150mA, 3μA Ultra Low Quiescent Current LDO Voltage Regulator

FEATURES

- Input Voltage 2.0V~6.0V
- Output Voltage 0.8V~5.0V
- 200mV Typical Dropout Voltage at 150mA load current and 3.3V output voltage
- Ultra Low Quiescent Current: 3μA
- Line Regulation, typical: 2mV
- Load Regulation, typical: 2mV
- Current Limiting and Thermal Protection
- Stable with 1μF Input & Output Ceramic Capacitor
- Available in SOT-23, SOT-23-5, SOT-89, DFN-6 2mmx2mm

GENERAL DESCRIPTION

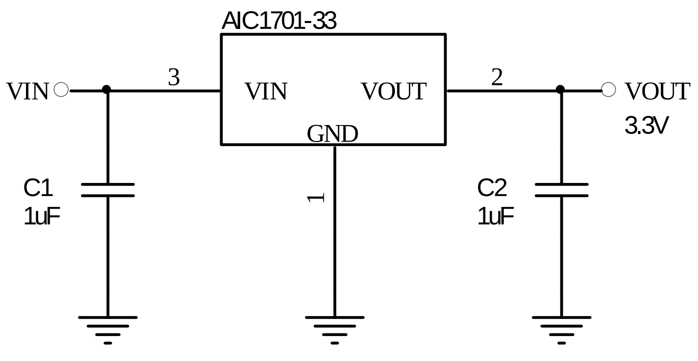
The AIC1701 is an Ultra Low Quiescent Current, low dropout voltage regulator. The output voltages are of 0.8V, 1.0V, 1.2V, 1.5V, 1.8V, 2.0V, 2.1V, 2.5V, 3.3V and 5V. Dropout voltage of 200mV is guaranteed at 150mA output current and 3.3V output voltage. The low quiescent and wide input voltage range make this device ideal for portable microprocessor applications.

The AIC1701 requires output ceramic capacitor of a minimum 1μF for stability. Built-in output current limiting and thermal limiting provide maximal protection to the AIC1701 against fault conditions.

APPLICATIONS

- Smoke Detectors
- Battery-Powered Alarms / Smart Battery Packs
- PDAs / Handy Terminals
- Real-time Clocks/ CMOS Backup Power
- Laptop, Palmtops, Notebook Computer

TYPICAL APPLICATION CIRCUIT



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DS-1701G-03 20130226

ORDERING INFORMATION

AIC1701-XX X XX XX

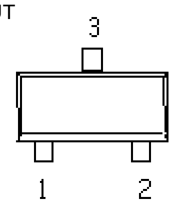
- PACKING TYPE
  TR: TAPE & REEL
  BG: BAG
- PACKAGE TYPE
  U3: SOT-23
  X3: SOT-89
  DA: DFN-6 (2*2)
- G: Green Package
- OUTPUT VOLTAGE

08:	0.8V
10:	1.0V
12:	1.2V
15:	1.5V
18:	1.8V
20:	2.0V
21:	2.1V
25:	2.5V
33:	3.3V
50:	5.0V

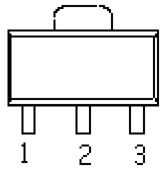
(Of a unit of 0.1V within 0.8~5.0V, additional voltage versions are available on demand)

PIN CONFIGURATION

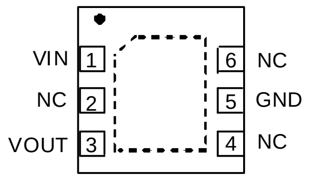
SOT-23
TOP VIEW
1: GND
2: VOUT
3: VIN



SOT-89
TOP VIEW
1: GND
2: VIN
3: VOUT



DFN-6 (2mmx2mm)
TOP VIEW



Example : AIC1701-18GU3TR
→ 1.8V Output Voltage,
Green SOT-23 Package
Tape & Reel Packing Type

AIC1701X-XX X XX XX

PACKING TYPE
TR: TAPE & REEL
BG: BAG

PACKAGE TYPE
V5: SOT-23-5

G: Green Package

OUTPUT VOLTAGE

08:	0.8V
10:	1.0V
12:	1.2V
15:	1.5V
18:	1.8V
20:	2.0V
25:	2.5V
30:	3.0V
33:	3.3V
50:	5.0V

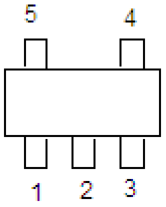
(Of a unit of 0.1V within 0.8~5.0V, additional voltage versions are available on demand)

ENABLE TYPE
L: Chip Enable Low
H: Chip Enable High

Example : AIC1701H-18GV5TR
→ 1.8V Output Voltage,
Chip Enable High
Green SOT-23-5 Package
Tape & Reel Packing Type

PIN CONFIGURATION

SOT-23-5
TOP VIEW
1: VIN
2: GND
3: EN
4:NC
5:VOUT



ABSOLUTE MAXIMUM RATINGS

Input Voltage		7V
EN Pin Voltage		7V
Operating Temperature Range		-40ºC~85ºC
Maximum Junction Temperature		150ºC
Storage Temperature Range		-65ºC~150ºC
Lead Temperature (Soldering, 10 sec)		260ºC
Thermal Resistance (Junction to Case)	SOT-23	115ºC /W
	SOT-89	45ºC /W
	DFN-6	30ºC /W
Thermal Resistance (Junction to Ambient)	SOT-23	250ºC /W
(Assume no ambient airflow, no heat sink)	SOT-89	160ºC /W
	DFN-6	165ºC /W

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

■ ELECTRICAL CHARACTERISTICS (V_{IN}=V_{out}+1V, C_{IN}=C_{OUT}=1µF, T_A=25°C, unless otherwise specified.) (Note1)

