5-Phase Stepper Motor Driver ICs

■Absolute Maximum Ratings

(T_a=25°C)

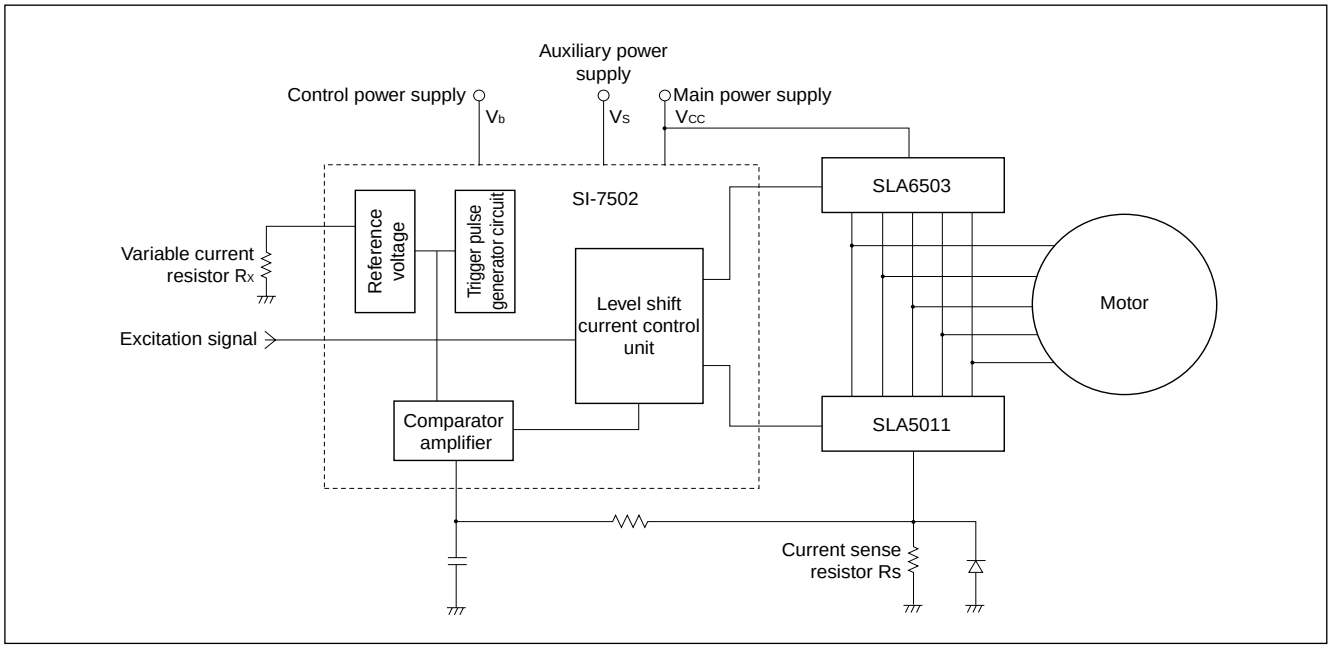
Part No.	Parameter	Symbol	Ratings	Units
SI-7502	Motor supply voltage	V_{CC}	44	V
	Auxiliary supply voltage	V_S	15	V
	Control voltage	V_b	7	V
	Reference voltage	V_{ref}	1.5	V
	Detection voltage	V_{RS}	5	V
	Power dissipation	P_D	1	W
	Ambient operating temperature	T_{OP}	0 to +65	°C
SLA5011	Drain -Source voltage	V_{DSS}	60	V
	Drain current	I_D	±5	A
	Avalanche energy capability (Single pulse)	E_{AS}	2	mJ
	Power dissipation	P_T	35	W
	Channel temperature	T_{ch}	150	°C
	Storage temperature	T_{stg}	−40 to +150	°C
SLA6503	Collector-Base voltage	V_{CBO}	−60	V
	Collector-Emitter voltage	V_{CEO}	−60	V
	Emitter-Base voltage	V_{EBO}	−6	V
	Collector current	I_C	−3	A
	Collector current (Pulse)	$I_{C\ (pulse)}$	−6	A
	Base current	I_B	−1	A
	Power dissipation	P_T	35	W
	Junction temperature	T_j	150	°C
	Storage temperature	T_{stg}	−40 to +150	°C

