Dual Output Low ESR Cap. Low-Dropout 600mA Linear Regulator

FEATURES

- Up to 600mA Output Current for Each LDO.
- Low Quiescent Current : 50μA (V_{OUT1} and V_{OUT2} Enable Mode).
- Low Dropout : 470mV at 600mA Load Current and 3.3V Output Voltage.
- High PSRR : 70dB at 1kHz.
- Independent Shutdown Controls.
- Current Limit and Thermal Protection.
- SOT-23-6, SOP-8 Package.

APPLICATIONS

- Cellular Phones.
- PDAs.
- Digital Still Cameras.
- Portable Consumer Equipments.

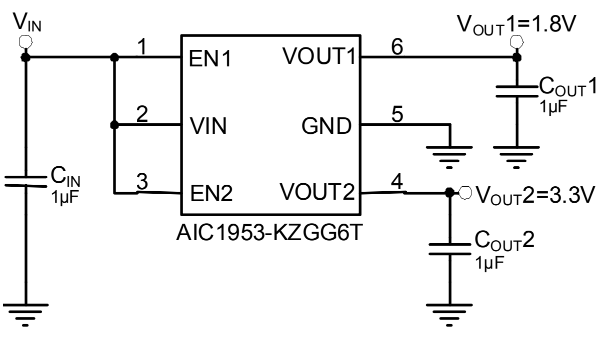
DESCRIPTION

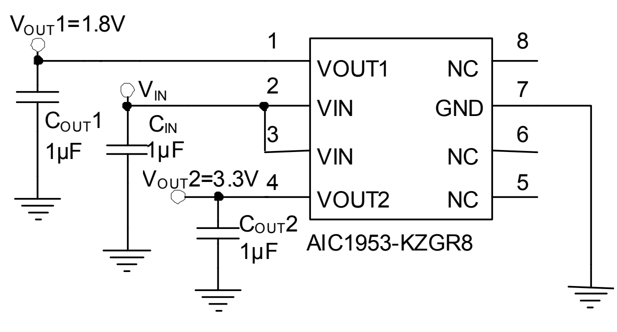
The AIC1953 is a dual output linear regulator in a SOT-23-6 and SOP-8 package. It is optimized for low ESR ceramic capacitors operation and up to 600mA continuous current on each output.

The AIC1953 offers high precision output voltage of ±2%. At 600mA load current, a 470mV dropout is performed when output voltage is equal to 3.3V. The quality of low quiescent current and low dropout voltage makes this device ideal for battery power applications. The high ripple rejection and low noise of the AIC1953 provide enhanced performances for critical applications such as cellular phones, and PDAs.

The AIC1953 includes current limit and thermal shutdown protection. Each of the output is controlled independently.

TYPICAL APPLICATION CIRCUIT





ORDERING INFORMATION

AIC1953-XXXXXXXX

- PACKING TYPE
  - TR: TAPE & REEL
  - BG: BAG
- PACKAGE TYPE
  - G6T: SOT-23-6
  - G6A: SOT-23-6
  - R8: SOP-8 Exposed Pad (Heat Sink)
  - S8: SOP-8
- G: GREEN PACKAGE
- OUTPUT2 VOLTAGE:

	VOUT2
A	0.8V
:	:
:	:
Z	3.3V
3	2.85V
4	3.4V
5	3.5V
6	3.6V
7	3.7V
8	3.8V

- OUTPUT1 VOLTAGE:

	VOUT1
A	0.8V
:	:
:	:
Z	3.3V
3	2.85V
4	3.4V
5	3.5V
6	3.6V
7	3.7V
8	3.8V

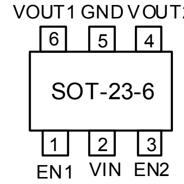
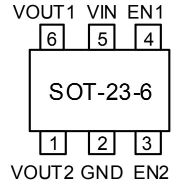
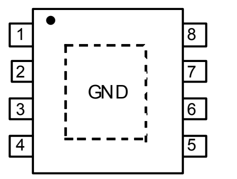
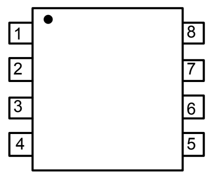
(Internally set VOUT1、VOUT2 and PACKAGE TYPE, refer to the “designator xxxxxx” table below. For other combinations, a unit of 0.1V within 0.8~3.8V, additional voltage versions and package type are available on demand.)

Example: AIC1953-KEGR8TR

→ Vout1 = 1.8V, Vout2 = 1.2V, with GR8 type pin configuration in SOP-8 Exposed Pad (Heat Sink) Green package and TAPE & REEL packing.

AIC1953-ZKGS8TR

→ Vout1 = 3.3V, Vout2 = 1.8V, with GS8 type pin configuration in SOP-8 Green package and TAPE & REEL packing.

PACKAGE TYPE	PIN CONFIGURATION
G6T (SOT-23-6)	FRONT VIEW 
G6A (SOT-23-6)	FRONT VIEW 
R8 (SOP-8)	SOP-8 (R8) Exposed Pad (Heat Sink) 1: VOUT1 2: VIN 3: VIN 4: VOUT2 5: NC 6: NC 7: GND (TAB) 8: NC TOP VIEW 
S8 (SOP-8)	SOP-8 (S8) 1: VOUT1 2: VIN 3: VIN 4: VOUT2 5: GND 6: GND 7: GND 8: GND TOP VIEW 

●Designator xxxxxx

Designator	Output Voltage		Designator	Output Voltage	
xxxxxx	VOUT1	VOUT2	xxxxxx	VOUT1	VOUT2
WWGG6T WWGG6A WWGR8 WWGS8	3.0	3.0	KEGG6T KEGG6A KEGR8 KEGS8	1.8	1.2
EZGG6T EZGG6A EZGR8 EZGS8	1.2	3.3	ZUGG6T ZUGG6A ZUGR8 ZUGS8	3.3	2.8
ZKGG6T ZKGG6A ZKGR8 ZKGS8	3.3	1.8	ZWGG6T ZWGG6A ZWGR8 ZWGS8	3.3	3.0
UHGG6T UHGG6A UHGR8 UHGS8	2.8	1.5	ZZGG6T ZZGG6A ZZGR8 ZZGS8	3.3	3.3
KUGG6T KUGG6A KUGR8 KUGS8	1.8	2.8	KZGG6T KZGG6A KZGR8 KZGS8	1.8	3.3

