

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

# TA2069AFG

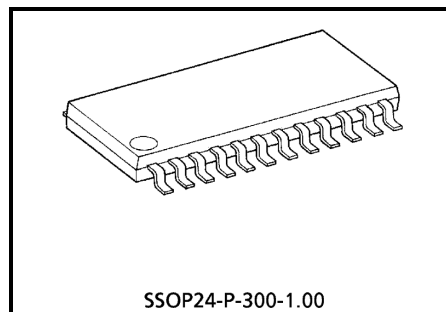
## 3V Stereo Headphone Amplifier (3V USE)

The TA2069AFG is developed for play-back stereo headphone equipments (3V use).

It is built in dual preamplifiers, dual OCL power amplifiers, motor governor, DC volume control and volume limiter 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.)
- Built-in power amplifier  
OCL (output condenser-less)  
Voltage gain :  $G_V = 31dB$  (typ.)
- Built-in motor governor  
Current proportion type
- Built-in DC volume control function  
DC volume maximum attenuation :  $ATT = 82dB$  (typ.)
- Built-in volume limiter function
- Built-in bass boost function
- Operating supply voltage range ( $T_a = 25^\circ C$ )  
PRE + PW:  $V_{CC} (opr) = 1.8 \sim 3.6V$   
GVN:  $V_{CC} (opr) = 2.1 \sim 3.6V$  (motor voltage = 1.8V)
- Low supply current ( $V_{CC} = 3V$ ,  $f = 1kHz$ ,  $T_a = 25^\circ C$ , typ.)  
PRE + PW

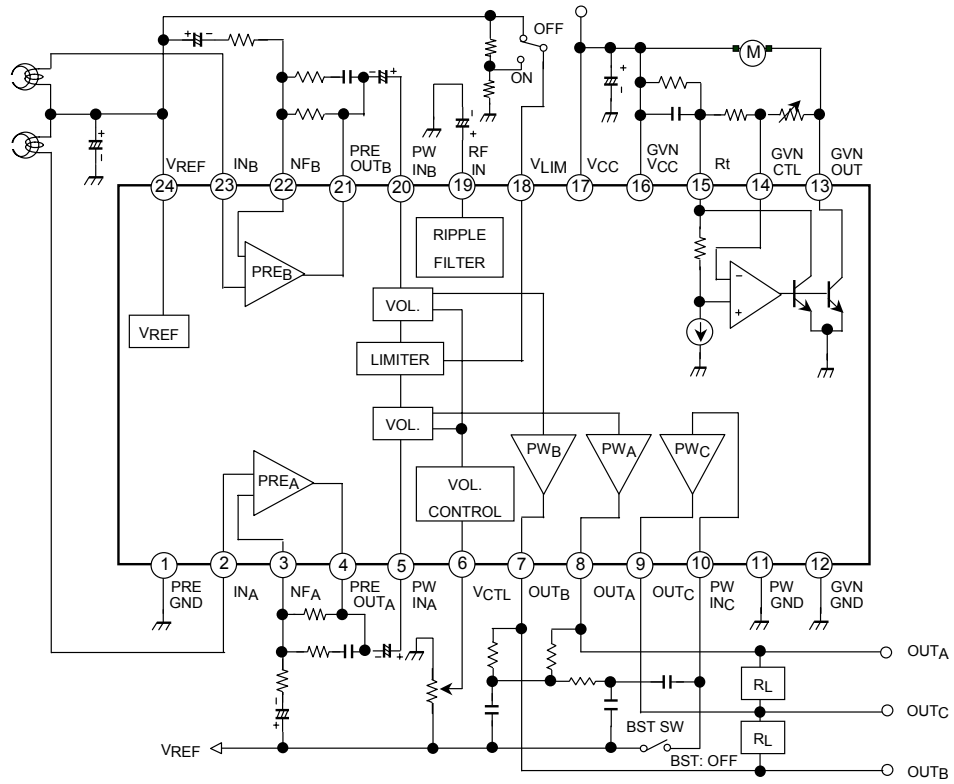


Weight: 0.32g (typ.)

|                  | No Signal | Output Power |           |
|------------------|-----------|--------------|-----------|
|                  |           | 0.1mW × 2    | 0.5mW × 2 |
| $R_L = 16\Omega$ | 9.5mA     | 14.2mA       | 19.5mA    |
| $R_L = 32\Omega$ | 9.5mA     | 12.5mA       | 16.5mA    |

GVN:  $I_{CC} = 2.5mA$

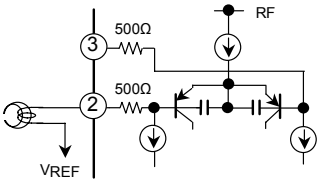
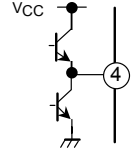
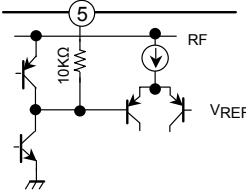
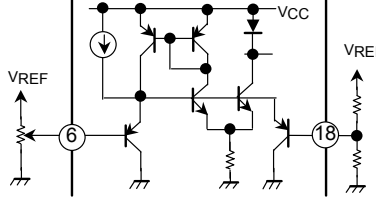
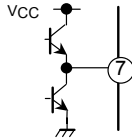
## Block Diagram

