



# TFB0503

## Half-Bridge Gate Driver

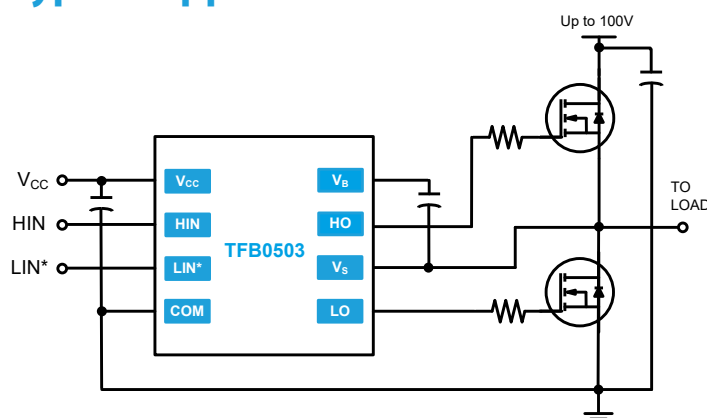
### Features

- Floating high-side driver in bootstrap operation to 100V
- Drives two N-channel MOSFETs or IGBTs in a half bridge configuration
- Integrated bootstrap diode for compact design
- 300mA source/550mA sink output current capability
- Outputs tolerant to negative transients
- Internal dead time of 420ns to protect MOSFETs
- Wide low side gate driver supply voltage: 10V to 20V
- Logic input (HIN and LIN\*) 3.3V capability
- Schmitt triggered logic inputs
- Undervoltage lockout for  $V_{CC}$  (logic and low side supply)
- Extended temperature range: -40°C to +125°C
- Space saving TDFN-10 3x3mm package

### Applications

- Stepper motor drives
- DC-DC Converters
- Battery powered tools
- BLDC motor drive

### Typical Application



### Description

The TFB0503 is a half-bridge gate driver with integrated bootstrap diode capable of driving N-channel MOSFETs and IGBTs in a half-bridge configuration. TF Semiconductor's advanced process enables the floating high-side driver to operate to 100V in a bootstrap configuration.

The TFB0503 logic inputs are compatible with standard TTL and CMOS levels (down to 3.3V) to interface easily with controlling devices. The driver outputs feature high pulse current buffers designed for minimum driver cross conduction. TFB0503 has a fixed internal deadtime of 420ns (typical).

To simplify design and decrease the BOM, the TFB0503 has an integrated bootstrap diode. Also the TFB0503 is offered in a space saving TDFN-10 package and operates over an extended -40 °C to +125 °C temperature range.



