

### Description

The ACE150x series are monolithic IC designed for a step-down DC/DC converter, and own the ability of driving 2A load without additional transistor. It saves board space.

The Internal compensation makes feedback control having good line and load regulation without external design. Regarding protected function, thermal shutdown is to prevent over temperature operating from damage, and current limit is against over current operating of the output switch. If current limit function occurs and  $V_{FB}$  is down below 0.5V, the switching frequency will be reduced.

The ACE150x series operate at a switching frequency of 150KHz. Other features include a guaranteed +4% tolerance on output voltage under specified input voltage and output load conditions, and +15% on the oscillator frequency. The output version included fixed 3.3V, 5V, 12V, and an adjustable type. The chips are available in a standard 8-lead SOP-8 package..

### Features

- Guaranteed 2A output current
- 3.3V, 5V, 12V and adjustable output versions
- Thermal shutdown and current limit protection
- Internal oscillator of 150kHz fixed frequency.
- Built-in TTL On/Off control

### Application

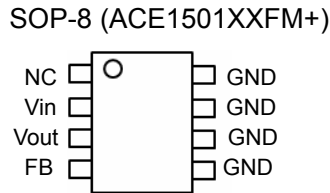
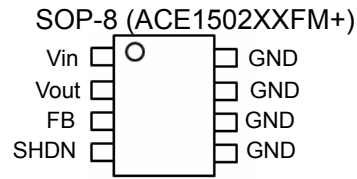
- One Channel switching regulators
- LCD Monitors
- High-efficiency step-down regulator

### Absolute Maximum Ratings

Parameter	Symbol	Max	Unit
Input supply voltage	$V_{CC}$	24	V
ON/OFF Pin Input Voltage	$V_{SD}$	-0.3 to +18	V
Feedback Pin Voltage	$V_{FB}$	-0.3 to +18	V
Output Voltage to Ground	$V_{OUT}$	-1	V
Power Dissipation	$P_D$	Internally Limited	W
Thermal resistance junction to ambient SOP-8	$\theta_{JA}$	70	°C/W
Operating junction temperature	$T_J$	150	°C
Storage temperature range	$T_{STG}$	- 60 to 150	°C
Operating temperature	$T_{OPR}$	-40 to +125	°C

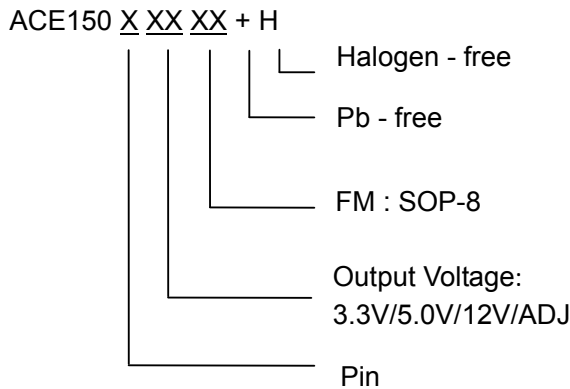
Note : Exceeding these rating could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of the specified terminal.

## Packaging Type



## Pin Description

### Selection Guide



## Power Dissipation Table

Package	$\theta_{JA}$ ( $^{\circ}\text{C}/\text{W}$ )	Df(mW/ $^{\circ}\text{C}$ ) $T_A \geq 25^{\circ}\text{C}$	$T_A \leq 25^{\circ}\text{C}$ Power rating(mW)	$T_A=70^{\circ}\text{C}$ Power rating(mW)	$T_A= 85^{\circ}\text{C}$ Power rating (mW)
FM	70	6.06	1785	1142	928

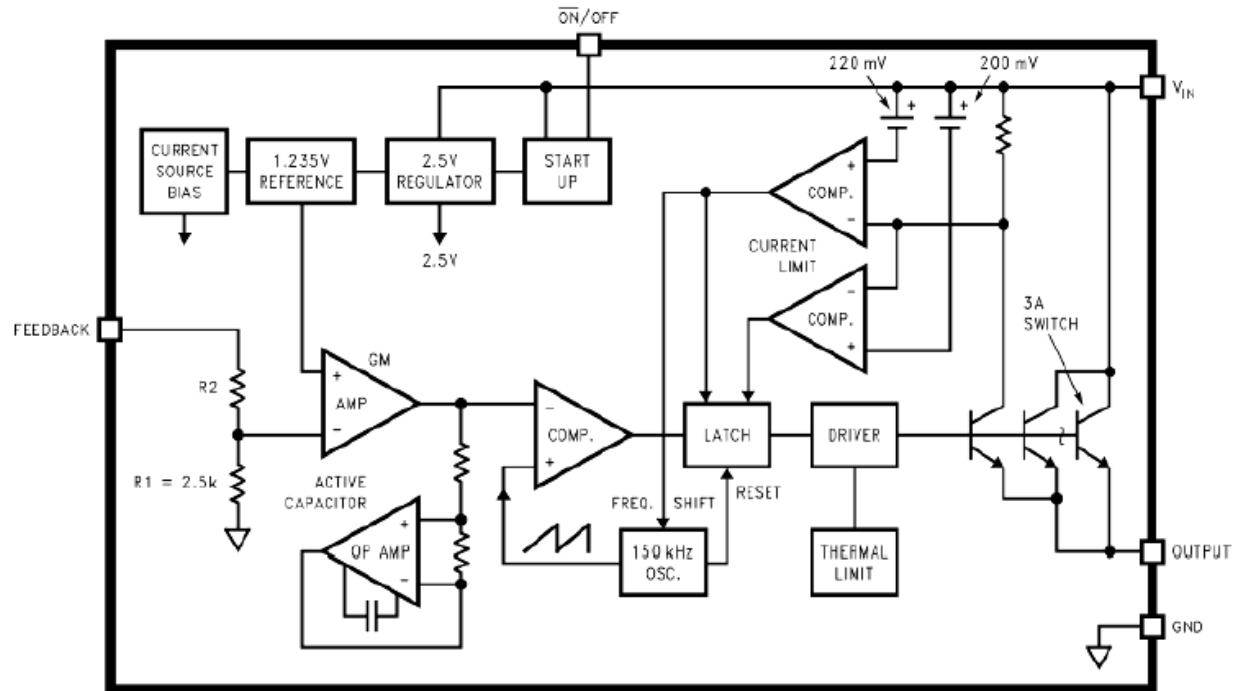
Note:

- Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into Thermal shutdown.
- $T_J$ : Junction Temperature Calculation  $T_J = T_A + (P_D \times \theta_{JA})$   
The  $\theta_{JA}$  numbers are guidelines for the thermal performance of the device/PC-board system. All of the above assume no Ambient airflow.
- $\theta_{JA}$  : Thermal Resistance-Junction to Ambient, Df: Derating factor, Po: Power consumption

### Pin Description

No.	ACE1501 Pin Name	Function	No.	ACE1502 Pin Name	Function
1	N.C.	NC	1	V <sub>IN</sub>	Supply Voltage
2	V <sub>IN</sub>	Supply Voltage	2	V <sub>OUT</sub>	Switch Pin. Connect inductor/diode
3	V <sub>OUT</sub>	Switch Pin. Connect inductor/diode	3	FB	Feedback Pin.
4	FB	Feedback Pin.	4	SHDN	Shutdown Control Input. Active-Low into shutdown mode
5	GND	Ground Pin	5	GND	Ground Pin
6	GND	Ground Pin	6	GND	Ground Pin
7	GND	Ground Pin	7	GND	Ground Pin
8	GND	Ground Pin	8	GND	Ground Pin

### Block Diagram



### Electrical Characteristics

$T_A=25^{\circ}\text{C}$ ,  $V_{IN}=12\text{V}$  for 3.3V,5V, and Adjustable version and  $V_{IN}=18\text{V}$  for the 12V version,  $I_o = 0.5\text{A}$ , unless Otherwise specified.

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	ACE1501/2-3.3	$V_{OUT}$	$5.5\text{V}<V_{IN}<22\text{V}$ , $0.2\text{A}<I_{LOAD}<2\text{A}$	3.168	3.3	3.432	V
Efficiency		$\eta$	$V_{IN}=12\text{V}$ , $I_{LOAD}=2\text{A}$	-	75	-	%
Output Voltage	ACE1501/2-5.0	$V_{OUT}$	$8\text{V}<V_{IN}<22\text{V}$ , $0.2\text{A}<I_{LOAD}<2\text{A}$	4.800	5.0	5.200	V
Efficiency		$\eta$	$V_{IN}=12\text{V}$ , $I_{LOAD}=2\text{A}$	-	80	-	%
Output Voltage	ACE1501/2-1.2	$V_{OUT}$	$15\text{V}<V_{IN}<22\text{V}$ , $0.2\text{A}<I_{LOAD}<2\text{A}$	11.52	12	12.48	V
Efficiency		$\eta$	$V_{IN}=16\text{V}$ , $I_{LOAD}=2\text{A}$	-	89	-	%
Feedback Voltage	ACE1501/2-ADJ	$V_{FB}$	$5\text{V}<V_{IN}<22\text{V}$ , $0.2\text{A}<I_{LOAD}<2\text{A}$	1.193	1.230	1.267	V
Efficiency		$\eta$	$V_{IN}=12\text{V}$ , $I_{LOAD}=2\text{A}$	-	74	-	%
Feedback bias Current		$I_{FB}$	$V_{FB} = 1.3\text{V}$ (Adjustable Only)	-	-10	-50	nA
Oscillator Frequency		$F_{OSC}$	$T_J=25^{\circ}\text{C}$	127	150	173	KHz
Oscillator Frequency OF Short Circuit Protect		$F_{SCP}$	When current limit occurred and $V_{FB}<0.5\text{V}$ , $T_A=25^{\circ}\text{C}$	5	15	25	KHz
Saturation Voltage		$V_{SAT}$	$I_o = 2\text{A}$ , No outside circuit and $V_{FB}=0\text{V}$ force driver on	-	1.4	1.6	V
Max. Duty Cycle ( ON)		$D_C$	$V_{FB} = 0\text{V}$ force driver on	-	100	-	%
Min. Duty Cycle ( OFF)		$D_C$	$V_{FB} = 12\text{V}$ force driver off	-	0	-	%
Current Limit		$I_{LIMIT}$	Peak current, No outside circuit and $V_{FB}= 0\text{V}$ force driver on	3.6	4.5	5.5	A
Output Leakage Current		$I_{LEAK}$	Output Leakage Current No outside circuit $V_{FB}=12\text{V}$ force driver off, $V_{OUT}=0\text{V}$	-	-	-200	$\mu\text{A}$
			$V_{IN}=22\text{V}$ , $V_{OUT}=-1\text{V}$	-5	-	30	
Quiescent Current		$I_Q$	$V_{FB} = 12\text{V}$ force driver off	-	5	10	mA
Standby Quiescent Current		$I_{STBY}$	ON/OFF Pin=5V, $V_{IN}=22\text{V}$	-	70	156	$\mu\text{A}$
ON/OFF Pin Logic Input Threshold Voltage		$V_{IL}$	Low(Regulator(ON))	-	1.3	0.6	V
		$V_{IH}$	High(Regulator(OFF))	2.0		-	
ON/OFF Pin Logic Input Current		$V_{IL}$	$V_{LOGIC}=2.5\text{V}$ (OFF)			-0.01	$\mu\text{A}$
		$V_{IH}$	$V_{LOGIC}=0.5\text{V}$ (ON)		-0.1	-1	

