

### 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

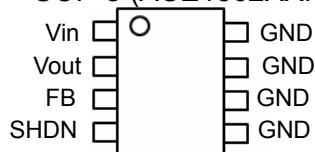
### Absolute Maximum Ratings

| 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<br>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   |

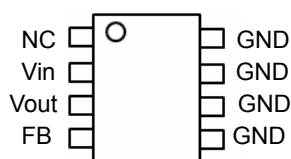
Note : Exceeding these rating could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of the specified terminal.

### Packaging Type

SOP-8 (ACE1502XXFM+)



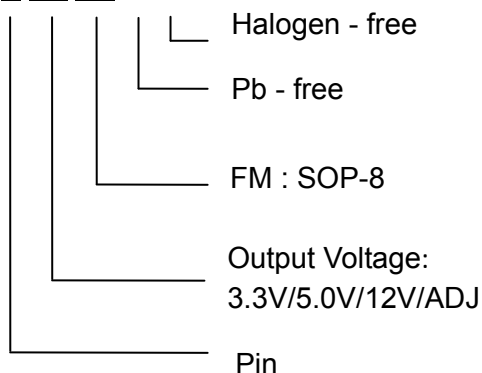
SOP-8 (ACE1501XXFM+)



### Pin Description

#### Selection Guide

ACE150 X XX XX + H



### Power Dissipation Table

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

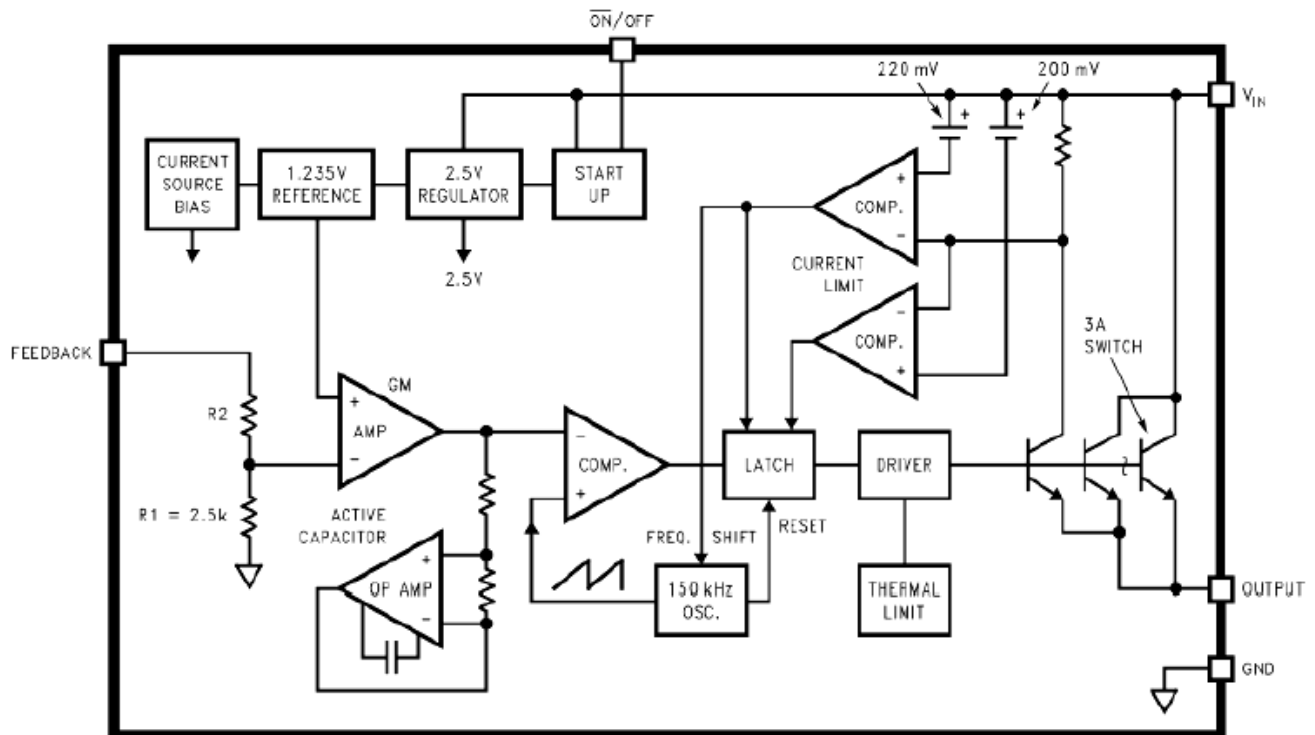
Note:

- 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,  $D_f$ : Derating factor,  $P_o$ : Power consumption

