

## 2-Phase Stepper Motor Unipolar Driver ICs

## Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings		Units
		SLA7032M	SLA7033M	
Motor supply voltage	V <sub>CC</sub>	46		V
Control supply voltage	V <sub>S</sub>	46		V
FET Drain-Source voltage	V <sub>DSS</sub>	100		V
TTL input voltage	V <sub>IN</sub>	-0.3 to +7		V
SYNC terminal voltage	V <sub>SYNC</sub>	-0.3 to +7		
Reference voltage	V <sub>REF</sub>	-0.3 to +7		V
Sense voltage	V <sub>RS</sub>	-5 to +7		V
Output current	I <sub>O</sub>	1.5	3	A
Power dissipation	P <sub>D1</sub>	4.5 (Without Heatsink)		W
	P <sub>D2</sub>	35 (T <sub>c</sub> = 25°C)		W
Channel temperature	T <sub>ch</sub>	+150		°C
Storage temperature	T <sub>stg</sub>	-40 to +150		°C

## Electrical Characteristics

Parameter	Symbol	Ratings						Units	
		SLA7032M			SLA7033M				
		min	typ	max	min	typ	max		
Control supply current	I <sub>S</sub>		10	15		10	15	mA	
	Condition	V <sub>S</sub> =44V			V <sub>S</sub> =44V				
Control supply voltage	V <sub>S</sub>	10	24	44	10	24	44	V	
FET Drain-Source voltage	V <sub>DSS</sub>	100			100			V	
	Condition	V <sub>S</sub> =44V, I <sub>DSS</sub> =250μA			V <sub>S</sub> =44V, I <sub>DSS</sub> =250μA				
FET ON voltage	V <sub>DS</sub>			0.6			0.85	V	
	Condition	I <sub>D</sub> =1A, V <sub>S</sub> =14V			I <sub>D</sub> =3A, V <sub>S</sub> =14V				
FET diode forward voltage	V <sub>SD</sub>			1.1			2.3	V	
	Condition	I <sub>SD</sub> =1A			I <sub>SD</sub> =3A				
FET drain leakage current	I <sub>DSS</sub>			250			250	μA	
	Condition	V <sub>DSS</sub> =100V, V <sub>S</sub> =44V			V <sub>DSS</sub> =100V, V <sub>S</sub> =44V				
DC characteristics	IN terminal	OUT	V <sub>IH</sub>	2.0		2.0		V	
			Condition	I <sub>D</sub> =1A			I <sub>D</sub> =3A		
		V <sub>IL</sub>			0.8				0.8
		Condition	V <sub>DSS</sub> =100V			V <sub>DSS</sub> =100V			
	OUT	V <sub>IH</sub>	2.0			2.0			V
		Condition	V <sub>DSS</sub> =100V			V <sub>DSS</sub> =100V			
		V <sub>IL</sub>			0.8			0.8	
		Condition	I <sub>D</sub> =1A			I <sub>D</sub> =3A			
Input current	I <sub>I</sub>			±1			±1	μA	
	Condition	V <sub>S</sub> =44V, V <sub>I</sub> =0 or 5V			V <sub>S</sub> =44V, V <sub>I</sub> =0 or 5V				
SYNC terminal	Input voltage	V <sub>SYNC</sub>	4.0		4.0			V	
		Condition	Synchronous chopping mode			Synchronous chopping mode			
		V <sub>SYNC</sub>			0.8				0.8
	Input current	Condition	Asynchronous chopping mode			Asynchronous chopping mode			
		I <sub>SYNC</sub>			0.1			0.1	mA
		Condition	V <sub>S</sub> =44V, V <sub>YS</sub> =5V			V <sub>S</sub> =44V, V <sub>YS</sub> =5V			
I <sub>SYNC</sub>			-0.1			-0.1			
REF terminal	Input current	V <sub>REF</sub>	0		2.0	0		V	
		Condition	Reference voltage input			Reference voltage input			
		V <sub>REF</sub>	4.0		5.5	4.0			5.5
	Input current	Condition	Output FET OFF			Output FET OFF			
		I <sub>REF</sub>			±1			±1	μA
		Condition	No synchronous trigger			No synchronous trigger			
Internal resistance	R <sub>REF</sub>		40			40		Ω	
	Condition	Resistance between GND and REF terminal at synchronous trigger			Resistance between GND and REF terminal at synchronous trigger				
Switching time	T <sub>r</sub>			0.5			0.5	μs	
		Condition	V <sub>S</sub> =24V, I <sub>D</sub> =1A			V <sub>S</sub> =24V, I <sub>D</sub> =1A			
		T <sub>sig</sub>			0.7				0.7
	Condition	V <sub>S</sub> =24V, I <sub>D</sub> =1A			V <sub>S</sub> =24V, I <sub>D</sub> =1A				
	T <sub>f</sub>			0.1			0.1		
	Condition	V <sub>S</sub> =24V, I <sub>D</sub> =1A			V <sub>S</sub> =24V, I <sub>D</sub> =1A				
Chopping OFF time	T <sub>OFF</sub>			12			12	μs	
	Condition	V <sub>S</sub> =24V			V <sub>S</sub> =24V				



