5uA Low Iq，40V 150mA LDO　TD1408S/TD1408G/TD1408T/TD1408P/TD1408Y

General Description

The TD1408 series is a group of positive voltage output 3-terminal linear regulator, capable of delivering 150mA current and working under 40V input voltage. It also features extremely low standby current which is only 5μA, while still keeps very fast load transient response capability. With the extremely low 5uA standby current, TD1408 can greatly improve natural life of batteries.

TD1408 includes high accuracy voltage reference, error amplifier, and current limit circuit and output driver module. TD1408 has well load transient response and good temperature characteristic. And it uses trimming technique to guarantee output voltage accuracy within ±2%. TD1408 can provide 3.0V,3.3V,3.6V,5.0V,9.0V,12V output value. It also can be customized on command.

TD1408 is housed in 3 different types of packages, which are SOT23-3SL, SOT23-3L，SOT23-5 and SOT89-3L.

Features

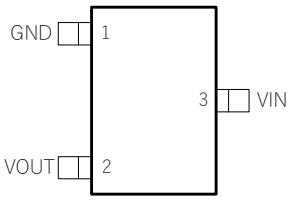
- Low Power Consumption:5.0μA（Typ.）
- Maximum Output Current:150mA
- Low Dropout Voltage
- 740mV@100mA (VOUT=3.3V)
- 1300mV@150mA (VOUT=3.3V)
- Input Voltage Range:3V~40V
- Output Voltage Range:3.0V,3.3V,3.6V,5.0V,9.0V,12V
- Highly Accuracy: ±2%
- Current Limit and Short Protection
- Over Temperature Protection

Application

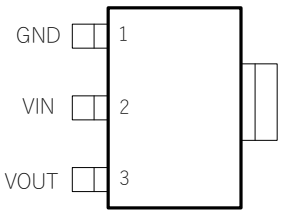
- Wearables
- Toys
- Smart Home Application
- Battery Powered equipment

Pin Configurations

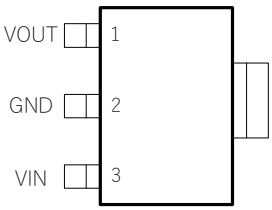
SOT23-3SL&SOT23-3L



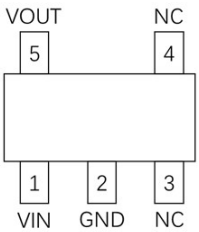
SOT89-3L



SOT89-3L(B-TYPE)



SOT23-5



Pin Description

Pin Number					Pin Name	Description
SOT23-3SL	SOT23-3L	SOT23-5	SOT89-3L	SOT89-3L(B-TYPE)		
1	1	2	1	2	GND	Ground
2	2	5	3	1	VOUT	Output of the regulator
3	3	1	2	3	VIN	Power Supply Input
		3,4			NC	Not connected

Ordering Information

Part No	Package	Voltage option
TD1408S-30	SOT23-3SL	3.0V
TD1408S-33	SOT23-3SL	3.3V
TD1408S-36	SOT23-3SL	3.6V
TD1408S-50	SOT23-3SL	5.0V
TD1408S-90	SOT23-3SL	9.0V
TD1408S-120	SOT23-3SL	12.0V
TD1408G-30	SOT23-5	3.0V
TD1408G-33	SOT23-5	3.3V
TD1408G-36	SOT23-5	3.6V
TD1408G-50	SOT23-5	5.0V
TD1408G-90	SOT23-5	9.0V
TD1408G-120	SOT23-5	12.0V
TD1408T-30	SOT23-3L	3.0V
TD1408T-33	SOT23-3L	3.3V
TD1408T-36	SOT23-3L	3.6V
TD1408T-50	SOT23-3L	5.0V
TD1408T-90	SOT23-3L	9.0V
TD1408T-120	SOT23-3L	12.0V
TD1408P-30	SOT89-3L	3.0V
TD1408P-33	SOT89-3L	3.3V
TD1408P-36	SOT89-3L	3.6V
TD1408P-50	SOT89-3L	5.0V
TD1408P-90	SOT89-3L	9.0V
TD1408P-120	SOT89-3L	12.0V
TD1408Y-30	SOT89-3L(B-Type)	3.0V
TD1408Y-33	SOT89-3L(B-Type)	3.3V
TD1408Y-36	SOT89-3L(B-Type)	3.6V
TD1408Y-50	SOT89-3L(B-Type)	5.0V
TD1408Y-90	SOT89-3L(B-Type)	9.0V
TD1408Y-120	SOT89-3L(B-Type)	12.0V

