TB6634FNG
Usage considerations

Rev. 1.0

Summary

The TB6634FNG is a controller IC for three-phase brushless DC motor. It controls the motor rotation speed by sine-wave current drive. It is developed for fan of home appliance.

Contents

1. Power supply

Operating range of the power supply voltage is 6V to 16.5V. The absolute maximum rating of the power supply voltage is 18V that must not be exceeded, even for a moment. Do not exceed any of these ratings. Please use the IC within the range of the power dissipation.

2. Notes in operating IC

When the motor operation is turned off or configured low-speed rotation from normal speed rotation, the power supply may boost because the current is regenerated to the motor power supply by the influence of the back-electromotive force. Pay attention to change the motor rotation speed from high to low or off. Confirm and control the IC operation by experiments in decreasing the motor rotation speed slowly to avoid the destruction of the power device by power supply voltage boosting.

3. Application circuit example

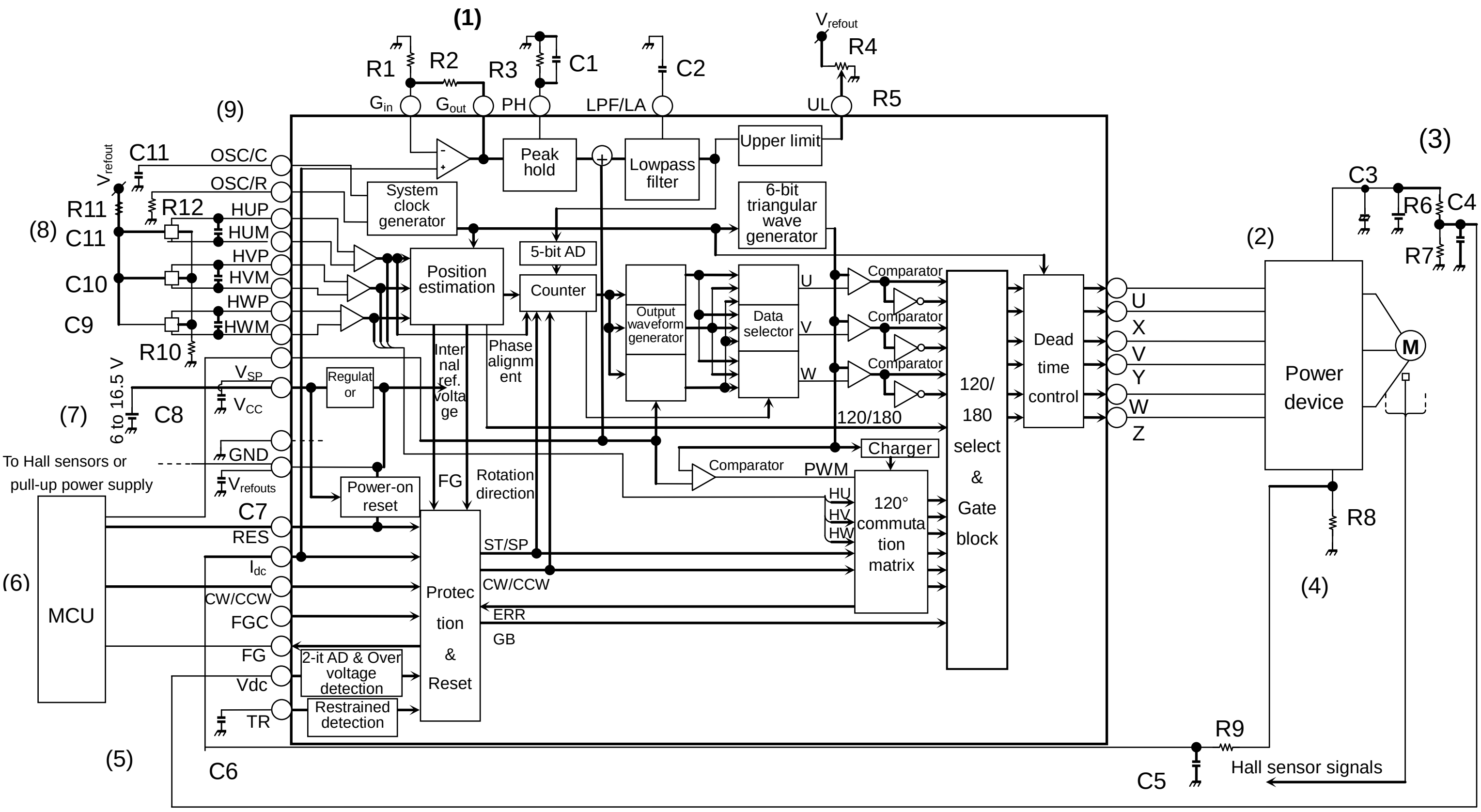


Figure 1 Application circuit example

(1) Setting lead angle

1. Determine the lead angle by using the actual equipment because the lead angle level changes depending on the motor.

