

## 17V/6A High Efficiency Synchronous Step-Down Converter

### DESCRIPTION

ETA2236 is a wide input range, high efficiency and high frequency DC to DC step-down switching regulator, capable of delivering up to 6A 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, ETA2236 goes into a PFM mode that saves switching loss achieving high efficiency. An OVP function protects the IC itself and its downstream system against input voltage surges. ETA2236 is available in FCTSOT23-8 and DFN3×3-10 Package.

### FEATURES

- ◆ Wide Input Range: 4.5V-17V
- ◆ Adaptive COT Control
- ◆ Ultra-fast Load Transient Response
- ◆ High Efficiency PFM Mode at Light Load
- ◆ Low RDS(ON) Internal Power FETs
- ◆ Capable of Delivering Up to 6A
- ◆ No External Compensation Needed
- ◆ Thermal Shutdown and UVLO
- ◆ Output Auto-discharge Function
- ◆ Available in FCTSOT23-8 and DFN3×3-10 Package
- ◆ RoHS Compliant

### APPLICATIONS

- ◆ LCD TV
- ◆ Set Top Box
- ◆ DSL Modem

### TYPICAL APPLICATION

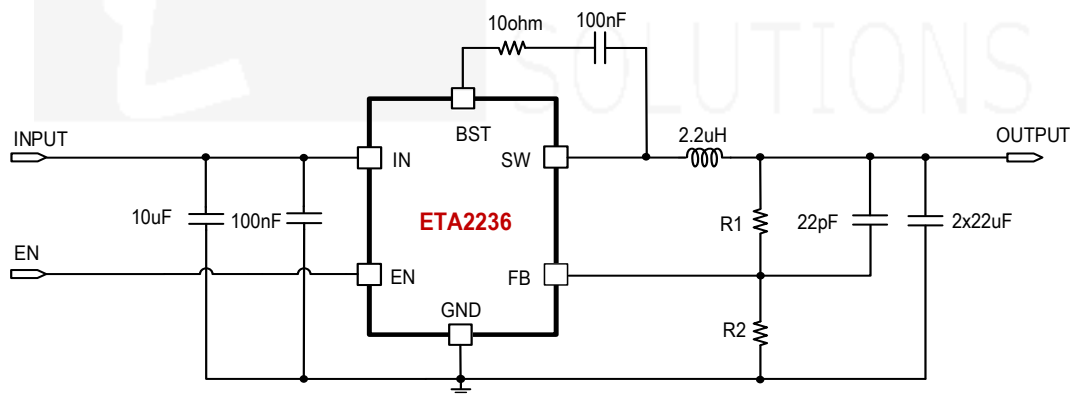


Figure 1: Typical Application Circuit

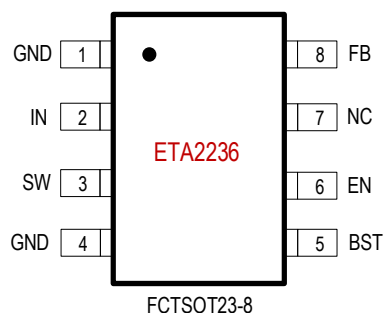
\*R2 has to be set between 1KΩ to 20KΩ

### ORDERING

### INFORMATION

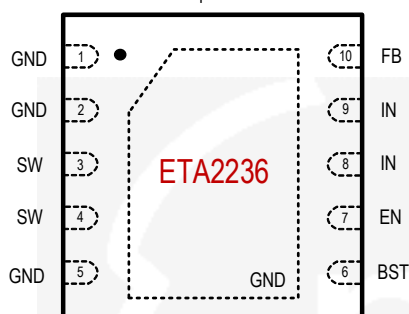
PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA2236D3K	DFN3×3-10	ETA2236 YWW3L	5000
ETA2236FT2I	FCTSOT23-8	MSY <u>W</u>	3000

## PIN CONFIGURATION



FCTSOT23-8

Top View



DFN3x3-10

## ABSOLUTEMAXIMUM RATINGS

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

IN, SW, EN Voltage .....	-0.3V to 19V
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	$\theta_{JA}$ $\theta_{JC}$
FCTSOT23-8.....	56.....6.3..... °C/W
DFN3x3-10.....	50.....12.....°C/W
Lead Temperature (Soldering 10 sec).....	260°C

## ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Supply Range		4.5		17	V
Input Under Voltage Lockout	$V_{IN}$ Rising		4.05		V
UVLO Hysteresis	$V_{IN}$ Falling		300		mV
IN Over Voltage Protection Threshold	$V_{IN}$ Rising		18.5		V
OVP Hysteresis	$V_{IN}$ Falling		0.9		V
Quiescent Current	$V_{EN} = 2V$		230		$\mu A$
Shutdown Current	$V_{EN} = 0V$		7	17	$\mu A$
Output Discharge Resistance	$V_{EN} = 0V$		50		$\Omega$
FB Pin Regulation Voltage		0.594	0.6	0.606	V
FB Input Current			0	1	$\mu A$
Switching Frequency			550		KHz
Maximum Duty Cycle			93		%
Short Circuit Hiccup Time	On Time		2		ms
	Off Time		6		ms
FB out of Hiccup Threshold	$V_{OUT}$ rising		75		%
FB under voltage hysteresis	$V_{OUT}$ falling		50		mV

High Side Switch On Resistance	$I_{SW}=1A$		20		mΩ
Low Side Switch On Resistance	$I_{SW}=1A$		15		mΩ
SW Leakage Current	$V_{IN}=V_{SW}=12V$			10	μA
Peak Inductor Protection Current	High Side ON		14.5		A
Low Side Current Limit Protection			7.9		A
EN Rising Threshold			1.15		V
EN Threshold Hysteresis			100		mV
EN Input Current			2	6	μA
Thermal Shutdown			155		°C
Thermal Hysteresis			40		°C

## PIN DESCRIPTION

FCTSOT23-8 PIN #	DFN3×3-10 PIN #	PIN NAME	DESCRIPTION
1/4	1/2/5	GND	Ground.
2	8/9	IN	Supply Voltage. Bypass with a 100nF HF filter plus a 10μF ceramic capacitor to GND
3	3/4	SW	Inductor Connection. Connect an inductor between SW and the regulator output.
5	6	BST	Bootstrap pin. Connect a 100nF capacitor from this pin to SW
6	7	EN	Enable pin for the IC. Drive this pin high to enable the part, low or floating to disable.
7		NC	Not connect
8	10	FB	Feedback Input. Connect an external resistor divider from the output to FB and GND to set $V_{OUT}$ .

