

## 2MHz, 2.5A, DC/DC Step-Down Power Module with Integrated Inductor

### DESCRIPTION

The ETA-M-3457FSM is a high-density power module for space sensitive applications. It is a very compact solution to offer 2.5A of continuous output current. The module operates from an input voltage range of 2.5V to 5.5V and provides output voltages from 0.6V to VIN, making the ETA-M-3457FSM ideal for low voltage power conversions. ETA-M-3457FSM adopts an adaptive COT control scheme that enables a very fast transient response and provides a very smooth transition when the output varies from light load to heavy load. During light load, ETA-M-3457FSM 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.

The ETA-M-3457FSM offers standard features: internal soft-start control circuitry reduces inrush current. Short-circuit and thermal-overload protection improves design reliability.

The ETA-M-3457FSM integrates an inductor, power switches and a switching controller, running at a fixed frequency of 2MHz allows the use of small capacitors, thereby this compact solution is ideal for space sensitive systems.

ETA-M-3457FSM is available in a QFN-12 package.

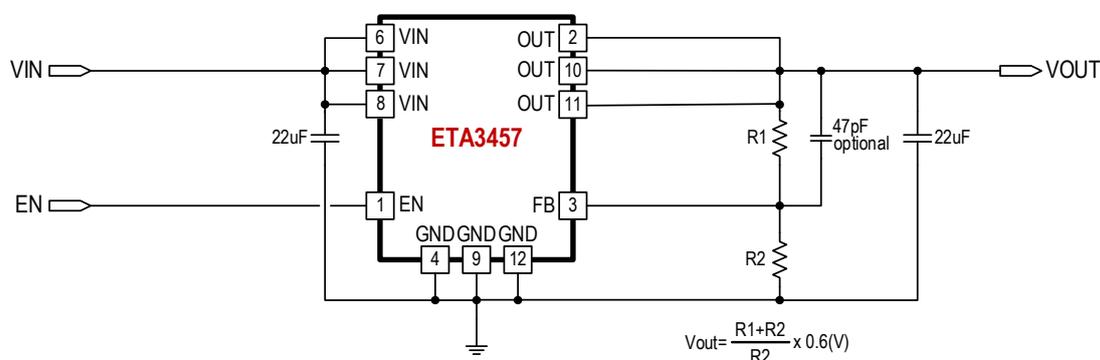
### FEATURES

- ◆ Integrated Controller, Switches, Inductor
- ◆ Up to 2.5A Max Output Current
- ◆ Adaptive COT Control
- ◆ Ultra-fast Load Transient Response
- ◆ Low Radiated Emissions(EMI) Complies with EN55022 Class B standard
- ◆ 2MHz Frequency
- ◆ High Efficiency PFM Mode at Light Load
- ◆ 50uA Quiescent Current
- ◆ 1% Feedback Accuracy
- ◆ Adjustable Output from 0.6V
- ◆ Cycle-by-cycle Over Current Protection
- ◆ Short Circuit Protection with Hiccup Mode
- ◆ Stable with Low-ESR Output Ceramic Capacitors
- ◆ Only 4 External Components Needed: 2 Ceramic Capacitors and FB Divider Resistors
- ◆ Available in QFN-12 Package

### APPLICATIONS

- ◆ Portable Products
- ◆ Space-Limited Applications
- ◆ Storage (SSD/HDD)

