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™).

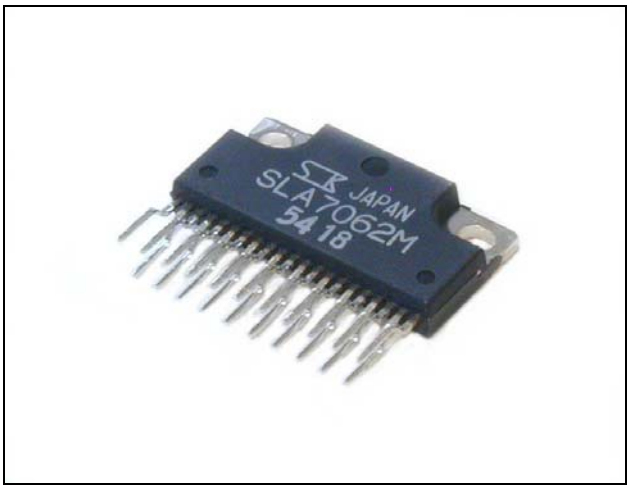
There are no phase-sequence tables, high-frequency control lines, orcomplex interfaces to program.The CMOS logic section provides the sequencing logic, direction,control, synchronous/asynchronous PWM operation, and a "sleep"function. The minimum CLOCK input is an ideal fit for applications where a complex µP 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.

■Package



■Applications

- ●PPC
- ●Printer
- ●OA Equipment

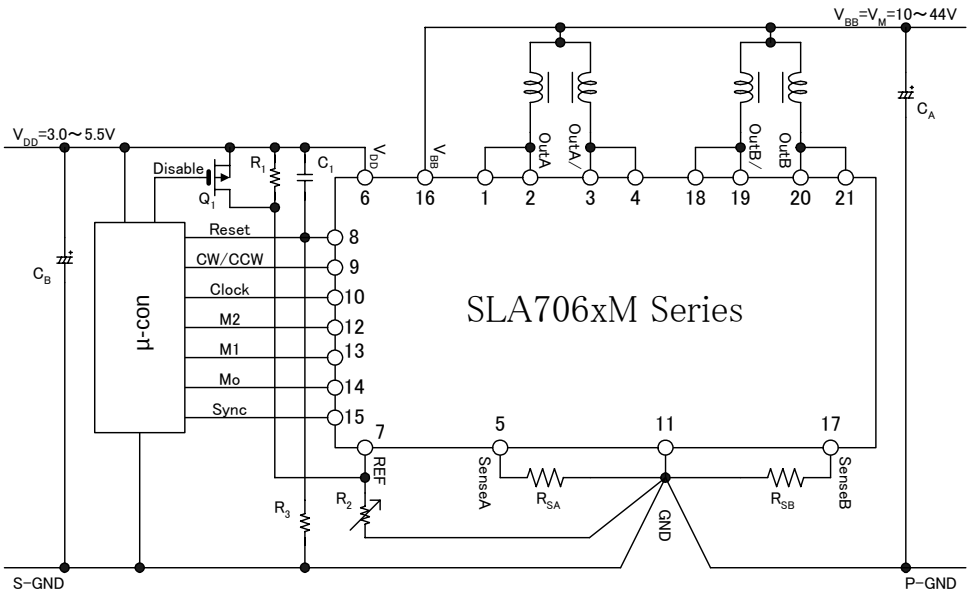
■Features

- ●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 rDS(on) NMOS Outputs (150 milli-ohms typical)
- ●Advanced, Improved Body Diodes
- ●nputs Compatible with 3.3 V or 5 V Control Signals
- ●Sleep Mode
- ●Internal Clamp Diodes

■Key Specifications

- ●Motor Supply Voltage (VM)：44V max
- ●Load Supply Voltage (Vs)：10V～44V
- ●Logic Supply Voltage (Vcc)：3V～5.5V
- ●Output Current (Io)：1A(SLA7060M,SLA7065M)
  2A(SLA7061M,SLA7066M)
  3A(SLA7062M,SLA7067M)
- ●Output Maximum Voltage (V_{DSS})：100V min

Typical Connection



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

October 2005

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～V_{DD}+0.3	V	
REF Input Voltage	V_{REF}	−0.3～V_{DD}+0.3	V	
Sense Voltage	V_{RS}	±2	V	Tw<1μS doesn't contain it.
Power Dissipation	P_D	3.5	W	at T_a=25℃
		16	W	at T_C=25℃
Junction Temperature	T_j	150	℃	
Operating Temperature Range	T_a	−20～85	℃	
Storage Temperature Range	T_{stg}	−30～150	℃	

※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).

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	℃	11Pin temperature (at No Fin)

Electrical Characteristic (T_a=25°C,V_{BB}=24V,V_{DD}=5V Unless Otherwise Noted.)

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

Electrical Characteristic(continued) (T_a=25°C,V_{BB} =24V,V_{DD} =5V Unless Otherwise Noted.)