### FUNCTIONAL BLOCK DIAGRAM

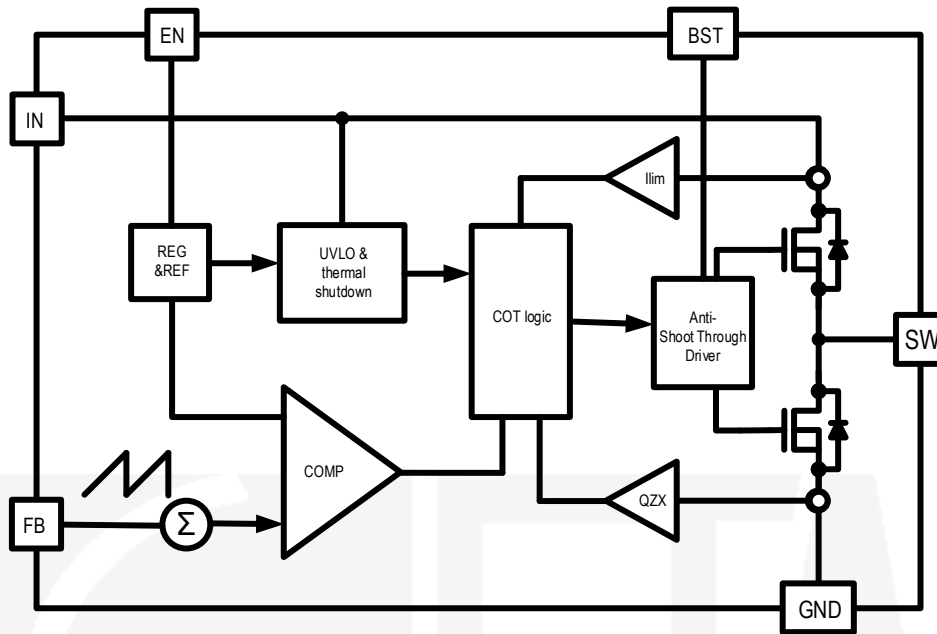
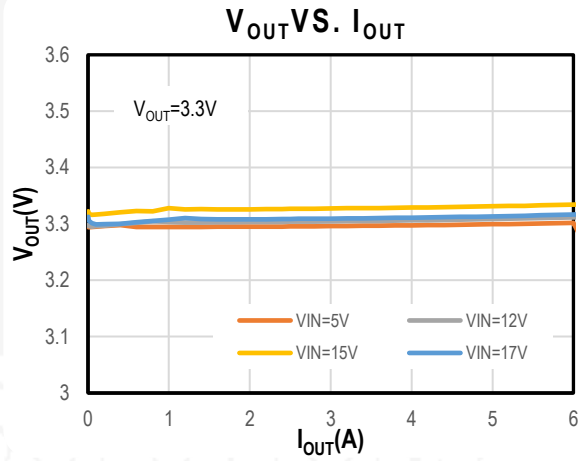
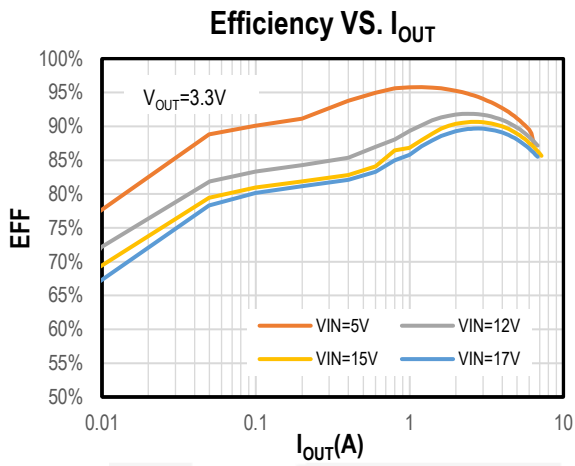
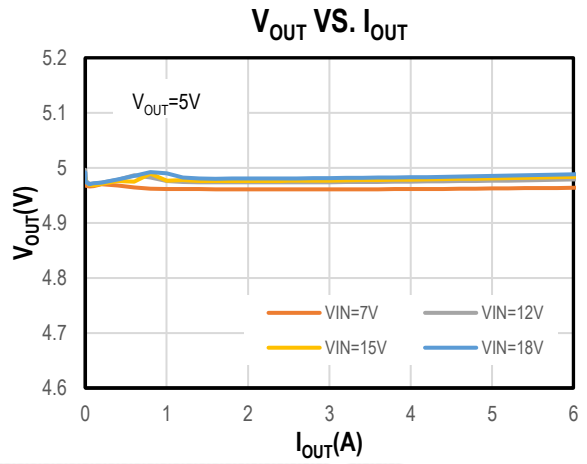
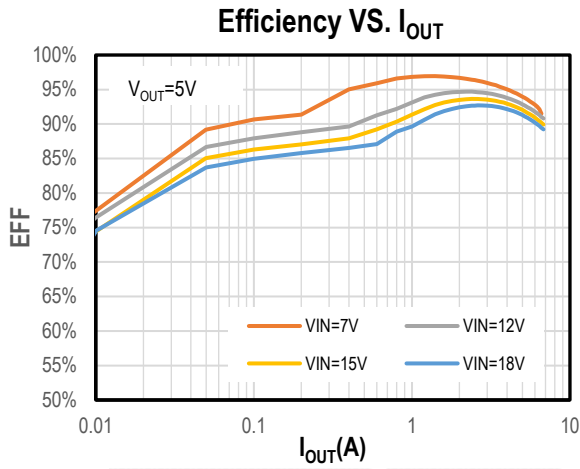


Figure 2: Functional Block Diagram

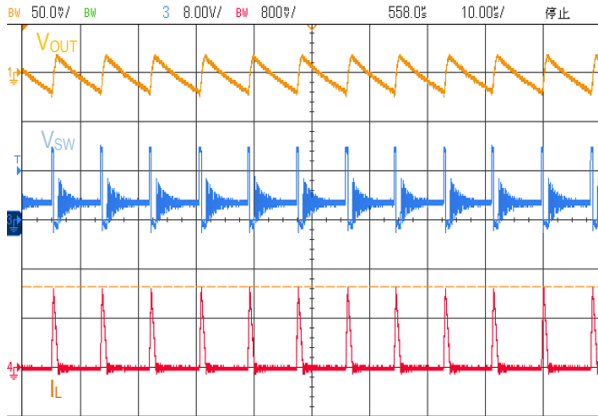
TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS (cont')

