36V, 200mA Low Dropout Voltage Linear Regulator

FEATURES

- 2.2μA Ground Current at no Load
- ±2% Output Accuracy
- 200mA Output Current
- Wide Operating Input Voltage Range: 2V to 36V
- Dropout Voltage: 0.66V at 100mA (V_{OUT}=5V)
- Support Fixed Output Voltage 1.8V, 3.3V, 5V, 9V, 12V
- Stable with Ceramic or Tantalum Capacitor
- Current Limit Protection
- Over-Temperature Protection
- SOT23-3, SOT23-5 and SOT89-3 Package Available

DESCRIPTION

The AIC1704B series are a group of low-dropout (LDO) voltage regulators offering the benefits of wide input voltage range, low dropout voltage, low power consumption, and miniaturized packaging.

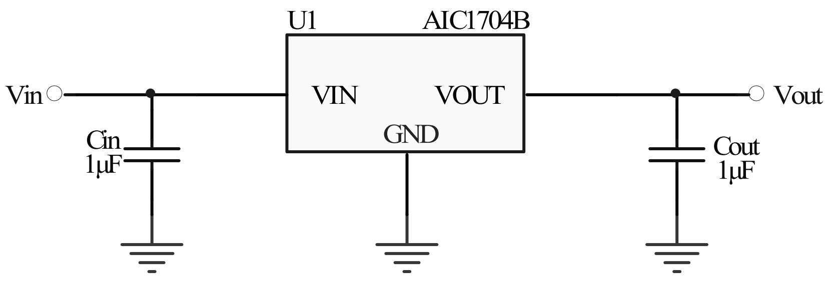
Quiescent current of only 2.2μA makes these devices ideal for powering the battery-powered, always-on systems that require very little idle-state power dissipation to a longer service life.

The AIC1704B series of linear regulators are stable with the ceramic output capacitor over its wide input range from 2V to 36V and the entire range of output load current (0mA to 200mA).

APPLICATIONS

- Portable, Battery Powered Equipment
- Low Power Microcontrollers
- Laptop, Palmtops and PDAs
- Wireless Communication Equipment
- Audio/Video Equipment
- Car Navigation Systems
- Industrial Controls
- Weighting Scales
- Meters
- Home Automation

TYPICAL APPLICATION CIRCUIT



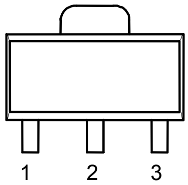
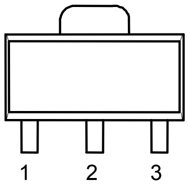
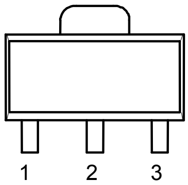
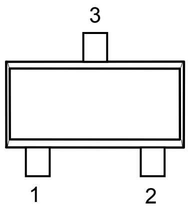
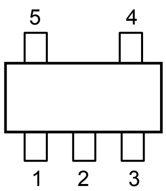
AIC1704B Typical Application Circuit

ORDERING INFORMATION

AIC1704B-XXXXXXXX

- PACKING TYPE
  TR: TAPE & REEL
  BG: BAG
- PACKAGE TYPE
  X3A: SOT89-3
  X3T: SOT89-3
  X3L: SOT89-3
  U3: SOT23-3
  U5: SOT23-5
- G: GREEN PACKAGE
- OUTPUT VOLTAGE
  18: 1.8V
  33: 3.3V
  50: 5.0V
  90: 9.0V
  A1: 12.0V
  (Special Request: Any Voltage between 1.8V and 12V under specific business agreement)

Example: AIC1704B-33GX3ATR
→ 3.3V Version, in Green SOT89-3 Package and Tape & Reel Packing Type

PIN CONFIGURATION	
SOT89-3(X3A) TOP VIEW 1: GND 2. VIN 3. VOUT	
SOT89-3(X3T) TOP VIEW 1: VOUT 2. GND 3. VIN	
SOT89-3(X3L) TOP VIEW 1: VIN 2. GND 3. VOUT	
SOT23-3(U3) TOP VIEW 1: GND 2. VOUT 3. VIN	
SOT23-5(U5) TOP VIEW 1: VIN 2. GND 3. NC 4. NC 5. VOUT	

