600mA LDO Regulator

General Description

The iD9302 is a 600mA fixed /adjustable output voltage, low dropout 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 iD9302 works well with low ESR ceramic capacitors, suitable for wireless battery-powered applications with stringent space requirements and demanding performance. It also offers low quiescent current.

Features

- Wide 2.5V to 7V Operating Range
- Quick Start-Up
- Current Limiting Protection
- Thermal Shutdown Protection
- Low Dropout : 110mV @ 300mA; V_{OUT} = 5V
- High Ripple Rejection 55dB@10Hz
- Standby Current Less Than 0.1μA
- Auto Discharge

Applications

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

Ordering Information

iD9302 - □□ □□□ □

Package
A30: SOT-23-3
B30: TSOT-23-3
A50: SOT-23-5
A20: SOT-89-3
A21: SOT-89-3-L Type
A70: SOT-223
A74: SOT-223-T Type
S80: SOP-8
FF6: TDFN-6L

Taping
R: Tape and Reel

Output Voltage	Voltage Code
1.5	15
1.8	18
2.5	25
2.8	28
3.0	30
3.3	33
Adjustable	AD

Note:
S80 package only for Adjustable Voltage
A70 package only for 3.3V

Marking Information

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

Typical Application Circuit

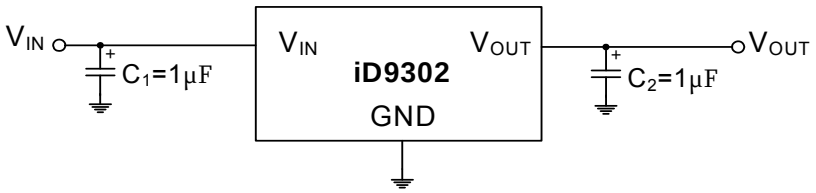
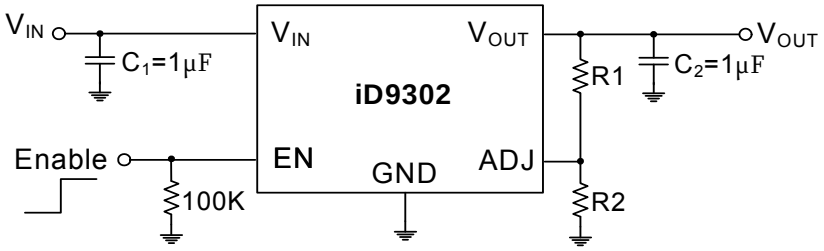


Figure1. Fixed Operation



$$V_{OUT} = 1.175 \times \left(1 + \frac{R_1}{R_2}\right) \text{Volts}$$

Figure2. Adjustable Operation

Absolute Maximum Ratings (Note 1)

Supply Voltage V_{IN}	8V
Power Dissipation, P_D @ T_A=25˚C	
SOP-08	625mW
(T)SOT-23-3 & SOT-23-5	400mW
SOT-89-3	570mW
SOT-223	1050mW
TDFN-6L	606mW
Thermal Resistance, θja	
SOP-08	160˚C/W
(T)SOT-23-3 & SOT-23-5	250˚C/W
SOT-89-3	175˚C/W
SOT-223	95˚C/W
TDFN-6L	165˚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 $V_{IN}=V_{OUT}+1V$, $T_A=25^{\circ}C$)

Parameters		Symbol	Condition		Min	Typ	Max	Units
Operating Voltage Range		V_{IN}			2.5		7	V
Shutdown Supply Current		I_{SBY}	V_{EN} = GND,Shutdown			0.01	1	μA
Supply Current Limit		I_{LIMIT}	R_{LOAD} = 1Ω			800		mA
Quiescent Current		I_Q	V_{EN} ≧ 1.2V, I_{OUT} = 0mA			90	150	μA
Dropout Voltage (Note 3)		V_{DROP}	I_{OUT}= 600mA	V_{out} = 1.5V		1000	1500	mV
				V_{out} = 1.8V		800	1000	mV
				V_{out} = 2.5V		600	750	mV
				V_{out} = 2.8V		350	450	mV
				V_{out} = 3.3V		250	400	mV
				V_{out} = 5.0V		230	350	mV
			I_{OUT}= 300mA	V_{out} = 5.0V		110	200	mV
EN input Bias Current		I_{IBSD}	V_{EN} = GND or V_{IN}			0	100	nA
Line regulation		ΔV_{LINE}	V_{IN} = (V_{OUT} +1V) to 6V, I_{OUT} = 1mA				6	mV/V
Load Regulation		ΔV_{LOAD}	1mA < I_{OUT} < 600mA				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}	I_{OUT} =1mA		-2		+2	%
EN Threshold	Logic-Low V	V_{IL}	V_{IN} = 2.5V to 6V,Shutdown				0.4	V
	Logic-High V	V_{IH}	V_{IN} = 2.5V to 6V,Start-Up		1.6			
Power Supply Rejection Rate	f = 10Hz	PSRR	C_{OUT} = 1 μF, I_{OUT} = 10mA			-55		dB

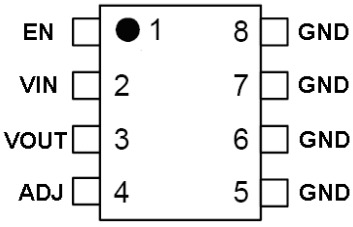
Note 1: Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

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

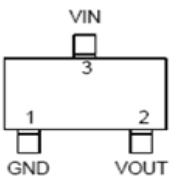
Note 3: The dropout voltage is defined as (V_{IN}-V_{OUT}) when V_{OUT} is 100Mv below the target value of V_{OUT}.

