Low power consumption headphone driver for digital audio

BA3577FS

The BA3577FS is a headphone driver developed for portable digital audio equipment that supports a voltage of 1.5V.

●Applications

Portable MD players and others

●Features

1) 1.5V supported.
2) Low current consumption
   (At P_O = 0.5mW / ch, V_{CC} inflow current = 3.3mA, and +B inflow current = 6.8mA (Typ.)).
3) Output coupling capacitor of 100μF produces f_C = 45Hz (R_L = 16Ω).
4) Internal muting switch.
5) Internal ripple filter.
6) Internal BEEP circuit.

●Absolute maximum ratings (Ta = 25°C)

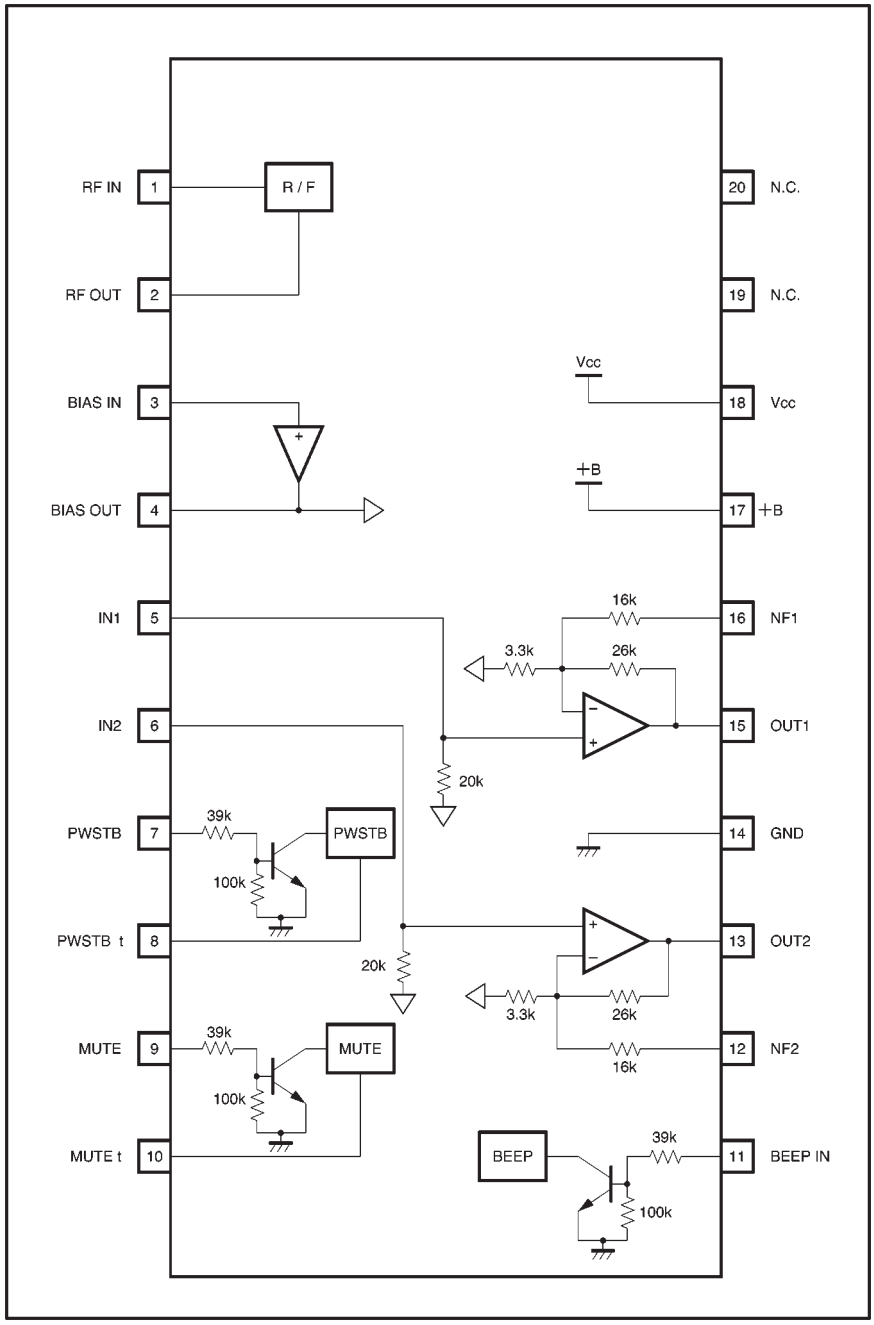
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	4.0	V
	+B	9.0	V
Power dissipation	Pd	600*1	mW
Operating temperature	Topr	−15～+60	℃
Storage temperature	Tstg	−55～+125	℃

*1 Reduced by 6.5mW for each increase in Ta of 1℃ over 25℃.

