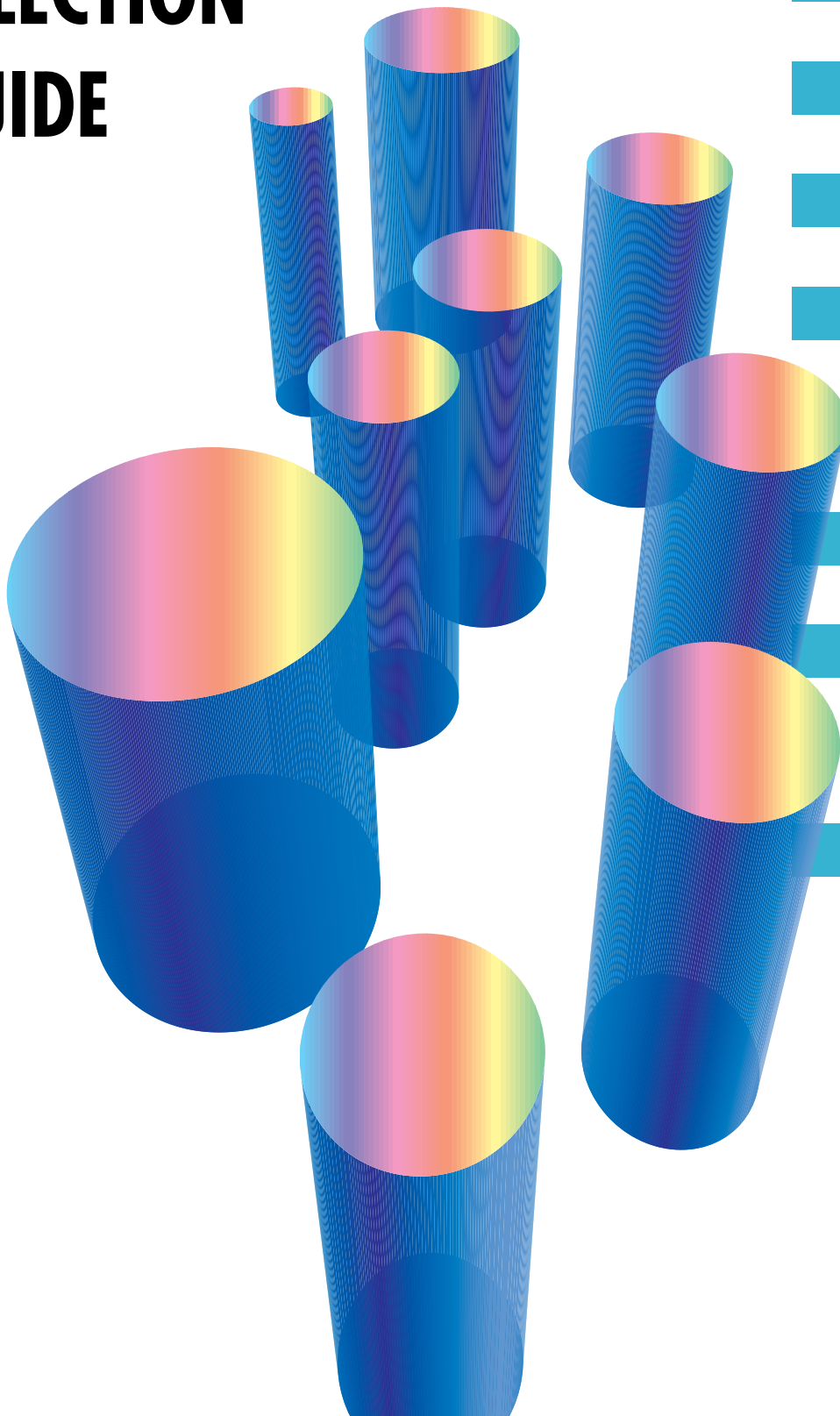


SEMICONDUCTORS SELECTION GUIDE



Microcomputer 1

IC Memory 2

Semi-Custom IC 3

Particular Purpose 4

General Purpose Linear IC 5

Transistor/Diode/Thyristor 6

RF and Microwave Devices 7

Optical Device 8

Index 9

The export of these products from Japan is regulated by the Japanese government. The export of some or all of these products may be prohibited without governmental license. To export or re-export some or all of these products from a country other than Japan may also be prohibited without a license from that country. Please call an NEC sales representative.

Exporting VR Series or equipment that includes these products may require a governmental license from the U.S.A. for some countries because these products utilizes technologies limited by the export control regulations of the U.S.A.

D²BGA, EEPROM, emIC-17K, FIP, FPBGA, IEBus, OCMOS FET, OPENCAD, SIMPLEHOST, VISTASL, V20HL, V30HL, V30MT, V30MX, V30MZ, V30MZC, V800 Series, V810 family, V830 family, V850 family, V821, V831, V832, V851, V852, V853, V854, V850E/MS1, V850/SA1, V850/SB1, V850/SB2, VR Series, VR4100 Series, VR4300 Series, VR4100, VR4101, VR4102, VR4111, VR4120, VR4121, VR4300, VR4305, VR4310, VR5000, VR5432, VR5464, VR10000, VR12000 are the trademarks of NEC Corporation.

JAVA and all the trademarks and logotypes related to JAVA are either trademarks or registered trademarks of Sun Microsystems, Inc. in the United States and/or other countries.

MS-DOS, Microsoft, Windows and WindowsNT are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Rambus, RDRAM and the Rambus Logo are registered trademarks of Rambus Inc.

DirectRambus, DirectRDRAM, RIMM, RModule and RSocket are trademarks of Rambus Inc.

PC/AT and PC DOS are trademarks of IBM Corporation.

Pentium is a trademark of Intel Corporation.

SPARCstation is a trademark of SPARC International, Inc.

TrueSpeech is a trademark of DSP Group, Inc.

Z80 is a trademark of ZILOG.

μBGA is a trademark of Tessera, Inc.

TRON is short for the Realtime Operating System Nucleus.

ITRON is short for Industrial TRON.

- **The information in this document is based on documents issued in February, 1999 at the latest. The information is subject to change without notice. For actual design-in, refer to the latest publications of data sheet, etc., for the most up-to-date specifications of the device.**
 - **Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.**
 - No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.
 - NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.
 - Descriptions of circuits, software, and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software, and information in the design of the customer's equipment shall be done under the full responsibility of the customer. NEC Corporation assumes no responsibility for any losses incurred by the customer or third parties arising from the use of these circuits, software, and information.
 - While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.
 - NEC devices are classified into the following three quality grades:
"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.
 - 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
 - Special: 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, life support systems or medical equipment for life support, etc.
- The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

The μ PD754144, 754244, 754264, 75F4264, 789196AY, 789197AY, 78F9197AY, 789216AY, 789217AY, 78F9217AY, 780973, 78F0974, 780949, 78F0949 are manufactured and sold in accordance with the license agreement with CP8 Transac pertinent to the patent of microcomputers with on-chip EEPROM.

Note that this product can not be used for the IC card (SMART CARD).

Caution: The I²C bus interface circuit is incorporated in the μ PD17709 subseries, 17719 subseries, 178018A subseries, 178048 subseries, 178078 subseries, 178098 subseries, 780018AY subseries, 780024AY subseries, 780034AY subseries, 780058Y subseries, 780078Y subseries, 78018FY subseries, 780308Y subseries, 78054Y subseries, 78058FY subseries, 78064Y subseries, 780701Y subseries, 78078Y subseries, 780833Y subseries, 784038Y subseries, 784216Y subseries, 784218Y subseries, 784225Y subseries, 784928Y subseries, 789197AY subseries, 789217AY subseries, μ PD17001, 17P001, 17003A, 17005, 17P005, 17010, 17P010, 703008Y, 70F3008Y, 703015Y, 703017Y, 70F3017Y, 703033Y, 70F3033Y, 70F3035Y, 78070AY, μ PC1851B, 1853, 1854A, 1857A, 1884, μ PD61882, 6221, 6222 and 72254Y.

Those who use the I²C bus interface can be granted the license below by giving prior notification before ordering the custom code.

Purchase of NEC I²C components conveys a license under the Philips I²C Patent Rights to use these components in an I²C system, provided that the system conforms to the I²C Standard Specification as defined by Philips.

[MEMO]

Table of Contents

1. Microcomputer	1	4. Particular Purpose IC	239
4-Bit Single-Chip Microcontroller	2	DSP	240
• 75XL Series	2	CCD Linear Image Sensor	243
• 17K Series	13	Communication IC	245
• μ PD6133, 6604, 63 Series	20	Mass Storage IC	250
8-Bit Single-Chip Microcontroller	22	Global Positioning System IC	251
• 178K Series	22	Display IC	251
• 78K/0S Series	26	Intelligent Power MOS LSI	254
• 78K/0 Series	41	Power Switch for USB Application	255
16-Bit Single-Chip Microcontroller	80	Image IC	255
• 78K/IV Series	80	MPEG IC	256
32-Bit Microprocessor	97	Audio IC	257
• V810 Family™, V830 Family™	98	TV IC	259
32-Bit Single-Chip Microcontroller	99	Multisync Monitor IC	262
• V850 Family™	99	Digital Image IC	263
64-Bit Microprocessor	105	On-Screen Character Display IC	265
• VR Series™	105	Video Camera IC	265
Development Tools	107	Remote Control IC	266
Middleware	134	Clock IC	266
2. IC Memory	137	Rotary Encoder IC	266
Dynamic RAM	138	A/D Converter IC	267
Dynamic RAM Module	142	D/A Converter IC	267
Static RAM	146	Line Driver Receiver IC	267
Mask ROM	151	5. General Purpose Linear IC	269
COMBO Memory	152	Operational Amplifier	270
Flash MEMORY	152	Comparator	271
MCP (Flash Memory + SRAM)	153	Fixed Output Voltage, 3-Terminal Regulator ...	271
Other	153	Variable Output Voltage Regulator	272
• Field/Line Buffer	153	Regulator with System Reset	272
3. Semi-Custom IC	155	Regulator with ON/OFF Function	272
NEC's ASICs	156	High Precision Reference Voltage	273
0.25 μ m ASIC	166	Switching Regulator Control Circuit	273
Gate Array	172	Functional Block	274
• CMOS Gate Array	176	6. Transistor/Diode/Thyristor	275
• BiCMOS Gate Array	195	Transistor	276
Cell-Based IC	200	• Quick Reference by Package	276
Embedded Array	217	• Quick Reference Table by	
Analog Master	220	Function/Application	286
Mixed Signal ASIC	223		

Field Effect Transistor	292	Infrared Transceivers	378
• Small Signal FET	292	Plastic Fiber Link	378
• Power MOS FET	295	Visible Lasers	380
Transistor with Internal Resistor	309	Fiberoptic Devices	380
Transistor for Array	314	• Lasers (Digital)	380
Transistor Array	315	• Pump Laser	381
Zener Diode	317	• Pulsed Lasers for OTDR	381
Noise Clipping Diode	319	• Detectors	382
Thyristor	321		
		9. Index	383
7. RF and Microwave Devices	323		
IC	324		
• AGC AMP. (μ PCxxxx, μ PGxxxx)	324		
• IQ Modulator/Demodulator (μ PCxxxx)	324		
• Up Converter (μ PCxxxx)	324		
• Prescaler (μ PBxxxx, μ PGxxxx)	325		
• Down Converter (μ PCxxxx)	326		
• PLL Synthesizer (μ PBxxxx)	327		
• Switch (μ PGxxxx)	327		
• Wide Band AMP. (μ PCxxxx, μ PGxxxx) ...	328		
• Driver AMP. (μ PGxxxx)	330		
• Power AMP. (μ PGxxxx, MC-xxxx)	330		
• Transistor Array (μ PAxxx)	330		
• Typical Characteristics	331		
Discrete	335		
• Dual Gate MES/MOS FET	335		
• Low Noise BIP. TR. (2SC, NE)	336		
• Twin TR. (μ PAxxx)	338		
• Low Noise GaAs/HJ FET (NE)	339		
• Power TR./FET (2SC, NE, NEL, NEM, NES, NEZ)	341		
• Cross-reference Table	344		
Application	351		
8. Optical Device	359		
Photocoupler	360		
• Tr. Output Type	360		
• IC Output Type	369		
• Safety Standards Approval List (Made in Japan, as of January 1999)	370		
• Safety Standards Approval List (Made in Taiwan, as of January 1999) ...	372		
OCMOS FET™ (Opto-Coupled MOS FET Relay)	373		
• Safety Standards Approval List (as of January 1999)	377		

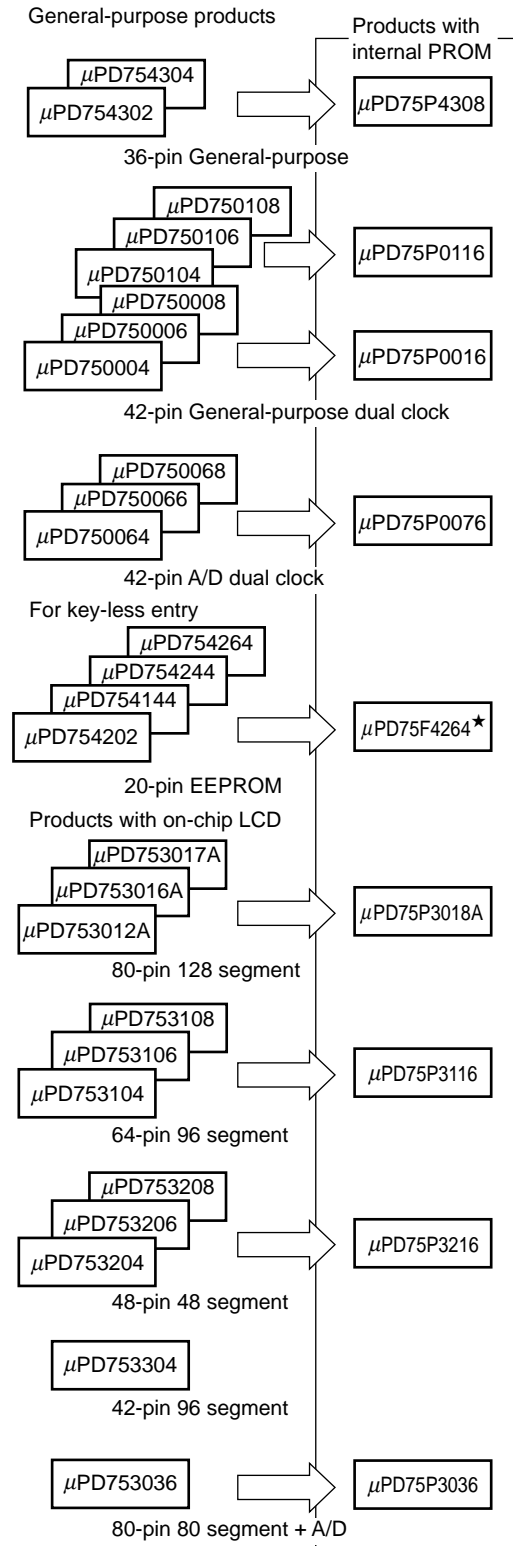
Microcomputer

4-Bit Single-Chip Microcontroller	2
• 75XL Series	2
• 17K Series	13
• μPD6133, 6604, 63 Series	20
8-Bit Single-Chip Microcontroller	22
• 178K Series	22
• 78K/0S Series	26
• 78K/0 Series	41
16-Bit Single-Chip Microcontroller	80
• 78K/IV Series	80
32-Bit Microprocessor	97
• V810 Family™, V830 Family™	98
32-Bit Single-Chip Microcontroller	99
• V850 Family™	99
64-Bit Microprocessor	105
• V_R Series™	105
Development Tools	107
Middleware	134

4-Bit Single-Chip Microcontroller

75XL Series

75XL Series Products Product Evolution



★ : Under development

4-Bit Single-Chip Microcontroller

75XL Series

■ General-Purpose 42-pin (1/2)

Part number		μ PD750004	μ PD750006	μ PD750008	μ PD75P0016
ROM (bytes)		4096 (Mask ROM)	6144 (Mask ROM)	8192 (Mask ROM)	16384 (One-time PROM)
RAM (\times 4 bits)		512			
General-purpose register		(4-bit \times 8) \times 4 banks or (8-bit \times 4) \times 4 banks			
Instruction cycle		<ul style="list-style-type: none"> • 0.95 μs, 1.91 μs, 3.81 μs, 15.3 μs (with 4.19 MHz main system clock) • 0.67 μs, 1.33 μs, 2.67 μs, 10.7 μs (with 6.0 MHz main system clock) • 122 μs (with 32.768 kHz subsystem clock) 			
Minimum instruction execution time		<ul style="list-style-type: none"> • 0.67 μs ($V_{DD} = 2.7$ to 5.5 V) • 0.95 μs ($V_{DD} = 2.2$ to 5.5 V) 			
I/O port	CMOS input	34	8	On-chip pull-up resistors are connectable by software: 7	
	CMOS I/O		18	Can drive LED On-chip pull-up resistors are connectable by software	
	N-ch open-drain I/O		8	Can drive LED, 13 V withstand voltage Pull-up resistors can be incorporated by mask option	Can drive LED 13 V withstand voltage No on-chip pull-up resistors
Timer		4 channels	<ul style="list-style-type: none"> • 8-bit timer/event counter \times 1 channel • Basic interval timer/watchdog timer \times 1 channel • Watch timer \times 1 channel • 8-bit timer \times 1 channel 		
Serial interface		Any of three modes can be used: <ul style="list-style-type: none"> • 3-wire serial I/O mode: MSB/LSB switchable • 2-wire serial I/O mode • SBI mode 			
Vectored interrupt		External: 3, Internal: 4			
Test input		External: 1, Internal: 1			
Clock output (PCL)		<ul style="list-style-type: none"> • Φ, 524 kHz, 262 kHz, 65.5 kHz (with 4.19 MHz main system clock) • Φ, 750 kHz, 375 kHz, 93.8 kHz (with 6.0 MHz main system clock) 			
Buzzer output (BUZ)		<ul style="list-style-type: none"> • 2 kHz, 4 kHz, 32 kHz (with 4.19 MHz main system clock, or 32.768 kHz subsystem clock) • 2.93 kHz, 5.86 kHz, 46.9 kHz (with 6.0 MHz main system clock) 			
Instruction set		<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 			
Power supply voltage		$V_{DD} = 2.2$ to 5.5 V ($V_{DD} = 1.8$ to 5.5 V with external clock)			
Package		<ul style="list-style-type: none"> • 42-pin plastic shrink DIP (600 mil) • 44-pin plastic QFP (10 \times 10 mm) 			
Development tools		Assembler, IE controller, device file, in-circuit emulator			
Applications		VCRs, CD players, cordless telephones, radios, cameras, home electric appliances, etc.			

4-Bit Single-Chip Microcontroller

75XL Series

■ **General-Purpose 42-pin (2/2)**

Part number		μ PD750104	μ PD750106	μ PD750108	μ PD75P0116
ROM (bytes)		4096 (Mask ROM)	6144 (Mask ROM)	8192 (Mask ROM)	16384 (One-time PROM)
RAM (\times 4 bits)		512			
General-purpose register		(4-bit \times 8) \times 4 banks or (8-bit \times 4) \times 4 banks			
Instruction cycle		<ul style="list-style-type: none"> • 2 μs, 4 μs, 8 μs, 32 μs (with RC 2.0 MHz main system clock) • 4 μs, 8 μs, 16 μs, 64 μs (with RC 1.0 MHz main system clock) • 122 μs (with 32.768 kHz subsystem clock) 			
Minimum instruction execution time		2 μ s ($V_{DD} = 1.8$ to 5.5 V)			
I/O port	CMOS input	34	8	On-chip pull-up resistors are connectable by software: 7	
	CMOS I/O		18	Can drive LED On-chip pull-up resistors are connectable by software	
	N-ch open-drain I/O		8	Can drive LED, 13 V withstand voltage Pull-up resistors can be incorporated by mask option	Can drive LED 13 V withstand voltage No on-chip pull-up resistors
Timer		4 channels	<ul style="list-style-type: none"> • 8-bit timer/event counter \times 1 channel • Basic interval timer/watchdog timer \times 1 channel • Watch timer \times 1 channel • 8-bit timer \times 1 channel 		
Serial interface		Any of three modes can be used: <ul style="list-style-type: none"> • 3-wire serial I/O mode: MSB/LSB switchable • 2-wire serial I/O mode • SBI mode 			
Vectored interrupt		External: 3, Internal: 4			
Test input		External: 1, Internal: 1			
Clock output (PCL)		Φ , 125 kHz, 62.5 kHz, 15.6 kHz (with 1.0 MHz main system clock)			
Buzzer output (BUZ)		<ul style="list-style-type: none"> • 2 kHz, 4 kHz, 32 kHz (with 32.768 kHz subsystem clock) • 0.49 kHz, 0.98 kHz, 7.81 kHz (with 1.0 MHz main system clock) 			
Instruction set		<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 			
Power supply voltage		$V_{DD} = 1.8$ to 5.5 V			
Package		<ul style="list-style-type: none"> • 42-pin plastic shrink DIP (600 mil) • 44-pin plastic QFP (10 \times 10 mm) 			
Development tools		Assembler, IE controller, device file, in-circuit emulator			
Applications		VCRs, CD players, cordless telephones, radios, cameras, home electric appliances, etc.			

4-Bit Single-Chip Microcontroller

75XL Series

■ General-Purpose 42-pin (A/D)

Part number		μ PD750064	μ PD750066	μ PD750068	μ PD75P0076
ROM (bytes)		4096 (Mask ROM)	6144 (Mask ROM)	8192 (Mask ROM)	16384 (One-time PROM)
RAM (\times 4 bits)		512			
General-purpose register		(4-bit \times 8) \times 4 banks or (8-bit \times 4) \times 4 banks			
Instruction cycle		<ul style="list-style-type: none"> • 0.95 μs, 1.91 μs, 3.81 μs, 15.3 μs (with 4.19 MHz main system clock) • 0.67 μs, 1.33 μs, 2.67 μs, 10.7 μs (with 6.0 MHz main system clock) • 122 μs (with 32.768 kHz subsystem clock) 			
Minimum instruction execution time		<ul style="list-style-type: none"> • 0.67 μs (V_{DD} = 2.7 to 5.5 V) • 0.95 μs (V_{DD} = 1.8 to 5.5 V) 			
I/O port	CMOS input	32	12	On-chip pull-up resistors are connectable by software: 7 Also used for analog input pins: 4	
	CMOS I/O		12	Can drive LED On-chip pull-up resistors are connectable by software Also used for analog input pins: 4	
	N-ch open-drain I/O		8	Can drive LED, 13 V withstand voltage Pull-up resistors can be incorporated by mask option	Can drive LED 13 V withstand voltage No on-chip pull-up resistors
Timer		4 channels		<ul style="list-style-type: none"> • 8-bit timer/event counter: 2 channels (Usable as 16-bit timer/event counter) • Basic interval timer/watchdog timer: 1 channel • Watch timer: 1 channel 	
Serial interface		Any of two modes can be used: <ul style="list-style-type: none"> • 3-wire serial I/O mode (MSB/LSB switchable) • 2-wire serial I/O mode 			
A/D converter		8-bit resolution \times 8 channels			
Vectored interrupt		External: 3, Internal: 4			
Test input		External: 1, Internal: 1			
Clock output (PCL)		<ul style="list-style-type: none"> • Φ, 1.05 MHz, 262 kHz, 65.5 kHz (with 4.19 MHz main system clock) • Φ, 1.5 MHz, 375 kHz, 93.8 kHz (with 6.0 MHz main system clock) 			
Buzzer output (BUZ)		<ul style="list-style-type: none"> • 2 kHz, 4 kHz, 32 kHz (with 4.19 MHz main system clock, or 32.768 kHz subsystem clock) • 2.93 kHz, 5.86 kHz, 46.9 kHz (with 6.0 MHz main system clock) 			
Instruction set		<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 			
Power supply voltage		V_{DD} = 1.8 to 5.5 V			
Package		<ul style="list-style-type: none"> • 42-pin plastic shrink DIP (600 mil, 1.778-mm pitch) • 42-pin plastic shrink SOP (375 mil, 0.8-mm pitch) 			
Development tools		Assembler, IE controller, device file, in-circuit emulator			
Applications		Cordless telephones, AV equipment, home electric appliances, OA equipment, health equipment, meters, gas tables, etc.			

4-Bit Single-Chip Microcontroller

75XL Series

■ **General-Purpose 36-pin**

Part number		μ PD754302	μ PD754304	μ PD75P4308
ROM (bytes)		2048 (Mask ROM)	4096 (Mask ROM)	8192 (One-time PROM)
RAM (\times 4 bits)		256		
General-purpose register		(4-bit \times 8) \times 4 banks or (8-bit \times 4) \times 4 banks		
Instruction cycle		<ul style="list-style-type: none"> • 0.95 μs, 1.91 μs, 3.81 μs, 15.3 μs (with 4.19 MHz main system clock) • 0.67 μs, 1.33 μs, 2.67 μs, 10.7 μs (with 6.0 MHz main system clock) 		
Minimum instruction execution time		<ul style="list-style-type: none"> • 0.67 μs ($V_{DD} = 2.7$ to 5.5 V) • 0.95 μs ($V_{DD} = 1.8$ to 5.5 V) 		
I/O port	CMOS input	30	8	On-chip pull-up resistors are connectable by software: 7
	CMOS I/O		18	Can drive LED On-chip pull-up resistors are connectable by software
	N-ch open-drain I/O		4	Can drive LED, 13 V withstand voltage Pull-up resistors can be incorporated by mask option
Timer		3 channels	8-bit timer/event counter \times 2 channels (usable as 16-bit timer/event counter) Basic interval timer/watchdog timer \times 1 channel	
Serial interface		Either of two modes can be used: <ul style="list-style-type: none"> • 3-wire serial I/O mode: MSB/LSB switchable • 2-wire serial I/O mode 		
Vectored interrupt		External: 3, Internal: 4		
Test input		External: 1		
Clock output (PCL)		<ul style="list-style-type: none"> • Φ, 524 kHz, 262 kHz, 65.5 kHz (with 4.19 MHz main system clock) • Φ, 750 kHz, 375 kHz, 93.8 kHz (with 6.0 MHz main system clock) 		
Instruction set		<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 		
Power supply voltage		$V_{DD} = 1.8$ to 5.5 V		
Package		• 36-pin plastic shrink SOP (300 mil, 0.8-mm pitch)		
Development tools		Assembler, IE controller, device file, in-circuit emulator		
Applications		Cordless telephones, TVs, VCRs, audio equipment, home electric appliances, OA equipment, etc.		

4-Bit Single-Chip Microcontroller

75XL Series

■ Keyless Entry

Part number		μ PD754202	μ PD754144	μ PD754244	μ PD754264	μ PD75F4264*
ROM (bytes)		2048 (Mask ROM)	4096 (Mask ROM)		4096 (Flash memory)	
RAM (\times 4 bits)		128				
EEPROM™ (bytes)		—	16		32	
General-purpose register		(4-bit \times 8) \times 4 banks or (8-bit \times 4) \times 4 banks				
Instruction cycle		<ul style="list-style-type: none"> • 0.95 μs, 1.91 μs, 3.81 μs, 15.3 μs (with 4.19 MHz System clock) • 0.67 μs, 1.33 μs, 2.67 μs, 10.7 μs (with 6.0 MHz System clock) 	<ul style="list-style-type: none"> • 4 μs, 8 μs, 16 μs, 64 μs (with 1 MHz system clock) 	<ul style="list-style-type: none"> • 0.95 μs, 1.91 μs, 3.81 μs, 15.3 μs (with 4.19 MHz system clock) • 0.67 μs, 1.33 μs, 2.67 μs, 10.7 μs (with 6.0 MHz system clock) 		
Minimum instruction execution time		<ul style="list-style-type: none"> • 0.67 μs (V_{DD} = 2.7 to 6.0 V) • 0.95 μs (V_{DD} = 1.8 to 6.0 V) 	2 μ s (V_{DD} = 1.8 to 6.0 V)	<ul style="list-style-type: none"> • 0.67 μs (V_{DD} = 2.7 to 6.0 V) • 0.95 μs (V_{DD} = 1.8 to 6.0 V) 		
I/O port	CMOS input	13	4	Pull-up resistors can be incorporated by mask option		No on-chip pull-up resistors
	CMOS I/O		9	Can drive LED On-chip pull-up resistors are connectable by software		
System clock oscillator		Crystal/ceramic oscillator	RC oscillator (external resistors and capacitors)	Crystal/ceramic oscillator		
Timer		4 channels	<ul style="list-style-type: none"> • 8-bit timer counter: 3 channels (Usable as 16-bit timer counter or remote controller signal carrier generator) • Basic interval timer/watchdog timer: 1 channel 			
Programmable threshold port		—	4-bit resolution \times 2		—	
A/D converter		—			8-bit resolution \times 2	
Others		Key return reset function				
Vectored interrupt		External: 1, internal: 5				
Test input		External: 1				
Instruction set		<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 				
Power supply voltage		V_{DD} = 1.8 to 6.0 V				
Package		<ul style="list-style-type: none"> • 20-pin plastic SOP (300 mil, 1.27-mm pitch) • 20-pin plastic shrink SOP (300 mil, 0.65-mm pitch) 			20-pin plastic SOP (300 mil, 1.27-mm pitch)	
Development tools		Assembler, IE controller, device file, in-circuit emulator				
Applications		Keyless entries, data carriers				

* : Under development

4-Bit Single-Chip Microcontroller

75XL Series

■ LCD-Driver 80-pin

Part number		μ PD753012A	μ PD753016A	μ PD753017A	μ PD75P3018A
ROM (bytes)		12288 (Mask ROM)	16384 (Mask ROM)	24576 (Mask ROM)	32768 (One-time PROM)
RAM (\times 4 bits)		1024			
General-purpose register		(4-bit \times 8) \times 4 banks or (8-bit \times 4) \times 4 banks			
Instruction cycle		<ul style="list-style-type: none"> • 0.95 μs, 1.91 μs, 3.81 μs, 15.3 μs (with 4.19 MHz main system clock) • 0.67 μs, 1.33 μs, 2.67 μs, 10.7 μs (with 6.0 MHz main system clock) • 122 μs (with 32.768 kHz subsystem clock) 			
Minimum instruction execution time		<ul style="list-style-type: none"> • 0.67 μs ($V_{DD} = 2.7$ to 5.5 V) • 0.95 μs ($V_{DD} = 1.8$ to 5.5 V) 			
I/O port	CMOS input	40	8	On-chip pull-up resistors are connectable by software: 7	
	CMOS I/O		16	Can drive LED On-chip pull-up resistors are connectable by software	
	CMOS I/O		8	Also used for segment pins	
	N-ch open-drain I/O		8	Can drive LED, 13 V withstand voltage Pull-up resistors can be incorporated by mask option	Can drive LED 13 V withstand voltage No on-chip pull-up resistors
LCD controller/driver		<ul style="list-style-type: none"> • Number of segments selectable: 24/28/32 segments (switchable to CMOS ports in multiples of 4: 8 maximum) • Selectable display mode: Static, 1/2 duty (1/2 bias), 1/3 duty (1/2 bias), 1/3 duty (1/3 bias), 1/4 duty (1/3 bias) 			
		Voltage divider resistors for LCD drive can be incorporated by mask option		No on-chip voltage divider resistors for LCD drive	
Timer		5 channels	<ul style="list-style-type: none"> • 8-bit timer/event counter: 3 channels (usable as 16-bit timer/event counter or remote-controller signal carrier generator) • Basic interval timer/watchdog timer \times 1 channel • Watch timer \times 1 channel 		
Serial interface		Any of three modes can be used: <ul style="list-style-type: none"> • 3-wire serial I/O mode: MSB/LSB switchable • 2-wire serial I/O mode • SBI mode 			
Vectored interrupt		External: 3, Internal: 5			
Test input		External: 1, Internal: 1			
Clock output (PCL)		<ul style="list-style-type: none"> • Φ, 524 kHz, 262 kHz, 65.5 kHz (with 4.19 MHz main system clock) • Φ, 750 kHz, 375 kHz, 93.8 kHz (with 6.0 MHz main system clock) 			
Buzzer output (BUZ)		<ul style="list-style-type: none"> • 2 kHz, 4 kHz, 32 kHz (with 4.19 MHz main system clock, or with 32.768 kHz subsystem clock) • 2.93 kHz, 5.86 kHz, 46.9 kHz (with 6.0 MHz main system clock) 			
Instruction set		<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 			
Power supply voltage		$V_{DD} = 1.8$ to 5.5 V			
Package		<ul style="list-style-type: none"> • 80-pin plastic QFP (14 \times 14 mm) • 80-pin plastic TQFP (fine pitch) (12 \times 12 mm) 			
Development tools		Assembler, IE controller, device file, in-circuit emulator			
Applications		Camcorders, CD players, telephones, cameras, pagers, remote controllers, etc.			

4-Bit Single-Chip Microcontroller

75XL Series

■ LCD-Driver 64-pin

Part number		μ PD753104	μ PD753106	μ PD753108	μ PD75P3116
ROM (bytes)		4096 (Mask ROM)	6144 (Mask ROM)	8192 (Mask ROM)	16384 (One-time PROM)
RAM (\times 4 bits)		512			
General-purpose register		(4-bit \times 8) \times 4 banks or (8-bit \times 4) \times 4 banks			
Instruction cycle		<ul style="list-style-type: none"> • 0.95 μs, 1.91 μs, 3.81 μs, 15.3 μs (with 4.19 MHz main system clock) • 0.67 μs, 1.33 μs, 2.67 μs, 10.7 μs (with 6.0 MHz main system clock) • 122 μs (with 32.768 kHz subsystem clock) 			
Minimum instruction execution time		<ul style="list-style-type: none"> • 0.67 μs ($V_{DD} = 2.7$ to 5.5 V) • 0.95 μs ($V_{DD} = 1.8$ to 5.5 V) 			
I/O port	CMOS input	32	8	On-chip pull-up resistors are connectable by software: 7	
	CMOS I/O		12	Can drive LED On-chip pull-up resistors are connectable by software	
	CMOS I/O		8	Also used for segment pins	
	N-ch open-drain I/O		4	Can drive LED, 13 V withstand voltage Pull-up resistors can be incorporated by mask option	Can drive LED 13 V withstand voltage No on-chip pull-up resistors
LCD controller/driver		<ul style="list-style-type: none"> • Number of segments selectable: 16/20/24 segments (switchable to CMOS ports in multiples of 4: 8 maximum) • Selectable display mode: Static, 1/2 duty (1/2 bias), 1/3 duty (1/2 bias), 1/3 duty (1/3 bias), 1/4 duty (1/3 bias) 			
		Voltage divider resistors for LCD drive can be incorporated by mask option		No on-chip voltage divider resistors for LCD drive	
Timer		5 channels	<ul style="list-style-type: none"> • 8-bit timer/event counter: 3 channels (usable as 16-bit timer/event counter or remote-controller signal carrier generator) • Basic interval timer/watchdog timer \times 1 channel • Watch timer \times 1 channel 		
Serial interface		Any of three modes can be used: <ul style="list-style-type: none"> • 3-wire serial I/O mode: MSB/LSB switchable • 2-wire serial I/O mode • SBI mode 			
Vectored interrupt		External: 3, Internal: 5			
Test input		External: 1, Internal: 1			
Clock output (PCL)		<ul style="list-style-type: none"> • Φ, 524 kHz, 262 kHz, 65.5 kHz (with 4.19 MHz main system clock) • Φ, 750 kHz, 375 kHz, 93.8 kHz (with 6.0 MHz main system clock) 			
Buzzer output (BUZ)		<ul style="list-style-type: none"> • 2 kHz, 4 kHz, 32 kHz (with 4.19 MHz main system clock, or with 32.768 kHz subsystem clock) • 2.93 kHz, 5.86 kHz, 46.9 kHz (with 6.0 MHz main system clock) 			
Instruction set		<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 			
Power supply voltage		$V_{DD} = 1.8$ to 5.5 V			
Package		<ul style="list-style-type: none"> • 64-pin plastic QFP (14 \times 14 mm) • 64-pin plastic TQFP (12 \times 12 mm) 			
Development tools		Assembler, IE controller, device file, in-circuit emulator			
Applications		Telephones, cameras, sphygmomanometers, gas meters, electronic scales, remote controllers, etc.			

4-Bit Single-Chip Microcontroller

75XL Series

■ LCD-Driver 48-pin

Part number		μ PD753204	μ PD753206	μ PD753208	μ PD75P3216
ROM (bytes)		4096 (Mask ROM)	6144 (Mask ROM)	8192 (Mask ROM)	16384 (One-time PROM)
RAM (\times 4 bits)		512			
General-purpose register		(4-bit \times 8) \times 4 banks or (8-bit \times 4) \times 4 banks			
Instruction cycle		<ul style="list-style-type: none"> • 0.95 μs, 1.91 μs, 3.81 μs, 15.3 μs (with 4.19 MHz main system clock) • 0.67 μs, 1.33 μs, 2.67 μs, 10.7 μs (with 6.0 MHz main system clock) 			
Minimum instruction execution time		<ul style="list-style-type: none"> • 0.67 μs ($V_{DD} = 2.7$ to 5.5 V) • 0.95 μs ($V_{DD} = 1.8$ to 5.5 V) 			
I/O port	CMOS input	30	6	On-chip pull-up resistors are connectable by software: 5	
	CMOS I/O		12	Can drive LED On-chip pull-up resistors are connectable by software	
	CMOS I/O		8	Also used for segment pins On-chip pull-up resistors are connectable by software	
	N-ch open-drain I/O		4	Can drive LED, 13 V withstand voltage Pull-up resistors can be incorporated by mask option	Can drive LED 13 V withstand voltage No on-chip pull-up resistors
LCD controller/driver		<ul style="list-style-type: none"> • Number of segments selectable: 4/8/12 segments • Selectable display mode: Static, 1/2 duty (1/2 bias), 1/3 duty (1/2 bias), 1/3 duty (1/3 bias), 1/4 duty (1/3 bias) 			
		Voltage divider resistors for LCD drive can be incorporated by mask option		No on-chip voltage divider resistors for LCD drive	
Timer		5 channels	<ul style="list-style-type: none"> • 8-bit timer/event counter \times 1 channel • Basic interval timer/watchdog timer \times 1 channel • Watch timer \times 1 channel • 8-bit timer \times 2 channels (usable as 16-bit timer or remote controller signal carrier generator) 		
Serial interface		Any of three modes can be used: <ul style="list-style-type: none"> • 3-wire serial I/O mode: MSB/LSB switchable • 2-wire serial I/O mode • SBI mode 			
Vectored interrupt		External: 2, Internal: 5			
Test input		External: 1, Internal: 1			
Clock output (PCL)		<ul style="list-style-type: none"> • Φ, 524 kHz, 262 kHz, 65.5 kHz (with 4.19 MHz main system clock) • Φ, 750 kHz, 375 kHz, 93.8 kHz (with 6.0 MHz main system clock) 			
Buzzer output (BUZ)		<ul style="list-style-type: none"> • 2 kHz, 4 kHz, 32 kHz (with 4.19 MHz main system clock) • 2.93 kHz, 5.86 kHz, 46.9 kHz (with 6.0 MHz main system clock) 			
Instruction set		<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 			
Power supply voltage		$V_{DD} = 1.8$ to 5.5 V			
Package		48-pin plastic shrink SOP (375 mil, 0.65-mm pitch)			
Development tools		Assembler, IE controller, device file, in-circuit emulator			
Applications		Remote controllers, cameras, sphygmomanometers, CD radio cassette players, gas meters, etc.			

4-Bit Single-Chip Microcontroller

75XL Series

■ LCD-Driver 42-pin

Part number	μPD753304		
ROM (bytes)	4096 (Mask ROM)		
RAM (× 4 bits)	256		
General-purpose register	(4-bit × 8) × 4 banks or (8-bit × 4) × 4 banks		
Instruction cycle	1.1 μs, 2.2 μs, 4.4 μs, 17.8 μs (with 3.6 MHz main system clock, RC oscillator)		
	85.1 μs (with 47 kHz subsystem clock, RC oscillator)		
Minimum instruction execution time	<ul style="list-style-type: none"> • 0.67 μs (V_{DD} = 4.5 to 5.5 V) • 0.8 μs (V_{DD} = 2.5 to 5.5 V) 		
I/O port	CMOS I/O	12	8 On-chip pull-up resistors are connectable by software: 4
	CMOS I/O		4 Also used for segment pins
LCD controller/driver	<ul style="list-style-type: none"> • Number of segments selectable: 20/24 segments (switchable to CMOS I/O ports in multiples of 4 : 4) • Selectable display mode: Static, 1/2 duty (1/2 bias), 1/3 duty (1/2 bias), 1/3 duty (1/3 bias), 1/4 duty (1/3 bias) 		
	On-chip voltage divider resistors for LCD drive		
Timer	3 channels	<ul style="list-style-type: none"> • 8-bit timer: 1 channel • Basic interval timer/watchdog timer: 1 channel • Watch timer: 1 channel 	
Vectored interrupt	External: 1, Internal: 2		
Test input	Internal: 1		
Clock output (PCL)	Φ, 3.6 MHz, 450 kHz, 225 kHz (with 3.6 MHz main system clock)		
Buzzer output (BUZ)	<ul style="list-style-type: none"> • 2.94 kHz, 5.88 kHz, 47 kHz (with 47 kHz subsystem clock) • 1.76 kHz, 3.52 kHz, 28.13 kHz (with 3.6 MHz main system clock) 		
Instruction set	<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 		
Power supply voltage	V _{DD} = 2.5 to 5.5 V		
Operating ambient temperature	T _A = -10 to +60°C		
Package	<ul style="list-style-type: none"> • 42-pin pellet/wafer • 42-pin ceramic shrink DIP (600 mil) (ES only) 		
Development tools	Assembler, IE controller, device file, in-circuit emulator		
Applications	Small-size LCD displays, etc.		

