Renesas Microcomputer

All Flash 78K

Microcontroller

Empower your creativity
Our "All Flash" concept of providing on-chip flash memory throughout our entire lineup of microcontroller products continues to advance.

A wide variety of microcontroller products are available with pin counts ranging from 10 to 144 pins and flash memory capacities from 1 KB to 512 KB. This provides support for software modifications and reduces the total cost of integrating peripheral functions.

Flash microcontrollers from Renesas Electronics combine high performance and low power consumption.

Renesas Electronics also provides a development environment that makes using All Flash microcontrollers simpler and more effective.

Our products and development environments for developers enable our customers to achieve success by exploiting the full potential of our flash memory microcontrollers.
Flash microcontrollers offer overwhelming advantages.

Compared to mask ROM microcontrollers, flash microcontrollers definitely contribute to speeding up system development. Microcontrollers can be ordered before program completion and programs can be written even after the microcontroller has been mounted on the board. Microcontroller order placement and program development can therefore be done concurrently, allowing TAT to be shortened as a result.

**For software designers**

Software can be changed just before mass production starts and development TAT can also be shortened.

Since mask ROM microcontrollers cannot be ordered until their specifications are finalized, last-minute software changes can be problematic. On the other hand, specifications for flash microcontrollers can be changed just prior to the start of mass production. Thus orders for flash microcontrollers can be placed while the software is still being developed, allowing the development TAT to be shortened.

In addition, when flash microcontrollers are used for products with many different versions or that are localized for specific regions, the cost of ordering mask ROM microcontrollers is eliminated and purchase and stock management costs can be slashed.

**For manufacturing divisions**

Parts sharing makes production planning easier and boosts production efficiency.

In the case of mass-produced mask ROM microcontrollers, the use of different software for different products necessitates the use of a different microcontroller for each type of product. In contrast, mass-produced flash microcontrollers facilitate the sharing of parts since they can be used for various products by simply rewriting the software.

**For purchasing divisions**

Flash microcontrollers protect you from fluctuations in demand and can reduce dead stock.

Mass-produced flash microcontrollers require evaluation only once, reducing development man-hours.

Use of mask ROM microcontrollers

- Development and evaluation of mask ROM microcontrollers
- Mass production of mask ROM microcontrollers

Use of All Flash microcontrollers

- Development and evaluation of All Flash microcontrollers
- Mass production of All Flash microcontrollers

Man-hours required for development reduced by half.

In the case of mass-produced ROM microcontrollers, evaluations of both flash microcontrollers and mask ROM microcontrollers are required. Since evaluated flash microcontrollers can be directly mass-produced, the man-hours required for development are reduced by half, resulting in greatly shortened development TAT.

Mass-produced mask ROM microcontrollers may become dead stock as the result of changes in software or fluctuations in demand. On the other hand, flash microcontrollers can be mass-produced immediately after software changes and used for other products, resulting in fewer lost opportunities, less dead stock, and lower ordering costs.

**For hardware designers**

Flash microcontrollers from Renesas Electronics enable customers to increase added value throughout the supply chain.

In the case of mass-produced mask ROM microcontrollers, evaluations of both flash microcontrollers and mask ROM microcontrollers are required. Since evaluated flash microcontrollers can be directly mass-produced, the man-hours required for development are reduced by half, resulting in greatly shortened development TAT.

Since mask ROM microcontrollers cannot be ordered until their specifications are finalized, last-minute software changes can be problematic. On the other hand, specifications for flash microcontrollers can be changed just prior to the start of mass production. Thus orders for flash microcontrollers can be placed while the software is still being developed, allowing the development TAT to be shortened.
Renesas Electronics delivers “All Flash” microcontrollers you can count on to boost the competitiveness of your products.

“Products you can count on” is the concept.

More and more manufacturers are adopting high-performance flash microcontrollers as an effective way to achieve better system performance and shortened development cycles. Gaining improved performance and flash memory lead to involve compromises, however, such as increased power consumption and incompatibility with existing software. Renesas Electronics overcomes these issues, utilizing innovative technologies to deliver microcontrollers you can count on.

Low cost you can count on

Reducing the total cost!
The 78K0R 16-bit microcontrollers are provided with features such as flash memory instead of EPROM, an oscillator, a voltage detector, and a power-on reset function. The number of components used and the system costs can be reduced in contrast to products not provided with these features. Also, costs can be further reduced because the 78K0R/Kx2 and 78K0R/Kx3, 78K0R/Kx2-A, 78K0R/Kx3-A, Kx2-L, Kx3-L, Kx2-A-L, Kx3-A-L, and 78K0R/Kx2-A-L include a programmable gain amplifier and a comparator.

Low power consumption you can count on

High functionality combined with low power consumption

The 78K0R achieves performance of 30.5 MIPS at 24 MHz through the use of a 16-bit CPU with a 3-stage pipeline architecture. The low power supply current compared with competing products provides improved energy efficiency.

Approx. 1/3 the power consumption of mask ROM products

Compared with the 7.6 mA operating current of a conventional mask ROM microcontroller operating at 10 MHz external ceramic resonator, the 78K0/KY2-L, 78K0/Kx2-L, and 78K0/Kx2-A, operating under the same conditions, have an operating current of 2.3 mA (78K0/Kx2-L) and 1.9 mA (78K0/Kx2-A) at 10 MHz. By utilizing the 78K0R/Kx2-L and 78K0R/Kx2-A (on-chip oscillator), the 78K0R delivers significantly lower power consumption than conventional mask ROM products.

High performance and functionality you can count on

Includes high-performance CPU and sophisticated peripheral functions!
The 78K0R microcontrollers execute all instruction processing in one clock via three-stage pipeline control. 32-bit (16 bits + 16 bits) calculations can also be performed thanks to the on-chip multiplier/divider. Furthermore, a sophisticated timer function can be realized by interlocking the operation of multiple-channel timers. The 78K0R/Lx3 enables A/D conversion in synchronization with 3-phase sine-wave PWM output and timers.

Broad range of products for specific applications you can count on

We offer ideal products for various applications!
Renesas Electronics offers a wide range of products for specific applications. These include the 78K0R/Kx2-C and 78K0R/Kx3-C with functionality for in-situ digital alterations, the 78K0R/Kx4 with on-chip multi-function timers for precision processing control, the 78K0R/Kx5 for PMAC and 78K0R/Lx5 for power meters, the µP77F044P with an on-chip LCD driver for easy communication with industrial systems, and the µP77F044P for use in remote controls for home electronics products. These microcontrollers offer a rich selection of specialized functions in addition to basic functionality, so you can choose a product that is ideal for the specific application.

Support for mass production you can count on

In addition to a large lineup of programming tools, we also offer programming services!
Renesas Electronics and partner manufacturers offer a large number of programming tool programming services as well as many different settings such as development environments and production lines. Moreover, programming services are also available from partner manufacturers both in Japan and overseas, serving a broad range of needs such as large-volume programming after shipping.

Selection you can count on

Broad lineup of 293 8-bit and 203 16-bit microcontroller products, for a total of 496
To meet the full range of customer requirements, Renesas Electronics offers an All Flash lineup consisting of 124 8-bit and 229 16-bit microcontroller products available in a variety of pin counts, ROM capacities, and package configurations. Our 8-bit microcontrollers such as the 78K0/KY2-L, 78K0/KA2-L, and 78K0/KB2-L achieve operation speeds up to 25 MHz, while our 78K0R/Kx2 16-bit microcontroller delivers an operation speed of 24 MHz. Products such as the 78K0/R1, 78K0/R2-L, 78K0/R3, 78K0/R3-L, and 78K0/R3-A support supply voltage ranges from 1.5 V to 5.5 V. The 78K0R/Kx2-A and 78K0R/Kx3-A are programmable with a high-performance 16-bit ADC converter, while the 78K0/Lx3 and 78K0/Rx3 feature on-chip LCD drivers. Package options include the compact SSOP with low pin counts of 16, 20, or 30 pins. The MQFP package measures 5 × 5 mm in the 32-pin version and 6 × 6 mm in the 40-pin version. These dimensions are up to 46% thinner and realize a package area up to 87% smaller than earlier Renesas Electronics products (50 × 50 LFQFP, 14 × 16 mm). The smaller mounting area contributes to a smaller system size overall. The extensive lineup makes it possible to choose a product that best fits the requirements of the specific application.

High reliability you can count on

Our products incorporate our experience and technology in the automotive field as well as software protection functions!
All our products incorporate the experience we have gained in the process of supplying microcontrollers for over 1,000 types of applications and the technology we developed for flash microcontrollers for the automotive field. Our products also feature functions that disable reading and malicious software rewriting and erasing, thus offering maximum protection of your valuable software.
Selection of 16-bit microcontrollers you can count on (1/2)

Wide variety of packages and ROM/RAM sizes!

