µPC177GR-9LG, µPC339GR-9LG

Single Power Supply Quad Comparator

R03DS0140EJ0100
Rev.1.00
2019.1.17

DESCRIPTION

µPC177GR-9LG, µPC339GR-9LG comparators are designed for single power supply operation. The features include low-voltage operation, common-mode input voltage range from V-(GND) level, open-collector output and low current consumption. Furthermore, these products can operate with both power supplies and can be widely used for various voltage comparison application.

Depending on the usage and operating ambient temperature range, the µPC177GR-9LG is design for extended temperature and µPC339GR-9LG is design for general purposes.

In addition, compatible DC parameter selection for the comparators are available under special products.

Along with this series of lineup are dual type comparators, µPC277GR-9LG, µPC277MP-KAA, and µPC393GR-9LG with the same circuit configuration are also available.

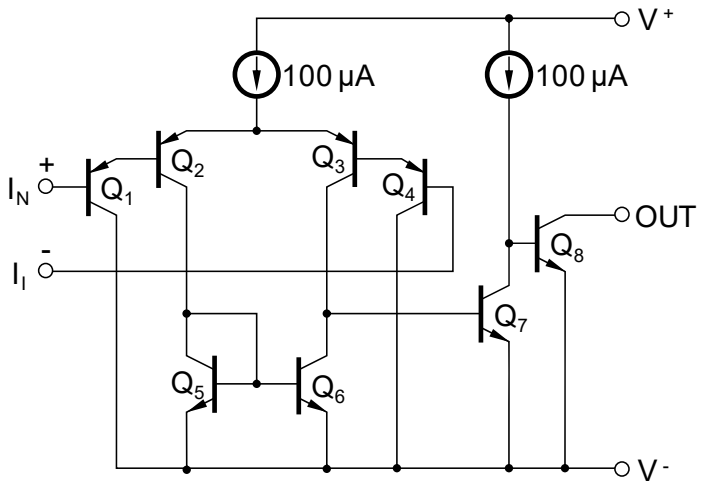
FEATURES

- Input Offset Voltage ±1 mV (TYP.)
- Input Bias Current 20 nA (TYP.)
- Voltage Gain 200000 (TYP.)
- Pulse Response Time 1.6 µs (TYP.)
- Output Sink Current 16 mA (TYP.)
- A wired OR is possible as the output is an open collector
- Low Voltage Operation $V^+ - V^-$: +2 ~ +32 V
- Small Package (Half the footprint size of 14-pin plastic SOP (1.27 mm pitch))

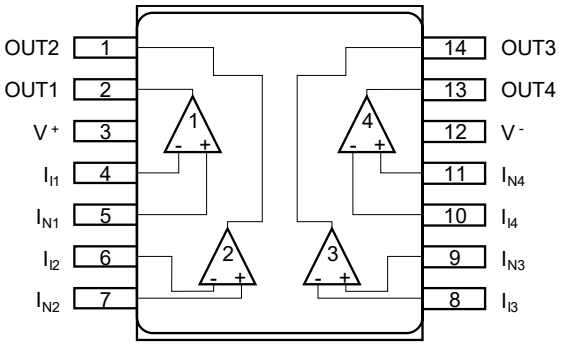
ORDERING INFORMATION

Order Name	Selected Grade	Package
µPC177GR-9LG-A	Standard	14-pin plastic TSSOP (5.72 mm (225))
µPC177GR(5)-9LG-A	DC Parameter Selection	14-pin plastic TSSOP (5.72 mm (225))
µPC393GR-9LG-A	Standard	14-pin plastic TSSOP (5.72 mm (225))
µPC393GR(5)-9LG-A	DC Parameter Selection	14-pin plastic TSSOP (5.72 mm (225))

EQUIVALENT CIRCUIT (1/4 Circuit)



PIN CONFIGURATION (Marking side)



ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C)

