Actual Size
3 mm x 3 mm

650 kHz/1.2 MHz, 18.5 V STEP-UP DC-DC CONVERTER

FEATURES

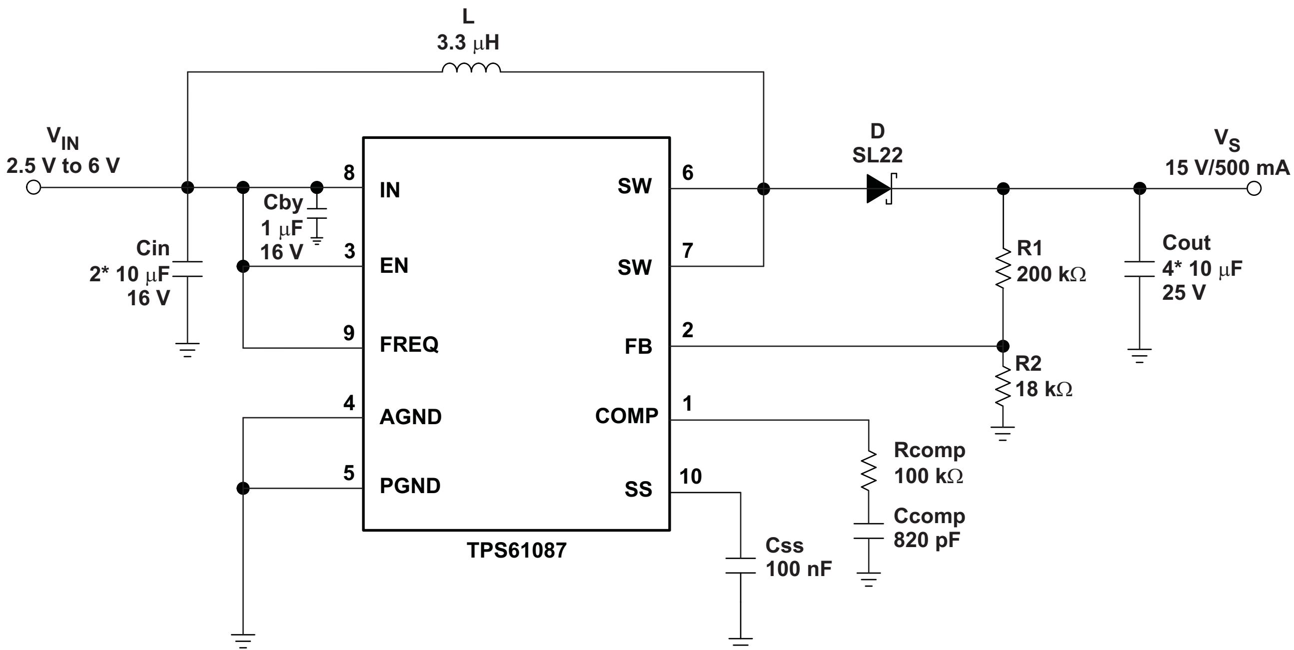
- 2.5 V to 6.0 V Input Voltage Range
- 18.5 V Boost Converter With 3.2 A Switch Current
- 650 kHz/1.2 MHz Selectable Switching Frequency
- Adjustable Soft-Start
- Thermal Shutdown
- Undervoltage Lockout
- 10-Pin QFN Package

APPLICATIONS

- Handheld Devices
- GPS Receiver
- Digital Still Camera
- Portable Applications
- DSL Modem
- PCMCIA Card
- TFT LCD Bias Supply

DESCRIPTION

The TPS61087 is a high frequency, high efficiency DC to DC converter with an integrated 3.2 A, 0.13 Ω power switch capable of providing an output voltage up to 18.5 V. The selectable frequency of 650 kHz and 1.2 MHz allows the use of small external inductors and capacitors and provides fast transient response. The external compensation allows optimizing the application for specific conditions. A capacitor connected to the soft-start pin minimizes inrush current at startup.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

ORDERING INFORMATION(1)(2)

T_A	ORDERING	PACKAGE	PACKAGE MARKING
–40 to 85°C	TPS61087DRC	QFN-10 (DRC)	PMOQ

(1) The DRC package is available taped and reeled.
(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)(1)

	VALUE	UNIT
Input voltage range IN(2)	–0.3 to 7.0	V
Voltage range on pins EN, FB, SS, FREQ, COMP	–0.3 to 7.0	V
Voltage on pin SW	20	V
ESD rating HBM	2	kV
ESD rating MM	200	V
ESD rating CDM	500	V
Continuous power dissipation	See Dissipation Rating Table	
Operating junction temperature range	–40 to 150	°C
Storage temperature range	–65 to 150	°C
Lead temperature (soldering, 10 sec)	260	°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.

DISSIPATION RATINGS(1)(2)

PACKAGE	$R_{\theta JA}$	$T_A \le 25°C$ POWER RATING	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING
QFN	30°C/W	3.3 W	1.8 W	1.3 W

(1) $P_D = (T_J - T_A)/R_{\theta JA.}$
(2) The exposed thermal die is soldered to the PCB using thermal vias. For more information, please refer to the Texas Instruments Application report SLMA002 regarding thermal characteristics of the PowerPAD package.

RECOMMENDED OPERATING CONDITIONS

		MIN	TYP	MAX	UNIT
V_{IN}	Input voltage range	2.5		6.0	V
V_S	Boost output voltage range	V_{IN} + 0.5		18.5	V
T_A	Operating free-air temperature	–40		85	°C
T_J	Operating junction temperature	–40		125	°C

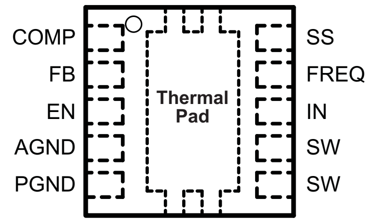
ELECTRICAL CHARACTERISTICS

V_{IN} = 5 V, EN = IN, Vs = 15 V, T_A = –40°C to 85°C, typical values are at T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY						
V_{IN}	Input voltage range		2.5		6.0	V
I_Q	Operating quiescent current into IN	Device not switching, V_{FB} = 1.3 V		75	100	µA
I_{SDVIN}	Shutdown current into IN	EN = GND			1	µA
V_{UVLO}	Under-voltage lockout threshold	V_{IN} falling			2.4	V
		V_{IN} rising			2.5	V
T_{SD}	Thermal shutdown	Temperature rising		150		°C
T_{SDHYS}	Thermal shutdown hysteresis			14		°C
LOGIC SIGNALS EN, FREQ						
V_{IH}	High level input voltage	V_{IN} = 2.5 V to 6.0 V	2			V
V_{IL}	Low level input voltage	V_{IN} = 2.5 V to 6.0 V			0.5	V
I_{INLEAK}	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	0.18	Ω
		V_{IN} = V_{GS} = 3V, I_{SW} = current limit		0.16	0.23	
I_{SWLEAK}	SW leakage current	EN = GND, V_{SW} = 6.0V			10	µA
I_{LIM}	N-Channel MOSFET current limit		3.2	4.0	4.8	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} = 2.5 V to 6.0 V, I_{OUT} = 10 mA		0.0002		%/V
	Load regulation	V_{IN} = 5.0 V, I_{OUT} = 1 mA to 1 A		0.11		%/A

PIN ASSIGNMENT

DRC PACKAGE (TOP VIEW)



10-PIN 3mm x 3mm x 1mm QFN

TERMINAL FUNCTIONS

TERMINAL		I/O	DESCRIPTION
NAME	NO.		
COMP	1	I/O	Compensation pin
FB	2	I	Feedback pin
EN	3	I	Shutdown control input. Connect this pin to logic high level to enable the device
AGND	4		Analog ground
PGND	5		Power ground
SW	6, 7		Switch pin
IN	8		Input supply pin
FREQ	9	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
SS	10		Soft-start control pin. Connect a capacitor to this pin if soft-start needed. Open = no soft-start

TYPICAL CHARACTERISTICS

TABLE OF GRAPHS

			FIGURE
η	Efficiency	vs Load current, V_S = 15 V, V_{IN} = 5 V	Figure 1
η	Efficiency	vs Load current, V_S = 9 V, V_{IN} = 3.3 V	Figure 2
	PWM switching - discontinuous conduction		Figure 3
	PWM switching - continuous conduction		Figure 4
	Load transient response	at High frequency	Figure 5
	Load transient response	at Low frequency	Figure 6
	Soft-start		Figure 7
	Supply current	vs Supply voltage	Figure 8
	Frequency	vs Load current	Figure 9
	Frequency	vs Supply voltage	Figure 10

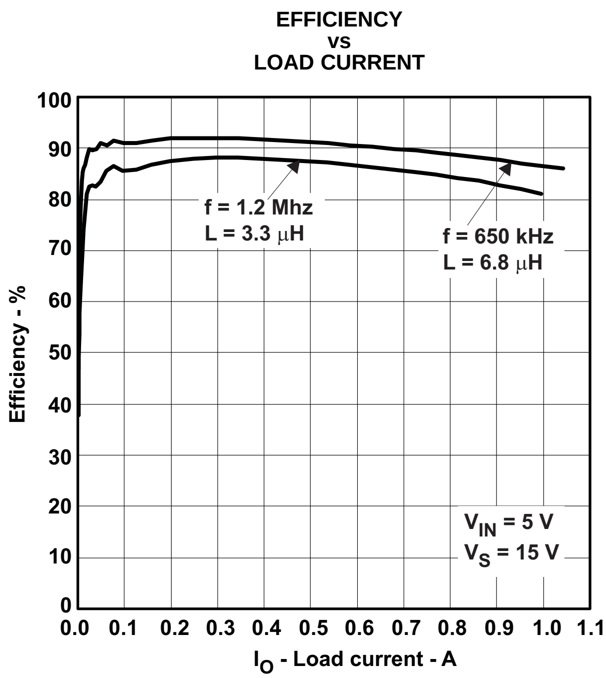


Figure 1.