Pin Configurations

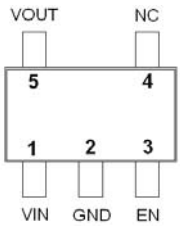
(Top View)



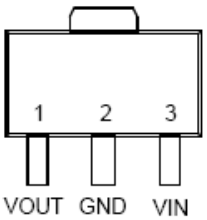
SOP-08



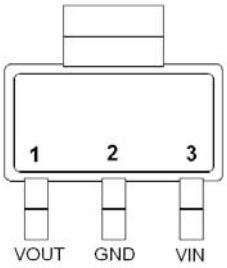
(T)SOT-23-3



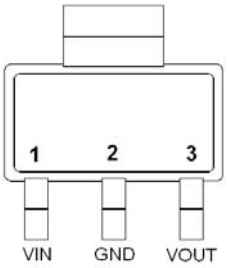
SOT23-5



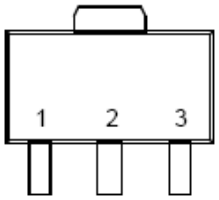
SOT-89



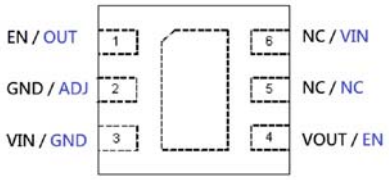
SOT223



SOT223 (T-Type)



SOT89-3(L-Type)

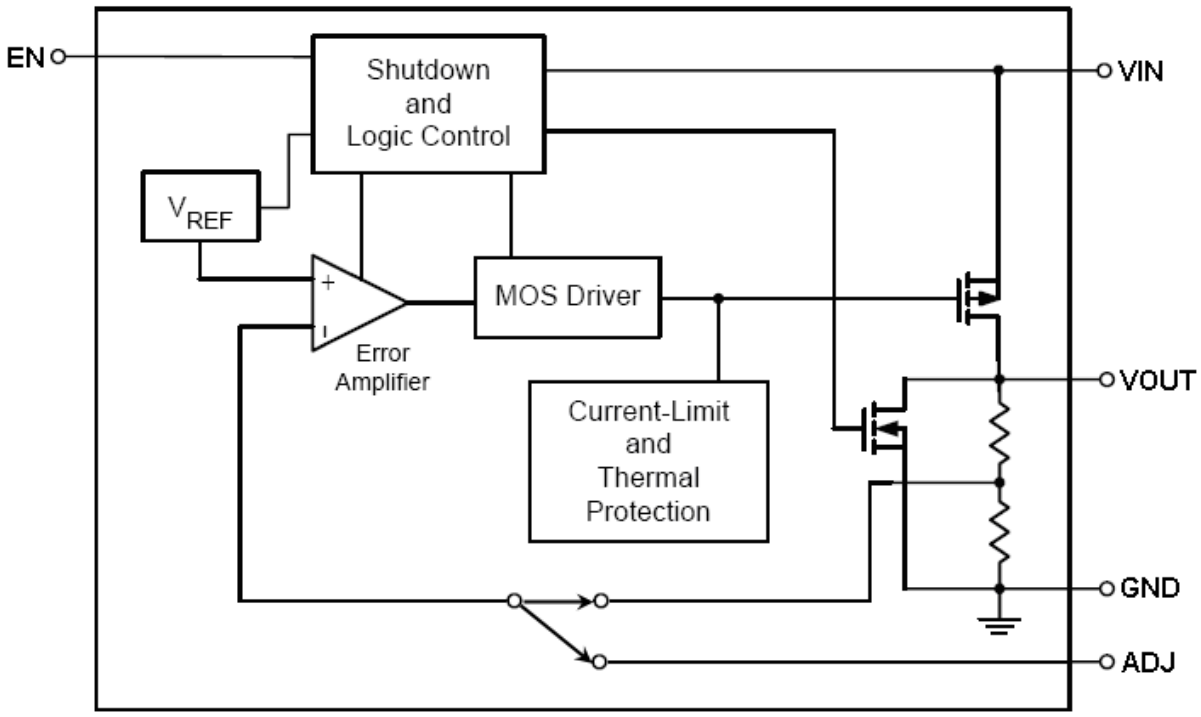


TDFN-6L
(FIX / ADJ)

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
NC	No Internal Connection (Floating or Connecting to GND).

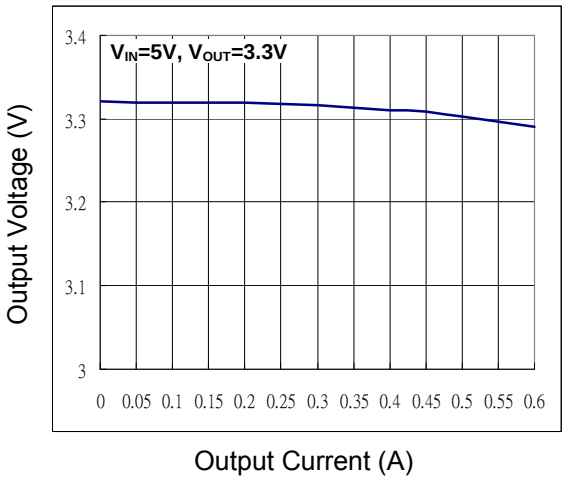
Function Block Diagram



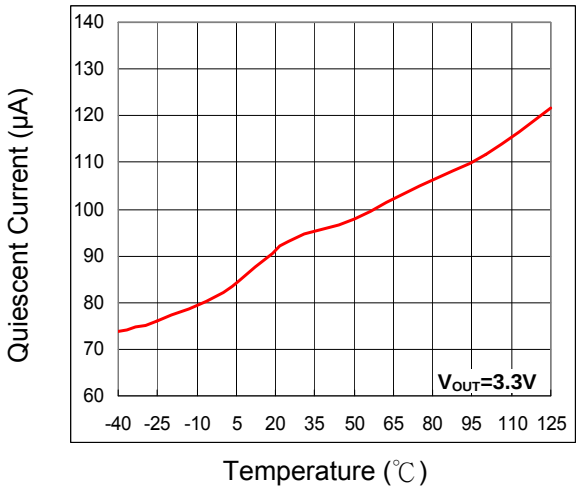
Typical Operating Characteristics

(Unless otherwise specified, V_{IN}= V_{OUT} + 1V, T_A = 25°C, C_{IN} = C_{OUT} = 1μF)

