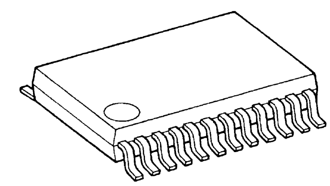
TOSHIBA Bipolar Linear Integrated Circuit SIlicon Monolithic

TA2120FNG

Low Consumption Current Stereo Headphone Power Amplifier for Portable CD (3V Use)

The TA2120FNG is a low consumption current stereo headphone power amplifier developed for portable CD players (3V). This IC has active bass boost, output limiter, input pin for beep sound.

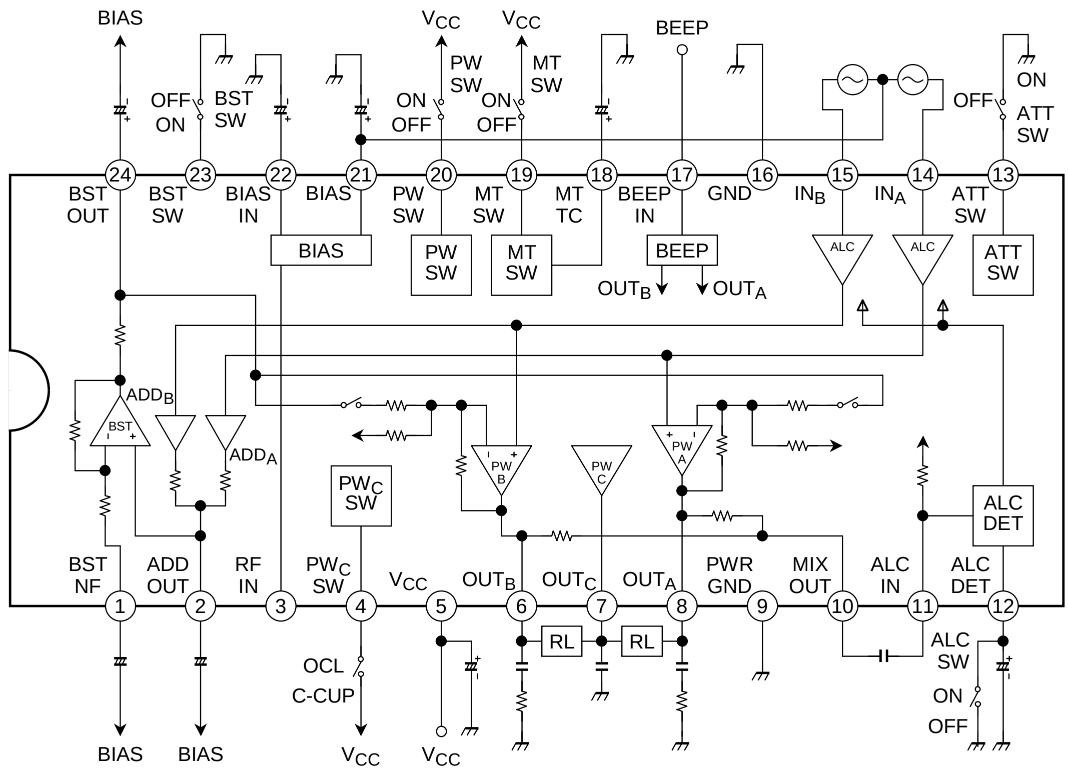


Weight: 0.14 g (typ.)

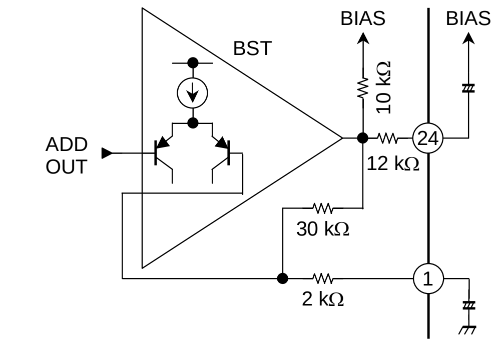
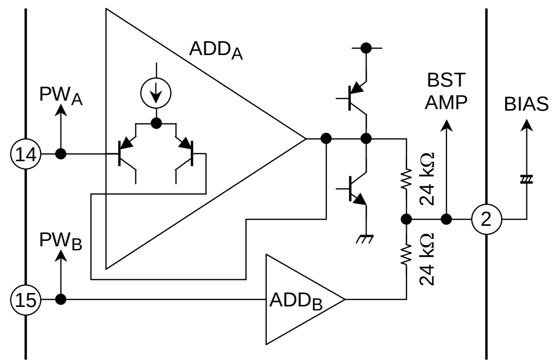
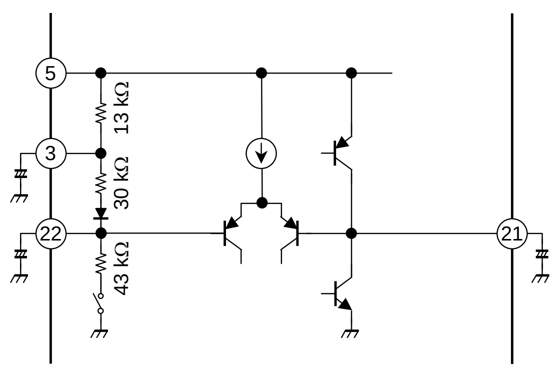
Features

