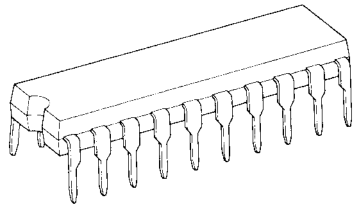
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

# TA8184P,TA8184F

Dual Channel Voltage/Tone Control IC

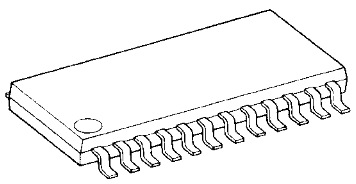
The TA8184P, TA8184F is DC controlled dual volume, balance, tone (Bass and treble) IC.
It is suitable for car stereo, radio cassette, music center, TV multiplex sound receiver and remote controlled applications.

TA8184P



DIP20-P-300-2.54A

TA8184F



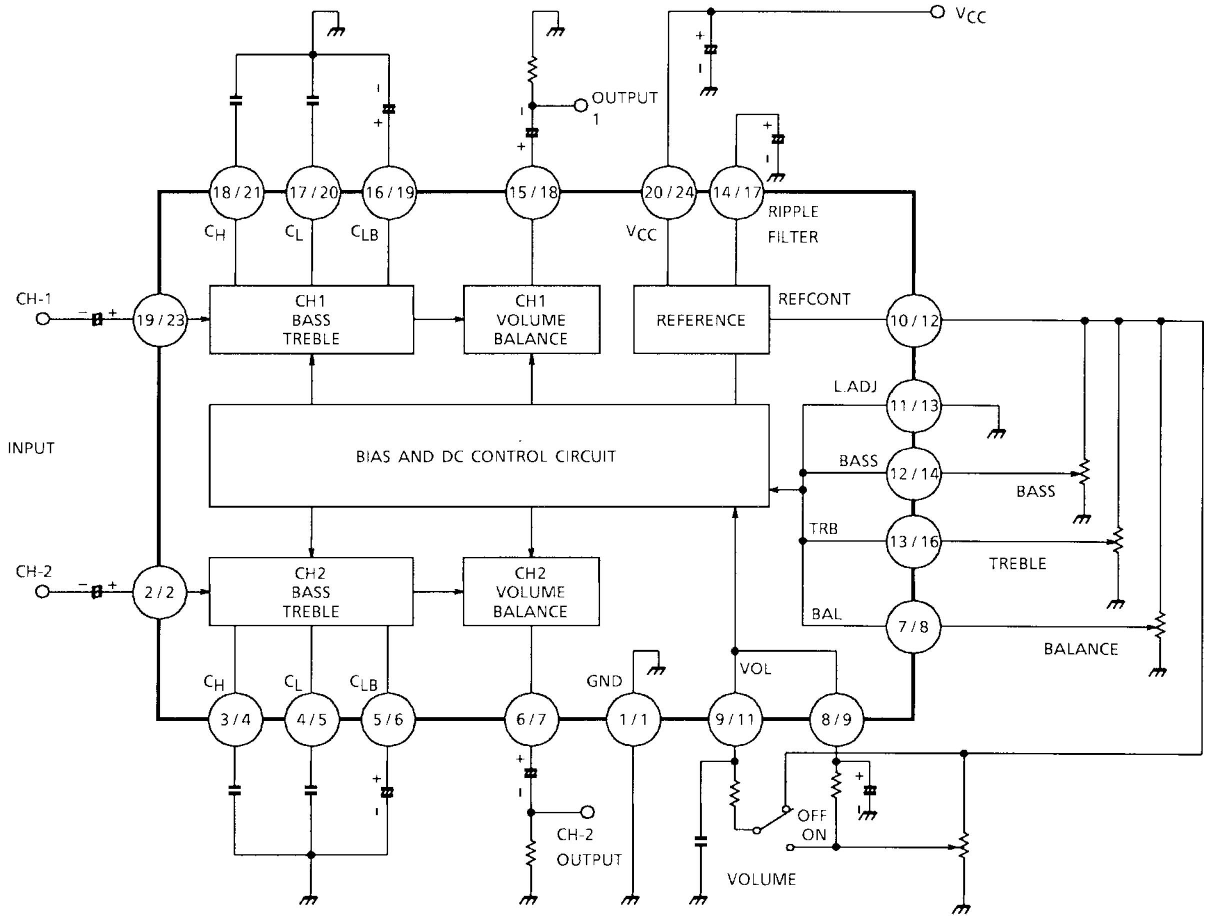
SSOP24-P-300-1.00

Weight
DIP20-P-300-2.54A: 1.4 g (typ.)
SSOP24-P-300-1.00: 0.31 g (typ.)

## Features

- Dual channel
- Wide volume control range
  : Maximum attenuation ATT = 100dB (typ.)
  (Vol. → Min, $V_{IN}$ = 1 Vrms, BW = 400 Hz~30 kHz)
- Wide tone control range
  : Bass $V_B$ = +12.5~−12.5dB (typ.), (f = 100 Hz)
  : Treble $V_T$ = +12.5~−12.5dB (typ.), (f = 10 kHz)
- Built in loudness control
- Operating supply voltage range
  : $V_{CC\ (opr)}$ = 7.5~15 V (TA8184P) (Ta = 25°C)
  : $V_{CC\ (opr)}$ = 7.5~12.5 V (TA8184F) (Ta = 25°C)

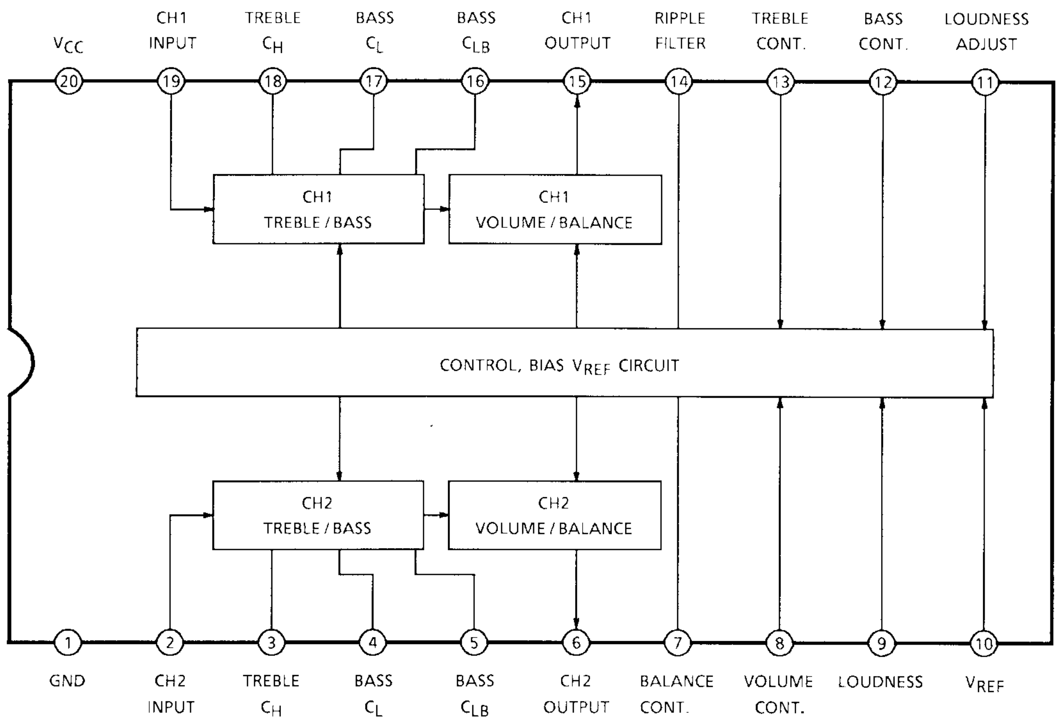
## Block Diagram




PIN CONNECTION : (P/F)

