

2-Phase Stepper Motor Unipolar Driver ICs

Absolute Maximum Ratings

(Ta=25°C)

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

Electrical Characteristics

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

Internal Block Diagram

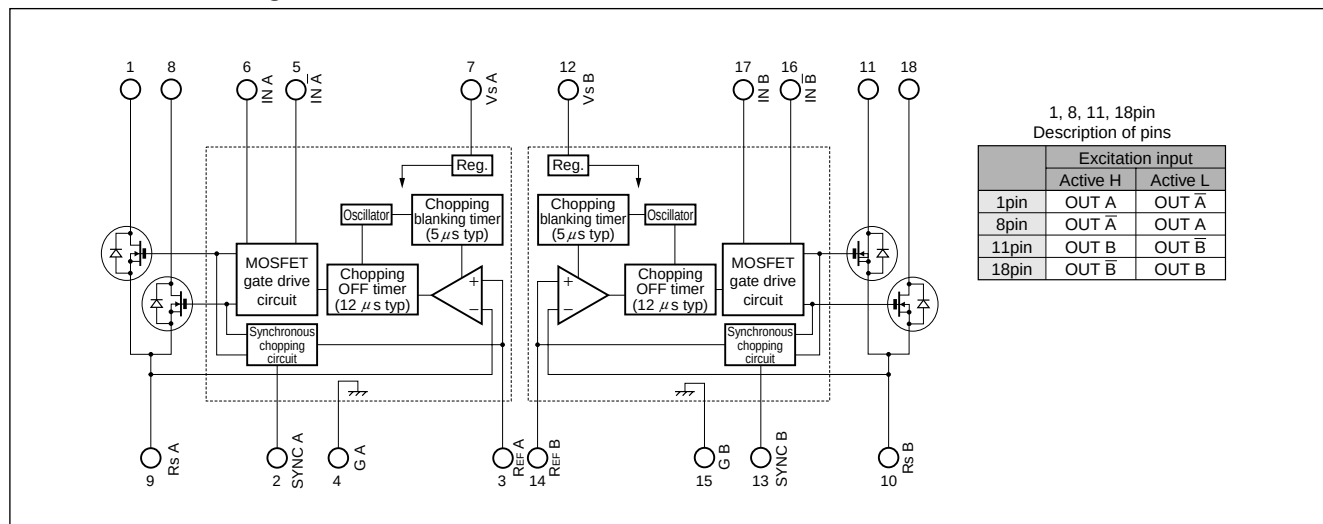
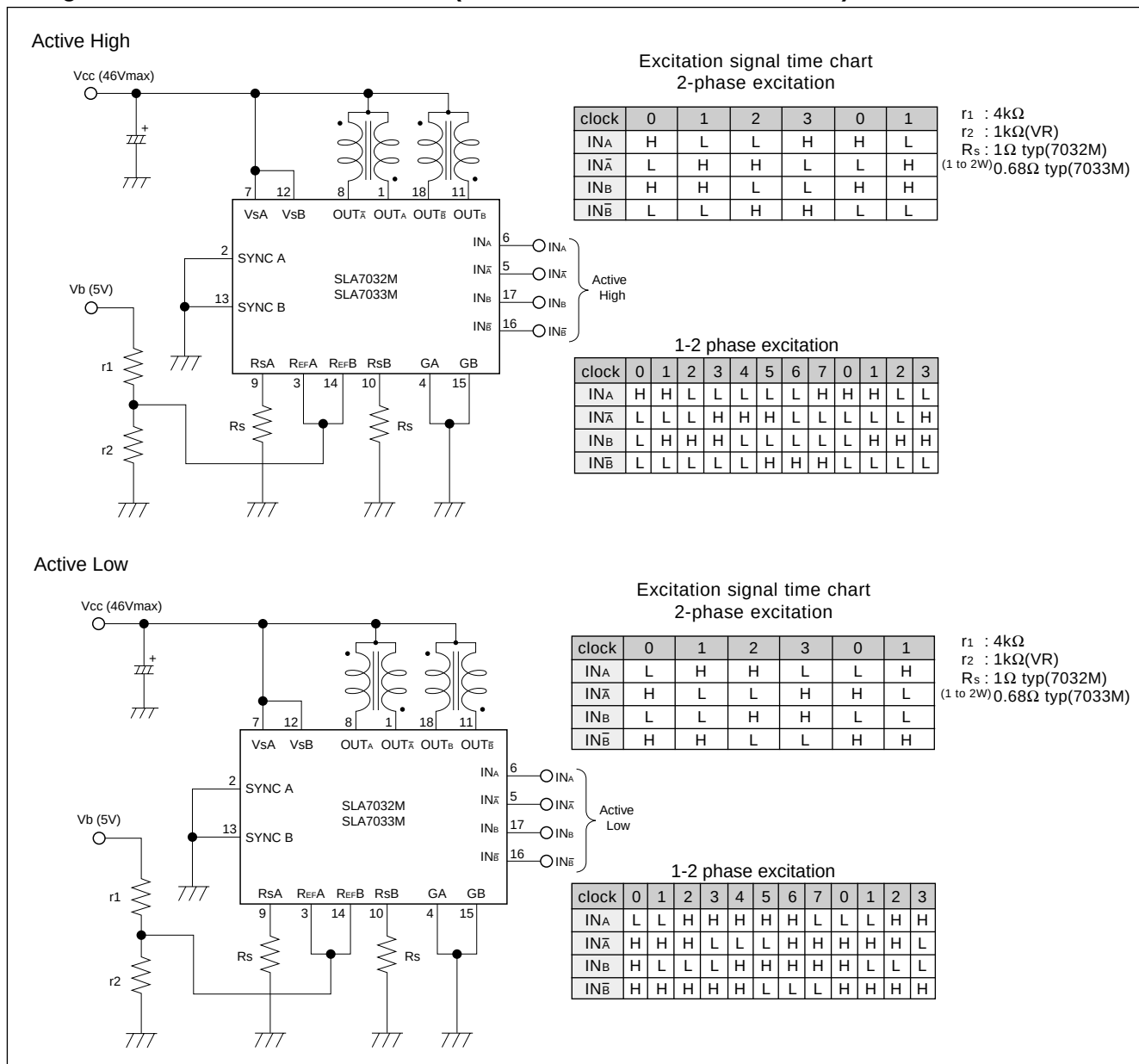
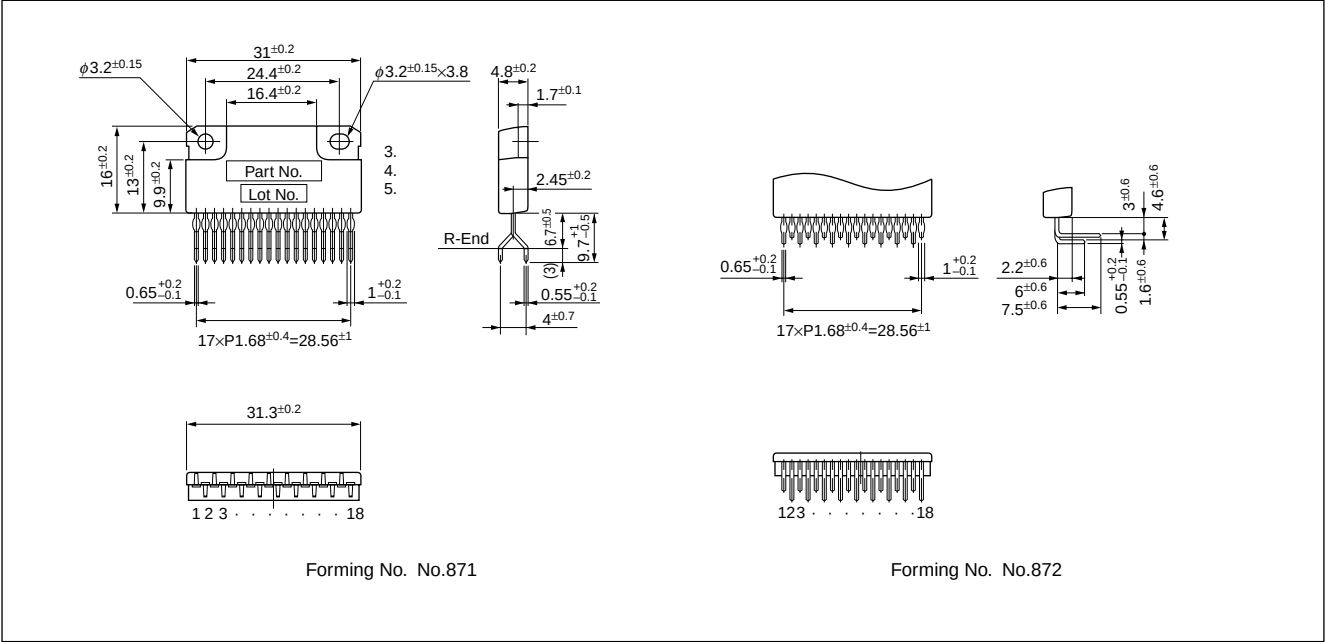


