

用于低压电源轨的单路同步降压 控制器

查询样品: **TPS53015**

特性

- **D-CAP2™** 模式控制
 - 快速瞬态响应
 - 环路补偿无需外部部件
 - 与陶瓷输出电容器兼容
- 高初始参考准确度 ($\pm 1\%$)
- 宽输入电压范围: **4.5V 至 28V**
- 输出电压范围: **0.77V 至 7.0V**
- 低侧 R_{DS} (接通) 无损电流感应
- **1.4ms** 固定软启动 中将“可调软启动”改为“**1.4ms** 固定软启动”
- 非吸入预偏置软 启动
- **500kHz** 开关频率
- 逐周期过流限制控制
- 用于在轻载时保持高效率的自动跳过 **Eco-Mode™**
- 电源 良好输出

- 过流 (OCL) / 过压 (OVP) / 欠压 (UVP) / 欠压闭锁 (UVLO) / 热关断 (TSD) 保护
- 自适应栅极驱动器, 带集成式升压 P 通道场效应晶体管 (PMOS) 开关
- 热补偿 **OC**, **4000 ppm/°C**
- **10** 引脚超小型小外形尺寸封装 (VSSOP)

应用范围

- 针对广泛 应用的低功耗系统中的负载点调节
 - 数字电视电源
 - 网络互联家庭终端设备
 - 数字机顶盒 (STB)
 - DVD 播放器/刻录机
 - 游戏控制台和其它设备

说明

TPS53015 是一款单一、自使用启动时间 D-CAP2™ 模式同步降压控制器。TPS53015 可使系统设计人员能够通过一个成本 有效低外部组件数量和低待机电流解决方案来完成各种终端设备的电源总线调节器集。TPS53015 的主控制环路使用 D-CAP2™ 模式控制, 此控制方式 提供一个无需外部补偿组件的极快速瞬态响应。自适应 接通时间控制支持较高负载条件下 PWM 模式与 轻负载下 Eco-mode™ 运行间的无缝转换。Eco-mode™ 使 TPS53015 能够在较轻负载条件下保持高 效率。TPS53015 也能够去适应诸如 POSCAP 或者 SP-CAP 的低 等效串联电阻 (ESR) 和超低 ESR 陶瓷电容器。此器件在 4.5V 至 28V 的输入电压和 0.77V 至 7.0V 的输出电压下提供便捷和高 效运行。

TPS53015 采用 3.0mm x 3.0mm 10 引脚 超小型小外形尺寸 (VSSOP) (DGS) 封装, 额定环境运行温度范围为 -40°C 至 85°C。



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.

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TPS53015

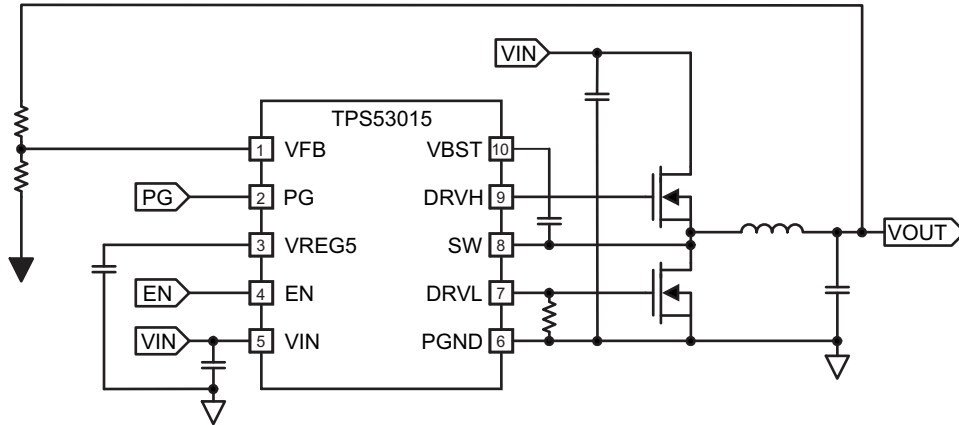
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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

典型应用电路



ORDERING INFORMATION ⁽¹⁾

T _A	PACKAGE ⁽¹⁾	ORDERING PART NUMBER	PINS	OUTPUT SUPPLY	ECO PLAN
-40°C to 85°C	VSSOP	TPS53015DGSR	10	Tape-and-Reel	Green (RoHS & no Sb/Br)
		TPS53015DGS		Tube	

(1) 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

Operating under free-air temperature range (unless otherwise noted) ⁽¹⁾

		VALUE	UNIT
Input voltage range	VIN, EN	-0.3 to 30	V
	VBST	-0.3 to 36	
	VBST - SW	-0.3 to 6	
	VFB	-0.3 to 6	
	SW	-0.3 to 30	
	SW (10 nsec transient)	-3.0 to 30	
Output voltage range	DRVH	-2 to 36	V
	DRVH - SW	-0.3 to 6	
	DRVL, VREG5, PG	-0.3 to 6	
	PGND	-0.3 to 0.3	
T _A	Operating ambient temperature range	-40 to 85	°C
T _{STG}	Storage temperature range	-55 to 150	°C
T _J	Junction temperature range	-40 to 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.

THERMAL INFORMATION

THERMAL METRIC ⁽¹⁾		TPS53015	UNITS
		DGS (10 PINS)	
θ_{JA}	Junction-to-ambient thermal resistance	172.2	°C/W
θ_{JCTop}	Junction-to-case (top) thermal resistance	44.0	
θ_{JB}	Junction-to-board thermal resistance	93.0	
Ψ_{JT}	Junction-to-top characterization parameter	1.6	
Ψ_{JB}	Junction-to-board characterization parameter	91.4	
θ_{JCbott}	Junction-to-case (bottom) thermal resistance	n/a	

(1) 有关传统和新的热 度量的更多信息，请参阅 IC 封装热量应用报告，SPRA953。

RECOMMENDED OPERATING CONDITIONS

		MIN	MAX	UNIT
Supply input voltage range	VIN	4.5	28	V
Input voltage range	VBST	-0.1	33.5	V
	VBST - SW	-0.1	5.5	
	VFB	-0.1	5.5	
	EN	-0.1	28	
	SW	-1.0	28	
Output Voltage range	DRVH	-1.0	33.5	V
	DRVH - SW	-0.1	5.5	
	DRVL, VREG5, PG	-0.1	5.5	
	PGND	-0.1	0.1	
T_A	Operating free-air temperature	-40	85	°C
T_J	Operating junction temperature	-40	125	°C

ELECTRICAL CHARACTERISTICS

over recommended free-air temperature range, VIN = 12 V (unless otherwise noted)