### TYPICAL APPLICATION

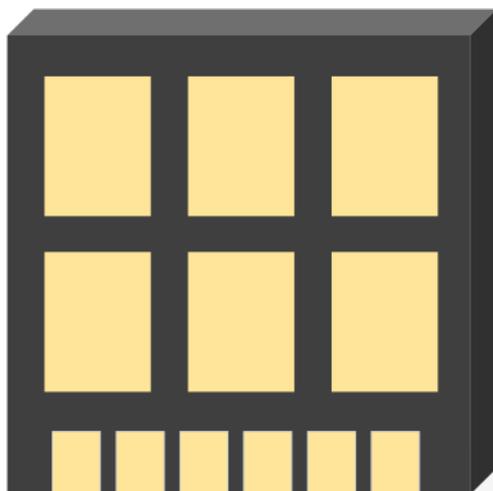


### ORDERING INFORMATION

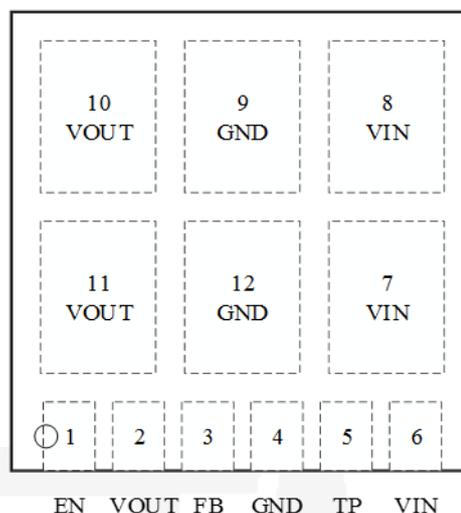
PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA-M-3457FSM	QFN-12	ETA3457 YWW2L	5000

## PIN CONFIGURATION

BOTTOM VIEW



TOP VIEW



## PIN DESCRIPTION

PIN #	NAME	DESCRIPTION
1	EN	On/Off control
2,10,11	VOUT	Output power pin, connect it to output capacitors
3	FB	Feedback pin. An external resistor divider from the output to GND (tapped to the FB), sets the output voltage
4,9,12	GND	Power ground. Must be soldered directly to ground plane
5	TP	Test point. This pin is internally connected to the common switching node of the internal MOSFETs. They must be soldered to PCB but not be electrically connected to any external signal, ground, or voltage. Failure to follow this guideline may result in device damage.
6,7,8	VIN	Supply voltage pin. Bypass with a 22 $\mu$ F ceramic capacitor to GND

## ABSOLUTE MAXIMUM RATINGS

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

VIN, FB, EN, OUT, TP, Voltage .....	-0.3V to 6V	
Operating Temperature Range .....	-40°C to 85°C	
Storage Temperature Range .....	-55°C to 150°C	
Thermal Resistance	$\theta_{JA}$	$\theta_{JC}$
QFN-12 .....	97 .....	38.6 .....
Lead Temperature (Soldering 10sec) .....	260°C	

