TPS63027 高电流、高效单电感器降压-升压转换器

1 特性

- 真正的降压或升压运行，可在降压与升压运行状态之间自动无缝切换
- 2.3V 至 5.5V 输入电压范围
- 1.0V 至 5.5V 输出电压范围
- 2A 持续输出电流：$V_{IN} \geq 2.5V$，$V_{OUT} = 3.5V$
- 效率高达 96%
- 2.5MHz 典型开关频率
- 35µA 静态工作电流
- 集成软启动
- 节能模式
- 真正实现关断
- 输出电容器放电功能
- 过热保护以及过流保护
- 宽泛的电容选择
- 小型 2.1mm x 2.1mm，25 引脚晶圆级芯片 (WCSP) 封装

2 应用范围

- 手机、智能电话
- 平板个人电脑
- 个人电脑和智能手机配件
- 负载点稳压
- 电池供电类 应用

3 说明

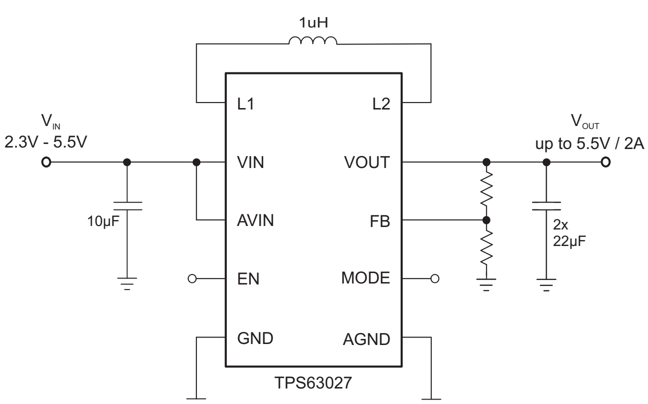
TPS63027 是一款具有低静态电流的高效降压-升压转换器，适用于输入电压可能高于或低于输出电压的应用。在升压模式下，输出电流可高达 2A，而在降压模式下，输出电流可高达 4A。开关的最大平均电流限制为 4.5A（典型值）。TPS63027 能够根据输入电压在降压与升压模式之间自动切换，确保在两种模式之间无缝切换，从而在整个输入电压范围内调节输出电压。此降压-升压转换器基于一个使用同步整流的固定频率、脉宽调制 (PWM) 控制器以获得最高效率。在低负载电流情况下，此转换器进入省电模式，以便在整个负载电流范围内保持高效率。有一个使用户能够在自动 PFM/PWM 模式运行和强制 PWM 运行之间进行选择的 PFM/PWM 引脚。在 PWM 模式下通常使用 2.5MHz 固定频率。使用一个外部电阻器分压器可对输出电压进行编程，或者在芯片上对输出电压进行内部固定。转换器可被禁用以大大减少电池消耗。在关机期间，负载从电池上断开。此器件采用 25 引脚 2.1mm x 2.1 mm WCSP 封装。

器件信息[(1)]

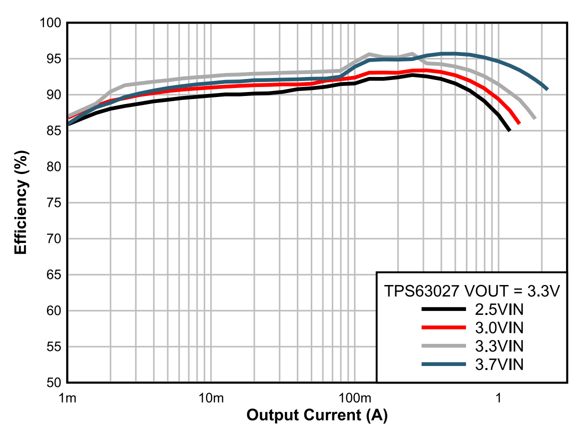
器件型号	封装	封装尺寸（标称值）
TPS63027	DSBGA (25)	2.1mm x 2.1mm

(1) 要了解所有可用封装，请见数据表末尾的可订购产品附录。

4 典型应用



效率与输出电流间的关系



目录

5 修订历史记录

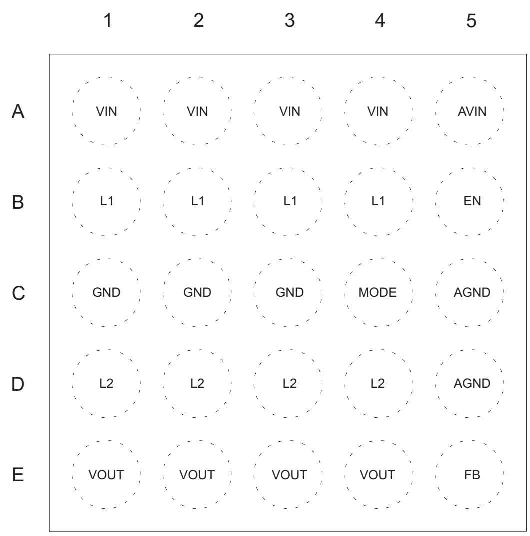
日期	修订版本	注释
2016 年 12 月	*	最初发布版本

6 Device Comparison Table

PART NUMBER	VOUT
TPS63027	Adjustable

7 Pin Configuration and Functions

YFF Package
DSBGA 25-Pin
Top View



Pin Functions

PIN		DESCRIPTION
NAME	NO	
VIN	A1, A2, A3, A4	Supply voltage for power stage
AVIN	A5	Supply voltage for control stage
L1	B1, B2, B3, B4	Connection for Inductor
EN	B5	Enable input. Set high to enable and low to disable. It must not be left floating
GND	C1,C2,C3	Power Ground
MODE	C4	PFM/PWM Mode selection. Set HIGH for PFM mode, set LOW for forced PWM mode. It must not be left floating
AGND	C5, D5	Analog Ground
L2	D1, D2, D3, D4	Connection for Inductor
VOUT	E1, E2, E3, E4	Buck-Boost converter output
FB	E5	Voltage feedback of adjustable version, must be connected to VOUT on fixed output voltage versions

8 Specifications

D/S

8.1 Absolute Maximum Ratings

over junction temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
Voltage(2)	VIN, L1, L2, EN, VINA, PFM/PWM, VOUT, FB	–0.3	7	V
Input current	Continuos average current into L1(3)		2.7	A
Operating junction temperature, T_J		–40	125	°C
Storage temperature, T_{stg}		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values are with respect to network ground pin.
(3) Maximum continuos average input current 3.5 A, under those condition do not exceed 105°C for more than 25% operating time.

8.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±2000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	±500	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

8.3 Recommended Operating Conditions

See (1)

		MIN	NOM	MAX	UNIT
V_{IN}	Input voltage	2.3		5.5	V
V_{OUT}	Output voltage	1		5.5	V
T_A	Operating ambient temperature	–40		85	°C
T_J	Operating virtual junction temperature	–40		125	°C

(1) Refer to the *Application and Implementation* section for further information

8.4 Thermal Information

THERMAL METRIC(1)		TPS63027 YFF (DSBGA) 25 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	62.1	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	0.4	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	10.4	°C/W
ψ_{JT}	Junction-to-top characterization parameter	0.2	°C/W
ψ_{JB}	Junction-to-board characterization parameter	10.5	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	°C/W

(1) For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report.