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNITS
Operating Voltage		V_{IN}	2.0		6	V
Output Voltage Accuracy	V_{IN}= V_{OUT} +0.5V	V_{OUT}	-2.0		+2.0	%
Line Regulation	V_{IN} = V_{OUT} + 0.5V to 6V, I_{OUT} = 1mA	ΔV_{LIR}		2	10	mV
Load Regulation	I_{OUT}=1mA~150mA	ΔV_{LOR}		2	20	mV
Dropout Voltage	V_{OUT} = 3.3V, I_{OUT}=150mA	V_{DROP}		200		mV
Current Limit		I_{IL}	180	250		mA
Short Circuit Current	V_{OUT} =0V (Note 2)	I_{SHORT}		150		mA
Output Voltage Temperature Coefficient	-40°C ≦ T_A ≦ 125°C	TC		100		ppm/°C
GND Pin Current	I_{OUT}=1mA	I_{GND}		3	6	µA
	I_{OUT}=150mA			3	6	µA
Shutdown Standby Current	V_{EN}=0 or $V_{\overline{EN}}$=V_{IN}	I_{STBY}			0.2	µA
Ripple Rejection	F=1kHz, C_{OUT}=1µF	PSRR		40		dB
Shutdown Pin Current	V_{EN} = V_{IN}≦6V or GND	I_{EN}		0	100	nA
Shutdown Exit Delay Time	I_{OUT} = 30mA	Δt		0.5		mS
Max Output Discharge Resistance to GND during Shutdown		RDSON_CLMP		20	40	Ω
V_{EN} threshold	High threshold	V_{ENH}	1.6			V
	Low threshold	V_{ENL}			0.4	V
Thermal Shutdown Temperature		T_{SD}		135		℃
Thermal Shutdown Hysteresis		ΔT_{SD}		25		℃

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).

