FT3206D

Three Phase Sine-wave Sensorless Motor Driver

Overview

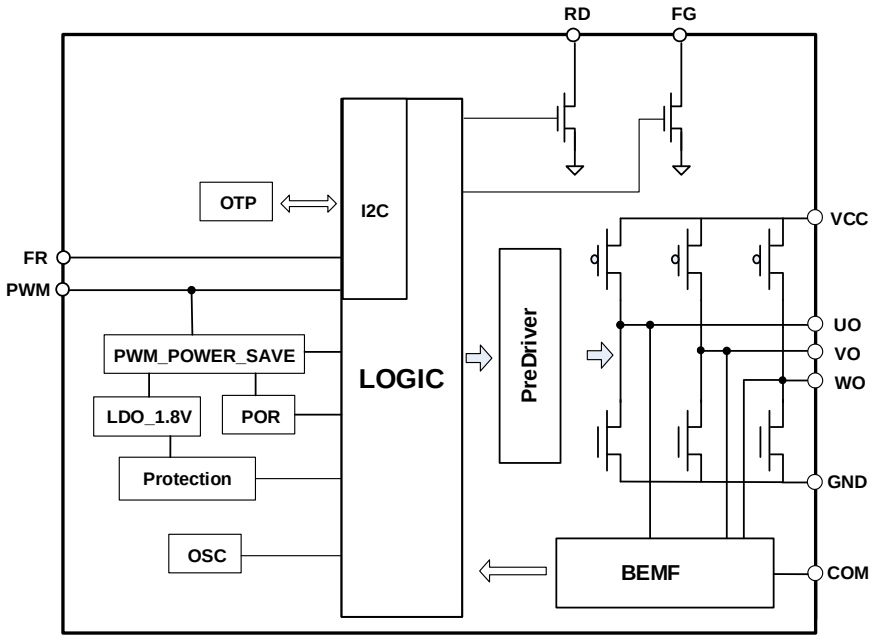
The FT3206D is a three-phase sensorless brushless DC motor driver IC designed for low noise and low voltage applications.It drives the motor sinusoidally, giving low noise performance. The FT3206D has useful functions such as start-up circuit, Pulse Width Modulation (PWM) speed control, RD\FG output for different control applications, as well as protective features such as lock and thermal protection. FT3206D is best suited for silent applications such as game consoles or CPU fans. It is available in DFN3x3-10 package.

Protection functions of FT3206D are comprehensive, including lock protection and automatic recovery, thermal shutdown. These prevent the control circuits and the motor from being damaged, particularly under stressed applications and demanding environments.

Feature

- Three-Phase class Sine-wave driver method
- Three-Phase Sensor-Less Drive Method
- Built-In External PWM Speed Control
- Built-In Quick Start Function
- FG (Rotation Speed Detection) Output
- RD (Rotation Detection) Output
- Soft Switching Circuit (for Noise reduction)
- Power Saving Function (when input PWM Duty Cycle is (0%)
- Built-In Lock Protection and Auto Restart Function
- Built-in thermal shutdown protection (TSD)
- FG division for different pole paired motors
- I2C interface for parameter setting and internal OTP write support
- Low Rds (0.7Ω)

Block Diagram



1. Pin Assignment

Package：DFN10 (3x3)

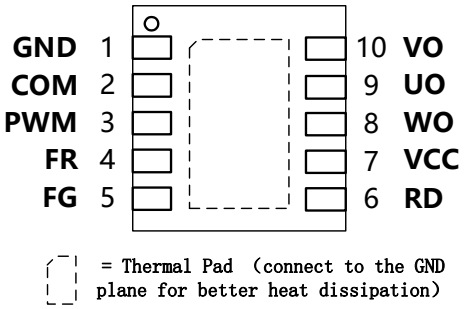


Table 1 Pin Configuration

Pin No.	Pin Name	I/O	Description
1	GND	GND	Ground Pin
2	COM	I	Motor Neutral Point Input Pin
3	PWM	I	PWM Signal Input Pin. Input PWM signal to control rotation speed.
4	FR	I	Motor Spin Direction Control Pin.
5	FG	O	Rotation Speed Output.
6	RD	I	Rotation Detection Output.
7	VCC	POWER	Supply Voltage Input Pin.
8	WO	O	Driver Output Pin. Output signal for driving motor phase W.
9	UO	O	Driver Output Pin. Output signal for driving motor phase U.
10	VO	O	Driver Output Pin. Output signal for driving motor phase V.

