

TPS63027 高电流、高效单电感器降压-升压转换器

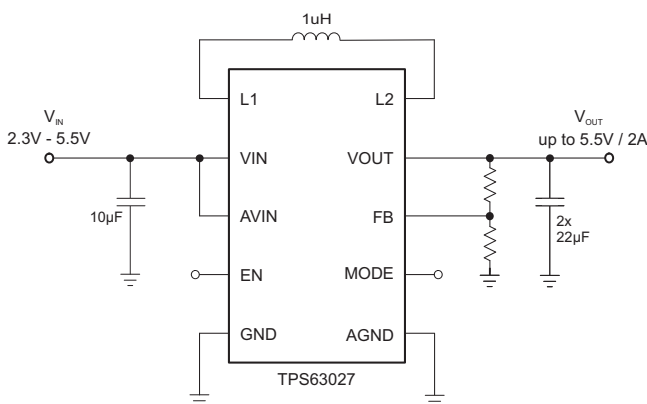
1 特性

- 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
- 35 μ A 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

4 典型应用



3 说明

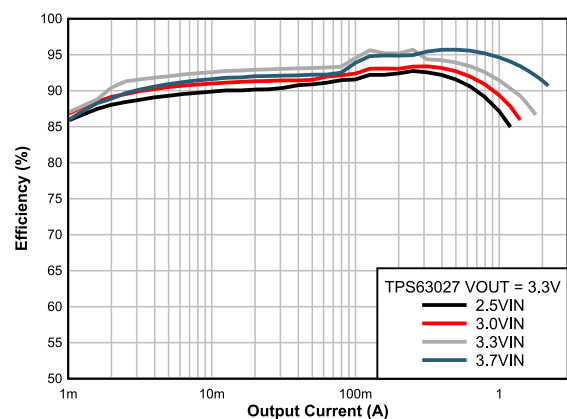
TPS63027 是一款具有低静态电流的高效降压-升压转换器，适用于输入电压可能高于或低于输出电压的应用。在升压模式下，输出电流可高达 2A，而在降压模式下，输出电流可高达 4A。开关的最大平均电流限制为 4.5A（典型值）。TPS63027 能够根据输入电压在降压与升压模式之间自动切换，确保在两种模式之间无缝切换，从而在整个输入电压范围内调节输出电压。此降压-升压转换器基于一个使用同步整流的固定频率、脉宽调制 (PWM) 控制器以获得最高效率。在低负载电流情况下，此转换器进入省电模式，以便在整个负载电流范围内保持高效率。有一个使用户能够在自动 PFM/PWM 模式运行和强制 PWM 运行之间进行选择的 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。

效率与输出电流间的关系



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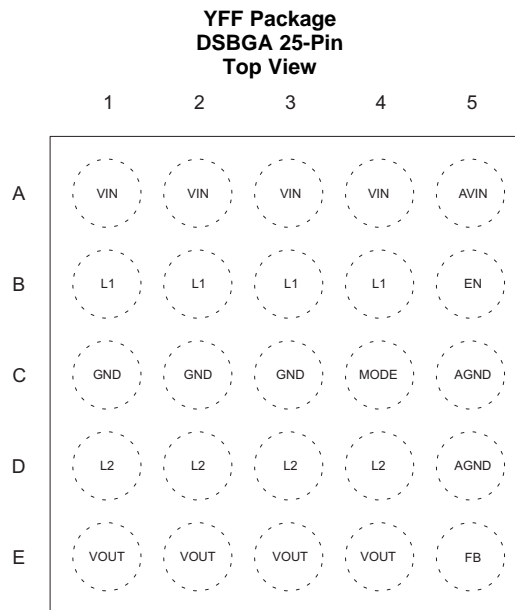
5 修订历史记录

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



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⁾	V _{IN} , L1, L2, EN, V _{INA} , PFM/PWM, V _{OUT} , FB	−0.3	7	V
Input current	Continuous 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 continuous 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
		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	UNIT
		YFF (DSBGA)	
		25 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	62.1	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	0.4	°C/W
R _{θJB}	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 _{θJC(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