### Pin Description

| No. | ACE1501<br>Pin Name | Function                              | No. | ACE1502<br>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.<br>Connect inductor/diode | 3   | FB                  | Feedback Pin.                                            |
| 4   | FB                  | Feedback Pin.                         | 4   | SHDN                | Shutdown Control Input.<br>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 <sub>OUT</sub>   | 5.5V<V <sub>IN</sub> <22V, 0.2A<I <sub>LOAD</sub> <2A                                                       | 3.168 | 3.3   | 3.432 | V    |
| Efficiency                                       |               | η                  | V <sub>IN</sub> =12V,I <sub>LOAD</sub> =2A                                                                  | -     | 75    | -     | %    |
| Output Voltage                                   | ACE1501/2-5.0 | V <sub>OUT</sub>   | 8V< V <sub>IN</sub> <22V , 0.2A<I <sub>LOAD</sub> <2A                                                       | 4.800 | 5.0   | 5.200 | V    |
| Efficiency                                       |               | η                  | V <sub>IN</sub> =12V,I <sub>LOAD</sub> =2A                                                                  | -     | 80    | -     | %    |
| Output Voltage                                   | ACE1501/2-1.2 | V <sub>OUT</sub>   | 15V<V <sub>IN</sub> <22V , 0.2A<I <sub>LOAD</sub> <2A                                                       | 11.52 | 12    | 12.48 | V    |
| Efficiency                                       |               | η                  | V <sub>IN</sub> =16V,I <sub>LOAD</sub> =2A                                                                  | -     | 89    | -     | %    |
| Feedback Voltage                                 | ACE1501/2-ADJ | V <sub>FB</sub>    | 5V<V <sub>IN</sub> <22V, 0.2A<I <sub>LOAD</sub> <2A                                                         | 1.193 | 1.230 | 1.267 | V    |
| Efficiency                                       |               | η                  | V <sub>IN</sub> =12V,I <sub>LOAD</sub> =2A                                                                  | -     | 74    | -     | %    |
| Feedback bias Current                            |               | I <sub>FB</sub>    | V <sub>FB</sub> = 1.3V<br>(Adjustable Only)                                                                 | -     | -10   | -50   | nA   |
| Oscillator Frequency                             |               | F <sub>OSC</sub>   | T <sub>J</sub> =25 °C                                                                                       | 127   | 150   | 173   | KHz  |
| Oscillator Frequency OF Short<br>Circuit Protect |               | F <sub>SCP</sub>   | When current limit occurred and<br>V <sub>FB</sub> <0.5V, T <sub>A</sub> =25°C                              | 5     | 15    | 25    | KHz  |
| Saturation Voltage                               |               | V <sub>SAT</sub>   | I <sub>o</sub> = 2A, No outside circuit and<br>V <sub>FB</sub> =0V force driver on                          | -     | 1.4   | 1.6   | V    |
| Max. Duty Cycle ( ON)                            |               | D <sub>C</sub>     | V <sub>FB</sub> = 0V force driver on                                                                        | -     | 100   | -     | %    |
| Min. Duty Cycle ( OFF)                           |               | D <sub>C</sub>     | V <sub>FB</sub> = 12V force driver off                                                                      | -     | 0     | -     | %    |
| Current Limit                                    |               | I <sub>LIMIT</sub> | Peak current, No outside circuit and<br>V <sub>FB</sub> = 0V force driver on                                | 3.6   | 4.5   | 5.5   | A    |
| Output Leakage Current                           |               | I <sub>LEAK</sub>  | Output Leakage Current No outside<br>circuit V <sub>FB</sub> =12V force driver off,<br>V <sub>OUT</sub> =0V | -     | -     | -200  | μA   |
|                                                  |               |                    | V <sub>IN</sub> =22V, V <sub>OUT</sub> =-1V                                                                 | -5    | -     | 30    |      |
| Quiescent Current                                |               | I <sub>Q</sub>     | V <sub>FB</sub> = 12V force driver off                                                                      | -     | 5     | 10    | mA   |
| Standby Quiescent Current                        |               | I <sub>STBY</sub>  | ON/OFF Pin=5V,V <sub>IN</sub> =22V                                                                          | -     | 70    | 156   | μA   |
| ON/OFF Pin Logic Input<br>Threshold Voltage      |               | V <sub>IL</sub>    | Low(Regulator(ON)                                                                                           | -     | 1.3   | 0.6   | V    |
|                                                  |               | V <sub>IH</sub>    | High(Regulator(OFF)                                                                                         | 2.0   |       | -     |      |
| ON/OFF Pin Logic Input Current                   |               | V <sub>IL</sub>    | V <sub>LOGIC</sub> =2.5V(OFF)                                                                               |       |       | -0.01 | μA   |
|                                                  |               | V <sub>IH</sub>    | V <sub>LOGIC</sub> =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°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<br>SR302<br>MBR320           |                  | 1N5823<br>SR502<br>MBR520            |
| 30    | SK33            | 1N5821<br>MBR330<br>31DQ03          | 50WQ03           | 1N5824<br>SR503<br>SB530             |
| 40    | SK34<br>MBRS340 | 1N5822<br>SR304<br>MBR340<br>31DQ04 | 50WQ04           | 1N5825<br>SR504<br>SB540             |
| 50    | SK35<br>MBRS360 | SR305<br>MBR350<br>31DQ05<br>MUR320 | 50WQ05<br>50WF10 | SB550<br>50SQ080<br>HER601<br>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                  |