8.5 Electrical Characteristics

V_{IN}= 2.3 V to 5.5 V, T_J= –40°C to +125°C, typical values are at T_A= 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY						
V_{IN}	Input voltage range		2.3		5.5	V
$V_{IN;LOAD}$	Minimum input voltage to turn on into full load	I_{OUT} = 2 A		2.8		V
I_{OUT}	Continuous output current(1)	V_{IN} ≥ 2.5 V, V_{OUT} = 3.3 V		2		A
I_Q	Quiescent current, V_{IN}	I_{OUT} = 0 mA, EN = V_{IN} = 3.6 V, V_{OUT} = 3.3 V T_J = –40°C to +85°C, not switching (PFM Mode)		35	70	µA
	Quiescent current, V_{OUT}	I_{OUT} = 0 mA, EN = V_{IN} = 3.6 V, V_{OUT} = 3.3 V T_J = –40°C to +85°C, not switching (PFM Mode)			12	µA
I_{SD}	Shutdown current	EN = low, T_J = –40°C to +85°C		0.1	2	µA
UVLO	Undervoltage lockout threshold	V_{IN} falling	1.6	1.7	2	V
	Undervoltage lockout hysteresis			60		mV
	Thermal shutdown	Temperature rising		140		°C
	Thermal shutdown hysteresis			20		°C
LOGIC SIGNALS EN, PFM/PWM						
V_{IH}	High-level input voltage	V_{IN} = 2.3 V to 5.5 V	1.2			V
V_{IL}	Low-level input voltage	V_{IN} = 2.3 V to 5.5 V			0.4	V
I_{lkg}	Input leakage current	EN = GND or V_{IN}		0.01	0.2	µA
OUTPUT						
V_{OUT}	Output voltage range	V_{IN} = 3.6 V, I_{OUT} = 100 mA	1		5.5	V
V_{FB}	Feedback regulation voltage			0.8		V
V_{FB}	Feedback voltage accuracy	PWM mode	–1%		1%	
V_{FB}	Feedback voltage accuracy(2)	PFM mode	–1%	1.3%	3%	
$I_{PWM/PFM}$	Output current to enter PFM mode	V_{IN} = 3 V; V_{OUT} = 3.3 V		350		mA
I_{FB}	Feedback input bias current	V_{FB} = 0.8 V		10	100	nA
$R_{DS;ON(Buck)}$	High-side FET on-resistance	V_{IN} = 3 V, V_{OUT} = 3.3 V		48		mΩ
	Low-side FET on-resistance	V_{IN} = 3 V, V_{OUT} = 3.3 V		56		mΩ
$R_{DS;ON(Boost)}$	High-side FET on-resistance	V_{IN} = 3 V, V_{OUT} = 3.3 V		33		mΩ
	Low-side FET on-resistance	V_{IN} = 3 V, V_{OUT} = 3.3 V		56		mΩ
I_{IN}	Average input current limit(3)	V_{IN} = 3 V, V_{OUT} = 3.3 V T_J = 65°C to 125°C	3.5	4.5	5	A
f_{SW}	Switching frequency			2.5		MHz
R_{ON_DISC}	Discharge ON-resistance	EN = low		120		Ω
	Line regulation	V_{IN} = 2.8 V to 5.5 V, I_{OUT} = 2 A		7.4		mV/V
	Load regulation	V_{IN}= 3.6 V, I_{OUT} = 0 A to 2 A		5		mV/A

(1) For minimum output current in a specific working point see 图 6 and 公式 1 trough 公式 4.
(2) Conditions: L = 1 µH, C_{OUT} = 2 × 22 µF.
(3) For variation of this parameter with Input voltage and temperature see 图 6.

8.6 Timing Requirements

V_{IN}= 2.3 V to 5.5 V, T_J= –40°C to +125°C, typical values are at T_A= 25°C (unless otherwise noted)

			MIN	NOM	MAX	UNIT
OUTPUT						
t_{SS}	Soft-start time	V_{OUT} = EN = low to high, Buck mode V_{IN} = 3.6 V, V_{OUT} = 3.3 V, I_{OUT} = 2 A		450		µs
		V_{OUT} = EN = low to high, Boost mode V_{IN} = 2.8 V, V_{OUT} = 3.3 V, I_{OUT} = 2 A		700		µs
t_d	Start up delay	Time from when EN = high to when device starts switching		100		µs

