

Renesas Microcomputer
All Flash 78K
Microcontroller

Empower your
creativity



Ecological power embracing a world of applications

All Flash

All our new 8-bit and 16-bit general-purpose microcontrollers incorporate on-chip flash memory.



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

Our "All Flash" concept of providing on-chip flash memory throughout our entire lineup of microcontroller products continues to advance. A wide variety of microcontroller products are available with pin counts ranging from 10 to 144 pins and flash memory capacities from 1 KB to 512 KB.

This provides support for software modifications and reduces the total cost of integrating peripheral functions.

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

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

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

16-bit Road Map

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/KG3-C	μPD78F8043 IO-Link support 56-pin μPD78F8043
78K0R/Lx3-M For power meters 100-pin 78K0R/LG3-M	78K0R/Kx3-A Analog enhancement, low power, wide-voltage operation support 64-pin 78K0R/KE3-A	μPD78F8058 RF remote control support 56-pin μPD78F8058
78K0R/Kx3-L (USB) Low-power, USB support 64-pin 78K0R/KE3-L 48-pin 78K0R/KC3-L	78K0R/Hx3 CAN support, analog enhancement 100-pin 78K0R/HG3 80-pin 78K0R/HE3 64-pin 78K0R/HE3 48-pin 78K0R/HC3	

8-bit Road Map

78K0S Microcontrollers			
	78K0S/Kx1+ Low pin count microcontrollers 30/32-pin 78K0S/KB1+ 20-pin 78K0S/KA1+ 16-pin 78K0S/KY1+ 10-pin 78K0S/KU1+		
78K0 Microcontrollers	78K0/Lx3 LCD controller/driver 80-pin 78K0/LF3 64-pin 78K0/LE3 52-pin 78K0/LD3 48-pin 78K0/LC3	78K0/Lx3-M For power meters 100-pin 78K0/LG3-M 64-pin 78K0/LE3-M	78K0/Kx2 Wide-voltage operation 80-pin 78K0/KF2 64-pin 78K0/KE2 52-pin 78K0/KD2 38/44/48-pin 78K0/KC2 30/36-pin 78K0/KB2
78K0/Kx2-L Low-power, wide-voltage operation 40/44/48-pin 78K0/KC2-L 30-pin 78K0/KB2-L 20/25/32-pin 78K0/KA2-L 16-pin 78K0/KY2-L	78K0/Kx2-A High-resolution A/D converter, wide-voltage operation 36/48-pin 78K0/KC2-A 30-pin 78K0/KB2-A	78K0/Kx2-C Supports digital home appliance communication 64-pin 78K0/KE2-C 48-pin 78K0/KC2-C	μPD78F8025 LED lighting control 64-pin μPD78F8025
μPD78F071x Inverter motor control 64-pin μPD78F0714 30-pin μPD78F0712 30-pin μPD78F0711	78K0/lx2 Power supplies, lighting inverters, LED lighting control 30/32-pin 78K0/lB2 20-pin 78K0/lA2 16-pin 78K0/lY2	μPD179F1xx For preset remote control 38-pin μPD179F12x 30-pin μPD179F11x	μPD78F0730 USB2.0 function 30-pin μPD78F0730

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

Home appliances

Air conditioners, refrigerators, washing machines, microwave ovens

Portable devices

PDA, IC recorders

Industrial equipment

Industrial motors, control equipment, vending machines, power meters

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

Other

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

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



Flash microcontrollers offer overwhelming advantages.

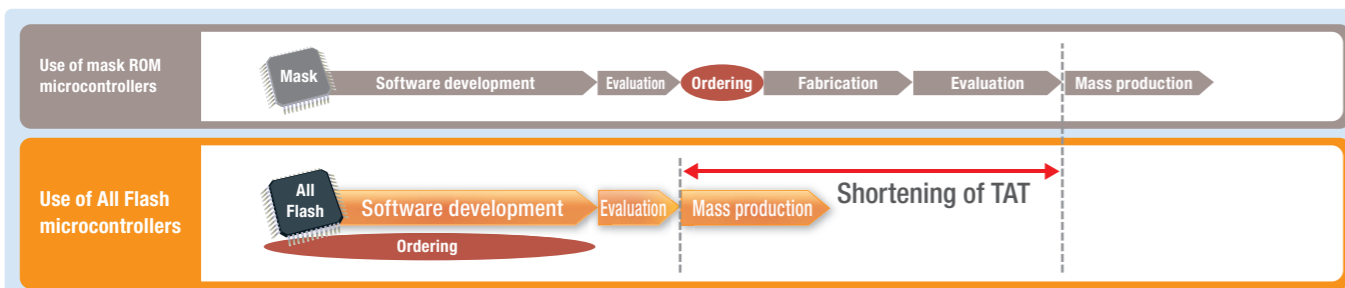
Compared to mask ROM microcontrollers, flash microcontrollers definitely contribute to speeding up system development. Microcontrollers can be ordered before program completion and programs can be written even after the microcontroller has been mounted on the board. Microcontroller order placement and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

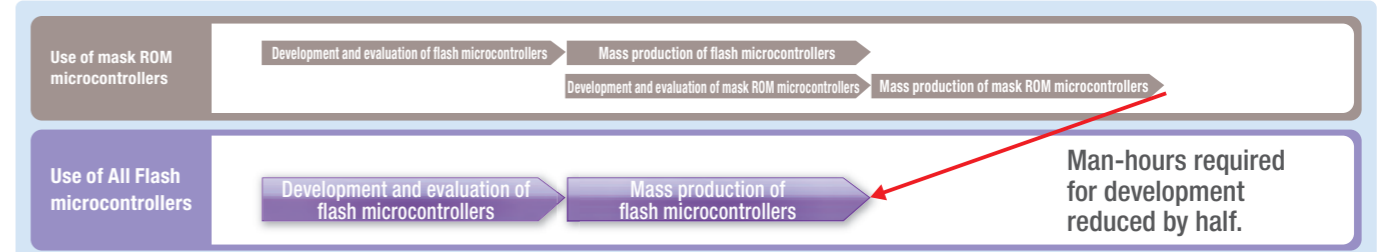


Since mask ROM microcontrollers cannot be ordered until their specifications are finalized, last-minute software changes can be problematic. On the other hand, specifications for flash microcontrollers can be changed just prior to the start of mass production. Thus orders for flash microcontrollers can 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.

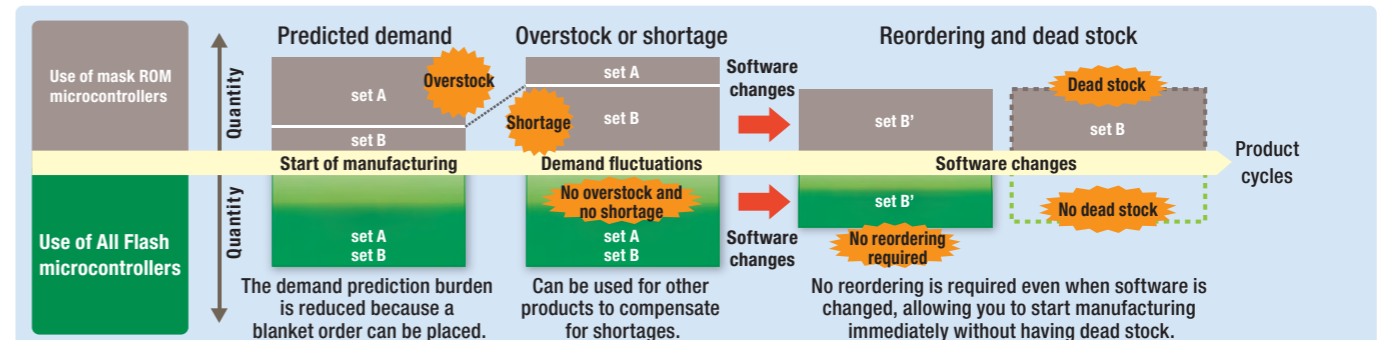


In the case of mass-produced mask ROM microcontrollers, evaluations of both flash microcontrollers and mask ROM microcontrollers are required. Since evaluated flash microcontrollers can be directly mass-produced, the man-hours required for development are reduced by half, resulting in greatly shortened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

Renesas Electronics delivers "All Flash" microcontrollers you can count on to boost the competitiveness of your products.

"Products you can count on" is the concept.



More and more manufacturers are adopting high-performance flash microcontrollers as an effective way to achieve better system performance and shorten development cycles. Gaining improved performance and flash memory used to involve compromises, however, such as increased power consumption and incompatibility

with existing software. Renesas Electronics overcomes these issues, utilizing innovative technologies to deliver microcontrollers you can count on.

Selection you can count on

Broad lineup of 293 8-bit and 200 16-bit microcontroller products, for a total of 493!

To meet the full range of customer requirements, Renesas Electronics offers an All Flash lineup consisting of 293 8-bit and 200 16-bit microcontroller products available in a variety of pin counts, ROM capacities, and package configurations. Our 8-bit microcontrollers such as the 78K0/Kx2, 78K0/Kx2-A, and μ PD78F8025 achieve operation speeds up to 20 MHz, while our 78K0R/Hx3 16-bit microcontroller delivers an operation speed of 24 MHz. Products such as the 78K0/Kx2, 78K0/Kx2-L, 78K0/Kx3, 78K0R/Kx3, 78K0R/Kx3-L, and 78K0R/Lx3 support power supply voltages ranging from 1.8 V to 5.5 V. The 78K0/Kx2-A and 78K0R/Kx3-A are provided with a high-performance 12-bit A/D converter, while the 78K0/Lx3 and 78K0R/Lx3 feature an on-chip LCD driver. Package options include the compact SSOP with low pin counts of 16, 20, or 30 pins. The WFQN package measures 5 x 5 mm in the 32-pin version and 6 x 6 mm in the 40-pin version. These dimensions are up to 46% thinner and realize a package area up to 87% smaller than earlier Renesas Electronics products (80-pin LQFP, 14 x 14 mm). The smaller mounting area contributes to a smaller system size overall. The extensive lineup makes it possible to choose a product that best fits the requirements of the specific application.

Low cost you can count on

Reducing the total cost!

The 78K0R 16-bit microcontrollers are provided with features such as flash memory instead of 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, 78K0/Kx2-A, Kx2-L^{1,2}, lx2⁴ 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.

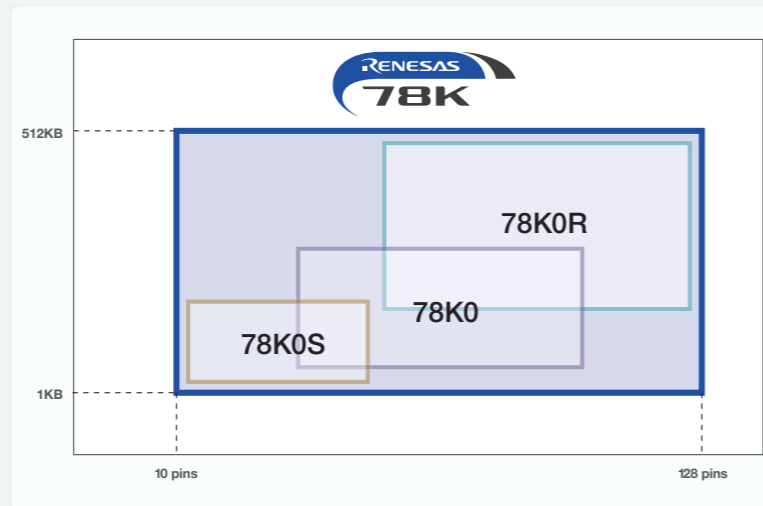
Low power consumption you can count on

High functionality combined with low power consumption

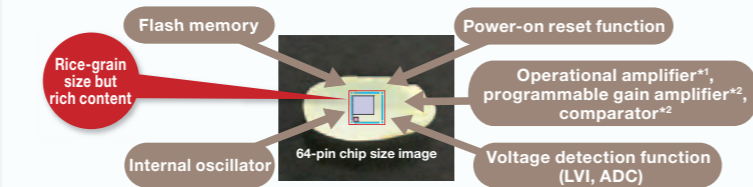
The 78K0R achieves performance of 30.5 MIPS at 24 MHz¹ through the use of a 16-bit CPU with a 3-stage pipeline architecture. The low power supply current compared with competing products provides improved energy efficiency.

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

Compared with the 7.6 mA operating current of a conventional mask ROM microcontroller operating at 5 V/10 MHz (external ceramic resonator), the 78K0/Kx2, 78K0/Kx2-L, and 78K0/Kx2-A, operating under the same conditions, have an operating current of only 2.3 mA (1.9 mA for the 78K0/Lx3) at 10 MHz (external ceramic resonator) and 1.4 mA (1.3 mA for the 78K0/Kx2-L) at 8 MHz (on-chip oscillator). The 78K0 delivers significantly lower power consumption than conventional mask ROM products.

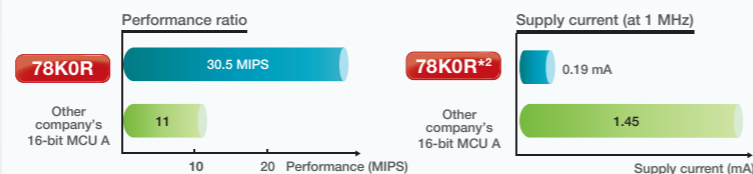


Total cost reduction through embedded peripheral IC functions



*1. 78K0R/Kx3-A, 78K0R/Lx3only *2. 78K0R/KC3-L, 78K0R/KD3-L, 78K0R/KE3-L, 78K0R/lx3only
*3. 78K0/KY2-L (μ PD78F0555, 0556, 0557), 78K0/KA2-L (μ PD78F0565, 0566, 0567), 78K0/KB2-L (μ PD78F0576, 0577, 0578) 78K0/KC2-L (μ PD78F0586, 0587, 0588) only
*4. 78K0/lY2 (μ PD78F0750, 0751, 0752), 78K0/lA2 (μ PD78F0753, 0754), 78K0/lB2 (μ PD78F0755, 0756) only

Saving energy with high performance of 16-bit design



Realization of lower power consumption than mask ROM products

Condition (5 V power supply voltage)	External ceramic resonator 10 MHz	Operating current
Mask ROM products	External ceramic resonator 10 MHz	7.6 mA
Flash memory 78K0/Kx2, 78K0/Kx2-L, 78K0/Kx2-A	External ceramic resonator 10 MHz	2.3 mA
78K0/Lx3	External ceramic resonator 10 MHz	1.9 mA
78K0/Kx2, 78K0/Kx2-A, 78K0/Lx3	Internal oscillator 8 MHz	1.4 mA
78K0/Kx2-L	Internal oscillator 8 MHz	1.3 mA

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

Broad range of products for specific applications you can count on

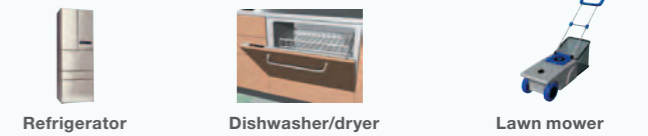
We offer ideal products for various applications!

Renesas Electronics offers a wide range of products for specific applications. These include the 78K0R/Kx3-C and 78K0/Kx2-C with functionality for linking digital AV devices, the 78K0R/lx3 with on-chip multifunction timers for precision inverter control, the 78K0R/Lx3-M and 78K0/Lx3-M for power meters, the μ PD78F8043 with an on-chip IO-Link transceiver for easy communication with industrial systems, and the μ PD179F1xx for use in remote controls for home electronics products. These microcontrollers offer a rich selection of specialized functions in addition to basic functionality, so you can choose a product that is ideal for the specific application.

78K0R/KF3-C, KG3-C



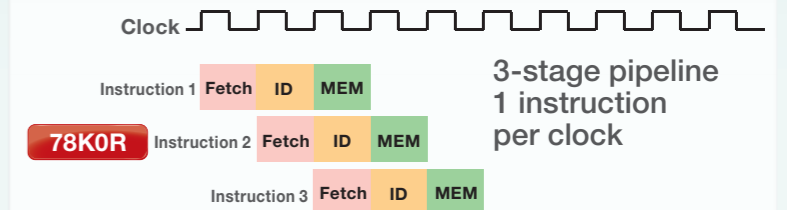
78K0R/IB3, IC3, ID3, IE3



High performance and functionality you can count on

Includes high-performance CPU and sophisticated peripheral functions!

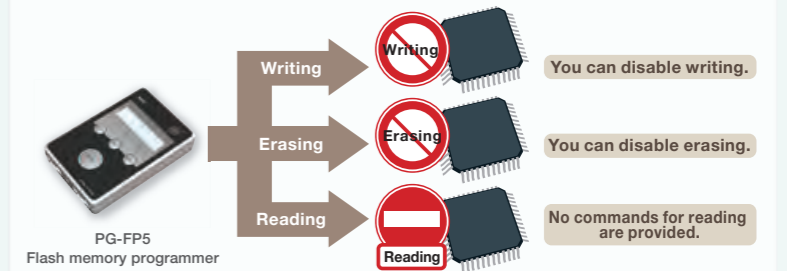
The 78K0R microcontrollers execute most instruction processing in one clock via three-stage pipeline control. 32-bit (16 bits x 16 bits) calculations can also be performed thanks to the on-chip multiplier/divider. Furthermore, a sophisticated timer function can be realized by interlocking the operation of multiple-channel timers. The 78K0R/lx3 enables A/D conversion in synchronization with 3 phase sine-wave PWM output and timers.



High reliability you can count on

Our products incorporate our experience and technology in the automotive field as well as software protection functions!

All our products incorporate the experience we have gained in the process of supplying microcontrollers for over 1,000 types of applications and the technology we developed for flash microcontrollers for the automotive field. Our products also feature functions that disable reading and malicious software rewriting and erasing, thus offering maximum protection of your valuable software.

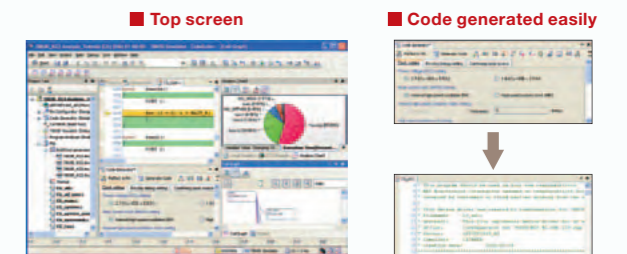


Rich development environment you can count on

We offer tools that are inexpensive, simple, and easy to use!

Renesas Electronics offers development tools that are simple and convenient to use. The new CubeSuite+ integrated development environment provides compiler and debugger components as well as functions for managing pin assignments, generating program code for microcontroller peripheral functions, and building projects at high speed. When combined with hardware such as the E1 on-chip debugging emulator with built-in flash memory programming, CubeSuite+ provides powerful support for speedy system development.

