ACE150X

150KHz,2A, PWM Step-Down DC/DC Converter

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

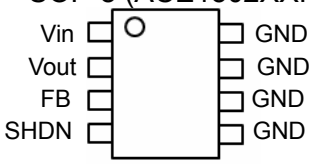
Absolute Maximum Ratings

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	θ_{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

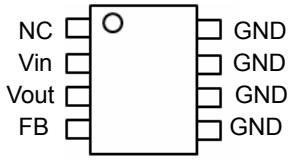
Note : Exceeding these rating could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of the specified terminal.

Packaging Type

SOP-8 (ACE1502XXFM+)



SOP-8 (ACE1501XXFM+)



Pin Description

Selection Guide

ACE150 X XX XX + H

- Halogen - free
- Pb - free
- FM : SOP-8
- Output Voltage: 3.3V/5.0V/12V/ADJ
- Pin

Power Dissipation Table

Package	θ_{JA} (°C /W)	Df(mW/℃)TA≧25℃	T_A≤ 25 °C Power rating(mW)	T_A=70 °C Power rating(mW)	T_A= 85 °C Power rating (mW)
FM	70	6.06	1785	1142	928

Note:

1.Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into Thermal shutdown.

2.T_J: Junction Temperature Calculation $T_J = T_A + (P_D \times \theta_{JA})$

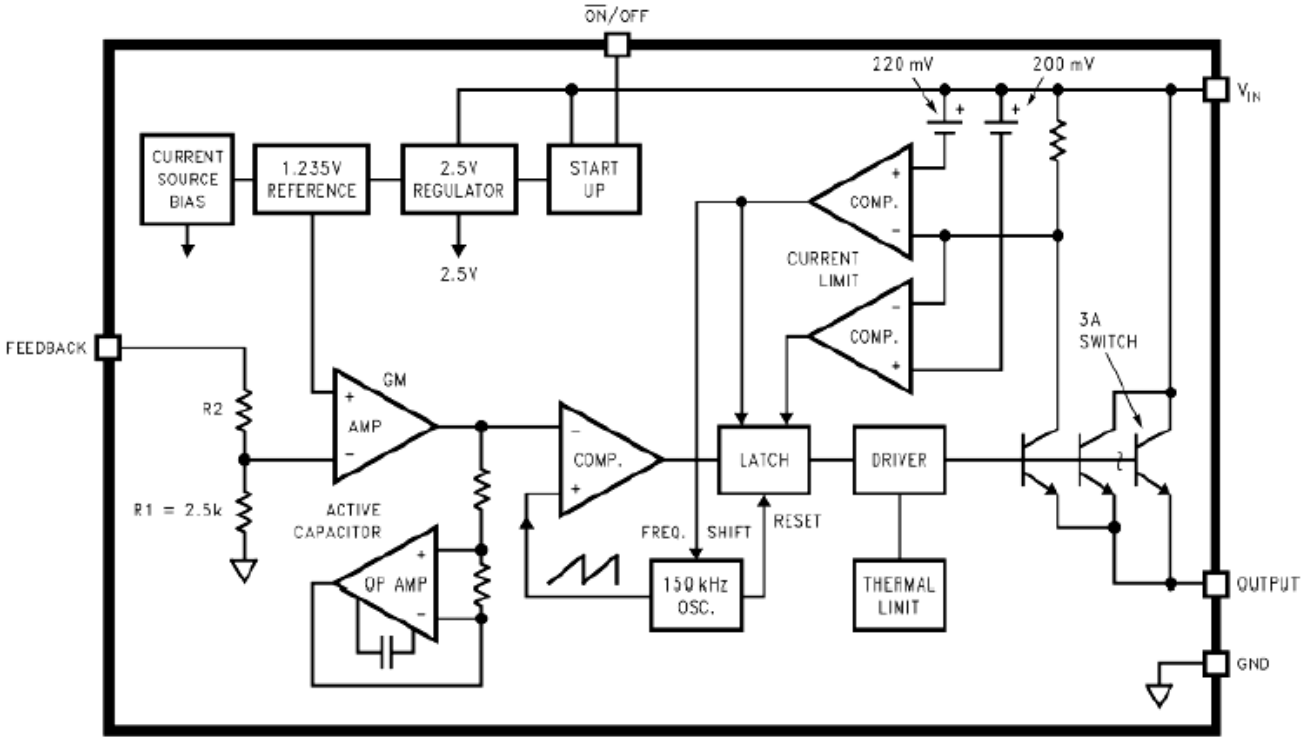
The θ_{JA} numbers are guidelines for the thermal performance of the device/PC-board system. All of the above assume no Ambient airflow.

