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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
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4-channel BTL driver for CD players and CD-ROMs

BA5970FP

The BA5970FP is a 4-channel BTL driver developed to drive CD player motors and actuators. The driver input stage contains an operational amplifier, supports a variety of input formats, and allows simple configuration of a filter.

●Applications
CD players, CD-ROM

●Features
1) 4-channel BTL driver.
2) Wide dynamic range (4V when $PREV_{CC}$ = 8V, $POWV_{CC}$ = 5V, and R_L = 8Ω).
3) Internal thermal shutdown circuit.
4) Driver gain is adjustable with externally connected resistor.
5) Independent power supplies $PREV_{CC}$, $POWV_{CC}$ (for channels 1 and 2), and $POWV_{CC}$ (for channels 3 and 4), and low voltage operation for a highly efficient drive.
6) Independent mute pins for channels 1 and 2 and channels 3 and 4.
7) Perfect for compact applications with the use of the HSOP28-pin power package.

●Absolute maximum ratings (Ta = 25°C)

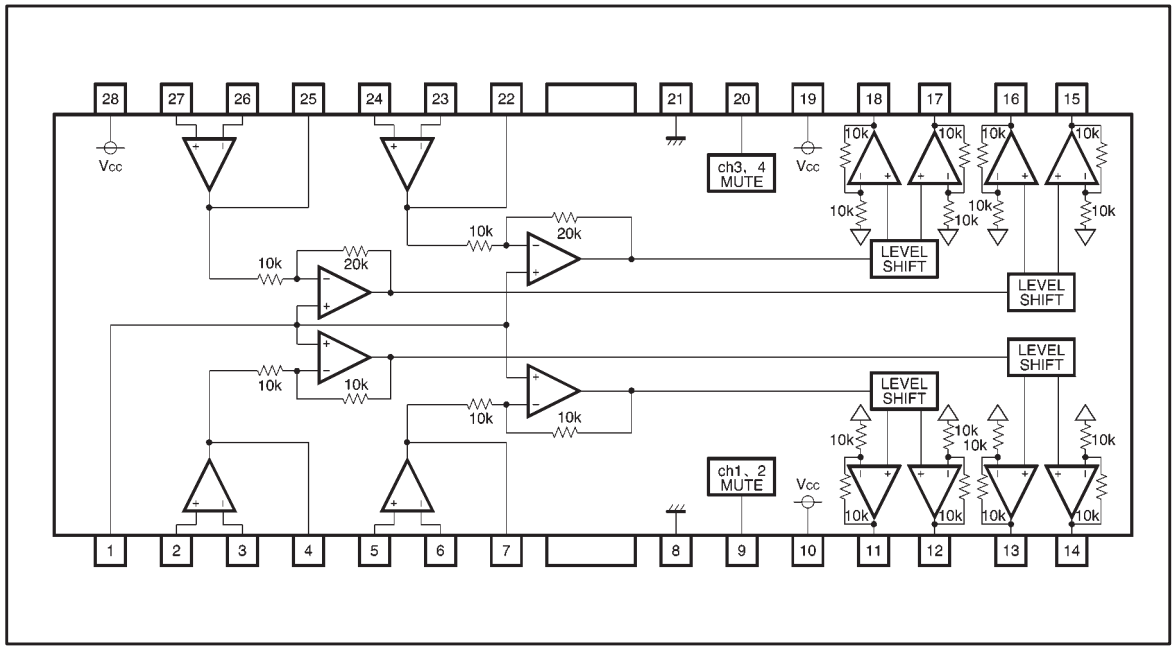
Parameter	Symbol	Limits	Unit
Power supply voltage	$PREV_{CC}$, $POWV_{CC}$	13.5	V
Power dissipation	Pd	1.7*1	W
Operating temperature	Topr	−35～+85	℃
Storage temperature	Tstg	−55～+150	℃

*1 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 Ta of 1℃ over 25℃.

