# 40V/3A, 9μA IQ, High Efficiency Synchronous Step-Down Converter

## DESCRIPTION

The ETA2893 is a high-efficiency and high-frequency DC-to-DC step-down switching regulator, capable of delivering up to 3A of output current. The device operates with input voltage from 3.6V to 40V, making the ETA2893 ideal for wide input voltage range power conversion. ETA2893 adopts adjustable frequency current mode, the high frequency allows the use of small inductance value and low DCR inductors, thereby achieving higher space efficiencies. During light load, the converter goes into PFM mode that saves switching loss to achieve high power efficiency.

ETA2893 is available in ESOP8 package.

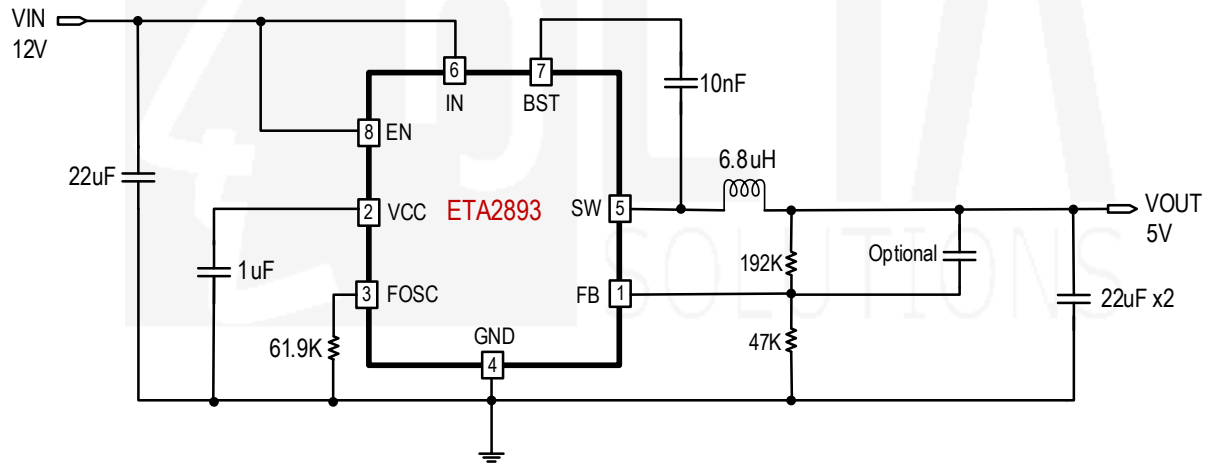
## FEATURES

- Wide Input voltage range 3.6V-40V
- Ultra No load IQ 9uA
- Capable of Delivering 3A output
- Current mode Control
- Programmable switching frequency
- High Efficiency PFM mode at light load
- High Efficiency Synchronous operation
- Low Rdson Internal power FETs
- Thermal Shutdown and UVLO protection
- Available in ESOP8 Package

## APPLICATIONS

- Vehicle Electrical Devices
- Smart Home
- Surveillance

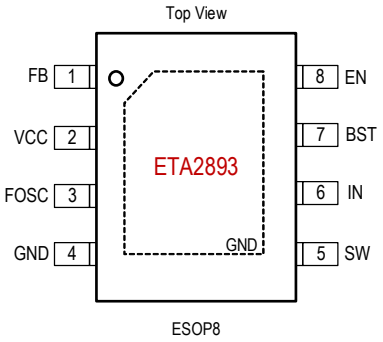
## TYPICAL APPLICATION




## ORDERING INFORMATION

| PART No. | PACKAGE | TOP MARK | Pcs/Reel |
|---|---|---|---|
| ETA2893E8A | ESOP8 | ETA2893<br>YWW2L | 4000 |

## PIN CONFIGURATION




## ABSOLUTE MAXIMUM 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 45V
BST Voltage .....–0.3V to SW+6V
FB,FOSC,VCC Voltage .....–0.3V to 6.5V
Operating Temperature Range .....–40°C to 85°C
Storage Temperature Range.....–55°C to 150°C
Thermal Resistance $\theta_{JA}$ $\theta_{JC}$
ESOP8 .....50.....10.....°C/W
Lead Temperature (Soldering 10sec) .....260°C

## ELECTRICAL CHARACTERISTICS

($V_{IN}$ = 12V, $V_{OUT}$ = 5V, unless otherwise specified. Typical values are at TA = 25°C.)

