

# TA2145AF

## 3 V STEREO HEADPHONE AMPLIFIER (3 V USE)

The TA2145AF is developed for play-back stereo headphone equipments (3 V USE).  
It is built in dual preamplifiers, dual OCL power amplifiers, motor governor, DC volume control and preamplifier on/off switch etc.

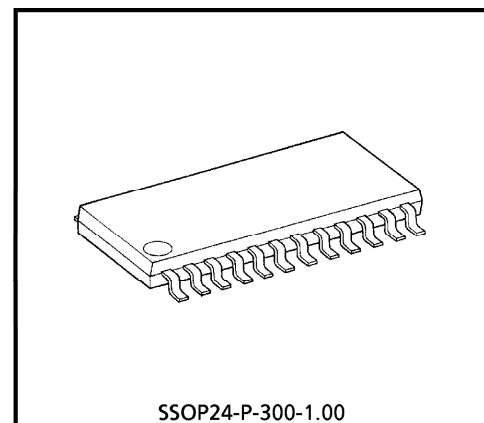
### FEATURES

- Built-in preamplifier  
Input coupling condenser-less  
Built-in input capacitor for reducing buzz noise  
Low noise :  $V_{ni} = 1.2 \mu V_{rms}$  (Typ.)  
Preamplifier on/off switch.
- Built-in power amplifier  
OCL (Output condenser-less)  
Voltage gain :  $G_V = 31$  dB (Typ.)
- Built-in motor governor  
Current proportion type
- Built-in DC volume control function  
DC volume maximum attenuation :  $ATT = 82$  dB ( $T_a = 25^\circ C$ , Typ.)
- Built-in bass boost function
- Low supply current ( $V_{CC} = 3$  V,  $T_a = 25^\circ C$ , Typ.)  
PRE + PW ( $f = 1$  kHz, PRE OUT =  $100$  mV<sub>rms</sub>)

|                   | No Signal<br>(Vol : MIN.) | Output Power |            |
|-------------------|---------------------------|--------------|------------|
|                   |                           | 0.1 mW × 2   | 0.5 mW × 2 |
| $R_L = 16 \Omega$ | 8.5 mA                    | 10.5 mA      | 16.5 mA    |
| $R_L = 32 \Omega$ | 8.5 mA                    | 9.8 mA       | 14.0 mA    |

GVN :  $I_{CC} = 2.5$  mA

- Operating supply voltage range ( $T_a = 25^\circ C$ )  
PRE + PW :  $V_{CC} (opr) = 1.8 \sim 3.6$  V  
GVN :  $V_{CC} (opr) = 2.1 \sim 3.6$  V (Motor voltage = 1.8 V)

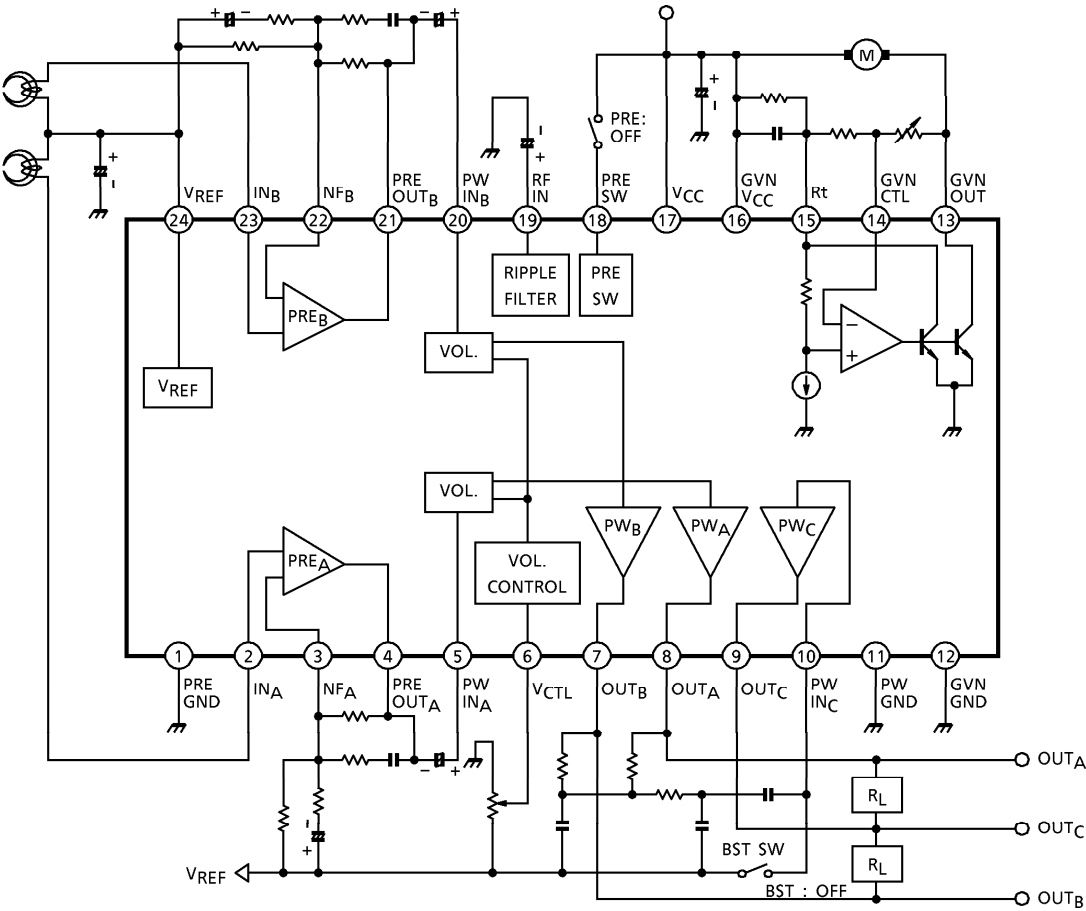


Weight : 0.32 g (Typ.)

