

Synchronous Boost Converter with 1uA Ultra Low IQ

FEATURES

- ❖ 1uA Ultra-Low IQ into Vin Pin When No switching
- ❖ Adjustable output voltage from 3.0V to 5.1 V
- ❖ Selectable Fixed Output voltage 5.1V/3.6V/3.3V/3.0V
- ❖ Up to 94% Efficiency
- ❖ Output to Input Disconnect At Shutdown Mode
- ❖ Over Current Protection
- ❖ Over Temperature Protection
- ❖ Output Reversed Current Protection
- ❖ Internal Compensation of Soft-Start
- ❖ 1.2MHz Fixed Frequency Switch
- ❖ SOT23-6 & DFN2x2-6 Package

APPLICATIONS

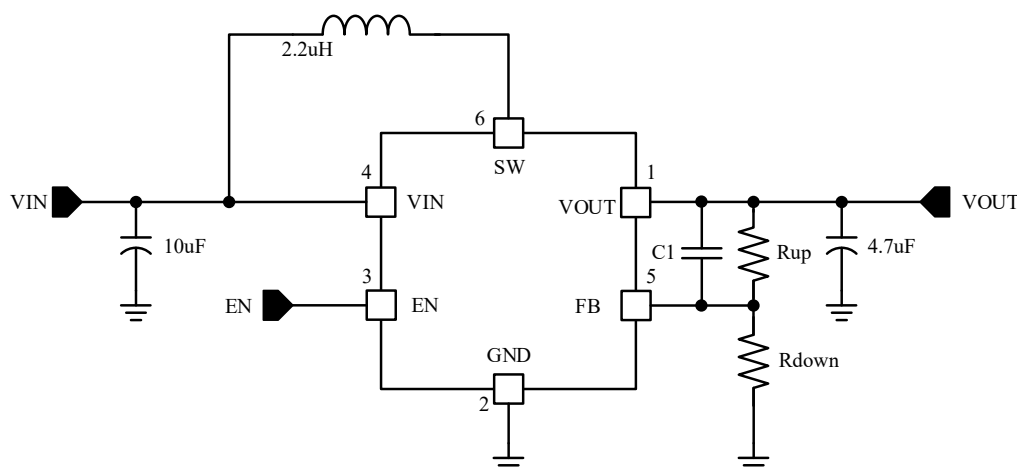
- ❖ MID, Tablet
- ❖ Smart Phone
- ❖ Bluetooth Applications
- ❖ Battery powered systems

GENERAL DESCRIPTION

The HM6315 is a device that can convert a low voltage synchronous boost converter with ultra-low quiescent current. It is designed for products powered by multiple types of batteries, and only consumes 1-μA quiescent current under light load condition, where high efficiency under light load condition is critical to achieve long battery life operation. It can achieve up to 75% efficiency at 20-μA load. For 3.6V convert to 5.1V application it can also achieve up to 94% efficiency at 200-mA load. It features a true-shutoff function that disconnects the output from input, during shutdown and output short-circuit conditions.

The HM6315 has fixed output voltage version with 5.1V/3.6V/3.3V/3.0V output, and make sure that the FB PIN is floating, it can not connect to any devices. Over Current Protection, Over Temperature Protection, Output short Protection make the device operating safe.