Function Block

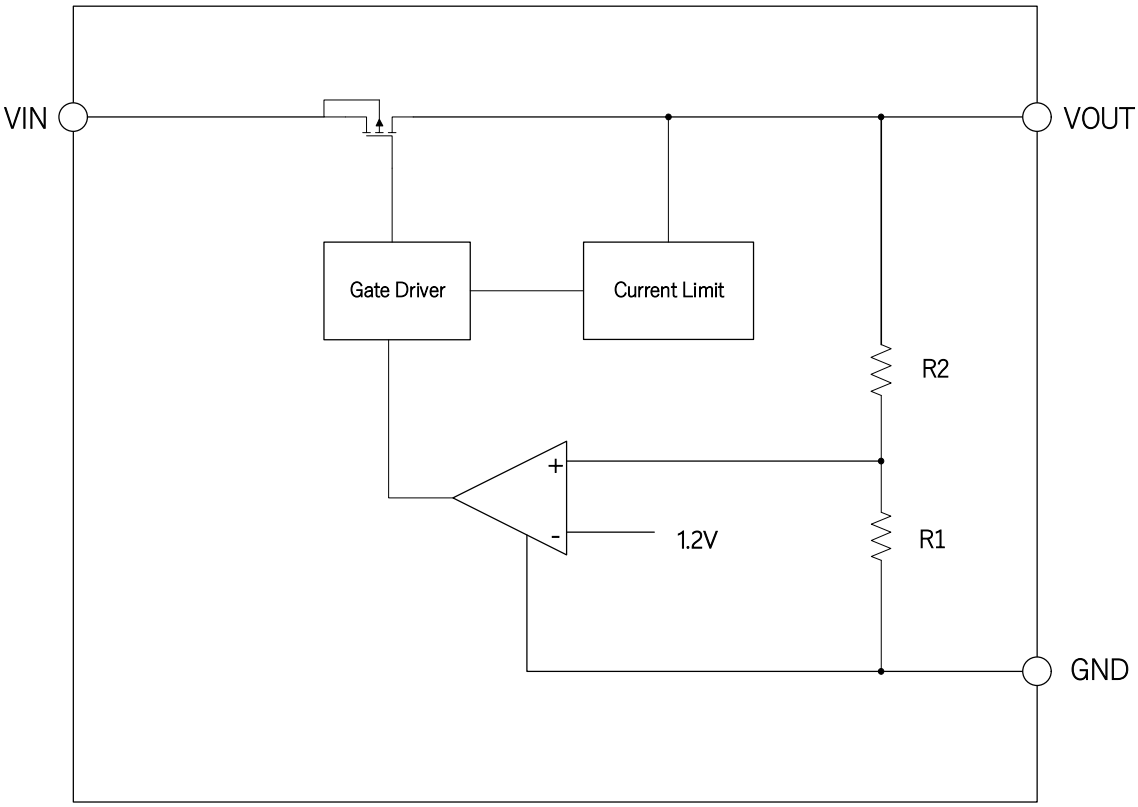
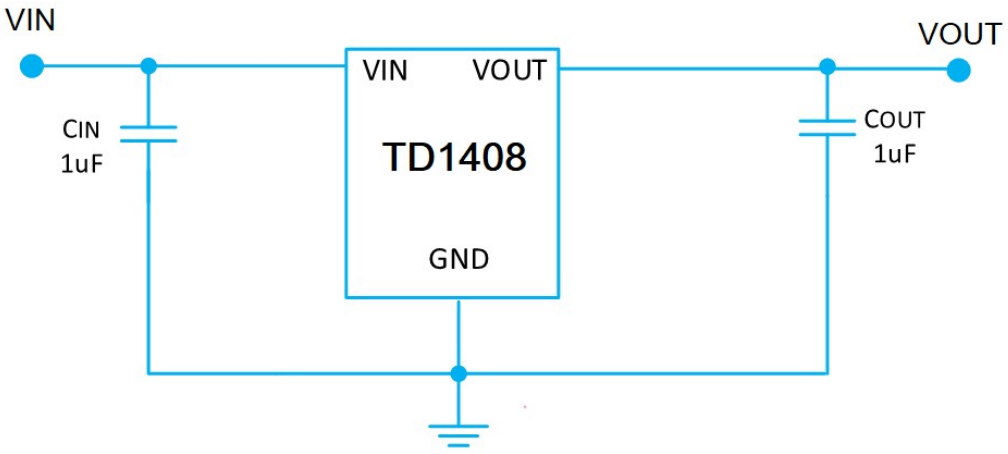