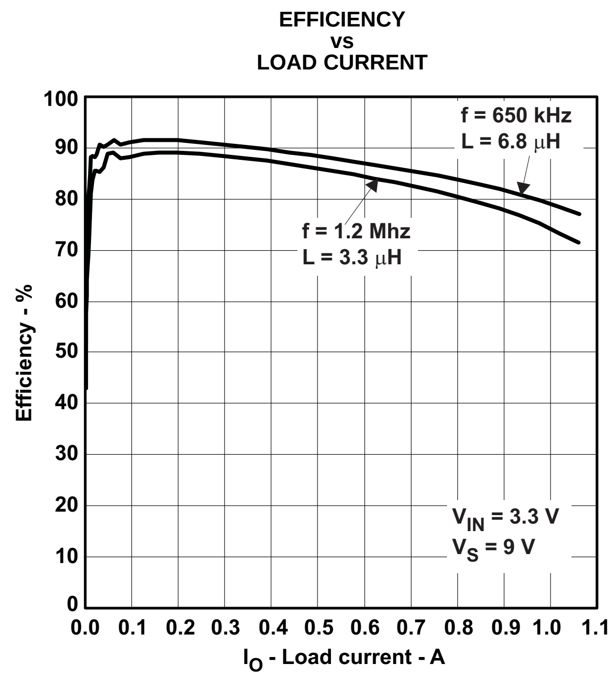


Figure 2.

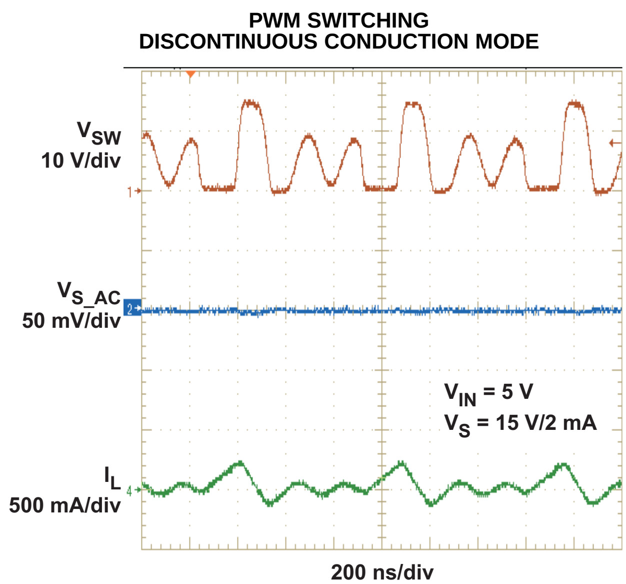


Figure 3.

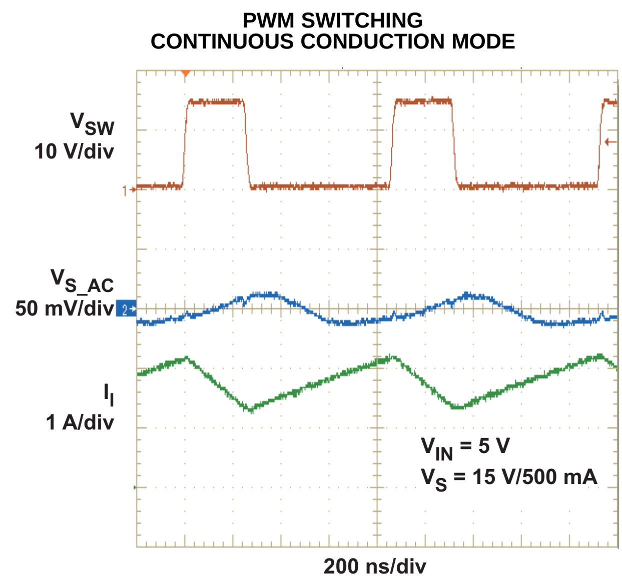


Figure 4.

LOAD TRANSIENT RESPONSE HIGH FREQUENCY (1.2 MHz)

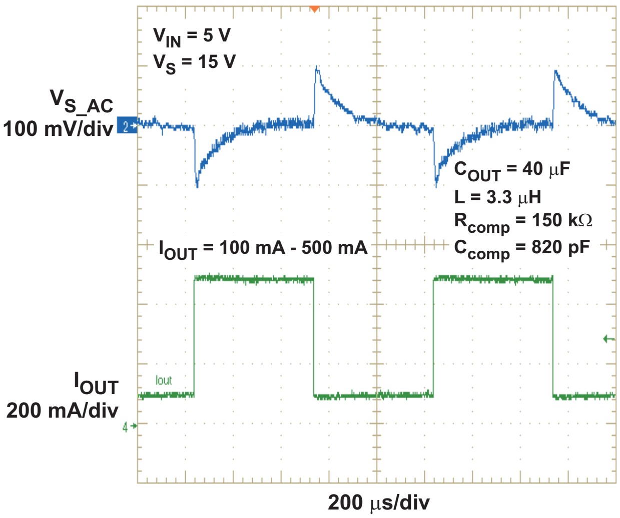


Figure 5.

LOAD TRANSIENT RESPONSE LOW FREQUENCY (650 kHz)

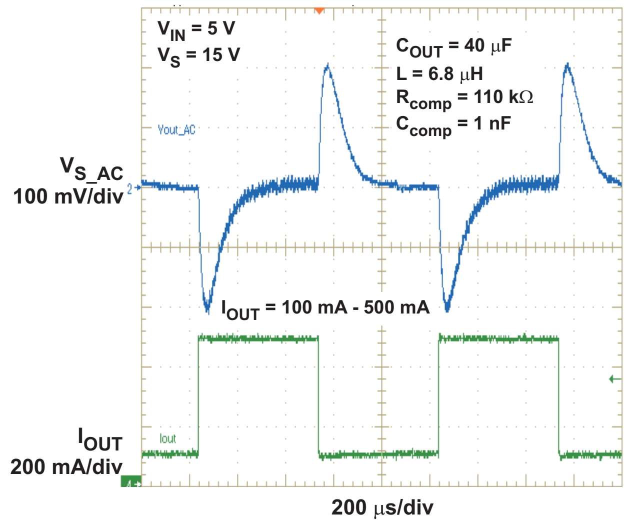


Figure 6.

SOFT-START

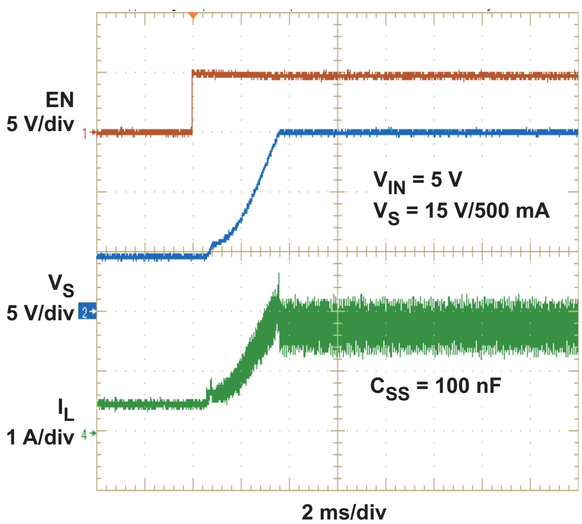


Figure 7.

SUPPLY CURRENT vs SUPPLY VOLTAGE

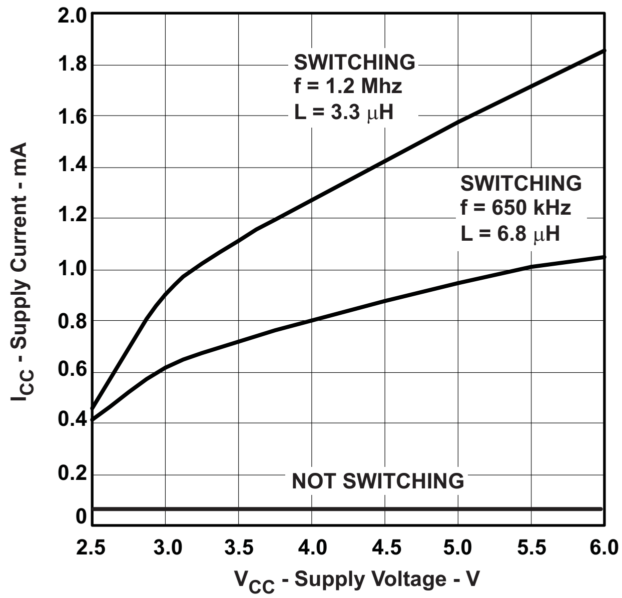


Figure 8.

