

## DRV8300-Q1: 100V 三相 BLDC 栅极驱动器

### 1 特性

- 符合面向汽车应用的 AEC-Q100 标准
  - 温度等级 1 :  $-40^{\circ}\text{C} \leq \text{TA} \leq 125^{\circ}\text{C}$
- 100V 三相半桥栅极驱动器
  - 驱动 N 沟道 MOSFET (NMOS)
  - 栅极驱动器电源 (GVDD) : 5-20V
  - MOSFET 电源 (SHx) 支持高达 100V 的电压
- 集成自举二极管
- 自举栅极驱动架构
  - 750mA 拉电流
  - 1.5A 灌电流
- 支持高达 48V 的汽车系统
- SHx 引脚具有低泄漏电流 (小于 55 $\mu\text{A}$ )
- 绝对最大 BSTx 电压高达 115V
- 支持 SHx 上低达 -22V 的负电压瞬变
- 内置跨导保护
- 固定插入 215 ns 死区时间
- 支持 3.3V 和 5V 逻辑输入 (绝对最大值为 20V)
- 4ns 典型传播延迟匹配
- 紧凑型 TSSOP 封装
- 具有电源块的高效系统设计
- 集成保护特性
  - BST 欠压锁定 (BSTUV)
  - GVDD 欠压 (GVDDUV)

### 2 应用

#### 48V 汽车和工业应用

- 电动自行车和电动汽车
- 电动踏板车
- 压缩机
- HVAC 风机风扇
- 汽车风扇和鼓风机

### 3 说明

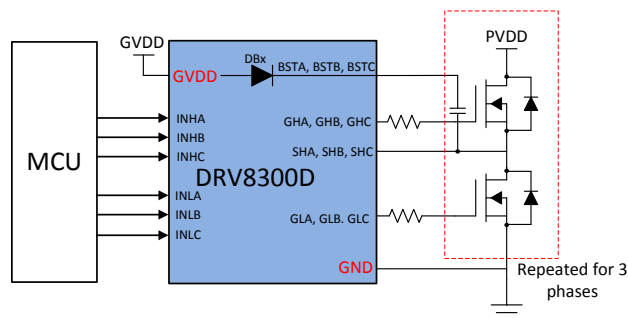
DRV8300-Q1 是一款 100V 三相半桥栅极驱动器，能够驱动高侧和低侧 N 沟道功率 MOSFET。DRV8300-Q1 使用集成自举二极管和外部电容为高侧 MOSFET 生成合适的栅极驱动电压。GVDD 用于为低侧 MOSFET 生成栅极驱动电压。栅极驱动架构支持高达 750 mA 的峰值拉电流和 1.5A 的峰值灌电流。

相位引脚 SHx 能够承受显著的负电压瞬变；而高侧栅极驱动器电源 BSTx 和 GHx 能够支持更高的正电压瞬变 (115V) 绝对最大值，从而提高系统的稳健性。较小的传播延迟和延迟匹配规格可最大限度地降低死区时间要求，从而进一步提高效率。通过 GVDD 和 BST 欠压锁定功能为低侧和高侧提供欠压保护。

#### 器件信息

器件型号 <sup>(1)</sup>	封装	封装尺寸 (标称值)
DRV8300QDPWRQ1	TSSOP (20)	6.40mm × 4.40mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。



DRV8300-Q1 的简化版原理图



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## 4 Revision History

注：以前版本的页码可能与当前版本的页码不同

表 4-1.

Date	Revision	Notes
April 2022	*	Initial Release

## 5 Device Comparison Table

Device Variants	Package	Integrated Bootstrap Diode	GLx polarity with respect to INLx Input	Deadtime
DRV8300D	20-Pin TSSOP	Yes	Non-Inverted	Fixed

## 6 Pin Configuration and Functions

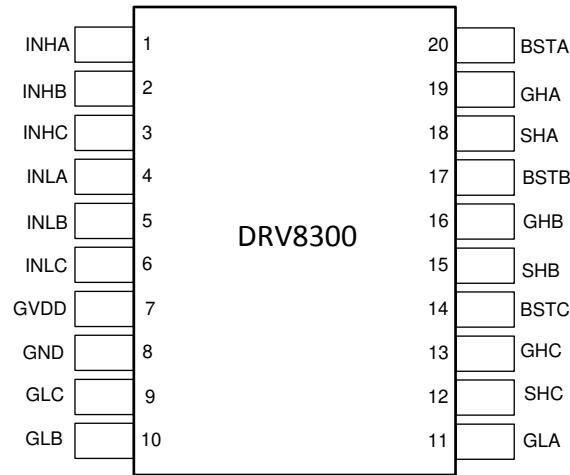


图 6-1. DRV8300-Q1 PW Package 20-Pin TSSOP Top View

表 6-1. Pin Functions—20-Pin DRV8300-Q1 Devices

PIN		TYPE <sup>1</sup>	DESCRIPTION
NAME	NO.		
BSTA	20	O	Bootstrap output pin. Connect capacitor between BSTA and SHA
BSTB	17	O	Bootstrap output pin. Connect capacitor between BSTB and SHB
BSTC	14	O	Bootstrap output pin. Connect capacitor between BSTC and SHC
GHA	19	O	High-side gate driver output. Connect to the gate of the high-side power MOSFET.
GHB	16	O	High-side gate driver output. Connect to the gate of the high-side power MOSFET.
GHC	13	O	High-side gate driver output. Connect to the gate of the high-side power MOSFET.
GLA	11	O	Low-side gate driver output. Connect to the gate of the low-side power MOSFET.
GLB	10	O	Low-side gate driver output. Connect to the gate of the low-side power MOSFET.
GLC	9	O	Low-side gate driver output. Connect to the gate of the low-side power MOSFET.
INHA	1	I	High-side gate driver control input. This pin controls the output of the high-side gate driver.
INHB	2	I	High-side gate driver control input. This pin controls the output of the high-side gate driver.
INHC	3	I	High-side gate driver control input. This pin controls the output of the high-side gate driver.
INLA	4	I	Low-side gate driver control input. This pin controls the output of the low-side gate driver.
INLB	5	I	Low-side gate driver control input. This pin controls the output of the low-side gate driver.
INLC	6	I	Low-side gate driver control input. This pin controls the output of the low-side gate driver.
GND	8	PWR	Device ground.
SHA	18	I	High-side source sense input. Connect to the high-side power MOSFET source.
SHB	15	I	High-side source sense input. Connect to the high-side power MOSFET source.
SHC	12	I	High-side source sense input. Connect to the high-side power MOSFET source.
GVDD	7	PWR	Gate driver power supply input. Connect a X5R or X7R, GVDD-rated ceramic and greater than or equal to 10-uF local capacitance between the GVDD and GND pins.