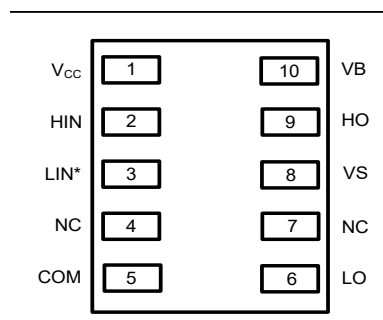
TDFN-10

Year Year Week Week

### Ordering Information

PART NUMBER	PACKAGE	PACK / Qty	MARK
TFB0503-NHS	TDFN-10	Tube / 120	YYWW TFB0503
TFB0503-NHP	TDFN-10	T&R / 3,000	

## Pin Diagrams

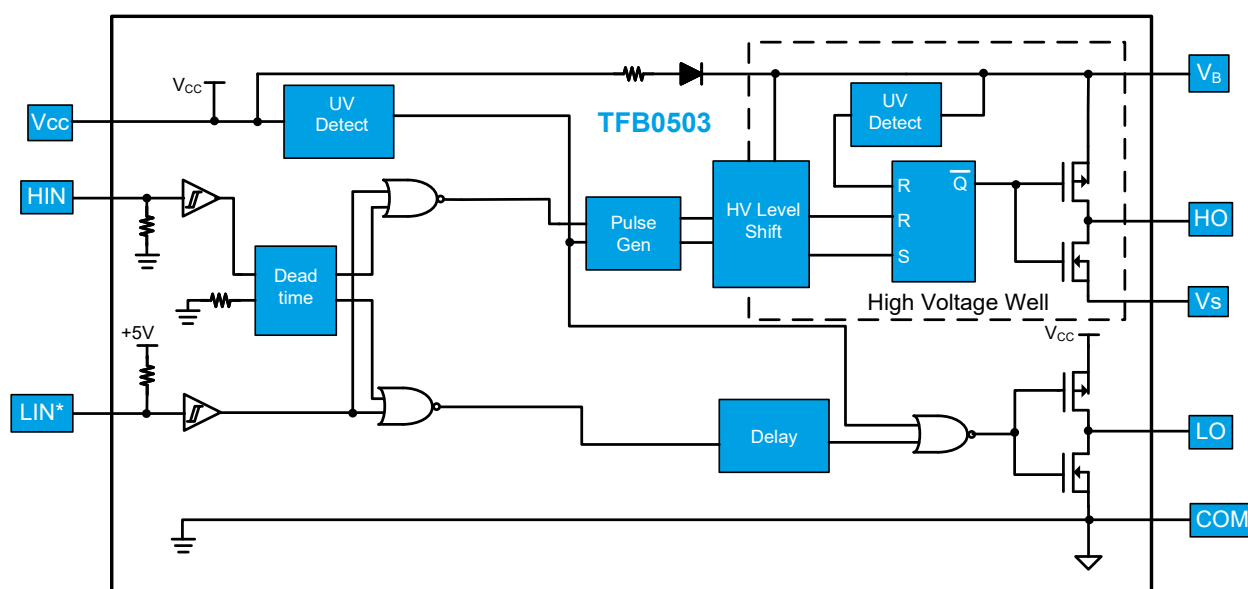


Top View: TDFN-10

## Pin Descriptions

PIN NAME	PIN NUMBER	PIN DESCRIPTION
V <sub>CC</sub>	1	Logic and low side supply
HIN	2	Logic input for high-side gate driver output in phase with HO
LIN*	3	Logic input for low-side gate driver output out of phase with LO
NC	4, 7	No connect
COM	5	Low-side and logic return
LO	6	Low-side gate drive output
V <sub>S</sub>	8	High-side floating supply return
HO	9	High-side gate drive output
V <sub>B</sub>	10	High-side floating supply

## Functional Block Diagram





## Half-Bridge Gate Driver

## Absolute Maximum Ratings (NOTE1)

$V_B$  - High side floating supply voltage.....-0.3V to +124V  
 $V_S$  - High side floating supply offset voltage... $V_B$ -24V to  $V_B$ +0.3V  
 $V_{HO}$  - High side floating output voltage..... $V_S$ -0.3V to  $V_B$ +0.3V  
 $dV_S/dt$  - Offset supply voltage transient.....50 V/ns

$V_{CC}$  - Low-side fixed supply voltage.....-0.3V to +24V  
 $V_{LO}$  - Low-side output voltage.....-0.3V to  $V_{CC}$ +0.3V  
 $V_{IN}$  - Logic input voltage (HIN and LIN\*).....-0.3V to  $V_{CC}$ +0.3V

**NOTE1** 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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

$P_D$  - Package power dissipation at  $T_A \leq 25^\circ\text{C}$   
 TDFN-10.....0.4W

## TDFN-10 Thermal Resistance (NOTE2)

$\theta_{JA}$ .....64°C/W  
 $\theta_{JC}$ .....42°C/W

$T_J$  - Junction operating temperature.....+150 °C  
 $T_L$  - Lead Temperature (soldering, 10 seconds).....+300 °C  
 $T_{stg}$  - Storage temperature .....-55 to 150 °C

**NOTE2** When mounted on a standard JEDEC 2-layer FR-4 board.

## Recommended Operating Conditions

Symbol	Parameter	MIN	MAX	Unit
$V_B$	High side floating supply absolute voltage	$V_S + 10$	$V_S + 20$	V
$V_S$	High side floating supply offset voltage	<b>NOTE3</b>	100	V
$V_{HO}$	High side floating output voltage	$V_S$	$V_B$	V
$V_{CC}$	Low side fixed supply voltage	10	20	V
$V_{LO}$	Low side output voltage	0	$V_{CC}$	V
$V_{IN}$	Logic input voltage (HIN and LIN*)	0	5	V
$T_A$	Ambient temperature	-40	125	°C

**NOTE3** Logic operational for  $V_S$  of -5V to +100V.



## DC Electrical Characteristics (NOTE4)

$V_{BIAS} (V_{CC}, V_{BS}) = 15V, T_A = 25^\circ C$ , unless otherwise specified.

