

# 350mA, 3 $\mu$ A Ultra Low Quiescent Current LDO Voltage Regulator

## FEATURES

- Input Voltage 2.0V~6.8V
- Output Voltage 0.8V~5.0V
- 550mV Typical Dropout Voltage at 350mA load current and 3.3V output voltage
- Ultra Low Quiescent Current: 3 $\mu$ A
- Line Regulation, typical: 2mV
- Load Regulation, typical: 2mV
- Current Limiting and Thermal Protection
- Stable with 1 $\mu$ F Input & Output Ceramic Capacitor
- Available in SOT-23, SOT-23-5, SOT-89, DFN-6 2mmx2mm

## GENERAL DESCRIPTION

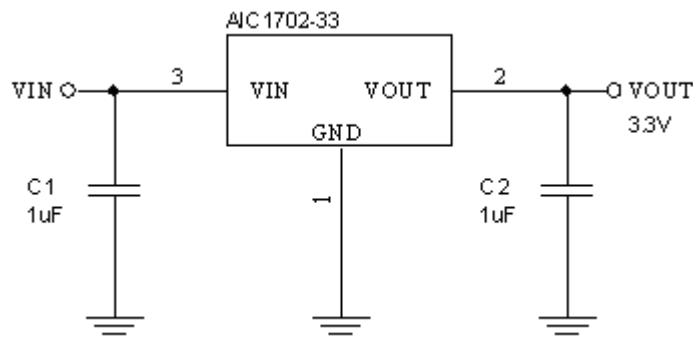
The AIC1702 is an Ultra Low Quiescent Current, low dropout voltage regulator. The output voltages are of 0.8V, 1.0V, 1.2V, 1.5V, 1.8V, 2.0V, 2.5V, 3.0V, 3.3V and 5V. Dropout voltage of 200mV is guaranteed at 350mA output current and 3.3V output voltage. The low quiescent and wide input voltage range make this device ideal for portable microprocessor applications.

The AIC1702 requires output ceramic capacitor of a minimum 1 $\mu$ F for stability. Built-in output current limiting and thermal limiting provide maximal protection to the AIC1702 against fault conditions.

## APPLICATIONS

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

## TYPICAL APPLICATION CIRCUIT



## ORDERING INFORMATION

AIC1702-XX X XX XX

PACKING TYPE  
TR: TAPE & REEL  
BG: BAG

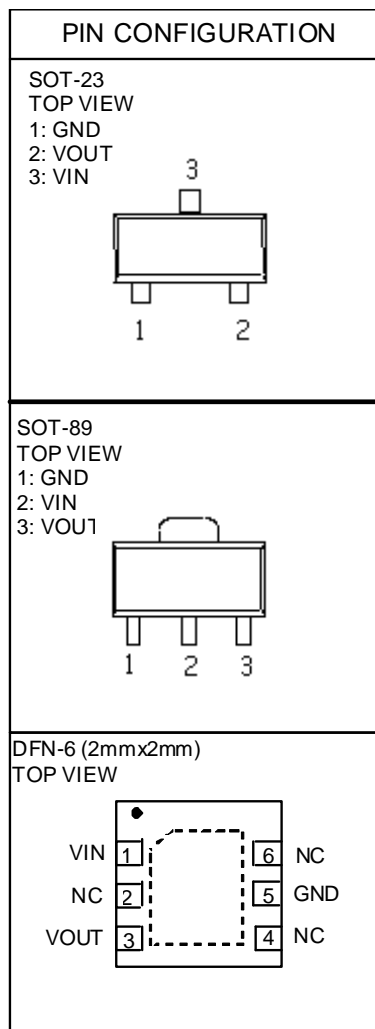
PACKAGE TYPE  
U3: SOT-23  
X3: SOT-89  
DA: DFN-6 (2\*2)

G: Green Package

OUTPUT VOLTAGE

08:	0.8V
10:	1.0V
12:	1.2V
15:	1.5V
18:	1.8V
20:	2.0V
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)



Example : AIC1702-18GU3TR  
 → 1.8V Output Voltage,  
 Green SOT-23 Package  
 Tape & Reel Packing Type

AIC1702X-XX X XX XX

PACKING TYPE  
 TR: TAPE & REEL  
 BG: BAG

PACKAGE TYPE  
 V5: SOT-23-5

G: Green Package

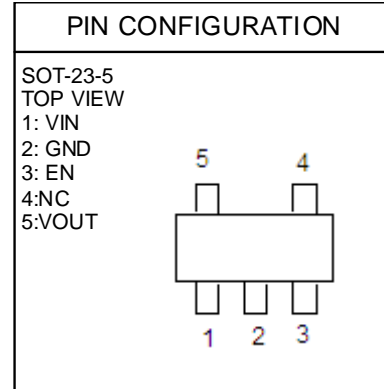
OUTPUT VOLTAGE

- 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 : AIC1702H-18GV5TR

- 1.8V Output Voltage,
- Chip Enable High
- Green SOT-23-5 Package
- Tape & Reel Packing Type

**■ ABSOLUTE MAXIMUM RATINGS**

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

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

**■ ELECTRICAL CHARACTERISTICS ( $V_{IN}=V_{OUT}+1V$ ,  $C_{IN}=C_{OUT}=1\mu F$ ,  $T_A=25^\circ C$ , unless otherwise specified.) (Note1)**

