

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

## FEATURES

- Up to 600mA Output Current for Each LDO.
- Low Quiescent Current : 50 $\mu$ A ( $V_{OUT1}$  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.
- SOP-8 Package.

## APPLICATIONS

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

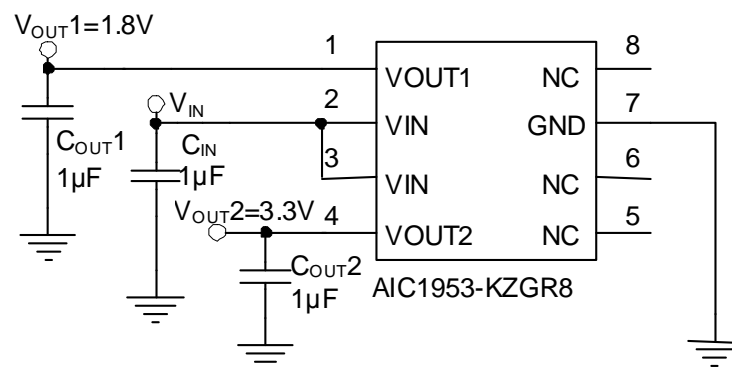
## DESCRIPTION

The AIC1953 is a dual output linear regulator in a 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  $\pm 2\%$ . 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.

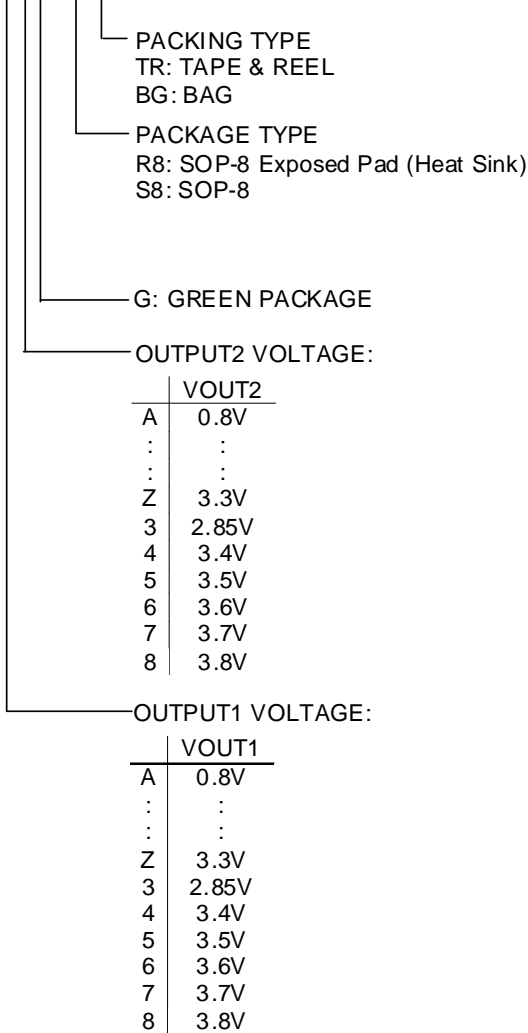
The AIC1953 includes current limit and thermal shutdown protection. Each of the output is controlled independently.

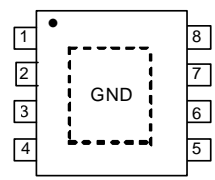
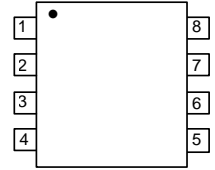
## TYPICAL APPLICATION CIRCUIT



**ORDERING INFORMATION**

AIC1953-XXXXXX



PACKAGE TYPE	PIN CONFIGURATION	
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 

(Internally set VOUT1 · VOUT2 and PACKAGE TYPE, refer to the “designator xxxxx” 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.

●Designator xxxxx

Designator	Output Voltage		Designator	Output Voltage	
	VOUT1	VOUT2		VOUT1	VOUT2
xxxxx			xxxxx		
WWGR8 WWGS8	3.0	3.0	KEGR8 KEGS8	1.8	1.2
EZGR8 EZGS8	1.2	3.3	ZUGR8 ZUGS8	3.3	2.8
ZKGR8 ZKGS8	3.3	1.8	ZWGR8 ZWGS8	3.3	3.0
UHGR8 UHGS8	2.8	1.5	ZZGR8 ZZGS8	3.3	3.3
KUGR8 KUGS8	1.8	2.8	KZGR8 KZGS8	1.8	3.3

