

# HA12089NT/MP

## Sound Signal Processing IC for Automatic Telephone Answering System

The HA12089 is the IC designed for sound signal processing for automatic telephone answering system. As the device builds mainly in fundamental features necessary to the automatic answering telephone, it can construct the sound signal processing needed for automatic answering telephone on 1 chip.

### Features

- Adjustable with frequency characteristic and each gain of LINE-REC-PB-Monitor series by external parts
- Possible to trim AC current flowing head by external resistance because of using current drive type for OGM/ICM head change
- High Integration
  - (SW Part)
    - OGM/ICM Head Change SW Circuit
    - OGM/ICM Bias SW Circuit for Erase
    - MIC/LINE Input Change SW Circuit
    - PRE Amp Frequency Change Circuit
  - (REC/PB Part)
    - PRE Amp-Buffer Amp-REC Amp
    - Power Amp-Power Mute Circuit
    - ALC Circuit-ATT Circuit when FF/REW
  - (LINE Part)
    - Filter Amp-LINE Amp-ATT Circuit when FF/REW
  - (VOX Part)
    - VOX Amp-COMP Amp; (Detection Circuit)

HA12089NT



DP-42SA

HA12089MP



MP-44

## Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Ratings	Unit
Supply Voltage *	Vcc (max)	7.0	V
Power Dissipation **	Pr	300	mW
Operating Temperature	Topr	-20 to +65	°C
Storage Temperature	Tstg	-55 to +125	°C

Note) \* Standard Operating Voltage... Vcc 6.0 V ± 0.5 V  
 \*\* Allowable Value under the condition of Ta = 65°C

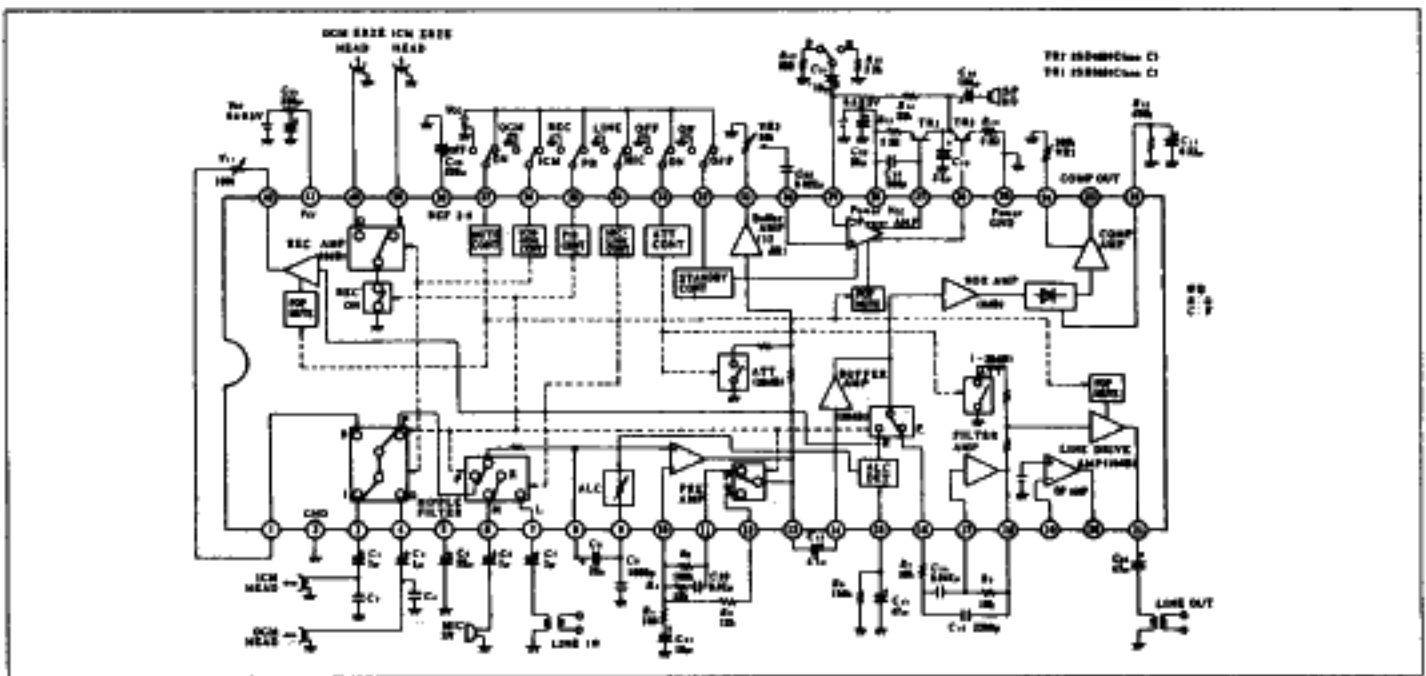


Figure 1-1 Standard External Circuit and Block Diagram (HA12089NT)

