µPC271, 311

High Performance Comparator

R03DS0151EJ0100
Rev.1.00
2019.10.1

DESCRIPTION

The µPC271 and µPC311 are high-performance general-purpose comparators that have the same input characteristics as general-purpose operational amplifiers and can directly drive standard logic circuits such as TTL, CMOS, and HNIL. Its power supply voltage range is flexible whereby it exhibits excellent characteristics not only in a 5 V single power supply but also in ± 15 V power supply which is equivalent to an operational amplifier.

These products are equipped with a strobe terminal and input offset adjustment terminals, thus they can be widely applied to various voltage comparison circuits.

Depending on the operating ambient temperature, the µPC271 is suitable for communication application while the µPC311 is suitable for general-purpose usage.

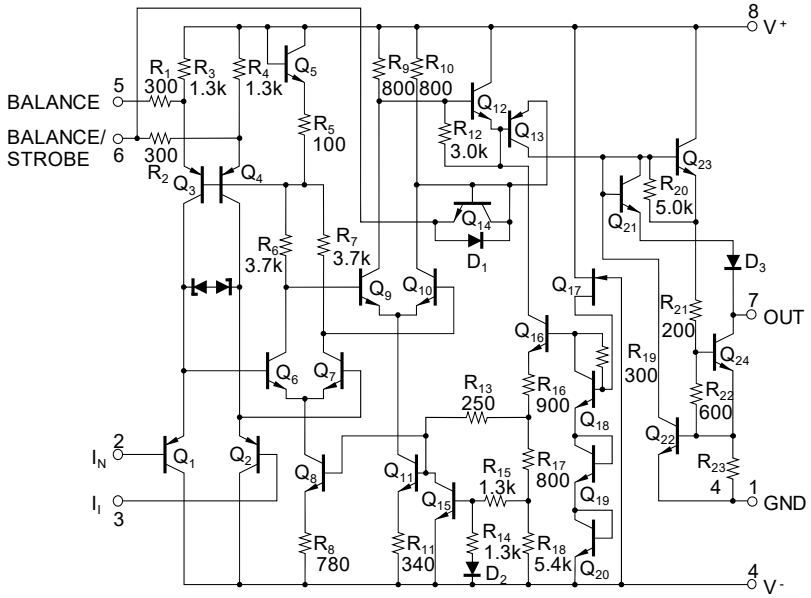
FEATURES

- Input Offset Voltage ±2 mV (TYP.)
- Input Bias Current 100 nA (TYP.)
- Pulse Response Time 200 ns (TYP.)
- Equipped with a Strobe Terminal, ideal for interfacing with logic circuits.
- Two output circuit formats are possible. (open collector, emitter follower)
- Large output current capacity to directly drive the LEDs and lamps.

ORDERING INFORMATION

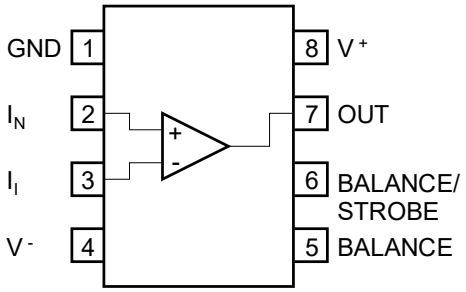
Ordering Name	Package
µPC271G2-A	8-pin plastic SOP (5.72 mm (225 mil))
µPC311G2-A	8-pin plastic SOP (5.72 mm (225 mil))

EQUIVALENT CIRCUIT



PIN CONFIGURATION (Top View)

µPC271G2, µPC311G2



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ABSOLUTE MAXIMUM RATING (T_A = 25 °C)

PARAMETER	SYMBOL	µPC271G2	µPC311G2	UNIT
Power Supply Voltage Note1	$V^+ - V^-$	-0.3 to +36		V
Differential Input Voltage	V_{ID}	±30		V
Input Voltage Note2	V_I	V^- -0.3 to V^+ +0.3		V
Output to Negative Supply Voltage Note3	$V_O - V^-$	-0.3 to +40		V
Ground to Negative Supply Voltage Note3	$V_{GND} - V^-$	-0.3 to +30		V
Total Power Dissipation Note4	P_T	440		mW
Output Short Circuit Duration Note5		10		s
Operating Ambient Temperature	T_A	-40 to +85	-20 to +80	°C
Storage Temperature	T_{stg}	-55 to +125		°C

[Note] 1. Note that reverse connections of the power supply may damage the ICs.

2. The input terminal must be applied within the input voltage range to avoid deterioration or damaging the device characteristic. Do not exceed the ratings including during transient state such as ON/OFF, etc. The Comparator input voltage must operate within the electrical characteristics range of input common-mode voltage.

