

TB67B000AFG

Reference Guide

Evaluation Board Manual

RD180-RGUIDE1-01-E

Toshiba Electronic Devices & Storage Corporation

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1. Outline

This document describes the directions for using the brushless DC motor driver IC TB67B000AFG evaluation board, and the notes to be aware of at the time of use. This evaluation board allows the user to connect this IC with the target motor for performing evaluation by configuring the power supply and input logic signals.

TB67B000AFG is a three-phase sine-wave PWM driver for brushless motors. It is a high voltage IC of 600V. This IC has a 2 in 1 (MCP: Multi Chip Package) structure which includes a controller (sine-wave PWM / wide-angle conduction) and a high voltage driver. Rotation speed of a DC brushless motor can be controlled directly by a speed control signal (analog) from a microcontroller. Moreover, this IC has various built-in error detection functions like overcurrent protection, thermal shutdown, under voltage lockout, and motor-lock detection.

This board is **not for sale**. For evaluating this IC before adoption, kindly contact our distributor or Toshiba's sales representative.

2. Evaluation Board Specification

The specification outline of this evaluation board is shown in Table 2.1.

Table 2.1 Evaluation board specification outline

Item	Description
IC mounted on board	TB67B000AFG (Motor driver IC)
Power supply voltage (V_{BB})	280V (Typ.) (50V – 450V *Operating condition of IC)
Power supply voltage (V_{CC})	15V (Typ.) (13.5V – 16.5V *Operating condition of IC)
Output current (I_{out})	2A (Max)
Evaluation board size	110mm × 110mm
Board material	Glass epoxy board (Both sides)

The internal block diagram of IC TB67B000AFG with a connection example is shown in Figure 2.1.