ABSOLUTE MAXIMUM RATINGS

VIN Pin to GND Pin Voltage .... -0.3V to 40V
VOUT Pin to GND Pin Voltage .... -0.3V to 14V
VOUT Pin to VIN Pin Voltage .... -40V to 0.3V
Storage Temperature Range .... -60ºC~150ºC
Lead Temperature (Soldering, 10 sec) 260ºC
Junction Temperature 150ºC
Operating Ambient Temperature Range T_A .... -40ºC~85ºC

Thermal Resistance Junction to Case, $R\theta_{JC}$	SOT23-3	115°C/W
	SOT23-5	115°C/W
	SOT89-3	45°C/W
Thermal Resistance Junction to Ambient, $R\theta_{JA}$	SOT23-3	250°C/W
	SOT23-5	250°C/W
	SOT89-3	160°C/W

(Assume no Ambient Airflow, no Heatsink)

Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

ELECTRICAL CHARACTERISTICS

(V_{IN}=15V, V_{EN}=5V, T_A=25°C, unless otherwise specified) (Note 1)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage		V_{IN}	2		36	V
DC Output Voltage Accuracy	I_{LOAD}=0.1mA		-2		2	%
Dropout Voltage	I_{LOAD}=100mA, V_{OUT}≥5V	V_{DROP}		0.66		V
	I_{LOAD}=100mA, V_{OUT}=3.3V	$V_{DROP\_3.3V}$		0.75		
	I_{LOAD}=100mA, V_{OUT}=1.8V	$V_{DROP\_1.8V}$		1		
GND Current	I_{LOAD}=0mA, V_{OUT}≤5V	I_Q		2.2		μA
	I_{LOAD}=0mA, 5V<V_{OUT}≤12V	I_{QH}		4.2		
Line Regulation	I_{LOAD}=1mA, 5V≤V_{IN}≤36V	ΔLINE		0.3		%
Load Regulation	1mA≤I_{LOAD}≤200mA	ΔLOAD		0.1		%
Output Current Limit	V_{OUT}=0V	I_{LIM}	201	300		mA
Power Supply Rejection Ratio	V_{OUT}=5V, I_{LOAD}=1mA, V_{IN}=12V, f=100Hz	PSRR		70		dB
Thermal Shutdown Temperature	I_{LOAD}=10mA	T_{SD}		160		°C
Thermal Shutdown Hysteresis	I_{LOAD}=10mA	ΔT_{SD}		15		°C

Note 1. Specifications are production tested at T_A=25°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with Statistical Quality Controls (SQC).