●SOT-23-6 Marking

Part No.	Package Code	Package Type	Marking	Output Voltage
AIC1953-xx	GG6T	SOT-23-6	GVxxG	1st x = Vout1, 2nd x = Vout2 x=A, B, …, Y, Z, 3~8 (A=0.8V, B=0.9V,……Y=3.2V, Z=3.3V, 0.1V a step, 3=2.85V, 4=3.4V, 5=3.5V, 6=3.6V, 7=3.7V, 8=3.8V)
AIC1953-xx	GG6A	SOT-23-6	GUxxG	

ABSOLUTE MAXIMUM RATINGS

Input Voltage 7V
EN Pin Voltage 7V
Operating Ambient Temperature Range T_A .... -40ºC~85ºC
Operating Maximum Junction Temperature T_J 150ºC
Storage Temperature Range T_{STG} .... -65ºC~150ºC
Lead Temperature (Soldering 10 Sec.) 260ºC
Thermal Resistance Junction to Case SOT-23-6 .... 115°C/W
SOP-8 (Exposed Pad) .... 15ºC /W
SOP-8 .... 40ºC /W
Thermal Resistance Junction to Ambient SOT-23-6 .... 250°C/W
SOP-8 (Exposed Pad)… .... 60ºC /W
SOP-8 .... 160ºC /W
(Assume no Ambient Airflow, no Heat sink)

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

* The package is placed on a two layers PCB with 2 ounces copper and 2 square inch, connected by 8 vias

ELECTRICAL CHARACTERISTICS

(V_{IN} = V_{OUT} + 1V, V_{EN1}=V_{EN2}= V_{IN}, T_J=25°C, unless otherwise specified) (Note 1)

PARAMETER	TEST CONDITIONS		SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Voltage (Note 2)			V_{IN}	1.6		6.0	V
Output Voltage Tolerance	V_{IN}= 6.0V, I_{OUT} = 1mA		V_{OUT}	-2		2	%
Continuous Output Current			I_{OUT}	600			mA
Quiescent Current	V_{EN2} = V_{EN1} = V_{IN}		I_Q		50	80	μA
GND Pin Current	I_{OUT1} = 600mA & I_{OUT2} = 600mA, V_{EN2} = V_{EN1} = V_{IN}		I_{GND}		55	80	μA
Standby Current	V_{EN1}=V_{EN2}= 0		I_{STBY}			0.1	μA
Output Current Limit	V_{OUT} = GND		I_{IL}	650	950		mA
Dropout Voltage	I_{OUT} = 600mA	V_{OUT}=1.8V	V_{DROP}		710	850	mV
		V_{OUT}=2.5V			580	700	
		V_{OUT}=3.3V			470	560	
Line Regulation	V_{IN} = V_{OUT} + 1V to 6V		ΔV_{LIR}		3	16	mV
Load Regulation	I_{OUT} = 1mA to 600mA		ΔV_{LOR}		2	10	mV
Ripple Rejection	f=1kHz, Ripple=0.5Vp-p,		PSRR		70		dB
Output Noise Voltage	f= 10~100KHz				24		μVrms
Temperature Coefficient			TC		50		ppm/℃
Thermal Shutdown Temperature	V_{IN} = V_{OUT} + 1V				150		℃
Thermal Shutdown Hysteresis					35		℃
EN Pin SPECIFICATIONS							
EN Pin Current	V_{EN1} = V_{EN2} = V_{IN}		I_{EN}			0.1	μA
Shutdown Exit Delay Time			Δt		100		μS
Max Output Discharge Resistance to GND during shutdown			RDSON_CLMP		20		Ω
EN Input Threshold	Output ON		V_{ENH}	1.6			V
	Output OFF		V_{ENL}			0.25	

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}(min) is the higher value of Vout + Dropout Voltage or 1.6V.