3. The output terminal and GND terminal must be apply within the output voltage range to avoid deteriorating or damaging the device characteristic. The GND terminal must be less than V^+. Do not exceed the ratings including during transient state such as ON/OFF, etc.

4. This is the value at $T_A \leq +25$ °C. De-rate value at -4.4 mW/°C when $T_A > 25$ °C.

5. Pay attention to output terminal current and GND terminal current. Please use the total loss and the de-rating value from Note 4.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Power Supply Voltage (Dual Supply)	$V^\pm$	±4		±16	V
Power Supply Voltage (V^- = GND)	V^+	+5		+32	V

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

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Input Offset Voltage Note6	V_{IO}		±2.0	±7.5	mV	$V^+ - V^- = 5$ V to 30 V, $R_S \leq 50$ kΩ
Input Offset Current Note6	I_{IO}		±6.0	±50	nA	$V^+ - V^- = 5$ V to 30 V
Input Bias Current	I_B		100	250	nA	$V^+ - V^- = 5$ V to 30 V
Voltage Gain	A_V		200000			R_L = 1.0 kΩ
Pulse Response Time			200		ns	Input step 100 mV, Overdrive 5 mV
Output Saturation Voltage	V_{OL}		0.75	1.5	V	$V_I \leq -10$ mV, I_O = 50 mA
Strobe Operating Current			3.0		mA	
Output Leakage Current	$I_{O\ LEAK}$		0.2	50	nA	$V_I \geq 10$ mV, V_O = 35 V
Positive Supply Current	I^+		5.1	7.5	mA	I_O = 0 A
Negative Supply Current	I^-		4.1	5.0	mA	I_O = 0 A
Input Offset Voltage Note6	V_{IO}			±10	mV	$V^+ - V^- = 5$ V to 30 V, $R_S \leq 50$ kΩ, T_A = 0 to +70 °C
Input Offset Current Note6	I_{IO}			±70	nA	$V^+ - V^- = 5$ V to 30 V, T_A = 0 to +70°C
Input Bias Current	I_B			300	nA	$V^+ - V^- = 5$ V to 30 V, T_A = 0 to +70°C
Common Mode Input Voltage Range	V_{ICM}	+13.0 -14.5	+13.8 -14.7		V	
Output Saturation Voltage	V_{OL}		0.23	0.4	V	$V^+ \geq 4.5$ V, $V^- = 0$ V, $V_I \leq -10$ mV, I_O = 8 mA

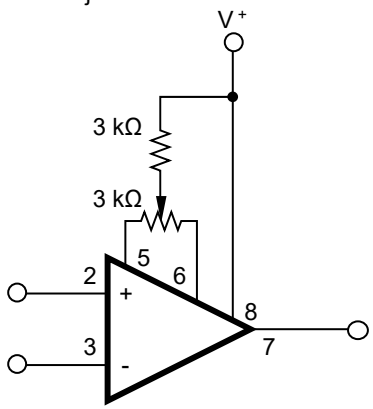
[Note] 6. The difference of the input voltage and the input bias current when the load current is 1 mA and the output is inverted.

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CIRCUIT CONNECTION EXAMPLE (1)

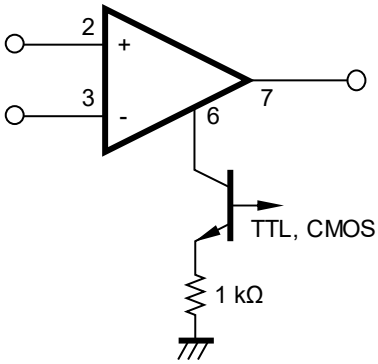
● BALANCE terminal, BALANCE/STROBE terminal

Offset Adjustment

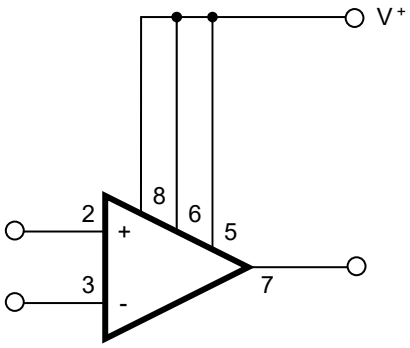


Strobe

Output goes high when BALANCE/STROBE terminal is low. Set the strobe operating current between 3 to 5mA



Common Mode Slew Rate Increase Method

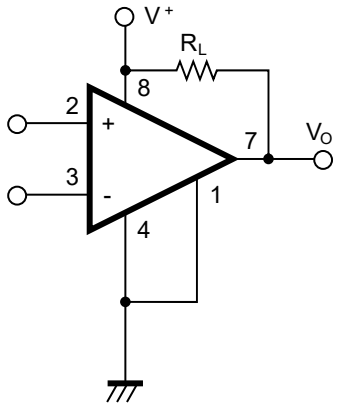


Note Use either pin 5 and pin 6 open (no offset adjustment), the offset adjustment circuit, the strobe circuit (pin 5 open) or the common mode slew rate increase method as shown in above figures. In other cases, malfunction, characteristic deterioration or damage may occur.