■ **ABSOLUTE MAXIMUM RATINGS**

Input Voltage .....	7V
Operating Ambient Temperature Range $T_A$ .....	-40°C~85°C
Operating Maximum Junction Temperature $T_J$ .....	150°C
Storage Temperature Range $T_{STG}$ .....	-65°C~150°C
Lead Temperature (Soldering 10 Sec.).....	260°C
Thermal Resistance Junction to Case	SOP-8 (Exposed Pad)* ..... 15°C /W
	SOP-8 ..... 40°C /W
Thermal Resistance Junction to Ambient	SOP-8 (Exposed Pad)* ..... 60°C /W
	SOP-8 ..... 160°C /W

(Assume no ambient airflow)

**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**
**( $V_{IN} = V_{OUT} + 1V$ ,  $V_{EN1}=V_{EN2}= V_{IN}$ ,  $T_J=25^{\circ}C$ , 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	$\mu A$		
GND Pin Current	$I_{OUT1} = 600mA$ & $I_{OUT2} = 600mA$ , $V_{EN2} = V_{EN1} = V_{IN}$	$I_{GND}$		55	80	$\mu A$		
Standby Current	$V_{EN1}=V_{EN2}= 0$	$I_{STBY}$			0.1	$\mu A$		
Output Current Limit	$V_{OUT} = GND$	$I_{IL}$	650	950		mA		
Dropout Voltage	$I_{OUT} = 600mA$	$V_{DROP}$			710	850	mV	
				$V_{OUT}=1.8V$		580		700
				$V_{OUT}=2.5V$		470		560
	$V_{OUT}=3.3V$							
Line Regulation	$V_{IN} = V_{OUT} + 1V$ to 6V	$\Delta V_{LIR}$		3	16	mV		
Load Regulation	$I_{OUT} = 1mA$ to 600mA	$\Delta V_{LOR}$		2	10	mV		
Ripple Rejection	$f=1kHz$ , Ripple=0.5Vp-p,	PSRR		70		dB		
Output Noise Voltage	$f= 10\sim 100KHz$			24		$\mu V_{rms}$		
Temperature Coefficient		TC		50		ppm/ $^{\circ}C$		
Thermal Shutdown Temperature	$V_{IN} = V_{OUT} + 1V$			150		$^{\circ}C$		
Thermal Shutdown Hysteresis				35		$^{\circ}C$		

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:  $V_{IN}(min)$  is the higher value of  $V_{out} + \text{Dropout Voltage}$  or 1.6V.

