

### INTERPROGRAM SENSOR FOR CASSETTE TAPE PLAYER

The KIA6941S is an interprogram sensor IC. Which is designed for one-program-skipping car stereo or radio cassette applications.

#### FEATURES

- Wide Operating Supply Voltage Range :  $V_{CC}=4\sim 16V$
- Built-in Mixing Amplifier for Dual
- Very Few External Parts
- Low Quiescent Current :  $I_{CCQ}=2mA(Typ.)$

#### MAXIMUM RATINGS ( $T_a=25^{\circ}C$ )

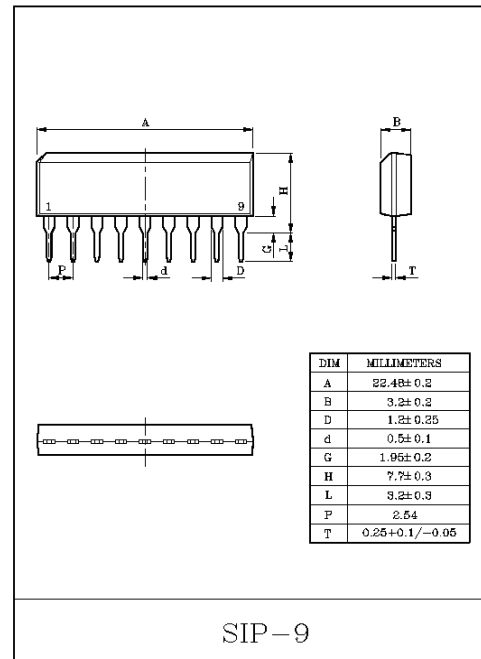
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	$V_{CC}$	16	V
Output Current	$I_{OUT}$	150	mA
Power Dissipation (Note)	$P_D$	500	mW
Operating Temperature	$T_{opr}$	$-25\sim 75$	$^{\circ}C$
Storage Temperature	$T_{stg}$	$-55\sim 150$	$^{\circ}C$

Note : Derated above  $T_a=25^{\circ}C$  in the proportion of  $4mW/^{\circ}C$ .

#### ELECTRICAL CHARACTERISTICS

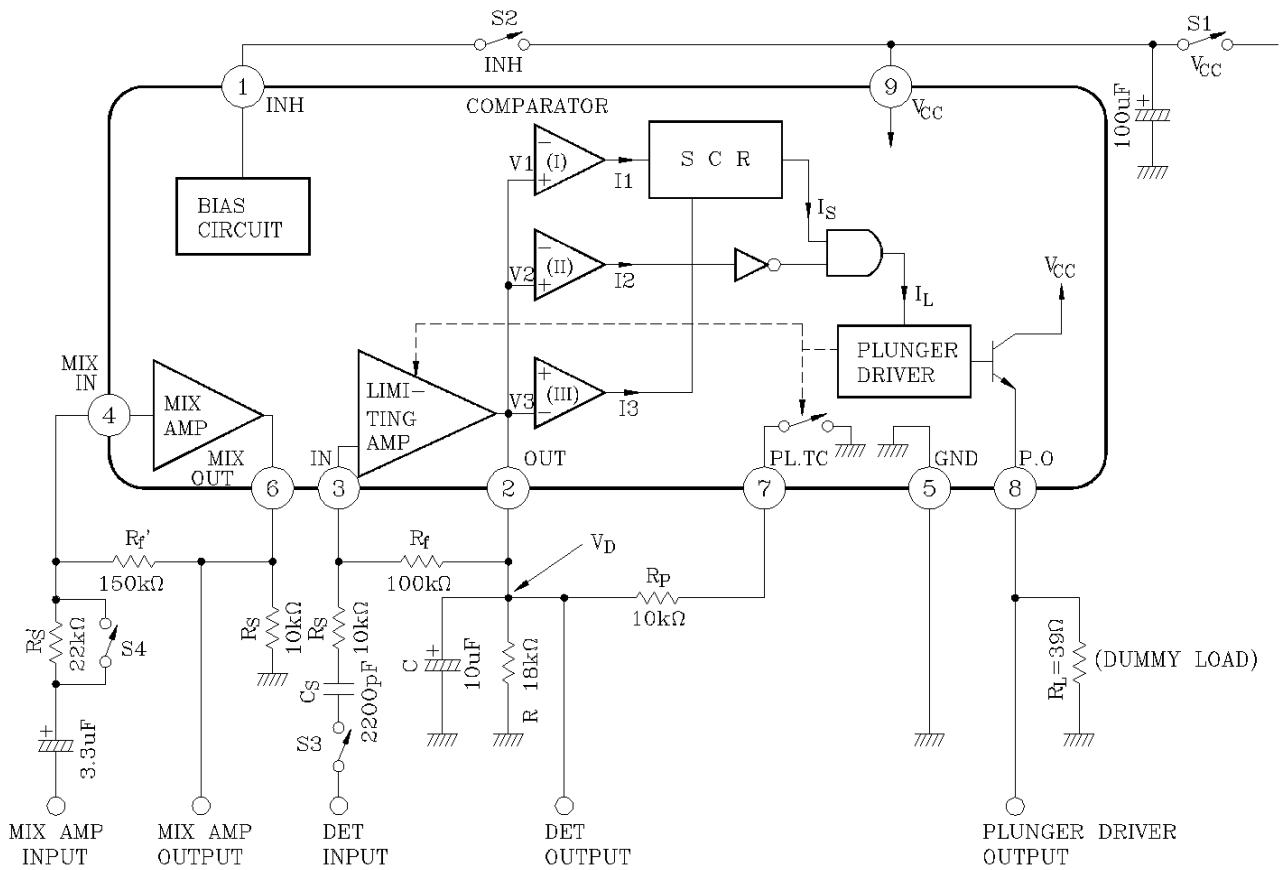
(Unless otherwise specified,  $V_{CC}=6V$ ,  $f=10kHz$ ,  $T_a=25^{\circ}C$ )