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNITS
Operating Voltage		$V_{IN}$	2.0		6.8	V
Output Voltage Accuracy	$V_{OUT} \geq 1.0V$ , $V_{IN} = V_{OUT} + 1.0V$ $V_{OUT} < 1.0V$ , $V_{IN} = 2.0V$	$V_{OUT}$	-2.0		+2.0	%
Line Regulation	$I_{OUT} = 1mA$ , (Note2)	$\Delta V_{LIR}$		2	15	mV
Load Regulation	$I_{OUT}=1mA\sim 350mA$	$\Delta V_{LOR}$		2	20	mV
Dropout Voltage	$V_{OUT} = 3.3V$ , $I_{OUT}=350mA$	$V_{DROP}$		550		mV
Current Limit	$V_{OUT} \geq 1.5V$ , $V_{IN} = V_{OUT} + 1.0V$	$I_{IL}$	400	500		mA
	$V_{OUT} < 1.5V$ , $V_{IN} = 2.5V$	$I_{IL}$	350			mA
Short Circuit Current	$V_{OUT} = 0V$ (Note 3)	$I_{SHORT}$		350		mA
Output Voltage Temperature Coefficient	$-40^\circ C \leq T_A \leq 125^\circ C$	TC		100		ppm/ $^\circ C$
GND Pin Current	$I_{OUT}=1mA$	$I_{GND}$		3	6	$\mu A$
	$I_{OUT}=350mA$ (Note 3)			3	6	$\mu A$
Shutdown Standby Current	$V_{EN}=0$ or $V_{EN}^- = V_{IN}$	$I_{STBY}$			0.2	$\mu A$
Ripple Rejection	$F=1kHz$ , $C_{OUT}=1\mu F$	PSRR		40		dB
Shutdown Pin Current	$V_{EN} = V_{IN} \leq 6.8V$ or GND	$I_{EN}$		0	100	nA
Shutdown Exit Delay Time	$I_{OUT} = 30mA$	$\Delta t$		0.5		mS
Max Output Discharge Resistance to GND during Shutdown		RDSON_C LMP		20	40	$\Omega$
$V_{EN}$ threshold	High threshold	$V_{ENH}$	1.6			V
	Low threshold	$V_{ENL}$			0.4	V
Thermal Shutdown Temperature		$T_{SD}$		135		$^\circ C$
Thermal Shutdown Hysteresis		$\Delta T_{SD}$		25		$^\circ C$