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| Input Voltage Range (1) | | 3.6 | | 40 | V |
| Input UVLO | Rising | | 3.9 | | V |
| | Falling | | 3.6 | | V |
| Input OVP (1) | Rising | | 40 | | V |
| | Falling | | 37.5 | | V |
| Input Supply Current | $V_{FB}$=1.1V, no switching | | 9 | | μA |
| Input Shutdown Current | | | 1.2 | | μA |
| VCC Internal Voltage | | 5 | 5.5 | 6 | V |
| VCC Current Limit | | | 30 | | mA |
| FB_ Voltage | | 0.985 | 1 | 1.015 | V |
| FB_ Input Current (1) | | | 0 | | μA |
| Switching Frequency | Ff, $R_{OSC}$ open | | 130 | | KHz |
| | $R_{OSC}$=62K | | 456 | | KHz |
| | Fs, $R_{OSC}$ =0 | | 1.1 | | MHz |
| Switching Frequency Range | | 130 | | 1100 | KHz |
| Maximum Duty Cycle | $F_{SW}$=500KHz, $C_{BST}$=10nF, $V_{IN}$=4.9V, Voutset=5V | | 99 | | % |
| Short Circuit Hiccup Time (1) | On Time, $F_{SW}$=500KHz | | 2.5 | | mS |
| | Off Time, $F_{SW}$=500KHz | | 6.5 | | mS |
| FB_ Hiccup Falling Threshold | | | 42 | | %VFB |

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| FB_ Hiccup Rising | | | 46 | | %VFB |
| FB_ OVP Rising | | | 113 | | %VFB |
| FB_ OVP Falling | | | 111 | | %VFB |
| Load Step | $V_{IN}$ = 12V, $V_{OUT}$ = 5V, $C_{OUT}$=44uF,$I_{OUT}$=0.1A to 3A | | 5 | | %/A |
| High Side Switch On Resistance (1) | | | 131 | | mΩ |
| Low Side Switch On Resistance (1) | | | 84 | | mΩ |
| High Side Current Limit (1) | | | 6.5 | | A |
| | During Foldback | | 2.1 | | A |
| Low Side Zero Crossing Current (1) | | | 100 | | mA |
| SW Leakage Current | $V_{IN}$=$V_{SW}$=12V | | 0 | | μA |
| FOSC Voltage | | | 1 | | V |
| EN Rising Threshold | Rising | | 1 | | V |
| EN Falling Threshold | Falling | | 0.9 | | V |
| EN Pull Up Current | $V_{EN}$=0V | | 0.25 | | uA |
| Thermal Shutdown (2) | Rising | | 160 | | °C |
| Thermal Shutdown Hys (2) | | | 40 | | °C |

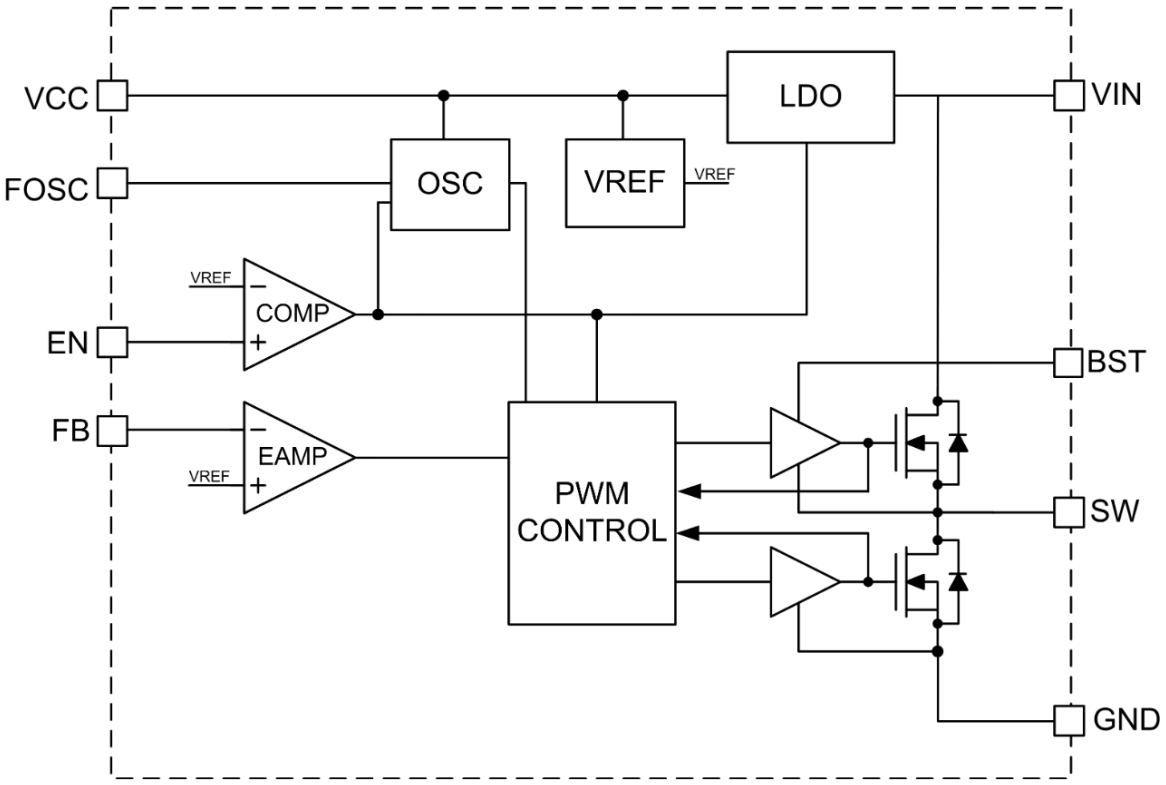
**Notes**:

1) Guaranteed by Design
2) Guaranteed by Engineering Characterization

## PIN DESCRIPTION

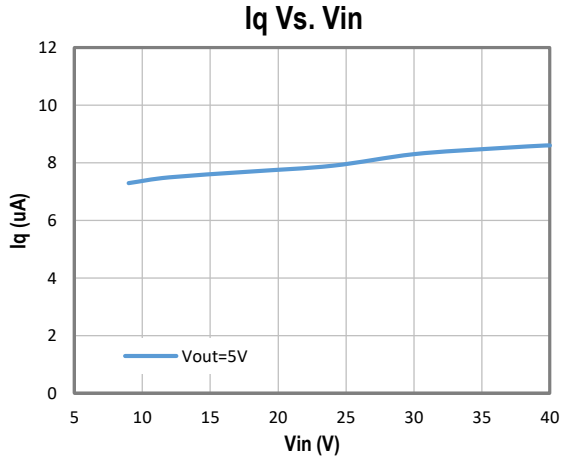
| PIN # | NAME | DESCRIPTION |
|---|---|---|
| 1 | FB | Feedback Input. Connect an external resistor divider from the output to FB and GND to set $V_{OUT}$ |
| 2 | VCC | Power supply pin for internal circuit. Bypass with a 1uF capacitor |
| 3 | FOSC | Frequency Setting pin. Connect a resistor from this pin to GND to set the switching frequency between 130KHz to 1.1MHz. The switching frequency equals to: $F_{SW}=28000/R_{OSC}$ KHz, where $R_{OSC}$ is in KΩ |
| 4 | GND | Ground pin |
| 5 | SW | Inductor Connection. Connect an inductor between SW and the regulator output |
| 6 | IN | Input power pin. Bypass to GND with a minimum 10uF X7R or X5R capacitor |
| 7 | BST | Bootstrap pin . Connect a 10nF capacitor from this pin to SW |
| 8 | EN | Enable pin. Drive this pin high or floating to enable, low to disable.It has an accurate threshold for seting UVLO externally |
| Exposed Pad | GND | Ground pin |

