



4.5-60V 0.5A 480KHz  
Step-down converter in a SOT23-6

Preliminary v01 01/2020

## Description

The ECP2459 is a monolithic, step-down, switch-mode converter with a built-in power MOSFET. It achieves a 0.5A peak-output current over a wide input supply range with excellent load and line regulation. Current-mode operation provides a fast transient response and eases loop stabilization. Fault condition protections include cycle-by-cycle current limiting and thermal shutdown. The ECP2459 requires a minimal number of readily available, external components and is available in a space saving SOT23-6 package.

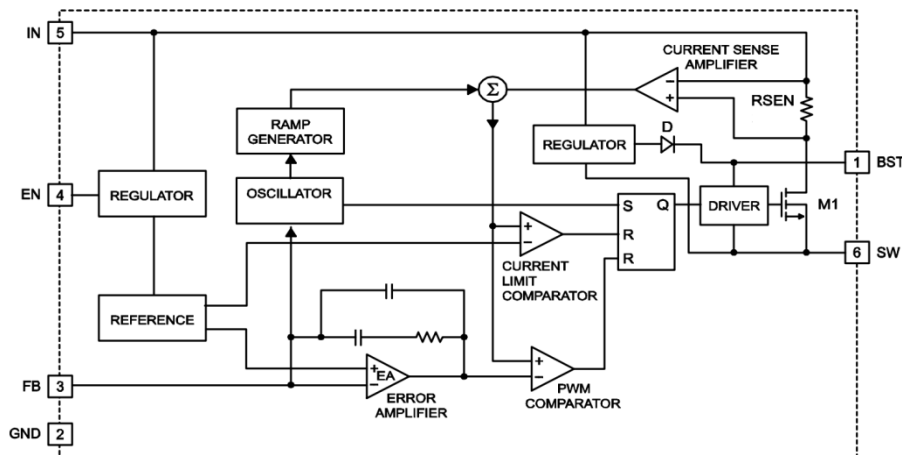
## Feature

- ◆ Input voltage range : 4.5V~60V
- ◆ 0.5A peak output current
- ◆ 1Ω Internal power MOSFET
- ◆ Fixed 480KHz frequency
- ◆ Up to 90% efficiency
- ◆ 1μA shutdown mode
- ◆ Package Type : SOT23-6

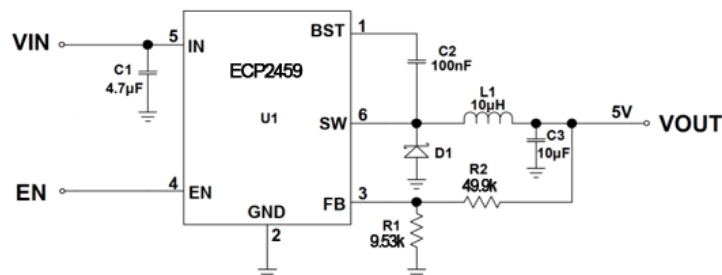
## Application

- ◆ Power meters
- ◆ Distributed power systems
- ◆ Industrial power systems
- ◆ Battery chargers
- ◆ Pre-regulator for linear regulators

## Functional Block Diagram



## Typical Application



## Absolute Maximum Ratings

| Parameter            | Symbol   | Condition | Min. | Typ. | Max. | Unit |
|----------------------|----------|-----------|------|------|------|------|
| Supply Voltage       | $V_{IN}$ |           | -0.3 |      | 62   | V    |
| SW Voltage           | $V_{SW}$ |           | -0.3 |      | 62   | V    |
| EN Voltage           | $V_{EN}$ |           | -0.3 |      | 44   | V    |
| FB Voltage           | $V_{FB}$ |           | -0.3 |      | 6    | V    |
| Junction Temperature | $T_J$    |           |      |      | +150 | °C   |