Internal Block Diagram

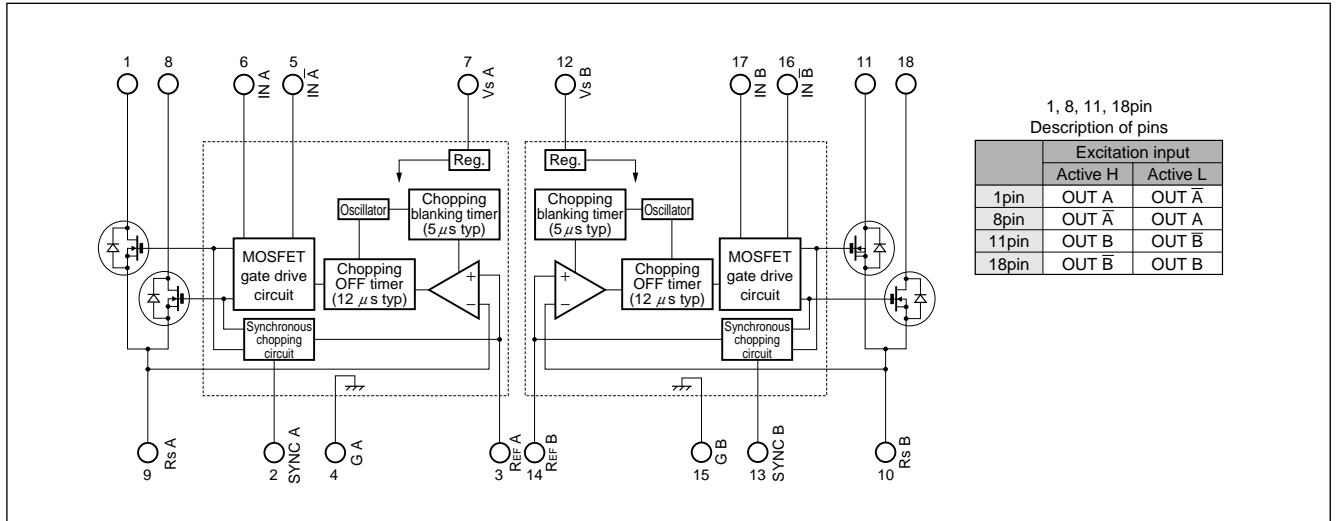
