General Description

The EC3202F is a current mode monolithic buck switching regulator. Operating with an input range of 2.7V-6.0V, the delivers 1A of continuous output current with integrated -Channel and N - Channel MOSFETs. The internal synchronous power switches provide high efficiency. At light loads, the regulator operate in low frequency to maintain high efficiency and low output ripples.

The EC3202F guarantees robustness with hiccup output short-circuit protection, FB short-circuit protection, input under voltage lockout and hot-plug in, and thermal protection.

The EC3202F is available in 5-pin SOT23-5 package, which provides a compact solution with minimal external components.

Applications

- 5V or 3.3V Point of Load Conversion
- Set Top Boxes
- Telecom/Networking Systems
- Storage Equipment
- GPU/DDR Power Supply

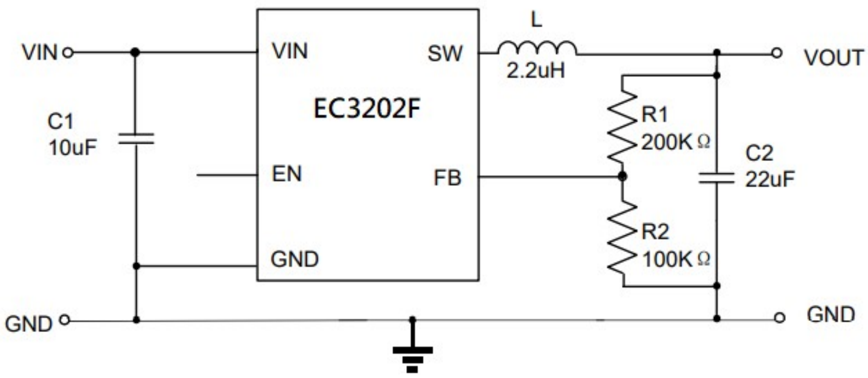
Features

- Wide Input Range 2.7V~6V
- Constant Output Current 1A
- Switching Frequency 1.2MHz
- Peak Efficiency 94%
- Internal Soft-Start
- Input under Voltage Lockout
- Hot-plug in Protection
- Short Circuit Protection(SCP)
- Over Temperature Protection (OTP

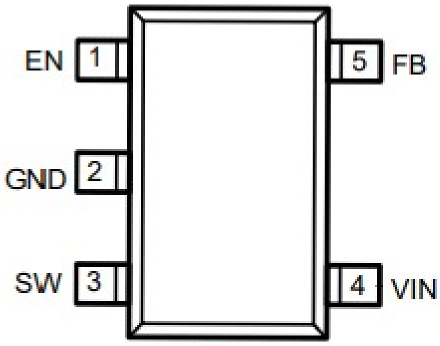
Package

- SOT23-5

Typical Application



Functional Pin Description

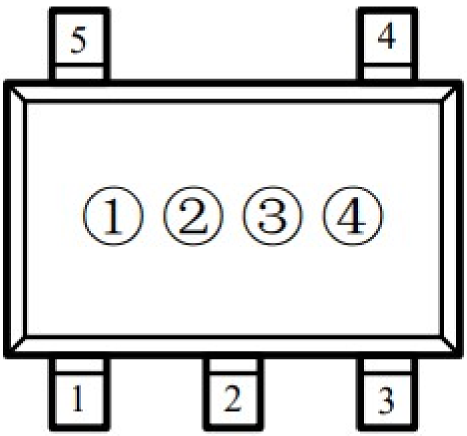


SOT23-5
(TOP VIEW)

Pin Number	Pin Name	Function
1	EN	Enable
2	GND	Common Ground
3	SW	Switch Output
4	VIN	Power Input
5	FB	Feedback Voltage

Marking Rule

SOT23-5



SOT23-5
(TOP VIEW)

