Toshiba **INTEGRATED CIRCUIT**

TECHNICAL DATA

TA7313AP

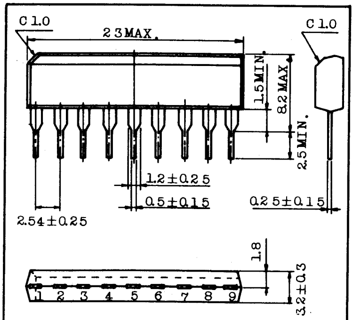
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT

SILICON MONOLITHIC

AUDIO POWER AMPLIFIER

- Designed for Output Power, Radio and Portable Casset Tape Recorder.
- Output Power : P_{OUT}=500mW(Typ.)
  at V_{CC}=6V, R_L=8Ω, THD=10%
- Wide Operating Supply Voltage Range : V_{CC}=4 ~ 14V
- Low Quiescent Current
- Without Heat Sink

Unit in mm



Lead pitch is 2.54 and tolerance is ±0.25 against theoretical center of each lead that is obtained on the basis of No.1 lead.

JEDEC	—
TOSHIBA	5−23B

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	14	V
Output Current (Peak)	$I_{O(peak)}$	0.5	A
Power Dissipation	P_D	750	mW
Operating Temperature	T_{opr}	-25 ~ 75	°C
Storage Temperature	T_{stg}	-55 ~ 150	°C

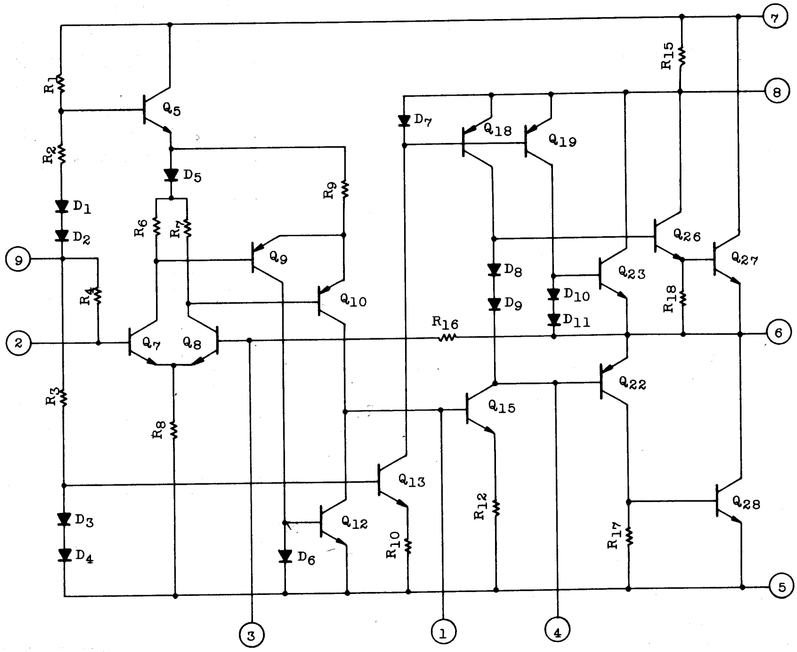
ELECTRICAL CHARACTERISTICS

(Unless otherwise specified V_{CC}=6V, R_L=8Ω, R_g=600Ω, R_f=47Ω, f=1kHz)