Select the best flash microcontroller for your product or application.

| Commercial Name | 78K0R/KC3-L | 78K0R/KC3-L | 78K0R/KC3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L | 78K0R/KF3-L |
|-----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| ROM (bytes)     | 512 K       | 384 K       | 256 K       | 192 K       | 128 K       | 96 K        | 64 K        | 48 K        | 32 K        | 16 K        | 40/44-pin   | 48-pin      | 52-pin      | 64-pin      | 80-pin      | 100-pin     |
| Pin Count       | 40-pin      | 48-pin      | 52-pin      | 64-pin      | 80-pin      | 100-pin     | 48-pin      | 64-pin      | 64-pin      | 64-pin      | 80-pin      | 100-pin     | 128-pin     | 144-pin     | 128-pin     | 144-pin     |
| 78K0R/Kx3       | µPD78F1003  | µPD78F1006  | µPD78F1009  | µPD78F1013  | µPD78F1016  | µPD78F1025  | µPD78F1043  | µPD78F1065  | µPD78F1087  | µPD78F1099  | µPD78F1101  | µPD78F1125  | µPD78F1142  | µPD78F1163  | µPD78F1168  | µPD78F1174  |
| µPD78F1004      | µPD78F1007  | µPD78F1010  | µPD78F1014  | µPD78F1023  | µPD78F1026  | µPD78F1029  | µPD78F1032  | µPD78F1054  | µPD78F1078  | µPD78F1092  | µPD78F1097  | µPD78F1116  | µPD78F1139  | µPD78F1144  | µPD78F1164  |
| µPD78F1005      | µPD78F1011  | µPD78F1013  | µPD78F1016  | µPD78F1024  | µPD78F1026  | µPD78F1029  | µPD78F1032  | µPD78F1055  | µPD78F1079  | µPD78F1093  | µPD78F1098  | µPD78F1117  | µPD78F1140  | µPD78F1145  | µPD78F1165  |
| µPD78F1008      | µPD78F1012  | µPD78F1016  | µPD78F1025  | µPD78F1029  | µPD78F1032  | µPD78F1035  | µPD78F1056  | µPD78F1060  | µPD78F1074  | µPD78F1094  | µPD78F1099  | µPD78F1118  | µPD78F1141  | µPD78F1146  | µPD78F1166  |
| µPD78F101001    | µPD78F1011  | µPD78F1013  | µPD78F1016  | µPD78F1024  | µPD78F1026  | µPD78F1029  | µPD78F1032  | µPD78F1056  | µPD78F1075  | µPD78F1095  | µPD78F1099  | µPD78F1119  | µPD78F1142  | µPD78F1147  | µPD78F1167  |
| µPD78F101004    | µPD78F1007  | µPD78F1012  | µPD78F1016  | µPD78F1024  | µPD78F1026  | µPD78F1029  | µPD78F1032  | µPD78F1056  | µPD78F1076  | µPD78F1096  | µPD78F1099  | µPD78F1120  | µPD78F1144  | µPD78F1150  | µPD78F1168  |
| µPD78F101005    | µPD78F1012  | µPD78F1016  | µPD78F1024  | µPD78F1026  | µPD78F1029  | µPD78F1032  | µPD78F1056  | µPD78F1077  | µPD78F1097  | µPD78F1099  | µPD78F1121  | µPD78F1145  | µPD78F1151  | µPD78F1169  | µPD78F1170  |
| µPD78F101000    | µPD78F1007  | µPD78F1012  | µPD78F1016  | µPD78F1024  | µPD78F1026  | µPD78F1029  | µPD78F1056  | µPD78F1078  | µPD78F1098  | µPD78F1100  | µPD78F1101  | µPD78F1146  | µPD78F1152  | µPD78F1165  | µPD78F1171  |

Legend

Top: Product name
Bottom: RAM (bytes)

Remarks: The packages are shown in their actual size.

* 32 KB when the self-programming function is used.
* 64 KB when the self-programming function is used.
* 128 KB when the self-programming function is used.
* 256 KB when the self-programming function is used.
* 512 KB when the self-programming function is used.
## Selection of 16-bit microcontrollers you can count on (2/2)

### Wide variety of packages and ROM/RAM sizes!

Select the best flash microcontroller for your product or application.

<table>
<thead>
<tr>
<th>Commercial Name</th>
<th>Pin Count</th>
<th>ROM (bytes)</th>
<th>80-pin</th>
<th>100-pin</th>
<th>48-pin</th>
<th>64-pin</th>
<th>80-pin</th>
<th>100-pin</th>
<th>56-pin</th>
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<th>30-pin</th>
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<tbody>
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### 78K0R/HC3 Microcontrollers

- Microcontroller with On-Chip Memory
- Microcontroller with On-Chip Transceiver

### 78K0R/Hx3 Microcontrollers

- Microcontroller with On-Chip Transceiver

### 78K0R/Lx3 Microcontrollers

- Microcontroller with On-Chip Transceiver

### 78K0R/Lx3-M Microcontrollers

- Microcontroller with On-Chip Transceiver

### Package

- 56-pin LQFP (GC) Thickness: 1.4 mm Pitch: 0.5 mm
- 100-pin LQFP (GC) Thickness: 1.4 mm Pitch: 0.5 mm
- 80-pin LQFP (GB) Thickness: 1.4 mm Pitch: 0.5 mm
- 52-pin LQFP (GB) Thickness: 1.4 mm Pitch: 0.5 mm
- 64-pin LQFP (GA) Thickness: 1.4 mm Pitch: 0.5 mm
- 100-pin LQFP (GA) Thickness: 1.4 mm Pitch: 0.5 mm
- 48-pin LQFP (GB) Thickness: 1.4 mm Pitch: 0.5 mm
- 30-pin SSOP (MC) Thickness: 1.4 mm Pitch: 0.5 mm

### Remarks

- The packages are shown in their actual size.
- Under development.
- *1: 78K0R/LG3-M: when the self-programming function is not used.
Selection of 8-bit microcontrollers you can count on

Wide variety of packages and ROM/RAM sizes!

Select the best flash microcontroller for your product or application.

<table>
<thead>
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<th>Commercial Name</th>
<th>78K0S/KU+</th>
<th>78K0S/KY1+</th>
<th>78K0S/KA1+</th>
<th>78K0S/KB1+</th>
<th>78K0S/KB2</th>
<th>78K0S/KC2</th>
<th>78K0S/KD2</th>
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<td>10-pin</td>
<td>16-pin</td>
<td>20-pin</td>
<td>30/32-pin</td>
<td>30/36-pin</td>
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</tbody>
</table>

Wide variety of packages and ROM/RAM sizes!

Select the best flash microcontroller for your product or application.

<table>
<thead>
<tr>
<th>Commercial Name</th>
<th>78K0S/Kx2 Microcontrollers</th>
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<tbody>
<tr>
<td>Package</td>
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<tr>
<td>ROM (bytes)</td>
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</tr>
<tr>
<td>10-pin SSOP (MA)</td>
<td>Thickness: 1.20 mm Pitch: 0.85 mm</td>
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<tr>
<td>15-pin SSOP (MB)</td>
<td>Thickness: 1.50 mm Pitch: 0.85 mm</td>
</tr>
<tr>
<td>20-pin SDP (CS)</td>
<td>Thickness: 2.00 mm Pitch: 1.778 mm</td>
</tr>
<tr>
<td>20-pin SDP (MC)</td>
<td>Thickness: 1.20 mm Pitch: 1.778 mm</td>
</tr>
<tr>
<td>30-pin SDP (MC)</td>
<td>Thickness: 1.20 mm Pitch: 0.85 mm</td>
</tr>
<tr>
<td>38-pin SDP (MC)</td>
<td>Thickness: 1.20 mm Pitch: 0.85 mm</td>
</tr>
<tr>
<td>38-pin SDP (MC)</td>
<td>Thickness: 1.40 mm Pitch: 0.80 mm</td>
</tr>
<tr>
<td>44-pin QFP (GA)</td>
<td>Thickness: 1.40 mm Pitch: 0.80 mm</td>
</tr>
<tr>
<td>52-pin QFP (GB)</td>
<td>Thickness: 1.40 mm Pitch: 0.80 mm</td>
</tr>
</tbody>
</table>

Legend
Top: Product name
Bottom: RAM (bytes)

Remark: The packages are shown in their actual size.
## Selection of 8-bit microcontrollers you can count on (2/3)

### Wide variety of packages and ROM/RAM sizes!

Select the best flash microcontroller for your product or application.

<table>
<thead>
<tr>
<th>Commercial Name</th>
<th>78K0/Kx2-L</th>
<th>78K0/Kx2-A</th>
<th>78K0/Kx2-C</th>
<th>78K0/Kx2-A</th>
<th>78K0/Kx2-C</th>
<th>78K0/Kx2-C</th>
<th>µPD178F1xx</th>
<th>µPD78F0730</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin Count</td>
<td>16-pin</td>
<td>25/25/32-pin</td>
<td>30-pin</td>
<td>40/44/48-pin</td>
<td>30-pin</td>
<td>36/48-pin</td>
<td>48-pin</td>
<td>64-pin</td>
</tr>
<tr>
<td>ROM (bytes)</td>
<td>128 K</td>
<td>96 K</td>
<td>60 K</td>
<td>48 K</td>
<td>32 K</td>
<td>24 K</td>
<td>16 K</td>
<td>8 K</td>
</tr>
</tbody>
</table>

### Remarks
- The packages are shown in their actual size.
### Wide variety of packages and ROM/RAM sizes!

Select the best flash microcontroller for your product or application.

<table>
<thead>
<tr>
<th>Commercial Name</th>
<th>78K0/Ix2</th>
<th>78K0/IA2</th>
<th>78K0/Ix2</th>
<th>µPD78F025</th>
<th>µPD78F01x</th>
<th>78K0/LC3</th>
<th>78K0/LD3</th>
<th>78K0/LE3</th>
<th>78K0/LF3</th>
<th>78K0/LE3-M</th>
<th>78K0/LG3-M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin Count</td>
<td>16-pin</td>
<td>20-pin</td>
<td>30/32-pin</td>
<td>64-pin</td>
<td>30-pin</td>
<td>64-pin</td>
<td>48-pin</td>
<td>52-pin</td>
<td>64-pin</td>
<td>80-pin</td>
<td>64-pin</td>
</tr>
<tr>
<td>ROM (bytes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>128 K</td>
<td></td>
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<tr>
<td>96 K</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>60 K</td>
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<tr>
<td>48 K</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>32 K</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>24 K</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 K</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 K</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Package

- 16-pin SSOP (366)
  - Thickness: 1.00 mm
  - Pitch: 0.65 mm
- 20-pin SOP (MC)
  - Thickness: 1.20 mm
  - Pitch: 1.27 mm
- 30-pin SOP (MC)
  - Thickness: 1.20 mm
  - Pitch: 0.65 mm
- 96-pin LQFP (GA)
  - Thickness: 1.40 mm
  - Pitch: 0.50 mm
- 80-pin LQFP (GC)
  - Thickness: 1.40 mm
  - Pitch: 0.50 mm

#### Select the best flash microcontroller for your product or application.

### Remarks

- The packages are shown in their actual size.
- *1 Under development
- *2 µPD78F044, µPD78F045 only

**Legend**

- Top: Product name
- Bottom: RAM (bytes)
Low cost you can count on

All the required peripheral functions are provided on chip, saving you money and space.