CHARACTERISTICS	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Current	$I_{CCQ}$	-	$V_{IN}=0$ , $INH= "ON"$	-	2	4	mA
Signal Portion Threshold	$V_S(ON)$	-	(Note 1)	-21	-18	-15	dBV
Blank Portion Threshold	$V_S(OFF)$	-	(Note 2)	-27	-24	-21	dBV
Hysteresis	$\Delta V_S$	-	(Note 3)	-	6	-	dB
No Signal Sensing Time	T	-	(Note 4)	-	100	-	msec
Plunger Driver ON Time	$T_P$	-	(Note 5)	-	20	-	msec
Mixing AMP Gain	$G_{VO}$	-	(Note 6)	35	40	-	dB



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## TEST CIRCUIT / BLOCK DIAGRAM



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## TEST CONDITION

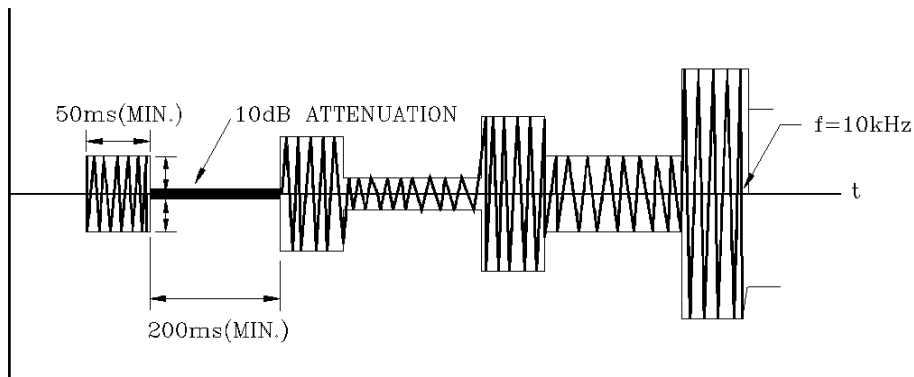
Note 1). Signal Portion Threshold ;  $V_S(\text{ON})$

(1) The input signal ( $f=10\text{kHz}$ ) is applied to the "DET INPUT" terminal.