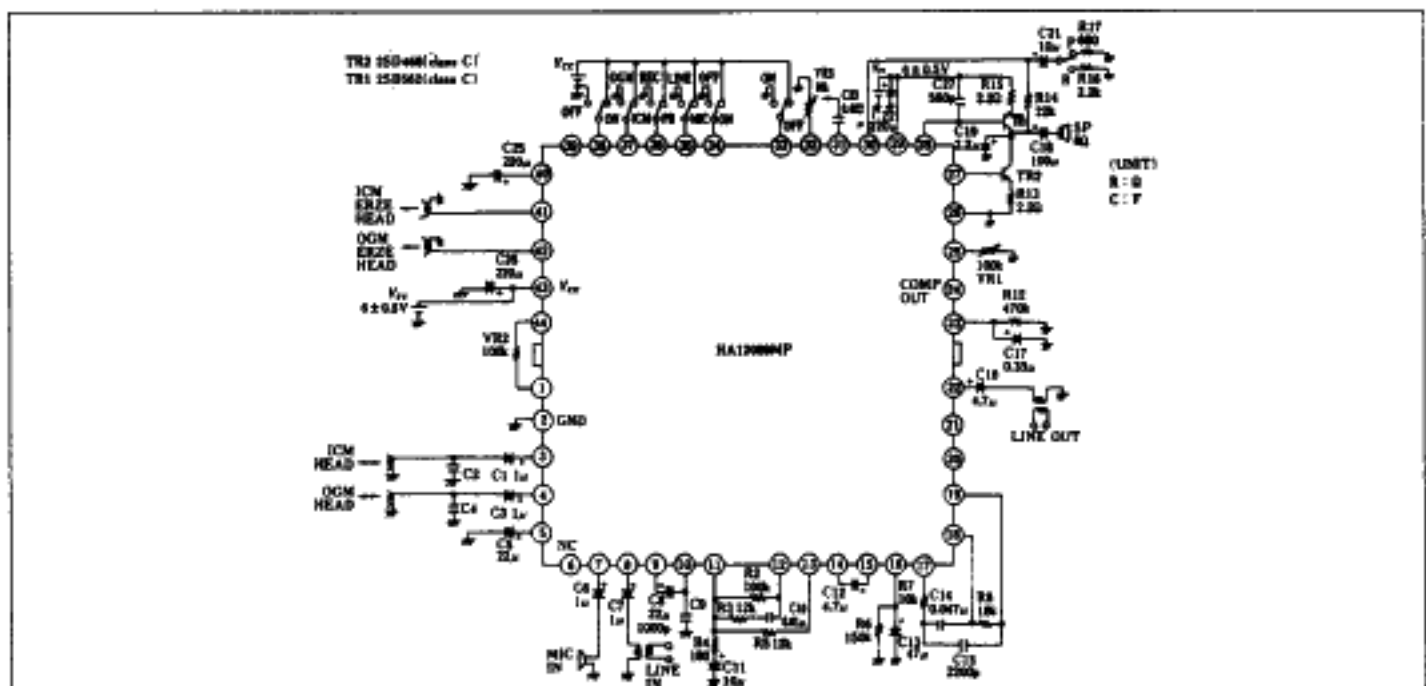


Figure 1-2 Standard External Circuit (HA12089MP)

## HA12089NT/MP

### Pin Description (HA12089NT)

Pin No.	Symbol	Description
1	REC-OUT1	REC Output
2	GND	GND (Small signal)
3	ICM	ICM Input/Output
4	OGM	OGM Input/Output
5	RIP-FIL	Ripple Filter
6	MIC-IN	Mic Input
7	LINE-IN	Line Input
8	ALC-DC-CUT	ALC DC Cut
9	ALC	ALC Input
10	PRE-IN	Pre Amp Input
11	PB-FB	Play Pre Amp Output
12	REC-FB	REC Pre Amp Output
13	PRE-OUT	Pre Amp Output
14	BUFF-IN	Buffer Amp Input
15	ALC-DET	ALC Detector
16	PB-BUFF-OUT	Play Buffer Amp Output
17	FIL-IN	Filter Amp Input
18	FIL-OUT	Filter Amp Output
19	AMP-IN	Attached Amp Input
20	AMP-OUT	Attached Amp Output
21	LINE-OUT	Line Amp Output
22	VOX-DET	Vox Detection
23	COMP-OUT	Comparator Output
24	COMP-ADJ	Comparative Level Adjustment
25	POWER-GND	GND (Power)
26	POWER-DR1	External Power Transistor Drive
27	POWER-DR2	External Power Transistor Drive
28	POWER-Vcc	Vcc (Power)
29	POWER-FB	Power Amp Feedback Input
30	POWER-IN	Power Amp Input
31	BUFF-OUT	Buffer Amp Output
32	STANDBY	Power Amp Standby Control *
33	ATT	Attenuator Control
34	MIC/LINE	MIC/LINE Input SW Control
35	PB/REC	PLAY/REC SW Control
36	ICM/OGM	ICM/OGM SW Control
37	MUTE	Mute Control
38	V <sub>REF</sub>	Reference
39	ICM-ERS	ICM DC Erase
40	OGM-ERS	OGM DC Erase
41	Vcc	Vcc (Small signal)
42	REC-OUT2	REC output

