

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

# TA2069AF

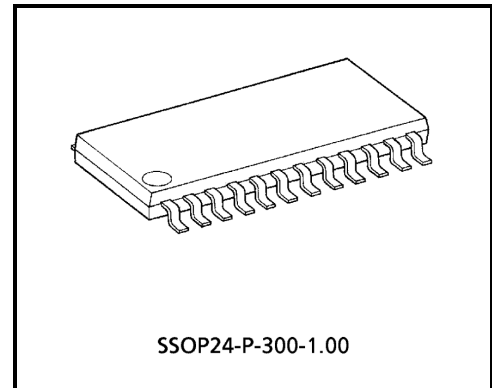
## 3V Stereo Headphone Amplifier (3V USE)

The TA2069AF 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

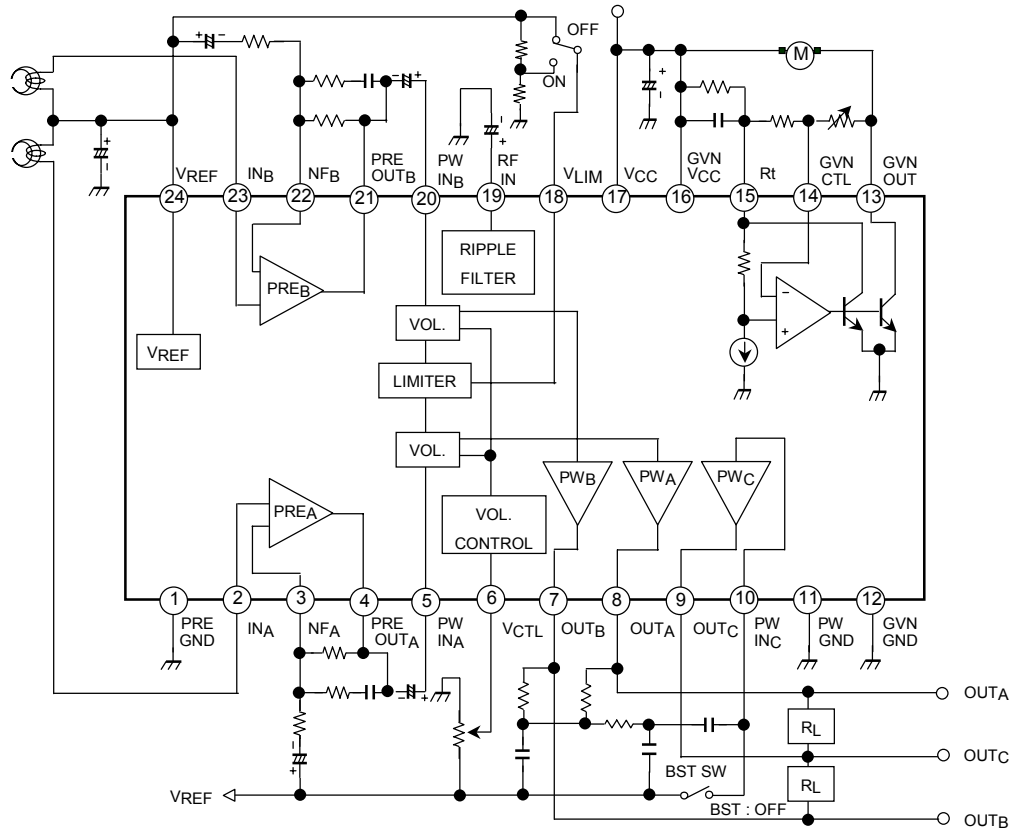


Weight: 0.32g (typ.)

	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 governer stage.	—	0
2	IN <sub>A</sub>	Input of preamplifier		1.2
23	IN <sub>B</sub>			1.2
3	NFA			1.2
22	NFB	NF of preamplifier		
4	PRE OUT <sub>A</sub>	Output of preamplifier		1.2
21	PRE OUT <sub>B</sub>			1.2
5	PW IN <sub>A</sub>	Input of power amplifier		1.2
20	PW IN <sub>B</sub>			1.2
6	V <sub>CTL</sub>	The terminal of DC volume control · This terminal can be used also for V <sub>LIM</sub> terminal.		—
18	V <sub>LIM</sub>	The terminal of volume limiter level control · 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>			1.2
9	OUT <sub>C</sub>			1.2

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
19	RF IN	Ripple filter of power supply		2.5
24	VREF	Reference voltage · 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)	400
		(Note 2)	925
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 3.2mW / °C