Diagram of Standard External Circuit (Recommended Circuit Constants)



■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)

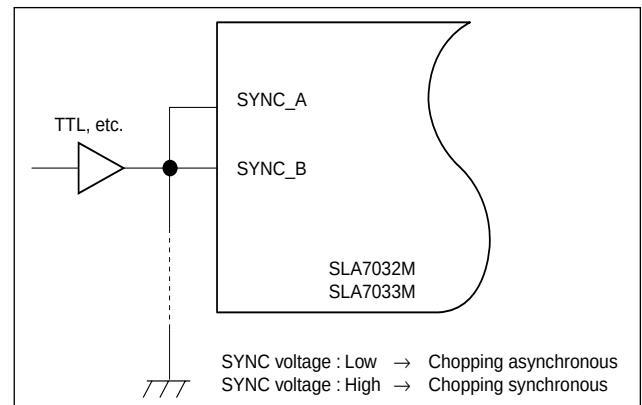
A motor may generate abnormal noise when it is not running. This phenomenon is attributable to asynchronous chopping between phases A and B. To prevent the phenomenon, SLA7032M (SLA7033M) contains a synchronous chopping circuit. Do not leave

the SYNC terminals open because they are for CMOS input.

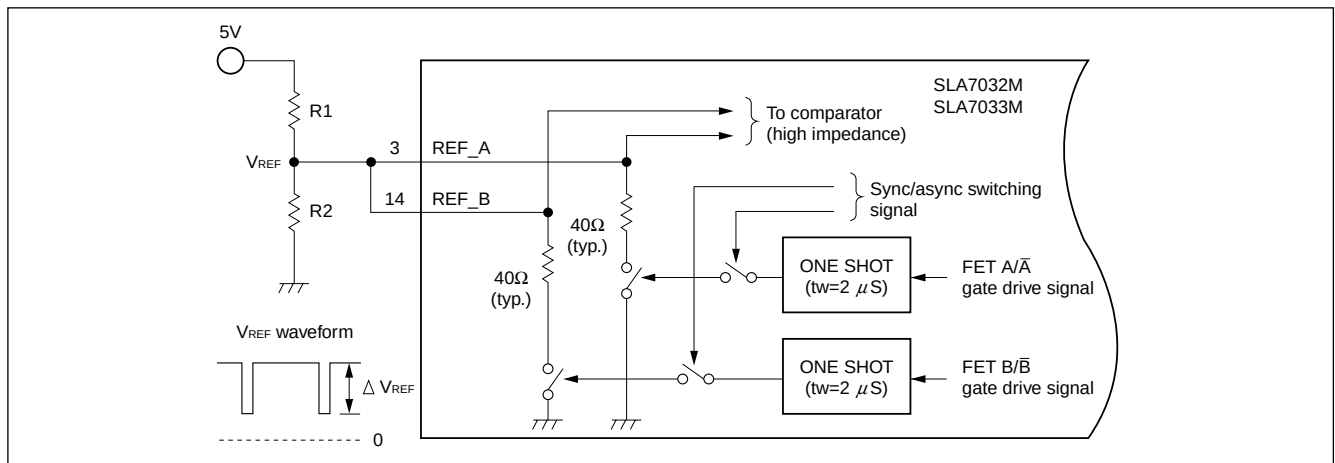
Connect TTL or similar to the SYNC terminals and switch the SYNC terminal level high or low.