■Electrical Characteristics

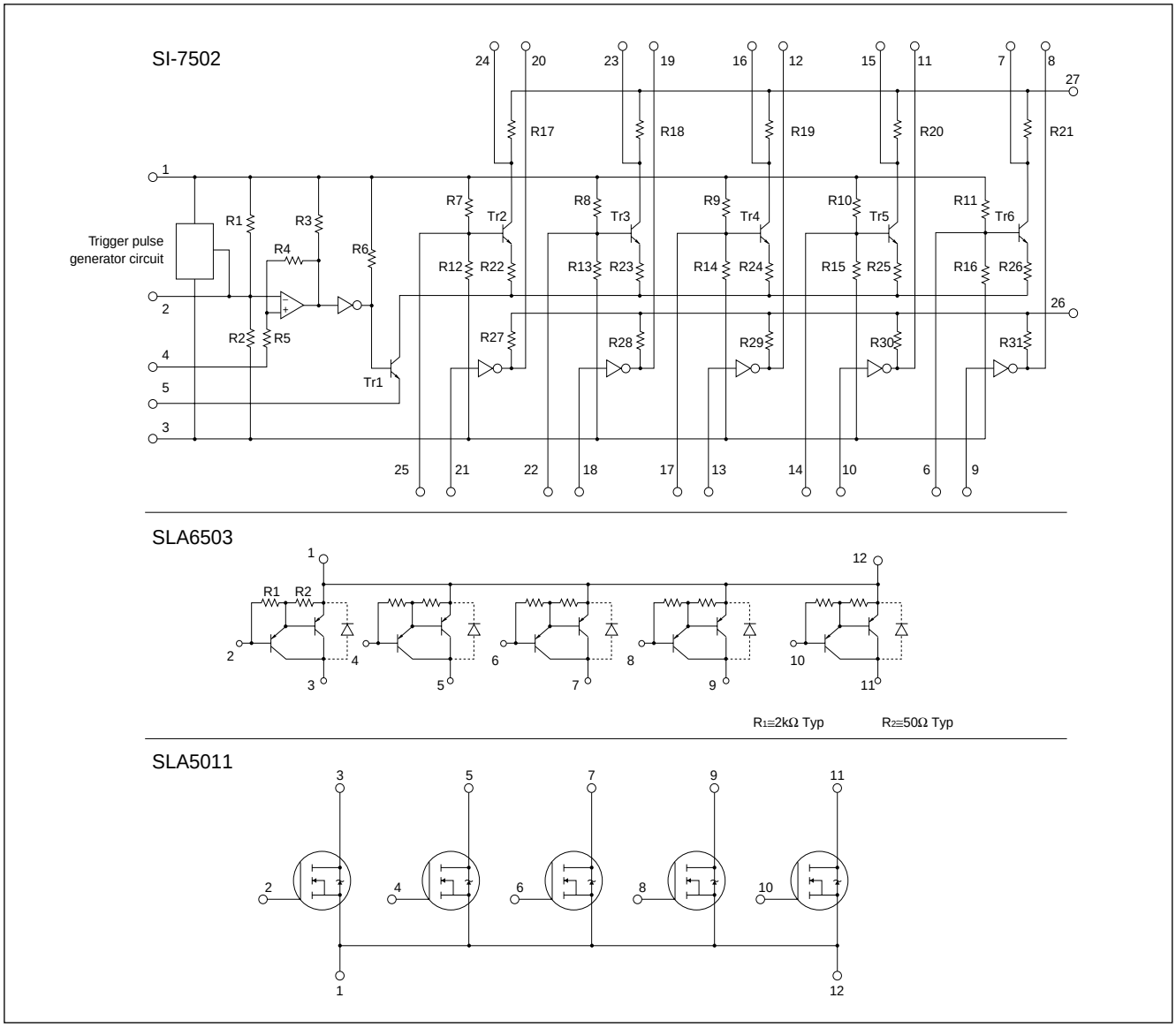
(T_a=25°C)

