

# SI-7502

# SLA5011

# SLA6503

## ■ Absolute maximum ratings

(Ta = 25°C)

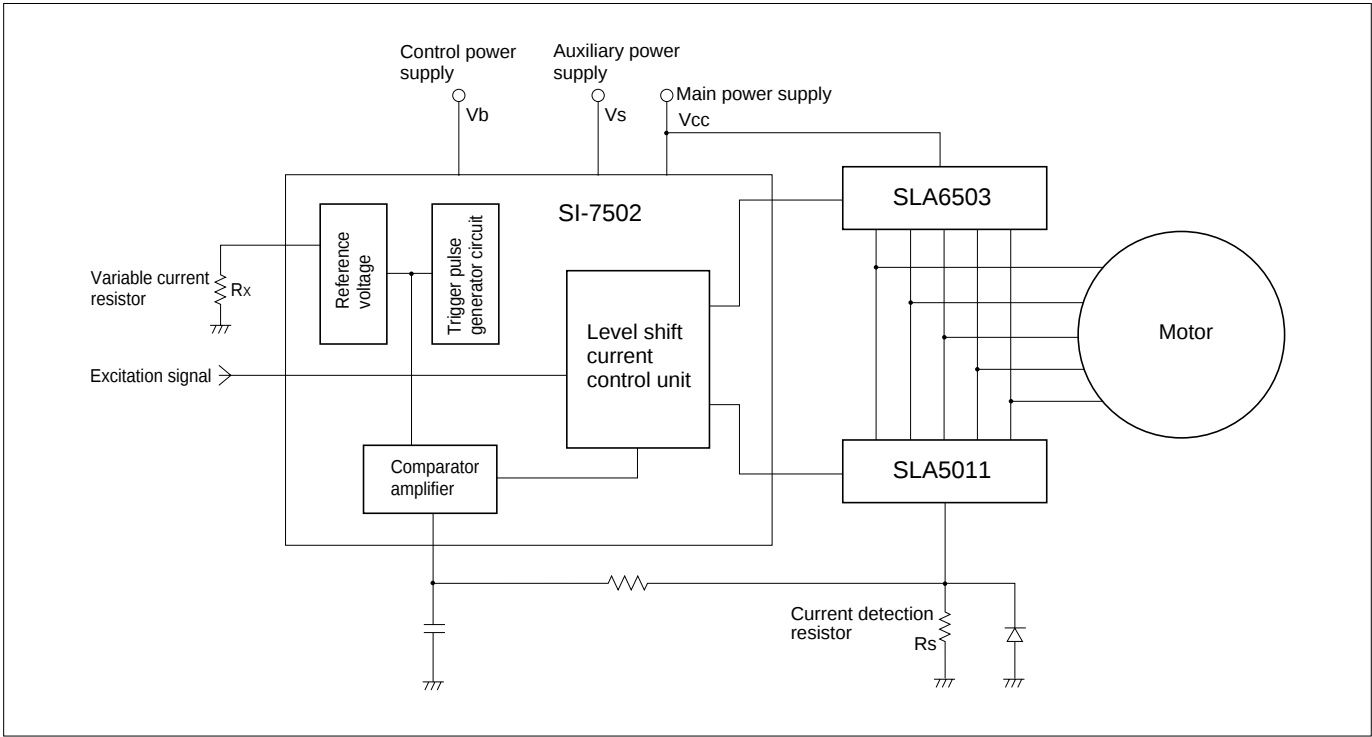
| Type No. | Parameter                                      | Symbol                 | Ratings     | Unit |
|----------|------------------------------------------------|------------------------|-------------|------|
| SI-7502  | Motor supply voltage                           | V <sub>CC</sub>        | 44          | V    |
|          | Auxiliary supply voltage                       | V <sub>S</sub>         | 15          | V    |
|          | Control voltage                                | V <sub>b</sub>         | 7           | V    |
|          | Reference voltage                              | V <sub>ref</sub>       | 1.5         | V    |
|          | Detected voltage                               | V <sub>RS</sub>        | 5           | V    |
|          | Power dissipation                              | P <sub>D</sub>         | 1           | W    |
|          | Ambient operating temperature                  | T <sub>OP</sub>        | 0 to +65    | °C   |
| SLA5011  | Drain source voltage                           | V <sub>DSS</sub>       | 60          | V    |
|          | Drain current                                  | I <sub>D</sub>         | ±5          | A    |
|          | Avalanche energy proof quantity (Single pulse) | E <sub>AS</sub>        | 2           | mJ   |
|          | Power dissipation                              | P <sub>T</sub>         | 35          | W    |
|          | Channel temperature                            | T <sub>ch</sub>        | 150         | °C   |
|          | Storage temperature                            | T <sub>stg</sub>       | −40 to +150 | °C   |
| SLA6503  | Collector-Base voltage                         | V <sub>CBO</sub>       | −60         | V    |
|          | Controller-Emitter voltage                     | V <sub>CEO</sub>       | −60         | V    |
|          | Emitter-Base voltage                           | V <sub>EBO</sub>       | −6          | V    |
|          | Collector current                              | I <sub>C</sub>         | −3          | A    |
|          | Collector current (Pulse)                      | I <sub>C</sub> (pulse) | −6          | A    |
|          | Base current                                   | I <sub>B</sub>         | −1          | A    |
|          | Power dissipation                              | P <sub>T</sub>         | 35          | W    |
|          | Junction temperature                           | T <sub>J</sub>         | 150         | °C   |
|          | Storage temperature                            | T <sub>stg</sub>       | −40 to +150 | °C   |