 $V_{IN} = 2.3\text{ V to }5.5\text{ V}$, $T_J = -40^{\circ}\text{C to }+125^{\circ}\text{C}$, typical values are at $T_A = 25^{\circ}\text{C}$ (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	$I_{OUT} = 2\text{ A}$		2.8		V
I_{OUT}	Continuous output current ⁽¹⁾	$V_{IN} \geq 2.5\text{ V}$, $V_{OUT} = 3.3\text{ V}$		2		A
I_Q	Quiescent current, V_{IN}	$I_{OUT} = 0\text{ mA}$, $EN = V_{IN} = 3.6\text{ V}$, $V_{OUT} = 3.3\text{ V}$ $T_J = -40^{\circ}\text{C to }+85^{\circ}\text{C}$, not switching (PFM Mode)		35	70	μA
	Quiescent current, V_{OUT}	$I_{OUT} = 0\text{ mA}$, $EN = V_{IN} = 3.6\text{ V}$, $V_{OUT} = 3.3\text{ V}$ $T_J = -40^{\circ}\text{C to }+85^{\circ}\text{C}$, not switching (PFM Mode)			12	μA
I_{SD}	Shutdown current	$EN = \text{low}$, $T_J = -40^{\circ}\text{C to }+85^{\circ}\text{C}$		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		$^{\circ}\text{C}$
	Thermal shutdown hysteresis			20		$^{\circ}\text{C}$
LOGIC SIGNALS EN, PFM/PWM						
V_{IH}	High-level input voltage	$V_{IN} = 2.3\text{ V to }5.5\text{ V}$	1.2			V
V_{IL}	Low-level input voltage	$V_{IN} = 2.3\text{ V to }5.5\text{ V}$			0.4	V
I_{IKg}	Input leakage current	$EN = \text{GND or }V_{IN}$		0.01	0.2	μA
OUTPUT						
V_{OUT}	Output voltage range	$V_{IN} = 3.6\text{ V}$, $I_{OUT} = 100\text{ mA}$	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	$V_{IN} = 3\text{ V}$; $V_{OUT} = 3.3\text{ V}$		350		mA
I_{FB}	Feedback input bias current	$V_{FB} = 0.8\text{ V}$		10	100	nA
$R_{DS,ON(Buck)}$	High-side FET on-resistance	$V_{IN} = 3\text{ V}$, $V_{OUT} = 3.3\text{ V}$		48		m Ω
	Low-side FET on-resistance	$V_{IN} = 3\text{ V}$, $V_{OUT} = 3.3\text{ V}$		56		m Ω
$R_{DS,ON(Boost)}$	High-side FET on-resistance	$V_{IN} = 3\text{ V}$, $V_{OUT} = 3.3\text{ V}$		33		m Ω
	Low-side FET on-resistance	$V_{IN} = 3\text{ V}$, $V_{OUT} = 3.3\text{ V}$		56		m Ω
I_{IN}	Average input current limit ⁽³⁾	$V_{IN} = 3\text{ V}$, $V_{OUT} = 3.3\text{ V}$ $T_J = 65^{\circ}\text{C to }125^{\circ}\text{C}$	3.5	4.5	5	A
f_{SW}	Switching frequency			2.5		MHz
R_{ON_DISC}	Discharge ON-resistance	$EN = \text{low}$		120		Ω
	Line regulation	$V_{IN} = 2.8\text{ V to }5.5\text{ V}$, $I_{OUT} = 2\text{ A}$		7.4		mV/V
	Load regulation	$V_{IN} = 3.6\text{ V}$, $I_{OUT} = 0\text{ A to }2\text{ A}$		5		mV/A

(1) For minimum output current in a specific working point see 图 6 and 公式 1 through 公式 4.

(2) Conditions: $L = 1\text{ }\mu\text{H}$, $C_{OUT} = 2 \times 22\text{ }\mu\text{F}$.

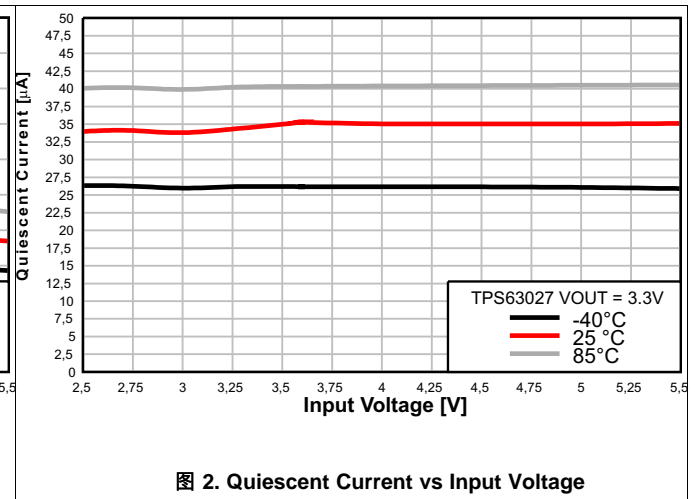
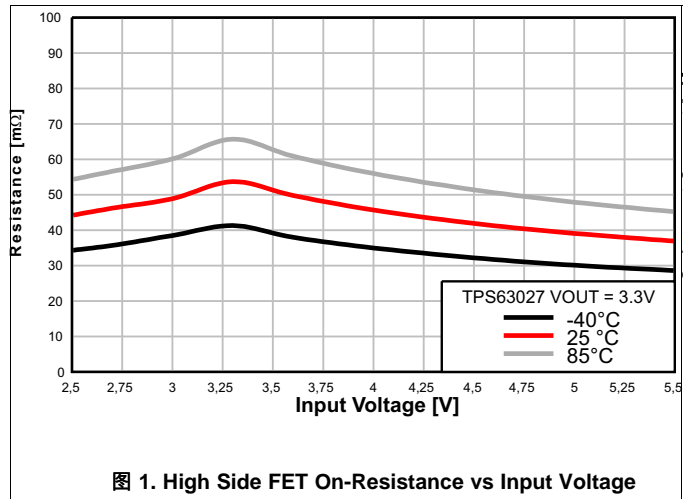
(3) For variation of this parameter with Input voltage and temperature see 图 6.

