

# 4-channel BTL driver for CD players

## BA5937AFP

The BA5937AFP is a 4-channel BTL driver developed for use with CD players. In addition to internal drivers for the focus coil, tracking coil, and sled motor, it also contains a driver for the loading motor.

### ●Applications

CD-ROM, CD players

### ●Features

- 1) Perfect for compact applications with the use of the HSOP 28-pin power package.
- 2) Internal thermal shutdown circuit.
- 3) Gain is adjustable with externally connected resistor.  
(For channels 1, 3, and 4.)
- 4) External mute pin enables the muting of the output current for channels 1 and 4.
- 5) Power supply is divided into three systems  
( $V_{cc1}$  = ch1 and ch4,  $V_{cc2}$  = ch2 and current source,  $V_{cc3}$  = ch3).

### ●Absolute maximum ratings ( $T_a = 25^\circ\text{C}$ )

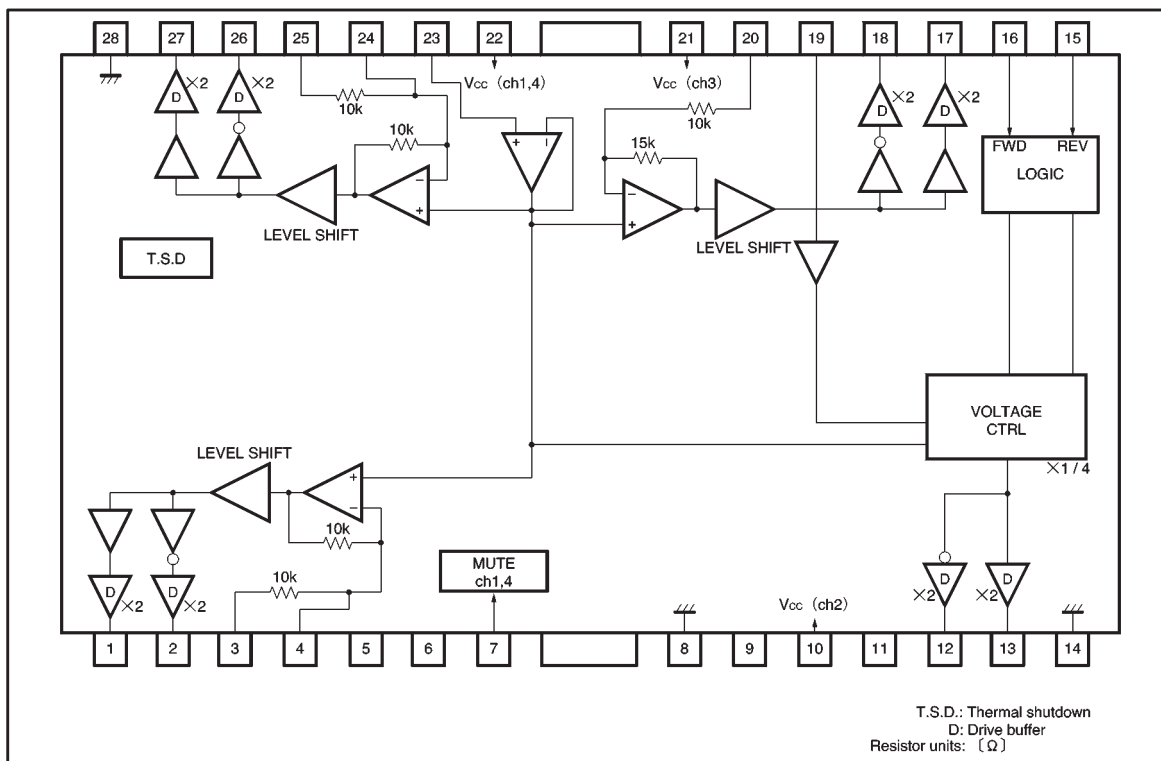
| Parameter             | Symbol    | Limits          | Unit             |
|-----------------------|-----------|-----------------|------------------|
| Power supply voltage  | $V_{cc}$  | 13.5            | V                |
| Power dissipation     | $P_d$     | 1.7 *           | W                |
| Operating temperature | $T_{opr}$ | $-35 \sim +85$  | $^\circ\text{C}$ |
| Storage temperature   | $T_{stg}$ | $-55 \sim +150$ | $^\circ\text{C}$ |

\* When mounted on a 70mm × 70mm × 1.6mm glass epoxy board with copper foil coverage of less than 3%. Reduced by 13.6mW for each increase in  $T_a$  of  $1^\circ\text{C}$  over  $25^\circ\text{C}$ .