**TYPICAL PERFORMANCE CHARACTERISTICS**

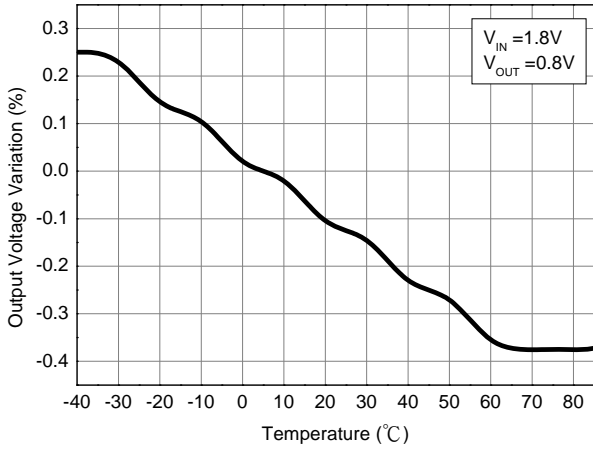


Fig.1 Output Voltage Variation vs. Temperature

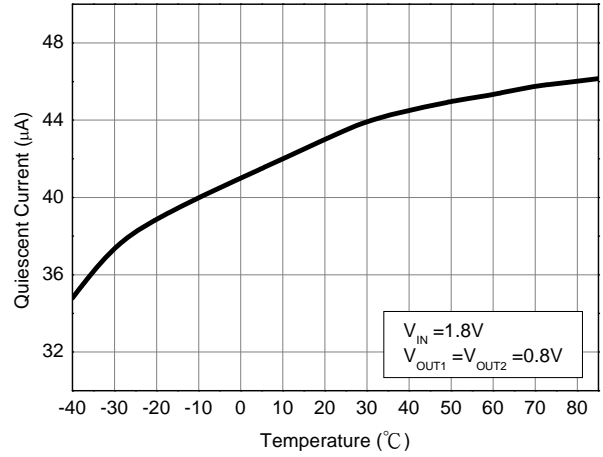


Fig.2 Dual LDO Quiescent Current vs. Temperature

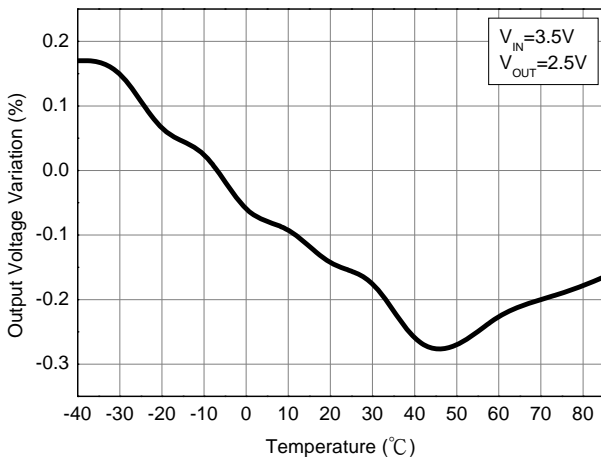


Fig.3 Output Voltage Variation vs. Temperature

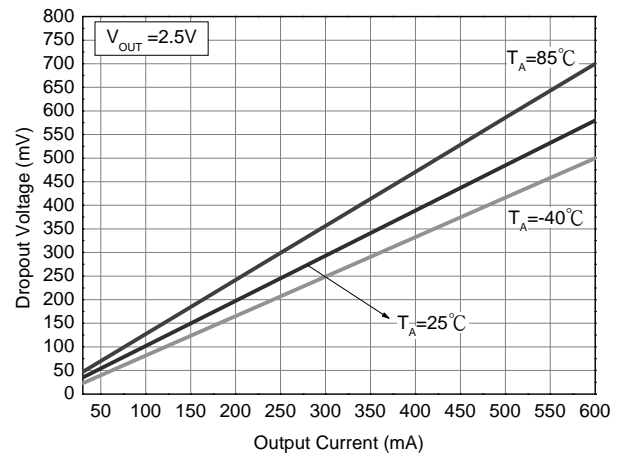


Fig.4 Dropout Voltage vs. Output Current

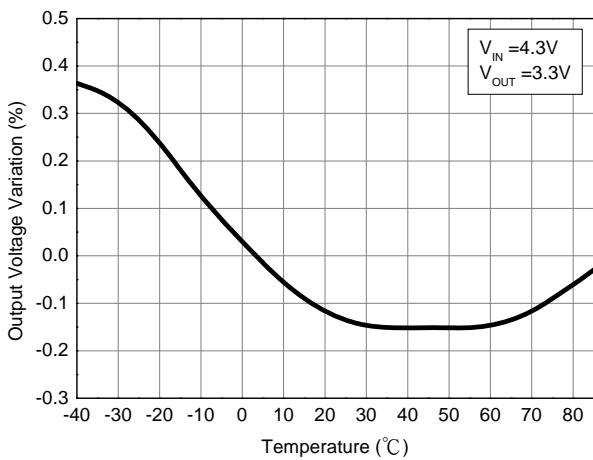


Fig.5 Output Voltage Variation vs. Temperature

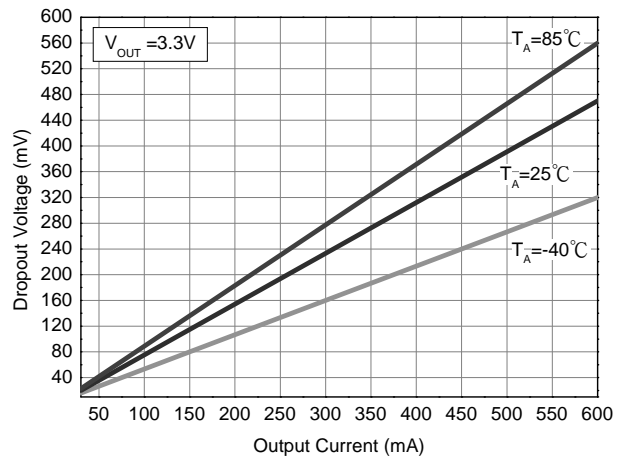


Fig.6 Dropout Voltage vs. Output Current

**■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)**

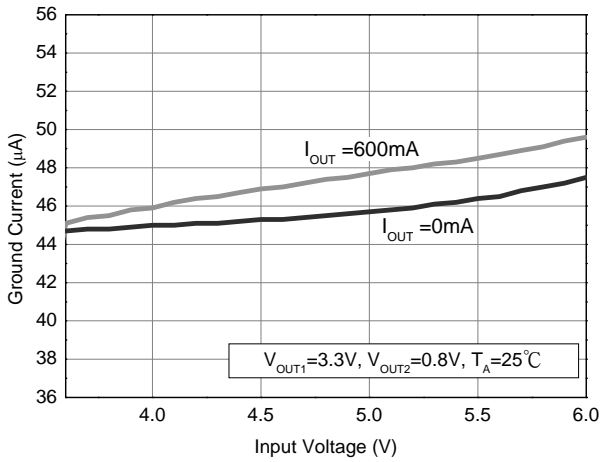


Fig.7 Dual LDO Quiescent Current and Ground Current vs. Input Voltage

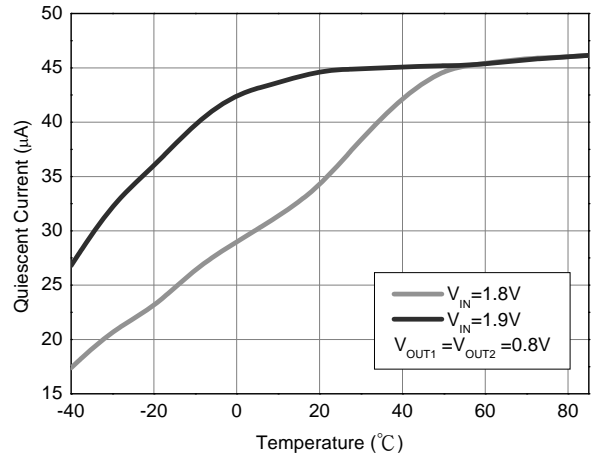


Fig.8 Quiescent Current vs. Temperature.