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

## Electrical Characteristics

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

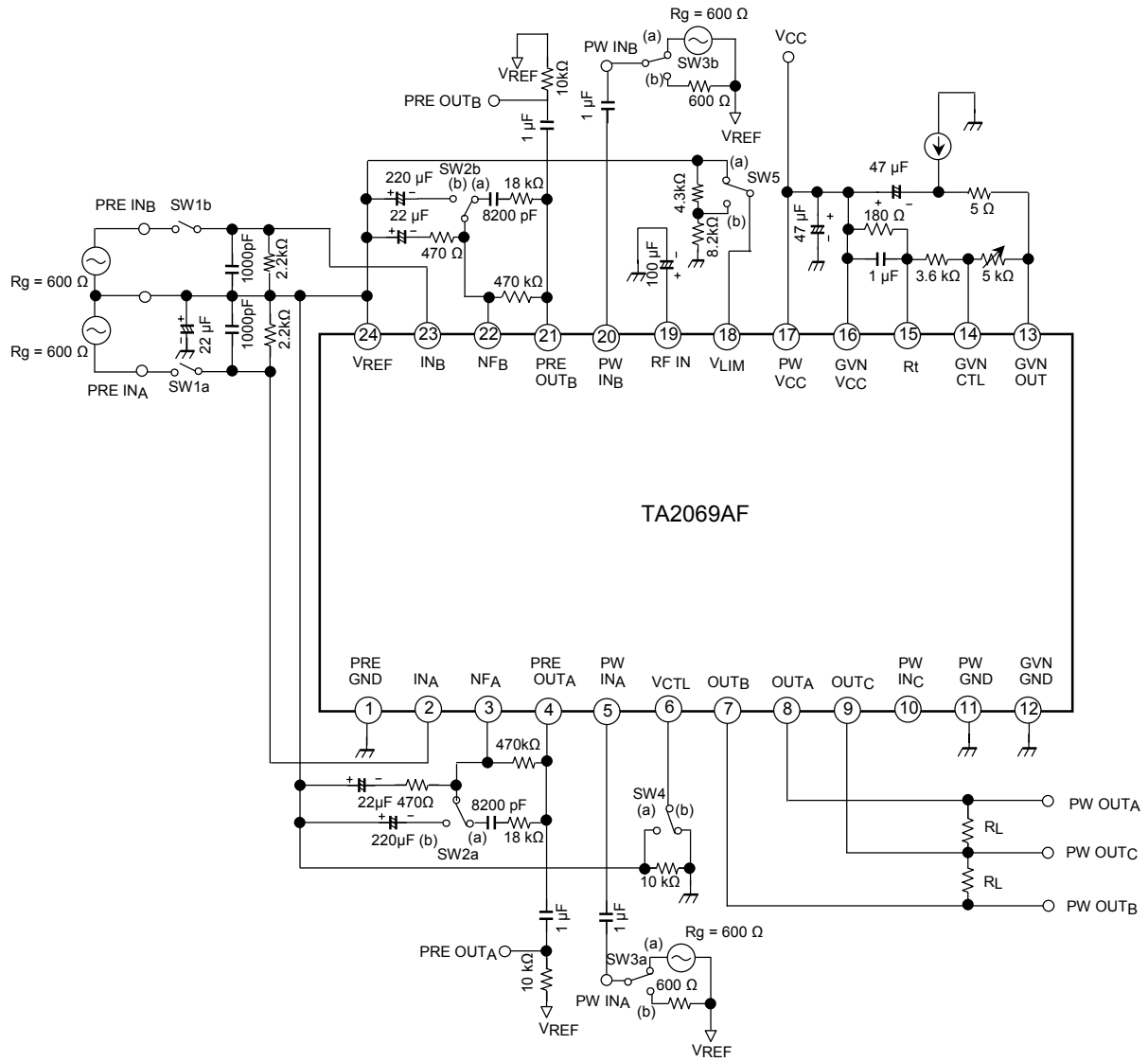
Preamplifier:  $R_g = 2.2k\Omega$ ,  $R_L = 10k\Omega$ , SW1: ON, SW3: b, SW4: b

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 $V_{in} = 0$ , 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 BPF = 20Hz~20kHz, NAB ( $G_V = 35dB$ , $f = 1kHz$ )	—	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 BPF = 20Hz~20kHz	—	270	400	$\mu V_{rms}$
	Output noise voltage 2	$V_{no2}$	—	$R_g = 600\Omega$ , SW3: b 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	—	$V_o = -10dBV$ SW4: a→b (VOL: Max→min)	—	82	—	dB
	Motor Governor	Supply current	$I_{CC}$	—	$I_m = 0$	—	2.5	4.3
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