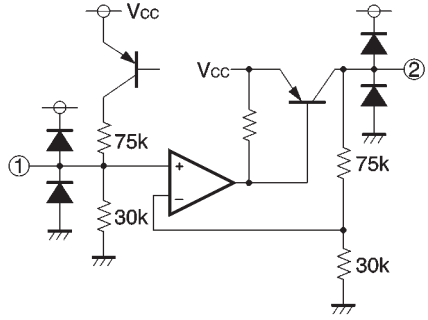
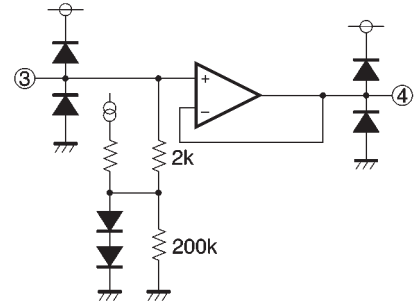
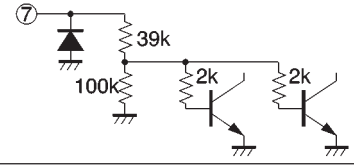
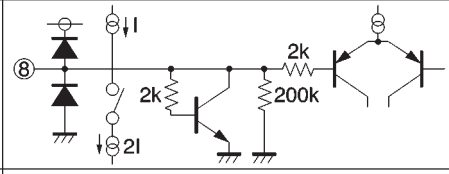
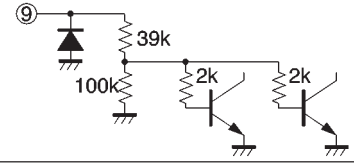
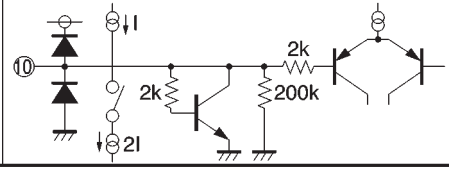
●Recommended operating conditions (Ta = 25°C)

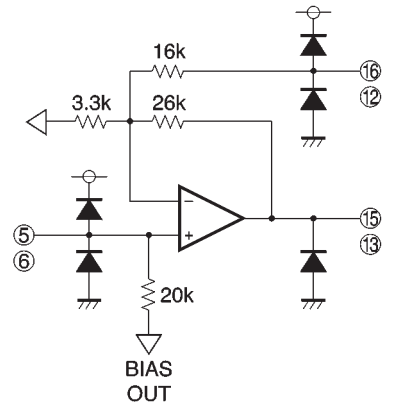
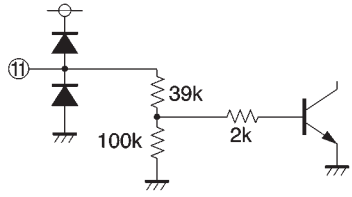
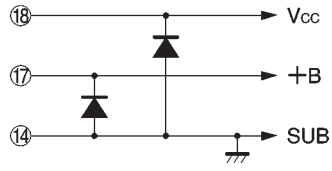
Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CC}	2.2	2.8	3.6	V
	+B	0.8	1.2	4.0	V

●Block diagram



●Pin descriptions

Pin No.	Pin name	I / O	Equivalent circuit	Function
1	RF IN	I		Ripple filter amplifier input
2	RF OUT	O		Ripple filter amplifier output
3	BIAS IN	I		Bias amplifier input
4	BIAS OUT	O		Bias amplifier output
7	PWSTB	I		Power standby switch High : Standby canceled Low : Standby
8	PWSTB t	I / O		Constant pin for power standby switching
9	MUTE	I		Power muting switch High : Muted Low : Muting canceled
10	MUTE t	I / O		Constant pin for power muting switching

