TPS82084 2-A High Efficiency Step-Down Converter MicroSiP™ with Integrated Inductor

1 Features

- 2-A, Low Profile MicroSiP™ Power Module
- DCS-Control™ Topology
- Up to 95% Efficiency
- 17-µA Operating Quiescent Current
- -40°C to 125°C Operating Temperature Range
- Hiccup Short Circuit Protection
- 2.5-V to 6-V Input Voltage Range
- 0.8-V to V_{IN} Adjustable Output Voltage
- Power Save Mode for Light Load Efficiency
- 100% Duty Cycle for Lowest Dropout
- Output Discharge Function
- Power Good Output
- Integrated Soft Startup
- Over Temperature Protection
- 3.0-mm x 2.8-mm x 1.3-mm 8-Pin µSiL Package

2 Applications

- Battery Powered Applications
- Solid State Drives
- Processor Supply
- Mobile Phones

3 Description

The TPS82084 device is a 2-A step-down converter MicroSiP™ module optimized for small solution size and high efficiency. The power module integrates a synchronous step-down converter and an inductor to simplify design, reduce external components and save PCB area. The low profile and compact solution is suitable for automated assembly by standard surface mount equipment.

To maximize efficiency, the converter operates in PWM mode with a nominal switching frequency of 2.4MHz and automatically enters Power Save Mode operation at light load currents. In Power Save Mode, the device operates with typically 17-µA quiescent current. Using the DCS-Control™ topology, the device achieves excellent load transient performance and accurate output voltage regulation. The EN and PG pins, which support sequencing configurations, bring a flexible system design. An integrated soft startup reduces the inrush current required from the input supply. Over temperature protection and Hiccup short circuit protection deliver a robust and reliable solution.

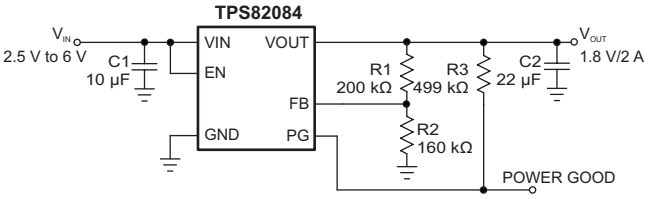
Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS82084	µSiL (8)	3.00 mm x 2.80 mm

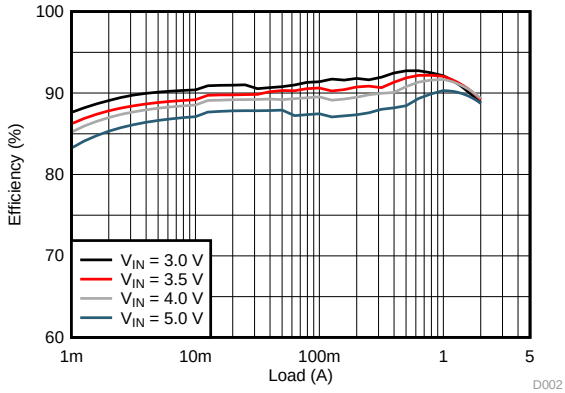
(1) For all available packages, see the orderable addendum at the end of the datasheet.

4 Simplified Schematic

1.8 V Output Application



1.8 V Output Efficiency



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

Table of Contents

1 Features ... 1
2 Applications ... 1
3 Description ... 1
4 Simplified Schematic ... 1
5 Revision History ... 2
6 Pin Configuration and Functions ... 3
7 Specifications ... 4
7.1 Absolute Maximum Ratings ... 4
7.2 ESD Ratings ... 4
7.3 Recommend Operating Conditions ... 4
7.4 Thermal Information ... 4
7.5 Electrical Characteristics ... 5
7.6 Timing Requirements ... 5
7.7 Typical Characteristics ... 6
8 Detailed Description ... 7
8.1 Overview ... 7
8.2 Functional Block Diagram ... 7
8.3 Feature Description ... 7
8.4 Device Functional Modes ... 9
9 Application and Implementation ... 10
9.1 Application Information ... 10
9.2 Typical Applications ... 10
10 Power Supply Recommendations ... 15
11 Layout ... 15
11.1 Layout Guidelines ... 15
11.2 Layout Example ... 15
11.3 Thermal Consideration ... 16
12 Device and Documentation Support ... 17
12.1 Device Support ... 17
12.2 Community Resources ... 17
12.3 Trademarks ... 17
12.4 Electrostatic Discharge Caution ... 17
12.5 Glossary ... 17
13 Mechanical, Packaging, and Orderable Information ... 17

5 Revision History

Changes from Original (June 2015) to Revision A **Page**

- Changed Product Status to Production Data ... 1
- Changed ESD rating for CDM spec from "±500 V" to "±1000 V" ... 4
- Added Community Resources section ... 17

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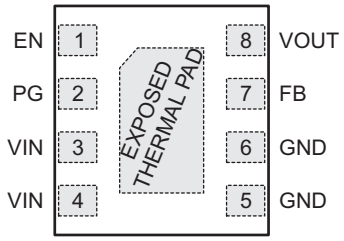
6 Pin Configuration and Functions

μSiL Package
(8-Pins)
Top View



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
EN	1	I	Enable pin. Pull High to enable the device. Pull Low to disable the device. This pin has an internal pull-down resistor of typically 400 kΩ when the device is disabled.
PG	2	O	Power good open drain output pin. A pull-up resistor can be connected to any voltage less than 6V. Leave it open if it is not used.
VIN	3,4	PWR	Input voltage pin.
GND	5,6		Ground pin.
FB	7	I	Feedback reference pin. An external resistor divider connected to this pin programs the output voltage.
VOUT	8	PWR	Output voltage pin.
Exposed Thermal Pad			The exposed thermal pad must be connected to the GND pin. Must be soldered to achieve appropriate power dissipation and mechanical reliability.

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7 Specifications

7.1 Absolute Maximum Ratings

See Note (1)

		MIN	MAX	UNIT
Voltage at pins(2)	EN, PG, VIN, FB, VOUT	-0.3	7	V
Sink current	PG		1.0	mA
Module operating temperature		–40	125	°C
T_{stg}	Storage temperature	–40	125	°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 pin.

7.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±2000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101(2)	±1000	

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

7.3 Recommend Operating Conditions

Over operating free-air temperature range, unless otherwise noted.

		MIN	MAX	UNIT
V_{IN}	Input voltage range	2.5	6	V
V_{PG}	Power good pull-up resistor voltage		6	V
V_{OUT}	Output voltage range	0.8	V_{IN}	V
I_{OUT}	Output current range(1)	0	2	A
T_J	Module operating temperature range(1)	-40	125	°C

(1) The module operating temperature range includes module self temperature rise and IC junction temperature rise. In applications where high power dissipation is present, the maximum operating temperature or maximum output current must be derated.