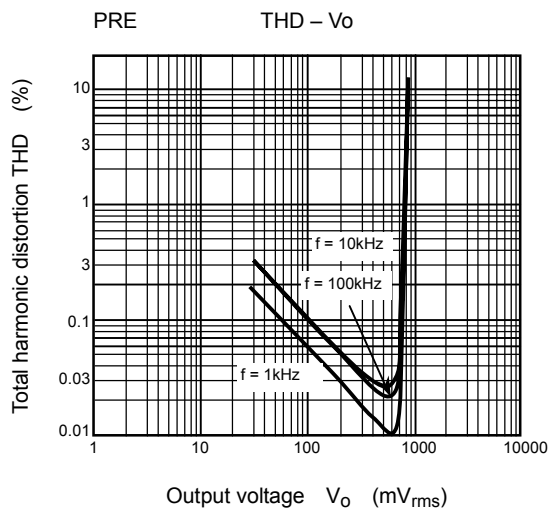
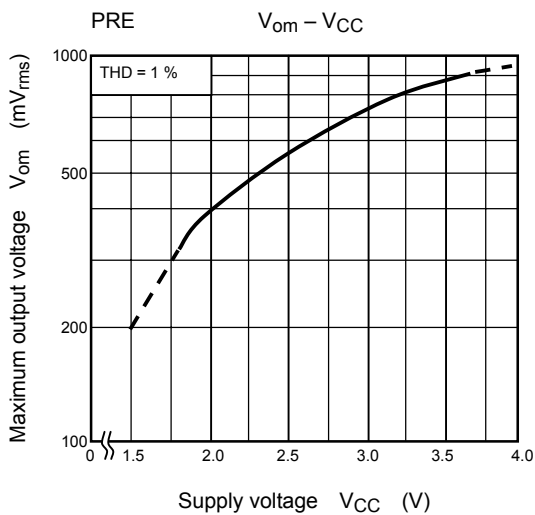
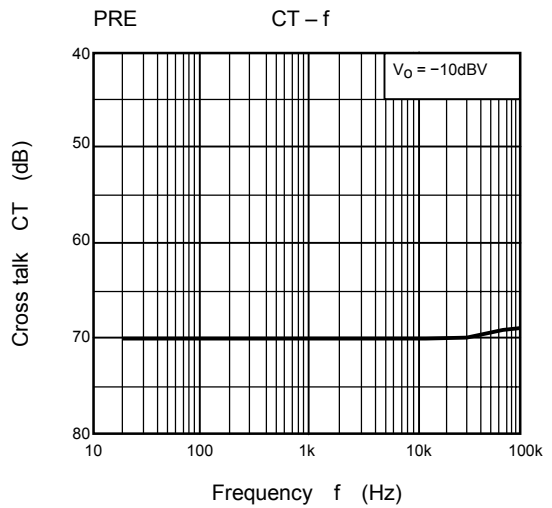
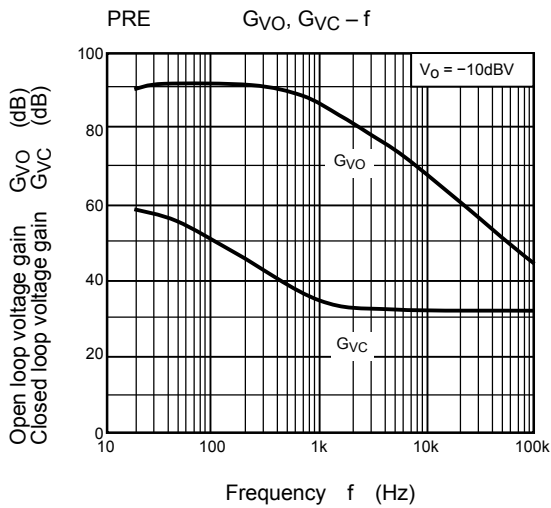
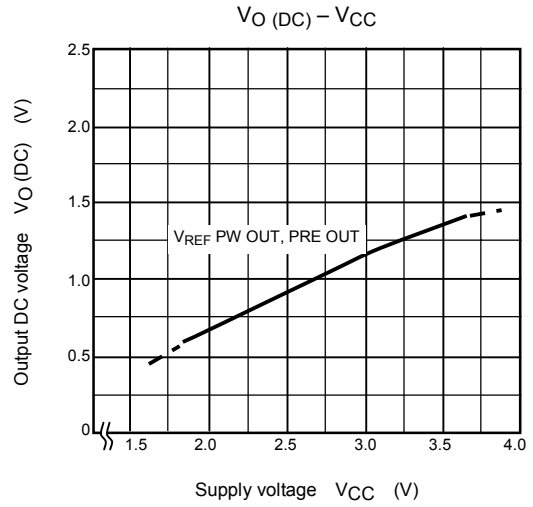
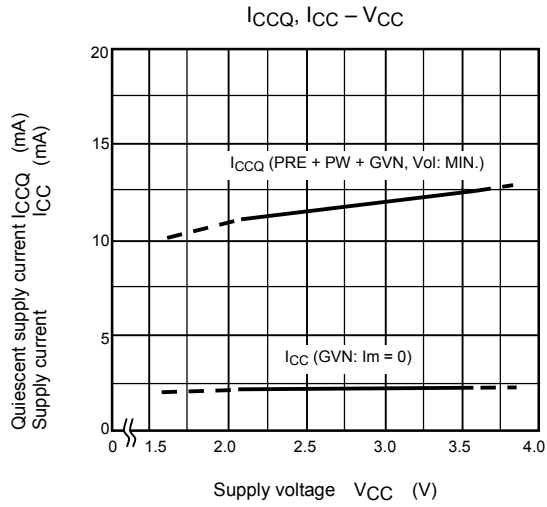
Unless otherwise specified

