

# 4-channel BTL driver for CD players

## BA6398FP

The BA6398FP is a 4-channel BTL driver for CD player motors and actuators. This IC has an internal 5V regulator, and is suited to a wide range of applications.

### ●Applications

CD players and CD-ROM drives

### ●Features

- 1) 28-pin HSOP package allows for miniaturization of applications.
- 2) Low number of external components.
- 3) Driver gain is adjustable with a single attached resistor.
- 4) Internal 5V regulator. (requires attached PNP transistor)
- 5) Internal standard operational amplifier.
- 6) Internal thermal shutdown circuit.

### ●Absolute maximum ratings (Ta = 25°C)

| Parameter             | Symbol           | Limits   | Unit |
|-----------------------|------------------|----------|------|
| Power supply voltage  | V <sub>CC</sub>  | 18       | V    |
| Power dissipation     | P <sub>d</sub>   | 1.7*1    | W    |
| Operating temperature | T <sub>opr</sub> | -35~+85  | °C   |
| Storage temperature   | T <sub>stg</sub> | -55~+150 | °C   |

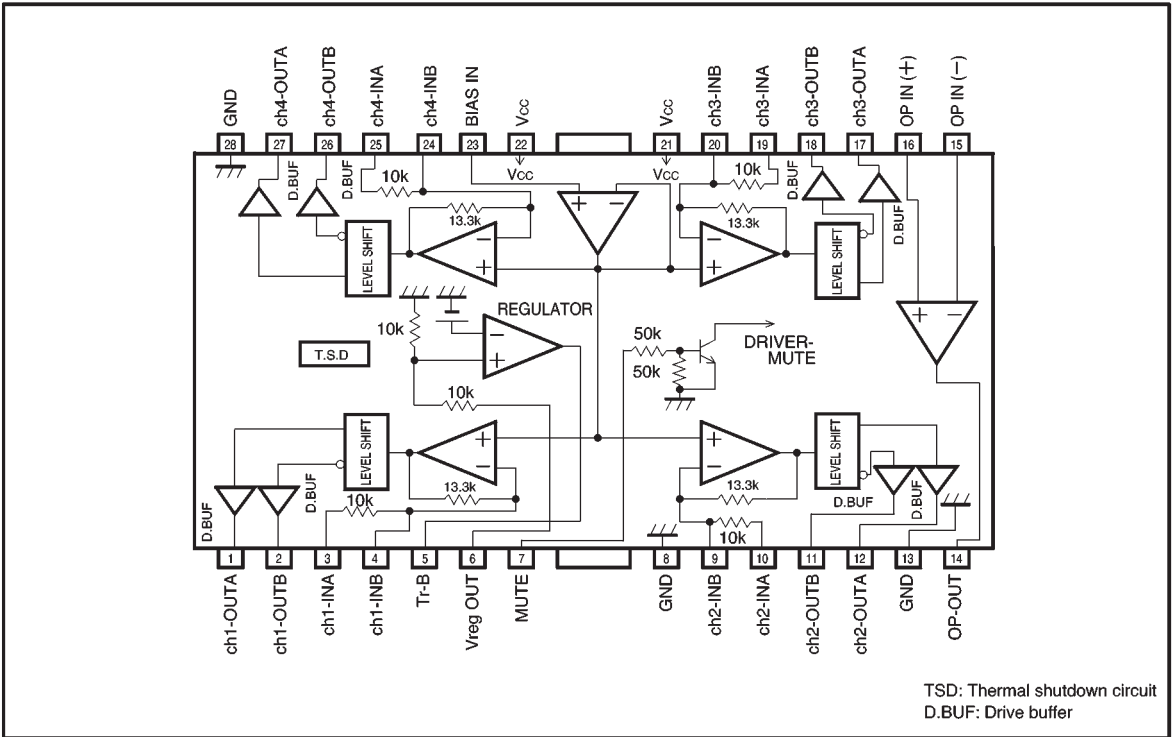
\*1 When mounted on a 50 mm × 50 mm × 1.0 mm paper phenol board.  
Reduced by 13.6 mW for each increase in Ta of 1°C over 25°C.