980910EBA1

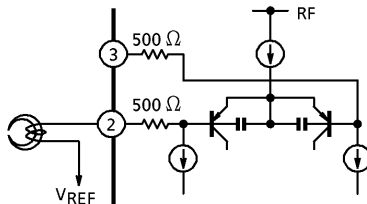
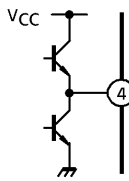
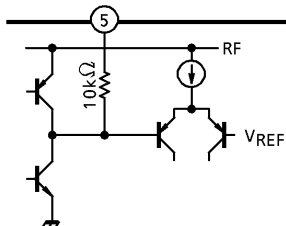
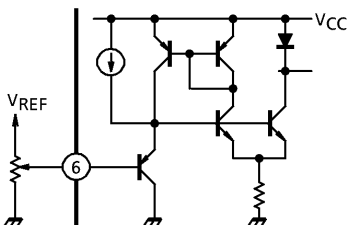
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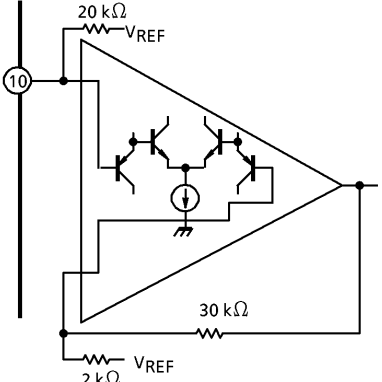
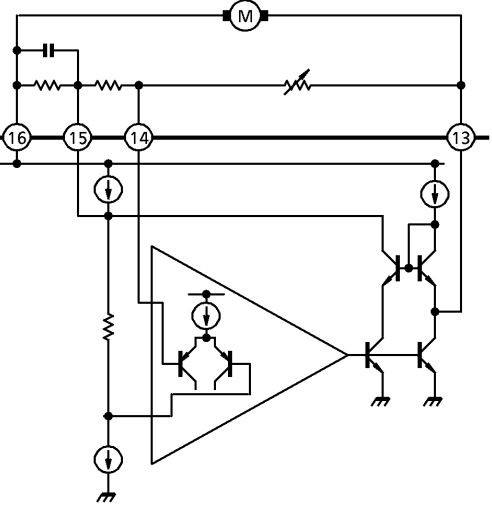
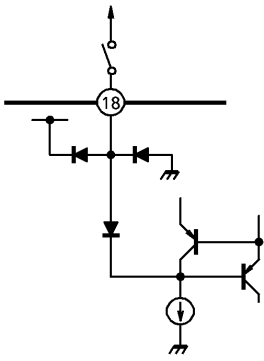
BLOCK DIAGRAM



TERMINAL EXPLANATION

TERMINAL VOLTAGE : Typical terminal voltage at no signal with test circuit ( $V_{CC} = 3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ )

| TERMINAL |                      | FUNCTION                                                        | INTERNAL CIRCUIT                                                                     | TERMINAL VOLTAGE (V) |
|----------|----------------------|-----------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------|
| No.      | NAME                 |                                                                 |                                                                                      |                      |
| 1        | PRE GND              | The GND, except for power drive stage and motor governor stage. | —                                                                                    | 0                    |
| 2        | IN <sub>A</sub>      | Input of preamplifier                                           |    | 1.2                  |
| 23       | IN <sub>B</sub>      |                                                                 |                                                                                      |                      |
| 3        | NF <sub>A</sub>      | NF of preamplifier                                              |                                                                                      | 1.2                  |
| 22       | NF <sub>B</sub>      |                                                                 |                                                                                      |                      |
| 4        | PRE OUT <sub>A</sub> | Output of preamplifier                                          |   | 1.2                  |
| 21       | PRE OUT <sub>B</sub> |                                                                 |                                                                                      |                      |
| 7        | OUT <sub>B</sub>     | Output of power amplifier                                       |                                                                                      |                      |
| 8        | OUT <sub>A</sub>     |                                                                 |                                                                                      |                      |
| 9        | OUT <sub>C</sub>     |                                                                 |                                                                                      |                      |
| 5        | PW IN <sub>A</sub>   | Input of power amplifier                                        |  | 1.2                  |
| 20       | PW IN <sub>B</sub>   |                                                                 |                                                                                      |                      |
| 6        | V <sub>CTL</sub>     | The terminal of DC volume control                               |  | —                    |

| TERMINAL |         | FUNCTION                                                                                                                     | INTERNAL CIRCUIT                                                                     | TERMINAL VOLTAGE (V) |
|----------|---------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------|
| No.      | NAME    |                                                                                                                              |                                                                                      |                      |
| 10       | PW INC  | Input of center amplifier                                                                                                    |    | 1.2                  |
| 11       | PW GND  | GND for power drive stage                                                                                                    | —                                                                                    | 0                    |
| 12       | GVN GND | GND for motor governor stage                                                                                                 | —                                                                                    | 0                    |
| 13       | GVN OUT | Motor terminal                                                                                                               |   | —                    |
| 14       | GVN CTL | The terminal of motor speed control                                                                                          |                                                                                      | —                    |
| 15       | Rt      | The terminal of amateur compensation resistor                                                                                |                                                                                      | —                    |
| 16       | GVN VCC | VCC for motor governor stage                                                                                                 |                                                                                      | 3                    |
| 17       | VCC     | VCC for preamplifier stage and power amplifier stage.                                                                        | —                                                                                    | 3                    |
| 18       | PRE SW  | Muting switch of preamplifier<br>( Preamp. on : "L" level / open<br>Preamp. off : "H" level<br><br>Refer to application note |  | —                    |

| TERMINAL |       | FUNCTION                                                                           | INTERNAL CIRCUIT | TERMINAL VOLTAGE (V) |
|----------|-------|------------------------------------------------------------------------------------|------------------|----------------------|
| No.      | NAME  |                                                                                    |                  |                      |
| 19       | RF IN | Ripple filter of power supply                                                      |                  | 2.5                  |
| 24       | VREF  | Reference voltage<br>• Preamplifier and power amplifier operate on this reference. |                  | 1.2                  |

**APPLICATION NOTE****1.  $V_{CC}$  and GND**

This IC has two  $V_{CC}$  terminals and three GND terminals. Pattern layout should be designed carefully to reduce the common impedance.

 **$V_{CC}$** 

- $V_{CC}$  (pin 17) : Preamplifier stage and power amplifier stage.
- GVN  $V_{CC}$  (pin 16) : Motor governor stage.

**GND**

- PRE GND (pin 1) : Preamplifier stage, and power amplifier stage except for the power drive stage.
- PW GND (pin 11) : Power drive stage of power amplifier.
- GVN GND (pin 12) : Motor governor stage.

**2.  $V_{REF}$** 

It is necessary to stabilize the  $V_{REF}$  circuit, because the internal circuit operate on this reference.

**3. RF IN**

As this terminal is an input terminal of the ripple filter, it cannot supply a power supply to other ICs etc.

**4. Preamplifier**

Input signal should be applied to  $V_{REF}$  standard, otherwise pop noise become bigger when  $V_{CC}$  is turned on and off.

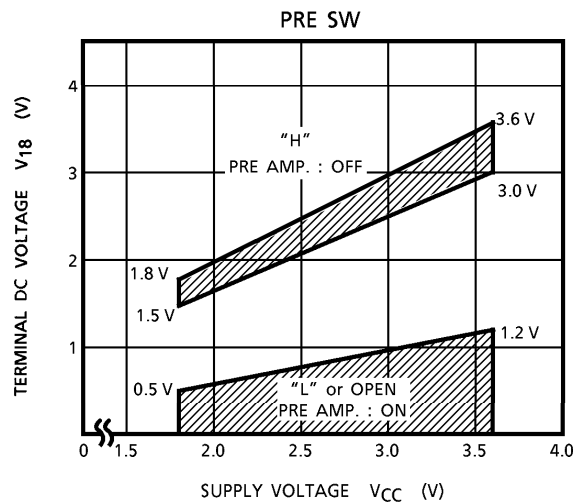
**5. Power amplifier**

It is necessary to insert the coupling capacitor through the PW IN terminal. In case that DC current or DC voltage is applied to the PW IN terminal, the internal circuit has unbalance and the power amplifier doesn't operate normally.

