

Synchronous Boost Converter with Ultra-Low IQ

General Description

The ET82097BV28 is a synchronous boost converter with ultra-low quiescent current. The device is designed for products powered by an alkaline battery, lithium battery or rechargeable Li-Ion battery, for which high efficiency under light load condition is critical to achieve long battery life operation.

The ET82097BV28 offers 2.80V fixed output voltage. Hysteric control topology has been employed to obtain maximal efficiency at minimal quiescent current. ET82097BV28 can achieve up to 80% efficiency at 100 μ A load. It can also support up to 300mA output current, and achieve up to 93% at 200mA load.

The ET82097BV28 supplies Pass-Through operations for different applications. In Pass-Through Mode, the output voltage follows input voltage.

The ET82097BV28 available in SOT23-5 Package.

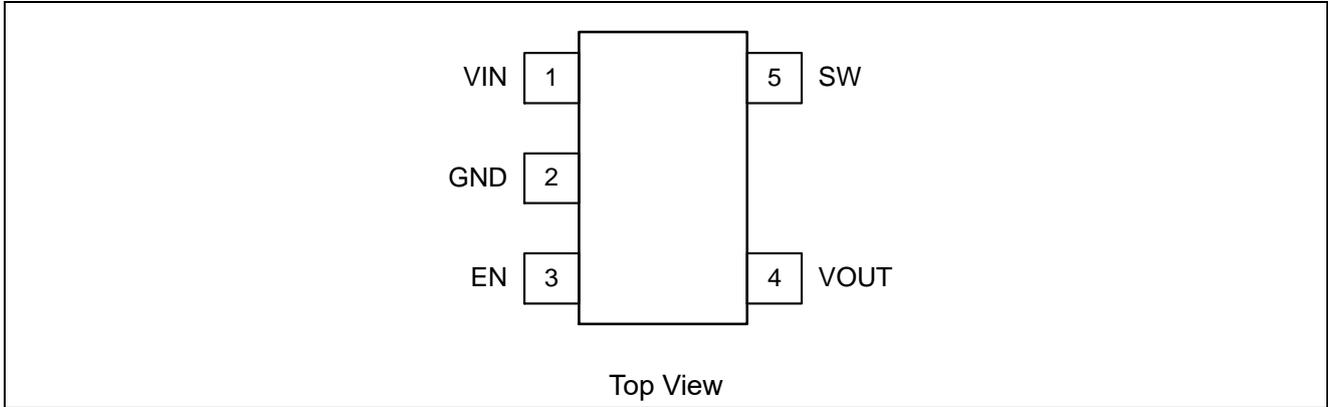
Features

- 250nA Ultra-Low IQ into VIN Pin
- 3.5uA IQ into VOUT Pin
- Pass-Through Mode
- Operating Input Voltage from 0.7V to 5.5V
- Fixed Output Voltage 2.8V
- Max 0.6A Switch Peak Current Limit
- Up to 93% Efficiency
- Part No. and Package

