TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

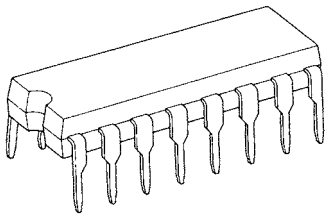
TA7745P/PG, TA7745F/FG

3-Phase Full-Wave (Half-Wave) Brushless DC Motor Driver IC

Features

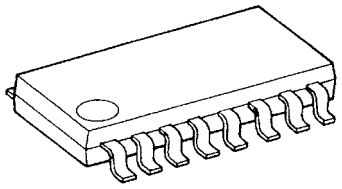
- Three-phase, full-wave (and half-wave) driving
- Voltage control system
- Forward rotation, reverse rotation, and stop can be controlled using only one pin
- High efficiency is obtained.
- Housed in a flat package (type F/FG only)
- Operating voltage range : V_{CC} = 4.0 to 15 V
  V_S = 2 to 15 V
- High sensitivity of position sensing inputs, having a hysteresis
  : V_H = 20 mV_{p-p} (typ.)
- Output current : I_O (max) = 1.0 A
- Built-in thermal shutdown circuit

TA7745P/PG



DIP16-P-300-2.54A

TA7745F/FG

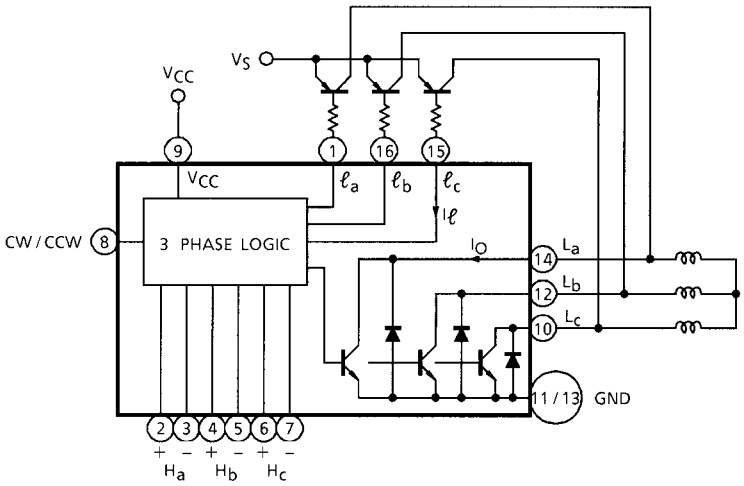


SSOP16-P-225-1.00A

Weight
DIP16−P−300−2.54A: 1.11 g (typ.)
SSOP16−P−225−1.00A: 0.14 g (typ.)

The TA7745PG/FG is a Pb-free product.
The following conditions apply to solderability:
*Solderability
1. Use of Sn-37Pb solder bath
   *solder bath temperature = 230°C
   *dipping time = 5 seconds
   *number of times = once
   *use of R-type flux
2. Use of Sn-3.0Ag-0.5Cu solder bath
   *solder bath temperature = 245°C
   *dipping time = 5 seconds
   *the number of times = once
   *use of R-type flux

Block Diagram



Pin Function

Pin No.	Symbol	Functional Description
1	ℓ_a	a−phase Pre−drive stage output terminal
2	H_a+	a−phase Hall Amp. positive input terminal
3	H_a−	a−phase Hall Amp. negative input terminal
4	H_b+	b−phase Hall Amp. positive input terminal
5	H_b−	b−phase Hall Amp. negative input terminal
6	H_c+	c−phase Hall Amp. positive input terminal
7	H_c−	c−phase Hall Amp. negative input terminal
8	CW/CCW	Forward rotation/reverse rotation switch terminal
9	V_{CC}	Power Supply input terminal
10	L_c	c−phase drive output terminal
11	GND	GND terminal
12	L_b	b−phase drive output terminal
13	GND	GND terminal
14	L_a	a−phase drive output terminal
15	ℓ_c	c−phase Pre−drive stage output terminal
16	ℓ_b	b−phase Pre−drive stage output terminal