8.6 Timing Requirements

V_{IN} = 2.3 V to 5.5 V, T_J = -40°C to $+125^{\circ}\text{C}$, typical values are at T_A = 25°C (unless otherwise noted)

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

8.7 Typical Characteristics



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 used 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 rises monotonically 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 than 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

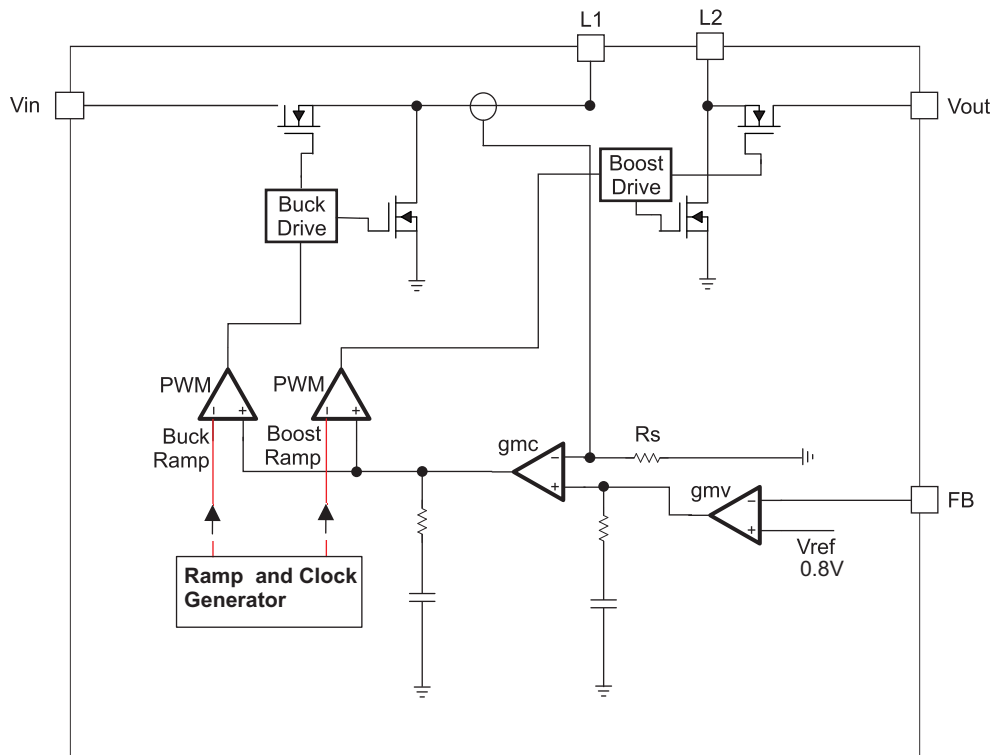


图 3. Average Current Mode Control

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

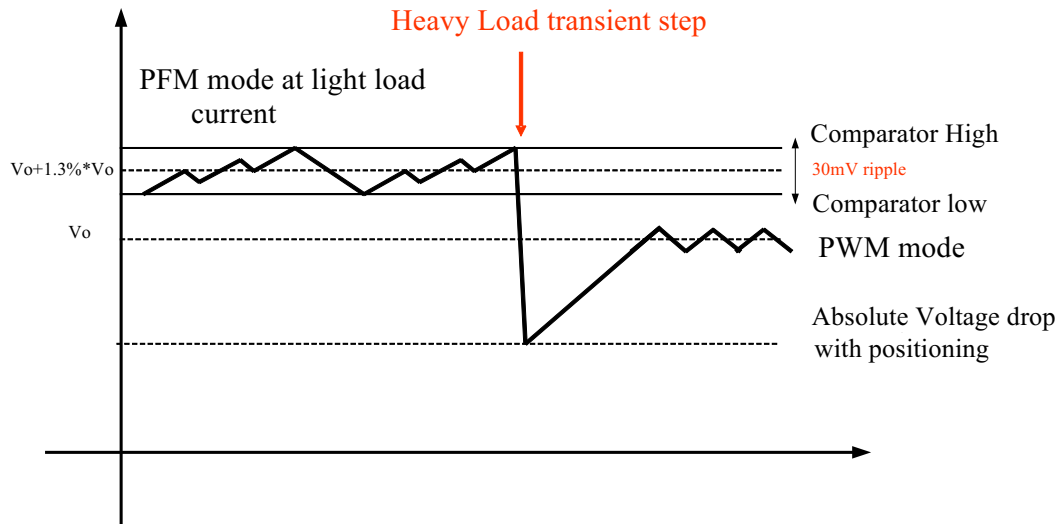


图 4. Power Save Mode Operation

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- μ F 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](#).

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

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

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

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

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

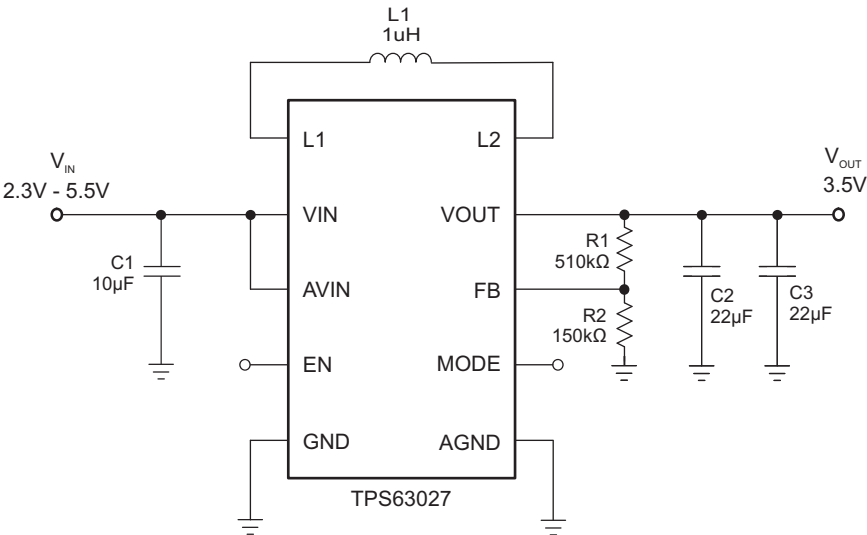


图 5. 3.3-V Output Voltage

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 Disclaimer](#)

