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## **500mA Dual Linear Regulator with Internal Power Switch**

### ■ **FEATURES**

- Continuous 3.3V Output from Three Inputs.
- Complete Power Management Solution.
- $V_{CC}$ ,  $V_{SBY}$  Regulator Supplies 500mA Output.
- Built-in Hysteresis When Selecting Input Supplies.
- Integrated Switch has Very Low  $R_{DS(ON)}$  120m $\Omega$  (typ.).
- Integrated Switch Supplies 500mA From  $V_{AUX}$  .
- Output can be Forced Higher than Input (Off-State).

### ■ **APPLICATIONS**

- Desktop Computers.
- PCI Adapter Cards with Wake-On-LAN.
- Network Interface Cards (NICs).
- Multi Power System.
- System with Standby Capabilities.

### ■ **DESCRIPTION**

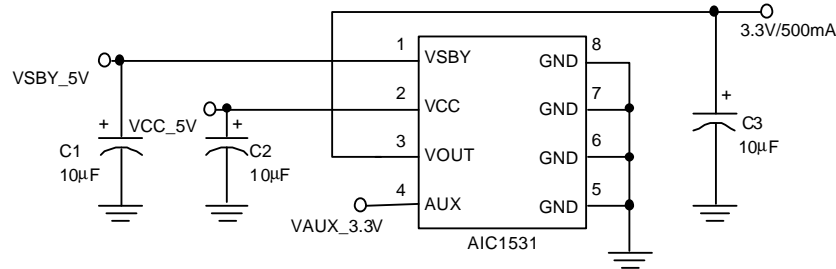
AIC1531 is a dual input regulator with  $V_{AUX}$  switch capable of delivering 3.3V/500mA continuously. The output power is provided from three independent input voltage sources on a prioritized basis. Power is always taken in priority using the following order  $V_{CC}$ ,  $V_{SBY}$ , and  $V_{AUX}$  .

The AIC1531 meets Intel's " Instantly Available " power requirements which follows the "Advanced Configuration and Power Interface" (ACPI) standards. When either  $V_{CC}$  or  $V_{SBY}$  is present, the device automatically enables the regulator and produces a stable 3.3V output  $V_{OUT}$ . When only  $V_{AUX}$  (3.3V) is present, the device provides a low impedance direct connection (120m $\Omega$  typ.) from  $V_{AUX}$  to  $V_{OUT}$ .

The AIC1531 also prevents excessive current from flowing  $V_{OUT}$  to either input voltage or ground when the output voltage is higher than the input voltage.

All the necessary control circuitry needed to provide a smooth and automatic transition between all the three supplies has been incorporated. This allows both  $V_{CC}$  and  $V_{SBY}$  to be dynamically switched without loss of output voltage.

## ■ TYPICAL APPLICATION CIRCUIT



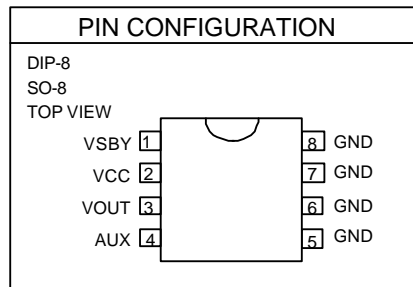
**Dual Input Regulator with Auxiliary Power Switch**

## ■ ORDERING INFORMATION

AIC1531CXXX

PACKING TYPE  
TR: TAPE & REEL  
TB: TUBE

PACKAGE TYPE  
N: PLASTIC DIP  
S: SMALL OUTLINE



Example: AIC1531CSTR

→ in SO-8 Package & Taping & Reel Packing Type  
(CN is not available in Tape & Reel packing type.)

## ■ ABSOLUTE MAXIMUM RATINGS

$V_{CC}$ , $V_{SBY}$ Input Voltage .....	7.0V
$V_{AUX}$ Input Voltage .....	4.0V
$V_{OUT}$ Output Voltage .....	5.0V
Operating Temperature Range .....	-40°C~85°C
Storage Temperature Range .....	-65°C ~ 150°C

