4-channel H-bridge type BTL driver for CD players

BA5950FP

The BA5950FP is a 4-channel H-bridge BTL power driver for CD players. Input is PWM, and gain and the filter constant can be changed with an attached resistor and capacitor.

●Applications

CD players, CD-ROM drives and other optical disc devices

●Features

1) 4-channel BTL driver on a HSOP 28-pin power package, allowing for application miniaturization.
2) Direct PWM input.
3) Filter constants can be changed with an attached resistor and capacitor.
4) Internal thermal shutdown circuit with hysteresis capabilities.
5) Internal mute circuit.

●Absolute maximum ratings (Ta = 25°C)

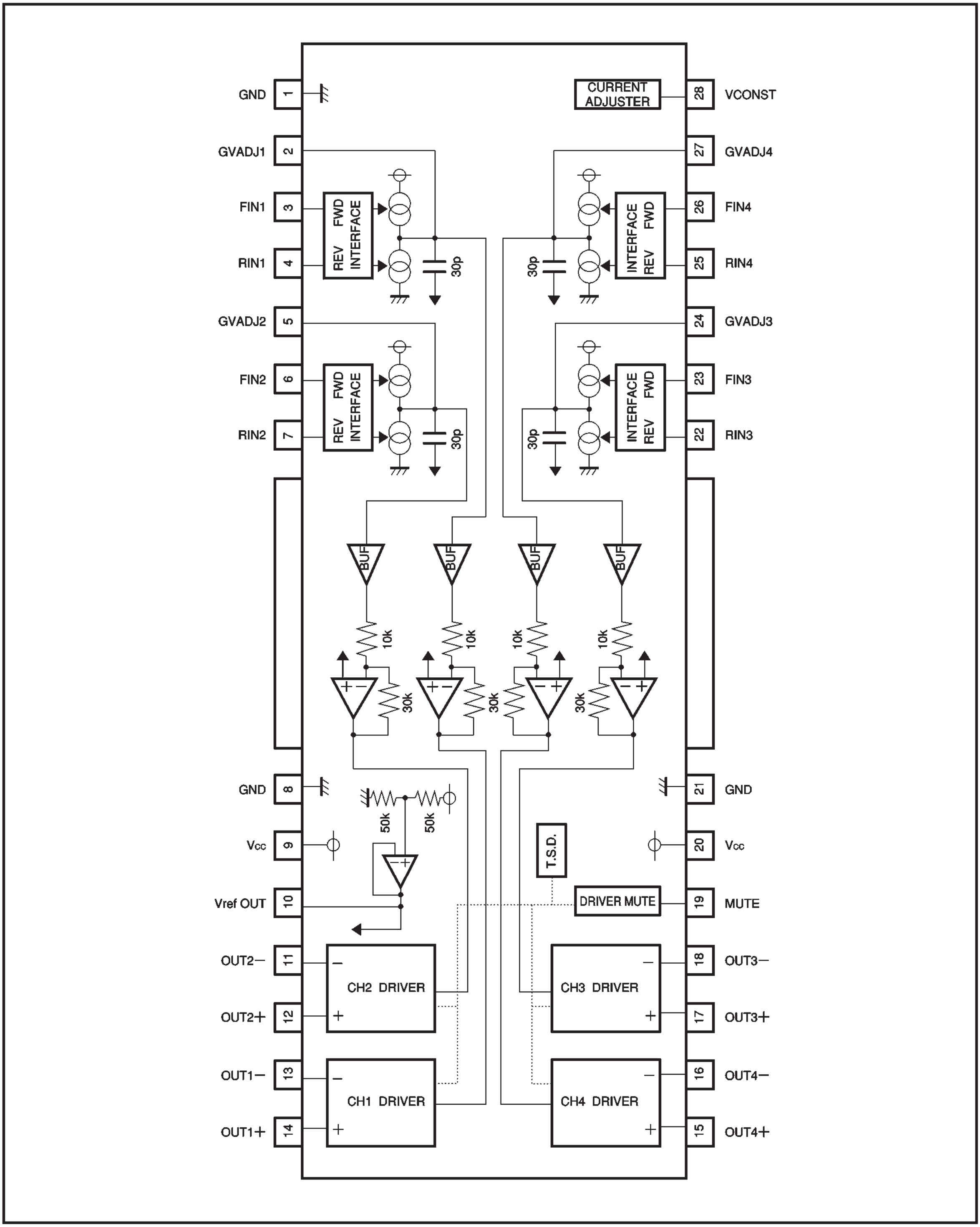
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	18	V
Power dissipation	Pd	1800*	mW
Operating temperature	Topr	−35～+85	℃
Storage temperature	Tstg	−55～+150	℃

* Reduced by 14.4 mW for ach increase in Ta of 1℃ over 25℃.
When mounted on a 70 × 70 × 1.6 mm glass epoxy board.