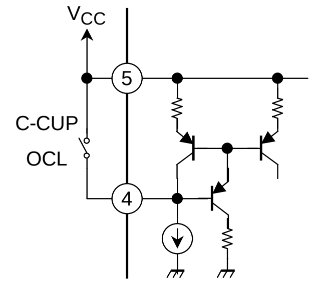
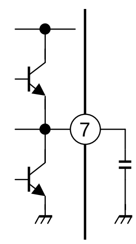
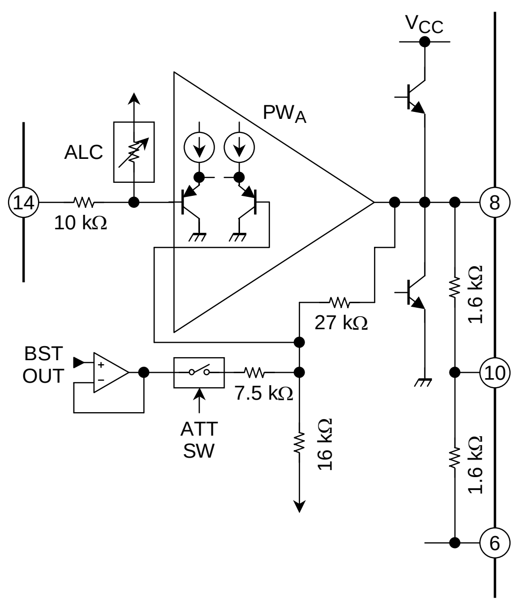
- Low consumption current: I_{CCQ} = 1.9 mA (C-CUP) (typ.)
  I_{CCQ} = 2.6 mA (OCL) (typ.)
- Two kinds of gain mode available: G_V = 16dB or 8.5dB
- Output power (V_{CC} = 2.0 V, f = 1 kHz, THD = 10%, R_L = 16 Ω)
  P_o = 8 mW (typ.)
- Low noise: V_{no} = −98dBV (typ.)
- Built-in the center amplifier ON/OFF function.
  (Favorable for low dissipation current in the C-Couple output configuration)
- Built-in active bass boost system
- Built-in output limiter function
- Input pin for beep sound
- Excellent ripple rejection ratio
- Built-in capacitor for reducing buzz noise
- Built-in power mute
- Built-in a power on/off switch
- Operating supply voltage range (Ta = 25°C): V_{CC} = 1.8~4.5 V

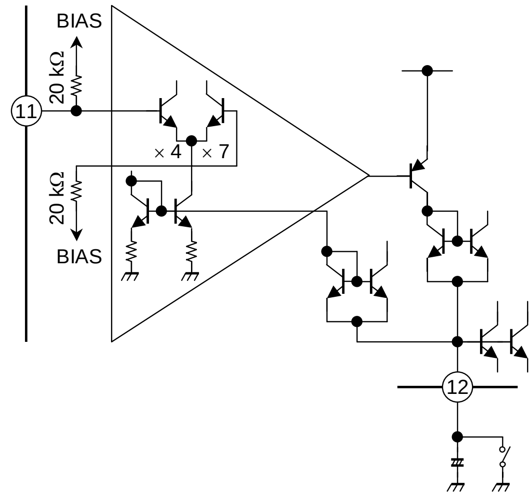
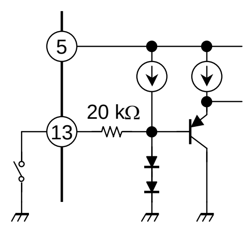
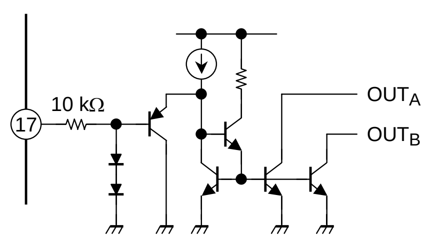
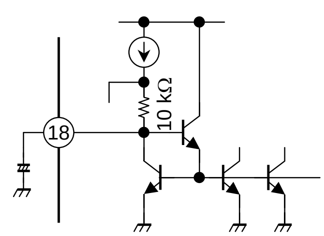
Block Diagram

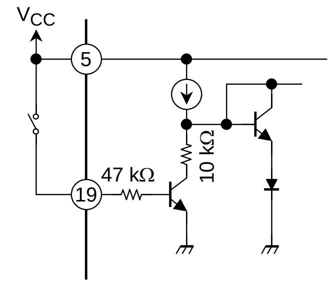
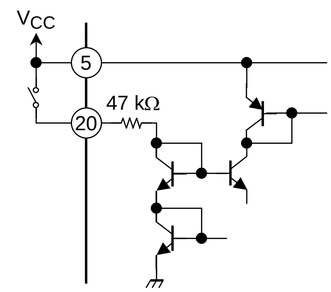
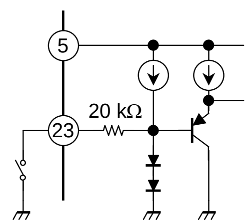


Terminal Explanation (Terminal voltage: Typical terminal voltage at no signal with test circuit, V_{CC} = 2.4 V, Ta = 25°C)

Terminal No.	Terminal Name	Function	Internal Circuit	Terminal Voltage (V)
1	BST NF	NF of BST amplifier		0.85
24	BST OUT	Output of BST amplifier (Terminal for filter)		0.85
2	ADD OUT	Output of ADD amplifier (Terminal for filter)		0.85
3	RF IN	Terminal for ripple filter circuit		1.44
21	BIAS	BIAS voltage		0.85
22	BIAS IN	Filter terminal for BIAS circuit		0.85

<table>
<tr><th colspan="2">Terminal</th><th rowspan="2">Function</th><th rowspan="2">Internal Circuit</th><th rowspan="2">Terminal Voltage (V)</th></tr>
<tr><th>No.</th><th>Name</th></tr>
<tr><td>4</td><td>PW_C SW</td><td>Center amplifier on/off switchover
V_{CC}: Center amplifier off (C-CUP)
OPEN: Center amplifier on (OCL)</td><td></td><td>—</td></tr>
<tr><td>7</td><td>OUT_C</td><td>Output of center amplifier (Common terminal for OCL output configuration)</td><td></td><td>0.85</td></tr>
<tr><td>5</td><td>V_{CC}</td><td>—</td><td>—</td><td>2.4</td></tr>
<tr><td>6</td><td>OUT_B</td><td rowspan="2">Output of power amplifier</td><td rowspan="5"></td><td rowspan="2">0.85</td></tr>
<tr><td>8</td><td>OUT_A</td></tr>
<tr><td>14</td><td>IN_A</td><td rowspan="2">Input of power amplifier</td><td rowspan="2">0.85</td></tr>
<tr><td>15</td><td>IN_B</td></tr>
<tr><td>10</td><td>MIX OUT</td><td>Output of power amplifier (Mixed)</td><td>0.85</td></tr>
<tr><td>9</td><td>PWR GND</td><td>GND of power amplifier</td><td>—</td><td>0</td></tr>
</table>