■ TYPICAL PERFORMANCE CHARACTERISTICS

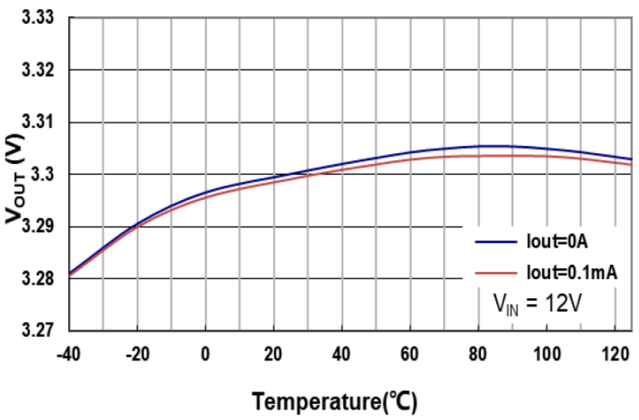


Fig. 1 Output Voltage vs. Temperature

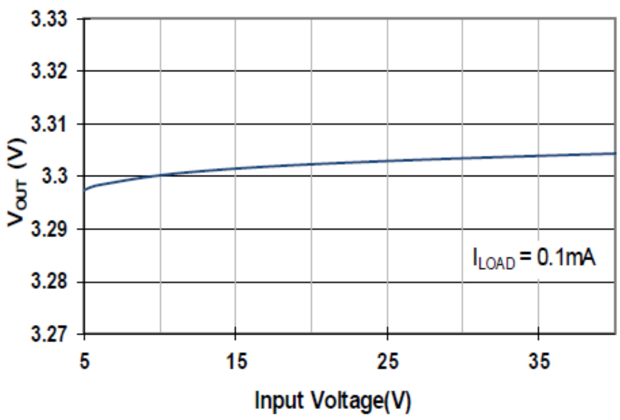


Fig. 2 Output Voltage vs. Input Voltage

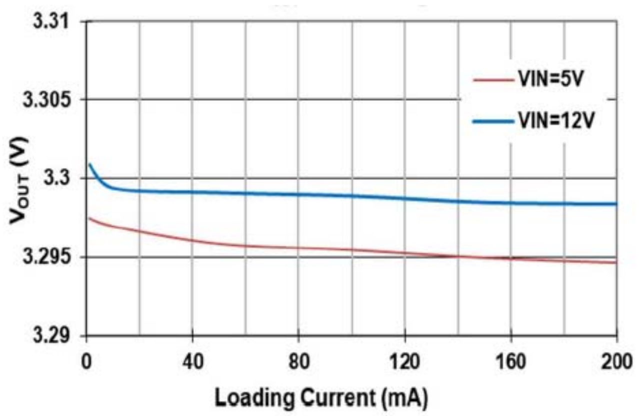


Fig.3 Output Voltage vs. Loading Current

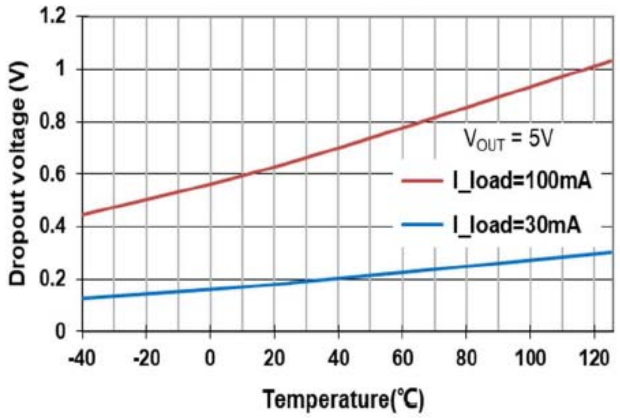


Fig.4 Dropout Voltage vs. Temperature

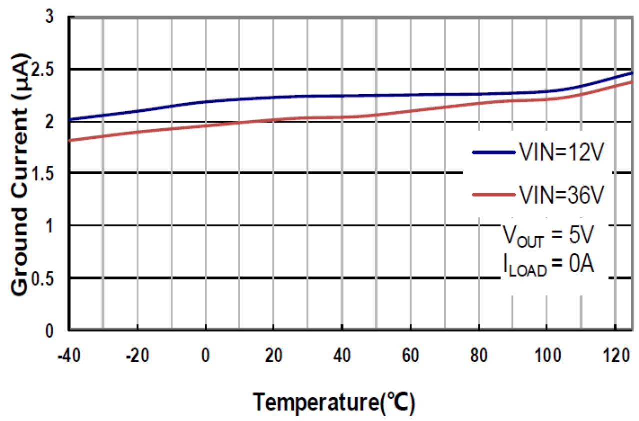


Fig.5 Ground Current vs. Temperature

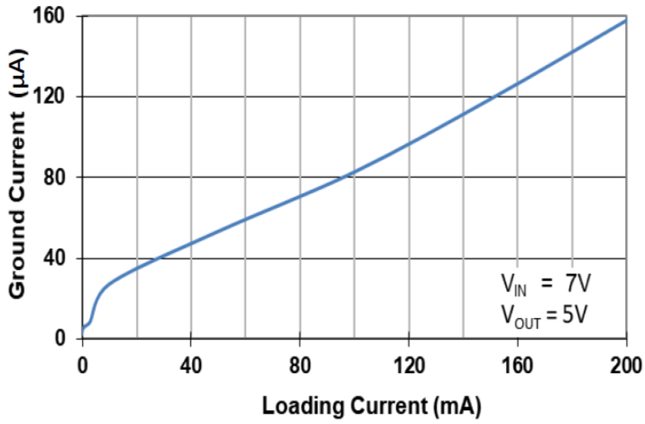


Fig.6 Ground Current vs. Loading Current

TYPICAL PERFORMANCE CHARACTERISTICS(Continued)