TA8184F : pin③, ⑩, ⑮, ㉒ : N.C

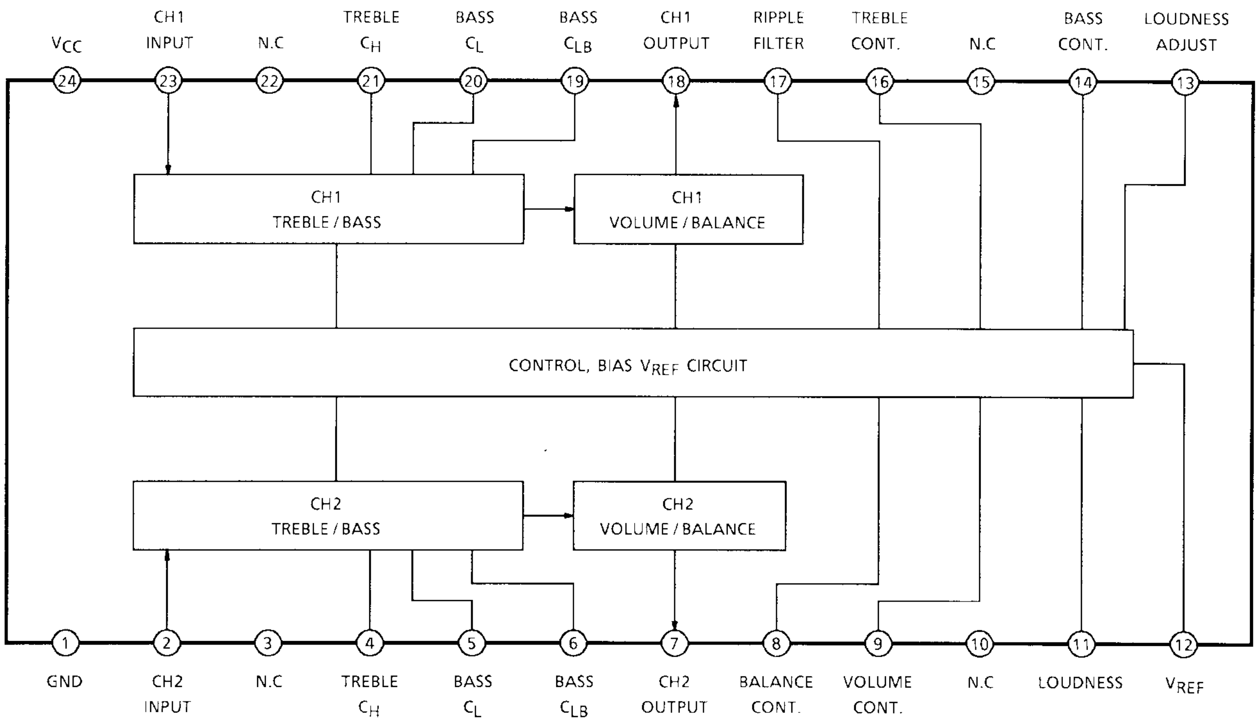
## Pin Connection (TA8184P)




## Pin Function

| Pin No. | Symbol | Explanation | Pin No. | Symbol | Explanation |
|---|---|---|---|---|---|
| 1 | GND | GND | 11 | L.ADJ. | Loudness adjust |
| 2 | IN2 | CH2, input | 12 | BASS | Bass control |
| 3 | $C_{H (2)}$ | CH2, treble control time constant | 13 | TRBL | Treble control |
| 4 | $C_{L (2)}$ | CH2, bass control time constant | 14 | RIP | Ripple filter |
| 5 | $C_{LB (2)}$ | CH2, bass control time constant | 15 | OUT1 | CH1, output |
| 6 | OUT2 | CH2, output | 16 | $C_{LB (1)}$ | CH1, bass control time constant |
| 7 | BAL | Balance control | 17 | $C_{L (1)}$ | CH1, bass control time constant |
| 8 | VOL | Volume control | 18 | $C_{H (1)}$ | CH1, treble control time constant |
| 9 | LOUD | Loudness switch | 19 | IN1 | CH1, input |
| 10 | REF | Reference | 20 | $V_{CC}$ | $V_{CC}$ |

## Pin Connection (TA8184F)




## Pin Function

| Pin No. | Symbol | Explanation | Pin No. | Symbol | Explanation |
|---|---|---|---|---|---|
| 1 | GND | GND | 13 | L.ADJ. | Loudness adjust |
| 2 | IN2 | CH2, input | 14 | BASS | Bass control |
| 3 | N.C | | 15 | N.C | |
| 4 | $C_{H\ (2)}$ | CH2, treble control time constant | 16 | TRBL | Treble control |
| 5 | $C_{L\ (2)}$ | CH2, bass control time constant | 17 | RIP | Ripple filter |
| 6 | $C_{LB\ (2)}$ | CH2, bass control time constant | 18 | OUT1 | CH1, output |
| 7 | OUT2 | CH2, output | 19 | $C_{LB\ (1)}$ | CH1, bass control time constant |
| 8 | BAL | Balance control | 20 | $C_{L\ (1)}$ | CH1, bass control time constant |
| 9 | VOL | Volume control | 21 | $C_{H\ (1)}$ | CH1, treble control time constant |
| 10 | N.C | | 22 | N.C | |
| 11 | LOUD | Loudness switch | 23 | IN1 | CH1, input |
| 12 | REF | Reference | 24 | $V_{CC}$ | $V_{CC}$ |

## Operating Precautions and Application Methods (Pin No.: (P/F))

### 1. How to determine tone controlled frequency characteristic time constants

Bass characteristics determining elements: $C_L$, $C_{LB}$ terminals ((4/5), (5/6), (16/19), (17/20)) Figure 1
Low-bandwidth cut-off frequencies $f_{L1}$, $f_{L2}$, $f_{L3}$ of bass characteristics are determined by the following equations :

$$f_{L1} = \frac{1}{2\pi \cdot C_{LB} \cdot 10\,k\Omega} \quad \text{---(1)}$$

(10 kΩ is determined in IC interior)

$$f_{L2} = \frac{1}{2\pi \cdot C_{LB} \cdot 1\,k\Omega} \quad \text{----(2)}$$

(1 kΩ is determined in IC interior)

$$f_{L3} = \frac{1}{2\pi \cdot C_L \cdot 10\,k\Omega} \quad \text{----(3)}$$

(10 kΩ is determined in IC interior)