Pin No.	Pin name	I / O	Equivalent circuit	Function
5	IN1	I		Power amplifier input
6	IN2	I		
15	OUT1	O		Power amplifier output
13	OUT2	O		
16	NF1	I		Feedback pin in low-pass range This corrects attenuation in the low pitch range caused by the output coupling capacitor.
12	NF2	I		
11	BEEP IN	I		BEEP amplifier input
14	GND	I		Ground
17	+B	I		Battery power supply (power supply for terminal stage of power amplifier)
18	Vcc	I		Booster power supply

●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 2.8V, +B = 1.2V, PWSTB = 2.8V, MUTE = 0V, R_L = 16Ω, f = 1kHz, DIN AUDIO)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Coniditions
V_{CC} quiescent current	I_{O1}	—	3.2	5.0	mA	$V_{IN1,2}$=0
+B quiescent current	I_{O2}	—	3.3	6.4	mA	$V_{IN1,2}$=0
V_{CC} operating current	I_{IN1}	—	3.3	5.2	mA	$P_{O1,2}$=0.5mW
+B operating current	I_{IN2}	—	6.8	9.8	mA	$P_{O1,2}$=0.5mW
+B leak current	ΔI_{+B}	—	0	3.0	μA	+B input current when V_{CC}=0V
Voltage gain	G_V	9.6	11.6	13.9	dB	—
Frequency characteristic 1	ΔG_{V1}	1.1	3.3	5.5	dB	G_V (1kHz) − G_V (50Hz)
Frequency characteristic 2	ΔG_{V2}	0	0.5	3.0	dB	G_V (1kHz) − G_V (20kHz), 80kHz LPF
Total harmonic distortion	THD	—	0.1	0.5	%	V_O=0.1Vrms
Rated output	P_O	5.6	10.0	—	mW	THD=10%
Output noise voltage	V_{NO}	—	−98	−92	dBm	Rg=0, IHF A
Input resistance	R_{IN}	15	20.7	25	kΩ	—
Channel separation	CS	60	77	—	dB	Rg=0, V_O=0.2Vrms, 1kHz BPF
Muting level	ML	—	−98	−92	dBm	V_{IN}=−30dBV, V_9=2.8V, 1kHz BPF
Ripple rejection 1	RR_1	62	72	—	dB	Rg=0, f_R=100Hz, 100Hz BPF V_R=−20dBm applied only to V_{CC}
Ripple rejection 2	RR_2	63	73	—	dB	Rg=0, f_R=100Hz, 100Hz BPF V_R=−20dBm applied only to +B
BEEP IN pin inflow current	I_{BP}	—	50	100	μA	I_{11} when V_{11}=V_{CC}
BEEP output voltage	V_{BP}	2.6	6.0	10.0	mV_{P-P}	V_{BPIN}=2.8V_{P-P} ⎍⎍, f=1kHz
PWSTB OFF pin voltage	V_S	—	0.95	1.4	V	V_7 when V_8 ≧ 0.5V
PWSTB OFF pin inflow current	I_S	—	52	100	μA	I_7 when V_7=V_{CC}
MUTE ON pin voltage	V_M	—	0.95	1.4	V	V_9 when V_{10} ≧ 0.5V
MUTE ON pin inflow current	I_M	—	52	100	μA	I_9 when V_9=V_{CC}

◎Not designed for radiation resistance.

