

# READ4606G

High Drivability & High Slew Rate, Output Full Range

High Voltage, Low Power Consumption

CMOS Quad Operational Amplifier

## Description

The READ4606G is quad CMOS Operational Amplifier, which is the features the same performance as the Bipolar products (UPC844) about the voltage resistance (power supply voltage: 36V Max.) and high slew rate (8V/μs Typ.). This IC is the output full-range product with greatly reduced power consumption and input bias current compared to bipolar products.

## Features

- Output full range (Rail-to-Rail output)
- Absolute Maximum Ratings
  - Power Supply Voltage
  - Operating Ambient Temperature Range
- Electrical Characteristics
  - Power Supply Voltage
  - Input Offset Voltage
  - Input Bias Current
  - Supply current (per channel)
  - Slew Rate

$V_{DD} = -0.3$  to  $+36V$

$T_A = -40$  to  $+125\text{ }^{\circ}C$

$V_{DD} = +4.5V$  to  $+32V$

$V_{IO} \leq \pm 9mV$

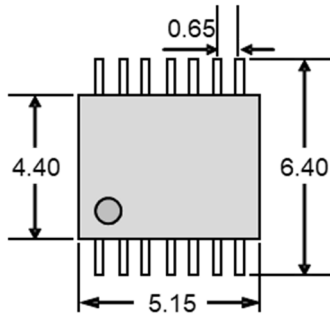
$I_B \leq (1pA)$

$I_{DD} = 0.7\text{ mA Typ.}, 1.0\text{ mA Max. (@}V_{DD}=5.0V)$

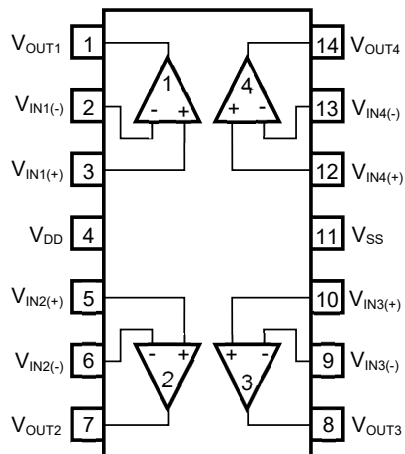
$SR = 8\text{ V}/\mu s\text{ Typ.}$

( ) reference value of design

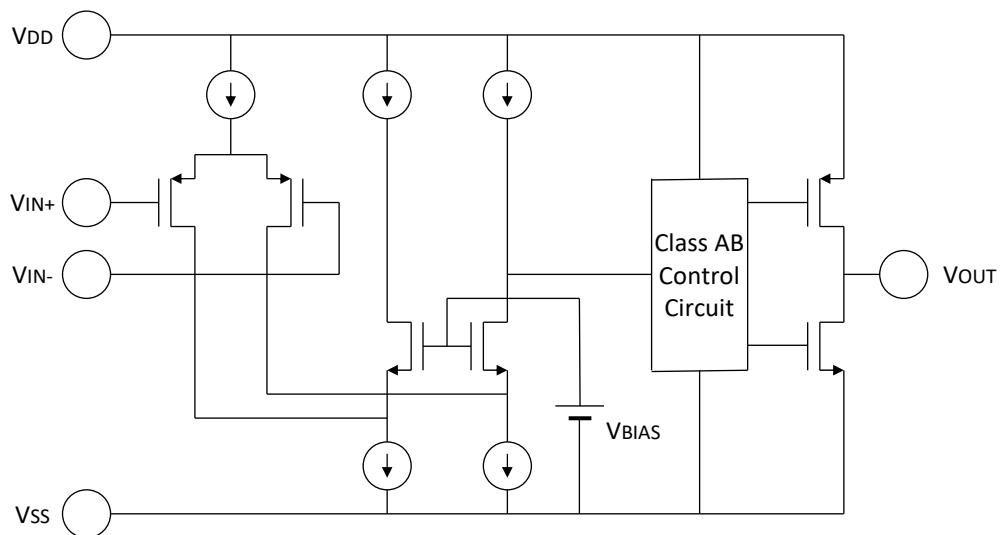
## Product Line-up

Package	TSSOP
Product Name	READ4606GSP#GC0
Quality Level	Normal Quality Level
Outline	<div style="text-align: right;">Unit : mm</div> 

## Pin Arrangement



## Equivalent Circuit (per one channel)



## Absolute Maximum Ratings

<T<sub>A</sub>=25°C>

Items	Symbol	Ratings	Unit
Supply voltage <sup>Note.1</sup>	V <sub>DD</sub>	-0.3 to +36	V
Differential input voltage	V <sub>ID</sub>	±2	V
Input voltage <sup>Note.2</sup>	V <sub>I</sub>	V <sub>SS</sub> -0.3 to V <sub>DD</sub> +0.3	V
Maximum output current	I <sub>O</sub>	20	mA
Power dissipation <sup>Note.3</sup>	P <sub>T</sub>	550	mW
Junction temperature	T <sub>J</sub>	-40 to +150	°C
Operating temp. range	T <sub>A</sub>	-40 to +125	°C
Storage temp. range	T <sub>stg</sub>	-55 to +150	°C

Note 1. Please take note that reverse connection of a power supply may cause destruction.

2. Stresses above these ratings may cause permanent damage such as characteristics degradation or destruction. Please do not exceed voltage below of V<sub>SS</sub> (GND)-0.3V as it is bottom limit. In addition, operation amplifier is operated as normal when input voltage for electrical characteristics is in common mode input voltage range.

