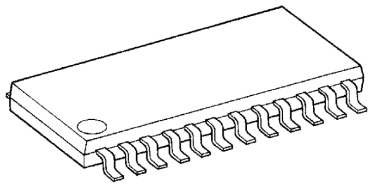
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

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.



SSOP24-P-300-1.00

Weight: 0.32g (typ.)

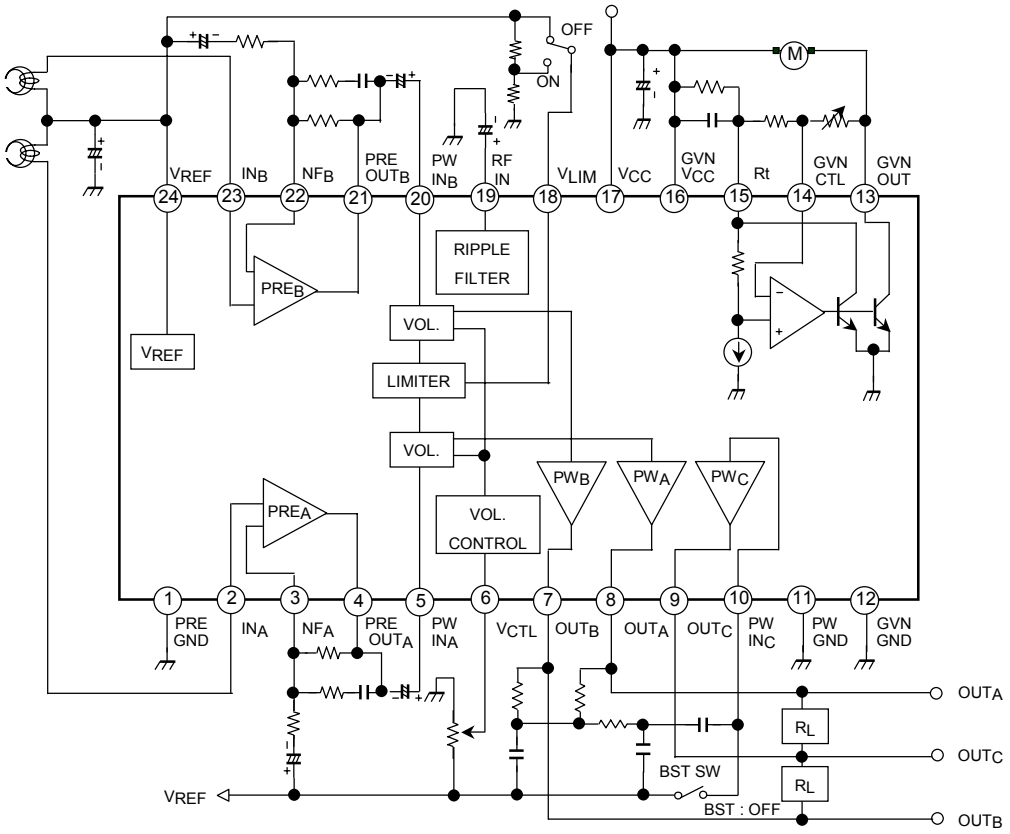
Features

- Built−in preamplifier
  Input coupling condenser−less
  Built−in input capacitor for reducing buzz noise
  Low noise: V_{ni} = 1.2 μV_{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 (Ta = 25°C)
  PRE + PW: V_{CC} (opr) = 1.8~3.6V
  GVN: V_{CC} (opr) = 2.1~3.6V (motor voltage = 1.8V)
- Low supply current (V_{CC} = 3V, f = 1kHz, Ta = 25°C, typ.)
  PRE + PW

	No Signal	Output Power	
		0.1mW × 2	0.5mW × 2
R_L = 16Ω	9.5mA	14.2mA	19.5mA
R_L = 32Ω	9.5mA	12.5mA	16.5mA

GVN: I_{CC} = 2.5mA

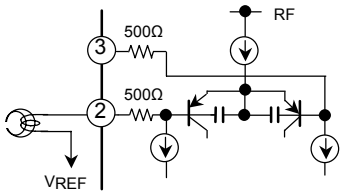
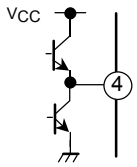
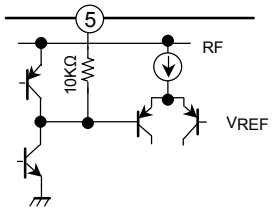
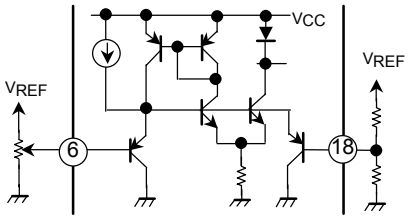
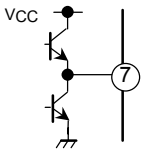
Block Diagram