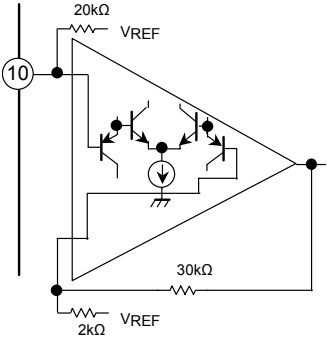
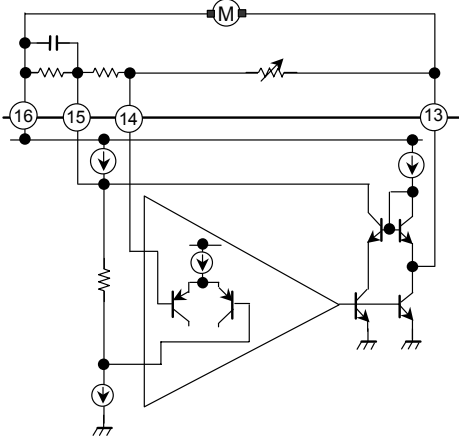
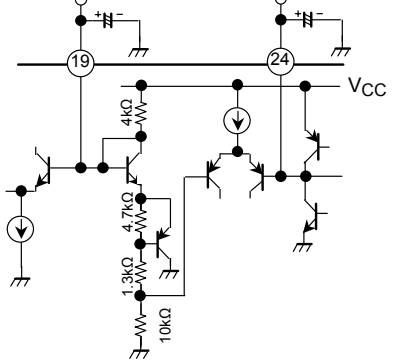


## Terminal Explanation

Terminal Voltage: Typical terminal voltage at no signal with test circuit

( $V_{CC} = 3V$ ,  $T_a = 25^\circ C$ )

| 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>      |                                                                                                                 |                                                                                      | 1.2                  |
| 3        | NF <sub>A</sub>      | NF of preamplifier                                                                                              |                                                                                      |                      |
| 22       | NF <sub>B</sub>      |                                                                                                                 |                                                                                      |                      |
| 4        | PRE OUT <sub>A</sub> | Output of preamplifier                                                                                          |    | 1.2                  |
| 21       | PRE OUT <sub>B</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<br>• This terminal can be used also for V <sub>LIM</sub> terminal.            |  | —                    |
| 18       | V <sub>LIM</sub>     | The terminal of volume limiter level control<br>• This terminal can be used also for V <sub>CTL</sub> terminal. |                                                                                      | —                    |
| 7        | OUT <sub>B</sub>     | Output of power amplifier                                                                                       |  | 1.2                  |
| 8        | OUT <sub>A</sub>     |                                                                                                                 |                                                                                      |                      |
| 9        | OUT <sub>C</sub>     |                                                                                                                 |                                                                                      |                      |

| Terminal |                     | Function                                                                           | Internal Circuit                                                                     | Terminal Voltage (V) |
|----------|---------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------|
| No.      | Name                |                                                                                    |                                                                                      |                      |
| 10       | PW IN <sub>C</sub>  | 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       | R <sub>t</sub>      | The terminal of amateur compensation resistor                                      |                                                                                      | —                    |
| 16       | GVN V <sub>CC</sub> | V <sub>CC</sub> for motor governor stage.                                          |                                                                                      | 3                    |
| 17       | V <sub>CC</sub>     | V <sub>CC</sub> for preamplifier stage and power amplifier stage.                  | —                                                                                    | 3                    |
| 19       | RF IN               | Ripple filter of power supply                                                      |  | 2.5                  |
| 24       | V <sub>REF</sub>    | Reference voltage<br>• Preamplifier and power amplifier operate on this reference. |                                                                                      | 1.2                  |

## Application Note

### 1. VCC and GND

This IC has two VCC terminals and three GND terminals. Pattern layout should be designed carefully to reduce the common impedance.

#### VCC

VCC (pin 17): Preamplifier stage and power amplifier stage.

GVN VCC (pin 16): Motor governor stage.

#### GND

PRE GND (pin 1): Preamplifier stage and power amplifier stage except the power drive stage.

PW GND (pin 11): Power drive stage of power amplifier.

GVN GND (pin 12): Motor governor stage.

### 2. VREF

It is necessary to stabilize the VREF circuit, the internal circuit operate on this reference.

### 3. Preamplifier

Input signal should be applied to VREF standard, otherwise pop noise become bigger when VCC is turned on and off.

### 4. 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.

## Maximum Ratings (Ta = 25°C)

| Characteristic           | Symbol               | Rating   | Unit |
|--------------------------|----------------------|----------|------|
| Supply voltage           | V <sub>CC</sub>      | 4        | V    |
| Power dissipation        | P <sub>D</sub>       | (Note 1) | mW   |
|                          |                      | (Note 2) |      |
| Output current (PW AMP.) | I <sub>O</sub> (PW)  | 200      | mA   |
| Output current (GVN)     | I <sub>O</sub> (GVN) | 700      | mA   |
| Operating temperature    | T <sub>opr</sub>     | -25~75   | °C   |
| Storage temperature      | T <sub>stg</sub>     | -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,  $V_{CC} = 3V$ ,  $T_a = 25^\circ C$ ,  $f = 1kHz$ , SW2: a, SW5: a

