

D2-4P

Layout Guidelines

Abstract

The D2-4P ([D2-45057](#) and [D2-45157](#)) IC devices are complete Class-D digital audio amplifiers combining integrated power stages with a PWM controller and DSP audio processing. These devices provide a flexible and efficient single-chip audio amplifier solution.

Performance of audio amplifier systems is typically dependent upon circuit layout. This application note provides guidelines and layout recommendations for successful D2-4P based system designs.

Contents

1. Design Goals Include	2
1.1 Figure References	2
2. Layout Recommendations	4
2.1 Component Placement Priority	4
3. Revision History	8

List of Figures

Figure 1. Simplified Schematic of Layout Example	3
Figure 2. PCB Layout Example - Ground Connections to Thermal Pad	5
Figure 3. PCB Layout Example - Decoupling Capacitor Placements	6
Figure 4. PCB Layout Example - Output Traces, Components	7
Figure 5. PCB Layout Example - Power Traces	8

Related Literature

For a full list of related documents, visit our website:

- [D2-45057](#), [D2-45157](#) device pages

1. Overview

1.1 Design Goals

- Optimize amplifier output performance
 - Maximize efficiency by circuit trace routing
 - Minimize noise and interference
- Optimize thermal performance
 - Best use of PC board and layout to dissipate heat
- Optimize EMI performance
 - Effective bypassing to minimize interferences
- Minimize PC board complexity and cost

1.2 Figure References

The figures in this document include a simplified schematic ([Figure 1 on page 3](#)) showing the significant power bypass capacitors and related connections and components. [Figures 2](#) through [5](#) starting on [page 5](#), show examples for PCB layout (top view).