4-Bit Single-Chip Microcontroller

75XL Series

■ LCD-Driver 80-pin (A/D)

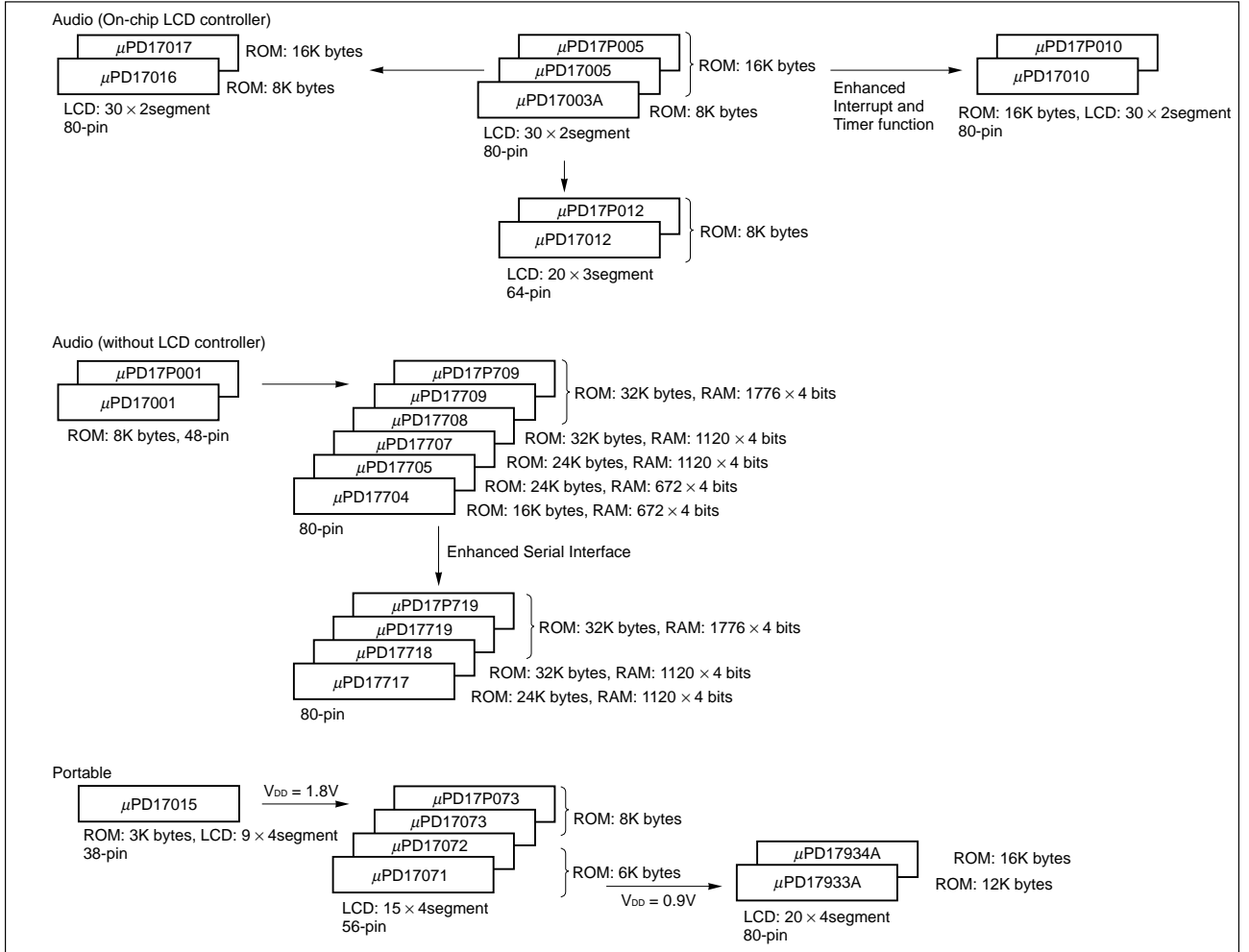
Part number		μ PD753036		μ PD75P3036	
ROM (bytes)		16384 (Mask ROM)		16384 (One-time PROM)	
RAM (\times 4 bits)		768			
General-purpose register		(4-bit \times 8) \times 4 banks or (8-bit \times 4) \times 4 banks			
Instruction cycle		<ul style="list-style-type: none"> • 0.95 μs, 1.91 μs, 3.81 μs, 15.3 μs (with 4.19 MHz main system clock) • 0.67 μs, 1.33 μs, 2.67 μs, 10.7 μs (with 6.0 MHz main system clock) • 122 μs (with 32.768 kHz subsystem clock) 			
Minimum instruction execution time		<ul style="list-style-type: none"> • 0.67 μs ($V_{DD} = 2.7$ to 5.5 V) • 0.95 μs ($V_{DD} = 1.8$ to 5.5 V) 			
I/O port	CMOS input	44	8	On-chip pull-up resistors are connectable by software: 7	
	CMOS I/O		20	Can drive LED On-chip pull-up resistors are connectable by software	
	Bit-port output		8	Also used for segment pins	
	N-ch open-drain I/O		8	Can drive LED 13 V withstand voltage Pull-up resistors can be incorporated by mask option	Can drive LED, 13 V withstand voltage No on-chip pull-up resistors
LCD controller/driver		<ul style="list-style-type: none"> • Number of segments selectable: 12/16/20 segments (switchable to bit-port output in multiples of 4: 8 maximum) • Selectable display mode: Static, 1/2 duty (1/2 bias), 1/3 duty (1/2 bias), 1/3 duty (1/3 bias), 1/4 duty (1/3 bias) 			
		Voltage divider resistors for LCD drive can be incorporated by mask option		No on-chip voltage divider resistors for LCD drive	
Timer		5 channels	<ul style="list-style-type: none"> • 8-bit timer/event counter: 3 channels (Usable as 16-bit timer/event counter or remote controller signal carrier generator) • Basic interval timer/watchdog timer: 1 channel • Watch timer: 1 channel 		
Serial interface		Any of three modes can be used: <ul style="list-style-type: none"> • 3-wire serial I/O mode (MSB/LSB switchable) • 2-wire serial I/O mode • SBI mode 			
A/D converter		8-bit resolution \times 8 channels			
Vectored interrupt		External: 3, Internal: 5			
Test input		External: 1, Internal: 1			
Clock output (PCL)		<ul style="list-style-type: none"> • Φ, 524 kHz, 262 kHz, 65.5 kHz (with 4.19 MHz main system clock) • Φ, 750 kHz, 375 kHz, 93.8 kHz (with 6.0 MHz main system clock) 			
Buzzer output (BUZ)		<ul style="list-style-type: none"> • 2 kHz, 4 kHz, 32 kHz (with 4.19 MHz main system clock, or 32.768 kHz subsystem clock) • 2.93 kHz, 5.86 kHz, 46.9 kHz (with 6.0 MHz main system clock) 			
Instruction set		<ul style="list-style-type: none"> • Bit data set/reset/test/boolean operations • 4-/8-bit data transfer/operations/increment and decrement/comparison 			
Power supply voltage		$V_{DD} = 1.8$ to 5.5 V			
Package		<ul style="list-style-type: none"> • 80-pin plastic QFP (14 \times 14 mm) • 80-pin plastic TQFP (fine pitch) (12 \times 12 mm) 			
Development tools		Assembler, IE controller, device file, in-circuit emulator			
Applications		Cordless telephones, AV equipment, home electric appliances, OA equipment, health equipment, meters, gas tables, etc.			

4-Bit Single-Chip Microcontroller

17K Series

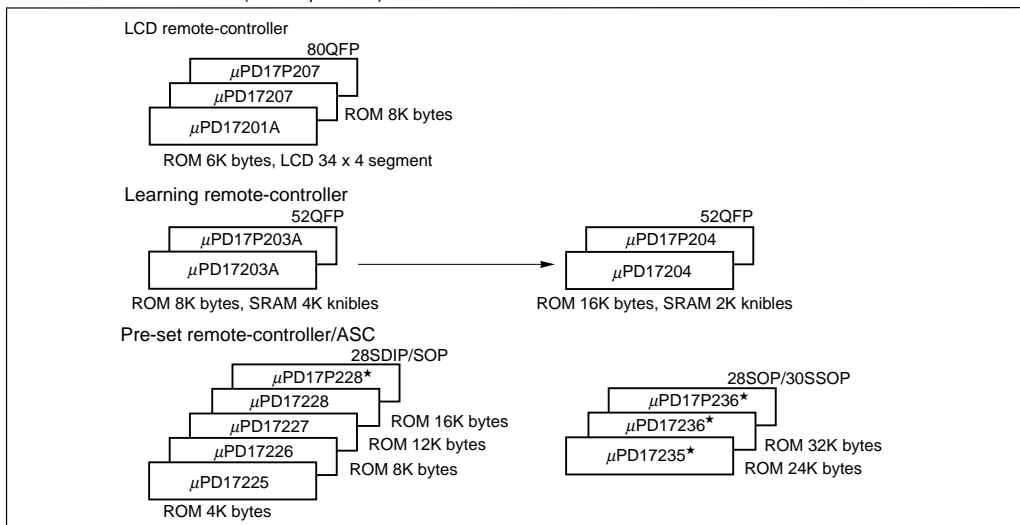
17K Series Product Evolution

DTS



★: Under development

Remote control transmitter (2.2 V operation)



★: Under development

4-Bit Single-Chip Microcontroller

17K Series

■ Audio (On-Chip LCD Controller)

Part number	μ PD17003A	μ PD17005	μ PD17010	μ PD17016	μ PD17017	μ PD17012
Main application	High-end tuner, automotive radio					
ROM size	3836 × 16 bits	7932 × 16 bits	7932 × 16 bits	3836 × 16 bits	7932 × 16 bits	4096 × 16 bits
RAM size	320 × 4 bits	432 × 4 bits	432 × 4 bits	320 × 4 bits	432 × 4 bits	316 × 4 bits
Display	On-chip LCD driver Segment signal: 30 Common signal: 2					On-chip LCD driver Segment signal: 20 Common signal: 3
Input port	8					
Output port	9 (+30)			9 (+8)		8 (+20)
I/O port	16					14
D/A converter	4			2		2
A/D converter	6			6		2
Modulo timer	—					1
Power supply voltage	+5 V ±10%					
Crystal	4.5 MHz					
PLL reference frequency	1, 1.25, 2.5, 3, 5, 6.25, 9, 10, 12.5, 25, 50, 100 kHz					
Applicable prescaler	On-chip (150 MHz)					On-chip (250 MHz)
Package	80-pin plastic QFP					64-pin plastic QFP
One-time PROM product	μ PD17P005	μ PD17P010	μ PD17P005	μ PD17P005	μ PD17P012	μ PD17P012
Development tools	Assembler, C-like compiler, device file, integrated debugger, in-circuit emulator					

4-Bit Single-Chip Microcontroller

17K Series

■ Audio (without LCD Controller) (1/2)

Subseries name	–	μ PD17709 Subseries				
Part number	μ PD17001	μ PD17704	μ PD17705	μ PD17707	μ PD17708	μ PD17709
Main application	High-end tuner, automotive radio					
ROM size	3836 × 16 bits	8192 × 16 bits	12288 × 16 bits		16384 × 16 bits	
RAM size	224 × 4 bits	672 × 4 bits		1120 × 4 bits		1776 × 4 bits
Input port	8	12				
Output port	12	4				
I/O port	12	46				
D/A converter	4	3				
A/D converter	6	6				
Modulo timer	–	4 (Used also PWM: 1)				
Power supply voltage	+5 V ±10%					
Crystal	4.5 MHz					
PLL reference frequency	*	1, 1.25, 2.5, 3, 5, 6.25, 9, 10, 12.5, 18, 20, 25, 50 kHz				
Applicable prescaler	On-chip (130 MHz)					
Package	48-pin plastic QFP	80-pin plastic QFP				
One-time PROM product	μ PD17P001	μ PD17P709				
Development tools	Assembler, C-like compiler, device file, integrated debugger, in-circuit emulator					

*: 1, 1.25, 2.5, 3, 5, 6.25, 9, 10, 12.5, 25, 50, 100 kHz

4-Bit Single-Chip Microcontroller

17K Series

■ Audio (without LCD Controller) (2/2)

Subseries name	μ PD17719 Subseries		
Part number	μ PD17717	μ PD17718	μ PD17719
Main application	High-end tuner, automotive radio		
ROM size	12288 \times 16 bits	16384 \times 16 bits	
RAM size	1120 \times 4 bits		1776 \times 4 bits
Input port	12		
Output port	4		
I/O port	46		
D/A converter	3		
A/D converter	6		
Serial interface	2-wire/3-wire/SBI/I ² C bus (selectable): 1 channel 3-wire/UART (selectable): 1 channel		
Modulo timer	4 (Used also PWM: 1)		
Power supply voltage	+5 V \pm 10%		
Crystal	4.5 MHz		
PLL reference frequency	1, 1.25, 2.5, 3, 5, 6.25, 9, 10, 12.5, 18, 20, 25, 50 kHz		
Applicable prescaler	On-chip (130 MHz)		
Package	80-pin plastic QFP		
One-time PROM product	μ PD17P719		
Development tools	Assembler, C-like compiler, device file, integrated debugger, in-circuit emulator		

4-Bit Single-Chip Microcontroller

17K Series

■ Portable

Part number	μ PD17015	μ PD17071	μ PD17072	μ PD17073	μ PD17933A	μ PD17934A
Main application	Portable radio					
ROM size	1528 × 16 bits	3072 × 16 bits		4096 × 16 bits	6144 × 16 bits	8192 × 16 bits
RAM size	97 × 4 bits	174 × 4 bits			448 × 4 bits	
Display	On-chip LCD driver Segment signal: 9 Common signal: 4	On-chip LCD driver Segment signal: 15 Common signal: 4			On-chip LCD driver Segment signal: 20 Common signal: 4	
Input port	3	4			11	
Output port	7	9			6	
I/O port	2	8			20	
A/D converter	—		2		3	
Power supply voltage	1.7 to 2.6 V (when PLL is stopped) 1.8 to 3.6 V (when PLL is operating)	1.8 to 3.6 V			0.9 to 1.8 V	
Crystal	75 kHz					
PLL reference frequency	1, 3, 5, 12.5 kHz	1, 3, 5, 6.25, 12.5, 25 kHz				
Applicable prescaler	On-chip (220 MHz)	On-chip (230 MHz)				
Package	38-pin plastic shrink SOP	56-pin plastic QFP	56-pin plastic QFP 64-pin plastic TQFP		80-pin plastic TQFP	
One-time PROM product	—	μ PD17P073			—	
Development tools	Assembler, C-like compiler, device file, integrated debugger, in-circuit emulator					

4-Bit Single-Chip Microcontroller

17K Series

■ LCD Remote-Controller, Learning Remote-Controller

Part number	μ PD17201A	μ PD17207	μ PD17203A	μ PD17204
Main application	Infrared remote controller with LCD display		Infrared remote controller for learning	
ROM size	3072 × 16 bits	4096 × 16 bits	4096 × 16 bits	7936 × 16 bits
RAM size	336 × 4 bits		336 × 4 bits	
Static RAM	—	—	4096 × 4 bits	2048 × 4 bits
LCD controller/driver	136 segments maximum		None	
Carrier generator for infrared remote-controller signal	On-chip		On-chip	
Infrared remote-controller signal receiver preamplifier	None		On-chip	
I/O port	19		28	
External interrupt	1		1	
Analog input	A/D converter: 4 channels (8-bit resolution)		—	
Timer	2 channels		4 channel	
Serial interface	1 channel		1 channel	
Watchdog timer	On-chip ($\overline{\text{WDOOUT}}$ output)		On-chip ($\overline{\text{WDOOUT}}$ output)	
Dual clock	On-chip		On-chip	
Instruction execution time	4 μ s at 4 MHz		4 μ s at 4 MHz	
Power supply voltage	2.2 to 5.5 V		2.2 to 5.5 V	
Package	80-pin plastic QFP		52-pin plastic QFP	
One-time PROM product	μ PD17P207	μ PD17P207	μ PD17P203A	μ PD17P204
Development tools	Assembler, C-like compiler, device file, integrated debugger, in-circuit emulator			

4-Bit Single-Chip Microcontroller

17K Series

■ Pre-set Remote-Controller/ASC

Part number	μ PD17225	μ PD17226	μ PD17227	μ PD17228
Main application	Pre-set remote controller, toy, portable system			
ROM size	2048 × 16 bits	4096 × 16 bits	6144 × 16 bits	8192 × 16 bits
RAM size	111 × 4 bits		223 × 4 bits	
Carrier generator for infrared remote-controller signal	On-chip			
I/O port	CMOS input: 9 N-ch open-drain output: 8 CMOS I/O: 4			
External interrupt	1			
Timer	2 channels			
Watchdog timer	On-chip ($\overline{\text{WDOUT}}$ output)			
Low voltage detection circuit	On-chip ($\overline{\text{WDOUT}}$ output)			
P0C/P0D standby operation	The output level existing immediately before setting standby mode is maintained.			
Instruction execution time	High speed mode: 2 μ s (at 8 MHz) Normal mode: 4 μ s (at 8 MHz)			
Power supply voltage	2.2 to 3.6 V (4 μ s, 2.0 to 3.6 V)			
Package	28-pin plastic SDIP, 28-pin plastic SOP, 30-pin plastic shrink SOP			
One-time PROM product	μ PD17P228*			
Development tools	Assembler, C-like compiler, device file, integrated debugger, in-circuit emulator			

Part number	μ PD17235*	μ PD17236*
Main application	Pre-set remote controller, toy, portable system	
ROM size	12288 × 16 bits	16384 × 16 bits
RAM size	223 × 4 bits	
Carrier generator for infrared remote-controller signal	On-chip	
I/O port	CMOS input: 9 or 10 N-ch open-drain output: 8 or 9 CMOS I/O: 4	
External interrupt	1	
Timer	2 channels	
Watchdog timer	On-chip	
Low voltage detection circuit	On-chip	
P0C/P0D standby operation	The output level existing immediately before setting standby mode is maintained.	
Instruction execution time	High speed mode: 2 μ s (at 8 MHz) Normal mode: 4 μ s (at 8 MHz)	
Power supply voltage	2.2 to 3.6 V (4 μ s, 2.0 to 3.6 V)	
Package	28-pin plastic SOP, 30-pin plastic shrink SOP	
One-time PROM product	μ PD17P236*	
Development tools	Assembler, C-like compiler, device file, integrated debugger, in-circuit emulator	

* : Under development

4-Bit Single-Chip Microcontroller

μ PD6133, 6604, 63 Series

■ Remote Controller (μ PD6133 Series)

Part number	μ PD6133	μ PD6134	μ PD61P34B
Main application	AV, household electric appliances		
ROM size	512 × 10 bits	1002 × 10 bits	
	Mask ROM		One time PROM
RAM size	32 × 4 bits		
Number of supported keys	32 (standard), 48 (when using key expansion pin), 96 (when expanded by diode)		
Operation clock frequency (f_x)	300 kHz to 1 MHz (ceramic oscillator)		
Instruction execution time	16 μ s (at $f_x = 500$ kHz)		
Modulation carrier frequency	f_x , $f_x/2$, $f_x/8$, $f_x/12$, $f_x/16$, $f_x/24$, no carrier (high level)		
Timer	9-bit programmable timer		
POC circuit	Mask option		On-chip
Power supply voltage (V_{DD})	1.8 to 3.6 V, 2.2 to 3.6 V (when POC circuit is incorporated)		2.2 to 3.6 V
Package	20-pin plastic SOP, 20-pin plastic shrink SOP		
Development tools	Assembler		

■ Remote Controller (μ PD6604 Series)

Part number	μ PD6604	μ PD66P04B
Main application	AV, household electric appliances	
ROM size	1002 × 10 bits	
	Mask ROM	One time PROM
RAM size	32 × 4 bits	
Number of supported keys	32 (standard), 48 (when using key expansion pin), 96 (when expanded by diode)	
Operation clock frequency (f_x)	300 kHz to 1 MHz (RC oscillator)	
Instruction execution time	16 μ s (at $f_x = 500$ kHz)	
Modulation carrier frequency	f_x , $f_x/2$, $f_x/8$, $f_x/12$, $f_x/16$, $f_x/24$, no carrier (high level)	
Timer	9-bit programmable timer	
POC circuit	Mask option	On-chip
Power supply voltage (V_{DD})	1.8 to 3.6 V, 2.2 to 3.6 V (when POC circuit is incorporated)	2.2 to 3.6 V
Package	20-pin plastic SOP, 20-pin plastic shrink SOP	
Development tools	Assembler	

4-Bit Single-Chip Microcontroller

μ PD6133, 6604, 63 Series

■ Remote Controller (μ PD63 Series)

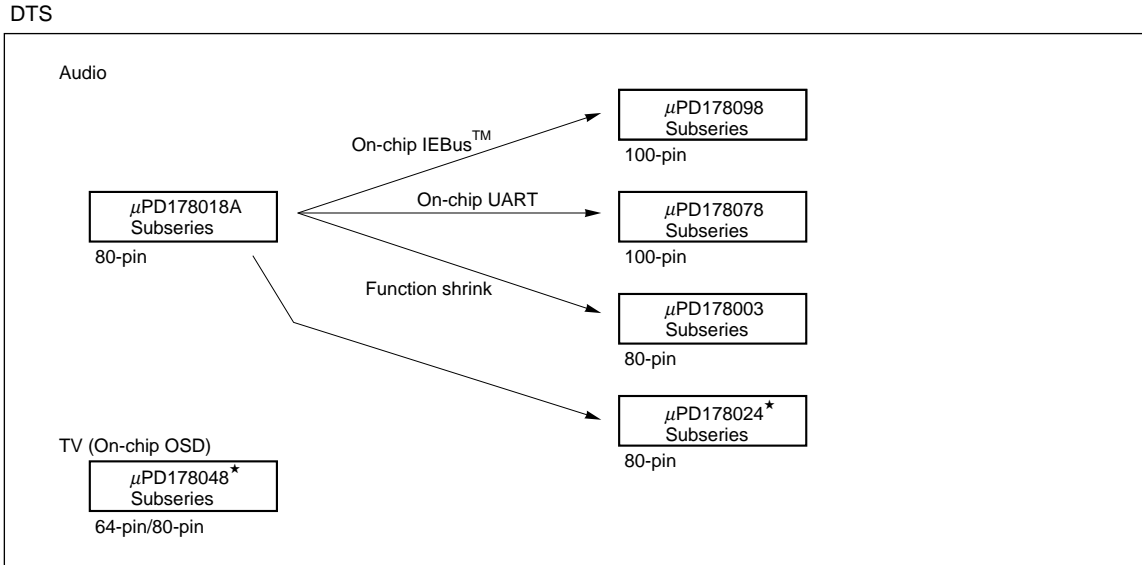
Part number	μ PD62	μ PD63A	μ PD64	μ PD6P4B	μ PD65*
Main application	AV, household electric appliances				
ROM size	512 × 10 bits	768 × 10 bits	1002 × 10 bits		2026 × 10 bits
	Mask ROM			One time PROM	Mask ROM
RAM size	32 × 4 bits				
Number of supported keys	32 (standard), 48 (when using key expansion pin), 96 (when expanded by diode)				56 (standard)
Operation clock frequency (f_x)	2.4 MHz to 8 MHz (ceramic oscillator)				
Instruction execution time	16 μ s (at $f_x = 4$ MHz)				
Modulation carrier frequency	$f_x/8$, $f_x/16$, $f_x/64$, $f_x/96$, $f_x/128$, $f_x/192$, no carrier (high level)				
Timer	9-bit programmable timer				
POC circuit	Mask option			On-chip	Mask option
Power supply voltage (V_{DD})	1.8 to 3.6 V, 2.2 to 3.6 V (when POC circuit is incorporated)			2.2 to 3.6 V	
Package	20-pin plastic shrink SOP	20-pin plastic SOP	20-pin plastic SOP 20-pin plastic shrink SOP		20-pin plastic shrink SOP
Development tools	Assembler				

*: Under development

8-Bit Single-Chip Microcontroller

178K Series

■ 178K Series Product Evolution



★: Under development

■ Differences among the Subseries

Subseries name	Function	ROM capacity	Timer			8-bit A/D	8-bit D/A	Serial interface	I/O	VDD MIN. value	Remark
			8-bit	16-bit	WDT						
Audio	μPD178098	48K to 60K	2 ch	1 ch	1 ch	8 ch	-	4 ch (UART: 1 ch, I ² C: 1 ch)	80	4.5 V	-
	μPD178078							4 ch (UART: 1 ch, IEBus: 1 ch)			
	μPD178024	24K to 32K	-	-	6 ch	2 ch (I ² C: 1 ch)	62				
	μPD178018A	32K to 60K	3 ch	-	-	3 ch	2 ch (I ² C: 1 ch)	-			
	μPD178003	16K to 24K	2 ch	-	-	-	1 ch				
TV	μPD178048	48K to 60K	4 ch	-	1 ch	4 ch	-	3 ch (I ² C: 2 ch)	46	4.5 V	-

8-Bit Single-Chip Microcontroller

178K Series

■ Audio (μ PD178003, 178018A Subseries)

Subseries name	μ PD178003 Subseries			μ PD178018A Subseries		
Part number	μ PD178002	μ PD178003	μ PD178004A	μ PD178006A	μ PD178016A	μ PD178018A
Main application	High-end tuner, automotive radio					
ROM size	16K bytes	24K bytes	32K bytes	48K bytes		60K bytes
RAM size	512 bytes		1K bytes		3K bytes	
Input port	1					
Output port	3					
I/O port	58					
D/A converter	–			3		
A/D converter	6					
Modulo timer	2		3 (Used also PWM: 1)			
Power supply voltage	+5 V \pm 10%					
Crystal	4.5 MHz					
PLL reference frequency	1, 3, 9, 10, 12.5, 25, 50 kHz			1, 3, 5, 9, 10, 25, 50 kHz		
Applicable prescaler	On-chip (160 MHz)					
Package	80-pin plastic QFP					
One-time PROM product	μ PD178P018A					
Development tools	Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					

■ Audio (μ PD178024 Subseries)

Part number	μ PD178023*	μ PD178024*
Main application	High-end tuner, automotive radio	
ROM size	24K bytes	32K bytes
RAM size	1K bytes	
Input port	6	
Output port	3 (N-ch open drain)	
I/O port	53 (N-ch open drain: 2)	
Serial interface	I ² C bus: 1 channel 3-wire: 1 channel	
A/D converter	6	
Modulo timer	8 bits \times 2 ch	
Power supply voltage	4.5 to 5.5 V (When PLL or A/D converter is operating) 3.5 to 5.5 V (When only CPU is operating)	
Crystal	4.5 MHz	
PLL reference frequency	1, 3, 9, 10, 12.5, 25, 50 kHz	
Applicable prescaler	On-chip (160 MHz)	
Package	80-pin plastic QFP (14 \times 14 mm, 0.65 mm pitch) 80-pin plastic QFP (14 \times 20 mm, 0.8 mm pitch)	
Development tools	Assembler, C compiler, real-time OS, integrated debugger, device file, in-circuit emulator	

*: Under development

8-Bit Single-Chip Microcontroller**178K Series****■ Audio (μ PD178098 Subseries)**

Part number	μ PD178096	μ PD178098
Main application	High-end tuner, automotive radio	
ROM size	48K bytes	60K bytes
RAM size	2048 bytes	3072 bytes
Input port	8	
Output port	8 (N-ch open drain)	
I/O port	64 (N-ch open drain: 3)	
Serial interface	IEBus (mode 1 only): 1 channel 3-wire/2-wire/SBI/I ² C bus (selectable): 1 channel 3-wire: 1 channel 3-wire (with function for automatic transmission and reception): 1 channel	
D/A converter	—	
A/D converter	8	
Modulo timer	16 bits \times 1, 8 bits \times 2	
Power supply voltage	+5 V \pm 10%	
Crystal	6.3 MHz	
PLL reference frequency	1, 3, 9, 10, 12.5, 25, 50 kHz	
Applicable prescaler	On-chip (160 MHz)	
Package	100-pin plastic QFP	
Flash memory product	μ PD178F098	
Development tools	Assembler, C compiler, real-time OS, integrated debugger, device file, in-circuit emulator	

■ Audio (μ PD178078 Subseries)

Part number	μ PD178076	μ PD178078
Main application	High-end tuner, automotive radio	
ROM size	48K bytes	60K bytes
RAM size	2K bytes	3K bytes
Input port	8	
Output port	8 (N-ch open drain)	
I/O port	64 (N-ch open drain: 3)	
Serial interface	3-wire/2-wire/SBI/I ² C bus (selectable): 1 channel 3-wire: 1 channel 3-wire (with function for automatic transmission and reception): 1 channel UART: 1 channel	
A/D converter	8-bit resolution \times 8 channels	
Power supply voltage	+5 V \pm 10%	
Crystal	6.3 MHz, 4.5 MHz	
PLL reference frequency	1, 3, 9, 10, 12.5, 25, 50 kHz	
Applicable prescaler	On-chip (160 MHz)	
Package	100-pin plastic QFP	
Flash memory product	μ PD178F098	
Development tools	Assembler, C compiler, real-time OS, integrated debugger, device file, in-circuit emulator	

8-Bit Single-Chip Microcontroller

178K Series

■ TV (μ PD178048 Subseries)

Part number	μ PD178046*	μ PD178048*
Main application	TV sets, CATV	
ROM size	48K bytes	60K bytes
RAM size	1K bytes	
Display	On-chip OSD Kind of character: 255 Display character: 12 lines \times 24 columns Character type: 12 \times 18 dot Character color: 8	
Input port	4	
Output port	5 (N-ch open drain)	
I/O port	37 (N-ch open drain: 4)	
Serial interface	I ² C bus: 2 channels 3-wire: 1 channel	
PWM	14-bit \times 1 8-bit \times 4	
A/D converter	8-bit resolution \times 4 channels	
Power supply voltage	+5 V \pm 10%	
Crystal	5.0 MHz	
Package	64-pin plastic shrink DIP, 80-pin plastic TQFP	
Flash memory product	μ PD178F048*	
Development tools	Assembler, C compiler, real-time OS, integrated debugger, device file, in-circuit emulator	

*: Under development

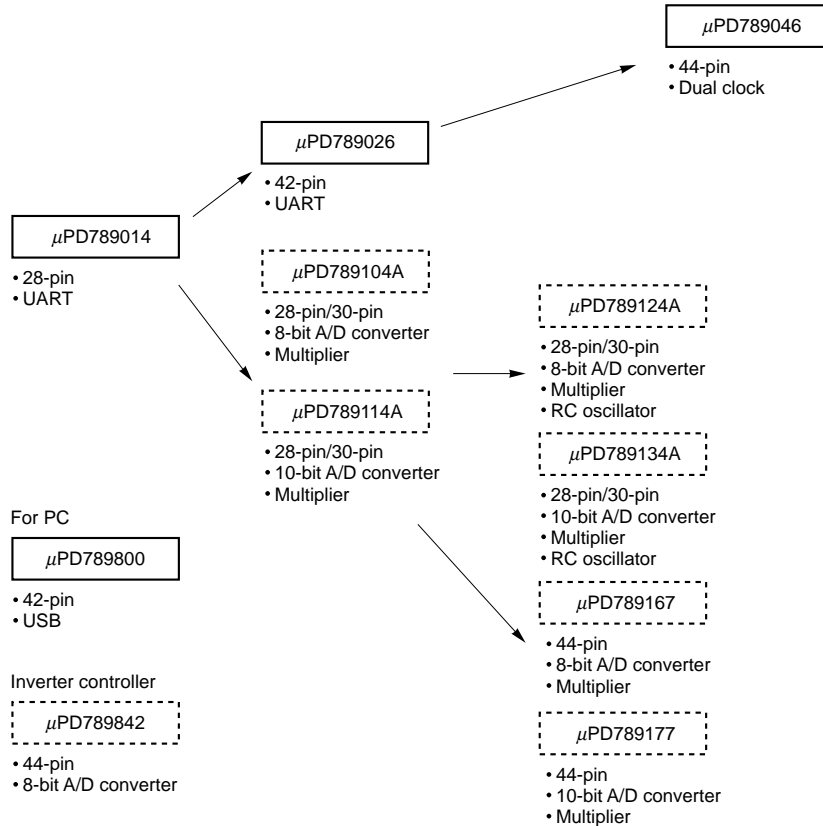
8-Bit Single-Chip Microcontroller

78K/0S Series

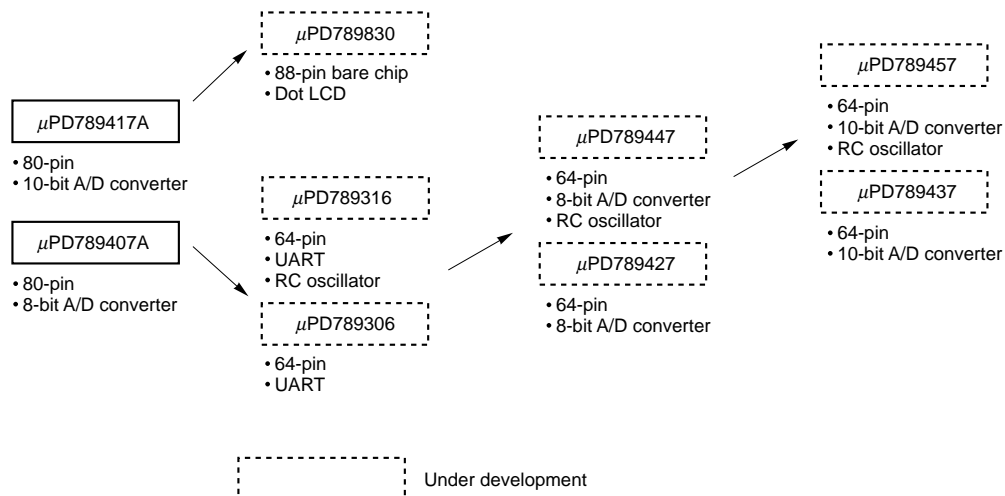
■ 78K/0S Series Product Evolution

Subseries names are shown inside frames.

Small-scale general purpose



LCD driver



8-Bit Single-Chip Microcontroller

78K/0S Series

■ Differences among the Subseries

Subseries name	Function	ROM capacity	Timer				8-bit A/D	10-bit A/D	Serial interface	I/O	V _{DD} MIN. value	Remark
			8-bit	16-bit	Watch	WDT						
Small-scale general-purpose	μ PD789046	16K	1 ch	1 ch	1 ch	1 ch	–	–	1 ch (UART: 1 ch)	34	1.8 V	–
	μ PD789026	4K to 16K										
	μ PD789014	2K to 4K	2 ch	–						22		
Small-scale general-purpose + A/D	μ PD789177	16K to 24K	3 ch	1 ch	1 ch	1 ch	–	8 ch	1 ch (UART: 1 ch)	31	1.8 V	–
	μ PD789167						8 ch	–				
	μ PD789134A	2K to 8K	1 ch				–	4 ch		20		RC oscillation
	μ PD789124A						4 ch	–				
	μ PD789114A						–	4 ch				
	μ PD789104A						4 ch	–				
Inverter controller	μ PD789842	8K to 16K	3 ch	*	1 ch	1 ch	8 ch	–	1 ch (UART: 1 ch)	30	4.0 V	–
LCD driver	μ PD789417A	12K to 24K	3 ch	1 ch	1 ch	1 ch	–	7 ch	1 ch (UART: 1 ch)	43	1.8 V	–
	μ PD789407A						7 ch	–				
	μ PD789457	16K to 24K	2 ch				–	4 ch	2 ch (UART: 1 ch)	25	1.8 V	RC oscillation
	μ PD789447						4 ch	–				
	μ PD789437						–	4 ch				
	μ PD789427						4 ch	–				
	μ PD789316	8K to 16K					–					RC oscillation
	μ PD789306											
	μ PD789830	24K	1 ch							30	2.7 V	–
For PC	μ PD789800	8K	2 ch	1 ch	–	1 ch	–	–	2 ch (USB: 1 ch)	31	4.0 V	–

*: 10-bit timer 1 channel

8-Bit Single-Chip Microcontroller

78K/0S Series

■ Small-Scale General-Purpose (μ PD789014 Subseries)

Part number			μ PD789011	μ PD789012	μ PD78P9014
Number of basic instructions			48		
Minimum instruction execution time			0.4 μ s (5.0 MHz)		
Instruction cycle			Selectable from 0.4 μ s and 1.6 μ s (5.0 MHz)		
Internal memory	ROM	Size (bytes)	2K	4K	8K (PROM)
	RAM	Size (bytes)	128		256
Address space			64K bytes		
Interrupt function		External	3		
		Internal	7		
I/O pin	CMOS I/O		22		
Timer			8-bit timer/event counter \times 2 channels Watchdog timer \times 1 channel		
Timer output			2		
Serial interface			3-wire/UART mode (selectable): 1 channel		
Standby function			STOP/HALT		
Operating power supply voltage range			$V_{DD} = 1.8$ to 5.5 V		
Package			<ul style="list-style-type: none"> • 28-pin plastic shrink DIP (400 mil) • 28-pin plastic SOP (375 mil) 		
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications			Remote control, game machines, etc.		

8-Bit Single-Chip Microcontroller

78K/0S Series

■ Small-Scale General-Purpose (μ PD789026 Subseries)

Part number		μ PD789022	μ PD789024	μ PD789025	μ PD789026	μ PD78F9026A*
Number of basic instructions		48				
Minimum instruction execution time		0.4 μ s (5.0 MHz)				
Instruction cycle		Selectable from 0.4 μ s and 1.6 μ s (5.0 MHz)				
Internal memory	ROM	Size (bytes)	4K	8K	12K	16K (Flash memory)
	RAM	Size (bytes)	256		512	
Address space		64K bytes				
Interrupt function		External	4			
		Internal	6			
I/O pin	CMOS I/O	34				
Timer		16-bit timer counter \times 1 channel 8-bit timer/event counter \times 1 channel Watchdog timer \times 1 channel				
Timer output		2				
Serial interface		3-wire/UART mode (selectable): 1 channel				
Standby function		STOP/HALT				
Operating power supply voltage range		$V_{DD} = 1.8$ to 5.5 V				
Package		<ul style="list-style-type: none"> • 42-pin plastic shrink DIP (600 mil) • 44-pin plastic QFP (10 \times 10 mm) 				
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator				
Applications		Compact household appliances, car accessories, air-conditioners, games, etc.				

* : Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ **Small-Scale General-Purpose (μ PD789046 Subseries)**

Part number		μ PD789046	μ PD78F9046*
Number of basic instructions		48	
Minimum instruction execution time		0.4 μ s	
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s and 1.6 μ s (5.0 MHz)	
	When subsystem clock is selected	122 μ s (32.768 kHz)	
Internal memory	ROM	Size (bytes)	16K
	RAM	Size (bytes)	512
Address space		64K bytes	
Interrupt function	External	4	
	Internal	8	
I/O pin	CMOS I/O	34	
Timer		16-bit timer counter \times 1 channel 8-bit timer/event counter \times 1 channel Watch timer \times 1 channel Watchdog timer \times 1 channel	
Timer output		2	
Serial interface		3-wire/UART mode (selectable): 1 channel	
Standby function		STOP/HALT	
Operating power supply voltage range		$V_{DD} = 1.8$ to 5.5 V	
Package		<ul style="list-style-type: none"> • 44-pin plastic QFP (10 \times 10 mm, resin thickness 2.7 mm) • 44-pin plastic QFP (10 \times 10 mm, resin thickness 1.4 mm) 	
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator	
Applications		Cordless phones, etc.	

★: Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ Small-Scale General-Purpose + A/D (μ PD789104A, 789114A Subseries)

Subseries name			μ PD789104A Subseries			μ PD789114A Subseries			
Part number			μ PD789101A*	μ PD789102A*	μ PD789104A*	μ PD789111A*	μ PD789112A*	μ PD789114A*	μ PD78F9116A*
Number of basic instructions			48						
Minimum instruction execution time			0.4 μ s (5.0 MHz)						
Instruction cycle			Selectable from 0.4 μ s and 1.6 μ s (5.0 MHz)						
System clock			Ceramic oscillator						
Internal memory	ROM	Size (bytes)	2K	4K	8K	2K	4K	8K	16K (Flash memory)
	RAM	Size (bytes)	256						
Address space			64K bytes						
Interrupt function	External		3						
	Internal		7						
Multiplier			$8 \times 8 = 16$ bits						
I/O pin	CMOS input		4						
	CMOS I/O		12						
	N-ch open-drain I/O		4						
Timer			16-bit timer counter \times 1 channel 8-bit timer/event counter \times 1 channel Watchdog timer \times 1 channel						
Timer output			2						
Serial interface			3-wire/UART mode (selectable): 1 channel						
A/D converter			8-bit resolution \times 4 channels			10-bit resolution \times 4 channels			
Standby function			STOP/HALT						
Operating power supply voltage range			$V_{DD} = 1.8$ to 5.5 V						
Package			<ul style="list-style-type: none"> • 28-pin plastic shrink DIP (400 mil) • 30-pin plastic shrink SOP (300 mil) 						
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator						
Applications			Cleaners, washing machines, refrigerators, etc.						

* : Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ Small-Scale General-Purpose + A/D (μ PD789124A, 789134A Subseries)

Subseries name			μ PD789124A Subseries			μ PD789134A Subseries			
Part number			μ PD789121A*	μ PD789122A*	μ PD789124A*	μ PD789131A*	μ PD789132A*	μ PD789134A*	μ PD78F9136A*
Number of basic instructions			48						
Minimum instruction execution time			0.5 μ s (4.0 MHz)						
Instruction cycle			Selectable from 0.5 μ s and 2.0 μ s (4.0 MHz)						
System clock			RC oscillator						
Internal memory	ROM	Size (bytes)	2K	4K	8K	2K	4K	8K	16K (Flash memory)
	RAM	Size (bytes)	256						
Address space			64K bytes						
Interrupt function	External		3						
	Internal		7						
Multiplier			$8 \times 8 = 16$ bits						
I/O pin	CMOS input		4						
	CMOS I/O		12						
	N-ch open-drain I/O		4						
Timer			16-bit timer counter \times 1 channel 8-bit timer/event counter \times 1 channel Watchdog timer \times 1 channel						
Timer output			2						
Serial interface			3-wire serial I/O mode/UART mode (selectable): 1 channel						
A/D converter			8-bit resolution \times 4 channels			10-bit resolution \times 4 channels			
Standby function			STOP/HALT						
Operating power supply voltage range			$V_{DD} = 1.8$ to 5.5 V						
Package			<ul style="list-style-type: none"> • 28-pin plastic shrink DIP (400 mil) • 30-pin plastic shrink SOP (300 mil) 						
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator						
Applications			Battery chargers, etc.						

* : Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ Small-Scale General-Purpose + A/D (μ PD789167, 789177 Subseries)

Subseries name		μ PD789167 Subseries		μ PD789177 Subseries		
Part number		μ PD789166*	μ PD789167*	μ PD789176*	μ PD789177*	μ PD78F9177*
Number of basic instructions		48				
Minimum instruction execution time		0.4 μ s (5.0 MHz)				
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s and 1.6 μ s (5.0 MHz)				
	When subsystem clock is selected	122 μ s (32.768 kHz)				
System clock		Ceramic oscillator				
Internal memory	ROM	Size (bytes)	16K	24K	16K	24K
	RAM	Size (bytes)	512			
Address space		64K bytes				
Interrupt function	External	4				
	Internal	11				
Multiplier		8 \times 8 = 16 bits				
I/O pin	CMOS input	8				
	CMOS I/O	17				
	N-ch open-drain I/O	6				
Timer		16-bit timer counter \times 1 channel 8-bit timer counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel				
Timer output		4				
Serial interface		3-wire/UART mode (selectable): 1 channel				
A/D converter		8-bit resolution \times 8 channels		10-bit resolution \times 8 channels		
Standby function		STOP/HALT				
Operating power supply voltage range		$V_{DD} = 1.8$ to 5.5 V				
Package		44-pin plastic QFP (10 \times 10 mm)				
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator				
Applications		Power windows, keyless entries, battery management units, side air bags, etc.				

* : Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ LCD Driver (μ PD789306, 789316 Subseries)

Subseries name		μ PD789306 Subseries		μ PD789316 Subseries	
Part number		μ PD789304*	μ PD789306*	μ PD789314*	μ PD789316*
Number of basic instructions		48			
Minimum instruction execution time		0.4 μ s (5.0 MHz)		0.5 μ s (4.0 MHz)	
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s and 1.6 μ s (5.0 MHz)		Selectable from 0.5 μ s and 2.0 μ s (4.0 MHz)	
	When subsystem clock is selected	122 μ s (32.768 kHz)			
Resonator	Main	Ceramic/crystal 1 to 5 MHz		RC oscillator 2 to 4 MHz	
	Sub	Crystal 32.768 kHz			
Internal memory	ROM	Size (bytes)	8K	16K	8K
	RAM	Size (bytes)	256		
	LCD data RAM	Size (bytes)	20		
Address space		64K bytes			
Interrupt function	External	4			
	Internal	10			
I/O pin	CMOS input	4			
	CMOS I/O	17			
	N-ch open-drain I/O	4			
Timer		16-bit timer counter \times 1 channel 8-bit timer counter \times 1 channel 8-bit timer/event counter \times 1 channel Watch timer \times 1 channel Watchdog timer \times 1 channel			
Timer output		3			
Serial interface		3-wire/UART mode (selectable): 1 channel 3-wire: 1 channel			
LCD controller/driver		Segment signal outputs: 20 maximum Common signal outputs: 4 maximum Bias: 1/3, on-chip booster			
Standby function		STOP/HALT			
Operating power supply voltage range		$V_{DD} = 1.8$ to 5.5 V			
Package		<ul style="list-style-type: none"> • 64-pin plastic QFP (14 \times 14 mm) • 64-pin plastic TQFP (fine pitch) (12 \times 12 mm) 			
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator			
Applications		Remote controller, etc.			

* : Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ LCD Driver (μ PD789407A, 789417A Subseries)

Subseries name		μ PD789407A Subseries				μ PD789417A Subseries			
Part number		μ PD789405A	μ PD789406A	μ PD789407A	μ PD789415A	μ PD789416A	μ PD789417A	μ PD78F9418A*	
Number of basic instructions		48							
Minimum instruction execution time		0.4 μ s (5.0 MHz)							
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s and 1.6 μ s (5.0 MHz)							
	When subsystem clock is selected	122 μ s (32.768 kHz)							
Internal memory	ROM	Size (bytes)	12K	16K	24K	12K	16K	24K	32K (Flash memory)
	RAM	Size (bytes)	512						
	LCD data RAM	Size (bytes)	28						
Address space		64K bytes							
Interrupt function		External	5						
		Internal	12						
I/O pin	CMOS input		7						
	CMOS I/O		32						
	N-ch open-drain I/O		4						
Timer		16-bit timer counter \times 1 channel 8-bit timer counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel							
Timer output		2							
Serial interface		3-wire/UART mode (selectable): 1 channel							
A/D converter		8-bit resolution \times 7 channels				10-bit resolution \times 7 channels			
LCD controller/driver		Segment signal outputs: 28 maximum Common signal outputs: 4 maximum Bias: 1/2 or 1/3 (switchable)							
Standby function		STOP/HALT							
Operating power supply voltage range		$V_{DD} = 1.8$ to 5.5 V							
Package		<ul style="list-style-type: none"> • 80-pin plastic QFP (14 \times 14 mm) • 80-pin plastic TQFP (fine pitch) (12 \times 12 mm, resin thickness 1.05 mm) • 80-pin plastic TQFP (fine pitch) (12 \times 12 mm, resin thickness 1.0 mm) 							
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator							
Applications		APS compact cameras, etc.							

* : Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ LCD Driver (μ PD789427, 789437 Subseries)

Subseries name		μ PD789427 Subseries		μ PD789437 Subseries		
Part number		μ PD789426*	μ PD789427*	μ PD789436*	μ PD789437*	μ PD78F9437*
Number of basic instructions		48				
Minimum instruction execution time		0.4 μ s (5.0 MHz)				
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s and 1.6 μ s (5.0 MHz)				
	When subsystem clock is selected	122 μ s (32.768 kHz)				
Resonator	Main	Ceramic/crystal 1 to 5 MHz				
	Sub	Crystal 32.768 kHz				
Internal memory	ROM	Size (bytes)	16K	24K	16K	24K
	RAM	Size (bytes)	512			
	LCD data RAM	Size (bytes)	20			
Address space		64K bytes				
Interrupt function	External	4				
	Internal	10				
I/O pin	CMOS input	4				
	CMOS I/O	17				
	N-ch open-drain I/O	4				
Timer	16-bit timer counter \times 1 channel 8-bit timer counter \times 1 channel 8-bit timer/event counter \times 1 channel Watch timer \times 1 channel Watchdog timer \times 1 channel					
Timer output	3					
Serial interface	3-wire/UART mode (selectable): 1 channel 3-wire: 1 channel					
A/D converter	8-bit resolution \times 4 channels		10-bit resolution \times 4 channels			
LCD controller/driver	Segment signal outputs: 20 maximum Common signal outputs: 4 maximum Bias: 1/3, on-chip booster					
Standby function	STOP/HALT					
Operating power supply voltage range	$V_{DD} = 1.8$ to 5.5 V					
Package	<ul style="list-style-type: none"> • 64-pin plastic QFP (14 \times 14 mm) • 64-pin plastic TQFP (fine pitch) (12 \times 12 mm) 					
Development tools	Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications	Portable audio, etc.					

* : Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ LCD Driver (μ PD789447, 789457 Subseries)

Subseries name		μ PD789447 Subseries		μ PD789457 Subseries		
Part number		μ PD789446*	μ PD789447*	μ PD789456*	μ PD789457*	μ PD78F9457*
Number of basic instructions		48				
Minimum instruction execution time		0.5 μ s (4.0 MHz)				
Instruction cycle	When main system clock is selected	Selectable from 0.5 μ s and 2.0 μ s (4.0 MHz)				
	When subsystem clock is selected	122 μ s (32.768 kHz)				
Resonator	Main	RC oscillator 2 to 4 MHz				
	Sub	Crystal 32.768 kHz				
Internal memory	ROM	Size (bytes)	16K	24K	16K	24K
	RAM	Size (bytes)	512			
	LCD data RAM	Size (bytes)	20			
Address space		64K bytes				
Interrupt function	External	4				
	Internal	10				
I/O pin	CMOS input	4				
	CMOS I/O	17				
	N-ch open-drain I/O	4				
Timer		16-bit timer counter \times 1 channel 8-bit timer counter \times 1 channel 8-bit timer/event counter \times 1 channel Watch timer \times 1 channel Watchdog timer \times 1 channel				
Timer output		3				
Serial interface		3-wire/UART mode (selectable): 1 channel 3-wire: 1 channel				
A/D converter		8-bit resolution \times 4 channels		10-bit resolution \times 4 channels		
LCD controller/driver		Segment signal outputs: 20 maximum Common signal outputs: 4 maximum Bias: 1/3, on-chip booster				
Standby function		STOP/HALT				
Operating power supply voltage range		$V_{DD} = 1.8$ to 5.5 V				
Package		<ul style="list-style-type: none"> • 64-pin plastic QFP (14 \times 14 mm) • 64-pin plastic TQFP (fine pitch) (12 \times 12 mm) 				
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator				
Applications		Portable audio, etc.				

*: Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ LCD Driver (μ PD789830 Subseries)

Part number			μ PD789830*	μ PD78F9831*
Number of basic instructions			48	
Minimum instruction execution time			0.4 μ s	
Instruction cycle	When main system clock is selected		Selectable from 0.4 μ s and 1.6 μ s (5.0 MHz)	
	When subsystem clock is selected		122 μ s (32.768 kHz)	
Internal memory	ROM	Size (bytes)	24K	48K (Flash memory)
	RAM	Size (bytes)	1024	2048
	LCD data RAM	Size (bytes)	80	
Address space			64K bytes	
Interrupt function	External		3	5
	Internal		11	
I/O pin	CMOS I/O		30	38
Timer			16-bit timer counter \times 1 channel 8-bit timer counter \times 1 channel Watch timer \times 1 channel Watchdog timer \times 1 channel	
Timer output			2	
Serial interface			UART: 1 channel	
LCD controller/driver			Segment signal outputs: 40 maximum Common signal outputs: 16 maximum	
Standby function			STOP/HALT	
Operating power supply voltage range			$V_{DD} = 2.7$ to 5.5 V	
Delivery form			88-pin bare chip	100-pin plastic LQFP (14 \times 14 mm)
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator	
Applications			Card readers, etc.	

*: Under development

8-Bit Single-Chip Microcontroller

78K/0S Series

■ For PC (μ PD789800 Subseries)

Part number			μ PD789800	μ PD78F9801
Number of basic instructions			48	
Minimum instruction execution time			0.33 μ s (6.0 MHz)	
Instruction cycle			Selectable from 0.33 μ s and 1.33 μ s (6.0 MHz)	
Internal memory	ROM	Size (bytes)	8K	16K (Flash memory)
	RAM	Size (bytes)	256	
Address space			64K bytes	
Interrupt function		External	2	
		Internal	10	
I/O pin	CMOS I/O		31 (18 ports of the above CMOS I/O ports can be switched to N-ch open-drain I/O ports)	
Timer			8-bit timer \times 1 channel 8-bit timer/event counter \times 1 channel Watchdog timer \times 1 channel	
Serial interface			USB (Universal Serial Bus): 1 channel 3-wire: 1 channel	
Regulator			Incorporated ($V_{REG} = 3.3 \pm 0.3$ V)	
Standby function			STOP/HALT	
Operating power supply voltage range			$V_{DD} = 4.0$ to 5.5 V	
Operating ambient temperature			$T_A = -40$ to $+85^\circ\text{C}$ (When the USB is not operating) $T_A = 0$ to 70°C (When the USB is operating)	
Package			<ul style="list-style-type: none"> • 42-pin plastic shrink DIP (600 mil) • 44-pin plastic QFP (10 \times 10 mm, resin thickness 2.7 mm) • 44-pin plastic QFP (10 \times 10 mm, resin thickness 1.4 mm) 	
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator	
Applications			USB keyboards, etc.	

8-Bit Single-Chip Microcontroller

78K/0S Series

■ Inverter Controller (μ PD789842 Subseries)

Part number			μ PD789841*	μ PD789842*	μ PD78F9842*
Number of basic instructions			48		
Minimum instruction execution time			0.24 μ s (8.38 MHz)		
Instruction cycle			Selectable from 0.24 μ s and 0.96 μ s (8.38 MHz)		
Internal memory	ROM	Size (bytes)	8K	16K	16K (Flash memory)
	RAM	Size (bytes)	256		
Address space			64K bytes		
Interrupt function		External	2		
		Internal	12		
Multiplier			10 \times 10 = 20 bits		
I/O pin	CMOS input		8		
	CMOS I/O		22		
Timer			10-bit timer for inverter control \times 1 channel 8-bit timer counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output			7 (Timer output: 1, inverter control output: 6)		
Serial interface			UART: 1 channel		
A/D converter			8-bit resolution \times 8 channels		
Standby function			STOP/HALT		
Operating power supply voltage range			$V_{DD} = 4.0$ to 5.5 V		
Package			<ul style="list-style-type: none"> • 44-pin plastic QFP (10 \times 10 mm, resin thickness 2.7 mm) • 44-pin plastic QFP (10 \times 10 mm, resin thickness 1.4 mm) 		
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications			Motor control for inverter-type air conditioners, etc.		

* : Under development

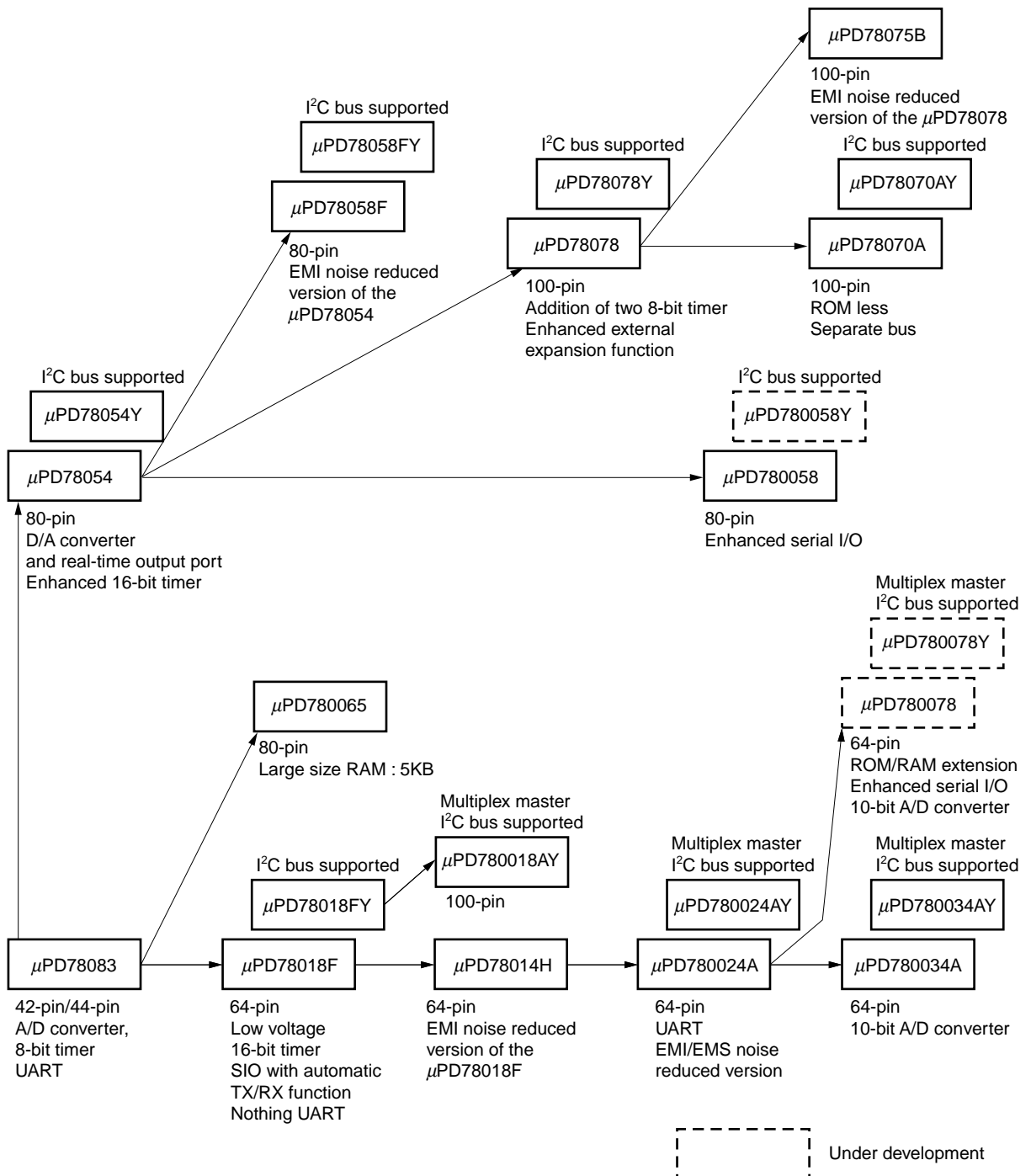
8-Bit Single-Chip Microcontroller

78K/0 Series

■ **78K/0 Series Product Evolution (1/3)**

Subseries names are shown inside frames.

Controller series



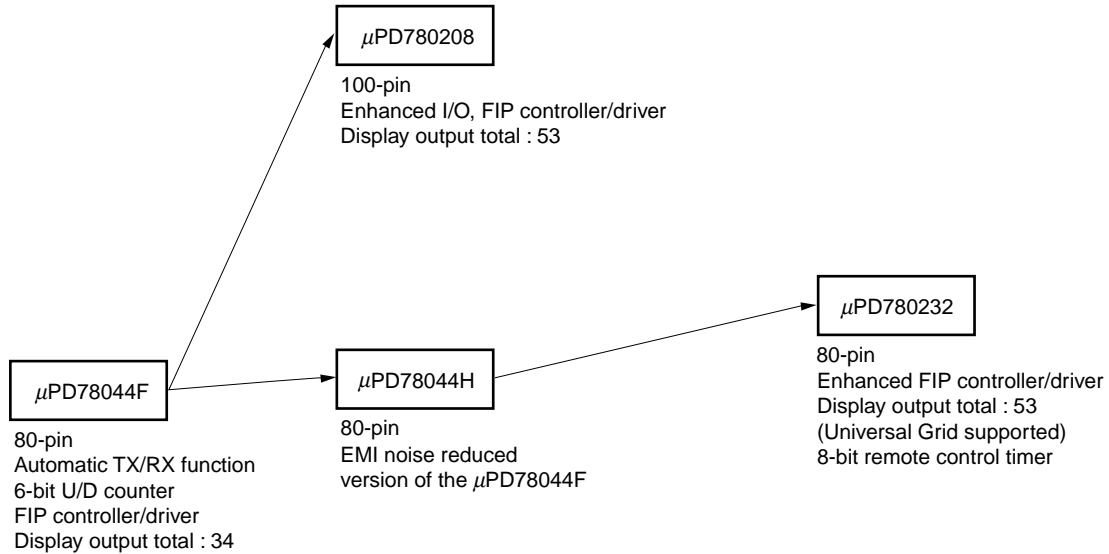
8-Bit Single-Chip Microcontroller

78K/0 Series

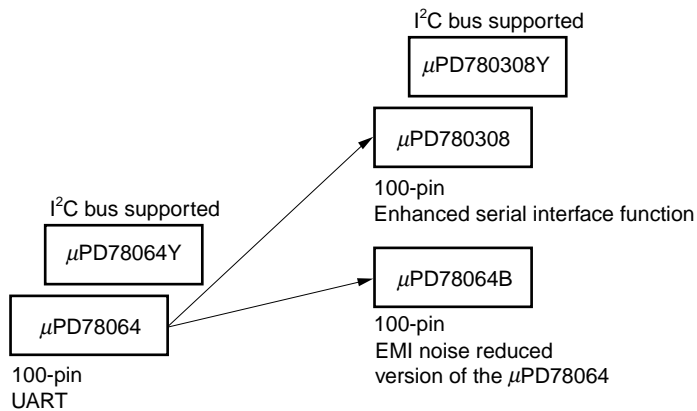
■ 78K/0 Series Product Evolution (2/3)

Subseries names are shown inside frames.

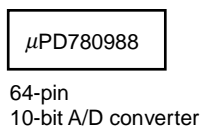
FIP™ drive series



LCD drive series



Inverter controller series



8-Bit Single-Chip Microcontroller

78K/0 Series

■ 78K/0 Series Product Evolution (3/3)

Subseries names are shown inside frames.

Call ID series

μ PD780841

80-pin
Call ID decoder
Simple DTMF

Super low power consumption (meter controller) series

μ PD780955

80-pin
Consumption current
When operating : 3.4 μ A typical
When HALT : 1.1 μ A typical

μ PD780958

100-pin
Consumption current
When operating : 200 μ A typical (1.0 MHz)
When operating : 4.5 μ A typical 32.768 kHz)
When HALT : 2 μ A typical 32.768 kHz)

Dashboard controller series

μ PD780973

80-pin
Meter controller/driver

Bus controller series

μ PD78098B

80-pin
IEBus controller

μ PD780701Y

80-pin
(μ PD780701Y : DCAN controller
 μ PD780702Y : IEBus controller
 μ PD78F0701Y : DCAN/IEBus controller)

μ PD780833Y

80-pin
J1850 (CLASS2) controller

μ PD780948

100-pin
DCAN controller

Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Differences among the Subseries (1/2)

Subseries name	Function	ROM capacity	Timer				8-bit A/D	10-bit A/D	8-bit D/A	Serial interface	I/O	V _{DD} MIN. value	External expansion								
			8-bit	16-bit	Watch	WDT															
Controller	μ PD78075B	32K to 40K	4 ch	1 ch	1 ch	1 ch	8 ch	-	2 ch	3 ch (UART: 1 ch)	88	1.8 V	√								
	μ PD78078	48K to 60K								3 ch (UART: 1 ch, I ² C: 1 ch)											
	μ PD78078Y																				
	μ PD78070A	-								3 ch (UART: 1 ch)	61	2.7 V									
	μ PD78070AY									3 ch (UART: 1 ch, I ² C: 1 ch)											
	μ PD780018AY	48K to 60K								2 ch								-	3 ch (I ² C: 1 ch)	88	
	μ PD780058	24K to 60K	3 ch (time-division UART: 1 ch)	68	1.8 V																
	μ PD780058Y		3 ch (time-division UART: 1 ch, I ² C: 1 ch)																		
	μ PD78058F	48K to 60K	3 ch (UART: 1 ch)	69	2.7 V																
	μ PD78058FY		3 ch (UART: 1 ch, I ² C: 1 ch)																		
	μ PD78054	16K to 60K	3 ch (UART: 1 ch)	2.0 V																	
	μ PD78054Y		3 ch (UART: 1 ch, I ² C: 1 ch)																		
	μ PD780065	40K to 48K	1 ch															-	4 ch (UART: 1 ch)	60	2.7 V
	μ PD780078	48K to 60K																3 ch (UART: 2 ch)	52	1.8 V	
	μ PD780078Y																	4 ch (UART: 2 ch, I ² C: 1 ch)			
	μ PD780034A	8K to 32K																3 ch (UART: 1 ch, time-division 3-wire: 1 ch)	51		
	μ PD780024A																	3 ch (UART: 1 ch, I ² C: 1 ch)			
	μ PD780034AY																				
	μ PD780024AY																				
	μ PD78014H									2 ch	53										
μ PD78018F	8K to 60K																				
μ PD78018FY																					
μ PD78083	8K to 16K	-	-		1 ch (UART: 1 ch)	33															
Inverter controller	μ PD780988	16K to 60K	3 ch	*	-	1 ch	-	8 ch	-	3 ch (UART: 2 ch)	47	4.0 V	√								

*: 16-bit timer 2 channels
10-bit timer 1 channel

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Differences among the Subseries (2/2)

Subseries name	Function	ROM capacity	Timer				8-bit A/D	10-bit A/D	8-bit D/A	Serial interface	I/O	V _{DD} MIN. value	External expansion
			8-bit	16-bit	Watch	WDT							
FIP driver	μ PD780208	32K to 60K	2 ch	1 ch	1 ch	1 ch	8 ch	-	-	2 ch	74	2.7 V	-
	μ PD780232	16K to 24K	3 ch	-	-	-	4 ch			40	4.5 V		
	μ PD78044H	32K to 48K	2 ch	1 ch	1 ch	-	8 ch			1 ch	67	2.7 V	
	μ PD78044F	16K to 40K	-	-	-	-	-			2 ch	-	-	
LCD driver	μ PD780308	48K to 60K	2 ch	1 ch	1 ch	1 ch	8 ch	-	-	3 ch (time-division UART: 1 ch)	57	2.0 V	-
	μ PD780308Y									3 ch (time-division UART: 1 ch, I ² C: 1 ch)			
	μ PD78064B	32K								2 ch (UART: 1 ch)			
	μ PD78064	16K to 32K								2 ch (UART: 1 ch, I ² C: 1 ch)			
	μ PD78064Y												
For Call ID	μ PD780841	24K to 32K	2 ch	-	1 ch	1 ch	2 ch	-	-	2 ch (UART: 1 ch)	58	2.7 V	-
On-chip bus controller	μ PD780948	60K	2 ch	2 ch	1 ch	1 ch	8 ch	-	-	3 ch (UART: 1 ch)	79	4.0 V	√
	μ PD78098B	40K to 60K		1 ch						2 ch	69	2.7 V	-
	μ PD780701Y	60K	3 ch	2 ch	-	16 ch	-	4 ch (UART: 1 ch, I ² C: 1 ch)	67	3.5 V			
	μ PD780833Y	60K	3 ch	-	-	-	-	65	4.5 V				
Meter controller	μ PD780958	40K to 60K	4 ch	2 ch	-	1 ch	-	-	-	2 ch (UART: 1 ch)	69	2.7 V	-
	μ PD780955	40K	6 ch	1 ch	-	-	1 ch	-	-	2 ch (UART: 2 ch)	50	2.2 V	-
Dashboard controller	μ PD780973	24K to 32K	3 ch	1 ch	1 ch	1 ch	5 ch	-	-	2 ch (UART: 1 ch)	56	4.5 V	-

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78018F Subseries)

Part number		μ PD78011F	μ PD78012F	μ PD78013F	μ PD78014F	μ PD78015F	μ PD78016F	μ PD78018F	μ PD78P018F	
Number of basic instructions		63								
Minimum instruction execution time		0.4 μ s (10.0 MHz)								
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, and 6.4 μ s (10.0 MHz)								
	When subsystem clock is selected	122 μ s (32.768 kHz)								
Internal memory	ROM	Size (bytes)	8K	16K	24K	32K	40K	48K	60K	60K (PROM)
	RAM	Size (bytes)	544		1056		1568		2080	
Address space		64K bytes								
Interrupt function	External	4								
	Internal	10								
I/O pin	CMOS input	2								
	CMOS I/O	47								
	N-ch open-drain I/O	4								
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel								
Timer output		3 (PWM output: 1)								
Serial interface		3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel								
A/D converter		8-bit resolution \times 8 channels								
Others		Clock output function Buzzer output function								
Standby function		STOP/HALT								
Operating power supply voltage range		1.8 to 5.5 V								
Package		<ul style="list-style-type: none"> • 64-pin plastic shrink DIP (750 mil) • 64-pin plastic QFP (14 \times 14 mm, 0.8-mm pitch) • 64-pin plastic LQFP (12 \times 12 mm, 0.65-mm pitch) 							*	
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator								
Applications		VCRs, TVs, audio equipments, etc.								

- *: • 64-pin plastic shrink DIP (750 mil)
 • 64-pin plastic QFP (14 \times 14 mm, 0.8-mm pitch)
 • 64-pin plastic LQFP (12 \times 12 mm, 0.65-mm pitch)
 • 64-pin ceramic shrink DIP with window (750 mil)
 • 64-pin ceramic WQFN (14 \times 14 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78018FY Subseries)

Part number			μ PD78011FY	μ PD78012FY	μ PD78013FY	μ PD78014FY	μ PD78015FY	μ PD78016FY	μ PD78018FY	μ PD78P018FY
Number of basic instructions			63							
Minimum instruction execution time			0.4 μ s (10.0 MHz)							
Instruction cycle	When main system clock is selected		Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, and 6.4 μ s (10.0 MHz)							
	When subsystem clock is selected		122 μ s (32.768 kHz)							
Internal memory	ROM	Size (bytes)	8K	16K	24K	32K	40K	48K	60K	60K (PROM)
	RAM	Size (bytes)	544		1056		1568		2080	
Address space			64K bytes							
Interrupt function	External		4							
	Internal		10							
I/O pin	CMOS input		2							
	CMOS I/O		47							
	N-ch open-drain I/O		4							
Timer			16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel							
Timer output			3 (PWM output: 1)							
Serial interface			3-wire/2-wire/I ² C bus mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel							
A/D converter			8-bit resolution \times 8 channels							
Others			Clock output function Buzzer output function							
Standby function			STOP/HALT							
Operating power supply voltage range			1.8 to 5.5 V							
Package			<ul style="list-style-type: none"> • 64-pin plastic shrink DIP (750 mil) • 64-pin plastic QFP (14 \times 14 mm, 0.8-mm pitch) • 64-pin plastic LQFP (12 \times 12 mm, 0.65-mm pitch) (except μPD78013FY, 78015FY, 78016FY) 							*
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator							
Applications			VCRs, TVs, audio equipments, etc.							

- *: • 64-pin plastic shrink DIP (750 mil)
• 64-pin plastic QFP (14 \times 14 mm, 0.8-mm pitch)
• 64-pin plastic LQFP (12 \times 12 mm, 0.65-mm pitch)
• 64-pin ceramic shrink DIP with window (750 mil)
• 64-pin ceramic WQFN (14 \times 14 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78014H Subseries)

Part number		μ PD78011H	μ PD78012H	μ PD78013H	μ PD78014H
Number of basic instructions		63			
Minimum instruction execution time		0.4 μ s (10.0 MHz)			
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, and 6.4 μ s (10.0 MHz)			
	When subsystem clock is selected	122 μ s (32.768 kHz)			
Internal memory	ROM	8K	16K	24K	32K
	RAM	544		1056	
Address space		64K bytes			
Interrupt function	External	4			
	Internal	10			
I/O pin	CMOS input	2			
	CMOS I/O	47			
	N-ch open-drain I/O	4			
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel			
Timer output		3 (PWM output: 1)			
Serial interface		3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel			
A/D converter		8-bit resolution \times 8 channels			
Others		Clock output function Buzzer output function			
Standby function		STOP/HALT			
Operating power supply voltage range		1.8 to 5.5 V			
Package		<ul style="list-style-type: none"> • 64-pin plastic shrink DIP (750 mil) • 64-pin plastic QFP (14 \times 14 mm, 0.8-mm pitch) • 64-pin plastic LQFP (12 \times 12 mm, 0.65-mm pitch) 			
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator			
Applications		Cellular phones, VCRs, audio equipments, cameras, home appliances, etc.			

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD780024A, 780034A Subseries)

Part number		μ PD780021A μ PD780031A	μ PD780022A μ PD780032A	μ PD780023A μ PD780033A	μ PD780024A μ PD780034A	μ PD78F0034A	
Number of basic instructions		63					
Minimum instruction execution time		0.24 μ s (8.38 MHz)					
Instruction cycle	When main system clock is selected	Selectable from 0.24 μ s, 0.48 μ s, 0.95 μ s, 1.91 μ s, and 3.81 μ s (8.38 MHz)					
	When subsystem clock is selected	122 μ s (32.768 kHz)					
Internal memory	ROM	Size (bytes)	8K	16K	24K	32K	32K (Flash memory)
	RAM	Size (bytes)	512		1024		
Address space		64K bytes					
Interrupt function	External		5				
	Internal		15				
I/O pin	CMOS input		8				
	CMOS I/O		39				
	N-ch open-drain I/O		4				
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel					
Timer output		3 (PWM output: 2)					
Serial interface		3-wire: 2 channels UART: 1 channel					
A/D converter		8-bit resolution \times 8 channels (μ PD780021A, 780022A, 780023A, 780024A) 10-bit resolution \times 8 channels (μ PD780031A, 780032A, 780033A, 780034A, 78F0034A)					
Others		Clock output function Buzzer output function					
Standby function		STOP/HALT					
Operating power supply voltage range		1.8 to 5.5 V					
Package		<ul style="list-style-type: none"> • 64-pin plastic shirink DIP (750 mil) • 64-pin plastic QFP (14 \times 14 mm, 0.8-mm pitch) • 64-pin plastic LQFP (12 \times 12 mm, 0.65-mm pitch) 					
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications		VCRs, TVs, audio equipments, etc.					

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD780024AY, 780034AY Subseries)

Part number		μ PD780021AY μ PD780031AY	μ PD780022AY μ PD780032AY	μ PD780023AY μ PD780033AY	μ PD780024AY μ PD780034AY	μ PD78F0034AY	
Number of basic instructions		63					
Minimum instruction execution time		0.24 μ s (8.38 MHz)					
Instruction cycle	When main system clock is selected	Selectable from 0.24 μ s, 0.48 μ s, 0.95 μ s, 1.91 μ s, and 3.81 μ s (8.38 MHz)					
	When subsystem clock is selected	122 μ s (32.768 kHz)					
Internal memory	ROM	Size (bytes)	8K	16K	24K	32K	32K (Flash memory)
	RAM	Size (bytes)	512		1024		
Address space		64K bytes					
Interrupt function	External	5					
	Internal	15					
I/O pin	CMOS input		8				
	CMOS I/O		39				
	N-ch open-drain I/O		4				
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel					
Timer output		3 (PWM output: 2)					
Serial interface		3-wire: 1 channel UART: 1 channel I ² C bus (supporting multiplex master): 1 channel					
A/D converter		8-bit resolution \times 8 channels (μ PD780021AY, 780022AY, 780023AY, 780024AY) 10-bit resolution \times 8 channels (μ PD780031AY, 780032AY, 780033AY, 780034AY, 78F0034AY)					
Others		Clock output function Buzzer output function					
Standby function		STOP/HALT					
Operating power supply voltage range		1.8 to 5.5 V					
Package		<ul style="list-style-type: none"> • 64-pin plastic shirink DIP (750 mil) • 64-pin plastic QFP (14 \times 14 mm, 0.8-mm pitch) • 64-pin plastic LQFP (12 \times 12 mm, 0.65-mm pitch) 					
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications		VCRs, TVs, audio equipments, etc.					

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD780078, 780078Y Subseries)

Subseries name			μ PD780078 Subseries			μ PD780078Y Subseries		
Part number			μ PD780076*	μ PD780078*	μ PD78F0078*	μ PD780076Y*	μ PD780078Y*	μ PD78F0078Y*
Number of basic instructions			63					
Minimum instruction execution time			0.24 μ s (8.38 MHz)					
Instruction cycle	When main system clock is selected		Selectable from 0.24 μ s, 0.48 μ s, 0.95 μ s, 1.91 μ s, and 3.81 μ s (8.38 MHz)					
	When subsystem clock is selected		122 μ s (32.768 kHz)					
Internal memory	ROM	Size (bytes)	48K	60K	60K (Flash memory)	48K	60K	60K (Flash memory)
	RAM	Size (bytes)	2048					
Address space			64K bytes					
Interrupt function	External		5					
	Internal		15					
I/O pin	CMOS input		8					
	CMOS I/O		40					
	N-ch open-drain I/O		4					
Timer			16-bit timer/event counter \times 2 channels 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel					
Timer output			4 (PWM output: 2)					
Serial interface			3-wire/UART mode (selectable): 1 channel UART: 1 channel 3-wire: 1 channel			3-wire/UART mode (selectable): 1 channel UART: 1 channel 3-wire: 1 channel I ² C bus (supporting multiplex master): 1 channel		
A/D converter			10-bit resolution \times 8 channels					
Others			Clock output function Buzzer output function					
Standby function			STOP/HALT					
Operating power supply voltage range			$V_{DD} = 1.8$ to 5.5 V					
Package			<ul style="list-style-type: none"> • 64-pin plastic QFP (14 \times 14 mm, 0.8-mm pitch) • 64-pin plastic LQFP (12 \times 12 mm, 0.65-mm pitch) 					
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications			Telephones, AV equipment, automotive electronics, etc.					

* : Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD780065 Subseries)

Part number		μ PD780065	μ PD78F0066*
Number of basic instructions		63	
Minimum instruction execution time		0.24 μ s (8.38 MHz)	
Instruction cycle	When main system clock is selected	Selectable from 0.24 μ s, 0.48 μ s, 0.96 μ s, 1.92 μ s, 3.84 μ s and 7.68 μ s (8.38 MHz)	
	When subsystem clock is selected	122 μ s (32.768 kHz)	
Internal memory	ROM	40K	48K (Flash memory)
	RAM	5K	
Address space		64K bytes	
Interrupt function	External	4	
	Internal	13	
I/O pin	CMOS I/O	53	
Timer		16-bit timer/event counter \times 1 channel 8-bit timer \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel	
Timer output		3 (PWM output: 2)	
Serial interface		3-wire: 1 channel 2-wire: 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel UART: 1 channel	
A/D converter		8-bit resolution \times 8 channels	
Others		Clock output function Buzzer output function	
Standby function		STOP/HALT	
Operating power supply voltage range		$V_{DD} = 2.7$ to 5.5 V	
Package		80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)	
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator	
Applications		Control of audio systems compatible with CD text, etc.	

*: Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78054 Subseries)

Part number			μ PD78052	μ PD78053	μ PD78054	μ PD78P054	μ PD78055	μ PD78056	μ PD78058	μ PD78P058
Number of basic instructions			63							
Minimum instruction execution time			0.4 μ s (5.0 MHz)							
Instruction cycle	When main system clock is selected		Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)							
	When subsystem clock is selected		122 μ s (32.768 kHz)							
Internal memory	ROM	Size (bytes)	16K	24K	32K	32K (PROM)	40K	48K	60K	60K (PROM)
	RAM	Size (bytes)	544	1056					2080	
Address space			64K bytes							
Interrupt function	External		7							
	Internal		15							
I/O pin	CMOS input		2							
	CMOS I/O		63							
	N-ch open-drain I/O		4							
Timer			16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel							
Timer output			3 (PWM output: 1)							
Serial interface			3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire/UART mode (selectable): 1 channel							
A/D converter			8-bit resolution \times 8 channels							
D/A converter			8-bit resolution \times 2 channels							
Others			Clock output function Buzzer output function							
Standby function			STOP/HALT							
Operating power supply voltage range			2.0 to 6.0 V							
Package			<ul style="list-style-type: none"> • 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch) • 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch) 			*1	<ul style="list-style-type: none"> • 80-pin plastic QFP (14 \times 14 mm) • 80-pin plastic TQFP (12 \times 12 mm) 			*2
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator							
Applications			Cellular phones, pagers, printers, AV equipments, air conditioners, cameras, PPCs, fuzzy home appliances, vending machines, etc.							

- *1: • 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)
 • 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch)
 • 80-pin ceramic WQFN (14 \times 14 mm)

- *2: • 80-pin plastic QFP (14 \times 14 mm)
 • 80-pin ceramic WQFN (14 \times 14 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78054Y Subseries)

Part number		μ PD78052Y	μ PD78053Y	μ PD78054Y	μ PD78055Y	μ PD78056Y	μ PD78058Y	μ PD78P058Y
Number of basic instructions		63						
Minimum instruction execution time		0.4 μ s (5.0 MHz)						
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)						
	When subsystem clock is selected	122 μ s (32.768 kHz)						
Internal memory	ROM	Size (bytes)	16K	24K	32K	40K	48K	60K
	RAM	Size (bytes)	544	1056			2080	
Address space		64K bytes						
Interrupt function	External	7						
	Internal	15						
I/O pin	CMOS input	2						
	CMOS I/O	63						
	N-ch open-drain I/O	4						
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel						
Timer output		3 (PWM output: 1)						
Serial interface		3-wire/I ² C bus/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire/UART mode (selectable): 1 channel						
A/D converter		8-bit resolution \times 8 channels						
D/A converter		8-bit resolution \times 2 channels						
Others		Clock output function Buzzer output function						
Standby function		STOP/HALT						
Operating power supply voltage range		2.0 to 6.0 V						
Package		<ul style="list-style-type: none"> • 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch) • 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch) 			<ul style="list-style-type: none"> • 80-pin plastic QFP (14 \times 14 mm) 		*1	*2
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator						
Applications		Cellular phones, pagers, printers, AV equipments, air conditioners, cameras, PPCs, fuzzy home appliances, vending machines, etc.						

- *1: • 80-pin plastic QFP (14 \times 14 mm)
• 80-pin plastic TQFP (12 \times 12 mm)
- *2: • 80-pin plastic QFP (14 \times 14 mm)
• 80-pin ceramic WQFN (14 \times 14 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78058F Subseries)

Part number			μ PD78056F	μ PD78058F	μ PD78P058F
Number of basic instructions			63		
Minimum instruction execution time			0.4 μ s (5.0 MHz)		
Instruction cycle	When main system clock is selected		Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)		
	When subsystem clock is selected		122 μ s (32.768 kHz)		
Internal memory	ROM	Size (bytes)	48K	60K	60K (PROM)
	RAM	Size (bytes)	1056	2080	
Address space			64K bytes		
Interrupt function	External		7		
	Internal		15		
I/O pin	CMOS input		2		
	CMOS I/O		63		
	N-ch open-drain I/O		4		
Timer			16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output			3 (PWM output: 1)		
Serial interface			3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire/UART mode (selectable): 1 channel		
A/D converter			8-bit resolution \times 8 channels		
D/A converter			8-bit resolution \times 2 channels		
Others			Clock output function Buzzer output function		
Standby function			STOP/HALT		
Operating power supply voltage range			2.7 to 6.0 V		
Package			• 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)	• 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch) • 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch)	• 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications			Cellular phones, AV equipments, car stereo, cameras, PPCs, etc.		

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78058FY Subseries)

Part number		μ PD78056FY	μ PD78058FY	μ PD78P058FY
Number of basic instructions		63		
Minimum instruction execution time		0.4 μ s (5.0 MHz)		
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)		
	When subsystem clock is selected	122 μ s (32.768 kHz)		
Internal memory	ROM	Size (bytes)	48K	60K
	RAM	Size (bytes)	1056	60K (PROM) 2080
Address space		64K bytes		
Interrupt function	External	7		
	Internal	15		
I/O pin	CMOS input		2	
	CMOS I/O		63	
	N-ch open-drain I/O		4	
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output		3 (PWM output: 1)		
Serial interface		3-wire/I ² C bus/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire/UART mode (selectable): 1 channel		
A/D converter		8-bit resolution \times 8 channels		
D/A converter		8-bit resolution \times 2 channels		
Others		Clock output function Buzzer output function		
Standby function		STOP/HALT		
Operating power supply voltage range		2.7 to 6.0 V		
Package		• 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)	• 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch) • 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch)	• 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Cellular phones, AV equipments, car stereo, cameras, PPCs, etc.		

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD780058 Subseries)

Part number		μ PD780053	μ PD780054	μ PD780055	μ PD780056	μ PD780058	μ PD78F0058*
Number of basic instructions		63					
Minimum instruction execution time		0.4 μ s (5.0 MHz)					
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)					
	When subsystem clock is selected	122 μ s (32.768 kHz)					
Internal memory	ROM	Size (bytes)	24K	32K	40K	48K	60K (Flash memory)
	RAM	Size (bytes)	1056			2080	
Address space		64K bytes					
Interrupt function	External	7					
	Internal	15					
I/O pin	CMOS input	2					
	CMOS I/O	62					
	N-ch open-drain I/O	4					
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel					
Timer output		3 (PWM output: 1)					
Serial interface		3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire/UART mode (with time-division transmission function) (selectable): 1 channel					
A/D converter		8-bit resolution \times 8 channels					
D/A converter		8-bit resolution \times 2 channels					
Others		Clock output function Buzzer output function					
Standby function		STOP/HALT					
Operating power supply voltage range		1.8 to 5.5 V					
Package		<ul style="list-style-type: none"> • 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch) • 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch) 					
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications		Cellular phones, pagers, printers, AV equipments, air conditioners, cameras, PPCs, fuzzy home appliances, vending machines, etc.					

* : Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD780058Y Subseries)

Part number		μ PD780053Y*	μ PD780054Y*	μ PD780055Y*	μ PD780056Y*	μ PD780058Y*	μ PD78F0058Y*
Number of basic instructions		63					
Minimum instruction execution time		0.4 μ s (5.0 MHz)					
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)					
	When subsystem clock is selected	122 μ s (32.768 kHz)					
Internal memory	ROM	Size (bytes)	24K	32K	40K	48K	60K (Flash memory)
	RAM	Size (bytes)	1056			2080	
Address space		64K bytes					
Interrupt function	External	7					
	Internal	15					
I/O pin	CMOS input		2				
	CMOS I/O		62				
	N-ch open-drain I/O		4				
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel					
Timer output		3 (PWM output: 1)					
Serial interface		3-wire/I ² C bus/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire/UART mode (with time-division transmission function) (selectable): 1 channel					
A/D converter		8-bit resolution \times 8 channels					
D/A converter		8-bit resolution \times 2 channels					
Others		Clock output function Buzzer output function					
Standby function		STOP/HALT					
Operating power supply voltage range		1.8 to 5.5 V					
Package		<ul style="list-style-type: none"> • 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch) • 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch) 					
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications		Cellular phones, pagers, printers, AV equipments, air conditioners, cameras, PPCs, fuzzy home appliances, vending machines, etc.					

★: Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD780018AY Subseries)

Part number		μ PD780016AY	μ PD780018AY	μ PD78P0018AY
Number of basic instructions		63		
Minimum instruction execution time		0.4 μ s (5.0 MHz)		
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, and 6.4 μ s (5.0 MHz)		
	When subsystem clock is selected	122 μ s (32.768 kHz)		
Internal memory	ROM	Size (bytes)	48K	60K
	RAM	Size (bytes)	2080	
Address space		64K bytes		
Interrupt function	External		7	
	Internal		13	
I/O pin	CMOS input		9	
	CMOS I/O		79	
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 4 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output		5 (PWM output: 3)		
Serial interface		3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire (with time-division transmission function): 1 channel I ² C bus (supporting multiplex master): 1 channel		
A/D converter		8-bit resolution \times 8 channels		
Others		Clock output function Buzzer output function		
Standby function		Main STOP/Sub STOP/HALT		
Operating power supply voltage range		2.7 to 5.5 V		
Package		• 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)		*
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Mini-component stereo systems, car stereos, etc.		

- *: • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)
• 100-pin ceramic WQFN (14 \times 20 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78075B, 78078 Subseries)

Subseries name		μ PD78075B Subseries		μ PD78078 Subseries		
Part number		μ PD78074B	μ PD78075B	μ PD78076	μ PD78078	μ PD78P078
Number of basic instructions		63				
Minimum instruction execution time		0.4 μ s (5.0 MHz)				
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)				
	When subsystem clock is selected	122 μ s (32.768 kHz)				
Internal memory	ROM	Size (bytes)	32K	40K	48K	60K
	RAM	Size (bytes)	1056		2080	
Address space		64K bytes				
Interrupt function	External	7				
	Internal	17				
I/O pin	CMOS input		2			
	CMOS I/O		78			
	N-ch open-drain I/O		8			
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 4 channels Watch timer \times 1 channel Watchdog timer \times 1 channel				
Timer output		5 (PWM output: 3)				
Serial interface		3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire/UART mode (selectable): 1 channel				
A/D converter		8-bit resolution \times 8 channels				
D/A converter		8-bit resolution \times 2 channels				
Others		Clock output function Buzzer output function				
Standby function		STOP/HALT				
Operating power supply voltage range		1.8 to 5.5 V				
Package		<ul style="list-style-type: none"> • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch) • 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 				*
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator				
Applications		Cellular phones, cordless phones, audio equipments, VCRs, printers, etc.				

- *: • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)
• 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch)
• 100-pin ceramic WQFN (14 \times 20 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78078Y Subseries)

Part number		μ PD78076Y	μ PD78078Y	μ PD78P078Y
Number of basic instructions		63		
Minimum instruction execution time		0.4 μ s (5.0 MHz)		
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)		
	When subsystem clock is selected	122 μ s (32.768 kHz)		
Internal memory	ROM	Size (bytes)	48K	60K
	RAM	Size (bytes)	2080	
Address space		64K bytes		
Interrupt function	External	7		
	Internal	17		
I/O pin	CMOS input		2	
	CMOS I/O		78	
	N-ch open-drain I/O		8	
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 4 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output		5 (PWM output: 3)		
Serial interface		3-wire/2-wire/I ² C bus mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire/UART mode (selectable): 1 channel		
A/D converter		8-bit resolution \times 8 channels		
D/A converter		8-bit resolution \times 2 channels		
Others		Clock output function Buzzer output function		
Standby function		STOP/HALT		
Operating power supply voltage range		1.8 to 5.5 V		
Package		<ul style="list-style-type: none"> • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch) • 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 		*
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		VCRs, TVs, audio equipments, etc.		