\* Consumption Current : 20 mA Typ → 1 mA Typ

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**HA12089NT/MP**

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**Pin Function (HA12089MP)**

Pin No.	Symbol	Description
1	REC-OUT1	REC output
2	GND	GND (Small signal)
3	ICM	ICM Input/Output
4	OGM	OGM Input/Output
5	RIP-FIL	Ripple Filter
6	NC	No Connect
7	MIC-IN	Mic Input
8	LINE-IN	Line Input
9	ALC-DC-CUT	ALC DC Cut
10	ALC	ALC Input
11	PRE-IN	Pre Amp Input
12	PB-FB	Play Pre Amp Output
13	REC-FB	REC Pre Amp Output
14	PRE-OUT	Pre Amp Output
15	BUFF-IN	Buffer Amp Input
16	ALC-DET	ALC Detector
17	PB-BUFF-OUT	Play Buffer Amp Output
18	FIL-IN	Filter Amp Input
19	FIL-OUT	Filter Amp Output
20	AMP-IN	Attached Amp Input
21	AMP-OUT	Attached Amp Output
22	LINE-OUT	Line Amp Output
23	VOX-DET	Vox Detection
24	COMP-OUT	Comparator Output
25	COMP-ADJ	Comparative Level Adjustment
26	POWER-GND	GND (Power)
27	POWER-DR1	External Power Transistor Drive
28	POWER-DR2	External Power Transistor Drive
29	POWER-Vcc	Vcc (Power)
30	POWER-FB	Power Amp Feedback Input
31	POWER-IN	Power Amp Input
32	BUFF-OUT	Buffer Amp Output
33	STANDBY	Power Amp Standby Control *
34	ATT	Attenuator Control
35	MIC/LINE	MIC/LINE Input SW Control
36	PB/REC	PLAY/REC SW Control
37	ICM/OGM	ICM/OGM SW Control
38	MUTE	Mute Control
39	NC	No Connect
40	VREF	Reference
41	ICM-ERS	ICM DC Erase
42	OGM-ERS	OGM DC Erase
43	Vcc	Vcc (Small signal)
44	REC-OUT2	REC Output

\* Consumption Current : 20 mA Typ → 1 mA Typ

## HA12089NT/MP

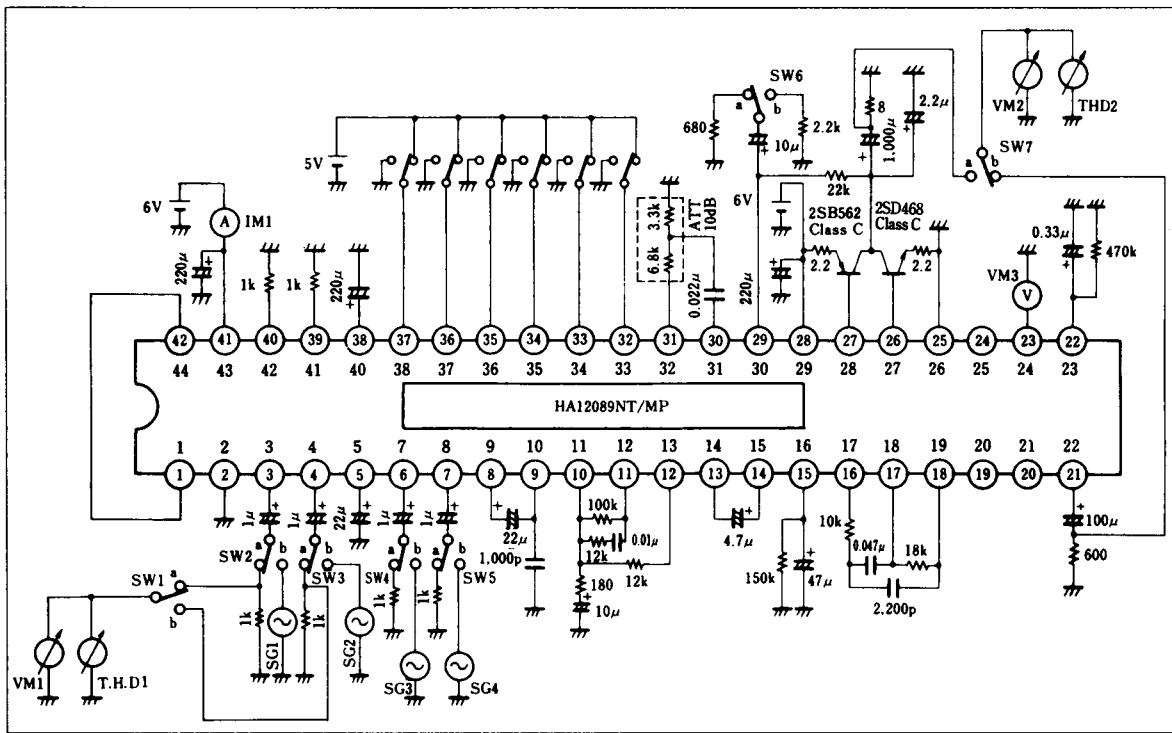
### Electrical Characteristics (Ta = 25°C, VCC = 6 V)

