UPC802

Ultra-low power High-performance Operational Amplifiers

DESCRIPTION

UPC802 is an operational amplifier circuit with an extremely low power consumption of 14μW. This operational amplifier has a wide power supply voltage range (± 1V to ± 16V), and various electrical characteristics such as input bias current that can be programmed using the set current value. This device is ideal for high-precision analog circuits in battery-operated portable electronic devices.

FEATURES

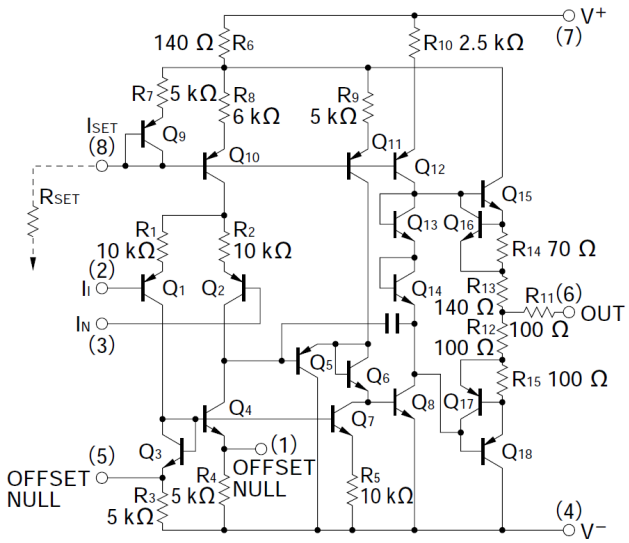
- Input Offset Voltage ±1mV (TYP.)
- Input Offset Current ±3nA (TYP.)
- Input Bias Current 20nA (I_{SET} = 10μA, TYP.)
  3nA (I_{SET} = 1μA, TYP.)
- Power Dissipation 14μW (I_{SET} = 1μA, $V^{\pm}$= ±1.5V) (TYP.)
- Low supply voltage operation ±1 V
- Electrical characteristics can be changed by changing the set current
- Built-In Phase Compensation Circuit
- Equipped with an offset adjustment terminal
- Built-In Output Short Circuit Protection

ORDERING INFORMATION

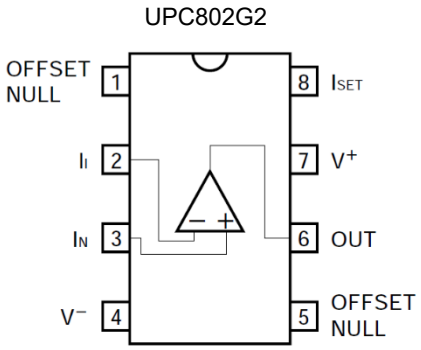
Order Name (1)	Package
UPC802G2-AP	8-pin plastic SOP (5.72 mm (225))

(1) Order names containing E1 or E2 indicate that the packaging format is embossed taping.
Pin 1 of E1 is on draw-out side, and pin 1 of E2 is at take-up side.

EQUIVALENT CIRCUIT



PIN CONFIGURATION (Top View)



ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	UPC802G2	Unit
Voltage between V^+ and V^- Note 1	$V^+ - V^-$	-0.3 ~ +36	V
Differential Input Voltage	V_{ID}	±30	V
Input Voltage Note 2	V_I	V^- -0.3 ~ V^+ +0.3	V
Output Voltage Note 3	V_O	V^- -0.3 ~ V^+ +0.3	V
I_{SET} Current	I_{SET}	150	μA
Total Power Dissipation Note 4	P_T	440	mW
Output Short Circuit Duration Note 5		Indefinite	s
Operating Ambient Temperature	T_A	-40 ~ +85	°C
Storage Temperature	T_{stg}	-55 ~ +125	°C

【Note】 **1.** Reverse connection of supply voltage can cause destruction.

2. The input voltage should be allowed to input without damage or destruction. Even during the transition period of supply voltage, power on/off etc., this specification should be kept. The normal operation will establish when the both inputs are within the Common Mode Input Voltage range of electrical characteristics.