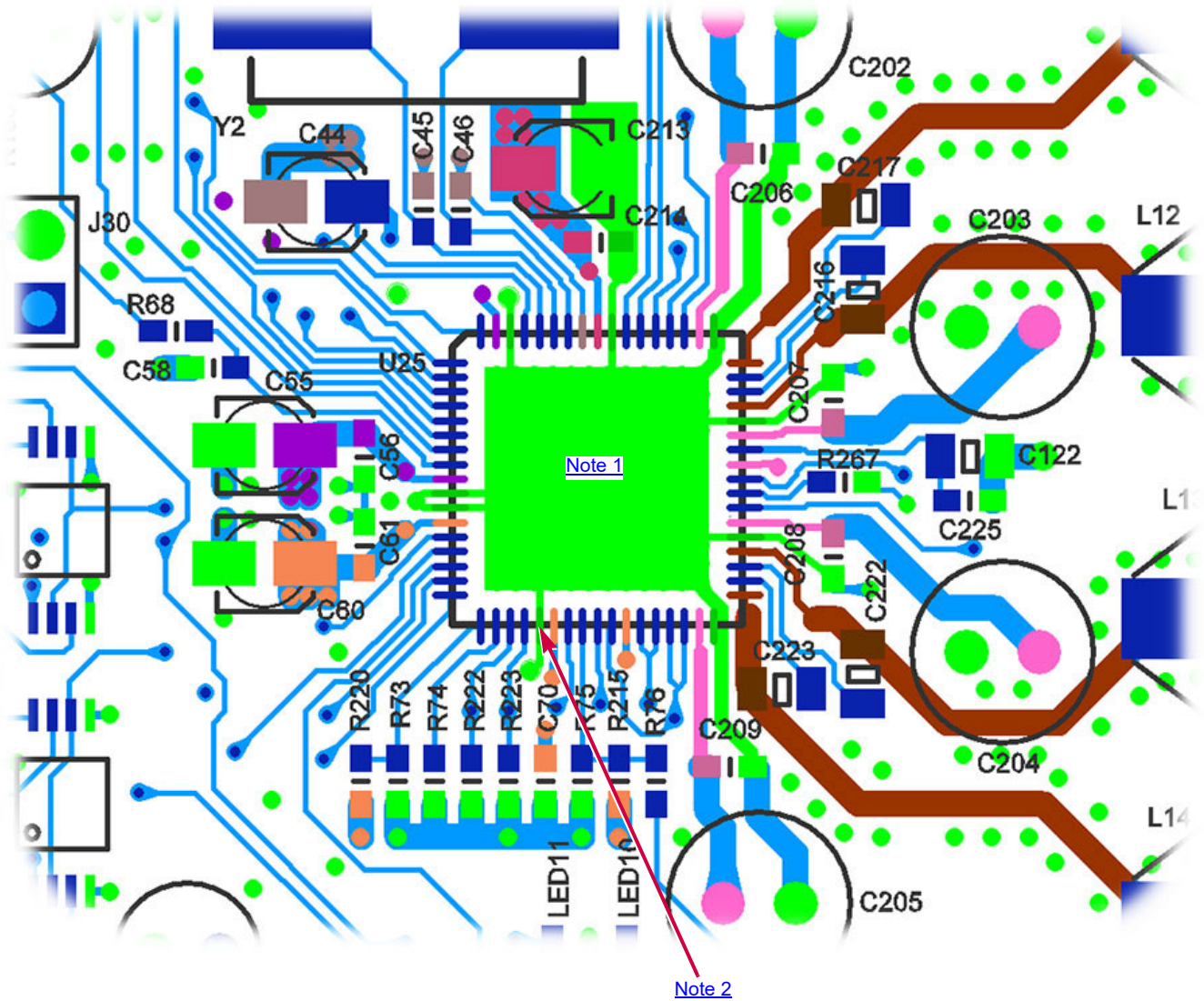
2. Layout Recommendations

- Tie the I_{REF} resistor connected to Pin 43 directly to the thermal pad ground to avoid noise pickup. I_{REF} is sensitive to noise, so route its connections as short and direct as possible, and do not connect near any HGND ground connections.
- Low voltage signals and power should follow standard design practices, avoid routing or component placement close to the HVDD, HGND, or output circuits.
- When routing ground connections on both top and bottom of the PCB, use as many “stitching” vias as possible to minimize connection impedance, and to maximize the connected surface area.
- Heat dissipation is improved by filling PCB space with as much copper as possible. The PCB provides the heat dissipation path, but heavier copper plating and higher copper surface area helps to improve thermal performance. Minimize the amount of circuit traces on the bottom-side PCB layer within the immediate area below the D2-4P, to allow as much contiguous copper area as possible to aid in dissipating heat from that area.
- Wherever it is practical and acceptable within circuit connection limitations, use additional vias to tie the top layer to the bottom copper layers, further aiding heat dissipation. Typically an application supports adding at least 20 to 30 vias to help spread heat from top to bottom of the PCB.
- Avoid using vias crossing from top to bottom of any power traces located between bypass components and D2-4P pins. While via use may help in thermal dissipation, their use in power and ground connection circuits is not as optimum for minimizing conductor path impedances.

2.1 Component Placement Priority

Ideally, mount all components as close as possible to the D2-4P device, but physical space requirements can limit placement options. The priority of components to be placed closest to the device is:

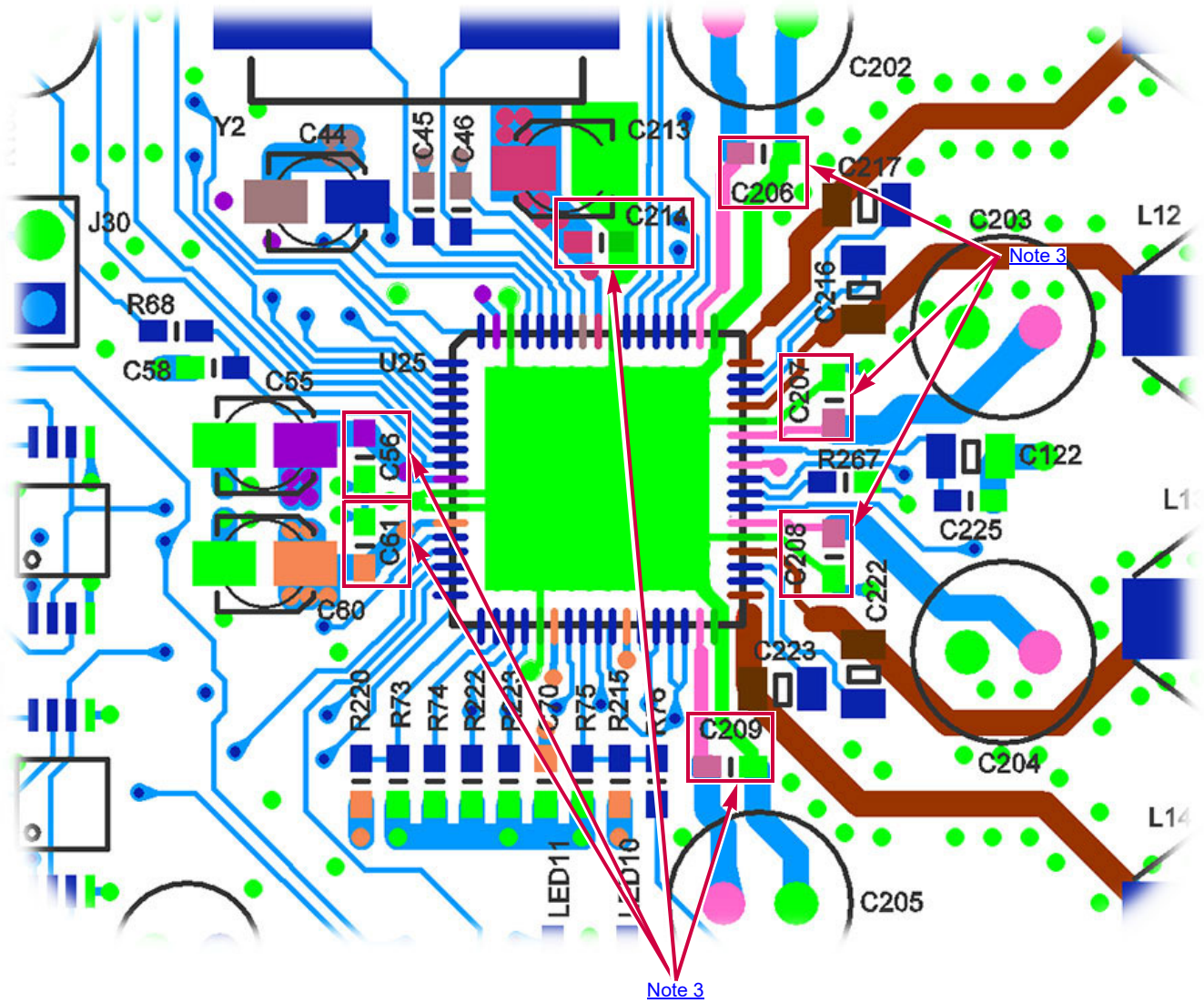
1. Power supply 0.1 μ F decoupling capacitors (low voltage and high voltage supplies). This maximizes efficiency of power conditioning to the device, reduces noise, and minimizes the exposure that can contribute to EMI. These capacitors perform high-frequency bypassing, and to maximize that capability, close placement minimizes high-frequency impedance from interconnecting PCB traces.
2. Output 0.22 μ F bootstrap capacitors.
3. Power supply filter capacitors.
4. Mount other components on either the top or bottom of the PCB as close as possible to the D2-4P.



Notes:

1. The D2-4P package includes a thermal pad on its bottom side that is internally connected within the device to its ground connections. The printed circuit board should provide this thermal pad on the top layer of the PCB, and use it as one of the ground connections to the D2-4P. The PCB copper is used to dissipate heat away from the D2-4P device, but is also a circuit ground.
2. Connect all ground pins (nine places) of the D2-4P directly to this thermal ground pad on the PC board.

