TA7688P
TA7688F

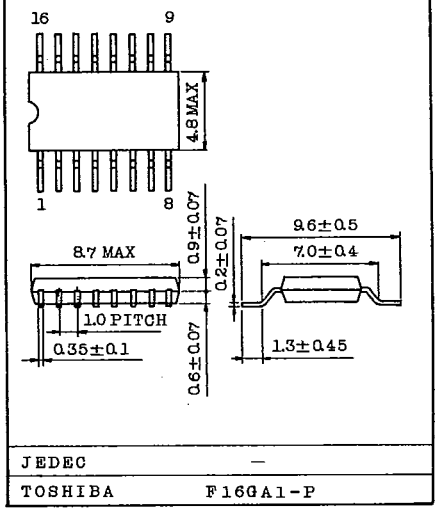
T-77-21

DUAL HEADPHONE DRIVER (3V USE)

The TA7688F/P are dual headphone driver ICS designed for portable cassette player applications.

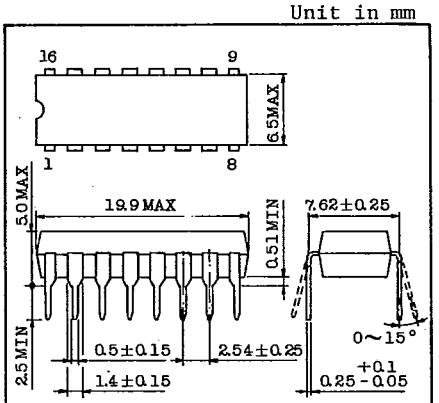
- Flat Package 16 pin (TA7688F), DIP 16 pin (TA7688P)
- Small Installed Area and Few External Parts
- Low Supply Current : I_{CCQ}=7mA (Typ.) at 3V
- Built-in Ripple Filter
- Built-in Power OFF Circuit
- Operating Supply Voltage Range : V_{CC}(opr)=1.8~6V
- Recommended Supply Voltage : V_{CC}=3V

Unit in mm



JEDEC	—
TOSHIBA	F16GA1-P

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 and No.16 leads.

JEDEC	—
TOSHIBA	3D16A-P

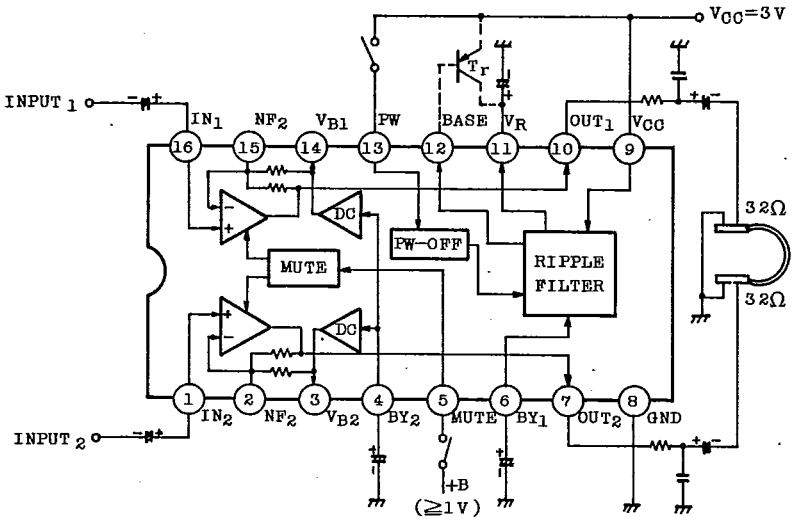
MAXIMUM RATINGS (Ta=25°C)

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)	TA7688P	P_D	750	mW
	TA7688F		350	
Operating Temperature		T_{opr}	-25~75	°C
Storage Temperature		T_{stg}	-55~150	°C

Note : Derated above Ta=25°C in the proportion of 6mW/°C for TA7688P and of 2.8mW/°C for TA7688F.