3. This specification is the voltage which should be allowed to supply to the output terminal from external without damage or destruction. Even during the transition period of supply voltage, power on/off etc., this specification should be kept. The output voltage of normal operation will be the Output Voltage Swing of electrical characteristics.

4. Thermal derating factor is -4.4 mV/°C when operating ambient temperature is higher than 25°C.

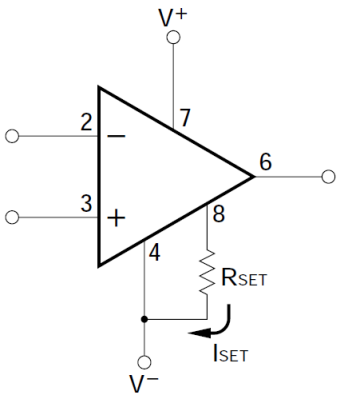
5. Pay careful attention to the total power dissipation not to exceed the absolute maximum ratings, Note 4.

RECOMMENDED OPERATING CONDITIONS

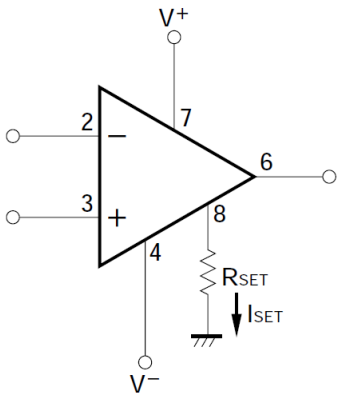
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	$V^{\pm}$	±1		±16	V
I_{SET} Current	I_{SET}	0.1		50	μA

TYPICAL CONNECTIONS

I_{SET}



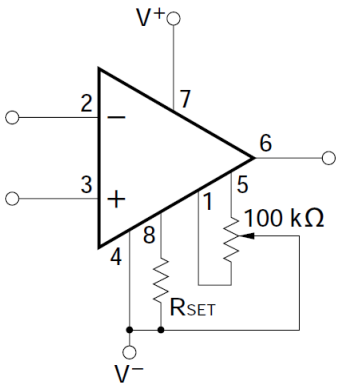
$$I_{SET} \fallingdotseq \frac{V^+ - V^- - 0.5}{R_{SET}}$$



$$I_{SET} \fallingdotseq \frac{V^+ - 0.5}{R_{SET}}$$

Remark I_{SET} is indispensable to operate.

OFFSET VOLTAGE NULL CIRCUIT



The OFFSET NULL terminal should be opened or connected to V^- through a resistor as shown in the figure on the left.
Connections other than V^- may cause malfunction, degradation, or damage.

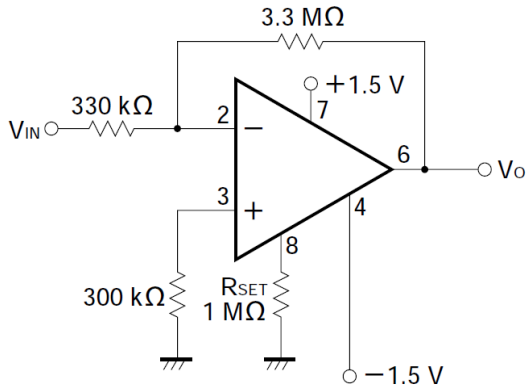
ELECTRICAL CHARACTERISTICS (T_A = 25 °C, $V^{\pm}$ = ±15 V)