7.4 Thermal Information

THERMAL METRIC(1)		TPS82084 µSiL 8-Pin	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	68.7	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	n/a	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	n/a	°C/W
ψ_{JT}	Junction-to-top characterization parameter	0.4	°C/W
ψ_{JB}	Junction-to-board characterization parameter	30.0	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	n/a	°C/W

(1) For more information about traditional and new thermal metrics, see the IC Package Thermal Metrics application report, SPRA953

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7.5 Electrical Characteristics

T_J = -40°C to 125°C and V_{IN} = 2.5V to 6V. Typical values are at T_J = 25°C and V_{IN} = 3.6V, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY						
V_{IN}	Input voltage range		2.5		6	V
I_Q	Quiescent current into VIN	No load, device not switching T_J = -40°C to 85°C, V_{IN} = 2.5 V to 5.5 V		17	25	µA
I_{SD}	Shutdown current into VIN	EN = Low, T_J = -40°C to 85°C, V_{IN} = 2.5 V to 5.5 V		0.7	5	µA
V_{UVLO}	Under voltage lock out threshold	V_{IN} falling	2.1	2.2	2.3	V
		V_{IN} rising	2.3	2.4	2.5	V
T_{JSD}	Thermal shutdown threshold	T_J rising		150		°C
	Thermal shutdown hysteresis	T_J falling		20		°C
LOGIC INTERFACE EN						
V_{IH}	High-level input voltage		1.0	0.8		V
V_{IL}	Low-level input voltage			0.7	0.4	V
$I_{lkg(EN)}$	Input leakage current into EN pin	EN = High		0.01	0.16	µA
R_{PD}	Pull-down resistance at EN pin	EN = Low		400		kΩ
SOFT START, POWER GOOD						
V_{PG}	Power good threshold	V_{OUT} rising, referenced to V_{OUT} nominal	93%	95%	98%	
		V_{OUT} falling, referenced to V_{OUT} nominal	88%	90%	93%	
$V_{PG,OL}$	Low-level output voltage	I_{sink} = 1mA			0.4	V
$I_{lkg(PG)}$	Input leakage current into PG pin	V_{PG} = 5V		0.01	0.16	µA
OUTPUT						
V_{OUT}	Output voltage range		0.8		V_{IN}	V
V_{FB}	Feedback regulation voltage	PWM mode	792	800	808	mV
		PSM mode, C_{OUT} = 22 µF	792	800	817	
$I_{lkg(FB)}$	Feedback input leakage current	V_{FB} = 0.8 V		0.01	0.1	µA
R_{DIS}	Output discharge resistor	EN = Low, V_{OUT} = 1.8 V		260		Ω
	Line regulation	I_{OUT} = 1 A, V_{IN} = 2.5 V to 6 V		0.02		%/V
	Load regulation	I_{OUT} = 0.5 A to 2 A		0.16		%/A
POWER SWITCH						
$R_{DS(on)}$	High-side FET on-resistance	I_{SW} = 500 mA		31	56	mΩ
	Low-side FET on-resistance	I_{SW} = 500 mA		23	45	mΩ
R_{DP}	Dropout resistance	100% mode		69		mΩ
I_{LIMF}	High-side FET switch current limit			3.6		A
f_{SW}	PWM switching frequency	I_{OUT} = 1 A		2.4		MHz

7.6 Timing Requirements

T_J = -40°C to 125°C and V_{IN} = 2.5V to 6V. Typical values are at T_J = 25°C and V_{IN} = 3.6V, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SOFT START						
t_{SS}	Soft start time	Time from EN high to 95% of V_{OUT} nominal		0.8		ms

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7.7 Typical Characteristics

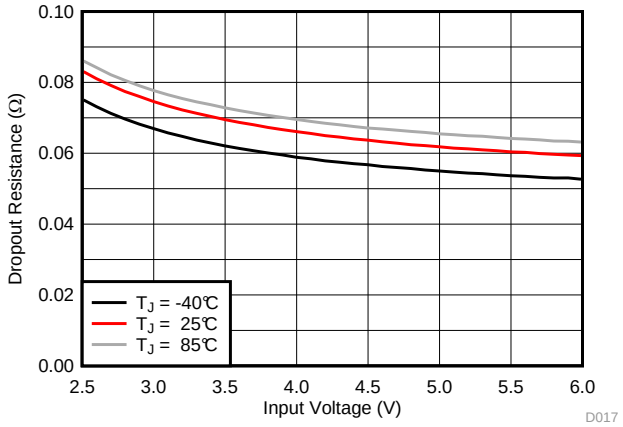

Figure 1. Dropout Resistance

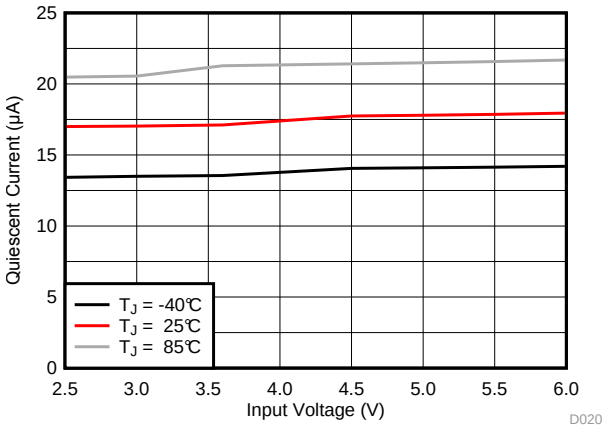

Figure 2. Quiescent Current

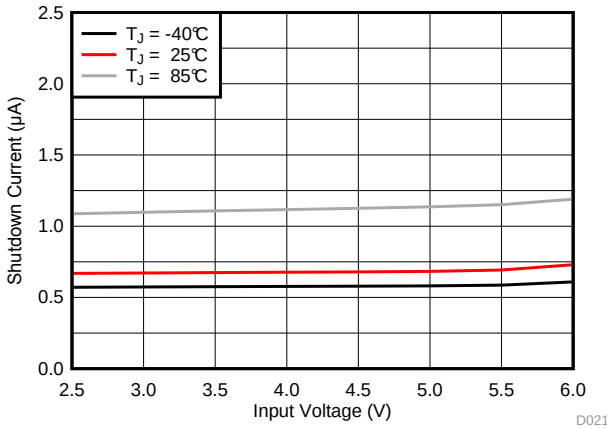

Figure 3. Shutdown Current

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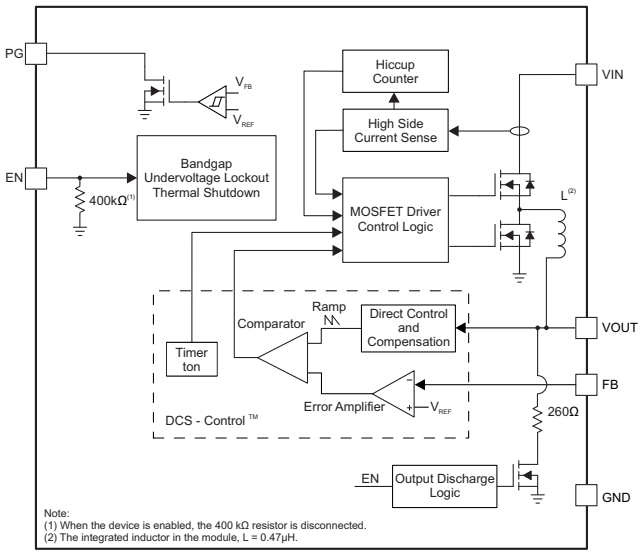
8 Detailed Description

8.1 Overview

The TPS82084 synchronous step-down converter power module is based on DCS-Control™ (Direct Control with Seamless transition into Power Save Mode). This is an advanced regulation topology that combines the advantages of hysteretic, voltage and current mode control.

