

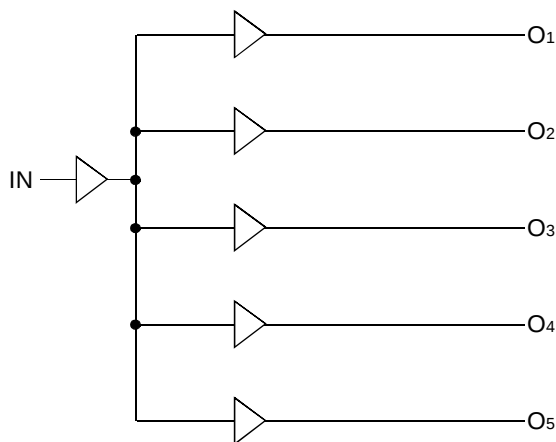
## FEATURES:

- Advanced CMOS Technology
- Guaranteed low skew < 100ps (max.)
- Very low duty cycle distortion < 250ps (max.)
- High speed propagation delay < 3ns (max.)
- Very low CMOS power levels
- TTL compatible inputs and outputs
- 1:5 fanout
- Maximum output rise and fall time < 1.5ns (max.)
- Low input capacitance: 3pF typical
- $V_{CC} = 3.3V \pm 0.3V$
- Inputs can be driven from 3.3V or 5V components
- Operating frequency up to 166MHz
- Available in SOIC package

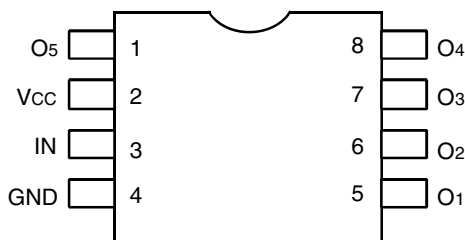
## DESCRIPTION:

The FCT38075 is a 3.3V clock driver built using advanced CMOS technology. This low skew clock driver offers 1:5 fanout. The large fanout from a single input reduces loading on the preceding driver and provides an efficient clock distribution network. Multiple power and grounds reduce noise. Typical applications are clock and signal distribution.

## FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION



SOIC  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol           | Description                | Max                          | Unit |
|------------------|----------------------------|------------------------------|------|
| V <sub>CC</sub>  | Input Power Supply Voltage | −0.5 to +4.6                 | V    |
| V <sub>I</sub>   | Input Voltage              | −0.5 to +5.5                 | V    |
| V <sub>O</sub>   | Output Voltage             | −0.5 to V <sub>CC</sub> +0.5 | V    |
| T <sub>J</sub>   | Junction Temperature       | 150                          | °C   |
| T <sub>STG</sub> | Storage Temperature        | −65 to +165                  | °C   |

### NOTE:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## CAPACITANCE (T<sub>A</sub> = +25°C, f = 1.0MHz)

| Symbol           | Parameter <sup>(1)</sup> | Conditions            | Typ. | Max. | Unit |
|------------------|--------------------------|-----------------------|------|------|------|
| C <sub>IN</sub>  | Input Capacitance        | V <sub>IN</sub> = 0V  | 3    | 4    | pF   |
| C <sub>OUT</sub> | Output Capacitance       | V <sub>OUT</sub> = 0V | —    | 6    | pF   |

### NOTE:

- This parameter is measured at characterization but not tested.

## PIN DESCRIPTION

| Pin Names      | Description |
|----------------|-------------|
| I <sub>N</sub> | Input       |
| O <sub>x</sub> | Outputs     |

## POWER SUPPLY CHARACTERISTICS

| Symbol           | Parameter                                              | Test Conditions <sup>(1)</sup>                                                                     |                                                                   | Min. | Typ. <sup>(2)</sup> | Max. | Unit   |
|------------------|--------------------------------------------------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|------|---------------------|------|--------|
| I <sub>CCQ</sub> | Quiescent Power Supply Current                         | V <sub>CC</sub> = Max.                                                                             | V <sub>IN</sub> = GND or V <sub>CC</sub>                          | —    | 0.1                 | 30   | μA     |
| ΔI <sub>CC</sub> | Power Supply Current per Input HIGH                    | V <sub>CC</sub> = Max.                                                                             | V <sub>IN</sub> = V <sub>CC</sub> - 0.6V                          | —    | 45                  | 300  | μA     |
| I <sub>CCD</sub> | Dynamic Power Supply Current per Output <sup>(3)</sup> | V <sub>CC</sub> = Max.<br>C <sub>L</sub> = 15pF<br>All Outputs Toggling                            | V <sub>IN</sub> = V <sub>CC</sub><br>V <sub>IN</sub> = GND        | —    | 80                  | 120  | μA/MHz |
| I <sub>C</sub>   | Total Power Supply Current <sup>(4)</sup>              | V <sub>CC</sub> = Max.<br>C <sub>L</sub> = 15pF<br>All Outputs Toggling<br>f <sub>i</sub> = 133MHz | V <sub>IN</sub> = V <sub>CC</sub><br>V <sub>IN</sub> = GND        |      | 90                  | 120  | mA     |
|                  |                                                        |                                                                                                    | V <sub>IN</sub> = V <sub>CC</sub> - 0.6V<br>V <sub>IN</sub> = GND |      | 90                  | 120  |        |
|                  |                                                        | V <sub>CC</sub> = Max.<br>C <sub>L</sub> = 15pF<br>All Outputs Toggling<br>f <sub>i</sub> = 166MHz | V <sub>IN</sub> = V <sub>CC</sub><br>V <sub>IN</sub> = GND        | —    | 120                 | 150  |        |
|                  |                                                        |                                                                                                    | V <sub>IN</sub> = V <sub>CC</sub> - 0.6V<br>V <sub>IN</sub> = GND | —    | 120                 | 150  |        |

### NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at V<sub>CC</sub> = 3.3V, +25°C ambient.
- This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
- I<sub>C</sub> = I<sub>QUIESCENT</sub> + I<sub>INPUTS</sub> + I<sub>DYNAMIC</sub>  

$$I_C = I_{CC} + \Delta I_{CC} \cdot DH \cdot NT + I_{CCD} \cdot (f_i)$$

$$I_{CC} = \text{Quiescent Current}$$

$$\Delta I_{CC} = \text{Power Supply Current for a TTL High Input (V}_{IN} = V_{CC} - 0.6V)$$

$$DH = \text{Duty Cycle for TTL Inputs High}$$

$$NT = \text{Number of TTL Inputs at DH}$$

$$I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$$

$$f_i = \text{Input Frequency}$$

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified

Industrial:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 0.3\text{V}$

| Symbol    | Parameter             | Test Conditions <sup>(1)</sup>                                                        |                            | Min.               | Typ. <sup>(2)</sup> | Max.    | Unit          |
|-----------|-----------------------|---------------------------------------------------------------------------------------|----------------------------|--------------------|---------------------|---------|---------------|
| $V_{IH}$  | Input HIGH Level      |                                                                                       |                            | 2                  | —                   | 5.5     | V             |
| $V_{IL}$  | Input LOW Level       |                                                                                       |                            | -0.5               | —                   | 0.8     | V             |
| $I_{IH}$  | Input HIGH Current    | $V_{CC} = \text{Max.}$                                                                | $V_I = 5.5\text{V}$        | —                  | —                   | $\pm 1$ | $\mu\text{A}$ |
| $I_{IL}$  | Input LOW Current     | $V_{CC} = \text{Max.}$                                                                | $V_I = \text{GND}$         | —                  | —                   | $\pm 1$ | $\mu\text{A}$ |
| $V_{IK}$  | Clamp Diode Voltage   | $V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$                                         |                            | —                  | -0.7                | -1.2    | V             |
| $I_{ODH}$ | Output HIGH Current   | $V_{CC} = 3.3\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_O = 1.5\text{V}^{(3,4)}$ |                            | -45                | -75                 | -180    | mA            |
| $I_{ODL}$ | Output LOW Current    | $V_{CC} = 3.3\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_O = 1.5\text{V}^{(3,4)}$ |                            | 50                 | 92                  | 200     | mA            |
| $I_{OS}$  | Short Circuit Current | $V_{CC} = \text{Max.}, V_O = \text{GND}^{(3,4)}$                                      |                            | -60                | -135                | -240    | mA            |
| $V_{OH}$  | Output HIGH Voltage   | $V_{CC} = \text{Min.}$                                                                | $I_{OH} = -12\text{mA}$    | 2.4 <sup>(5)</sup> | 3                   | —       | V             |
|           |                       | $V_{IN} = V_{IH} \text{ or } V_{IL}$                                                  | $I_{OH} = -100\mu\text{A}$ | $V_{CC} - 0.2$     | —                   | —       |               |
| $V_{OL}$  | Output LOW Voltage    | $V_{CC} = \text{Min.}$                                                                | $I_{OL} = 12\text{mA}$     | —                  | 0.3                 | 0.5     | V             |
|           |                       | $V_{IN} = V_{IH} \text{ or } V_{IL}$                                                  | $I_{OL} = 100\mu\text{A}$  | —                  | —                   | 0.2     |               |

### NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 3.3$ ,  $25^{\circ}\text{C}$  ambient.
- This parameter is guaranteed but not tested.
- Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
- $V_{OH} = V_{CC} - 0.6\text{V}$  at rated current.