Characteristic	Symbol	Limits			Unit	Test Condition
		Min.	Typ.	Max.		
Sense Voltage	V_{SENSE}	0.95	1.00	1.05	V	V_{REF}=1.0V at Mode F
Sense pins Sink Current	I_{SENSE}		±10		μA	
Step Reference Current Ratio	Mode F		100		%	V_{SENSE}=100% V_{REF}=0.1~1V
	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_{SE}	100			μs	V_{REF} : 2.0→1.5V
Switching Time	t_{pdon}		2.0		μs	Clock→Out ON
	t_{pdoff}		1.5		μs	Clock → Out OFF
PWM Minimum On Time	$t_{ON(min)}$		1.8		μs	
PWM OFF Time	t_{OFF1}		12		μs	Mode 8~F
	t_{OFF2}		9		μs	Mode 4~7
	t_{OFF3}		7		μs	Mode 1~3

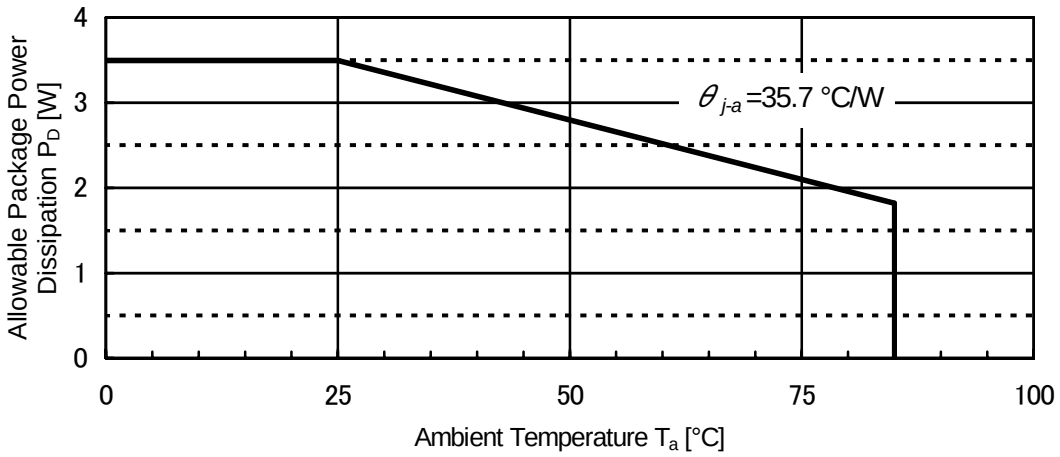
Note.

・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.