8.7 Typical Characteristics

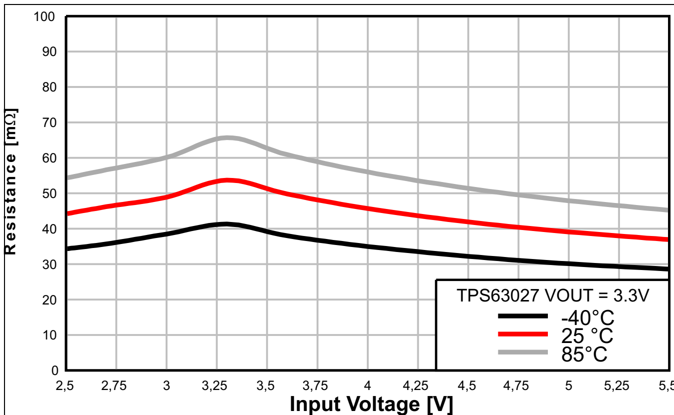


图 1. High Side FET On-Resistance vs Input Voltage

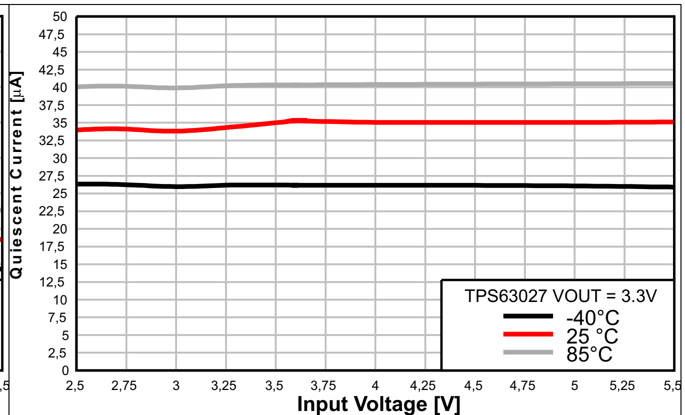


图 2. Quiescent Current vs Input Voltage

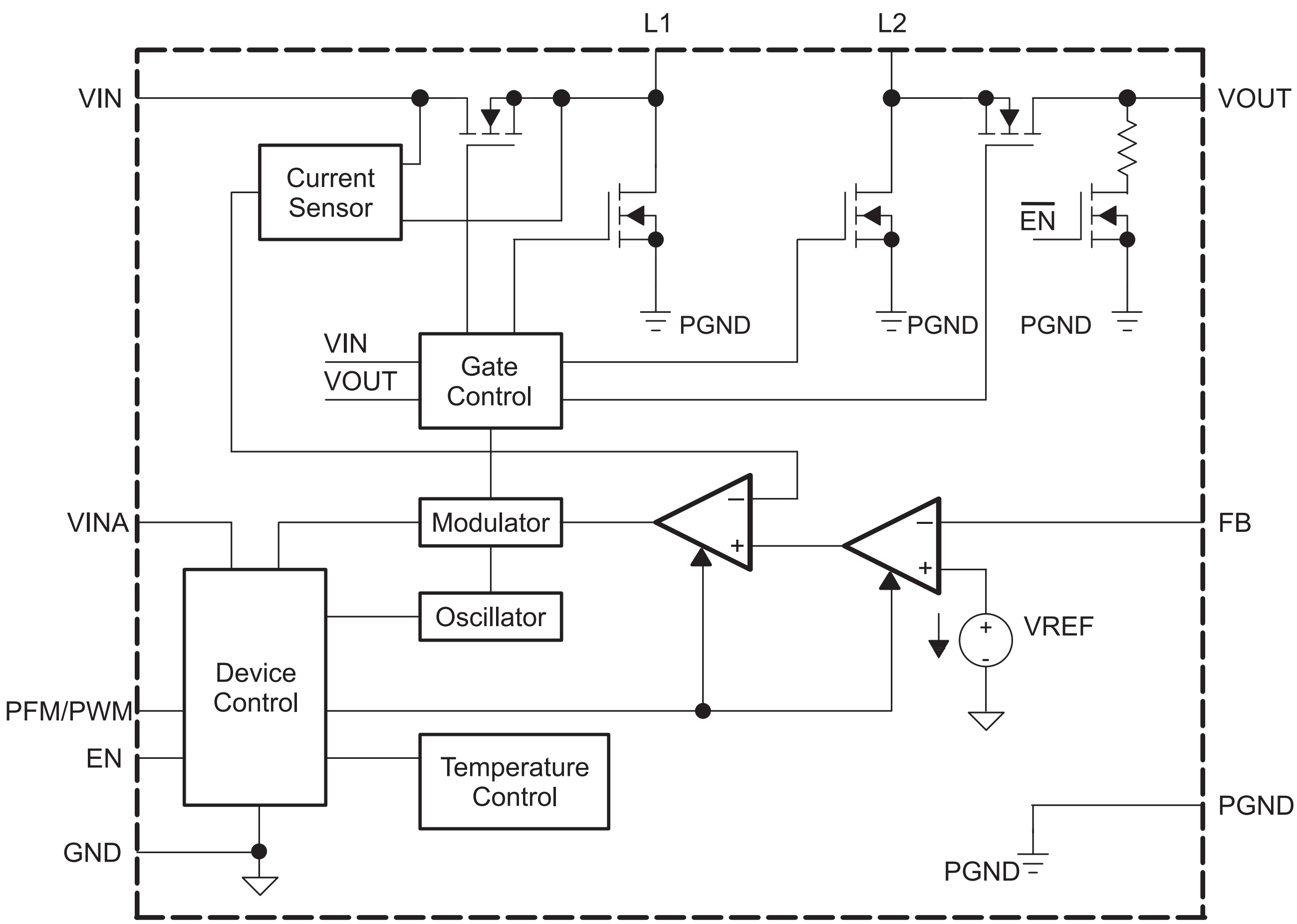
9 Detailed Description

9.1 Overview

The TPS63027 use 4 internal N-channel MOSFETs to maintain synchronous power conversion at all possible operating conditions. This enables the device to keep high efficiency over the complete input voltage and output power range. To regulate the output voltage at all possible input voltage conditions, the device automatically switches from buck operation to boost operation and back as required by the configuration. It always uses one active switch, one rectifying switch, one switch is held on, and one switch held off. Therefore, it operates as a buck converter when the input voltage is higher than the output voltage, and as a boost converter when the input voltage is lower than the output voltage. There is no mode of operation in which all 4 switches are switching at the same time. Keeping one switch on and one switch off eliminates their switching losses. The RMS current through the switches and the inductor is kept at a minimum, to minimize switching and conduction losses. Controlling the switches this way allows the converter to always keep higher efficiency.

The device provides a seamless transition from buck to boost or from boost to buck operation.

9.2 Functional Block Diagram



9.3 Feature Description

9.3.1 Undervoltage Lockout (UVLO)

To avoid mis-operation of the device at low input voltages, an undervoltage lockout is included. UVLO shuts down the device at low input voltages to ensure proper operation. See eletrical characteristics table for the dedicated values.

Feature Description (接下页)

9.3.2 Output Discharge Function

When the device is disabled by pulling enable low and the supply voltage is still applied, the internal transistor use to discharge the output capacitor is turned on, and the output capacitor is discharged until UVLO is reached. This means, if there is no supply voltage applied the output discharge function is also disabled. The transistor which is responsible of the discharge function, when turned on, operates like an equivalent 120-Ω resistor, ensuring typically less than 10ms discharge time for 20-µF output capacitance and a 3.3 V output.

9.3.3 Thermal Shutdown

The device goes into thermal shutdown once the junction temperature exceeds typically 140°C with a 20°C hysteresis.

9.3.4 Softstart

To minimize inrush current and output voltage overshoot during start up, the device has a Softstart. At turn on, the input current raises monotonic until the output voltage reaches regulation. During Softstart, the input current follows the current ramp charging the internal Softstart capacitor. The device smoothly ramps up the input current bringing the output voltage to its regulated value even if a large capacitor is connected at the output.

The Softstart time is measured as the time from when the EN pin is asserted to when the output voltage has reached 90% of its nominal value. There is a delay time from when the EN pin is asserted to when the device starts the switching activity. The Softstart time depends on the load current, the input voltage, and the output capacitor. The Softstart time in boost mode is longer then the time in buck mode.

The inductor current is able to increase and always assure a soft start unless a real short circuit is applied at the output.

9.3.5 Short Circuit Protection

The TPS63027 provides short circuit protection to protect itself and the application. When the output voltage does not increase above 1.2V, the device assumes a short circuit at the output and limits the input current to 4 A.

9.4 Device Functional Modes

9.4.1 Control Loop Description

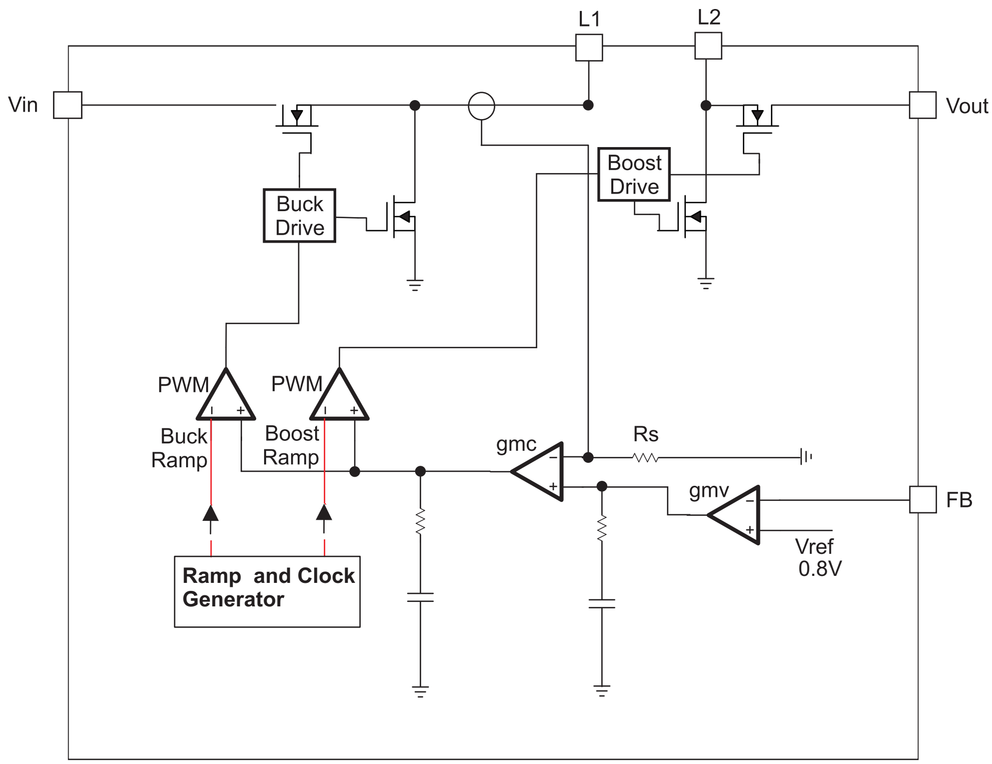


图 3. Average Current Mode Control

The controller circuit of the device is based on an average current mode topology. The average inductor current is regulated by a fast current regulator loop which is controlled by a voltage control loop. 图 3 shows the control loop.

The non inverting input of the transconductance amplifier, gmv, is assumed to be constant. The output of gmv defines the average inductor current. The inductor current is reconstructed by measuring the current through the high side buck MOSFET. This current corresponds exactly to the inductor current in boost mode. In buck mode the current is measured during the on time of the same MOSFET. During the off time, the current is reconstructed internally starting from the peak value at the end of the on time cycle. The average current and the feedback from the error amplifier gmv forms the correction signal gmc. This correction signal is compared to the buck and the boost sawtooth ramp giving the PWM signal. Depending on which of the two ramps the gmc output crosses either the Buck or the Boost stage is initiated. When the input voltage is close to the output voltage, one buck cycle is always followed by a boost cycle. In this condition, no more than three cycles in a row of the same mode are allowed. This control method in the buck-boost region ensures a robust control and the highest efficiency.