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 Disclaimer](#)

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.

$$\text{Duty Cycle Boost} \quad D = \frac{V_{OUT} - V_{IN}}{V_{OUT}} \quad (5)$$

$$I_{PEAK} = \frac{I_{OUT}}{\eta \times (1 - D)} + \frac{V_{IN} \times D}{2 \times f \times L}$$

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 44µF nominal capacitor (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, R₂, 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](#):

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

10.2.3 Application Curves

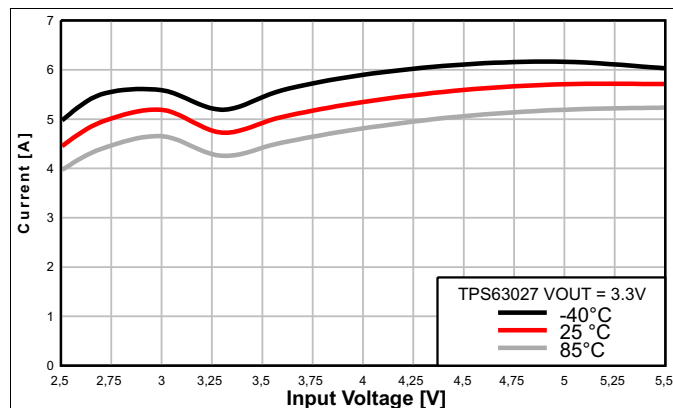


图 6. Average Input Current vs Input Voltage

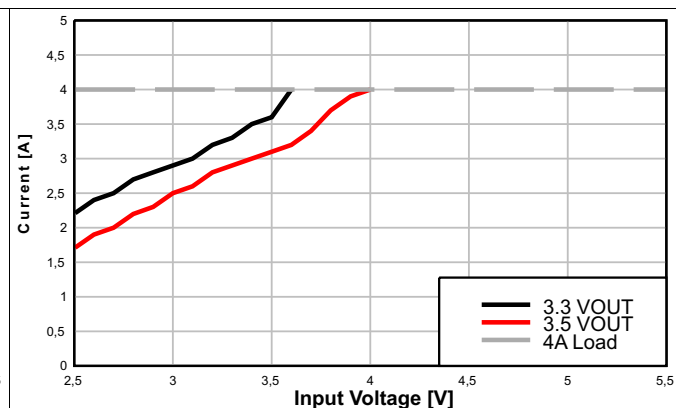


图 7. Maximum Output Current for a 4A Load

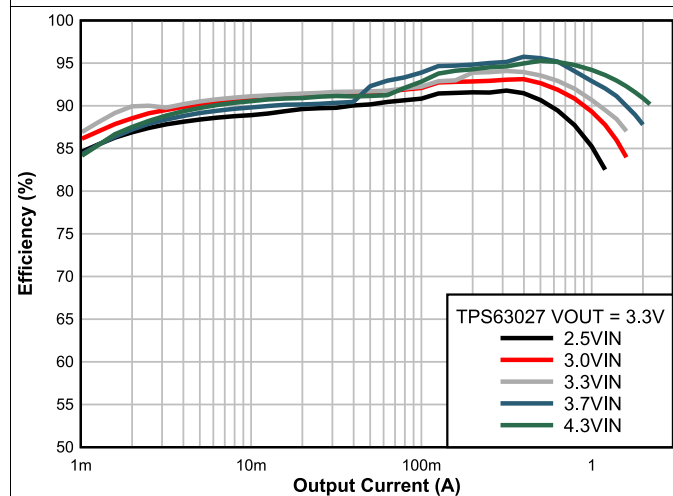


图 8. Efficiency vs Output Current

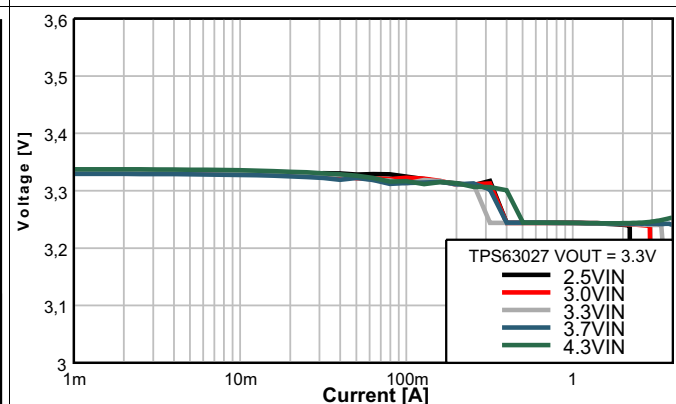


图 9. Output Voltage vs Output Current

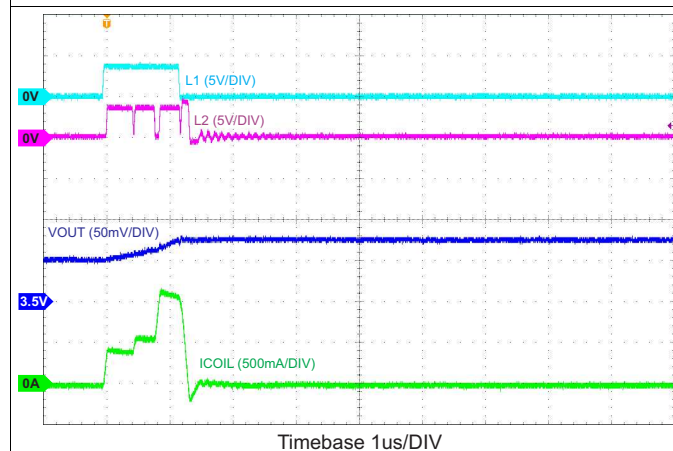


图 10. Output Voltage Ripple in Buck-Boost Mode, $V_{IN} = 3.6V$, $V_{OUT} = 3.5V$, no Load