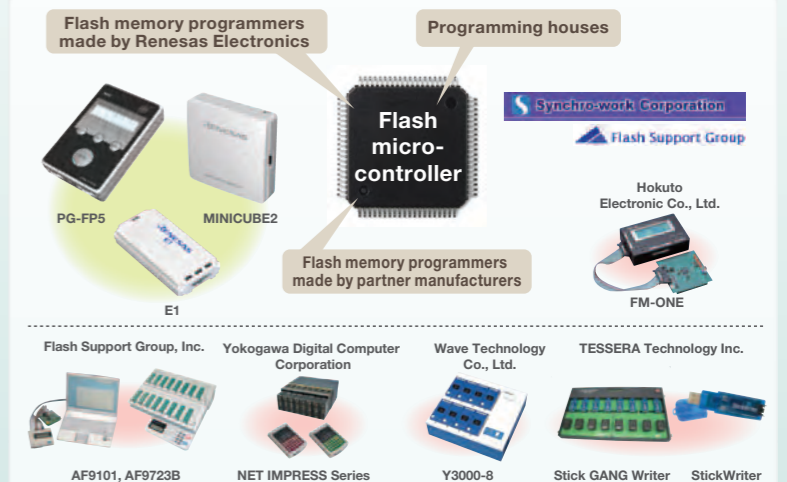
CubeSuite+ automatically generates source code (a device driver program) to control the microcontroller peripherals (such as the timers, UART, and A/D converter).



Support for mass production you can count on

In addition to a large lineup of programming tools, we also offer programming services!

Renesas Electronics and partner manufacturers offer a large number of programming 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.
























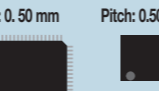







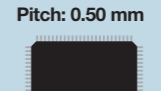
Selection of 16-bit microcontrollers you can count on (1/2)

Wide variety of packages and ROM/RAM sizes!

Select the best flash microcontroller for your product or application.

Legend

μPD78F1188A (30 K*) Top: Product name
Bottom: RAM (bytes)

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	40/44-pin	48-pin	52-pin	64-pin		80-pin	100-pin		48-pin	64-pin	64-pin	64-pin		80-pin	100-pin	128-pin	144-pin
ROM (bytes)																	
512 K	78K0R/Kx3 Microcontrollers																
384 K																	
256 K																	
192 K	78K0R/Kx3-L Microcontrollers					μPD78F1028 (12 K*) ²	μPD78F1030 (12 K*) ²	78K0R/Kx3-L(USB) Microcontrollers			12-bit A/D Converter 78K0R/Kx3-A Microcon- trollers		μPD78F1146A (12 K*) ³	μPD78F1156A (12 K*) ³	μPD78F1166A (12 K*) ³	μPD78F1176A (12 K)	μPD78F1186A (12 K)
128 K						μPD78F1027 (10 K)	μPD78F1029 (10 K)						μPD78F1024 (8 K*) ⁴	μPD78F1026 (8 K*) ⁴	μPD78F1018 (7 K)	μPD78F1145A (10 K)	μPD78F1155A (10 K)
96 K	78K0R/Kx3-L Microcontrollers					μPD78F1012 (8 K*) ⁴	μPD78F1014 (8 K*) ⁴	μPD78F1023 (8 K*) ⁴	μPD78F1025 (8 K*) ⁴	μPD78F1017 (6 K)	μPD78F1144A (8 K)	μPD78F1154A (8 K)	μPD78F1164A (8 K)	μPD78F1174A (8 K)	μPD78F1184A (8 K)		
64 K						μPD78F1003 (3 K*) ⁵	μPD78F1003 (3 K*) ⁵	μPD78F1006 (3 K*) ⁵	μPD78F1009 (3 K*) ⁵	μPD78F1010 (4 K)	μPD78F1022 (6 K)	μPD78F1016 (4 K)	μPD78F1143A (6 K)	μPD78F1153A (6 K)	μPD78F1163A (6 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: 1.40 mm 10 x 10 mm Pitch: 0.80 mm 	48-pin TQFP (GA) Thickness: 1.00 mm 7 x 7 mm Pitch: 0.50 mm 	52-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.65 mm 	64-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.65 mm 	64-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.50 mm 	80-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.65 mm 	100-pin LQFP (GF) Thickness: 1.40 mm 14 x 20 mm Pitch: 0.65 mm 		48-pin TQFP (GA) Thickness: 1.00 mm 7 x 7 mm Pitch: 0.50 mm 	64-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.50 mm 	64-pin FBGA (F1) Thickness: 1.11 mm 6 x 6 mm Pitch: 0.65 mm 	64-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.65 mm 	64-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.50 mm 	80-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.65 mm 	100-pin LQFP (GF) Thickness: 1.40 mm 14 x 20 mm Pitch: 0.65 mm 	128-pin LQFP (GF) Thickness: 1.40 mm 14 x 20 mm Pitch: 0.50 mm 	144-pin LQFP (GJ) Thickness: 1.40 mm 20 x 20 mm Pitch: 0.50 mm 
	40-pin WQFN (K8) Thickness: 0.75 mm 6 x 6 mm Pitch: 0.50 mm 	48-pin WQFN (K8) Thickness: 0.75 mm 7 x 7 mm Pitch: 0.50 mm 	64-pin TQFP (GA) Thickness: 1.00 mm 7 x 7 mm Pitch: 0.40 mm 		64-pin FBGA (F1) Thickness: 0.69 mm 5 x 5 mm Pitch: 0.50 mm 	80-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.50 mm 	100-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.50 mm 	100-pin FBGA* (F1) Thickness: 0.69 mm 6 x 6 mm Pitch: 0.50 mm 	48-pin WQFN (K8) Thickness: 0.75 mm 7 x 7 mm Pitch: 0.50 mm 	64-pin TQFP (GA) Thickness: 1.00 mm 7 x 7 mm Pitch: 0.40 mm 	64-pin FBGA (F1) Thickness: 0.91 mm 5 x 5 mm Pitch: 0.50 mm 	64-pin TQFP (GA) Thickness: 1.00 mm 7 x 7 mm Pitch: 0.40 mm 	64-pin FBGA (F1) Thickness: 1.11 mm 6 x 6 mm Pitch: 0.65 mm 	80-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.50 mm 	100-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.50 mm 		

*1. 28 KB when the self programming function is used.
*2. 11 KB when the self programming function is used.
*3. 10 KB when the self programming function is used.
Remarks: The packages are shown in their actual size.

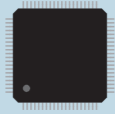

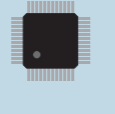





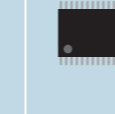
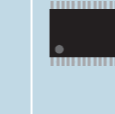
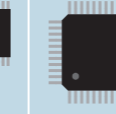
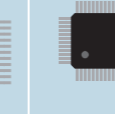
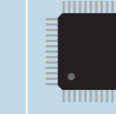
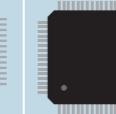

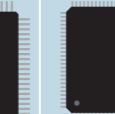
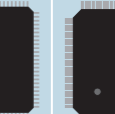

*4. 7 KB when the self programming function is used.
*5. 2 KB when the self programming function is used.
*6. μPD78F1013,78F1014only

Selection of 16-bit microcontrollers you can count on (2/2)

Wide variety of packages and ROM/RAM sizes!

Legend
 μPD78F1188A (30 K*) Top: Product name
 Bottom: RAM (bytes)

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	78K0R/LG3-M ^{*1}	
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	100-pin		
ROM (bytes)	512 K																			
	384 K																			
	256 K																			
	192 K																			
	128 K																			
	96 K																			
	64 K																			
	48 K																			
	32 K																			
	16 K																			
Package	80-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.50 mm 	100-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.50 mm 	48-pin LQFP (GA) Thickness: 1.40 mm 7 x 7 mm Pitch: 0.50 mm 	64-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.50 mm 	80-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.50 mm 	100-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.50 mm 	56-pin WQFN (K8) Thickness: 0.75 mm 8 x 8 mm Pitch: 0.50 mm 	56-pin WQFN (K8) Thickness: 0.75 mm 8 x 8 mm Pitch: 0.50 mm 	30-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm 	38-pin SSOP (MC) Thickness: 1.70 mm 7.62 mm (300) Pitch: 0.65 mm 	44-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.80 mm 	48-pin TQFP (GA) Thickness: 1.00 mm 7 x 7 mm Pitch: 0.50 mm 	52-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.65 mm 	64-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.65 mm 	80-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.65 mm 	100-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.50 mm 	128-pin LQFP (GF) Thickness: 1.40 mm 14 x 20 mm Pitch: 0.50 mm 	100-pin LQFP Thickness: 1.40 mm 14x14 mm Pitch: 0.50 mm 		
			78K0R/Hx3 Microcontrollers																	
	78K0R/Kx3-C 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
			μPD78F1034 ^{*1} (12 K)	μPD78F1039 ^{*1} (12 K)	μPD78F1044 ^{*1} (12 K)	μPD78F1049 ^{*1} (12 K)														78K0R/Lx3-M Microcontrollers for Power Meters
			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)	μPD78F8070 (7 K)	
	μPD78F1847A (8 K ^{*2})	μPD78F1849A (8 K ^{*2})	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)		
	μPD78F1846A (6 K)	μPD78F1848A (6 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)			
												μPD78F1214 (2 K)	μPD78F1224 (2 K)	μPD78F1234 (2 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)					
										μPD78F1201 (1 K)	μPD78F1211 (1 K)	μPD78F1211 (1 K)								

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








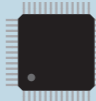
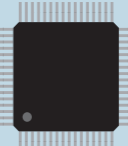
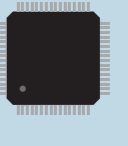
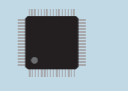
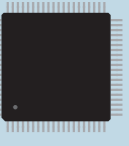

Selection of 8-bit microcontrollers you can count on (1/3)

Wide variety of packages and ROM/RAM sizes!

Select the best flash microcontroller for your product or application.

Legend

μPD78F1188A (30 K*)
 Top: Product name
 Bottom: RAM (bytes)

Commercial Name	78K0S/KU1+	78K0S/KY1+	78K0S/KA1+	78K0S/KB1+	78K0/KB2	78K0/KC2			78K0/KD2	78K0/KE2	78K0/KF2
Pin Count	10-pin	16-pin	20-pin	30/32-pin	30/36-pin	38-pin	44-pin	48-pin	52-pin	64-pin	80-pin
ROM (bytes)											
128 K									μPD78F0527A, μPD78F0527DA*2 (7 K)	μPD78F0537A, μPD78F0537DA*2 (7 K)	μPD78F0547A, μPD78F0547DA*2 (7 K)
96 K									μPD78F0526A (5 K)	μPD78F0536A (5 K)	μPD78F0546A (5 K)
60 K								μPD78F0515A, μPD78F0515DA*2 (3 K)	μPD78F0525A (3 K)	μPD78F0535A (3 K)	μPD78F0545A (3 K)
48 K								μPD78F0514A (2 K)	μPD78F0524A (2 K)	μPD78F0534A (2 K)	μPD78F0544A (2 K)
32 K					μPD78F0503A, μPD78F0503DA*2 (1 K)	μPD78F0513A, μPD78F0513DA*2 (1 K)	μPD78F0513A, μPD78F0513DA*2 (1 K)	μPD78F0513A (1 K)	μPD78F0523A (1 K)	μPD78F0533A (1 K)	
24 K	78K0S/Kx1+ Microcontrollers (Low Pin Count Microcontrollers)				μPD78F0502A (1 K)	μPD78F0512A (1 K)	μPD78F0512A (1 K)	μPD78F0512A (1 K)	μPD78F0522A (1 K)	μPD78F0532A (1 K)	
16 K					μPD78F0501A (768)	μPD78F0511A (768)	μPD78F0511A (768)	μPD78F0511A (768)	μPD78F0521A (768)	μPD78F0531A (768)	
8 K			μPD78F9224 (256)	μPD78F9234 (256)	μPD78F0500A (512)						
4 K	μPD78F9202, μPD78F9502 (128)	μPD78F9212, μPD78F9512 (128)	μPD78F9222 (256)	μPD78F9232 (256)					78K0/Kx2 Microcontrollers		
2 K	μPD78F9201, μPD78F9501 (128)	μPD78F9211, μPD78F9511 (128)	μPD78F9221 (128)								
1 K	μPD78F9200, μPD78F9500 (128)	μPD78F9210, μPD78F9510 (128)									
Package	10-pin SSOP (MA) Thickness: 1.20 mm 5.72 mm (225) Pitch: 0.65 mm 	16-pin SDIP*1 (CS) Thickness: 2.80 mm 7.62 mm (300) Pitch: 1.778 mm  16-pin SSOP*1 (MA) Thickness: 1.50 mm 5.72 mm (225) Pitch: 0.65 mm  16-pin SSOP (GR) Thickness: 1.44 mm 5.72 mm (225) Pitch: 0.65 mm  16-pin WLBGA*1 (FH) Thickness: 0.40 mm 2 x 2.3 mm Pitch: 0.50 mm 	20-pin SDIP (CS) Thickness: 2.80 mm 7.62 mm (300) Pitch: 1.778 mm  20-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm 	32-pin SDIP (CS) Thickness: 2.80 mm 7.62 mm (300) Pitch: 1.778 mm  30-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm 	30-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm  36-pin FLGA (FC) Thickness: 0.91 mm 4 x 4 mm Pitch: 0.50 mm 	38-pin SSOP (MC) Thickness: 1.70 mm 7.62 mm (300) Pitch: 0.65 mm 	44-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.80 mm 	48-pin LQFP (GA) Thickness: 1.40 mm 7 x 7 mm Pitch: 0.50 mm 	52-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.65 mm 	64-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.80 mm  64-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.65 mm  64-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.50 mm  64-pin TQFP (GA) Thickness: 1.00 mm 7 x 7 mm Pitch: 0.40 mm  64-pin FLGA (FC) Thickness: 0.91 mm 5 x 5 mm Pitch: 0.50 mm  64-pin FPBGA (F1) Thickness: 0.69 mm 4 x 4 mm Pitch: 0.40 mm 	80-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.65 mm  80-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.50 mm 

*1. μPD78F9210, 78F9211, 78F9212 only
 *2. Supports on-chip debugging of 78K0/Kx2
 Remarks The packages are shown in their actual size.

















Selection of 8-bit microcontrollers you can count on (2/3)

Wide variety of packages and ROM/RAM sizes!

Legend

μPD78F1188A (30 K*) Top: Product name
Bottom: RAM (bytes)

Select the best flash microcontroller for your product or application.

Commercial Name	78K0/KY2-L	78K0/KA2-L	78K0/KB2-L	78K0/KC2-L	78K0/KB2-A	78K0/KC2-A	78K0/KC2-C	78K0/KE2-C	μPD179F1xx	μPD78F0730			
Pin Count	16-pin	20/25/32-pin	30-pin	40/44/48-pin	30-pin	36/48-pin	48-pin	64-pin	30-pin	38-pin	30-pin		
ROM (bytes)													
128 K													
96 K													
60 K							μPD78F0762 (3 K)	μPD78F0765 (3 K)					
48 K							μPD78F0761 (2 K)	μPD78F0764 (2 K)					
32 K			μPD78F0573, μPD78F0578 (1 K)	μPD78F0583, μPD78F0588 (1 K)	μPD78F0591 (1 K)	μPD78F0593 (1 K)	μPD78F0760 (1 K)	μPD78F0763 (1 K)	μPD179F114 (1 K)	μPD179F124 (1 K)			
24 K							78K0/Kx2-C Microcontrollers for Digital AV Applications		μPD179F113 (1 K)	μPD179F123 (1 K)			
16 K	μPD78F0552, μPD78F0557 (768)	μPD78F0562, μPD78F0567 (768)	μPD78F0572, μPD78F0577 (768)	μPD78F0582, μPD78F0587 (768)	μPD78F0590 (1 K)	μPD78F0592 (1 K)			μPD179F112 (768)	μPD179F122 (768)	μPD78F0730 (3 K)		
8 K	μPD78F0551, μPD78F0556 (512)	μPD78F0561, μPD78F0566 (512)	μPD78F0571, μPD78F0576 (512)	μPD78F0581, μPD78F0586 (512)	12-bit A/D Converter 78K0/Kx2-A Microcontrollers				μPD179F111 (512)				
4 K	μPD78F0550, μPD78F0555 (384)	μPD78F0560, μPD78F0565 (384)								μPD179F110 (512)		USB Micro-controllers	
2 K									Microcontrollers for Preset Remote Control				
1 K		78K0/Kx2-L Microcontrollers											
Package	16-pin SSOP (MA) Thickness: 1.50 mm 5.72 mm (225) Pitch: 0.65 mm 	20-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm  25-pin FLGA (FC) Thickness: 0.69 mm 3 x 3 mm Pitch: 0.50 mm 	32-pin WQFN (K8) Thickness: 0.75 mm 5 x 5 mm Pitch: 0.50 mm 	30-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm 	44-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.80 mm  40-pin WQFN (K8) Thickness: 0.75 mm 6 x 6 mm Pitch: 0.50 mm 	48-pin LQFP (GA) Thickness: 1.40 mm 7 x 7 mm Pitch: 0.50 mm 	30-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm 	48-pin LQFP (GA) Thickness: 1.40 mm 7 x 7 mm Pitch: 0.50 mm  36-pin FLGA (FC) Thickness: 0.69 mm 4 x 4 mm Pitch: 0.50 mm 	48-pin LQFP (GA) Thickness: 1.40 mm 7 x 7 mm Pitch: 0.50 mm 	64-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.50 mm 	30-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm 	38-pin SSOP (MC) Thickness: 1.70 mm 7.62 mm (300) Pitch: 0.65 mm 	30-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm 






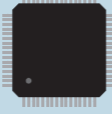

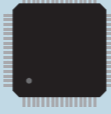

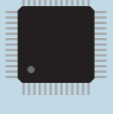







Remarks The packages are shown in their actual size.

Wide variety of packages and ROM/RAM sizes!

Select the best flash microcontroller for your product or application.