Note 2: V_{IN}≧2.5V and V_{IN}≧V_{OUT}+1

TYPICAL PERFORMANCE CHARACTERISTICS

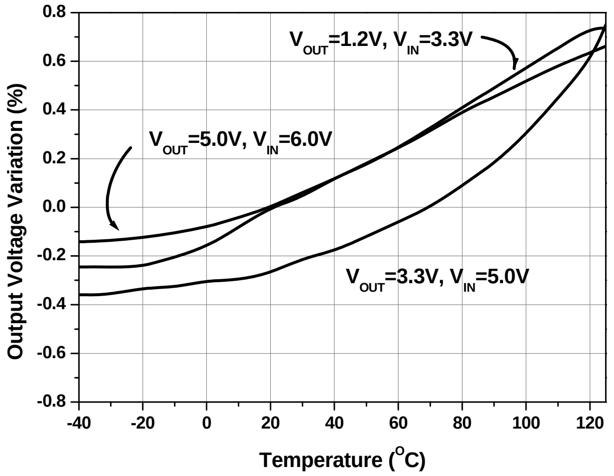


Fig. 1 Output Voltage Variation vs. Temperature

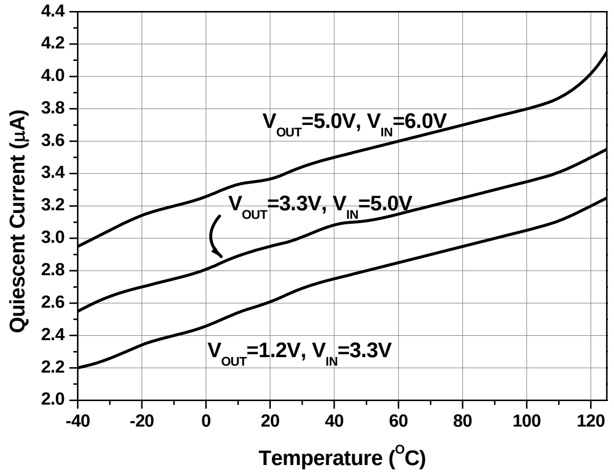


Fig. 2 Quiescent Current vs. Temperature

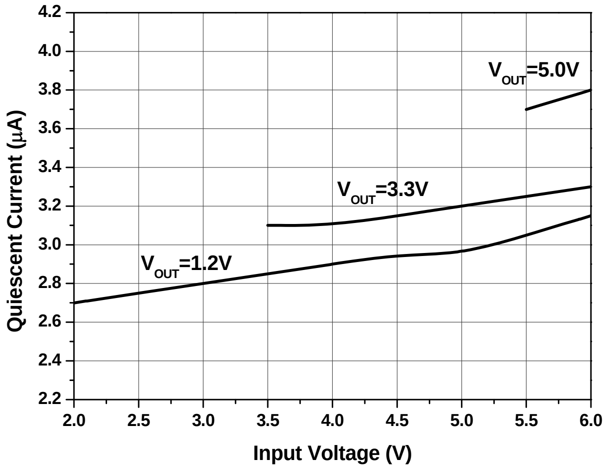


Fig. 3 Quiescent Current vs. Input Voltage

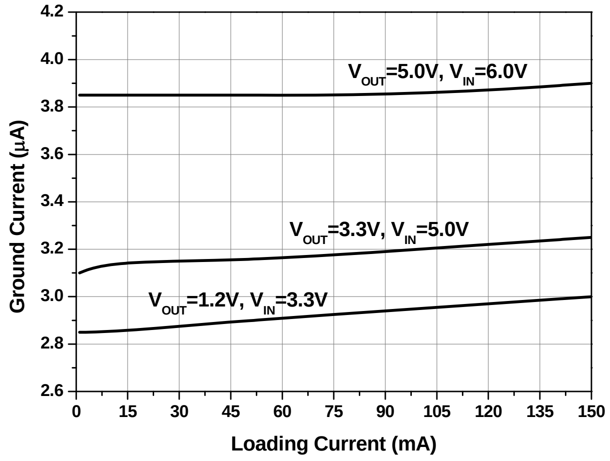


Fig. 4 Ground Current vs. Loading Current

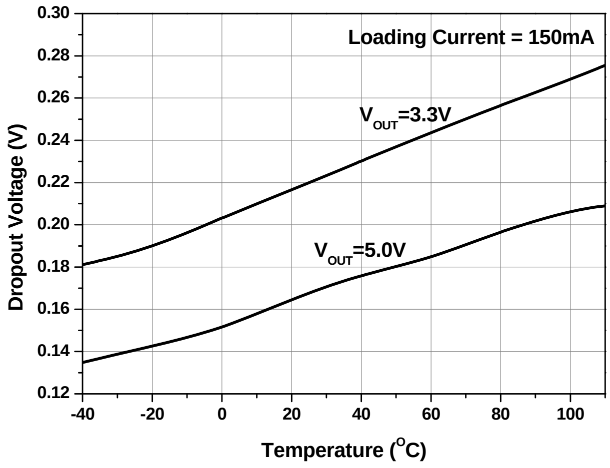


Fig. 5 Dropout Voltage vs. Temperature

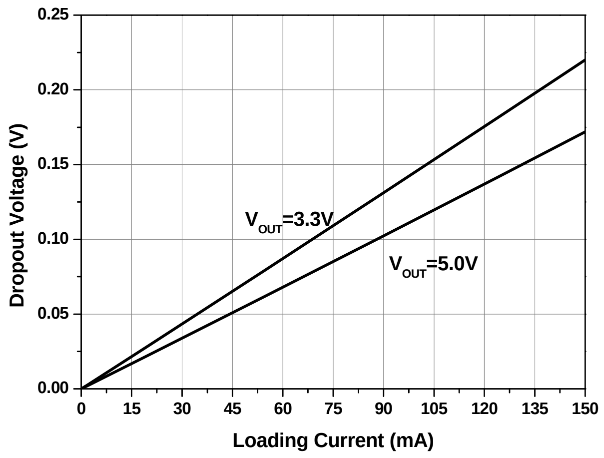


Fig. 6 Dropout Voltage vs. Loading Current

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

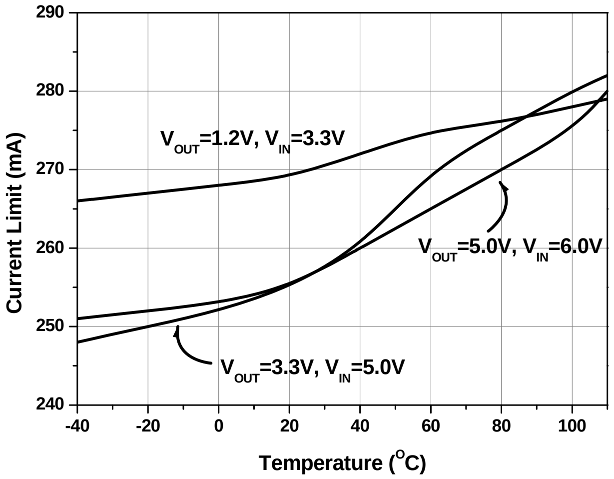


Fig. 7 Current Limit vs. Temperature

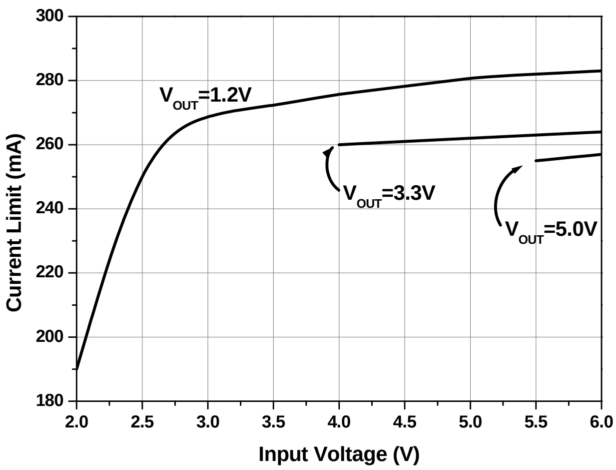


Fig. 8 Current Limit vs. Input Voltage

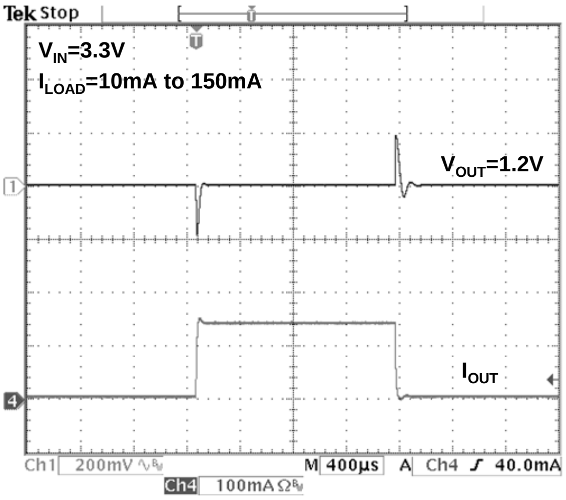


Fig. 9 Load Transient Response at V_{IN}=3.3V, V_{OUT}=1.2V

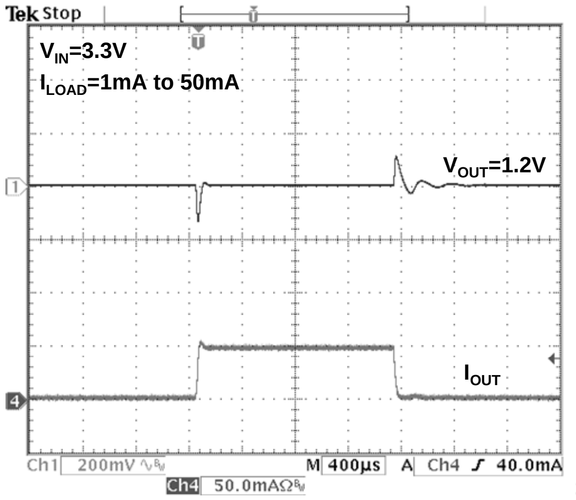


Fig. 10 Load Transient Response at V_{IN}=3.3V, V_{OUT}=1.2V

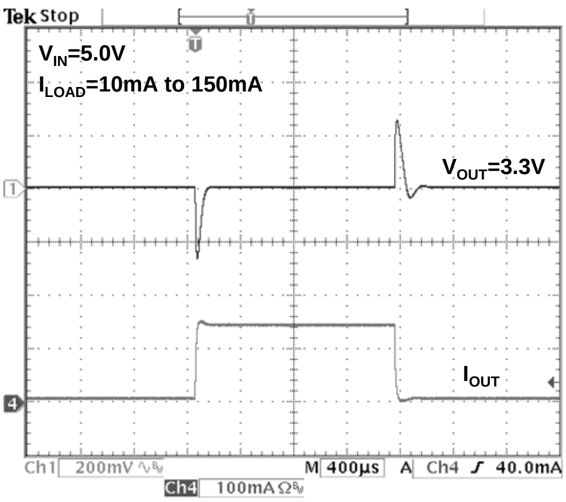


Fig. 11 Load Transient Response at V_{IN}=5.0V, V_{OUT}=3.3V

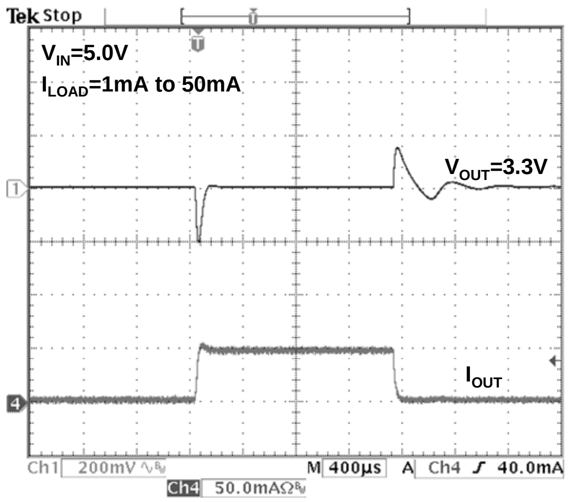


Fig. 12 Load Transient Response at V_{IN}=5.0V, V_{OUT}=3.3V

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