① Represents the product name

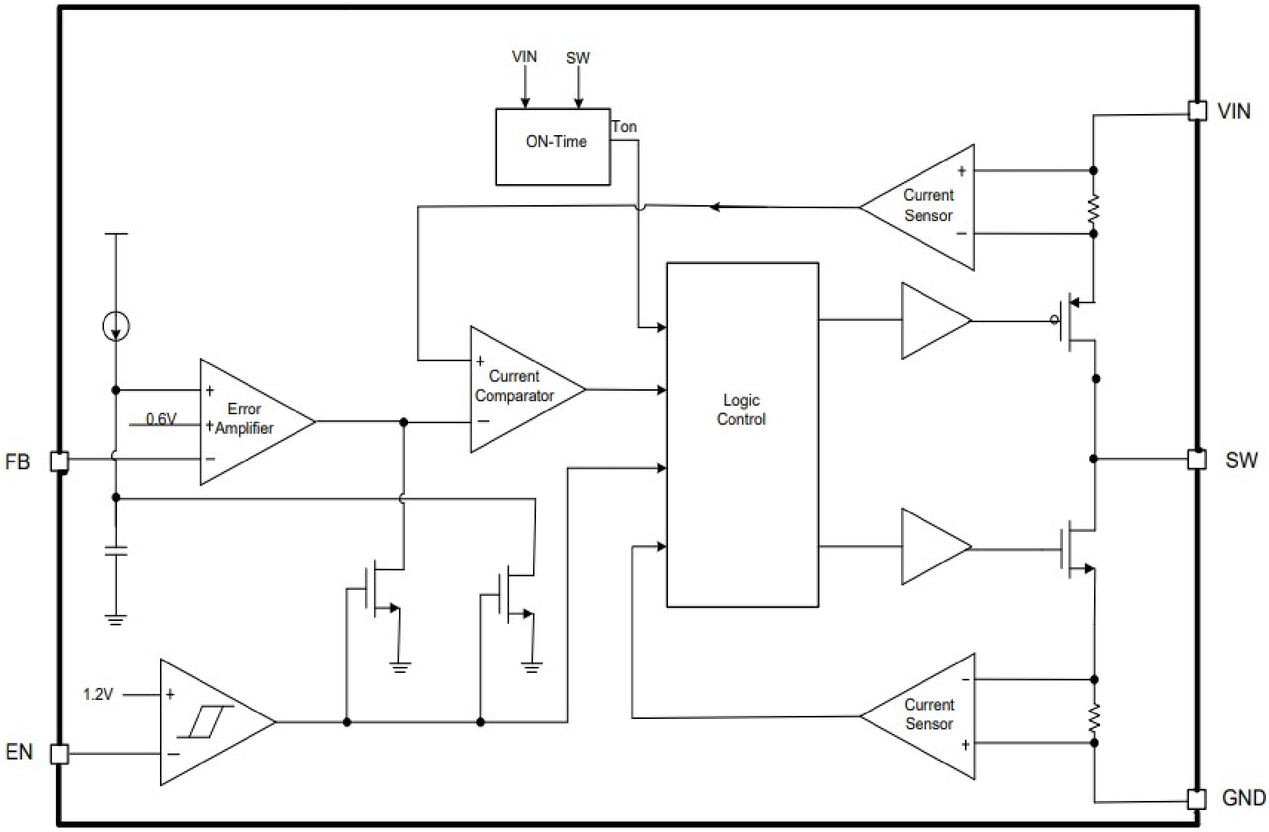
Symbol	Product Name
5	EC3202F ◆◆◆◆◆

② ③Represents the output voltage

Symbol	Describe	Description	
②	Output Current	1	1A

③ Represents the technological processes change
0-9，A-Z，0-9，A-Z mirror writing，repeated（G，I，J，O，Q，W exception）

Function Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Units
Input Supply Voltage	V_{IN}	-0.3～7	V
Output Voltage	V_{OUT}	-0.3～7	
Operating Temperature Range	T_{opr}	-40～+125	℃
Storage Temperature Range	T_{stg}	-65～+150	