1. PWR = power, I = input, O = output, NC = no connection

## 7 Specifications

### 7.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
Gate driver regulator pin voltage	GVDD	-0.3	21.5	V
Bootstrap pin voltage	BSTx	-0.3	115	V
Bootstrap pin voltage	BSTx with respect to SHx	-0.3	21.5	V
Logic pin voltage	INHx, INLx	-0.3	V <sub>GVDD</sub> +0.3	V
High-side gate drive pin voltage	GHx	-22	115	V
High-side gate drive pin voltage	GHx with respect to SHx	-0.3	22	V
Transient 500-ns high-side gate drive pin voltage	GHx with respect to SHx	-5	22	V
Low-side gate drive pin voltage	GLx	-0.3	V <sub>GVDD</sub> +0.3	V
Transient 500-ns low-side gate drive pin voltage	GLx	-5	V <sub>GVDD</sub> +0.3	V
High-side source pin voltage	SHx	-22	100	V
Ambient temperature, T <sub>A</sub>		- 40	125	°C
Junction temperature, T <sub>J</sub>		- 40	150	°C
Storage temperature, T <sub>stg</sub>		- 65	150	°C

- (1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime

### 7.2 ESD Ratings AUTO

			VALUE	UNIT	
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per AEC Q100-002 <sup>(1)</sup> HBM ESD Classification Level 2	±2000	V	
		Charged device model (CDM), per AEC Q100-011 CDM ESD Classification Level C4B	Corner pins		±750
			Other pins		±750

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

### 7.3 Recommended Operating Conditions

over operating temperature range (unless otherwise noted)

			MIN	NOM	MAX	UNIT
V <sub>GVDD</sub>	Power supply voltage	GVDD	5		20	V
V <sub>SHx</sub>	High-side source pin voltage	SHx	-2		85	V
V <sub>SHx</sub>	Transient 2μs high-side source pin voltage	SHx	-22		85	V
V <sub>BST</sub>	Bootstrap pin voltage	BSTx	5		105	V
V <sub>BST</sub>	Bootstrap pin voltage	BSTx with respect to SHx	5		20	V
V <sub>IN</sub>	Logic input voltage	INHx, INLx, MODE, DT	0		GVDD	V
f <sub>PWM</sub>	PWM frequency	INHx, INLx	0		200	kHz
V <sub>SHSL</sub>	Slew rate on SHx pin				2	V/ns
C <sub>BOOT</sub> <sup>(1)</sup>	Capacitor between BSTx and SHx				1	μF
T <sub>A</sub>	Operating ambient temperature		- 40		125	°C
T <sub>J</sub>	Operating junction temperature		- 40		150	°C

- (1) Current flowing through boot diode (D<sub>BOOT</sub>) needs to be limited for C<sub>BOOT</sub> > 1μF

## 7.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		DRV8300-Q1	UNIT
		PW (TSSOP)	
		20 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	97.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	38.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	48.8	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	4.3	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	48.4	°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 [Semiconductor and IC Package Thermal Metrics](#) application report.

## 7.5 Electrical Characteristics

$4.8\text{ V} \leq V_{GVDD} \leq 20\text{ V}$ ,  $-40^{\circ}\text{C} \leq T_J \leq 150^{\circ}\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>POWER SUPPLIES (GVDD, BSTx)</b>						
$I_{GVDD}$	GVDD standby mode current	INHx = INLx = 0; $V_{BSTx} = V_{GVDD}$	400	800	1400	$\mu\text{A}$
	GVDD active mode current	INHx = INLx = Switching @20kHz; $V_{BSTx} = V_{GVDD}$ ; NO FETs connected	400	825	1400	$\mu\text{A}$
$I_{BSx}$	Bootstrap pin leakage current	$V_{BSTx} = V_{SHx} = 85\text{V}$ ; $V_{GVDD} = 0\text{V}$	2	4	7	$\mu\text{A}$
$I_{BS\_TRAN}$	Bootstrap pin active mode transient leakage current	INHx = Switching@20kHz	30	105	220	$\mu\text{A}$
$I_{BS\_DC}$	Bootstrap pin active mode leakage static current	INHx = High	30	85	150	$\mu\text{A}$
$I_{SHx}$	High-side source pin leakage current	INHx = INLx = 0; $V_{BSTx} - V_{SHx} = 12\text{V}$ ; $V_{SHx} = 0$ to 85V	30	55	80	$\mu\text{A}$
<b>LOGIC-LEVEL INPUTS (INHx, INLx, MODE)</b>						
$V_{HYS\_MODE}$	Input hysteresis	Mode pin	1600	2000	2400	mV
$V_{HYS}$	Input hysteresis	INLx, INHx pins	40	100	260	mV
$I_{IL\_INLx}$	INLx Input logic low current	$V_{PIN}$ (Pin Voltage) = 0 V; INLx in non-inverting mode	-1	0	1	$\mu\text{A}$
$I_{IH\_INLx}$	INLx Input logic high current	$V_{PIN}$ (Pin Voltage) = 5 V; INLx in non-inverting mode	5	20	30	$\mu\text{A}$
$I_{IL}$	INHx, MODE Input logic low current	$V_{PIN}$ (Pin Voltage) = 0 V;	-1	0	1	$\mu\text{A}$
$I_{IH}$	INHx, MODE Input logic high current	$V_{PIN}$ (Pin Voltage) = 5 V;	5	20	30	$\mu\text{A}$
$R_{PD\_INHx}$	INHx Input pulldown resistance	To GND	120	200	280	k $\Omega$
$R_{PD\_INLx}$	INLx Input pulldown resistance	To GND, INLx in non-inverting mode	120	200	280	k $\Omega$
$R_{PD\_MODE}$	MODE Input pulldown resistance	To GND	120	200	280	k $\Omega$
<b>GATE DRIVERS (GHx, GLx, SHx, SLx)</b>						
$V_{GHx\_LO}$	High-side gate drive low level voltage	$I_{GLx} = -100\text{ mA}$ ; $V_{GVDD} = 12\text{V}$ ; No FETs connected	0	0.15	0.35	V
$V_{GHx\_HI}$	High-side gate drive high level voltage ( $V_{BSTx} - V_{GHx}$ )	$I_{GHx} = 100\text{ mA}$ ; $V_{GVDD} = 12\text{V}$ ; No FETs connected	0.3	0.6	1.2	V
$V_{GLx\_LO}$	Low-side gate drive low level voltage	$I_{GLx} = -100\text{ mA}$ ; $V_{GVDD} = 12\text{V}$ ; No FETs connected	0	0.15	0.35	V
$V_{GLx\_HI}$	Low-side gate drive high level voltage ( $V_{GVDD} - V_{GLx}$ )	$I_{GHx} = 100\text{ mA}$ ; $V_{GVDD} = 12\text{V}$ ; No FETs connected	0.3	0.6	1.2	V
$I_{DRIVEP\_HS}$	High-side peak source gate current	GHx-SHx = 12V	400	750	1200	mA
$I_{DRIVEN\_HS}$	High-side peak sink gate current	GHx-SHx = 0V	850	1500	2100	mA