# SI-7502, SLA5011 and SLA6503

## Electrical characteristics

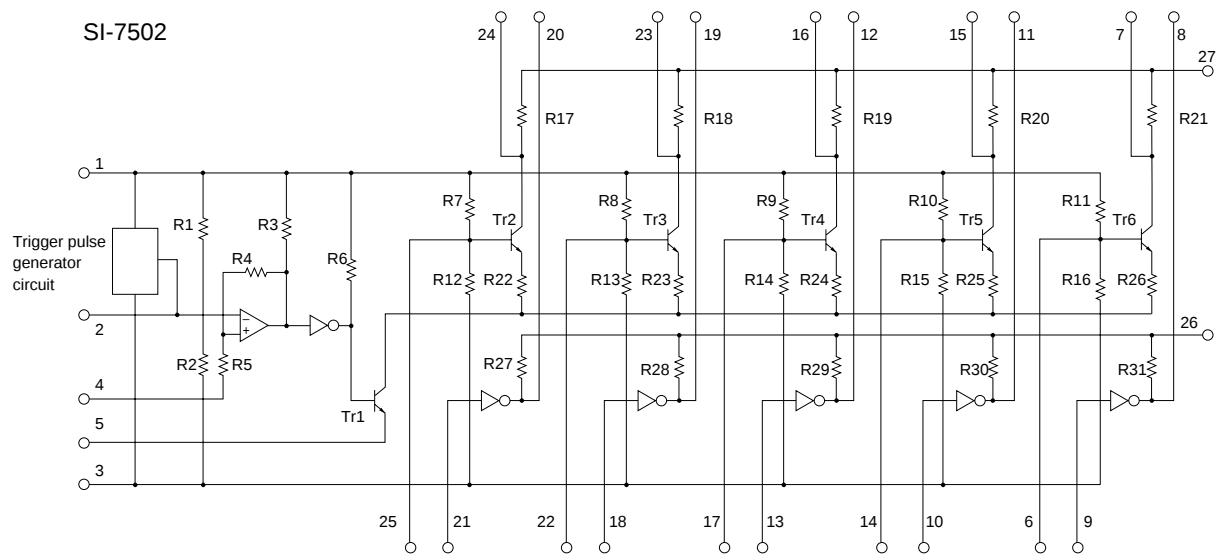
| Type No. | Parameter                                         | Symbol                                | Limit               |      |      | Unit | Condition                                     |
|----------|---------------------------------------------------|---------------------------------------|---------------------|------|------|------|-----------------------------------------------|
|          |                                                   |                                       | min                 | typ  | max  |      |                                               |
| SI-7502  | Supply current                                    | I <sub>CC</sub>                       |                     |      | 40   | mA   | V <sub>CC</sub> = 42V, V <sub>b</sub> = 5.5V  |
|          |                                                   | I <sub>S</sub>                        |                     |      | 12.5 | mA   | V <sub>S</sub> = 12.4V                        |
|          |                                                   | I <sub>b</sub>                        |                     |      | 50   | mA   | V <sub>b</sub> = 5.5V                         |
|          | Input current                                     | I <sub>IU-L</sub> , I <sub>IL-L</sub> |                     |      | 1.6  | mA   | V <sub>IU</sub> = V <sub>IL</sub> = 0.4V      |
|          | Upper drive circuit drive current                 | I <sub>OU-on</sub>                    | 8                   |      | 11   | mA   | V <sub>b</sub> = 5V, AIU to EIU pin open      |
|          |                                                   | I <sub>OU-off</sub>                   |                     |      | 10   | μA   | V <sub>b</sub> = 5V                           |
|          | Lower drive circuit voltage                       | V <sub>OL-on</sub>                    | V <sub>S</sub> -1.5 |      |      | V    | V <sub>b</sub> = 5V, AIL-EIL pin open         |
|          |                                                   | V <sub>OL-off</sub>                   |                     |      | 1.5  | V    | V <sub>b</sub> = 5V                           |
| SLA5011  | Oscillation frequency                             | F                                     | 20                  |      | 30   | kHz  | V <sub>b</sub> = 5V                           |
|          | Detected current                                  | V <sub>RS</sub>                       | 0.8                 |      | 1.05 | V    | V <sub>b</sub> = 5V, V <sub>ref</sub> pin     |
|          | Gate threshold voltage                            | V <sub>TH</sub>                       | 2.0                 |      | 4.0  | V    | V <sub>DS</sub> = 10V, I <sub>D</sub> = 250μA |
|          | Current transmission conductance                  | Re(yfs)                               | 2.2                 | 3.3  |      | S    | V <sub>DS</sub> = 10V, I <sub>D</sub> = 5A    |
|          | DC ON-resistance                                  | R <sub>DS(ON)</sub>                   |                     | 0.17 | 0.22 | Ω    | V <sub>GS</sub> = 10V, I <sub>D</sub> = 5A    |
|          | Input capacity                                    | C <sub>ISS</sub>                      |                     | 300  |      | pF   | V <sub>DS</sub> = 25V, f = 1.0MHz,            |
|          | Output capacity                                   | C <sub>OSS</sub>                      |                     | 160  |      | pF   | V <sub>GS</sub> = 0V                          |
|          | Di forward voltage between source and drain       | V <sub>SD</sub>                       |                     | 1.1  | 1.5  | V    | I <sub>SD</sub> = 5A                          |
| SLA6503  | Di reverse recovery time between source and drain | trr                                   |                     | 150  |      | ns   | I <sub>SD</sub> = ±100mA                      |
|          | Collector cut-off current                         | I <sub>CBO</sub>                      |                     |      | -10  | μA   | V <sub>CB</sub> = -60V                        |
|          | Collector emitter voltage                         | V <sub>CEO</sub>                      | -60                 |      |      | V    | I <sub>C</sub> = -10mA                        |
|          | DC current gain                                   | h <sub>FE</sub>                       | 2000                |      |      |      | V <sub>CE</sub> = -4V, I <sub>C</sub> = -3A   |
|          | Collector emitter saturation voltage              | V <sub>CE(sat)</sub>                  |                     |      | -1.5 | V    | I <sub>C</sub> = -3A, I <sub>B</sub> = -6mA   |