FREQUENCY
vs
LOAD CURRENT

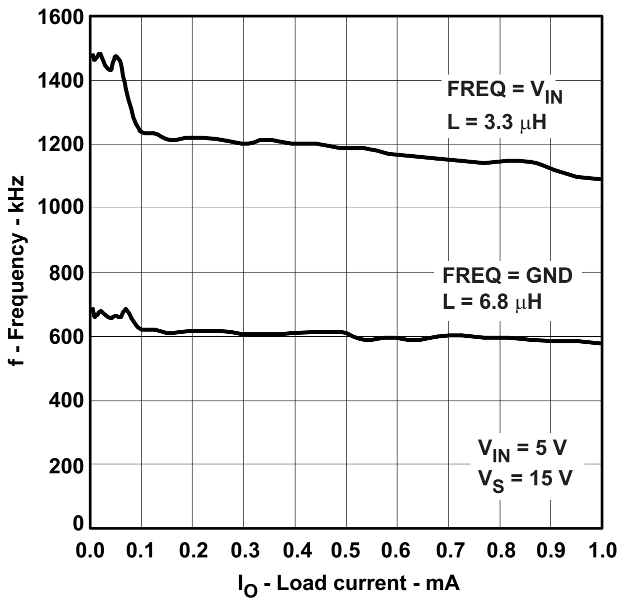


Figure 9.

FREQUENCY
vs
SUPPLY VOLTAGE

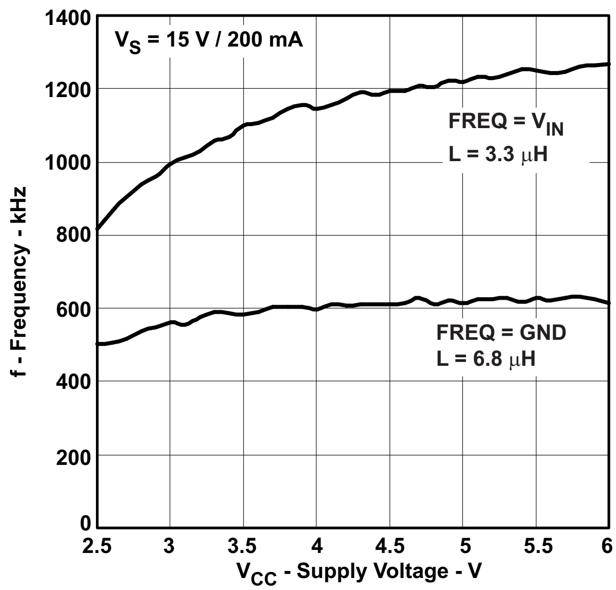


Figure 10.

DETAILED DESCRIPTION

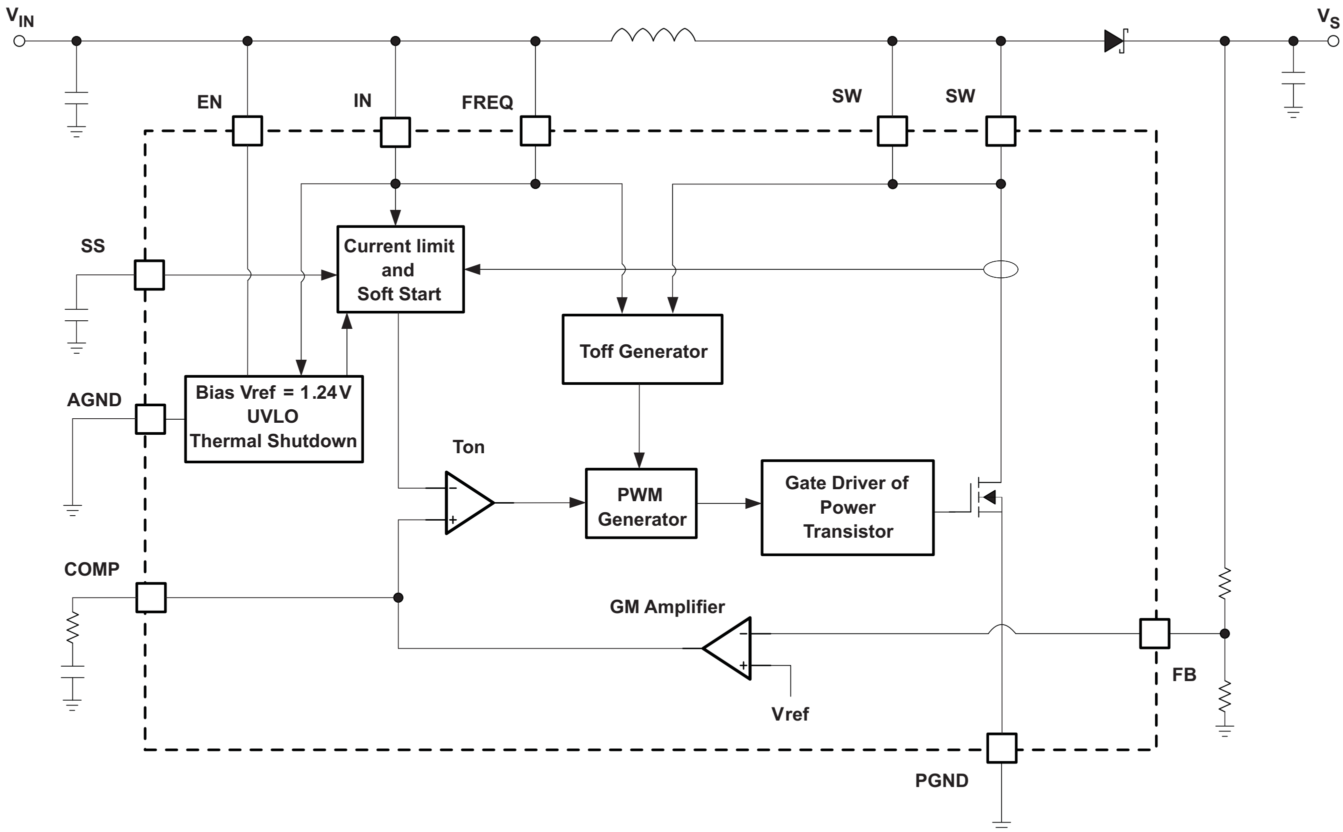


Figure 11. Block Diagram

The boost converter is designed for output voltages up to 18.5 V with a switch peak current limit of 3.2 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 and 1.2 MHz and the minimum input voltage is 2.5 V. To control the inrush current at start-up a soft-start pin is available.

During the on-time, the voltage across the inductor causes the current in it to rise. When the current reaches a threshold value set by the internal GM amplifier, the power transistor is turned off, the energy stored into the inductor is then released and the current flows through the Schottky diode towards the output of the boost converter. The off-time is fixed for a certain V_{IN} and V_S, and therefore maintains the same frequency when varying these parameters.

However, for different output loads, the frequency may slightly change due to the voltage drop across the Rdson of the power transistor which will have an effect on the voltage across the inductor and thus on t_{ON} (t_{OFF} remains fixed). Some slight frequency changes might also appear with a fixed output load due to the fact that the output voltage V_S is not sensed directly but via the SW Pin, which affects accuracy.

Because of the quasi-constant frequency behavior of the device, the TPS61087 eliminates the need for an internal oscillator and slope compensation, which provides better stability for the system over a wide of input and output voltages range, and more stable and accurate current limiting operation compared to boost converters operating with a conventional PWM scheme. The TPS61087 topology has also the benefits of providing very good load and line regulations, and excellent load transient response.

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, e.g. 90%.

1. Duty Cycle: $D = 1 - \frac{V_{IN} \times \eta}{V_S}$
2. Maximum output current: $Iout = \left(I_{swpeak} - \frac{\Delta I_L}{2}\right) \times (1 - D)$
3. Peak switch current: $I_{swpeak} = \frac{\Delta I_L}{2} + \frac{I_{out}}{1 - D}$

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

and

I_{swpeak} = converter switch current (minimum switch current limit = 3.2 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)
ΔI_L = Inductor peak-to-peak ripple current

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

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 $V_{SS} \approx$ 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.

Inductor Selection

The TPS61087 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 should be higher than the peak switch current as calculated in the *Design Procedure* section with additional margin to cover for heavy load transients. An alternative, more conservative, is to choose an inductor with a saturation current at least as high as the maximum switch current limit of 4.8 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 TPS61087, 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 we recommend inductors between 6 µH and 13 µH, typically 6.8 µH. Possible inductors are shown in Table 1.