**ELECTRICAL CHARACTERISTICS** ( $V_{IN}=5V$ ,  $T_A=25^\circ C$ , unless otherwise specified.)

PARAMETERS	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Regulated Output Voltage	$0mA < I_{LOAD} < 500mA$	3.135	3.300	3.465	V
Regulated Output Current		500			mA
Output Voltage Load Regulation	$V_{CC}$ selected $I_{LOAD}=50mA \sim 500mA$ $V_{SBY}$ selected $I_{LOAD}=50mA \sim 500mA$		20		mV
Output Voltage Line Regulation	$V_{CC}=4.5V \sim 5.5V$ , $I_{LOAD}=5mA$ $V_{SBY}=4.5V \sim 5.5V$ , $I_{LOAD}=5mA$		2		mV
$V_{CC}$ Select Voltage $V_{CC}$ Deselect Voltage	$V_{SBY} > V_{SBYDES}$ or $V_{AUX}$ present $V_{CC} < V_{CCDES}$	3.90	4.50 4.20	4.60	V
$V_{SBY}$ Select Voltage $V_{SBY}$ Deselect Voltage	$V_{AUX}$ present $V_{SBY} < V_{SBYDES}$	3.90	4.50 4.20	4.60	V
Hysteresis Voltage			0.30		V
Auxiliary Switch Resistance	$V_{CC}$ , $V_{SBY}$ are deselected		120	200	m $\Omega$
Short Circuit Current	$V_{CC}/SBY=5V$ , $V_{OUT}=0V$		1000		mA
$V_{CC}$ Pin Reverse Leakage $V_{SBY}$ Pin Reverse Leakage AUX Pin Reverse Leakage	One supply input taken to ground while the others remain at nominal voltage		5	50	$\mu A$
$V_{CC}$ Supply Current (when $V_{SBY}$ is not present)	$V_{CC} > V_{CCSEL}$ , $I_{LOAD}=0mA$ $V_{CCDES} > V_{CC} > V_{OUT}$ $V_{OUT} > V_{CC}$		70 50 10	300 200 20	$\mu A$
$V_{SBY}$ Supply Current (when $V_{CC}$ is not present)	$V_{SBY} > V_{CCSEL}$ , $I_{LOAD}=0mA$ $V_{SBYDES} > V_{SBY} > V_{OUT}$ $V_{OUT} > V_{SBY}$		70 50 10	300 200 20	$\mu A$
$V_{AUX}$ Supply Current	$V_{CC}$ or $V_{SBY} > V_{OUT}$ $V_{CC}$ and $V_{SBY} < V_{OUT}$		10 50	100 400	$\mu A$
Ground Current	Both $V_{CC}$ and $V_{SBY}$ are deselected $V_{CC}/SBY=5V$ , $I_{LOAD} = 0mA$ $V_{CC}/SBY=5V$ , $I_{LOAD} = 500mA$		60 100 100	300 500 500	$\mu A$