Total cost reduction achieved through the following on-chip peripheral functions

- Operational amplifier
- Programmable gain amplifier
- Comparator
- Resonator
- Reset & WDT IC

Board downsizing

Package downsizing

EEPROM

19

Low cost you can count on

World’s lowest power consumption for 16-bit microcontrollers

16-bit microcontroller performance combined with low power consumption

Sophisticated application functions can be realized while maintaining low power consumption.

World’s lowest power consumption for 16-bit microcontrollers

Lowered standby power consumption realized through lower standby current and enhanced watch count function

As a result, energy saving for applications and longer battery life can be achieved.

Standby power

Function that implements low power consumption has been added

RTC (real-time counter)

- No need for updating, with the CPU!
- Calendar function for automatic updating until 2099.
- Sustained watch operation without wake-up! Power consumption can be reduced.
- Built-in alarm function starts the microcontroller at an arbitrary set time (day, hour, minute).

Highly reliable watchdog timer (WDT)

Highly reliable WDT that can realize the same functions as those of an external WDT (see page 33).

Remarks

- The detection voltage
- The configuration below enables the operation.
- The on-chip peripheral functions are incorporated.

- 16-bit microcontroller performance combined with low power consumption
- Sophisticated application functions can be realized while maintaining low power consumption.

- Lowered standby power consumption realized through lower standby current and enhanced watch count function
- As a result, energy saving for applications and longer battery life can be achieved.

- Function that implements low power consumption has been added
- RTC (real-time counter)

- No need for updating, with the CPU!
- Calendar function for automatic updating until 2099.
- Sustained watch operation without wake-up! Power consumption can be reduced.
- Built-in alarm function starts the microcontroller at an arbitrary set time (day, hour, minute).

- Highly reliable watchdog timer (WDT)

- Highly reliable WDT that can realize the same functions as those of an external WDT (see page 33).

- Remarks

- The above is an example of using the TM8K57F100. Specifications differ depending on the product.
Low power consumption you can count on (8-bit)

The low power consumption is comparable to that of conventional mask ROM products, allowing you to build more eco-friendly systems.

Low power consumption comparable to that of mask ROM products

Power supply voltage 5 V

<table>
<thead>
<tr>
<th>Conventional mask ROM microcontrollers</th>
<th>Operation mode</th>
<th>Resistor: 22.76 kHz</th>
<th>Operating current</th>
</tr>
</thead>
<tbody>
<tr>
<td>78K0R/K2, 78K0R/K2-L, 78K0R/K2-A</td>
<td>Stop</td>
<td>Resistor: 22.76 kHz</td>
<td>2.3 mA</td>
</tr>
<tr>
<td>78K0S/K2</td>
<td>Stop</td>
<td>Resistor: 22.76 kHz</td>
<td>1.5 mA</td>
</tr>
<tr>
<td>78K0R/K2, 78K0R/K2-A, 78K0R/K2-L</td>
<td>HALT</td>
<td>Resistor: 22.76 kHz</td>
<td>5 μA</td>
</tr>
<tr>
<td>78K0R/K2</td>
<td>STOP</td>
<td>Resistor: 22.76 kHz</td>
<td>3.5 μA</td>
</tr>
</tbody>
</table>

Power supply voltage 3 V

<table>
<thead>
<tr>
<th>Conventional mask ROM microcontrollers</th>
<th>Standby mode</th>
<th>Resistor: 22.76 kHz</th>
<th>Standby current</th>
</tr>
</thead>
<tbody>
<tr>
<td>78K0R/K2, 78K0R/K2-L, 78K0R/K2-A</td>
<td>STOP</td>
<td>Resistor: 22.76 kHz</td>
<td>2.4 μA</td>
</tr>
<tr>
<td>78K0R/K2</td>
<td>STOP</td>
<td>Resistor: 22.76 kHz</td>
<td>1.4 μA</td>
</tr>
<tr>
<td>78K0R/K2</td>
<td>STOP</td>
<td>All clocks stop</td>
<td>0.3 μA</td>
</tr>
<tr>
<td>Remarks: The current values are typical values.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The internal oscillator allows fast startup, eliminating the need for oscillation wait time and reducing average power consumption.

Microcontroller operation starts with internal oscillation clock.

Internal oscillators require almost no wait time for oscillation stabilization.

2. System minimization and cost reductions realized by incorporating circuits required for motor control

Example: Refrigerator

The circuits required for inverter control, such as the amplifier, comparators, noise filters, and A/D converter, which were conventionally provided as external circuits, have been incorporated into the microcontroller. The number of components has been reduced to achieve system minimization and reduce costs.
We offer ideal products for various applications. You can choose the optimal product for your needs.

USB microcontrollers (78K0R/KC3-L, 78K0R/KE3-L)

1. USB 2.0 function interface included on the chip
   To reduce componentry and reduce size, we have integrated a USB 2.0 function interface on the microcontroller chip, so you do not have to connect an external USB chip. We also provide a large number of endpoints so you can use our USB microcontrollers in a wide range of applications.

   **USB specifications**
   - On-chip USB 2.0 function (full-speed) interface
   - USB function interface endpoint configuration: Two endpoints for Control transfers, two endpoints for Bulk transfers, and two endpoints for Interrupt transfers
   - FIFO size: 64 bytes (Bulk transfer × 2), 64 bytes (Control transfer × 2, Interrupt transfer × 2)

2. Extensive USB driver support
   We supply drivers to implement USB function applications, helping you build your system quickly.

   **USB function driver**
   Renesas Electronics provides free sample code.

3. Example applications
   You can use to develop a small-scale, low-power wireless communication system.

Microcontroller for industrial system sensors (µPD78F8043)

Renesas Electronics has commercialized the µPD78F8043, a 16-bit 78K0R microcontroller with an on-chip transceiver that can communicate with IO-Link devices. By using the µPD78F8043, you can build a sophisticated sensor network. We have also provided a software stack to help you develop your system more efficiently.

1. IO-Link
   Many industrial systems today include controllers that operate in combination with multiple sensors and actuators. To respond to the increasing sophistication of these sensors and actuators, today's industrial systems must have capabilities such as acquiring quantitative data using digital communication as well as diagnostic features. IO-Link is a new and popular standard for standardizing communication between the controllers and sensors & actuators in industrial systems.

2. Features of IO-Link
   - Used to connect controllers to sensors and actuators in industrial systems.
   - Comply with the IEC61131-2 standard.
   - Supports asynchronous serial communication and pulse modulation.
   - Supports transmission and reception of quantitative data and parameters, and self-diagnosis.
   - Maximum communication rate: 230.4 kbps
   - Point-to-point connection
   - Operating mode can be switched between IO-Link communication mode and standard I/O mode.
   - Existing cables (M12, etc.) can be used.

3. µPD78F8043 microcontroller with on-chip IO-Link transceiver
   - A 16-bit 78K0R microcontroller with an on-chip IO-Link device transceiver
   - Includes a DMA controller to reduce the software load when transferring data.
   - Has overcurrent and wake-up detection capabilities.
   - We provide a software stack for IO-Link communication that lets you concentrate on developing your application.

RF microcontroller (µPD78F8058)

1. Microcontroller and RF transceiver integrated into a single package
   The µPD78F8058 integrates a 16-bit microcontroller and 2.4 GHz RF transceiver into a single package. Now you can design your system without having to add an external RF transceiver. Your system will have fewer components and can be made much smaller.

   **RF transceiver specifications**
   - Complies with IEEE802.15.4-2006 (modulation system: G-QPSK, spread system: DSSS, communication rate: 250 kbps)
   - PHY block
     - 16 channels operating in a 2.405 to 2.480 GHz ISM band
     - Sensitivity: -95 dBm, input level: 3 dBm (max.)
     - RSSI (received signal strength indicator) ADC and I/Q (in-phase/quadrature phase) DAC included
   - Auto ACK response
   - Security engine

2. Supportive development environment
   Renesas Electronics provides an RF transceiver-compliant starter kit—the TK-RF8058+SB (from TESSERA Technology Inc.)—which you can use to develop a small-scale, low-power wireless communication system. See Connecting (ZigBee®) on the Application examples page for details.

3. Example applications
   - Wireless remote control (RF4CE compliant)
   - Digital TVs
   - Water meters, power meters, etc.
Broad range of products for specific applications you can count on

We offer ideal products for various applications. You can choose the optimal product for your needs.

1. **HDMI™-CEC transmission/reception via hardware**
   Digital AV devices can be mutually controlled by simply connecting them via an HDMI cable.

2. **Improved system operability**
   The CEC circuit and remote control signal receiver are provided as hardware. CEC and remote control can therefore be processed simultaneously and easily. Development efficiency has been improved by reducing the labor required for developing software.

3. **Operating current during HDMI-CEC transmission/reception reduced by 99.8% or more**
   Operation when a DVD is inserted into a DVD recorder.

   - The TV is automatically switched on and the active channel is switched to video input.
   - About 3 mA
   - Operating current corresponding to remote control
   - Operating current corresponding to CEC transmission/reception
   - About 3 mA
   - About 3 mA

4. **Application evaluation board CEC-78K0R/KG3C provided to evaluate HDMI-CEC functions**
   Evaluation boards for testing HDMI-CEC applications are available for the 78K0 and 78K0R. Simply connect the board to a PC to perform testing.