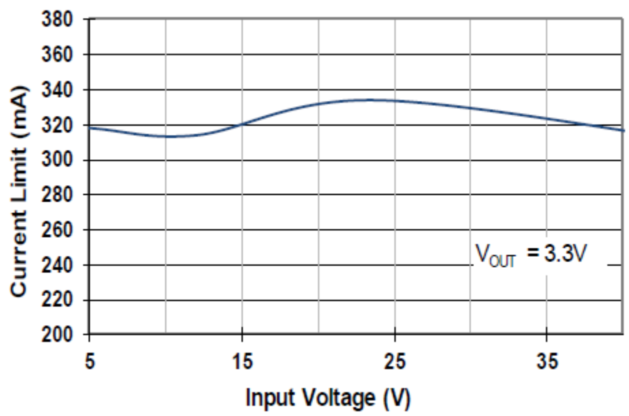


Fig. 7 Current Limit vs. Input Voltage

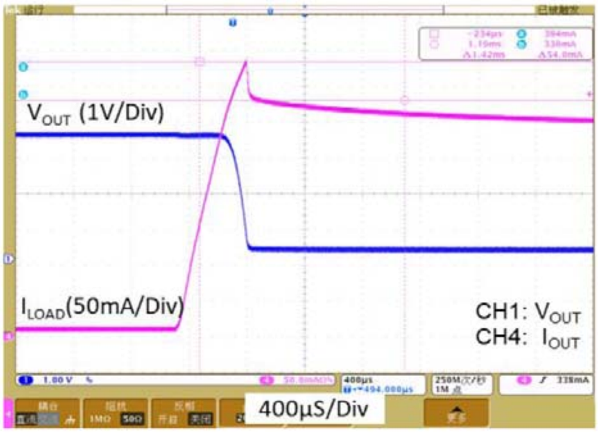


Fig. 8 Current Limit Response

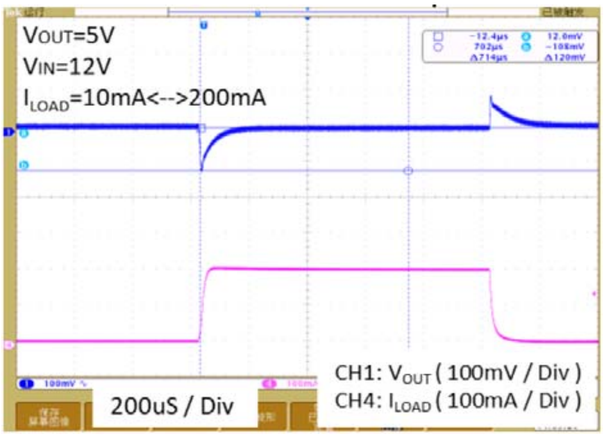


Fig. 9 Load Transient Response