   Ⅰ. Drive the motor by necessary rotation number, short-circuit the UL terminal to the Vrefout terminal, apply the voltage (0 to 5 V) externally to the LPF/LA terminal, and confirm the current waveform or efficiency to determine the most appropriate voltage of the LPF/LA terminal.

   Ⅱ. Amplify the voltage conversion value of the shunt resistance by external resistances of Gin and Gout terminals to set the voltage of the LPF/LA terminal determined in ‘step Ⅰ’.

   Ⅲ. Drive the motor and confirm that the voltage of the LPF/LA terminal equals the value that is determined in ‘step Ⅰ’.

2. Recommended setting value

   ・PH terminal: R3=100 kΩ/C1=0.1 μF
   ・LPF/LA terminal: C2=0.1 μF
   ・Gin terminal/Gout terminal (gain=(1+(R2/R1))
   When R1=10 kΩ/R2=100 kΩ, 11 times

3. Setting fixed lead angle

   Ⅰ. Pattern A
   ・Gin terminal/Gout terminal: R1=OPEN/R2=short-circuit
   ・PH terminal: OPEN
   ・LPF/LA terminal: short-circuit to Vrefout terminal
   ・UL terminal: input fixed voltage

   Ⅱ. Pattern B
   (Voltage changes unless the input impedance of the fixed voltage is not configured lower because the LPF/LA terminal is input/output terminal.)
   ・Gin/Gout terminal: R1=OPEN/R2=short-circuit
   ・PH terminal: OPEN
   ・LPF/LA terminal: input fixed voltage
   ・UL terminal: short-circuit to Vrefout terminal

4. Reference data of lead angle setting

Ⅰ. Reference data of lead angle setting

・Measuring method

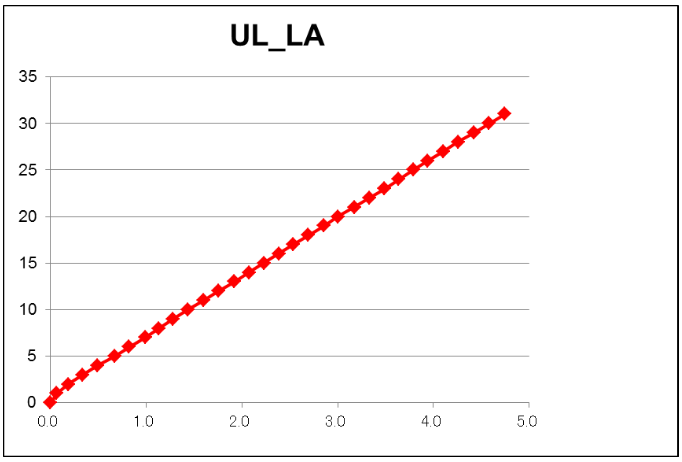
Result of confirming the lead angle (steps) in the test mode by changing UL applied voltage.