Part No.	Parameter	Symbol	Limits			Units	Conditions
			min	typ	max		
SI-7502	Supply current	I_{CC}			40	mA	V_{CC}=42V, V_b=5.5V
		I_S			12.5	mA	V_S=12.5V
		I_b			50	mA	V_b=5.5V
	Input current	I_{IU-L}, I_{IL-L}			1.6	mA	V_{IU}=V_{IL}=0.4V
	Upper drive circuit drive current	I_{OU}-on	8		11	mA	V_b=5V, AIU to EIU pin open
		I_{OU}-off			10	μA	V_b=5V
	Lower drive circuit voltage	V_{OL}-on	V_S−1.5			V	V_b=5V, AIL to EIL pin open
		V_{OL}-off			1.5	V	V_b=5V
	Oscillation frequency	F	20		30	kHz	V_b=5V
	Detection voltage	V_{RS}	0.8		1.05	V	V_b=5V, V_{REF} pin open
SLA5011	Gate threshold voltage	V_{TH}	2.0		4.0	V	V_{DS}=10V, I_D=250μA
	Forward Transconductance	$R_{e\ (yts)}$	2.2	3.3		S	V_{DS}=10V, I_D=5A
	DC ON-resistance	$R_{DS\ (ON)}$		0.17	0.22	Ω	V_{GS}=10V, I_D=5A
	Input capacitance	C_{ISS}		300		pF	V_{DS}=25V, f=1.0MHz,V_{GS}=0V
	Output capacitance	C_{OSS}		160		pF	
	Di forward voltage between source and drain	V_{SD}		1.1	1.5	V	I_{SD}=5A
	Di reverse recovery time between source and drain	t_{rr}		150		ns	I_{SD}=±100mA
SLA6503	Collector cut-off current	I_{CBO}			−10	μA	V_{CB}=−60V
	Collector-emitter voltage	V_{CEO}	−60			V	I_C=−10mA
	DC current gain	h_{FE}	2000				V_{CE}=−4V, I_C=−3A
	Collector emitter saturation voltage	$V_{CE\ (sat)}$			1.5	V	I_C=−3A, I_B=−6mA

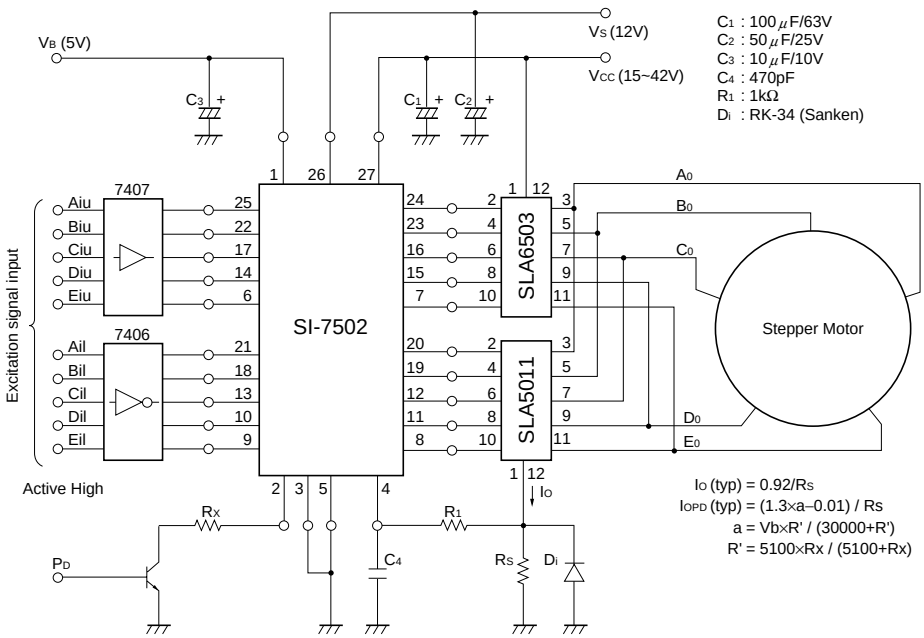
■Internal Block Diagram (Dotted Line)