Figure1 Function Block Diagram of TD1408

Typical Application Circuit



Note: Input capacitor (C_{IN}=1μF) and Output capacitor (C_{OUT}≥1μF) are recommended in all application circuit.

Absolute Maximum Ratings (at T_A=25℃)

Symbol	Parameter	Rating	Unit
V_{IN}	Input Voltage	42	V
V_{OUT}	Output Voltage	-0.3V to +20	V
P_D	Power Dissipation(T_A=25℃)	0.3(SOT23-3L)	W
		0.5(SOT89-3L)	
ESD	ESD Susceptibility (Human Body Model)	2K	V
θ_{JA}	Junction-to-Ambient Resistance in free air	250.4 (SOT23-3SL)	°C/W
		206 (SOT23-3L)	°C/W
		204.8 (SOT23-5)	°C/W
		54.8 (SOT89-3)	°C/W
θ_{JC}	Junction-to-Case Resistance in free air	140.4 (SOT23-3SL)	°C/W
		145.2 (SOT23-3L)	°C/W
		134.1 (SOT23-5)	°C/W
		88.1 (SOT89-3)	°C/W
T_{SDR}	Maximum Lead Soldering Temperature (10 Seconds)	260	°C

Electrical Characteristics

Unless otherwise specified, these specifications apply over T_J=25°C

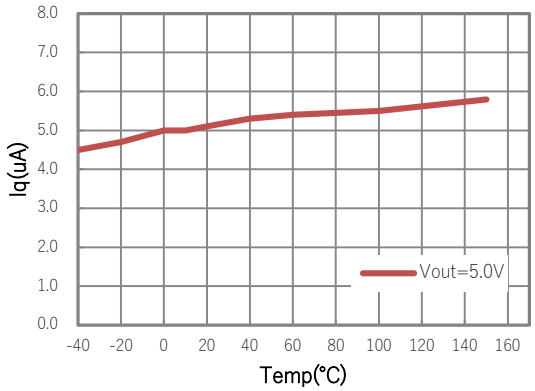
Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}		3	-	40	V
Output Voltage Range	V_{OUT}		3	-	12	V
Output Accuracy			-2	-	+2	%
Ground supply current		No load	-	5	10	μA
Max output current		Vin-Vout=2V	150	-	-	mA
Line regulation		Iload=1mA	-	0.01	0.1	%/V
Load regulation		Iload=1-100mA	-	2	4	%
Dropout Voltage		Iload=100mA, Vout>3V	-	740	1000	mV
Current Limit			-	200	-	mA
Short current			-	200	-	mA
PSRR@100Hz		Vin=Vout+0.5V, Iload=1mA	-	65	-	dB
Startup time			-	500	-	μS
OTP			-	150	-	°C
OTP hysteresis			-	30	-	°C

Note: All tests are conducted under ambient temperature 25°C and within a short period of time 20ms.

