ACE722A

2A 3MHz 6V Synchronous Buck Converter

Description

The ACE722A is a high-efficiency synchronous, buck DC/DC converter. Its input voltage range is from 2.6V to 6V and provides an adjustable regulated output voltage from 0.6V to Vin while delivering up to 2A of output current.

The internal synchronous switches increase efficiency and eliminate the need for an external Schottky diode. It runs at a fixed 3MHz frequency, which allows the use of small inductor with L<1uH while maintaining a high efficiency and small output voltage ripple.

When Mode pin is connected to Gnd, the ACE722A is operating in PFM/PWM auto-switch mode which enhance the efficiency at light-load.

The ACE722A is available in DFN2x2-8L and SOT-23-5 packages.

Features

- Adjustable Output Voltage, Vfb=0.6V
- Maximum output current is 2A
- Range of operation input voltage: Max 6V
- Standby current: 30uA (typ)
- Line regulation: 0.1%/V (typ)
- Load regulation: 10mV (typ)
- High efficiency, up to 96%
- Environment Temperature: -20℃～85℃

Application

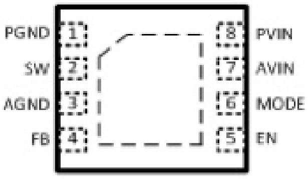
- Power Management for 3G modem
- Smart Phone
- Table PC
- Set Top Box
- Other Battery Powered Device

Absolute Maximum Rating

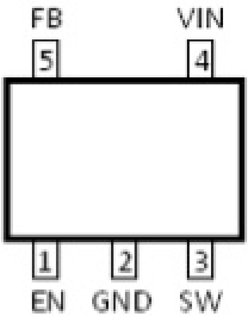
Parameter		Value
Max Input Voltage		6V
Max Operating Junction Temperature(Tj)		125
Ambient Temperature(Ta)		-20℃~85℃
Pacage Thermal Resistance (Θjc)	DFN2x2-8L	25℃/W
Power Dissipation	SOT-23-5	250mW
Storage Temperature(Ts)		-40℃-150℃
Lead Temperature & Time		260℃,105
ESD (HBM)		>2000V

Note: Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect device reliability.