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY CURRENT						
I_{IN}	VIN Supply current	VIN current, $T_A = 25^\circ\text{C}$, EN = 5V, $V_{VFB} = 0.8\text{V}$, $V_{SW} = 0\text{V}$	660			μA
$I_{VINS DN}$	VIN Shutdown current	VIN current, $T_A = 25^\circ\text{C}$, No Load, $V_{EN} = 0\text{V}$, VREG5 = OFF	6.0			μA
VFB VOLTAGE and DISCHARGE RESISTANCE						
V_{VFBTHL}	VFB Threshold voltage	$T_A = 25^\circ\text{C}$, $V_{OUT} = 1.05\text{V}$	765.3	773.0	780.7	mV
TC_{VFB}	VFB Temperature coefficient	Relative to $T_A = 25^\circ\text{C}^{(1)}$	-140		140	ppm/°C
I_{VFB}	VFB Input current	VFB = 0.8V, $T_A = 25^\circ\text{C}$	-150	-10	100	nA
VREG5 OUTPUT						
V_{VREG5}	VREG5 Output voltage	$T_A = 25^\circ\text{C}$, $6\text{V} < V_{IN} < 28\text{V}$, $I_{VREG5} = 5\text{mA}$	5.1			V
I_{VREG5}	Output current	VIN = 5.5V, $V_{VREG5} = 4.0\text{V}$, $T_A = 25^\circ\text{C}$	120			mA
OUTPUT: N-CHANNEL MOSFET GATE DRIVERS						
R_{DRVH}	DRVH resistance	Source, $I_{DRVH} = -50\text{mA}$, $T_A = 25^\circ\text{C}$	3.2	4.7		Ω
		Sink, $I_{DRVH} = 50\text{mA}$, $T_A = 25^\circ\text{C}$	1.4	2.4		
R_{DRVL}	DRVL resistance	Source, $I_{DRVL} = -50\text{mA}$, $T_A = 25^\circ\text{C}$	6.9	8.2		Ω
		Sink, $I_{DRVL} = 50\text{mA}$, $T_A = 25^\circ\text{C}$	0.8	1.7		
T_D	Dead time	DRVH-low to DRVL-on ⁽¹⁾	15			ns
		DRVL-low to DRVH-on ⁽¹⁾	20			

(1) Ensured by design. Not production tested.

ELECTRICAL CHARACTERISTICS (continued)

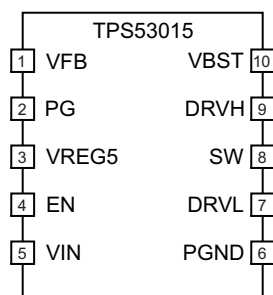
 over recommended free-air temperature range, $V_{IN} = 12\text{ V}$ (unless otherwise noted)

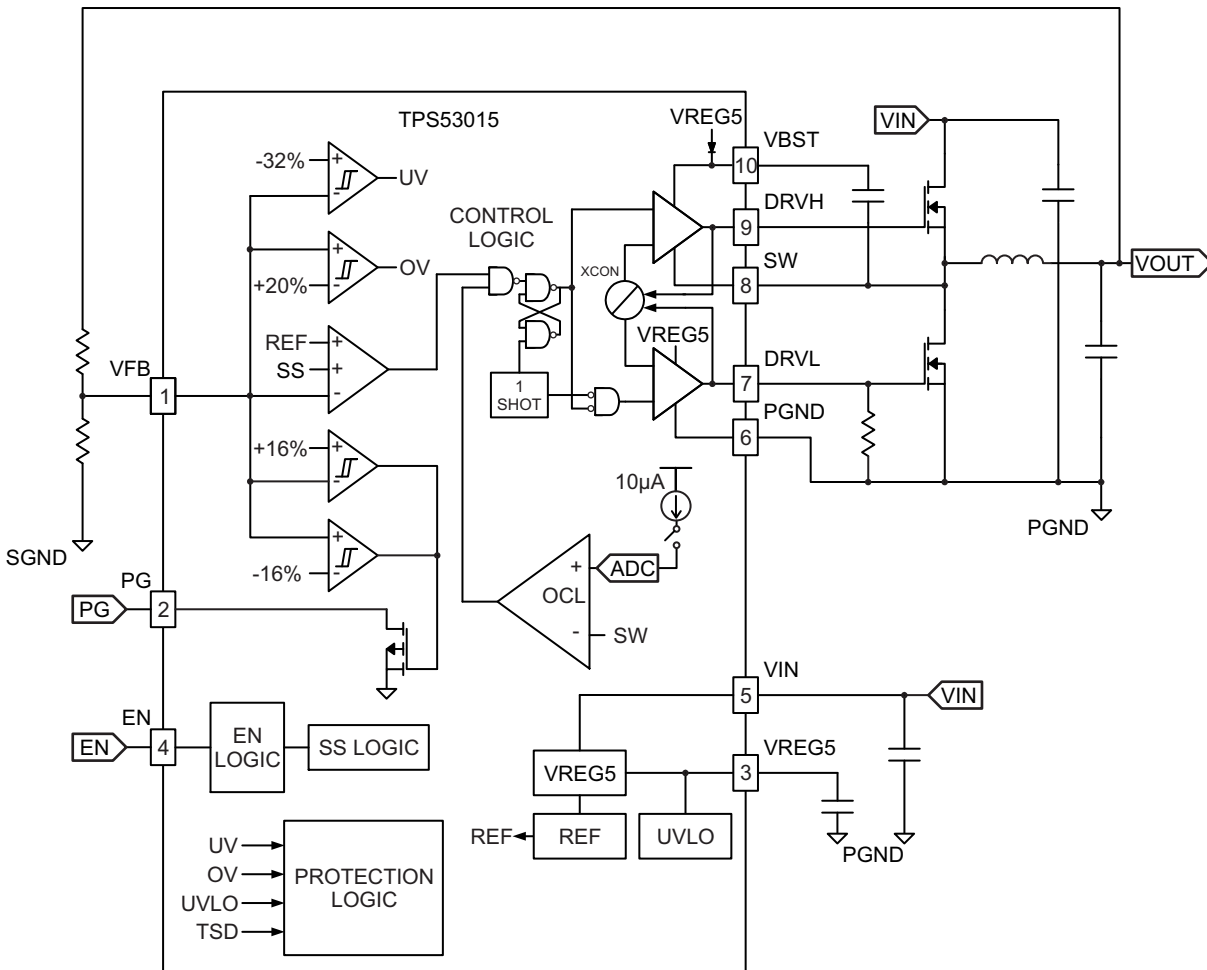
PARAMETER		CONDITIONS	MIN	TYP	MAX	UNIT
INTERNAL BOOST DIODE						
V_{FBST}	Forward voltage	$V_{VREG5-VBST}$, $I_F = 10\text{mA}$, $T_A = 25^\circ\text{C}$		0.1	0.2	V
SOFT START						
T_{ss}	Internal soft start time			1.4		ms
POWER GOOD						
V_{PGTH}	PGOOD threshold	PGOOD LOW		84		%
		PGOOD HIGH		116		%
I_{PG}	PGOOD sink current	$V_{PG} = 0.5\text{ V}$		5		mA
T_{PGDLY}	PGOOD delay time	Delay for PGOOD in		1.2		ms
		Delay for PGOOD out		2		μs
$T_{PGCOMPSS}$	PGOOD comparator start up delay	PGOOD comparator wake up delay		2.3		ms
UVLO						
$V_{UVVREG5}$	VREG5 UVLO threshold	VREG5 Rising		4.0		V
		Hysteresis		0.3		
LOGIC THRESHOLD						
V_{ENH}	EN H-level threshold voltage		1.6			V
V_{ENL}	EN L-level threshold voltage				0.5	V
R_{EN}	EN pin resistance to GND	$V_{EN} = 12\text{ V}$	225	450	900	k Ω
CURRENT SENSE						
I_{TRIP}	TRIP Source current	$V_{DRVL} = 0.1\text{V}$, $T_A = 25^\circ\text{C}$	14.3	15	15.8	μA
TC_{VTRIP}	V_{TRIP} Temperature coefficient	Relative to $T_A = 25^\circ\text{C}$		4000		ppm/ $^\circ\text{C}$
V_{OCL}	Current limit threshold	$R_{TRIP} = 75\text{k}\Omega$, $T_A = 25^\circ\text{C}$	234	336	424	mV
		$R_{TRIP} = 27\text{k}\Omega$, $T_A = 25^\circ\text{C}$	121	174	220	
		$R_{TRIP} = 6.8\text{k}\Omega$, $T_A = 25^\circ\text{C}$	35	50	63	
ON-TIME TIMER CONTROL						
T_{ON}	On time	$V_{OUT} = 1.05\text{ V}^{(2)}$		250		ns
$T_{OFF(MIN)}$	Minimum off time	$V_{IN} = 4.5\text{ V}$, $V_{VFB} = 0.7\text{ V}$, $T_A = 25^\circ\text{C}$		230		ns
OUTPUT UNDERVOLTAGE AND OVERVOLTAGE PROTECTION						
V_{OVP}	Output OVP trip threshold	OVP detect voltage	115	120	125	%
T_{OVPDEL}	Output OVP propagation delay				10	μs
V_{UVP}	Output UVP trip threshold	UVP detect voltage	63	68	73	%
T_{UVPDEL}	Output UVP delay			1		ms
T_{UVPEN}	Output UVP enable delay		1.7	2.2	2.7	ms
THERMAL SHUTDOWN						
T_{SDN}	Thermal shutdown threshold	Shutdown temperature ⁽²⁾		150		$^\circ\text{C}$
		Hysteresis ⁽²⁾		25		