3.θ_{JA} : Thermal Resistance-Junction to Ambient, D_F: Derating factor, Po: Power consumption

Pin Description

No.	ACE1501 Pin Name	Function	No.	ACE1502 Pin Name	Function
1	N.C.	NC	1	V_{IN}	Supply Voltage
2	V_{IN}	Supply Voltage	2	V_{OUT}	Switch Pin. Connect inductor/diode
3	V_{OUT}	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℃, V_{IN}=12V for 3.3V,5V, and Adjustable version and V_{IN}=18V for the 12V version, Io = 0.5A, unless Otherwise specified.

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	ACE1501/2-3.3	V_{OUT}	5.5V<V_{IN}<22V, 0.2A<I_{LOAD}<2A	3.168	3.3	3.432	V
Efficiency		η	V_{IN}=12V,I_{LOAD}=2A	-	75	-	%
Output Voltage	ACE1501/2-5.0	V_{OUT}	8V< V_{IN}<22V , 0.2A<I_{LOAD}<2A	4.800	5.0	5.200	V
Efficiency		η	V_{IN}=12V,I_{LOAD}=2A	-	80	-	%
Output Voltage	ACE1501/2-1.2	V_{OUT}	15V<V_{IN}<22V , 0.2A<I_{LOAD}<2A	11.52	12	12.48	V
Efficiency		η	V_{IN}=16V,I_{LOAD}=2A	-	89	-	%
Feedback Voltage	ACE1501/2-ADJ	V_{FB}	5V<V_{IN}<22V, 0.2A<I_{LOAD}<2A	1.193	1.230	1.267	V
Efficiency		η	V_{IN}=12V,I_{LOAD}=2A	-	74	-	%
Feedback bias Current		I_{FB}	V_{FB} = 1.3V (Adjustable Only)	-	-10	-50	nA
Oscillator Frequency		F_{OSC}	T_J=25 ℃	127	150	173	KHz
Oscillator Frequency OF Short Circuit Protect		F_{SCP}	When current limit occurred and V_{FB}<0.5V, T_A=25℃	5	15	25	KHz
Saturation Voltage		V_{SAT}	Io = 2A, No outside circuit and V_{FB}=0V force driver on	-	1.4	1.6	V
Max. Duty Cycle (ON)		D_C	V_{FB} = 0V force driver on	-	100	-	%
Min. Duty Cycle (OFF)		D_C	V_{FB} = 12V force driver off	-	0	-	%
Current Limit		I_{LIMIT}	Peak current, No outside circuit and V_{FB}= 0V force driver on	3.6	4.5	5.5	A
Output Leakage Current		I_{LEAK}	Output Leakage Current No outside circuit V_{FB}=12V force driver off, V_{OUT}=0V	-	-	-200	μA
			V_{IN}=22V, V_{OUT}=-1V	-5	-	30	
Quiescent Current		I_Q	V_{FB} = 12V force driver off	-	5	10	mA
Standby Quiescent Current		I_{STBY}	ON/OFF Pin=5V,V_{IN}=22V	-	70	156	μA
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}=2.5V(OFF)			-0.01	μA
		V_{IH}	V_{LOGIC}=0.5V(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℃ (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 (μF/V)	Nichicon PL Series (μF/V)	Feed forward Capacitor	Panasonic HFQ Series (μF/V)	Nichicon PL Series (μF/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

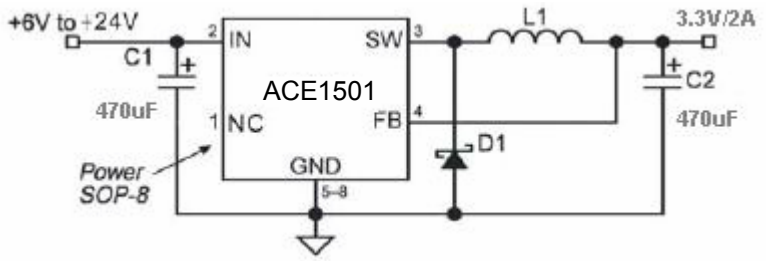
Quick design component selection table for Fixed output

Input / Output Condition			Inductor		Output Capacitor (μF/V)			
					Through Hole Electrolytic		Surface Mount Tantalum	
Output Voltage (V)	Load Current (A)	Max. input Voltage (V)	Inductance (μF)	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

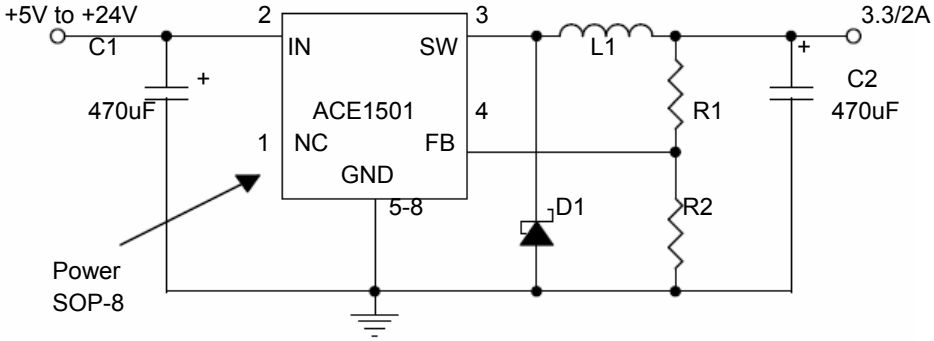
Typical Applications

1. ACE1501 Reference :

Fix Output Voltage Version:



Adjustable Voltage Version :

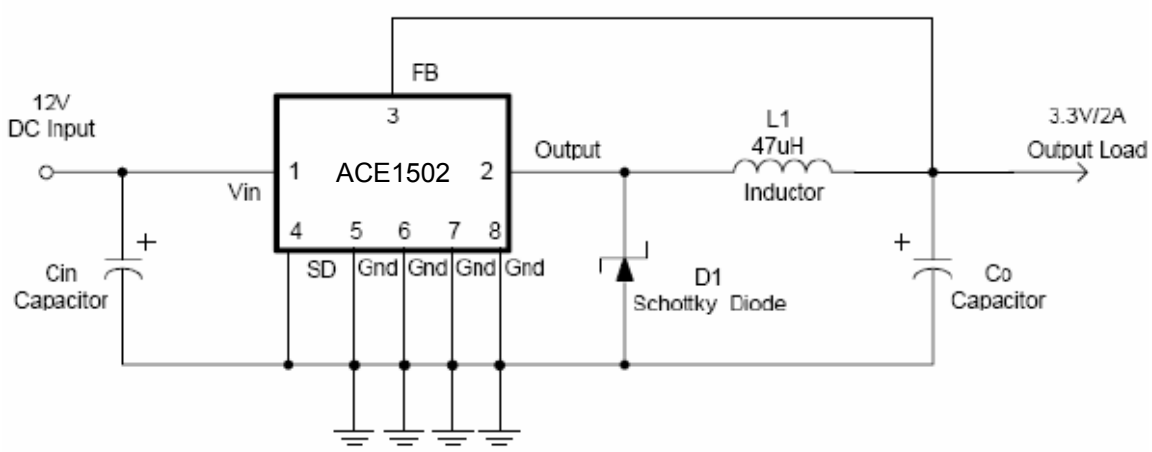


$V_{OUT} = V_{FB} (I + R1/R2)$

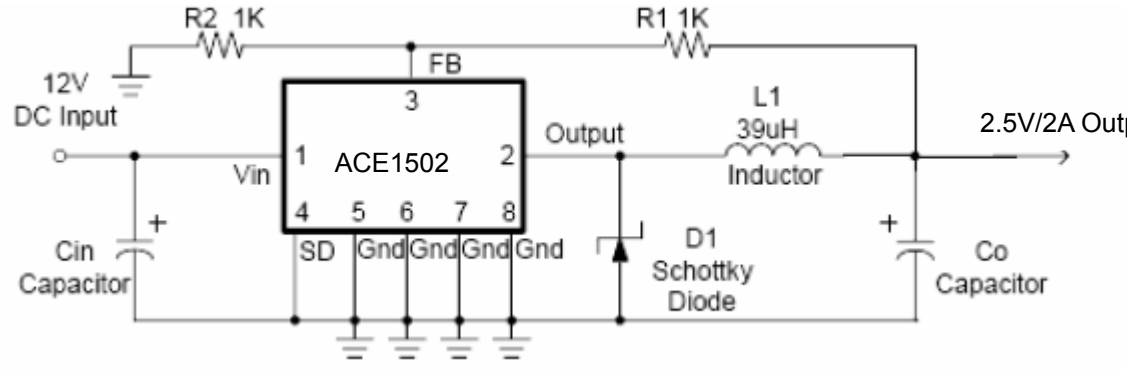
$V_{FB} = 1.23V$. R2 = 1K - 3K

2. ACE1502 Reference :

Fix Output Voltage Version :



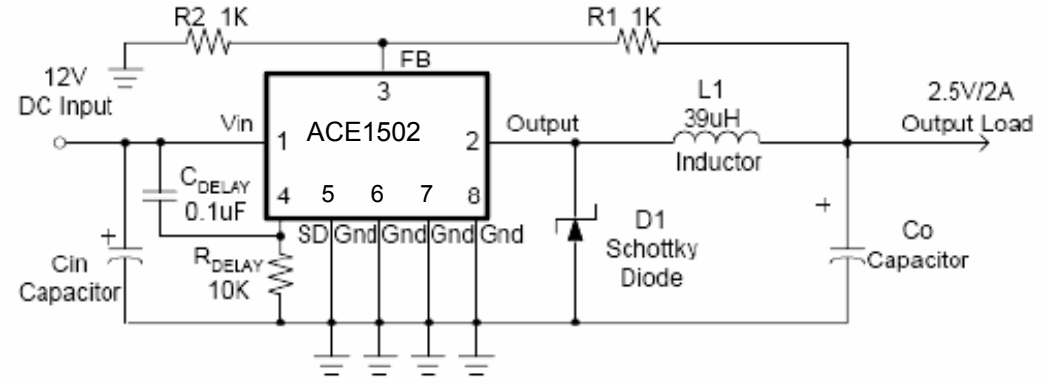
Adjustable Voltage Version :



