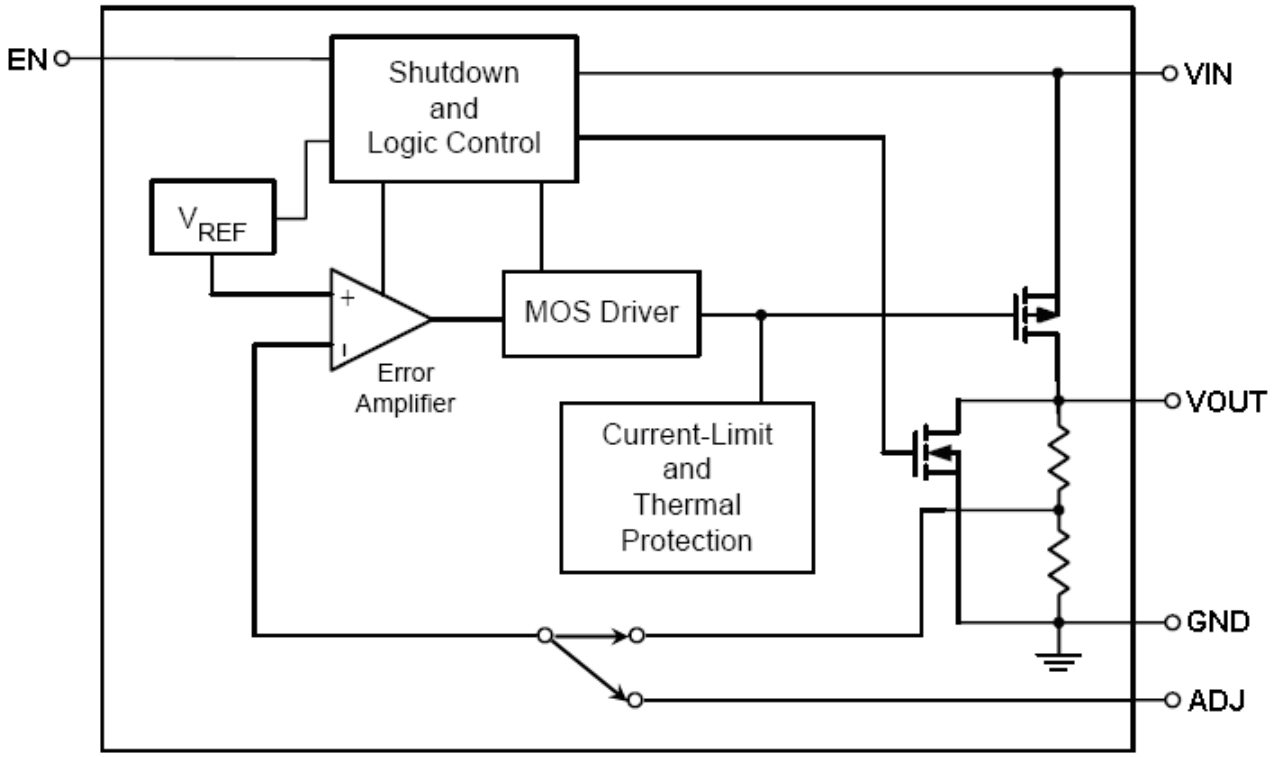


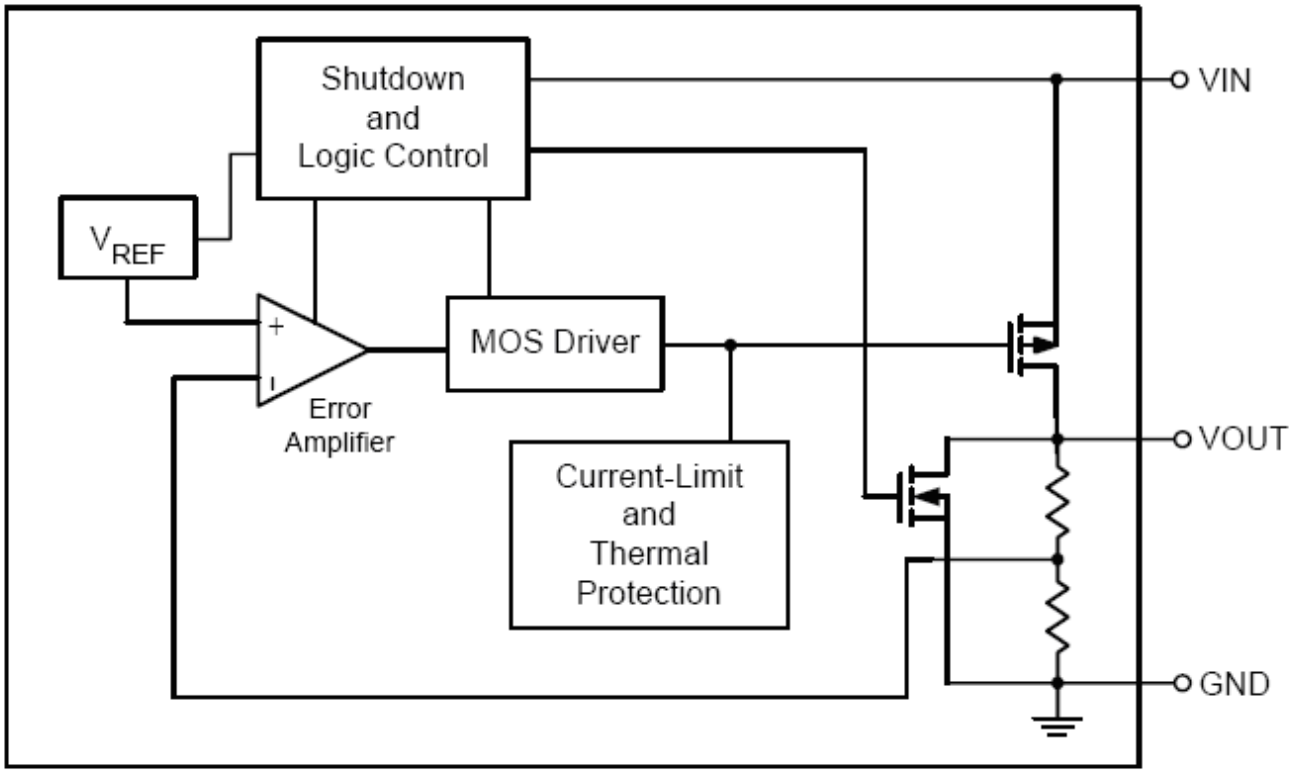
SOP-8

Pin Description

Pin Name	Pin Function
EN	Chip Enable (Active High). Note that this pin is high impedance. There should be a pull low 100kΩ resistor connected to GND when the control signal is floating.