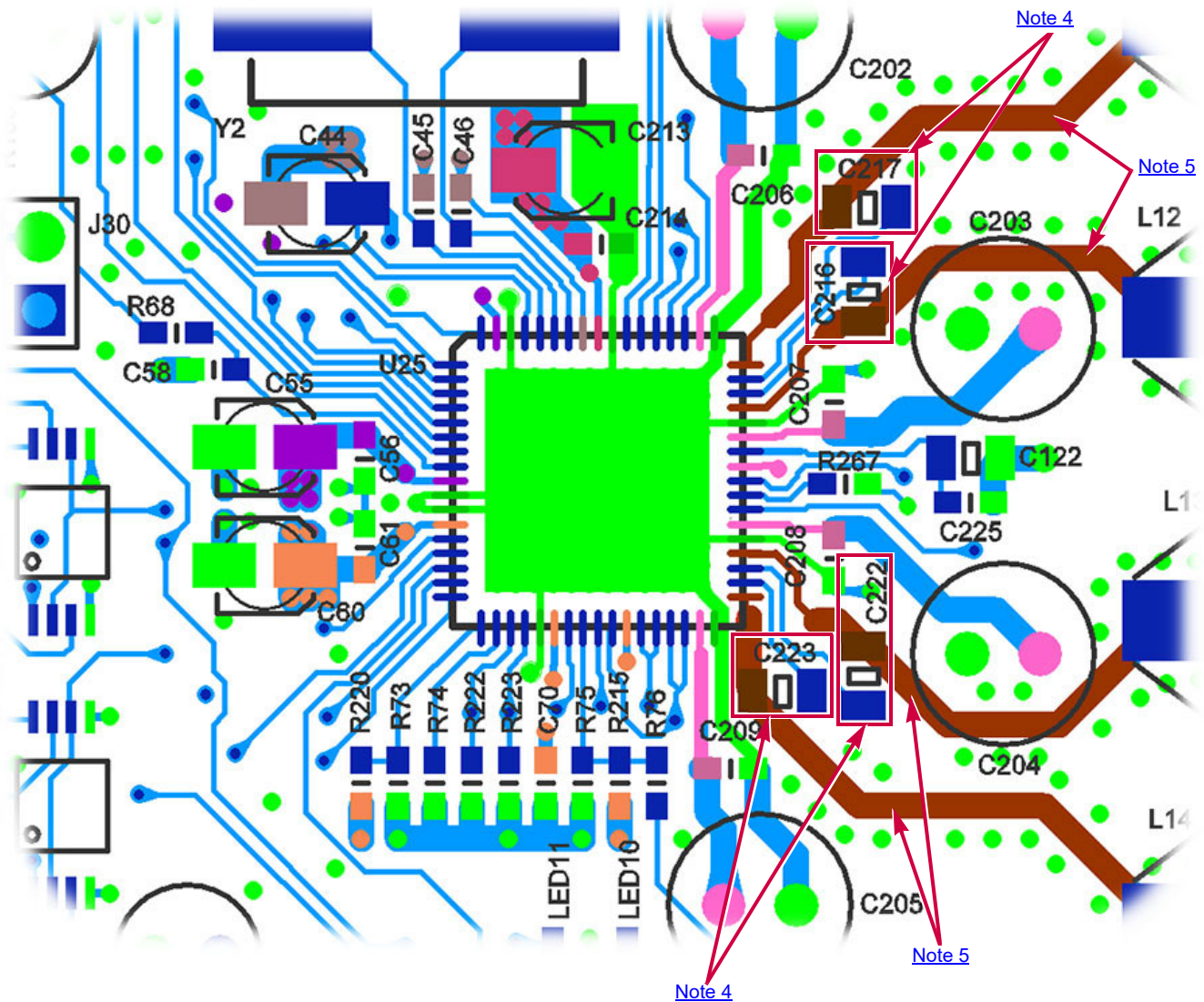
Figure 2. PCB Layout Example - Ground Connections to Thermal Pad



Note:

3. Mount all decoupling capacitors on the top side of the PCB. Route all power and ground connections between the D2-4P and the bypass capacitors on the top side.

