

# SLA7060M/61M/62M/65M/66M/67M

October 2005

## ■General Description

Combining low-power CMOS logic with high-current, high-voltage power FET outputs, the Series SLA706xM translator/drivers provide complete control and drive for a two-phase unipolar stepper motor with internal fixed off time and pulse-width modulation (PWM) control of the output current in a power multi-chip module (PMCM™).

There are no phase-sequence tables, high-frequency control lines, or complex interfaces to program. The CMOS logic section provides the sequencing logic, direction control, synchronous/asynchronous PWM operation, and a "sleep" function. The minimum CLOCK input is an ideal fit for applications where a complex  $\mu$ P is unavailable or overburdened. TTL or LSTTL may require the use of appropriate pull-up resistors to ensure a proper input-logic high. For PWM current control, the maximum output current is determined by the user's selection of a reference voltage and sensing resistor. The NMOS outputs are capable of sinking up to 1, 2, or 3 A (depending on device) and withstanding 46 V in the off state.

Clamp diodes provide protection against inductive transients. Special power-up sequencing is not required.

Half-, quarter-, eighth-, and sixteenth-step operation are externally selectable for the SLA7060/61/62M. Full-, Half-, quarter-, and eighth-step operation are externally selectable for the SLA7065/66/67M.

Half-step excitation alternates between the one-phase and two-phase modes (A-AB-B-AB-A-AB-BAB), providing an eight-step sequence.

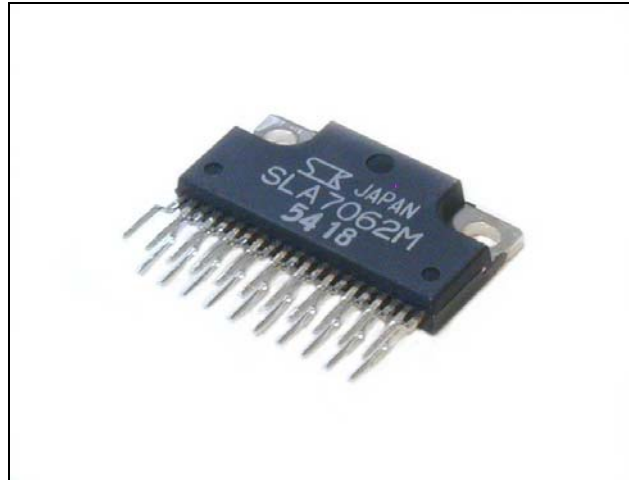
## ■Applications

- PPC
- Printer
- OA Equipment

## ■Features

- To 3 A Output Rating
- Internal Sequencer for Microstepping Operation
- PWM Constant-Current Motor Drive
- Cost-Effective, Multi-Chip Solution
- 100 V, Avalanche-Rated NMOS Outputs
- Low  $r_{DS(on)}$  NMOS Outputs (150 milli-ohms typical)
- Advanced, Improved Body Diodes
- Inputs Compatible with 3.3 V or 5 V Control Signals
- Sleep Mode
- Internal Clamp Diodes

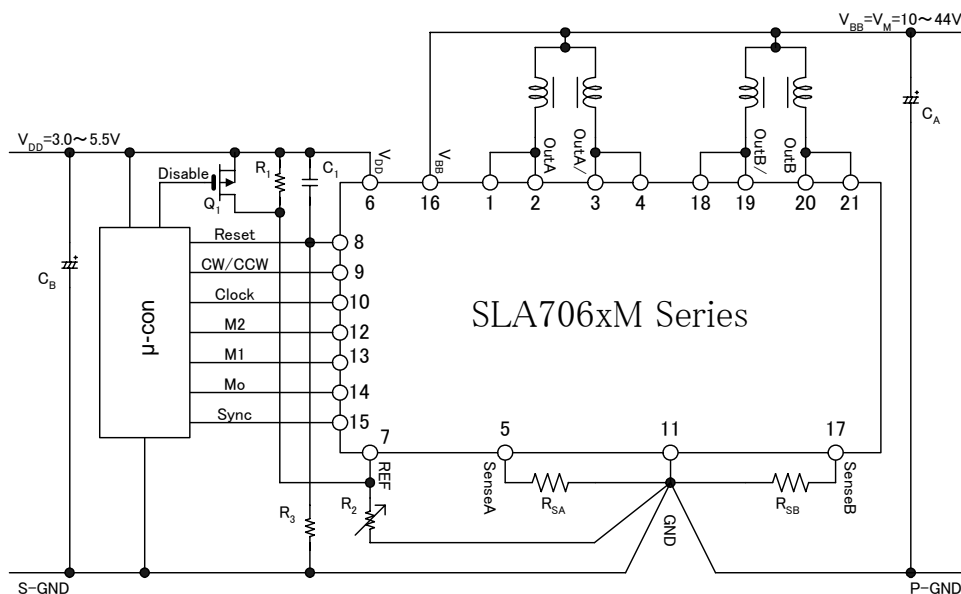
## ■Package



## ■Key Specifications

- Motor Supply Voltage ( $V_M$ ) : 44V max
- Load Supply Voltage ( $V_S$ ) : 10V~44V
- Logic Supply Voltage ( $V_{CC}$ ) : 3V~5.5V
- Output Current ( $I_O$ ) : 1A(SLA7060M,SLA7065M)  
2A(SLA7061M,SLA7066M)  
3A(SLA7062M,SLA7067M)
- Output Maximum Voltage ( $V_{DSS}$ ) : 100V min

## Typical Connection



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<http://www.sanken-ele.co.jp/en/>

I03-003EA-051006

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## Scope

The present specifications shall apply to a micro-stepping capable 2-phase unipolar stepper motor

driver IC, SLA706xM Series.

The present specifications shall apply to SLA706xM Series which is performed RoHS instructions.

Lead part solder : Pb free    Inner solder : Lead content > 85%

## Outline

Type	Hybrid integrated circuit
Structure	Plastic molded (transfer mold)
Applications	To drive a 2-phase stepper motor. (Micro-Stepping Capable. PWM Constant-Current Control.)