- *: • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)
 • 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch)
 • 100-pin ceramic WQFN (14 \times 20 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78070A, 78070AY)

Part number		μ PD78070A	μ PD78070AY
Number of basic instructions		63	
Minimum instruction execution time		0.4 μ s (5.0 MHz)	
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)	
	When subsystem clock is selected	122 μ s (32.768 kHz)	
Internal memory	ROM	Size (bytes)	
	RAM	Size (bytes)	
Address space		64K bytes	
Interrupt function	External	7	
	Internal	17	
I/O pin	CMOS input	2	
	CMOS I/O	51	
	N-ch open-drain I/O	8	
Timer	16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 4 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output	5 (PWM output: 3)		
Serial interface	*1	*2	
A/D converter	8-bit resolution \times 8 channels		
D/A converter	8-bit resolution \times 2 channels		
Others	Clock output function Buzzer output function		
Standby function	STOP/HALT		
Operating power supply voltage range	2.7 to 5.5 V		
Package	<ul style="list-style-type: none"> • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch) • 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 		
Development tools	Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications	CD-ROMs, printers, PPCs, etc.		

- *1: • 3-wire/SBI/2-wire mode (selectable): 1 channel
• 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel
• 3-wire/UART mode (selectable): 1 channel
- *2: • 3-wire/2-wire/I²C bus mode selectable: 1 channel
• 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel
• 3-wire/UART mode (selectable): 1 channel

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Controller Series (μ PD78083 Subseries)

Part number			μ PD78081	μ PD78082	μ PD78P083
Number of basic instructions			63		
Minimum instruction execution time			0.4 μ s (5.0 MHz)		
Instruction cycle		When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s and 12.8 μ s (5.0 MHz)		
Internal memory	ROM	Size (bytes)	8K	16K	24K (PROM)
	RAM	Size (bytes)	256	384	512
Address space			64K bytes		
Interrupt function		External	3		
		Internal	10		
I/O pin	CMOS input		1		
	CMOS I/O		32		
Timer			8-bit timer/event counter \times 2 channels Watchdog timer \times 1 channel		
Timer output			2 (PWM output: 2)		
Serial interface			3-wire/UART mode (selectable): 1 channel		
A/D converter			8-bit resolution \times 8 channels		
Others			Clock output function Buzzer output function		
Standby function			STOP/HALT		
Operating power supply voltage range			1.8 to 5.5 V		
Package			<ul style="list-style-type: none"> • 42-pin plastic shrink DIP (600 mil) • 44-pin plastic QFP (10 \times 10 mm, 0.8-mm pitch) 		<ul style="list-style-type: none"> • 42-pin plastic shrink DIP (600 mil) • 44-pin plastic QFP (10 \times 10 mm, 0.8-mm pitch) • 42-pin ceramic shrink DIP with window (600 mil)
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications			Automotive electronics, OA equipments, display equipments, air conditioners, keyless entry, etc.		

8-Bit Single-Chip Microcontroller

78K/0 Series

■ FIP Drive Series (μ PD78044F Subseries)

Part number		μ PD78042F	μ PD78043F	μ PD78044F	μ PD78045F	μ PD78P048A
Number of basic instructions		63				
Minimum instruction execution time		0.4 μ s (5.0 MHz)				
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, and 6.4 μ s (5.0 MHz)				
	When subsystem clock is selected	122 μ s (32.768 kHz)				
Internal memory	ROM	Size (bytes)	16K	24K	32K	40K
	RAM	Size (bytes)	624		1136	
Interrupt function	External	4				
	Internal	12				
I/O pin	CMOS input	2				
	CMOS I/O	27				
	N-ch open-drain I/O	5				
	P-ch open-drain I/O	16				
	P-ch open-drain output	18				
Timer	16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel 6-bit up/down counter \times 1 channel					
Timer output	3 (PWM output: 1)					
Serial interface	3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 64 bytes): 1 channel					
A/D converter	8-bit resolution \times 8 channels					
FIP controller/driver	Number of segments: 9 to 24 Number of digits: 2 to 16					
Others	Clock output function Buzzer output function					
Standby function	STOP/HALT					
Operating power supply voltage range	2.7 to 5.5 V					
Package	• 80-pin plastic QFP (14 \times 20 mm, 0.8-mm pitch) *					
Development tools	Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications	VCRs, audio equipments, microwave ovens, etc.					

- *: • 80-pin plastic QFP (14 \times 20 mm, 0.8-mm pitch)
• 80-pin ceramic WQFN (14 \times 20 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ FIP Drive Series (μ PD78044H Subseries)

Part number		μ PD78044H	μ PD78045H	μ PD78046H
Number of basic instructions		63		
Minimum instruction execution time		0.4 μ s (5.0 MHz)		
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, and 6.4 μ s (5.0 MHz)		
	When subsystem clock is selected	122 μ s (32.768 kHz)		
Internal memory	ROM	Size (bytes)	32K	40K
	RAM	Size (bytes)	1136	
Interrupt function	External		4	
	Internal		10	
I/O pin	CMOS input		2	
	CMOS I/O		19	
	N-ch open-drain I/O		13	
	P-ch open-drain I/O		16	
	P-ch open-drain output		18	
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output		3 (PWM output: 1)		
Serial interface		3-wire: 1 channel		
A/D converter		8-bit resolution \times 8 channels		
FIP controller/driver		Number of segments: 9 to 24 Number of digits: 2 to 16		
Others		Clock output function Buzzer output function		
Standby function		STOP/HALT		
Operating power supply voltage range		2.7 to 5.5 V		
Package		• 80-pin plastic QFP (14 \times 20 mm, 0.8-mm pitch)		
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Mini-component stereo systems, microwave ovens, ECRs, etc.		

8-Bit Single-Chip Microcontroller

78K/0 Series

■ FIP Drive Series (μ PD780208 Subseries)

Part number		μ PD780204	μ PD780205	μ PD780206	μ PD780208	μ PD78P0208
Number of basic instructions		63				
Minimum instruction execution time		0.4 μ s (5.0 MHz)				
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, and 6.4 μ s (5.0 MHz)				
	When subsystem clock is selected	122 μ s (32.768 kHz)				
Internal memory	ROM	Size (bytes)	32K	40K	48K	60K
	RAM	Size (bytes)	1168		2192	
Interrupt function	External	4				
	Internal	12				
I/O pin	CMOS input	2				
	CMOS I/O	27				
	N-ch open-drain I/O	5				
	P-ch open-drain I/O	24				
	P-ch open-drain output	16				
Timer	16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel					
Timer output	3 (PWM output: 1)					
Serial interface	3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 64 bytes): 1 channel					
A/D converter	8-bit resolution \times 8 channels					
FIP controller/driver	Number of segments: 9 to 40 Number of digits: 2 to 16					
Others	Clock output function Buzzer output function					
Standby function	STOP/HALT					
Operating power supply voltage range	2.7 to 5.5 V					
Package	• 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch) *					
Development tools	Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications	VCRs, audio equipments, microwave ovens, etc.					

*: • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)

• 100-pin ceramic WQFN (14 \times 20 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ FIP Drive Series (μ PD780232 Subseries)

Part number			μ PD780232	μ PD78F0233*
Number of basic instructions			63	
Minimum instruction execution time			0.4 μ s (5.0 MHz)	
Instruction cycle			Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s and 6.4 μ s (5.0 MHz)	
Internal memory	ROM	Size (bytes)	16K	24K (Flash memory)
	RAM	Size (bytes)	768	
Interrupt function		External	2	
		Internal	12	
I/O pin	CMOS I/O		11	
	P-ch open-drain I/O		29	
	P-ch open-drain output		24	
Timer			8-bit remote control timer \times 1 channel 8-bit timer \times 2 channels Watchdog timer \times 1 channel	
Timer output			3 (PWM output: 2)	
Serial interface			2-wire: 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel	
A/D converter			8-bit resolution \times 4 channels	
FIP controller/driver			Display outputs: 53	
Standby function			STOP/HALT	
Operating power supply voltage range			$V_{DD} = 4.5$ to 5.5 V	
Package			80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)	
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator	
Applications			Combined mini-component stereo systems, separate mini-component stereo systems, tuners, cassette tape decks, compact disc/mini disc players, audio amplifiers, etc.	

*: Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ LCD Drive Series (μ PD78064, 78064B Subseries)

Subseries name		μ PD78064 Subseries				μ PD78064B Subseries	
Part number		μ PD78062	μ PD78063	μ PD78064	μ PD78P064	μ PD78064B	μ PD78P064B
Number of basic instructions		63					
Minimum instruction execution time		0.4 μ s (5.0 MHz)					
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)					
	When subsystem clock is selected	122 μ s (32.768 kHz)					
Internal memory	ROM	Size (bytes)	16K	24K	32K	32K (PROM)	32K
	RAM	Size (bytes)	532	1044			
Interrupt function	External		6				
	Internal		14				
I/O pin	CMOS input		2				
	CMOS I/O		55				
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel					
Timer output		3 (PWM output: 1)					
Serial interface		3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire/UART mode (selectable): 1 channel					
A/D converter		8-bit resolution \times 8 channels					
LCD controller/driver		Segment signal outputs: 40 maximum Common signal outputs: 4 maximum Bias: 1/2 or 1/3 (switchable)					
Others		Clock output function Buzzer output function					
Standby function		STOP/HALT					
Operating power supply voltage range		2.0 to 6.0 V					
Package		<ul style="list-style-type: none"> • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch) • 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 			*	<ul style="list-style-type: none"> • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch) • 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 	
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications		Cellular phones, CD players, cameras, etc.					

- *: • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)
• 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch)
• 100-pin ceramic WQFN (14 \times 20 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ LCD Drive Series (μ PD78064Y Subseries)

Part number		μ PD78062Y	μ PD78063Y	μ PD78064Y
Number of basic instructions		63		
Minimum instruction execution time		0.4 μ s (5.0 MHz)		
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)		
	When subsystem clock is selected	122 μ s (32.768 kHz)		
Internal memory	ROM	Size (bytes)	16K	24K
	RAM	Size (bytes)	532	1044
Interrupt function	External		6	
	Internal		14	
I/O pin	CMOS input		2	
	CMOS I/O		55	
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output		3 (PWM output: 1)		
Serial interface		3-wire/2-wire/I ² C bus mode (selectable): 1 channel 3-wire/UART mode (selectable): 1 channel		
A/D converter		8-bit resolution \times 8 channels		
LCD controller/driver		Segment signal outputs: 40 maximum Common signal outputs: 4 maximum Bias: 1/2 or 1/3 (switchable)		
Others		Clock output function Buzzer output function		
Standby function		STOP/HALT		
Operating power supply voltage range		2.0 to 6.0 V		
Package		<ul style="list-style-type: none"> • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch) • 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 		
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Cellular phones, CD players, cameras, etc.		

8-Bit Single-Chip Microcontroller

78K/0 Series

■ LCD Drive Series (μ PD780308, 780308Y Subseries)

Subseries name		μ PD780308 Subseries			μ PD780308Y Subseries		
Part number		μ PD780306	μ PD780308	μ PD78P0308*	μ PD780306Y	μ PD780308Y	μ PD78P0308Y*
Number of basic instructions		63					
Minimum instruction execution time		0.4 μ s (5.0 MHz)					
Instruction cycle	When main system clock is selected	Selectable from 0.4 μ s, 0.8 μ s, 1.6 μ s, 3.2 μ s, 6.4 μ s, and 12.8 μ s (5.0 MHz)					
	When subsystem clock is selected	122 μ s (32.768 kHz)					
Internal memory	ROM	Size (bytes)	48K	60K	48K	60K	60K (PROM)
	RAM	Size (bytes)	2068				
Address space		64K bytes					
Interrupt function	External	6					
	Internal	15					
I/O pin	CMOS input	2					
	CMOS I/O	55					
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel					
Timer output		3 (PWM output: 1)					
Serial interface		3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire/UART mode (selectable): 1 channel 3-wire (with time-division transmission function): 1 channel			3-wire/I ² C bus/2-wire mode (selectable): 1 channel 3-wire/UART mode (selectable): 1 channel 3-wire (with time-division transmission function): 1 channel		
A/D converter		8-bit resolution \times 8 channels					
LCD controller/driver		Segment signal outputs: 40 maximum Common signal outputs: 4 maximum Bias: 1/2 or 1/3 (switchable)					
Others		Clock output function Buzzer output function					
Standby function		STOP/HALT					
Operating power supply voltage range		2.0 to 5.5 V					
Package		<ul style="list-style-type: none"> • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch) • 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 	*		<ul style="list-style-type: none"> • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch) • 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 	*	
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications		Cellular phones, pagers, CD players, meters, etc.					

- *: • 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)
• 100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch)
• 100-pin ceramic WQFN (14 \times 20 mm)

★: Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Inverter Controller Series (μ PD780988 Subseries)

Part number			μ PD780982*	μ PD780983*	μ PD780984*	μ PD780986	μ PD780988	μ PD78F0988*
Number of basic instructions			63					
Minimum instruction execution time			0.24 μ s (8.38 MHz)					
Instruction cycle			Selectable from 0.24 μ s, 0.48 μ s, 0.95 μ s, 1.9 μ s and 3.8 μ s (8.38 MHz)					
Internal memory	ROM	Size (bytes)	16K	24K	32K	48K	60K	60K (Flash memory)
	RAM	Size (bytes)	1024			2048		
Address space			64K bytes					
Interrupt function		External	8					
		Internal	16					
I/O pin	CMOS input		8					
	CMOS I/O		39					
Timer			10-bit timer for inverter control \times 1 channel 16-bit timer/event counter \times 2 channels 8-bit timer/event counter \times 3 channels Watchdog timer \times 1 channel					
Timer output			11 (PWM output: 3, inverter control output: 6)					
Serial interface			3-wire: 1 channel UART: 2 channels					
A/D converter			10-bit resolution \times 8 channels					
Others			Real-time output port					
Standby function			STOP/HALT					
Operating power supply voltage range			$V_{DD} = 4.0$ to 5.5 V					
Package			64-pin plastic shrink DIP (750 mil) 64-pin plastic QFP (14 \times 14 mm, 0.8 mm pitch)					
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator					
Applications			Motor control for inverter-type air conditioners, washing machines, etc.					

*: Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Call ID Series (μ PD780841 Subseries)

Part number		μ PD780840*	μ PD780841*	μ PD78F0841*
Number of basic instructions		63		
Instruction cycle	When main system clock is selected	0.56 μ s (3.58 MHz)		
	When subsystem clock is selected	122 μ s (32.768 kHz)		
Internal memory	ROM	Size (bytes)	24K	32K
	RAM	Size (bytes)	1024	
Address space		64K bytes		
Interrupt function	External		5	
	Internal		8	
I/O pin	CMOS input		2	
	CMOS I/O		55	
	N-ch open-drain I/O		4	
Timer		8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output		2 (PWM output: 2)		
Serial interface		3-wire: 1 channel 3-wire/UART mode (selectable): 1 channel		
A/D converter		8-bit resolution \times 2 channels		
Others		Call ID decoder function Simple DTMF function		
Standby function		STOP/HALT		
Operating power supply voltage range		$V_{DD} = 2.7$ to 5.5 V		
Package		80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)		
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Cordless phones, etc.		

*: Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Super Low Power Consumption (Meter Controller) Series (μ PD780955)

Part number			μ PD780955*
Number of basic instructions			62
Minimum instruction execution time			52 μ s (38.4 kHz)
Internal memory	ROM	Size (bytes)	40K
	RAM	Size (bytes)	1024
Address space			64K bytes
Interrupt function	External		7
	Internal		10
I/O pin	CMOS I/O		47
	N-ch open drain I/O		3
Timer			16-bit counter \times 1 channel 8-bit timer/event counter \times 1 channel 8-bit timer \times 5 channels Watchdog timer \times 1 channel
Timer output			1
Serial interface			UART: 2 channels
A/D converter			8-bit resolution \times 1 channel
LCD controller			Segment signal outputs: 19 maximum Common signal outputs: 1 Static display mode only
Others			Quality grade: Special (μ PD780955(A)) only (for high reliability electronic equipment)
Standby function			HALT
Operating power supply voltage range			$V_{DD} = 2.2$ to 3.5 V
Package			80-pin plastic QFP (14 \times 20 mm, 0.8 mm pitch)
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator
Applications			Gas meters, etc.

* : Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Super Low Power Consumption (Meter Controller) Series (μ PD780958 Subseries)

Part number			μ PD780957*	μ PD780958*
Number of basic instructions			62	
Minimum instruction execution time			2 μ s (1.0 MHz), 61 μ s (32.768 kHz)	
Internal memory	ROM	Size (bytes)	48K	60K
	RAM	Size (bytes)	2048	
Address space			64K bytes	
Interrupt function	External		7	
	Internal		17	
I/O pin	CMOS I/O		66	
	N-ch open-drain I/O		3	
Timer			16-bit timer/event counter \times 2 channels 8-bit timer \times 4 channels Watchdog timer \times 1 channel	
Timer output			1	
Serial interface			UART: 1 channel 3-wire: 1 channel	
LCD controller/driver			Segment signal outputs: 30 maximum Common signal outputs: 3 maximum Bias: static or 1/3 (switchable)	
Others			MR control function Sampling output function Quality grade: Special (μ PD780957(A), μ PD780958(A)) only (for high reliability electronic equipment)	
Standby function			HALT	
Operating power supply voltage range			$V_{DD} = 2.2$ to 3.5 V	
Package			100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch)	
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator	
Applications			Gas meters, etc.	

* : Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Dashboard Controller Series (μ PD780973 Subseries)

Part number			μ PD780973*	μ PD78F0974*
Number of basic instructions			63	
Minimum instruction execution time			0.24 μ s (8.38 MHz)	
Instruction cycle			Selectable from 0.24 μ s, 0.48 μ s, 0.95 μ s, 1.91 μ s, and 3.81 μ s (8.38 MHz)	
Internal memory	ROM	Size (bytes)	24K	32K (Flash memory)
	RAM	Size (bytes)	778	1034
	EEPROM	Size (bytes)	256	
Address space			64K bytes	
Interrupt function		External	3	
		Internal	18	
I/O pin	CMOS input		5	
	CMOS Output		16	
	CMOS I/O		35	
Timer			16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 3 channels Watch timer \times 1 channel Watchdog timer \times 1 channel	
Timer output			2 (PWM output: 2)	
Serial interface			3-wire: 1 channel UART: 1 channel	
A/D converter			8-bit resolution \times 5 channels	
LCD controller/driver			Segment signal outputs: 20 maximum Common signal outputs: 4 maximum Bias: 1/3	
Sound generator			Buzzer output signal with composed amplitude	
Meter controller/driver			4 meter control (Cross-coil or stepper motor)	
Others			Clock output function	
Standby function			STOP/HALT	
Operating power supply voltage range			4.5 to 5.5 V	
Package			80-pin plastic QFP (14 \times 20 mm, 0.8-mm pitch)	
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator	
Applications			Vehicle meters control (dashboard mounted)	

*: Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■Bus Controller Series (μ PD78098B Subseries)

Part number		μ PD78095B	μ PD78096B	μ PD78098B	μ PD78P098B
Number of basic instructions		63			
Minimum instruction execution time		0.4 μ s (5.0 MHz)			
Instruction cycle	When main system clock is selected	Selectable from 0.5 μ s, 1.0 μ s, 2.0 μ s, 4.0 μ s, 8.0 μ s, and 16.0 μ s (6.0 MHz)			
	When subsystem clock is selected	122 μ s (32.768 kHz)			
Internal memory	ROM	Size (bytes)	40K	48K	60K
	RAM	Size (bytes)	1056		3104
Address space		64K bytes			
Interrupt function	External	7			
	Internal	16			
I/O pin	CMOS input	2			
	CMOS I/O	63			
	N-ch open-drain I/O	4			
Timer		16-bit timer/event counter \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel			
Timer output		3 (PWM output: 1)			
Serial interface		3-wire/SBI/2-wire mode (selectable): 1 channel 3-wire (with function for automatic transmission and reception of up to 32 bytes): 1 channel 3-wire/UART mode (selectable): 1 channel			
A/D converter		8-bit resolution \times 8 channels			
D/A converter		8-bit resolution \times 2 channels			
IEBus controller		Effective transmission speed: 26 kbps maximum			
Others		Clock output function Buzzer output function			
Standby function		STOP/HALT			
Operating power supply voltage range		2.7 to 5.5 V			
Package		• 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)			*
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator			
Applications		Car audios, CD changers, etc.			

- *: • 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)
• 80-pin ceramic WQFN (14 \times 14 mm)

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Bus Controller Series (μ PD780948 Subseries)

Part number		μ PD780948*	μ PD780949*	μ PD78F0948*	μ PD78F0949*
Number of basic instructions		63			
Minimum instruction execution time		0.25 μ s (8.0 MHz)			
Instruction cycle	When main system clock is selected	Selectable from 0.25 μ s, 0.5 μ s, 1 μ s, 2 μ s and 4 μ s (8.0 MHz)			
	When subsystem clock is selected	122 μ s (32.768 kHz)			
Internal memory	ROM	Size (bytes)	60K		60K (Flash memory)
	Internal fast RAM	Size (bytes)	1024		
	Internal expansion RAM	Size (bytes)	1024		
	EEPROM	Size (bytes)	–	256	–
Address space		64K bytes			
Interrupt function	External	5			
	Internal	24			
I/O pin	CMOS input	8			
	CMOS I/O	71			
Timer		16-bit timer/event counter \times 1 channel 16-bit timer \times 1 channel 8-bit timer/event counter \times 2 channels Watch timer \times 1 channel Watchdog timer \times 1 channel			
Timer output		4 (16-bit PWM output: 1, 8-bit PWM output: 2)			
Serial interface		3-wire: 1 channel 2-wire: 1 channel UART: 1 channel			
CAN controller		Conformed on CAN protocol Ver. 2.0 (part B), transmission speed: 500 kbps maximum			
A/D converter		8-bit resolution \times 8 channels			
LCD controller/driver		Segment signal output: 40 maximum Common signal output: 4 maximum Bias: 1/3 bias			
Power fail detect function		Battery voltage detect function			
Sound generator		Buzzer output function (with composed amplitude)			
Standby function		STOP/HALT			
Operating power supply voltage range		$V_{DD} = 4.0$ to 5.5 V			
Package		100-pin plastic QFP (14 \times 20 mm, 0.65 mm pitch)			
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator			
Applications		Control of automotive dashboard and electrical equipment in car body, etc.			

* : Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Bus Controller Series (μ PD780701Y Subseries)

Part number		μ PD780701Y*	μ PD780702Y*	μ PD78F0701Y*
Number of basic instructions		63		
Minimum instruction execution time		0.32 μ s (6.29 MHz)		
Instruction cycle		Selectable from 0.32 μ s, 0.64 μ s, 1.27 μ s, 2.54 μ s, and 5.09 μ s (6.29 MHz)		
Internal memory	ROM	60K		60K (Flash memory)
	RAM	3350		
Address space		64K bytes		
Interrupt function	External	8		
	Internal	21		
I/O pin	CMOS I/O	56		
	TTL input/CMOS output	8		
	N-ch open-drain I/O	3		
Timer		16-bit timer/event counter \times 2 channels 8-bit timer/event counter \times 3 channels Watch timer \times 1 channel Watchdog timer \times 1 channel		
Timer output		5 (PWM output: 3)		
Serial interface		3-wire: 2 channels UART: 1 channel I ² C bus (supporting multiplex master): 1 channel		
A/D converter		8-bit resolution \times 16 channels		
Power fail detect function		Battery voltage detect function		
Others		Clock output function Buzzer output function		
Bus controller		DCAN controller	IEBus controller	DCAN controller or IEBus controller
Standby function		STOP/HALT		
Operating power supply voltage range		$V_{DD} = 3.5$ to 5.5 V		
Package		80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch)		
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Car audio systems, etc.		

* : Under development

8-Bit Single-Chip Microcontroller

78K/0 Series

■ Bus Controller Series (μ PD780833Y Subseries)

Part number			μ PD780831Y*	μ PD780833Y*	μ PD78F0833Y*
Number of basic instructions			63		
Minimum instruction execution time			0.48 μ s (4.19 MHz)		
Instruction cycle			Selectable from 0.48 μ s, 0.96 μ s, 1.92 μ s, 3.84 μ s, and 7.68 μ s (4.19 MHz)		
Internal memory	ROM	Size (bytes)	60K		60K (Flash memory)
	RAM	Size (bytes)	3104		
Address space			64K bytes		
Interrupt function		External	9		
		Internal	20		
I/O pin	CMOS I/O		54		
	TTL input/CMOS output		8		
	N-ch open-drain I/O		3		
Timer			16-bit timer/event counter × 2 channels Watch timer × 1 channel Watchdog timer × 1 channel	16-bit timer/event counter × 2 channels 8-bit timer/event counter × 3 channels Watch timer × 1 channel Watchdog timer × 1 channel	
Timer output			5 (PWM output: 3)		
Serial interface			3-wire: 2 channels UART: 1 channel I ² C bus (supporting multiplex master): 1 channel		
A/D converter			8-bit resolution × 8 channels × 2		
Others			Clock output function		
Bus controller			J1850 (CLASS2) bus interface		
Standby function			STOP/HALT		
Operating power supply voltage range			V _{DD} = 4.5 to 5.5 V		
Package			80-pin plastic QFP (14 × 14 mm, 0.65-mm pitch)		
Development tools			Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications			Car audio systems, etc.		

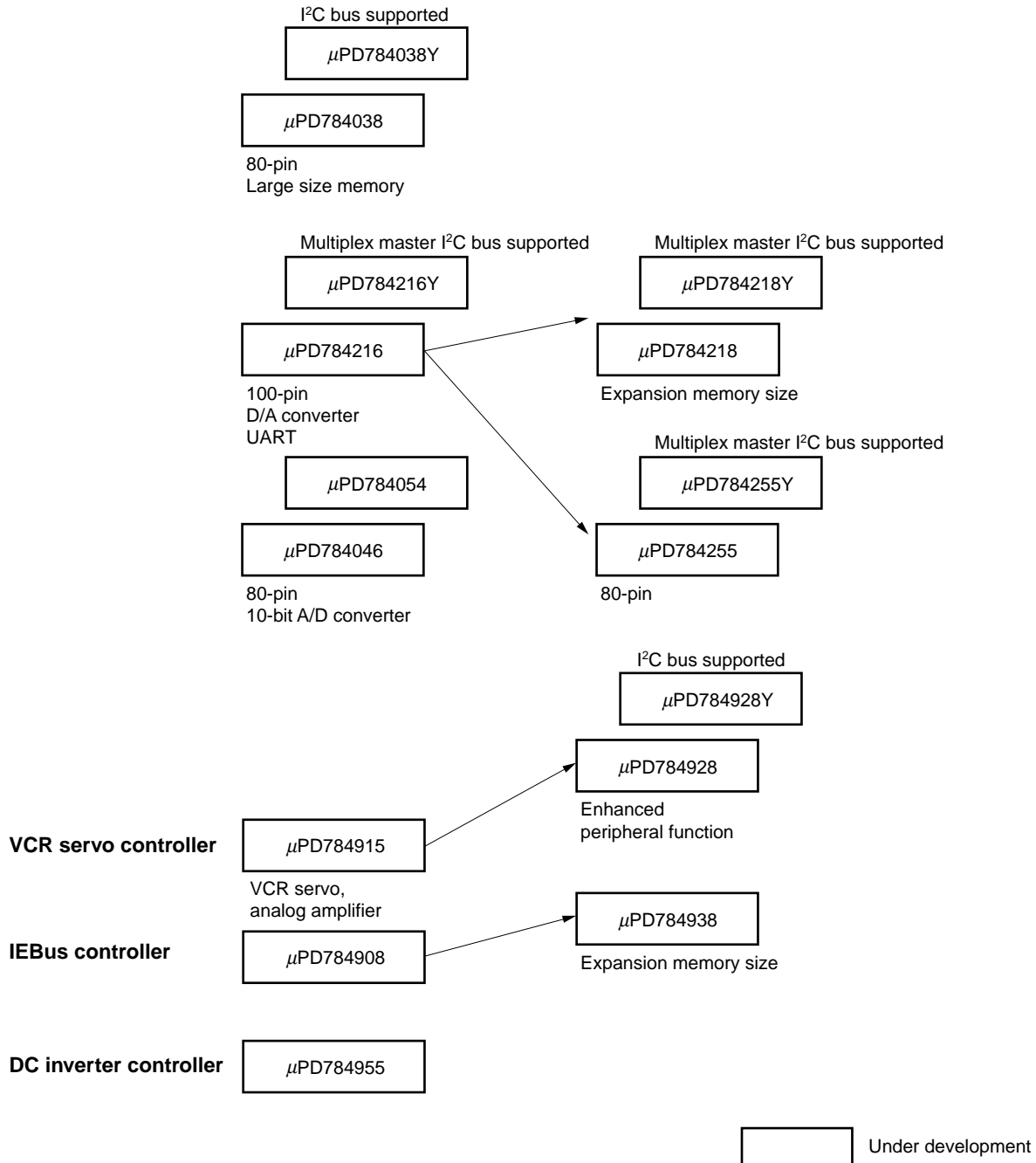
*: Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ **78K/IV Series Product Evolution**

Subseries names are shown inside frames.



16-Bit Single-Chip Microcontroller

78K/IV Series

■ Differences among the Subseries

Subseries name	Function	ROM capacity	Timer				8-bit A/D	10-bit A/D	8-bit D/A	Serial interface	I/O	V _{DD} MIN. value
			8-bit	16-bit	Watch	WDT						
General-purpose	μ PD784225	96K to 128K	4 ch	1 ch	1 ch	1 ch	8 ch	-	2 ch	3 ch (UART: 2 ch)	67	1.8 V
	μ PD784225Y									3 ch (UART: 2 ch, I ² C: 1 ch)		
	μ PD784218	192K to 256K	6 ch							3 ch (UART: 2 ch)	86	2.2 V
	μ PD784218Y									3 ch (UART: 2 ch, I ² C: 1 ch)		
	μ PD784216	96K to 128K								3 ch (UART: 2 ch)		
	μ PD784216Y									3 ch (UART: 2 ch, I ² C: 1 ch)		
	μ PD784054	32K	-	3 ch	-	-	-	16 ch	-	2 ch (UART: 2 ch)	64	4.5 V
	μ PD784046	32K to 64K		5 ch							65	
	μ PD784038	48K to 128K									3 ch (UART: 2 ch)	46/64
μ PD784038Y	3 ch (UART: 2 ch, I ² C: 1 ch)											
VCR servo controller	μ PD784928	96K to 128K	2 ch	6 ch	-	-	12 ch	-	-	2 ch	74	2.7 V
	μ PD784928Y									3 ch (I ² C: 1 ch)		
	μ PD784915	48K to 62K								2 ch	54	
On-chip IEBus controller	μ PD784938	96K to 256K	-	4 ch	-	1 ch	8 ch	-	-	4 ch (UART: 2 ch)	80	4.0 V
	μ PD784908	96K to 128K										
DC inverter controller	μ PD784955	24K to 64K	2 ch	6 ch	-	1 ch	8 ch	-	-	2 ch (UART: 1 ch)	67	4.5 V

16-Bit Single-Chip Microcontroller

78K/IV Series

■ **General-Purpose (μ PD784038 Subseries)**

Part number	μ PD784031	μ PD784035	μ PD784036	μ PD784037	μ PD784038	μ PD78P4038	
Number of instructions	113						
Minimum instruction cycle	125 ns (32 MHz)						
Memory expansion function	Total of 1M bytes for both programs and data						
Internal memory	ROM size (bytes)	–	48K	64K	96K	128K	128K (PROM)
	RAM size (bytes)	2K		3.5K		4.25K	
Interrupt function	4-level programmable priority, macro service, vectored interrupt, context switching function						
	External source	7					
	Internal source	18					
	Number of interrupts supporting the use of a macro service	19					
	Type of macro service	4 types, 21 kinds					
I/O pin	Input	8					
	Output	4	0				
	I/O	34	56				
Timer/counter	16-bit timer/counter \times 3 channels 16-bit timer \times 1 channel						
Serial interface	UART/IOE (with on-chip baud rate generator): 2 channels CSI (3-wire/2wire mode): 1 channel						
A/D converter	8-bit resolution \times 8 channels						
D/A converter	8-bit resolution \times 2 channels						
PWM output	12-bit resolution \times 2 channels						
Standby function	HALT/IDLE/STOP mode						
Pseudo-SRAM refresh function	Provided						
Feature	<ul style="list-style-type: none"> • Large internal memory • Wide operating voltage range (2.7 to 5.5 V) • System clock dividing function (1/2, 1/4, 1/8, 1/16) 						
Package	80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 2.7-mm thick) 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 1.4-mm thick) 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch)					*	
Development tools	Assembler, C compiler, real-time OS, system performance analyzer, integrated debugger, system simulator, device file, in-circuit emulator						
Applications	PPCs, LBPs, autofocus cameras, etc.						

- *: • 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 2.7-mm thick)
 • 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 1.4-mm thick)
 • 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch)
 • 80-pin ceramic WQFN (14 \times 14 mm, 0.65-mm pitch)

16-Bit Single-Chip Microcontroller

78K/IV Series

■ General-Purpose (μ PD784038Y Subseries)

Part number	μ PD784031Y	μ PD784035Y	μ PD784036Y	μ PD784037Y	μ PD784038Y	μ PD78P4038Y	
Number of instructions	113						
Minimum instruction cycle	125 ns (32 MHz)						
Memory expansion function	Total of 1M bytes for both programs and data						
Internal memory	ROM size (bytes)	–	48K	64K	96K	128K	128K (PROM)
	RAM size (bytes)	2K			3.5K	4.25K	
Interrupt function	4-level programmable priority, macro service, vectored interrupt, context switching function						
	External source	8					
	Internal source	19					
	Number of interrupts supporting the use of a macro service	20					
	Type of macro service	4 types, 21 kinds					
I/O pin	Input	8					
	Output	4	0				
	I/O	34	56				
Timer/counter	16-bit timer/counter \times 3 channels 16-bit timer \times 1 channel						
Serial interface	UART/IOE (with on-chip baud rate generator): 2 channels CSI (3-wire/2-wire/I ² C bus mode): 1 channel						
A/D converter	8-bit resolution \times 8 channels						
D/A converter	8-bit resolution \times 2 channels						
PWM output	12-bit resolution \times 2 channels						
Standby function	HALT/IDLE/STOP mode						
Pseudo-SRAM refresh function	Provided						
Feature	<ul style="list-style-type: none"> • Large internal memory • Wide operating voltage range (2.7 to 5.5 V) • System clock dividing function (1/2, 1/4, 1/8, 1/16) 						
Package	80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 2.7-mm thick) 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 1.4-mm thick) 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch)					*	
Development tools	Assembler, C compiler, real-time OS, system performance analyzer, integrated debugger, system simulator, device file, in-circuit emulator						
Applications	Cellular phones, cordless phones, AV equipment, etc.						

- ※: • 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 2.7-mm thick)
• 80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 1.4-mm thick)
• 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch)
• 80-pin ceramic WQFN (14 \times 14 mm, 0.65-mm pitch)

16-Bit Single-Chip Microcontroller

78K/IV Series

■ **General-Purpose (μ PD784046, 784054 Subseries)**

Subseries name		μ PD784046 Subseries			μ PD784054 Subseries
Part number		μ PD784044	μ PD784046	μ PD784046	μ PD784054
Number of instructions		113			
Minimum instruction cycle		125 ns (32 MHz)			
Memory expansion function		Total of 1M bytes for both programs and data			
Internal memory	ROM size (bytes)	32K	64K	64K (flash memory)	32K
	RAM size (bytes)	1024	2048	2048	1024
Interrupt function		4-level programmable priority, macro service, vectored interrupt, context switching function			
	External source	8			
	Internal source	23			19
	Number of interrupts supporting the use of a macro service	25			21
	Type of macro service	7 types, 27 kinds			7 types, 23 kinds
I/O pin	Input	17			
	Output	0			
	I/O	48			47
Timer/counter		16-bit timer \times 3 channels 16-bit timer/counter \times 2 channels			16-bit timer \times 3
Serial interface		UART/CSI \times 2 channels			
A/D converter		10-bit resolution \times 16 channels			
Standby function		HALT/IDLE/STOP mode			HALT/IDLE/STOP/standby invalidation mode
Feature		On-chip timer unit optimum for real-time control			
Package		80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 2.7-mm thick)			
Development tools		Assembler, C compiler, real-time OS, system performance analyzer, integrated debugger, system simulator, device file, in-circuit emulator			
Applications		Hot water supplier, vending machines, etc.			

16-Bit Single-Chip Microcontroller

78K/IV Series

■ General-Purpose (μ PD784216 Subseries)

Part number		μ PD784214	μ PD784215	μ PD784216	μ PD78F4216*
Number of instructions		113			
Minimum instruction cycle		160 ns (Main system clock 12.5 MHz)/61 μ s (Subsystem clock 32.768 kHz)			
Memory expansion function		Total of 1M bytes for both programs and data			
Internal memory	ROM size (bytes)	96K	128K	128K	128K (Flash memory)
	RAM size (bytes)	3584	5120	8192	
Interrupt function		4-level programmable priority, macro service, vectored interrupt, context switching function			
	External source	9			
	Internal source	20			
	Number of interrupts supporting the use of a macro service	27			
	Type of macro service	4 types, 21kinds			
I/O pin	Input	8			
	I/O	72			
	N-ch open-drain I/O	6			
Timer/counter		16-bit timer/counter \times 1 channel 8-bit timer/counter \times 6 channels			
Real-time output port		4-bit \times 2 ports or 8-bit \times 1 port			
Serial interface		UART/IOE (with dedicated on-chip baud rate generator): 2 channels CSI (3-wire mode): 1 channel			
A/D converter		8-bit resolution \times 8 channels			
D/A converter		8-bit resolution \times 2 channels			
Clock output		Select of f_{xx} , $f_{xx}/2$, $f_{xx}/2^2$, $f_{xx}/2^3$, $f_{xx}/2^4$, $f_{xx}/2^5$, $f_{xx}/2^6$, $f_{xx}/2^7$, f_{XT}			
Buzzer output		Select of $f_{xx}/2^{10}$, $f_{xx}/2^{11}$, $f_{xx}/2^{12}$, $f_{xx}/2^{13}$			
Clock timer		1 channel			
Standby function		HALT/STOP/IDLE mode HALT/IDLE mode at Low power consumption mode (CPU operation using subsystem clock)			
Feature		<ul style="list-style-type: none"> • Large internal memory • Wide operation voltage range (Mask ROM version: 2.2 to 5.5 V, Flash memory version: 2.7 to 5.5 V) • Using peripheral functions of 78K/0 series 			
Package		100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)			
Development tools		Assembler, C compiler, real-time OS, system performance analyzer, integrated debugger, system simulator, device file, in-circuit emulator			
Applications		Cellular phones, PHS, cordless phones, CD-ROMs, AV equipment, etc.			

*: Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ General-Purpose (μ PD784216Y Subseries)

Part number	μ PD784214Y	μ PD784215Y	μ PD784216Y	μ PD78F4216Y*
Number of instructions	113			
Minimum instruction cycle	160 ns (Main system clock 12.5 MHz)/61 μ s (Subsystem clock 32.768 kHz)			
Memory expansion function	Total of 1M bytes for both programs and data			
Internal memory	ROM size (bytes)	96K	128K	128K
	RAM size (bytes)	3584	5120	8192
Interrupt function	4-level programmable priority, macro service, vectored interrupt, context switching function			
	External source	9		
	Internal source	20		
	Number of interrupts supporting the use of a macro service	27		
	Type of macro service	4 types, 21kinds		
I/O pin	Input	8		
	I/O	72		
	N-ch open-drain I/O	6		
Timer/counter	16-bit timer/counter \times 1 channel 8-bit timer/counter \times 6 channels			
Real-time output port	4-bit \times 2 ports or 8-bit \times 1 port			
Serial interface	UART/IOE (with dedicated on-chip baud rate generator): 2 channels CSI (3-wire/I ² C bus supporting multiplex master mode): 1 channel			
A/D converter	8-bit resolution \times 8 channels			
D/A converter	8-bit resolution \times 2 channels			
Clock output	Select of f_{xx} , $f_{xx}/2$, $f_{xx}/2^2$, $f_{xx}/2^3$, $f_{xx}/2^4$, $f_{xx}/2^5$, $f_{xx}/2^6$, $f_{xx}/2^7$, f_{xt}			
Buzzer output	Select of $f_{xx}/2^{10}$, $f_{xx}/2^{11}$, $f_{xx}/2^{12}$, $f_{xx}/2^{13}$			
Clock timer	1 channel			
Standby function	HALT/STOP/IDLE mode HALT/IDLE mode at Low power consumption mode (CPU operation using subsystem clock)			
Feature	<ul style="list-style-type: none"> • Large internal memory • Wide operation voltage range (Mask ROM version: 2.2 to 5.5 V, Flash memory version: 2.7 to 5.5 V) • Using peripheral functions of 78K/0 series 			
Package	100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)			
Development tools	Assembler, C compiler, real-time OS, system performance analyzer, integrated debugger, system simulator, device file, in-circuit emulator			
Applications	Cellular phones, PHS, cordless phones, CD-ROMs, AV equipment, etc.			

*: Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ General-Purpose (μ PD784218 Subseries)

Part number		μ PD784217*	μ PD784218	μ PD78F4218
Number of instructions		113		
Minimum instruction cycle		160 ns (Main system clock 12.5 MHz)/61 μ s (Subsystem clock 32.768 kHz)		
Memory expansion function		Total of 1M bytes for both programs and data		
Internal memory	ROM size (bytes)	192K	256K	256K (Flash memory)
	RAM size (bytes)	12800		
Interrupt function		4-level programmable priority, macro service, vectored interrupt, context switching function		
	External source	9		
	Internal source	20		
	Number of interrupts supporting the use of a macro service	27		
	Type of macro service	4 types, 21 kinds		
I/O pin	Input	8		
	I/O	72		
	N-ch open-drain I/O	6		
Timer/counter		16-bit timer/counter \times 1 channel 8-bit timer/counter \times 6 channels		
Real-time output port		4-bit \times 2 ports or 8-bit \times 1 port		
Serial interface		UART/IOE (with dedicated on-chip baud rate generator): 2 channels CSI (3-wire mode): 1 channel		
A/D converter		8-bit resolution \times 8 channels		
D/A converter		8-bit resolution \times 2 channels		
Clock output		Select of f_{xx} , $f_{xx}/2$, $f_{xx}/2^2$, $f_{xx}/2^3$, $f_{xx}/2^4$, $f_{xx}/2^5$, $f_{xx}/2^6$, $f_{xx}/2^7$, f_{xt}		
Buzzer output		Select of $f_{xx}/2^{10}$, $f_{xx}/2^{11}$, $f_{xx}/2^{12}$, $f_{xx}/2^{13}$		
Clock timer		1 channel		
Standby function		HALT/STOP/IDLE mode HALT/IDLE mode at Low power consumption mode (CPU operation using subsystem clock)		
Feature		<ul style="list-style-type: none"> • Large internal memory • Wide operation voltage range (Mask ROM version: 2.2 to 5.5 V, Flash memory version: 2.7 to 5.5 V) • Using peripheral functions of 78K/0 series 		
Package		100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)		
Development tools		Assembler, C compiler, real-time OS, system performance analyzer, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Cellular phones, PHS, cordless phones, CD-ROMs, AV equipment, etc.		

*: Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ General-Purpose (μ PD784218Y Subseries)

Part number		μ PD784217Y*	μ PD784218Y*	μ PD78F4218Y*
Number of instructions		113		
Minimum instruction cycle		160 ns (Main system clock 12.5 MHz)/61 μ s (Subsystem clock 32.768 kHz)		
Memory expansion function		Total of 1M bytes for both programs and data		
Internal memory	ROM size (bytes)	192K	256K	256K (Flash memory)
	RAM size (bytes)	12800		
Interrupt function		4-level programmable priority, macro service, vectored interrupt, context switching function		
	External source	9		
	Internal source	20		
	Number of interrupts supporting the use of a macro service	27		
	Type of macro service	4 types, 21 kinds		
I/O pin	Input	8		
	I/O	72		
	N-ch open-drain I/O	6		
Timer/counter		16-bit timer/counter \times 1 channel 8-bit timer/counter \times 6 channels		
Real-time output port		4-bit \times 2 ports or 8-bit \times 1 port		
Serial interface		UART/IOE (with dedicated on-chip baud rate generator): 2 channels CSI (3-wire/I ² C bus supporting multiplex master mode): 1 channel		
A/D converter		8-bit resolution \times 8 channels		
D/A converter		8-bit resolution \times 2 channels		
Clock output		Select of f_{xx} , $f_{xx}/2$, $f_{xx}/2^2$, $f_{xx}/2^3$, $f_{xx}/2^4$, $f_{xx}/2^5$, $f_{xx}/2^6$, $f_{xx}/2^7$, f_{XT}		
Buzzer output		Select of $f_{xx}/2^{10}$, $f_{xx}/2^{11}$, $f_{xx}/2^{12}$, $f_{xx}/2^{13}$		
Clock timer		1 channel		
Standby function		HALT/STOP/IDLE mode HALT/IDLE mode at Low power consumption mode (CPU operation using subsystem clock)		
Feature		<ul style="list-style-type: none"> • Large internal memory • Wide operation voltage range (Mask ROM version: 2.2 to 5.5 V, Flash memory version: 2.7 to 5.5 V) • Using peripheral functions of 78K/0 series 		
Package		100-pin plastic LQFP (14 \times 14 mm, 0.5-mm pitch) 100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)		
Development tools		Assembler, C compiler, real-time OS, system performance analyzer, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Cellular phones, PHS, cordless phones, CD-ROMs, AV equipment, etc.		

* : Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ General-Purpose (μ PD784225 Subseries)

Part number		μ PD784224*	μ PD784225*	μ PD78F4225*
Number of instructions		113		
Minimum instruction cycle		160 ns (Main system clock 12.5 MHz)/61 μ s (Subsystem clock 32.768 kHz)		
Memory expansion function		Total of 1M bytes for both programs and data		
Internal memory	ROM size (bytes)	96K	128K	128K (Flash memory)
	RAM size (bytes)	3584	4352	
Interrupt function		4-level programmable priority, macro service, vectored interrupt, context switching function		
	External source	7		
	Internal source	18		
	Number of interrupts supporting the use of a macro service	23		
	Type of macro service	4 types, 21 kinds		
I/O pin	Input	8		
	I/O	59		
Timer/counter		16-bit timer/counter \times 1 channel 8-bit timer/counter \times 4 channels		
Real-time output port		4-bit \times 2 ports or 8-bit \times 1 port		
Serial interface		UART/IOE (with dedicated on-chip baud rate generator): 2 channels CSI (3-wire mode): 1 channel		
A/D converter		8-bit resolution \times 8 channels		
D/A converter		8-bit resolution \times 2 channels		
Clock output		Select of f_{xx} , $f_{xx}/2$, $f_{xx}/2^2$, $f_{xx}/2^3$, $f_{xx}/2^4$, $f_{xx}/2^5$, $f_{xx}/2^6$, $f_{xx}/2^7$, f_{XT}		
Buzzer output		Select of $f_{xx}/2^{10}$, $f_{xx}/2^{11}$, $f_{xx}/2^{12}$, $f_{xx}/2^{13}$		
Clock timer		1 channel		
Standby function		HALT/STOP/IDLE mode HALT/IDLE mode at Low power consumption mode (CPU operation using subsystem clock)		
Feature		<ul style="list-style-type: none"> • Large internal memory • Wide operation voltage range (1.8 to 5.5 V) • Using peripheral functions of 78K/0 series 		
Package		80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch) 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch)		
Development tools		Assembler, C compiler, real-time OS, system performance analyzer, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Car audio, portable audio, telephones, etc.		

*: Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ General-Purpose (μ PD784225Y Subseries)

Part number		μ PD784224Y*	μ PD784225Y*	μ PD78F4225Y*
Number of instructions		113		
Minimum instruction cycle		160 ns (Main system clock 12.5 MHz)/61 μ s (Subsystem clock 32.768 kHz)		
Memory expansion function		Total of 1M bytes for both programs and data		
Internal memory	ROM size (bytes)	96K	128K	128K (Flash memory)
	RAM size (bytes)	3584	4352	
Interrupt function		4-level programmable priority, macro service, vectored interrupt, context switching function		
	External source	7		
	Internal source	18		
	Number of interrupts supporting the use of a macro service	23		
	Type of macro service	4 types, 21 kinds		
I/O pin	Input	8		
	I/O	59		
Timer/counter		16-bit timer/counter \times 1 channel 8-bit timer/counter \times 4 channels		
Real-time output port		4-bit \times 2 ports or 8-bit \times 1 port		
Serial interface		UART/IOE (with dedicated on-chip baud rate generator): 2 channels CSI (3-wire I ² C bus supporting multiplex master mode): 1 channel		
A/D converter		8-bit resolution \times 8 channels		
D/A converter		8-bit resolution \times 2 channels		
Clock output		Select of f_{xx} , $f_{xx}/2$, $f_{xx}/2^2$, $f_{xx}/2^3$, $f_{xx}/2^4$, $f_{xx}/2^5$, $f_{xx}/2^6$, $f_{xx}/2^7$, f_{xt}		
Buzzer output		Select of $f_{xx}/2^{10}$, $f_{xx}/2^{11}$, $f_{xx}/2^{12}$, $f_{xx}/2^{13}$		
Clock timer		1 channel		
Standby function		HALT/STOP/IDLE mode HALT/IDLE mode at Low power consumption mode (CPU operation using subsystem clock)		
Feature		<ul style="list-style-type: none"> • Large internal memory • Wide operation voltage range (1.8 to 5.5 V) • Using peripheral functions of 78K/0 series 		
Package		80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch) 80-pin plastic TQFP (12 \times 12 mm, 0.5-mm pitch)		
Development tools		Assembler, C compiler, real-time OS, system performance analyzer, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Car audio, portable audio, telephones, etc.		

* : Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ VCR Servo Controller (μ PD784915 Subseries)

Part number		μ PD784915, 784915A	μ PD784915B	μ PD784916A	μ PD784916B	μ PD78P4916
Number of instructions		113				
Minimum instruction cycle		250 ns (Internal clock: 8 MHz)				
Internal memory	ROM size (bytes)	48K	62K		62K (PROM)	
	RAM size (bytes)	1280			2048	
Interrupt function		4 levels (programmable), vectored interrupt, macro service, vectored interrupt, context switching function				
	External source	9 (including NMI)				
	Internal source	20 (including software interrupts)				
I/O pin	Input	8				
	Output	0				
	I/O	46				
Real-time output port		11 (including pseudo V sync, head amplifier switch, chroma-rotation outputs)				
Super timer unit	Timer/counter	22-bit FRC counter \times 1 channel 16-bit timer \times 6 channels (including 3 channels for general-purpose timers) 8-bit counter \times 2 channels 5-bit UDC counter \times 1 channel				
	Special circuit for VCR	V sync separator circuit, H sync separator circuit VISS detection circuit, wide aspect detection circuit Field identification circuit Head amplifier switch/chroma-rotation output circuit				
	PWM output	16-bit resolution \times 3 channels (Carrier frequency: 62.5 kHz) 8-bit resolution \times 3 channels (Carrier frequency: 62.5 kHz)				
Serial interface		Synchronous serial interface (3-wire): 2 channels (including 1 channel supporting BUSY/STRB control)				
A/D converter		8-bit resolution \times 12 channels (Conversion time: 10 μ s)				
Analog VCR circuits		CTL amplifier, RECCTL driver (with rewrite capability) CFG amplifier DFG amplifier, DPG comparator, DPFG separator circuit (3-value separator circuit) Reel FG comparator (2 channels) Csync comparator				
Standby function		HALT/STOP mode HALT mode for low power consumption				
Clock function		0.5-second measurement, low voltage operation ($V_{DD} = 2.7$ V) allowed				
Package		100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)				
Development tools		Assembler, C compiler, integrated debugger, system simulator, device file, in-circuit emulator				
Applications		VCRs, camcorder, integrated TV-VCR machines, etc.				

16-Bit Single-Chip Microcontroller

78K/IV Series

■ VCR Servo Controller (μ PD784928 Subseries)

Part number		μ PD784927	μ PD784928	μ PD78F4928*
Number of instructions		113		
Minimum instruction cycle		250 ns (Internal clock: 8 MHz)		
Internal memory	ROM size (bytes)	96K	128K	128K (Flash memory)
	RAM size (bytes)	2048	3584	
Interrupt function		4 levels (programmable), vectored interrupt, macro service, context switching function		
	External source	9 (including NMI)		
	Internal source	22 (including software interrupts)		
I/O pin	Input	20		
	Output	0		
	I/O	54		
Real-time output port		11 (including pseudo V sync, head amplifier switch, chroma-rotation outputs)		
Super timer unit	Timer/counter	22-bit FRC counter \times 1 channel 16-bit timer \times 6 channels (including 3 channels for general-purpose timers) 8-bit counter \times 2 channels 5-bit UDC counter \times 1 channel		
	Special circuit for VCR	V sync separator circuit, H sync separator circuit VISS detection circuit, wide aspect detection circuit Field identification circuit Head amplifier switch/chroma-rotation output circuit		
	PWM output	16-bit resolution \times 3 channels (Carrier frequency: 62.5 kHz) 8-bit resolution \times 3 channels (Carrier frequency: 62.5 kHz)		
Serial interface		Synchronous serial interface (3-wire): 2 channels (including 1 channel supporting BUSY/STRB control)		
A/D converter		8-bit resolution \times 12 channels (Conversion time: 10 μ s)		
Analog VCR circuits		CTL amplifier, RECCTL driver (with rewrite capability) CFG amplifier DFG amplifier, DPG amplifier, DPGF separator circuit (3-value separator circuit) Reel FG comparator (2 channels) Csync comparator		
Standby function		HALT/STOP mode Low power consumption mode/HALT mode for low power consumption		
Clock function		0.5-second measurement, low voltage operation ($V_{DD} = 2.7$ V) allowed		
Package		100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)		
Development tools		Assembler, C compiler, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		VCRs, camcorder, integrated TV-VCR machines, etc.		

*: Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ VCR Servo Controller (μ PD784928Y Subseries)

Part number		μ PD784927Y	μ PD784928Y	μ PD78F4928Y*
Number of instructions		113		
Minimum instruction cycle		250 ns (Internal clock: 8 MHz)		
Internal memory	ROM size (bytes)	96K	128K	128K (Flash memory)
	RAM size (bytes)	2048	3584	
Interrupt function		4 levels (programmable), vectored interrupt, macro service, context switching function		
	External source	9 (including NMI)		
	Internal source	23 (including software interrupts)		
I/O pin	Input	20		
	Output	0		
	I/O	54		
Real-time output port		11 (including pseudo V sync, head amplifier switch, chroma-rotation outputs)		
Super timer unit	Timer/counter	22-bit FRC counter \times 1 channel 16-bit timer \times 6 channels (including 3 channels for general-purpose timers) 8-bit counter \times 2 channels 5-bit UDC counter \times 1 channel		
	Special circuit for VCR	V sync separator circuit, H sync separator circuit VISS detection circuit, wide aspect detection circuit Field identification circuit Head amplifier switch/chroma-rotation output circuit		
	PWM output	16-bit resolution \times 3 channels (Carrier frequency: 62.5 kHz) 8-bit resolution \times 3 channels (Carrier frequency: 62.5 kHz)		
Serial interface		Synchronous serial interface (3-wire): 2 channels (including 1 channel supporting BUSY/STRB control) I ² C bus interface: 1 channel		
A/D converter		8-bit resolution \times 12 channels (Conversion time: 10 μ s)		
Analog VCR circuits		CTL amplifier, RECCTL driver (with rewrite capability) CFG amplifier DFG amplifier, DPG amplifier, DPFG separator circuit (3-value separator circuit) Reel FG comparator (2 channels) Csync comparator		
Standby function		HALT/STOP mode Low power consumption mode/HALT mode for low power consumption		
Clock function		0.5-second measurement, low voltage operation ($V_{DD} = 2.7$ V) allowed		
Package		100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)		
Development tools		Assembler, C compiler, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		VCRs, camcorder, integrated TV-VCR machines, etc.		

* : Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ IEBus Controller (μ PD784908 Subseries)

Part number		μ PD784907	μ PD784908	μ PD78P4908
Number of instructions		113		
Minimum instruction cycle		320 ns (6.29 MHz) 160 ns (12.58 MHz)		
Memory expansion function		Total of 1M bytes for both programs and data		
Internal memory	ROM size (bytes)	96K	128K	128K (PROM)
	RAM size (bytes)	3584	4352	
Interrupt function		4-level programmable priority, macro service, vectored interrupt, context switching function		
	External source	7		
	Internal source	20		
I/O pin	Input	8		
	I/O	72		
	LED direct drive output	24		
	Transistor direct drive	8		
	N-ch open-drain I/O	4		
Timer/counter		16-bit timer/counter \times 4 channels		
Real-time output port		4-bit \times 2 ports or 8-bit \times 1 port		
IEBus controller		Incorporated (simple version)		
Serial interface		UART/IOE (3-wire): 2 channels CSI (3-wire): 2 channels		
A/D converter		8-bit resolution \times 8 channels		
PWM output		12-bit resolution \times 2 channels		
Clock output		Select of f_{xx} , $f_{xx}/2$, $f_{xx}/2^2$, $f_{xx}/2^3$, $f_{xx}/2^4$		
Watchdog timer		1 channel		
Standby function		HALT/STOP/IDLE mode		
Power supply voltage		$V_{DD} = 4.0$ to 5.5 V (Main clock: $f_{xx} = 12.58$ MHz, internal system clock = f_{xx} , $f_{CYK} = 79$ ns) $V_{DD} = 3.5$ to 5.5 V (Other than above, $f_{CYK} = 159$ ns)		$V_{DD} = 4.5$ to 5.5 V (Main clock: $f_{xx} = 12.58$ MHz, internal system clock = f_{xx} , $f_{CYK} = 79$ ns) $V_{DD} = 4.0$ to 5.5 V (Other than above, $f_{CYK} = 159$ ns)
Package		100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)		
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Car audio, etc.		

16-Bit Single-Chip Microcontroller

78K/IV Series

■ IEBus Controller (μ PD784938 Subseries)

Part number	μ PD784935	μ PD784936	μ PD784937*	μ PD784938*	μ PD78F4938*
Number of instructions	113				
Minimum instruction cycle	320 ns (6.29 MHz) 160 ns (12.58 MHz)				
Memory expansion function	Total of 1M bytes for both programs and data				
Internal memory	ROM size (bytes)	96K	128K	192K	256K (Flash memory)
	RAM size (bytes)	5120	6656	8192	10240
Interrupt function	4-level programmable priority, macro service, vectored interrupt, context switching function				
	External source	7			
	Internal source	20			
I/O pin	Input	8			
	I/O	72			
	LED direct drive output	24			
	Transistor direct drive	8			
	N-ch open-drain I/O	4			
Timer/counter	16-bit timer/counter \times 4 channels				
Real-time output port	4-bit \times 2 ports or 8-bit \times 1 port				
IEBus controller	Incorporated (simple version)				
Serial interface	UART/IOE (3-wire): 2 channels CSI (3-wire): 2 channels				
A/D converter	8-bit resolution \times 8 channels				
PWM output	12-bit resolution \times 2 channels				
Clock output	Select of f_{xx} , $f_{xx}/2$, $f_{xx}/2^2$, $f_{xx}/2^3$, $f_{xx}/2^4$				
Watchdog timer	1 channel				
Standby function	HALT/STOP/IDLE mode				
Package	100-pin plastic QFP (14 \times 20 mm, 0.65-mm pitch)				
Development tools	Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator				
Applications	Car audio, etc.				

*: Under development

16-Bit Single-Chip Microcontroller

78K/IV Series

■ DC Inverter Controller (μ PD784955 Subseries)

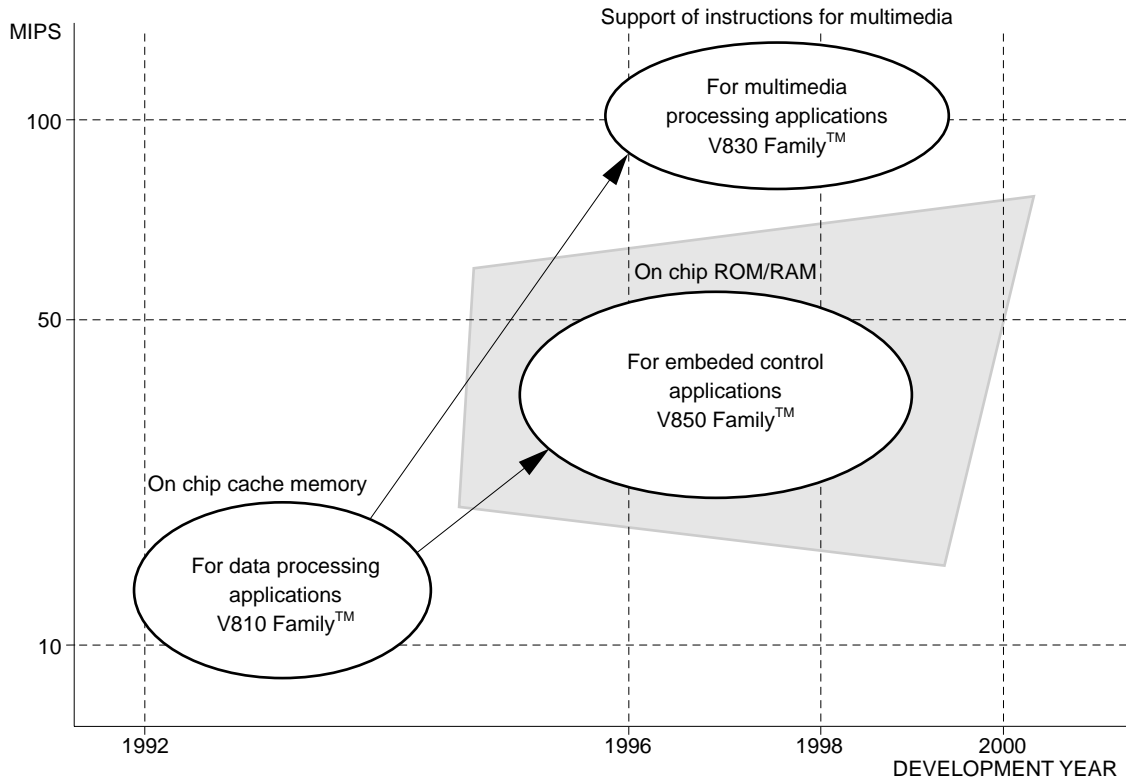
Part number		μ PD784953*	μ PD784955*	μ PD78F4956*
Number of instructions		113		
Minimum instruction cycle		160 ns (Internal 12.5 MHz)		
Internal memory	ROM size (bytes)	24K	48K	64K (Flash memory)
	RAM size (bytes)	768	2048	
Interrupt function		4-level programmable priority, macro service, vectored interrupt, context switching function		
	External source	8 (Also internal source: 2)		
	Internal source	22		
I/O pin	Input	8		
	I/O	59		
	Pin with pull-up register	59		
	LED direct drive output	32		
Timer/counter		16-bit timer/counter \times 6 channels 8-bit timer/counter \times 2 channels		
Serial interface		Synchronous serial interface (3-wire): 1 channel UART: 1 channel		
A/D converter		8-bit resolution \times 8 channels		
Watchdog timer		1 channel		
Standby function		HALT/STOP/IDLE mode		
Package		80-pin plastic QFP (14 \times 14 mm, 0.65-mm pitch, 1.4-mm thick)		
Development tools		Assembler, C compiler, real-time OS, integrated debugger, system simulator, device file, in-circuit emulator		
Applications		Motor control for inverter air-conditioners, etc.		

*: Under development

32-Bit Microprocessor

V800 Series™

■ **V800 Series Road Map**



32-Bit Microprocessor

V810 Family, V830 Family

Part number	μ PD70741	μ PD705101	μ PD705102*
Alias	V821™	V831™	V832™
Performance	16 MIPS/25 MHz	118 MIPS/100 MHz	170 MIPS/143 MHz
Operating frequency	25 MHz	100 MHz	143 MHz
Operating voltage	4.5 to 5.5 V	3.0 to 3.6 V	2.3 to 2.7 V 3.0 to 3.6 V
Power consumption (max.)	500 mW (5 V/25 MHz)	550 mW (3.3 V/100 MHz)	350 mW (2.5 V, 3.3 V/143 MHz)
Address bus	24-bit	24-bit	
Data bus	16-bit	16-/32-bit	
Address space	Internal: 4 G bytes External: 64M bytes (maximum)	Internal: 4 G bytes External: 128M bytes (maximum)	
Cache	Instruction cache: 1K bytes	Instruction cache: 4K bytes, Data cache: 4K bytes	
Internal RAM	—	Instruction RAM: 4K bytes, Data RAM: 4K bytes	
DSP	—	32 bits	
Peripheral I/O	Timer	2 channels	2 channels
	Interrupt	External: 9, Internal: 11	External: 9, Internal: 11
	Serial I/O	2 channels	2 channels
	DMA	2 channels	4 channels
	Memory interface	Fast page mode DRAM, SRAM, I/O, Page-ROM	EDO DRAM, SRAM, I/O, Page-ROM
Others	Watchdog timer	Debug controller	
Package	100-pin plastic QFP	160-pin plastic LQFP	
Development tools	Real-time OS	Real-time OS, task debugger, C compiler, system performance analyzer, device file	
Applications	Printers, facsimiles, word processors, game machines, car navigation, PDAs, etc.	Internet/intra-net systems, car navigation, color facsimile machines, high-performance TVs, etc.	Internet/intra-net systems, car navigation, color facsimile machines, digital still cameras, etc.

*: Under development

32-Bit Single-Chip Microcontroller

V850 Family

■ V850E/MS1™

Part number		μ PD703100/ μ PD703100-A*	μ PD703101/ μ PD703101-A*	μ PD703102/ μ PD703102-A*	μ PD70F3102/ μ PD70F3102-A*
CPU core		V850E			
CPU performance (Dhrystone)		—			
On-chip ROM (bytes)		—	96K	128K	128K (Flash memory)
On-chip RAM (bytes)		4K			
External bus interface	Address bus	24-bit			
	Data bus	16-bit			
	Programmable wait	0 to 7			
Interrupt controller		External: 25, Internal: 47			
DSP	$32 \times 32 \rightarrow 64$	0.025 to 0.05 μ s (40 MHz)	0.03 to 0.06 μ s (33 MHz)		
	$32 \times 32 + 32 \rightarrow 32$	0.075 μ s (40 MHz)	0.09 μ s (33 MHz)		
	$16 \times 16 \rightarrow 32$	—			
	$16 \times 16 + 32 \rightarrow 32$	—			
Timer/counter (RPU)		16-bit \times 8 channels			
Serial interface (SIO)	CSI	2 channels			
	CSI/I ² C	—			
	CSI/UART	2 channels			
	UART	—			
	Dedicated baud rate generator	3 channels			
A/D converter		10-bit resolution \times 8 channels			
DMA controller		4 channels			
Real-time output port		—			
Port	Input/output	114			
	Input	9			
Other peripheral function		Memory access control function (Direct connectable various memory)			
Power save function		HALT/IDLE/STOP			
Operating frequency		2 to 40 MHz	2 to 33 MHz		
Operating voltage		Internal unit: 3.3 V, A/D converter: 5 V/3.3 V, External pin: 5 V/3.3 V			
Power consumption (TYP.)		570 mW/ 360 mW (40 MHz)	470 mW/300 mW (33 MHz)		
Package		144-pin plastic LQFP (20 \times 20 mm) 157-pin plastic FBGA (14 \times 14 mm)*			
Development tools		Real-time OS, task debugger, C compiler, debugger, system performance analyzer, device file, in-circuit emulator			
Applications		Printers, facsimiles, PPCs, digital still cameras, video printers, DVD systems, etc.			

*: Except μ PD703100, 703101, 703102, 70F3102

★: Under development

32-Bit Single-Chip Microcontroller

V850 Family

■ V850/SA1™

Part number		μ PD703015/ μ PD703015Y	μ PD703017*/ μ PD703017Y*	μ PD70F3017*/ μ PD70F3017Y*
CPU core		V850		
CPU performance (Dhrystone)		19 MIPS (17 MHz)		
On-chip ROM (bytes)		128K	256K	256K (Flash memory)
On-chip RAM (bytes)		4K	8K	
External bus interface	Address bus	22-bit		
	Data bus	16-bit		
	Programmable wait	0 to 3		
Interrupt controller		External: 8, Internal: 23		
DSP	$32 \times 32 \rightarrow 64$	—		
	$32 \times 32 + 32 \rightarrow 32$	—		
	$16 \times 16 \rightarrow 32$	0.059 to 0.118 μ s (17 MHz)		
	$16 \times 16 + 32 \rightarrow 32$	0.177 μ s (17 MHz)		
Timer/counter (RPU)		16-bit \times 2 channels 8-bit \times 4 channels (Cascade connection supported)		
Serial interface (SIO)	CSI	2 channels/1 channel	2 channels/1 channel	2 channels/1 channel
	CSI/I ² C	0 channels/1 channel	0 channels/1 channel	0 channels/1 channel
	CSI/UART	1 channel		
	UART	1 channel		
	Dedicated baud rate generator	2 channels (UART only)		
A/D converter		10-bit resolution \times 12 channels		
DMA controller		3 channels (internal RAM \leftrightarrow internal peripheral I/O)		
Real-time output port		8-bit \times 1 or 4-bit \times 2		
Port	Input/output	72		
	Input	13		
Other peripheral function		Watch timer: 1 channel Watchdog timer: 1 channel		
Power save function		HALT/IDLE/STOP		
Operating frequency		1 to 17 MHz (main clock, 3 V) 32.768 kHz (subclock)		
Operating voltage		2.7 to 3.6 V		
Power consumption (TYP.)		30 mW (main clock: 10 MHz, 3 V)		
Package		100-pin plastic LQFP (14 \times 14 mm) 121-pin plastic FBGA (12 \times 12 mm)		
Development tools		Real-time OS, task debugger, C compiler, debugger, system performance analyzer, device file, in-circuit emulator		
Applications		Portable equipment such as camcorders, PHS (Personal Handyphone System), digital still cameras, cellular phones, portable MDs, etc.		

* : Under development

32-Bit Single-Chip Microcontroller

V850 Family

■ V850/SB1™, V850/SB2™

Part number		μ PD703033*/ μ PD703033Y*	μ PD70F3033*/ μ PD70F3033Y*	μ PD70F3035*/ μ PD70F3035Y*
Alias		V850/SB1™		V850/SB2™
CPU core		V850		
CPU performance (Dhrystone)		22 MIPS (20 MHz)		
On-chip ROM (bytes)		256K	256K (Flash memory)	
On-chip ROM (bytes)		16K		
External bus interface	Address bus	22-bit		
	Data bus	16-bit		
	Programmable wait	0 to 3		
Interrupt controller		External: 8, Internal: 30 (31 for Y products)		External: 8 Internal: 32 (33 for Y products)
DSP	32 × 32 → 64	—		
	32 × 32 + 32 → 32	—		
	16 × 16 → 32	0.050 to 0.100 μ s (20 MHz)		
	16 × 16 + 32 → 32	0.150 μ s (20 MHz)		
Timer/counter (RPU)		16-bit × 2 channels 8-bit × 6 channels (Cascade connection supported)		
Serial interface (SIO)	CSI	3 channels/1 channel	3 channels/1 channel	3 channels/1 channel
	CSI/I ² C	0 channels/2 channels	0 channels/2 channels	0 channels/2 channels
	CSI/UART	2 channels		
	UART	—		
	Dedicated baud rate generator	3 channels		
A/D converter		10-bit resolution × 12 channels		
DMA controller		6 channels (internal RAM ↔ internal peripheral I/O)		
Real-time output port		8-bit × 1 or 4-bit × 2		
Port	Input/output	71		
	Input	12		
Other peripheral function		Watch timer: 1 channel Watchdog timer: 1 channel		Watch timer: 1 channel Watchdog timer: 1 channel IEBus (Simple version)
Power save function		HALT/IDLE/STOP		
Operating frequency		2 to 20 MHz (main clock) 32.768 kHz (subclock)		
Operating voltage		4.5 to 5.5 V		
Power consumption (TYP.)		40 mW (target value) (main clock: 5 V, 10 MHz)		
Package		100-pin plastic LQFP (14 × 14 mm) 100-pin plastic QFP (14 × 20 mm)		
Development tools		Real-time OS, task debugger, C compiler, debugger, system performance analyzer, device file, in-circuit emulator		
Applications		AV equipment such as car audio systems, TVs, and VCRs, and other applications		

* : Under development

32-Bit Single-Chip Microcontroller

V850 Family

■ V854™

Part number		μPD703006	μPD703008	μPD703008Y	μPD70F3008*/ μPD70F3008Y*
CPU core		V850			
CPU performance (Dhrystone)		—	29 MIPS (25 MHz)	38 MIPS (33 MHz)	18 MIPS (16 MHz)
On-chip ROM (bytes)		—	128K		128K (Flash memory)
On-chip RAM (bytes)		4K			
External bus interface	Address bus	24-bit			
	Data bus	16-bit			
	Programmable wait	0 to 3			
Interrupt controller		External: 22, Internal: 31			
DSP	32 × 32 → 64	—			
	32 × 32 + 32 → 32	—			
	16 × 16 → 32	0.03 to 0.06 μs (33 MHz)	0.04 to 0.08 μs (25 MHz)	0.03 to 0.06 μs (33 MHz)	0.06 to 0.12 μs (16 MHz)
	16 × 16 + 32 → 32	0.09 μs (33 MHz)	0.12 μs (25 MHz)	0.09 μs (33 MHz)	0.18 μs (16 MHz)
Timer/counter (RPU)		24-bit × 2 channels 16-bit × 6 channels			
Serial interface (SIO)	CSI	3 channels	3 channels	2 channels	3 channels/2 channels
	CSI/I ² C	0 channels	0 channels	1 channel	0 channels/1 channel
	CSI/UART	1 channel			
	UART	—			
	Dedicated baud rate generator	4 channels			
A/D converter		8-bit resolution × 16 channels			
DMA controller		—			
Real-time output port		8			
Port	Input/output	96			
	Input	16			
Other peripheral function		PWM: 4 channels (12 to 16-bit resolution)			
Power save function		HALT/IDLE/STOP			
Operating frequency		2 to 33 MHz (3.3 V)	2 to 25 MHz (3 V)	2 to 33 MHz (3.3 V)	2 to 16 MHz (3.3 V)
Operating voltage		3.0 to 3.6 V	2.7 to 3.6 V	3.0 to 3.6 V	3.1 to 3.6 V
Power consumption (TYP.)		195 mW (3.3 V, 33 MHz)	120 mW (3 V, 25 MHz)	195 mW (3.3 V, 33 MHz)	136 mW (3.3 V, 16 MHz)
Package		144-pin plastic LQFP (20 × 20 mm)			
Development tools		Real-time OS, task debugger, C compiler, debugger, simulator, system performance analyzer, device file, in-circuit emulator			
Applications		Low-voltage-operation equipment including camcorders, VCRs, cellular phones, PDAs, and digital still cameras			

★: Under development

32-Bit Single-Chip Microcontroller

V850 Family

■ V853™

Part number		μ PD703003/ μ PD703003A*	μ PD703004A*	μ PD70F3003	μ PD70F3003A*	μ PD703025A*	μ PD70F3025A*
CPU core		V850					
CPU performance (Dhrystone)		38 MIPS (33 MHz)		29 MIPS (25 MHz)	38 MIPS (33 MHz)		
On-chip ROM (bytes)		128K	96K	128K (Flash memory)		256K	256K (Flash memory)
On-chip RAM (bytes)		4K				8K	
External bus interface	Address bus	20-bit					
	Data bus	16-bit					
	Programmable wait	0 to 3					
Interrupt controller		External: 17, Internal: 32					
DSP	$32 \times 32 \rightarrow 64$	—					
	$32 \times 32 + 32 \rightarrow 32$	—					
	$16 \times 16 \rightarrow 32$	0.03 to 0.06 μ s (33 MHz)					
	$16 \times 16 + 32 \rightarrow 32$	0.09 μ s (33 MHz)					
Timer/counter (RPU)		16 bit \times 5 channels					
Serial interface (SIO)	CSI	2 channels					
	CSI/I ² C	—					
	CSI/UART	2 channels					
	UART	—					
	Dedicated baud rate generator	3 channels					
A/D converter		10-bit resolution \times 8 channels					
DMA controller		—					
Real-time output port		—					
Port	Input/output	67					
	Input	8					
Other peripheral function		PWM: 4 ch (8/9/10/12-bit resolution) D/A converter: 2 channels					
Power save function		HALT/IDLE/STOP					
Operating frequency		5 to 33 MHz (5 V)		5 to 25 MHz (5 V)	5 to 33 MHz (5 V)		
Operating voltage		4.5 to 5.5 V		4.75 to 5.25 V	4.5 to 5.5 V		
Power consumption (TYP.)		450 mW/365 mW (5 V, 33 MHz)	365 mW (5 V, 33 MHz)	385 mW (5 V, 25 MHz)	425 mW (5 V, 33 MHz)	450 mW (5 V, 33 MHz)	480 mW (5 V, 33 MHz)
Package		*	100-pin plastic LQFP (14 \times 14 mm)	100-pin plastic QFP (14 \times 14 mm)	100-pin plastic LQFP (14 \times 14 mm)		
Development tools		Real-time OS, task debgger, C compiler, debugger, simulator, system performance analyzer, device file, in-circuit emulator					
Applications		HDDs, PPCs, VCRs, motor control, robots, LBPs, printers, NC machine tools, single-lens reflex cameras, digital still cameras, etc.					

*: • 100-pin plastic QFP (14 \times 14 mm)
• 100-pin plastic LQFP (14 \times 14 mm)

*: Under development

32-Bit Single-Chip Microcontroller

V850 Family

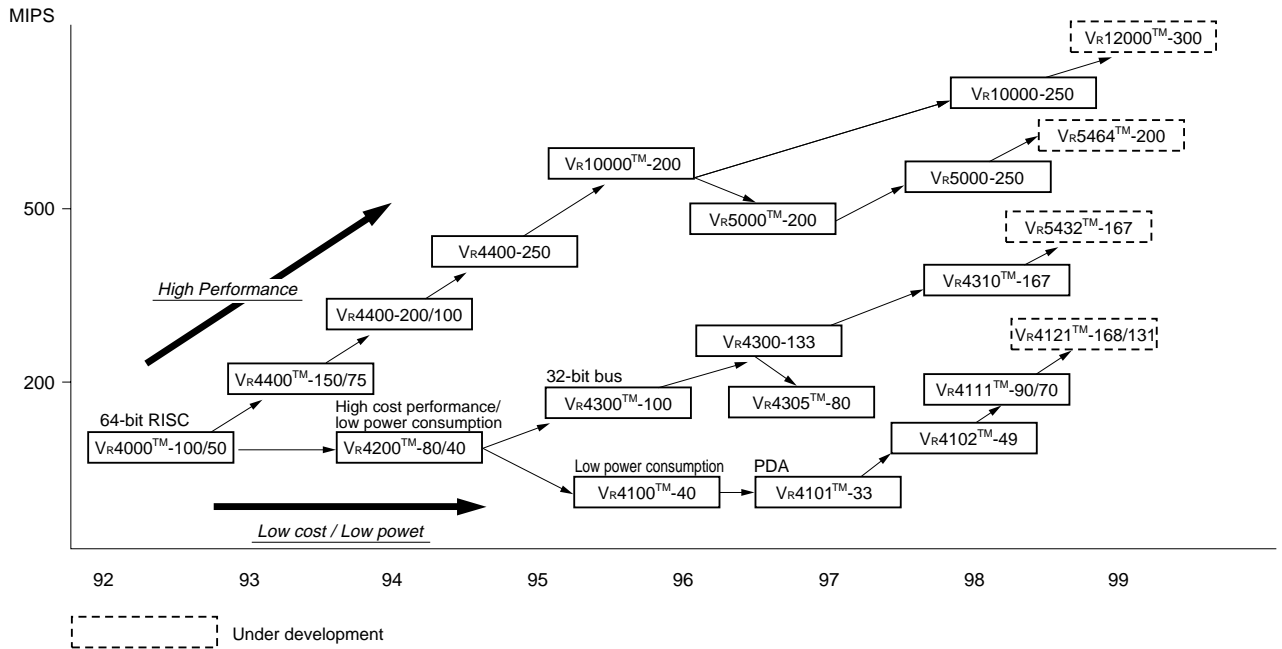
■ V852™

Part number		μ PD703002	μ PD70P3002
CPU core		V850	
CPU performance (Dhrystone)		29 MIPS (25 MHz)	
On-chip ROM (bytes)		90K	90K (PROM)
On-chip RAM (bytes)		3K	
External bus interface	Address bus	24-bit	
	Data bus	16-bit	
	Programmable wait	0 to 3	
Interrupt controller		External: 9, Internal: 16	
DSP	32 × 32 → 64	—	
	32 × 32 + 32 → 32	—	
	16 × 16 → 32	0.04 to 0.08 μ s (25 MHz)	
	16 × 16 + 32 → 32	0.12 μ s (25 MHz)	
Timer/counter (RPU)		16-bit × 2 channels	
Serial interface (SIO)	CSI	3 channels	
	CSI/I ² C	—	
	CSI/UART	—	
	UART	1 channel	
	Dedicated baud rate generator	2 channels	
A/D converter		—	
DMA controller		—	
Real-time output port		—	
Port	Input/output	67	
	Input	1	
Other peripheral function		—	
Power save function		HALT/IDLE/STOP	
Operating frequency		3 to 25 MHz (5 V)	
Operating voltage		4.5 to 5.5 V	
Power consumption (TYP.)		250 mW (5 V, 25 MHz)	320 mW (5 V, 25 MHz)
Package		<ul style="list-style-type: none"> • 100-pin plastic QFP (14 × 14 mm) • 100-pin plastic LQFP (14 × 14 mm) 	100-pin plastic QFP (14 × 14 mm)
Development tools		Real-time OS, task debugger, C compiler, debugger, simulator, system performance analyzer, device file, in-circuit emulator	
Applications		HDDs, PPCs, VCRs, motor control, robots, LBPs, printers, NC machine tools, digital phones, engine control, etc.	

64-Bit Microprocessor

VR Series™

■ VR Series Road Map



64-Bit Microprocessor

VR Series

■ VR Series Products (1/2)

Part number	μ PD30121*		μ PD30200		μ PD30210	μ PD30500
Alias	VR4121		VR4300	VR4305	VR4310	VR5000
Internal frequency	131 MHz	168 MHz	100 MHz 133 MHz	80 MHz	167 MHz	200 MHz 250 MHz
Operating voltage	External: 3.3 V Internal: 2.5 V		3.3 V			3.3 V
Cache size	Instruction: 16K bytes Data: 8K bytes		Instruction: 16K bytes Data: 8K bytes			Instruction: 32K bytes Data: 32K bytes
Performance	163 MIPS	208 MIPS	177 MIPS 80 SPECint92 60 SPECfp92	106 MIPS 48 SPECint92 36 SPECfp92	222 MIPS 100 SPECint92 75 SPECfp92	391 MIPS 6.8 SPECint95 6.8 SPECfp95
Features	CPU core: VR4120™ On-chip peripheral function ideal for PDAs High-speed processing by 168 MHz operation and 0.25 μ m process rule Low power consumption design		Software compatible with VR4000 Series 32-bit external bus High-speed floating-point operation		Software compatible with VR4300 32-bit external bus High-speed floating-point operation	Two-way superscalar On-chip large primary cache On-chip secondary cache interface
Package	224-pin plastic FBGA		120-pin plastic QFP			272-pin plastic BGA 223-pin ceramic PGA
Applications	PDAs such as handheld PCs and palm-size PCs		Embedded equipment for LBP, and game machines			High-end embedded equipment for color LBPs, network routers, etc

*: Under development

■ VR Series Products (2/2)

Part number	μ PD30540*	μ PD30541*	μ PD30700		μ PD30710
Alias	VR5464	VR5432	VR10000		VR12000
Internal frequency	200 MHz	167 MHz	200 MHz	250 MHz	300 MHz
Operating voltage	External: 3.3 V, Internal: 2.5 V		3.3 V	2.6 V	2.6 V
Cache size	Instruction: 32K bytes Data: 32K bytes		Instruction: 32K bytes Data: 32K bytes		
Performance	309 MIPS 7 SPECint95 4 SPECfp95	258 MIPS 6.6 SPECint95 3.6 SPECfp95	9.0 SPECint95 19.0 SPECfp95	14 SPECint95 23 SPECfp95	16.8 SPECint95 27.8 SPECfp95
Features	Two-way superscalar On-chip large primary cache with line-lock function Hardware debugging function		Five-way superscalar On-chip FPU and MMU On-chip multiprocessor and secondary cache interface		
Package	272-pin plastic BGA	208-pin plastic QFP	599-pin ceramic LGA		
Applications	High-end embedded equipment for color LBPs and STB, etc.		Advanced WSs, servers		

*: Under development

Development Tools

75XL Series Software Tools

■ List of Software Tools

Host machine	Software tool name
PC-9800 Series IBM PC/AT™ and compatibles PC98-NX Series	Relocatable assembler RA75X IE control program IE75X

■ List of Device Files

Target device	Device file name	Target device	Device file name	Target device	Device file name
μ PD750004 μ PD750006 μ PD750008	DF750008	μ PD753036	DF753036	μ PD754144 μ PD754244	DF754244
μ PD750104 μ PD750106 μ PD750108		μ PD753104 μ PD753106 μ PD753108		μ PD754202	
μ PD750064 μ PD750066 μ PD750068	DF750068	μ PD753204 μ PD753206 μ PD753208	DF753208	μ PD754264	DF754264
μ PD753012A μ PD753016A μ PD753017A	DF753017	μ PD753304	DF753304	μ PD754302 μ PD754304	DF754304

Development Tools

75XL Series Hardware Tools

■ **Common Hardware Tools**

Tool name	Product name
In-circuit emulator	IE-75001-R
Emulation board	IE-75300-R-EM

■ **List of Hardware Tools**

Target device		Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Device name	Package		
μ PD750004	42-pin SDIP (600 mil)	EP-75008CU-R	–
μ PD750006	44-pin QFP (10 × 10)	EP-75008GB-R	EV-9200G-44
μ PD750008			
μ PD750104	42-pin SDIP (600 mil)	EP-75008CU-R	–
μ PD750106	44-pin QFP (10 × 10)	EP-75008GB-R	EV-9200G-44
μ PD750108			
μ PD750064	42-pin SDIP (600 mil)	EP-750068CU-R	–
μ PD750066	42-pin SSOP (375 mil)	EP-750068GT-R	EV-9500GT-42
μ PD750068			
μ PD753012A	80-pin QFP (14 × 14)	EP-753017GC-R	EV-9200GC-80
μ PD753016A	80-PIN TQFP (12 × 12)	EP-753017GK-R	TGK-080SDW*
μ PD753017A			
μ PD753036	80-pin QFP (14 × 14)	EP-75336GC-R	EV-9200GC-80
	80-pin TQFP (12 × 12)	EP-75336GK-R	TGK-080SDW*
μ PD753104	64-pin QFP (14 × 14)	EP-753108GC-R	EV-9200GC-64
μ PD753106	64-pin LQFP (12 × 12)	EP-753108GK-R	TGK-064SBW*
μ PD753108			
μ PD753204	48-pin SSOP (375 mil)	EP-753208GT-R	EV-9500GT-48
μ PD753206			
μ PD753208			
μ PD753304	42-pin SDIP (600 mil) (ES only)	EP-753304DU-R (ES only)	–
μ PD754144	20-pin SOP (300 mil)	EP-754144GS-R	EV-9501GS-20
μ PD754244	20-pin SSOP (300 mil)		EV-9500GS-20
μ PD754264	20-pin SOP (300 mil)		EV-9501GS-20
μ PD754202	20-pin SOP (300 mil)	EP-754144GS-R	EV-9501GS-20
	20-pin SSOP (300 mil)		EV-9500GS-20
μ PD754302	36-pin SSOP (300 mil)	EP-754304GS-R	EV-9500GS-36
μ PD754304			

*: This is a product of Tokyo Eletech Corporation.

Development Tools

17K Series Software Tools

■ List of Software Tools

Host machine	Software tool name
PC-9800 Series	Relocatable assembler RA17K
IBM PC/AT and compatibles	C-like compiler <i>emIC-17K™</i>
PC98-NX Series	Integrated debugger <i>SIMPLEHOST™</i>

■ List of Device Files

Target device	Device file name	Target device	Device file name	Target device	Device file name
μ PD17001	AS17001	μ PD17053	AS17053	μ PD17933A	AS17934
μ PD17003A	AS17003	μ PD17062	AS17062	μ PD17934A	
μ PD17005	AS17005	μ PD17068	AS17068	μ PD17201A	AS17201
μ PD17010	AS17010	μ PD17071	AS17071	μ PD17203A	AS17203
		μ PD17072		μ PD17204	AS17204
		μ PD17073		μ PD17207	AS17207
μ PD17012	AS17012	μ PD17704	AS17707	μ PD17225	AS17225
		μ PD17705		μ PD17226	
μ PD17015	AS17015	μ PD17707		μ PD17227	
		μ PD17708		μ PD17228	
		μ PD17709		μ PD17235*	AS17235*
μ PD17717	μ PD17236*				
μ PD17016	AS17016	μ PD17718			
μ PD17017		μ PD17719			

*: Under development

Development Tools

17K Series Hardware Tools

■ **Common Hardware Tools**

Tool name	Product name
In-circuit emulator	IE-17K IE-17K-ET EMU-17K*

*: This is a product of I.C Corporation.

