

Renesas Microcomputer
16-bit All Flash
78K0R Microcontrollers

Empower your
creativity



Flash

Shifting to "All Flash"

All of our new 16-bit general-purpose microcontrollers incorporate flash memories.

All Flash Continues to Evolve, Contributing to the Success of Customers

The "Shifting to All Flash" concept involves switching to flash memory products for the entire lineup of microcontrollers offered by Renesas Electronics.

This lineup comprises the V850E and V850ES 32-bit microcontrollers delivering high performance for system control, and the 78K0 and 78K0S 8-bit microcontrollers, which boast a small size and low power consumption making them ideal as subcontrollers.

Renesas Electronics' All Flash lineup is completed by the 78K0R 16-bit microcontrollers, positioned between 8-bit and 32-bit microcontrollers.

These microcontrollers achieve a low power consumption on a par with that of 8-bit microcontrollers while delivering the performance of 16-bit microcontrollers.

Renesas Electronics' All Flash lineup supports from 30 to 144 pins and ROM capacities of 16 to 512 KB. The lineup also inherits the existing 78K0 and 78K0S 8-bit microcontrollers. Should 8-bit microcontrollers fall short in terms of performance and ROM capacity for the intended application, smooth migration to 16-bit microcontrollers is possible.

Renesas Electronics also offers an infrastructure that enables more effective and simple use of All Flash. Our products and environment, which make the most of the merits of flash memory products, work for the success of our customers everywhere.

Road Map

All Flash

78K0R/Kx3

Wide-voltage operation support

- 144-pin **78K0R/KJ3**
- 128-pin **78K0R/KH3**
- 100-pin **78K0R/KG3**
- 80-pin **78K0R/KF3**
- 64-pin **78K0R/KE3**

78K0R/lx3

Inverter control support

- 64-pin **78K0R/IE3**
- 52-pin **78K0R/ID3**
- 38/44/48-pin **78K0R/IC3**
- 30-pin **78K0R/IB3**

78K0R/Lx3

LCD controller/drivers, analog enhancement, low power

- 128-pin **78K0R/LH3**
- 100-pin **78K0R/LG3**
- 80-pin **78K0R/LF3**

78K0R/Kx3-L

Low-power and wide-voltage operation support

- 100-pin **78K0R/KG3-L**
- 80-pin **78K0R/KF3-L**
- 64-pin **78K0R/KE3-L**
- 52-pin **78K0R/KD3-L**
- 40/44/48-pin **78K0R/KC3-L**

78K0R/Kx3-C

Low-power, digital home electronics communication support

- 100-pin **78K0R/KG3-C**
- 80-pin **78K0R/KF3-C**

78K0R/Kx3-A

Analog enhancement, low power, wide-voltage operation support

- 64-pin **78K0R/KE3-A**

78K0R/Kx3-L (USB)

Low-power, USB support

- 64-pin **78K0R/KE3-L**
- 48-pin **78K0R/KC3-L**

μPD78F8043

IO-Link support

- 56-pin **μPD78F8043**

μPD78F8058

RF remote control support

- 56-pin **μPD78F8058**

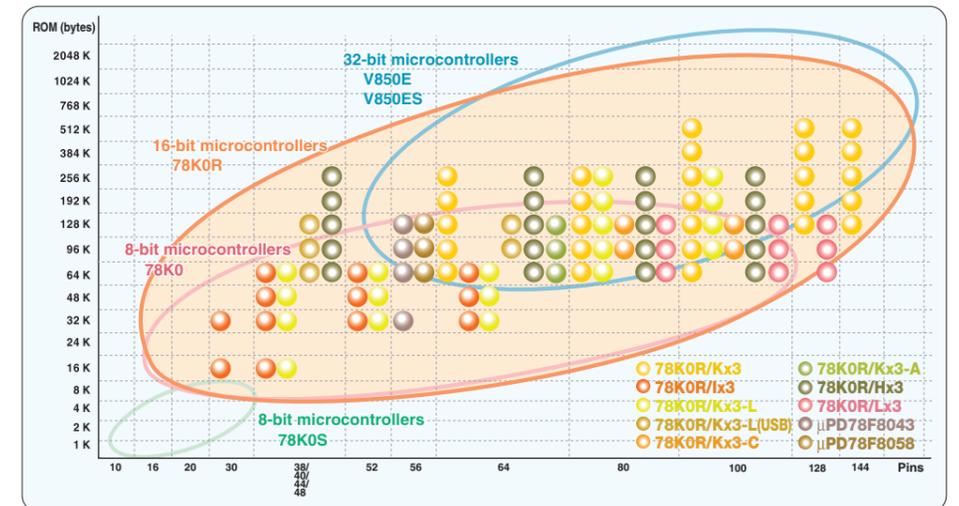
78K0R/Hx3

CAN support, analog enhancement

- 100-pin **78K0R/HG3**
- 80-pin **78K0R/HF3**
- 64-pin **78K0R/HE3**
- 48-pin **78K0R/HC3**

All Flash product lineup

- Expanded from 8 bits to 32 bits -
The 78K0R 16-bit microcontrollers, positioned at the high end of the 78K microcontrollers, support your systems by giving them higher performance and more sophisticated functions.



Application examples

All Flash microcontrollers are suitable for various systems using an 8- or 16-bit microcontroller and raise the commercial value of customer systems.



Cameras
Digital still cameras, digital video cameras, SLR cameras



Audio
Portable audio, component stereo systems, home theater systems



Computer peripherals
LBP, PPC, MFP, inkjet printers, scanners, fax machines



Video and recording equipment
Blu-ray players, Blu-ray recorders, industrial cameras



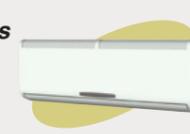
Healthcare equipment
Body fat scales, blood pressure monitors



Industrial equipment
Industrial motors, control equipment, vending machines, power meters



Portable devices
PDA, IC recorders



Home appliances
Air conditioners, refrigerators, washing machines, microwave ovens



Other
Electronic instruments, electric bidets, toys, remote controllers, etc.

Flash microcontrollers can boost the competitiveness of your systems. Based on this concept, we are shifting to "All Flash".



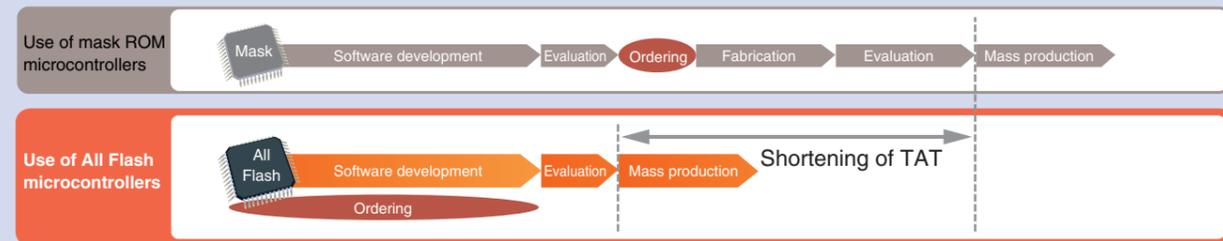
Flash microcontrollers offer overwhelming advantages.

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.

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 software designers

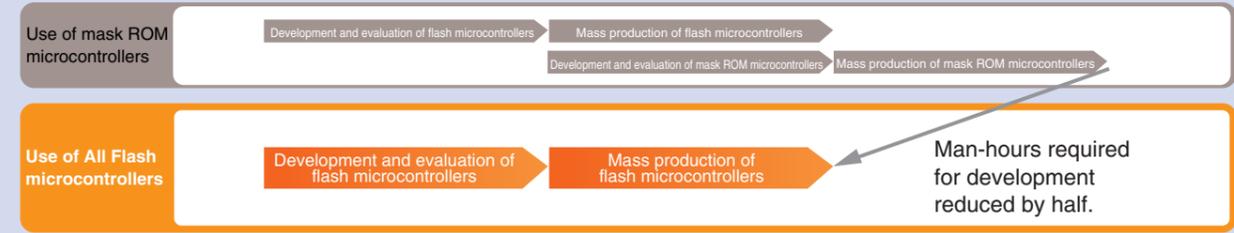
Software can be changed just before mass production starts and development TAT can also be shortened.



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.

For hardware designers

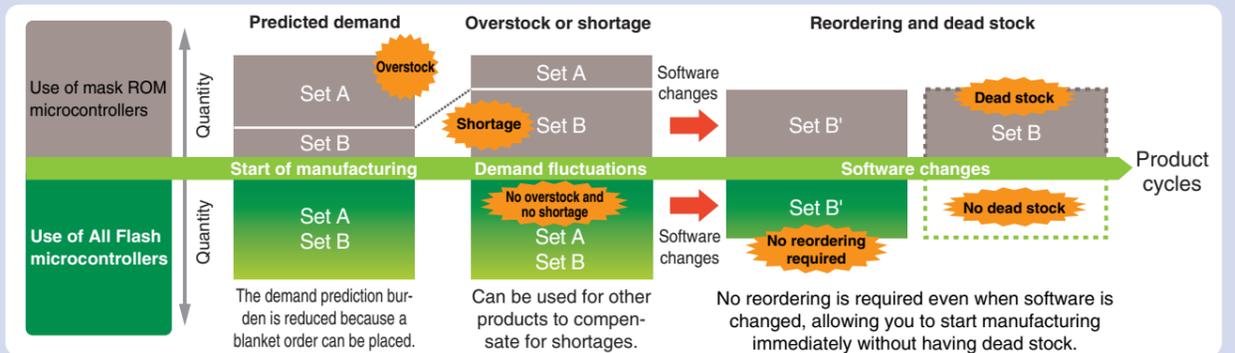
Mass-produced flash microcontrollers require evaluation only once, reducing development man-hours.



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.

For purchasing divisions

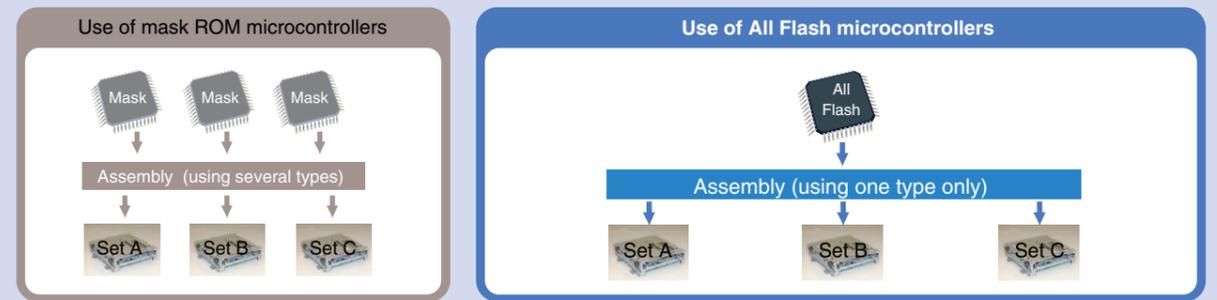
Flash microcontrollers protect you from fluctuations in demand and can reduce dead stock.



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 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.

Have you ever had to give up something when upgrading a system? With Renesas Electronics, you don't have to compromise.



16-bit All Flash microcontrollers that do not compromise

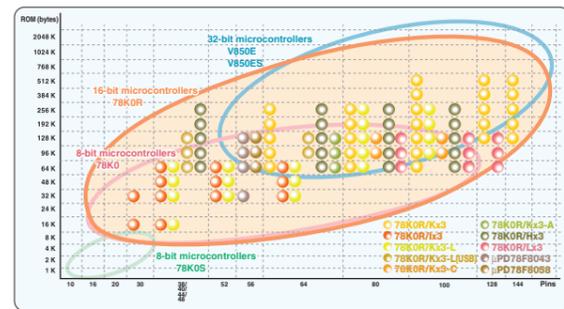
The use of high-performance microcontrollers and flash microcontrollers has become widespread to support ever-increasing system performance and fast development TAT. However, the use of high performance microcontrollers and flash microcontrollers often imposes compromises,

in terms of higher power consumption and the compatibility of existing software resources. Renesas Electronics' 78K0R 16-bit microcontroller realizes 16-bit performance with All Flash without such compromises.

Large selection

We offer 202 products!

To respond to demands for various types of microcontrollers, we offer a range of 202 All Flash 16-bit microcontrollers. Among these are the 78K0R/Kx3, which features a large-capacity memory, the 78K0R/Kx3-L, which has a low standby current, the 78K0R/Kx3-A with a built-in high-performance 12-bit A/D converter and the 78K0R/Lx3 with a built-in LCD driver, and the 78K0R/Hx3, which has a fast operating speed of 24 MHz. Our 16-bit All Flash microcontrollers are available in either a 40-pin 6 x 6 mm WQFN or a 48-pin 7 x 7 mm WQFN. These packages are 46% thinner and 75% smaller than our conventional 16-bit microcontroller package (which is a 100-pin LQFP with a size of 14 mm x 14 mm), helping you reduce the size of your set. With this extensive lineup, you can choose the optimal product.

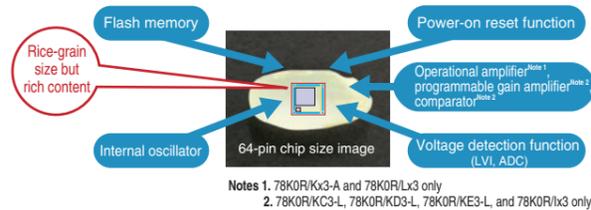


Low cost

Reducing the total cost!

The 78K0R 16-bit microcontrollers are provided with features such as flash memory instead of EEPROM, 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/Kx3-A and 78K0R/Lx3 include an operational amplifier, and the 78K0R/KC3-L, 78K0R/KD3-L, 78K0R/KE3-L, and 78K0R/Lx3 include a programmable gain amplifier and a comparator.

Total cost reduction through embedded peripheral IC functions



Low power consumption

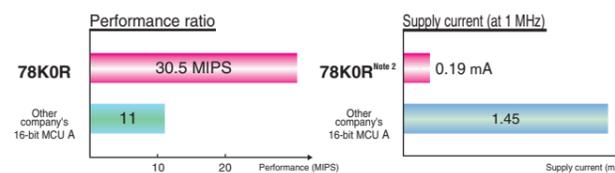
Go fast. Stay cool. Combining high performance with low power consumption!

Through the use of a 16-bit design, Renesas Electronics has achieved 3-stage pipeline architecture CPUs that boast a performance of 30.5MIPS at 24 MHz^{Note 1}. These microcontrollers save energy thanks to their supply current, which is low compared to the 16-bit products of other companies.

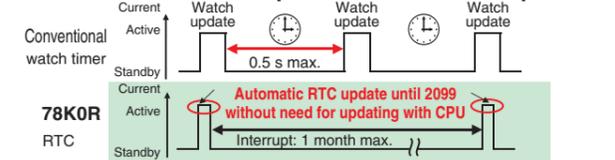
They also feature a calendar function (RTC) that automatically updates the time and date until 2099 without the need to boot the CPU, helping extend battery life in systems that require a watch counter. Current users of 16-bit microcontrollers can achieve lower power consumption, while 8-bit microcontroller users can enjoy higher performance without an increase in power consumption.

Notes 1. Dhystone 2.1
2. When using the 78K0R/KC3-L, 78K0R/KD3-L, 78K0R/KE3-L, 78K0R/Lx3, or 78K0R/Kx3-A

Saving energy with high performance of 16-bit design



Realization of watch operation without wakeup



Wide variety of products for specific applications

We offer ideal products for various applications!

Renesas Electronics offers a wide range of products for specific applications, such as the 78K0R/Kx3-C provided with a feature for linking digital AV devices, the 78K0R/Lx3 with a multifunction timer capable of precision inverter control, the μ PD78F8043 with an on-chip IO-Link transceiver that facilitates communication in industrial systems, and the μ PD78F8058 which enables communication with RF remote controllers. In addition to the basic features, the specialized features of the products are well developed, enabling you to choose the best product for your application.

78K0R/KF3-C, KG3-C

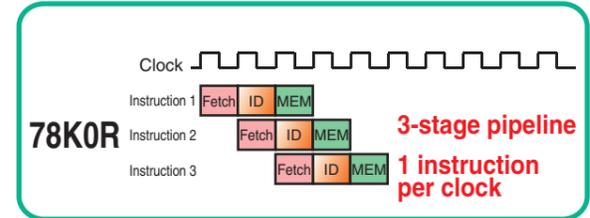


78K0R/IB3, IC3, ID3, IE3

High performance and functionality

Includes high-performance CPU and sophisticated peripheral functions!

The 78K0R microcontrollers execute most instruction processing in one clock via three-stage pipeline control. 32-bit (16 bits x 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.