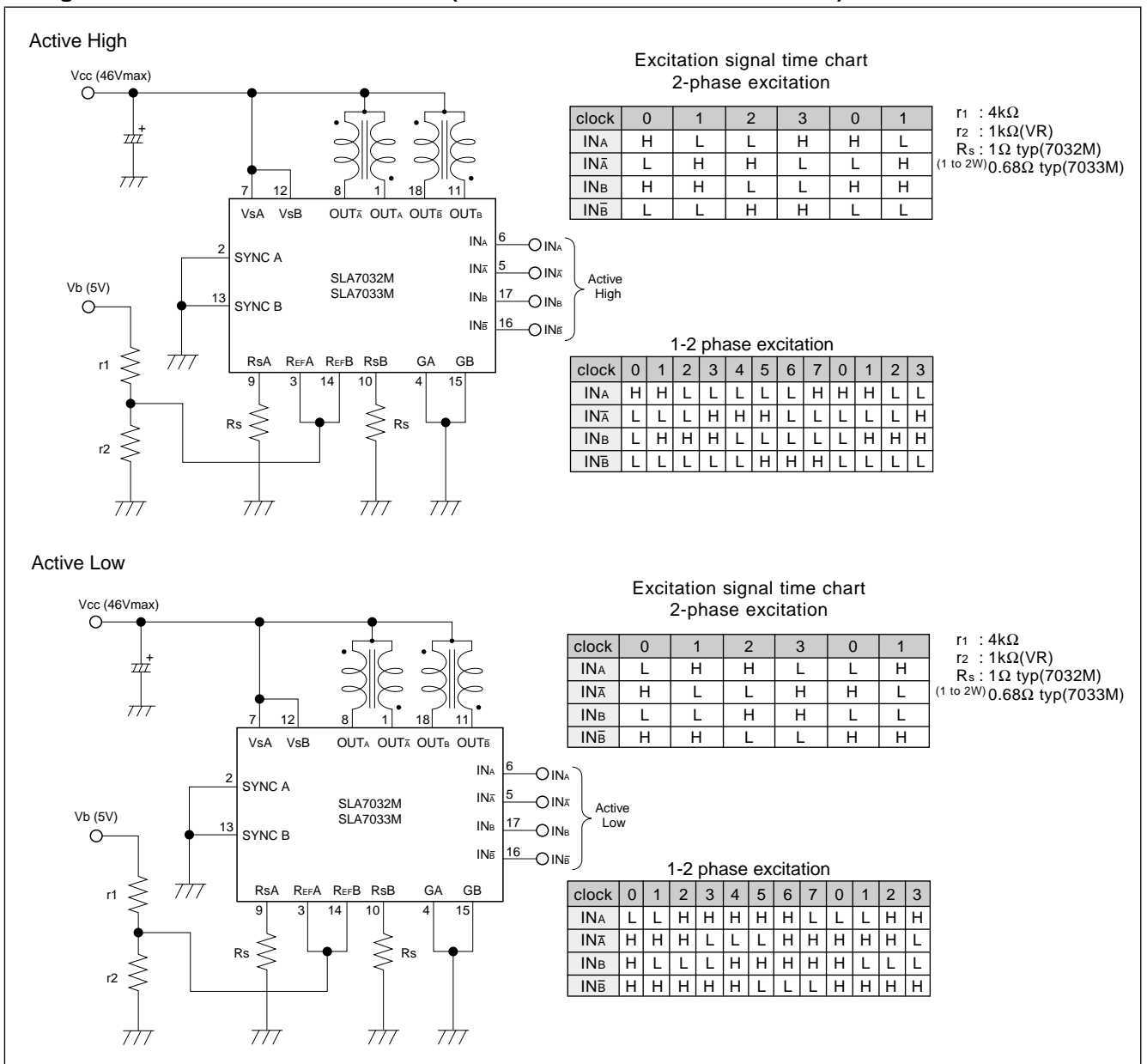
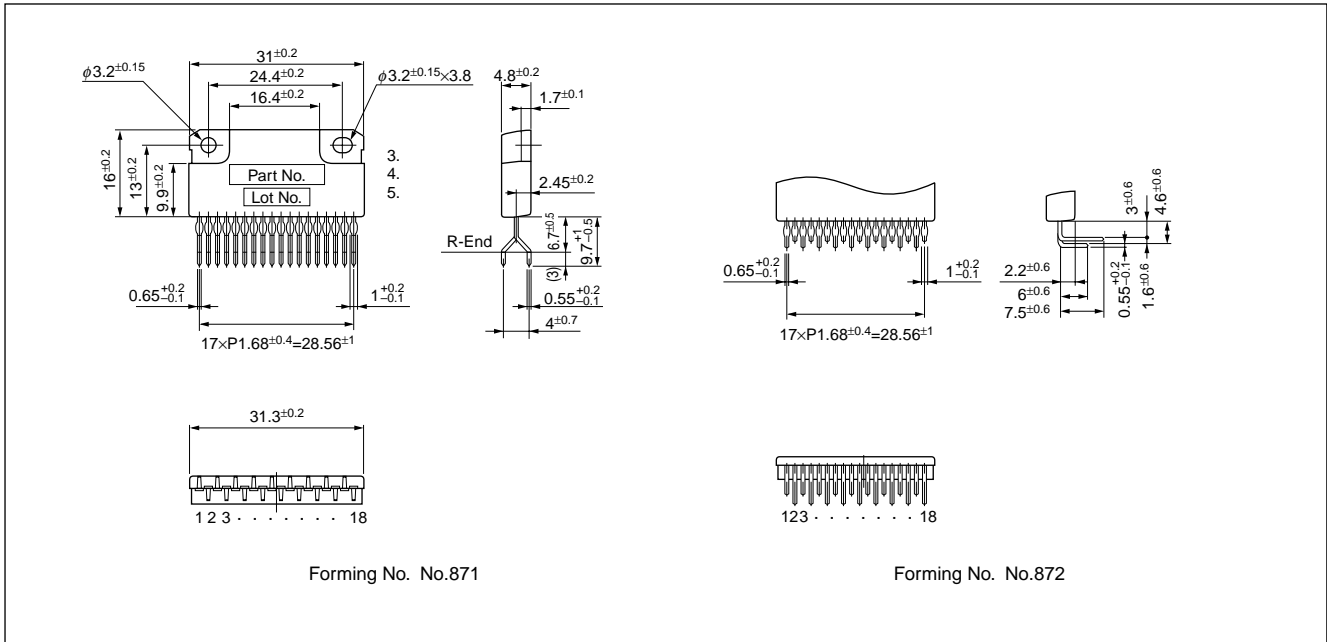