Part No.	Package	MSL
ET82097BV28	SOT23-5	Level 1

ET82097BV28

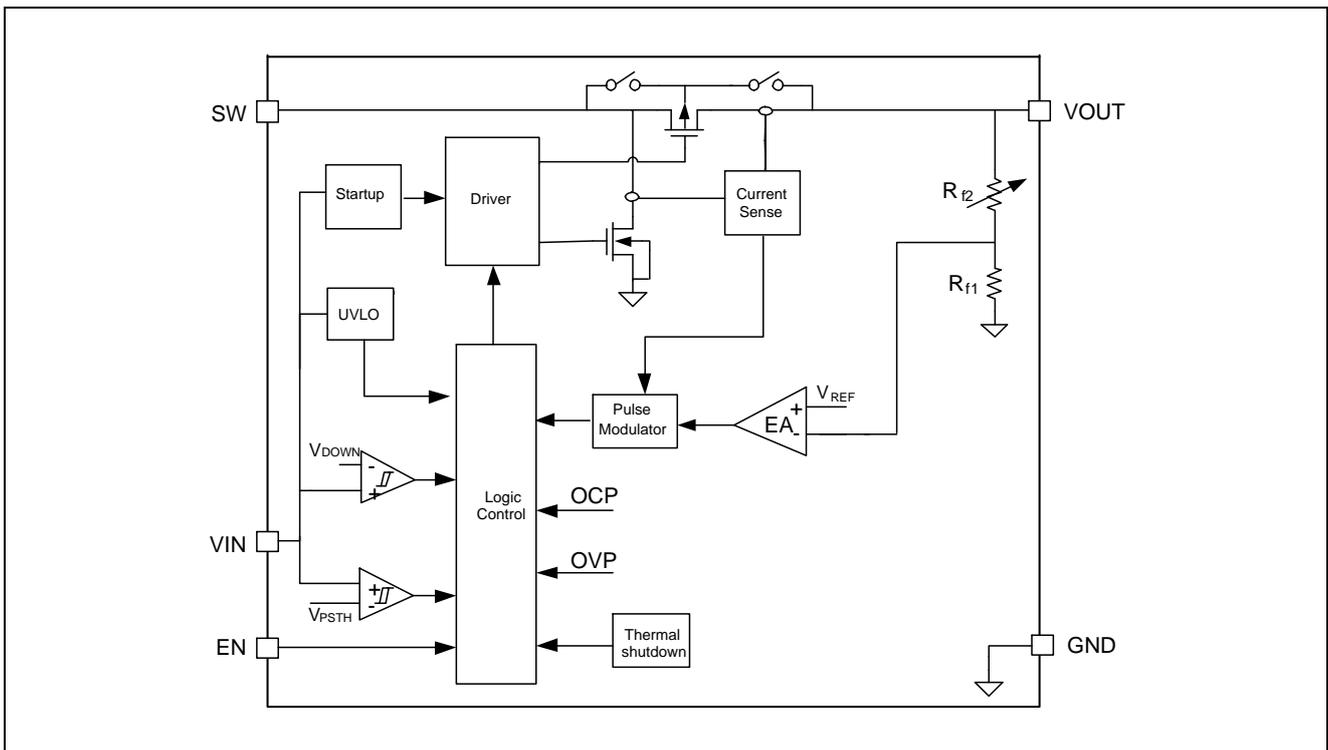
Pin Configuration



Pin Function

Pin Name	Pin No.	Type	Description
VIN	1	IN	IC power supply input
GND	2	PWR	Ground
EN	3	IN	Enable logic input, Logic high voltage enables the device. Don't let it floating
VOUT	4	PWR	Boost converter output.
SW	5	PWR	Switch pin of the converter

Block Diagram



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Functional Description

Boost Controller Operation

The ET82097BV28 boost converter is controlled by a hysteretic current mode controller. This controller regulates the output voltage by keeping the inductor ripple current constant in the range of 300mA and adjusting the offset of this inductor current depending on the output load. Since the input voltage, output voltage and inductor value all affect the rising and falling slopes of inductor ripple current, the switching frequency is not fixed and is determined by the operation condition. If the required average input current is lower than the average inductor current defined by this constant ripple, the inductor current goes discontinuously to keep the efficiency high under light load condition. If the load current is reduced further, the boost converter enters into Burst mode.

In Burst mode, the boost converter ramps up the output voltage with several switching cycles. Once the output voltage exceeds a setting threshold, the device stops switching and goes into a sleep status. In sleep status, the device consumes less quiescent current. It resumes switching when the output voltage is below the setting threshold. It exits the Burst mode when the output current can no longer be supported in this mode.

To achieve high efficiency, the power stage is realized as a synchronous boost topology. The output voltage V_{OUT} is monitored via an external or internal feedback network which is connected to the voltage error amplifier. To regulate the output voltage, the voltage error amplifier compares this feedback voltage to the internal voltage reference and adjusts the required offset of the inductor current accordingly.

Under-Voltage Lockout

An under-voltage lockout (UVLO) circuit stops the operation of the converter when the input voltage drops below the typical UVLO threshold of 0.4V. A hysteresis of 200mV is added so that the device cannot be enabled again until the input voltage goes up to 0.6V. This function is implemented in order to prevent malfunctioning of the device when the input voltage is between 0.4V and 0.6V.

Enable

When the input voltage is above UVLO rising threshold and the EN pin is pulled to high voltage, the ET82097BV28 is enabled.

Soft Start

After the EN pin is tied to high voltage, the ET82097BV28 begins to startup. At the beginning, the device operates at the boundary of Discontinuous Conduction Mode (DCM) and Continuous Conduction Mode (CCM), and the inductor peak current is limited to around 200mA during this stage. When the output voltage is charged above approximately 1.6V, the device starts the hysteric current mode operation. The soft start function reduces the inrush current during startup. After V_{OUT} reaches the target value, soft start stage ends and the peak current is determined by the output of an internal error amplifier which compares the feedback of the output voltage and the internal reference voltage.

