

# PWM driver for CD and MD players

## BH6505K

The BH6505K is a 4-channel PWM driver designed for CD and MD player motor and actuator drives. The power MOS-FET output stage allows for applications with low power consumption. This IC also has a charge pump circuit and standard operational amplifier (needed for power MOSFET gate drives), and so supports a wide spectrum of applications.

### ●Applications

Portable CD players, MD players

### ●Features

- 1) Low power consumption.
- 2) A minimum of attached components.
- 3) Good gain precision because of the voltage feedback circuit.
- 4) Internal mute function for channels 1 and 2.
- 5) Allows for free-running and clock synchronization operation.
- 6) Internal standard operational amplifier.
- 7) Internal charge pump circuit for gate drive.

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

Parameter	Symbol	Limits	Unit
H bridge supply voltage	BATTERY	7	V
Control circuit supply voltage	Pre.Vcc	7	V
Predriver supply voltage	VG (pin18)	7	V
Driver output current	Io	500	mA
Power dissipation	Pd	500*1	mW
Operating temperature	Topr	-30~+85	°C
Storage temperature	Tstg	-55~+125	°C

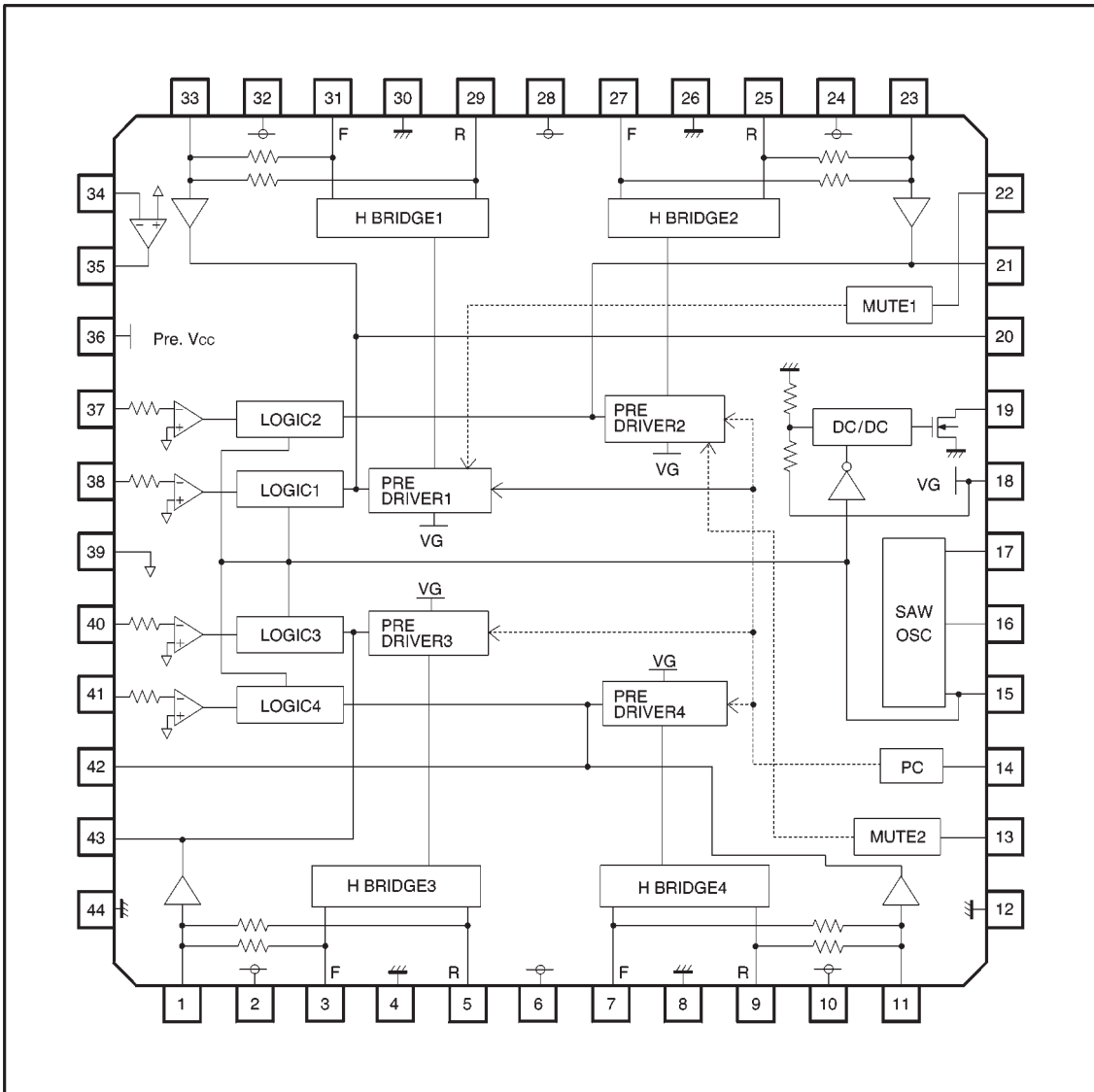
\*1 Reduced by 5.0 mW for each increase in Ta of 1°C over 25°C.

