

# 36V Wide Input Range 3A Step-Down Synchronous DC/DC Converter

## FEATURES

- P-MOS+N-MOS Switch Structure
- Wide Input Voltage: 4.3V to 36V
- Quiescent Current  $I_q=1\text{mA}$  Typical
- High Efficiency up to 93%@ $12V_{IN}$  to 5V/3A
- 3.0A Output Current
- PFM in Light Load Condition
- 75kHz to 600kHz Adjustable Switching Frequency
- Internal Compensation
- Hiccup Output Short Current Protection
- 1.22V Feedback Voltage
- Integrated Soft Start
- Thermal Shutdown
- Duty Cycle up to 100%
- Low BOM Cost
- SOP8 Package

## GENERAL DESCRIPTION

TMI3493 is a wide input voltage, high efficiency 3.0A synchronous rectified step-down converter. The TMI3493 operates at high efficiency over a wide output current load range. TMI3493 provides up to total 3A output current at 5V output. Switching frequency can be set by external resistor. Maximum 100% duty cycle could be obtained. TMI3493 internal integrate 78mΩ high side and 30mΩ low side power MOSFET.

Advanced production features include UVLO, Thermal Shutdown, Soft Start and input OVP.

## APPLICATIONS

- Automotive Equipment
- Car Charger/ Adaptor
- Rechargeable Portable Devices
- General-Purpose DC/DC Supply

## TYPICAL APPILCATION

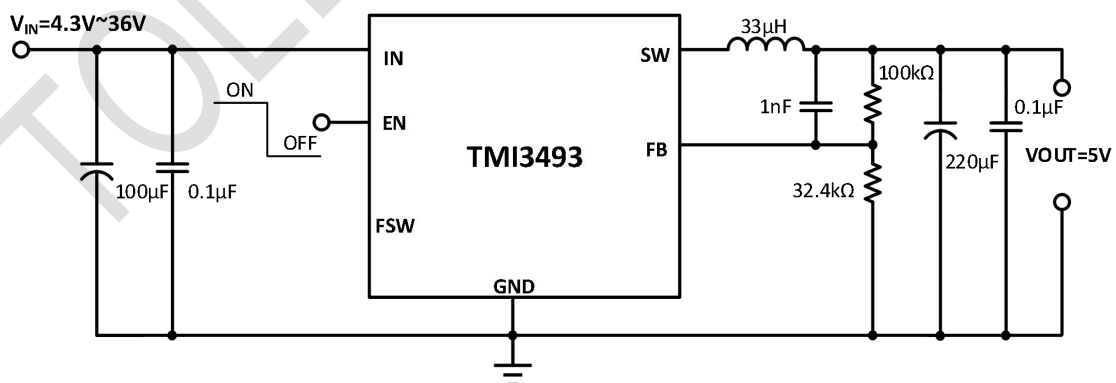


Figure 1. Basic Application Circuit with 120kHz Switching Frequency

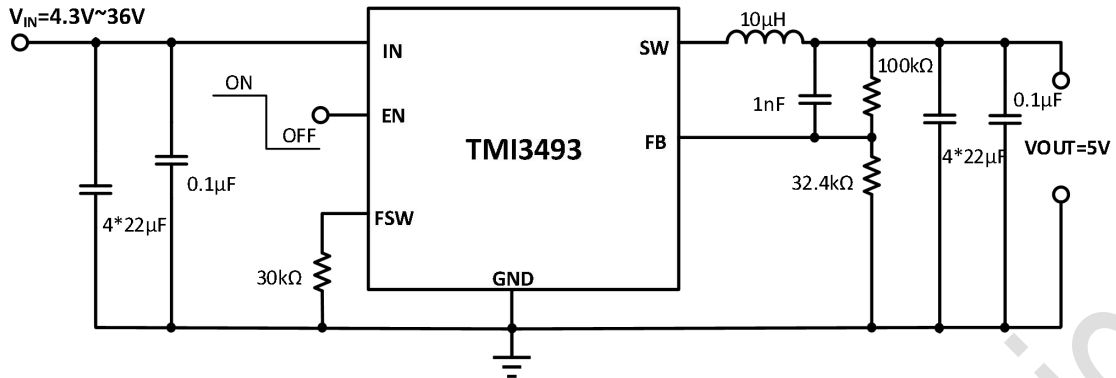


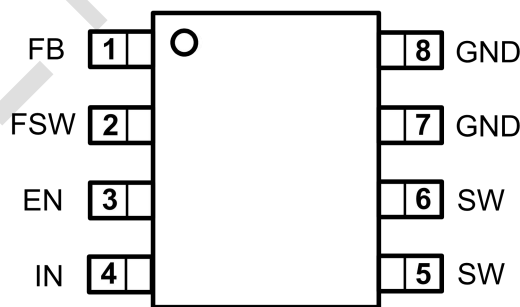
Figure 2. Basic Application Circuit with 320kHz Switching Frequency

