



# TFB0504

## Half-Bridge Gate Driver

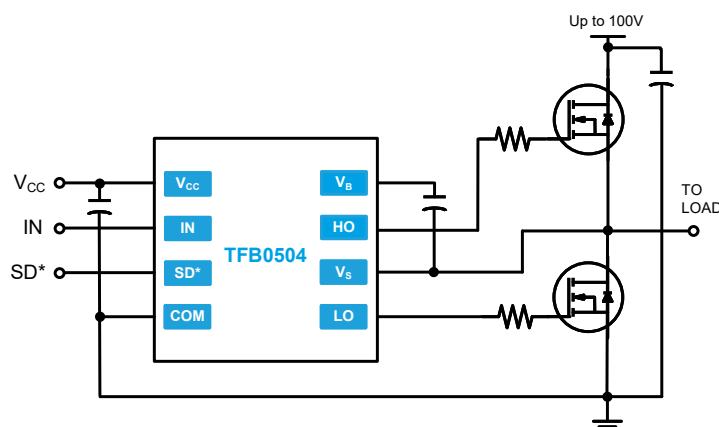
### Features

- 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 (IN and SD\*) 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 TFB0504 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 TFB0504 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. TFB0504 has a fixed internal deadtime of 420ns (typical).

To simplify design and decrease the BOM, the TFB0504 has an integrated bootstrap diode. Also the TFB0504 is offered in a space saving TDFN-10 package and operates over an extended -40 °C to +125 °C temperature range.



TDFN-10

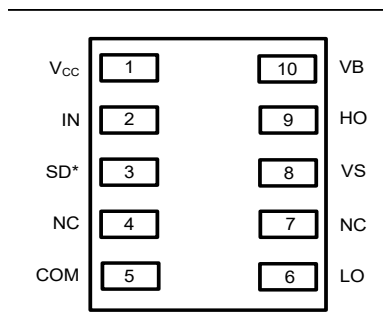
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### Ordering Information