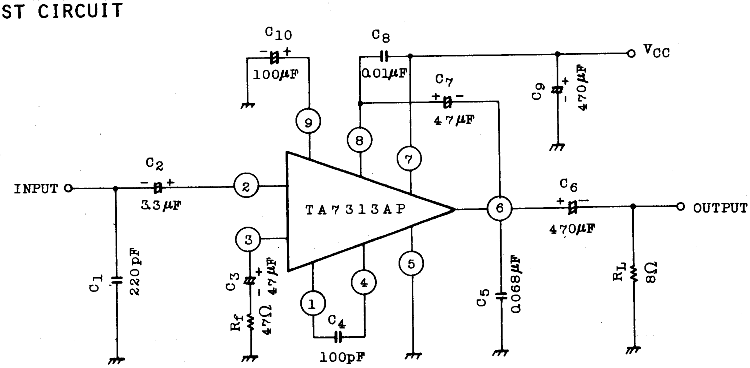
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Current	I_{CCQ}	-	V_{CC}=4V	7	-	-	mA
			V_{CC}=6V	-	15	20	
			V_{CC}=9V	-	17	23	
Output Power	P_{OUT}	-	THD=10%	0.45	0.5	-	W
			V_{CC}=9V, R_L=16Ω	-	0.70	-	
Total Harmonic Distortion	THD	-	P_{OUT}=100mW	-	0.3	1.0	%
Open Loop Voltage Gain	G_{VO}	-	R_f=0	65	71	-	dB
Closed Loop Voltage Gain (Note)	G_V	-	R_f=47Ω	47	50	52	dB
Input Resistance	R_{IN}	-	-	-	15	-	kΩ
Output Noise Voltage	V_{NO}	-	R_g=10kΩ, BW=50 ~ 20kHz	-	0.4	1.0	mV_{rms}

Note: In regard to the value of closed loop voltage gain, it is possible to be classified.