Legend

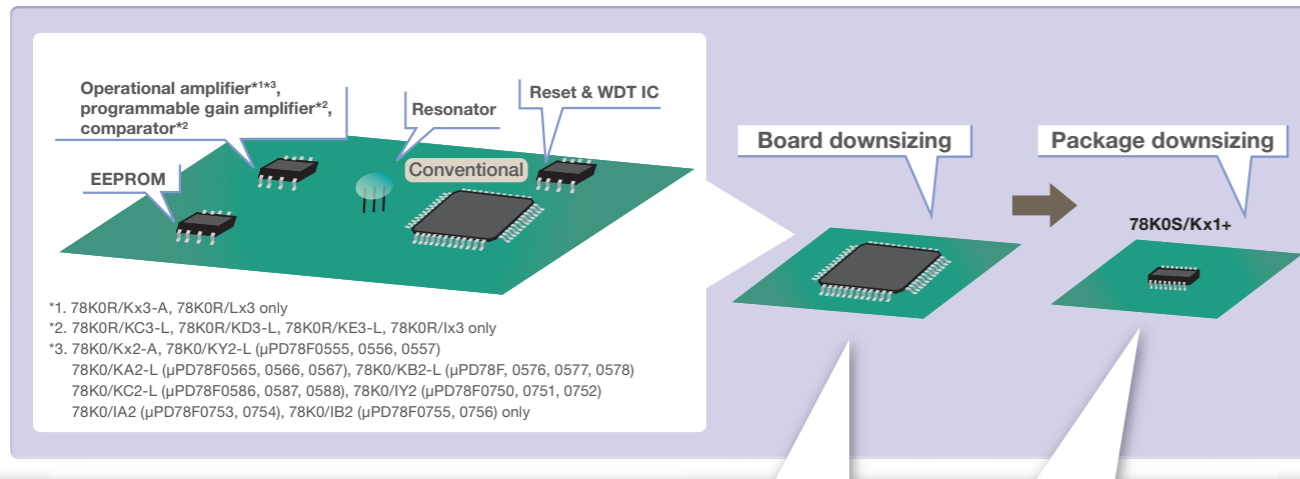
μPD78F1188A (30 K*) Top: Product name
Bottom: RAM (bytes)

Commercial Name	78K0/IY2	78K0/IA2	78K0/IB2	μPD78F8025	μPD78F071x		78K0/LC3	78K0/LD3	78K0/LE3	78K0/LF3	78K0/LE3-M ^{*1}	78K0/LG3-M ^{*1}			
Pin Count	16-pin	20-pin	30/32-pin	64-pin	30-pin	64-pin	48-pin	52-pin	64-pin	80-pin	64-pin	100-pin			
ROM (bytes)															
128 K															
96 K															
60 K															
48 K	78K0/Ix2														
32 K	Microcontrollers for Power Supplies, Lighting Inverters, and LED Lighting Control			μPD78F8025 (1 K)	μPD78F0714 (1 K)		μPD78F0403, μPD78F0413 (1 K)	μPD78F0423, μPD78F0433 (1 K)	μPD78F0443, μPD78F0453, μPD78F0463 (1 K)	μPD78F0483, μPD78F0493, μPD78F0473 (1 K)	μPD78F8053 (1 K)				
24 K															
16 K	μPD78F0742, μPD78F0752 (768)	μPD78F0744, μPD78F0754 (768)	μPD78F0746, μPD78F0756 (768)	μPD78F8024 (512)	μPD78F0712 (768)			μPD78F0401, μPD78F0411 (768)	μPD78F0421, μPD78F0431 (768)	μPD78F0441, μPD78F0451, μPD78F0461 (768)	μPD78F0481, μPD78F0491, μPD78F0471 (768)	μPD78F8052 (768)			
8 K	μPD78F0741, μPD78F0751 (512)	μPD78F0743, μPD78F0753 (512)	μPD78F0745, μPD78F0755 (512)	Microcontrollers for LED Lighting Control		μPD78F0711 (768)			μPD78F0400, μPD78F0410 (512)	μPD78F0420, μPD78F0430 (512)					
4 K	μPD78F0740, μPD78F0750 (384)														
2 K															
1 K															
Package	16-pin SSOP (MA) Thickness: 1.50 mm 5.72 mm (225) Pitch: 0.65 mm 	20-pin SOP (MC) Thickness: 1.70 mm 7.62 mm (300) Pitch: 1.27 mm  20-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm 	30-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm  32-pin WQFN (K8) Thickness: 0.75 mm 5 x 5 mm Pitch: 0.50 mm 	64-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.65 mm 	30-pin SSOP (MC) Thickness: 1.20 mm 7.62 mm (300) Pitch: 0.65 mm 	64-pin TQFP (GK) Thickness: 1.00 mm 12 x 12 mm Pitch: 0.65 mm 	48-pin LQFP (GA) Thickness: 1.40 mm 7 x 7 mm Pitch: 0.50 mm 	52-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.65 mm 	64-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.65 mm  64-pin TQFP ^{*2} (GA) Thickness: 1.00 mm 7 x 7 mm Pitch: 0.40 mm 	64-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.50 mm 	80-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.65 mm  80-pin LQFP (GK) Thickness: 1.40 mm 12 x 12 mm Pitch: 0.50 mm 	64-pin LQFP (GB) Thickness: 1.40 mm 10 x 10 mm Pitch: 0.50 mm 	100-pin LQFP (GC) Thickness: 1.40 mm 14 x 14 mm Pitch: 0.50 mm 		

*1. Under development
*2. μPD78F044x, 78F045x only
Remarks: The packages are shown in their actual size.

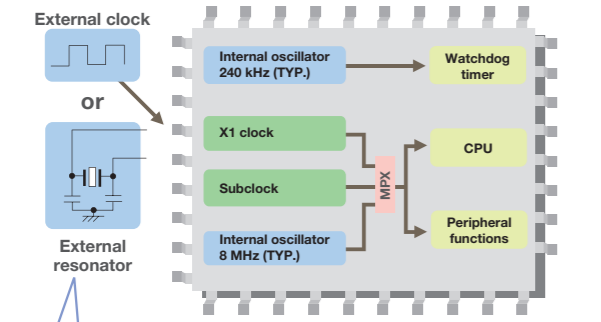
All the required peripheral functions are provided on chip, saving you money and space.

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



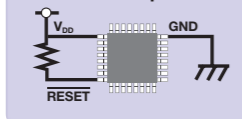
Internal oscillator

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



The external resonator pin can be used as an I/O if no external resonator is needed.

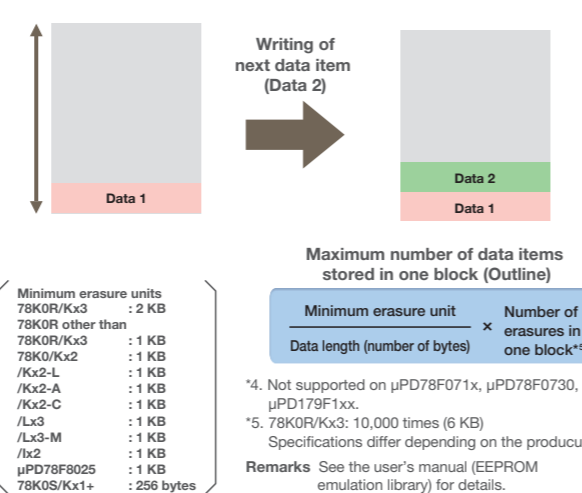
The configuration below enables the operation.



Remarks The above is an example of using the 78K0R/Kx3. Specifications differ depending on the product.

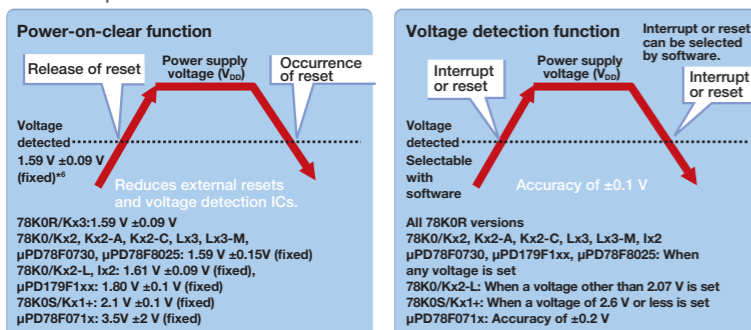
EEPROM[®] emulation function⁴

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



Reset function

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



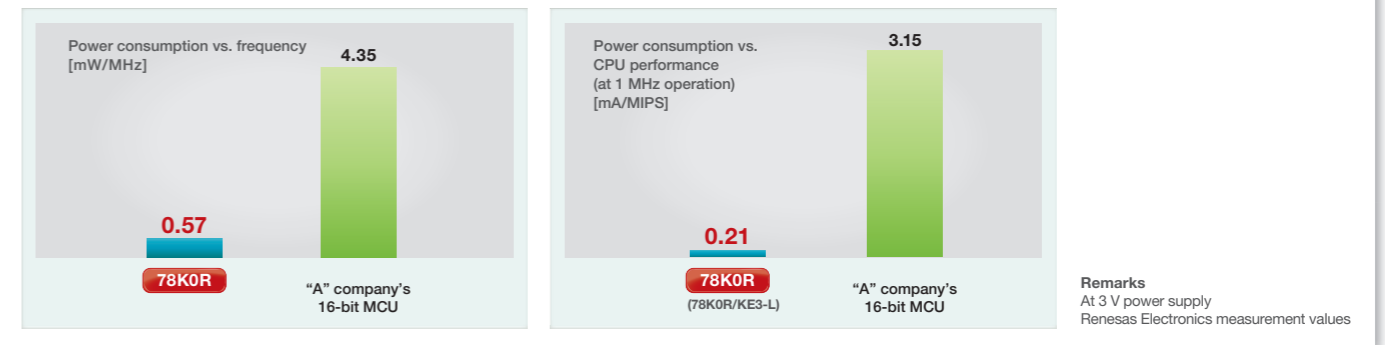
⁶. In products other than the 78K0R/Kx3, the detection voltage when reset is released differs from the voltage when reset occurs.
 •When a reset is released: 1.61 ± 0.09 V (target value)
 •When a reset occurs: 1.59 ± 0.09 V (target value)

Highly reliable watchdog timer (WDT)

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

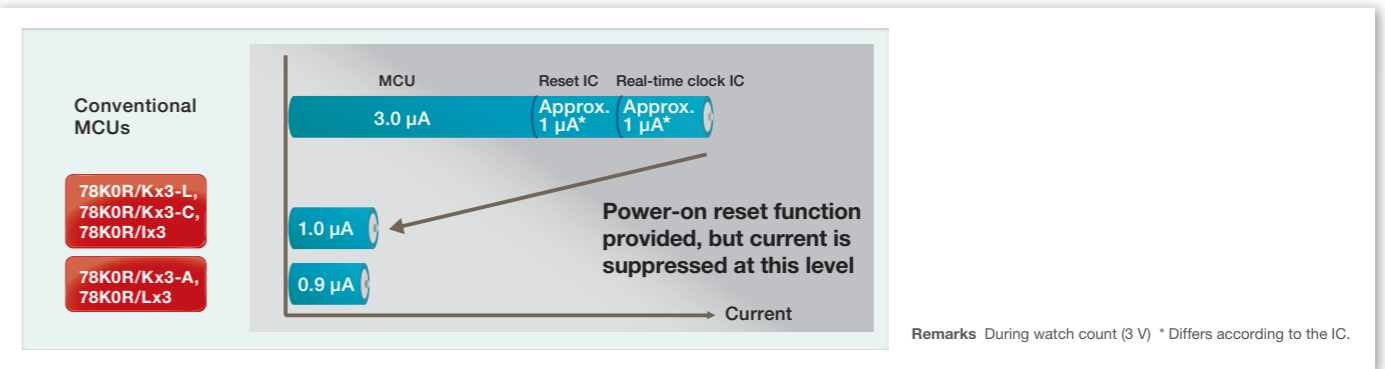
16-bit microcontroller performance combined with low power consumption
 Sophisticated application functions can be realized while maintaining low power consumption.

World's lowest power consumption for 16-bit microcontrollers



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

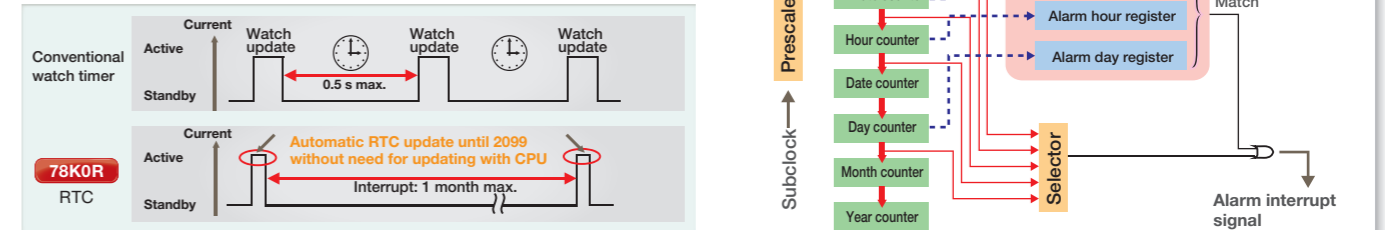
Standby power



Function that implements low power consumption has been added

RTC (real-time counter)

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



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

Low power consumption comparable to that of mask ROM products

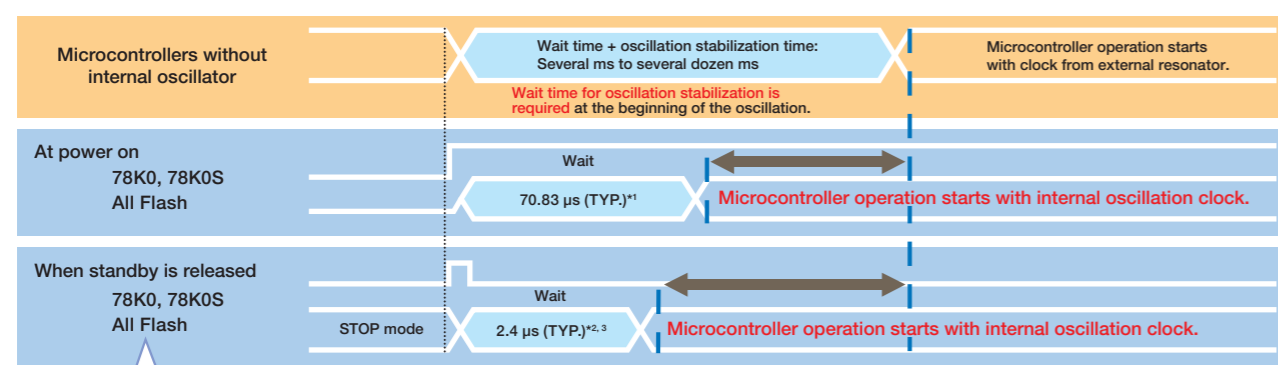
Power supply voltage: 5 V				Operating current	
Conventional mask ROM microcontrollers	Operation mode	Resonator 10 MHz		7.6 mA	
78K0/Kx2, 78K0/Kx2-L, 78K0/Kx2-A		Resonator 10 MHz	2.3 mA	70% reduced	
78K0/Lx3		Resonator 10 MHz	1.9 mA	75% reduced	
78K0/Kx2, 78K0/Kx2-A, 78K0/Lx3		Internal oscillator 8 MHz	1.4 mA	82% reduced	
78K0/Kx2-L		Internal oscillator 8 MHz	1.3 mA	83% reduced	

Power supply voltage: 3 V				Standby current	
Conventional mask ROM microcontrollers	HALT mode	Resonator 32.768 kHz		6 μ A	
78K0/Kx2		Resonator 32.768 kHz	3.5 μ A	42% reduced	
78K0/Lx3		Resonator 32.768 kHz	2.4 μ A	60% reduced	
78K0/Kx2-L		Resonator 32.768 kHz	1 μ A	73% reduced	
78K0/Kx2, 78K0/Kx2-A, 78K0/Kx2-C, 78K0/Lx3, μ PD179F1xx	STOP mode	All clocks stop.	1 μ A		
78K0/Kx2-L		All clocks stop.	0.3 μ A		

Remarks: The current values are typical values.

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

Power-consumption reduction achieved by fast startup



Internal oscillators require almost no wait time for oscillation stabilization.

The non-productive time intervals indicated by the arrows above are eliminated, which reduces the average power consumption.

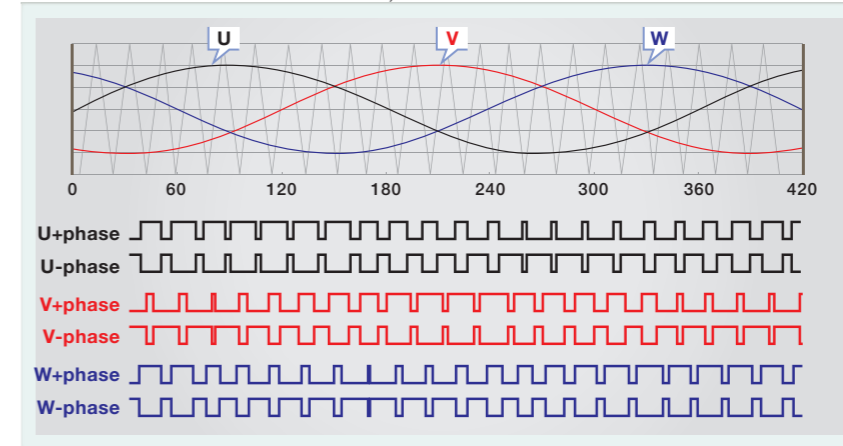
*1. In the case of the μ PD78F071x, 78K0S/Kx1+: 544 μ s (TYP.)
 *2. In the case of the 78K0/Kx2, 78K0/Kx2-L, 78K0/Kx2-A, 78K0/Kx2-C, μ PD78F8025, 78K0/Lx3, and 78K0/lx2, μ PD179F1xx: 4.8 μ s, μ PD78F0730: 5 μ s, μ PD78F071x: 70.83 μ s
 *3. 78K0/Kx2, 78K0/Kx2-A, 78K0/Kx2-C, μ PD78F8025: When oscillation frequency is 10 MHz or less (AMPH = 0)

Microcontroller for inverter control (78K0R/lx3)

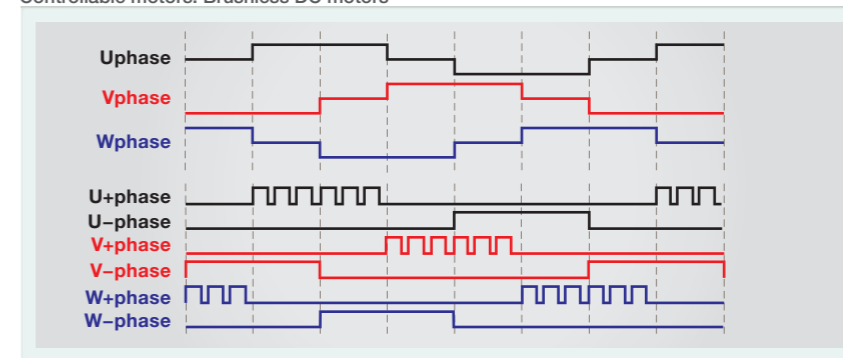
1. On-chip multi-function timer enabling fine inverter control

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

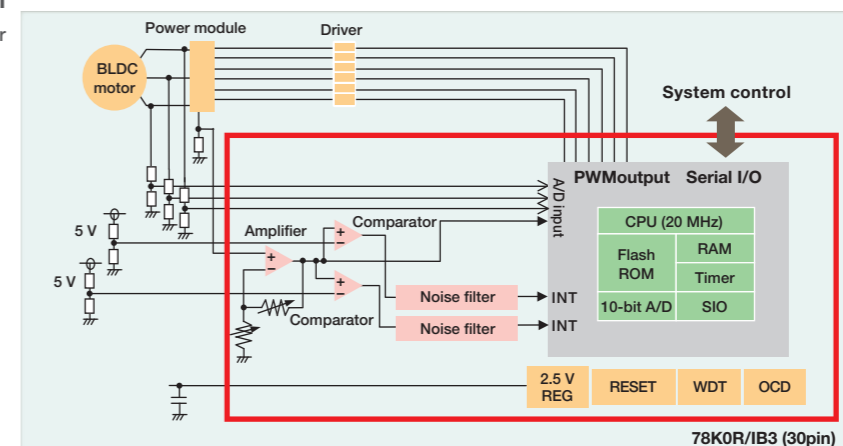


Example 2: [Non-complementary method modulation output function] (120° excitation)
 Controllable motors: Brushless DC motors



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.