3. The value is measured under mounted on a glass epoxy base board (size 100mm x 100mm, 1mm thickness, copper foiled surface base board area with 15% solid pattern).

Note that restrictions will be made to the following conditions for each product, and the derating ratio depending on the operating ambient temperature.

READ4606GSP: Derate at -7.0 mW/°C when T<sub>A</sub> > 71 °C

(Junction – ambient thermal resistance R<sub>th(J-A)</sub> = 144 °C/W)

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Power Supply Voltage (V <sub>SS</sub> = GND)	V <sub>DD</sub>	+4.5		+32	V
Power Supply Voltage (Dual Supply)	V <sub>DD</sub> – V <sub>SS</sub>	±2.25		±16	V

## Electrical Characteristics

<  $T_A=25^{\circ}\text{C}$ ,  $V_{DD}=5.0\text{V}$ ,  $V_{SS}=\text{GND}$  >

Items	Symbol	MIN.	TYP.	MAX.	Unit	Test Condition
Input offset voltage	$V_{IO}$		$\pm 3$	$\pm 9$	mV	
Input offset current	$I_{IO}$			$(\pm 1)$	pA	
Input bias current	$I_B$			$(\pm 1)$	pA	
Output high voltage	$V_{OH}$	$V_{DD}-0.3$			V	$I_L = 10\text{mA}$
Output low voltage	$V_{OL}$			$V_{SS}+0.3$	V	$I_L = 10\text{mA}$
Voltage gain	$A_V$	60	90		dB	$R_L \geq 100\text{k}\Omega$
Channel supply current	$I_{DD}/ch$		0.7	1.0	mA	$R_L = \infty$ , $I_O = 0$
Common mode rejection ratio	CMRR	60	80		dB	
Supply voltage rejection ratio	SVRR	60	80		dB	
Common mode input voltage range	$V_{ICM}$	$V_{SS}$		$V_{DD}-2$	V	
Gain bandwidth product	GBW		6		MHz	$C_L = 20\text{pF}$
Slew rate	SR		8		V/ $\mu\text{s}$	$C_L = 20\text{pF}$
Channel Separation			80		dB	$f = 20\text{ Hz to } 20\text{ kHz}$

<  $T_A=25^{\circ}\text{C}$ ,  $V_{DD,SS}=\pm 15\text{ V}$  >

Items	Symbol	MIN.	TYP.	MAX.	Unit	Test Condition
Input offset voltage	$V_{IO}$		$\pm 3$	$\pm 12$	mV	
Input offset current	$I_{IO}$			$(\pm 1)$	pA	
Input bias current	$I_B$			$(\pm 1)$	pA	
Output high voltage	$V_{OH}$	$V_{DD}-0.3$			V	$I_L = 10\text{mA}$
Output low voltage	$V_{OL}$			$V_{SS}+0.3$	V	$I_L = 10\text{mA}$
Voltage gain	$A_V$	60	90		dB	$R_L \geq 100\text{k}\Omega$
Channel supply current	$I_{DD}/ch$		0.7	1.0	mA	$R_L = \infty$ , $I_O = 0$
Common mode rejection ratio	CMRR	55	80		dB	
Supply voltage rejection ratio	SVRR	60	80		dB	
Common mode input voltage range	$V_{ICM}$	$V_{SS}$		$V_{DD}-2$	V	
Gain bandwidth product	GBW		6		MHz	$C_L = 20\text{pF}$
Slew rate	SR		8		V/ $\mu\text{s}$	$C_L = 20\text{pF}$
Channel Separation			80		dB	$f = 20\text{ Hz to } 20\text{ kHz}$