The ET82097BV28 is able to start up with 0.7V input voltage with larger than 3k Ω load. However, if the load during startup is so heavy that the ET82097BV28 fails to charge the output voltage above 1.6V, the ET82097BV28 can't start up successfully until the input voltage is increased or the load current is reduced. The startup time depends on input voltage and load current.

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Current Limit Operation

ET82097BV28 features cycle-by-cycle over current protection function. If the inductor peak current reaches the current limit threshold I_{LIM} , the main switch turns off so as to stop further increase of the input current. In this case the output voltage will decrease until the power balance between input and output is achieved. If $V_{OUT} < V_{IN} - I_{OUT} * (DCR + R_{DS(on)_HS})$, the ET82097BV28 enters into Pass-Through Mode. In Pass-Through operation, current limit function is not enabled.

Output Short-to-Ground Protection

If short to ground condition occurs, the short current is limited at about 85mA. Once the short condition is removed, the ET82097BV28 goes back to soft start again and regulates the output voltage.

Over Voltage Protection

ET82097BV28 has an output over-voltage protection (OVP) to protect the device in case that the external feedback resistor divider is wrongly populated. When the output voltage of the ET82097BV28 exceeds the OVP threshold of 5.8V, the device stops switching. Once the output voltage falls to 0.1V below the OVP threshold, the device starts operating again.

Pass-Through Operation

The ET82097BV28 features Pass-Through operation when input voltage is higher than output voltage.

In the Pass-Through operation, the boost converter stops switching. The rectifying PMOS constantly turns on and low side switch constantly turns off. The output voltage is the input voltage minus the voltage drop across the dc resistance (DCR) of the inductor and the on-resistance of the rectifying PMOS.

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) ⁽¹⁾

Symbol	Parameters	Min	Max	Unit
$V_{IN}, V_{SW}, V_{OUT}, V_{FB}, V_{EN}$	Voltage range at terminals ⁽²⁾	-0.3	6	V
T_J	Operating junction temperature	-40	150	°C
T_A	Operating ambient temperature	-40	85	°C
T_{STG}	Storage temperature range	-65	150	°C

Notes:

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) All voltage values are with respect to network ground terminal.

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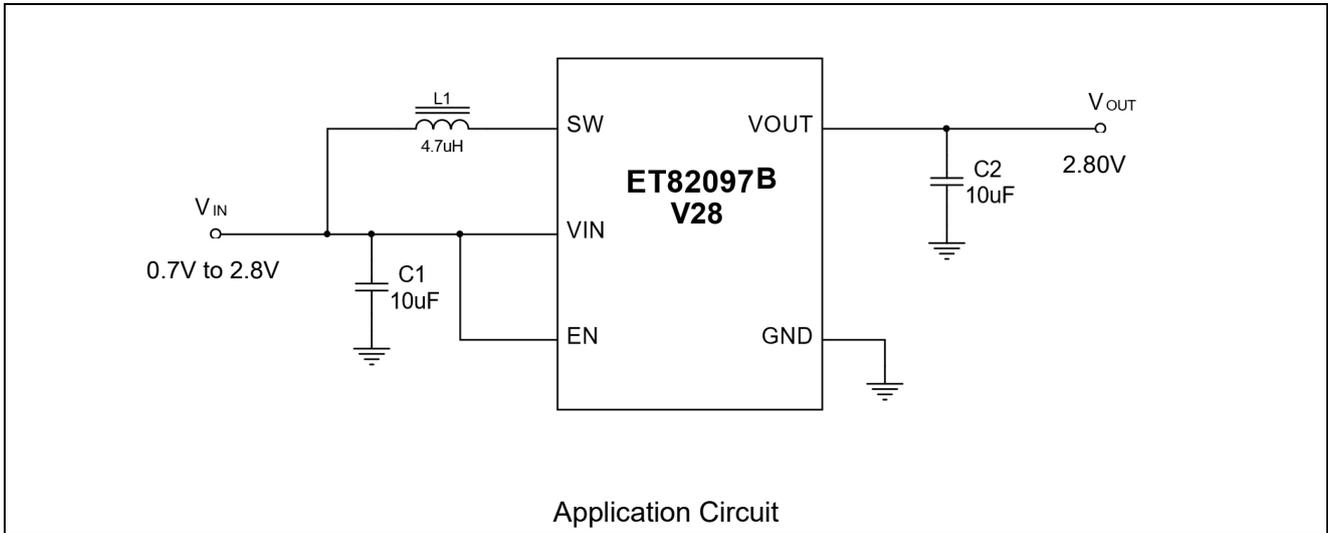
Electrical Characteristics

$T_A = -40^{\circ}\text{C}$ to 85°C and $V_{IN} = 0.7\text{V}$ to 5.5V . Typical values are at $V_{IN} = 2.5\text{V}$, $T_A = 25^{\circ}\text{C}$, unless otherwise noted.