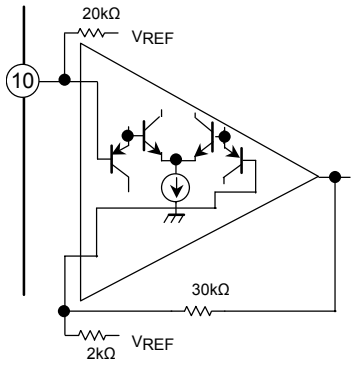
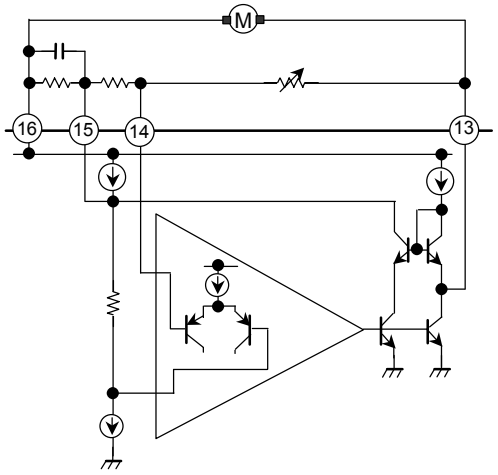
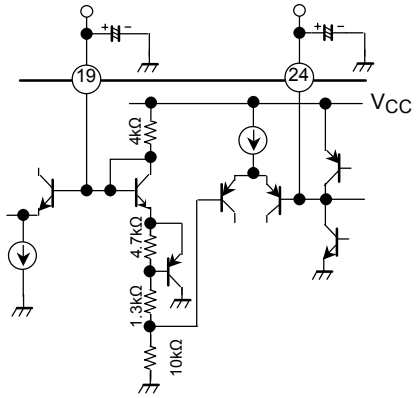


Terminal Explanation

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

(V_{CC} = 3V, Ta = 25°C)

Terminal No.	Terminal Name	Function	Internal Circuit	Terminal Voltage (V)
1	PRE GND	The GND, except for power drive stage and motor governer stage.	—	0
2	IN_A	Input of preamplifier		1.2
23	IN_B			1.2
3	NF_A	NF of preamplifier		1.2
22	NF_B			1.2
4	PRE OUT_A	Output of preamplifier		1.2
21	PRE OUT_B			1.2
5	PW IN_A	Input of power amplifier		1.2
20	PW IN_B			1.2
6	V_{CTL}	The terminal of DC volume control ・This terminal can be used also for V_{LIM} terminal.		—
18	V_{LIM}	The terminal of volume limiter level control ・This terminal can be used also for V_{CTL} terminal.		—
7	OUT_B	Output of power amplifier		1.2
8	OUT_A			1.2
9	OUT_C			1.2

Terminal No.	Terminal Name	Function	Internal Circuit	Terminal Voltage (V)
10	PW IN_C	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 V_{CC}	V_{CC} for motor governor stage.		3
17	V_{CC}	V_{CC} for preamplifier stage and power amplifier stage.	—	3
19	RF IN	Ripple filter of power supply		2.5
24	V_{REF}	Reference voltage ・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 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, the internal circuit operate on this reference.

3. Preamplifier
   Input signal should be applied to V_{REF} standard, otherwise pop noise become bigger when V_{CC} 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_{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 3.2mW / °C

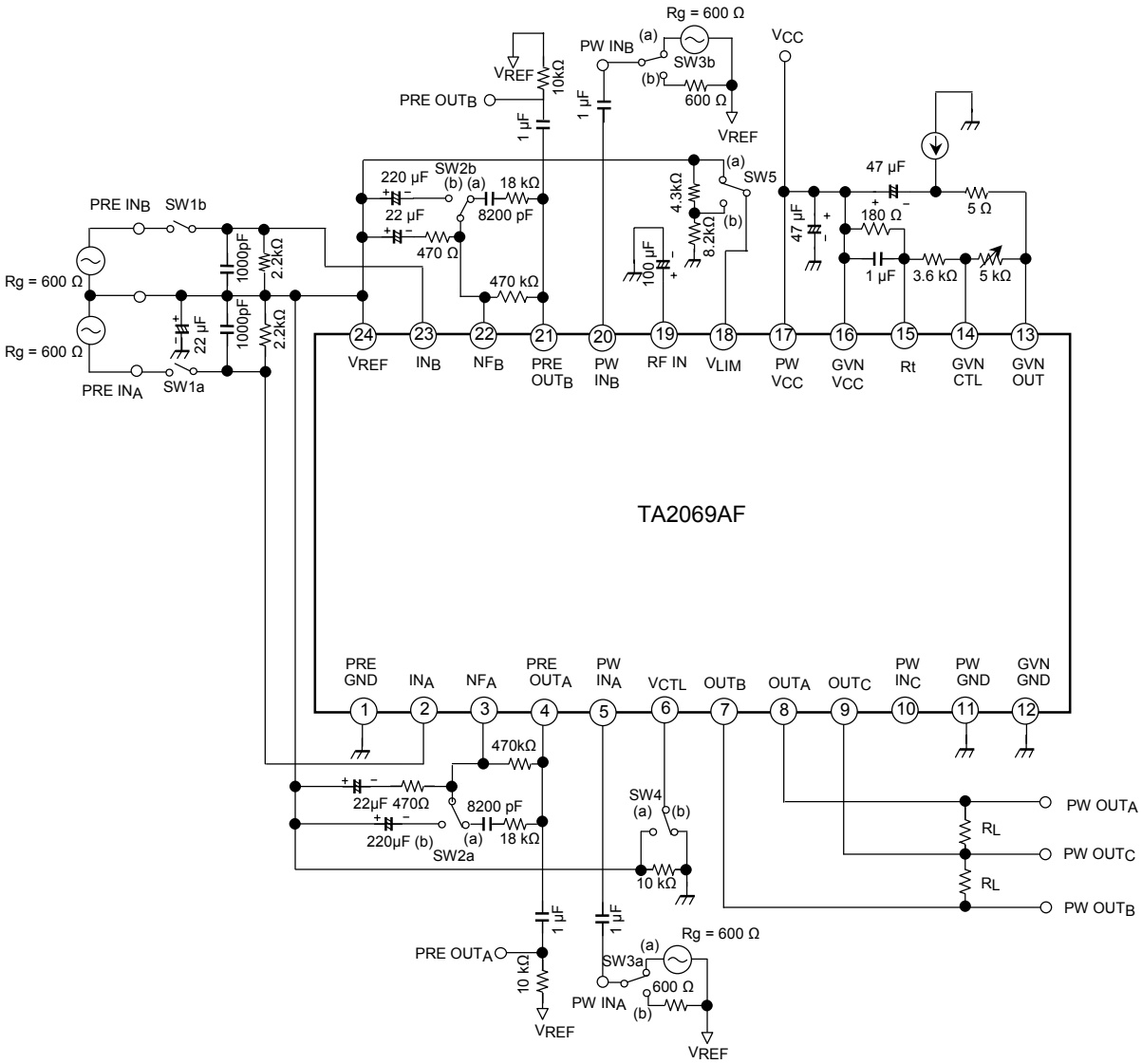
(Note 2) IC + PCB (TOSHIBA typical PCB): Derated above Ta = 25°C in the proportion 7.4mW / °C