Function

FRS ((8) PIN)	Position Sensing Input			Coil Output		
	H_a	H_b	H_c	L_a	L_b	L_c
V_{RVS}	1	0	1	H	L	M
	1	0	0	H	M	L
	1	1	0	M	H	L
	0	1	0	L	H	M
	0	1	1	L	M	H
	0	0	1	M	L	H
V_{FWD}	1	0	1	L	H	M
	1	0	0	L	M	H
	1	1	0	M	L	H
	0	1	0	H	L	M
	0	1	1	H	M	L
	0	0	1	M	H	L
V_{STOP}	1	0	1	High impedance		
	1	0	0			
	1	1	0			
	0	1	0			
	0	1	1			
	0	0	1			

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Supply voltage		V_{CC}	18	V
		V_S	18	V
Output current		I_O	1.0	A
		$I_ℓ$	20.0	mA
Power dissipation	TA7745P/PG	P_D	350	mW
			550 (Note)	
	TA7745F/FG		1200	
Operating temperature		T_{opr}	−30 to 75	°C
Storage temperature		T_{stg}	−55 to 150	°C

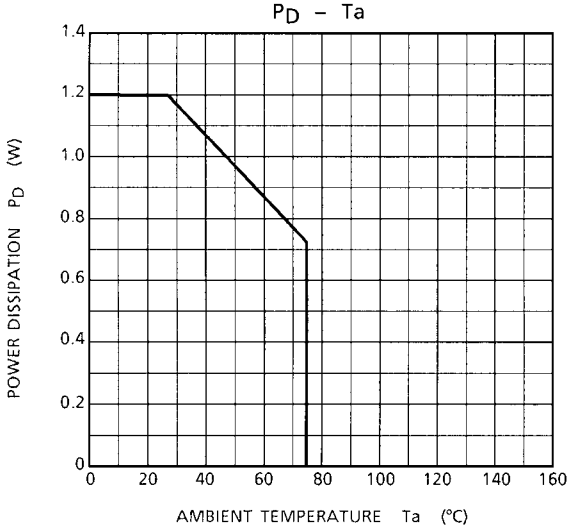
Note: This rating is obtained by mounting on 20 × 20 × 0.8 mm PCB that occupied above 60% of copper area.

Electrical Characteristics (Unless otherwise specified, Ta = 25°C)

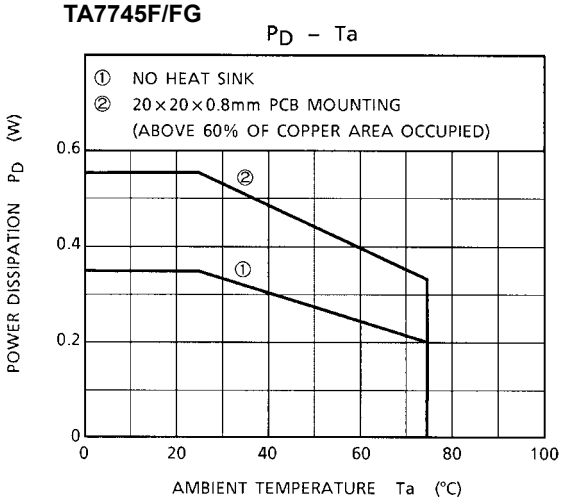
Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply current		I_{CC1}		V_{CC} = 5 V, Output "OPEN"	0.5	1	3.0	mA
		I_{CC2}		V_{CC} = 9 V, Output "OPEN"	0.6	1.3	3.5	
		I_{CC3}		V_{CC} = 12 V, Output "OPEN"	0.7	1.5	5.0	
Saturation voltage	L_a, L_b, L_c Side	V_{SL-1}		I_O = 0.1 A	—	0.12	0.3	V
		V_{SL-2}		I_O = 0.5 A	—	0.5	1.0	
	ℓ_a, ℓ_b, ℓ_c Side	V_{SU}		I_ℓ = 1.0 mA	—	—	0.2	
Position sensing input	Sensitivity	V_H			—	20	—	mV
	Operating DC level	CMR−H			1	—	$V_{CC-1.5}$	V
Diode forward voltage		V_F		I_F = 1 A	—	2.0	—	V
Rotation control input voltage	Forward	V_{FWD}		Source current mode	3.9	—	V_{CC}	V
	Stop	V_{STOP}		No current flow (Note)	1.8	—	2.6	
	Reverse	V_{RVS}		Sink current mode	0	—	0.9	
Saturation voltage differential (L_a, L_b, L_c Side)		ΔV_S		I_O = 200 mA	—	—	50	mV
Leakage current		I_L		V = 18 V	—	—	50	μA