## Absolute maximum ratings

Characteristic	Symbol	Ratings	Unit	Remarks
Load Supply Voltage	$V_M$	46	V	
Main Power Supply Voltage	$V_{BB}$	46	V	
Logic Supply Voltage	$V_{DD}$	7	V	
Output Current	$I_O^{**}$	1.0	A	SLA7060M,SLA7065M
		2.0		SLA7061M,SLA7066M
		3.0		SLA7062M,SLA7067M
Logic Input Voltage	$V_{IN}$	$-0.3 \sim V_{DD}+0.3$	V	
REF Input Voltage	$V_{REF}$	$-0.3 \sim V_{DD}+0.3$	V	
Sense Voltage	$V_{RS}$	$\pm 2$	V	$T_w < 1\mu S$ doesn't contain it.
Power Dissipation	$P_D$	3.5	W	at $T_a = 25^\circ C$
		16	W	at $T_C = 25^\circ C$
Junction Temperature	$T_j$	150	$^\circ C$	
Operating Temperature Range	$T_a$	$-20 \sim 85$	$^\circ C$	
Storage Temperature Range	$T_{stg}$	$-30 \sim 150$	$^\circ C$	

※Output current rating may be limited by duty cycle, ambient temperature, and heat sinking.

Under any set of conditions, do not exceed the specified junction temperature( $T_j$ ).

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## Electrical characteristics

## Recommendable Operating Range

Characteristic	Symbol	Ratings		Unit	Remarks
		MIN	MAX		
Load Supply Voltage	$V_M$		44	V	
Main Power Supply Voltage Range	$V_{BB}$	10	44	V	
Logic Supply Voltage Range	$V_{DD}$	3.0	5.5	V	Please adjust the Vcc surge voltage to 0.5V or less.
REF Input Voltage Range	$V_{REF}$	0.1	1.0	V	The control current accuracy decreases in 0.1V or less.
Case Temperature	$T_C$		90	°C	11Pin temperature (at No Fin)

Electrical Characteristic ( $T_a=25^\circ\text{C}$ ,  $V_{BB}=24\text{V}$ ,  $V_{DD}=5\text{V}$  Unless Otherwise Noted.)

Characteristic	Symbol	Limits			Unit	Test Condition
		Min.	Typ.	Max.		
Main Power Supply Current	$I_{BB}$			15	mA	Regularity
	$I_{BBS}$			100	$\mu\text{A}$	at SLEEP operates
Logic Supply Current	$I_{DD}$			4	mA	
Drain-Source Breakdown	$V_{(BR)DS}$	100			V	$V_{BB}=44\text{V}$ $I_D=1\text{mA}$
Output On Resistance	$R_{DS(on)}$		0.25	0.4	$\Omega$	$I_D=2\text{A}$
Body Diode Forward Voltage	$V_F$		0.95	1.2	V	$I_F=2\text{A}$
Maximum Clock Frequency	$f_{clk}$	250*			kHz	duty=50%
Logic Input Voltage	$V_{IL}$			$0.25 V_{DD}$	V	
	$V_{IH}$	$0.75 V_{DD}$			V	
Logic Input Current	$I_{IL}$		$\pm 1$		$\mu\text{A}$	Clock, Reset, CW/CCW, Sync
	$I_{IH}$		$\pm 1$		$\mu\text{A}$	
	$I_{ILM}$	-75	-50	-25	$\mu\text{A}$	M1, M2
	$I_{IHM}$		$\pm 1$		$\mu\text{A}$	
REF Input Voltage Range	$V_{REF}$	0		1.5	V	Stationary current control
	$V_{REFS}$	2.0		$V_{DD}$	V	at SLEEP operates
REF Input Current	$I_{REF}$		$\pm 10$		$\mu\text{A}$	$V_{REF}=0\sim V_{DD}$
Mo Output Voltage	$V_{MOL}$			1.25	V	$I_{MOL}=1.5\text{mA}$
	$V_{MOH}$	$V_{DD}-1.25$			V	$I_{MOH}=-1.5\text{mA}$
Mo Output Current	$I_{MOL}$			3	mA	
	$I_{MOH}$	-3			mA	

\*Operation at a step frequency greater than the specified minimum value is possible but not warranted.

Note.

Negative current is defined as coming out of the specified pin.

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Electrical Characteristic(continued) ( $T_a=25^{\circ}\text{C}$ ,  $V_{\text{BB}}=24\text{V}$ ,  $V_{\text{DD}}=5\text{V}$  Unless Otherwise Noted.)

Characteristic	Symbol	Limits			Unit	Test Condition
		Min.	Typ.	Max.		
Sense Voltage	$V_{\text{SENSE}}$	0.95	1.00	1.05	V	$V_{\text{REF}}=1.0\text{V}$ at Mode F
Sense pins Sink Current	$I_{\text{SENSE}}$		$\pm 10$		$\mu\text{A}$	
Step Reference Current Ratio	Mode F		100		%	$V_{\text{SENSE}}=100\%$ $V_{\text{REF}}=0.1\sim 1\text{V}$
	Mode E		98.1		%	
	Mode D*		95.7		%	
	Mode C		92.4		%	
	Mode B*		88.2		%	
	Mode A		83.1		%	
	Mode 9*		77.3		%	
	Mode 8		70.7		%	
	Mode 7*		63.4		%	
	Mode 6		55.5		%	
	Mode 5*		47.1		%	
	Mode 4		38.2		%	
	Mode 3*		29.0		%	
	Mode 2		19.5		%	
Mode 1*		9.8		%		
Wake-Up time	$t_{\text{SE}}$	100			$\mu\text{s}$	$V_{\text{REF}}: 2.0 \rightarrow 1.5\text{V}$
Switching Time	$t_{\text{pdon}}$		2.0		$\mu\text{s}$	Clock $\rightarrow$ Out ON
	$t_{\text{pdoff}}$		1.5		$\mu\text{s}$	Clock $\rightarrow$ Out OFF
PWM Minimum On Time	$t_{\text{ON(min)}}$		1.8		$\mu\text{s}$	
PWM OFF Time	$t_{\text{OFF1}}$		12		$\mu\text{s}$	Mode 8~F
	$t_{\text{OFF2}}$		9		$\mu\text{s}$	Mode 4~7
	$t_{\text{OFF3}}$		7		$\mu\text{s}$	Mode 1~3

Note.

- Negative current is defined as coming out of the specified pin.
- SLA7065M, SLA7066M, and SLA7067M of the item of \* sign of Step Reference Current Ratio are off the subject.