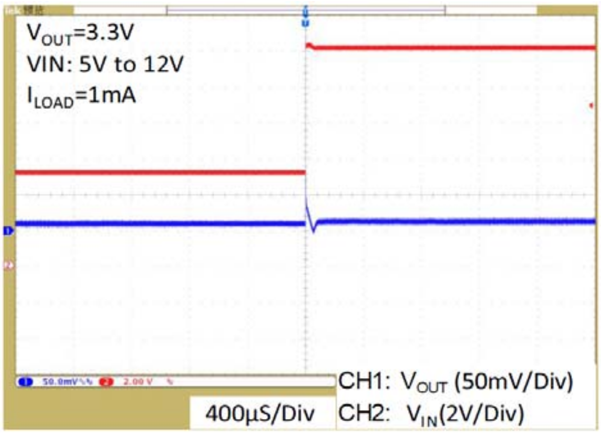


Fig. 10 Line Transient Response

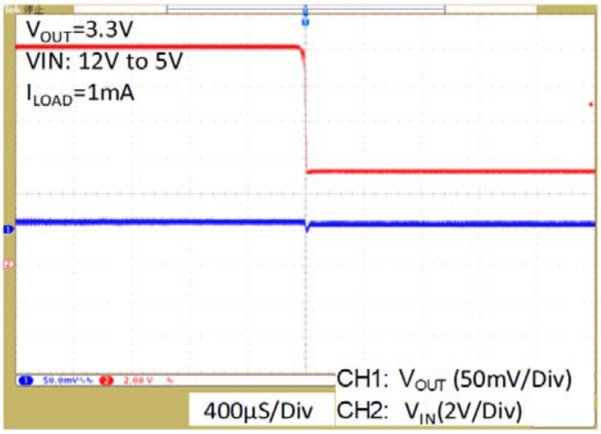


Fig. 11 Line Transient Response

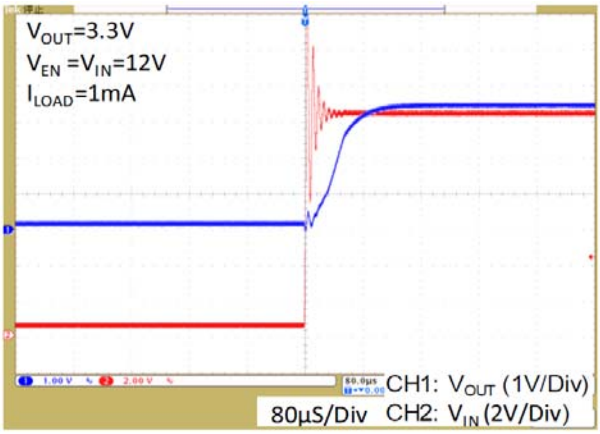
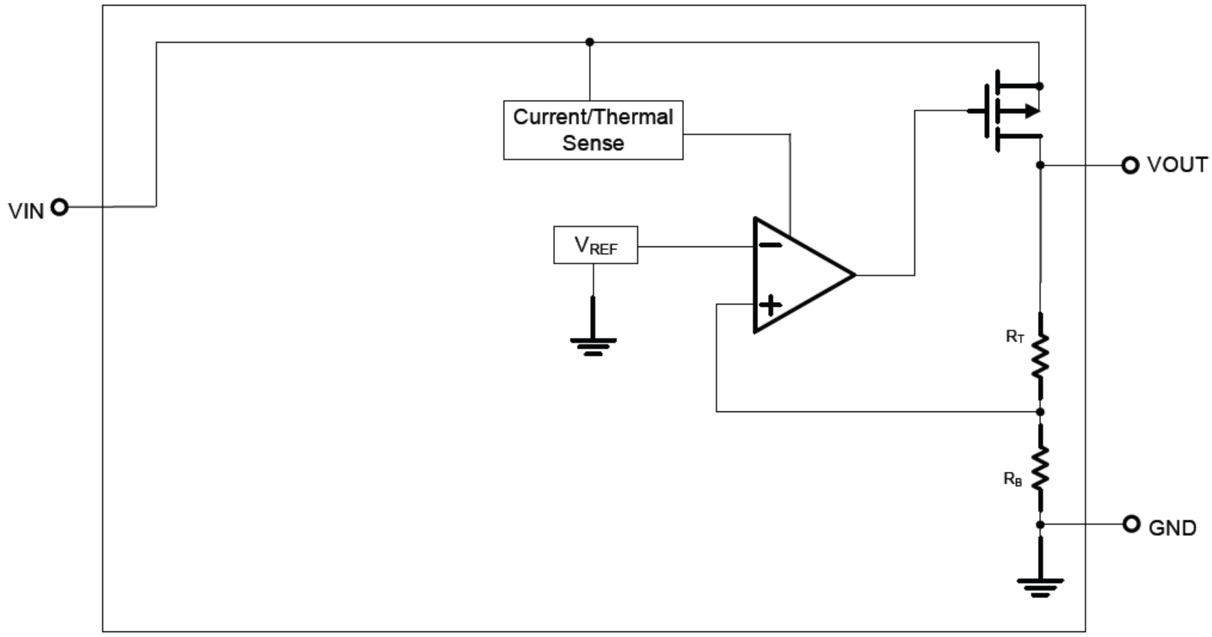