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 x 2 (Bulk transfer x 2)
64 bytes (Control transfer x 2, Interrupt transfer x 2)

All our USB microcontrollers are USB certified.



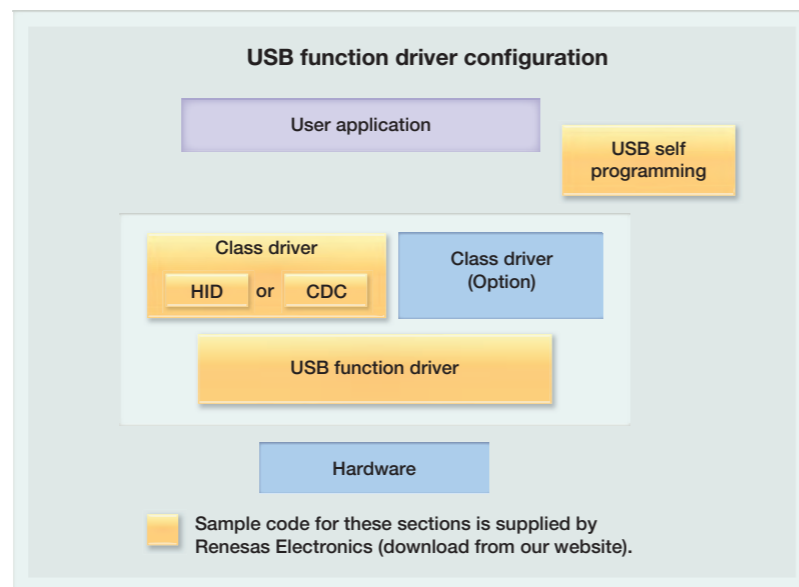
2. Extensive USB driver support

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

USB function driver

Renesas Electronics provides free sample code.

Remarks 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 mPD78F8043, a 16-bit 78K0R microcontroller with an on-chip transceiver that can communicate with IO-Link devices. By using the mPD78F8043, you can build a sophisticated sensor network. We have also provided a software stack to help you develop your system more efficiently.

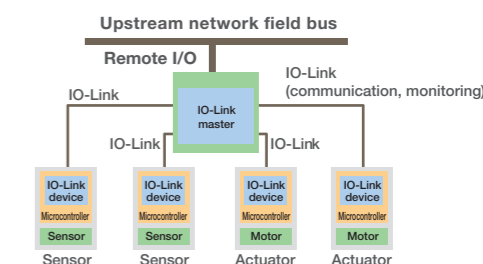
1. IO-Link

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.



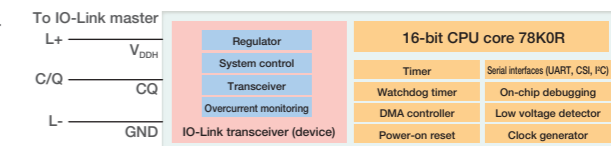
2. Features of IO-Link

- 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)

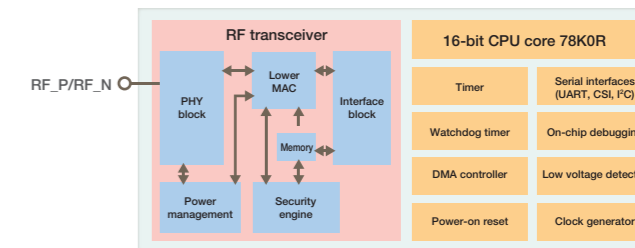
1. Microcontroller and RF transceiver integrated into a single package

The mPD78F8058 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.

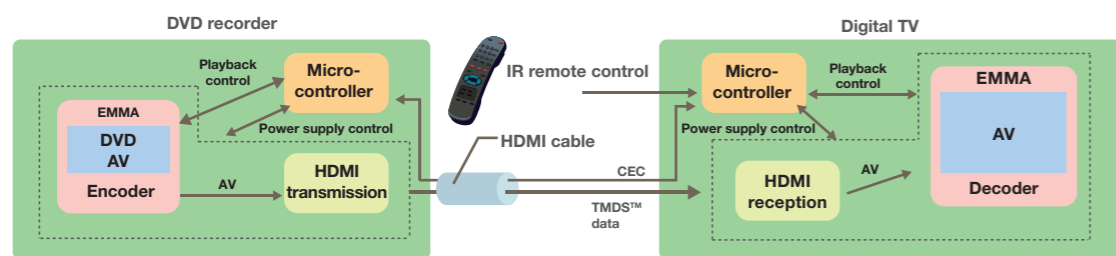
We offer ideal products for various applications. You can choose the optimal product for your needs.

Microcontroller for digital AV applications (78K0R/Kx3-C, 78K0/Kx2-C)

1. HDMI™-CEC transmission/reception via hardware

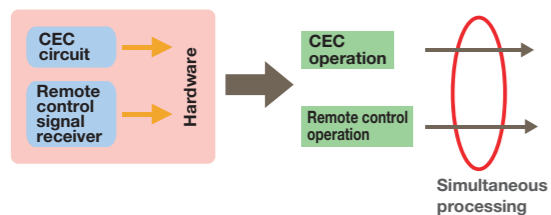
Digital AV devices can be mutually controlled by simply connecting them via an HDMI cable.

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.

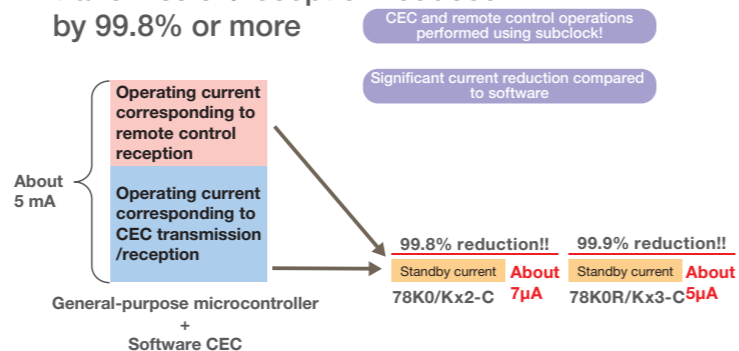


2. Improved system operability

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 by 99.8% or more



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

Evaluation boards for testing HDMI-CEC applications are available for the 78K0 and 78K0R. Simply connect the board to a PC to perform testing. It comes with custom software to simplify the development of applications with CEC functionality. The software emulates transmission of specified CEC commands, CEC communication using CEC data logging, etc.



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

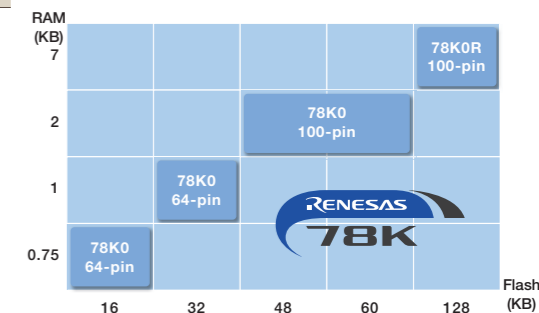
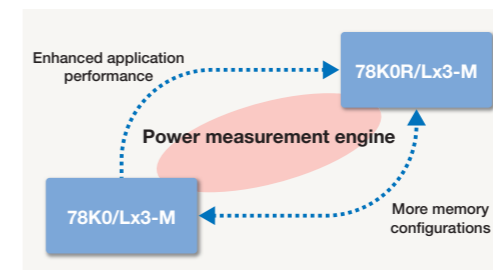
Microcontrollers for power meters (78K0R/Lx3-M, 78K0/Lx3-M)

All the functions required by a single-phase power meter on a single chip

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

Lineup of products for various application systems

- 16-bit 78K0R/Lx3-M, 8-bit 78K0/Lx3-M
- Memory capacity: 16 KB to 128 KB of flash, 0.75 KB to 7 KB of RAM

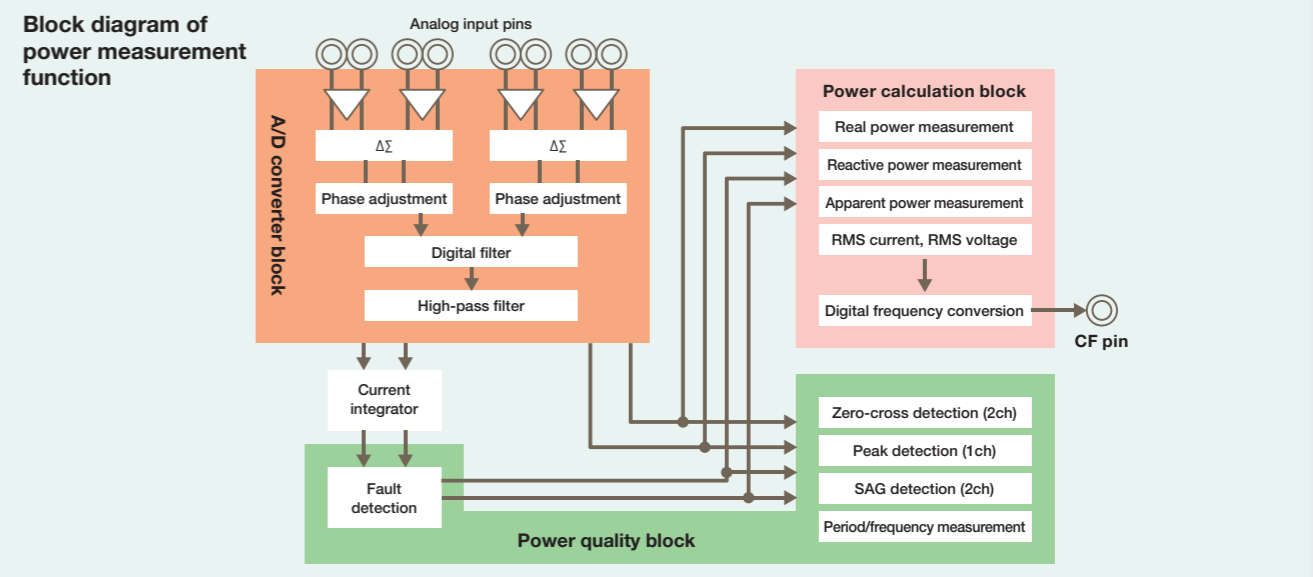


Features

- **24-bit $\Delta\Sigma$ A/D converter (4 channels):**
 2 channels for current and 2 channels for voltage*1
 High-resolution analog-to-digital conversion
 On-chip phase regulator regulates input signal phase shift caused by external circuits or components
- **Precision power metrology**
 Detection of active power, reactive power, apparent power, RMS voltage, and RMS current
 Active power calculation error: 0.1% (typ.)
 Reactive power calculation error: 0.5% (typ.)
- **Current integration**
 A current integrator can be specified to be used or not used for each current channel, and different sensors can be connected.
- **Power quality measurement**
 Anti-tamper (fault detection) feature Peak detection
 Zero-cross detection SAG detection Period and frequency measurement
- **On-chip LCD controller**
 Selectable among three display modes*2 (internal-resistance division, voltage boost, capacitance division) to match the LCD application
- **Remote-control transmitter (78K0/Lx3-M only)**
 Remote-control transmission is achieved by using a timer and UART.
- **Real-time counter**
 The power supplies are separated, allowing the microcontroller to run on the real-time clock even when the power supply is stopped.
- **16-bit multiplier/divider (78K0R/Lx3-M only)**

*1. 2 channels for current and 1 channel for voltage (3 channels in total) in the μ PD78F8052 and 78F8053.
 *2. The 78K0/Lx3-M supports selection between external-resistance division and internal-resistance division.

Block diagram of power measurement feature



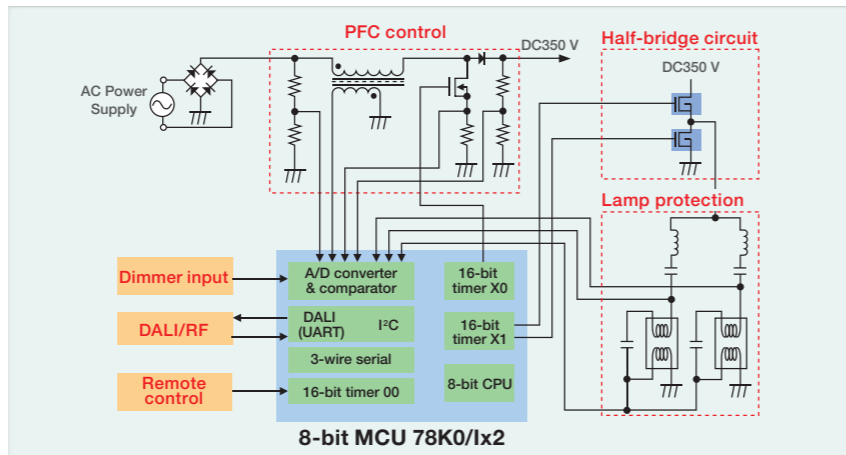
We offer ideal products for various applications.

You can choose the optimal product for your needs.

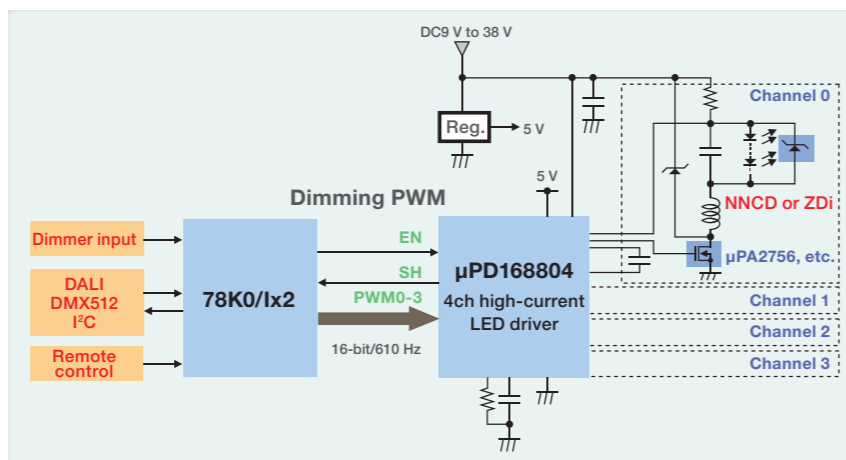
Microcontrollers for power supplies, lighting inverters, and LED lighting control (78K0/Ix2), microcontrollers for LED lighting control (μ PD78F8025) (1/2)

Renesas Electronics has developed a dedicated driver capable of independently driving lighting control, which can be used to facilitate system configuration. By using the 78K0/Ix2, you can achieve low power consumption through PFC/dimmer control and by linking operations with a network. The μ PD78F8025 allows efficient and reliable control thanks to its switching-type constant current driver and extensive on-chip protection circuits, including circuits to prevent overcurrent and overheating.

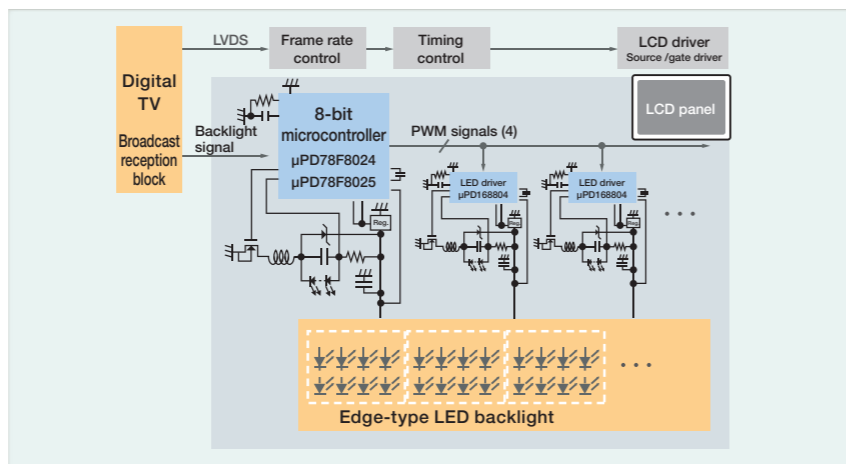
Lighting ballast control



LED lighting



LCD control in digital TVs



Microcontrollers for power supplies, lighting inverters, and LED lighting control (78K0/Ix2), microcontrollers for LED lighting control (μ PD78F8025) (2/2)

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

[Lighting solution evaluation boards]

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

Lighting Applications	Illumination Lighting LED Solution		General Lighting Fluorescent Lighting Solution	Lighting Communication Master Evaluation Board
Evaluation board	Microcontroller only	Microcontroller + driver		
Mounted device (MCU)	(78K0/Ix2)			

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

[Automatic software generator] Applilet® EZ for HCD

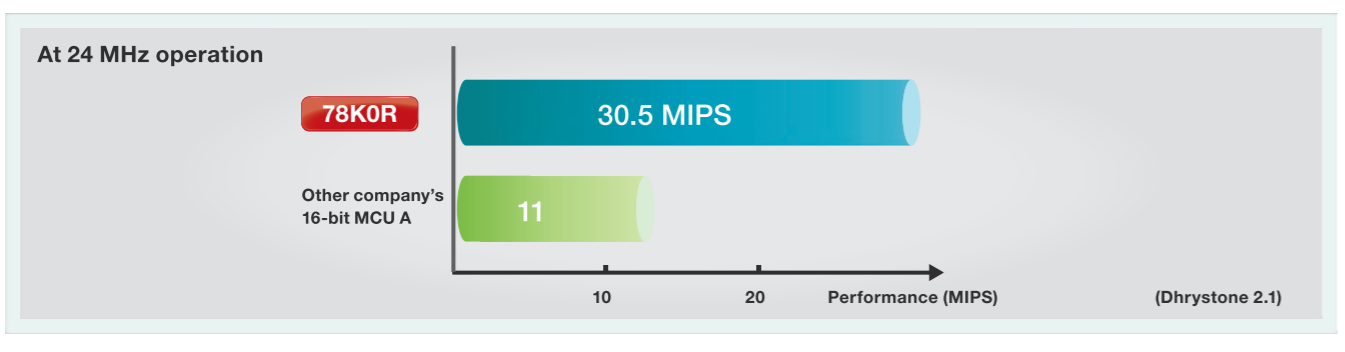
Applilet EZ for HCD automatically generates sample software for LED lighting, which can then be written to the microcontroller on the board. Applilet EZ for HCD is easy to operate even for first-time users, and will lighten your software development load.