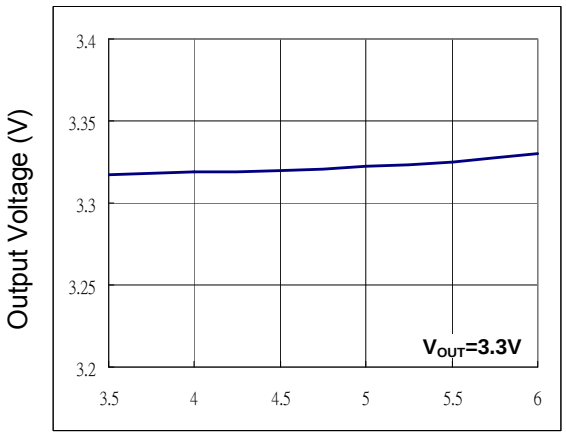
Load Regulation



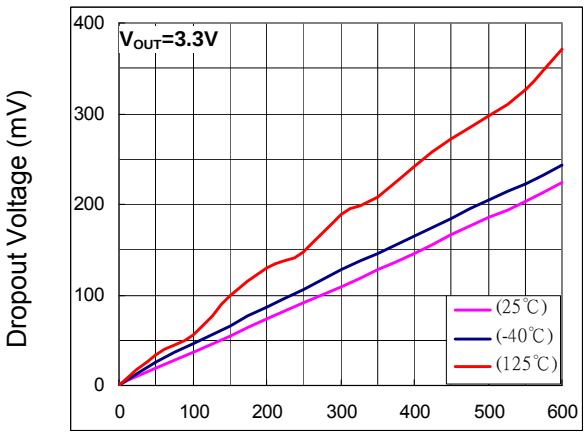
Quiescent Current vs. Temperature



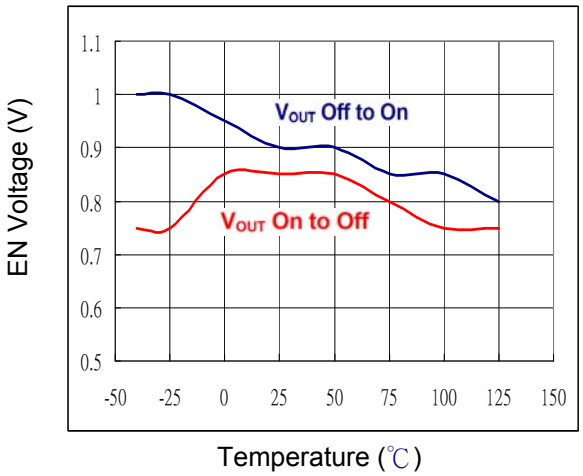
Line Regulation



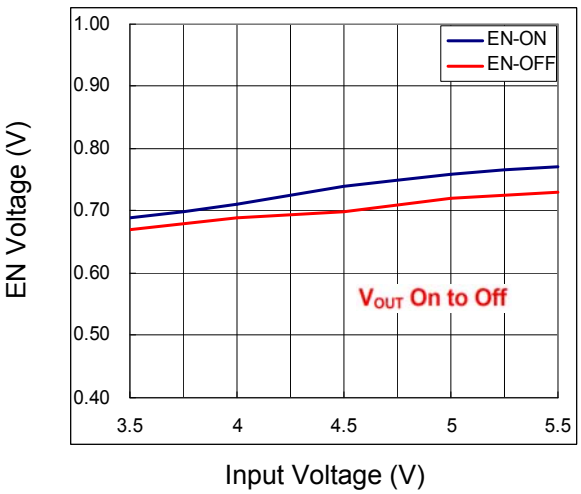
Dropout Voltage vs. Output Current



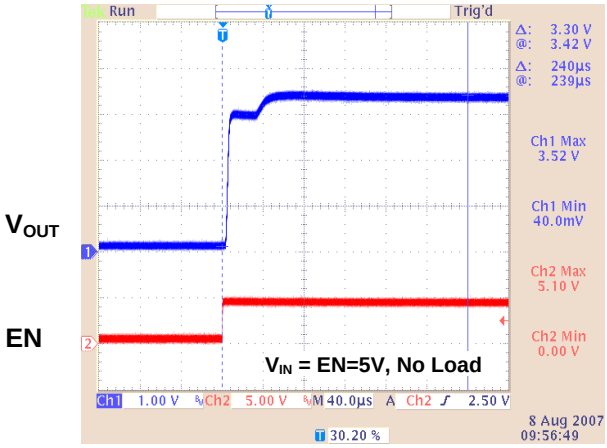
Enable Threshold vs. Temperature



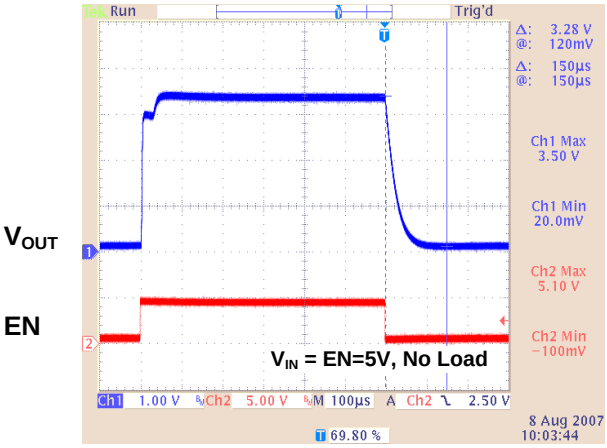
Enable Threshold vs. Input Voltage



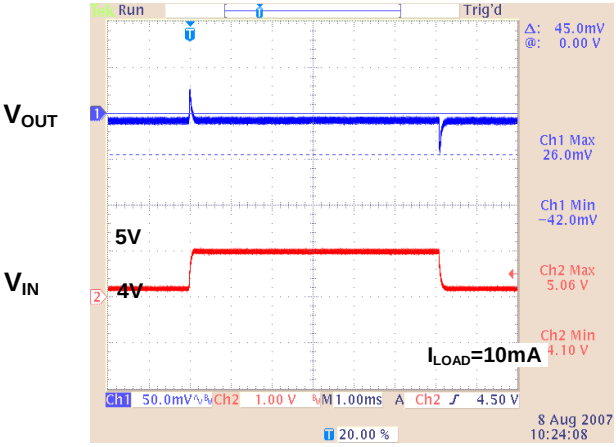
Start Up Response



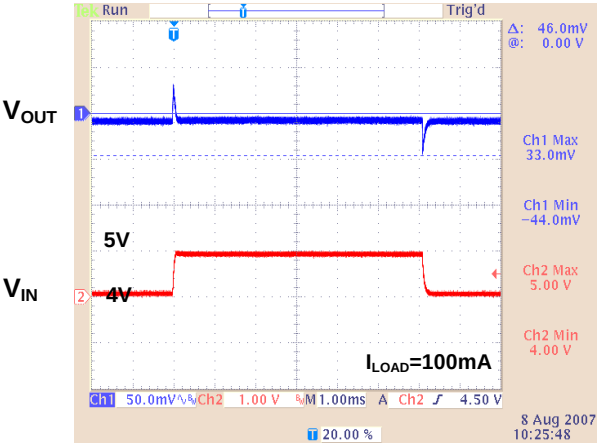
EN Pin Shutdown Response



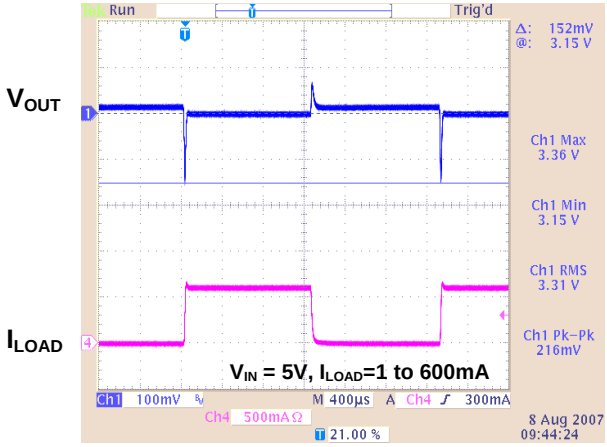
Line Transient Response



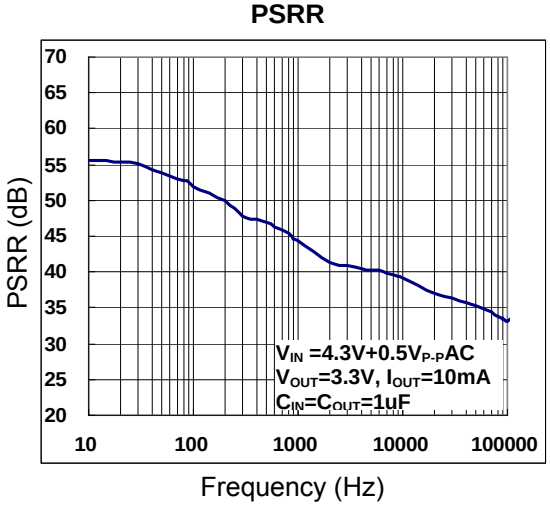
Line Transient Response



Load Transient Response



PSRR



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. 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 iD9302 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 iD9302 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.

Thermal Considerations

For continuous operation, do not exceed the maximum operation junction temperature 125°C. The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junctions to ambient. The maximum power dissipation can be calculated by following formula:

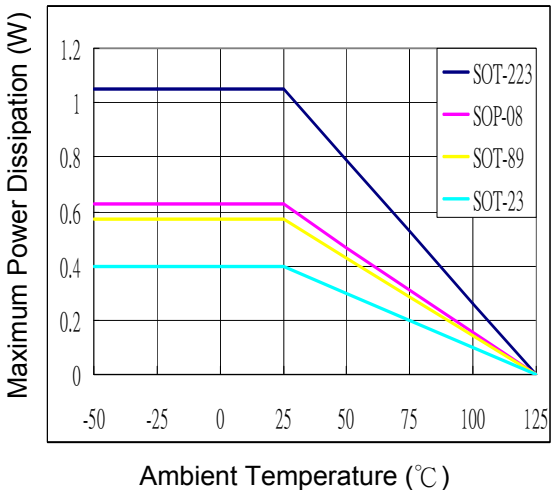