### ●Recommended operating conditions (Ta = 25°C)

| Parameter            | Symbol          | Limits | Unit |
|----------------------|-----------------|--------|------|
| Power supply voltage | V <sub>CC</sub> | 6~9*2  | V    |

\*2 The driver can operate as low as 5.5 V.

● Block diagram



## ● Pin descriptions

| Pin No. | Pin name        | Function  |
|---------|-----------------|---|
| 1       | ch1—OUT A       | Driver channel 1 negative output                                      |
| 2       | ch1—OUT B       | Driver channel 1 positive output                                      |
| 3       | ch1—IN A        | Driver channel 1 input  |
| 4       | ch1—IN B        | Driver channel 1 gain adjustment pin                                  |
| 5       | Tr—B            | Connect to external transistor base                                   |
| 6       | Vreg OUT        | Constant voltage output<br>(connect to external transistor collector) |
| 7       | MUTE            | Mute control pin  |
| 8       | GND             | Ground  |
| 9       | ch2—IN B        | Driver channel 2 gain adjustment pin                                  |
| 10      | ch2—IN A        | Driver channel 2 input  |
| 11      | ch2—OUT B       | Driver channel 2 positive output                                      |
| 12      | ch2—OUT A       | Driver channel 2 negative output                                      |
| 13      | GND             | Substrate ground  |
| 14      | OP OUT          | Operational amplifier output  |
| 15      | OP IN (—)       | Operational amplifier negative input                                  |
| 16      | OP IN (+)       | Operational amplifier positive input                                  |
| 17      | ch3—OUT A       | Driver channel 3 negative output                                      |
| 18      | ch3—OUT B       | Driver channel 3 positive output                                      |
| 19      | ch3—IN A        | Driver channel 3 input  |
| 20      | ch3—IN B        | Driver channel 3 gain adjustment pin                                  |
| 21      | V <sub>CC</sub> | Power supply  |
| 22      | V <sub>CC</sub> | Power supply  |
| 23      | BIAS IN         | Bias amplifier input pin  |
| 24      | ch4—IN B        | Driver channel 4 gain adjustment pin                                  |
| 25      | ch4—IN A        | Driver channel 4 input  |
| 26      | ch4—OUT B       | Driver channel 4 positive output                                      |
| 27      | ch4—OUT A       | Driver channel 4 negative output                                      |
| 28      | GND             | Substrate ground  |

Note: Positive and negative output is relative to the polarity of the input pins.