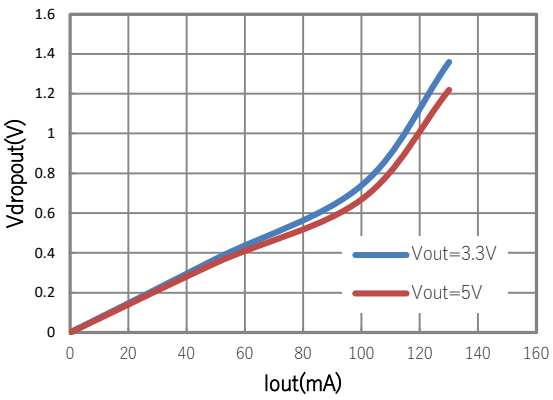
Typical Operating Characteristics

C_{IN}=C_{OUT}=1uF, T_A = 25°C, unless otherwise specified

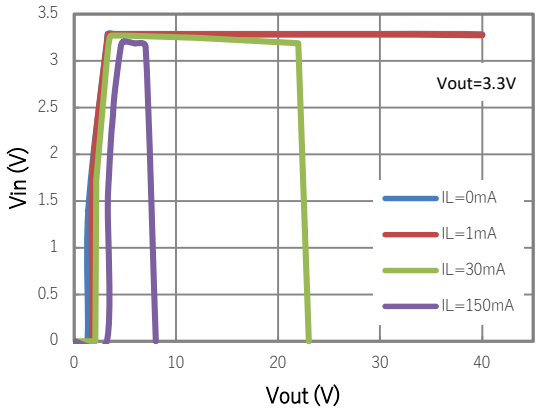
Iq VS.Temp



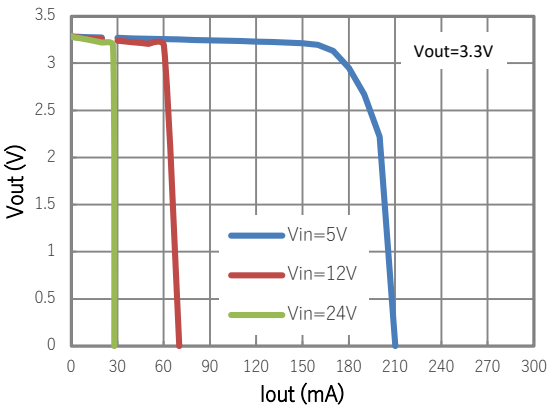
Iout VS. Dropout



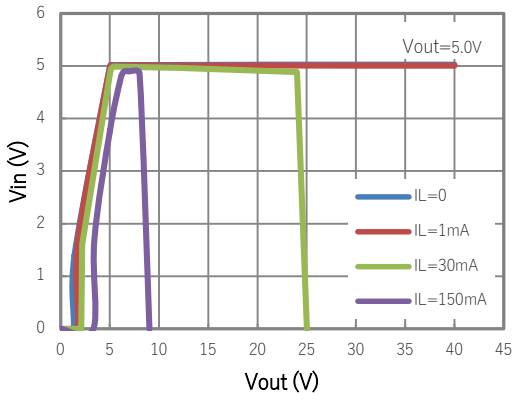
Line Regulation



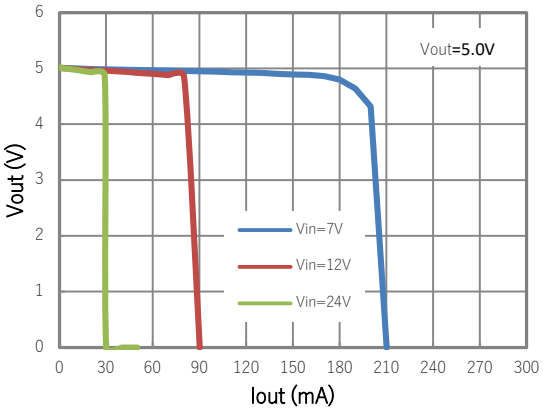
Load Regulation



