Datasheet

FD2004D

24V Half-bridge Gate Driver

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FD2004D 24V Half-bridge Gate Driver

1 System Introduction

1.1 Overview

The FD2004D is a half-bridge gate drive IC designed for driving N-type MOSFETs at high frequency and speed with integrated bootstrap diodes. The FD2004D has a built-in under voltage (UVLO) protection function which prevents the MOSFET from operating at too low voltage and improves efficiency. The FD2004D has built-in pass-through prevention and dead time settings to prevent the MOSFETs on the high and low side of the drive from passing straight through, which can effectively protecting the power device. The FD2004D integrates the enable & shutdown functions for simultaneous shutdown of hi-channel and lo-channel outputs.

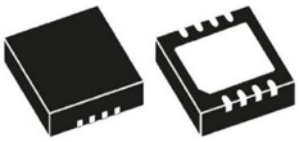
1.2 Applications

- Half/full bridge converters
- Double-ended Forward Converters
- Motor drive

1.3 Characteristics

- Absolute voltage of suspension: +20V
- Built-in bootstrap diode
- Supply voltage: 4.4 ~ 16V
- Compatible voltages for input logic: 3.3V/5V
- VCC undervoltage protection (UVLO)
- Built-in dead time
- Integrated enable shutdown function
- High side output in phase with the input, low side output out of phase with the input
- High and low channel matching

1.4 Packaging



DFN8(3*3)

1.5 Pinout of the chip

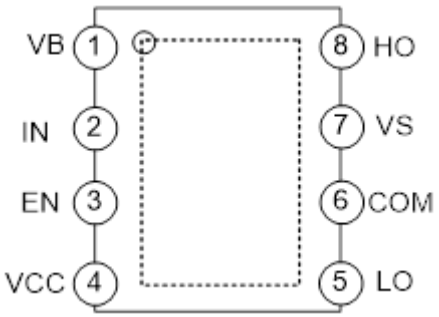


Figure 1-1 Pinout of the FD2004D

1.5.1 Pin Description

Pin number	Pin Name	Pin Description
1	VB	Floating absolute voltage on the high side
2	IN	Input
3	EN	Enabled switch-off input
4	VCC	Supply voltage on low side
5	LO	Output on the low side
6	COM	Grounding
7	VS	Floating offset voltage on the high side
8	HO	Output on the high side