## ELECTRICAL CHARACTERISTICS

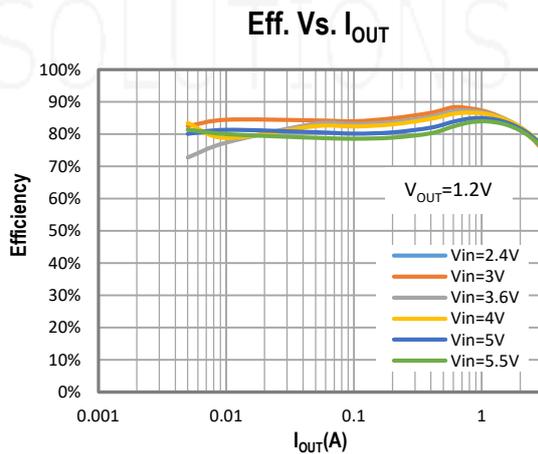
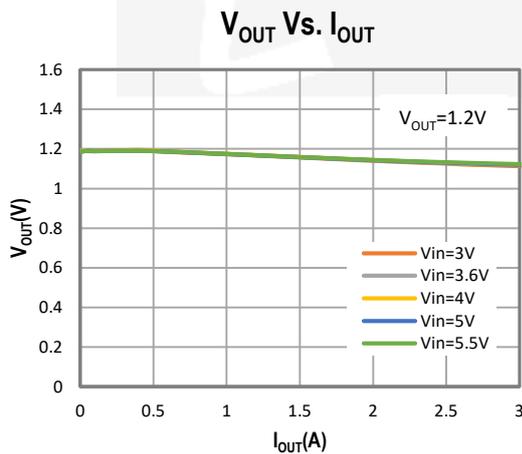
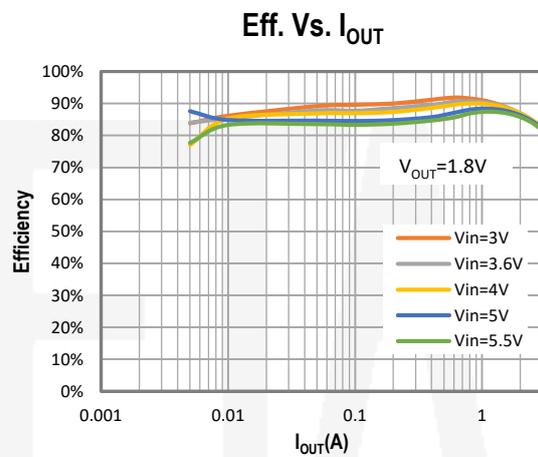
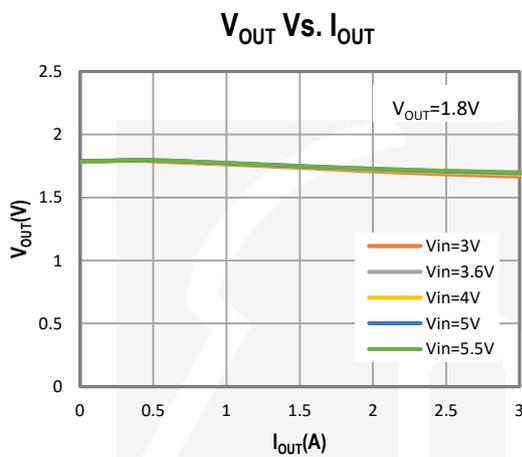
(VIN = 5.0V, Tj = -40°C ~85°C, Typical values is tested under 25°C)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage Range		2.5		5.5	V
Input UVLO	Vin Rising	2.3	2.4	2.5	V
Hysteresis	Hysteresis=200mV		200		mV
Input OVP threshold Hysteresis	VOUT Rising, Hysteresis=0.9V	5.55	5.85	6.15	V
Input Supply Current	VFB=0.65V, no switching		50	100	μA
Input Shutdown Current			0	1	μA
FB Voltage	2.5V ≤ VIN ≤ 5.5V	0.594	0.6	0.606	V
FB Input Current			0	1	μA
Output Voltage Range		0.6		VIN	V
Load Regulation			1		%/A
Line Regulation	Vin=2.5V to 5.5V		0.2		%/V
Switching Frequency		1.5	2	2.5	MHz
Maximum Duty Cycle			100		%
Soft Start Time	VOUT rise from 10% to 90%		1.2		mS
Short Circuit Hiccup Time	On Time		2		mS
	Off Time		18		mS
FB Hiccup Threshold			0.2		V
High Side Switch On Resistance			47	70	mΩ
Low Side Switch On Resistance			40	60	mΩ
Inductor value			1		uH
Inductor DC value			30		mΩ
Dropout Resistance	100% duty		77		mΩ
Power inductor DC-resistance	At 25°C	20	30		mΩ
High Side Current Limit		4.5	6		A
Low Side Current Limit		3	4		A
EN Rising Threshold	Rising	1.2			V
EN Falling Threshold	Falling			0.4	V

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
EN Input Current				1	uA
Thermal shutdown threshold	T <sub>J</sub> Rising		150		°C
Hysteresis			25		°C