Diagram of Standard External Circuit (Recommended Circuit Constants)



External Dimensions

(Unit: mm)



## Application Notes

### ■Outline

SLA7032M (SLA7033M) is a stepper motor driver IC developed to reduce the number of external parts required by the conventional SLA7024M (SLA7026M). This IC successfully eliminates the need for some external parts without sacrificing the features of SLA7024M (SLA7026M). The basic function pins are compatible with those of SLA7024M (SLA7026M).

### ■Notes on Replacing SLA7024M (SLA7026M)

SLA7032M (SLA7033M) is pin-compatible with SLA7024M (SLA7026M). When using the IC on an existing board, the following preparations are necessary:

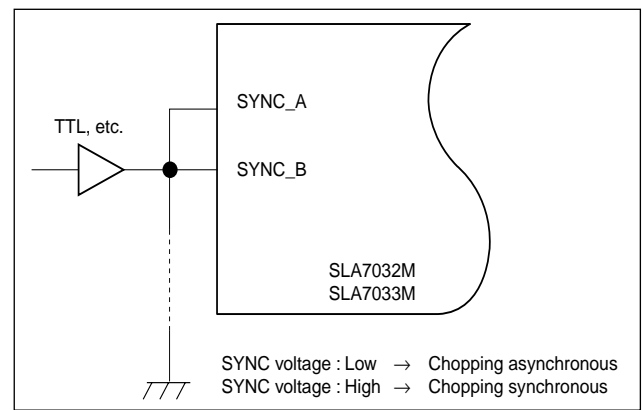
- (1) Remove the resistors and capacitors attached for setting the chopping OFF time. ( $r_3$ ,  $r_4$ ,  $C_1$ , and  $C_2$  in the catalog)
- (2) Remove the resistors and capacitors attached for preventing noise in the detection voltage  $V_{RS}$  from causing malfunctioning and short the sections from which the resistors were removed using jumper wires. ( $r_5$ ,  $r_6$ ,  $C_3$ , and  $C_4$  in the catalog)
- (3) Normally, keep pins 2 and 13 grounded because their functions have changed to synchronous and asynchronous switching (SYNC terminals). For details, see "Circuit for Preventing Abnormal Noise When the Motor Is Not Running (Synchronous circuit)." (Low: asynchronous, High: synchronous)

### ■Circuit for Preventing Abnormal Noise When the Motor Is Not Running (Synchronous Circuit)

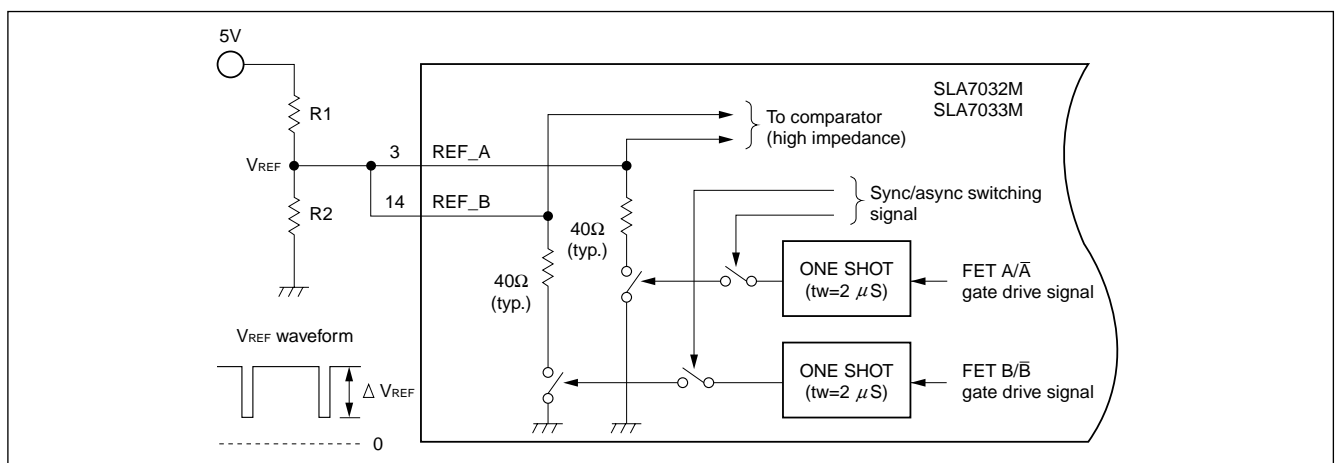
A motor may generate abnormal noise when it is not running. This phenomenon is attributable to asynchronous chopping between phases A and B. To prevent the phenomenon, SLA7032M (SLA7033M) contains a synchronous chopping circuit. Do not leave

the SYNC terminals open because they are for CMOS input. Connect TTL or similar to the SYNC terminals and switch the SYNC terminal level high or low.

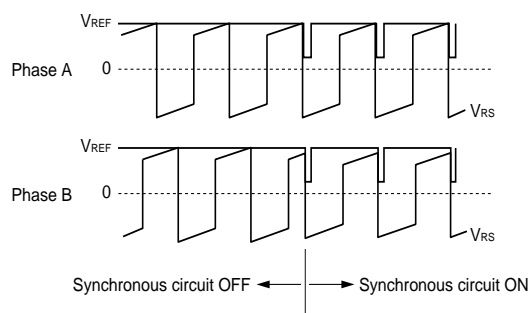
When the motor is not running, set the TTL signal high (SYNC terminal voltage: 4 V or more) to make chopping synchronous. When the motor is running, set the TTL signal low (SYNC terminal voltage: 0.8 V or less) to make chopping asynchronous. If chopping is set to synchronous at when the motor is running, the motor torque deteriorates before the coil current reaches the set value. If no abnormal noise occurs when the motor is not running, ground the SYNC terminals (TTL not necessary).



The built-in synchronous chopping circuit superimposes a trigger signal on the REF terminal for synchronization between the two phases. The figure below shows the internal circuit of the REF terminal. Since the  $\Delta V_{REF}$  varies depending on the values of R1 and R2, determine these values for when the motor is not running within the range where the two phases are synchronized.