## Electrical Characteristics $V_{in}=12V, V_{out}=5V, T_A=25^{\circ}C$ (unless otherwise noted)

| Parameter                                | Symbol        | Condition              | Min.  | Typ.  | Max.  | Unit     |
|--|---------------|------------------------|-------|-------|-------|----------|
| Input Voltage Range                      | $V_{IN}$      |                        | 4.5   |       | 60    | V        |
| Feedback Voltage                         | $V_{FB}$      | 4V~30V                 | 0.792 | 0.812 | 0.832 | V        |
| Feedback Current                         | $I_{FB}$      | $V_{EN}=0V$            |       | 0.1   | 1.0   | $\mu A$  |
| Switch-On Resistance                     | $R_{DS(ON)}$  | $V_{BST}-V_{SW}=5V$    |       | 1.0   |       | $\Omega$ |
| Switch Leakage                           | $I_{SW\_LKG}$ | $V_{EN}=0V, V_{SW}=0V$ |       |       | 1.0   | $\mu A$  |
| Current Limit                            | $I_{LIM}$     |                        | 1.0   | 1.25  | 1.5   | A        |
| Oscillator Frequency                     | $f_{SW}$      | $V_{FB}=0.6V$          | 380   | 480   | 580   | kHz      |
| Foldback Frequency                       | $f_{SW\_F}$   | $V_{FB}=0V$            |       | 100   |       | kHz      |
| Minimum ON-Time(1)                       | $\tau_{ON}$   |                        |       | 100   |       | ns       |
| Under-Voltage Lockout Threshold, Rising  | $V_{UVLO\_R}$ |                        | 2.9   | 3.3   | 3.7   | V        |
| Under-Voltage Lockout Threshold, Falling | $V_{UVLO\_F}$ |                        | 2.65  | 3.05  | 3.45  | V        |
| EN Threshold, Rising                     | $V_{EN\_R}$   |                        |       | 1.35  |       | V        |
| EN Threshold, Falling                    | $V_{EN\_F}$   |                        |       | 1.17  |       | V        |
| EN Input Current                         | $I_{EN}$      | $V_{EN}=2V$            |       | 3.1   |       | $\mu A$  |
|  |               | $V_{EN}=0V$            |       | 0.1   |       |          |
| Supply Current(Shutdown)                 | $I_S$         | $V_{EN}=0V$            |       | 0.1   | 1.0   | $\mu A$  |
| Supply Current(Quiescent)                | $I_Q$         | $V_{EN}=2V, V_{FB}=1V$ |       | 0.73  | 0.85  | mA       |
| Thermal Shutdown(1)                      | $T_{SD}$      |                        |       | 165   |       | °C       |
| Thermal Shutdown Hysteresis(1)           | $T_{SD\_HYS}$ |                        |       | 20    |       | °C       |

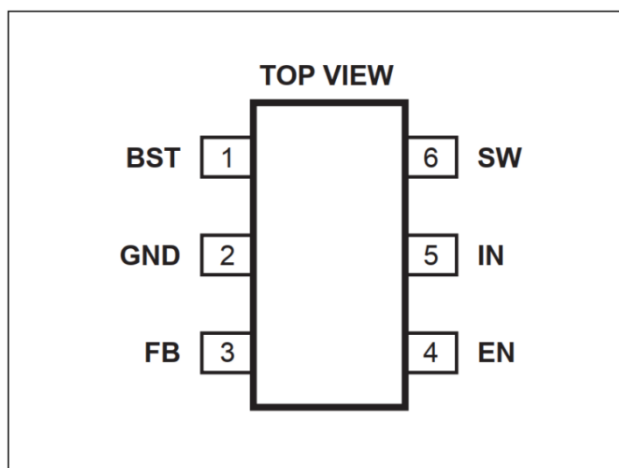
Notes:

1) Derived from bench characterization. Not tested in production.

## Ordering Information

| Part Number* | Package | Top Marking |
|--------------|---------|-------------|
| ECP2459      | SOT23-6 | 59XXX       |

