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 $R_{DS(ON)}$ 120mΩ (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

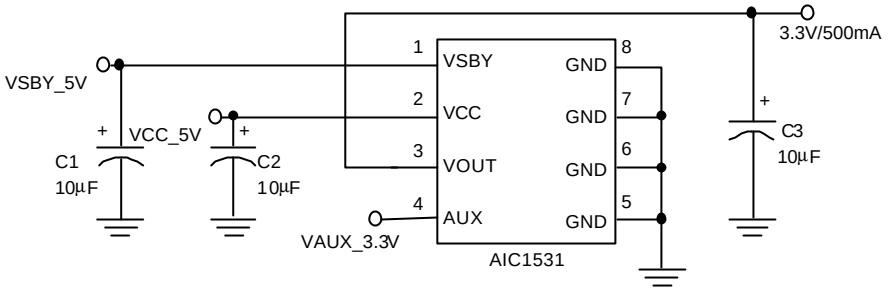
AIC1531 is a dual input regulator with V_{AUX} switch capable of delivering 3.3V/500mA continuously. The output power is provided from three independent input voltage sources on a prioritized basis. Power is always taken in priority using the following order V_{CC}, V_{SBY}, and V_{AUX} .

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 (120mΩ 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

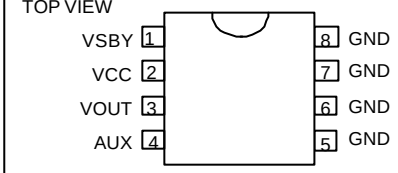
AIC1531CXXX

PACKING TYPE
TR: TAPE & REEL
TB: TUBE

PACKAGE TYPE
N: PLASTIC DIP
S: SMALL OUTLINE

PIN CONFIGURATION

DIP-8
SO-8
TOP VIEW



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°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 ~ 500 mA V_{SBY} selected I_{LOAD}=50mA ~ 500mA		20		mV
Output Voltage Line Regulation	V_{CC}=4.5V~5.5V, I_{LOAD}=5mA V_{SBY}=4.5V~5.5V, I_{LOAD}=5mA		2		mV
VCC Select Voltage VCC 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	mΩ
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	µA
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	µA
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	µA
V_{AUX} Supply Current	V_{CC} or V_{SBY} > V_{OUT} V_{CC} and V_{SBY} < V_{OUT}		10 50	100 400	µA
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	µA