### ●Recommended operating conditions ( $T_a = 25^\circ\text{C}$ )

| Parameter            | Symbol   | Limits   | Unit |
|----------------------|----------|----------|------|
| Power supply voltage | $V_{cc}$ | 4.5~13.2 | V    |

## ● Block diagram



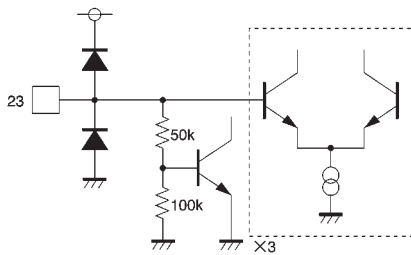
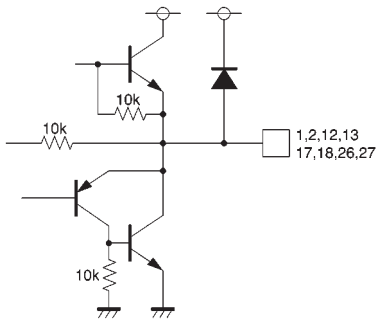
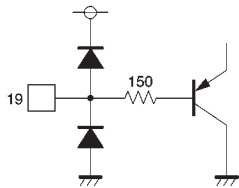
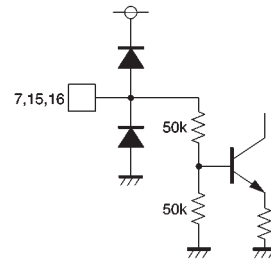
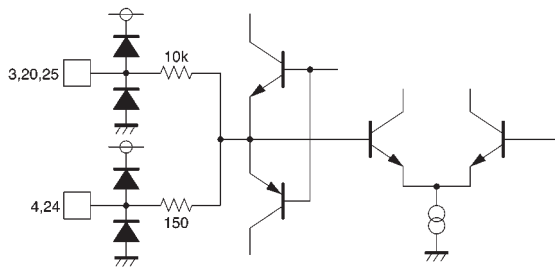
## ● Pin descriptions

| Pin No. | Pin name | Function                            | Pin No. | Pin name | Function                            |
|---------|----------|-------------------------------------|---------|----------|-------------------------------------|
| 1       | OUT1-1   | Channel 1 negative output           | 15      | REV      | Loading motor reverse input         |
| 2       | OUT1-2   | Channel 1 positive output           | 16      | FWD      | Loading motor forward input         |
| 3       | IN1-1    | Channel 1 input                     | 17      | OUT3-1   | Channel 3 negative output           |
| 4       | IN1-2    | Input for channel 1 gain adjustment | 18      | OUT3-2   | Channel 3 positive output           |
| 5       | N.C.     | N.C.                                | 19      | LDIN     | Loading motor input                 |
| 6       | N.C.     | N.C.                                | 20      | IN3      | Channel 3 input                     |
| 7       | MUTE     | Mute control for channels 1 and 4   | 21      | Vcc3     | Vcc (channel 3)                     |
| 8       | GND      | GND                                 | 22      | Vcc1     | Vcc (channels 1 and 4)              |
| 9       | N.C.     | N.C.                                | 23      | VrefIN   | Bias amplifier input                |
| 10      | Vcc2     | Vcc (channel 2)                     | 24      | IN4-2    | Input for channel 4 gain adjustment |
| 11      | N.C.     | N.C.                                | 25      | IN4-1    | Channel 4 input                     |
| 12      | OUT2-2   | Loading motor positive output       | 26      | OUT4-2   | Channel 4 positive output           |
| 13      | OUT2-1   | Loading motor negative output       | 27      | OUT4-1   | Channel 4 negative output           |
| 14      | GND      | Substrate GND                       | 28      | GND      | Substrate GND                       |

Note 1: Positive output and negative output are the polarities with respect to the input.