2. Absolute Maximum Ratings (@Ta=25℃)

Stresses exceeding the absolute maximum ratings may damage the device. The device may be damaged or may not function or be operational above these ratings and stressing the device to/above these levels is not recommended. Fortior does not recommend exceeding or designing about the Absolute Maximum Ratings.

Table 2

Parameter	Symbol	Condition	Ratings	Unit
Power supply voltage	VCC max		7	V
Output current	IOUT max		1	A
Driver output pin withstand voltage	Vmot max		7	V
Logic input pin withstand voltage	Vlogic max		7	V
RD/FG output pin withstand voltage	VRD/FG max		7	V
RD/FG output current	IRD/FG max		10	mA
Operating temperature	Topr		-40 ~ +105	℃
Storage temperature	Tstg		-65 ~ +150	℃
Thermal Resistance-Junction to Ambient NOTE1	θ_{JA}		93	℃/W
Thermal Resistance-Junction to Case NOTE2	θ_{JC}		42	℃/W

NOTE1：θ_{JA} is measured with the component mountend on a 76.2mm × 114.3mm × 1.6mm glass epoxy board (one-layer) in free air,

NOTE2：The junction-to-case thermal resistance is obtained by simulatinga cold plate test on the exposed (power) pad. No specificJEDEC standard test exists,but a close description can be found in the ANSI SEMI standard G30-88.

3. Recommended Operating Conditions

Table 3

Parameter	Symbol	Condition	Ratings	Unit
Power supply voltage	VCC		2~6	V
Output current	IO	UO/VO/WO Average Output Current	0~500	mA

4. Electrical Characteristics

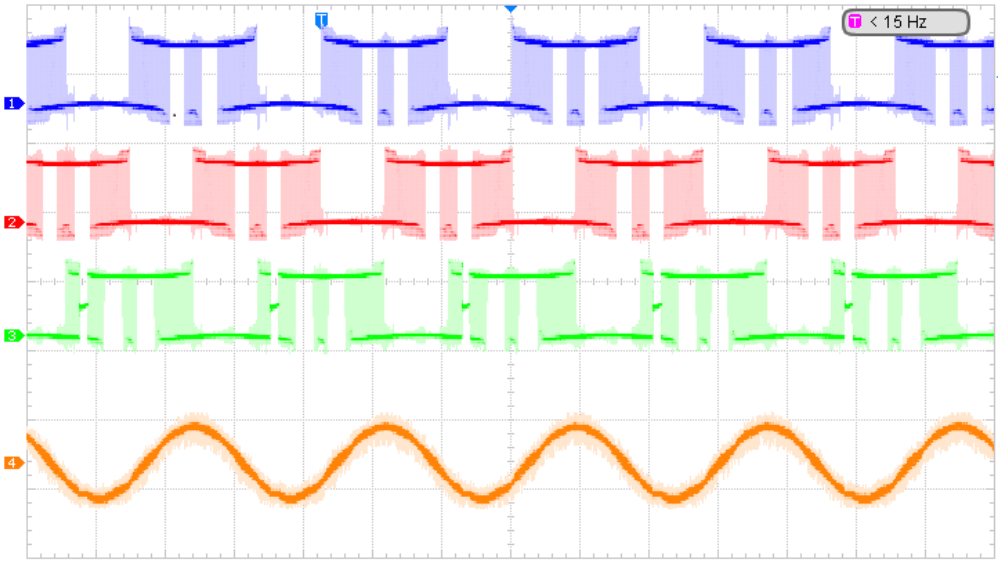
Table 4 (Unless otherwise specified, Ta = 25℃, VCC = 5 V)

Parameter	Symbol	Condition	Ratings			Unit
			Min.	Typ.	Max.	
Power supply current 1	$I_{CC}1$	Working current	-	5	-	mA
Power supply current 2	$I_{CC}2$	Standby current	-	100	-	uA
Output Block						
High-side switch ON resistance	Ron (H)	I_O = 0.5A	-	0.4	0.7	Ω
Low-side switch ON resistance	Ron (L)	I_O = 0.5A	-	0.3	0.5	Ω
Digital I/O Section — PWM、FR						
Digital high-level input voltage	Vdinh	-	3.0	-	VCC+0.3	V
Digital low-level input voltage	Vdinl	-	-0.3	-	0.8	V
PWM High Input Current	I_{PWMH}	PWM=VCC	-	0	-	uA
PWM Low Input Current	I_{PWML}	PWM=GND	-	7	-	uA
Digital I/O internal pull up resistor	Rdio	-	-	70k	-	ohm
PWM Input Frequency	F_{PWM}		0.2	-	50	kHz
RD/FG Output Pin						
RD/FG output low-level voltage	V_{RDFG}	When I_O = 5 mA	-	0.1	0.2	V
LOCK PRPTECTION NOTE2						
Lock Detection Off Time	T_{OFF}		-	5	-	s
Thermal Protection Circuit						
Thermal protection circuit operating temperature	TSD	Design target	-	165	-	℃
Temperature hysteresis width	ΔTSD	Design target	-	30	-	℃