Parameter	Symbol	µPC177GR-9LG, µPC177GR(5)-9LG	µPC339GR-9LG, µPC339GR(5)-9LG	Unit
Power Supply Voltage Note 1	$V^+ - V^-$	-0.3 ~ +36		V
Differential Input Voltage	V_{ID}	±36		V
Input Voltage Note 2	V_I	V^- -0.3 ~ V^- +36		V
Output Voltage Note 3	V_O	V^- -0.3 ~ V^- +36		V
Total Power Note 4	P_T	550		mW
Output Short Circuit Duration (vs. GND) Note 5	t_S	Indefinite		s
Operating Ambient Temperature	T_A	-40 ~ +125	-40 ~ +85	°C
Storage Temperature	T_{stg}	-55 ~ +150	-55 ~ +125	°C

【Note】 1. Note that reverse connections of the power supply may damage the ICs.

2. This is the input voltage range that can be applied to the input terminal without any characteristics degradation or breakdown. It can be applied regardless of the supply voltage. Do not apply the voltage below V-(GND)-0.3V. The comparator electrical characteristics will operate normally when the input voltage is operating within the common-mode input voltage range.
3. Voltage range that can be applied externally to the output terminal without deteriorating or damage to the product. It can be applied regardless of the power supply. Caution not to exceed the ratings, including transient conditions such as when the power supply is ON/OFF.
4. This is the value when mounting the glass epoxy board (size 100 mm x 100 mm, thickness 1 mm, and copper foil only on one side with 15% solid wiring of the board area). Please take note that depending on the operating ambient temperature, each product following conditions and de-rating rate as below:
   µPC177GR-9LG : For T_A ＞ 71 °C, de-rate at -7.0 mW/°C
   (Junction-Ambient Thermal Resistance, $R_{th(J-A)}$ = 144 °C/W)
   µPC339GR-9LG : For T_A ＞ 46 °C, de-rate at -7.0 mW/°C
   (Junction-Ambient Thermal Resistance, $R_{th(J-A)}$ = 144 °C/W)
5. A short circuit to the V+ side may destroy the IC. Please use the total loss and de-rating value from Note 4.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Power Supply Voltage (Dual Supply)	$V^{\pm}$	±1		±16	V
Power Supply Voltage (V^- = GND)	V^+	+2		+32	V

ELECTRICAL CHARACTERISTICS

µPC177GR-9LG, µPC339GR-9LG (T_A = 25 °C, V^+ = +5 V, V^- = GND)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Input Offset Voltage	V_{IO}		±1	±5	mV	V_O = 1.4 V, V_{REF} = 1.4 V, R_S = 0 Ω
Input Offset Current	I_{IO}		±5	±50	nA	V_O = 1.4 V
Input Bias Current Note 6	I_B		20	250	nA	V_O = 1.4 V
Large Signal Voltage Gain	A_V		200000			R_L = 15 kΩ
Circuit Current Note 7	I_{CC}		1.1	2	mA	R_L = ∞, I_O = 0 A
Common Mode Input Voltage Range	V_{ICM}	0		V^+ -1.5	V	
Output Saturation Voltage	V_{OL}		0.2	0.4	V	$V_{IN(-)}$ = 1 V, $V_{IN(+)}$ = 0 V, $I_{O\ SINK}$ = 4 mA
Output Sink Current	$I_{O\ SINK}$	6	16		mA	$V_{IN(-)}$ = 1 V, $V_{IN(+)}$ = 0 V, V_O ≦ 1.5 V
Output Leakage Current	$I_{O\ LEAK}$		0.1		nA	$V_{IN(+)}$ = 1 V, $V_{IN(-)}$ = 0 V, V_O = 5 V
Pulse Response Time Note 8			1.6		µs	R_L = 5.1 kΩ, V_{RL} = 5 V

µPC177GR(5)-9LG, µPC339GR(5)-9LG (T_A = 25 °C, V^+ = +5 V, V^- = GND)