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

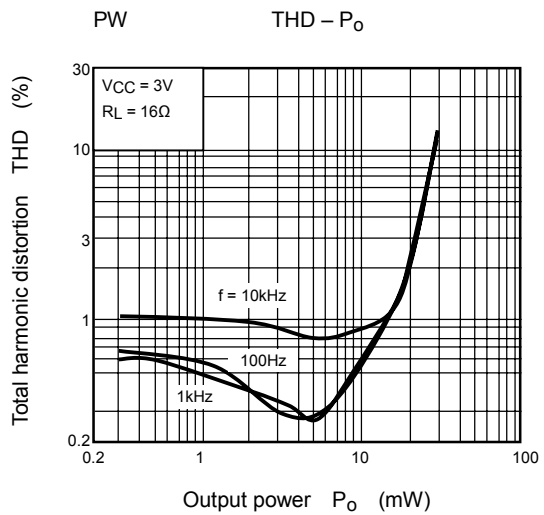
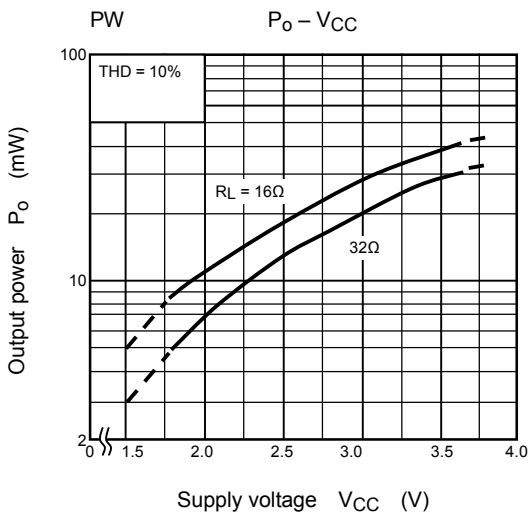
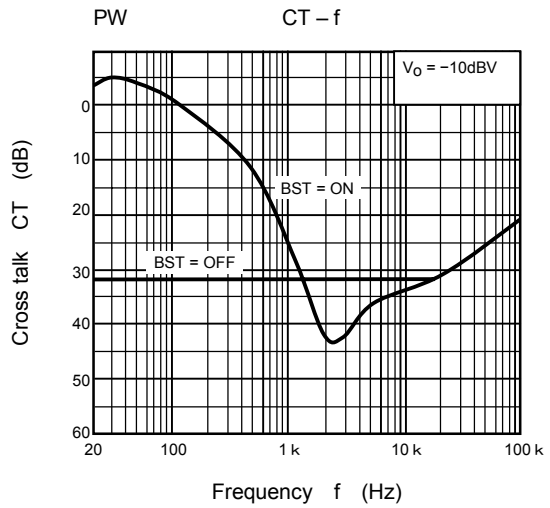
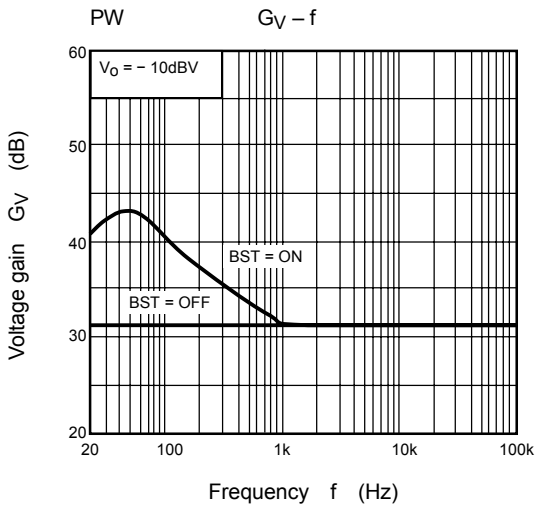
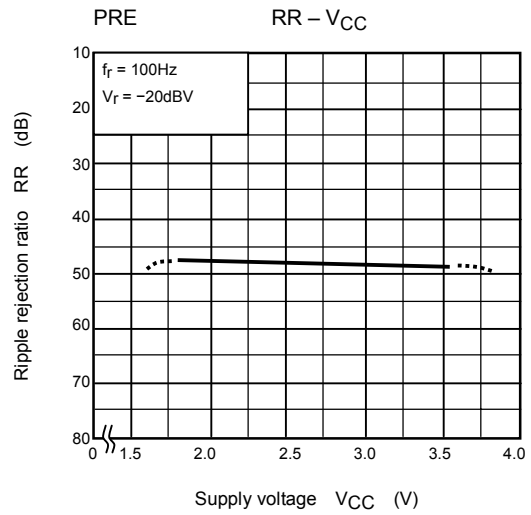
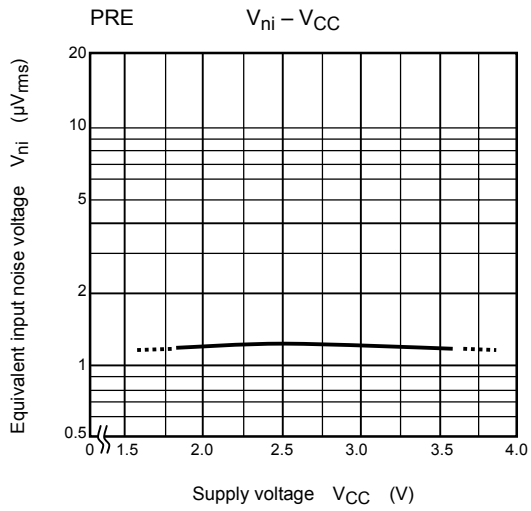
Preamplifier:  $R_g = 2.2k\Omega, R_L = 10k\Omega$