GND	Ground
VOUT	Output Voltage
VIN	Input Voltage
ADJ	Adjust Output Voltage

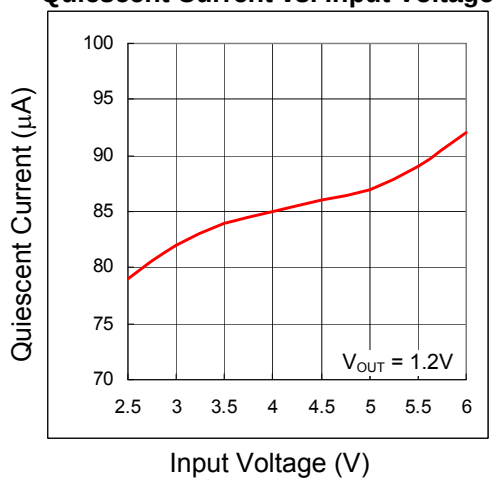
Function Block Diagram



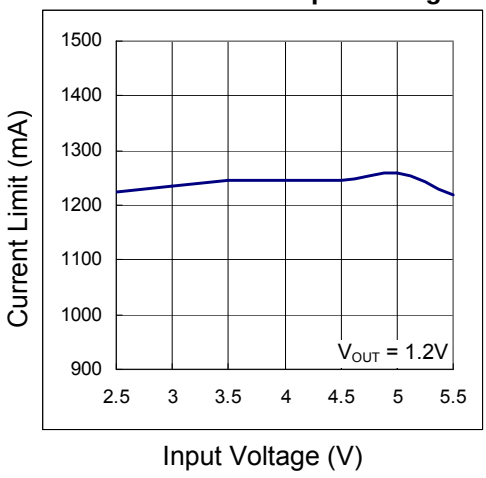

Shutdown
and
Logic Control
VIN
VREF
MOS Driver
Error
Amplifier
VOUT
Current-Limit
and
Thermal
Protection
GND