●Measurement circuit

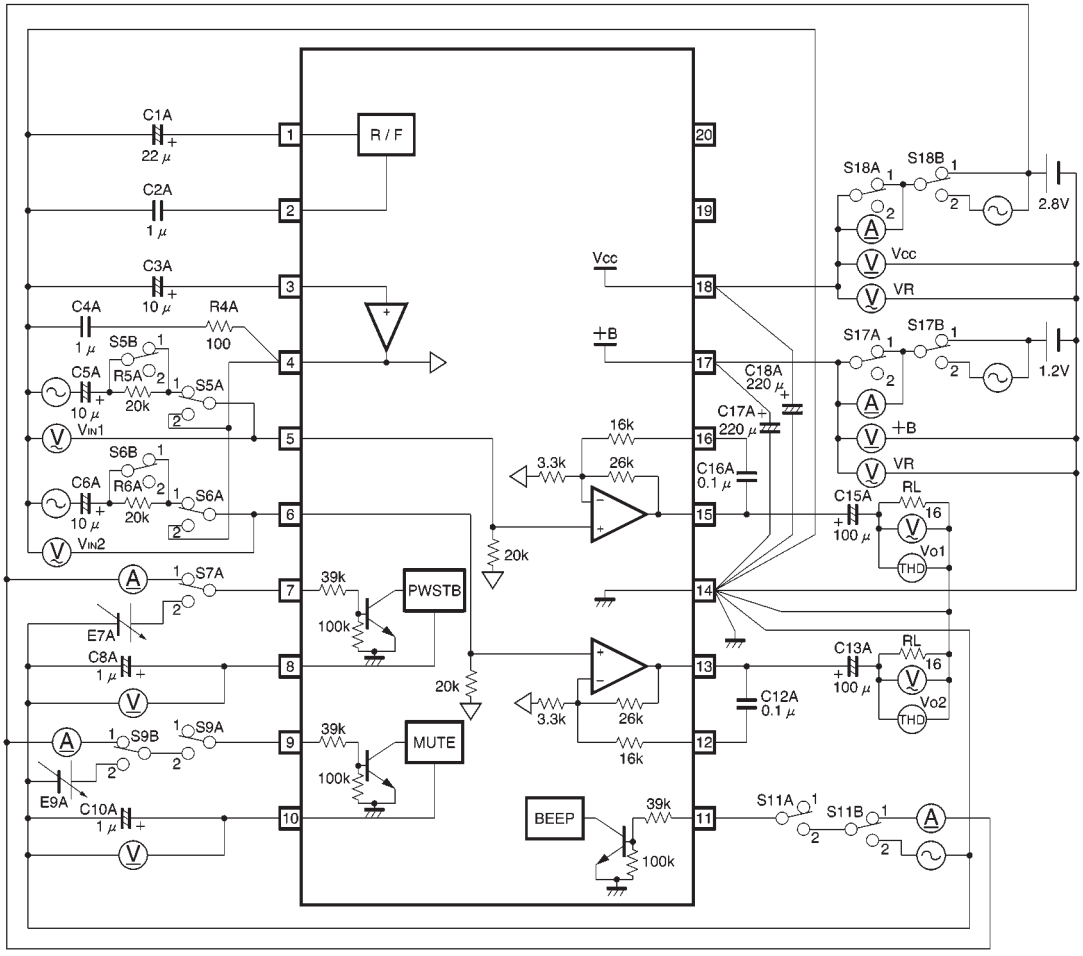


Fig.1

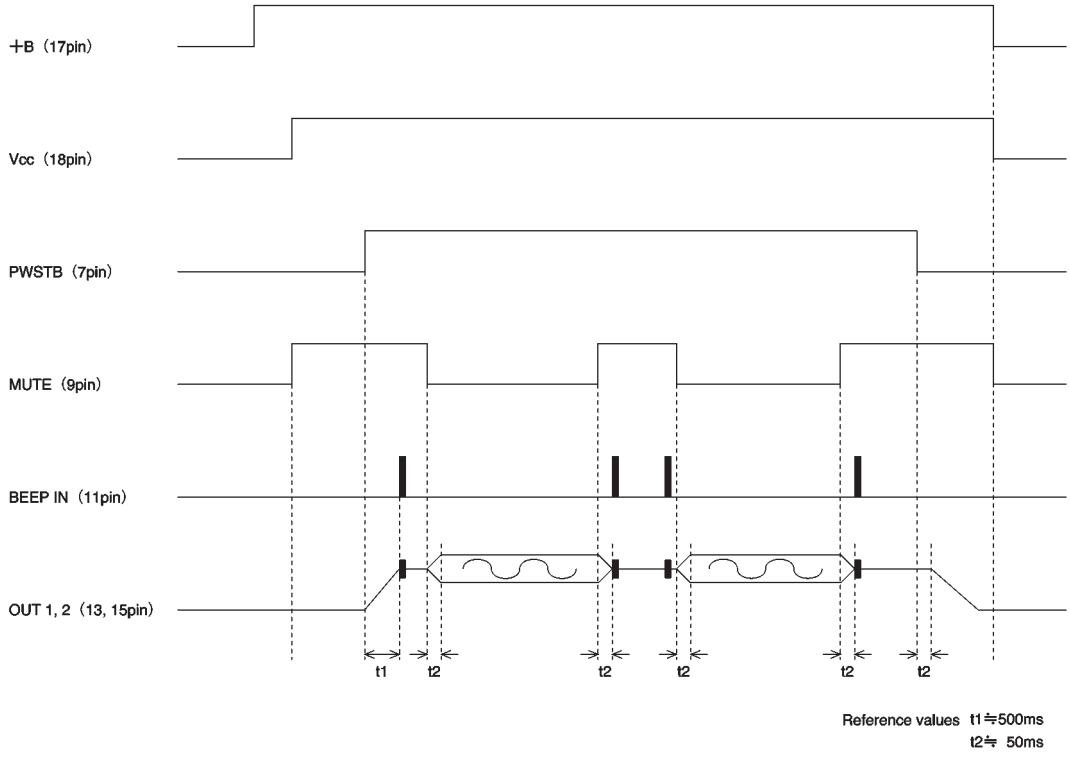
Units
Resistance : Ω (±1%)
Capacitance (film) : F (±1%)
Capacitance (electrolytic) : F (±5%)

