Low Noise 300mA LDO Regulator

General Description

The iD9301 is a 300mA with fixed output voltage options ranging from 1.5V, 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 iD9301 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

iD9301 - □□ □□□ □

Package
C50:SC70-5
A30:SOT23-3
A50:SOT23-5
A20:SOT89-3
A21:SOT89-3-L Type

Packing
R: Tape and Reel

Output Voltage	Voltage Code
1.5	15
1.8	18
2.5	25
2.7	27
2.8	28
3.0	30
3.3	33

Other voltage outputs may be available. For further details, please contact an iDesyn sales or distributor.

Features

- Low-Noise application
- Wide 2.5V to 6V Operating Range
- Quick Start-Up
- Seven Fixed Voltage Options Available
- Current Limiting Protection
- Thermal Shutdown Protection
- Low Dropout : 200mV @ 300mA
- High Ripple Rejection 55dB@10Hz
- Standby Current Less Than 0.1μA
- Auto Discharge

Applications

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

Marking Information

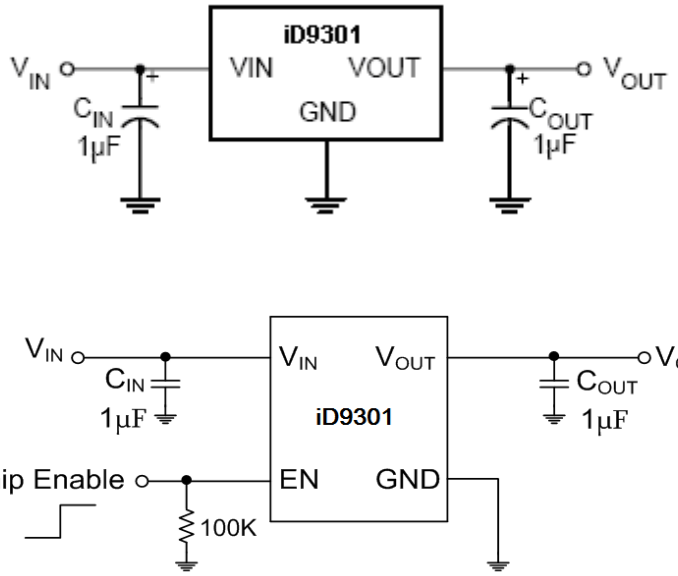
Type I:	Type II:	Type III:
SOT89-3	SOT23-3 SOT23-5	SC70-5
9301 xxxxxx□x	A1□xx	A1□x

Output Voltage

F:1.5V K:3.0V
H:1.8V V:3.1V
L:2.5V X:3.2V
S:2.7V T:3.3V
O:2.8V Y:3.5V
U:2.85V

Please use the table shown above for output voltage indication on IC marking. For other marking information, please contact our sales representative directly or through an iDesyn distributor around your location.

Typical Application Circuit



Absolute Maximum Ratings

Supply Voltage V_{IN}	6V
Power Dissipation, P_D @ T_A=25˚C	
SC70-5	300mW
SOT23-3 & SOT23-5	400mW
SOT89-3	570mW
Thermal Resistance, θ_{ja}	
SC70-5	333˚C/W
SOT23-3 & SOT23-5	250˚C/W
SOT89-3	175˚C/W
Lead Temperature	260 ˚C
Storage Temperature	-65˚C to 150˚C
ESD Susceptibility	
HBM (Human Body Mode)	4kV
MM (Machine Mode)	300V

Recommended Operating Conditions

Input Voltage V_{IN}	2.5V to 6V
EN Input Voltage	0V to 5.5V
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		Symbo	Condition		Min	Typ	Max	Units
Operating Voltage Range (Note 2)		V_{IN}			2.5		6	V
V_{IN} Discharge to Normal Operation Power on Voltage (Note 3)					0.4			V
Shutdown Supply Current		I_{SBY}	V_{EN} = GND, Shutdown			0.01	1	μA
Supply Current Limit		I_{Limit}	R_{LOAD} = 1Ω		360	400		mA
Quiescent Current		I_Q	V_{EN} ≧ 1.2V, I_{OUT} = 0mA			90	130	μA
Dropout Voltage (Note 4)		V_{DROP}	I_{OUT} = 300mA	V_{OUT} = 1.5V		1360	1800	mV
				V_{OUT} = 1.8V		1100	1500	mV
				V_{OUT} = 2.5V		580	800	mV
				V_{OUT} = 2.8V		410	500	mV
				V_{OUT} = 2.85V		390	490	mV
				V_{OUT} = 3V		300	400	mV
				V_{OUT} = 3.3V		200	300	mV
Standby Current		I_{STBY}	V_{EN} =GND			0.01	1	μA
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 5.5V, I_{OUT} = 1mA				6	mV/V
Load Regulation		ΔV_{LOAD}	1mA < I_{OUT} < 300mA				40	mV
Output Noise Voltage		eNO	10Hz to 100kHz I_{OUT} = 200mA, C_{OUT} = 1μF			100		μV_{RMS}
Fast Discharge N-MOSFET Turn On Resistance		$R_{DISCHARGE}$	V_{IN} = 4V, V_{EN} = 0V			35		Ω
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} = 3V to 5.5V,Shutdown				0.4	V
	Logic-High V	V_{IH}	V_{IN} = 3V to 5.5V,Start-Up		1.2			V
Power Supply Rejection Rate	f = 10Hz	PSRR	C_{OUT} = 1μF, I_{OUT} = 10mA			-55		dB