Fig. 12 V_{OUT} Turn on by V_{IN} Quick Power Up

BLOCK DIAGRAM



Functional Block Diagram of AIC1704B

PIN DESCRIPTION

VIN - Input of Supply Voltage.
GND - Ground.
VOUT - Output of the Regulator.
NC - No Internal Connection.

APPLICATION INFORMATION

INPUT-OUTPUT CAPACITOR REQUIREMENTS

The external input and output capacitors of AIC1704B series must be properly selected for stability and performance. Use a 1μF or larger input capacitor and place it close to the IC's VIN and GND pins. Any output capacitor meeting the minimum 1mΩ ESR (Equivalent Series Resistance) and effective capacitance between 1μF and 22μF requirement may be used. Place the output capacitor close to the IC's VOUT and GND pins. Increasing capacitance and decreasing ESR can improve the circuit's PSRR and line transient response.

CURRENT LIMIT

The AIC1704B series contain the current limiter of output power transistor, which monitors and controls the transistor, limiting the output current to 300mA (typical). The output can be shorted to ground indefinitely without damaging the part.

DROPOUT VOLTAGE

The AIC1704B series use a PMOS pass transistor to achieve low dropout. When (V_{IN} – V_{OUT}) is less than the dropout voltage (V_{DROP}), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the $R_{DS(ON)}$ of the PMOS pass element. V_{DROP} scales approximately with the output current because the PMOS device behaves as a resistor in dropout condition.

As any linear regulator, PSRR and transient response are degraded as (V_{IN} – V_{OUT}) approaches dropout condition.

OTP (OVER TEMPERATURE PROTECTION)

The over temperature protection function of AIC1704B series will turn off the P-MOSFET when the junction temperature exceeds 160°C (typ.). Once the junction temperature cools down by approximately 15°C, the regulator will automatically resume operation.

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:

$P_{D(MAX)} = (T_{J(MAX)} - T_A) / (R\theta_{JA})$

Where $T_{J(MAX)}$ is the maximum allowable junction temperature, and T_A is the ambient temperature suitable in application.

Power dissipation (P_D) is equal to the product of the output current and the voltage drop across the output pass element, as shown in the equation below:

$P_D = (V_{IN} – V_{OUT}) \times I_{OUT}$.

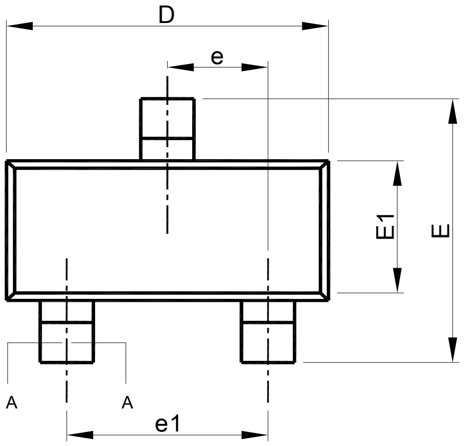
LAYOUT CONSIDERATION

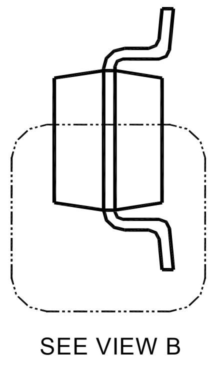
By placing input and output capacitors on the same side of the PCB as the LDO, and placing them as close as is practical to the package can achieve the best performance. The ground connections for input and output capacitors must be back to the AIC1704B ground pin using as wide and as short of a copper trace as is practical.