## Package Reference



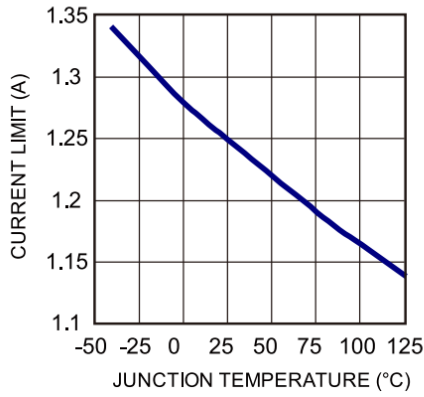
## Pin Functions

| Pin# | Name | Description   |
|------|------|---|
| 1    | BST  | Bootstrap pin for top switch. A 0.1uF or larger capacitor should be connected between this pin and the SW pin to supply current to the top switch and top switch driver.  |
| 2    | GND  | Ground pin.   |
| 3    | FB   | Output feedback pin. Input to the error amplifier. Set the output voltage. When the load is short-circuited, FB voltage is lower than 250mV, the return circuit will reduce the oscillation frequency to ensure reliable current limiting protection. |
| 4    | EN   | Enable input, pull the pin voltage below the specified threshold to close the chip. Pull above the specified threshold to make the chip work. Connect 100K resistor with IN to start automatically .  |
| 5    | IN   | Input voltage pin. VIN supplies power to the IC. Connect a 4.5V to 60V supply to VIN and bypass VIN to GND with a suitably large capacitor to eliminate noise on the input to the IC  |
| 6    | SW   | SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load.  |

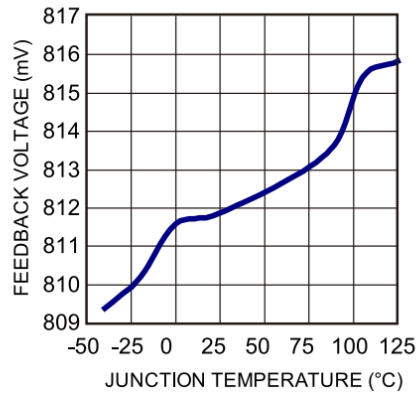
## Typical Characteristics

$V_{IN}=12V$ , unless otherwise noted.