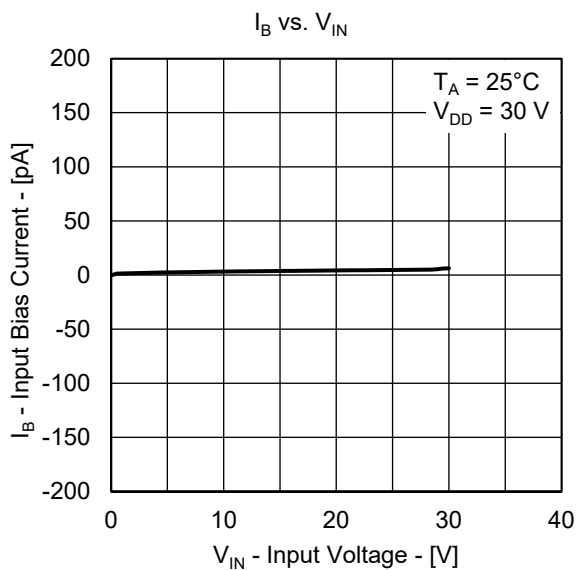
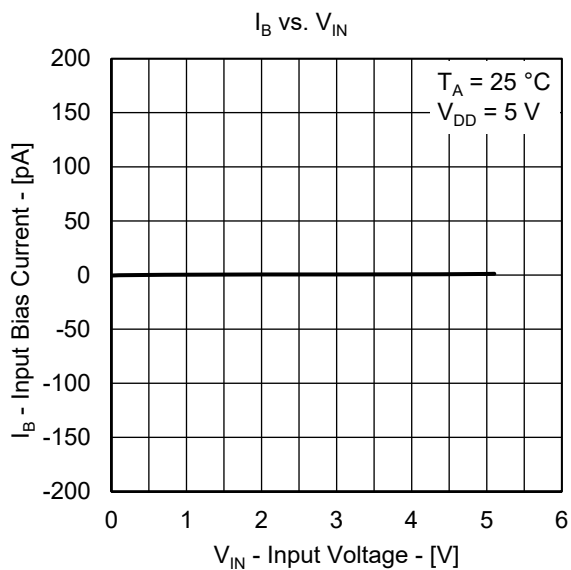
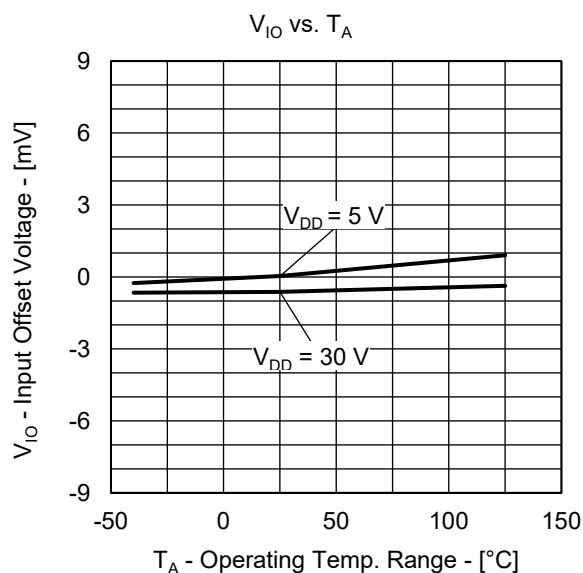
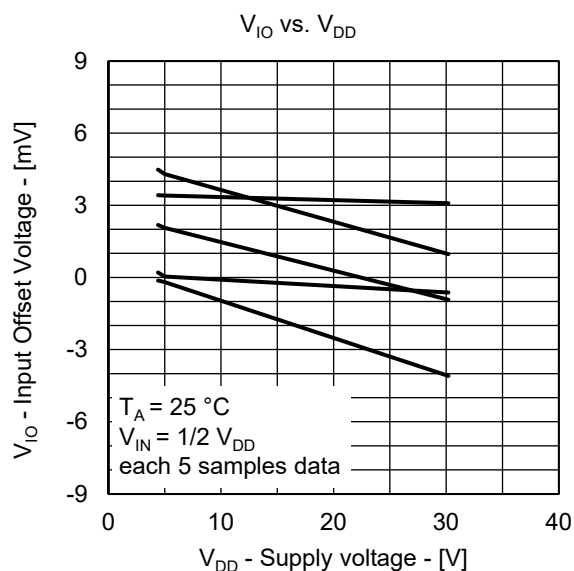
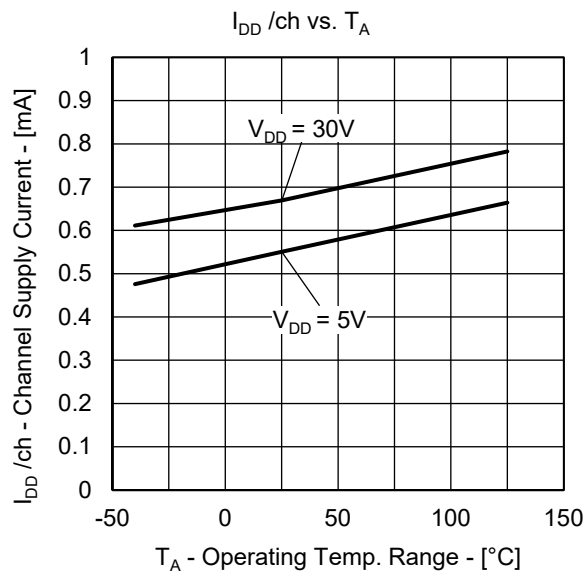
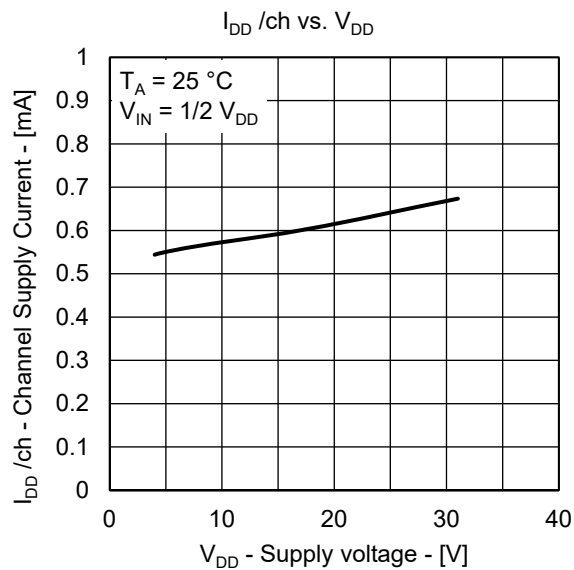
( ) reference value of design