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE (3,4)

| Symbol                 | Parameter                                         | Conditions <sup>(1,8)</sup>                   | Min. <sup>(2)</sup> | Max. | Unit |
|------------------------|---------------------------------------------------|-----------------------------------------------|---------------------|------|------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay                                 | $C_L = 15\text{pF}$<br>$f \leq 166\text{MHz}$ | 0.5                 | 3    | ns   |
| $t_R$                  | Output Rise Time (0.8V to 2V)                     |                                               | —                   | 1.5  | ns   |
| $t_F$                  | Output Fall Time (2V to 0.8V)                     |                                               | —                   | 1.5  | ns   |
| $t_{SK(O)}$            | Same device output pin-to-pin skew <sup>(5)</sup> |                                               | —                   | 100  | ps   |
| $t_{SK(P)}$            | Pulse skew <sup>(6)</sup>                         |                                               | —                   | 250  | ps   |
| $t_{SK(PP)}$           | Part to part skew <sup>(7)</sup>                  |                                               | —                   | 550  | ps   |
| $f_{MAX}$              | Input Frequency                                   |                                               | —                   | 166  | MHz  |

### NOTES:

- See test circuits and waveforms.
- Minimum limits are guaranteed but not tested on Propagation Delays.
- $t_{PLH}$ ,  $t_{PHL}$ ,  $t_{SK(P)}$ , and  $t_{SK(O)}$  are production tested. All other parameters guaranteed but not production tested.
- Propagation delay range indicated by Min. and Max. limit is due to  $V_{CC}$ , operating temperature and process parameters. These propagation delay limits do not imply skew.
- Skew measured between all outputs under identical transitions and load conditions.
- Skew measured is difference between propagation delay times  $t_{PHL}$  and  $t_{PLH}$  of same output under identical load conditions.
- Part to part skew for all outputs given identical transitions and load conditions at identical  $V_{CC}$  levels and temperature.
- Airflow of 1m/s is recommended for frequencies above 133MHz.

## TEST CIRCUITS

### TEST CONDITIONS

| Symbol                          | V <sub>CC</sub> = 3.3V ±0.3V        | Unit |
|---------------------------------|-------------------------------------|------|
| C <sub>L</sub>                  | 15                                  | pF   |
| R <sub>L</sub>                  | 33                                  | Ω    |
| R <sub>T</sub>                  | Z <sub>OUT</sub> of pulse generator | Ω    |
| t <sub>R</sub> / t <sub>F</sub> | 1 (0V to 3V or 3V to 0V)            | ns   |

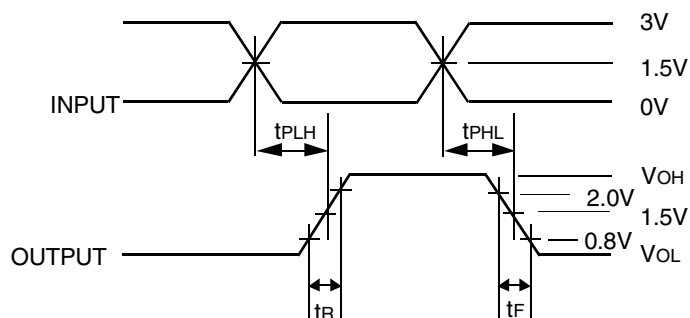
#### DEFINITIONS:

C<sub>L</sub> = Load capacitance: includes jig and probe capacitance.

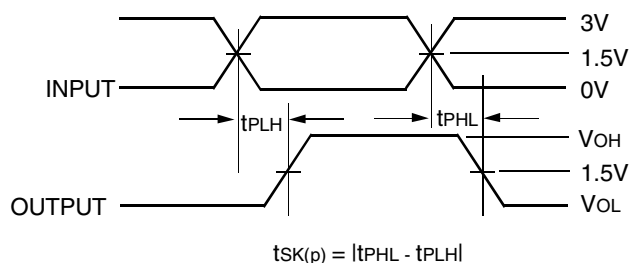
R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

t<sub>R</sub> / t<sub>F</sub> = Rise/Fall time of the input stimulus from the Pulse Generator.