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

V_{FB} = 1.23V . R2 = 1K - 3K

Delay Start Circuit :



Application Note

Maximum Power Dissipation Calculation:

P_D (max) = 〔 (V_{IN} (max) – V_O (nom)) 〕x I_O (nom) + V_{IN} (max) x I_Q

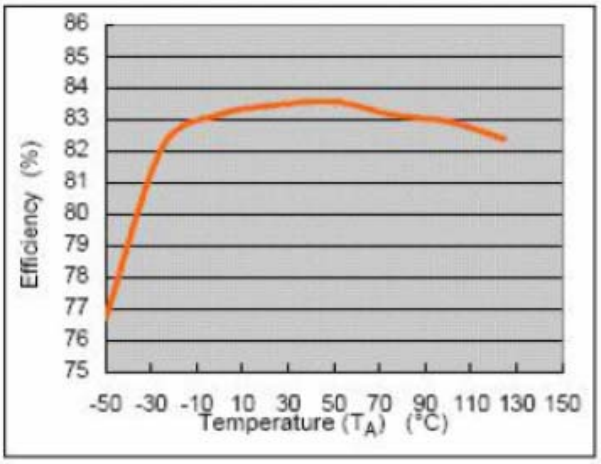
Where: $V_{O(nom)}$: The nominal output voltage

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

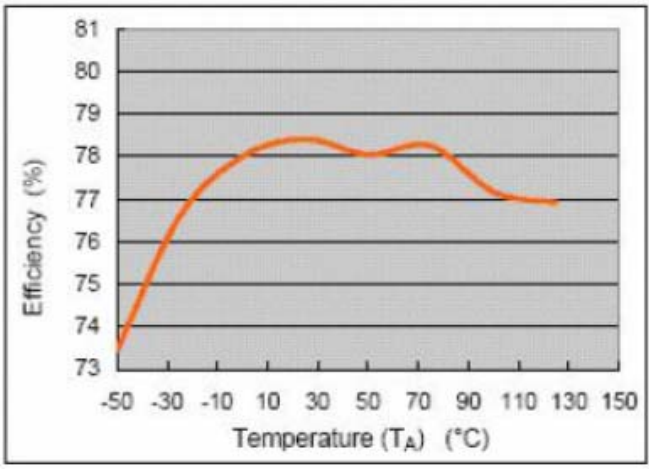
I_Q: The quiescent current the regulator consumes at $I_{O(MAX)}$

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

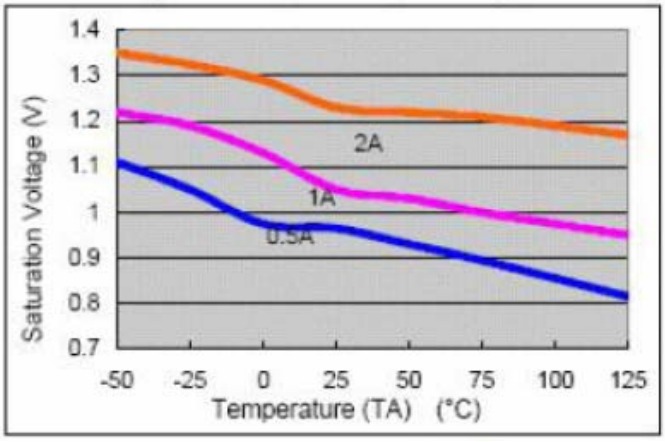
ACE150X Efficiency vs. Temperature (Vin=12V, Vout=5V,Io=2A)



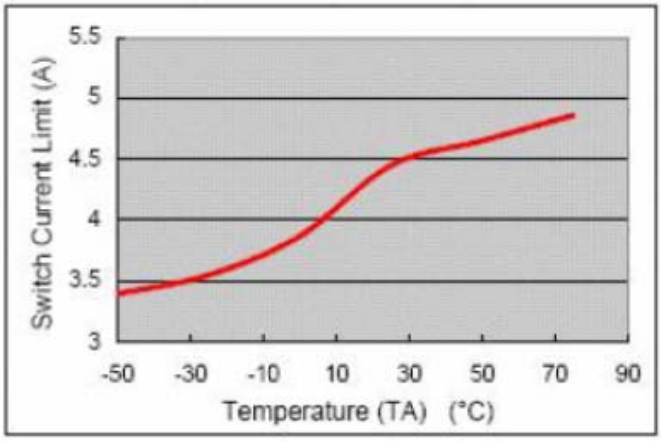
ACE150X Efficiency vs. Temperature (Vin=12V, Vout=3.3V,Io=2A)