● Input/output circuits

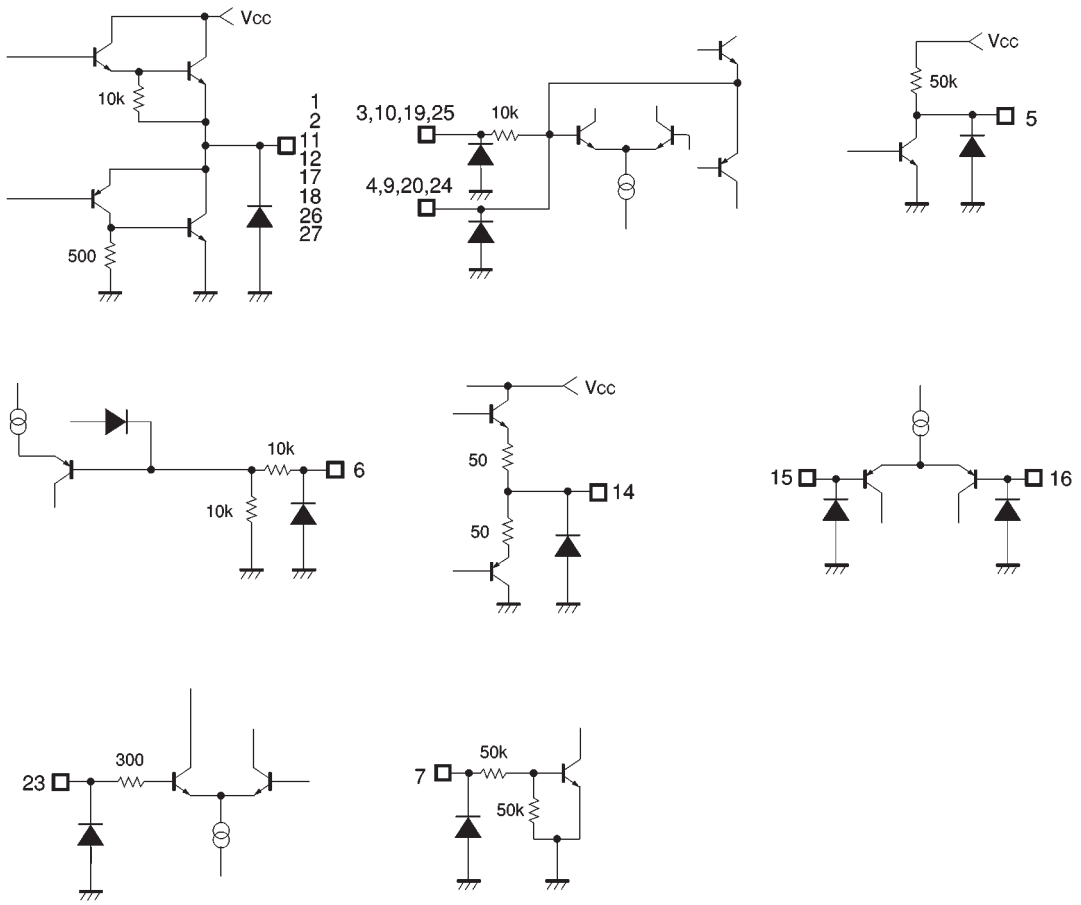


Fig.1

●Electrical characteristics (unless otherwise noted,  $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 8\text{V}$ ,  $f = 1\text{kHz}$ ,  $R_L = 8\Omega$ )

| Parameter                         | Symbol           | Min. | Typ. | Max. | Unit              | Conditions                                      |
|-----------------------------------|------------------|------|------|------|-------------------|---|
| Quiescent current dissipation     | $I_{CC}$         | 6.0  | 10.0 | 14.0 | mA                | No load   |
| Output voltage, offset            | $V_{OO}$         | -40  | -    | 40   | mV                |   |
| Maximum output high level voltage | $V_{OHD}$        | 5.2  | 5.6  | -    | V                 |   |
| Maximum output low level voltage  | $V_{OLD}$        | -    | 1.3  | 1.55 | V                 |   |
| Closed loop voltage gain          | $G_{VC}$         | 7.0  | 8.0  | 9.0  | dB                | $V_{IN}=0.1V_{rms}$ , 1kHz                      |
| Ripple rejection ratio            | RR               | -    | 60   | -    | dB                | $V_{IN}=0.1V_{rms}$ , 100Hz                     |
| Slew rate                         | SR               | -    | 2.0  | -    | V / $\mu\text{s}$ | 100 kHz square wave, 3 V <sub>P-P</sub> output  |
| Mute Off voltage                  | $V_{MOFF}$       | 2.0  | -    | -    | V                 |   |
| 〈5 V regulator〉                   |                  |      |      |      |                   |   |
| Output voltage                    | $V_{REG}$        | 4.75 | 5.00 | 5.25 | V                 | $I_L=100\text{mA}$                              |
| Output load differential          | $\Delta V_{RL}$  | -50  | 0    | 10   | mV                | $I_L=0\sim 200\text{mA}$                        |
| Power supply voltage differential | $\Delta V_{VCC}$ | -10  | 0    | 25   | mV                | ( $V_{CC}=6\sim 9\text{V}$ ) $I_L=100\text{mA}$ |
| 〈Operational amplifier〉           |                  |      |      |      |                   |   |
| Offset voltage                    | $V_{OFOP}$       | -5   | 0    | 5    | mV                |   |
| Input bias current                | $V_{BOP}$        | -    | -    | 300  | nA                |   |
| Output high level voltage         | $V_{OHOP}$       | 6.0  | -    | -    | V                 |   |
| Output low level voltage          | $V_{OLOP}$       | -    | -    | 1.8  | V                 |   |
| Output drive current (sink)       | $I_{SINK}$       | 10   | 50   | -    | mA                | $V_{CC}$ at 50 $\Omega$                         |
| Output drive current (source)     | $I_{SOURCE}$     | 10   | 40   | -    | mA                | 50 $\Omega$ at ground                           |
| Open loop voltage gain            | $G_{VO}$         | -    | 78   | -    | dB                | $V_{IN}=-75\text{dBV}$ , 1kHz                   |
| Slew rate                         | $SR_{OP}$        | -    | 1    | -    | V / $\mu\text{s}$ | 100 kHz square wave, 4 V <sub>P-P</sub> output  |
| Ripple rejection ratio            | $RR_{OP}$        | -    | 65   | -    | dB                | $V_{IN}=-20\text{dBV}$ , 100Hz                  |
| Common mode rejection ratio       | CMRR             | 70   | 84   | -    | dB                | $V_{IN}=-20\text{dBV}$ , 1kHz                   |