TYPICAL PERFORMANCE CHARACTERISTICS

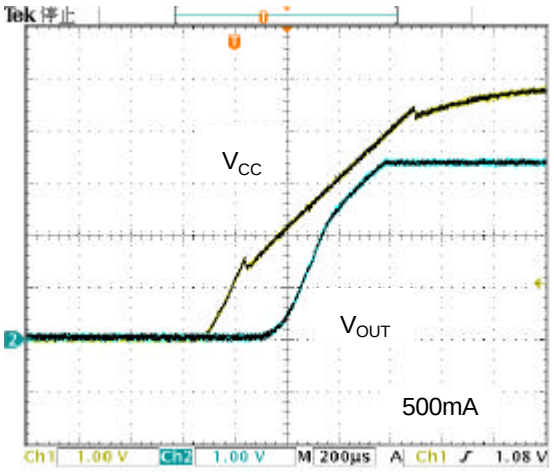


Fig. 1 V_{CC} Cold Start

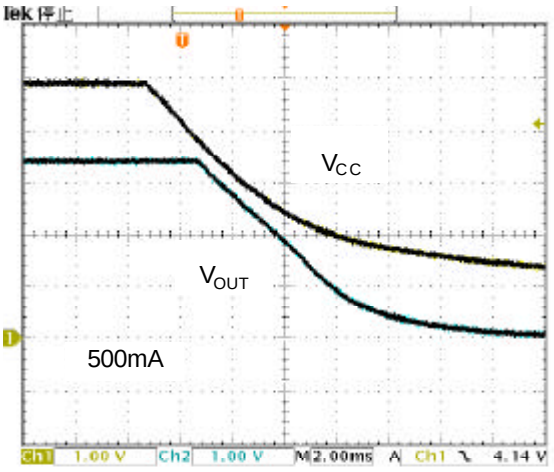


Fig. 2 V_{CC} Full Power Down

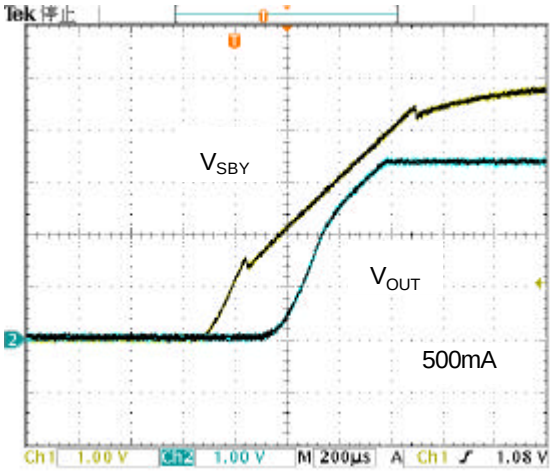


Fig 3. V_{SBY} Cold Start

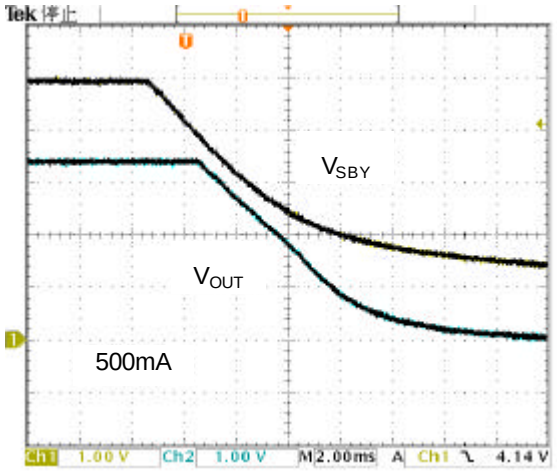


Fig. 4 V_{SBY} Full Power Down.

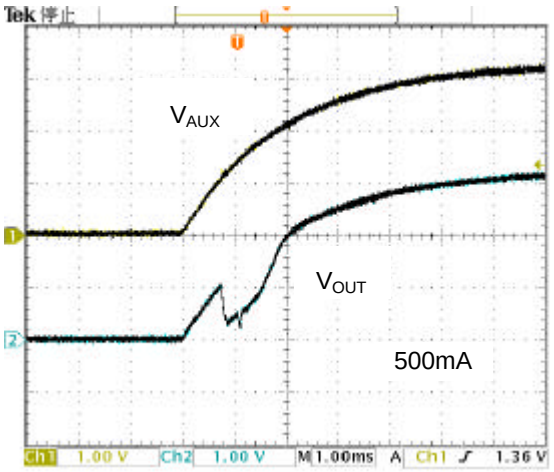


Fig. 5 V_{AUX} Cold Start

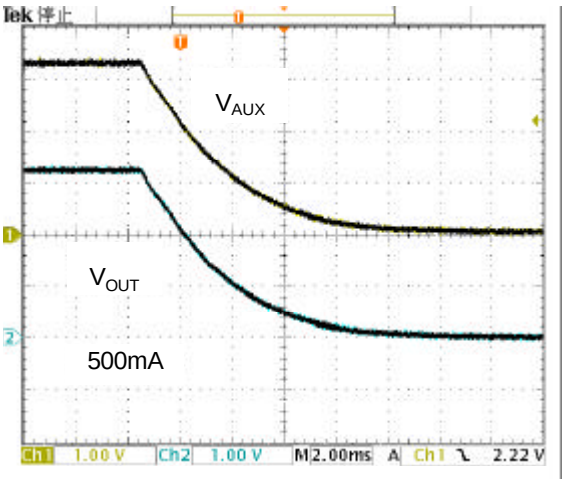


Fig. 6 V_{AUX} Full Power Down.