Item	Symbol	Test Condition	Min	Typ	Max	Unit	Application Terminal	Remark
Quiescent Current	I <sub>Q</sub>	Pin ⑤ (⑤) = 5 V Non-signal	—	15	23	mA	④ (④)	
PB Voltage Gain	G <sub>v1</sub>	V <sub>o</sub> = 0 dBm	71	74	77	dB	③→②	
PB Maximum Output Voltage	V <sub>om1</sub>	T.H.D = 10%	1.2	1.7	—	V <sub>rms</sub>	③→②	
PB Distortion Ratio	THD1	V <sub>o</sub> = 0 dBm	—	0.4	2.0	%		1
REC Voltage Gain	G <sub>v2</sub>	V <sub>in</sub> = -70 dBm	51	54	57	dB	⑥→③	
REC Maximum Input Voltage	V <sub>im1</sub>	THD ≤ 2%	—	—	-30	dBm	⑦→③	
REC Distortion Ratio	THD2	V <sub>in</sub> = -50 dBm	—	0.7	2.0	%		1
REC Cross Talk	C.T.1	V <sub>in</sub> = -30 dBm	—	—	-60	dB	⑥→⑦ ⑦→⑥	1
REC Voltage When ALC Operating	G <sub>v</sub> ALC	V <sub>in</sub> = -50 dBm	-9	-6	-3	dBm	⑥→③ ⑦→③	
Power Voltage Gain	G <sub>v3</sub>	PB Mode 10 dB ATT V <sub>o</sub> = 0 dBm	68.5	71.5	74.5	dB	③→ Power Output	
Power Maximum Output Voltage	V <sub>om2</sub>	PB Mode 10 dB ATT THD = 10%	1.2	1.7	—	V <sub>rms</sub>		
Power Distortion	THD3	PB Mode 10 dB ATT V <sub>o</sub> = 0 dBm	—	0.6	2.0	%		1
Power Mute Attenuation	ATT1	V <sub>o</sub> = 0 dBm Pin ⑦ (⑦) = 5 V PB Mode	—	—	-50	dB		1
Comparator H Output Voltage	V <sub>OH</sub>	Pin ② (②) = 1.9 V REC Mode V <sub>in</sub> = -60 dBm	3.8	—	5.0	V	② (②)	
Comparator L Output Voltage	V <sub>OL</sub>	Pin ② (②) = 1.9 V REC Mode	-0.3	—	0.5	V		
Control H Input Voltage	V <sub>IH</sub>	Lo Mode → Hi Mode Change Voltage	3.8	—	V <sub>CC</sub>	V	⑫~⑬ (⑫~⑬)	
Control L Input Voltage	V <sub>IL</sub>	Hi Mode → Lo Mode Change Voltage	0	—	0.5	V		

Remark 1) B.P.F in 400 Hz to 15 kHz

Number inside ( ) shows terminal pin number for HA12089MP.