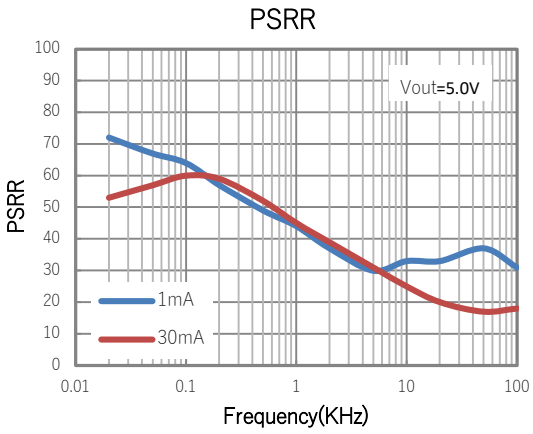
Line Regulation



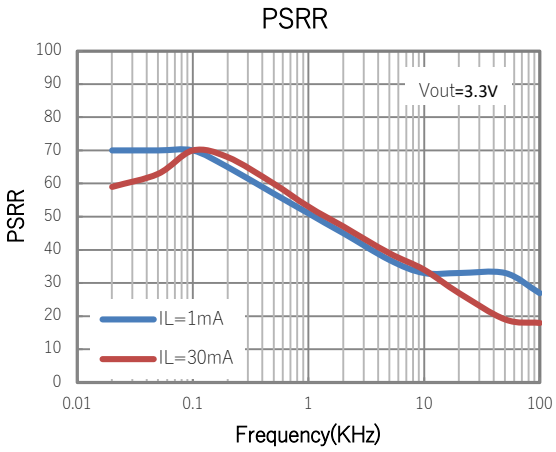
Load Regulation



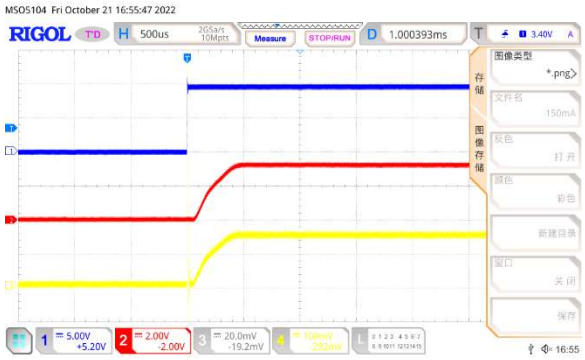
Typical Operating Characteristics(Cont.)



Vin fast on 150mA，Vout=3.3V



Vin fast off 150mA，Vout=3.3V



Vin fast on 150mA，Vout=5.0V

Vin fast off 150mA,Vout=5.0V

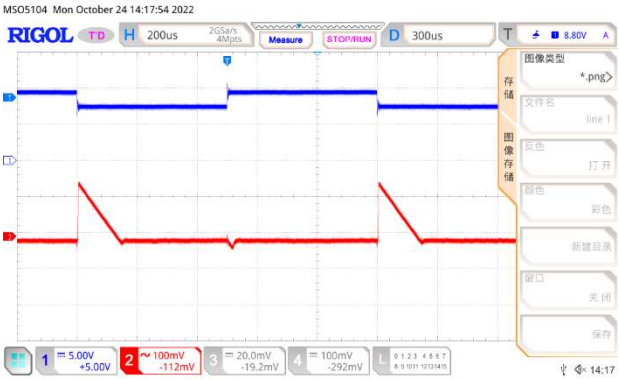
Typical Operating Characteristics(Cont.)