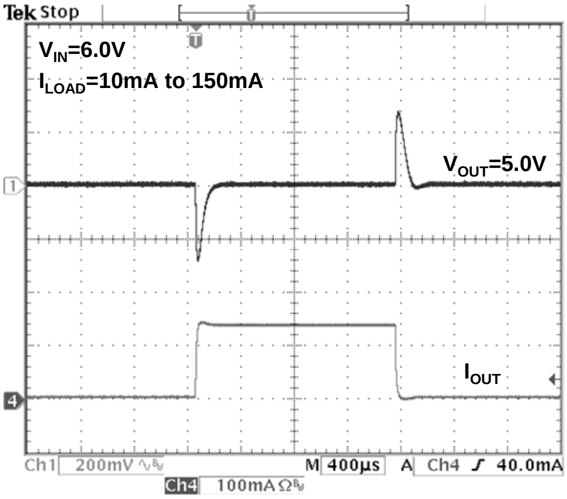


Fig. 13 Load Transient Response at V_{IN}=6.0V, V_{OUT}=5.0V

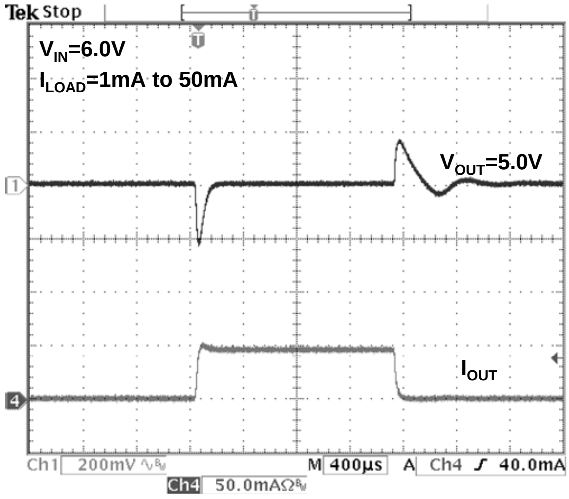


Fig. 14 Load Transient Response at V_{IN}=6.0V, V_{OUT}=5.0V

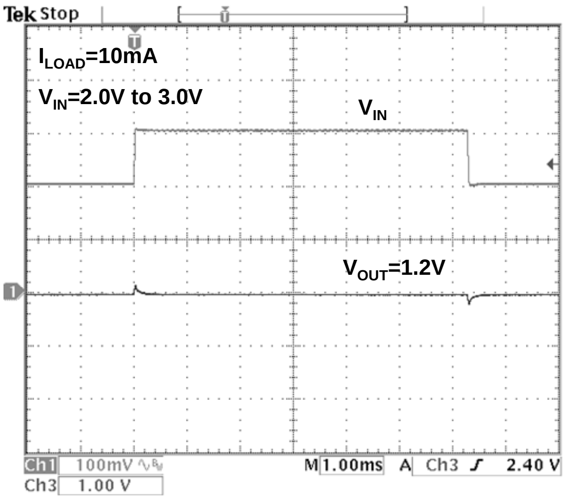


Fig. 15 Line Transient Response at V_{OUT}=1.2V, I_{OUT}=10mA

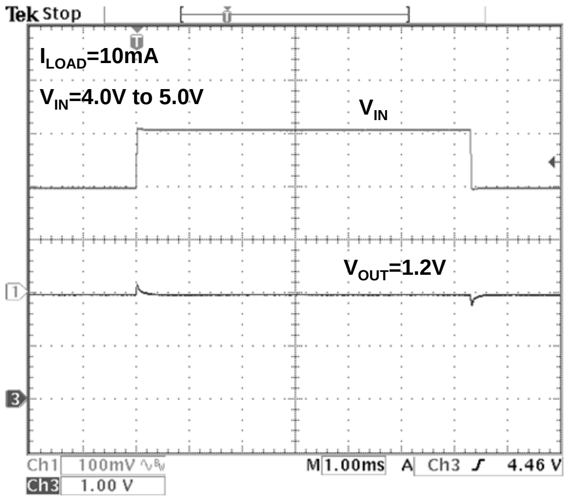


Fig. 16 Line Transient Response at V_{OUT}=1.2V, I_{OUT}=10mA

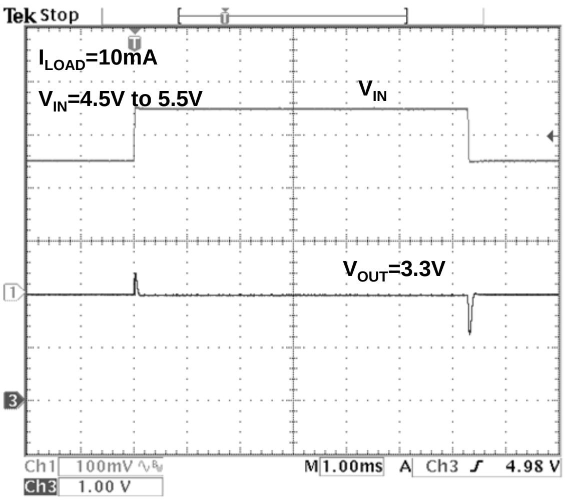


Fig. 17 Line Transient Response at V_{OUT}=3.3V, I_{OUT}=10mA

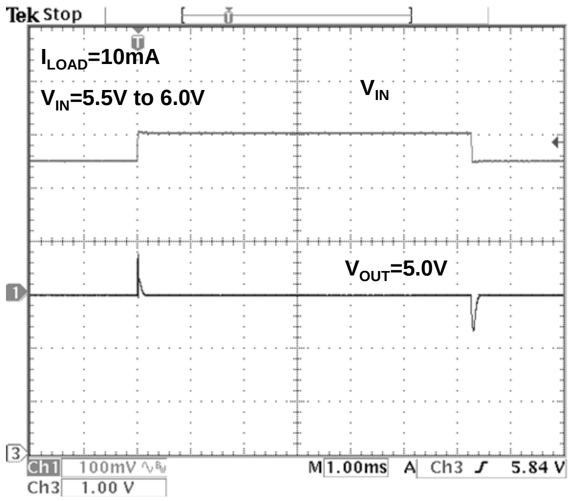


Fig. 18 Line Transient Response at V_{OUT}=5.0V, I_{OUT}=10mA

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

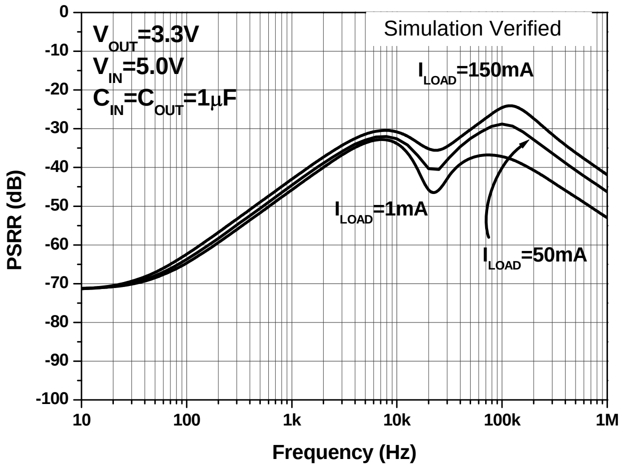


Fig. 19 PSRR vs. Frequency

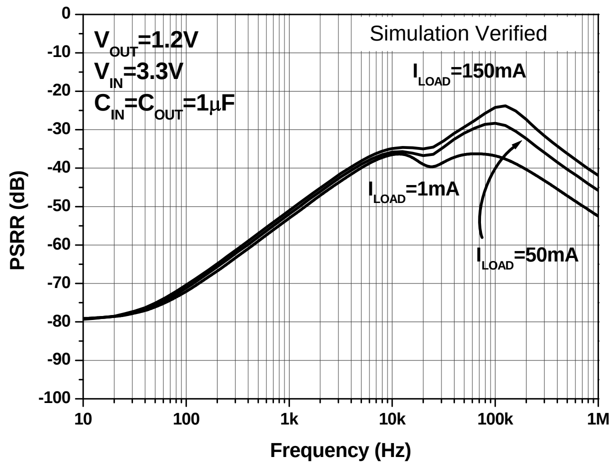


Fig. 20 PSRR vs. Frequency

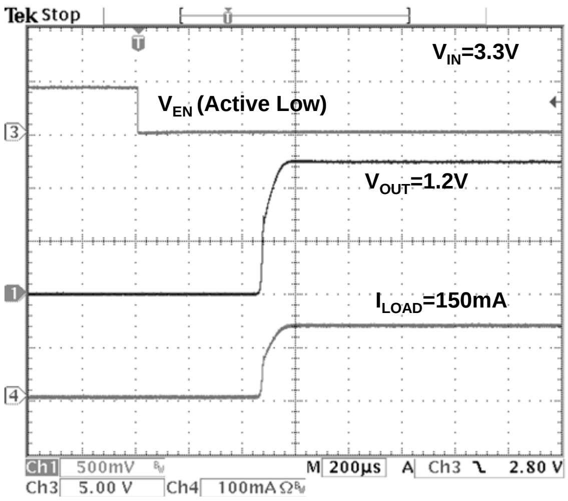


Fig. 21 Start-Up Waveform at V_{OUT}=1.2V, I_{OUT}=150mA

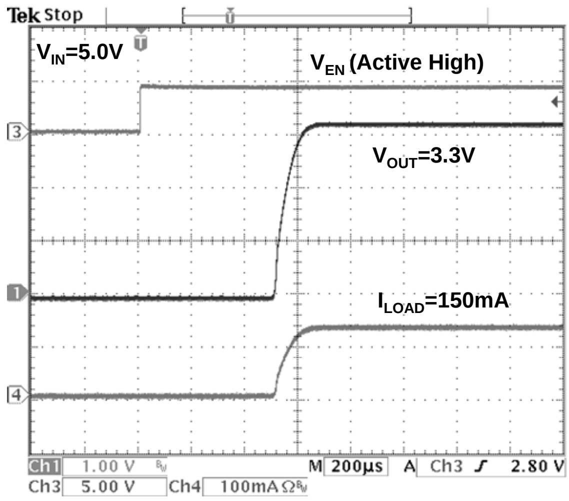


Fig. 22 Start-Up Waveform at V_{OUT}=3.3V, I_{OUT}=150mA

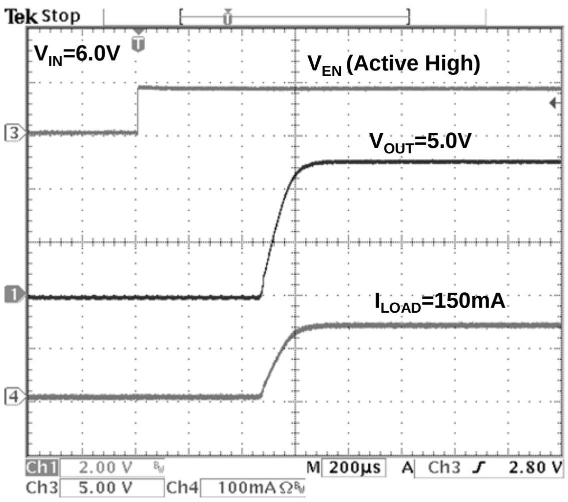


Fig. 23 Start-Up Waveform at V_{OUT}=5.0V, I_{OUT}=150mA

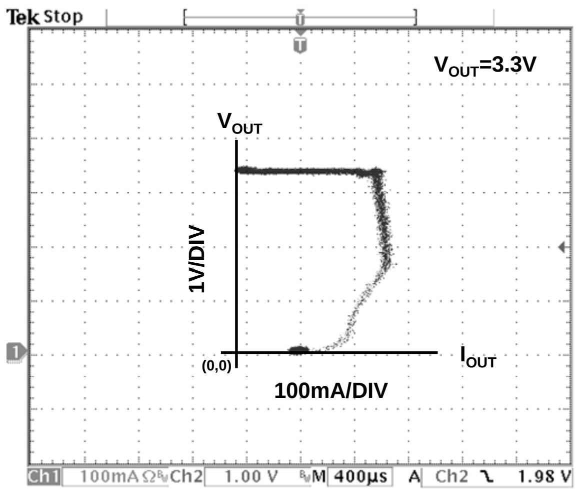
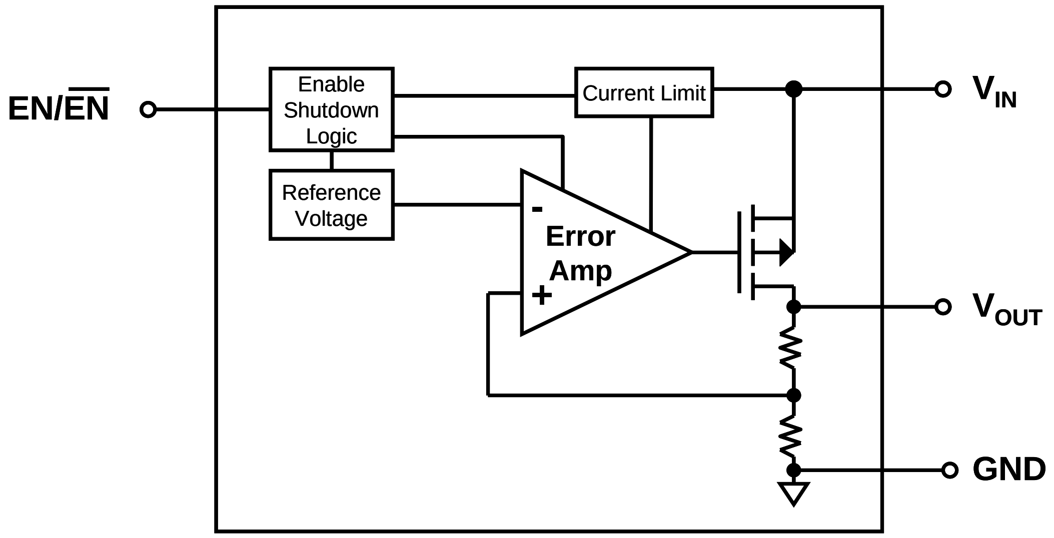


Fig. 24 Current Foldback at V_{IN}=5.0V, V_{OUT}=3.3V

