TB62213AFG Usage Considerations

This document includes application circuit examples and IC usage considerations for motor driver evaluation purposes. Please note that some expresions in this document is not officially guaranteed. Please see the datasheet for more specification.

1. Power supply

1.1 Operating ranges (VM power supply)

The absolute maximum voltage is rated at 40V; but please remind to use the IC between 10V ~ 38V (operating range).

1.2 Power-on and power-off sequence

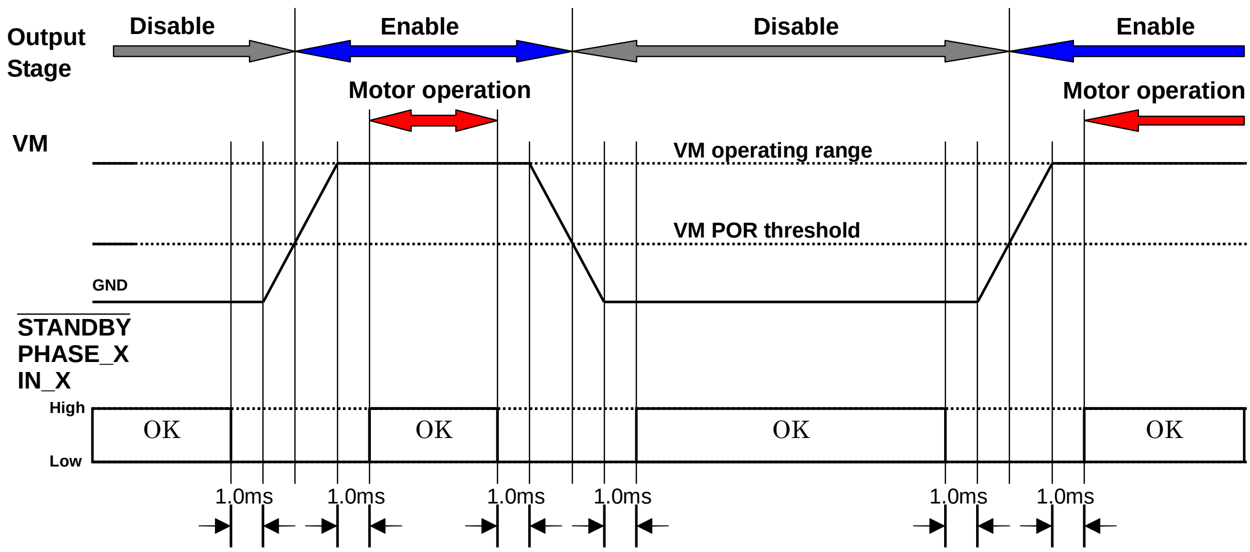
Before applying the VM power supply, please check the following. -- It is that the signal of STANDBY, PHASE_A, PHASE_B, IN_A1, IN_A2, IN_B1, and IN_B-2 is a low level. Also, please set both pins as shown above, when cutting the VM power supply off. The TB62213AFG has an internal voltage monitor circuit to avoid missfunction during power-on; but to be certain, It is that the signal of STANDBY, PHASE_A, PHASE_B, IN_A1, IN_A2, IN_B1, and IN_B-2 is a low level during power-on and power-off sequence.

When the control signal is applied while VM power supply is off:

The TB62213AFG is designed to not missfunction when the control signal is applied and the VM power supply if off. But, this content is not tested, therefore is not officially guaranteed.

The TB62213AFG has an internal VM voltage monitor circuit (Power-on-reset also known as Under Voltage Lockout circuit) which will monitor the supplied voltage; when the VM reaches above the VM POR threshold, the device becomes active, and when the VM is below the VM POR threshold, the device will go to OFF(reset) mode.