**6. Operating supply voltage range of motor governor stage**

As for the minimum of operating supply voltage range, the motor voltage is 1.8 V.  
In case that it is more than 1.8 V, the low voltage performance becomes bad.

7. PRE SW sensitivity (Ta = 25°C)



MAXIMUM RATINGS (Ta = 25°C)

| CHARACTERISTIC           | SYMBOL      |        | RATING   | UNIT |
|--------------------------|-------------|--------|----------|------|
| Supply Voltage           | $V_{CC}$    |        | 4        | V    |
| Power Dissipation        | $P_D$       | Note 1 | 400      | mW   |
|                          |             | Note 2 | 925      |      |
| Output Current (PW AMP.) | $I_O$ (PW)  |        | 200      | mA   |
| Output Current (GVN)     | $I_O$ (GVN) |        | 700      | mA   |
| Operating Temperature    | $T_{opr}$   |        | - 25~75  | °C   |
| Storage Temperature      | $T_{stg}$   |        | - 55~150 | °C   |

(Note 1) : IC only : Derated above Ta = 25°C in the proportion 3.2 mW / °C

(Note 2) : IC + PCB (TOSHIBA typical PCB) : Derated above Ta = 25°C in the proportion 7.4 mW / °C

## ELECTRICAL CHARACTERISTICS

Unless otherwise specified,  $V_{CC} = 3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ ,  $f = 1\text{ kHz}$ , SW2 : a, SW5 : OPEN

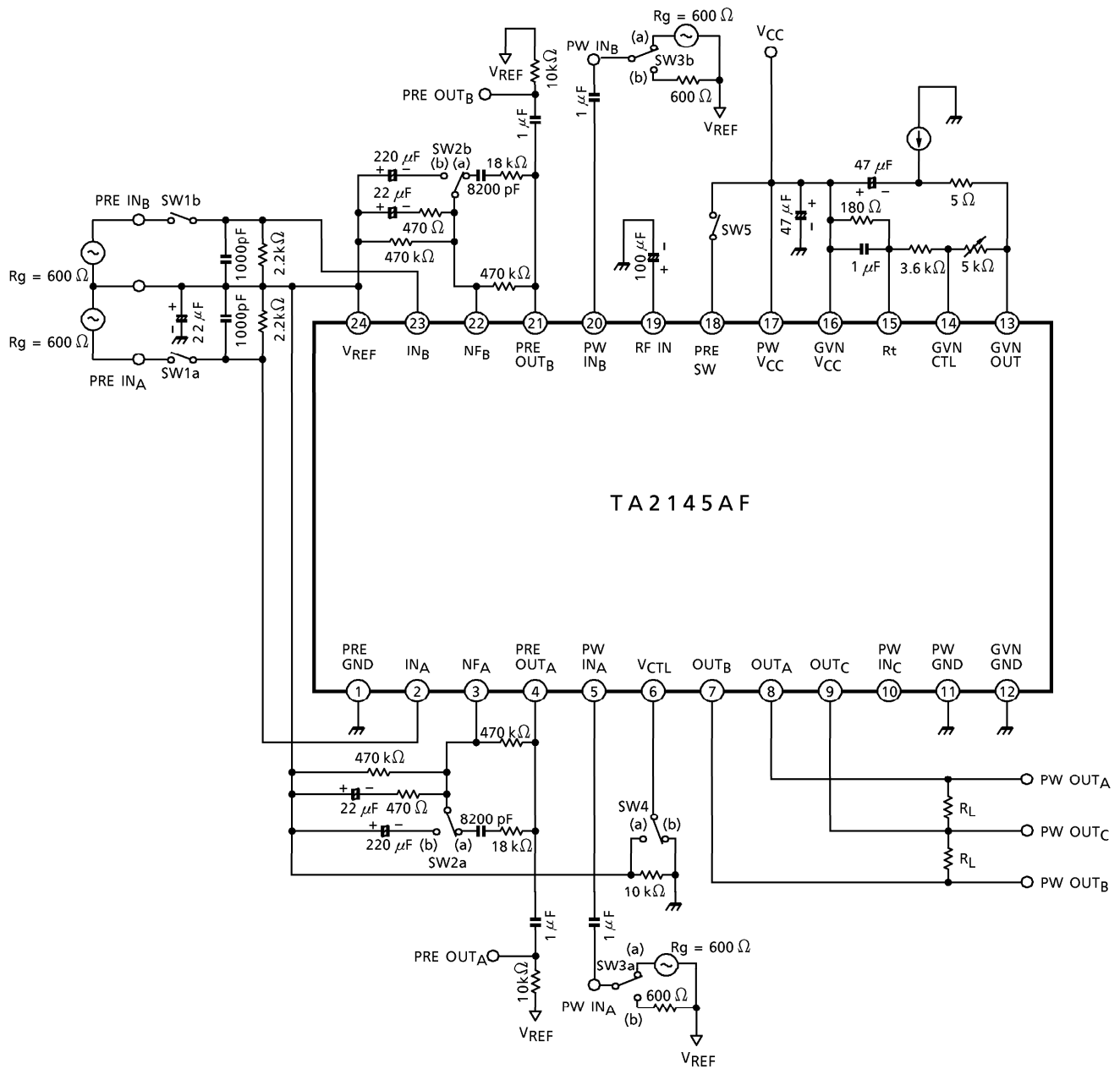
Preamplifier :  $R_g = 2.2\text{ k}\Omega$ ,  $R_L = 10\text{ k}\Omega$ , SW1 : ON, SW3 : b, SW4 : b

Power amplifier :  $R_g = 600\text{ }\Omega$ ,  $R_L = 16\text{ }\Omega$ , Vol : MAX, SW1 : OPEN, SW3 : a, SW4 : a