Electrial Characteristics

V_{IN}=5V ,C_{IN}=10uF ,C_L=22uF ,L=2.2uH (TA=25 ℃ unless otherwise stated)

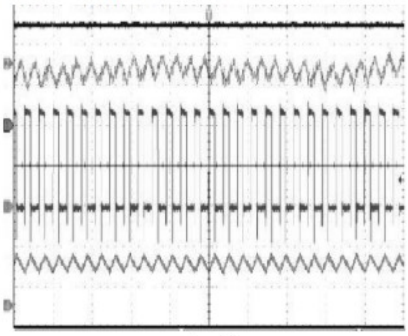
Parameter	Symbol	Conditions	MIN	TYP	MAX	Units
V_{IN} Under Voltage Lockout Threshold	V_{IN_UVLO}	V_{IN} rising	2.3	2.5	2.7	V
V_{IN} Under Voltage Lockout Hysteresis	$V_{IN\_UVLO\_HYST}$	V_{IN} falling	-	250	-	mV
V_{IN} Hot-plug in Protection Threshold	V_{IN_OVP}	V_{IN} rising	5.7	6.3	-	V
V_{IN} Hot-plug in Protection Hysteresis	$V_{IN\_OVP\_HYST}$	V_{IN} falling	-	600	-	mV
Shutdown Current	I_{SHDN}	V_{IN}=6.0V, V_{EN}=0	-	0.1	1	uA
Quiescent Current	I_Q	V_{EN} =5V, I_{OUT} =0A, V_{FB} = V_{REF} *105%	-	40	70	uA
Regulated Feedback Voltage	V_{FB}	2.7V<VIN<6.0V	0.588	-	0.612	V
PFET On Resistance	R_{DSON_P}	V_{IN} =3.6V, I_{SW}=200mA	-	200	-	mΩ
NFET On Resistance	R_{DSON_N}	V_{IN} =3.6V, I_{SW}=200mA	-	100	-	mΩ
PFET Leakage Current	I_{LEAK_P}	V_{IN}=6.0V, V_{EN}=0,V_{SW}=0			1	uA
NFET Leakage Current	I_{LEAK_N}	V_{IN}=6.0V, V_{EN}=0,V_{SW}=6.0V			1	uA
PFET Current Limit	I_{LIM_TOP}	-	1.5	2.0	2.4	A
NFET Current Limit	I_{LIM_BOT}	-	1.2	1.5	1.8	A
Switch Frequency	F_{SW}	I_{OUT} =1A	-	1.2	-	MHz
Minimum On Time	T_{ON_MIN}	-	-	100	-	ns
Maximum Duty Cycle	D_{MAX}	-	-	100	-	%
EN Rising Threshold	V_{EN_TH}	V_{EN} rising, V_{FB} =0.3V	1.5	-	-	V
EN Falling Threshold	V_{EN_HYST}	V_{EN} falling, V_{FB} =0.3V	-	-	0.4	V
Thermal Shutdown Threshold	T_{SHDN}	-	-	150	-	℃
Thermal Shutdown Hysteresis	T_{HYST}	-	-	20	-	℃