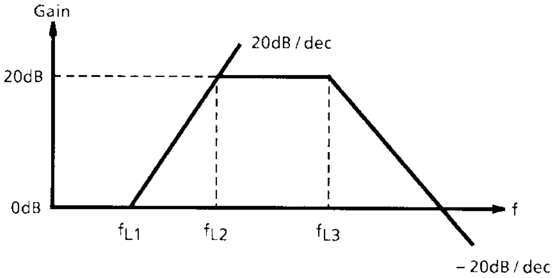


**Figure 1 Bass characteristics (during boosting)**

Under reference circuits of $C_L$ = 0.33 μF and $C_{LB}$ = 10 μF, setting is made as follows:
$f_{L1} \approx 1.59$ Hz, $f_{L2} \approx 15.9$ Hz, $f_{L3} \approx 48.2$ Hz
When the characteristics during boosting are considered, crossing with 0dB axis is made at $f_{L1}$, increase starts by 20dB/dec., and flat characteristics of Gain = 20dB is obtained at $f_{L2}$.
Low-bandwidth f response is determined at $f_{L3}$-namely, $C_L$ and gain starts decreasing from $f_{L3}$ by −20dB /dec.
As explained above, low-bandwidth characteristics can be varied by varying $C_L$ and $C_{LB}$.

Treble characteristics determining element: CH ((3/4), (18/21))
Figure 2 High-bandwidth cut-off frequencies $f_{H1}$ and $f_{H2}$ of treble characteristics can be determined by the following equations:

$$f_{H1} = \frac{1}{2\pi \cdot C_H \cdot 10\,k\Omega} \quad \text{----(4)}$$

(10 kΩ is determined in IC interior)

$$f_{H2} = \frac{1}{2\pi \cdot C_H \cdot 1\,k\Omega} \quad \text{-----(5)}$$

(1 kΩ is determined in IC interior)

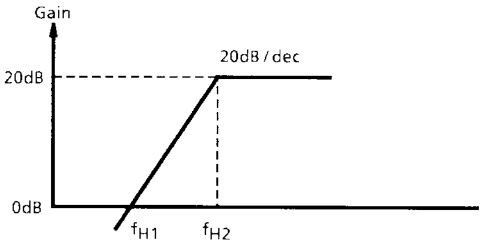


**Figure 2 Treble characteristics (during boosting)**

Under reference circuit of $C_H$ = 0.0082 μF setting is made as follows:
$f_{H1} \approx 1.94$ kHz, $f_{H2}$ = 19.4 kHz
As explained above, high-bandwidth characteristics can be varied by varying $C_H$.
By creating the status of $C_L$ → decrease and $C_H$ → increase, low/high bandwidth gains (f = 100 Hz, 10 kHz) increase but gain near f = 1 kHz is also increased.
On the other hand, when the status of $C_L$ → increase and $C_H$ → decrease is created, take note that gain near f = 1 kHz approaches 0dB while low/high-bandwidth gains are decreased.

### 2. Loudness control

By connecting pin (9/11) (loudness terminal) to pin (8/9) (volume terminal), "Loudness" status can be created. Loudness boost amount is determined by pin (9/11) DC voltage (refer to the subsequently described $G_V$-V (9/11) data).
Loudness is controlled by considering that sound levels will become uniform for all frequency levels through increasing low/high-bandwidth gains when volume is reduced-namely, sound volume is low.
When loudness control is not used, connect pin (9/11) to pin (10/12) (reference terminal).
The capacitor (typ. 0.047 μF) between pin (9/11) and GND is for reducing pop sound during loudness → ON while the capacitor (typ. 1 μF) between pin (8/9) and GND is used for the same purpose during loudness → OFF.

### 3. Loudness adjustment

When loudness is set, the boost amount can be varied by adjusting voltage at pin (11/13).
Under V (11/13) = 0 V, maximum boost amount is obtained and under V (11/13) = $V_{REF}$ (connected to pin (10/12)), minimum boost amount is obtained (refer to the subsequently described $G_V$ − V (11/13) data).

### 4. Relations between tone control and loudness

Because of the circuit configuration on this IC, the sum of boost amount by bass/treble control and boost amount by loudness setting is restricted to become below a constant value. Therefore, the greater the boost amount in-creases, the lower the boost amount by bass/treble control is reduced because loudness is extensively applied. As opposed to this phenomenon, on the other hand, the cut amount increases. (Refer to the subsequent descriptions on tone control frequency response during loudness.)

## Maximum Ratings (Ta = 25°C)

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Power supply voltage | TA8184P | $V_{CC}$ | 15 | V |
| | TA8184F | | 12.5 | |
| Power dissipation | TA8184P | $P_D$ (Note 1) | 1200 | mW |
| | TA8184F | | 750 (Note 2) | |
| Operating temperature | | $T_{opr}$ | −30~85 | °C |
| Storage temperature | | $T_{stg}$ | −55~150 | °C |

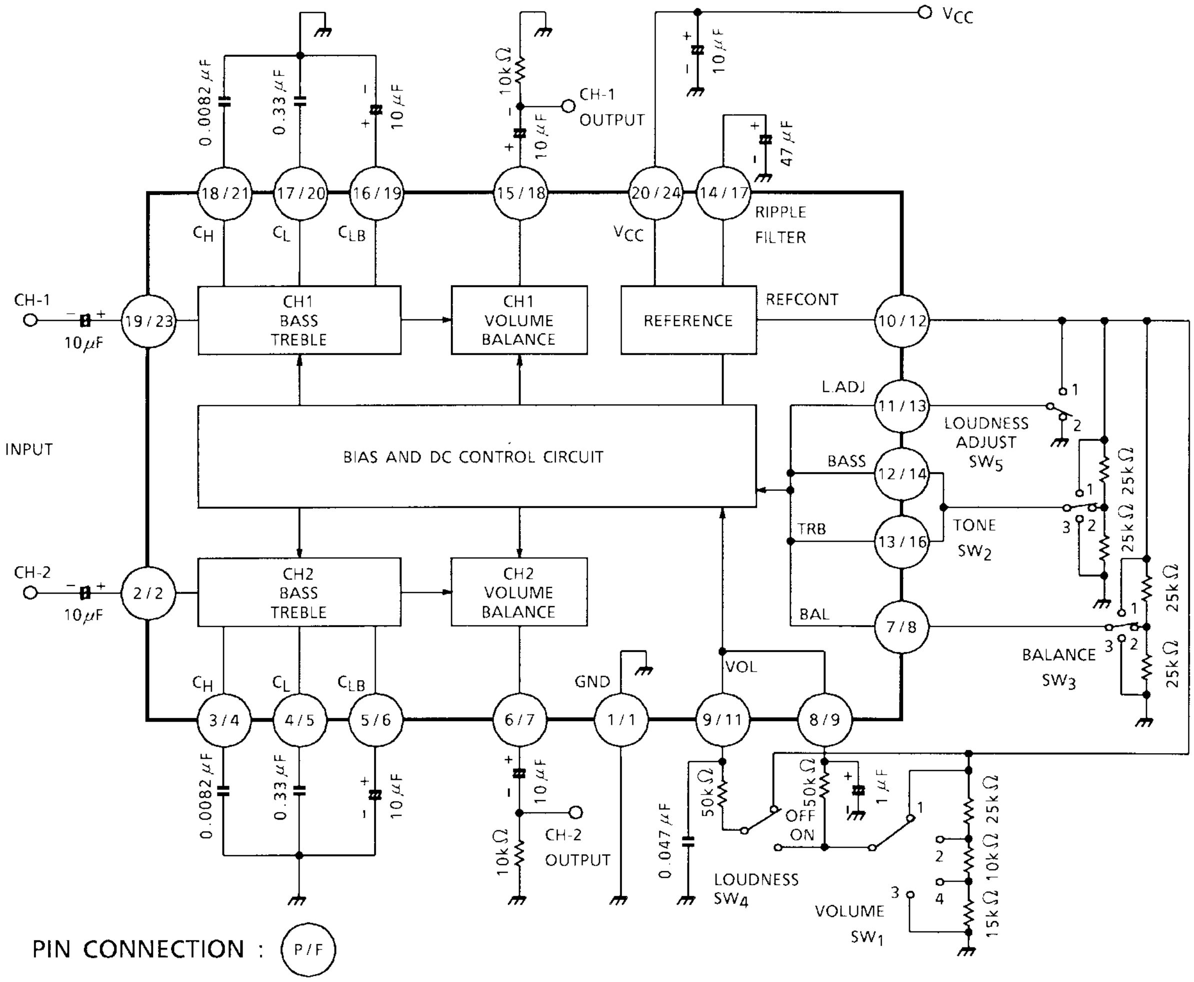
Note 1: Derated above Ta = 25°C in the proportion of 9.6 mW/°C for TA8184P, and of 6.0 mW/°C for TA8184F.