$$P_{D(MAX)} = \frac{\left(T_{J(MAX)} - T_A\right)}{\theta_{JA}}$$

Where $T_{J(MAX)}$ is the maximum operation junction temperature 125°C, T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance. For recommended operating conditions specification of iD9302 where $T_{J(MAX)}$ is the maximum junction temperature of the die (125°C) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance θ_{JA} is layout dependent. For SOP8 packages, the thermal resistance θ_{JA} is 160°C/W on the standard JEDEC 51-7 four-layers thermal test board. The maximum power dissipation at T_A = 25°C can be calculated by following formula:

$P_{D(MAX)}$ = (125°C – 25°C) / (160°C/W) = 0.625W

for SOP8 packages. The maximum power dissipation depends on operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance θ_{JA}. For iD9302 packages, the Figure 3 of de-rating curves allows the designer to see the effect of rising ambient temperature on the maximum power allowed.

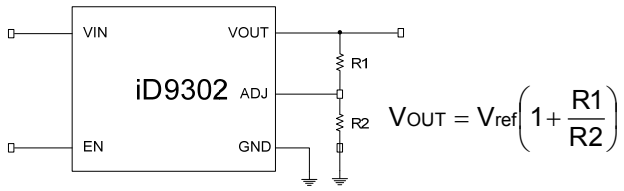
Figure3: Maximum Power dissipation



Adjustable Operation

The adjustable version of the iD9302 has an output voltage ranging from 1.2V to 5V. The output voltage of the iD9302 adjustable regulator is programmed using an external resistor divider as shown in Figure4. The output voltage can be calculated using:

Figure 4.