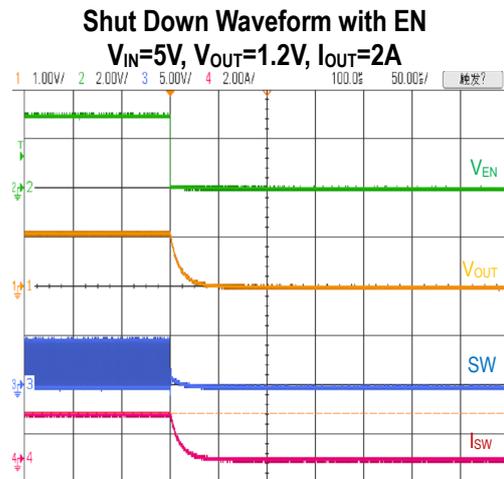
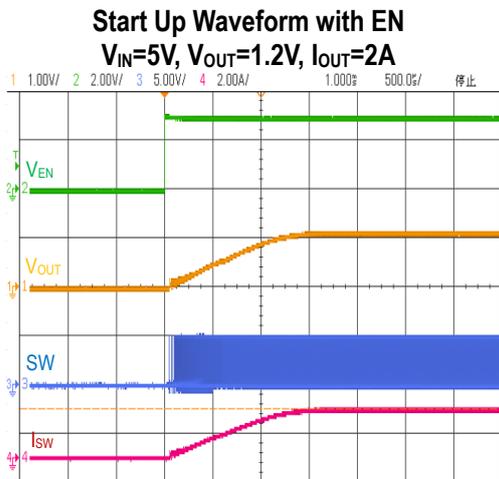
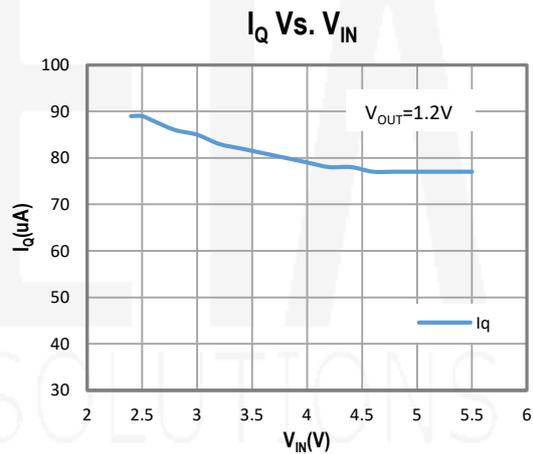
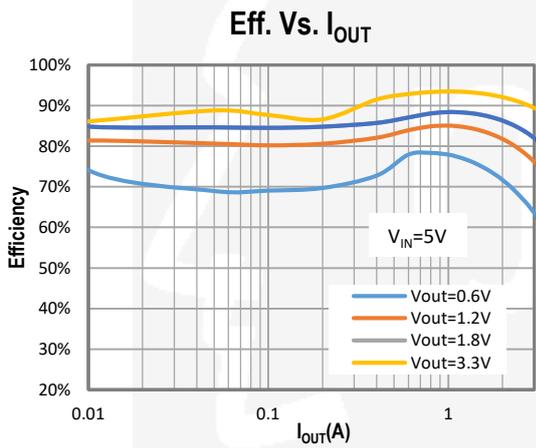
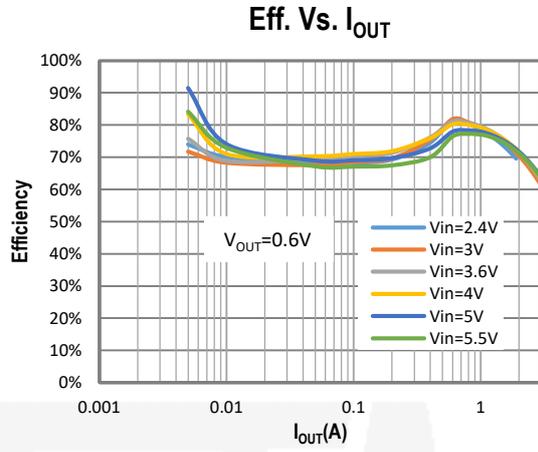
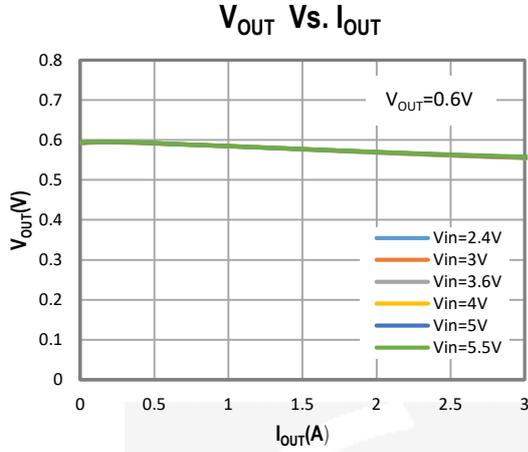
## TYPICAL CHARACTERISTICS

(Typical values are at T<sub>A</sub> = 25°C unless otherwise specified.)