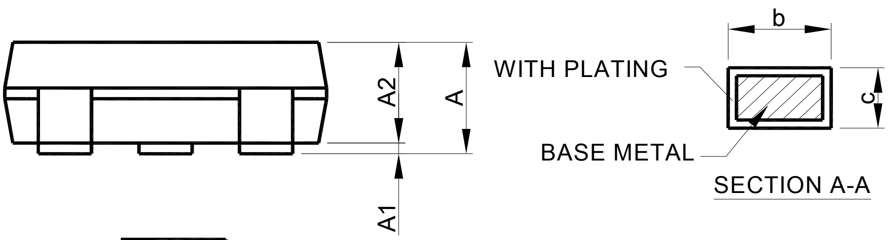
Connections using long trace lengths, narrow trace widths, and/or connections through via must be avoided. These add parasitic inductances and resistance that results in worse performance especially during transient conditions.

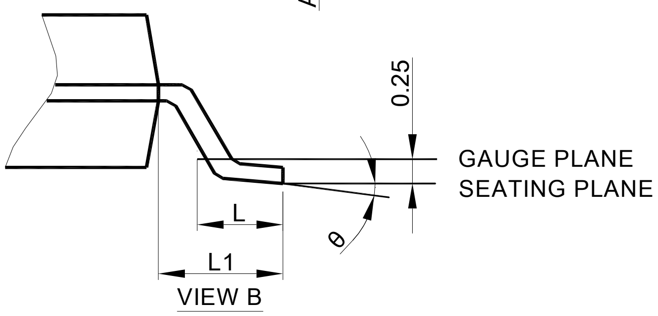
PHYSICAL DIMENSIONS

- **SOT23-3**





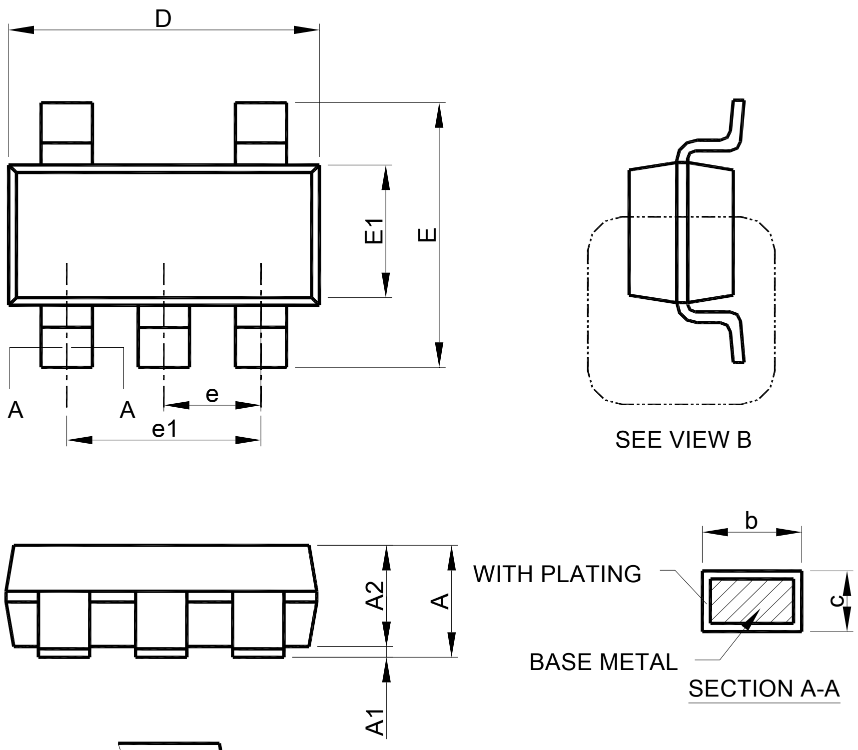


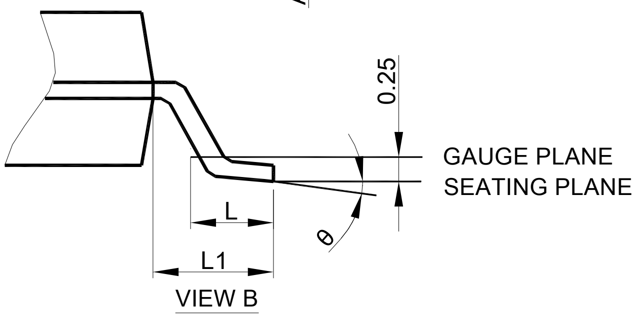


SYMBOL	SOT23-3	
	MILLIMETERS	
	MIN.	MAX.
A	0.95	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.22
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.95 BSC	
e1	1.90 BSC	
L	0.30	0.60
L1	0.60 REF	
θ	0°	8°