Packaging Type



DFN2x2-8



SOT-23-5

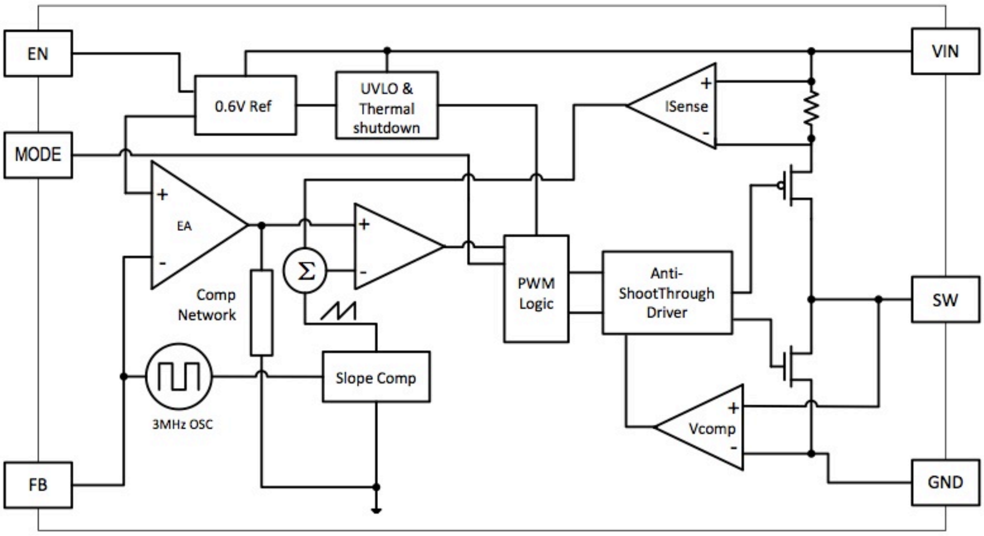
Ordering information

ACE722A XX + H

- Halogen - free
- Pb - free
- BN : SOT-23-5
  DN: DFN2*2-8

SOT-23-5	DFN2*2-8	NAME	DESCRIPTION
2	1	PGND	Power Ground. Bypass with a 10uF ceramic capacitor to PVIN
3	2	SW	Inductor Connection. Connect an inductor Between SW and the regulator output.
	3	AGND	Analog Ground, Connect to PGND
5	4	FB	Feedback Input. Connect an external resistor divider from the output to FB and GND to set the output to a voltage between 0.6V and VIN
1	5	EN	Enable pin for the IC. Drive this pin to high to enable the part, low to disable.
	6	MODE	When forced high, the device operates in fixed frequency PWM mode. When forced low, it enables the power Save Mode with automatic transition from PFM mode to fixed frequency PWM mode. This pin must be terminated.
	7	AVIN	Analog Power. Short externally to PVIN
4	8	PVIN	Supply Voltage. Bypass with a 10uF ceramic capacitor to PGND

BLOCK DIAGRAM



Recommended Work Condition

Parameter	Value
Input Voltage Range	Max. 6V
Operating Junction Temperature(Tj)	-20℃-125℃

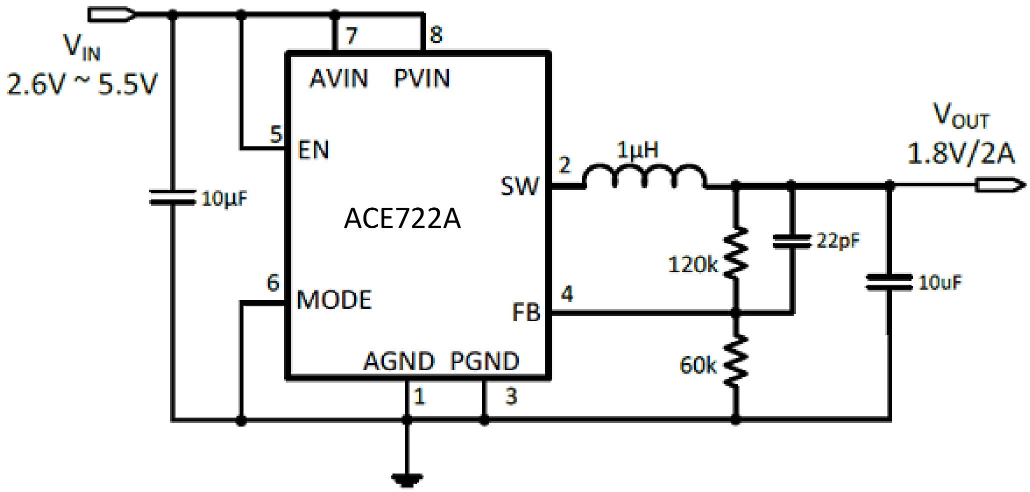
Electrical Characteristics

(V_{IN} =5, T_A=25℃)

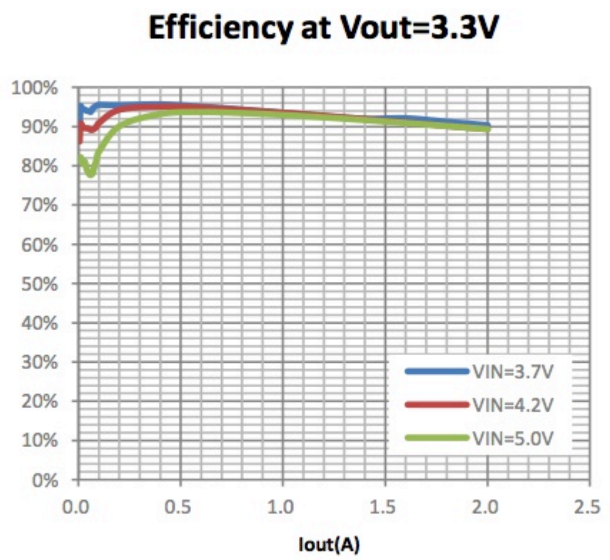
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VDD	Input Voltage Range		2.6		6	V
UVLO	Input Under Voltage Lockout	Increase Vin	2.1	2.2		V
Vref	Feedback Voltage	Vin=5V, Ven=5V	0.588	0.6	0.612	V
Ifblk	Feedback Leakage current			0.01	0.1	uA
Iq	Quiescent Current	Active, Vfb=0.65, No Switching		30		uA
		Shutdown		0.1	1	uA
LnReg	Line Regulation	Vin=2.7V to 5.5V		0.04		%/V
LdReg	Load Regulation	Iout=0.01 to 2A		0.15		%/A
Fsoc	Switching Frequency		2.4	3	3.6	MHz
RdsonP	PMOS Rdson	Lsw=200mA		100	120	Mohm
RdsonN	NMOS Rdson	Lsw=200mA		80	100	mohm
Ilimit	Peak Current Limit		2.5	3		A
Iswlk	SW Leakage Current	Vout=5.5V, EN=GND			10	uA