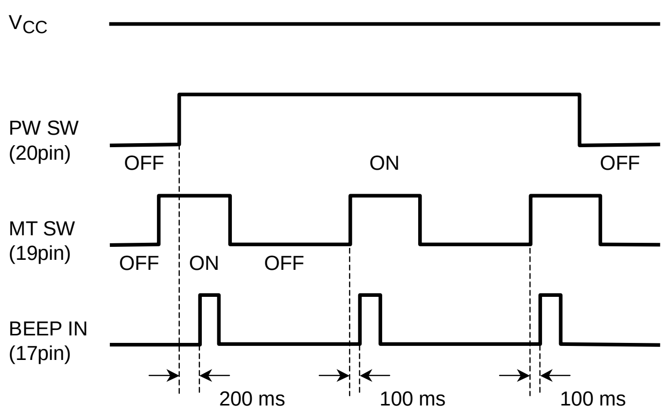
<table>
<tr><th colspan="2">Terminal</th><th rowspan="2">Function</th><th rowspan="2">Internal Circuit</th><th rowspan="2">Terminal Voltage (V)</th></tr>
<tr><th>No.</th><th>Name</th></tr>
<tr><td>11</td><td>ALC IN</td><td>Input terminal for ALC detector circuit</td><td rowspan="2"></td><td>0.85</td></tr>
<tr><td>12</td><td>ALC DET</td><td>Smoothing for ALC detection, ALC on/off switchover
GND: ALC off
OPEN: ALC on</td><td>—</td></tr>
<tr><td>13</td><td>ATT SW</td><td>Power amplifier gain switchover
OPEN/V_{CC}:
ATT off (G_V = 16dB)
GND:
ATT on (G_V = 8.5dB)</td><td></td><td>—</td></tr>
<tr><td>16</td><td>GND</td><td>GND of input stage in power amplifier</td><td>—</td><td>0</td></tr>
<tr><td>17</td><td>BEEP IN</td><td>Input terminal for Beep sound
It receive beep sound from microcomputer. And power amplifier outputs this beep sound.</td><td></td><td>0</td></tr>
<tr><td>18</td><td>MT TC</td><td>Terminal of mute smoothing
Smoothing for shock noise at power muting switch over</td><td></td><td>1.4</td></tr>
</table>

Terminal		Function	Internal Circuit	Terminal Voltage (V)
No.	Name			
19	MT SW	Power mute switchover GND/OPEN: Mute off V_{CC}: Mute on		—
20	PW SW	Power on/off switchover V_{CC}: Power on GND/OPEN: Power off		—
23	BST SW	Bst on/off switchover BST on: OPEN/V_{CC} BST off: GND		—

Application Note

1. Beep Sound

Beep sound signals from, for example, a micro controller can be received through the beep input pin 17. At power mute mode, PW_A and PW_B are turned off. The current of the beep signal input to been via beep amplifier is amplified at the output stage of PW_A and PW_B. The output from beep amplifier becomes the constant voltage source. As a result, the beep sound is output to the headphone load.
If the input signal for beep (Pin 17) is not, this terminal should be fixed GND level.



2. Power Switch

As long as the power switch is not connect to V_{CC}, the IC does not operate.
If external noise causes malfunctions, we recommend to connect a pull-down resistor externally (Sensitivity of the power mute switch is high).

3. Center Amplifier (PW_C)

Terminal for PW_C output is common terminal for OCL output configuration.
PW_C ON/OFF mode is controlled by PW_C switch (Pin 4).
To reduce the consumption current, PW_C should be turned off by this switch.

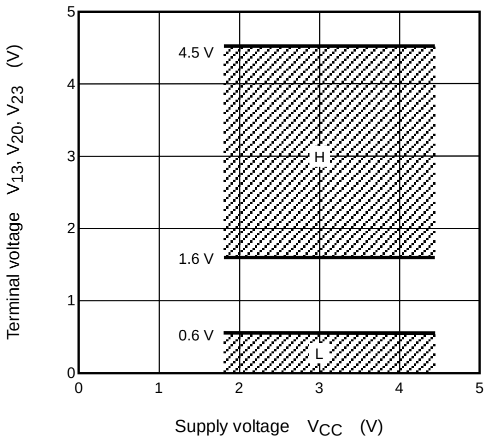
PW_C SW $\begin{cases} \text{OPEN: OCL} \\ V_{CC}\text{: C-Couple} \end{cases}$

4. Terminal of RF IN (3pin)

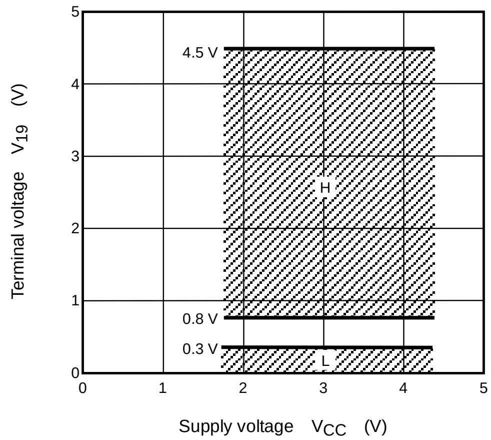
Adding Capacitor (Recommendation: 10 μF) to terminal of RF IN (Pin 3), the ripple rejection ratio is improved by secondly ripple filter (In the C-Couple output configuration , this capacitor should be connected.)