4.8 V ≤ V<sub>GVDD</sub> ≤ 20 V, -40°C ≤ T<sub>J</sub> ≤ 150°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I <sub>DRIVEP_LS</sub>	Low-side peak source gate current	GLx = 12V	400	750	1200	mA
I <sub>DRIVEN_LS</sub>	Low-side peak sink gate current	GLx = 0V	850	1500	2100	mA
t <sub>PD</sub>	Input to output propagation delay	INHx, INLx to GHx, GLx; V <sub>GVDD</sub> = V <sub>BSTx</sub> - V <sub>SHx</sub> > 8V; SHx = 0V, No load on GHx and GLx	70	125	180	ns
t <sub>PD_match</sub>	Matching propagation delay per phase	GHx turning OFF to GLx turning ON, GLx turning OFF to GHx turning ON; V <sub>GVDD</sub> = V <sub>BSTx</sub> - V <sub>SHx</sub> > 8V; SHx = 0V, No load on GHx and GLx	-30	±4	30	ns
t <sub>PD_match</sub>	Matching propagation delay phase to phase	GHx/GLx turning ON to GHy/GLy turning ON, GHx/GLx turning OFF to GHy/GLy turning OFF; V <sub>GVDD</sub> = V <sub>BSTx</sub> - V <sub>SHx</sub> > 8V; SHx = 0V, No load on GHx and GLx	-30	±4	30	ns
t <sub>R_GLx</sub>	GLx rise time (10% to 90%)	C <sub>LOAD</sub> = 1000 pF; V <sub>GVDD</sub> = V <sub>BSTx</sub> - V <sub>SHx</sub> > 8V; SHx = 0V	10	24	50	ns
t <sub>R_GHx</sub>	GHx rise time (10% to 90%)	C <sub>LOAD</sub> = 1000 pF; V <sub>GVDD</sub> = V <sub>BSTx</sub> - V <sub>SHx</sub> > 8V; SHx = 0V	10	24	50	ns
t <sub>F_GLx</sub>	GLx fall time (90% to 10%)	C <sub>LOAD</sub> = 1000 pF; V <sub>GVDD</sub> = V <sub>BSTx</sub> - V <sub>SHx</sub> > 8V; SHx = 0V	5	12	30	ns
t <sub>F_GHx</sub>	GHx fall time (90% to 10%)	C <sub>LOAD</sub> = 1000 pF; V <sub>GVDD</sub> = V <sub>BSTx</sub> - V <sub>SHx</sub> > 8V; SHx = 0V	5	12	30	ns
t <sub>DEAD</sub>	Gate drive dead time		150	215	280	ns
t <sub>PW_MIN</sub>	Minimum input pulse width on INHx, INLx that changes the output on GHx, GLx		40	70	150	ns

**BOOTSTRAP DIODES (DRV8300D, DRV8300DI)**

V <sub>BOOTD</sub>	Bootstrap diode forward voltage	I <sub>BOOT</sub> = 100 μA	0.45	0.7	0.85	V
		I <sub>BOOT</sub> = 100 mA	2	2.3	3.1	V
R <sub>BOOTD</sub>	Bootstrap dynamic resistance (ΔV <sub>BOOTD</sub> /ΔI <sub>BOOT</sub> )	I <sub>BOOT</sub> = 100 mA and 80 mA	11	15	25	Ω

**PROTECTION CIRCUITS**

V <sub>GVDDUV</sub>	Gate Driver Supply undervoltage lockout (GVDDUV)	Supply rising	4.45	4.6	4.7	V
		Supply falling	4.2	4.35	4.4	V
V <sub>GVDDUV_HYS</sub>	Gate Driver Supply UV hysteresis	Rising to falling threshold	250	280	310	mV
t <sub>GVDDUV</sub>	Gate Driver Supply undervoltage deglitch time		5	10	13	μs
V <sub>BSTUV</sub>	Boot Strap undervoltage lockout (V <sub>BSTx</sub> - V <sub>SHx</sub> )	Supply rising	3.6	4.2	4.8	V
		Supply falling	3.5	4	4.5	V
V <sub>BSTUV_HYS</sub>	Bootstrap UV hysteresis	Rising to falling threshold		200		mV
t <sub>BSTUV</sub>	Bootstrap undervoltage deglitch time		6	10	22	μs