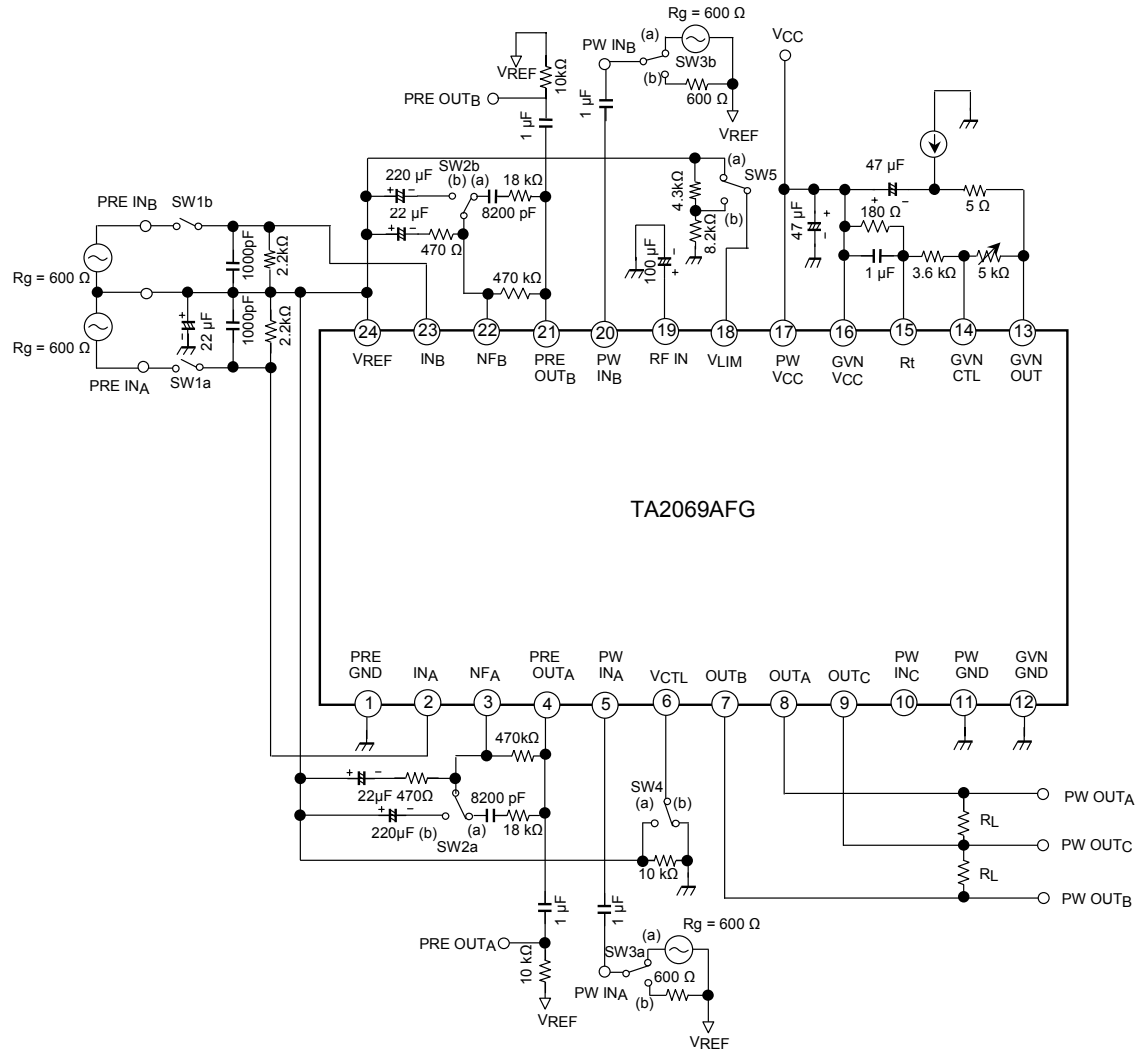
Preamplifier:  $R_g = 2.2k\Omega$ ,  $R_L = 10k\Omega$ , SW1: ON, SW3: b, SW4: b

Power amplifier:  $R_g = 600\Omega$ ,  $R_L = 16\Omega$ , Vol: Max, SW1: OPEN, SW3: a, SW4: a

Motor governor:  $I_m = 100mA$ , SW1: OPEN, SW3: b, SW4: b

| Characteristic           | Symbol                          | Test Circuit      | Test Condition                                                                          | Min  | Typ.  | Max  | Unit              |
|--------------------------|---------------------------------|-------------------|-----------------------------------------------------------------------------------------|------|-------|------|-------------------|
| Quiescent supply current | $I_{CCQ}$                       | —                 | PRE + PW + GVN<br>$V_{in} = 0$ , VOL: Min, SW4: b                                       | —    | 12    | 18   | mA                |
| Pre AMP.                 | Open loop voltage gain          | $G_{VO}$          | $V_O = -10dBV$ , SW2: b                                                                 | —    | 86    | —    | dB                |
|                          | Closed loop voltage gain        | $G_{VC}$          | $V_O = -10dBV$                                                                          | —    | 35    | —    | dB                |
|                          | maximum output voltage          | $V_{om}$          | THD = 1%                                                                                | 550  | 720   | —    | mV <sub>rms</sub> |
|                          | Total harmonic distortion       | THD1              | $V_O = -10dBV$                                                                          | —    | 0.02  | 0.3  | %                 |
|                          | Equivalent input noise voltage  | $V_{ni}$          | $R_g = 2.2k\Omega$ , SW1: OPEN<br>BPF = 20Hz~20kHz, NAB ( $G_V$<br>= 35dB, $f = 1kHz$ ) | —    | 1.2   | 2.4  | $\mu V_{rms}$     |
|                          | Cross talk                      | CT1               | $V_O = -10dBV$                                                                          | —    | 70    | —    | dB                |
|                          | Ripple rejection ratio          | RR1               | $f_r = 100Hz$ , $V_r = -20dBV$                                                          | —    | 48    | —    | dB                |
| Power AMP.               | Voltage gain 1                  | $G_{V1}$          | $V_O = -10dBV$                                                                          | 29   | 31    | 33   | dB                |
|                          | Channel balance                 | CB                |                                                                                         | -1.5 | 0     | +1.5 | dB                |
|                          | Voltage gain 2                  | $G_{V2}$          | $V_O = -10dBV$ , SW5: b                                                                 | —    | 5     | —    | dB                |
|                          | Output power 1                  | $P_{O1}$          | $R_L = 16\Omega$ , THD = 10%                                                            | 17   | 28    | —    | mW                |
|                          | Output power 2                  | $P_{O2}$          | $R_L = 32\Omega$ , THD = 10%                                                            | —    | 20    | —    | mW                |
|                          | Total harmonic distortion       | THD2              | $P_O = 1mW$                                                                             | —    | 0.5   | —    | %                 |
|                          | Output noise voltage 1          | $V_{no1}$         | $R_g = 600\Omega$ , SW3: b<br>BPF = 20Hz~20kHz                                          | —    | 270   | 400  | $\mu V_{rms}$     |
|                          | Output noise voltage 2          | $V_{no2}$         | $R_g = 600\Omega$ , SW3: b<br>SW5: b, BPF = 20Hz~20kHz                                  | —    | 45    | —    | $\mu V_{rms}$     |
|                          | Ripple rejection ratio          | RR2               | $f_r = 100Hz$ , $V_r = -20dBV$                                                          | —    | 52    | —    | dB                |
|                          | Cross talk                      | CT2               | $V_O = -10dBV$                                                                          | —    | 32    | —    | dB                |
|                          | DC volume maximum attenuation   | ATT               | $V_O = -10dBV$<br>SW4: a→b<br>(VOL: Max→min)                                            | —    | 82    | —    | dB                |
|                          | Supply current                  | $I_{CC}$          | $I_m = 0$                                                                               | —    | 2.5   | 4.3  | mA                |
| Motor Governor           | Saturation voltage              | $V_{CE(sat)}$     | $I_m = 200mA$                                                                           | —    | —     | 0.5  | V                 |
|                          | Reference voltage               | $V_{REF}$         | $I_m = 100mA$                                                                           | 0.76 | 0.81  | 0.86 | V                 |
|                          | Reference voltage fluctuation 1 | $\Delta V_{REF1}$ | $V_{CC} = 2.1\sim 3.6V$                                                                 | —    | 0.25  | —    | % / V             |
|                          | Reference voltage fluctuation 2 | $\Delta V_{REF2}$ | $I_m = 25\sim 250mA$                                                                    | —    | 0.003 | —    | % / mA            |
|                          | Reference voltage fluctuation 3 | $\Delta V_{REF3}$ | $T_a = -25\sim 75^\circ C$                                                              | —    | 0.005 | —    | % / $^\circ C$    |
|                          | Current ratio                   | K                 |                                                                                         | 34.5 | 37.5  | 40.5 |                   |
|                          | Current ratio fluctuation 1     | $\Delta K1$       | $V_{CC} = 2.1\sim 3.6V$                                                                 | —    | 0.25  | —    | % / V             |
|                          | Current ratio fluctuation 2     | $\Delta K2$       | $I_m = 25\sim 250mA$                                                                    | —    | 0.08  | —    | % / mA            |
|                          | Current ratio fluctuation 3     | $\Delta K3$       | $T_a = -25\sim 75^\circ C$                                                              | —    | 0.005 | —    | % / $^\circ C$    |