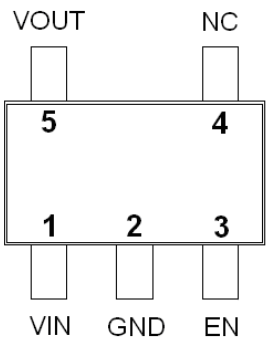
Note 1: Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

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

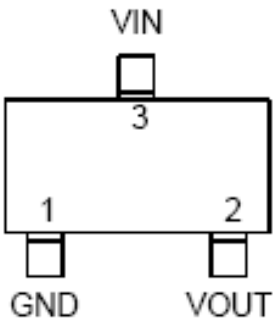
Note 3: When input voltage power off, the input capacitor voltage must be discharged under 0.4V. It will assure internal circuitry properly work on next time.

Note 4: The dropout voltage is defined as (V_{IN}-V_{OUT}) when V_{OUT} is 100mV below the target value of V_{OUT}.

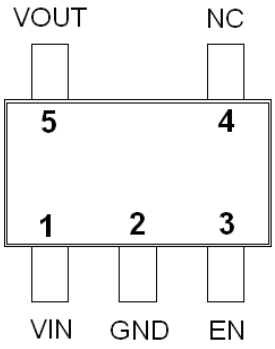
Pin Configurations (Top View)



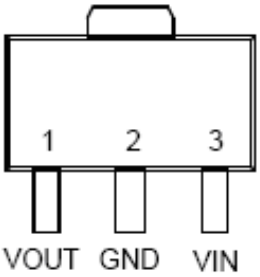
SC70-5



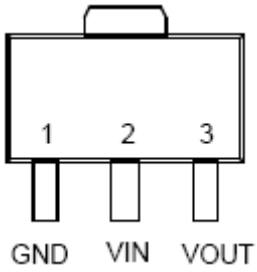
SOT23-3



SOT23-5



SOT89-3

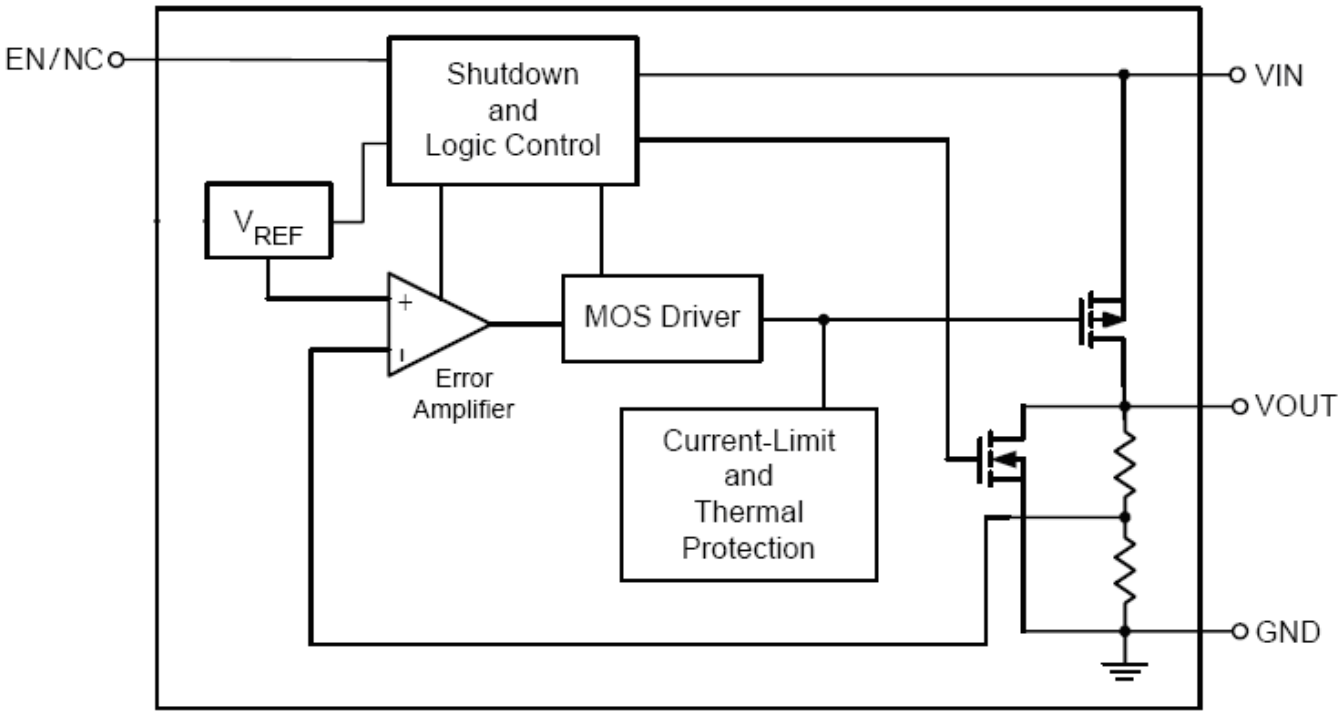


SOT89-3(L-Type)