S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>
ON	ON	ON	OFF

(2) The input signal wave is shown in the following figure.

The envelope of input signal is pulse wave, and its level is gradually increased. At the same time, the output is observed on a oscilloscope. Signal Portion Threshold  $V_S(\text{ON})$  is defined as input level that the output pulse is just observed. This input level is measured in continuous wave.



Note 2). Blank Portion Threshold ;  $V_S(\text{OFF})$

The input signal (continuous wave) is gradually decreased from the level of more than  $V_S(\text{ON})$ .

S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>
ON	ON	ON	OFF

Blank Portion Threshold  $V_S(\text{OFF})$  is defined as the input level that the output pulse is just observed.

The output pulse is appeared at pin⑧ when input signal level changes from more than  $V_S(\text{ON})$  to  $V_S(\text{OFF})$ .

Note 3). Hysteresis ;  $\Delta V_S$

$$\Delta V_S = V_S(\text{ON}) - V_S(\text{OFF})$$

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Note 4). No Signal Sensing Time ; T

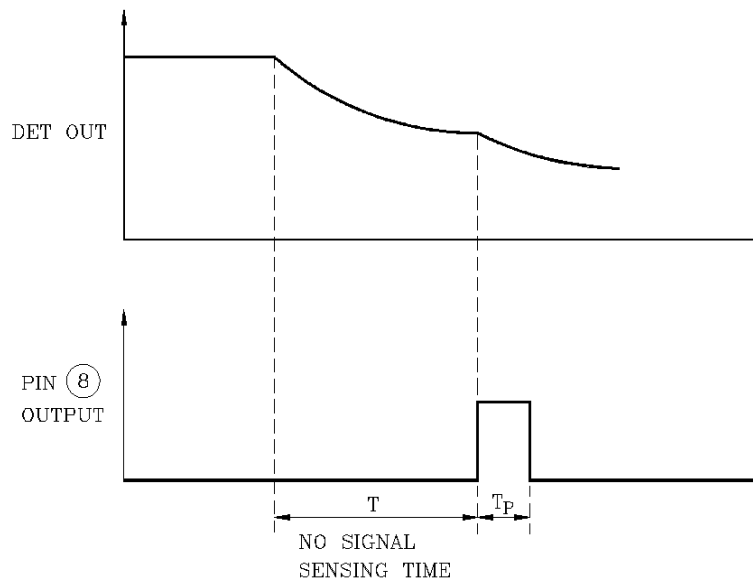
The input signal is applied to the "DET INPUT" terminal.

S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>
ON	ON	ON→OFF	ON

Its level is -10dBV and frequency is 10kHz.

The switch S<sub>3</sub> is on at first, and next is turned off. After switching, time is measured until the output pulse is observed. This term is no signal sensing time T. In another words, a plunger can be driven when blank portion continues during more than T (no signal sensing time).

Note 5). Plunger Driver ON Time ; T<sub>p</sub>.



The output pulse width is measured as T<sub>p</sub>

Note 6). Mixing Amplifier Gain ; G<sub>vo</sub>

The input signal is applied to the "MIX INPUT" terminal.