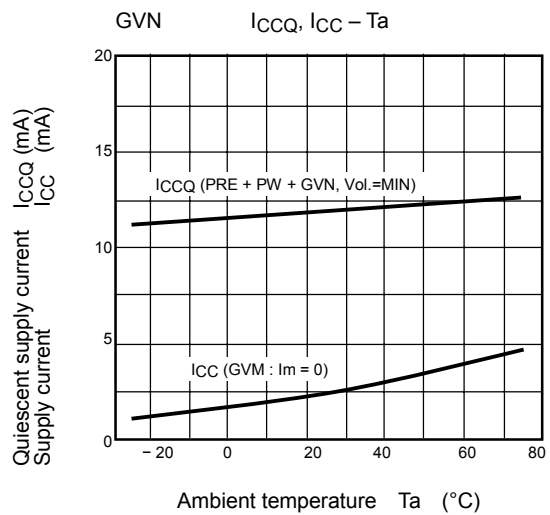
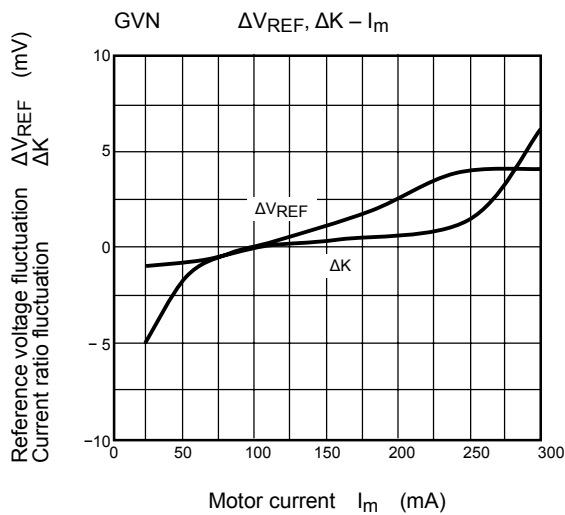
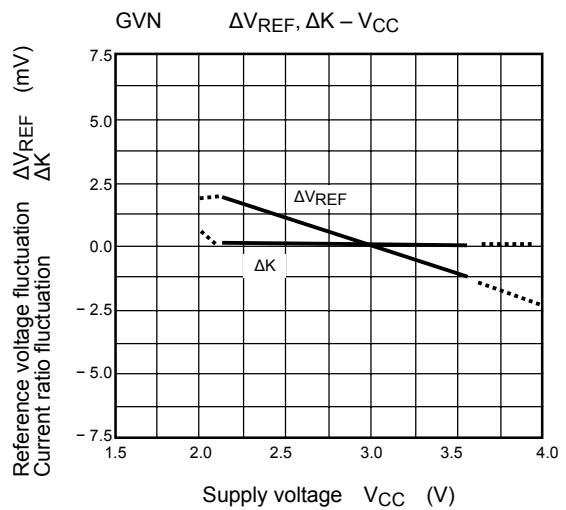
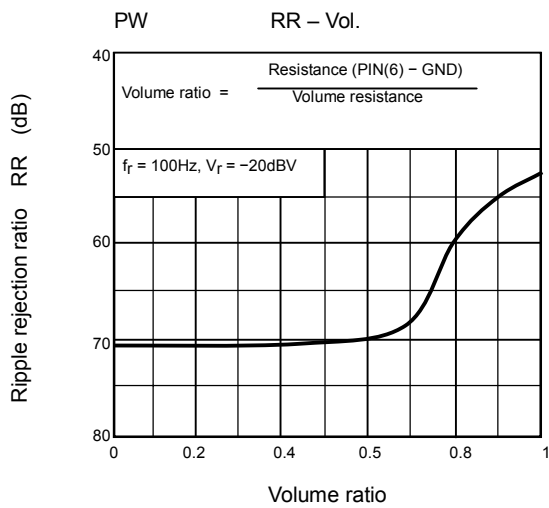
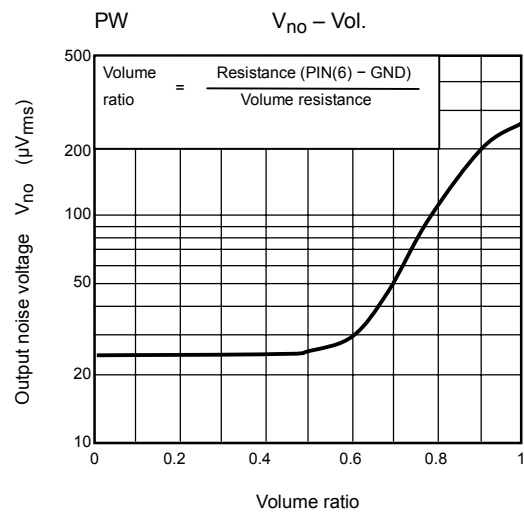
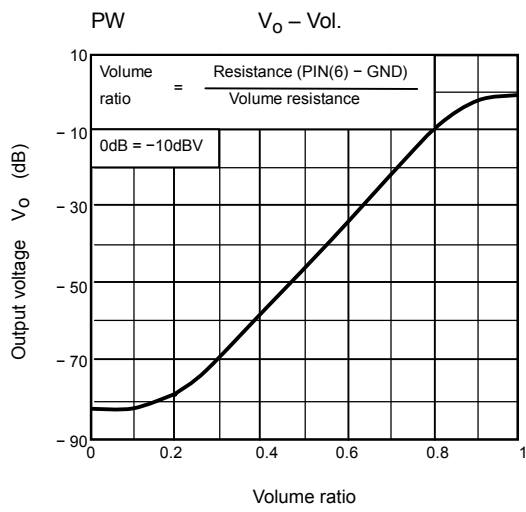
Power amplifier:  $R_g = 600\Omega, R_L = 16\Omega, Vol = max.$