Table 1-1 FD2004D DFN8(3*3) 1.5.1 Pin Description

1.6 Circuit block diagram

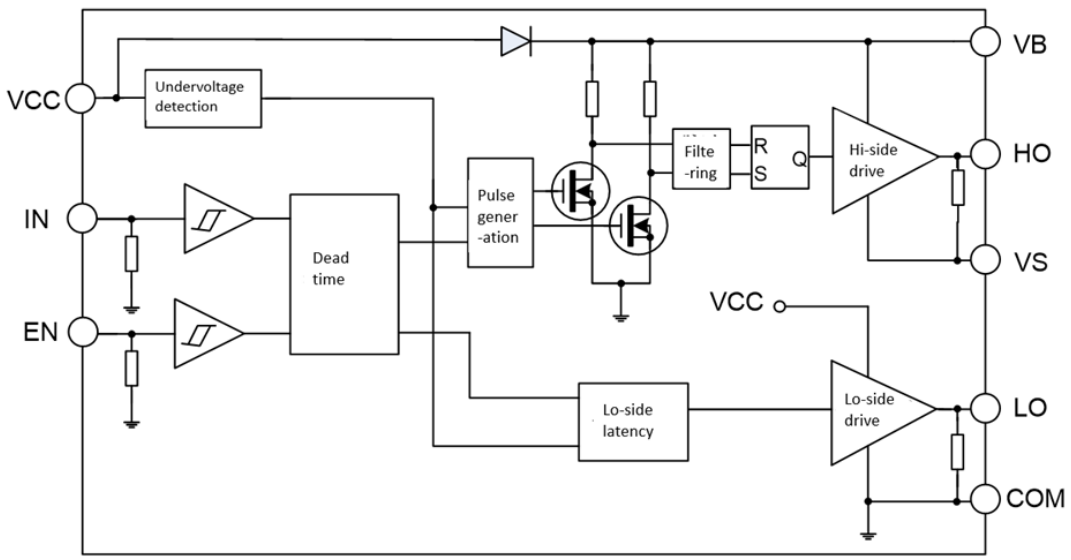


Figure1-2 Circuit Block Diagram of FD2004D

1.7 Typical application circuit

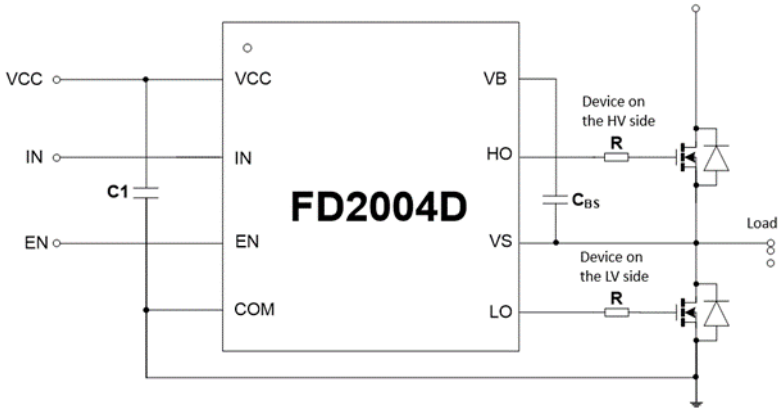


Figure1-3 FD2004D Typical application circuit

Notes:

[1] C1: Power supply filter capacitor, depending on the circuit, can be selected from 1μF ~ 10μF;

[2] R: Gate drive resistor, resistance value depends on the driven device;

[3] C_{BS}: Bootstrap capacitor. Ceramic or tantalum capacitors should be selected from 0.1μF ~ 10μF.