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

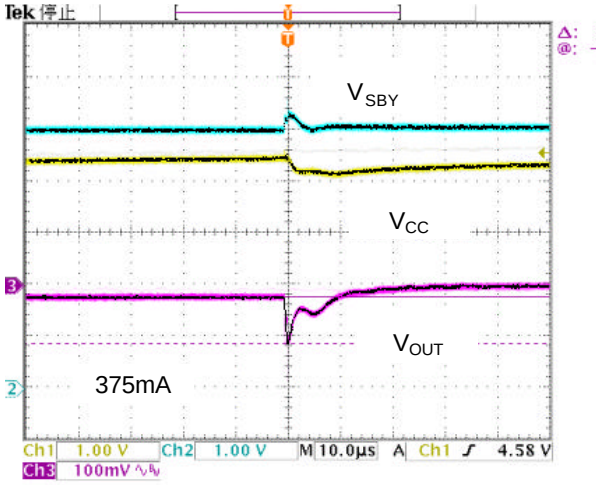


Fig. 7 V_{CC} Power Up (V_{SBY} =5V)

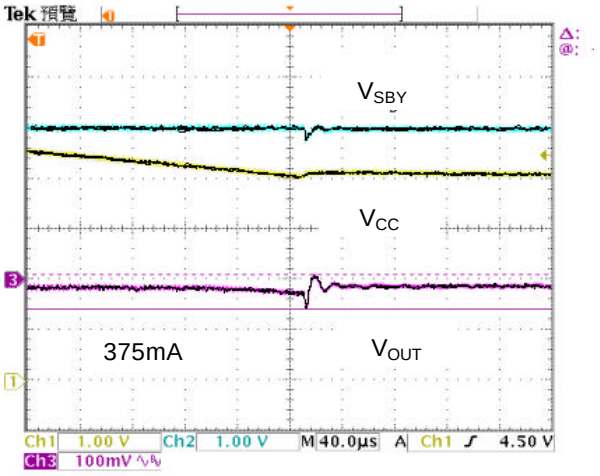


Fig. 8 V_{CC} Power down (V_{SBY} =5V)

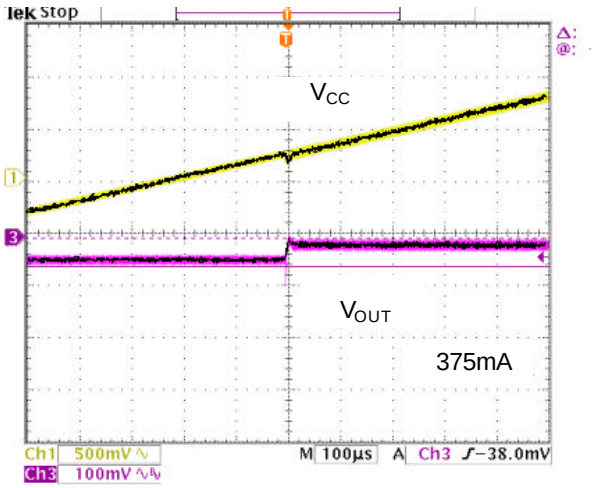


Fig. 9 V_{CC} Power Up (V_{AUX} = 3.3V)

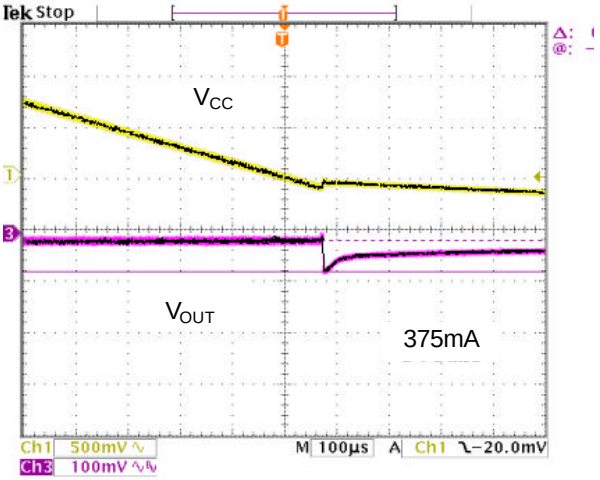


Fig. 10 V_{CC} Power Down (V_{AUX} = 3.3V)