### ●Recommended operating conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
H bridge supply voltage	BATTERY	1.6	2.4	4.5	V
Control circuit supply voltage	Pre.Vcc	2.7	3.0	4.5	V
Predriver supply voltage*2	VG (pin18)	BATTERY +1.6	6.5	6.9	V
Ambient temperature	Ta	-10	25	70	°C

\*2 When voltage is supplied externally without using an internal DC / DC converter.

●Block diagram



## ● Pin descriptions

Pin No.	Pin name	Function	Pin No.	Pin name	Function
1	CO3	Channel 3 voltage feedback filter	23	CO2	Channel 2 voltage feedback filter
2	BATT3	Power amplifier power supply input	24	BATT2	Power amplifier power supply input
3	OUT 3F	Channel 3 positive output	25	OUT 2R	Channel 2 negative output
4	POWGND	Power amplifier power supply ground	26	POWGND	Power amplifier power supply ground
5	OUT 3R	Channel 3 negative output	27	OUT 2F	Channel 2 positive output
6	BATT34	Power amplifier power supply input	28	BATT12	Power amplifier power supply input
7	OUT 4F	Channel 4 positive output	29	OUT 1R	Channel 1 negative output
8	POWGND	Power amplifier power supply ground	30	POWGND	Power amplifier power supply ground
9	OUT 4R	Channel 4 negative output	31	OUT 1F	Channel 1 positive output
10	BATT 4	Power amplifier power supply input	32	BATT1	Power amplifier power supply input
11	CO4	Channel 4 voltage feedback filter	33	CO1	Channel 1 voltage feedback filter
12	D.GND	Pre-drive circuit power supply ground	34	OP—	Operational amplifier negative input
13	MUTE2	Channel 2 mute	35	OP OUT	Operational amplifier output
14	PC	All-driver output mute	36	Pre.V <sub>cc</sub>	Input of the control circuit power supply
15	CT	Triangular wave output	37	ERR2	Input of the channel 2 control signal
16	RT	Setting the charging current	38	ERR1	Input of the channel 1 control signal
17	CLK	Input for synchronizing the external clock	39	VC	Reference voltage input
18	VG	Input of the pre-drive circuit power supply	40	ERR3	Input of the channel 3 control signal
19	LG	Attaching the DC / DC converter	41	ERR4	Input of the channel 4 control signal
20	CN1	Channel 1 phase compensation filter	42	CN4	Channel 4 phase compensation filter
21	CN2	Channel 2 phase compensation filter	43	CN3	Channel 3 phase compensation filter
22	MUTE1	Channel 1 mute	44	Pre.GND	Ground for the control circuit power supply

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

● Input / output circuits

Pin name	Pin No.	Pin equivalent circuit
CO3 BATT3 OUT 3F POWGN4 OUT 3R BATT34	1 2 3 4 5 6	
OUT 4F POWGN4 OUT 4R BATT4 CO4	7 8 9 10 11	
D.GND	12	Predriver circuit ground pin
MUTE2	13	
PC	14	

Pin name	Pin No.	Pin equivalent circuit
CT RT	15 16	
CLK	17	
VG	18	<p>Predriver circuit power supply pin</p>
LG	19	
CN1 CN2 CN4 CN3	20 21 42 43	
MUTE1	22	