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	$PREV_{CC}$	4.5～13.2	V
	$POWV_{CC}$	4.5～$PREV_{CC}$	V

●Block diagram



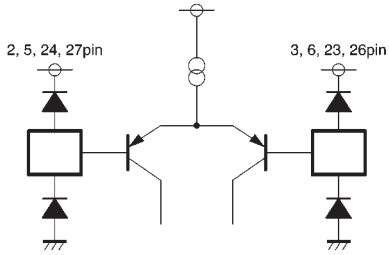
●Pin descriptions

Pin No.	Pin name	Function	Pin No.	Pin name	Function
1	BIAS IN	Bias amplifier input	15	VO4 (+)	Driver channel 4 positive output
2	OPIN1 (+)	Channel 1 pre-amplifier non-inverse input	16	VO4 (−)	Driver channel 4 negative output
3	OPIN1 (−)	Channel 1 pre-amplifier inverse input	17	VO3 (+)	Driver channel 3 positive output
4	OPOUT1	Channel 1 pre-amplifier output	18	VO3 (−)	Driver channel 3 negative output
5	OPIN2 (+)	Channel 2 pre-amplifier non-inverse input	19	POWVcc	POWVcc (channels 3 and 4)
6	OPIN2 (−)	Channel 2 pre-amplifier inverse input	20	MUTE2	Mute control for channels 3 and 4
7	OPOUT2	Channel 2 pre-amplifier output pin	21	GND	GND
8	GND	GND	22	OPOUT3	Channel 3 pre-amplifier output
9	MUTE1	Mute control for channels 1 and 2	23	OPIN3 (−)	Channel 3 pre-amplifier inverse input
10	POWVcc	POWVcc (channels 1 and 2)	24	OPIN3 (+)	Channel 3 pre-amplifier non-inverse input
11	VO2 (−)	Driver channel 2 negative output	25	OPOUT4	Channel 4 pre-amplifier output
12	VO2 (+)	Driver channel 2 positive output	26	OPIN4 (−)	Channel 4 pre-amplifier inverse input
13	VO1 (−)	Driver channel 1 negative output	27	OPIN4 (+)	Channel 4 pre-amplifier non-inverse input
14	VO1 (+)	Driver channel 1 positive output	28	PREVcc	PREVcc

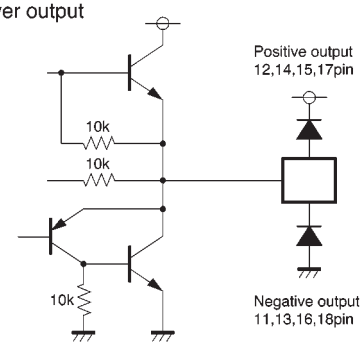
Note : Positive output and negative output are the polarities with respect to the input.
(For example, if pin 4 voltage is high, then pin 14 voltage becomes high.)

●Input / output circuits

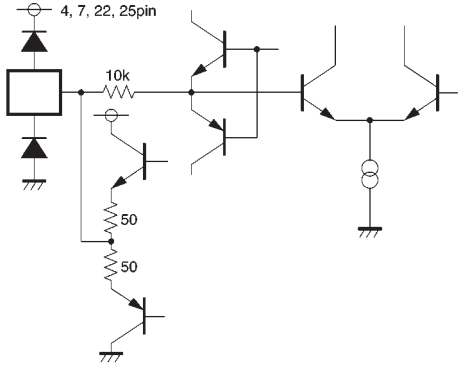
Pre-amplifier input



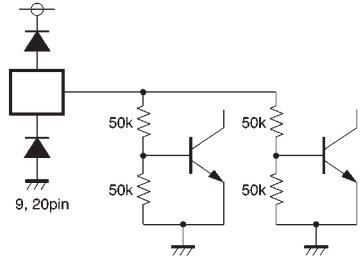
Driver output



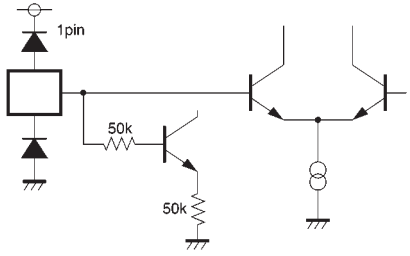
Pre-amplifier output (driver input)