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

**Note 2:**  $V_{OUT} \geq 1.0V$ ,  $V_{IN} = V_{OUT} + 1.0V$  to 6.8V  
 $V_{OUT} < 1.0V$ ,  $V_{IN} = 2.0V$  to 6.8V

**Note 3:**  $V_{OUT} \geq 1.5V$ ,  $V_{IN} = V_{OUT} + 1.0V$   
 $V_{OUT} < 1.5V$ ,  $V_{IN} = 2.5V$

**TYPICAL PERFORMANCE CHARACTERISTICS**

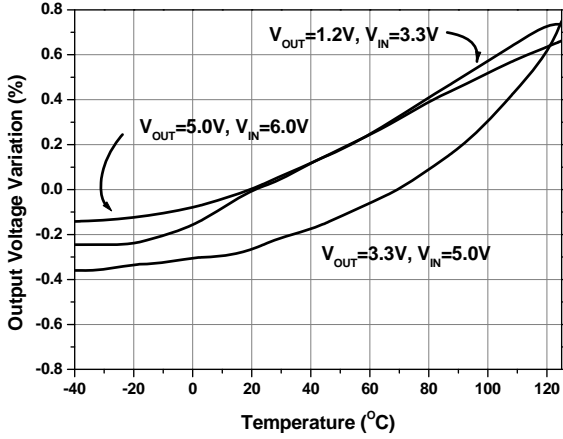


Fig.1 Output Voltage Variation vs. Temperature

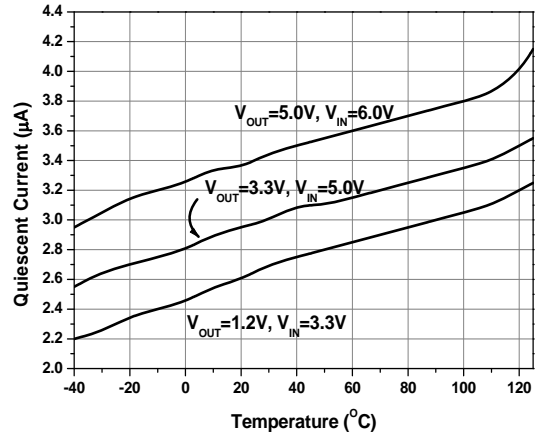


Fig.2 Quiescent Current vs. Temperature

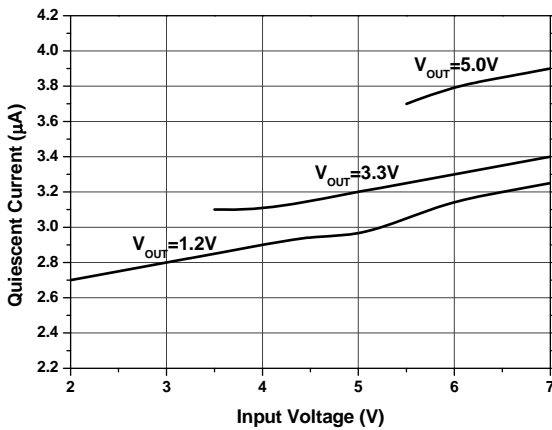


Fig.3 Quiescent Current vs. Input Voltage

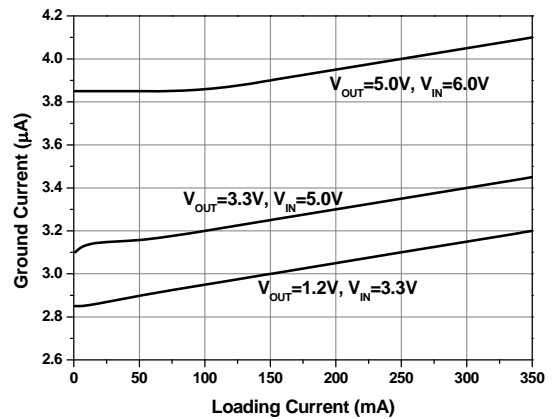


Fig.4 Ground Current vs. Loading Current

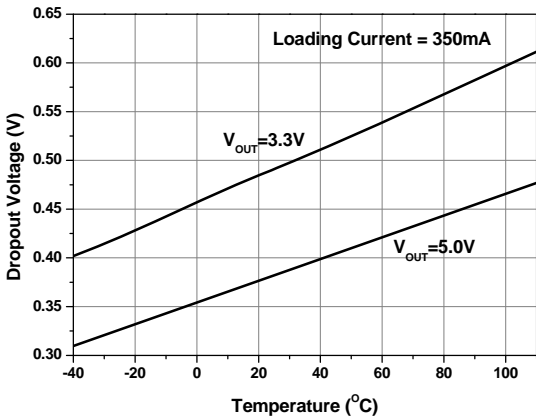


Fig.5 Dropout Voltage vs. Temperature

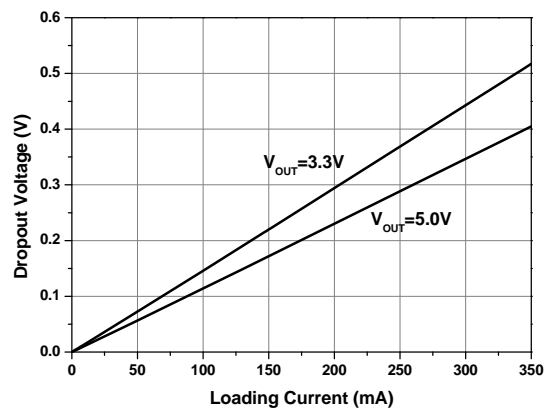


Fig.6 Dropout Voltage vs. Loading Current

**TYPICAL PERFORMANCE CHARACTERISTICS (Continued)**

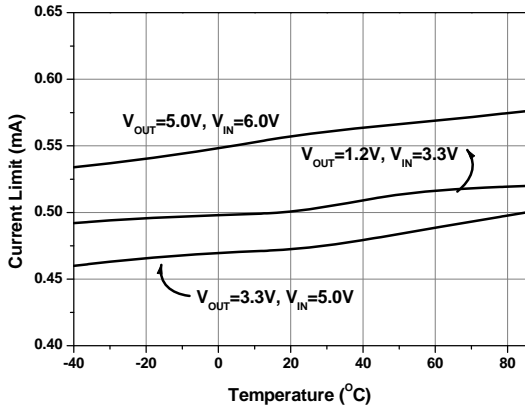


Fig.7 Current Limit vs. Temperature

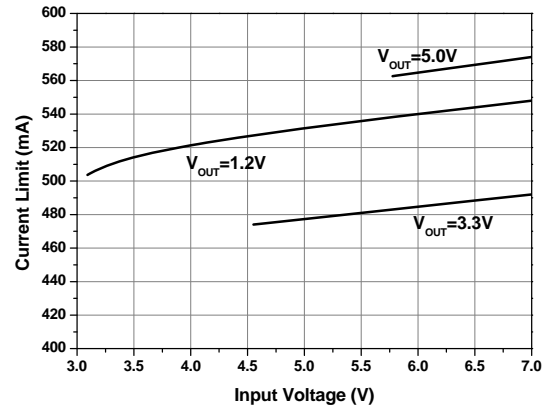


Fig.8 Current Limit vs. Input Voltage