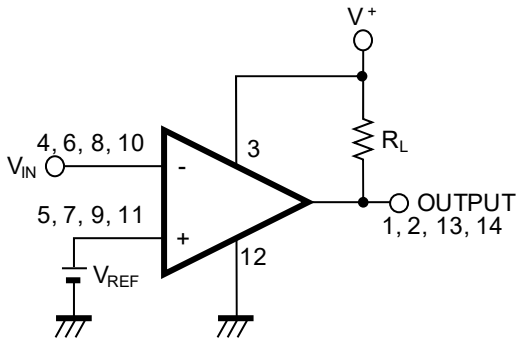
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Input Offset Voltage	V_{IO}		±1	±2.5	mV	V_O = 1.4 V, V_{REF} = 1.4 V, R_S = 0 Ω
Input Offset Current	I_{IO}		±5	±50	nA	V_O = 1.4 V
Input Bias Current Note 6	I_B		20	60	nA	V_O = 1.4 V
Large Signal Voltage Gain	A_V		200000			R_L = 15 kΩ
Circuit Current Note 7	I_{CC}		1.1	1.2	mA	R_L = ∞, I_O = 0 A
Common Mode Input Voltage Range	V_{ICM}	0		V^+ -1.4	V	
Output Saturation Voltage	V_{OL1}			0.2	V	$V_{IN(-)}$ = 1 V, $V_{IN(+)}$ = 0 V, $I_{O\ SINK}$ = 4 mA
Output Sink Current	V_{OL2}			1.5	V	$V_{IN(-)}$ = 1 V, $V_{IN(+)}$ = 0 V, $I_{O\ SINK}$ =10mA
Output Leakage Current	$I_{O\ SINK}$	10	16		mA	$V_{IN(-)}$ = 1 V, $V_{IN(+)}$ = 0 V, V_O ≦ 1.5 V
Common Mode Input Voltage Range	$I_{O\ LEAK}$		0.1	100	nA	$V_{IN(+)}$ = 1 V, $V_{IN(-)}$ = 0 V, V_O = 5 V
Pulse Response Time Note 8			1.6		µs	R_L = 5.1 kΩ, V_{RL} = 5 V

【Note】 6. Direction of the input bias current flowing out of the IC due to first stage of IC consists of PNP transistors In addition, the value of this item is the value when the differential amplifier circuit of the input stage is balanced. It means that twice the current amount will flow to the lower potential terminal.

7. Current flowing through the internal circuit. This current flow regardless of the channel used.

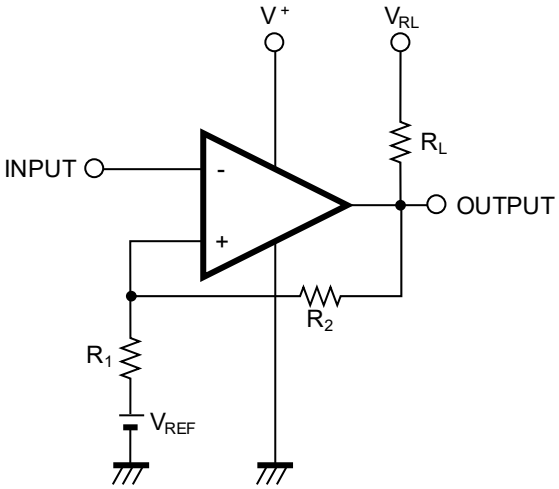
8. Value when the input amplitude is 100mV and the overdrive is 5mV. The response time can be reduces by increasing the overdrive value.

TYPICAL APPLICATION CIRCUIT EXAMPLE



V_{REF} : V^- ~ V^+ -1.5 [V]

Comparator with Hysteresis



- Threshold Voltage

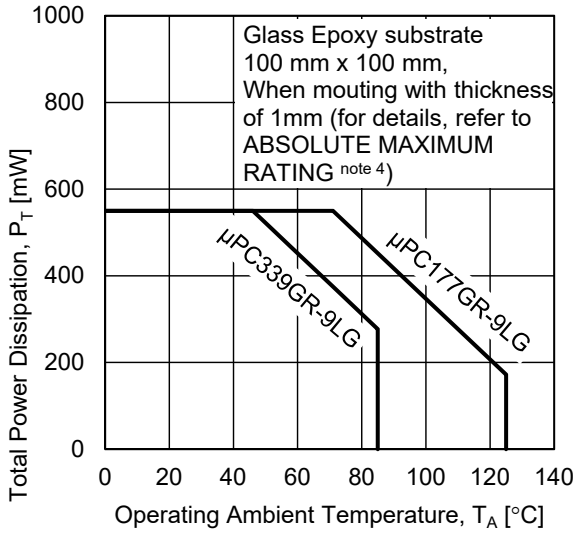
$$V_{TH\ (High)} \fallingdotseq V_{REF} + \frac{R_1}{R_L + R_2 + R_1}(V_{RL} - V_{REF})$$