■ BLOCK DIAGRAM



■ PIN DESCRIPTION

VIN	PIN	– Power supply input pin. Bypass with a 1µF ceramic capacitor to GND
VOUT	PIN	– Regulator Output pin. Sources up to 150mA.
EN	PIN	– Chip Enable (Active High). This pin isn't allowed to float.
$\overline{EN}$	PIN	– Chip Enable (Active Low). This pin isn't allowed to float.
GND	PIN	– Ground.

APPLICATION INFORMATION

The AIC1701 is a high performance linear regulator that provides low-dropout voltage and low quiescent-current. The device is available in a fixed output voltages ranging from 0.8V to 5.0V, and the device can supply loads up to 150mA.

Capacitor Selection

Linear regulators require input and output capacitors to maintain stability. Input capacitor with a 1μF, output capacitor with a 1μF ceramic output capacitor is recommended. When choosing the input and output ceramic capacitors, X5R and X7R types are recommended because they retain their capacitance over wider ranges of voltage and temperature than other types.

Current Limit

The AIC1701 includes a current limiter, which monitors and controls the maximum output current. If the output is overloaded or shorted to ground, this can protect the device from being damaged.

Dropout Voltage

The minimum input-output voltage differential (dropout) determines the lowest usable supply voltage. The dropout voltage is a function of drain-to-source on resistance multiplied by the load current.

Thermal Protection

The AIC1701 includes a thermal-limiting circuit, which is designed to protect the device against overload condition. When the junction temperature exceeds T_J=135ºC, the thermal-limiting circuit turns off the pass transistor and allows the IC to cool. For continuous load condition, maximum rating of junction temperature must not be exceeded.

Power Dissipation

The maximum power dissipation of AIC1701 depends on the thermal resistance of its case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The rate of temperature rise is greatly affected by the mounting pad configuration on the PCB, the board material, and the ambient temperature. When the IC mounting with good thermal conductivity is used, the junction temperature will be low even when large power dissipation applies.

The power dissipation across the device is

$P = I_{OUT} (V_{IN}-V_{OUT})$

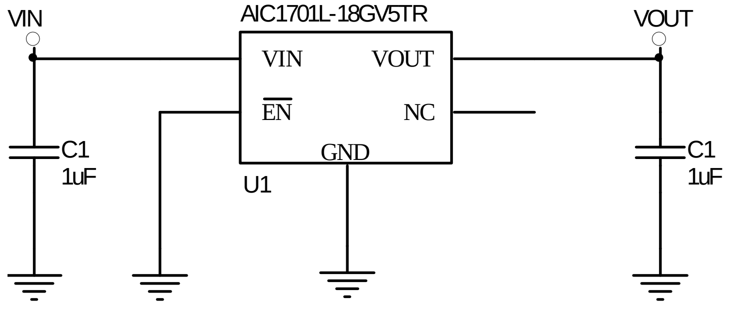
The maximum power dissipation is:

$$P_{MAX} = \frac{(T_{J\text{-}max} - T_A)}{R\theta_{JA}}$$

Where $T_{J\text{-}max}$ is the maximum allowable junction temperature (135°C), and T_A is the ambient temperature suitable in application.