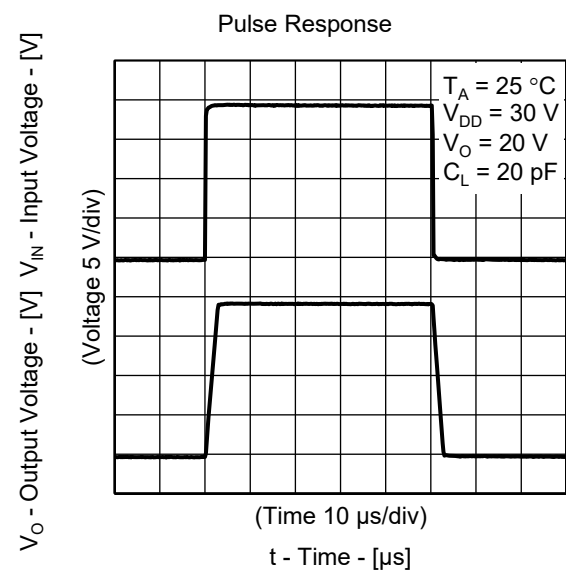
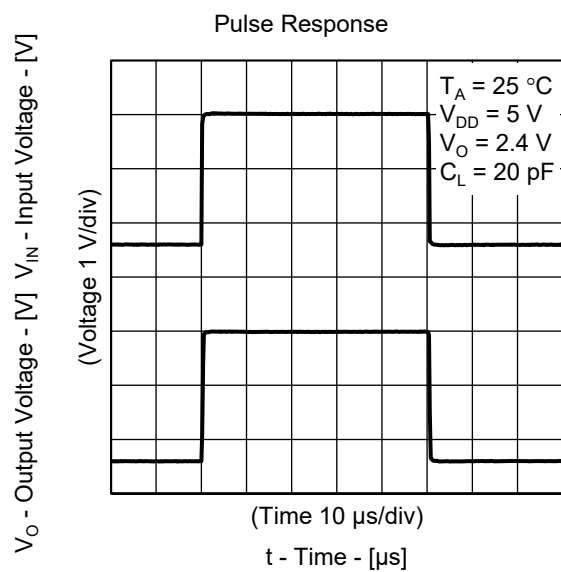
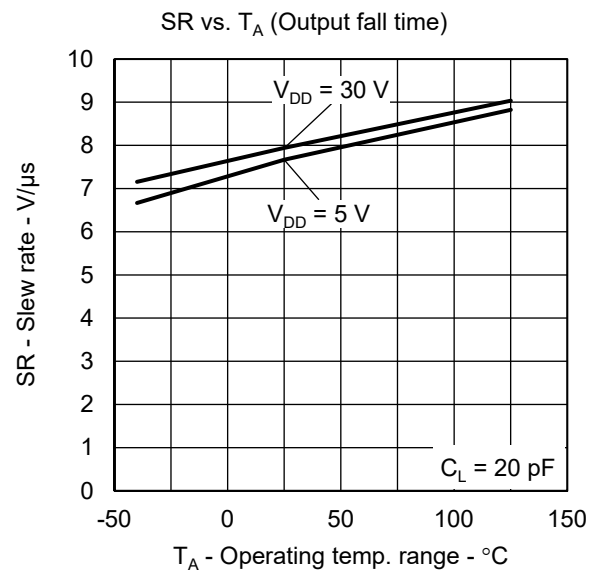
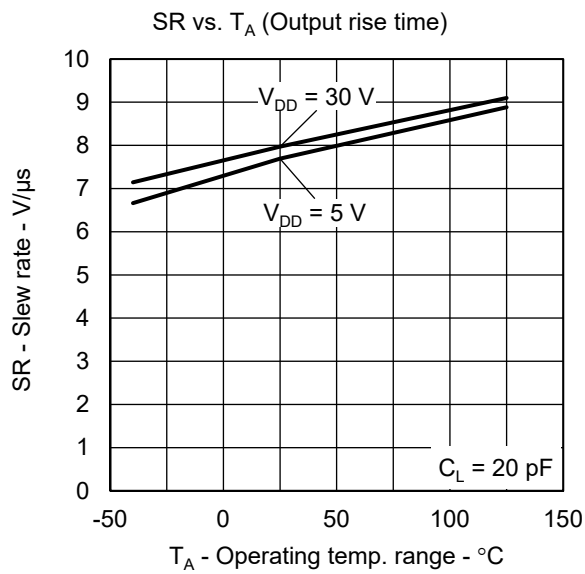
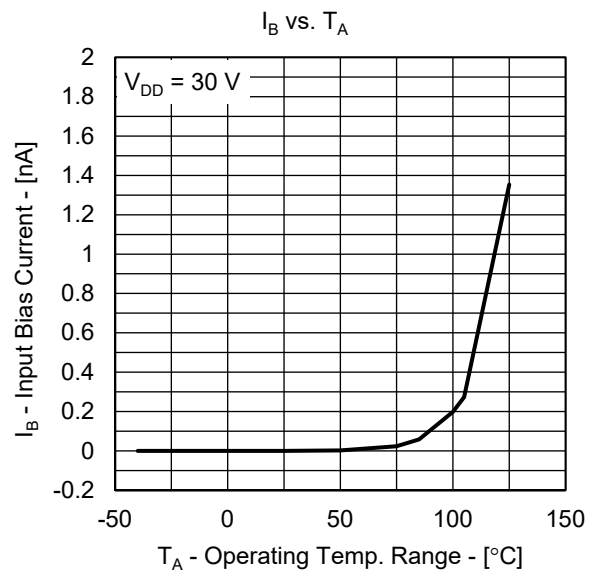
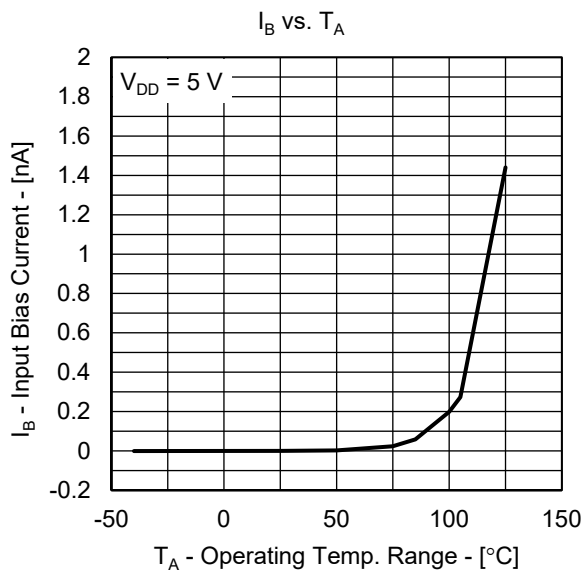
## Notes