### ABSOLUTE MAXIMUM RATINGS

| Parameter                              | Value   | Unit |
|--|---------|------|
| Input Supply Voltage IN, EN, SW        | -0.3~40 | V    |
| All Other Pins Voltage Range           | -0.3~6  | V    |
| Storage Temperature Range              | -65~150 | °C   |
| Junction Temperature Range             | -40~150 | °C   |
| Junction-to-ambient Thermal Resistance | 60      | °C/W |
| Junction-to-case Thermal Resistance    | 36      | °C/W |
| Power Dissipation                      | 2       | W    |
| Lead Temperature (Soldering, 10s)      | 260     | °C   |

Over operating free-air temperature range (unless otherwise noted)

### PACKAGE/ORDER INFORMATION



SOP8

Top Mark: T3493 XXXXX (T3493: Device Code, XXXXX: Inside Code)

| Part Number | Package | Top mark       | Quantity/ Reel |
|-------------|---------|----------------|----------------|
| TMI3493     | SOP8    | T3493<br>XXXXX | 3000           |

TMI3493 devices are Pb-free and RoHS compliant.

## PIN FUNCTIONS

| Pin | Name | Function  |
|-----|------|---|
| 1   | FB   | Feedback pin.   |
| 2   | FSW  | Switching Frequency set pin. Connected a resistor to ground.<br>If FSW pin is floating: Fs=130kHz. Short circuit to ground is prohibited. |
| 3   | EN   | Enable Pin. EN pin has internal pull up connection.   |
| 4   | IN   | Power input pin.  |
| 5   | SW   | Switch pin. Connected to external Inductor.   |
| 6   |      |   |
| 7   | GND  | Ground.   |
| 8   |      |   |

## ESD RATING

| Items            | Description                   | Value | Unit |
|------------------|-------------------------------|-------|------|
| V <sub>ESD</sub> | Human Body Model for all pins | ±2000 | V    |

JEDEC specification JS-001

## RECOMMENDED OPERATING CONDITIONS

| Items           | Description                          | Min | Max | Unit |
|-----------------|--------------------------------------|-----|-----|------|
| V <sub>IN</sub> | IN Voltage Range                     | 4.3 | 36  | V    |
| T <sub>J</sub>  | Operating Junction Temperature Range | -40 | 125 | °C   |

## ELECTRICAL CHARACTERISTICS

( $V_{IN}=12V$ ,  $V_{OUT}=5V$ ,  $T_A = 25^{\circ}C$ , unless otherwise noted.)

| Parameter                               | Test Conditions                               | Min  | Typ  | Max  | Unit        |
|---|---|------|------|------|-------------|
| Input Voltage Range                     |   | 4.3  |      | 36   | V           |
| Input Over Voltage Protection Threshold |   |      | 38   |      | V           |
| Under Voltage Lockout Threshold         | $V_{IN}$ rising                               |      | 3.8  |      | V           |
| UVLO Hysteresis                         |   |      | 0.16 |      | V           |
| Quiescent Current                       | no load                                       |      | 1    |      | mA          |
| Shutdown Current                        | EN=GND  |      | 65   |      | $\mu A$     |
| Feedback Voltage Accuracy               |   | 1.19 | 1.22 | 1.25 | V           |
| Soft Start Time                         |   |      | 4    |      | ms          |
| Switching Current limit                 | Duty=50%                                      |      | 4.8  |      | A           |
| SW leakage                              |   |      |      | 10   | $\mu A$     |
| Maximum Duty Cycle                      | $F_S=130kHz$                                  |      |      | 100  | %           |
| Switching Frequency                     | $R_{FSW}=30k\Omega$                           |      | 360  |      | kHz         |
|   | F <sub>SW</sub> pin floating                  |      | 130  |      | kHz         |
| Switch On-Resistance (high side)        | $V_{IN}=12V$                                  |      | 50   |      | m $\Omega$  |
|   | $V_{IN}=5V$                                   |      | 78   |      | m $\Omega$  |
| Switch On-Resistance (low side)         | $V_{IN}=12V$                                  |      | 30   |      | m $\Omega$  |
| Short circuit Frequency in Hiccup Mode  | $V_{FB}=0V$ ,<br>F <sub>SW</sub> pin floating |      | 40   |      | kHz         |
| Minimum On Time                         |   |      | 230  |      | ns          |
| EN Input Low Voltage                    |   |      |      | 0.3  | V           |
| EN Input High Voltage                   |   | 0.9  |      |      | V           |
| Thermal Shutdown Threshold              | Guaranteed By design                          |      | 150  |      | $^{\circ}C$ |
| Thermal Shutdown Hysteresis             | Guaranteed By design                          |      | 20   |      | $^{\circ}C$ |