## HA12089NT/MP



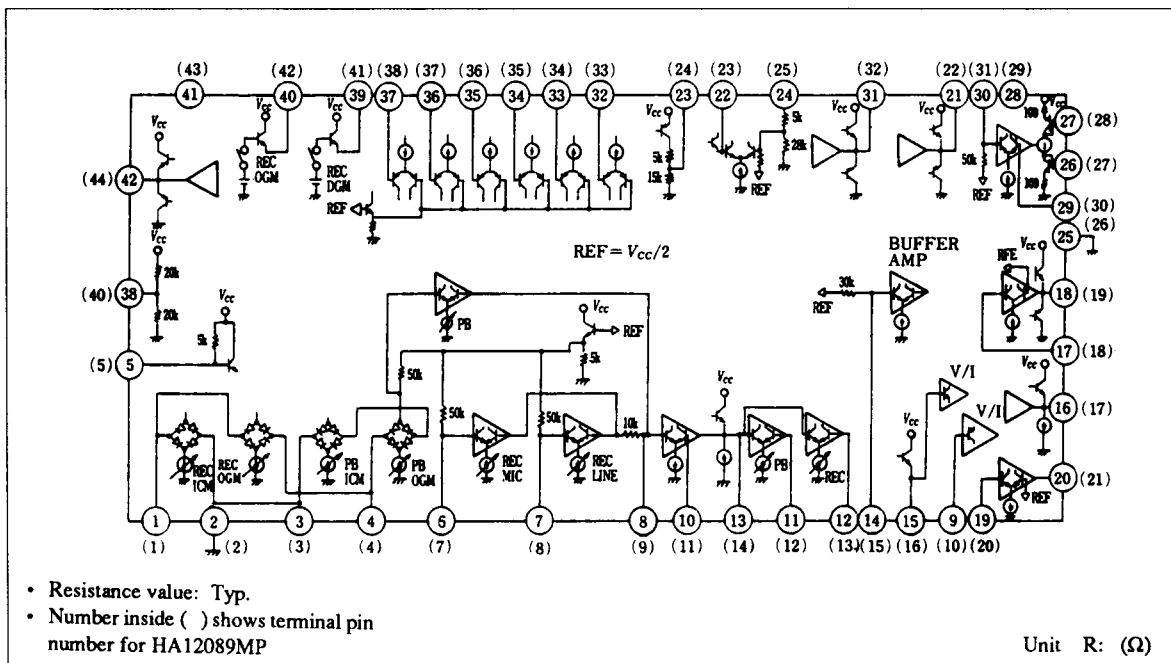
**Figure 2 Test Circuit**

**Table 1. Switched Position Table**

No.	Symbol	Control Terminal						SW Position							Source Signal & Measurement
		32(33)	33(34)	34(35)	35(36)	36(37)	37(38)	SW1	SW2	SW3	SW4	SW5	SW6	SW7	
1	I <sub>Q</sub>	L	L	L	H	L	L	a	a	a	a	a	a	a	IM1
2	G <sub>v1</sub>	H	↓	↓	↓	H	↓	↓	b	↓	↓	↓	↓	b	SG1, VM2
3	V <sub>om1</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	SG1, VM2, THD2
4	THD1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
5	G <sub>v2</sub>	↓	↓	H	L	↓	↓	a	↓	b	↓	b	a	SG3, VM1	
6	V <sub>im1</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	SG3, THD1	
7	THD2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
8	C.T1	↓	↓	L	↓	↓	↓	↓	↓	↓	↓	↓	↓	SG3, VM1	
9	G <sub>v ALC</sub>	↓	↓	H	↓	↓	↓	↓	↓	↓	↓	↓	↓	SG3, THD1	
10	G <sub>v3</sub>	↓	↓	L	H	↓	↓	b	↓	a	↓	a	↓	SG1, VM2	
11	V <sub>om2</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	SG1, VM2, THD2	
12	THD3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
13	ATT1	↓	↓	↓	↓	H	↓	↓	↓	↓	↓	↓	↓	SG1, VM2	
14	V <sub>OH</sub>	↓	↓	H	L	↓	L	↓	a	↓	b	b	↓	SG3, VM3	
15	V <sub>OL</sub>	↓	↓	↓	↓	↓	↓	↓	↓	a	↓	↓	↓	↓	
16	V <sub>IH</sub>	↓	H	H	H	H	H	↓	↓	↓	↓	↓	↓	—	
17	V <sub>IL</sub>	L	L	L	L	L	L	↓	↓	↓	↓	↓	↓	—	

H = 5 (V), L = 0 (V)

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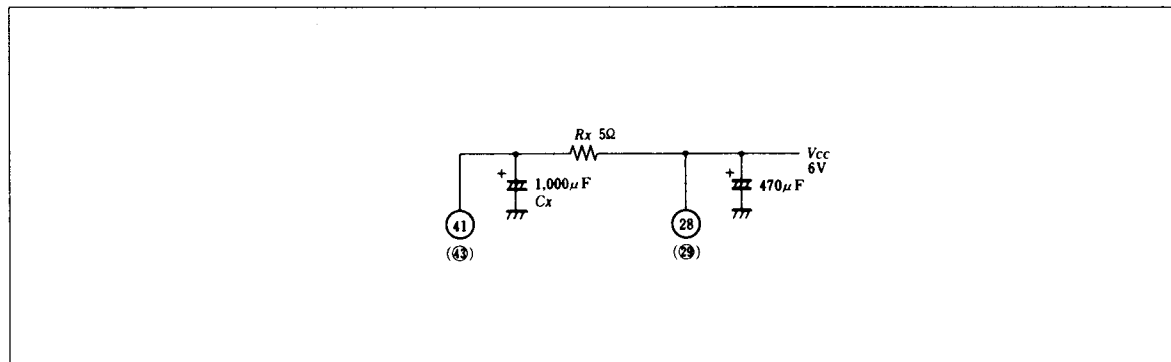