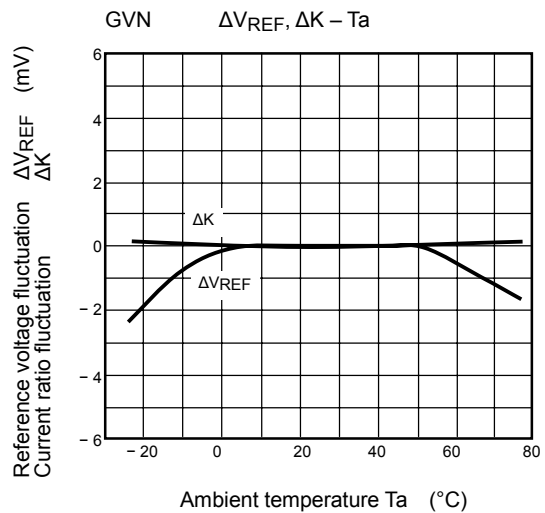
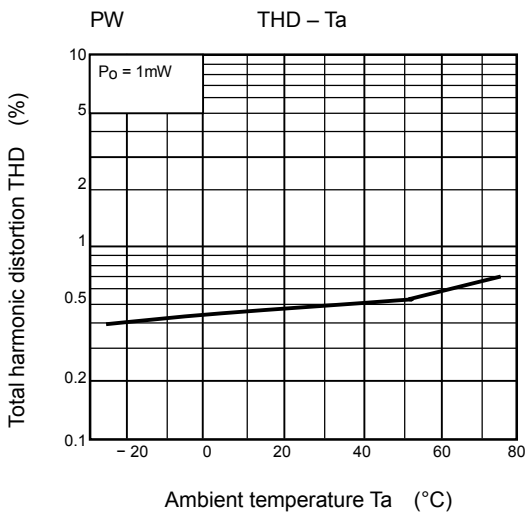
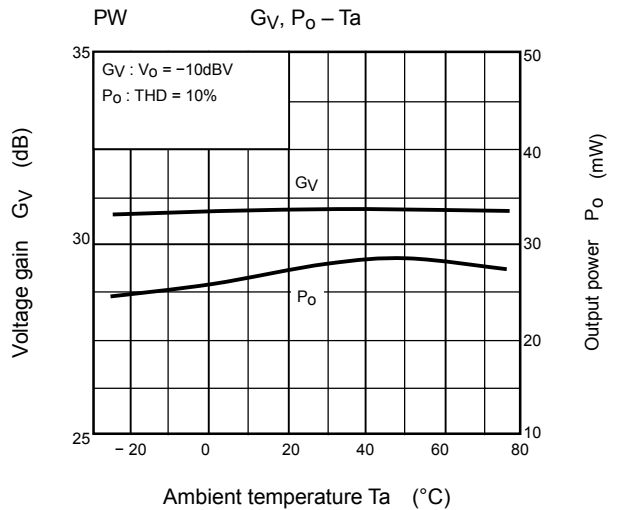
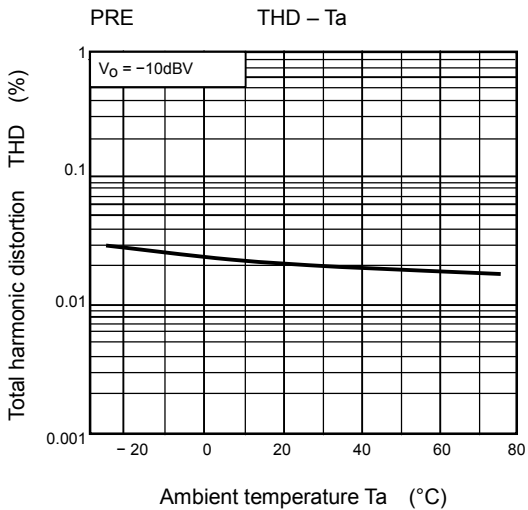
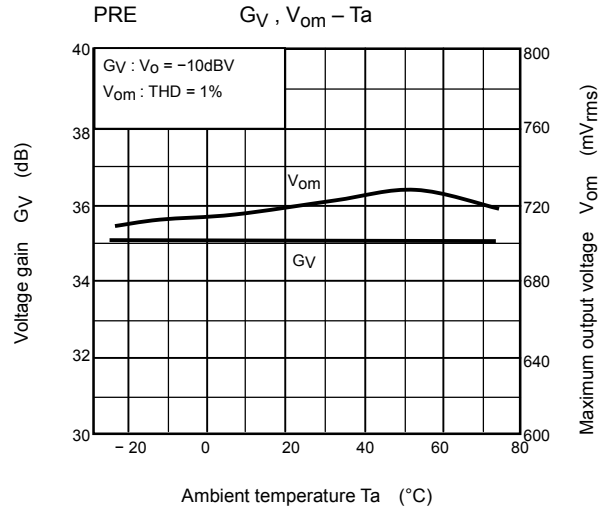
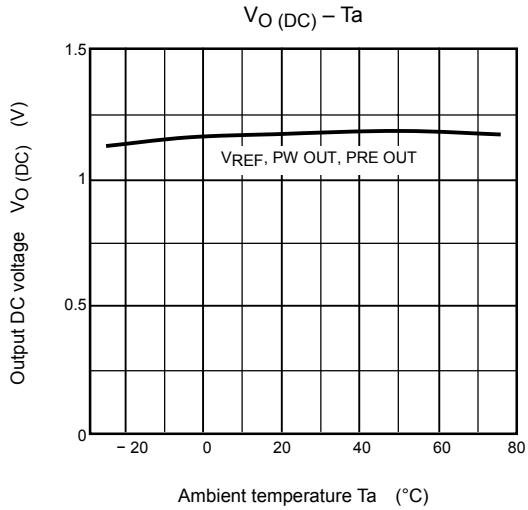
Motor governor:  $I_m = 100mA$



