**TEXAS INSTRUMENTS**

# 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°C 至 +105°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
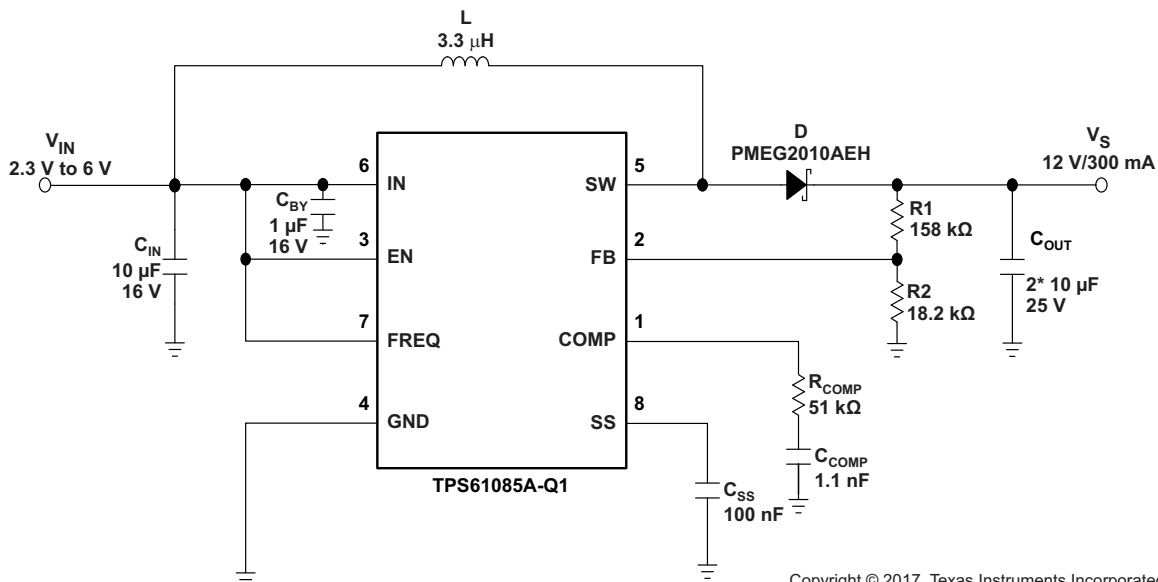  - 车身控制模块
  - 网关
- 远程信息处理和紧急呼叫
- 高级驾驶辅助系统 (ADAS)

## 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、0.13Ω 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[1]

| 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

# 4 修订历史记录

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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" ............................................................................................................................... 1

# 5 Pin Configuration and Functions

**DGK Package**
**8-Pin VSSOP**
**Top View**

```
       COMP  ▢  1      8  ▢  SS
         FB  ▢  2      7  ▢  FREQ
         EN  ▢  3      6  ▢  IN
       PGND  ▢  4      5  ▢  SW
```

Not to scale
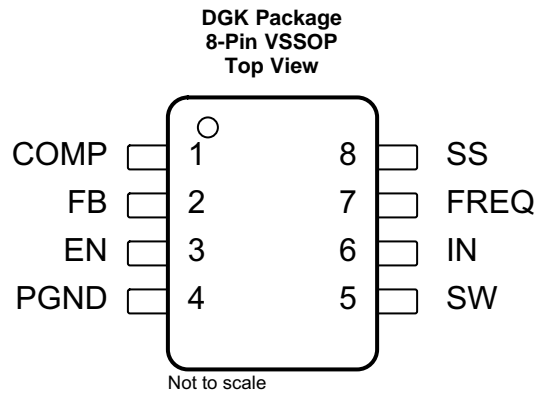
## Pin Functions

| PIN NO. | PIN NAME | TYPE | DESCRIPTION |
|---|---|---|---|
| 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)[1]

| | MIN | MAX | UNIT |
|---|---|---|---|
| Input voltage, IN[2] | −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 *Thermal Information* | | |
| 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[1] | ±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[1] | | 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 V, EN = IN, $V_S$ = 12 V, $T_A$ = –40°C to +105°C, typical values are at $T_A$ = 25°C (unless otherwise noted)

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

## 6.6 Typical Characteristics

The typical characteristics are measured with the 3.3-µH inductor for high-frequency (part number-7447789003) or 6.8-µH inductor for low frequency (part number-B82464G4) and the rectifier diode with part number SL22.

### Table 1. Table of Graphs

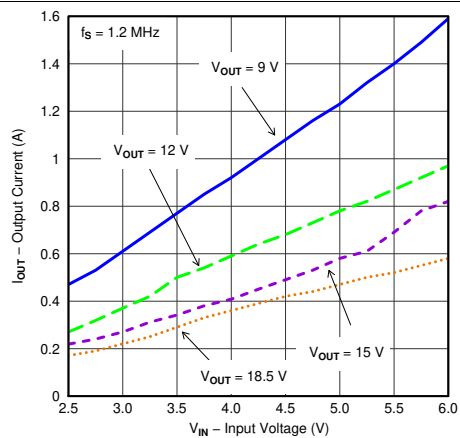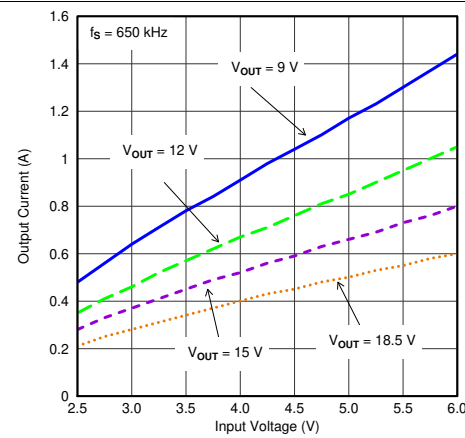| | | | FIGURE |
|---|---|---|---|
| $I_{OUT(max)}$ | Maximum load current | vs Input voltage at high frequency (1.2 MHz) | Figure 1 |
| | | vs Input voltage at low frequency (650 kHz) | Figure 2 |
| η | Efficiency | vs Load current, $V_S$ = 12 V, $V_{IN}$ = 3.3 V | Figure 3 |
| | | vs Load current, $V_S$ = 9 V, $V_{IN}$ = 3.3 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**