Note: The IC puts the motor in the stop mode even when pin 8 is open.
Applying V_{FWD} to the pin puts the IC in the source mode. Applying V_{RVS} puts the IC in the sink mode.
Applying V_{STOP} prevents a current flow.

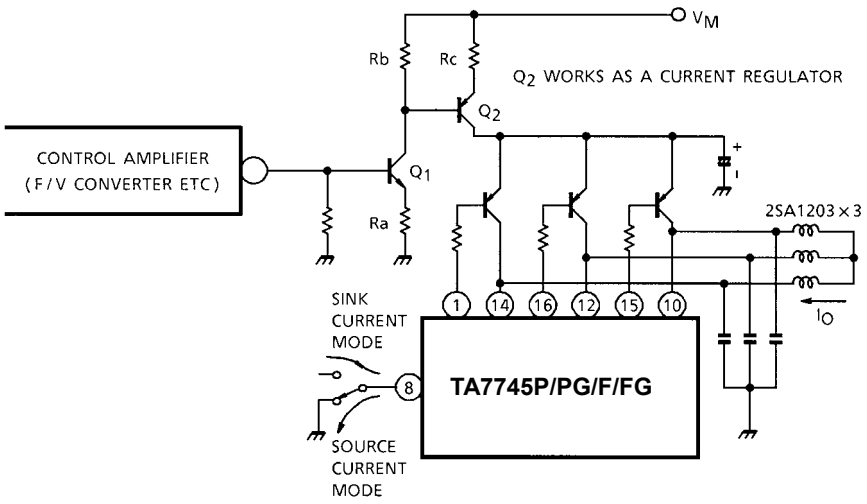
TA7745P/PG



TA7745F/FG



Application Circuit 1
(3 phase Bi−Pola drive)

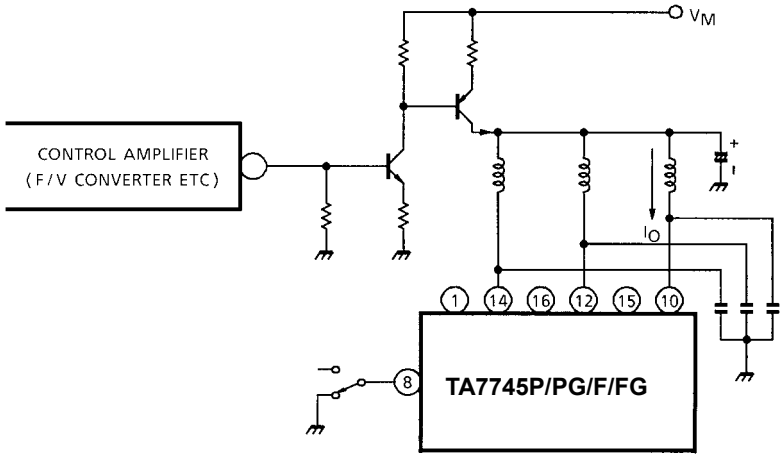


$$I_O \approx \frac{R_b}{R_a R_c} V_{IN} - \frac{1}{R_c}\left(\frac{R_b}{R_c} V_{BE1} + V_{BE2}\right)$$