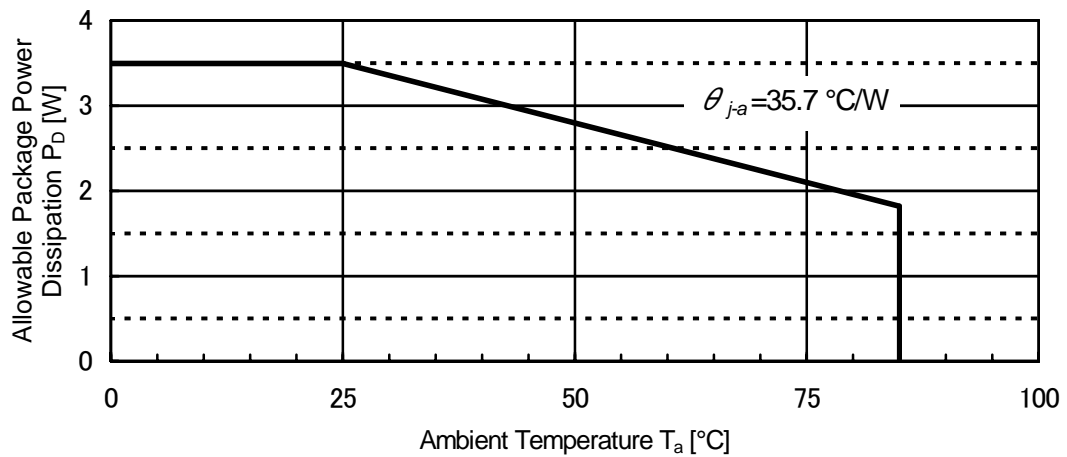
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熱設計データ

Thermal Design Data

### Thermal Ratings



### Truth Table

• Input Pin

Pin Name	Low Level	High Level	Clock
Reset	Run	Logic Reset	-
CW/CCW	Forward (CW)	Reverse (CCW)	
M1 M2	Micro-Stepping Operation Mode Setting		
REF	Enable	Sleep Mode	-
Sync	Asynchronous PWM operation	Synchronous PWM operation	-

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## Micro-Stepping Operation Mode Setting

【SLA7060M, SLA7061M, SLA7062M】

Operation Mode	Input Level	
	M1	M2
4W 1-2phase (1/16 Step)	L	L
2W 1-2phase (1/8 Step)	L	H
W 1-2phase (1/4 Step)	H	L
1-2phase (1/2 Step)	H	H

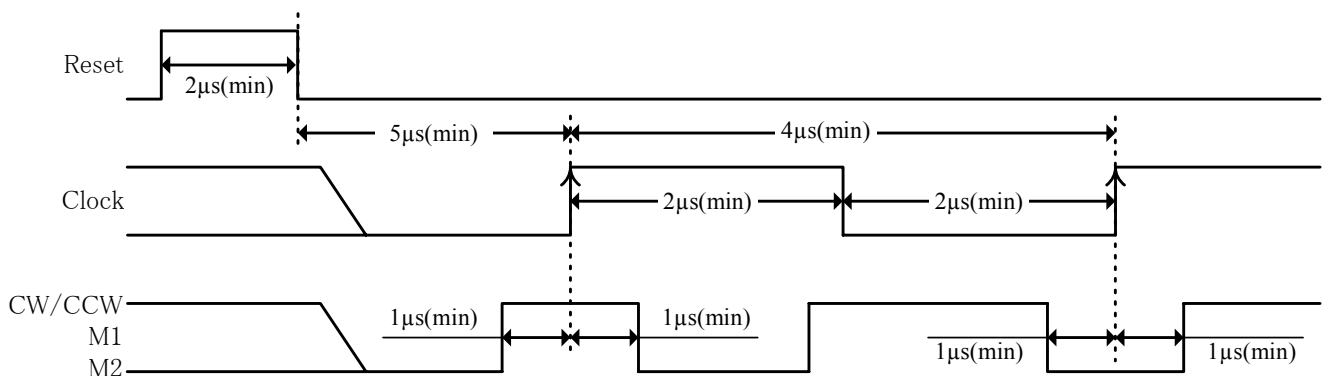
【SLA7065M, SLA7066M, SLA7067M】

Operation Mode	Input Level	
	M1	M2
2W 1-2phase (1/8 Step)	L	L
W 1-2phase (1/4 Step)	L	H
1-2phase (1/2 Step)	H	L
2-2phase (Full Step)	H	H