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CC}	4.5	—	13.5	V

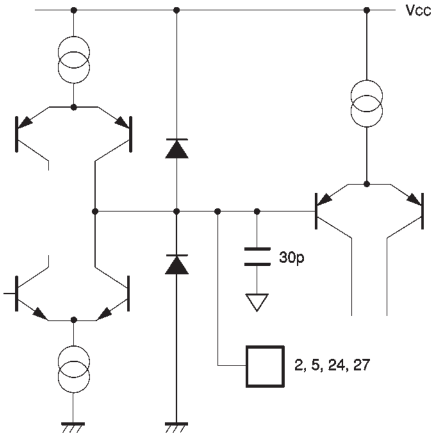
●Block diagram

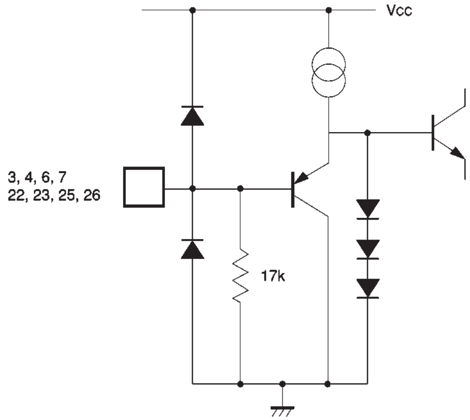


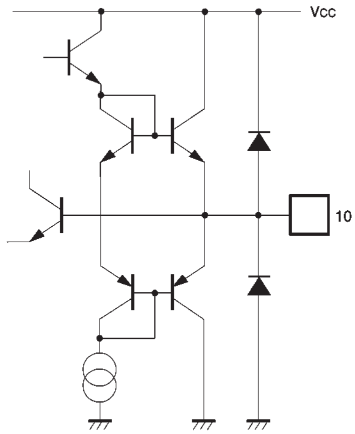
●Pin descriptions

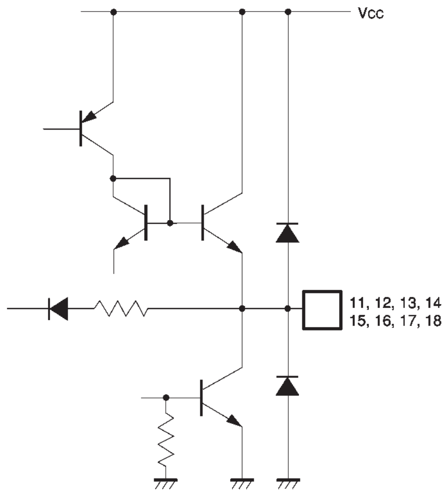
Pin No.	Pin name	Function
1	GND	Ground
2	GVADJ1	Channel 1 gain adjustment
3	FIN1	Channel 1 forward input
4	RIN1	Channel 1 reverse input
5	GVADJ2	Channel 2 gain adjustment
6	FIN2	Channel 2 forward input
7	RIN2	Channel 2 reverse input
8	GND	Substrate ground
9	V_{CC}	Vcc
10	Vref OUT	Reference voltage output
11	OUT2−	Channel 2 negative output
12	OUT2+	Channel 2 positive output
13	OUT1−	Channel 1 negative output
14	OUT1+	Channel 1 positive output
15	OUT4+	Channel 4 positive output
16	OUT4−	Channel 4 negative output
17	OUT3+	Channel 3 positive output
18	OUT3−	Channel 3 negative output
19	MUTE	Mute
20	V_{CC}	Vcc
21	GND	Substrate ground
22	RIN3	Channel 3 reverse input
23	FIN3	Channel 3 forward input
24	GVADJ3	Channel 3 gain adjustment
25	RIN4	Channel 4 reverse input
26	FIN4	Channel 4 forward input
27	GVADJ4	Channel 4 gain adjustment
28	VCONST	Output of constant voltage used to determine gain