Note 2: Value for mounting on PC board (60 mm × 85 mm × 1.2 mm, Glass epoxy.)

## Electrical Characteristics (unless otherwise specified, $V_{CC}$ = 8 V, f = 1 kHz, Ta = 25°C)

| Characteristics | Symbol | Test Circuit | Test Condition | | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| Quiescent current | $I_{CCQ}$ | — | $V_{IN}$ = 0 | | — | 19 | 27 | mA |
| Reference voltage | $V_{ref}$ | — | — | | 4.7 | 5.1 | 5.5 | V |
| Maximum output voltage | $V_{OM}$ | — | Tone/Bal = Center<br>Vol. = max, THD = 1% | | 1.2 | 1.6 | — | Vrms |
| Voltage gain | $G_V$ | — | Tone/Bal = Center<br>Vol. = max, $V_{IN}$ = 0.1 Vrms | | −2.0 | 0 | 2.0 | dB |
| Maximum attenuation | ATT | — | Tone/Bal = Center<br>BW = 400 Hz~30 kHz<br>Vol. = min, $V_{IN}$ = 1 Vrms | | 85 | 100 | — | dB |
| Bass control range | $V_{B\ MAX}$ | — | Tone = max | Vol. = max<br>Bal = Center<br>$f_{IN}$ = 1 kHz → 100 Hz<br>$V_{IN}$ = 0.1 Vrms | 9.5 | 12.5 | 15.5 | dB |
| | $V_{B\ MIN}$ | — | Tone = min | | −15.5 | −12.5 | −9.5 | |
| Treble control range | $V_{T\ MAX}$ | — | Tone = max | Vol. = max<br>Bal = Center<br>$f_{IN}$ = 1 kHz → 10 kHz<br>$V_{IN}$ = 0.1 Vrms | 9.0 | 12.5 | 16.0 | dB |
| | $V_{T\ MIN}$ | — | Tone = min | | −16.0 | −12.5 | −9.0 | |
| Total harmonic distortion | THD | — | Tone/Bal = Center,<br>f = 1 kHz, Vol. = max,<br>$V_{IN}$ = 1 Vrms | | — | 0.05 | 0.2 | % |
| Output noise voltage | $V_{NO}$ | — | Tone/Bal = Center<br>BW = 20 Hz~20 kHz<br>Vol. = min, input open | | — | 4 | 10 | μVrms |
| Loudness control | $V_{LB}$ | — | f = 100 Hz | Tone/Bal = Center<br>Loudness = ON<br>$V_{IN}$ = 1 Vrms<br>Vol. = $SW_1$ [4]<br>Loudness test<br>= $SW_5$ [2] | 8 | 11 | 14 | dB |
| | $V_{LT}$ | — | f = 10 Hz | | 8 | 11 | 14 | |

## Test Circuit

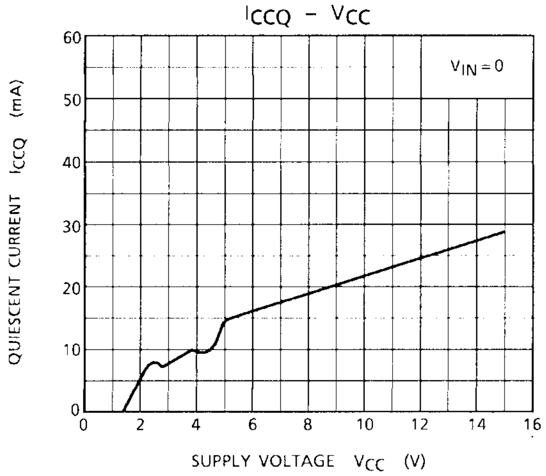



TA8184F : pin③, ⑩, ⑮, ㉒ : N.C

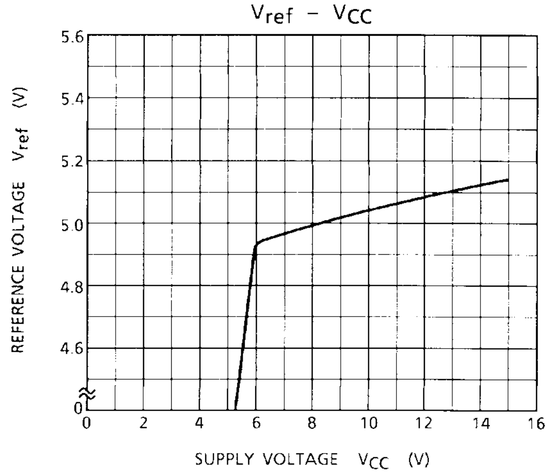
## Switch Explanation

| Switch Name | Position | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | ON | OFF |
| $SW_1$ : Volume | max | Center | min | Loudness test | — | — |
| $SW_2$ : Tone | max | Center | min | — | — | — |
| $SW_3$ : Balance | CH2 Cut | Center | CH1 Cut | — | — | — |
| $SW_4$ : Loudness | — | — | — | — | Loudness ON | Loudness OFF |
| $SW_5$ : Loudness adjust | min | max | — | — | — | — |