Typically, it is recommended that the inductor current ripple is below 20% of the average inductor current. The following equation can therefore be used to calculate the inductor value:

$$L = \left(\frac{V_{IN}}{V_S}\right)^2 \times \left(\frac{V_S - V_{IN}}{I_{out\_max} \times f}\right) \times \left(\frac{\eta}{0.35}\right) \quad (1)$$

Table 1. Inductor Selection

L (µH)	SUPPLIER	COMPONENT CODE	SIZE (L×W×H mm)	DCR TYP (mΩ)	Isat (A)
1.2 MHz					
4.2	Sumida	CDRH5D28	5.7 × 5.7 × 3	23	2.2
4.7	Wurth Elektronik	7447785004	5.9 × 6.2 × 3.3	60	2.5
5	Coilcraft	MSS7341	7.3 × 7.3 × 4.1	24	2.9
5	Sumida	CDRH6D28	7 × 7 × 3	23	2.4
4.6	Sumida	CDR7D28	7.6 × 7.6 × 3	38	3.15
4.7	Wurth Elektronik	7447789004	7.3 × 7.3 × 3.2	33	3.9
3.3	Wurth Elektronik	7447789003	7.3 × 7.3 × 3.2	30	4.2
650 kHz					
10	Wurth Elektronik	744778910	7.3 × 7.3 × 3.2	51	2.2
10	Sumida	CDRH8D28	8.3 × 8.3 × 3	36	2.7
6.8	Sumida	CDRH6D26HPNP	7 × 7 × 2.8	52	2.9
6.2	Sumida	CDRH8D58	8.3 × 8.3 × 6	25	3.3
10	Coilcraft	DS3316P	12.95 × 9.40 × 5.08	80	3.5
10	Sumida	CDRH8D43	8.3 × 8.3 × 4.5	29	4
6.8	Wurth Elektronik	74454068	12.7 × 10 × 4.9	55	4.1

Rectifier Diode Selection

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

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

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 has to be able to dissipate the power. The dissipated power is the average rectified forward current times the diode forward voltage.

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

Typically the diode should be able to dissipate around 500mW depending on the load current and forward voltage.

Table 2. Rectifier Diode Selection

CURRENT RATING Iavg	Vr	$V_{forward / Iavg}$	SUPPLIER	COMPONENT CODE
2 A	20 V	0.44 V / 2 A	Vishay Semiconductor	SL22
2 A	20 V	0.5 V / 2 A	Fairchild Semiconductor	SS22

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:

$$R2 = \frac{Vref}{70\mu A} \approx 18k\Omega \qquad R1 = R2 \times \left(\frac{Vs}{Vref} - 1\right) \tag{2}$$

Compensation (COMP)

The regulator loop can 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} = 16 kΩ and C_{COMP} = 2.7 nF will work for the majority of the applications.

Please refer to Table 3 for dedicated compensation networks giving an improved load transient response. The following equations can be used to calculate R_{COMP} and C_{COMP}:

$$R_{COMP} = \frac{110 \times V_{IN} \times V_S \times Cout}{L \times Iout\_max} \qquad C_{COMP} = \frac{V_S \times Cout}{7.5 \times Iout\_max \times R_{COMP}} \tag{3}$$

Table 3. 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	100 kΩ	820 pF
			3.3 V	91 kΩ	1.2 nF
		12 V	5 V	68 kΩ	820 pF
			3.3 V	68 kΩ	1.2 nF
		9 V	5 V	39 kΩ	820 pF
			3.3 V	39 kΩ	1.2 nF
Low (650 kHz)	6.8 µH	15 V	5 V	51 kΩ	1.5 nF
			3.3 V	47 kΩ	2.7 nF
		12 V	5 V	33 kΩ	1.5 nF
			3.3 V	33 kΩ	2.7 nF
		9 V	5 V	18 kΩ	1.5 nF
			3.3 V	18 kΩ	2.7 nF

Table 3 gives conservatives Rcomp and Comp values for certain inductors, input and output voltages providing a very stable system. For a faster response time, a higher Rcomp value can be used to enlarge the bandwidth, as well as a slightly lower value of Ccomp to keep enough phase margin. These adjustments should be performed in parallel with the load transient response monitoring of TPS61087.

Input Capacitor Selection

For good input voltage filtering low ESR ceramic capacitors are recommended. TPS61087 has an analog input IN. Therefore, a 1 µF bypass is highly recommended as close as possible to the IC from IN to GND.

Two 10 µF (or one 22 µF) ceramic input capacitors are sufficient for most of the applications. For better input voltage filtering this value can be increased. Refer to Table 4 and typical applications for input capacitor recommendations.

Output Capacitor Selection

For best output voltage filtering a low ESR output capacitor like ceramic capcaitor is recommended. Four 10 µF ceramic output capacitors (or two 22 µF) work for most of the applications. Higher capacitor values can be used to improve the load transient response. Refer to Table 4 for the selection of the output capacitor.

Table 4. Rectifier Input and Output Capacitor Selection

	CAPACITOR	VOLTAGE RATING	SUPPLIER	COMPONENT CODE
C_{IN}	22 µF/1206	16 V	Taiyo Yuden	EMK316 BJ 226ML
IN bypass	1 µF/0603	16 V	Taiyo Yuden	EMK107 BJ 105KA
C_{OUT}	10 µF/1206	25 V	Taiyo Yuden	TMK316 BJ 106KL

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. Usually, it is recommended to use 1.2 MHz switching frequency unless light load efficiency is a major concern.

Undervoltage Lockout (UVLO)

To avoid mis-operation of the device at low input voltages an undervoltage lockout is included that disables the device, if the input voltage falls below 2.4 V.

Thermal Shutdown

A thermal shutdown is implemented to prevent damages due to excessive heat and power dissipation. Typically the thermal shutdown threshold is 150°C. When the thermal shutdown is triggered the device stops switching until the temperature falls below typically 136°C. Then the device starts switching again.

APPLICATION INFORMATION

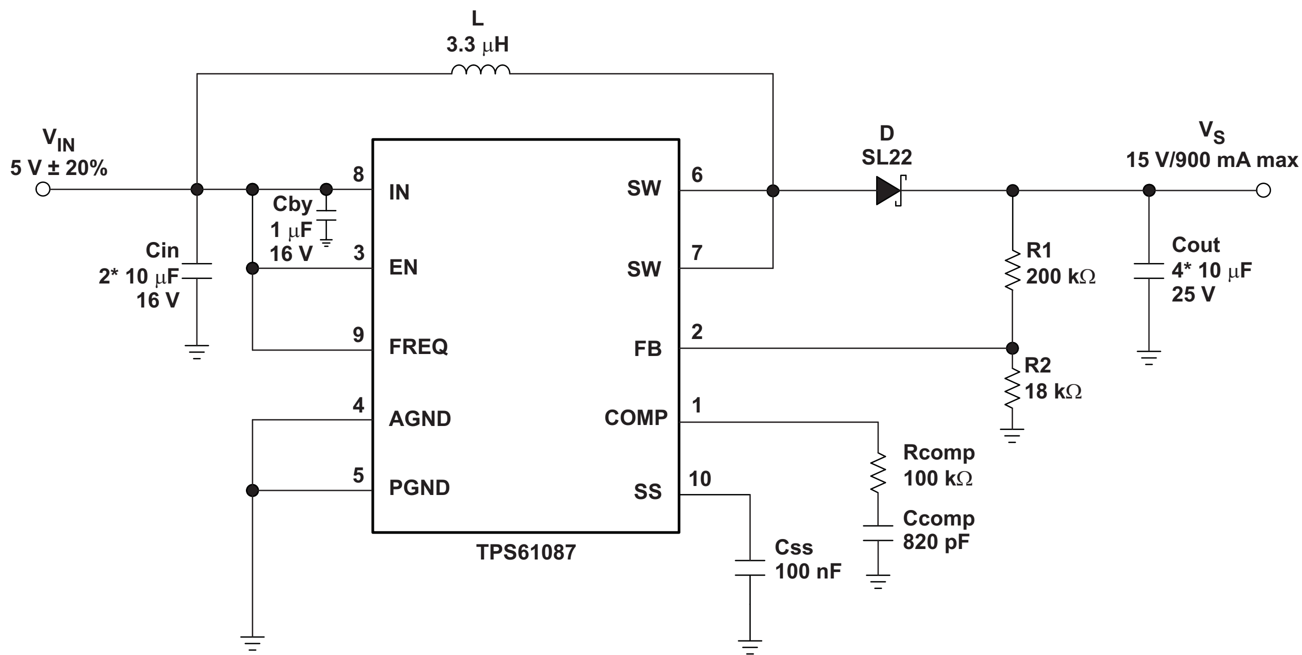


Figure 12. Typical Application, 5 V to 15 V (f_{sw} = 1.2 MHz)