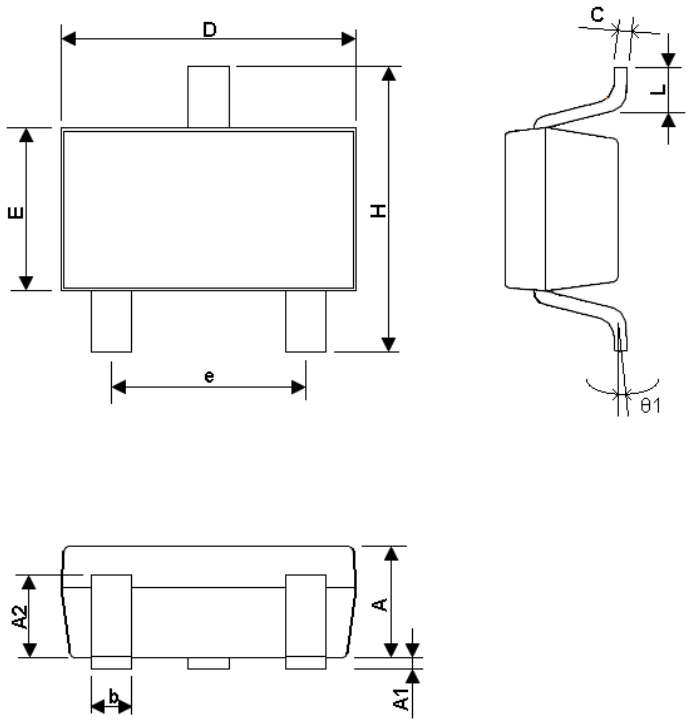
Where:

Vref= 1.175V typ. (the internal reference voltage)

To enable default output voltage (pre-set), connect ADJ pin to ground. There is no external component needed to decide voltage.

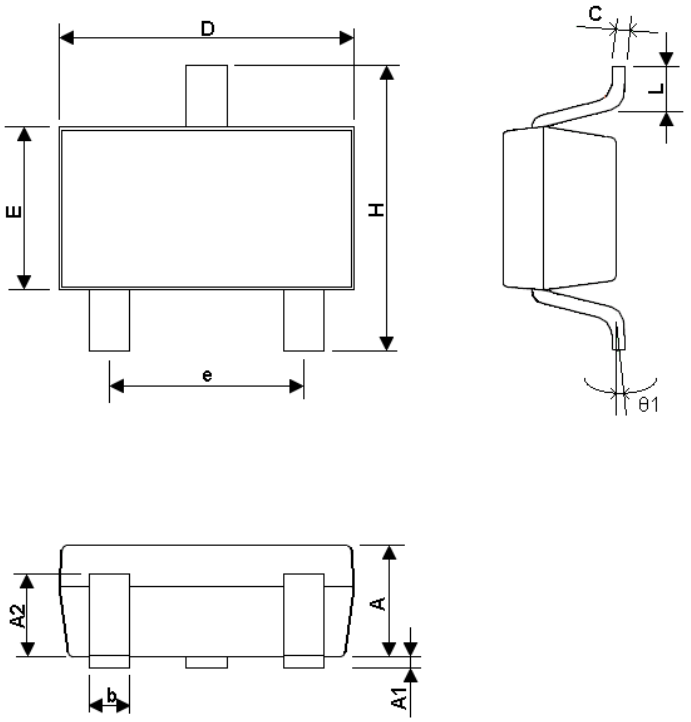
Packaging

SOT-23-3



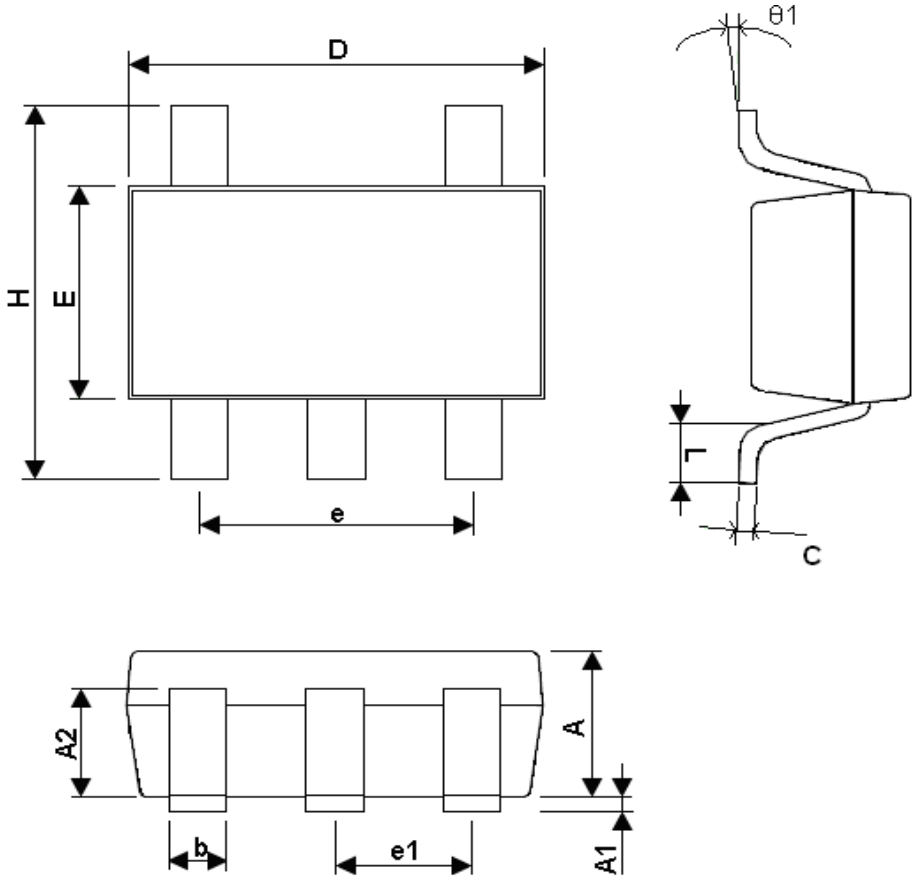
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.00	1.10	1.30	0.039	0.043	0.051
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.80	0.90	0.027	0.031	0.035
b	0.35	0.40	0.50	0.013	0.016	0.020
C	0.10	0.15	0.25	0.004	0.006	0.001
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.40	1.60	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°