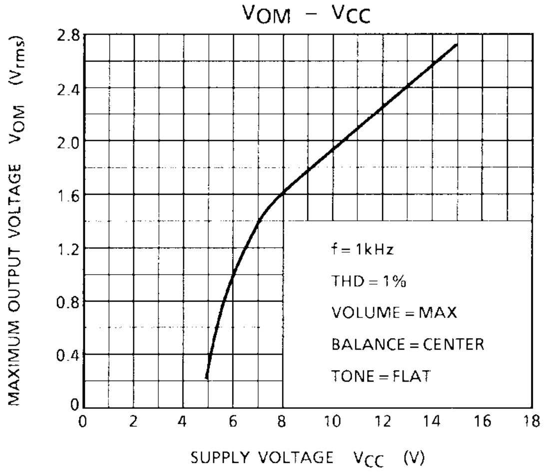
$I_{CCQ}$ – $V_{CC}$



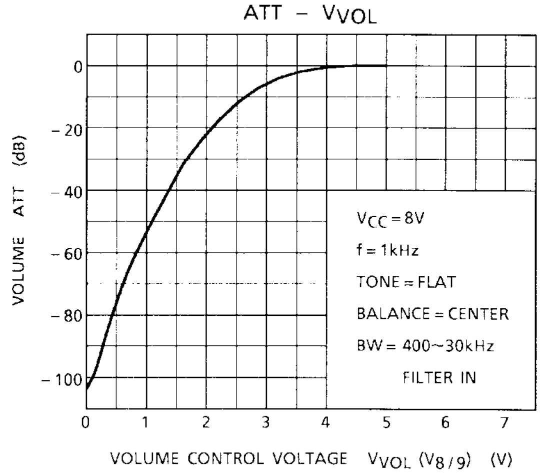

$V_{ref}$ – $V_{CC}$



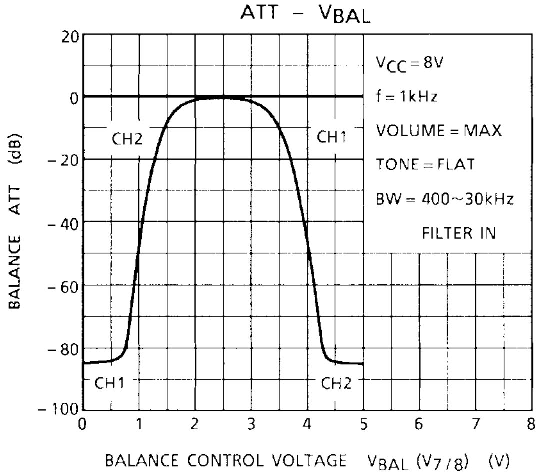

$V_{OM}$ – $V_{CC}$



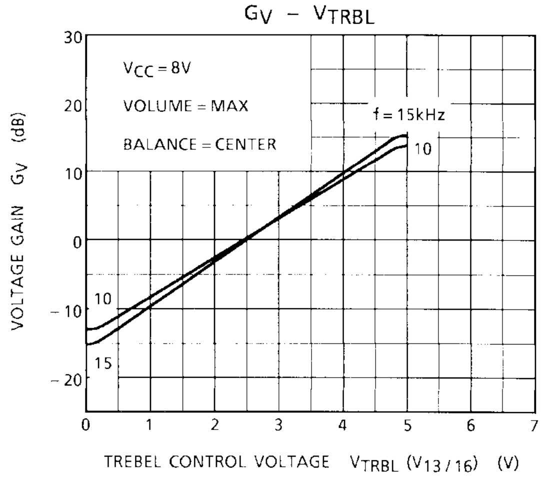

ATT – $V_{VOL}$



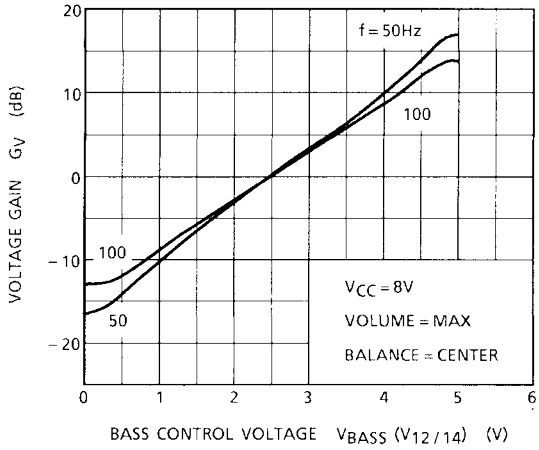

ATT – $V_{BAL}$



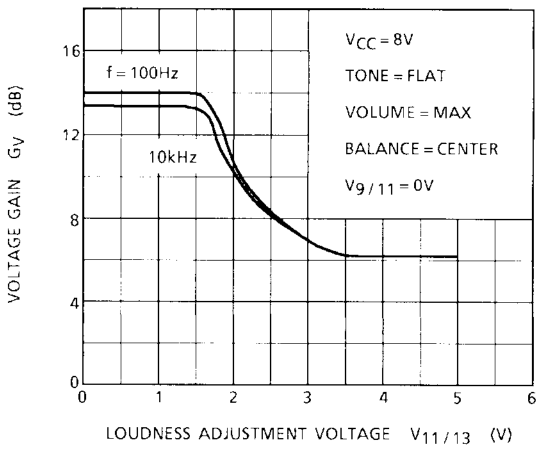

$G_V$ – $V_{TRBL}$



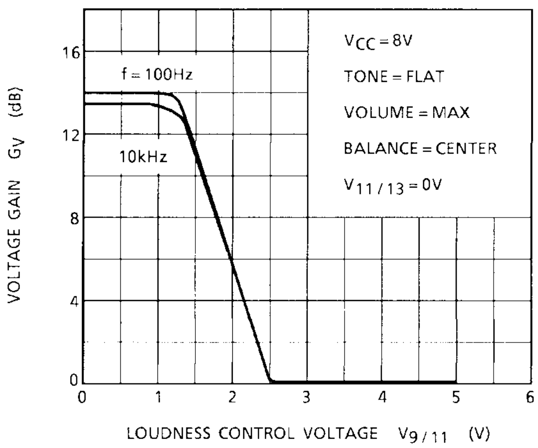