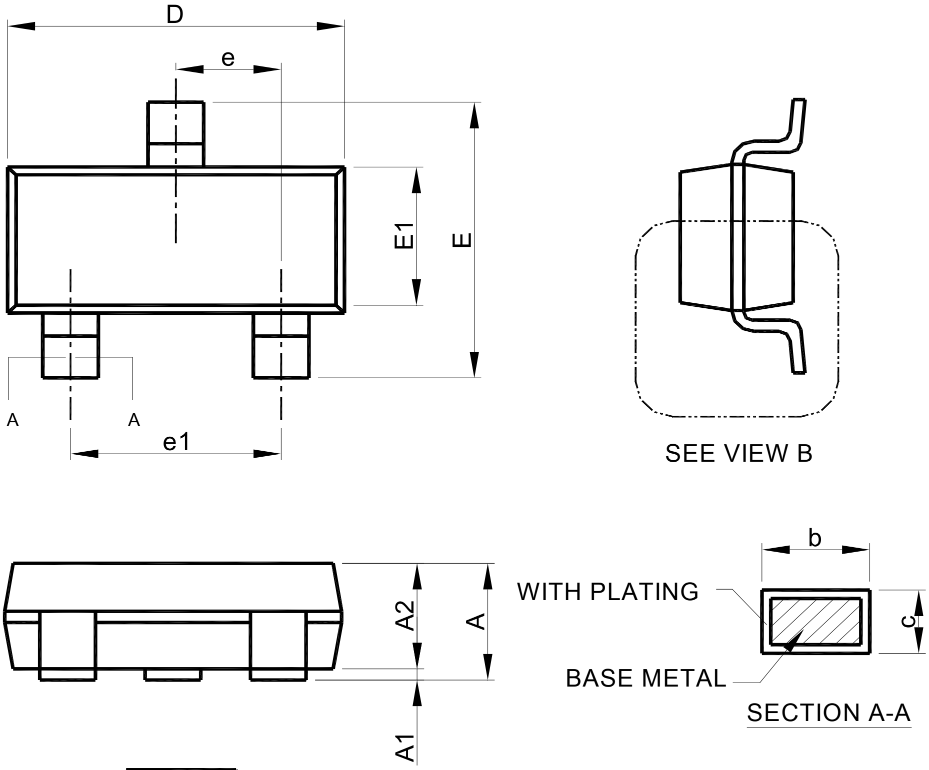
As a general rule, the lower temperature is, the better reliability of the device is. So the PCB mounting pad should provide maximum thermal conductivity to maintain low device temperature.

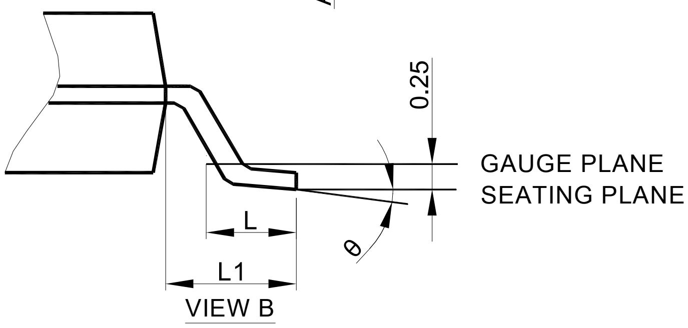
APPLICATION CIRCUIT



PHYSICAL DIMENSIONS (unit: mm)

- **SOT-23 PACKAGE OUTLINE DRAWING**

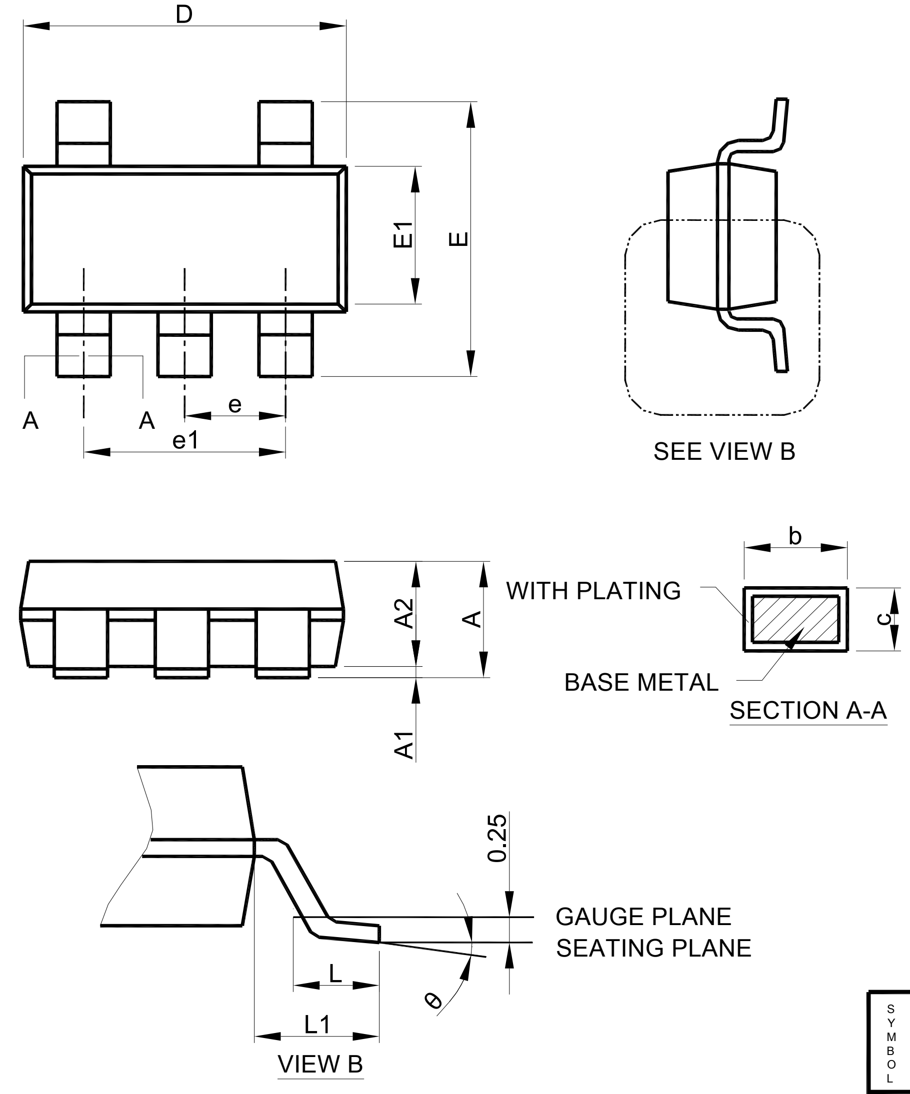




SYMBOL	SOT-23	
	MILLIMETERS	
	MIN.	MAX.
A	0.95	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.22
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.95 BSC	
e1	1.90 BSC	
L	0.30	0.60
L1	0.60 REF	
θ	0°	8°

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.