Typical Operating Characteristics

（unless otherwise noted，VIN =5V，VOUT=1.8V，L=2.2uH，CIN=10uF，COUT=22uF，TA=25℃）

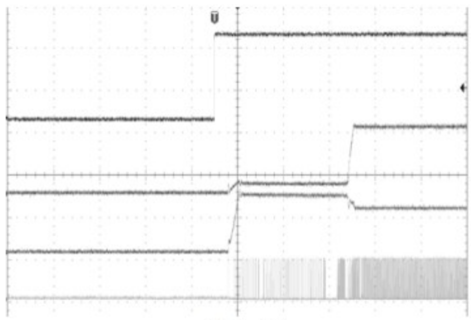
1、 Steady State Test

V_{IN} = 5.0V,Vout = 1.8V,Iout = 1.0A



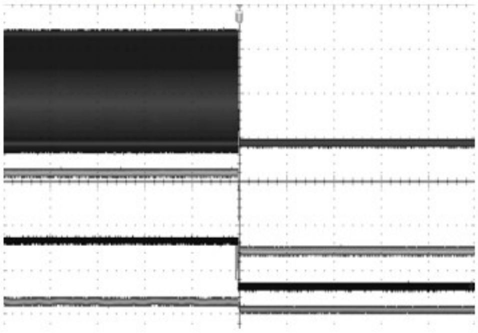
2、Startup through Enalbe

V_{IN} = 5.0V,Vout = 1.8V,Iout = 1.0A（Resistive load）



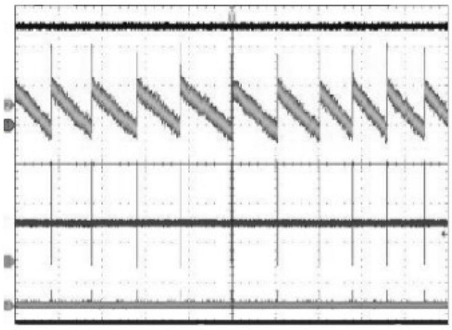
3、Shutdown through Enable

V_{IN} = 5.0V,Vout = 1.8V,Iout = 1.0A



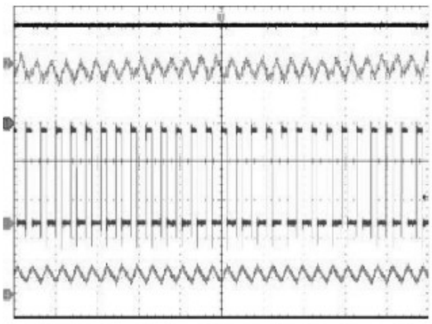
4、Light Load Operation

IL=0A



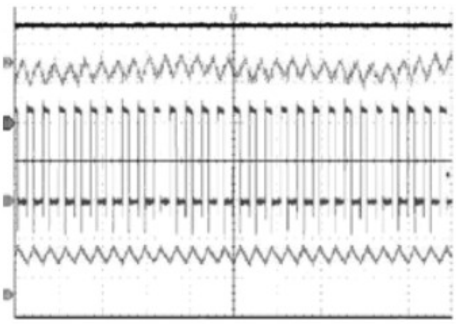
5、Medium Load Operation

IL=0.5A



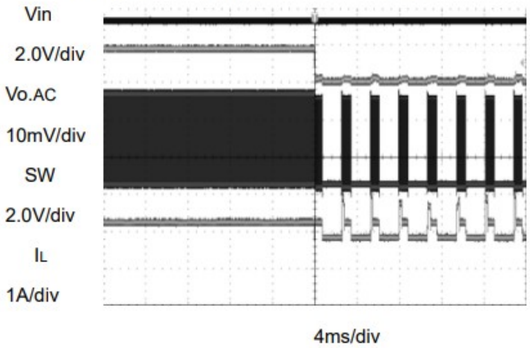
6、Heavy Load Operation

IL=1A



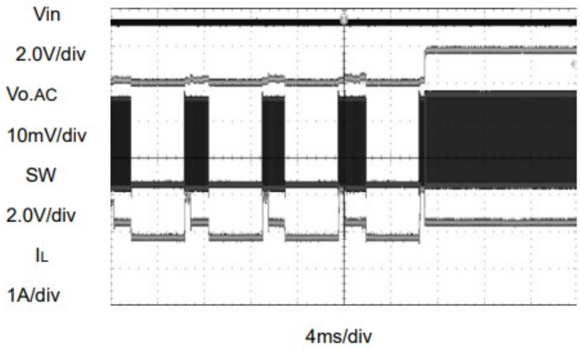
7、Short Circuit Protection

V_{IN} = 5.0V,Vout = 1.8V,Iout = 1.0A-short



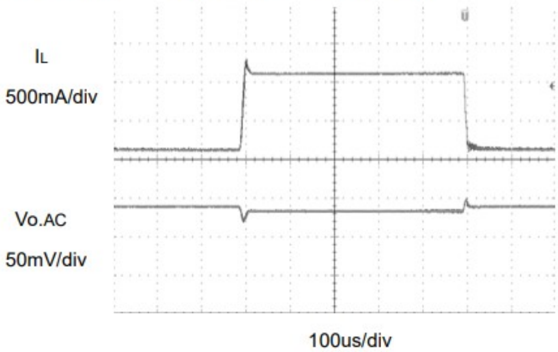
8、Short Circuit Protection

V_{IN} = 5.0V,Vout = 1.8V,Iout = short-1.0A

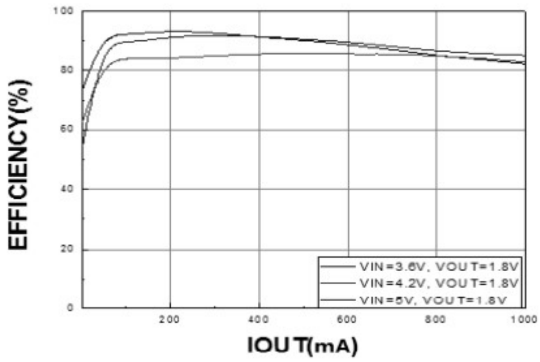


9、Load Transient

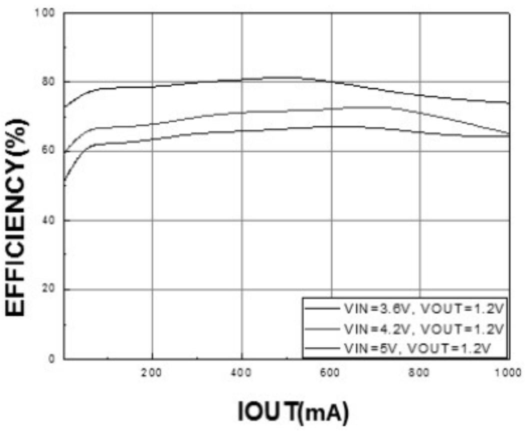
0.1A LOAD → 1.0A LOAD →0.1ALOAD



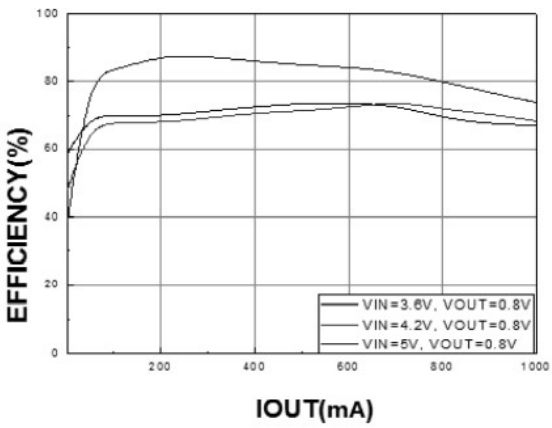
10、Efficiency @ Vout=1.8V



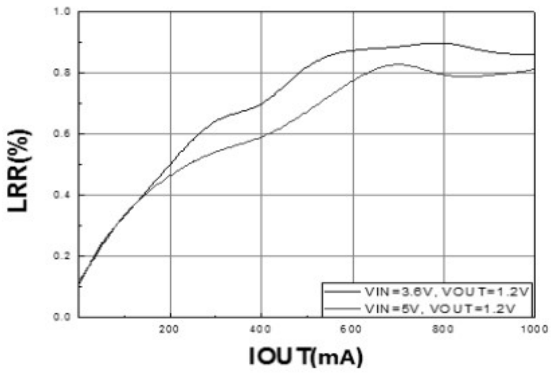
11、Efficiency @ Vout=1.2V



12、Efficiency @ Vout=0.8V

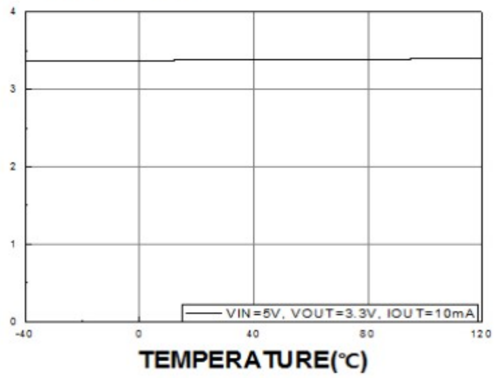


13、Load regulation @ Vout=1.2V



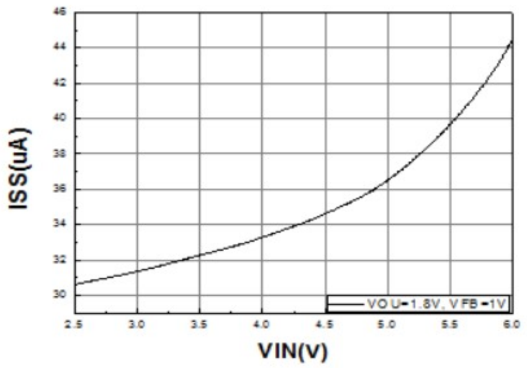
14、Output Voltage Vs Temperature

VIN=VEN=5V, Iout =10mA



15、Quiescent Current Vs. Input Voltage