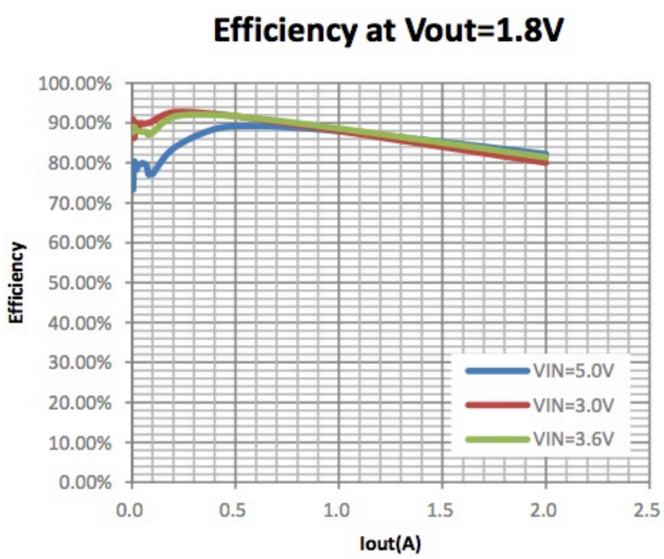
Venh,Vmdh	EN/MODE High Threshold				1.5	V
Venl,Vmdl	EN/MODE Low Threshold		0.4			V
Ienlk,Imdlk	EN/MODE Leakage Current	EN=MODE=GND			1	uA
Rdischarge	Discharge Resistance	EN=GND	180	300	450	Ohm

Typical Application Circuit

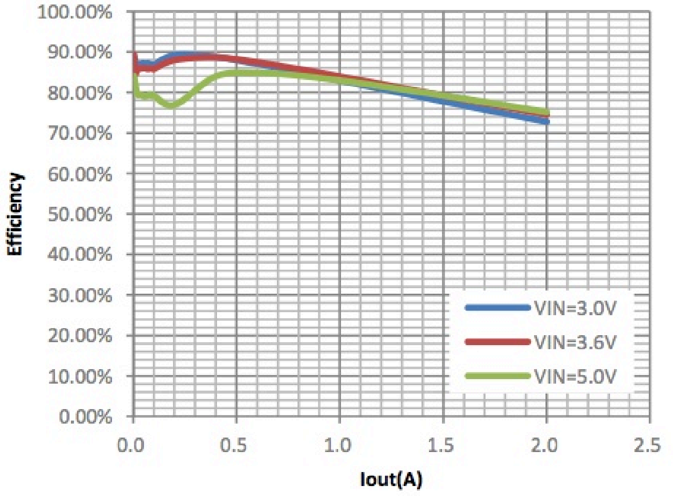


TYPICAL PERFORMANCE CHARACTERISTICS
(Vin=3.6V, L=1uH, Cin=10uF, $T_{A=}$25℃ unless otherwise stated)