Pin Description

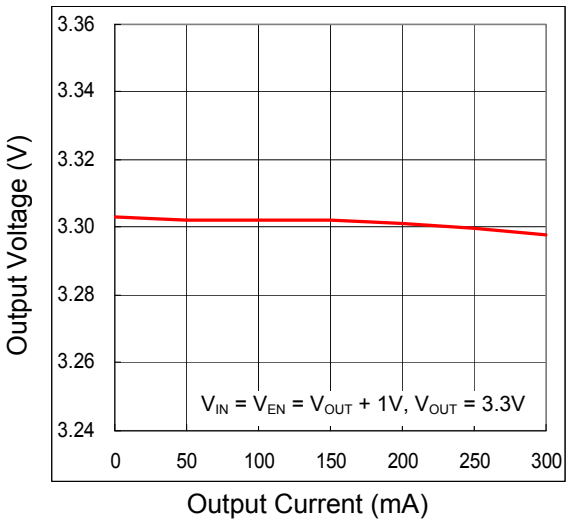
Pin Name	Pin Function
EN	Chip Enable (Active High). Note that this pin is high impedance. There should be a pull low 100kΩ resistor connected to GND when the control signal is floating.
GND	Ground
VOUT	Output Voltage
VIN	Input Voltage

Function Block Diagram

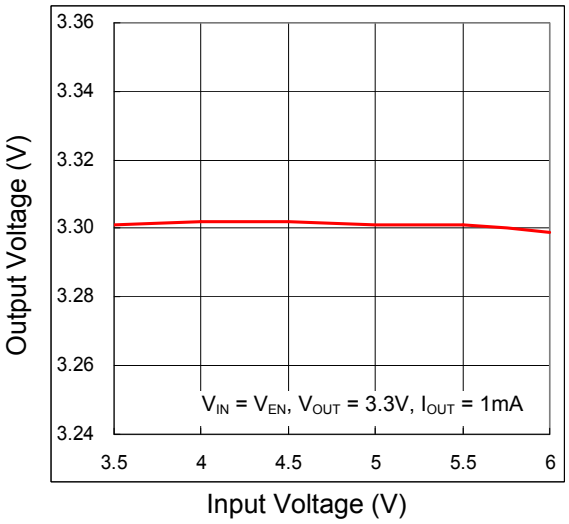


Typical Operating Characteristics

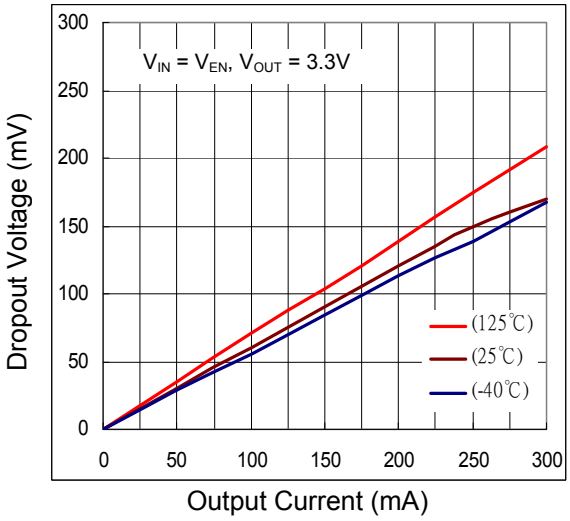
Load Regulation



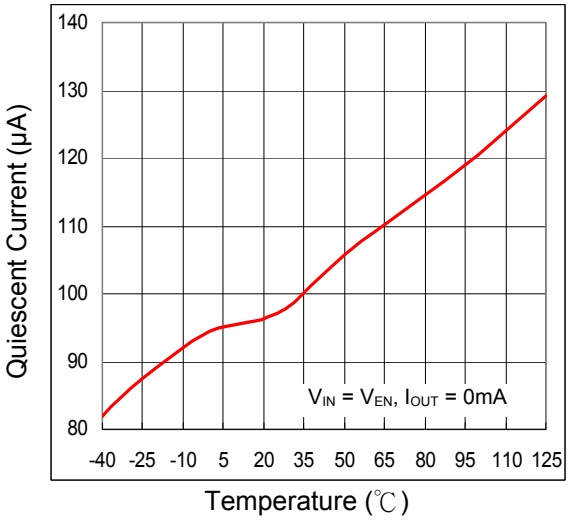
Line Regulation



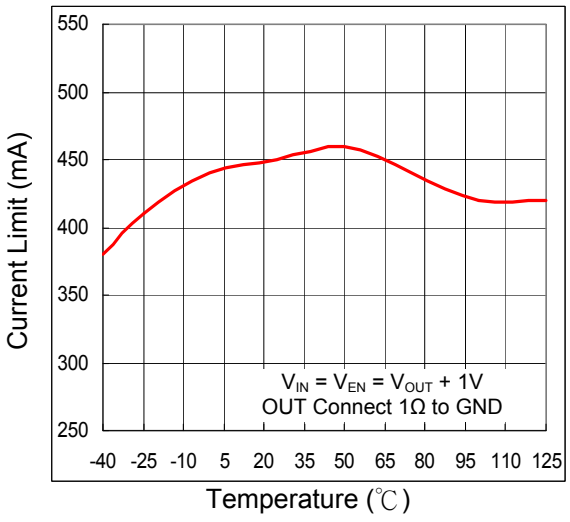
Dropout Voltage vs. Output Current



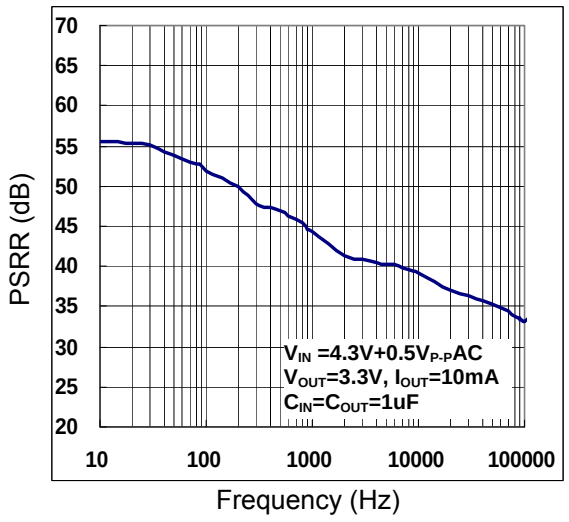
Quiescent Current vs. Temperature



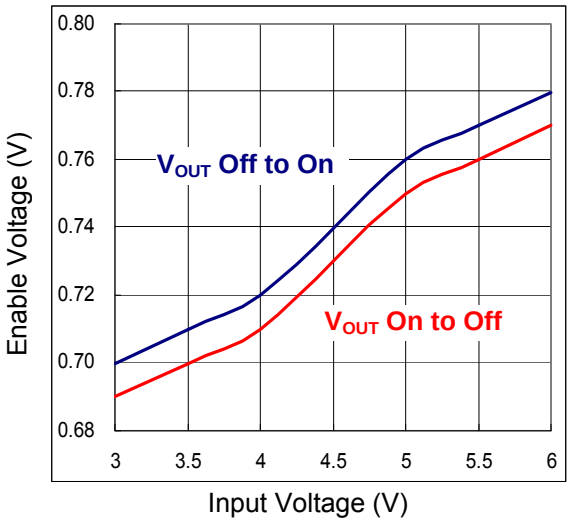