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

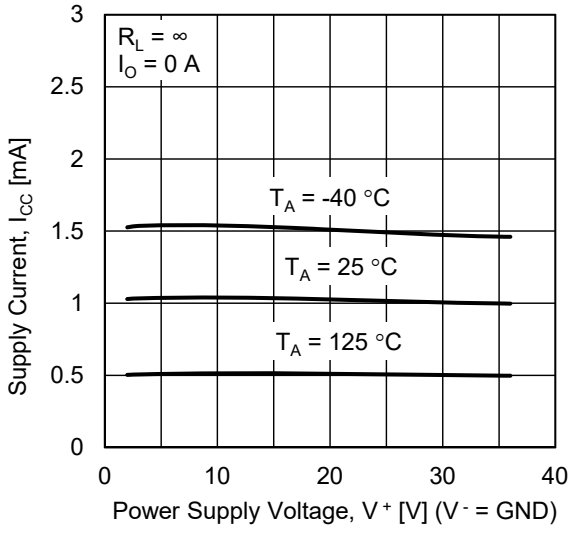
($V_{RL} > V_{REF} > V_{OL}$)

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

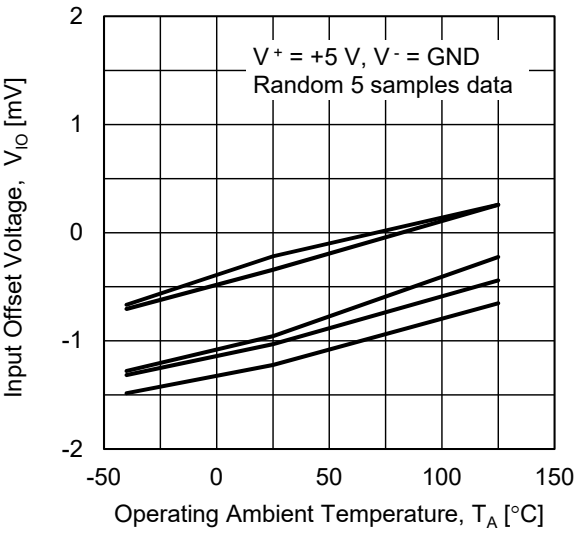
P_T vs. T_A



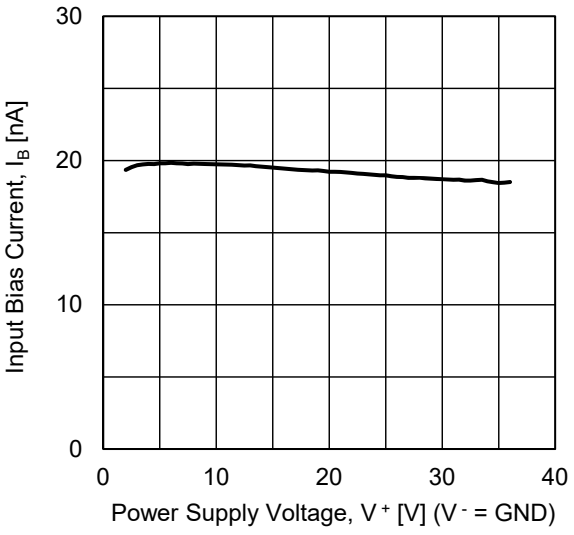
I_{CC} vs. V^+