The DCS-Control™ topology operates in PWM (Pulse Width Modulation) mode for medium to heavy load conditions and in PSM (Power Save Mode) at light load currents. In PWM, the converter operates with its nominal switching frequency of 2.4 MHz having a controlled frequency variation over the input voltage range. As the load current decreases, the converter enters Power Save Mode, reducing the switching frequency and minimizing the IC's quiescent current to achieve high efficiency over the entire load current range. DCS-Control™ supports both operation modes using a single building block and therefore has a seamless transition from PWM to PSM without effects on the output voltage. The TPS82084 offers excellent DC voltage regulation and load transient regulation, combined with low output voltage ripple, minimizing interference with RF circuits.

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 PWM and PSM Operation

The TPS82084 includes a fixed on-time (t_{ON}) circuitry. This t_{ON}, in steady-state operation in PWM and PSM modes, is estimated as:

$$t_{ON} = 420ns \times \frac{V_{OUT}}{V_{IN}} \quad (1)$$

In PWM mode, the TPS82084 operates with pulse width modulation in continuous conduction mode (CCM) with a t_{ON} shown in Equation 1 at medium and heavy load currents. A PWM switching frequency of typically 2.4 MHz is achieved by this t_{ON} circuitry. The device operates in PWM mode as long as the output current is higher than half the inductor's ripple current estimated by Equation 2.

$$\Delta I_L = t_{ON} \times \frac{V_{IN} - V_{OUT}}{L} \quad (2)$$

To maintain high efficiency at light loads, the device enters Power Save Mode seamlessly when the load current decreases. This happens when the load current becomes smaller than half the inductor's ripple current. In PSM, the converter operates with a reduced switching frequency and with a minimum quiescent current to maintain high efficiency. The on time in PSM is also based on the same t_{ON} circuitry. The switching frequency in PSM is estimated as:

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Feature Description (continued)

$$f_{PFM} = \frac{2 \times I_{OUT}}{t_{ON}^2 \times \frac{V_{IN}}{V_{OUT}} \times \frac{V_{IN} - V_{OUT}}{L}} \quad (3)$$

In PSM, the output voltage rises slightly above the nominal output voltage in PWM mode. This effect is reduced by increasing the output capacitance. The output voltage accuracy in PSM operation is reflected in the electrical specification table and given for a 22-µF output capacitor.

8.3.2 Low Dropout Operation (100% Duty Cycle)

The device offers a low input to output voltage differential by entering 100% duty cycle mode. In this mode, the high-side MOSFET switch is constantly turned on. This is particularly useful in battery powered applications to achieve longest operation time by taking full advantage of the whole battery voltage range. The minimum input voltage to maintain a minimum output voltage is given by:

$V_{IN(min)} = V_{OUT(min)} + I_{OUT} \times R_{DP}$ (4)

where

- R_{DP} = Resistance from V_{IN} to V_{OUT}, including high-side FET on-resistance and DC resistance of the inductor.
- $V_{OUT(min)}$ = Minimum output voltage the load can accept.

8.3.3 Soft Startup

The TPS82084 has an internal soft start circuit which ramps up the output voltage to the nominal voltage during a soft start time of typically 0.8ms. This avoids excessive inrush current and creates a smooth output voltage slope. It also prevents excessive voltage drops of primary cells and rechargeable batteries with high internal impedance. The device is able to monotonically start into a pre-biased output capacitor. The device starts with the applied bias voltage and ramps the output voltage to its nominal value.

8.3.4 Switch Current Limit and Short Circuit Protection (Hiccup-Mode)

The switch current limit prevents the device from high inductor current and from drawing excessive current from the battery or input voltage rail. Excessive current might occur with a heavy load/shorted output circuit condition. If the inductor peak current reaches the switch current limit, the high-side FET is turned off and the low-side FET is turned on to ramp down the inductor current. Once this switch current limits is triggered 32 times, the devices stop switching and enables the output discharge. The devices then automatically start a new startup after a typical delay time of 66µs has passed. This is named HICCUP short circuit protection. The devices repeat this mode until the high load condition disappears.

8.3.5 Undervoltage Lockout

To avoid mis-operation of the device at low input voltages, an under voltage lockout is implemented, which shuts down the devices at voltages lower than V_{UVLO} with a hysteresis of 200 mV.

8.3.6 Thermal Shutdown

The device goes into thermal shutdown and stops switching once the junction temperature exceeds T_{JSD}. Once the device temperature falls below the threshold by 20°C, the device returns to normal operation automatically.

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8.4 Device Functional Modes

8.4.1 Enable and Disable

The device is enabled by setting the EN pin to a logic High. Accordingly, shutdown mode is forced if the EN pin is pulled Low with a shutdown current of typically 0.7 µA. An internal resistor of 260 Ω discharges the output via the VOUT pin smoothly when the device is disabled. The output discharge function also works when thermal shutdown, undervoltage lockout or short circuit protection are triggered.

An internal pull-down resistor of 400 kΩ is connected to the EN pin when the EN pin is Low. The pull-down resistor is disconnected when the EN pin is High.

8.4.2 Power Good Output

The device has a power good (PG) output. The PG pin goes high impedance once the output is above 95% of the nominal voltage, and is driven low once the output voltage falls below typically 90% of the nominal voltage. The PG pin is an open drain output and is specified to sink up to 1 mA. The power good output requires a pull-up resistor connecting to any voltage rail less than 6 V.

The PG pin goes low when the device is disabled or in thermal shutdown. When the device is in UVLO, the PG pin is high impedance. The PG signal can be used for sequencing of multiple rails by connecting it to the EN pin of other converters. Leave the PG pin floating when it is not used.

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9 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.

9.1 Application Information

The TPS82084 is a synchronous step-down converter power module whose output voltage is adjusted by component selection. The following section discusses the design of the external components to complete the power supply design for several input and output voltage options by using typical applications as a reference.

9.2 Typical Applications

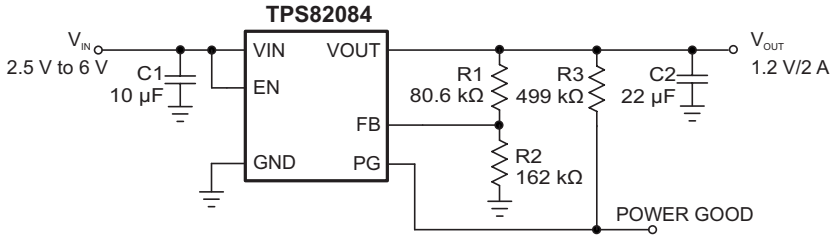

Figure 4. 1.2-V Output Application

9.2.1 Design Requirements

For this design example, use the input parameters shown in Table 1.