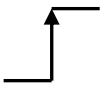
熱設計データ
Thermal Design Data

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	-

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

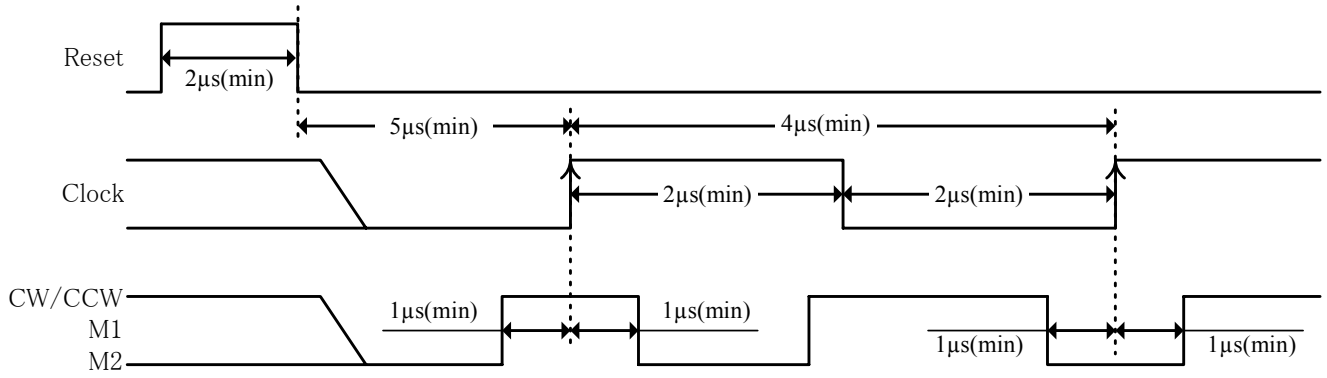
【SLA7065M, SLA7066M, SLA7067M】

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)	-