**Notes:**

**Thermal Considerations:**

The SOP-8 package needs a heat sink under most conditions. The size of the heat sink depends on the input voltage, the load current and ambient temperature. The ACE150X junction temperature rises above ambient temperature for a 2A load and different input and output voltages. The data for these curves was taken with the ACE150X(SOP-8 package) operating as a buck-switching regulator in an ambient temperature of 25°C (still air). These temperature increments are all approximate and are affected by many factors.

Higher ambient temperatures require more heat sinker. For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. ( One exception is the output(switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

Package thermal resistance and junction temperature increments are affected by a lot of factors. Some of these factors include board size, shape, thickness, position, location, and even board temperature. Other factors are, trace width, total printed circuit copper area, copper thickness, single or double-sided, multi-layer board and the amount of solder on the board. The effectiveness of the PC board to dissipate heat also depends on the size, Furthermore, some of these components such as the catch diode will add heat to the PC board and the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type or core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

**Application Data**

VR(V)	3A Diode		3A Diode	
	Surface Mount	Through Hole	Surface Mount	Through Hole
	Scgittky	Schottky	Scgittky	Schottky
20	SK32	1N5820 SR302 MBR320		1N5823 SR502 MBR520
30	SK33	1N5821 MBR330 31DQ03	50WQ03	1N5824 SR503 SB530
40	SK34 MBRS340	1N5822 SR304 MBR340 31DQ04	50WQ04	1N5825 SR504 SB540
50	SK35 MBRS360	SR305 MBR350 31DQ05 MUR320	50WQ05 50WF10	SB550 50SQ080 HER601 MUR620

**Quick design component selection table for adjustable output**

Output Voltage (V)	Through Hole Output Capacitor			Surface Mount Output Capacitor		
	Panasonic HFQ Series ( $\mu$ F/V)	Nichicon PL Series ( $\mu$ F/V)	Feed forward Capacitor	Panasonic HFQ Series ( $\mu$ F/V)	Nichicon PL Series ( $\mu$ F/V)	Feed forward Capacitor
2	820/35	820/35	33nF	330/6.3	470/4	33nF
4	560/35	470/35	10nF	330/6.3	390/6.3	10nF
6	470/25	470/25	3.3nF	220/10	330/10	3.3nF
9	330/35	330/25	1.5nF	100/16	180/16	1.5nF
12	330/25	330/25	1nF	100/16	180/16	1nF
15	220/35	220/25	680pF	68/20	120/20	680pF
24	220/35	150/35	560pF	33/25	33/25	220pF

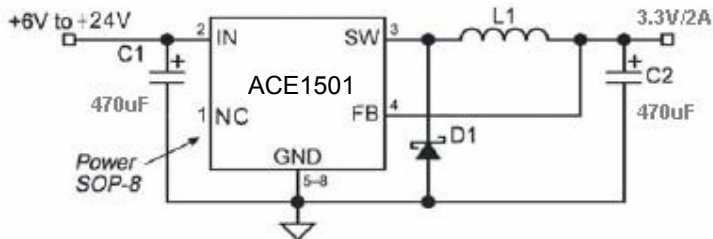
**Quick design component selection table for Fixed output**

Input / Output Condition			Inductor		Output Capacitor ( $\mu$ F/V)			
					Through Hole Electrolytic		Surface Mount Tantalum	
Output Voltage (V)	Load Current (A)	Max. input Voltage (V)	Inductance ( $\mu$ F)	Current (A)	Nichicon PL Series	Panasonic HFQ Series	Sprague 595D Series	AVX TPS Series
5	3	8	22	3.5	560/25	560/25	330/10	220/10
		15	33	3.5	330/35	330/35	330/10	220/10
		25	47	3.5	270/35	330/35	330/10	220/10
	2	9	22	3.1	560/16	470/25	330/10	220/10
		15	68	3.1	180/35	180/35	270/10	100/10
		25	68	3.1	180/35	180/35	270/10	100/10
3.3	3	5	22	3.5	560/16	470/25	390/6.3	330/6.3
		12	22	3.5	560/25	560/35	390/6.3	330/6.3
		25	33	3.5	470/35	680/35	390/6.3	330/6.3
	2	6	22	3.1	470/35	470/25	390/6.3	330/6.3
		12	33	3.1	330/35	330/35	390/6.3	330/6.3
		25	47	3.1	270/50	330/35	330/10	220/10

