Bipolar Driver IC

SI-7230M

■ Ratings

(Ta = 25°C)

Absolute maximum rating	Supply voltage (V)		Peak voltage of pins C_A and C_B (V)	Output current (A)	Junction temperature (°C)	Operating ambient temperature (°C)	Storage temperature (°C)
Type No.	V_{CC1}	V_{CC2}	V_{SP}	I_o	T_j	T_{op}	T_{stg}
SI-7230M	50	7	70	3.2	+125	−20 to +80	−30 to +100

■ Characteristics

| Electrical charac-teristics	Supply voltage (V)						Output current (mA/ø)					*Comparator threshold voltage (V)						Excitation signal input voltage (V)				Excitation signal input current (mA)	Oscillation frequency (kHz)			V_{CC2} input current (mA)
	V_{CC1}			V_{CC2}			I_o		I_{OM}			V_{THF}			V_{THPD}			$V_{IL(ON)}$		$V_{IH(OFF)}$		I_{IL}	F			I_{CC2}
Type No.	min	typ	max	min	typ	max	min	max	min	typ	max	min	typ	max	min	typ	max	min	max	min	max	max	min	typ	max	max
SI-7230M	15	30	45	4.5	5	5.5	200	3000	535	580	625	1.025	1.125	1.225	0.515	0.555	0.595	0	0.5	V_{CC2} −0.4	V_{CC2} +2	1.6	19	21	25	150

*V_{THF} : Conditions shown in the standard external connection diagram with V_{CC2} = 5V and R_S = 1Ω
 V_{THPD} : Conditions shown in the standard external connection diagram with R_X = 1kΩ, V_{CC2} = 5V and R_S = 1Ω
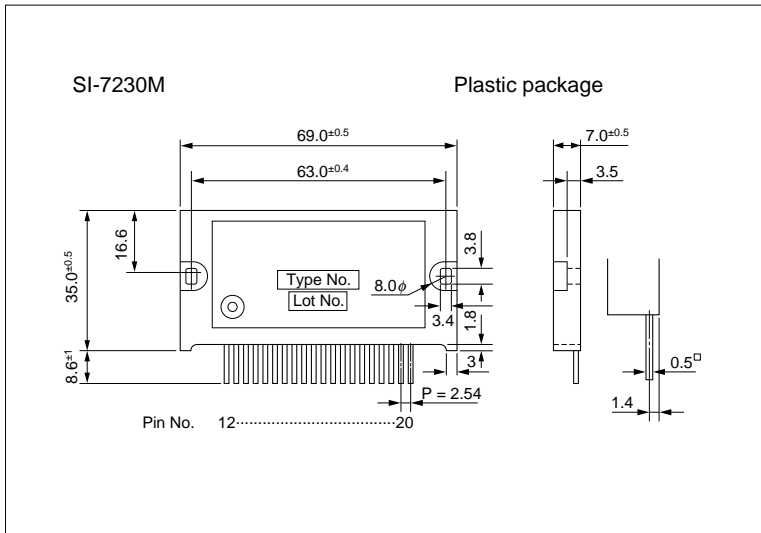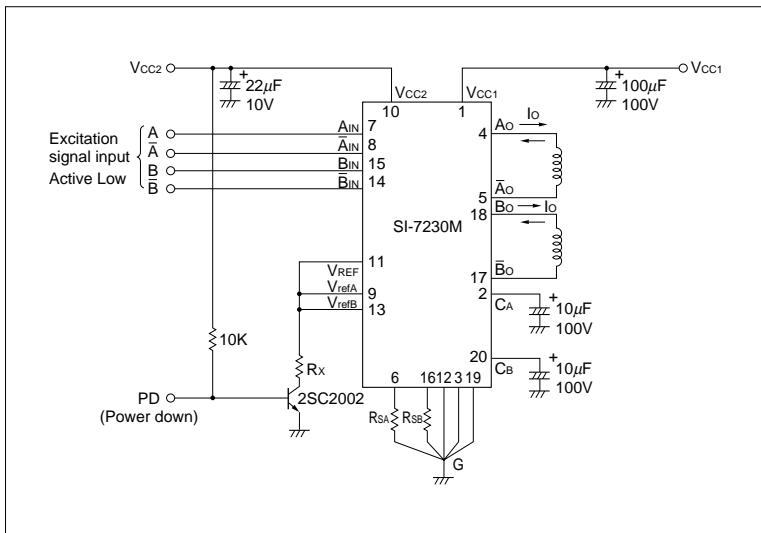
■ Block diagram
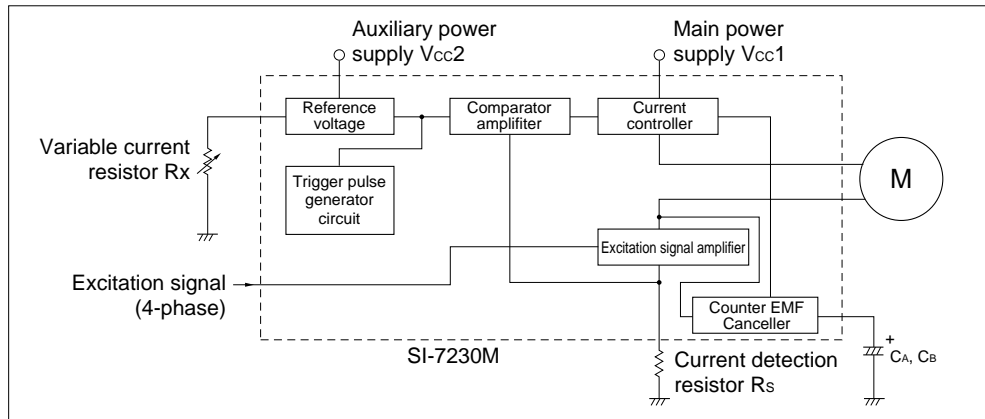
■ Equivalent circuit diagram
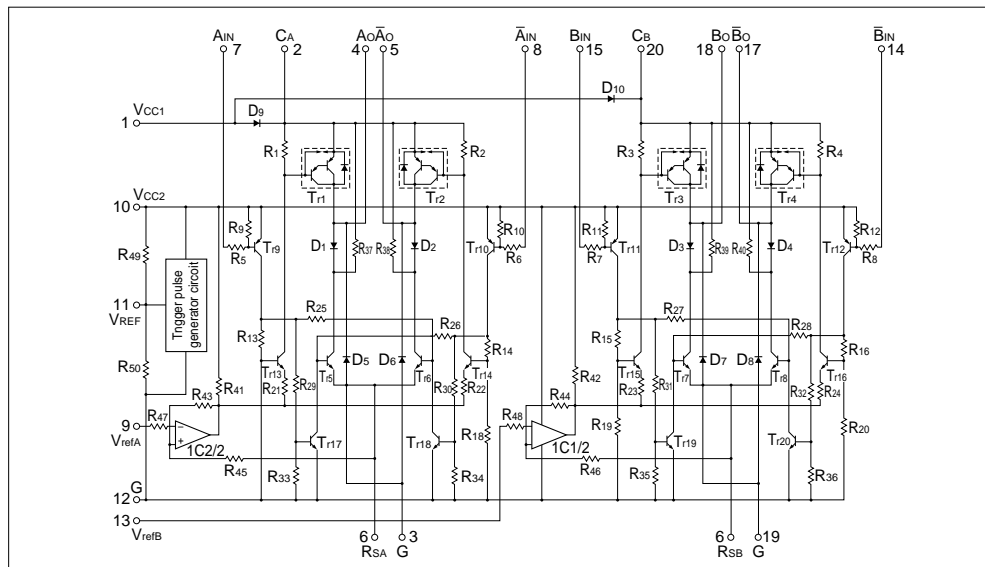
SI-7230M