   - The 78K0R/KG3C provides to evaluate HDMI-CEC functions
   - CEC and remote control operations
   - Significant current reduction compared by 99.8% or more
   - Standby current
   - Operating current

**Microcontrollers for power meters (78K0R/Lx3-M, 78K0/Lx3-M)**

Remesas Electronics delivers on a single chip all the functions required to realize a single-phase power meter, making it possible to reduce system size. Extensive peripherals also mean that the 78K0R/Lx3-M and 78K0/Lx3-M can be used for a variety of power meter applications.

**Features:**

- **24-bit \(\Delta\Sigma\) A/D converter (4 channels):** 2 channels for current and 2 channels for voltage
- **High-resolution analog-to-digital conversion**
- **On-chip phase regulator**
- **Detection of active power, reactive power, apparent power, RMS voltage, and RMS current**
- **Active power calculation error:** 0.1% (typ.)
- **Reactive power calculation error:** 0.5% (typ.)
- **Current integration**

**Lineup of products for various application systems**

- **16-bit 78K0R/Lx3-M, 8-bit 78K0/Lx3-M**
- **Memory capacity:** 16 KB to 128 KB of flash, 0.75 KB to 7 KB of RAM
- **Features:**
  - **Enhanced application performance**
  - **Multiple memory configurations**

**Block diagram of power measurement feature**

- **Analog input unit**
- **Power calculation block**
- **Current integrator**
- **Phase adjustment**
- **Digital filter**
- **Apparent power measurement**
- **RMS current, RMS voltage**
- **Digital frequency conversion**
- **Zero-cross detection (1ch)**
- **Peak detection (1ch)**
- **SAG detection (1ch)**
- **Pulselength measurement**

**Remarks:**

- HDMI (High-Definition Multimedia Interface): Standardized digital audio/video I/O interface for home electronics and AV devices.
- CEC (Consumer Electronics Control): Control protocol (control method) for device control signals standardized by HDMI.
- Made by TESSERA Technology Inc.
- Digital AV devices can be controlled by using one remote controller.
We offer ideal products for various applications. You can choose the optimal product for your needs.

Microcontrollers for power supplies, lighting inverters, and LED lighting control (78K0/Ix2), microcontrollers for LED lighting control (µPD78F8025) (T/2)

Renesas Electronics has developed a dedicated driver capable of independently driving lighting control, which can be used to facilitate system configuration. By using the 78K0/Ix2, you can achieve low power consumption through PFC/dimmer control and by linking operations with a network. The µPD78F8025 allows efficient and reliable control thanks to its switching-type constant current driver and extensive on-chip protection circuits, including circuits to prevent overcurrent and overheating.

Lighting ballast control

[Diagram: AC Power Supply, Dimmer control, DALI/RF, Remote control, 8-bit MCU 78K0/Ix2, PFC control, Half-bridge circuit, DC350 V input, 8-bit MCU 78K0/Ix2, Lamp protection]

LED lighting

[Diagram: Lamp protection, DALI/RF, Remote control, LED lighting control (µPD78F8025), Dimmer input]

LED Driver

[Diagram: µPD168804, 4ch High-current LED Driver, µPD168804, 5 V, DC9 V to 38 V, 5 V, 8-bit MCU, µPD78F8024, µPD78F8025]

A wide range of tools to aid the efficient development of high-performance lighting

[Lighting solution evaluation boards]

- Renesas Electronics provides evaluation boards dedicated to each lighting application. Everything you need to evaluate your system, including manuals, circuit diagrams, and development tools, can be downloaded from our website, providing you with fine-tuned, comprehensive development support.

- Solution boards can be evaluated separately. When evaluating lights that feature communication capabilities, each solution board can be evaluated separately in combination with a master evaluation board.

[Automatic software generator] Applilet® EZ for HCD

Applilet EZ for HCD automatically generates sample software for LED lighting, which can then be written to the microcontroller on the board. Applilet EZ for HCD is easy to operate even for first-time users, and will lighten your software development load.
High-performance CPU embedded
We provide reliable performance for system function expansion.

High performance of 30.5 MIPS in a 16-bit microcontroller

- **Performance-enhancing oscillator**
  - Oscillators enable realization of a high-performance watchdog timer, a reduction in the number of external resonators, and improved timer resolution.
  - **78K0R/Kx3**
  - **78K0R/Kx3-L**

**Achieves high performance with 16-bit, 3-stage pipeline architecture**

- 3-stage pipeline, takes 1 clock for 1 instruction

**Reason for high performance**

- Performance-enhancing oscillator
- Achieves high performance with 16-bit, 3-stage pipeline architecture

**Functions for enhancing performance**

- **Multiplier (78K0R)**
  - *16-bit × 16-bit = 32 bits, 32 bits ÷ 32 bits = 32 bits*

- **Multiplier/divider (78K0R/Kx3-L)**

**Flow of time (state) Diagram**

- Fetch
- ID
- MEM

**At 24 MHz operation**

- **78K0R**
  - 30.5 MIPS

**Reason for high performance**

- Performance-enhancing oscillator
- Oscillators enable realization of a high-performance watchdog timer, a reduction in the number of external resonators, and improved timer resolution.

**Multiplier (78K0R/Kx2)**

- Functions:
  - Executes processing of 8 bits × 8 bits = 16 bits
  - Executes processing of 16 bits × 16 bits = 32 bits

**Multiplier/divider (78K0R/Kx3-L)**

- Multiplication/division block
- Data flow during multiplication
- Data flow during division

---

**Data exchanges can be performed automatically between the special function register (SFR) of the peripheral hardware and the internal RAM without the CPU, using interrupts from the timer, serial interface, or A/D converter, or software triggers.**
Transmission unit
LIN-UART (78K0R/Hx3)
CSI
ANO 1
High performance and function and simple I²C function with one channel. Using two channels, a full-duplex UART function can be realized.
The serial array unit provides one shift register and one buffer register per channel, allowing the configuration of a 3-wire serial communication
On-chip timer unit incorporating one 16-bit counter and one capture/compare register
• Interval timer
• Frequency divider function
• External event counter
• Input pulse interval measurement
Transfer rate: Up to 1 Mbps

Functions
The following serial communication functions can be selected.
• CSI
• UART
• Simple I²C

Serial array unit (78K0R)
The serial array unit provides one shift register and one buffer register per channel, allowing the configuration of a 3-wire serial communication function and simple I²C function with one channel. Using two channels, a full-duplex UART function can be realized.

Example: In the case of the 78K0R/KG3:
• Interval counting for up to 8 channels is possible.
• PWM output for up to 7 channels is possible.

ON-chip timer unit incorporating one 16-bit counter and one capture/compare register
• Interval timer
• Frequency divider function
• External event counter
• Input pulse interval measurement

PWM output through combination of multiple timers

Example: In the case of the 78K0R/Kx3:
• 5-phase sine-wave PWM output and 2-phase modulation are possible.
• Full-bridge drive for 2 channels is possible.
• Full-bridge drive is possible.

Serial array unit (78K0R)
The following serial communication functions can be selected.
• CSI
• UART
• Simple I²C

CAN controller (78K0R/Hx3)
• Complies with CAN protocol standard ISO 11898.
• Both standard and extended frames can be sent and received.
• Transfer rate: Up to 1 Mbps
• On-chip 16-message buffer

LIN-UART (78K0R/Hx3)
• Communication using 8-bit data possible
• Transfer rate: Up to 1 Mbps
• On-chip 18-message buffer (using 2 channels)
• Hardware-based auto baud rate correction capability (slave)

CPU that can inherit 8-bit microcontroller resources.
Instructions have been added to further raise efficiency and performance.

Enhanced analog features (78K0R/Lx3*, 78K0R/Kx3-A, 78K0/Kx2-A*)

These high-performance and easy-to-use 16-bit microcontrollers provide excellent compatibility with 8-bit microcontrollers. (78K0R)

Upward compatible for instructions from 8-bit microcontrollers
CPU that can inherit 8-bit microcontroller resources.
Instructions have been added to further raise efficiency and performance.

Major pins are pin compatible
In terms of hardware design, the pin configuration of the 78K0/Kx2, such as the major power supplies, has been adopted.
Applications employing our flash microcontrollers can be found in all our flash microcontrollers, making them a safe choice.

A flash security setting function is provided to protect your software from malicious rewriting and reading.

The enhanced watchdog timer (WDT) offers improved reliability and functionality equivalent to that of an external WDT.

The watchdog timer incorporates enhanced functions.

A boot swap function is incorporated to enable important system operation settings by hardware, eliminating setting errors caused by inadvertent program loops.
Rich development environment you can count on (1/2)

### Various development environments for each development phase are available.

#### Lineup of development environment (78K0R)

<table>
<thead>
<tr>
<th>Test board</th>
<th>Target board for E1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter kit</td>
<td>Made by TESSERA Technology Inc.</td>
</tr>
</tbody>
</table>

- **Software development**
  - Integrated development environment (Cubitool; Free evaluation version available)
  - Software packages
    - Assembler (RA78K0R), Compiler (CC78K0R)
  - Device driver configurator (Applied for 78K0RKG3, 78K0RKE3L, 78K0RIE3, 78K0RKG3C, 78K0RKG3L)
  - Simulator (Sim-78K0R; for 78K0R, 78K0R/Kx3)

- **Debugging/verification**
  - On-chip debugging emulator with programming function (E1)
  - Flash memory programmer PG-FP5

- **Writing**
  - Full-spec emulator (IECUBE®)
  - On-chip debugging emulator with programming function (E1)

Note: A conversion adapter (QB-F14T16-01) is required to connect the E1 to the target boards (for MINICUBE2) at right.