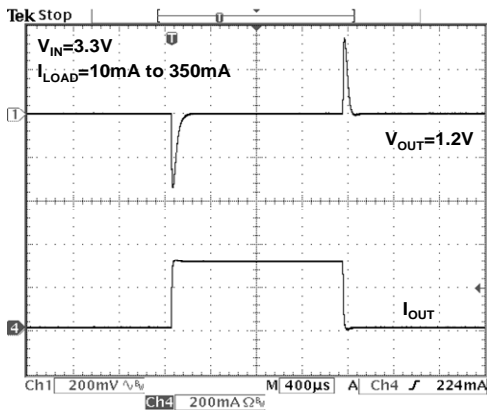


Fig.9 Load Transient Response at  $V_{IN}=3.3V, V_{OUT}=1.2V$

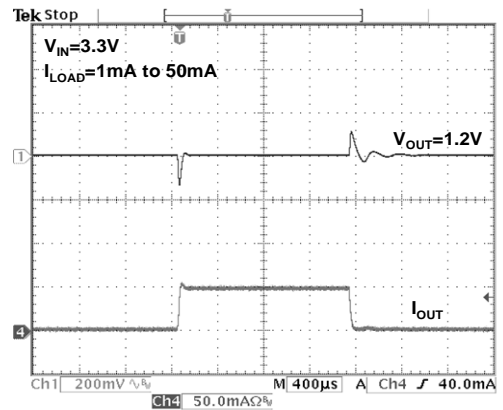


Fig.10 Load Transient Response at  $V_{IN}=3.3V, V_{OUT}=1.2V$

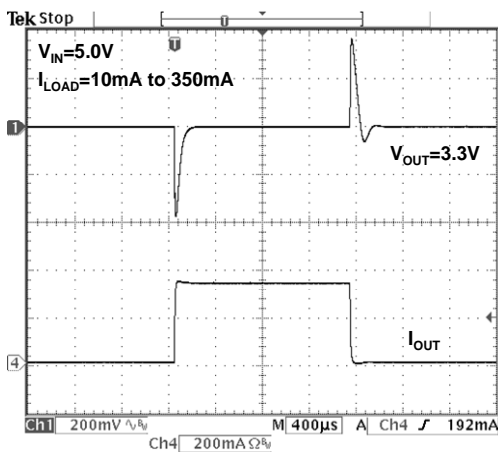


Fig.11 Load Transient Response at  $V_{IN}=5.0V, V_{OUT}=3.3V$

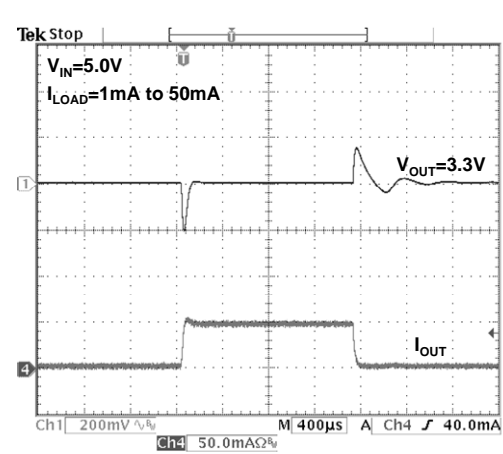


Fig.12 Load Transient Response at  $V_{IN}=5.0V, V_{OUT}=3.3V$

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

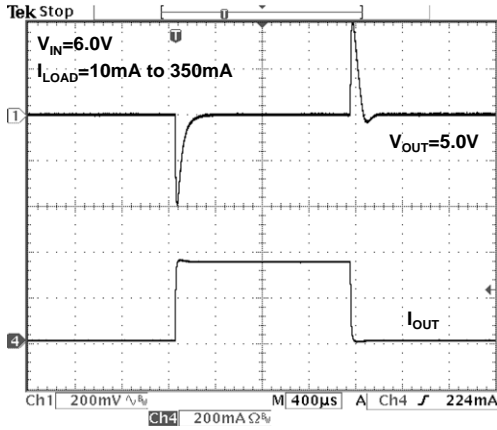


Fig.13 Load Transient Response at  $V_{IN}=6.0V$ ,  $V_{OUT}=5.0V$

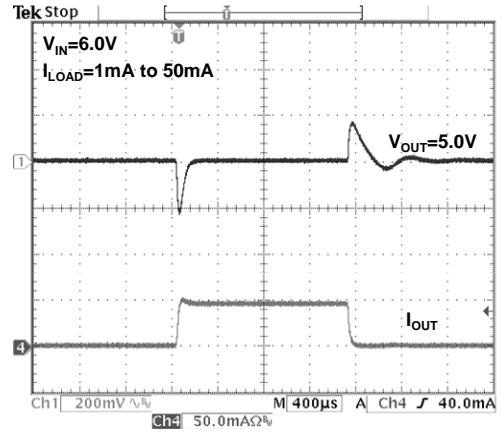


Fig.14 Load Transient Response at  $V_{IN}=6.0V$ ,  $V_{OUT}=5.0V$

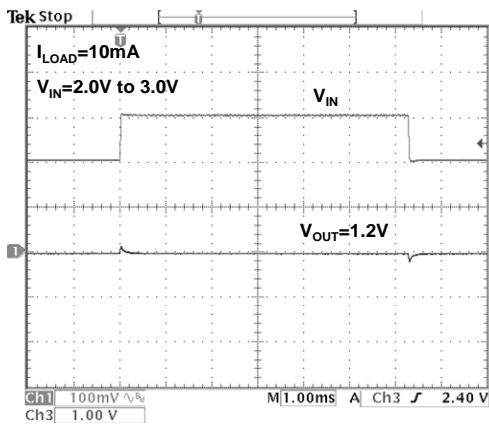


Fig.15 Line Transient Response at  $V_{OUT}=1.2V$ ,  $I_{OUT}=10mA$

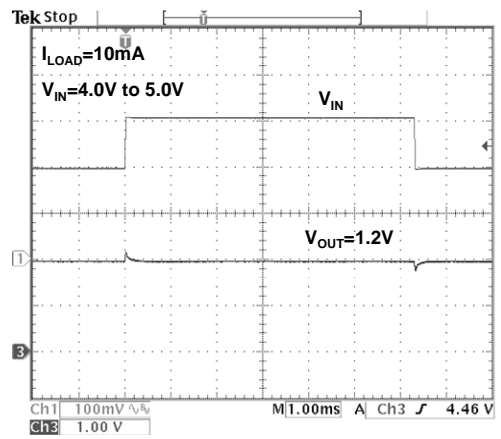


Fig.16 Line Transient Response at  $V_{OUT}=1.2V$ ,  $I_{OUT}=10mA$

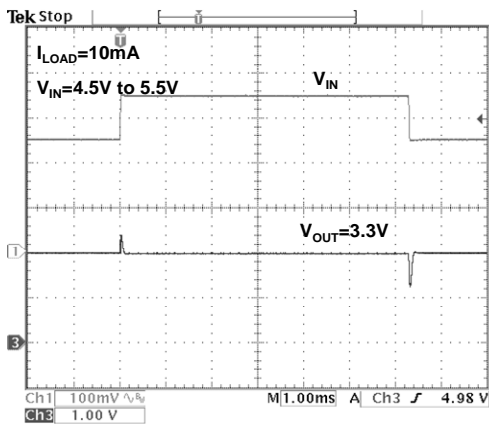


Fig.17 Line Transient Response at  $V_{OUT}=3.3V$ ,  $I_{OUT}=10mA$

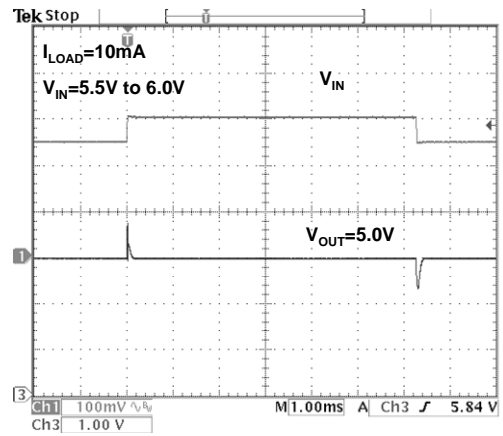