Mute



Bias



●Electrical characteristics (unless otherwise noted, Ta = 25°C, $PREV_{CC}$ = 8V, $POWV_{CC}1$ = 5V, $POWV_{CC}2$ = 8V, BIAS = 2.5V, R_L = 8Ω)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I_{Q1}	—	20	30	mA	Input open
〈Driver〉						
Output offset voltage 1	V_{OO1}	−70	0	70	mV	channel 1, 2
Output offset voltage 2	V_{OO2}	−90	0	90	mV	channel 3, 4
Maximum output amplitude 1	V_{OM1}	3.6	4.0	—	V	channel 1, 2, V_{IN}=±2.0V
Maximum output amplitude 2	V_{OM2}	5.4	6.0	—	V	channel 3, 4, V_{IN}=±2.0V
Voltage gain 1	GV_{C1}	10	12	14	dB	V_{IN}=±0.5V
Voltage gain 2	GV_{C2}	16	18	20	dB	V_{IN}=±0.5V
Mute on voltage	V_{MON}	2.0	—	—	V	
Mute off voltage	V_{MOFF}	—	—	0.5	V	
〈Pre-stage operational amplifier〉						
Common-mode input voltage	V_{ICM}	−0.3	—	6.8	mV	
Offset voltage	V_{OFOP}	−6	0	6	mV	
Input bias current	V_{BOP}	—	—	300	nA	
Output high level voltage	V_{OHOP}	6.9	7.35	—	V	
Output low level voltage	V_{OLOP}	—	0.75	1.1	V	
Output drive current sink	I_{SI}	1	—	—	mA	50Ω at V_{CC}
Output drive current source	I_{SO}	1	—	—	mA	50Ω at GND
Slew rate	SR_{OP}	—	1	—	V/μs	100kHz rectangular wave, $2V_{P-P}$ output

◎Not designed for radiation resistance.

