

## **5.5V Input, 9A, Synchronous Step-Up Converter with Output Disconnect**

### **General Description**

The ET8290B is a high-efficiency, synchronous, current-mode, step-up converter with output disconnection. The ET8290B starts up from an input voltage as low as 1.9V, while providing inrush current limiting and output short-circuit protection. The integrated P-channel synchronous rectifier improves efficiency and eliminates the need for an external Schottky diode. This P-channel disconnects the output from the input during shutdown.

The 1.0MHz switching frequency allows small external components, while the internal compensation and soft-start minimize external component count. The ET8290B provides a compact solution for a 5V output, 3.1A load requirement, using a supply voltage down to 2.8V.

The ET8290B is available in QFN14 package.

### **Features**

- Up to 98% Efficiency
- 1.9V to 5.5V Input Range
- Adjustable Output Voltage from 2.5V to 5.0V
- Internal Synchronous Rectifier
- 1.0MHz Fixed Switching Frequency
- 9A Typical Switch Current Limit
- 43uA Quiescent Current
- High Efficiency over Full Load Range
- Internal Soft-start and Compensation
- True Output Load Disconnect from Input
- OCP, SCP, OVP and OTP Protection
- Part No. and Package

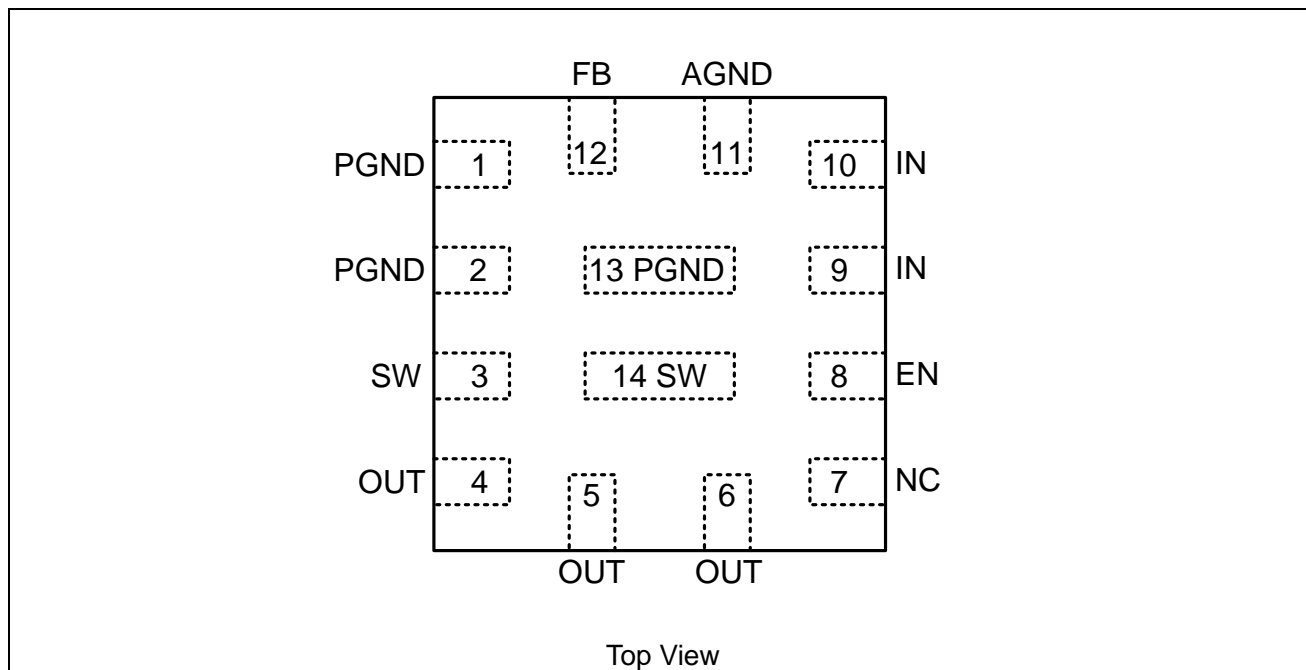
<b>Part No.</b>	<b>Package</b>	<b>MSL</b>
ET8290B	QFN14 (2mm×2mm)	1

### **Application**

- Battery-Powered Products
- Power Banks, Juice Packs, Battery Back-up Units
- USB Power Supply
- Consumer Electronic Accessories