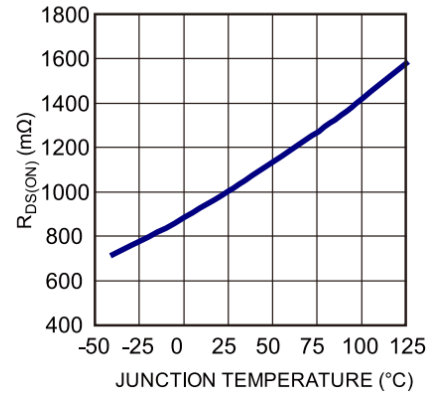
Current Limit vs.  $T_J$



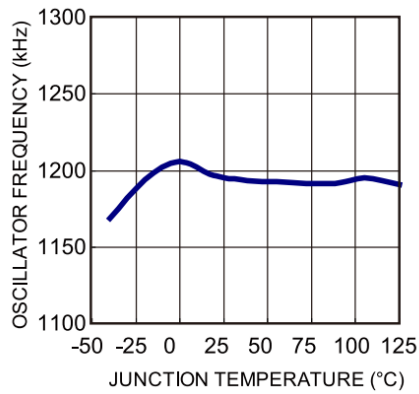
Feedback Voltage vs.  $T_J$



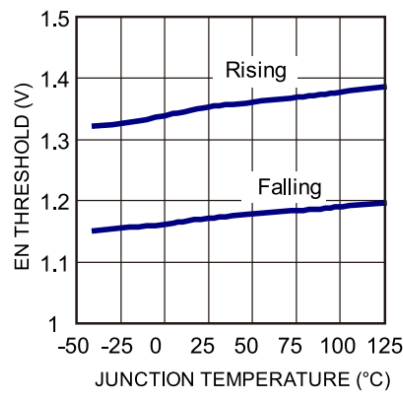
$R_{DS(ON)}$  vs.  $T_J$



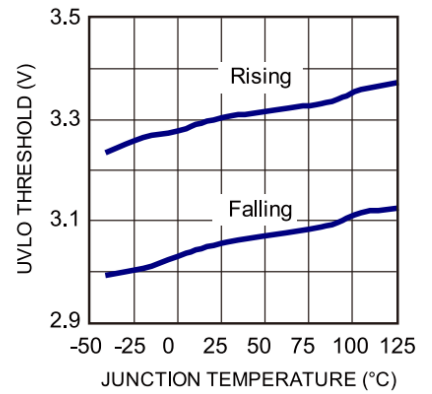
Oscillator Frequency vs.  $T_J$



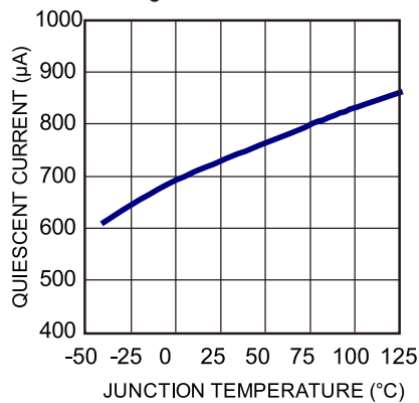
EN Threshold vs.  $T_J$



UVLO Threshold vs.  $T_J$

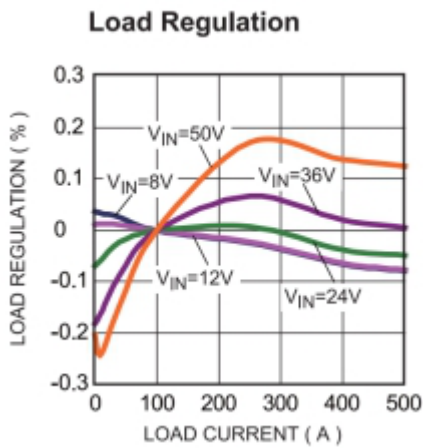
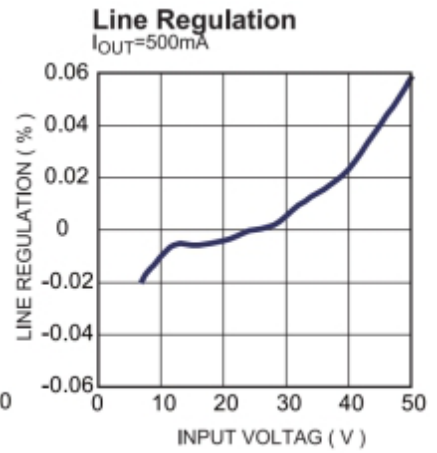
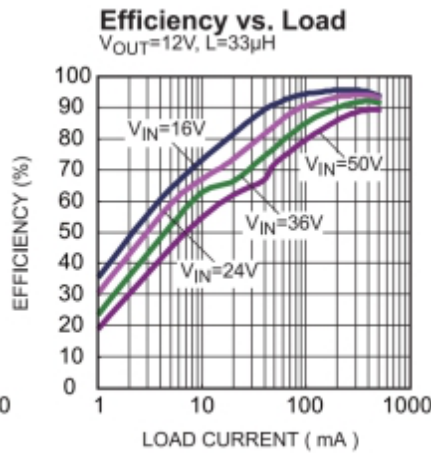
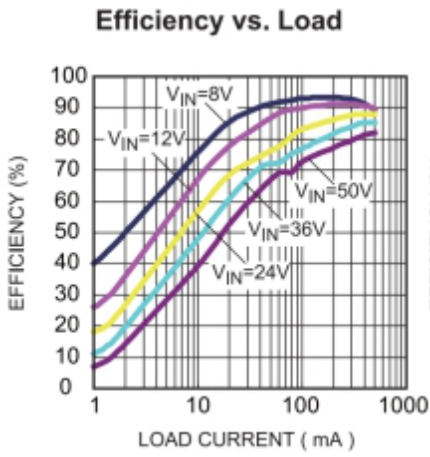