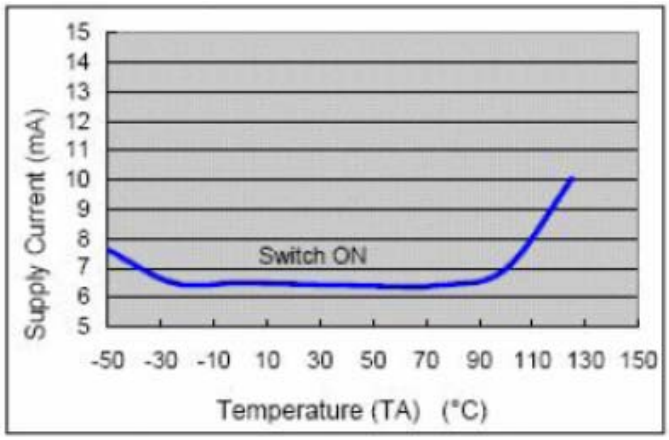
ACE150X Saturation Voltage vs. Temperature, (Vcc=12V, V_{FB}=0V,V_{SD}=0)

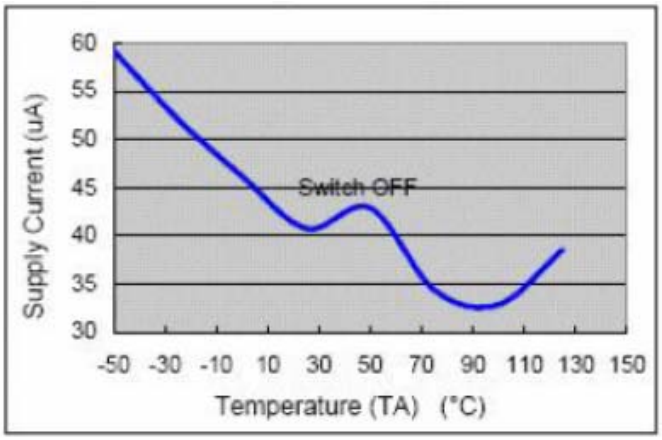


ACE150X Switch Current Limit vs. Temperature (Vcc=12V, V_{FB}=0V)

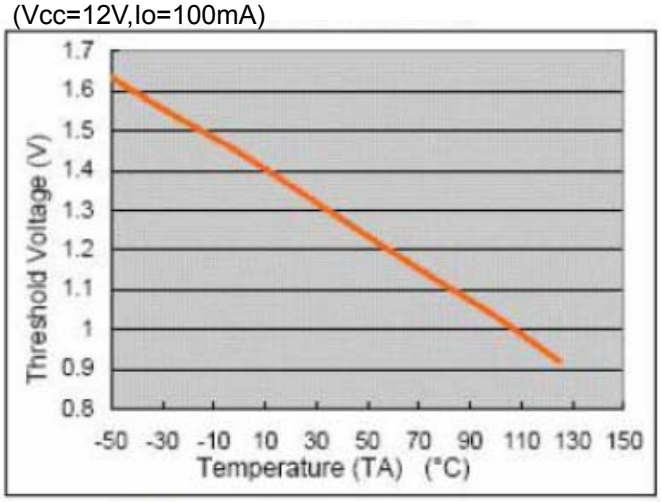


Supply Current vs. Temperature (Vcc=12V, No Load, Von/off=0V (Switch ON), Von/off=5V (Switch OFF)