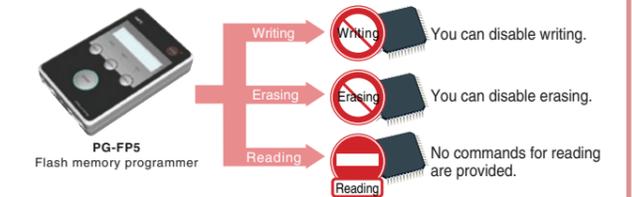


High reliability

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.

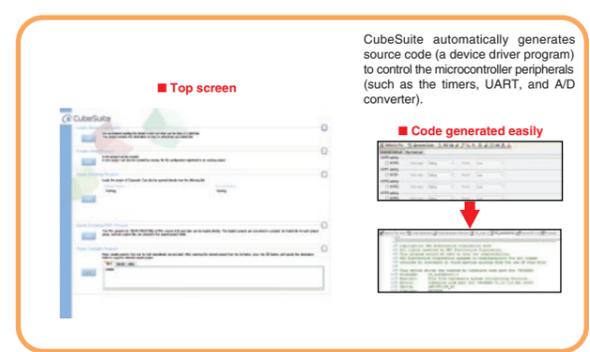
Incorporated software protection functions



Rich development environment

We offer inexpensive, easy-to-use, and convenient tools!

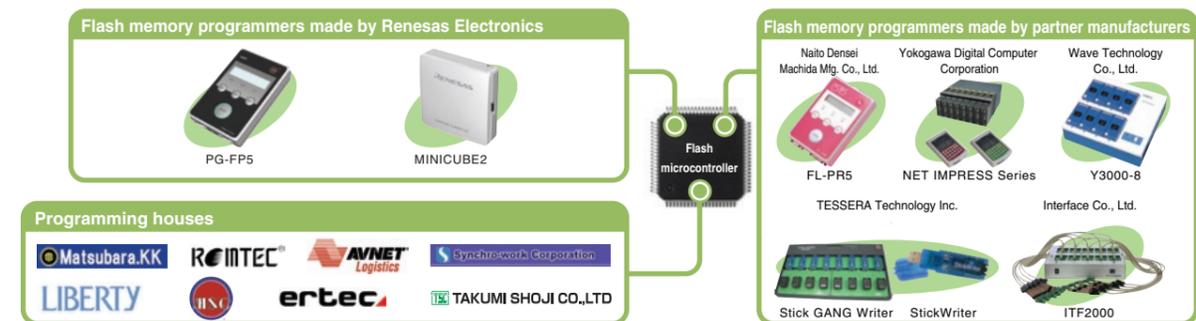
Renesas Electronics provides an easy-to-use and convenient development environment, exemplified by our newly released CubeSuite™ integrated development platform. CubeSuite can be used to compile and debug programs, manage pin layouts, generate code for microcontroller peripherals, and execute high-speed building. Add MINICUBE2, an on-chip debug emulator with flash memory programming capability, into the mix and you have a powerful environment that enables fast and accurate system development.



Support for mass production

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 tools, making programming possible in 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.



Large selection (1/2)

We offer flash microcontrollers in various packages and ROM or RAM sizes, allowing you to select the best flash microcontroller for your product or application.

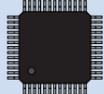
| Commercial Name | 78K0R/KC3-L | | 78K0R/KD3-L | 78K0R/KE3-L | | 78K0R/KF3-L | 78K0R/KG3-L | 78K0R/KC3-L | 78K0R/KE3-L | 78K0R/KE3-A | 78K0R/KE3 | 78K0R/KF3 | 78K0R/KG3 | 78K0R/KH3 | 78K0R/KJ3 | | | | | |
|--------------------------|--|--|---|---|--|---|--|--|--|--|---|--|---|--|---|---|---------------------|--------------------|--------------------|-------------------|
| Pin Count ROM (bytes) | 40/44-pin | 48-pin | 52-pin | 64-pin | 80-pin | 100-pin | 100-pin | 48-pin | 64-pin | 64-pin | 64-pin | 80-pin | 100-pin | 128-pin | 144-pin | | | | | |
| 512 K | Product name (RAM (bytes)) | | | | | | | | | | 78K0R/Kx3 Microcontrollers | | | μPD78F1168A (30 K*) | μPD78F1178A (30 K*) | μPD78F1188A (30 K*) | | | | |
| 384 K | | | | | | | | | | | 78K0R/Kx3 Microcontrollers | | | μPD78F1167A (24 K) | μPD78F1177A (24 K) | μPD78F1187A (24 K) | | | | |
| 256 K | | | | | | | | | | | μPD78F1028*2 (12 K*) | μPD78F1030*2 (12 K*) | 12-bit A/D Converter 78K0R/Kx3-A Microcontrollers | | μPD78F1146A (12 K*) | μPD78F1156A (12 K*) | μPD78F1166A (12 K*) | μPD78F1176A (12 K) | μPD78F1186A (12 K) | |
| 192 K | 78K0R/Kx3-L Microcontrollers | | | | | μPD78F1027*2 (10 K) | μPD78F1029*2 (10 K) | 78K0R/Kx3-L (USB) Microcontrollers | | | μPD78F1145A (10 K) | μPD78F1155A (10 K) | μPD78F1165A (10 K) | μPD78F1175A (10 K) | μPD78F1185A (10 K) | | | | | |
| 128 K | | | | | | | | | | | μPD78F1012 (8 K*) | μPD78F1014 (8 K*) | μPD78F1024 (8 K*) | μPD78F1026 (8 K*) | μPD78F1018 (7 K) | μPD78F1144A (8 K) | μPD78F1154A (8 K) | μPD78F1164A (8 K) | μPD78F1174A (8 K) | μPD78F1184A (8 K) |
| 96 K | | | | | | | | | | | μPD78F1011 (6 K) | μPD78F1013 (6 K) | μPD78F1023 (8 K*) | μPD78F1025 (8 K*) | μPD78F1017 (6 K) | μPD78F1143A (6 K) | μPD78F1153A (6 K) | μPD78F1163A (6 K) | | |
| 64 K | μPD78F1003 (3 K*) | μPD78F1003 (3 K*) | μPD78F1006 (3 K*) | μPD78F1009 (3 K*) | μPD78F1010 (4 K) | | | μPD78F1022 (6 K) | | μPD78F1016 (4 K) | μPD78F1142A (4 K) | μPD78F1152A (4 K) | μPD78F1162A (4 K) | | | | | | | |
| 48 K | μPD78F1002 (2 K) | μPD78F1002 (2 K) | μPD78F1005 (2 K) | μPD78F1008 (2 K) | | | | | | | | | | | | | | | | |
| 32 K | μPD78F1001 (1.5 K) | μPD78F1001 (1.5 K) | μPD78F1004 (1.5 K) | μPD78F1007 (1.5 K) | | | | | | | | | | | | | | | | |
| 16 K | μPD78F1000 (1 K) | | | | | | | | | | | | | | | | | | | |
| Package | 44-pin LQFP (GB) Thickness: 1.4 mm 10 × 10 mm Pitch: 0.8 mm | 48-pin TQFP (GA) Thickness: 1.0 mm 7 × 7 mm Pitch: 0.5 mm | 52-pin LQFP (GB) Thickness: 1.4 mm 10 × 10 mm Pitch: 0.65 mm | 64-pin LQFP (GK) Thickness: 1.4 mm 12 × 12 mm Pitch: 0.65 mm | 64-pin LQFP (GB) Thickness: 1.4 mm 10 × 10 mm Pitch: 0.5 mm | 80-pin LQFP (GC) Thickness: 1.4 mm 14 × 14 mm Pitch: 0.65 mm | 100-pin LQFP (GF) Thickness: 1.4 mm 14 × 20 mm Pitch: 0.65 mm | 48-pin TQFP (GA) Thickness: 1.0 mm 7 × 7 mm Pitch: 0.5 mm | 64-pin LQFP (GB) Thickness: 1.4 mm 10 × 10 mm Pitch: 0.5 mm | 64-pin FBGA (F1) Thickness: 1.11 mm 6 × 6 mm Pitch: 0.65 mm | 64-pin LQFP (GK) Thickness: 1.4 mm 12 × 12 mm Pitch: 0.65 mm | 64-pin LQFP (GB) Thickness: 1.4 mm 10 × 10 mm Pitch: 0.5 mm | 80-pin LQFP (GC) Thickness: 1.4 mm 14 × 14 mm Pitch: 0.65 mm | 100-pin LQFP (GF) Thickness: 1.4 mm 14 × 20 mm Pitch: 0.65 mm | 128-pin LQFP (GF) Thickness: 1.4 mm 14 × 20 mm Pitch: 0.5 mm | 144-pin LQFP (GJ) Thickness: 1.4 mm 20 × 20 mm Pitch: 0.5 mm | | | | |
| | 40-pin WQFN ² (K8) Thickness: 0.75 mm 6 × 6 mm Pitch: 0.5 mm | 48-pin WQFN ² (K8) Thickness: 0.75 mm 7 × 7 mm Pitch: 0.5 mm | | 64-pin TQFP (GA) Thickness: 1.0 mm 7 × 7 mm Pitch: 0.4 mm | 64-pin FBGA (F1) Thickness: 0.69 mm 5 × 5 mm Pitch: 0.5 mm | 80-pin LQFP (GK) Thickness: 1.4 mm 12 × 12 mm Pitch: 0.5 mm | 100-pin LQFP (GC) Thickness: 1.4 mm 14 × 14 mm Pitch: 0.5 mm | 48-pin WQFN ² (K8) Thickness: 0.75 mm 7 × 7 mm Pitch: 0.5 mm | 64-pin TQFP (GA) Thickness: 1.0 mm 7 × 7 mm Pitch: 0.4 mm | 64-pin FBGA (F1) Thickness: 0.91 mm 5 × 5 mm Pitch: 0.5 mm | 64-pin LQFP (GA) Thickness: 1.0 mm 7 × 7 mm Pitch: 0.4 mm | 64-pin FBGA (F1) Thickness: 0.69 mm 5 × 5 mm Pitch: 0.5 mm | 80-pin LQFP (GK) Thickness: 1.4 mm 12 × 12 mm Pitch: 0.5 mm | 100-pin LQFP (GC) Thickness: 1.4 mm 14 × 14 mm Pitch: 0.5 mm | | | | | | |

*1 28 KB when the self programming function is used.
 *3 11 KB when the self programming function is used.
 *5 7 KB when the self programming function is used.
 *7 μPD78F1013 and 78F1014 only
Remark The packages are shown in their actual size.

*2 Under development
 *4 10 KB when the self programming function is used.
 *6 2 KB when the self programming function is used.

Large selection (2/2)

We offer flash microcontrollers in various packages and ROM or RAM sizes, allowing you to select the best flash microcontroller for your product or application.

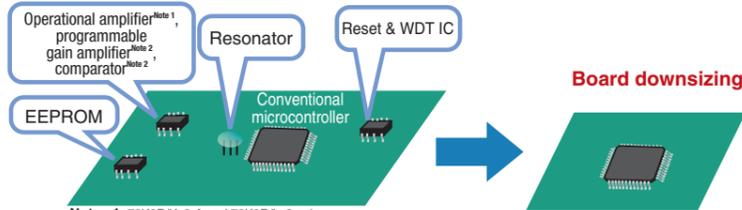
| Commercial Name | 78K0R/KF3-C | 78K0R/KG3-C | 78K0R/HC3 | 78K0R/HE3 | 78K0R/HF3 | 78K0R/HG3 | μPD78F8043 | μPD78F8058 | 78K0R/IB3 | 78K0R/IC3 | | | 78K0R/ID3 | 78K0R/IE3 | 78K0R/LF3 | 78K0R/LG3 | 78K0R/LH3 | |
|-----------------|---|--|---|---|--|--|---|--|---|---|---|---|--|--|--|--|--|--|
| Pin Count | 80-pin | 100-pin | 48-pin | 64-pin | 80-pin | 100-pin | 56-pin | 56-pin | 30-pin | 38-pin | 44-pin | 48-pin | 52-pin | 64-pin | 80-pin | 100-pin | 128-pin | |
| ROM (bytes) | 80-pin | 100-pin | 48-pin | 64-pin | 80-pin | 100-pin | 56-pin | 56-pin | 30-pin | 38-pin | 44-pin | 48-pin | 52-pin | 64-pin | 80-pin | 100-pin | 128-pin | |
| 512 K | Product name (RAM (bytes)) | | | | | | | | | | | | | | | | | |
| 384 K | 78K0R/Kx3-C | | 78K0R/Hx3 Microcontrollers | | | | | | | | | | | | | | | |
| 256 K | Microcontrollers for Digital AV Applications | | μPD78F1035*1 (16 K) | μPD78F1040*1 (16 K) | μPD78F1045*1 (16 K) | μPD78F1050*1 (16 K) | Microcontroller with On-Chip IO-Link Transceiver | Microcontroller with On-Chip RF Transceiver | | | | | | | 78K0R/Lx3 Microcontrollers | | | |
| 192 K | | | μPD78F1034*1 (12 K) | μPD78F1039*1 (12 K) | μPD78F1044*1 (12 K) | μPD78F1049*1 (12 K) | | | | | | | | | | | | |
| 128 K | μPD78F1847A (8 K ^{*2}) | μPD78F1849A (8 K ^{*2}) | μPD78F1033*1 (8 K) | μPD78F1038*1 (8 K) | μPD78F1043*1 (8 K) | μPD78F1048*1 (8 K) | μPD78F8043 (7 K) | μPD78F8058*1 (8 K ^{*2}) | 78K0R/Ix3 Microcontrollers for Inverter Control | | | | | | μPD78F1502A, μPD78F1512A (7 K) | μPD78F1505A, μPD78F1515A (7 K) | μPD78F1508A, μPD78F1518A (7 K) | |
| 96 K | μPD78F1846A (6 K) | μPD78F1848A (6 K) | μPD78F1032*1 (6 K) | μPD78F1037*1 (6 K) | μPD78F1042*1 (6 K) | μPD78F1047*1 (6 K) | μPD78F8042 (6 K) | μPD78F8057*1 (8 K ^{*2}) | | | | | | | μPD78F1501A (6 K) | μPD78F1504A (6 K) | μPD78F1507A (6 K) | |
| 64 K | | | μPD78F1031*1 (4 K) | μPD78F1036*1 (4 K) | μPD78F1041*1 (4 K) | μPD78F1046*1 (4 K) | μPD78F8041 (4 K) | μPD78F8056*1 (8 K ^{*2}) | | | | μPD78F1215 (3 K ^{*3}) | μPD78F1225 (3 K ^{*3}) | μPD78F1235 (3 K ^{*3}) | μPD78F1500A, μPD78F1510A (4 K) | μPD78F1503A, μPD78F1513A (4 K) | μPD78F1506A, μPD78F1516A (4 K) | |
| 48 K | | | | | | | | | | | | μPD78F1214 (2 K) | μPD78F1224 (2 K) | μPD78F1234 (2 K) | | | | |
| 32 K | | | | | | | μPD78F8040 (4 K) | | μPD78F1203 (1.5 K) | μPD78F1213 (1.5 K) | μPD78F1213 (1.5 K) | μPD78F1213 (1.5 K) | μPD78F1223 (1.5 K) | μPD78F1233 (1.5 K) | | | | |
| 16 K | | | | | | | | | μPD78F1201 (1 K) | μPD78F1211 (1 K) | μPD78F1211 (1 K) | | | | | | | |
| Package | 80-pin LQFP (GK) Thickness: 1.4 mm 12 × 12 mm Pitch: 0.5 mm  | 100-pin LQFP (GC) Thickness: 1.4 mm 14 × 14 mm Pitch: 0.5 mm  | 48-pin LQFP (GA) Thickness: 1.4 mm 7 × 7 mm Pitch: 0.5 mm  | 64-pin LQFP (GB) Thickness: 1.4 mm 10 × 10 mm Pitch: 0.5 mm  | 80-pin LQFP (GK) Thickness: 1.4 mm 12 × 12 mm Pitch: 0.5 mm  | 100-pin LQFP (GC) Thickness: 1.4 mm 14 × 14 mm Pitch: 0.5 mm  | 56-pin WQFN (K8) Thickness: 0.75 mm 8 × 8 mm Pitch: 0.5 mm  | 56-pin WQFN (K8) Thickness: 0.75 mm 8 × 8 mm Pitch: 0.5 mm  | 30-pin SSOP (MC) Thickness: 1.2 mm 7.62 mm (300) Pitch: 0.65 mm  | 38-pin SSOP (MC) Thickness: 1.7 mm 7.62 mm (300) Pitch: 0.65 mm  | 44-pin LQFP (GB) Thickness: 1.4 mm 10 × 10 mm Pitch: 0.8 mm  | 48-pin TQFP (GA) Thickness: 1.0 mm 7 × 7 mm Pitch: 0.5 mm  | 52-pin LQFP (GB) Thickness: 1.4 mm 10 × 10 mm Pitch: 0.65 mm  | 64-pin LQFP (GK) Thickness: 1.4 mm 12 × 12 mm Pitch: 0.65 mm  | 80-pin LQFP (GC) Thickness: 1.4 mm 14 × 14 mm Pitch: 0.65 mm  | 100-pin LQFP (GC) Thickness: 1.4 mm 14 × 14 mm Pitch: 0.5 mm  | 128-pin LQFP (GF) Thickness: 1.4 mm 14 × 20 mm Pitch: 0.5 mm  | |
| | | | | | | | 56-pin FBGA [†] (F1) Thickness: 0.91 mm 4 × 7 mm Pitch: 0.5 mm  | | | | | | | | 64-pin LQFP (GB) Thickness: 1.4 mm 10 × 10 mm Pitch: 0.5 mm  | 80-pin LQFP (GK) Thickness: 1.4 mm 12 × 12 mm Pitch: 0.5 mm  | | |

*1 Under development *2 7 KB when the self programming function is used. *3 2 KB when the self programming function is used.
Remark The packages are shown in their actual size.