Note 2: Loading positive output and loading negative output are the polarities with respect the mode.

## ● Input / output circuits



●Electrical characteristics (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 8V, R<sub>L</sub> = 8Ω, VBIAS = 2.5V)

| Parameter                               | Symbol          | Min. | Typ. | Max. | Unit | Conditions                                           |
|-----------------------------------------|-----------------|------|------|------|------|------------------------------------------------------|
| Circuit current                         | I <sub>CC</sub> | —    | 12.5 | 21.0 | mA   | No load                                              |
| 〈All drivers except the loading driver〉 |                 |      |      |      |      |                                                      |
| Output offset voltage                   | VOO             | −40  | —    | 40   | mV   | Ch1, ch3, and ch4 drivers                            |
| Maximum output pin-to-pin voltage 1     | VOH1            | 5.4  | 6.0  | —    | V    | VBIAS=4V, V <sub>IN</sub> =8V                        |
| Maximum output pin-to-pin voltage 2     | VOH2            | —    | −6.0 | −5.4 | V    | VBIAS=4V, V <sub>IN</sub> =0.7V                      |
| Closed-loop voltage gain 1              | GVC1            | 9.5  | 11.5 | 13.5 | dB   | V <sub>IN</sub> =VBIAS±0.5V, ch1, 4                  |
| Closed-loop voltage gain 2              | GVC2            | 13.0 | 15.0 | 17.0 | dB   | V <sub>IN</sub> =VBIAS±0.5V, ch3                     |
| Ripple rejection                        | RR              | —    | 60   | —    | dB   | V <sub>IN</sub> =0.1V <sub>rms</sub> , 100Hz         |
| Mute on voltage                         | VMON            | 2.0  | —    | —    | V    |                                                      |
| Mute off voltage                        | VMOFF           | —    | —    | 0.5  | V    |                                                      |
| 〈Loading driver〉                        |                 |      |      |      |      |                                                      |
| Voltage between outputs F               | VOF             | 2.0  | 2.6  | 3.2  | V    | V <sub>CC</sub> =8V, R <sub>L</sub> =8Ω, LDIN=2.5V   |
| Voltage between outputs R               | VOR             | −3.1 | −2.5 | −1.9 | V    |                                                      |
| Output voltage range F                  | VOMF            | 2.5  | 3.2  | —    | V    | V <sub>CC</sub> =5V, R <sub>L</sub> =8Ω, LDIN=4.5V*1 |
| Output voltage range R                  | VOMR            | —    | −3.2 | −2.5 | V    |                                                      |
| Output load regulation F1               | ΔVF1            | —    | 100  | 500  | mV   | V <sub>CC</sub> =8V, LDIN=3.0V                       |
| Output load regulation R1               | ΔVR1            | —    | 100  | 500  | mV   | I=100→400mA*2                                        |
| Output load regulation F2               | ΔVF2            | —    | 150  | 850  | mV   | V <sub>CC</sub> =5V, LDIN=OPEN                       |
| Output load regulation R2               | ΔVR2            | —    | 150  | 850  | mV   | I=100→400mA*2                                        |
| Power supply voltage regulation F       | ΔVFL            | −500 | —    | 500  | mV   | V <sub>CC</sub> =5V→13V, R <sub>L</sub> =∞           |
| Power supply voltage regulation R       | ΔVRL            | −500 | —    | 500  | mV   |                                                      |
| Output offset voltage                   | VOOL            | −50  | —    | 50   | mV   | During braking; voltage between outputs              |
| 〈Controller FWD REV pins〉               |                 |      |      |      |      |                                                      |
| Input high level voltage 1              | VIH1            | 2.0  | —    | —    | V    | FWD (16pin), REV (15pin)                             |
| Input low level voltage 1               | VIL1            | —    | —    | 0.5  | V    | Voltage at input pins                                |
| Input high level current                | IIH             | —    | —    | 500  | μA   | V <sub>IN</sub> =5V                                  |
| Input low level current                 | IIL             | —    | —    | 500  | μA   | V <sub>IN</sub> =0V                                  |

◎Not designed for radiation resistance.