Table 1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input voltage range	2.5 V to 6 V
Output voltage	1.2 V
Output ripple voltage	< 20 mV
Output current rating	2 A

Table 2 lists the components used for the example.

Table 2. List of Components(1)

REFERENCE	DESCRIPTION	MANUFACTURER
C1	1 0µF, Ceramic Capacitor, 10 V, X7R, size 0805, GRM21BR71A106KE51	Murata
C2	22 µF, Ceramic Capacitor, 6.3 V, X7R, size 0805, CL21B226MQQNNNE or 22 µF, Ceramic Capacitor, 6.3 V, X7S, size 0805, C2012X7S1A226M125AC	Samsung or TDK
R1	Depending on the output voltage, 1% accuracy	Std
R2	16 kΩ, 1% accuracy	Std
R3	499 kΩ, 1% accuracy	Std

(1) See *Third-Party Products* disclaimer

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9.2.2 Detailed Design Procedure

9.2.2.1 Setting the Output Voltage

The output voltage is set by an external resistor divider according to the following equations:

$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2}\right) = 0.8\ V \times \left(1 + \frac{R1}{R2}\right) \quad (5)$$

R2 should not be higher than 180 kΩ to achieve high efficiency at light load while providing acceptable noise sensitivity. Larger currents through R2 improve noise sensitivity and output voltage accuracy. Figure 4 shows a recommended external resistor divider value for a 1.2-V output. Choose appropriate resistor values for other output voltages.

9.2.2.2 Input and Output Capacitor Selection

For best output and input voltage filtering, ceramic capacitors are required. The input capacitor minimizes input voltage ripple, suppresses input voltage spikes and provides a stable system rail for the device. A 10-µF or larger input capacitor is required. The output capacitor value can range from 22 µF up to more than 150 µF. The recommended typical output capacitor value is 22 µF. Values over 150 µF may be possible with a reduced load during startup in order to avoid triggering the Hiccup short circuit protection. A feed forward capacitor is not required for proper operation.

Ceramic capacitor has a DC-Bias effect, which has a strong influence on the final effective capacitance. Choose the right capacitor carefully in combination with considering its package size and voltage rating. Ensure that the input effective capacitance is at least 5 µF and the output effective capacitance is at least 8µF.

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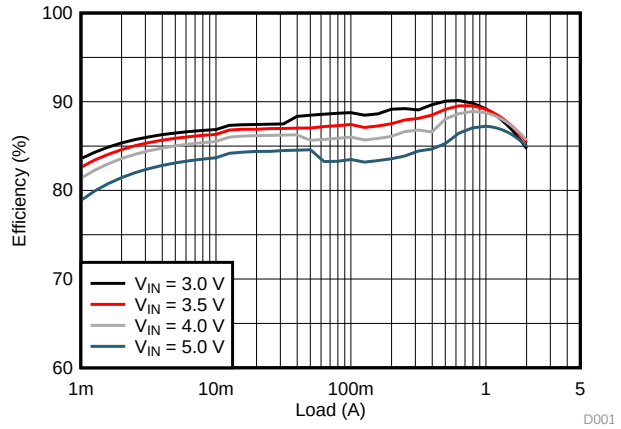
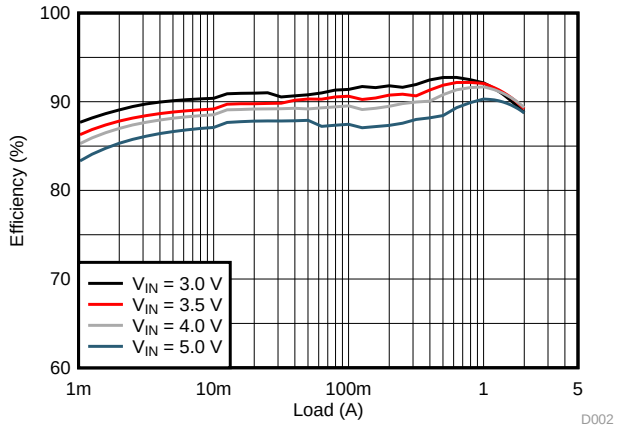
9.2.3 Application Performance Curves

T_A = 25°C, V_{IN} = 5 V, V_{OUT} = 1.2 V, unless otherwise noted.