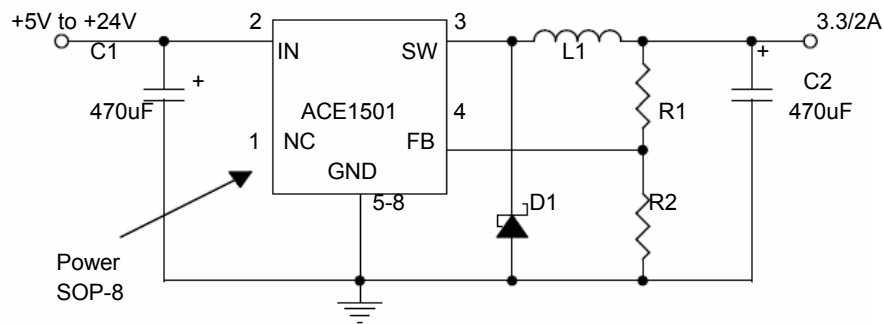
### Typical Applications

#### 1. ACE1501 Reference :

Fix Output Voltage Version:



Adjustable Voltage Version :

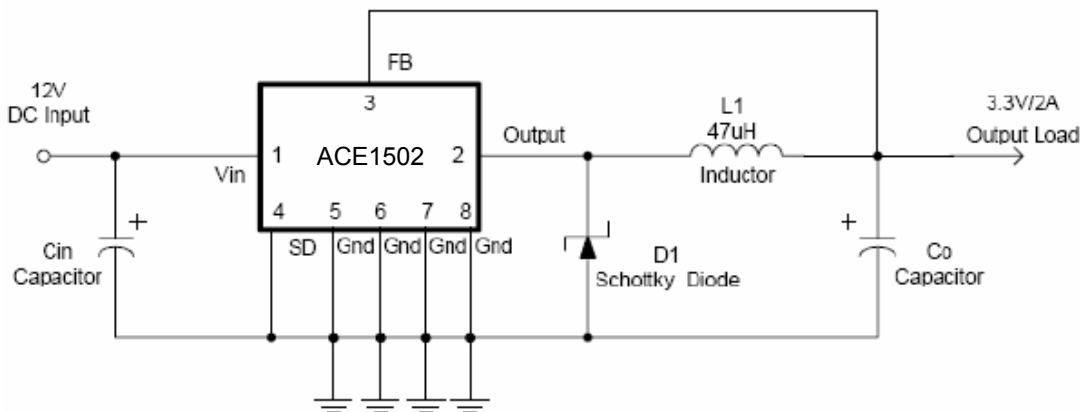


$$V_{OUT} = V_{FB} (1 + R1/R2)$$

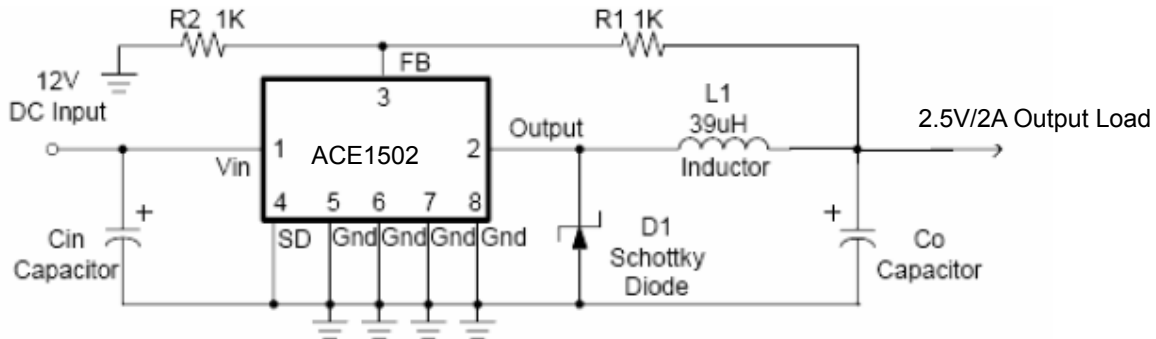
$$V_{FB} = 1.23V \cdot R2 = 1K - 3K$$

#### 2. ACE1502 Reference :

Fix Output Voltage Version :



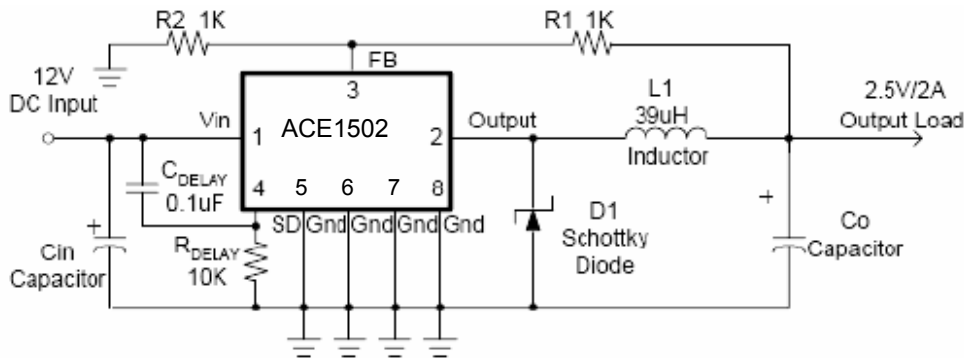
Adjustable Voltage Version :



$$V_{OUT} = V_{FB} \left( 1 + \frac{R1}{R2} \right)$$

$$V_{FB} = 1.23V \cdot R2 = 1K - 3K$$

Delay Start Circuit :