Electrical Characteristics

Unless otherwise specified, V_{CC} = 3V, Ta = 25°C, f = 1kHz, SW2: a, SW5: a
Preamplifier: R_g = 2.2kΩ, R_L = 10kΩ, SW1: ON, SW3: b, SW4: b
Power amplifier: R_g = 600Ω, R_L = 16Ω, 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_{rms}
	Total harmonic distortion	THD1	—	V_o = −10dBV	—	0.02	0.3	%
	Equivalent input noise voltage	V_{ni}	—	R_g = 2.2kΩ, SW1: OPEN BPF = 20Hz~20kHz, NAB (G_V = 35dB, f = 1kHz)	—	1.2	2.4	μV_{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 = 16Ω, THD = 10%	17	28	—	mW
	Output power 2	P_{o2}	—	R_L = 32Ω, THD = 10%	—	20	—	mW
	Total harmonic distortion	THD2	—	P_o = 1mW	—	0.5	—	%
	Output noise voltage 1	V_{no1}	—	R_g = 600Ω, SW3: b BPF = 20Hz~20kHz	—	270	400	μV_{rms}
	Output noise voltage 2	V_{no2}	—	R_g = 600Ω, SW3: b SW5: b, BPF = 20Hz~20kHz	—	45	—	μV_{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	mA
	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	ΔV_{REF1}	—	V_{CC} = 2.1~3.6V	—	0.25	—	% / V
	Reference voltage fluctuation 2	ΔV_{REF2}	—	I_m = 25~250mA	—	0.003	—	% / mA
	Reference voltage fluctuation 3	ΔV_{REF3}	—	Ta = −25~75°C	—	0.005	—	% / °C
	Current ratio	K	—		34.5	37.5	40.5	
	Current ratio fluctuation 1	ΔK1	—	V_{CC} = 2.1~3.6V	—	0.25	—	% / V
	Current ratio fluctuation 2	ΔK2	—	I_m = 25~250mA	—	0.08	—	% / mA
	Current ratio fluctuation 3	ΔK3	—	Ta = −25~75°C	—	0.005	—	% / °C

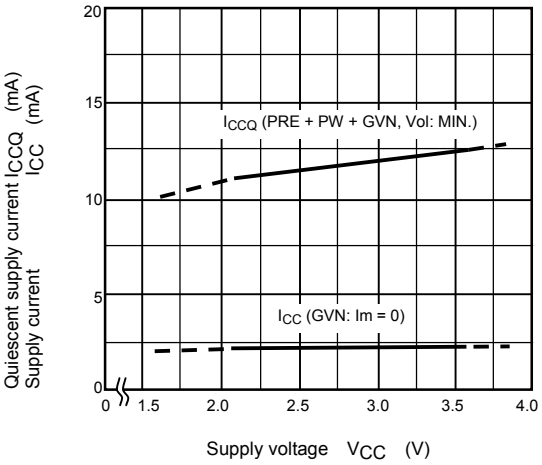
Test Circuit



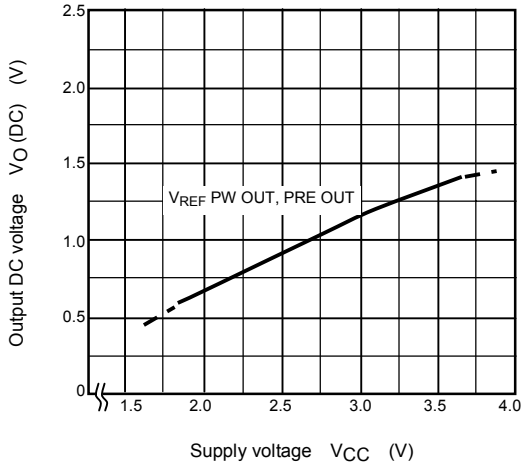
Characteristic Curves

Unless otherwise specified V_{CC} = 3V, Ta = 25°C, f = 1kHz
Preamplifier: Rg = 2.2kΩ, R_L = 10kΩ
Power amplifier: Rg = 600Ω, R_L = 16Ω, Vol = max.
Motor governor: I_m = 100mA