Quiescent Current vs.  $T_J$



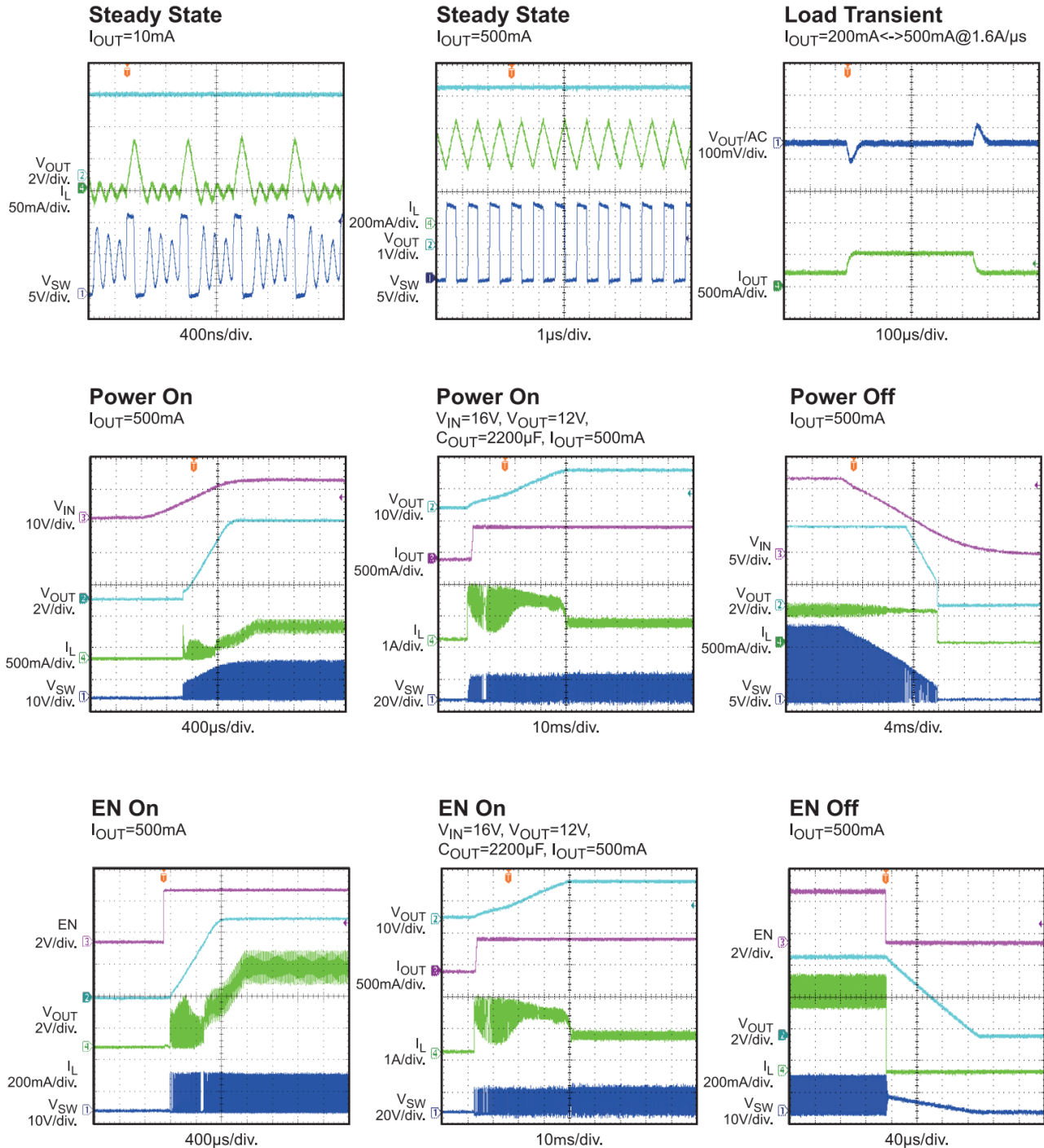
### Typical Performance Characteristics (continued)

$V_{IN}=12V$ ,  $V_{OUT}=5V$ ,  $L=10\mu H$ ,  $T_A=25^\circ C$ , unless otherwise noted.