**7.6 Timing Diagrams**

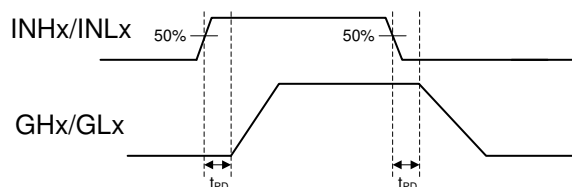


图 7-1. Propagation Delay(t<sub>PD</sub>)

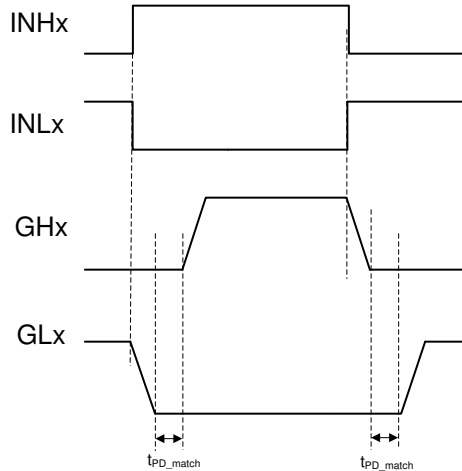


图 7-2. Propagation Delay Match ( $t_{PD\_match}$ )

## 7.7 Typical Characteristics

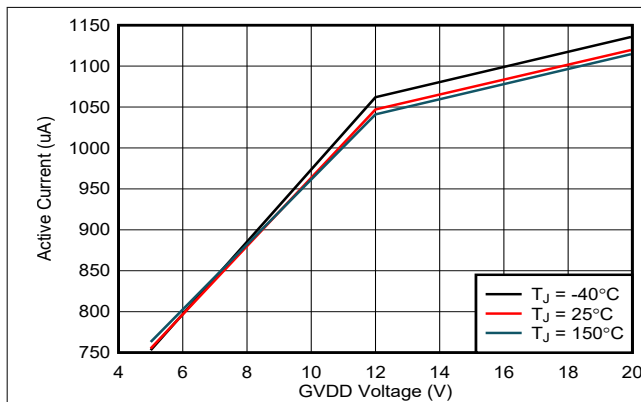


图 7-3. Supply Current Over GVDD Voltage

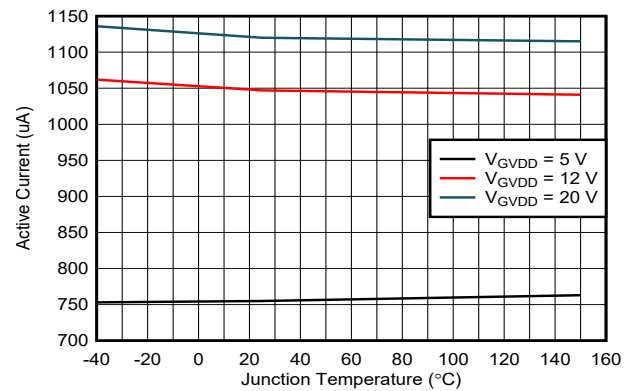


图 7-4. Supply Current Over Temperature

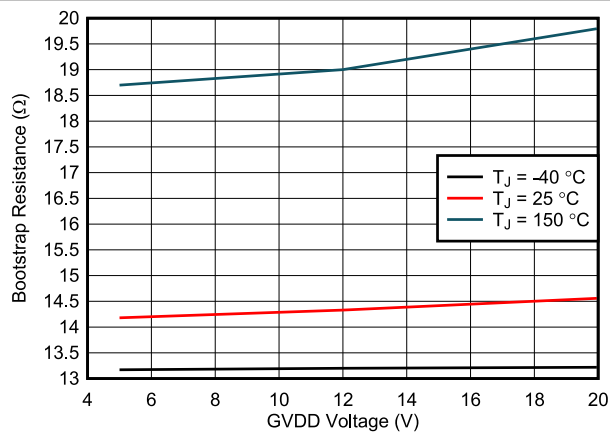


图 7-5. Bootstrap Resistance Over GVDD Voltage

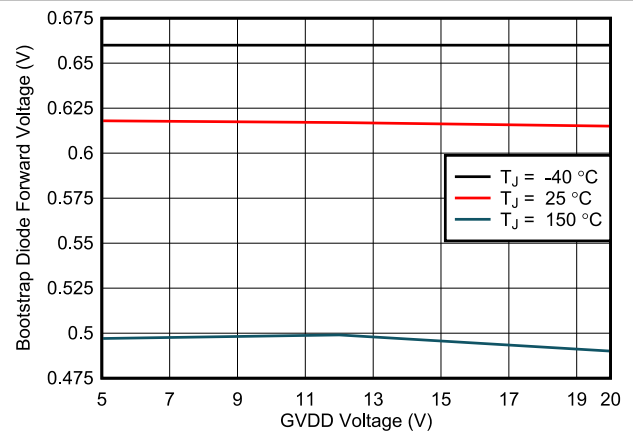


图 7-6. Bootstrap Diode Forward Voltage over GVDD Voltage



## 8 Detailed Description

### 8.1 Overview

The DRV8300-Q1 is a gate driver for three-phase motor drive applications. These devices decrease system component count, saves PCB space and cost by integrating three independent half-bridge gate drivers and optional bootstrap diodes.

DRV8300-Q1 supports external N-channel high-side and low-side power MOSFETs and can drive 750-mA source, 1.5-A sink peak currents with total combined 30-mA average output current. The DRV8300-Q1 is available in 0.65-mm pitch TSSOP surface-mount packages. The TSSOP body size is 6.5 × 4.4 mm (0.65-mm pin pitch) for the 20-pin package.

