

# TPS61085A-Q1 650kHz 和 1.2MHz、18.5V 升压直流/直流转换器

## 1 特性

- 符合面向汽车应用的 AEC-Q100 标准：
  - 器件温度等级 2:  $-40^{\circ}\text{C}$  至  $+105^{\circ}\text{C}$ ,  $T_A$
- 2.3V 至 6V 输入电压范围
- 具有 2A 开关电流的 18.5V 升压转换器
- 650kHz 或 1.2MHz 可选开关频率
- 可调节软启动
- 热关断
- 欠压锁定
- 8 引脚 VSSOP 封装

## 2 应用

- 汽车信息娱乐系统仪表组
  - 仪表组、音响主机
  - 无线电、导航
  - 音频放大器
- 汽车车身电子设备
  - 车身控制模块
  - 网关
- 远程信息处理和紧急呼叫
- 高级驾驶辅助系统 (ADAS)

## 3 说明

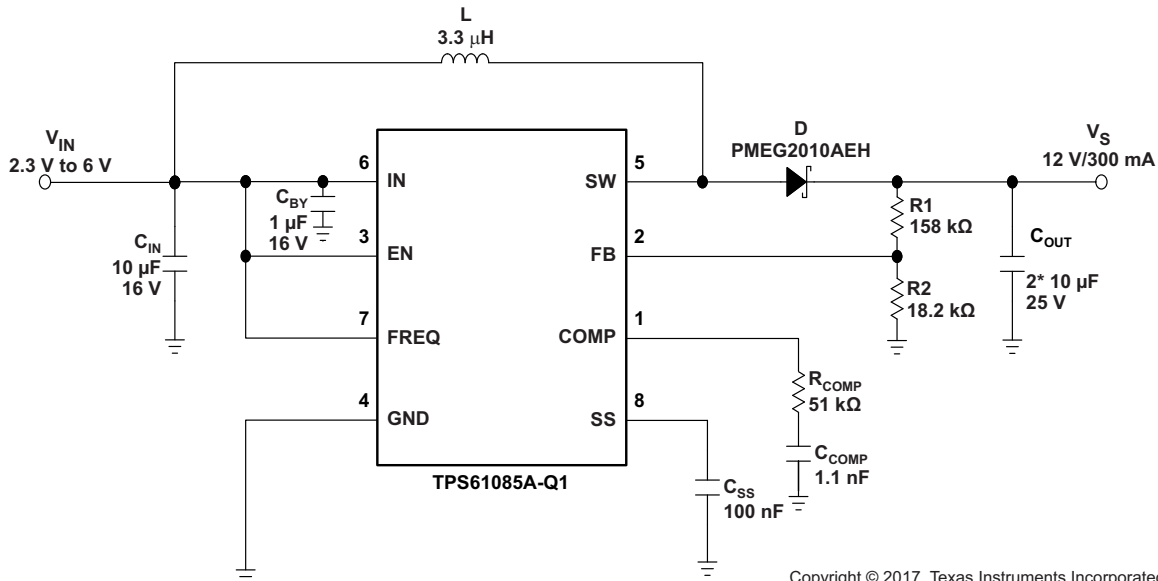
TPS61085A-Q1 器件是一款高频、高效的直流/直流升压转换器，具有能够提供高达 18.5V 输出电压的集成 2A、 $0.13\Omega$  电源开关。650kHz 或 1.2MHz 的可选频率使得此器件可使用小型外部电感器和电容器并提供快速瞬态响应。利用外部补偿，可以针对应用条件优化稳压器。连接至特定软启动引脚的电容器可最大程度地减小启动时的浪涌电流。

### 器件信息<sup>(1)</sup>

器件型号	封装	封装尺寸 (标称值)
TPS61085A-Q1	VSSOP (8)	3.00mm × 3.00mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。

简化原理图



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## 目录

<b>1</b>	特性 .....	<b>1</b>	<b>8</b>	<b>Application and Implementation</b> .....	<b>10</b>
<b>2</b>	应用 .....	<b>1</b>	8.1	Application Information.....	10
<b>3</b>	说明 .....	<b>1</b>	8.2	Typical Application .....	10
<b>4</b>	修订历史记录 .....	<b>2</b>	8.3	System Examples .....	16
<b>5</b>	<b>Pin Configuration and Functions</b> .....	<b>3</b>	<b>9</b>	<b>Power Supply Recommendations</b> .....	<b>19</b>
<b>6</b>	<b>Specifications</b> .....	<b>4</b>	<b>10</b>	<b>Layout</b> .....	<b>20</b>
6.1	Absolute Maximum Ratings .....	4	10.1	Layout Guidelines .....	20
6.2	ESD Ratings.....	4	10.2	Layout Example .....	20
6.3	Recommended Operating Conditions.....	4	<b>11</b>	<b>器件和文档支持</b> .....	<b>21</b>
6.4	Thermal Information .....	4	11.1	器件支持 .....	21
6.5	Electrical Characteristics.....	5	11.2	接收文档更新通知 .....	21
6.6	Typical Characteristics .....	6	11.3	社区资源 .....	21
<b>7</b>	<b>Detailed Description</b> .....	<b>8</b>	11.4	商标 .....	21
7.1	Overview .....	8	11.5	静电放电警告 .....	21
7.2	Functional Block Diagram .....	8	11.6	术语表 .....	21
7.3	Feature Description.....	9	<b>12</b>	<b>机械、封装和可订购信息</b> .....	<b>21</b>
7.4	Device Functional Modes.....	9			

## 4 修订历史记录

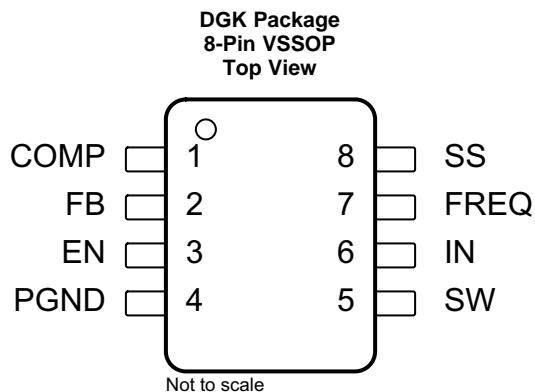
### Changes from Revision A (April 2018) to Revision B Page

•	首次将数据表公开发布到网络 .....	<b>1</b>
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### Changes from Original (September 2017) to Revision A Page

•	已更改 将状态更改成了“生产数据” .....	<b>1</b>
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## 5 Pin Configuration and Functions



### Pin Functions

PIN		TYPE	DESCRIPTION
NO.	NAME		
1	COMP	I/O	Compensation pin
2	FB	I	Feedback pin
3	EN	I	Shutdown control input. Connect this pin to logic high level to enable the device.
4	PGND	—	Power ground
5	SW	I	Switch pin
6	IN	PWR	Input supply pin
7	FREQ	I	Frequency select pin. The power switch operates at 650 kHz if FREQ is connected to GND and at 1.2 MHz if FREQ is connected to IN.
8	SS	O	Soft-start control pin. Connect a capacitor to this pin if soft-start required. Open = no soft start

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

	MIN	MAX	UNIT
Input voltage, $V_{IN}$ <sup>(2)</sup>	-0.3	7	V
Voltage on pins EN, FB, SS, FREQ, COMP	-0.3	7	V
Voltage on pin SW	-0.3	20	V
Continuous power dissipation	See <a href="#">Thermal Information</a>		
Lead temperature (soldering, 10 s)		260	°C
Operating junction temperature	-40	150	°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, 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.

### 6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), Classification Level 2 per AEC Q100-002 <sup>(1)</sup>	±2000	V
		Charged-device model (CDM), Classification Level C4A per AEC Q100-011	±500	
		Machine model (MM)	±200	

- (1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

### 6.3 Recommended Operating Conditions

		MIN	MAX	UNIT
$V_{IN}$	Input voltage	2.3	6	V
$V_S$	Boost output voltage	$V_{IN} + 0.5$	18.5	V
$T_A$	Operating free-air temperature	-40	105	°C
$T_J$	Operating junction temperature	-40	125	°C

### 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		TPS61085A-Q1	UNIT
		DGK (VSSOP)	
		8 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	189.7	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	75.4	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	110	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	13.7	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	108.6	°C/W