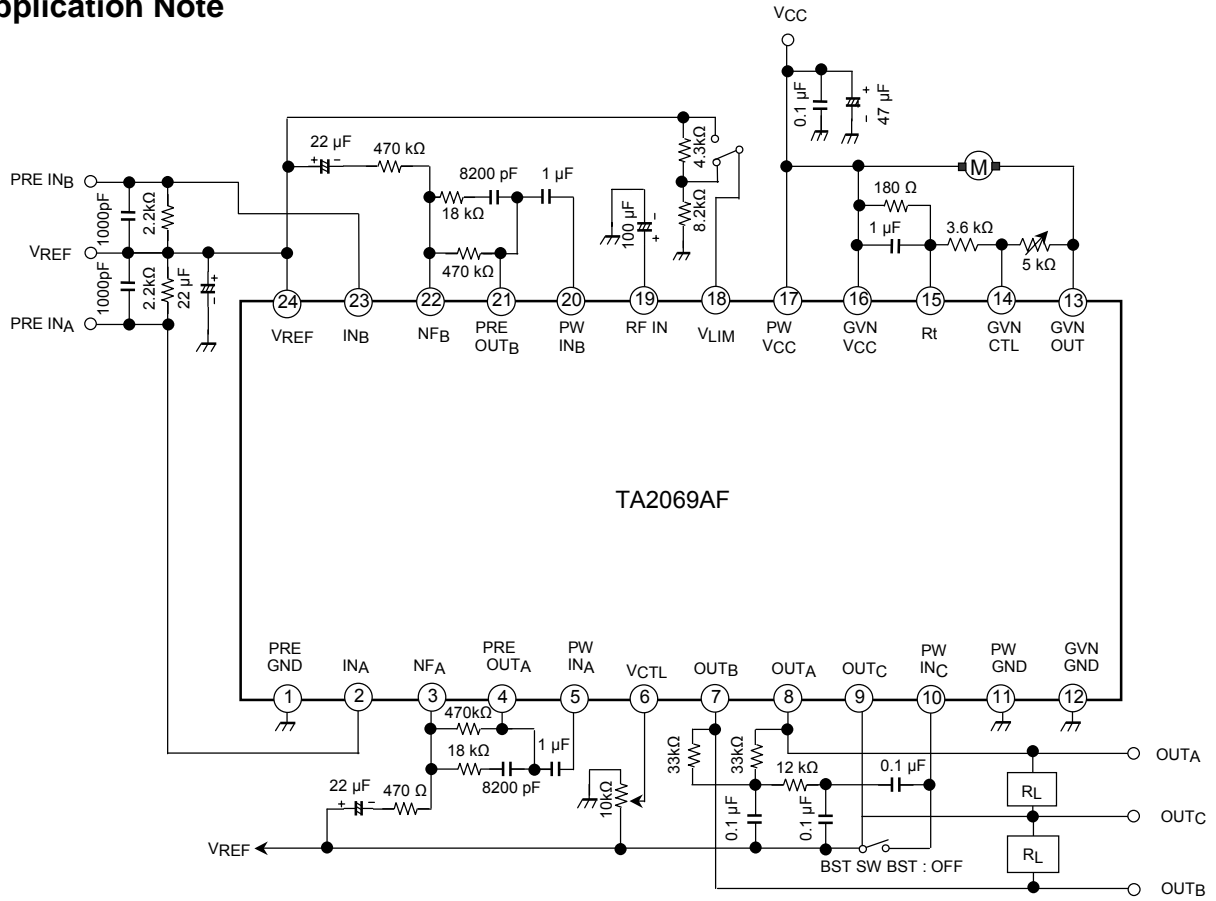








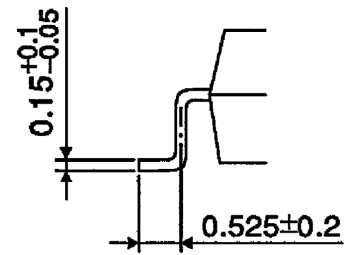
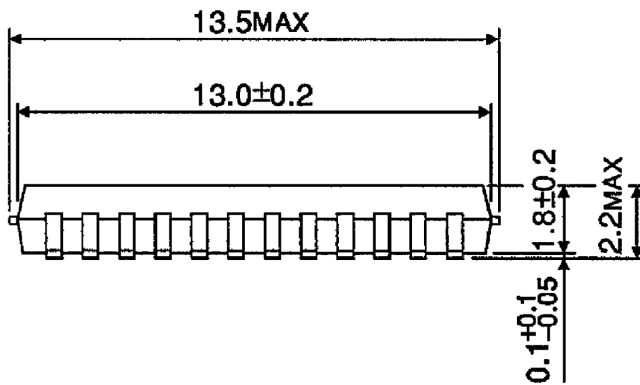
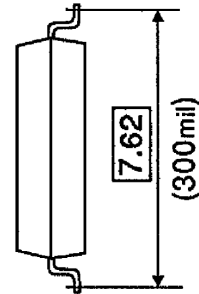