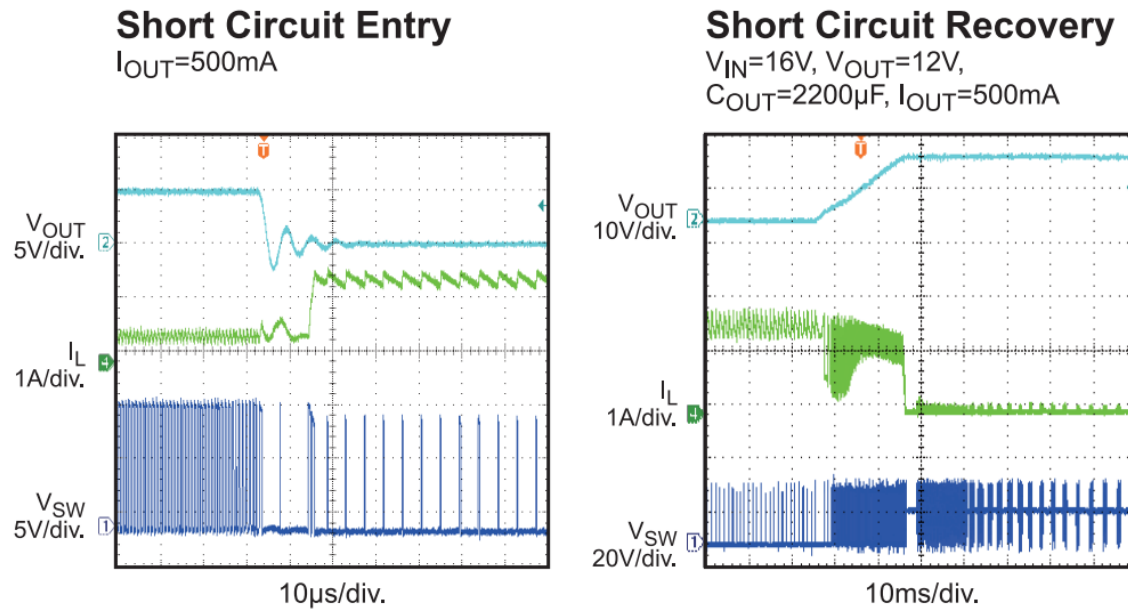
## Typical Performance Characteristics (continued)

V<sub>IN</sub>=12V, V<sub>OUT</sub>=5V, L=10μH, T<sub>A</sub>=25°C, unless otherwise noted.



## Typical Performance Characteristics (continued)

V<sub>IN</sub>=12V, V<sub>OUT</sub>=5V, L=10μH, T<sub>A</sub>=25°C, unless otherwise noted.



## Application Information

### Setting Output Voltage

The external resistor divider sets the output voltage (see the Typical Application schematic). Table 1 lists resistors for common output voltages. The feedback resistor (R2) also sets the feedback loop bandwidth with the internal compensation network (see Figure 1). R1 is:

$$R1 = \frac{R2}{\frac{V_{OUT}}{0.8V} - 1}$$

**Table1:** Resistor Selection for Common Output Voltages

| VOUT (V) | R1 (kΩ)  | R2 (kΩ)  |
|----------|----------|----------|
| 5        | 9.53(1%) | 49.9(1%) |
| 3.3      | 16.2(1%) | 49.9(1%) |
| 2.5      | 23.7(1%) | 49.9(1%) |
| 1.8      | 64.9(1%) | 80.6(1%) |

## Selecting the Inductor

The recommended inductor values are shown in the Application Diagram. It is important to guarantee the inductor core does not saturate during any foreseeable operational situation. The inductor should be rated to handle the peak load current plus the ripple current: Care should be taken when reviewing the different saturation current ratings that are specified by different manufacturers. Saturation current ratings are typically specified at 25°C, so ratings at maximum ambient temperature of the application should be requested from the manufacturer.

$$L = \frac{V_{OUT} * (V_{IN} - V_{OUT})}{V_{IN} * \Delta I_L * f_{SW}}$$

Where  $\Delta I_L$  is the inductor ripple current. Choose the inductor ripple current to be 30% of the maximum load current. The maximum inductor peak current is:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Under light-load conditions (below 100mA), use a larger inductance to improve efficiency.

## Selecting the Input Capacitor

The input capacitor reduces the surge current drawn from the input supply and the switching noise from the device. The input capacitor impedance at the switching frequency should be less than the input source impedance to prevent high-frequency-switching current from passing through the input. Use ceramic capacitors with X5R or X7R dielectrics for their low ESRs and small temperature coefficients. For most applications, a 4.7 $\mu$ F capacitor will be sufficient.

## Selecting the Output Capacitor

The output capacitor keeps the output voltage ripple small and ensures feedback loop stability. The output capacitor impedance should be low at the switching frequency. Use ceramic capacitors with X5R or X7R dielectrics for their low ESR characteristics. For most applications, a 22 $\mu$ F ceramic capacitor will be sufficient.



