

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

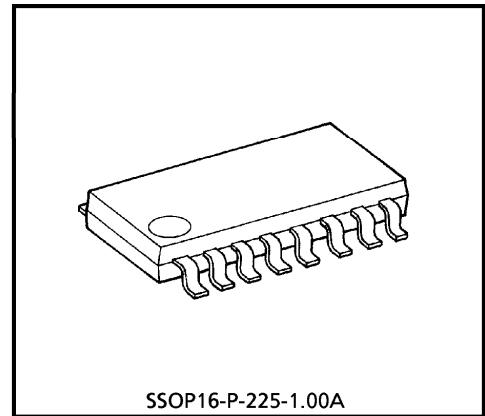
# TA7688F

## STEREO HEADPHONE AMPLIFIER (3V USE)

The TA7688F is a stereo headphone power amplifier IC designed for portable cassette player applications.

### FEATURES

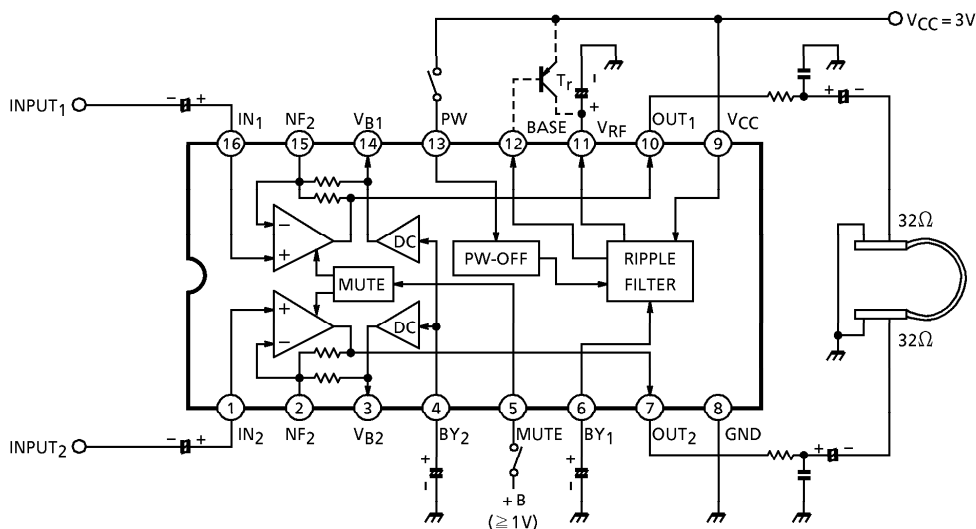
- Small installed area and few external parts
- Low supply current :  $I_{CCQ} = 7\text{mA}$  (Typ.) at 3V
- Built-in a ripple filter
- Built-in a power amplifier mute
- Built-in a power off circuit
- Operating supply voltage range :  $V_{CC(\text{opr})} = 1.8\sim 5\text{V}$
- Recommended supply voltage :  $V_{CC} = 3\text{V}$
- The standard model is TA7688F (SO)



SSOP16-P-225-1.00A

Weight : 0.14g (Typ.)

### BLOCK DIAGRAM



Dotted Line is an additional circuit to boost the stabilized current. (Option)

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APPLICATION NOTE

1. Voltage gain adjustment

The closed loop Voltage gain  $G_V$  is determined by the ratio of  $R_1$  and  $R_2$  shown in Fig.1.

$$G_V = 20 \log \frac{R_1 + R_2}{R_2} = 32 \text{dB}$$

But the actual value is 30.5dB because of influence of the other circuit.

Fig.2 shows the application circuit of higher or lower gain than recommended one.