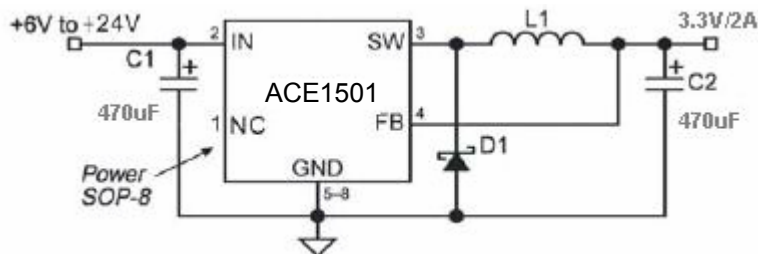
#### Quick design component selection table for Fixed output

| 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         |

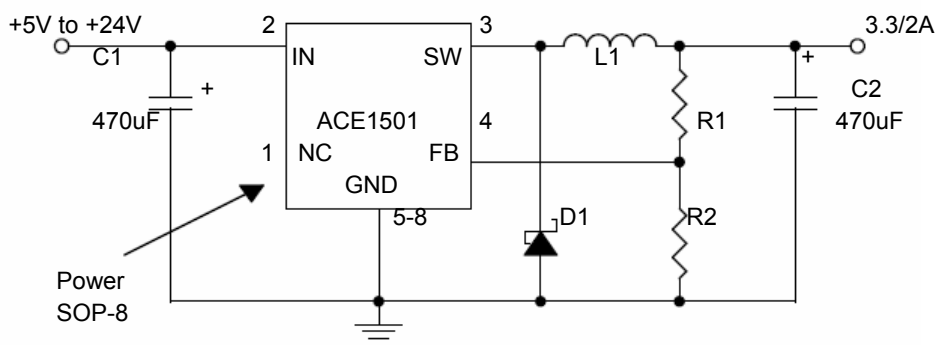
### Typical Applications

#### 1. ACE1501 Reference :

Fix Output Voltage Version:



Adjustable Voltage Version :

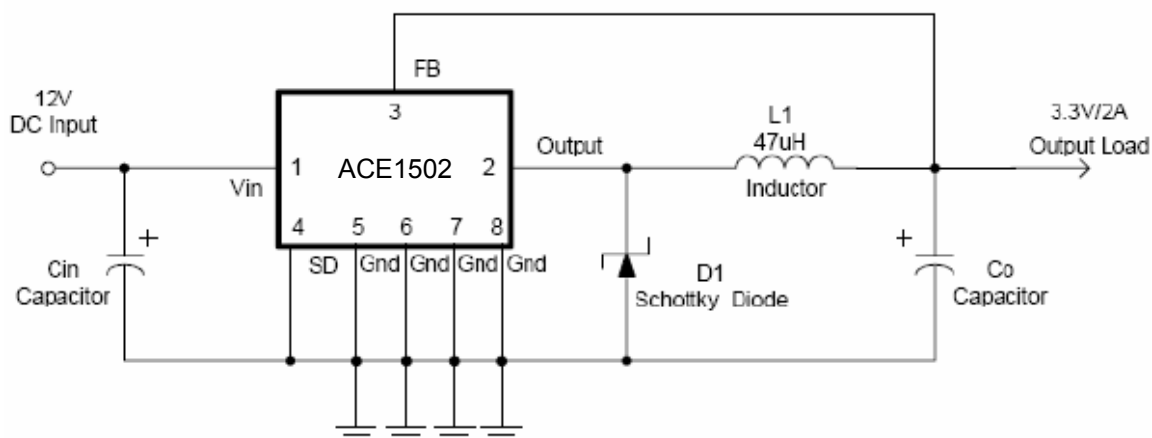


$$V_{OUT} = V_{FB} (1 + R1/R2)$$

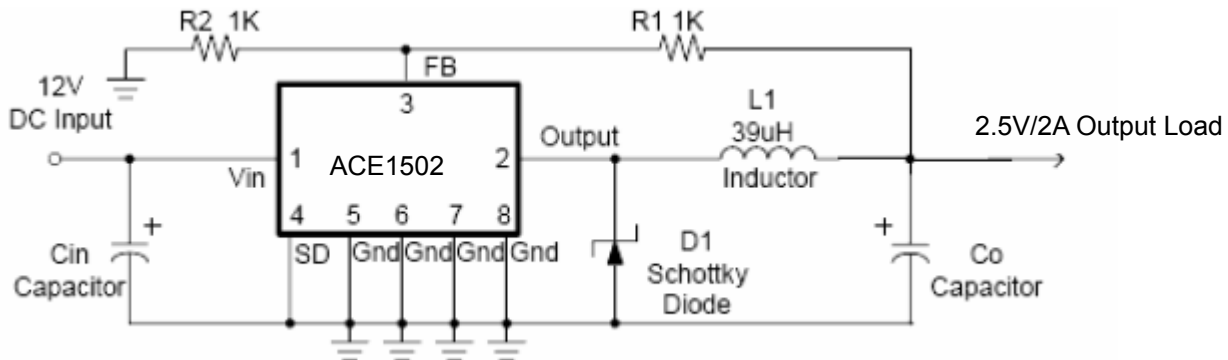
$$V_{FB} = 1.23V \cdot R2 = 1K - 3K$$

#### 2. ACE1502 Reference :

Fix Output Voltage Version :