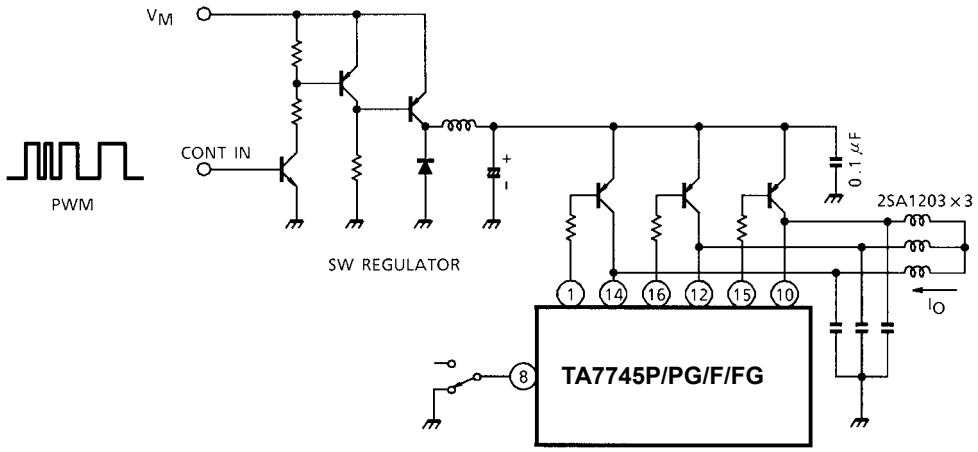
$$\approx (K_1 \cdot V_{IN}) + K_2$$

(K_1, K_2 = CONSTANT)

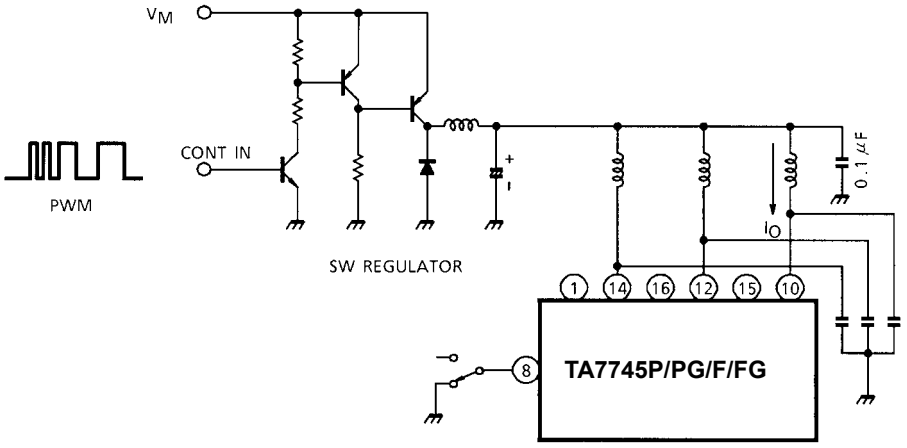
Application Circuit 2
(3 phase UNI−Pola drive)



Application Circuit 3
(high efficiency drive (UNI−Pola))



Application Circuit 4
(high efficiency drive (Bi−Pola))