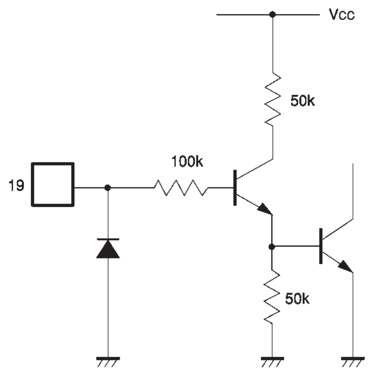
●Input / output circuits

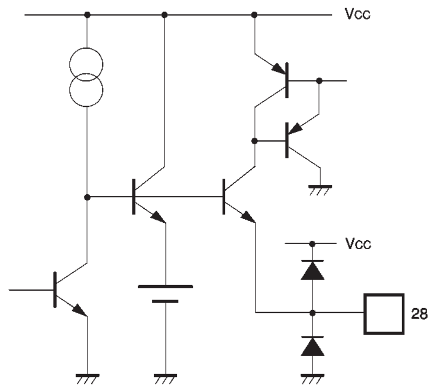












●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 8V, R_L = 8Ω)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Quiescent current dissipation	I_Q	—	14.0	18.0	mA	No load	Fig.1
Bias voltage	V_{BIAS}	3.70	4.00	4.30	V		Fig.1
Bias voltage variation	ΔV_{BIAS}	−30	—	30	mV	1 mA, source, sink	Fig.1
Pin 28 constant voltage output	V_{CONST}	1.10	1.25	1.40	V	30kΩ at GND	Fig.1
Mute On voltage	V_{MON}	2.0	—	—	V		Fig.1
Mute Off voltage	V_{MOFF}	—	—	0.5	V		Fig.1
〈Interface〉							
Input high level voltage	V_{IH}	2.0	—	—	V		Fig.1
Input low level voltage	V_{IL}	—	—	0.5	V		Fig.1
Input high level current	I_{IH}	220	300	420	μA	V_{IN}=5V	Fig.1
Input low level current	I_{IL}	0	—	−10	μA	V_{IN}=0V	Fig.1
Current pulse delay time 1	△tr	—	—	1	μs	At startup	Fig.2
Current pulse delay time 2	△tf	—	—	1	μs	At shutdown	Fig.2
Current pulse delay time differential	△tr-f	−200	—	200	ns		Fig.2
〈Driver〉							
Output offset voltage	V_{OO}	−30	—	30	mV		Fig.1
Maximum output amplitude 1	V_{OMD1}	5.2	5.6	—	V	V_{CC}=8V	Fig.1
Maximum output amplitude 2	V_{OMD2}	3.0	3.3	—	V	V_{CC}=5V	Fig.1
Voltage gain	GVD	7.0	9.5	11.5	dB	V_{IN}=±0.5V	Fig.1
Ripple rejection	RR	—	70	—	dB	V_{IN}=100mV_{rms}, 100Hz	Fig.1

◎Not designed for radiation resistance.