■ TYPICAL PERFORMANCE CHARACTERISTICS

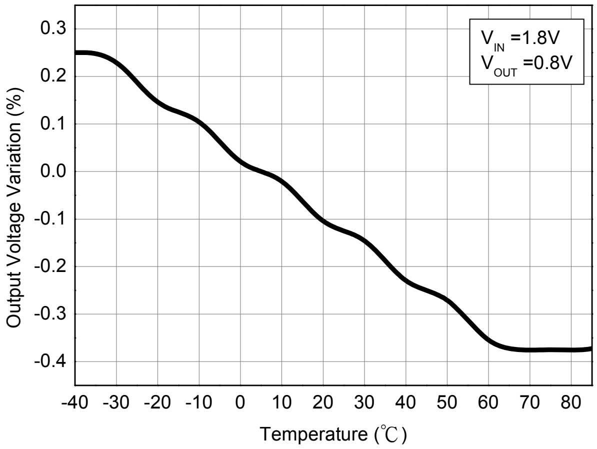


Fig.1 Output Voltage Variation vs. Temperature

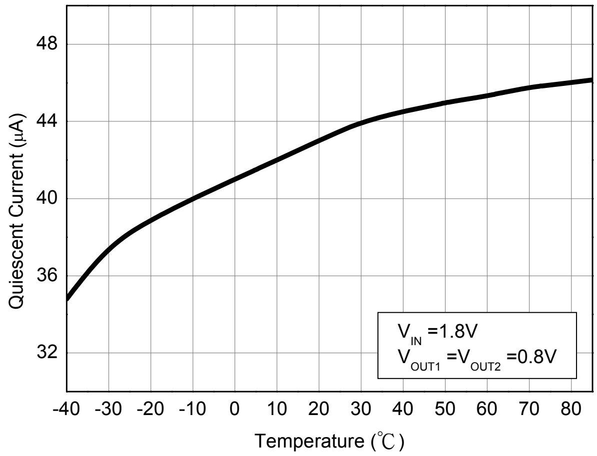


Fig.2 Dual LDO Quiescent Current vs. Temperature

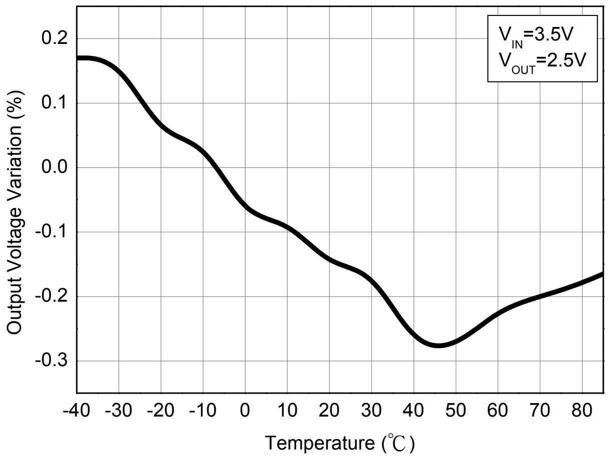


Fig.3 Output Voltage Variation vs. Temperature

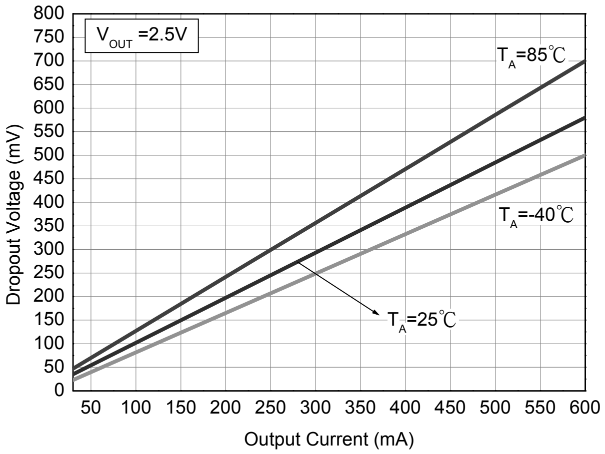


Fig.4 Dropout Voltage vs. Output Current

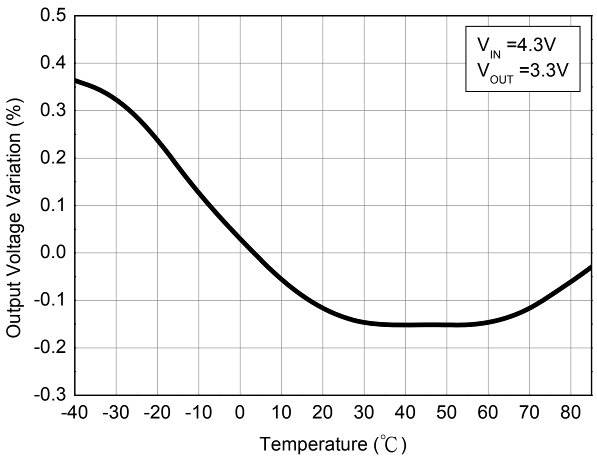


Fig.5 Output Voltage Variation vs. Temperature

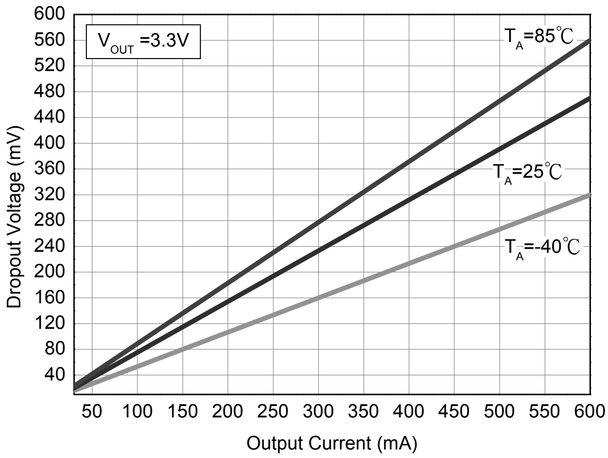


Fig.6 Dropout Voltage vs. Output Current

■ TYPICAL PERFORMANCE CHARACTERISTICS

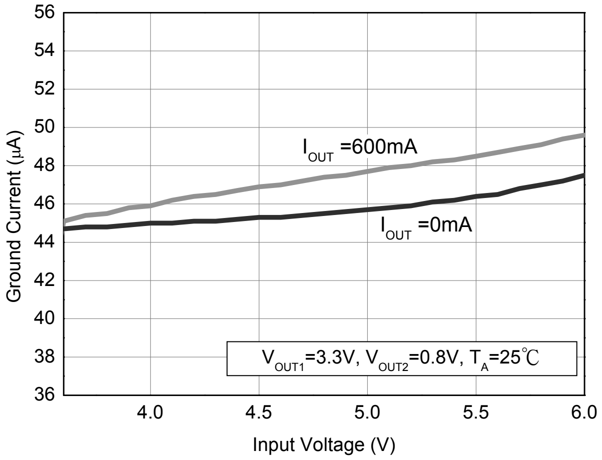


Fig.7 Dual LDO Quiescent Current and Ground Current vs. Input Voltage

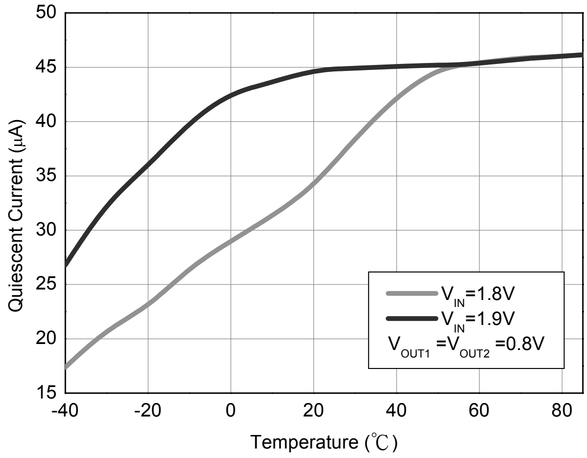


Fig.8 Quiescent Current vs. Temperature.