Typical Operating Characteristics

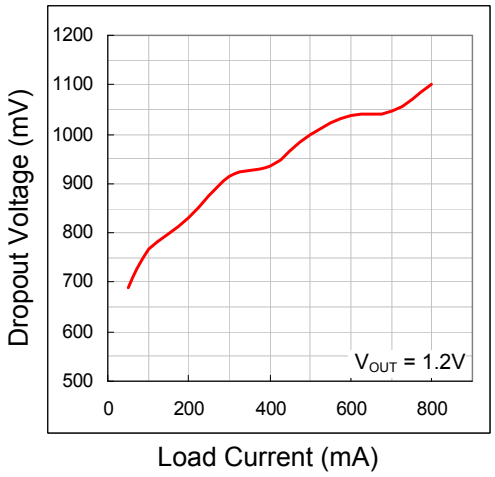
Quiescent Current vs. Input Voltage



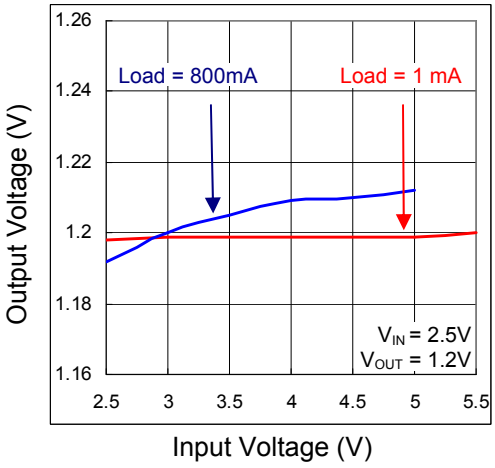
Current Limit vs. Input Voltage



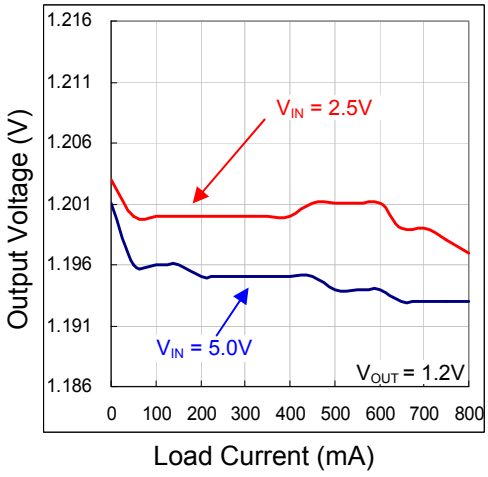
Dropout Voltage vs. Load Current



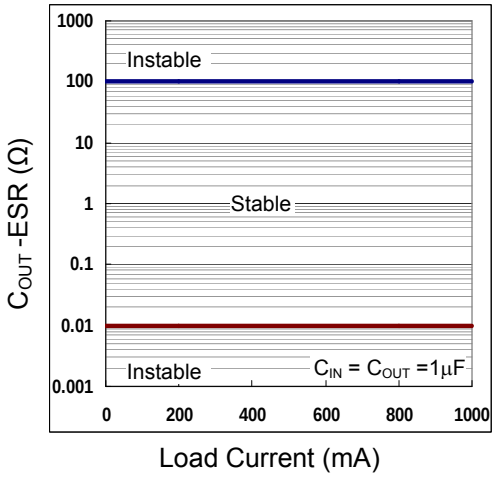
Line Regulation



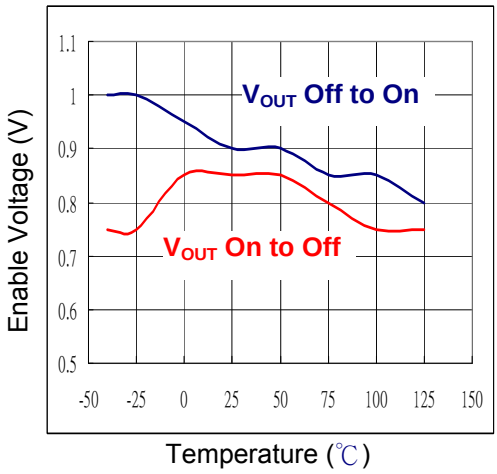
Load Regulation



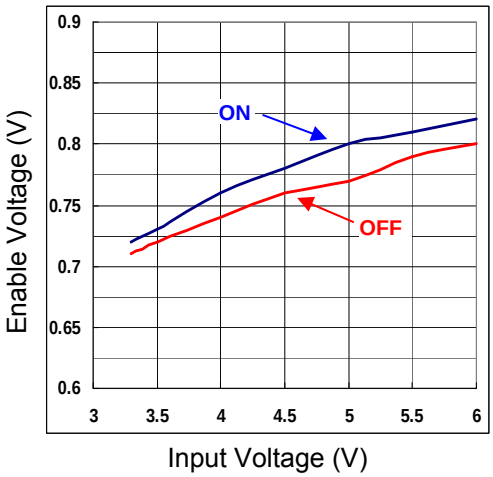
Region of Stable C_{OUT} ESR vs. Load Current



EN Threshold vs. Temperature



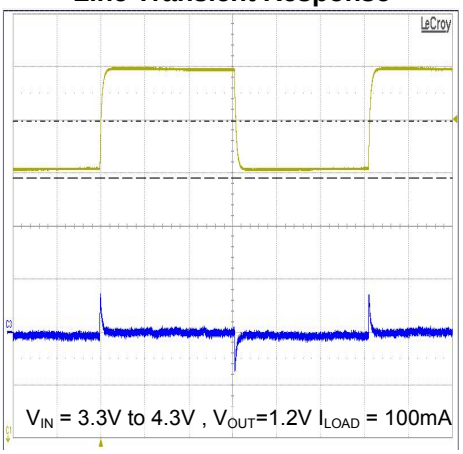
EN Threshold vs. Input Voltage



Line Transient Response

CH1: $V_{IN\ (DC)}$ (500mV/Div)

CH2: $V_{OUT\ (AC)}$ (20mV/Div)

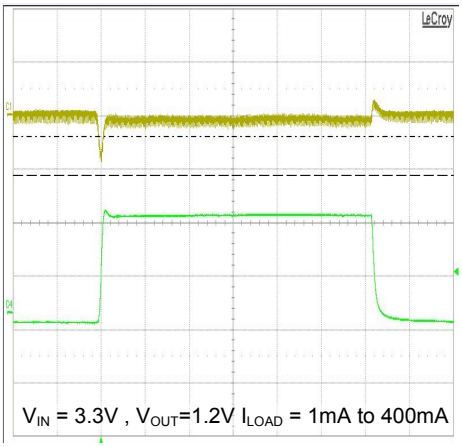


Time (1ms/Div)