TA7688P
TA7688F

BLOCK DIAGRAM



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

ELECTRICAL CHARACTERISTICS

1. DC CHARACTERISTICS (Ta=25°C, V_{CC}=3V, Terminal Voltage at No Signal)

ITEM	SYMBOL	RATING	UNIT
Terminal 1 (IN_2)	V_1	1.5	V
2 (V_{B2})	V_2	1.5	V
3 (NF_2)	V_3	1.5	V
4 ($BYPASS_2$)	V_4	1.5	V
5 (MUTE)	V_5	0	V
6 ($BYPASS_1$)	V_6	2.2	V
7 (OUT_2)	V_7	1.5	V
8 (GND)	V_8	0	V
9 (V_{CC})	V_9	3.0	V
10 (OUT_1)	V_{10}	1.5	V
11 (V_{stb})	V_{11}	2.3	V
12 (BASE)	V_{12}	2.2	V
13 (PW ON/OFF)	V_{13}	3.0	V
14 (V_{B1})	V_{14}	1.5	V
15 (NF_1)	V_{15}	1.5	V
16 (IN_1)	V_{16}	1.5	V

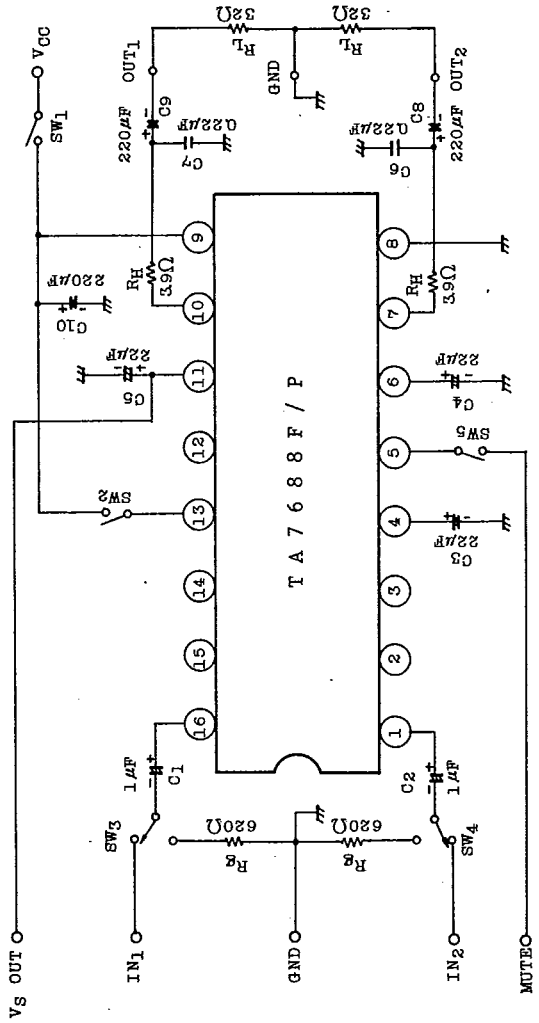
TA7688P
TA7688F

2. AC CHARACTERISTICS (Unless otherwise specified, Ta=25°C, V_{CC}=3V, R_g=600Ω, f=1kHz, R_H=3.9Ω, R_L=32Ω)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Current		$I_{CCQ}(1)$	-	V_{IN}=0	-	7	12	mA
		$I_{CCQ}(2)$		V_{IN}=0, SW_2:OFF	-	1	10	μA
Output Power		$P_{OUT}(1)$	-	THD=10%	20	27	-	mW
		$P_{OUT}(2)$		R_L=16Ω, THD=10%	-	38	-	
Total Harmonic Distortion		THD	-	P_O=10mW/ch	-	0.12	1.0	%
Closed Loop Voltage Gain		G_V	-	V_{IN}=-40dBm	28.5	30.5	32.5	dB
Channel Balance		ΔG_V	-	V_{IN}=-40dBm	-	0	±1	dB
Cross Talk		C.T.	-	V_{OUT}=0dBm, ch1↔ch2	45	65	-	dB
Ripple Rejection	Headphone AMP	R.R.(1)	-	f=1kHz, V_{IN}=-20dBm	30	45	-	dB
	Ripple Filter	R.R.(2)	-	f=100Hz, V_{IN}=-20dBm	-	40	-	dB
Output Noise Voltage		V_{NO}	-	BW=20Hz~20kHz	-	0.06	0.2	mV_{rms}
Input Resistance		R_{IN}	-	f=1kHz	15	20	25	kΩ
Ripple Filter Output Voltage		$V_S(1)$	-	V_{CC}=2V, I_r=10mA	1.45	1.6	-	V
		$V_S(2)$		I_r=10mA	2.1	2.3	2.5	
		$V_S(3)$		V_{CC}=4.5V, I_r=10mA	-	3.4	-	
Muting Attenuation		ATT	-	V_{MUTE}=3V (0dB=240mV_{rms})	60	80	-	dB
Muting Input Voltage		V_{MUTE}	-	ATT≧50dB (0dB=240mV_{rms})	-	0.7	1.0	V
Muting Input Current		I_{MUTE}	-	ATT≧50dB (0dB=240mV_{rms})	-	35	-	μA
Ripple Filter Current		I_B	-	-	-	0.05	-	mA