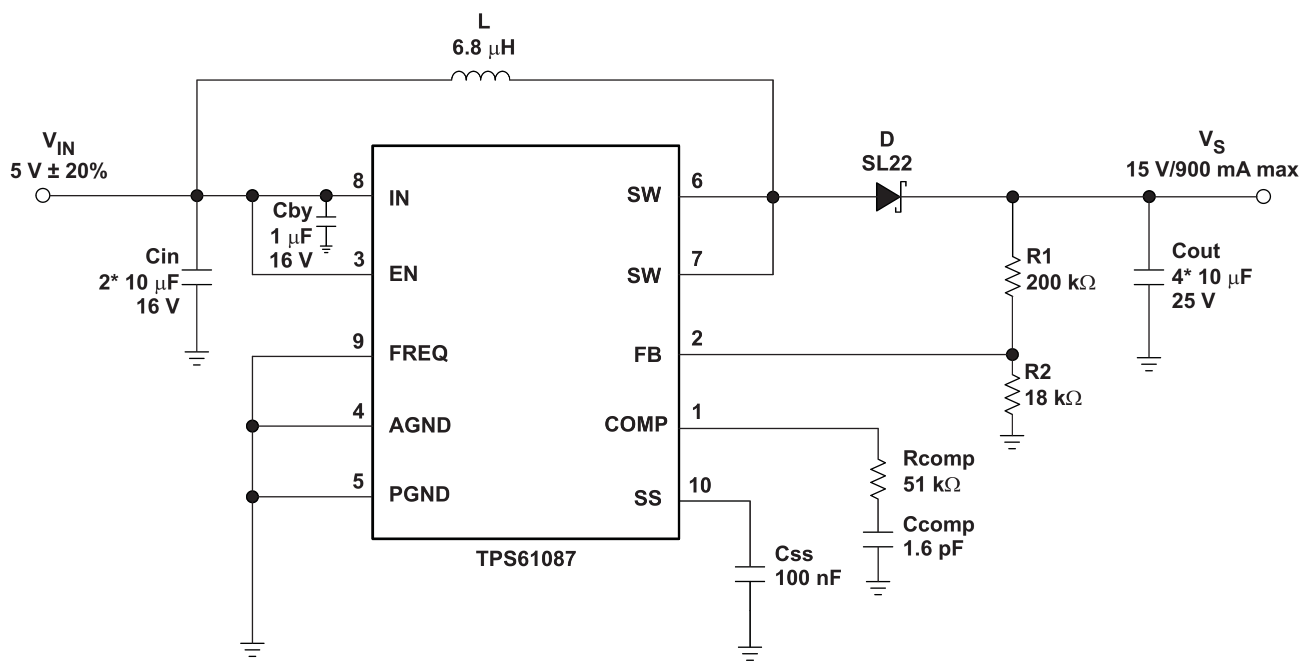


Figure 13. Typical Application, 5 V to 15 V (f_{sw} = 650 kHz)

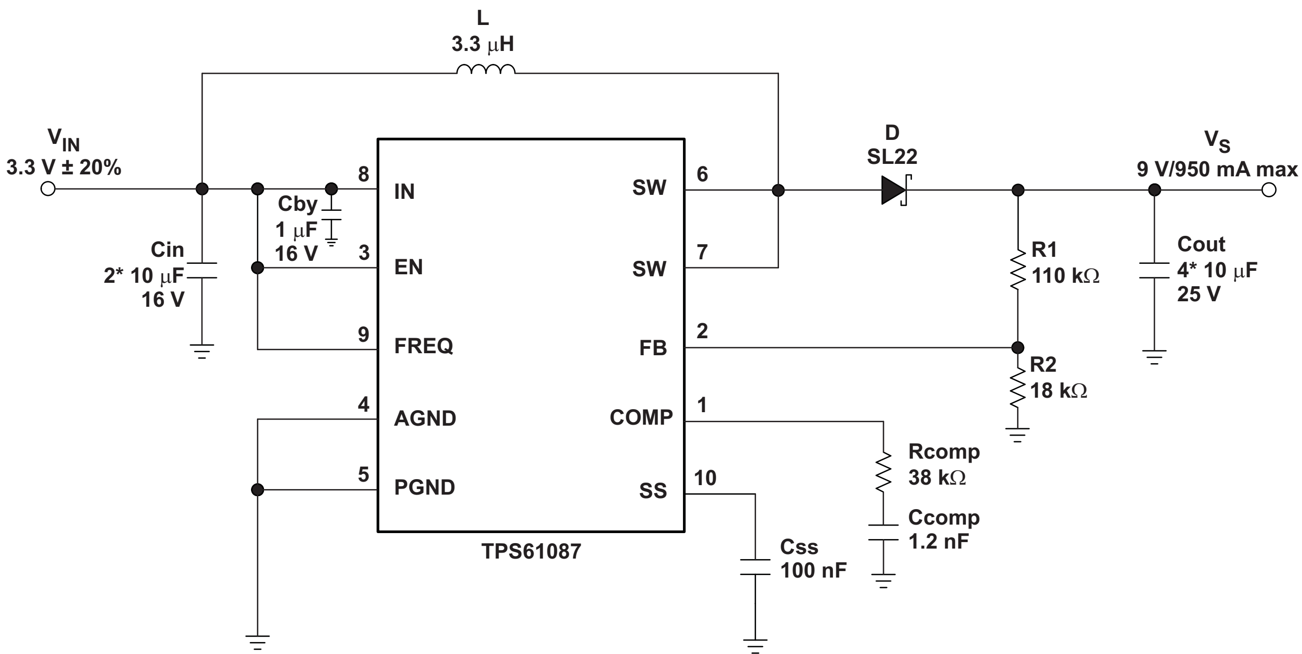


Figure 14. Typical Application, 3.3 V to 9 V (f_{sw} = 1.2 MHz)

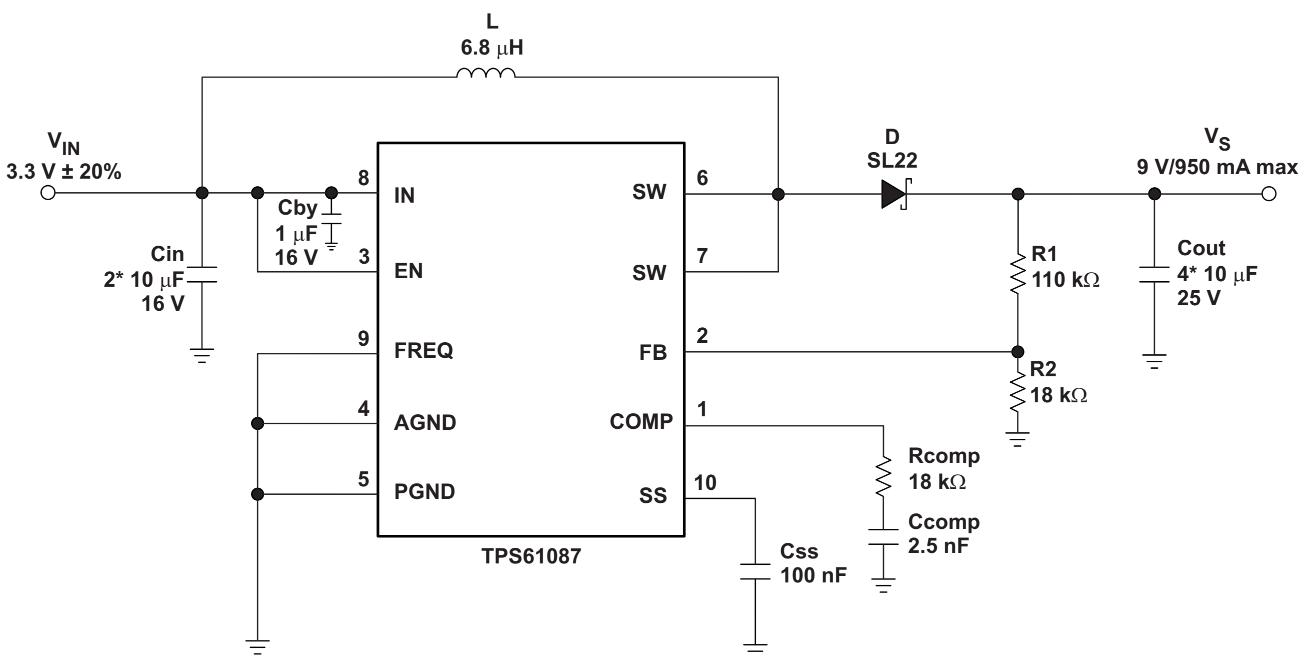


Figure 15. Typical Application, 3.3 V to 9 V (f_{sw} = 650 kHz)