Load Transient Response

CH1: $V_{OUT\ (AC)}$ (50mV/Div)

CH2: $I_{LOAD\ (DC)}$ (200mA/Div)

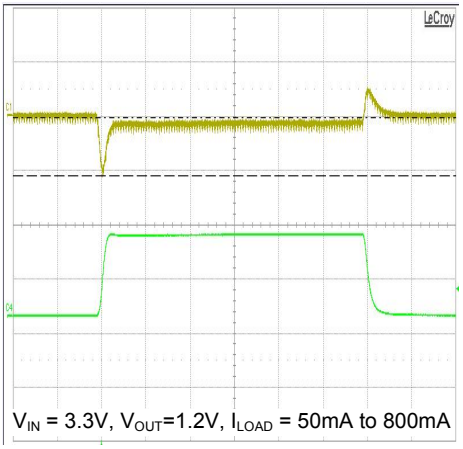


Time (200us/Div)

Load Transient Response

CH1: $V_{OUT\ (AC)}$ (50mV/Div)

CH2 $I_{LOAD\ (DC)}$ (500mA/Div)

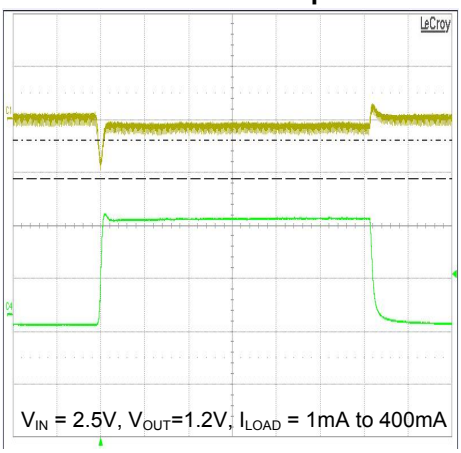


Time (100us/Div)

Load Transient Response

CH1: $V_{OUT\ (AC)}$ (50mV/Div)

CH2: $I_{LOAD\ (DC)}$ (200mA/Div)

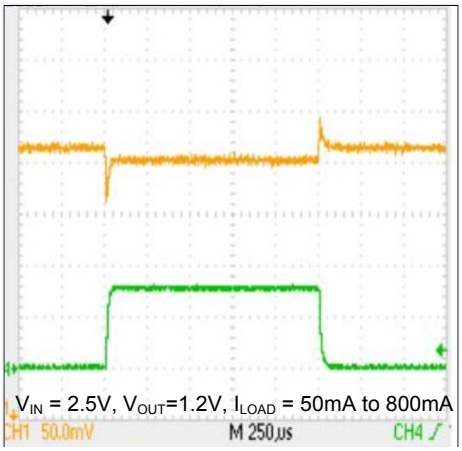


Time (200us/Div)

Load Transient Response

CH1: $V_{OUT\ (AC)}$ (50mV/Div)

CH2 : $I_{LOAD\ (DC)}$ (500mA/Div)



Time (250us/Div)

Application Information

Capacitor Selection and Regulator Stability

Input Capacitor

An input capacitance of 1μF is required between the device input pin and ground directly (the amount of the capacitance may be increased without limit). The input capacitor ***MUST*** be located less than 1 cm from the device to assure input stability (see PCB Layout Section). A lower ESR capacitor allows the use of less capacitance, while higher ESR type (like aluminum electrolytic) requires more capacitance. Capacitor types (aluminum, ceramic and tantalum) can be mixed in parallel, but the total equivalent input capacitance/ESR must be defined as above for stable operation. There are no requirements for the ESR on the input capacitor, but tolerance and temperature coefficient must be considered when selecting the capacitor to ensure the capacitance is 1 μF over the entire operating range.

Output Capacitor

The iD9307 is designed specifically to work with very small ceramic output capacitors. The minimum capacitance recommended (temperature characteristics of X7R, X5R, Z5U or Y5V) is within the 1μF to 10μF range with 5mΩ to 50mΩ ESR range ceramic capacitor between LDO output and GND for transient stability, but it may be increased without limit. Higher capacitance values help to improve transient response. The output capacitor's ESR is critical because it forms a zero to provide phase lead which is required for loop stability.

Enable Function

The iD9307 is shut down by pulling the EN pin low, and turned on by driving the input high. If the shutdown feature is not required, the EN pin should be tied to VIN to keep the regulator on at all times (the EN pin ***MUST NOT*** be left floating).

To assure proper operation, the signal source used to drive the EN pin must be able to swing above and below the specified turn-on/off voltage thresholds listed in the “Electrical Characteristics” under V_{IH} and V_{IL}. The ON/OFF signal may come from either CMOS output, or an open-collector output with pull-up resistor to the device input voltage or another logic supply. The high-level voltage may exceed the device input voltage, but must remain within the absolute maximum ratings for the EN pin.