Symbol	Parameters	Test Conditions	Min	Typ	Max	Unit
Power Supply						
V_{IN}	Input voltage range		0.7		5.5	V
V_{UVLO}	Input under voltage lockout threshold	V_{IN} rising		0.6	0.7	V
I_Q	Quiescent current into V_{IN} pin	EN = H, no Load, no Switching $T_A = -40^{\circ}\text{C}$ to 85°C		0.25	1.1	μA
	Quiescent current into V_{OUT} pin	EN = H, no Load, no Switching, Boost $T_A = -40^{\circ}\text{C}$ to 85°C	3	3.5	4.5	μA
I_{SD}	Shutdown current into V_{IN} pin	EN = L, $V_{IN} = 2.7\text{V}$, $V_{OUT} = 0\text{V}$, $T_A = -40^{\circ}\text{C}$ to 85°C		0.5	1.4	μA
Output						
V_{OUT}	Output voltage Accuracy	$V_{IN} < V_{OUT}$, $I_{OUT} = 5\text{mA}$	2.745	2.80	2.855	V
V_{OVP}	Output over-voltage protection threshold	V_{OUT} rising	5.6	5.8	6	V
Power Switch						
$R_{DS(on)_LS}$	Low side switch on resistance	$V_{OUT} = 2.80\text{V}$		300		$\text{m}\Omega$
$R_{DS(on)_HS}$	Rectifier on resistance	$V_{OUT} = 2.80\text{V}$		350		$\text{m}\Omega$
I_{LH}	Inductor current ripple	$V_{OUT} = 2.80\text{V}$		150		mA
I_{LIM}	Current limit threshold	$V_{OUT} \geq 2.5\text{V}$, boost operation		0.6		A
I_{SW_LKG}	Leakage into SW Pin (No switching)	$V_{SW} = 5.0\text{V}$, no switch, $T_A = -40^{\circ}\text{C}$ to 85°C			200	nA
Control Logic						
V_{IL}	EN input low voltage threshold	$V_{IN} \leq 1.5\text{V}$	$0.2 \times V_{IN}$			V
V_{IH}	EN input high voltage threshold	$V_{IN} \leq 1.5\text{V}$			$0.8 \times V_{IN}$	V
V_{IL}	EN input low voltage threshold	$V_{IN} > 1.5\text{V}$	0.4			V
V_{IH}	EN input high voltage threshold	$V_{IN} > 1.5\text{V}$			1.2	V
I_{EN_LKG}		$V_{EN} = 5.0\text{V}$			50	nA
T_{OTP}	Over temperature protection			150		$^{\circ}\text{C}$
T_{OTP_HYS}	Over temperature hysteresis			25		$^{\circ}\text{C}$