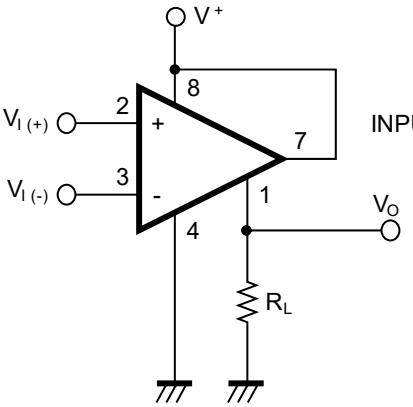
CIRCUIT CONNECTION EXAMPLE (2)

● Output terminal, GND terminal

Open Collector Output



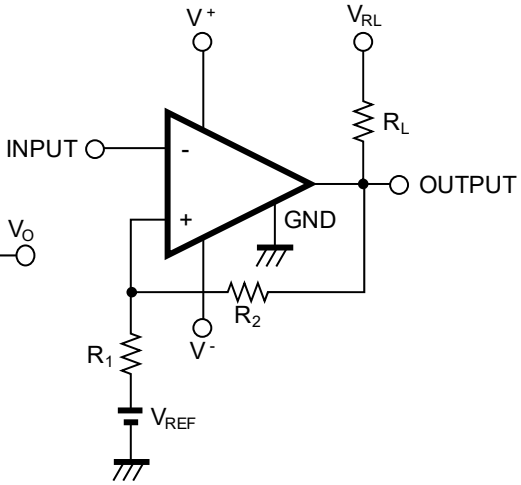
Emitter Follower Output



When $V_{I(+)} > V_{I(-)}$, V_O is low because emitter follower output.

APPLICATION CIRCUIT EXAMPLE

Comparator with Hysteresis



Threshold Voltage

$$V_{TH\,(High)} \fallingdotseq V_{REF} + \frac{R_1}{R_L + R_2 + R_1}(V_{RL} - V_{REF})$$

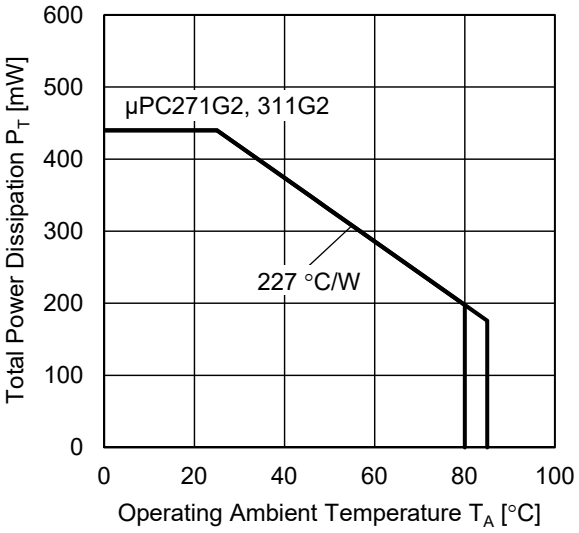
$$V_{TH\,(Low)} \fallingdotseq V_{REF} - \frac{R_1}{R_1 + R_2}(V_{REF} - V_{OL})$$

$(V_{RL} > V_{REF} > V_{OL})$

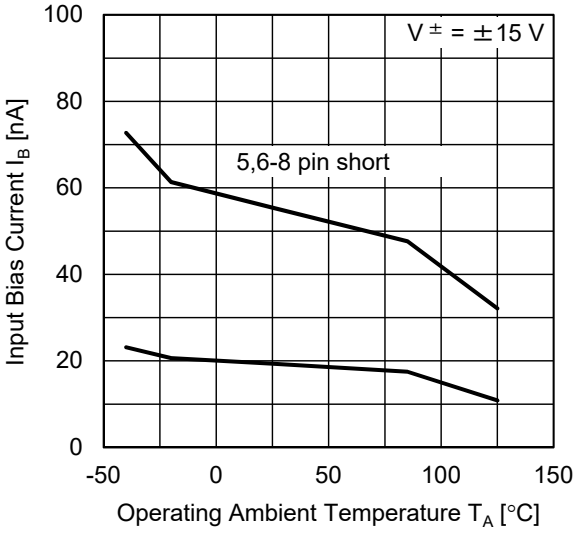
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TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25 °C, TYP.) (Reference Value)