**Figure 3 Input/Output Circuit**

**Note**

1. This IC is two supply voltage pins; ②⑨, ④① (②⑨, ④③) pin and two GND terminal pins; ②, ②⑥ (②, ②⑥) pin. Prevent signal from the supply source of another block by applying supply voltage to power ②⑥ (②⑨) pin and small signal ④① (④③) pin respectively. Distortion ratio may become worse by the signal

from the supply source of another block. In the case of single supply voltage of power and small signal, for example, avoid the signal from the supply source of power block to small signal one, by connecting wiring as shown below.



Take care of keeping 5.5 V or more of voltage of ④① (④③) pin by reducing Rx as much as possible.

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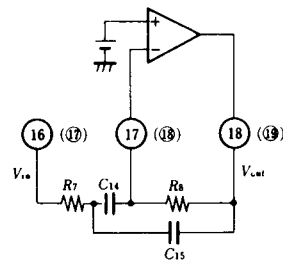
2. Determine the filter constant of ⑩, ⑰, ⑱ (⑰, ⑱, ⑲) pin as shown below.

$$\frac{V_{out}}{V_{in}} = T(S) = \frac{-\frac{1}{R_7 C_{15}} S}{S^2 + \frac{1}{R_8} \left( \frac{1}{C_{14}} + \frac{1}{C_{15}} \right) S + \frac{1}{C_{14} C_{15} R_7 R_8}}$$

Cut-off frequency is shown below to use as a band path filter.

$$\omega_H = \frac{\frac{1}{C_{14}} + \frac{1}{C_{15}}}{2R_8} \left( 1 + \sqrt{1 - \frac{4R_8}{R_7 \left( 2 + \frac{C_{14}}{C_{15}} + \frac{C_{15}}{C_{14}} \right)}} \right)$$

$$\omega_L = \frac{\frac{1}{C_{14}} + \frac{1}{C_{15}}}{2R_8} \left( 1 - \sqrt{1 - \frac{4R_8}{R_7 \left( 2 + \frac{C_{14}}{C_{15}} + \frac{C_{15}}{C_{14}} \right)}} \right)$$



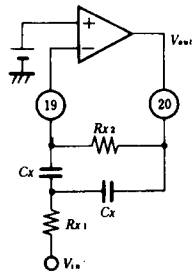
For example Cut-off frequency is  $f_H = 3.8$  kHz,  $f_L = 350$  Hz under the condition of  $R_7 = 10$  k $\Omega$ ,  $R_8 = 18$  k $\Omega$ ,  $C_{14} = 0.047$   $\mu$ F and  $C_{15} = 2200$  pF.

Number inside (O) shows terminal pin number for HA12089MP.

3. Example of using ⑲, ⑳ (㉑, ㉒) additional Amp.

$$\frac{V_{out}'}{V_{in}'} = \frac{-\frac{1}{C_x R_{x1}} S}{S^2 + \frac{2}{C_x R_{x2}} S + \frac{1}{C_x R_{x1} R_{x2}}}$$

## HA12089NT/MP



The resonance frequency;  $\omega_0$ , the band width; BW and the Q are shown below.

$$\omega_0 = \frac{1}{C_x \sqrt{R_{x1} R_{x2}}}, \quad BW = \frac{\omega_0}{Q} = \frac{2}{C_x R_{x2}}, \quad Q = \frac{1}{2} \sqrt{\frac{R_{x2}}{R_{x1}}}$$

The gain under condition of the resonance frequency;  $\omega_0$  is shown below.

$$\left| \frac{V_{out}}{V_{in}} \right|_{S = j\omega_0} = \frac{R_{x2}}{2R_{x1}}$$

For example, the following constant can be set to construct the resonance filter under the condition of  $\omega_0 = 1\text{kHz}$ .

$$C_x = 0.0015\mu\text{F} \quad R_{x1} = 10\text{k}\Omega \quad R_{x2} = 1\text{M}\Omega$$

$$Q = 5 \quad BW = 200\text{Hz} \quad G_v(f = 1\text{kHz}) = 50$$

- Power block is designed with our power transistor 2SD468, 2SB562C grade.  
Use the power transistor which has small deviation of  $V_{BE}$  to reduce the deviation of idling current.