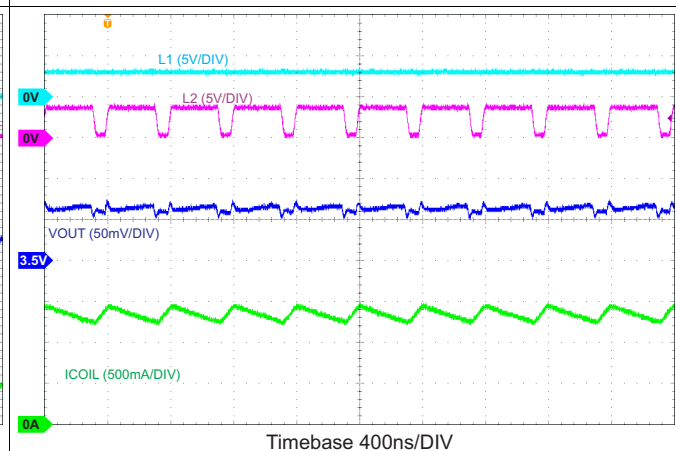


图 11. Switching Waveforms in Boost Mode, $V_{IN} = 3.0V$, $V_{OUT} = 3.5V$, 1-A Load

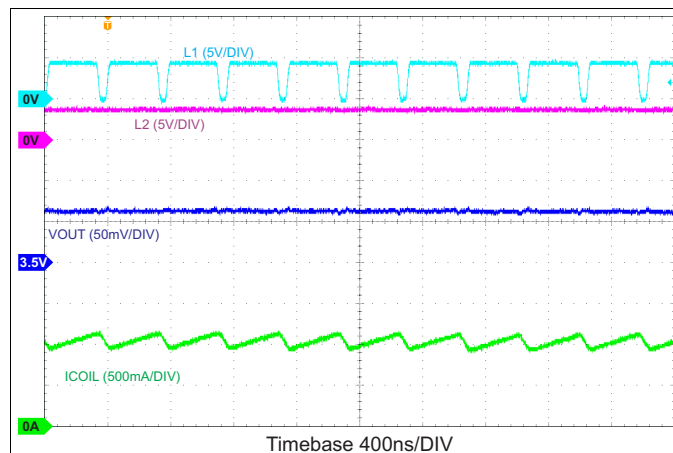


图 12. Switching Waveforms in Buck Mode, VIN = 4.3 V, VOUT = 3.5 V, 1-A Load

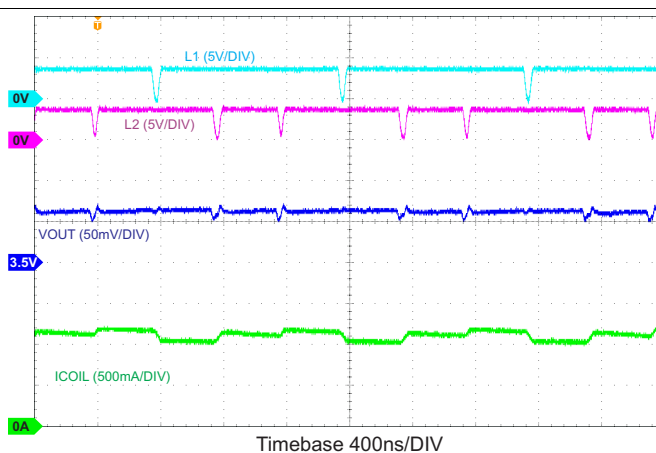


图 13. Switching Waveforms in Buck-Boost Mode, VIN = 3.55 V, VOUT = 3.5 V, 1-A Load