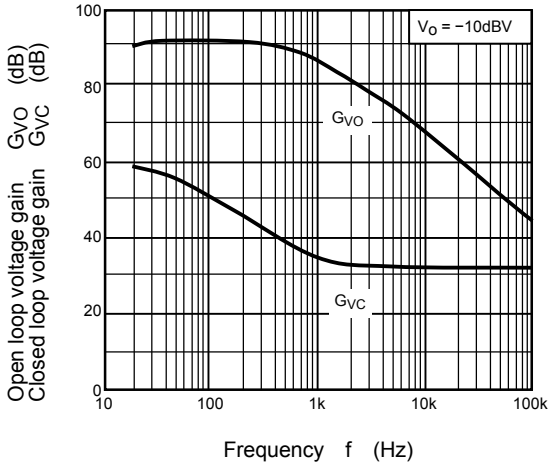
I_{CCQ}, I_{CC} – V_{CC}



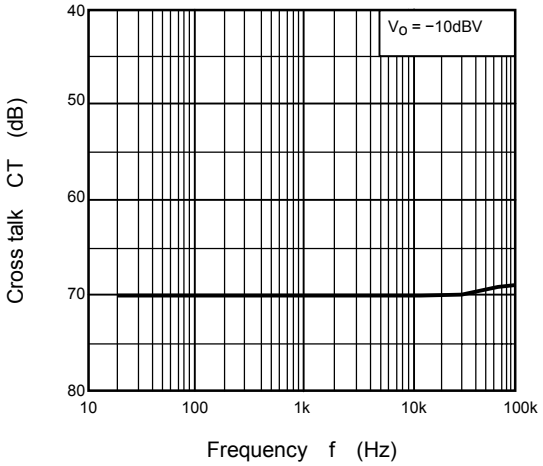
$V_{O\ (DC)}$ – V_{CC}



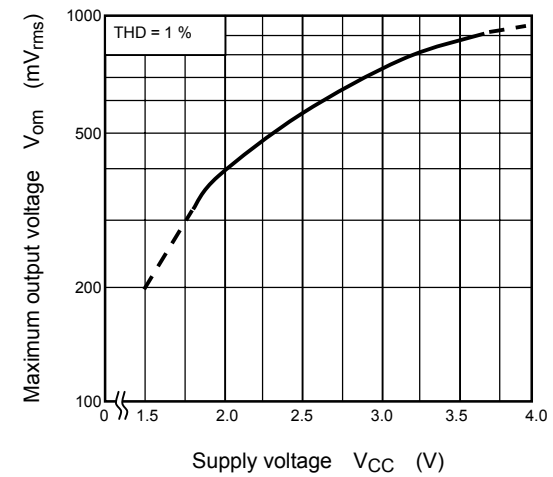
PRE G_{VO}, G_{VC} – f



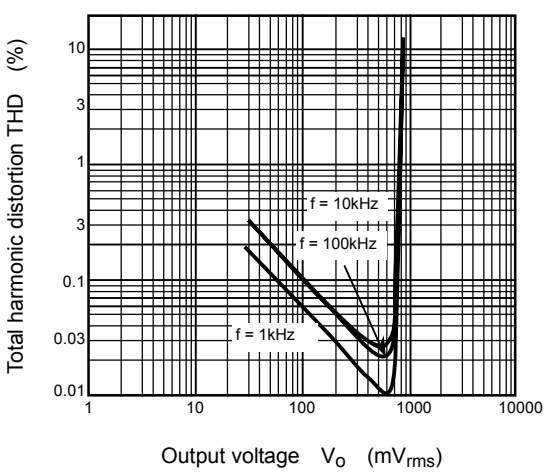
PRE CT – f



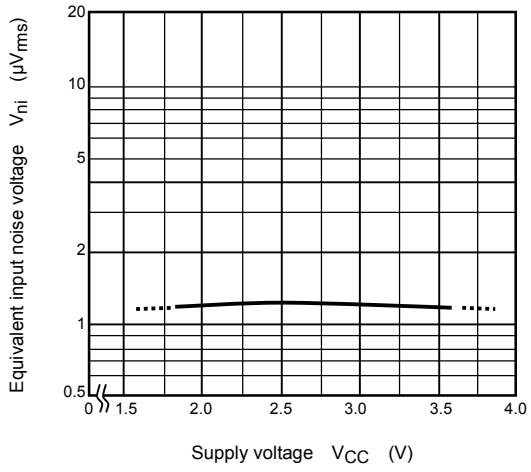
PRE V_{om} – V_{CC}



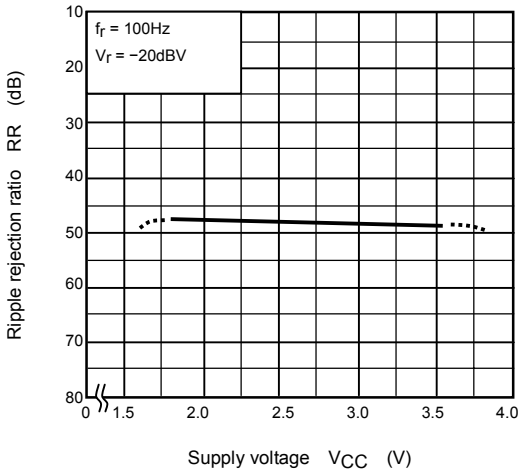
PRE THD – Vo