## APPLICATION INFORMATION

TMI3493 is a wide input voltage, high efficiency step-down DC/DC converter. TMI3493 provides up to total 3A output current at 5V output. Switching frequency can be set by external resistor on FSW pin. Maximum 100% duty cycle could be obtained. TMI3493 internal Integrate 50mΩ@VIN=12V and 78mΩ@VIN=5V high side and 30mΩ low side power MOSFET at VIN=12V. Advanced production features include UVLO, Thermal Shutdown, Soft Start and input OVP.

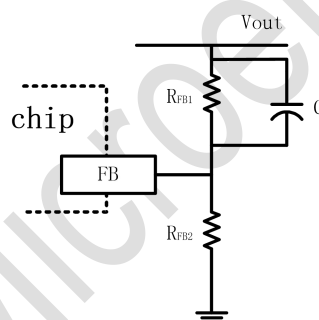
### Over Voltage Protection

The thresholds of input OVP circuit include are typical 38V. Once the input voltage is higher than the OVP threshold, the device is turned off. When the input voltage drops lower than the threshold, the high-side MOSFET will be enabled again.

### Thermal Shutdown

The TMI3493 disables switching when its junction temperature exceeds 150°C and resumes when the temperature has dropped by 20°C.

### Output Voltage Setting



**Figure 3. Output Voltage Setting**

Figure 3 shows the connection for setting the output voltage. Select the proper ratio of the two feedback resistors  $R_{FB1}$  and  $R_{FB2}$  based on the output voltage. Adding a capacitor in parallel with  $R_{FB1}$  helps the system stability and transient response. Typically, use  $R_{FB2} \approx 32.4\text{k}\Omega$  and determine  $R_{FB1}$  according to the following equation 1:

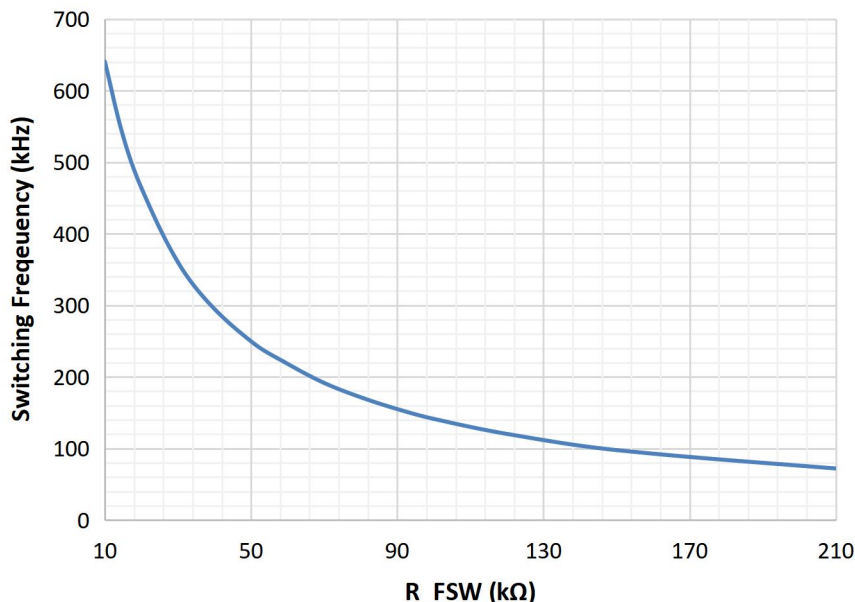
$$R_{FB1} = R_{FB2} \times \left( \frac{V_{OUT}}{1.22} - 1 \right) \quad \text{(Equation 1)}$$

### Short Circuits Protection

TMI3493 adapts peak current control mode and has peak current limit protection when output side is over current. The typical 4.8A output current limit is based on 33μH effective inductance value and 130kHz switching frequency. When output voltage drops until feedback voltage  $V_{FB}$  is below the output short voltage threshold  $V_{OS}$  which is about 0.765V (typical), TMI3493 enters into hiccup mode to periodically disable and restart switching operation. The hiccup mode helps to reduce power dissipation and thermal rise during output short to GND condition. In a typical application circuit with a switching frequency of 130kHz as shown in Figure 1, the period of hiccup mode is about 475ms.