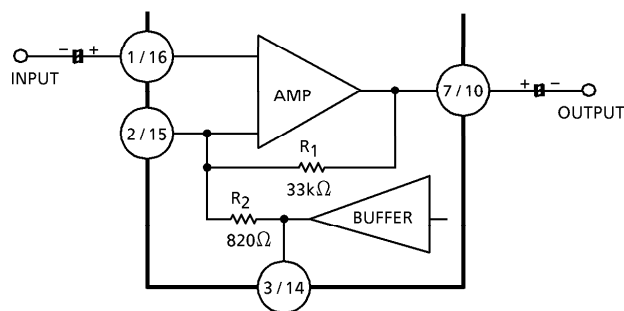


Fig.1

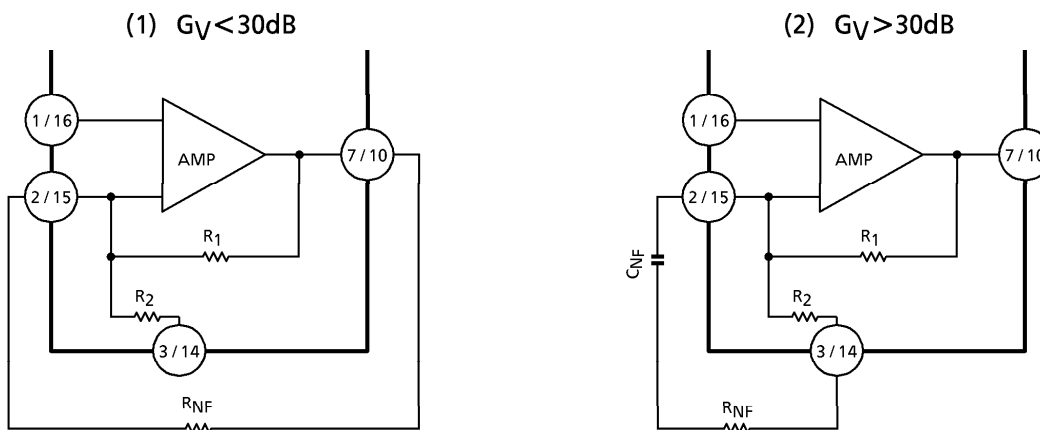


Fig.2

In the case of  $G_V < 30 \text{dB}$ , it happens to oscillate by phase delay at high frequency.

So this IC is not available at  $G_V < 30 \text{dB}$ . In the case of  $G_V > 30 \text{dB}$ , input offset is amplified, so that output DC voltage differs from center voltage. The unsymmetrical clipping wave is prevented by inserting capacitor  $C_{NF}$ .

Therefore this IC is available at  $G_V > 30 \text{dB}$  by using  $C_{NF}$ .

It is recommended to check pop noise based on  $C_{NF}$ .

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2. Muting

Muting operates when the voltage is applied to pin 5 or the current is flowed into pin 5.

Supply current is about half at muting ON.

It is necessary that muting drive current  $I_{MUTE}$  is less than  $150\mu A$ .

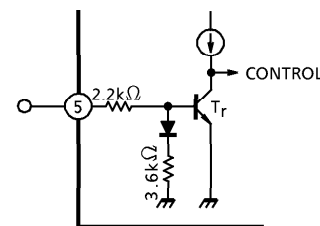


Fig.3

3. Oscillation precaution

(1) Oscillation preventing capacitor between output pin and GND is recommended to use capacitor with less temperature drift.

So suitable capacitor is not celamic or electrolytic capacitor, but tantalum or polyester film capacitor.

When protector resistor  $3.9\Omega$  is rejected, output power increases.

In this case, it is necessary to insert  $3.9\Omega$  as shown in Fig.4.

When  $R_L = 0$ , output current is very large in the circuit.

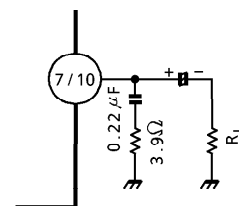


Fig.4

(2) It is necessary to use tantalum capacitor at Pin 11 ( $22\mu F$ ).

(3) Decoupling capacitor  $C_{10}$  is necessary to be near the pin 9.

4. Radiation precaution

Because of wide band (about 200kHz), the radiation from the amplifier degrade S/N at radio. As shown in Fig.5, it recommended to limit the band by C and R.

In this case, phase compensation check is necessary.

When  $C = 100pF$ ,  $R = 15k\Omega$ ,  $f_{HC}$  is 30~50kHz.

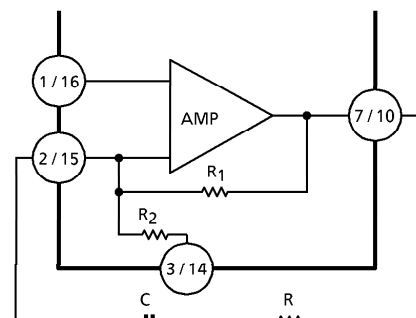


Fig.5

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

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	$V_{CC}$	7	V
Output Current	$I_O$	160 / ch	mA
Filter Output Current	$I_R$	10	mA
Power Dissipation (Note)	$P_D$	350	mW
Operating Temperature	$T_{opr}$	- 25~75	$^\circ C$
Storage Temperature	$T_{stg}$	- 55~150	$^\circ C$

Note : Derated above  $T_a = 25^\circ C$  in the proportion of  $2.8mW / ^\circ C$ .