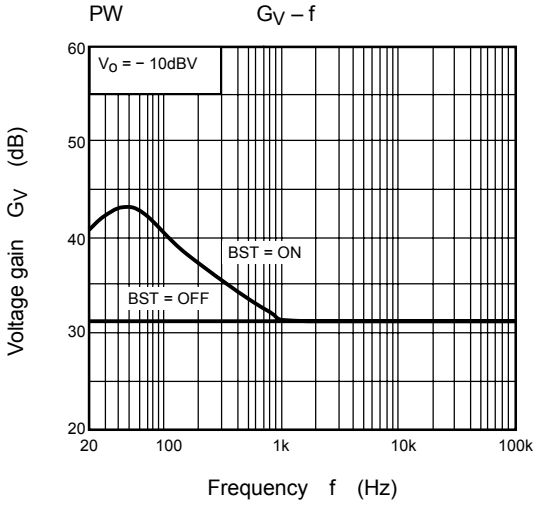
PRE $V_{ni} - V_{CC}$



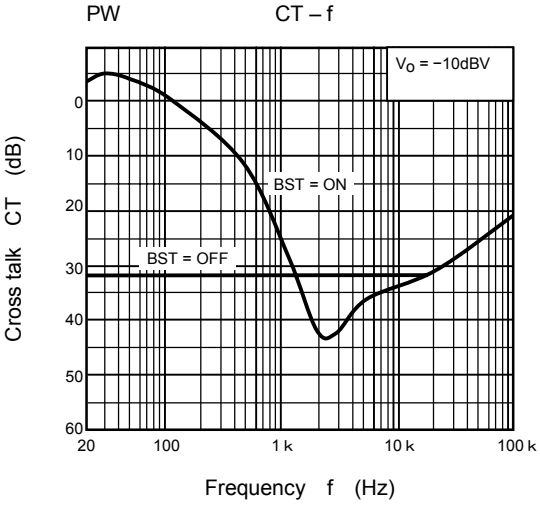
PRE $RR - V_{CC}$



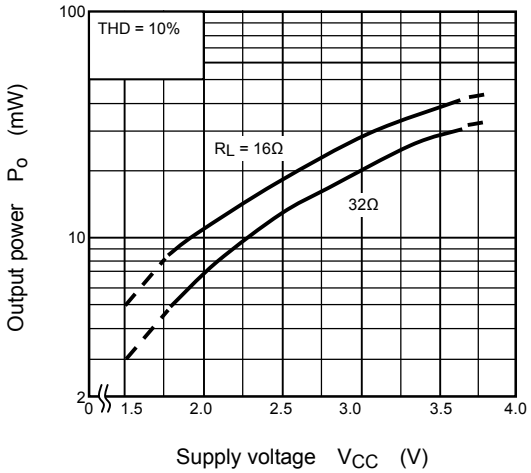
PW $G_V - f$



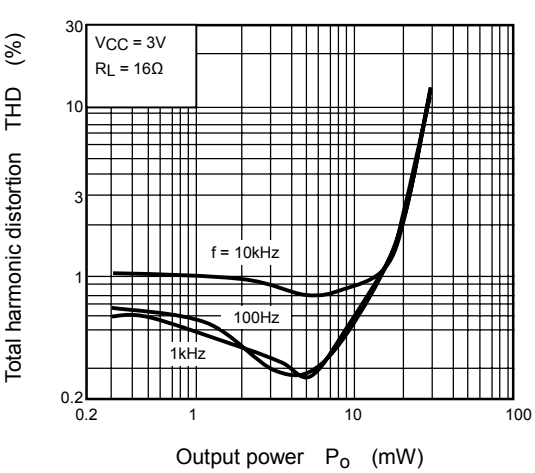
PW $CT - f$



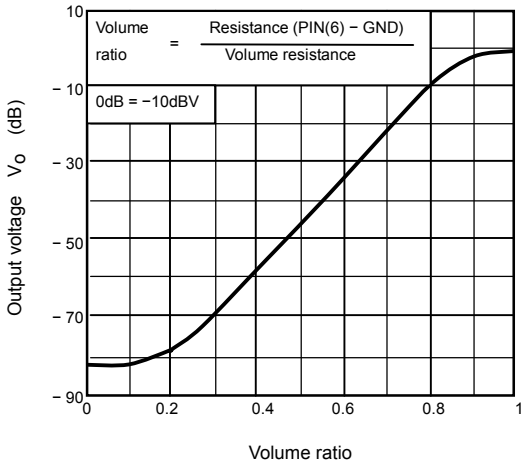
PW $P_o - V_{CC}$



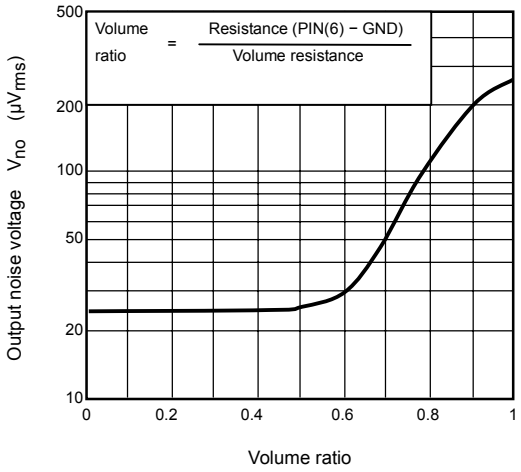
PW $THD - P_o$



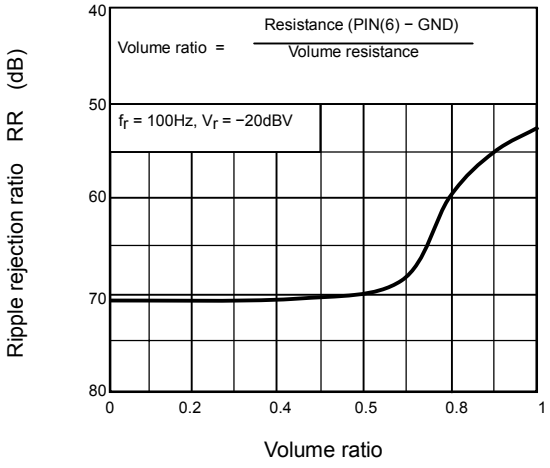
PW V_o – Vol.