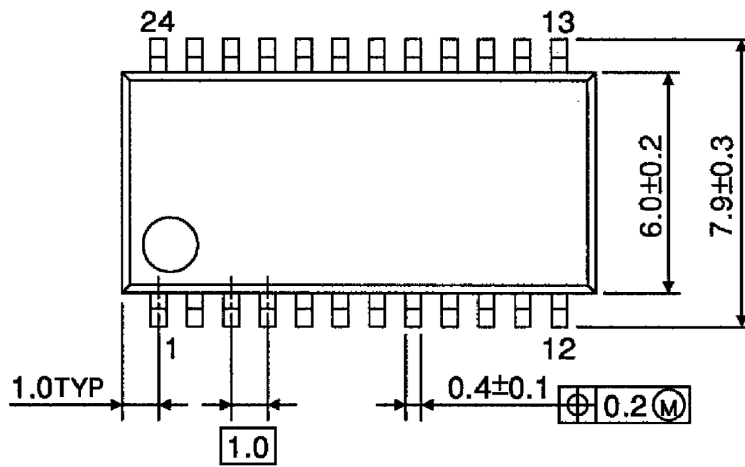
**Application Note**



**Package Dimensions**

SSOP24-P-300-1.00

Unit : mm



Weight: 0.32g (typ.)

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