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

## 6.5 Electrical Characteristics

 $V_{IN} = 3.3\text{ V}$ ,  $EN = IN$ ,  $V_S = 12\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+105^\circ\text{C}$ , typical values are at  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>SUPPLY</b>						
$V_{IN}$	Input voltage		2.3		6	V
$I_Q$	Operating quiescent current into IN	Device not switching, $V_{FB} = 1.3\text{ V}$		70	100	$\mu\text{A}$
$I_{SDVIN}$	Shutdown current into IN	$EN = \text{GND}$			1	$\mu\text{A}$
UVLO	Undervoltage lockout threshold	$V_{IN}$ falling			2.2	V
		$V_{IN}$ rising			2.3	
$T_{SD}$	Thermal shutdown	Temperature rising, $T_J$		150		$^\circ\text{C}$
$T_{SD(HYS)}$	Thermal shutdown hysteresis			14		$^\circ\text{C}$
<b>LOGIC SIGNALS EN, FREQ</b>						
$V_{IH}$	High level input voltage	$V_{IN} = 2.3\text{ V}$ to $6\text{ V}$	2			V
$V_{IL}$	Low level input voltage	$V_{IN} = 2.3\text{ V}$ to $6\text{ V}$			0.5	V
$I_{lkg}$	Input leakage current	$EN = \text{FREQ} = \text{GND}$			0.1	$\mu\text{A}$
<b>BOOST CONVERTER</b>						
$V_S$	Boost output voltage		$V_{IN} + 0.5$		18.5	V
$V_{FB}$	Feedback regulation voltage		1.230	1.238	1.246	V
gm	Transconductance error amplifier			107		$\mu\text{A/V}$
$I_{FB}$	Feedback input bias current	$V_{FB} = 1.238\text{ V}$			0.1	$\mu\text{A}$
$R_{DS(on)}$	N-channel MOSFET ON-resistance	$V_{IN} = V_{GS} = 5\text{ V}$ , $I_{SW} = \text{current limit}$		0.13	0.2	$\Omega$
		$V_{IN} = V_{GS} = 3.3\text{ V}$ , $I_{SW} = \text{current limit}$		0.15	0.24	
$I_{lkg}$	SW leakage current	$EN = \text{GND}$ , $V_{SW} = 6\text{ V}$			2	$\mu\text{A}$
$I_{LIM}$	N-channel MOSFET current limit		2	2.6	3.2	A
$I_{SS}$	Soft-start current	$V_{SS} = 1.238\text{ V}$	7	10	13	$\mu\text{A}$
$f_{osc}$	Oscillator frequency	FREQ = high	0.9	1.2	1.5	MHz
		FREQ = low	480	650	820	kHz
	Line regulation	$V_{IN} = 2.3\text{ V}$ to $6\text{ V}$ , $I_{OUT} = 10\text{ mA}$		0.0002		%/V
	Load regulation	$V_{IN} = 3.3\text{ V}$ , $I_{OUT} = 1\text{ mA}$ to $400\text{ mA}$		0.11		%/A

### 6.6 Typical Characteristics

The typical characteristics are measured with the 3.3- $\mu\text{H}$  inductor for high-frequency (part number-7447789003) or 6.8- $\mu\text{H}$  inductor for low frequency (part number-B82464G4) and the rectifier diode with part number SL22.

Table 1. Table of Graphs

			FIGURE
$I_{OUT(max)}$	Maximum load current	vs Input voltage at high frequency (1.2 MHz)	Figure 1
		vs Input voltage at low frequency (650 kHz)	Figure 2
$\eta$	Efficiency	vs Load current, $V_S = 12\text{ V}$ , $V_{IN} = 3.3\text{ V}$	Figure 3
		vs Load current, $V_S = 9\text{ V}$ , $V_{IN} = 3.3\text{ V}$	Figure 4
	Supply current	vs Supply voltage	Figure 5
Frequency		vs Load current	Figure 6
		vs Supply voltage	Figure 7

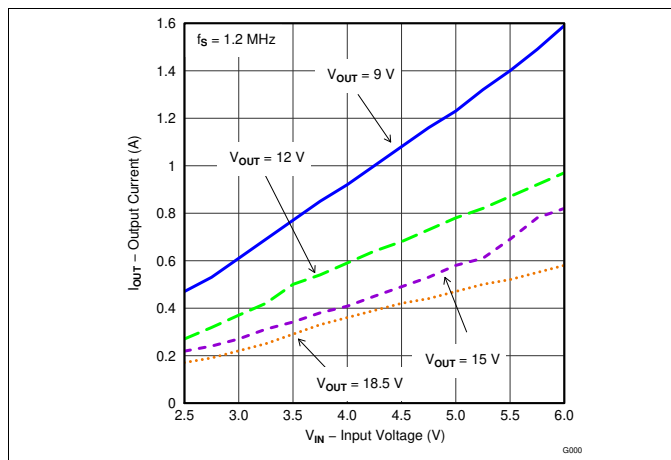


Figure 1. Maximum Load Current vs Input Voltage

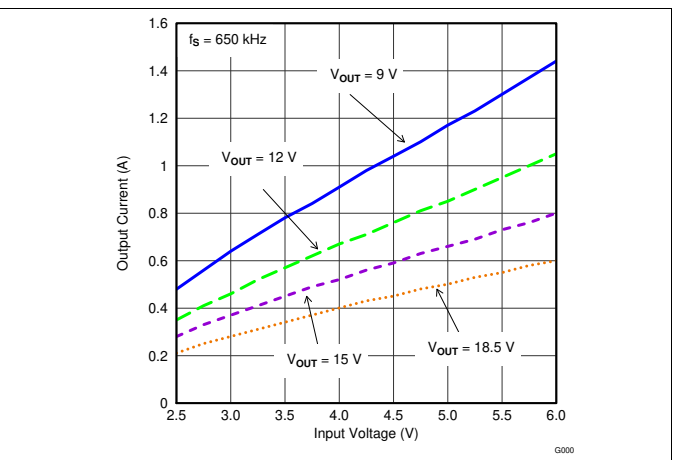


Figure 2. Maximum Load Current vs Input Voltage

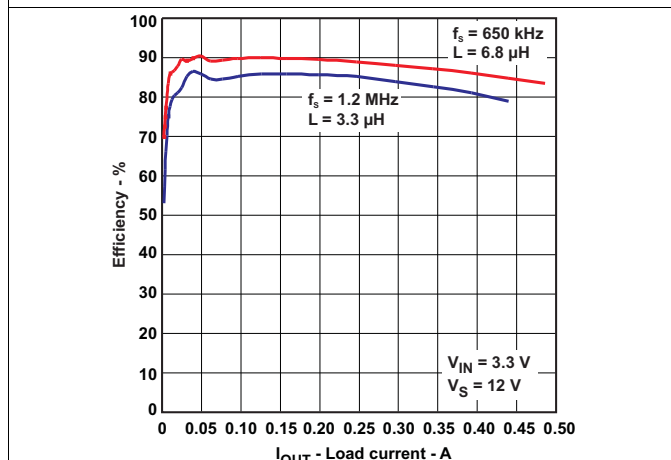


Figure 3. Efficiency vs Load Current,  $V_S = 12\text{ V}$ ,  $V_{IN} = 3.3\text{ V}$

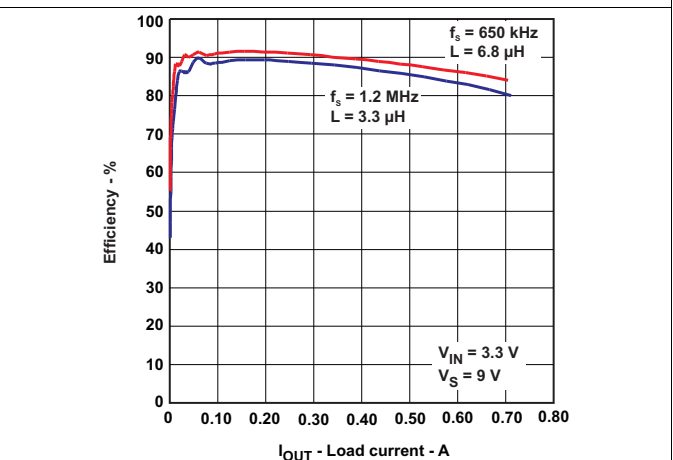


Figure 4. Efficiency vs Load Current,  $V_S = 9\text{ V}$ ,  $V_{IN} = 3.3\text{ V}$