Low cost

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

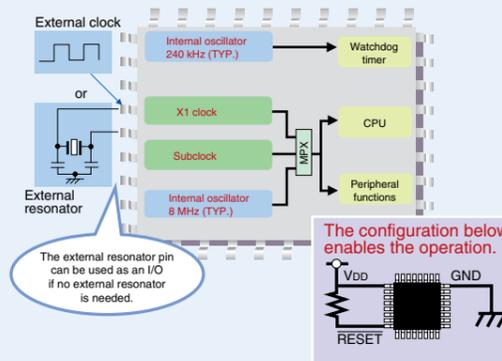
Total cost reduction achieved through the following on-chip peripheral functions



Notes 1. 78K0R/Kx3-A and 78K0R/Lx3 only
2. 78K0R/KC3-L, 78K0R/KD3-L, 78K0R/KE3-L, and 78K0R/lx3 only

Internal oscillator

Various oscillators are embedded. The flash microcontroller can operate with just an internal oscillator.

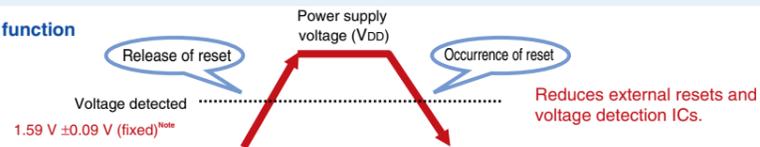


Remark The above is an example of using the 78K0R/Kx3.

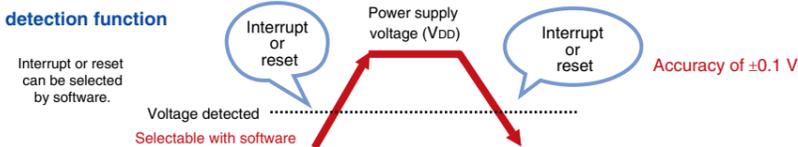
Reset function

Highly accurate and user-friendly voltage detection and reset functions are incorporated.

Power-on-clear function



Voltage detection function



Note In products other than the 78K0R/Kx3, the detection voltage when reset is released differs from the voltage when reset occurs.
• When a reset is released: 1.61 ± 0.09 V (target value)
• When a reset occurs: 1.59 ± 0.09 V (target value)

Highly reliable watchdog timer (WDT)

Highly reliable WDT that can realize the same functions as those of an external WDT (see page 23).

EEPROM™ emulation function

Any block can be used as nonvolatile memory for storing data with the self-programming function of the flash memory.



Maximum number of data items stored in one block (Outline)

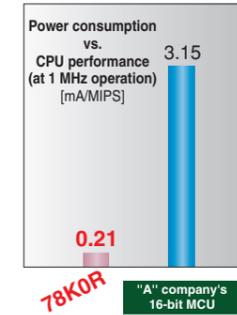
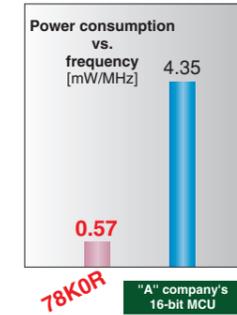
$$\frac{\text{Minimum erasure unit}}{\text{Data length (number of bytes)}} \times \text{Number of erasures in one block}^{\text{Note}}$$

Note 78K0R/Kx3: 10,000 times (6 KB)
Remark See the user's manual (EEPROM emulation library) for details.

Low power consumption

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

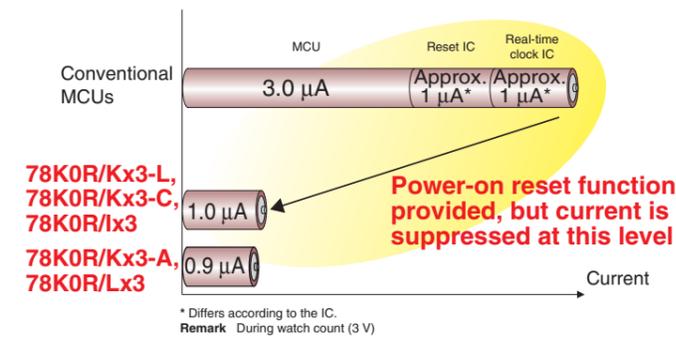
World's lowest power consumption for 16-bit microcontrollers



Remark At 3 V power supply

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.

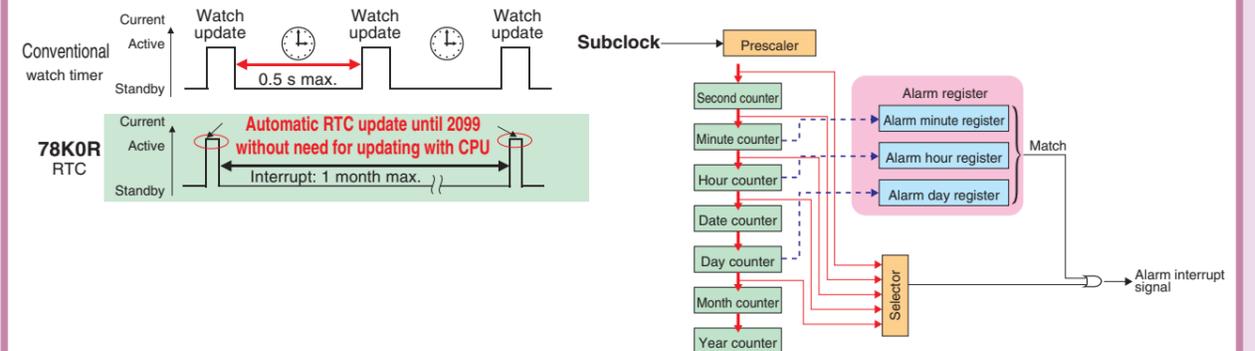
Standby power



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 wakeup! Power consumption can be reduced.
- Built-in alarm function starts the microcontroller at an arbitrary set time (day, hour, minute).



Wide variety of products for specific applications (1/2)

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

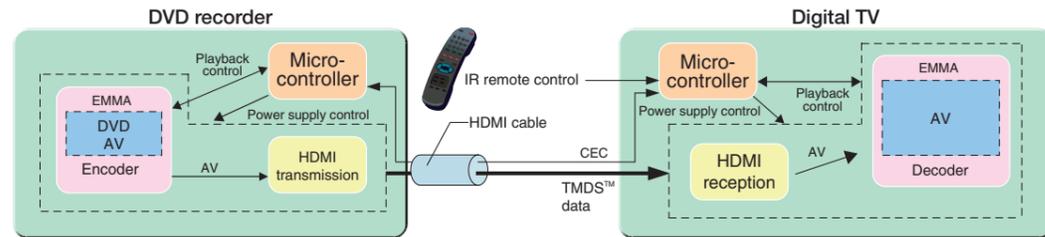
Microcontroller for digital AV applications (78K0R/Kx3-C)

1. HDMI™-CEC transmission/reception via hardware

Digital AV devices can be mutually controlled by simply connecting them via an HDMI cable.

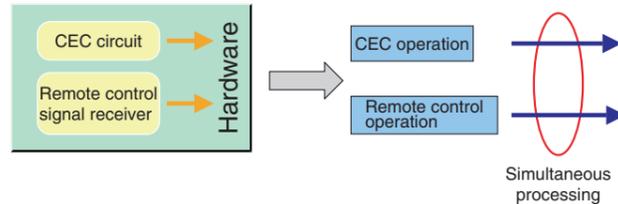
Example: Operation when a DVD is inserted into a DVD recorder

The TV is automatically switched on and the active channel is switched to video input.

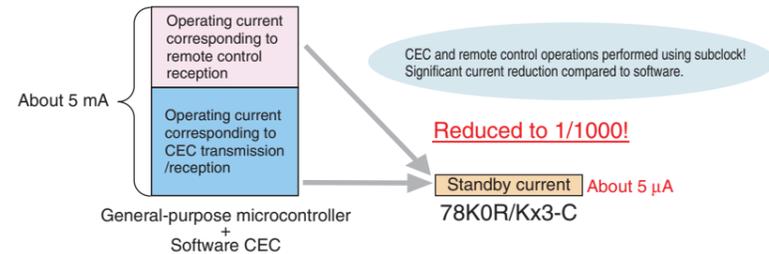


2. Improved system operability

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.

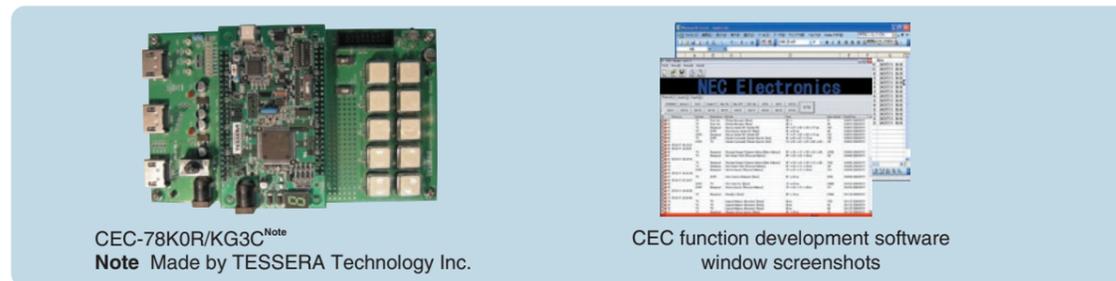


3. Operating current during HDMI-CEC transmission/reception reduced to 1/1000



4. Application evaluation board CEC-78K0R/KG3C provided to evaluate HDMI-CEC functions

The application evaluation board CEC-78K0R/KG3C expands the functions of the starter kit TK-78K0R/KG3C and enables application evaluation of the HDMI-CEC functions. A debugger*, compiler*, and circuit diagrams are included as standard, so that programs can be developed right away by connecting the board to a PC (*versions with limited functions). Furthermore, dedicated software to enable easy development of the CEC functions is also included. Specified CEC command transmission and CEC communication using the CEC data log can be reproduced and executed by using the dedicated software.



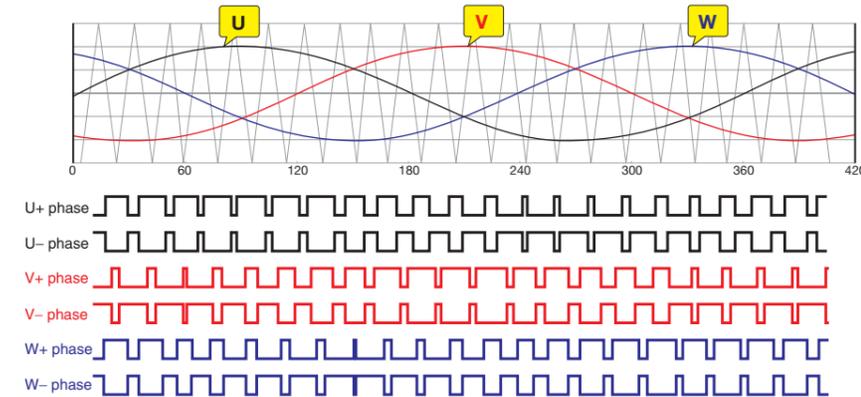
Remark HDMI (High-Definition Multimedia Interface): Standardized digital audio/video I/O interface for home electronics and AV devices.
CEC (Consumer Electronics Control): Control protocol (control method) for device control signals standardized by HDMI.
By using CEC, multiple AV devices can be controlled by using one remote controller.

Microcontroller for inverter control (78K0R/Ix3)

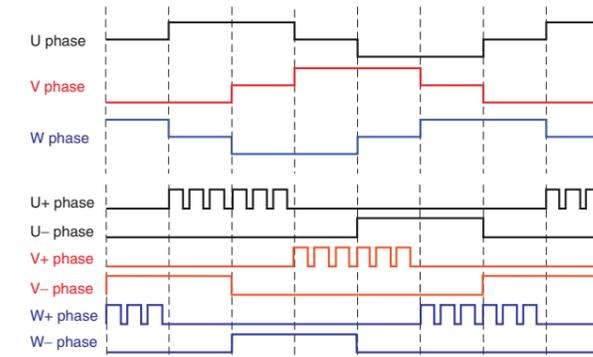
1. On-chip multi-function timer enabling fine inverter control

Twelve timer channels each having a 16-bit counter and a capture/compare register are provided in one unit. In addition to individual timer operations, multiple channels can be operated in conjunction to enable fine inverter control. Various waveforms can also be output.

Example 1: [6-phase triangular wave PWM output function (with dead time)] (180° excitation)
Controllable motors: Brushless DC motors, AC motors

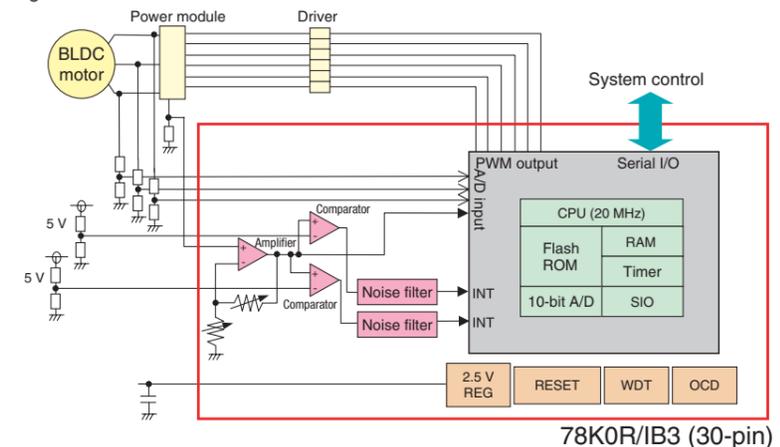


Example 2: [Non-complementary method modulation output function] (120° excitation)
Controllable motors: Brushless DC motors



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.

Wide variety of products for specific applications (2/2)

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 set 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 × 2 (Bulk transfer × 2)
64 bytes (Control transfer × 2, Interrupt transfer × 2)

■ All our USB microcontrollers are USB certified.



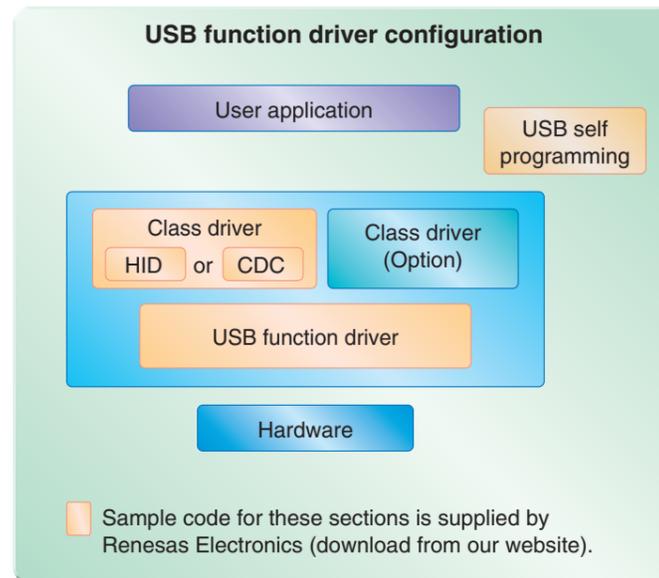
2. Extensive USB driver support

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

■ USB function driver

Renesas Electronics provides free sample code.

Remark HID: Human interface device
CDC: Communication device class



3. Example applications



Healthcare equipment



Printer/scanners



POS peripherals

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.

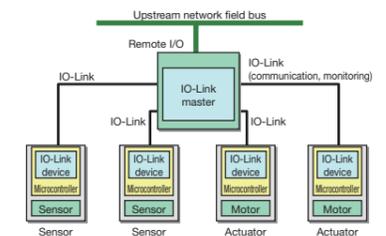
1. IO-Link

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.



