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

DESCRIPTION

The ETA2894 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 ETA2894 ideal for wide input voltage range power conversion. ETA2894 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.

ETA2894 is available in QFN3x4-24 package.

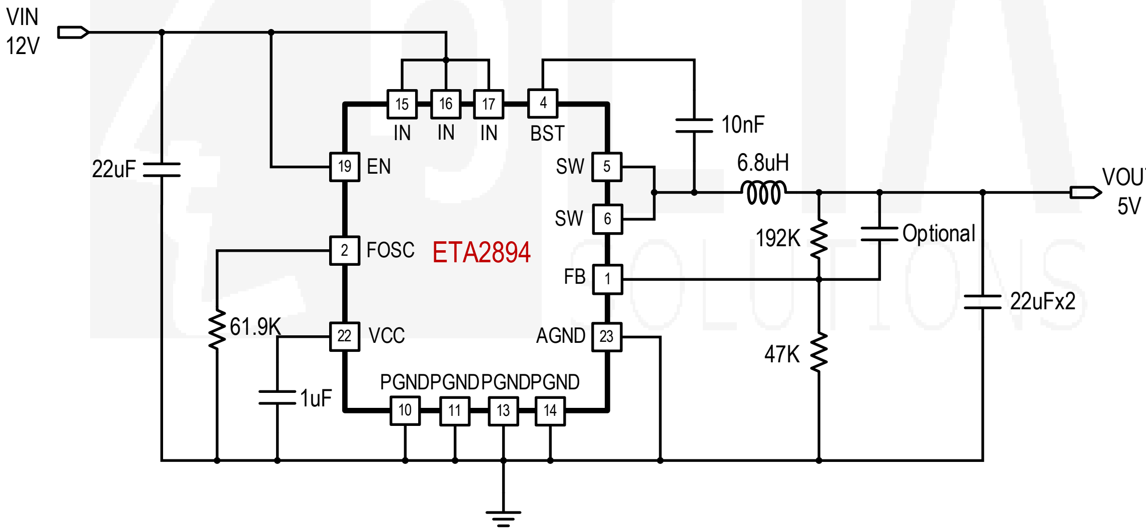
FEATURES

- 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 QFN3x4-24 Package

APPLICATIONS

- Vehicle Electrical Devices
- Smart Home
- Surveillance

TYPICAL APPLICATION

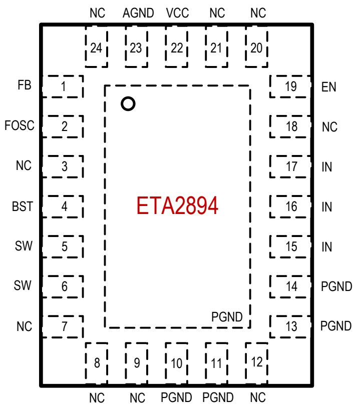


ORDERING INFORMATION

PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA2894Q3Y	QFN3x4-24	ETA2894 YWW2L	5000

PIN CONFIGURATION

Top View



QFN3x4-24

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 θ_{JA} θ_{JC}
QFN3x4-24……………….…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, Hysteresis=320mV		3.9		V
	Falling		3.6		V
Input OVP (1)	Rising, Hysteresis=5V		40		V
	Falling		35		V
Input Supply Current	VFB=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		150		1100	Khz
Maximum Duty Cycle	FSW=500KHz, Cbst=10nF, VIN=4.9V, Voutset=5V		99		%
Short Circuit Hiccup Time (1)	On Time, FSW=500KHz		2.5		mS
	Off Time, FSW=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	VIN = 12V, VOUT = 5V, cout=44uF, Iload=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	IN=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	VEN=0V		0.25		uA
Thermal Shutdown (2)	Rising		160		°C
Thermal Shutdown Hys (2)			40		°C