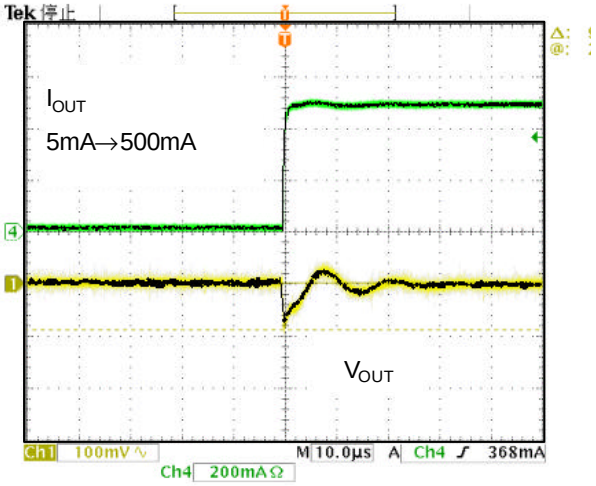


Fig. 11 V_{CC} Load Transient Rising

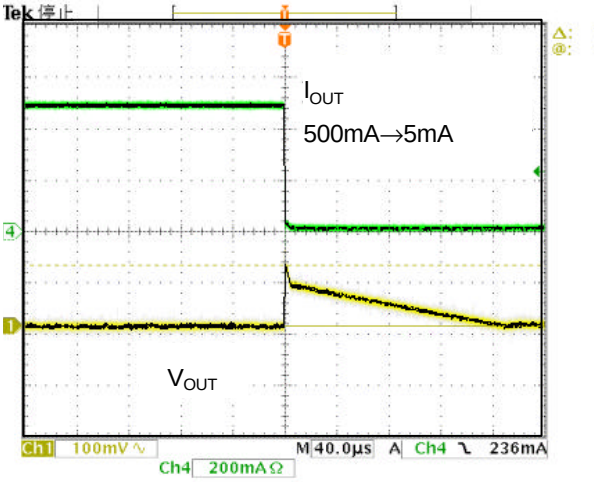


Fig. 12 V_{CC} Load Transient Falling

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

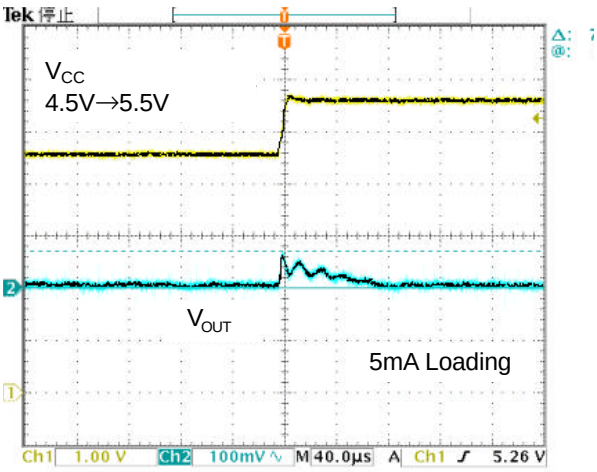


Fig. 13 V_{CC} Line Transient Rising

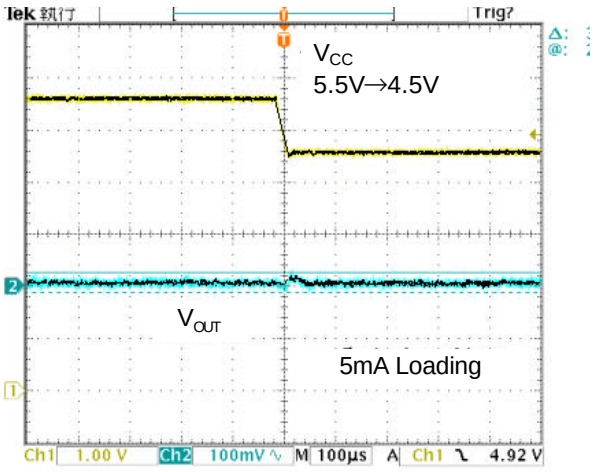