Fig.18 Line Transient Response at  $V_{OUT}=5.0V$ ,  $I_{OUT}=10mA$



■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

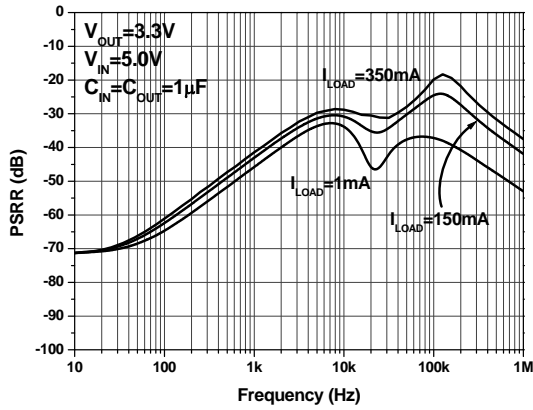


Fig 19. PSRR vs. Frequency

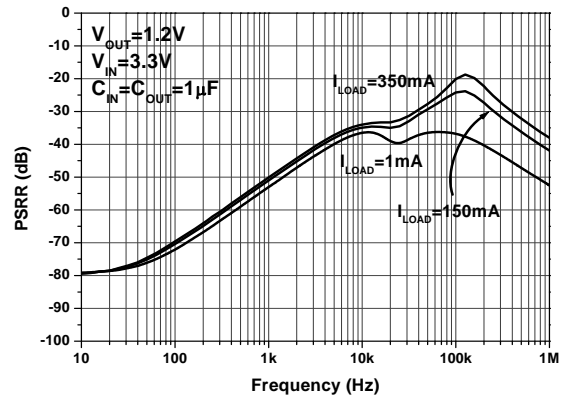


Fig 20. PSRR vs. Frequency

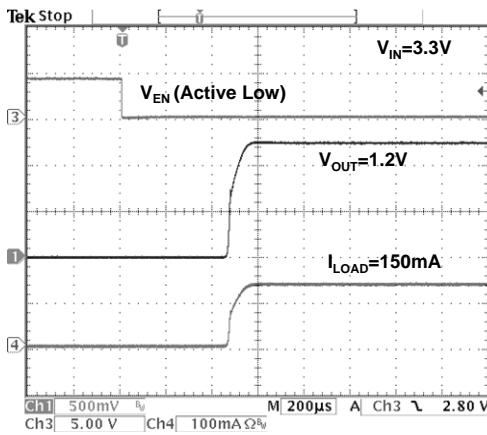


Fig.21 Start-Up Waveform at  $V_{OUT}=1.2V$ ,  $I_{OUT}=150mA$

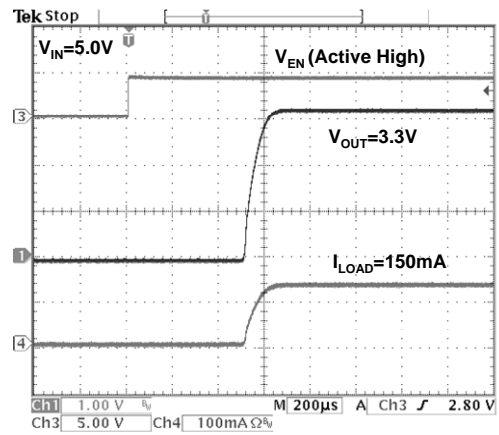


Fig.22 Start-Up Waveform at  $V_{OUT}=3.3V$ ,  $I_{OUT}=150mA$

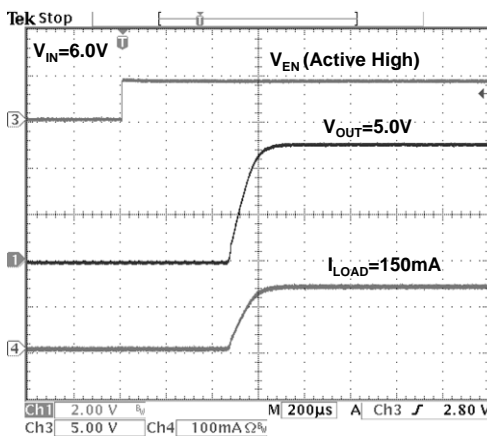


Fig.23 Start-Up Waveform at  $V_{OUT}=5.0V$ ,  $I_{OUT}=150mA$

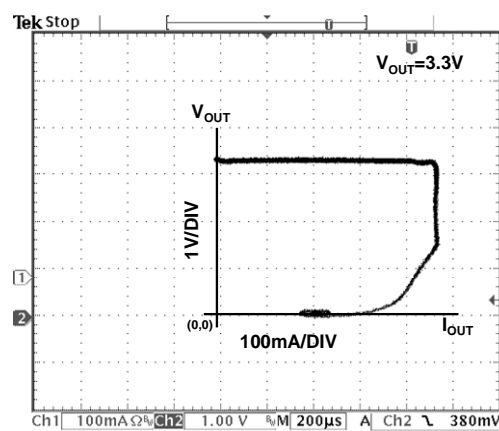
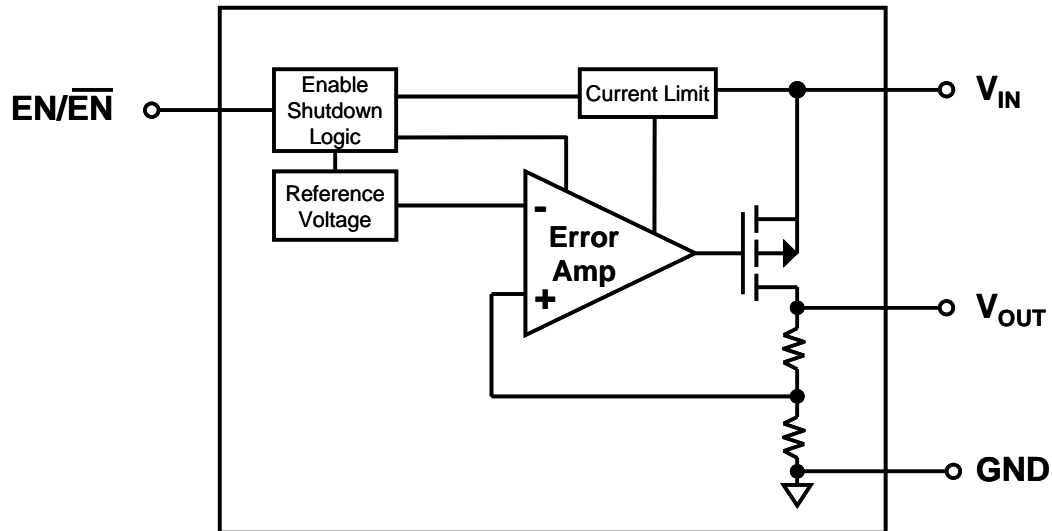


Fig.24 Current Foldback at  $V_{IN}=5.0V$ ,  $V_{OUT}=3.3V$

**■ BLOCK DIAGRAM**

**■ PIN DESCRIPTION**

V <sub>IN</sub>	PIN	– Power supply input pin. Bypass with a 1μF ceramic capacitor to GND
V <sub>OUT</sub>	PIN	– Regulator Output pin. Sources up to 350mA.
EN	PIN	– Chip Enable (Active High). This pin isn't allowed to float.