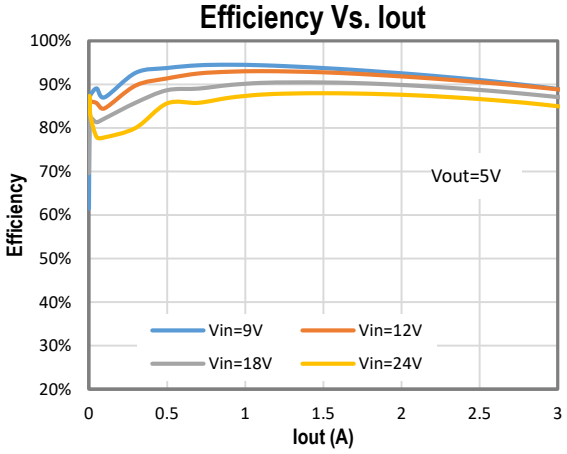
## FUNCTIONAL BLOCK DIAGRAM

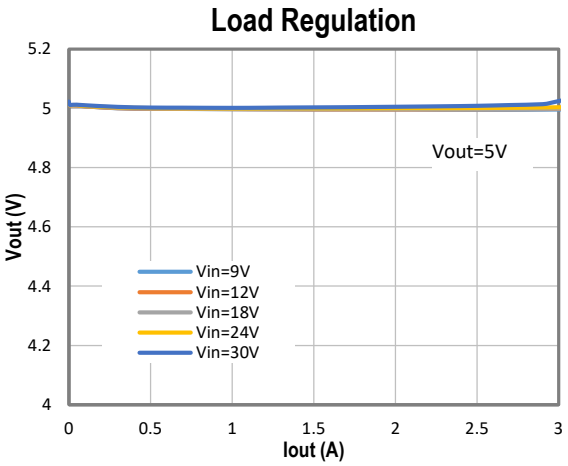


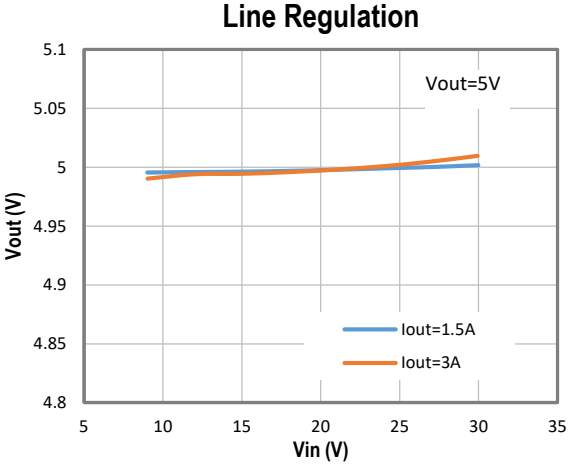
## TYPICAL CHARACTERISTICS

(Typical values are at $T_A$ = 25°C unless otherwise specified.)




## FUNCTIONAL DESCRIPTION

ETA2893 is a wide input range, high-efficiency and high-frequency DC-to-DC step-down switching regulators. It is capable of delivering up to 3A of output current

### *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 Rdson of the MOSFET and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. ETA2893 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 ETA2893 on and off. Drive EN High or floating to turn on the regulator, drive it Low to turn it off. An internal 0.25uA pullup current from VIN to EN allows EN float to turn on the chip.

### Over Current Protection and Hiccup

ETA2893 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 (42%Vfb), the ETA2893 will enter hiccup mode. It will turn off the chip immediately for 6.5mS. After that, it will try to re-starts as normal for 2.5mS. After 2.5mS, 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 160°C, allowing the device to cool down. When the junction temperature cools to approximately 120°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 ETA2893 regulator is programmed using an external resistor divider. The output voltage is calculated using below equation.

$$V_{OUT} = V_{FB} \times \ (1 + \frac{R_1}{R_2})$$

Where: $V_{FB}$ =1V typically

Resistors R2 has to be between 10kΩ to 100KΩ and thus R1 is calculated by following equation.

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

### External Frequency Setting

Use a resistor from FOSC pin to GND to setting the switching frequency.