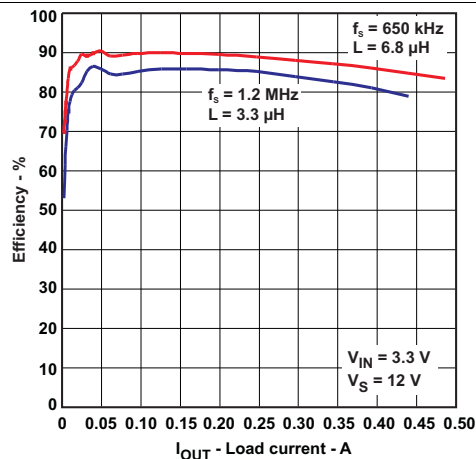**Figure 2. Maximum Load Current vs Input Voltage**



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



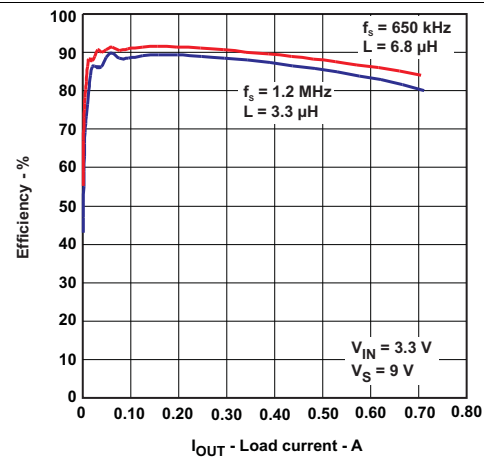**Figure 4. Efficiency vs Load Current, $V_S$ = 9 V, $V_{IN}$ = 3.3 V**
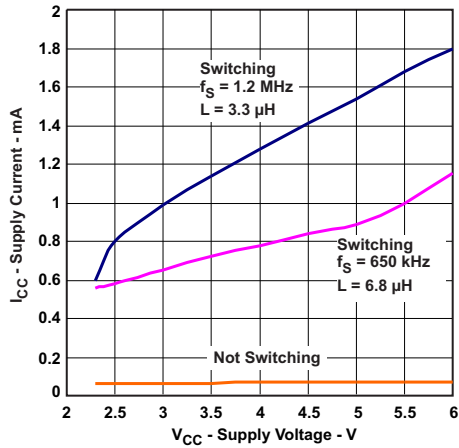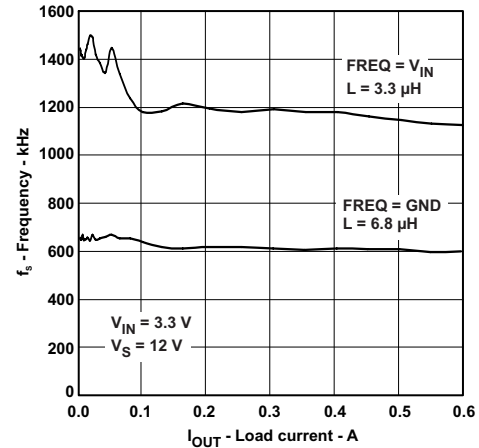
Figure 5. Supply Current vs Supply Voltage