TSOT-23-3



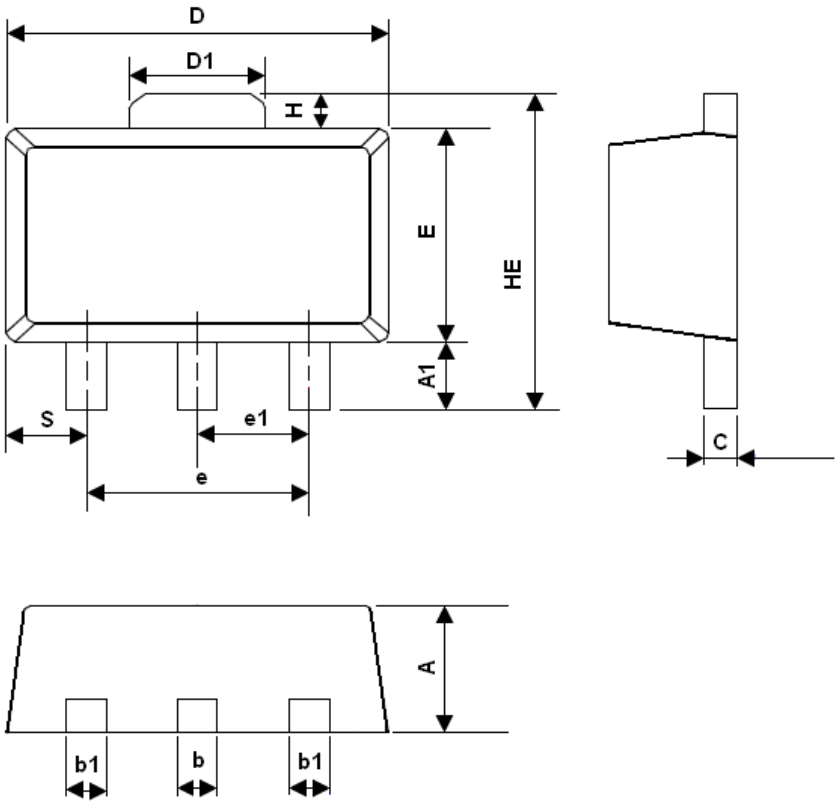
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.75	---	0.90	0.030	---	0.035
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.80	0.90	0.027	0.031	0.035
b	0.35	0.40	0.50	0.013	0.016	0.020
C	0.10	0.15	0.25	0.004	0.006	0.001
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.40	1.60	1.80	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



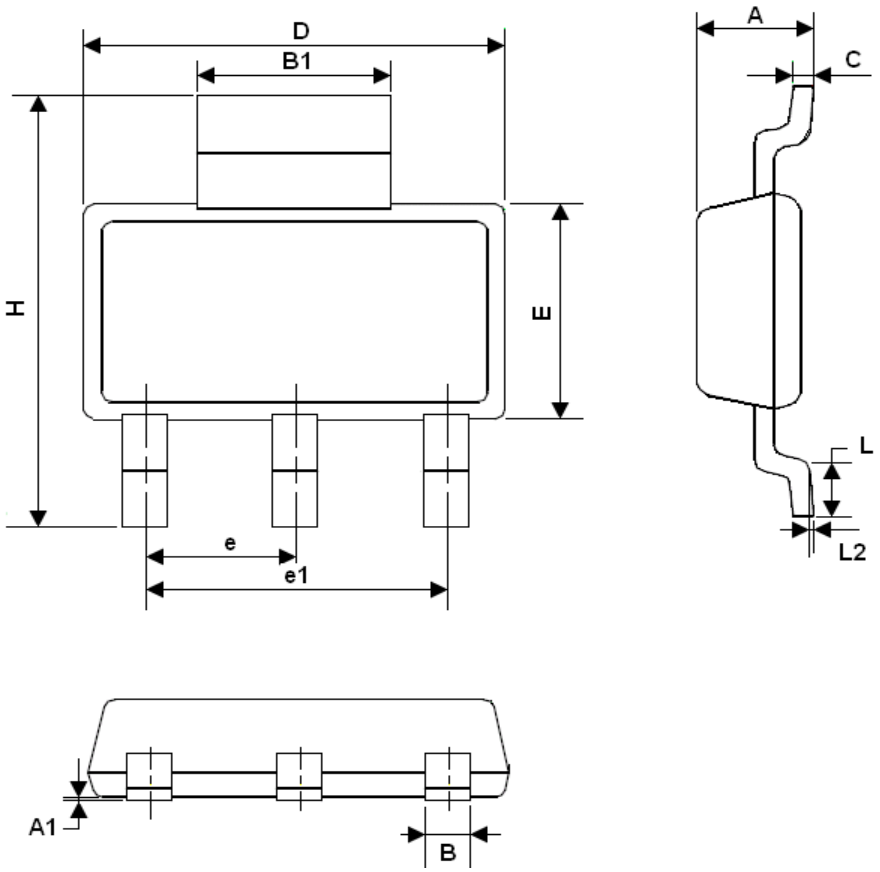
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.00	1.10	1.30	0.039	0.043	0.051
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.80	0.90	0.027	0.031	0.035
b	0.35	0.40	0.50	0.013	0.016	0.020
C	0.10	0.15	0.25	0.004	0.006	0.001
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.50	1.60	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	---