●Measurement circuit

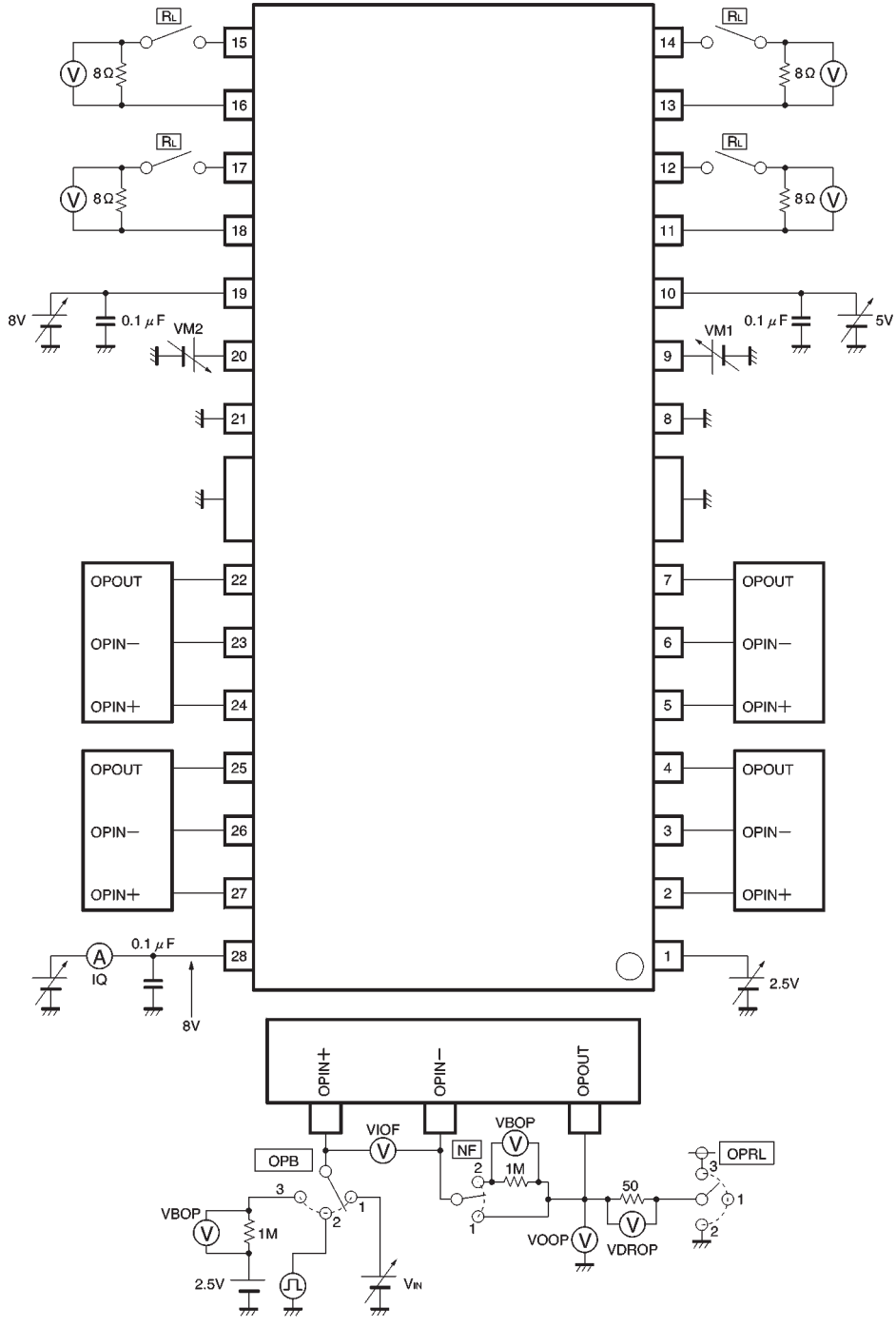


Fig.1

●Measurement circuit switch table

(1) Driver block (OPB → 1, NF → 1, OPRL → 1)

Symbol	Switch	Input		Remarks	Measurement point
	RL	V_{IN}	VM1, 2		
IQ	OFF	2.5V	0V	—	IQ
VOO1	ON	2.5V	0.5V	—	VO (channel 1, 2)
VOO2	ON	2.5V	0.5V	—	VO (channel 3, 4)
VOOM1	ON	±2.0V	0.5V	V_{IN}=0.5V and 4.5V	VO (channel 1, 2)
VOOM2	ON	±2.0V	0.5V	V_{IN}=0.5V and 4.5V	VO (channel 3, 4)
GVC1	ON	±0.5V	0.5V	V_{IN}=2.0V and 3.0V	VO (channel 1, 2)
GVC2	ON	±0.5V	0.5V	V_{IN}=2.0V and 3.0V	VO (channel 3, 4)
VMTON	ON	3.0V	2.0V	Verify output voltage is muted	VO
VMTOFF	ON	3.0V	0.5V	Verify output voltage is muted	VO

(2) Pre-stage operational amplifier block (VN1 = VM2 = 0V, RL → OFF)

Symbol	Switch			Input	Remarks	Measurement point
	OPB	NF	OPRL	V_{IN}		
VOFOP	1	1	1	2.5V	—	VIOF
VBOP	3	2	1	2.5V	—	VBOP/1MΩ
VOHOP	1	1	1	5V	—	VOOP
VOLOP	1	1	1	0V	—	VOOP
ISI	1	1	3	2.5V	—	VDROP/50Ω
ISO	1	1	2	2.5V	—	VDROP/50Ω
SROP	2	1	1	±1V	100kHz rectangular wave, 2.5±1V input	VOOP

