HX3029A/HX3029B

2.5A Synchronous Boost DC/DC Regulator

Features

- Efficiency: up to 93%
- Input Voltage: 2.5V ～ 5V
- Output Voltage: 2.8V ～ 5.5V
- Load Current: up to 2.5A(V_{IN} = 3.3V)
- Current Mode Operation for Excellent Line and Load Transient Response
- Small SOP-8L(HX3029A) /DFN3*3-8L(HX3029B)Package

Applications

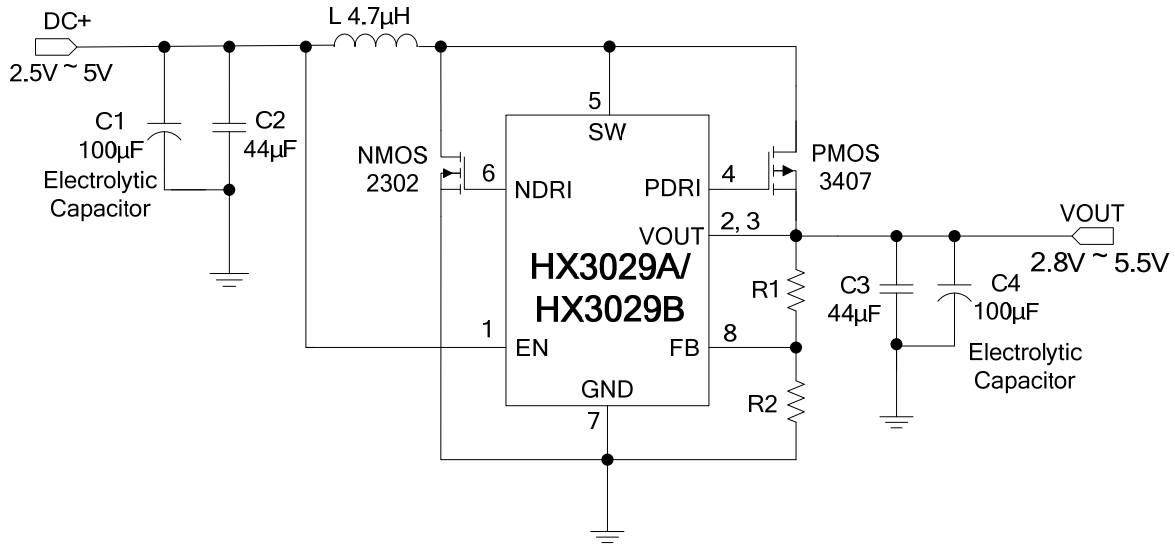
- Cellular Telephones
- RF- Communications
- Battery-Powered Equipment
- Portable Instrument
- Wireless Equipment
- Telecom/Network Systems

Description

The HX3029 is a compact and high efficiency synchronous step-up DC/DC converter. The boost converter includes current mode, fixed frequency, pulse width modulation (PWM) circuitry with external N-channel and P-channel MOSFET driven by a constant frequency. Current mode control provides improved transient response and simplified loop compensation. The HX3029 provides high efficiency at a wide range of load current.

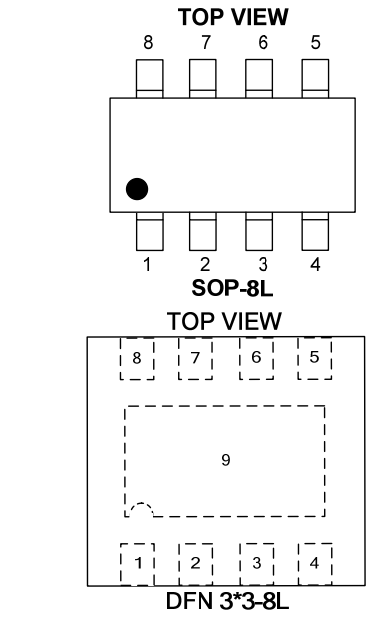
The HX3029A is available in a low profile SOP-8L package and HX3029B is available in a low profile DFN3*3-8L package.

Typical Application Circuit



* V_{OUT} = 1.212V • [1 + (R1/R2)].

Pin Assignment and Description



*The exposed pad must be soldered to a large PCB.