NOTE：Lock detection on time depend on UI setting.

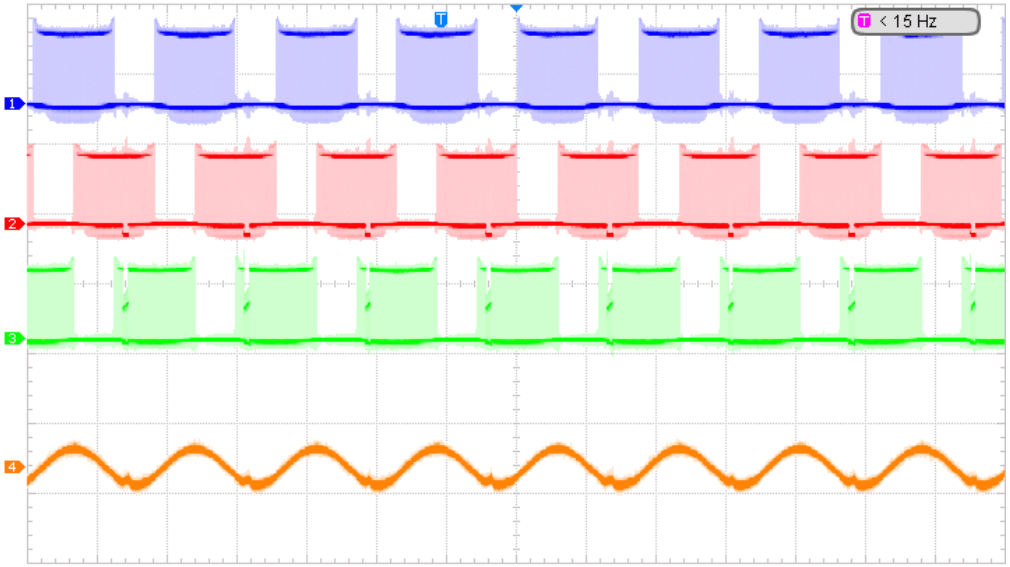
5. Operating Waveforms

Rotation Waveform (PWM=100%)



CH1: V_{UO}, 5V/div, DC ; CH2: V_{VO}, 5V/div, DC; CH3: V_{WO}, 5V/div, DC; CH4: I_{UO}, 200mA/div, DC

Rotation Waveform (PWM=50%)



CH1: V_{UO}, 5V/div, DC ; CH2: V_{VO}, 5V/div, DC; CH3: V_{WO}, 5V/div, DC; CH4: I_{UO}, 200mA/div, DC

6. Functional Description and Notes

Please read the following notes before designing driver circuits with FT3206D.

Starting

Starting of the motor is triggered by the detection of PWM signal and the IC injects a configurable starting commutation frequency to the motor. During this commutation, BLDC drive is used so as to detect back-EMF from the silent windows. After the IC has detected a stable back-EMF, it transits to SINE drive.

Dual Start

The IC adopts a strategy of dual starting. The IC will first be injected with a configurable commutable frequency for back-EMF detection. If a stable back-EMF is detected, it will transit to SINE drive. Upon detection of unstable back-EMF, the starting sequence will be immediately restarted, providing a consecutive/extended starting commutation. This aims to increase and improve the stability of the starting back-EMF

PWM Speed Control

The IC accepts a wide range of PWM input frequency from 200Hz to 50 kHz for motor speed control. The input PWM is translated to an output PWM fixed at a frequency of 30 kHz, away from the audible frequency range.