● Measurement circuits

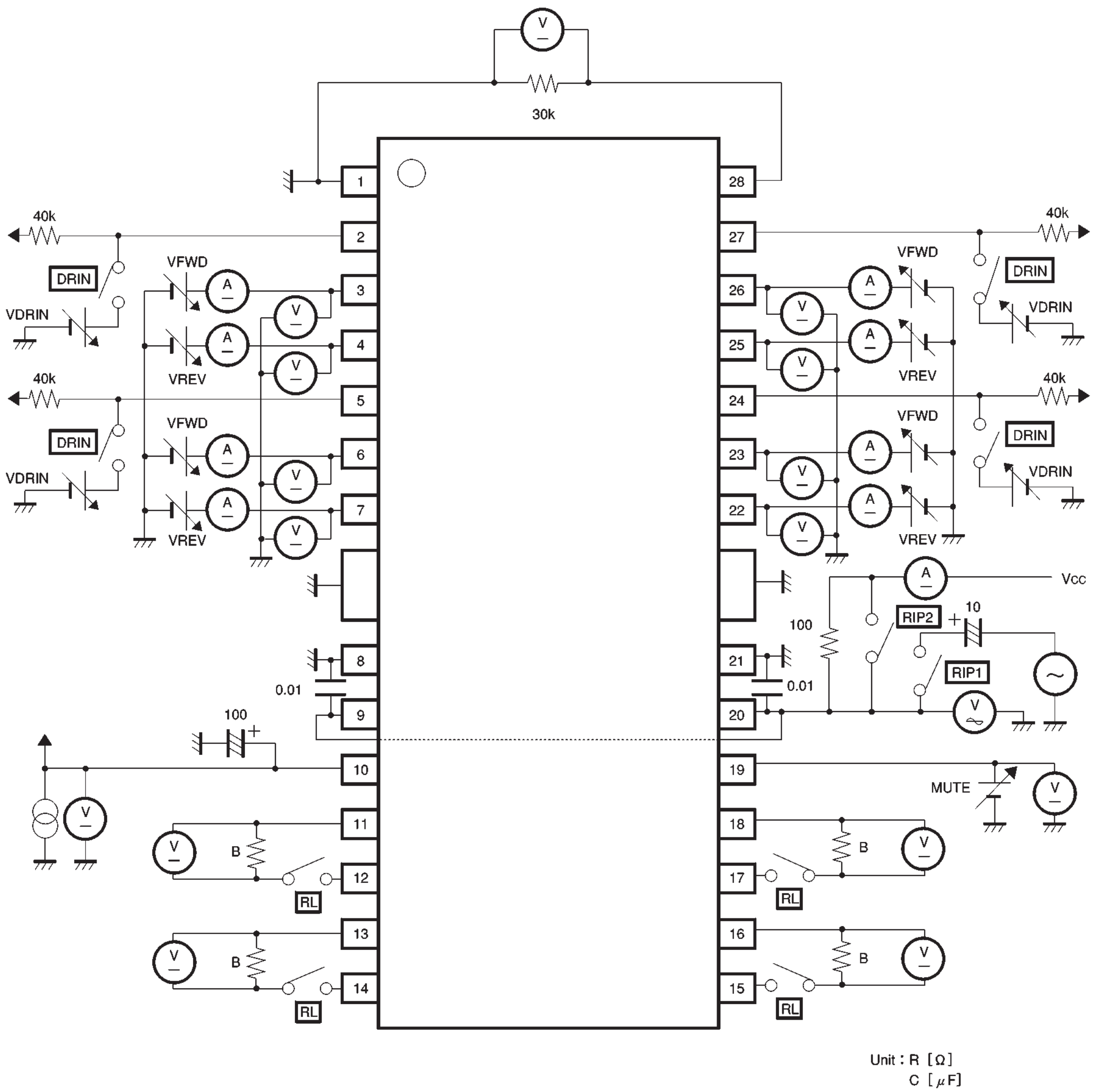


Fig.1

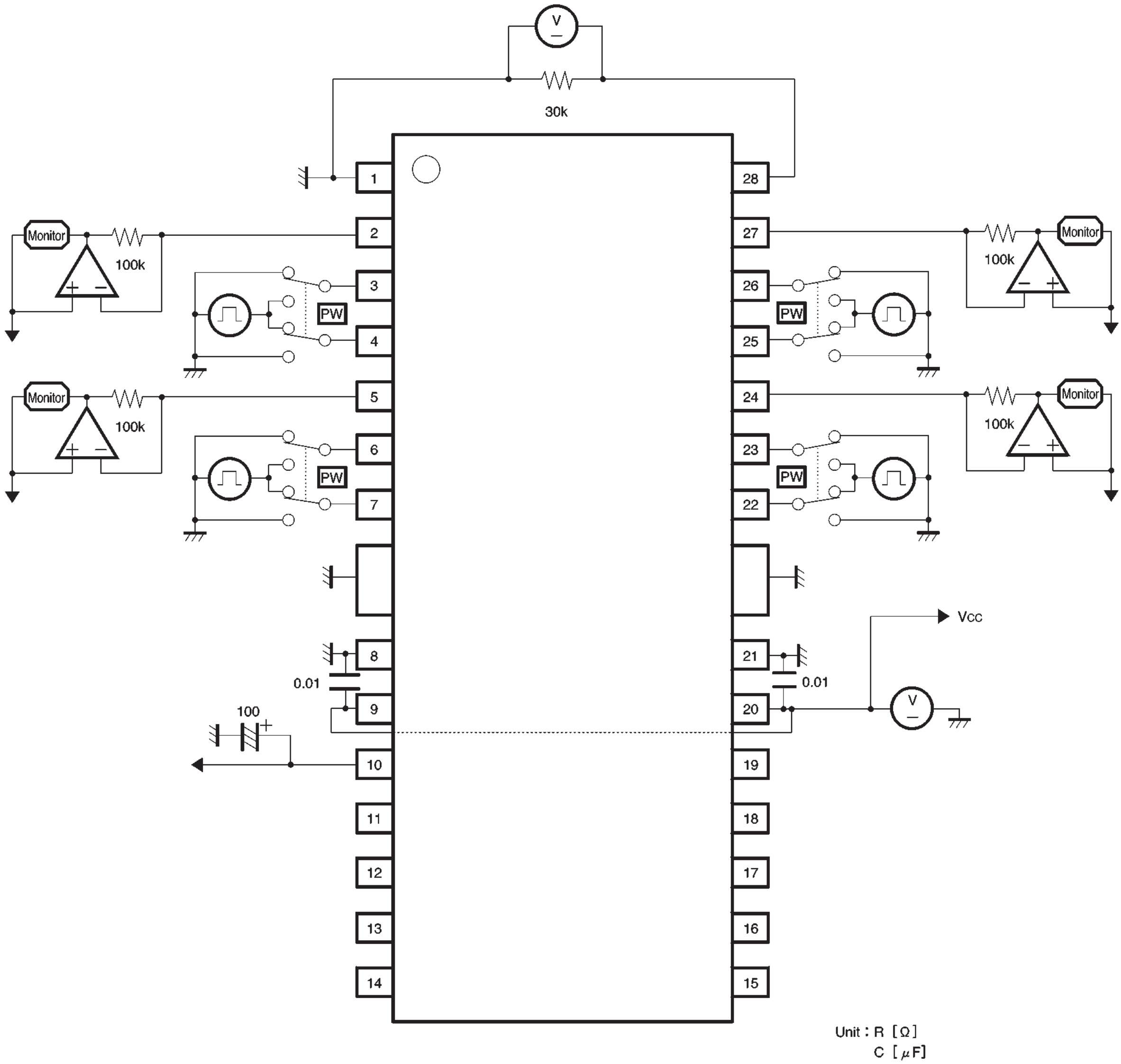

V
30k
1
2
3
4
5
6
7
8
9
10
11
12
13
14
28
27
26
25
24
23
22
21
20
19
18
17
16
15
Monitor
100k
PW
0.01
100
Vcc
Unit : R [Ω]
C [μF]

Fig.2

● Switch table

<table>
<tr><th rowspan="2">Parameter</th><th colspan="4">Switch</th><th colspan="4">Input</th><th rowspan="2">Note</th></tr>
<tr><th>RIP1</th><th>RIP2</th><th>RL</th><th>DRIN</th><th>MUTE</th><th>VDRIN</th><th>VFWD</th><th>VREV</th></tr>
<tr><td>Quiescent current dissipation</td><td rowspan="6">OFF</td><td rowspan="6">ON</td><td rowspan="4">OFF</td><td rowspan="6">OFF</td><td rowspan="4">0.5V</td><td>—</td><td rowspan="4">0V</td><td rowspan="4">0V</td><td></td></tr>
<tr><td>Bias pin voltage</td><td>—</td><td></td></tr>
<tr><td>Bias voltage variation</td><td>—</td><td></td></tr>
<tr><td>Pin 28 constant voltage output</td><td>—</td><td></td></tr>
<tr><td>Mute-on voltage</td><td rowspan="2">ON</td><td>2.0V</td><td>—</td><td>5V</td><td>0V</td><td></td></tr>
<tr><td>Mute-off voltage</td><td>0.5V</td><td>—</td><td>5V</td><td>0V</td><td></td></tr>
<tr><td colspan="10">〈Interface〉</td></tr>
<tr><td>Input high level voltage F</td><td rowspan="8">OFF</td><td rowspan="8">ON</td><td rowspan="8">OFF</td><td rowspan="8">OFF</td><td>—</td><td>—</td><td>2V</td><td>0V</td><td></td></tr>
<tr><td>Input high level voltage R</td><td>—</td><td>—</td><td>0V</td><td>2V</td><td></td></tr>
<tr><td>Input low level voltage F</td><td>—</td><td>—</td><td>0.5V</td><td>0V</td><td></td></tr>
<tr><td>Input low level voltage R</td><td>—</td><td>—</td><td>0V</td><td>0.5V</td><td></td></tr>