## 8.2 Functional Block Diagram

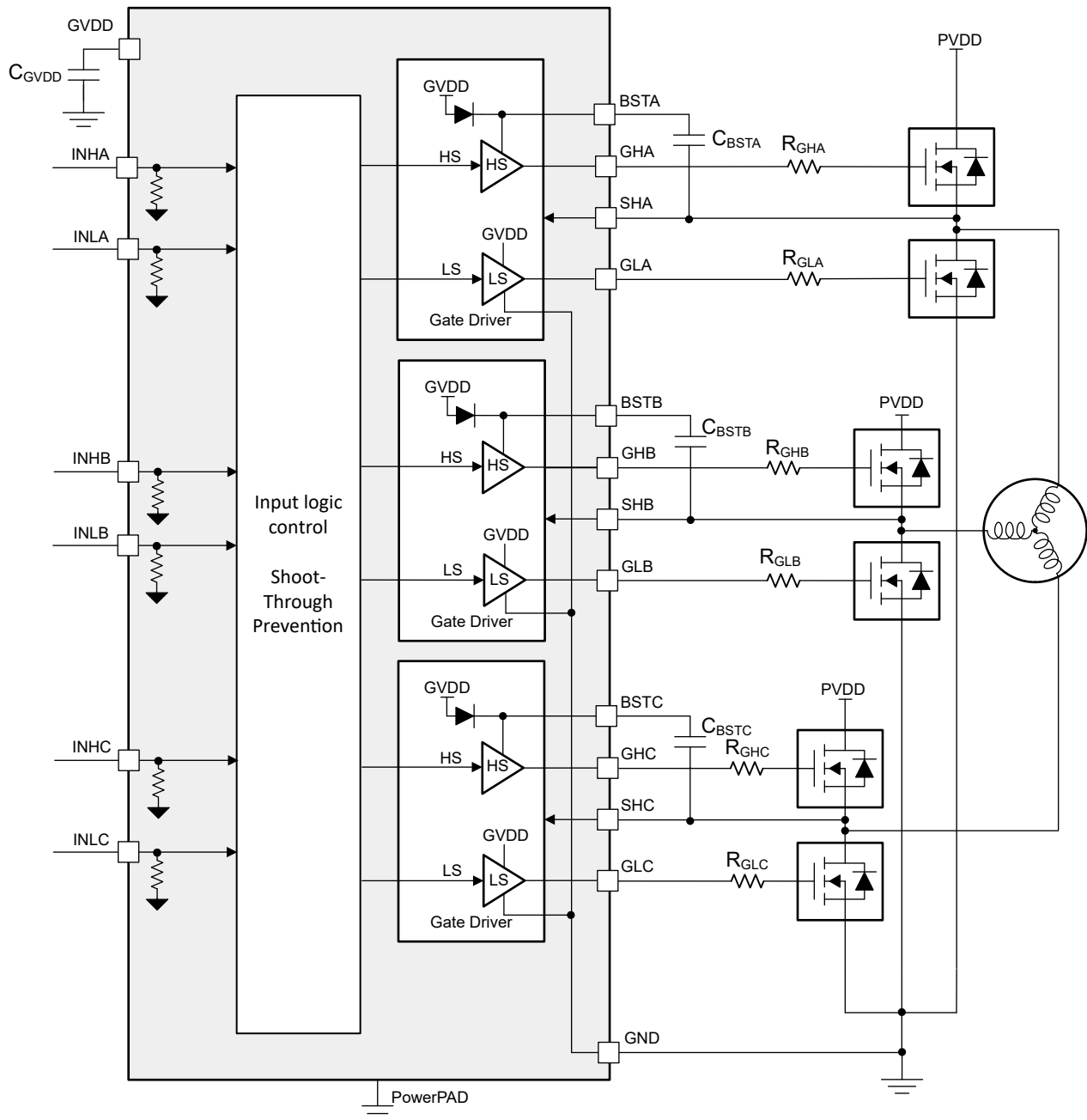


图 8-1. Block Diagram for DRV8300-Q1

## 8.3 Feature Description

### 8.3.1 Three BLDC Gate Drivers

The DRV8300-Q1 integrates three half-bridge gate drivers, each capable of driving high-side and low-side N-channel power MOSFETs. Input on GVDD provides the gate bias voltage for the low-side MOSFETs. The high voltage is generated using bootstrap capacitor and GVDD supply. The half-bridge gate drivers can be used in combination to drive a three-phase motor or separately to drive other types of loads.

#### 8.3.1.1 Gate Drive Timings

##### 8.3.1.1.1 Propagation Delay

The propagation delay time ( $t_{pd}$ ) is measured as the time between an input logic edge to a detected output change. This time has two parts consisting of the input deglitcher delay and the delay through the analog gate drivers.

The input deglitcher prevents high-frequency noise on the input pins from affecting the output state of the gate drivers. The analog gate drivers have a small delay that contributes to the overall propagation delay of the device.

##### 8.3.1.1.2 Deadtime and Cross-Conduction Prevention

In the DRV8300-Q1, high-side and low-side inputs operate independently, with an exception to prevent cross conduction when high and low side are turned ON at same time. The DRV8300-Q1 turns OFF high-side and low-side output to prevent shoot through when the both high-side and low-side inputs are at logic HIGH at same time.

Fixed deadtime of 215 ns (typical value) is inserted to prevent high and low side gate output turning ON at same time.