## ELECTRICAL CHARACTERISTICS

1. AC characteristics (Unless otherwise specified,  $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 3\text{V}$ ,  $R_g = 600\Omega$ ,  $f = 1\text{kHz}$ )  
 $R_H = 3.9\Omega$ ,  $R_L = 32\Omega$ )

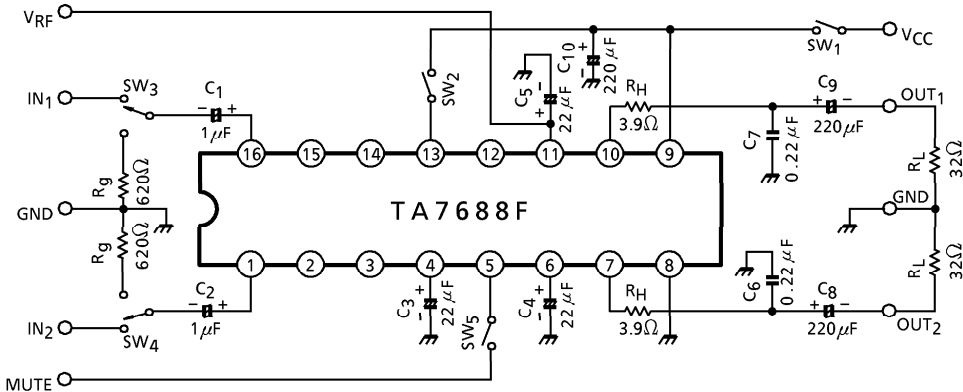
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Current		$I_{CCO(1)}$	—	$V_{in} = 0$	—	7	12	mA
		$I_{CCO(2)}$	—	$V_{in} = 0$ , $SW_2 : \text{OFF}$	—	1	10	$\mu\text{A}$
Output Power		$P_o(1)$	—	THD = 10%	20	27	—	mW
		$P_o(2)$	—	$R_L = 16\Omega$ , THD = 10%	—	38	—	
Total Harmonic Distortion		THD	—	$P_o = 10\text{mW/ch}$	—	0.12	1.0	%
Closed Loop Voltage Gain		$G_V$	—	$V_{in} = -42\text{dBV}$	28.5	30.5	32.5	dB
Channel Balance		$\Delta G_V$	—	$V_{in} = -42\text{dBV}$	—	0	$\pm 1$	dB
Cross Talk		CT	—	$V_o = -2\text{dBV}$ , $\text{ch1} \leftrightarrow \text{ch2}$	45	65	—	dB
Ripple Rejection	Headphone AMP	RR (1)	—	$f_r = 1\text{kHz}$ , $V_r = -22\text{dBV}$	30	45	—	dB
	Ripple Filter	RR (2)	—	$f_r = 100\text{Hz}$ , $V_r = -22\text{dBV}$	—	40	—	dB
Output Noise Voltage		$V_{no}$	—	BPF = 20Hz~20kHz	—	0.06	0.2	$\text{mV}_{\text{rms}}$
Input Resistance		$R_{IN}$	—	$f = 1\text{kHz}$	15	20	25	$\text{k}\Omega$
Ripple Filter Output Voltage		$V_{RF(1)}$	—	$V_{CC} = 2\text{V}$ , $I_{RF} = 10\text{mA}$	1.45	1.6	—	V
		$V_{RF(2)}$		$I_{RF} = 10\text{mA}$	2.1	2.3	2.5	
		$V_{RF(3)}$		$V_{CC} = 4.5\text{V}$ , $I_{RF} = 10\text{mA}$	—	3.4	—	
Muting Attenuation		ATT	—	$V_{MUTE} = 3\text{V}$ (0dB = 240 $\text{mV}_{\text{rms}}$ )	60	80	—	dB
Muting Input Voltage		$V_{MUTE}$	—	ATT $\geq 50\text{dB}$ (0dB = 240 $\text{mV}_{\text{rms}}$ )	—	0.7	1.0	V
Muting Input Current		$I_{MUTE}$	—	ATT $\geq 50\text{dB}$ (0dB = 240 $\text{mV}_{\text{rms}}$ )	—	35	—	$\mu\text{A}$
Ripple Filter Current		$I_B$	—	—	—	0.05	—	mA