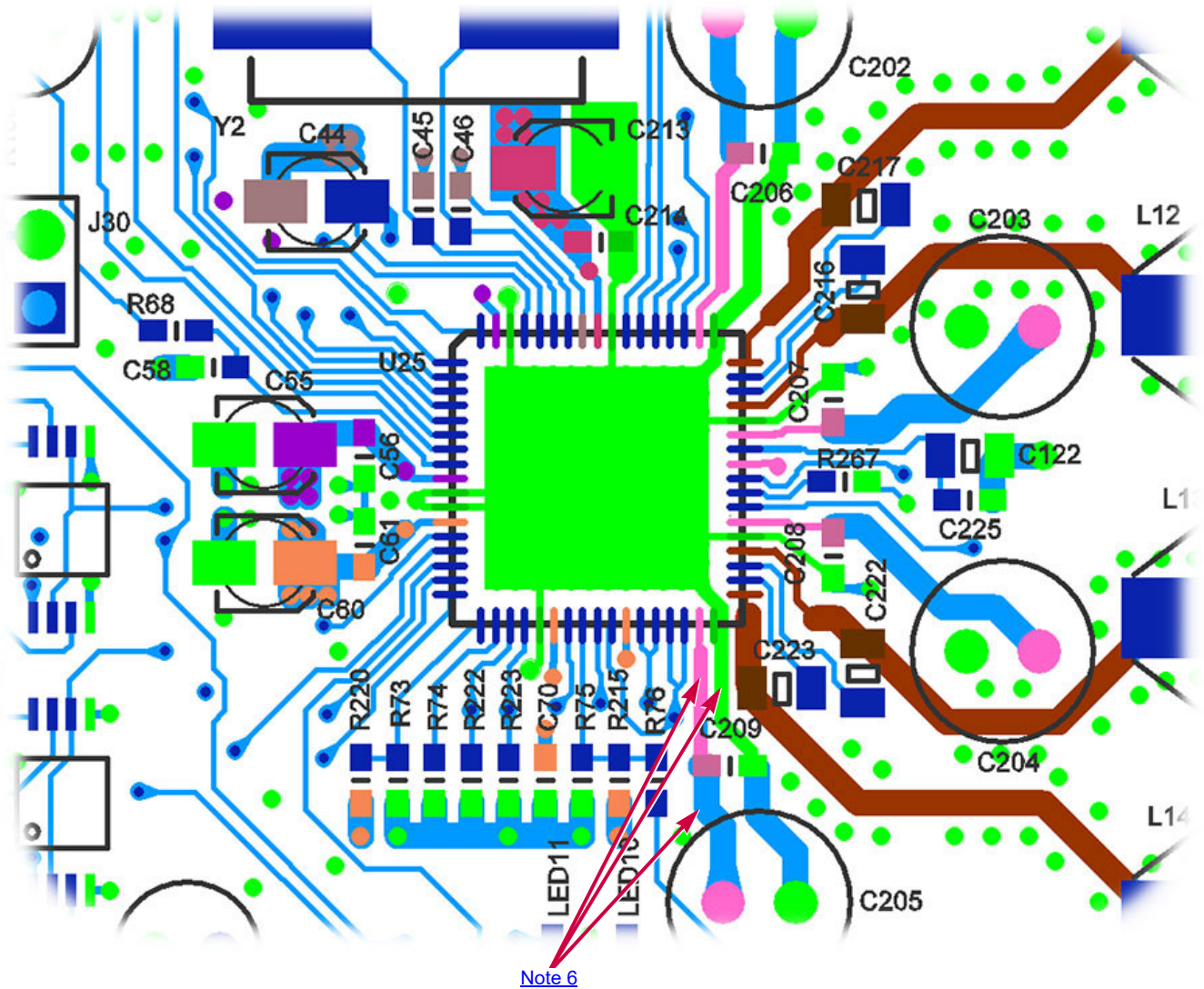
Figure 3. PCB Layout Example - Decoupling Capacitor Placements



Notes:

4. Mount the bootstrap capacitors on the top side of the PCB, as close as possible between the device bootstrap pins and the output pins. Route their connections directly on the top side of the PCB and avoid crossing from the top to bottom layers.
5. For power stage output traces, use large as possible trace sizes, and route traces as short and direct as possible.

Figure 4. PCB Layout Example - Output Traces, Components



Note:
 6. For HVDD supply power and HGND ground connections, use trace sizes as large as possible, and route traces as short and direct as possible.

Figure 5. PCB Layout Example - Power Traces

3. Revision History

Rev.	Date	Description
1.00	May.24.19	Initial release

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 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.
5. 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.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. 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.4.0-1 November 2017)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

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/

Trademarks

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