# ET8290B

## Pin Configuration

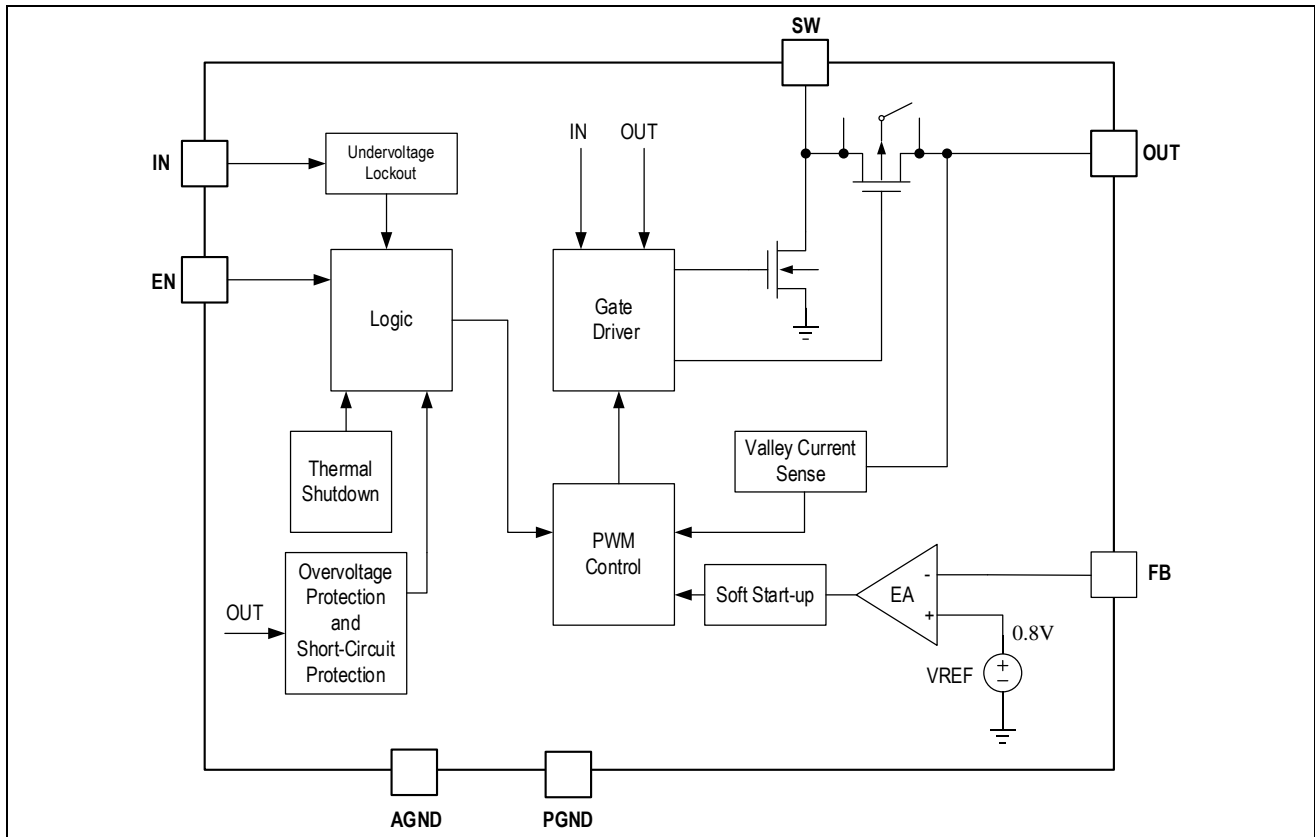


## Pin Function

Pin Name	Pin No.	Description
1, 2, 13	PGND	Power Ground.
3, 14	SW	Power Switch Output. SW is the connection node of the internal NMOS switch and synchronous switch. Connect the power inductor between SW and input power. Keep these PCB trace lengths as short and wide as possible to reduce EMI and voltage spikes.
4, 5, 6	OUT	Output Pin. OUT is the drain of the Internal Synchronous Rectifier MOSFET. Bias is derived from OUT when $V_{OUT}$ is higher than $V_{IN}$ . PCB trace length from OUT to the output filter capacitor(s) should be as short and wide as possible. OUT is completely disconnected from IN when EN is low due to the output disconnect feature.
7	NC	No Connect.
8	EN	Chip Enable Control Input.
9, 10	IN	Power Supply Input. The startup bias is derived from IN. Must be locally bypassed. Once OUT exceeds IN, bias comes from OUT. Thus, once started, operation is completely independent from IN. Pin 9 and 10 must be connected for using.
11	AGND	Analog Signal Ground.
12	FB	Voltage feedback of adjustable output voltage.

# ET8290B

## Block Diagram



## Functional Description

### Overview

The ET8290B is a 1MHz, synchronous step-up converter with true output disconnecting. The device features fixed-frequency current mode PWM controls for excellent line and load regulation. Internal soft-start and loop compensation simplifies the design process and minimizes external components. The internal low  $R_{DS(on)}$  MOSFETs, combined with frequency stretching operation, enables the device to maintain high efficiency over a wide load current range.