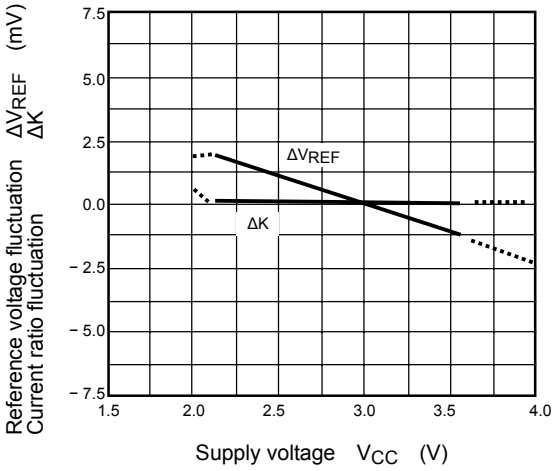
PW V_{no} – Vol.



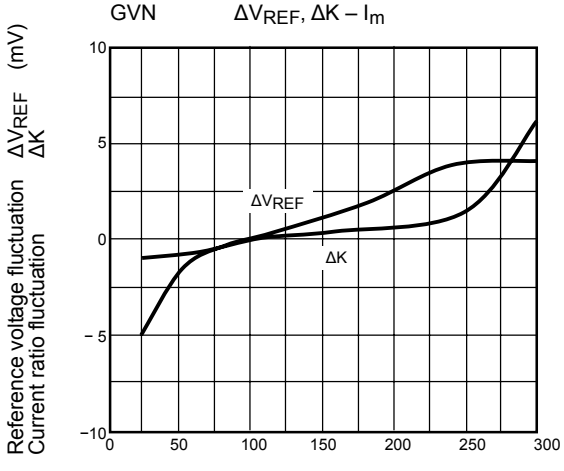
PW RR – Vol.