(2) Ensured by design. Not production tested.

PIN FUNCTIONS

PIN		I/O	DESCRIPTION
NAME	VSSOP-10		
VFB	1	I	D-CAP2 feedback input. Connect to output voltage with resistor divider.
PG	2	O	Open drain power good output.
VREG5	3	O	Output of 5-V linear regulator and supply for MOSFET driver. Bypass to GND with a minimum 4.7- μ F high quality ceramic capacitor. VREG5 is active when EN is asserted high.
EN	4	I	Enable. Pull High to enable converter.
VIN	5	I	Supply Input for 5-V linear regulator. Bypass to GND with a minimum 0.1- μ F high quality ceramic capacitor.
PGND	6	I	System ground.
DRVL	7	O	Low-side N-Channel MOSFET gate driver output. PGND referenced driver switches between PGND(OFF) and VREG5(ON).
SW	8	I/O	Switch node connections for both the high-side driver and over current comparator.
DRVH	9	O	High-side N-channel MOSFET gate driver output. SW referenced driver switches between SW(OFF) and VBST(ON).
VBST	10	I	High-side MOSFET gate driver bootstrap voltage input. Connect a capacitor from VBST to SW. An internal diode is connected between VREG5 and VBST

**10 PIN VSSOP
(TOP VIEW)**


FUNCTIONAL BLOCK DIAGRAM

OVERVIEW

The TPS53015 is single synchronous step-down (buck) controller. It operates using D-CAP2™ mode control. The fast transient response of D-CAP2™ control reduces the required amount of output capacitance to meet a specific level of performance. Proprietary internal circuitry allows the use of low ESR output capacitors including ceramic and special polymer types.

DETAILED DESCRIPTION
PWM OPERATION

The main control loop of the TPS53015 is an adaptive on-time pulse width modulation (PWM) controller that supports a proprietary D-CAP2™ control mode. D-CAP2™ control combines constant on-time control with an internal compensation circuit for pseudo-fixed frequency and low external component count configuration with both low ESR and ceramic output capacitors. It is stable even with virtually no ripple at the output. At the beginning of each cycle, the high-side MOSFET is turned on. This MOSFET is turned off when the internal timer expires. This timer is set by the converter input voltage V_{IN} , and the output voltage V_O , to maintain a pseudo-fixed frequency over the input voltage range, hence it is called adaptive on-time control. The timer is reset and the high-side MOSFET is turned on again when the feedback voltage falls below the nominal output voltage. An internal ramp is added to the reference voltage to simulate output ripple, eliminating the need for ESR induced output ripple from D-CAP2™ mode control.

AUTO-SKIP Eco-Mode™ CONTROL

The TPS53015 is designed with Auto-Skip Eco-mode™ to increase light load efficiency. As the output current decreases from heavy load condition, the inductor current is also reduced and eventually comes to point where its rippled valley touches zero level, which is the boundary between continuous conduction and discontinuous conduction modes. The rectifying MOSFET is turned off when its zero inductor current is detected. As the load current further decreases the converter run into discontinuous conduction mode. The on-time is kept almost half as is was in the continuous conduction mode because it takes longer time to discharge the output capacitor with smaller load current to the level of the reference voltage. The transition point to the light load operation IOX(LL) current can be calculated in [Equation 1](#) with 500kHz used as fsw.

$$I_{OUT(LL)} = \frac{1}{2 \times L \times f_{SW}} \times \frac{(V_{IN} - V_{OUT}) \times V_{OUT}}{V_{IN}} \quad (1)$$

DRIVERS

TPS53015 contains two high-current resistive MOSFET gate drivers. The low-side driver is a PGND referenced, VREG5 powered driver designed to drive the gate of a high-current, low $R_{DS(on)}$ N-channel MOSFET whose source is connected to PGND. The high-side driver is a floating SW referenced, VBST powered driver designed to drive the gate of a high-current, low $R_{DS(on)}$ N-channel MOSFET. To maintain the VBST voltage during the high-side driver ON time, a capacitor is placed from SW to VBST. Each driver draws average current equal to Gate Charge ($Q_g @ V_{gs} = 5V$) times Switching frequency (fsw). To prevent cross-conduction, there is a narrow dead-time when both high-side and low-side drivers are OFF between each driver transition. During this time the inductor current is carried by one of the MOSFETs body diodes.

5-VOLT REGULATOR

The TPS53015 has an internal 5V Low-Dropout (LDO) Regulator to provide a regulated voltage for all both drivers and the ICs internal logic. A high-quality 4.7μF or greater ceramic capacitor from VREG5 to GND is required to stabilize the internal regulator.

SOFT START AND PRE-BIASED SOFT START

The TPS53015 has an internally set, 1.4 ms soft start time. When the EN pin becomes high and the VREG5 voltage is above the UVLO threshold, an internal DAC ramps up the reference voltage to the PWM comparator. Smooth control of the output voltage is maintained during start up.

The TPS53015 contains a unique circuit to prevent current from being pulled from the output during startup if the output is pre-biased. When the soft-start commands a voltage higher than the pre-bias level (internal soft start becomes greater than internal feedback voltage VFB), the controller slowly activates synchronous rectification by starting the first low side FET gate driver pulses with a narrow on-time. It then increments that on-time on a cycle-by-cycle basis until it coincides with the time dictated by (1-D), where D is the duty cycle of the converter. This scheme prevents the initial sinking of the pre-biased output, and ensures that the output voltage (VO) starts and ramps up smoothly into regulation from pre-biased startup to normal mode operation.