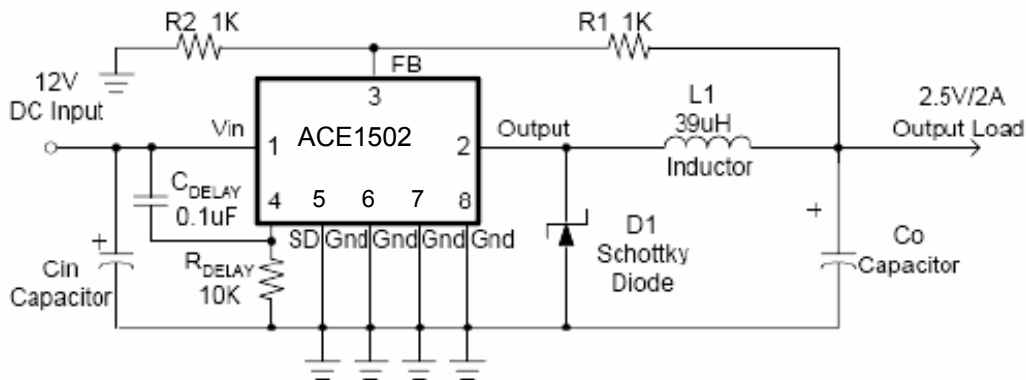
Adjustable Voltage Version :



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

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

Delay Start Circuit :



### Application Note

Maximum Power Dissipation Calculation:

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

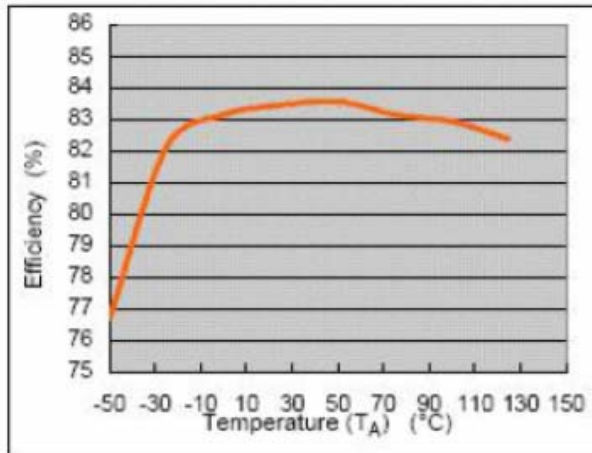
Where:  $V_{O(nom)}$  : The nominal output voltage

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

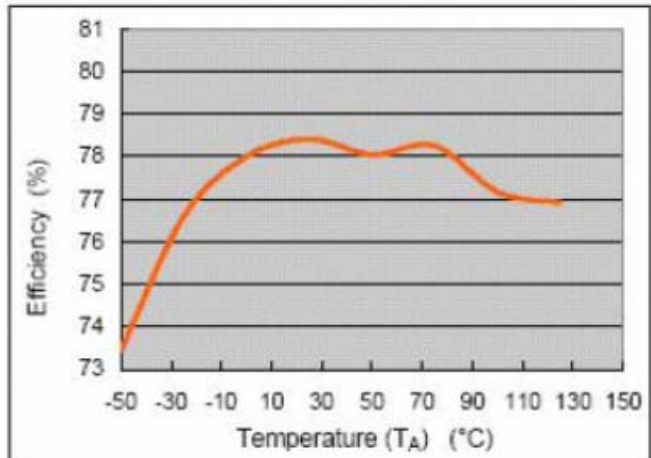
$I_Q$ : The quiescent current the regulator consumes at  $I_{O(MAX)}$

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

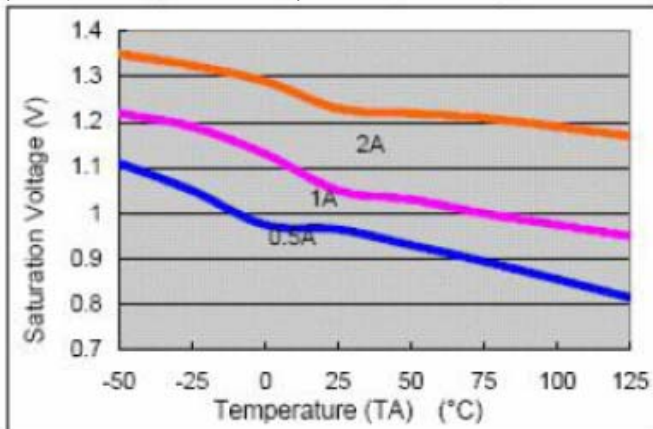
ACE150X Efficiency vs. Temperature ( $V_{in}=12V$ ,  $V_{out}=5V$ ,  $I_o=2A$ )