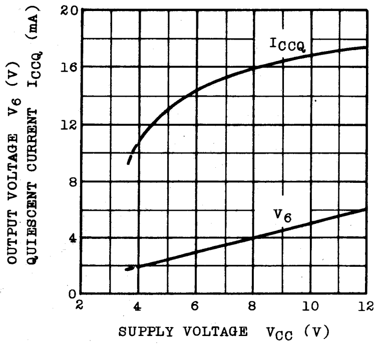
EQUIVALENT CIRCUIT



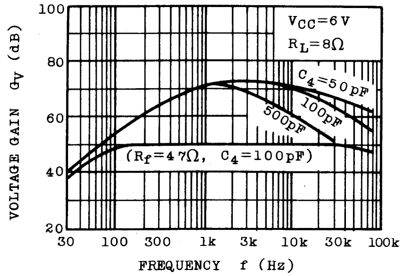
TEST CIRCUIT



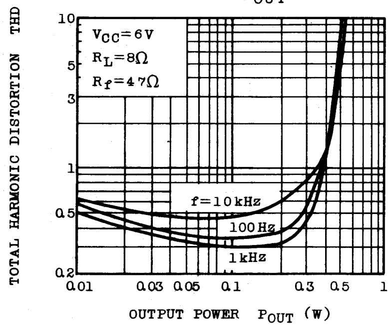
I_{CCQ}, V_6 — V_{CC}



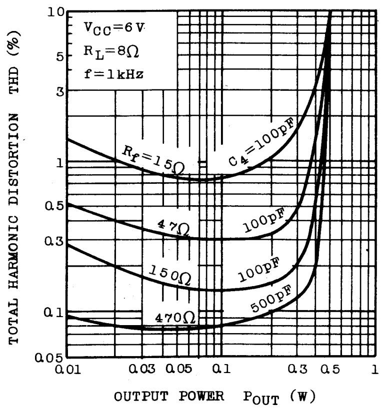
G_V — f



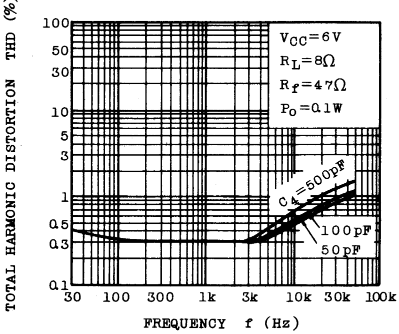
THD — P_{OUT}



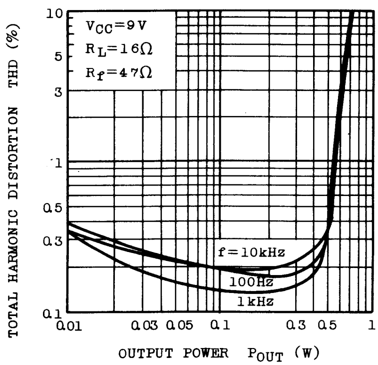
THD — P_{OUT}

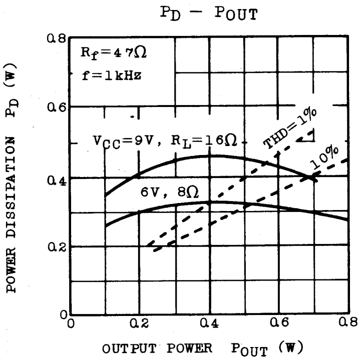


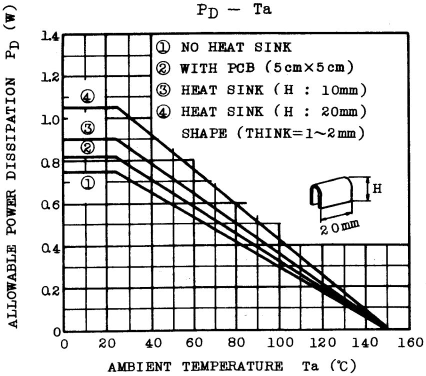
THD — f

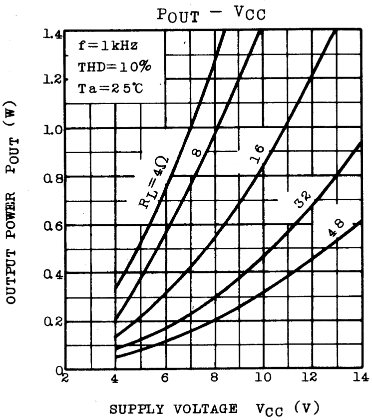


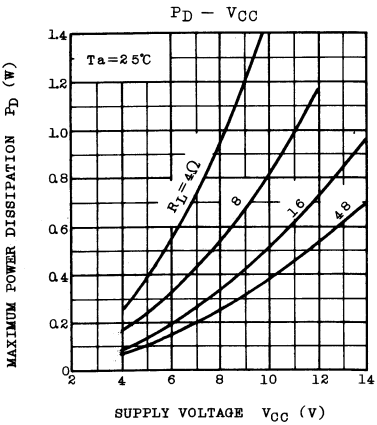
THD — P_{OUT}




P_D — P_{OUT}
R_f=47Ω
f=1kHz
V_{CC}=9V, R_L=16Ω
6V, 8Ω
THD=1%
10%
POWER DISSIPATION P_D (W)
OUTPUT POWER P_{OUT} (W)


P_D — Ta
① NO HEAT SINK
② WITH PCB (5cm×5cm)
③ HEAT SINK (H : 10mm)
④ HEAT SINK (H : 20mm)
SHAPE (THINK=1~2mm)
H
20mm
ALLOWABLE POWER DISSIPATION P_D (W)
AMBIENT TEMPERATURE Ta (℃)


P_{OUT} — V_{CC}
f=1kHz
THD=10%
Ta=25℃
R_L=4Ω
8
16
32
48
OUTPUT POWER P_{OUT} (W)
SUPPLY VOLTAGE V_{CC} (V)


P_D — V_{CC}
Ta=25℃
R_L=4Ω
8
16
48
MAXIMUM POWER DISSIPATION P_D (W)
SUPPLY VOLTAGE V_{CC} (V)

Toshiba **INTEGRATED CIRCUIT**

TECHNICAL DATA

TA7317P

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT

SILICON MONOLITHIC

PROTECTION CIRCUIT FOR OCL POWER AMPLIFIER AND SPEAKER

. Over current detecting circuit
Operation at the time of over load, such as a speaker terminal short.

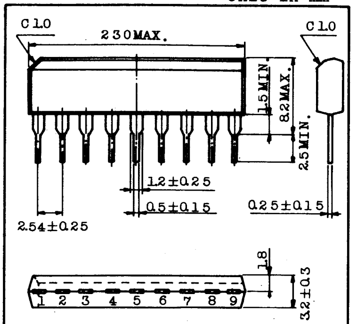
. DC voltage detecting circuit
Operation at the time when positive or negative DC voltage (±1.1V of detection level) has generated at output terminals.

. Muting circuit
Transient noise protection when power is ON-OFF.

. Relay driver circuit (Drive current of 130mA at Max.)

. Operation by dual power supply.

Unit in mm



Lead pitch is 2.54mm and tolerance is ±0.25 against theoretica center of each lead that is obtained on the basis of No.1 lead.