Current Limit vs. Temperature



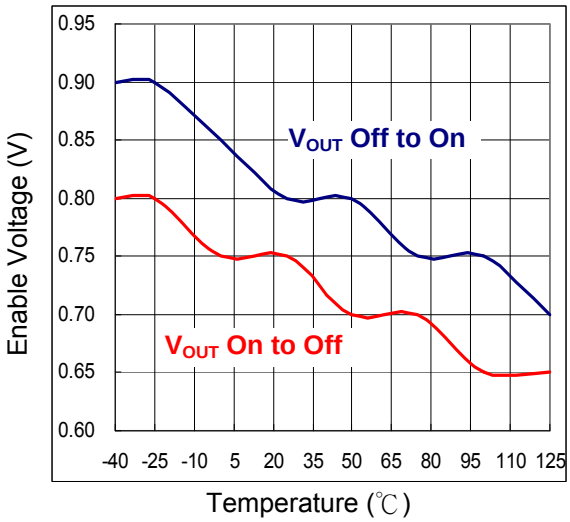
PSRR



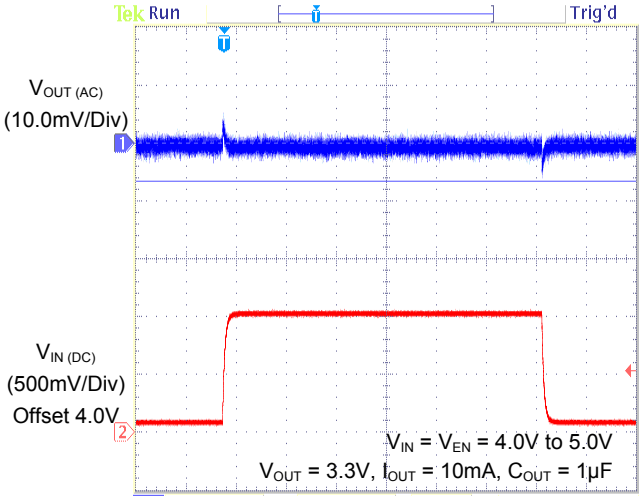
EN Threshold vs. Input Voltage



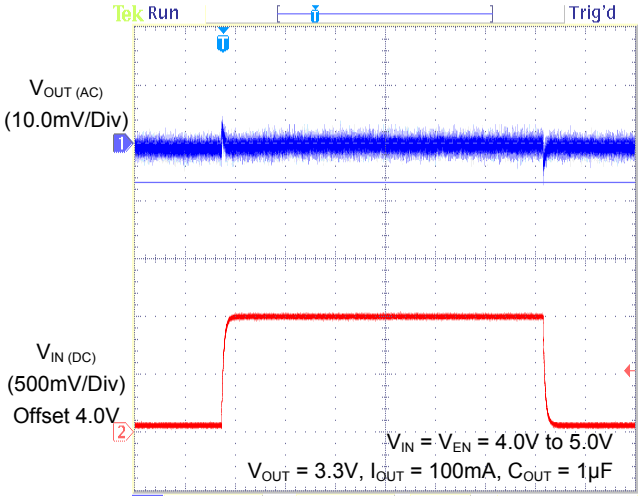
EN Threshold vs. Temperature



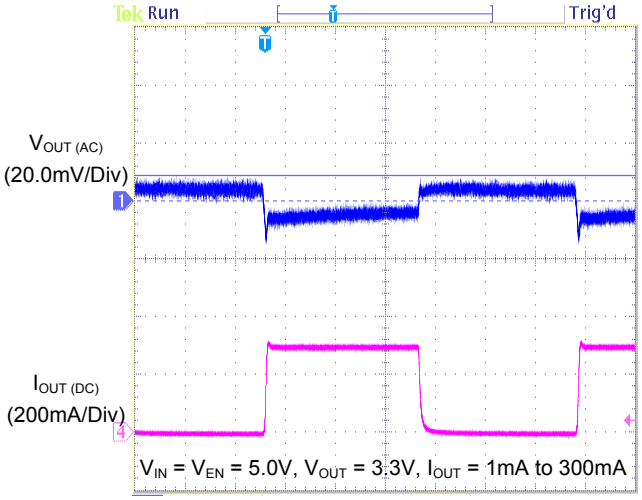
Line Transient Response



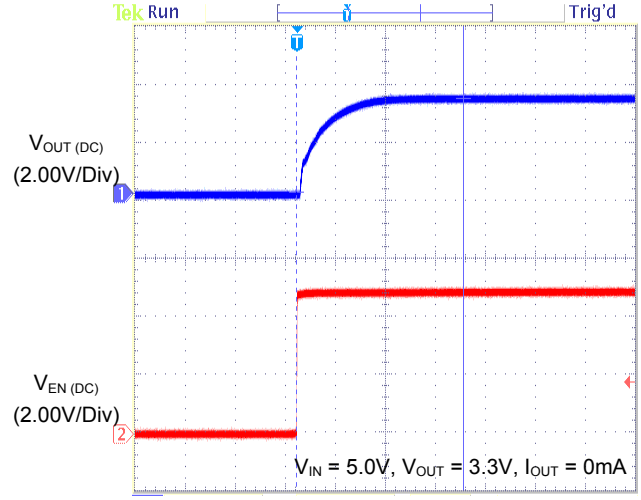
Line Transient Response



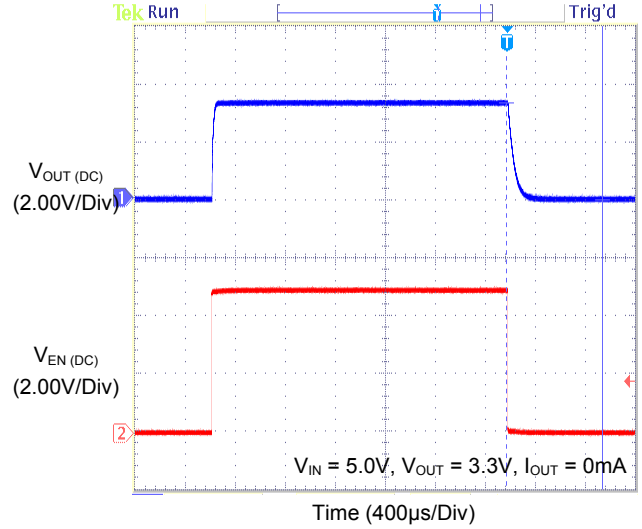
Load Transient Response



Start-up from EN



Shutdown from EN



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 iD9301 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 iD9301 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 iD9301 is a linear regulator, its power dissipation is always given by $P = I_{OUT} (V_{IN} – V_{OUT})$. The maximum power dissipation is given by: $P_{D\,(MAX)} = (T_J – T_A) / \theta_{JA} = (125^{\circ}C - 25^{\circ}C)/250^{\circ}C/W = 400mW$. Where $(T_J – T_A)$ is the temperature difference the iD9301 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 SOT-23-5 package, the thermal resistance is typically 250°C /Watt. Refer to Figure 1 & 2 for the iD9301 valid operating region (Safe Operating Area) and refer to Figure 3 for maximum power dissipation information of SOT23-5.

The die attachment area of the iD9301 lead frame is connected to pin 2, which is the GND pin. Therefore, the GND pin of iD9301 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.