PIN	NAME	FUNCTION
1	EN	ON/OFF Control(High active)
2,3	VOUT	Output Voltage Sense Input and the Internal Supply Power
4	PDRI	Output pin for driving external PMOS
5	SW	Switch Pin
6	NDRI	Output pin for driving external NMOS
7	GND	Signal and Power Ground.
8	FB	Feedback Input

Absolute Maximum Ratings (Note 1)

- Supply Voltage..... −0.3V ～ 6.5V
- SW Pin Switch Voltage.....−0.3V ～ 6.5V
- EN, FB Voltages.....−0.3V ～ 2.4V
- Other I/O Pin Voltages..... −0.3V ～ (VDD+0.3V)
- Operating Temperature(Note 2).....-40℃ ～ +85℃
- Junction Temperature Range.....−40℃ ～ +125℃
- Storage Temperature Range .....−65℃ ～ +150℃
- Lead Temperature.....+265℃

Note 1: Stresses beyond those listed Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: The HX3029 is guaranteed to meet performance specifications from 0°C to 85°C. Specifications over the –40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

Electrical Characteristics

Operating Conditions: T_A = 25°C, V_{IN} = 3.3V, V_{OUT} set to 5V, I_{OUT} = 0mA, unless otherwise specified.

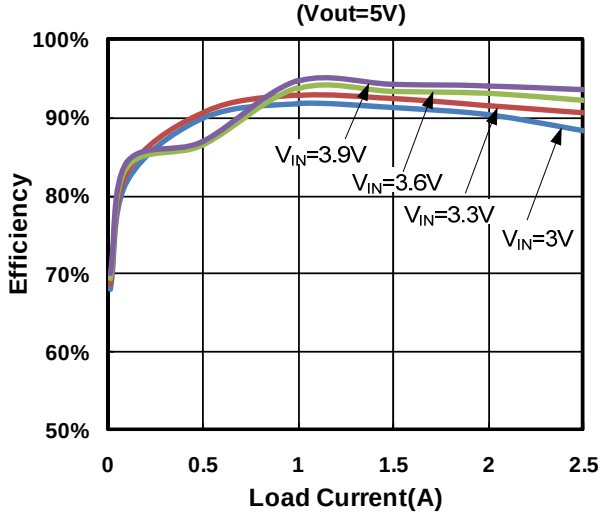
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{START}	Start-up Voltage	I_{OUT} = 1mA		2.3		V
V_{HOLD}	Hold-on Voltage	I_{OUT} = 1mA		0.8		V
V_{OUT}	Output Voltage Range		2.8		5.5	V
I_Q	Supply Current (Quiescent)	V_{IN} = 3V		1.7		mA
		V_{IN} = 4V		1.25		mA
I_{SHDN}	Shutdown Current	V_{EN} = 0V,V_{IN} = 3V		200		μA
V_{FB}	Feedback Reference Voltage	Close Loop, V_{OUT} = 3.3V		1.212		V
I_{FB}	FB Pin Bias Current			50		nA
f_{OSC}	Switching Frequency	V_{DD} = 3.3V		400		kHz
V_{ENH}	EN High Threshold	V_{IN} = 3V	1.2			V
V_{ENL}	EN Low Threshold	V_{IN} = 3V			0.6	V
I_{EN}	EN Input Current	EN = H(2V), V_{IN} = 3V		8.2		μA
		EN = L(0.6V), V_{IN} = 3V		80		nA
EFFI	Efficiency			92		%

Note: The EN pin shall be tied to VDD pin and inhibit to act the ON/OFF state whenever the VDD pin voltage may reach to 5V or above.

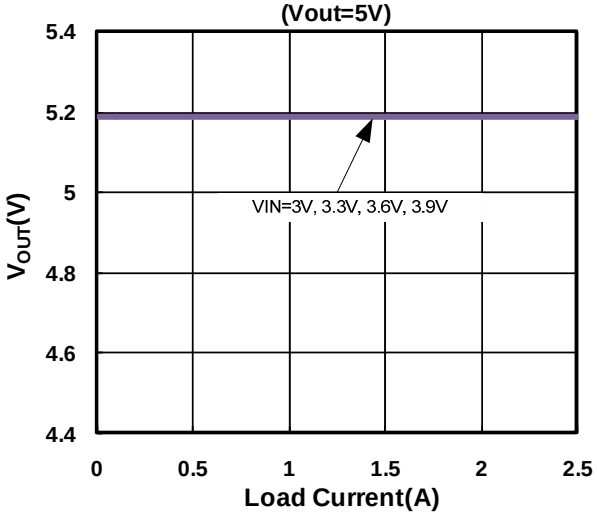
Typical Performance Characteristics

Operating Conditions: T_A=25℃, unless otherwise specified.