OVER CURRENT PROTECTION

TPS53015 has a cycle-by-cycle over current limit feature. The over current limits the inductor valley current by monitoring the voltage drop across the low-side MOSFET $R_{DS(on)}$ during the low-side driver on-time. If the inductor current is larger than the over current limit (OCL), the TPS53015 delays the start of the next switching cycle until the sensed inductor current falls below the OCL current. MOSFET $R_{DS(on)}$ current sensing is used to provide an accuracy and cost effective solution without external devices. To program the OCL, a resistor should be connected between DRVL and PGND. The recommended values are given in [Table 1](#).

Table 1. OCL Resistor Values

Resistor Value (k Ω)	V_{trip} (V)
6.8	0.050
11	0.087
18	0.125
27	0.174
39	0.224
56	0.274
75	0.336

I_{OCL} is determined by [Equation 2](#).

$$I_{OCL} = \left(\frac{(V_{IN} - V_{OUT})}{2 \times L \times f_{SW}} \times \frac{V_{OUT}}{V_{IN}} \right) + \frac{V_{TRIP}}{R_{DS(ON)}} \quad (2)$$

The trip voltage is set between 0.05V to 0.336V over all operational temperature, including the 4000ppm/°C temperature slope compensation for the temperature dependency of the $R_{DS(on)}$. If the load current exceeds the over-current limit, the voltage will begin to drop. If the over-current conditions continues the output voltage will fall below the under voltage protection threshold and the TPS53015 will shut down.

OVER/UNDER VOLTAGE PROTECTION

TPS53015 monitors a resistor divided feedback voltage to detect over and under voltage. If the feedback voltage is higher than 120% of the reference voltage, the OVP comparator output goes high and the circuit latches the high-side MOSFET driver OFF and the low-side MOSFET driver ON.

When the feedback voltage is lower than 68% of the reference voltage, the UVP comparator output goes high and an internal UVP delay counter begins counting. After 1ms, TPS53015 latches OFF both top and bottom MOSFET drivers. This function is enabled approximately 2.2 ms after power-on. The OVP and UVP latch off is reset when EN goes low.

UVLO PROTECTION

TPS53015 has under voltage lock out protection (UVLO) that monitors the voltage of VREG5 pin. When the VREG5 voltage is lower than UVLO threshold voltage, the device is shut off. All output drivers are OFF. The UVLO is non-latch protection.

THERMAL SHUTDOWN

TPS53015 monitors its temperature. If the temperature exceeds the threshold value (typically 150°C), the device shuts off. When the temperature falls below the threshold, the IC starts again. When VIN starts up and VREG5 output voltage is below its nominal value, the thermal shutdown threshold is kept lower than 150°C. As long as VIN rises, T_J must be kept less than 110°C.

POWER GOOD

The TPS53015 has a power-good output that this is measured on VFB. The power-good function is activated after soft-start has finished. If the output voltage is within $\pm 16\%$ of the target voltage, the internal comparator detects the power-good state and the power-good signal becomes high after 1.2ms delay. During start-up, this internal delay starts after 2.2 times the soft-start time to avoid a glitch of power-good signal. If the feedback voltage goes outside $\pm 16\%$ of target value, the power-good signal becomes low after 2 μ s delay.

TYPICAL CHARACTERISTICS

$V_{IN} = 12\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$ (unless otherwise noted)

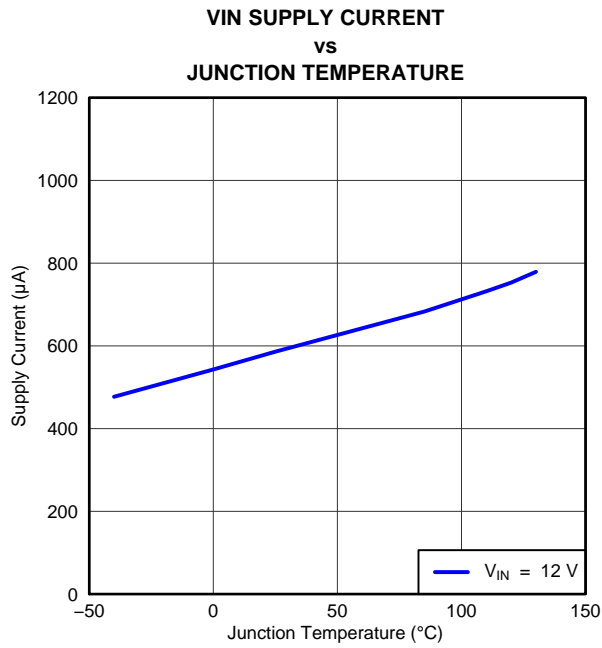


Figure 1.

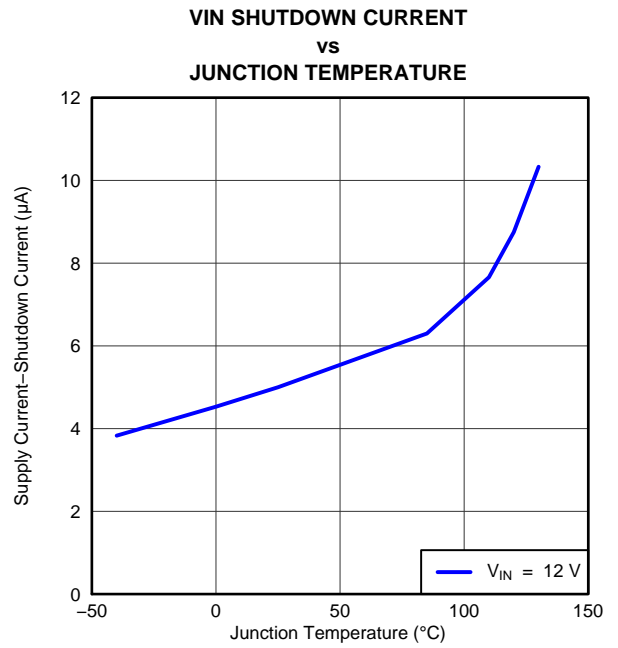


Figure 2.

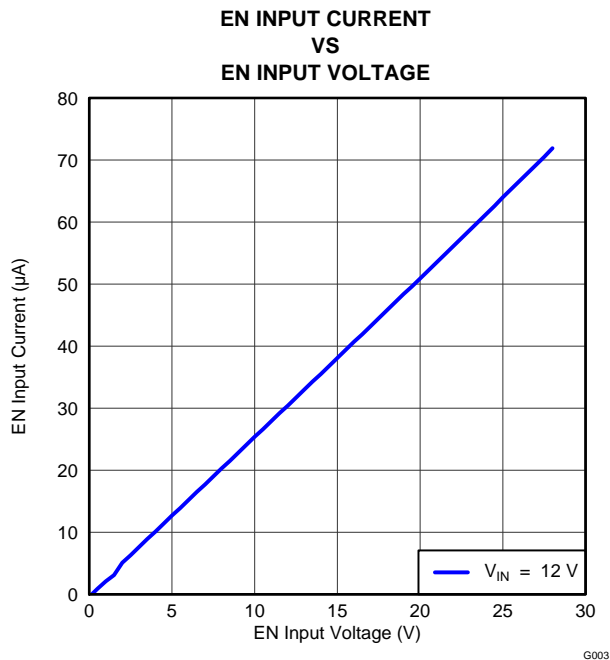


Figure 3.