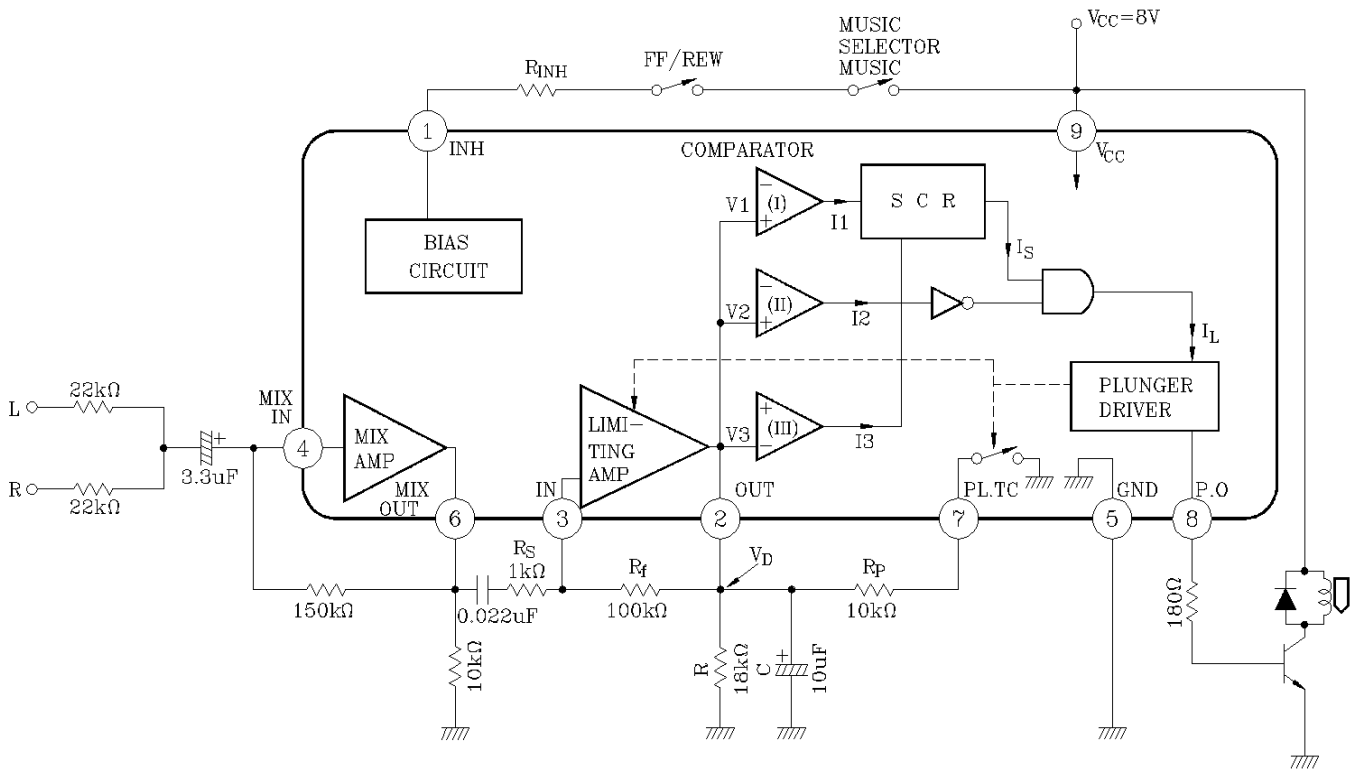
S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>
ON	ON	OFF	ON

Its level is -60dBV and frequency is 10kHz. The output voltage at "MIX OUTPUT" terminal is measured.