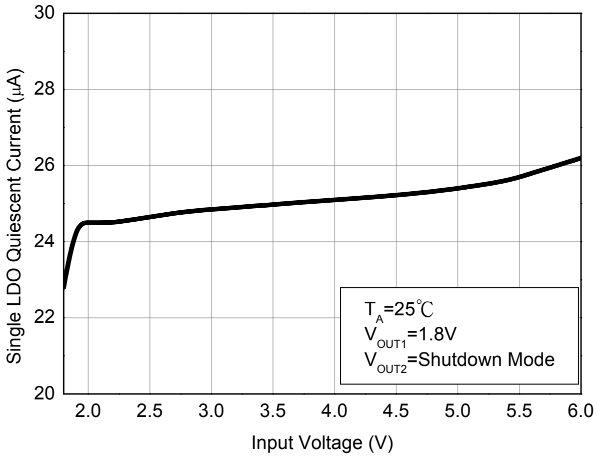


Fig.9 Single LDO Quiescent Current vs. Input Voltage

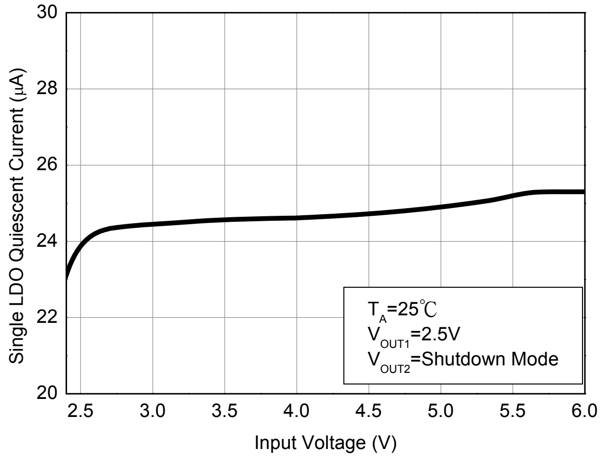


Fig.10 Single LDO Quiescent Current vs. Input Voltage

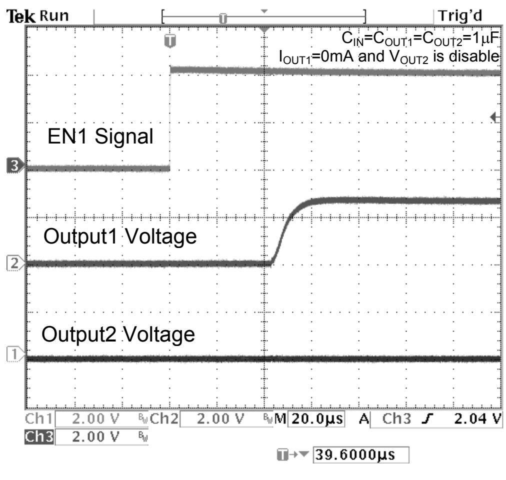


Fig.11 Start Up Waveform at V_{IN}=3.8V, V_{OUT1}=2.8V and V_{OUT2}=1.8V

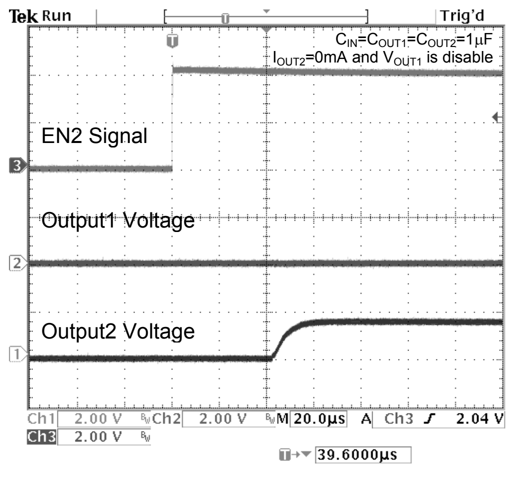


Fig.12 Start Up Waveform at V_{IN}=3.8V, V_{OUT1}=2.8V and V_{OUT2}=1.8 V

■ TYPICAL PERFORMANCE CHARACTERISTICS

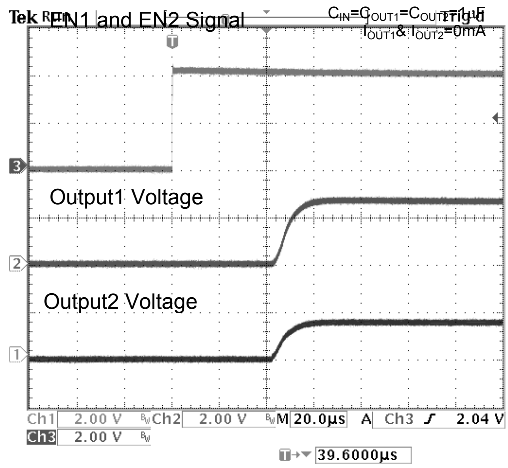


Fig.13 Start Up Waveform at V_{IN}=3.8V, V_{OUT1}=2.8V and V_{OUT2}=1.8V

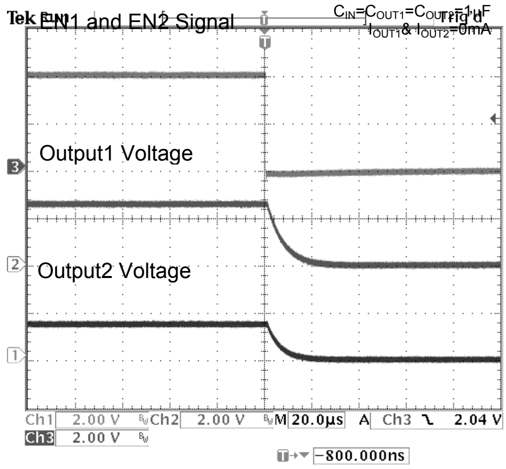


Fig.14 Shutdown Waveform at V_{IN}=3.8V, V_{OUT1}=2.8V and V_{OUT2}=1.8V

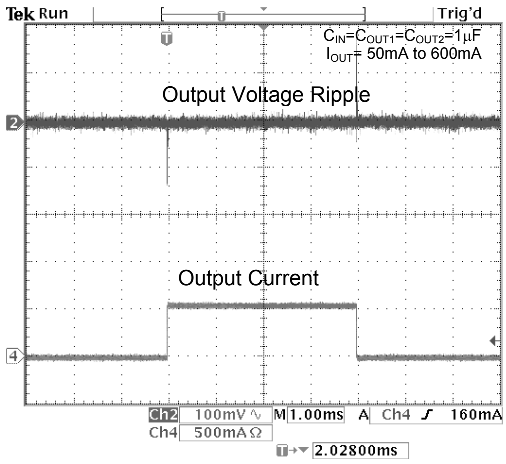