## Test Circuit



## Characteristic Curves

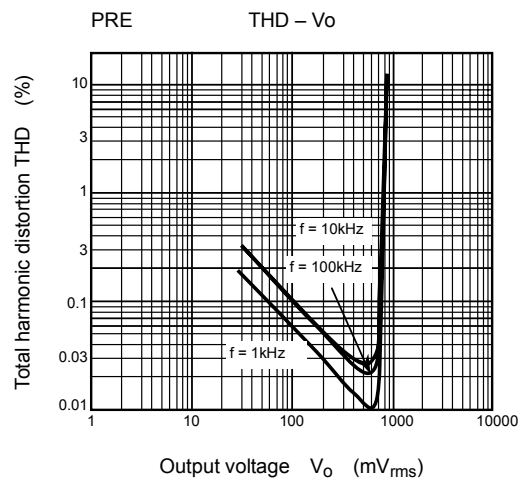
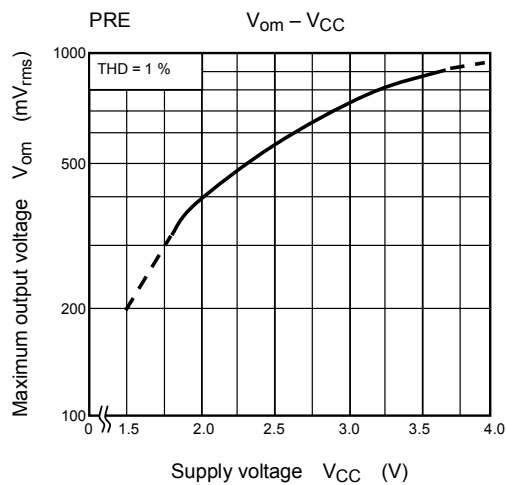
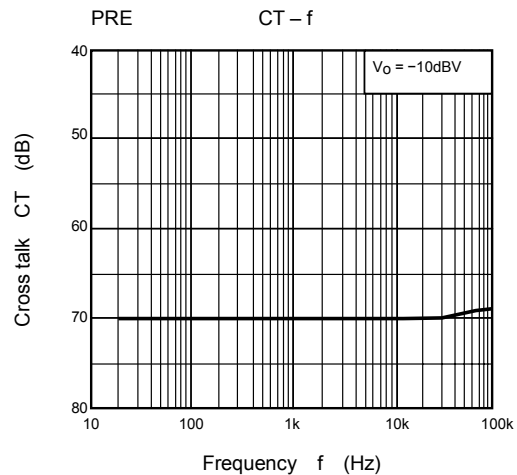
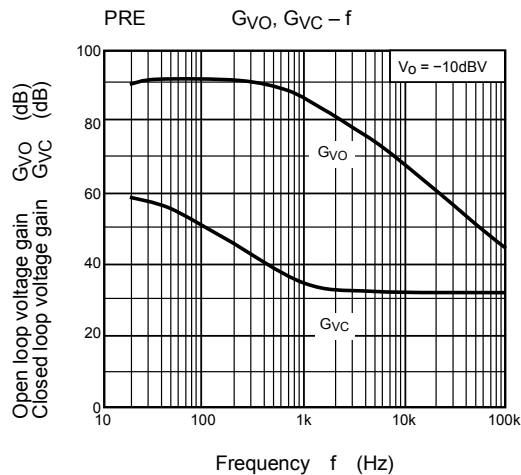
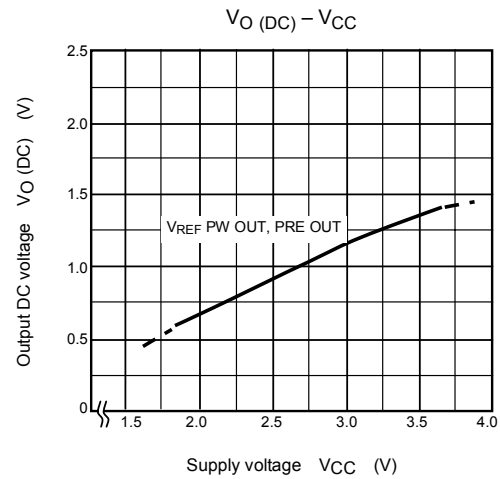
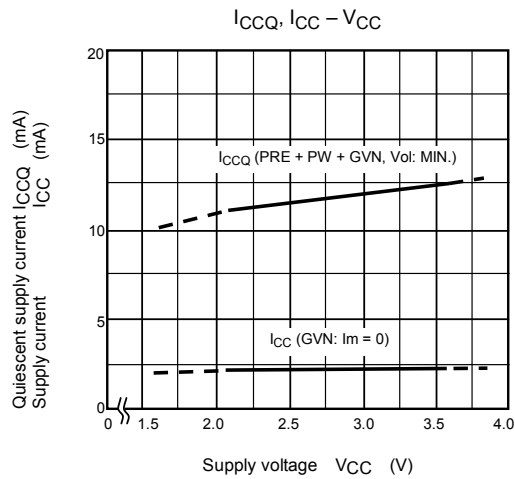