Parameter	Symbol	I_{SET} = 1μA		I_{SET} = 10μA		Unit	Test Condition
		MIN.	MAX.	MIN.	MAX.		
Input Offset Voltage	V_{IO}		±5		±6	mV	R_S ≤ 100 kΩ
			±5		±6		$V^{\pm}$ = ±1.5V, R_S ≤ 100 kΩ
Input Offset Current	I_{IO}		±6		±20	nA	
Input Bias Current Note6	I_B		10		75	nA	
			10		75		$V^{\pm}$ = ±1.5V
Large Signal Voltage Gain	A_V	60000					V_O = ±10 V, R_L = 100 kΩ
Large Signal Voltage Gain	A_V			60000			V_O = ±10 V, R_L = 10 kΩ
Supply Current	I_{CC}		11		100	μA	
			8		90		$V^{\pm}$ = ±1.5V
Power Consumption	P_d		330		3000	μW	
			24		270		$V^{\pm}$ = ±1.5V
Common Mode Rejection Ratio	CMR	70		70		dB	R_S ≤ 10 kΩ
Supply Voltage Rejection Ratio	SVR	74		74		dB	R_S ≤ 10 kΩ
Output Voltage Swing	V_{om}	±12				V	R_L = 100 kΩ
		±0.6					$V^{\pm}$ = ±1.5V, R_L = 100 kΩ
Output Voltage Swing	V_{om}			±12		V	R_L = 10 kΩ
				±0.6			$V^{\pm}$ = ±1.5V, R_L = 10 kΩ
Common Model Input Voltage Range	V_{ICM}	±13.5		±13.5		V	
		±0.6		±0.6			$V^{\pm}$ = ±1.5V

【Note】 **6.** The direction of the input bias current is the same direction that flows out from the IC because the first stage is composed of PNP transistor.

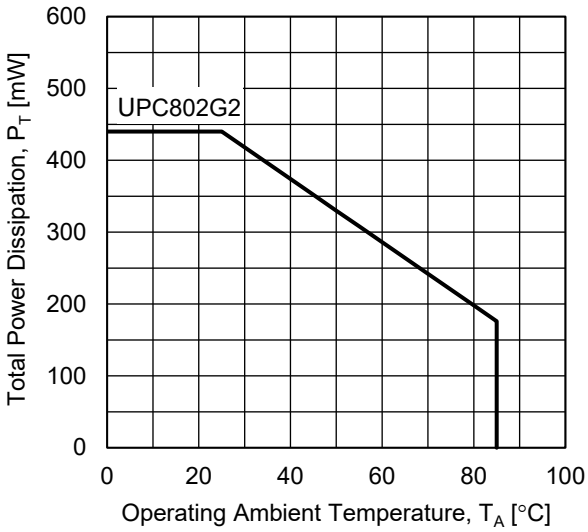
Examples of Applied Circuits

x10 Amplifier

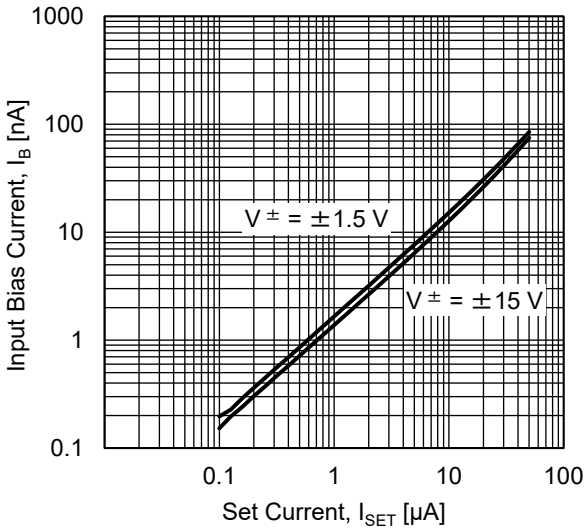


ELECTRICAL CHARACTERISTICS CURVE (T_A = 25 °C, TYP.)