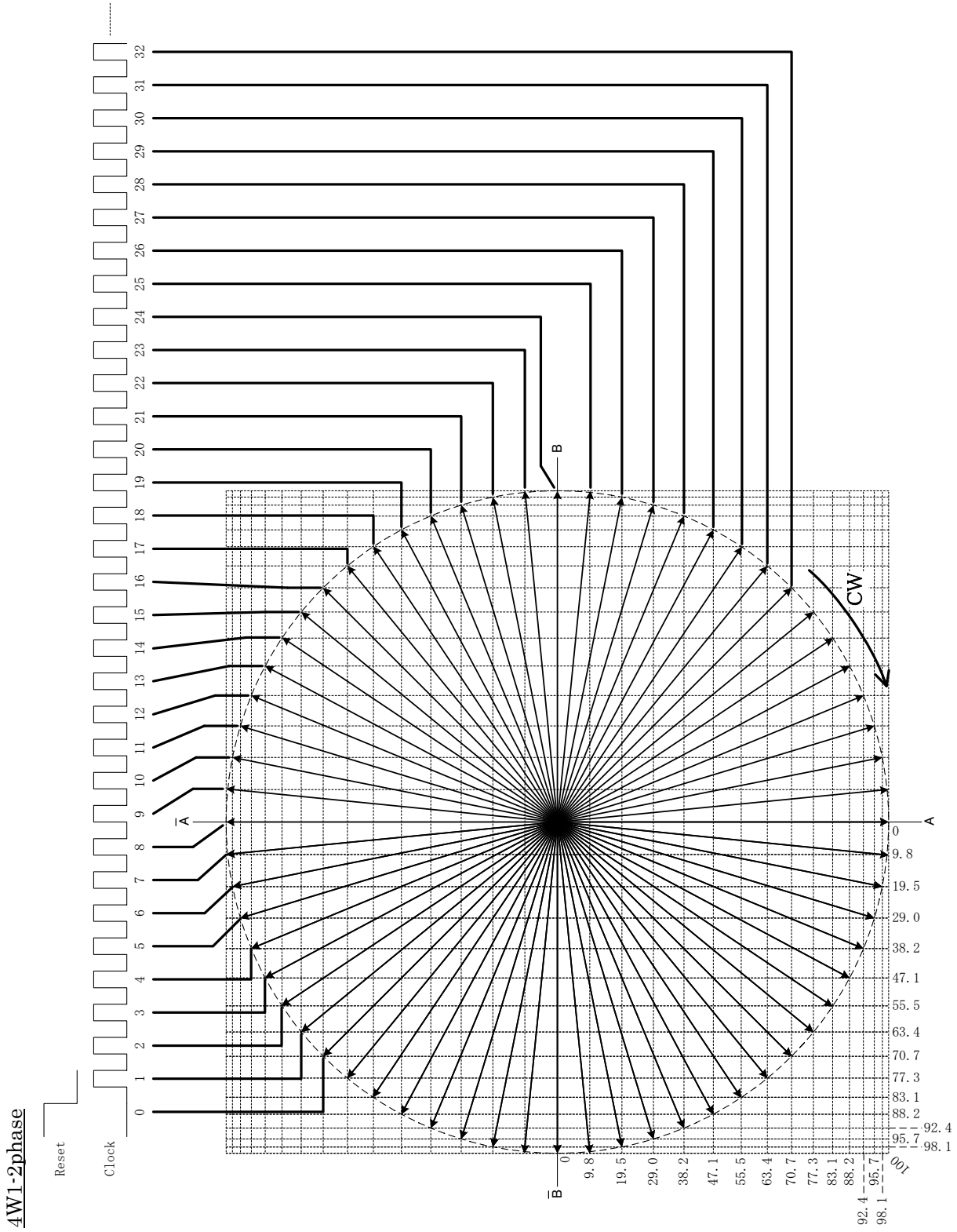
Logic Input Timing Requirements



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

October 2005

Step Sequencing Chart



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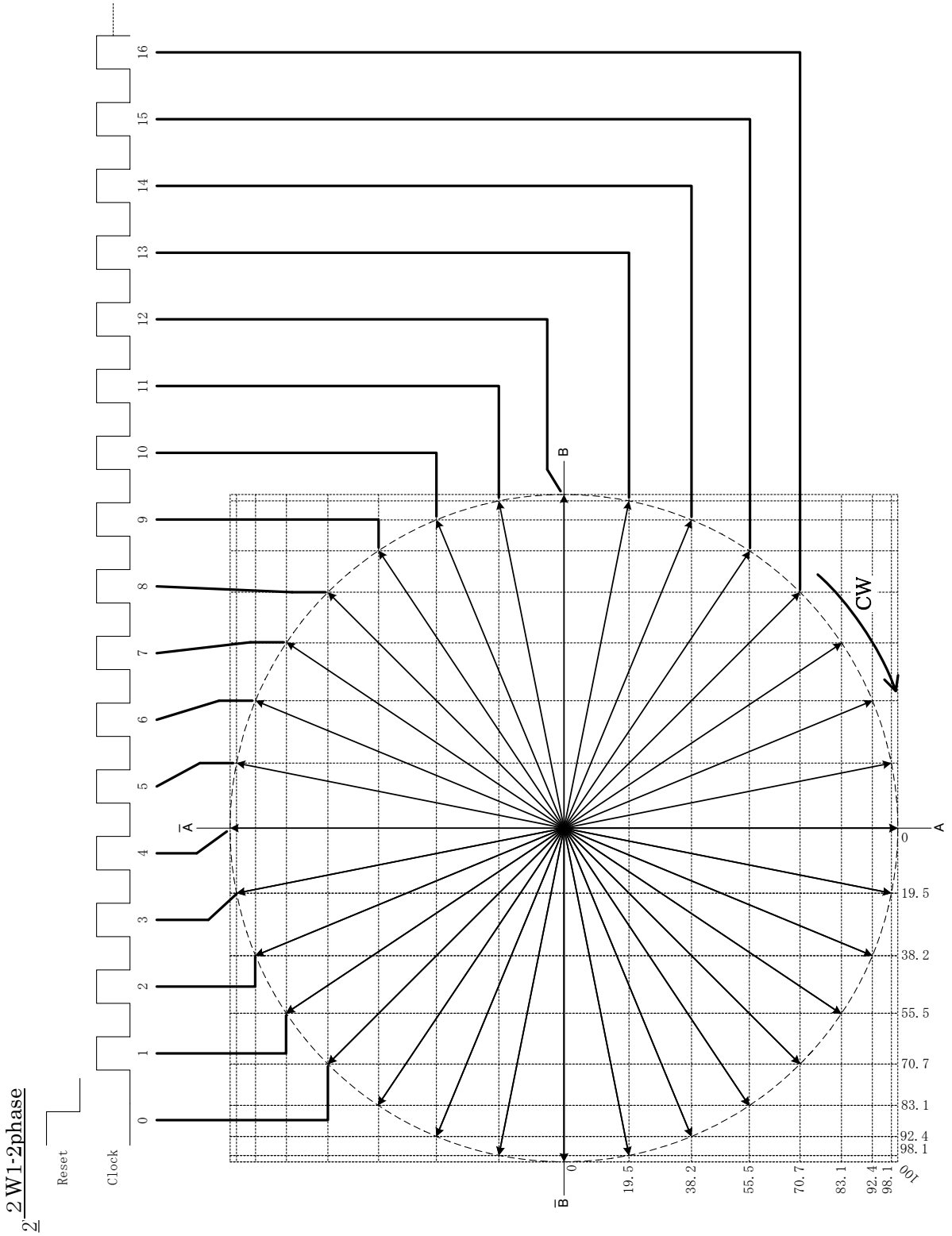
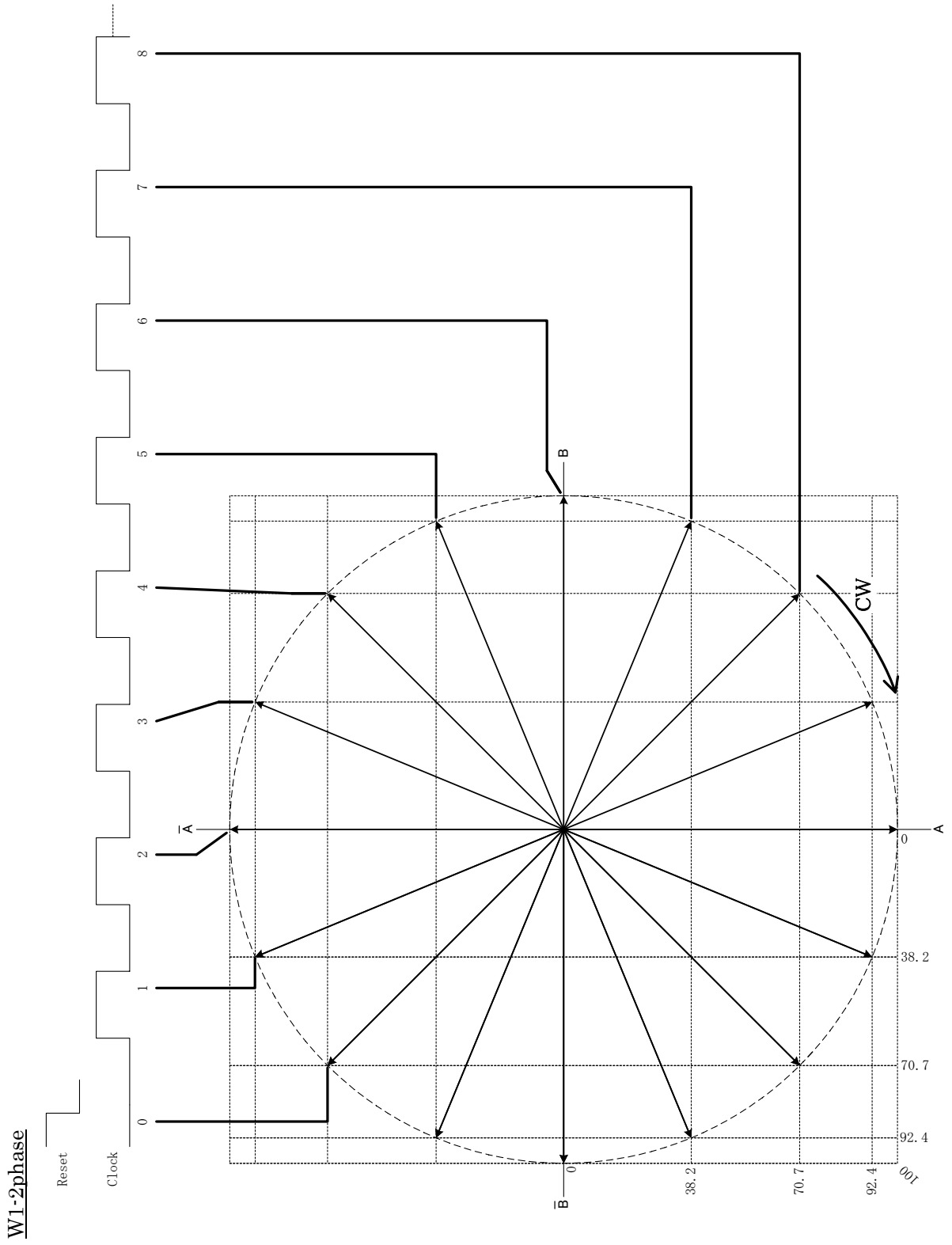
October 2005