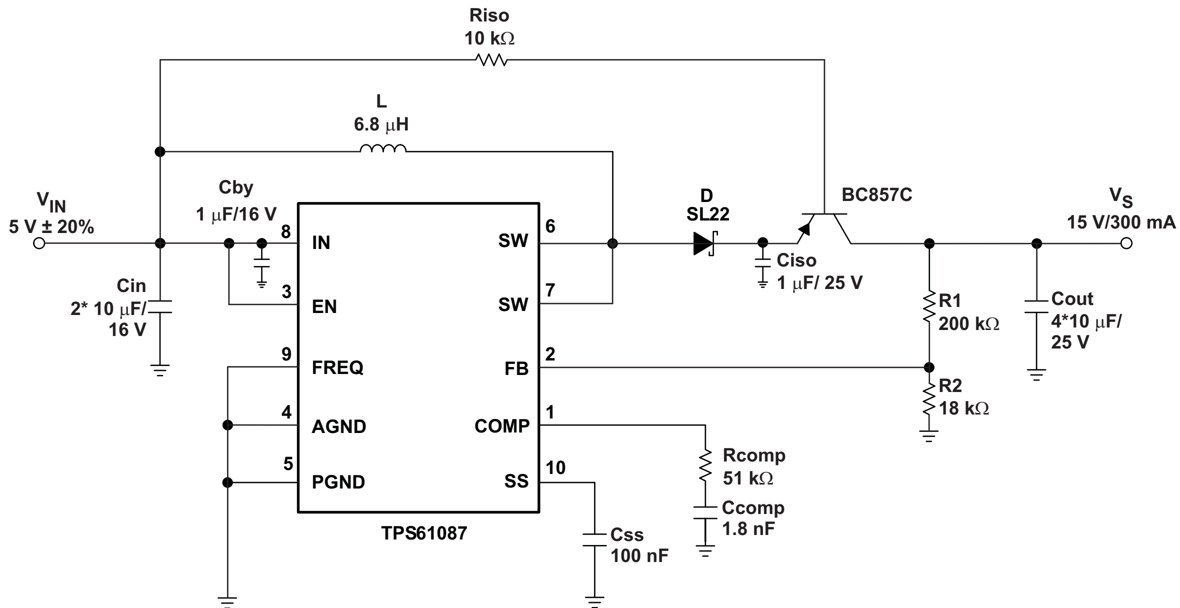


Figure 16. Typical Application with External Load Disconnect Switch

TFT LCD APPLICATION

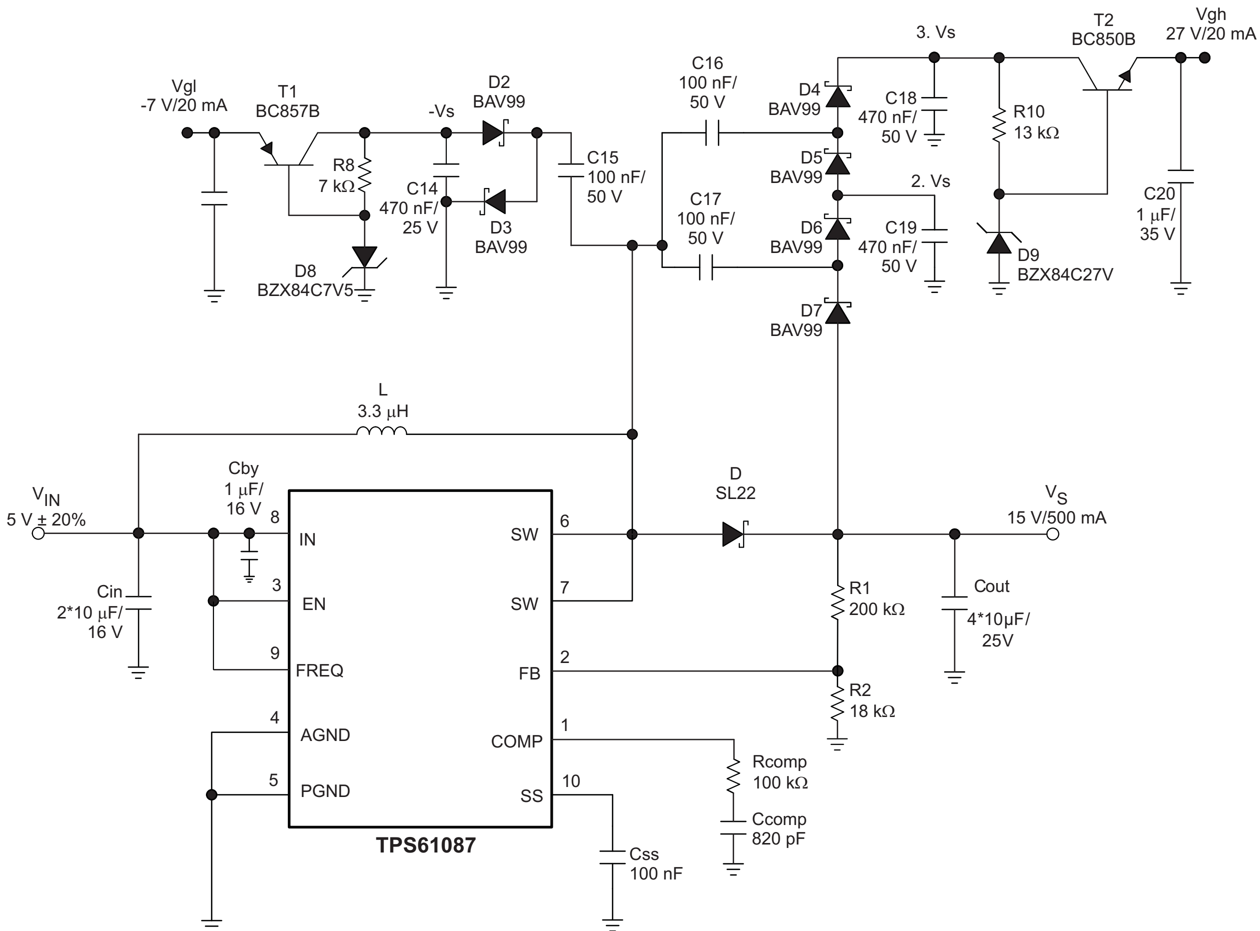


Figure 17. Typical Application 5 V to 15 V (f_{sw} = 1.2 MHz) for TFT LCD with External Charge Pumps (VGH, VGL)

WHITE LED APPLICATIONS

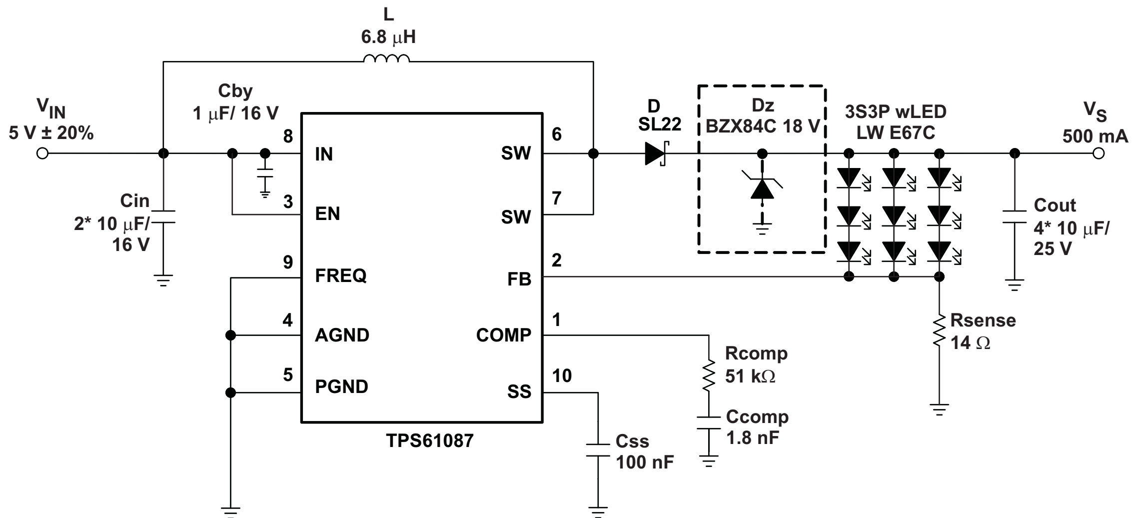


Figure 18. Simple Application (5 V input voltage) (f_{sw} = 650 kHz) for wLED Supply (3S3P) (with optional clamping Zener diode)

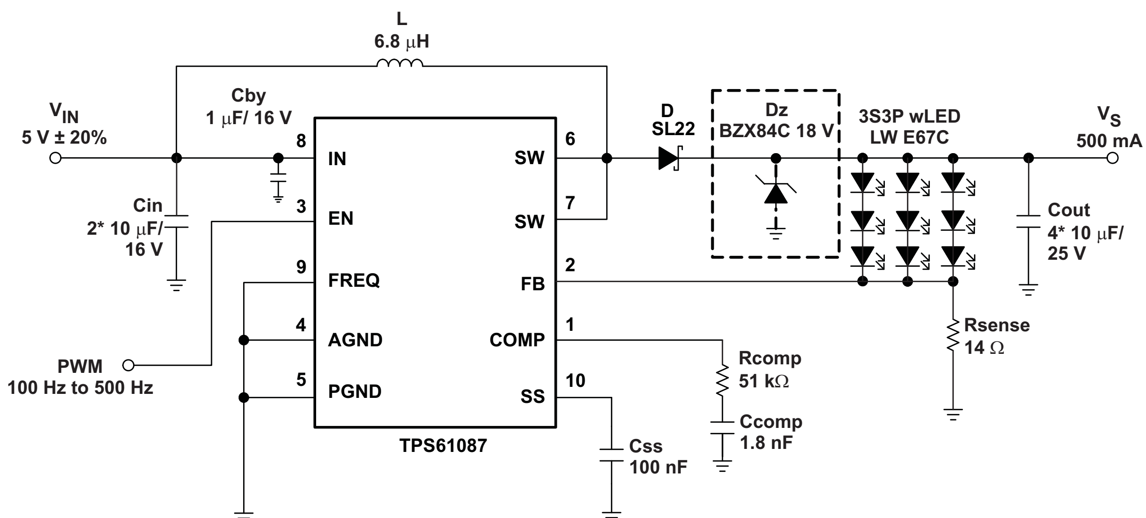


Figure 19. Simple Application (5 V input voltage) (f_{sw} = 650 kHz) for wLED Supply (3S3P) with Adjustable Brightness Control using a PWM Signal on the Enable Pin (with optional clamping Zener diode)

