

# 4-channel PWM driver for CD and MD players

## BH6511FS

The BH6511FS is an IC designed for CD and MD player motors and actuators, and has an internal 4-channel PWM driver, and a charge pump circuit that supplies the gate drive for the output stage power MOSFET. The power MOSFET in the output stage assures low power consumption for applications.

### ●Applications

CD and MD players

### ●Features

- 1) Internal 4-channel power MOS H-bridge.
- 2) Adaptable for PWM input.
- 3) Internal charge pump circuit to raise VG voltage.
- 4) Low ON resistance.
- 5) Low power consumption.
- 6) 32-pin SSOP-A compact package.

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

| Parameter                      | Symbol   | Limits       | Unit |
|--------------------------------|--|--------------|------|
| H-bridge supply voltage        | VM   | 9            | V    |
| Control circuit supply voltage | V <sub>DD</sub>  | 9            | V    |
| Predriver supply voltage       | VG (pin2)  | 12           | V    |
| Driver output current          | I <sub>o</sub> (ch1, ch3)<br>I <sub>o</sub> (ch2, ch4) | 500<br>300*1 | mA   |
| Power dissipation              | P <sub>d</sub>   | 850*2        | mW   |
| Operating temperature          | T <sub>opr</sub>                                       | -30~+85      | °C   |
| Storage temperature            | T <sub>stg</sub>                                       | -55~+150     | °C   |

\*1. 500 ms.

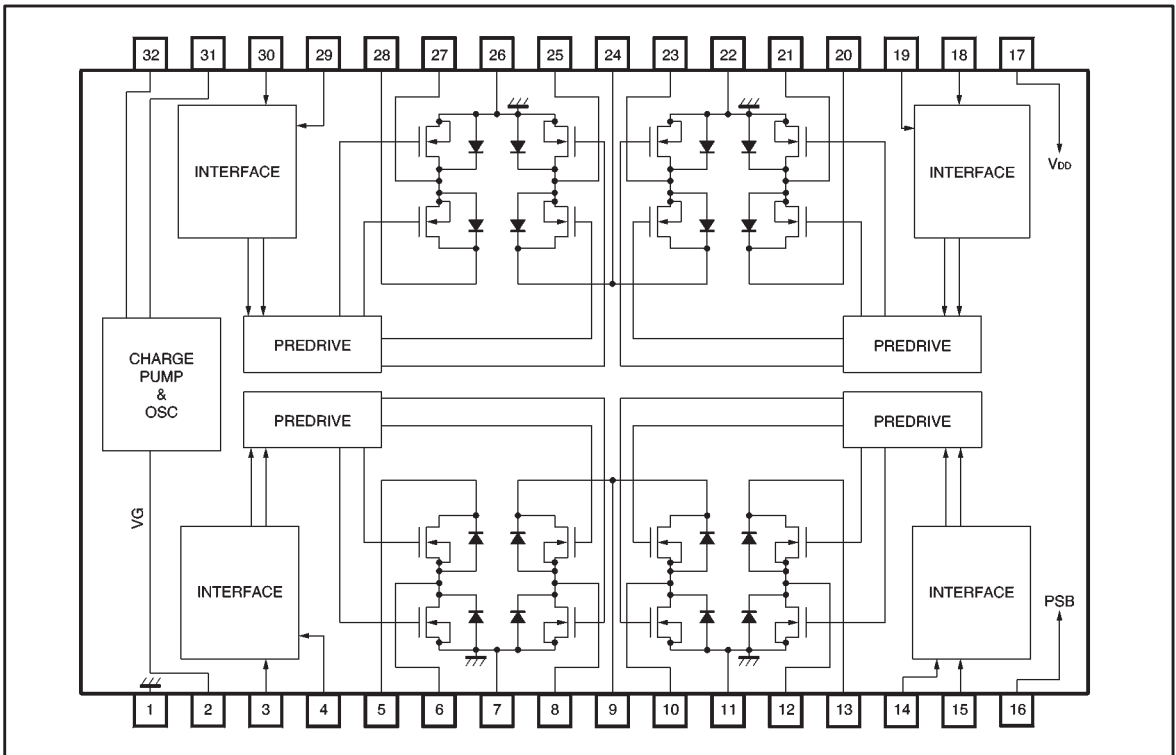
\*2. Reduced by 6.8 mW for each increase in Ta of 1°C over 25°C.