\*1 Even if the loading input (pin 19) LDIN is open, VOMF and VOMR remain approximately the same.

\*2 ΔVF1 and ΔVR1 perform load regulation with 3.0V output without the output clipping.

In order to open the input during reduced supply voltage of 5V, ΔVF2 and ΔVR2 clip the output. Load regulation is performed in this condition.

## ● Measurement circuit

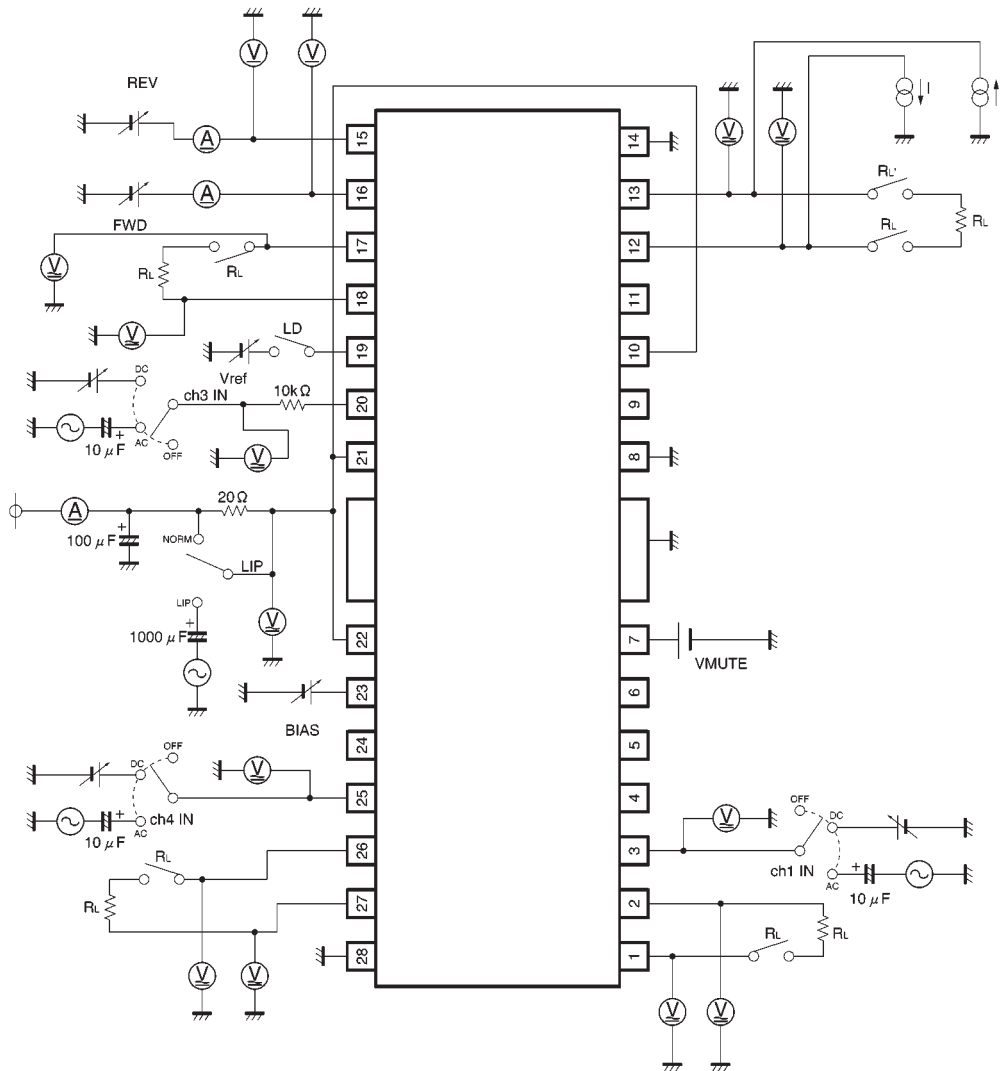


Fig.1