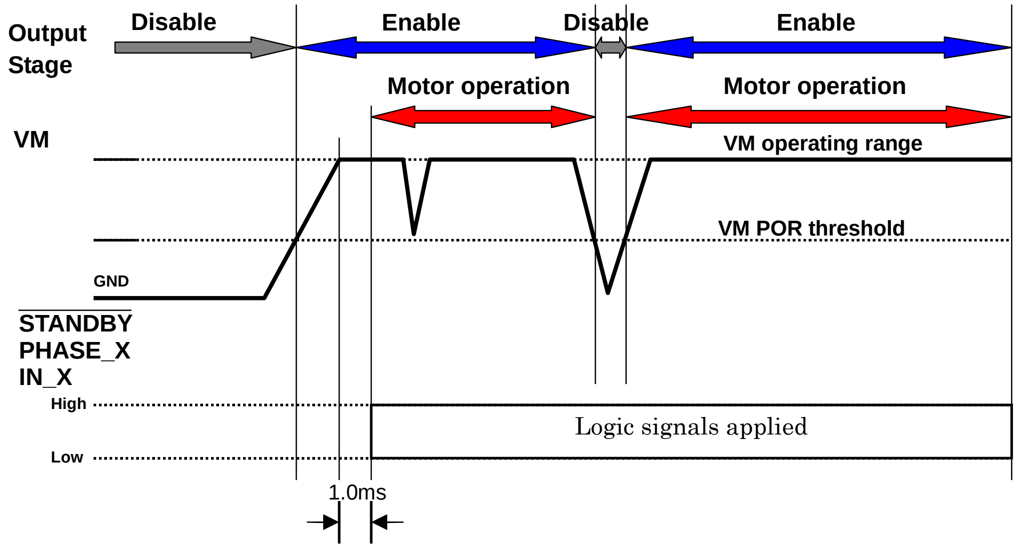
If the control signal is applied before the VM power is supplied; when the VM level reaches above the VM POR threshold, the internal logic will become active, which will then start to function before the VM level reaches the proper operating range. Also, the same situation will occur while power-off sequence. Therefore please apply the control signal after the VM power level sets to the proper operating range to avoid causing missfunction. The timing chart shown below is an example for the power-on and power-off sequence.



When the VM voltage level decreases while operation:

If the VM voltage level drops below the VM POR threshold, the output stage will be turned off. Please set the VM voltage to the proper operating level to restart the motor function.

Also, if the VM level decreases, but does not reach below the VM POR threshold; it is possible that the motor may missfunction due to the voltage drop, but the output stage will stay "ON".



Characteristics	Symbol	Test condition	Min	Typ	Max	Unit
VM POR threshold	V_{MR}	Ta = 25°C, V_M = 24 V	7.0	8.0	9.0	V

2. Output current

2.1 Output current error relative to the predetermined value

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Channel-to-channel differential	ΔI_{OUT1}	Channel-to-channel error	-5	0	5	%
Output current error relative to the predetermined value	ΔI_{OUT2}	I_{OUT} =1.0A	-5	0	5	%

The ΔI_{OUT2} is tested at 1.0A and 0.4A(motor current). The current precision between Iout=0.4～1.0A is not an outgoing test characteristics; therefore is not officially guaranteed.

2.2 OSC_M oscillation frequency , Chopper frequency range

Ta = 25°C, V_M = 24 V, 6.8 mH/5.7 Ω

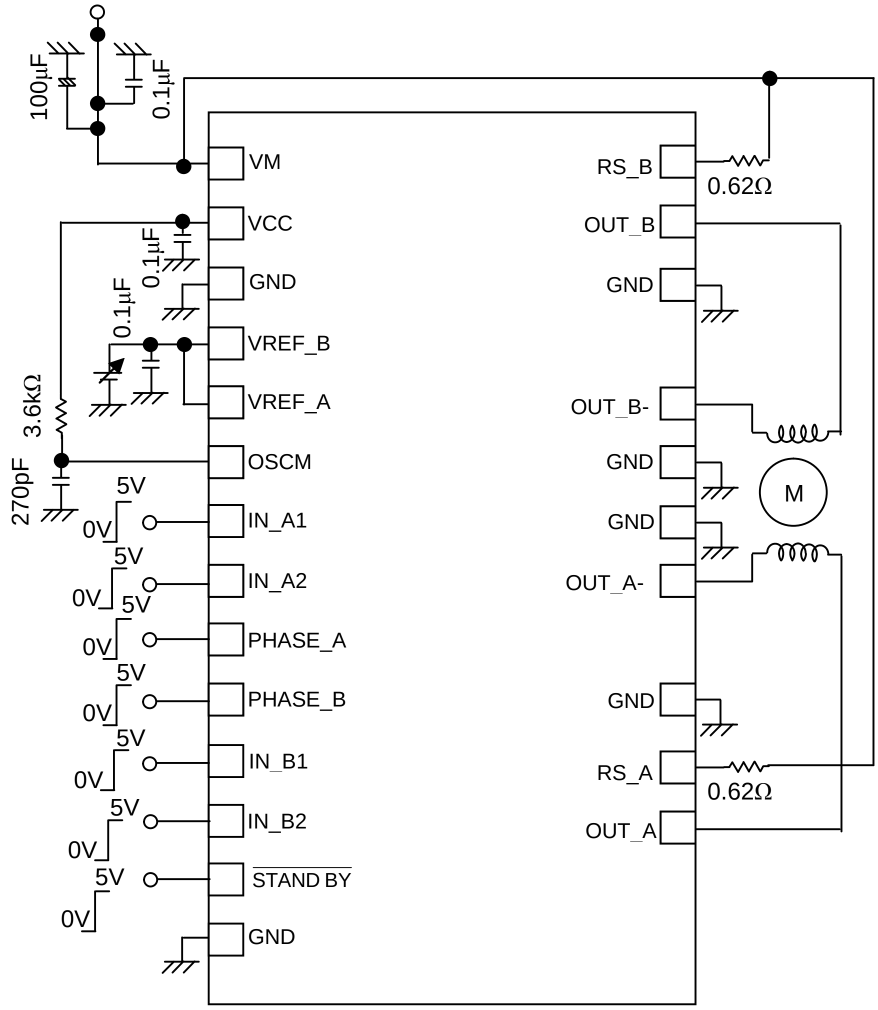
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
OSC_M oscillation frequency	f_{CR}	C_{osc}= 270 pF, R_{osc} =3.6 kΩ	1200	1600	2000	kHz
Chopper frequency range	$f_{chop(RANGE)}$	V_M=24 V, 出力 ACTIVE (I_{OUT}=1.0 A)	40	100	150	kHz
Chopper setting frequency	f_{chop}	出力 ACTIVE (I_{OUT} =1.0 A), CR= 1600 kHz	-	100	-	kHz

