Description

The ICS7152-01, -02, -11, and -12 are clock generators for EMI (Electro Magnetic Interference) reduction (see below for frequency ranges and multiplier ratios). Spectral peaks can be attenuated by slightly modulating the oscillation frequency. Both down and center spread profiles are selectable. Center spread maintains an average frequency equal to an unspread clock. Down spread meets maximum frequency specs over the entire modulation cycle.

Features

• Operating voltage of 3.3 V ±0.3 V
• Packaged in 8-pin SOIC
• Input frequency range of 16.6 to 134.0 MHz
• Output frequency range of 16.6 to 134.0 MHz
• Provides a spread spectrum clock output (±0.5%, ±1.5% center spread; -1.0%, -3.0% down spread)
• Advanced, low-power CMOS process
• Industrial temperature range available
• Pb (lead) free package, RoHS compliant

Block Diagram

![Block Diagram Image]

Product Lineup

<table>
<thead>
<tr>
<th>Product</th>
<th>Input Frequency Range</th>
<th>Modulation Type</th>
<th>Modulation Enable Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICS7152M-01, ICS7152MI-01</td>
<td>16.6 MHz to 67 MHz</td>
<td>Down spread</td>
<td>Yes</td>
</tr>
<tr>
<td>ICS7152M-02, ICS7152MI-02</td>
<td>40.0 MHz to 134.0 MHz</td>
<td>Down spread</td>
<td>Yes</td>
</tr>
<tr>
<td>ICS7152M-11, ICS7152MI-11</td>
<td>16.6 MHz to 67.0 MHz</td>
<td>Center spread</td>
<td></td>
</tr>
<tr>
<td>ICS7152M-12, ICS7152MI-12</td>
<td>40.0 MHz to 134.0 MHz</td>
<td>Center spread</td>
<td></td>
</tr>
</tbody>
</table>
**Pin Assignment**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Number</th>
<th>Pin Type</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XIN</td>
<td>1</td>
<td>Input</td>
<td>Crystal resonator connection pin/clock input pin.</td>
</tr>
<tr>
<td>XOUT</td>
<td>2</td>
<td>Output</td>
<td>Crystal resonator connection pin.</td>
</tr>
<tr>
<td>GND</td>
<td>3</td>
<td>Power</td>
<td>Connect to ground.</td>
</tr>
<tr>
<td>SEL</td>
<td>4</td>
<td>Input</td>
<td>Modulation rate setting pin.</td>
</tr>
<tr>
<td>CKOUT</td>
<td>5</td>
<td>Output</td>
<td>Modulated clock output pin.</td>
</tr>
<tr>
<td>VDD</td>
<td>6</td>
<td>Power</td>
<td>Connect to +3.3 V.</td>
</tr>
<tr>
<td>FREQ</td>
<td>7</td>
<td>Input</td>
<td>Frequency setting pin.</td>
</tr>
<tr>
<td>XENS</td>
<td>8</td>
<td>Input</td>
<td>Modulation enable setting pin.</td>
</tr>
</tbody>
</table>

**Modulation Enable Setting Table**

<table>
<thead>
<tr>
<th>XENS Pin 8</th>
<th>Spread Spectrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ON</td>
</tr>
<tr>
<td>1</td>
<td>OFF</td>
</tr>
</tbody>
</table>

**SEL Modulation Rate Setting Table**

<table>
<thead>
<tr>
<th>SEL Pin 4</th>
<th>Spread Direction</th>
<th>Spread Percentage (%)</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Center</td>
<td>±0.5</td>
<td>ICS7152M-11, ICS7152M-12</td>
</tr>
<tr>
<td></td>
<td>Down</td>
<td>-1.0</td>
<td>ICS7152M-01, ICS7152M-02</td>
</tr>
<tr>
<td>1</td>
<td>Center</td>
<td>±1.5</td>
<td>ICS7152M-11, ICS7152M-12</td>
</tr>
<tr>
<td></td>
<td>Down</td>
<td>-3.0</td>
<td>ICS7152M-01, ICS7152M-02</td>
</tr>
</tbody>
</table>

**Frequency Setting Table**

<table>
<thead>
<tr>
<th>FREQ Pin 7</th>
<th>Frequency</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>16.6 to 40 MHz</td>
<td>ICS7152M-01, ICS7152M-11</td>
</tr>
<tr>
<td></td>
<td>40 to 80 MHz</td>
<td>ICS7152M-02, ICS7152M-12</td>
</tr>
<tr>
<td>1</td>
<td>33 to 67 MHz</td>
<td>ICS7152M-01, ICS7152M-11</td>
</tr>
<tr>
<td></td>
<td>66 to 134 MHz</td>
<td>ICS7152M-02, ICS7152M-12</td>
</tr>
</tbody>
</table>
External Components

The ICS7152 requires a minimum number of external components for proper operation.