■Equivalent Circuit Diagram



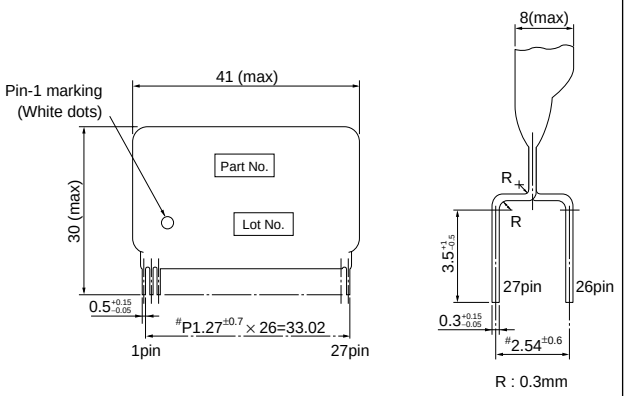
■Diagram of Standard External Circuit



■External Dimensions

(Unit: mm)

SI-7502

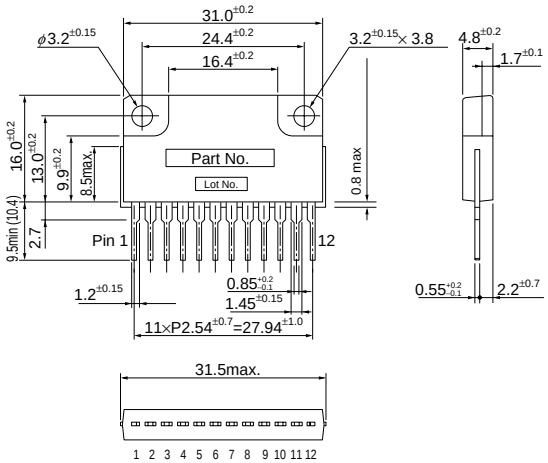


(Note) Dimensions marked with a # indicate dimensions of lead tip.

■External Dimensions

(Unit: mm)

SLA6503/SLA5011



Application Notes

■Determining the Output Current I_O (Control Current)

The main factors that determine the output current are current sense resistor R_S, supply voltage V_b, and variable current resistor R_X.

(1) Normal mode

To operate a motor at the maximum current level, set R_X to infinity (open).

From Fig. A, when the maximum current ripple is designated as I_{OH}, its value will be,

$$I_{OH}=\frac{V_{RSH}}{R_S} \quad \cdots\cdots (1)$$

V_{RSH} can be calculated as follows:

$$V_{RSH}=0.19\times V_b-0.03 \text{ (center value)} \quad \cdots\cdots (2)$$

From equations (1) and (2), the output current I_{OH} can be calculated as follows:

$$I_{OH}=\frac{1}{R_S}(0.19\times V_b\times -0.03)$$

The relationship between I_{OH} and R_S is shown in Fig. B.

(2) Power down mode

When an external resistor R_X is connected, V_{RSH} changes as shown in Fig. C even when R_S is retained. Obtain a power down output current I_{OHPD} from Fig. C and equation (1).

■Relation between Output Current I_O (Control Current) and Motor Winding Current I_{OM}

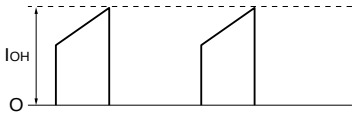
The SI-7502 uses the total current control system; therefore, the output current I_O is different from the motor winding current. In a general pentagonal driving system, the current flows as shown in Figure D. The relation between I_O and I_{OM} is as follows:

$I_O=4\times I_{OM}$

With some driving systems, the relation can also be as follows:

$I_O=2\times I_{OM}$

Fig. A



Waveform of output current

Fig. B Output current vs. Current sense resistor

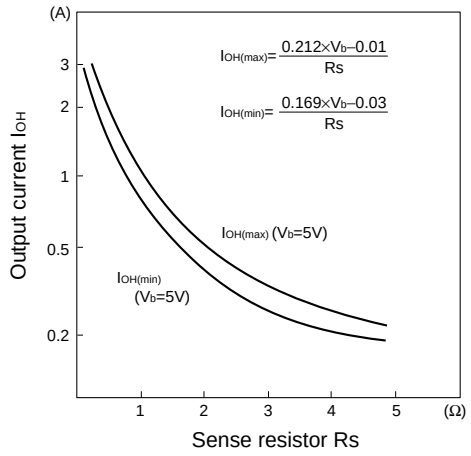


Fig. C Sense voltage vs. Variable current resistor

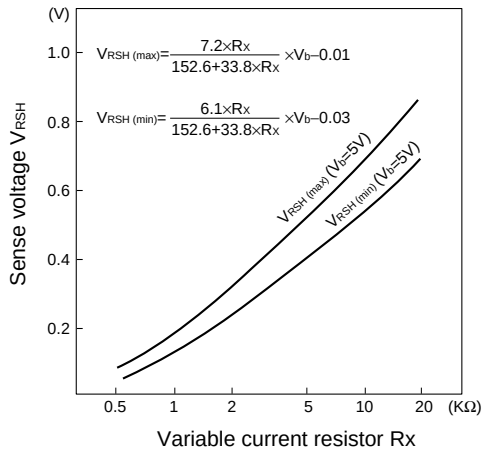
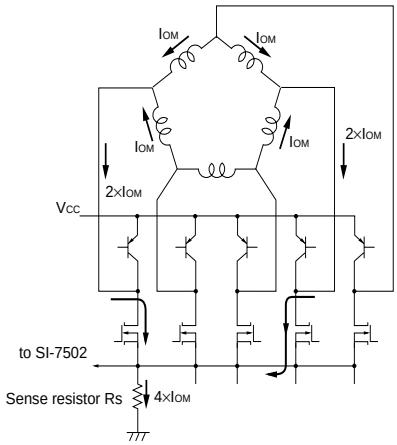


Fig. D Coil current flow at pentagonal driving



■Motor Connection

The 5-phase stepper motor supports various driving systems and the motor connection varies depending on the driving system used.

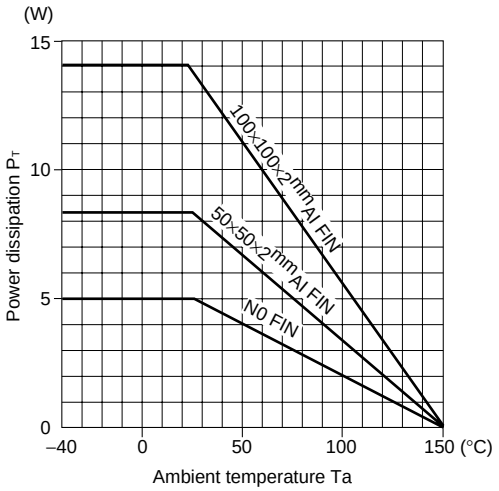
Use of the motor with some driving systems may be restricted by patents. Therefore, be sure to ask the motor manufacturer about the motor connection and driving system to be used.

■Thermal design

The driver (SLA5011/SLA6503) dissipation varies depending on a driving system used even if the output currents (control current) are the same. Therefore, measure the temperature rise of the driver under the actual operating conditions to determine the size of the heatsink.

Figure E shows an SLA5011/SLA6503 derating curve. This derating curve indicates T_j=150°C; however, when using this device, allow sufficient margin when selecting a heatsink so that $T_C \leq 100$°C (AI FIN temperature on the back of the SLA) is obtained.

Fig. E SLA5011/SLA6503 Derating curve



SI-7502

■Handling Precautions

Refer to the product specifications.

Solvents- Do not use the following solvents:

Substances that can dissolve the package	Chlorine-based solvents: Trichloroethylene, Trichloroethane, etc. Aromatic hydrogen compounds: Benzene, Toluene, Xylene, etc. Keton and Acetone group solvents
Substances that can weaken the package	Gasoline, Benzine, Kerosene, etc.