$G_V$ – $V_{BASS}$



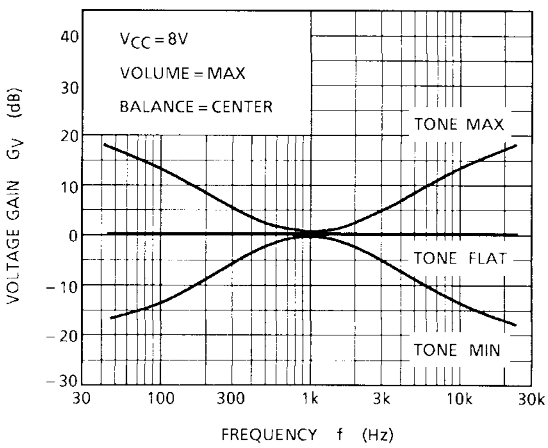

$G_V$ – $V_{11/13}$



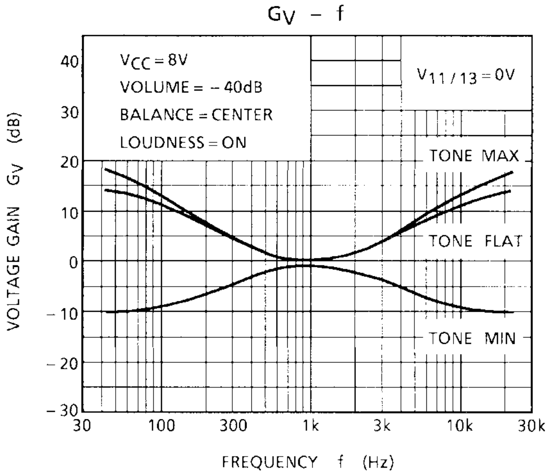

$G_V$ – $V_{9/11}$



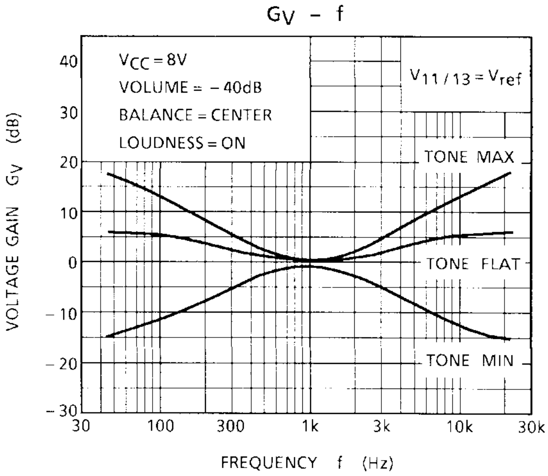

$G_V$ – f



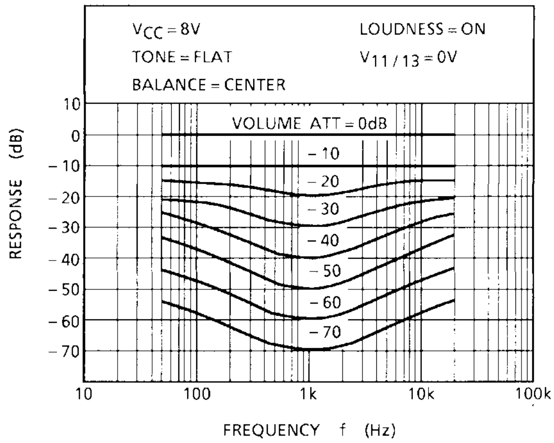

$G_V$ – f



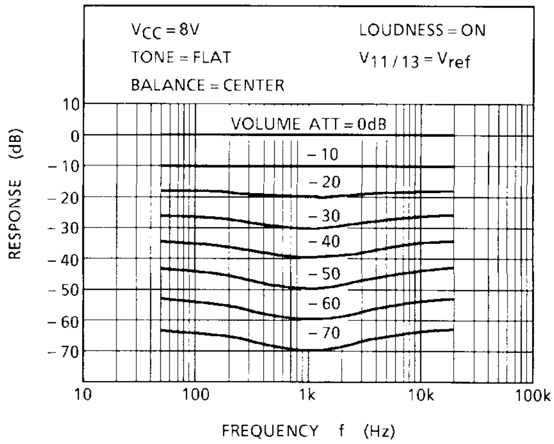

$G_V$ – f



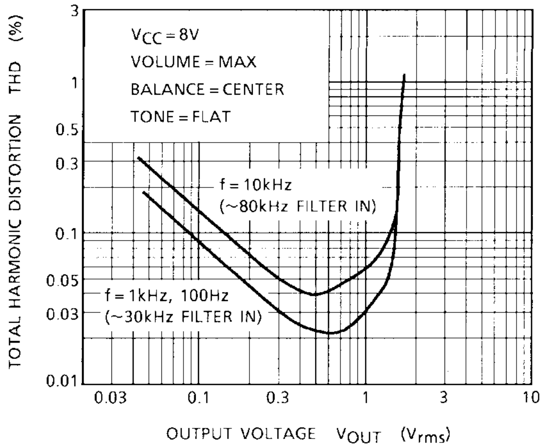
LOUDNESS (1)



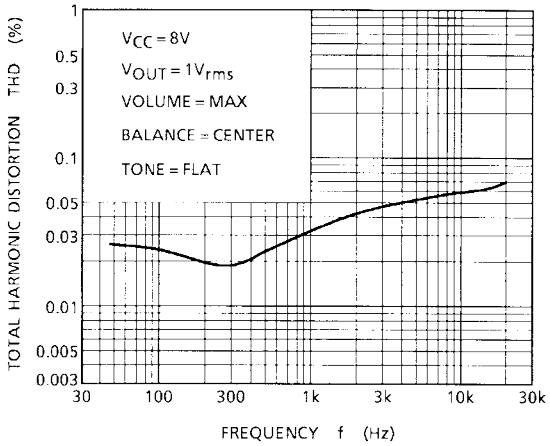

LOUDNESS (2)