PART NUMBER	PACKAGE	PACK / Qty	MARK
TFB0504-NHS	TDFN-10	Tube / 120	YYWW TFB0504
TFB0504-NHP	TDFN-10	T&R / 3,000	



**Pin Diagrams**

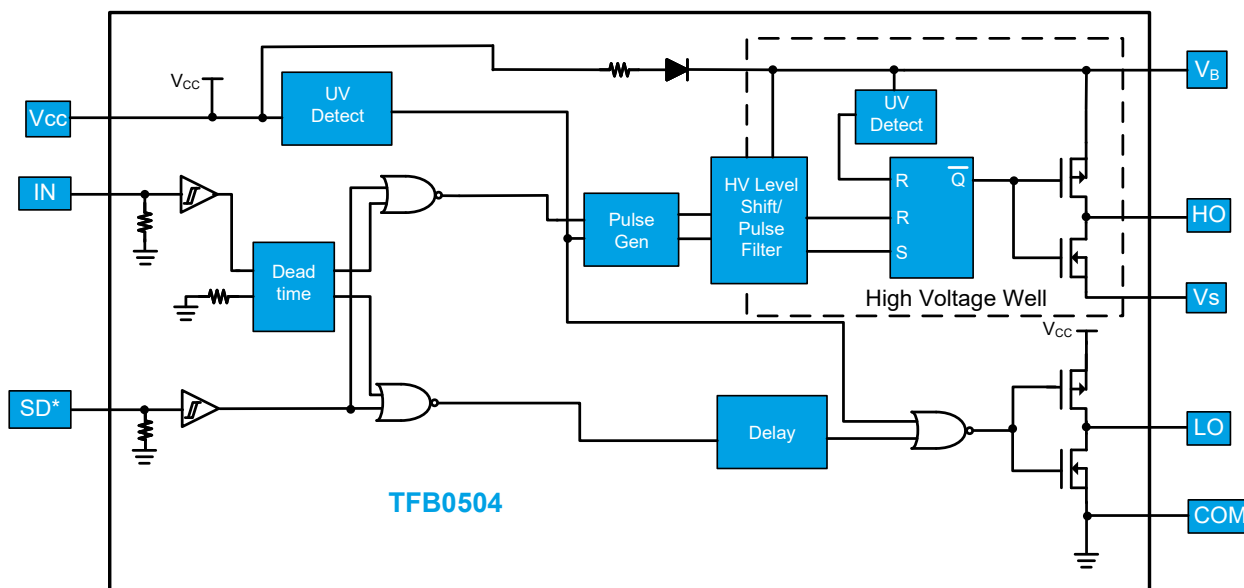


**Top View: TDFN-10**

**Pin Descriptions**

PIN NAME	PIN NUMBER	PIN DESCRIPTION
V <sub>CC</sub>	1	Logic and low side supply
IN	2	Logic input for high-side and low-side gate driver outputs (HO and LO), in phase with HO
SD*	3	Logic input for shutdown, enabled low turns off HO and 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.....50V/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 (IN and SD\*).....-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 (IN and SD*)	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" (IN) & Logic "0" (SD*) input voltage	$V_{CC} = 10V$ to $20V$ <b>NOTES</b>	2.5			V
$V_{IL}$	Logic "0" (IN) & Logic "1" (SD*) 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	$IN = 5V, SD^* = 0V$		3	10	
$I_{IN-}$	Logic "0" input bias current	$IN = 0V, SD^* = 5V$			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		3.6	4.5	5.6	V
$V_{BSUV-}$	$V_{BS}$ supply under-voltage negative going threshold		3.0	3.7	4.6	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: IN and SD\*. The  $V_O$  and  $I_O$  parameters are applicable to the respective output pins: HO and LO.

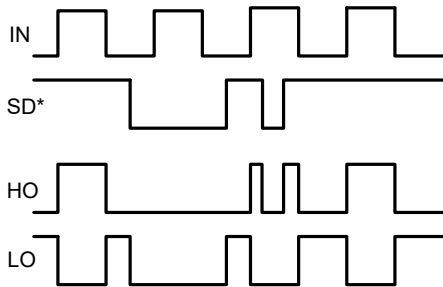
**NOTES** For optimal operation, it is recommended that the input pulse (to IN and SD\*) should have an amplitude of 2.5V minimum with a pulse width of 840ns minimum.

**AC Electrical Characteristics**

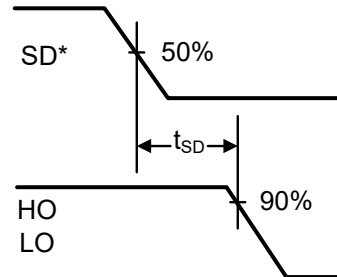
$V_{BIAS} (V_{CC}, V_{BS}) = 15V$ ,  $C_L = 1000pF$ , and  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified.