• Output Pin

Pin Name	High Level	Low Level
Mo	Half-Step Position (Mode 8)	-

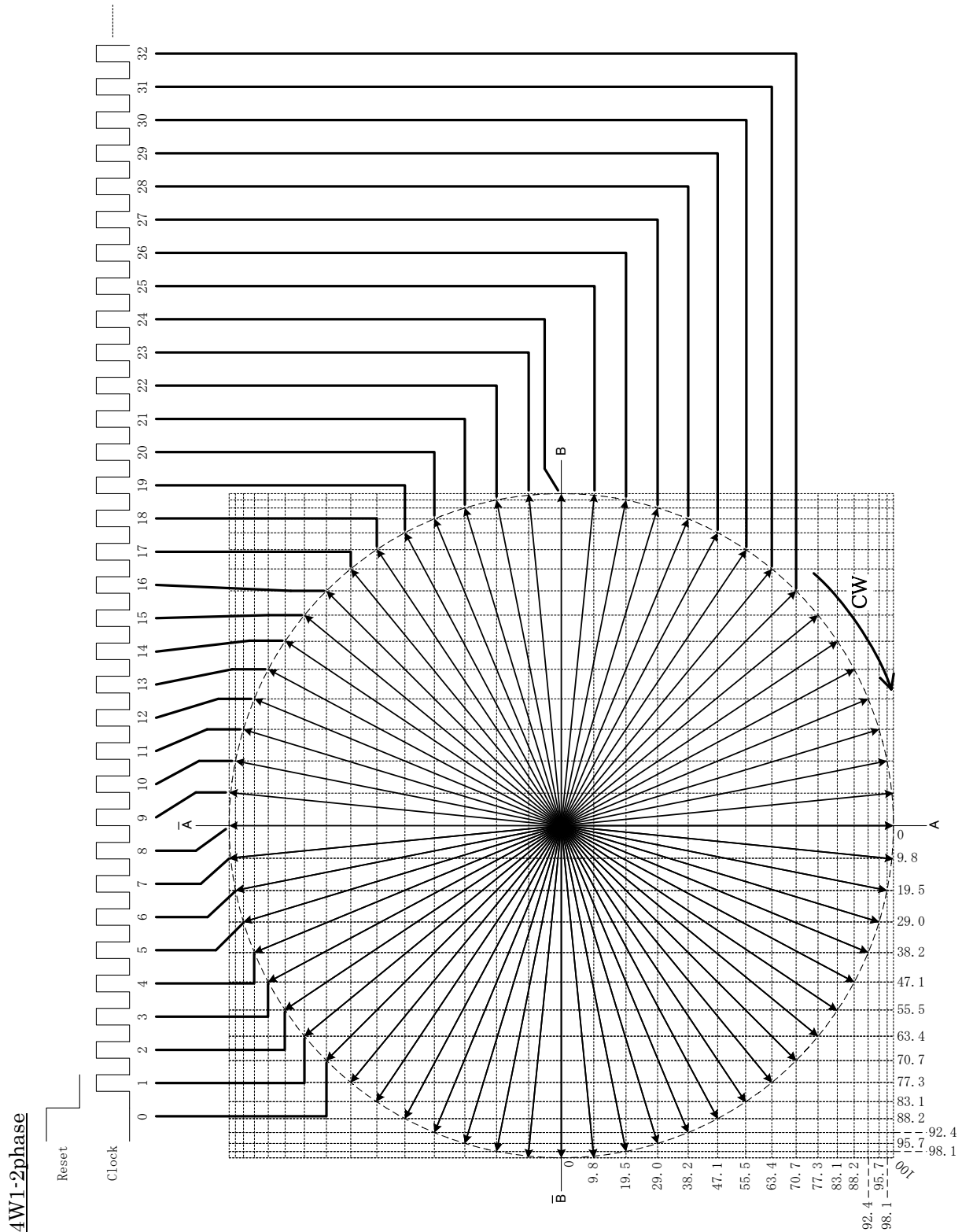
### Logic Input Timing Requirements



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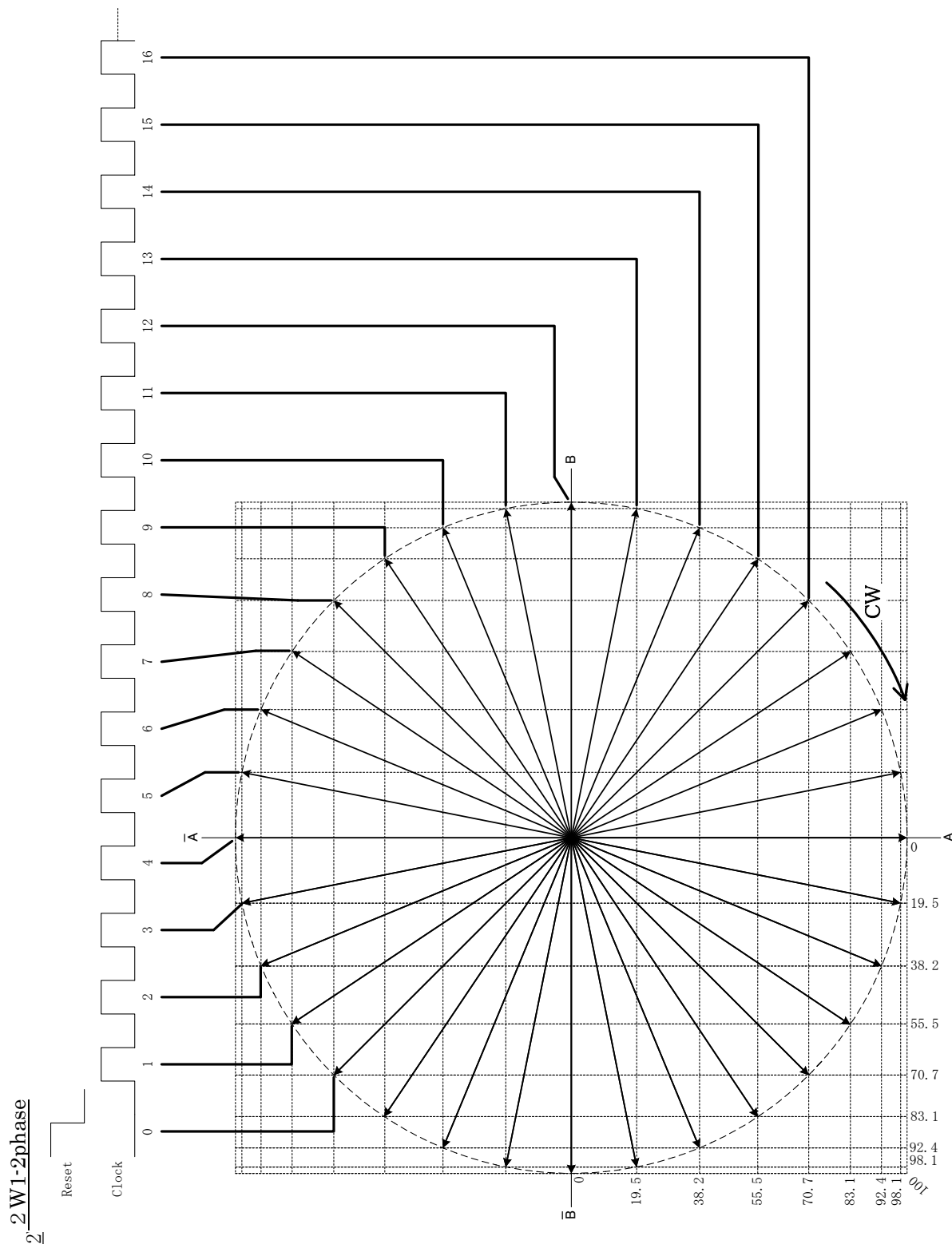
Step Sequencing Chart



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Step Sequencing Chart (continued)