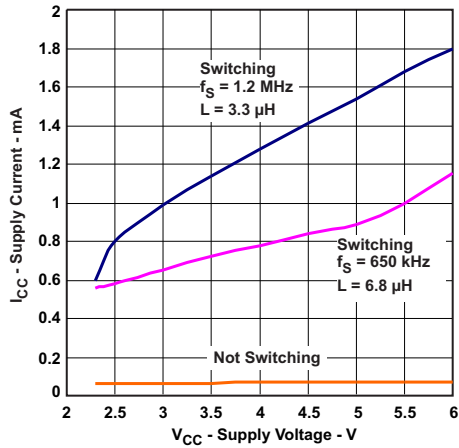


Figure 5. Supply Current vs Supply Voltage

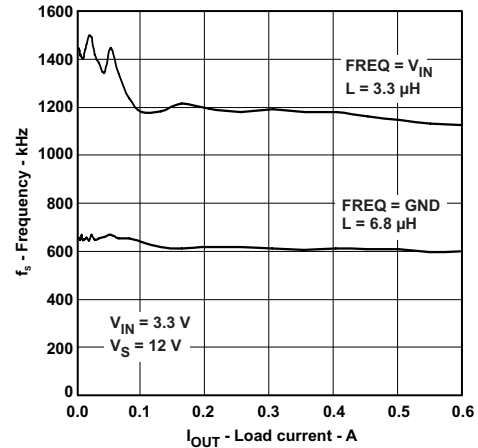


Figure 6. Frequency vs Load Current

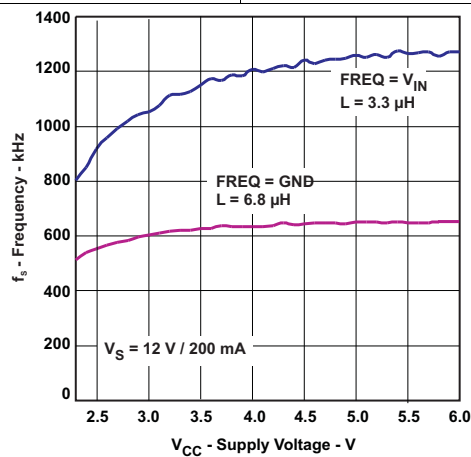


Figure 7. Frequency vs Supply Voltage

## 7 Detailed Description

### 7.1 Overview

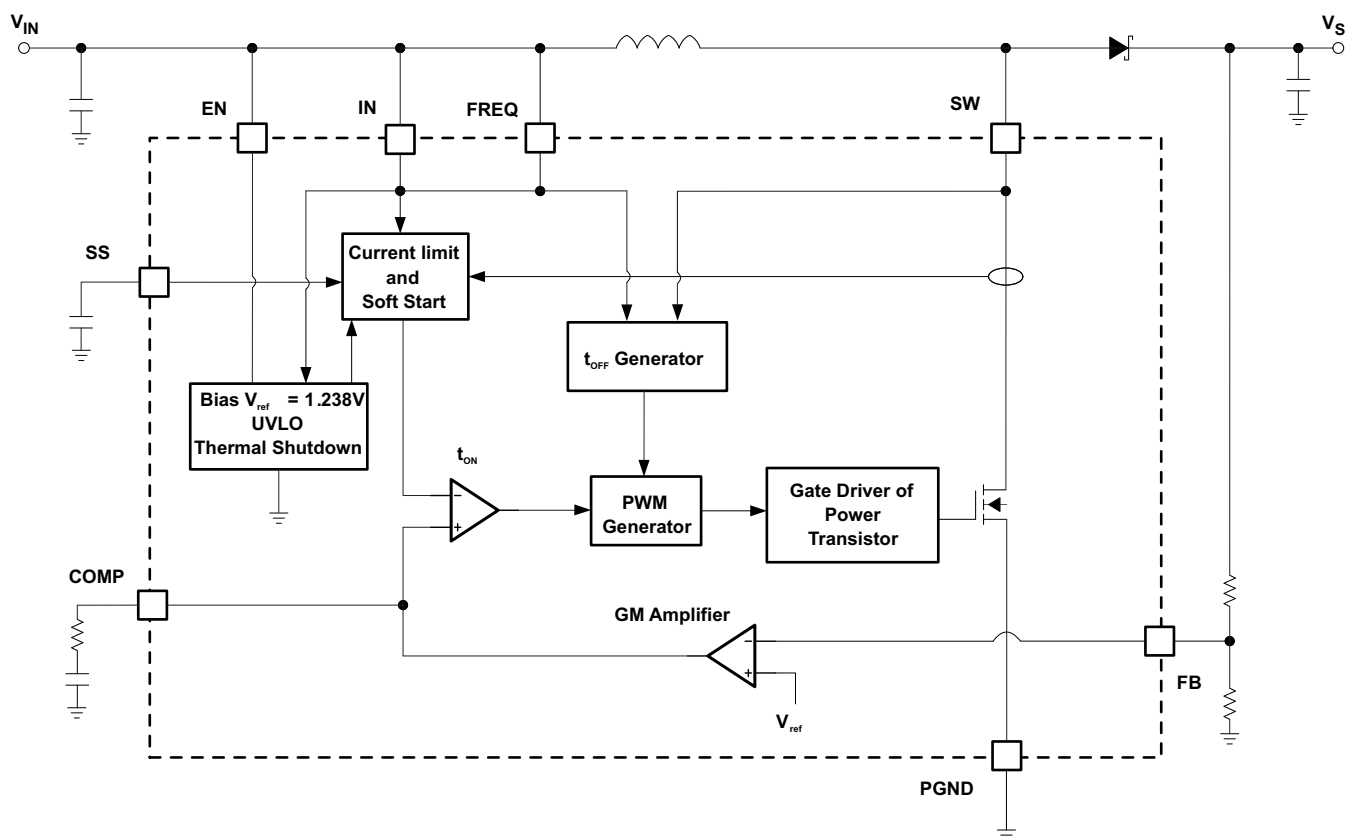
The TPS61085A-Q1 boost converter is designed for output voltages up to 18.5 V with a switch-peak current limit of 2 A minimum. The device, which operates in a current mode scheme with quasi-constant frequency, is externally compensated for maximum flexibility and stability. The switching frequency is selectable between 650 kHz or 1.2 MHz and the minimum input voltage is 2.3 V. To control the inrush current at start-up, a soft-start pin is available.

The novel topology of the TPS61085A-Q1 boost converter uses adaptive OFF-time to provide superior load and line transient responses. The device also operates over a wider range of applications than conventional converters.

The selectable switching frequency offers the possibility to optimize the design either for the use of small sized components (1.2 MHz) or for higher system efficiency (650 kHz). However, the frequency changes slightly because the voltage drop across the  $R_{DS(on)}$  has some influence on the current and voltage measurement and thus on the ON-time (the OFF-time remains constant).

Depending on the load current, the converter operates in continuous conduction mode (CCM), discontinuous conduction mode (DCM), or pulse skip mode to maintain the output voltage.

### 7.2 Functional Block Diagram



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## 7.3 Feature Description

### 7.3.1 Soft Start

The boost converter has an adjustable soft start to prevent high inrush current during start-up. To minimize the inrush current during start-up an external capacitor connected to the soft-start pin SS is used to slowly ramp up the internal current limit of the boost converter when charged with a constant current. When the EN pin is pulled high, the soft-start capacitor ( $C_{SS}$ ) is immediately charged to 0.3 V. The capacitor is then charged at a constant current of 10  $\mu$ A typically until the output of the boost converter  $V_S$  has reached its power good threshold (90% of  $V_S$  nominal value). During this time, the SS voltage directly controls the peak inductor current, starting with 0 A at  $V_{SS} = 0.3$  V up to the full current limit at  $V_{SS} \approx 800$  mV. The maximum load current is available after the soft start is completed. The larger the capacitor the slower the ramp of the current limit and the longer the soft-start time. A 100-nF capacitor is usually sufficient for most of the applications. When the EN pin is pulled low, the soft-start capacitor is discharged to ground.

### 7.3.2 Frequency Select Pin (FREQ)

The frequency select pin FREQ allows to set the switching frequency of the device to 650 kHz (FREQ = low) or 1.2 MHz (FREQ = high). Higher switching frequency improves load transient response but reduces slightly the efficiency. The other benefits of higher switching frequency are a lower output ripple voltage and smaller inductor size. Usually, TI recommends using 1.2-MHz switching frequency unless light-load efficiency is a major concern.

### 7.3.3 Undervoltage Lockout (UVLO)

To avoid misoperation of the device at low input voltages an undervoltage lockout is included that disables the device, if the input voltage falls below 2.2 V.

### 7.3.4 Thermal Shutdown

A thermal shutdown is implemented to prevent damages due to excessive heat and power dissipation. Typically the thermal shutdown threshold is at  $T_J = 150^\circ\text{C}$ . When the thermal shutdown is triggered the device stops switching until the temperature falls below typically  $T_J = 136^\circ\text{C}$ . Then the device starts switching again.

### 7.3.5 Overvoltage Prevention

If overvoltage is detected on the FB pin (typically 3% above the nominal value of 1.238 V) the part stops switching immediately until the voltage on this pin drops to its nominal value. This prevents overvoltage on the output and secures the circuits connected to the output from excessive overvoltage.

## 7.4 Device Functional Modes

The converter operates in continuous conduction mode (CCM) as soon as the input current increases above half the ripple current in the inductor. For lower load currents it switches into discontinuous conduction mode (DCM). If the load is further reduced, the part starts to skip pulses to maintain the output voltage.

## 8 Application and Implementation

### NOTE

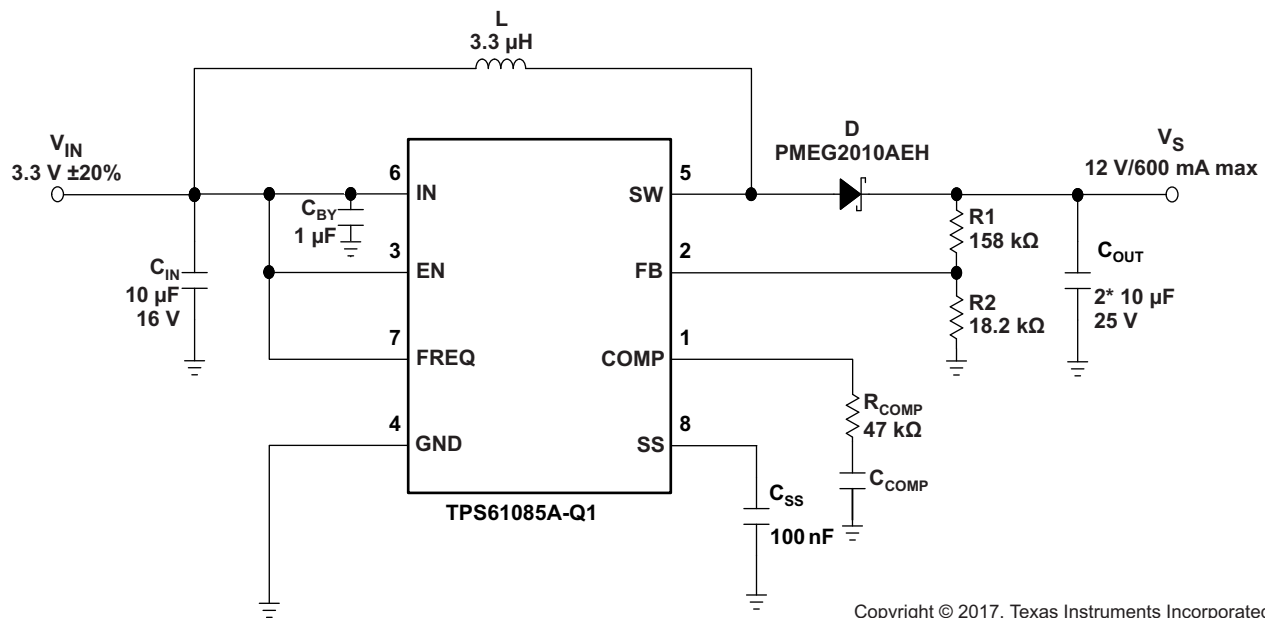
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation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