When the motor is not running, set the TTL signal high (SYNC terminal voltage: 4 V or more) to make chopping synchronous.

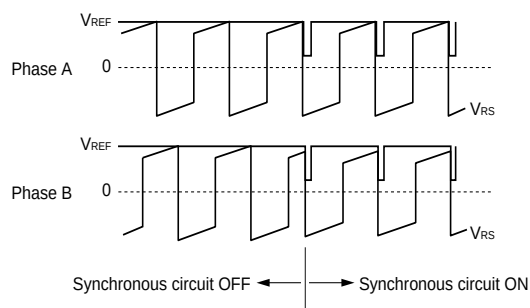
When the motor is running, set the TTL signal low (SYNC terminal voltage: 0.8 V or less) to make chopping asynchronous. If chopping is set to synchronous at when the motor is running, the motor torque deteriorates before the coil current reaches the set value. If no abnormal noise occurs when the motor 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 ΔV_{REF} varies depending on the values of R_1 and R_2 , 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 (I_o) based on this waveform is shown below.

(Parameters for determining the output current I_o)

V_b : Reference supply voltage

r_1, r_2 : Voltage-divider resistors for the reference supply voltage

R_s : Current sense resistor

(1) Normal rotation mode

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

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

(2) Power down mode

The circuit in Fig.3 (r_x and T_r) is added in order to decrease the coil current. I_o is then determined as follows.

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

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

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

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

Fig. 1 Waveform of coil current (Phase A excitation ON)