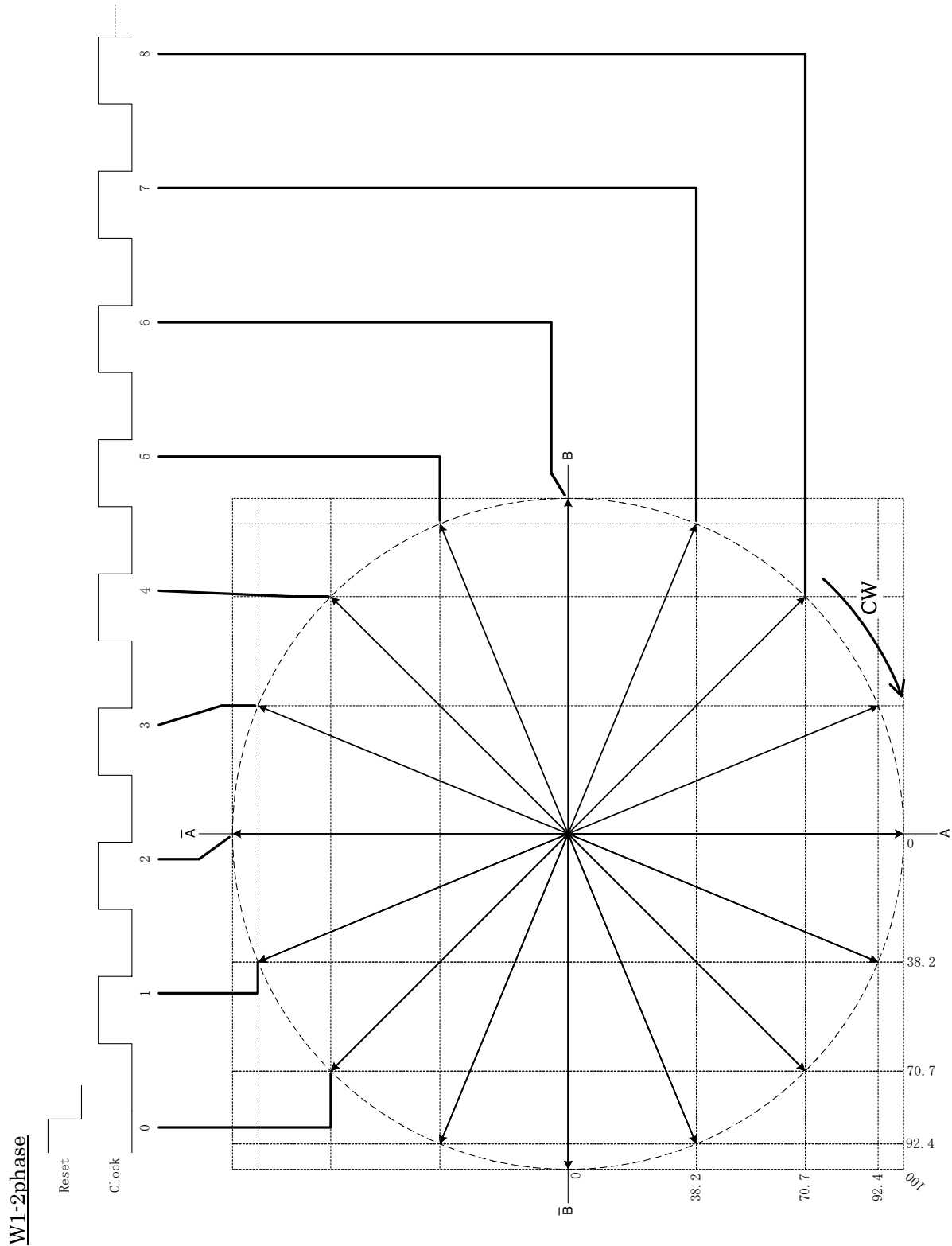




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Step Sequencing Chart (continued)



# SLA7060M/61M/62M/65M/66M/67M

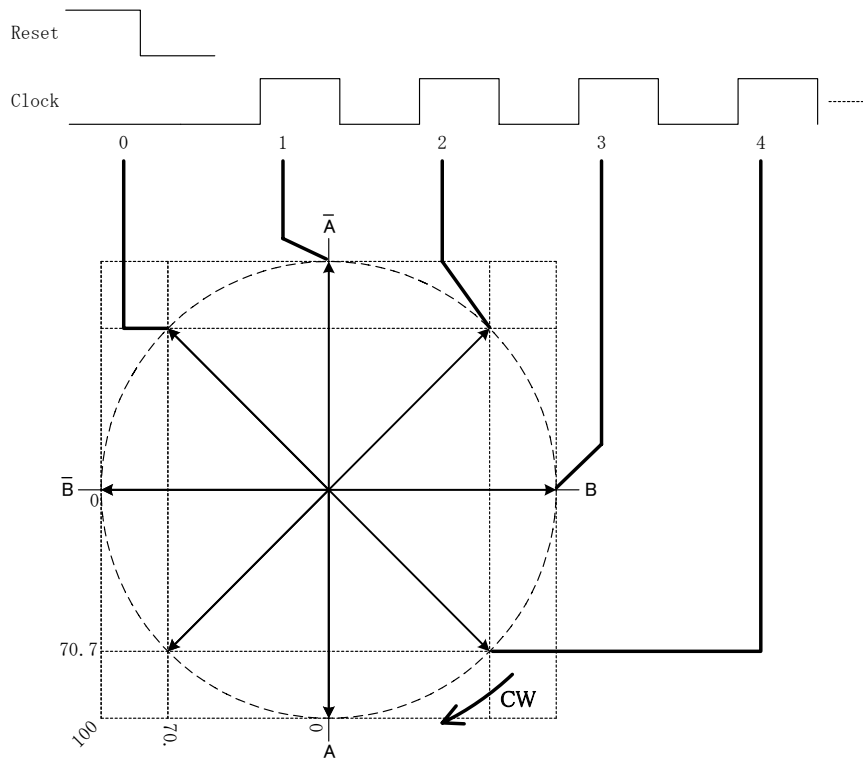
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Step Sequencing Chart (continued)

Block diagram (Connection diagram)