Step Sequencing Chart (continued)



Step Sequencing Chart (continued)

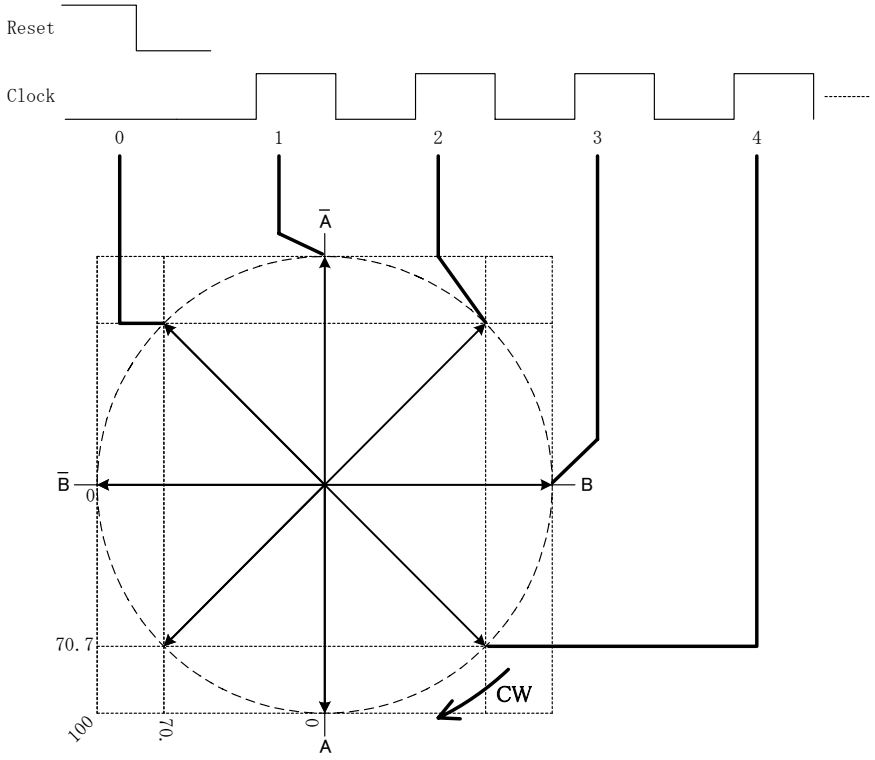


Step Sequencing Chart (continued)

Block diagram (Connection diagram)