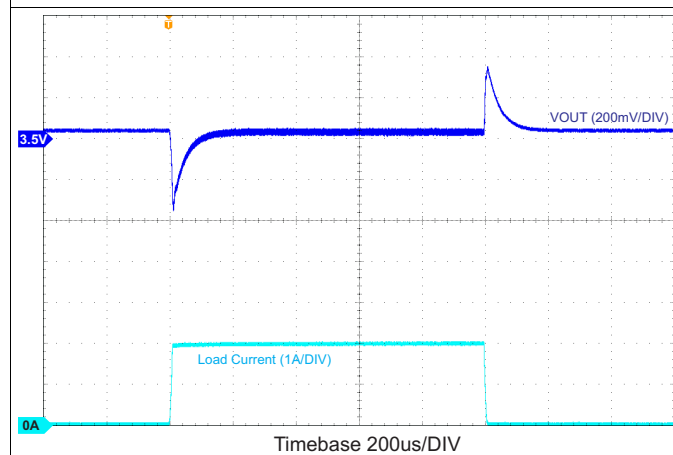


图 14. Load Transient Response Boost Mode, VIN = 3.0 V, VOUT = 3.5 V

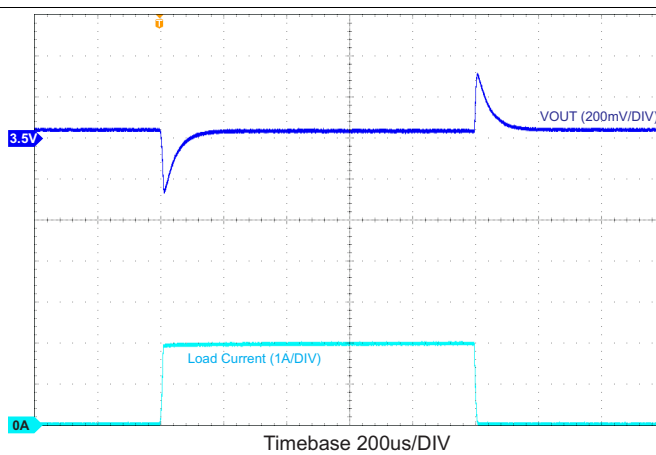


图 15. Load Transient Response Buck Mode, VIN = 4.3 V, VOUT = 3.5 V

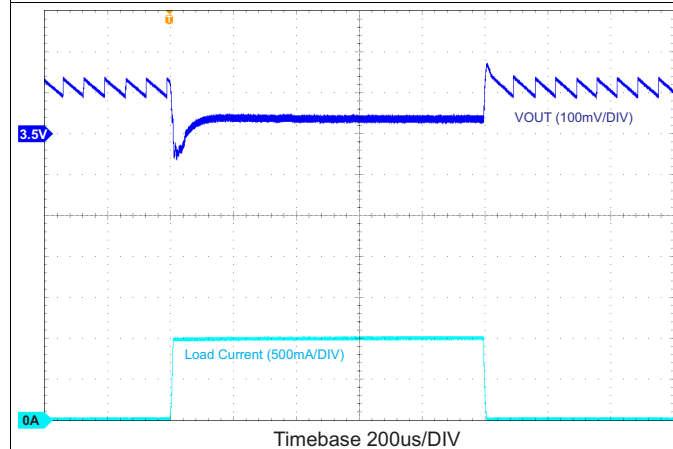


图 16. Load Transient Response, VIN = 3.5 V, VOUT = 3.5 V, PFM Mode

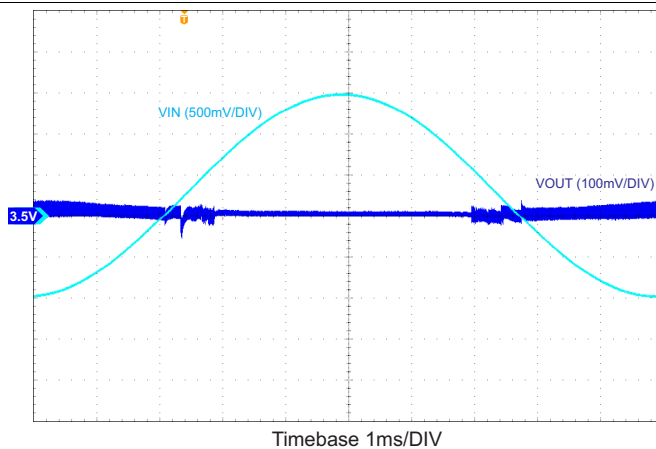


图 17. Line Sweep Response, VOUT = 3.5 V, 2-A Load

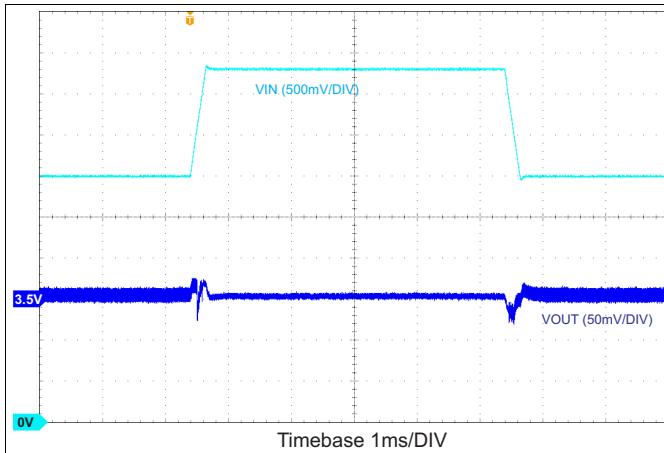


图 18. Line Transient Response,
VOUT = 3.5 V, 1-A Load

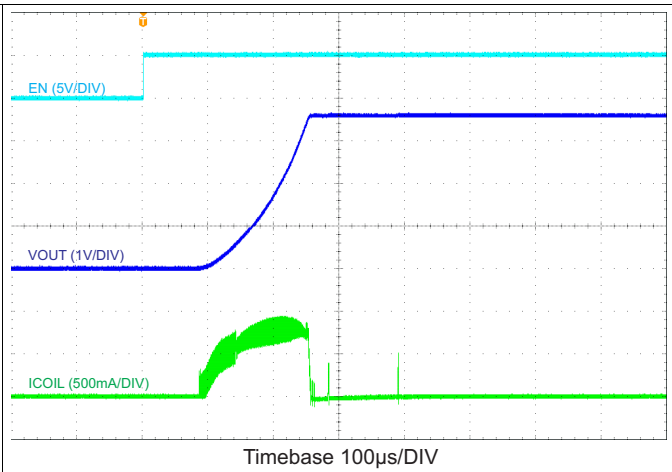


图 19. Start Up After Enable, VIN = 3.7 V, VOUT = 3.5 V, no
Load

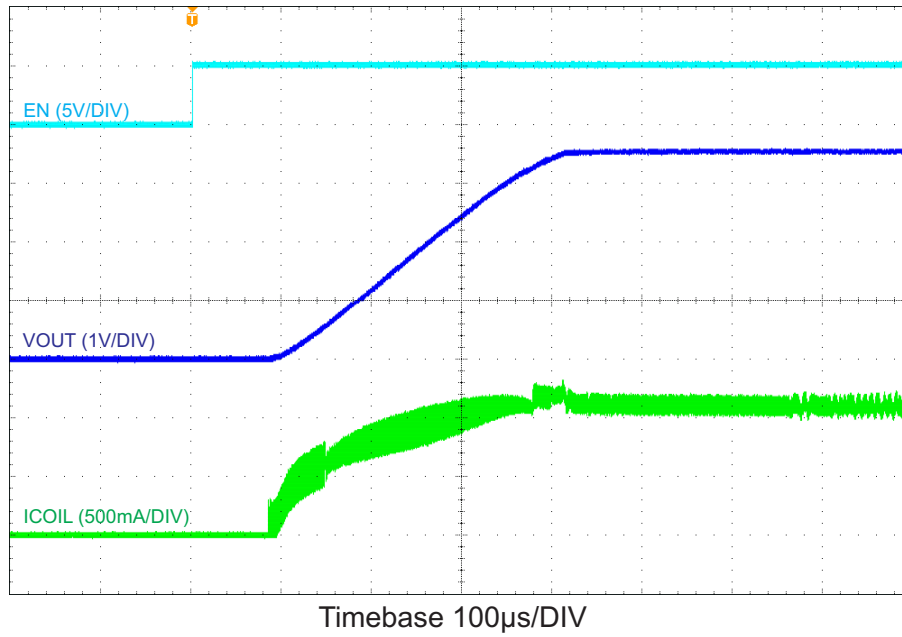


图 20. Start Up After Enable, VIN = 3.7 V, VOUT = 3.5 V, 1-A Load

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

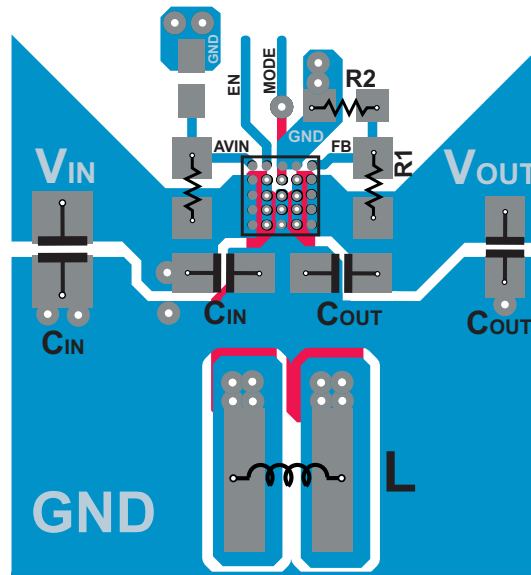


图 21. TPS63027 Layout

13 器件和文档支持

13.1 器件支持

13.1.1 Third-Party Products Disclaimer

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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