1.8 Logic Timing Diagram

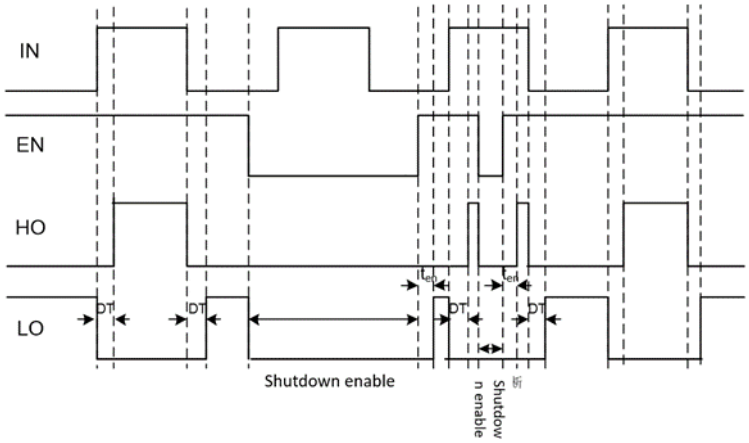


Figure 1-4 FD2004D Logic Timing Diagram

1.9 Test criteria for switching time

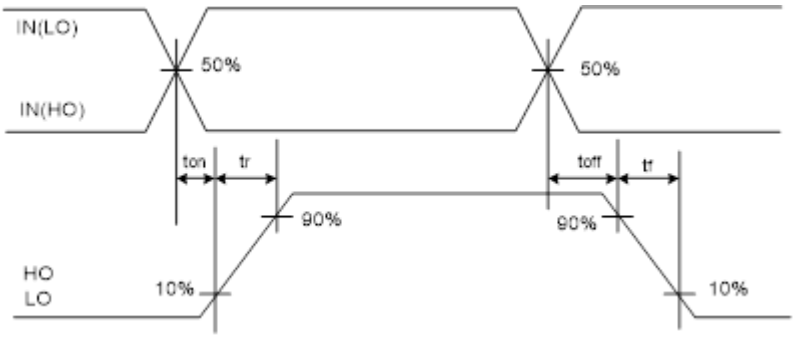


Figure 1-5 FD2004D Test criteria for switching time Diagram

1.10 Test criteria for transmission time matching

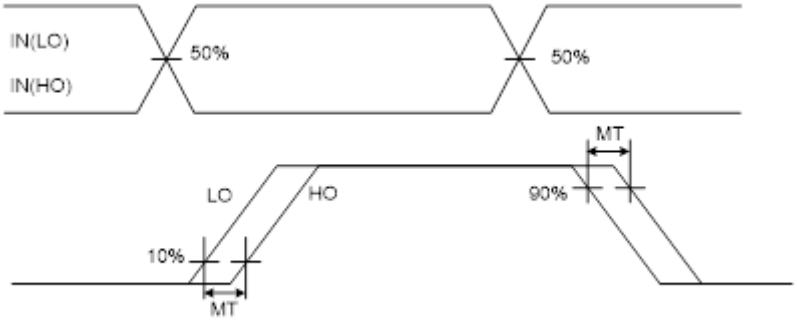


Figure 1-6 FD2004D Test criteria for transmission time matching Diagram

1.11 Test criteria for the time shutdown enabling

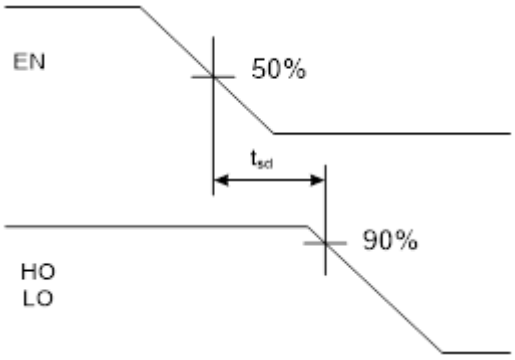


Figure 1-7 FD2004D Test criteria for the time shutdown enabling Diagram

2 Package size

2.1 DFN8(3*3)

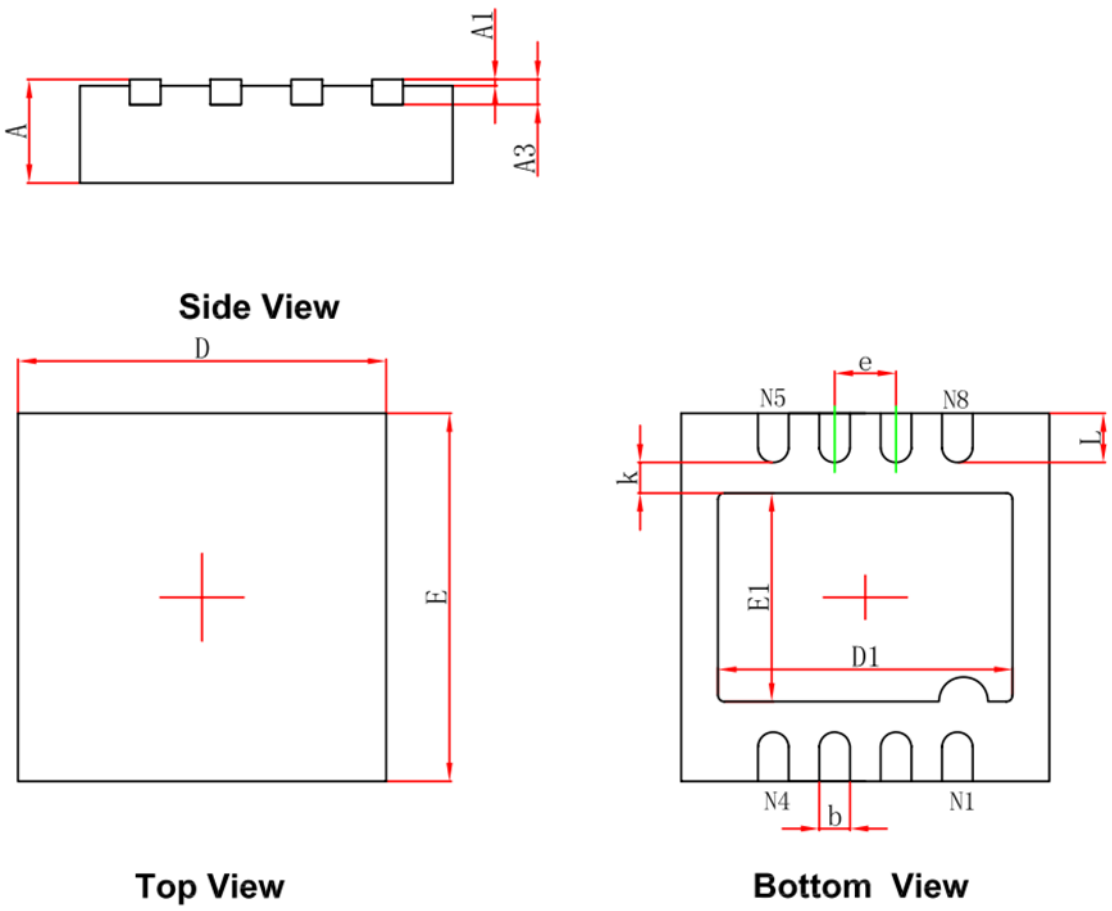


Figure 2-1 DFN8(3*3) Package Outline Dimensions

Table 2-1 Package Size Table of DFN8(3*3)

Symbol	Dimensions In Millimeter			
	Min.	Max.	Min.	Max.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1		0.050		0.002
A3	0.203REF		0.008REF	
D	2.924	3.076	0.115	0.121
E	2.924	3.076	0.115	0.121
D1	2.300	2.500	0.091	0.098
E1	1.600	1.800	0.063	0.071
k	0.200MIN.		0.008MIN.	
b	0.200	0.300	0.800	0.012
e	0.500TYP		0.020TYP	
l	0.324	0.476	0.013	0.019

3 Ordering Information

Table 3-1 Model Options

Model number	Form of package	Marking	Packaging	Quantity
FD2004D	DFN8(3*3) (Example)	FD2004D (Example)	Tape & Reel (Example)	5000 (Example)

4 Electrical Characteristics

4.1 Absolute Maximum Ratings

Table 4-1 Absolute Maximum Ratings[1]