**TYPICAL PERFORMANCE CHARACTERISTICS**

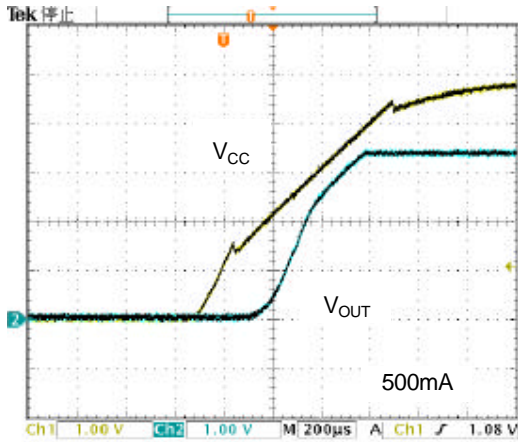


Fig. 1  $V_{CC}$  Cold Start

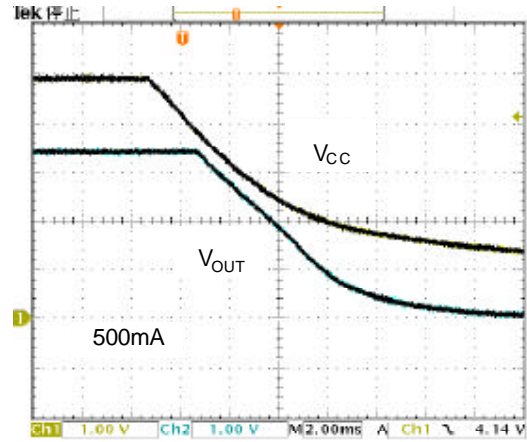


Fig. 2  $V_{CC}$  Full Power Down

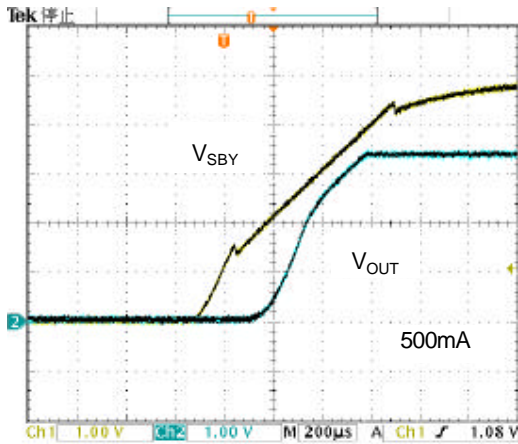


Fig. 3  $V_{SBY}$  Cold Start

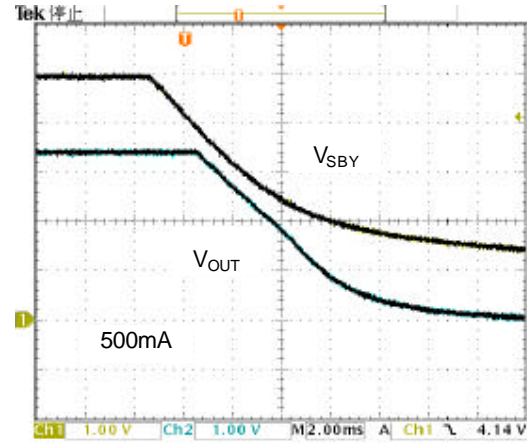


Fig. 4  $V_{SBY}$  Full Power Down.

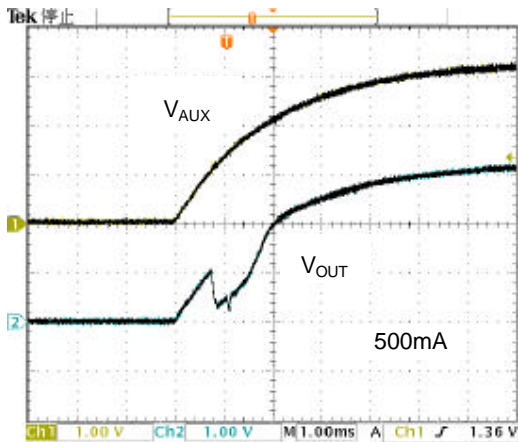


Fig. 5  $V_{AUX}$  Cold Start

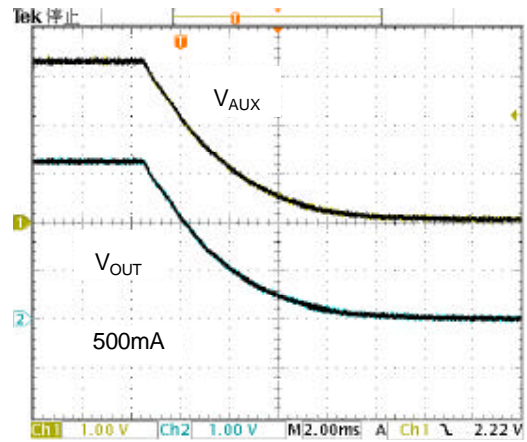


Fig. 6  $V_{AUX}$  Full Power Down.

**TYPICAL PERFORMANCE CHARACTERISTICS (Continued)**

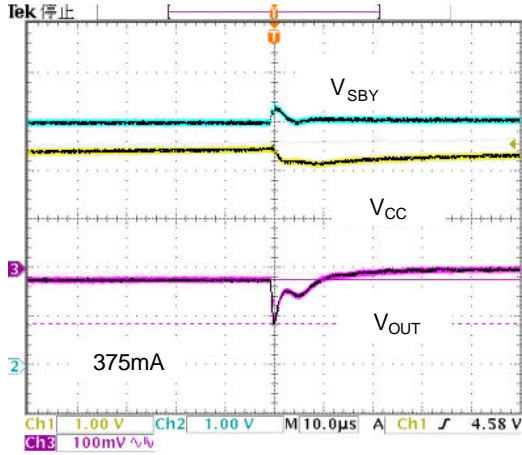


Fig. 7  $V_{CC}$  Power Up ( $V_{SBY} = 5V$ )