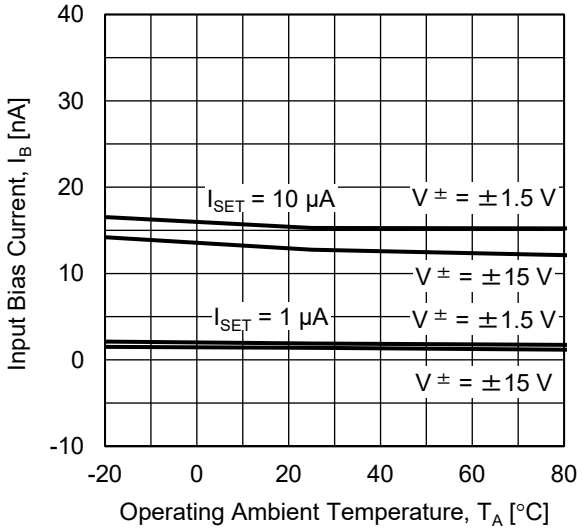
P_T vs. T_A (Absolute maximum rating)



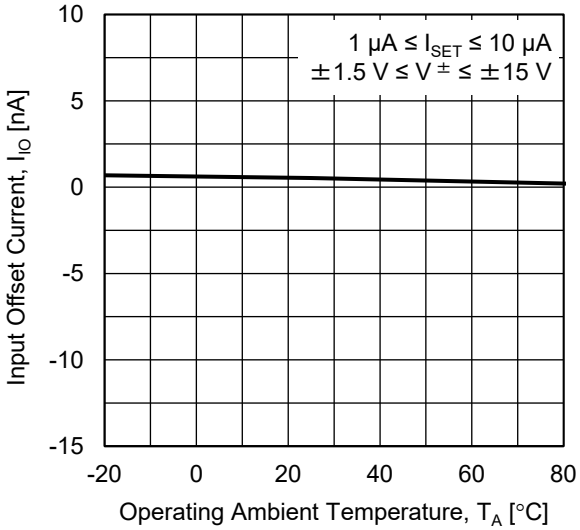
I_B vs. I_{SET}



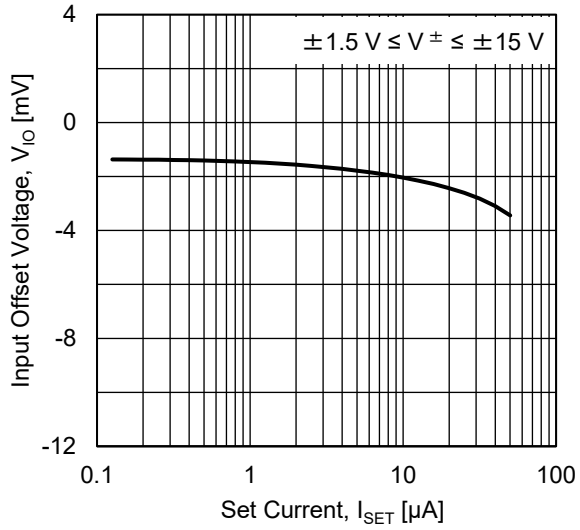
I_B vs. T_A