Motor governor :  $I_m = 100\text{ mA}$ , SW1 : OPEN, SW3 : b, SW4 : b

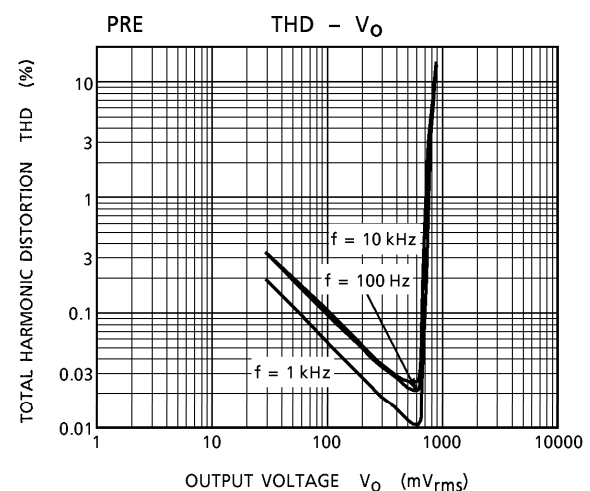
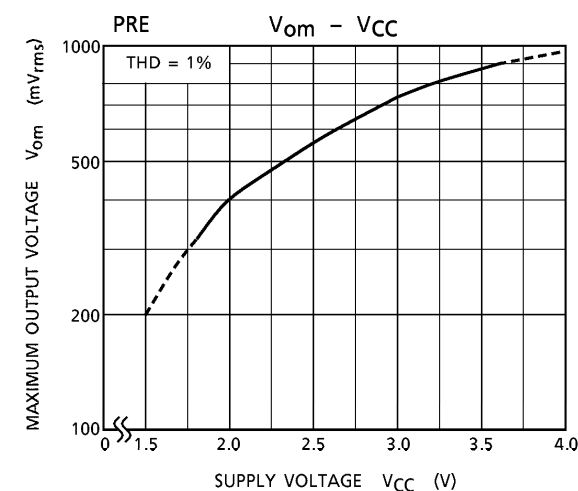
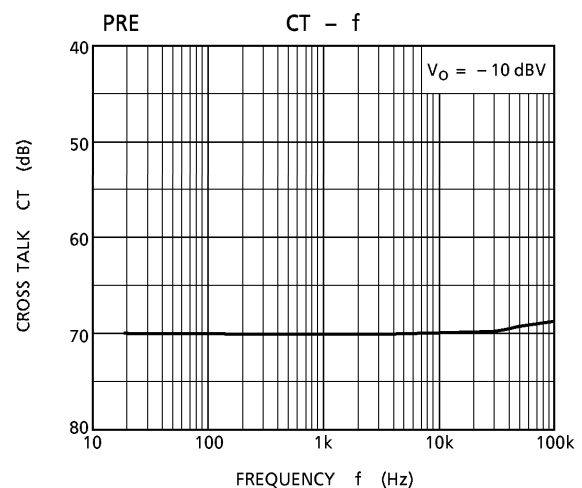
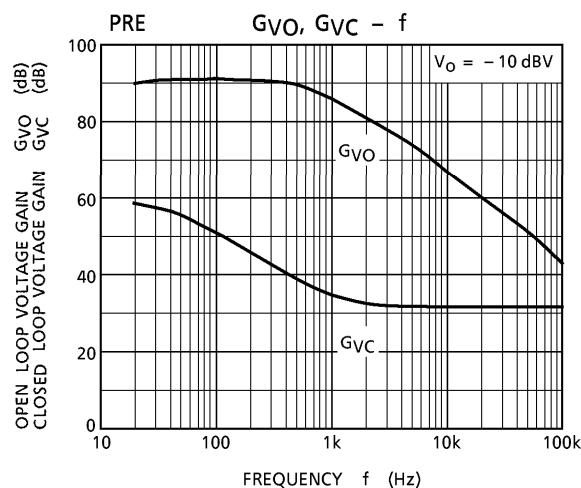
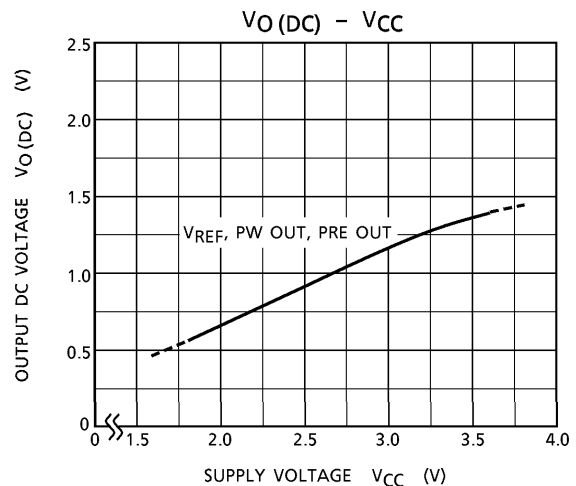
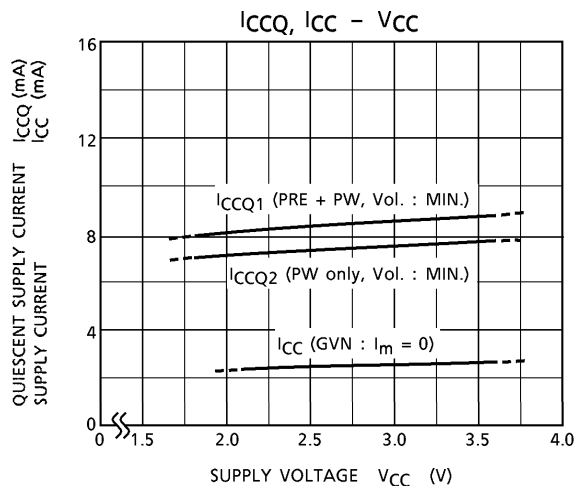
|                | CHARACTERISTIC                  | SYMBOL            | TEST CIR-<br>CUIT | TEST CONDITION                                                                                                      | MIN. | TYP.  | MAX. | UNIT                |
|----------------|---------------------------------|-------------------|-------------------|---------------------------------------------------------------------------------------------------------------------|------|-------|------|---------------------|
|                | Quiescent Supply Current 1      | $I_{CCQ1}$        | —                 | PRE OFF, $V_{in} = 0$ , Vol : MIN, SW4 : b, SW5 : ON                                                                | —    | 7.5   | 13   | mA                  |
|                | Quiescent Supply Current 2      | $I_{CCQ2}$        | —                 | $V_{in} = 0$ , Vol : MIN, SW4 : b                                                                                   | —    | 8.5   | 14.5 |                     |
| PRE AMP.       | Open Loop Voltage Gain          | $G_{VO}$          | —                 | $V_O = -10\text{ dBV}$ , SW2 : b                                                                                    | —    | 86    | —    | dB                  |
|                | Closed Loop Voltage Gain        | $G_{VC}$          | —                 | $V_O = -10\text{ dBV}$                                                                                              | —    | 35    | —    | dB                  |
|                | Maximum Output Voltage          | $V_{om}$          | —                 | THD = 1%                                                                                                            | 550  | 720   | —    | mV <sub>rms</sub>   |
|                | Total Harmonic Distortion       | THD1              | —                 | $V_O = -10\text{ dBV}$                                                                                              | —    | 0.02  | 0.3  | %                   |
|                | Equivalent Input Noise Voltage  | $V_{ni}$          | —                 | $R_g = 2.2\text{ k}\Omega$ , SW1 : OPEN<br>BPF = 20 Hz~20 kHz, NAB<br>( $G_V = 35\text{ dB}$ , $f = 1\text{ kHz}$ ) | —    | 1.2   | 2.4  | $\mu\text{V}_{rms}$ |
|                | Cross Talk                      | CT1               | —                 | $V_O = -10\text{ dBV}$                                                                                              | —    | 70    | —    | dB                  |
|                | Ripple Rejection Ratio          | RR1               | —                 | $f_r = 100\text{ Hz}$ , $V_r = -20\text{ dBV}$                                                                      | —    | 48    | —    | dB                  |
|                | Preamplifier Muting Attenuation | ATT1              | —                 | $V_O = -10\text{ dBV}$<br>SW5 : OPEN → ON                                                                           | —    | 80    | —    | dB                  |
|                | Preamplifier On Voltage         | $V_{18(OFF)}$     | —                 | $V_{CC} = 1.8\text{ V}$                                                                                             | 0    | —     | 0.5  | V                   |
|                | Preamplifier Off Voltage        | $V_{18(OFF)}$     | —                 |                                                                                                                     | 1.5  | —     | 1.8  | V                   |
| POWER AMP.     | Voltage Gain                    | $G_V$             | —                 | $V_O = -10\text{ dBV}$                                                                                              | 29   | 31    | 33   | dB                  |
|                | Channel Balance                 | CB                | —                 |                                                                                                                     | -1.5 | 0     | +1.5 | dB                  |
|                | Output Power 1                  | $P_{O1}$          | —                 | $R_L = 16\text{ }\Omega$ , THD = 10%                                                                                | 17   | 28    | —    | mW                  |
|                | Output Power 2                  | $P_{O2}$          | —                 | $R_L = 32\text{ }\Omega$ , THD = 10%                                                                                | —    | 20    | —    | mW                  |
|                | Total Harmonic Distortion       | THD2              | —                 | $P_O = 1\text{ mW}$                                                                                                 | —    | 0.5   | —    | %                   |
|                | Output Noise Voltage            | $V_{no}$          | —                 | $R_g = 600\text{ }\Omega$ , SW3 : b<br>BPF = 20 Hz~20 kHz                                                           | —    | 270   | 400  | $\mu\text{V}_{rms}$ |
|                | Ripple Rejection Ratio          | RR2               | —                 | $f_r = 100\text{ Hz}$ , $V_r = -20\text{ dBV}$                                                                      | —    | 52    | —    | dB                  |
|                | Cross Talk                      | CT2               | —                 | $V_O = -10\text{ dBV}$                                                                                              | —    | 32    | —    | dB                  |
|                | DC Volume Maximum Attenuation   | ATT2              | —                 | $V_O = -10\text{ dBV}$<br>SW4 : a → b<br>(Vol : MAX → MIN)                                                          | —    | 82    | —    | dB                  |
| MOTOR GOVERNOR | Supply Current                  | $I_{CC}$          | —                 | $I_m = 0$                                                                                                           | —    | 2.5   | 3.5  | mA                  |
|                | Saturation Voltage              | $V_{CE(sat)}$     | —                 | $I_m = 200\text{ mA}$                                                                                               | —    | —     | 0.5  | V                   |
|                | Reference Voltage               | $V_{REF}$         | —                 | $I_m = 100\text{ mA}$                                                                                               | 0.76 | 0.81  | 0.86 | V                   |
|                | Reference Voltage Fluctuation 1 | $\Delta V_{REF1}$ | —                 | $V_{CC} = 2.1\sim 3.6\text{ V}$                                                                                     | —    | 0.25  | —    | % / V               |
|                | Reference Voltage Fluctuation 2 | $\Delta V_{REF2}$ | —                 | $I_m = 25\sim 250\text{ mA}$                                                                                        | —    | 0.003 | —    | % / mA              |
|                | Reference Voltage Fluctuation 3 | $\Delta V_{REF3}$ | —                 | $T_a = -25\sim 75^\circ\text{C}$                                                                                    | —    | 0.005 | —    | % / °C              |
|                | Current Ratio                   | K                 | —                 |                                                                                                                     | 34.5 | 37.5  | 40.5 |                     |
|                | Current Ratio Fluctuation 1     | $\Delta K1$       | —                 | $V_{CC} = 2.1\sim 3.6\text{ V}$                                                                                     | —    | 0.25  | —    | % / V               |
|                | Current Ratio Fluctuation 2     | $\Delta K2$       | —                 | $I_m = 25\sim 250\text{ mA}$                                                                                        | —    | 0.08  | —    | % / mA              |
|                | Current Ratio Fluctuation 3     | $\Delta K3$       | —                 | $T_a = -25\sim 75^\circ\text{C}$                                                                                    | —    | 0.005 | —    | % / °C              |