Operating Region and Power Dissipation

Since the iD9307 is a linear regulator, its power dissipation is always given by $P = I_{OUT} (V_{IN} – V_{OUT})$. For SOP-8 package the maximum power dissipation is given by: $P_{D(MAX)} = (T_J–T_A) /\theta_{JA}$,=(125°C -25°C)/160°C /W = 625mW Where $(T_J–T_A)$ is the temperature difference the iD9307 die and the ambient air, θ_{JA}, is the thermal resistance of the chosen package to the ambient air. For surface mount device, heat sinking is accomplished by using the heat spreading capabilities of the PC board and its copper traces. In the case of a SOP-8 package, the thermal resistance is typically 160°C /Watt. Figure 1 is the maximum power dissipation information of SOT-223, SOT-23-5 and SOP-8. The die attachment area of the iD9307 lead frame is connected to GND pin. Therefore, the GND pin of iD9307 can dissipate the heat from the die very effectively. To improve the maximum power providing capability, connect the GND pin to ground using a large ground plane near the GND pin.

Adjustable Operation

The adjustable version of the iD9307 has an output voltage ranging from 1.0V to 5.0V. The output voltage of the iD9307 adjustable regulator is programmed using an external resistor divider as shown in Figure2. The output voltage can be calculated using:

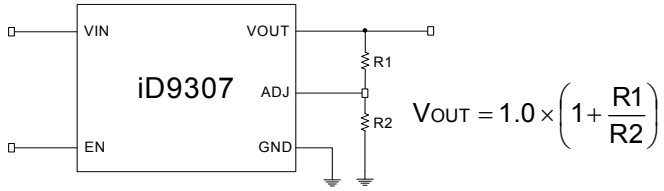
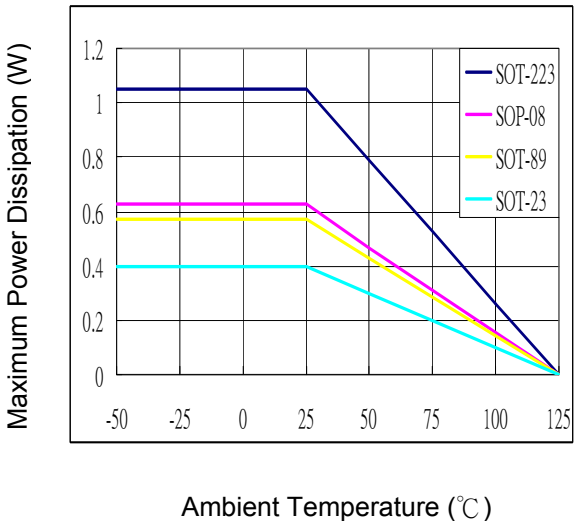


Figure 2. Output Voltage setting equation

Where:

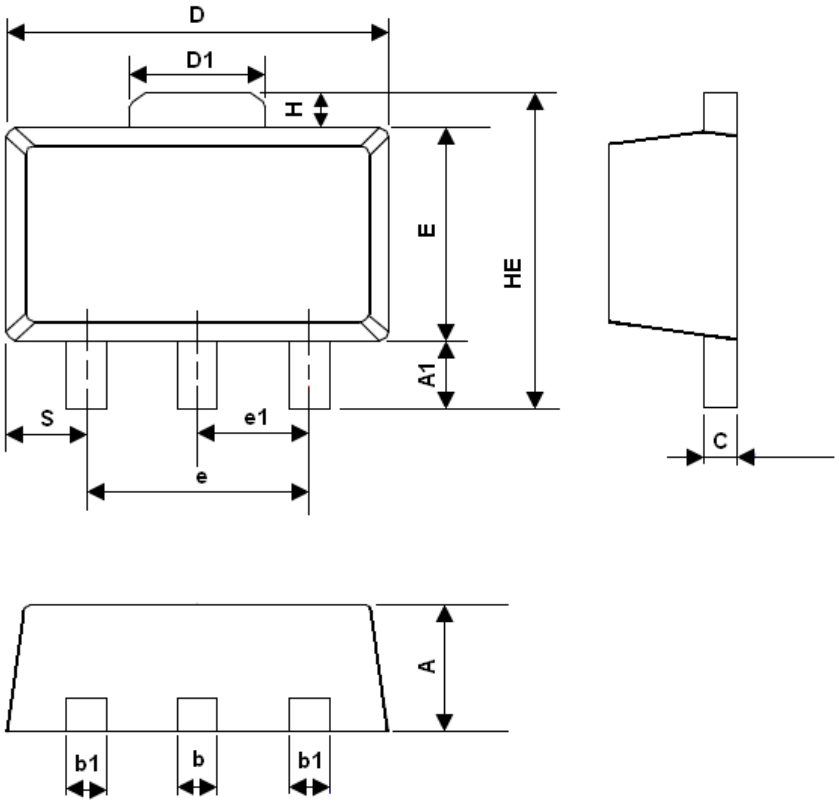
V_{REF}= 1.0V typ. (the internal reference voltage)