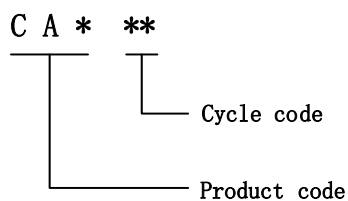
TYPICAL APPLICATIONS



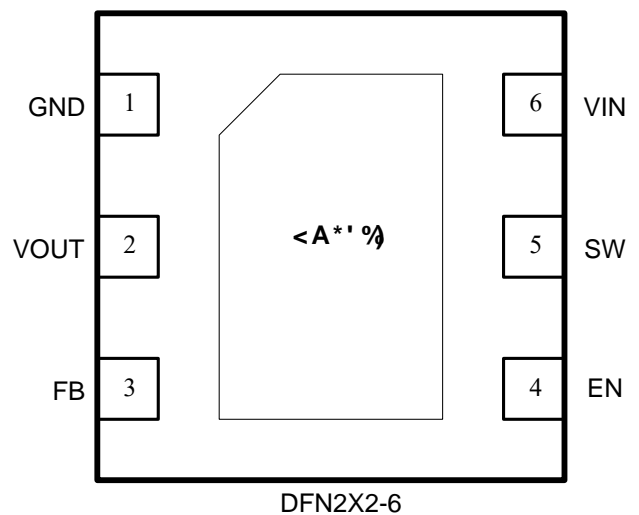
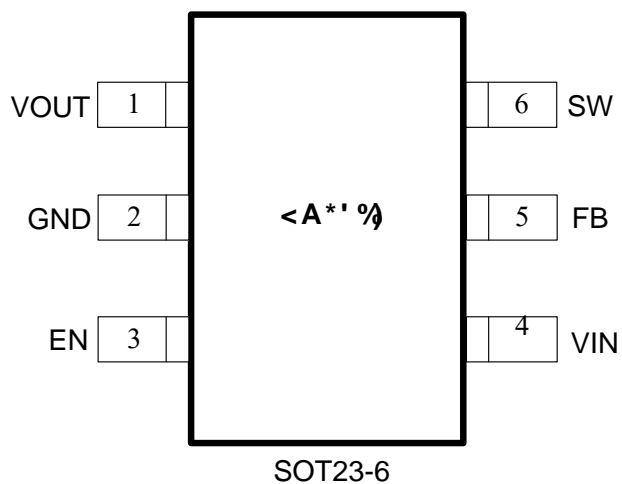
Ordering Information

Type	Order Code	Package	Ambient Temperature	Marking	Packaging	Shipping
HM6315	HM6315A51MR	SOT23-6	-40°C to +85°C	CAWxx	Tape and Reel	3000
HM6315	HM6315ADJMR	SOT23-6		CAXxx	Tape and Reel	3000
HM6315	HM6315A51DR	DFN2x2-6		CAWxx	Tape and Reel	3000
HM6315	HM6315ADJDR	DFN2x2-6		CAXxx	Tape and Reel	3000

Marking Description:



PIN CONFIGURATION



SOT23-6 PIN#	DFN2*2-6 PIN#	NAME	DESCRIPTION
1	2	VOUT	Voltage Output Pin.
2	1	GND	Ground Pin.
3	4	EN	Enable pin for the chip. EN is logic high, the device is enable, EN is logic low, the device is disable.
4	6	VIN	Power Supply Input.
5	3	FB	Feedback Voltage Input, Connect to the center tap of a resistor divider from VOUT to FB and GND to program the output voltage. No connect for fixed output voltage versions.
6	5	SW	It is connected to the inductor. Switch pin of the converter.

Table 1. PIN Descriptions

ABSOLUTE MAXIMUM RATINGS

Description		Min	Max	Units
VOUT,EN,VIN,FB,SW Voltage		-0.3	6.5	V
SW to GND current		Internally Limited		A
Storage Temperature Range		-65	+150	°C
Junction Temperature		-40	150	°C
Lead Temperature		260		°C
ESD Rating	HBM (Human Body Mode)	2000		V
	MM (Machine Mode)	200		V

THERMAL INFORMATION

Description			Units
Package Thermal Resistance (θ_{JA})	SOT23-6	180	°C/W
	DFN-2x2-6	80	°C/W

RECOMMENDED OPERATION CONDITIONS

Description	Min	Max	Units
Operating Junction Temperature	-40	125	°C
Operating Ambient Temperature	-40	85	°C
Supply Input Voltage	+0.9	+5.5	V
Continuous Output Current		1	A

Note 1. Stresses beyond those listed as the above ABSOLUTED MAXIMUM RATINGS may cause permanent damage to the device. These are for stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the RECOMMENDED OPERATION CONDITIONS section of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended.