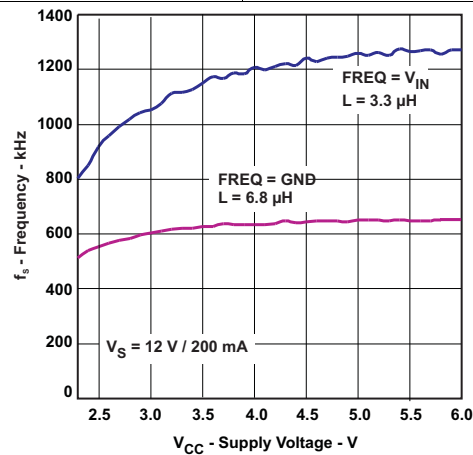Figure 6. Frequency vs Load Current



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 converteruses 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
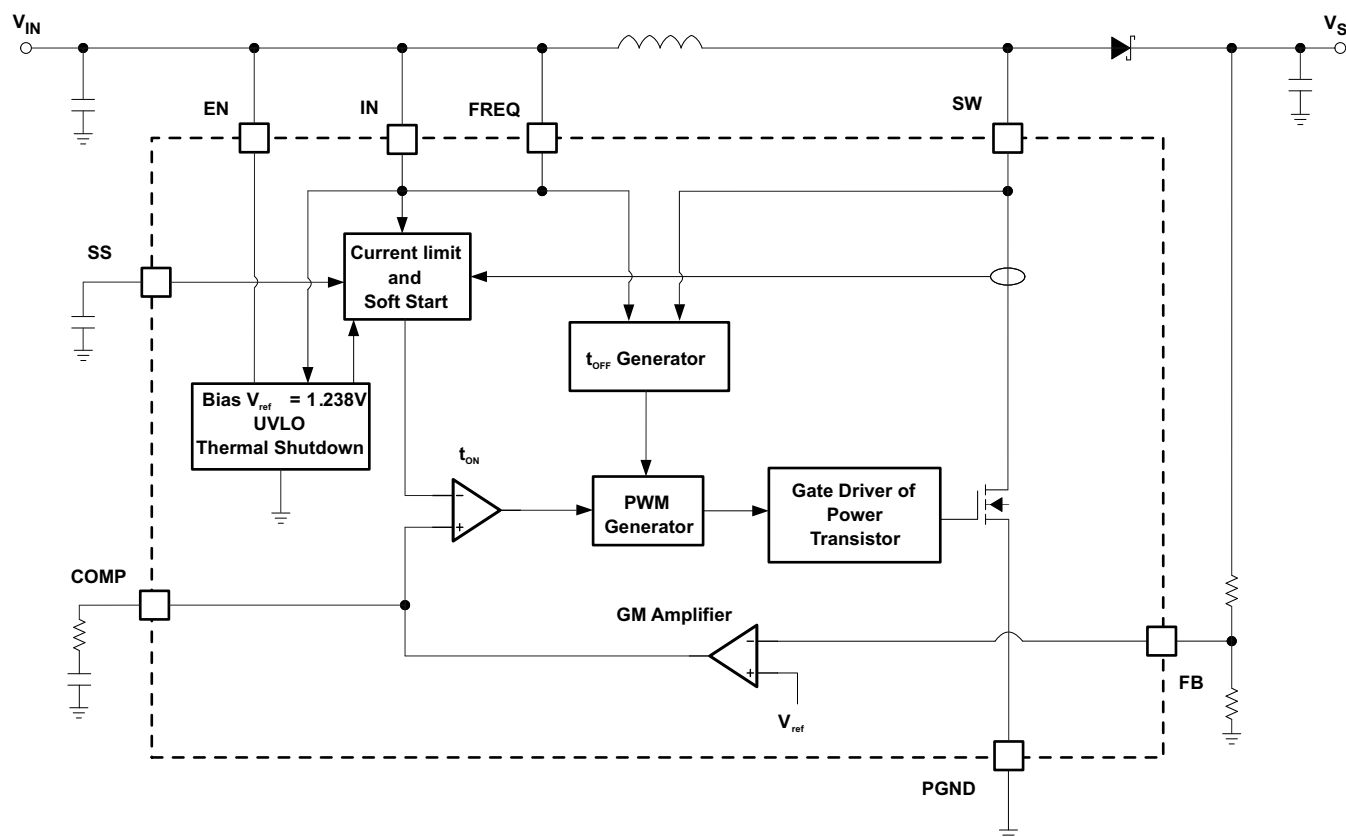


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## 7.3 Feature Description

### 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 μA 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 $V_{SS}$ ≈ 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°C. When the thermal shutdown is triggered the device stops switching until the temperature falls below typically $T_J$ = 136°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

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**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.

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## 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 ± 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:

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

(1)

2. Maximum output current:

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

(2)

3. Peak switch current:

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

where

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

- $I_{swpeak}$ = converter switch current (minimum switch current limit = 2 A)
- fs = Converter switching frequency (typically 1.2 MHz)
- L = Selected inductor value
- η = 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 µH and 6 µH are a good choice with a switching frequency of 1.2 MHz, typically 3.3 µH. At 650 kHz, TI recommends inductors between 6 µH and 13 µH, typically 6.8 µH. 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.

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

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 [1] | COMPONENT CODE | SIZE (L×W×H mm) | DCR TYP (mΩ) | Isat (A) |
|---|---|---|---|---|---|
| **1.2 MHz** | | | | | |
| 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 |
| **650 kHz** | | | | | |
| 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 $I_{out}$:

$$I_{avg} = I_{out}$$

(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.

$P_D = I_{avg} \times V_{forward}$                                                                          (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$_{forward}$ / Iavg | SUPPLIER[1] | 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:

$$R2 = \frac{Vref}{70\mu A} \approx 18k\Omega \qquad R1 = R2 \times \left( \frac{V_S}{Vref} - 1 \right)$$

(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$_{COMP}$ = 13 kΩ and C$_{COMP}$ = 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$_{COMP}$ and C$_{COMP}$:

$$R_{COMP} = \frac{110 \cdot V_{IN} \cdot V_s \cdot C_{OUT}}{L \cdot I_{OUT}} \qquad C_{COMP} = \frac{V_s \cdot C_{OUT}}{7.5 \cdot I_{OUT} \cdot R_{COMP}}$$

(8)

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

| FREQUENCY | L | V$_S$ | V$_{IN}$ ±20% | R$_{COMP}$ | C$_{COMP}$ |
|---|---|---|---|---|---|
| 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-uF bypass capacitor as close as possible to the IC from IN to GND.

One 10-µF 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-µF ceramic output capacitors (or one 22-µF) 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[1] | COMPONENT CODE |
|---|---|---|---|---|
| $C_{IN}$ | 10 µF/1206 | 16 V | Taiyo Yuden | EMK212 BJ 106KG |
| IN bypass | 1 µF/0603 | 16 V | Taiyo Yuden | EMK107 BJ 105KA |
| $C_{OUT}$ | 10 µF/1206 | 25 V | Taiyo Yuden | TMK316 BJ 106KL |