SOT-89



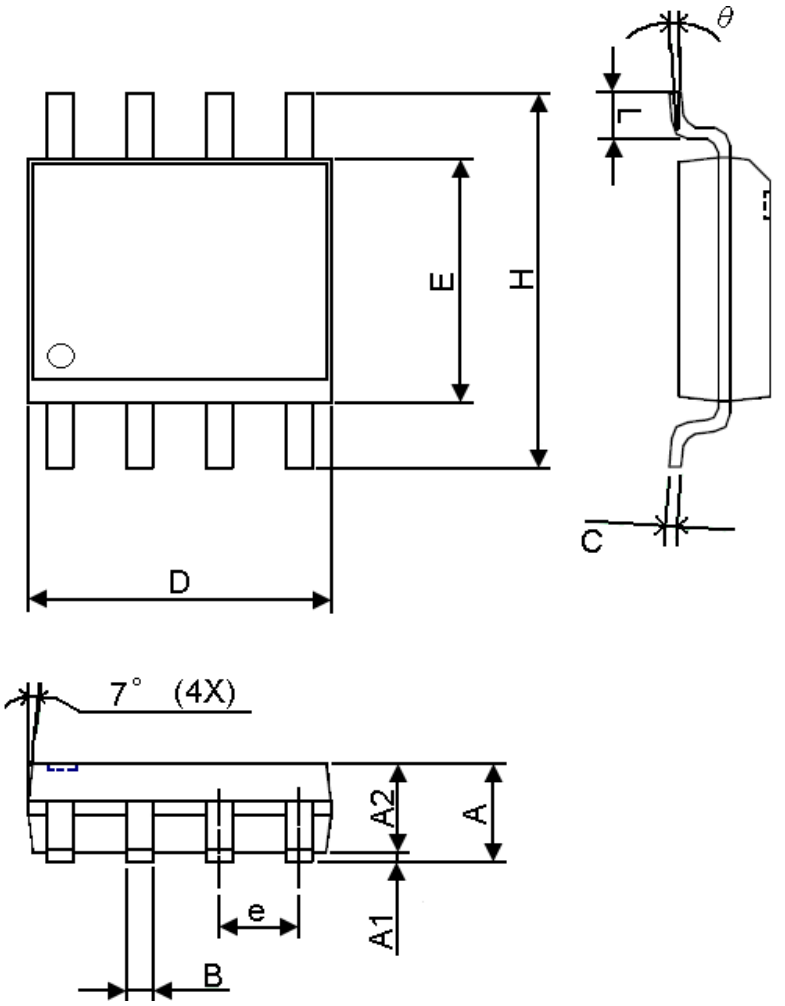
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.40	1.50	1.60	0.055	0.059	0.063
A1	0.80	1.04-	---	0.031	0.041	---
b	0.36	0.42	0.48	0.014	0.016	0.018
b1	0.41	0.47	0.53	0.016	0.18	0.020
C	0.38	0.40	0.43	0.014	0.015	0.017
D	4.40	4.50	4.600	0.173	0.177	0.181
D1	1.40	1.60	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



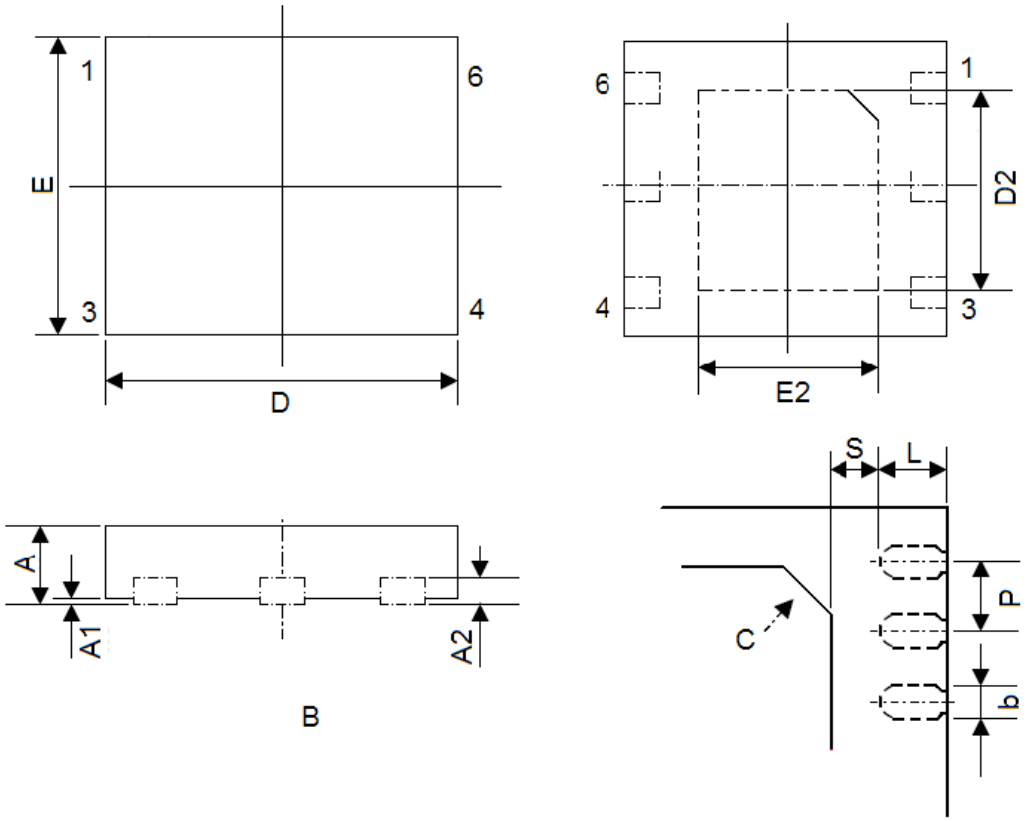
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.52	---	1.80	0.061	---	0.071
A1	0.02	---	0.10	0.0008	---	0.004
B	0. 60	---	0.8	0.024	---	0.031
B1	2.90	---	3.10	0.114	---	0.122
C	0.24	---	0.32	0.009	---	0.013
D	6.30	---	6.80	0.248	---	0.268
E	3.30	---	3.70	0.13	---	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		