Note 3. θ_{JA} is measured in the natural convection at $T_A=25^{\circ}\text{C}$ on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

Note 4. The device is not guaranteed to function outside its operating conditions.

Important information and disclaimer:

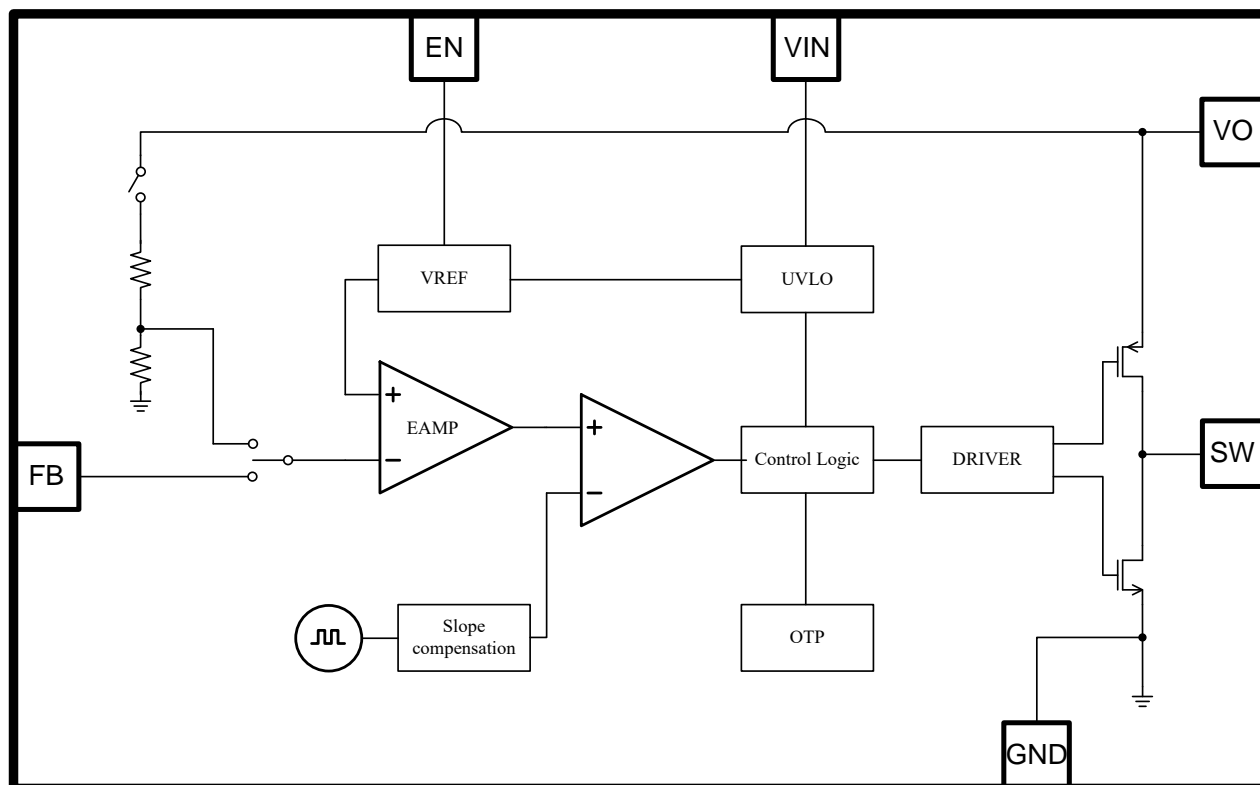
SHININGIC reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

ELECTRICAL CHARACTERISTICS

($V_{IN} = 3.6V$, $V_{out} = 5.1V$, $T_A = 25^{\circ}C$, unless otherwise specified.)