Pin name	Pin No.	Pin equivalent circuit
CO2 BATT2 OUT 2R POWGND OUT 2F BATT12	23 24 25 26 27 28	
OUT 1R POWGND OUT 1F BATT1 CO1	29 30 31 32 33	
OP -	34	
OP OUT	35	

Pin name	Pin No.	Pin equivalent circuit
Pre.Vcc	36	Control circuit power supply pin
ERR1 ERR2 ERR3 ERR4	38 37 40 41	<p>The diagram shows a circuit for error pins 37, 38, 40, and 41. Pin 37 is connected to a diode. Pin 38 is connected to a 15k resistor. Pin 40 is connected to a diode. Pin 41 is connected to ground. The resistor and diodes are connected to a transistor circuit.</p>
VC	39	<p>The diagram shows a circuit for VC pin 39. Pin 39 is connected to a diode. The diode is connected to a transistor circuit with a 5k resistor and a multiplier of 4.</p>
Pre.GND	44	Control circuit ground pin

- Electrical characteristics (unless otherwise noted, Ta = 25°C, BATTERY = 2.4V, Pre.VCC = 3.0V, Vc = 1.5V, fCLK = 176.4kHz, RL = 8Ω–47μH)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
Standby current	IST	—	—	3	μA	Pre.VCC=OFF	
Quiescent current dissipation	ICC1	—	4.5	9	mA	Including DC / DC converter coil current	
Operating current	ICC2	—	7	14	mA	4-channel drive Including DC / DC converter coil current	
〈PWM driver〉							
CH1 CH2 CH3 CH4	Output-on resistance	RON	—	1.3	2.0	Ω	Sum of top and bottom-on resistance
	Input offset voltage	VOI	−5.0	0	5.0	mV	
	Output offset voltage	VOO	−35	0	35	mV	
	Voltage gain	GVC1–4	6.5	8.5	10.5	dB	
	Positive / negative voltage gain differ.	GVC	−1.5	0	1.5	dB	
〈DC / DC converter*1〉							
Output voltage	VG	6.1	6.5	6.9	V		
Triangular wave generator							
Free-running oscill. frequency 1	fOSC1	—	140	—	kHz	RT=39kΩ, CT=220pF	
Synch. signal input frequency 1	fCLK1	150	176	200	kHz		
Free-running oscill. frequency 2	fOSC2	—	60	—	kHz	RT=39kΩ, CT=470pF	
Synch. signal input frequency 2	fCLK2	78	88	98	kHz		
〈Operational amplifier〉							
Input bias current	IBIAS	—	—	300	nA		
Input offset voltage	VOIOP	−5.5	0	5.5	mV		
Output high level voltage	VOHOP	2.8	—	—	V	RL=OPEN	
Output low level voltage	VOLOP	—	—	0.2	V	RL=OPEN	
Output drive current (source)	ISOU	0.3	0.5	—	mA	50Ω at GND	
Output drive current (sink)	ISIN	1	3	—	mA	50Ω at VCC	
Open loop voltage gain	GVO	—	70	—	dB	VIN=−75dBV, f=1kHz	
Slew rate	SR	—	0.5	—	V/μs		
〈Control pin threshold〉							
MUTE1-on level input voltage	VMT1ON	2.2	—	—	V	Channel 1 muted at the high level	
MUTE1-off level input voltage	VMT1OFF	—	—	0.5	V		
MUTE2-on level input voltage	VMT2ON	2.2	—	—	V	Channel 2 muted at the high level	
MUTE2-off level input voltage	VMT2OFF	—	—	0.5	V		
PC-on level input voltage	VPCON	2.2	—	—	V	All channels muted at the high level	
PC-off level input voltage	VPCOFF	—	—	0.5	V		

\*1 DC / DC converter circuit

Pre.VCC is raised to 6.5 V by attaching an inductance, Schottky barrier diode, and capacitor.

This voltage is the power supply (VG) for the predriver circuit.