TA7688P
TA7688F

TEST CIRCUIT



Note : R_H : Protection resistance

C_6 & C_7 : Tantalum Capacitor or Polyester Film Capacitor

C_5 : Tantalum Capacitor

TA7688P
TA7688F

APPLICATION

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.

$$G_V = 20\log\frac{R_1+R_2}{R_2} = 32\text{dB},\ R_1=33\text{k}\Omega,\ R_2=820\Omega$$

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

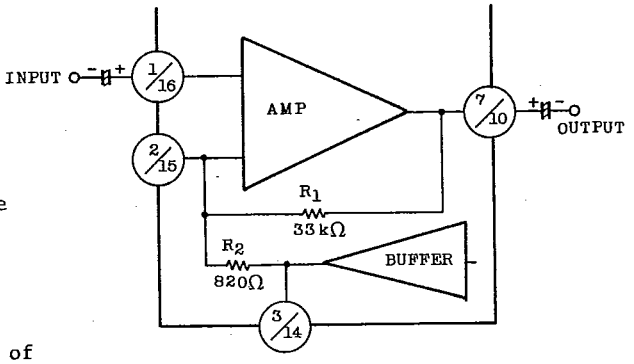
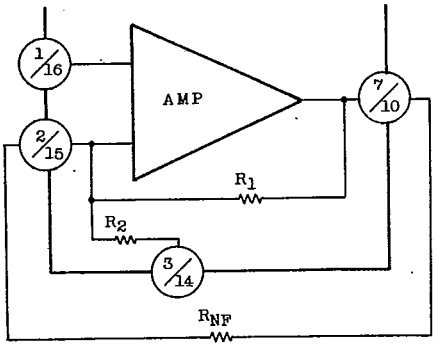


Fig. 1.

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

(1) $G_V < 30$dB



(2) $G_V > 30$dB

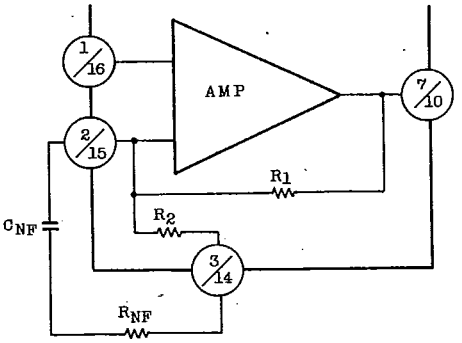


Fig. 2

In the case of $G_V < 30$dB, it happens to oscillate by phase delay at high frequency. So this IC is not available at $G_V < 30$dB. In the case of $G_V > 30$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 $G_V > 30$dB by using C_{NF}.
It is recommended to check pop noise based on C_{NF}.

TA7688P
TA7688F

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 150μA.

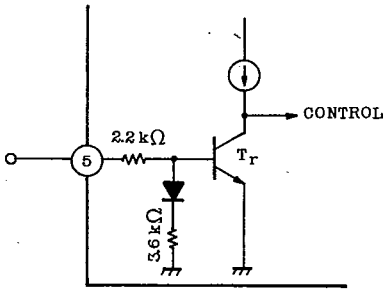


Fig. 3.

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 3.9Ω is rejected, output power increases. In this case, it is necessary to insert 3.9Ω as shown in Fig. 4. When R_L=0, output current is very large in the circuit.

(2) It is necessary to use tantalum capacitor at Pin 11 (22μF).