Fig.15 Load Transient Response at V_{IN}=2.8V, V_{OUT}=0.8V

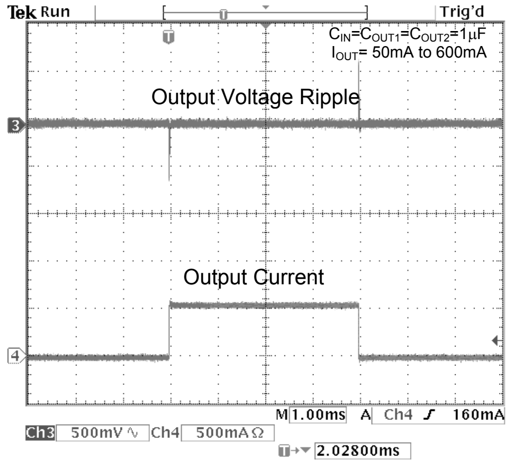


Fig.16 Load Transient Response at V_{IN}=4.8V, V_{OUT}=3.8V

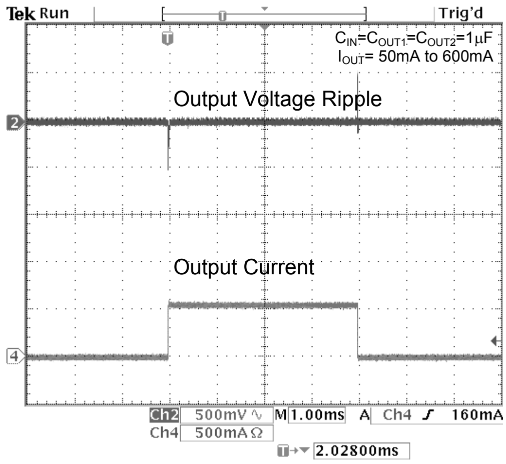


Fig.17 Load Transient Response at V_{IN}=3.8V, V_{OUT}=2.8V

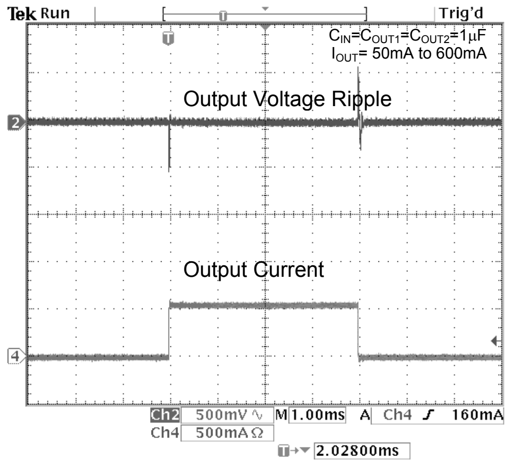


Fig.18 Load Transient Response at V_{IN}=4.3V, V_{OUT}=3.3V

■ TYPICAL PERFORMANCE CHARACTERISTICS

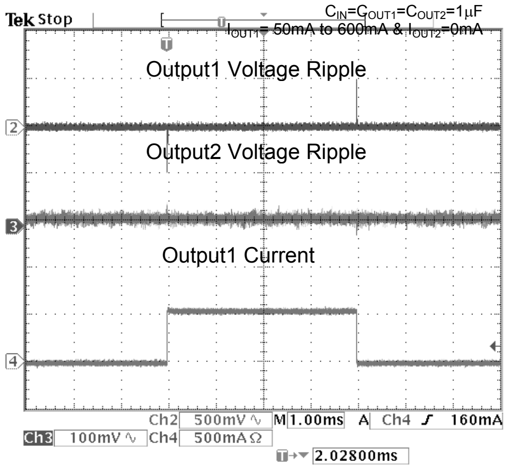


Fig.19 Cross Talk at V_{IN}=4.3V, V_{OUT1}=2.8V and V_{OUT2}=3.3V

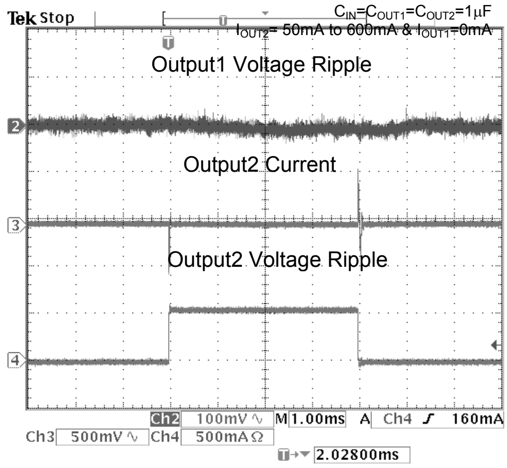


Fig.20 Cross Talk at V_{IN}=4.3V, V_{OUT1}=2.8V and V_{OUT2}=3.3V

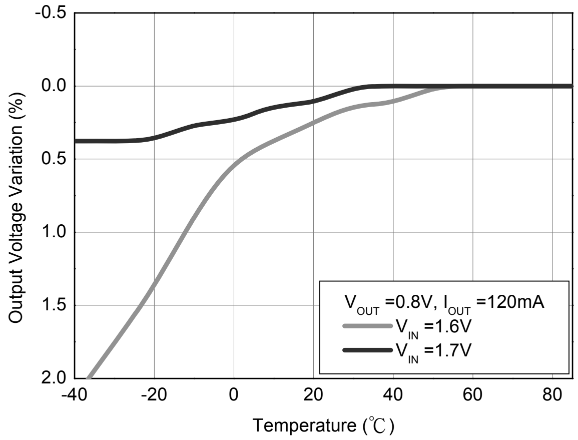


Fig.21 Output Voltage Variation vs. Temperature.