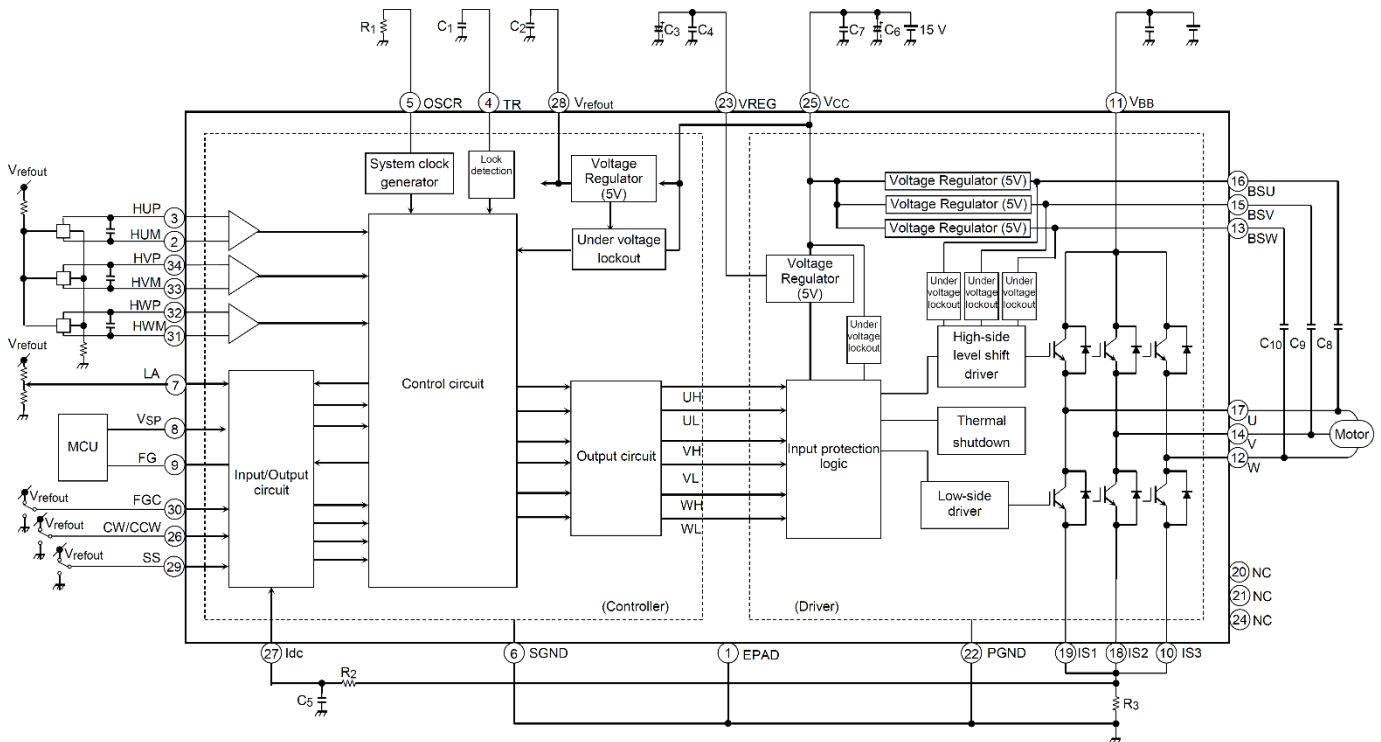


Figure 2.1 •• The internal block diagram of IC with a connection example

(Note) Some of the functional blocks, circuits, or constants in the block diagram may have been omitted or simplified for explanatory purposes. Refer to the data sheet for the detailed specifications of IC.

3. Directions for Use and Notes of Evaluation Board

3.1. Terminals of the Evaluation Board and Directions for use

Each terminal of this evaluation board is shown in Figure 3.1.

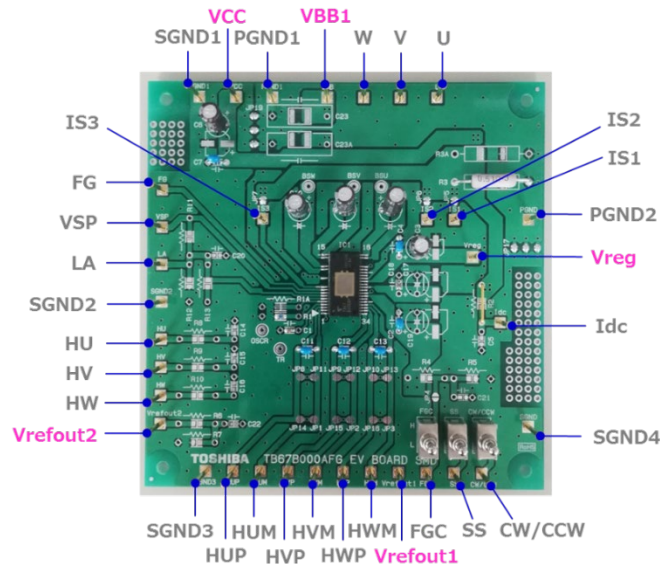


Figure 3.1 Board terminals

The directions for use and the notes of this evaluation board are shown below.

1. The target brushed DC motor is connected to U, V and W terminals.
2. The hall signals are connected to HUP, HUM, HVP, HVM, HWP and HWM terminals.
3. The power (15V) is supplied from the outside between V_{CC} (VCC) and GND (SGND) terminals. By supplying power to V_{CC} (VCC) terminal, the regulators inside IC operate and switch control is enabled.
4. CW/CCW (Forward/Reverse switching input), LA (Lead angle control input), SS (Switch for commutation waveform), FGC (FG output signal switch) are set up if needed. CW/CCW, SS and FGC can be switched by toggle switches on the board.

When controlling CW/CCW, SS and FGC terminal from an external microcontroller etc., please set the toggle switches (Note 1) on the board to center position (open state).

(Note 1) "H" of a toggle switches is connected to V_{refout} (5V (standard)), and "L" is connected to GND (SGND).

However, please supply voltage (Note 2) to input signals like CW/CCW, SS, FGC, V_{SP} (VSP) and LA after supplying power to V_{CC} (VCC) terminal.

(Note 2) Refer to the data sheet for logic signal voltage.

5. The power is supplied from the outside between V_{BB} (VBB) and GND (PGND) terminals.
6. Motor's operation, rotation and suspension can be controlled by applying analog voltage to V_{SP} (VSP) terminal. Moreover, when rotation speed needs to be controlled, connect a microcontroller to V_{SP} (VSP) signal and FG signal (indicates the motor rotation speed), and then control the motor rotation speed by using the feedback signal (FG signal).