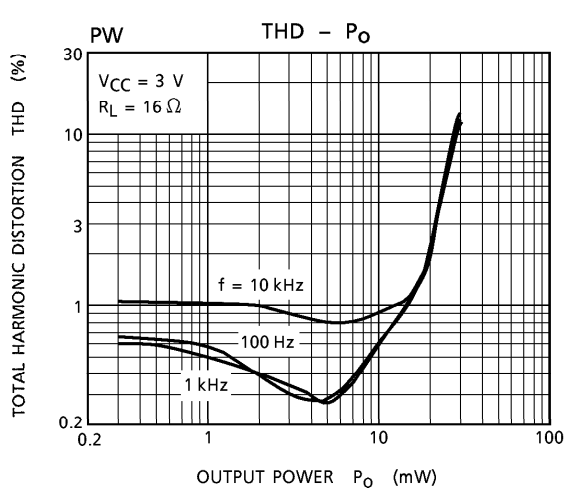
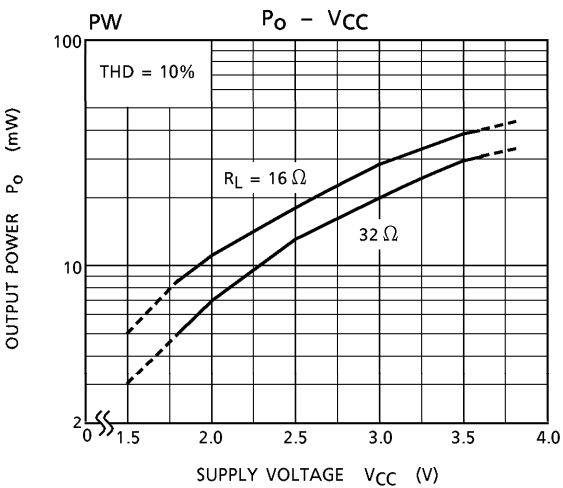
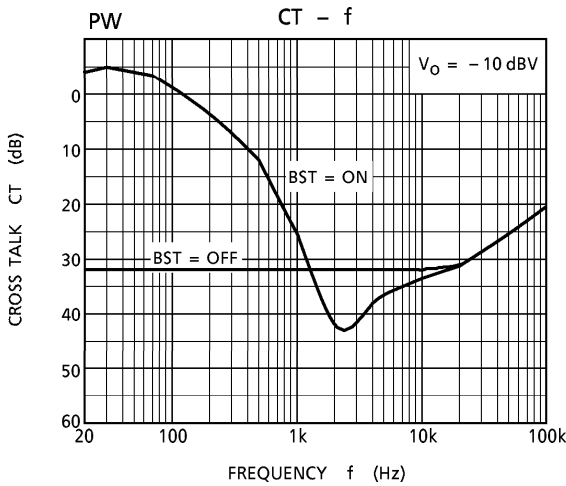
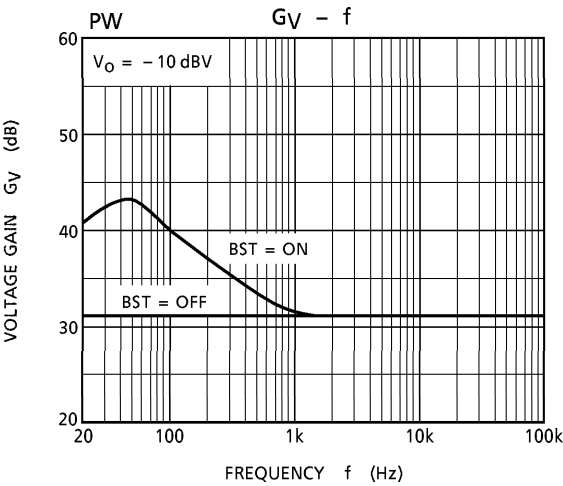
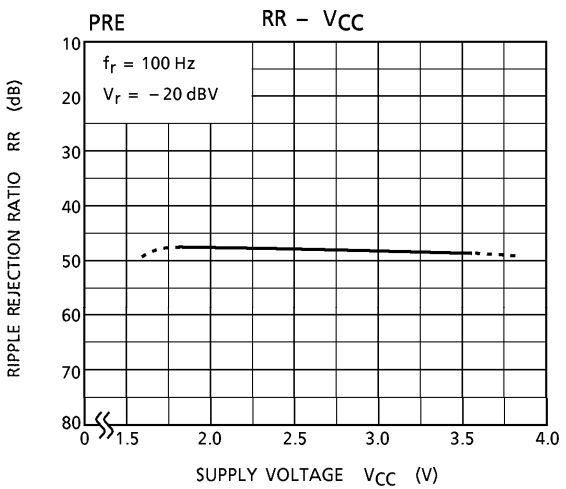
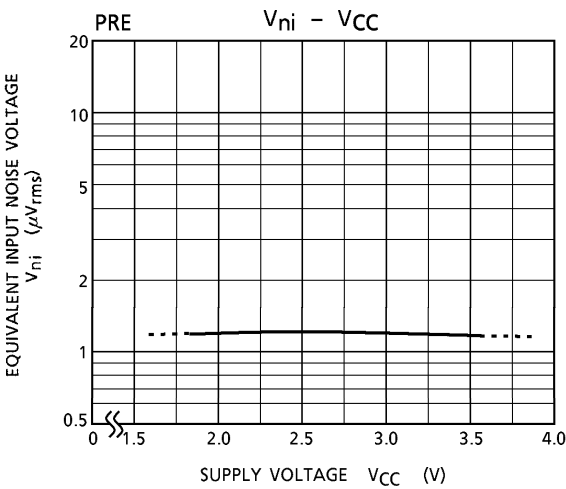
## TEST CIRCUIT