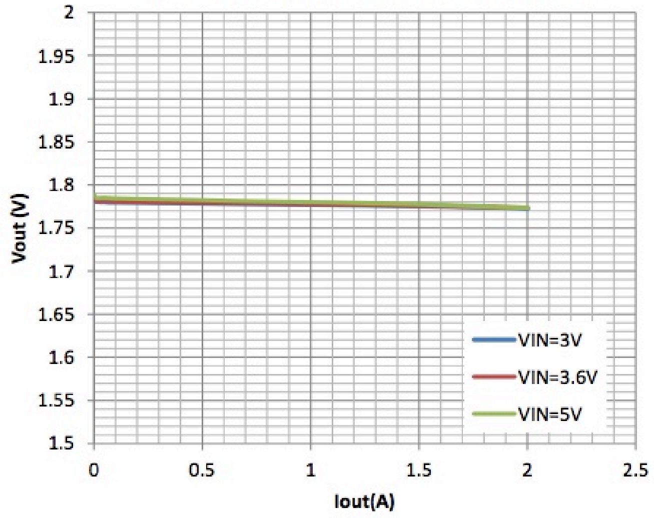




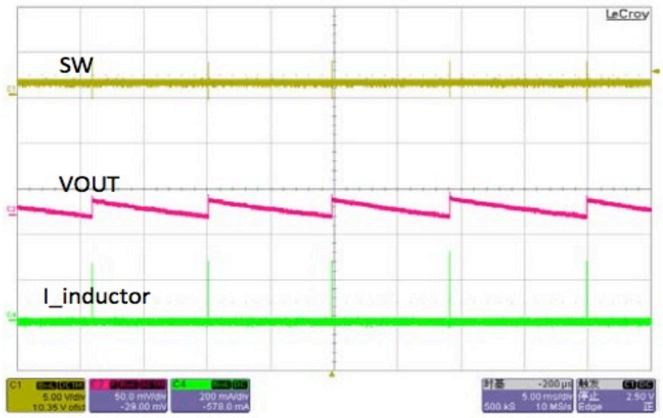
Efficiency at Vout=1.2V



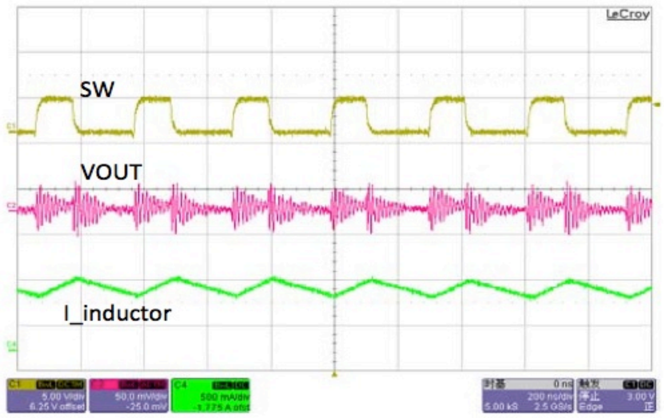
Load Regulation at Vout=1.8V



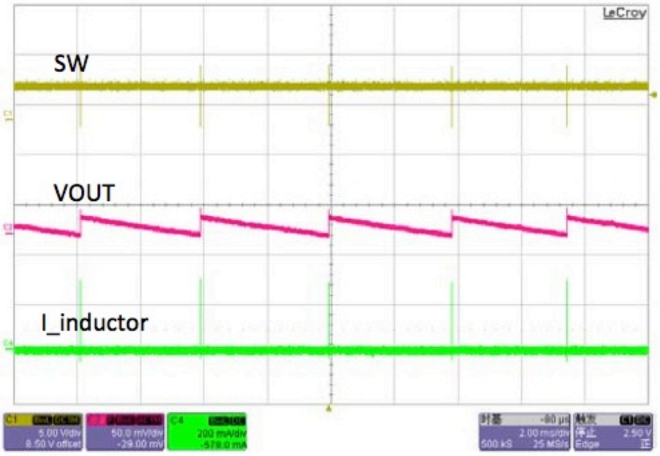
Switching waveform Vin=3.6V, Vout=1.2V Iout=0A