## HA12089NT/MP

### External Component

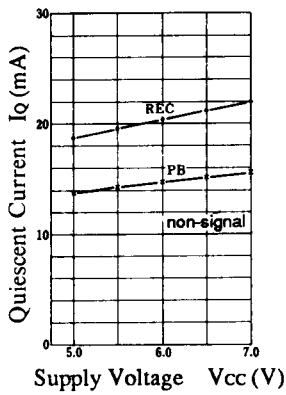
Part No.	Standard Value	Feature	Influence		Remarks
			Standard Value or less	Standard Value or more	
C1	1 $\mu$	DC CUT	—	—	
C2	1000 pF	High-band Cut-off	Large high-band gain	Small high-band gain	
C3	1 $\mu$	DC CUT	—	—	
C4	1000 pF	High-band Cut-off	Large high-band gain	Small high-band gain	
C5	22 $\mu$	Ripple Filter	Ripple rejection ratio becomes worse	—	
C6	1 $\mu$	DC CUT	—	—	
C7	1 $\mu$	DC CUT	—	—	
C8	22 $\mu$	DC CUT	Frequency characteristics become worse	Rising of AGC becomes slow	
C9	1000 pF	Oscillation Stop	ALC circuit oscillation	Frequency characteristics become worse	
C10	0.0 1 $\mu$	High Cut-off Frequency	Small cut-off frequency	Large cut-off frequency	
C11	10 $\mu$	Low Cut-off Frequency	Large cut-off frequency	Small cut-off frequency	
C12	4.7 $\mu$	DC CUT	Breaking off when attacking	—	
C13	47 $\mu$	ALC Time Constant	Distortion ratio becomes worse	Long attack recovery time	
C14	0.047 $\mu$	Filter Time Constant	See Note.		
C15	2200 pF				
C16	4.7 $\mu$	DC CUT	—	—	
C17	0.33 $\mu$	Detection Circuit	Unstability of comparator operating	Delay of comparator response	
C18	100 $\mu$	DC CUT	Frequency characteristics become worse	—	
C19	2.2 $\mu$	Phase Compensation	Power amp oscillation	Frequency characteristics become worse	
C20	Missing	Number			
C21	10 $\mu$	Low Cut-off	Small cut-off	Large cut-off	
C22	220 $\mu$	Power Source Ripple Rejection	Ripple rejection ratio becomes worse.	—	
C23	0.022 $\mu$	DC CUT	Small cut frequency	—	
C24	Missing	Number			
C25	220 $\mu$	Ripple Filter	Ripple rejection ratio becomes worse	—	
C26	220 $\mu$	Supply Voltage Ripple Rejection	Ripple rejection ratio becomes worse	—	
C27	560 pF	Stop of Oscillation	Power oscillation	Small cut-off frequency	

## HA12089NT/MP

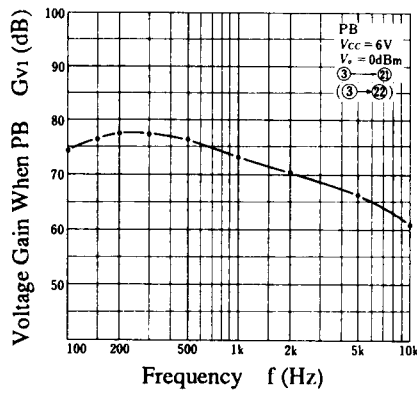
Part No.	Standard Value	Function	Influence		Remarks
			Standard Value or less	Standard Value or more	
R1	Missing Number				
R2	100 k	PB Gv	Small Gv	Large offset voltage of pin ③① (③②)	
R3	12 k	PB Gv	Small Gv	Large Gv	
R4	180	Pre Amp Gv	Large Gv	Small Gv	
R5	12 k	REC Gv	Small Gv	Large Gv	
R6	150 k	ALC Time Constant	Short attack recovery time	Long attack recovery time	
R7	10 k	Filter Amp Gv	Small Gv	Large Gv	
R8	18 k	Filter Amp Gv	Small Gv	Large off-set voltage of pin ②① (②②)	
R9 to 11	Missing Number				
R12	470 k	Detection Circuit	Unstability of comparator operating	Delay of comparator response	
R13, 15	2.2 $\Omega$	External Tr Idling Current	Large idling current	Small power output	
R14	22 k	Power Gv	Small Gv	Large off-set	
R16	2.2 k	REC Power Gv	Large Gv	Small Gv	
R17	680	PB Power Gv	Large Gv	Small Gv	