### Application Note

Maximum Power Dissipation Calculation:

$$P_D (\max) = [ (V_{IN} (\max) - V_O (\nom)) ] \times I_O (\nom) + V_{IN} (\max) \times I_Q$$

Where:  $V_{O(nom)}$  : The nominal output voltage

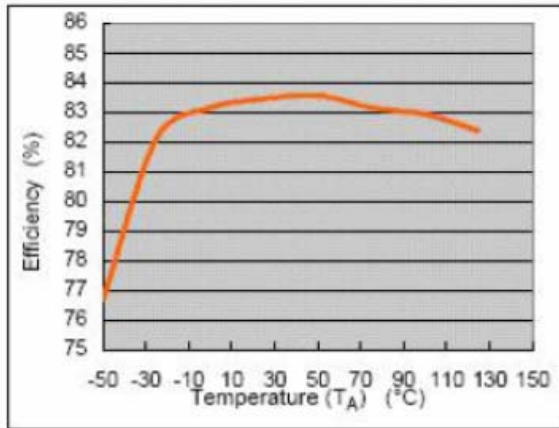
$I_{O(nom)}$ : The nominal output current and

$I_Q$ : The quiescent current the regulator consumes at  $I_{O(MAX)}$

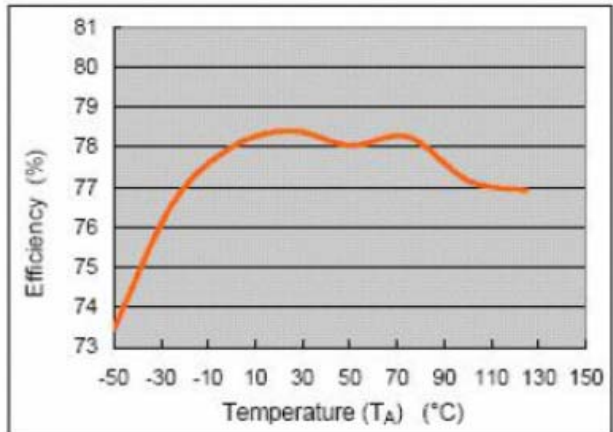
$V_{IN(max)}$ : The maximum input voltage



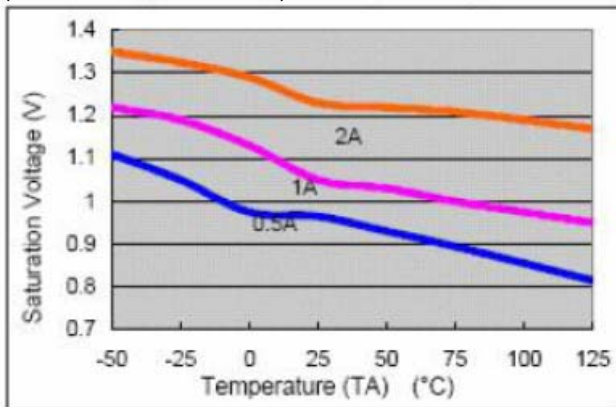
ACE150X Efficiency vs. Temperature (Vin=12V, Vout=5V, Io=2A)



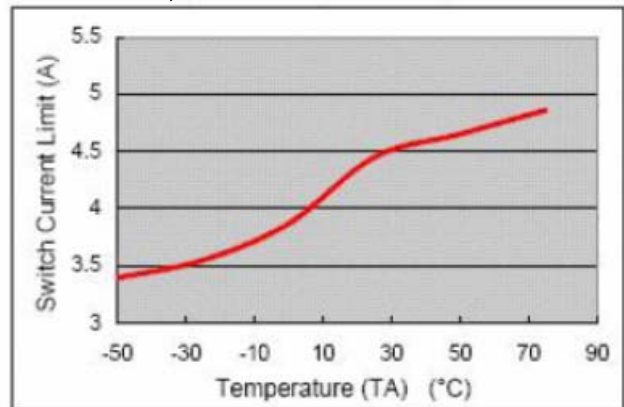
ACE150X Efficiency vs. Temperature (Vin=12V, Vout=3.3V, Io=2A)