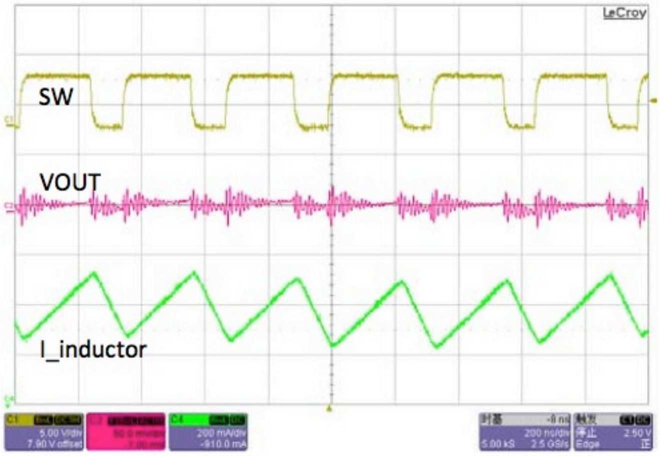
Switching waveform Vin=3.6V, Vout=1.2V Iout=0.7A



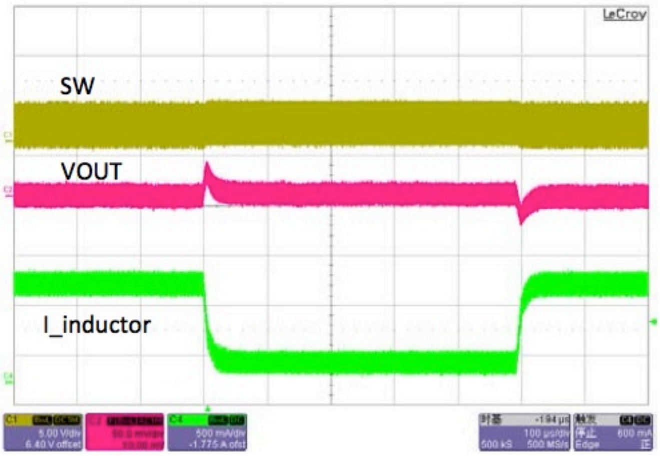
Switching waveform Vin=5V, Vout=3.3V, Iout=0A



Switching waveform Vin=5V, Vout=3.3V, Iout=0.5A



Load Transient
Vin=3.6V, Vout=1.2V, Iout=0.2A/1A



Load Transient
Vin=3.6V, Vout=1.8V, Iout=0.2A/1.5A

FUNCTIONAL DECRIPTIONS

The ACE722A high-efficiency switching regulator is a small, simple, DC-to-DC step-down converter capable of delivering up to 2A of output current. The device operates in pulse-width modulation (PWM) at 3MHz from a 2.6V to 5.5V input voltage and provides an output voltage from 0.6V to VIN, making the ACE722A ideal for on-board post-regulation applications. An internal synchronous rectifier improves efficiency and eliminates the typical Schottky free-wheeling diode. Using the on resistance of the internal high-side MOSFET to sense switching currents eliminates current-sense resistors, further improving efficiency and cost.

Load Operation

ACE722A uses a PWM current-mode control scheme. An open-loop comparator compares the integrated voltage-feedback signal against the sum of the amplified current-sense signal and the slope compensation ramp. At each rising edge of the internal clock, the internal high-side MOSFET turns on until the PWM comparator terminates the on cycle. During this on-time, current ramps up through the inductor, sourcing current to the output and storing energy in the inductor. The current mode feedback system regulates the peak inductor current as a function of the output voltage error signal. During the off cycle, the internal high-side P-channel MOSFET turns off, and the internal low-side N-channel MOSFET turns on. The inductor releases the stored energy as its current ramps down while still providing current to the output.

Current Sense

An internal current-sense amplifier senses the current through the high-side MOSFET during on time and produces a proportional current signal, which is used to sum with the slope compensation signal. The summed signal then is compared with the error amplifier output by the PWM comparator to terminate the on cycle.

Current Limit

There is a cycle-by-cycle current limit on the high-side MOSFET. When the current flowing out of SW exceeds this limit, the high-side MOSFET turns off and the synchronous rectifier turns on. ACE722A utilizes a frequency fold-back mode to prevent overheating during short-circuit output conditions. The device enters frequency fold-back mode when the FB voltage drops below 200mV, limiting the current to IPEAK and reducing power dissipation. Normal operation resumes upon removal of the short-circuit condition.