Note: 1. Refer to JEDEC MO-178.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.
3. Dimension "E1" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

- **SOT23-5**

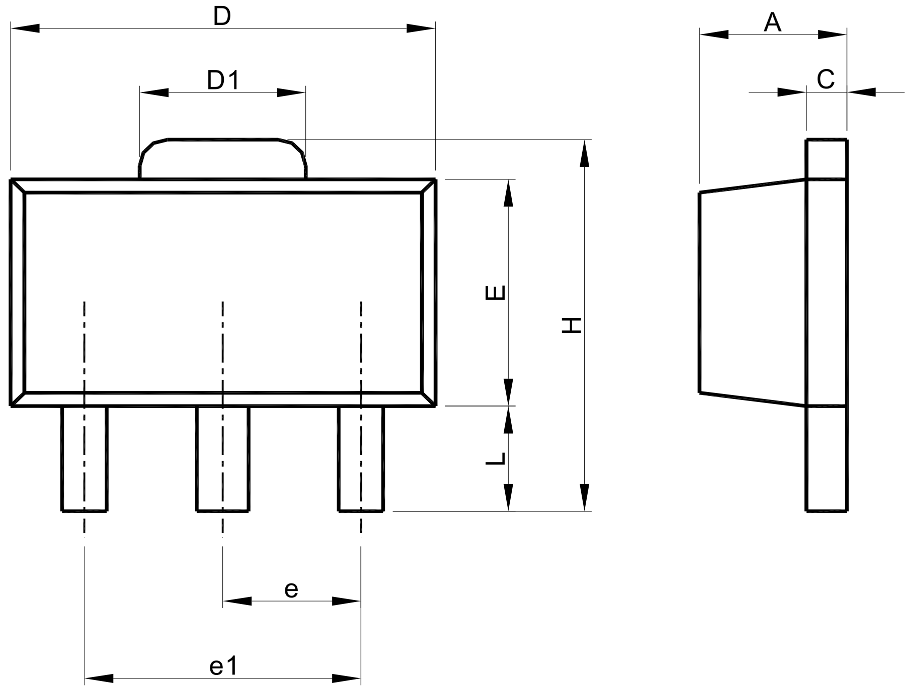


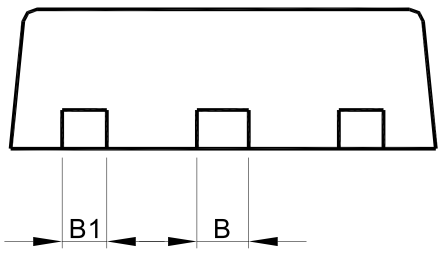


Note : 1. Refer to JEDEC MO-178AA.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.
3. Dimension "E1" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

SYMBOL	SOT23-5	
	MILLIMETERS	
	MIN.	MAX.
A	0.95	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.22
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.95 BSC	
e1	1.90 BSC	
L	0.30	0.60
L1	0.60 REF	
θ	0°	8°

- **SOT89-3**





Note: 1. Refer to JEDEC TO-243AA.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.
3. Dimension "E" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

SYMBOL	SOT89-3	
	MILLIMETERS	
	MIN.	MAX.
A	1.40	1.60
B	0.44	0.56
B1	0.36	0.48
C	0.35	0.44
D	4.40	4.60
D1	1.50	1.83
E	2.29	2.60
e	1.50 BSC	
e1	3.00 BSC	
H	3.94	4.25
L	0.89	1.20

Note:
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