## ● Application example

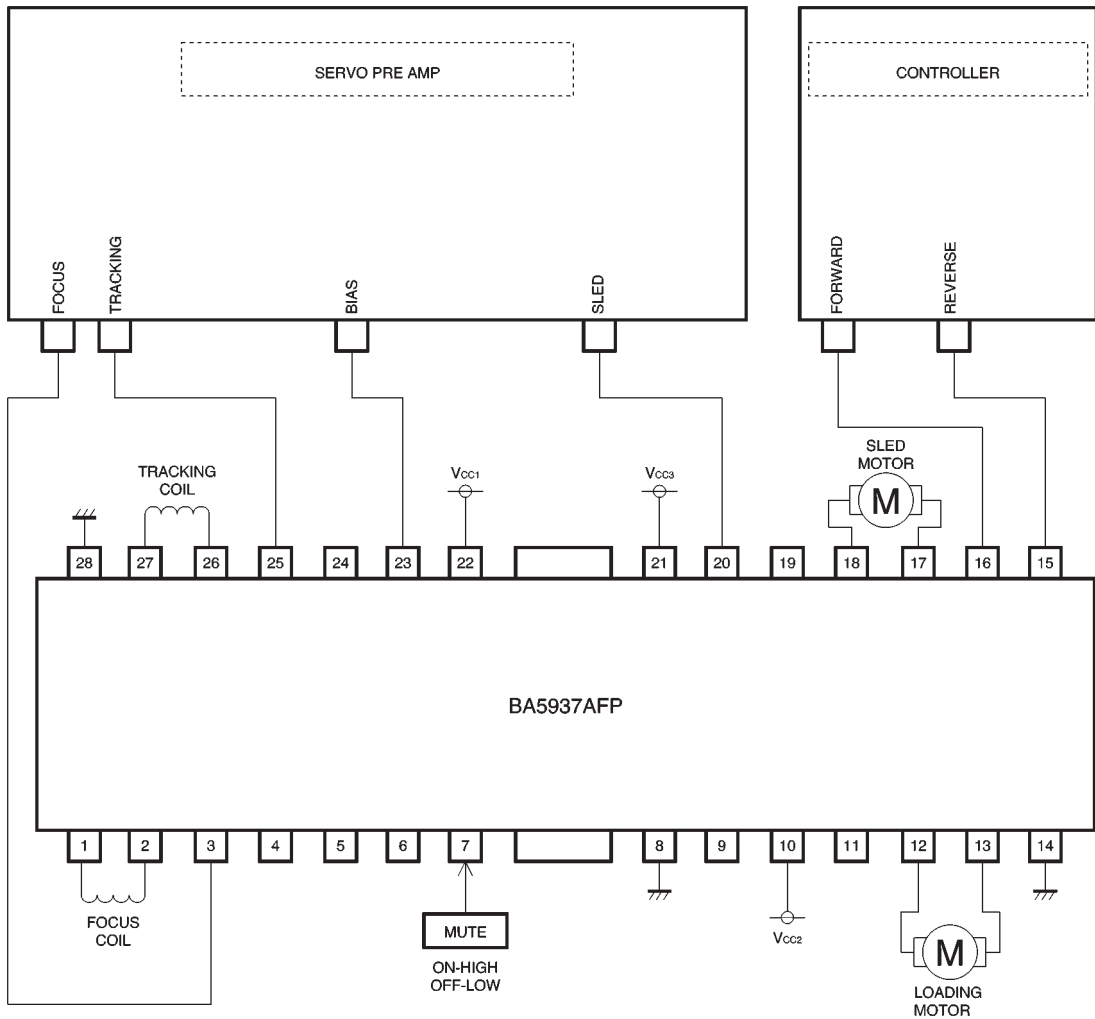


Fig.2

●Operation notes

(1) Output mode switch for loading motor driver ( $V_{CC} = 8V$ )

| FWD | REV | Loading output | Refer to |
|-----|-----|----------------|----------|
| L   | L   | High impedance | Fig.3    |
|     | H   | Reverse        | Fig.4    |
| H   | L   | Forward        | Fig.5    |
|     | H   | Brake          | Fig.6    |