Soft-start

ACE722A has a internal soft-start circuitry to reduce supply inrush current during startup conditions. When the device exits under-voltage lockout (UVLO), shutdown mode, or restarts following a thermal-overload event, the l soft-start circuitry slowly ramps up current available at SW.

UVLO and Thermal Shutdown

If VIN drops below 2V, the UNLO circuit inhibits switching. Once VIN rises 2.1V, the UVLO clears, and the soft-start sequence a activates. Thermal-overload protection limits total power dissipation in the device. When the junction temperature exceeds TJ=+160℃, a thermal sensor forces the device into shutdown, allowing the die to cool. The thermal sensor turns the device on again after the junction temperature cools by 15℃, resulting in a pulsed output during continuous overload conditions. The soft-start sequence begins.

DESIGN PROCEDURE

INDUCTOR SELECTION

The peak-to-peak ripple is limited to 30% of the maximum output current. This places the peak current far enough from the minimum overcurrent trip level to ensure relible operation while providing enough current ripples for the current mode converter to operate stably. In this case, for 2A maximum output current, the maximum inductor ripple current is 667 mA. The inductor size is estimated as following equation: $L_{IDEAL}=(V_{IN(MAX)}-V_{OUT})/I_{RIPPLE}*D_{MIN8}*D_{MIN*}(1/_{FOSC})$

Therefore

for V_{OUT}=1.8V,

The inductor values is calculated to be L=0.60uH. Choose 1uH

And for V_{OUT}=1.2V,

The inductor values is calculated to be L=0.469uH. Choose 0.47uH

The resulting ripples is

$I_{RIPPLE}=(V_{IN(MAX)}- V_{OUT})/L_{ACTUAL}*D_{MIN}*(1/F_{OSC})$

When,

V_{OUT}=1.8V,I_{RIPPLE}=403mA

V_{OUT}=1.2 V,I_{RIPPLE}=665mA

Output Capacitor Selection

For mos applications a nominal 10uF or 22 uF capacitor is suitable. The ACE722A internal compensation is designed for a fixed corner frequency that is equal to

FC=

For example, for $V_{OUT=}$1.8V, L=1uH, C_{OUT}=10uF, for V_{OUT}=1.2V, L=0.47uH, C_{OUT}=22uF

Setting Output Voltage

Output voltages are set by external resistors. The FB_threshold is 0.6V.

$R_{TOP}=R_{BOTTOM}$X〔（V_{OUT}/0.6）-1〕

Guidelines for input Capacitor and Output Capacitor

The input capacitor in a DC-to-DC converter reduces current peaks drawn from the battery or other input power source and reduces switching noise in the controller. The impedance of the input capacitor at the switching frequency should be less than that of the input source so high-frequency switching currents do not pass through the input source. The output capacitor keeps output ripple small and ensures control-loop stability. The output capacitor must also have low impedance at the switching frequency.

Ceramic, polymer, and tantalum capacitors are suitable, with ceramic exhibiting the lowest ESR and high-frequency impedance. Output ripple with a ceramic output capacitor is approximately as follows:

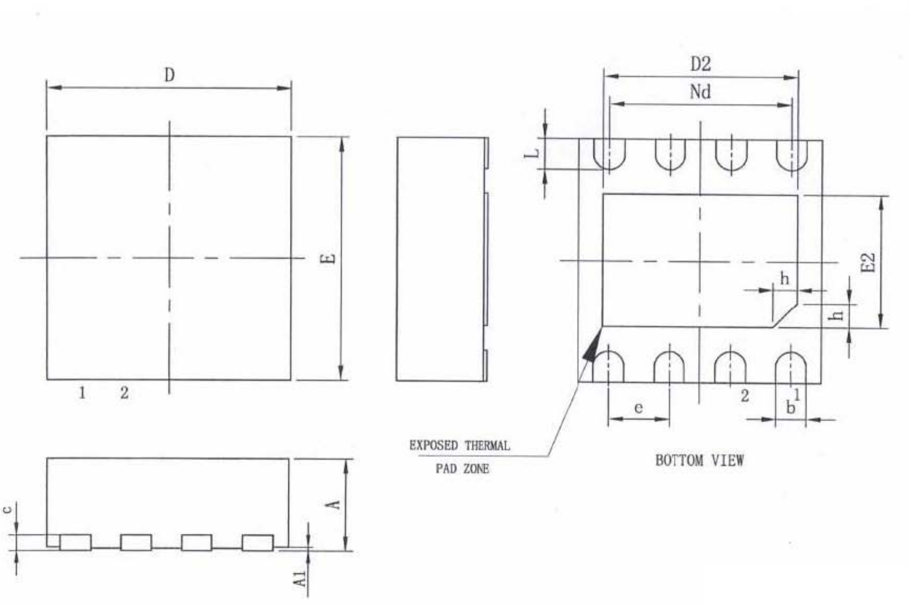
$R_{RIPPLE}=IL_{(PEAK)}[1/(2\pi \times F_{OSC} \times C_{OUT})]$

If the capacitor has significant ESR, the output ripple component due to capacitor ESR is follows:

$V_{RIPPLE(ESR)}=IL_{(PEAK)} \times ESR$

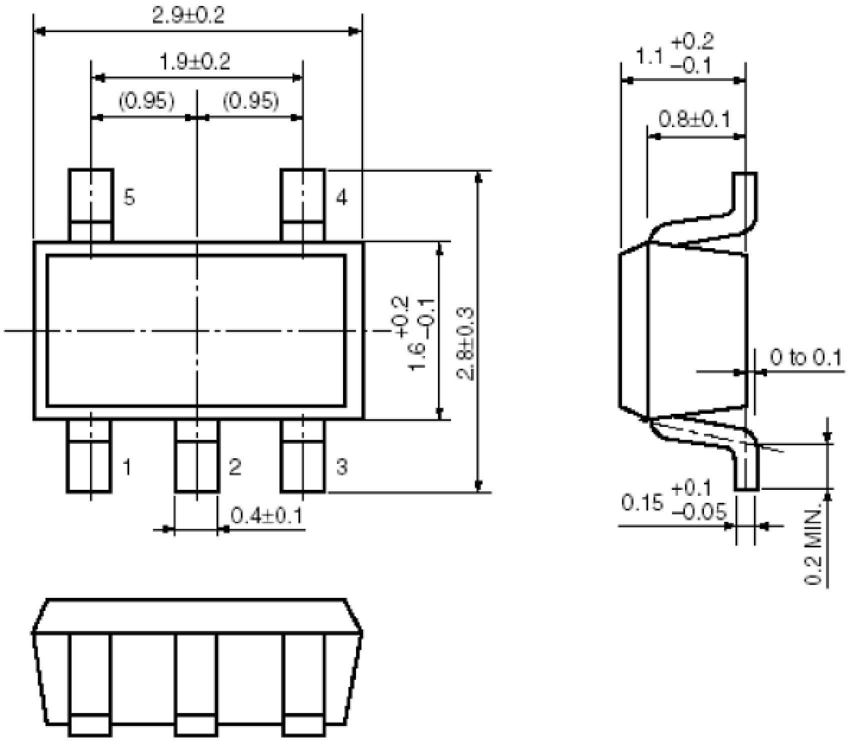
Packing Information

DFN2X2-8L



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0. 70	0.75	0. 80
A1	—	0.02	0. 05
b	0. 18	0.25	0. 30
c	0. 18	0.20	0. 25
D	1. 90	2. 00	2. 10
D2	1. 50	1. 60	1. 70
e	0. 50BSC		
Nd	1. 50BSC		
E	1. 90	2. 00	2. 10
E2	1. 00	1. 10	1. 20
L	0. 20	0.25	0. 30
h	0. 15	0. 20	0. 25
L/F表面电镀	NiPdAu(镍钯金)		
载体尺寸（mil)	67*47		

SOT-23-5



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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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