### Start-Up

When the IC is enabled and the voltage on the IN pin exceeds  $V_{UVLO\_IN-R}$ , the ET8290B starts up in the linear charge period. During this linear charge period, the PMOS rectifier turns on until the output capacitor is charged to  $V_{IN}$ . The PMOS current is limited to 0.2A when  $V_{OUT}$  is below 0.4V to avoid inrush current. While the output ramps up, the PMOS current limit also increases. This circuit also helps to limit the output current under short circuit conditions. Once the output is charged to  $V_{IN}$ , the linear charge period elapses and the ET8290B starts switching in normal closed loop operation.

In normal operation, works in boost mode when  $V_O$  is higher than  $V_{IN}+0.1V$  with 9A typical peak current limit.

Once the output voltage exceeds the input voltage, the ET8290B powers its internal circuits from  $V_{OUT}$  instead of  $V_{IN}$ .

# ET8290B

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## Soft-Start

The ET8290B provides soft-start by charging an internal capacitor with a current source. This soft start voltage continues to rise, following the FB voltage, during the linear charge period. Once the linear charge period elapses, and the voltage on this capacitor is charged. The soft start capacitor is discharged completely in the event of a commanded shutdown, thermal shutdown or short circuit at the output.

## Device Enable

Operation is enabled when the EN pin is switched high and placed into shutdown mode when low. In shutdown mode, the regulator stops switching and all internal control circuitry is off. The load is isolated from the input.

## Power-Save Mode

The ET8290B will automatically enter power save mode (PSM) when the load decreases and resume PWM mode when the load increases. When the device goes into PSM, it lowers the switching frequency saving switching and driver losses, and switches to pulse skip mode if the load continues to decrease.

## Error Amplifier

The error amplifier (EA) is an internally compensated amplifier. The EA compares the internal 0.807V reference voltage against  $V_{FB}$  to generate an error signal. The output voltage of the ET8290B is adjusted by an external resistor divider. A voltage divider from VOUT to ground programs the output voltage via the FB pin from 2.5V to 5.5V using the equation:

$$V_{OUT}=0.807V \times (1+R1/R2)$$

Set R2 values at 51kΩ are recommended for good stability and transient balance.

## Output Disconnect

The ET8290B is designed to allow true output disconnect by eliminating body diode conduction of the internal PMOS rectifier. This allows VOUT to go to zero volts during shutdown, or isolate and maintain an external bias on VOUT. It also allows for inrush current limit at start-up, minimizing surge current seen by the input supply. To obtain the advantage of output disconnect, there must not be an external Schottky diode connected between the switch pin and VOUT.

## Over Load and Short Circuit Protection

When an overload or a short circuit occurs, the output voltage will drop. If  $V_{OUT}$  drops below  $V_{IN}$ , The lower the output voltage reaches, the smaller the output current is. When the VOUT pin is short to ground, and the output voltage becomes less than 0.4 V, the output current is limited to approximate 200mA. Once the short circuit is released the ET8290 goes through the soft start-up again to the regulated output voltage.

## Over Voltage Protection

If  $V_{OUT}$  is higher than 5.8V, boost switching stops. This prevents over-voltage from damaging the internal power MOSFET. When the output drops below 5.7V, the device resumes switching automatically.

## Thermal Shutdown

The device contains an internal temperature monitor. The switches turn off if the die temperature exceeds 150°C. The device will resume normal operation below 130°C.

# ET8290B

## Absolute Maximum Ratings

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

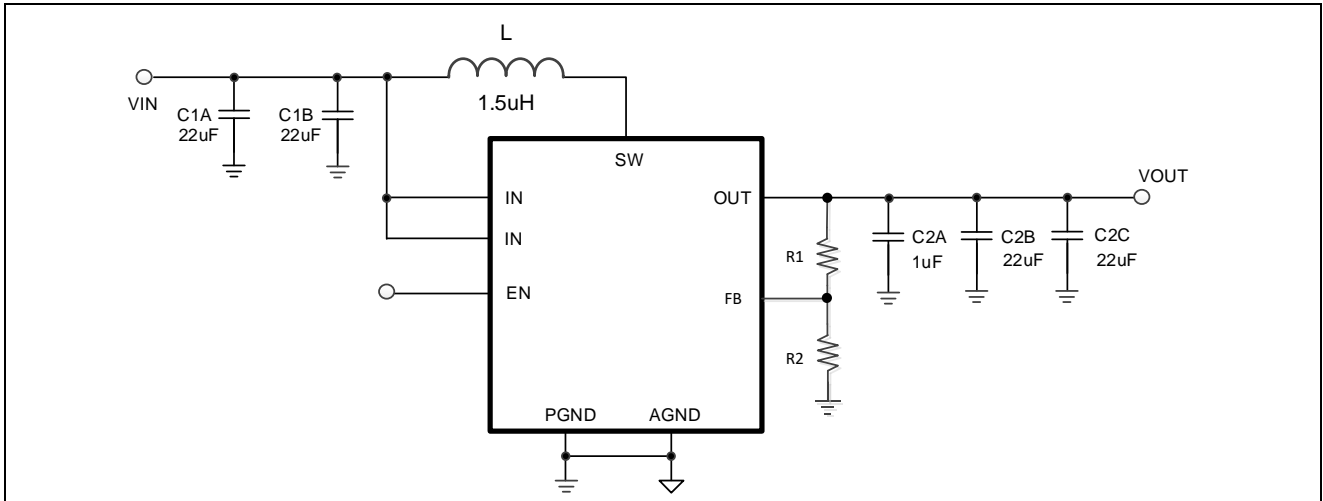
Symbol	Parameters	Min	Max	Unit
V <sub>OS</sub>	SW	-0.3	6.5	V
	All Other Pins	-0.3	6.5	V
V <sub>ESD</sub>	Human Body Model (JEDEC JS-001)		±3000	V
	Charged Device Model (JESD22-C101)		±1000	V
T <sub>J</sub>	Junction Temperature	-40	+150	°C
T <sub>STG</sub>	Storage Temperature	-65	+150	°C