### Synchronous circuit operating waveform



**Determining the Output Current**

Fig. 1 shows the waveform of the output current (motor coil current). The method of determining the peak value of the output current (Io) based on this waveform is shown below.

(Parameters for determining the output current Io)

Vb: Reference supply voltage

r1,r2: Voltage-divider resistors for the reference supply voltage

Rs: Current sense resistor

(1) Normal rotation mode

Io is determined as follows when current flows at the maximum level during motor rotation. (See Fig.2.)

$$I_o \cong \frac{r_2}{r_1+r_2} \cdot \frac{V_b}{R_s} \dots\dots\dots (1)$$

(2) Power down mode

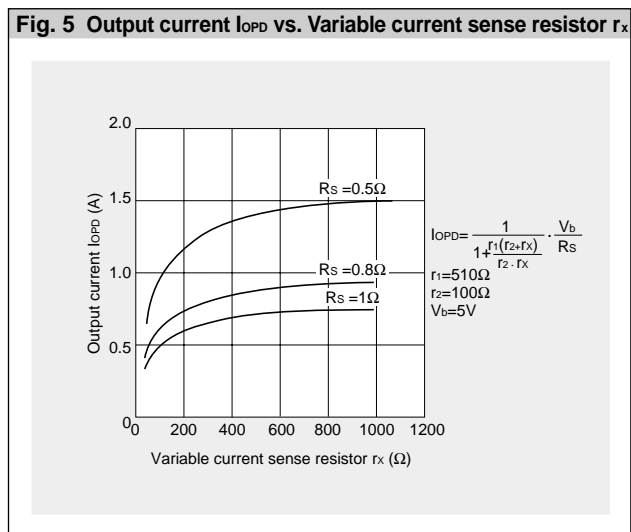
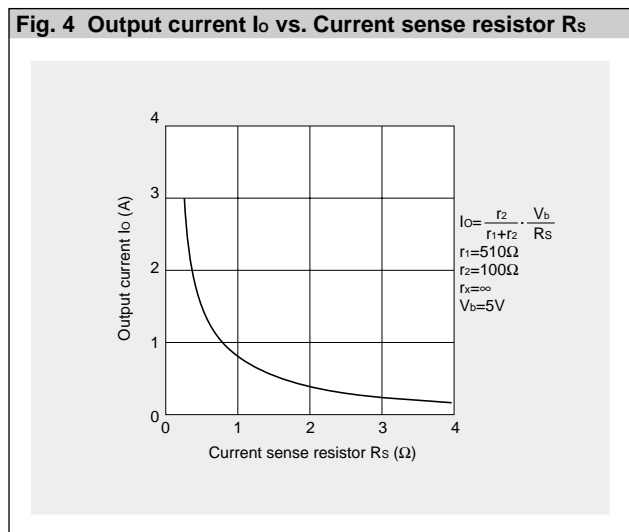
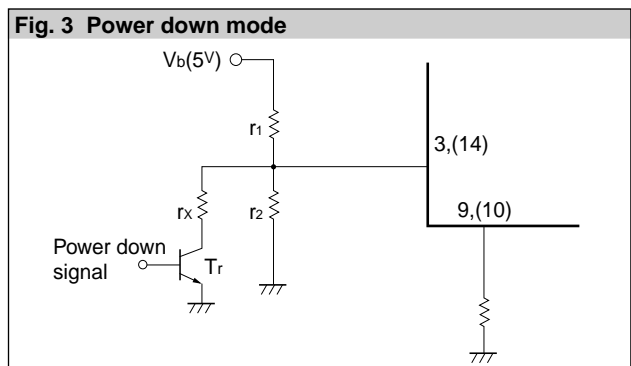
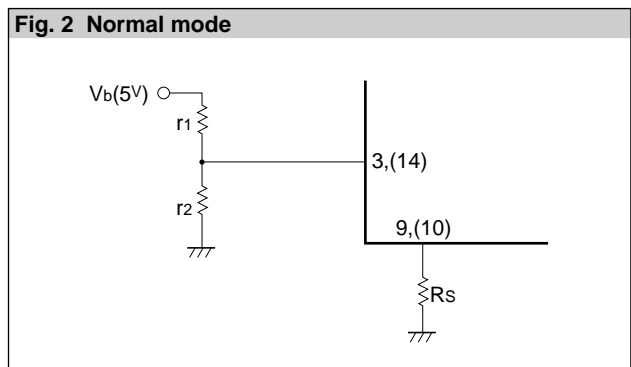
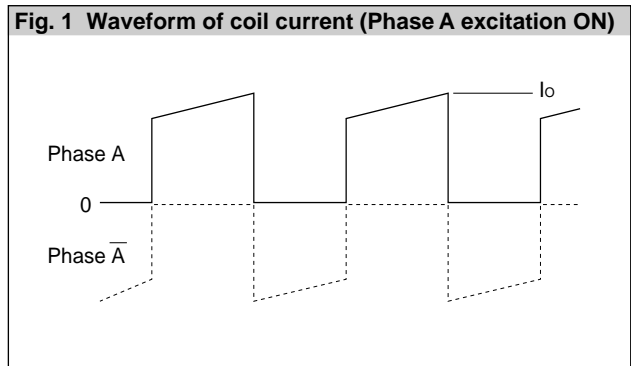
The circuit in Fig.3 (rx and Tr) is added in order to decrease the coil current. Io is then determined as follows.