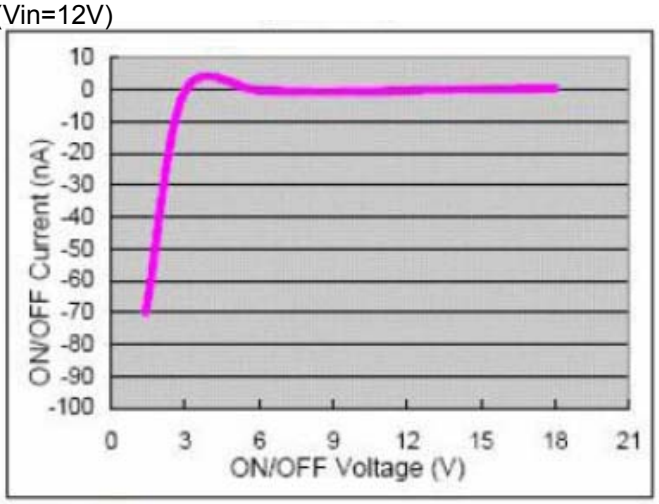




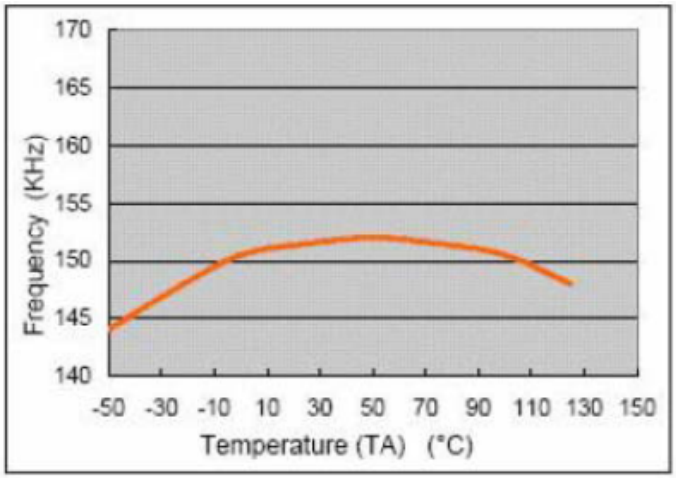
ACE150X Threshold voltage vs. Temperature, (Vcc=12V,Io=100mA)



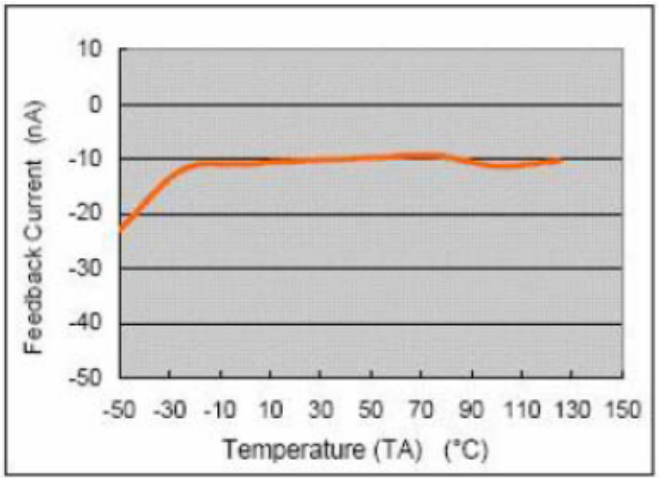
ACE150X ON/OFF Current vs. ON/OFF Voltage (Vin=12V)



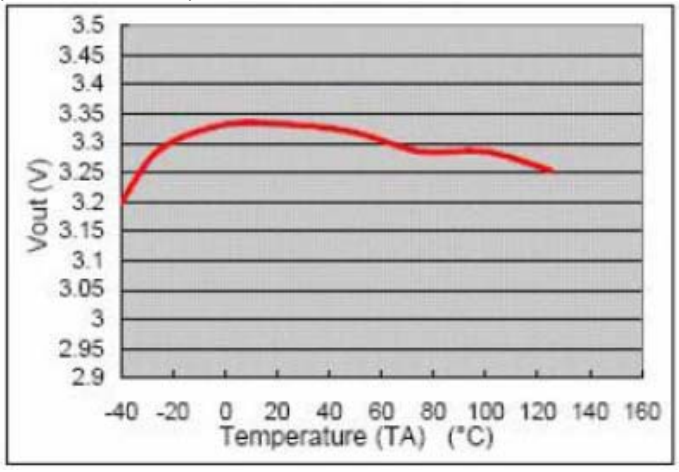
ACE150X Frequency vs. Temperature, (Vcc=12V,Io=100mA, Vout=5V)



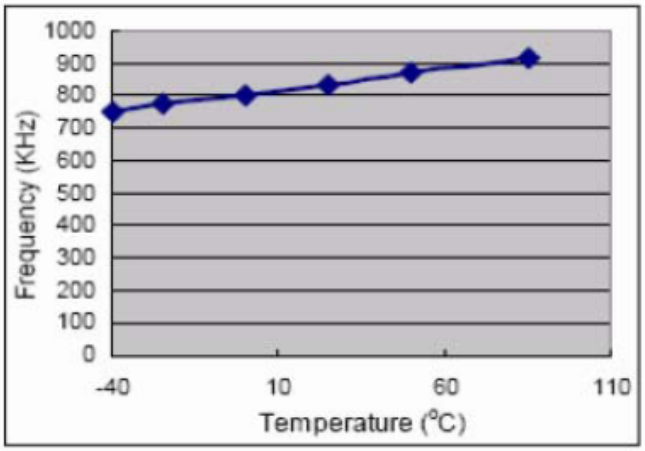
ACE150X Feedback Current vs. Temperature (Vcc=12V,Vout=5V,V_{FB}=1.3V)