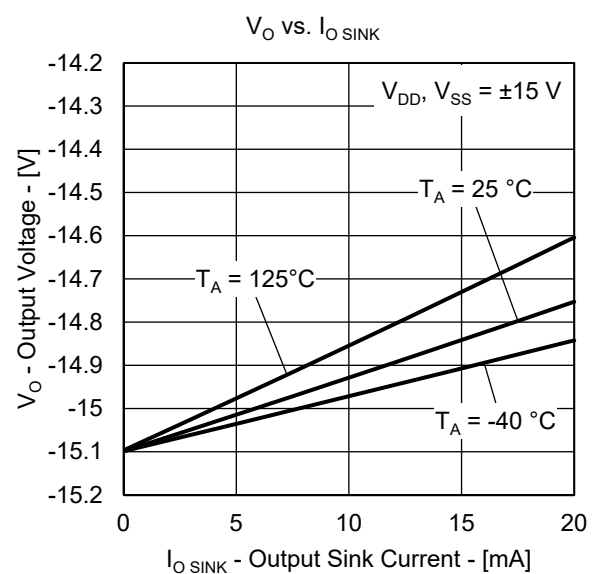
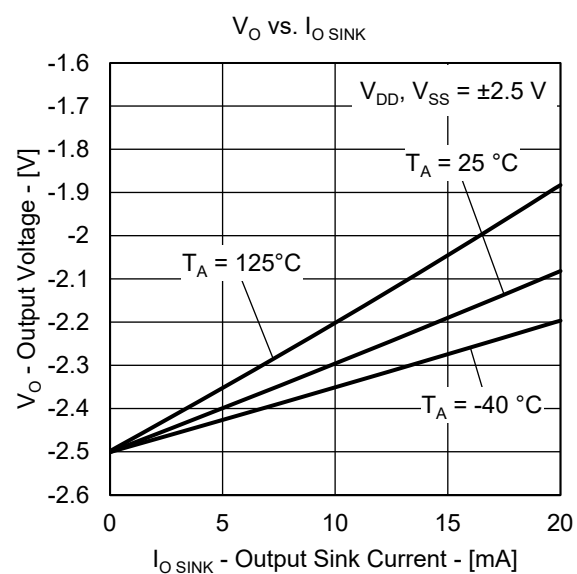
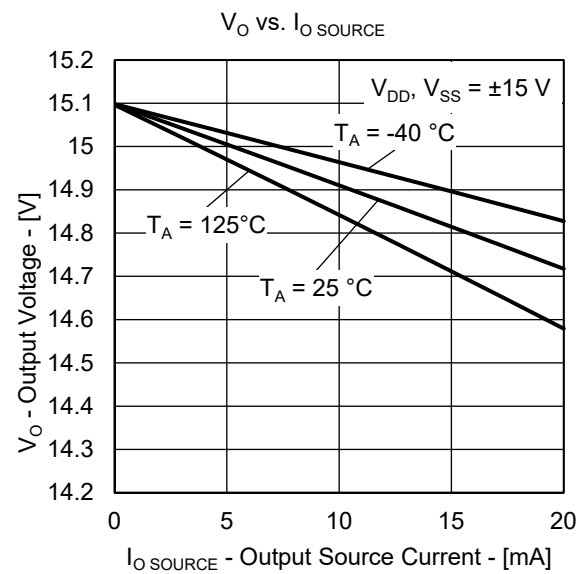
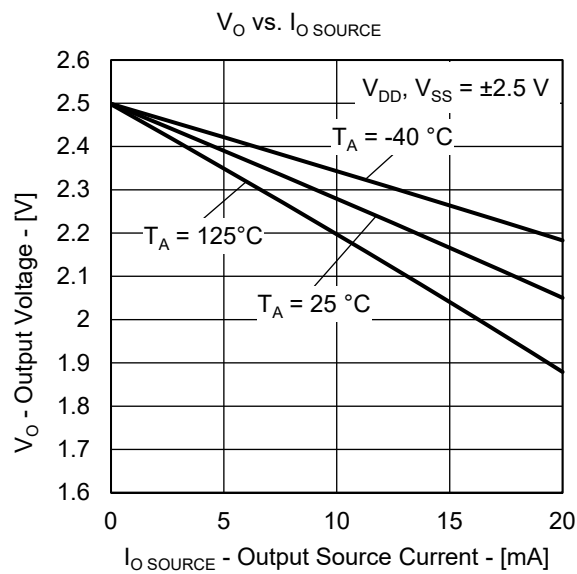
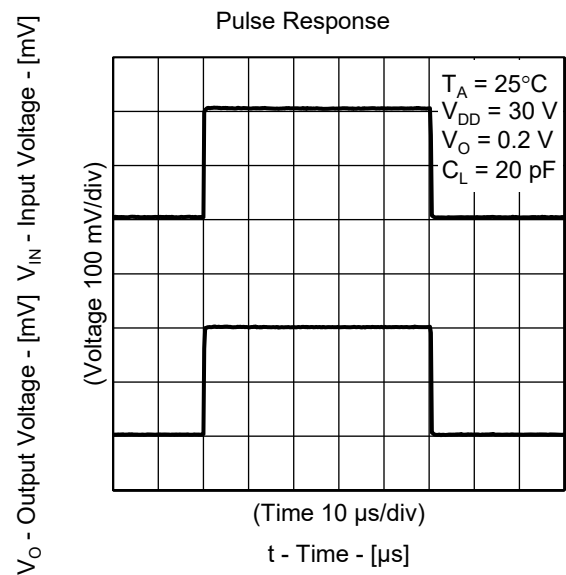
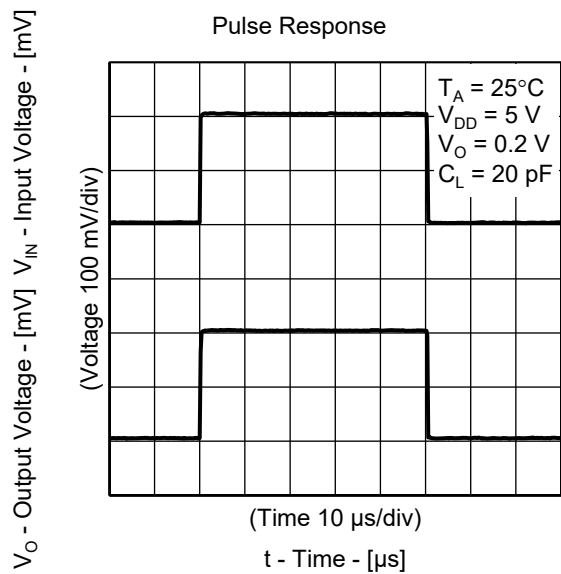
Output terminal: The over-current protection feature is not built in the output terminal of this product. Therefore, if the output is short circuit (from output to  $V_{DD}$  or from output to  $V_{SS}$ ) or the forward clamp circuit using the diode at the output pin, the excessive output current may flow. Please insert the series resistor in the output pin to limit the current.