High-performance CPU embedded

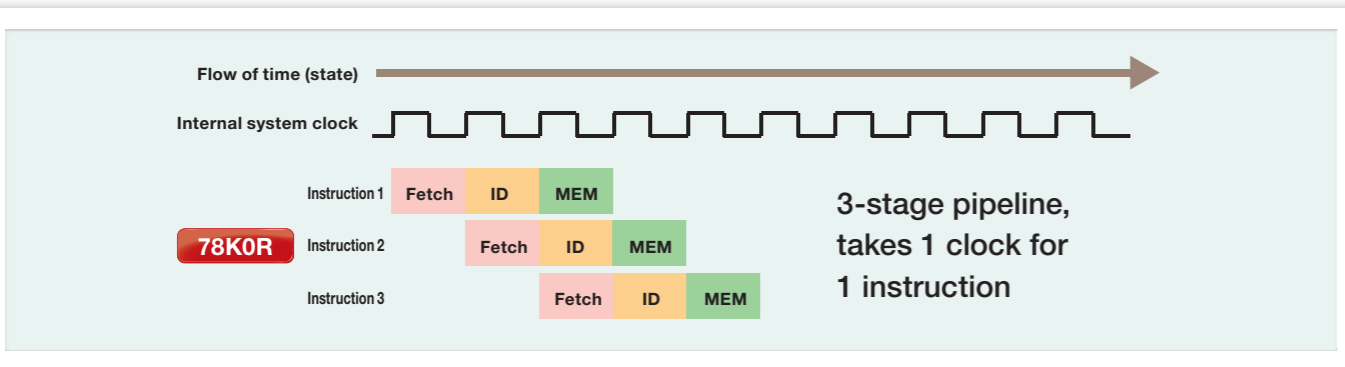
We provide reliable performance for system function expansion.

High performance of 30.5 MIPS in a 16-bit microcontroller



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

Reason for high performance

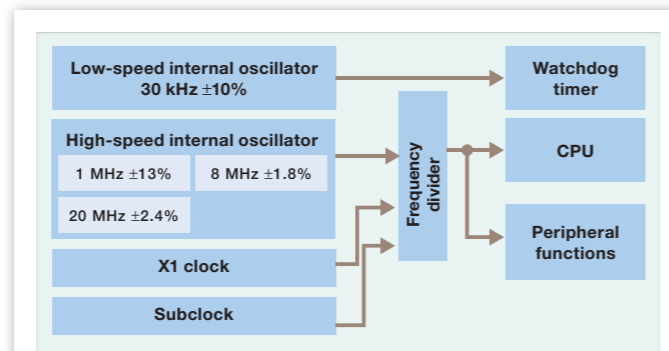
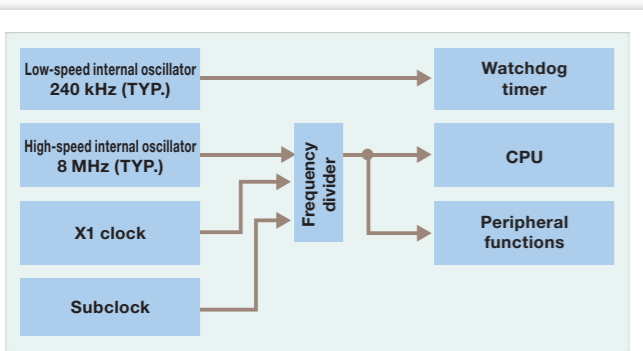


Performance-enhancing oscillator

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 (78K0R)

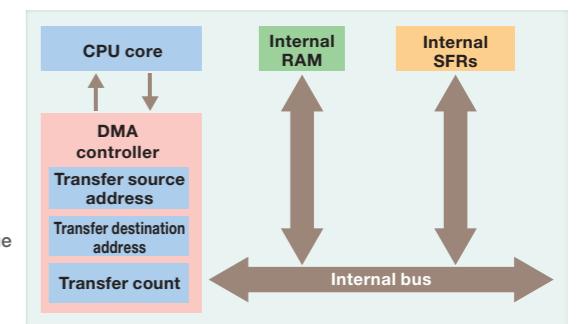
Data exchanges can be performed automatically between the special function registers (SFRs) of the peripheral hardware and the internal RAM without the CPU, using interrupts from the timer, serial interface, or A/D converter, or software triggers.

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

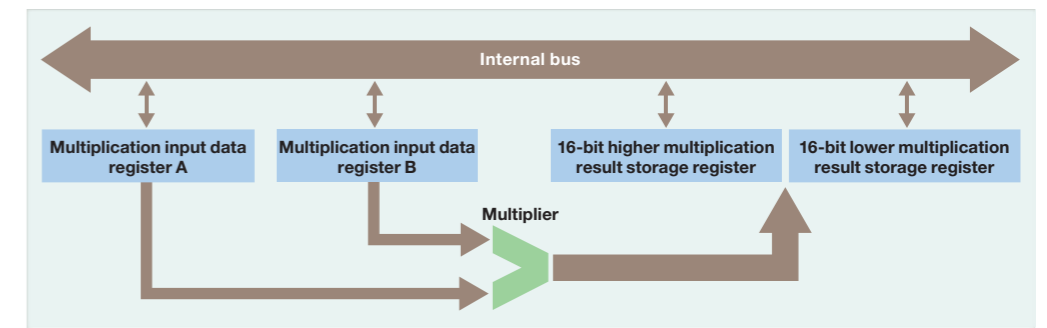
- CSI, UART (continuous transfer)
- A/D converter (continuous read of analog data, etc.)
- Timer (A/D conversion result, port value read, etc., at fixed intervals)
- Software trigger (DMA startup trigger can be generated through software)



Multiplier (78K0/lx2)

Functions

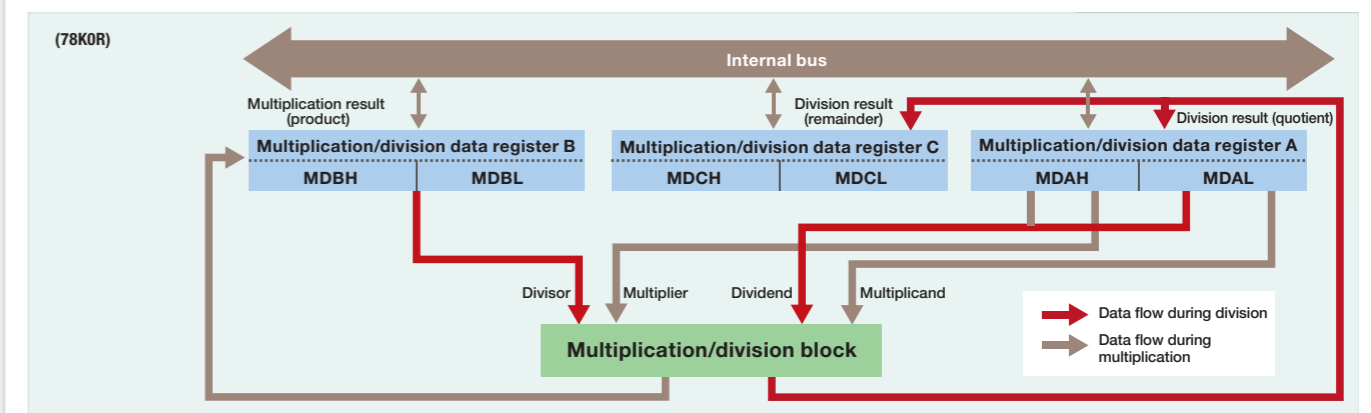
- Executes processing of 8 bits × 8 bits = 16 bits
- Executes processing of 16 bits × 16 bits = 32 bits



Multiplier/divider (78K0R/Kx3-L, 78K0R/Kx3-C, 78K0R/Hx3, 78K0R/lx3, 78K0R/Kx3-A, 78K0R/Lx3, μPD78F8043, μPD78F8058) (78K0/Kx2, 78K0/Kx2-A, 78K0/Kx2-C, 78K0/lx2, μPD78F071x)*1 *2

Functions

- 16bits × 16bits = 32bits, 32bits ÷ 32bits = 32bits



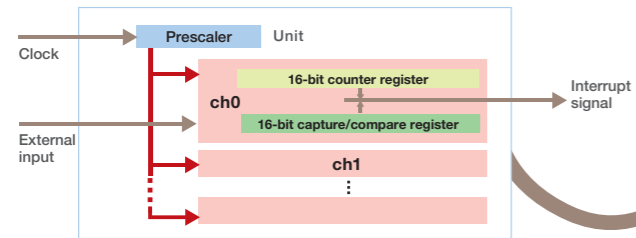
*1. The block diagram of the 78K0's multiplier/divider differs in structure from that of the 78K0R.
 *2. 78K0/Kx2 multiplier/divider: Implemented in 78K0/KC2 (μPD78F0514A, μPD78F0515A), 78K0/KD2 (μPD78F0524A, μPD78F0525A, μPD78F0526A, μPD78F0527A), 78K0/KE2 (μPD78F0534A, μPD78F0535A, μPD78F0536A, μPD78F0537A), and 78K0/KF2.

Enhanced functions for greater user friendliness

Timer array unit (78K0R)

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)

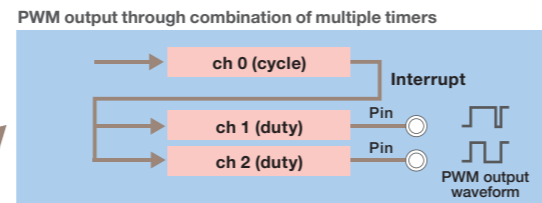


Example In the case of the 78K0R/KG3:

- Interval counting for up to 8 channels is possible.
- PWM output for up to 7 channels is possible.

Example In the case of the 78K0R/Lx3:

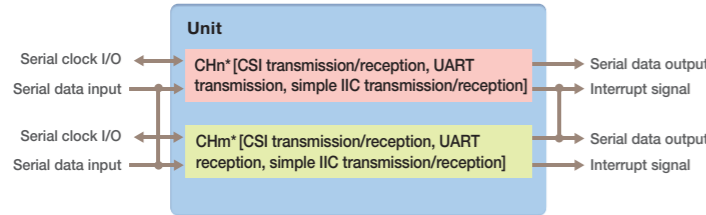
- 3-phase sine-wave PWM output and 2-phase modulation are possible.
- Half-bridge drive for 2 channels is possible.
- Full-bridge drive is possible.



Serial array unit (78K0R)

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

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



Flexible combination

Example:

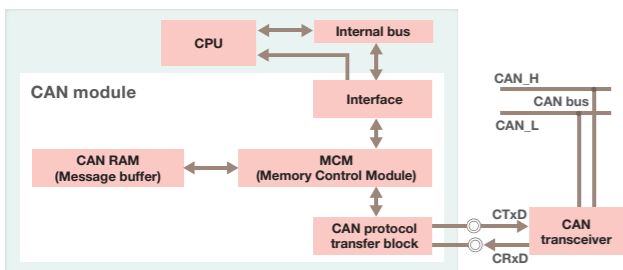
Channel	Combination Example
<1>	CSI transmission/reception
<2>	CSI transmission/reception
<3>	UART transmission/reception
<4>	Simple IIC transmission/reception
CHn	CSI transmission/reception
CHm	Simple IIC transmission/reception

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

Remarks The above table just shows an example. The actual combination varies depending on the product.

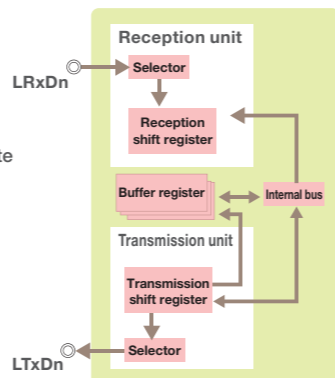
CAN controller (78K0R/Hx3)

- 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.

Best method for large panels

- External resistive division
- Display voltage: Depends on V_{DD}
- Drive capacity: High

Best method for battery sets

Availability of 8 common signals facilitates design

- Voltage boosting
- Display voltage: Constant: does not depend on V_{DD}
- Contrast adjustment feature (contrast adjustable between 2.4 V and 5.4 V)
- Drive capacity: Standard

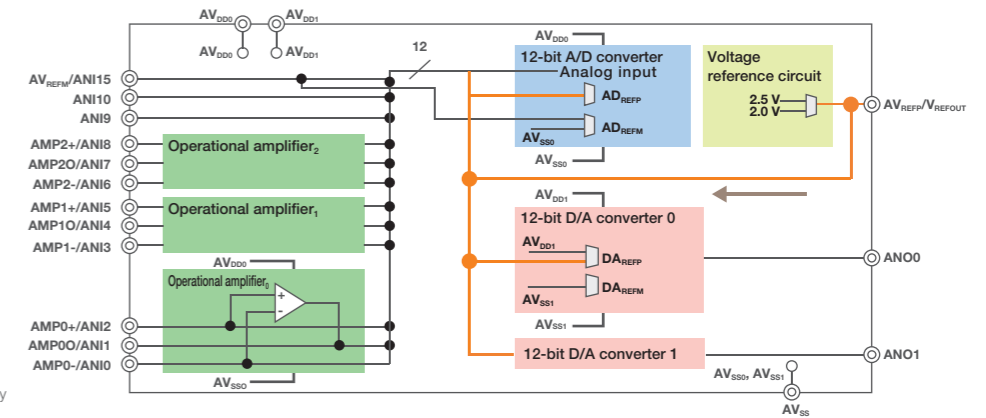
Best method for ultra-low current consumption (0.4 μA (TYP.))

- Capacitive division
- Display voltage: Depends on V_{DD}
- Drive capacity: Standard

First use of ultra-low current LCD driving method in All Flash product

Enhanced analog features (78K0R/Lx3*1, 78K0R/Kx3-A, 78K0/Kx2-A*2)

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.

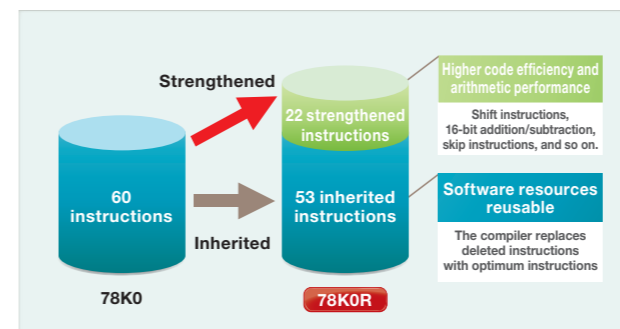


*1. μPD78F1500A to 78F1508A only
*2. 12-bit A/D converter and operational amplifier only

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

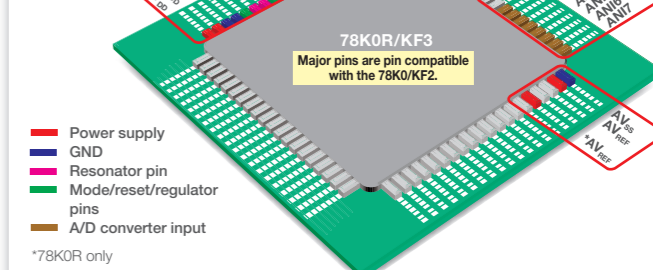
Upward compatible for instructions from 8-bit microcontrollers

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



Major pins are pin compatible

In terms of hardware design, the pin configuration of the 78K0/Kx2, such as the major power supplies, has been adopted.



*78K0R only

High reliability you can count on

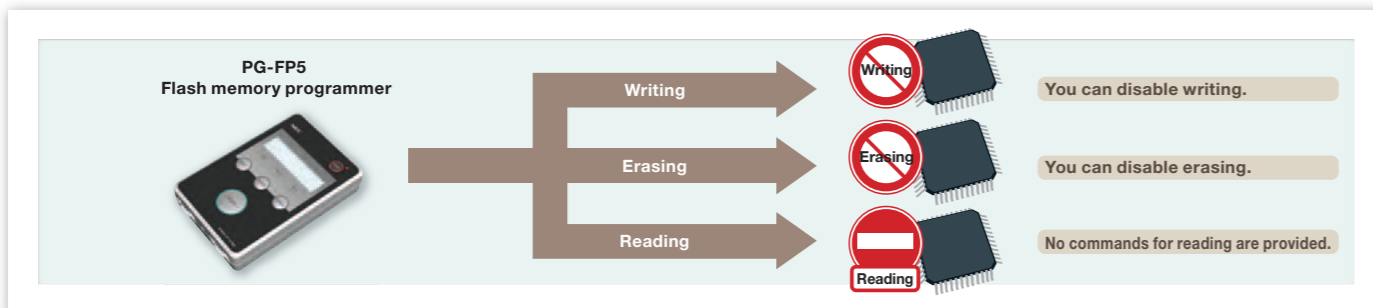
The reliability technologies developed for automotive flash microcontrollers can be found in all our flash microcontrollers, making them a safe choice.

Applications employing our flash microcontrollers



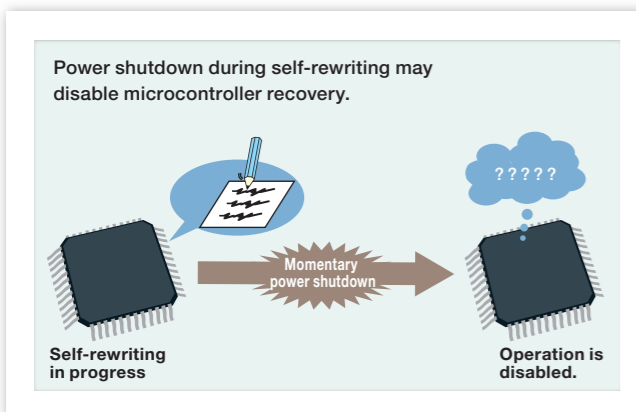
A flash security setting function is provided to protect your software from malicious rewriting and reading.