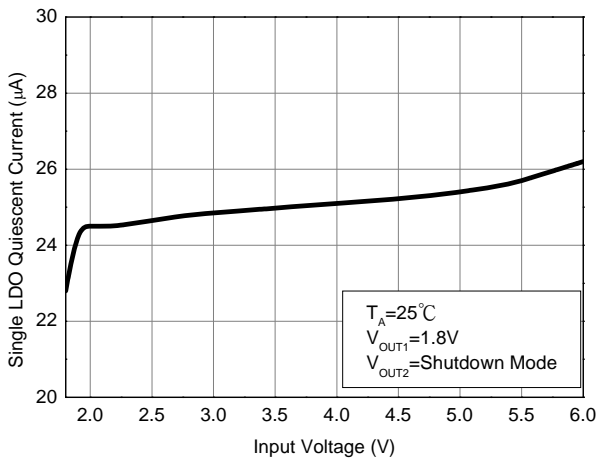


Fig.9 Single LDO Quiescent Current vs. Input Voltage

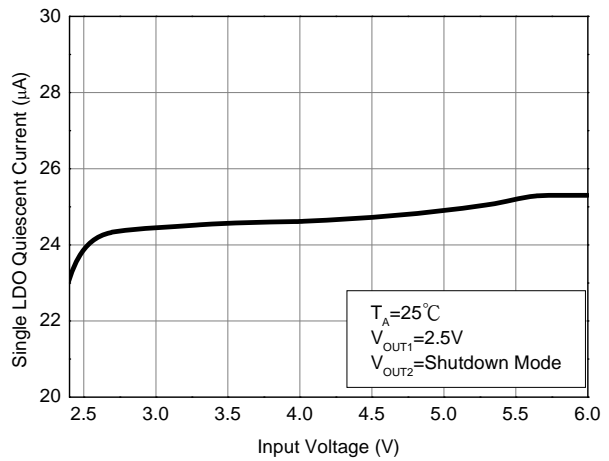


Fig.10 Single LDO Quiescent Current vs. Input Voltage

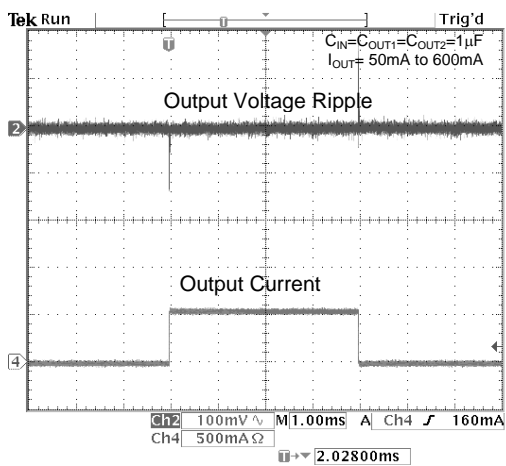


Fig.11 Load Transient Response at  $V_{IN}=2.8V$ ,  $V_{OUT}=0.8V$

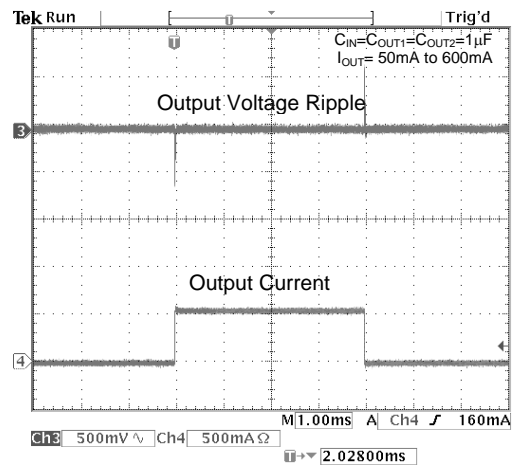