Symbol	Parameter	Conditions	MIN	TYP	MAX	Unit
$V_{IH}$	Logic "1" (HIN) & Logic "0" (LIN*) input voltage	$V_{CC} = 10V$ to $20V$ <b>NOTES</b>	2.5			V
$V_{IL}$	Logic "0" (HIN) & Logic "1" (LIN*) input voltage					
$V_{OH}$	High level output voltage, $V_{BIAS} - V_O$	$I_O = 2mA$		0.05	0.2	
$V_{OL}$	Low level output voltage, $V_O$	$I_O = 2mA$		0.02	0.1	
$I_{LK}$	Offset supply leakage current	$V_B = V_S = 100V$			50	$\mu A$
$I_{BSQ}$	Quiescent $V_{BS}$ supply current	$V_{IN} = 0V$ or $5V$		7	50	
$I_{CCQ}$	Quiescent $V_{CC}$ supply current	$V_{IN} = 0V$ or $5V$		350	500	
$I_{IN+}$	Logic "1" input bias current	$HIN = 5V, LIN^* = 0V$		3	10	
$I_{IN-}$	Logic "0" input bias current	$HIN = 0V, LIN^* = 5V$			5	
$V_{CCUV+}$	$V_{CC}$ supply under-voltage positive going threshold		7.0	8.4	9.8	V
$V_{CCUV-}$	$V_{CC}$ supply under-voltage negative going threshold		6.5	7.8	9.3	
$V_{BSUV+}$	$V_{BS}$ supply under-voltage positive going threshold			4.5		V
$V_{BSUV-}$	$V_{BS}$ supply under-voltage negative going threshold			3.7		V
$I_{O+}$	Output high short circuit pulsed current	$V_O = 0V, PW \leq 10 \mu s$	130	300		mA
$I_{O-}$	Output low short circuit pulsed current	$V_O = 15V, PW \leq 10 \mu s$	270	550		

**NOTE4** The  $V_{IH}$ ,  $V_{IL}$ , and  $I_{IN}$  parameters are applicable to the two logic input pins: HIN and LIN\*. The  $V_O$  and  $I_O$  parameters are applicable to the respective output pins: HO and LO.

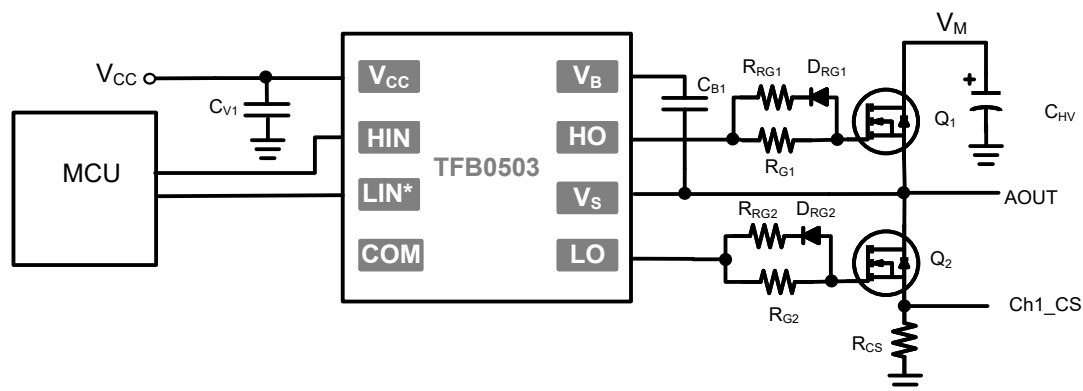
**NOTES** For optimal operation, it is recommended that the input pulse (to HIN and LIN\*) should have an amplitude of 2.5V minimum with a pulse width of 840ns minimum.