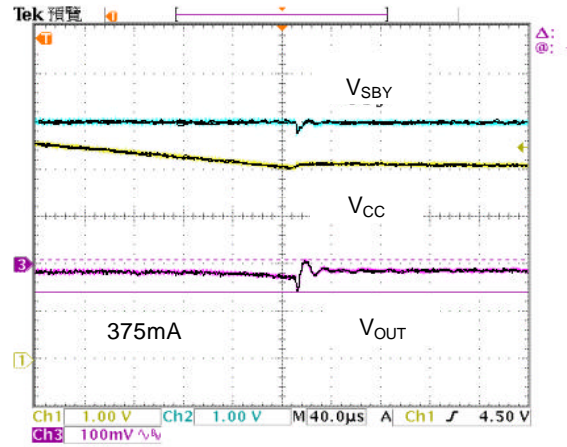


Fig. 8  $V_{CC}$  Power down ( $V_{SBY} = 5V$ )

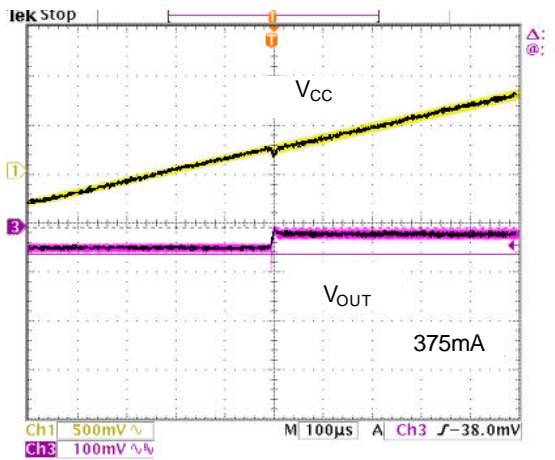


Fig. 9  $V_{CC}$  Power Up ( $V_{AUX} = 3.3V$ )

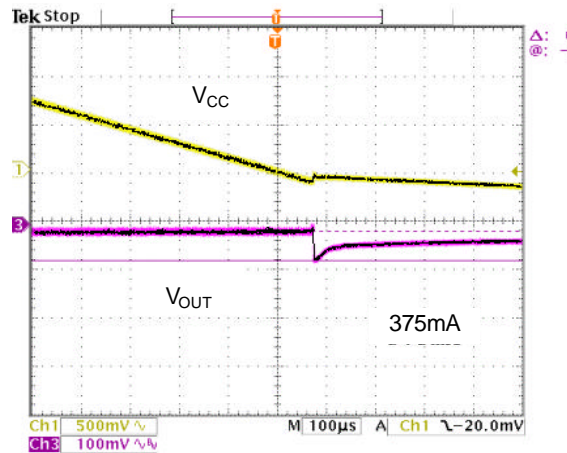


Fig. 10  $V_{CC}$  Power Down ( $V_{AUX} = 3.3V$ )