Fig.12 Load Transient Response at  $V_{IN}=4.8V$ ,  $V_{OUT}=3.8V$

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

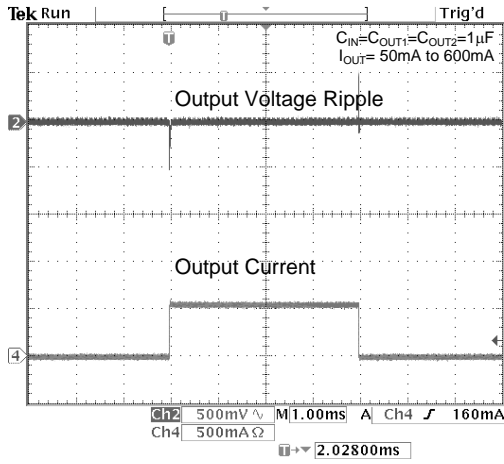


Fig.13 Load Transient Response at  $V_{IN}=3.8V$ ,  $V_{OUT}=2.8V$

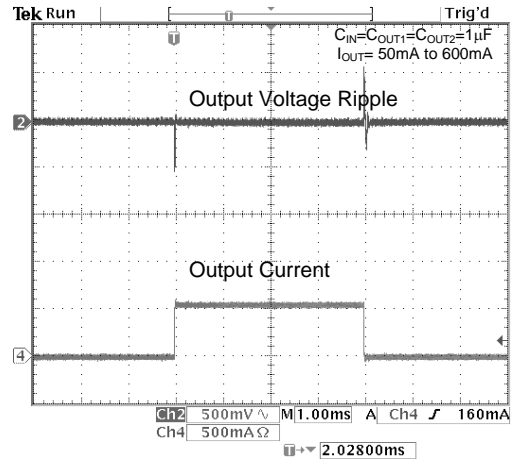


Fig.14 Load Transient Response at  $V_{IN}=4.3V$ ,  $V_{OUT}=3.3V$

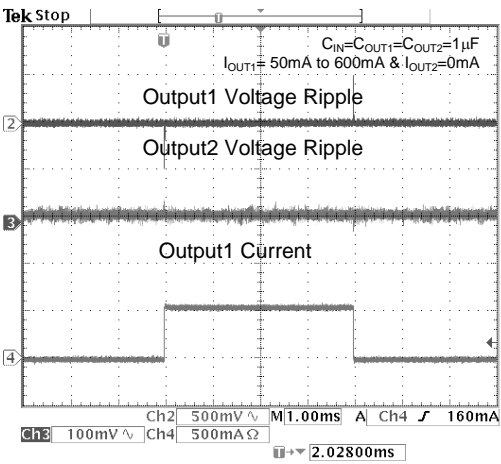