### 8.1 Application Information

With the TPS61085A-Q1 device, a boost regulator with an output voltage of up to 18.5 V can be designed with input voltage ranging from 2.3 V to 6 V. The TPS61085A-Q1 device has a peak switch current limit of 2 A minimum. The device, which operates in a current mode scheme and uses simple external compensation scheme for maximum flexibility and stability. Selectable switching frequency allows the regulator to be optimized either for smaller size (1.2 MHz) or for higher system efficiency (650 KHz). A dedicated soft-start (SS) pin allows the designer to control the inrush current at start-up.

The following section provides a step-by-step design approach for configuring the TPS61085A-Q1 as a voltage regulating boost converter.

### 8.2 Typical Application



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**Figure 8. Typical Application, 3.3 V to 12 V ( $f_{sw} = 1.2$  MHz)**

#### 8.2.1 Design Requirements

Table 2 lists the design parameters for this application example.

**Table 2. TPS61085A-Q1 Output Design Requirements**

PARAMETER	VALUE
Input voltage	3.3 V $\pm$ 20%
Output voltage	12 V
Output current	600 mA
Switching frequency	1.2 MHz

## 8.2.2 Detailed Design Procedure

The first step in the design procedure is to verify that the maximum possible output current of the boost converter supports the specific application requirements. A simple approach is to estimate the converter efficiency, by taking the efficiency numbers from the provided efficiency curves or to use a worst-case assumption for the expected efficiency, for example, 90%.

1. Duty cycle:

$$D = 1 - \frac{V_{IN} \times \eta}{V_S} \quad (1)$$

2. Maximum output current:

$$I_{out} = \left( I_{swpeak} - \frac{\Delta I_L}{2} \right) \times (1 - D) \quad (2)$$

3. Peak switch current:

$$I_{swpeak} = \frac{\Delta I_L}{2} + \frac{I_{out}}{1 - D}$$

where

$$\Delta I_L = \frac{V_{IN} \times D}{f_s \times L}$$

- $I_{swpeak}$  = converter switch current (minimum switch current limit = 2 A)
- $f_s$  = Converter switching frequency (typically 1.2 MHz)
- $L$  = Selected inductor value
- $\eta$  = Estimated converter efficiency (please use the number from the efficiency plots or 90% as an estimation)
- $\Delta I_L$  = Inductor peak-to-peak ripple current (3)

The peak switch current is the steady-state peak switch current that the integrated switch, inductor, and external Schottky diode must be able to handle. The calculation must be done for the minimum input voltage where the peak switch current is the highest.

### 8.2.2.1 Inductor Selection

The TPS61085A-Q1 is designed to work with a wide range of inductors. The main parameter for the inductor selection is the saturation current of the inductor which must be higher than the peak switch current as calculated in [Detailed Design Procedure](#) with additional margin to cover for heavy load transients. An alternative, more conservative option is to choose an inductor with a saturation current at least as high as the maximum switch current limit of 3.2 A. The other important parameter is the inductor DC resistance. Usually, the lower the DC resistance the higher the efficiency. It is important to note that the inductor DC resistance is not the only parameter determining the efficiency. Especially for a boost converter where the inductor is the energy storage element, the type and core material of the inductor influences the efficiency as well. At high switching frequencies of 1.2-MHz inductor core losses, proximity effects and skin effects become more important. Usually, an inductor with a larger form factor gives higher efficiency. The efficiency difference between different inductors can vary between 2% to 10%. For the TPS61085A-Q1, inductor values between 3  $\mu$ H and 6  $\mu$ H are a good choice with a switching frequency of 1.2 MHz, typically 3.3  $\mu$ H. At 650 kHz, TI recommends inductors between 6  $\mu$ H and 13  $\mu$ H, typically 6.8  $\mu$ H. [Table 3](#) shows a few inductors. Customers must verify and validate these components for suitability with their application before using them.

Typically, TI recommends the inductor current ripple is below 20% of the average inductor current. Calculate the inductor value using [Equation 4](#).

$$L = \left( \frac{V_{IN}}{V_S} \right)^2 \times \left( \frac{V_S - V_{IN}}{I_{out\_max} \times f} \right) \times \left( \frac{\eta}{0.35} \right)$$

where

- L is the inductor value
- $V_{IN}$  is input voltage
- $V_S$  is boost output voltage
- $\eta$  is efficiency
- $I_{out\_max}$  is the maximum output current
- f is frequency

(4)

**Table 3. Inductor Selection**

L (μH)	SUPPLIER <sup>(1)</sup>	COMPONENT CODE	SIZE (L×W×H mm)	DCR TYP (mΩ)	I <sub>sat</sub> (A)
<b>1.2 MHz</b>					
3.3	Sumida	CDH38D09	4 × 4 × 1	240	1.25
4.7	Sumida	CDPH36D13	5 × 5 × 1.5	155	1.36
3.3	Sumida	CDPH4D19F	5.2 × 5.2 × 2	33	1.5
3.3	Sumida	CDRH6D12	6.7 × 6.7 × 1.5	62	2.2
4.7	Würth Elektronik	7447785004	5.9 × 6.2 × 3.3	60	2.5
5	Coilcraft	MSS7341	7.3 × 7.3 × 4.1	24	2.9
<b>650 kHz</b>					
6.8	Sumida	CDP14D19	5.2 × 5.2 × 2	50	1
10	Coilcraft	LPS4414	4.3 × 4.3 × 1.4	380	1.2
6.8	Sumida	CDRH6D12/LD	6.7 × 6.7 × 1.5	95	1.25
10	Sumida	CDR6D23	5 × 5 × 2.4	133	1.75
10	Würth Elektronik	744778910	7.3 × 7.3 × 3.2	51	2.2
6.8	Sumida	CDRH6D26HP	7 × 7 × 2.8	52	2.9

(1) See [Third-party Products Disclaimer](#)

### 8.2.2.2 Rectifier Diode Selection

To achieve high efficiency, a Schottky type must be used for the rectifier diode. The reverse voltage rating must be higher than the maximum output voltage of the converter. The averaged rectified forward current  $I_{avg}$ , the Schottky diode requirement is rated for, is equal to the output current  $I_{out}$ :

$$I_{avg} = I_{out} \tag{5}$$

Usually a Schottky diode with 2-A maximum average rectified forward current rating is sufficient for most applications. The Schottky rectifier can be selected with lower forward current capability depending on the output current  $I_{out}$  but must be able to dissipate the power. The dissipated power is the average rectified forward current times the diode forward voltage.

$$P_D = I_{avg} \times V_{forward} \tag{6}$$

Typically the diode must be able to dissipate around 500 mW depending on the load current and forward voltage. See [Table 4](#) for few diode options. Customers must verify and validate these components for suitability with their application before using them.

**Table 4. Rectifier Diode Selection**

CURRENT RATING (Iavg)	Vr	V <sub>forward</sub> / Iavg	SUPPLIER <sup>(1)</sup>	COMPONENT CODE	PACKAGE TYPE
750 mA	20 V	0.425 V / 750 mA	Fairchild Semiconductor	FYV0704S	SOT-23
1 A	20 V	0.39 V / 1 A	NXP	PMEG2010AEH	SOD-123
1 A	20 V	0.52 V / 1 A	Vishay Semiconductor	B120	SMA
1 A	20 V	0.5 V / 1 A	Vishay Semiconductor	SS12	SMA
1 A	20 V	0.44 V / 1 A	Vishay Semiconductor	MSS1P2L	μ-SMP (Low Profile)

(1) See [Third-party Products Disclaimer](#)

### 8.2.2.3 Setting the Output Voltage

The output voltage is set by an external resistor divider. Typically, a minimum current of 50 μA flowing through the feedback divider gives good accuracy and noise covering. A standard low-side resistor of 18 kΩ is typically selected. The resistors are then calculated as:

$$R2 = \frac{V_{ref}}{70\mu A} \approx 18k\Omega \quad R1 = R2 \times \left( \frac{V_s}{V_{ref}} - 1 \right) \quad (7)$$

### 8.2.2.4 Compensation (COMP)

The regulator loop must be compensated by adjusting the external components connected to the COMP pin. The COMP pin is the output of the internal transconductance error amplifier. Standard values of R<sub>COMP</sub> = 13 kΩ and C<sub>COMP</sub> = 3.3 nF works for the majority of the applications.