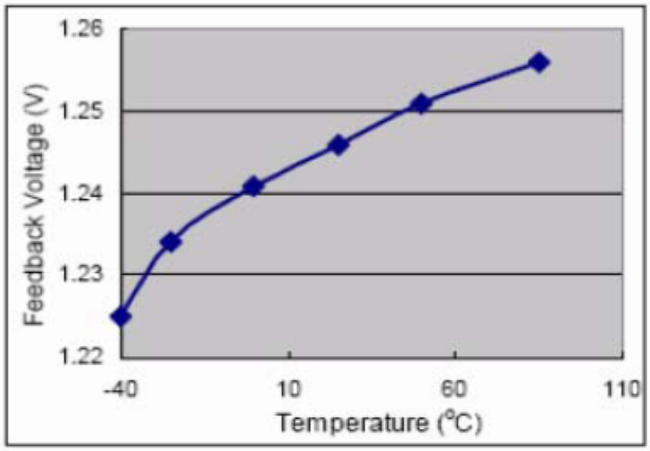
ACE150X Output Voltage vs. Temperature, (Vcc=12V,Io=2A)



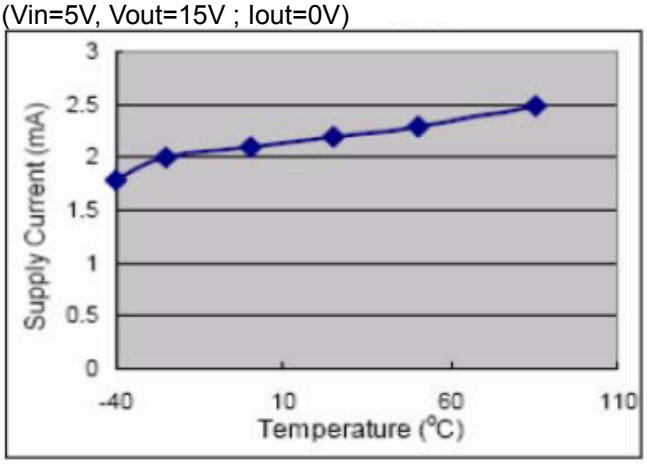
Frequency vs. Temperature,
(Vin=5V, Vout=15V)



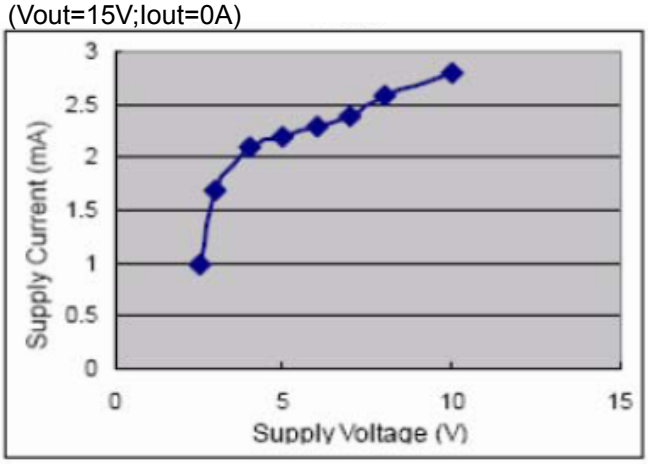
Feedback Voltage vs. Temperature
(Vin=5V,Vout=15V)



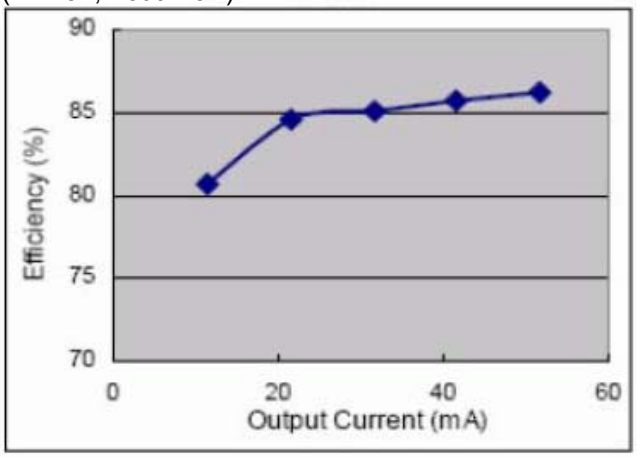
Supply Current vs. Temperature
(Vin=5V, Vout=15V ; Iout=0V)



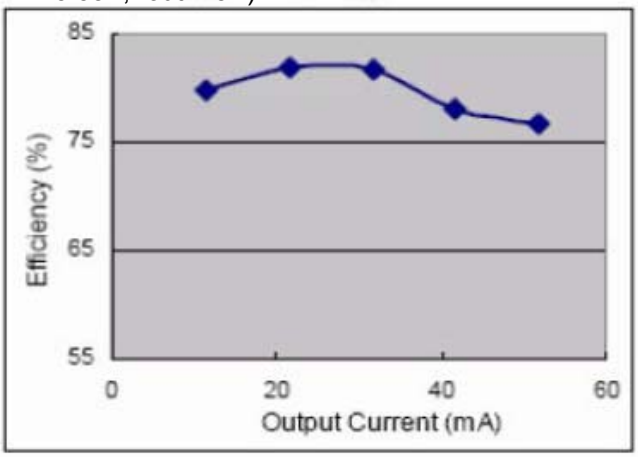
Supply Current vs. Supply Voltage
(Vout=15V;Iout=0A)