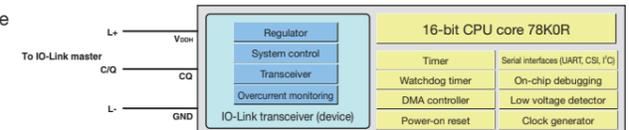
2. Features of IO-Link

- Used to connect controllers to sensors and actuators in industrial systems.
- Complies 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 wakeup detection capabilities.
- We provide a software stack for IO-Link communication that lets you concentrate on developing your application.



RF microcontroller (μPD78F8058)

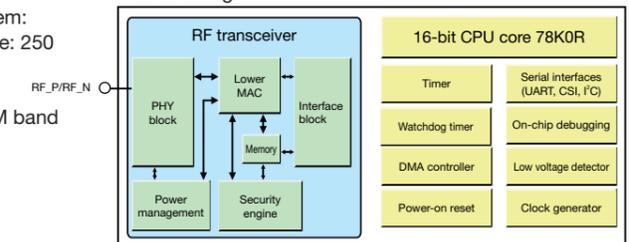
1. Microcontroller and RF transceiver integrated into a single package

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: O-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

■ Block diagram



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.

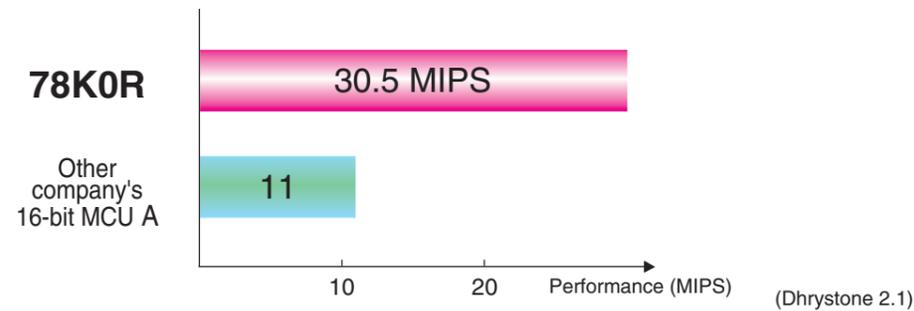
High performance and functionality (1/2)

High-performance CPU embedded

We provide reliable performance for system function expansion.

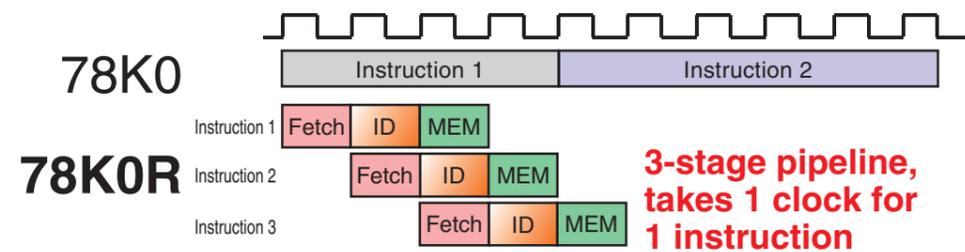
Performance equivalent to 16-bit microcontrollers

■ At 24 MHz operation



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

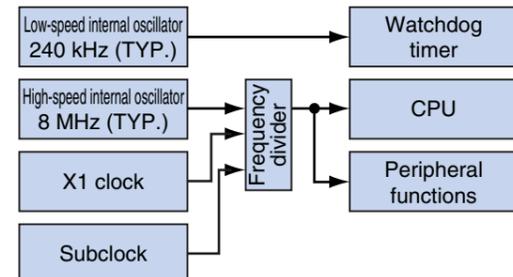
Reason for high performance



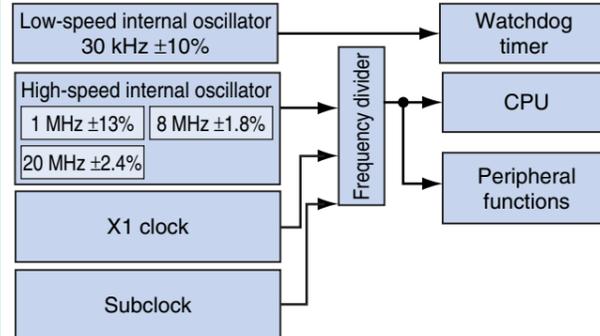
Performance-enhancing oscillator

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

78K0R/Kx3



78K0R/Kx3-L



Functions for enhancing performance

Reduces the CPU processing load.

DMA

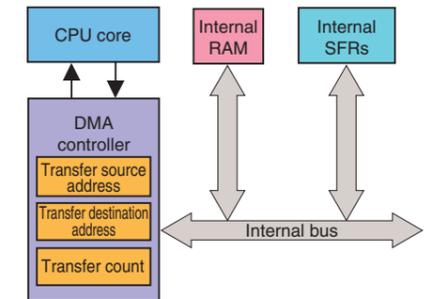
Data exchanges can be performed automatically between the special function registers (SFRs) of the peripheral hardware and the internal RAM without the CPU, using interrupts from the timer, serial interface, or A/D converter, or software triggers.

Functions

- Number of channels: 4 (78K0R/Hx3), 2 (other than 78K0R/Hx3)
- Transfer unit: 8 bits/16 bits
- Maximum number of transfers: 1024
- Transfer type: 2-cycle transfer
- Transfer mode: Single transfer mode
- Transfer targets: SFRs ↔ internal RAM

Applications

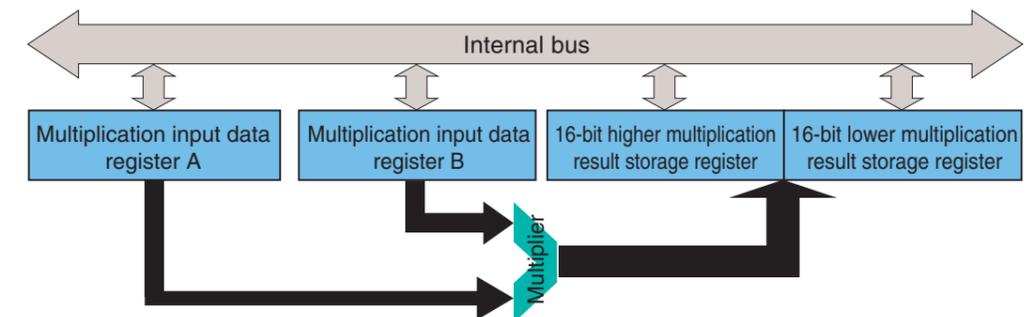
- CSI, UART (continuous transfer)
- A/D converter (continuous read of analog data, etc.)
- Timer (A/D conversion result, port value read, etc., at fixed intervals)
- Software trigger (DMA startup trigger can be generated through software)



Multiplier (78K0R/Kx3)

Function

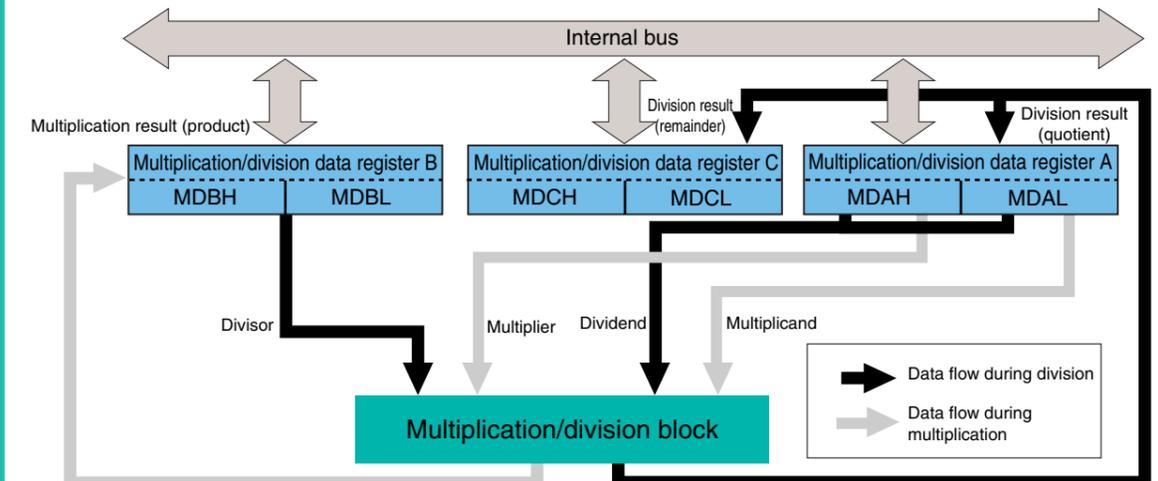
- Executes processing of 16 bits x 16 bits = 32 bits with 1 clock



Multiplier/divider (78K0R/Kx3-L, 78K0R/Kx3-C, 78K0R/Hx3, 78K0R/lx3, 78K0R/Kx3-A, 78K0R/Lx3, μPD78F8043, μPD78F8058)

Function

- 16 bits x 16 bits = 32 bits, 32 bits ÷ 32 bits = 32 bits



High performance and functionality (2/2)

Enhanced functions for greater user friendliness

Timer array unit

On-chip timer unit incorporating one 16-bit counter and one capture/compare register per channel. In addition to standalone operation of each timer, many different functions can be realized by operating multiple channels together.

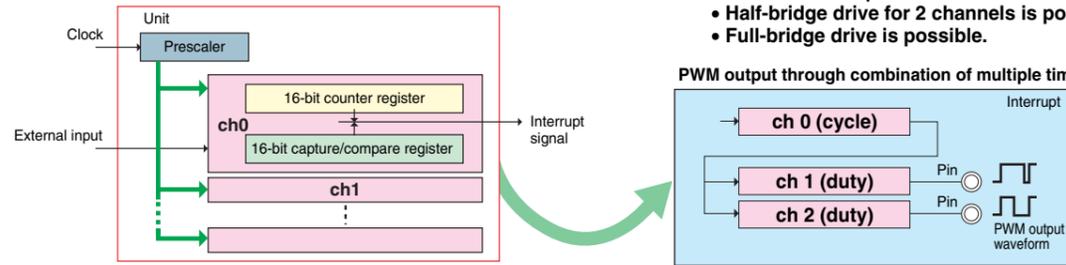
Functions

- Interval timer
- Frequency divider function
- External event counter
- Input pulse interval measurement
- Input signal high-/low-level width measurement
- PWM output
- One-shot pulse output
- Inverter control (78K0R/Lx3 only)

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.
- #### In the case of the 78K0R/Lx3:
- 3-phase sine-wave PWM output and 2-phase modulation are possible.
 - Half-bridge drive for 2 channels is possible.
 - Full-bridge drive is possible.

PWM output through combination of multiple timers

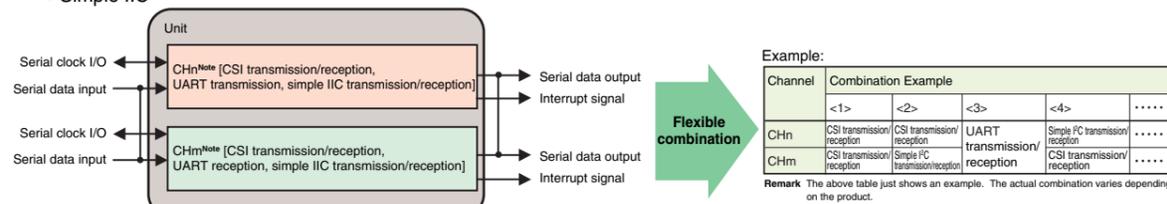


Serial array unit

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.

Functions

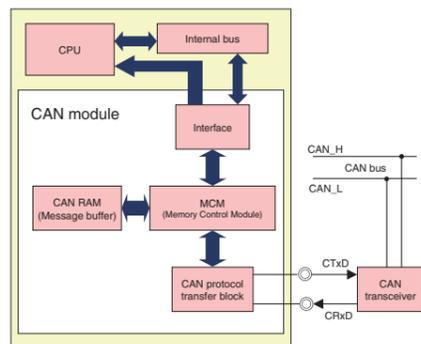
- The following serial communication functions can be selected.
- CSI
- UART
- Simple IIC



n: Even-number channel, m: Odd-number channel. Note: Implemented functions differ depending on the product.

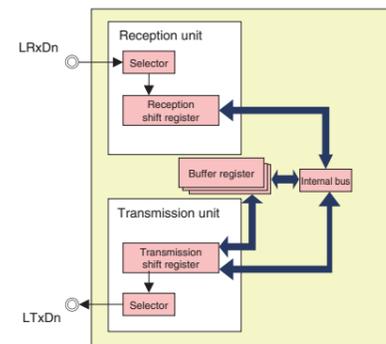
CAN controller (78K0R/Hx3)

- 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



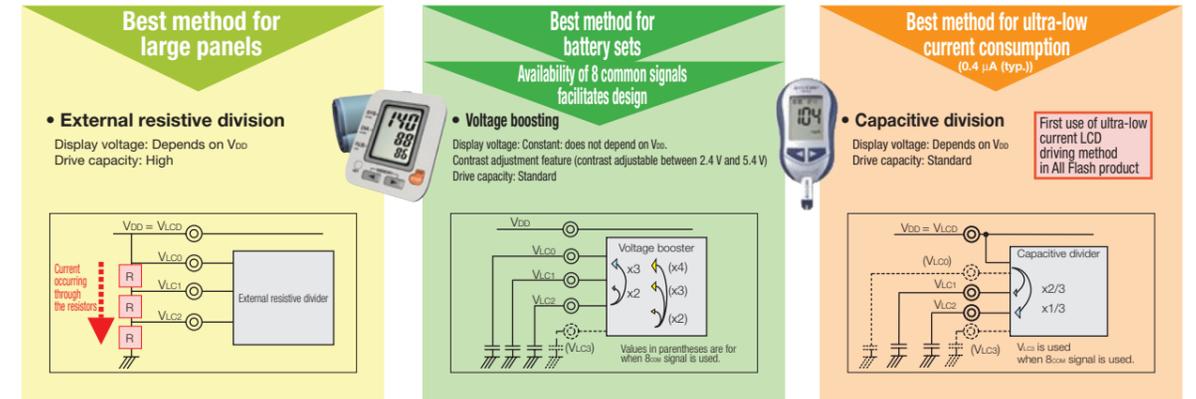
LIN-UART (78K0R/Hx3)

- Communication using 9-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)



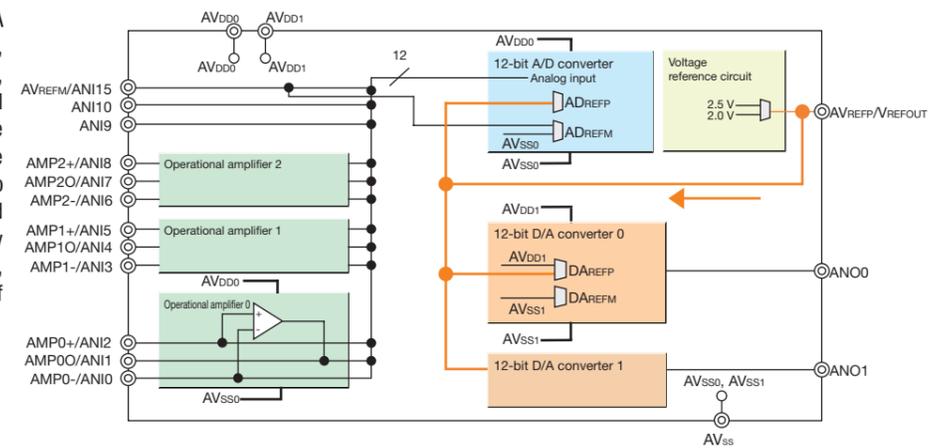
LCD controller/driver (78K0R/Lx3)

Three different display methods can be selected according to the LCD application.



Enhanced analog features (78K0R/Lx3^{Note}, 78K0R/Kx3-A)

The 78K0R/Lx3 and 78K0R/Kx3-A provide enhanced analog features, including 12-bit A/D converters, 12-bit D/A converters, operational amplifiers, and an analog voltage reference. These features enable sensor inputs to be converted into high-resolution digital signals, and eliminate the need to externally attach analog components, allowing you to reduce the size of your system.

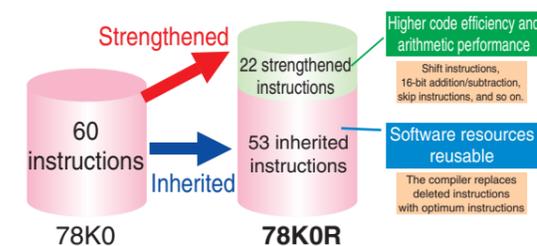


Note: μPD78F1500A to 78F1508A only

Shifting to high-performance 16-bit microcontrollers can be performed smoothly, taking compatibility with 8-bit microcontrollers into consideration.