$$G_{vo}(\text{dB}) = \text{Output Voltage (dBV)} - (-60\text{dBV})$$

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## APPLICATION CIRCUIT



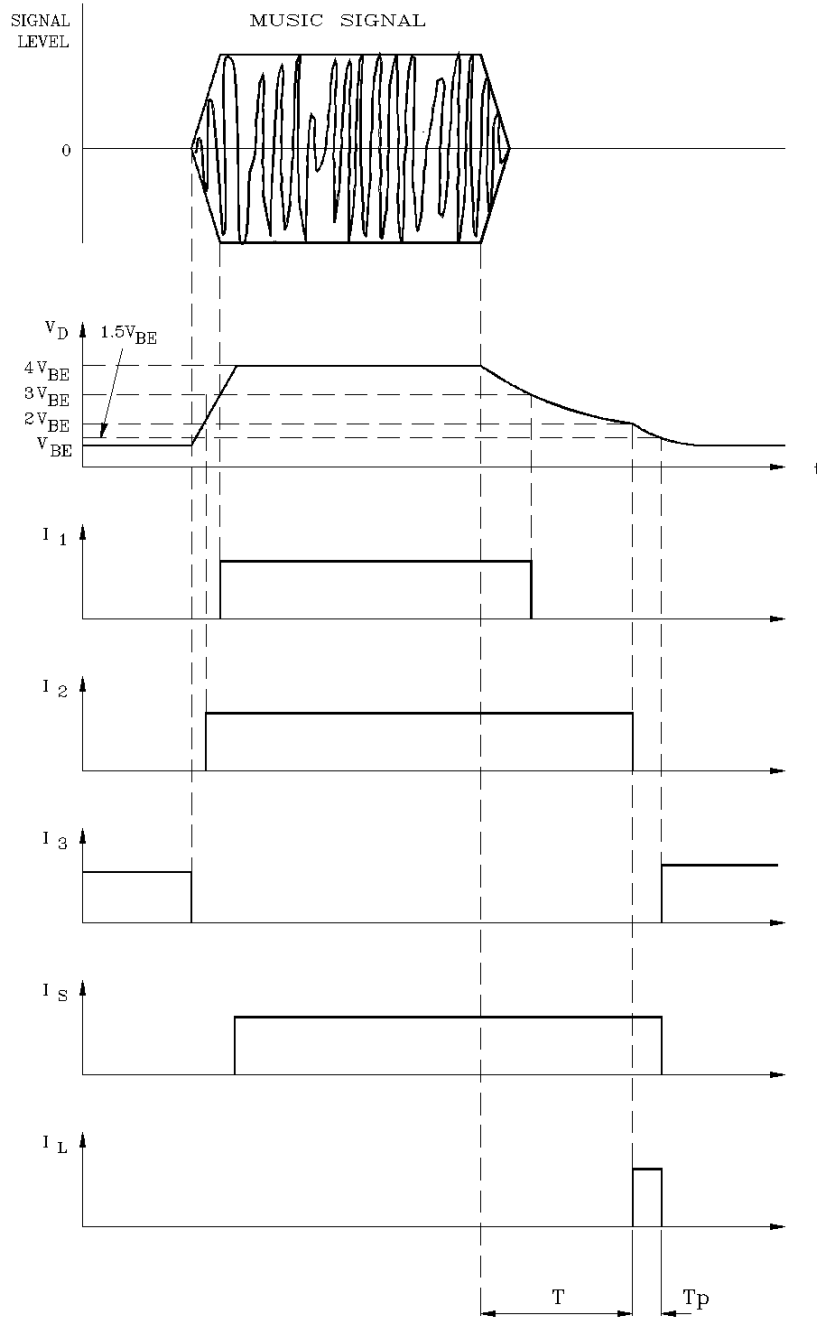
Note 1). No signal searching time  $T$  is adjustable by changing  $C$  or  $R$  because of  $T \propto CR$ .

Note 2). Plunger driver on time  $T_p$  is adjustable by changing  $R_p$  because of

$$T_p \propto C \times \frac{R \cdot R_p}{R + R_p} \quad (R_f \gg R, R_s)$$

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## TIMING DIAGRAM



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## OPERATING EXPLANATION

### OUTLINE

This IC converts input AC voltage to DC Voltage, compares it with a reference voltage and drives the plunger driving transistor.

#### 1) Operating Condition

The operating condition of each step are determined as follow.

- The reference level

$V1 = 3V_{BE}$  ..... Signal Portion Threshold

$V2 = 2V_{BE}$  ..... Blank Portion Threshold

$V3 = 1.5V_{BE}$  ..... Plunger Driver ON Time

$V_{D(MAX)} = 4V_{BE}$  ..... Limiting Level

- Cut off frequency .....  $f_c = 1/(2\pi CsRs)$

- No signal sensing time .....  $T \propto CR$

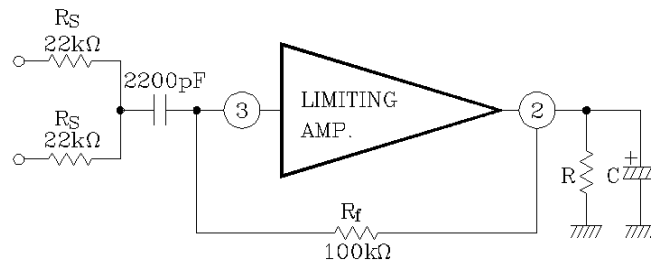
- Plunger driver on time .....  $T_p \propto C \times \frac{R \cdot R_p}{R + R_p}$

#### 2) Mixing Amplifier

R and L channel output of preamplifier are mixed by the resistor mixer and amplified about 15dB.