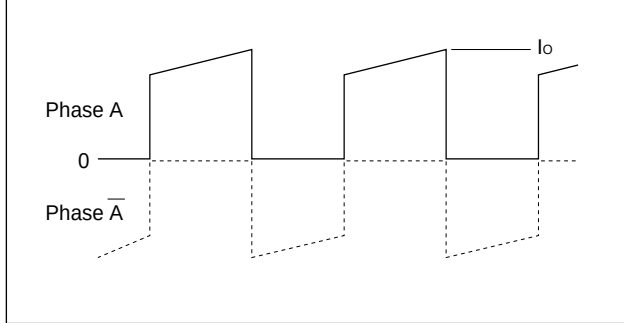


Fig. 2 Normal mode

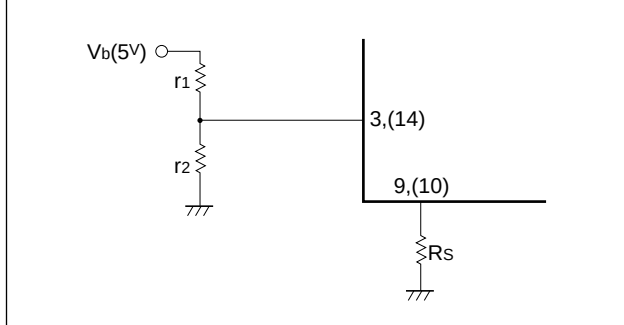


Fig. 3 Power down mode

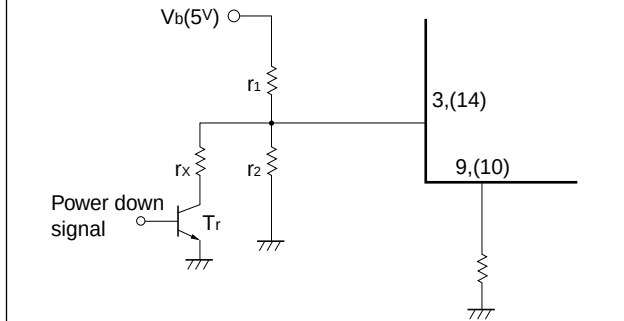


Fig. 4 Output current I_o vs. Current sense resistor R_s

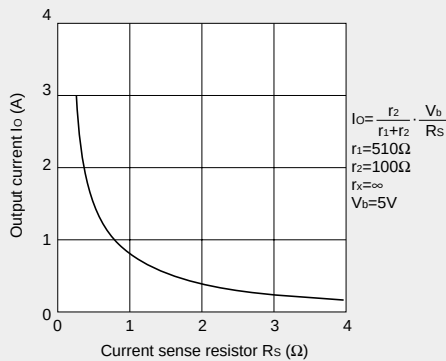
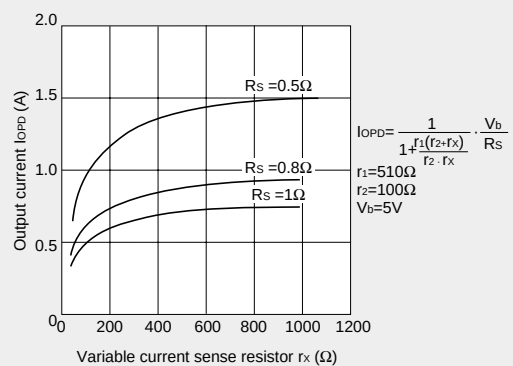


Fig. 5 Output current I_{OPD} vs. Variable current sense resistor r_x



■ 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.

$$\text{2-phase excitation: } P_{diss} \cong 2P_H + 0.015 \times V_S \text{ (W)}$$

$$\text{1-2 phase excitation: } P_{diss} \cong \frac{3}{2} P_H + 0.015 \times V_S \text{ (W)}$$