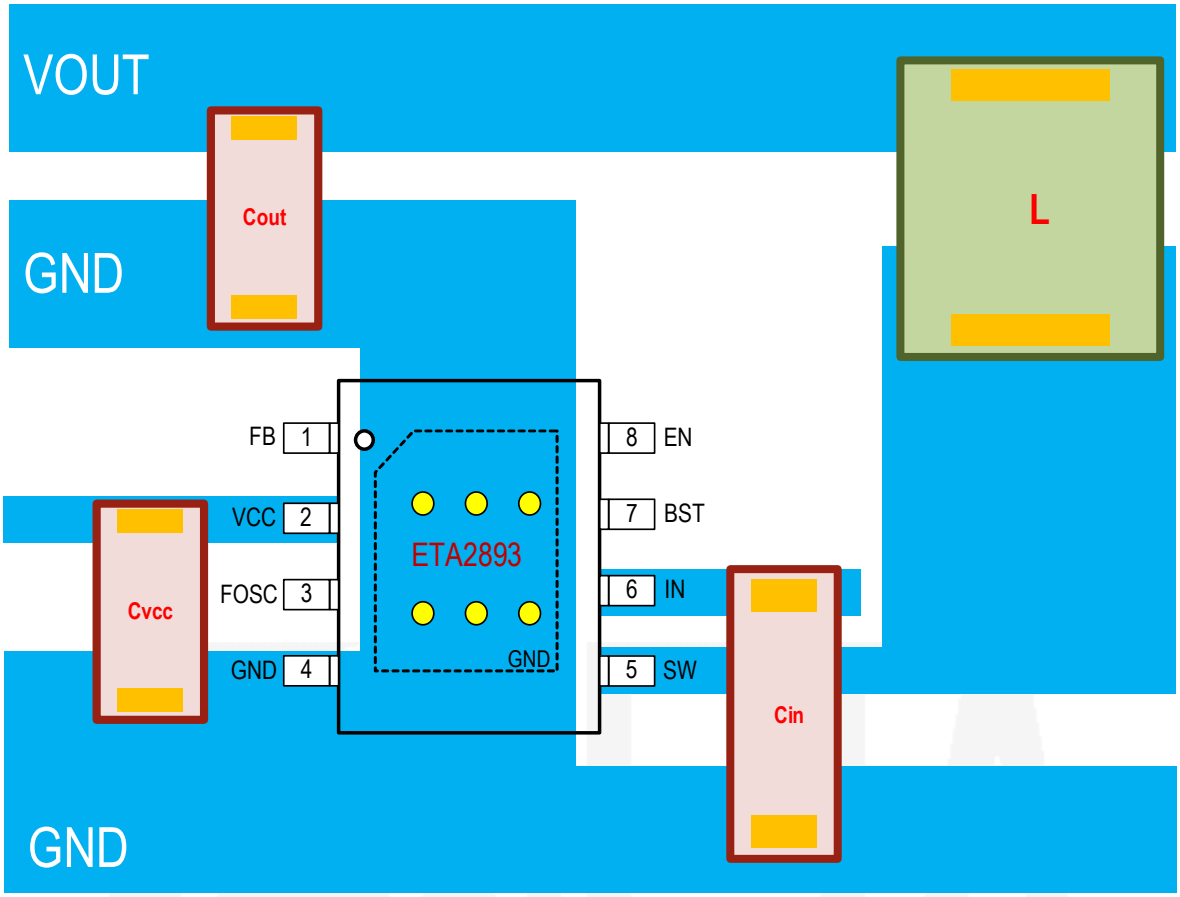
$$F_{sw} = \frac{28000}{R_{osc}} \quad (KHz)$$

With $R_{OSC}$ in KΩ.

If $R_{OSC}$ > 300KΩ the frequency will be fix is $F_{sw}$ =130KHz (Ff), incase $R_{OSC}$ < 30KΩ the frequency will be fix is $F_{sw}$= 1.1Mhz (Fs).

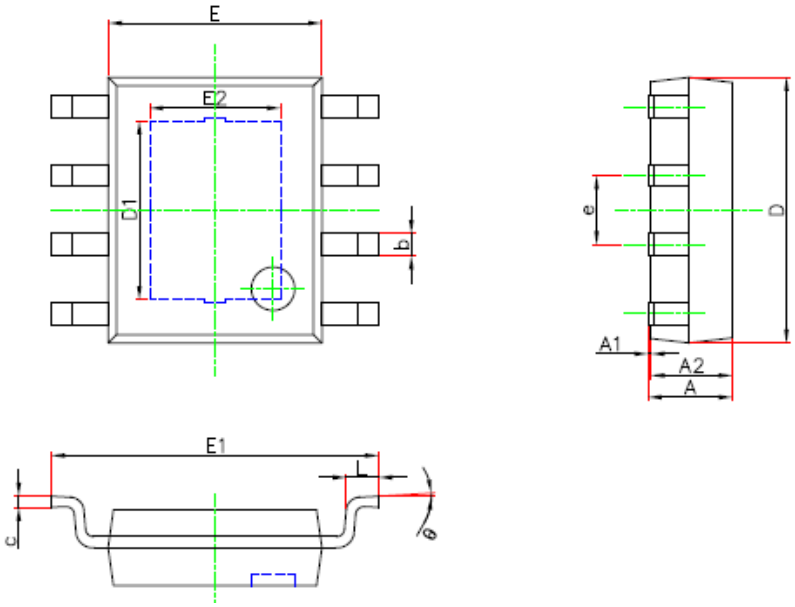
## PCB LAYOUT GUIDE

Keep the power devices as close to the chip as possible to achieve the smallest power loop area, which leads to the best EMI performance; Cin is always placed nearest to Vin and GND



## PACKAGE OUTLINE

Package: ESOP8




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 1.300 | 1.700 | 0.051 | 0.067 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.007 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.201 |
| D1 | 3.202 | 3.402 | 0.126 | 0.134 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.200 | 0.228 | 0.244 |
| E2 | 2.313 | 2.513 | 0.091 | 0.099 |
| e | 1.270(BSC) | | 0.050(BSC) | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

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