Decoupling Capacitor

A decoupling capacitor of 0.01µF must be connected between GND and VDD on pin 6, as close to this pin as possible. For optimum device performance, the decoupling capacitor should be mounted on the component side of the PCB. Avoid the use of vias in the decoupling circuit.

Series Termination Resistor

Series termination should be used on the clock output. To series terminate a 50Ω trace (a commonly used trace impedance) place a 27Ω resistor in series with the clock line, as close to the clock output pin as possible. The nominal impedance of the clock output is 25Ω.

PCB Layout Recommendations

For optimum device performance and lowest output phase noise, the following guidelines should be observed.

1) An optimum layout is one with all components on the same side of the board, minimizing vias through other signal layers. Other signal traces should be routed away from the ICS7152. This includes signal traces just underneath the device, or on layers adjacent to the ground plane layer used by the device.

Crystal Information

The crystal used should be a fundamental mode, parallel resonant. Crystal capacitors should be connected from pins X1 to ground and X2 to ground to optimize the initial accuracy. The value of these capacitors is given by the following equation:

\[ \text{Crystal caps (pF)} = (C_L - 6) \times 2 \]

In the equation, \( C_L \) is the crystal load capacitance. So, for a crystal with a 16 pF load capacitance, two 20 pF \([(16-6) \times 2]\) capacitors should be used.

Spread Spectrum Profile

The ICS7152 low EMI clock generator uses a triangular frequency modulation profile for optimal downstream tracking of zero delay buffers and other PLL devices. The frequency modulation amplitude is constant with variations of the input frequency.
Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS7152. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage, VDD</td>
<td>7 V</td>
</tr>
<tr>
<td>All Inputs and Outputs (referenced to GND)</td>
<td>-0.5 V to VDD+0.5 V</td>
</tr>
<tr>
<td>Ambient Operating Temperature</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-55 to +125°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>-40 to +125°C</td>
</tr>
<tr>
<td>Soldering Temperature</td>
<td>260°C</td>
</tr>
<tr>
<td>Overshoot (V_{IOVER})</td>
<td>VDD + 1.0 V (t_{OVER} ≤ 50 ns) max</td>
</tr>
<tr>
<td>Undershoot (V_{IUNDER})</td>
<td>GND - 1.0 V (t_{UNDER} ≤ 50 ns) min</td>
</tr>
</tbody>
</table>

Overshoot/Undershoot

![Overshoot/Undershoot graph]

Recommended Operation Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Operating Temperature</td>
<td>-40</td>
<td>+85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Power Supply Voltage (measured in respect to GND)</td>
<td>+3.0</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
</tr>
</tbody>
</table>
## DC Electrical Characteristics

Unless stated otherwise, VDD = 3.3 V ±0.3 V, Ambient Temperature -40 to +85°C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Voltage</td>
<td>VDD</td>
<td></td>
<td>3.0</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td>Supply Current</td>
<td>IDD</td>
<td>No load, at 3.3 V</td>
<td>14</td>
<td>28</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Input High Voltage</td>
<td>V_{IH}</td>
<td>SEL, FREQ, XENS</td>
<td>VDD x 0.8</td>
<td>VDD + 0.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>XIN, Input slew rate 3 V/ns, 16.6 to 100 MHz</td>
<td>VDD x 0.8</td>
<td>VDD + 0.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>XIN, Input slew rate 3 V/ns, 100 to 134 MHz</td>
<td>VDD x 0.9</td>
<td>VDD + 0.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input Low Voltage</td>
<td>V_{IL}</td>
<td>SEL, FREQ, XENS</td>
<td>GND</td>
<td>VDD x 0.20</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>XIN, Input slew rate 3 V/ns, 16.6 to 100 MHz</td>
<td>GND</td>
<td>VDD x 0.20</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>XIN, Input slew rate 3 V/ns, 100 to 134 MHz</td>
<td>GND</td>
<td>VDD x 0.10</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output High Voltage</td>
<td>V_{OH}</td>
<td>CKOUT, IOH = -4 mA</td>
<td>VDD - 0.5</td>
<td>VDD</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output Low Voltage</td>
<td>V_{OL}</td>
<td>CKOUT, IOH = 4 mA</td>
<td>GND</td>
<td>0.4</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>C_{IN}</td>
<td>SEL, SEL, XENS</td>
<td>XIN</td>
<td>16</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>Load Capacitance</td>
<td>C_{L}</td>
<td>CKOUT, 16.6 to 67 MHz</td>
<td>15</td>
<td>pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CKOUT, 67 to 100 MHz</td>
<td>10</td>
<td>pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CKOUT, 100 to 134 MHz</td>
<td>7</td>
<td>pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Impedance</td>
<td>Z_{O}</td>
<td>CKOUT, 16.6 to 134 MHz</td>
<td>25</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**AC Electrical Characteristics**