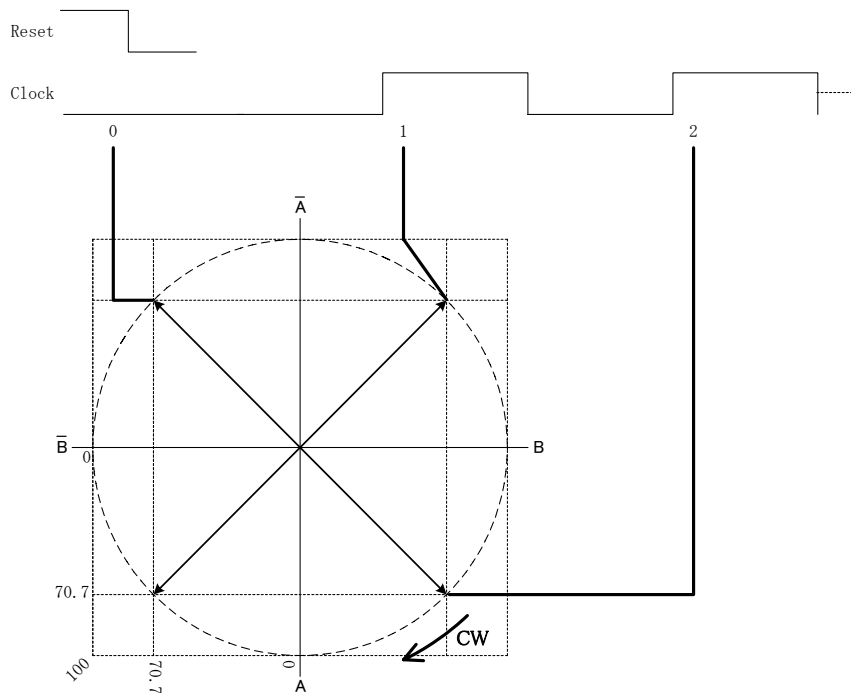
1-2phase

1-2相 1-2phase



2phase

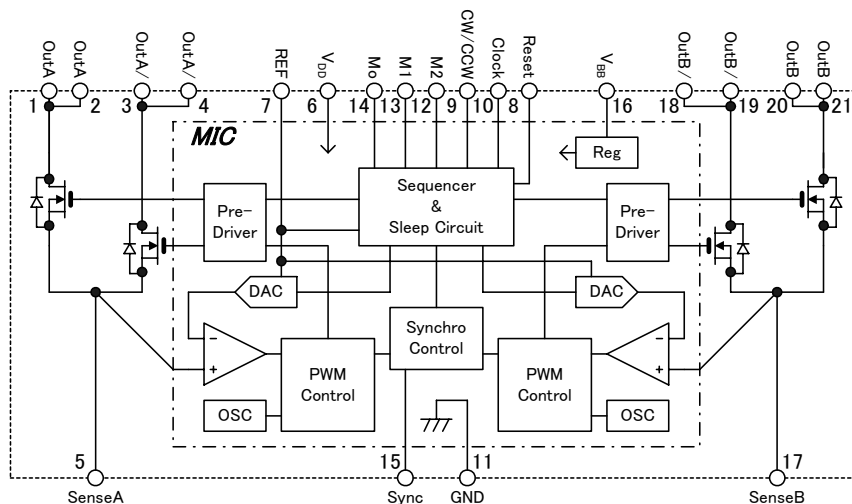
2-2相 2-2phase



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Internal functional block diagram



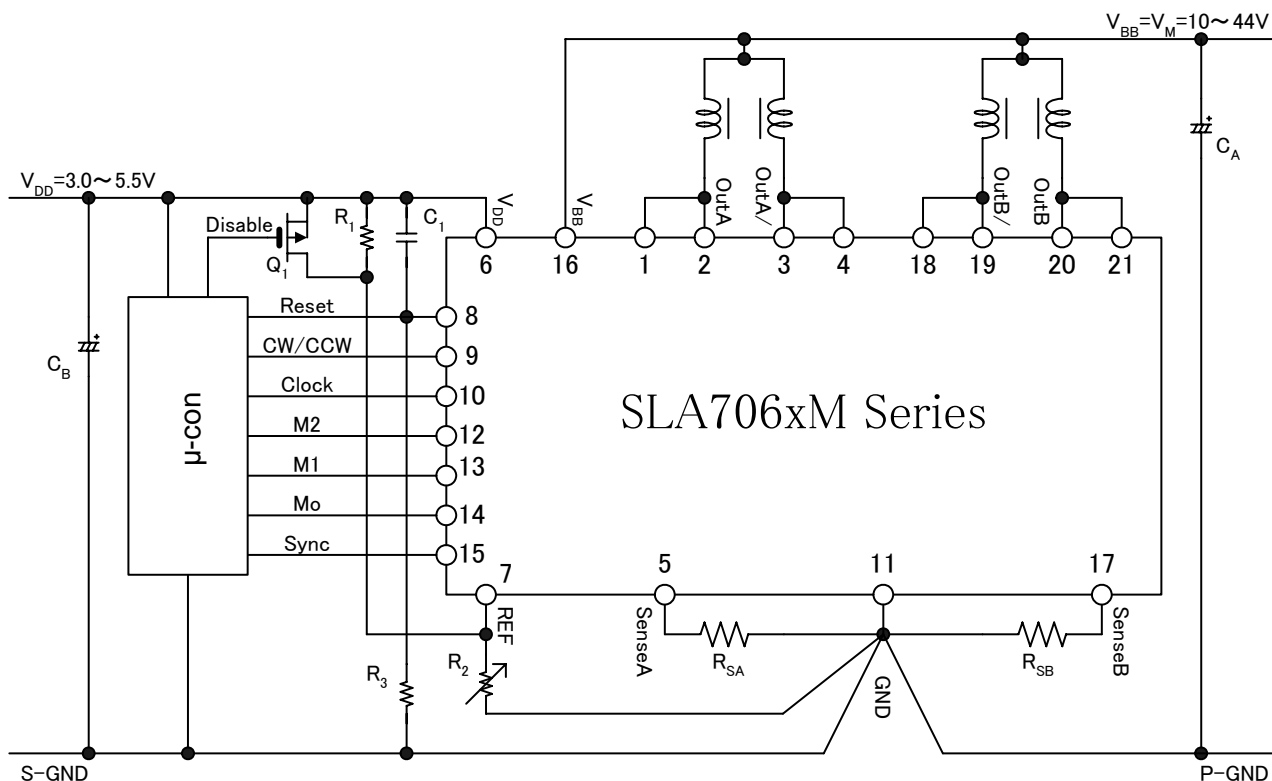
Pin Assignment (Terminal Functions)

Pin No.	Symbol	Function
1	OutA	Phase A Output
2		
3	OutA/	Phase A/ Output
4		
5	SenseA	Phase A Current Sense
6	V <sub>DD</sub>	Logic Supply
7	REF	Control Current Set & OFF Output
8	Reset	Reset Input for Logic Circuit
9	CW/CCW	Forward / Reverse Switch Input
10	Clock	Step Clock Input
11	GND	GND
12	M2	Micro-Stepping Operation Mode Setting Input
13	M1	
14	Mo	
15	Sync	PWM Chopping Function Select Input
16	V <sub>BB</sub>	Main Power Supply (For Motor)
17	SenseB	Phase B Current Sense
18	OutB/	Phase B/ Output
19		
20	OutB	B相出力 Phase B Output
21		

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## Example application circuit



## Reference constant

 $R_{SA}, R_{SB} = 0.1 \sim 2\Omega$  (※Loss attention  $P \approx I_o^2 \times R_s$ )

 $R_1 = 10k\Omega$ 
 $R_2 = 5.1k\Omega$  (VR)

 $R_3 = 10k\Omega$ 
 $C_A = 100\mu F / 50V$ 
 $C_B = 10\mu F / 10V$ 
 $C_1 = 0.1\mu F$ 
☆Precaution to avoid the noise on  $V_{DD}$  line.