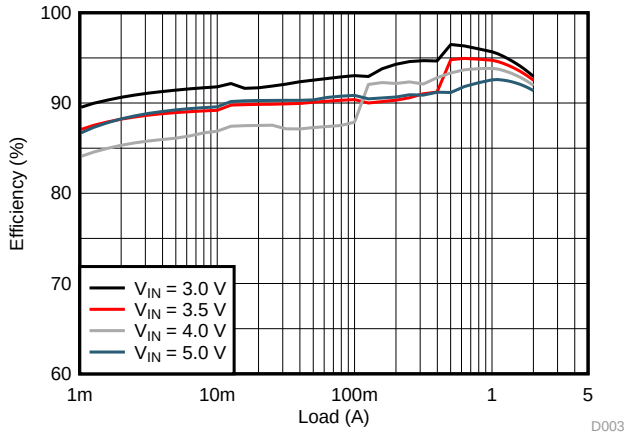
V_{OUT} = 1.2 V

Figure 5. Efficiency



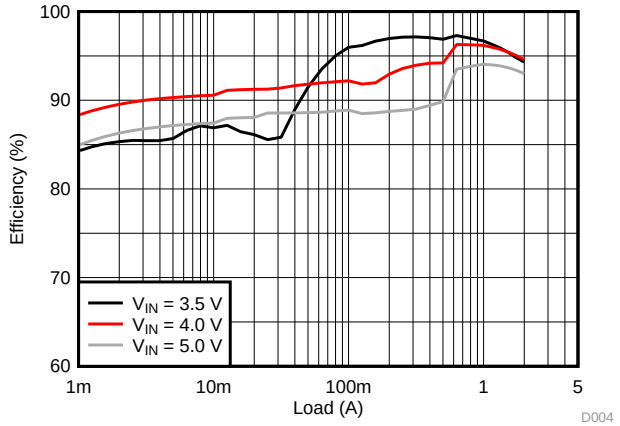
V_{OUT} = 1.8 V

Figure 6. Efficiency



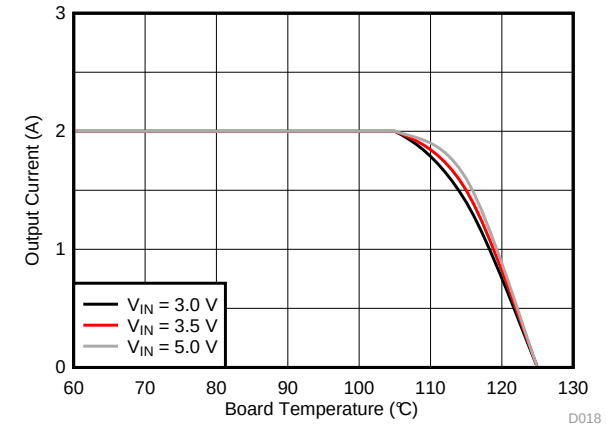
V_{OUT} = 2.6 V

Figure 7. Efficiency



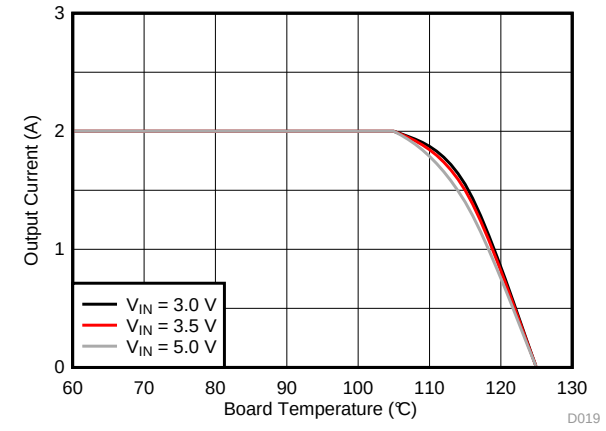
V_{OUT} = 3.3 V

Figure 8. Efficiency



V_{OUT} = 1.2 V ψ_{JB} = 30°C/W

Figure 9. Thermal Derating



V_{OUT} = 2.6 V ψ_{JB} = 30 °C/W

Figure 10. Thermal Derating

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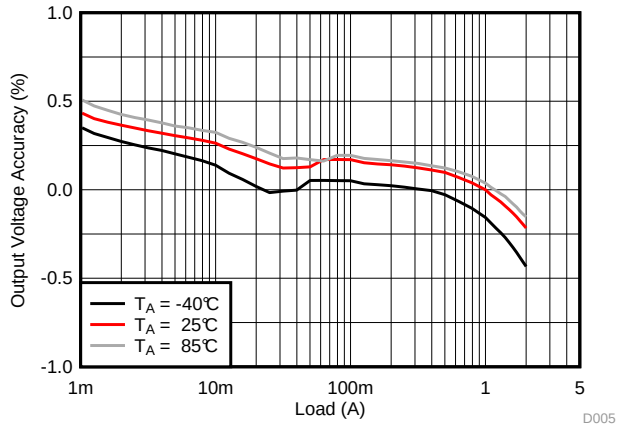
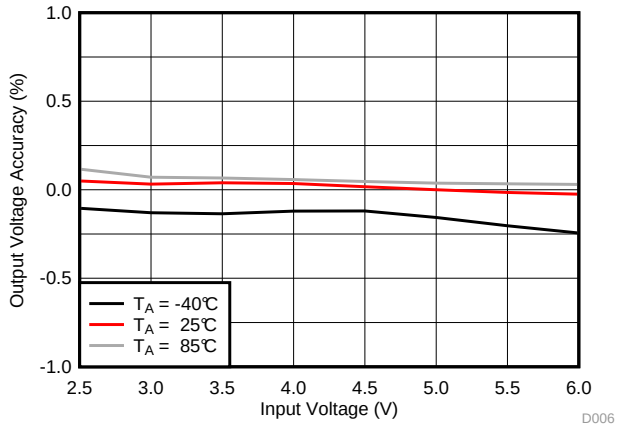
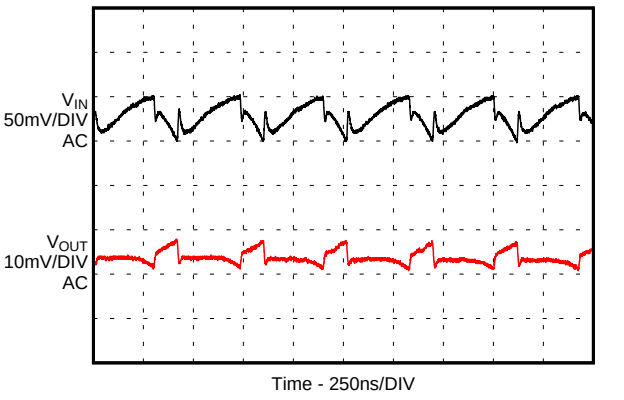