During normal operation, 1 PWM cycle will contain "Charge", "Slow", and "Fast" operation status. If the motor current level does not reach the current feedback threshold during 1 PWM cycle, the output stage will remain at "Charge" operation until the motor current reached the threshold level. (Please keep in mind that in this case, the chopper setting frequency may seem to operate at half the speed.)

3. Application circuit examples

3.1 Application circuit example (Setting the current threshold with an external Vref voltage)

The value of the external components shown below are some examples for evaluation. Please see the datasheet for more specific data.



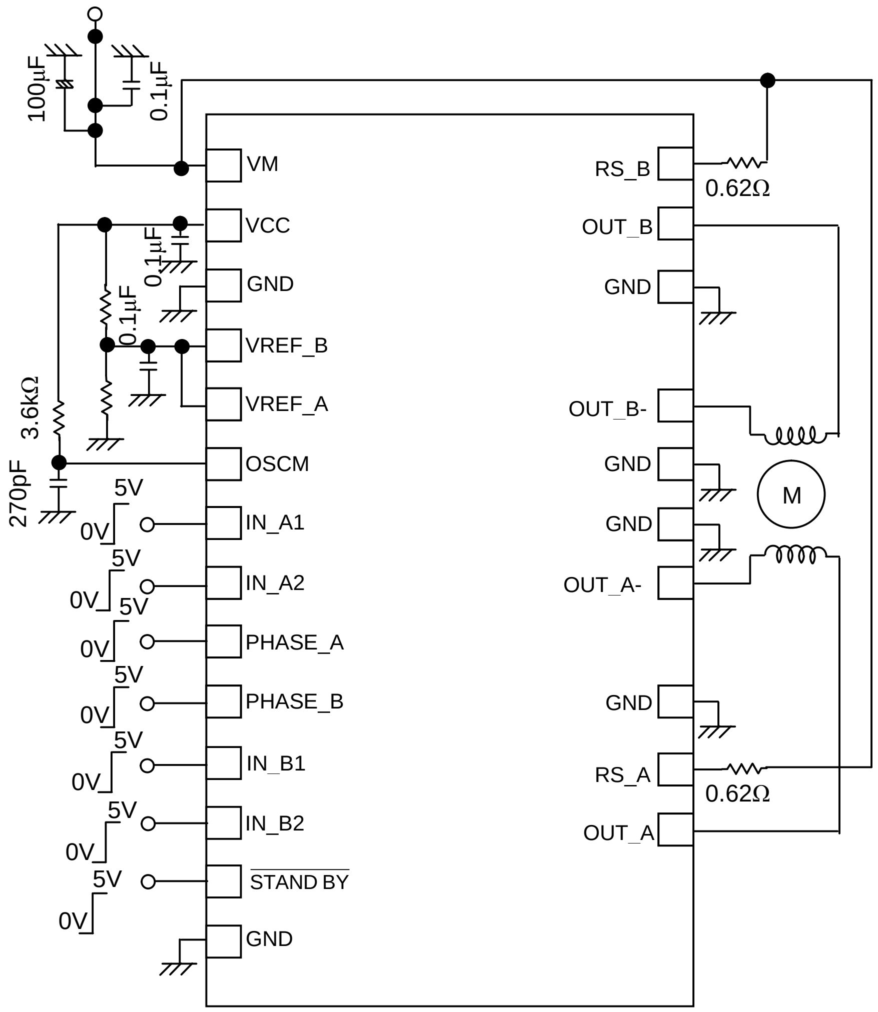
Note: Bypass capacitors should be added as necessary.