$$I_{OPD} \cong \frac{1}{1 + \frac{r_1(r_2+r_x)}{r_2 \cdot r_x}} \cdot \frac{V_b}{R_s} \dots\dots\dots (2)$$

Equation (2) can be modified to obtain equation to determine rx.

$$r_x = \frac{1}{\frac{1}{r_1} \left( \frac{V_b}{R_s \cdot I_{OPD}} - 1 \right) - \frac{1}{r_2}}$$

Fig. 4 and 5 show the graphs of equations (1) and (2) respectively.

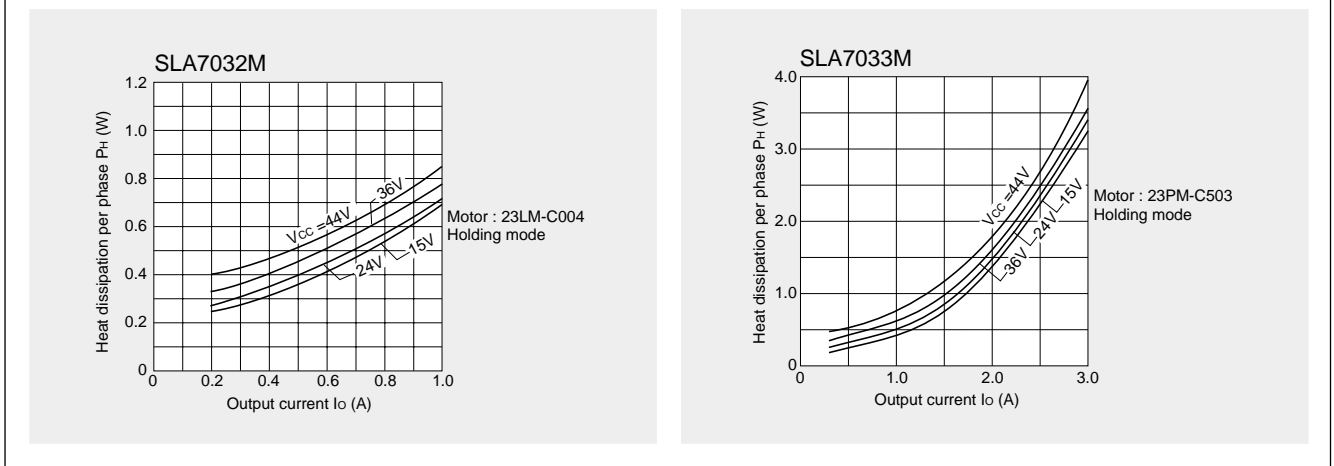


**Thermal Design**

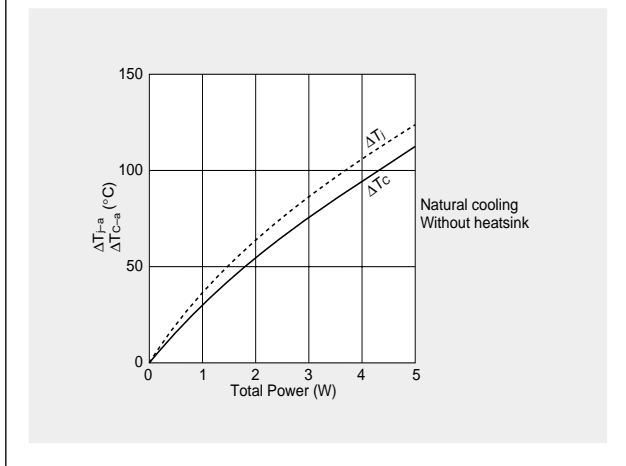
An outline of the method for calculated heat dissipation is shown below.

- (1) Obtain the value of  $P_H$  that corresponds to the motor coil current  $I_o$  from Fig. 6 "Heat dissipation per phase  $P_H$  vs. Output current  $I_o$ ."
- (2) The power dissipation  $P_{diss}$  is obtained using the following formula.  
 2-phase excitation:  $P_{diss} \cong 2P_H + 0.015 \times V_s$  (W)  
 1-2 phase excitation:  $P_{diss} \cong \frac{3}{2} P_H + 0.015 \times V_s$  (W)
- (3) Obtain the temperature rise that corresponds to the computed value of  $P_{diss}$  from Fig. 7 "Temperature rise."