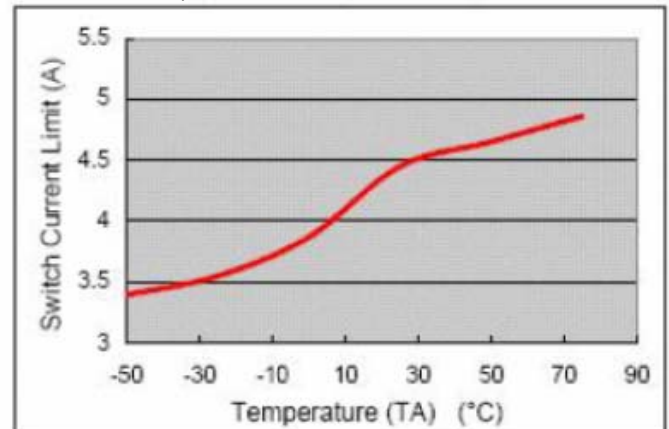
ACE150X Efficiency vs. Temperature ( $V_{in}=12V$ ,  $V_{out}=3.3V$ ,  $I_o=2A$ )



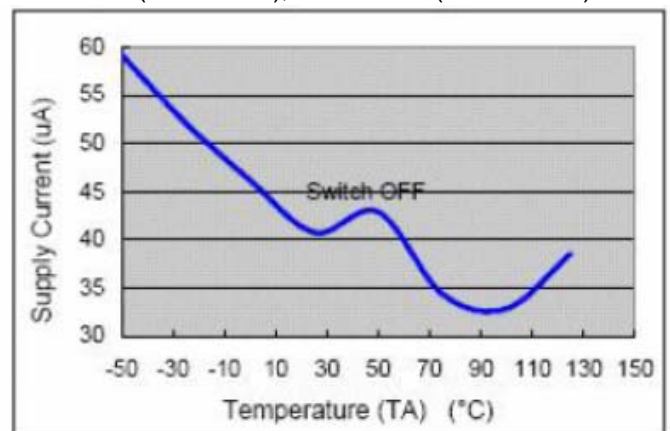
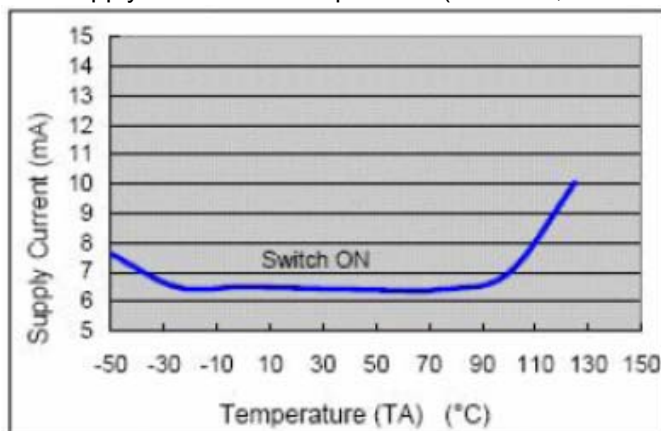
ACE150X Saturation Voltage vs. Temperature, ( $V_{cc}=12V$ ,  $V_{FB}=0V$ ,  $V_{SD}=0$ )



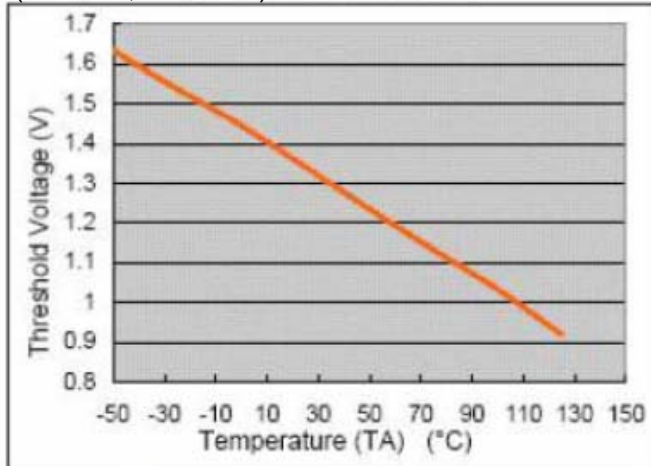
ACE150X Switch Current Limit vs. Temperature ( $V_{cc}=12V$ ,  $V_{FB}=0V$ )