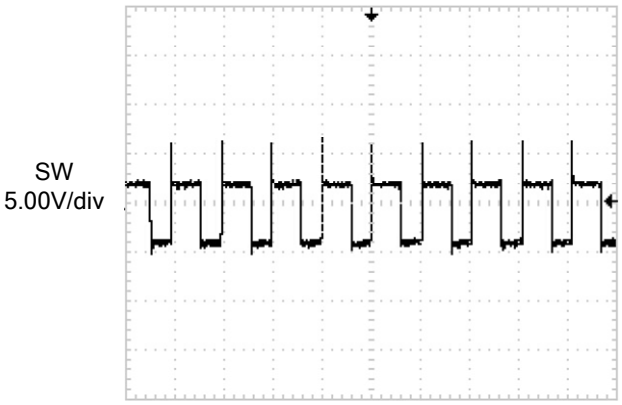
Efficiency vs Load Current
(Vout=5V)



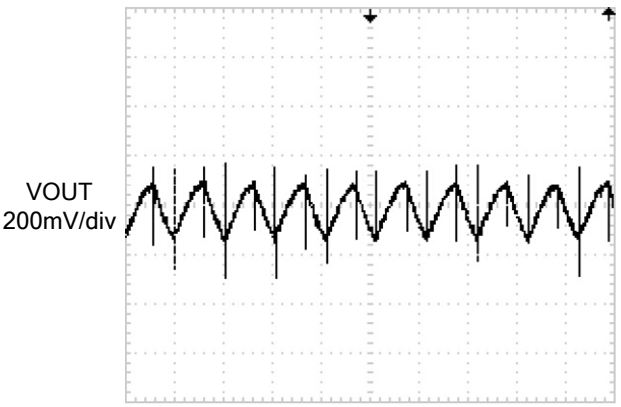
Output Voltage vs Load Current
(Vout=5V)



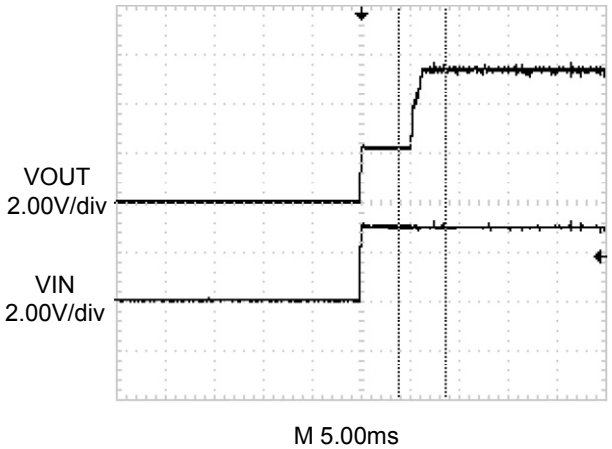
SW Waveform
(V_{IN}=3V, V_{OUT}=5V, I_{OUT}=2.5A)



VOUT Ripple
(V_{IN}=3V, I_{OUT}=2.5A)



Start up
(V_{IN}=3V, VOUT=5V, I_{OUT}=1.5A)



Pin Functions

EN (Pin 1): Logic Controlled Shutdown Input. EN=High: Normal free running operation. EN=Low: Shutdown, quiescent current<1μA. Output capacitor can be completely discharged through the load or feedback resistors.

VOUT (Pin 2, 3): Output Voltage Sense Input and the Internal Supply Power.

PDRI (Pin 4): Output pin for driving external PMOS.

