



ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

Description

ACE7223Z is a wide input range, high-efficiency and high frequency DC-to-DC step-down switching regulator, capable of delivering up to 3A of output current. It adopts an Adaptive COT control scheme that enables very fast transient response and provides a very smooth transition when the output varies from light load to heavy load. During light load, ACE7223Z goes into a PFM mode that saves switching loss achieving high efficiency. The adaptive COT control also maintains a constant switching frequency across line and load. An OVP function protects the IC itself and its downstream system against input voltage surges. With this OVP function, the IC can stand off input voltage as high as 19V, making it an ideal solution for industrial applications such as LCD TV, Set Top Box, Portable TV, etc.

Features

- Wide Input Range: 4.5V-18V
- Adaptive COT Control
- Ultra-fast load transient response
- High Efficiency PFM mode at light load
- High Efficiency Synchronous operation
- No load IQ 180uA
- Low Rdson Internal power FETs
- Capable of Delivering 3A
- No External Compensation Needed
- Thermal Shutdown and UVLO
- Available in SOT23-6 Package

Application

- LCD TV
- Set Top Box
- xDSL Modem

Absolute Maximum Ratings

| Parameter | Value | |
|-------------------------------------|--|---------|
| IN, EN Voltage | -0.3V to 19V | |
| SW Voltage | -0.3V (-5V for <10nS) to 19V (23V for <10nS) | |
| BST Voltage | -0.3V to SW+6V | |
| FB Voltage | -0.3V to 6V | |
| Operating Temperature Range | -40°C to 85°C | |
| Storage Temperature Range | -55°C to 150°C | |
| Thermal Resistance | θ_{JA} | 180°C/W |
| | θ_{JC} | 90°C/W |
| Lead Temperature (Soldering 10ssec) | 260°C | |

Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.

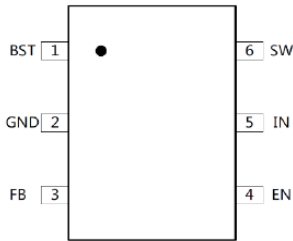


ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

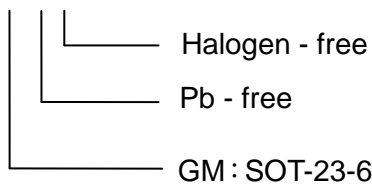
Packaging Type

SOT-23-6



Ordering information

ACE7223ZXX+H



Pin Description

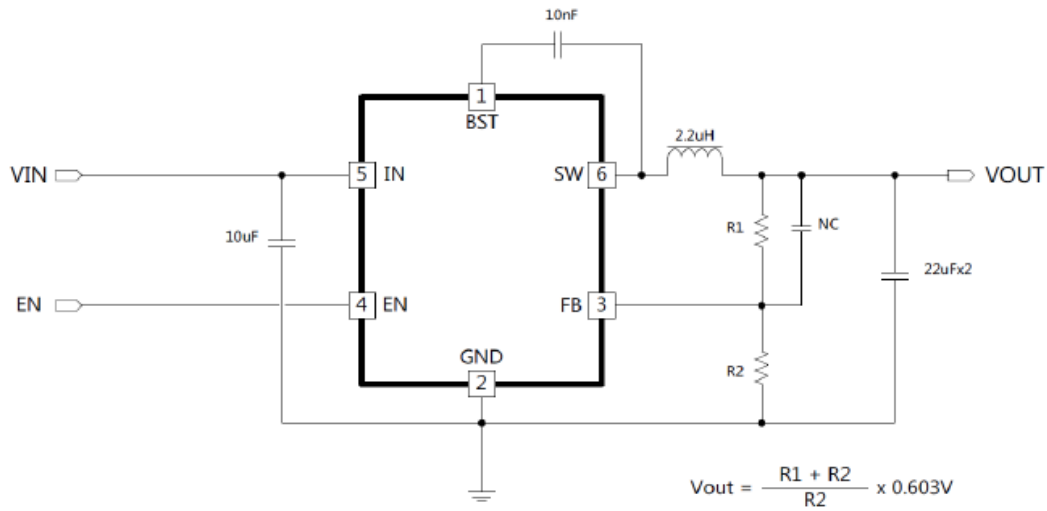
| SOT-23-6 | Description | Function |
|----------|-------------|---|
| 1 | BST | Bootstrap pin. Connect a 10nF capacitor from this pin to SW |
| 2 | GND | Ground |
| 3 | FB | Feedback Input. Connect an external resistor divider from the output to FB and GND to set V_{OUT} |
| 4 | EN | Enable pin for the IC. Drive this pin high to enable the part, low or floating to disable. |
| 5 | IN | Supply Voltage. Bypass with a 10 μ F ceramic capacitor to GND |
| 6 | SW | Inductor Connection. Connect an inductor Between SW and the regulator output. |