JEDEC	–
TOSHIBA	5–23B

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	60	V
Relay Driver Output Current	I_{OUT}	130	mA
Power Dissipation	P_D	500	mW
Operating Temperature	T_{opr}	-20 ~ 75	°C
Storage Temperature	T_{stg}	-55 ~ 150	°C

ELECTRICAL CHARACTERISTICS (V_{CC}=±50V, Ta=25°C)

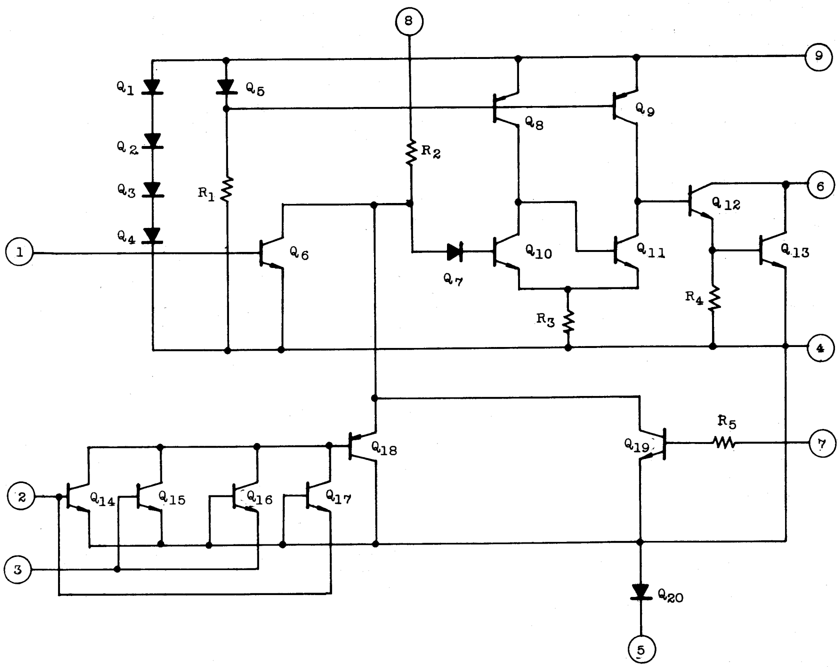
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{CC} ON	-	V_1 IN=-5V, ±V_{DC}=0V, SW:OFF	-	54	-	mA
	I_{CC} OFF	-	V_1 IN=0V, ±V_{DC}=0V, SW:OFF	1.5	2.4	4	
DC Detector Voltage	+V_{DC}	-	Note 1	0.9	1.1	1.3	V
	-V_{DC}	-	Note 1	-0.9	-1.1	-1.3	
Output Voltage	$V_{OUT(ON)}$	-	V_1 IN=-5V, ±V_{DC}=0V, SW:OFF	-	1	2	V
	$V_{OUT(OFF)}$	-	V_1 IN=0V, ±V_{DC}=0V, SW:OFF	-	50	-	
Muting Time at Power ON	M.T (V_{CC} ON)	-	Note 2	-	4	-	sec
Muting Time with Load Shorted	M.T	-	Note 3	-	3.5	-	sec
Pin 8 Entering Current	I_8	-	-	2	8	-	μA
Pin 9 Terminal Voltage	V_9	-	-	-	3.1	-	V
Pin 1 Terminal Voltage	V_1	-	-	-	0.75	-	V
Pin 5 Terminal Voltage	V_5	-	-	-	-0.75	-	V