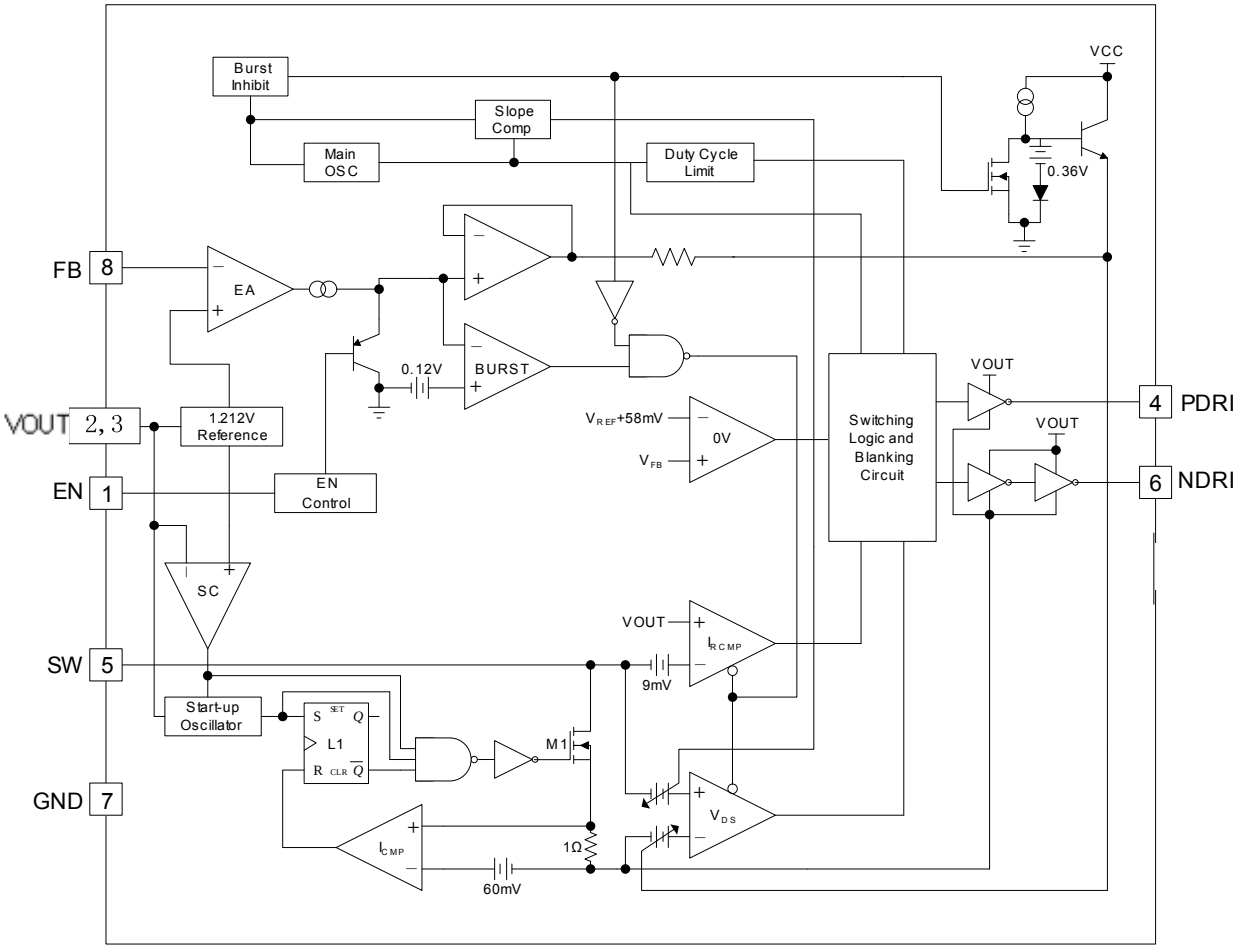
SW (Pin 5): Switch Pin. Connect inductor between SW and V_{IN}. Keep these PCB trace lengths as short and wide as possible to reduce EMI and voltage overshoot.

NDRI (Pin 6): Output pin for driving external NMOS.

GND (Pin 7): Signal and Power Ground. Provide a short direct PCB path between GND and the (–) side of the output capacitor(s).

FB (Pin 8): Feedback Input to the gm Error Amplifier. Connect resistor divider tap to this pin.

Block Diagram



Application Information

Operation

The HX3029 is a constant frequency, current mode PWM controller designed for DC/DC step-up converters. In normal operation, the main external N-channel power MOSFET is turned on when the oscillator sets a latch and turned off when the VDS sense amplifier (VDS) resets the latch. When the main MOSFET is turned off, the synchronous rectifier P-channel MOSFET is turn on until either the inductor current determined by the current reversal comparator (IRCMP) is about to reverse, or the next cycle begins. The peak inductor current measured by sensing the VDS potential across the conducting MOSFET is controlled by the output error amplifier. The output error amplifier receives an output feedback voltage VFB from external resistors between VOUT and GND. When the load current increases, it causes a slight decrease in VFB relative to the 1.212V reference. Simultaneously, the output error amplifier changes the average inductor current to match the new load current.