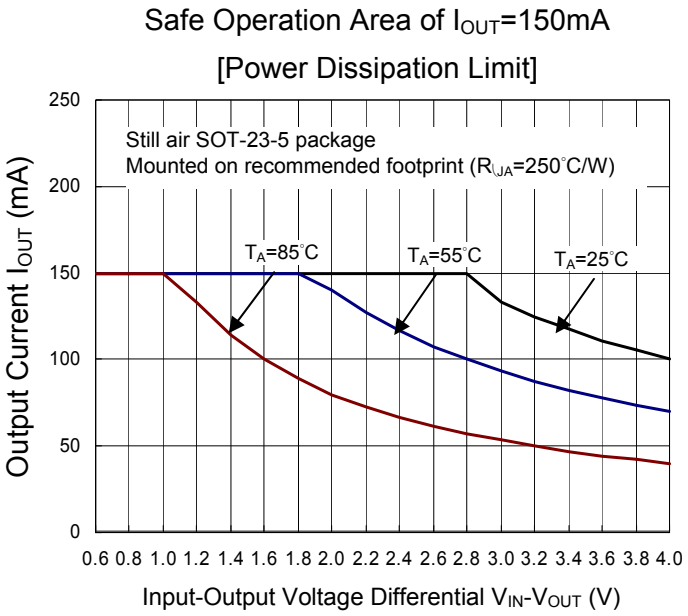


Fig 1

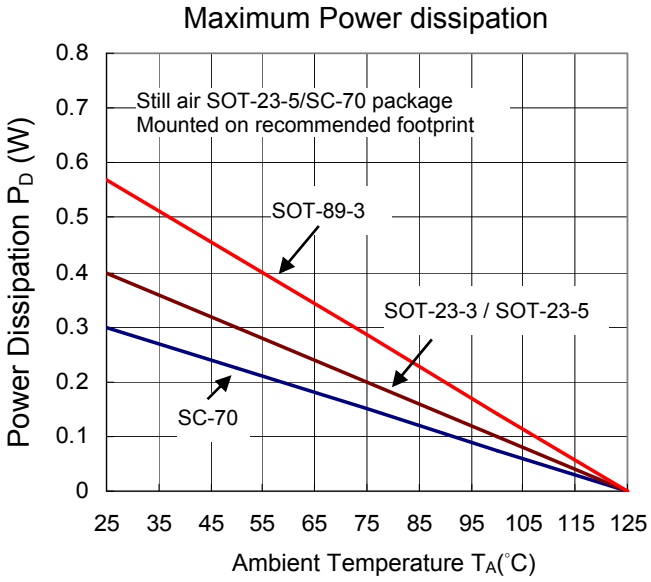


Fig 3

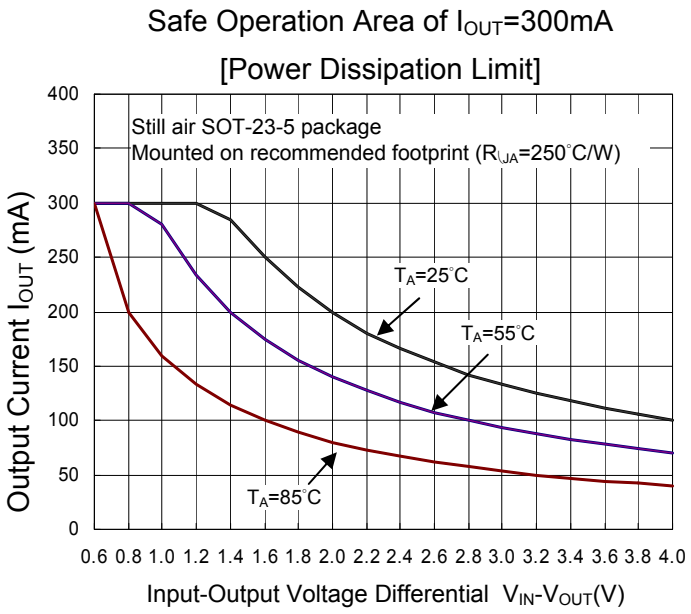
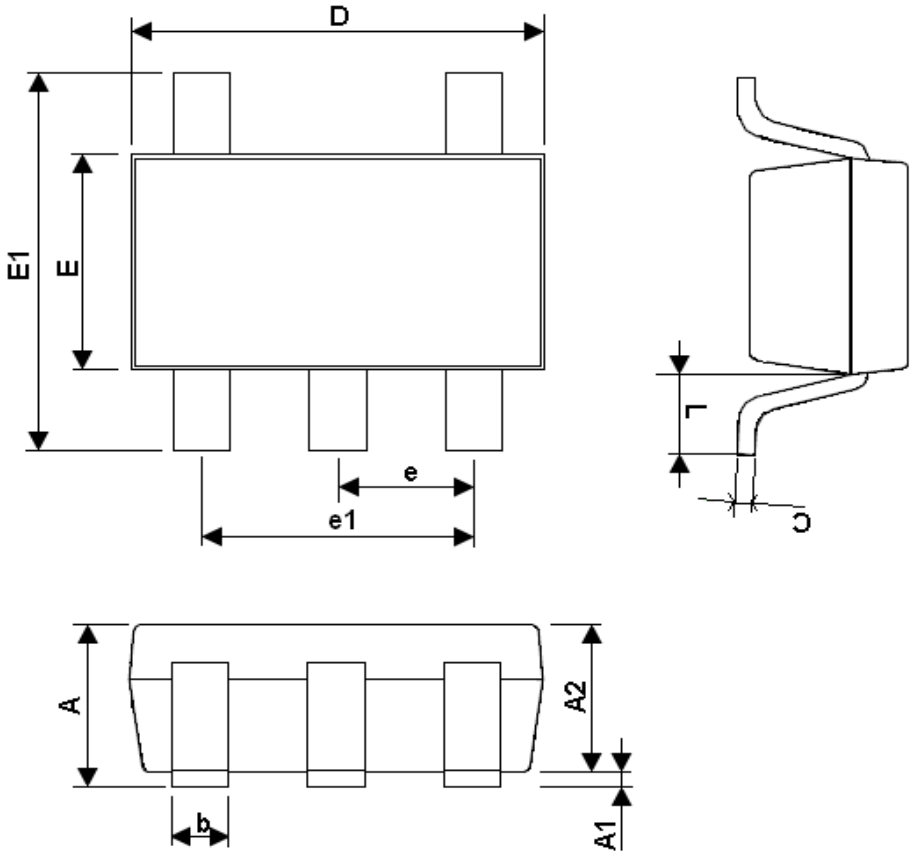