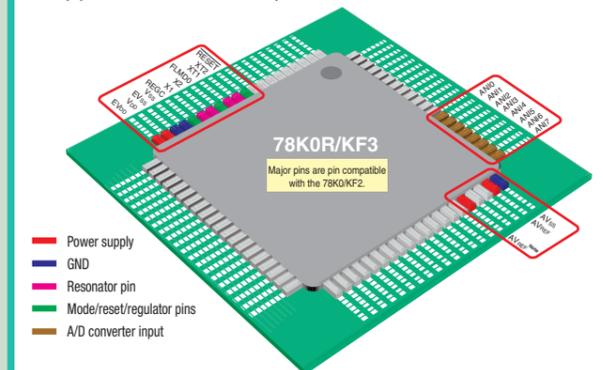
Upward compatible for instructions from 8-bit microcontrollers

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.



Note: 78K0R only

High reliability

The reliability technologies developed for automotive flash microcontrollers can be found in all our flash microcontrollers, making them a safe choice.

Record of shipment & applications employing our flash microcontrollers



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

Software protection function

PG-FP5
Flash memory programmer



Writing



You can disable writing.

Erasing



You can disable erasing.

Reading



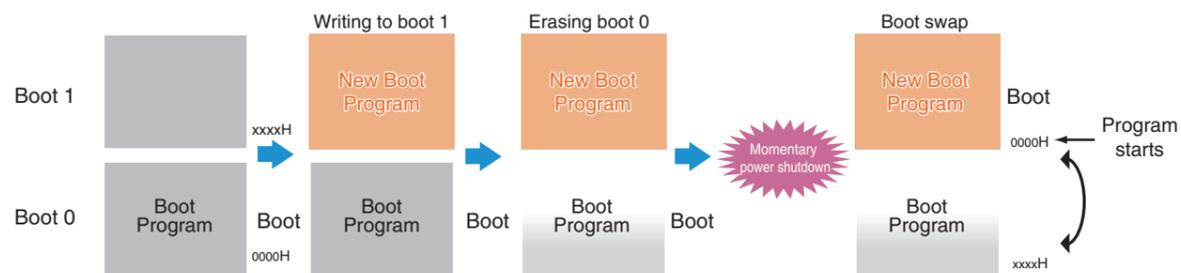
No commands for reading are provided.

A boot swap function is provided to protect important programs even when power shuts down during self-programming.

Problems during self-rewriting



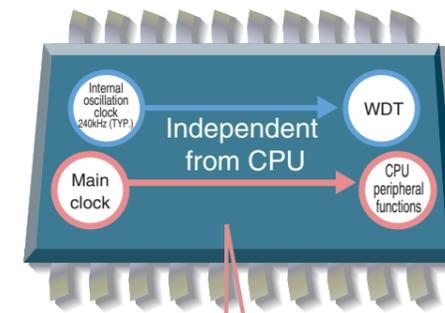
Boot swap function



The microcontroller can start normally even when momentary power shutdown occurs during boot rewriting.

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

WDT independent from CPU



This configuration is the same as that in which an external watchdog timer is connected.
The WDT does not stop even if the main clock stops.

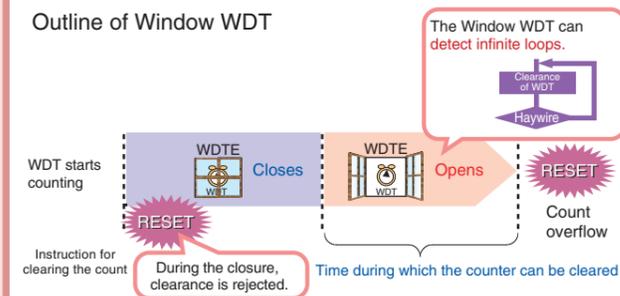
WDT function

| | Conventional microcontrollers | 78K0R/Kx3, 78K0R/Kx3-L, 78K0R/Kx3-C, 78K0R/lx3 |
|-------------------------|---|--|
| X1 clock stops | The watchdog timer also stops and the microcontroller haywire cannot be detected. | The watchdog timer does not stop. |
| Microcontroller haywire | It is doubtful whether the haywire is detected because counts are cleared by 1-bit flags. | No need to worry about haywire because counts are cleared by the byte instruction. |

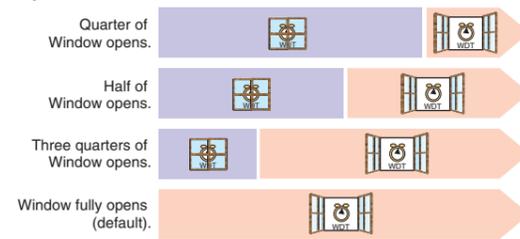
The watchdog timer incorporates enhanced functions.

Window WDT

Outline of Window WDT



Four types of Window settings can be selected according to the system.



An option byte function is incorporated to enable important system operation settings by hardware, eliminating setting errors caused by inadvertent program loops.

Option byte function

When RESET is released, you can set the setting value with the hardware.

ROM address

000C3H

000C1H

000C0H

000C0H

Setting 1 Watchdog timer operation in HALT/STOP mode Stop/enable operation

Setting 2 Watchdog timer overflow time 3.88 ms (TYP.) to 3971.88 ms (TYP.)

Setting 3 Watchdog timer operation Stop/enable operation

Setting 4 Watchdog timer window open time 25%/50%/75%/100%^{*1}

Setting 5 Watchdog timer interval interrupt Use/do not use

000C3H

Setting 1 On-chip debug operation control Disable/enable operation

Flash memory data processing when security ID authorization fails Delete/do not delete data

000C1H

Setting 1 LVI setting during reset release ON/OFF, LVI = default

Setting 2 High-speed internal oscillator frequency setting^{*2} Select from 1 MHz/8 MHz/20 MHz

^{*1} The 25% setting cannot be specified in the 78K0R/Kx3-L.
^{*2} 78K0R/lx3, 78K0R/Kx3-L, 78K0R/Kx3-C, 78K0R/Kx3-A, 78K0R/lx3, μPD78F8043, and μPD78F8058 only

Rich development environment

Various development environments for each development phase are available.

Lineup of development environment

Test board

Target board for MINICUBE2



QB-78K0RKG3-TB QB-78K0RLH3-TB
 QB-78K0RKE3L-TB QB-78K0RHG3-TB
 QB-78K0RIE3-TB QB-78F8041-TB
 QB-78K0RKG3C-TB (Under development) QB-78F1026-TB
 QB-78K0RKG3L-TB (QB-78K0RKG3-TB is shown to the left.)

Starter kit
 Made by TESSERA Technology Inc.



TK-78K0R/KG3
 TK-78K0R/KE3L
 TK-78K0R/KG3C
 TK-78K0R/LH3+LCD
 (TK-78K0R/KG3 is shown to the left.)

Software development Debugging/verification Writing

Development environment

Microcontroller integrated development environment (CubeSuite)



Full-function in-circuit emulator (IECUBE®)



On-chip debug emulator with programming function (MINICUBE2)



MINICUBE2 wireless option (QB-MINI2-RF)

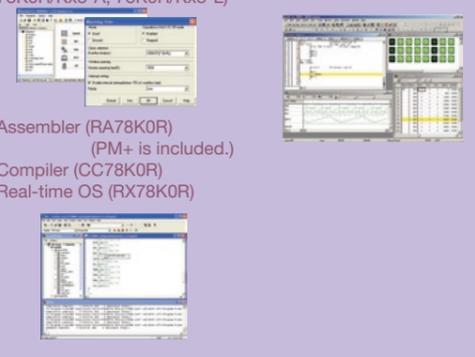
Flash memory programmer (PG-FP5)



Device driver configurator (Appilet3 for 78K0R/1x3, 78K0R/Kx3, 78K0R/Lx3, 78K0R/Kx3-A, 78K0R/Kx3-L)

Simulator (SM+ for 78K0R, 78K0R/Kx3)

Assembler (RA78K0R) (PM+ is included.)
 Compiler (CC78K0R)
 Real-time OS (RX78K0R)



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

Product-specific peripheral function settings automatically easily generated with Appilet® Appilet3 for 78K0R/Kx3

Software resources

C sources can be transported almost as is

Compiler (CC78K0R)
 Assembler (RA78K0R)

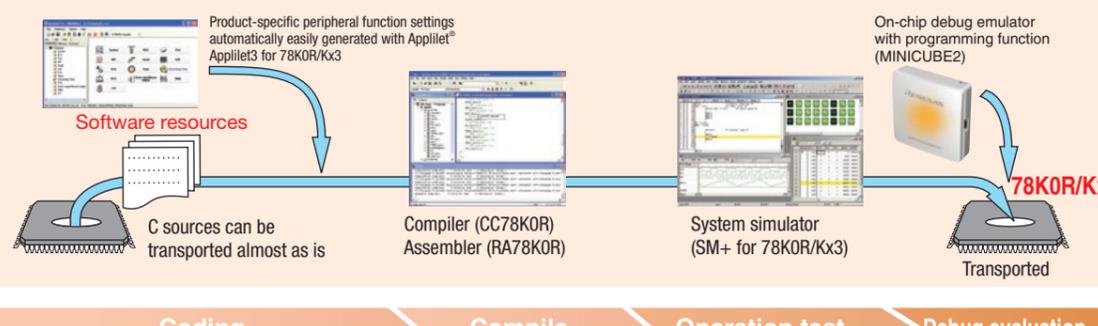
System simulator (SM+ for 78K0R/Kx3)

On-chip debug emulator with programming function (MINICUBE2)

78K0R/Kx3

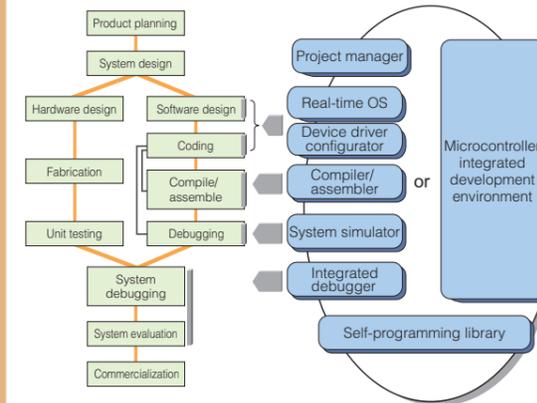
Transported

Coding **Compile** **Operation test** **Debug evaluation**



Software

Rich lineup of tools for each development phase



| Type | Name |
|--|---|
| Microcontroller integrated development environment | CubeSuite |
| Software package | SP78K0R |
| Project manager | PM+ |
| Assembler package | RA78K0R |
| C compiler | CC78K0R |
| System simulator | SM+ for 78K0R/Kx3 (instruction + peripheral simulation version) SM+ for 78K0R (instruction simulation version) |
| Integrated debugger | ID78K0R-QB |
| Real-time OS | RX78K0R |
| Self-programming library | FSL |
| Device driver configurator | Appilet3 for 78K0R/1x3, Kx3, Lx3, Kx3-A, Kx3-L |

- Microcontroller integrated development environment**
 - Used to compile and debug programs, manage pin layouts, generate code for microcontroller peripherals, and execute high-speed building.
- Software package**
 - Project manager, C compiler, assembler, integrated debugger, etc., provided on a single CD-ROM disk
- Project manager**
 - Various development tools integrated on Windows™
 - A series of operations, such as editor, builder, and debugger start-up, is possible.
- C compiler**
 - ANSI-C standard compliant
 - 78K0R specification expansion
 - Emphasis on ROM/RAM efficiency
 - Conscious embedded control
- Assembler package**
 - Macro functions
 - Conditional assembly function
 - Branch instruction optimization functions
 - Project manager (PM+) included
- System simulator**
 - GUI design similar to that of integrated debugger
 - Evaluation possible without target prior to target completion
 - Instruction/instruction + peripheral simulation version
- Integrated debugger**
 - Operates on Windows
 - Easy to understand and use GUI (Graphical User Interface)
 - Buttons provided for frequently used commands
 - Can be started up with a simple mouse click
- Real-time OS**
 - μITRON 4.0 specification compliant
- Self-programming library**
 - The flash memory can be programmed with the microcontroller itself, without using a programmer.
 - Built-in boot swap function for protecting the boot area at power down
- Device driver configurator**
 - The setting sources of the built-in peripheral functions can be automatically generated through GUI operation without referring to the device's user's manual.

Hardware

Full-function in-circuit emulator (IECUBE)

Enables detailed debugging through equivalent emulation of microcontrollers, using trace, time measurement, and other functions.

IECUBE system configuration

Socket configuration (T type) IECUBE main body USB cable Power supply cable CD-ROM (debugger, etc.) IECUBE accessories

Check-pin adapter Emulation probe Exchange adapter Space adapter YQ connector Mount adapter Target connector Target system

MINICUBE2 (accessory)

| Device | Corresponding IECUBE |
|--|----------------------|
| 78K0R/KE3, KF3, KG3, KH3, KJ3 | QB-78K0RKX3 |
| 78K0R/IB3, IC3, ID3, IE3 | QB-78K0RIX3 |
| 78K0R/KC3-L, KD3-L, KE3-L | QB-78K0RHX3 |
| 78K0R/KF3-L, KG3-L (ROM: Up to 128 KB) | QB-78K0RHX3C |
| 78K0R/KF3-L, KG3-L (ROM: 192 KB or more) | QB-78F1030 |
| 78K0R/KF3-C, KG3-C | QB-78K0RHX3C |
| 78K0R/KE3-A | QB-78K0RLX3 |
| 78K0R/LF3, LG3, LH3 | QB-78K0RLX3 |
| μPD78F8043 | QB-78K0RHX3C |
| 78K0R/KC3-L, KE3-L (USB) | QB-78F1026 |
| 78K0R/Hx3 | QB-78K0RFx3 |

On-chip debug emulator with programming function (MINICUBE2)

- On-chip debugging possible simply by starting integrated debugger
- Flash programming possible by starting programming GUI
- Supports V850, 78K0, and 78K0S All Flash microcontrollers
- Small and light weight

MINICUBE2 system configuration

Microcontroller Target system 16-pin target cable MINICUBE2 USB cable PC

Test board QB-78K0RKG3-TB (separately available)

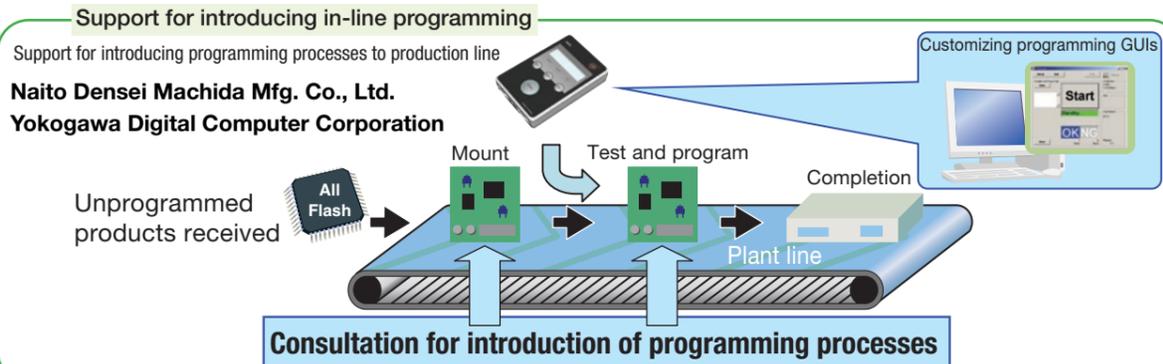
| MINICUBE2 supported devices |
|---|
| 78K0R/KE3, KF3, KG3, KH3, KJ3 |
| 78K0R/IB3, IC3, ID3, IE3 |
| 78K0R/KC3-L, KD3-L, KE3-L, KF3-L, KG3-L |
| 78K0R/KF3-C, KG3-C |
| 78K0R/KE3-A |
| 78K0R/LF3, LG3, LH3 |
| μPD78F8043 |
| μPD78F8058 |
| 78K0R/HC3, HE3, HF3, HG3 |

Support for mass production

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.