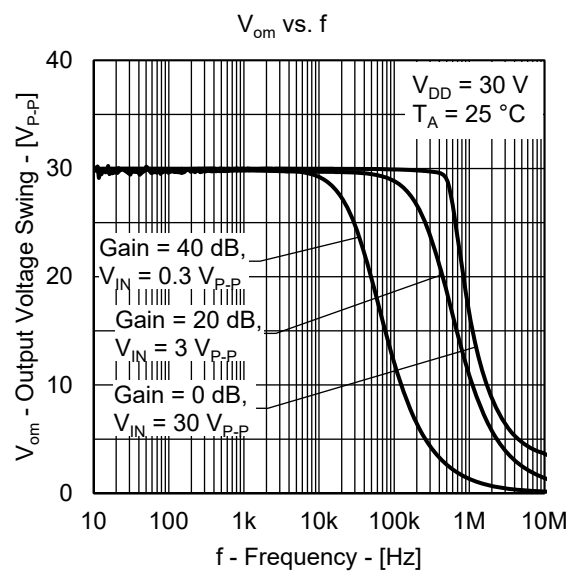
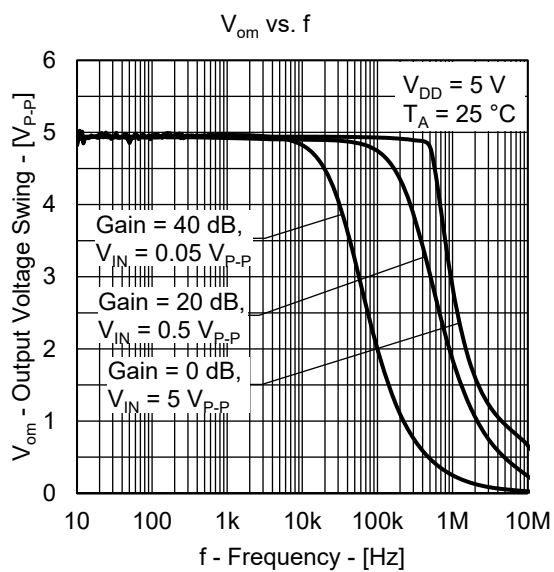
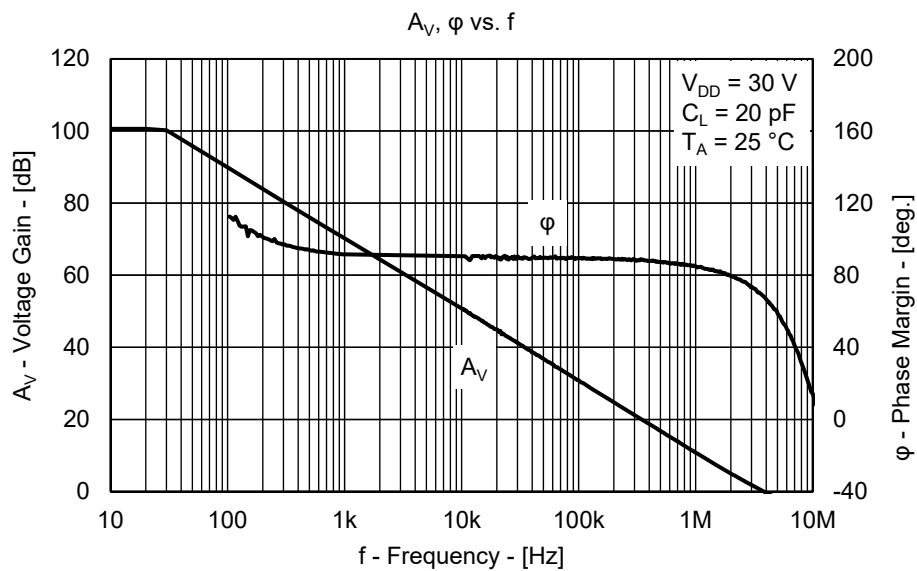
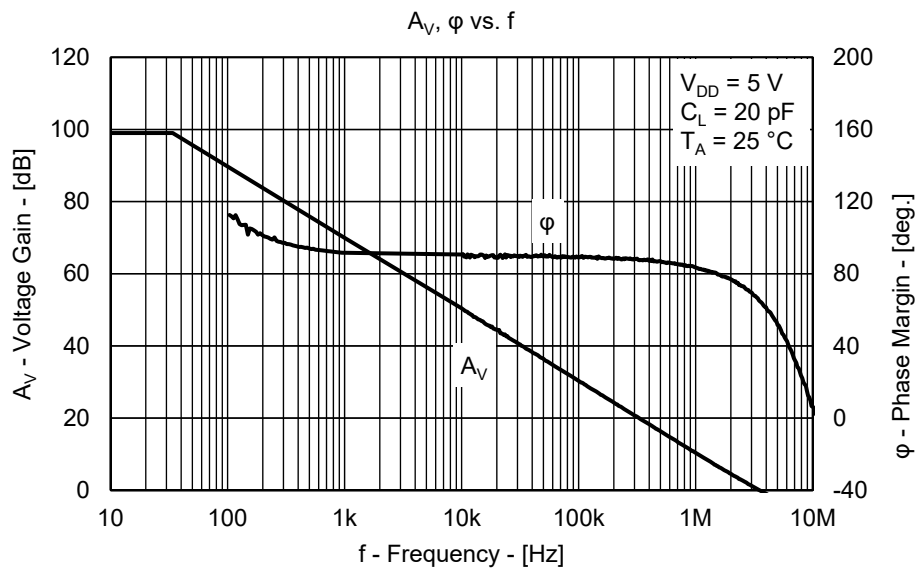
Application circuit: Please keep  $V_{ID}$  within  $\pm 2\text{V}$  during stationary operation and design the closed-loop operation composed feedback system: Voltage Follower, Inverting Amplifier and Non-inverting Amplifier.