### ●Recommended operating conditions

| Parameter                      | Symbol          | Min.   | Typ.  | Max. | Unit |
|--------------------------------|-----------------|--------|-------|------|------|
| H-bridge supply voltage        | VM*             | 1.6    | 5.0   | 5.5  | V    |
| Control circuit supply voltage | V <sub>DD</sub> | 2.7    | 3.0   | 5.5  | V    |
| Predriver supply voltage       | VG (pin2)       | VM+3.0 | 10    | 11.5 | V    |
| Ambient temperature            | T <sub>a</sub>  | -35    | 25    | 85   | °C   |
| Pulse input frequency          | f <sub>in</sub> | —      | 176.4 | 200  | kHz  |

\*Internal charge pump not used. When used, H-bridge supply voltage = 2.7-5.5 V.

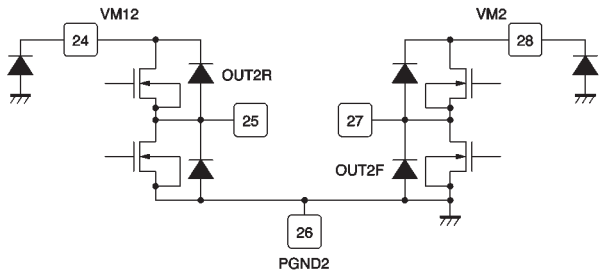
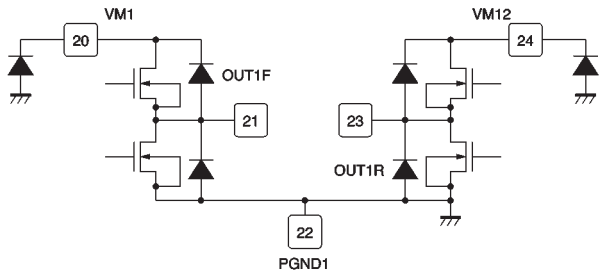
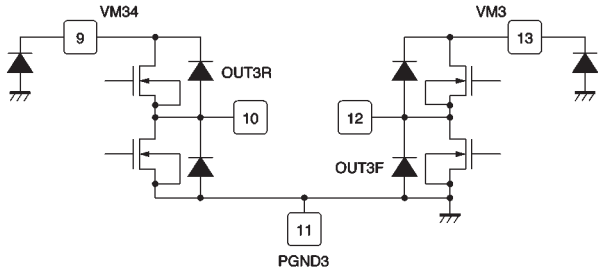
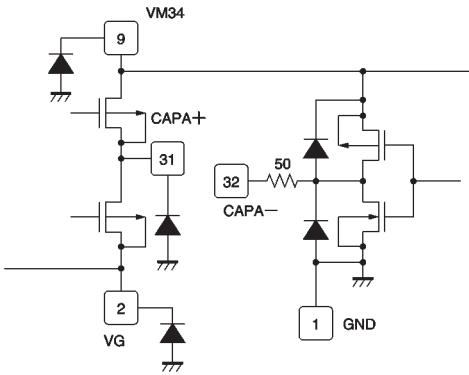
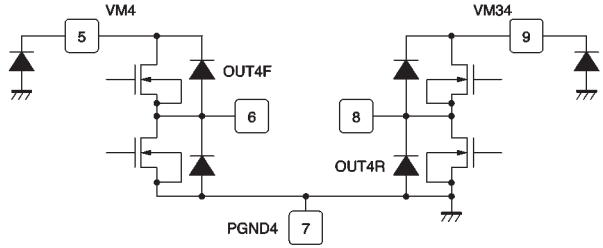
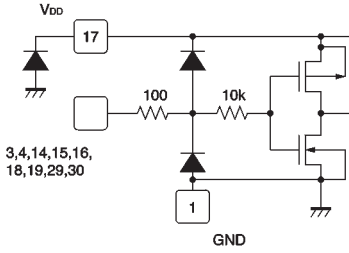
## ● Block diagram