<tr><td>Input high level current</td><td>—</td><td>—</td><td>5V</td><td>5V</td><td></td></tr>
<tr><td>Input low level current</td><td>—</td><td>—</td><td>0V</td><td>0V</td><td></td></tr>
<tr><td>Current pulse delay 1</td><td>—</td><td>—</td><td>—</td><td>—</td><td rowspan="2">Measure the delay in the monitors observed waveform relative to the input waveform</td></tr>
<tr><td>Current pulse delay 2</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>Current pulse delay differential</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td></td></tr>
<tr><td colspan="10">〈Driver〉</td></tr>
<tr><td>Output offset voltage</td><td rowspan="4">OFF</td><td rowspan="4">ON</td><td rowspan="5">ON</td><td>OFF</td><td rowspan="5">0.5V</td><td>—</td><td>—</td><td>—</td><td></td></tr>
<tr><td>Maximum output amplitude 1</td><td rowspan="3">ON</td><td>7V, 1V</td><td>—</td><td>—</td><td></td></tr>
<tr><td>Maximum output amplitude 2</td><td>4V, 1V</td><td>—</td><td>—</td><td></td></tr>
<tr><td>Voltage gain</td><td>*1</td><td>—</td><td>—</td><td>(pin 10 voltage ±0.5 V) *1</td></tr>
<tr><td>Ripple rejection</td><td>ON</td><td>OFF</td><td>OFF</td><td>—</td><td>—</td><td>—</td><td></td></tr>
</table>

● Circuit operation

(1) Overview

Fig. 6 shows the inputs from the digital servo IC. SW1 turns on when the forward input signal is received (HIGH level, above 2.0V). SW2 turns on when the reverse input signal is received (Fig. 3). When this happens, the constant current enters resistor R_1 and the capacitor, generating an integral waveform based on the duty of the input waveform. This is increased by a factor of 3 by the driver and output (Fig. 5).