## Characteristics Curve ( $T_A = 25\text{ }^{\circ}\text{C}$ ) (Reference Value)

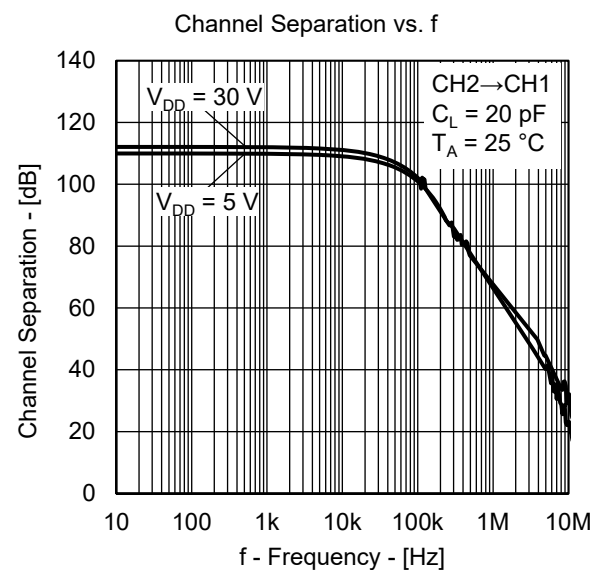
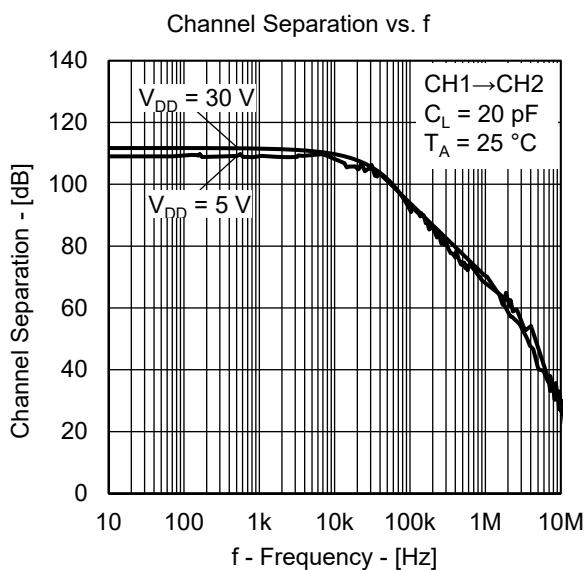
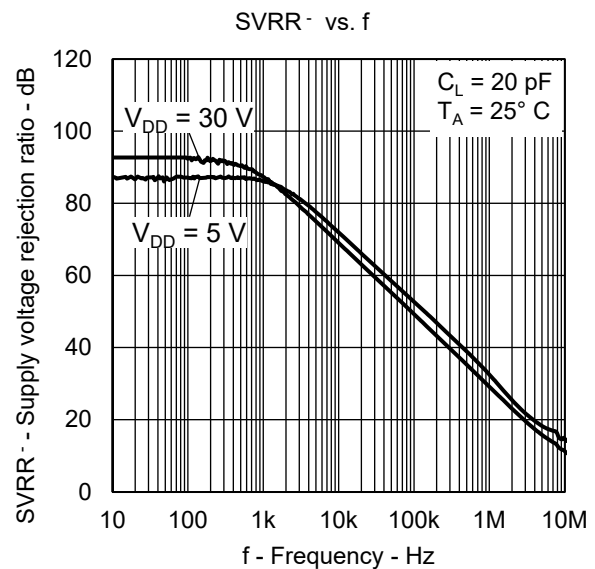
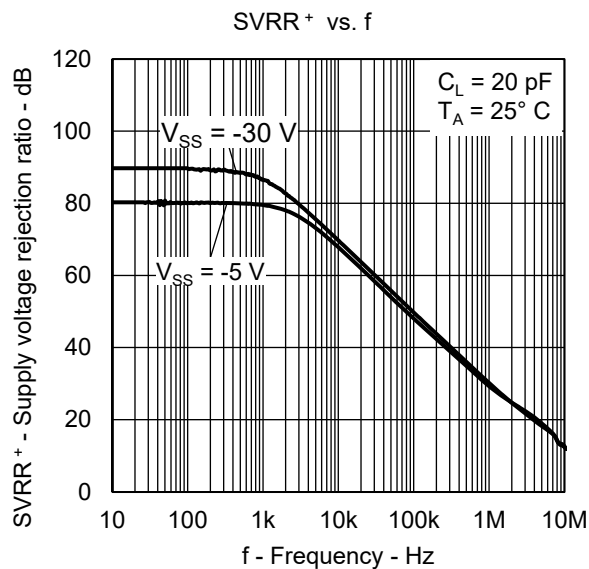
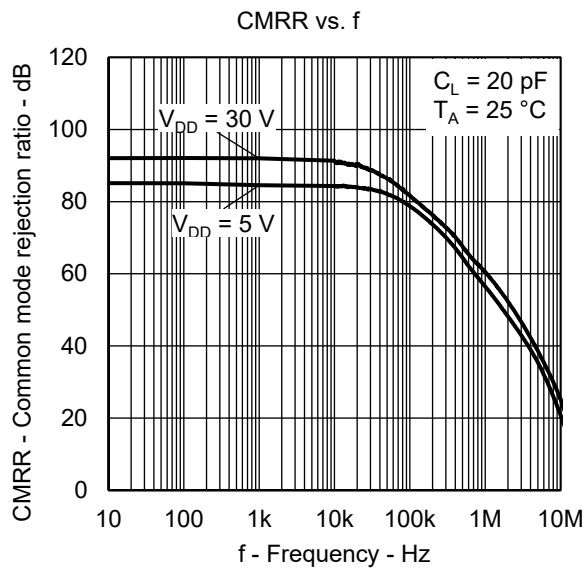