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

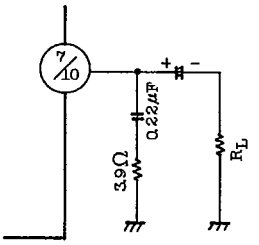
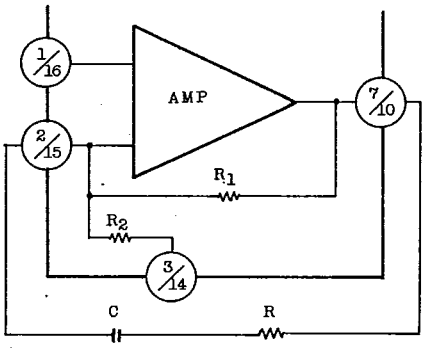


Fig. 4.

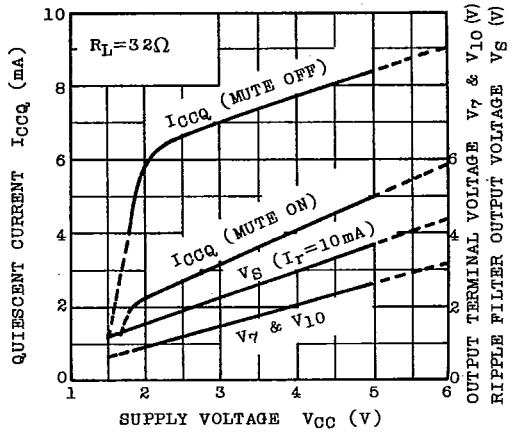
4. RADIATION PRECAUTION

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=15kΩ,
f_{HC} is 30kΩ ~ 50kHz.