5. Threshold Voltage of Each Switches

(1) PW SW, BST SW, ATT SW



(2) MT SW



	PW SW (V_{20})
"H"	Operating
"L" Open	IC OFF

	MT SW (V_{19})
"H"	Mute ON
"L" Open	Mute OFF

	ATT SW (V_{13})	BST SW (V_{23})
"H" Open	ATT ON	BST ON
"L"	ATT OFF	BST OFF

6. Extermimal capaciter

These capacitors which are prevent oscillation of power amplifier and de-coupled at terminals of BIAS and V_{CC} need to be small temperature coefficient and excellent frequency characteristic.

Absolute Maximum Ratings (Ta = 25°C)

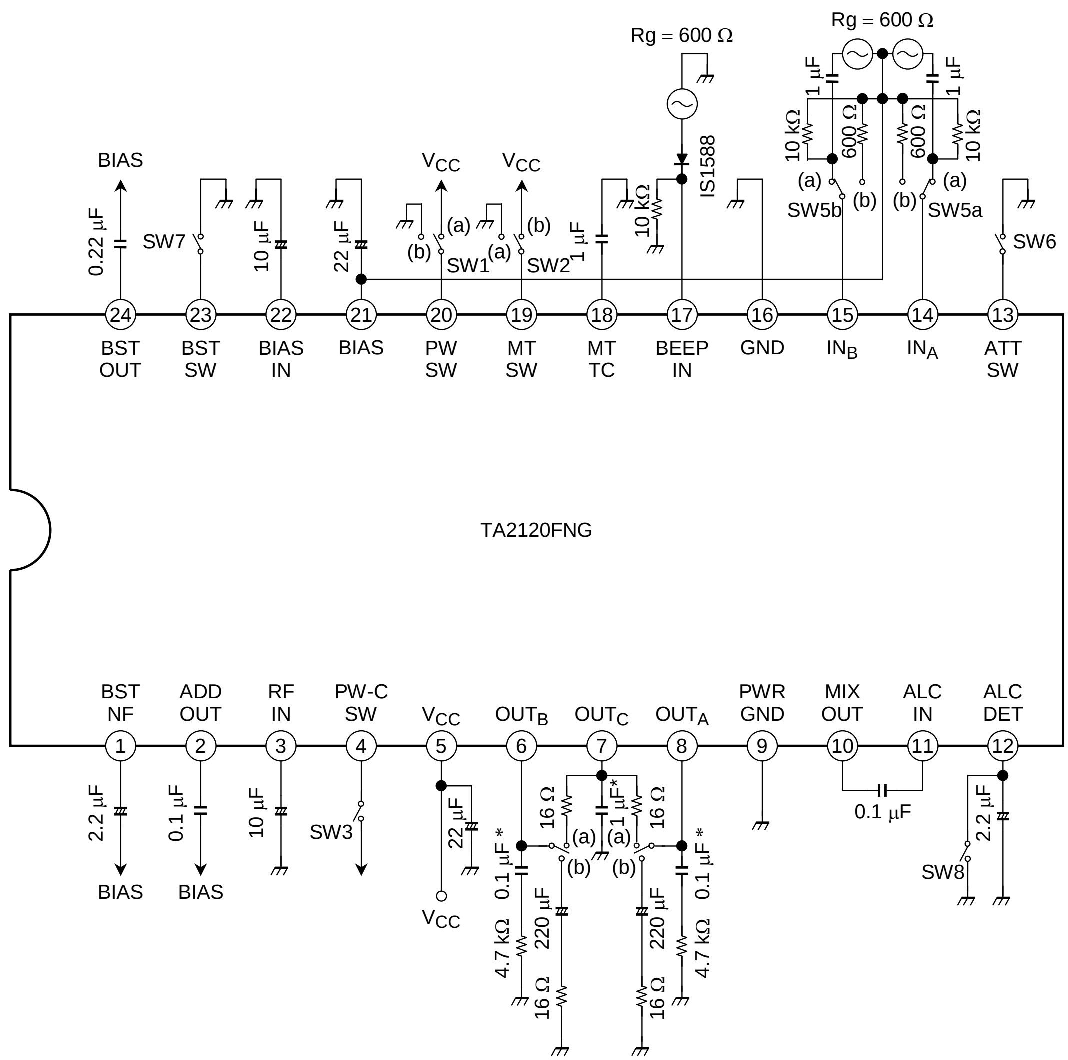
Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	4.5	V
Output Current	$I_{o\ (peak)}$	100	mA
Power dissipation	P_D (Note)	550	mW
Operating temperature	T_{opr}	−25~75	°C
Storage temperature	T_{stg}	−55~150	°C

Note: Derated above 25°C in the proportion of 4.4 mW/°C.

Electrical Characteristics
(Unless otherwise specified: V_{CC} = 2.4 V, Rg = 600 Ω, R_L = 16 Ω, f = 1 kHz, Ta = 25°C, SW1: a, SW2: a, SW3: OPEN, SW4: a, SW5: a, SW6: OPEN, SW7: ON, SW8: ON)