## 2. DC characteristics

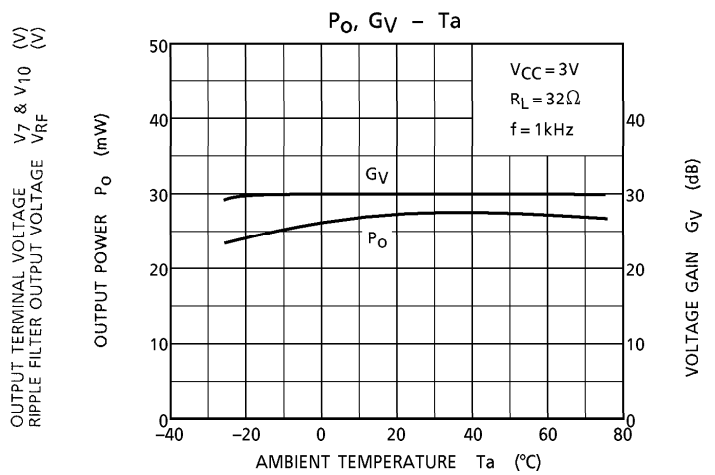
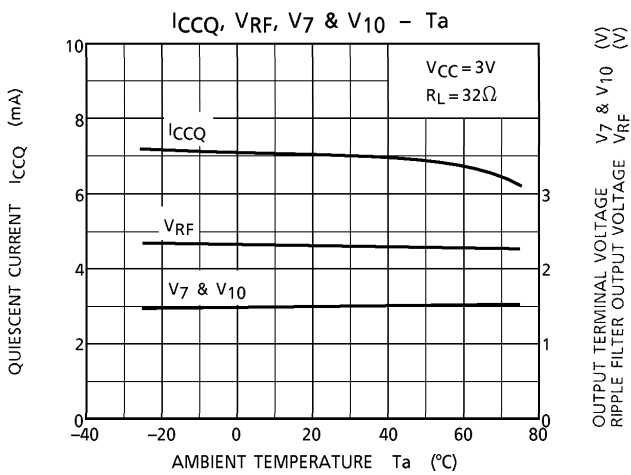
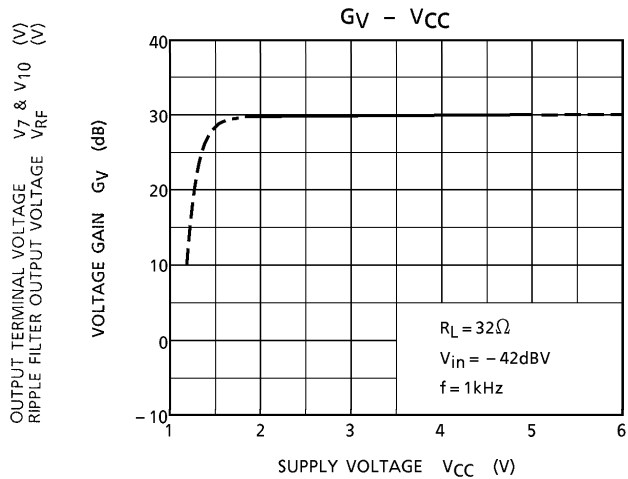
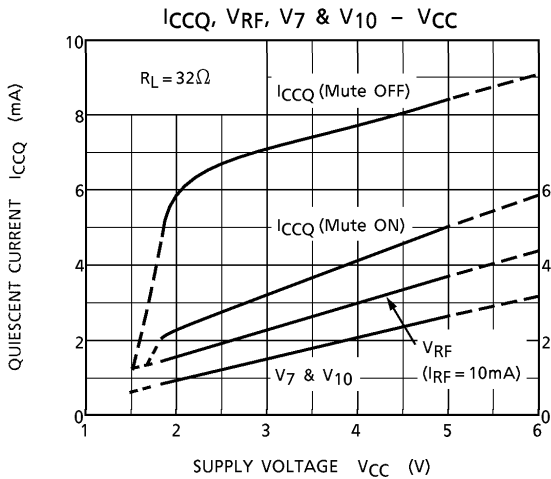
( $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 3\text{V}$ , Terminal voltage at no signal)