TA7317

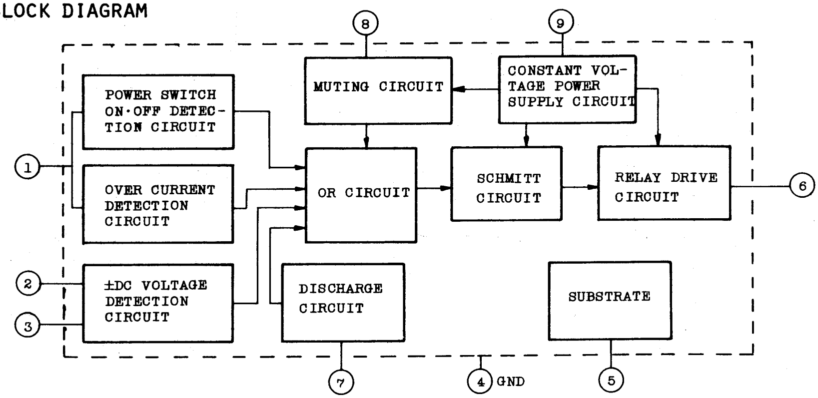
MAXIMUM INTO OR OUT CURRENT

CHARACTERISTIC	SYMBOL	RATING	UNIT
Pin 1 Current	I_1	±1.0	mA
Pin 2 Current	I_2	±1.0	mA
Pin 3 Current	I_3	±1.0	mA
Pin 5 Current	I_5	-6.0	mA
Pin 7 Current	I_7	1.0	mA
Pin 9 Current	I_9	5.0	mA

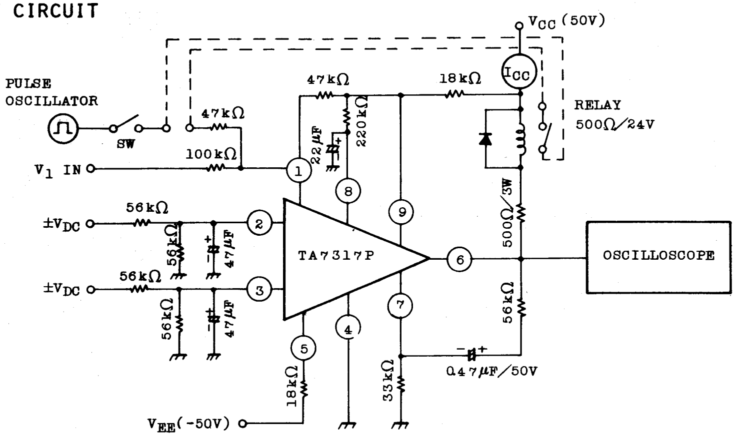
EQUIVALENT CIRCUIT



BLOCK DIAGRAM



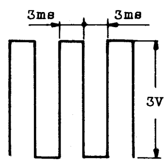
TEST CIRCUIT



(Note) 1. The value of $\pm V_{DC}$ at the time when the relay is turned from ON to OFF in the condition of V_1 IN=-5V and SW·OFF.

2. The time required for the relay being turned from OFF to ON at $+V_{CC}$ ON in the condition of V_1 IN=-5V, $\pm V_{DC}$=0V, and SW·OFF.

3. The duration of the relay being able to keep OFF when SW is turned ON in the condition of V_1 IN=-5V and $\pm V_{DC}$=0V. At that time input pulse is 3ms -3V.



* Figs.1,3,4 shows that C_1,C_3 and relay are in the state of room temperature.