## Block diagram

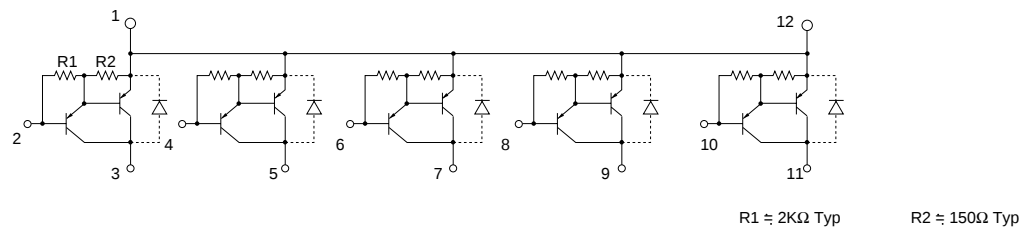


# SI-7502, SLA5011 and SLA6503

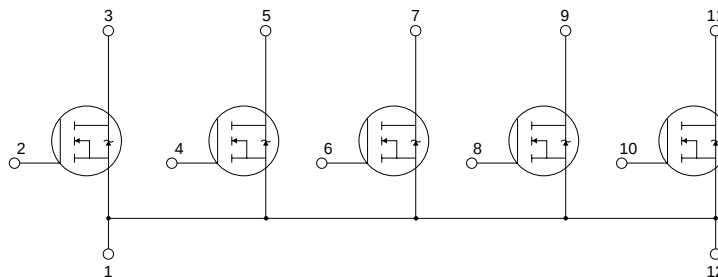
## ■ Equivalent circuit diagram



SLA6503



SLA5011





## Application Note

### ■ Determining the output current $I_O$ (motor coil current)

The main elements that determine the output current are Current detection resistor  $R_S$ , Supply voltage  $V_b$ , and Variable current resistor  $R_x$ .