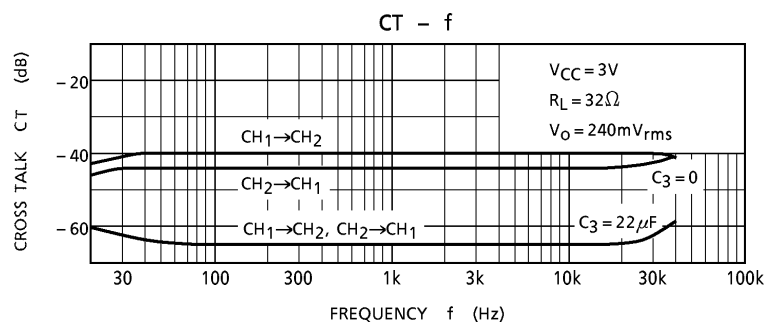
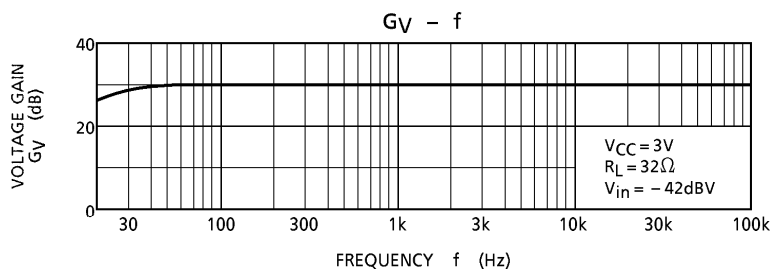
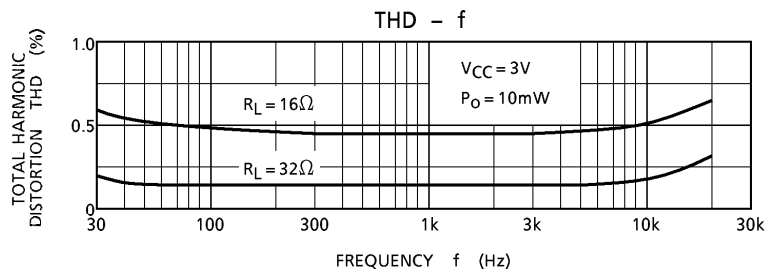
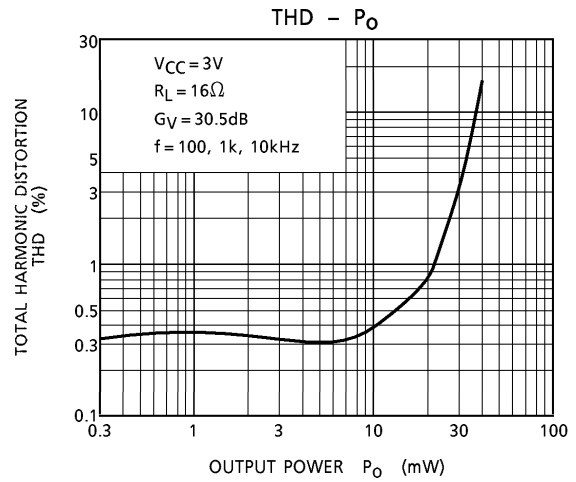
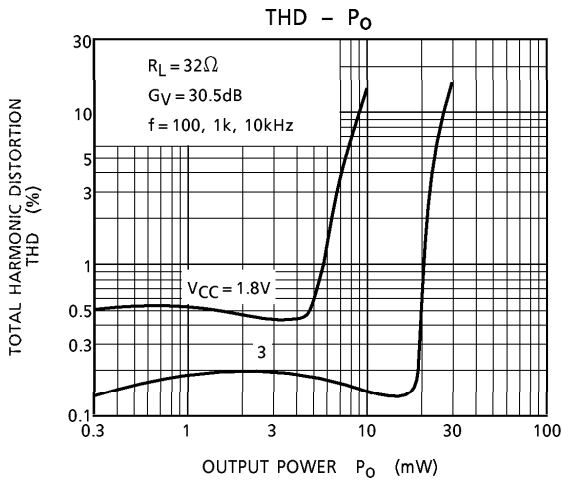
ITEM	SYMBOL	RATING	UNIT
Terminal 1 (IN <sub>2</sub> )	$V_1$	1.5	V
2 (NF <sub>2</sub> )	$V_2$	1.5	V
3 (V <sub>B2</sub> )	$V_3$	1.5	V
4 (BYPASS <sub>2</sub> )	$V_4$	1.5	V
5 (MUTE)	$V_5$	0	V
6 (BYPASS <sub>1</sub> )	$V_6$	2.2	V
7 (OUT <sub>2</sub> )	$V_7$	1.5	V
8 (GND)	$V_8$	0	V
9 (V <sub>CC</sub> )	$V_9$	3.0	V
10 (OUT <sub>1</sub> )	$V_{10}$	1.5	V
11 (V <sub>RF</sub> )	$V_{11}$	2.3	V
12 (BASE)	$V_{12}$	2.2	V
13 (PW ON/OFF)	$V_{13}$	3.0	V
14 (V <sub>B1</sub> )	$V_{14}$	1.5	V
15 (NF <sub>1</sub> )	$V_{15}$	1.5	V
16 (IN <sub>1</sub> )	$V_{16}$	1.5	V