● Measurement circuit

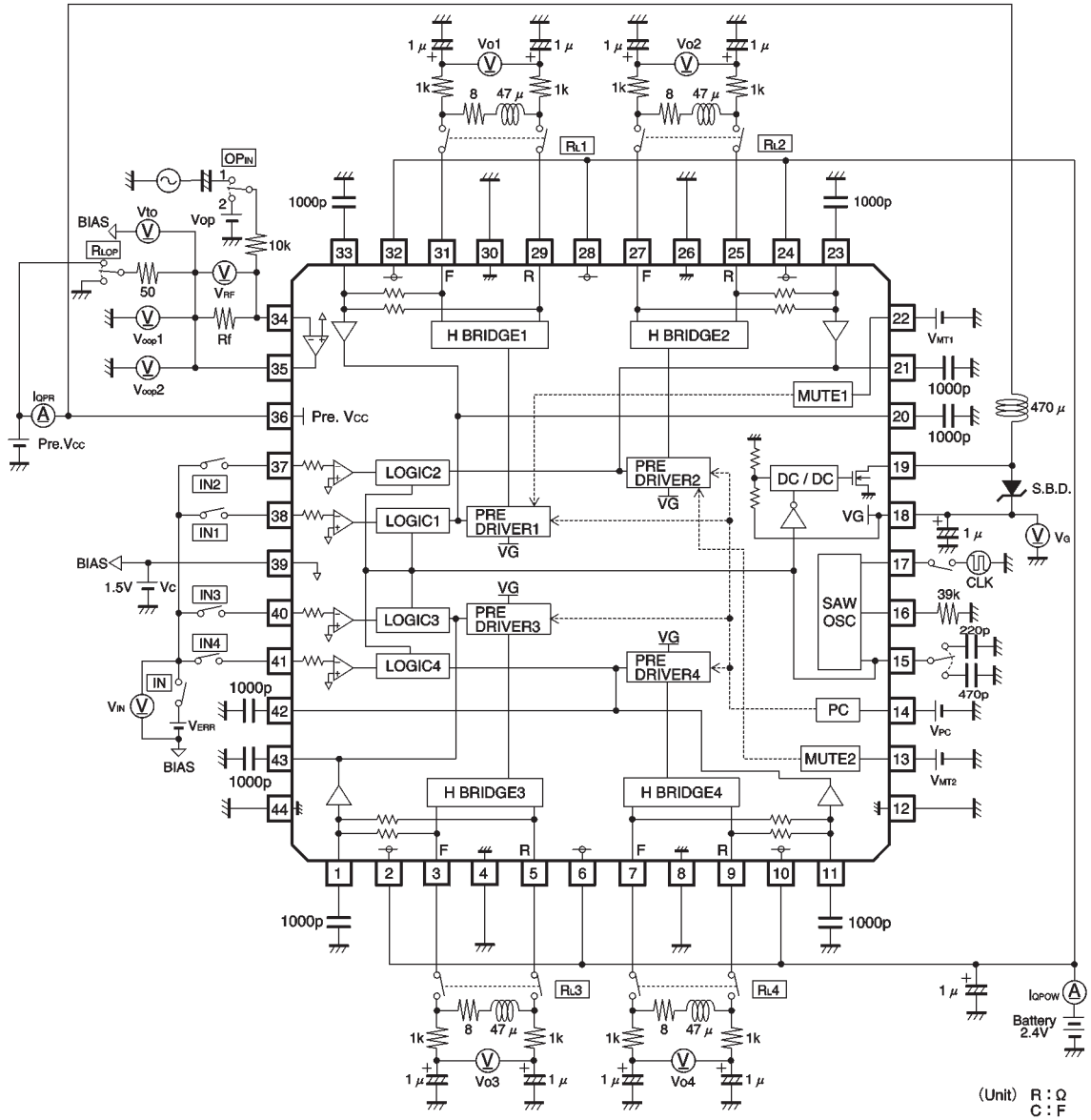


Fig. 1

### ● Circuit operation

#### (1) PWM driver

This is an H bridge driver with four N-type FETs in the output stage. Output polarity and PWM duty vary in proportion to the input differential voltage between  $V_c$ , and to the absolute value. The load is direct-PWM-driven by the square wave with this varying duty.

This is a voltage feedback driver and so delivers a constant gain regardless of battery voltage variation.