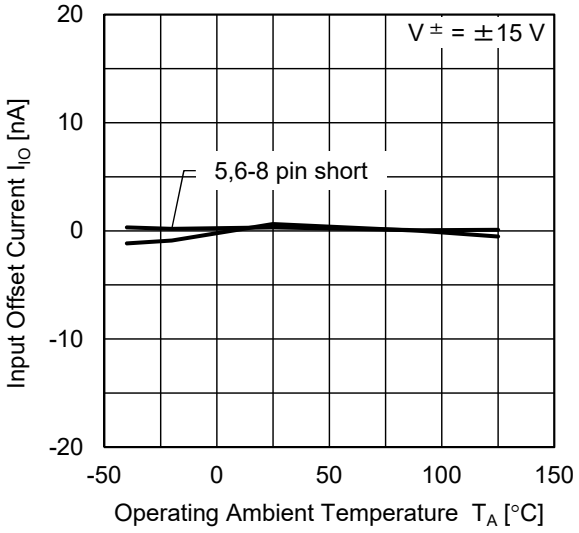
P_T vs. T_A (Absolute Maximum Rating)



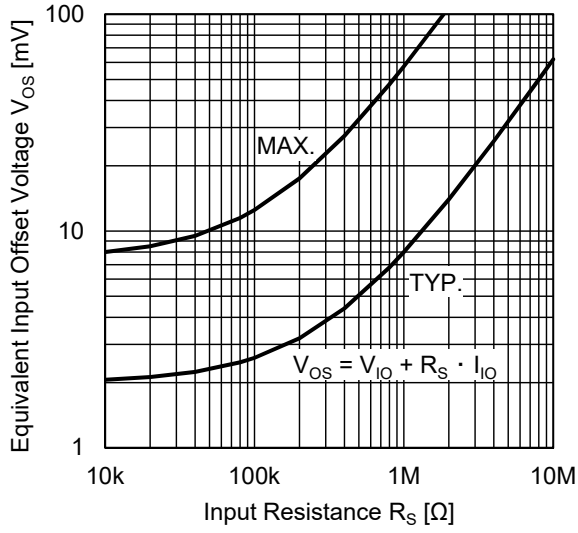
I_B vs. T_A



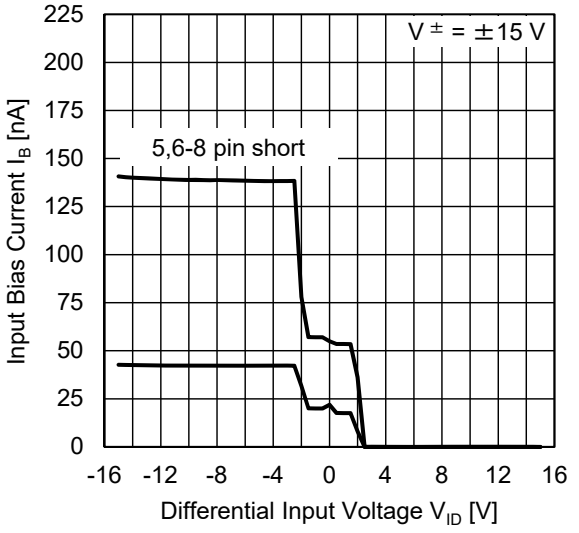
I_{IO} vs. T_A



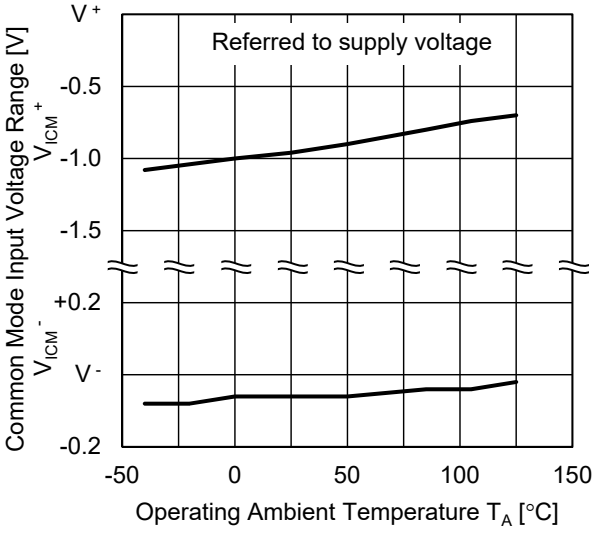