#### Lineup of development environments (78K0S, 78K0)

<table>
<thead>
<tr>
<th>Test board</th>
<th>Development environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter kit</td>
<td>Made by Sunhayato Corporation</td>
</tr>
</tbody>
</table>

- **Software development**
  - Integrated development environment (CubeSuite+; Free evaluation version available)
  - Software packages
    - Assembler (RA78K0S), Compiler (CC78K0S)
  - Device driver configurator (Applied for 78K0SKB1, 78K0SKB1+)
  - Simulator (Sim-78K0S; for 78K0S, 78K0S/Kx3)

- **Debugging/verification**
  - On-chip debugging emulator with programming function (MINICUBE2)
  - On-chip debugging emulator (E1)

- **Writing**
  - Full-spec emulator (IECUBE®)
  - Flash memory programmer (Free evaluation version available)

#### Product-specific peripheral function settings automatically and easily generated with Applilet®

"Significant man-hours are required to develop and modify software from existing chips". We propose developing environments to support such situations.

### Significant man-hours are required to develop and modify software from existing chips.

We propose developing environments to support such situations.

- **Software resources**
  - Product-specific peripheral function settings

- **Transported**
  - C sources can be transported almost as is

<table>
<thead>
<tr>
<th>78K0R</th>
<th>Coding</th>
<th>Compile</th>
<th>Operation test</th>
<th>Debug evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### We provide inexpensive, easy-to-use, and convenient development environments, allowing you to select the best development environment according to the device and development conditions.

<table>
<thead>
<tr>
<th>Development environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller training kit</td>
</tr>
<tr>
<td>Starter kit for quick microcontroller programming</td>
</tr>
<tr>
<td>Test boards for use with on-chip debuggers</td>
</tr>
<tr>
<td>Pitch conversion board</td>
</tr>
</tbody>
</table>

- **Software development**
  - Software package (SP78K0S)
    - Assembler (RA78K0S), Compiler (CC78K0S)
  - Device driver configurator (Applied for 78K0SKB1, 78K0SKB1+)
  - Simulator (Sim-78K0S; for 78K0S, 78K0S/Kx3)

- **Debugging/verification**
  - On-chip debugging emulator with programming function (MINICUBE2)
  - On-chip debugging emulator (E1)

- **Writing**
  - Full-spec emulator (IECUBE®)
  - Flash memory programmer (Free evaluation version available)

### Development environment

- **8-bit ON-chip debugging emulator with programming function**
  - MINICUBE2
  - MINICUBE2 wireless option
  - Flash programmer software
  - Rezones Flash Programmer (Free evaluation version available)

### Development environment

- **8-bit ON-chip debugging emulator with programming function**
  - MINICUBE2
  - MINICUBE2 wireless option
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### Development environment

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  - MINICUBE2 wireless option
  - Flash programmer software
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Rich development environment you can count on (2/2)

Hardware tool

IECUBE (Full-spec emulator)

- Hardware tool
- IECUBE (Full-spec emulator)
- USB cable
- CD-ROM (Debugger, etc.)

78K0S microcontroller
78K0R microcontroller
78K02 microcontroller
78K02R microcontroller

10-pin and 14-pin products

Target cable (14-pin single wire)

<1> Check pin adapter/device
- Adapter used for waveform observation with an oscilloscope, etc.

<2> Emulation probe
- Flexible-type emulation probe

<3> Exchange adapter
- Adapter that is used for pin conversion from IECUBE to the target connector according to the type of device

<4> Space adapter
- Adapter that adjusts the difference between the height of the target system and that of IECUBE, if necessary

<5> Mount adapter
- Adapter for mounting microcontrollers

<6> YQ connector
- Conversion adapter that connects the target connector to the exchange adapter

<7> Target connector
- Connector for mounting the microcontroller on the target system

Recommended target pin header
Specifications:
- Length: 0.635 mm
- Width: 0.635 mm
- Height: 6 mm

Note: For detailed information on system configurations when using IECUBE, see the electronic version of Development Environment Product List (available at: http://japan.renesas.com/tool_catalog).

Flash memory programmer

Product Name: 78K0S microcontroller
Package Content: ID78K0S-QB

- Product planning
- System design
- Software design
- Production
- Unit inspection
- System debugging
- System evaluation
- Communication

- Project planning
- Software design
- Production
- Product planning
- Production
- Software design
- System evaluation
- Communication

- Project manager
- Real-time OS
- Device driver configurator
- Compiler/assembler
- System simulator
- Assembler
- Project manager
- Software package
- Integrated development environment CubeSuite+ (Free evaluation version available)

- Integrated development environment CubeSuite+ (Free evaluation version available)

- Software design
- Coding
- Compilation/assembly
- Debugging
- Integrated debugger
- Flash programmer software / Self-programming library

- Device driver configurator
- Application
- Project manager
- C compiler
- Memory manager
- System simulator
- Software package
- Integrated development environment CubeSuite+ (Free evaluation version available)

- Flash memory can be programmed by using the microcontroller itself, and execute high-speed building.

- Software package
- Project manager, C compiler, assembler, system simulator (part)/Integrated debugger, etc., provided on a single CD-ROM disk.

Software development environment

- CubeSuite+2
- CubeSuite+3
- CubeSuite+4
- CubeSuite+5
- CubeSuite+6
- CubeSuite+7

- CubeSuite+5

- CubeSuite+6

- CubeSuite+7

- CubeSuite+8

- CubeSuite+9

- CubeSuite+10

- CubeSuite+11

- CubeSuite+12

- CubeSuite+13

- CubeSuite+14

- CubeSuite+15

- CubeSuite+16

- CubeSuite+17

- CubeSuite+18

- CubeSuite+19

- CubeSuite+20

- CubeSuite+21

- CubeSuite+22

- CubeSuite+23

- CubeSuite+24

- CubeSuite+25

- CubeSuite+26

- CubeSuite+27

- CubeSuite+28

- CubeSuite+29

- CubeSuite+30

- CubeSuite+31

- CubeSuite+32

- CubeSuite+33

- CubeSuite+34

- CubeSuite+35

- CubeSuite+36

- CubeSuite+37

- CubeSuite+38

- CubeSuite+39

- CubeSuite+40

- CubeSuite+41

- CubeSuite+42

- CubeSuite+43

- CubeSuite+44

- CubeSuite+45

- CubeSuite+46

- CubeSuite+47

- CubeSuite+48

- CubeSuite+49

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- CubeSuite+51

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- CubeSuite+70

- CubeSuite+71

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- CubeSuite+80

- CubeSuite+81

- CubeSuite+82

- CubeSuite+83

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- CubeSuite+170

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- CubeSuite+189

- CubeSuite+190

- CubeSuite+191

- CubeSuite+192

- CubeSuite+193

- CubeSuite+194

- CubeSuite+195

- CubeSuite+196

- CubeSuite+197

- CubeSuite+198

- CubeSuite+199

- CubeSuite+200

- CubeSuite+201

- CubeSuite+202

- CubeSuite+203

- CubeSuite+204

- CubeSuite+205

- CubeSuite+206

- CubeSuite+207

- CubeSuite+208

- CubeSuite+209

- CubeSuite+210

- CubeSuite+211

- CubeSuite+212

- CubeSuite+213

- CubeSuite+214

- CubeSuite+215

- CubeSuite+216

- CubeSuite+217

- CubeSuite+218

- CubeSuite+219
Support for mass production you can count on

Mass production support environment for your needs.
You can select the mass production method with the largest merit, according to delivery time or mass production quantity.

<table>
<thead>
<tr>
<th>Programming by the customer</th>
</tr>
</thead>
</table>

**Delivery time**: Practically none, highly flexible
- Flash memory programmers
- Various products selectable for your purposes and price range

**Flexible support for small-volume programming and short delivery time**
- The following programming service partners support microcontrollers manufactured by Renesas Electronics.
  - Stick GANG Writer* TESSERA Technology Inc.
  - StickWriter* TESSERA Technology Inc.
  - FM-ONE Hokuto Electronic Co., Ltd.
  - AF910+AF9723B Flash Support Group, Inc.
  - PG-FP5 Renesas Electronics
  - NET IMPRESS series* Yokogawa Digital Computer Corporation
  - Y3000-8® Wave Technology Co., Ltd.

Programmed products (Renesas Electronics)

Shipment form same as that of mask ROM microcontrollers
- The same way as mask ROM microcontrollers, programmed products can be delivered with a short TAT.

External programming (programming service partners)

Ordering service partner  Delivery time*: Several days
- Renesas Electronics  Delivery time*: About 1/2 that of mask

For details of ordering or delivery time, please contact the nearest service partner.

**Application examples**

Various functions achieved with 78K0, 78K0R All Flash features and libraries
New functions can be easily constructed. One example is introduced below.

**Speaking (ADPCM: Adaptive Differential Pulse Code Modulation)**

System control and voice function now in one chip! Contributes to reduced costs.

**Conventional**

- 78K0, 78K0R

**Compact!**

- 78K0R UD Stick

**Voice data**

- 78K0R UD Stick

**Adaptation**

- The bath is ready.

**Speaker**

- Water heater controller

**Evaluation environment to support “speaking”**

**Voice conversion tool**

- Voice conversion tool (Wave~ADPCM)

**Evaluation board lineup**

- [Board made by TESSERA Technology Inc.]
  - [TK-78K0R/NG3+4UD]
    - 16-bit microcontroller
    - 78K0R/KE3 mounted
    - Internal ROM: 512 KB
    - Internal RAM: 30 KB
  - [TK-RF808+SB]
    - 16-bit microcontroller
    - RF receiver nRF2401 mounted
    - Internal ROM: 128 KB
    - Internal RAM: 8 KB
  - [78K0R UD Stick]
    - 16-bit microcontroller
    - 78K0R/KE3 mounted
    - Internal ROM: 256 KB
    - Internal RAM: 12 KB

**Our All Flash microcontrollers comply with ZigBee PRO, providing total support for low-power wireless network applications.** You can start developing your application straight away.