#### (2) DC/DC converter

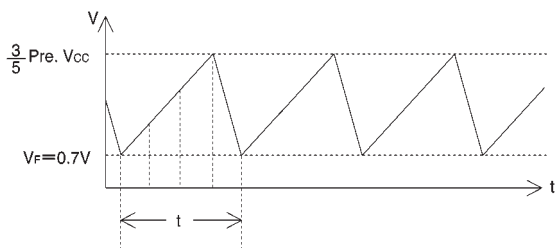
The DC/DC converter that generates the voltage needed to drive the FETs of the output-stage H bridge. Pre.V<sub>CC</sub> is raised to 6.5V by attaching an inductance, Schottky barrier diode, and capacitor.

#### (3) Triangular wave generator

##### 1) Freerunning

The free-running oscillation frequency of the triangular waves can be set with an attached resistor ( $R_t$ , between pin 16 and the ground) and capacitor ( $C_t$ , between pin 15 and the ground). The triangular wave has an amplitude of  $\frac{3}{5} \times \text{Pre.V}_{CC}$  at the top and  $V_F$  (approximately 0.7V) at the bottom. The ratio between rise time and fall time is 3 : 1. Free-running frequency ( $f_t$ ) is determined with the following equation:

$$f_t = \frac{3}{4} \cdot \frac{1}{C_t \cdot R_t \left[ 1 - \frac{V_F}{\frac{3}{5} \text{Pre.V}_{CC}} \right]}$$

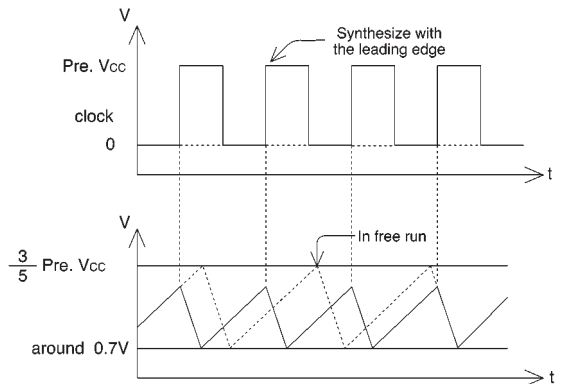


Freerunning frequency triangular wave form

##### 2) Clock synchronization

The triangular wave can be synchronized by inputting to the CLK pin (17 pin) a pulse wave equal to 0–Pre.V<sub>CC</sub> ( $V_p$ -p). The following precautions should be kept in mind:

- The amplitude of the triangular wave decreases as the clock frequency rises.
- The PWM driver is a voltage feedback driver, which should preclude any problems unless the setting is such that the triangular wave has an extremely small amplitude.
- As mentioned above, a capacitor and resistor are also required during clock synchronization.



The triangular waveform during clock synchronization

### ● Operation notes

Attach a bypass capacitor (roughly 1 $\mu$ F) to the power supply, at the base of the IC.