See [Table 5](#) for dedicated compensation networks giving an improved load transient response. [Equation 8](#) can be used to calculate R<sub>COMP</sub> and C<sub>COMP</sub>:

$$R_{COMP} = \frac{110 \cdot V_{IN} \cdot V_s \cdot C_{OUT}}{L \cdot I_{OUT}} \quad C_{COMP} = \frac{V_s \cdot C_{OUT}}{7.5 \cdot I_{OUT} \cdot R_{COMP}} \quad (8)$$

**Table 5. Recommended Compensation Network Values at High/Low Frequency**

FREQUENCY	L	V <sub>s</sub>	V <sub>IN</sub> ±20%	R <sub>COMP</sub>	C <sub>COMP</sub>
High (1.2 MHz)	3.3 μH	15 V	5 V	82 kΩ	1.1 nF
			3.3 V	75 kΩ	1.6 nF
		12 V	5 V	51 kΩ	1.1 nF
			3.3 V	47 kΩ	1.6 nF
		9 V	5 V	30 kΩ	1.1 nF
			3.3 V	27 kΩ	1.6 nF
Low (650 kHz)	6.8 μH	15 V	5 V	43 kΩ	2.2 nF
			3.3 V	39 kΩ	3.3 nF
		12 V	5 V	27 kΩ	2.2 nF
			3.3 V	24 kΩ	3.3 nF
		9 V	5 V	15 kΩ	2.2 nF
			3.3 V	13 kΩ	3.3 nF

Table 5 gives conservatives  $R_{COMP}$  and  $C_{COMP}$  values for certain inductors, input and output voltages providing a very stable system. For a faster response time, a higher  $R_{COMP}$  value can be used to enlarge the bandwidth, as well as a slightly lower value of  $C_{COMP}$  to keep enough phase margin. These adjustments must be performed in parallel with the load transient response monitoring of TPS61085A-Q1.

### 8.2.2.5 Input Capacitor Selection

For good input voltage filtering, TI recommends low-ESR ceramic capacitors. TPS61085A-Q1 has an analog input (IN). Therefore, TI highly recommends placing a 1- $\mu$ F bypass capacitor as close as possible to the IC from IN to GND.

One 10- $\mu$ F ceramic input capacitor is sufficient for most of the applications. For better input voltage, filtering this value can be increased. Refer to Table 6 and typical applications for input capacitor recommendations. Customers must verify and validate these components for suitability with their application before using them.

### 8.2.2.6 Output Capacitor Selection

For best output voltage filtering, TI recommends a low ESR output capacitor like ceramic capacitor. Two 10- $\mu$ F ceramic output capacitors (or one 22- $\mu$ F) work for most of the applications. Higher capacitor values can be used to improve the load transient response.

Pay attention to the derating of capacitor value with the DC voltage.

**Table 6. Rectifier Input and Output Capacitor Selection**

	CAPACITOR	VOLTAGE RATING	SUPPLIER <sup>(1)</sup>	COMPONENT CODE
$C_{IN}$	10 $\mu$ F/1206	16 V	Taiyo Yuden	EMK212 BJ 106KG
IN bypass	1 $\mu$ F/0603	16 V	Taiyo Yuden	EMK107 BJ 105KA
$C_{OUT}$	10 $\mu$ F/1206	25 V	Taiyo Yuden	TMK316 BJ 106KL

(1) See [Third-party Products Disclaimer](#)

### 8.2.3 Application Curves

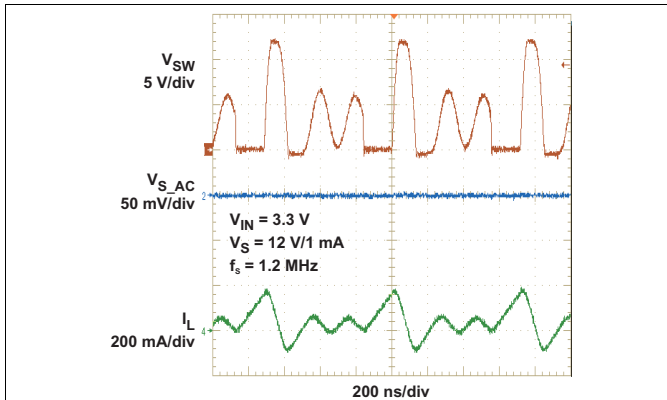


Figure 9. PWM Switching Discontinuous Conduction Mode

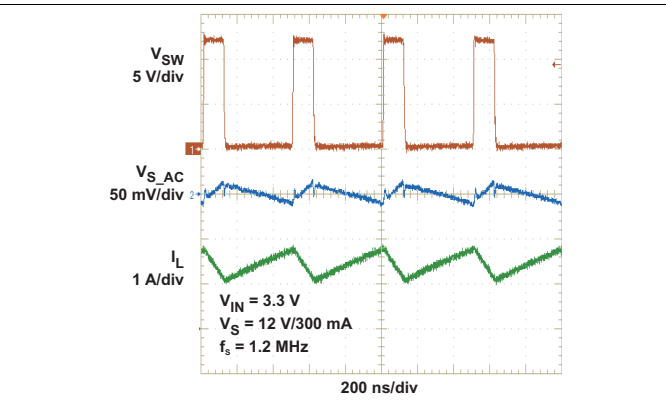


Figure 10. PWM Switching Continuous Conduction Mode

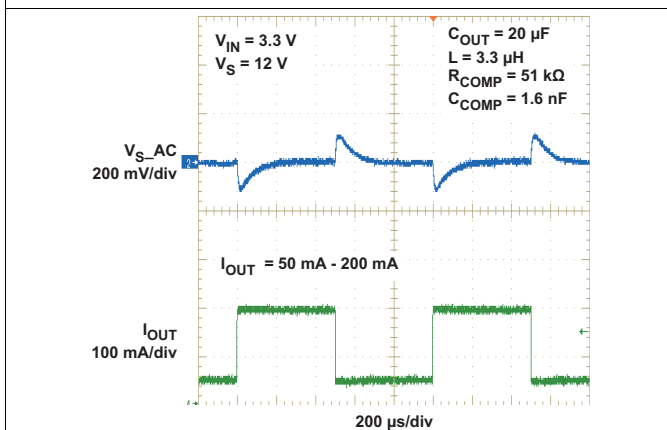


Figure 11. Load Transient Response High Frequency (1.2 MHz)

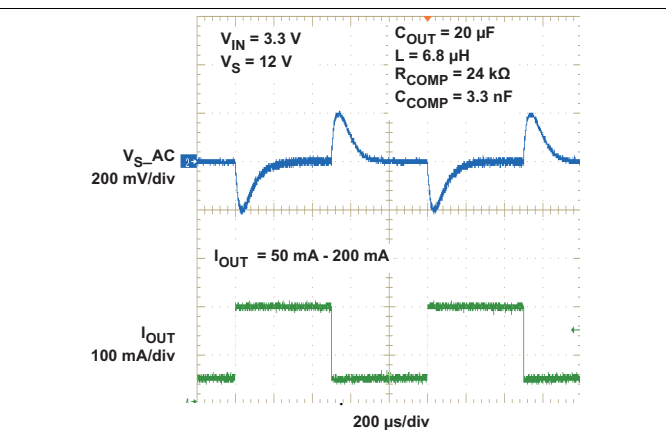


Figure 12. Load Transient Response Low Frequency (650 kHz)