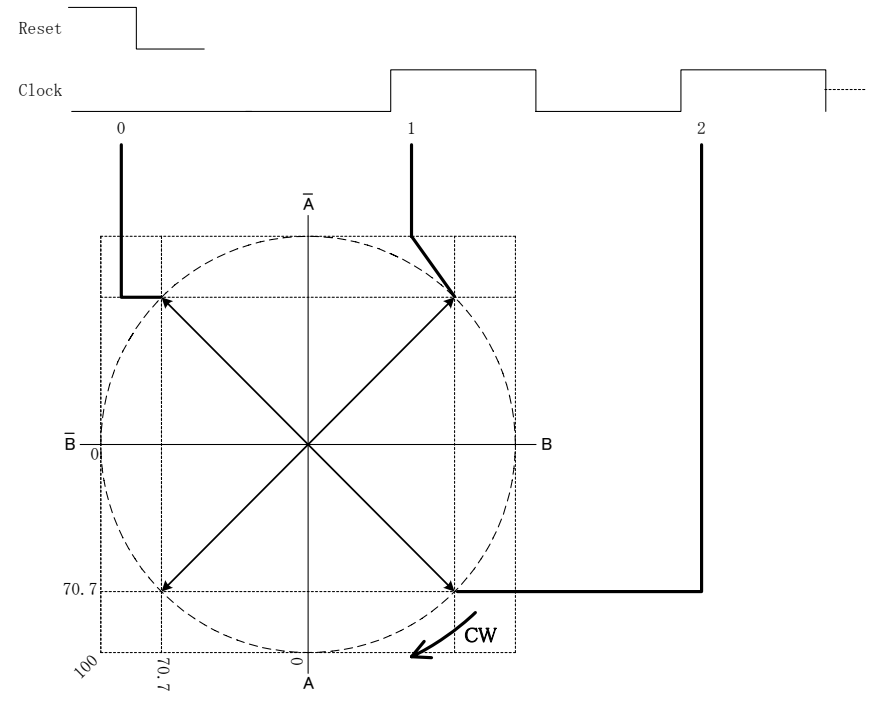
1-2phase

1－2相　1-2phase



2phase

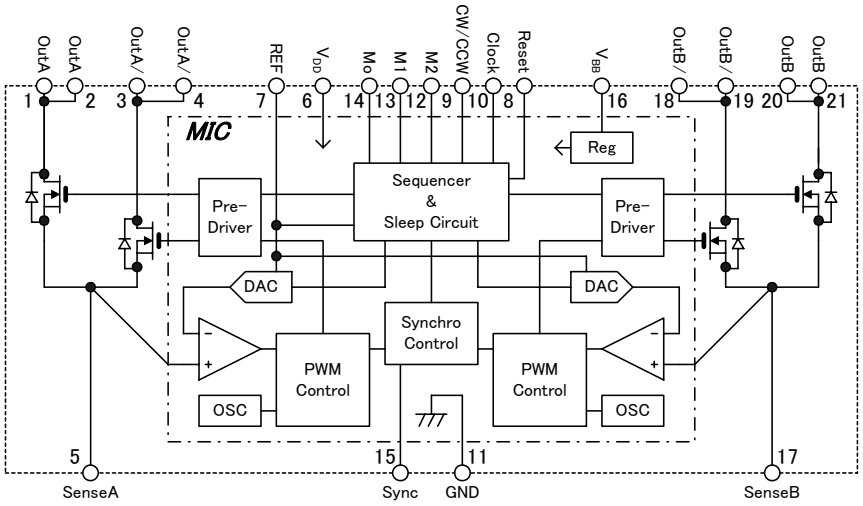
2－2相　2-2phase



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

October 2005

Internal functional block diagram



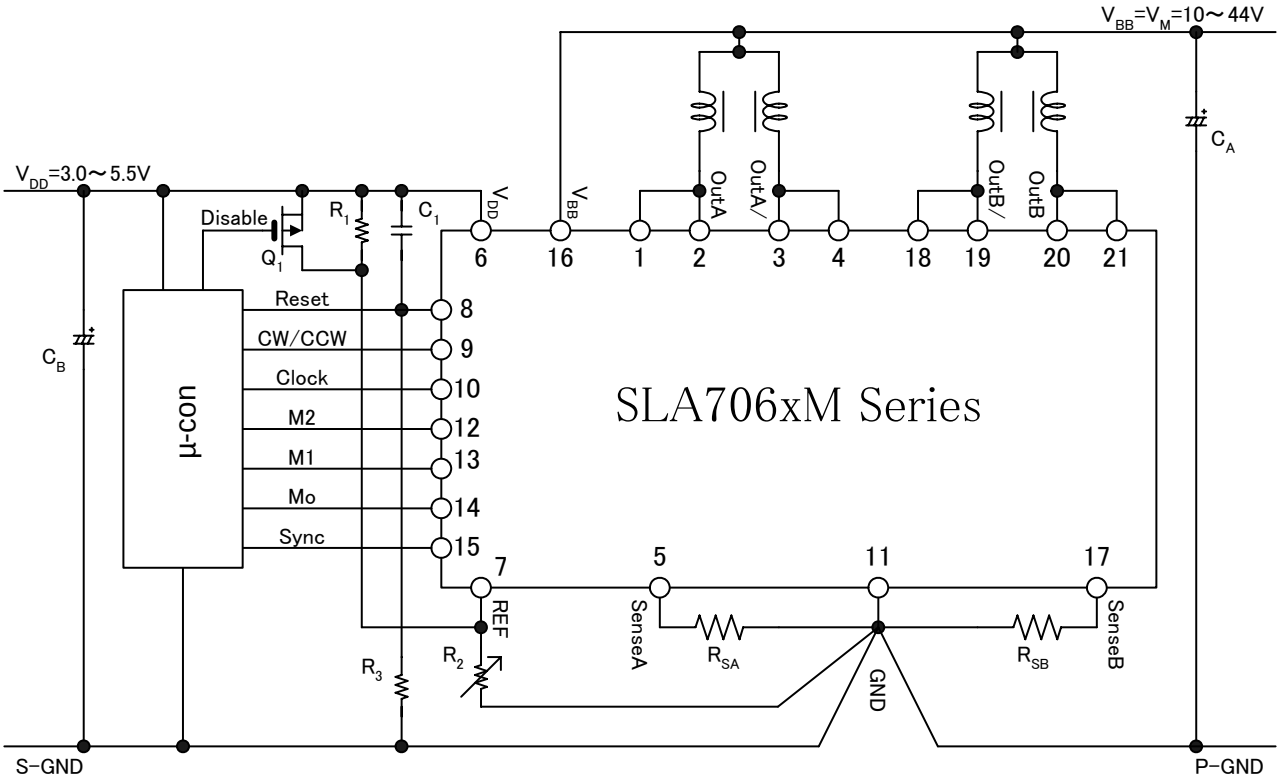
Pin Assignment (Terminal Functions)