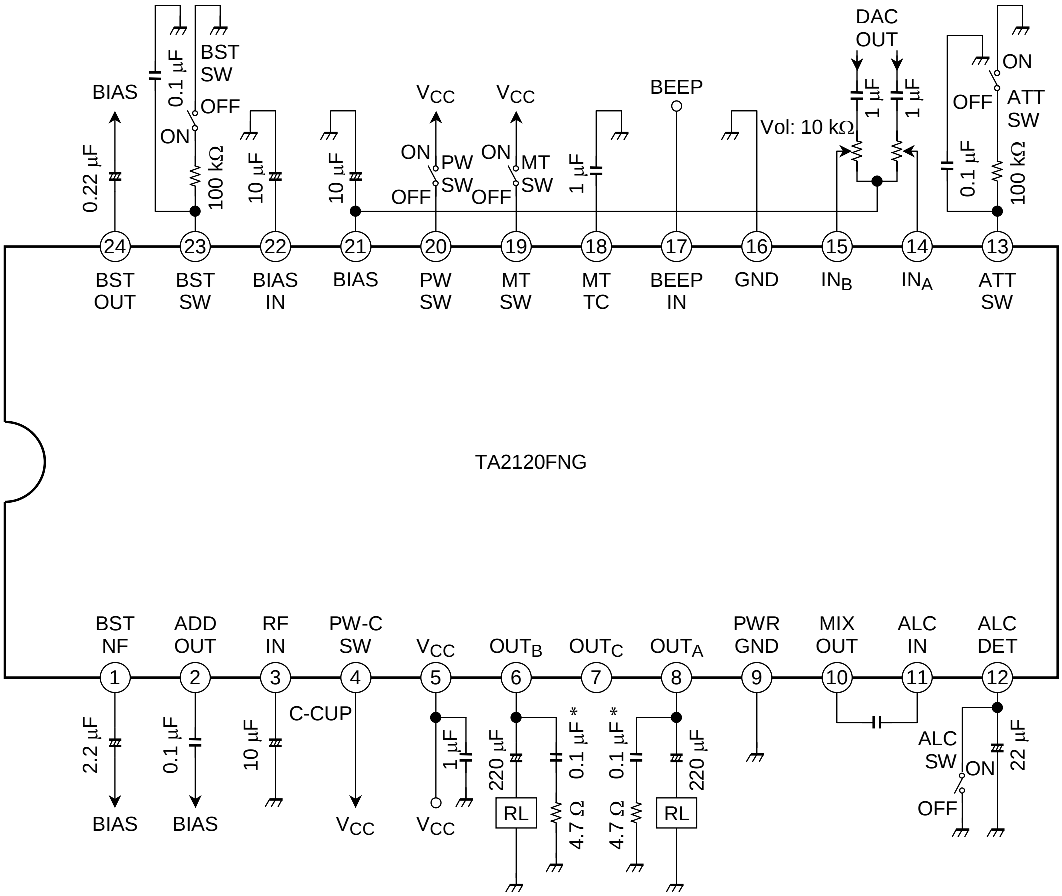
Characteristics		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Quiescent supply current		I_{CC1}	—	IC OFF (C-Couple) SW1: b, SW2: b, SW3: ON	—	0.1	5	μA
		I_{CC2}	—	IC OFF (OCL) SW1: b, SW2: b	—	0.1	5	
		I_{CC3}	—	MUTE ON (C-Couple) SW2: b, SW3: ON	—	1	2	mA
		I_{CC4}	—	MUTE ON (OCL) SW2: b	—	1.7	3	
		I_{CC5}	—	No signal (C-Couple) SW3: ON	—	1.9	3.5	
		I_{CC6}	—	No signal (OCL)	—	2.6	4.5	
Consumption supply current		I_{CC7}	—	P_o = 0.5 mW + 0.5 mW (C-CUP), SW3: ON	—	6.6	—	mA
		I_{CC8}		P_o = 0.5 mW + 0.5 mW (OCL)	—	12.1	—	
Power amplifier stage	Voltage gain (1)	G_{V1}	—	V_o = −22dBV, SW6: GND	5.5	8.5	10.5	dB
	Voltage gain (2)	G_{V2}	—	V_o = −22dBV	14	16	18	dB
	Output power	P_{omax}	—	THD = 10%, V_{CC} = 2.0 V	5	8	—	mW
	Total harmonic distortion	THD	—	V_o = −12.2dBV	—	0.1	0.5	%
	Output noise voltage	V_{no}	—	Rg = 600 Ω, Filter: IHF- A, SW5: b	—	−98	−92	dBV
	Crosstalk	CT	—	V_o = −12.2dBV	24	40	—	dB
	Ripple rejection ratio	RR	—	V_{CC} = 1.8V, f_r = 100 Hz, V_r = −20dBV	69	75	—	dB
	Mute attenuation	MUTE	—	V_o = −12.2dBv, SW2: b	80	90	—	dB
	Beep voltage	VBEEP	—	V Beep IN = 0dBV, SW2: b	−56	−51	−46	dBV
Boost gain		Bst	—	V_o = −30dBV, f = 100 Hz, SW7: ON → OPEN	9	11.5	14	dB
Output limiter level		V_{ALC}	—	V_{in} = −20dBV, SW8: OPEN	−41.5	−39.5	−37.5	dBV

Test Circuit



*: Monolithic ceramic capacitor

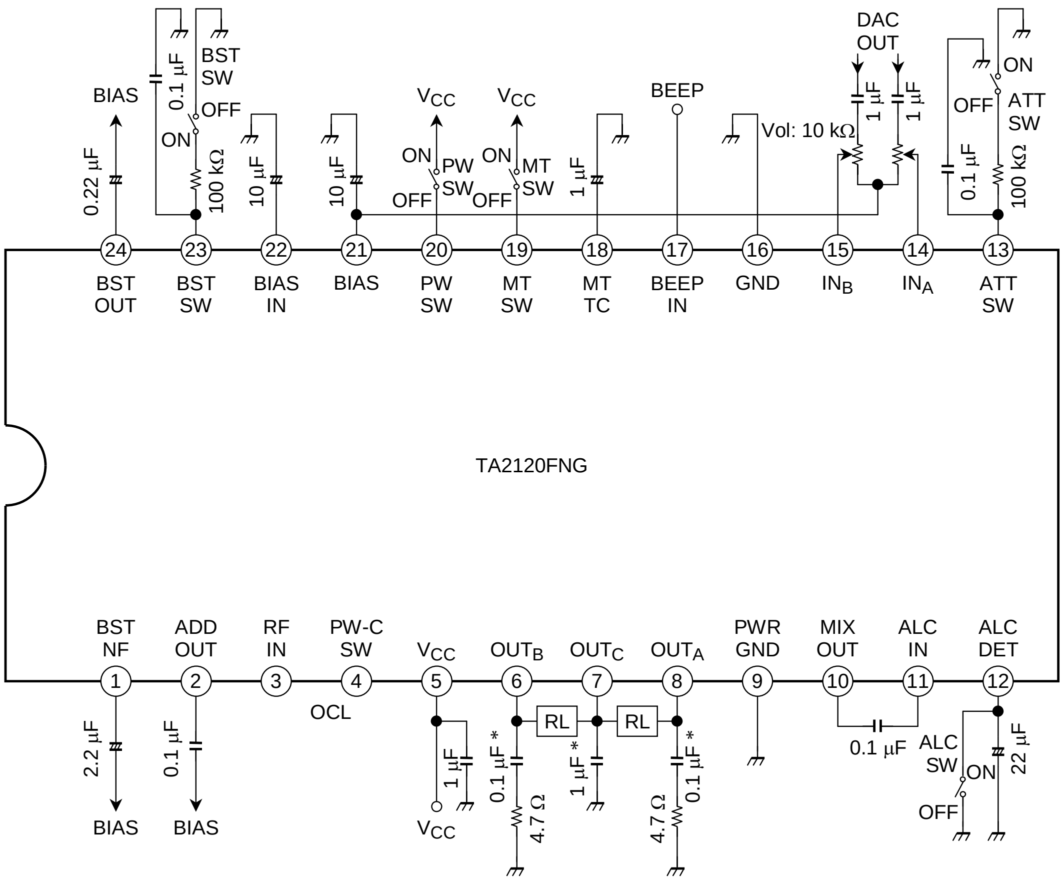
Application Circuit 1 (C-Couple mode)