Vin slow on/off 150mA，Vout=3.3V

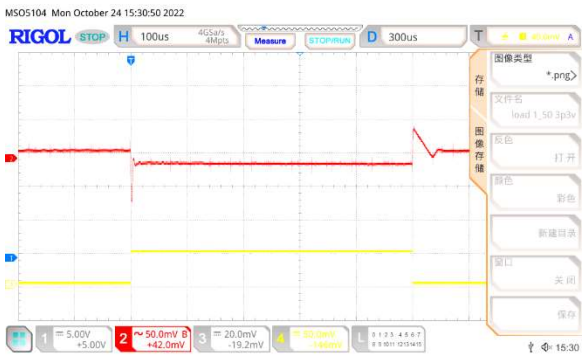
Vin slow on/off 150mA，Vout=5.0V

Line transient Vout=3.3V，Iout=1mA

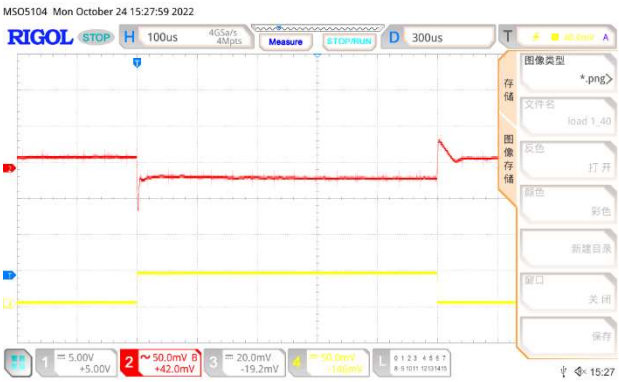
Line transient Vout=5.0V，Iout=1mA



Load transient Vout=3.3V，Iout=1mA-50mA



Load transient Vout=5.0V，Iout=1mA-40mA



Function Description

A minimum of 1μF capacitor must be connected from Vout to ground to insure stability. Input capacitor of 1uF is recommended to ensure the input voltage does not sag below the minimum dropout voltage during load transient event. Vin pin must always be dropout voltage higher than Vout in order for the device to regulate properly.

APPLICATION INFORMATION

Like any low-dropout regulators, TD1408 requires input and output decoupling capacitors. These capacitors must be correctly selected for good performance. Both input and output capacitors are recommended to be placed as close to chip pin as possible.

Capacitor Selection

Normally, use a 1μF capacitor on the input and a 1μF capacitor on the output of the TD1408. Larger input capacitor values and lower ESR (X5R, X7R) provide better supply noise rejection and transient response.

Input-Output (Dropout) Voltage

A regulator's minimum input-to-output voltage differential (dropout voltage) determines the lowest usable supply voltage. In battery-powered systems, this determines the useful end-of-life battery voltage. Because the device uses a PMOS, its dropout voltage is a function of drain to source on resistance, RDS (on), multiplied by the load current:

$$V_{dropout} = V_{in} - V_{out} = R_{DS(on)} \times I_{out}$$

Current Limit and Thermal Shutdown Protection

In order to prevent overloading or thermal condition from damaging the device, TD1408 has internal thermal and current limiting functions designed to protect the device. It will rapidly shut off PMOS pass element during overloading or over temperature condition.

Thermal Considerations

The TD1408 series can deliver a current of up to 150mA over the full operating junction temperature range. However, the maximum output current must be controlled at higher ambient temperature to ensure the junction temperature does not exceed 150°C. With all possible conditions, the junction temperature must be within the range specified under operating conditions. Power dissipation can be calculated based on the output current and the voltage drop across regulator.

$$P_d = (V_{in} - V_{out}) \times I_{out}$$

The final operating junction temperature for any set of conditions can be estimated by the following thermal equation:

$$P_{d(max)} = (T_{j(max)} - T_a) / \theta_{ja}$$

Where Tj (max) is the maximum junction temperature of the die (150°C) and Ta is the maximum ambient temperature.