Software protection function

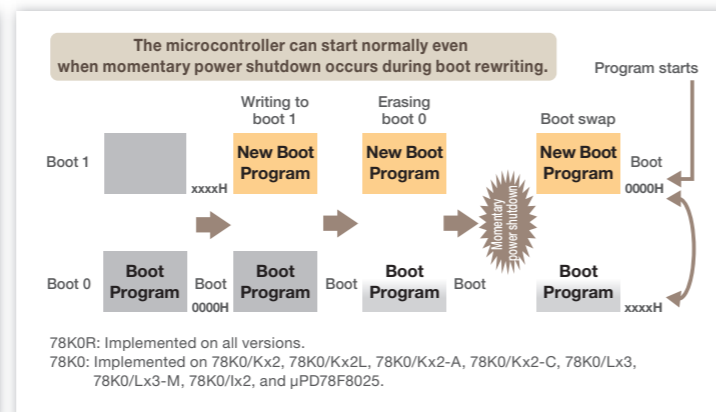


A boot swap function is provided to protect important programs even when power shuts down during self-programming.

Problems during self-rewriting

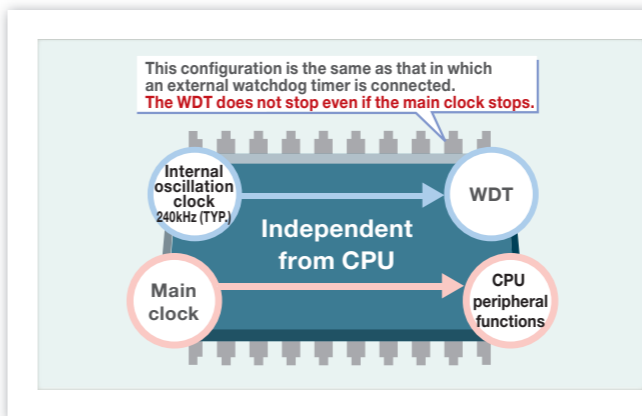


Boot swap function



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

WDT independent from CPU

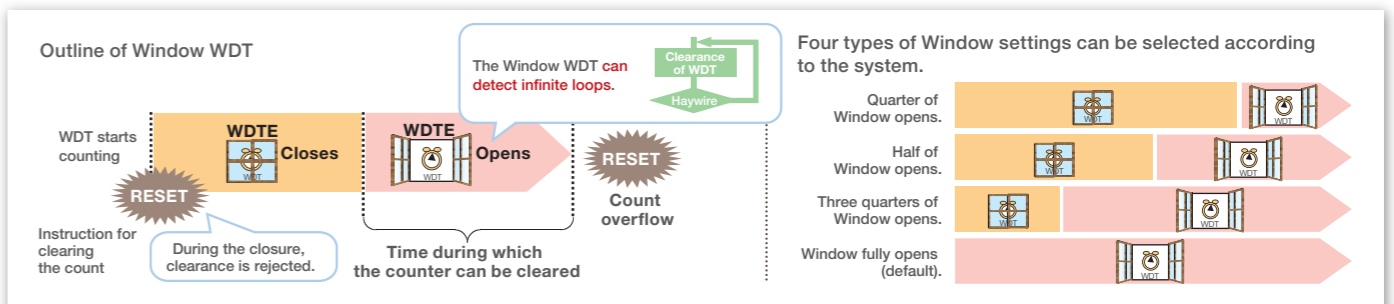


WDT function

	Conventional microcontrollers	78K0R/Kx3, 78K0/Kx2, 78K0S/Kx1+
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.

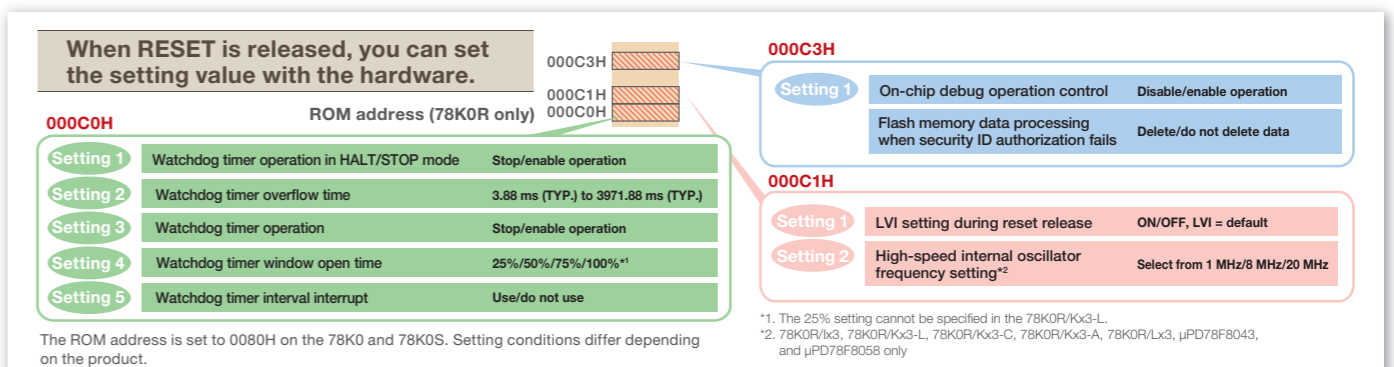
The watchdog timer incorporates enhanced functions.

Window WDT





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

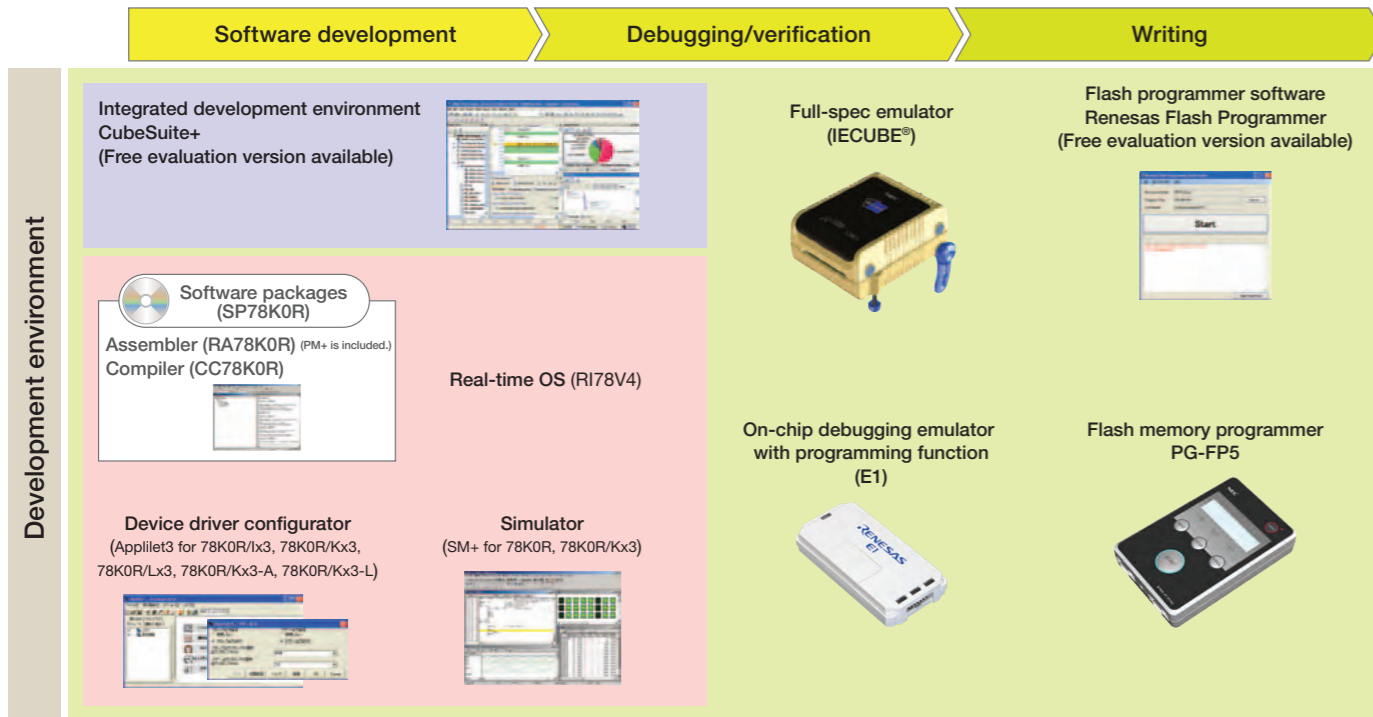
Option byte function



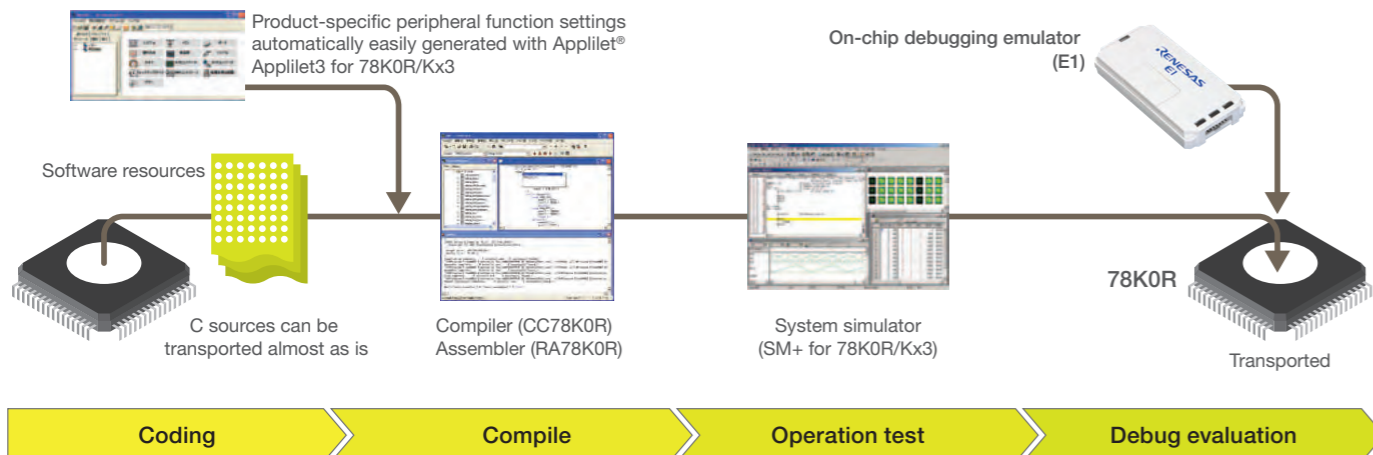
Various development environments for each development phase are available.

Lineup of development environment (78K0R)

Test board	Target board for E1  Note: A conversion adapter (QB-F14T16-01) is required to connect the E1 to the target boards (for MINICUBE2) at right. Starter kit Made by TESSERA Technology Inc. 	QB-78K0RKG3-TB QB-78K0RKE3L-TB QB-78K0RIE3-TB QB-78K0RKG3C-TB (Under development) QB-78K0RKG3L-TB	QB-78K0RLH3-TB QB-78K0RHG3-TB QB-78F8041-TB QB-78F1026-TB (QB-78K0RKG3-TB is shown to the left.)
	TK-78K0R/KG3 TK-78K0R/KE3L TK-78K0R/KG3C TK-78K0R/LH3+LCD TK-78K0R/KE3L+USB (TK-78K0R/KG3 is shown to the left.)		

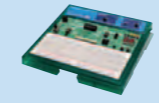







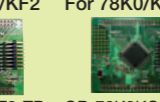



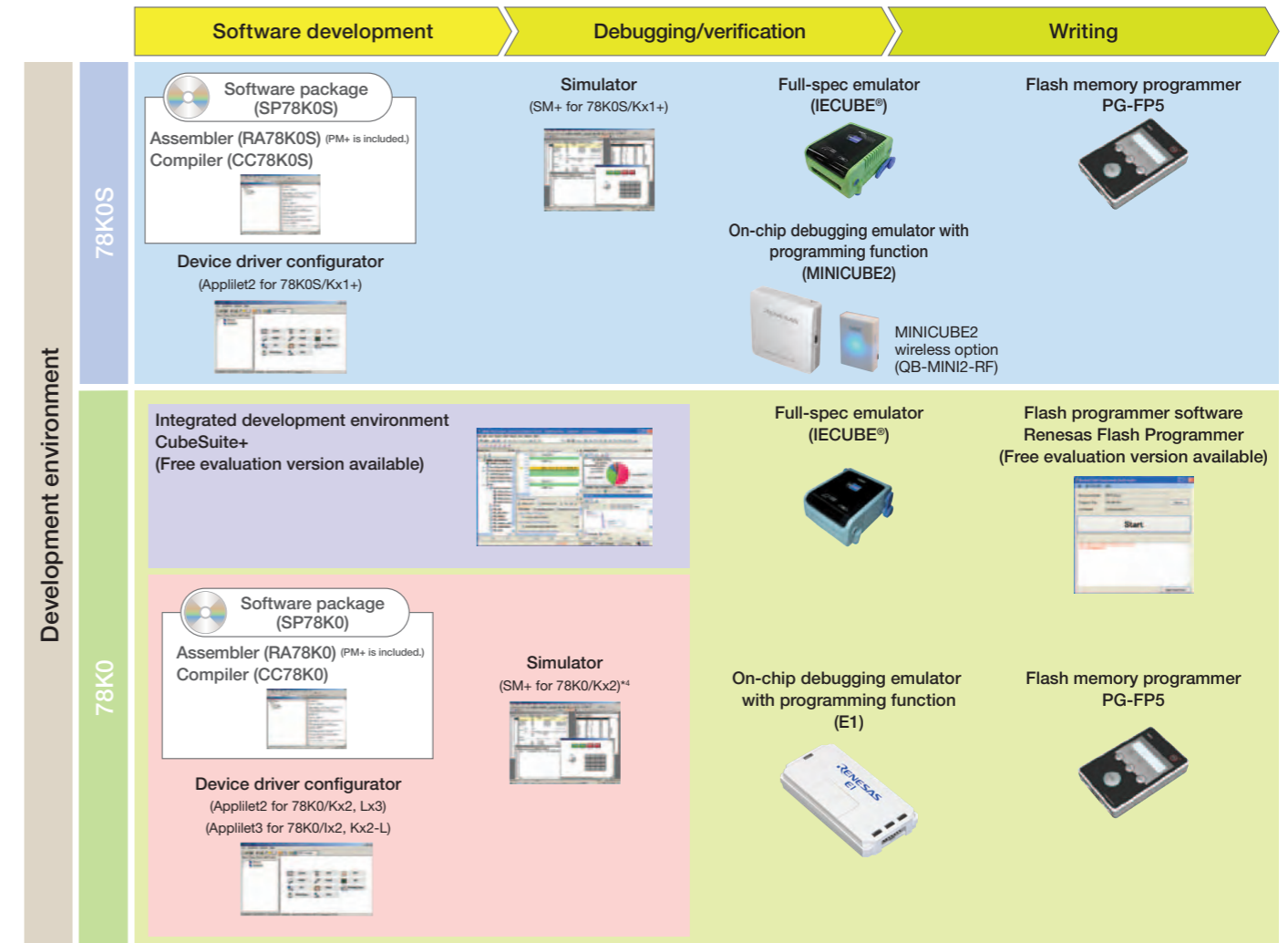
“Significant man-hours are required to develop and modify software from existing chips”. We propose developing environments to support such situations.



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

Lineup of development environments (78K0S, 78K0)

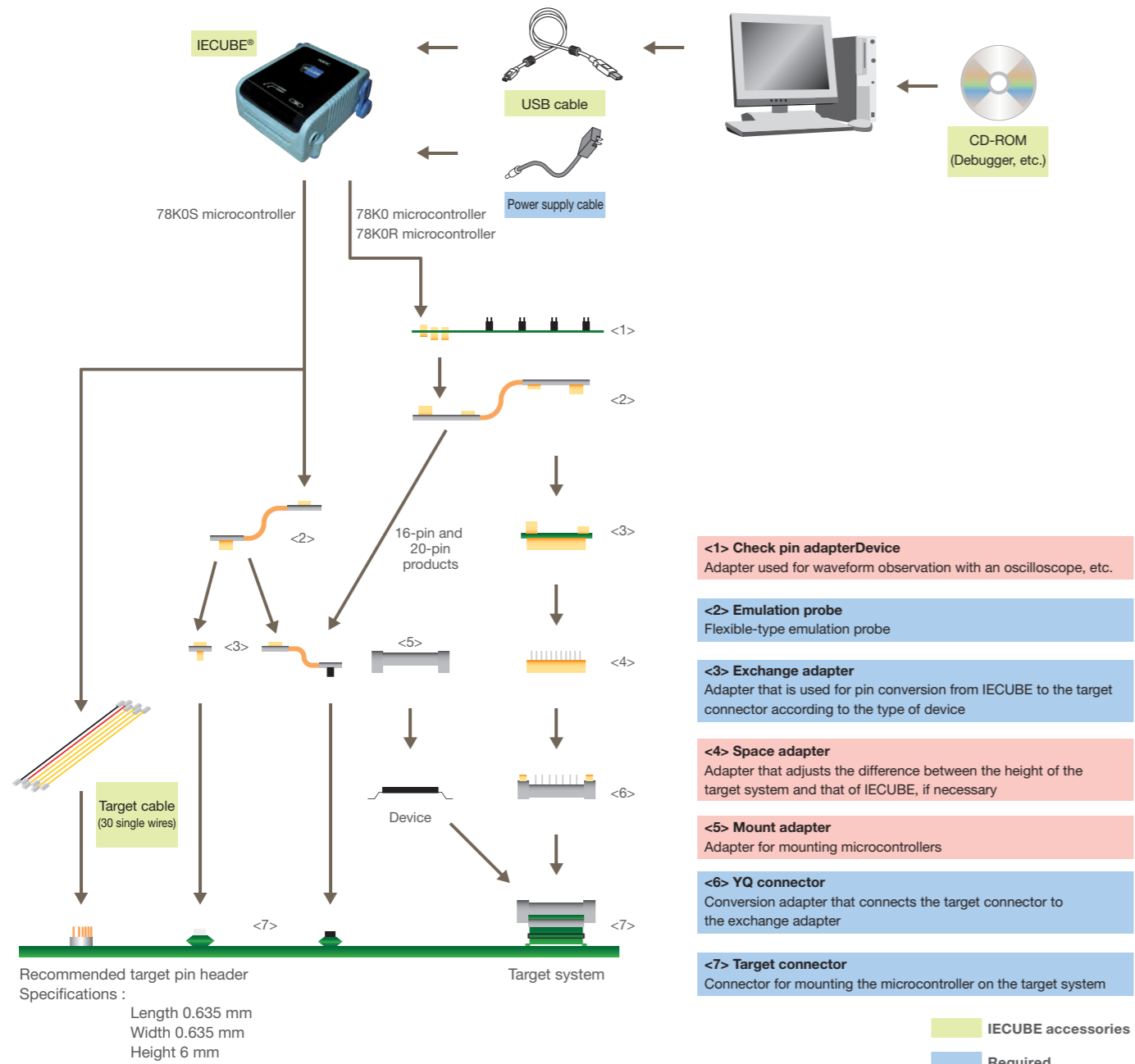
	Microcontroller training kit	Starter kit for quick microcontroller programming		Test boards for use with on-chip debuggers	Pitch conversion board
Test board ^{*4}	78K0S Microcontroller training kit  ReferSTAR 78K ^{*1}	For 20-pin SSOP package  EZ-0002	For 20-pin DIP package  CT-207 ^{*1}	For MINICUBE2 For 78K0S/KB1+  QB-78K0SKB1-TB	DIP conversion board  FB-78F922MC ^{*2}
	78K0 Microcontroller training kit  (ReferSTAR 78K upgrade kit ^{*1})	For 78K0/KF2  TK-78K0/KF2 ^{*3}	For 78K0/KC2-L  TK-78K0/KC2-L ^{*3}	For E1 ^{*5} For 78K0/KF2  QB-78K0KF2-TB	For 78K0/KC2-L  QB-78K0KC2L-TB



*1. Made by Sunhayato Corporation
 *2. Made by Naito Densai Machida Mfg. Co., Ltd.
 *3. Made by TESSERA Technology Inc.
 *4. Not supported by the μPD179F1xx.
 *5. A conversion adapter (QB-F14T16-01) is required to connect the E1 to the target boards for MINICUBE2.