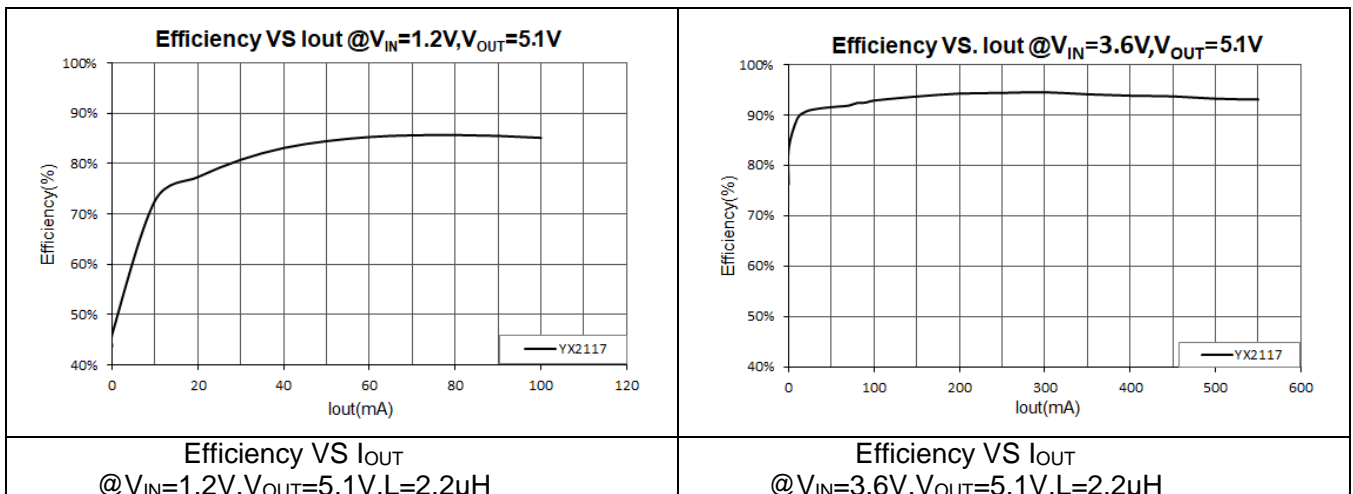
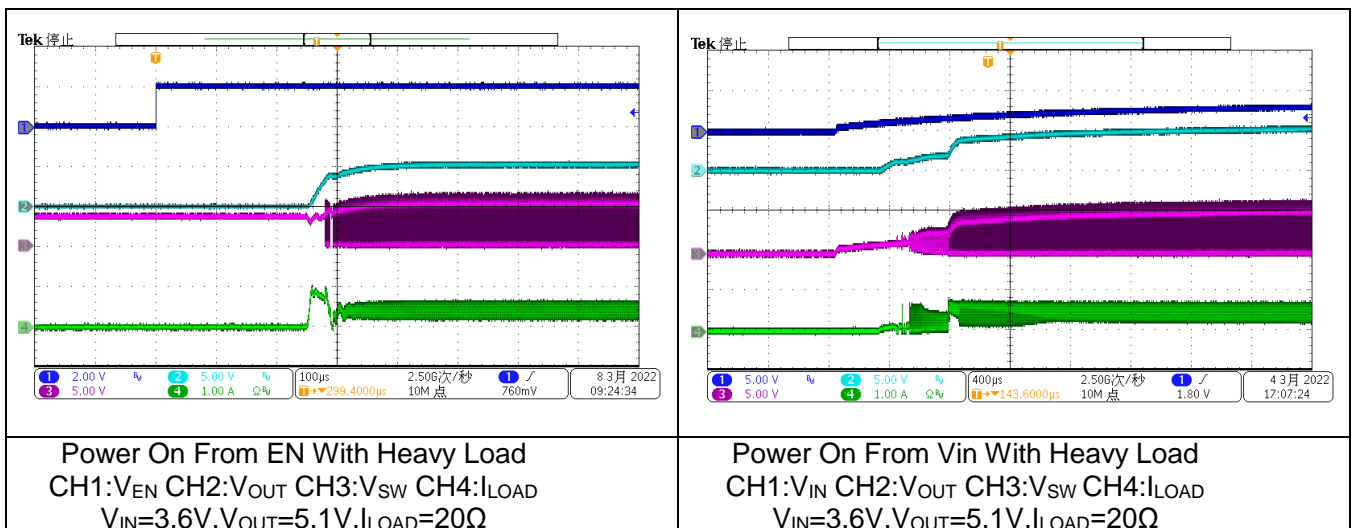
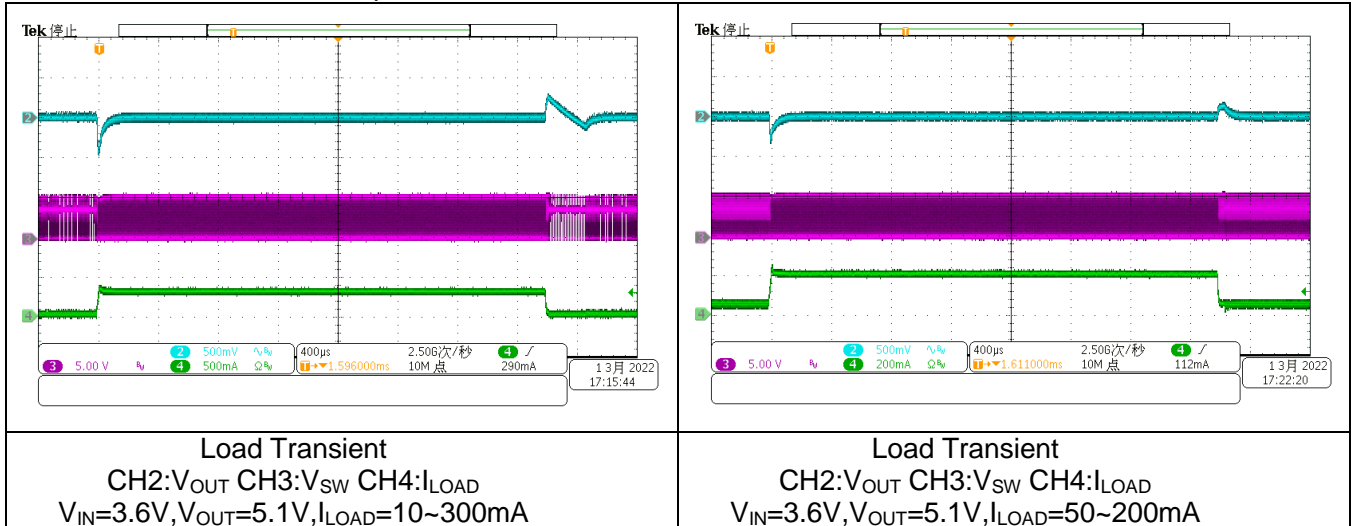
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Output Voltage at 5.1V	V_{OUT}		5	5.1	5.2	V
Feedback Voltage	V_{FB}			1.15		V
Supply Voltage	V_{IN}	After Start-up	0.6		5	V
Input UVLO	V_{UVLO}	V_{IN} rising		0.8		V
UVLO hysteresis	$V_{UVLO-HYS}$			200		mV
Supply Current	I_Q	$V_{EN}=V_{IN}=3.6V$, No load		1		μA
Supply Current(Shutdown)	I_{SD}	$V_{EN}=0V$, $V_{IN}=3.6V$		0.3		μA
Switching Frequency	F_{EQ}		960	1200	1440	kHz
EN Input Low Voltage	V_{EN-L}				0.3	V
EN Input High Voltage	V_{EN-H}		1.2			V
EN Input Current	I_{EN}	$V_{EN}=5V$	-1		1	μA
Low-side Current Limit	I_{CL-L}			1		A
Star-up Current Limit	I_{CL-S}			1		A
High-side On Resistance	R_{ON-H}			160		$m\Omega$
Low-side On Resistance	R_{ON-L}			220		$m\Omega$
SW Leakage Current	$I_{LEAK-SW}$	$EN=0V$			2	μA
Short Circuit Hiccup Time	$T_{SCHC-ON}$	ON		1.8		ms
	$T_{SCHC-OFF}$	OFF		45		ms
Thermal Shutdown	$TEMP_{OTP}$			165		$^{\circ}C$
Thermal Shutdown Hysteresis	$TEMP_{OTP-HYS}$			35		$^{\circ}C$