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	

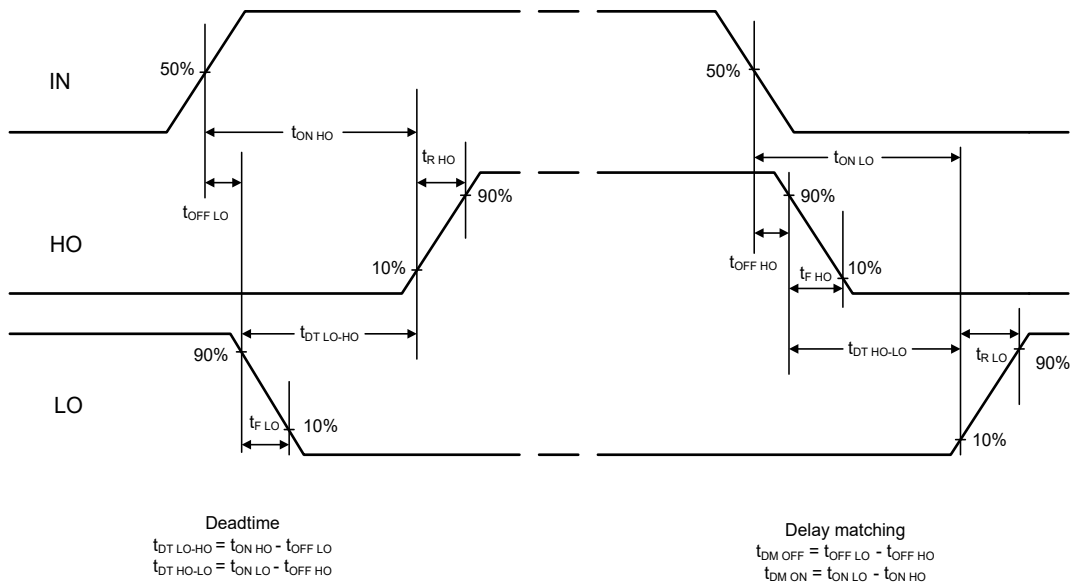
# Timing Waveforms



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



**Figure 2.** Shutdown Waveform Definition

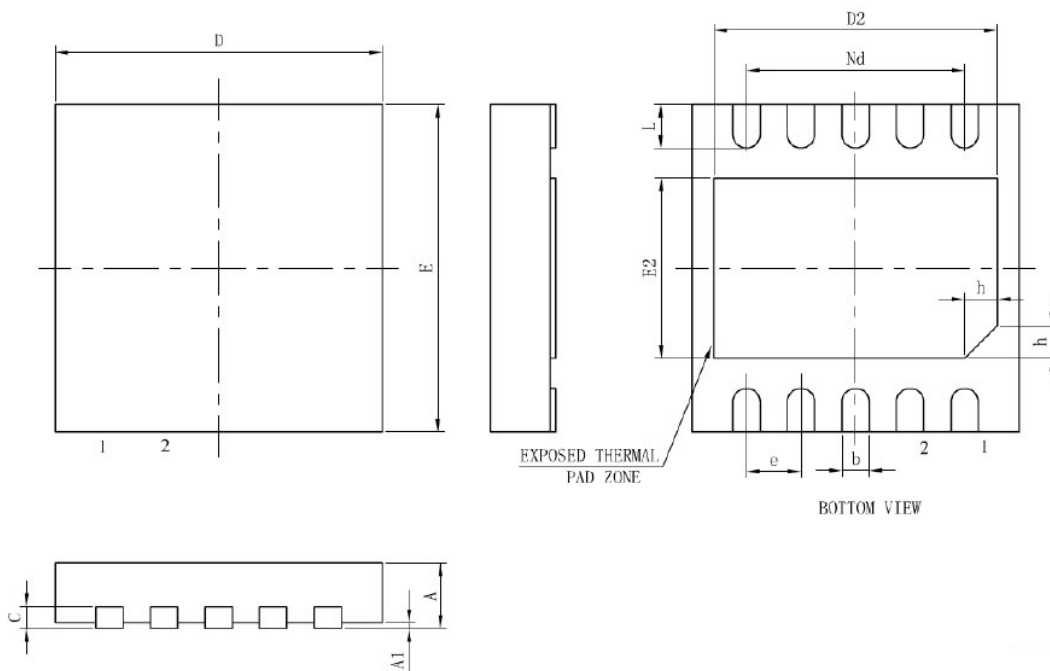


**Figure 3.** Switching time waveform definitions



## Package Dimensions (TDFN-10)

Please contact support@tfsemi.com for package availability.



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	—	0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	2.90	3.00	3.10
D2	2.40	2.50	2.60
c	0.50BSC		
Nd	2.00BSC		
E	2.90	3.00	3.10
E2	1.45	1.55	1.65
L	0.30	0.40	0.50
h	0.20	0.25	0.30



## Revision History

Rev.	Change	Owner	Date
1.0	First release, AI datasheet	Keith Spaulding	6/7/2023

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