Figure1: Maximum Power Dissipation



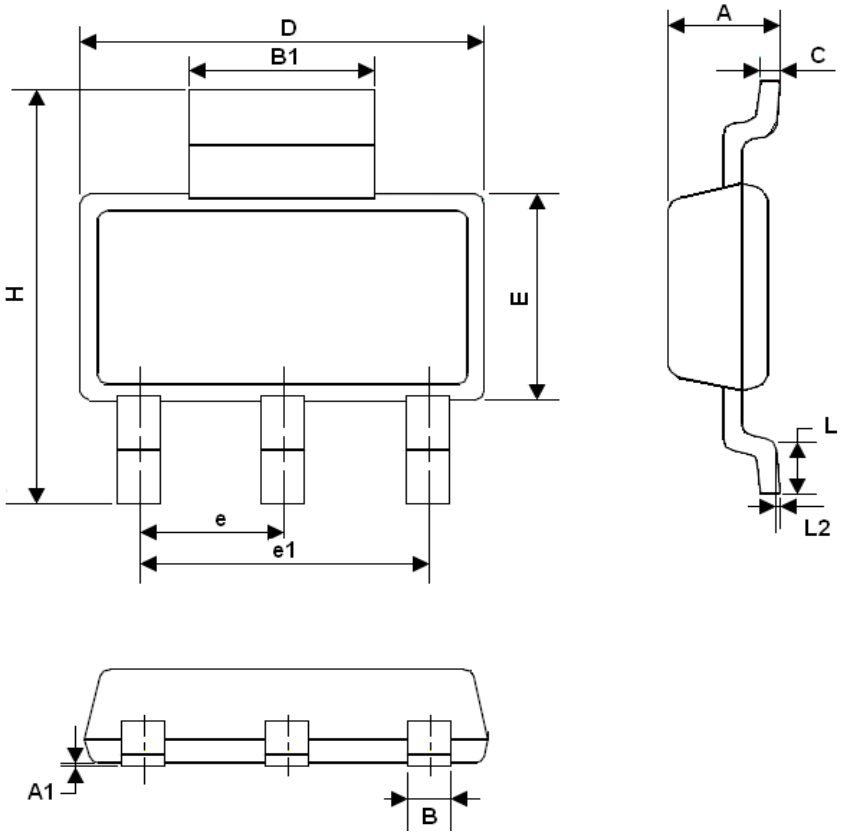
Packaging

SOT-89-3



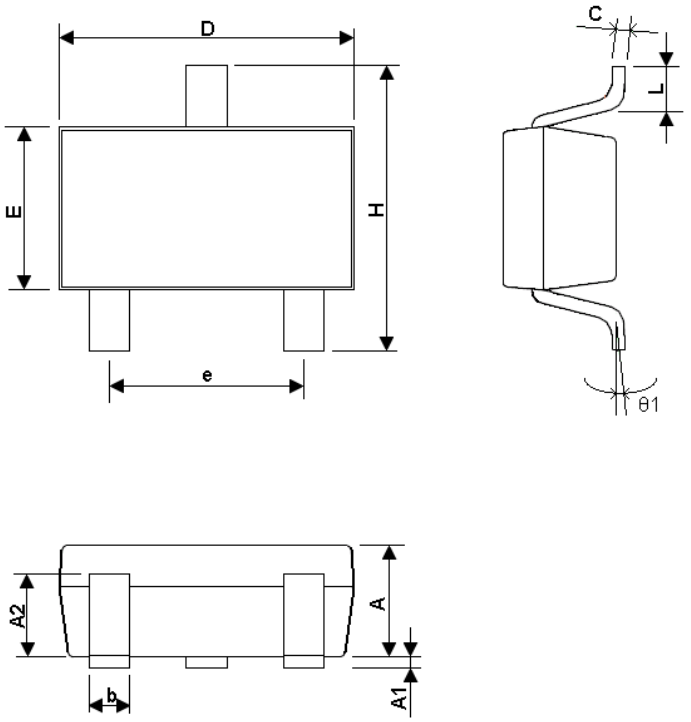
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.40	1.50	1.60	0.055	0.059	0.063
A1	0.80	1.04-	---	0.031	0.041	---
b	0.36	0.42	0.48	0.014	0.016	0.018
b1	0.41	0.47	0.53	0.016	0.18	0.020
C	0.38	0.40	0.43	0.014	0.015	0.017
D	4.40	4.50	4.600	0.173	0.177	0.181
D1	1.40	1.60	1.75	0.055	0.062	0.069
HE	---	---	4.25	---	---	0.167
E	2.40	2.50	2.60	0.094	0.098	0.102
e	2.90	3.00	3.10	0.114	0.118	0.122
H	0.35	0.40	0.45	0.014	0.016	0.018
S	0.65	0.75	0.85	0.026	0.030	0.034
e1	1.40	1.50	1.60	0.054	0.059	0.063