Connecting (ZigBee®)

- [ZigBee PRO, SimpleNET application]
  - [TK-78K0R/NG3+4UD]

- [Evaluation board lineup]
  - [Board made by TESSERA Technology Inc.]
  - [TK-78K0R/NG3+4UD]
    - 16-bit microcontroller
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    - Internal ROM: 256 KB
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**ZigBee SDK (software development kit)**

A protocol stack library that enables the establishment of wireless communication, diagnosis, and debugging through the use of Network Viewer, Sniffer, and other tools on your computer is included.
- The kit supports the ZigBee PRO, SimpleNET, and RF4CE standards.

*Product co-developed by Skyler Networks, Inc. and Renesas Electronics.
### Product specifications

<table>
<thead>
<tr>
<th>Commercial name</th>
<th>78K0R/KE3</th>
<th>78K0R/KF3</th>
<th>78K0R/KG3</th>
<th>78K0R/KH3</th>
<th>78K0R/KJ3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin count</td>
<td>64-pin</td>
<td>80-pin</td>
<td>100-pin</td>
<td>128-pin</td>
<td>144-pin</td>
</tr>
<tr>
<td>PIN count</td>
<td>64-pin</td>
<td>80-pin</td>
<td>100-pin</td>
<td>128-pin</td>
<td>144-pin</td>
</tr>
<tr>
<td>Flash memory (bytes)</td>
<td>64 K</td>
<td>96 K</td>
<td>128 K</td>
<td>192 K</td>
<td>256 K</td>
</tr>
<tr>
<td>RAM (bytes)</td>
<td>-4 K</td>
<td>-6 K</td>
<td>-8 K</td>
<td>10 K</td>
<td>12 K</td>
</tr>
<tr>
<td>External bus interface</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>8KB</td>
<td>824 K</td>
</tr>
<tr>
<td>Bus type</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Multiplied/separate</td>
<td>Multiplied/separate</td>
</tr>
<tr>
<td>Address bus</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Selectable from 8, 16, and 32</td>
<td>Selectable from 8, 16, and 32</td>
</tr>
<tr>
<td>Data bus</td>
<td>8/16 bits</td>
<td>8/16 bits</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>1.8 to 5.5 V</td>
<td>2.7 to 5.5 V</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Minimum instruction execution time</td>
<td>0.05 µs (20 MHz: VDD = 2.7 to 5.5 V), 0.2 µs (5 MHz: VDD = 1.8 to 5.5 V)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Clock</td>
<td>High-speed system clock</td>
<td>High-speed internal oscillation clock</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Subclock</td>
<td>Crystal 32.768 kHz</td>
<td>240 kHz (Typ.)/(for WDT)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>I/O ports</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Total</td>
<td>88</td>
<td>64</td>
<td>110</td>
<td>133</td>
<td>133</td>
</tr>
<tr>
<td>CMOS I/O</td>
<td>46</td>
<td>61</td>
<td>79</td>
<td>107</td>
<td>107</td>
</tr>
<tr>
<td>CMOS input</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>CMOS output</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N-ch open-drain</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Timer</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>16-bit timer</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Function</td>
<td>PWM</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Watchdog timer (WDT)</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
</tr>
<tr>
<td>Real-time counter (RTC)</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
</tr>
<tr>
<td>Serial interface</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>CSI: 2 channels, UART: 1 channel</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>CSI: 1 channel, UART: 1 channel</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>CSI: 2 channels, UART: 1 channel, simple I/O: 2 channels</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CSI: 1 channel, UART: 1 channel, simple I/O: 1 channel</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>CSI: 2 channels, UART (supporting LIN): 1 channel</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>CSI: 1 channel, simple I/O: 1 channel</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>CSI</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>UART: 1 channel, simple I/O: 1 channel</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>UART (supporting LIN)</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
</tr>
<tr>
<td>Simple I/O</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>I/O</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
</tr>
<tr>
<td>LCD controlled driver</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>A/D converter</td>
<td>10 bits x 8</td>
<td>10 bits x 8</td>
<td>10 bits x 16</td>
<td>10 bits x 16</td>
<td>10 bits x 16</td>
</tr>
<tr>
<td>D/A converter</td>
<td>8 bits x 2</td>
<td>8 bits x 2</td>
<td>8 bits x 2</td>
<td>8 bits x 2</td>
<td>8 bits x 2</td>
</tr>
<tr>
<td>DMA controller</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
<td>1 channel</td>
</tr>
<tr>
<td>Interrupt</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>External</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Internal</td>
<td>25</td>
<td>28</td>
<td>28</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>On-chip debug</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Multiplier/divider</td>
<td>Supported</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Low-voltage detector (OVL)</td>
<td>1.91/0.07 (initial value)/2.20/1.98/2.53/2.08/2.84/2.98/3.15</td>
<td>3.3/2.45/3.01/3.76/3.5/4.073.27 V (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Power-on clear (POC)</td>
<td>1.5 V (±0.05 V)</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td>Other peripheral functions</td>
<td>Key interrupt function</td>
<td>—</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td>Operating temperature</td>
<td>—40 to +85°C</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

* 0.1 µs when the self programming function is used.
* 0.26 µs when the self programming function is used.
<table>
<thead>
<tr>
<th>Product specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating temperature</strong></td>
</tr>
<tr>
<td><strong>Power-on clear (POC)</strong></td>
</tr>
<tr>
<td><strong>Multiplier/divider</strong></td>
</tr>
<tr>
<td><strong>On-chip debug</strong></td>
</tr>
<tr>
<td><strong>Low-voltage detector (SVL)</strong></td>
</tr>
<tr>
<td><strong>Power-on clear (POC)</strong></td>
</tr>
<tr>
<td><strong>Other peripheral functions</strong></td>
</tr>
<tr>
<td><strong>Operating temperature</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product name</th>
<th>40-pin</th>
<th>44-pin</th>
<th>48-pin</th>
<th>52-pin</th>
<th>64-pin</th>
<th>80-pin</th>
<th>100-pin</th>
<th>48-pin</th>
<th>64-pin</th>
<th>64-pin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flash memory (bytes)</strong></td>
<td>16 K</td>
<td>32 K</td>
<td>48 K</td>
<td>64 K</td>
<td>16 K</td>
<td>32 K</td>
<td>48 K</td>
<td>64 K</td>
<td>64 K</td>
<td>64 K</td>
</tr>
<tr>
<td><strong>RAM (byte)</strong></td>
<td>1 K</td>
<td>1.5 K</td>
<td>2 K</td>
<td>3 K*</td>
<td>1 K</td>
<td>1.5 K</td>
<td>2 K</td>
<td>3 K*</td>
<td>1.5 K</td>
<td>2 K</td>
</tr>
<tr>
<td><strong>External bus interface</strong></td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
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<td>--</td>
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<tr>
<td><strong>Bus type</strong></td>
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</tr>
<tr>
<td><strong>Address bus</strong></td>
<td>--</td>
<td>--</td>
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<td>--</td>
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</tr>
<tr>
<td><strong>Data bus</strong></td>
<td>--</td>
<td>--</td>
<td>--</td>
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<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
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</tr>
<tr>
<td><strong>Power supply voltage</strong></td>
<td>Normal operation mode</td>
<td>Flash memory programming mode</td>
<td>Normal operation mode</td>
<td>Flash memory programming mode</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>1.8 to 5.5 V</td>
<td>3.3 to 3.6 V (1.6 to 3.6 V when USB not used)</td>
<td>1.8 to 5.5 V</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Minimum instruction execution time</strong></td>
<td>0.05 µs (20 MHz: ( V_{DD} = 2.7 ) to 3.3 V, 2.05 µs (5 MHz: ( V_{DD} = 1.8 ) to 2.7 V)</td>
<td>1.8 to 3.6 V</td>
<td>1.8 to 5.5 V</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clock</strong></td>
<td>Main clock</td>
<td>High-speed system clock</td>
<td>High-speed internal oscillation clock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Crystal/crystal/external clock 2 to 20 MHz</strong></td>
<td>1 MHz ±13%, 6 MHz ±1.6%, 20 MHz ±2.4%</td>
<td>33</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subclock</strong></td>
<td>--</td>
<td>Crystal: 32-768 kHz</td>
<td>Crystal: 32-768 kHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Low-speed internal oscillation clock</strong></td>
<td>30 kHz ±10% (for WDT)</td>
<td>30 kHz ±10% (for WDT)</td>
<td>30 kHz ±10% (for WDT)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>I/O ports</strong></td>
<td>Total</td>
<td>CMOS I/O</td>
<td>CMOS input</td>
<td>CMOS output</td>
<td>N/C open drain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>33</td>
<td>37</td>
<td>41</td>
<td>45</td>
<td>53</td>
<td>71</td>
<td>89</td>
<td>20³</td>
<td>53³</td>
<td></td>
</tr>
<tr>
<td><strong>CMOS I/O</strong></td>
<td>33</td>
<td>33</td>
<td>34</td>
<td>48</td>
<td>62</td>
<td>60</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
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<tr>
<td><strong>CMOS input</strong></td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<tr>
<td><strong>CMOS output</strong></td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>--</td>
<td>1</td>
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<tr>
<td><strong>N/C open drain</strong></td>
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<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>Timer</strong></td>
<td>12 bit timer</td>
<td>Number of channels</td>
<td>Function</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of channels</strong></td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>12</td>
<td>8</td>
<td>12</td>
<td>8</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td>Interval time/external event counter/pulse frequency division function/pulse internal measurement/pulse width measurement/one-shot pulse output/PWM output</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>PWM</strong></td>
<td>6 channels max.</td>
<td>7 channels max.</td>
<td>7 channels max.</td>
<td>7 channels max.</td>
<td>7 channels max.</td>
<td>10 channels max.</td>
<td>10 channels max.</td>
<td>3 channels max.</td>
<td>5 channels max.</td>
<td>7 channels max.</td>
</tr>
<tr>
<td><strong>Watching timer (WDT)</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td><strong>Real-time clock (RTC)</strong></td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
</tr>
<tr>
<td><strong>Serial interface</strong></td>
<td>CSI 2 channels, UART 1 channel</td>
<td>CSI 2 channel, UART 1 channel</td>
<td>CSI 2 channel, UART 1 channel, simple PC 1 channel: 2 channels</td>
<td></td>
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<tr>
<td><strong>CSI 2 channel, UART 1 channel</strong></td>
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<tr>
<td><strong>CSI 1 channel, UART 1 channel</strong></td>
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</tr>
<tr>
<td><strong>CSI 2 channel, UART 1 channel, simple PC 1 channel</strong></td>
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</tr>
<tr>
<td><strong>CSI, UART 2 channel, simple PC 1 channel</strong></td>
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</tr>
<tr>
<td><strong>CSI, UART 2 channel, simple PC 1 channel</strong></td>
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<tr>
<td><strong>CSI, UART 1 channel, simple PC 1 channel</strong></td>
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</tr>
<tr>
<td><strong>UART (supporting LIN)</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td><strong>Simple PC</strong></td>
<td>--</td>
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<tr>
<td><strong>F/C</strong></td>
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<tr>
<td><strong>LED controlled driver</strong></td>
<td>--</td>
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<tr>
<td><strong>Segment signal output</strong></td>
<td>--</td>
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<tr>
<td><strong>Common signal output</strong></td>
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<td>--</td>
<td>--</td>
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</tr>
<tr>
<td><strong>A/D converter</strong></td>
<td>10 bits × 10</td>
<td>10 bits × 10</td>
<td>10 bits × 10</td>
<td>10 bits × 10</td>
<td>10 bits × 12</td>
<td>10 bits × 12</td>
<td>12 bits × 12</td>
<td>10 bits × 8</td>
<td>10 bits × 8</td>
<td>12 bits × 10</td>
</tr>
<tr>
<td><strong>D/A converter</strong></td>
<td>--</td>
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<td></td>
</tr>
<tr>
<td><strong>DMA controller</strong></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
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<tr>
<td><strong>Interrupt</strong></td>
<td>External</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>13</td>
<td>7</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td><strong>Internal</strong></td>
<td>22</td>
<td>24</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>33</td>
<td>35</td>
<td>33</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td><strong>On-chip debug</strong></td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1.2 KB when the self programming function is used.
*2.7 KB when the self programming function is used.
*3.11 KB when the self programming function is used.**4. One is for controlling the USB buffer.
*5.1.01% when the self programming function is used.**6.1.01% when the self programming function is used.**7.1.01% when the self programming function is used.**8.1.01% when the self programming function is used.
## Product specifications