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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.

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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 part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TPS63027YFFR	Active	Production	DSBGA (YFF) 25	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	TPS 63027
TPS63027YFFR.A	Active	Production	DSBGA (YFF) 25	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	TPS 63027
TPS63027YFFT	Active	Production	DSBGA (YFF) 25	250 SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	TPS 63027
TPS63027YFFT.A	Active	Production	DSBGA (YFF) 25	250 SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	TPS 63027

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts 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.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

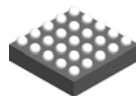
⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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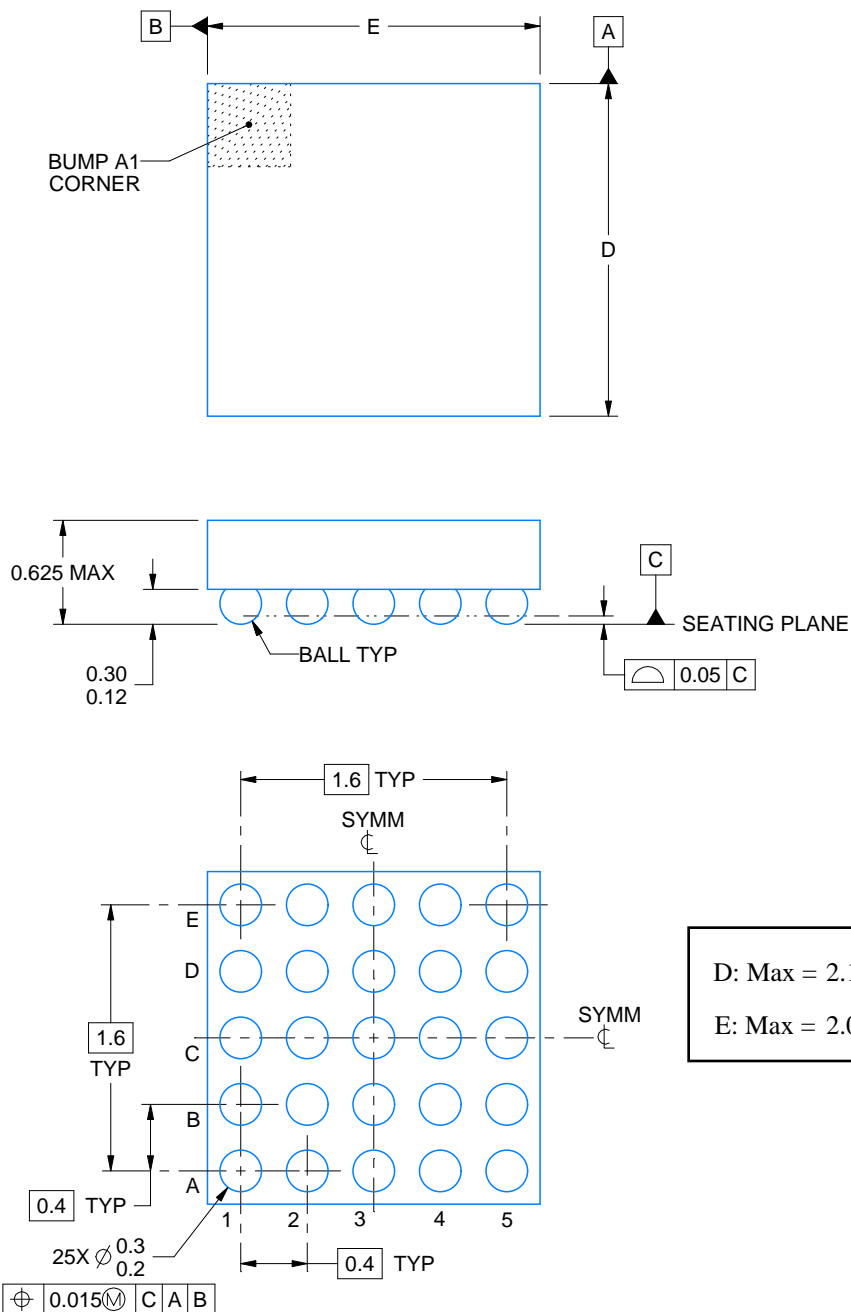
YFF0025