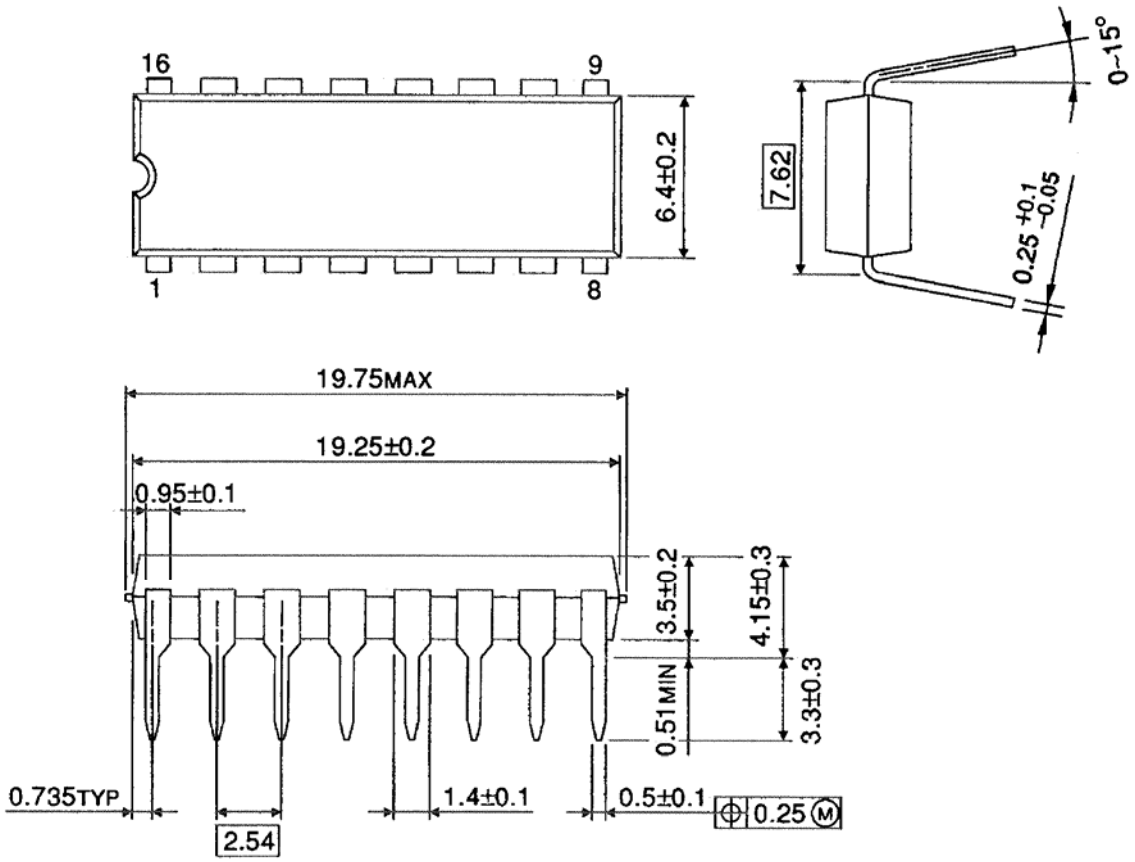


(Note)

Utmost care is necessary in the design of the output, V_{CC}, V_M, and GND lines since the IC may be destroyed by short-circuiting between outputs, air contamination faults, or faults due to improper grounding, or by short-circuiting between contiguous pins.