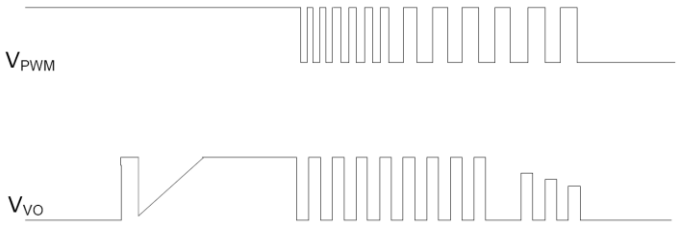


Figure 1 PWM Input Waveform

Quick Start

This IC disables the lock protection function when the PWM input keeps low level for more than 16ms. (SeeFigure 2 Quick Start Waveform)

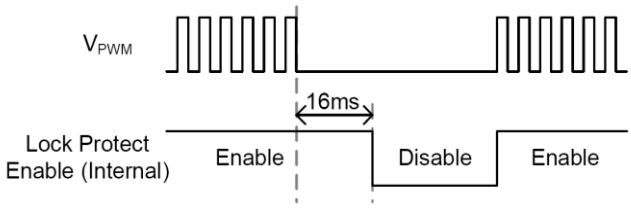


Figure 2 Quick Start Waveform

Pseudo-sine Output

The IC switches from BLDC to PSEUDO-SINE output after the back-EMF signals are stable. Under PSEUDO-SINE drive, the IC opens only a window for back-EMF detection while the rest of the cycle is driven sinusoidally. For the realization of the sine drive, SVPWM is being used.

FG Output

The FG pin is configurable to different multiples of the electrical motor frequency to accommodate for different pole paired motors. A square wave signal is provided to the open-drain output. Being an open-drain, a pull-up resistor is necessary for proper operation of the output.

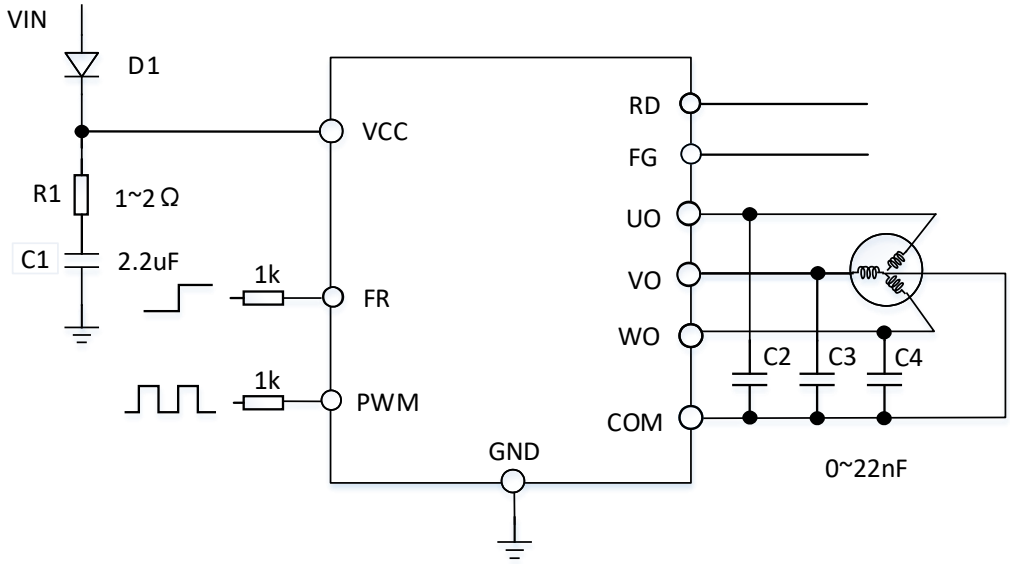
Lock Protection and Automatic Recovery

The IC has lock protection and configurable recovery function for both motor and IC protection. Upon detection of a lock condition or a detached motor terminal condition, the IC goes into a gate turn off condition. This will persist for 5secs before the IC is re-started. The number of times of re-starting is configurable to either 0, 1, 3 or 9 depending on application.

Thermal Protection

The IC has thermal protection function. When internal junction temperature reaches 160℃, the IC goes into gate turn off condition. As soon as the temperature drops to 130℃, the IC will do an internal reboot and starting sequence will commence.