Device Functional Modes (接下页)

9.4.2 Power Save Mode Operation

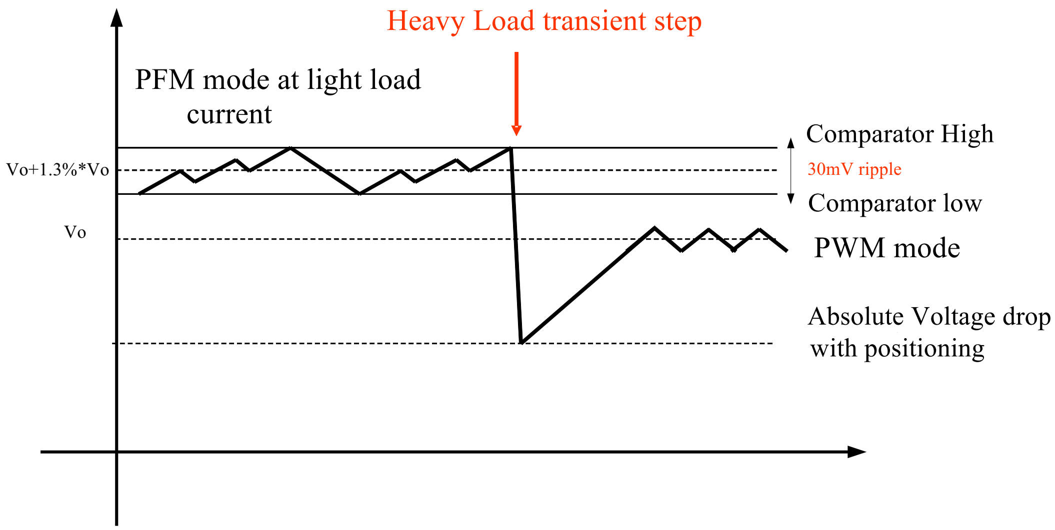


图 4. Power Save Mode Operation

Depending on the load current, in order to provide the best efficiency over the complete load range, the device works in PWM mode at load currents of typically 350mA or higher. At lighter loads, the device switches automatically into Power Save Mode to reduce power consumption and extend battery life. The MODE pin is used to select between the two different operation modes. To enable Power Save Mode, the MODE pin must be set HIGH.

During Power Save Mode, the part operates with a reduced switching frequency and lowest supply current to maintain high efficiency. The output voltage is monitored with a comparator at every clock cycle by the thresholds comp low and comp high. When the device enters Power Save Mode, the converter stops operating and the output voltage drops. The slope of the output voltage depends on the load and the output capacitance. When the output voltage reaches the comp low threshold, at the next clock cycle the device ramps up the output voltage again, by starting operation. Operation can last for one or several pulses until the comp high threshold is reached. At the next clock cycle, if the load is still lower than about 350mA, the device switches off again and the same operation is repeated. Instead, if at the next clock cycle, the load is above 350mA, the device automatically switches to PWM mode.

In order to keep high efficiency in PFM mode, there is only one comparator active to keep the output voltage regulated. The AC ripple in this condition is increased, compared to the PWM mode. The amplitude of this voltage ripple is typically 30 mV pk-pk, with 2-µF effective output capacitance. In order to avoid a critical voltage drop when switching from 0A to full load, the output voltage in PFM mode is typically 1.3% above the nominal value in PWM mode. This is called Dynamic Voltage Positioning and allows the converter to operate with a small output capacitor and still have a low absolute voltage drop during heavy load transients.

Power Save Mode is disabled by setting the MODE pin LOW.

Device Functional Modes (接下页)

9.4.3 Current Limit

The current limit variation depends on the difference between the input and output voltage. The maximum current limit value is at the highest difference.

Given the curves provided in *图 6*, it is possible to calculate the output current reached in boost mode, using *公式 1* and *公式 2* and in buck mode using *公式 3* and *公式 4*.

Duty Cycle Boost $$D = \frac{V_{OUT} - V_{IN}}{V_{OUT}} \quad (1)$$

Output Current Boost $$I_{OUT} = \eta \times I_{IN} (1-D) \quad (2)$$

Duty Cycle Buck $$D = \frac{V_{OUT}}{V_{IN}} \quad (3)$$

Output Current Buck $$I_{OUT} = (\eta \times I_{IN}) / D$$

where

- η = Estimated converter efficiency (use the number from the efficiency curves or 0.90 as an assumption)
- I_{IN}= Minimum average input current (*图 6*) (4)

9.4.4 Supply and Ground

The TPS63027 provides two input pins (VIN and AVIN) and two ground pins (GND and AGND).

The VIN pin supplies the input power, while the AVIN pin provides voltage for the control circuits. A similar approach is used for the ground pins. AGND and GND are used to avoid ground shift problems due to the high currents in the switches. The reference for all control functions is the AGND pin. The power switches are connected to GND. Both grounds must be connected on the PCB at only one point, ideally, close to the AGND pin.

9.4.5 Device Enable

The device starts operation when the EN pin is set high. The device enters shutdown mode when the EN pin is set low. In shutdown mode, the regulator stops switching, all internal control circuitry is switched off, and the load is disconnected from the input.

10 Application and Implementation

注

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

10.1 Application Information

The TPS63027 are high efficiency, low quiescent current buck-boost converters suitable for application where the input voltage is higher, lower or equal to the output. Output currents can go as high as 2A in boost mode and as high as 5A in buck mode. The maximum average current in the switches is limited to a typical value of 4.5 A.

10.2 Typical Applications

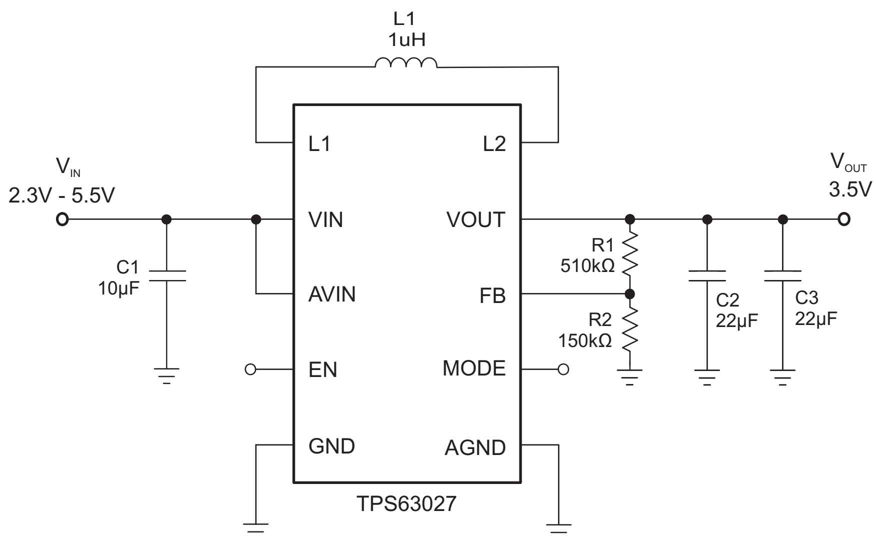


图 5. 3.3-V Output Voltage

10.2.1 Design Requirements

The design guideline provides a component selection to operate the device within the recommended operating conditions.

表 1 shows the list of components for the Application Characteristic Curves.

表 1. Components for Application Characteristic Curves(1)

REFERENCE	DESCRIPTION	MANUFACTURER
	TPS63027	Texas Instruments
L1	1 µH, 8.75A, 13mΩ, SMD	XAL4020-102MEB, Coilcraft
C1	10 µF 6.3V, 0603, X5R ceramic	Standard
C2	47 µF 6.3V, 0603, X5R ceramic	Standard
R1	510kΩ	Standard
R2	150kΩ	Standard

(1) See *Third-Party Products Discalimer*

10.2.2 Detailed Design Procedure

The first step is the selection of the output filter components. To simplify this process 表 2 outlines possible inductor and capacitor value combinations.

10.2.2.1 Output Filter Design

表 2. Matrix of Output Capacitor and Inductor Combinations

NOMINAL INDUCTOR VALUE [µH](1)	NOMINAL OUTPUT CAPACITOR VALUE [µF](2)				
	2x22	47	66	88	100
0.680	+	+	+	+	+
1.0	+(3)	+	+	+	+
1.5			+	+	+

(1) Inductor tolerance and current de-rating is anticipated. The effective inductance can vary by 20% and –30%.
(2) Capacitance tolerance and bias voltage de-rating is anticipated. The effective capacitance can vary by 20% and –50%.
(3) Typical application. Other check mark indicates recommended filter combinations

10.2.2.2 Inductor Selection

The inductor selection is affected by several parameter like inductor ripple current, output voltage ripple, transition point into Power Save Mode, and efficiency. See 表 3 for typical inductors.