**Note:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

## Recommended Operating Conditions

Symbol	Parameters	MIN	MAX	Unit
V <sub>IN</sub>	Supply Input Voltage Range	1.9	5.5	V
V <sub>OUT</sub>	Output Voltage Range	2.5	5.0	
T <sub>J</sub>	Operating Junction Temperature	-40	125	°C
T <sub>A</sub>	Ambient Temperature	-40	85	°C

## Application Circuit



## Recommended External Components

Component	Value	Size	Vendor
L	1.5uH	7040	744311150 (Wurth)
C1A、C1B	2*22uF / 16V	1210	CS3225X5R226K160NRL (SAMWHA)
C2A	1uF / 10V	0402	CL05B104KO5NNNC (SAMSUNG)
C2B、C2C	2*22uF / 16V	1210	CS3225X5R226K160NRL (SAMWHA)

# ET8290B

## Electrical Characteristics

$V_{IN} = V_{EN} = 3.3V$ ,  $V_{OUT} = 5V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$ , typical values are tested at  $T_A = 25^{\circ}C$ , unless otherwise noted.

Parameters	Symbol	Condition	Min	Typ	Max	Unit
<b>Voltage Range</b>						
Start Operating Input Voltage	$V_{IN}$		1.9		5.5	V
Quiescent Current	$I_{Q\_NS}$	$V_{EN}=V_{IN}=3.3V$ , $V_{OUT}=5V$ , no load Measured on OUT pin, $T_A=25^{\circ}C$		43	57	$\mu A$
		$V_{EN}=V_{IN}=3.3V$ , $V_{OUT}=5V$ , no load Measured on IN pin		0.3		$\mu A$
Shutdown Current	$I_{SD}$	$V_{EN}=V_{OUT}=0V$ , Measured on IN pin, $T_A=25^{\circ}C$		0.1	1	$\mu A$
IN UVLO Rising Threshold	$V_{UVLO\ INR}$	$V_{IN}$ Rising $T_A=25^{\circ}C$	1.6	1.7	1.8	V
IN UVLO Falling Threshold	$V_{UVLO\ INF}$	$V_{IN}$ Falling, $V_{OUT}=5V$		425		mV
<b>Step-up Converter</b>						
Operation Frequency	$F_{SW}$	$T_A=25^{\circ}C$	0.8	1	1.2	MHz
		$-40^{\circ}C \leq T_A \leq 85^{\circ}C$	0.7	1	1.3	
Feedback Voltage	$V_{FB}$	$T_A=25^{\circ}C$	795	807	819	mV
		$-40^{\circ}C \leq T_A \leq 85^{\circ}C$	791	807	823	
Feedback Input Current	$I_{FB}$	$V_{FB}=850mV$		1	50	nA
NMOS On-Resistance	$R_{NDSON}$			16		m $\Omega$
NMOS Leakage Current	$I_{NLK}$	$V_{SW}=5V$		100		nA
PMOS On-Resistance	$R_{PDSON}$			21		m $\Omega$
PMOS Leakage Current	$I_{PLK}$	$V_{SW}=5V$ , $V_{OUT}=0V$		0.1		$\mu A$
Maximum Duty Cycle	$D_{MAX}^{(1)}$		90	95		%
Linear Charge Current Limit	$I_{CH\_LIMIT}$	$V_{OUT} \leq 0.4V$		0.2		A
PMOS Valley Current Limit	$I_{LIMIT2}$	Duty=44%, $V_{IN}=2.8V$ , $V_{OUT}=5V$		9.0		A
<b>Logic Interface</b>						
High-Level Voltage	$V_{ENH}$		1.2			V
Low-Level Voltage	$V_{ENL}$				0.35	V
Input Current	$I_{EN}$	Connect to $V_{IN}$		10		nA
<b>Protection</b>						
Thermal Shutdown	$T_{SHDN}^{(1)}$			150		$^{\circ}C$
Over Temperature Hysteresis	$T_{HYS}^{(1)}$			20		$^{\circ}C$