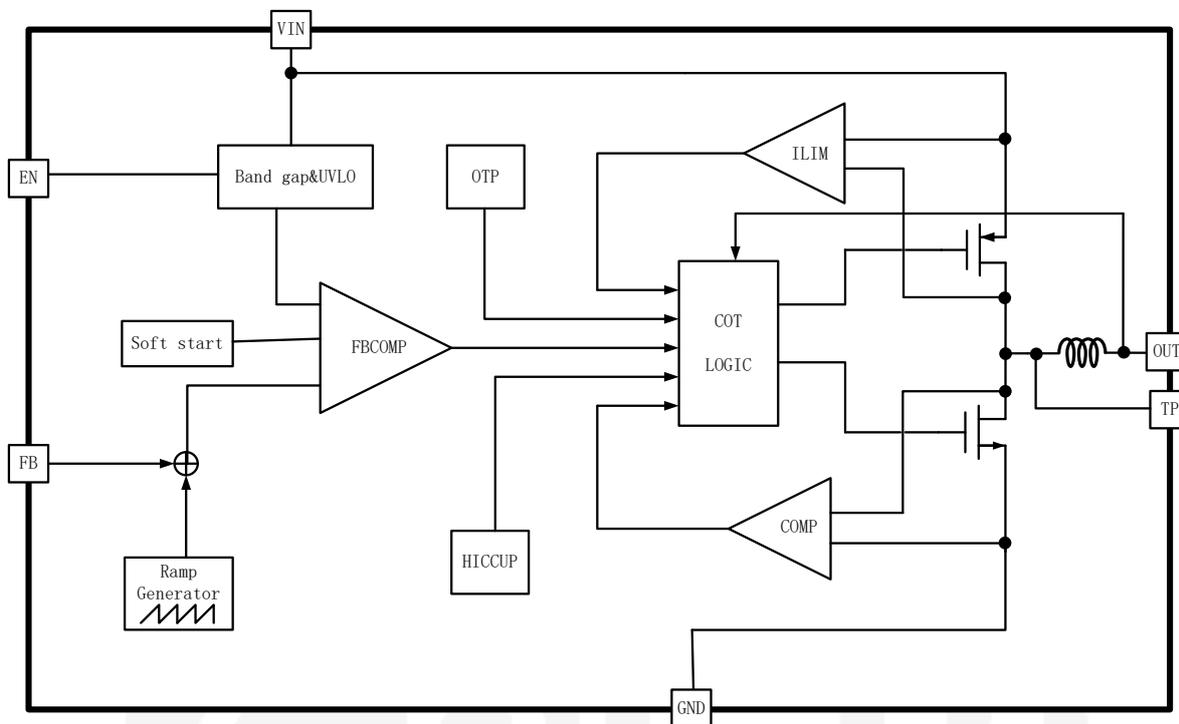


## TYPICAL CHARACTERISTICS (cont.)

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



## FUNCTIONAL BLOCK DIAGRAM



## FUNCTIONAL DESCRIPTION

The ETA-M-3457FSM is a synchronous buck regulator that integrates an inductor, top and bottom power MOSFETs on the same die to minimize the switching transition loss and conduction loss.

ETA-M-3457FSM is a high-efficiency, high-frequency DC-to-DC step-down switching regulator with an integrated inductor, capable of delivering up to 2.5A 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  $R_{DS(on)}$  of the MOSFET and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. ETA-M-3457FSM goes into a power save mode during light load, thereby extending the range of high efficiency operation.

### Over Current Protection and Hiccup

ETA-M-3457FSM 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 (0.2V), the ETA-M-3457FSM will enter hiccup mode. It will turn off the chip immediately for 18mS. 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 115°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.

## APPLICATION INFORMATION

### External Output Voltage Setting

In external Output Voltage Setting Version selected, the ETA-M-3457FSM regulator is programmed using an external resistor divider. The output voltage is calculated by using the below equation.