(1)   See *Third-party Products Disclaimer*

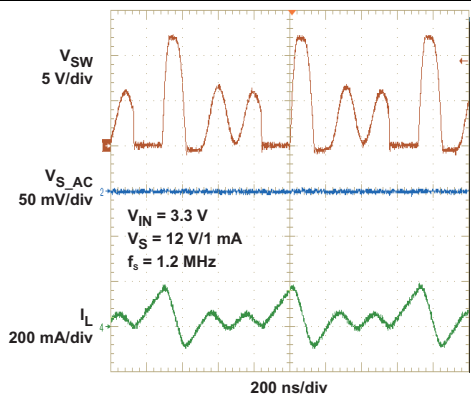## 8.2.3 Application Curves



**Figure 9. PWM Switching Discontinuous Conduction Mode**
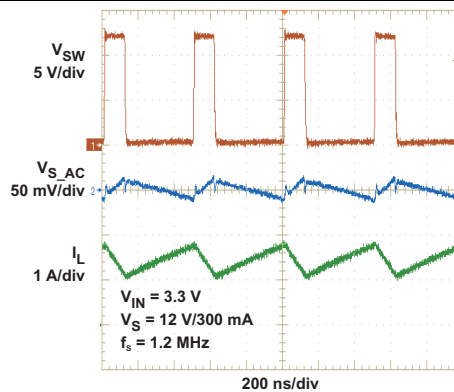


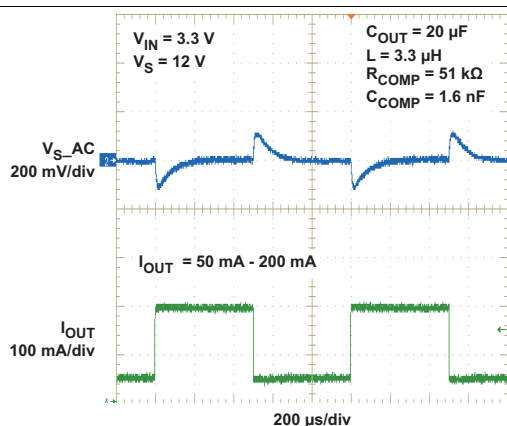**Figure 10. PWM Switching Continuous Conduction Mode**



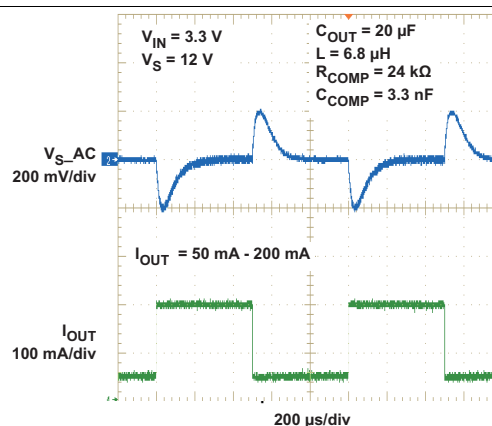**Figure 11. Load Transient Response High Frequency (1.2 MHz)**



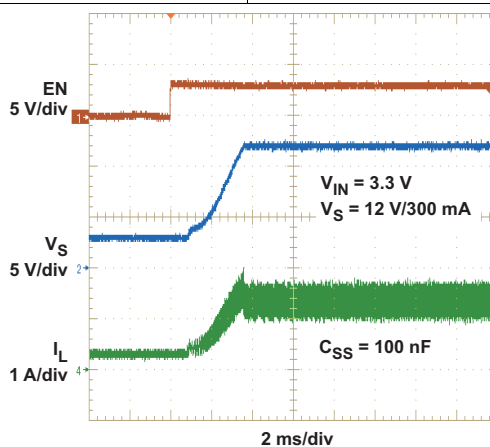**Figure 12. Load Transient Response Low Frequency (650 kHz)**



**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.
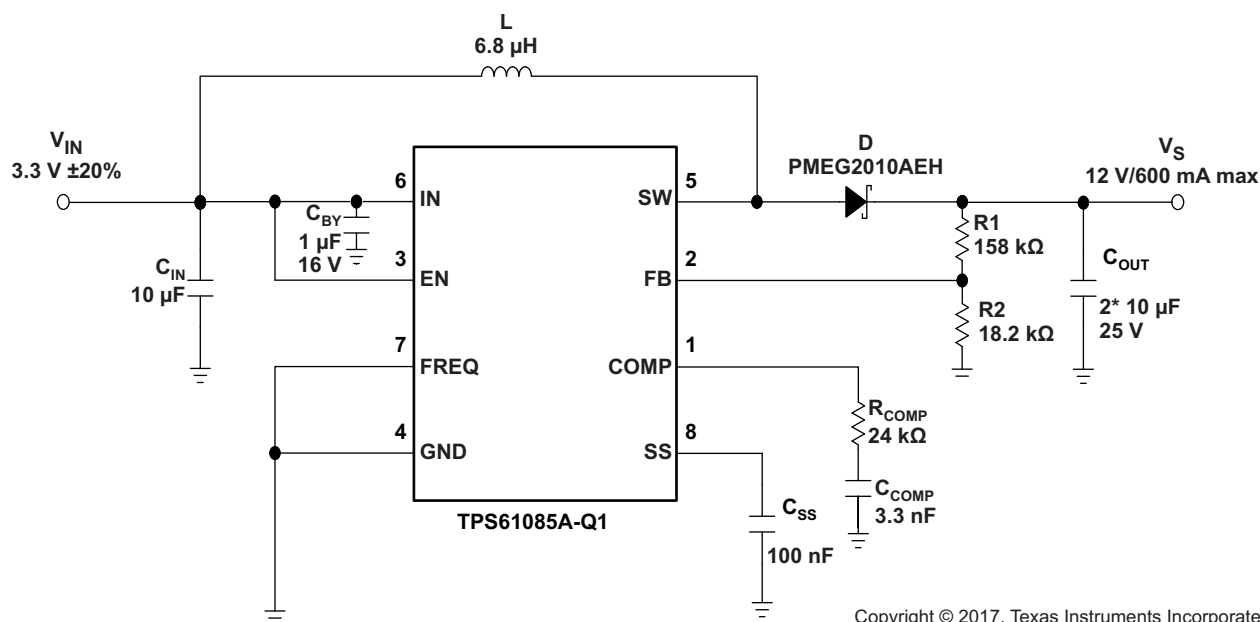


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**Figure 14. Typical Application, 3.3 V to 12 V ($f_{sw}$ = 650 kHz)**