V_{OS} vs. R_S



I_B vs. V_{ID}

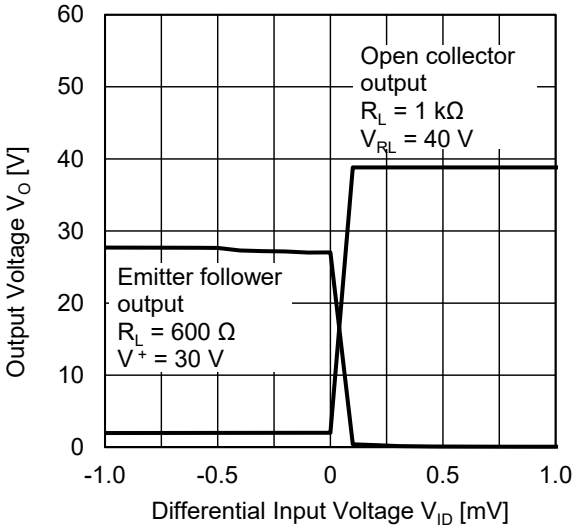


V_{ICM} vs. T_A

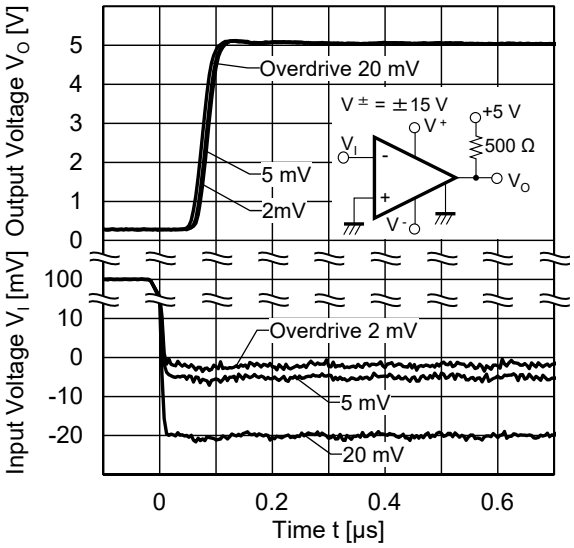


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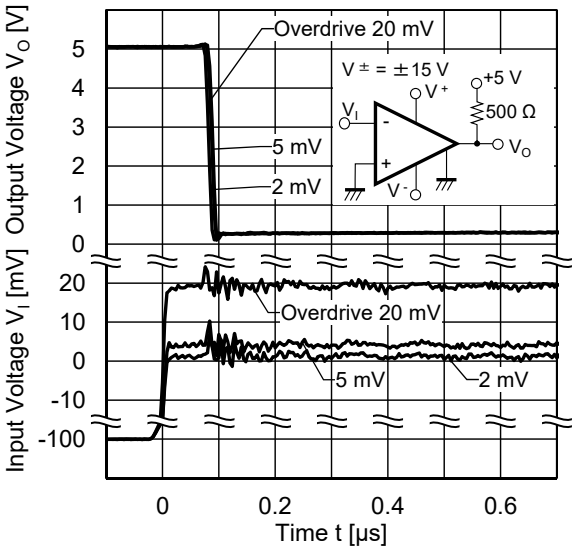
V_O vs. V_{ID}