When forward or reverse input remains at the HIGH level, the DC voltage generated at point A is :

$I \times R_1$ [V] (reverse : $-1 \times R_1$ [V])

This is the voltage generated relative V_{ref}. The width setting is such that the following driver buffer output is generated :

$3IR_1$ [V] (reverse : $-3IR_1$ [V]) ①

The time constant is :

$R_1 (C + 30p)$

This can be changed with an attached capacitor.

Dead zone width is set by input duty ratio according to the following equation :

$$\frac{10.0\ [k\Omega] \times 1.0\ [\mu A]}{I \times R_1} \times 100\ [\%]\ \text{(one side)} \quad ②$$

(2) Settings

The constant current is determined by the resistor (R_0) connected between pin 28 and pin 1 (GND).

$I = 1.25 / R_0$ [A]

Consequently, equations ① and ② are as follows.

$$3 \times 1.25 \times \frac{R_1}{R_0}\ [V] \quad ①'$$

$$\frac{10.0\ [k\Omega] \times 1.0\ [\mu A]}{1.25} \times \frac{R_0}{R_1} \times 100\ [\%] \quad ②'$$

The ratio of R_0 and R_1 determine everything. R_0 must stay between 10kΩ and 40kΩ, R_1 below 100kΩ.

Example : When R_0 = 30kΩ, R_1 = 40kΩ, input HIGH level = 5V

①→5V (0dB relative to input)

②→0.6% (input equivalent = 30mV)