©Not designed for radiation resistance

## ●Circuit operation

### (1) Driver

Inputs to the IC are the focus tracking error signal from the servo preamplifier and the control signal from the motor. The input signals, which normally center on 2.5V, are V/I converted by the preamplifier, generating a current corresponding to the input voltage. This current is

passed through a resistor and into the internal reference voltage component, the preamplifier output being a signal centering on the internal reference voltage. Two systems (positive phase and negative phase) are created during V/I conversion, generating BTL output via the driver buffer.

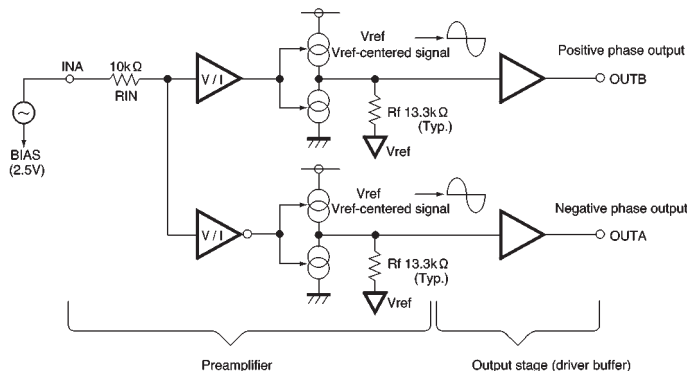


Fig. 2

(2) Regulator

This is a typical series regulator that generates a reference voltage internally. A PNP low saturation types transistor must be connected.

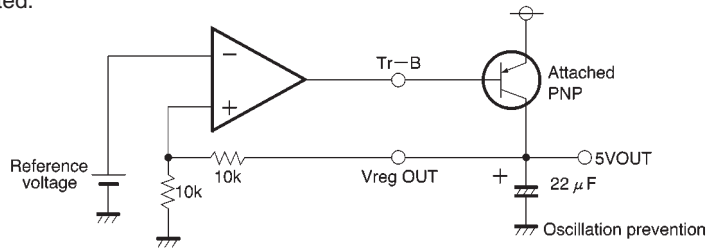


Fig. 3

(3) Operational amplifier

A standard 4558 type.