Programming by the customer

Delivery time^{Note 1}: Practically none, highly flexible



Flash memory programmers

Various products selectable for your purposes and price range



Programming by partner companies

Flexible support for small-volume programming and short delivery time

Programming houses

Just ask us about the programming houses in your region

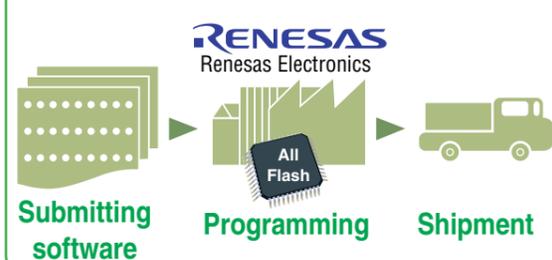


Programmed products

Shipment form same as that of mask ROM microcontrollers

Renesas Electronics

The same way as mask ROM microcontrollers, programmed products can be delivered with a short TAT



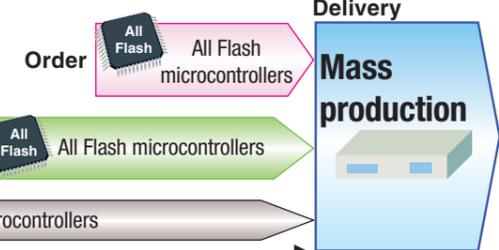
Programming houses

Delivery time^{Note 1}: **Several days**

Renesas Electronics

Delivery time^{Note 1}: **About 1/2 that of mask ROM**^{Note 2}

Order Conventional mask ROM microcontrollers



From ordering to delivery time for mass production start schedule

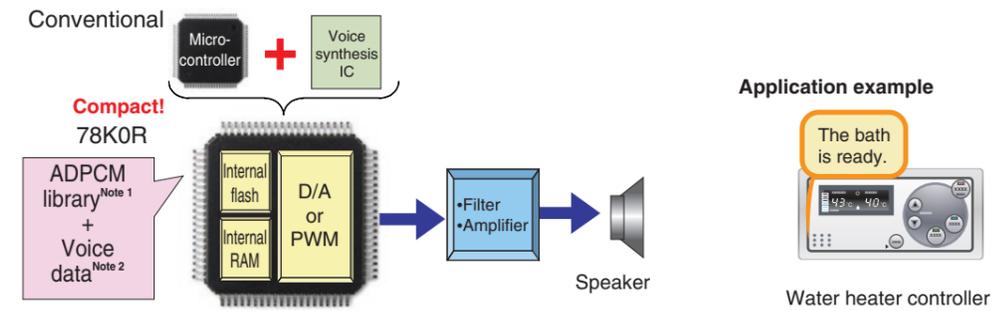
Notes 1. Period from completion of software until start of mass production
2. Delivery time may vary depending on purchase conditions, such as order quantity.

Application examples

Various functions achieved with 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.



Note 1. ADPCM library (ADPCM-SP) features

Two libraries are provided: the ADPCM-SP with both compression and extension capabilities, and the simplified ADPCM-SP2 with only extension capabilities.

| Library | Library sizes | | Processing functions (during 20 MHz drive) | |
|-----------|---------------|----------|--|--------------|
| | ROM | RAM | Compression | Extension |
| ADPCM-SP | 3 KB | 32 bytes | 35 μs, max. | 30 μs, max. |
| ADPCM-SP2 | 450 bytes | 8 bytes | - | 3.5 μs, max. |

Remarks 1. The above processing times are processing times for individual libraries. When mounted in a system, extra processing time is required for output processing.
2. Processing is necessary every 125 μs in the case of 8 kHz sampling voice.

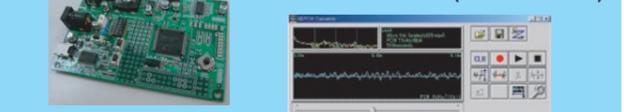
Note 2. Voice data compression can be chosen from 3 patterns.

| Compression rate | High audio quality ← High compression | | |
|------------------|---------------------------------------|--------|--------|
| | 4 KBps | 3 KBps | 2 KBps |
| | | | |

Remark The 3 KBps specification is not supported by the ADPCM-SP2 library.

Evaluation environment to support "speaking"

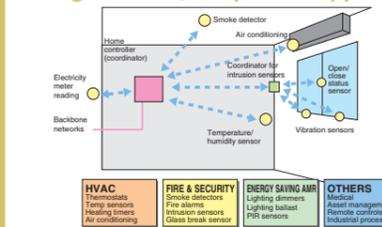
Voice conversion tool (WAVE→ADPCM)



Connecting (ZigBee[®])

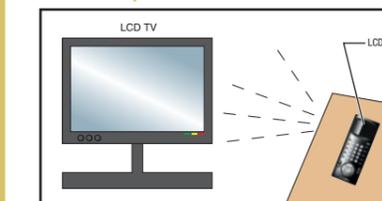
Our All Flash microcontrollers comply with ZigBee PRO, providing total support for low-power wireless network applications. You can start developing your application straight away.

• ZigBee PRO, SimpleNET application



- Build a low-power in-home network
- Supports 8, 16, and 32-bit microcontrollers

• RF4CE (wireless remote control) application



- The remote controller is omnidirectional, so you do not have to point it at the device.
- Bidirectional communication allows the device status to be displayed on the remote controller's screen.

• ZigBee SDK^{Note} (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.

Note Product co-developed by Skyley Networks, Inc. and Renesas Electronics.

Evaluation board lineup

(Boards made by TESSERA Technology Inc.)

TK-78K0R/KG3+UD

- 16-bit microcontroller 78K0R/KG3 mounted
- Internal ROM: 512 KB
- Internal RAM: 30 KB

TK-RF8058+SB

- 16-bit microcontroller with RF receiver μPD78F8058 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

Product specifications (1/4)

| Commercial name | | 78K0R/KE3 | | | | | 78K0R/KF3 | | | | | 78K0R/KG3 | | | | | | 78K0R/KH3 | | | | | 78K0R/KJ3 | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------------|---|--|---|-------------|-------------|------------------------|-------------|-----------------|-------------|-------------|------------------------|-----------------------------------|-----------------|-------------|-------------|------------------------|-------------|-----------------------------------|------------------|-------------|-------------|-------------|-----------------------------------|------------------|-------------|-------------|-------------|-----------------------------------|--|--|--|--|-------|--|--|--|--|-------|--|--|--|--|-------|--|--|--|--|
| Pin count | | 64-pin | | | | | 80-pin | | | | | 100-pin | | | | | | 128-pin | | | | | 144-pin | | | | | | | | | | | | | | | | | | | | | | | | |
| Product name | | μPD78F1142A | μPD78F1143A | μPD78F1144A | μPD78F1145A | μPD78F1146A | μPD78F1152A | μPD78F1153A | μPD78F1154A | μPD78F1155A | μPD78F1156A | μPD78F1162A | μPD78F1163A | μPD78F1164A | μPD78F1165A | μPD78F1166A | μPD78F1167A | μPD78F1168A | μPD78F1174A | μPD78F1175A | μPD78F1176A | μPD78F1177A | μPD78F1178A | μPD78F1184A | μPD78F1185A | μPD78F1186A | μPD78F1187A | μPD78F1188A | | | | | | | | | | | | | | | | | | | |
| Flash memory (bytes) | | 64 K | 96 K | 128 K | 192 K | 256 K | 64 K | 96 K | 128 K | 192 K | 256 K | 64 K | 96 K | 128 K | 192 K | 256 K | 384 K | 512 K | 128 K | 192 K | 256 K | 384 K | 512 K | 128 K | 192 K | 256 K | 384 K | 512 K | | | | | | | | | | | | | | | | | | | |
| RAM (bytes) | | 4 K | 6 K | 8 K | 10 K | 12 K ^{Note 1} | 4 K | 6 K | 8 K | 10 K | 12 K ^{Note 1} | 4 K | 6 K | 8 K | 10 K | 12 K ^{Note 1} | 24 K | 30 K ^{Note 2} | 8 K | 10 K | 12 K | 24 K | 30 K ^{Note 2} | 8 K | 10 K | 12 K | 24 K | 30 K ^{Note 2} | | | | | | | | | | | | | | | | | | | |
| External bus interface | External memory expansion space | - | | | | | - | | | | | 888 K | | | | | | 824 K | | | | | 824 K | | | | | 760 K | | | | | 696 K | | | | | 568 K | | | | | 440 K | | | | |
| | Bus type | - | | | | | - | | | | | Multiplexed/separate | | | | | | Multiplexed/separate | | | | | Multiplexed/separate | | | | | Multiplexed/separate | | | | | | | | | | | | | | | | | | | |
| | Address bus | - | | | | | - | | | | | Selectable from 8, 12, 16, and 20 | | | | | | Selectable from 8, 12, 16, and 20 | | | | | Selectable from 8, 12, 16, and 20 | | | | | Selectable from 8, 12, 16, and 20 | | | | | | | | | | | | | | | | | | | |
| | Data bus | - | | | | | - | | | | | 8/16 bits | | | | | | 8/16 bits | | | | | 8/16 bits | | | | | 8/16 bits | | | | | | | | | | | | | | | | | | | |
| Power supply voltage | Normal operation mode | 1.8 to 5.5 V | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Flash memory programming mode | 2.7 to 5.5 V | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Minimum instruction execution time | | 0.05 μs (20 MHz: V _{DD} = 2.7 to 5.5 V), 0.2 μs (5 MHz: V _{DD} = 1.8 to 5.5 V) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clock | Main clock | High-speed system clock | Ceramic/crystal/external clock: 2 to 20 MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | High-speed internal oscillation clock | 8 MHz (Typ.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Subclock | Crystal | 32.768 kHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Low-speed internal oscillation clock | 240 kHz (Typ.) (for WDT) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| I/O ports | Total | 55 | | | | | 70 | | | | | 88 | | | | | | 116 | | | | | 132 | | | | | | | | | | | | | | | | | | | | | | | | |
| | CMOS I/O | 46 | | | | | 61 | | | | | 79 | | | | | | 107 | | | | | 123 | | | | | | | | | | | | | | | | | | | | | | | | |
| | CMOS input | 4 | | | | | 4 | | | | | 4 | | | | | | 4 | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| | CMOS output | 1 | | | | | 1 | | | | | 1 | | | | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| | N-ch open-drain | 4 | | | | | 4 | | | | | 4 | | | | | | 4 | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| Timer | 16-bit timer | Number of channels | 8 | | | | | 8 | | | | | 8 | | | | | | 12 | | | | | 12 | | | | | | | | | | | | | | | | | | | | | | | |
| | | Function | Interval timer/external event counter/frequency division function/pulse interval measurement/pulse width measurement/one-shot pulse output/PWM output | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | PWM | 6 channels max. | | | | | 7 channels max. | | | | | 7 channels max. | | | | | | 10 channels max. | | | | | 10 channels max. | | | | | | | | | | | | | | | | | | | | | | | |
| | Watchdog timer (WDT) | 1 | | | | | 1 | | | | | 1 | | | | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Real-time counter (RTC) | 1 | | | | | 1 | | | | | 1 | | | | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Serial interface | CSI: 2 channels, UART: 1 channel | | - | | | | | 1 | | | | | 1 | | | | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| | CSI: 1 channel, UART: 1 channel | | 1 | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| | CSI: 2 channels, UART: 1 channel, simple I ² C: 2 channels | | - | | | | | - | | | | | - | | | | | | 2 | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | |
| | CSI: 1 channel, UART: 1 channel, simple I ² C: 1 channel | | 1 | | | | | 2 | | | | | 2 | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| | CSI: 2 channels, UART (supporting LIN): 1 channel | | - | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| | CSI: 1 channel, simple I ² C: 1 channel | | - | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| | CSI | | - | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| | UART: 1 channel, simple I ² C: 1 channel | | - | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| | UART (supporting LIN) | | 1 | | | | | 1 | | | | | 1 | | | | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| | UART | | - | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| Simple I ² C | | - | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | | |
| I ² C | | 1 | | | | | 1 | | | | | 1 | | | | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| LCD controller/driver | | | - | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| | Segment signal output | | - | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| | Common signal output | | - | | | | | - | | | | | - | | | | | | - | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| A/D converter | | 10 bits × 8 | | | | | 10 bits × 8 | | | | | 10 bits × 16 | | | | | | 10 bits × 16 | | | | | 10 bits × 16 | | | | | | | | | | | | | | | | | | | | | | | | |
| D/A converter | | - | | | | | 8 bits × 2 | | | | | 8 bits × 2 | | | | | | 8 bits × 2 | | | | | 8 bits × 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| DMA controller | | 2 | | | | | 2 | | | | | 2 | | | | | | 2 | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| Interrupt | External | 13 | | | | | 13 | | | | | 13 | | | | | | 13 | | | | | 13 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Internal | 25 | | | | | 28 | | | | | 28 | | | | | | 32 | | | | | 32 | | | | | | | | | | | | | | | | | | | | | | | | |
| On-chip debug (MINICUBE2) | | Supported | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Multiplier/divider | | Multiplier: 16 bits × 16 bits = 32 bits | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Low-voltage detector (LVI) | | 1.91/2.07 (initial value)/2.22/2.38/2.53/2.68/2.84/2.99/3.15/3.30/3.45/ 3.61/3.76/3.92/4.07/4.22 V ±0.1 V (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Power-on clear (POC) | | 1.59 V ±0.09 V | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Other peripheral functions | | Key interrupt function | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Operating temperature | | -40 to +85°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Notes 1. 10 KB when the self programming function is used.
2. 28 KB when the self programming function is used.

Product specifications (2/4)