■ **List of Hardware Tools (1/2)**

Target device		SE board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Device name	Package			
μPD17001	48-pin QFP	SE-17001	EP-17001GH	EV-9200GH-48
μPD17003A	80-pin QFP	SE-17010	EP-17003GF	EV-9200G-80
μPD17005	80-pin QFP	SE-17010	EP-17003GF	EV-9200G-80
μPD17010	80-pin QFP	SE-17010	EP-17003GF	EV-9200G-80
μPD17012	64-pin QFP	SE-17012	EP-17202GF	EV-9200G-64
μPD17015	38-pin SSOP	SE-17015	EP-17K38GT	EV-9500GT-38
μPD17016 μPD17017	80-pin QFP	SE-17010	EP-17003GF	EV-9200G-80
μPD17053	64-pin SDIP	SE-17053	EP-17052CW	—
μPD17062	48-pin SDIP	SE-17002	EP-17002CU	—
	64-pin QFP		EP-17002GC	EV-9200GC-64
μPD17068	100-pin QFP	SE-17008	EP-17068GF	EV-9200GF-100
μPD17071 μPD17072 μPD17073	56-pin QFP	SE-17072	EP-17K56GB -1 (Bend lead package)	TGB-056SBW*
			EP-17K56GB-2 (Inverted lead package)	
	64-pin TQFP		EP-17K64GB	TGB-064SDP*

*: This is a product of Tokyo Eletech Corporation.

Development Tools

17K Series Hardware Tools

<p>■ List of Hardware Tools (2/2)</p>
--

Target device		SE board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Device name	Package			
μPD17704 μPD17705 μPD17707 μPD17708 μPD17709 μPD17717 μPD17718 μPD17719	80-pin QFP	SE-17709	EP-17K80GC	EV-9200GC-80
μPD17933A μPD17934A	80-pin QFP	SE-17934	EP-17K80GK	TGB-080SDP*
μPD17201A	80-pin QFP (14 × 20)	SE-17207	EP-17201GF	EV-9200G-80
μPD17203A μPD17204	52-pin QFP (14 × 20)	SE-17204	EP-17203GC	EV-9200G-52
μPD17207	80-pin QFP (14 × 20)	SE-17207	EP-17201GF	EV-9200G-80
μPD17225	28-pin SDIP (400 mil)	SE-17225	EP-17K28CT	—
μPD17226	28-pin SOP (375 mil)		EP-17K28GT	EV-9500GT-28
μPD17227	30-pin SSOP (300 mil)		EP-17K30GS*	EV-9500GT-30
μPD17228				
μPD17235*	28-pin SOP (375 mil)	SE-17235*	EP-17K28GT	EV-9500GT-28
μPD17236*	30-pin SSOP (300 mil)		EP-17K30GS*	EV-9500GT-30

*: This is a product of Tokyo Eletech Corporation.

*: Under development

Development Tools

μPD6133, 6604, 63 Series Software Tools

■ **List of Software Tools**

Host machine	Product name
PC-9800 Series IBM PC/AT and compatibles PC98-NX Series	Absolute assembler AS6133

178K Series Software Tools

■ **List of Device Files**

Target device	Device file name	Target device	Device file name	Target device	Device file name
μPD178002	DF178018	μPD178023*	DF178134*	μPD178076*	DF178098
μPD178003		μPD178024*		μPD178078*	
μPD178004A		μPD178046*	DF178048*	μPD178096*	
μPD178006A		μPD178048*		μPD178098*	
μPD178016A					
μPD178018A					

*: Under development

Software tools other than device files are common to the 178K Series and the 78K/0 Series. See **78K/0 Series List of Software Tools** for details.

Development Tools

178K Series Hardware Tools

(1) When using the in-circuit emulator IE-78K0-NS

■ Common Hardware Tools (When using IE-78K0-NS)

Tool name	Product name
In-circuit emulator	IE-78K0-NS
Performance board	IE-78K0-NS-PA*
Power supply unit	IE-70000-MC-PS-B
Interface adapter	IE-70000-98-IF-C for C bus of PC-9800 Series IE-70000-PC-IF-C for ISA bus of PC/AT and compatibles IE-70000-PCI-IF for PCI bus IE-70000-CD-IF-A for PCMCIA socket

*: Under development

■ List of Hardware Tools (When using IE-78K0-NS)

Target device		Emulation board I/O board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Device name	Package			
μ PD178002 μ PD178003	80-pin QFP (14 × 14)	IE-178018-NS-EM1	NP-80GC*1	EV-9200GC-80
μ PD178004A μ PD178006A μ PD178016A μ PD178018A	80-pin QFP (14 × 14)	IE-178018-NS-EM1	NP-80GC*1	EV-9200GC-80
μ PD178023* μ PD178024*	80-pin QFP (14 × 20) 80-pin QFP (14 × 14)	IE-178134-NS-EM1*	NP-80GF*1 NP-80GC*1	EV-9200G-80 EV-9200GC-80
μ PD178046* μ PD178048*	64-pin SDIP (750 mil) 80-pin TQFP (12 × 12)	IE-178048-NS-EM1*	NP-64CW*1 NP-80GK*1	– TGK-080SDW*2
μ PD178076* μ PD178078*	100-pin QFP (14 × 20)	IE-178098-NS-EM1	NP-100GF*1	EV-9200GF-100
μ PD178096* μ PD178098*	100-pin QFP (14 × 20)	IE-178098-NS-EM1	NP-100GF*1	EV-9200GF-100

*1: This is a product of Natio Densai Machida Mfg. Co., Ltd.

*2: This is a product of Tokyo Eletech Corporation.

*: Under development

Development Tools

178K Series Hardware Tools

(2) When using the in-circuit emulator IE-78001-R-A

■ **Common Hardware Tools (When using IE-78001-R-A)**

Tool name	Product name
In-circuit emulator	IE-78001-R-A
Interface adapter	IE-70000-98-IF-C for C bus of PC-9800 Series
	IE-70000-PC-IF-C for ISA bus of PC/AT and compatibles
	IE-70000-PCI-IF for PCI bus

■ **List of Hardware Tools (When using IE-78001-R-A)**

Target device		Emulation board I/O board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Device name	Package	Emulation probe conversion board		
μ PD178002 μ PD178003	80-pin QFP (14 × 14)	IE-178018-R-EM	EP-78230GC-R	EV-9200GC-80
μ PD178004A μ PD178006A μ PD178016A μ PD178018A	80-pin QFP (14 × 14)	IE-178018-R-EM	EP-78230GC-R	EV-9200GC-80
μ PD178023*	80-pin QFP (14 × 20)	IE-178134-NS-EM1*	EP-78130GF-R	EV-9200G-80
μ PD178024*	80-pin QFP (14 × 14)	IE-78K0-R-EX1	EP-78230GC-R	EV-9200GC-80
μ PD178046* μ PD178048*	64-pin SDIP (750 mil) 80-pin TQFP (12 × 12)	Not supported. Use IE-78K0-NS for these devices.		
μ PD178076* μ PD178078*	100-pin QFP (14 × 20)	IE-178098-NS-EM1 IE-78K0-R-EX1	EP-78064GF-R	EV-9200GF-100
μ PD178096* μ PD178098*	100-pin QFP (14 × 20)	IE-178098-NS-EM1 IE-78K0-R-EX1	EP-78064GF-R	EV-9200GF-100

*: Under development

Development Tools

78K/0S Series Software Tools

■ List of Software Tools

Host machine	Software tool name
PC-9800 Series	Assembler package RA78K0S
IBM PC/AT and compatibles	C compiler CC78K0S
PC98-NX Series	C library source file CC78K0S-L
	Integrated debugger ID78K0S-NS
	System simulator SM78K0S
	Embedded OS MX78K0S
EWS	Assembler package RA78K0S
	C compiler CC78K0S
	C library source file CC78K0S-L

■ List of Device Files

Subseries name	Device file name	Subseries name	Device file name
μ PD789014	DF789014	μ PD789167*	DF789178
μ PD789026	DF789026	μ PD789177*	
μ PD789046	DF789046	μ PD789407A	DF789418
μ PD789104A*	DF789134	μ PD789417A	
μ PD789114A*		μ PD789800	DF789801
μ PD789124A*		μ PD789830*	DF789831
μ PD789134A*		μ PD789842*	DF789842

*: Under development

Development Tools

78K/0S Series Hardware Tools

■ Common Hardware Tools

Tool name	Product name	
In-circuit emulator	IE-78K0S-NS	
Power supply unit	IE-70000-MC-PS-B	
Interface adapter	IE-70000-98-IF-C	for C bus of PC-9800 Series
	IE-70000-PC-IF-C	for ISA bus of PC/AT and compatibles
	IE-70000-PCI-IF	for PCI bus
	IE-70000-CD-IF-A	for PCMCIA socket

■ List of Hardware Tools (1/2)

Target device		Emulation board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package			
μPD789014	28-pin SDIP (400 mil)	IE-789014-NS-EM1	NP-28CT*	—
	28-pin SOP (375 mil)		NP-28GT*	AXS628119P* AXS662821*
μPD789026	42-pin SDIP (600 mil)	IE-789026-NS-EM1	NP-42CU*	—
	44-pin QFP (10 × 10)		NP-44GB*	EV-9200G-44
μPD789046	44-pin QFP (10 × 10)	IE-789046-NS-EM1	NP-44GB*	EV-9200G-44
μPD789104A*	28-pin SDIP (400 mil)	IE-789136-NS-EM1	NP-28CT*	—
	30-pin SSOP (300 mil)		NP-36GS*	NGS-30* (attached to NP-36GS*)
μPD789114A*	28-pin SDIP (400 mil)	IE-789136-NS-EM1	NP-28CT*	—
	30-pin SSOP (300 mil)		NP-36GS*	NGS-30* (attached to NP-36GS*)
μPD789124A*	28-pin SDIP (400 mil)	IE-789136-NS-EM1	NP-28CT*	—
	30-pin SSOP (300 mil)		NP-36GS*	NGS-30* (attached to NP-36GS*)

*: This is a product of Naito Densai Machida Mfg. Co., Ltd.

*: Under development

Development Tools

78K/0S Series Hardware Tools

■ List of Hardware Tools (2/2)

Target device		Emulation board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package			
μPD789134A*	28-pin SDIP (400 mil)	IE-789136-NS-EM1	NP-28CT* ¹	–
	30-pin SSOP (300 mil)		NP-36GS* ¹	NGS-30* ¹ (attached to NP-36GS* ¹)
μPD789167*	44-pin QFP (10 × 10)	IE-789177-NS-EM1*	NP-44GB* ¹	EV-9200G-44
μPD789177*	44-pin QFP (10 × 10)	IE-789177-NS-EM1*	NP-44GB* ¹	EV-9200G-44
μPD789407A	80-pin QFP (14 × 14)	IE-789418-NS-EM1	NP-80GC* ¹	EV-9200GC-80
	80-pin TQFP (12 × 12)		NP-80GK* ¹	TGK-080SDW* ²
μPD789417A	80-pin QFP (14 × 14)	IE-789418-NS-EM1	NP-80GC* ¹	EV-9200GC-80
	80-pin TQFP (12 × 12)		NP-80GK* ¹	TGK-080SDW* ²
μPD789800	42-pin SDIP (600 mil)	IE-789801-NS-EM1	NP-42CU* ¹	–
	44-pin QFP (10 × 10)		NP-44GB* ¹	EV-9200G-44
μPD789830*	88-pin bare chip	IE-789831-NS-EM1	–	–
μPD78F9831*	100-pin LQFP (14 × 14)		NP-100GC* ¹	TGC-100SDW* ²
μPD789842*	44-pin QFP (10 × 10)	IE-789840-NS-EM1	NP-44GB* ¹	EV-9200G-44

*¹: This is a product of Naito Densai Machida Mfg. Co., Ltd.*²: Under development*²: This is a product of Tokyo Eletech Corporation.

Development Tools

78K/0 Series Software Tools

■ **List of Software Tools**

Host machine	Software tool name
PC-9800 Series IBM PC/AT and compatibles PC98-NX Series	Assembler package RA78K0
	C compiler CC78K0
	C library source file CC78K0-L
	Integrated debugger ID78K0-NS
	Integrated debugger ID78K0
	System simulator SM78K0
	Real-time OS RX78K/0
	Embedded OS MX78K0
EWS	Assembler package RA78K0
	C compiler CC78K0
	C library source file CC78K0-L
	Integrated debugger ID78K0

■ **List of Device Files**

Subseries name	Device file name	Subseries name	Device file name	Subseries name	Device file name
μ PD78018F	DF78014	μ PD78078	DF78078	μ PD780232	DF780233
μ PD78018FY		μ PD78078Y		μ PD780308	DF780308
μ PD78014H		μ PD78075B		μ PD780308Y	(μ SxxxDF78064)
μ PD78044F	DF78044	μ PD78083	DF78083	μ PD780701Y*	DF780701*
μ PD78044H		μ PD78098B	DF78098	μ PD780833Y*	DF780831*
μ PD78054	DF78054	μ PD780018AY	DF780018	μ PD780948*	DF780948*
μ PD78054Y		μ PD780024A	DF780024	μ PD780955*	DF780955
μ PD78058F	DF78054	μ PD780024AY	DF780034	μ PD780958*	DF780958*
μ PD78058FY		μ PD780034A		μ PD780973*	DF780974
μ PD78064	DF78064	μ PD780034AY	DF780058	μ PD780988	DF780988
μ PD78064Y		μ PD780058			
μ PD78064B		μ PD780058Y*			
μ PD78070A	DF78078	μ PD780065*	DF780066*		
μ PD78070AY		μ PD780208	DF780208		

*: Under development

Development Tools

78K/0 Series Hardware Tools

(1) When using the in-circuit emulator IE-78K0-NS

■ Common Hardware Tools (When using IE-78K0-NS)

Tool name	Product name	
In-circuit emulator	IE-78K0-NS	
Performance board	IE-78K0-NS-PA*	
Power supply unit	IE-70000-MC-PS-B	
Interface adapter	IE-70000-98-IF-C	for C bus of PC-9800 Series
	IE-70000-PC-IF-C	for ISA bus of PC/AT and compatibles
	IE-70000-PCI-IF	for PCI bus
	IE-70000-CD-IF-A	for PCMCIA socket

*: Under development

■ List of Hardware Tools (When using IE-78K0-NS) (1/3)

Target device		Emulation board I/O board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package			
μPD78018F	64-pin SDIP (750 mil)	IE-78018-NS-EM1	NP-64CW*1	—
	64-pin QFP (14 × 14)		NP-64GC*1	EV-9200GC-64
	64-pin LQFP (12 × 12)		NP-64GK*1	TGK-064SBW*2
μPD78018FY	64-pin SDIP (750 mil)	IE-78018-NS-EM1	NP-64CW*1	—
	64-pin QFP (14 × 14)		NP-64GC*1	EV-9200GC-64
	64-pin LQFP (12 × 12)		NP-64GK*1	TGK-064SBW*2
μPD78014H	64-pin SDIP (750 mil)	IE-78018-NS-EM1	NP-64CW*1	—
	64-pin QFP (14 × 14)		NP-64GC*1	EV-9200GC-64
	64-pin LQFP (12 × 12)		NP-64GK*1	TGK-064SBW*2
μPD78044F	80-pin QFP (14 × 20)	IE-78048-NS-EM1	NP-80GF*1	TGF-080RAW*2
μPD78044H	80-pin QFP (14 × 20)	IE-78048-NS-EM1	NP-80GF*1	TGF-080RAW*2
μPD78054	80-pin QFP (14 × 14)	IE-780308-NS-EM1	NP-80GC*1	EV-9200GC-80
	80-pin TQFP (12 × 12)	IE-780308-NS-EM1	NP-80GK*1	TGK-080SDW*2
μPD78054Y	80-pin QFP (14 × 14)	IE-780308-NS-EM1	NP-80GC*1	EV-9200GC-80
	80-pin TQFP (12 × 12)	IE-780308-NS-EM1	NP-80GK*1	TGK-080SDW*2
μPD78058F	80-pin QFP (14 × 14)	IE-780308-NS-EM1	NP-80GC*1	EV-9200GC-80
μPD78058FY	80-pin QFP (14 × 14)	IE-780308-NS-EM1	NP-80GC*1	EV-9200GC-80

*1: This is a product of Naito Densai Machida Mfg. Co., Ltd.

*2: This is a product of Tokyo Eletech Corporation.

Development Tools

78K/0 Series Hardware Tools

■ List of Hardware Tools (When using IE-78K0-NS) (2/3)

Target device		Emulation board I/O board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package			
μPD78064	100-pin SDIP (14 × 20)	IE-780308-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD78064Y	100-pin QFP (14 × 20)	IE-780308-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD78064B	100-pin QFP (14 × 20)	IE-780308-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD78070A	100-pin QFP (14 × 20)	IE-78078-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD78070AY	100-pin QFP (14 × 20)	IE-78078-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD78078	100-pin QFP (14 × 20)	IE-78078-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD78078Y	100-pin QFP (14 × 20)	IE-78078-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD78075B	100-pin QFP (14 × 20)	IE-78078-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD78083	42-pin SDIP (600 mil)	IE-78078-NS-EM1	NP-42CU*1	—
	44-pin QFP (10 × 10)		NP-44GB*1	EV-9200G-44
μPD78098B	80-pin QFP (14 × 14)	Not supported. Use IE-78001-R-A for these devices.		
μPD780018AY	100-pin QFP (14 × 20)	IE-780018-NS-EM1	NP-100GF*1	EV-9200GF-100
μPD780024A	64-pin SDIP (750 mil)	IE-780034-NS-EM1	NP-64CW*1	—
	64-pin QFP (14 × 14)		NP-64GC*1	EV-9200GC-64
	64-pin LQFP (12 × 12)		NP-64GK*1	TGK-064SBW*2
μPD780024AY	64-pin SDIP (750 mil)	IE-780034-NS-EM1	NP-64CW*1	—
	64-pin QFP (14 × 14)		NP-64GC*1	EV-9200GC-64
	64-pin LQFP (12 × 12)		NP-64GK*1	TGK-064SBW*2
μPD780034A	64-pin SDIP (750 mil)	IE-780034-NS-EM1	NP-64CW*1	—
	64-pin QFP (14 × 14)		NP-64GC*1	EV-9200GC-64
	64-pin LQFP (12 × 12)		NP-64GK*1	TGK-064SBW*2
μPD780034AY	64-pin SDIP (750 mil)	IE-780034-NS-EM1	NP-64CW*1	—
	64-pin QFP (14 × 14)		NP-64GC*1	EV-9200GC-64
	64-pin LQFP (12 × 12)		NP-64GK*1	TGK-064SBW*2

*1: This is a product of Naito Densai Machida Mfg. Co., Ltd.

*2: This is a product of Tokyo Eletech Corporation.

Development Tools

78K/0 Series Hardware Tools

■ List of Hardware Tools (When using IE-78K0-NS) (3/3)

Target device		Emulation board I/O board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package			
μPD780058	80-pin QFP (14 × 14)	IE-780308-NS-EM1	NP-80GC*1	EV-9200GC-80
	80-pin TQFP (12 × 12)		NP-80GK*1	TGK-080SDW*2
μPD780058Y*	80-pin QFP (14 × 14)	IE-780308-NS-EM1	NP-80GC*1	EV-9200GC-80
	80-pin TQFP (12 × 12)		NP-80GK*1	TGK-080SDW*2
μPD780065*	80-pin QFP (14 × 14)	IE-780066-NS-EM4* IE-78K0-NS-P01	NP-80GC*1	EV-9200GC-80
μPD780208	100-pin QFP (14 × 20)	IE-780208-NS-EM1	NP-100GF*1	EV-9200GF-100
μPD780232	80-pin QFP (14 × 14)	IE-780233-NS-EM4* IE-78K0-NS-P01	NP-80GC*1	EV-9200GC-80
μPD780308	100-pin QFP (14 × 20)	IE-780308-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD780308Y	100-pin QFP (14 × 20)	IE-780308-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD780701Y*	80-pin QFP (14 × 14)	IE-780701-NS-EM1*	NP-80GC*1	EV-9200GC-80
μPD780833Y*	80-pin QFP (14 × 14)	IE-780831-NS-EM4 IE-78K0-NS-P02	NP-80GC*1	EV-9200GC-80
μPD780948*	100-pin QFP (14 × 20)	Not supported. Use IE-78001-R-A for these devices.		
μPD780955*	80-pin QFP (14 × 20)	We, NEC, will support each requirement for the development environment of this subseries' devices. Please contact an NEC sales representative.		
μPD780958*	100-pin LQFP (14 × 14)	IE-780958-NS-EM4* IE-78K0-NS-P01	NP-100GC*1	TGC-100SDW*2
μPD780973*	80-pin QFP (14 × 20)	IE-780974-NS-EM1*	NP-80GF*1	EV-9200G-80
μPD780988	64-pin SDIP (750 mil)	IE-780988-NS-EM4	NP-64CW*1	—
	64-pin QFP (14 × 14)	IE-780K0-NS-P01	NP-64GC*1	EV-9200GC-64

*1: This is a product of Naito Densai Machida Mfg. Co., Ltd.

*: Under development

*2: This is a product of Tokyo Eletech Corporation.

Development Tools

78K/0 Series Hardware Tools

(2) When using the in-circuit emulator IE-78001-R-A

■ Common Hardware Tools (When using IE-78001-R-A)

Tool name	Product name
In-circuit emulator	IE-78001-R-A
Interface adapter	IE-70000-98-IF-C for C bus of PC-9800 Series
	IE-70000-PC-IF-C for ISA bus of PC/AT and compatibles
	IE-70000-PCI-IF for PCI bus

■ List of Hardware Tools (When using IE-78001-R-A) (1/3)

Target device		Emulation board I/O board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package	Emulation probe conversion board		
μPD78018F	64-pin SDIP (750 mil)	IE-78014-R-EM-A	EP-78240CW-R	–
	64-pin QFP (14 × 14)			EV-9200GC-64
	64-pin LQFP (12 × 12)			TGK-064SBW*
μPD78018FY	64-pin SDIP (750 mil)	IE-78014-R-EM-A	EP-78240CW-R	–
	64-pin QFP (14 × 14)			EV-9200GC-64
	64-pin LQFP (12 × 12)			TGK-064SBW*
μPD78014H	64-pin SDIP (750 mil)	IE-78014-R-EM-A	EP-78240CW-R	–
	64-pin QFP (14 × 14)			EV-9200GC-64
	64-pin LQFP (12 × 12)			TGK-064SBW*
μPD78044F	80-pin QFP (14 × 20)	IE-78044-R-EM	EP-78130GF-R	EV-9200G-80
μPD78044H	80-pin QFP (14 × 20)	IE-78044-R-EM	EP-78130GF-R	EV-9200G-80
μPD78054	80-pin QFP (14 × 14)	IE-780308-R-EM	EP-78230GC-R	EV-9200GC-80
	80-pin TQFP (12 × 12)			TGK-080SDW*
μPD78054Y	80-pin QFP (14 × 14)	IE-780308-R-EM	EP-78230GC-R	EV-9200GC-80
	80-pin TQFP (12 × 12)			TGK-080SDW*
μPD78058F	80-pin QFP (14 × 14)	IE-780308-R-EM	EP-78230GC-R	EV-9200GC-80
μPD78058FY	80-pin QFP (14 × 14)	IE-780308-R-EM	EP-78230GC-R	EV-9200GC-80
μPD78064	100-pin QFP (14 × 20)	IE-780308-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)			TGC-100SDW*
μPD78064Y	100-pin QFP (14 × 20)	IE-780308-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)			TGC-100SDW*
μPD78064B	100-pin QFP (14 × 20)	IE-780308-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)			TGC-100SDW*

*: This is a product of Tokyo Eletech Corporation.

Development Tools

78K/0 Series Hardware Tools

■ List of Hardware Tools (When using IE-78001-R-A) (2/3)

Target device		Emulation board I/O board Emulation probe conversion board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package			
μPD78070A	100-pin QFP (14 × 20)	IE-78078-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)		EP-78064GC-R	TGC-100SDW*
μPD78070AY	100-pin QFP (14 × 20)	IE-78078-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)		EP-78064GC-R	TGC-100SDW*
μPD78078	100-pin QFP (14 × 20)	IE-78078-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)		EP-78064GC-R	TGC-100SDW*
μPD78078Y	100-pin QFP (14 × 20)	IE-78078-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)		EP-78064GC-R	TGC-100SDW*
μPD78075B	100-pin QFP (14 × 20)	IE-78078-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)		EP-78064GC-R	TGC-100SDW*
μPD78083	42-pin SDIP (600 mil)	IE-78078-R-EM	EP-78083CU-R	—
	44-pin QFP (10 × 10)		EP-78083GB-R	EV-9200G-44
μPD78098B	80-pin QFP (14 × 14)	IE-780908-R-EM	EP-78230GC-R	EV-9200GC-80
μPD780018AY	100-pin QFP (14 × 20)	IE-780018-R-EM	EP-78064GF-R	EV-9200GF-100
μPD780024A	64-pin SDIP (750 mil)	IE-780034-NS-EM1	EP-78240CW-R	—
	64-pin QFP (14 × 14)	IE-78K0-R-EX1	EP-78240GC-R	EV-9200GC-64
	64-pin LQFP (14 × 14)		EP-78012GK-R	TGK-064SBW*
μPD780024AY	64-pin SDIP (750 mil)	IE-780034-NS-EM1	EP-78240CW-R	—
	64-pin QFP (14 × 14)	IE-78K0-R-EX1	EP-78240GC-R	EV-9200GC-64
	64-pin LQFP (12 × 12)		EP-78012GK-R	TGK-064SBW*
μPD780034A	64-pin SDIP (750 mil)	IE-780034-NS-EM1	EP-78240CW-R	—
	64-pin QFP (14 × 14)	IE-78K0-R-EX1	EP-78240GC-R	EV-9200GC-64
	64-pin LQFP (12 × 12)		EP-78012GK-R	TGK-064SBW*
μPD780034AY	64-pin SDIP (750 mil)	IE-780034-NS-EM1	EP-78240CW-R	—
	64-pin QFP (14 × 14)	IE-78K0-R-EX1	EP-78240GC-R	EV-9200GC-64
	64-pin LQFP (12 × 12)		EP-78012GK-R	TGK-064SBW*
μPD780058	80-pin QFP (14 × 14)	IE-780308-R-EM	EP-78230GC-R	EV-9200GC-80
	80-pin TQFP (12 × 12)		EP-78054GK-R	TGK-080SDW*
μPD780058Y*	80-pin QFP (14 × 14)	IE-780308-R-EM	EP-78230GC-R	EV-9200GC-80
	80-pin TQFP (12 × 12)		EP-78054GK-R	TGK-080SDW*

*: This is a product of Tokyo Eletech Corporation.

*: Under development

Development Tools

78K/0 Series Hardware Tools

■ List of Hardware Tools (When using IE-78001-R-A) (3/3)

Target device		Emulation board I/O board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package	Emulation probe conversion board		
μ PD780065*	80-pin QFP (14 × 14)	IE-780066-NS-EM4* IE-78K0-NS-P01 IE-78K0-R-EX1	EP-78230GC-R	EV-9200GC-80
μ PD780208	100-pin QFP (14 × 20)	IE-780208-R-EM	EP-78064GF-R	EV-9200GF-100
μ PD780232	80-pin QFP (14 × 14)	IE-780233-NS-EM4* IE-78K0-NS-P01 IE-78K0-R-EX1	EP-78230GC-R	EV-9200GC-80
μ PD780308	100-pin QFP (14 × 20)	IE-780308-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)		EP-78064GC-R	TGC-100SDW*
μ PD780308Y	100-pin QFP (14 × 20)	IE-780308-R-EM	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)		EP-78064GC-R	TGC-100SDW*
μ PD780701Y*	80-pin QFP (14 × 14)	IE-780701-NS-EM1* IE-78K0-R-EX1	EP-78230GC-R	EV-9200GC-80
μ PD780833Y*	80-pin QFP (14 × 14)	IE-780831-NS-EM4 IE-78K0-NS-P02 IE-78K0-R-EX1	EP-78230GC-R	EV-9200GC-80
μ PD780948*	100-pin QFP (14 × 20)	IE-780948-SL-EM1 IE-780948-SL-EM4	EP-100GF-SL	TQPACK100RB* or YQPACK100RB* + NQPAC100RB*
μ PD780955*	80-pin QFP (14 × 20)	We, NEC, will support each requirement for the development environment of this subseries' devices. Please contact an NEC sales representative.		
μ PD780958*	100-pin LQFP (14 × 14)	IE-780958-NS-EM4* IE-78K0-NS-P01 IE-78K0-R-EX1	EP-78064GC-R	TGC-100SDW*
μ PD780973*	80-pin QFP (14 × 20)	IE-780974-NS-EM1* IE-78K0-R-EX1	EP-78130GF-R	EV-9200G-80
μ PD780988	64-pin SDIP (750 mil)	IE-780988-NS-EM4 IE-78K0-NS-P01	EP-78024CW-R	—
	64-pin QFP (14 × 14)	IE-78K0-R-EX1	EP-78240GC-R	EV-9200GC-64

*: This is a product of Tokyo Eletech Corporation.

★: Under development

Development Tools

78K/IV Series Software Tools

■ List of Software Tools

Host machine	Software tool name
PC-9800 Series IBM PC/AT and compatibles PC98-NX Series	Assembler package RA78K4
	C compiler CC78K4
	C library source file CC78K4-L
	Integrated debugger ID78K4-NS
	Integrated debugger ID78K4
	System simulator SM78K4
	System performance analyzer AZ78K4
	Real-time OS RX78K4
	Embedded OS MX78K4
EWS	Assembler package RA78K4
	C compiler CC78K4
	C library source file CC78K4-L
	Integrated debugger ID78K4

■ List of Device Files

Subseries name	Device file name	Subseries name	Device file name	Subseries name	Device file name
μ PD784038	DF784038	μ PD784218	DF784218	μ PD784928	DF784928
μ PD784038Y		μ PD784218Y		μ PD784928Y	
μ PD784046	DF784046	μ PD784225*	DF784225	μ PD784938*	DF784937*
μ PD784054		μ PD784225Y*		μ PD784955*	
μ PD784216	DF784218	μ PD784908	DF784908		
μ PD784216Y		μ PD784915		DF784916	

★: Under development

Development Tools

78K/IV Series Hardware Tools

(1) When using the in-circuit emulator IE-78K4-NS

■ Common Hardware Tools (When using IE-78K4-NS)

Tool name	Product name	
In-circuit emulator	IE-78K4-NS	
Power supply unit	IE-70000-MC-PS-B	
Interface adapter	IE-70000-98-IF-C	for C bus of PC-9800 Series
	IE-70000-PC-IF-C	for ISA bus of PC/AT and compatibles
	IE-70000-PCI-IF	for PCI bus
	IE-70000-CD-IF-A	for PCMCIA socket

■ List of Hardware Tools (When using IE-78K4-NS)

Target device		Emulation board	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package			
μPD784038	80-pin QFP (14 × 14)	IE-784038-NS-EM1	NP-80GC*1	EV-9200GC-80
	80-pin TQFP (12 × 12)		NP-80GK*1	TGK-080SDW*2
μPD784038Y	80-pin QFP (14 × 14)	IE-784038-NS-EM1	NP-80GC*1	EV-9200GC-80
	80-pin TQFP (12 × 12)		NP-80GK*1	TGK-080SDW*2
μPD784046	80-pin QFP (14 × 14)	IE-784046-NS-EM1	NP-80GC*1	EV-9200GC-80
μPD784054	80-pin QFP (14 × 14)	IE-784046-NS-EM1	NP-80GC*1	EV-9200GC-80
μPD784216	100-pin QFP (14 × 20)	IE-784225-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD784216Y	100-pin QFP (14 × 20)	IE-784225-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD784218	100-pin QFP (14 × 20)	IE-784225-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD784218Y	100-pin QFP (14 × 20)	IE-784225-NS-EM1	NP-100GF*1	EV-9200GF-100
	100-pin LQFP (14 × 14)		NP-100GC*1	TGC-100SDW*2
μPD784225*	80-pin QFP (14 × 14)	IE-784225-NS-EM1	NP-80GC*1	EV-9200GC-80
	80-pin TQFP (12 × 12)		NP-80GK*1	TGK-080SDW*2
μPD784225Y*	80-pin QFP (14 × 14)	IE-784225-NS-EM1	NP-80GC*1	EV-9200GC-80
	80-pin TQFP (12 × 12)		NP-80GK*1	TGK-080SDW*2
μPD784908	100-pin QFP (14 × 20)	IE-784908-NS-EM1	NP-100GF*1	EV-9200GF-100
μPD784915	100-pin QFP (14 × 20)	IE-784928-NS-EM1	EP-784928GF-NS	NEV-921GF-100
μPD784928	100-pin QFP (14 × 20)	IE-784928-NS-EM1	EP-784928GF-NS	NEV-921GF-100
μPD784928Y	100-pin QFP (14 × 20)	IE-784928-NS-EM1	EP-784928GF-NS	NEV-921GF-100
μPD784938*	100-pin QFP (14 × 20)	IE-784937-NS-EM1	NP-100GF*1	EV-9200GF-100
μPD784955*	80-pin QFP (14 × 14)	IE-784956-NS-EM1	NP-80GC*1	EV-9200GC-80

*1: This is a product of Naito Densai Machida Mfg. Co., Ltd.

*: Under development

*2: This is a product of Tokyo Eletech Corporation.

Development Tools

78K/IV Series Hardware Tools

(2) When using the in-circuit emulator IE-784000-R

■ Common Hardware Tools (When using IE-784000-R)

Tool name	Product name
In-circuit emulator	IE-784000-R
Emulation board	IE-784000-R-EM
Interface board	IE-70000-98-IF-C for C bus of PC-9800 Series
	IE-70000-PC-IF-C for ISA bus of PC/AT and compatibles
	IE-70000-PCI-IF for PCI bus
	IE-70000-CD-IF-A for PCMCIA socket

■ List of Hardware Tools (When using IE-784000-R) (1/2)

Target device		I/O emulation board (emulation board)	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package	Emulation probe conversion board		
μ PD784038	80-pin QFP (14 × 14)	IE-784038-R-EM1	EP-78230GC-R	EV-9200GC-80
	80-pin TQFP (12 × 12)		EP-78054GK-R	TGK-080SDW*
μ PD784038Y	80-pin QFP (14 × 14)	IE-784038-R-EM1	EP-78230GC-R	EV-9200GC-80
	80-pin TQFP (12 × 12)		EP-78054GK-R	TGK-080SDW*
μ PD784046	80-pin QFP (14 × 14)	IE-784046-R-EM1	EP-78230GC-R	EV-9200GC-80
μ PD784054	80-pin QFP (14 × 14)	IE-784046-R-EM1	EP-78230GC-R	EV-9200GC-80
μ PD784216	100-pin QFP (14 × 20)	IE-784225-NS-EM1	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)	IE-78K4-R-EX3	EP-78064GC-R	TGC-100SDW*

*: This is a product of Tokyo Eletech Corporation.

Development Tools

78K/IV Series Hardware Tools

■ List of Hardware Tools (When using IE-784000-R) (2/2)

Target device		I/O emulation board (emulation board)	Emulation probe	Conversion socket/ Conversion adapter/ Flexible board
Subseries name	Package	Emulation probe conversion board		
μPD784216Y	100-pin QFP (14 × 20)	IE-784225-NS-EM1	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)	IE-78K4-R-EX3	EP-78064GC-R	TGC-100SDW*
μPD784218	100-pin QFP (14 × 20)	IE-784225-NS-EM1	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)	IE-78K4-R-EX3	EP-78064GC-R	TGC-100SDW*
μPD784218Y	100-pin QFP (14 × 20)	IE-784225-NS-EM1	EP-78064GF-R	EV-9200GF-100
	100-pin LQFP (14 × 14)	IE-78K4-R-EX3	EP-78064GC-R	TGC-100SDW*
μPD784225*	80-pin QFP (14 × 14)	IE-784225-NS-EM1	EP-78230GC-R	EV-9200GC-80
	80-pin TQFP (12 × 12)	IE-78K4-R-EX2	EP-78054GK-R	TGK-080SDW*
μPD784225Y*	80-pin QFP (14 × 14)	IE-784225-NS-EM1	EP-78230GC-R	EV-9200GC-80
	80-pin TQFP (12 × 12)	IE-78K4-R-EX2	EP-78054GK-R	TGK-080SDW*
μPD784908	100-pin QFP (14 × 20)	IE-784908-R-EM1	EP-784915GF-R	EV-9200GF-100
μPD784915	100-pin QFP (14 × 20)	IE-784928-NS-EM1 IE-78K4-R-EX3	EP-784928GF-NS	EV-9200GF-100
μPD784928	100-pin QFP (14 × 20)	IE-784928-NS-EM1 IE-78K4-R-EX3	EP-784928GF-NS	EV-9200GF-100
μPD784928Y	100-pin QFP (14 × 20)	IE-784928-NS-EM1 IE-78K4-R-EX3	EP-784928GF-NS	EV-9200GF-100
μPD784938*	100-pin QFP (14 × 20)	IE-784937-NS-EM1 IE-78K4-R-EX3	EP-78064GF-R	EV-9200GF-100
μPD784955*	80-pin QFP (14 × 14)	IE-784956-NS-EM1 IE-78K4-R-EX2	EP-784915GF-R	EV-9200GC-80

*: This is a product of Tokyo Eletech Corporation.

*: Under development

Development Tools

V810 Family Development Tools

■ List of Software Tools

Product name		Target device	Host machine
Real-time OS	RX732	V821	PC-9800 Series IBM PC/AT and compatibles SPARCstation™
File system	RX-FS732		PC-9800 Series SPARCstation

Remark Please contact an NEC sales representative if you use host machines not mentioned above.

■ List of Hardware Tools

Product name	Target device	Part number	Remarks
In-circuit emulator	V821	IE-70741-BX	Conversion socket : TQPACK100SD* + TQSOCKET100SDW* (essential)
Interface board		IE-70000-98-IF-C	For PC-9800 Series
		IE-70000-PC-IF-C	For IBM PC/AT and compatibles
Expansion memory board		IE-70000-BX-MM2	Expands 2M bytes of the emulation memory
External logic probe		IE-70000-BX-EP	Consists of one GND and eight external inputs
Conversion adapter / Conversion socket		TQPACK100SD* TQSOCKET100SDW*	Probe included in the in-circuit emulator → 100-pin QFP

*: This is a product of Tokyo Eletech Corporation.

V830 Family Development Tools

■ List of Software Tools

Product name		Target device	Host machine
Real-time OS	RX830	V830 Family	PC-9800 Series IBM PC/AT and compatibles SPARCstation
Compiler	CA830	V830 V831	PC-9800 Series IBM PC/AT and compatibles SPARCstation
System performance analyzer	AZ830	V830 Family	PC-9800 Series IBM PC/AT and compatibles
Device file	DF705100	V830	PC-9800 Series IBM PC/AT and compatibles
	DF705101	V831	SPARCstation

Remark Please contact an NEC sales representative if you use host machines not mentioned above.

Hardware tools are not provided. Please contact an NEC sales representative about the development environment of the V830 Family.

Development Tools

V850 Family Software Tools■ **List of Software Tools**

Product name		Target device	Host machine
Real-time OS	RX850	V850 Family	PC-9800 Series IBM PC/AT and compatibles SPARCstation
	RX850 pro		
Compiler	CA850		PC-9800 Series IBM PC/AT and compatibles SPARCstation
Debugger	ID850		PC-9800 Series IBM PC/AT and compatibles
Simulator	SM850		PC-9800 Series IBM PC/AT and compatibles
System performance analyzer	AZ850		PC-9800 Series IBM PC/AT and compatibles
Device file	DF703002	V852	PC-9800 Series IBM PC/AT and compatibles SPARCstation
	DF703003	V853	
	DF703008	V854	
	DF703017	V850/SA1	
	DF703037	V850/SB1	
		V850/SB2	
DF703102	V850E/MS1		

Remark Please contact an NEC sales representative if you use host machines not mentioned above.

Development Tools

V850 Family Hardware Tools

■ List of Hardware Tools (1/2)

Product name	Target device	Part number	Remarks
In-circuit emulator	V850E/MS1	IE-703102-MC	A PC interface cable, external logic probe, and conversion sockets*1 are included
	V850/SA1, V850/SB1, V852, V853, V854	IE-703002-MC	
In-circuit emulator option board	V850/SA1	IE-703017-MC-EM1	NQPACK100SD*2 is included
	V850/SB1, V850/SB2	IE-703037-MC-EM1*	Conversion socket not included (the V850/SB2 version is under development)
	V853	IE-703003-MC-EM1	NQPACK100SD*2 is included
	V854	IE-703008-MC-EM1	NQPACK144SD*2, YQPACK144SD*2, HQPACK144SD*2, and YQGUIDE*2 are included
	V850E/MS1	IE-703102-MC-EM1*	For 5V, conversion socket not included
		IE-703102-MC-EM1-A*	For 3.3V, conversion socket not included
Power supply unit	V850/SA1, V850/SB1, V850/SB2, V850E/MS1, V852, V853, V854	IE-70000-MC-PS-B	Power supply cable for AC100 to 240V is included
PC Interface board	V850/SA1, V850/SB1, V850/SB2, V850E/MS1, V852, V853, V854	IE-70000-98-IF-B or IE-70000-98-IF-C	For PC-9800 (C bus)*3
		IE-70000-PC-IF-B or IE-70000-PC-IF-C	For IBM PC/AT and compatibles (ISA bus)*3
	IE-70000-CD-IF-A	For PCMCIA socket*4	
	IE-70000-PCI-IF	For PCI bus*4	

*1: The following conversion sockets, which are products of Tokyo Eletech Corporation, are included. *: Under development

IE-703102-MC : NQPACK144SD, YQPACK144SD, HQPACK144SD, YQGUIDE

IE-703002-MC : NQPACK100SD, YQPACK100SD, HQPACK100SD, YQSOCKET100SDN, YQGUIDE

*2: This is a product of Tokyo Eletech Corporation.

*3: Not available for PC98-NX Series.

*4: Available for PC98-NX Series.

Development Tools

V850 Family Hardware Tools

■ List of Hardware Tools (2/2)

Product name	Target device	Part number	Remarks
Conversion adapter/ conversion socket	V850/SA1	CSPACK121A1312N02*	Conversion socket for 121-pin FPBGA
		CSICE121A1312N02*	Conversion adapter for 121-pin FPBGA CSPACK121A1312N02* is necessary when using this
	V850/SA1, V850/SB1, V850/SB2, V852, V853	NQPACK100SD*	Conversion socket for target board (for 100-pin QFP (0.5-mm pitch))
		YQPACK100SD*	Conversion socket for connection to an in-circuit emulator
		HQPACK100SD*	Cover of the socket for 100-pin QFP
		YQSOCKET100SDN*	Socket for spacer
		YQGUIDE*	Fixing screws
	V850/SB1, V850/SB2	NEXB-100SD/RB*	100-pin GC-GF conversion board
		NQPACK100RB*	Conversion socket for target board (for 100-pin QFP (14 × 20 mm, 0.65-mm pitch))
		YQPACK100RB*	Conversion socket for connection to an in-circuit emulator
		HQPACK100RB*	Cover of the socket for 100-pin QFP
		YQSOCKET100RBN*	Socket for spacer
		YQGUIDE*	Fixing screws
	V850E/MS1, V854	NQPACK144SD*	Conversion socket for target board (for 144-pin QFP (0.5-mm pitch))
		YQPACK144SD*	Conversion socket for connection to an in-circuit emulator
		HQPACK144SD*	Cover of the socket for 144-pin QFP
		YQSOCKET144SDN*	Socket for spacer
		YQGUIDE*	Fixing screws
	V850E/MS1	CSPACK157A1614N01*	Conversion socket for 157-pin FPBGA
		CSICE157A1614N01*	Conversion adapter for 157-pin FPBGA CSPACK157A1614N01* is necessary when using this
Expansion probe	V850/SA1, V850/SB1, V850/SB2, V852, V853	SC-100SDN*	Expansion probe for 100-pin QFP (0.5-mm pitch)
	V850E/MS1, V854	SC-144SDN*	Expansion probe for 144-pin QFP (0.5-mm pitch)

*: This is a product of Tokyo Eletech Corporation.