Fig.15 Cross Talk at  $V_{IN}=4.3V$ ,  $V_{OUT1}=2.8V$  and  $V_{OUT2}=3.3V$

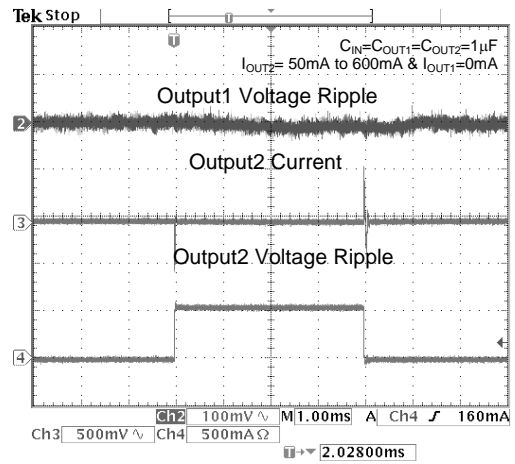


Fig.16 Cross Talk at  $V_{IN}=4.3V$ ,  $V_{OUT1}=2.8V$  and  $V_{OUT2}=3.3V$

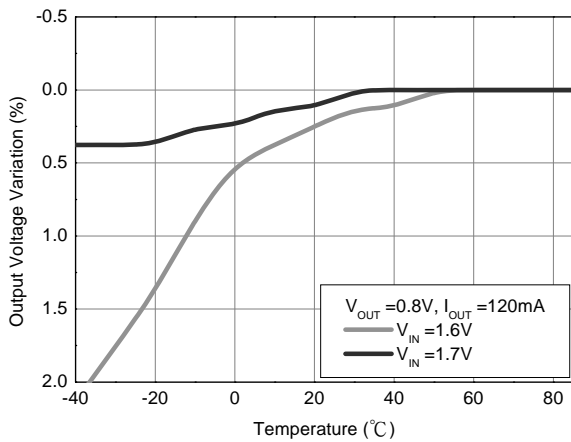


Fig.17 Output Voltage Variation vs. Temperature.

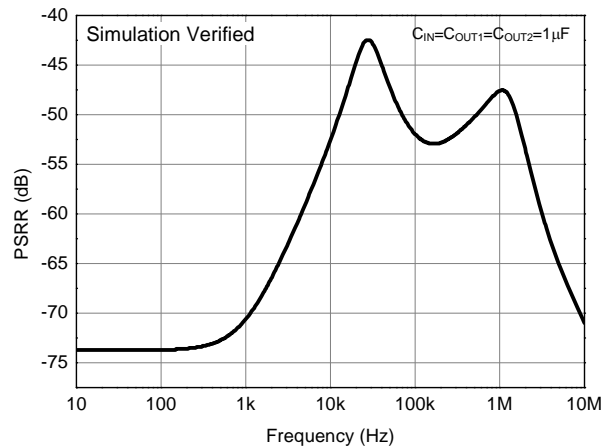
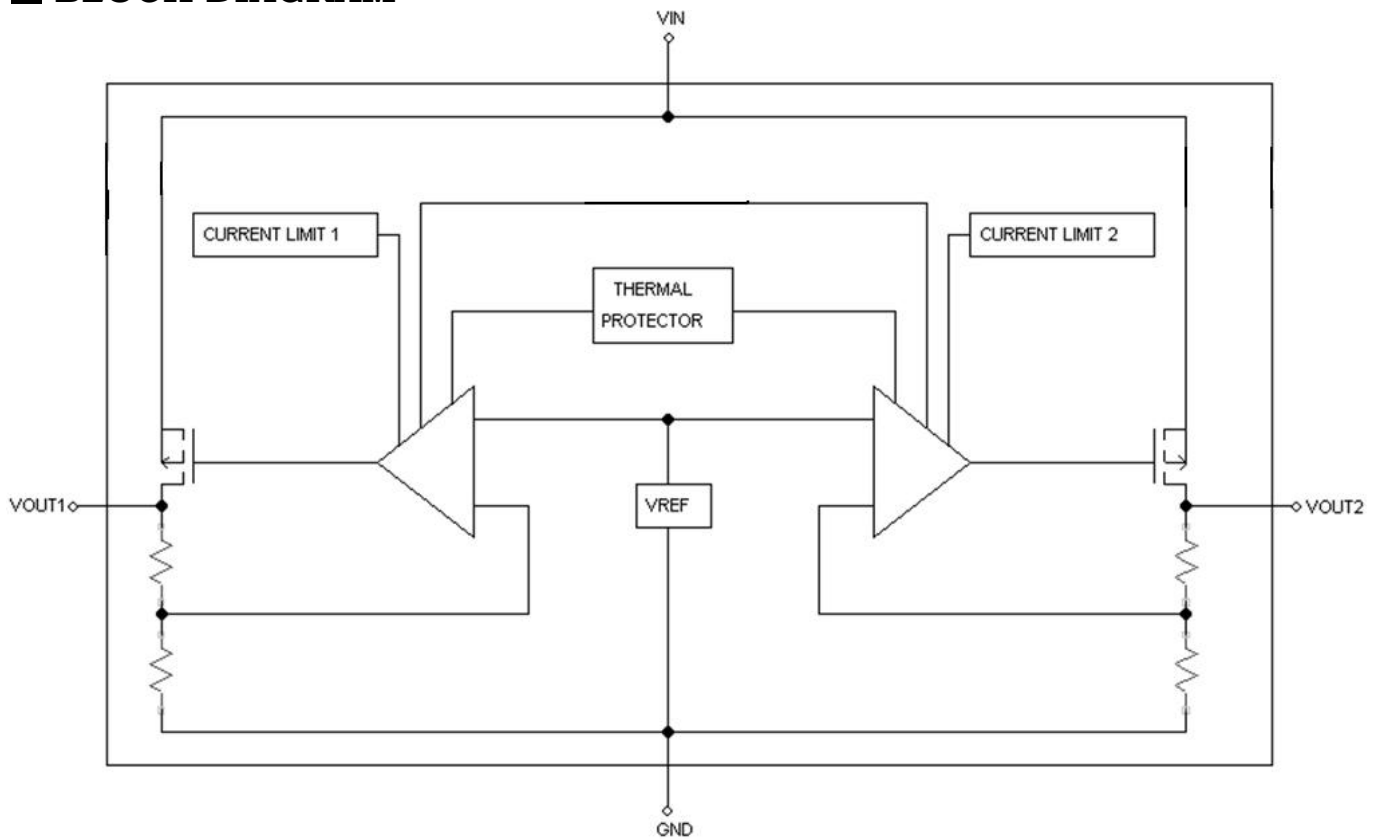