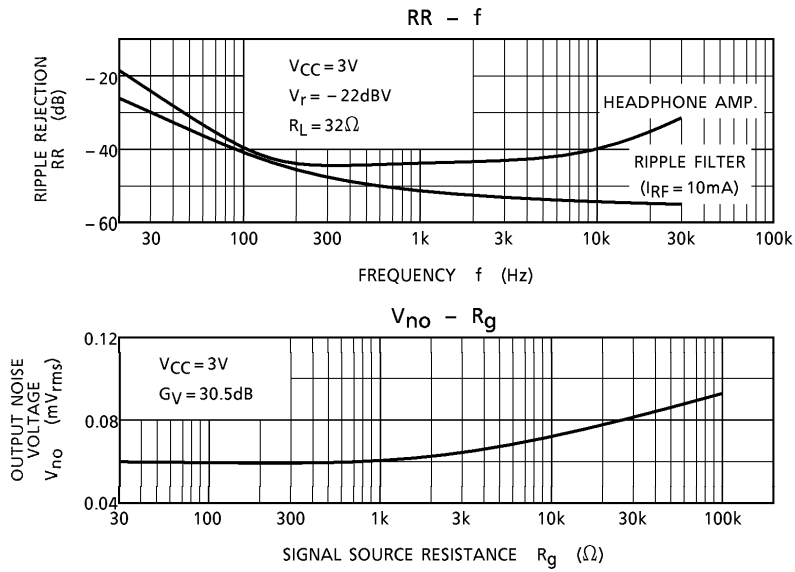
TEST CIRCUIT



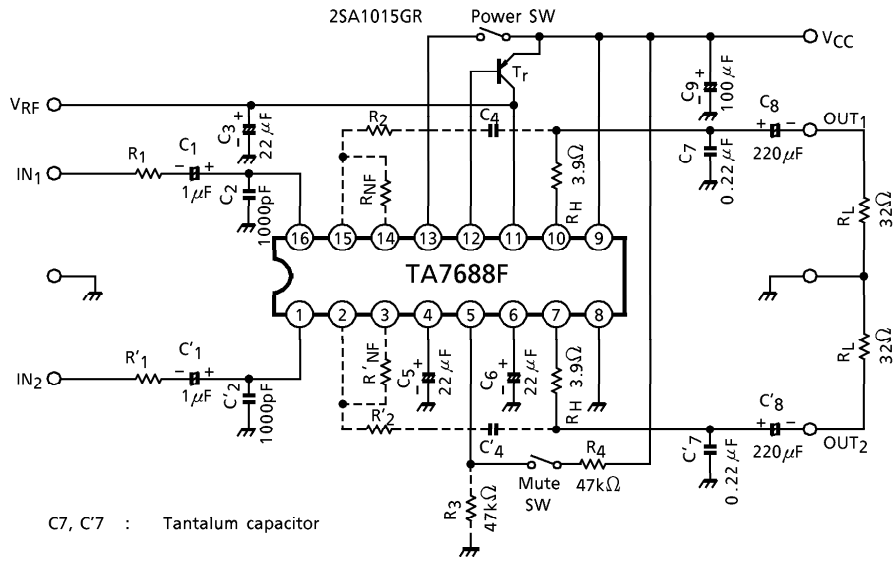
Note :  $R_H$  : Protection resistance  
 $C_6$  &  $C_7$  : Tantalum capacitor or polyester film capacitor  
 $C_5$  : Tantalum capacitor







APPLICATION CIRCUIT

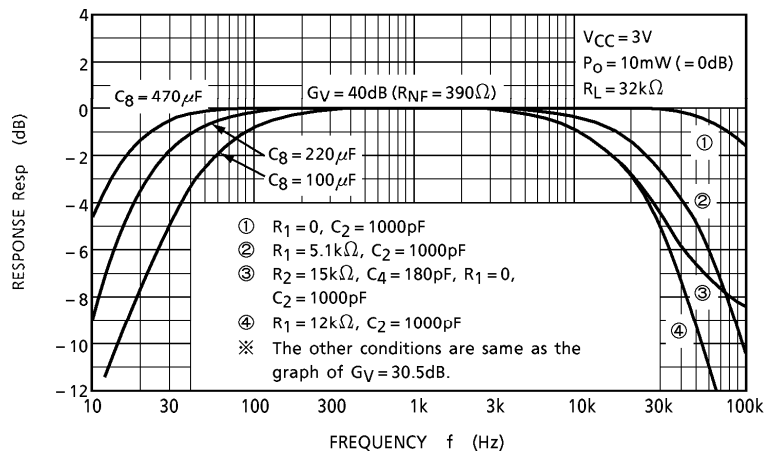
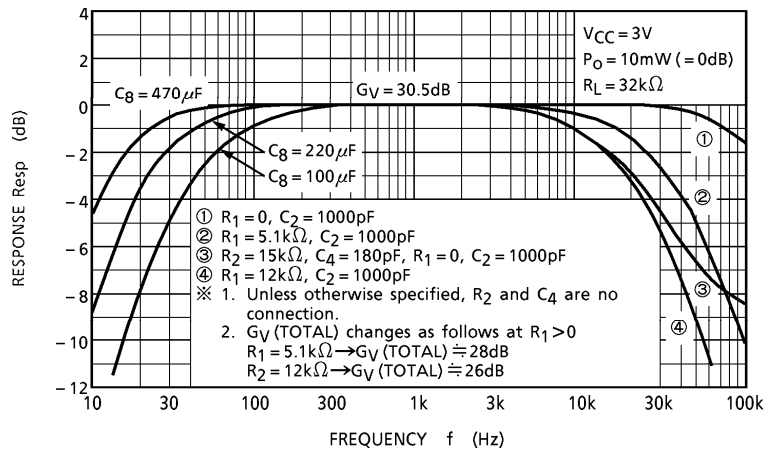


EXTERNAL PARTS TABLE (Mention only CH<sub>1</sub>)