## ● Pin descriptions

| Pin No. | Pin name | Function                 | Pin No. | Pin name        | Function                                    |
|---------|----------|--------------------------|---------|-----------------|---|
| 1       | GND      | Predrive ground          | 17      | V <sub>DD</sub> | Predrive power supply                       |
| 2       | VG       | Gate voltage supply      | 18      | IN1R            | Channel 1 reverse input                     |
| 3       | IN4R     | Channel 4 reverse input  | 19      | IN1F            | Channel 1 forward input                     |
| 4       | IN4F     | Channel 4 forward input  | 20      | VM1             | Power supply                                |
| 5       | VM4      | Power supply             | 21      | OUT1F           | Channel 1 forward output                    |
| 6       | OUT4F    | Channel 4 forward output | 22      | PGND1           | Power ground                                |
| 7       | PGND4    | Power ground             | 23      | OUT1R           | Channel 1 reverse output                    |
| 8       | OUT4R    | Channel 4 reverse output | 24      | VM12            | Power supply                                |
| 9       | VM34     | Power supply             | 25      | OUT2R           | Channel 2 reverse output                    |
| 10      | OUT3R    | Channel 3 reverse output | 26      | PGND2           | Power ground                                |
| 11      | PGND3    | Power ground             | 27      | OUT2F           | Channel 2 forward output                    |
| 12      | OUT3F    | Channel 3 forward output | 28      | VM2             | Power supply                                |
| 13      | VM3      | Power supply             | 29      | IN2F            | Channel 2 forward input                     |
| 14      | IN3F     | Channel 3 forward input  | 30      | IN2R            | Channel 2 reverse input                     |
| 15      | IN3R     | Channel 3 reverse input  | 31      | CAPA+           | Charge pump capacitor connection (positive) |
| 16      | PSB      | Power cut                | 32      | CAPA-           | Charge pump capacitor connection (negative) |

● Pin equivalent circuit diagrams



- Electrical characteristics (unless otherwise noted,  $T_a = 25^\circ\text{C}$ ,  $V_M = 5\text{V}$ ,  $V_{DD} = 3\text{V}$ ,  $V_G =$  internal charge pump output,  $f_{IN} = 176\text{kHz}$ ,  $R_L = 8\Omega - 47\mu\text{H}$ )

| Parameter                                       | Symbol            | Min.         | Typ. | Max. | Unit            | Conditions  | Measurement Circuit |
|---|-------------------|--------------|------|------|-----------------|---|---------------------|
| 〈H-bridge supply current〉                       |                   |              |      |      |                 |   |                     |
| No input  | IMST              | —            | 320  | 380  | $\mu\text{A}$   | $V_{DD}=3\text{V}$ , $V_M=5\text{V}$  | Fig.3               |
| 〈Control circuit supply current〉                |                   |              |      |      |                 |   |                     |
| No input  | I <sub>DD1</sub>  | —            | —    | —1   | $\mu\text{A}$   |   | Fig.3               |
| Operating                                       | I <sub>DD2</sub>  | —            | 6    | 70   | $\mu\text{A}$   | IDD1 / 4-channel simultaneous drive   | Fig.3               |
| 〈Predriver supply voltage〉 (charge pump output) |                   |              |      |      |                 |   |                     |
| No input  | VGST              | 8.8          | 9.95 | 12   | V               |   | Fig.3               |
| Operating                                       | VGA               | 7.9          | 8.5  | 11   | V               | 4-channel simultaneous drive  | Fig.3               |
| 〈Logic input characteristics〉                   |                   |              |      |      |                 |   |                     |
| Input high level voltage                        | V <sub>IH</sub>   | $V_{DD}-0.6$ | —    | —    | V               |   | Fig.3               |
| Input low level voltage                         | V <sub>IL</sub>   | —            | —    | 0.6  | V               |   | Fig.3               |
| Input high level current                        | I <sub>IH</sub>   | —            | —    | 1    | $\mu\text{A}$   |   | Fig.3               |
| Input low level current                         | I <sub>IL</sub>   | —1           | —    | —    | $\mu\text{A}$   |   | Fig.3               |
| Output ON resistance                            | RON1, 3           | —            | 0.8  | 1.2  | $\Omega$        | Sum of top and bottom ON resistance<br>$V_M=2.5\text{V}$ , $V_{DD}=3\text{V}$ , $V_G=10\text{V}$<br>( $V_G$ is supplied externally) | Fig.3               |
|   | RON2, 4           | —            | 1.2  | 2.0  |                 |   |                     |
| Output delay time                               | t <sub>RISE</sub> | —            | 0.2  | 1    | $\mu\text{sec}$ |   | Fig.3               |
|   | t <sub>FALL</sub> | —            | 0.2  | 1    | $\mu\text{sec}$ |   | Fig.3               |
| Minimum input pulse width                       | t <sub>Min.</sub> | 150          | —    | —    | nsec            | Output pulse width = 2 / 3 t <sub>min.</sub> (minimum)  | Fig.3               |
| Oscillator frequency                            | f <sub>osc</sub>  | 150          | 370  | 520  | kHz             | Pin 31 waveform monitor   | Fig.3               |

© Not designed for radiation resistance.