●Application example

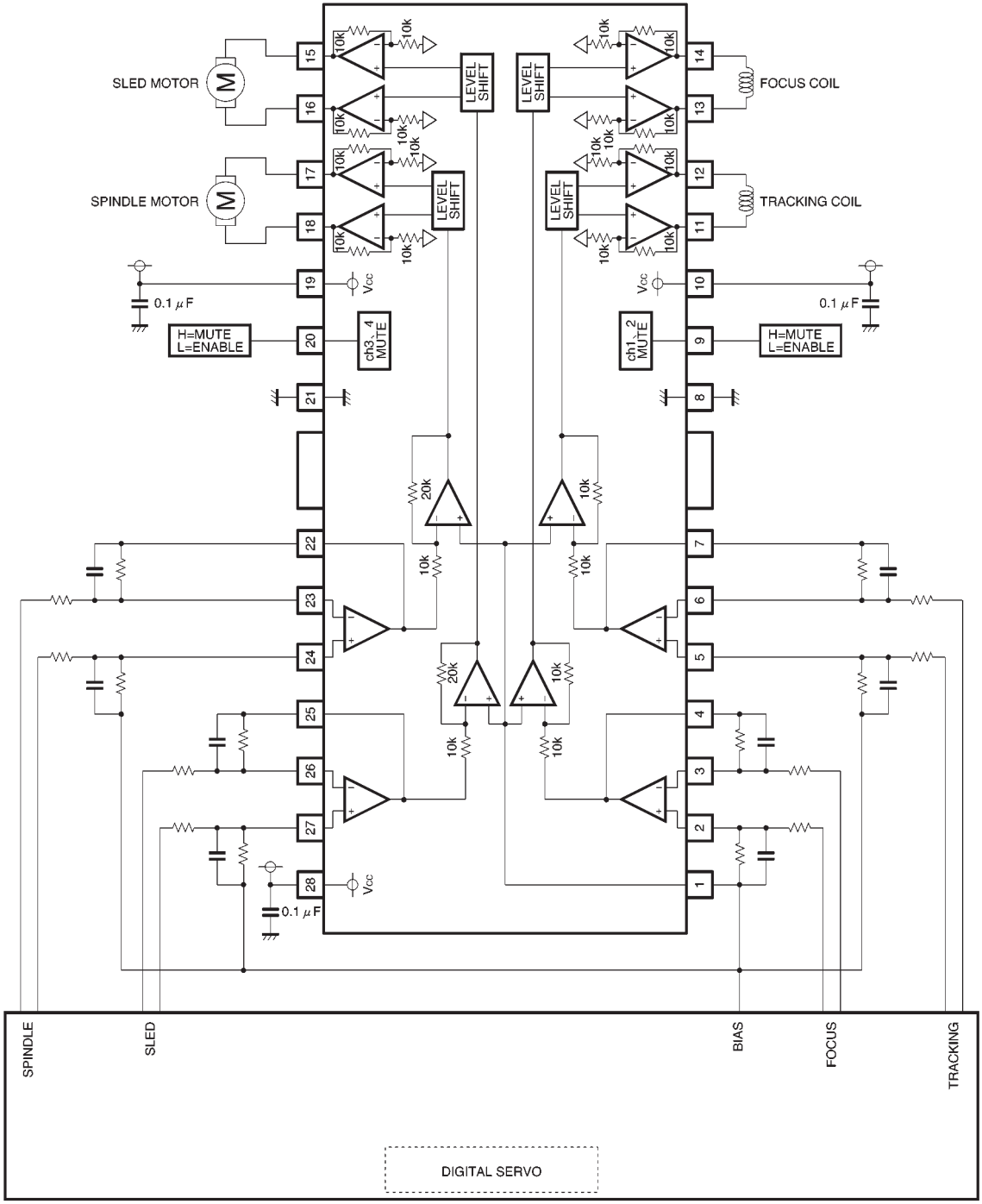


Fig.2

●Operation notes

(1) The BA5970FP 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.

(2) By having the mute pin voltage pulled up to 2.0V or greater, you can mute the output current. For normal conditions, have mute pin open or at 0.5V or below. (Pin 9 mutes channels 1 and 2, and pin 20 mutes channels 3 and 4.)

(3) If the voltage of the bias pin (pin 1) drops below 1.4V (Typ.), outputs are muted. For normal conditions, have the voltage above 1.7V.

(4) If the power supply voltage drops below 3.8V (Typ.), internal circuits turns off. If the power supply voltage then rises to 4.0V (Typ.), the circuits turn on.

(5) If the voltage of the thermal shutdown, mute ON, or bias pin drops, or if the power supply voltage 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. $V_{CC}/2$ for channels 1 and 2, and $(V_{CC}–VF)/2$ for channels 3 and 4).