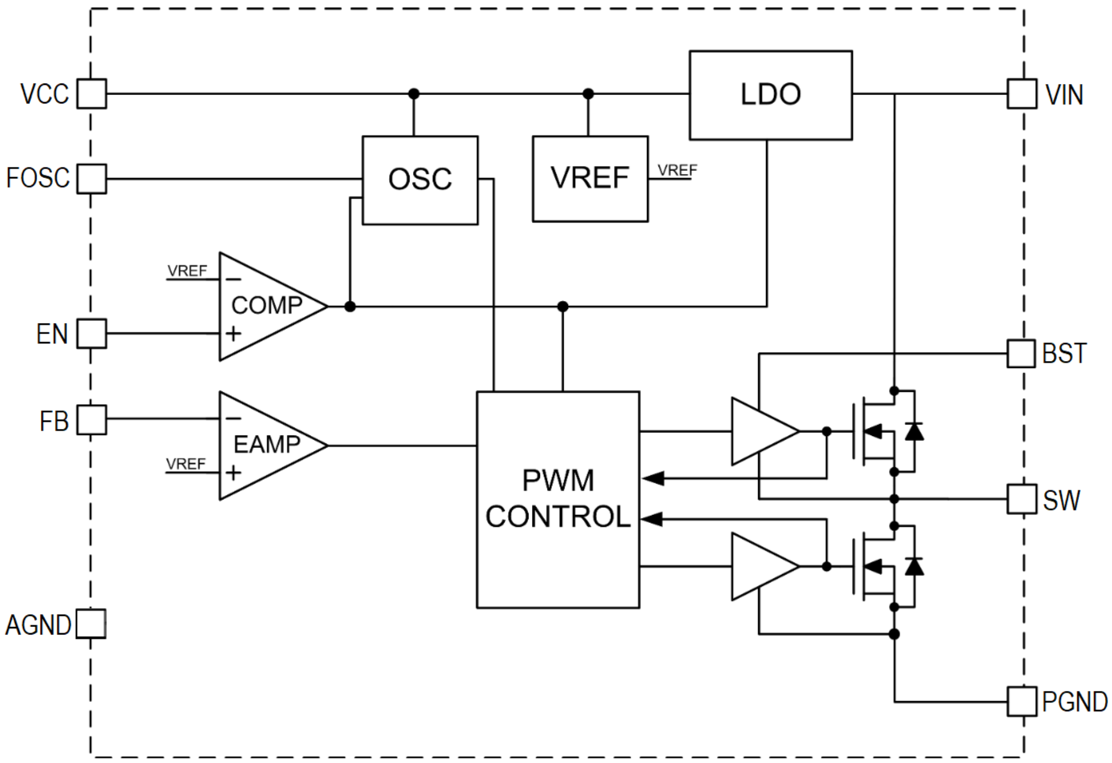
Notes:

1) Guaranteed by Design
2) Guaranteed by Engineering Characterization

PIN DESCRIPTION

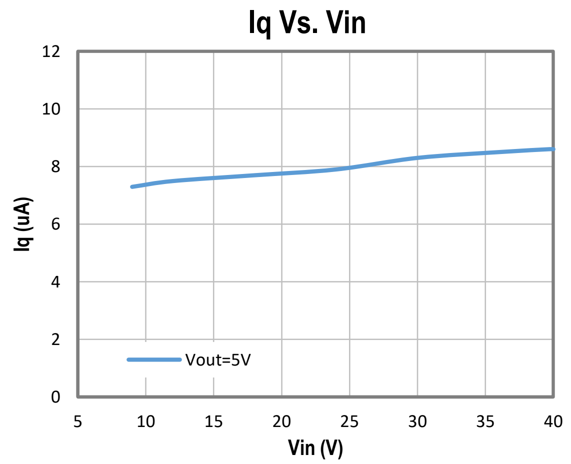
PIN#	NAME	DESCRIPTION
1	FB	Feedback Input. Connect an external resistor divider from the output to FB and GND to set V_{OUT}
22	VCC	Power supply pin for internal circuit. Bypass with a 1uF capacitor
2	FOSC	Frequency Setting pin. Connect a resistor from this pin to GND to set the switching frequency between 130kHz to 1.1MHz. The switching frequency equals to: F_{SW}=28000/R_{OSC} kHz, where R_{OSC} is in kΩ
5,6	SW	Inductor Connection. Connect an inductor between SW and the regulator output
15,16,17	IN	Input power pin. Bypass to GND with a minimum 10uF X7R or X5R capacitor
4	BST	Bootstrap pin . Connect a 10nF capacitor from this pin to SW
19	EN	Enable pin. Drive this pin high or floating to enable, low to disable.It has an accurate threshold for seting UVLO externally
10,11,13,14/ Exposed Pad	PGND	Power Ground pin
23	AGND	Analog Ground pin. Short to PGND
3,7,8,9,12, 18,20,21,24	NC	Not Connected