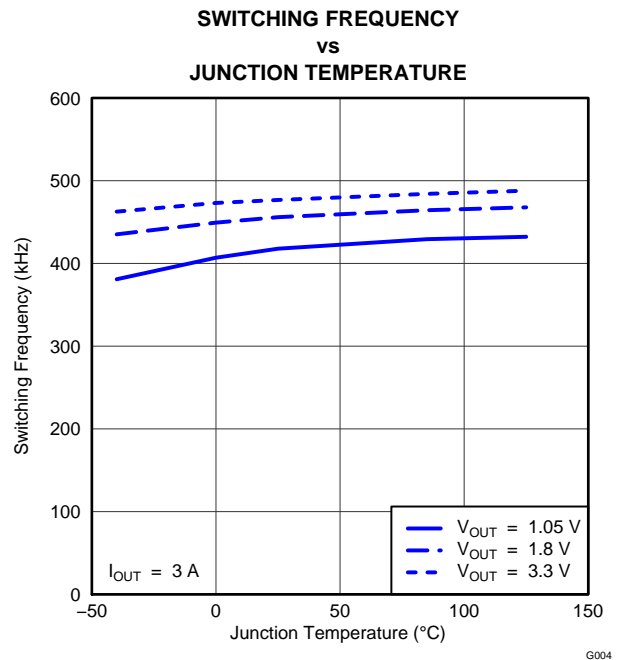


Figure 4.

TYPICAL CHARACTERISTICS (continued)

$V_{IN} = 12\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$ (unless otherwise noted)

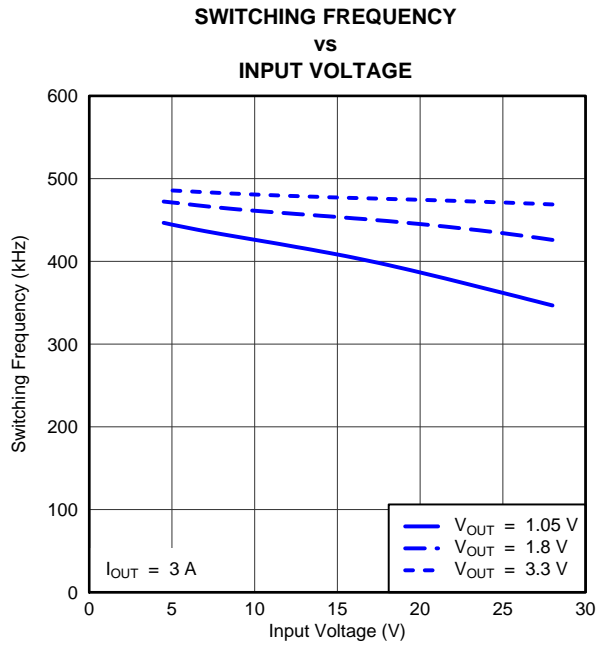


Figure 5.

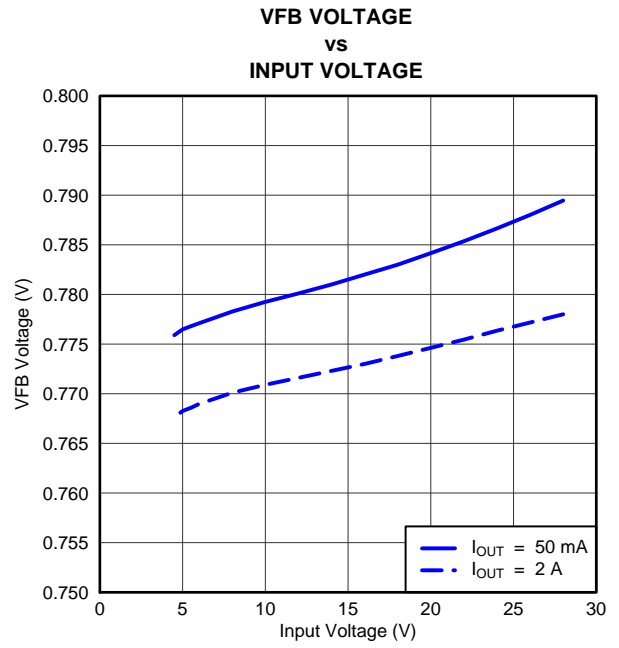


Figure 6.

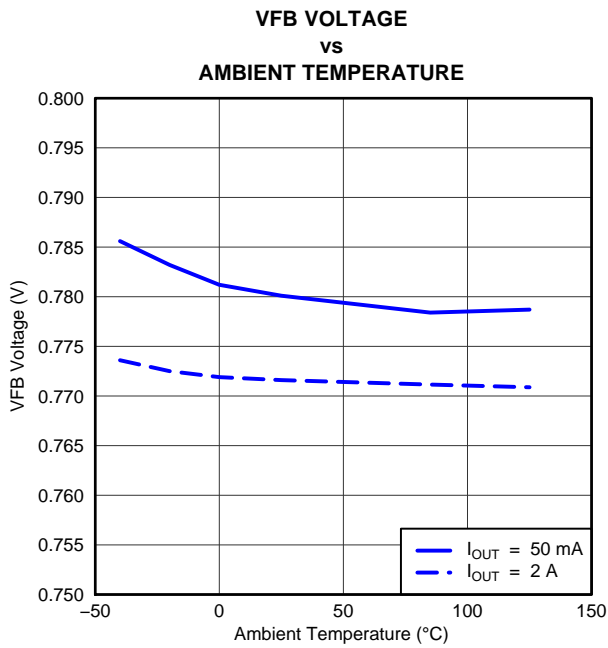


Figure 7.

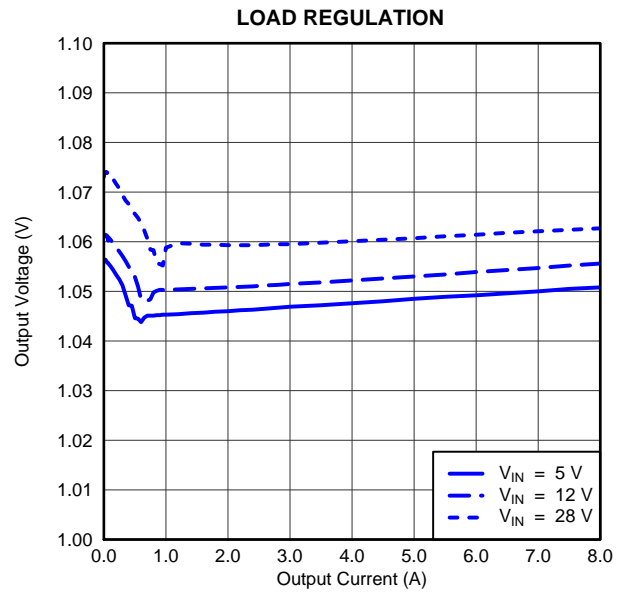


Figure 8.