## PCB Layout Guide

PCB layout is very important to stability. Please follow these guidelines and use Figure 1 as reference.

- 1) Keep the path of switching current short and minimize the loop area formed by the input capacitor, high-side MOSFET, and Schottky diode.
- 2) Keep the connection from the power ground →Schottky diode→SW pin as short and wide as possible.
- 3) Ensure all feedback connections are short and direct. Place the feedback resistors and compensation components as close to the chip as possible.
- 4) Route SW away from sensitive analog areas such as FB.
- 5) Connect IN, SW, and especially GND to large copper areas to cool the chip for improved thermal performance and longterm reliability. For single layer PCBs, avoid soldering the exposed pad.

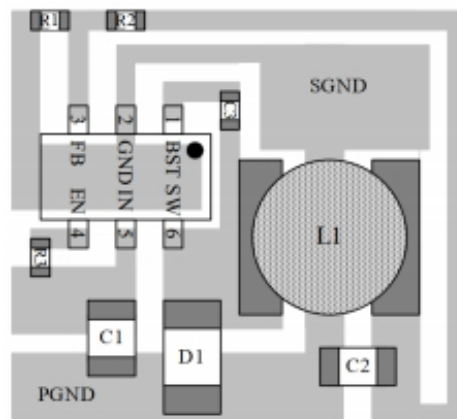


Figure 1:PCB Layout

### Typical Application Circuit

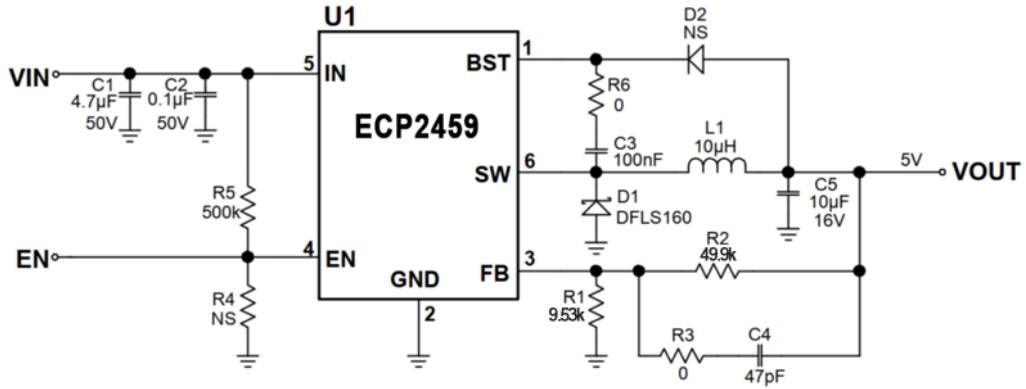


Figure 3: 5V Output Typical Application Circuit:

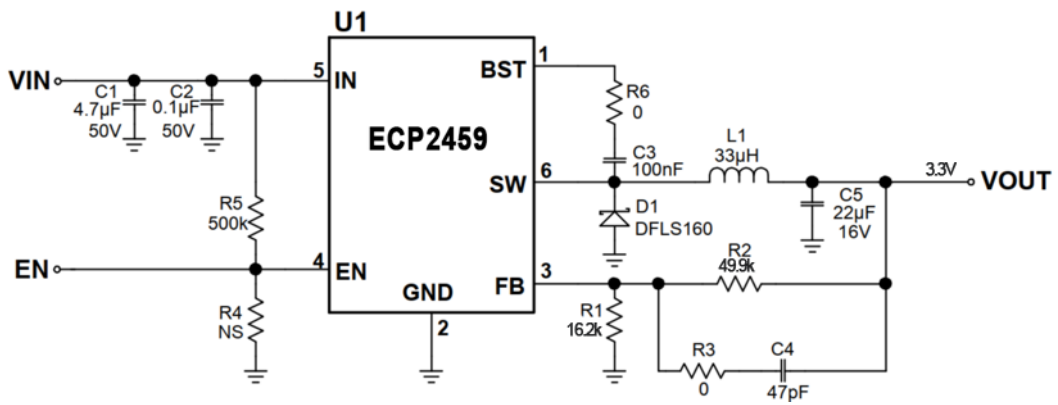
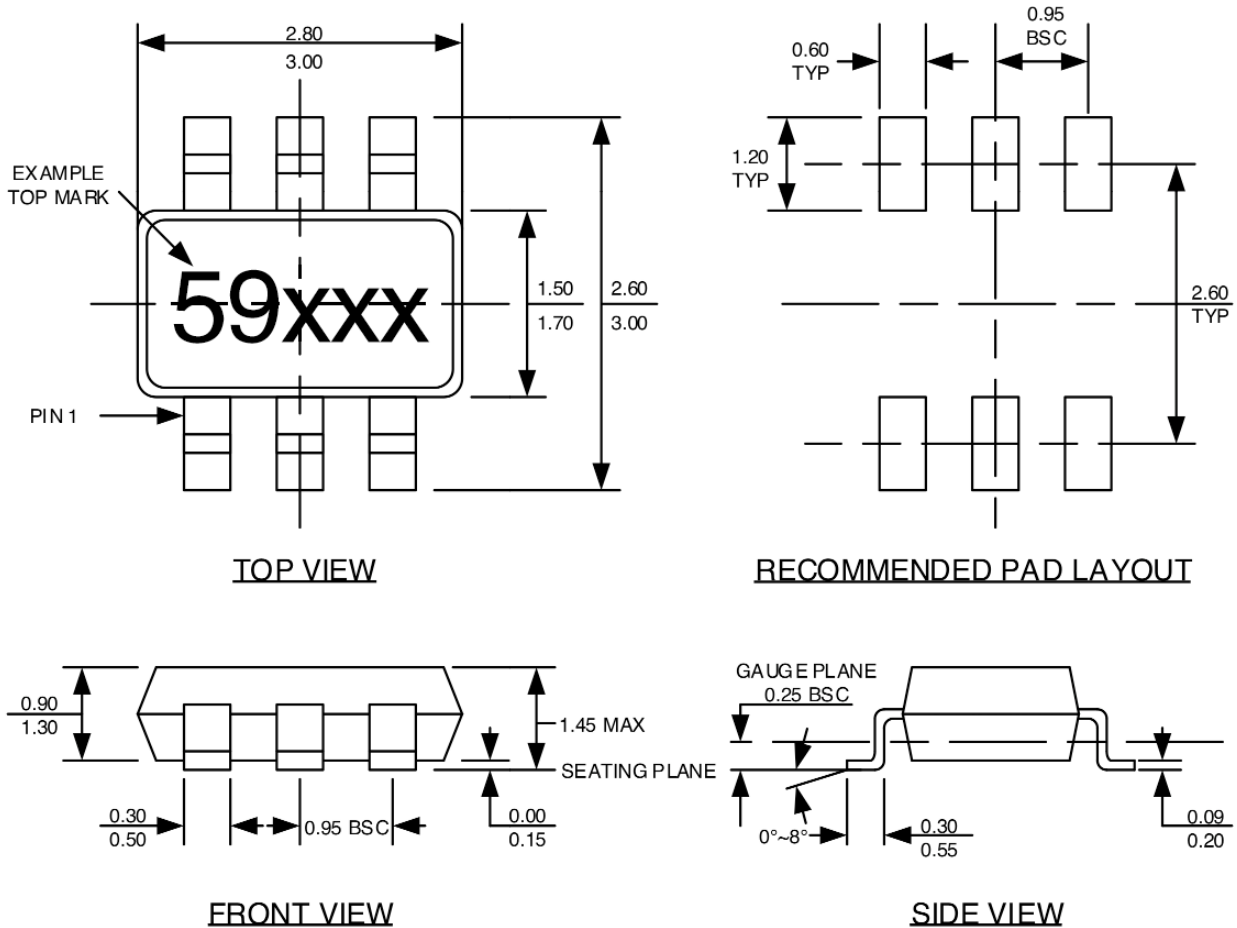


Figure 4: 3.3V Output Typical Application Circuit

## Package Information

### SOT23-6



#### Note:

1. All dimensions are in millimeters.
2. Package length does not include mold flash, protrusion or gate burr.
3. Package width does not include flash or protrusion.
4. Lead coplanarity (bottom of leads after forming) shall be 0.10 millimeters max.
5. Pin 1 is lower left pin when reading top mark from left to right.