表 3. List of Recommended Inductors(1)

INDUCTOR VALUE	COMPONENT SUPPLIER	SIZE (LxWxH mm)	Isat/DCR
1 µH	Coilcraft XAL4020-102ME	4 X 4 X 2.10	4.5A/10mΩ
1 µH	Toko, DFE322512C	3.2 X 2.5 X 1.2	4.7A/34mΩ
1 µH	TDK, SPM4012	4.4 X 4.1 X 1.2	4.1A/38mΩ
1 µH	Wuerth, 74438334010	3 X 3 X 1.2	6.6A/42.10mΩ
0.6 µH	Coilcraft XFL4012-601ME	4 X 4 X 1.2	5A/17.40mΩ
0.68µH	Wuerth,744383340068	3 X 3 X 1.2	7.7A/36mΩ

(1) See *Third-Party Products Desclaimer*

For high efficiencies, the inductor should have a low dc resistance to minimize conduction losses. Especially at high-switching frequencies, the core material has a high impact on efficiency. When using small chip inductors, the efficiency is reduced mainly due to higher inductor core losses. This needs to be considered when selecting the appropriate inductor. The inductor value determines the inductor ripple current. The larger the inductor value, the smaller the inductor ripple current and the lower the conduction losses of the converter. Conversely, larger inductor values cause a slower load transient response. To avoid saturation of the inductor, the peak current for the inductor in steady state operation is calculated using Equation 6. Only the equation which defines the switch current in boost mode is shown, because this provides the highest value of current and represents the critical current value for selecting the right inductor.

Duty Cycle Boost $$D = \frac{V_{OUT} - V_{IN}}{V_{OUT}}$$

$$I_{PEAK} = \frac{Iout}{\eta \times (1 - D)} + \frac{Vin \times D}{2 \times f \times L} \quad (5)$$

where

- D =Duty Cycle in Boost mode
- f = Converter switching frequency (typical 2.5MHz)
- L = Inductor value
- η = Estimated converter efficiency (use the number from the efficiency curves or 0.90 as an assumption) (6)

Calculating the maximum inductor current using the actual operating conditions gives the minimum saturation current of the inductor needed. It's recommended to choose an inductor with a saturation current 20% higher than the value calculated using 公式 6. Possible inductors are listed in 表 3.

10.2.2.3 Capacitor Selection

10.2.2.3.1 Input Capacitor

At least a 10µF input capacitor is recommended to improve line transient behavior of the regulator and EMI behavior of the total power supply circuit. An X5R or X7R ceramic capacitor placed as close as possible to the VIN and PGND pins of the IC is recommended. This capacitance can be increased without limit. If the input supply is located more than a few inches from the TPS63027 converter additional bulk capacitance may be required in addition to the ceramic bypass capacitors. An electrolytic or tantalum capacitor with a value of 47 µF is a typical choice.

10.2.2.3.2 Output Capacitor

For the output capacitor, use of a small ceramic capacitors placed as close as possible to the VOUT and PGND pins of the IC is recommended. The recommended effective output capacitance value is 20 µF with a variance as outlined in 表 2 . This translates into a 44uF nominal cpacitor (6.3V rated) for output voltages up to 3.5V.

There is also no upper limit for the output capacitance value. Larger capacitors causes lower output voltage ripple as well as lower output voltage drop during load transients.

10.2.2.4 Setting The Output Voltage

When the adjustable output voltage version TPS63027 is used, the output voltage is set by an external resistor divider. The resistor divider must be connected between VOUT, FB and GND. When the output voltage is regulated properly, the typical value of the voltage at the FB pin is 800 mV. The current through the resistive divider should be about 10 times greater than the current into the FB pin. The typical current into the FB pin is 0.1 µA, and the voltage across the resistor between FB and GND, R_2, is typically 800 mV. Based on these two values, the recommended value for R2 should be lower than 180 kΩ, in order to set the divider current at 4µA or higher. It is recommended to keep the value for this resistor in the range of 180kΩ. From that, the value of the resistor connected between VOUT and FB, R1, depending on the needed output voltage (V_{OUT}), can be calculated using 公式 7:

$$R1 = R2 \times \left(\frac{V_{OUT}}{V_{FB}} - 1 \right) \tag{7}$$

10.2.3 Application Curves

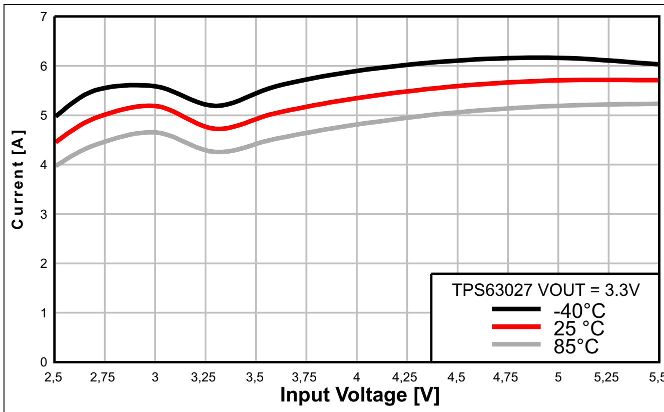


图 6. Average Input Current vs Input Voltage

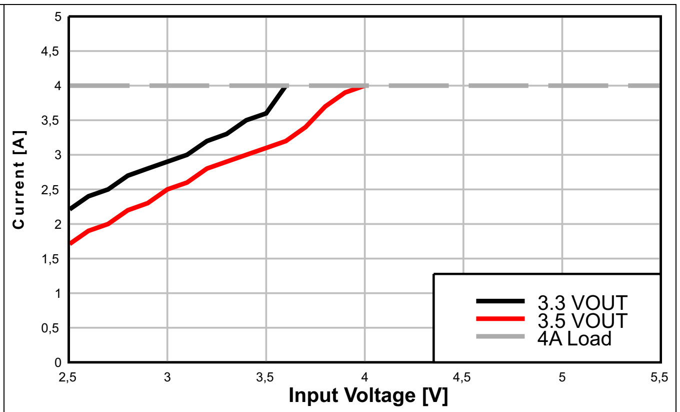


图 7. Maximum Output Current for a 4A Load

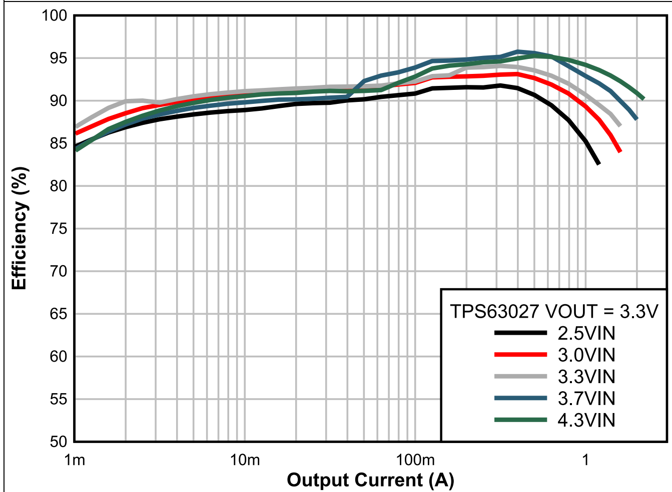


图 8. Efficiency vs Output Current

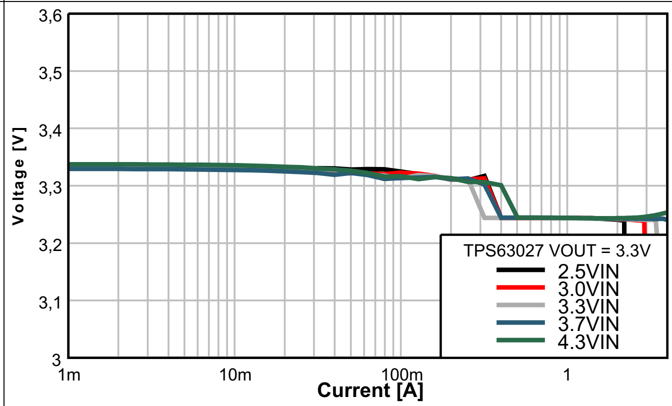


图 9. Output Voltage vs Output Current

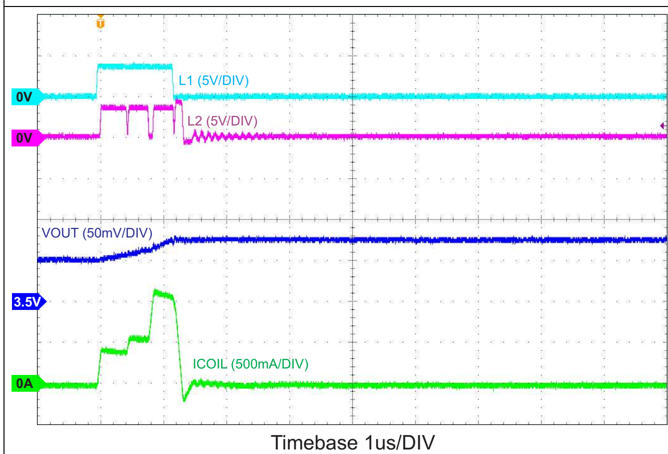


图 10. Output Voltage Ripple in Buck-Boost Mode, VIN = 3.6 V, VOUT = 3.5 V, no Load