Note 1: Please refer to the data sheet for the details about all settings and all error detection functions.

Note 2: SGND and PGND are connected by JP (slit lands) on the board.

Note 3: This board is not for sale. For evaluating this IC before adoption, kindly contact our distributor or Toshiba's sales representative.

3.2. Notes of Sequence of Power Supply/Shut down process and Output Current

3.2.1. Power supply voltage

Power supply voltages of V_{BB} and V_{CC} terminals of TB67B000AFG have two standards, which are absolute maximum rating and the usage range. The absolute maximum rating of the power supply voltage must not be exceeded even for a moment. Please use the IC within the usage range.

Table 3.1 Absolute maximum ratings of power supply voltage ($T_a = 25^\circ\text{C}$)

Characteristic	Symbol	Rating	Unit
Power supply voltage	V_{BB}	600	V
	V_{CC}	18	

Table 3.2 Power supply voltage usage range ($T_a = 25^\circ\text{C}$)

Characteristic	Symbol	Min	Typ.	Max	Unit
Power supply voltage	V_{BB}	50	280	450	V
	V_{CC}	13.5	15	16.5	

3.2.2. Sequence of power supply/shut down process

Sequence of Power Supply and Shut down processes of TB67B000AFG are as follows.

1. Sequence of Power supply process

Please supply the power by following procedure of (1) to (3).

(1) Apply power to V_{CC} .

While applying power to V_{CC} , connect V_{SP} to GND or keep it open.

In case terminals of CW/CCW, LA, and SS are controlled by signals of an external IC, connect them to GND or open. After applying power supply to V_{CC} , set the terminal of CW/CCW, LA, and SS to high-level if needed.

(2) Apply power to V_{BB} .

(3) Apply voltage to V_{SP} .

2. Sequence of power shut down process

Please shut down the power by following procedure of (1) to (3).

(1) Set V_{SP} to 0V.

In case terminals of CW/CCW, LA, and SS are controlled by signals of external IC after setting V_{SP} 0V, connect them to GND or open.

(2) Shut down V_{BB} .

(3) Shut down V_{CC} .

3.2.3. Output Current

The absolute maximum rating is 2A that must not be exceeded, even for a moment. Design an actual application system with the IC so as not to make the inrush current and the lockout current exceed the absolute maximum ratings, especially when the motor starts up or gets stuck.

The available output current depends on the usage conditions (ambient temperature, mounting board method, and so on). Design an actual application system with a sufficient margin in order that T_j (junction temperature) does not exceed 150°C.

3.3. Notes of Board Design

Please consider the following, when designing the board layout pattern with high-voltage PWM brushless DC motor driver IC TB67B000AFG.

- Utmost care is necessary in the design of board layout since the IC may be destroyed and cause smoke or ignition because of short-circuit between outputs, air contamination faults, or faults due to improper grounding, or by short-circuit between contiguous pins.
- Specially, in the design of the output, V_{BB} (VBB), U, V, W, IS1, IS2, IS3, BSU, BSV, BSW and GND lines which have high voltage and high current, utmost care is necessary. Add overcurrent protection such as a fuse to prevent a continuous flow of large current in case of over current generation or IC breakdown.
- The logic input pins must also be wired correctly. Otherwise, the device may get damaged owing to a current running through the IC that is larger than the specified current. Careful attention should be paid to design patterns and mountings.

4. Circuit Diagram

The circuit diagram of this evaluation board is shown below.