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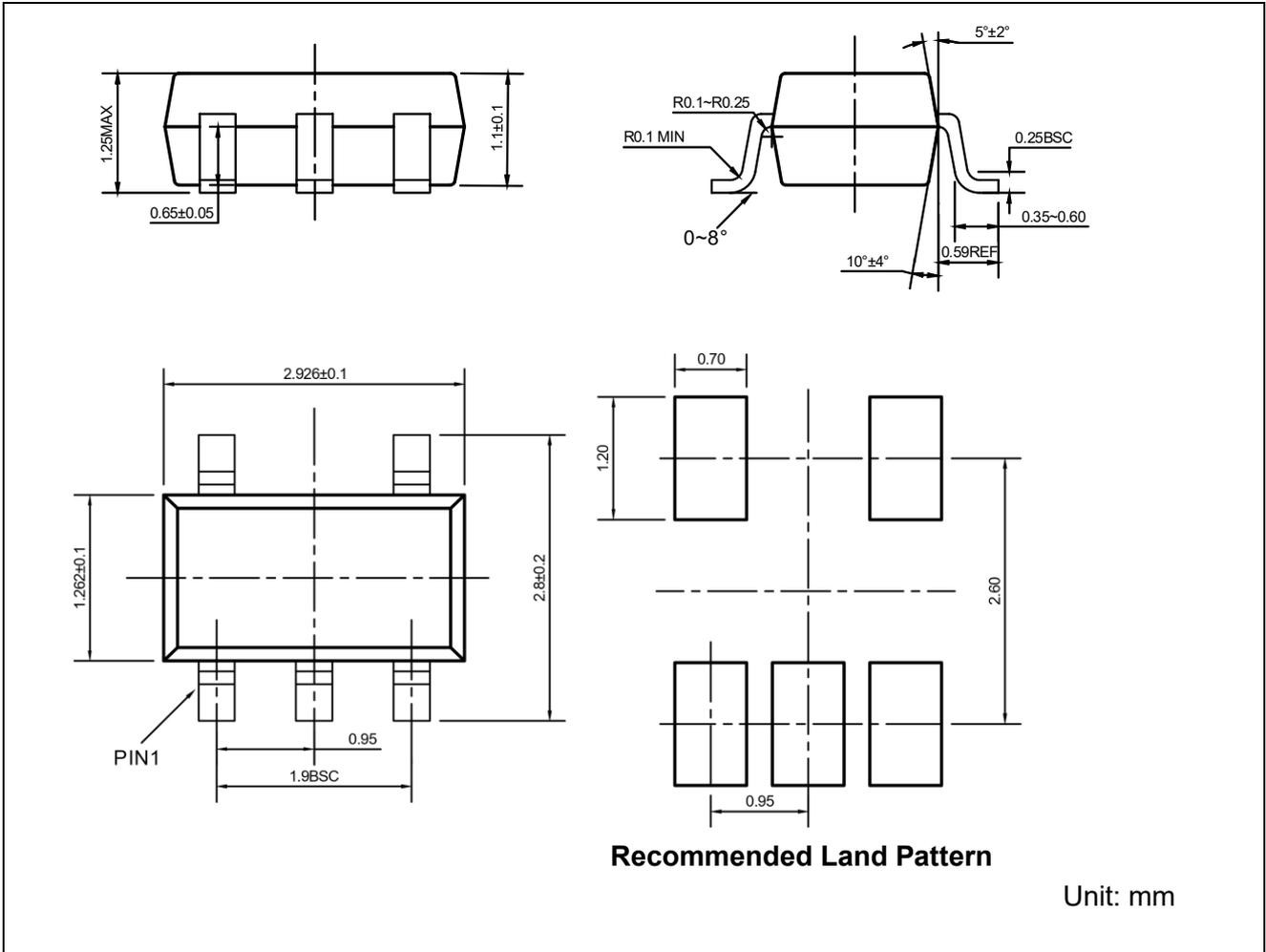
Application Circuits



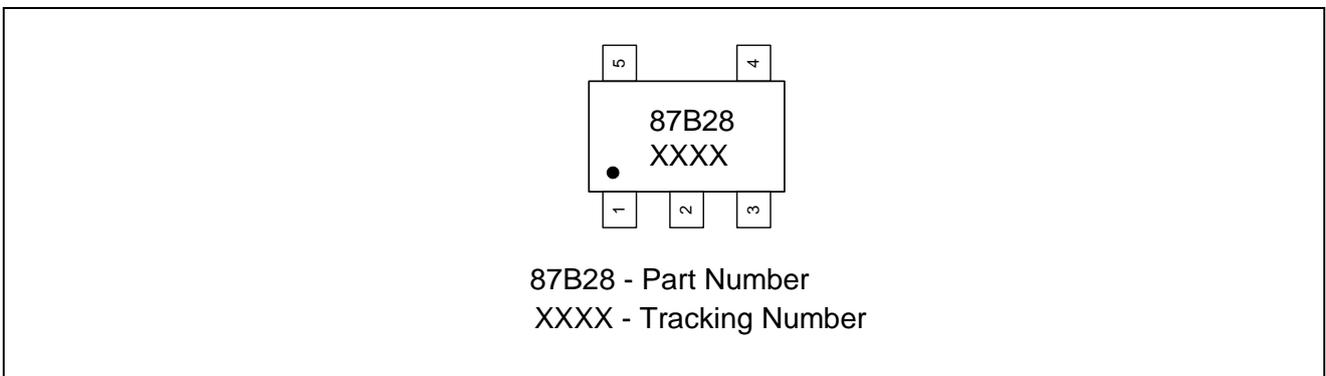
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Package Dimension

SOT23-5



Marking



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Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2024-06-24	Official Version	LiuC	Xielh	Liuju
1.1	2025-01-06	Update VOUT voltage	Wuhs	Xielh	Liuju
1.2	2025-02-06	Update VOUT Range	Wuhs	Xielh	Liuju
1.3	2026-1-11	Add marking	Shib	Xielh	Liuju