**Programmable Switching Frequency**

The switching frequency of the device can be programmed by the resistor connected between FSW and GND. Figure 4 gives the curve of programmable switching frequency vs. resistance of R\_FSW. If FSW pin is floating: Fs=130kHz (typical). The recommended maximum switching frequency is 600kHz for all input voltage range.



**Figure 4. Switching Frequency vs. R\_FSW**

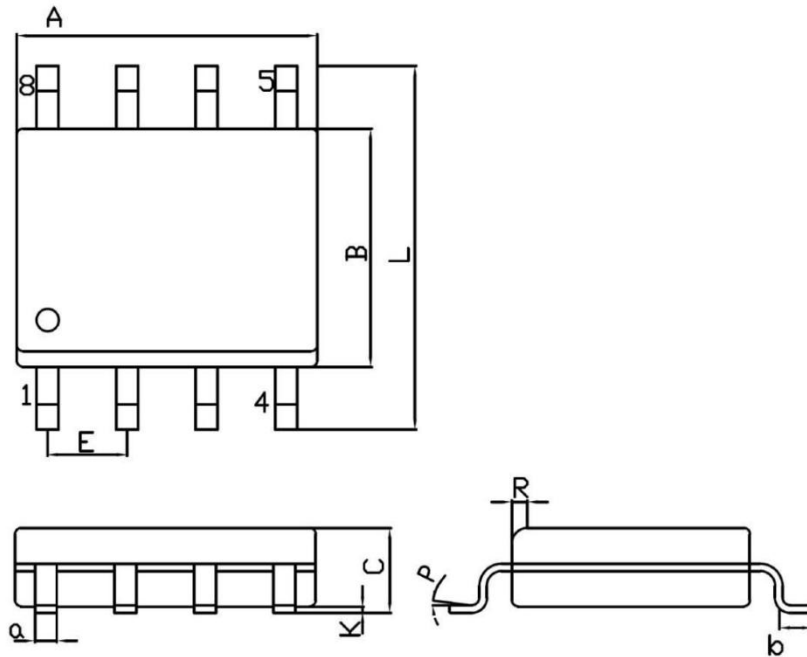
**PC Board Layout Guidance**

When laying out the printed circuit board, the Following checklist should be used to ensure proper operation of the IC.

- 1) Arrange the power components to reduce the AC loop size consisting of C<sub>IN</sub>, IN pin, SW pin and the IC power GND.
- 2) Place input decoupling ceramic capacitor C<sub>IN</sub> as close to IN pin as possible. C<sub>IN</sub> is connected power GND with via or short and wide path.
- 3) Return FB to signal GND pin, and connect the signal GND to power GND at a single point for best noise immunity.
- 4) Place feedback resistor close to FB pin.