Here,  $G_v = -R_f/R_s'$

When an output level of preamplifier is enough higher than signal portion threshold  $V_s(ON)$ , the output can be directly connected to the limiting amplifier as shown the following figure.



### 3) Limiting Amplifier

The voltage gain of limiting amplifier is as follows.

$$\text{Gain} : G_V = -R_f/R_s$$

When a capacitor C is connected to the amplifier as a load, C is charged during the negative half cycle of the input signal and the amplifier is cutoff during the positive half cycle.

Then, when the charged-up voltage of C, that is Vd, becomes to the point of  $4V_{BE}$ , the inner limiting diodes turn on and Vd cannot be larger than  $4V_{BE}$ .

### 4) Comparator and Others

The reference voltages of each comparator are given as shown in above section 1).

When some music source as shown in timing diagram is given, Vd increases from  $V_{BE}$  to  $4V_{BE}$  through  $1.5V_{BE}$ ,  $2V_{BE}$  and  $3V_{BE}$ , and is held to  $4V_{BE}$  still the end of music.

Above  $3V_{BE}$ , the output I<sub>1</sub> of comparator (Dis "ON" and then I<sub>S</sub> is "ON"

Next, when the music ends, Vd decreases by discharging.

Below  $2V_{BE}$ , the output I<sub>2</sub> of comparator (II) turn to "OFF" .

Then the plunger driver turns on because of AND (I<sub>3</sub> · I<sub>2</sub>), and drives the limiting amplifier into cutoff states. When V<sub>D</sub> is below  $1.5V_{BE}$ , the plunger driver turns off, and all the functions return to initial states.

### 5) Plunger Driver

The plunger driver output circuit is darlington-configuration emitter follower, and the pin⑧ is emitter open.



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## PRECAUTION FOR USE

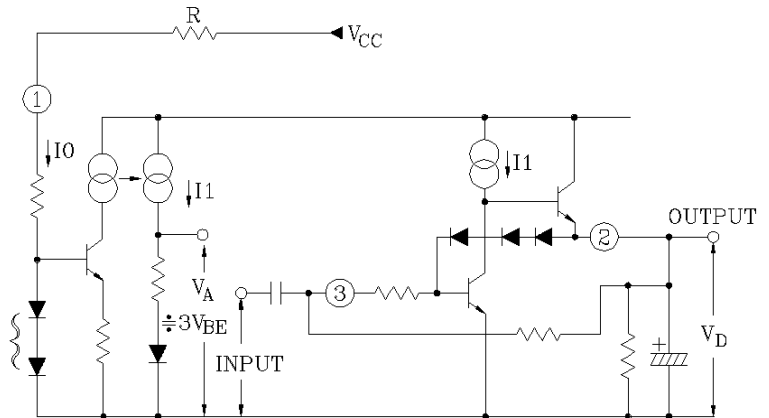
### 1. Supply voltage Dependency

When  $V_{CC}$  is more than 6V, it is necessary to insert a resistor R between pin ① and  $V_{CC}$  because of supply voltage dependency. Resistance of R is determined in the following equation.

$$R = \frac{V_{CC} - 6}{0.4} \text{ [k}\Omega\text{]} \quad (\text{because of } I_o \leq 0.4\text{mA})$$

If the R is not inserted at high supply voltage, the bias current  $I_1$  increases in proportion to  $I_o$ . Then, the reference voltage  $V_A$  of comparator (I) is large  $3V_{BE}$  because  $V_A$  depends on  $I_1$ .

On the other hand,  $V_D$  (pin ② output voltage) is input voltage for comparator (I).  $V_D$  is limited into  $4V_{BE}$  as shown in the figure. The forward current of the diodes inserted between pin ② and ③ is so small because of only the bias current,  $V_D$  is too low voltage for  $4V_{BE}$ . Therefore,  $V_A$  is higher than  $V_D$  at high supply voltage, and then it results in function error.



### 2. Output Current

The output Current from pin ⑧ should be designed to be within 150mA.