Figure 11. Load Regulation



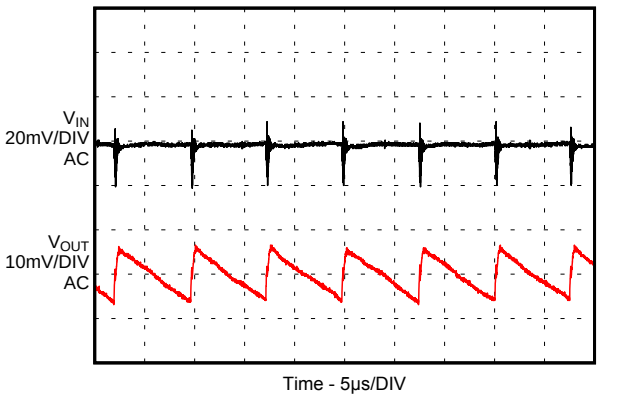
I_{OUT} = 1 A

Figure 12. Line Regulation



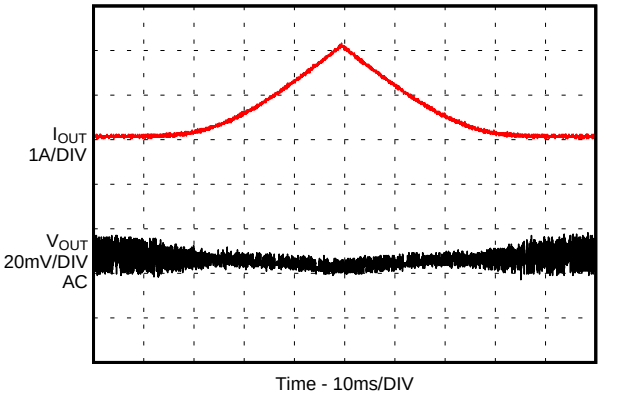
I_{OUT} = 2 A

Figure 13. Input and Output Ripple in PWM Mode



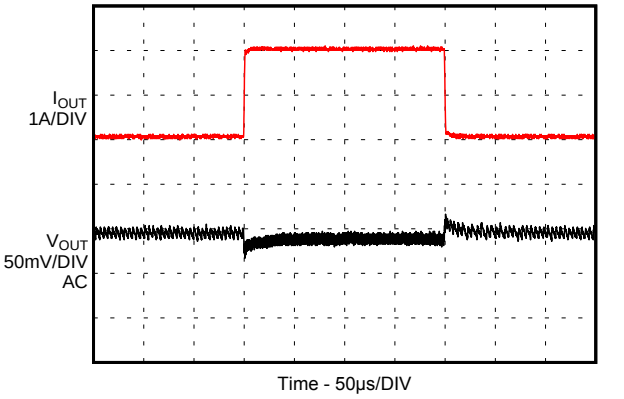
I_{OUT} = 25 mA

Figure 14. Input and Output Ripple in PSM Mode



I_{OUT} = 25 mA to 2 A

Figure 15. Load Sweep



I_{OUT} = 25 mA to 2A

Figure 16. Load Transient

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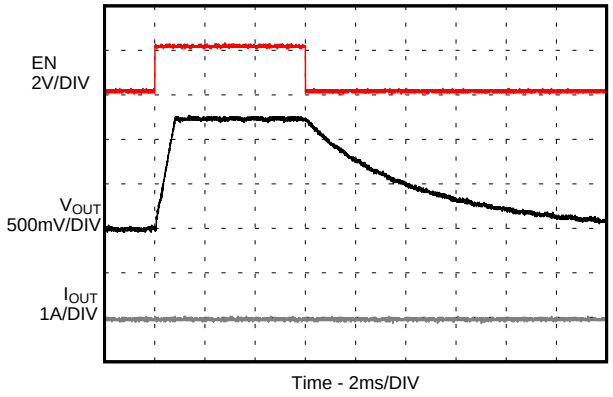
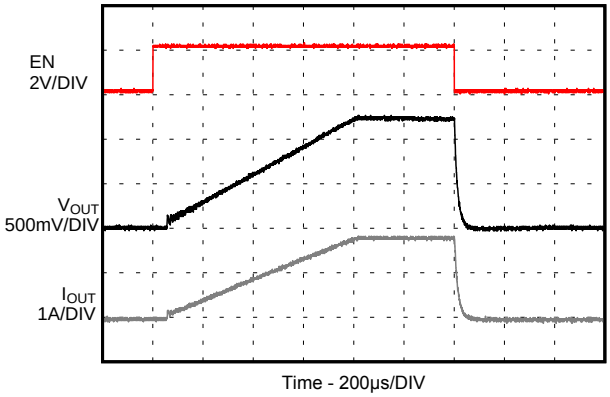


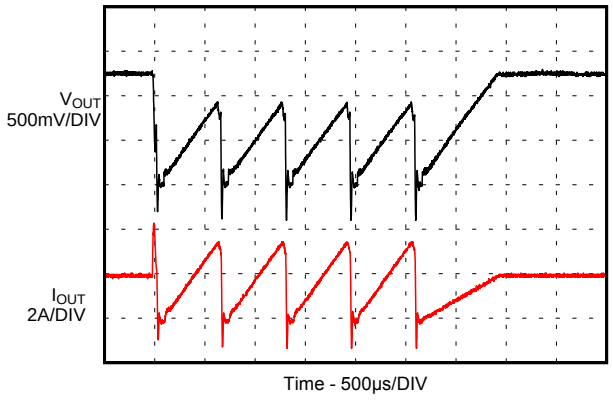
I_{OUT} = no load

Figure 17. Startup / Shutdown without Load



Load = 0.68 Ω

Figure 18. Startup / Shutdown with Resistive Load



I_{OUT} = 2 A

Figure 19. Short Circuit, HICCUP Protection Entry / Exit

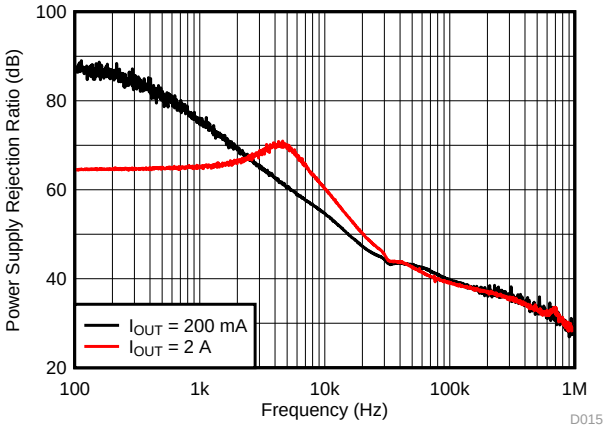


Figure 20. Power Supply Rejection Ratio (PSRR)

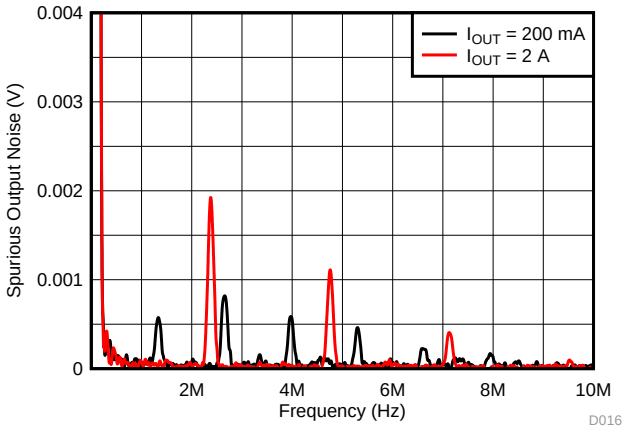


Figure 21. Spurious Output Noise

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10 Power Supply Recommendations

The devices are designed to operate from an input supply voltage range between 2.5 V and 6 V. The average input current of the TPS82084 is calculated as:

$$I_{IN} = \frac{1}{\eta} \times \frac{V_{OUT} \times I_{OUT}}{V_{IN}} \quad (6)$$

Ensure that the power supply has a sufficient current rating for the application.

11 Layout

11.1 Layout Guidelines

- It is recommended to place all components as close as possible to the IC. Specially, the input capacitor placement must be closest to the VIN and GND pins of the device.
- Use wide and short traces for the main current paths to reduce the parasitic inductance and resistance.
- To enhance heat dissipation of the device, the exposed thermal pad should be connected to bottom or internal layer ground planes using vias.
- Refer to Figure 22 for an example of component placement, routing and thermal design.
- The recommended land pattern for the TPS82084 is shown at the end of this data sheet. For best manufacturing results, it is important to create the pads as solder mask defined (SMD). This keeps each pad the same size and avoids solder pulling the device during reflow.

11.2 Layout Example

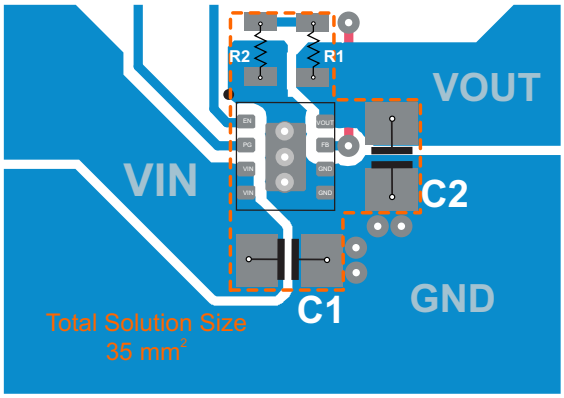


Figure 22. TPS82084 PCB Layout

11.3 Thermal Consideration

The TPS82084's output current needs to be derating when the device operates in a high ambient temperature or deliver high output power. The amount of current derated is dependent upon the input voltage, output power, PCB layout design and environmental thermal condition. Care should especially be taken in applications where the localized PCB temperature exceeds 65°C.