Pin No.	Symbol	Function
1	OutA	Phase A Output
2		
3	OutA/	Phase A/ Output
4		
5	SenseA	Phase A Current Sense
6	V_{DD}	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	Position Monitoring Output
15	Sync	PWM Chopping Function Select Input
16	V_{BB}	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		

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

October 2005

Example application circuit



Reference constant

R_{SA},R_{SB}＝0.1～2Ω（※Loss attention　P≒Io^2×R_S）

R_1＝10kΩ　　C_A＝100μF／50V

R_2＝5.1kΩ(VR)　　C_B＝10μF／10V

R_3＝10kΩ　　C_1＝0.1μF

☆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).

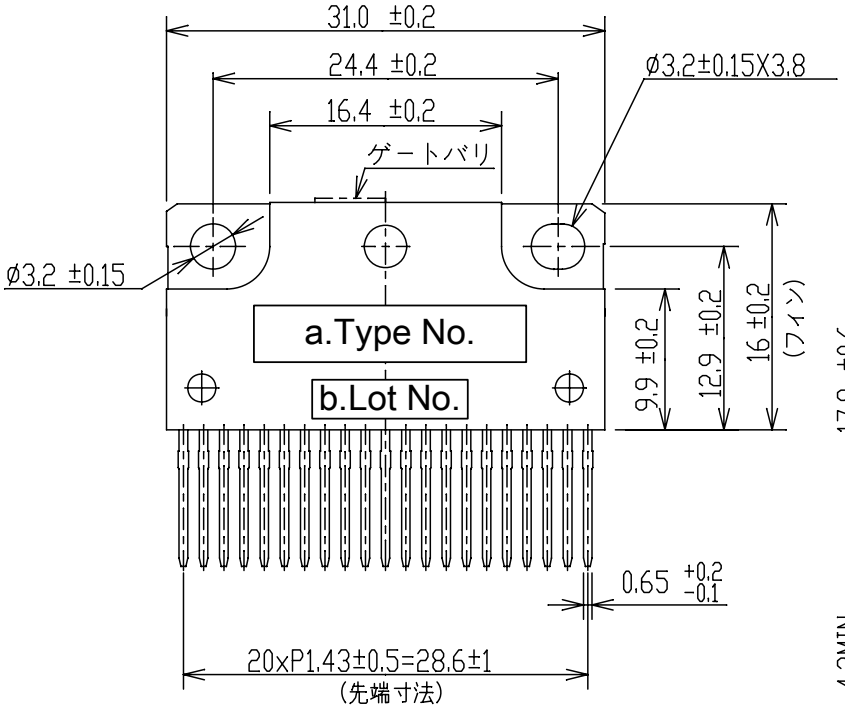
☆The loss of 'Rs' resistance will occur.

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

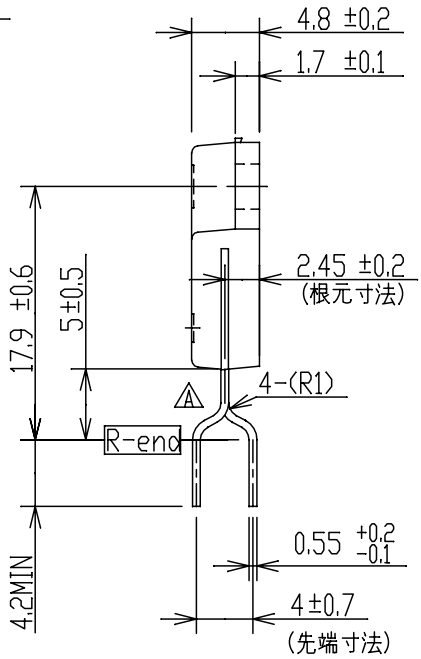
October 2005

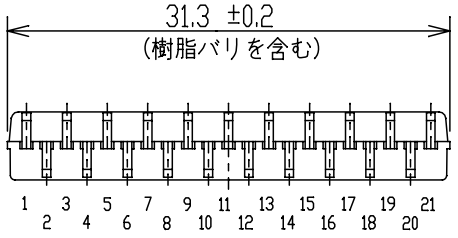
Package information

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 planting + solder dip (Pb Free)