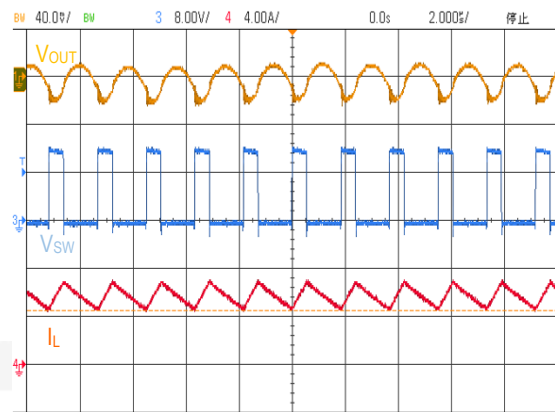
Output Ripple

( $V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.1A$ )



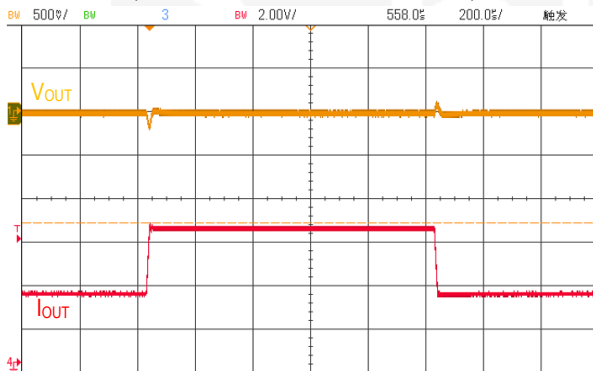
Output Ripple

( $V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=6A$ )



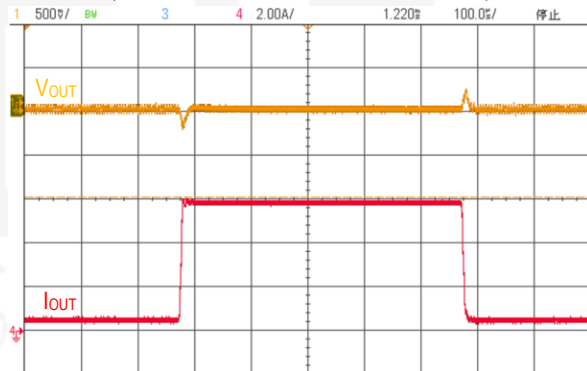
Load Transient

( $V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=3\sim 6A$ )



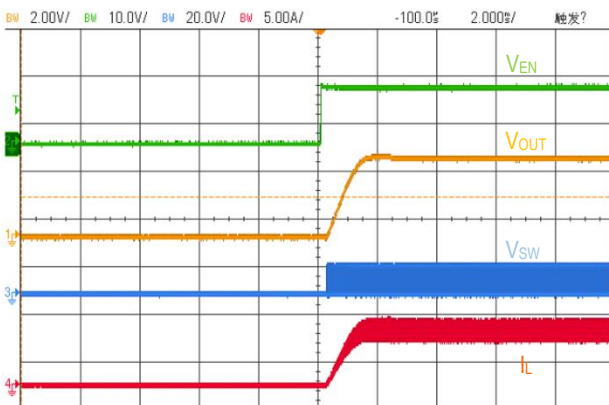
Load Transient

( $V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.6A\sim 6A$ )