Setting Output Voltage

The output voltage is set by two external resistors (R1 and R2, Typical Application Circuit). For most applications, a resistor in the 10kΩ to 1MΩ range is suggested for R2. R1 is then given by:

$$R1 = R2 \bullet [(V_{OUT} / V_{REF}) -1]$$

where V_{REF} is 1.212V.

EN/Soft-Start Function

The EN pin is a dual function pin that provides soft-start and shut down control. When EN is low, all IC functions are shut down. The soft-start feature is a closed loop soft start, meaning that the output voltage follows a linear ramp that is proportional to the ramp generated at the EN pin. This ramp is generated by an internal resistor and an external soft-start capacitor connected from the EN pin to GND.

The recommended soft-start capacitor is 0.1μF. Larger soft-start capacitors can be used and will not damage the device. However, the soft-start capacitor may not be discharged fully when re-enabled. Larger Soft-start capacitors could be a problem in applications where the user needs to rapidly pulse the enable pin and still requires the device to soft-start from ground. In addition, the soft-start capacitor must be low leakage.

Current Limit

Current limiting is provided by sensing the voltage drop across the main MOSFET without an external sense resistor. This improves efficiency at heavy loads. This current limiter can protect the device from being damaged by limiting the output current to 3A (TYP) during a short-circuit fault or other overload conditions.

MOSFET Selection

The HX3029 requires two external MOSFETs, one for the main switch (N-channel) and one for the synchronous rectifier (P-channel). Since the HX3029 limits the voltage operating range to no more than 6V, the breakdown voltage of the MOSFETs is not a concern. The HX3029 can achieve best performance especially at low input voltages with low-threshold MOSFETs that specify on-resistance.

When selecting an MOSFET, key parameters should be considered:

1) Total gate charge (Qg)

2) Reverse transfer capacitance or charge (C_{RSS})

3) On-resistance ($R_{DS(ON)}$)

4) Maximum drain-to-source current ($I_{DS(MAX)}$)

5) Minimum threshold voltage ($V_{TH(MIN)}$)

Inductor Selection

Because of the HX3029's high switching frequency, inductors with a ferrite core or equivalent are recommended. Powdered iron cores are not recommended due to their high losses at frequencies over 50kHz.

Output and Input Capacitors Selection

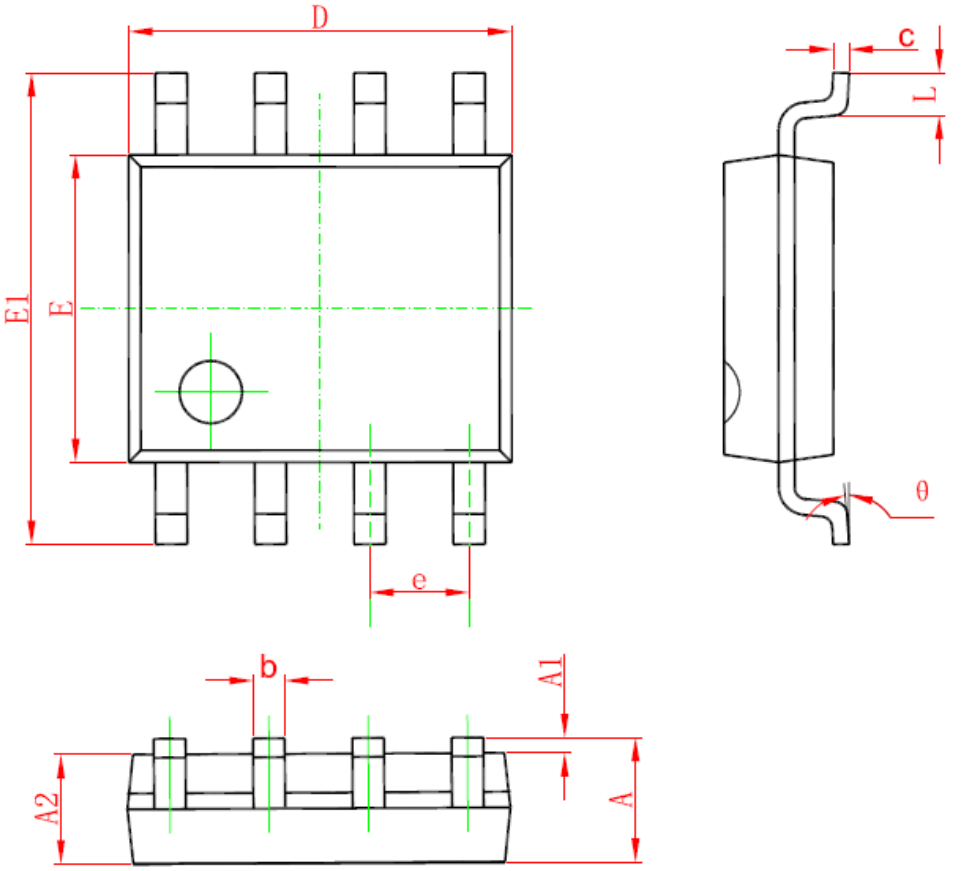
Larger output capacitors reduce noise and improve load-transient response, stability, and power-supply rejection. Since output ripple in boost DC-DC designs is dominated by capacitor equivalent series resistance (ESR), Low-ESR capacitors must be used.