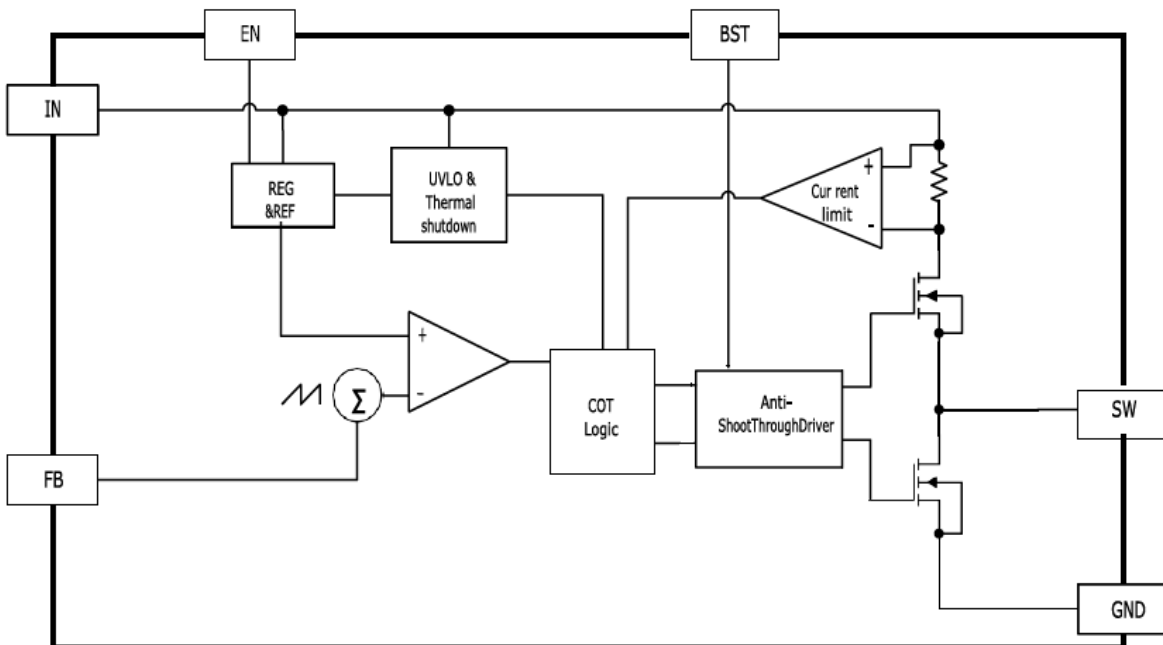
ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

Typical Application



Block Diagram





ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

Electrical Characteristics

($V_{IN} = 12V$, $V_{OUT} = 3.3V$, unless otherwise specified. Typical values are at $T_A = 25^{\circ}C$.)

| Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|------------------------------------|-------|-------|-------|-------------|
| Input Voltage Range | | 4.5 | | 18 | V |
| Input UVLO | Rising, Hysteresis=320mV | | 4.05 | | V |
| Input OVP | Rising, Hysteresis=0.9V | | 19 | | V |
| Input Supply Current | $V_{FB}=0.65V$, no switching | | 180 | | μA |
| Input Shutdown Current | | | 7 | 14 | μA |
| FB Voltage | | 0.591 | 0.603 | 0.615 | V |
| FB Input Current | | | 0 | 1 | μA |
| Switching Frequency | | | 500 | | kHz |
| Maximum Duty Cycle | | | 97 | | % |
| Short Circuit Hiccup Time | On Time | | 2 | | mS |
| | Off Time | | 6 | | mS |
| FB Hiccup Threshold | | | 0.4 | | V |
| High Side Switch On Resistance | | | 83 | | m Ω |
| Low Side Switch On Resistance | | | 50 | | m Ω |
| High Side Current Limit | | | 4.5 | | A |
| SW Leakage Current | $I_N=SW=12V$ | | | 10 | μA |
| EN Rising Threshold | Rising | 1 | 1.2 | 1.4 | V |
| EN Falling Threshold | Falling | 0.9 | 1.1 | 1.3 | V |
| EN Input Current | $V_{EN}=2V$ | | 2 | 6 | μA |
| Thermal Shutdown | Rising, Hysteresis =36 $^{\circ}C$ | | 150 | | $^{\circ}C$ |