Fig. 14 V_{CC} Line Transient Falling

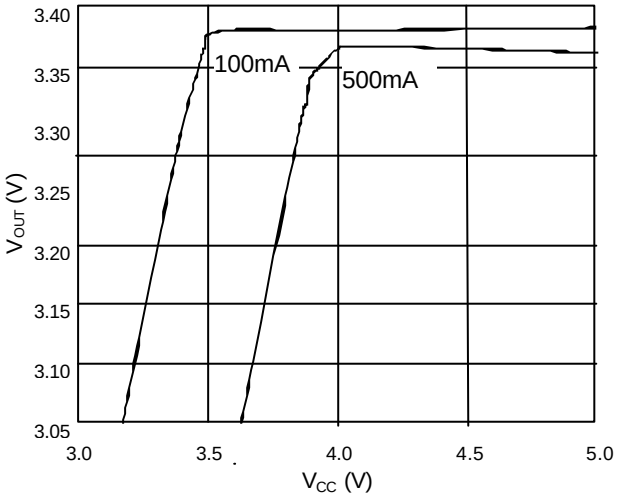


Fig. 11 V_{CC} Line Regulation

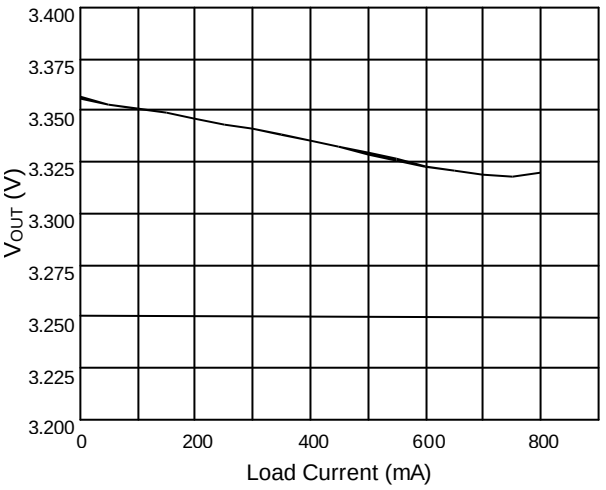


Fig. 16 Load Regulation

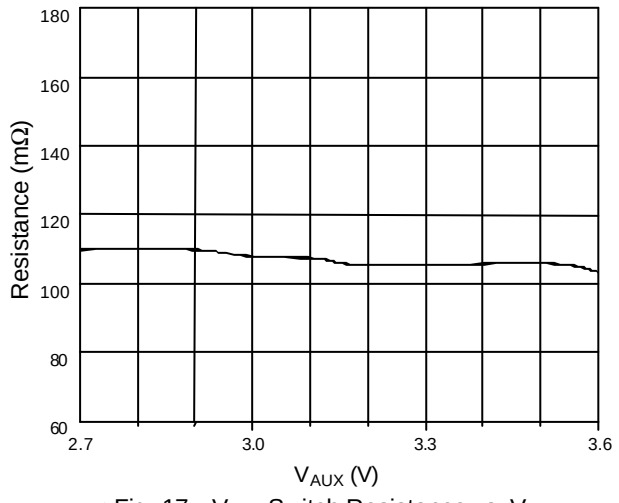


Fig. 17 V_{AUX} Switch Resistance vs. V_{AUX}

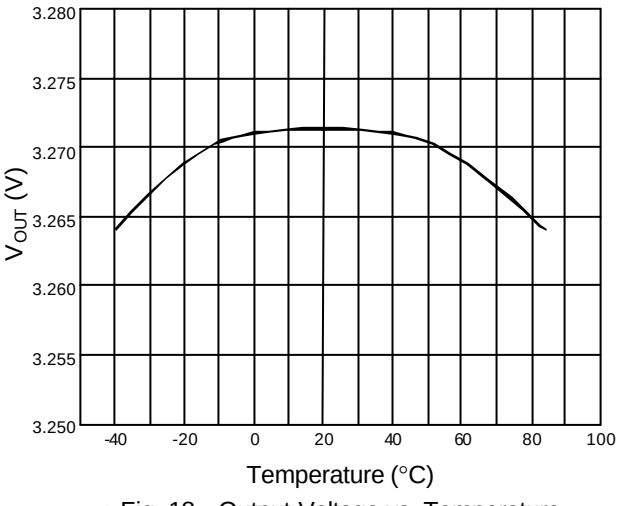
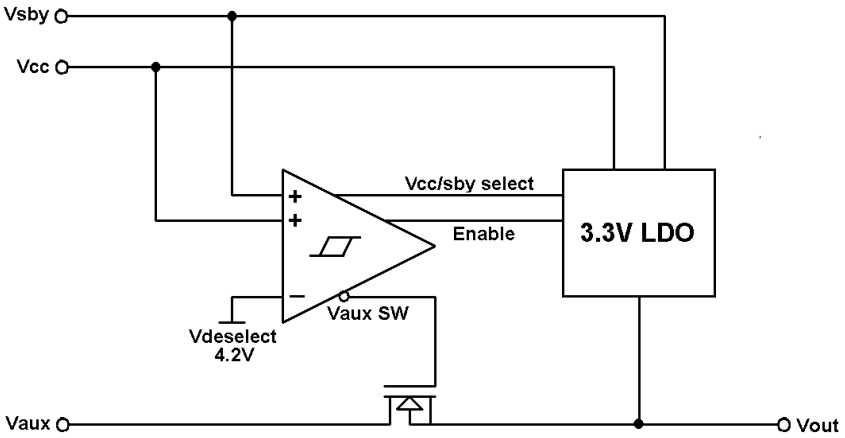