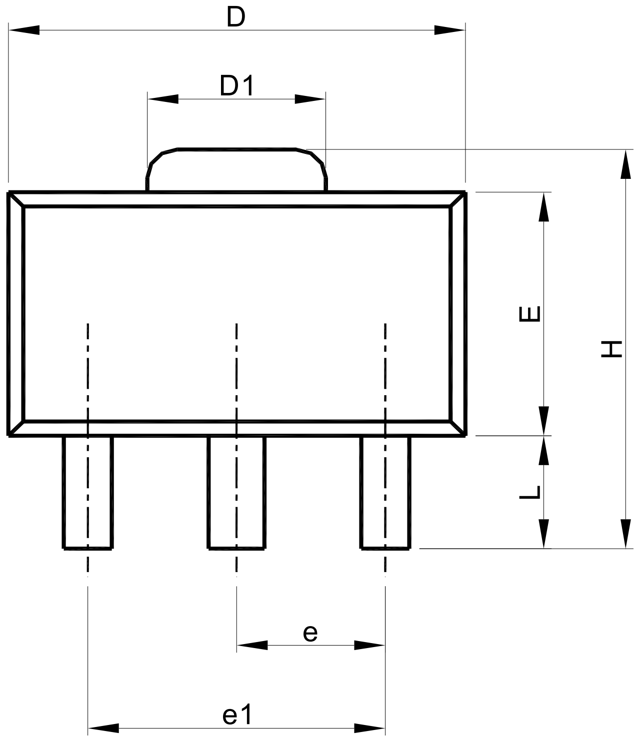
- **SOT-23-5**

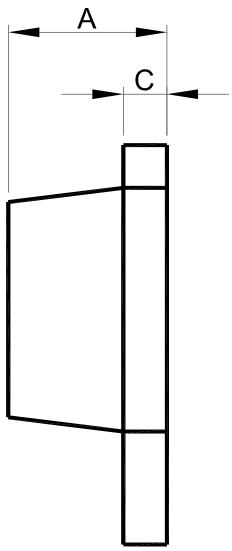


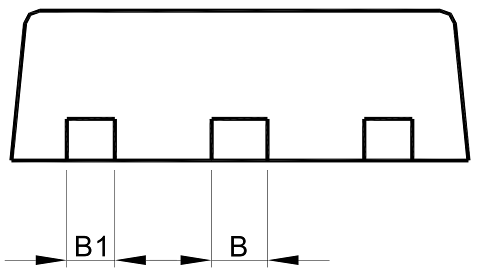
SYMBOL	SOT-23-5	
	MILLIMETERS	
	MIN.	MAX.
A	0.95	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.22
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.95 BSC	
e1	1.90 BSC	
L	0.30	0.60
L1	0.60 REF	
θ	0°	8°

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.

- **SOT-89**



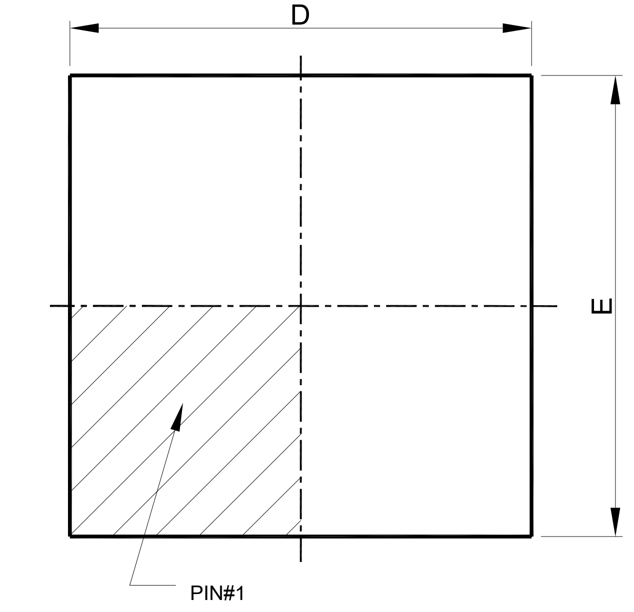




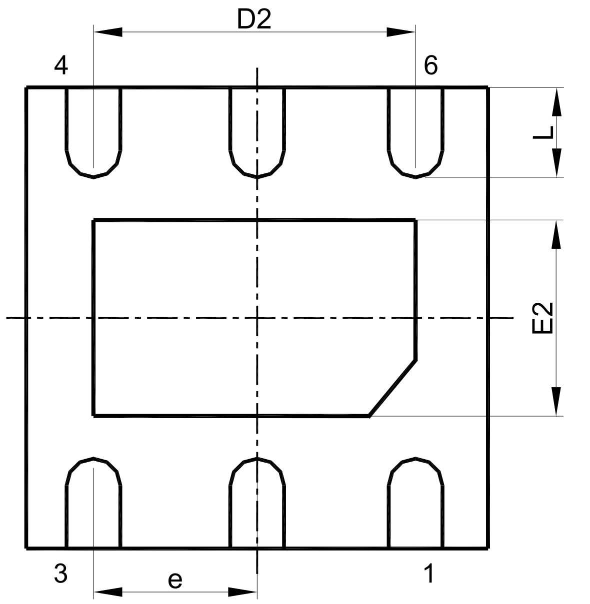
SYMBOL	SOT-89	
	MILLIMETERS	
	MIN.	MAX.
A	1.40	1.60
B	0.44	0.56
B1	0.36	0.48
C	0.35	0.44
D	4.40	4.60
D1	1.50	1.83
E	2.29	2.60
e	1.50 BSC	
e1	3.00 BSC	
H	3.94	4.25
L	0.89	1.20

Note: 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.

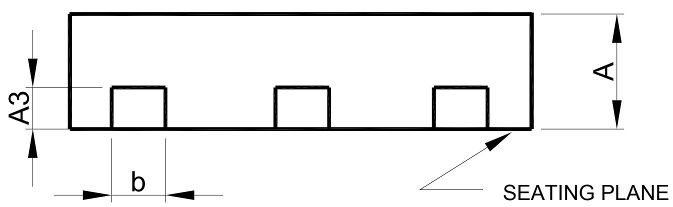
- **DFN 6L 2x2 PACKAGE OUTLINE DRAWING**



TOP VIEW



BOTTOM VIEW



SIDE VIEW

SYMBOL	DFN 6L-2x2x0.75-0.65mm	
	MILLIMETERS	
	MIN.	MAX.
A	0.70	0.80
A3	0.20 BSC	
b	0.20	0.35
D	2.00 BSC	
D2	1.10	1.60
E	2.00 BSC	
E2	0.55	0.85
e	0.65 BSC	
L	0.25	0.45

Note : 1. DIMENSION AND TOLERANCING CONFORM TO ASME Y14.5M-1994.
2.CONTROLLING DIMENSIONS：MILLIMETER，CONVERTED INCH DIMENSION ARE NOT NECESSARILY EXACT.
3.DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.10 AND 0.25 mm FROM TERMINAL TIP.