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

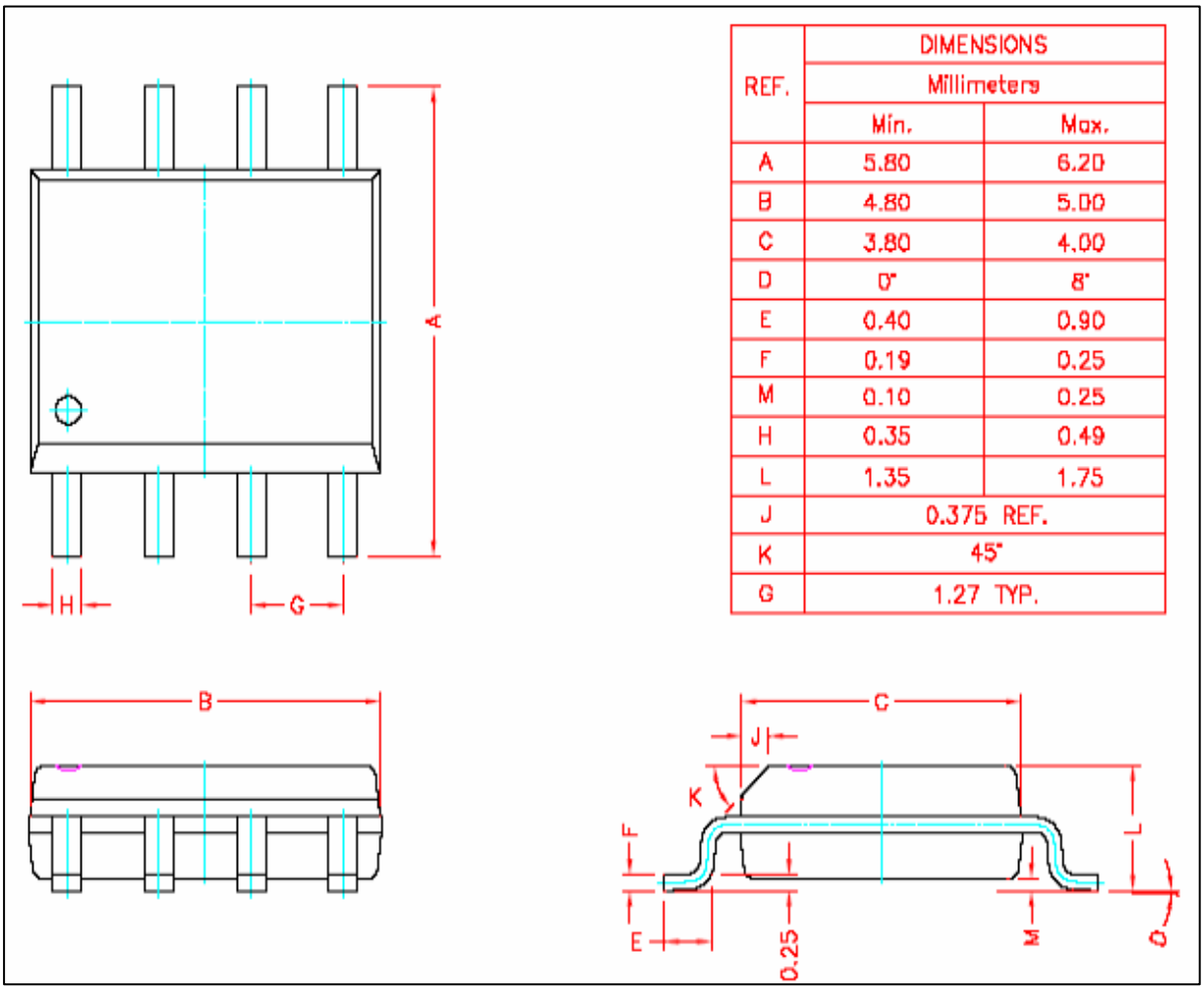


Efficiency vs. Output Current
(Vin=3.35V;Vout=15V)



Packing Information

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



REF.	DIMENSIONS	
	Millimeters	
	Min.	Max.
A	5.80	6.20
B	4.80	5.00
C	3.80	4.00
D	0°	8°
E	0.40	0.90
F	0.19	0.25
M	0.10	0.25
H	0.35	0.49
L	1.35	1.75
J	0.375 REF.	
K	45°	
G	1.27 TYP.	

Notes

ACE does not assume any responsibility for use as critical components in life support devices or systems without the express written approval of the president and general counsel of ACE Electronics Co., LTD. As sued herein:

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 shoes 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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