It is recommended to use a single ground plane for the entire board whenever possible, and a grounding method should be considered for efficient heat dissipation.
In cases where mode setting pins are controlled via switches, either pull-down or pull-up resistors should be added to them to avoid floating states.
For a description of the input values, see the function tables.

The above application circuit example is presented only as a guide and should be fully evaluated prior to production. Also, no intellectual property right is ceded in any way whatsoever in regard to its use.
The external components in the above diagram are used to test the electrical characteristics of the device: it is not guaranteed that no system malfunction or failure will occur.

3.2 Application Circuit example(Setting the current threshold level using the internal VCC voltage)

The value of the external components shown below are some examples for evaluation. Please see the datasheet for more specific data.



Careful attention should be paid to the layout of the output, V_{DD} (V_M) and GND traces to avoid short-circuits across output pins or to the power supply or ground. If such a short-circuit occurs, the TB62213AFG may be permanently damaged. Also, if the device is installed in a wrong orientation, a high voltage might be applied to components with lower voltage ratings, causing them to be damaged. The TB62213AFG does not have an overvoltage protection circuit. Thus, if a voltage exceeding the rated maximum voltage is applied, the TB62213AFG will be damaged; it should be ensured that it is used within the specified operating conditions.

Note: Bypass capacitors should be added as necessary.

It is recommended to use a single ground plane for the entire board whenever possible, and a grounding method should be considered for efficient heat dissipation.

Careful attention should be paid to the layout of the output, V_{DD} (V_M) and GND traces to avoid short-circuits across output pins or to the power supply or ground. If such a short-circuit occurs, the TB62213AFG may be permanently damaged. Also, if the device is installed in a wrong orientation, a high voltage might be applied to components with lower voltage ratings, causing them to be damaged. The TB62213AFG does not have an overvoltage protection circuit. Thus, if a voltage exceeding the rated maximum voltage is applied, the TB62213AFG will be damaged; it should be ensured that it is used within the specified operating conditions.

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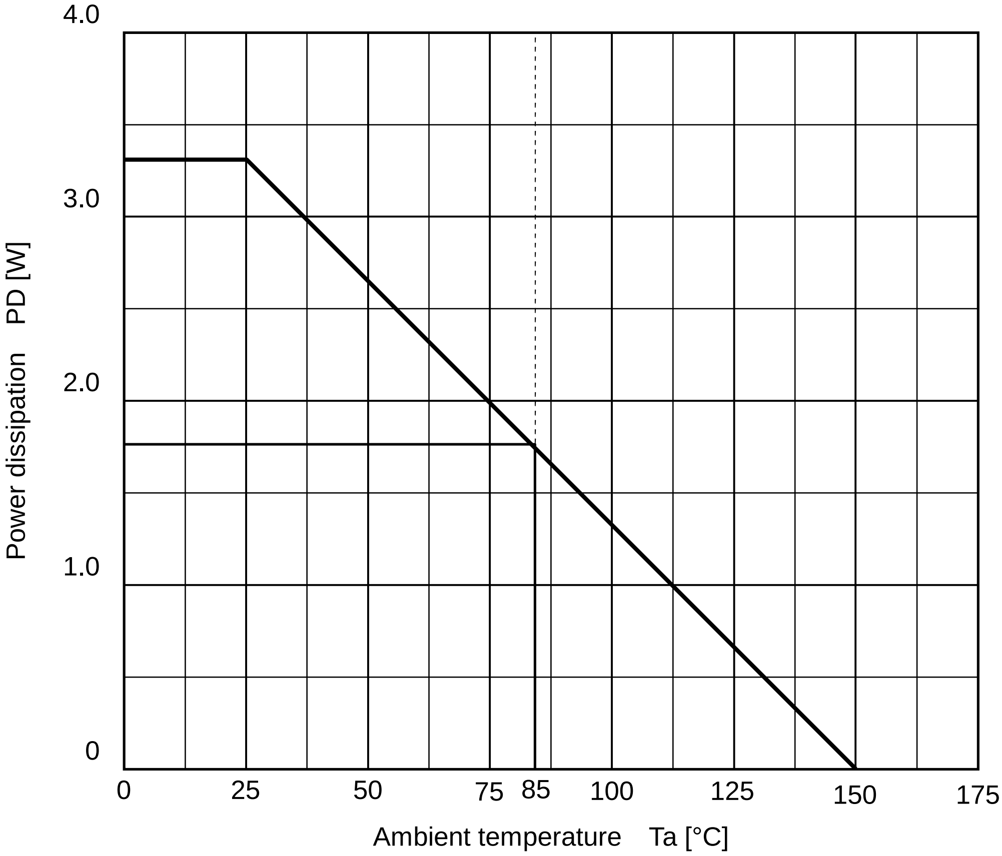
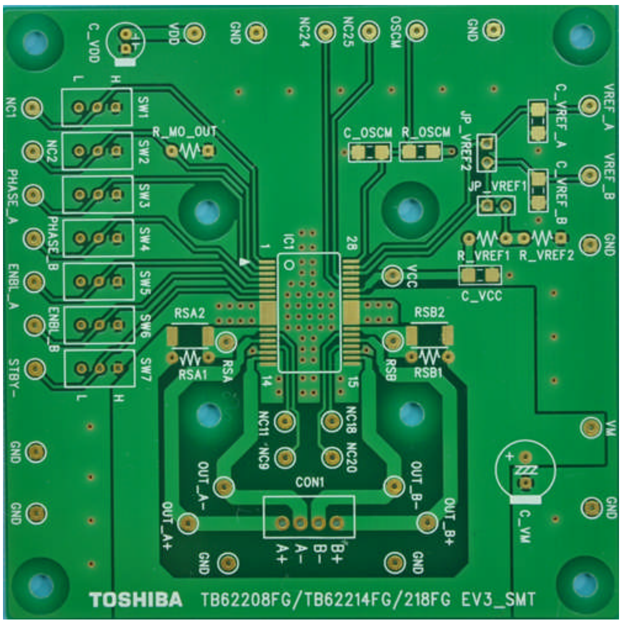
4. P_D – Ta (package power dissipation)