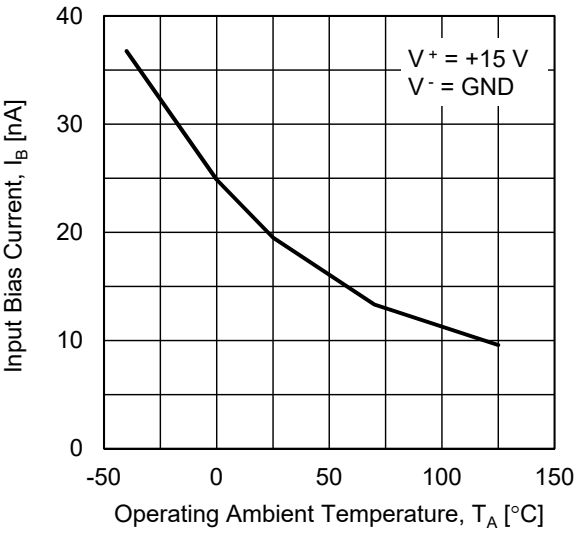
V_{IO} vs. T_A



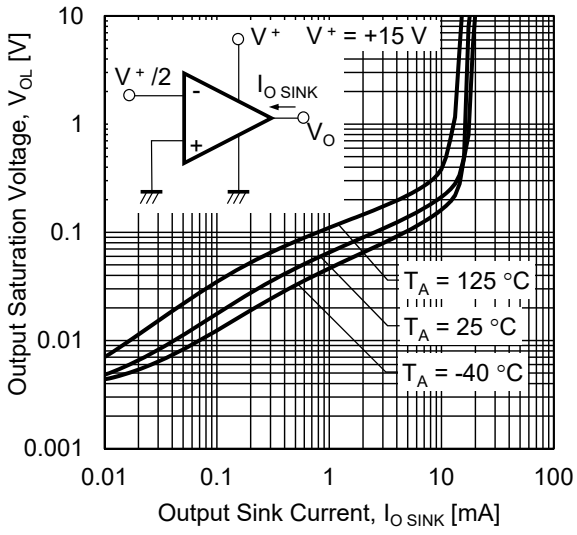
I_B vs. V^+



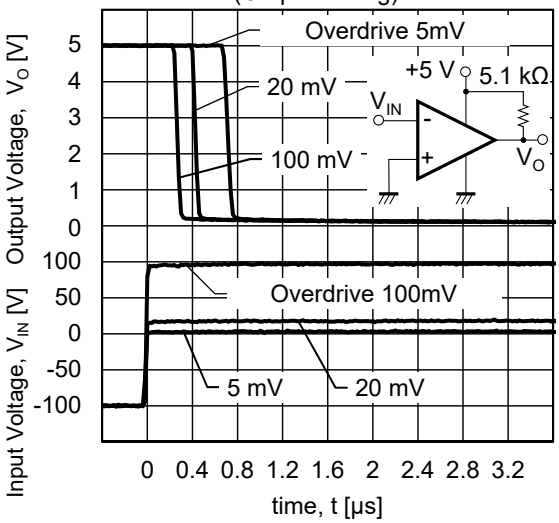
I_B vs. T_A



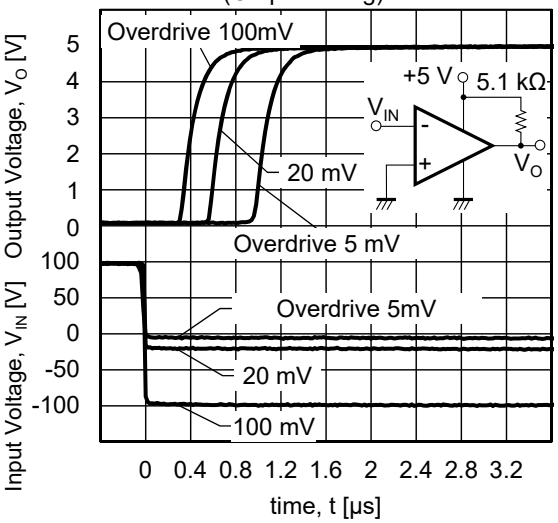
V_{OL} vs. $I_{O\ SINK}$



Pulse Response Characteristics I
(Output Falling)