$\overline{\text{EN}}$	PIN	– Chip Enable (Active Low). This pin isn't allowed to float.
GND	PIN	– Ground.

## APPLICATION INFORMATION

The AIC1702 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 350mA.

### 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 AIC1702 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 AIC1702 includes a thermal-limiting circuit, which is designed to protect the device against overload

condition. When the junction temperature exceeds  $T_J=135^{\circ}\text{C}$ , 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 AIC1702 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

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

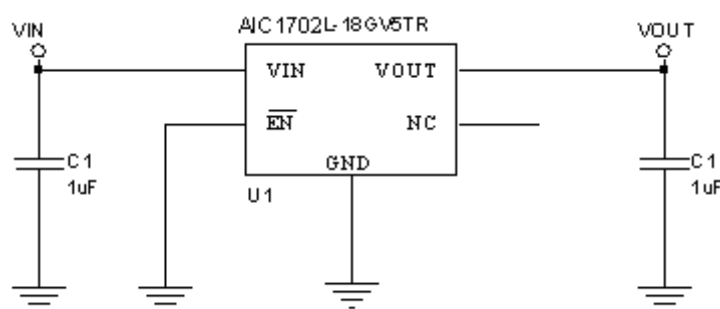
The maximum power dissipation is:

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

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

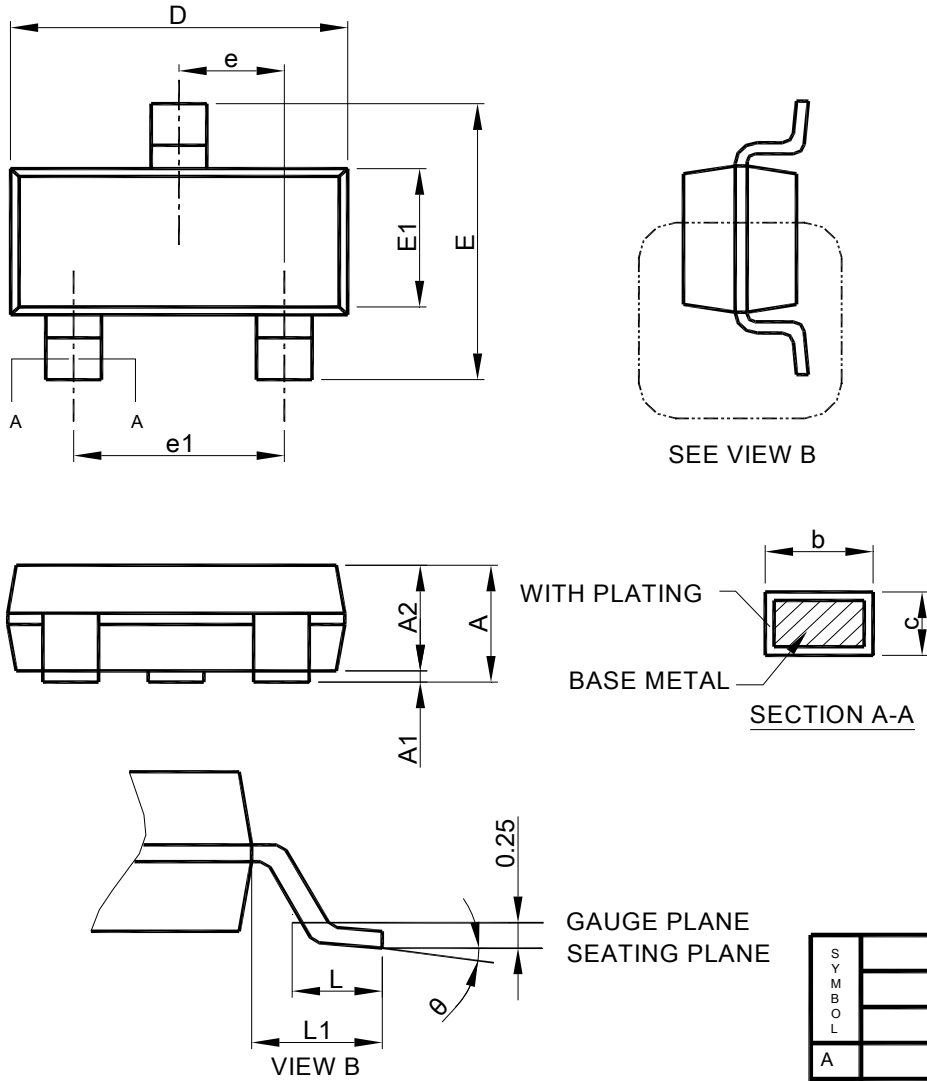
As a general rule, the lower temperature is, the better reliability of the device is. So the PCB mounting pad should provide maximum thermal conductivity to maintain low device temperature.