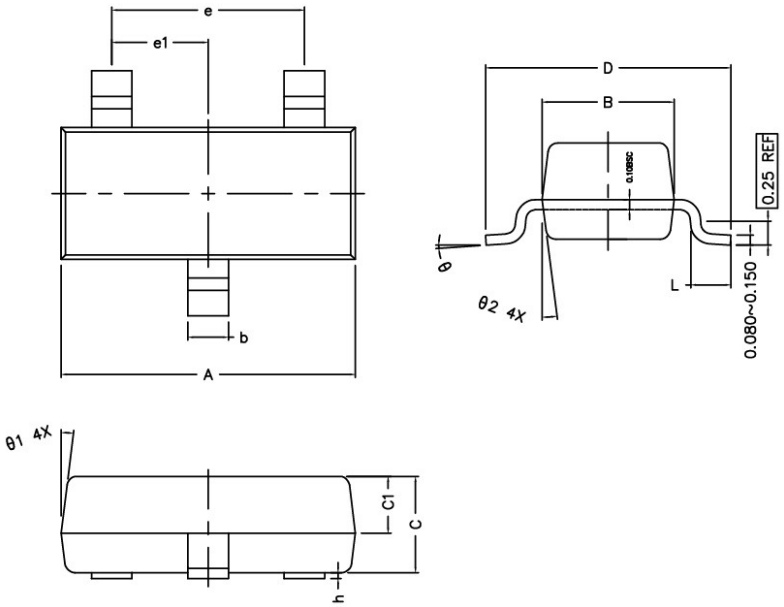
When junction temperature exceeds 150°C, over temperature protection may be triggered to prevent device from over heat.

PCB Layout

An input capacitance of 1μF is required between the TD1408 input pin and ground (the amount of the capacitance may be increased without limit), this capacitor must be located a distance of not more than 1cm from the input and return to a clean analog ground. Input capacitor can filter out the input voltage spikes caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire. Otherwise, the actual voltage at the Vin pin may exceed the absolute maximum rating. The output capacitor also must be located a distance of not more than 1cm from output to a clean analog ground. Because it can filter out the output spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire.