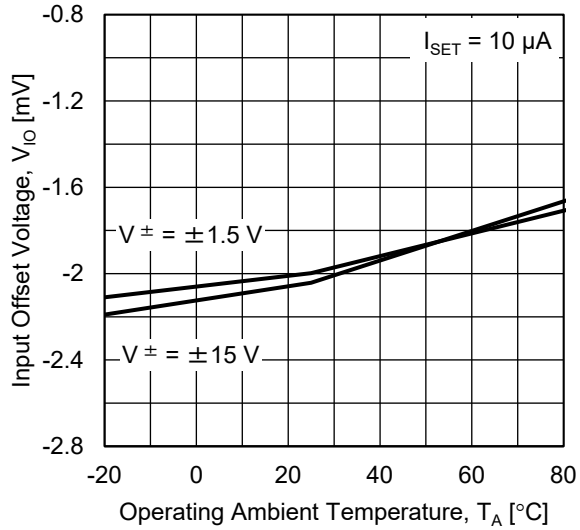
I_{IO} vs. T_A



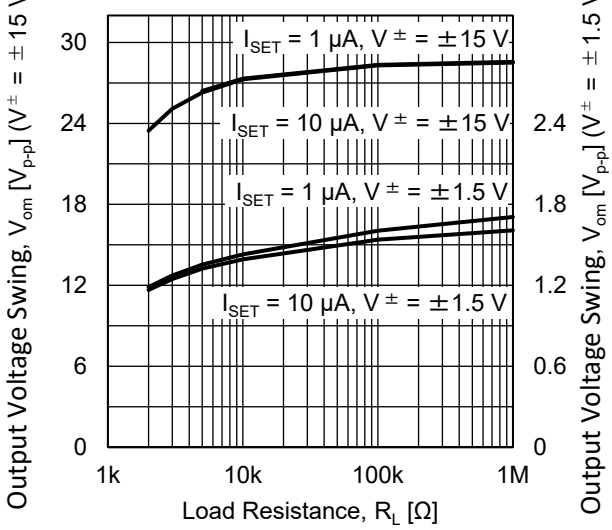
V_{IO} vs. I_{SET} (unnull)



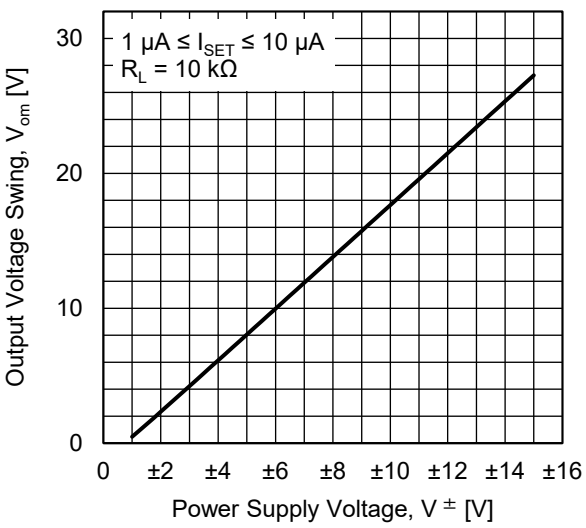
V_{IO} vs. T_A (unnull)