- (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

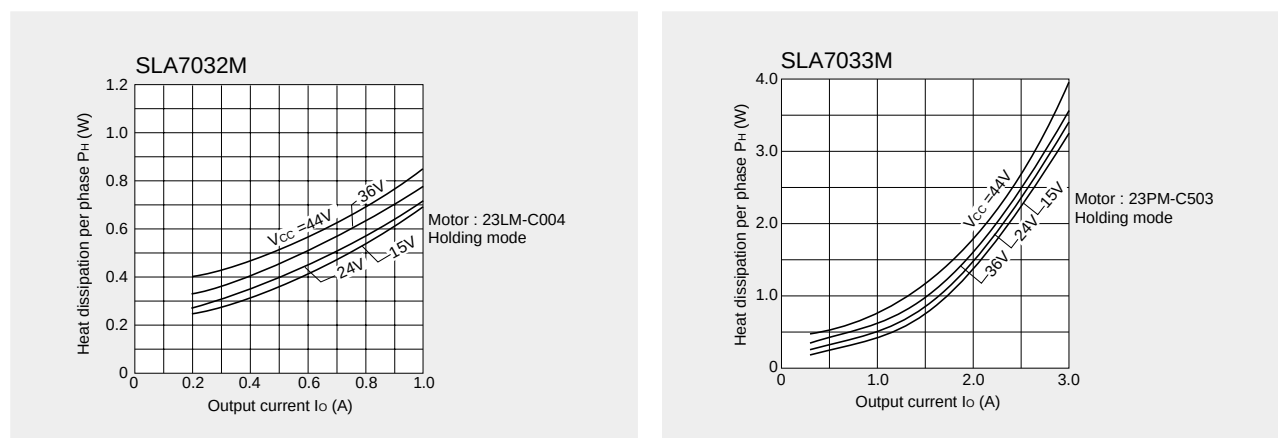
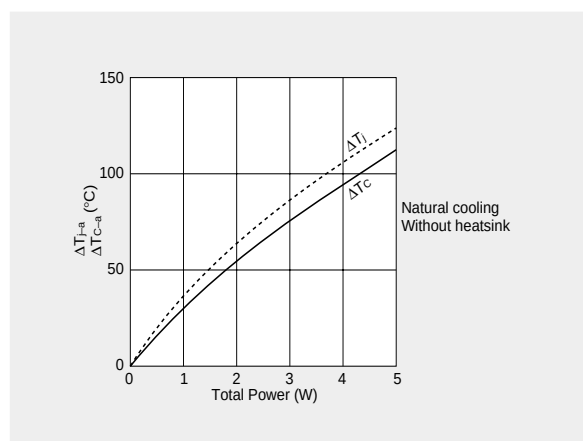
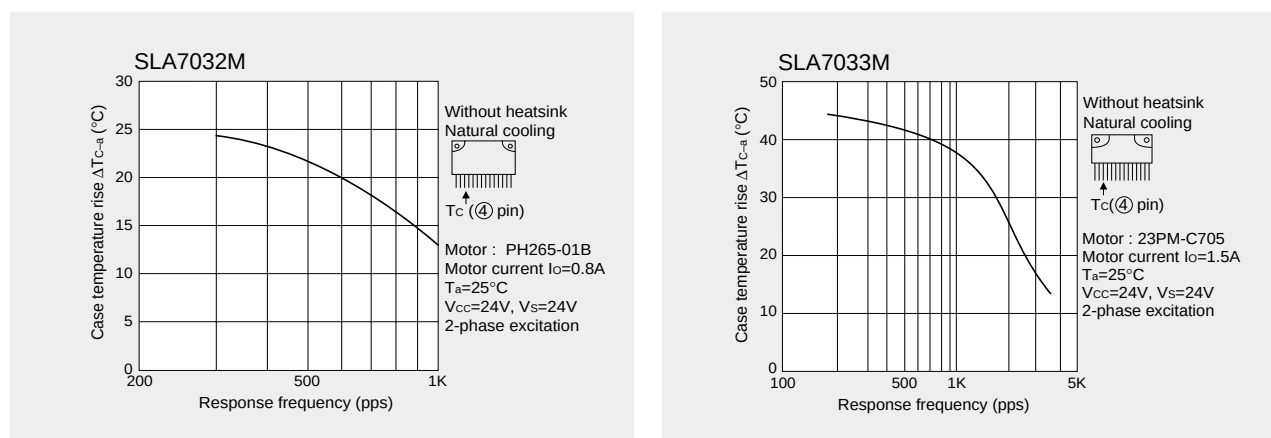


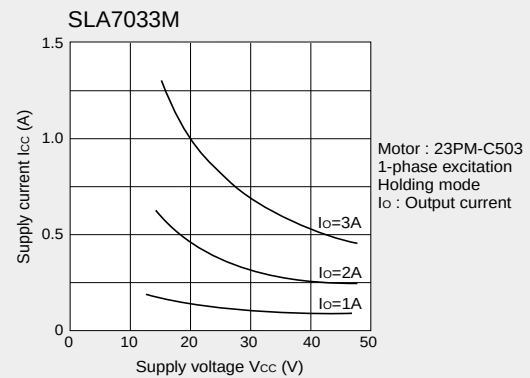
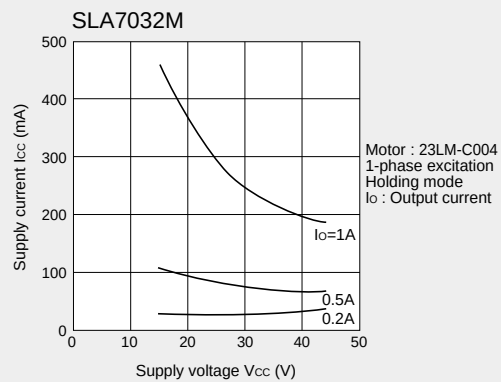
Fig. 7 Temperature rise