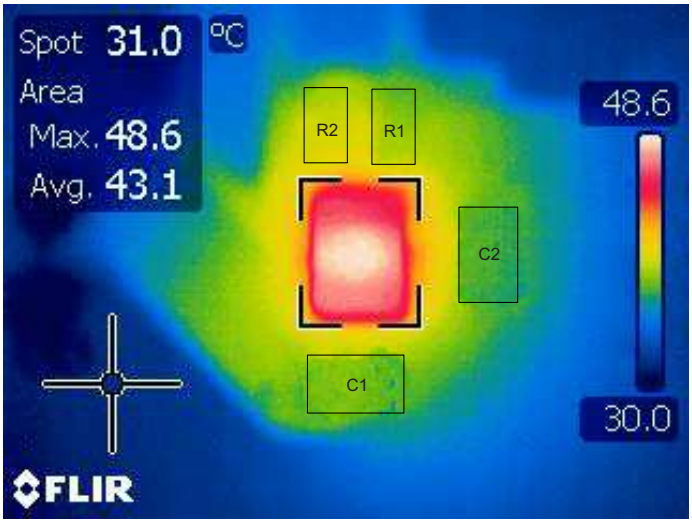
The TPS82084 module temperature must be kept less than the maximum rating of 125°C. Three basic approaches for enhancing thermal performance are listed below:

- Improve the power dissipation capability of the PCB design.
- Improve the thermal coupling of the component to the PCB.
- Introduce airflow into the system.

To estimate approximate module temperature of TPS82084, apply the typical efficiency stated in this datasheet to the desired application condition for the module power dissipation, then calculate the module temperature rise by multiplying the power dissipation by its thermal resistance. For more details on how to use the thermal parameters in real applications, see the application notes: SZZA017 and SPRA953.

Figure 23 shows the thermal measurement on the TPS82084EVM-672. It gives a guideline on the temperature rise when the TPS82084 is operated in free air at 25°C ambient under certain application conditions. The temperatures are checked at Spot and Area as listed below:

- Spot: temperature of the EVM board
- Area: temperature of the TPS82084



V_{IN} = 5 V, V_{OUT} = 3.3 V, I_{OUT} = 2 A

Figure 23. Thermal Measurement

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12 Device and Documentation Support

12.1 Device Support

12.1.1 Third-Party Products Disclaimer

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12.3 Trademarks

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12.4 Electrostatic Discharge Caution

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.

12.5 Glossary

SLYZ022 — *TI Glossary*.

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

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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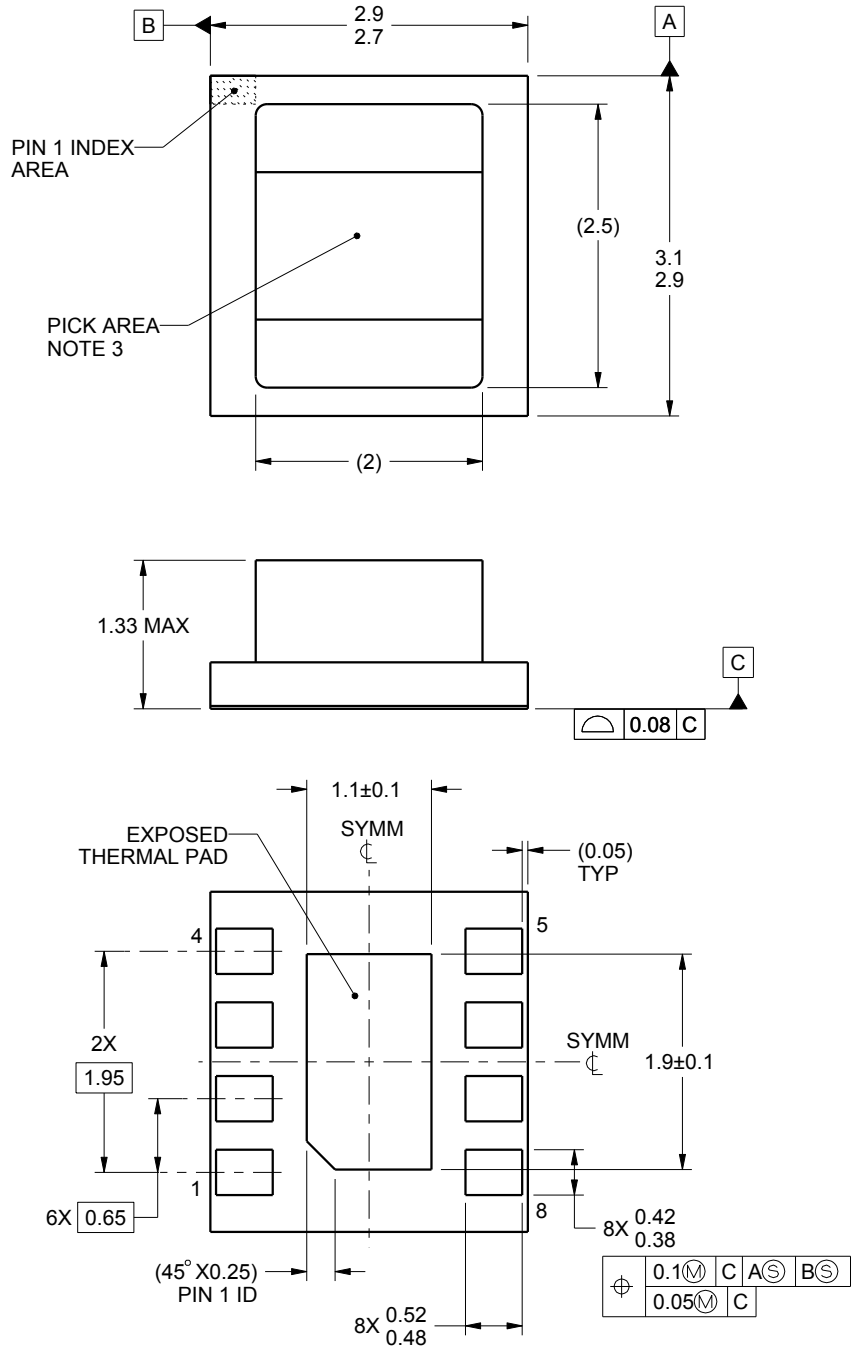
PACKAGE OUTLINE

SIL0008C

MicroSiP ™ - 1.33 mm max height

MICRO SYSTEM IN PACKAGE



4221448/D 04/2015

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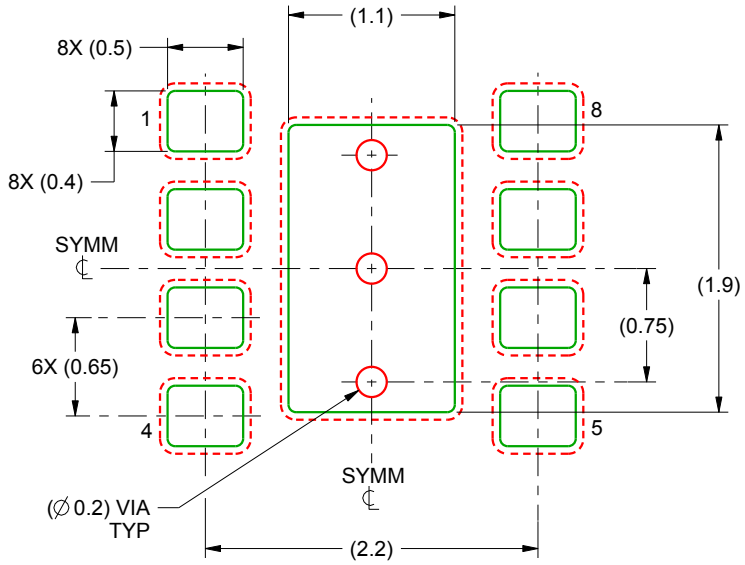
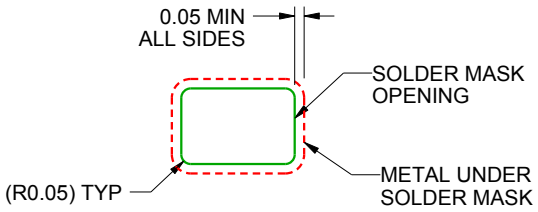
NOTES:

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. Pick and place nozzle ∅ 1.3 mm or smaller recommended.
4. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



LAND PATTERN EXAMPLE
SOLDER MASK DEFINED
SCALE:20X



DETAIL
NOT TO SCALE

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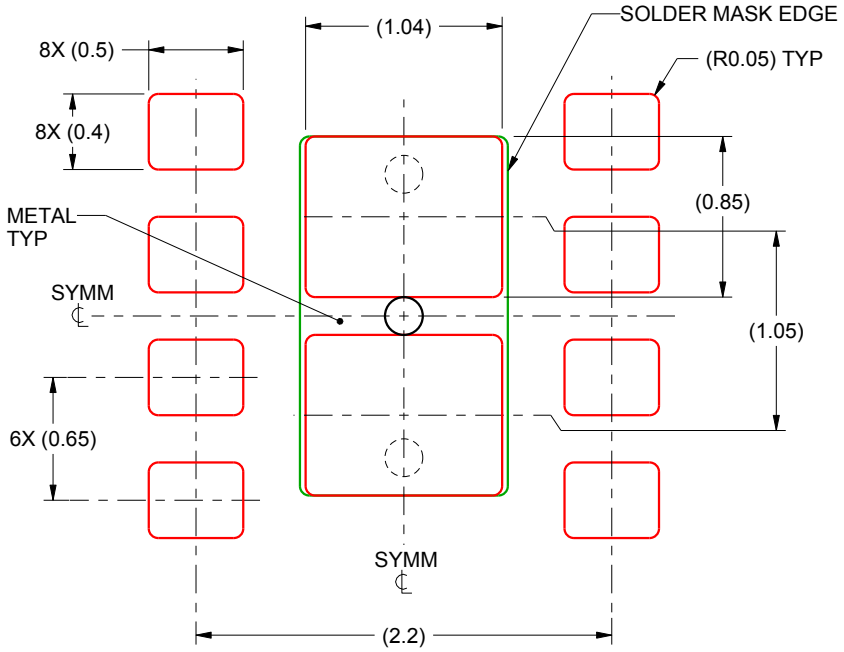
NOTES: (continued)

5. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
85% PRINTED SOLDER COVERAGE BY AREA
SCALE:25X

4221448/D 04/2015

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS82084SILR	ACTIVE	uSiP	SIL	8	3000	RoHS (In Work) & Green (In Work)	Call TI	Level-2-260C-1 YEAR	-40 to 125	1D TXI084*EC	Samples
TPS82084SILT	ACTIVE	uSiP	SIL	8	250	RoHS (In Work) & Green (In Work)	Call TI	Level-2-260C-1 YEAR	-40 to 125	1D TXI084*EC	Samples

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

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

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

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

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

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

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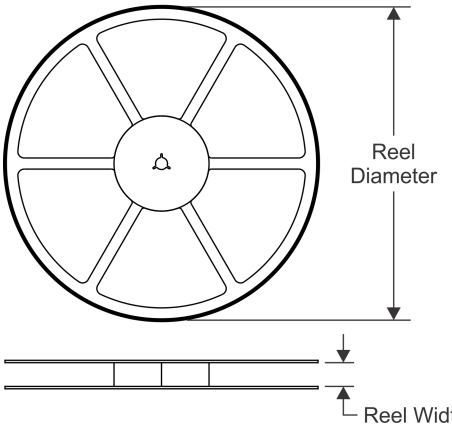
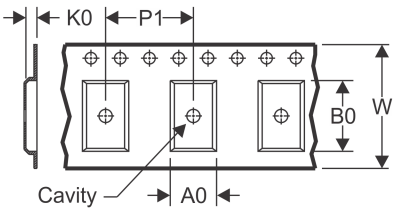
TAPE AND REEL INFORMATION

REEL DIMENSIONS

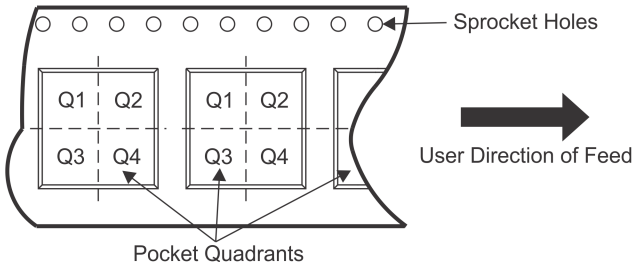


TAPE DIMENSIONS



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

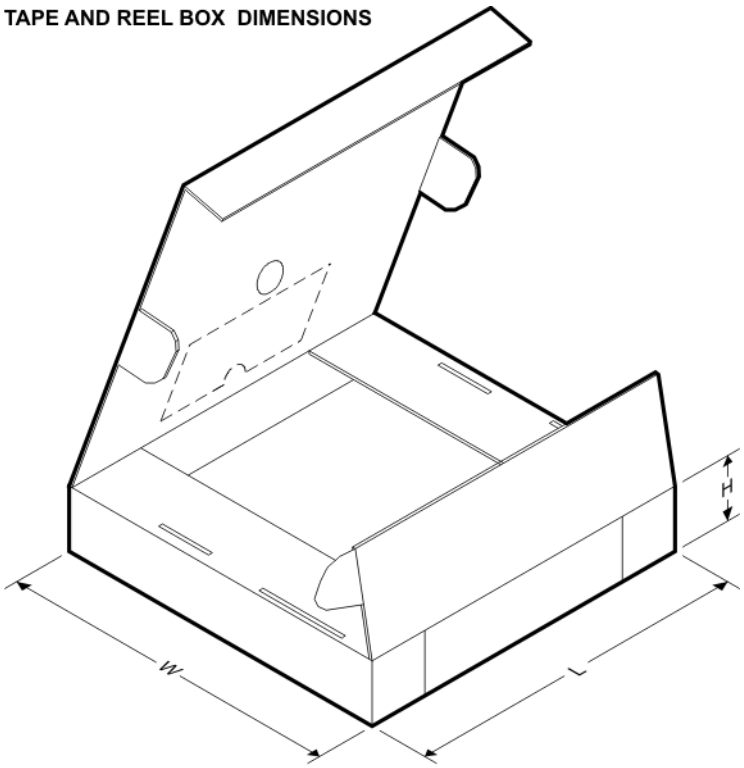
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TPS82084SILR	uSiP	SIL	8	3000	330.0	12.4	3.0	3.2	1.45	4.0	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)
TPS82084SILR	uSiP	SIL	8	3000	383.0	353.0	58.0

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