Measurement conditions

Parameter	Symbol	S5A	S5B	S6A	S6B	S7A	S9A	S9B	S11A	S11B	S17A	S17B	S18A	S18B
V_{CC} quiescent current	I_{O1}	1	1	1	1	1	1	1	1	1	1	1	2	1
+B quiescent current	I_{O2}	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
V_{CC} operating current	I_{IN1}	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	2	↓
+B operating current	I_{IN2}	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
+B leak current	ΔI_{+B}	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
Voltage gain	G_V	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	↓	↓
Voltage gain deviation 1	ΔG_{V1}	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Voltage gain deviation 2	ΔG_{V2}	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Total harmonic distortion	THD	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Rated output	P_O	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Output noise voltage	V_{NO}	2	↓	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Input resistance	R_{IN}	1	2	1	2	↓	↓	↓	↓	↓	↓	↓	↓	↓
Channel separation	CS	1 / 2	1	2 / 1	1	↓	↓	↓	↓	↓	↓	↓	↓	↓
Muting level	ML	1	↓	1	↓	↓	2	↓	↓	↓	↓	↓	↓	↓
Ripple rejection 1	RR_1	2	↓	2	↓	↓	1	↓	↓	↓	↓	↓	↓	2
Ripple rejection 2	RR_2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1
BEEP IN pin inflow current	I_{BP}	1	↓	↓	↓	↓	↓	↓	2	↓	↓	↓	↓	↓
BEEP output voltage	V_{BP}	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	↓	↓	↓
PWSTB OFF pin voltage	V_S	↓	↓	↓	↓	2	↓	↓	1	↓	↓	↓	↓	↓
PWSTB OFF pin inflow current	I_S	↓	↓	↓	↓	1	↓	↓	↓	↓	↓	↓	↓	↓
MUTE ON pin voltage	V_M	↓	↓	↓	↓	↓	2	2	↓	↓	↓	↓	↓	↓
MUTE ON pin inflow current	I_M	↓	↓	↓	↓	↓	2	1	↓	↓	↓	↓	↓	↓