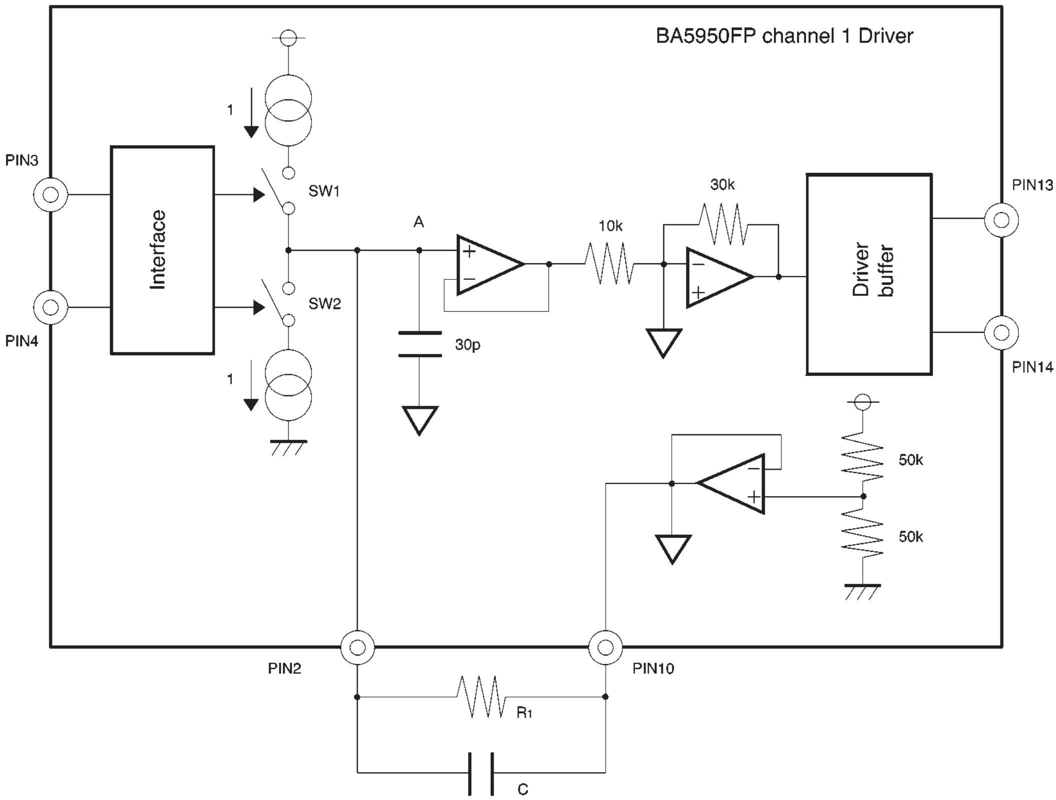


Fig. 3

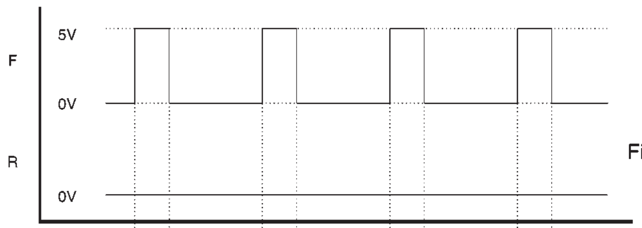


Fig. 4

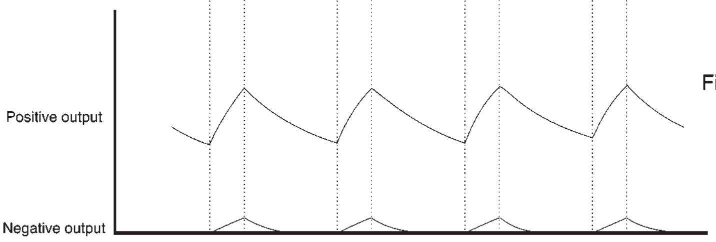


Fig. 5

● Application example

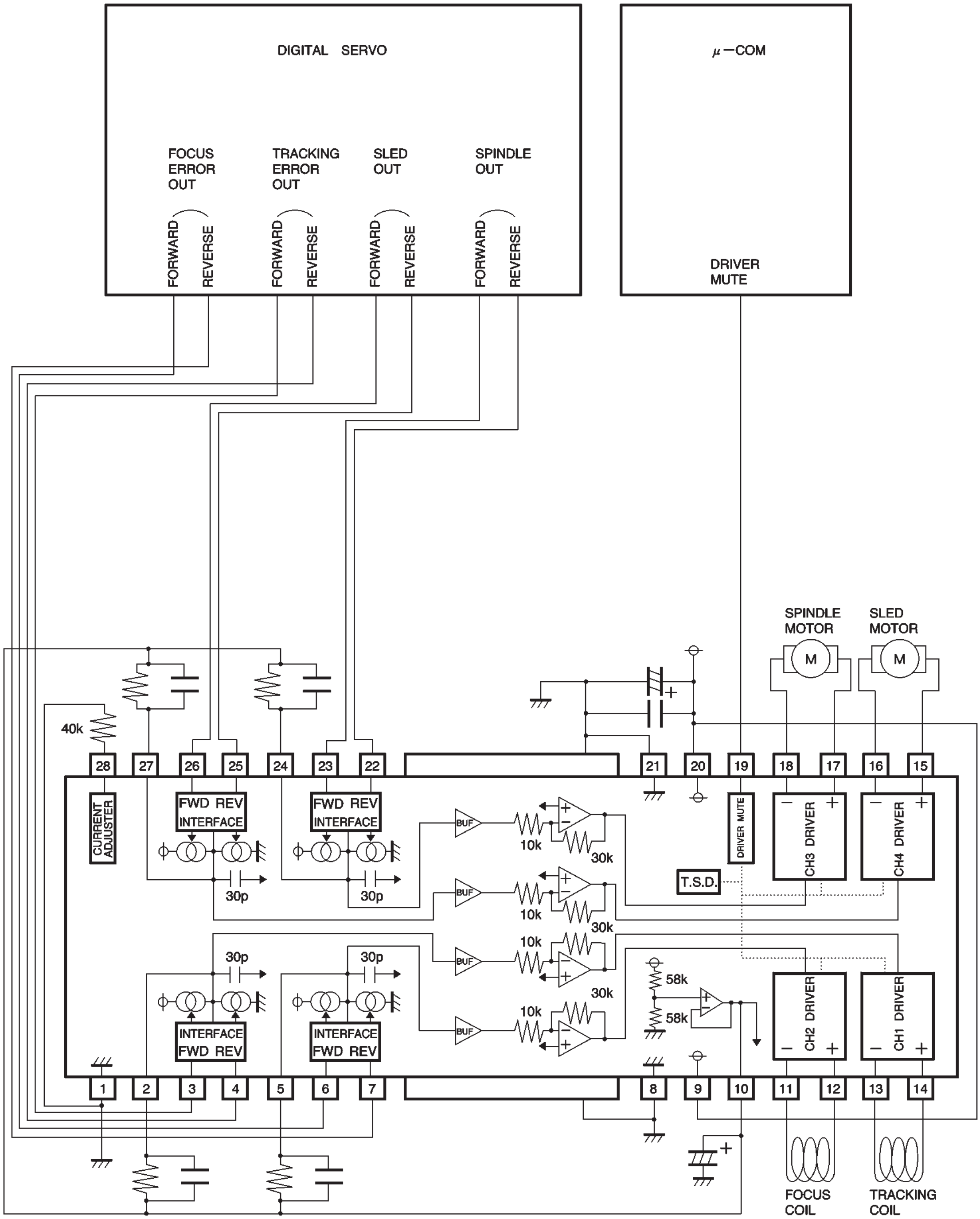


Fig. 6

●Operation notes

(1) The BA5950FP has an internal thermal shutdown circuit with hysteresis. Output current is muted when the chip temperature exceeds 175°C (typically) and restored when the chip temperature falls to 150°C (typically).

(2) Output current can be muted by raising the mute pin (pin19) voltage above 2.0V. The mute pin must be kept below 0.5V during normal operation.

(3) All four driver output channels are muted during thermal shutdown, muting and a drop in bias pin voltage. No other components are muted.

(4) Connect a stabilizing capacitor (roughly 1μF) to the internal reference voltage output pin (pin10).