TYPICAL CHARACTERISTICS (continued)

$V_{IN} = 12\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$ (unless otherwise noted)

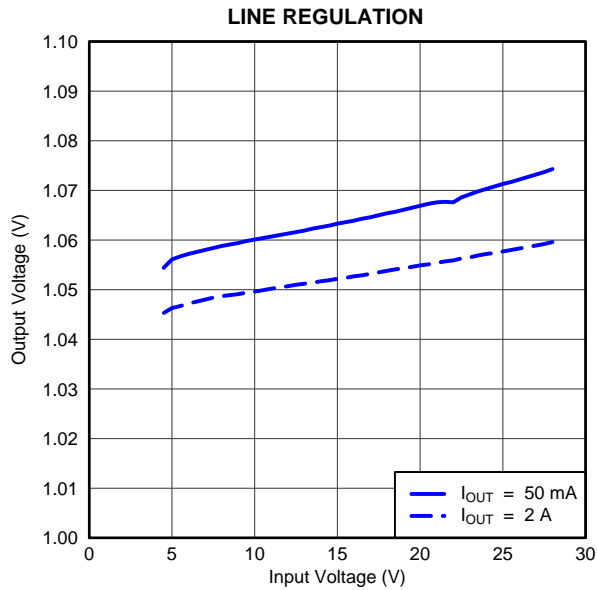


Figure 9.

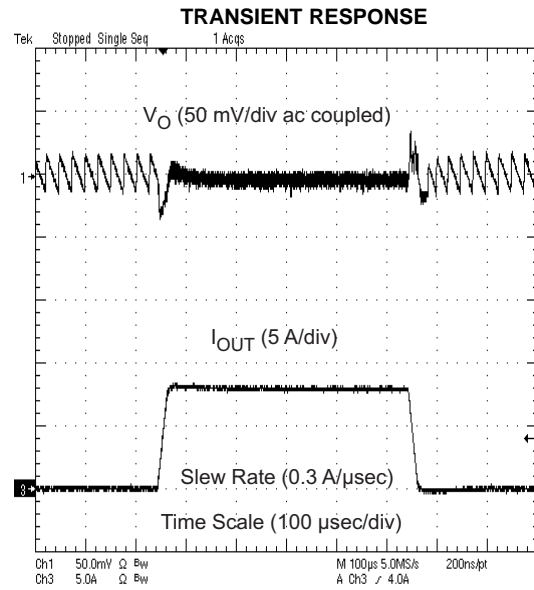


Figure 10.

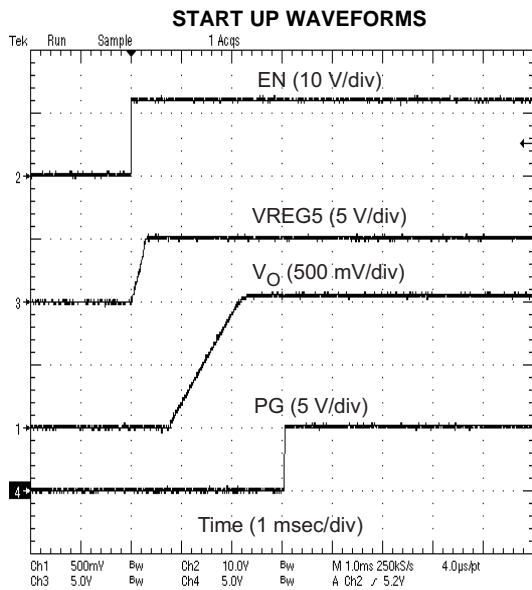


Figure 11.

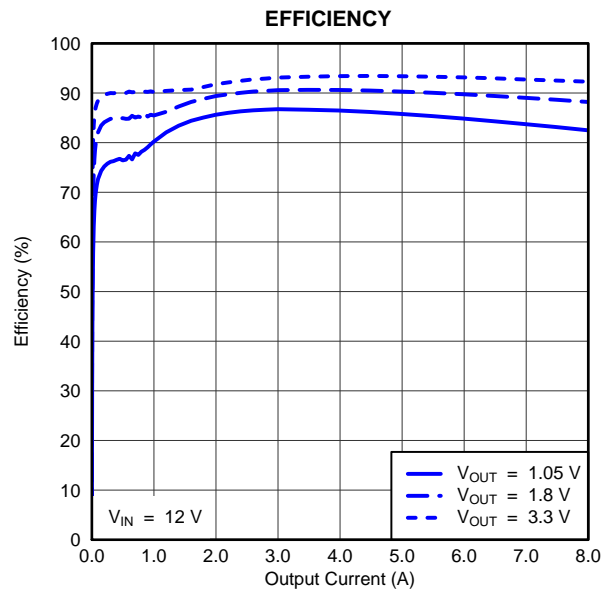


Figure 12.

TYPICAL CHARACTERISTICS (continued)

$V_{IN} = 12\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$ (unless otherwise noted)

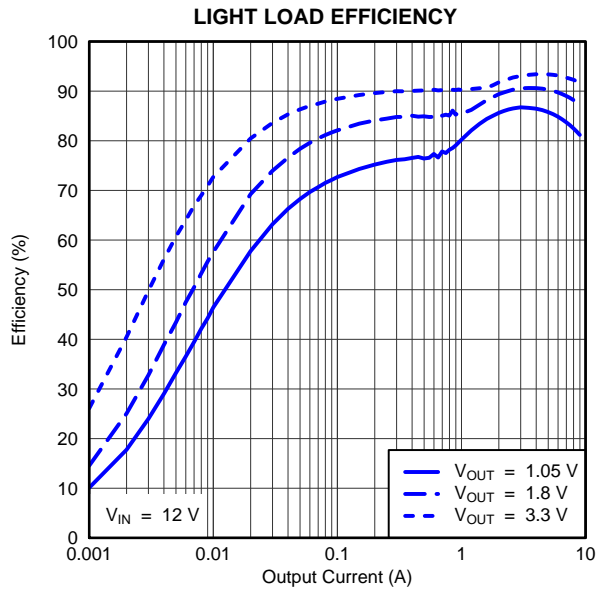


Figure 13.

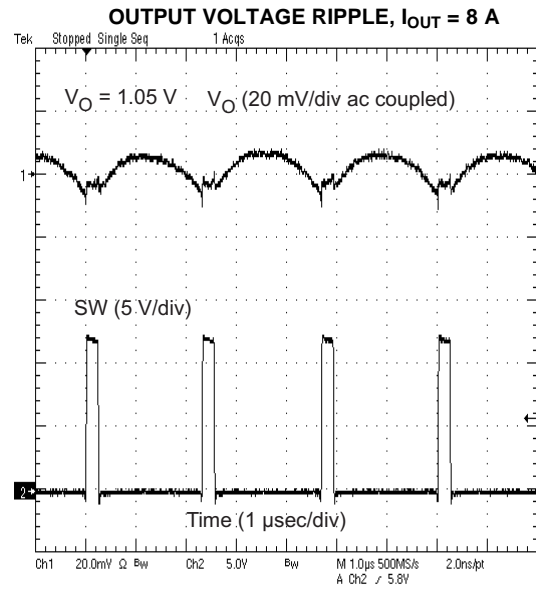


Figure 14.