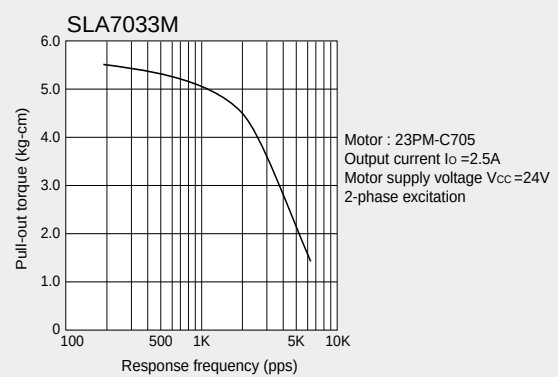
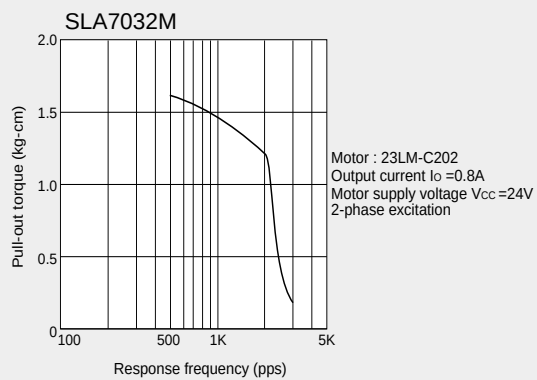
Thermal characteristics



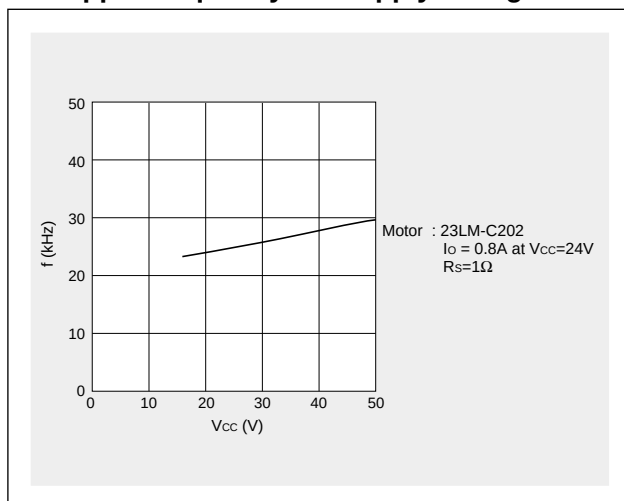
■ Supply Voltage V_{CC} vs. Supply Current I_{CC}



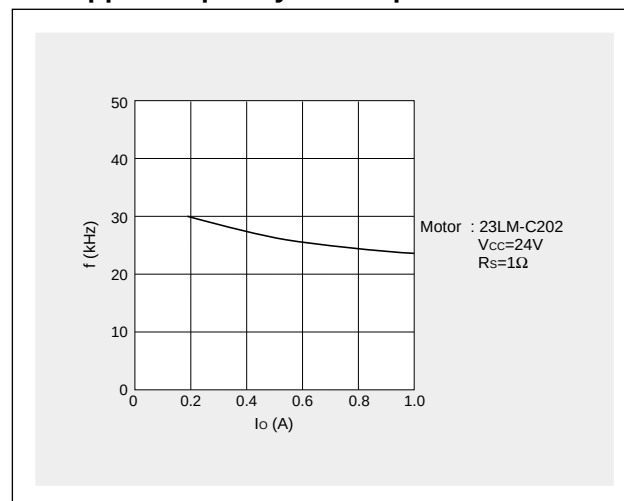
■ Torque Characteristics



■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 _A (pin6)	OUT _A (pin1)
IN _A [̄] (pin5)	OUT _A [̄] (pin8)
IN _B (pin17)	OUT _B (pin11)
IN _B [̄] (pin16)	OUT _B [̄] (pin18)

Active Low

Input	Corresponding output
IN _A (pin6)	OUT _A (pin8)
IN _A [̄] (pin5)	OUT _A [̄] (pin1)
IN _B (pin17)	OUT _B (pin18)
IN _B [̄] (pin16)	OUT _B [̄] (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.