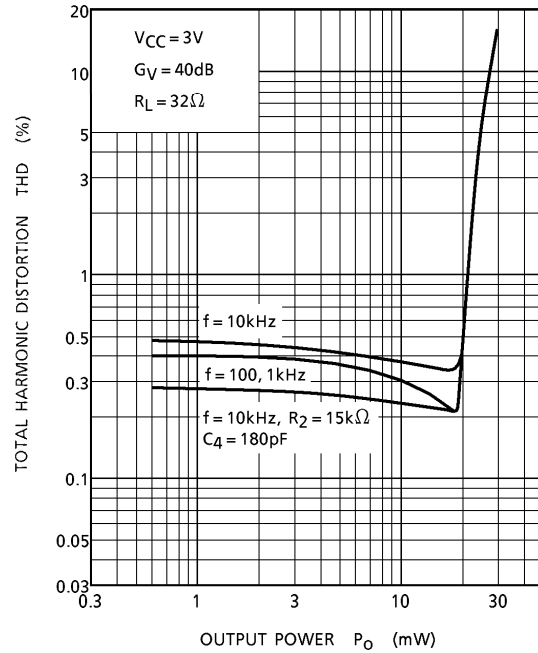
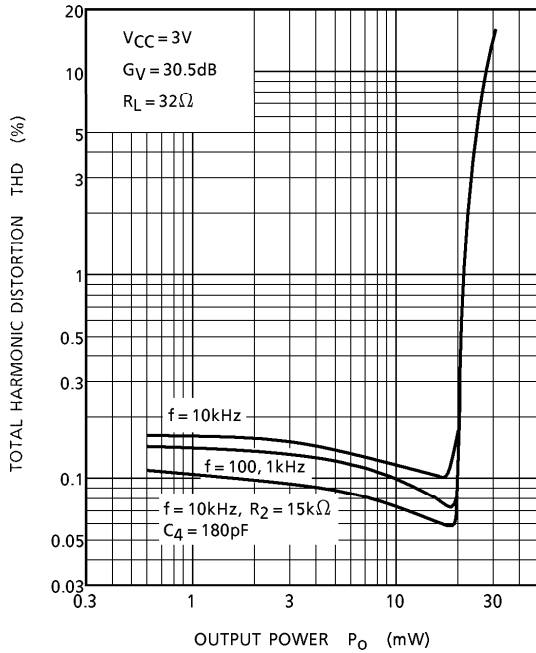
PARTS No.	TYPICAL	PURPOSE	INFLUENCE		NOTE
			SMALLER THAN TYP.	GREATER THAN TYP.	
C <sub>1</sub>	1 $\mu$ F	Coupling	Bad low frequency response	"Pop" noise is high.	Input
C <sub>2</sub>	1000pF	LPF	$f_{CH} = \frac{1}{2\pi C_2 (R_1 // Z_{in})}$ - 3dB (30kHz) at R <sub>1</sub> = 5.6k $\Omega$ - 3dB (20kHz) at R <sub>1</sub> = 12k $\Omega$		Noise receiving protection
R <sub>1</sub>	—				Equivalent signal source impedance
C <sub>3</sub>	22 $\mu$ F	Decoupling for V <sub>RF</sub>	Stability (OSC) decreases, V <sub>no</sub> at V <sub>RF</sub> increases	(It is better to connect to input side GND)	Use tantalum capacitor
R <sub>NF</sub>	—	G <sub>V</sub> Adjustment	Not available at G <sub>V</sub> < 30dB If necessary devide at input level by resistors		—
R <sub>2</sub>	(15k $\Omega$ )	f-response control, THD improvement at high freq.	- 3dB point is 20kHz. Check ringing at clip by OSC margine down.		Low OSC margine at G <sub>V</sub> < 40dB
C <sub>4</sub>	(180pF)				
C <sub>5</sub>	22 $\mu$ F	Bypass capacitor for bias	THD and V <sub>no</sub> Degradation	—	It is better to connect to input side GND.
C <sub>6</sub>	22 $\mu$ F	Bypass capacitor for ripple filter	Ripple rejection ratio degradation	—	It is better to connect to output side GND.
R <sub>3</sub>	47k $\Omega$	Pull down resistor at mute pin	I <sub>CC</sub> increases at mute ON	Pull down effect down	Additional resistor at long pattern only
R <sub>4</sub>	47k $\Omega$	I <sub>MUTE</sub> limiter	I <sub>MUTE</sub> increases (Unnecessary at V <sub>CC</sub> = 3V)	I <sub>MUTE</sub> decreases	I <sub>MUTE</sub> < 150 $\mu$ A
R <sub>H</sub>	3.9 $\Omega$	Protection resistance. Phase compensation	Rush current increases. Phase compensation is out.	Output decreases. Phase compensation is out.	CR filter with C <sub>7</sub>
C <sub>7</sub>	0.22 $\mu$ F	Phase compensation	Oscillation	THD degradation by load capacitance	Recommended to use tantalum or film capacitor
C <sub>8</sub>	220 $\mu$ F	Coupling	Bad low frequency response	"Pop" noise is high.	Output
C <sub>9</sub>	100 $\mu$ F	V <sub>CC</sub> decoupling	Oscillation margin decreases	—	Necessary to be near pin 9
T <sub>r</sub>	2SA1015GR	Booster for V <sub>RF</sub>	—	—	To be added at I <sub>RF</sub> > 10mA