Fig 2

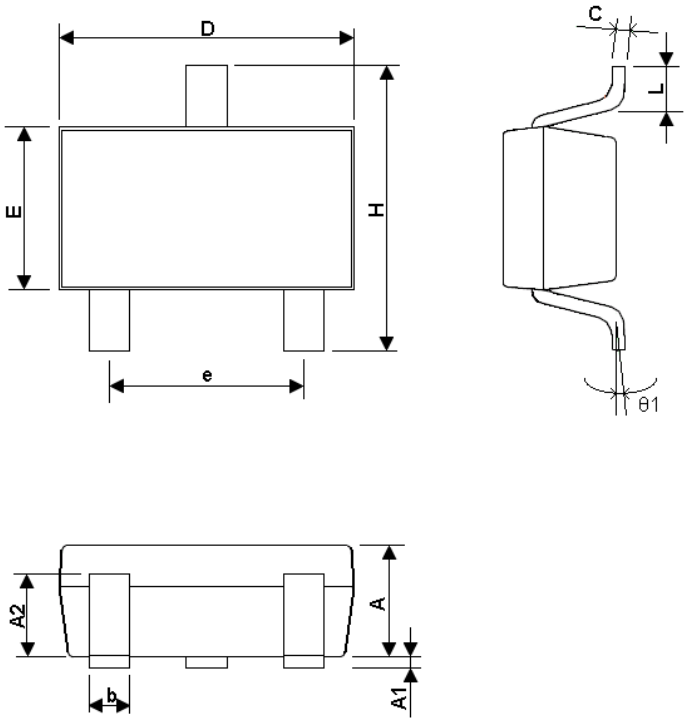
Packaging

SC70-5



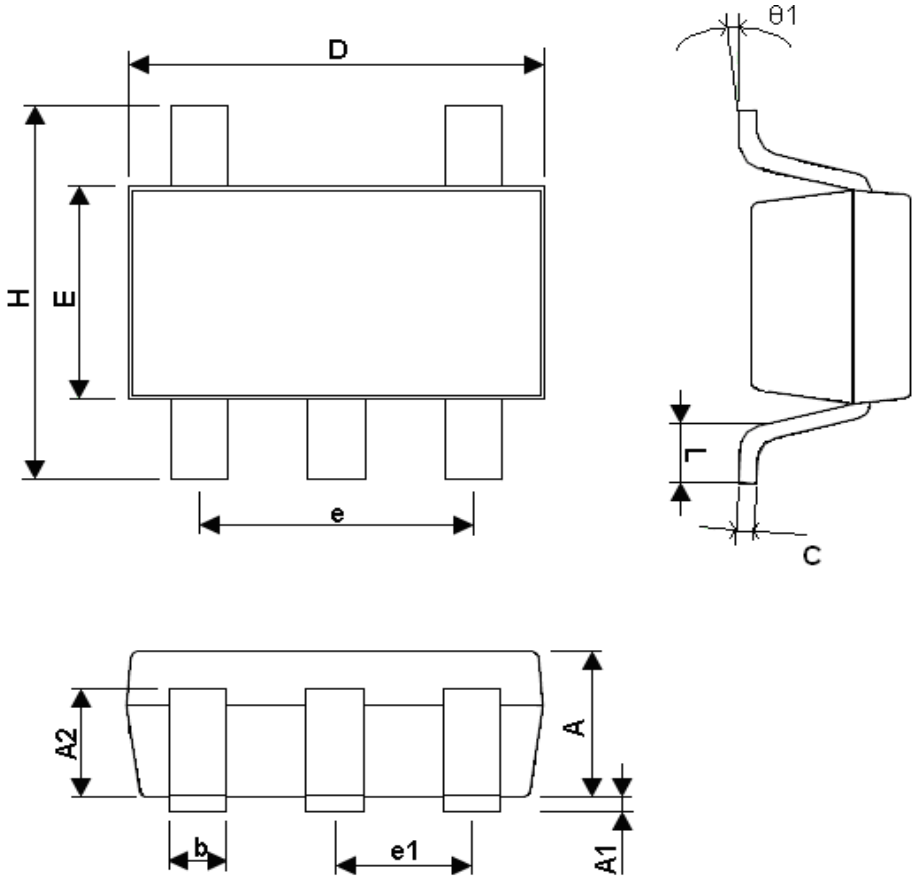
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.90	---	1.10	0.036	---	0.044
A1	0.025	---	0.10	0.001	---	0.004
A2	0.875	---	1.00	0.035	---	0.040
b	0.20	---	0.40	0.008	---	0.016
C	0.10	---	0.15	0.004	---	0.006
D	1.90	---	2.10	0.076	---	0.084
E	1.15	---	1.35	0.046	---	0.054
E1	2.00	---	2.20	0.080	---	0.088
e	0.65 BSC.			0.026 BSC.		
e1	1.30 BSC.			0.052 BSC.		
L	0.425 REF.			0.017 REF.		