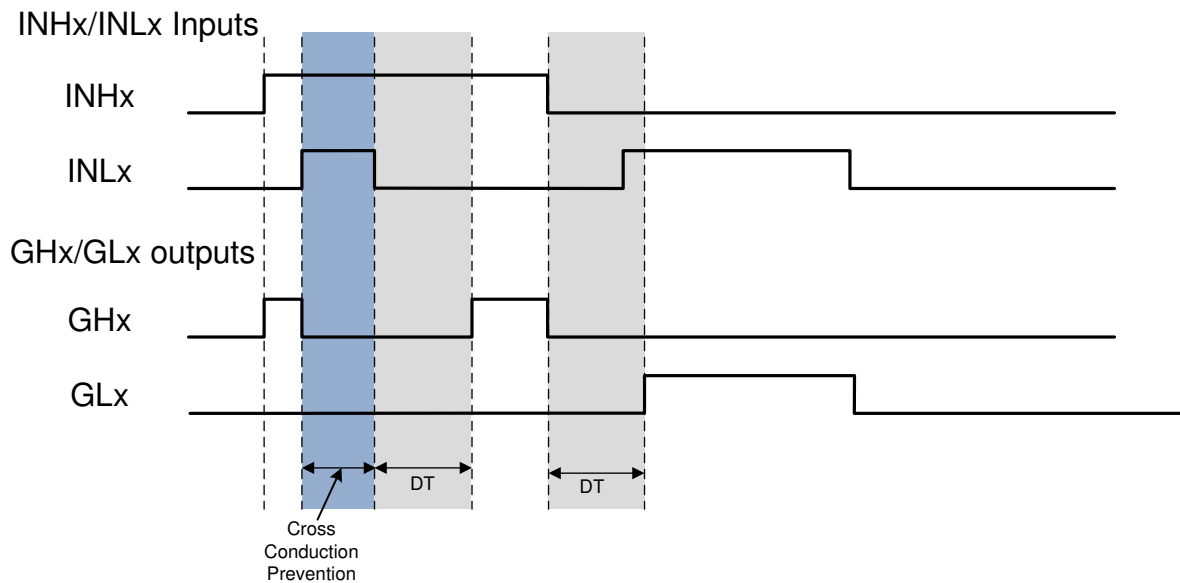


图 8-2. Cross Conduction Prevention and Deadtime Insertion

### 8.3.1.2 Gate Driver Outputs

图 8-3 shows the relation between INHx and INLx inputs and GHx and GLx outputs for DRV8300-Q1.

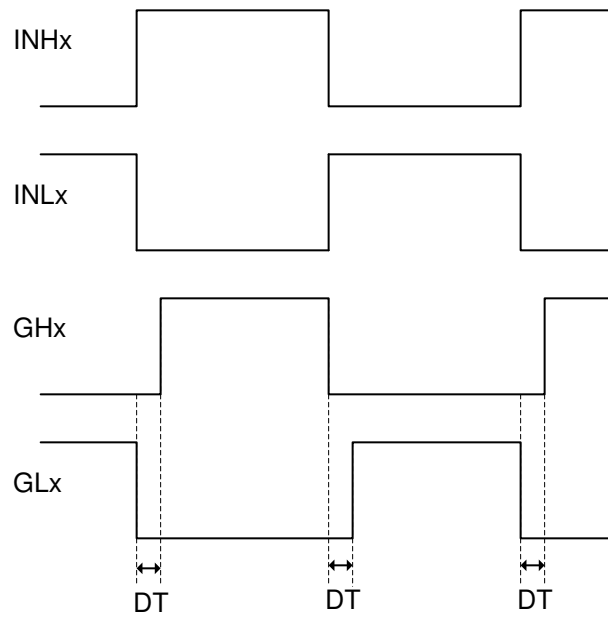


图 8-3. Non-Inverted INLx inputs

### 8.3.2 Pin Diagrams

图 8-4 shows the input structure for the logic level pins INHx, INLx.

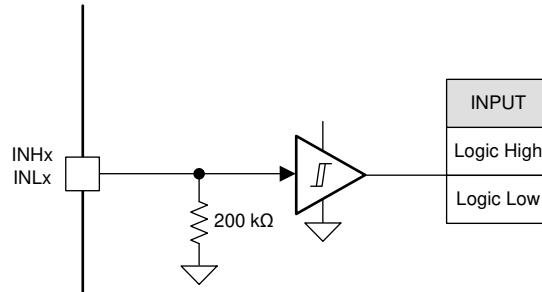


图 8-4. INHx and INLx Logic-Level Input Pin Structure

### 8.3.3 Gate Driver Protective Circuits

The DRV8300-Q1 is protected against BSTx undervoltage and GVDD undervoltage events.

表 8-1. Fault Action and Response

FAULT	CONDITION	GATE DRIVER	RECOVERY
V <sub>BSTx</sub> undervoltage (BSTUV)	V <sub>BSTx</sub> < V <sub>BSTUV</sub>	GHx - Hi-Z	Automatic: V <sub>BSTx</sub> > V <sub>BSTUV</sub> and low to high PWM edge detected on INHx pin
GVDD undervoltage (GVDDUV)	V <sub>GVDD</sub> < V <sub>GVDDUV</sub>	Hi-Z	Automatic: V <sub>GVDD</sub> > V <sub>GVDDUV</sub>

#### 8.3.3.1 V<sub>BSTx</sub> Undervoltage Lockout (BSTUV)

The DRV8300-Q1 has separate voltage comparator to detect undervoltage condition for each phases. If at any time the voltage on the BSTx pin falls lower than the V<sub>BSTUV</sub> threshold, high side external MOSFETs of that particular phase is disabled by disabling (Hi-Z) GHx pin. Normal operation starts again when the BSTUV condition clears and low to high PWM edge is detected on INHx input of the same phase that BSTUV condition was detected. BSTUV protection ensures that high-side MOSFETs are not driven when the BSTx pins has lower value.

#### 8.3.3.2 GVDD Undervoltage Lockout (GVDDUV)

If at any time the voltage on the GVDD pin falls lower than the V<sub>GVDDUV</sub> threshold voltage, all of the external MOSFETs are disabled. Normal operation starts again when the GVDDUV condition clears. GVDDUV protection ensures that external MOSFETs are not driven when the GVDD input is at lower value.

### 8.4 Device Functional Modes

The DRV8300-Q1 is in operating (active) mode, whenever the GVDD and BST pins are higher than the UV threshold (GVDD > V<sub>GVDDUV</sub> and V<sub>BSTx</sub> > V<sub>BSTUV</sub>). In active mode, the gate driver output GHx and GLx will follow respective inputs INHx and INLx.