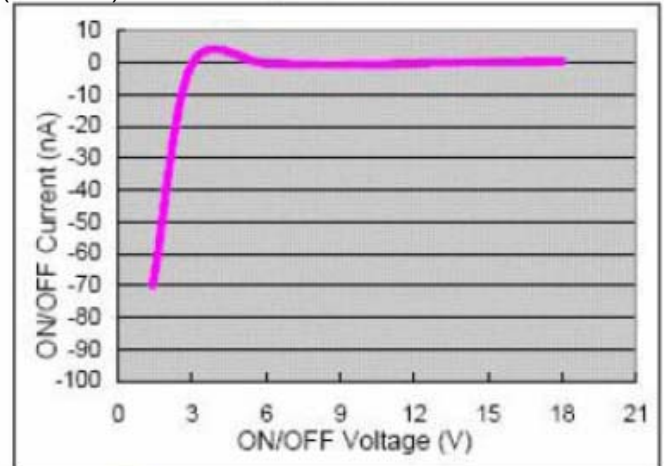
Supply Current vs. Temperature ( $V_{cc}=12V$ , No Load,  $V_{on/off}=0V$  (Switch ON),  $V_{on/off}=5V$  (Switch OFF))



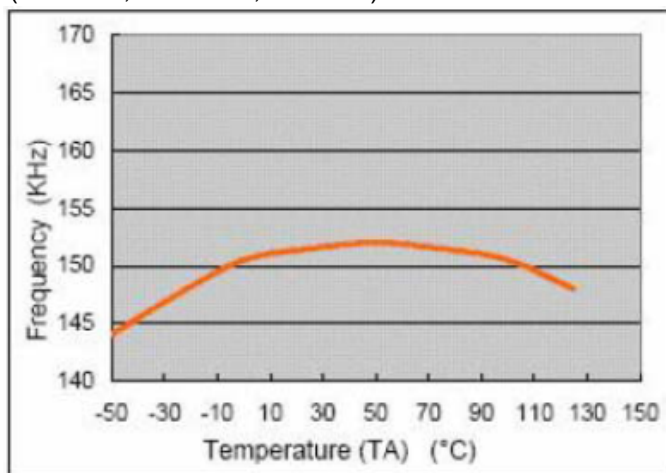
ACE150X Threshold voltage vs. Temperature,  
( $V_{CC}=12V, I_o=100mA$ )



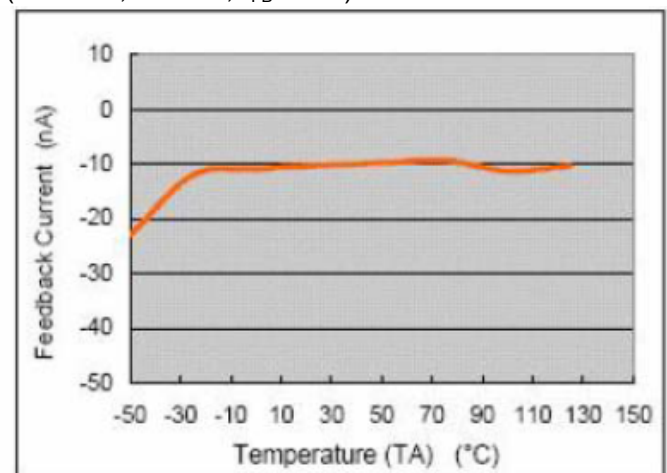
ACE150X ON/OFF Current vs. ON/OFF Voltage  
( $V_{in}=12V$ )



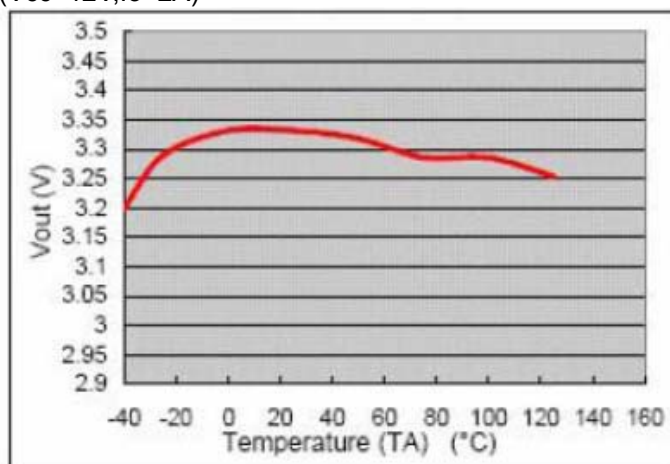
ACE150X Frequency vs. Temperature,  
( $V_{CC}=12V, I_o=100mA, V_{out}=5V$ )