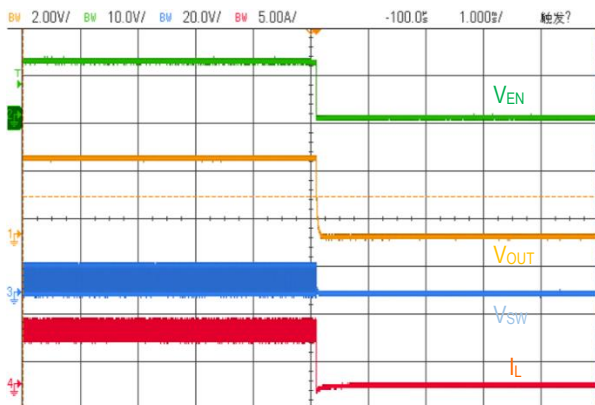
Startup from Enable

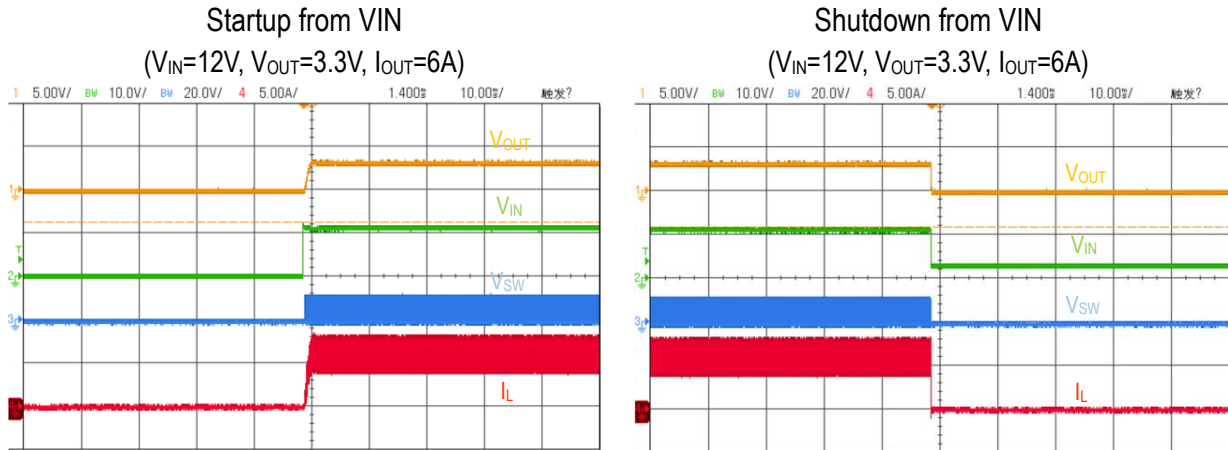
( $V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=6A$ )



Shutdown from Enable

( $V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=6A$ )





## FEATURE DESCRIPTION

ETA2236 is a synchronous buck regulator ICs that integrates an adaptive COT control, top and bottom switches on the same die to minimize the switching transition loss and conduction loss.

ETA2236 is a wide input range, high-efficiency and high frequency DC-to-DC step-down switching regulator, capable of delivering up to 6A 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  $R_{DS(ON)}$  of the MOSFET and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. ETA2236 goes 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 ETA2236 on and off. Driving EN high to turn on the regulator, low to turn 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*

ETA2236 has a cycle-by-cycle over current limit for both inductor current peak value and inductor current valley value. Meanwhile both inductor currents during LS\_FET ON or HS\_FET ON are monitored. During LS\_FET on, sensed inductor current is monitored by a valley current limit comparator. HS\_FET always wait until valley current limit disappear to be on again. Once, HS\_FET is ON, it will be immediately OFF whenever max on time or peak current limit is reached.

When the output voltage drop until FB falls below UV threshold ( $70\% V_{NORMAL}$ ), the ETA2236 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  $155^{\circ}\text{C}$ , allowing the device to cool down. When the junction temperature cools to approximately  $110^{\circ}\text{C}$ , 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.