## 9 Application and Implementation

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### 备注

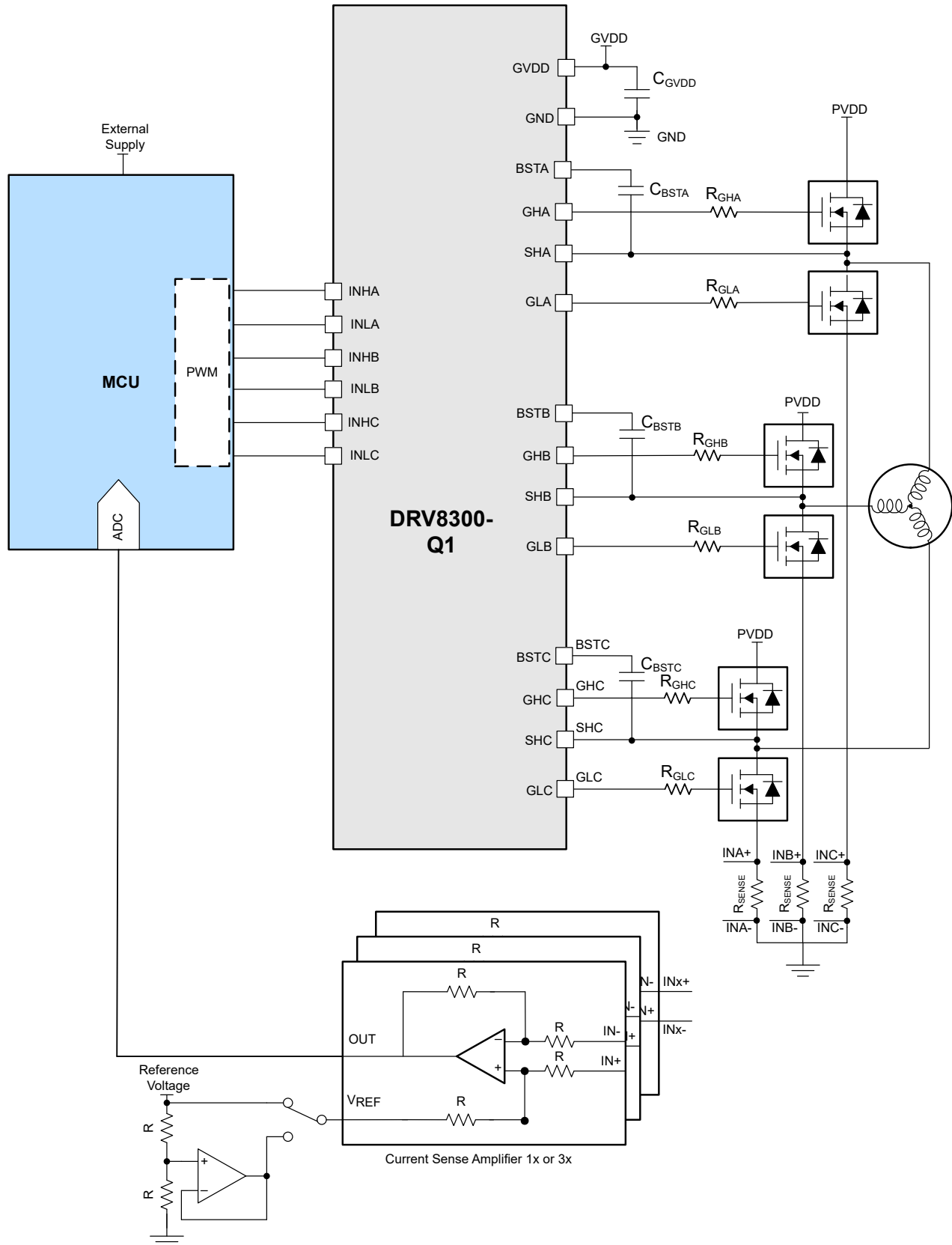
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation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

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### 9.1 Application Information

The DRV8300-Q1 family of devices is primarily used in applications for three-phase brushless DC motor control. The design procedures in the *Typical Application* section highlight how to use and configure the DRV8300-Q1.

## 9.2 Typical Application



**图 9-1. Application Schematic**

## 9.2.1 Design Requirements

表 9-1 lists the example design input parameters for system design.

表 9-1. Design Parameters

EXAMPLE DESIGN PARAMETER	REFERENCE	EXAMPLE VALUE
MOSFET	-	CSD19532Q5B
Gate Supply Voltage	$V_{GVDD}$	12 V
Gate Charge	$Q_G$	48 nC

## 9.2.2 Bootstrap Capacitor and GVDD Capacitor Selection

The bootstrap capacitor must be sized to maintain the bootstrap voltage above the undervoltage lockout for normal operation. 方程式 1 calculates the maximum allowable voltage drop across the bootstrap capacitor:

$$\Delta V_{BSTX} = V_{GVDD} - V_{BOOTD} - V_{BSTUV} \quad (1)$$

$$= 12 \text{ V} - 0.85 \text{ V} - 4.5 \text{ V} = 6.65 \text{ V}$$

where

- $V_{GVDD}$  is the supply voltage of the gate drive
- $V_{BOOTD}$  is the forward voltage drop of the bootstrap diode
- $V_{BSTUV}$  is the threshold of the bootstrap undervoltage lockout

In this example the allowed voltage drop across bootstrap capacitor is 6.65 V. It is generally recommended that ripple voltage on both the bootstrap capacitor and GVDD capacitor should be minimized as much as possible. Many of commercial, industrial, and automotive applications use ripple value between 0.5 V to 1 V.

The total charge needed per switching cycle can be estimated with 方程式 2:

$$Q_{TOT} = Q_G + \frac{I_{LBS\_TRANS}}{f_{SW}} \quad (2)$$

$$= 48 \text{ nC} + 220 \text{ } \mu\text{A} / 20 \text{ kHz} = 50 \text{ nC} + 11 \text{ nC} = 61 \text{ nC}$$

where

- $Q_G$  is the total MOSFET gate charge
- $I_{LBS\_TRAN}$  is the bootstrap pin leakage current
- $f_{SW}$  is the is the PWM frequency

The minimum bootstrap capacitor can then be estimated as below assuming 1V  $\Delta V_{BSTX}$ :

$$C_{BST\_MIN} = Q_{TOT} / \Delta V_{BSTX} \quad (3)$$

$$= 61 \text{ nC} / 1 \text{ V} = 61 \text{ nF}$$

The calculated value of minimum bootstrap capacitor is 61 nF. It should be noted that, this value of capacitance is needed at full bias voltage. In practice, the value of the bootstrap capacitor must be greater than calculated value to allow for situations where the power stage may skip pulse due to various transient conditions. It is recommended to use a 100 nF bootstrap capacitor in this example. It is also recommended to include enough margin and place the bootstrap capacitor as close to the BSTx and SHx pins as possible.

$$C_{GVDD} \geq 10 \times C_{BSTX} \quad (4)$$

$$= 10 \times 100 \text{ nF} = 1 \text{ } \mu\text{F}$$



For this example application choose 1  $\mu\text{F}$   $C_{\text{GVDD}}$  capacitor. Choose a capacitor with a voltage rating at least twice the maximum voltage that it will be exposed to because most ceramic capacitors lose significant capacitance when biased. This value also improves the long term reliability of the system.