## APPLICATION CIRCUIT



■ PHYSICAL DIMENSIONS (unit: mm)

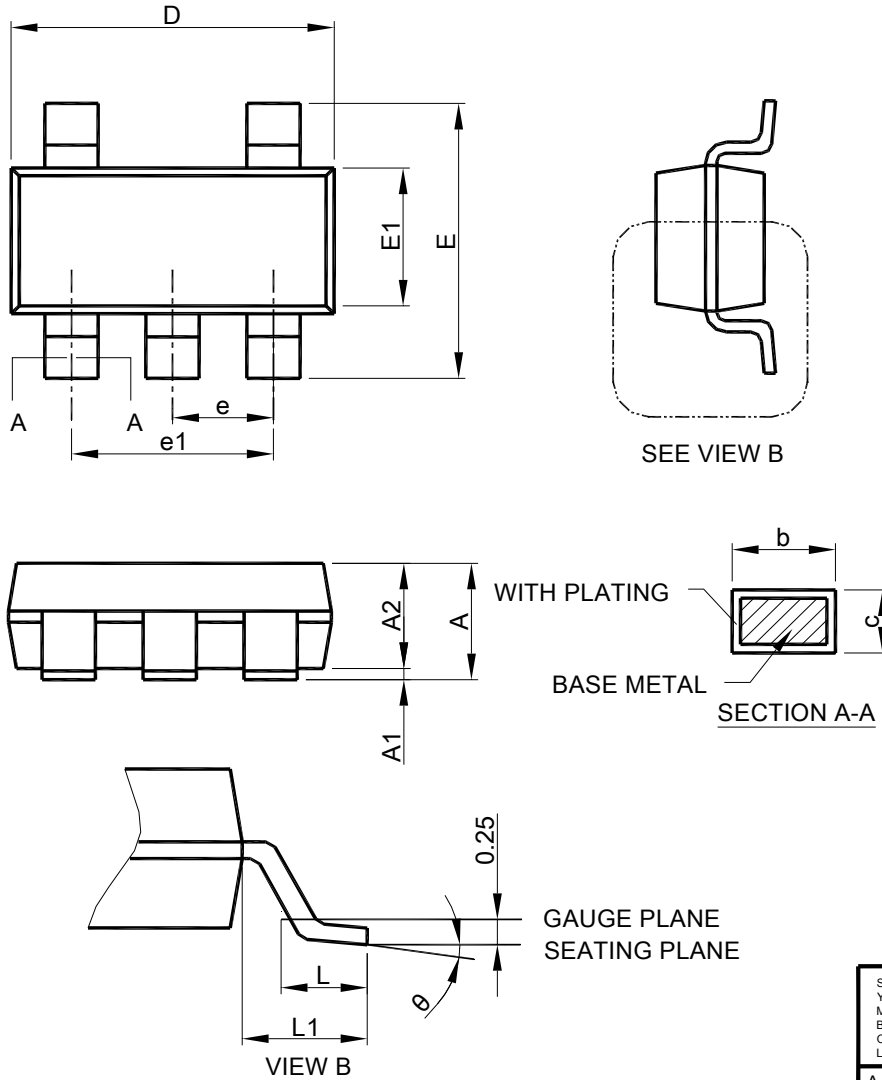
● SOT-23 PACKAGE OUTLINE DRAWING



- 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.