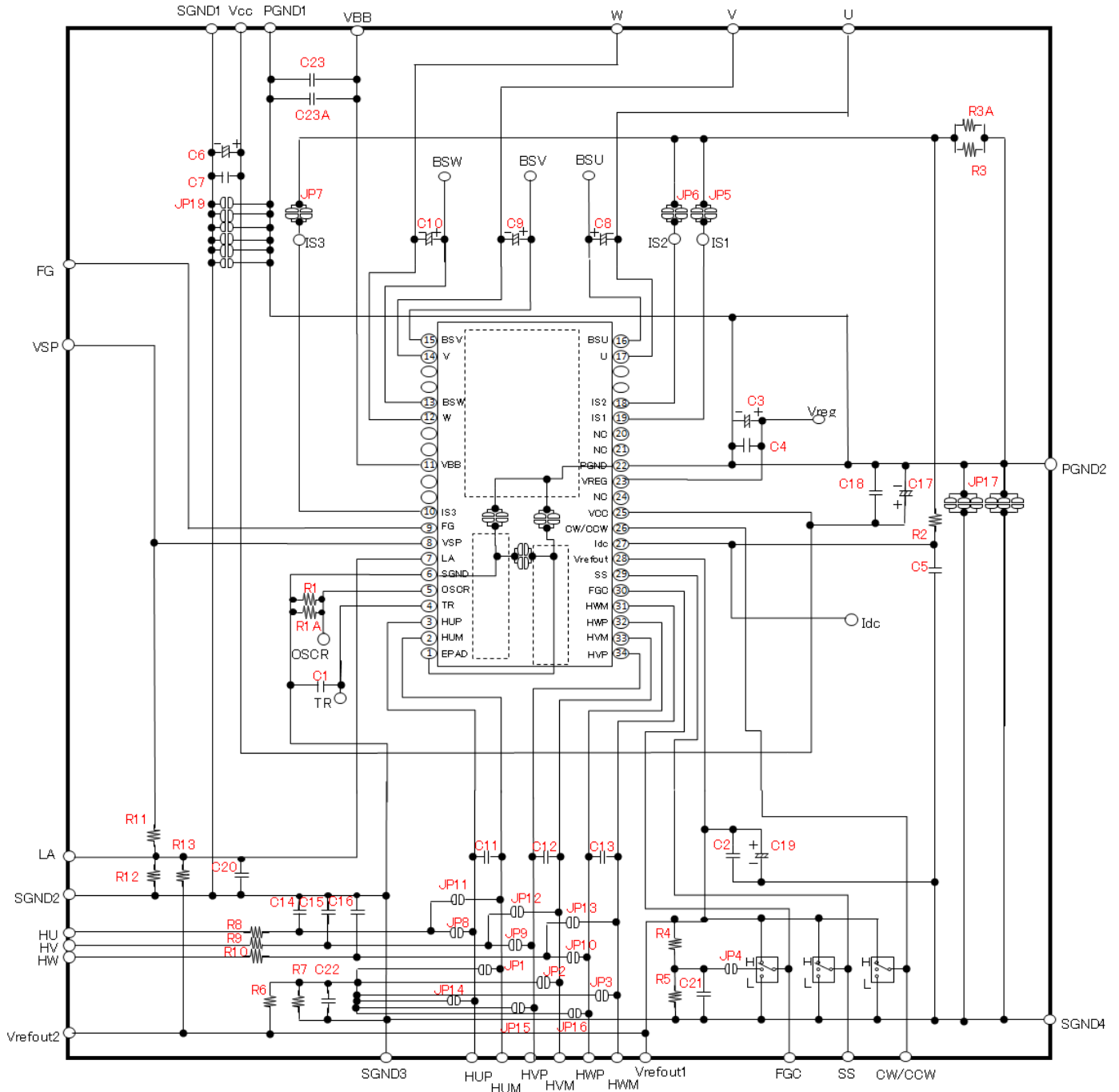


Figure 4.1 Circuit diagram of TB67B000AFG evaluation board

(Note) This circuit diagram is a reference example and does not guarantee operation including protection features or reliability. Thorough evaluation of the board and peripheral parts is required, especially at the mass production design stage.

5. Reference Documents

Refer to the data sheet of brushless motor driver IC TB67B000AFG for the detailed specifications.
The Data sheet and the Application Note of TB67B000AFG are downloadable from following web site.

<https://toshiba.semicon-storage.com/ap-en/semiconductor/product/motor-driver-ics/brushless-dc-motor-driver-ics/detail.TB67B000AFG.html>

Click Here

Moreover, the circuit diagram, BOM (bill of materials), and PCB data of the evaluation board are downloadable from Reference Design Center of Toshiba web site.

https://toshiba.semicon-storage.com/ap-en/semiconductor/design-development/referencedesign/articles/3-phase-brushless_motor_peripheral_evb06.html

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