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

(7) 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

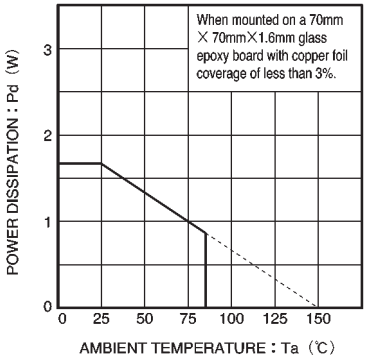


Fig.3 Thermal derating curve

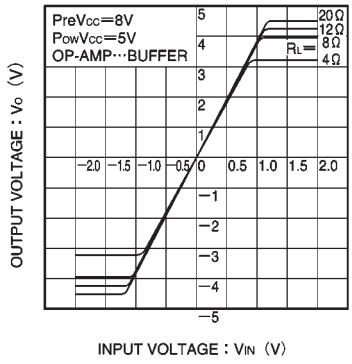


Fig.4 I / O characteristics (channels 1 and 2)

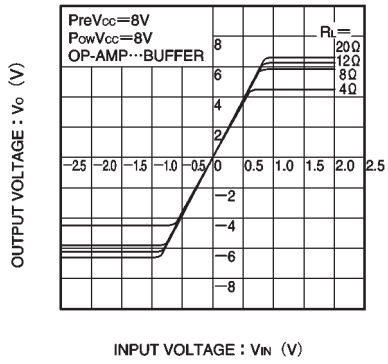


Fig.5 I / O characteristics (channels 3 and 4)

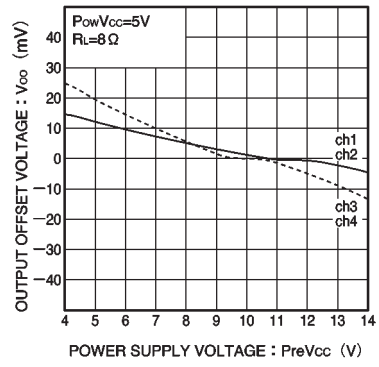


Fig.6 Power supply voltage vs. output offset voltage

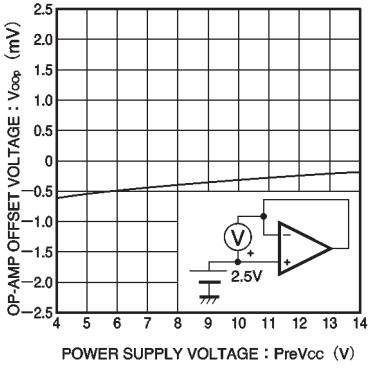


Fig.7 Power supply voltage vs. operational amplifier offset voltage

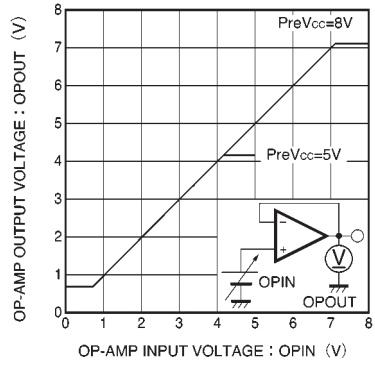
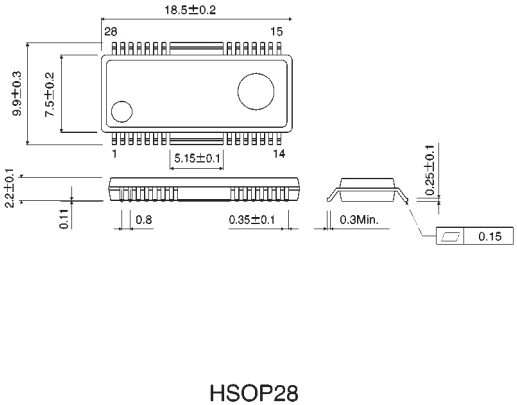


Fig.8 Operational amplifier I / O characteristics

●External dimensions (Units: mm)



HSOP28