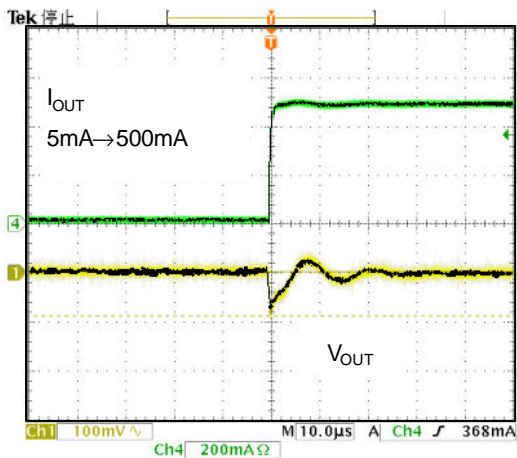


Fig. 11  $V_{CC}$  Load Transient Rising

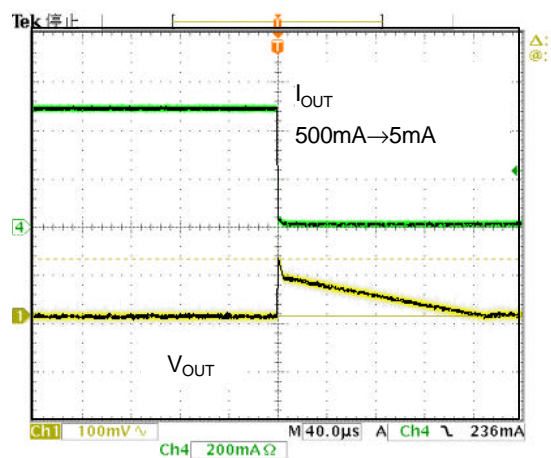


Fig. 12  $V_{CC}$  Load Transient Falling



**TYPICAL PERFORMANCE CHARACTERISTICS (Continued)**

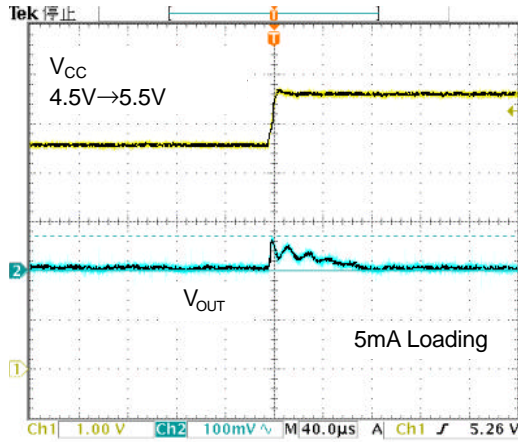


Fig. 13  $V_{CC}$  Line Transient Rising

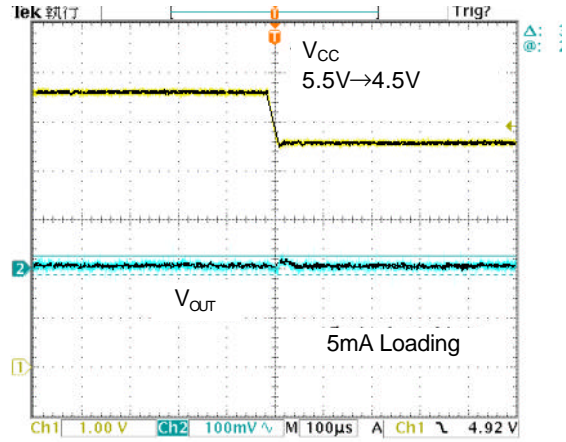


Fig. 14  $V_{CC}$  Line Transient Falling

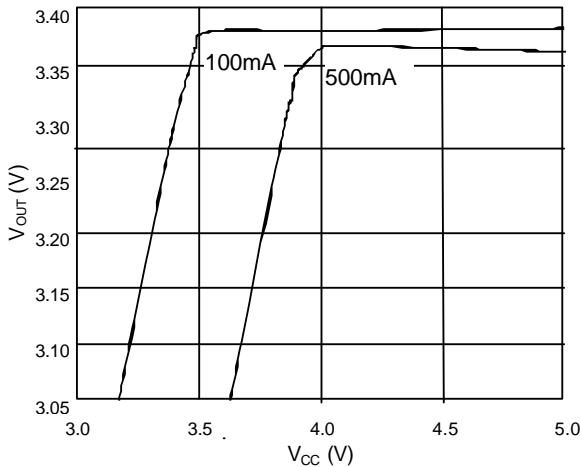


Fig. 11  $V_{CC}$  Line Regulation

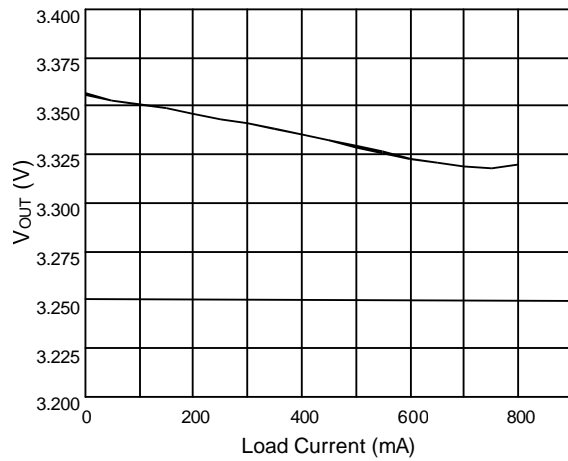


Fig. 16 Load Regulation

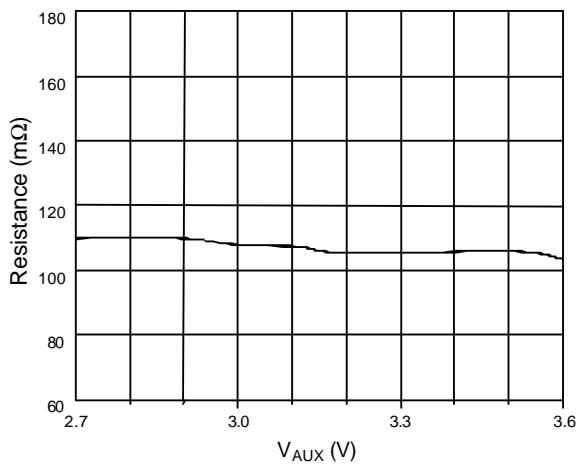


Fig. 17  $V_{AUX}$  Switch Resistance vs.  $V_{AUX}$

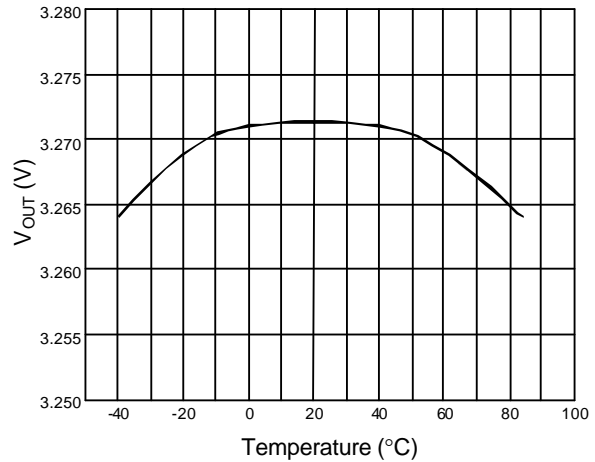
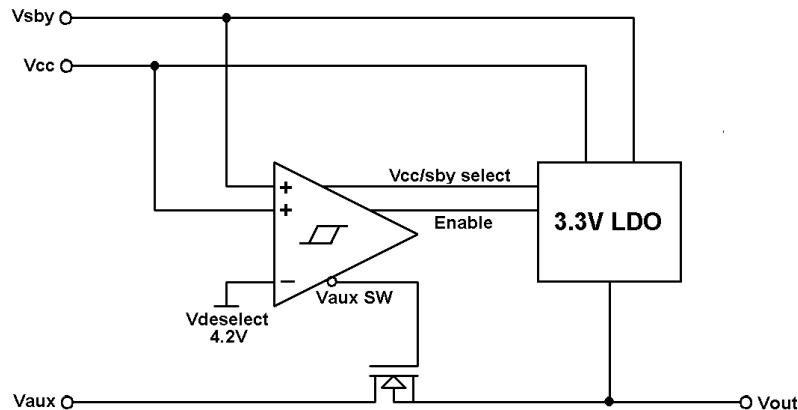


Fig. 18 Output Voltage vs. Temperature

## ■ BLOCK DIAGRAM



## ■ PIN DESCRIPTION

- PIN 1: VSBY** - Standby supply voltage (5V) input for 3.3V regulator when VCC falls below  $V_{CCDES}$ . Some NICs that operate in "Wake-On-LAN" mode get a 5V standby through a cable that connects directly to a specific header on the Motherboard.
- PIN 2: VCC** - Primary supply voltage (5V) input for 3.3V regulator.
- PIN 3: VOUT** - 3.3V regulated output voltage when either  $V_{CC}$  or  $V_{SBY}$  is present.

When only  $V_{AUX}$  (3.3V) is present,  $V_{OUT}$  voltage comes from  $V_{AUX}$  through an internal low impedance switch.

- PIN 4: AUX** - Auxiliary supply voltage (3.3V) input for low impedance switch.
- PIN 5-8: GND** - Negative reference for all voltages.

## ■ APPLICATIONS INFORMATION

### The Requirement for External Capacitors

The selection of the output capacitor is based on two requirements: LDO compensation and the transition between power sources. During the takeover between sources, the output capacitor provides the loading. Therefore a larger output capacitor can improve the transition. And since the output capacitor plays the important role in the compensation of LDO, a 10 $\mu$ F Tantalum capacitor or larger is recommended.

The input capacitor is required to be as close to the

IC as possible. The input capacitor can reduce the parasitic effect formed by the power supply output impedance or the trace. A 10 $\mu$ F Tantalum capacitor is a good choice. Additional ceramic capacitor can be placed close to input and output to reduce the high frequency noise. A 0.1 $\mu$ F is recommended.