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

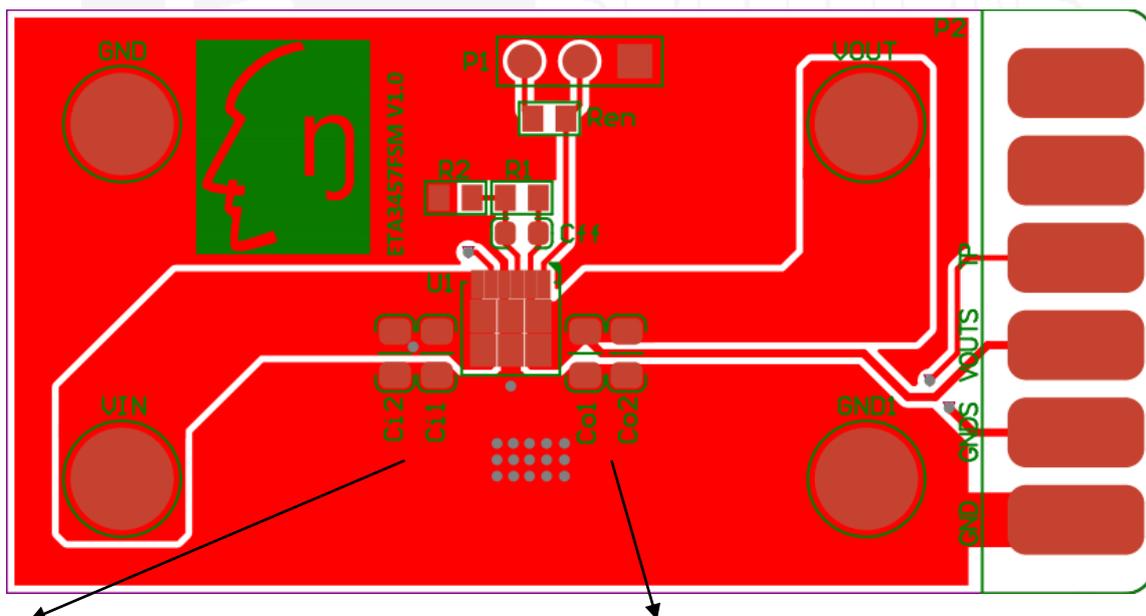
Where:  $V_{REF} = 0.6V$  typically (the internal reference voltage)

R2 has to be between 1KΩ to 70KΩ and thus R1 is calculated by following equation.