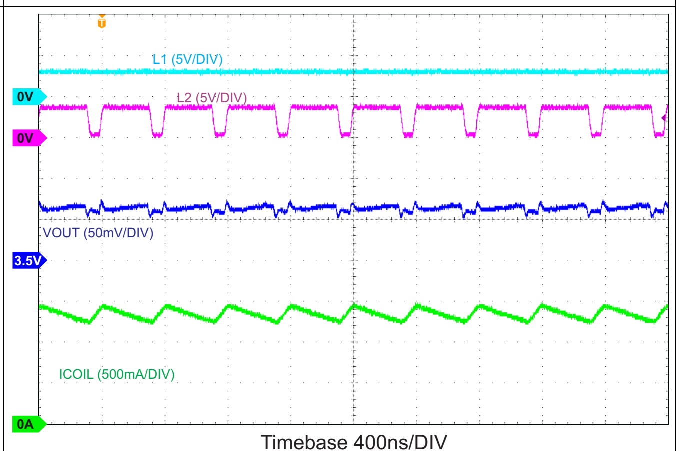


图 11. Switching Waveforms in Boost Mode, VIN = 3.0 V, VOUT = 3.5 V, 1-A Load

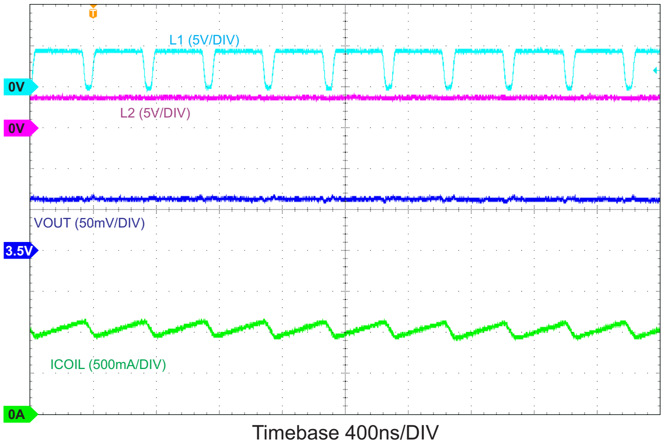


图 12. Switching Waveforms in Buck Mode, VIN = 4.3 V, VOUT = 3.5 V, 1-A Load

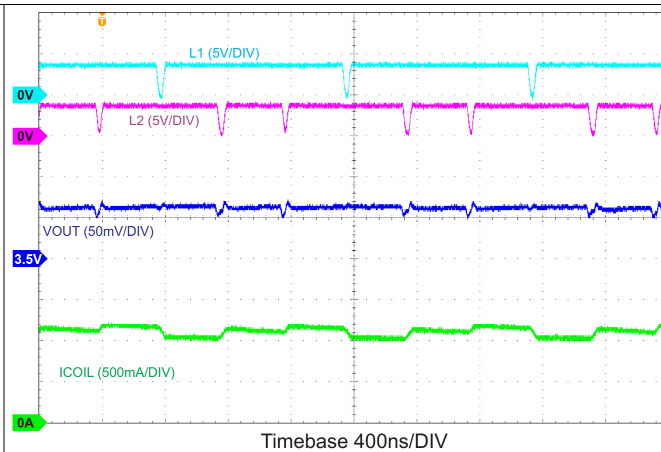


图 13. Switching Waveforms in Buck-Boost Mode, VIN = 3.55 V, VOUT = 3.5 V, 1-A Load