SOT23-3



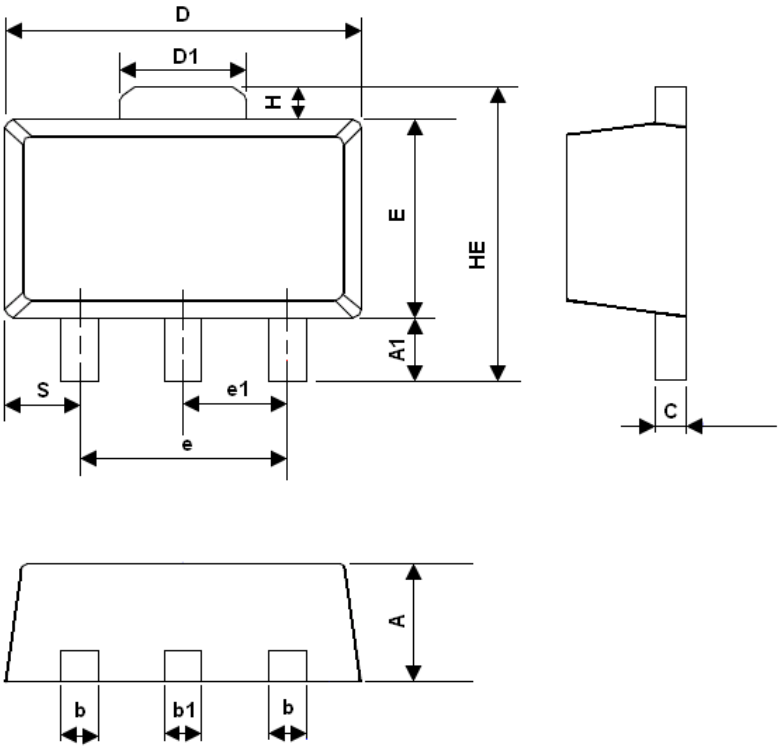
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.00	1.10	1.30	0.039	0.043	0.051
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.80	0.90	0.027	0.031	0.035
b	0.35	0.40	0.50	0.013	0.016	0.020
C	0.10	0.15	0.25	0.004	0.006	0.001
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.40	1.60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

SOT23-5



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	---

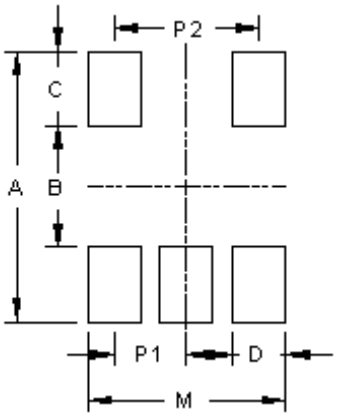
SOT89-3



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	0.185	0.020
C	0.38	0.40	0.43	0.014	0.016	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

Footprints

SOT23-5



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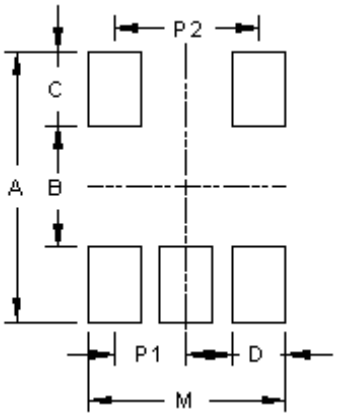
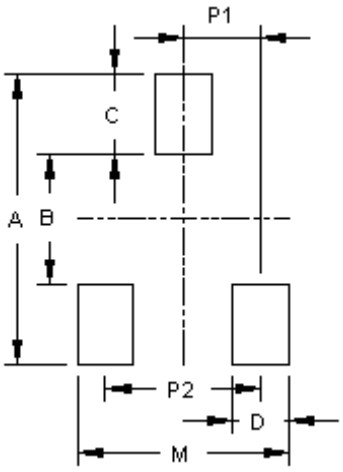
Package	Number of PIN	Footprint Dimension (mm)							Tolerance
		P1	P2	A	B	C	D	M	
SOT23-5	5	0.95	1.90	3.60	1.60	1.00	0.70	2.60	±0.10

SC70-5



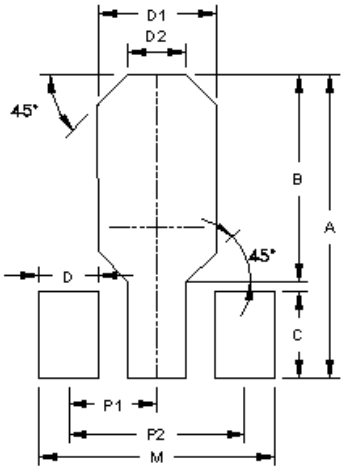
Package	Number of PIN	Footprint Dimension (mm)							Tolerance
		P1	P2	A	B	C	D	M	
SC70-5	5	0.65	1.30	2.70	1.10	0.80	0.40	1.70	±0.10

SOT23-3



Package	Number of PIN	Footprint Dimension (mm)							Tolerance
		P1	P2	A	B	C	D	M	
SOT23-3	3	0.95	1.90	3.60	1.60	1.00	0.80	2.70	±0.10

SOT89-3



Package	Number of PIN	Footprint Dimension (mm)										Tolerance
		P1	P2	A	B	B1	C	D	D1	D2	M	
SOT89-3	3	1.50	3.00	5.10	3.40	--	1.50	1.00	2.20	1.00	4.00	±0.10