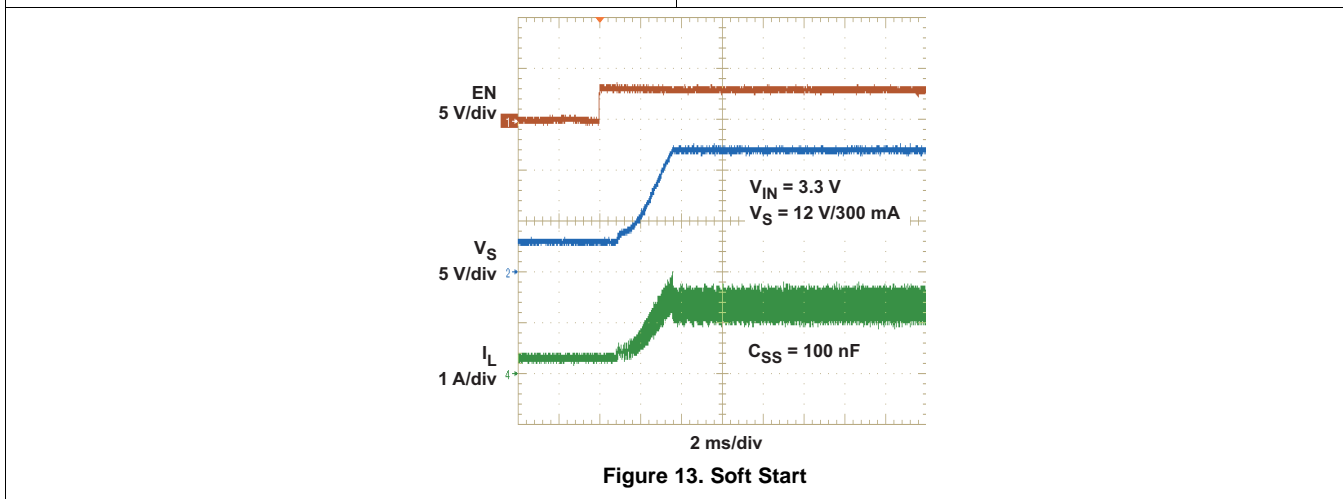
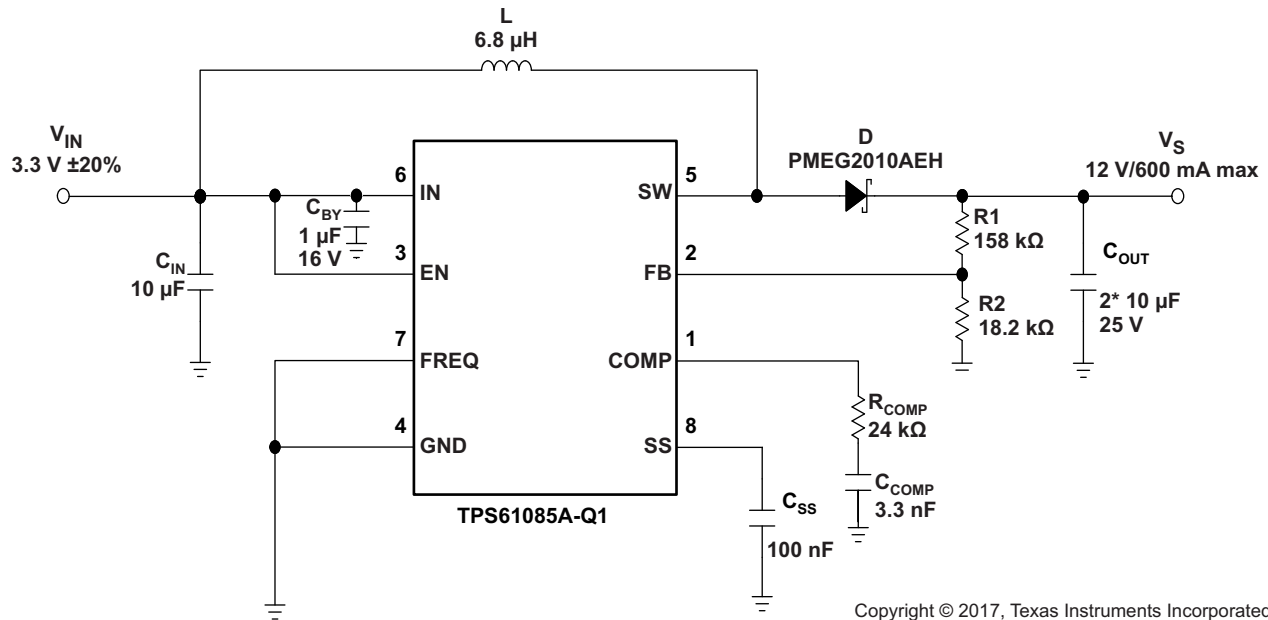


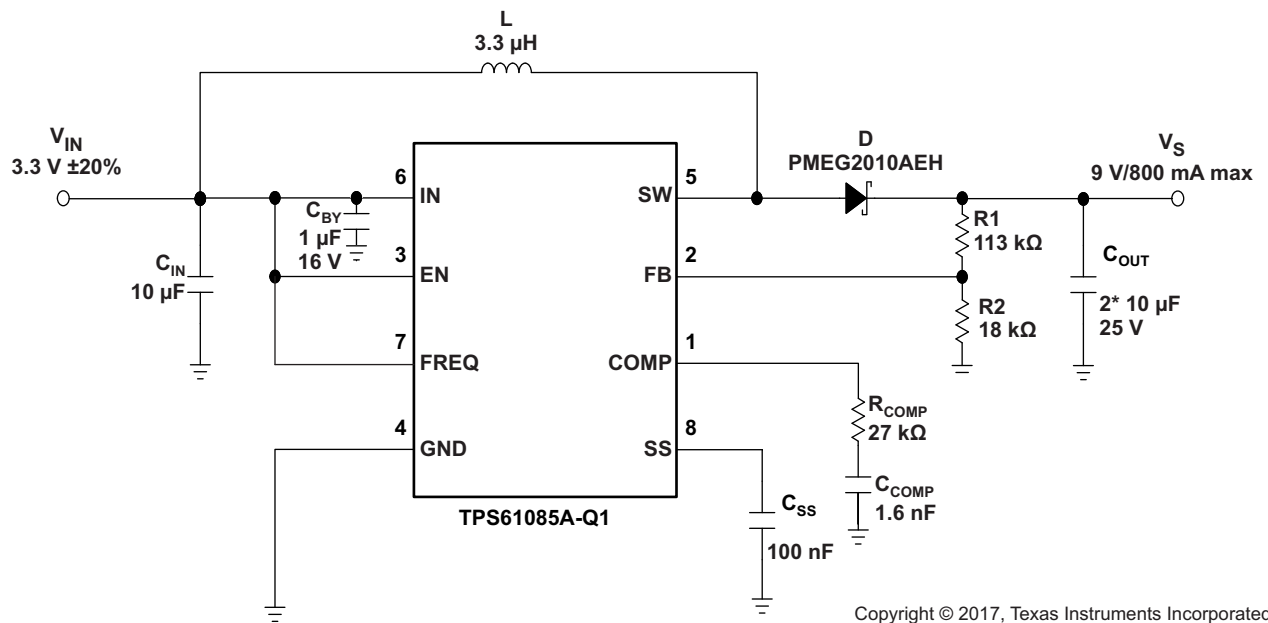
Figure 13. Soft Start

### 8.3 System Examples

Figure 14 to Figure 21 show application circuit examples using the TPS61085A-Q1 device. These circuits must be fully validated and tested by customers before using these circuits in their designs. TI does not warrant the accuracy or completeness of these circuits, nor does TI accept any responsibility for them.



**Figure 14. Typical Application, 3.3 V to 12 V ( $f_{sw} = 650$  kHz)**



**Figure 15. Typical Application, 3.3 V to 9 V ( $f_{sw} = 1.2$  MHz)**

System Examples (continued)

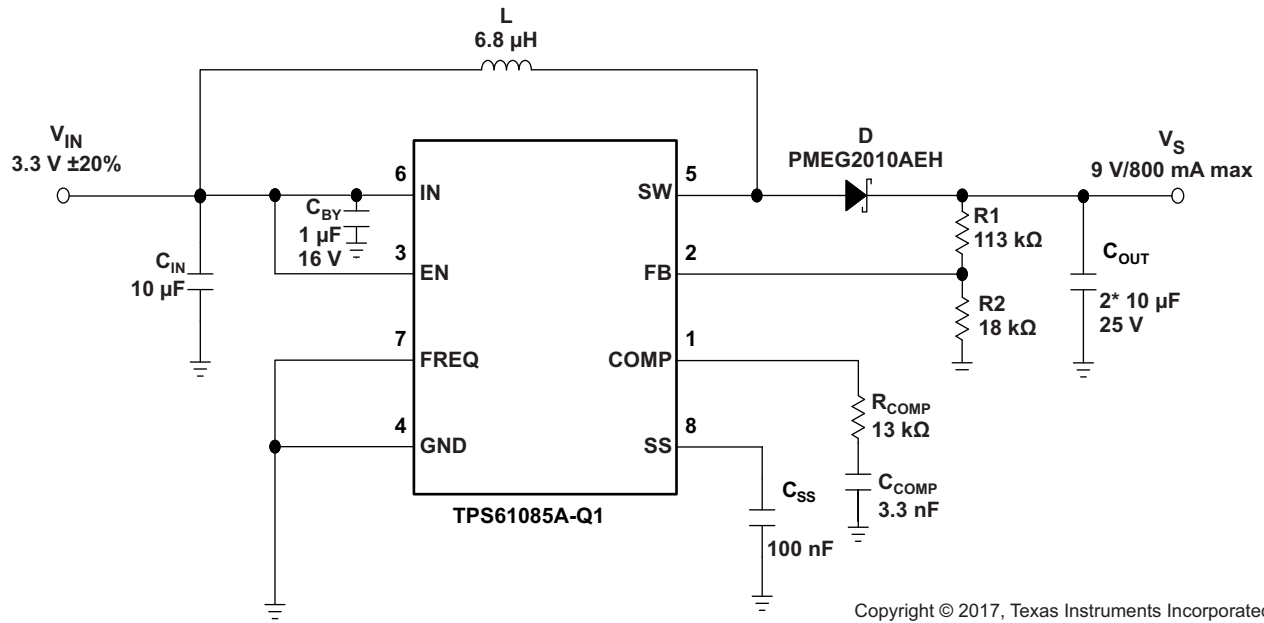


Figure 16. Typical Application, 3.3 V to 9 V ( $f_{sw} = 650$  kHz)