**Note1:** Not production tested, design assurance.

## Typical Characteristics

$V_{IN} = 3.3V$ ,  $V_{OUT} = 5V$ ,  $L = 1.5\mu H$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

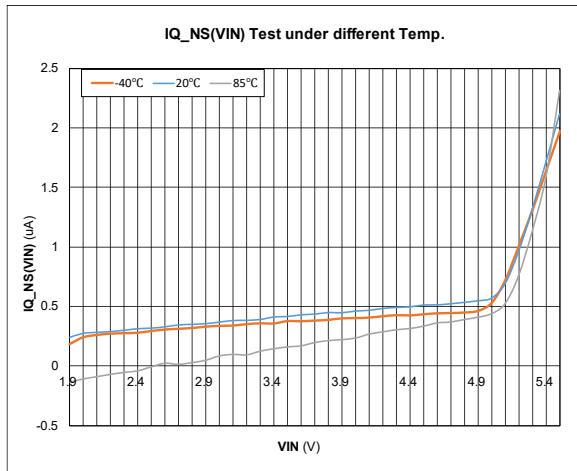


Figure 1. Quiescent Current (VIN) vs. VIN

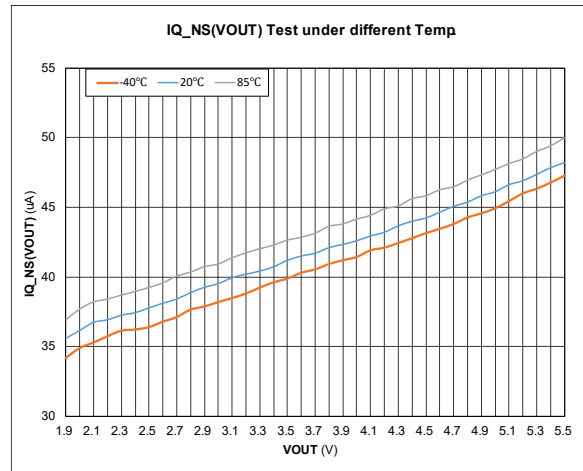


Figure 2. Quiescent Current (VOUT) vs. VOUT

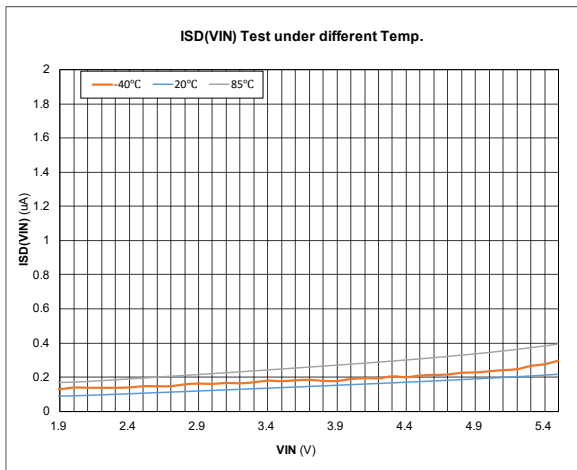


Figure 3. Shutdown Current vs. VIN

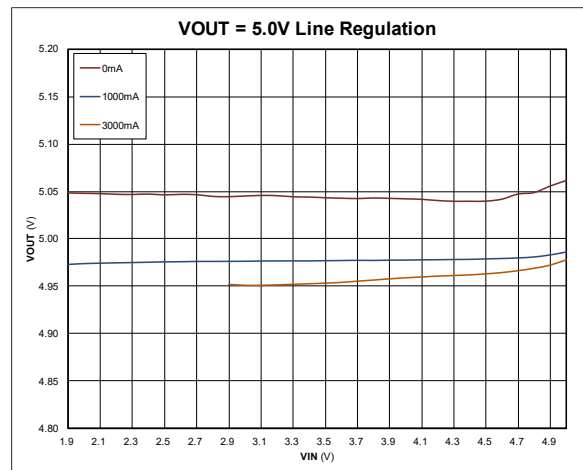


Figure 4. Line Regulation

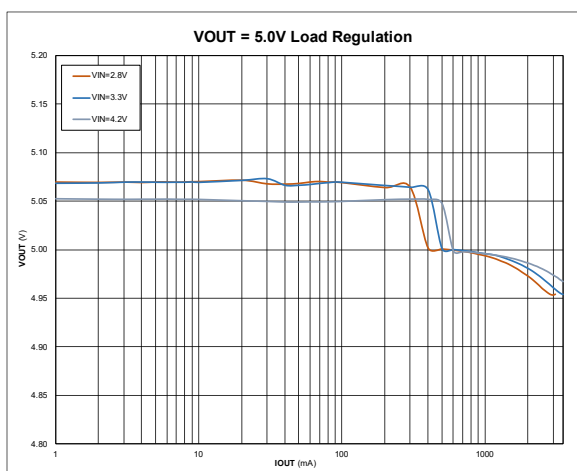


Figure 5. Load Regulation

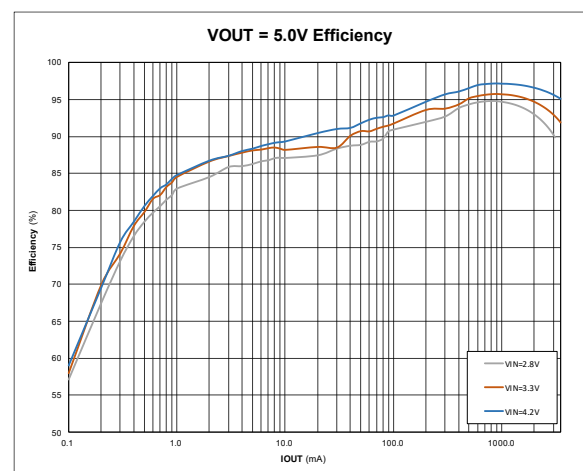


Figure 6. Efficiency vs. Load Current

# ET8290B

## Typical Characteristics (continued)

$V_{IN} = 3.3V$ ,  $V_{OUT} = 5V$ ,  $L = 1.5\mu H$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