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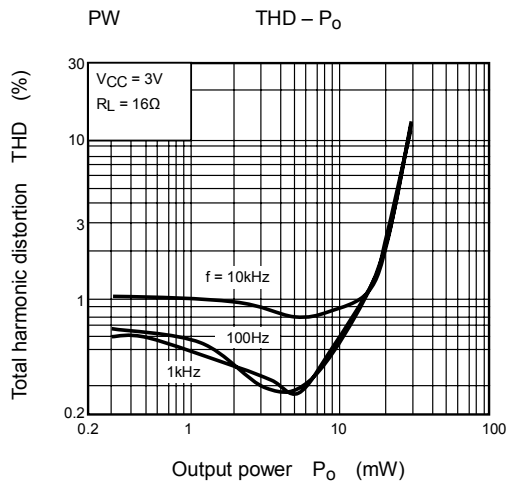
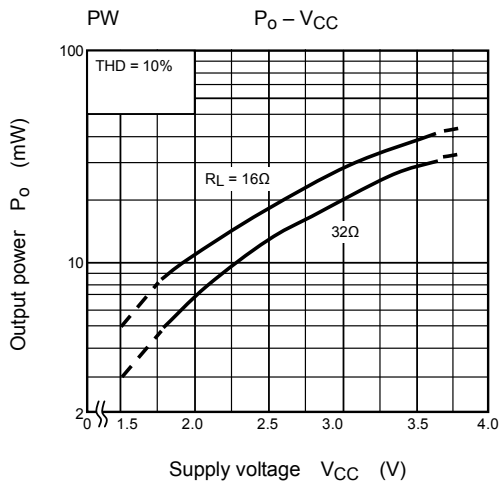
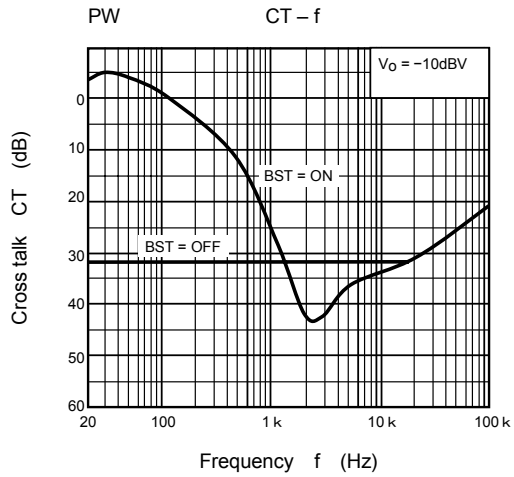
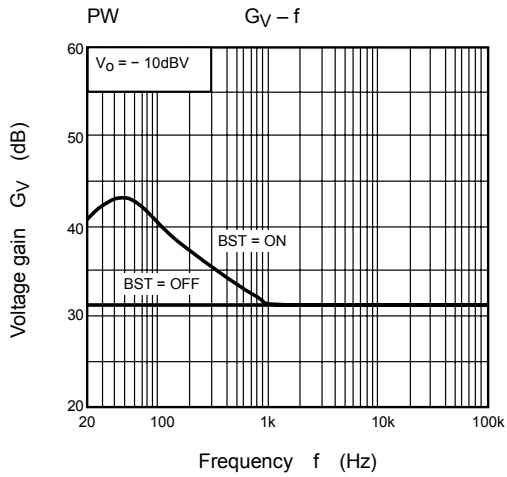
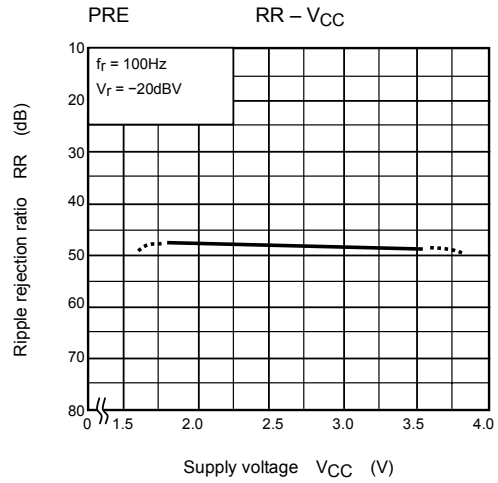
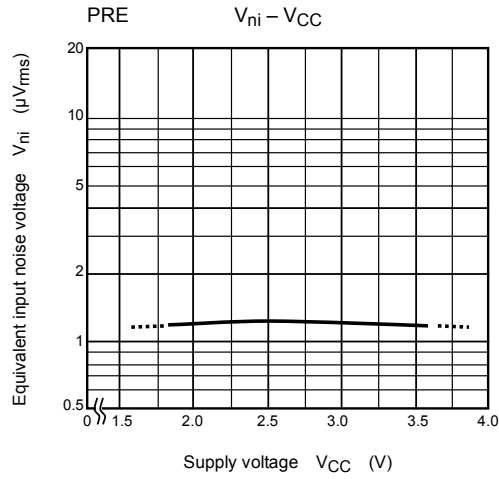
$V_{CC} = 3V$ ,  $T_a = 25^\circ C$ ,  $f = 1kHz$