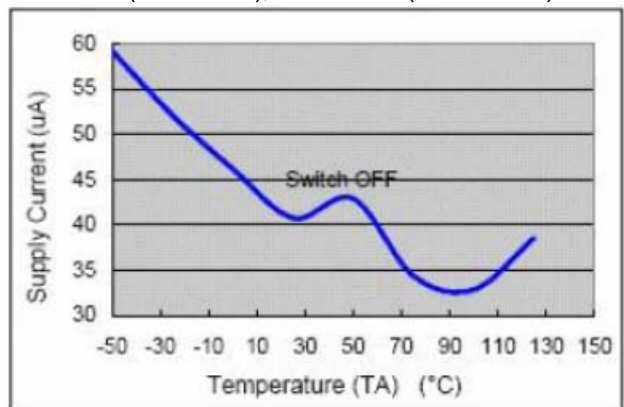
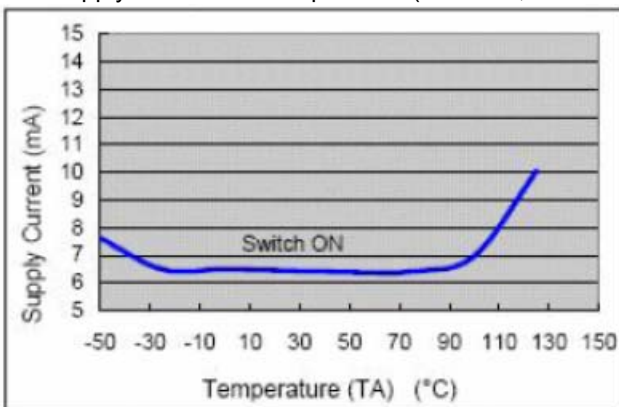
ACE150X Saturation Voltage vs. Temperature, (Vcc=12V, VFB=0V, VSD=0)



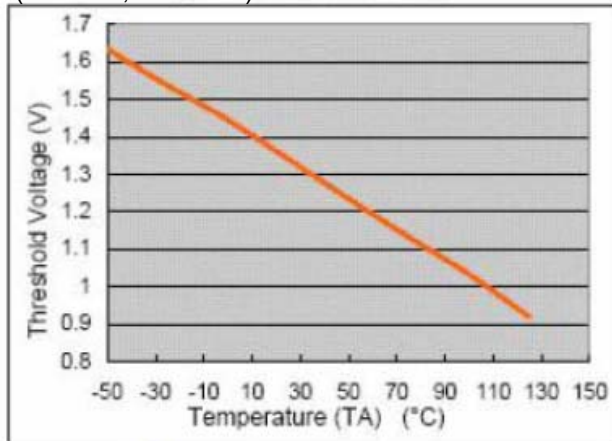
ACE150X Switch Current Limit vs. Temperature (Vcc=12V, VFB=0V)



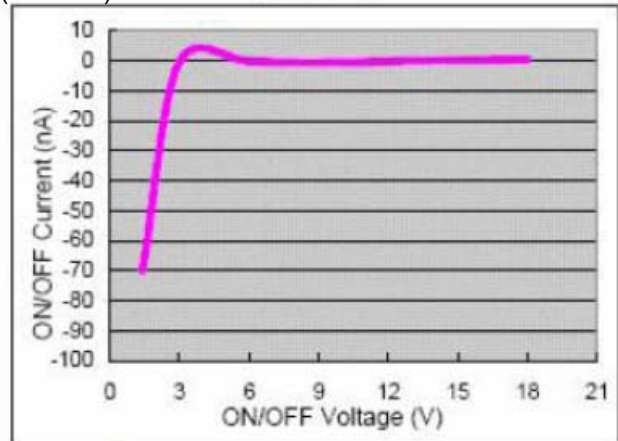
Supply Current vs. Temperature (Vcc=12V, No Load, Von/off=0V (Switch ON), Von/off=5V (Switch OFF))



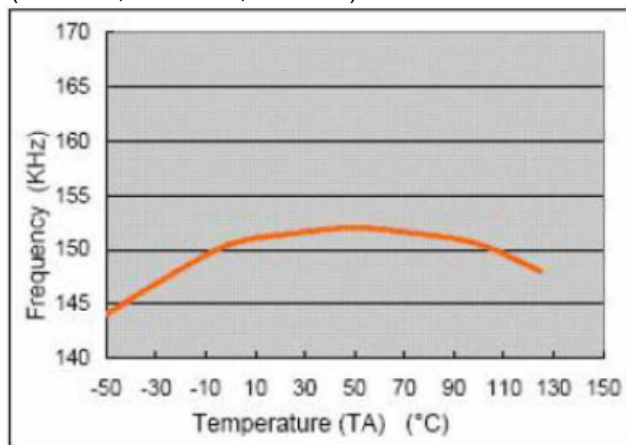
ACE150X Threshold voltage vs. Temperature,  
( $V_{CC}=12V, I_o=100mA$ )



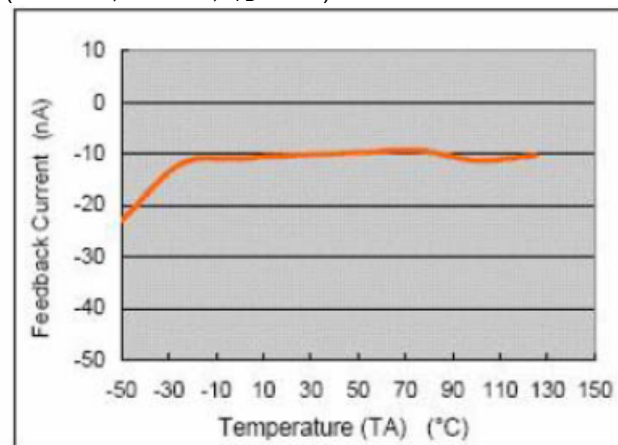
ACE150X ON/OFF Current vs. ON/OFF Voltage  
( $V_{in}=12V$ )