VIN=2.5V~6V,VEN=2.5V,VFB=1V



Function Description

- The EC3202F is a COT control, synchronous, step-down regulator. It regulates input voltages from 2.7V~6.0V down to an output voltage as low as 0.6V, and is capable of supplying up to 1A of load current.
- COT
  The EC3202F utilizes constant on-time control to regulate the output voltage. The output voltage is measured at the FB pin through a resistive voltage divider and the error is amplified by the internal transconductance error amplifier.
  Output of the internal error amplifier is compared with the switch current measured internally to control the output current limit.
- PFM Mode
  The EC2302F operates in PFM mode at light load. In PFM mode, switch frequency is continuously controlled in proportion to the load current, i.e. switch frequency decreases when load current drops to boost power efficiency at light load by reducing switch-loss, while switch frequency increases when load current rises, minimizing output voltage ripples.
- Shut-down Mode
  The EC2302F operates in shut-down mode when voltage at EN pin is driven below 0.4V. In shut-down mode, the entire regulator is off and the supply current consumed by the drops below 1uA.
- Power Switches
  P-channel and N-channel MOSFET switches are integrated on the EC2302F to down convert the input voltage to the regulated output voltage.
- Short Circuit Protection
  When output is shorted to ground, the switching frequency is reduced to prevent the inductor current from increasing beyond PFET current limit. If short circuit condition holds for more than1024 cycles, both PFET and NFET are forced off and can be enabled again after 8ms. This procedure is repeated as long as short circuit condition is not removed.
- FB Short Circuit Protection
  When FB is shorted to ground and holds for more 16 cycles, NFET will be turned off after inductor current drops to zero, and then both PFET and NFET are latched off. When short circuit condition is removed, it can be recovery.
- Hot Plug-in Protection
  When input voltage is greater than hot plug-in protection threshold, typical 6.3V, it will disable . When input voltage decrease below 6V, it will be enabled again.
- Thermal Protection
  When the temperature of the EC3202F rises above 150°C, it is forced into thermal shut-down. Only when core temperature drops below 130°C can the regulator becomes active again.

Application Information

- Setting Output Voltage

The output voltage is determined by the resistor divider connected at the FB pin, and the voltage, ratio is：

$$V_{FB} = V_{OUT} \times \frac{R3}{R2 + R3}$$

Where VFB is the feedback voltage and VOUT is the output voltage. Choose R3 around 10KΩ, and then R2 can be calculated by:

$$R2 = R3 \times (\frac{V_{OUT}}{0.6V} - 1)$$

The following table lists the recommended values.