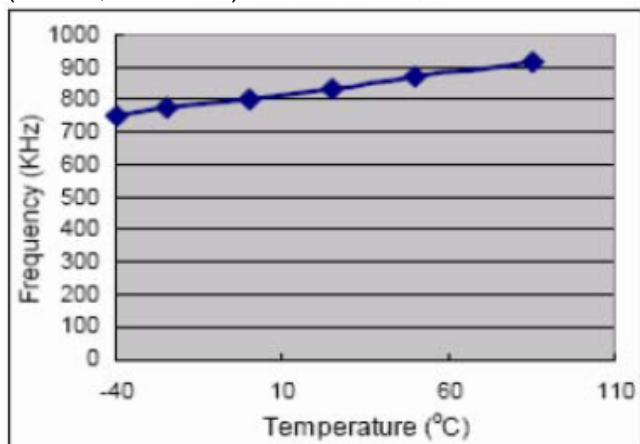
ACE150X Feedback Current vs. Temperature  
( $V_{CC}=12V, V_{out}=5V, V_{FB}=1.3V$ )



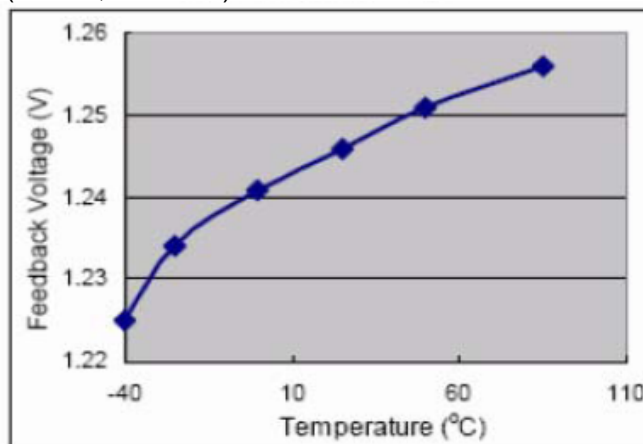
ACE150X Output Voltage vs. Temperature,  
( $V_{CC}=12V, I_o=2A$ )



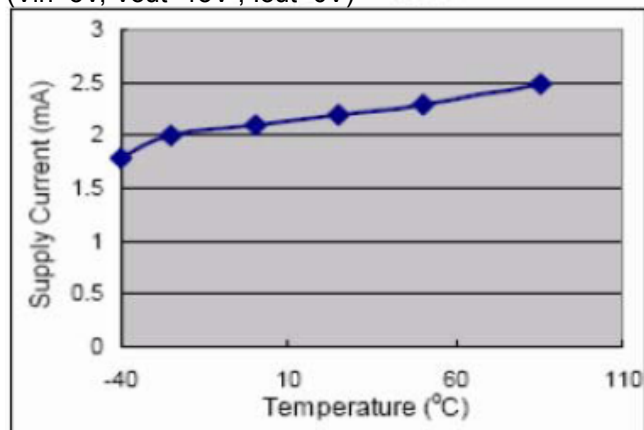
Frequency vs. Temperature,  
( $V_{in}=5V$ ,  $V_{out}=15V$ )



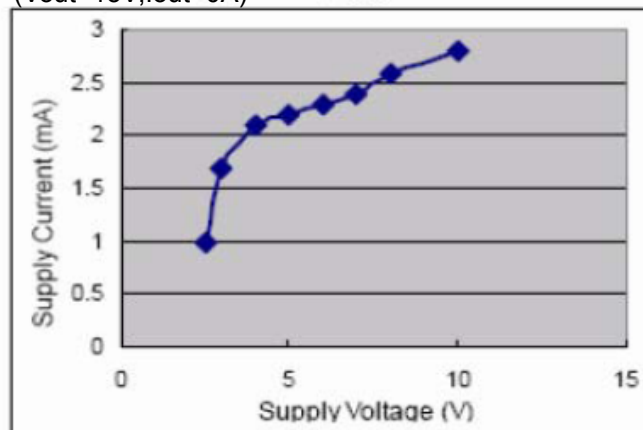
Feedback Voltage vs. Temperature  
( $V_{in}=5V$ ,  $V_{out}=15V$ )



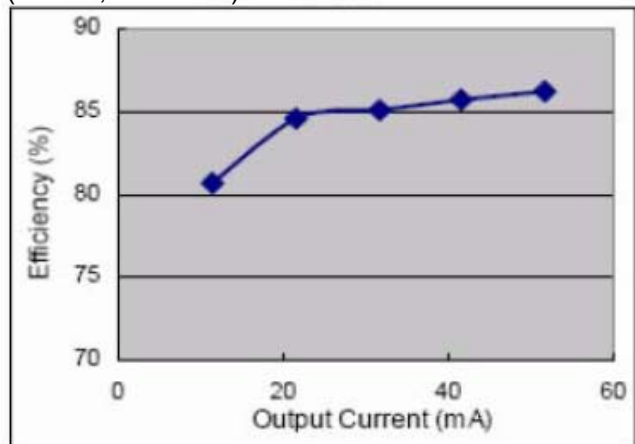
Supply Current vs. Temperature  
( $V_{in}=5V$ ,  $V_{out}=15V$ ;  $I_{out}=0V$ )