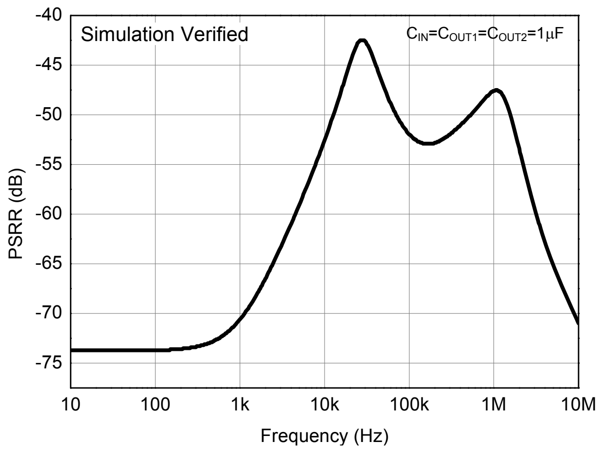
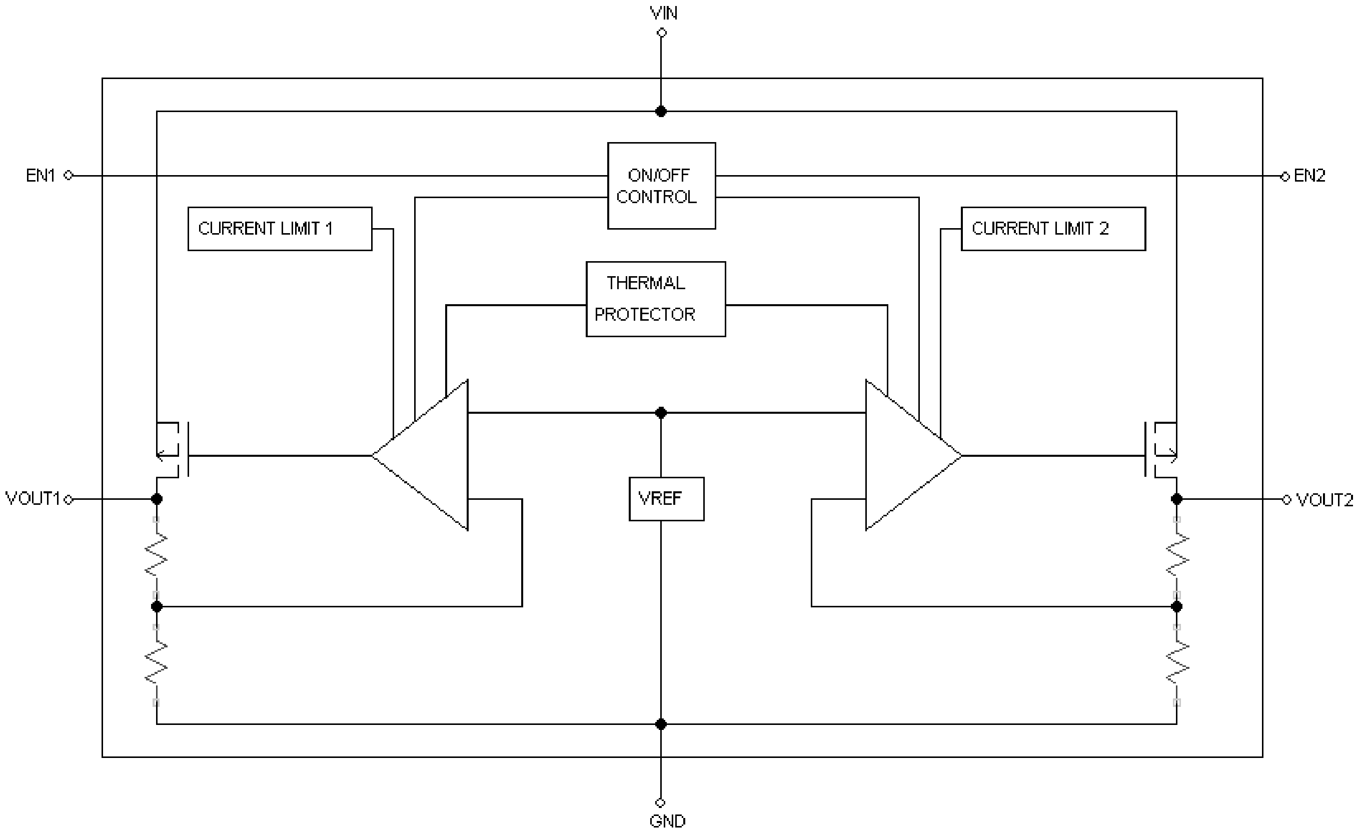


Fig.22 PSRR at V_{IN}=2.5V, V_{OUT}=1.0V and I_{OUT}=10mA.

BLOCK DIAGRAM



PIN DESCRIPTION

VIN PIN	- Power input.
GND PIN	- Ground.
EN1 PIN(SOT-23-6)	- Output 1 ON/OFF controller. This pin isn't allowed to float.
EN2 PIN(SOT-23-6)	- Output 2 ON/OFF controller. This pin isn't allowed to float.
VOUT1 PIN	- Output 1.
VOUT2 PIN	- Output 2.

APPLICATION INFORMATION

The AIC1953 is a low-dropout, low quiescent-current, dual-output linear regulator for battery power applications. These parts are available with preset output voltages ranging from 0.8V to 3.8V, and the parts can supply loads up to 600mA.

SHUTDOWN

The AIC1953 has two independent shutdown control inputs (EN1 and EN2). By connecting EN1 pin to ground, output1 can be shut down. By connecting EN2 pin to ground, output2 can be shut down. By connecting both of EN1 pin and EN2 pin to ground, the AIC1953 can be shut down to reduce the supply current to 0.1μA.

CURRENT LIMIT

The AIC1953 includes two independent current limiters, which monitor and control the maximum output current. If the output is overloaded or shorted to ground, this can protect the device from being damaged.