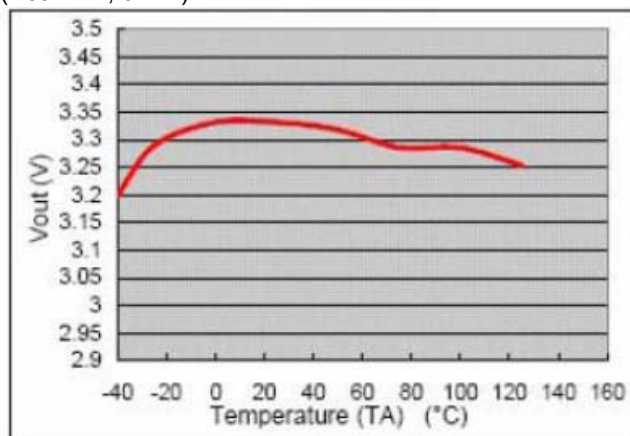
ACE150X Frequency vs. Temperature,  
( $V_{CC}=12V, I_o=100mA, V_{out}=5V$ )



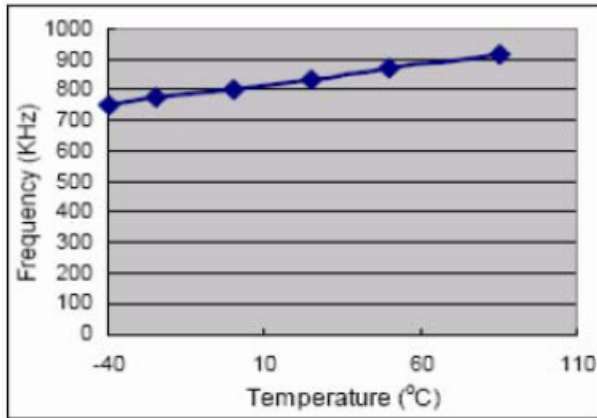
ACE150X Feedback Current vs. Temperature  
( $V_{CC}=12V, V_{out}=5V, V_{FB}=1.3V$ )



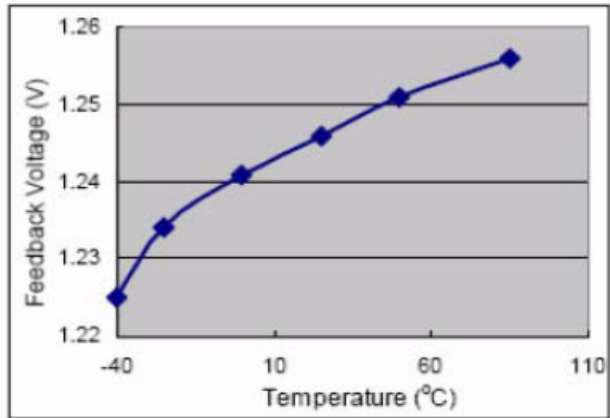
ACE150X Output Voltage vs. Temperature,  
( $V_{CC}=12V, I_o=2A$ )



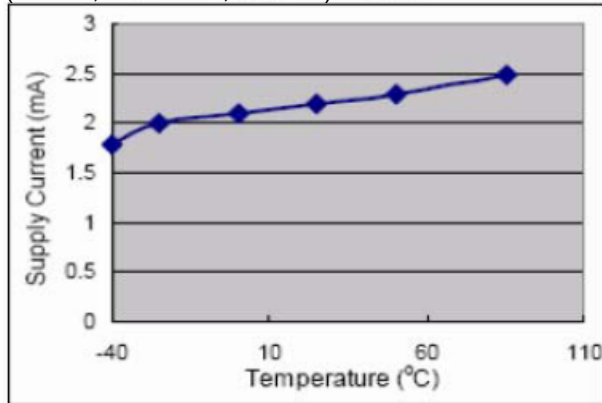
Frequency vs. Temperature,  
(Vin=5V, Vout=15V)



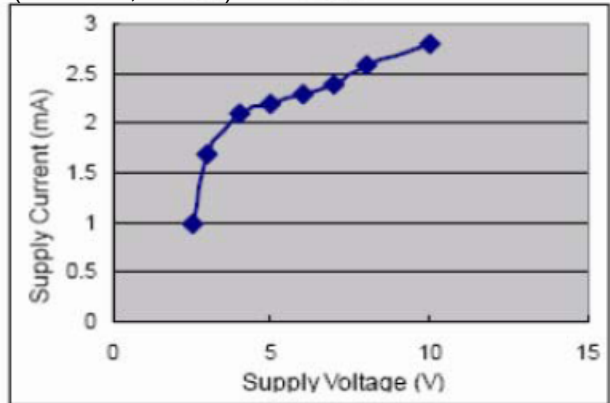
Feedback Voltage vs. Temperature  
(Vin=5V,Vout=15V)