Package Dimensions

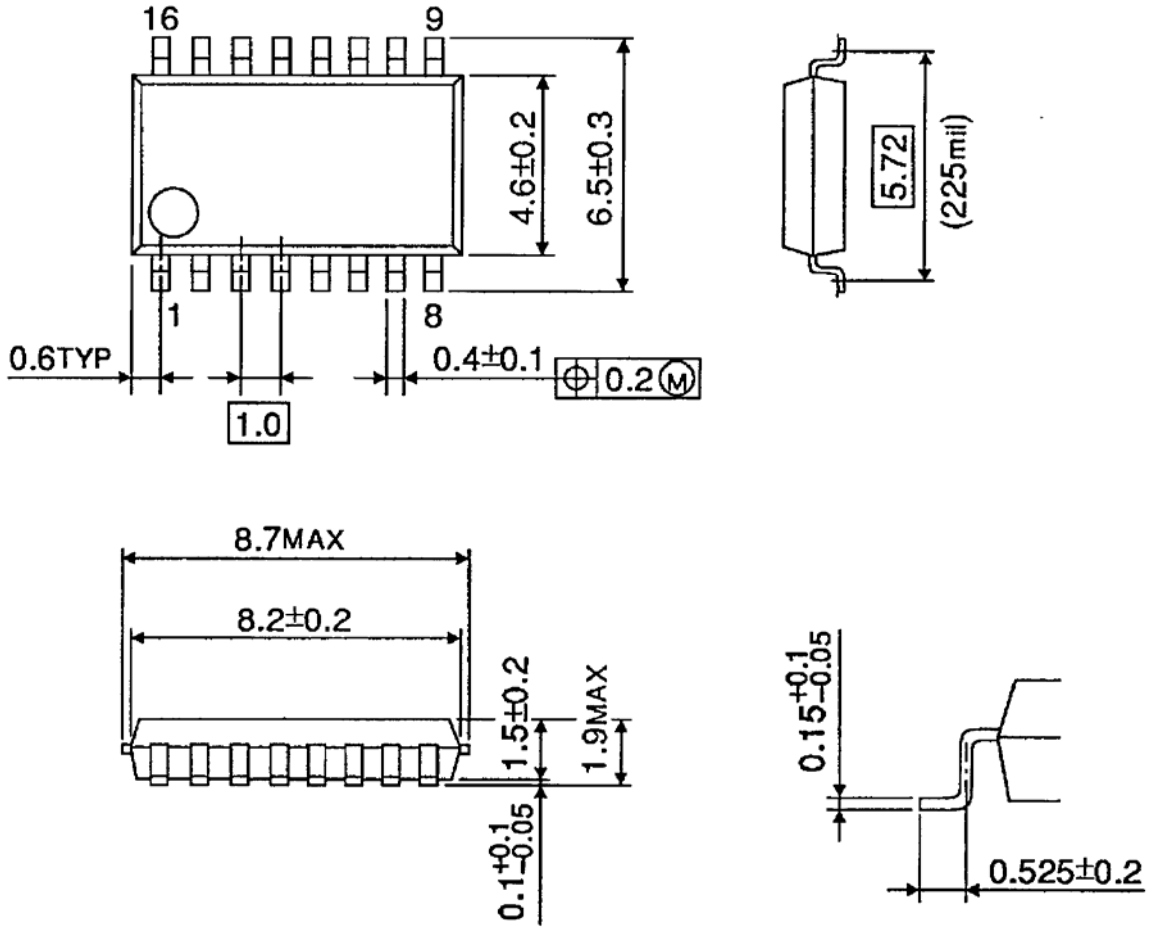
DIP16-P-300-2.54A Unit : mm



Weight: 1.11 g (typ.)

Package Dimensions

SSOP16-P-225-1.00A Unit : mm



Weight: 0.14 g (typ.)

Notes on Contents

1. Block Diagrams

Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purposes.

2. Equivalent Circuits

The equivalent circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

3. Timing Charts

Timing charts may be simplified for explanatory purposes.

4. Application Circuits

The application circuits shown in this document are provided for reference purposes only. Thorough evaluation is required, especially at the mass production design stage.
Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

5. Test Circuits

Components in the test circuits are used only to obtain and confirm the device characteristics. These components and circuits are not guaranteed to prevent malfunction or failure from occurring in the application equipment.

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.

[3] If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.
Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

[4] Do not insert devices in the wrong orientation or incorrectly.
Make sure that the positive and negative terminals of power supplies are connected properly.
Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
In addition, do not use any device that is applied the current with inserting in the wrong orientation or incorrectly even just one time.

Points to remember on handling of ICs

(1) 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.

(2) Heat Radiation Design

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 (T_J) at any time and condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, please design the device taking into considerate the effect of IC heat radiation with peripheral components.

(3) Back-EMF

When a motor rotates in the reverse direction, stops or slows down abruptly, a current flow back to the motor's power supply due to the effect of back-EMF. If the current sink capability of the power supply is small, the device's motor power supply and output pins might be exposed to conditions beyond maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

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