Development Tools

V_R Series Development Tools

■ List of Software Tools

Product name	Target device	Host machine
Real-time OS RX4000	V _R 4100 Series™	PC-9800 Series
	V _R 4300 Series™	IBM PC/AT and compatibles

Other than above, tools as follows are also provided by development tool makers for V_R Series.

Software tools	Hardware tools
Operating system	Evaluation board
Real-time OS	ROM emulator
Optimization compiler	
Source debugger	

Middleware

Middleware that Holds the Key to Multimedia

Various key technologies are needed to realize multimedia applications, such as a human-machine interface as speech recognition, and data compression/decompression including data communications. And these technologies require high-performance RISC microcomputers capable of high-speed data processing. The V800 Series and V_R Series answer these requirements with powerful CPU performance complemented by middleware support based on multimedia performance.

■ The positioning of middleware

◦ Software integration

- User programs
- Middleware
 - Human interface (speech recognition, handwritten character recognition, etc.)
 - Internet
 - Multimedia signal processing (JPEG, voice compression, moving picture processing)
 - Communication (modem, mobile communications, etc.)

◦ Hardware integration

- CPU
- Memory
- Standard macro
- Dedicated macro
- Analog circuit
- User logic

■ Features

◦ Reduced overall costs due to shorter TAT development and lower development costs

If middleware that has been optimized to the CPU architecture is used, the amount of time taken to develop each individual system can be markedly reduced. Moreover, as there is no need to use dedicated devices, the cost is further streamlined.

◦ Improved CPU performance

The CPU, due to the improvement in CPU performance, can now easily realize applications that could previously only be performed by dedicated hardware or personal computers/workstations. The addition, modification and deletion of functions difficult to perform with hardware, as well as the organization of user-friendly interfaces have now been made simpler.

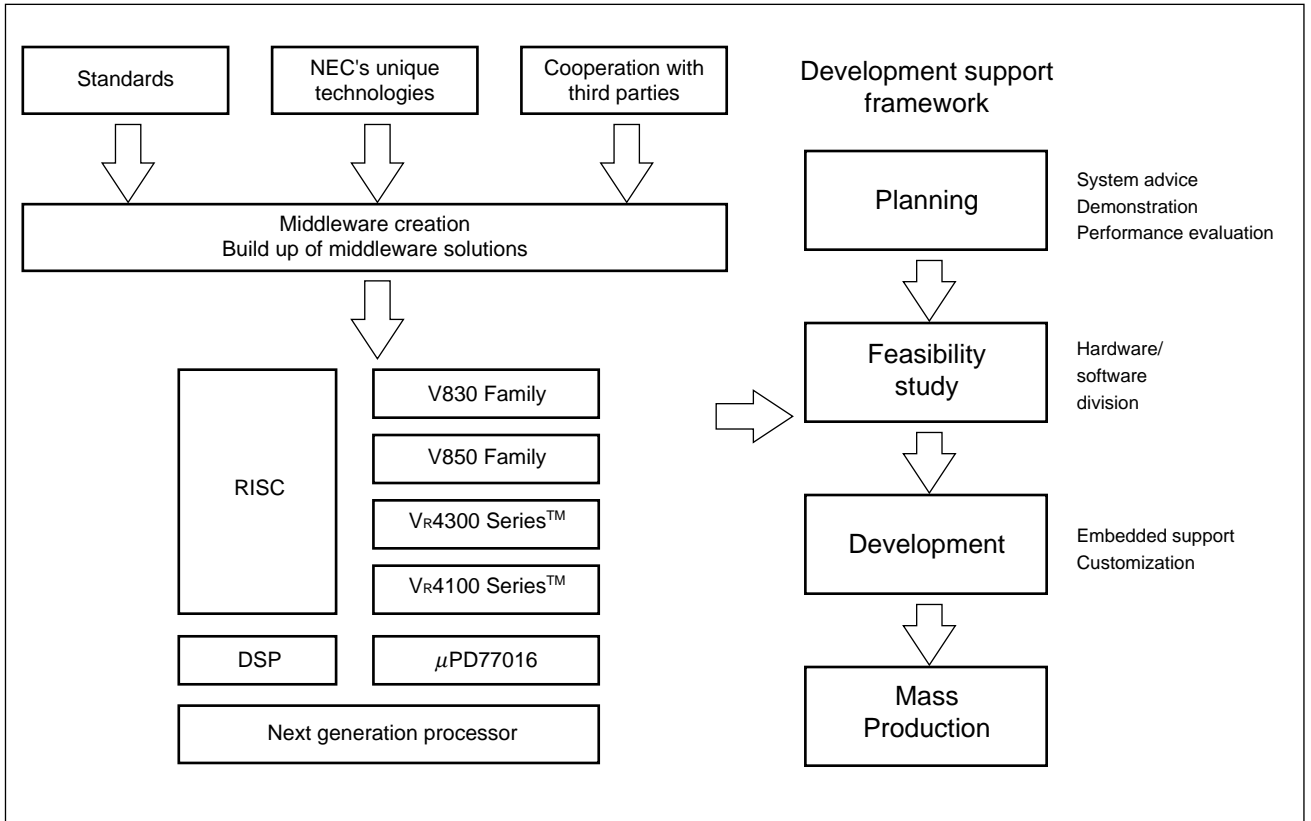
◦ Spread of Internet and multimedia signal-processing applications

Through the popularity of the Internet, the management of multimedia information such as picture images and speech has expanded considerably. To employ dedicated hardware to process this information would take a large-scale system and considerable cost. By using middleware, the processing of this information can be easily realized by the CPU alone.

Middleware

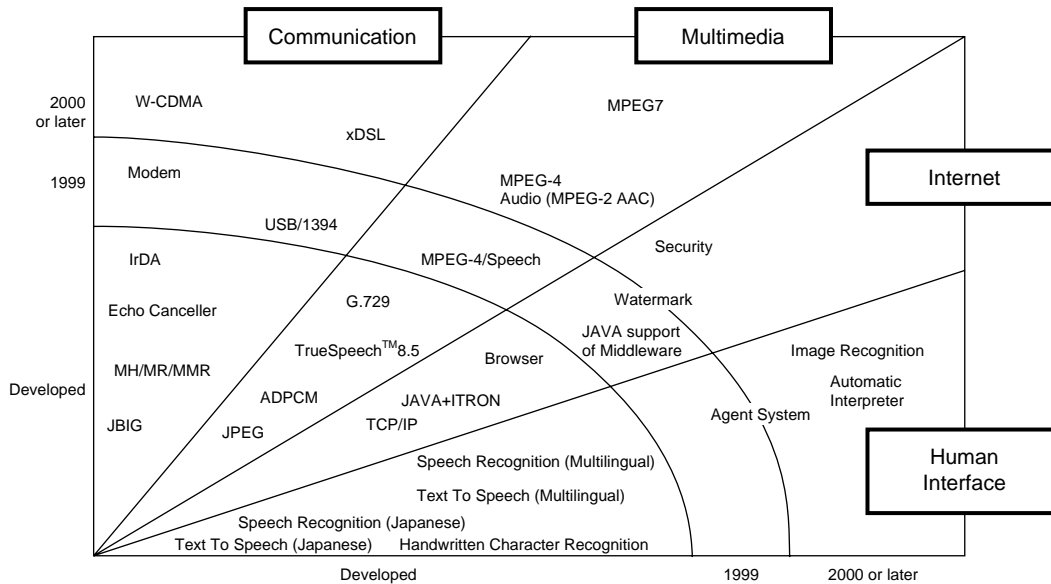
Middleware Development Framework

NEC middleware will gradually develop into optimal processor for each system. Furthermore, NEC plans to realize standardized middleware by using not only NEC's uniquely developed technologies, but also the most outstanding third party technologies and standards.



Middleware

Middleware Road Map



Middleware Products

Field	Middleware		V800 Series		V _R Series
			V830 Family	V850 Family	
Image	MH/MR/MMR		◎	◎	◎
	JBIG		◎	◎	◎
	JPEG		◎	◎	◎
Speech	Text To Speech	Japanese	◎	◎	○
		Multilingual Version (TTS3000*1)	◎	-	-
		English*2	-	-	○
	TrueSpeech8.5		◎	-	◎
	G.726 (ADPCM)		Sample	◎	△
	G.729/AnnexA/B		-	-	△
	MPEG-4/Speech (CELP)		-	-	△
Echo Cancellor (for Hands-free operation)		◎	-	◎	
Sound	MPEG-4 Audio (MPEG-2 AAC)		△	-	△
Recognition	Speech Recognition	Multilingual Version (ASR1600/C*1)	◎	-	△
		English*2	-	-	○
		Japanese (large vocabulary)	◎	-	○
	Handwritten Character Recognition		◎	◎	◎
Internet (Third party products)	Browser		◎	○	◎
	JAVA		◎	-	◎
	TCP/IP		◎	○	◎
Interface	IrDA protocol stack*3		◎	◎	△

*1: English/German/French/Italian/Dutch/Spanish (Jointly developed with L&H Inc.)

*2: WindowsCE supported

*3: This is a product of Okaya Systemware Co., Ltd.

Remark ◎: Developed, ○: Under Development, △: Under Planning

IC Memory

Dynamic RAM	138
Dynamic RAM Module	142
Static RAM	146
Mask ROM	151
COMBO Memory	152
Flash Memory	152
MCP (Flash Memory + SRAM)	153
Other	153
• Line Buffer	153

Dynamic RAM

■ Synchronous DRAM: SDR (Single Data Rate)

(1/3)

Density (bits)	Organization (words × bits × banks)	Part number	Speed grade	/CAS latency	Clock frequency (MHz)	Clock access time MAX. (ns)	Self refresh current MAX. (mA)	Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Package	Remark
256M*	16M×4×4	μPD45256441	A75	3	133	5.4	2	3.3±0.3	8K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)	PC133 Compliant (3-3-3)
				A80	3	125						6
			2		100	7	PC100 Compliant (3-2-2)					
			A10	3	100		8					—
				2	77	1						PC100 Compliant (2-2-2)
			A10B	3	100		7					PC100 Compliant (3-2-2)
				2	67	8						—
			A80L	3	125	6	1					PC100 Compliant (2-2-2)
				2	100	7						PC100 Compliant (3-2-2)
			A10L	3	100		8					2
				2	77	1						
			A10BL	3	100		7					1
	2	67		8	—							
	8M×8×4	μPD45256841	A75	3	133	5.4	2	3.3±0.3	8K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)	PC133 Compliant (3-3-3)
				A80	3	125						6
			2		100	7	PC100 Compliant (3-2-2)					
			A10	3	100		8					—
				2	77	1						PC100 Compliant (2-2-2)
			A10B	3	100		7					1
				2	67	8						
			A80L	3	125	6	1					PC100 Compliant (2-2-2)
				2	100	7						PC100 Compliant (3-2-2)
			A10L	3	100		8					2
				2	77	1						
A10BL			3	100	7		1					PC100 Compliant (3-2-2)
	2	67	8	—								
4M×16×4	μPD45256163	A80	3	125	6	2	3.3±0.3	8K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)	PC100 Compliant (2-2-2)	
			2	100	7						PC100 Compliant (3-2-2)	
		A10	3	100		8					—	
			2	77	1						PC100 Compliant (2-2-2)	
		A10B	3	100		7					1	PC100 Compliant (3-2-2)
			2	67	8							—
		A80L	3	125	6	1					PC100 Compliant (2-2-2)	
			2	100	7						PC100 Compliant (3-2-2)	
		A10L	3	100		8					2	—
			2	77	1							PC100 Compliant (2-2-2)
		A10BL	3	100		7					1	PC100 Compliant (3-2-2)
			2	67	8							—

★: Under development

Dynamic RAM

■ Synchronous DRAM: SDR (Single Data Rate)

(2/3)

Density (bits)	Organization (words × bits × banks)	Part number	Speed grade	/CAS latency	Clock frequency (MHz)	Clock access time MAX. (ns)	Self refresh current MAX. (mA)	Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Package	Remark
128M	8M×4×4	μPD45128441	A75	3	133	5.4	2	3.3±0.3	4K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)	PC133 Compliant (3-3-3)
				A80	3	125						6
			2		100	7	PC100 Compliant (3-2-2)					
			A10	3	100		8					—
				2	77	0.8						PC100 Compliant (2-2-2)
			A10B	3	100		7					PC100 Compliant (3-2-2)
				2	67	8						—
			A80L	3	125	6	0.8					PC100 Compliant (2-2-2)
				2	100	7						PC100 Compliant (3-2-2)
			A10L	3	100		8					7
				2	77	7						
			A10BL	3	100	8	8					—
	2	67		8	—							
	4M×8×4	μPD45128841	A75	3	133	5.4	2	3.3±0.3	4K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)	PC133 Compliant (3-3-3)
				A80	3	125						6
			2		100	7	PC100 Compliant (3-2-2)					
			A10	3	100		8					—
				2	77	0.8						PC100 Compliant (2-2-2)
			A10B	3	100		7					PC100 Compliant (3-2-2)
				2	67	8						—
			A80L	3	125	6	0.8					PC100 Compliant (2-2-2)
				2	100	7						PC100 Compliant (3-2-2)
			A10L	3	100		8					7
				2	77	7						
A10BL			3	100	8	8	—					
	2	67	8	—								
2M×16×4	μPD45128163	A80	3	125	6	2	3.3±0.3	4K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)	PC100 Compliant (2-2-2)	
			A10	3	100						7	PC100 Compliant (3-2-2)
		2		77	8	—						
		A10B	3	100		8					0.8	PC100 Compliant (2-2-2)
			2	67	8							PC100 Compliant (3-2-2)
		A80L	3	125	6	0.8					PC100 Compliant (2-2-2)	
			2	100	7						PC100 Compliant (3-2-2)	
		A10L	3	100		8					7	—
			2	77	7							—
		A10BL	3	100	8	8					—	
			2	67							8	—

Dynamic RAM

■ Synchronous DRAM: SDR (Single Data Rate)

(3/3)

Density (bits)	Organization (words × bits × banks)	Part number	Speed grade	/CAS latency	Clock frequency (MHz)	Clock access time MAX. (ns)	Self refresh current MAX. (mA)	Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Package	Remark	
64M	4M×4×4	μPD4564441	A75	3	133	5.4	1	3.3±0.3	4K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)	PC133 Compliant (3-3-3)	
				A80	3	125						6	PC100 Compliant (2-2-2)
			2		100	7	PC100 Compliant (3-2-2)						
			A10	3	100		8					—	
				2	77	0.4						PC100 Compliant (2-2-2)	
			A10B	3	100		7					PC100 Compliant (3-2-2)	
				2	67	8						—	
			A80L	3	125	6	0.4					PC100 Compliant (2-2-2)	
				2	100	7						PC100 Compliant (3-2-2)	
			A10L	3	100		8					0.4	—
				2	77	7							—
			A10BL	3	100	6	0.4					PC100 Compliant (2-2-2)	
	2	67		8	PC100 Compliant (3-2-2)								
	2M×8×4	μPD4564841	A75	3	133	5.4	1	3.3±0.3	4K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)	PC133 Compliant (3-3-3)	
				A80	3	125						6	PC100 Compliant (2-2-2)
			2		100	7	PC100 Compliant (3-2-2)						
			A10	3	100		8					—	
				2	77	0.4						PC100 Compliant (2-2-2)	
			A10B	3	100		7					0.4	PC100 Compliant (3-2-2)
				2	67	8							—
			A80L	3	125	6	0.4					PC100 Compliant (2-2-2)	
				2	100	7						PC100 Compliant (3-2-2)	
			A10L	3	100		8					0.4	—
				2	77	7							—
			A10BL	3	100	6	0.4					PC100 Compliant (2-2-2)	
		2		67	8	PC100 Compliant (3-2-2)							
		1M×16×4	μPD4564163	A80	3	125	6	1	3.3±0.3	4K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)	PC100 Compliant (2-2-2)
					2	100	7						PC100 Compliant (3-2-2)
				A10	3	100		8					0.4
					2	77	0.4						
				A10B	3	100		7					0.4
					2	67	8						
			A80L	3	125	6	0.4	PC100 Compliant (2-2-2)					
				2	100	7		PC100 Compliant (3-2-2)					
			A10L	3	100		8	0.4					—
				2	77	7							—
A10BL			3	100	6	0.4	PC100 Compliant (2-2-2)						
	2		67	8	PC100 Compliant (3-2-2)								
512K×32×4	μPD4564323	A80*	3	125	6	1	3.3±0.3	4K/64	LVTTL	G5: 86-pin TSOP(II) (400 mil)	PC100 Compliant (2-2-2)		
			2	100	7						PC100 Compliant (3-2-2)		
		A10*	3	100		8					0.4	—	
			2	77	0.4							PC100 Compliant (2-2-2)	
		A10B	3	100		7					0.4	PC100 Compliant (3-2-2)	
			2	67	8							—	
	A80L*	3	125	6	0.4	PC100 Compliant (2-2-2)							
		2	100	7		PC100 Compliant (3-2-2)							
	A10L*	3	100		8	0.4					—		
		2	77	7							—		
	A10BL*	3	100	6	0.4	PC100 Compliant (2-2-2)							
		2	67	8		PC100 Compliant (3-2-2)							

★: Under development

Dynamic RAM

■ **Virtual Channel Synchronous DRAM:SDR (Single Data Rate)**

Density (bits)	Organization (words × bits × banks)	Part number	Speed grade	Read latency	Clock frequency (MHz)	Clock access time MAX. (ns)	Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Package	Remark			
												64M	8M×4×2	μPD4565421
A75	133	5.4												
A10	100	6												
A15	67	12												
4M×8×2	μPD4565821	A70*	2	143	5.4	3.3±0.3	4K/64	LVTTL	G5: 54-pin TSOP(II) (400 mil)					
		A75		133	5.4									
		A10		100	6									
		A15		67	12									
2M×16×2	μPD4565161	A70*	2	143	5.4	3.3±0.3	4K/64	LVTTL			G5: 54-pin TSOP(II) (400 mil)			
		A75		133	5.4									
		A10		100	6									
		A15		67	12									

★: Under development

■ **Synchronous DRAM: DDR (Double Data Rate)**

Density (bits)	Organization (words × bits × banks)	Part number	Speed grade	/CAS latency	Clock frequency (MHz)	Self refresh current MAX. (mA)	Supply voltage (V)		Refresh cycle (cycles /ms)	Interface level	Package	Remark						
							Vcc	VccQ										
128M	8M×4×4	μPD45D128442	C80*	2.5	133	2	2.5±0.125	2.5±0.125	4K/64	SSTL_2	G5: 66-pin TSOP(II) (400 mil)							
					125													
					C10								2.5	125				
					100													
	4M×8×4	μPD45D128842	C80*	2.5	133	2	2.5±0.125	2.5±0.125	4K/64	SSTL_2			G5: 66-pin TSOP(II) (400 mil)					
					125													
					C10										2.5	125		
					100													
	2M×16×4	μPD45D128164	C80*	2.5	133	2	2.5±0.125	2.5±0.125	4K/64	SSTL_2					G5: 66-pin TSOP(II) (400 mil)			
					125													
					C10												2.5	125
					100													

★: Under development

■ **Direct Rambus™ DRAM**

Density (bits)	Organization (words × bits × banks)	Part number	Clock frequency		Access time		Maximum supply current (mA)			Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Package		Remark
			Class	1/t _{CYCLE} (MHz)	Class	t _{RAC} (ns)	Active	Refresh					Type	Pin configuration	
								Auto	Self						
72M	256K×18×16	μPD488385	C80	400	40	40	TBD	TBD	TBD	2.5±0.13	8K/32	RSL	FB: 74-pin D ² BGA™	BF1:Normal	
					45	45									
128M	256K×16×32	μPD488448	C80	400	40	40	TBD	TBD	TBD	2.5±0.13	8K/32	RSL	FB: 62-pin D ² BGA	• Normal • Mirrored	
					45	45									
144M	256K×18×32	μPD488488	C80	400	40	40	TBD	TBD	TBD	2.5±0.13	8K/32	RSL	FB: 62-pin D ² BGA	• Normal • Mirrored	
					45	45									
			C60	300	53	53									

Dynamic RAM Module

■ **168-pin SDRAM DIMM (Dual In-line Memory Module): Unbuffered Type**

Density (bytes)	Organization (words × bits)	Bank organization	Part number	Speed grade	/CAS latency	Clock frequency (MHz)	Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Mounted devices	Package height (mm/inch)	Remark	
256M	32M×72	2	MC-4532CC726	A80	3	125	3.3±0.3	4K/64	LVTTTL	μPD45128841G5 ×18 pcs.	34.93/1.375	PC100 Compliant (2-2-2)	
					2	100						PC100 Compliant (3-2-2)	
				A10	3	100						PC100 Compliant (2-2-2)	
					2	77						PC100 Compliant (3-2-2)	
	32M×64	2	MC-4532CD646	A80	3	125						μPD45128841G5 ×16 pcs.	PC100 Compliant (2-2-2)
					2	100							PC100 Compliant (3-2-2)
				A10	3	100							PC100 Compliant (2-2-2)
					2	77							PC100 Compliant (3-2-2)
128M	16M×72	2	MC-4516CC726	A80	3	125	μPD4564841G5 ×18 pcs.	34.93/1.375	PC100 Compliant (2-2-2)				
					2	100			PC100 Compliant (3-2-2)				
				A10	3	100			PC100 Compliant (2-2-2)				
					2	77			PC100 Compliant (3-2-2)				
			2	MC-4516CC725	A10B	3			100	33.02/1.30	—		
						2			67		—		
	16M×64	2	MC-4516CD646	A80	3	125	μPD4564841G5 ×16 pcs.	34.93/1.375	PC100 Compliant (2-2-2)				
					2	100			PC100 Compliant (3-2-2)				
				A10	3	100			PC100 Compliant (2-2-2)				
					2	77			PC100 Compliant (3-2-2)				
			2	MC-4516CD645	A10B	3			100	33.02/1.30	—		
						2			67		—		
64M	8M×72	1	MC-458CA726	A80	3	125	μPD4564841G5 ×9 pcs.	34.93/1.375	PC100 Compliant (2-2-2)				
					2	100			PC100 Compliant (3-2-2)				
				A10	3	100			PC100 Compliant (2-2-2)				
					2	77			PC100 Compliant (3-2-2)				
			1	MC-458CA725	A10B	3			100	31.75/1.25	—		
						2			67		—		
	8M×64	1	MC-458CB646	A80	3	125	μPD4564841G5 ×8 pcs.	34.93/1.375	PC100 Compliant (2-2-2)				
					2	100			PC100 Compliant (3-2-2)				
				A10	3	100			PC100 Compliant (2-2-2)				
					2	77			PC100 Compliant (3-2-2)				
			1	MC-458CB645	A10B	3			100	31.75/1.25	—		
						2			67		—		
32M	4M×72	1	MC-454CA726	A80	3	125	μPD4564163G5 ×5 pcs.	34.93/1.375	PC100 Compliant (2-2-2)				
					2	100			PC100 Compliant (3-2-2)				
				A10	3	100			PC100 Compliant (2-2-2)				
					2	77			PC100 Compliant (3-2-2)				
			4M×64	1	MC-454CB646	A10B			3	125	μPD4564163G5 ×4 pcs.	34.93/1.375	PC100 Compliant (2-2-2)
									2	100			PC100 Compliant (3-2-2)
	A80	3				100	PC100 Compliant (2-2-2)						
		2				77	PC100 Compliant (3-2-2)						
	1	MC-454CB645		A10B	3	100	29.21/1.15	—					
					2	67		—					

Dynamic RAM Module

■ 168-pin SDRAM DIMM (Dual In-line Memory Module): Registered Type

Density (bytes)	Organization (words × bits)	Bank organization	Part number	Speed grade	/CAS latency	Clock frequency (MHz)	Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Mounted devices	Package height (mm/inch)	Remark
512M	64M×72	2	MC-4564DC726	A80	3	125	3.3±0.3	4K/64	LVTTTL	μPD45128441G5 ×36 pcs.	43.18/1.70	PC100 Compliant (2-2-2)
					2	100						PC100 Compliant (3-2-2)
				A10	3	100						PC133 Compliant (3-3-3)
					2	77						PC100 Compliant (2-2-2)
256M	32M×72	1	MC-4532DA727	A75	3	133	3.3±0.3	4K/64	LVTTTL	μPD45128441G5 ×18 pcs.	43.18/1.70	PC133 Compliant (3-3-3)
					2	100						PC100 Compliant (2-2-2)
			MC-4532DA726	A80	3	125						PC100 Compliant (3-2-2)
					2	100						PC100 Compliant (3-2-2)
			A10	3	100	PC133 Compliant (3-3-3)						
				2	77	PC100 Compliant (2-2-2)						
128M	16M×72	1	MC-4516DA727	A75	3	133	3.3±0.3	4K/64	LVTTTL	μPD4564441G5 ×18 pcs.	43.18/1.70	PC133 Compliant (3-3-3)
					2	100						PC100 Compliant (2-2-2)
			MC-4516DA726	A80	3	125						PC100 Compliant (3-2-2)
					2	100						PC100 Compliant (3-2-2)
			A10	3	100	PC133 Compliant (3-3-3)						
				2	77	PC100 Compliant (2-2-2)						
64M	8M×72	1	MC-458DA727	A75	3	133	3.3±0.3	4K/64	LVTTTL	μPD4564841G5 ×9 pcs.	38.1/1.50	PC133 Compliant (3-3-3)
					2	100						PC100 Compliant (2-2-2)
			MC-458DA726	A80	3	125						PC100 Compliant (3-2-2)
					2	100						PC100 Compliant (3-2-2)
			A10	3	100	PC133 Compliant (3-3-3)						
				2	77	PC100 Compliant (2-2-2)						
32M	4M×72	1	MC-454DA726	A80	3	125	3.3±0.3	4K/64	LVTTTL	μPD4564163G5 ×5 pcs.	38.1/1.50	PC100 Compliant (2-2-2)
					2	100						PC100 Compliant (3-2-2)
				A10	3	100						PC100 Compliant (2-2-2)
					2	77						PC100 Compliant (3-2-2)

Dynamic RAM Module

■ 144-pin SDRAM SO DIMM (Small Outline Dual In-line Memory Module)

Density (bytes)	Organization (words × bits)	Bank organization	Part number	Speed grade	/CAS latency	Clock frequency (MHz)	Self refresh current (mA)	Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Mounted devices	Package height (mm/inch)	Remark
128M	16M×64	1	MC-4516CB64ES	A10B	3	100	16	3.3±0.3	4K/64	LVTTL	μPD45128841G5 ×8 pcs.	26.67/1.05	—
					2	67							
					3	100							
				A10BL	2	67							
					3	100							
					2	67							
		2	MC-4516CD64ES	A10B	3	100	16				μPD45128163G5 ×8 pcs.		
					2	67							
					3	100							
				A10BL	2	67							
					3	100							
					2	67							
2	MC-4516CD641ES	A80	3	125	16	31.75/1.25	PC100 Compliant (2-2-2), Rev.1.0						
			2	100									
			3	100									
		A10	2	77									
			3	100									
			2	77									
64M	8M×64	1	MC-458CB64LSA	A10B	3	100	8	26.67/1.05	μPD4564841G5 ×8 pcs.	26.67/1.05	—		
					2	67							
					3	100							
				A10BL	2	67							
					3	100							
					2	67							
		1	MC-458CB641ES	A80	3	125	4			25.4/1.0	PC100 Compliant (2-2-2), Rev.1.0		
					2	100							
					3	100							
				A10	2	77							
					3	100							
					2	77							
2	MC-458CD64LS	A10B	3	100	8	26.67/1.05	—						
			2	67									
			3	100									
		A10BL	2	67									
			3	100									
			2	67									
2	MC-458CD641LS	A80	3	125	8	31.75/1.25	PC100 Compliant (2-2-2), Rev.1.0						
			2	100									
			3	100									
		A10	2	77									
			3	100									
			2	77									
32M	4M×64	1	MC-454CB64LS	A10B	3	100	4	25.4/1.00	μPD4564163G5 ×4 pcs.	25.4/1.00	—		
					2	67							
					3	100							
				A10BL	2	67							
					3	100							
					2	67							
			MC-454CB641LS	A80	3	125	4			25.4/1.00	PC100 Compliant (2-2-2), Rev.0.7		
					2	100							
					3	100							
				A10	2	77							
					3	100							
					2	77							

Dynamic RAM Module

■ **168-pin Virtual Channel SDRAM DIMM (Dual In-line Memory Module): Unbuffered Type**

Density (bytes)	Organization (words × bits)	Bank organization	Part number	Speed grade	Read latency	Prefetch read latency	Clock frequency (MHz)	Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Mounted devices	Package height (mm/inch)	Remark
128M	16M×64	2	MC-45V16AD641	A75	2	4	133	3.3±0.3	4K/64	LVTTL	μPD4565821G5 ×16 pcs.	34.93/1.375	
				A10			100						
				A15	66								
64M	8M×64	1	MC-45V8AB641	A75	2		133				μPD4565821G5 ×8 pcs.		
				A10			100						
				A15	66								

■ **144-pin Virtual Channel SDRAM SO DIMM (Small Outline Dual In-line Memory Module)**

Density (bytes)	Organization (words × bits)	Bank organization	Part number	Speed grade	Read latency	Prefetch read latency	Clock frequency (MHz)	Supply voltage (V)	Refresh cycle (cycles /ms)	Interface level	Mounted devices	Package height (mm/inch)	Remark
64M*	8M×64	1	MC-45V8AB641KS	A75	2	4	133	3.3±0.3	4K/64	LVTTL	μPD4565821G5 ×8 pcs.	31.75/1.25	
				A10			100						
				A15	66								
		2	MC-45V8AD641KS	A75	2		133				μPD4565161G5 ×8 pcs.		
				A10			100						
				A15	66								

★: Under development

■ **184-pin Direct Rambus™ RIMM™**

Density (bytes)	Organization (words × bits)	Bank organization	Part number	Class	Clock frequency 1/T _{CYCLE} (MHz)	Access time t _{TRAC} (ns)	Supply voltage (V)	Interface level	Mounted devices	Remark
128M	64M × 18	16 × 16	MC-4R128BKD8J	840	400	40	2.5±0.13	RSL	μPD488385FB ×16 pcs.	With heat spreader
				845		45				
				653	300	53				
64M	32M × 18	16 × 8	MC-4R64BKD8J	840	400	40			μPD488385FB ×8 pcs.	With heat spreader
				845		45				
				653	300	53				
—	—	—	MC-4RCNTYK	—	—	—	—	—	—	Note

Note This module is the Direct Rambus RIMM continuity module which is designed to be inserted into any unused RIMM sockets in Direct Rambus systems. It continues the Rambus channel through unused RIMM connectors to terminate signals properly on motherboard, and has no active components mounted on it.

Static RAM

■ Low Power SRAM (Temperature range TA = 0 to 70°C)

Density (bits)	Organization (words × bits)	Part number	Supply voltage (V)	Version	Class	Access time MAX. (ns)	Maximum supply current			Package					
							Active (mA)	Standby (μA)	Data retention (μA)						
1M	128K × 8	μPD431000A	4.5 to 5.5	L	70	70	70	100	50	GW: 32-pin SOP (525 mil)					
					85	85									
					LL	70					70	70	20	10	GW: 32-pin SOP (525 mil) GU: 32-pin TSOP(I) (8 × 13.4 mm) (Normal bent) (Reverse bent) GZ: 32-pin TSOP(I) (8 × 20 mm) (Normal bent) (Reverse bent)
						85					85				
				3.0 to 5.5	A	10	100	35	13	10	GW: 32-pin SOP (525 mil) GU: 32-pin TSOP(I) (8 × 13.4 mm) (Normal bent) (Reverse bent) GZ: 32-pin TSOP(I) (8 × 20 mm) (Normal bent) (Reverse bent)				
						70 (V _{CC} =4.5 to 5.5)	70					20			
						12	120					35	13		
					2.7 to 5.5	B	10	100	30	11		10			
							70 (V _{CC} =4.5 to 5.5)	70					20		
							12	120					30	11	
				15	70 (V _{CC} =4.5 to 5.5)	30	11	70	20						
						15	150	30	11						
				70 (V _{CC} =4.5 to 5.5)	70	20	70	20							
					70	20									
256K	32K × 8	μPD43257B	4.5 to 5.5	L	70	70	45	50	20	GU: 28-pin SOP (450 mil)					
					85	85									
				LL	70	70	45	15	7						
					85	85									
				μPD43256B	4.5 to 5.5	L	70	70	45		50	20	GU: 28-pin SOP (450 mil) GW: 28-pin TSOP(I) (8 × 13.4 mm) (Normal bent) (Reverse bent)		
							85	85							
						LL	70	70	45		15	7			
							85	85							
		3.0 to 5.5	A			85	85	45	15	7					
						10	100								
						85 (V _{CC} =4.5 to 5.5)	85				15				
						12	120				85 (V _{CC} =4.5 to 5.5)				
			2.7 to 5.5	B	10	100	20	10	7						
					85 (V _{CC} =4.5 to 5.5)	45				15					
		12	85 (V _{CC} =4.5 to 5.5)	20	10	45	15								
				45	15										
				15	150			20	10						
				85 (V _{CC} =4.5 to 5.5)	45					15					

Static RAM

■ Low Power SRAM (Extended Temperature TA = -25 to +85°C)

Density (bits)	Organization (words × bits)	Part number	Supply voltage (V)	Version	Class	Access time MAX. (ns)	Maximum supply current			Package		
							Active (mA)	Standby (μA)	Data retention (μA)			
4M	512K × 8	μPD444010L-X	2.7 to 3.6	B	70	70	40	7	7	GY: 48-pin TSOP(I) (12 × 18 mm) (Normal bent) (Reverse bent)		
					85	85						
			2.2 to 3.6	C	10	100						
					12	120						
			1.8 to 3.6	D	12	120						
					15	150						
	256K × 16	μPD444012L-X	2.7 to 3.6	B	70	70	40	7	7			
					85	85						
			2.2 to 3.6	C	10	100						
					12	120						
			1.8 to 3.6	D	12	120						
					15	150						
2M	256K × 8	μPD442000L-X	2.7 to 3.6	B	85	85	35	2	2	GU: 32-pin TSOP(I) (8 × 13.4 mm) (Normal bent) (Reverse bent) GZ: 32-pin TSOP(I) (8 × 20 mm) (Normal bent) (Reverse bent) F1: 36-pin FPBGA (10.5 × 6.5 mm)		
					10	100						
				2.2 to 3.6	C	10					100	
						12					120	
			1.8 to 3.6	D	15	150	25					
					18	180						
				2.7 to 3.6	B	70		70	25		2	2
						85		85				
			2.2 to 3.6	C	10	100						
					12	120						
			1.8 to 3.6	D	12	120						
					15	150						
1M	128K × 8	μPD441000L-X		2.7 to 3.6	B	70	70	25	2	2	GU: 32-pin TSOP(I) (8 × 13.4 mm) (Normal bent) (Reverse bent) GZ: 32-pin TSOP(I) (8 × 20 mm) (Normal bent) (Reverse bent) F1: 36-pin FPBGA (6 × 6 mm)	
						85	85					
			2.2 to 3.6	C	10	100						
					12	120						
			1.8 to 3.6	D	12	120						
					15	150						
		μPD431000A-X	4.5 to 5.5	—	70	70	70	50	20			
					85	85						
			3.0 to 5.5	A	10	100						
					70 (V _{CC} =4.5 to 5.5)	70				50		
					12	120				35		26
					70 (V _{CC} =4.5 to 5.5)	70				50		
2.7 to 5.5	B	10	100	30	22							
		70 (V _{CC} =4.5 to 5.5)	70	50								
		12	120	30	22							
		70 (V _{CC} =4.5 to 5.5)	70	50								
15		150	150	30	22							
		70 (V _{CC} =4.5 to 5.5)	70	50								
		256K	32K × 8	μPD43256B-X	4.5 to 5.5	—	70	70	45	50	20	GW: 28-pin TSOP(I) (8 × 13.4 mm) (Normal bent) (Reverse bent)
							85	85				
10	100											
3.0 to 5.5	A				85	85	45	50				
					10	100						
					12	120						
100 (V _{CC} =4.5 to 5.5)	40											
2.7 to 5.5	B			10	100	25	25					
				12	120	25	25					
				100 (V _{CC} =4.5 to 5.5)	40	50						
				15	150	25	25					
				100 (V _{CC} =4.5 to 5.5)	40	50						
		15	150	25	25							
100 (V _{CC} =4.5 to 5.5)	40	50										

Static RAM

■ **CMOS Fast SRAM**

Density (bits)	Organization (words × bits)	Part number	Class	Access time MAX. (ns)	Maximum supply current		Supply voltage (V)	Package	Remark		
					Active (mA)	Standby (mA)					
4M	4M × 1	μPD434001A	15	15	140	10	5.0±0.5	LE: 32-pin SOJ (400 mil)			
			17	17	130						
			20	20	120						
		μPD434001AL	A15	15	130	5	3.3±0.3			LE: 32-pin SOJ (400 mil) G5: 32-pin TSOP (II) (400 mil)	
			A17	17	120						
			A20	20	110						
	1M × 4	μPD434004A	15	15	140	10	5.0±0.5	LE: 32-pin SOJ (400 mil)			
			17	17	130						
			20	20	120						
		μPD434004AL	A15	15	130	5	3.3±0.3			LE: 32-pin SOJ (400 mil)	
			A17	17	120						
			A20	20	110						
	512K × 8	μPD434008A	μPD434008A	12	12	200	10	5.0±0.5		LE: 36-pin SOJ (400 mil)	
				15	15	170					
				17	17	160					
				20	20	150					
			μPD434008AL	A15	15	150	5	3.3±0.3			LE: 36-pin SOJ (400 mil)
				A17	17	140					
	256K × 16	μPD434016A	μPD434016A	12	12	230	10	5.0±0.5		LE: 44-pin SOJ (400 mil) G5: 44-pin TSOP (II) (400 mil)	
				15	15	200					
				17	17	190					
				20	20	180					
			μPD434016AL	A15	15	190	5	3.3±0.3		LE: 44-pin SOJ (400 mil) G5: 44-pin TSOP (II) (400 mil)	
				A17	17	180					
A20				20	170						

Static RAM

■ CMOS Synchronous Fast SRAM

Density (bits)	Organization (words × bits)	Part number	Class	Clock frequency (MHz)	Clock access time MAX.(ns)	Maximum supply current			Supply voltage (V)		Package	Remark		
						Active (mA)	Standby (mA)	Power down (mA)	Chip	I/O				
2M	64K × 36	μPD432836AL	A36	275	3.53	350	3.5	—	3.3±0.2	2.0	GF: 100-pin LQFP	Pipeline operation		
			A37	267	3.65	350								
			A40	250	3.9	350								
			A44	225	4.34	350								
			A50	200	4.9	350								
			A55	183	5.3	335								
			A57	175	5.3	325								
			A60	167	5.3	290								
		μPD432836L	A40	250	3.9	350	3.5	3.5	3.3±0.2	2.0				
			A44	225	4.34	350								
			A50	200	4.9	350								
			A55	183	5.3	335								
			A57	175	5.3	325								
			A60	167	5.3	290								
64K × 32	μPD432232L	A5	100	5.0	180	2	2	3.3+0.3/-0.2	3.0 or 2.5					
		A7	83	7.0										
		A8	66	8.0										
1M	32K × 32	μPD431231L	A7	83	7.0	130	5	1	3.3+0.3/-0.2	2.5	GF: 100-pin LQFP	Pipeline operation		
			A8	66	8.0									
		μPD431632L	A6	150	4.6	220	20	20	3.3±0.165	3.3 or 2.5		Pipeline operation		
			A7	133	5.0	200								
		μPD431532L	A8	100	8.5	200	5	5	3.3±0.165	3.3 or 2.5		Flow Through operation		
			A9	100	9.0									
			A10	83	10.0									
			A12	66	12.0									
		32K × 36	μPD431636L	A6	150	4.6	220	20	20	3.3±0.165		3.3 or 2.5	GF: 100-pin LQFP	Pipeline operation
				A7	133	5.0	200							
			μPD431536L	A8	100	8.5	200	5	5	3.3±0.165		3.3 or 2.5		Flow Through operation
				A9	100	9.0								
				A10	83	10.0								
				A12	66	12.0								

Static RAM

■ **Bi-CMOS Synchronous Fast SRAM**

Density (bits)	Organization (words × bits)	Part number	Class	Clock frequency (MHz)	Clock access time MAX.(ns)	Maximum supply current		Supply voltage (V)	Interface level	Package	Remark	
						Active (mA)	Standby (mA)					
4M	256K × 18	μPD464318AL	A4	250	2.0	550	55	3.3±0.15	HSTL	S1: 119-pin BGA	Single clock RR mode	
			A44	225	2.3							
			A5	200	2.5							
		μPD464318L	A5	200	2.6	600	—	3.3±0.15	HSTL		Single clock RR mode	
			A6	167	3.0							
			A65	154	3.5							
		μPD464518AL	A55	182	5.5	400	45	3.3±0.15	LVTTTL		Single clock RL mode	
			A6	166	6.0							
			A7	143	7.0							
	μPD464518L	A8	125	8.0	450	150	3.3±0.15	LVTTTL	Single clock RL mode			
	128K × 36	μPD464336AL	A4	250	2.0	750	55	3.3±0.15	HSTL	Single clock RR mode		
				A44	225						2.3	
				A5	200						2.5	
			μPD464336L	A5	200	2.6	700	—	3.3±0.15		HSTL	Single clock RR mode
				A6	167	3.0						
				A65	154	3.5						
μPD464536AL		A55	182	5.5	650	45	3.3±0.15	LVTTTL	Single clock RL mode			
		A6	166	6.0								
		A7	143	7.0								
μPD464536L		A8	125	8.0	550	150	3.3±0.15	LVTTTL	Single clock RL mode			

Mask ROM

■ Mask ROM

Density (bits)	Organization (words × bits)	Part number	Access time MAX. (ns)		Maximum supply current		Supply voltage (V)	Package
			Normal	Page access	Active (mA)	Standby (μA)		
128M	16M × 8 or 8M × 16	μPD23C128000L	120	—	TBD	TBD	3.3±0.3	GY: 48-pin TSOP (I) (12 × 18 mm) (Normal bent) (Reverse bent)
			140				3.0±0.3	
		μPD23C128040L	120	TBD	TBD	TBD	3.3±0.3	GY: 48-pin TSOP (I) (12 × 18 mm) (Normal bent) (Reverse bent)
			140				3.0±0.3	
64M	4M × 16	μPD23C64020	120	—	70	—	5.0±0.5	CZ: 42-pin DIP (600 mil)
	8M × 8 or 4M × 16	μPD23C64000AL	90	—	45	30	3.3±0.3	GX: 44-pin SOP (600 mil)
			100	—	40	30	3.0±0.3	GY: 48-pin TSOP (I) (12 × 18 mm) (Normal bent) (Reverse bent)
	μPD23C64040AL	90	25	60	30	3.3±0.3	GX: 44-pin SOP (600 mil)	
100		30	55	30	3.0±0.3	GY: 48-pin TSOP (I) (12 × 18 mm) (Normal bent) (Reverse bent)		
32M	4M × 8 or 2M × 16	μPD23C32000A	120	—	70	100	5.0±0.5	GX: 44-pin SOP (600 mil) GY: 48-pin TSOP (I) (12 × 18 mm) (Normal bent) (Reverse bent) G5: 44-pin TSOP (II) (400 mil)
	2M × 16	μPD23C32020A	120	—	70	100	5.0±0.5	CZ: 42-pin DIP (600 mil)
	4M × 8 or 2M × 16	μPD23C32000L	120	—	40	30	3.3±0.3	GX: 44-pin SOP (600 mil)
			140		35	30	3.0±0.3	GY: 48-pin TSOP (I) (12 × 18 mm) (Normal bent) (Reverse bent) G5: 44-pin TSOP (II) (400 mil)
	μPD23C32040L	140	40	60	30	3.3±0.3	GX: 44-pin SOP (600 mil) GY: 48-pin TSOP (I) (12 × 18 mm) (Normal bent) (Reverse bent) G5: 44-pin TSOP (II) (400 mil)	
	2M × 16 or 1M × 32	μPD23C32082L	100	30	80	30	3.3±0.3	G7: 70-pin SSOP (500 mil)
24M	3M × 8 or 1.5M × 16	μPD23C24000	120	—	70	100	5.0±0.5	GX: 44-pin SOP (600 mil)
	1.5M × 16	μPD23C24020	120	—	70	100	5.0±0.5	CZ: 42-pin DIP (600 mil)
16M	2M × 8 or 1M × 16	μPD23C16000AL	85	—	45	30	3.3±0.3	GY: 48-pin TSOP (I) (12 × 18 mm) (Normal bent) (Reverse bent)
			100		40		3.0±0.3	
		μPD23C16040AL	85	30	60	30	3.3±0.3	G5: 44-pin TSOP (II) (400 mil)
			100	40	55		3.0±0.3	