Fig. 18 Output Voltage vs. Temperature

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 10µF 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 10µF Tantalum capacitor is a good choice. Additional ceramic capacitor can be placed close to input and output to reduce the high frequency noise. A 0.1µF 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

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

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°C/W where the AIC1531 is mounted on the double-sided PCB and measured under the forced-air thermal chamber.

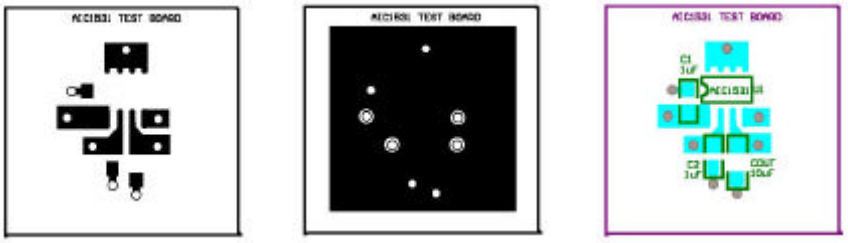


Fig.19 The layout of AIC1531

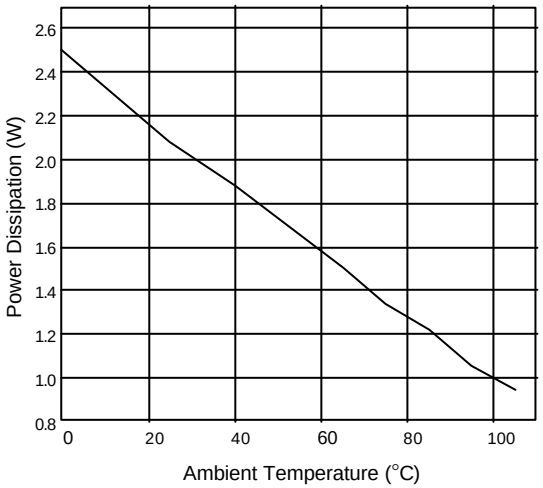


Fig.20 The power thermal shutdown dissipation vs. ambient temperature where R_{JA} is 70.36°C/W in the forced-air thermal chamber