#### (1) Normal mode

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

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

$$I_{OH} = \frac{V_{RSH}}{R_S} \quad \text{..... [A]}$$

$V_{RSH}$  can be computed as follows:

$$V_{RSH} = 0.19 \times V_b - 0.03 \text{ (center value) ..... [B]}$$

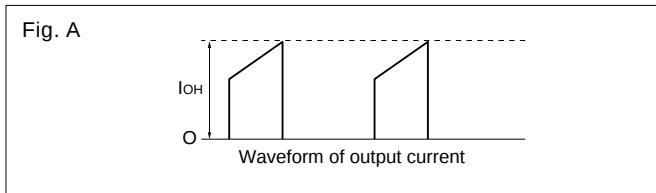
From equations [A] and [B], the output current  $I_{OH}$  can be computed as follows:

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

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 the Fig. C even when  $R_S$  is retained. Obtain the power down output current  $I_{OHPD}$  from Fig. C and equation [A].



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

The SI-7502 adopts 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:

$$I_O = 4 \times I_{OM}$$

The following relation is obtained depending on driving systems:

$$I_O = 2 \times I_{OM}$$

Fig. B Output current vs. Current detection resistor

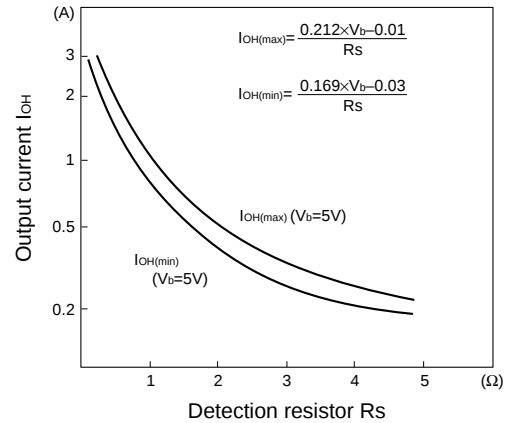


Fig. C Detection voltage vs. Variable current resistor

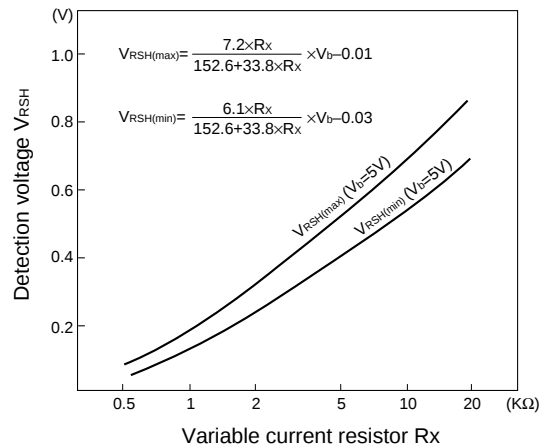
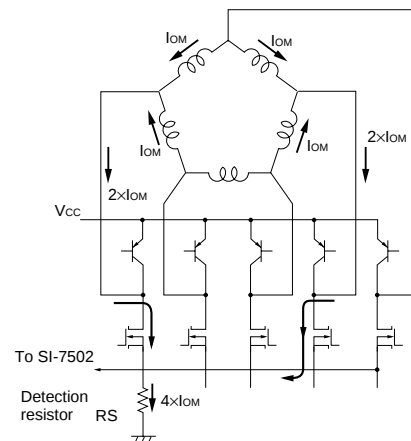


Fig. D Coil current flow at pentagonal driving



## SI-7502, SLA5011 and SLA6503

### ■ Motor connection

The 5-phase stepping motor supports various driving systems and the motor connection varies depending on those driving systems.

In some driving systems, the use of the motor 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 to be used even if those output currents (control current) are the same. Therefore, measure the temperature rise of the driver under the actual operation conditions and determine the size of heatsink.

Figure E shows an SLA5011/SLA6503 derating curve. This derating curve indicates  $T_j = 150^{\circ}\text{C}$ ; however, before using this device, set a margin and select a heatsink so that  $T_c < 100^{\circ}\text{C}$  (Al FIN temperature on the back of the SLA) is obtained.

Fig. E SLA5011/SLA6503 Derating curve