PACKAGE OUTLINE

DSBGA - 0.625 mm max height

DIE SIZE BALL GRID ARRAY



4223786/A 06/2017

NOTES:

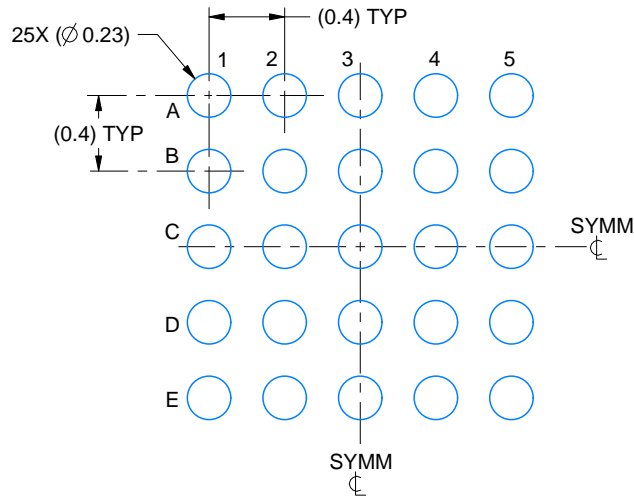
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

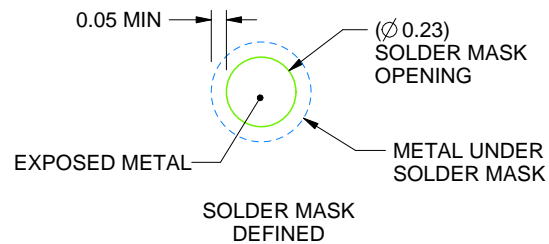
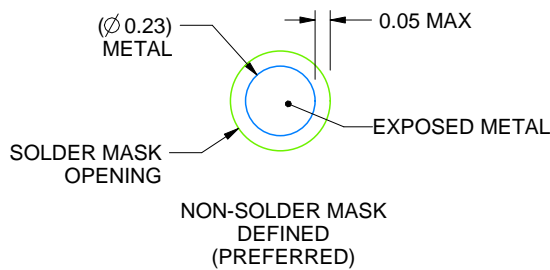
YFF0025

DSBGA - 0.625 mm max height

DIE SIZE BALL GRID ARRAY



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:25X



SOLDER MASK DETAILS
NOT TO SCALE

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NOTES: (continued)

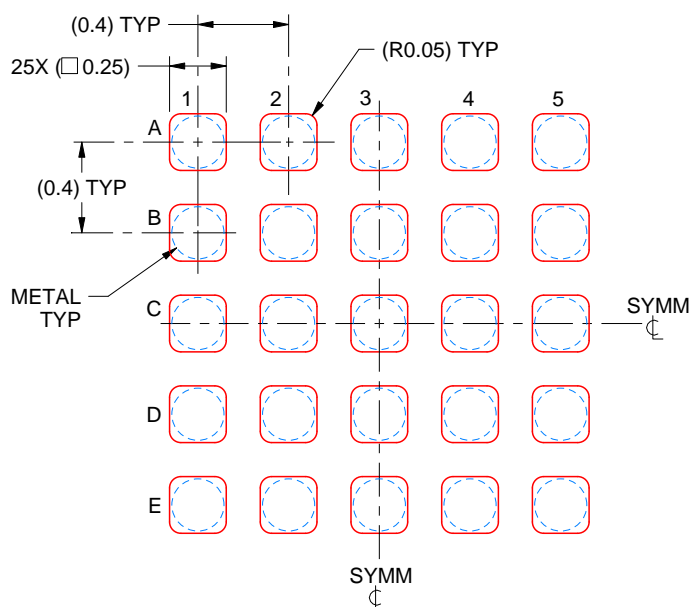
- Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).

EXAMPLE STENCIL DESIGN

YFF0025

DSBGA - 0.625 mm max height

DIE SIZE BALL GRID ARRAY



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

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NOTES: (continued)

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

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