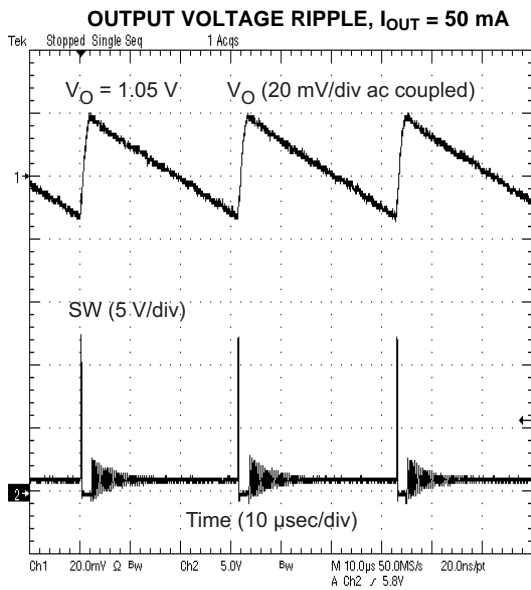


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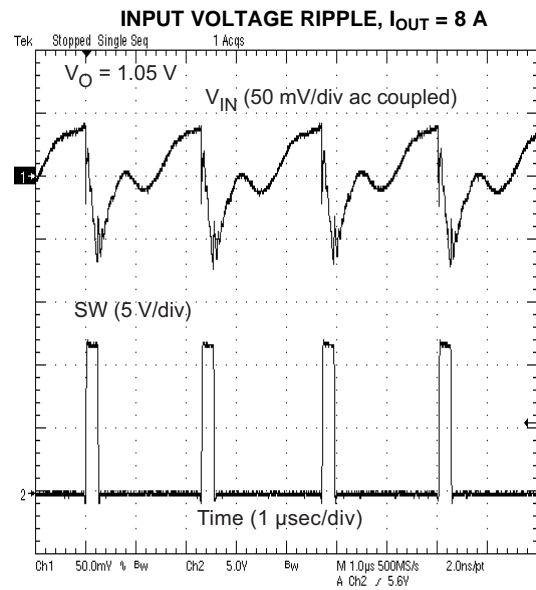


Figure 16.

TYPICAL CHARACTERISTICS (continued)

$V_{IN} = 12\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$ (unless otherwise noted)

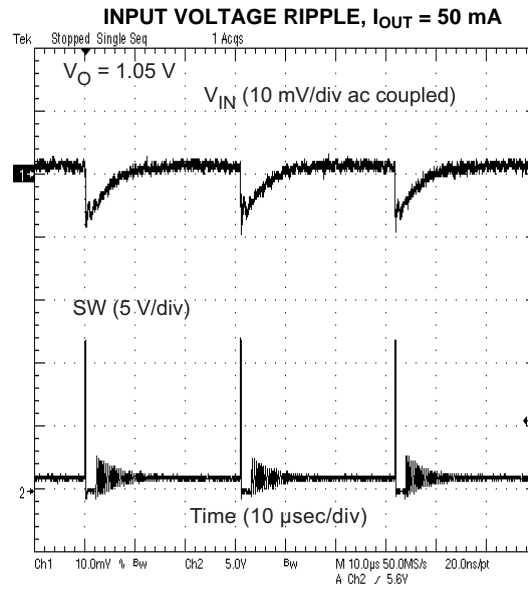


Figure 17.

APPLICATION INFORMATION

APPLICATION SCHEMATIC

A typical application schematic is shown in [Figure 18](#).

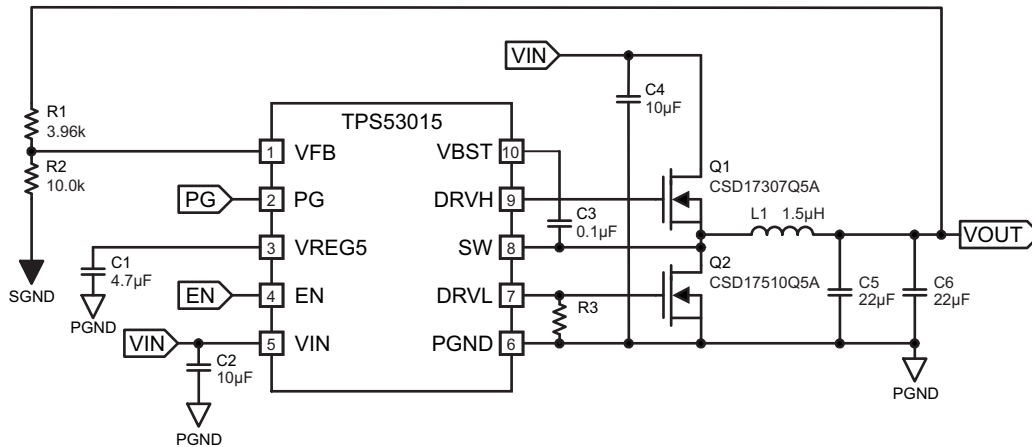


Figure 18. Application Schematic

COMPONENT SELECTION

INDUCTOR

The inductance value is selected to provide approximately 30% peak to peak ripple current at maximum load. Larger ripple current increases output ripple voltage, improve S/N ratio and contribute to stable operation. [Equation 3](#) can be used to calculate the value for L_{OUT} .

$$L_{OUT} = \frac{V_{IN(MAX)} - V_{OUT}}{I_{L(RIPPLE)} \times f_{SW}} \times \frac{V_{OUT}}{V_{IN(MAX)}} \quad (3)$$

The inductor's current ratings need to support both the RMS (thermal) current and the peak (saturation) current. The RMS and peak inductor current can be estimated as follows:

$$I_{L(RIPPLE)} = \frac{V_{IN(MAX)} - V_{OUT}}{L_{OUT} \times f_{SW}} \times \frac{V_{OUT}}{V_{IN(MAX)}} \quad (4)$$

$$I_{L(PEAK)} = \frac{V_{TRIP}}{R_{DS(ON)}} + I_{L(RIPPLE)} \quad (5)$$

$$I_{L(RMS)} = \sqrt{I_{OUT}^2 + \frac{1}{12} \times I_{L(RIPPLE)}^2} \quad (6)$$

Note:

The calculation above shall serve as a general reference. To further improve transient response, the output inductance could be reduced further. This needs to be considered along with the selection of the output capacitor.

OUTPUT CAPACITOR

The capacitor value and ESR determine the amount of output voltage ripple and load transient response. Ceramic output capacitors with X5R dielectric or better are recommended.

$$C_{OUT} = \frac{I_{L(RIPPLE)}}{8 \times V_{OUT(RIPPLE)}} \times \frac{1}{f_{SW}} \quad (7)$$

$$C_{OUT} = \frac{\Delta I_{LOAD}^2}{2 \times V_{OUT} \times \Delta V_{OS}} \times L_{OUT} \quad (8)$$

$$C_{OUT} = \frac{\Delta I_{LOAD}^2}{2 \times K \times \Delta V_{US}} \times L_{OUT} \quad (9)$$

Where:

$$K = (V_{IN} - V_{OUT}) \times \frac{T_{ON}}{T_{ON} - T_{OFF(MIN)}} \quad (10)$$

- ΔV_{OS} = The allowable amount of overshoot voltage in load transition
- ΔV_{US} = The allowable amount of undershoot voltage in load transition
- $T_{OFF(MIN)}$ = Minimum off time

Select the capacitance value greater than the largest value calculated from [Equation 7](#), [Equation 8](#) and [Equation 9](#). The minimum recommended output capacitance is 44 μF .

INPUT CAPACITOR

The TPS53015 requires an input decoupling capacitor and a bulk capacitor is needed depending on the application. A minimum 10- μF high-quality ceramic capacitor is recommended for the input capacitor. The capacitor voltage rating needs to be greater than the maximum input voltage.

BOOTSTRAP CAPACITOR

The TPS53015 requires a bootstrap capacitor from SW to VBST to provide the floating supply for the high-side drivers. A minimum 0.1- μF high-quality ceramic capacitor is recommended. The capacitor voltage rating should be greater than 10 V.