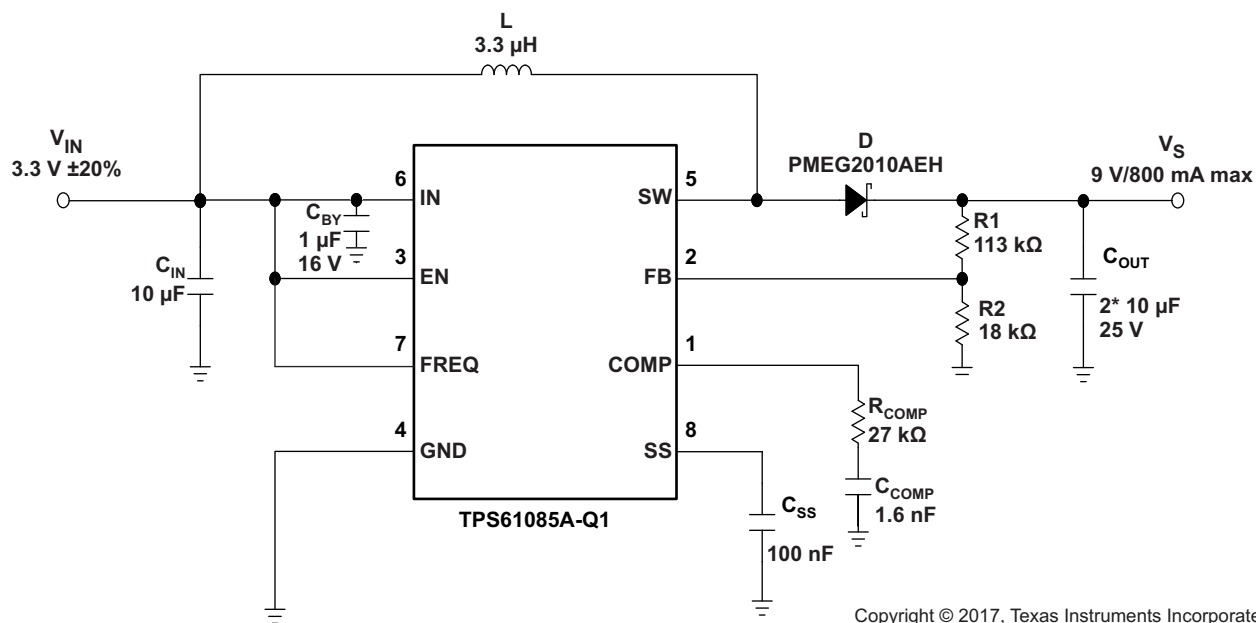Copyright © 2017, Texas Instruments Incorporated

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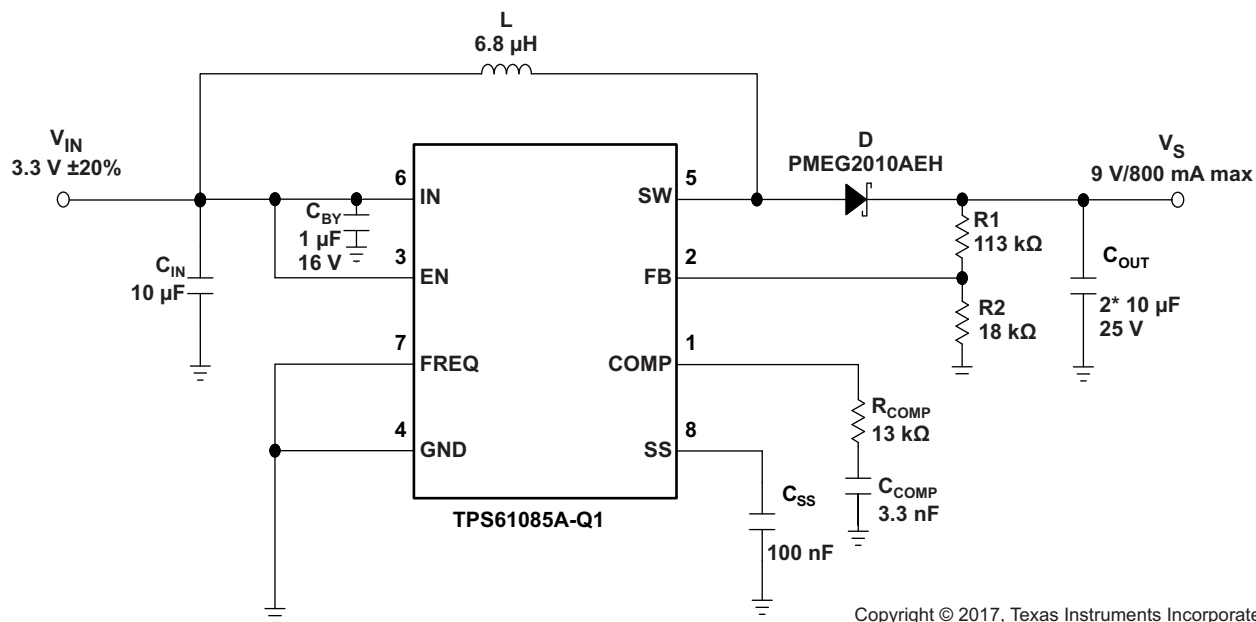
## System Examples (continued)