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

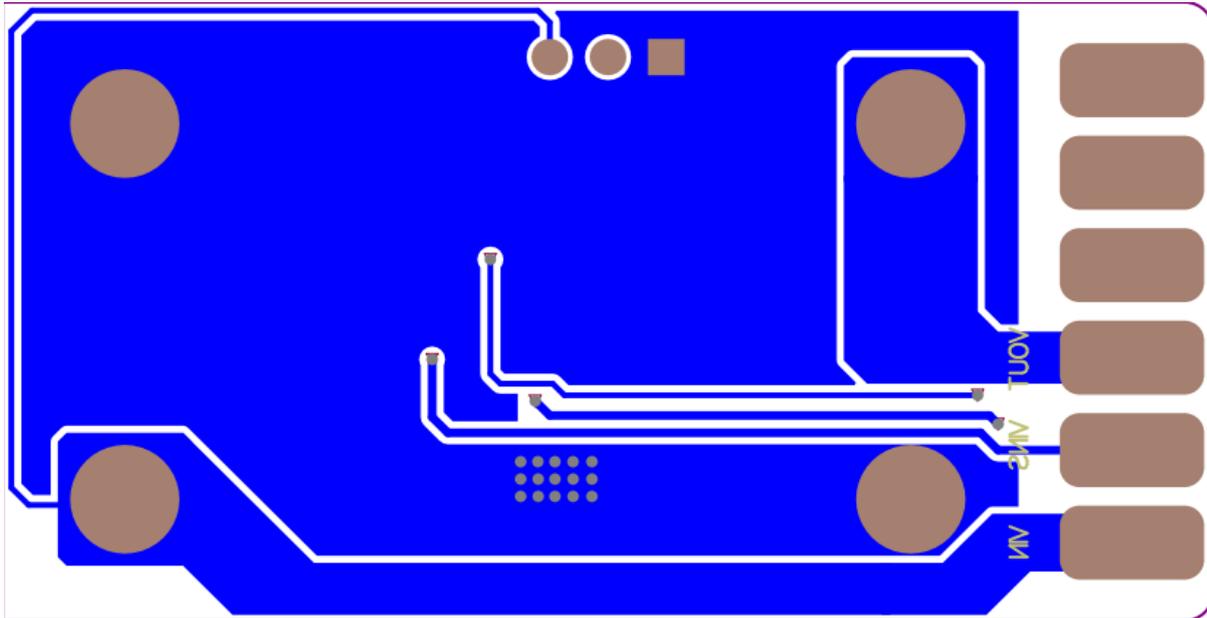
## PCB LAYOUT GUIDE

TOP View



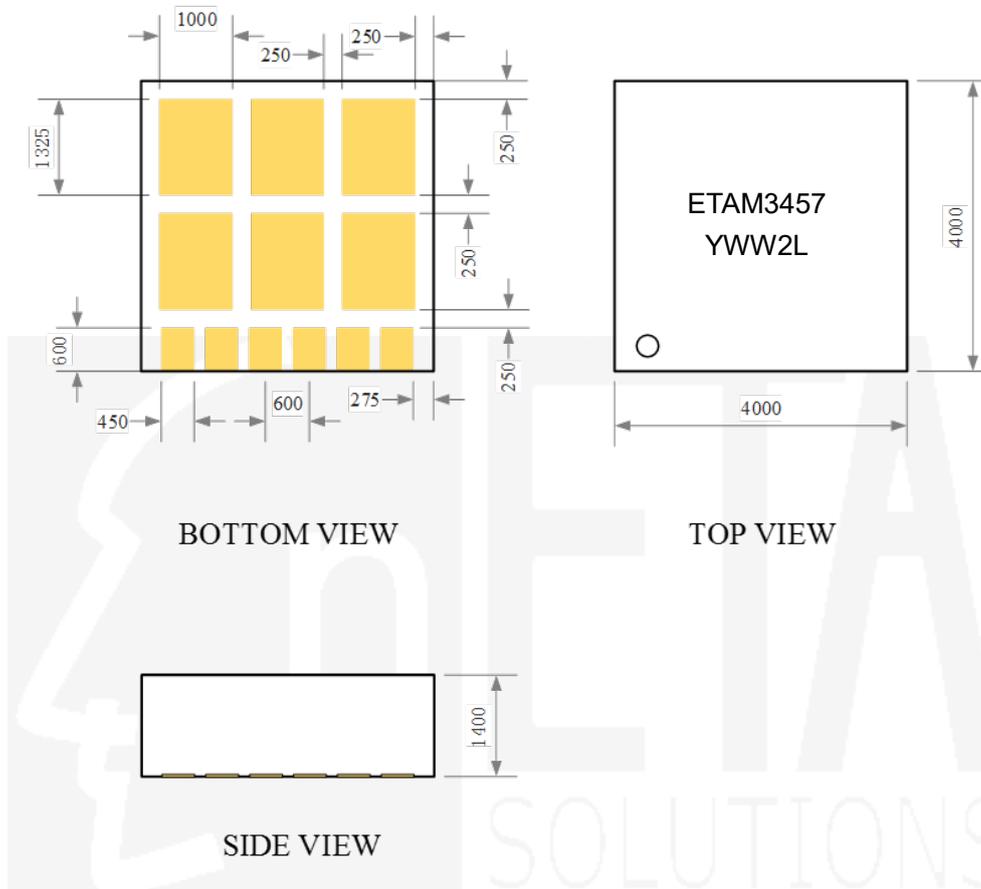
Ci1,Ci2 has to be placed very close to VIN and GND ; and Co1,Co2 has to be placed very close to VOUT and GND

BOTTOM View



## PACKAGE OUTLINE

Unit: um



QFN-12(4mm x 4mm x 1.4mm) Package Outline