BLOCK DIAGRAM



TYPICAL CHARACTERISTICS

TA =25°C, unless otherwise specified.



FUNCTION DESCRIPTION

Overview

The HM6315 device is a high efficiency synchronous boost converter with ultra-low quiescent current. It is designed for products powered by multiple types of batteries, and only consumes 1-μA quiescent current under light load condition to achieve long battery life operation. It can achieve up to 75% efficiency at 20-μA load, For 3.6V to 5.1V application it can also achieve up to 94% efficiency at 200-mA load. It features a true-shutoff function that disconnects the input and output during shutdown and output short-circuit conditions so as to minimize the leakage current.

There are two ways to set the output voltage of HM6315. For the fixed output voltage version, it can output 3.0V/3.3V/3.6V/5.1V. For the adjustable output voltage version, the programmable output voltage is provided by adjusting the external resistance voltage divider R_{UP} and R_{DOWN} , which can be calculated by the following formula.

$$V_{OUT} = 1.15V \times \left(1 + \frac{R_{UP}}{R_{DOWN}}\right)$$

The adjustable version suggests using 1% or higher precision resistors to improve output voltage accuracy, smaller R_{DOWN} to improve noise resistance, and larger R_{DOWN} to reduce leakage current through the feedback resistor, thereby improving the no-load efficiency of the device. In this case, R_{DOWN} recommends using 1M resistance, which is more susceptible to noise if the resistance is too high. It is recommended to use an external feed capacitor (C1) in parallel with R_{UP} to improve device stability.

Controller Operation

The EN pin is pulled to high voltage, the HM6315 is enabled. When the EN pin is pulled to low voltage, it goes into shutdown mode. In shutdown mode, the device stops switching and the rectifying PMOS fully turns off, providing the completed disconnection between input and output.

The HM6315 boost converter is controlled by current mode and voltage mode. This controller regulates the output voltage by keeping the inductor ripple current constant in the range, and adjusting the offset of this inductor current depending on the output load. 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 will ramp up the output voltage, 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. When the output voltage is below the setting threshold it resumes switching. 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. The voltage error amplifier compares this feedback voltage to the internal voltage reference to regulate the output voltage.

Soft-Start

After the EN pin is tied to high voltage, the $\mu\text{C}100$ begins to startup. When the output voltage is charged above approximately 2.0V, the device starts the current mode operation. After VOUT reaches the target value, soft start stage ends and the peak current is now determined by the output of an internal error amplifier which compares the feedback of the output voltage and the internal reference voltage.

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 0.6 V. A hysteresis of 200 mV is added so that the device cannot be enabled again until the input voltage goes up to 0.8 V. This function is implemented in order to prevent malfunctioning of the device when the input voltage is between 0.6 V and 0.8 V.

Enable and Disable

When the input voltage is above UVLO rising threshold and the EN pin is pulled to high voltage, the $\mu\text{C}100$ is enabled. When the EN pin is pulled to low voltage, the $\mu\text{C}100$ goes into shutdown mode. In shutdown mode, the device stops switching and the rectifying PMOS fully turns off, providing the completed disconnection between input and output. Less than 0.32- μA input current is consumed in shutdown mode.

Current Limit Operation

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.