| Commercial name | | 78K0R/KC3-L | | | | | | | | | | 78K0R/KD3 -L | | | 78K0R/KE3-L | | | 78K0R/KF3-L | | | | 78K0R/KG3-L | | | | 78K0R/KC3-L | | | 78K0R/KE3-L | | 78K0R/KE3-A | | | | | | | | |
|--------------------------------------|---|--|-----------------|---|-----------------------|--------------|-----------------|------------|-----------------------|--------------|-----------------|-----------------------|------------|--------------|-----------------------|------------|--------------|--|--------------------------|---|--|------------------------------|---|------------------|--|--|---|--|--|-----------------------|-----------------------|---|--------------|------------|-----------------|----|-----------------|----|--|
| Pin count | | 40-pin | | | | 44-pin | | | | 48-pin | | | | 52-pin | | | 64-pin | | | 80-pin | | | | 100-pin | | | | 48-pin | | | 64-pin | | 64-pin | | | | | | |
| Product name | | μPD78F1000 | μPD78F1001 | μPD78F1002 | μPD78F1003 | μPD78F1000 | μPD78F1001 | μPD78F1002 | μPD78F1003 | μPD78F1001 | μPD78F1002 | μPD78F1003 | μPD78F1004 | μPD78F1005 | μPD78F1006 | μPD78F1007 | μPD78F1008 | μPD78F1009 | μPD78F1010 | μPD78F1011 | μPD78F1012 | μPD78F1027 ^{Note 1} | μPD78F1028 ^{Note 1} | μPD78F1013 | μPD78F1014 | μPD78F1029 ^{Note 1} | μPD78F1030 ^{Note 1} | μPD78F1022 | μPD78F1023 | μPD78F1024 | μPD78F1025 | μPD78F1026 | μPD78F1016 | μPD78F1017 | μPD78F1018 | | | | |
| Flash memory (bytes) | | 16 K | 32 K | 48 K | 64 K | 16 K | 32 K | 48 K | 64 K | 32 K | 48 K | 64 K | 32 K | 48 K | 64 K | 32 K | 48 K | 64 K | 64 K | 96 K | 128 K | 192 K | 256 K | 96 K | 128 K | 192 K | 256 K | 64 K | 96 K | 128 K | 96 K | 128 K | 64 K | 96 K | 128 K | | | | |
| RAM (bytes) | | 1 K | 1.5 K | 2 K | 3 K ^{Note 2} | 1 K | 1.5 K | 2 K | 3 K ^{Note 2} | 1.5 K | 2 K | 3 K ^{Note 2} | 1.5 K | 2 K | 3 K ^{Note 2} | 1.5 K | 2 K | 3 K ^{Note 2} | 4 K | 6 K | 8 K ^{Note 3} | 10 K | 12 K ^{Note 4} | 6 K | 8 K ^{Note 3} | 10 K | 12 K ^{Note 4} | 6 K | 8 K ^{Note 3} | 8 K ^{Note 3} | 8 K ^{Note 3} | 8 K ^{Note 3} | 4 K | 6 K | 7 K | | | | |
| External bus interface | External memory expansion space | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Bus type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Address bus | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Data bus | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Power supply voltage | Normal operation mode | | | | | | | | | | | | | | | | | 1.8 to 5.5 V | | | | | | | 3.0 to 3.6 V (1.8 to 3.6 V when USB not used) | | | 1.8 to 5.5 V | | | | | | | | | | | |
| | Flash memory programming mode | | | | | | | | | | | | | | | | | 1.8 to 5.5 V | | | | | | | 1.8 to 3.6 V | | | 1.8 to 5.5 V | | | | | | | | | | | |
| Minimum instruction execution time | | | | | | | | | | | | | | | | | | 0.05 μs (20 MHz: V _{DD} = 2.7 to 5.5 V), | | | 0.2 μs (5 MHz: V _{DD} = 1.8 to 2.7 V) | | | | 0.05 μs (20 MHz: V _{DD} = 2.7 to 3.6 V), 0.2 μs (5 MHz: V _{DD} = 1.8 to 3.6 V) | | | 0.05 μs (20 MHz: V _{DD} = 2.7 to 3.6 V), 0.2 μs (5 MHz: V _{DD} = 1.8 to 3.6 V) | | | | | | | | | | | |
| Clock | Main clock | | | | | | | | | | | | | | | | | Ceramic/crystal/external clock: 2 to 20 MHz | | | | | | | Ceramic/crystal/external clock: 2 to 20 MHz | | | Ceramic/crystal/external clock: 2 to 20 MHz | | | | | | | | | | | |
| | | High-speed system clock | | | | | | | | | | | | | | | | | 1 MHz ±13%, 8 MHz ±1.8%, | | | 20 MHz ±2.4% | | | | 1 MHz ±13% (target), 8 MHz ±1.8% (target), 20 MHz ±2.4% (target) | | | 1 MHz ±13% (target), 8 MHz ±2% (target), 20 MHz ±2.4% (target) | | | | | | | | | | |
| | High-speed internal oscillation clock | | | | | | | | | | | | | | | | | 1 MHz ±13%, 8 MHz ±1.8%, | | | 20 MHz ±2.4% | | | | 1 MHz ±13% (target), 8 MHz ±1.8% (target), 20 MHz ±2.4% (target) | | | 1 MHz ±13% (target), 8 MHz ±2% (target), 20 MHz ±2.4% (target) | | | | | | | | | | | |
| | Subclock | | | | | | | | | | | | | | | | | Crystal: 32.768 kHz | | | | | | | Crystal: 32.768 kHz | | | Crystal: 32.768 kHz | | | | | | | | | | | |
| Low-speed internal oscillation clock | | | | | | | | | | | | | | | | | | 30 kHz ±10% | | | (for WDT) | | | | 30 kHz ±10% (for WDT) | | | 30 kHz ±10% (for WDT) | | | | | | | | | | | |
| I/O ports | Total | 33 | | | | 37 | | | | 41 | | | | 45 | | | 55 | | | 71 | | | | 89 | | | | 39 ^{Note 5} | | | 53 ^{Note 5} | | 53 | | | | | | |
| | CMOS I/O | 31 | | | | 33 | | | | 34 | | | | 38 | | | 48 | | | 62 | | | | 80 | | | | 30 | | | 43 | | 46 | | | | | | |
| | CMOS input | 2 | | | | 4 | | | | 4 | | | | 4 | | | 4 | | | 4 | | | | 4 | | | | 4 | | | 4 | | 4 | | | | | | |
| | CMOS output | - | | | | - | | | | 1 | | | | 1 | | | 1 | | | 1 | | | | 1 | | | | - | | | 1 | | 1 | | | | | | |
| | N-ch open-drain | - | | | | - | | | | 2 | | | | 2 | | | 2 | | | 4 | | | | 4 | | | | 4 | | | 4 | | 2 | | | | | | |
| Timer | 16-bit timer | Number of channels | | 8 | | | | 8 | | | | 8 | | | | 8 | | | 8 | | | 12 | | | | 12 | | | | 8 | | | 8 | | 12 | | | | |
| | | Function | | Interval timer/external event counter/frequency division function/pulse interval measurement/pulse width measurement/one-shot pulse output/PWM output | | | | | | | | | | | | | | | | Interval timer/external event counter/frequency division function/pulse interval measurement/pulse width measurement/one-shot pulse output/PWM output | | | Interval timer/external event counter/frequency division function/pulse interval measurement/pulse width measurement/one-shot pulse output/PWM output | | | | Interval timer/external event counter/frequency division function/pulse interval measurement/pulse width measurement/one-shot pulse output/PWM output | | | | | | | | | | | | |
| | PWM | | 6 channels max. | | | | 7 channels max. | | | | 7 channels max. | | | | 7 channels max. | | | max. | | | 7 channels max. | | | 10 channels max. | | | | 10 channels max. | | | | 3 channels max. | | | 5 channels max. | | 7 channels max. | | |
| | Watchdog timer (WDT) | | 1 | | | | 1 | | | | 1 | | | | 1 | | | 1 | | | 1 | | | | 1 | | | | 1 | | | 1 | | 1 | | | | | |
| Real-time counter (RTC) | | - | | | | 1 | | | | 1 | | | | 1 | | | 1 | | | 1 | | | | 1 | | | | 1 | | | 1 | | 1 | | | | | | |
| Serial interface | CSI: 2 channels, UART: 1 channel | | - | | | | - | | | | - | | | | - | | | - | | | 1 | | | | 2 | | | | 1 | | | 2 | | - | | | | | |
| | CSI: 1 channel, UART: 1 channel | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | 1 | | | 1 | | 1 | | | | | |
| | CSI: 2 channels, UART: 1 channel, simple I ² C: 2 channels | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | - | | | | | |
| | CSI: 1 channel, UART: 1 channel, simple I ² C: 1 channel | | 1 | | | | 1 | | | | 1 | | | | 1 | | | 1 | | | 2 | | | | 2 | | | | 1 | | | 2 | | 2 | | | | | |
| | CSI: 2 channels, UART (supporting LIN): 1 channel | | 1 | | | | 1 | | | | 1 | | | | 1 | | | 1 | | | - | | | | - | | | | - | | | - | | - | | | | | |
| | CSI: 1 channel, simple I ² C: 1 channel | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | - | | | | | |
| | CSI | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | - | | | | | |
| | UART: 1 channel, simple I ² C: 1 channel | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | - | | | | | |
| | UART (supporting LIN) | | - | | | | - | | | | - | | | | - | | | - | | | 1 | | | | 1 | | | | 1 | | | 1 | | 1 | | | | | |
| | UART | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | - | | | | | |
| Simple I ² C | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | - | | | | | | |
| I ² C | | - | | | | - | | | | 1 | | | | 1 | | | 1 | | | 1 | | | | 1 | | | | 1 | | | 1 | | 1 | | | | | | |
| LCD controller/driver | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | - | | | | | | |
| Segment signal output | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | - | | | | | | |
| Common signal output | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | - | | | | | | |
| A/D converter | | 10 bits × 10 | | | | 10 bits × 10 | | | | 10 bits × 11 | | | | 10 bits × 11 | | | 10 bits × 12 | | | 10 bits × 12 | | | | 10 bits × 16 | | | | 10 bits × 8 | | | 10 bits × 8 | | 12 bits × 12 | | | | | | |
| D/A converter | | - | | | | - | | | | - | | | | - | | | - | | | - | | | | - | | | | - | | | - | | 12 bits × 2 | | | | | | |
| DMA controller | | 2 | | | | 2 | | | | 2 | | | | 2 | | | 2 | | | 2 | | | | 2 | | | | 2 | | | 2 | | 2 | | | | | | |
| Interrupt | External | 8 | | | | 9 | | | | 9 | | | | 9 | | | 9 | | | 13 | | | | 13 | | | | 7 | | | 11 | | 12 | | | | | | |
| | Internal | 22 | | | | 24 | | | | 25 | | | | 25 | | | 25 | | | 33 | | | | 35 | | | | 33 | | | 35 | | 36 | | | 41 | | 33 | |
| On-chip debug (MINICUBE2) | | Supported | | | | | | | | | | | | | | | | Supported | | | Supported | | | | Supported | | | Supported | | | | | | | | | | | |
| Multiplier/divider | | Multiplier/divider: 16 bits × 16 bits = 32 bits, | | | | | | | | | | | | | | | | 32 bits + 32 bits = 32 bits, remainder: 32 bits | | | | | | | Multiplier/divider: 16 bits × 16 bits = 32 bits, 32 bits + 32 bits = 32 bits, remainder: 32 bits | | | | | | | | | | | | | | |
| Low-voltage detector (LVI) | | 1.91/2.07 (initial value)/2.22/2.38/2.53/2.68/2.84/2.99/3.15/3.30/3.45/3.61/3.76/3.92/4.07/4.22 V ±0.1 V | | | | | | | | | | | | | | | | (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed | | | (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed | | | | 1.91/2.07 (initial value)/2.22/2.38/2.53/2.68/2.84/2.99/3.15/3.30/3.45 V ±0.1 V (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed | | | Note 6 | | | | | | | | | | | |
| Power-on clear (POC) | | Power-on reset: 1.61 V ±0.09 V, | | | | | | | | | | | | | | | | power-down reset: 1.59 V ±0.09 V | | | | | | | Power-on reset: 1.61 V ±0.09 V, power-down reset: 1.59 V ±0.09 V | | | | | | | | | | | | | | |
| Other peripheral functions | | Comparator: 2 channels, programmable gain amplifier: 1 channel, | | | | | | | | | | | | | | | | key interrupt function | | | Key interrupt function | | | | Key interrupt function | | | | USB function controller, key interrupt function | | | Operational amplifier: 3 channels, key interrupt function | | | | | | | |
| Operating temperature | | -40 to | | | | | | | | | | | | | | | | +85°C | | | | | | | -40 to +85°C | | | -40 to +85°C | | | | | | | | | | | |

Notes 1. Under development
 2. 2 KB when the self programming function is used.
 3. 7 KB when the self programming function is used.
 4. 11 KB when the self programming function is used.
 5. One is for controlling the USB buffer.
 6. 1.91/2.07 (initial value)/2.22/2.38/2.53/2.68/2.84/2.99/3.15/3.30/3.45/3.61/3.76/3.92/4.07/4.22 V ±0.1 V (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed

Product specifications (3/4)

| Commercial name | | 78K0R/KF3-C | | 78K0R/KG3-C | | 78K0R/HC3 | | | | | 78K0R/HE3 ^{Note 1} | | | | 78K0R/HF3 ^{Note 1} | | | | 78K0R/HG3 ^{Note 1} | | | | | μPD78F8043 | | | | μPD78F8058 ^{Note 1} | | | | |
|------------------------------------|---|---|-----------------------|--|-----------------------|--------------|---|-----------------------|--|------------------|-----------------------------|--------------|--|------------------|-----------------------------|--------------|------------|--|-----------------------------|---|------------|----------------------|---|-----------------------|---|----------------------|---|------------------------------|------------|-----------------------|-----------------------|-----------------------|
| Pin count | | 80-pin | | 100-pin | | 48-pin | | | | | 64-pin | | | | 80-pin | | | | 100-pin | | | | | 56-pin | | | | 56-pin | | | | |
| Product name | | μPD78F1846A | μPD78F1847A | μPD78F1848A | μPD78F1849A | μPD78F1031 | μPD78F1032 | μPD78F1033 | μPD78F1034 | μPD78F1035 | μPD78F1036 | μPD78F1037 | μPD78F1038 | μPD78F1039 | μPD78F1040 | μPD78F1041 | μPD78F1042 | μPD78F1043 | μPD78F1044 | μPD78F1045 | μPD78F1046 | μPD78F1047 | μPD78F1048 | μPD78F1049 | μPD78F1050 | μPD78F8040 | μPD78F8041 | μPD78F8042 | μPD78F8043 | μPD78F8056 | μPD78F8057 | μPD78F8058 |
| Flash memory (bytes) | | 96 K | 128 K | 96 K | 128 K | 64 K | 96 K | 128 K | 192 K | 256 K | 64 K | 96 K | 128 K | 192 K | 256 K | 64 K | 96 K | 128 K | 192 K | 256 K | 64 K | 96 K | 128 K | 192 K | 256 K | 32 K | 64 K | 96 K | 128 K | 64 K | 96 K | 128 K |
| RAM (bytes) | | 6 K | 8 K ^{Note 2} | 6 K | 8 K ^{Note 2} | 4 K | 6 K | 8 K | 12 K | 16 K | 4 K | 6 K | 8 K | 12 K | 16 K | 4 K | 6 K | 8 K | 12 K | 16 K | 4 K | 6 K | 8 K | 12 K | 16 K | 4 K | 4 K | 6 K | 7 K | 8 K ^{Note 2} | 8 K ^{Note 2} | 8 K ^{Note 2} |
| 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 | | 2.7 to 5.5 V | | 2.7 to 5.5 V | | | | | 2.7 to 5.5 V | | | | 2.7 to 5.5 V | | | | 2.7 to 5.5 V | | | | | 3.0 to 5.5 V | | | | 1.8 to 3.6 V | | | | |
| | Flash memory programming mode | 2.7 to 5.5 V | | 2.7 to 5.5 V | | 2.7 to 5.5 V | | | | | 2.7 to 5.5 V | | | | 2.7 to 5.5 V | | | | 2.7 to 5.5 V | | | | | 3.0 to 5.5 V | | | | 1.8 to 3.6 V | | | | |
| Minimum instruction execution time | | 0.05 μs (20 MHz: V _{DD} = 2.7 to 5.5 V) | | | | | 42 ns (24 MHz: V _{DD} = 2.7 to 5.5 V) | | | | | | | | | | | 0.05 μs (20 MHz: V _{DD} = 3.0 to 5.5 V) | | | | | 0.05 μs (20 MHz: V _{DD} = 2.7 to 3.6 V), 0.2 μs (5 MHz: V _{DD} = 1.8 to 3.6 V) | | | | | | | | | |
| Clock | Main clock | High-speed system clock | | Ceramic/crystal/external clock: 2 to 20 MHz | | | | | Ceramic/crystal/external clock: 2 to 20 MHz | | | | | | | | | | | Ceramic/crystal/external clock: 2 to 20 MHz | | | | | Ceramic/crystal/external clock: 2 to 20 MHz | | | | | | | |
| | | High-speed internal oscillation clock | | 8 MHz ±2% (target), 20 MHz ±2% (target) | | | | | 4 MHz ±2% (target), 8 MHz ±2% (target) | | | | | | | | | | | 1 MHz (typ.), 8 MHz (typ.), 20 MHz (typ.) | | | | | 1 MHz (typ.), 8 MHz (typ.), 20 MHz (typ.) | | | | | | | |
| | Subclock | | Crystal: 32.768 kHz | | | | | - | | | | | | | | | | | - | | | | | Crystal: 32.768 kHz | | | | | | | | |
| | Low-speed internal oscillation clock | | 30 kHz ±10% (for WDT) | | | | | 30 kHz ±10% (for WDT) | | | | | | | | | | | 30 kHz ±10% (for WDT) | | | | | 30 kHz ±10% (for WDT) | | | | | | | | |
| I/O ports | Total | 71 | 89 | 41 | | | | | 55 | | | | 71 | | | | 89 | | | | | 26 ^{Note 3} | | | | 18 ^{Note 5} | | | | | | |
| | CMOS I/O | 62 | 80 | 32 | | | | | 46 | | | | 62 | | | | 80 | | | | | 23 | | | | 13 | | | | | | |
| | CMOS input | 4 | 4 | 4 | | | | | 4 | | | | 4 | | | | 4 | | | | | 1 | | | | 4 | | | | | | |
| | CMOS output | 1 | 1 | 1 | | | | | 1 | | | | 1 | | | | 1 | | | | | - | | | | 1 | | | | | | |
| | N-ch open-drain | 4 | 4 | 4 | | | | | 4 | | | | 4 | | | | 4 | | | | | 2 | | | | - | | | | | | |
| Timer | 16-bit timer | Number of channels | | 11 | | 17 | | | | | 21 | | | | 21 | | | | 25 | | | | | 12 | | | | 12 | | | | |
| | | Function | | Interval timer/external event counter/frequency division | | | | | function/pulse interval measurement/pulse width measurement/one-shot pulse output/PWM output | | | | Interval timer/external event counter/pulse width measurement/one-shot pulse output/PWM output | | | | | Interval timer/external event counter/pulse width measurement/one-shot pulse output/PWM output | | | | | | | | | | | | | | |
| | PWM | | 9 channels max. | | 14 channels max. | | | | | 17 channels max. | | | | 17 channels max. | | | | 21 channels max. | | | | | 6 channels max. | | | | 2 channels max. | | | | | |
| | Watchdog timer (WDT) | | 1 | | 1 | | | | | 1 | | | | 1 | | | | 1 | | | | | 1 | | | | 1 | | | | | |
| Real-time counter (RTC) | | 1 | | - | | | | | - | | | | - | | | | - | | | | | - | | | | 1 | | | | | | |
| Serial interface | CSI: 2 channels, UART: 1 channel | | 1 | | - | | | | | - | | | | - | | | | - | | | | | - | | | | - | | | | | |
| | CSI: 1 channel, UART: 1 channel | | - | | - | | | | | - | | | | - | | | | - | | | | | - | | | | - | | | | | |
| | CSI: 2 channels, UART: 1 channel, simple I ² C: 2 channels | | - | | - | | | | | - | | | | - | | | | - | | | | | - | | | | - | | | | | |
| | CSI: 1 channel, UART: 1 channel, simple I ² C: 1 channel | | 2 | | 2 | | | | | - | | | | - | | | | - | | | | | 1 | | | | 1 | | | | | |
| | CSI: 2 channels, UART (supporting LIN): 1 channel | | - | | - | | | | | - | | | | - | | | | - | | | | | - | | | | - | | | | | |
| | CSI: 1 channel, simple I ² C: 1 channel | | - | | - | | | | | - | | | | - | | | | 1 | | | | | - | | | | - | | | | | |
| | CSI | | - | | 2 | | | | | 3 | | | | 3 | | | | 3 | | | | | - | | | | 1 (used exclusively for internal communication with the RF transceiver) | | | | | |
| | UART: 1 channel, simple I ² C: 1 channel | | - | | - | | | | | 1 | | | | 1 | | | | 1 | | | | | - | | | | - | | | | | |
| | UART (supporting LIN) | | - | | 2 | | | | | 2 | | | | 2 | | | | 2 | | | | | 1 | | | | 1 | | | | | |
| | UART | | - | | - | | | | | - | | | | - | | | | - | | | | | 1 (used exclusively for internal communication with the IO-Link transceiver) | | | | 1 (transmission only) | | | | | |
| LCD controller/driver | Segment signal output | | - | | - | | | | | - | | | | - | | | | - | | | | | - | | | | - | | | | | |
| | Common signal output | | - | | - | | | | | - | | | | - | | | | - | | | | | - | | | | - | | | | | |
| | A/D converter | | 10 bits × 12 | | 10 bits × 16 | | 10 bits × 11 | | | | | 10 bits × 15 | | | | 10 bits × 16 | | | | 10 bits × 24 | | | | | 10 bits × 6 | | | | - | | | |
| D/A converter | | - | | - | | - | | | | | - | | | | - | | | | - | | | | | - | | | | - | | | | |
| DMA controller | | 2 | | 2 | | 4 | | | | | 4 | | | | 4 | | | | 4 | | | | | 2 | | | | 2 | | | | |
| Interrupt | External | 9 | | 9 | | 10 | | | | | 11 | | | | 12 | | | | 12 | | | | | 5 ^{Note 4} | | | | 4 | | | | |
| | Internal | 35 | | 35 | | 41 | | | | | 47 | | | | 47 | | | | 49 | | | | | 28 | | | | 27 | | | | |
| On-chip debug (MINICUBE2) | | Supported | | | | | Supported | | | | | | | | | | | Supported | | | | | Supported | | | | | | | | | |
| Multiplier/divider | | Multiplier/divider: 16 bits × 16 bits = 32 bits, 32 bits + 32 bits = 32 bits, remainder: 32 bits | | | | | Multiplier/divider: 16 bits × 16 bits = 32 bits, 32 bits + 32 bits = 32 bits, remainder: 32 bits | | | | | | | | | | | Multiplier/divider: 16 bits × 16 bits = 32 bits, 32 bits + 32 bits = 32 bits, remainder: 32 bits | | | | | Multiplier/divider: 16 bits × 16 bits = 32 bits, 32 bits + 32 bits = 32 bits, remainder: 32 bits | | | | | | | | | |
| Low-voltage detector (LVI) | | 2.84/2.99/3.15/3.30/3.45/3.61/3.76/3.92/4.07/4.22 V ±0.1 V (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed | | | | | 2.84/2.99/3.15/3.30/3.45/3.61/3.76/3.92/4.07/4.22 V ±0.1 V (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed | | | | | | | | | | | (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed | | | | | 3.15/3.30/3.45/3.61/3.76/3.92/4.07/4.22 V ±0.1 V (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed | | | | | | | | | |
| Power-on clear (POC) | | Power-on reset: 1.61 V ±0.09 V, power-down reset: 1.59 V ±0.09 V | | | | | Power-on reset: 1.61 V ±0.09 V, power-down reset: 1.59 V ±0.09 V | | | | | | | | | | | Power-on reset: 1.61 V ±0.09 V, power-down reset: 1.59 V ±0.09 V | | | | | Power-on reset: 1.61 V ±0.09 V, power-down reset: 1.59 V ±0.09 V | | | | | | | | | |
| Other peripheral functions | | CEC, remote control signal reception, key interrupt function | | | | | CAN controller, data flash memory: 16 KB, key interrupt function | | | | | | | | | | | IO-Link transceiver | | | | | RF transceiver | | | | | | | | | |
| Operating temperature | | -40 to +85°C | | | | | -40 to +85°C | | | | | | | | | | | -40 to +85°C | | | | | -40 to +85°C | | | | | | | | | |