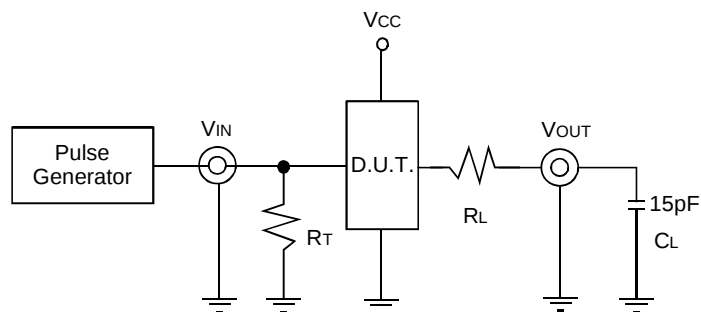
### TEST WAVEFORMS



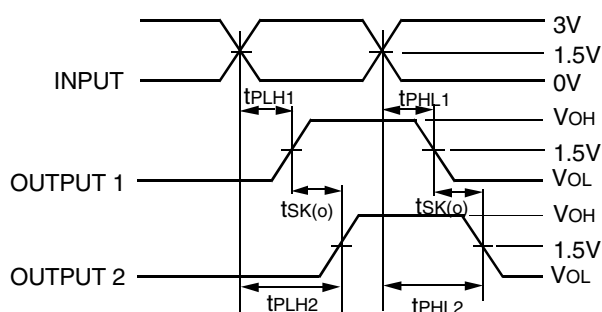
Propagation Delay



Pulse Skew - tSK(P)

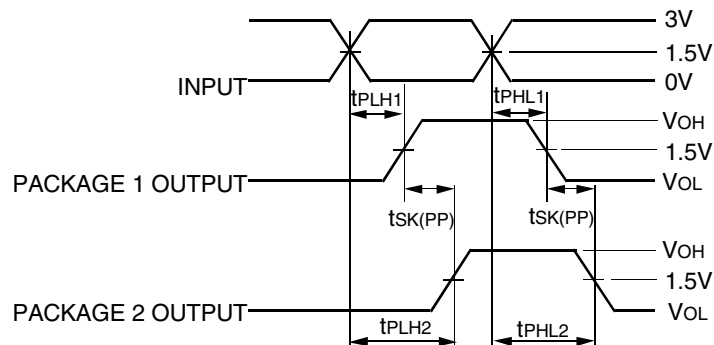


CL = 15pF Circuit



$$t_{SK(O)} = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

Output Skew - tSK(O)

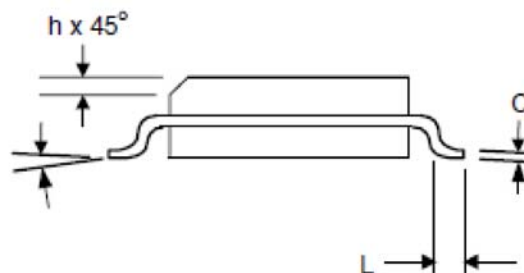
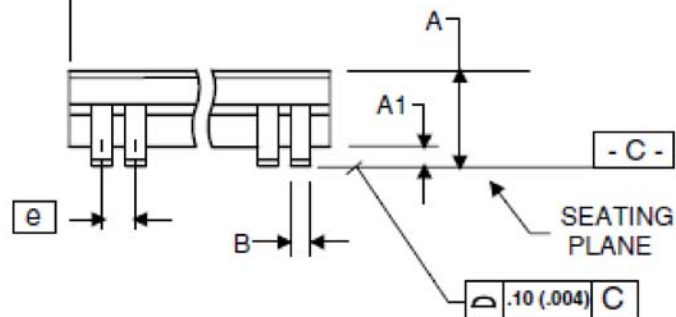


$$t_{SK(PP)} = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

Part-to-Part Skew - tSK(PP)

Part-to-Part Skew is for the same package and speed grade.

|          | Millimeters |      | Inches      |       |
|----------|-------------|------|-------------|-------|
| Symbol   | Min         | Max  | Min         | Max   |
| A        | 1.35        | 1.75 | .0532       | .0688 |
| A1       | 0.10        | 0.25 | .0040       | .0098 |
| B        | 0.33        | 0.51 | .013        | .020  |
| C        | 0.19        | 0.25 | .0075       | .0098 |
| D        | 4.80        | 5.00 | .1890       | .1968 |
| E        | 3.80        | 4.00 | .1497       | .1574 |
| e        | 1.27 BASIC  |      | 0.050 BASIC |       |
| H        | 5.80        | 6.20 | .2284       | .2440 |
| h        | 0.25        | 0.50 | .010        | .020  |
| L        | 0.40        | 1.27 | .016        | .050  |
| $\alpha$ | 0°          | 8°   | 0°          | 8°    |



## ORDERING INFORMATION

| 74FCT | XXXX        | X       | X       |  |                               |
|-------|-------------|---------|---------|--|-------------------------------|
|       | Device Type | Package | Process |  |                               |
|       |             |         | I       |  | -40°C to +85°C (Industrial)   |
|       |             |         | DCG     |  | SOIC - Green                  |
|       |             |         | 38075   |  | 3.3V CMOS 1-to-5 Clock Driver |

## 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](http://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/](http://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.