● Measurement circuit

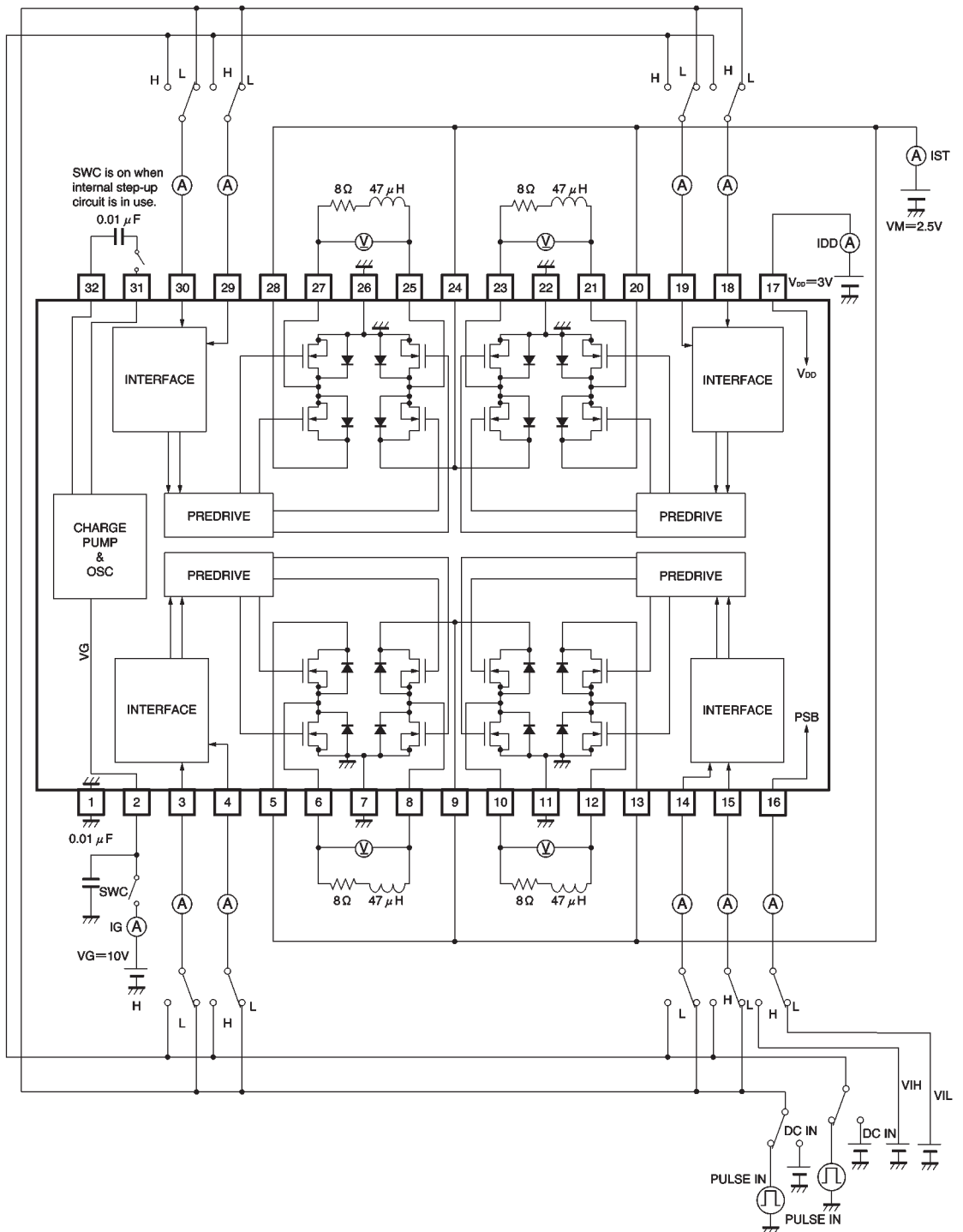


Fig. 1

● Circuit operation

(1) PWM driver

The output stage is an H-bridge driver with four N-type FET circuits. Output PWM duty is changed according to input PWM duty. This pulse drives the load (direct PWM).