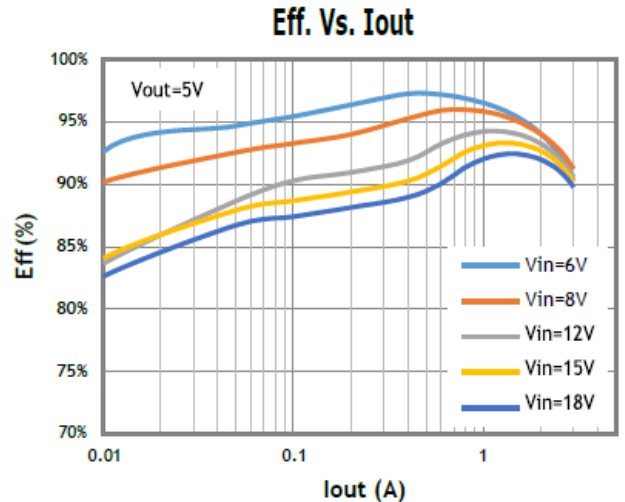
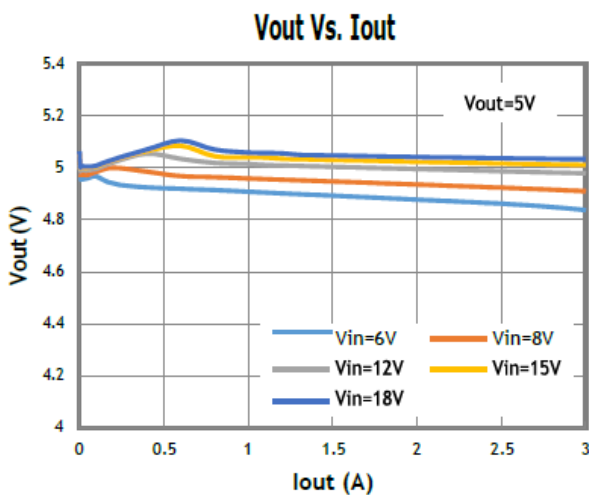
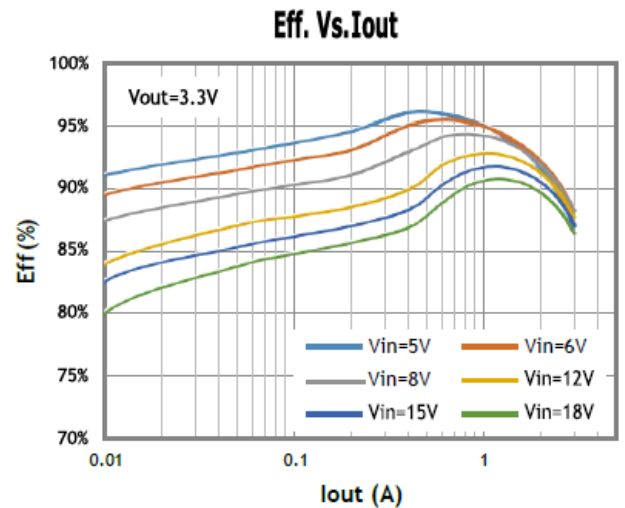
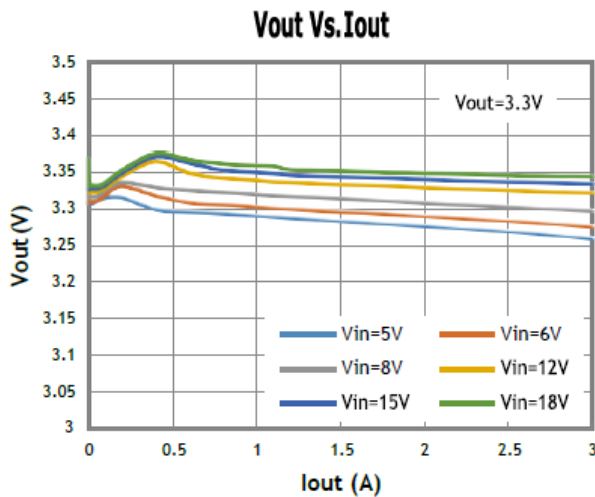
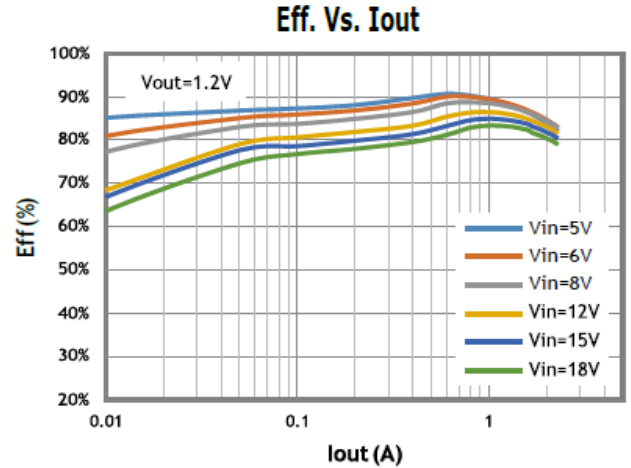
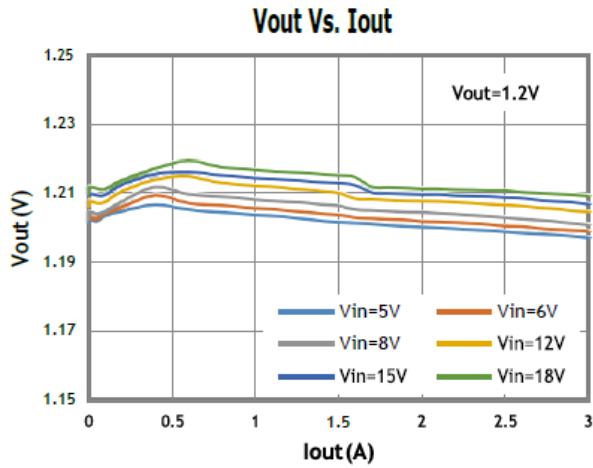


ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

Typical performance characteristics

Typical values are at $T_A=25^\circ\text{C}$ unless otherwise specified

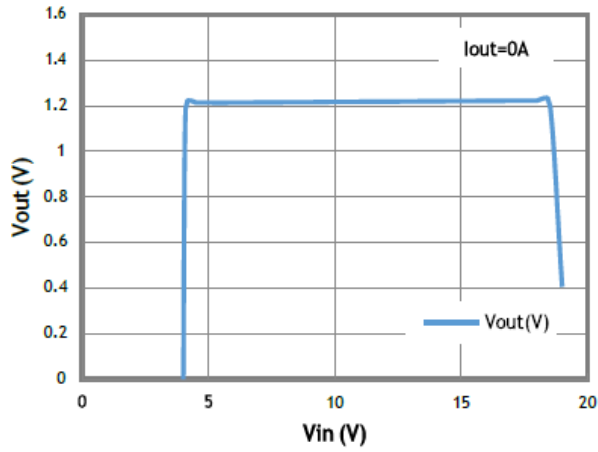




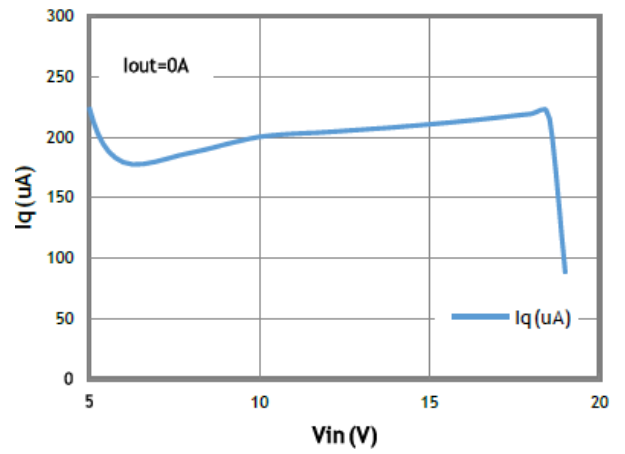
ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