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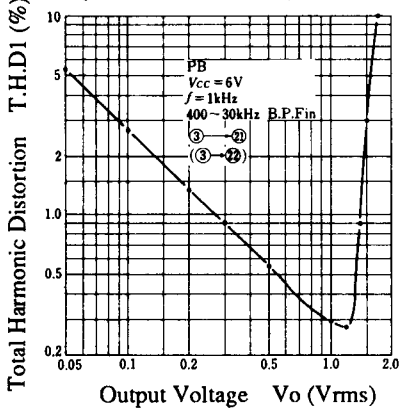
**Quiescent Current vs. Supply Voltage Characteristics**



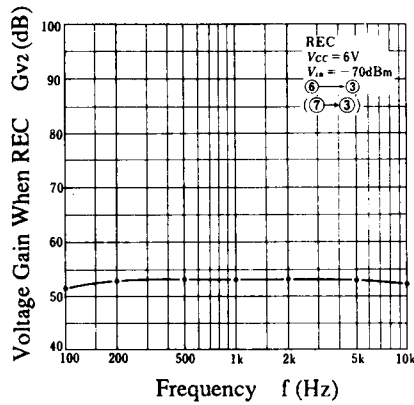
**Voltage Gain vs. Frequency Characteristics (When PB)**



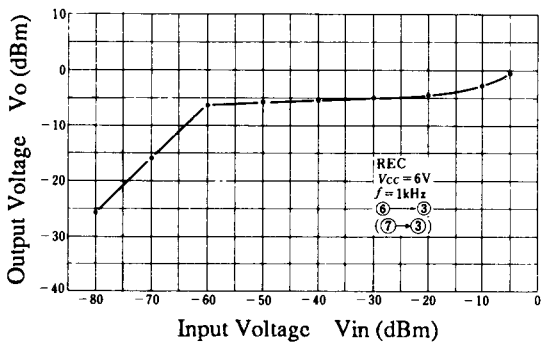
**Total Harmonic Distortion vs. Output Characteristics (When PB)**



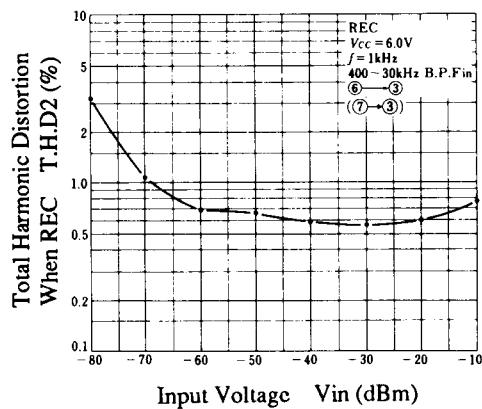
**Voltage Gain vs. Frequency Characteristics (When REC)**



**Input/Output Characteristics (When REC)**

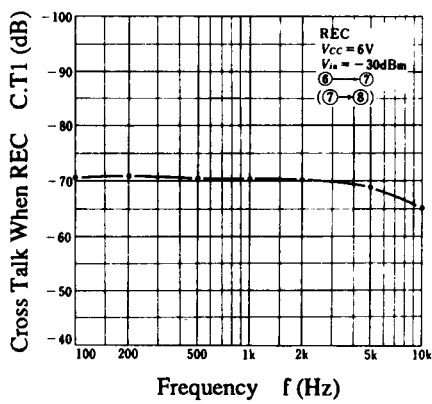


**Total Harmonic Distortion vs. Input Voltage Characteristics (When REC)**

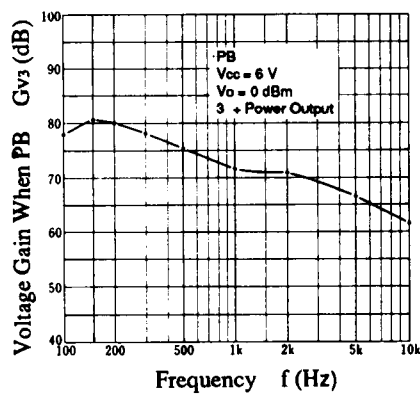


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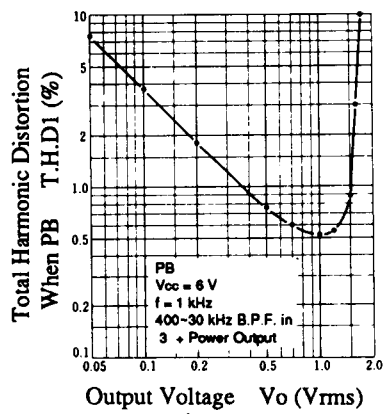
**Cross Talk vs. Frequency (When REC)**



**Voltage Gain vs. Frequency Characteristics (When PB)**



**Total Harmonic Distortion vs. Output Voltage Characteristics (When PB)**



**Power Mute Attenuation vs. Frequency Characteristics**