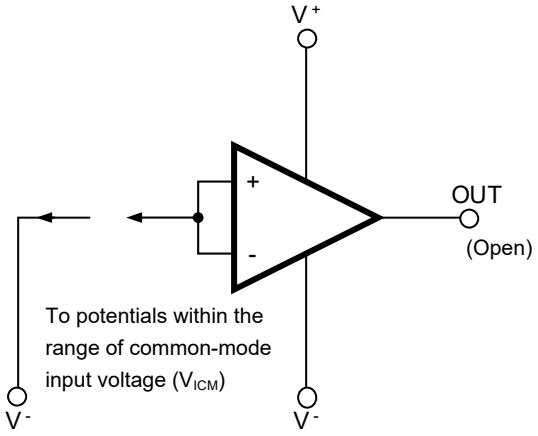
Pulse Response Characteristics
(Output Rising)



USE WITH PRECAUTIONS

- **Managing unused circuits**
  If there is an unused circuit, the following connection is recommended.

Example of unused circuit process



- **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^- ~ V^+ -1.5 [V] (T_A = 25 °C)

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

- **Regarding Input Current**
  The Input Bias Current [I_B] specified in the electrical characteristics table, is the average value of current flowing through the +input terminal [I_N] and the current flowing through the –input terminal [I_I} in the balanced state of the differential amplifier circuit of the input stage (with negative feedback).
  Therefore, since the differential amplifier circuit of the input stage is not balanced during comparison operation (in the case of comparator operation), the input current flows twice as much towards the low potential terminal.

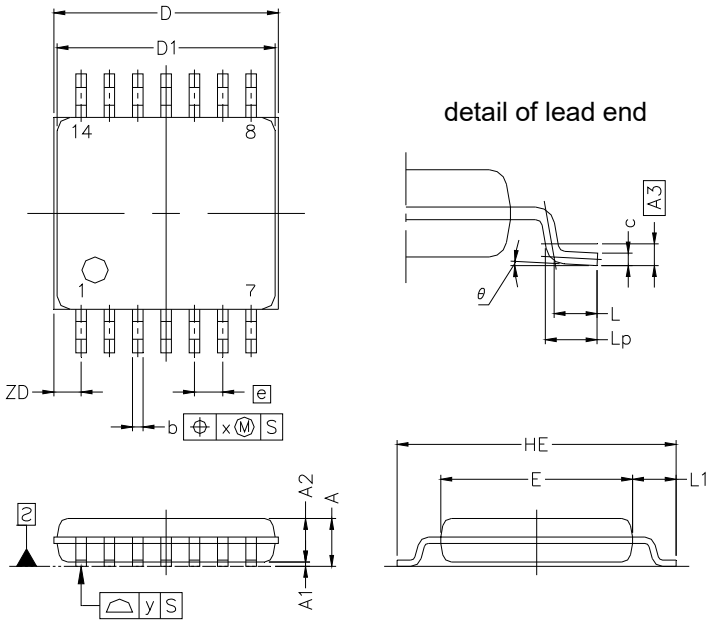
- **Handling of ICs**
  When stress is added to the ICs due to warpage or bending of a board, the characteristic may fluctuates due to piezoelectric (piezo) effect. Therefore, pay attention to warpage or bending of a board.

PACKAGE DRAWINGS

14-PIN PLASTIC TSSOP

JEITA Package code	RENESAS code	Previous code	MASS(TYP.) [g]
P-TSSOP14-0225-0.65	PTSP0014JB-A	P14GR-65-9LG-1	–

Unit : mm



NOTE

Each lead centerline is located within 0.10 mm of its true position at maximum material condition.

ITEM	MILLIMETERS
D	5.15 ±0.15
D1	5.00 ±0.10
E	4.40 ±0.10
HE	6.40 ±0.20
A	1.20 MAX.
A1	0.10 ±0.05
A2	1.00 ±0.05
A3	0.25
b	0.24 +0.06 -0.05
c	0.145 ±0.055
L	0.5
Lp	0.60 ±0.15
L1	1.00 ±0.20
θ	3° +5° -3°
e	0.65
x	0.10
y	0.10
ZD	0.625

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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。
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（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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