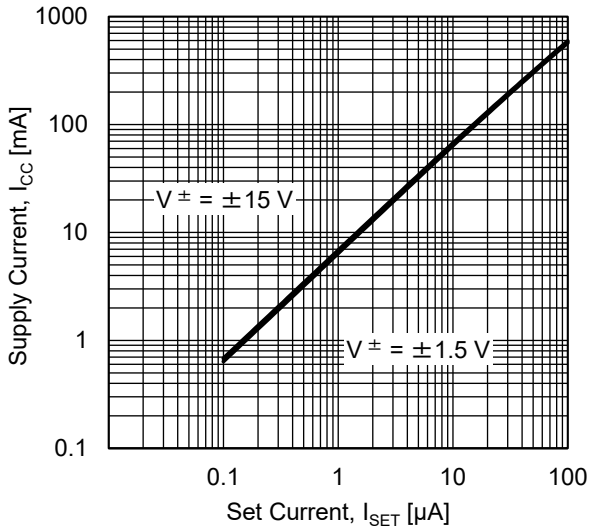
V_{om} vs. R_L



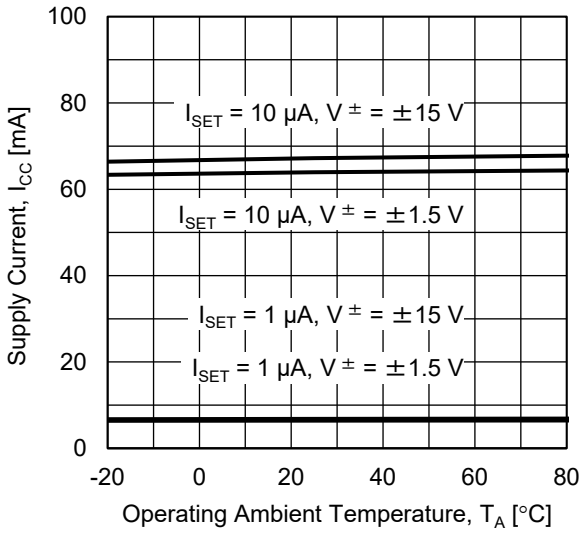
V_{om} vs. $V^{\pm}$



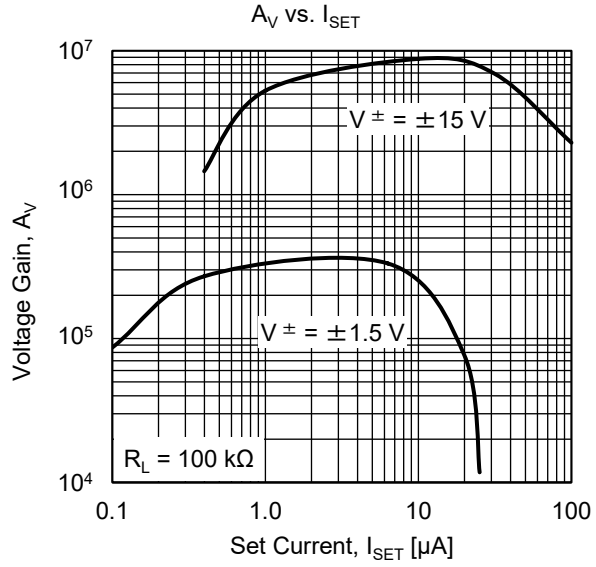
I_{CC} vs. I_{SET}



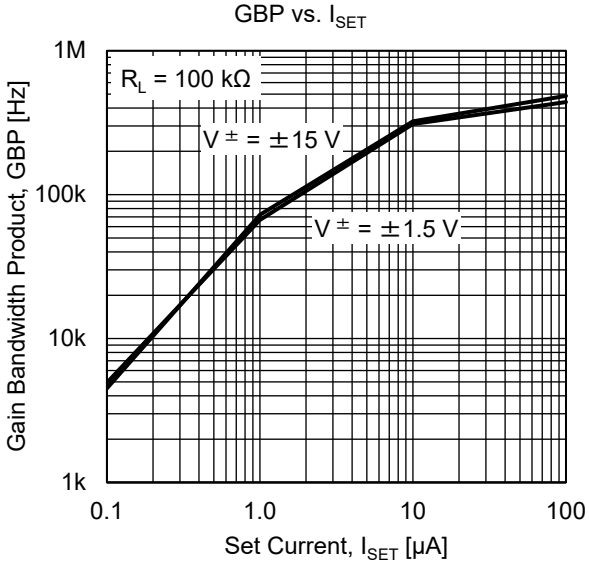
I_{CC} vs. T_A



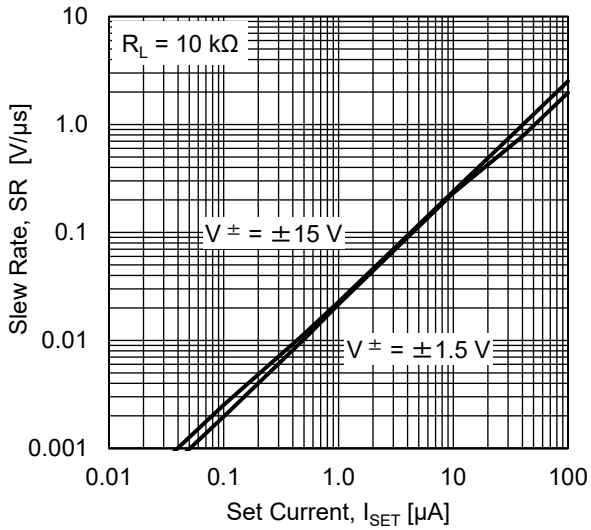
A_V vs. I_{SET}



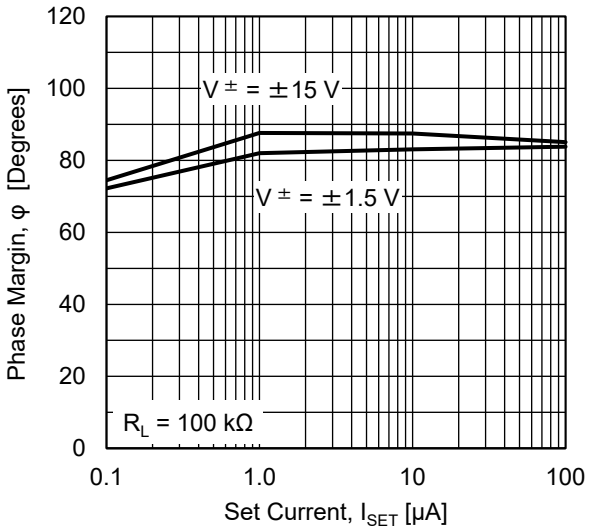
GBP vs. I_{SET}



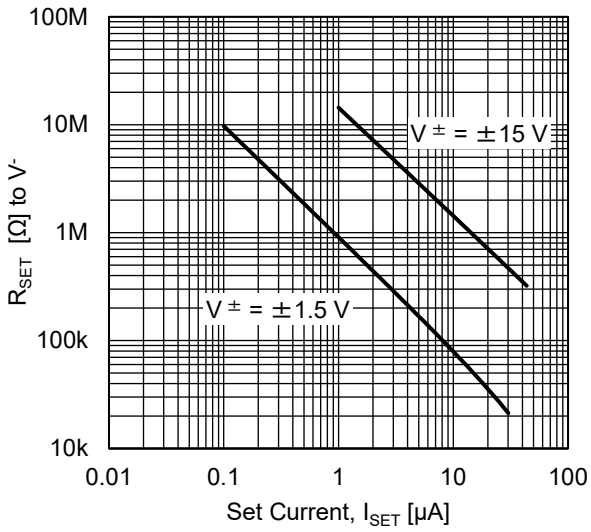
SR vs. I_{SET}



φ vs. I_{SET}



R_{SET} vs. I_{SET}



USE WITH PRECAUTIONS

- **Set Current (I_{SET})**

  This IC is a circuit configuration that supplies current to each internal element by flowing a set current (I_{SET}) (the direction in which it flows out of the IC). Be sure to apply the set current when using. Also, make sure that the potential of the ISET pin does not exceed the range of V^- ~ V^+.

- **Power Supply (Dual Power Supply / Single Power Supply)**

  The op-amp operates as long as a predetermined voltage is applied between V^+ and V^-.
  Therefore, it can operate with a single power supply (V^- = GND), but it cannot operate the input and output near GND.
  Common-mode input voltage Please pay attention to the range and maximum output voltage.

- **Ratings of input/output pin voltage**

  When the voltage of input/output pin exceeds the absolute maximum rating, the parasitic diode within the IC may conduct, causing characteristics degradation or damage. In addition, if the input pin is lower than V^-, or the output pin exceeds the power supply voltage, it is recommended to make a clamping circuit using a diode with low forward voltage (e.g.: Schottky diode) as protection.

- **Range of common-mode input voltage**

  When the supply voltage does not meet the condition of electrical characteristics, the range of common-mode input voltage is as follows.

  V_{ICM} (TYP.) : V^- +0.4 ~ V^+ -0.7 [V] (T_A = 25 °C)

  During designing, do include some tolerance by considering temperature characteristics etc.

- **Maximum output voltage**

  The TYP. value range of the maximum output voltage when the supply voltage does not meet the condition of electrical characteristics is as follows:

  V_{om}^+ (TYP.) : V^+ -1 [V] (T_A = 25 °C), V_{om}^- (TYP.) : V^- +1 [V] (T_A = 25 °C)

  During designing, do include some tolerance by considering characteristics variation, temperature characteristics and so on. In addition, also note that the output voltage range ($V_{om}^+ - V_{om}^-$) will become narrow when the output current increases.