### *OUTPUT VOLTAGE CONFIGURATION*

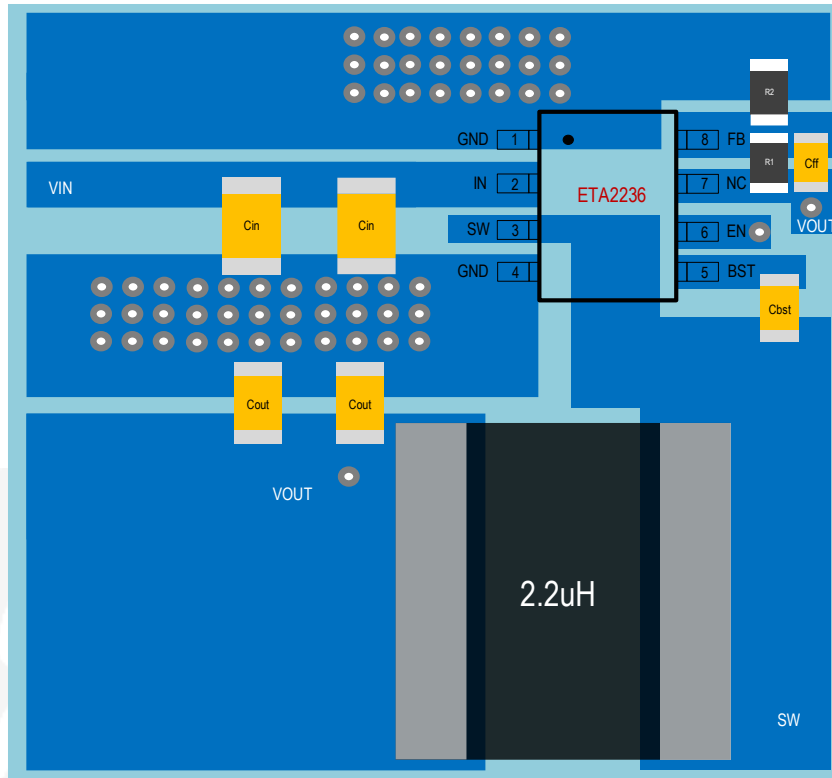
ETA2236 regulator is programmed using an external resistor divider. The output voltage is calculated using below equation.

$$V_{OUT} = V_{FB} \times \frac{R_1 + R_2}{R_2}$$

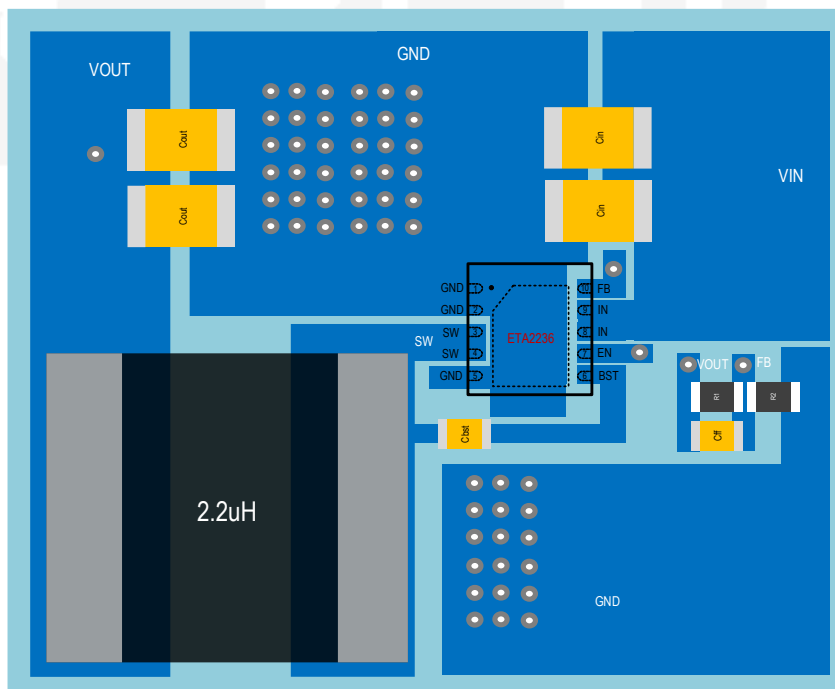
Resistors R2 has to be between  $1\text{k}\Omega$  to  $20\text{k}\Omega$  and thus R1 is calculated by following equation.