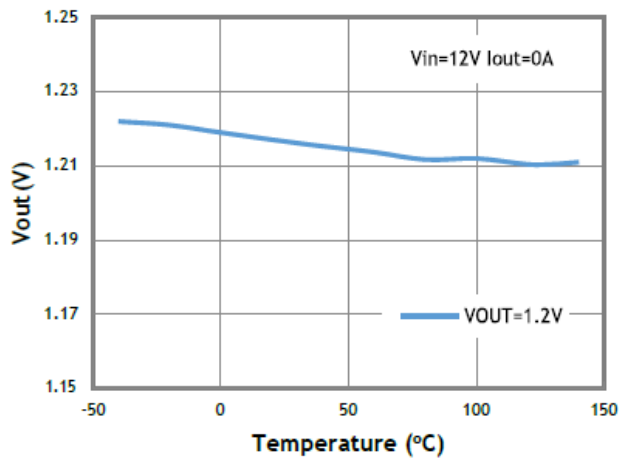
UVLO & OVP



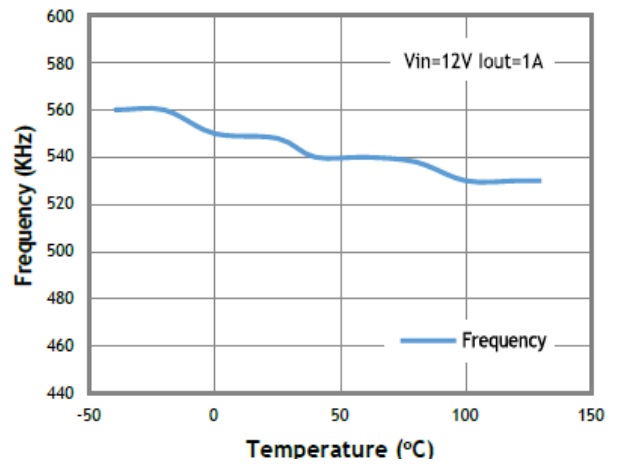
Iq Vs. Vin



Vout Vs. Temp



Freq Vs. Temp

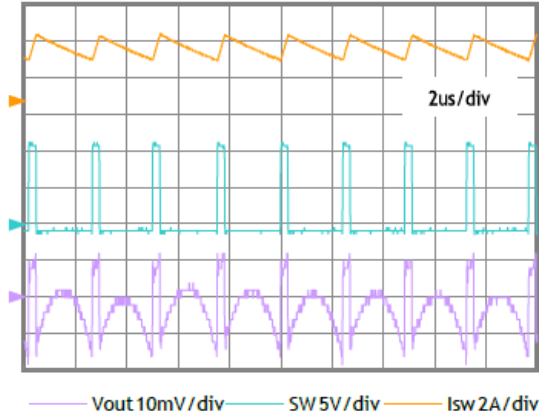




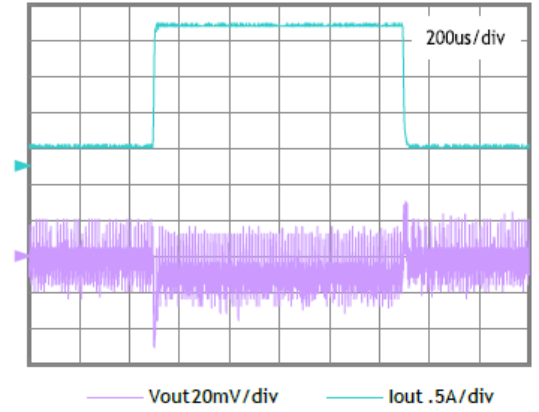
ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

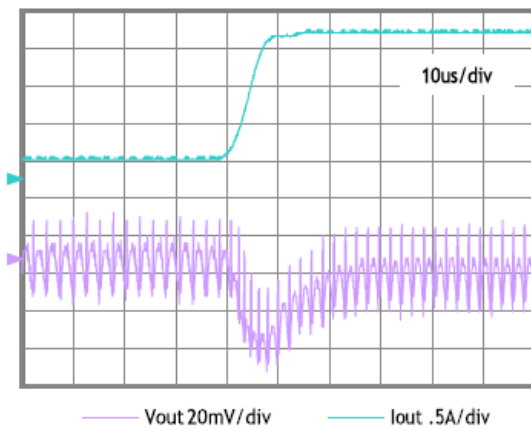
Waveform 1.2V/3A Vin=12V



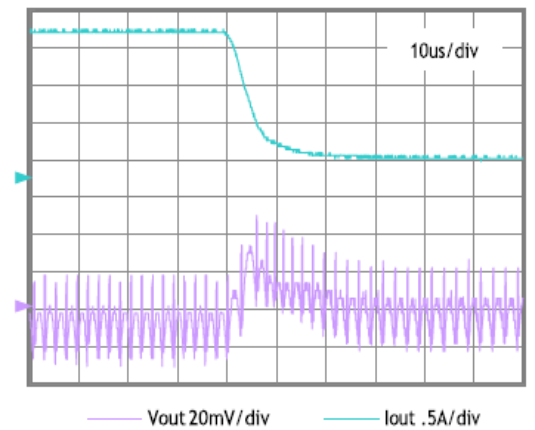
1.2V Load Step 0.3A-2A-0.3A Vin=12V



1.2V Load Step rising 0.3A-2A Vin=12V



1.2V Load Step falling 2A-0.3A Vin=12V





ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

Functional Description

The ACE7223Z is a synchronous buck regulator ICs that integrates the adaptive COT control, top and bottom switches on the same die to minimize the switching transition loss and conduction loss.

ACE7223Z is a wide input range, high-efficiency and high frequency DC-to-DC step-down switching regulator, capable of delivering up to 3A of output current, It adopts an Adaptive COT control scheme that enables very fast transient response and provides a very smooth transition when the output varies from light load to heavy load. It compares the sum of the FB voltage and a ripple voltage that mimics the voltage due to the output ESR and capacitance. The constant-on-time timer varies with line to achieve relative constant switching frequency across line.

Light Load Operation

Traditionally, a fixed constant frequency PWM DC-DC regulator always switches even when the output load is small. When energy is shuffling back and forth through the power MOSFET, power is lost due to the finite R_{dson} of the MOSFET and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. ACE7223Z employs a proprietary control scheme that improves efficiency in this situation by enabling then device into a power save mode during light load, thereby extending the range of high efficiency operation.

Enable

EN is a digital control pin that turns the ACE7223Z on and off. Drive EN High to turn on the regulator, drive it Low to turn it off. An internal $1M\Omega$ resistor from EN pin to GND allows EN to float to shut down the chip. Connecting the EN pin through a pull up resistor or shorted EN to IN will automatically turn on the chip whenever plug in IN.