VREG5 CAPACITOR

The TPS53015 requires that the VREG5 regulator is bypassed. A minimum 4.7- μF high-quality ceramic capacitor must be connected between the VREG5 and PGND for proper operation. The capacitor voltage rating should be greater than 10 V.

CHOOSE OUTPUT VOLTAGE RESISTORS

The output voltage is set with a resistor divider from output voltage node to the VFB pin. It is recommended to use 1% tolerance or better resistors. Select R2 between 10 k Ω and 100 k Ω and use [Equation 11](#) to calculate R1.

$$R1 = \left(\frac{V_{OUT}}{V_{VFB}} - 1 \right) \times R2 \quad (11)$$

LAYOUT SUGGESTIONS

- Keep the input switching current loop as small as possible.
- Place the input capacitor close to the top switching FET. The output current loop should also be kept as small as possible.
- Keep the SW node as physically small and short as possible as to minimize parasitic capacitance and inductance and to minimize radiated emissions. Kelvin connections should be brought from the output to the feedback pin (VFB) of the device.
- Keep analog and non-switching components away from switching components.
- Make a single point connection from the signal ground to power ground.
- Do not allow switching current to flow under the device.

REVISION HISTORY

Changes from Original (July 2012) to Revision A Page

- Added 将版本 A 添加到文献编号 1
 - Changed Package designator from DDA to DGS in Thermal Information table header 3
-

Changes from Revision A (July 2012) to Revision B Page

- Changed 文献编号从修订版本 A 改为修订版本 B 1
 - Changed 在 特性列表 1
 - Added 将“电源 良好输出”添加到特性 1
 - Changed from "SS" to "PG" in the Absolute Maximum Ratings table 2
 - Changed from "SS" to "PG" in the Recommended Operating Conditions table 3
 - Changed T_{SS} spec from "1.0 ms" to "1.4 ms" Typical 4
 - Changed T_{PGDLY} spec from "1.5 ms" to "1.2 ms" 4
 - Changed $T_{PGCOMPSS}$ spec from "2.2 ms" to "2.3 ms" 4
 - Changed T_{UVPEN} spec from "1.4 ms, 1.7 ms, 2.0 ms" MIN, TYP, MAX to "1.7 ms, 2.2 ms, 2.7 ms" respectively. 4
 - Changed "+10%" and "-10%" to "+16%" and "-16%" in the Functional Block Diagram 6
 - Changed soft start time from "1.0 ms" to "1.4 ms" 7
 - Changed timing from "1.7 ms" to "2.2 ms" in the OVER/UNDER VOLTAGE PROTECTION section 8
 - Added section describing POWER GOOD operation 8
-

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
TPS53015DGS	ACTIVE	VSSOP	DGS	10	80	Green (RoHS & no Sb/Br)	CU NIPDAUAG	Level-2-260C-1 YEAR	-40 to 85	53015	Samples
TPS53015DGSR	ACTIVE	VSSOP	DGS	10	2500	Green (RoHS & no Sb/Br)	CU NIPDAUAG	Level-2-260C-1 YEAR	-40 to 85	53015	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) 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.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS53015DGSR	VSSOP	DGS	10	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS53015DGSR	VSSOP	DGS	10	2500	366.0	364.0	50.0

DGS (S-PDSO-G10)

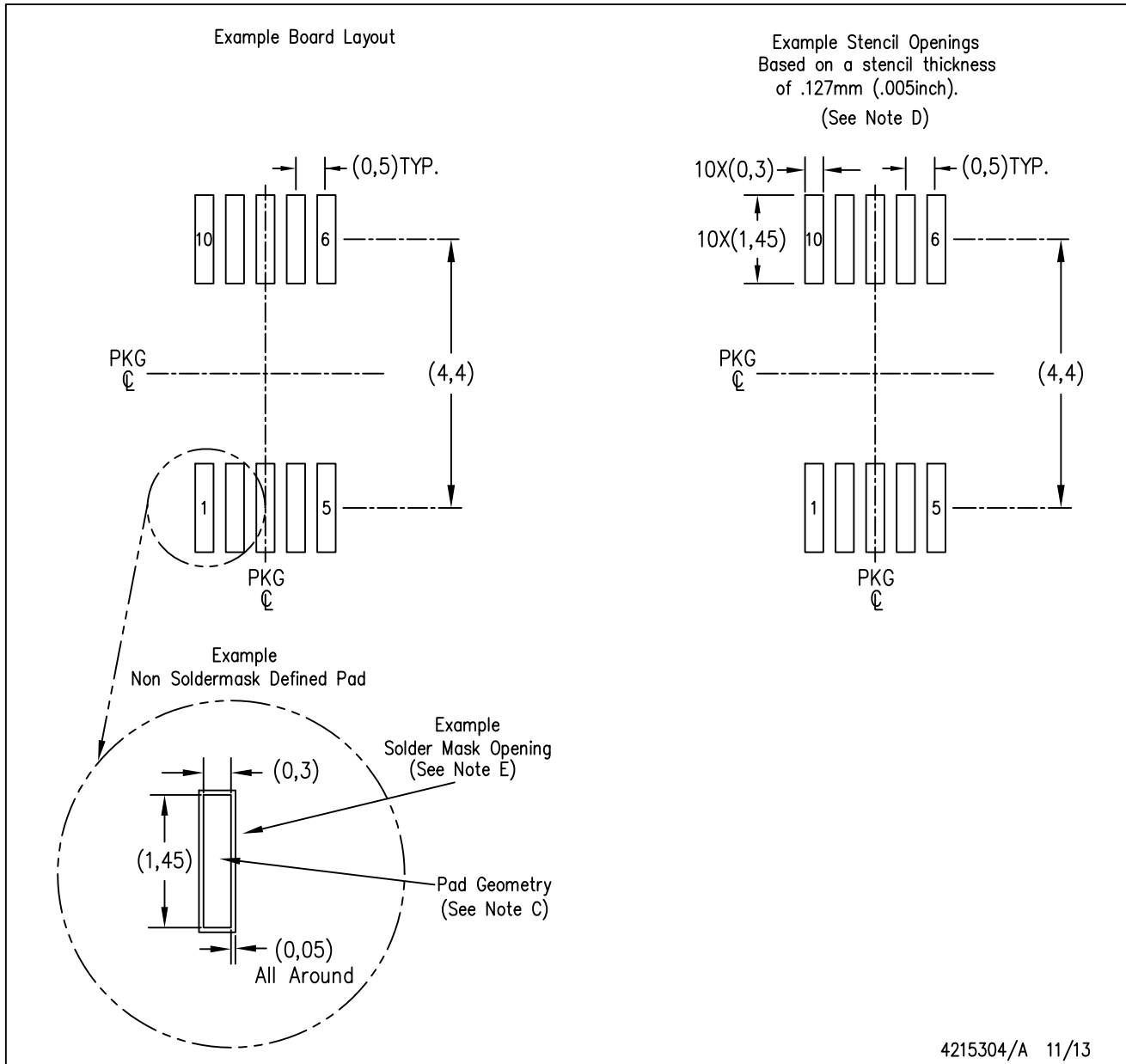
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion.
 - D. Falls within JEDEC MO-187 variation BA.

DGS (S-PDSO-G10)

PLASTIC SMALL OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - 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 other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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