Unless stated otherwise, $VDD = 3.3\, \text{V} \pm 0.3\, \text{V}$, Ambient Temperature $-40$ to $+85^\circ\, \text{C}$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Crystal Frequency</td>
<td>$f_{IN}$</td>
<td>ICS7152-01, -11</td>
<td>16.6</td>
<td>40</td>
<td>67</td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ICS7152-02, -12</td>
<td>40</td>
<td></td>
<td>134</td>
<td>MHz</td>
</tr>
<tr>
<td>Input Clock Frequency</td>
<td>$f_{IN}$</td>
<td>CKOUT, ICS7152-01, -11</td>
<td>16.6</td>
<td>40</td>
<td>67</td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CKOUT, ICS7152-02, -12</td>
<td>40</td>
<td></td>
<td>134</td>
<td>MHz</td>
</tr>
<tr>
<td>Output Frequency</td>
<td>$f_{OUT}$</td>
<td>CKOUT, ICS7152-01, -11</td>
<td>16.6</td>
<td>40</td>
<td>67</td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CKOUT, ICS7152-02, -12</td>
<td>40</td>
<td></td>
<td>134</td>
<td>MHz</td>
</tr>
<tr>
<td>Input Clock Duty Cycle</td>
<td>$t_{DCI}$</td>
<td>XIN, 16.6 to 100 MHz</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XIN, 100 to 134 MHz</td>
<td>45</td>
<td>50</td>
<td>55</td>
<td>%</td>
</tr>
<tr>
<td>Output Clock Duty Cycle</td>
<td>$t_{DCC}$</td>
<td>CKOUT, 1.5 V</td>
<td>40</td>
<td></td>
<td>60</td>
<td>%</td>
</tr>
<tr>
<td>Output Slew Rate</td>
<td></td>
<td>CKOUT, 0.4 to 2.4 V, $CL = 15, \text{pF}$</td>
<td>0.5</td>
<td></td>
<td>3.0</td>
<td>V/ns</td>
</tr>
<tr>
<td>Cycle-to-Cycle Jitter</td>
<td>$t_{JC}$</td>
<td>No load, spread off, ICS7152-01, -02</td>
<td></td>
<td></td>
<td>150</td>
<td>ps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No load, spread off, ICS7152-11, -12</td>
<td></td>
<td></td>
<td>250</td>
<td>ps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No load, spread off, ICS7152-01, 33.33 MHz, SEL = 0, FREQ = 1</td>
<td></td>
<td></td>
<td>120</td>
<td>ps</td>
</tr>
<tr>
<td>Power-up Time</td>
<td></td>
<td>PLL lock-time from power-up to 1% of final value</td>
<td>2</td>
<td>5</td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>Modulation Frequency</td>
<td>$f_{MOD}$</td>
<td>CKOUT</td>
<td>33</td>
<td></td>
<td></td>
<td>kHz</td>
</tr>
</tbody>
</table>
**Input Frequency** \( f_{IN} = 1/t_{IN} \)

![Input Frequency Diagram](image1)

**Output Slew Rate**

![Output Slew Rate Diagram](image2)

\[
SR = \frac{(2.4 - 0.4)}{t_r}, \quad SR = \frac{(2.4 - 0.4)}{t_f}
\]