Fig.18 PSRR at  $V_{IN}=2.5V$ ,  $V_{OUT}=1.0V$  and  $I_{OUT}=10mA$ .

**■ BLOCK DIAGRAM**



Functional Block Diagram of AIC1953

**■ PIN DESCRIPTION**

- VIN PIN - Power input.
- GND PIN - Ground.
- 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.

### 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  $T_J=150^{\circ}\text{C}$ , 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  $1\mu\text{F}$  with a  $1\mu\text{F}$  ceramic output capacitor for each regulator 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.

### 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

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

The maximum power dissipation is:

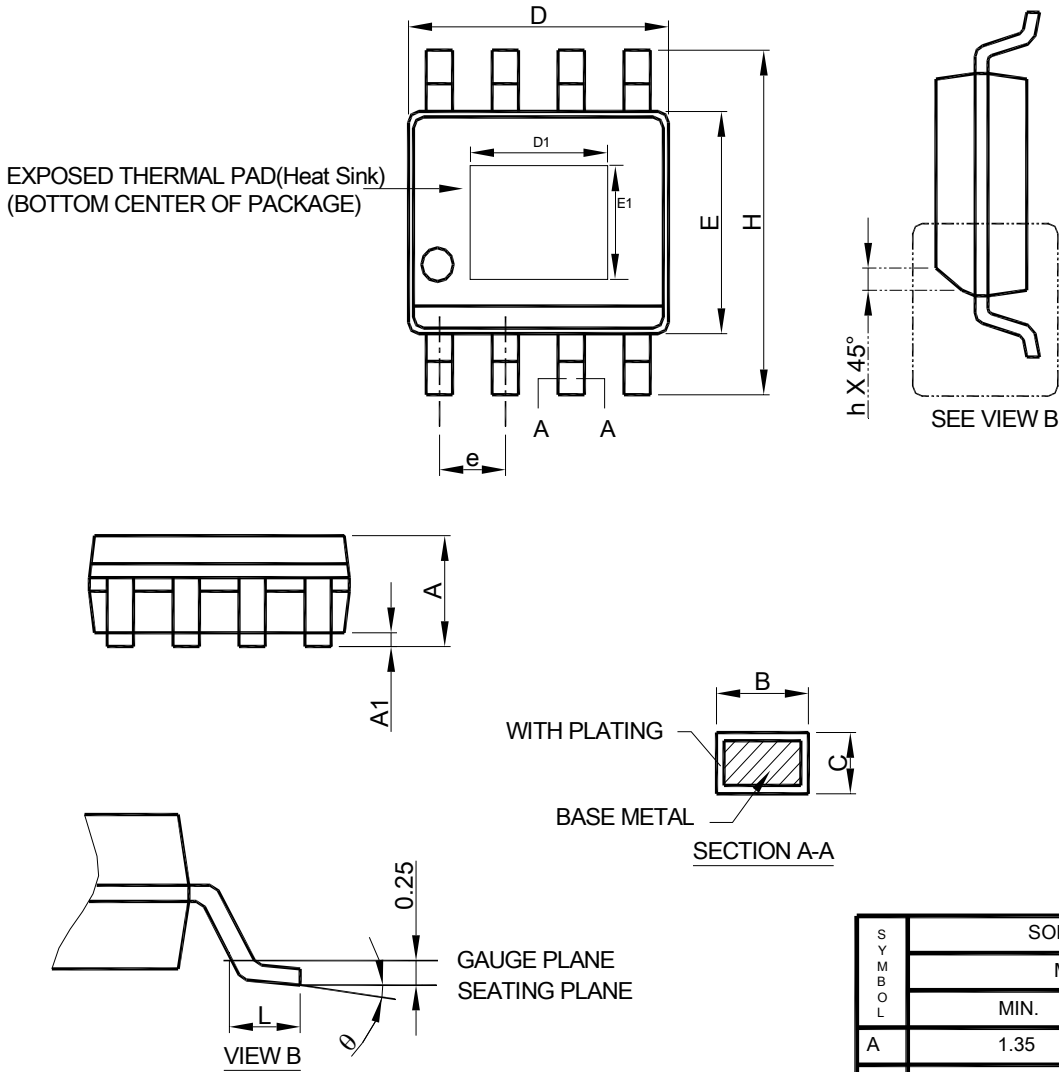
$$P_{\text{MAX}} = \frac{(T_{\text{J-max}} - T_{\text{A}})}{R\theta_{\text{JA}}}$$