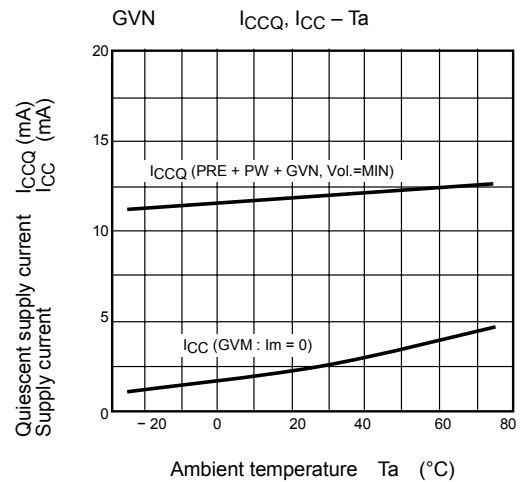
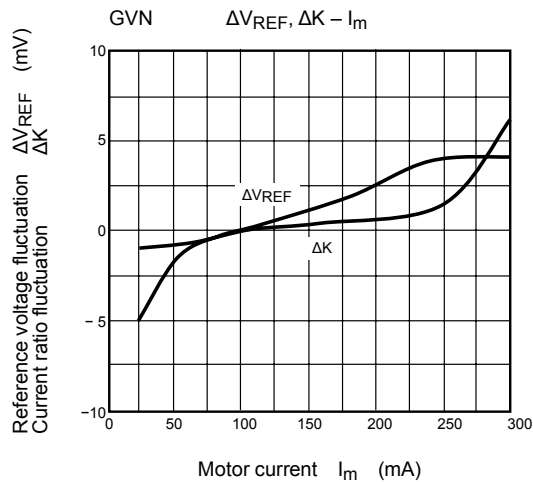
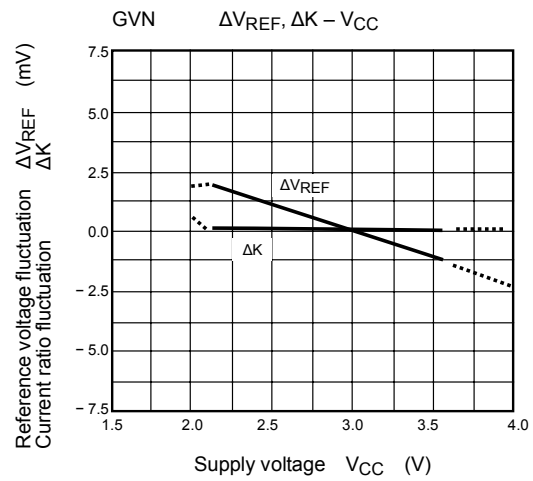
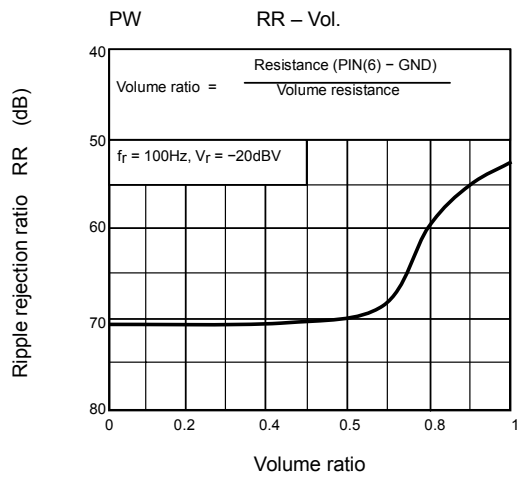
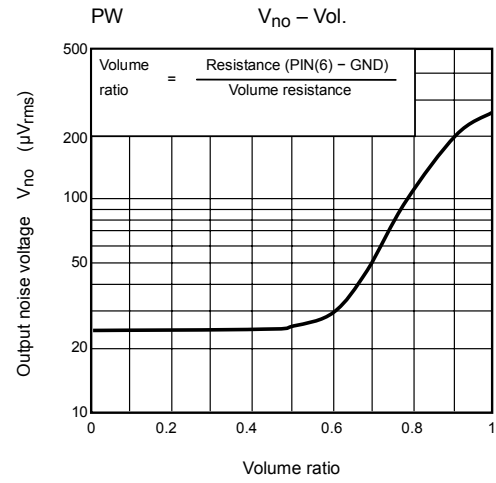
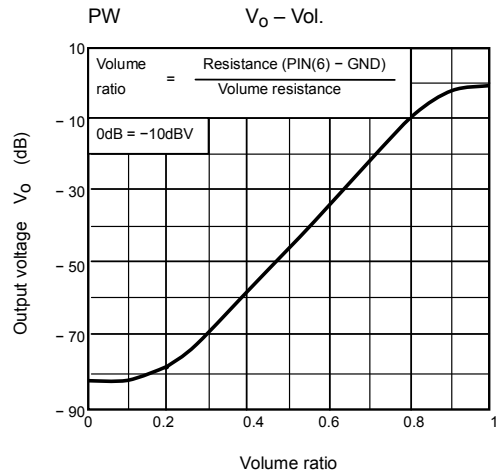
Preamplifier:  $R_g = 2.2k\Omega$ ,  $R_L = 10k\Omega$