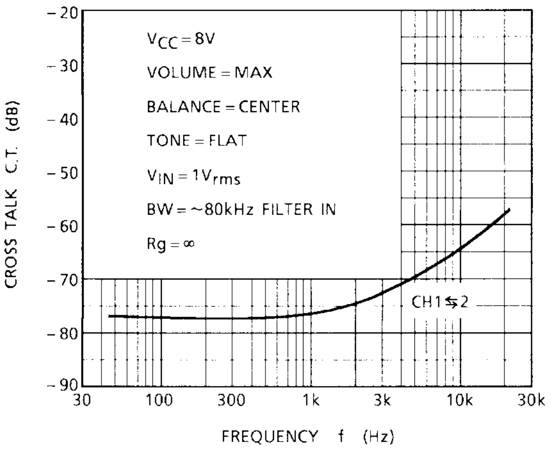

THD − VOUT



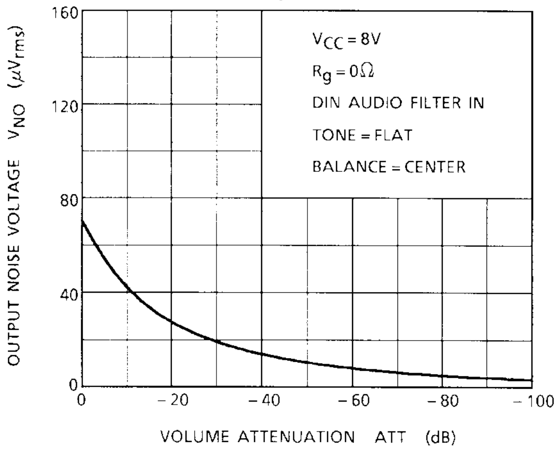

THD − f

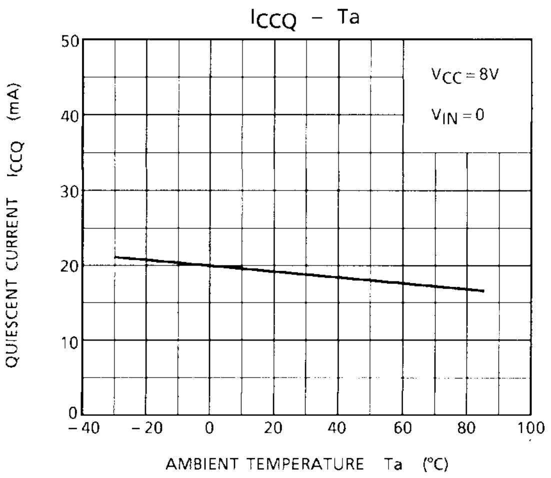


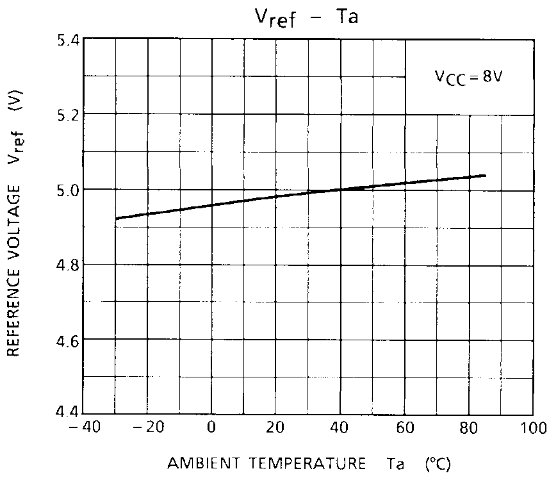

C.T. − f

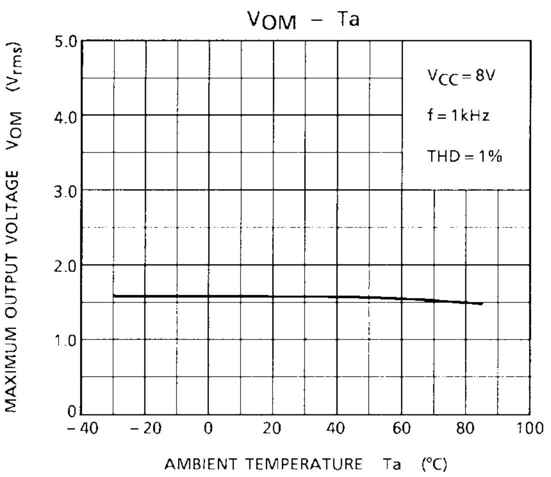


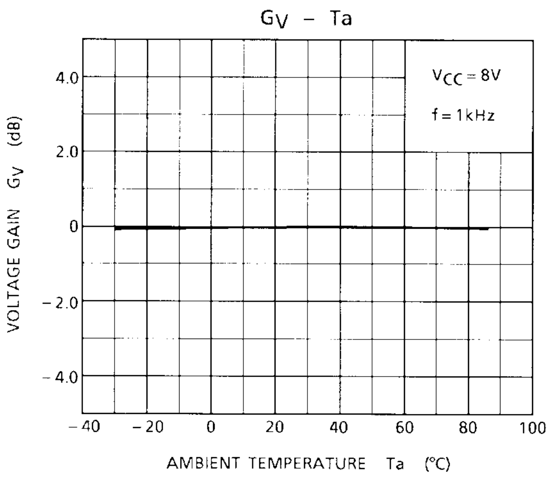

VNO − ATT

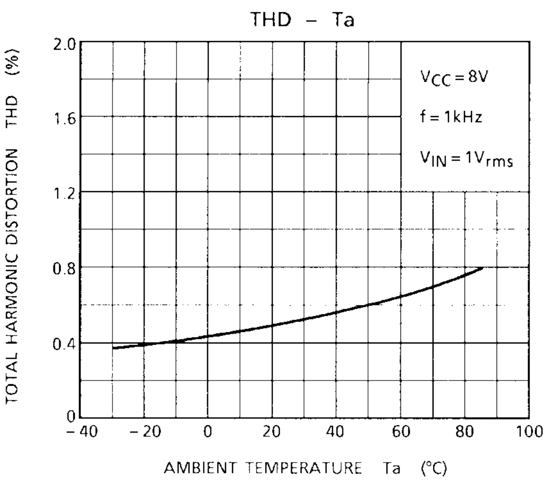



ICCQ – Ta
VCC = 8V
VIN = 0
QUIESCENT CURRENT ICCQ (mA)
AMBIENT TEMPERATURE Ta (°C)

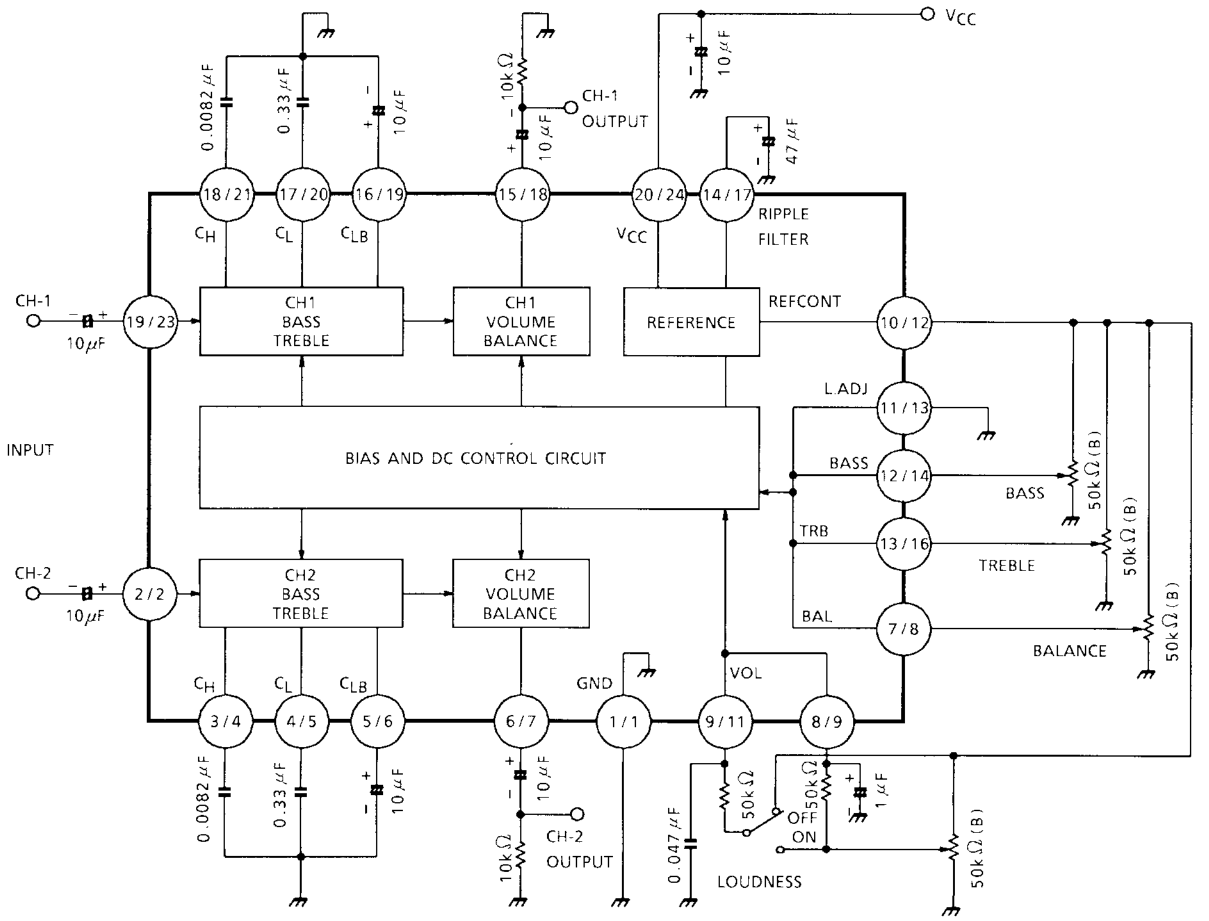

Vref – Ta
VCC = 8V
REFERENCE VOLTAGE Vref (V)
AMBIENT TEMPERATURE Ta (°C)