●Application example

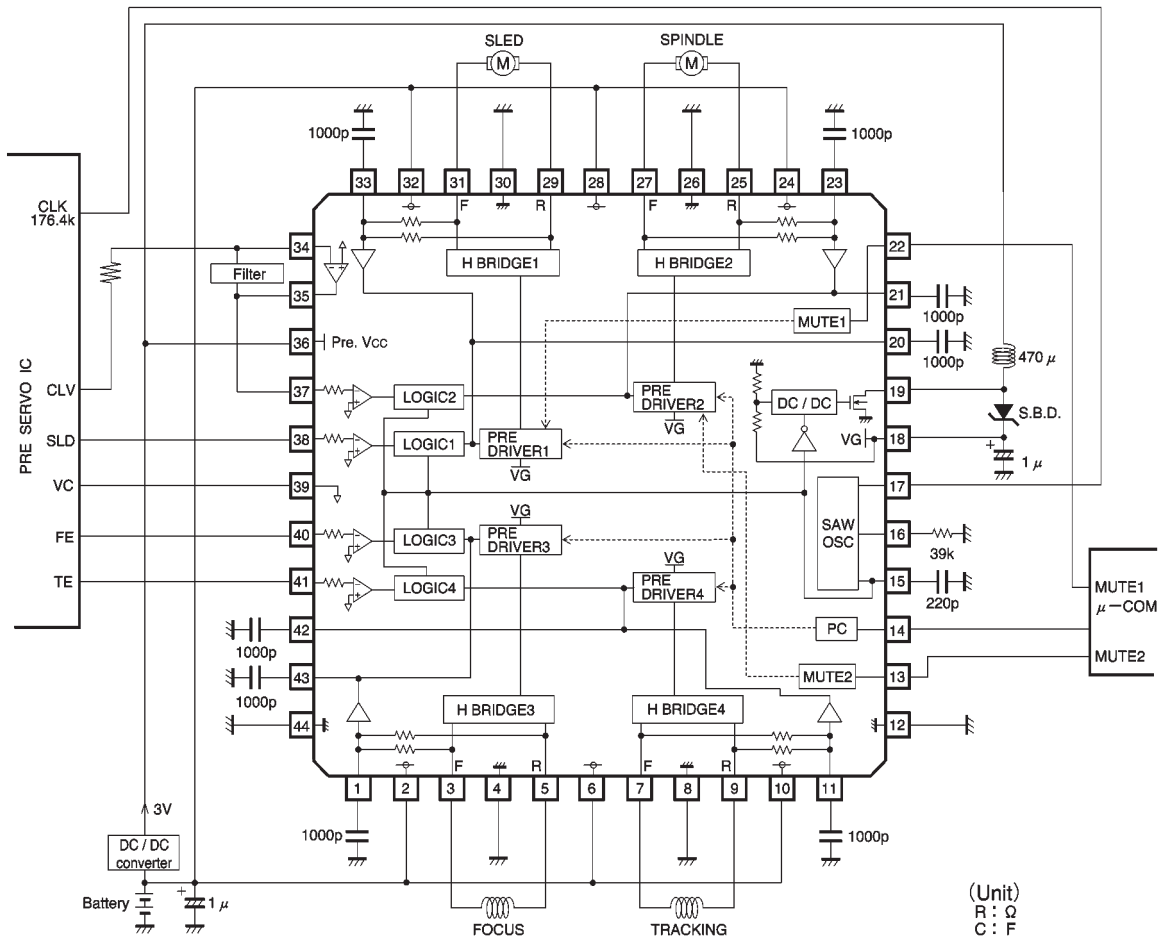


Fig. 2

●Electrical characteristic curves

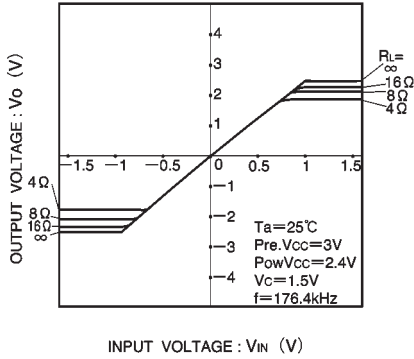


Fig. 3 Driver I/O characteristics (variable load)

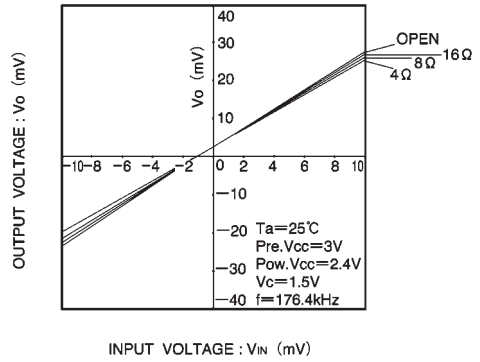


Fig. 4 I/O characteristics near the dead zone (variable load)

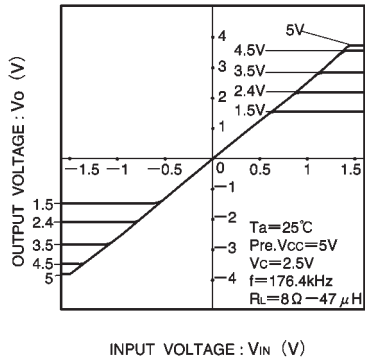


Fig. 5 I/O characteristics (variable power supply)

●External dimensions (Units: mm)