Notes 1. Under development

2. 7 KB when the self programming function is used.

3. Three of these pins are connected to the IO-Link transceiver.

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

Notes 4. Two of the external interrupt sources are connected to the IO-Link transceiver.

5. Four of these pins are connected to the RF transceiver.

Product specifications (4/4)

| Commercial name | | 78K0R/IB3 | | 78K0R/IC3 | | | | 78K0R/ID3 | | | 78K0R/IE3 | | | 78K0R/LF3 | | | | | 78K0R/LG3 | | | | | 78K0R/LH3 | | | | | | | | | |
|------------------------------------|---|---|---------------------|--|-----------------------|--------------|-----------------|--------------|-----------------|-----------------------|--------------|-----------------|-----------------------|--------------|------------------|--|---|--|-----------------------|-------------|-------------|--------------------------------|-----------------|-------------|-------------|-------------|--------------------------------|------------------|-------------|-------------|-------------|--|--|
| Pin count | | 30-pin | | 38-pin | | 44-pin | | 48-pin | | | 52-pin | | | 64-pin | | | 80-pin | | | | | 100-pin | | | | | 128-pin | | | | | | |
| Product name | | μPD78F1201 | μPD78F1203 | μPD78F1211 | μPD78F1213 | μPD78F1211 | μPD78F1213 | μPD78F1213 | μPD78F1214 | μPD78F1215 | μPD78F1223 | μPD78F1224 | μPD78F1225 | μPD78F1233 | μPD78F1234 | μPD78F1235 | μPD78F1500A | μPD78F1510A | μPD78F1501A | μPD78F1502A | μPD78F1512A | μPD78F1503A | μPD78F1513A | μPD78F1504A | μPD78F1505A | μPD78F1515A | μPD78F1506A | μPD78F1516A | μPD78F1507A | μPD78F1508A | μPD78F1518A | | |
| Flash memory (bytes) | | 16 K | 32 K | 16 K | 32 K | 16 K | 32 K | 32 K | 48 K | 64 K | 32 K | 48 K | 64 K | 32 K | 48 K | 64 K | 64 K | 96 K | 128 K | 128 K | 64 K | 96 K | 128 K | 128 K | 64 K | 96 K | 128 K | 64 K | 96 K | 128 K | | | |
| RAM (bytes) | | 1 K | 1.5 K | 1 K | 1.5 K | 1 K | 1.5 K | 1.5 K | 2 K | 3 K ^{Note 1} | 1.5 K | 2 K | 3 K ^{Note 1} | 1.5 K | 2 K | 3 K ^{Note 1} | 4 K | 6 K | 7 K | 7 K | 4 K | 6 K | 7 K | 7 K | 4 K | 6 K | 7 K | 4 K | 6 K | 7 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 | | | | | | | | | | | | | | 1.8 to 5.5 V | | | | | | | | | | | | | | | | | |
| | Flash memory programming mode | 2.7 to 5.5 V | | | | | | | | | | | | | | 1.8 to 5.5 V | | | | | | | | | | | | | | | | | |
| Minimum instruction execution time | | 0.05 μs (20 MHz: V _{DD} = 2.7 to 5.5 V) | | | | | | | | | | | | | | 0.05 μs (20 MHz: V _{DD} = 2.7 to 5.5 V), 0.2 μs (5 MHz: V _{DD} = 1.8 to 5.5 V) | | | | | | | | | | | | | | | | | |
| Clock | Main clock | High-speed system clock | | Ceramic/crystal/external clock: 2 to 20 MHz | | | | | | | | | | | | | | Ceramic/crystal/external clock: 2 to 20 MHz | | | | | | | | | | | | | | | |
| | | High-speed internal oscillation clock | | 8 MHz ±1.8%, 40 MHz ^{Note 2} ±2.9%/-4.1% | | | | | | | | | | | | | | 1 MHz ±13%, 8 MHz ±2%, 20 MHz ±2.4% (target) | | | | | | | | | | | | | | | |
| | Subclock | | - | | Crystal: 32.768 kHz | | | | | | | | | | | | | | Crystal: 32.768 kHz | | | | | | | | | | | | | | |
| | Low-speed internal oscillation clock | | - | | 30 kHz ±10% (for WDT) | | | | | | | | | | | | | | 30 kHz ±10% (for WDT) | | | | | | | | | | | | | | |
| I/O ports | Total | 23 | | 31 | | 37 | | 41 | | | 45 | | | 55 | | | 51 | | | | | 67 | | | | | 83 | | | | | | |
| | CMOS I/O | 21 | | 27 | | 33 | | 34 | | | 38 | | | 48 | | | 46 | | | | | 60 | | | | | 76 | | | | | | |
| | CMOS input | 2 | | 4 | | 4 | | 4 | | | 4 | | | 4 | | | 4 | | | | | 4 | | | | | 4 | | | | | | |
| | CMOS output | - | | - | | - | | 1 | | | 1 | | | 1 | | | 1 | | | | | 1 | | | | | 1 | | | | | | |
| | N-ch open-drain | - | | - | | - | | 2 | | | 2 | | | 2 | | | - | | | | | 2 | | | | | 2 | | | | | | |
| Timer | 16-bit timer | Number of channels | | 12 | | 12 | | 12 | | 12 | | | 12 | | | 12 | | | 12 | | | | | 12 | | | | | 12 | | | | |
| | | Function | | Interval timer/external event counter/frequency division function/pulse interval measurement/pulse width measurement/one-shot pulse wave PWM output (supporting 2-phase modulation)/half-bridge 2-channel drive/full-bridge drive/real-time output/interrupt signal thinning | | | | | | | | | | | | | | output/PWM output/3-phase sine-function/AD conversion trigger output | | | | | | | | | | | | | | | |
| | PWM | | 7 channels max. | | 9 channels max. | | 9 channels max. | | 9 channels max. | | | 9 channels max. | | | 11 channels max. | | | 5 channels max. | | | | | 7 channels max. | | | | | 10 channels max. | | | | | |
| | Watchdog timer (WDT) | | 1 | | 1 | | 1 | | 1 | | | 1 | | | 1 | | | 1 | | | | | 1 | | | | | 1 | | | | | |
| Real-time counter (RTC) | | - | | 1 | | 1 | | 1 | | | 1 | | | 1 | | | 1 | | | | | 1 | | | | | 1 | | | | | | |
| Serial interface | CSI: 2 channels, UART: 1 channel | | - | | - | | - | | - | | | - | | | - | | | - | | | | | 1 | | | | | | | | | | |
| | CSI: 1 channel, UART: 1 channel | | - | | - | | - | | - | | | - | | | - | | | - | | | | | 1 | | | | | | | | | | |
| | CSI: 2 channels, UART: 1 channel, simple I ² C: 2 channels | | - | | - | | - | | - | | | - | | | - | | | - | | | | | - | | | | | | | | | | |
| | CSI: 1 channel, UART: 1 channel, simple I ² C: 1 channel | | 1 | | 1 | | 1 | | 1 | | | 1 | | | 1 | | | 2 | | | | | 2 | | | | | | | | | | |
| | CSI: 2 channels, UART (supporting LIN ^{Note 3}): 1 channel | | - | | - | | 1 | | 1 | | | 1 | | | 1 | | | - | | | | | - | | | | | | | | | | |
| | CSI: 1 channel, simple I ² C: 1 channel | | - | | - | | - | | - | | | - | | | - | | | - | | | | | - | | | | | | | | | | |
| | CSI | | - | | - | | - | | - | | | - | | | - | | | - | | | | | - | | | | | | | | | | |
| | UART: 1 channel, simple I ² C: 1 channel | | - | | - | | - | | - | | | - | | | - | | | - | | | | | - | | | | | | | | | | |
| | UART (supporting LIN) | | 1 ^{Note 3} | | 1 ^{Note 3} | | - | | - | | | - | | | - | | | 1 | | | | | 1 | | | | | | | | | | |
| | UART | | - | | - | | - | | - | | | - | | | - | | | - | | | | | - | | | | | | | | | | |
| Simple I ² C | | - | | - | | - | | - | | | - | | | - | | | - | | | | | - | | | | | | | | | | | |
| I ² C | | - | | - | | - | | 1 | | | 1 | | | 1 | | | - | | | | | 1 | | | | | | | | | | | |
| LCD controller/driver | | - | | - | | - | | - | | | - | | | - | | | Display method can be switched between internal voltage boosting, capacitive division, and external resistive division. | | | | | | | | | | | | | | | | |
| Segment signal output | | - | | - | | - | | - | | | - | | | - | | | 31 (27) ^{Note 4} | | | | | 40 (36) ^{Note 4} | | | | | 54 (50) ^{Note 4} | | | | | | |
| Common signal output | | - | | - | | - | | - | | | - | | | - | | | 4 (8) ^{Note 4} | | | | | 4 (8) ^{Note 4} | | | | | 4 (8) ^{Note 4} | | | | | | |
| A/D converter | | 10 bits × 6 | | 10 bits × 8 | | 10 bits × 10 | | 10 bits × 11 | | | 10 bits × 11 | | | 10 bits × 12 | | | 12 bits ^{Note 5} × 8 | | | | | 12 bits ^{Note 5} × 12 | | | | | 12 bits ^{Note 5} × 12 | | | | | | |
| D/A converter | | - | | - | | - | | - | | | - | | | - | | | 12 bits × 2 ^{Note 6} | | | | | 12 bits × 2 ^{Note 6} | | | | | 12 bits × 2 ^{Note 6} | | | | | | |
| DMA controller | | 2 | | 2 | | 2 | | 2 | | | 2 | | | 2 | | | 2 | | | | | 2 | | | | | 2 | | | | | | |
| Interrupt | External | 6 | | 8 | | 8 | | 8 | | | 8 | | | 8 | | | 8 | | | | | 12 | | | | | 13 | | | | | | |
| | Internal | 31 | | 33 | | 33 | | 34 | | | 34 | | | 34 | | | 28 | | | | | 33 | | | | | 33 | | | | | | |
| On-chip debug (MINICUBE2) | | Supported | | | | | | | | | | | | | | Supported | | | | | | | | | | | | | | | | | |
| Multiplier/divider | | Multiplier/divider: 16 bits × 16 bits = 32 bits, 32 bits + 32 bits = | | | | | | | | | | | | | | Multiplier/divider: 16 bits × 16 bits = 32 bits, 32 bits + 32 bits = 32 bits, remainder: 32 bits | | | | | | | | | | | | | | | | | |
| Low-voltage detector (LVI) | | 2.84/2.99/3.15/3.30/3.45/3.61/3.76/3.92/4.07/ (selectable by software), low-voltage detection for an external | | | | | | | | | | | | | | 4.22 V ±0.1 V (selectable by software), low-voltage detection for an external input pin (EXLVI) can be performed | | | | | | | | | | | | | | | | | |
| Power-on clear (POC) | | Power-on reset: 1.61 V ±0.09 V, power-down reset: | | | | | | | | | | | | | | 1.59 V ±0.09 V | | | | | | | | | | | | | | | | | |
| Other peripheral functions | | Comparator: 2 channels, programmable gain amplifier: | | | | | | | | | | | | | | 1 channel | | | | | | | | | | | | | | | | | |
| Operating temperature | | -40 to +85°C | | | | | | | | | | | | | | -40 to +85°C | | | | | | | | | | | | | | | | | |

Notes 1. 2 KB when the self 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.

Notes 4. Values in parentheses are the number of signal outputs when 8com signal is used.

5. The A/D converter has 10-bit resolution in the μPD78F151xA.

6. Not available in the μPD78F151xA.

Renesas Microcomputer 16-bit All Flash

Renesas Electronics Corporation

Notes:

- All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
 - Renesas Electronics does not assume any liability for infringement of 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. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
 - You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
 - 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 of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
 - When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may 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.
 - Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
 - Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheet or data books, etc.
"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.
"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.
"Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
 - You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
 - Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, 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, please evaluate the safety of the final products or system manufactured by you.
 - Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
 - This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
 - Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.
- (Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.
(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.



SALES OFFICES

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

Renesas Electronics America Inc.

2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited

1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH

Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.

7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.

Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

Renesas Electronics Hong Kong Limited

Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.

7F, No. 363 Fu Shing North Road Taipei, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.

1 harbourFront Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: +65-6213-0200, Fax: +65-6278-8001

Renesas Electronics Malaysia Sdn.Bhd.

Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.

11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