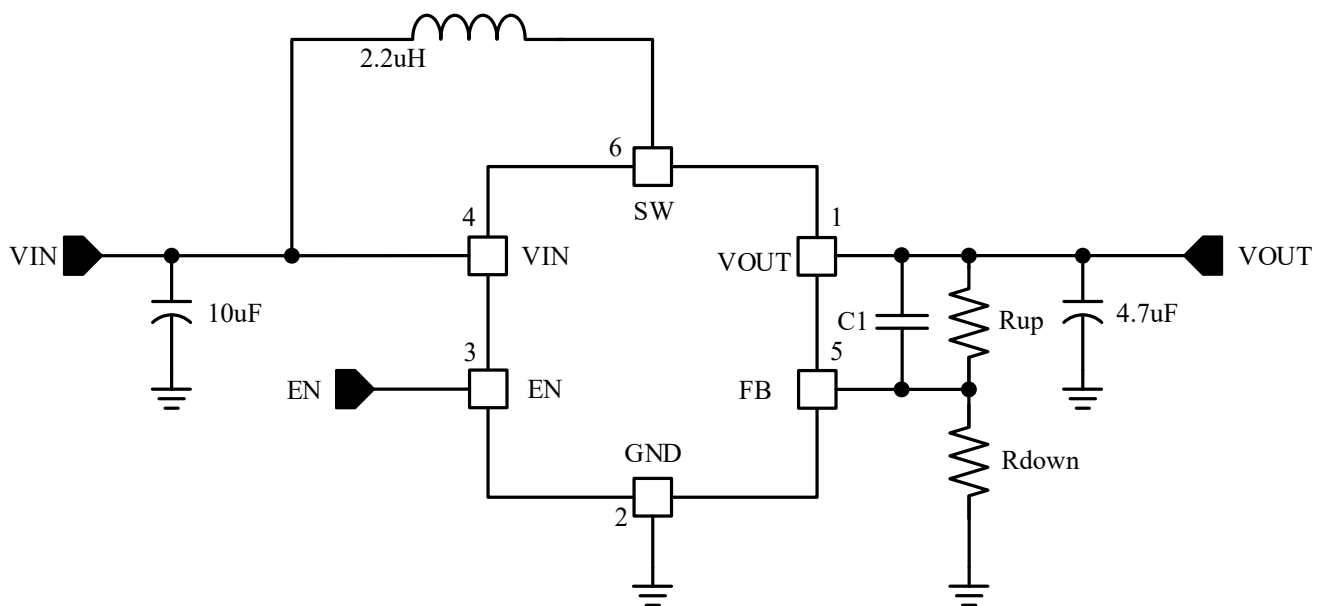
Output Short-to-Ground Protection

The $\mu\text{C}100$ starts to limit the switch current to 200 mA when the output voltage is below target voltage. If short-to-ground condition occurs, switch current is limited at 200 mA. Once the short circuit is released, the $\mu\text{C}100$ goes back to soft start again and regulates the output voltage.