### 9.2.3 Application Curves

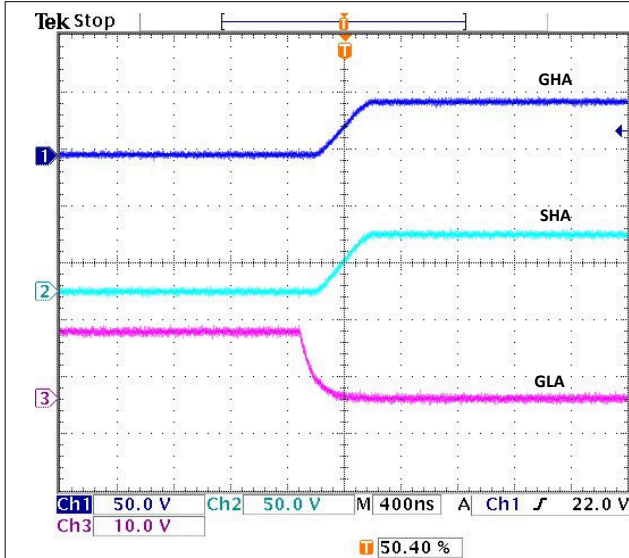


图 9-2. Gate voltages, SHx rising with 15 ohm gate resistor and CSD19532Q5B MOSFET

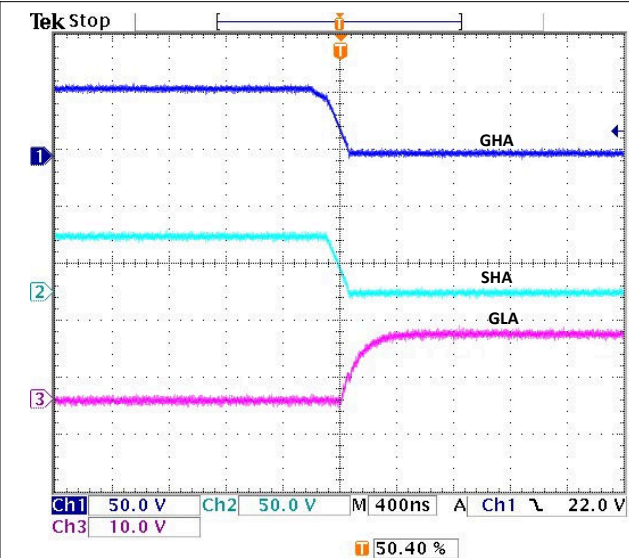


图 9-3. Gate voltages, SHx falling with 15 ohm gate resistor and CSD19532Q5B MOSFET

## 10 Power Supply Recommendations

The DRV8300-Q1 is designed to operate from an input voltage supply (GVDD) range from 4.8 V to 20 V. A local bypass capacitor should be placed between the GVDD and GND pins. This capacitor should be located as close to the device as possible. A low ESR, ceramic surface mount capacitor is recommended. It is recommended to use two capacitors across GVDD and GND: a low capacitance ceramic surface-mount capacitor for high frequency filtering placed very close to GVDD and GND pin, and another high capacitance value surface-mount capacitor for device bias requirements. In a similar manner, the current pulses delivered by the GHx pins are sourced from the BSTx pins. Therefore, capacitor across the BSTx to SHx is recommended, it should be high enough capacitance value capacitor to deliver GHx pulses

## 11 Layout

### 11.1 Layout Guidelines

- Low ESR/ESL capacitors must be connected close to the device between GVDD and GND and between BSTx and SHx pins to support high peak currents drawn from GVDD and BSTx pins during the turn-on of the external MOSFETs.
- To prevent large voltage transients at the drain of the top MOSFET, a low ESR electrolytic capacitor and a good quality ceramic capacitor must be connected between the high side MOSFET drain and ground.
- In order to avoid large negative transients on the switch node (SHx) pin, the parasitic inductances between the source of the high-side MOSFET and the source of the low-side MOSFET must be minimized.
- In order to avoid unexpected transients, the parasitic inductance of the GHx, SHx, and GLx connections must be minimized. Minimize the trace length and number of vias wherever possible. Minimum 10 mil and typical 15 mil trace width is recommended.
- Place the gate driver as close to the MOSFETs as possible. Confine the high peak currents that charge and discharge the MOSFET gates to a minimal physical area by reducing trace length. This confinement decreases the loop inductance and minimize noise issues on the gate terminals of the MOSFETs.
- Refer to sections *General Routing Techniques and MOSFET Placement and Power Stage Routing* in [Application Report](#)

## 12 Device and Documentation Support

### 12.1 接收文档更新通知

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### 12.2 支持资源

**TI E2E™ 支持论坛** 是工程师的重要参考资料，可直接从专家获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题可获得所需的快速设计帮助。

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### 12.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 12.5 术语表

**TI 术语表** 本术语表列出并解释了术语、首字母缩略词和定义。

## 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.

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DRV8300DPWRQ1	ACTIVE	TSSOP	PW	20	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	8300D-Q	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.

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

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**OTHER QUALIFIED VERSIONS OF DRV8300-Q1 :**

- Catalog : [DRV8300](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product



4220206/A 02/2017

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220206/A 02/2017

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



# EXAMPLE STENCIL DESIGN

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

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NOTES: (continued)

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

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