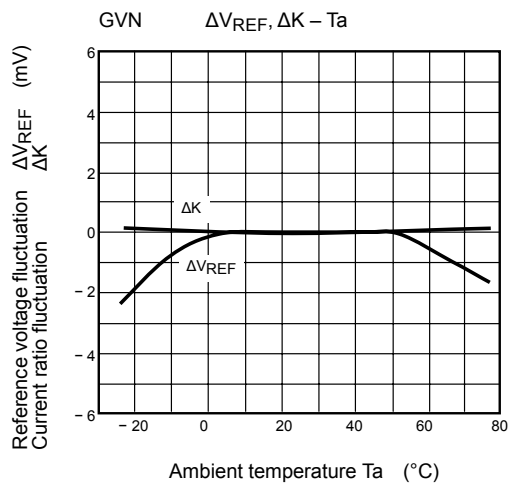
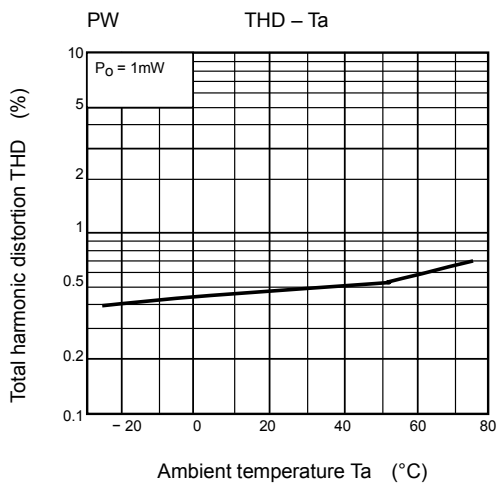
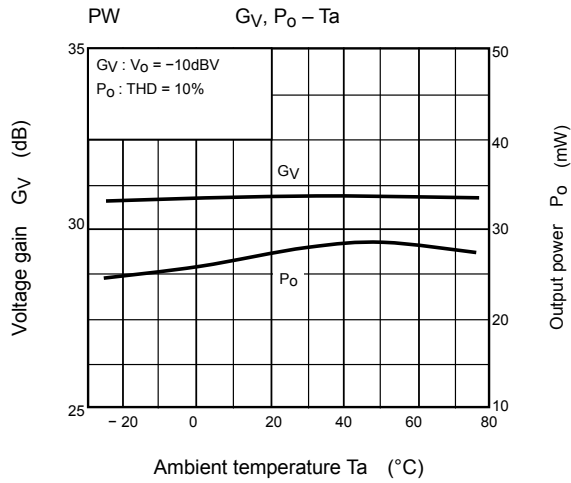
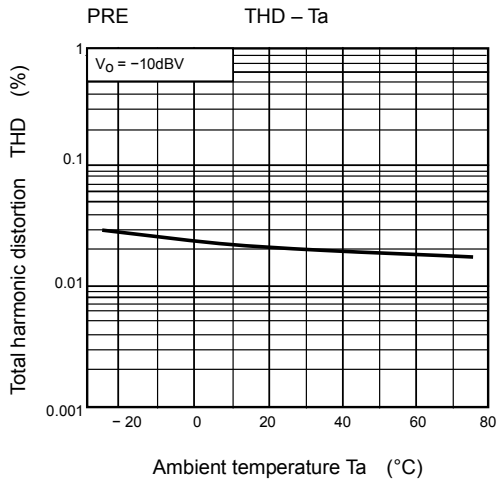
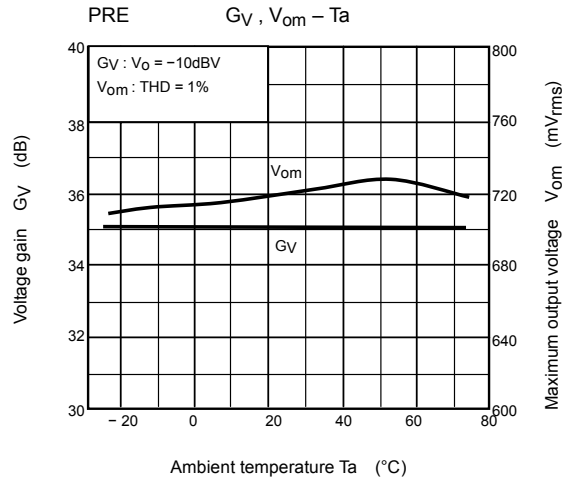
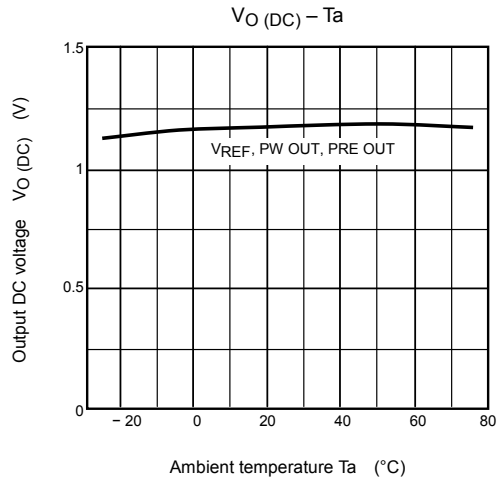
Power amplifier:  $R_g = 600\Omega$ ,  $R_L = 16\Omega$ ,  $V_{ol} = \max.$