●Application example

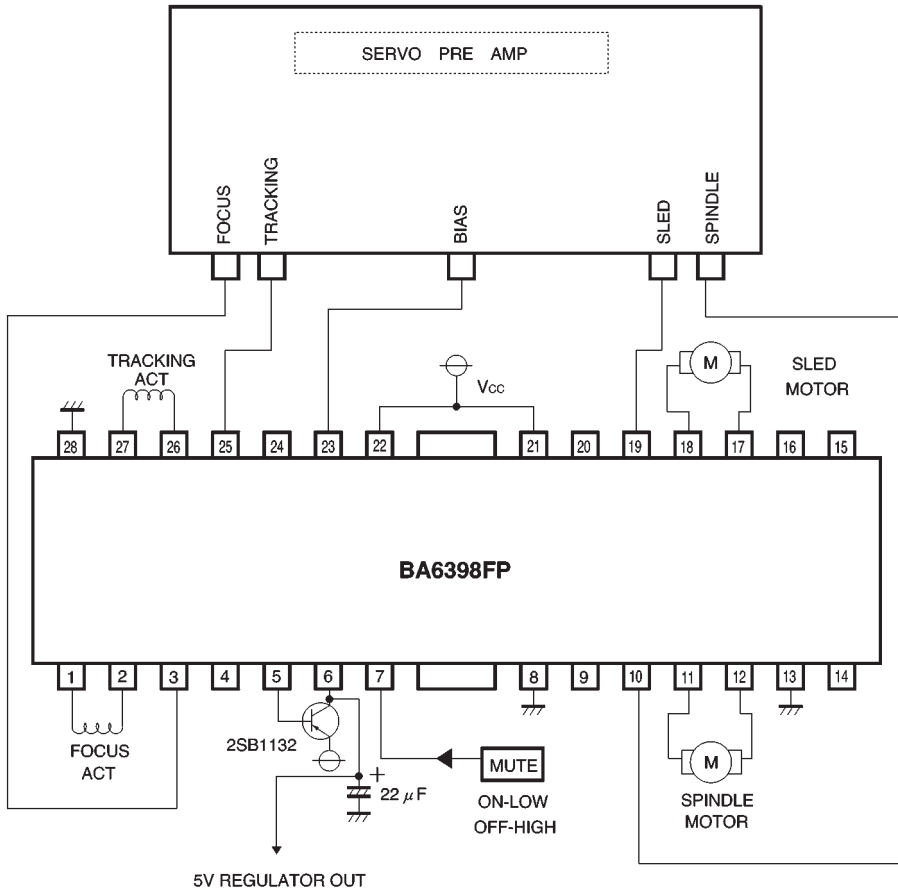


Fig. 4

### ● Operation notes

- (1) The BA6398FP has an internal thermal shutdown circuit. Output current is muted when the chip temperature exceeds 175°C (typically).
- (2) If the mute pin (pin 7) voltage is opened or lowered below 0.5V, the output current will be muted. Pin 7 should be pulled up above 2.0V during normal use.
- (3) The bias pin (pin 23) is muted when lowered below 1.4V (typically). Make sure it stays above 1.6V during normal use.
- (4) The driver circuit shuts down when the supply voltage drops below 4.5V (typically), and starts up again when the voltage rises above 4.7V (typically).
- (5) Muting occurs during thermal shutdown, mute-on operations or a drop in the bias pin voltage or supply voltage. In each case, only the drivers are muted. During muting, the output pins remain at the internal bias voltage, roughly  $(V_{CC}-V_F)/2$ .

- (6) The internal input resistor has a positive temperature coefficient of roughly 2000ppm/degree, and so when changing the gain using an attached resistor, gain will also change at a rate of roughly 2000ppm/degree. There is virtually no gain variation due to temperature when using the internal input resistor.
- (7) Be sure to connect the IC to a 0.1μF bypass capacitor to the power supply, at the base of the IC.
- (8) The radiating fin is connected to the package's internal GND, but should also be connected to an external ground.
- (9) The capacitor between regulator output (pin 6) and GND also serves to prevent oscillation of the IC, so select one with good temperature characteristics.