PCB LAYOUT GUIDE



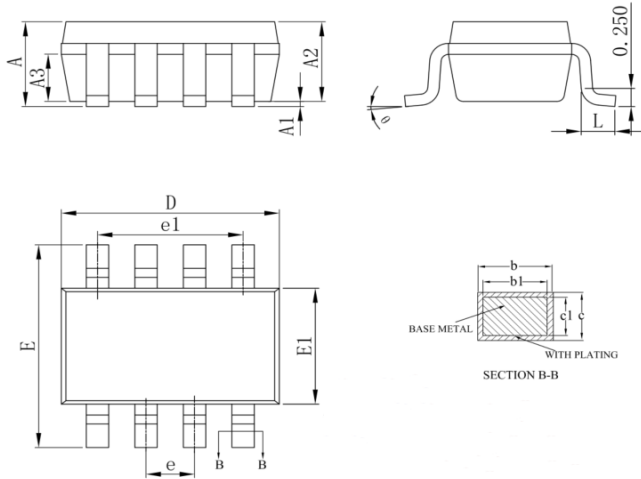
FCTSOT23-8



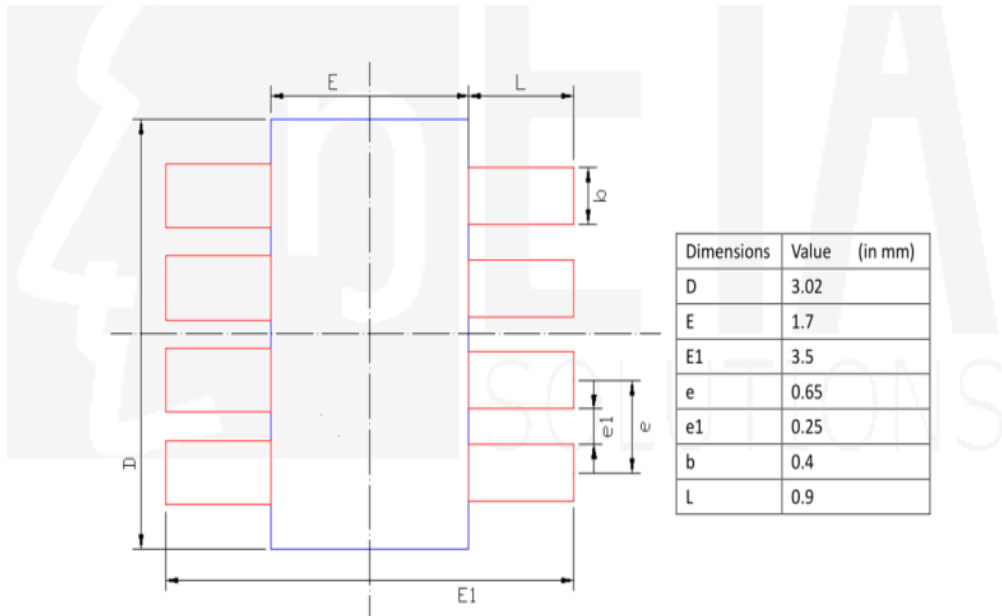
DFN3x3-10

## PACKAGE OUTLINE

Package: FCTSOT23-8



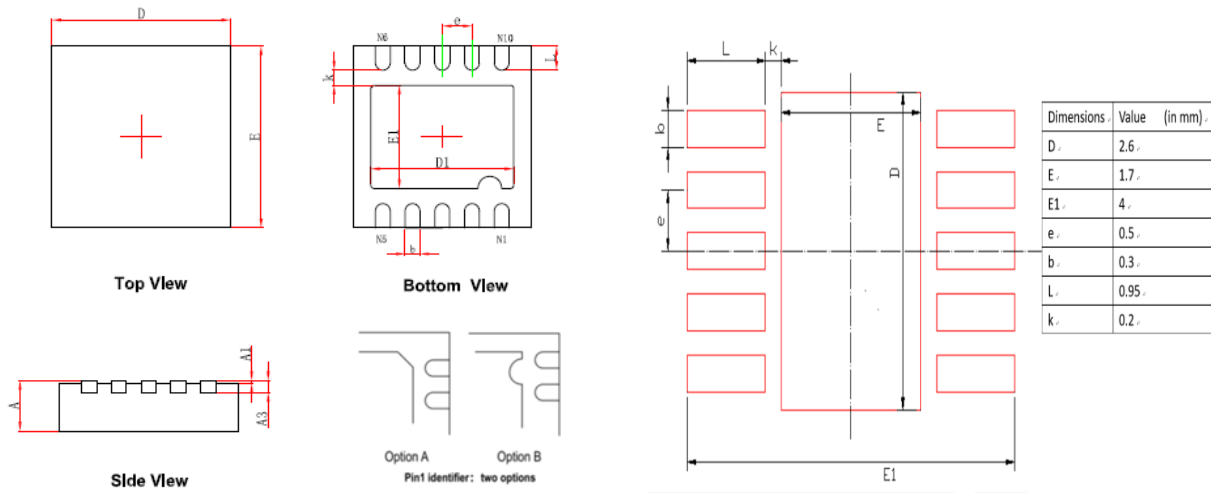
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	0.95
A1	0.00	—	0.10
A2	0.75	0.80	0.85
A3	0.35	0.40	0.45
b	0.28	—	0.36
b1	0.27	0.30	0.33
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	2.82	2.92	3.02
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.65BSC		
e1	1.95BSC		
L	0.30	—	0.60
θ	0	—	8°