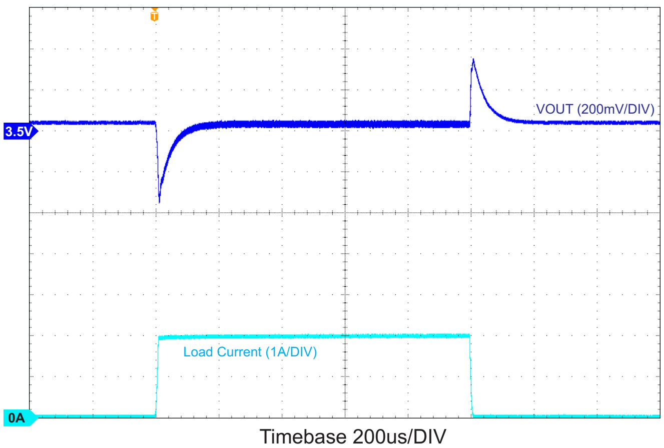


图 14. Load Transient Response Boost Mode, VIN = 3.0 V, VOUT = 3.5 V

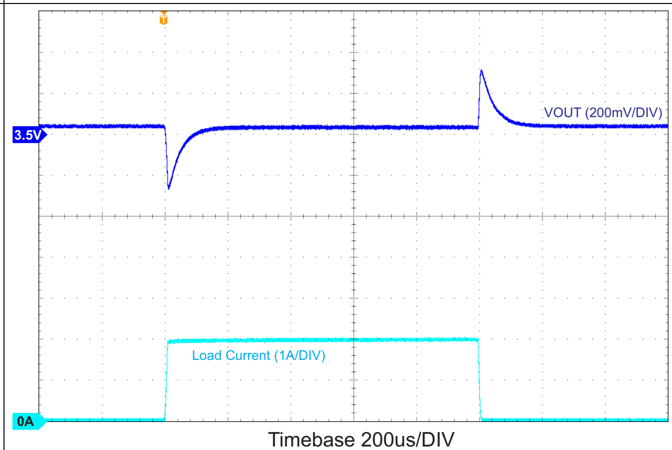


图 15. Load Transient Response Buck Mode, VIN = 4.3 V, VOUT = 3.5 V

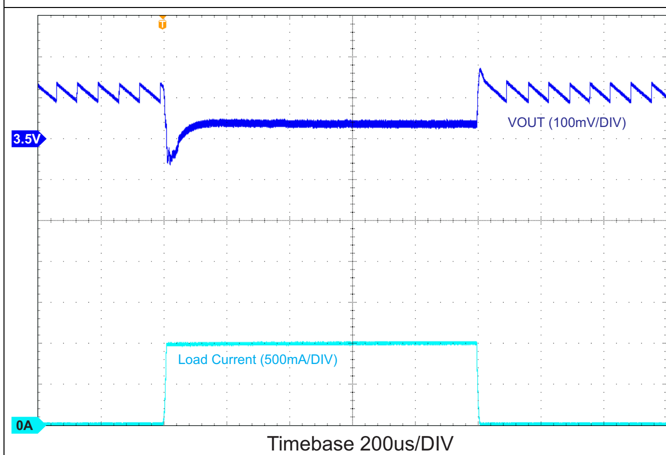


图 16. Load Transient Response, VIN = 3.5 V, VOUT = 3.5 V, PFM Mode

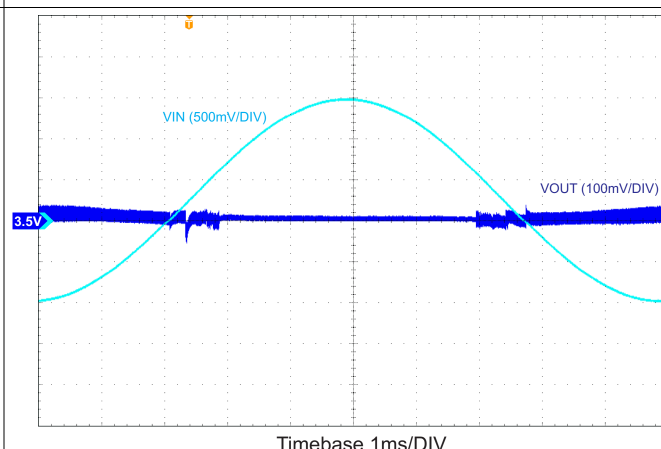


图 17. Line Sweep Response, VOUT = 3.5 V, 2-A Load

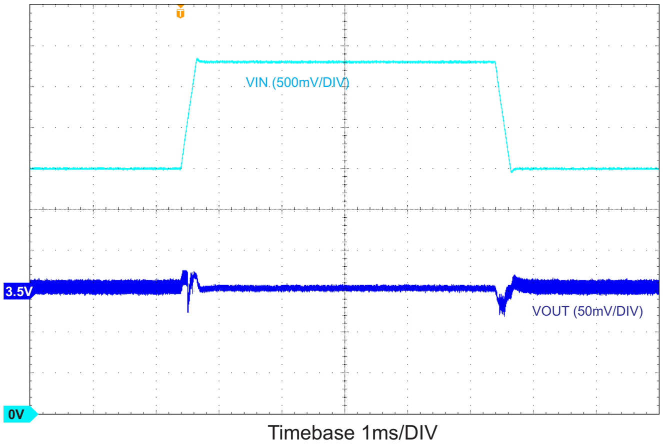


图 18. Line Transient Response, VOUT = 3.5 V, 1-A Load

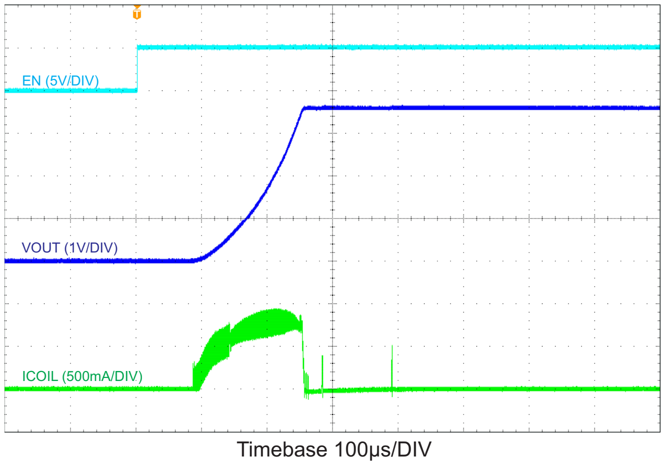


图 19. Start Up After Enable, VIN = 3.7 V, VOUT = 3.5 V, no Load

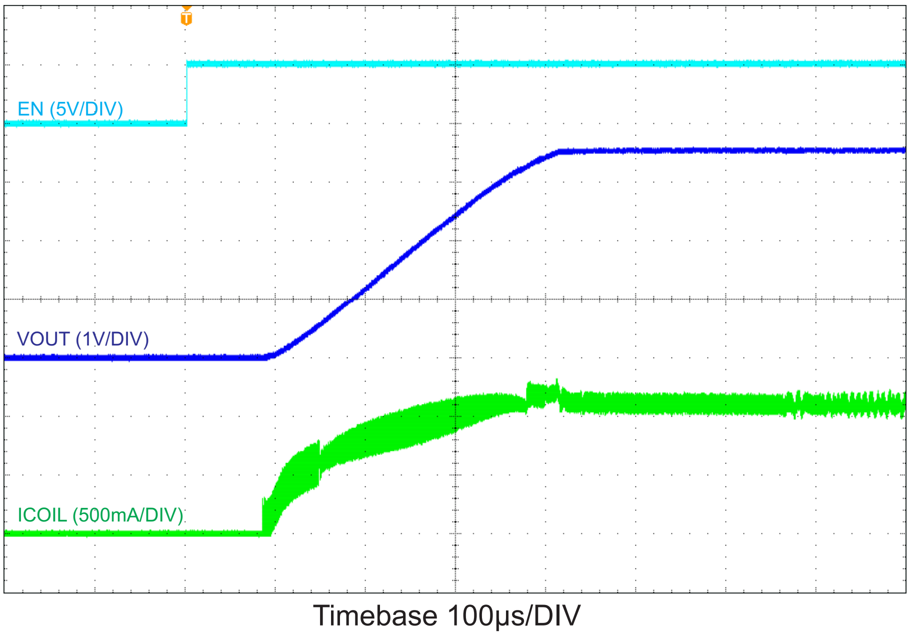


图 20. Start Up After Enable, VIN = 3.7 V, VOUT = 3.5 V, 1-A Load

11 Power Supply Recommendations

The TPS63027 device family has no special requirements for its input power supply. The input power supply's output current needs to be rated according to the supply voltage, output voltage and output current of the TPS63027.

12 Layout

12.1 Layout Guidelines

The PCB layout is an important step to maintain the high performance of the TPS63027 devices.

- Place input and output capacitors as close as possible to the IC. Traces need to be kept short. Routing wide and direct traces to the input and output capacitor results in low trace resistance and low parasitic inductance.
- Use a common-power GND
- Use separate traces for the supply voltage of the power stage; and, the supply voltage of the analog stage.
- The sense trace connected to FB is signal trace. Keep these traces away from L1 and L2 nodes.

12.2 Layout Example

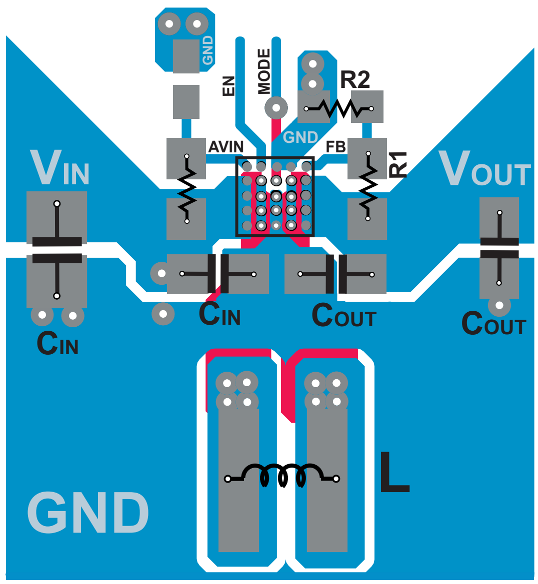


图 21. TPS63027 Layout

13 器件和文档支持

13.1 器件支持

13.1.1 Third-Party Products Disclaimer

TI'S PUBLICATION OF INFORMATION REGARDING THIRD-PARTY PRODUCTS OR SERVICES DOES NOT CONSTITUTE AN ENDORSEMENT REGARDING THE SUITABILITY OF SUCH PRODUCTS OR SERVICES OR A WARRANTY, REPRESENTATION OR ENDORSEMENT OF SUCH PRODUCTS OR SERVICES, EITHER ALONE OR IN COMBINATION WITH ANY TI PRODUCT OR SERVICE.