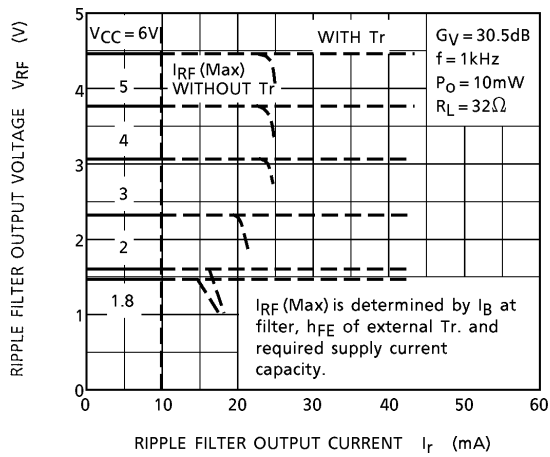
1. f-Resp (Mention Only CH<sub>1</sub>)



2. P<sub>O</sub>-THD (Correspond to 1. f-Resp)

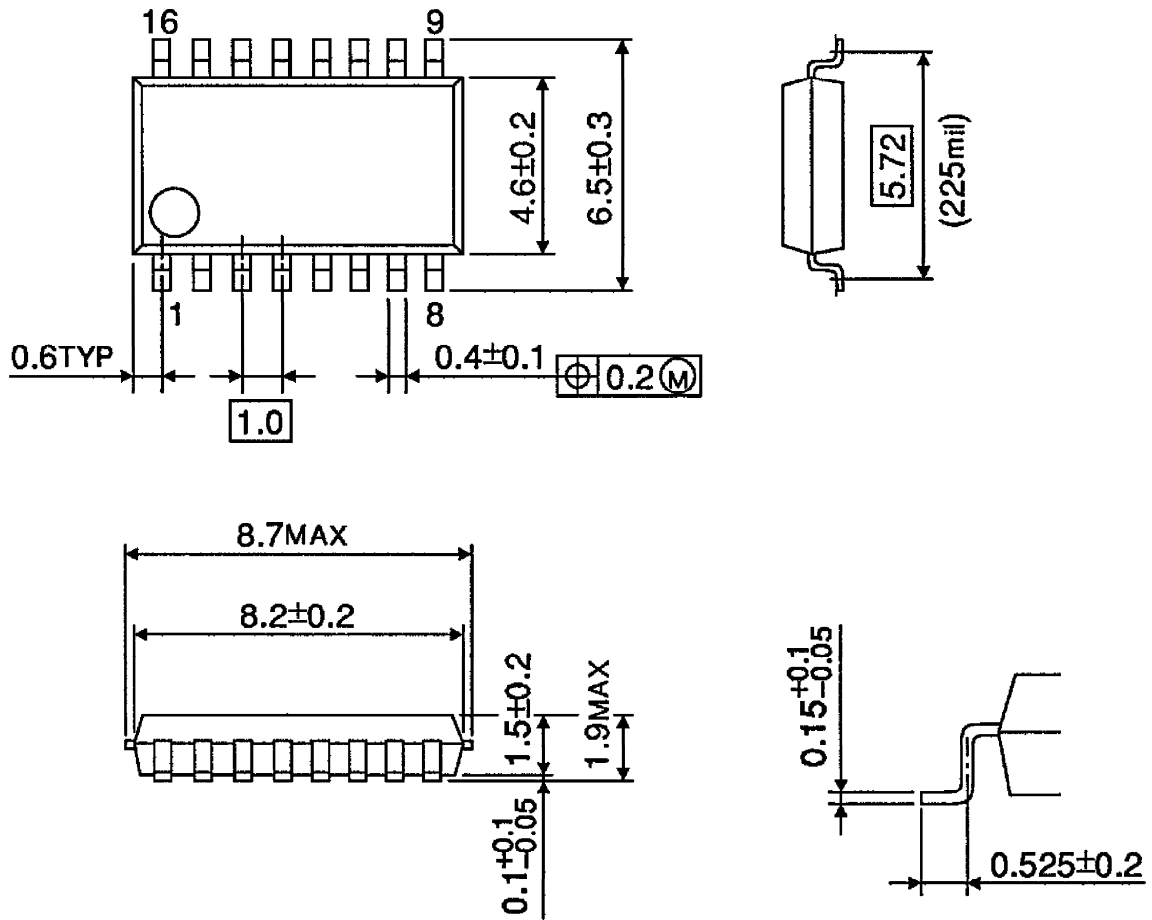


3. I<sub>RF</sub>-V<sub>RF</sub>



**OUTLINE DRAWING**  
SSOP16-P-225-1.00A

Unit : mm



Weight : 0.14g (Typ.)