---

**Thermal Characteristics 8 SOIC**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Resistance Junction to Ambient</td>
<td>( \theta_{JA} )</td>
<td>Still air</td>
<td>150</td>
<td></td>
<td></td>
<td>( ^\circ \text{C/W} )</td>
</tr>
<tr>
<td></td>
<td>( \theta_{JA} )</td>
<td>1 m/s air flow</td>
<td>140</td>
<td></td>
<td></td>
<td>( ^\circ \text{C/W} )</td>
</tr>
<tr>
<td></td>
<td>( \theta_{JA} )</td>
<td>3 m/s air flow</td>
<td>120</td>
<td></td>
<td></td>
<td>( ^\circ \text{C/W} )</td>
</tr>
<tr>
<td>Thermal Resistance Junction to Case</td>
<td>( \theta_{JC} )</td>
<td></td>
<td>40</td>
<td></td>
<td></td>
<td>( ^\circ \text{C/W} )</td>
</tr>
</tbody>
</table>
Package Outline and Package Dimensions (8-pin SOIC, 150 Mil. Body)

Package dimensions are kept current with JEDEC Publication No. 95
## Ordering Information

<table>
<thead>
<tr>
<th>Part / Order Number</th>
<th>Marking</th>
<th>Shipping Packaging</th>
<th>Package</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>7152M-01LF</td>
<td>52M-01LF</td>
<td>Tubes</td>
<td>8-pin SOIC</td>
<td>0 to +70°C</td>
</tr>
<tr>
<td>7152M-01LFT</td>
<td>52M-01LF</td>
<td>Tape and Reel</td>
<td>8-pin SOIC</td>
<td>0 to +70°C</td>
</tr>
<tr>
<td>7152MI-01LF</td>
<td>52MI01LF</td>
<td>Tubes</td>
<td>8-pin SOIC</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>7152MI-01LFT</td>
<td>52MI01LF</td>
<td>Tape and Reel</td>
<td>8-pin SOIC</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>7152M-02LF</td>
<td>7152M02L</td>
<td>Tubes</td>
<td>8-pin SOIC</td>
<td>0 to +70°C</td>
</tr>
<tr>
<td>7152M-02LFT</td>
<td>7152M02L</td>
<td>Tape and Reel</td>
<td>8-pin SOIC</td>
<td>0 to +70°C</td>
</tr>
<tr>
<td>7152MI-02LF</td>
<td>52MI02LF</td>
<td>Tubes</td>
<td>8-pin SOIC</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>7152MI-02LFT</td>
<td>52MI02LF</td>
<td>Tape and Reel</td>
<td>8-pin SOIC</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>7152M-11LF</td>
<td>7152M11L</td>
<td>Tubes</td>
<td>8-pin SOIC</td>
<td>0 to +70°C</td>
</tr>
<tr>
<td>7152M-11LFT</td>
<td>7152M11L</td>
<td>Tape and Reel</td>
<td>8-pin SOIC</td>
<td>0 to +70°C</td>
</tr>
<tr>
<td>7152MI-11LF</td>
<td>52MI11LF</td>
<td>Tubes</td>
<td>8-pin SOIC</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>7152MI-11LFT</td>
<td>52MI11LF</td>
<td>Tape and Reel</td>
<td>8-pin SOIC</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>7152M-12LF</td>
<td>52M-12LF</td>
<td>Tubes</td>
<td>8-pin SOIC</td>
<td>0 to +70°C</td>
</tr>
<tr>
<td>7152M-12LFT</td>
<td>52M-12LF</td>
<td>Tape and Reel</td>
<td>8-pin SOIC</td>
<td>0 to +70°C</td>
</tr>
<tr>
<td>7152MI-12LF</td>
<td>52MI12LF</td>
<td>Tubes</td>
<td>8-pin SOIC</td>
<td>-40 to +85°C</td>
</tr>
<tr>
<td>7152MI-12LFT</td>
<td>52MI12LF</td>
<td>Tape and Reel</td>
<td>8-pin SOIC</td>
<td>-40 to +85°C</td>
</tr>
</tbody>
</table>

"LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

While the information presented herein has been checked for both accuracy and reliability, Integrated Device Technology (IDT) assumes no responsibility for either its use or for the infringement of any patents or other rights of third parties, which would result from its use. No other circuits, patents, or licenses are implied. This product is intended for use in normal commercial applications. Any other applications such as those requiring extended temperature range, high reliability, or other extraordinary environmental requirements are not recommended without additional processing by IDT. IDT reserves the right to change any circuitry or specifications without notice. IDT does not authorize or warrant any IDT product for use in life support devices or critical medical instruments.
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 products 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 Toyoosu, 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.

© 2019 Renesas Electronics Corporation. All rights reserved.