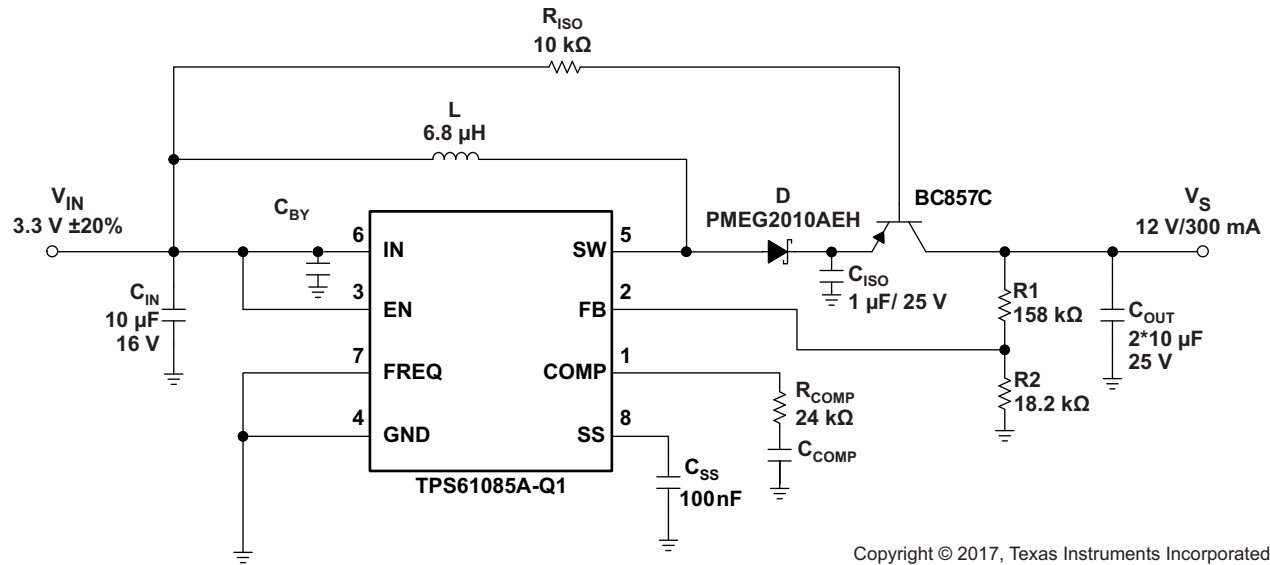


Figure 17. Typical Application With External Load Disconnect Switch

System Examples (continued)

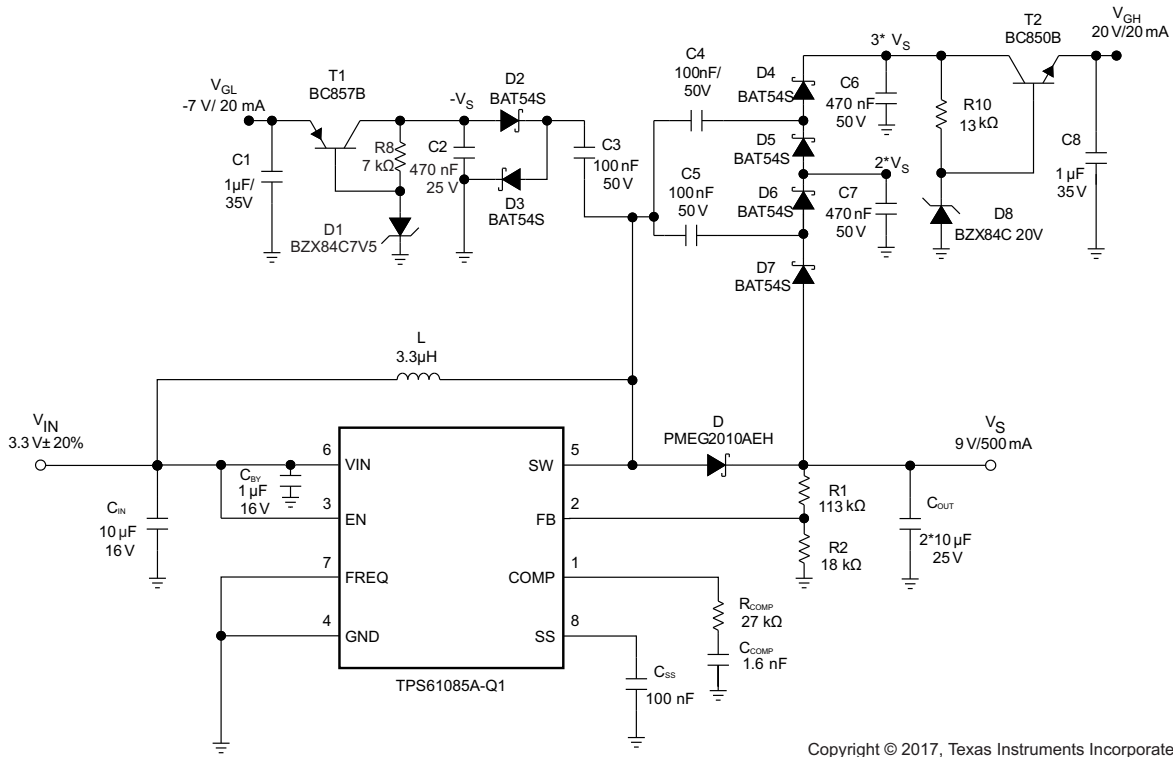


Figure 18. Typical Application 3.3 V to 9 V ( $f_{sw} = 1.2$  MHz) For TFT LCD With External Charge Pumps ( $V_{GH}$ ,  $V_{GL}$ )

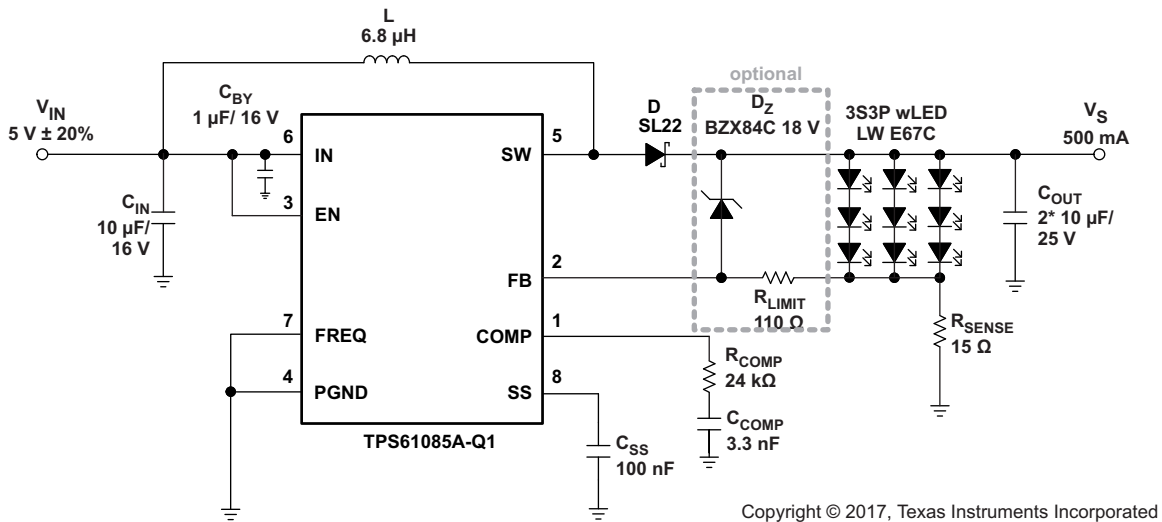


Figure 19. Simple Application (5-V Input,  $f_{sw} = 650$  kHz) For wLED Supply (3S3P) (With Optional Clamping Zener Diode)

System Examples (continued)

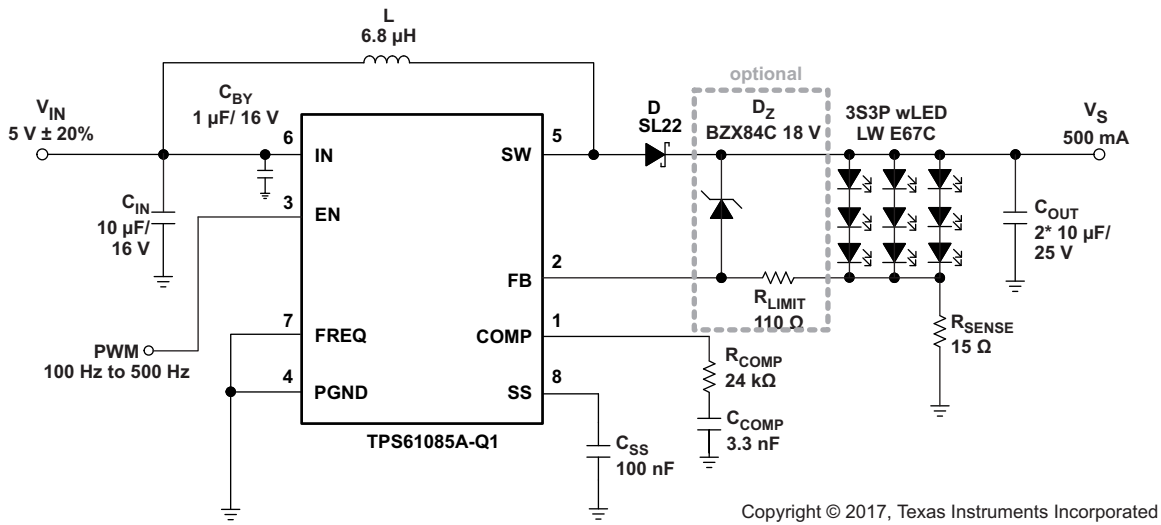


Figure 20. Simple Application (3.3-V Input,  $f_{sw} = 650$  kHz) For wLED Supply (3S3P) With Adjustable Brightness Control Using a PWM Signal on the Enable Pin (With Optional Clamping Zener Diode)