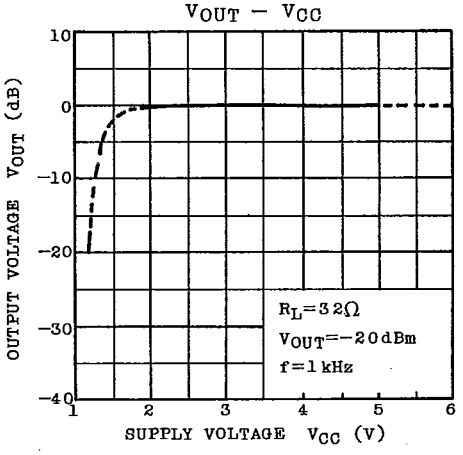


TA7688P
TA7688F

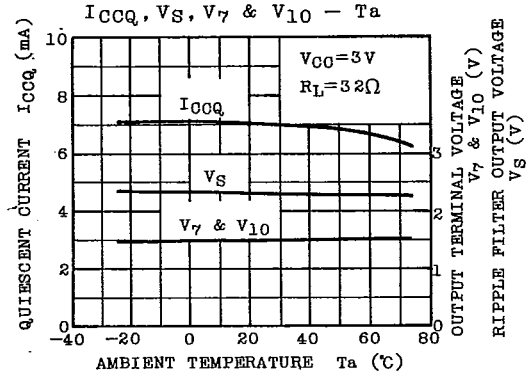
I_{CCQ}, V_S, V_7 & V_{10} — V_{CC}



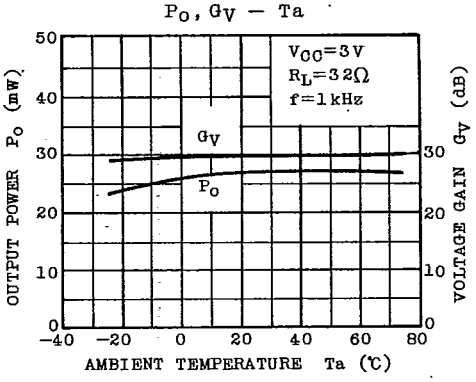
V_{OUT} — V_{CC}



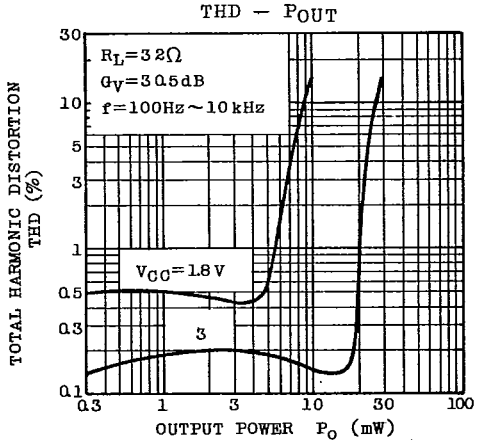
I_{CCQ}, V_S, V_7 & V_{10} — Ta



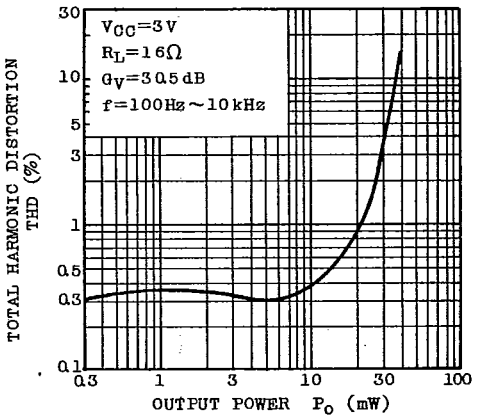
P_O, G_V — Ta



THD — P_{OUT}



THD — P_{OUT}



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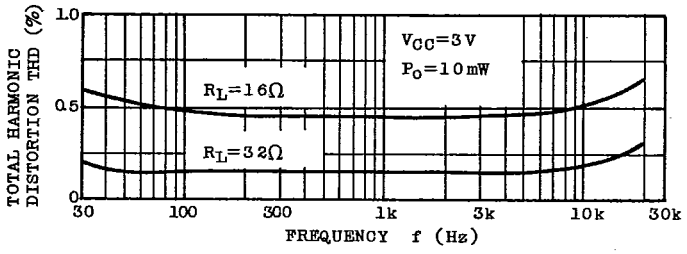
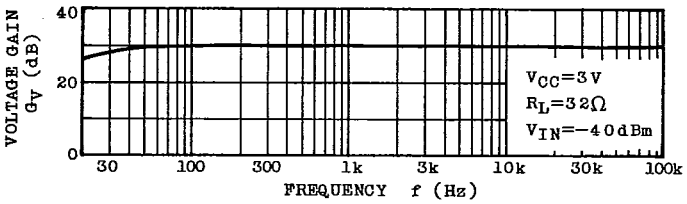
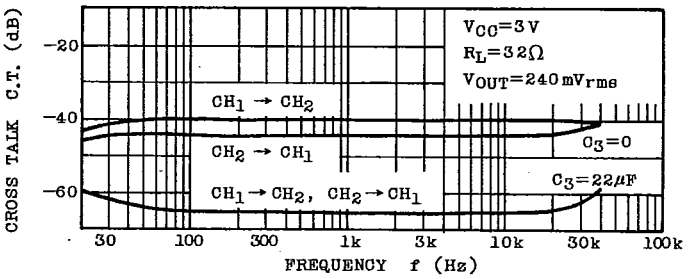
THD – f