Dimensions	Value	(in mm)
D	3.02	
E	1.7	
E1	3.5	
e	0.65	
e1	0.25	
b	0.4	
L	0.9	

RECOMMENDED LAND PATTERN

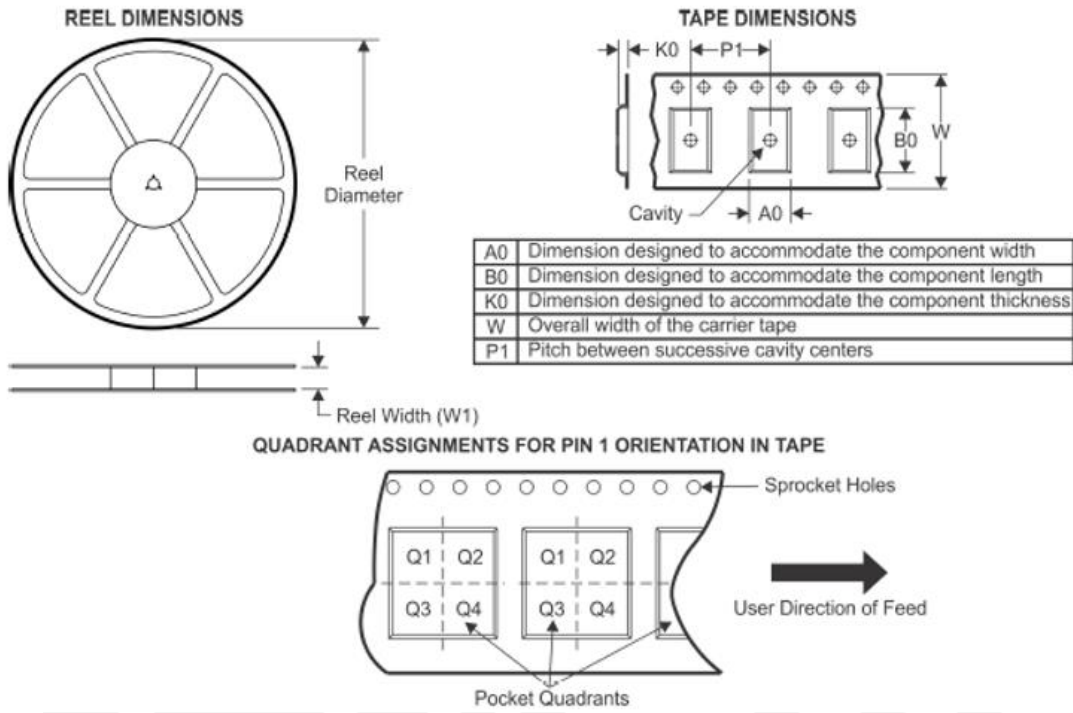
Package: DFN3x3-10



### RECOMMENDED LAND PATTERN

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	2.924	3.076	0.115	0.121
E	2.924	3.076	0.115	0.121
D1	2.300	2.500	0.091	0.098
E1	1.600	1.800	0.063	0.071
k	0.200MIN.		0.008MIN.	
b	0.200	0.300	0.008	0.012
e	0.500TYP.		0.020TYP.	
L	0.324	0.476	0.013	0.019

## TAPE AND REEL INFORMATION



Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ETA2236D3K	DFN3x3-10	10	5000	330	12.4	3.35	3.35	1.13	8	12	Q1
ETA2236FT2I	FCTSOT23-8	8	3000	178	8.4	3.1	3.1	1.3	4	8	Q3