THERMAL PROTECTION

The AIC1953 includes a thermal-limiting circuit, which is designed to protect the device against overload condition. When the junction temperature exceeds T_J=150ºC, the thermal-limiting circuit turns off the pass transistors and allows the IC to cool. For continuous load condition, maximum rating of junction temperature must not be exceeded.

INPUT-OUTPUT CAPACITORS

Linear regulators require input and output capacitors to maintain stability. Input capacitor at 1μF with a 1μF ceramic output capacitor for each regulator is recommended. To avoid oscillation, it is recommended to follow the figure of “Region of Stable C_{OUT} ESR vs. Load Current” to choose proper capacitor specifications.

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.

POWER DISSIPATION

The maximum power dissipation of AIC1953 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

$P = I_{OUT1} (V_{IN}-V_{OUT1}) + I_{OUT2} (V_{IN}-V_{OUT2})$

The maximum power dissipation is:

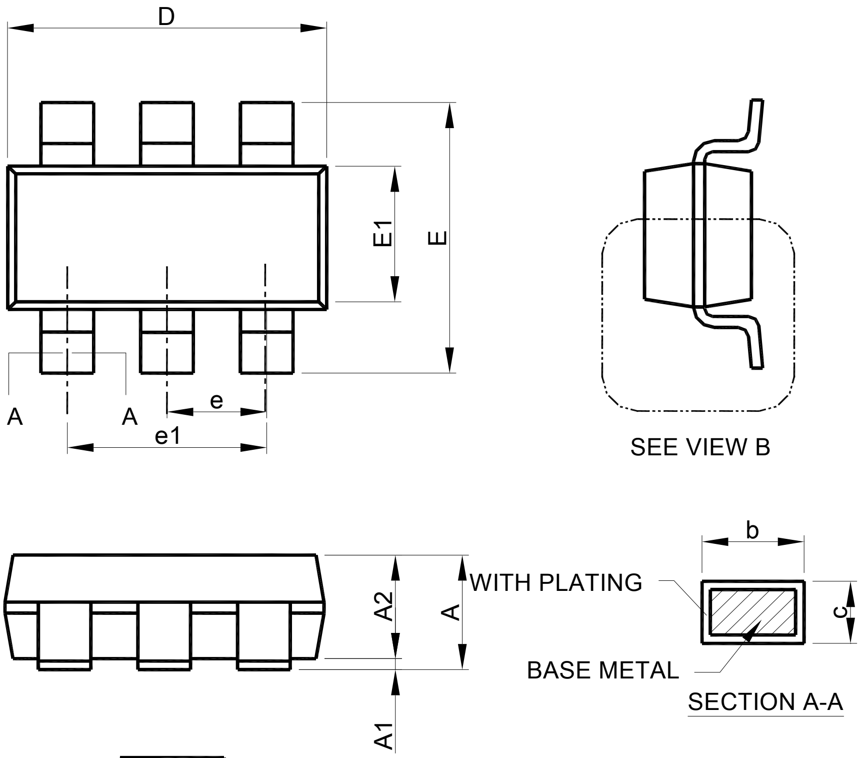
$$P_{MAX} = \frac{(T_{J\text{-}max} - T_A)}{R\theta_{JA}}$$

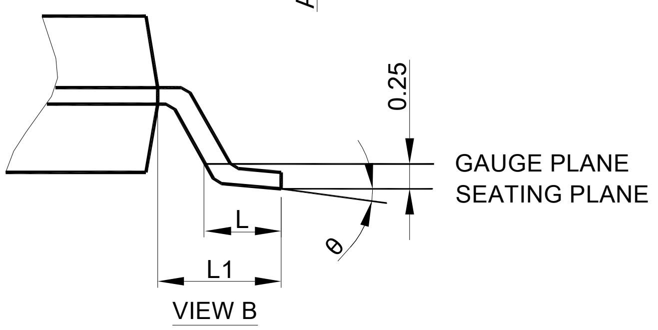
Where $T_{J\text{-}max}$ is the maximum allowable junction temperature (150°C), and T_A is the ambient temperature suitable in application.

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.