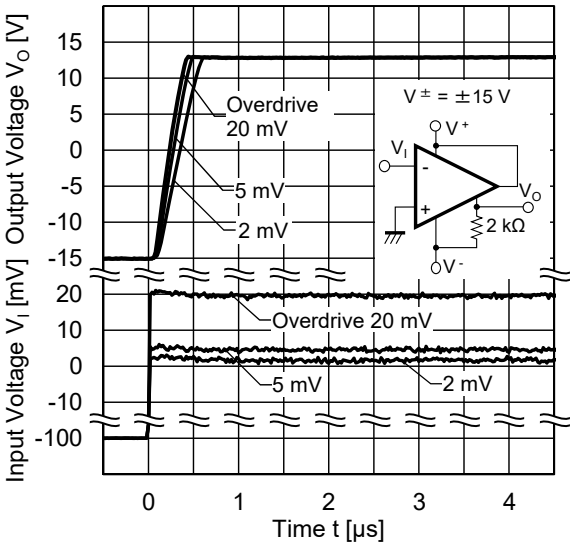
Pulse Response Characteristics I



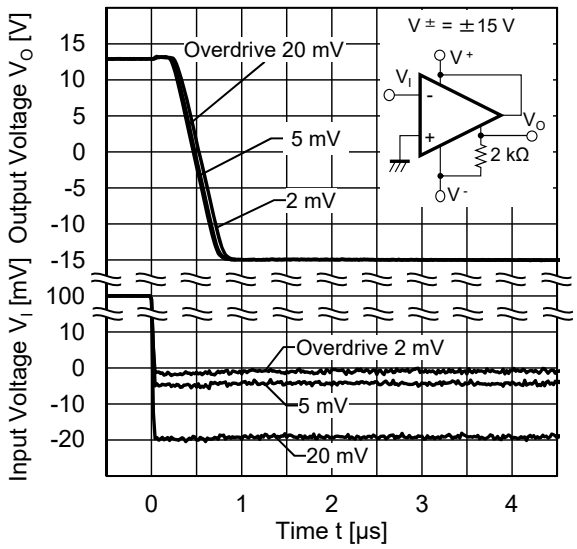
Pulse Response Characteristics II



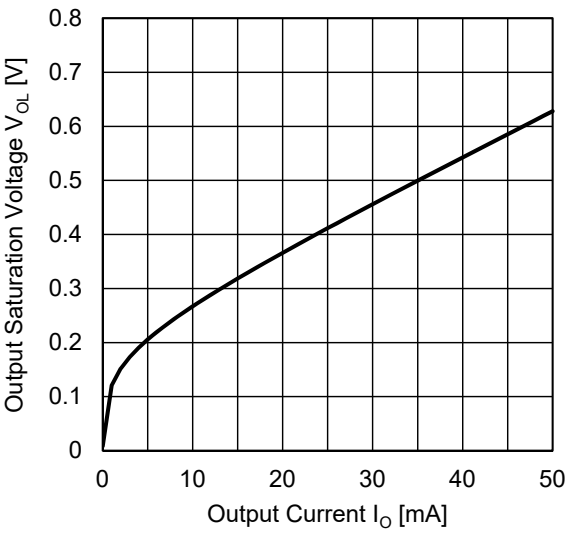
Pulse Response Characteristics III



Pulse Response Characteristics IV

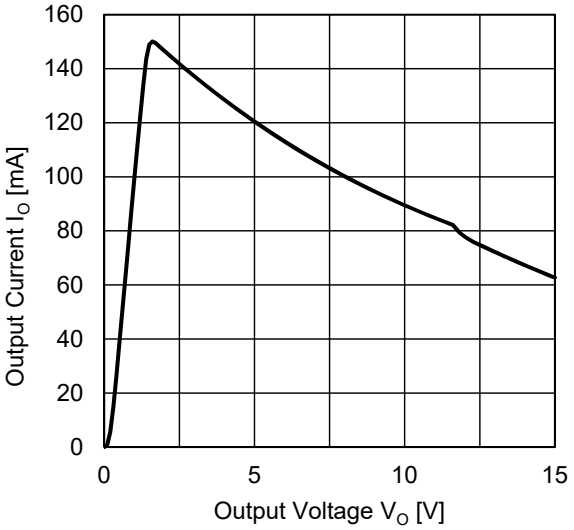


V_{OL} vs. I_O

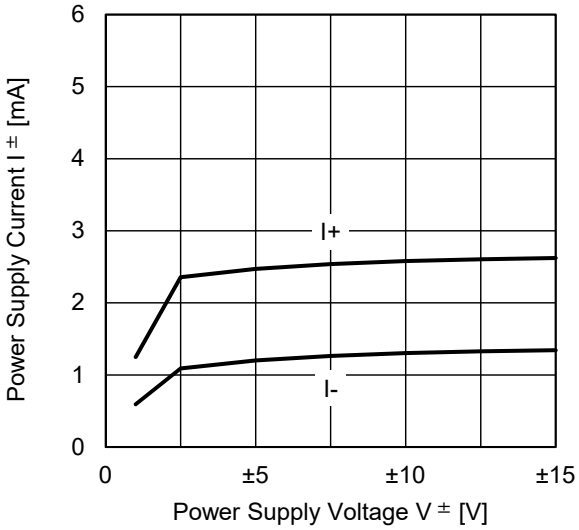


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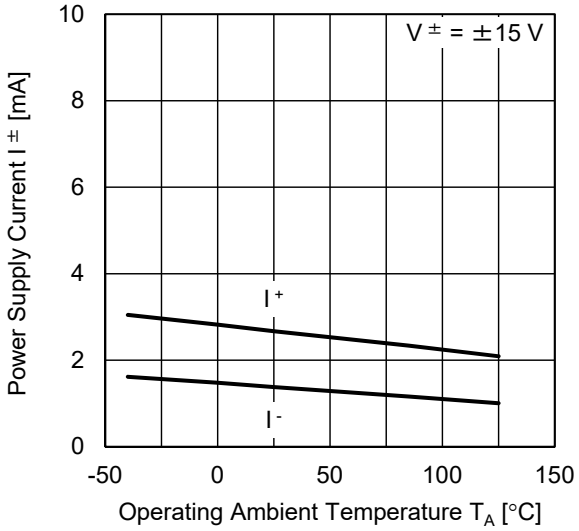
I_O vs. V_O