**AC Electrical Characteristics**

$V_{BIAS} (V_{CC}, V_{BS}) = 15V$ ,  $C_L = 1000pF$ , and  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified.

Symbol	Parameter	Conditions	MIN	TYP	MAX	Unit
$t_{on}$	Turn-on propagation delay	$V_S = 0V$		560	820	ns
$t_{off}$	Turn-off propagation delay	$V_S = 600V$		150	220	
$t_{DM}$	Delay matching, HS & LS turn-on/turn-off				70	
$t_r$	Turn-on rise time	$V_S = 0V$		80	170	
$t_f$	Turn-off fall time			35	90	
$t_{DT}$	Deadtime: $t_{DT\ LO-HO}$ & $t_{DT\ HO-LO}$		300	420	650	

## Application Information

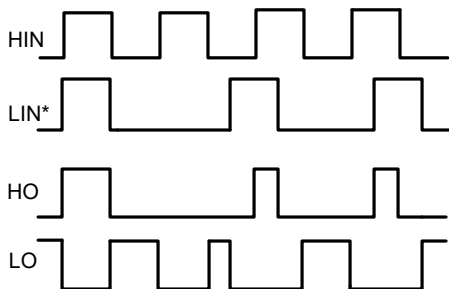


**Figure 6.** Single phase (of four) for Stepper motor driver application using the TFB0503

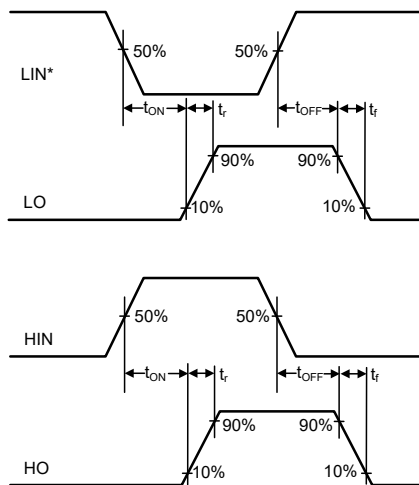
- R<sub>RG1</sub> and R<sub>RG2</sub> values are typically between 0Ω and 10Ω, exact value decided by MOSFET junction capacitance and drive current of gate driver; 10Ω is used in this example.
- R<sub>G1</sub> and R<sub>G2</sub> values are typically between 20Ω and 100Ω, exact value decided by MOSFET junction capacitance and drive current of gate driver; 50Ω is used in this example.
- R<sub>B1</sub> value is typically between 3Ω and 20Ω, exact value depending on bootstrap capacitor value and amount of current limiting required for bootstrap capacitor charging; 10Ω is used in this example. Also DB should be an ultra fast diode of 1A rating minimum and voltage rating greater than system operating voltage.
- It is recommended that the input pulse (to HIN and LIN\*) should have an amplitude of 2.5V minimum (for VDD=15V) with a minimum pulse width of 840ns.