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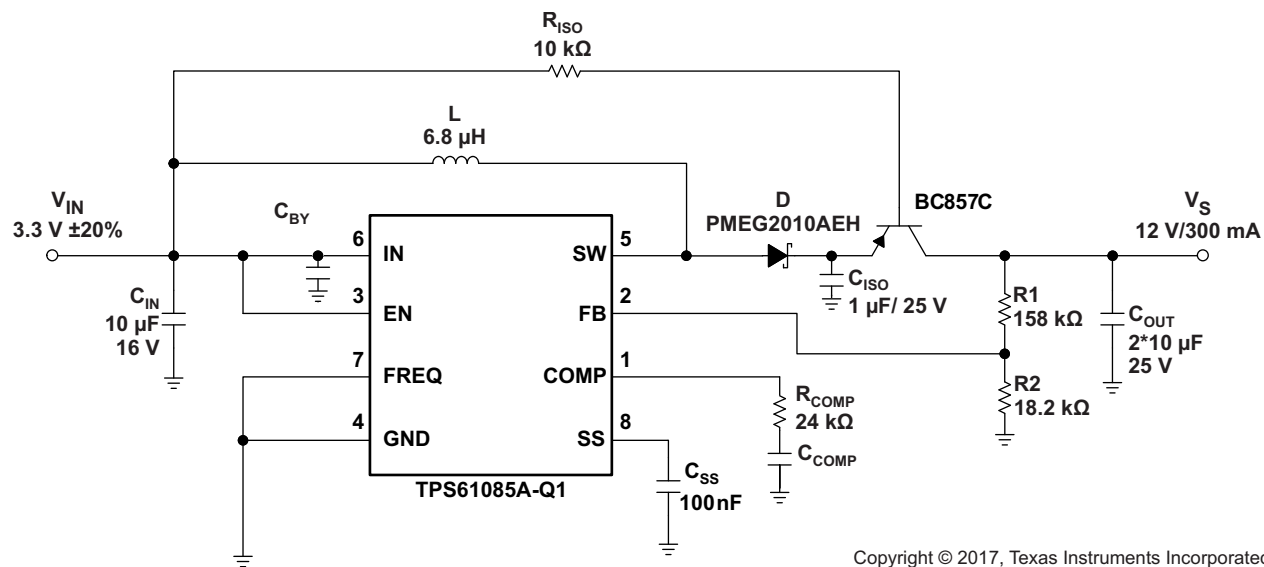


**Figure 17. Typical Application With External Load Disconnect Switch**

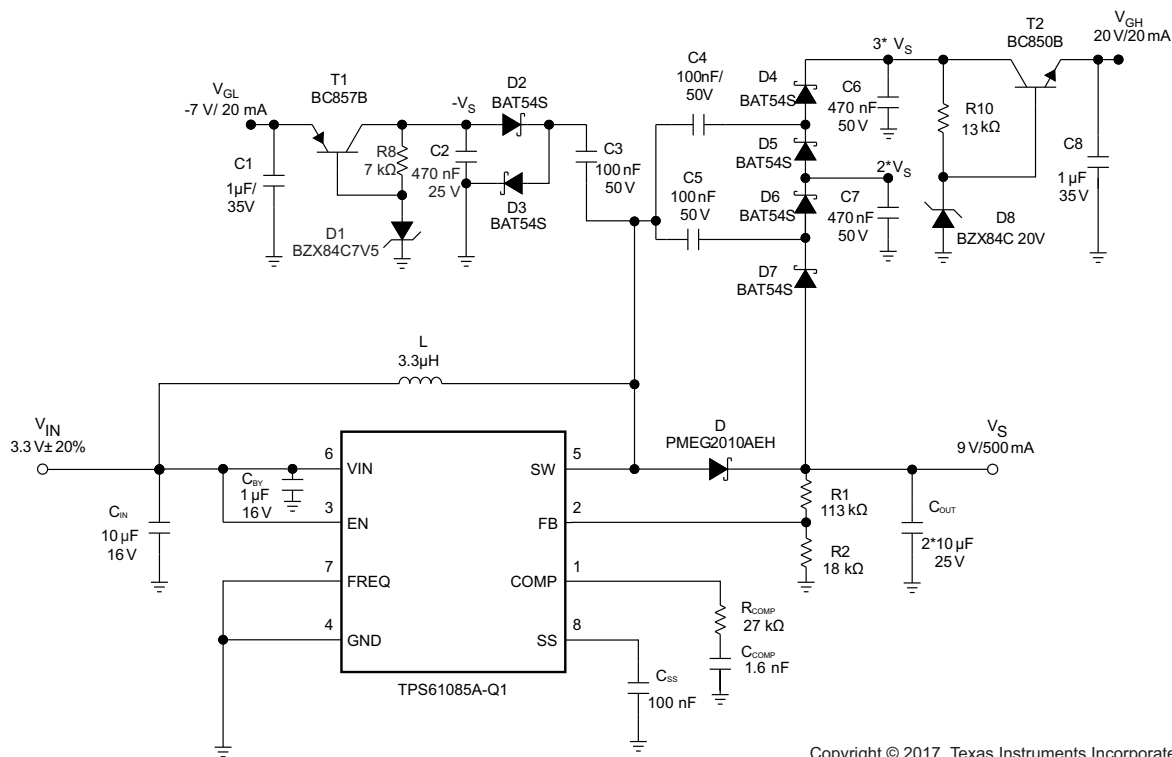## System Examples  (continued)