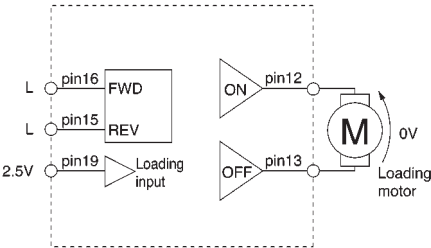


Fig.3

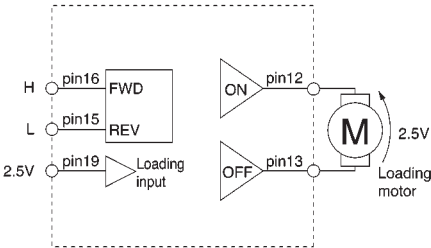


Fig.4

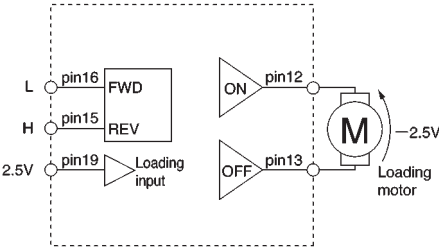


Fig.5

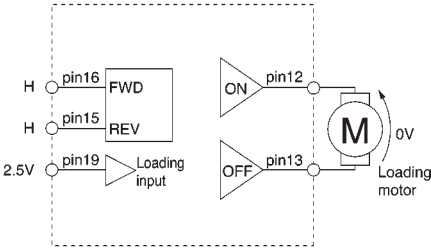


Fig.6

Note: Loading driver gain is 0dB.

## (2) Voltage setting for loading motor driver (ex: forward mode)

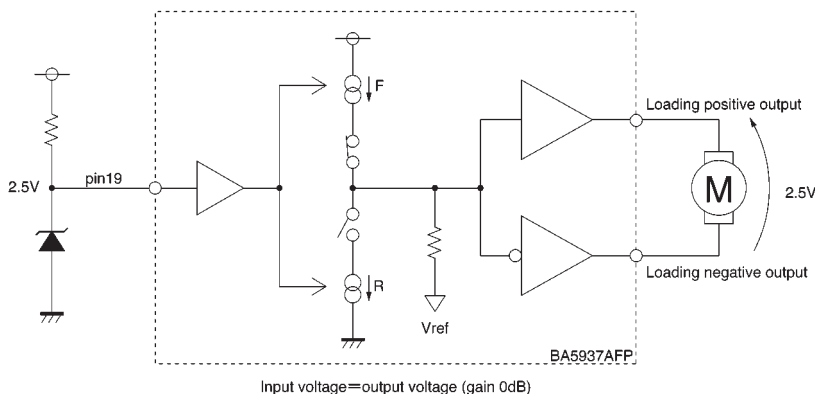


Fig.7

\*When setting the output voltage from the loading driver, even if an output voltage is set that exceeds the maximum output voltage with respect to the power supply voltage, the output will not exceed the maximum output voltage.

If a voltage is set that is under the maximum output voltage, the example above is applicable. Also, by having the loading input (pin 19) open, the maximum output voltage with respect to the power supply voltage is output.

(3) The BA5937AFP contains a thermal shutdown circuit.

When the chip temperature reaches 175°C (Typ.), the output current is muted. If the chip temperature then drops below 150°C (Typ.), then the mute is released.

(4) If the voltage of the bias pin (pin 23) drops below 1.0V (Typ.), outputs are muted.

For normal conditions, have the voltage above 1.4V and below 6.5V.

(5) By having the mute pin (pin 7) voltage pulled up to 2.0V or greater, you can mute the output current for channels 1 and 4. For normal conditions, have pin 7 open or at 0.5V or below.

(6) If the voltage of the thermal shutdown, mute ON, or bias pin drops, the mute is activated; however, in these situations, only the drivers are muted. Also, the output pin voltage becomes the internal bias voltage (approx.  $(V_{CC} - V_F)/2$ ).

(7) Connect a bypass capacitor (approx. 0.1μF) between the bases of the power supply pins of this IC.

(8) Even though the radiation fins are connected to ground within the package, be sure to also connect them to a ground externally as well.