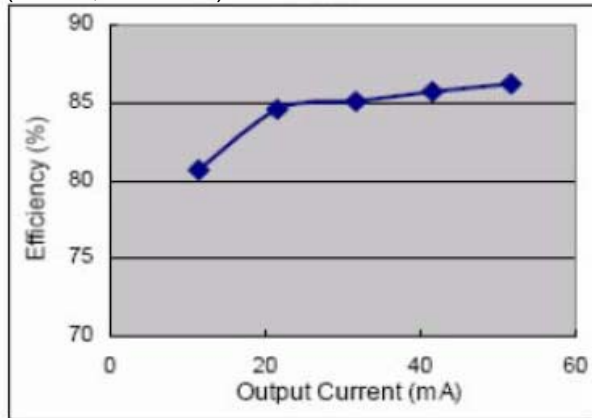
Supply Current vs. Temperature  
(Vin=5V, Vout=15V ; Iout=0V)



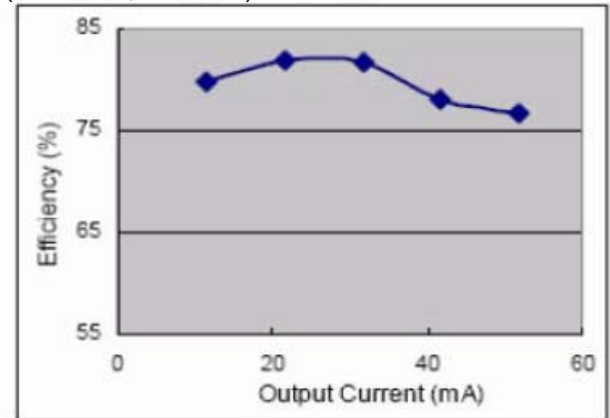
Supply Current vs. Supply Voltage  
(Vout=15V;Iout=0A)



Efficiency vs. Output Current  
(Vin=5V, Vout=15V)

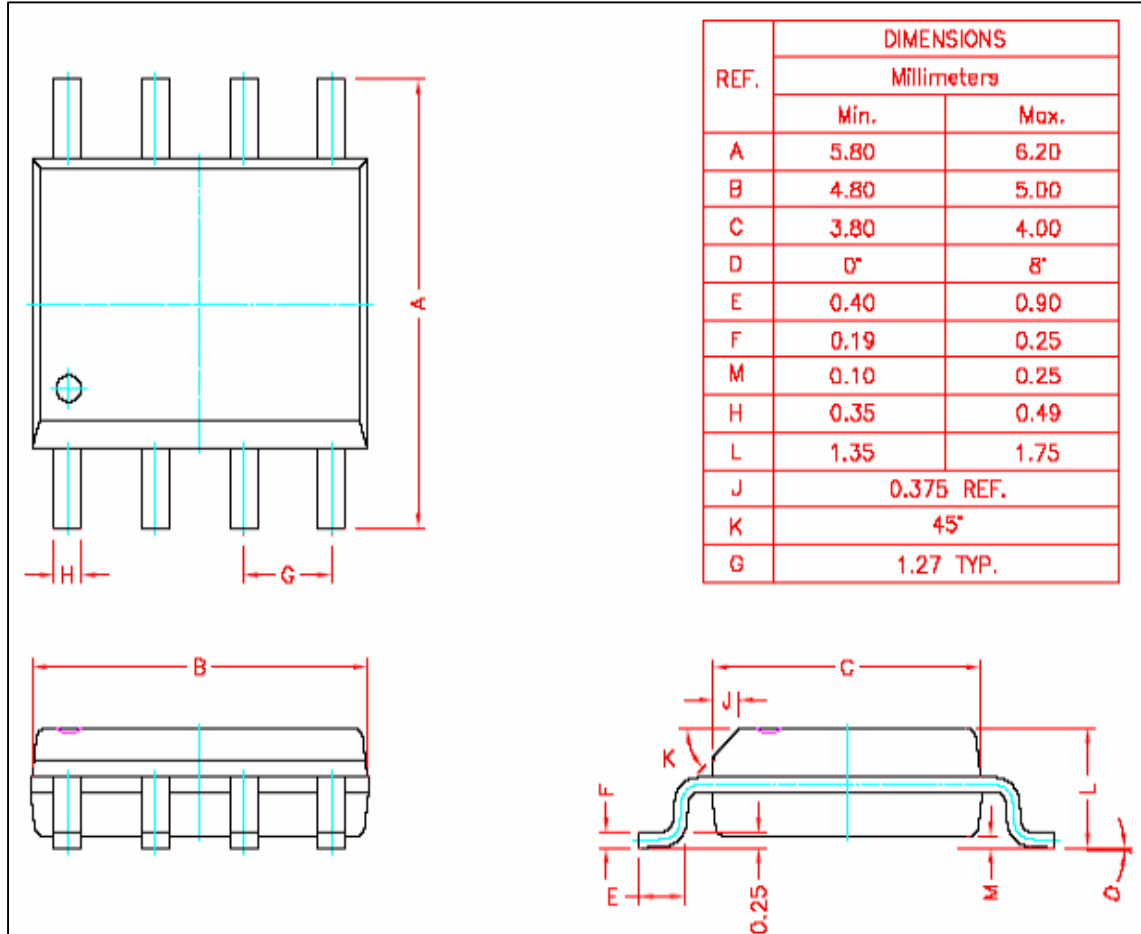


Efficiency vs. Output Current  
(Vin=3.35V;Vout=15V)



## Packing Information

### 8-Pin Plastic S.O.I.C.



### Notes

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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) 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.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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