7. Application Circuit Example



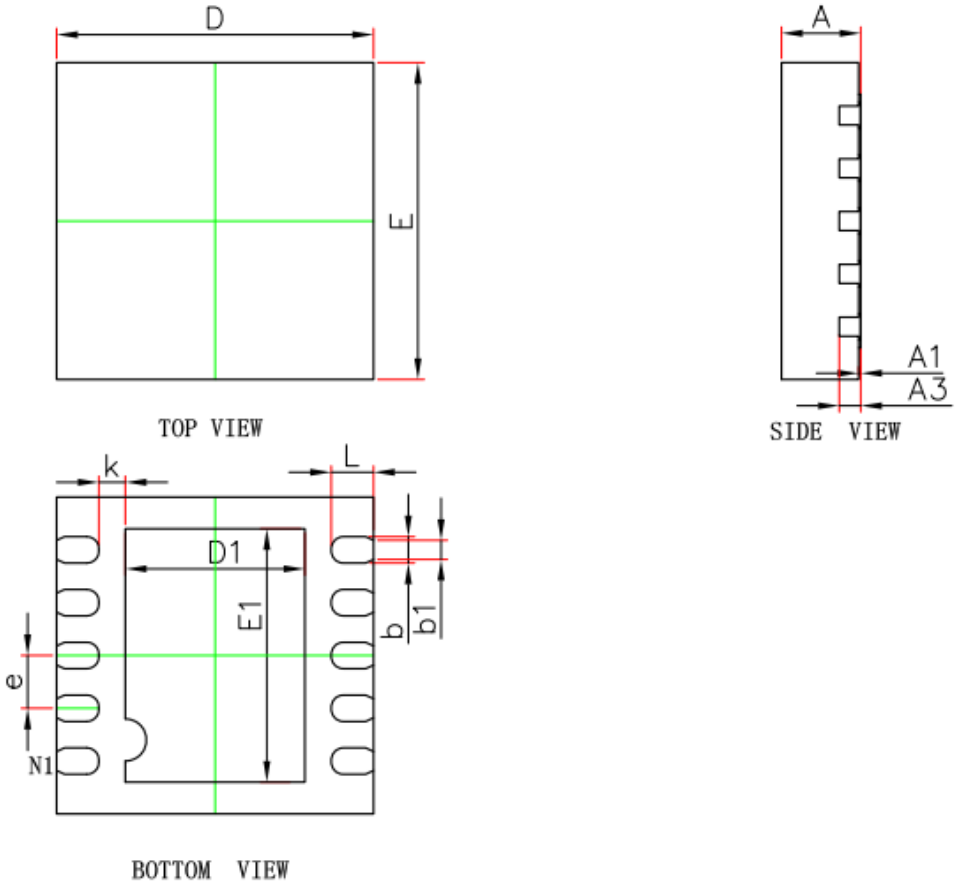
Note1: D1 is to prevent the damage from the power reverse connection.

Note2: R1 and C1 are for power supply filtering function, and must be placed as close to IC as possible.

Note3: C2~C4 are optional. It depends on the performance of the motor

8. Package Information

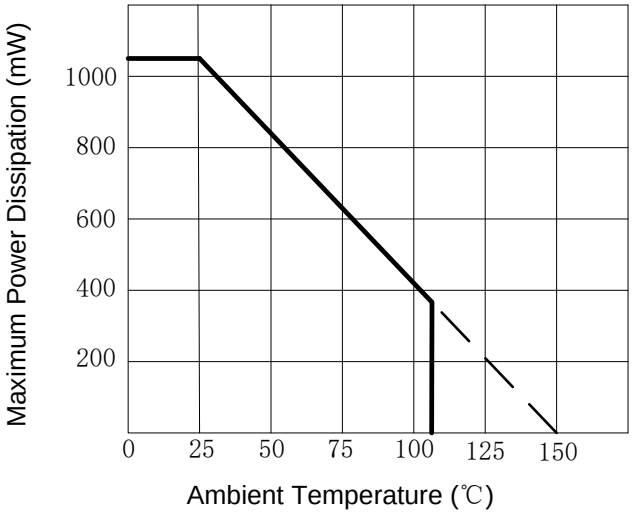
DFN10（3x3 mm）



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN.	MAX.	MIN.	MAX.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	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	1.600	1.800	0.063	0.071
E1	2.300	2.500	0.091	0.098
b	0.200	0.300	0.008	0.012
b1	0.180REF		0.007REF	
e	0.500BSC.		0.020BSC.	
k	0.250REF		0.010REF	
L	0.324	0.476	0.013	0.019

Part Number	Package Type	Marking ID	Package Method	Quantity
FT3206D	DFN10	FT3206D	Tray	624

Maximum Power Dissipation vs. Ambient Temperature



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