・Conditions

VSP and LA/LPF=6V

LA (steps)	UL[V]
0	0.00
1	0.07
2	0.19
3	0.34
4	0.49
5	0.67
6	0.82
7	0.99
8	1.14
9	1.28
10	1.44
11	1.60
12	1.76
13	1.92
14	2.07
15	2.23
16	2.39
17	2.54
18	2.69
19	2.86
20	3.00
21	3.17
22	3.33
23	3.49
24	3.64
25	3.79
26	3.94
27	4.11
28	4.26
29	4.42
30	4.58
31	4.74

LA [Steps]



UL [V]

Ⅱ. Reference data of lead angle setting

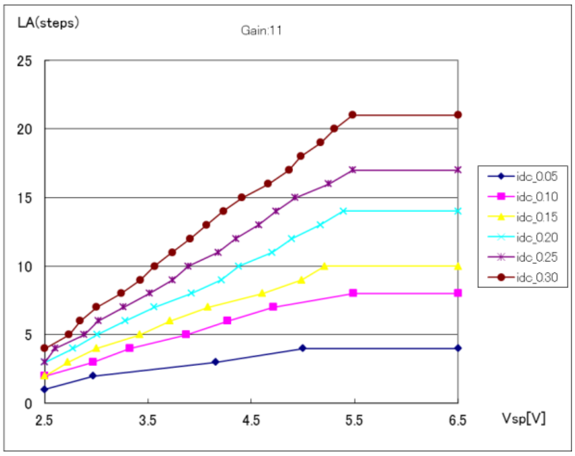
・Measuring method

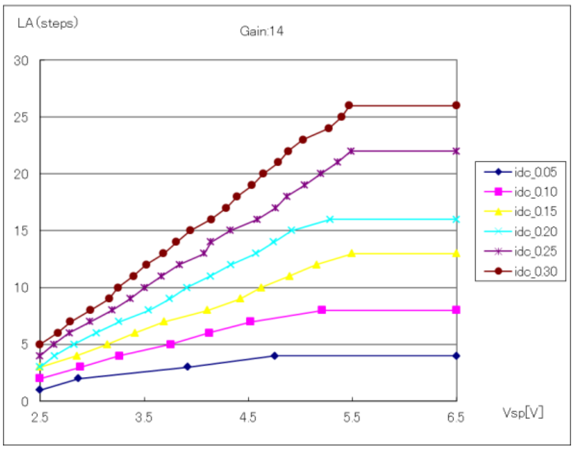
Result of confirming the lead angle (steps) in the test mode by changing VSP and applied voltage of Idc in each gain configuration.

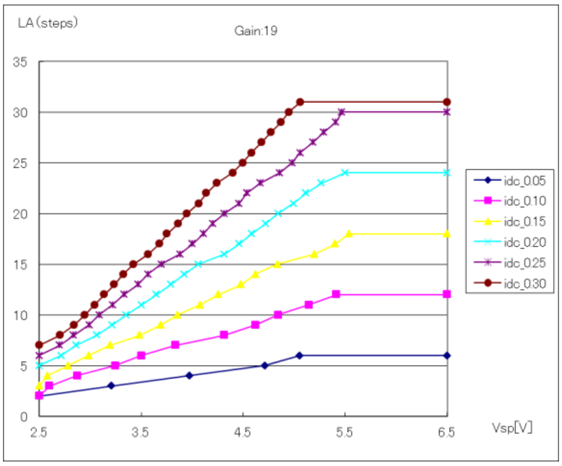
・Conditions

PH=100kΩ/0.1μF

LPF/LA=0.1μF







(2) Power device

Connect the capacitor to reduce the noise and variation of the voltage of the motor power supply. Wiring pattern should be taken wide because large current flows in the power supply, ground, and outputs of the power device. Specially, for the ground, wiring pattern should be taken as wide as possible.

・Recommended device
TPD4123AK (500 V/1 A)
TPD4144AK (500 V/2 A)
TPD4135AK (500 V/3 A)

(3) Vdc terminal setting

The voltage of Vdc terminal is configured by the resistive divider of R6 and R7.
In case variation of the voltage of Vdc terminal and the noise are large, connect the capacitor to C4.
The accuracy of the resistance is recommended to be set 1% or less.

(4) Idc terminal setting

Idc terminal inputs the functions of current limit and lead angle by detecting the output current with the shunt resistance of R8.
The current limit function works when the voltage of Idc terminal rises 0.3V (typ.) or more.
Current limit value=0.3V/R8
Ex.) When R8=0.2Ω,
Current limit value=0.3V/0.2Ω=1.5A

Lead angle function should be set by referring to the lead angle configuration shown in (1) above.