Appearance

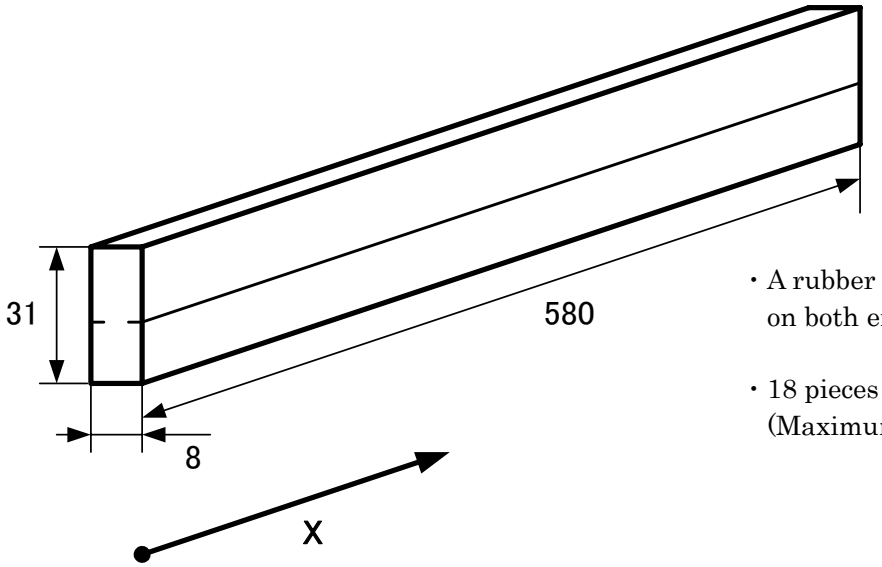
The body shall be clean and shall not bear any stain, rust or flaw.

Marking

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

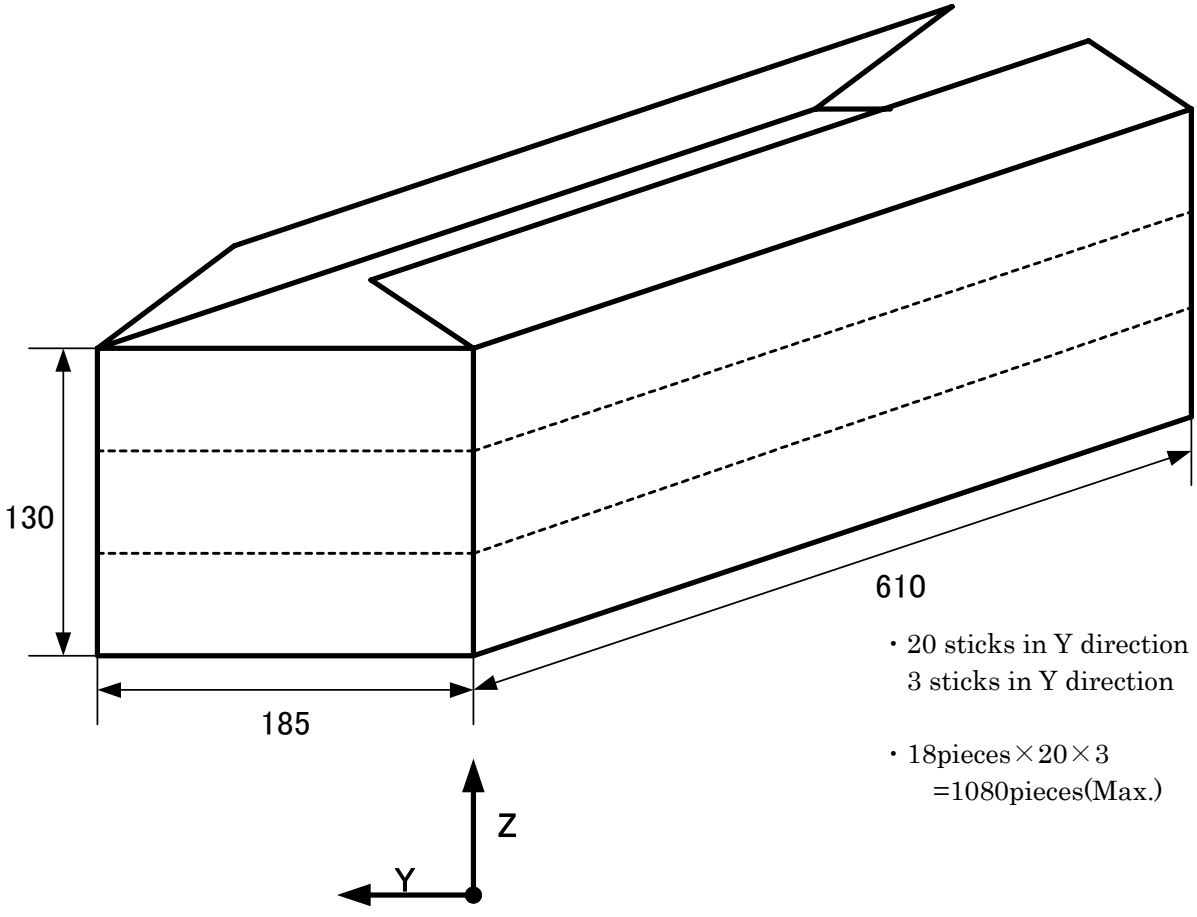
Packing specifications

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

・18pieces×20×3
=1080pieces(Max.)

Dimensions in millimeters

Cautions and warnings

The calculation of control current

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

$$I_O = V_{REF} / R_S$$

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

October 2005

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