*: Monolithic ceramic capacitor

PWR AMP GAIN
ATT ON: $G_V = 8.5$dB
ATT OFF: $G_V = 16$dB

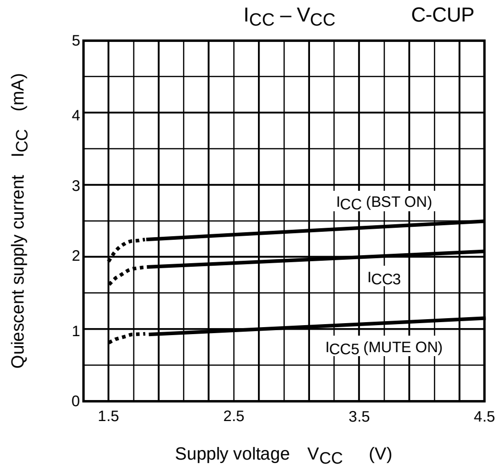
Application Circuit 2 (OCL mode)

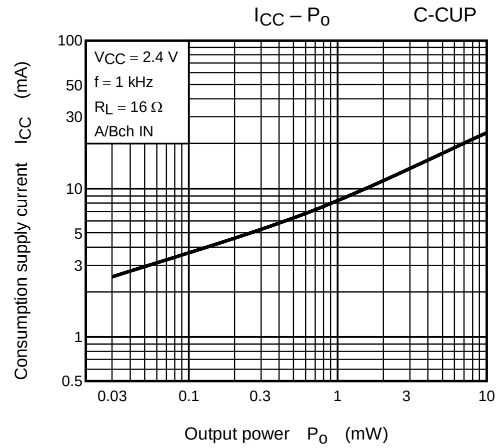


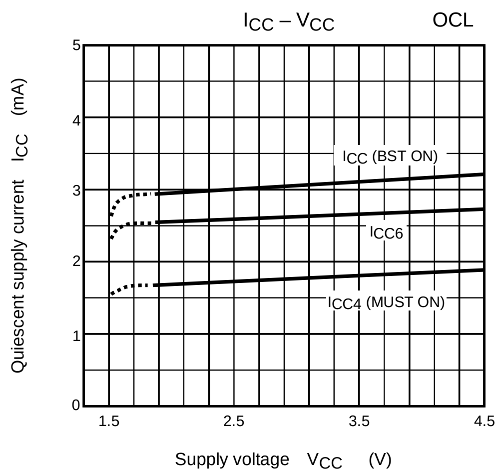
*: Monolithic ceramic capacitor

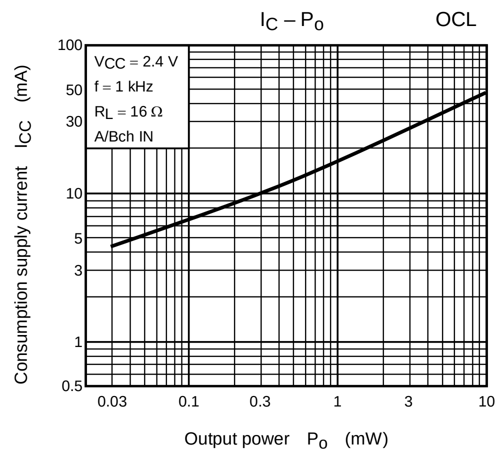
PWR AMP GAIN
ATT ON: G_V = 8.5dB
ATT OFF: G_V = 16dB

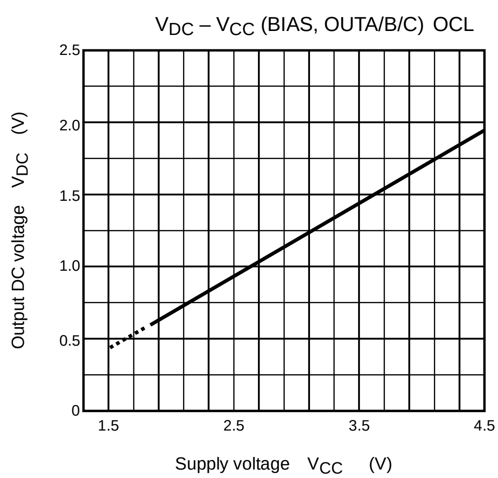
Characteristics (Unless otherwise specified: V_{CC} = 2.4 V, R_L = 16 Ω, Rg = 600 Ω, f = 1 kHz, Ta = 25°C, OCL, ATT OFF)