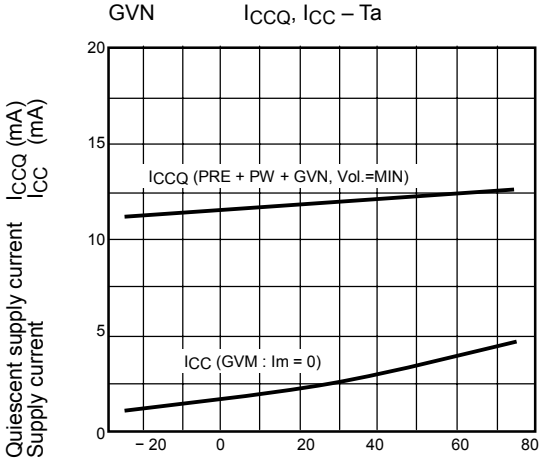
GVN ΔV_{REF}, ΔK – V_{CC}



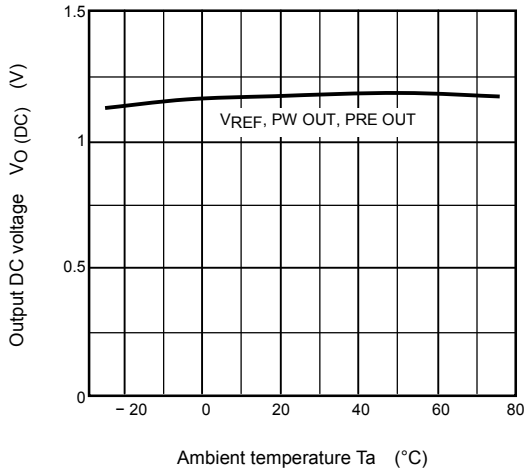
GVN ΔV_{REF}, ΔK – I_m



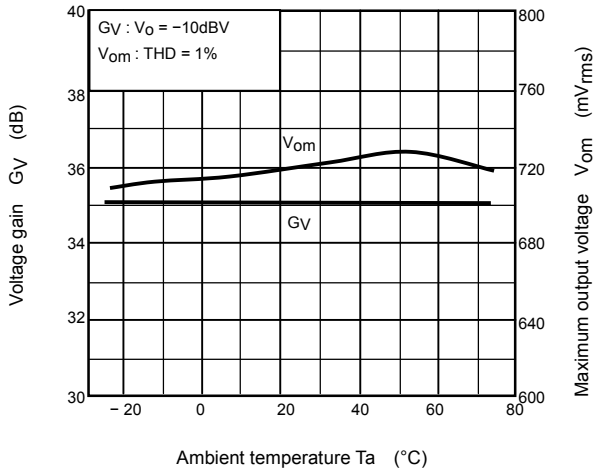
GVN I_{CCQ}, I_{CC} – Ta



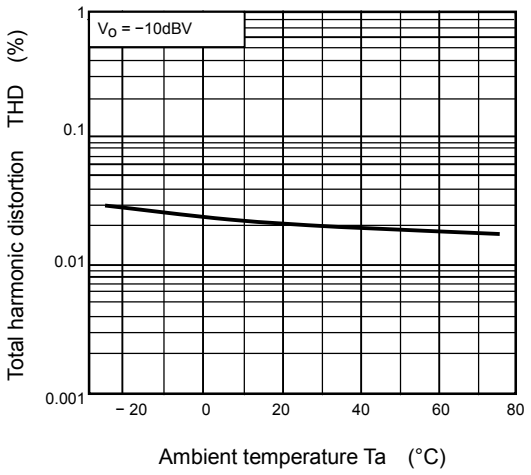
$V_{O\ (DC)}$ – Ta



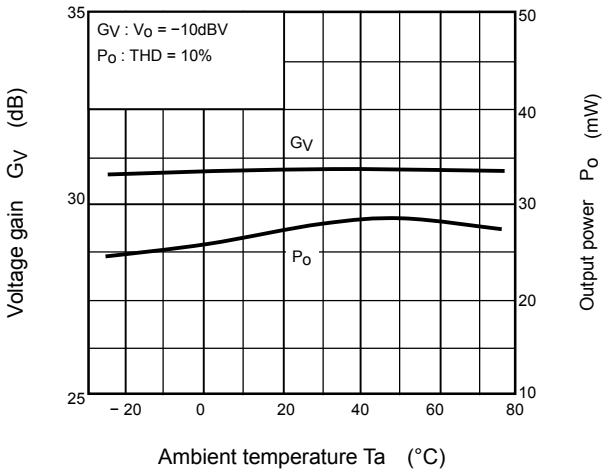
PRE G_V , V_{om} – Ta



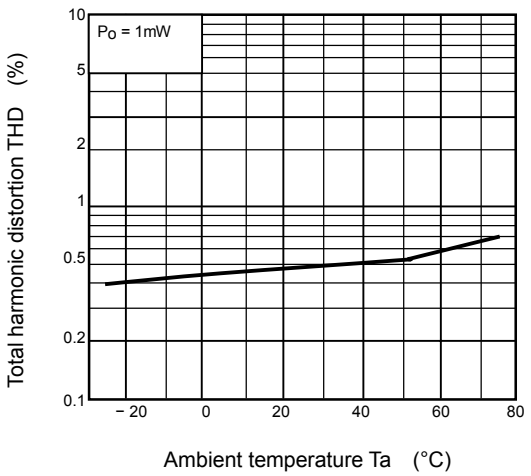
PRE THD – Ta