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	
theta	0°	8°

● SOT-23-5 PACKAGE OUTLINE DRAWING

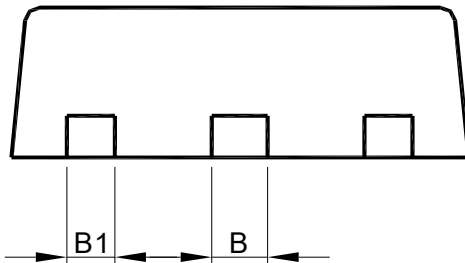
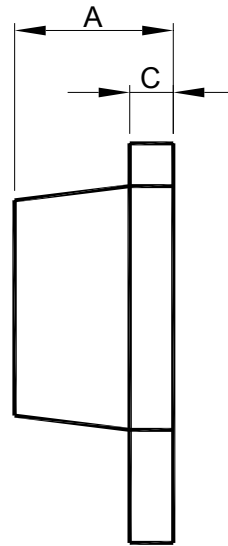
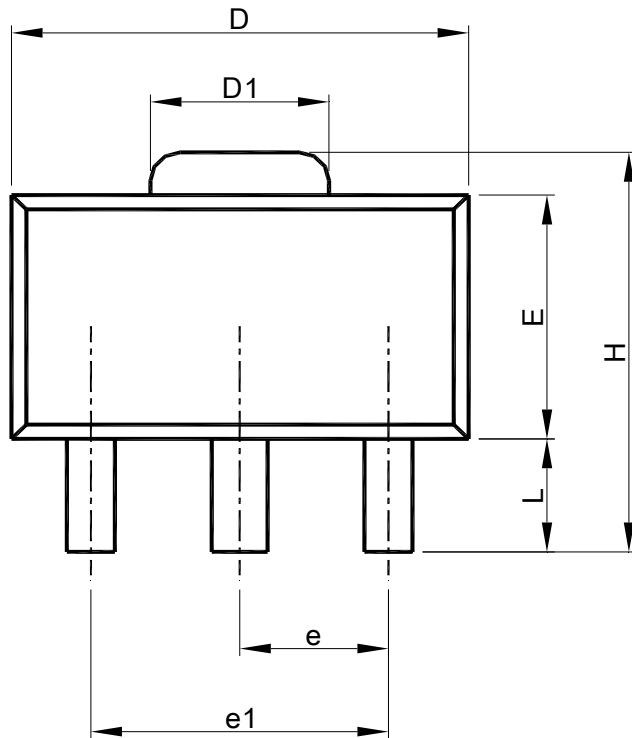


Note : 1. Refer to JEDEC MO-178AA.

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	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°

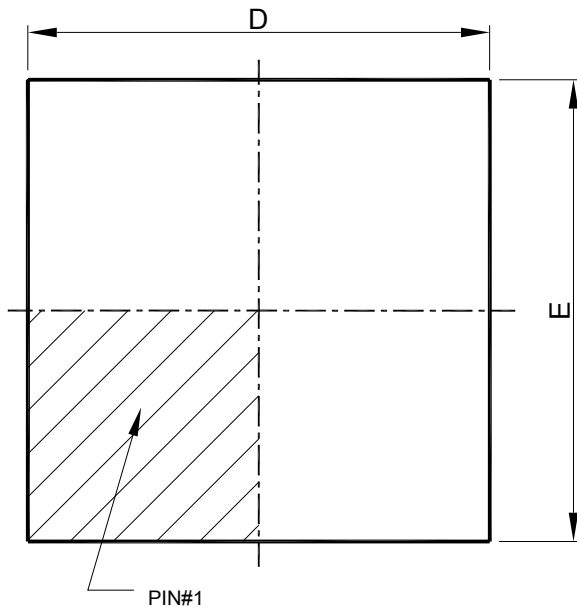
● SOT-89 PACKAGE OUTLINE DRAWING



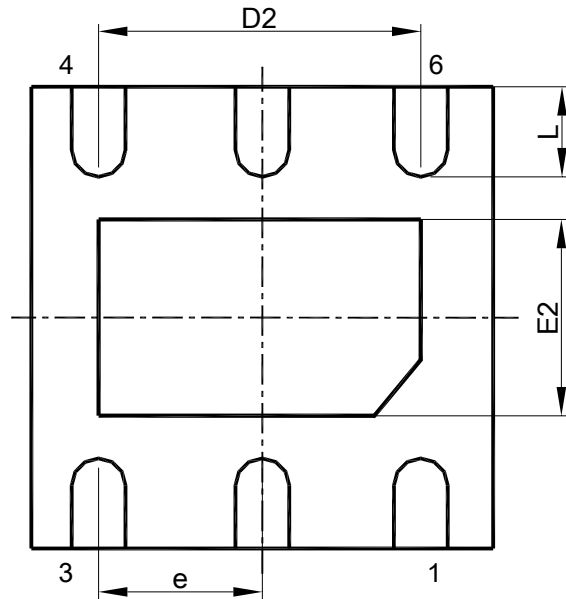
SYMBOL	SOT-89	
	MILLIMETERS	
	MIN.	MAX.
A	1.40	1.60
B	0.44	0.56
B1	0.36	0.48
C	0.35	0.44
D	4.40	4.60
D1	1.50	1.83
E	2.29	2.60
e	1.50 BSC	
e1	3.00 BSC	
H	3.94	4.25
L	0.89	1.20

- 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.

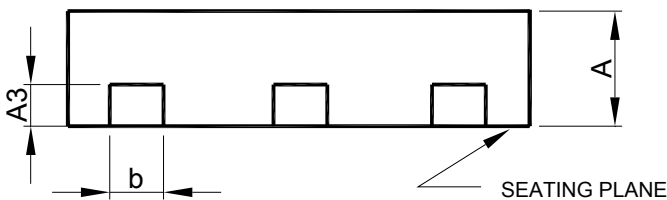
● DFN 6L-2x2x0.75-0.65mm PACKAGE OUTLINE DRAWING



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	0.25	0.35
D	2.00 BSC	
D2	1.20	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.

**Note:**

Information provided by AIC is believed to be accurate and reliable. However, we cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in an AIC product; nor for any infringement of patents or other rights of third parties that may result from its use. We reserve the right to change the circuitry and specifications without notice.

Life Support Policy: AIC does not authorize any AIC product for use in life support devices and/or systems. Life support devices or systems are devices or systems which, (i) are intended for surgical implant into the body or (ii) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.