Over Current Protection and Hiccup

ACE7223Z has a cycle-by-cycle over current limit for when the inductor current peak value is over the set current limit threshold. When the output voltage drop until FB falls below UV threshold (0.4V), the ACE7223Z will enter hiccup mode. It will turn off the chip immediately for 6mS. After that, it will try to re-starts as normal for 2mS. After 2mS, if FB is still below UV threshold, then the chip enters hiccup mode again. If FB is higher than UV threshold, it will enter the normal mode.

Over-Temperature Protection

Thermal protection disables the output when the junction temperature rises to approximately 150°C , allowing the device to cool down. When the junction temperature cools to approximately 110°C , the output circuitry is again enabled. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits regulator dissipation, protecting the device from damage as a result of overheating.



ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

Application Information

External Output Voltage Setting

In external Output Voltage Setting Version selected, the ACE7223Z regulator is programmed using an external resistor divider. The output voltage is calculated using below equation.

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_1}{R_2}\right)$$

Where: VREF =0.603V typically (the internal reference voltage)

Resistors R2 has to be between 1kOhm to 20KOhm and thus R1 is calculated by following equation.

$$R_1 = \left(\frac{V_{OUT}}{V_{REF}} - 1\right) \times R_2$$

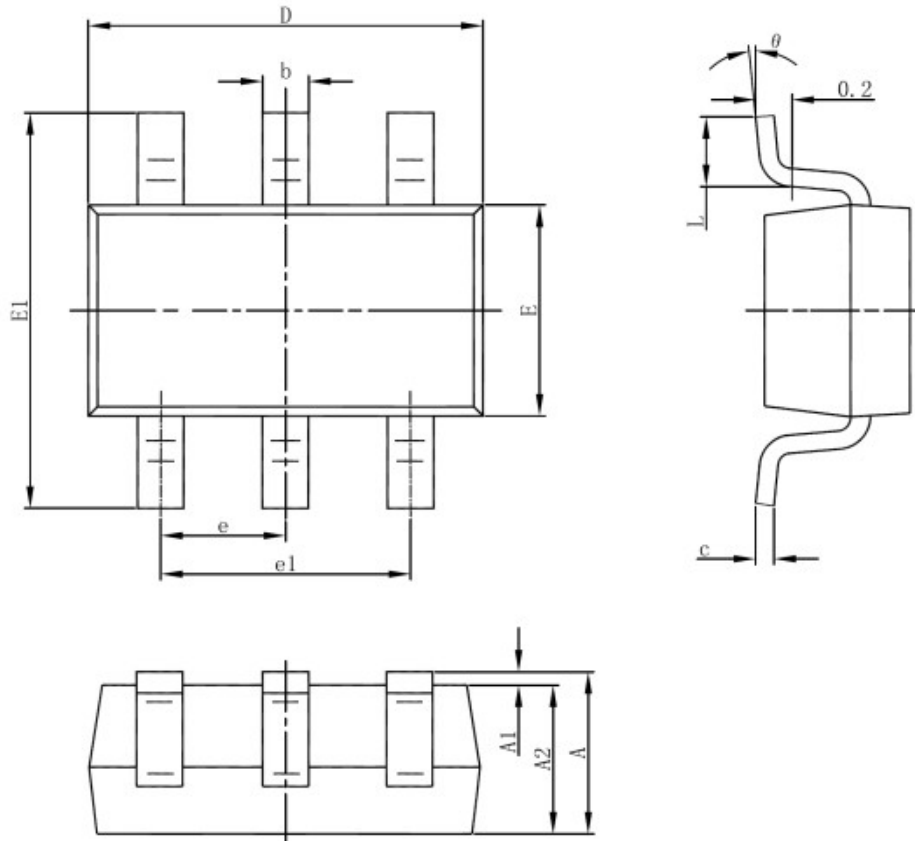


ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

Packing Information

SOT-23-6



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D | 2.820 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.950(BSC) | | 0.037(BSC) | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |



ACE7223Z

18V, 3A, High Efficiency Synchronous Step-Down Converter

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 used 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.