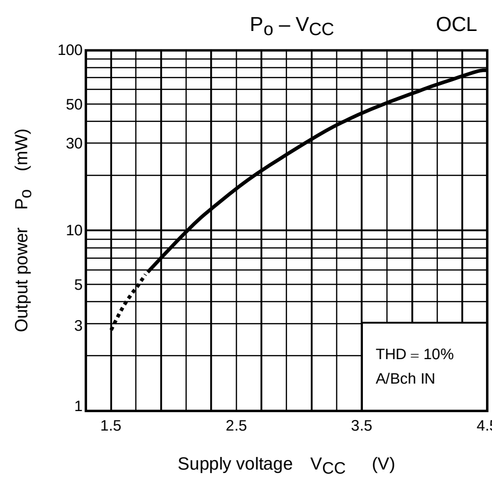


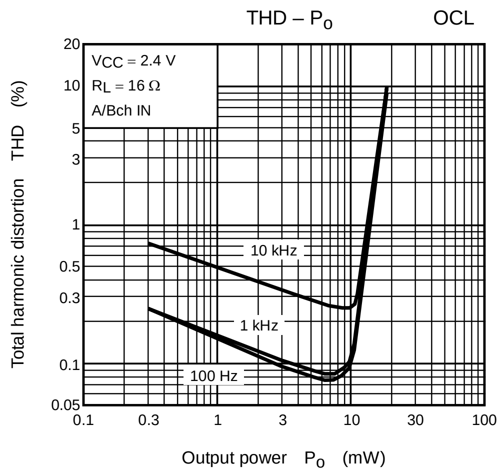


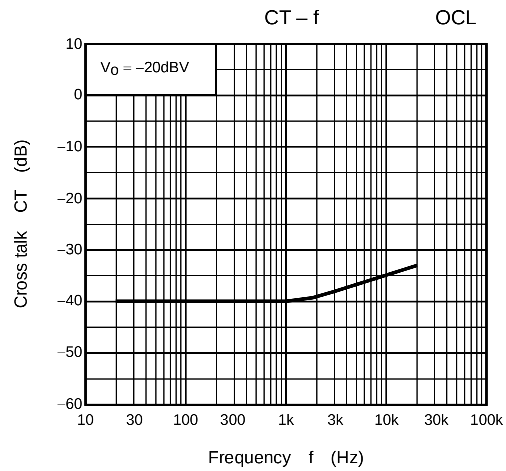


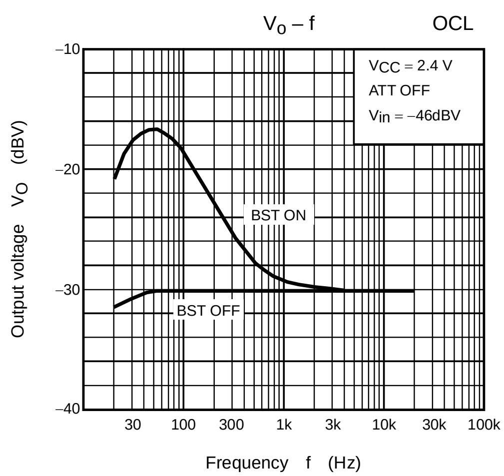


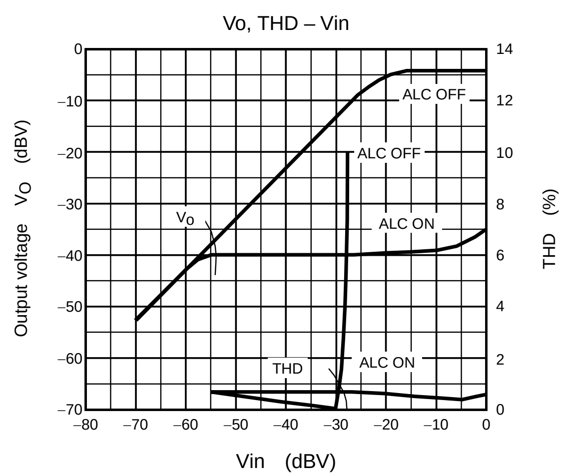


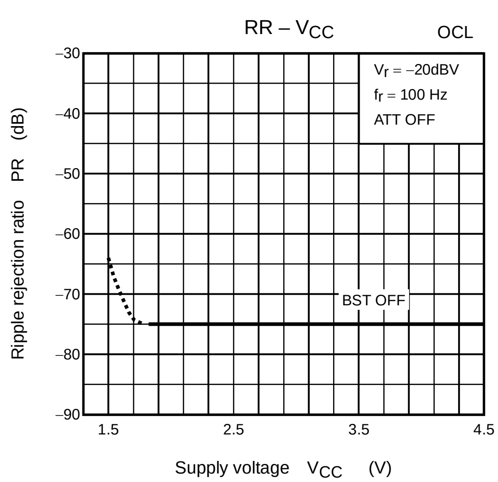


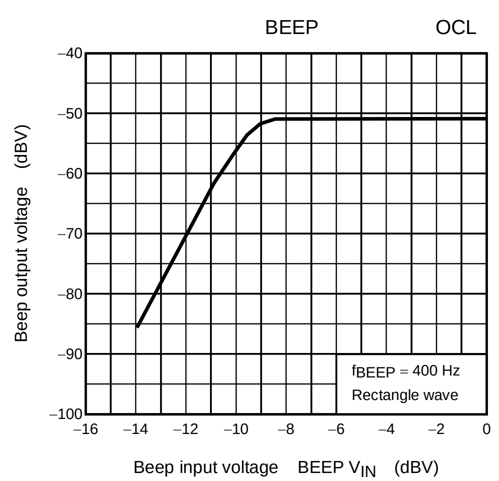

THD – P_o OCL
V_{CC} = 2.4 V
R_L = 16 Ω
A/Bch IN
10 kHz
1 kHz
100 Hz
Total harmonic distortion THD (%)
Output power P_o (mW)