■ External dimensions (Unit: mm)

SI-7230M — Plastic package

■ Standard external connection diagram

* For details on the characteristics and thermal design, refer to the technical manual.

SI-7230M

Application Note

■ Determining the output current Io ▬▬ (motor coil current)

The output current, Io is fixed by the following elements:

Rs   : Current detection resistor
Vcc2 : Supply voltage
Rx   : Variable current resistor

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

To compute Io when different values are used for Rs and Vcc2, use the approximation formula below. The maximum ripple value IOH of the output current waveform can be computed as follows:
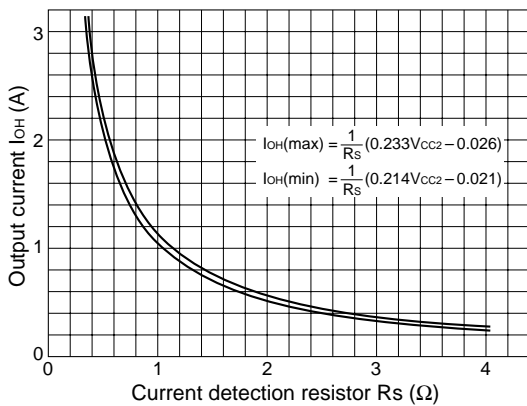
$$I_{OH(max)} = \frac{1}{R_S}\ (0.233 \cdot V_{CC2} - 0.026)\ [A]$$