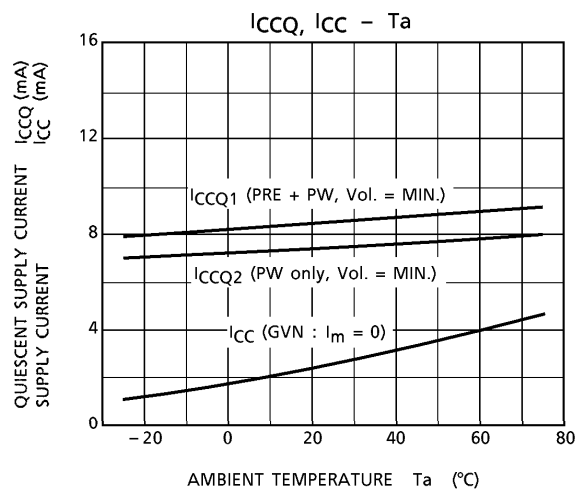
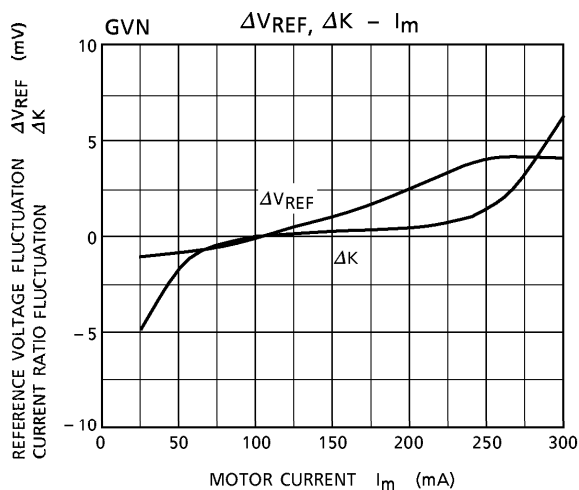
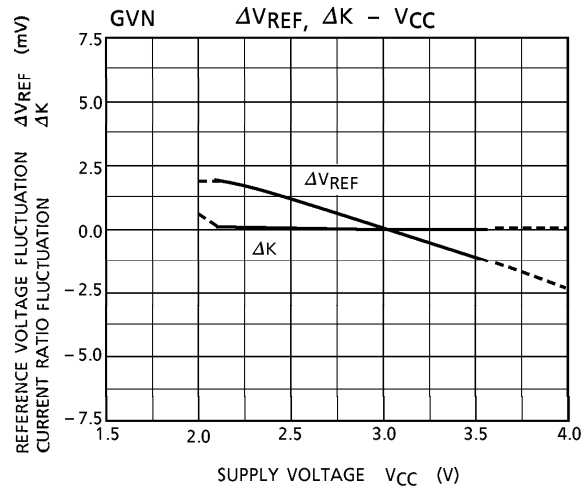
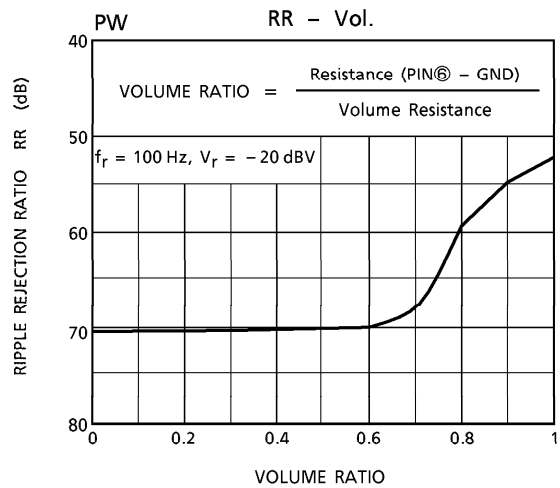
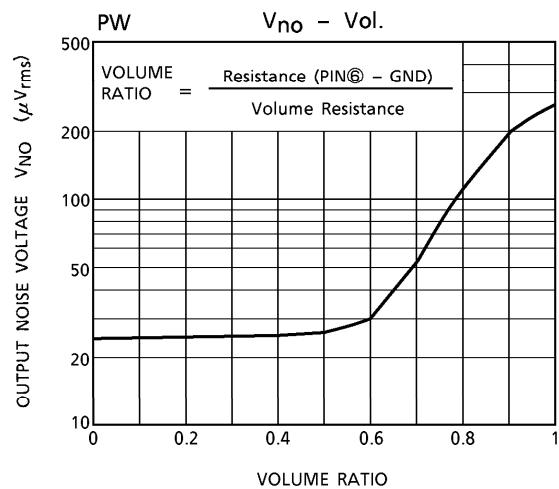
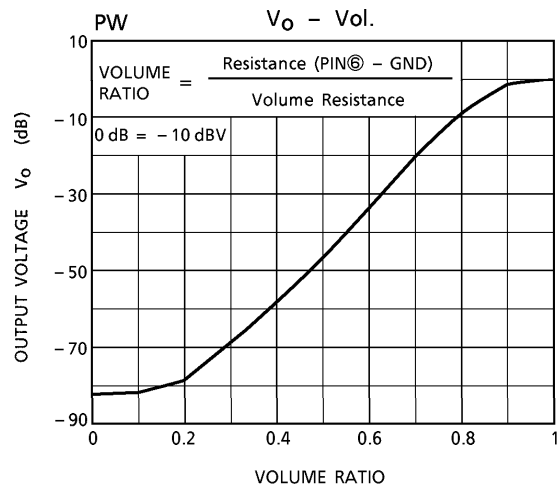