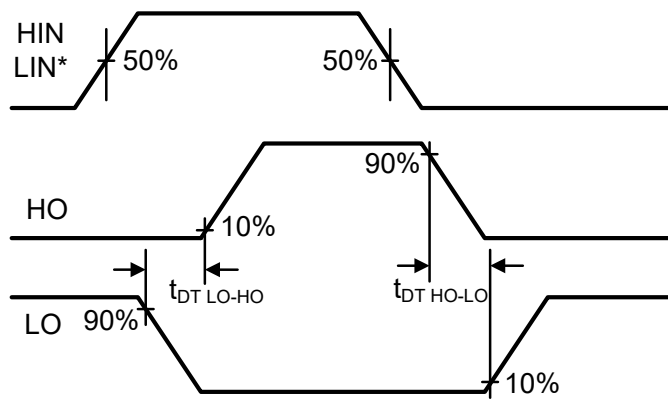
# Timing Waveforms



**Figure 1.** Input / Output Timing Diagram



**Figure 2.** Switching Time Waveform Definitions

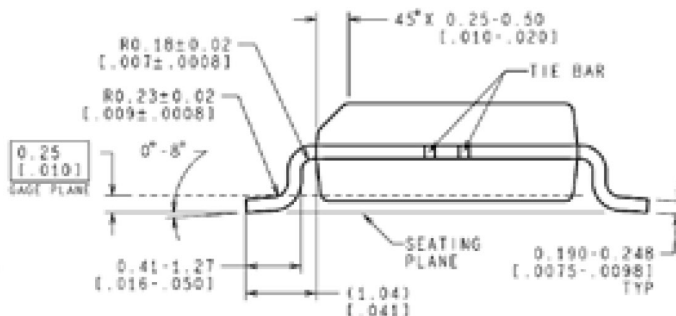
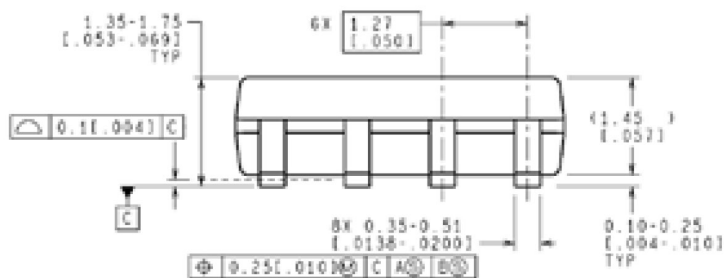
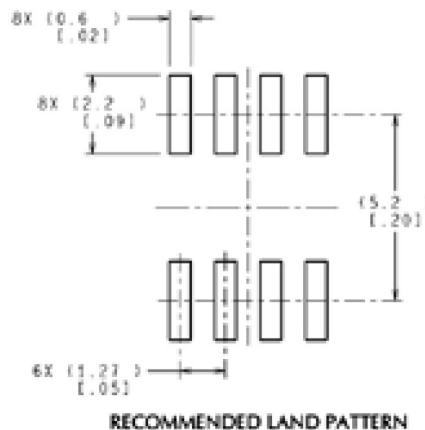
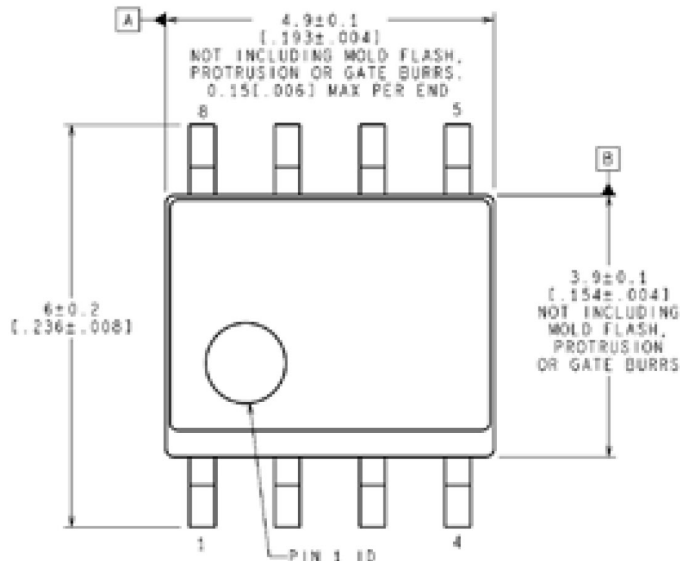


**Figure 3.** Deadtime Waveform Definitions



## Package Dimensions (SOIC-8 N)

Please contact support@telefunkensemi.com for package availability.



NOTES: UNLESS OTHERWISE SPECIFIED

1. REFERENCE JEDEC REGISTRATION MS-012, VARIATION AA.

CONTROLLING DIMENSION IS MILLIMETER  
VALUES IN [ ] ARE INCHES  
DIMENSIONS IN ( ) FOR REFERENCE ONLY





## Revision History

Rev.	Change	Owner	Date
1.0	First release, AI datasheet	Keith Spaulding	11/28/2022

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