Fig. 1 I_{CC} ON·OFF – Ta

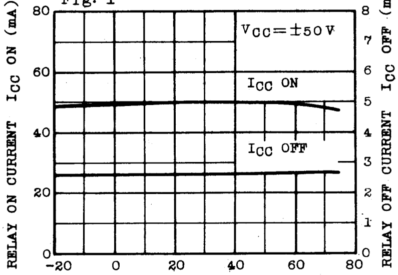


Fig. 2 M·T – R_1

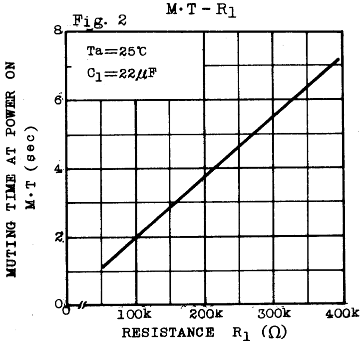


Fig. 3 M·T – Ta

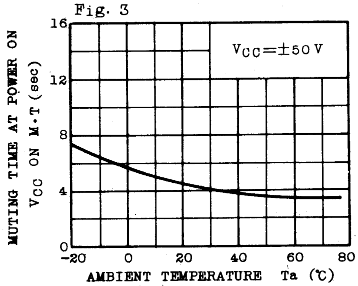


Fig. 4 $\pm V_{DC}$ – Ta

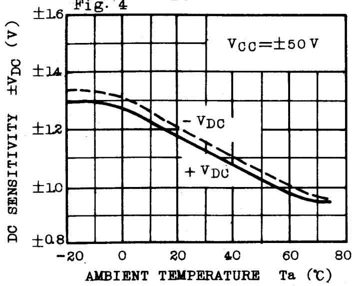


Fig. 5 T – $\pm V_{DC}$

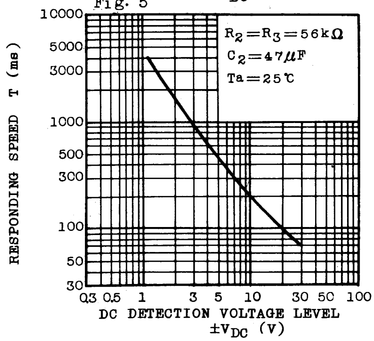
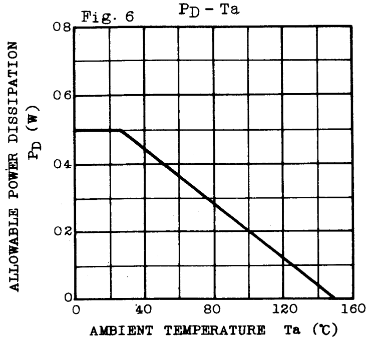
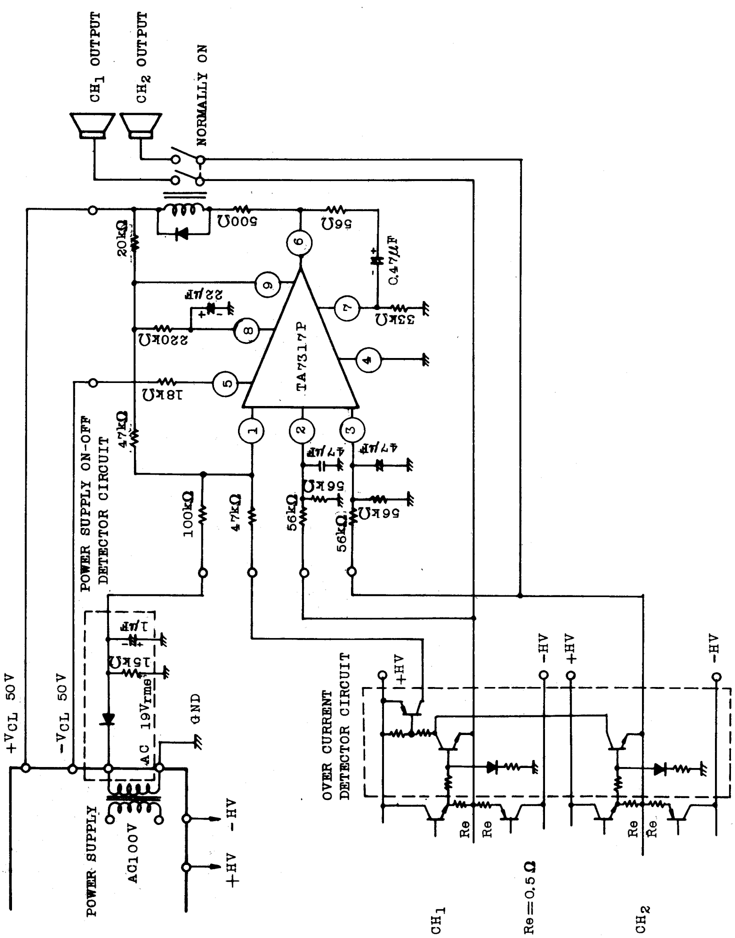