PHYSICAL DIMENSIONS

- **SOT-23-6 PACKAGE OUTLINE DRAWING**

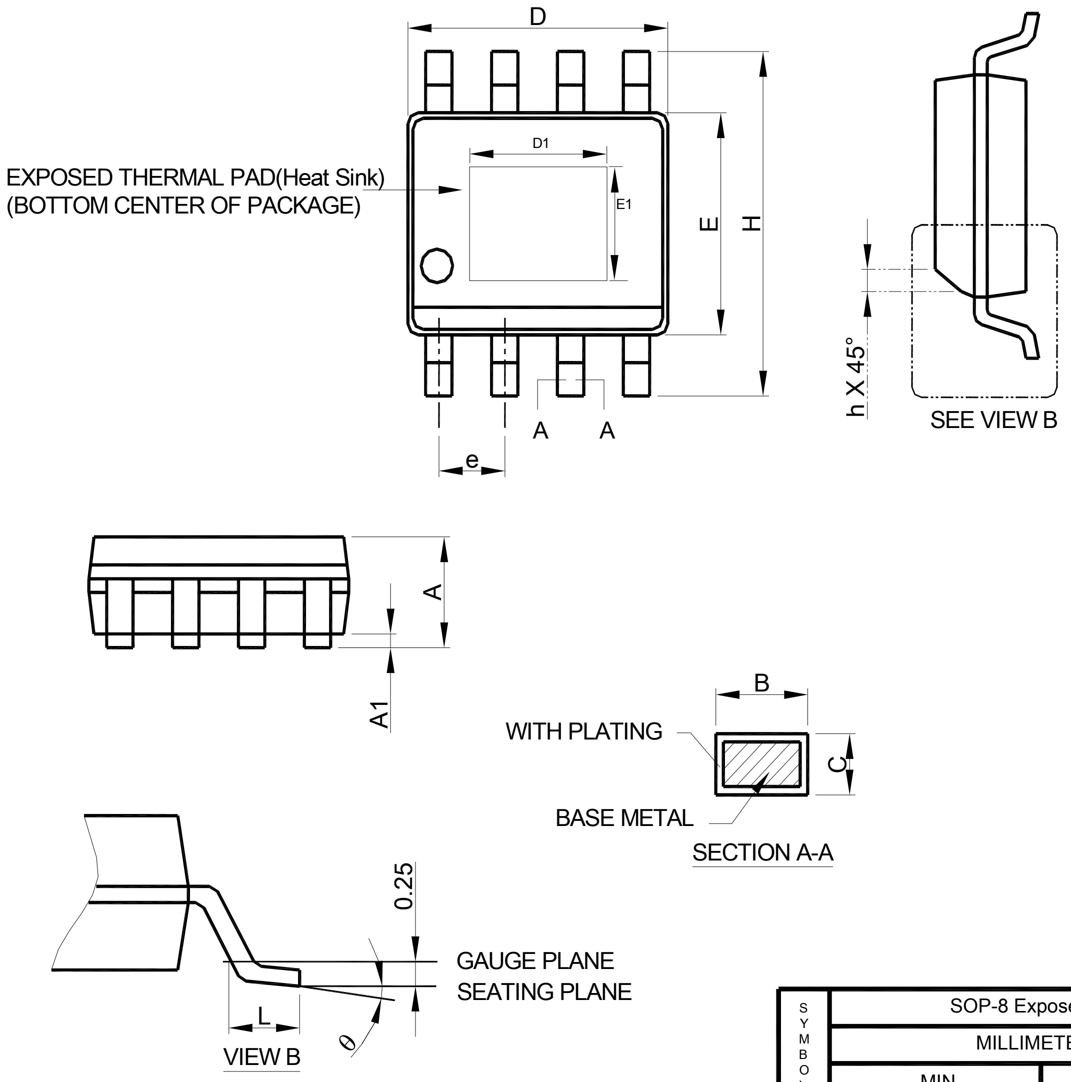




SYMBOL	SOT-23-6	
	MILLIMETERS	
	MIN.	MAX.
A	0.95	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.22
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.95 BSC	
e1	1.90 BSC	
L	0.30	0.60
L1	0.60 REF	
θ	0°	8°

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

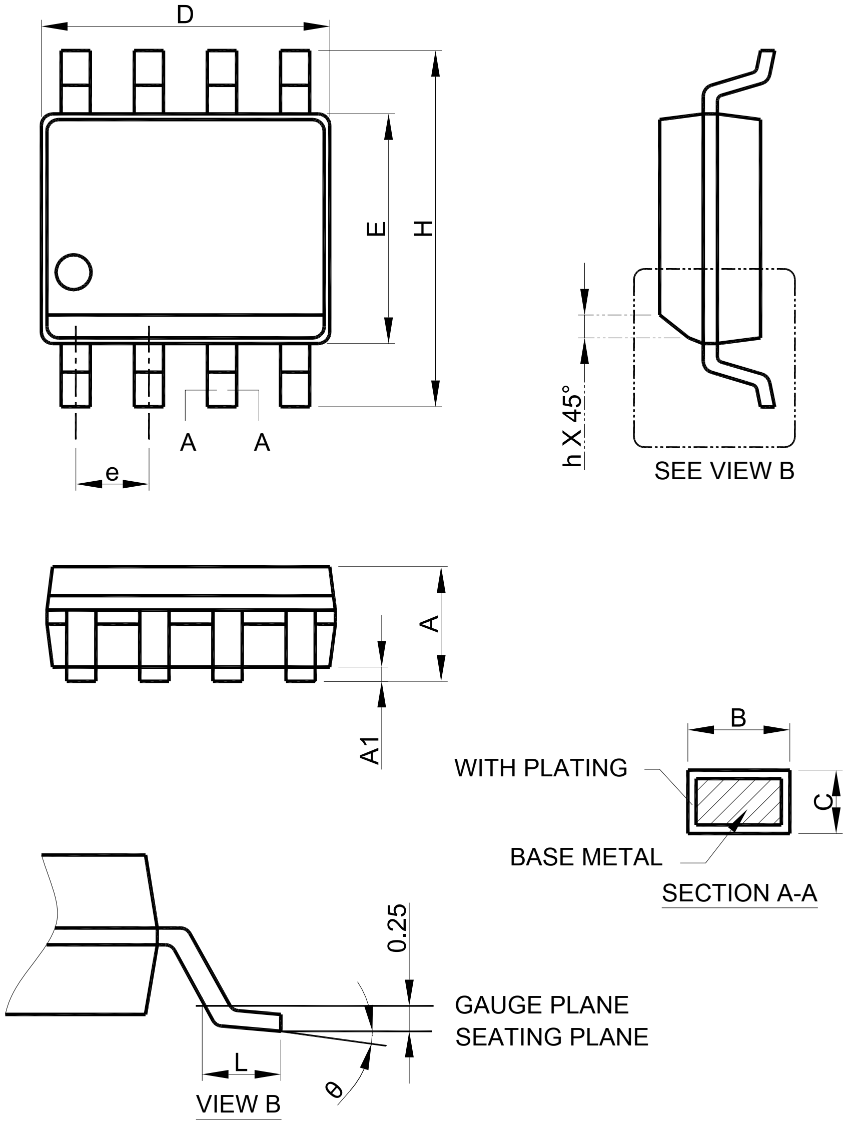
- **SOP-8 Exposed Pad (Heat Sink) PACKAGE OUTLINE DRAWING**



Note : 1. Refer to JEDEC MS-012E.
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	SOP-8 Exposed Pad(Heat Sink)	
	MILLIMETERS	
	MIN.	MAX.
A	1.35	1.75
A1	0.00	0.15
B	0.31	0.51
C	0.17	0.25
D	4.80	5.00
D1	1.50	3.50
E	3.80	4.00
E1	1.0	2.55
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.27
θ	0°	8°

- **SOP-8 PACKAGE OUTLINE DRAWING**



SYMBOL	SOP-8	
	MILLIMETERS	
	MIN.	MAX.
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.27
θ	0°	8°

Note: 1. Refer to JEDEC MS-012AA.
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.