Motor governor:  $I_m = 100mA$

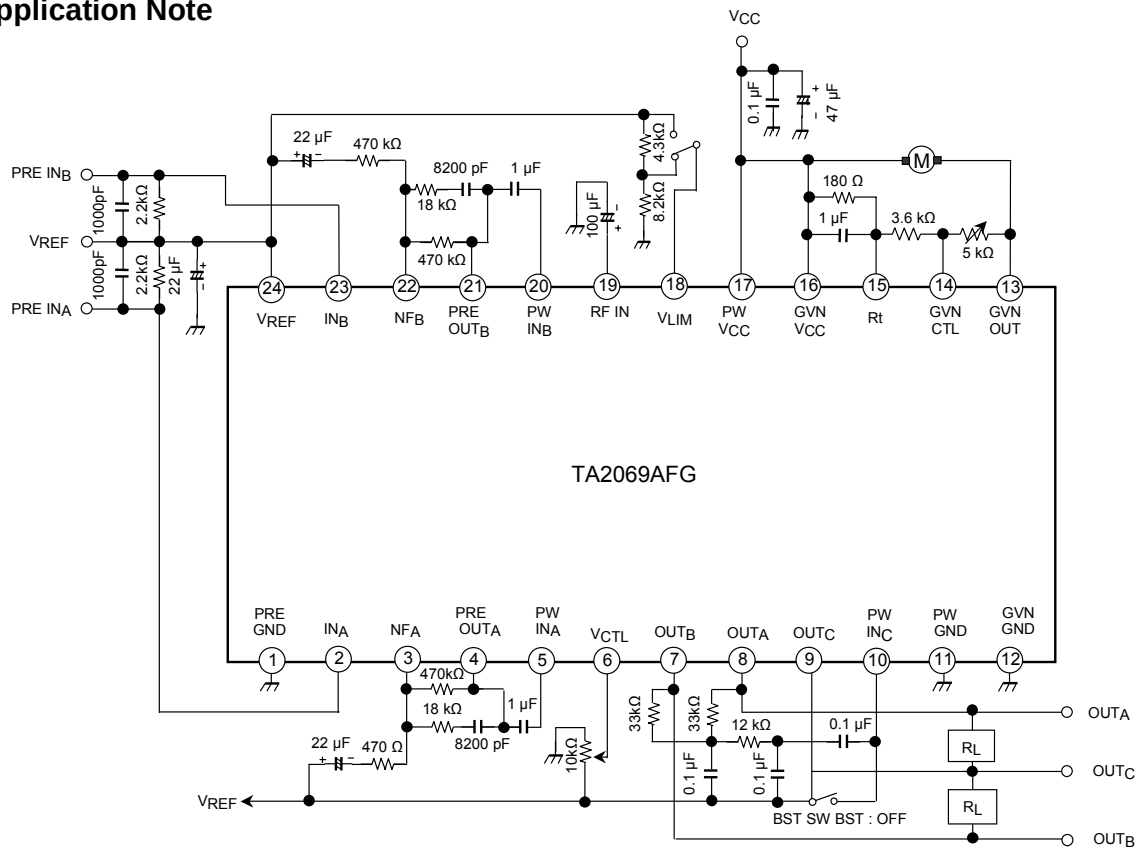








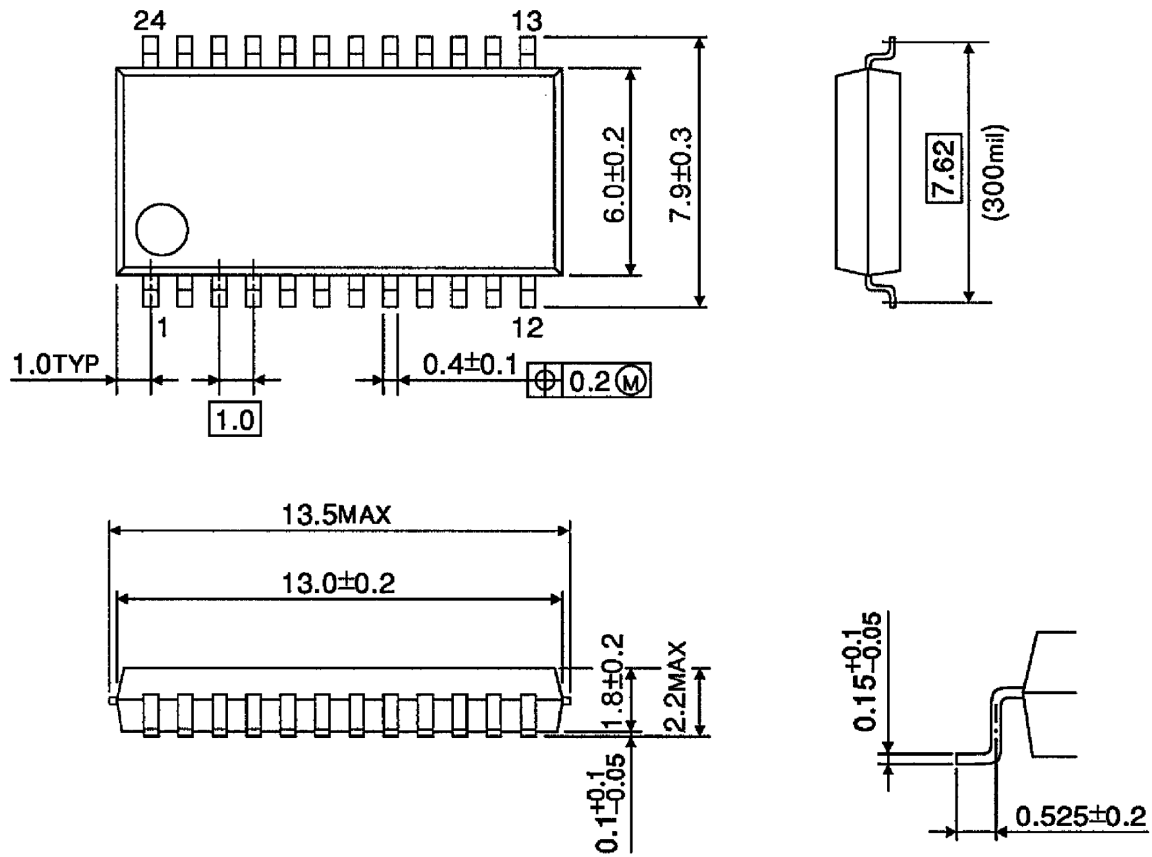
## Application Note



## Package Dimensions

SSOP24-P-300-1.00

Unit : mm



Weight: 0.32g (typ.)

About solderability, following conditions were confirmed

- Solderability

- (1) Use of Sn-63Pb solder Bath

- solder bath temperature = 230°C
    - dipping time = 5 seconds
    - the number of times = once
    - use of R-type flux

- (2) Use of Sn-3.0Ag-0.5Cu solder Bath

- solder bath temperature = 245°C
    - dipping time = 5 seconds
    - the number of times = once
    - use of R-type flux

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030619EBA

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