### The layout and Thermal Considerations

The AIC1531 is housed in a thermally enhanced package where the GND pins (Pin5 to Pin8) are integrated to the leadframe. Generally, heat sinks are not available for most surface-mounted devices.

Instead, they rely on the printed-circuit board to provide the thermal path. When the AIC1531 operates normally, the maximum power dissipation is

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} = (5 - 3.3) \times 0.5 = 0.85W$$

At the maximum operation temperature, the thermal resistance seen by the device, or the combination of all the thermal paths, should be

$$R_{JA} < \frac{165 - 85}{0.85} = 94^{\circ}C/W .$$

When the device is mounted on a double-sided printed circuit board, the ground plane is the most

used thermal path. To make sure the thermal resistance small enough and the shutdown function work normally, the thermal resistance between GND pins to GND plane should be as small as possible by means of adding more vias. And the GND plane should be at least 1 square centimeters of copper.

The layout of AIC1531 is shown in Fig.1. In Fig. 2, the thermal resistance  $R_{JA}$  is  $70.36^{\circ}C/W$  where the AIC1531 is mounted on the double-sided PCB and measured under the forced-air thermal chamber.

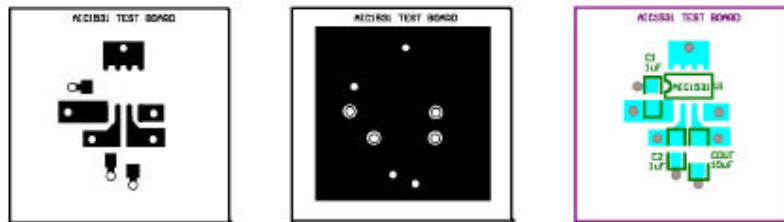


Fig.19 The layout of AIC1531

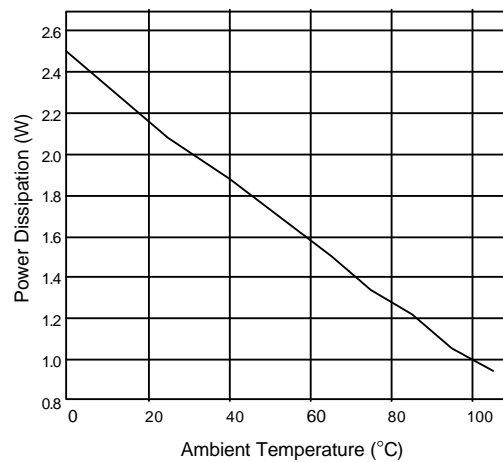


Fig.20 The power thermal shutdown dissipation vs. ambient temperature where  $R_{JA}$  is  $70.36^{\circ}C/W$  in the forced-air thermal chamber