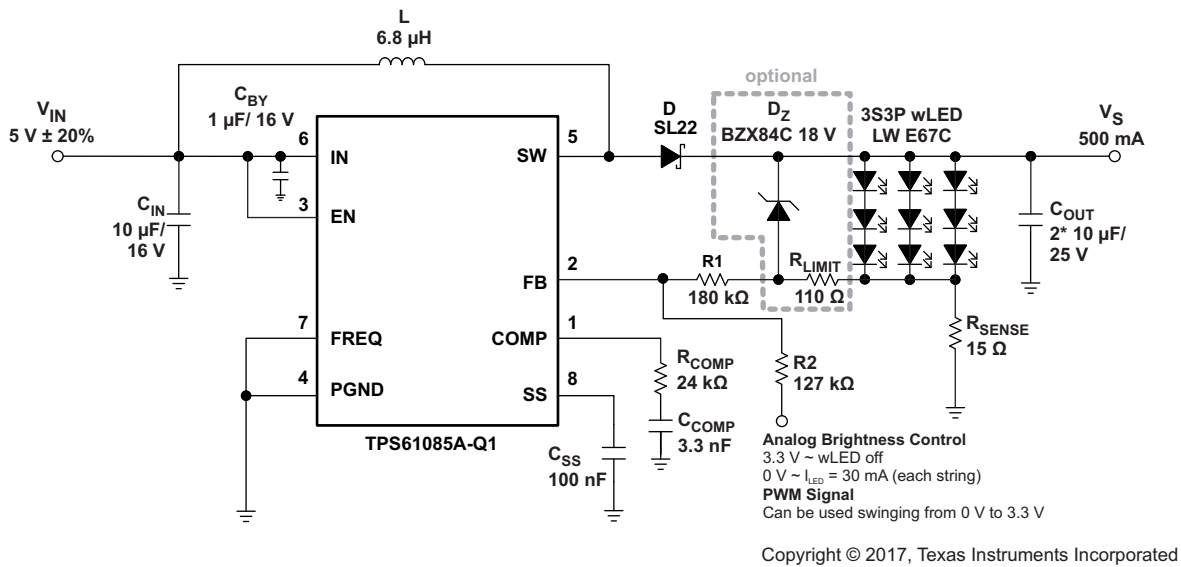


Figure 21. Simple Application (3.3-V Input,  $f_{sw} = 650$  kHz) For wLED Supply (3S3P) With Adjustable Brightness Control Using an Analog Signal on the Feedback Pin (With Optional Clamping Zener Diode)

9 Power Supply Recommendations

The TPS61085A-Q1 is designed to operate from an input voltage supply range from 2.3 V to 6 V. The required power supply for the TPS61085A-Q1 must have a current rating according to the output voltage and output current of the TPS61085A-Q1.

## 10 Layout

### 10.1 Layout Guidelines

For all switching power supplies, the layout is an important step in the design, especially at high peak currents and high switching frequencies. If the layout is not carefully done, the regulator could show stability problems as well as EMI problems.

*Layout Example* provides an example of layout design with the TPS61085A-Q1 device.

- Use wide and short traces for the main current path and for the power ground tracks.
- The input capacitor, output capacitor, and the inductor must be placed as close as possible to the IC.
- Use a common ground node for power ground and a different one for control ground to minimize the effects of ground noise. Connect these ground nodes at the GND terminal of the IC.
- The most critical current path for all boost converters is from the switching FET, through the rectifier diode, then the output capacitors, and back to ground of the switching FET. Therefore, the output capacitors and their traces must be placed on the same board layer as the IC and as close as possible between the SW pin and the GND terminal of the IC.

### 10.2 Layout Example

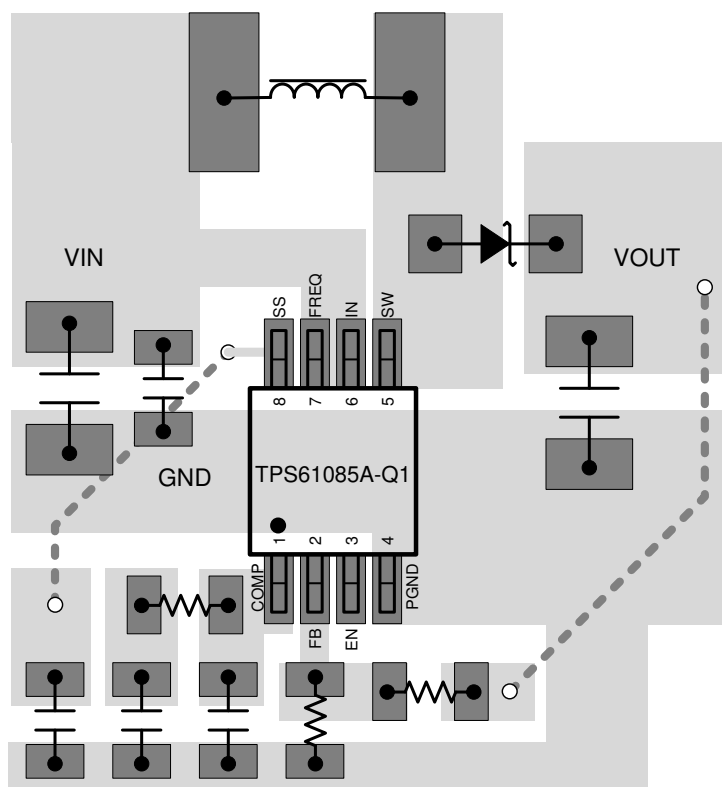


Figure 22. TPS61085A-Q1 Layout Example

## 11 器件和文档支持

### 11.1 器件支持

#### 11.1.1 第三方产品免责声明

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### 11.3 社区资源

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### 11.6 术语表

**SLYZ022** — TI 术语表。

这份术语表列出并解释术语、缩写和定义。

## 12 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。如需获取此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)
<a href="#">TPS61085ATDGKRQ1</a>	Active	Production	VSSOP (DGK)   8	2000   LARGE T&R	Yes	Call TI   Nipdauag   Nipdau	Level-3-260C-168 HR	-40 to 125	1EGV
TPS61085ATDGKRQ1.B	Active	Production	VSSOP (DGK)   8	2000   LARGE T&R	Yes	Call TI	Level-3-260C-168 HR	-40 to 125	1EGV
<a href="#">TPS61085ATDGKTQ1</a>	Active	Production	VSSOP (DGK)   8	250   SMALL T&R	Yes	Call TI   Nipdauag   Nipdau	Level-3-260C-168 HR	-40 to 125	1EGV
TPS61085ATDGKTQ1.B	Active	Production	VSSOP (DGK)   8	250   SMALL T&R	Yes	Call TI	Level-3-260C-168 HR	-40 to 125	1EGV

(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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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS61085ATDGKRQ1	VSSOP	DGK	8	2000	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS61085ATDGKRQ1	VSSOP	DGK	8	2000	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS61085ATDGKTQ1	VSSOP	DGK	8	250	180.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS61085ATDGKTQ1	VSSOP	DGK	8	250	180.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS61085ATDGKRQ1	VSSOP	DGK	8	2000	353.0	353.0	32.0
TPS61085ATDGKRQ1	VSSOP	DGK	8	2000	353.0	353.0	32.0
TPS61085ATDGKTQ1	VSSOP	DGK	8	250	213.0	191.0	35.0
TPS61085ATDGKTQ1	VSSOP	DGK	8	250	210.0	185.0	35.0

DGK0008A



# PACKAGE OUTLINE

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



4214862/A 04/2023

## NOTES:

PowerPAD is a trademark of Texas Instruments.

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.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.

# EXAMPLE BOARD LAYOUT

DGK0008A

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 15X



SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

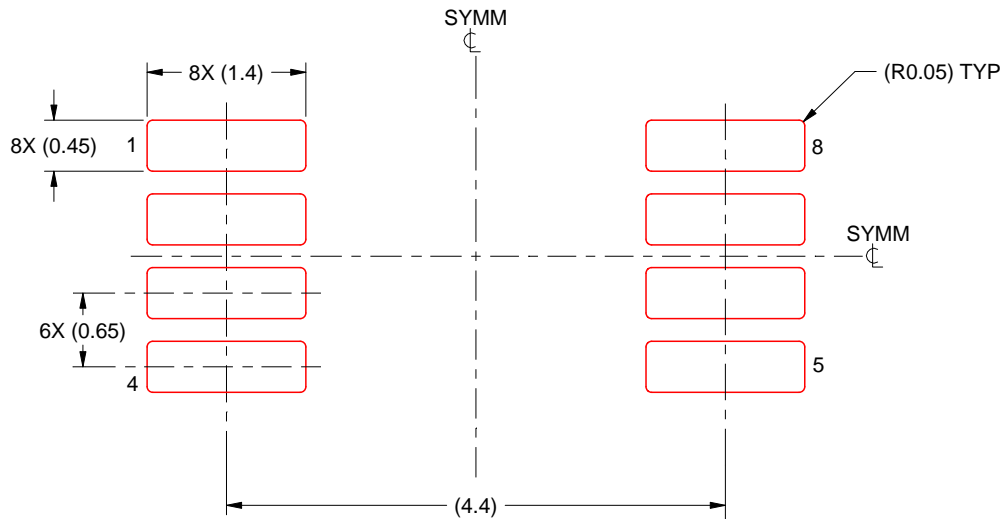
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.

# EXAMPLE STENCIL DESIGN

DGK0008A

<sup>TM</sup> VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
SCALE: 15X

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NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.

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