The input capacitor (C_{IN}) reduces the current peaks caused by the input supply and reduces noise injection. Its value is largely determined by the source impedance of the input supply. High source impedance requires high input capacitance, particularly at the input voltage falls. At low input voltage, increasing C_{IN} or lowering its ESR can improve efficiency. Using the same capacitance value for C_{IN} as for C_{OUT} is a good start.

The C_{OUT} ESR affects loop stability by introducing a left half-plane zero. A small capacitor C1 between FB and GND forms a pole with the feedback resistance that cancels the ESR zero. This small capacitor C1 and provide sufficient compensation for the loop.

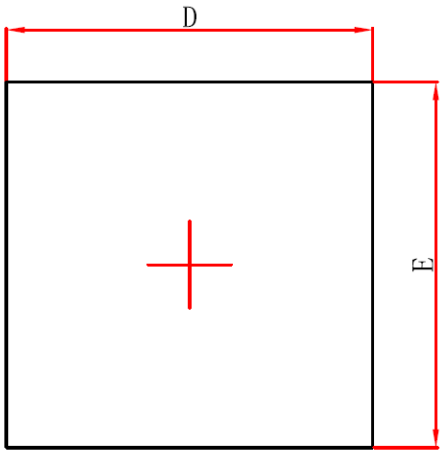
Packaging Information

SOP-8L Package Outline Dimension

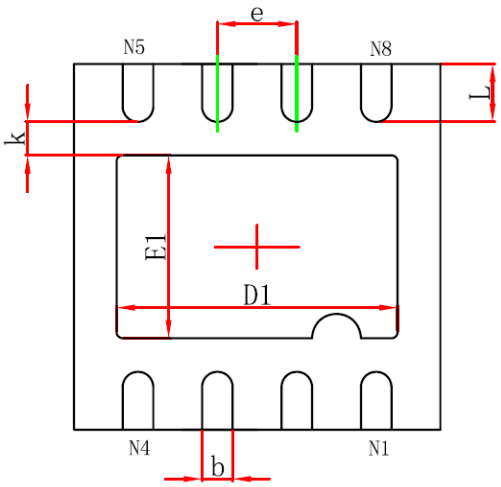


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

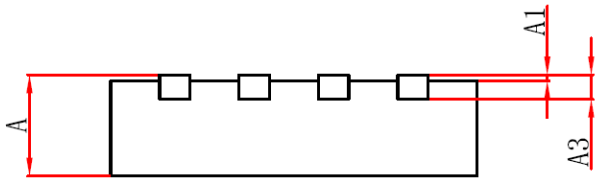
DFN3*3-8L Package Outline Dimension



Top View



Bottom View



Side View

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF		0.008REF	
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
D1	2.200	2.400	0.087	0.094
E1	1.400	1.600	0.055	0.063
k	0.200MIN		0.008MIN	
b	0.180	0.300	0.007	0.012
e	0.650TYP		0.026TYP	
L	0.375	0.575	0.015	0.023

Subject changes without notice.