(Unless otherwise stated, all pins are referenced to COM)

Parameters		Symbols	Range	Unit
Floating absolute voltage on the high side		V_B	-0.3 ~ 24	V
High-side floating offset voltage		V_S	V_B-16 ~ VB + 0.3	V
High-side output voltage		V_{HO}	V_S-0.3 ~ VB + 0.3	V
Low side supply voltage		V_{CC}	-0.3 ~ 16	V
Low-side output voltage		V_{LO}	-0.3 ~ V_{CC} + 0.3	V
Logic input voltage (IN, EN)		V_{IN}	-0.3 ~ 6.5	V
Range of offset voltage swings		dV_S/dt	≤ 50	V/ns
Power consumption @T_A ≤ 25°C	DFN8	PD	2.5	W
Thermal resistance of the junction to environment	DFN8	RthJA	50	°C/W
Junction temperature range		T_j	≤ 150	°C
Environmental temperature of operation		T_A	-40 ~ 125	°C
Temperature range for storage		T_{stg}	-55 ~ 150	°C

Notes:

[4] Voltage exceeding the absolute maximum rating may damage the chip;

[5] In any case, do not exceed the PD.

4.2 Recommended Operating Conditions

Table 4-2 Recommended Operating Conditions

(All voltages are referred to COM)

Parameters	Symbols	Minimum	Maximum	Unit
High-side floating absolute voltage	V_{BS}	V_S + 4.4	V_S + 16	V
Floating offset voltage on static high side	V_{SN}	-3	20	V
High-side output voltage	V_{HO}	V_S	V_B	V
Low-side supply voltage	V_{CC}	4.4	16	V
Low-side output voltage	V_{LO}	0	V_{CC}	V
Logic input voltage (IN, EN)	V_{IN}	0	6.0	V
Environmental temperature	T_A	-40	125	°C

4.3 Electric parameters

Table 4-3 Global Electrical Characteristics

(T_A = 25°C, VCC = 15V, unless otherwise specified)

Parameters	Symbol	Test Condition	Minimum	Typical	Maximum	Unit
Power supply current						
VCC operating voltage range	V_{CC}		4.4	--	16	V
VCC static current	I_{QCC}	V_{EN} = 0V	--	0.56	0.8	mA
Leakage currents in suspended power	I_{LK}	V_B = V_S = 20V	--	0.1	5.0	μA
Input IN/EN						
Hi-level input threshold voltage	V_{IH}		2.7	2.2	--	V
Lo-level input threshold voltage	V_{IL}		--	1.4	0.8	V
Hi-level input bias current	$I_{IN/EN+}$	$V_{IN/EN}$ = 5V	--	65	100	μA
Lo-level input bias current	$I_{IN/EN-}$	$V_{IN/EN}$ = 0V	--	--	2	μA
UVLO						
VCC opening voltage for undervoltage protection	V_{CCUV+}		3.4	3.9	4.4	V
VCC switch-off voltage for undervoltage protection	V_{CCUV-}		3.2	3.7	4.2	V
VCC hysteresis voltage for undervoltage protection	V_{CCUVH}		--	0.2	--	V
Bootstrap diode						
Forward voltage	V_{F1}	I_S = 10mA	---	0.75	---	V
	V_{F2}	I_S = 50mA	---	0.95	---	V
High-end output						
High-level output voltage	V_{OHH}	I_O = -100mA	--	0.2	0.36	V

Parameters	Symbol	Test Condition	Minimum	Typical	Maximum	Unit
Low-level output voltage	V_{OLH}	I_O = 100mA	--	0.1	0.18	V
High-level output short-circuit pulse current	I_{OHH}	V_O=0V	2.0	3.2	--	A
Low-level output short-circuit pulse current	I_{OLH}	V_O=12V	2.0	3.0	--	A
Low-end output						
High-level output voltage	V_{OHL}	I_O = -100mA	--	0.2	0.36	V
Low-level output voltage	V_{OLL}	I_O = 100mA	--	0.1	0.18	V
High-level output short-circuit pulse current	I_{OHL}	V_O = 0V	2.0	3.2	--	A
Low-level output short-circuit pulse current	I_{OLL}	V_O = 12V	2.0	3.0	--	A
Switching time parameters						
Transmission time of the output rising edge	t_{on}		--	80	--	ns
Transmission time of the output falling edge	t_{off}		--	40	--	ns
Deadtime	DT		--	50	--	ns
Transmission time of the output rising edge	t_r	C_L = 3000pF	--	45	--	ns
Transmission time of the output falling edge	t_f	C_L = 3000pF	--	40	--	ns
High and low-side delay matching	MT		--	--	30	ns
Delay time for enabling shutdown	t_{sd}		--	40	--	ns

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