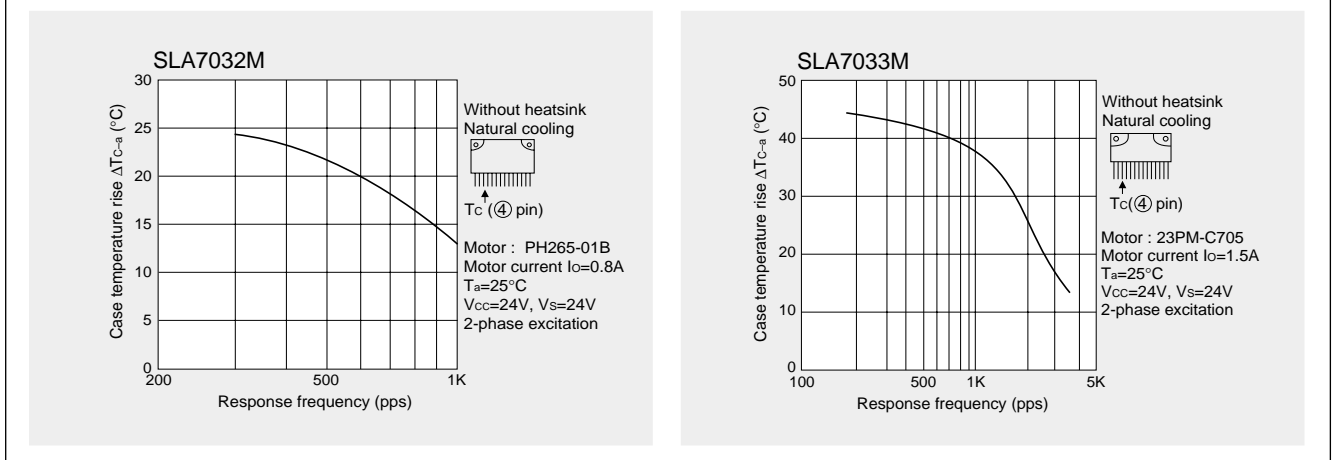
**Fig. 6 Heat dissipation per phase  $P_H$  vs. Output current  $I_o$**