When mounted on a special glass-epoxy two-layer board for HSOP28-P-450-0.8
(2 layer board, Cu thickness: 55μm, Size: 85 mm × 85 mm × 1.6 mm, θ(j-a) = 38[°C/W]: typ.)





【HSOP28-P-450-0.8】

5. IC Power Consumption

The power consumed by the TB62213AFG is approximately the sum of the following two: 1) the power consumed by the output transistors, and 2) the power consumed by the digital logic and pre-drivers.

- The power consumed by the output transistors is calculated, using the R_{ON} (D-S) value of 1.0Ω.
- Whether in Charge, Fast Decay or Slow Decay mode, two of the four transistors comprising each H-bridge contribute to its power consumption at a given time.

Thus the power consumed by each H-bridge is given by:

$$P\ (out) = I_{OUT}\ (A) \times V_{DS}\ (V) = I_{OUT}^2 \times R_{ON}$$

The power consumption in the I_M domain is calculated separately for normal operation and standby modes:

$I\ (I_{M3}) = 5.0$ mA (typ.): Normal operation mode.
$I\ (I_{M1}) = 2.0$ mA (typ.): Standby mode.

The current consumed in the digital logic portion of the TB62213AFG is indicated as I_{max}. The digital logic operates off a voltage regulator that is internally connected to the V_M power supply. It consists of the digital logic connected to V_M (24 V) and the network affected by the switching of the output transistors. The total power consumed by I_{Mx} can be estimated as:

$$P\ (IM3) = 24\ (V) \times 0.005\ (A) = 0.12\ (W)$$
$$P\ (IM1) = 24\ (V) \times 0.002\ (A) = 0.048\ (W)$$

Hence, the total power consumption of the TB62213AFG is:

$$P = P\ (out) + P\ (IM3) = P\ (out) + 0.12\ (W)$$

The standby power consumption is given by:

$$P = P\ (IM1) = 0.048\ (W)$$

5.1 Heat radiation design

While considering the heat calculation of eval boards please perform mounting evaluation enough.

In using an IC with large current flow such as power amp, regulator or driver, please design the device so that heat is appropriately radiated, not to exceed the specified junction temperature (TJ) at any time and condition. Please remind to keep the device below Ta=150°C.

$$T_j = P \times R_{th\ (j\text{-}a)} + T_a$$

※ : $R_{th\ (j\text{-}a)}$: junction– Ta heat resistance
※ : Ta: Ambient temperature

Please note that the $R_{th\ (j\text{-}a)}$ will be effected due to the circumstances around the device.

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