## ●Electrical characteristic curves

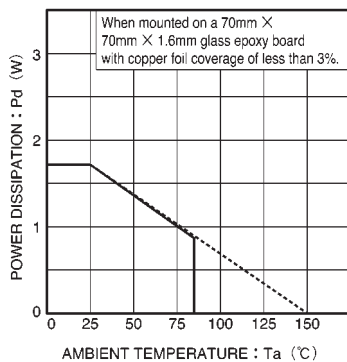


Fig.8 Thermal derating curve

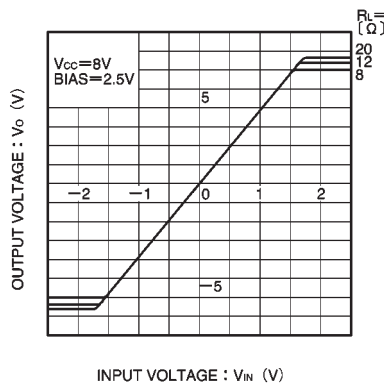


Fig.9 Driver I / O characteristics (channels 1 and 4) (during load regulation)

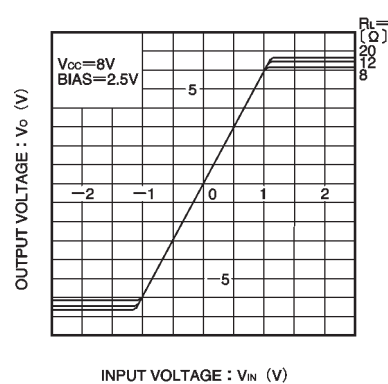


Fig.10 Driver I / O characteristics (channel 3) (during load regulation)

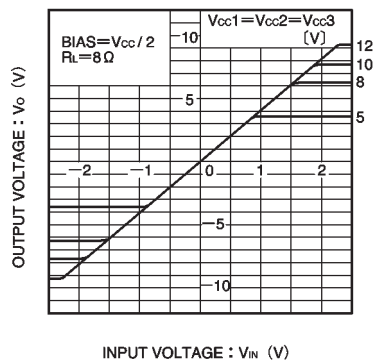


Fig.11 Driver I / O characteristics (channels 1 and 4) (during Vcc regulation)

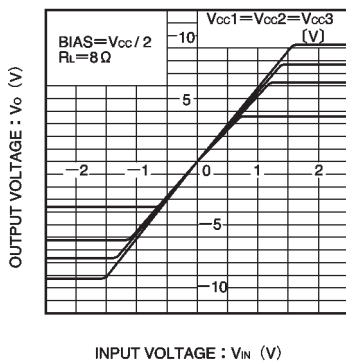


Fig.12 Driver I / O characteristics (channel 3) (during Vcc regulation)

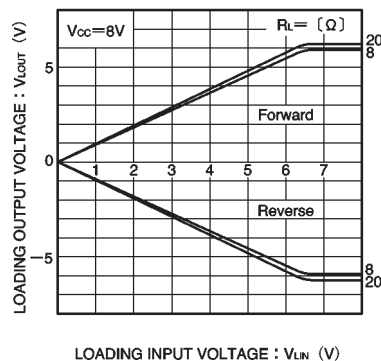
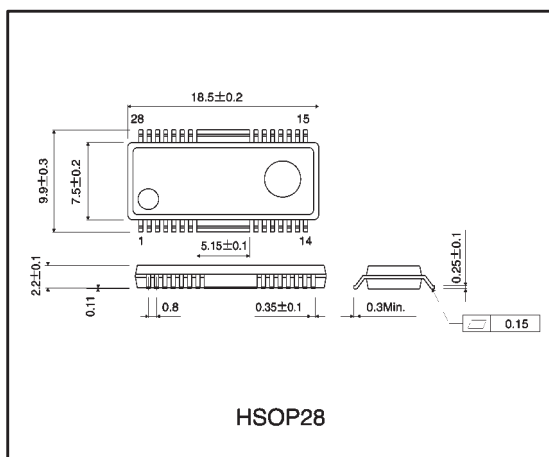


Fig.13 Loading I / O characteristics

## ●External dimensions (Units: mm)



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