(5) Connect the IC to a 0.1μF bypass capacitor to the power supply, at the base of the IC.

(6) Connect the radiating fin to an external ground.

●Electrical characteristic curves

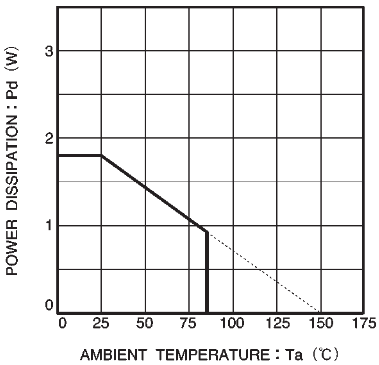


Fig. 7 Thermal derating curve

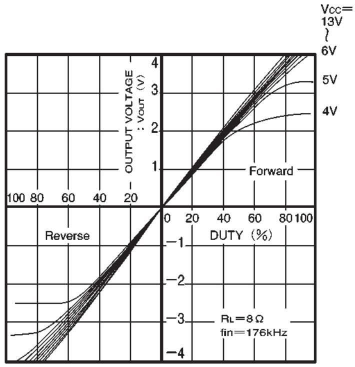


Fig. 8 Driver I/O characteristics (variable Vcc)

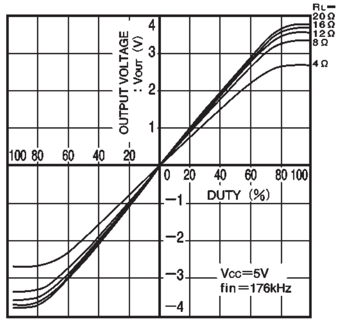


Fig. 9 Driver I/O characteristics (variable load)

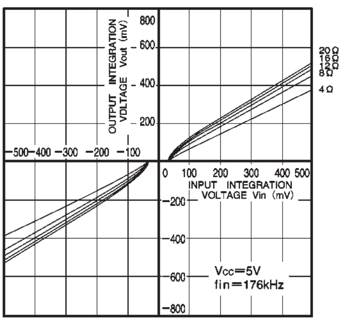


Fig. 10 Driver ultralow input I / O characteristic (variable load)

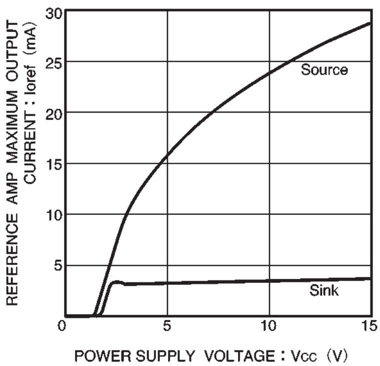
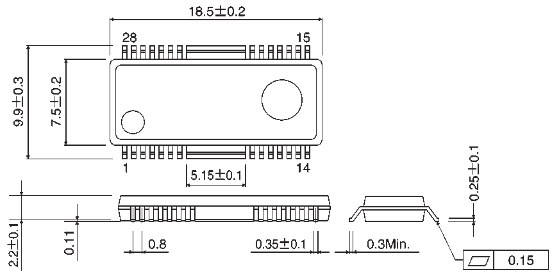


Fig. 11 Power supply voltage vs. Vref amplifier output drive current

●External dimensions (Units: mm)



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