SOT-223



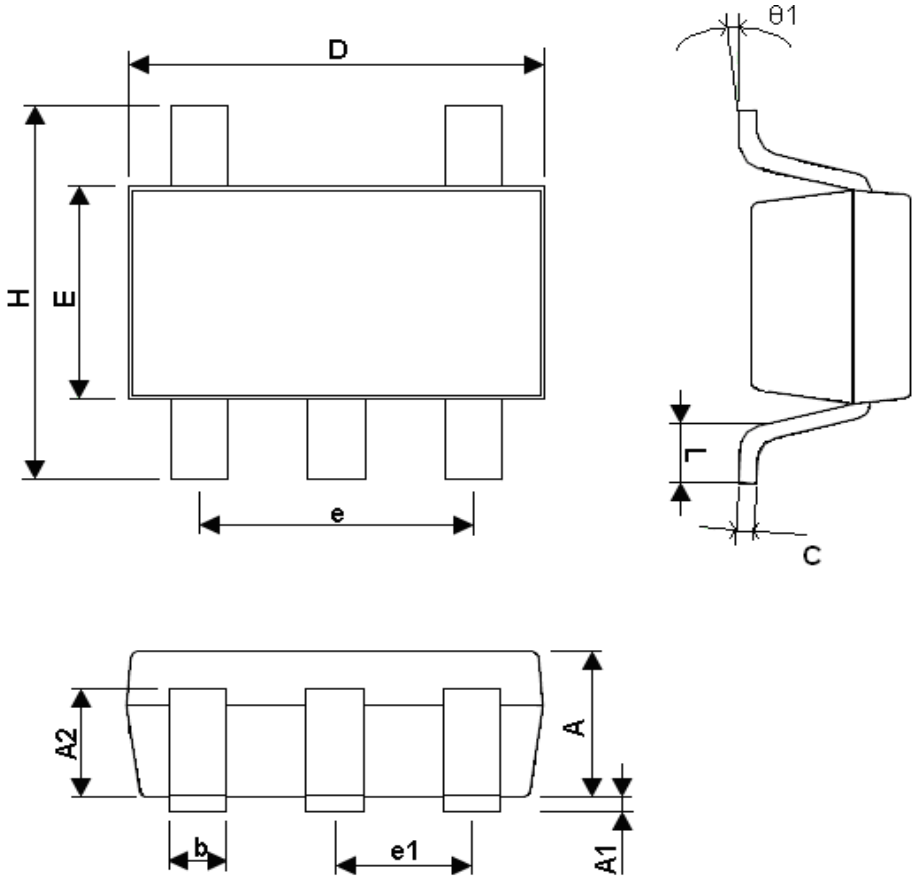
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.55	---	1.60	0.061	---	0.071
A1	0.02	---	0.10	0.0008	---	0.004
B	0. 60	---	0.8	0.024	---	0.031
B1	2.90	---	3.10	0.114	---	0.122
C	0.24	---	0.32	0.009	---	0.013
D	6.30	---	6.80	0.248	---	0.268
E	3.30	---	3.70	0.13	---	0.146
e	2.30 BSC			0.090 BSC		
e1	4.60 BSC			0.181 BSC		
H	6.70		7.30	0.264		0.287
L	0.90 MIN			0.036 MIN		
L2	0.06 BSC			0.0024 BSC		

SOT-23-3



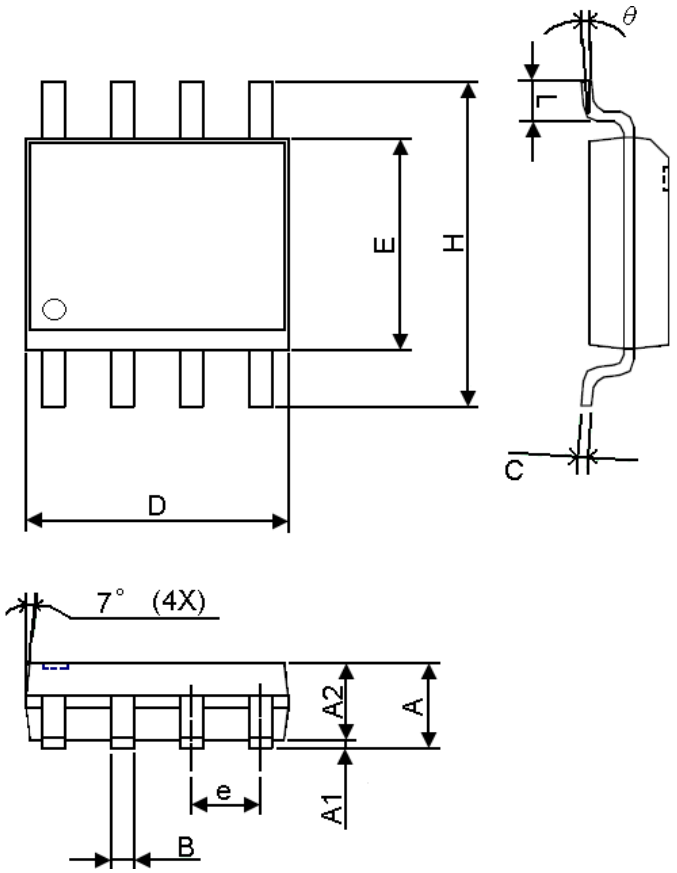
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.00	1.10	1.30	0.039	0.043	0.051
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.80	0.90	0.027	0.031	0.035
b	0.35	0.40	0.50	0.013	0.016	0.020
C	0.10	0.15	0.25	0.004	0.006	0.001
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.40	1.60	1.80	0.055	0.063	0.071
e	---	1.90(TYP)	---	---	0.075	---
H	2.60	2.80	3.00	0.102	0.110	0.118
L	0.370	---	---	0.015	---	---
Θ1	1°	5°	9°	1°	5°	9°