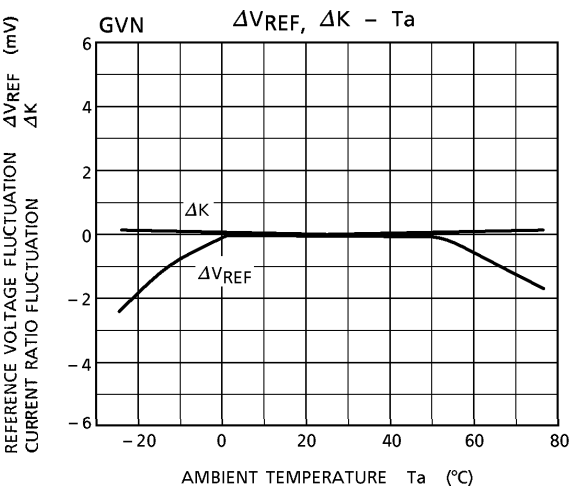
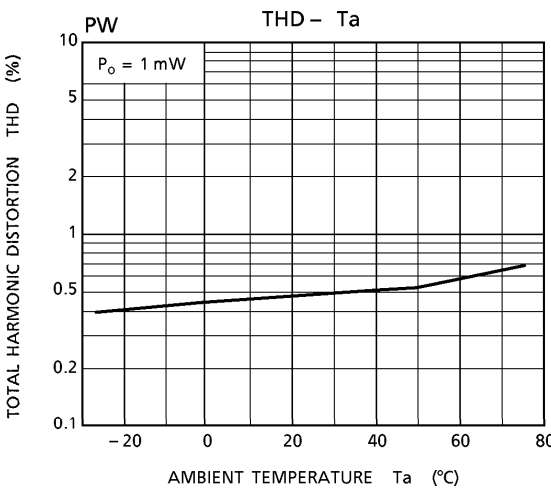
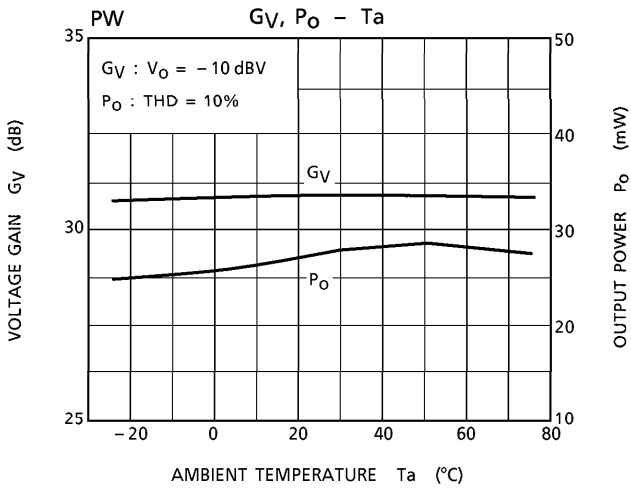
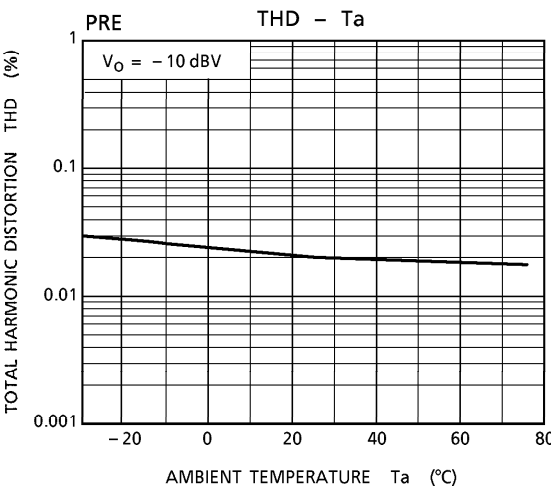
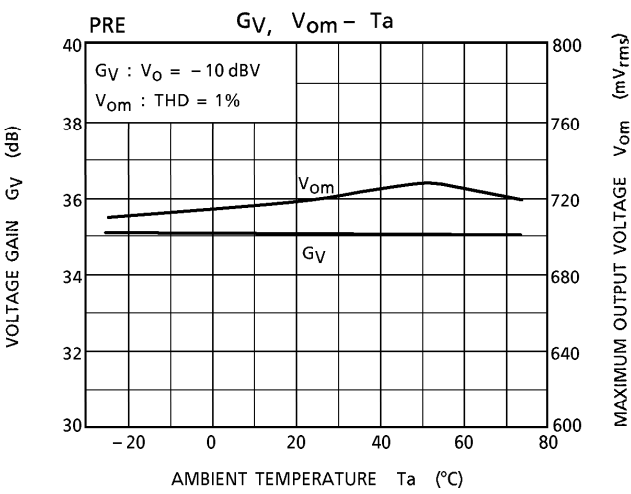
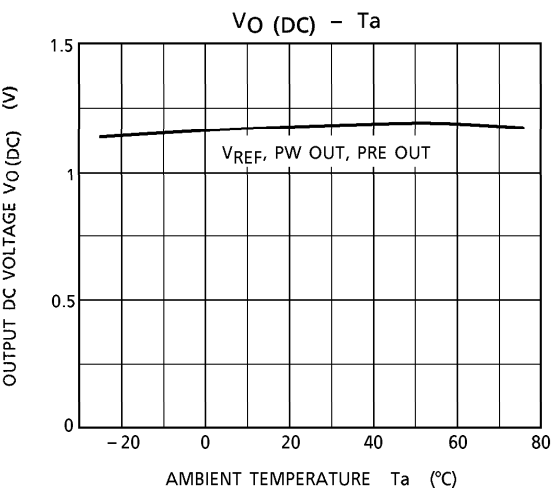
CHARACTERISTIC CURVES

Unless otherwise specified  $V_{CC} = 3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ ,  $f = 1\text{ kHz}$   
Preamplifier :  $R_g = 2.2\text{ k}\Omega$ ,  $R_L = 10\text{ k}\Omega$   
Power amplifier :  $R_g = 600\text{ }\Omega$ ,  $R_L = 16\text{ }\Omega$ , Vol = MAX.  
Motor governor :  $I_m = 100\text{ mA}$