Switching noise from PCB traces, where high current flows, to the  $V_{DD}$  line should be minimized

because the noise level more than 0.5V on the  $V_{DD}$  line may cause malfunctioning operation.

The tip for avoiding such problem is to separate the logic GND (S-GND) and the power GND (P-GND) on a PCB,

and then connect them together at IC GND pin (#11).

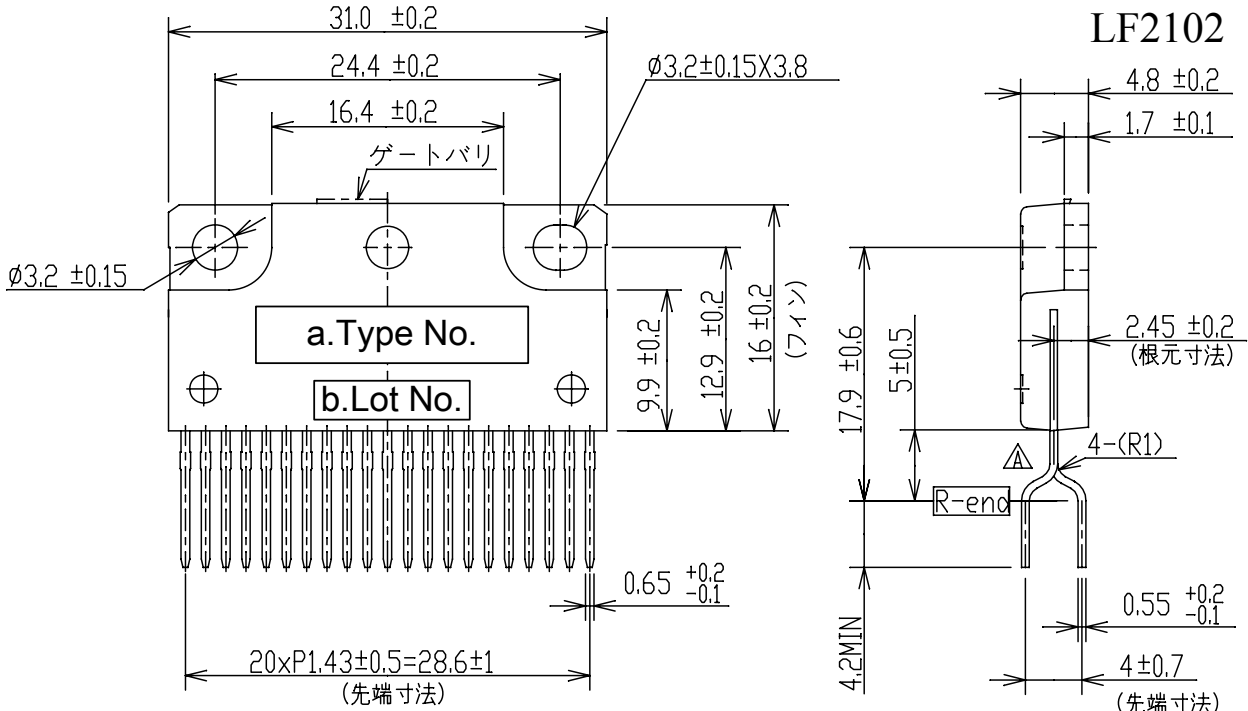
## ☆The loss of 'Rs' resistance will occur.

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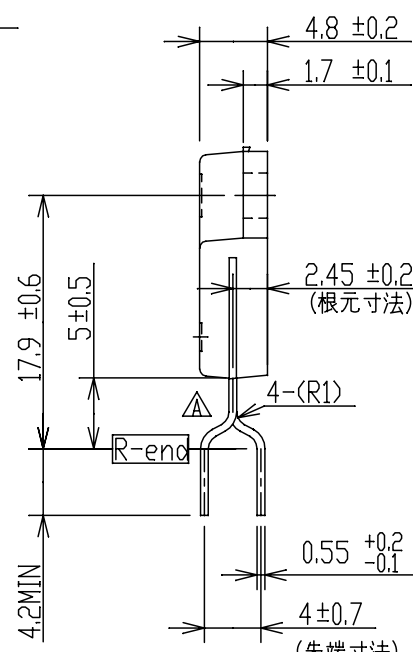
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## Package information

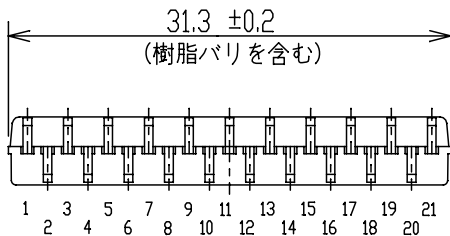
Package type and physical dimensions



LF2102



- a.Type Number      SLA706xM
- b.Lot Number
- 1st letter          The last digit of year
- 2nd letter          Month
  - 1~9月 : Arabic Numerals
  - 10月 : O
  - 11月 : N
  - 12月 : D
- 3rd & 4th letter      Day
  - 01~31 : Arabic Numerals



Dimensions in millimeters  
 Material of terminal : Cu  
 Treatment of terminal : Ni plating + solder dip (Pb Free)

### Appearance

The body shall be clean and shall not bear any stain, rust or flaw.

### Marking

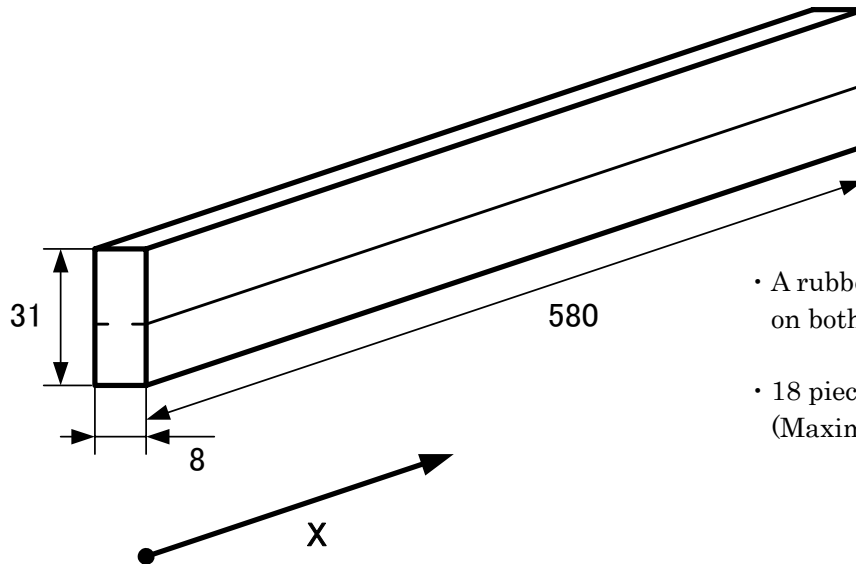
The type number and lot number shall be clearly marked in white.