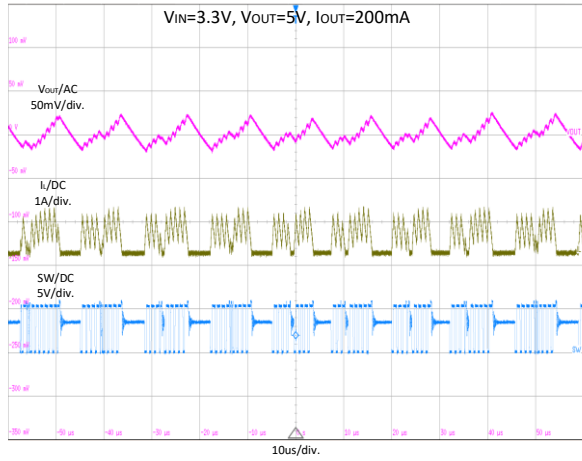


Figure 7. Output Voltage Ripple at Light Load

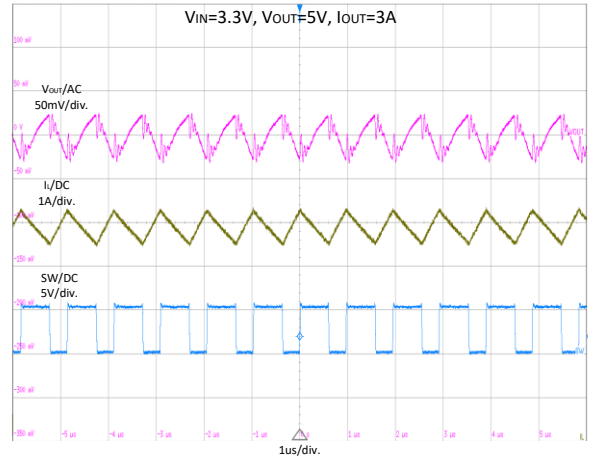


Figure 8. Output Voltage Ripple at Heavy Load

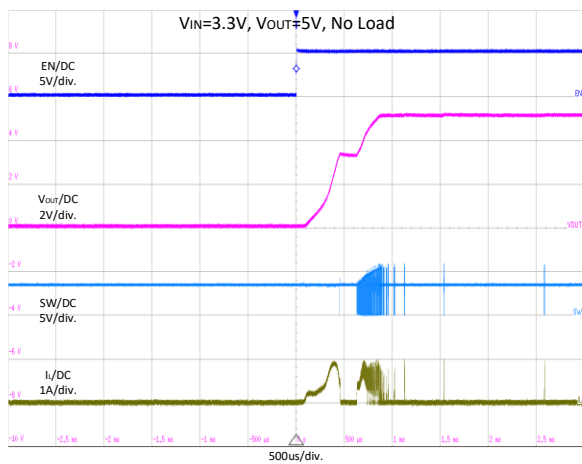


Figure 9. EN Startup

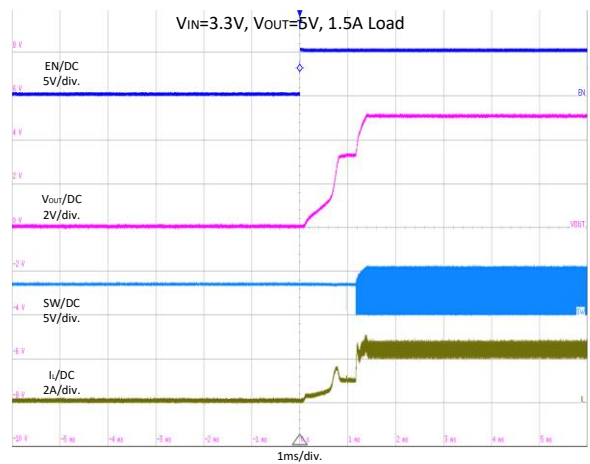


Figure 10. EN Startup at Heavy Load

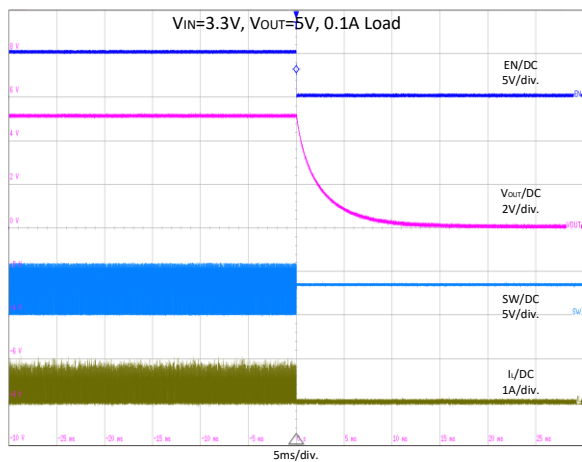


Figure 11. EN Shutdown

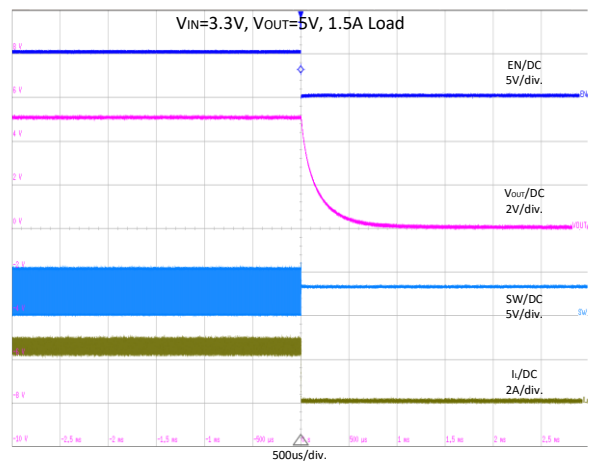


Figure 12. EN Shutdown at Heavy Load



## Typical Characteristics (continued)

$V_{IN} = 3.3V$ ,  $V_{OUT} = 5V$ ,  $L = 1.5\mu H$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