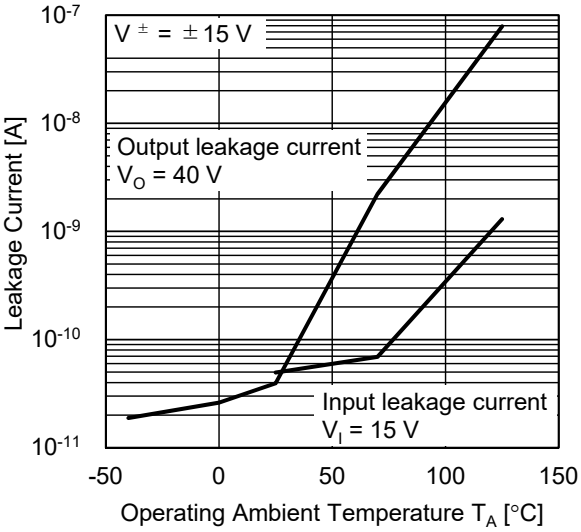
$I^{\pm}$ vs. $V^{\pm}$



$I^{\pm}$ vs. T_A



Leakage Current Characteristics



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USE WITH PRECAUTIONS

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

  The comparator operates when a predetermine voltage is applied between V^+ - V^-. Therefore, while it operates from a single power supply (V^- = GND), it is not possible to operate the input near GND. So please be careful of the common-mode input voltage range.

- **Ratings of input pin voltage**

  When the voltage of input pin exceeds the absolute maximum rating, the parasitic diode within the IC may conduct, causing characteristics degradation or damage. Therefore, please use the input pin within the power supply voltage range. In addition, if it 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 power supply voltage does not meet the condition of electrical characteristics, the range of common-mode input voltage is as follows.

  V_{ICM} (TYP.) : V^- +0.3 to V^+ -1.2 [V] (T_A = 25 °C)

  During designing, do include some margin by considering characteristics variation and temperature characteristics, etc.

- **Handling of ICs**

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

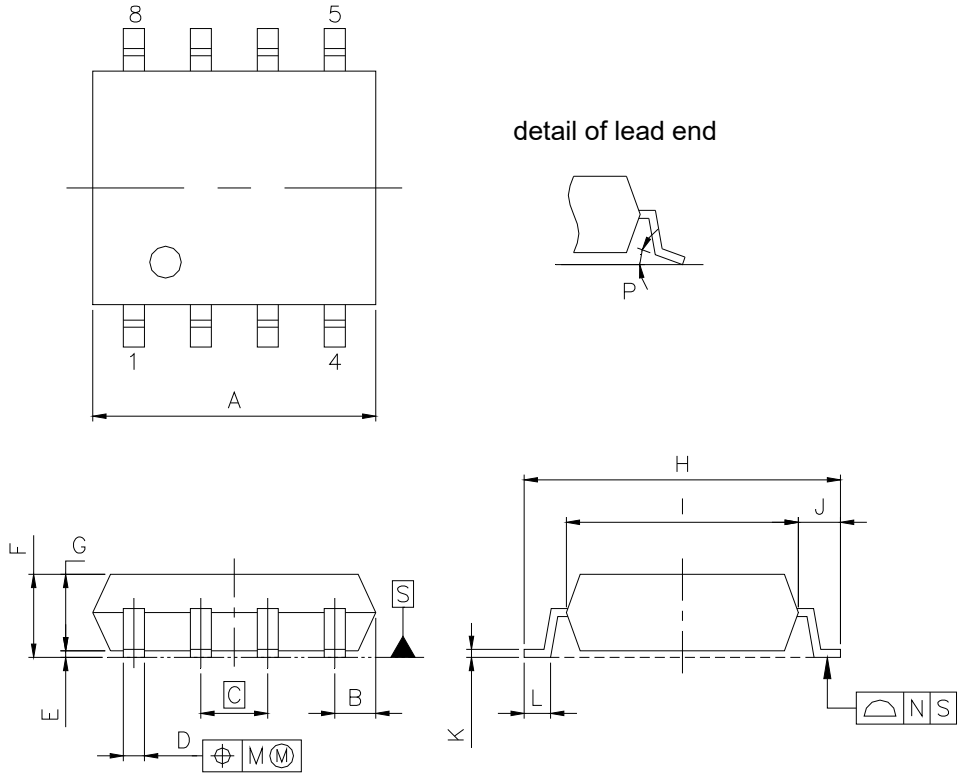
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PACKAGE DRAWINGS

8-PIN PLASTIC SOP

JEITA Package code	RENESAS code	Previous code	MASS (TYP.) [g]
P-SOP8-0225-1.27	PRSP0008DL-A	S8GM-50-225B	0.08