Hardware tool

IECUBE (Full-spec emulator)



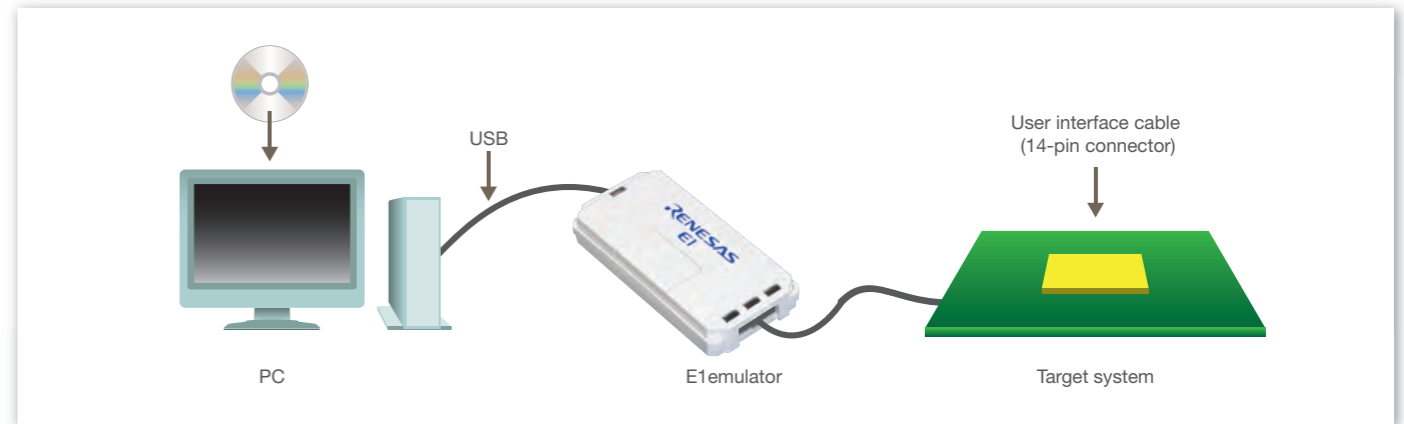
Note: For detailed information on system configurations when using IECUBE, see the electronic version of Development Environment Catalog Supplement: Development Environment Product List (available at: http://japan.renesas.com/tool_catalog).

Flash memory programmer

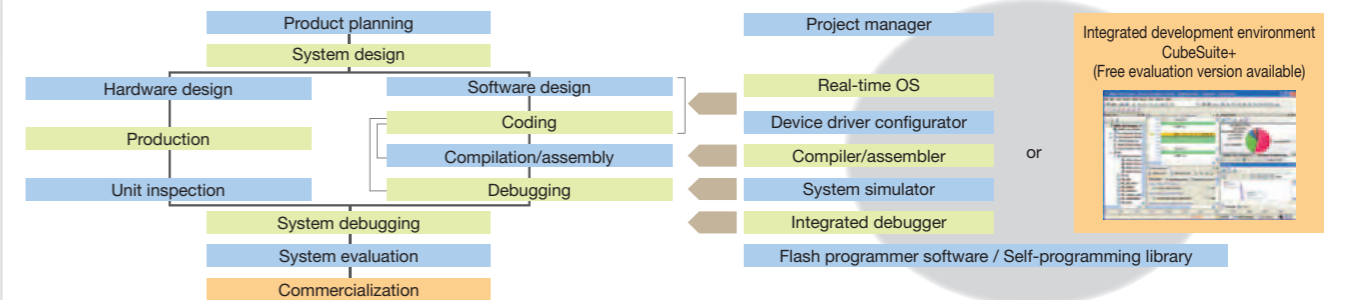
Product Name	Package Contents
PG-FP5 (flash memory programmer)	PG-FP5 main unit, USB cable, serial cable, target cable, and ground cable (The power supply is sold separately.)



E1 (On-chip debugging emulator)



Software development environment



Type	78K0S Microcontrollers	78K0 Microcontrollers	78K0R Microcontrollers
Integrated development environment (w/ compiler & simulator)	-	CubeSuite*1	CubeSuite*1
Software package	SP78K0S	SP78K0	SP78K0R
Project manager	PM+	PM+	PM+
C compiler	CC78K0S	CC78K0	CC78K0R
Assembler	RA78K0S	RA78K0	RA78K0R
System simulator	SM+ for 78K0S/Kx1+, SM78K0S	SM+ for 78K0/Kx2, SM78K0	SM+*2 (instruction + peripheral simulation) SM+ for 78K0R (instruction simulation)
Integrated debugger	ID78K0S-QB	ID78K0-QB	ID78K0R-QB
Real-time OS	-	-	R178V4
Flash programmer software	-	Renesas Flash Programmer	Renesas Flash Programmer
Self-programming library	Sample program	Library	Library
Device driver configurator	Applilet2 for 78K0S/Kx1+	Applilet2*3, Applilet3*4	Applilet3*5

*1. See the following URL for information on functions supported by CubeSuite+: <http://www.renesas.com/cubesuite+>

*2. Supported only in the 78K0R/Kx3 *3. Supported only in the 78K0/Kx2, 78K0/Fx2, and 78K0/Lx3 *4. Supported only in the 78K0/lx2 and 78K0/Kx2-L

*5. Supported only in the 78K0R/lx3, 78K0R/Kx3, 78K0R/Lx3, 78K0R/Kx3-A and 78K0R/Kx3-L

- Integrated development environment CubeSuite+ (Free evaluation version available)**
 - 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, system simulator (part), Integrated debugger, etc. provided on a single CD-ROM disk.
- Project manager**
 - Various development tools integrated in Windows.
 - The project manager can execute a series of operations, such as editing, building, and starting the debugger.
- C compiler**
 - ANSI C standard compliant.
 - Supports extended specifications unique to 78K0, 78K0S, 78K0R microcontrollers.
- System simulator**
 - Same GUI design as that of an integrated debugger.
 - Evaluation possible without target prior to target completion.
- 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.
- Assembler**
 - Converts a source program, which are described in assembly language into machine language.
 - Made up of the following six programs:
 - Structured assembler preprocessor
 - Assembler
 - Linker
 - Object converter
 - Librarian
 - List converter
 - Also includes project manager PM+.
- Real-time OS**
 - μITRON4.0 specification compliant.
- Renesas Flash Programmer**
 - Support for controlling programming from a PC
 - GUI designed specifically for flash programming
 - Works with E1 on-chip debugging emulator (with programming function) as the programmer
- Self-programming library**
 - The flash memory can be programmed by using the microcontroller itself, without using a programmer.
 - Built-in boot swap function for protecting the boot area at power down.
- Device driver configurator**
 - Easily generates initialization programs for troublesome peripheral functions (timers, UART, etc.).

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*1: Practically none, highly flexible

Flash memory programmers

Various products selectable for your purposes and price range

*Support details differ depending on the product. Contact the manufacturer for information on suitability for use on mass production lines.



Stick GANG Writer*
TESSERA
Technology Inc.



StickWriter*
TESSERA
Technology Inc.



FM-ONE
Hokuto Electronic Co., Ltd.



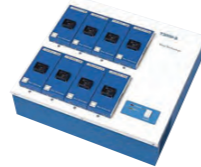
AF9101•AF9723B
Flash Support Group, Inc.



PG-FP5
Renesas Electronics



NET IMPRESS series*
Yokogawa Digital
Computer Corporation



Y3000-8*
Wave Technology Co., Ltd.

External programming (programming service partners)

Flexible support for small-volume programming and short delivery time

The following programming service partners support microcontrollers manufactured by Renesas Electronics.



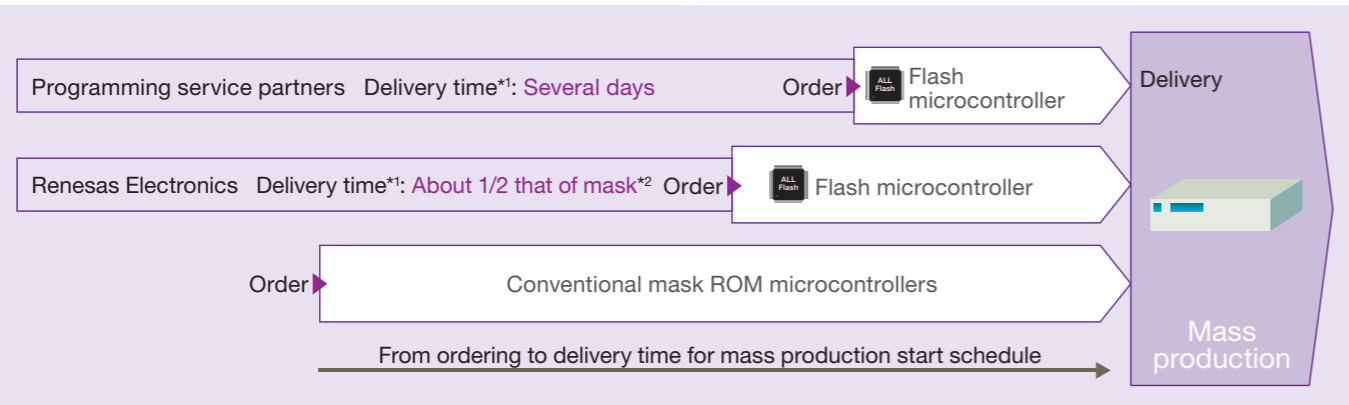
Programmed products (Renesas Electronics)

Shipment form same as that of mask ROM microcontrollers

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



*Contact the Renesas Electronics sales department or a sales agent for information on supported microcontrollers.



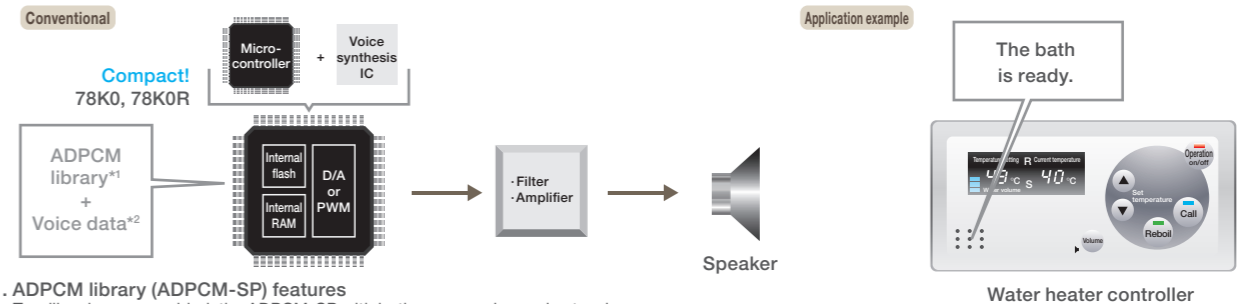
*1. Period from completion of software until start of mass production
*2. Delivery time may vary depending on purchase conditions, such as order quantity.

Various functions achieved with 78K0, 78K0R All Flash features and libraries

New functions can be easily constructed. One example is introduced below.

Speaking (ADPCM: Adaptive Differential Pulse Code Modulation)

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



*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	Supported products	Library sizes		Processing functions (during 20 MHz drive)	
		ROM	RAM	Compression	Extension
ADPCM-SP	78K0R	3K bytes	32 bytes	35µs, max.	30 µs, max.
ADPCM-SP2	78K0R	450 bytes	8 bytes	-	3.5 µs, max.
	78K0	600 bytes	8 bytes	-	17µs, 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.
Remarks 2. Processing is necessary every 125 ms in the case of 8 kHz sampling voice.

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

Library	Compression rate		
	High audio quality	High compression	High compression
ADPCM-SP	4K bytes/second	3K bytes/second	2K bytes/second
ADPCM-SP2	4K bytes/second	-	2K bytes/second

Remarks The 3 Kbps specification is not supported by the ADPCM-SP2 library.

Evaluation environment to support "speaking"

TK-78K0/KF2+Voice
Made by TESSERA Technology Inc.

TK-78K0R/KG3+Voice
Made by TESSERA Technology Inc.

CvADPCM
Made by Renesas Electronics Corporation
Obtained from our Website

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

- ENERGY SAVING AMR**: Lighting dimmers, Lighting ballast, PIR sensors
- FIRE & SECURITY**: Smoke detectors, Fire alarms, Intrusion sensors, Glass break sensor
- HVAC**: Thermostats, Temp sensors, Heating timers, Air conditioning
- OTHERS**: Medical, Asset management, Remote controls, Industrial process

- 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.

[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 mPD78F8058 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

ZigBee SDK* (software development kit)

A protocol stack library that enables the establishment of wireless communication, diagnosis, and debugging through the use of Network Viewer, Sniffer, and other tools on your computer is included.

- The kit supports the ZigBee PRO, SimpleNET, and RF4CE standards.

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

Product specifications

(16-bit 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	512K	128 K	192 K	256 K	384 K	512K	128 K	192 K	256 K	384 K	512 K
RAM (bytes)		4 K	6 K	8 K	10 K	12 K ^{*1}	4 K	6 K	8 K	10 K	12 K ^{*1}	4 K	6 K	8 K	10 K	12 K ^{*1}	24 K	30 K ^{*2}	8 K	10 K	12 K	24 K	30 K ^{*2}	8 K	10 K	12 K	24 K	30 K ^{*2}
External bus interface	External memory expansion space	—					—					888 K	824 K	824 K	760 K	696 K	568 K	440 K	824 K	760 K	696 K	568 K	440 K	824 K	760 K	696 K	568 K	440 K
	Bus type	—					—					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					
	Data bus	—					—					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		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																										

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

Product specifications

(16-bit 2/4)

Commercial name		78K0R/KC3-L												78K0R/KD 3-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	μPD78F1028	μPD78F1013	μPD78F1014	μPD78F1029	μPD78F1030	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*	1 K	1.5 K	2 K	3 K*	1.5 K	2 K	3 K*	1.5 K	2 K	3 K*	4 K	6 K	8 K*	10 K	12 K*	6 K	8 K*	10 K	12 K*	6 K	8 K*	8 K*	8 K*	8 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													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							
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 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				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		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 ±1.8% (target), 20 MHz ±2.4% (target)			1 MHz ±13% (target), 8 MHz ±1.8% (target), 20 MHz ±2.4% (target)		1 MHz ±13% (target), 8 MHz ±1.8% (target), 20 MHz ±2.4% (target)										
	Subclock	-		Crystal: 32.768 kHz												Crystal: 32.768 kHz				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)			30 kHz ±10% (for WDT)		30 kHz ±10% (for WDT)										
I/O ports	Total	33				37				41				45			55			71				89				39*			53*		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			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		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.			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						
Real-time counter (RTC)		-				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			2				2				1			2		2					
	CSI: 2 channels, UART (supporting LIN): 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				1				1			1		1					
	UART		-				-				-			-			-				-				-			-		-					
	Simple I ² C		-				-				-			-			-				-				-			-		-					
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		
On-chip debug														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											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					*5					
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				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					

*1. 2 KB when the self programming function is used.
 *2. 7 KB when the self programming function is used.
 *3. 11 KB when the self programming function is used.

*4. One is for controlling the USB buffer.
 *5. 1.91/2.07 (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

(16-bit 3/4)

Commercial name		78K0R/KF3-C				78K0R/KG3-C				78K0R/HC3*1					78K0R/HE3*1					78K0R/HF3*1					78K0R/HG3*1				μPD78F8043				μPD78F8058*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*2	6 K	8 K*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*2	8 K*2	8 K*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										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										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)			30 kHz ±10% (for WDT)																			
I/O ports	Total	71	89	41					55					71					89				26*3			18*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 interval measurement/pulse width measurement/one-shot pulse output/PWM output																	
	PWM		9 channels max.		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			1							
Real-time counter (RTC)	1		1		-					-					-					-				-			1								
Serial interface	CSI: 2 channels, UART: 1 channel	1		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*4			4							
	Internal	35		35		41					47					47					49				28			27							
On-chip debug		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										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				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														
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														

*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.