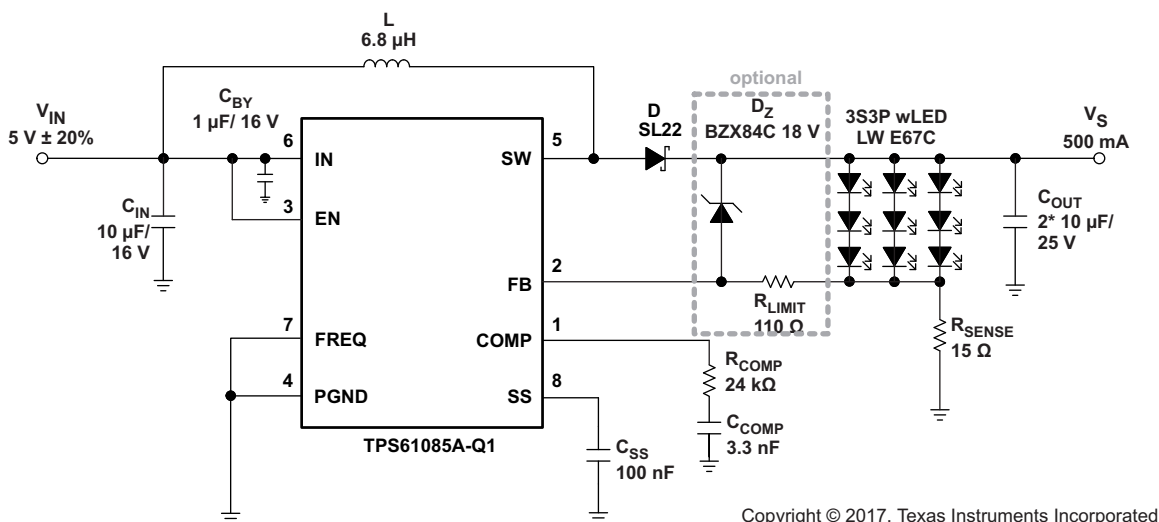**Figure 18.  Typical Application 3.3 V to 9 V ($f_{sw}$ = 1.2 MHz) For TFT LCD With External Charge Pumps (VGH, VGL)**



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

## System Examples  (continued)
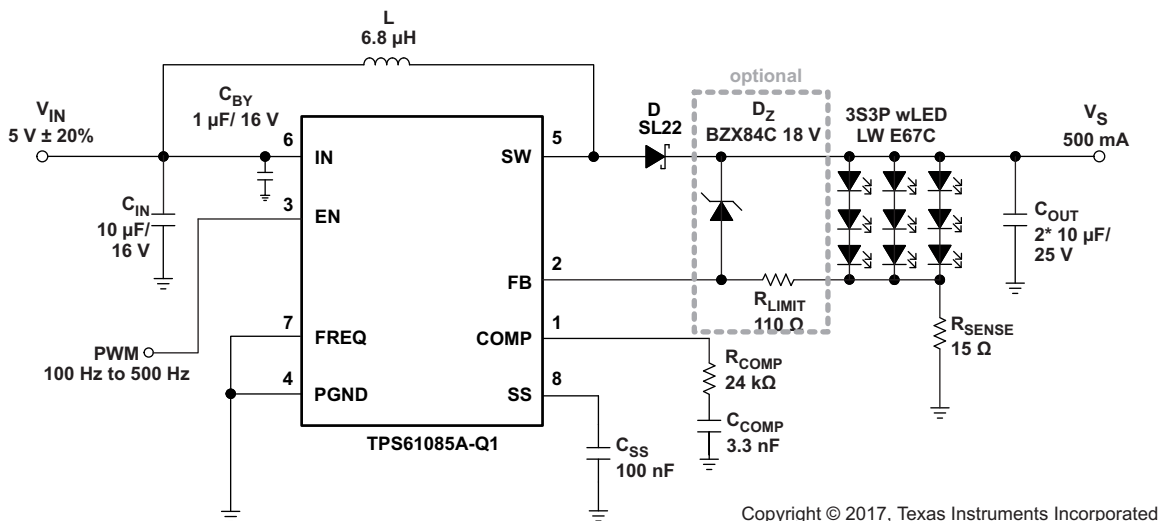


**Figure 20.  Simple Application (3.3-V Input, $f_{sw}$ = 650 kHz) For wLED Supply (3S3P) With Adjustable Brightness Control Using a PWM Signal on the Enable Pin (With Optional Clamping Zener Diode)**
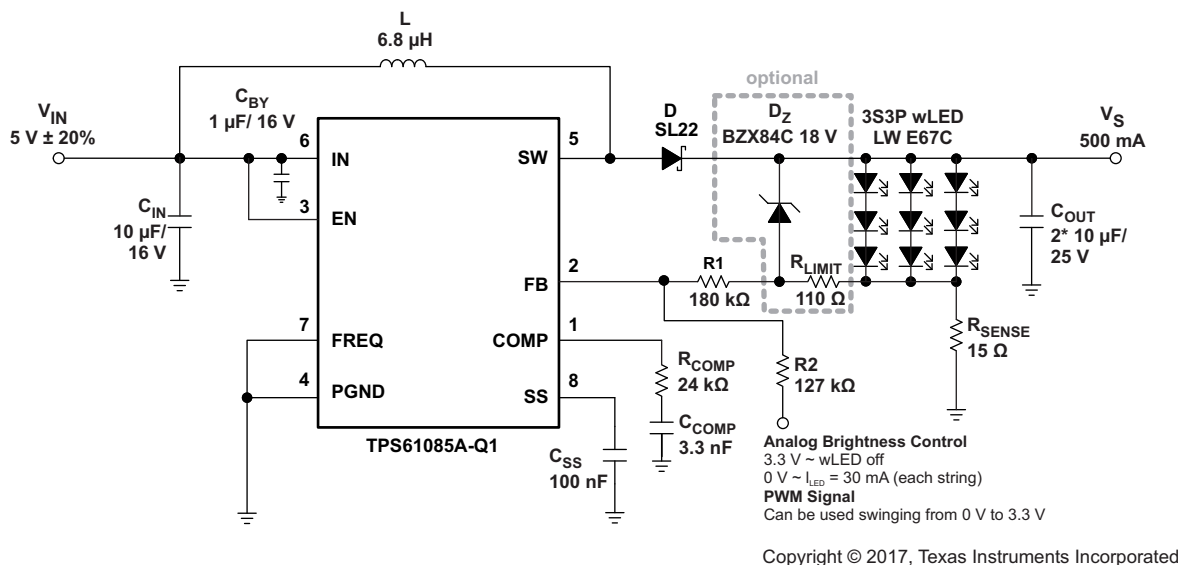