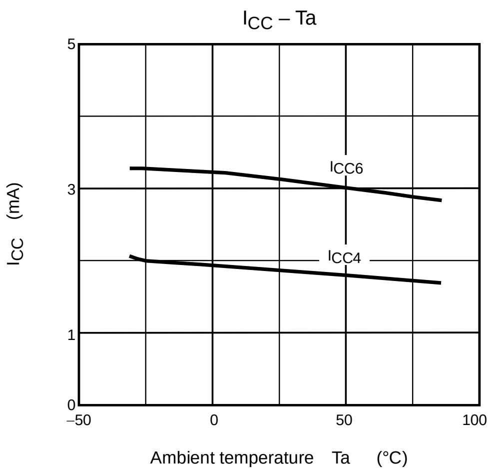

CT – f OCL
V_o = −20dBV
Cross talk CT (dB)
Frequency f (Hz)

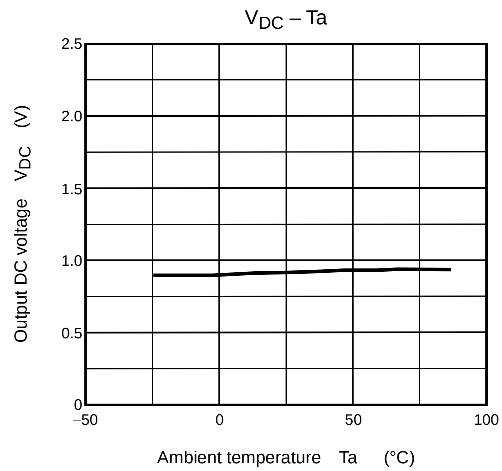

V_o – f OCL
V_{CC} = 2.4 V
ATT OFF
V_{in} = −46dBV
BST ON
BST OFF
Output voltage V_O (dBV)
Frequency f (Hz)


Vo, THD – Vin
ALC OFF
ALC OFF
ALC ON
ALC ON
V_o
THD
Output voltage V_O (dBV)
THD (%)
Vin (dBV)

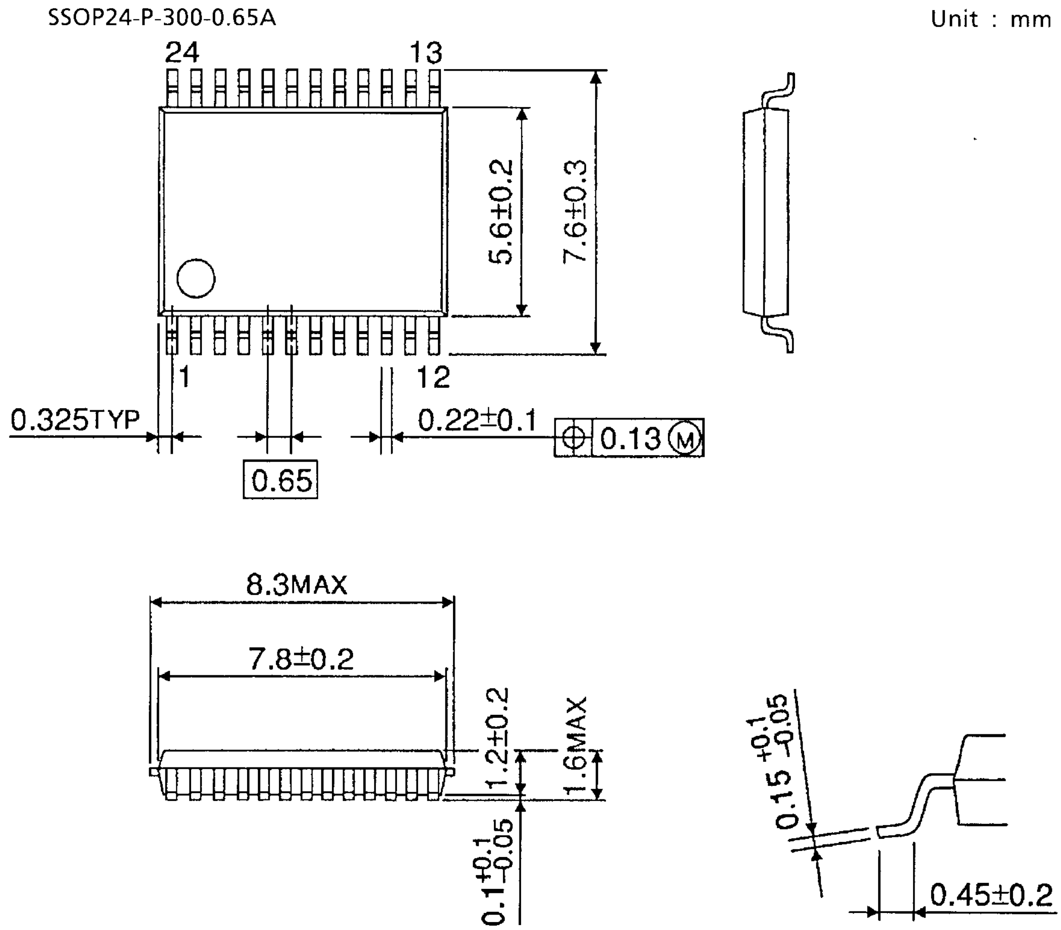

RR – V_{CC} OCL
V_r = −20dBV
f_r = 100 Hz
ATT OFF
BST OFF
Ripple rejection ratio PR (dB)
Supply voltage V_{CC} (V)


BEEP OCL
f_{BEEP} = 400 Hz
Rectangle wave
Beep output voltage (dBV)
Beep input voltage BEEP V_{IN} (dBV)


I_{CC} – Ta
I_{CC} (mA)
5
3
1
0
–50
0
50
100
I_{CC6}
I_{CC4}
Ambient temperature Ta (°C)


V_{DC} – Ta
Output DC voltage V_{DC} (V)
2.5
2.0
1.5
1.0
0.5
0
–50
0
50
100
Ambient temperature Ta (°C)

Package Dimensions



Weight: 0.14 g (typ.)

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About solderability, following conditions were confirmed

- Solderability

  (1) Use of Sn-37Pb 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