### (16-bit 3/4)

<table>
<thead>
<tr>
<th>Pin count</th>
<th>80-pin</th>
<th>100-pin</th>
<th>48-pin</th>
<th>64-pin</th>
<th>80-pin</th>
<th>100-pin</th>
<th>56-pin</th>
<th>56-pin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Popular product</strong></td>
<td><strong>78K0R/KF3-C</strong></td>
<td><strong>78K0R/KG3-C</strong></td>
<td><strong>78K0R/HE3</strong></td>
<td><strong>78K0RF/H5</strong></td>
<td><strong>78K0RF/H5</strong></td>
<td><strong>µPD78F8043</strong></td>
<td><strong>µPD78F8058</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Flash memory (bytes)
- 96 K
- 128 K
- 256 K
- 512 K

### RAM (byte)
- 6 K
- 8 K
- 8 K
- 4 K
- 4 K
- 2 K
- 1 K
- 1 K

### External bus interface
- External memory expansion space
- Bus type
- Address bus
- Data bus

### Power supply voltage
- Normal operation mode: 2.7 to 5.5 V
- Power-on clear (POC) voltage: 2.7 to 5.5 V

### Minimum instruction execution time
- 0.05 μs (32 MHz, VDD = 2.7 to 5.5 V)

### Clock
- High-speed system clock: Ceramic/crystal/external clock: 2 to 20 MHz
- High-speed internal oscillation clock: 4 MHz (±2% target), 8 MHz (±2% target)

### Power-on clear
- Voltage: 1.59 V

### Pin count
- 80-pin
- 100-pin
- 48-pin
- 64-pin
- 80-pin
- 100-pin
- 56-pin
- 56-pin

### Remarks
The specifications of products still under development are subject to change without notice.

### Multiplex I/O

<table>
<thead>
<tr>
<th>Multiplexing: 16 bits</th>
<th>16 bits</th>
<th>16 bits</th>
<th>16 bits</th>
<th>16 bits</th>
<th>16 bits</th>
<th>16 bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>32 bits</td>
<td>32 bits</td>
<td>32 bits</td>
<td>32 bits</td>
<td>32 bits</td>
<td>32 bits</td>
</tr>
</tbody>
</table>

### Operating temperature
- -40 to +85°C

### Power-on clear
- Minimum: 1.61 V
- Maximum: 1.89 V

### Other peripheral functions
- CAN controller, data flash memory, 16 KB, bus interrupt function

### The specifications of products still under development are subject to change without notice.
**Product specifications (16-bit 4/4)**

<table>
<thead>
<tr>
<th>Commercial name</th>
<th>78K0R/B3</th>
<th>78K0R/IC3</th>
<th>78K0R/E3</th>
<th>78K0R/E4</th>
<th>78K0R/LF3</th>
<th>78K0R/LG3</th>
<th>78K0R/LH3</th>
<th>78K0L3-1F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin count</td>
<td>30-pin</td>
<td>38-pin</td>
<td>44-pin</td>
<td>48-pin</td>
<td>52-pin</td>
<td>64-pin</td>
<td>80-pin</td>
<td>100-pin</td>
</tr>
</tbody>
</table>

- **Flash memory (bytes)**: 16 K, 32 K, 16 K, 16 K, 32 K, 48 K, 64 K, 32 K, 48 K, 64 K, 32 K, 48 K, 64 K, 64 K, 96 K, 1.08 K, 64 K, 96 K, 128 K, 64 K, 96 K, 128 K, 128 K
- **RAM (byte)**: 1 K, 1.5 K, 1 K, 1.5 K, 1 K, 1.5 K, 2 K, 3 K, 1.5 K, 2 K, 3 K, 1.5 K, 2 K, 3 K, 4 K, 6 K, 7 K, 4 K, 6 K, 7 K, 4 K, 6 K, 7 K, 4 K, 6 K, 7 K, 4 K, 6 K, 7 K
- **External bus**
  - External memory expansion space
  - Bus type
  - Address bus
  - Data bus
- **Other peripheral functions**
  - Low-voltage detector (LVI)
  - DMA controller
  - D/A converter
  - A/D converter
  - Serial interface
  - Power supply voltage
  - Flash memory programming mode
  - Minimum instruction execution time (μs)
    - Main clock: 0.05 (30 MHz, VDD = 2.7 to 5.5 V)
    - Low-speed internal clock:
      - 8 MHz ± 1.5%, 40 MHz ± 2.5%, 4.6 K ± 1.5%, 1 MHz ± 15%, 8.0 MHz ± 12%, 20 MHz ± 1.5% (16-bit)
      - 16 kHz (70% BS)
  - Subclock
    - Crystal: 32.768 kHz (25 kHz ± 10%, low WDT)
    - Crystal: 32.768 kHz (30 kHz TYP)
  - I/O ports
    - 7 channels max., 9 channels max., 9 channels max., 6 channels max., 6 channels max., 11 channels max., 5 channels max., 7 channels max., 10 channels max.
  - 16-bit timer
    - Number of channels: 12, 12
    - Function: Internal timer, external event counter, frequency division function, PWM output, pulse measurement, pulse width measurement, one-shot pulse output
    - PWM output: 3-phase sine-wave AC converter trigger output
  - Serial interface
    - SCI: 2 channels, UART: 1 channel
    - SCI: 2 channels, UART: 1 channel
    - SCI: 2 channels, UART: 1 channel, simple I2C: 2 channels
    - SCI: 1 channel, UART: 1 channel, simple I2C: 1 channel
    - SCI: 2 channels, UART: 2 channels (supporting LIN): 1 channel
    - SCI: 1 channel, simple I2C: 1 channel
    - UART (supporting LIN)
    - UART
    - Simple I2C
    - I²C
  - LCD controlled display
    - Supported
    - Display method can be switched between internal voltage boosting, capacitive division, and external resistance division.
  - I/O converter
    - 10 bits = 0, 10 bits = 8, 10 bits = 10, 10 bits = 11, 10 bits = 12
    - 12 bits = 0, 12 bits = 8, 12 bits = 12
    - 12 bits = 2, 12 bits = 4
  - DMA controller
    - 2, 2, 2
  - Interrupt
    - External: 6, 8, 8, 8, 8, 8, 8, 12, 12, 13, 13, 13, 13, 33, 33
    - Internal
    - Power-off clear (POC)
    - Power-on reset: 1.61 V ± 0.09 V, power-down reset: 1.59 V ± 0.09 V
    - Operating temperature
      - -40 to +85°C
  - Other peripheral functions
    - Comparator 2 channels, programmable gain amplifier: 1 channel
    - Operational amplifier 3 channels, key interrupt function
    - Operational amplifier 3 channels, key interrupt function
    - Operational amplifier 3 channels, key interrupt function