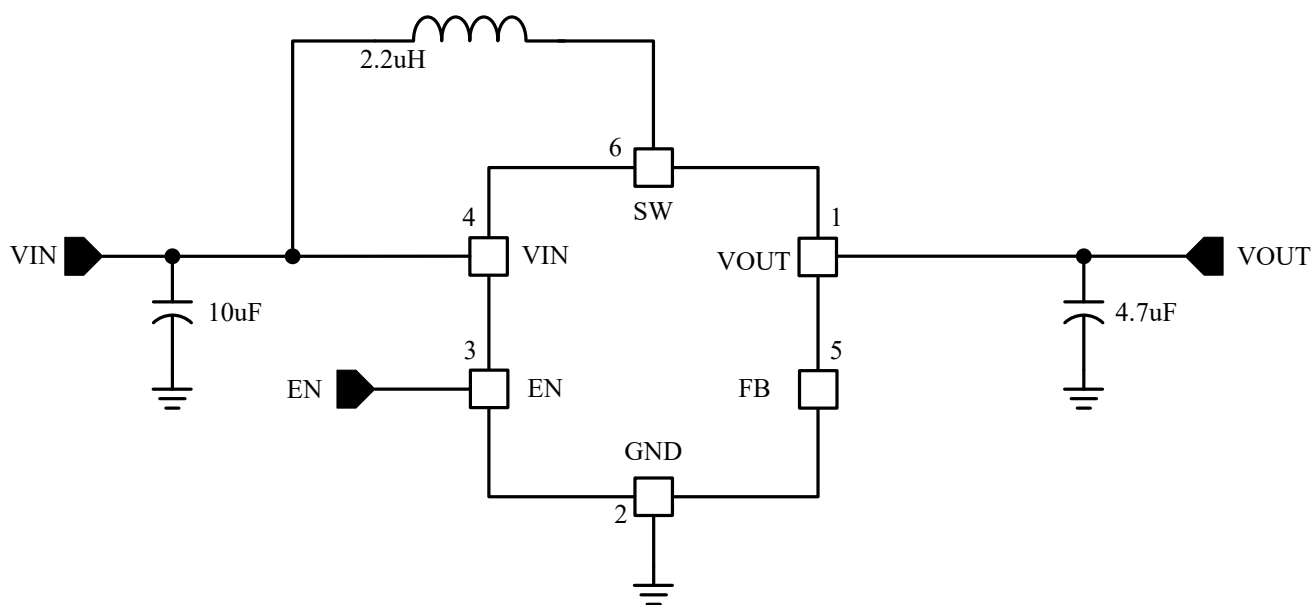
Thermal Shutdown

The $\mu\text{C}100$ has a built-in temperature sensor which monitors the internal junction temperature in boost mode operation. If the junction temperature exceeds the threshold 165°C, the device stops operating. As soon as the junction temperature drops below the shutdown temperature minus the hysteresis, typically 130°C, it starts operating again.

TYPICAL APPLICATION



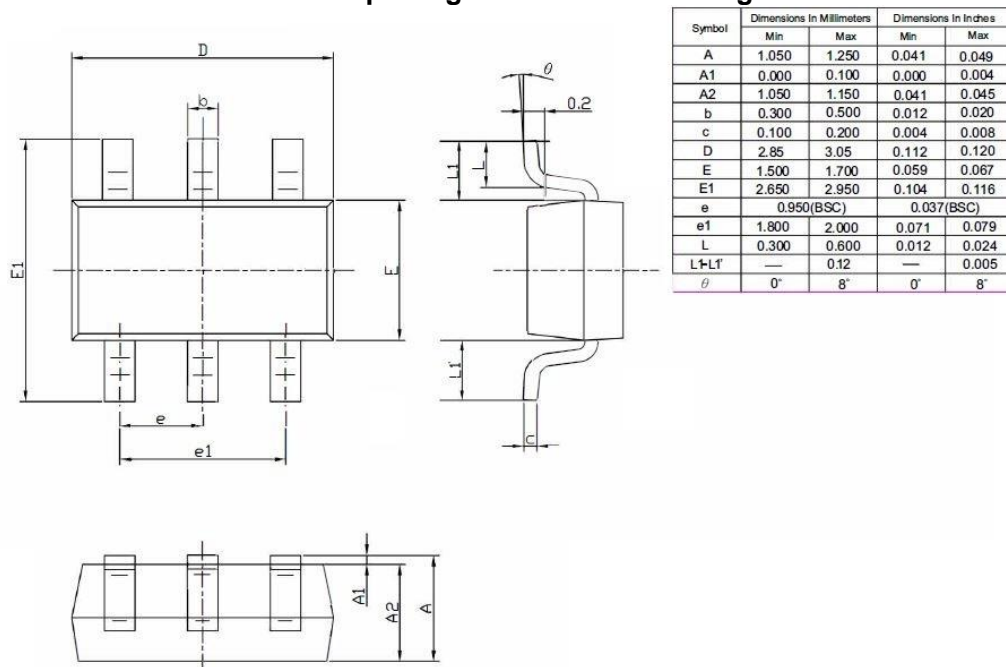
Typical Application Circuit1
 (Adjustable output voltage versions)



Typical Application Circuit2
 (Fixed output voltage versions)

PACKAGE DESCRIPTION

SOT23-6 package mechanical drawing



DFN2x2-6 package mechanical drawing