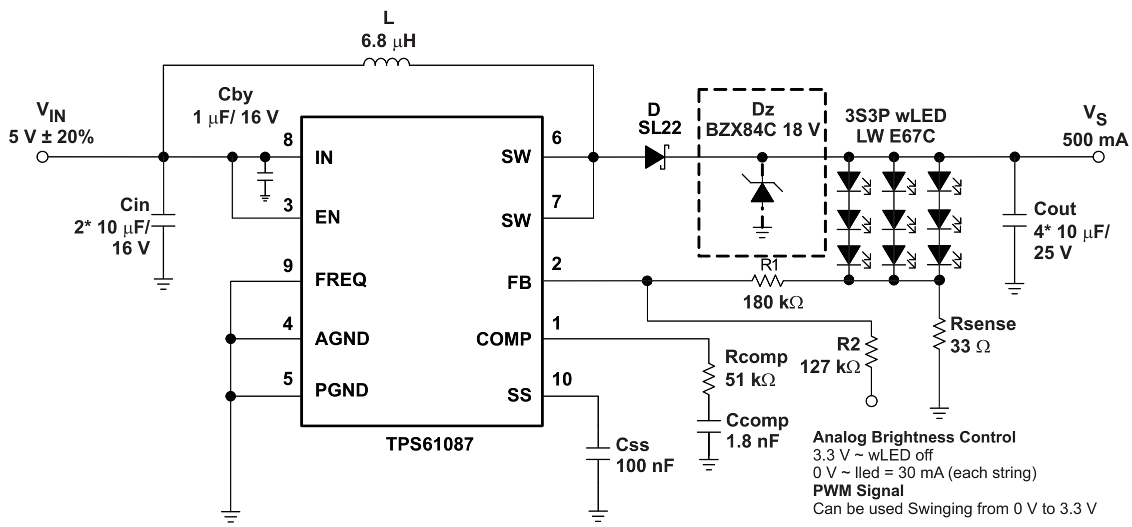


Figure 20. Simple Application (5 V input voltage) (f_{SW} = 650 kHz) for wLED Supply (3S3P) with Adjustable Brightness Control using an Analog Signal on the Feedback Pin (with optional clamping Zener diode)

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
TPS61087DRCR	ACTIVE	SON	DRC	10	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
TPS61087DRCRG4	ACTIVE	SON	DRC	10	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
TPS61087DRCT	ACTIVE	SON	DRC	10	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
TPS61087DRCTG4	ACTIVE	SON	DRC	10	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR

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

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

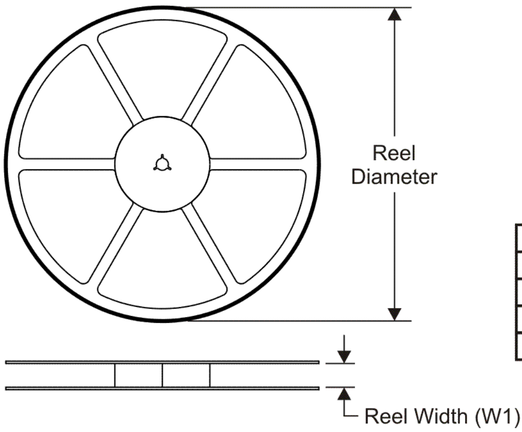
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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

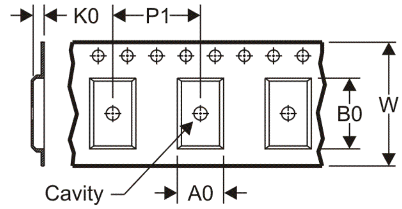
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

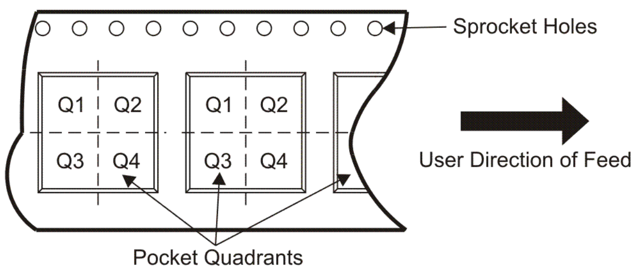


TAPE DIMENSIONS



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

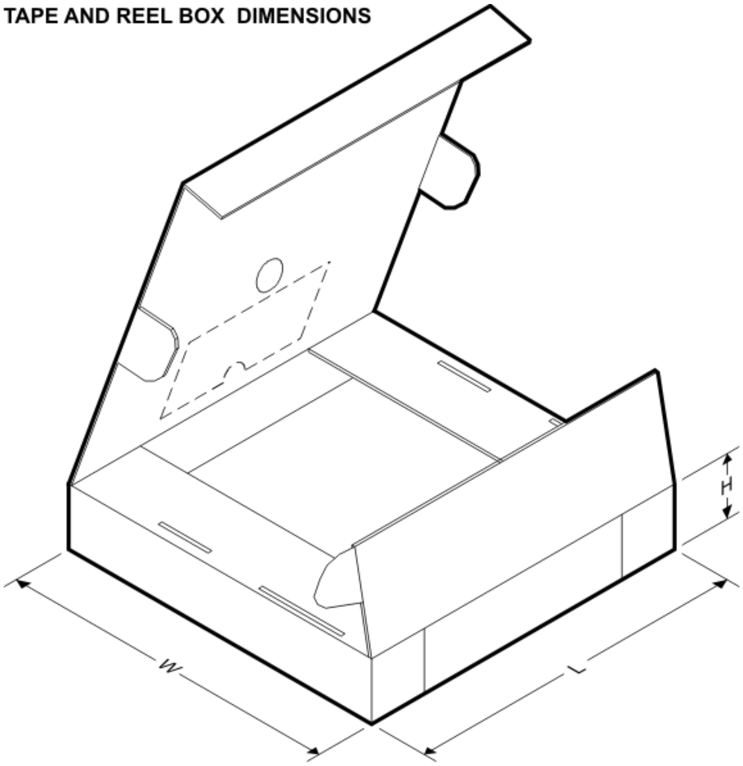
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TPS61087DRCR	SON	DRC	10	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TPS61087DRCT	SON	DRC	10	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2