The Application circuits

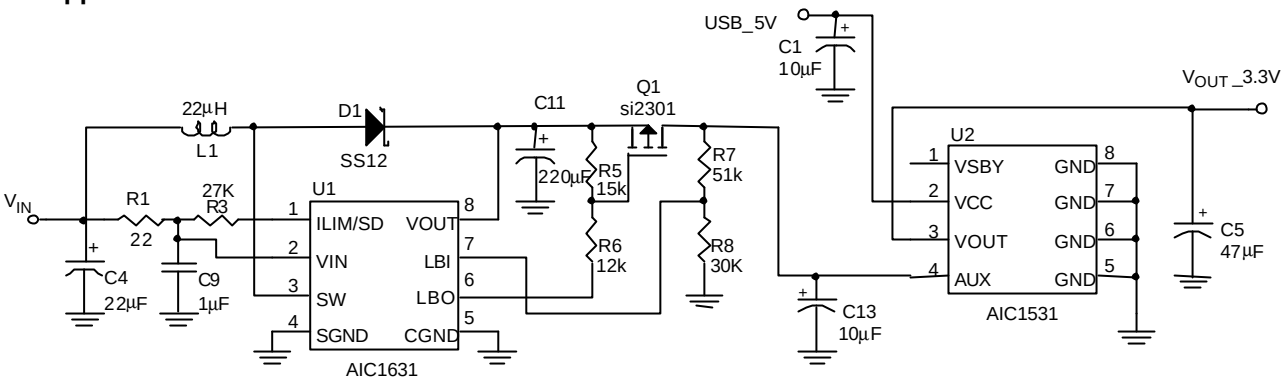


Fig.21 The Step Up/Down converter with OR function for dual power system

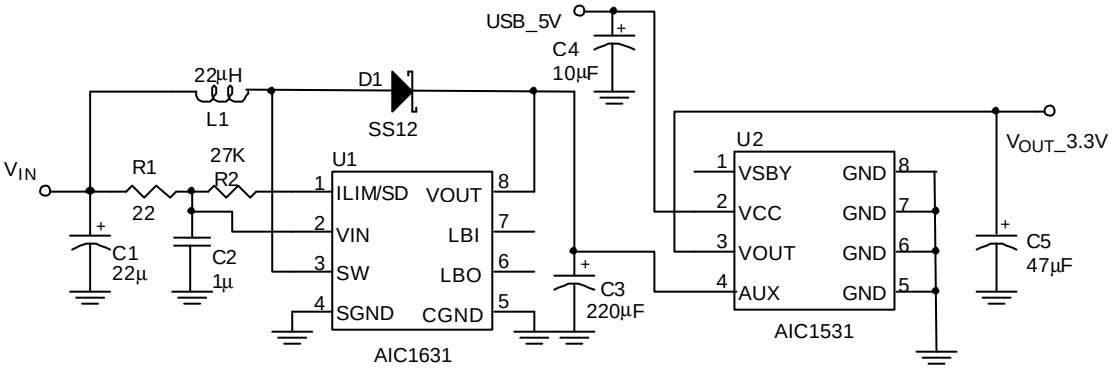


Fig.22 The Step Up converter with OR function for dual power system

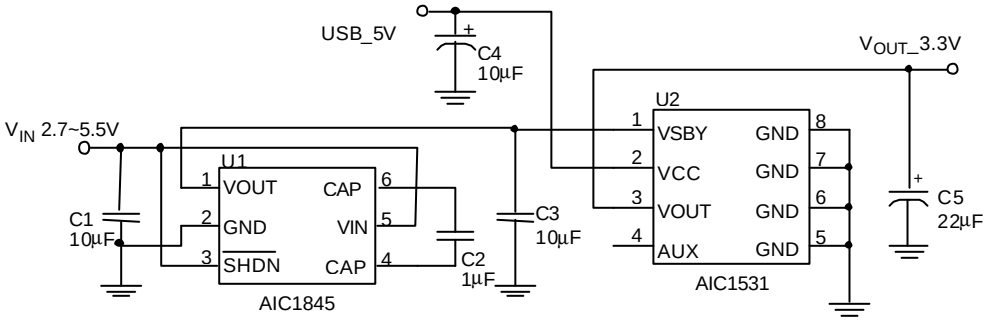
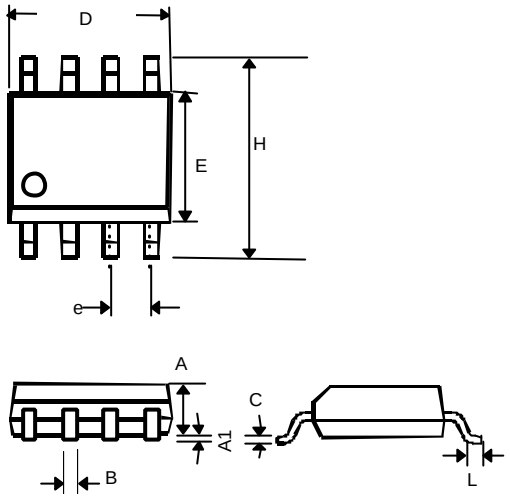


Fig. 23 The Step Up/Down converter with OR function for dual power system

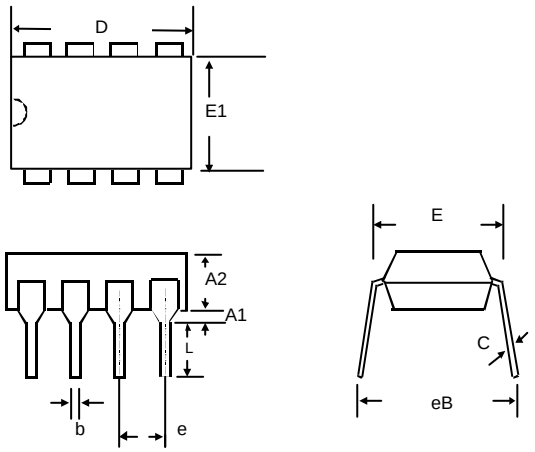
PHYSICAL DIMENSIONS

- **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