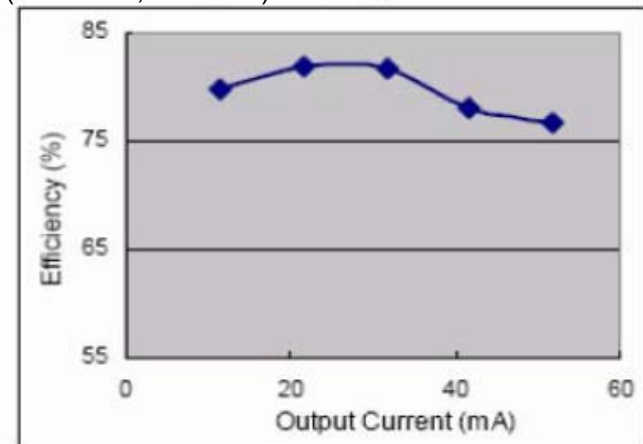
Supply Current vs. Supply Voltage  
( $V_{out}=15V$ ;  $I_{out}=0A$ )



Efficiency vs. Output Current  
( $V_{in}=5V$ ,  $V_{out}=15V$ )

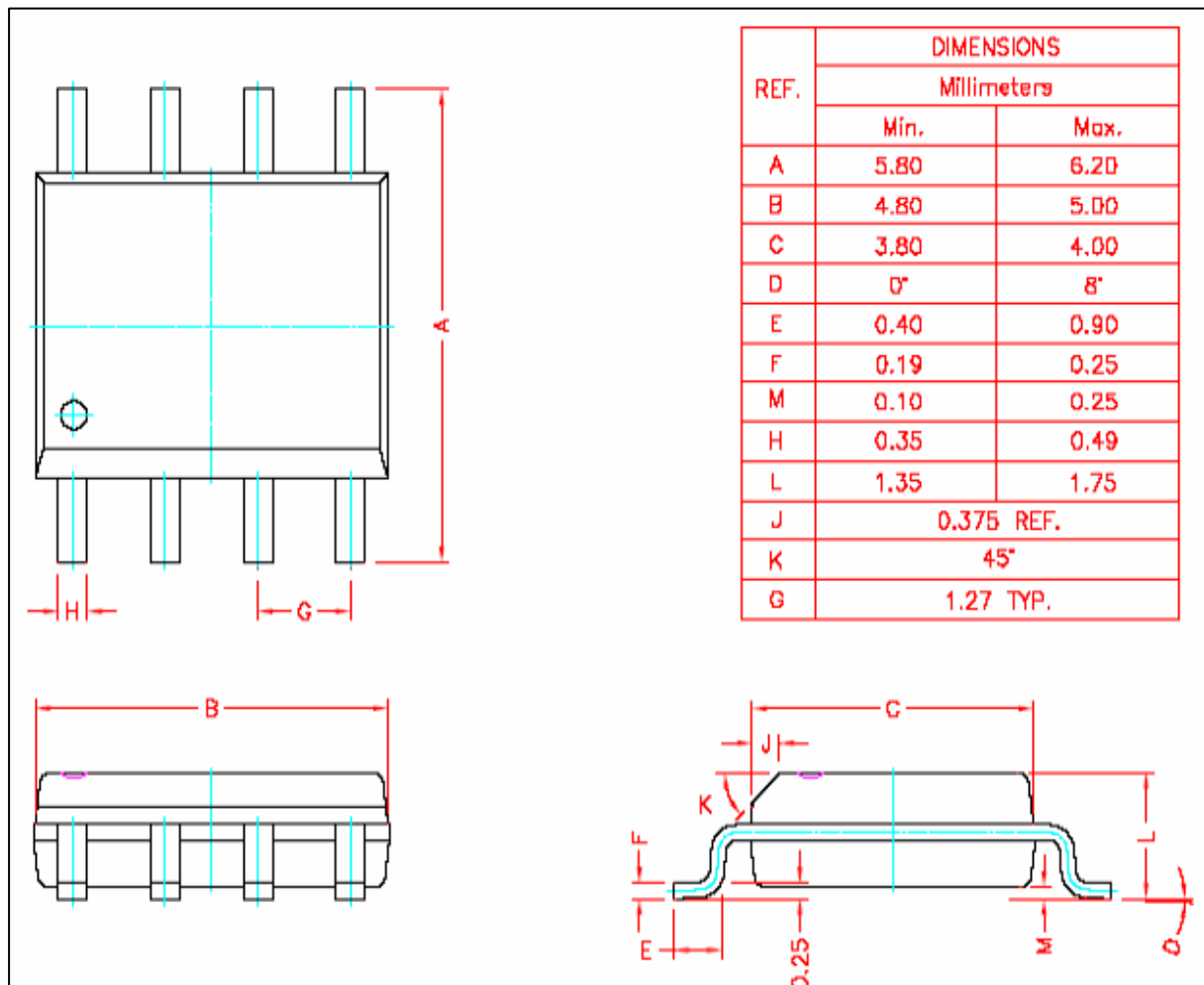


Efficiency vs. Output Current  
( $V_{in}=3.35V$ ;  $V_{out}=15V$ )



### Packing Information

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



## 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 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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