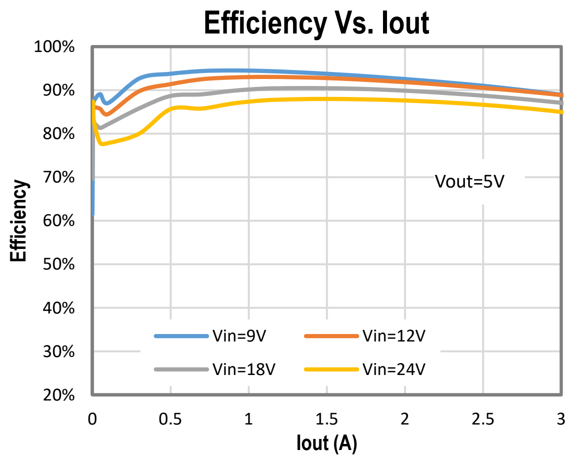
FUNCTIONAL BLOCK DIAGRAM

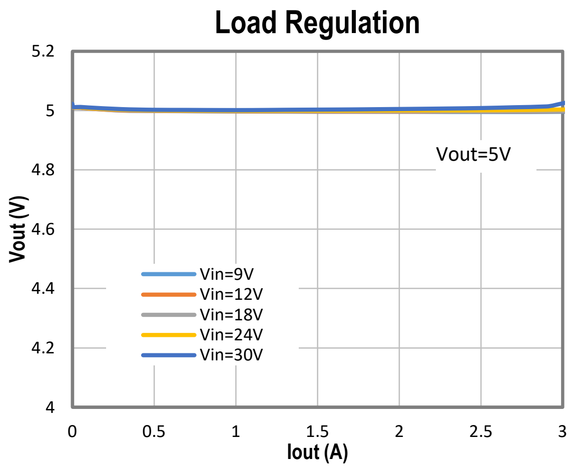


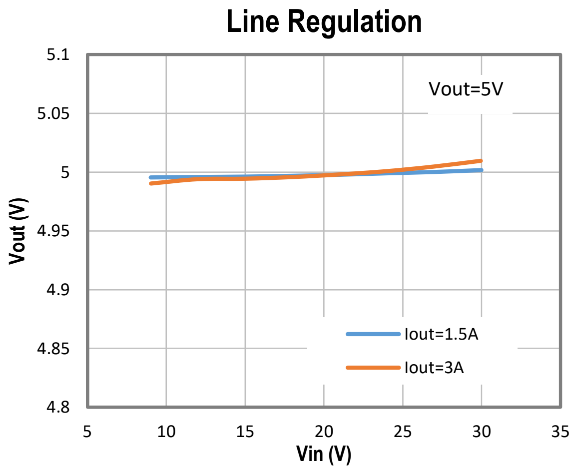
TYPICAL CHARACTERISTICS

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









FUNCTIONAL DESCRIPTION

ETA2894 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. ETA2894 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 ETA2894 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

ETA2894 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 ETA2894 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 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 110°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 ETA2894 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.

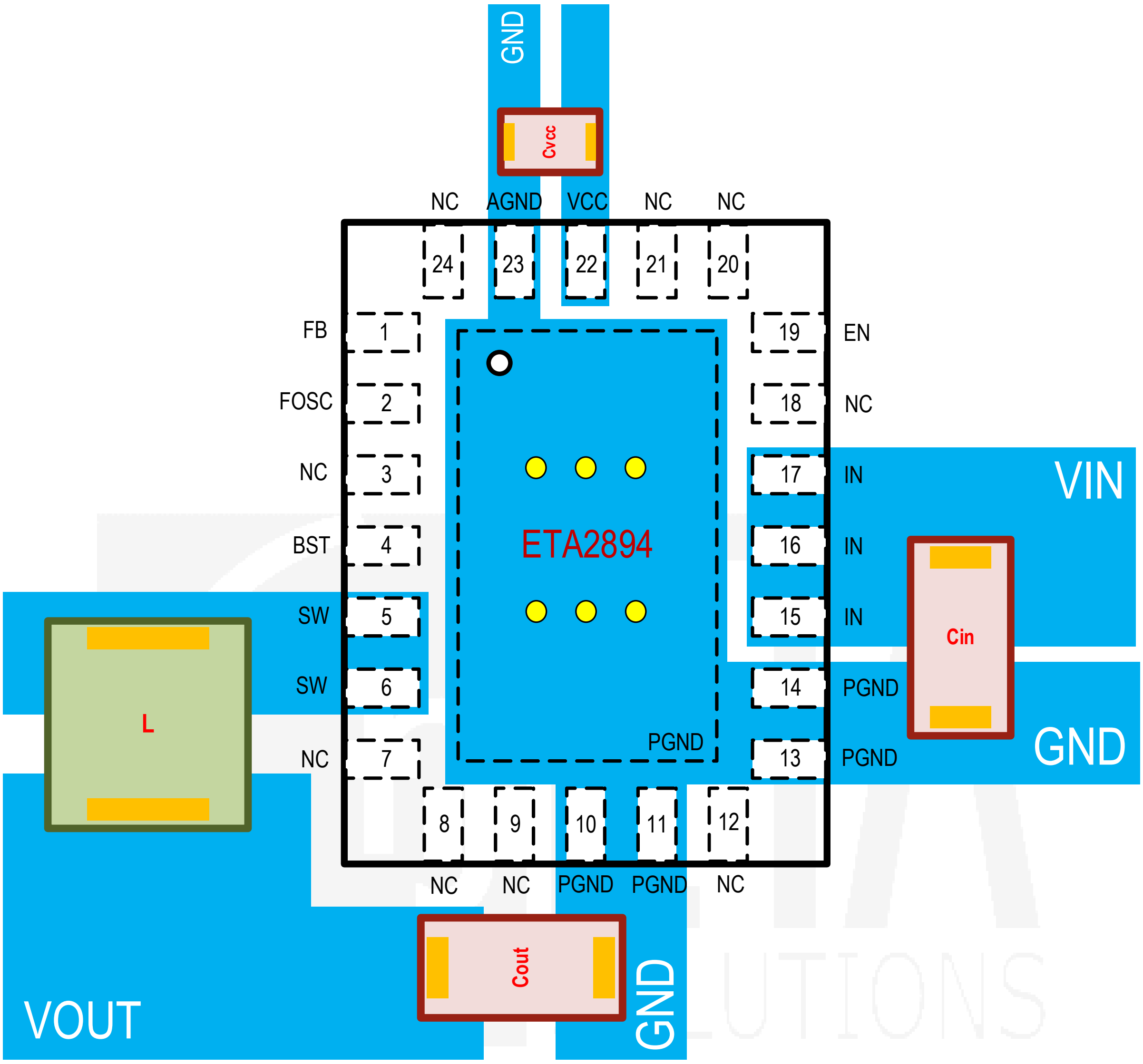
$$F_{sw} = \frac{28000}{R_{osc}} \quad (Khz)$$