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°

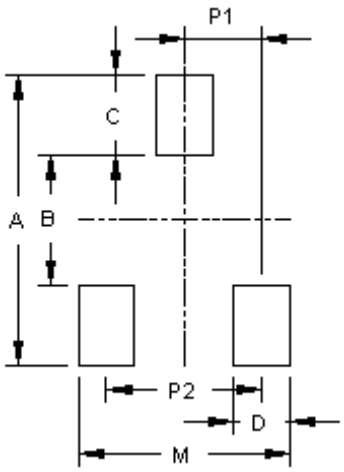
TDFN-6L (2mm x 2mm)
Pitch=0.65



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.7	0.75	0.8	0.028	0.03	0.031
A1	0.005	0.03	0.06	0.0002	0.0011	0.0024
A2	0.15	0.2	0.25	0.006	0.008	0.010
B	0.225	0.275	0.325	0.009	0.01	0.013
C	---	0.25REF	---	---	0.01REF	---
D	1.95	2.00	2.05	0.077	0.079	0.08
E	1.95	2.00	2.05	0.077	0.079	0.08
E2	0.62	---	---	0.024	---	---
D2	1.176	---	---	0.046	---	---
L	0.30	0.35	0.40	0.012	0.014	0.016
P	0.60	0.65	0.70	0.024	0.026	0.028
S	0.21	---	---	0.008	---	---

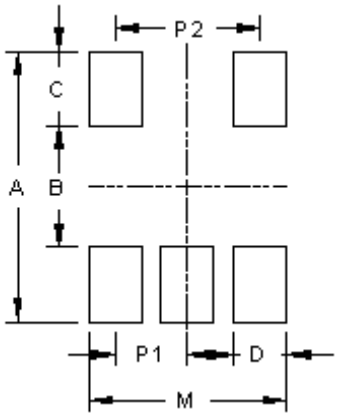
Footprints

(T)SOT-23-3



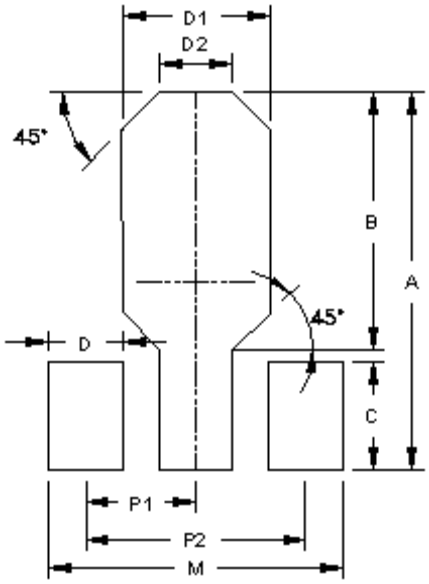
Package	Number of PIN	Footprint Dimension (mm)							Tolerance
		P1	P2	A	B	C	D	M	
SOT-23-3	3	0.95	1.90	3.60	1.60	1.00	0.80	2.70	±0.10

SOT-23-5



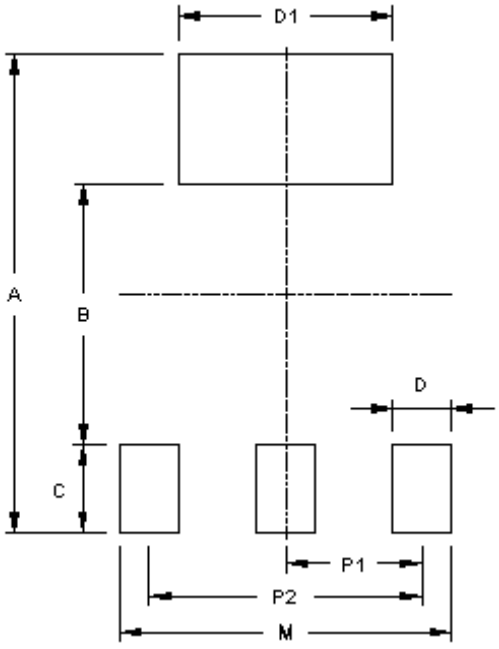
Package	Number of Pin	Footprint Dimension (mm)							Tolerance
		P1	P2	A	B	C	D	M	
SOT-23-5	5	0.95	1.90	3.60	1.60	1.00	0.70	2.60	±0.10

SOT-89-3



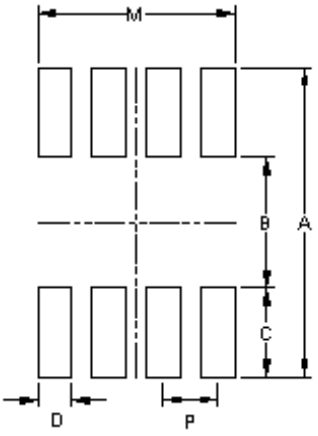
Package	Number of Pin	Footprint Dimension (mm)									Tolerance
		P1	P2	A	B	B1	C	D	D1	D2	M	
SOT-89-3	3	1.50	3.00	5.10	3.40	--	1.50	1.00	2.20	1.00	4.00	±0.10

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

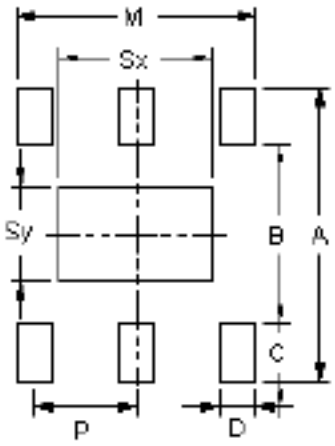
SOP-8



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

TDFN-6L (2mm × 2mm)

Pitch = 0.65



Package	Number of PIN	Footprint Dimension (mm)								Tolerance
		P	A	B	C	D	Sx	Sy	M	
TDFN-6L 2x2	6	0.65	2.80	1.20	0.80	0.35	1.40	0.70	1.65	±0.050