Package Information

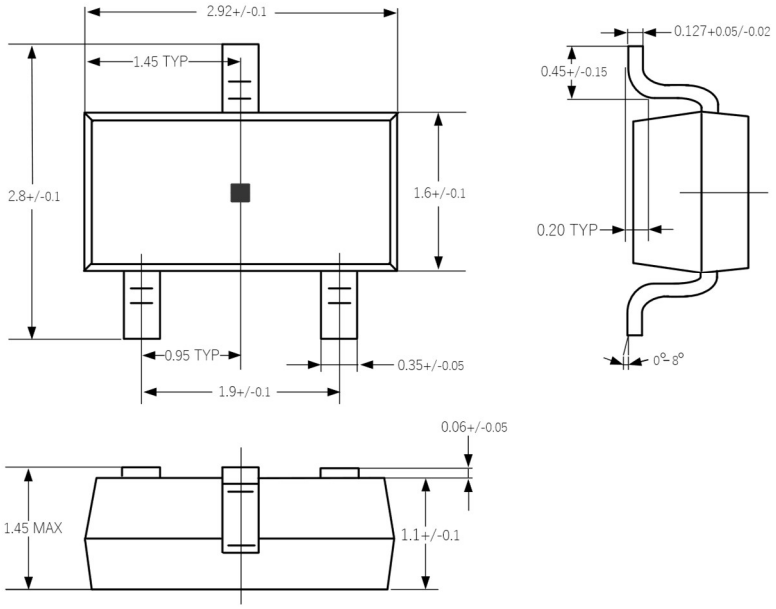
SOT23-3SL Package Outline Dimensions



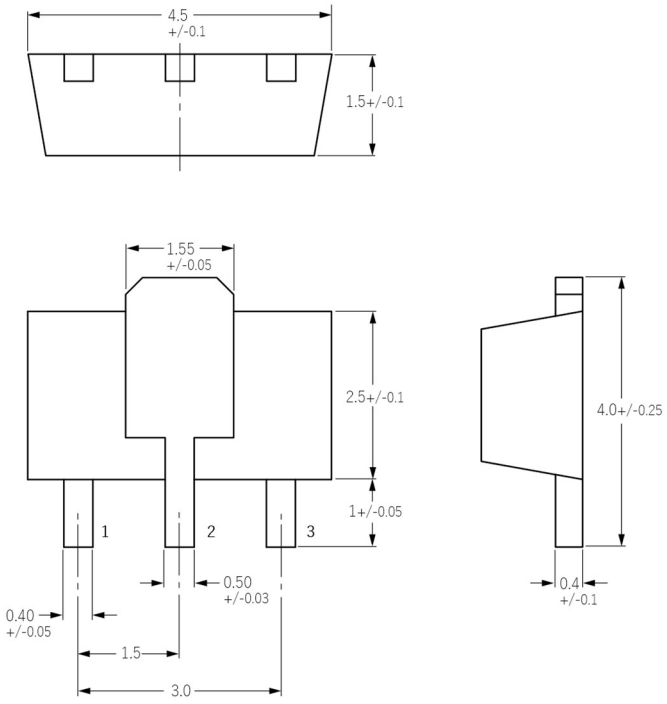
Symbol	MIN	NORM	MAX
A	2.800	2.900	3.000
B	1.200	1.300	1.400
C	0.900	1.000	1.100
C1	0.500	0.550	0.600
D	2.250	2.400	2.550
L	0.300	0.400	0.500
h	0.010	0.050	0.100
b	0.300	0.400	0.500
e	1.90TYP		
e 1	0.95TYP		
θ1	7° TYP		
θ2	7° TYP		
θ	0° -7°		

Package Information

SOT23-3L Package Outline Dimensions

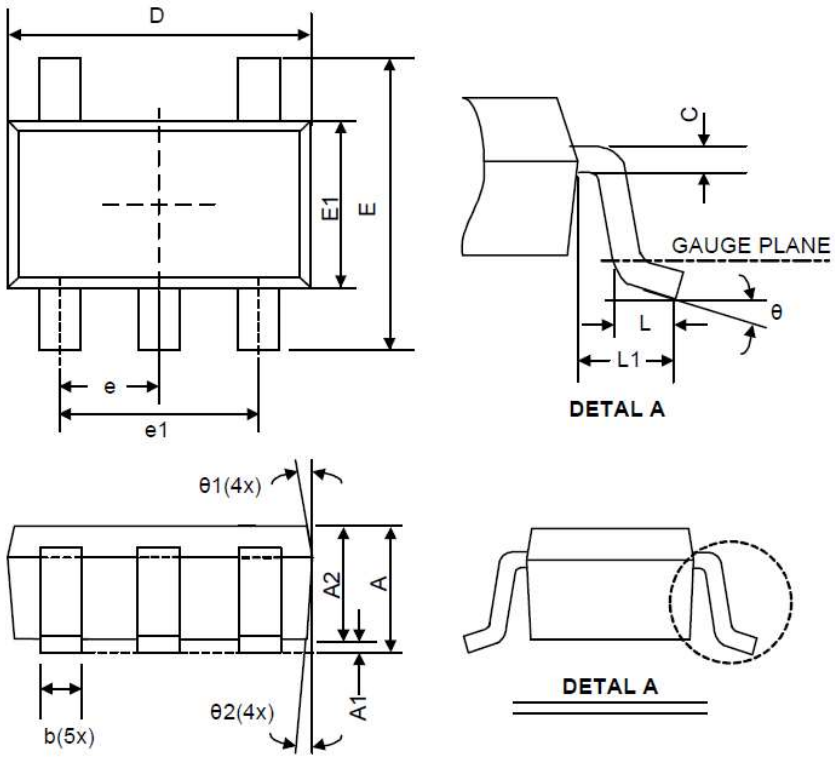


SOT89-3L Package Outline Dimensions



Package Information

SOT23-5 Package Outline Dimensions



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.05	-	1.35	0.041	-	0.053
A1	0.05	-	0.15	0.002	-	0.006
A2	1.00	1.10	1.20	0.039	0.043	0.047
b	0.30	-	0.50	0.012	-	0.020
C	0.08	-	0.22	0.003	-	0.009
D	2.80	2.90	3.00	0.110	0.114	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
E	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	-	0.60	0.012	-	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e1	1.80	1.90	2.00	0.071	0.075	0.079
e	0.85	0.95	1.05	0.033	0.037	0.041
θ	0°	4°	8°	0°	4°	8°
θ1	5°	10°	15°	5°	10°	15°
θ2	5°	10°	15°	5°	10°	15°

Design Notes