### ● Electrical characteristic curves

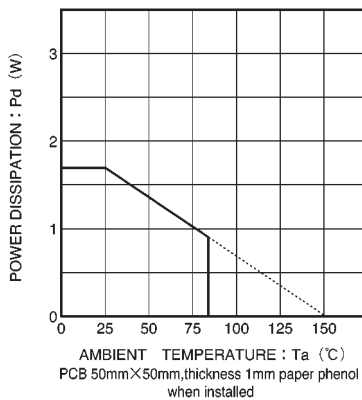


Fig. 5 Thermal derating curve

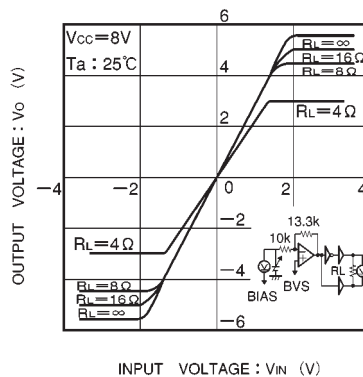


Fig. 6 Driver I/O characteristics (variable load)

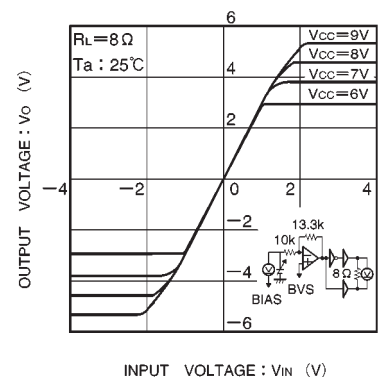


Fig. 7 Driver I/O characteristics (variable power supply)

●Electrical characteristic curves

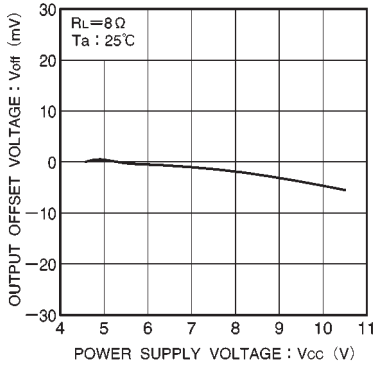


Fig. 8 Power supply voltage vs. output offset voltage

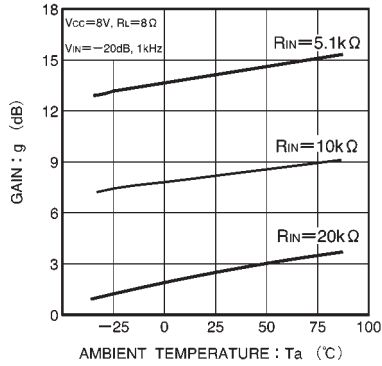


Fig. 9 Driver gain vs. temperature (R<sub>IN</sub> connected via gain adjustment pin)

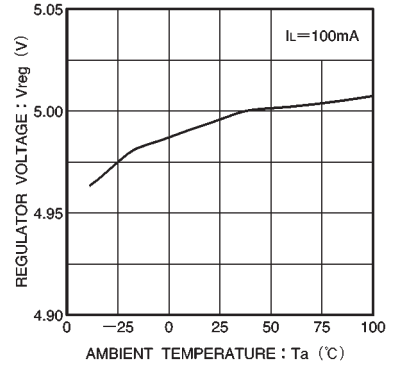


Fig. 10 Regulator voltage vs. temperature

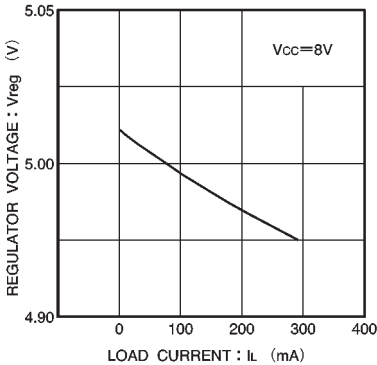


Fig. 11 Load current vs. regulator voltage

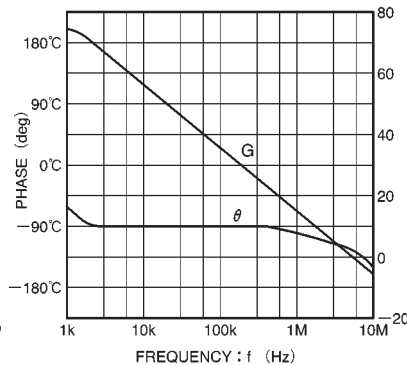


Fig. 12 Operational amplifier vs. open loop

●External dimensions (Units: mm)