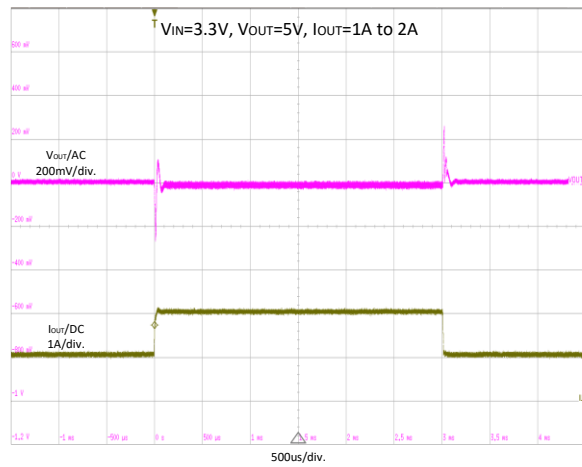


Figure 13. Load Transient

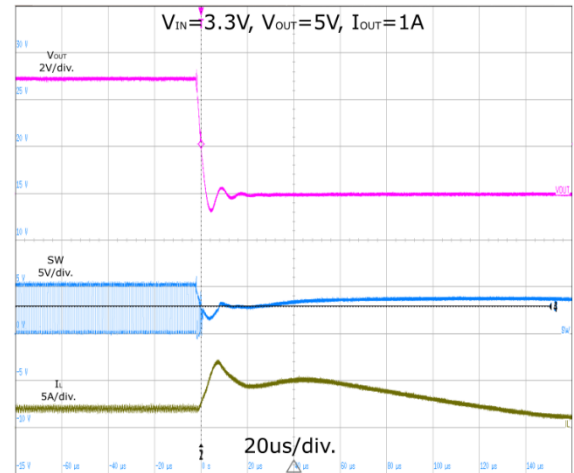


Figure 14. Short Circuit Entry

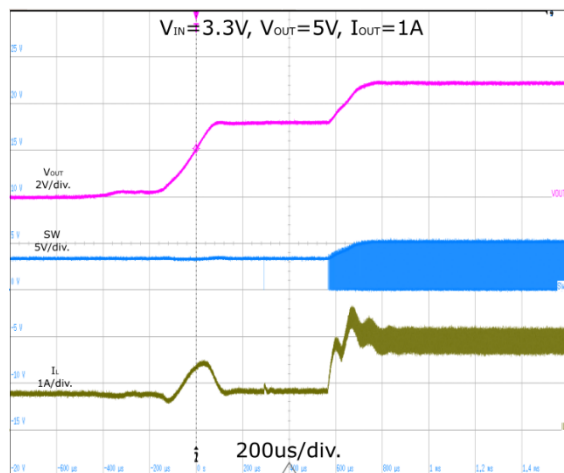
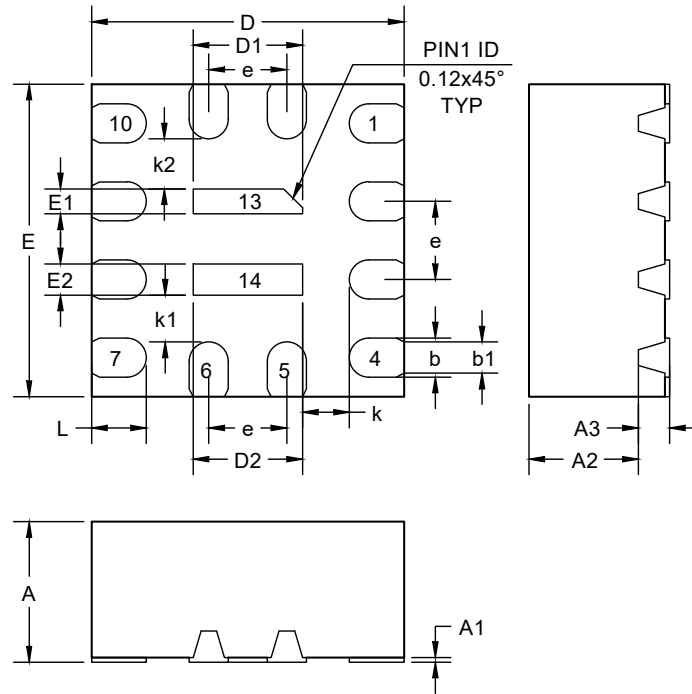


Figure 15. Short Circuit Recovery

# ET8290B

## Package Dimension

### QFN14

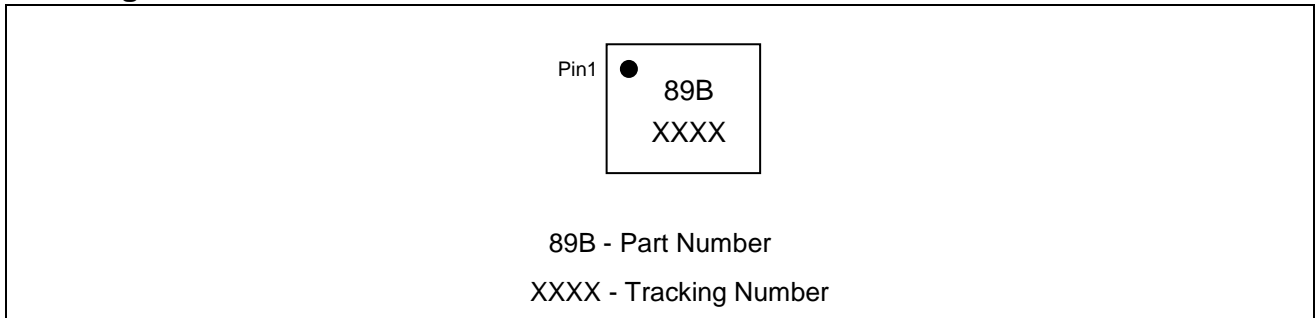


COMMON DIMENSIONS  
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.70	0.75	0.8
A1	0	0.02	0.05
A2	-	0.55	-
A3	0.203 REF		
b	0.2	0.25	0.3
b1	0.18 REF		
D	2 BSC		
E	2 BSC		
D1	0.65	0.7	0.75
E1	0.11	0.16	0.21
D2	0.65	0.7	0.75
E2	0.15	0.2	0.25
e	0.5 BSC		
L	0.3	0.35	0.4
k	0.3 REF		
k1	0.3 REF		
K2	0.32 REF		

# ET8290B

## Marking



## Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2024-08-29	Official Version	Chenlj	Gexj	Liujoy
1.1	2024-11-10	Update Block Diagram and Marking	Chenlj	Gexj	Liujoy