Driver truth table

| PSB* | IN1~4F | IN1~4R | OUT1~3F | OUT1~3R | OUT4F | OUT4R |
|------|--------|--------|---------|---------|-------|-------|
| H    | L      | L      | L       | L       | L     | L     |
| H    | L      | H      | L       | H       | L     | H     |
| H    | H      | L      | H       | L       | L     | L     |
| H    | H      | H      | L       | L       | H     | L     |
| L    | X      | X      | L       | L       | L     | L     |

\* All outputs are L,L in the PSB mode, regardless of inputs. Even in this state, however, the charge pump circuit does not stop free-run oscillation.

(2) Charge pump

A dedicated charge pump that supplies the drive voltage to the output stage H-bridge power MOSFET.

(3) Because the charge pump circuit doubles the voltage using pin 9 voltage as its reference, VG is not output unless VM is impressed on pin 9. Also, be sure to set the VM voltage to keep the charge pump voltage under the absolute maximum rating.

(4) When supplying VG directly from an external source, rather than using the internal charge pump circuit, disconnect the capacitor between pins 31 and 32.

(5) A charge pump capacitor between 0.01 and 0.1 $\mu$ F is recommended. Using one with a greater capacity will not significantly improve performance.

●Application example

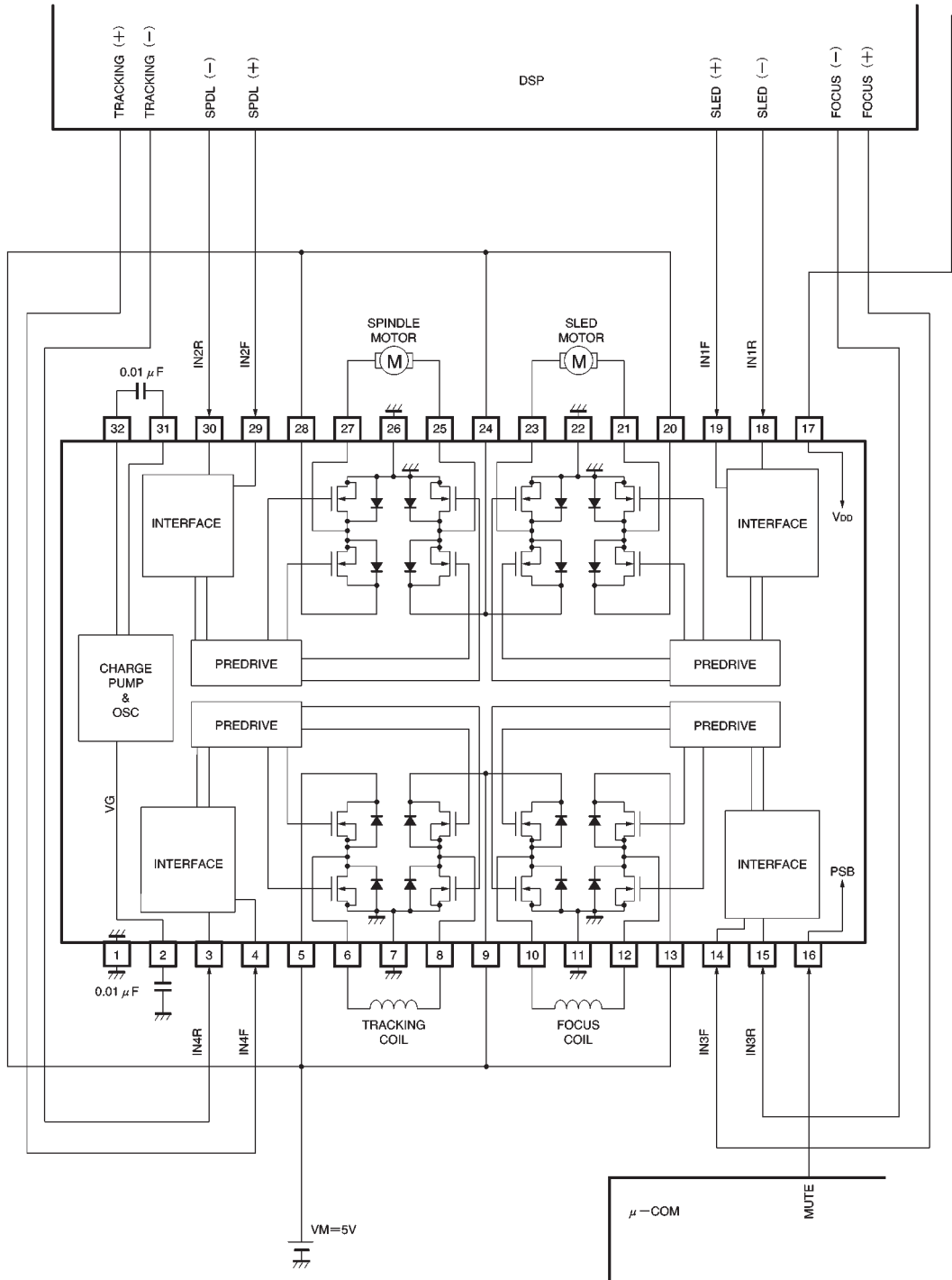


Fig. 2

●Electrical characteristic curves

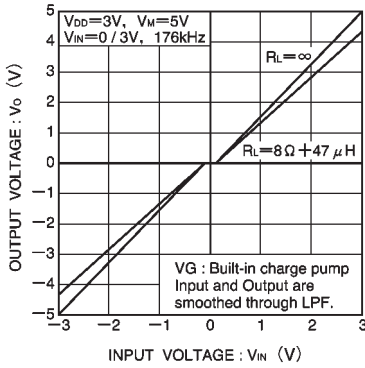


Fig. 3 I/O characteristics (CH1, CH3)

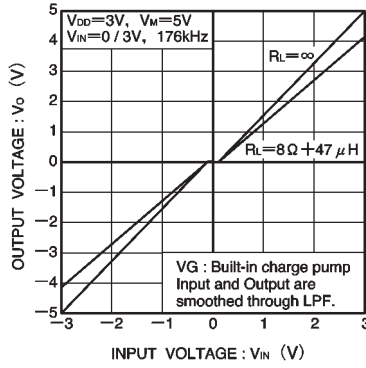


Fig. 4 I/O characteristics (CH2, CH4)

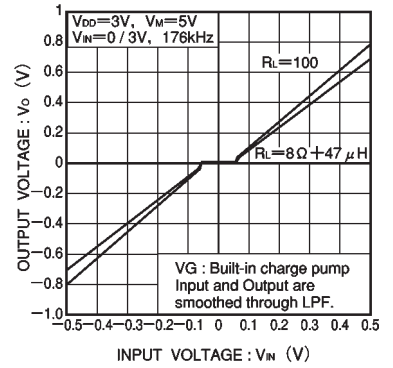


Fig. 5 I/O characteristics during ultralow input (CH1, CH3)

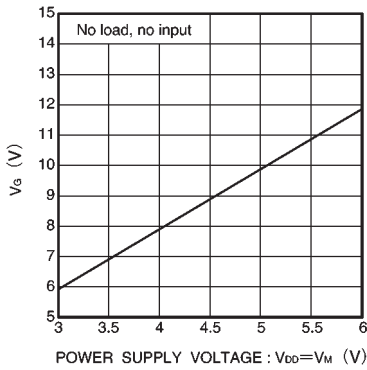
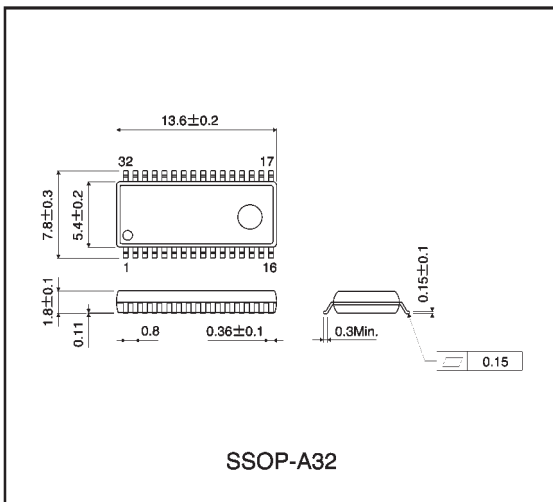


Fig. 6 Power supply voltage vs. charge pump output

●External dimensions (Units: mm)



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