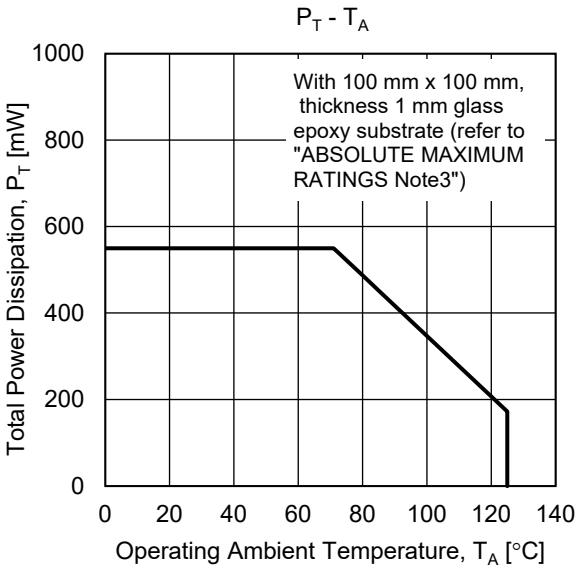










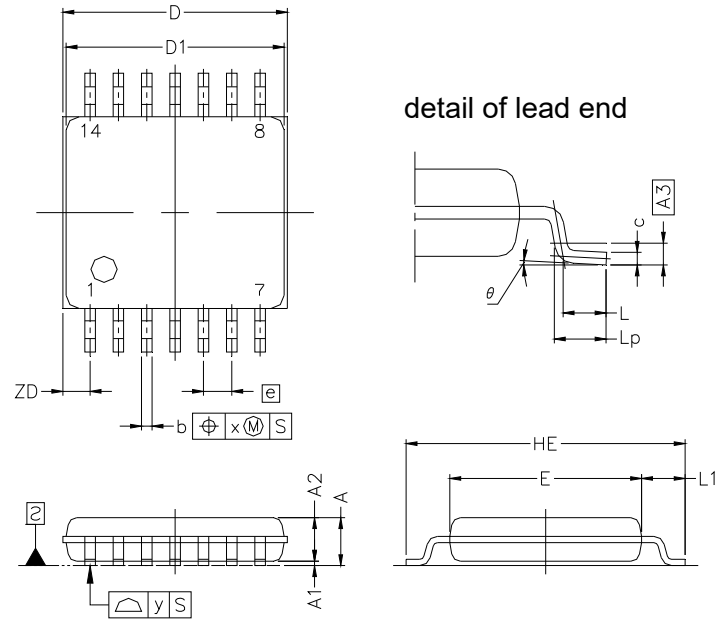


Package Dimensions

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 <sup>+0.06</sup> <sub>-0.05</sub>
c	0.145 ±0.055
L	0.5
Lp	0.60 ±0.15
L1	1.00 ±0.20
θ	3° <sup>+5°</sup> <sub>-3°</sub>
e	0.65
x	0.10
y	0.10
ZD	0.625

## Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
6. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.

7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION ("Vulnerability Issues"). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
8. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.5.0-1 October 2020)

## Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

## Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

## Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:  
[www.renesas.com/contact/](http://www.renesas.com/contact/)