13.2 文档支持

13.2.1 相关文档

相关文档如下：

- 《*TPS63027EVM-813 用户指南，TPS63027 高电流、高效率单电感器降压-升压转换器*》，SLVUA24

13.3 接收文档更新通知

如需接收文档更新通知，请访问 www.ti.com.cn 网站上的器件产品文件夹。点击右上角的*提醒我* (Alert me) 注册后，即可每周定期收到已更改的产品信息。有关更改的详细信息，请查阅已修订文档中包含的修订历史记录。

13.4 社区资源

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

13.5 商标

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

13.6 静电放电警告

这些装置包含有限的内置 ESD 保护。 存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

13.7 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

14 机械、封装和可订购信息

以下页中包括机械、封装和可订购信息。这些信息是针对指定器件可提供的最新数据。这些数据会在无通知且不对本文档进行修订的情况下发生改变。欲获得该数据表的浏览器版本，请查阅左侧的导航栏。

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS63027YFFR	ACTIVE	DSBGA	YFF	25	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 125	TPS 63027	Samples
TPS63027YFFT	ACTIVE	DSBGA	YFF	25	250	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 125	TPS 63027	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

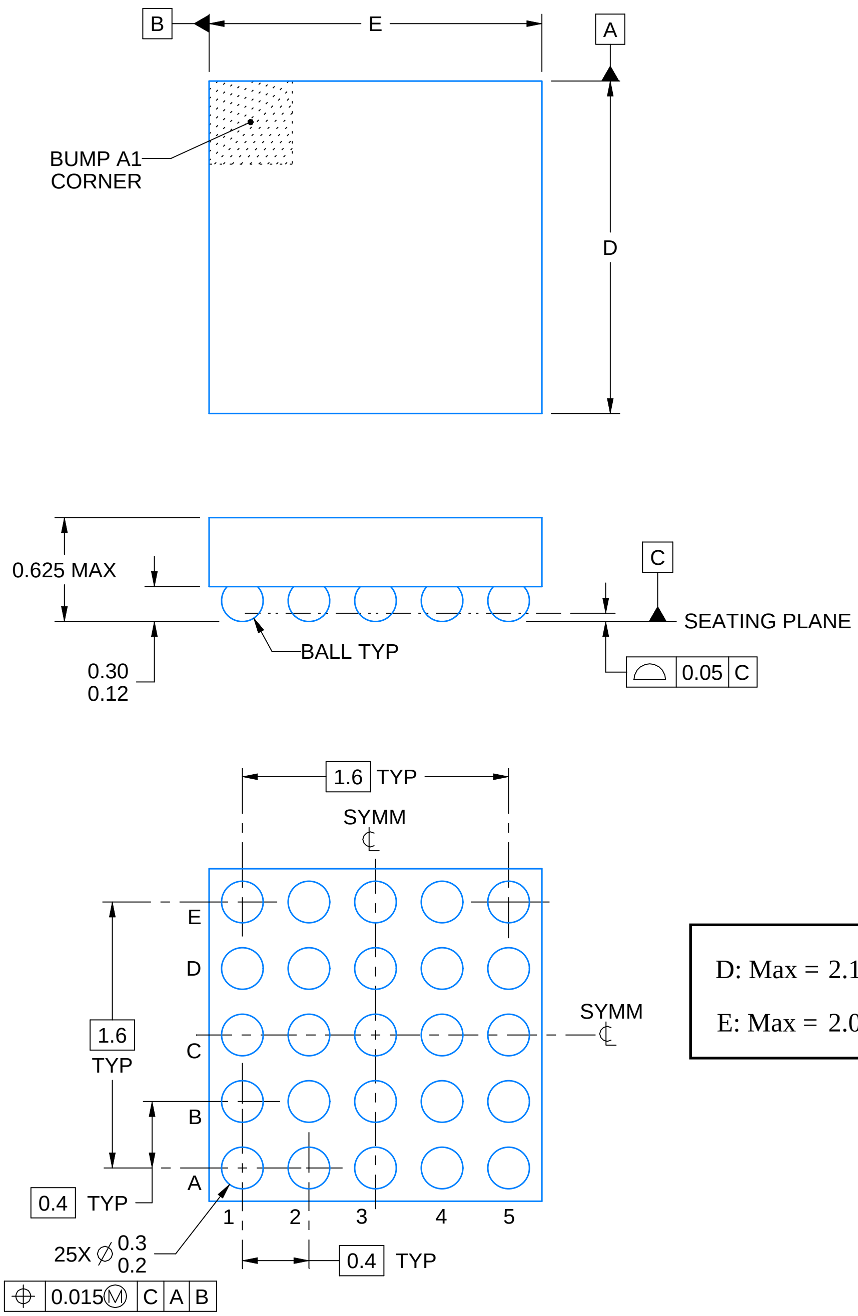
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

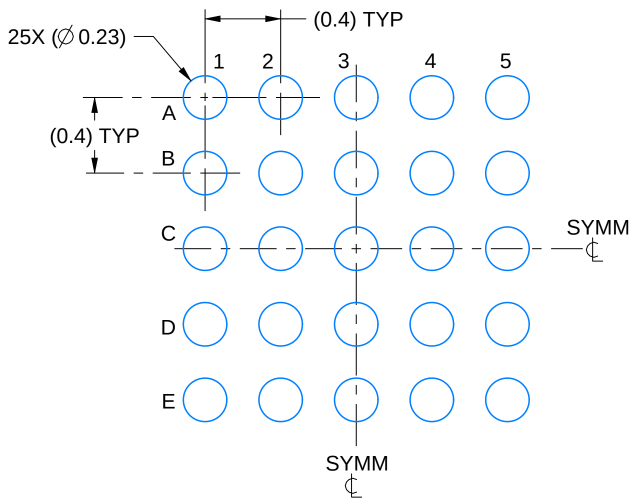


D: Max = 2.116 mm, Min =2.056 mm
E: Max = 2.098 mm, Min =2.038 mm

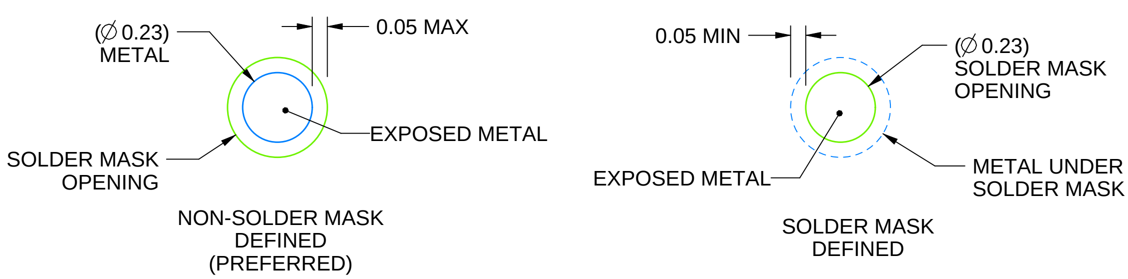
4223786/A 06/2017

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:25X

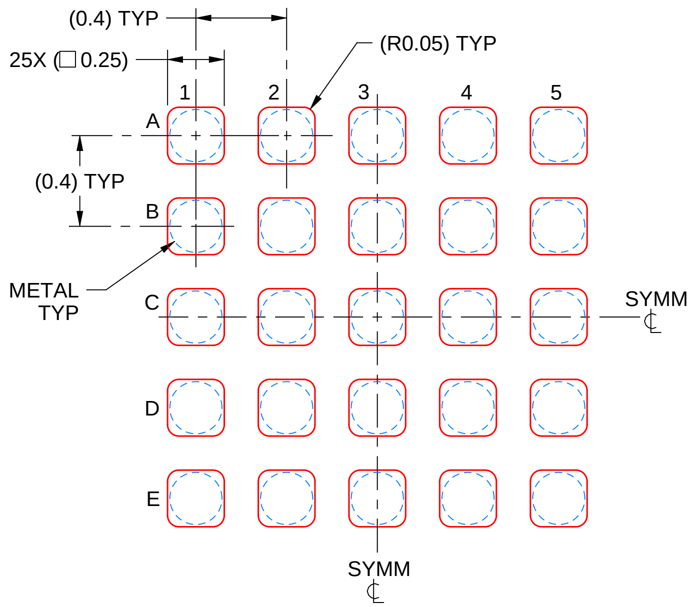


SOLDER MASK DETAILS
NOT TO SCALE

4223786/A 06/2017

NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:30X

4223786/A 06/2017

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

重要声明和免责声明

TI"按原样"提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做出任何明示或暗示的担保，包括但不限于对适销性、某特定用途方面的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他功能安全、信息安全、监管或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的应用。严禁对这些资源进行其他复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。您应全额赔偿因在这些资源的使用中对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，TI 对此概不负责。

TI 提供的产品受 TI 的销售条款或 ti.com 上其他适用条款/TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

邮寄地址：Texas Instruments, Post Office Box 655303, Dallas, Texas 75265