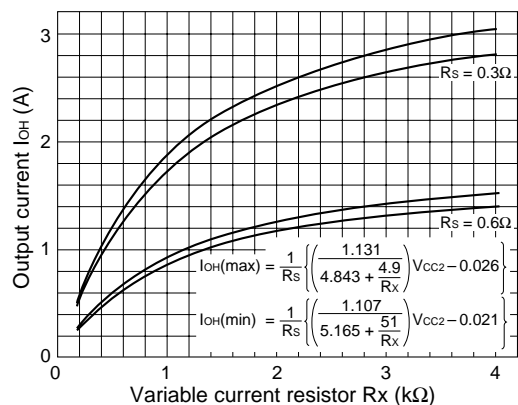$$I_{OH(min)} = \frac{1}{R_S}\ (0.214 \cdot V_{CC2} - 0.021)\ [A]$$

The graph of the equations above is shown below.

Waveform of the output current
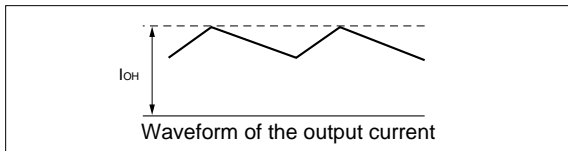
SI-7230M Output current IOH vs. Current detection resistor Rs

$I_{OH(max)} = \frac{1}{R_S}(0.233V_{CC2} - 0.026)$

$I_{OH(min)} = \frac{1}{R_S}(0.214V_{CC2} - 0.021)$

SI-7230M Output current IOH vs. Variable current resistor Rx

Rs = 0.3Ω

Rs = 0.6Ω

$$I_{OH(max)} = \frac{1}{R_S}\left\{\left(\frac{1.131}{4.843 + \frac{4.9}{R_X}}\right)V_{CC2} - 0.026\right\}$$

$$I_{OH(min)} = \frac{1}{R_S}\left\{\left(\frac{1.107}{5.165 + \frac{51}{R_X}}\right)V_{CC2} - 0.021\right\}$$

■ Power down mode ▬▬

SI-7230M can be operated in power down mode. The circuit is shown below. When transistor Tr is switched on, the reference voltage drops and the output current can be decreased.
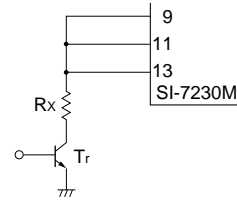
■ Surge absorption capacitor ▬▬ CA and CB and capacitance

The upper diagram shown on the next page is the flow of the counter EMF produced by the motor coils when it charges CA and CB and the lower diagram shows the direction of the energy discharged by CA and CB. When phase $\overline{A}$ shown in the figure is off, the counter EMF (energy built-up by the coil inductance) produced by the motor coils passes through the path shown by the dotted lines and charges CA and CB.

When phase $\overline{A}$ is on, the energy stored by the capacitors are discharged in the direction shown by the dotted lines in the lower left diagram on the next page. The capacitors are discharged until the voltage across their pins equal the supply voltage VCC. The peak voltage VSP across the capacitors is given by the equation:

$$V_{SP} = \sqrt{\frac{L}{C}} \cdot I_O + V_{CC}$$

where, L : Motor coil inductance between pins 4 and 5 or pins 18 and 17

C : Capacitance of CA and CB

Io : Output current
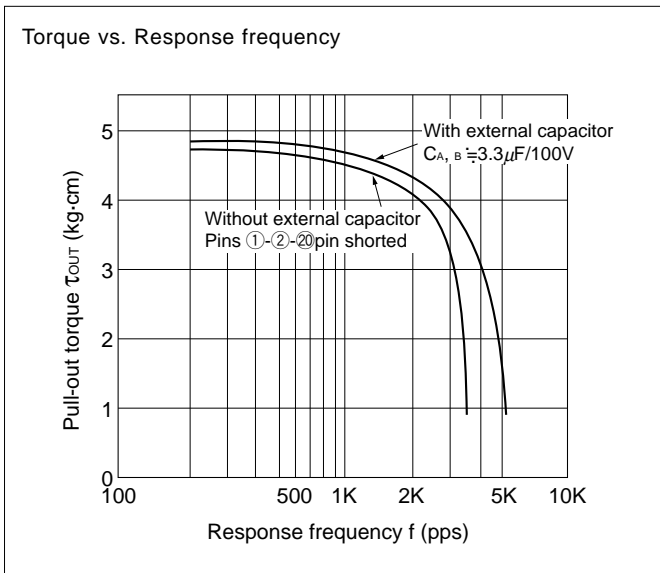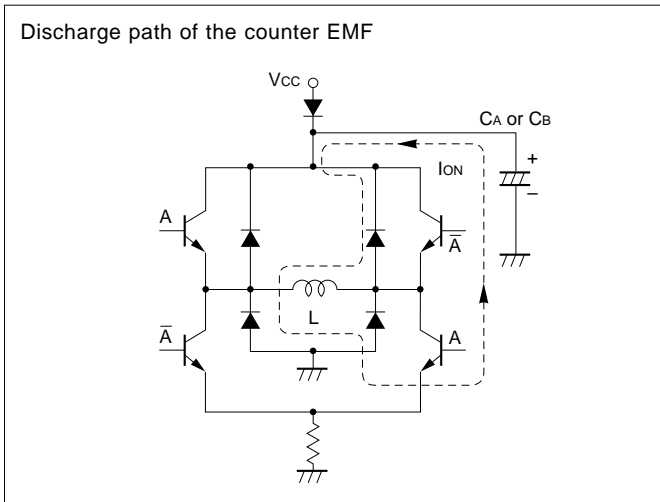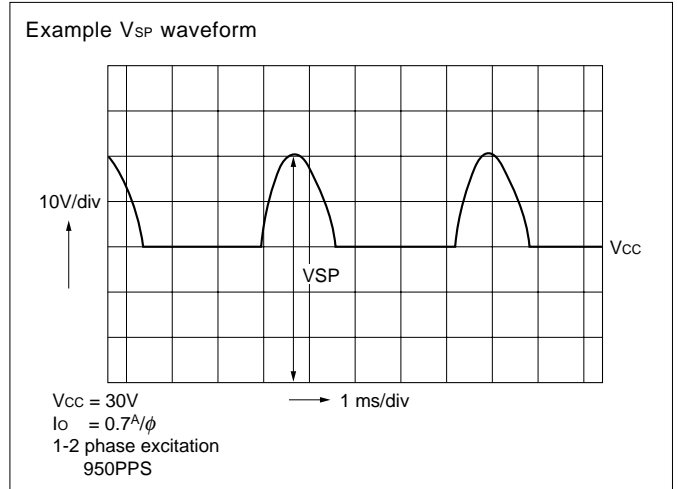
An example waveform of VSP is shown in the middle figure on the next page.

A VSP that can be obtained when high voltage is applied can also be produced by using the counter EMF when the coil current rises.

Notes in selecting CA and CB.

(1) VSP must not exceed the breakdown voltage of the hybrid IC (70V).

(2) CA and CB are charged/discharged in the same rate as the phase is switched. Hence, a capacitor with excellent anti-ripple characteristics should be selected.

Application Note

Charging path of the counter EMF

V_CC

C_A or C_B

I_OFF

A

$\overline{A}$

$\overline{A}$

A

L

+
−

Example V_SP waveform

10V/div

VSP

V_CC

V_CC = 30V
I_O = 0.7^A/ϕ
1-2 phase excitation
    950PPS

1 ms/div

Discharge path of the counter EMF

V_CC

C_A or C_B

I_ON

A

$\overline{A}$

$\overline{A}$

A

L

+
−

Torque vs. Response frequency

Pull-out torque τ_{OUT} (kg·cm)

5

4

3

2

1

0
100   500 1K   2K   5K   10K

Response frequency f (pps)

With external capacitor
C_A, B = 3.3μF/100V

Without external capacitor
Pins ①-②-⑳ pin shorted

Measurement conditions   V_CC1 = 35V, V_CC2 = 5V
I_O = 2.5A/ϕ
2-phase excitation
Motor : 23LM-CO35
            (Manufactured by Minevea)

Motor connection

$\overline{A}$ $\overline{B}$

A   X   B   X
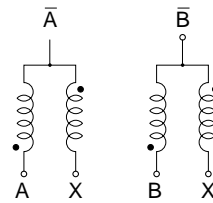
X : Open

SI-7200M, SI-7230M, SI-7115B, SI-7300A, SI-7330A, SI-7500A and SI-7502

Handling Precautions

(Note: The SI-7502 is applicable for item (2) only.)

For details, refer to the relevant product specifications.

(1) Tightening torque:

The torque to be applied in tightening screws when mounting the IC on a heatsink should be below 49N•m.

(2) Solvent:

Do not use the following solvents:

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

(3) Silicone grease:

The silicone grease to be used between the aluminum base plate of the hybrid IC and the heatsink should be any of the following:

- G-746   SHINETSU CHEMICAL INDUSTRIES CO., LTD.
- YG6260   TOSHIBA SILICONE CO., LTD.
- SC102   DOW CORNING TORAY SILICONE CO., LTD.

Please pay sufficient attention in selecting silicone grease since oil in some grease may penetrate the product, which will result in an extremely short product life.

Others

- Resistance against radiation
  Resistance against radiation was not considered in the development of these ICs because it is assumed that they will be used in ordinary environment.