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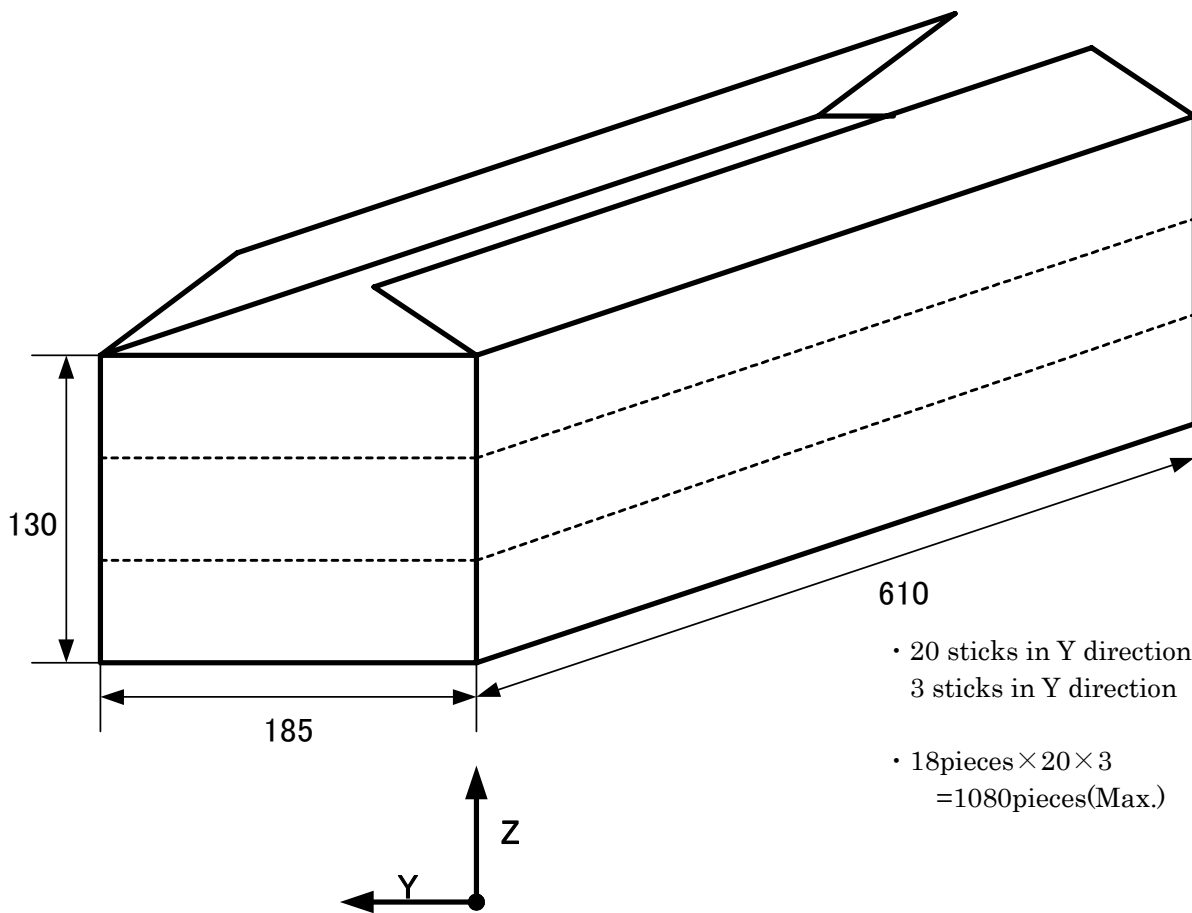
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## Packing specifications

1



- A rubber stopper is provided on both ends of the stick.
- 18 pieces in X direction  
(Maximum 18 pieces in one stick)



- 20 sticks in Y direction  
3 sticks in Y direction
- $18 \text{ pieces} \times 20 \times 3 = 1080 \text{ pieces (Max.)}$

Dimensions in millimeters

# SLA7060M/61M/62M/65M/66M/67M

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## Cautions and warnings

The calculation of control current

SLA706xM Series control current  $I_o$  (at Mode F) is calculated as follow.

$$I_o = \frac{V_{REF}}{R_s}$$

REF voltage is recommended to be from 0.1 to 1.0V.

※When the REF<0.1V, the accuracy of the current control becomes worst.

Moreover, setting the REF voltage more than 2V activates the sleep mode (all outputs is in OFF state).

However, the internal logic circuit is alive.

Logic inputs/output (RESET, CLOCK, CW/CCW, M1, M2, SYNC, Mo)

- Following timing should comply with the "Logic input timing".
  - The rising edge timing of CW/CCW, M1, M2 and that of CLOCK input
  - The RESET release timing(=the falling edge on RESET input) and the rising edge timing of CLOCK input

※In case it does not comply with the "Logic input timing", it may operate at an unexpected sequence.
- Be sure to prevent the logic inputs(RESET, CLOCK, CW/CCW, M1, M2, SYNC) from being "OPEN".
 

If some of the logic inputs are not used, be sure to connect them to VDD or GND.

※In case some of the logic inputs stay "OPEN", a malfunction may occur due to external noises.
- When the logic output(Mo) is not used, be sure to keep it "OPEN".
 

※In case it is connected to VDD or GND, it may cause the device's deterioration or/and breakdown.

Installation to a heat sink

- 1) Recommended Clamping Torque (to External Heat sink) 0.490~0.822N·m
- 2) Recommended Silicone
 

G746	{SHIN-ETSU CHEMICAL}
YG6260	{TOSHIBA SILICONE}
SC102	{DOW CORNING TORAY SILICONE}

Notice

This driver has C-MOS inputs. Please notice as following contents.

- When static electricity is a problem, care should be taken to properly control the room humidity. This is particularly true in the winter when static electricity is most troublesome.
- Care should be taken with device leads and with assembly sequencing to avoid applying static charges to IC leads. PC board pins should be shorted together to keep them at the same potential to avoid this kind of trouble.

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