**PACKAGE INFORMATION**

SOP8



Unit: mm

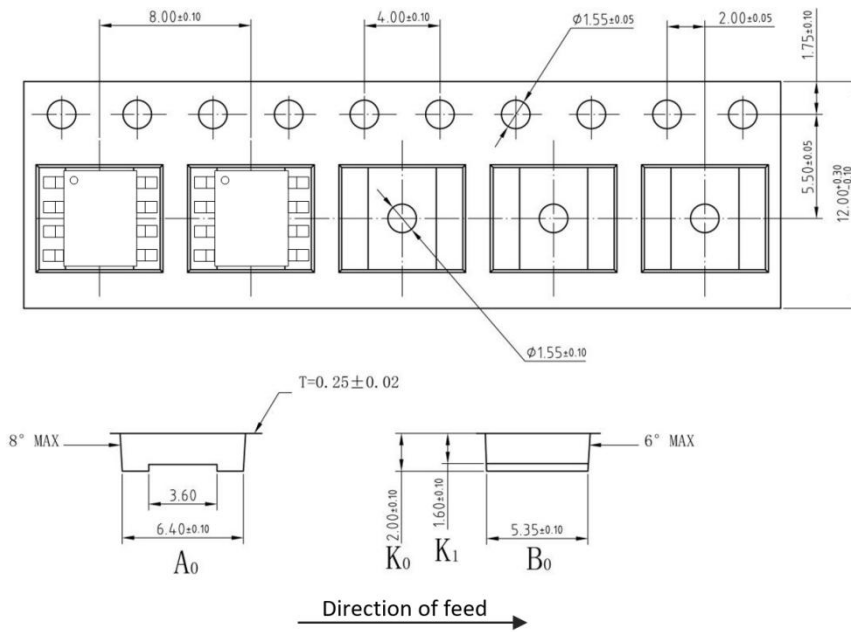
| Symbol | Dimensions In Millimeters |      | Symbol | Dimensions In Millimeters |      |
|--------|---------------------------|------|--------|---------------------------|------|
|        | Min                       | Max  |        | Min                       | Max  |
| A      | 4.70                      | 5.10 | C      | 1.35                      | 1.75 |
| B      | 3.70                      | 4.10 | a      | 0.35                      | 0.49 |
| L      | 6.00                      | 6.40 | R      | 0.30                      | 0.60 |
| E      | 1.27 BSC                  |      | P      | 0°                        | 7°   |
| K      | 0.12                      | 0.22 | b      | 0.40                      | 1.25 |

**Note:**

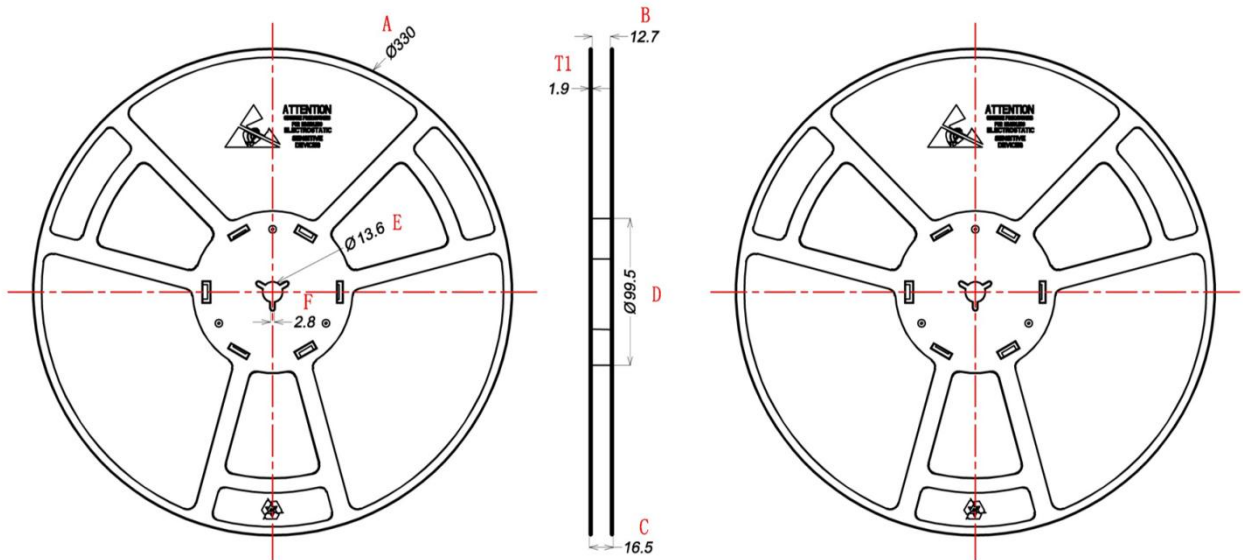
- 1) All dimensions are in millimeters.
- 2) Package length does not include mold flash, protrusion or gate burr.
- 3) Package width does not include inter lead flash or protrusion.
- 4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
- 5) Pin 1 is lower left pin when reading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

## TAPE AND REEL INFORMATION

### TAPE DIMENSIONS: SOP8



### REEL DIMENSIONS: SOP8



Unit: mm

| A                | B              | C              | D                   | E                   | F             | T1            |
|------------------|----------------|----------------|---------------------|---------------------|---------------|---------------|
| $\phi 330 \pm 1$ | $12.7 \pm 0.5$ | $16.5 \pm 0.3$ | $\phi 99.5 \pm 0.5$ | $\phi 13.6 \pm 0.2$ | $2.8 \pm 0.2$ | $1.9 \pm 0.2$ |

**Note:**

- 1) All Dimensions are in Millimeter
- 2) Quantity of Units per Reel is 3000
- 3) MSL level is level 3.