Though the system of current limit incorporates the low pass filter (200kΩ, 5pF) and the digital filter (5clk@fosc), the filter should be connected to C5 and R9 corresponding to the noise of the power block
Time constant of C5 / R9 is recommended to 2μs or less.

(5) TR terminal setting

Motor lock detection operates repeatedly (operating time: stopping time=1:6). This term can be set by the external capacitor (C6) of TR terminal.

・Driving term Ton[s]=C6×(VH—VL)×2/I×500 counters
・Stopping term Toff[s]=C6×(VH—VL)×2/I×3000 counters

・Example: When C6 = 0.01μF,
I = 3.15uA (typ.), VH= 2 V (typ.), VL= 0.5V (typ.),
Ton[s] =4.76s (typ.) and Toff[s] =28.57s (typ.).

・In case motor lock detection is not used, connect TR terminal to GND.

(6) RES terminal

When input signal (RES) level is low, commutation signal outputs low. When RES is high, it is released with every carrier frequency and re-starts.
When RES is low, the boosting strap capacitor is not charged (refresh).
To charge the boosting strap capacitor in recovering mode, input the voltage command as follows; 1.0 V < Vsp ≤ 2.1 V

(7) VCC terminal/Vrefout terminal and GND terminal setting

Connect the capacitor between VCC and GND, and Vrefout and GND as close to the IC as possible.
Specifically connect the electrolytic capacitor and ceramic capacitor in parallel between VCC and GND to reduce the noise and the variation of voltage.
Take the wiring pattern of the GND terminal of the IC widely not to be influenced by the GND of motor power system.
Vrefout terminal is used for the reference power supply of internal IC. Do not forget to connect the capacitor regardless of using Vrefout power supply.

VCC-GND: C8:
Electrolytic capacitor 1μF to 47μF
Ceramic capacitor 0.001μF to 1μF
Vrefout-GND
Ceramic capacitor 0.001μF to 1μF

(8) Hall signal setting

Hall signal input terminal may cause malfunction of the IC because it has a high impedance and easy to be influenced by noise. To avoid the malfunction, connect the capacitors of C9 between HUP and HUM, C10 between HVP and HVM, and C11 between HWP and HWM terminals. The recommended capacitor range is 0.001μF to 0.1μF.
Input voltage range of the same phase of the hall signal is 1.5V to 3.5V. So, adjust the resistors of R10 and R11 to set the voltage of the input signal within this range.

(9) OSC/C terminal and OSC/R terminal setting

Formula of the frequency configured by OSC/R: R and OSC/C: C is as follows;

- Oscillation frequency fosc=4.485/(0.29CR) [Hz]
- Carrier frequency Fc=4.485/(252×0.29CR) [Hz]

- Example 1: When OSC/R: 9.1kΩ and OSC/C: 330pF,
  Carrier frequency Fc (20) =20.5 kHz

- Example 2: When OSC/R: 10kΩ and OSC/C: 330pF,
  Carrier frequency Fc (18) =18.5 kHz

OSC/R: R and OSC/C: C should be connected as close to the IC as possible in order not to be influenced by noise and wiring impedance. Use the resistor and capacitor whose accuracy is 1% or less.

IC Usage Considerations

Notes on handling of ICs

[1] The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.

[2] Use an appropriate power supply fuse to ensure that a large current does not continuously flow in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead smoke or ignition. To minimize the effects of the flow of a large current in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

Points to remember on handling of ICs

(1) Over current Protection Circuit
Over current protection circuits (referred to as current limiter circuits) do not necessarily protect ICs under all circumstances. If the over current protection circuits operate against the over current, clear the over current status immediately.
Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the over current protection circuit to not operate properly or IC breakdown before operation. In addition, depending on the method of use and usage conditions, if over current continues to flow for a long time after operation, the IC may generate heat resulting in breakdown.

(2) Thermal Shutdown Circuit
Thermal shutdown circuits do not necessarily protect ICs under all circumstances. If the thermal shutdown circuits operate against the over temperature, clear the heat generation status immediately depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the thermal shutdown circuit to not operate properly or IC breakdown before operation.

RESTRICTIONS ON PRODUCT USE