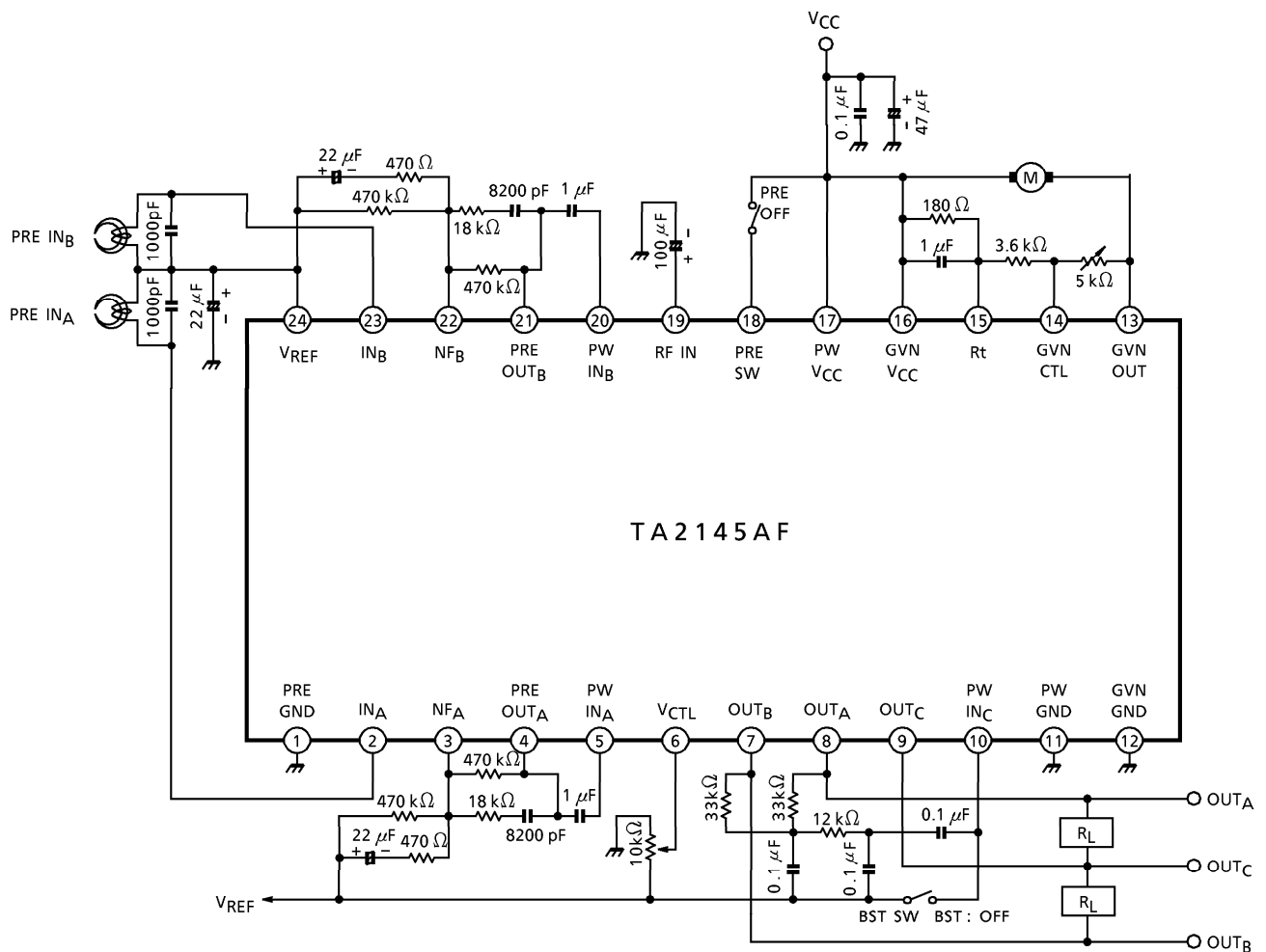






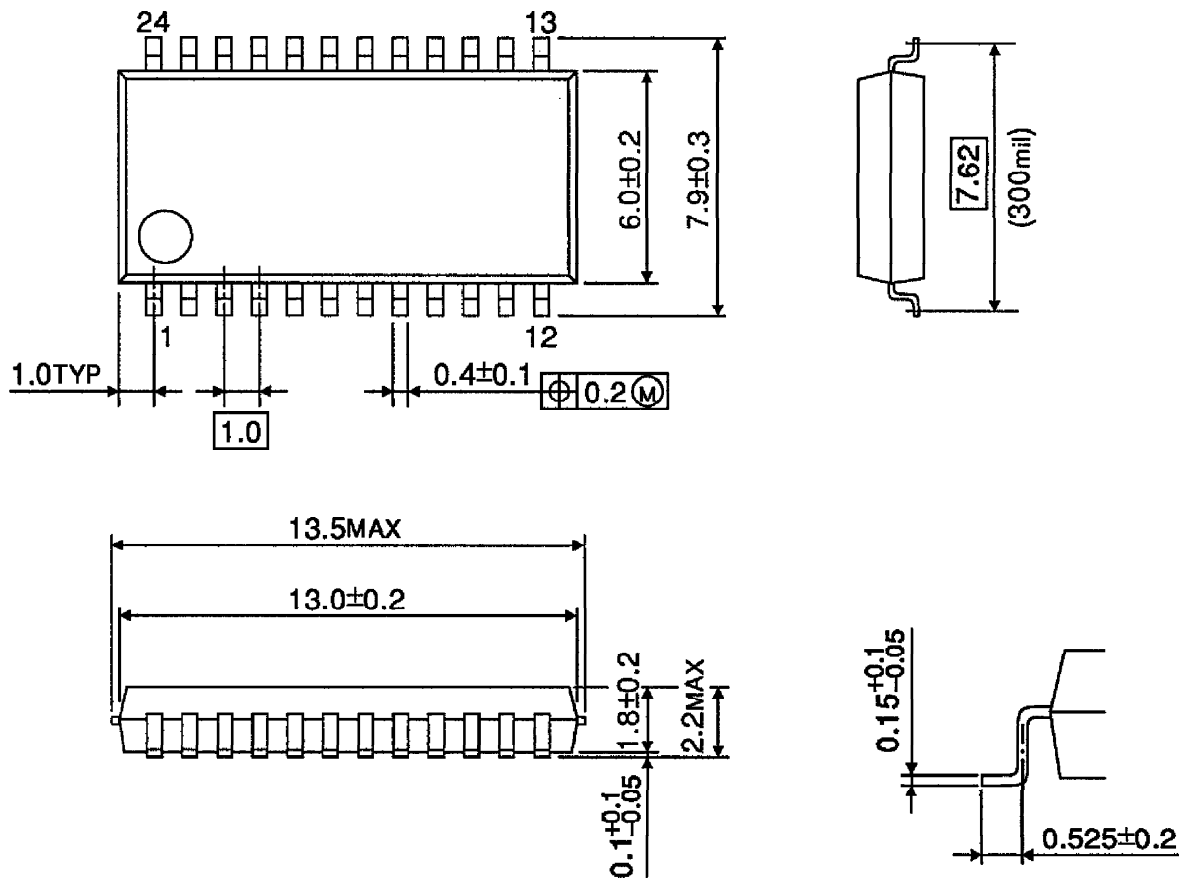


## APPLICATION CIRCUIT



PACKAGE DIMENSIONS  
SSOP24-P-300-1.00

Unit : mm



Weight : 0.32 g (Typ.)