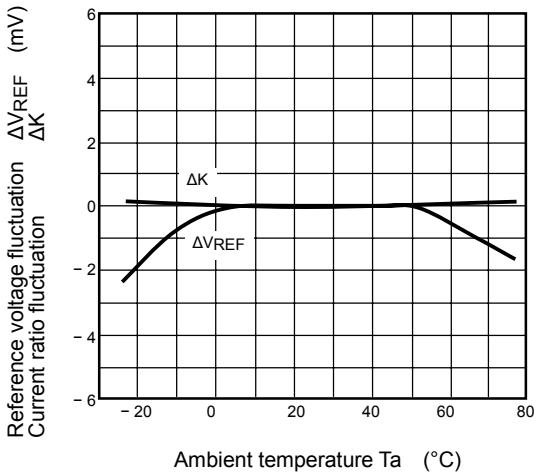
PW G_V, P_O – Ta



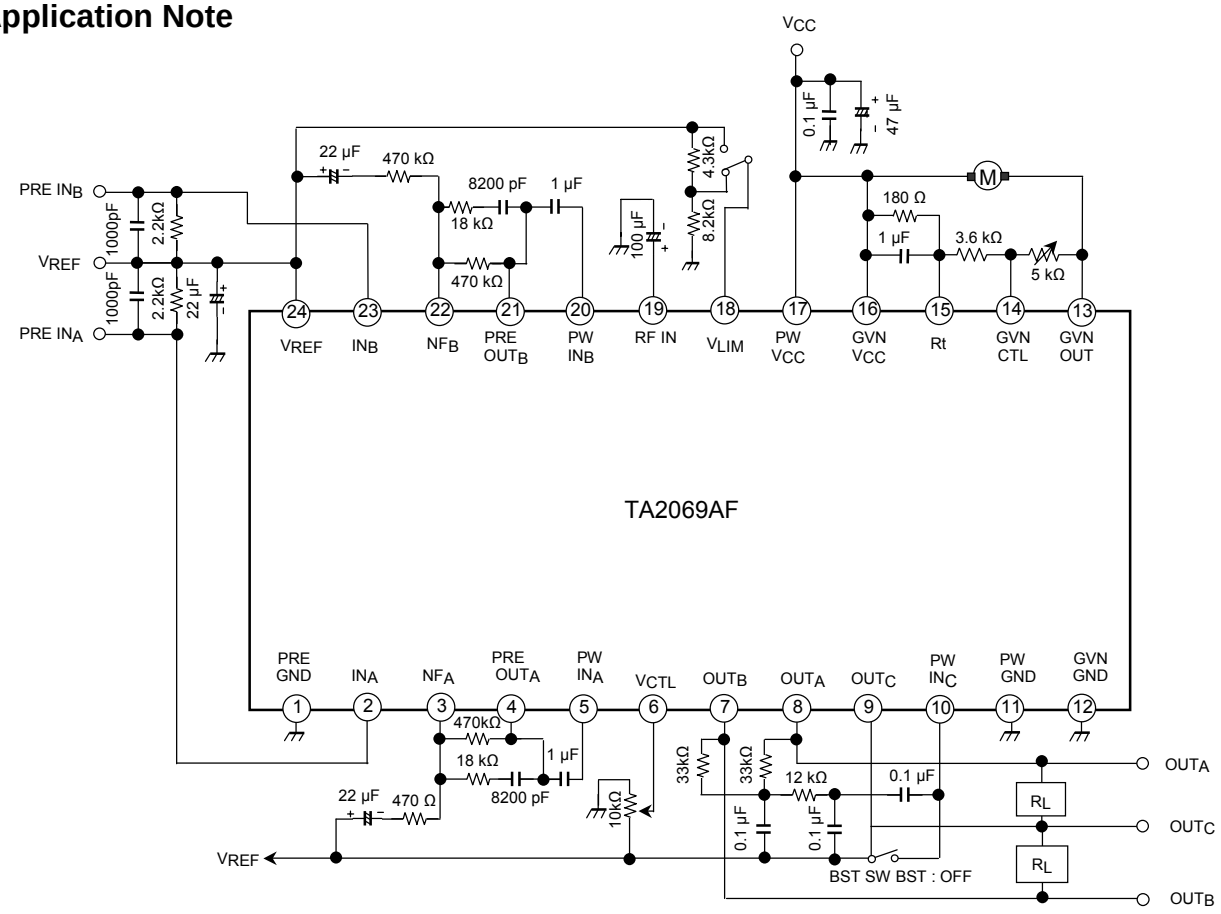
PW THD – Ta



GVN ΔV_{REF}, ΔK – Ta

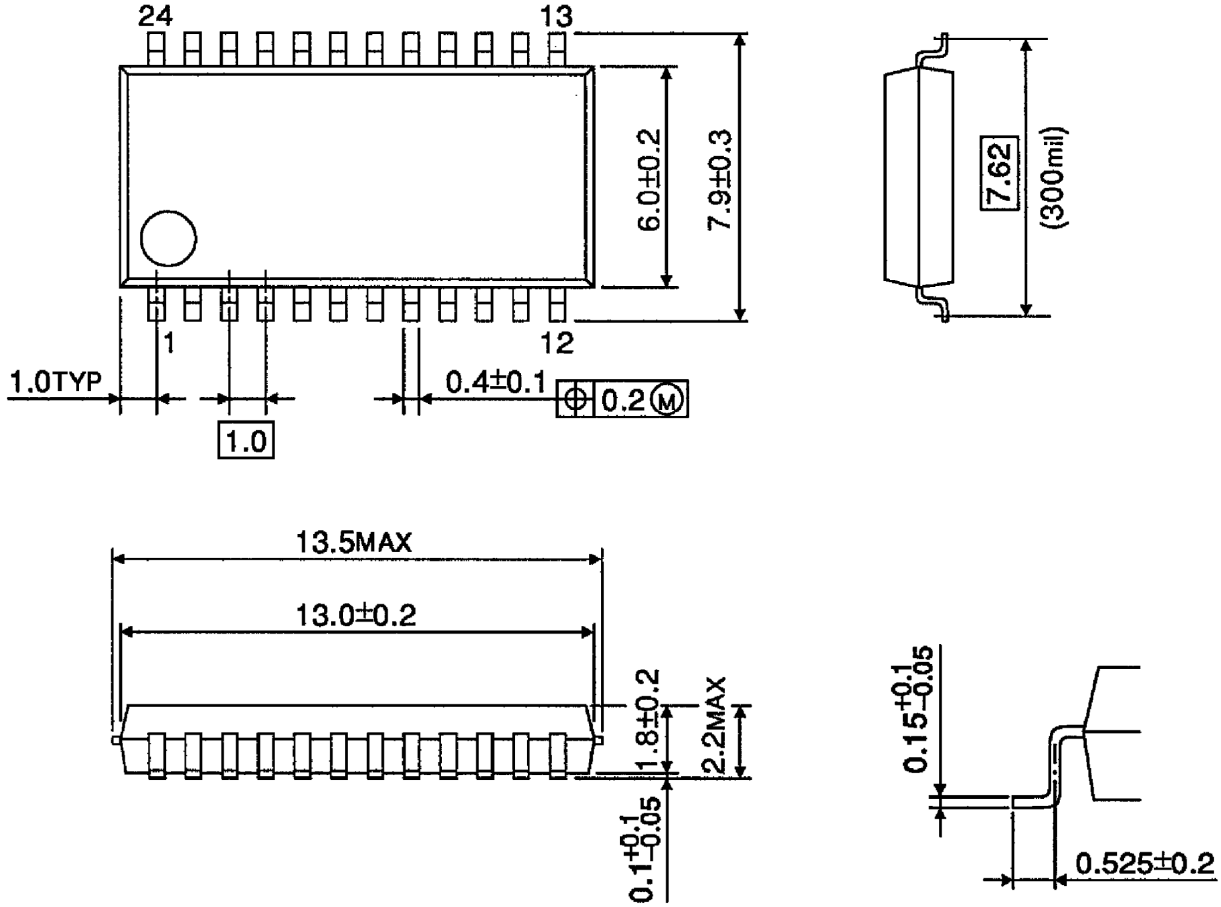


Application Note



Package Dimensions

SSOP24-P-300-1.00 Unit : mm



Weight: 0.32g (typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..
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