Where  $T_{\text{J-max}}$  is the maximum allowable junction temperature ( $150^{\circ}\text{C}$ ), 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.

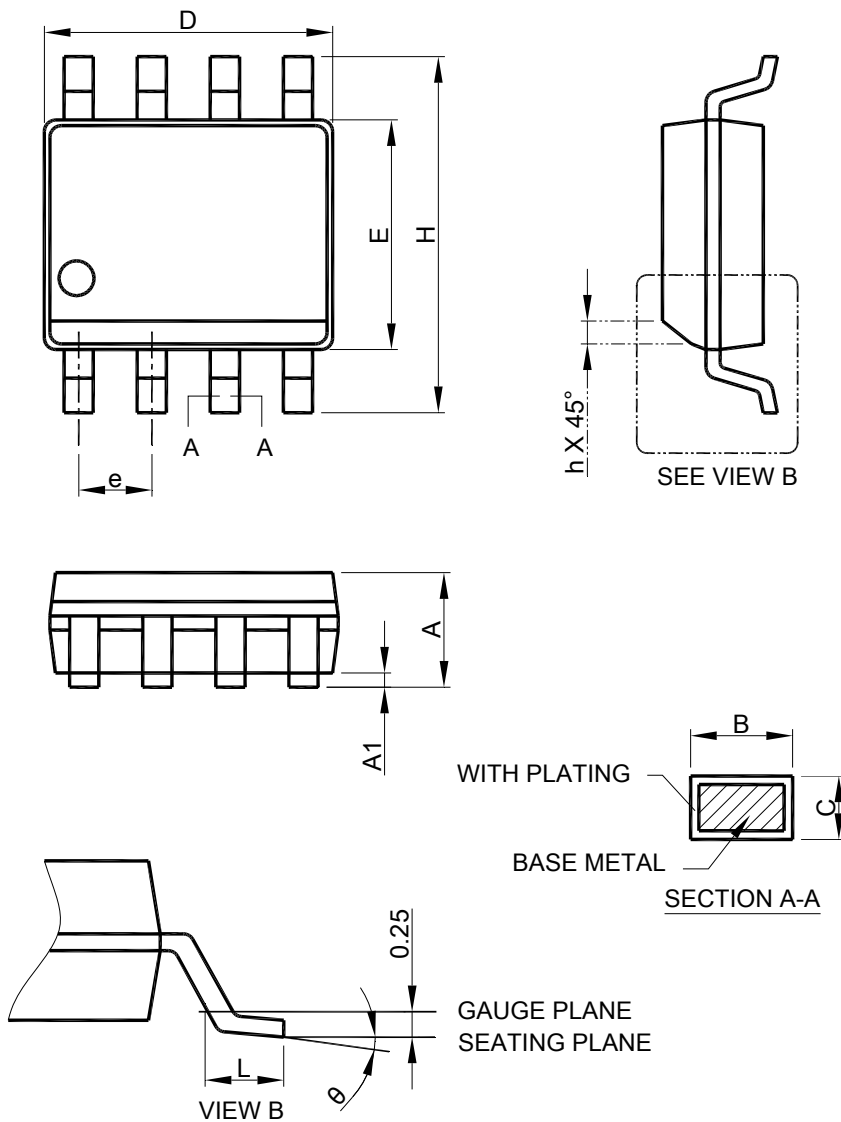
■ PHYSICAL DIMENSIONS

● 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.

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