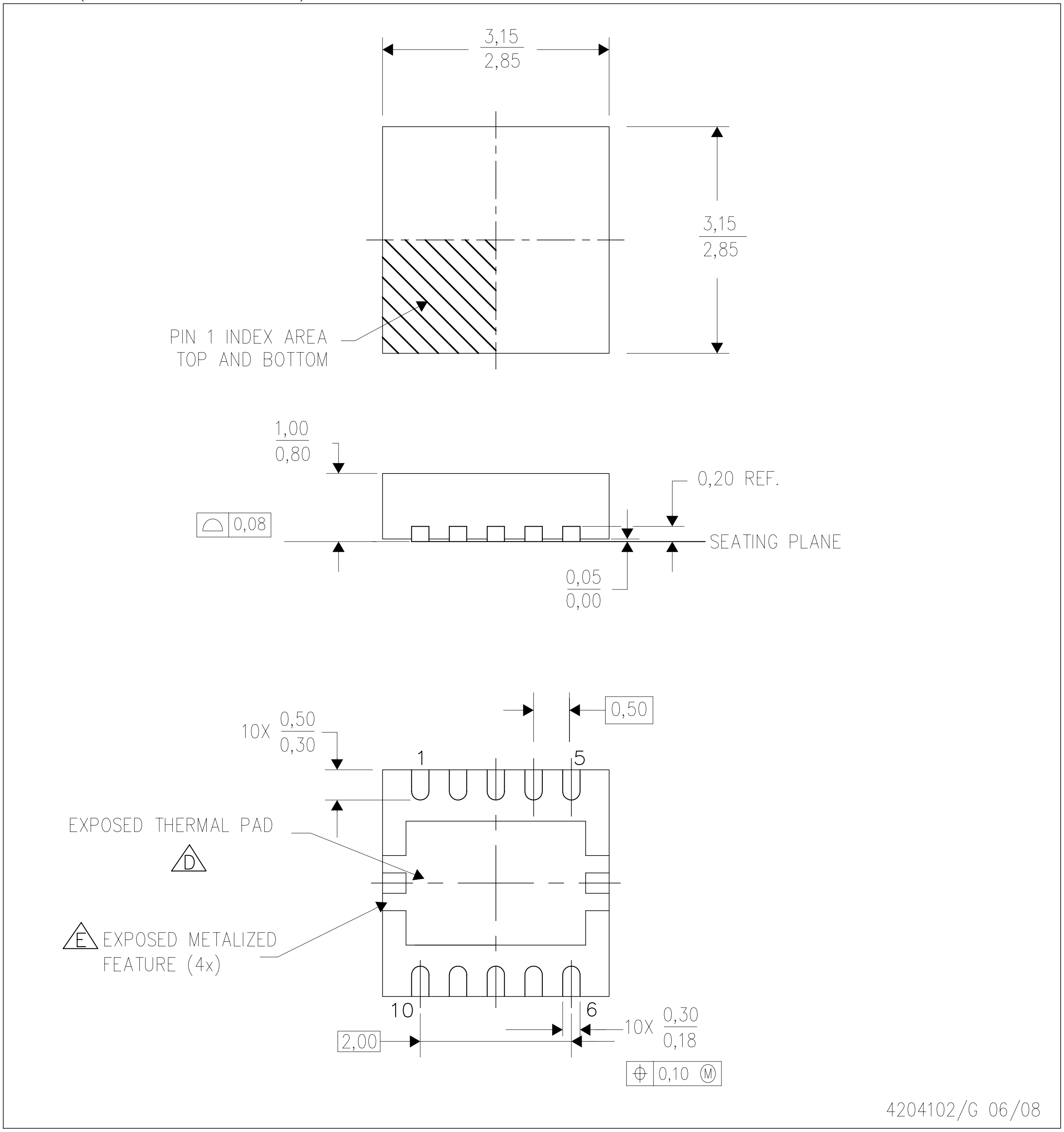
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS61087DRCR	SON	DRC	10	3000	346.0	346.0	29.0
TPS61087DRCT	SON	DRC	10	250	190.5	212.7	31.8

DRC (S-PVSON-N10) PLASTIC SMALL OUTLINE NO-LEAD



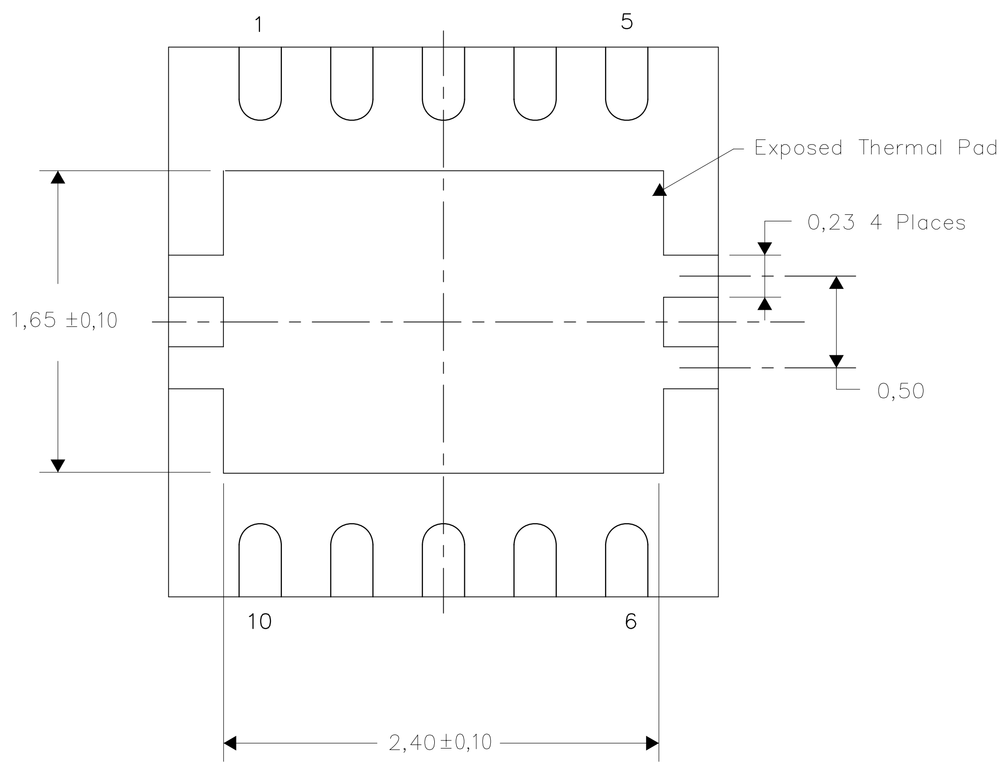
NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
- B. This drawing is subject to change without notice.
- C. Small Outline No-Lead (SON) package configuration.
- D. The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.
- E. Metalized features are supplier options and may not be on the package.

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.

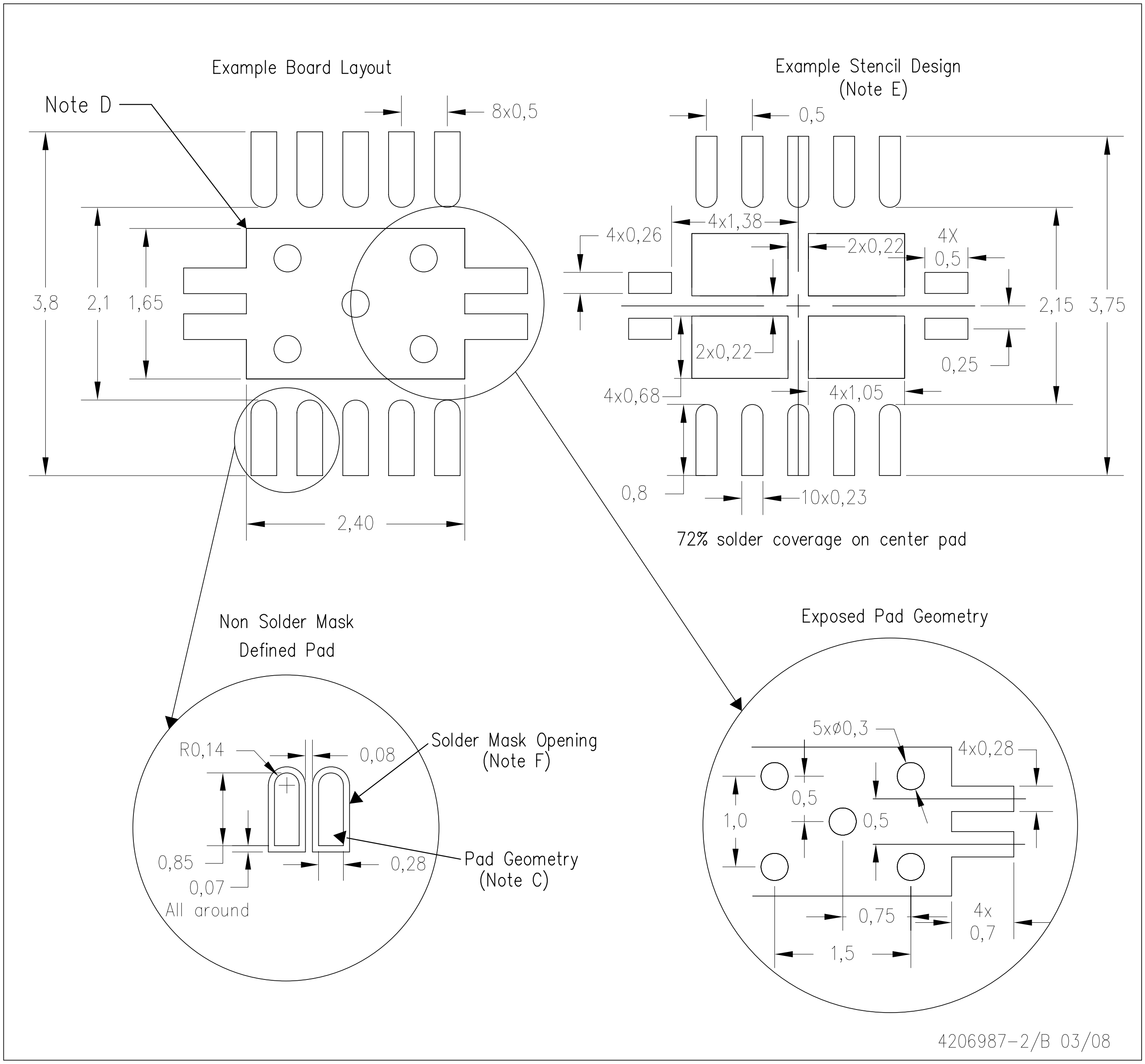


Bottom View

NOTE: All linear dimensions are in millimeters

Exposed Thermal Pad Dimensions

DRC (S–PVSON–N10)



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat–Pack Packages, Texas Instruments Literature No. SCBA017, SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <http: //www.ti.com>.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
F. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.