VOUT(V)	R2(KΩ)	R3(KΩ)
1.2	100	100
1.8	200	100
2.5	316	100
3.3	499	100

Input Capacitor Selection

The input capacitor is used to supply the AC input current to the step-down converter and maintaining the DC input voltage. The ripple current through the input capacitor can be calculated by:

$$I_{C1} = I_{LOAD} \times \sqrt{\frac{V_{OUT}}{V_{IN}}\left(1 - \frac{V_{OUT}}{V_{IN}}\right)}$$

Where ILOAD is the load current，VOUT is the output voltage, VIN is the input voltage. Thus the input capacitor can be calculated by the following equation when the input ripple voltage is determined.

$$C_1 = \frac{I_{OUT(MAX)}}{\Delta v_{IN} \times f_S} \times \frac{V_{OUT}}{V_{IN}}\left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

Where C1 is the input capacitance，fs is the switching frequency，△VIN is the input ripple current. The input capacitor can be electrolytic, tantalum or ceramic. To minimizing the potential noise, a small X5R or X7R ceramic capacitor, i.e. 0.1uF, should be placed closer than 3mm to the IC as possible when using electrolytic capacitors. A 10uF ceramic capacitor is recommended in typical application.

- Output Capacitor Selection
  The output capacitor is required to maintain the DC output voltage, and the capacitance value determines the output ripple voltage. The output voltage ripple can be calculated by:

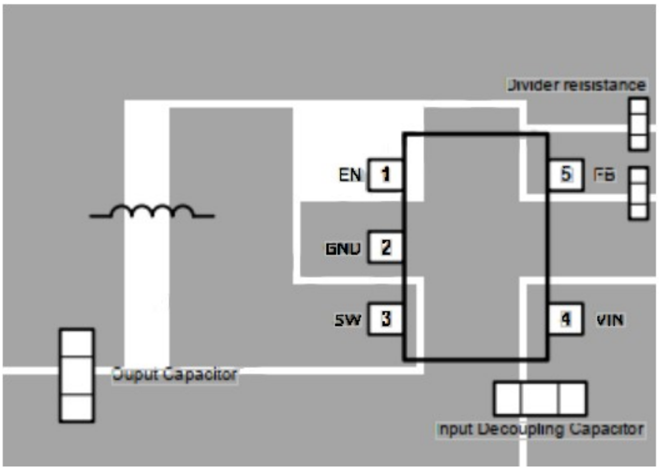
$$\Delta V_{OUT} = \frac{V_{OUT}}{f_s \times L}\left(1 - \frac{V_{OUT}}{V_{IN}}\right)\left(ESR + \frac{1}{8 \times f_S \times C_2}\right)$$

  Where C2 is the output capacitance value and ESR is the equivalent series resistance value of the output capacitor. The output capacitor can be low ESR electrolytic, tantalum or ceramic, which lower ESR capacitors get lower output ripple voltage. The output capacitors also affect the system stability and transient response, and a 22uF ceramic capacitor is recommended in typical application.

- Inductor Selection
  The inductor is used to supply constant current to the output load, and the value determines the ripple current which affect the efficiency and the output voltage ripple. The ripple current is typically allowed to be 30% of the maximum switch current limit, thus the inductance value can be calculated by:

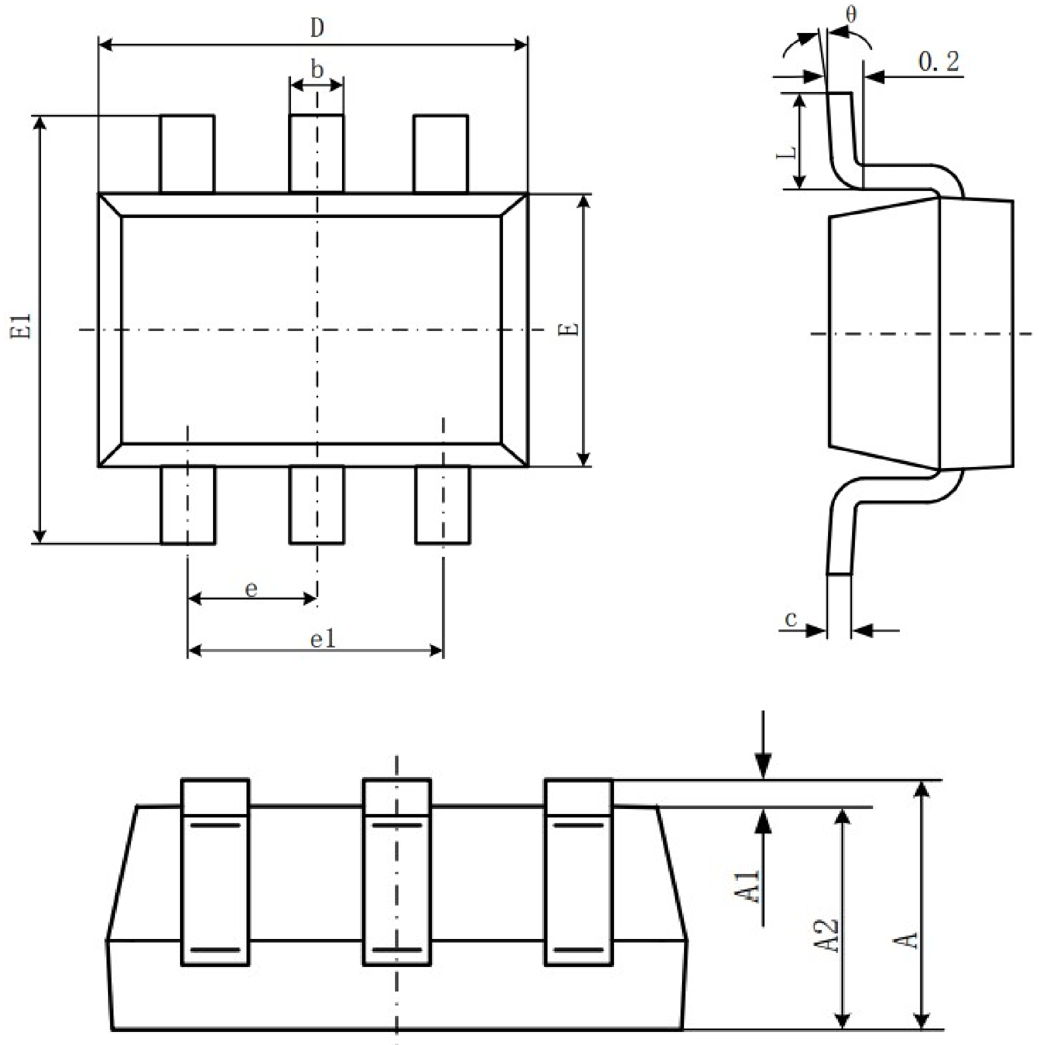
$$L = \frac{V_{OUT}}{f_S \times \Delta I_L} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

  Where VIN is the input voltage, VOUT is the output voltage, fs is the switching frequency，△IL is the peak-to-peak inductor ripple current.
- PCB Layout Note
  The following advice should be considered when laying out a printed circuit board for the EC3202F
  1、Place the input decoupling capacitor as close to EC3202F (VIN pin and PGND) as possible to eliminate noise at the input pin. The loop area formed by input capacitor and GND is not minimized. IC cannot work well when Vin pin is interfered by noise.
  2、Put the feedback trace as far away from the inductor and noisy power traces as possible.
  3、The ground plane on the PCB should be as large as possible for better heat dissipation.



Packaging information

- SOT23-5



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
Z	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°