SOT-23-5



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.00	1.10	1.30	0.039	0.043	0.051
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.80	0.90	0.027	0.031	0.035
b	0.35	0.40	0.50	0.013	0.016	0.020
C	0.10	0.15	0.25	0.004	0.006	0.001
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.50	1.60	1.80	0.059	0.063	0.071
e	---	1.90(TYP)	---	---	0.075	---
H	2.60	2.80	3.00	0.102	0.110	0.118
L	0.370	---	---	0.015	---	---
Θ1	1°	5°	9°	1°	5°	9°
e1	---	0.95(TYP)	---	---	0.037	---

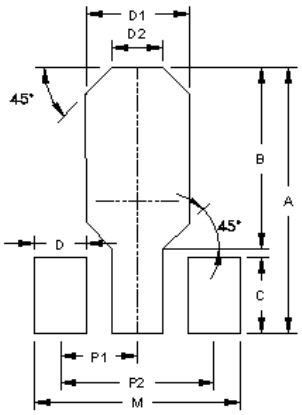
SOP-8



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.60	1.75	0.053	0.063	0.069
A1	0.10	---	0.25	0.004	---	0.010
A2	---	1.45	---	---	0.057	---
B	0.33	---	0.51	0.013	---	0.020
C	0.19	---	0.25	0.007	---	0.010
D	4.80	---	5.00	0.189	---	0.197
E	3.80	---	4.00	0.150	---	0.157
e	---	1.27	---	---	0.050	---
H	5.80	---	6.20	0.228	---	0.244
L	0.40	---	1.27	0.016	---	0.050
y	---	---	0.10	---	---	0.004
θ	0°	---	8°	0°	---	8°

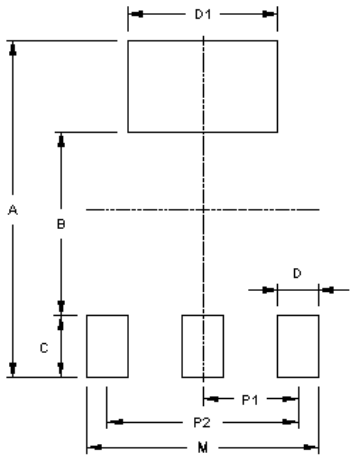
Footprints

SOT-89-3



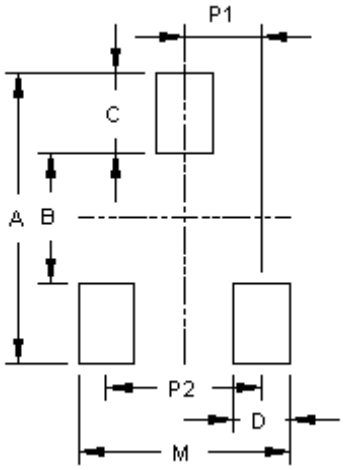
Package	Number of Pin	Footprint Dimension (mm)										Tolerance
		P1	P2	A	B	B1	C	D	D1	D2	M	
SOT-89-3	3	1.50	3.00	5.10	3.40	--	1.50	1.00	2.20	1.00	4.00	±0.10

SOT-223



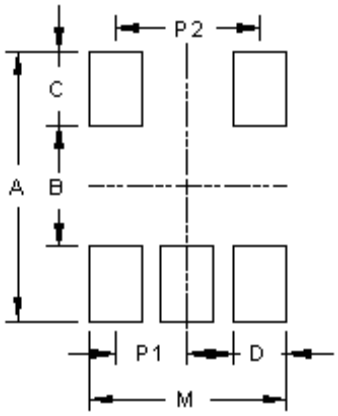
Package	Number of Pin	Footprint Dimension (mm)								Tolerance
		P1	P2	A	B	C	D	D1	M	
SOT-223	4	2.30	4.60	8.00	4.60	1.60	1.00	3.30	5.60	±0.10

SOT-23-3



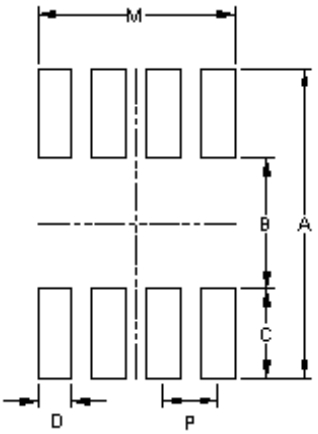
Package	Number of PIN	Footprint Dimension (mm)							Tolerance
		P1	P2	A	B	C	D	M	
SOT-23-3	3	0.95	1.90	3.60	1.60	1.00	0.80	2.70	±0.10

SOT-23-5



Package	Number of Pin	Footprint Dimension (mm)							Tolerance
		P1	P2	A	B	C	D	M	
SOT-23-5	5	0.95	1.90	3.60	1.60	1.00	0.70	2.60	±0.10

SOP-8



Package	Number of Pin	Footprint Dimension (mm)								Tolerance
		P	A	B	C	D	Sx	Sy	M	
SOP-8	8	1.27	6.80	4.20	1.30	0.70	--	--	4.51	±0.10