Unit: mm



NOTE

Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	5.2 +0.17 -0.20
B	0.78 MAX
C	1.27 (T.P)
D	0.42 +0.08 -0.07
E	0.1 ±0.1
F	1.59 ±0.21
G	1.49
H	6.5 ±0.3
I	4.4 ±0.15
J	1.1 ±0.2
K	0.17 +0.08 -0.07
L	0.6 ±0.2
M	0.12
N	0.10
P	3° +7° -3°

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5. 瑞萨电子产品根据其质量等级分为两个等级：“标准等级”和“高质量等级”。 每种瑞萨电子产品的预期用途均取决于产品的质量等级，如下所示：
   标准等级： 计算机、办公设备、通讯设备、测试和测量设备、视听设备、家用电器、机械工具、个人电子设备、工业机器人等。
   高质量等级： 运输设备（汽车、火车、轮船等）、交通控制系统（交通信号灯）、大型通讯设备、关键金融终端系统、安全控制设备等。
   除非是瑞萨电子数据表或其他瑞萨电子文档中明确指定为高可靠性产品或用于恶劣环境的产品，否则瑞萨电子产品不能用于、亦未授权用于可能对人类生命造成直接威胁的产品或系统及可能造成人身伤害的产品或系统（人工生命维持装置或系统、植埋于体内的装置等）中，或者可能造成重大财产损失的产品或系统（太空系统、海底增音机、核能控制系统、飞机控制系统、关键装置系统、军用设备等）中。对于用户或任何第三方因使用不符合瑞萨电子数据表、使用说明书或其他瑞萨电子文档的瑞萨电子产品而遭受的任何损害或损失，瑞萨电子概不承担任何责任。
6. 使用瑞萨电子产品时，请参阅最新产品信息（数据表、使用说明书、应用指南、可靠性手册中的“半导体元件处理和使用一般注意事项”等），并确保使用条件在瑞萨电子指定的最大额定值、电源工作电压范围、散热特性、安装条件等范围内使用。对于在上述指定范围之外使用瑞萨电子产品而产生的任何故障、失效或事故，瑞萨电子概不承担任何责任。
7. 虽然瑞萨电子一直致力于提高瑞萨电子产品的质量和可靠性，但是，半导体产品有其自身的具体特性，如一定的故障发生率以及在某些使用条件下会发生故障等。除非是瑞萨电子数据表或其他瑞萨电子文档中指定为高可靠性产品或用于恶劣环境的产品，否则瑞萨电子产品未进行防辐射设计。用户负责执行安全保护措施，以避免因瑞萨电子产品失效或发生故障而造成身体伤害、火灾导致伤害或损害和/或其他对公众构成危险的事故。例如进行软硬件安全设计（包括但不限于冗余设计、防火控制以及故障预防等）、适当的老化处理或其他适当的措施等。由于对微机软件单独进行评估非常困难且不实际，所以请用户自行负责对最终产品或系统进行安全评估。
8. 关于环境保护方面的详细内容，例如每种瑞萨电子产品的环境兼容性等，请与瑞萨电子的营业部门联系。用户负责仔细并充分查阅对管制物质的使用或含量进行管理的所有适用法律法规（包括但不限于《欧盟RoHS指令》），并在使用瑞萨电子产品时遵守所有适用法律法规。对于因用户未遵守相应法律法规而导致的损害或损失，瑞萨电子概不承担任何责任。
9. 不可将瑞萨电子产品和技术用于或者嵌入日本国内或海外相应的法律法规所禁止生产、使用及销售的任何产品或系统中。也不可将瑞萨电子产品或技术用于(1)与大规模杀伤性武器（例如核武器、化学武器、生物武器或运送此等武器的导弹，包括无人机(UAV)）的开发、设计、制造、使用、存储等相关的任何目的；(2)与常规武器的开发、设计、制造或使用相关的任何目的；(3)扰乱国际和平与安全的任何其他目的，并且不可向任何第三方销售、出口、租赁、转让、或让与瑞萨电子产品或技术，无论直接或间接知悉或者有理由知悉该第三方或任何其他方将从事上述活动。用户必须遵守对各方或交易行使司法管辖权的任意国家/地区政府所公布和管理的任何适用出口管制法律法规。
10. 瑞萨电子产品的买方或分销商，或者分销、处置产品、或以其他方式向第三方出售或转让产品的任何其他方有责任事先向所述第三方通知本文档规定的内容和条件。
11. 在事先未得到瑞萨电子书面认可的情况下，不得以任何形式部分或全部再版、转载或复制本文档。
12. 如果对本文档所记载的信息或瑞萨电子产品有任何疑问，请向瑞萨电子的营业部门咨询。

（注1） 瑞萨电子：在本文档中指瑞萨电子株式会社及其控股子公司。
（注2） 瑞萨电子产品：指瑞萨电子开发或生产的任何产品。

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