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

Product specifications

(16-bit 4/4)

Commercial name		78K0R/IB3				78K0R/IC3				78K0R/ID3			78K0R/IE3			78K0R/LF3					78K0R/LG3					78K0R/LH3				78K0R/LG3-M ⁷		
Pin count		30-pin		38-pin		44-pin		48-pin		52-pin			64-pin			80-pin					100-pin					128-pin				100-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	μPD78F8070
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	64 K	96 K	128 K	64 K	96 K	128 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	3K ^{*1}	1.5 K	2 K	3K ^{*1}	1.5 K	2 K	3K ^{*1}	4 K	6 K	7 K	7 K	4 K	6 K	7 K	4 K	6 K	7 K	4 K	6 K	7 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										1.8 to 3.6 V						
	Flash memory programming mode	2.7 to 5.5 V														1.8 to 5.5 V										2.7 to 3.6 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)										0.05 μs (20MHz; V _{DD} = 2.7 to 3.6V), 0.2 μs (5MHz; V _{DD} = 1.8 to 3.6V)						
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				
		High-speed internal oscillation clock		8 MHz ±1.8%, 40 MHz ^{*2} ±2.9%/-4.1%														1 MHz ±13%, 8 MHz ±2%, 20 MHz ±2.4% (target)										1 MHz (TYP), 8 MHz (TYP)				
	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 (TYP)						
I/O ports	Total	23	31	37	41	45	55	51	67	83	45																					
	CMOS I/O	21	27	33	34	38	48	46	60	76	39																					
	CMOS input	2	4	4	4	4	4	4	4	4	3																					
	CMOS output	-	-	-	1	1	1	1	1	1	1																					
	N-ch open-drain	-	-	-	2	2	2	-	2	2	2																					
Timer	16-bit timer	Number of channels		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 output/PWM output (supporting 2-phase modulation)/half-bridge 2-channel drive/full-bridge drive/real-time output/interrupt signal thinning function/AD conversion trigger output														Interval timer/pulse interval measurement/PWM 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.	3																				
	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	-	-	-	-	-	-	-	-	-	-																					
	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	1	1	1	1	1	1	2	2	2	1																					
	CSI: 2 channels, UART (supporting LIN): 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 ^{*3}	1 ^{*3}	-	-	-	-	1	1	1	1																					
	UART	-	-	-	-	-	-	-	-	-	1																					
Simple I ² C	-	-	-	-	-	-	-	-	-	-																						
I ² C	-	-	-	1	1	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) ^{*4}	40 (36) ^{*4}	54 (50) ^{*4}	40												
	Common signal output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4 (8) ^{*4}	4 (8) ^{*4}	4 (8) ^{*4}	4												
A/D converter	10 bits × 6		10 bits × 8		10 bits × 10		10 bits × 11		10 bits × 11			10 bits × 12			12 bits ^{*5} × 8					12 bits ^{*5} × 12					12 bits ^{*5} × 12				Successive approximation: 10 bits × 2, A/D: 24 bits × 4			
D/A converter	-		-		-		-		-			-			12 bits × 2 ^{*6}					12 bits × 2 ^{*6}					12 bits × 2 ^{*6}				-			
DMA controller	2		2		2		2		2			2			2					2					2				2			
Interrupt	External	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	12	13	13	13	13	13	13	13	13	13	13	13	13	4	
	Internal	31	33	33	34	34	34	34	34	34	34	34	34	34	34	34	28	33	33	33	33	33	33	33	33	33	33	33	33	33	32	
On-chip debug		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)		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														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										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 (selectable by software)						
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														Operational amplifier: 2 channels ^{*6} , key interrupt function					Operational amplifier: 3 channels ^{*6} , key interrupt function					Operational amplifier: 3 channels ^{*6} , key interrupt function				Power calculation, power quality measurement, digital frequency conversion		
Operating temperature		-40 to +85°C														-40 to +85°C																

*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.

*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.

*7. Under development

Product specifications

(8-bit 1/3)

CPU Core		78K0S														78K0																																																											
Commercial name		78K0S/KU1+				78K0S/KY1+				78K0S/KA1+		78K0S/KB1+		78K0/ KB2		78K0/KC2				78K0/KD2				78K0/KE2				78K0/KF2																																															
Pin count		10-pin				16-pin				20-pin		30/32-pin		30/36-pin		38-pin		44-pin		48-pin		52-pin				64-pin				80-pin																																													
Product name		μPD78F9200	μPD78F9201	μPD78F9202	μPD78F9500	μPD78F9501	μPD78F9502	μPD78F9210	μPD78F9211	μPD78F9212	μPD78F9510	μPD78F9511	μPD78F9512	μPD78F9221	μPD78F9222	μPD78F9224	μPD78F9232	μPD78F9234	μPD78F9500A	μPD78F9501A	μPD78F9502A	μPD78F9503A	μPD78F9511A	μPD78F9512A	μPD78F9513A	μPD78F9514A	μPD78F9515A	μPD78F9521A	μPD78F9522A	μPD78F9523A	μPD78F9524A	μPD78F9525A	μPD78F9526A	μPD78F9527A	μPD78F9531A	μPD78F9532A	μPD78F9533A	μPD78F9534A	μPD78F9535A	μPD78F9536A	μPD78F9537A	μPD78F9544A	μPD78F9545A	μPD78F9546A	μPD78F9547A																														
Flash memory (bytes)	Bank	—				—				—		—		—		—		—		—				—				—				—																																											
		1 K	2 K	4 K	1 K	2 K	4 K	1 K	2 K	4 K	1 K	2 K	4 K	2 K	4 K	8 K	4 K	8 K	8 K	16 K	24 K	32 K	16 K	24 K	32 K	16 K	24 K	32 K	48 K	60 K	16 K	24 K	32 K	48 K	60 K	96 K	128 K	16 K	24 K	32 K	48 K	60 K	96 K	128 K	48 K	60 K	96 K	128 K																											
RAM (bytes)		128				128				128		256		256		512		768		1 K		1 K		768		1 K		1 K		768		1 K		1 K		2 K		3 K		768		1 K		1 K		2 K		3 K		5 K		7 K		768		1 K		1 K		2 K		3 K		5 K		7 K		2 K		3 K		5 K		7 K	
Power supply voltage	Normal operation mode	2.0 to 5.5 V														1.8 to 5.5 V																																																											
	Flash memory programming mode	2.7 to 5.5 V														2.7 to 5.5 V																																																											
Minimum instruction execution time		0.20 μs (10 MHz: V _{DD} = 4.0 to 5.5 V)/0.33 μs (6 MHz: V _{DD} = 3.0 to 5.5 V)/ 0.40 μs (5 MHz: V _{DD} = 2.7 to 5.5 V)/1.0 μs (2 MHz: V _{DD} = 2.0 to 5.5 V)														0.10 μs (20 MHz: V _{DD} = 4.0 to 5.5 V)/0.20 μs (10 MHz: V _{DD} = 2.7 to 5.5 V)/ 0.40 μs (5 MHz: V _{DD} = 1.8 to 5.5 V)																																																											
Clock	Main clock	Ceramic*/crystal*/external clock: 1 to 10 MHz														Ceramic/crystal/external clock: 1 to 20 MHz																																																											
	High-speed system clock	8 MHz ±5%														8 MHz ±5%																																																											
	High-speed internal oscillator	8 MHz ±5%														8 MHz ±5%																																																											
	Subclock	—														Crystal/external clock: 32.768 kHz																																																											
Low-speed internal oscillator	240 kHz (TYP.) (clock for watchdog timer and 8-bit timer TMH1)														240 kHz ±10% (clock for watchdog timer and 8-bit timer TMH1)																																																												
I/O ports	Total	8				14				17		26		23		31		37		41		45				55				71																																													
	CMOS I/O	7				13				15		24		21		29		33		36		40				50				66																																													
	CMOS input	1				1				1		1		—		—		—		—				—				—																																															
	CMOS output	—				—				1		1		—		—		—		1		1				1				1																																													
	N-ch open-drain	—				—				—		—		2		4		4		4		4				4				4																																													
Timer	16-bit timer (TM0)	Number of channels	1				—				1		1		1		1		1		1		1				1				2		2																																										
		Function	Interval timer/external event counter/PPG output/pulse width measurement/ square-wave output/one-shot pulse output														Interval timer/external event counter/PPG output/pulse width measurement/ square-wave output/one-shot pulse output																																																										
	16-bit timer (TMx)	Number of channels	—				—				—		—		—		—		—		—		—				—				—																																												
		Function	—														—																																																										
	8-bit timer (TMH)	Number of channels	1				1				1		1		2		2		2		2		2				2				2																																												
		Function	Interval timer/PWM output/square-wave output														Interval timer/PWM output/carrier generator output/square-wave output																																																										
	8-bit timer (TM5)	Number of channels	—				—				—		—		2		2		2		2		2				2				2																																												
		Function	—														Interval timer/external event counter/PWM output/square-wave output																																																										
	8-bit timer (TM8)	Number of channels	—				—				1		1		—		—		—		—				—				—																																														
		Function	—														Interval timer																																																										
	Watchdog timer (WDT)		1				1				1		1		1		1		1		1				1				1																																														
Watch timer		—				—				—		—		—		—		—		—				—				—																																															
Real-time counter (RTC)		—				—				—		—		—		—		—		—				—				—																																															
Serial interface	UART (supporting LIN)	—				—				1		1		1		1		1		1				1				1																																															
	UART	—				—				—		—		—		—		—		—				—				—																																															
	UART/CSI	—				—				—		—		1		1		1		1				1				1																																															
	CSI	—				—				—		—		—		—		—		—				—				1																																															
	Automatic transmit/receive 3-wire CSI	—				—				—		—		—		—		—		—				—				—																																															
	I ² C	—				—				—		—		1		1		1		1				1				1																																															
A/D converter	Successive approximation	10 bits × 4				—				10 bits × 4		10 bits × 4		10 bits × 4		10 bits × 6		10 bits × 8		10 bits × 8				10 bits × 8				10 bits × 8																																															
	ΔΣ	—				—				—		—		—		—		—				—				—																																																	
Interrupt	External	2				2				4		4		6		7		7		8				8				9		9																																													
	Internal	5				3				5		4		9		9		14		16		16				16				19		20																																											
Maximum number of segments displayed in LCD	8 commons	—				—				—		—		—		—		—		—				—				—																																															
	4 commons	—				—				—		—		—		—		—		—				—				—																																															
On-chip debug		Supported				Supported				Supported		Supported		—		Supported ¹		—		Supported ¹		—				Supported ¹				—																																													
Multiplier/divider		—				—				—		8-bit × 8-bit		—		—		—		—				16-bit × 16-bit, 32-bit ÷ 16-bit				—				16-bit × 16-bit, 32-bit ÷ 16-bit																																											
Low-voltage detector (LVI)		2.35/2.6 V ±0.1 V or 2.85/3.1/3.3 V ±0.15 V or 3.5/3.7/3.9/4.1/4.3 V ±0.2 V (Selectable by software)														1.93/2.08/2.24/2.39/2.55/2.70/2.85/3.01/3.16/3.32/3.47/3.62/3.78/3.93/4.09/4.24 V (default) ±0.1 V, The detected voltage can be input to pins. (Selectable by software)																																																											
Power-on clear (POC)		2.1 V ±0.1 V														1.59 V ±0.15 V																																																											
Other		—														Clock output																																																											
Operating temperature		T _A = -40 to +85°C (model with expanded temperature range)														T _A = -40 to +85°C (model with expanded temperature range)																																																											

*1. The μPD78F9500, 78F9501, and 78F9502 cannot connect to a ceramic or crystal resonator.
*2. Only supported in the μPD78F0503DA, 78F0513DA, 78F0515DA, 78F0527DA, 78F0537DA, and 78F0547DA.

Product specifications

(8-bit 3/3)

CPU Core		78K0		78K0		78K0		78K0		78K0		78K0																											
Commercial name		μPD78F8025		μPD78F071x		78K0/LC3		78K0/LD3		78K0/LE3		78K0/LF3																											
Pin count		64-pin		30-pin		64-pin		52-pin		64-pin		80-pin																											
Product name		μPD78F8024		μPD78F8025		μPD78F0400		μPD78F0401		μPD78F0402		μPD78F0403																											
		μPD78F0711		μPD78F0712		μPD78F0714		μPD78F0410		μPD78F0411		μPD78F0412																											
		μPD78F0402		μPD78F0403		μPD78F0410		μPD78F0411		μPD78F0412		μPD78F0413																											
		μPD78F0420		μPD78F0421		μPD78F0422		μPD78F0423		μPD78F0430		μPD78F0631																											
		μPD78F0432		μPD78F0433		μPD78F0441		μPD78F0442		μPD78F0443		μPD78F0444																											
		μPD78F0451		μPD78F0452		μPD78F0453		μPD78F0454		μPD78F0455		μPD78F0461																											
		μPD78F0462		μPD78F0463		μPD78F0464		μPD78F0465		μPD78F0471		μPD78F0472																											
		μPD78F0473		μPD78F0474		μPD78F0475		μPD78F0481		μPD78F0482		μPD78F0483																											
		μPD78F0484		μPD78F0485		μPD78F0491		μPD78F0492		μPD78F0493		μPD78F0494																											
		μPD78F0495		μPD78F8052		μPD78F8053		μPD78F8054		μPD78F8055		μPD78F8055																											
Flash memory (bytes)	Bank	8 K	32 K	8 K	16 K	32 K	8 K	16 K	24 K	32 K	8 K	16 K	24 K	32 K	8 K	16 K	24 K	32 K	48 K	60 K	16 K	24 K	32 K	48 K	60 K	16 K	24 K	32 K	48 K	60 K	16 K	24 K	32 K	48 K	60 K				
RAM (bytes)		512	1 K	768	768	1 K	512	768	1 K	1 K	512	768	1 K	1 K	512	768	1 K	1 K	768	1 K	1 K	2 K	2 K	768	1 K	1 K	2 K	2 K	768	1 K	1 K	2 K	2 K	768	1 K	1 K	2 K	2 K	
Power supply voltage	Normal operation mode	1.8 to 5.5 V*		4.0 to 5.5 V																																			
	Flash memory programming mode	2.7 to 5.5 V*		4.0 to 5.5 V																																			
Minimum instruction execution time		*3		0.10 μs (20 MHz; V _{DD} = 4.0 to 5.5 V)																																			
Clock	Main clock	High-speed system clock	*4		Ceramic/crystal/external clock: 5 to 20 MHz																																		
		High-speed internal oscillator	8 MHz ±5%		8 MHz ±5%																																		
	Subclock	—		—																																			
	Low-speed internal oscillator	*5		240 kHz																																			
I/O ports	Total	23		15		48		30		34		46		62		32		65																					
	CMOS I/O	21		11		40		26		30		42		58		29		62																					
	CMOS input	—		4		8		4		4		4		4		2		3																					
	CMOS output	—		—		—		—		—		—		—		—		—		—																			
	N-ch open-drain	2		—		—		—		—		—		—		—		—		—																			
Timer	16-bit timer (TM0)	Number of channels	1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1				
		Function	Interval timer/external event counter/PPG output/pulse width measurement/square-wave output/one-shot pulse output																																				
	16-bit timer (TMx)	Number of channels	—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		
		Function	—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		
	8-bit timer (TMH)	Number of channels	2		—		1		3		3		3		3		3		3		3		3		3		3		3		3		3		3				
		Function	Interval timer/PWM output/carrier generator output/square-wave output																																				
	8-bit timer (TM5)	Number of channels	2		2		3		3		3		3		3		3		3		3		3		3		3		3		3		3		3				
		Function	Interval timer/external event counter/PWM output/square-wave output																																				
	8-bit timer (TM8)	Number of channels	—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—				
		Function	—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—				
Watchdog timer (WDT)		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1					
Watch timer		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—					
Real-time counter (RTC)		—		—		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1					
Serial interface	UART (supporting LIN)	1		—		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1					
	UART	—		1		1		—		—		—		—		—		—		—		—		—		—		—		—		—		—					
	UART/CSI	1		—		—		1		1		1		1		1		1		1		1		1		1		1		1		1		1					
	CSI	—		—		1		—		—		—		—		—		—		—		—		—		—		—		—		—		—					
	Automatic transmit/receive 3-wire CSI	—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—					
	I ² C	1		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—					
A/D converter	Successive approximation	10 bits × 4		10 bits × 4		10 bits × 6		—		10 bits × 6		—		10 bits × 8		10 bits × 8		—		10 bits × 8		10 bits × 8		10 bits × 8		10 bits × 1		10 bits × 8		10 bits × 8		10 bits × 8							
	ΔΣ	—		—		—		—		—		—		—		16 bits × 3		—		—		16 bits × 3		—		24 bits × 3		24 bits × 4		—		—							
Interrupt	External	6		5		8		5		5		6		7		4		5																					
	Internal	14		14		20		17		18		19		20		19		20		21		20		21		22		17		17									
Maximum number of segments displayed in LCD	8 commons	—		—		144		160		224		224		160		288		288		224		—		—		—		—		—		—							
	4 commons	—		—		88		96		128		128		96		160		160		128		—		—		96		160		—		—							
On-chip debug		—		Supported		Supported		Supported		Supported		Supported		Supported		Supported		Supported		Supported		Supported		Supported		Supported		Supported		Supported									
Multiplier/divider		—		16-bit × 16-bit		—		—		—		—		—		—		—		—		—		—		—		—		—		—							
Low-voltage detector (LVI)		*6		4.3 V ±0.2 V																														*11					
Power-on clear (POC)		1.59 V ±0.15 V		3.5 V ±0.2 V																														1.59 V ±0.15 V					
Other		*7		*8		*9		Manchester code generator, buzzer output		Manchester code generator, buzzer output, remote control receiver		Manchester code generator, buzzer output, remote control receiver, clock output		Manchester code generator, buzzer output, remote control receiver, clock output		Manchester code generator, buzzer output, remote control receiver, clock output		Manchester code generator, buzzer output, remote control receiver, clock output		Manchester code generator, buzzer output, remote control receiver, clock output		Manchester code generator, buzzer output, remote control receiver, clock output		Manchester code generator, buzzer output, remote control receiver, clock output		Manchester code generator, buzzer output, remote control receiver, clock output		Manchester code generator, buzzer output, remote control receiver, clock output		Manchester code generator, buzzer output, remote control receiver, clock output									
Operating temperature		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C		T _A = -40 to +85°C									

*1. Under development
 *2. When the constant-current driver is not used
 *3. 0.1 μs (20 MHz; V_{DD} = 2.7 to 5.5 V)/0.4 μs (5 MHz; V_{DD} = 1.8 to 5.5 V) (When the constant-current driver is not used)
 *4. Ceramic/crystal/external clock: 1 to 20 MHz
 *5. 240 kHz ±10% (clock for watchdog timer and 8-bit timer TMH1)
 *6. 1.93/2.08/2.24/2.39/2.55/2.70/2.85/3.01/3.16/3.32/3.47/3.62/3.78/3.93/4.09/4.24 V (default) ±0.1 V. The detected voltage can be input to pins. (Selectable by software)
 *7. Constant-current driver for which stepping up or stepping down can be specified.
 *8. Timer for 10-bit inverter control, real-time output port, Hi-Z output controller
 *9. Timer for 10-bit inverter control, real-time output port, Hi-Z output controller, 16-bit up/down counter, buzzer output
 *10. TM0 and TM5 can be connected in cascade and used as a 24-bit event counter.
 *11. 1.93/2.08/2.24/2.39/2.55/2.70/2.85/3.01/3.16/3.32 V ±0.1 V. The detected voltage can be input to pins. (Selectable by software)
 *12. Power calculation, power quality measurement, digital frequency conversion, buzzer output, remote control transmitter
 Remarks The specifications of products still under development or in planning are subject to change without notice.

Renesas Microcomputer All Flash 78K

Renesas Electronics Corporation Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

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. 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 sheets 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.
13F, 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