*1: 3.0V when the soft programming function is used.
*2: The 40 MHz clock is only supplied to the timer array unit and the 20 MHz clock is supplied to the CPU and peripheral functions.
*3: 3-phase sine-wave PWM output full-bridge drive is disabled when LIN is used. Half-bridge drive is also restricted to 1 channel.
*4: Vout is the sum of the number of output signals when clock. Signal is used.
*5: The A/D converter has 10-bit resolution in the µPD78F151A.
*6: Not available in the µPD78F151A.
<table>
<thead>
<tr>
<th>Function</th>
<th>Number of channels</th>
<th>78K0S/KU1+</th>
<th>78K0S/KY1+</th>
<th>78K0S/KA1+</th>
<th>78K0S/KB2</th>
<th>78K0S/KC2</th>
<th>78K0S/KD2</th>
<th>78K0S/KE2</th>
<th>78K0S/KF2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer</td>
<td>16-bit timer (TIM)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Function</td>
<td>Internal timer/event counter/PIC output/pulse width measurement/8-bit square-wave output/one-shot pulse output</td>
<td>Internal timer/event counter/PIC output/pulse width measurement/8-bit square-wave output/one-shot pulse output</td>
<td>Internal timer/PWM output/8-bit square-wave output</td>
<td>Internal timer/PWM output/8-bit square-wave output</td>
<td>Internal timer/PWM output/8-bit square-wave output</td>
<td>Internal timer/PWM output/8-bit square-wave output</td>
<td>Internal timer/PWM output/8-bit square-wave output</td>
<td>Internal timer/PWM output/8-bit square-wave output</td>
</tr>
<tr>
<td>Serial interface</td>
<td>UART (supporting LIN)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>UARF</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>UART/CSI</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>CSI</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Automatic transmit/receive 3-way CSI</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>PC</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>A/D converter</td>
<td>Successive approximation</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Intertap</td>
<td>External</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>9</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Maximum number of segments displayed in LCD</td>
<td>8 commons</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>4 commons</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Multiplid/holder</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Low-voltage detector (LVR)</td>
<td>2.35/2.6 V (0.15 V or 1.25 V) or 15.3/15.5 V (0.15 V or 1.25 V)</td>
<td>10 bits (32-bit) ≤ 16-bit</td>
<td>10 bits (32-bit) ≤ 16-bit</td>
<td>10 bits (32-bit) ≤ 16-bit</td>
<td>10 bits (32-bit) ≤ 16-bit</td>
<td>10 bits (32-bit) ≤ 16-bit</td>
<td>10 bits (32-bit) ≤ 16-bit</td>
<td>10 bits (32-bit) ≤ 16-bit</td>
<td>10 bits (32-bit) ≤ 16-bit</td>
</tr>
<tr>
<td>Power-on clear (POC)</td>
<td>1.59 V (3.0 V)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Other</td>
<td>Operating temperature</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

*1: Only supported in the µPD78F0503DA, 78F0510DA, 78F0511DA, 78F0512DA, 78F0513DA, and 78F0514DA. Connect to a ceramic or crystal resonator.

*2: Only supported in the µPD78F0513DA, 78F0514DA, 78F0515DA, 78F0527DA, 78F0537DA, and 78F0547DA.
**Product specifications**

(8-bit 2/3)

<table>
<thead>
<tr>
<th>CPU core</th>
<th>Commercial name</th>
<th>Pin count</th>
<th>Flash memory (bytes)</th>
<th>RAM (bytes)</th>
<th>Power supply voltage</th>
<th>Minimum execution resolution time</th>
<th>Clock</th>
<th>Subclock</th>
<th>Low-speed internal oscillator</th>
<th>I/O ports</th>
<th>Timer</th>
<th>Serial interface</th>
<th>A/D converter</th>
<th>Interrupt</th>
<th>Maximum number of segments displayed in LCD</th>
<th>Multiplier/divider</th>
<th>PVoltage (V)</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>78K0</td>
<td>78K0/KY2-L</td>
<td>16-pin</td>
<td>8 K</td>
<td>512/384</td>
<td>1.8 to 5.5 V</td>
<td>0.1 μs (10 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td>UART (supporting LIN)</td>
<td>10 bits x 4</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78K0</td>
<td>78K0/KAZ2-L</td>
<td>20/25-pin</td>
<td>16 K</td>
<td>384/512</td>
<td>2.0 to 5.5 V</td>
<td>0.1 μs (20 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>24</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78K0</td>
<td>78K0/KB2-L</td>
<td>30-pin</td>
<td>3 K</td>
<td>512/384</td>
<td>1.8 to 5.5 V</td>
<td>0.1 μs (20 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>24</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78K0</td>
<td>78K0/KC2-L</td>
<td>40/44-pin</td>
<td>5 K</td>
<td>512/384</td>
<td>2.0 to 5.5 V</td>
<td>0.1 μs (20 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78K0</td>
<td>78K0/KB2-L</td>
<td>48-pin</td>
<td>7 K</td>
<td>512/384</td>
<td>1.8 to 5.5 V</td>
<td>0.1 μs (20 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78K0</td>
<td>78K0/KB2-L</td>
<td>64-pin</td>
<td>1 K</td>
<td>512/384</td>
<td>2.0 to 5.5 V</td>
<td>0.1 μs (20 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78K0</td>
<td>μPD179F1xx</td>
<td>30-pin</td>
<td>1 K</td>
<td>512/384</td>
<td>1.8 to 5.5 V</td>
<td>0.1 μs (10 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>78K0</td>
<td>μPD179F1xx</td>
<td>36-pin</td>
<td>1 K</td>
<td>512/384</td>
<td>0.1 V.</td>
<td>0.1 μs (20 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78K0</td>
<td>μPD179F1xx</td>
<td>40-pin</td>
<td>1 K</td>
<td>512/384</td>
<td>0.1 V.</td>
<td>0.1 μs (20 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78K0</td>
<td>μPD179F1xx</td>
<td>48-pin</td>
<td>1 K</td>
<td>512/384</td>
<td>0.1 V.</td>
<td>0.1 μs (20 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78K0</td>
<td>μPD179F1xx</td>
<td>64-pin</td>
<td>1 K</td>
<td>512/384</td>
<td>0.1 V.</td>
<td>0.1 μs (20 MHz TMH)</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td>UART</td>
<td>10 bits x 7</td>
<td>10 bits x 7</td>
<td>10 bits x 11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 1. 5 V (±0.5 V) or 3.3 V (±0.3 V) for 32-pin products.
* 2. 4.2 V ± 0.1V to 5.5 V ± 0.1V for 32-pin products.
* 3. Clock output, operational amplifier 3-ch
* 4. CEC, clock output, booster output, remote control receiver
* 5. 240 kHz (selectable by software)
* 6. 240 kHz

---

**Notes:**
- The detected voltage can be input to pins. (selectable by software)
- Clock output, operational amplifier 3-ch
- CEC, clock output, booster output, remote control receiver
- 240 kHz (selectable by software)
## Product specifications

### CPU Core
- **Commercial name:**
  - 78K0: µPD78F025
  - 78K0/LC3: µPD78F027
  - 78K0/LD3: µPD78F029
  - 78K0/LE3: µPD78F037
  - 78K0/LF3: µPD78F039

### Pin count
- **Package sizes:**
  - 64-pin
  - 30-pin Sip
  - 48-pin
  - 52-pin

### Product name
- **Flash memory (bytes):**
  - 8 K
  - 16 K
  - 32 K
  - 64 K
  - 128 K
  - 256 K
  - 512 K
  - 1 M
  - 2 M
  - 4 M

### Bank
- 8 K
- 16 K
- 32 K
- 64 K
- 128 K
- 256 K
- 512 K
- 1 M
- 2 M
- 4 M

### RAM (bytes)
- 1 K
- 2 K
- 4 K
- 8 K
- 16 K
- 32 K
- 64 K

### Power supply voltage
- **Normal operation mode:**
  - 1.8 V to 5.5 V
  - 2.7 V to 5.5 V

### Minimum instruction execution time
- 5% off 25 MHz
- 0.2 µs (10 MHz: 80% off 2.7 to 5.5 V)
- 5% off 5 MHz: 80% off 4.5 to 5.5 V

### Clock
- **Main clock**
  - High-speed system clock: 4 MHz
  - High-speed internal oscillator: 8 MHz

### Other
- **Multiplier/divider**
- **On-chip debug**
- **Maximum number of interrupt**
- **Serial interface**
  - Automatic transmit/receive 3-wire CSI
  - UART (supporting LIN)
  - Watchdog timer (WDT)
  - 8-bit timer (TM8)
  - 16-bit timer (TMx)

### RAM (bytes)
- 1 K
- 8 K
- 768 K

### Voltage
- **2.7 to 5.5 V**
- **1.8 to 5.5 V**
- **0.15 V**
- **1.59 V**

### Development
- **1.93/2.08/2.24/2.39/2.55/2.70/2.85/3.01/3.16/3.32 V**

### Notes
- *1: Under development
- *2: When the constant-current driver is not used
- *3: 0.5 to 3.6 V (V DD )
- *4: 1.8 to 5.5 V (V DD )
- *5: Constant-current driver for which stepping up or stepping down can be specified.
- *6: Timer for 10-bit inverter control, real-time output port, Hi-Z output controller.
- *7: Manchester code generator, buzzer output
- *8: Manchester code generator, buzzer output, remote control receiver
- *9: Manchester code generator, buzzer output, remote control receiver, clock output

### Power-on clear (POC)
- **1.8 V to 5 V**
- **3.5 V to 5.2 V**

### Operating temperature
- **1.8 V to 5 V**
- **3.5 V to 5.2 V**

### Other
- Manchester code generator, buzzer output
- Manchester code generator, buzzer output, remote control receiver
- Manchester code generator, buzzer output, remote control receiver, clock output

### Multiplexer/driver
- **16-bit + 16-bit**
- **32-bit + 16-bit**

### Low-voltage detector (LVR)
- **4.3 V ± 0.2 V**

### Operating temperature
- **1.8 V to 3.6 V**
- **3.5 V to 5.2 V**

**Remarks:** The specifications of products under development or in planning are subject to change without notice.
MEMO

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