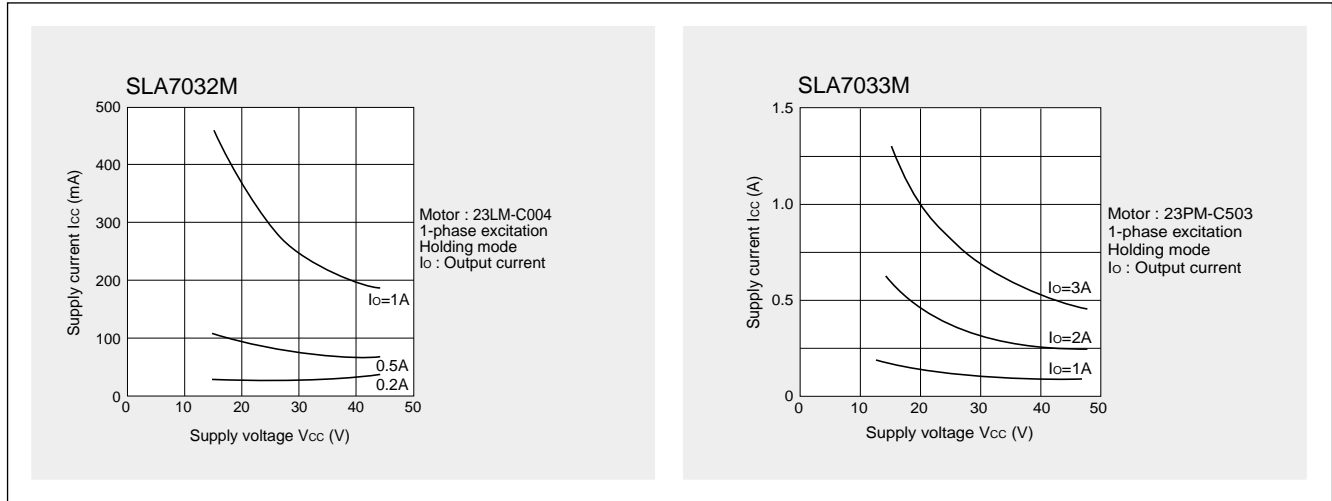
**Fig. 7 Temperature rise**



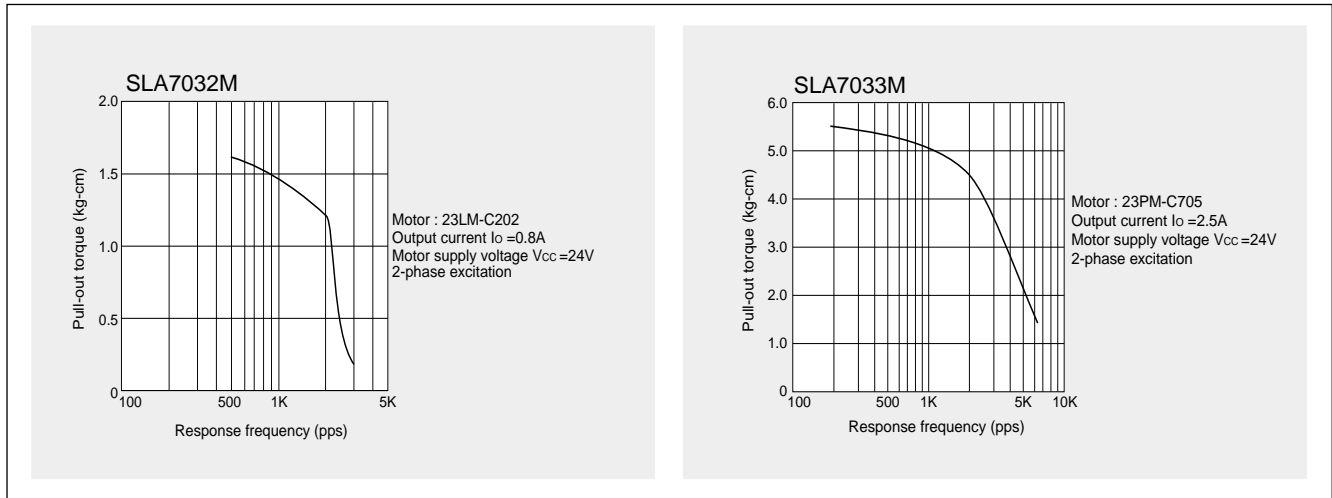
**Thermal characteristics**



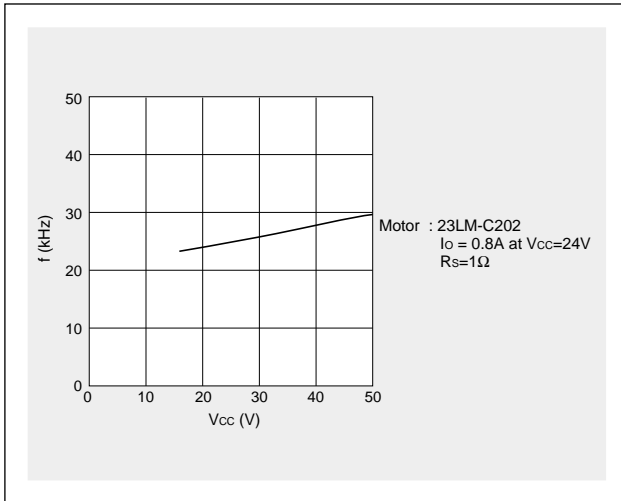
■ Supply Voltage  $V_{CC}$  vs. Supply Current  $I_{CC}$



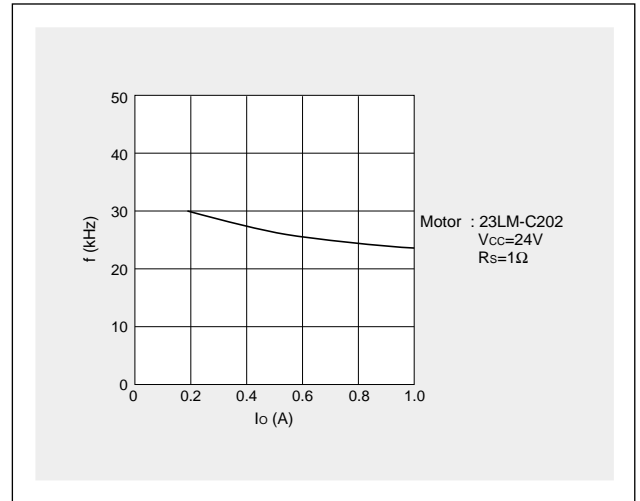
■ Torque Characteristics



### ■ Chopper frequency vs. Supply voltage



### ■ Chopper frequency vs. Output current



### ■ Note

The excitation input signals of the SLA7032M, SLA7033M can be used as either Active High or Active Low. Note, however, that the corresponding output (OUT) changes depending on the input (IN).

#### Active High

Input	Corresponding output
IN <sub>A</sub> (pin6)	OUT <sub>A</sub> (pin1)
IN <sub>A</sub> <sup>̄</sup> (pin5)	OUT <sub>A</sub> <sup>̄</sup> (pin8)
IN <sub>B</sub> (pin17)	OUT <sub>B</sub> (pin11)
IN <sub>B</sub> <sup>̄</sup> (pin16)	OUT <sub>B</sub> <sup>̄</sup> (pin18)

#### Active Low

Input	Corresponding output
IN <sub>A</sub> (pin6)	OUT <sub>A</sub> <sup>̄</sup> (pin8)
IN <sub>A</sub> <sup>̄</sup> (pin5)	OUT <sub>A</sub> (pin1)
IN <sub>B</sub> (pin17)	OUT <sub>B</sub> <sup>̄</sup> (pin18)
IN <sub>B</sub> <sup>̄</sup> (pin16)	OUT <sub>B</sub> (pin11)

### ■ Handling Precautions

The input terminals of this product use C-MOS circuits. Observe the following precautions.

- Carefully control the humidity of the room to prevent the buildup of static electricity. Since static electricity is particularly a problem during the winter, be sure to take sufficient precautions.
- Take care to make sure that static electricity is not applied to the IC during wiring and assembly. Take precautions such as shorting the terminals of the printed wiring board to ensure that they are at the same electrical potential.