VOM – Ta
VCC = 8V
f = 1kHz
THD = 1%
MAXIMUM OUTPUT VOLTAGE VOM (Vrms)
AMBIENT TEMPERATURE Ta (°C)


GV – Ta
VCC = 8V
f = 1kHz
VOLTAGE GAIN GV (dB)
AMBIENT TEMPERATURE Ta (°C)


THD – Ta
VCC = 8V
f = 1kHz
VIN = 1Vrms
TOTAL HARMONIC DISTORTION THD (%)
AMBIENT TEMPERATURE Ta (°C)

## Application

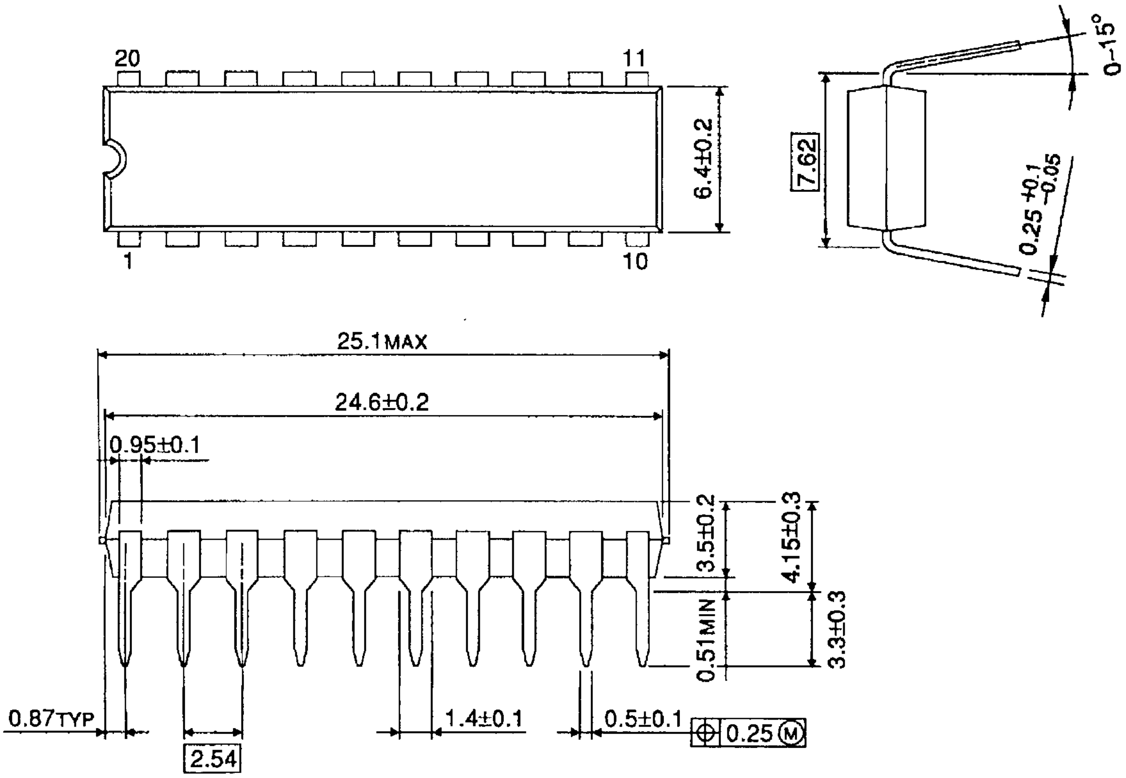



PIN CONNECTION : (P/F)

TA8184F : pin③, ⑩, ⑮, ㉒ : N.C

## Package Dimensions

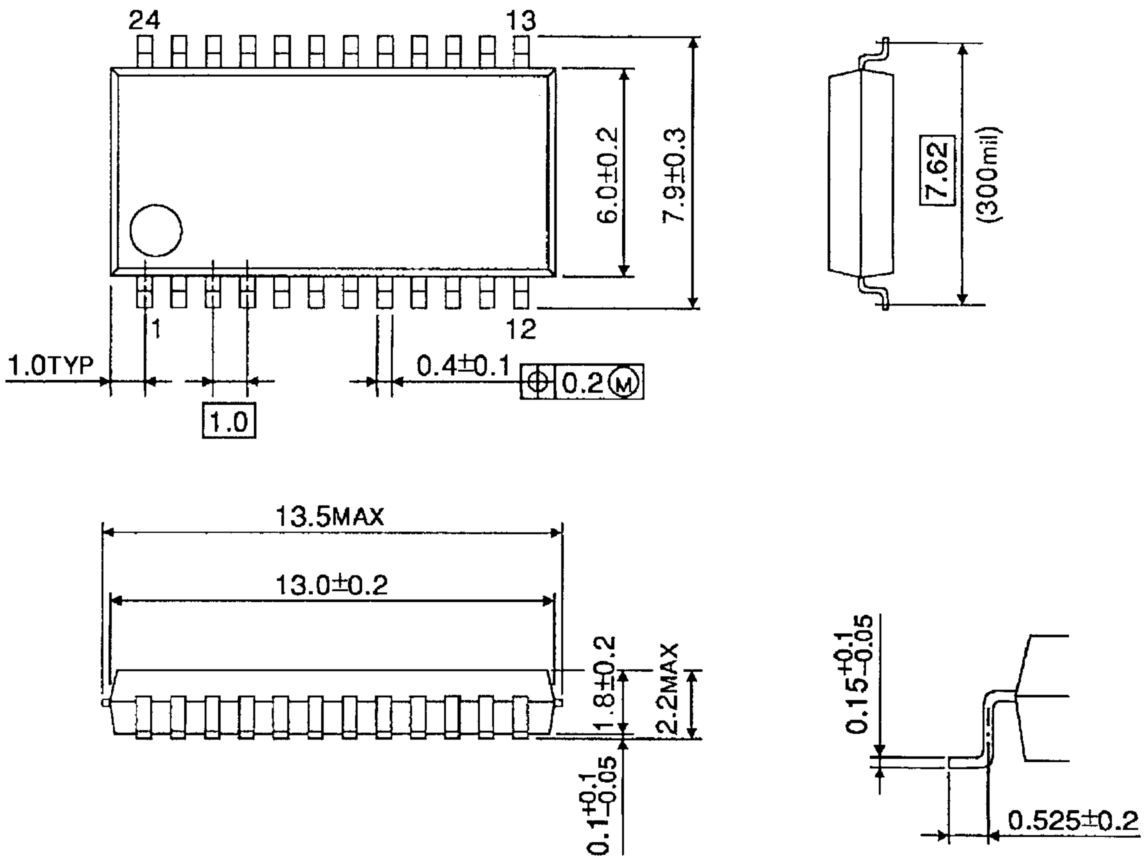
DIP20-P-300-2.54A Unit : mm




Weight: 1.4 g (typ.)

## Package Dimensions

SSOP24-P-300-1.00 Unit : mm




Weight: 0.31 g (typ.)

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000707EBA

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