Fig. 6 P_D – Ta

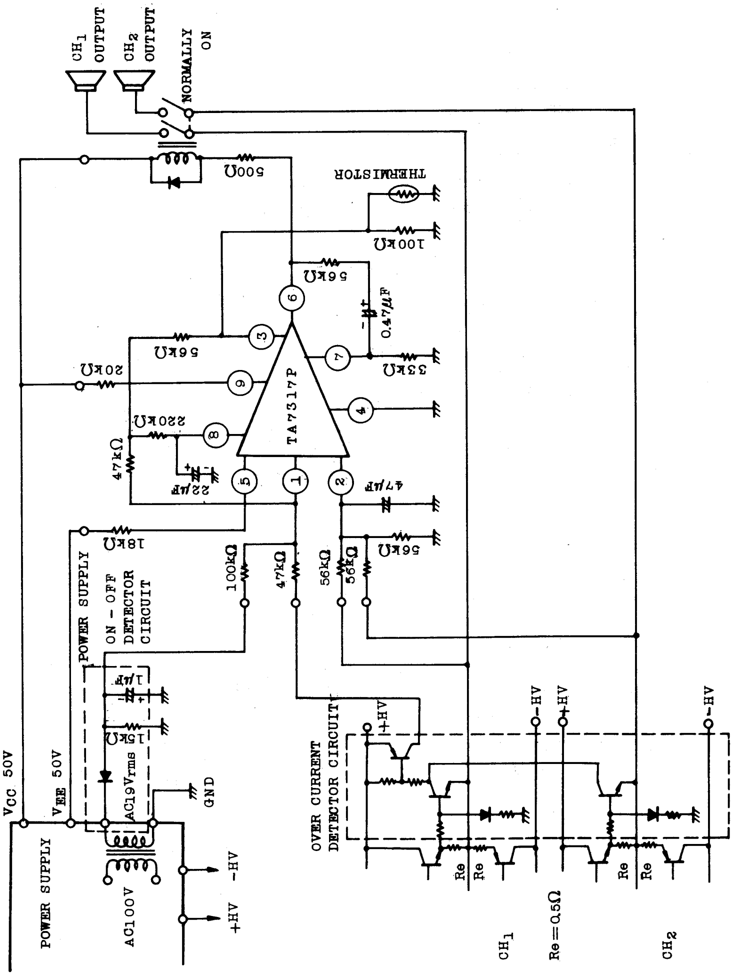


EXAMPLE OF APPLICATION CIRCUIT 1.

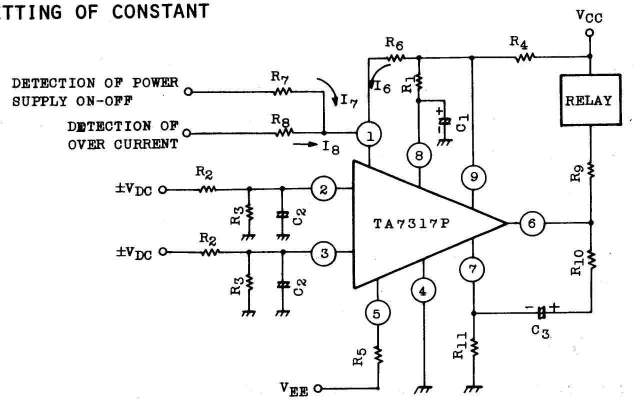


APPLICATION CIRCUIT 2.

(In case where 3 pin is used for detecting temperature)



SETTING OF CONSTANT



1. Setting of R_1 and C_1

The muting time (MT) at the time when the power supply is turned on, is determined by the time constants of R_1 and C_1. The approximate value can be obtained from the following theoretical formula:

$$MT = C_1 R_1 \ell n \left(\frac{1}{1 - \frac{V_8}{V_9}} \right),$$

where V_9 is made into a constant voltage in the IC, and V_9=3.1V.
When V_8 has become about 1.3V, the relay is turned ON.

However, since the discharge circuit connected to pin 7 at the instant the power supply has been turned ON, there is some difference between the actual value and the theoretical value.
Fig. 2 shows the measured value of R_1 to the muting time (MT) in case of C_1=22μF.

2. Setting of R_2, R_3 and C_2

The R_2, R_3 and C_2 not only determine the level sensitivity (time) detecting the DC voltage, but also operate as a filter bypassing an AC signal.

The time constant of this filter is $T=C_2R_2R_3/(R_2+R_3)$; therefore, let the lowest frequency of the desired amplifier be f_L, this time constant should be selected to $f_L \gg \frac{1}{2\pi T}$. And, the DC detecting voltage is so set that relay is ON when the absolute value of pin 2-voltage (or pin 3-voltage) is increased more than about 0.6V ~ 0.8V;

accordingly, the level should be set so that $\frac{R_3}{R_2+R_3} V_{DC} > 0.6V \sim 0.8V$.

As an example, Fig.5 shows the DC voltage detecting level corresponding sensitivity (with the relay ON).