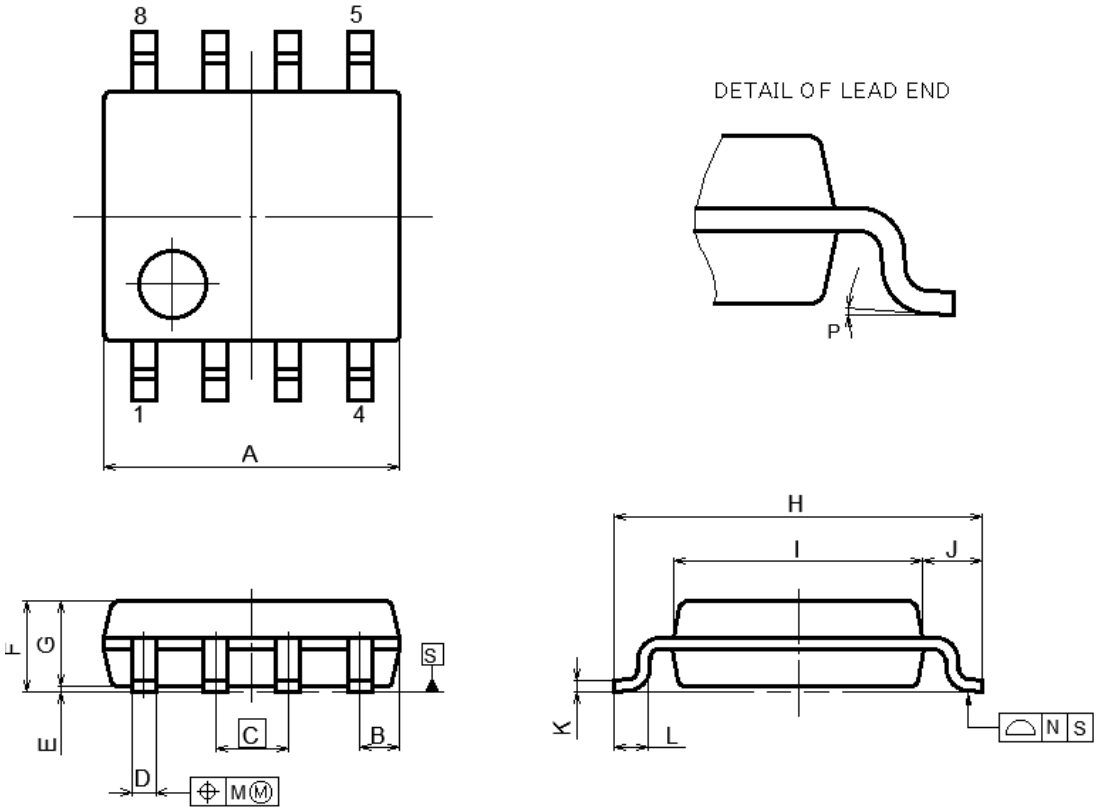
- **Handling of ICs**

  When stress is added to ICs due to warpage or bending of a board, the characteristic may fluctuates due to piezoelectric (piezo) effect. Therefore, pay attention to warpage or bending of a board.

PACKAGE DRAWINGS

8-PIN PLASTIC SOP

JEITA Package code	RENESAS code	MASS (TYP.) [g]
P-LSOP8-4.4×5.2-1.27	PLSP0008DE-A	0.09[g]



NOTE
EACH LEAD CENTERLINE IS LOCATED WITHIN 0.12 MM OF
ITS TRUE POSITION(T.P.) AT MAXIMUM MATERIAL CONDITION.

(UNIT:mm)

ITEM	DIMENSIONS
A	5.2±0.17
B	0.78MAX
C	1.27(T.P)
D	0.40±0.05
E	0.1±0.1
F	1.59±0.21
G	1.49
H	6.5±0.3
I	4.4±0.1
J	1.05±0.15
K	0.2±0.07
L	0.6±0.20
M	0.1MAX
N	0.1MAX
P	4°±4°

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