●Circuit operation

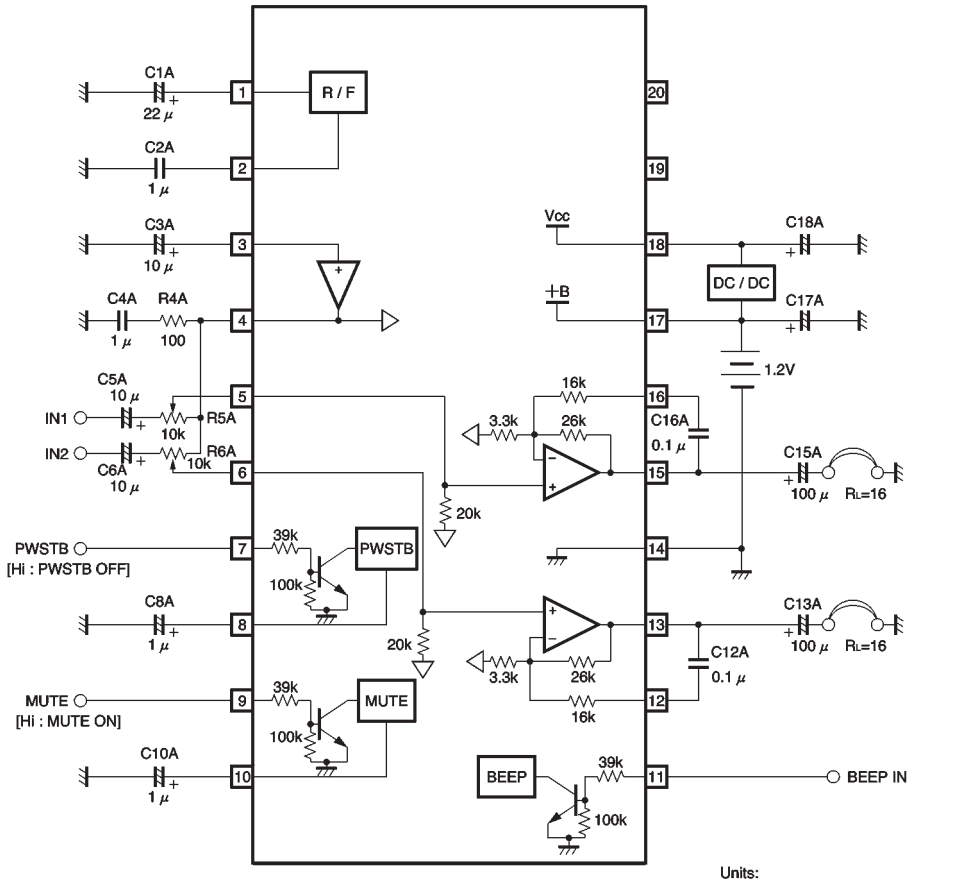
(1) The BA3577FS operates at the timing chart shown below, which prevents popping noises in the headphone output.



(2) The ripple filters (pins 1 and 2) and bias amplifiers (pins 3 and 4) of the BA3577FS cannot be used as external power supplies or reference voltages.

(3) The BA3577FS outputs a BEEP signal only when the PWSTB pin (pin 7) and the MUTE pin (pin 9) are HIGH. Also, input a rectangular waveform of 500Hz to 5kHz with an amplitude from the GND to V_{CC} to the BEEP IN pin (pin 11).

●Application example



Units:
Resistance : Ω (± 5%)
Capacitance (film) : F (±10%)
Capacitance (electrolytic) : F (±20%)

Fig.2

●Electrical characteristic curves

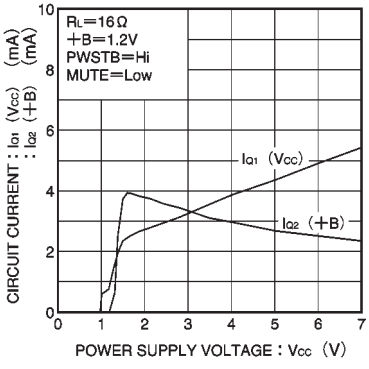


Fig.3 Quiescent current vs. power supply voltage

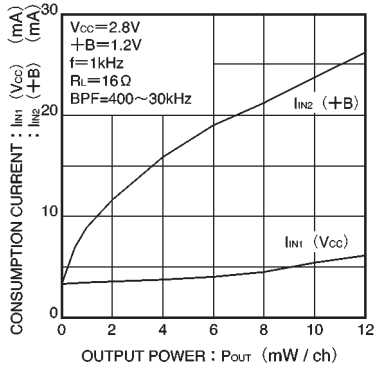


Fig.4 Current consumption vs. output power

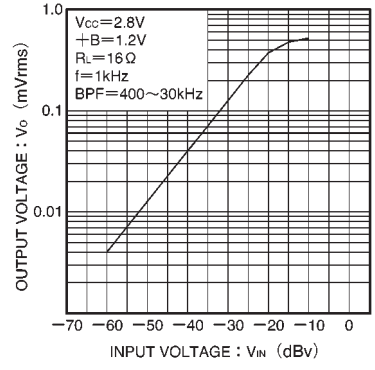


Fig.5 Output voltage vs. input voltage

●External dimensions (Units: mm)