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).

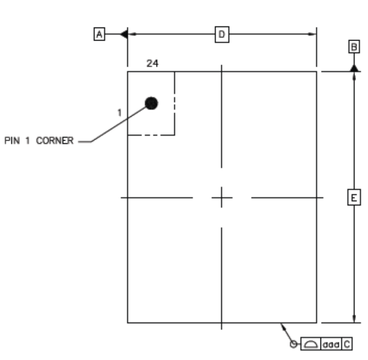
PCB LAYOUT GUIDE

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

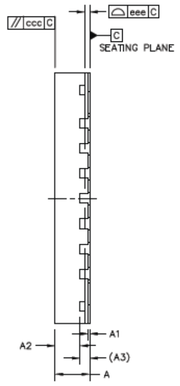


PACKAGE OUTLINE

Package: QFN3x4-24

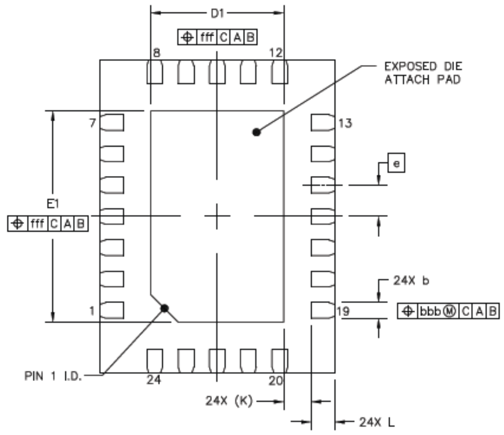


TOP VIEW



SIDE VIEW

		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.5	0.55	0.6
STAND OFF		A1	0	0.02	0.05
MOLD THICKNESS		A2	---	0.4	---
L/F THICKNESS		A3	0.152 REF		
LEAD WIDTH		b	0.15	0.2	0.25
BODY SIZE	X	D	3 BSC		
	Y	E	4 BSC		
LEAD PITCH		e	0.4 BSC		
EP SIZE	X	D1	1.6	1.7	1.8
	Y	E1	2.6	2.7	2.8
LEAD LENGTH		L	0.25	0.3	0.35
LEAD TIP TO EXPOSED PAD EDGE		K	0.35 REF		
PACKAGE EDGE TOLERANCE		aaa	0.1		
MOLD FLATNESS		ccc	0.1		
COPLANARITY		eee	0.08		
LEAD OFFSET		bbb	0.1		
EXPOSED PAD OFFSET		fff	0.1		



BOTTOM VIEW

NOTES

1.REFER TO JEDEC MO-220;
2.COPLANARITY APPLIES TO LEADS, CORNER LEADS AND DIE ATTACH PAD;
3.BAN TO USE THE LEVEL 1 ENVIRONMENT-RELATED SUBSTANCES OF JCET PRESCRIBING;
4.FINISH: Cu/EP • Sn8~20s