3. Setting of R_4 and R_5

R_4 is a resistance to determine a current flowing into Pin 9. The current value should be set so as to become 2 ~ 3mA.

When these resistances are used under the condition that $+V_{CC}=50V$, since V_9 is 3.1V fixed, then

$$V_{CC}-V_9=46.9V$$

Let the flowing current be 2.5mA,

$$R_4 = \frac{46.9V}{2.5mA} = 17.96k\Omega \;.....\; 18k\Omega \text{ should be used for } R_4.$$

R_5 determines a current to (pull) draw from the substrate so that the current become 3mA. If it is used under the condition that $V_{EE}=-50V$, $V_5 \cong -0.75V$ because V_5 is the value in the forward voltage of Q_{20}. If I_5 is 3mA, because $V_5-(V_{EE})=49.25V$:

$$R_5 = \frac{49.25V}{3mA} = 16.42k\Omega \;.....\; 18k\Omega \text{ should be used for } R_5.$$

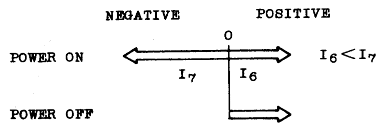
4. Setting of R_6, R_7 and R_8

R_6 and R_7 can determine the power supply ON or OFF, and R_8 can determine the over current. R_6 should be so designed that the current approx. 50 A fully driving Q_8 can be flown.

Since V_9=3.1V and V_1=0.75V, V_9-V_1=2.35V, therefore;

$$R_6 = \frac{2.35V}{50\mu A} = 47k\Omega \;.....\; 47k\Omega \text{ should be used } R_6.$$

The currents flowing to R_6, R_7 and R_8 be I_6, I_7 and I_8 respectively, the current relation at time of the detection of power supply ON and OFF is as follows: (The current flowing in Pin 1 is considered as a positive current).

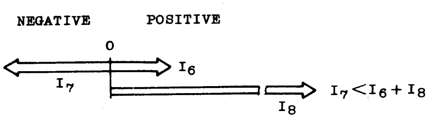


Therefore, R_7 create form I_7 which satisfies $I_6 < I_7$. For example, when detection is made from AC 19V_{rms}, if I_7 is 260 A, R_7 is as follows:

$$19V_{rms} = \sqrt{2}\,19V_{p-p} \doteqdot 26V_{p-p}$$

$$R_7 = \frac{26}{0.26mA} = 100k\Omega \;.....\; 100k\Omega \text{ is used for } R_7.$$

Similarly, at time of load detection, the current relation is as follows:



Compared I_8 with I_6 and I_7, it is a larger current; therefore, R_8 functions a protector for detection circuit input. Here, 47kΩ is used for R_8.

5. Setting of R_9

R_9 determines the current to flow to the relay. The relay specification be 500Ω/24V, and the current of approx. 50mA be flown, V_{CC}=50V, and $V_6 = V_{CE(sat)}\ Q_{13} \cong 1V$

Therefore, $(R_9 + 500\Omega) = \frac{49V}{50mA} = 1k\Omega$ ..... 500Ω is used for R_9.

6. Setting of R_{10}, R_{11} and C_3

R_{10} and C_3 are a resistance and a capacitor which function to allow the discharge circuit to operate instantly. The time constants of them should be extremely short. Here, R_{10}=56kΩ and C_3=0.47μF are used.

R_{11} is a resistance for mis-operating of dischage circuit, in which R_{11}=33kΩ.

7. The response time of output transistor (relay driver) is designed so as to operate more quickly and more stably by means of Schmitt circuit; in case of OFF→ON, the response time is approx. 0.5μs, while, in case of ON→OFF, the respons time is approx. 0.2μs,

8. The power dissipation of IC can be obtained from the following formular:

$$P_D \doteqdot V_{OUT(ON)} \cdot \frac{V_{CC} - V_{OUT(ON)}}{R_R + R_S} + I_{CC(OFF)} \cdot V_9$$

R_R : Relay DC resistance

R_S : Series resistance

V_9 : 9-pin voltage (3.1V TYP.)

In case V_{CC}=50V, R_R=500Ω, R_S=500Ω,

$P_D \doteqdot 111.5(mV)$