**Figure 21.  Simple Application (3.3-V Input, $f_{sw}$ = 650 kHz) For wLED Supply (3S3P) With Adjustable Brightness Control Using an Analog Signal on the Feedback Pin (With Optional Clamping Zener Diode)**

## 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.
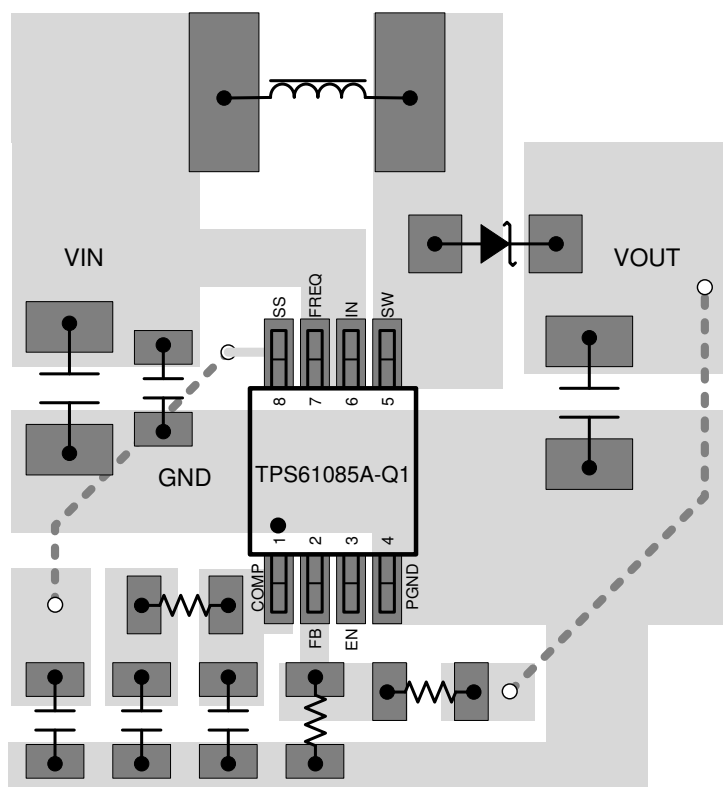
## 10.2  Layout Example



**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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**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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## 11.5 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。

## 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) |
|---|---|---|---|---|---|---|---|---|---|
| TPS61085ATDGKRQ1 | Active | Production | VSSOP (DGK) \| 8 | 2000 \| LARGE T&R | Yes | Call TI \| Nipdauag | 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 |
| TPS61085ATDGKTQ1 | 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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# PACKAGE MATERIALS INFORMATION

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**



**TAPE DIMENSIONS**



| A0 | Dimension designed to accommodate the component width |
|----|------------------------------------------------------|
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

**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 |
| 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 |

# PACKAGE MATERIALS INFORMATION

**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 |
| TPS61085ATDGKTQ1 | VSSOP | DGK | 8 | 250 | 213.0 | 191.0 | 35.0 |
| TPS61085ATDGKTQ1 | VSSOP | DGK | 8 | 250 | 210.0 | 185.0 | 35.0 |

5.05
4.75 TYP

PIN 1 INDEX AREA

A

C

△ 0.1 C

SEATING
PLANE

1

8

6X 0.65

2X

1.95

3.1
2.9
NOTE 3

4

5

8X 0.38
0.25

B

3.1
2.9
NOTE 4

⊕ 0.13Ⓜ C A B

0.23
0.13

SEE DETAIL A

0.25
GAGE PLANE

1.1 MAX

0°-8°

0.7
0.4

0.15
0.05

**DETAIL A**
TYPICAL

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PowerPAD is a trademark of Texas Instruments.

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.
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.

### DGK0008A

SYMM

8X (1.4)

8X (0.45)     1

(R0.05) TYP

8

SYMM

6X (0.65)

4

5

SEE DETAILS

(4.4)

LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X

SOLDER MASK
OPENING

METAL

EXPOSED METAL

0.05 MAX
ALL AROUND

NON-SOLDER MASK
DEFINED
(PREFERRED)

METAL UNDER
SOLDER MASK

SOLDER MASK
OPENING

EXPOSED METAL

0.05 MIN
ALL AROUND

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

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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.

SYMM

8X (1.4)

8X (0.45)   1

(R0.05) TYP

8

SYMM

6X (0.65)

4

5

(4.4)

**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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