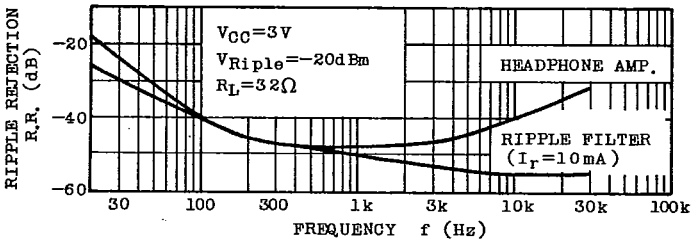
G_V – f



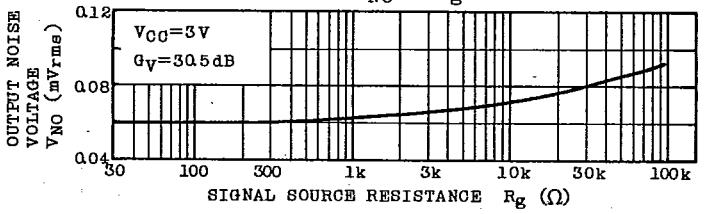
C.T. – f



R.R. – f

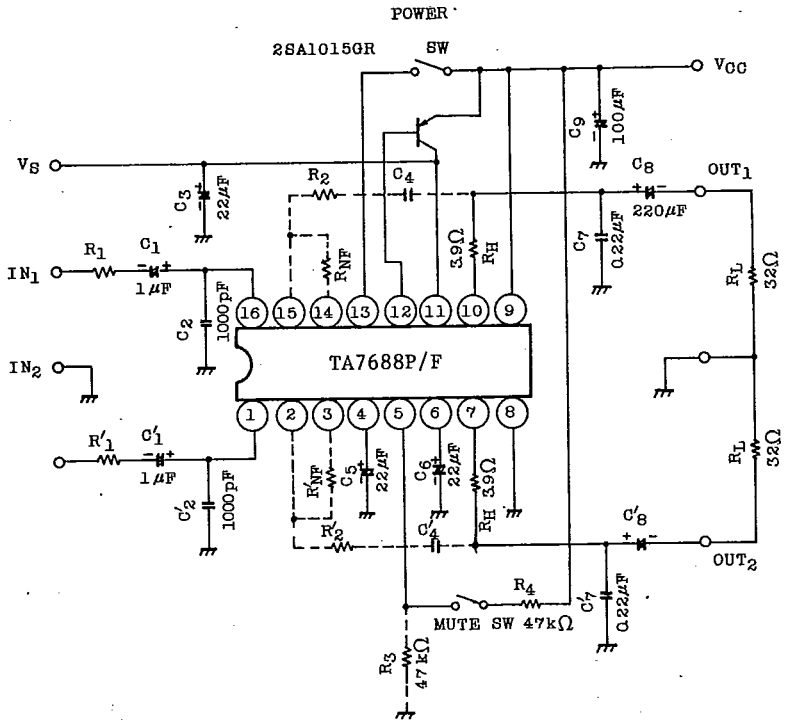


V_{NO} – R_g



TA7688P
TA7688F

APPLICATION



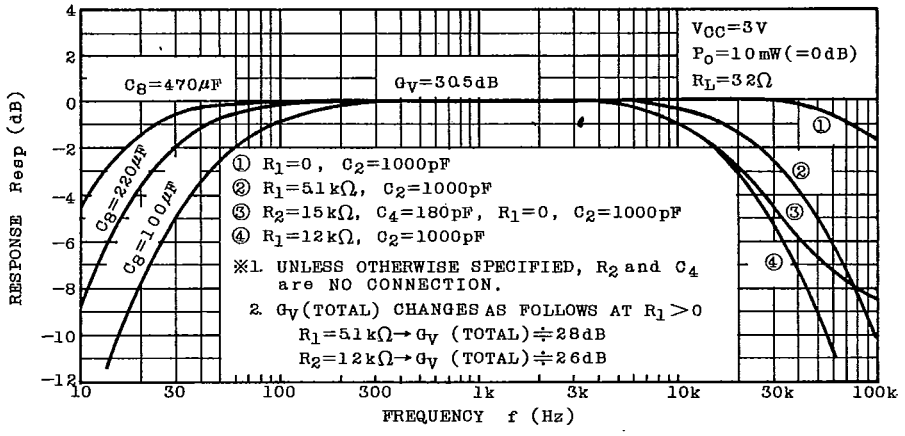
TA7688P
TA7688F

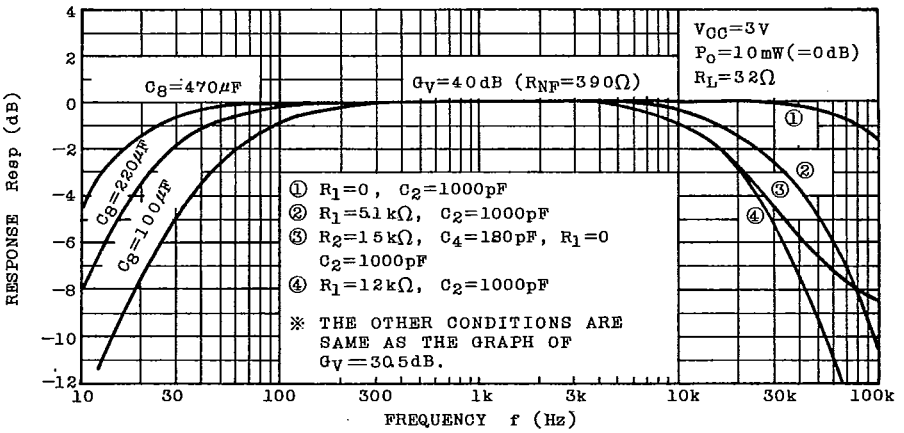
EXTERNAL PARTS TABLE (Mention only CH_1)