## The Application circuits

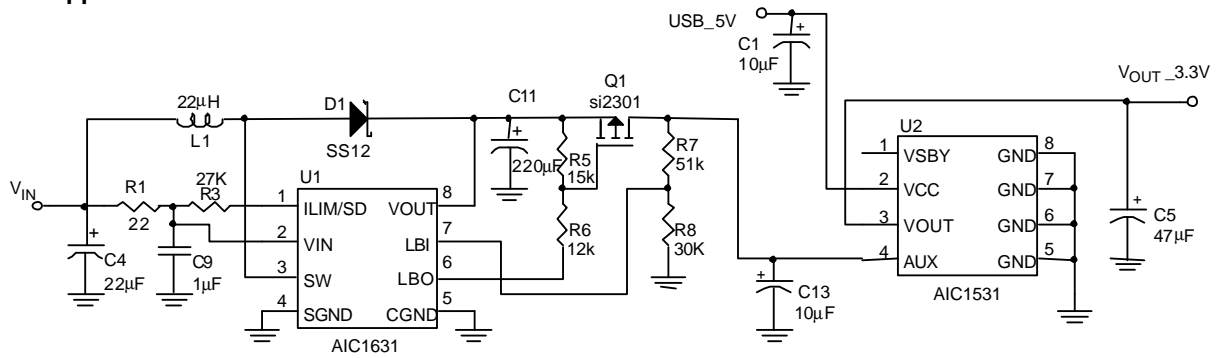


Fig. 21 The Step Up/Down converter with OR function for dual power system

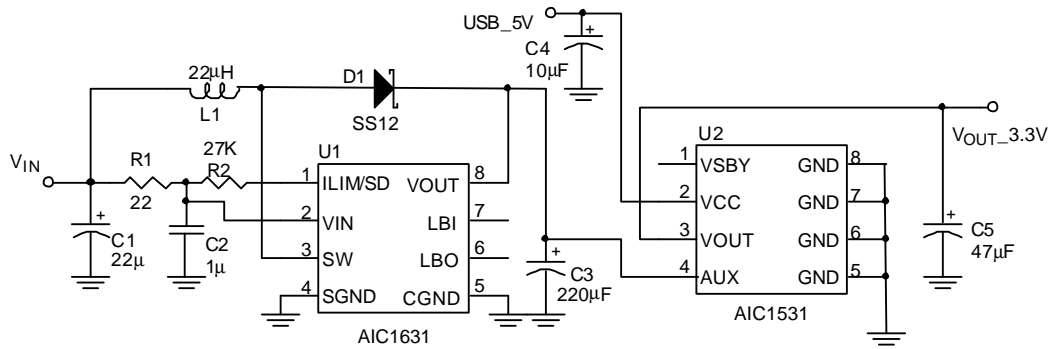


Fig. 22 The Step Up converter with OR function for dual power system

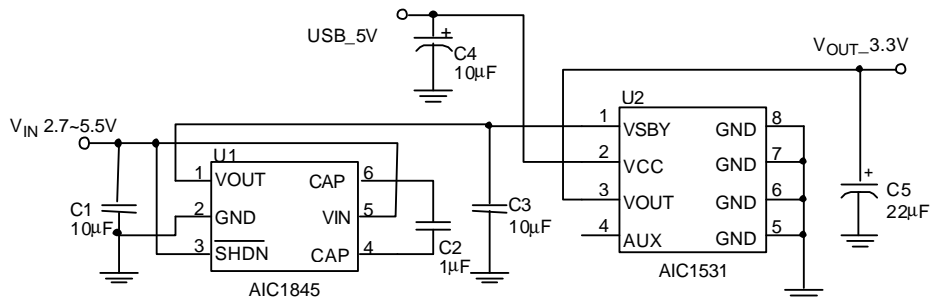
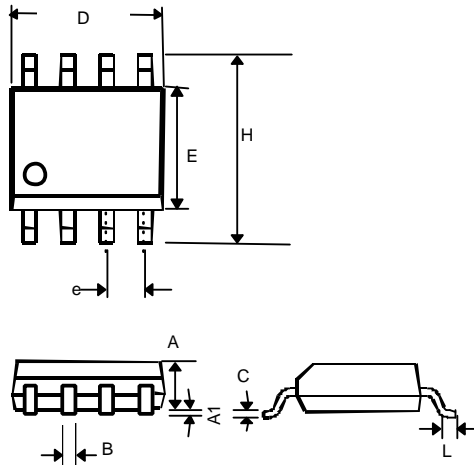
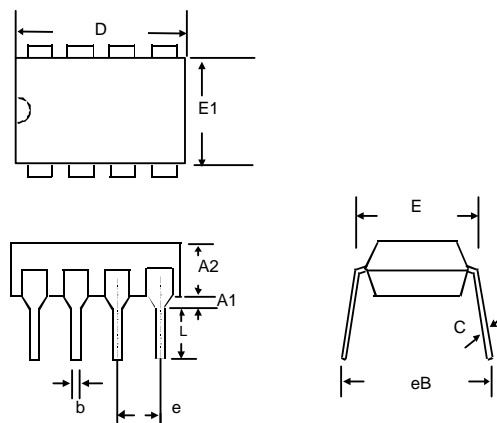


Fig. 23 The Step Up/Down converter with OR function for dual power system

**PHYSICAL DIMENSIONS**
**● 8 LEAD PLASTIC SO (unit: mm)**


SYMBOL	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(TYP)	
H	5.80	6.20
L	0.40	1.27

**● 8 LEAD PLASTIC DIP (unit: mm)**


SYMBOL	MIN	MAX
A1	0.381	—
A2	2.92	4.96
b	0.35	0.56
C	0.20	0.36
D	9.01	10.16
E	7.62	8.26
E1	6.09	7.12
e	2.54 (TYP)	
eB	—	10.92
L	2.92	3.81