PARTS No.	TYPICAL	PURPOSE	INFLUENCE		NOTE
			SMALLER THAN TYP.	GREATER THAN TYP.	
C_1	1μF	Coupling	Bad low frequency response	"P_{op}" Noise is high	Input
C_2	1000pF	L.P.F.	-3dB(30kHz) at R_1=5.6kΩ $f_{CH} = \frac{1}{2\pi C_2(R_1 // Z_{in})}$		Noise receiving protection
R_1			-3dB(20kHz) at R_1=12kΩ		Equivalent signal soruce impedance
C_3	22μF	Decoupling for V_S	Stability (OSC) decreases V_{NO} at V_S increases	(It is better to connect to input side GND)	Use tantalum capacitor
R_{NF}		G_V Adjustment	Not available at G_V<30dB If necessary devide at input level by resistors		
R_2 C_4	(15kΩ) (180pF)	f-response control, THD imperovement at hgih freq.	-3dB point is 20kHz. Check ringing at clip by OSC margine down.		Low OSC margine at G_V<40dB
C_5	22μF	Bypass capacitor for bias	THD and V_{NO} Degradation		It is better to connect to input side GND
C_6	22μF	Bypass capacitor for ripple filter	Ripple rejection ratio degradation		It is better to connect to output side GND
R_3	47kΩ	Pull down resistor at mute pin	I_{CC} increases at mute ON	Pull dwon effect down	Additional resistor at long pattern only
R_4	47kΩ	I_{MUTE} limiter	I_{MUTE} increases (Unnecessary at V_{CC}=3V)	I_{MUTE} decreases	I_{MUTE}<150μA
R_H	3.9Ω	Protection resistance. Phase compensation	Rush current increases. Phase compensation is out	Output decreases. Phase compensation is out	CR filter with C_7
C_7	0.22μF	Phase compensation	Oscillation	THD degradation by load capacitance	Recommended to use tantalum or film capacitor
C_8	220μF	Coupling	Bad low frequency response	"P_{op}" noise is high	Output
C_9	100μF	V_{CC} decoupling	Oscillation margin decreases		Necessary to be near pin 9
T_r	2CA1015GR	Booster for V_S			To be added at I_r>10mA

TA7688P
TA7688F

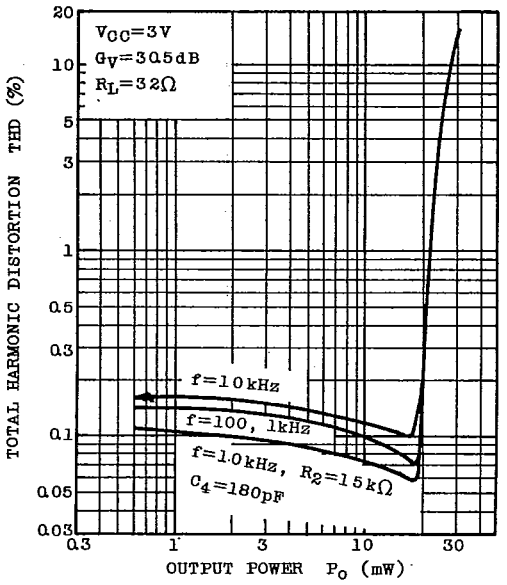
1. f - Resp (Mention Only CH_1)

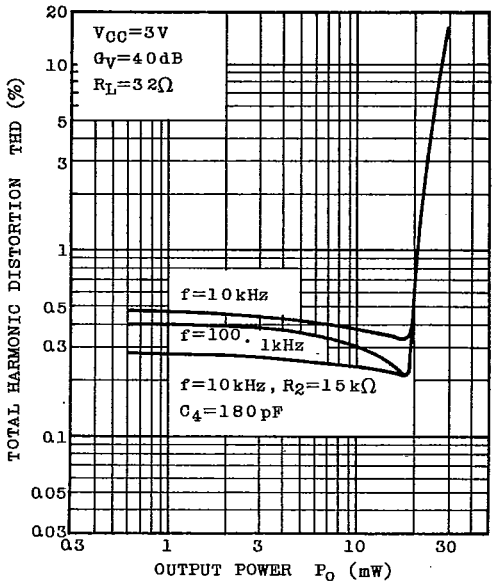




TA7688P
TA7688F

2. P_O - THD (Correspond to 1. f - Resp)





3. I_r - V_S