■ Synchronous Mask ROM

Density (bits)	Organization (words × bits)	Part number	Clock frequency (MHz)	/CAS latency MIN.	/RAS latency MIN.	Clock access time MAX. (ns)	Maximum supply current active (mA)	Supply voltage (V)	Interface level	Package	Remark
32M	2M × 16 or 1M × 32	μPD23C32202L	66	5	2	10	150	3.3±0.3	LVTTL	G5: 86-pin TSOP (II) (400 mil)	
			50	4	1	15					
			33	3	1	25					

COMBO Memory

■ COMBO Memory

Part number	Function	Density (bits) Organization (words × bits)	Supply voltage (V)	Access time MAX. (ns)	Maximum supply current			Package
					Active (mA)	Standby (μ A)	Data Retention (μ A)	
μ PD26401	SRAM +	1M (128K × 8) +	1.8 to 2.2	500	3.5	6.5	10	GU: 32-pin TSOP (I) (8 × 13.4 mm) (Normal bent) (Reverse bent)
			2.2 to 2.7	375	5.5	8.0		
	ROM	2M (256K × 8)	2.7 to 3.3	250	7.5	10.0		
μ PD26411	SRAM +	1M (128K × 8) +	1.8 to 2.2	500	4.0	6.5	10	GZ: 32-pin TSOP (I) (8 × 20 mm) (Normal bent) (Reverse bent)
			2.2 to 2.7	375	6.0	8.0		
	ROM	2M (256K × 8)	2.7 to 3.3	250	10.0	10.0		

Flash Memory

■ Flash Memory

Density (bits)	Organization (words × bits)	Part number	Access time MAX. (ns)	Maximum supply current		Supply voltage (V)	Boot code Sector architecture	Package
				Active (mA)	Standby (μ A)			
8M	1M × 8	μ PD29F008AL-X*	90	12	5	2.7 to 3.6	top or bottom	GZ: 40-pin TSOP (I) (10 × 20 mm) (Normal bent) (Reverse bent)
			100					
			120	12	5	2.2 to 2.7		
			150					
	1M × 8 or 512K × 16	μ PD29F800AL-X*	90	12	5	2.7 to 3.6	top or bottom	GZ: 48-pin TSOP (I) (12 × 20 mm) (Normal bent) (Reverse bent)
			100					
			120	12	5	2.2 to 2.7		
			150					

★: Under development

MCP (Flash Memory + SRAM)

■ MCP (Flash Memory and SRAM)

Part number	Function	Density (bits) Organization (words × bits)	Access time MAX. (ns)	Maximum supply current			Supply Voltage (V)	Boot code Sector architecture	Package	
				Active (mA)	Standby (μ A)	Data Retention (μ A)				
MC-22100	Flash Memory	16M (2M × 8)	100	35	5	—	2.7 to 3.6	Top	F1-DE: 48-pin BGA (10 × 14 mm)	
	SRAM	2M (256K × 8)			2	2		—		
MC-22101	Flash Memory	16M (2M × 8)			5	—		Bottom		
	SRAM	2M (256K × 8)			2	2		—		
MC-22102	Flash Memory	16M (1M × 16)			5	—		Top		
	SRAM	2M (256K × 8)			2	2		—		
MC-22103	Flash Memory	16M (1M × 16)			5	—		Bottom		
	SRAM	2M (256K × 8)			2	2		—		
MC-22104	Flash Memory	16M (2M × 8)			5	—		Top		
	SRAM	1M (128K × 8)			26	20		—		
MC-22105	Flash Memory	16M (2M × 8)			5	—		Bottom		
	SRAM	1M (128K × 8)			26	20		—		
MC-22106	Flash Memory	16M (1M × 16)			5	—		Top		
	SRAM	1M (128K × 8)			26	20		—		
MC-22107	Flash Memory	16M (1M × 16)			5	—		Bottom		
	SRAM	1M (128K × 8)			26	20		—		
MC-22000	Flash Memory	8M (1M × 8)			5	—		Top		F1-DB: 48-pin BGA (10 × 11 mm)
	SRAM	2M (256K × 8)			2	2		—		
MC-22001	Flash Memory	8M (1M × 8)			5	—		Bottom		
	SRAM	2M (256K × 8)			2	2		—		
MC-22002	Flash Memory	8M (1M × 8 or 512K × 16)			5	—		Top		
	SRAM	2M (256K × 8)			2	2		—		
MC-22003	Flash Memory	8M (1M × 8 or 512K × 16)			5	—		Bottom		
	SRAM	2M (256K × 8)			2	2		—		
MC-22004	Flash Memory	8M (1M × 8)			5	—		Top		
	SRAM	1M (128K × 8)			26	20		—		
MC-22005	Flash Memory	8M (1M × 8)			5	—		Bottom		
	SRAM	1M (128K × 8)			26	20		—		
MC-22006	Flash Memory	8M (1M × 8 or 512K × 16)	5	—	Top					
	SRAM	1M (128K × 8)	26	20	—					
MC-22007	Flash Memory	8M (1M × 8 or 512K × 16)	5	—	Bottom					
	SRAM	1M (128K × 8)	26	20	—					

Other

■ Line Buffer

Density (bits)	Organi- zation (words × bits)	Part number	Read/Write cycle time MIN. (ns)	Data hold period (ms)	Maximum supply current active (mA)	Supply voltage (V)	Package	Remark
80K	10096 × 8 5048 × 16	μ PD485506	25/25 35/35	—	140	5.0±0.5	• 44-pin TSOP II	FAX, PPC Line buffer FIFO structure
40K	5048 × 8	μ PD485505	25/25 35/35	—	80		• 24-pin SOP	

[MEMO]

Semi-Custom IC

NEC's ASICs	156
0.25 μm ASIC	166
Gate Array	172
• CMOS Gate Array	176
• BiCMOS Gate Array	195
Cell-Based IC	200
Embedded Array	217
Analog Master	220
Mixed Signal ASIC	223

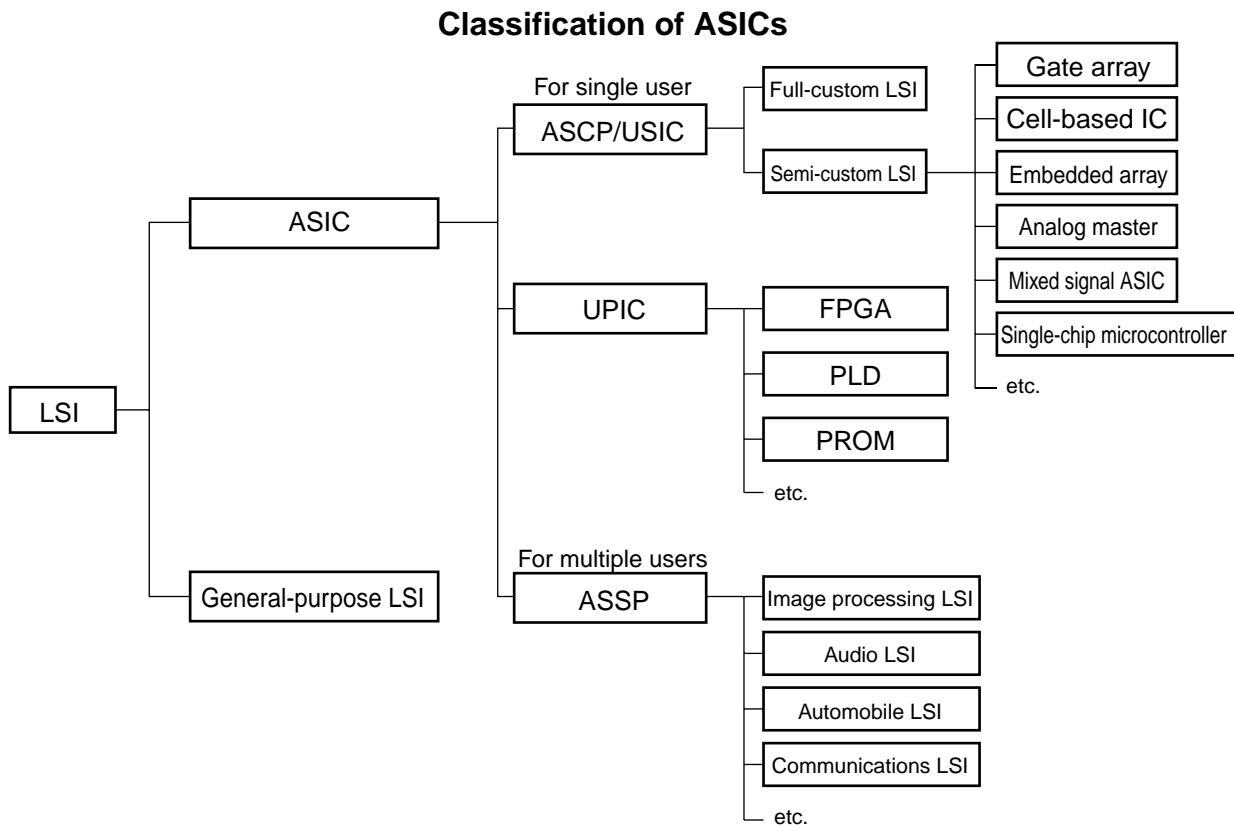
NEC's ASICs

What Is ASICs ? (1/2)

LSIs are broadly classified into two types: general-purpose LSIs and Application-Specific ICs (ASICs).

The general-purpose LSIs are designed and supplied as standard products by the manufacturers. Because these LSIs are mass-produced, generally they are inexpensive and do not require much work or expense for development from the user even if each user uses only a small quantity of these LSIs. However, because they are general-purpose products, some of their functions may be redundant for some users, and some functions may not be available. Moreover, the user's own unique functions cannot be provided.

In contrast, ASICs are for specific applications and can be further classified as illustrated below.



- Remark**
- ASCPApplication Specific Custom Product
 - ASSPApplication Specific Standard Product
 - FPGAField Programmable Gate Array
 - PLD Programmable Logic Device
 - PROMProgrammable Read Only Memory
 - USICUser Specific IC
 - UPICUser Programmable IC

ASICs are broadly classified into LSIs for single users (ASCPs, USICs, and UPICs) and those for multiple users, as shown above.

NEC's ASICs**■ What Is ASICs ? (2/2)****● ASIC for single users (ASCP/USIC)**

ASICs of this type are designed for a specific user and are used for security and to improve performance (such as increasing speed and lowering power consumption). On the other hand, the load on the user for development is heavy. These ASICs are classified into full custom LSIs and semi-custom LSIs.

Full-custom LSIs are developed by the users who have mastered LSI production technologies, and require a long development time and incur large costs. A contract for production with the manufacturer is made on the assumption of mass production of the application system. Usually, the LSIs developed in this way offer extremely high performance.

The word semi-custom LSI is used to differentiate from full-custom LSIs. With full-custom LSIs, all the development processes, from circuit design to photo mask, are tailored to that particular design. In contrast, the elements on the chip of a semi-custom LSI are designed and produced in advance by the manufacturer, and the user builds his own unique functions using these elements. Take gate arrays for example. A common photo mask is used for the diffusion process and only the photo mask for the wiring process is created according to the specifications of the user. This means an LSI can be developed in a shorter time.

● ASIC for single user (UPIC)

FPGA, PLD, and PROM are collectively called UPIC. These are ASICs that can be developed by the user by using dedicated development tools for production runs as small as a single sample.

In particular, because the logical operations of FPGA and PLD are the same as those of gate arrays, these UPICs are highly useful as sample LSIs to evaluate the breadboard and circuit operations before the development of gate arrays. Compared with gate array products, the development cost of UPICs can be kept very low, and the development period is short. For these reasons, UPICs are also used to check parts of large-scale LSIs.

● ASIC for multiple users (ASSP)

ASSPs are standard LSIs produced by the manufacturer for specific fields. Because they are designed and produced by the manufacturer, the user does not have to shoulder any development burden and there is no limit to the production quantity. These LSIs include graphics display controllers and field memories.

NEC's ASICs

■ Selecting an LSI

Users' products increasingly require the following features:

- High added value
- Implementation in software
- Total solutions
- System integration, etc.

Integrating the circuits formerly implemented with conventional ICs using an ASIC is the best way to achieve these things. Consequently, it is important to select an ASIC manufacturer who can provide you with powerful device technology, system technology, and upstream software support.

NEC offers a variety of ASIC products that can satisfy every user's needs, as well as comprehensive support. The key to selecting the most suitable ASIC product is completely understanding the characteristics required by the entire system to be developed and the circuits to be integrated into an ASIC.

These characteristics include the following conditions:

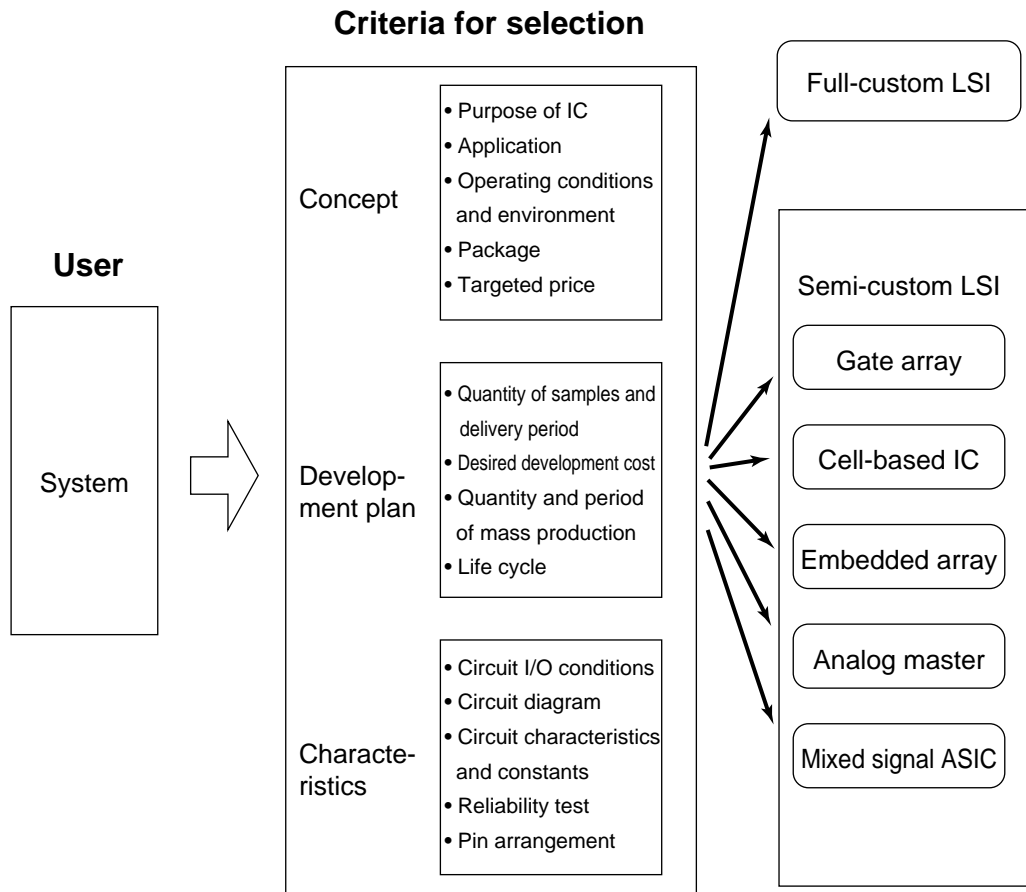
- Development investment
- Development period (delivery period)
- Quantity of production
- Necessary functions and performance
- Application

If you use the list of criteria on the next page, taking these points into consideration, you can find the ASIC you really need.

NEC's ASICs

■ Criteria for Selection (1/4)

Whether a full-custom or semi-custom LSI should be used, or whether ASSP or general-purpose LSI should be used depend on your concept, development plan, and the characteristics you require. By considering the items in the following diagram you can select the products that satisfy all your requirements. The subsequent sections 1 through 4 compare the major semi-custom products and full-custom products for your reference.



NEC's ASICs

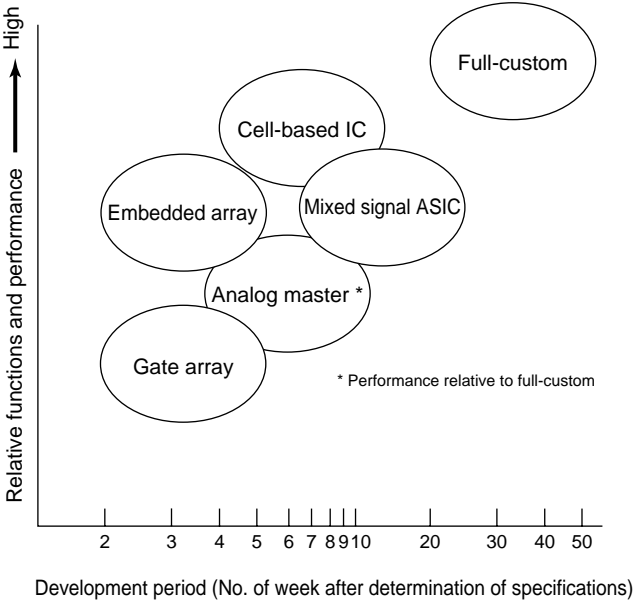
■ **Criteria for Selection (2/4)**

● **Development Period and Relative Performance**

As shown in the figure on the right, full-custom LSIs have high performance but require a long development period. In contrast, the development period of semi-custom LSIs, such as gate arrays and analog masters, is shorter, although these LSIs have some redundant functions.

For embedded arrays, the wafer is produced when the macros to be used have been determined. In the meantime, the circuits are determined through simulation. After simulation has been completed, only the wiring process is left, and development can be completed in almost the same period as gate arrays. If the macros and gate scale of the wafer are the same as those of gate arrays, the wafer can be used as a master wafer; consequently, the development period is equivalent to that of gate arrays.

Cell-based ICs, and new semi-custom LSIs fall somewhere between full-custom LSIs and gate arrays. Although these LSIs offer performance and functions comparable to those of full-custom LSIs, their development period is only slightly longer than that of gate arrays.



NEC's ASICs

■ Criteria for Selection (3/4)

● Development Investment and Element Cost

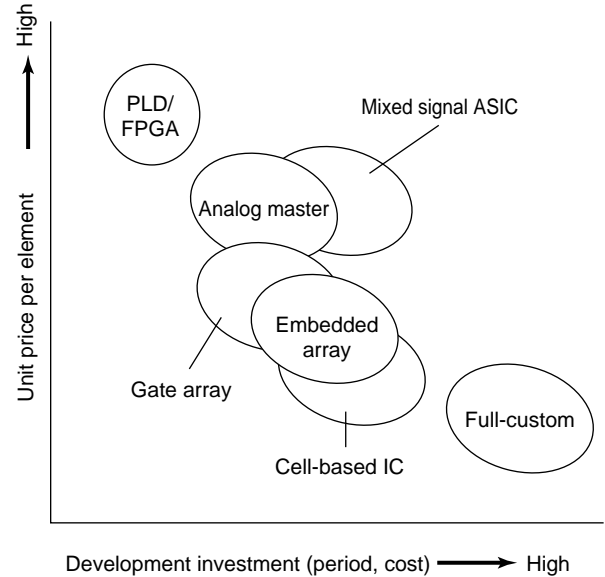
As shown in the figure on the right, there is a clear relationship between the development investment and unit cost.

PLD (Programmable Logic Device) and FPGA (Field Programmable Gate Array) are types of general-purpose LSIs with a design philosophy close to that of gate arrays. You can purchase one unit of these LSIs, and can program and use the LSI on the day you purchase it. Therefore, the development investment is extremely low. However, the price per element of PLDs and FPGAs is high.

Conversely, although the development period and cost of a full-custom LSI are higher, the unit price of each element is very low, partly because almost 100% of the elements are used and partly because the full-custom LSI is usually mass-produced.

The various semi-custom LSI products fall between these two. Therefore, semi-custom LSIs are ideal if the development period and cost are limited and at the same time, the unit price of the element must be kept low.

In addition, because many development tools and standard cell libraries are available for semi-custom LSIs, the development period can be further shortened.



NEC's ASICs

Criteria for Selection (4/4)

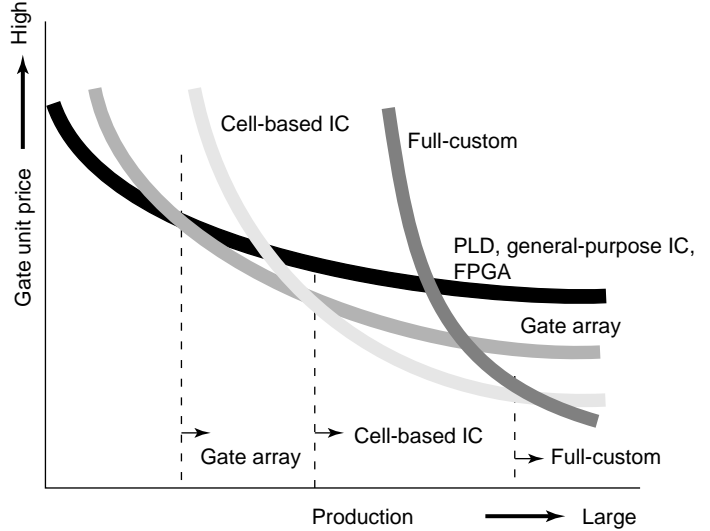
Total Production and Gate Units (Guideline)

One of the indexes that indicate the price of an LSI is a gate unit price. The gate unit price of PLD and general-purpose LSIs is low if the production is small. However, the unit price does not decrease even if the volume of production increases.

Full-custom LSIs are not profitable unless they are produced in a large quantity.

Semi-custom LSIs can be profitable whether they are produced in a small or large quantity.

Of these semi-custom LSIs, gate arrays are more suitable for small-scale production than cell-based ICs.

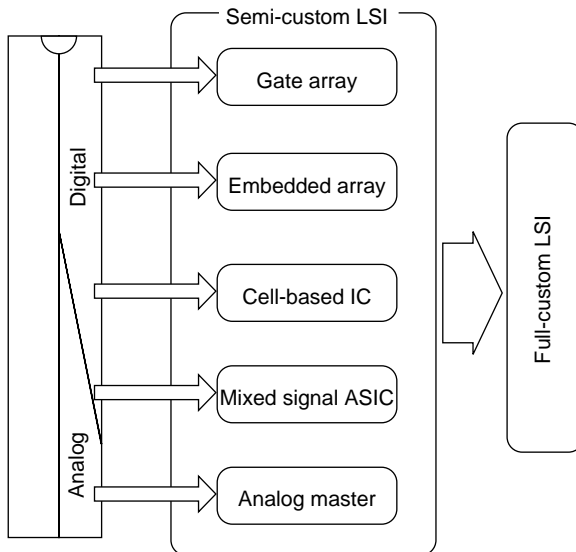


Suitability for Different Types of Circuit

Circuits can be broadly classified into analog circuits and digital circuits.

As shown in the figure on the right, among the semi-custom LSIs gate arrays are suitable for digital circuits, and analog masters can be used to integrate analog circuits. Cell-based ICs are mainly used for digital circuits, but can also be used to combine analog and digital circuits.

A complicated circuit with a special configuration that cannot be realized using semi-custom LSI must be created as a full-custom LSI. A full-custom LSI can be used to integrate both analog circuits and digital circuits.



NEC's ASICs

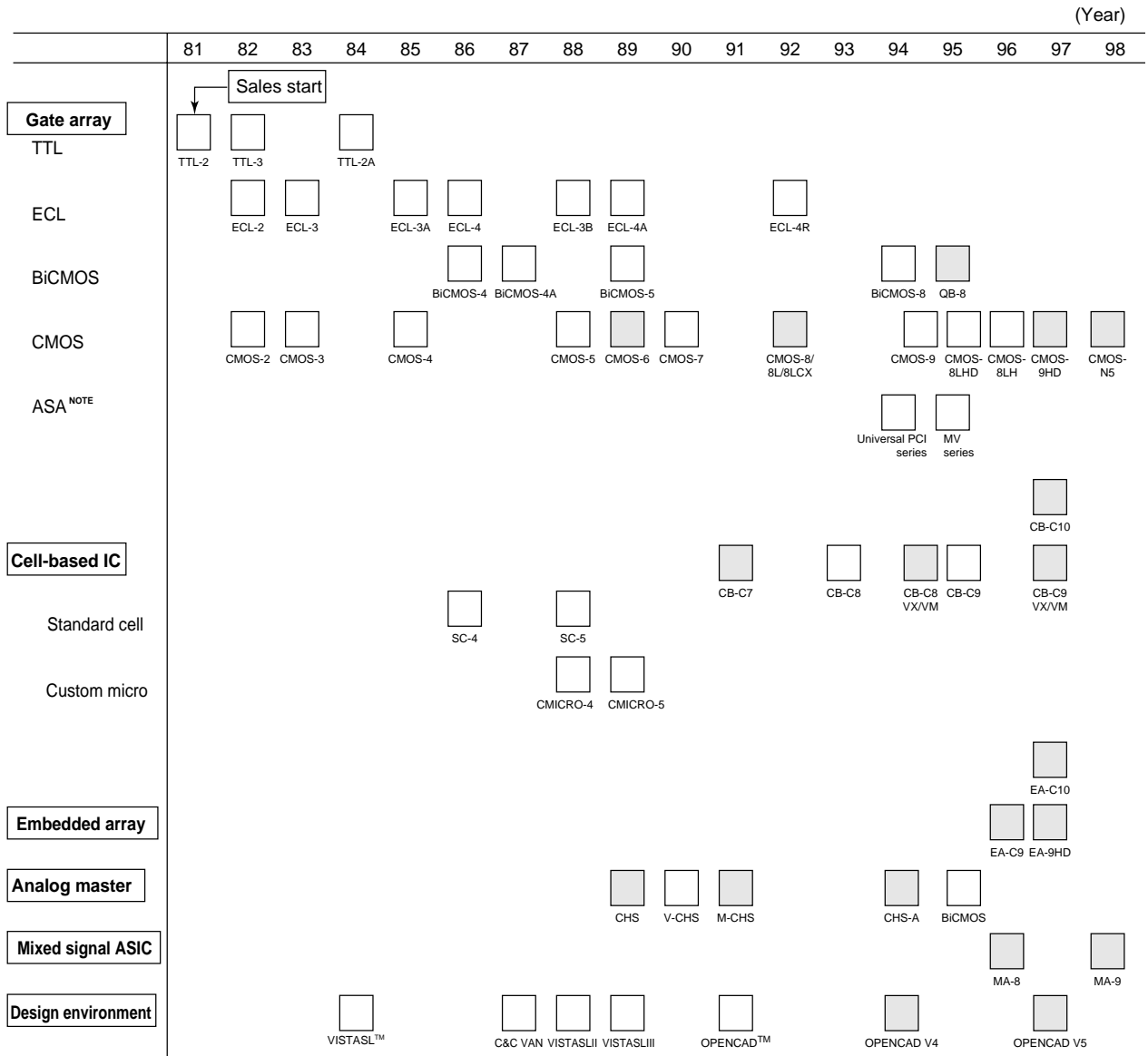
History of Development of ASIC

NEC developed device technology and basic software for its ASICs in the 1970's, and started sales of its ASICs from 1981.

Semi-custom LSIs were first developed in response to demands to improve the performance of systems such as computers and private branch exchanges. When the advantages of ASICs became more widely recognized as device development and tool organization advanced in the 1980's, the use of ASICs increasingly became widespread.

Today, users who have experience of development using gate arrays wish to develop using ASICs to achieve a larger scale and higher performance. Consequently, device manufacturers are required to supply state-of-the-art semiconductor chips and efficient design environments.

To satisfy these requirements, NEC supplies a wide range of services including an extensive line-up of processes and technologies, and integrated CAD systems using original EWS and networking.



Note Application Specific Arrays
Remark □ : Maintenance parts

NEC's ASICs

■ NEC's ASIC Products (1/2)

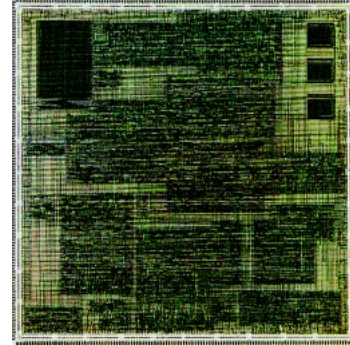
● Gate array

Gate arrays are semi-custom LSIs. Gates are laid out on master wafers in the form of an array. These gates are wired together to create the desired LSI.

To lay out gates, an area where no gates are placed may be provided on the wafer (channel structure) or gates may be laid out over the entire surface of the wafer (channel-less structure).

The channel gate arrays have fixed wiring areas and gate areas. Almost all the gates of these gate arrays can be used. However, it is difficult to integrate memories on these gate arrays.

The channel-less gate arrays can be used to integrate a large-scale system on a single chip. They allow you to determine the width of the wiring area and the shape of the gates freely and to integrate memories efficiently.

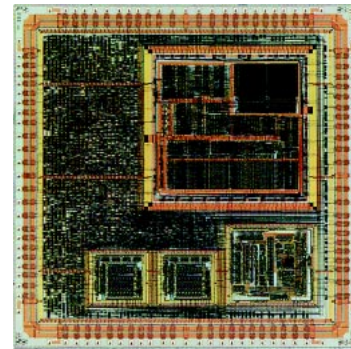


● Cell-based IC

Cell-based ICs are high-performance semi-custom LSIs for integrating memories such as RAM and ROM, CPU, CPU peripherals, and analog circuits, as well as logic, on a single chip, by means of a building block type standard cell design technique.

Cell-based ICs cannot only realize a density higher than gate arrays and embedded arrays, but also integrate high-performance macros. Therefore, they have increasingly grown in popularity recently as semi-custom LSIs for achieving systems-on-chip.

Unlike gate arrays, no master wafers are available for cell-based ICs, and a cell-based IC is processed from the very first process, i.e., the diffusion process, to satisfy the user's particular requirements.



NEC's ASICs

■ NEC's ASIC Products (2/2)

● Embedded array

Embedded arrays are high-performance semi-custom LSIs that use the basic cells of a gate array in the internal area, and that can be used to integrate memories like cell-based ICs, such as RAM and ROM.

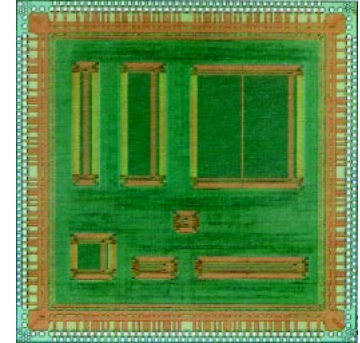
LSIs with sophisticated functions and high performance comparable to those of cell-based ICs can be created.

Because the wafer is produced in parallel with simulation, only the wiring process must be done after simulation has been completed. Consequently, the development period up to completion of a sample is as short as that of gate arrays.

If a cell-based IC is used for initial production, the production of the system can be started in a short time.

If the macro configuration and gate scale are the same, the same master wafer can be used to develop other LSIs. Therefore, many variations of LSIs can be created at a lower cost than cell-based ICs.

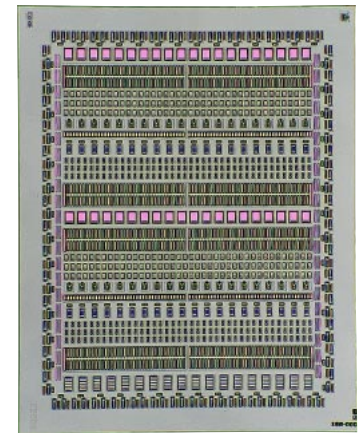
In addition, the circuits of embedded arrays can be easily modified, so that the risk involved in development can be lowered.



● Analog master

An analog master is used to create an analog LSI by using a master wafer on which transistors, resistors, and capacitors are laid out in advance, and designing the appropriate wiring in a similar way to when a gate array is used.

If you think it would be too difficult to create a full-custom analog circuit from the viewpoint of development period, cost, and the quantity of ICs used, the analog master is the ideal product.

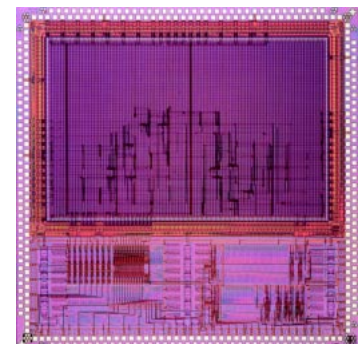


● Mixed signal ASIC

This is a semi-custom LSI that integrates the functions of a CMOS gate array and an analog semi-custom IC on a single chip.

The gate array block consists of the basic cells of a CMOS gate array, and can be designed in the same manner as a gate array.

The analog delay block incorporates CMOS transistors and bipolar transistors for analog circuits, so that high-performance analog circuits can be constructed.



0.25 μm ASIC**■ EA-C10 Family****● Features (1/3)**

High-density, super high-speed, and low-power consumption embedded array using the most advanced 0.25 μm technology

- High-level function and high-performance LSI compatible to cell-based IC
- 2.5 V/3.3 V interface
- Short turn around time equivalent to gate array
- High-density of system-on-a-chip level
- Easy development and modification of derivative models
- Macro maintenance common to cell-based IC (CB-C10) (including analog circuit)

Family Name		EA-C10
Maximum density (total number of gates)		7 million gates
Supply voltage		2.5 V \pm 0.2 V
Delay time	Internal gate ^{Note 1}	59 ps
	Input buffer ^{Note 2}	79 ps
	Output buffer ^{Note 3}	1363 ps
Power consumption		0.14 μW /MHz/cell (internal gates)

Notes 1. 2-input NAND power gate, fanout: 1, wiring length: 0.5 mm
 2. Fanout: 2, wiring length: 0 mm
 3. Load capacitance: 50 pF, $I_{OL} = 12$ mA

0.25 μm ASIC**■ EA-C10 Family****● Features (2/3)****Wide variety of macro libraries (1/2)**

Functional cell
Logic gate
Delay gate
Adder
Decoder
Multiplexer
Latch
Flip-flop
Shift register
Counter

Compiled macro (cell-based IC type)
High-speed 1-port RAM
High-speed 2-port RAM
Super high-speed 1-port RAM
High-density 1-port RAM
High-density 2-port RAM
High-speed ROM

Mega macro to be developed					
Macro name	PC	Consumer	Portable equipment	Communication	Graphic
PCI controller	<input type="radio"/>				
USB	<input type="radio"/>				
IEEE1394	<input type="radio"/>	<input type="radio"/>			
V8xx CPU		<input type="radio"/>	<input type="radio"/>		
Vr4xxx CPU		<input type="radio"/>	<input type="radio"/>		
V30MZ™		<input type="radio"/>	<input type="radio"/>		
MPEG2 (decoder)		<input type="radio"/>			
A/D, D/A		<input type="radio"/>			
Modem CODEC		<input type="radio"/>			
DSP (SPRX, OAK/Pine)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
ARM CPU		<input type="radio"/>	<input type="radio"/>		
ATM (25MHz, 155MHz)				<input type="radio"/>	
Ethernet 10/100 Base PHY, MAC				<input type="radio"/>	
RAC (Rambus™ ASIC Core cell)					<input type="radio"/>
2D, 3D accelerator					<input type="radio"/>

- Remarks 1.** The release schedule differs depending on the macro. For details, consult NEC.
2. Including macro libraries under development and under study

0.25 μm ASIC**■ EA-C10 Family****● Features (3/3)****Wide variety of macro libraries (2/2)**

I/O buffer
LVC MOS/LVTTL
Slew rate buffer
3-state buffer
Open-drain buffer

Others
DPLL (to 250 MHz)
APLL (to 500 MHz)
Multiplier
UART
Register file
DRAM
Flash memory
Scan block
JTAG

High-speed I/O
GTL/GTL+ (Gunning Transceiver Logic)
PCI ^{Note 1} (Peripheral Component Interconnect)
HSTL (High Speed Transceiver Logic)
pECL (Pseudo Emitter Coupled Logic)
SSTL (Stub Series Terminated Transfer Logic)
LVDS (Low Voltage Differential Signaling)
USB (Universal Serial Bus)
IEEE1394

RAM macro (gate array type) ^{Note 2}
High-speed 1-port RAM
High-speed 2-port RAM

Notes 1. Interface standard proposed by Intel.

2. RAM macro for gate array. Bit/word fixed.

Remarks 1. The release schedule differs depending on the macro. For details, consult NEC.

2. Including macro libraries under development and under study

0.25 μm ASIC**■ CB-C10 Family****● Features (1/3)****High-density, super high-speed, and low-power consumption cell-based IC using the most advanced 0.25 μm technology**

In addition to featuring a high-density of 20 million gates (MAX.) and low-power consumption, high-speed internal gates, the EA-C10 Family achieves system-on-chip capabilities through a wide variety of application-oriented macros.

Furthermore, a macro library which operates on low voltage (to 1.8 V) is also being prepared.

Family Name		CB-C10
Maximum density (number of usable gates)		20M gates (15M gates)
Supply voltage		2.5 V \pm 0.2 V
Delay time	Internal gate ^{Note 1}	93.4 ps
	Input buffer ^{Note 2}	31.5 ps
	Output buffer ^{Note 3}	1363 ps
Power consumption		0.04 $\mu\text{W}/\text{MHz}/\text{gate}$

Note 1. 2-input NAND power gate, fanout: 1, wiring length: 0 mm

2. Fanout: 2, wiring length: 0 mm

3. Load capacitance: 50 pF, $I_{OL} = 12$ mA

0.25 μ m ASIC**■ CB-C10 Family****● Features (2/3)****Wide variety of macro libraries (1/2)**

Functional cell
Logic gate
Delay gate
Adder
Decoder
Multiplexer
Latch
Flip-flop
Shift register
Counter

Compiled macro
High-speed 1-port RAM
High-speed 2-port RAM
Super high-speed 1-port RAM
High-density 1-port RAM
High-density 2-port RAM
High-speed ROM

Mega macro to be developed					
Macro name	PC	Consumer	Portable equipment	Communication	Graphic
PCI controller	<input type="radio"/>				
USB	<input type="radio"/>				
IEEE1394	<input type="radio"/>	<input type="radio"/>			
V8xx CPU		<input type="radio"/>	<input type="radio"/>		
Vr4xxx CPU		<input type="radio"/>	<input type="radio"/>		
V30MZ		<input type="radio"/>	<input type="radio"/>		
MPEG2 (decoder)		<input type="radio"/>			
A/D, D/A		<input type="radio"/>			
Modem CODEC		<input type="radio"/>			
DSP (SPRX, OAK/Pine)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
ARM CPU		<input type="radio"/>	<input type="radio"/>		
ATM (25MHz, 155MHz)				<input type="radio"/>	
Ethernet 10/100 Base PHY, MAC				<input type="radio"/>	
RAC (Rambus™ ASIC Core cell)					<input type="radio"/>
2D, 3D accelerator					<input type="radio"/>

- Remarks 1.** The release schedule differs depending on the macro. For details, consult NEC.
2. Including macro libraries under development and under study

0.25 μm ASIC**■ CB-C10 Family****● Features (3/3)****Wide variety of macro libraries (2/2)**

I/O buffer
LVC MOS/LVTTL
Slew rate buffer
3-state buffer
Open-drain buffer

Others
DPLL (to 250 MHz)
APLL (to 500 MHz)
Multiplier
UART
Register file
DRAM
Flash memory
Scan block
JTAG

High-speed I/O
GTL/GTL+ (Gunning Transceiver Logic)
PCI ^{Note} (Peripheral Component Interconnect)
HSTL (High Speed Transceiver Logic)
pECL (Pseudo Emitter Coupled Logic)
SSTL (Stub Series Terminated Transfer Logic)
LVDS (Low Voltage Differential Signaling)
USB (Universal Serial Bus)
IEEE1394

Note Interface standard proposed by Intel.

Remarks 1. The release schedule differs depending on the macro. For details, consult NEC.
2. Including macro libraries under development and under study

Gate Array

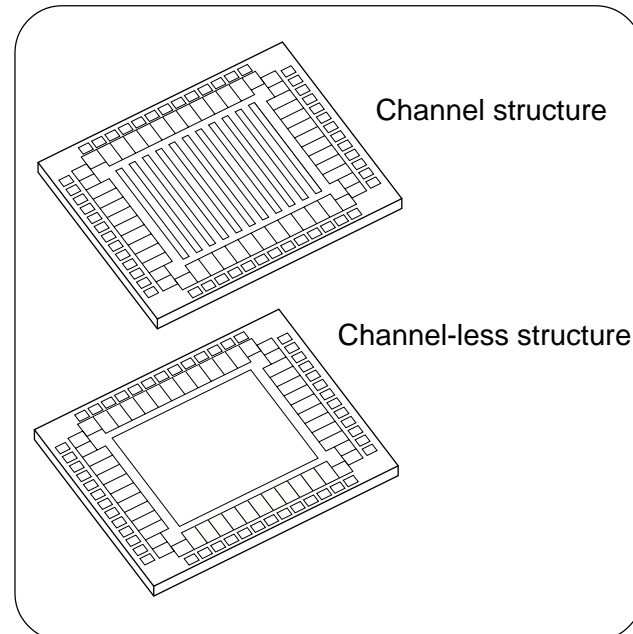
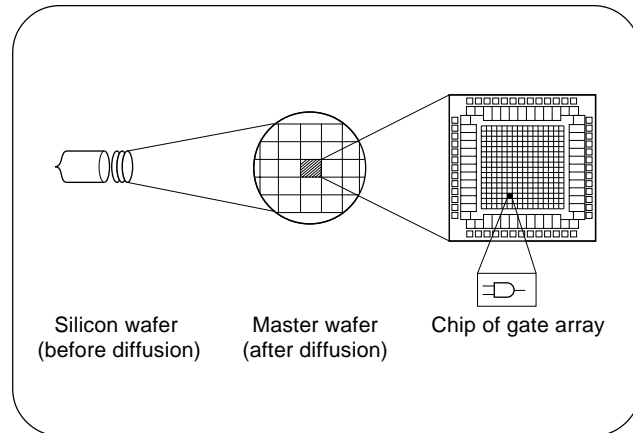
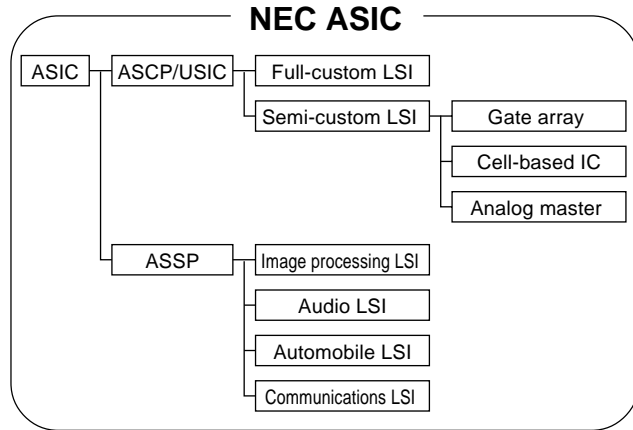
■ **What Is a Gate Array ?**

When producing LSIs, the diffusion process that forms elements such as transistors on a silicon wafer takes a long time. With gate arrays, manufacturers can supply wafers called master wafers whose diffusion process has been completed. On a master wafer, logic gates (basic cells) are arranged in the shape of a grid (array). These basic cells are not wired to each other at first, and are electrically independent. When the required circuit has been determined, these basic cells are combined to create it. Therefore, because the user produce product in the short time required for the processes following the wiring process, very short development times are possible. In addition, even a small quantity of products can be produced at a low cost by individually wiring master wafers chosen from the many different types readily available.

As the density of gate arrays has increased, a type called the channel-less gate array that can be used to integrate a large-scale system on a single chip has come into the spotlight.

A channel-less gate array does not have a wiring area, unlike conventional gate arrays, but has transistors over its entire surface. The major features of the channel-less gate array, in addition to a short development period, are as follows:

- Memories can be efficiently implemented.
- The width of the wiring area and the shapes of the gates can be determined as you like.

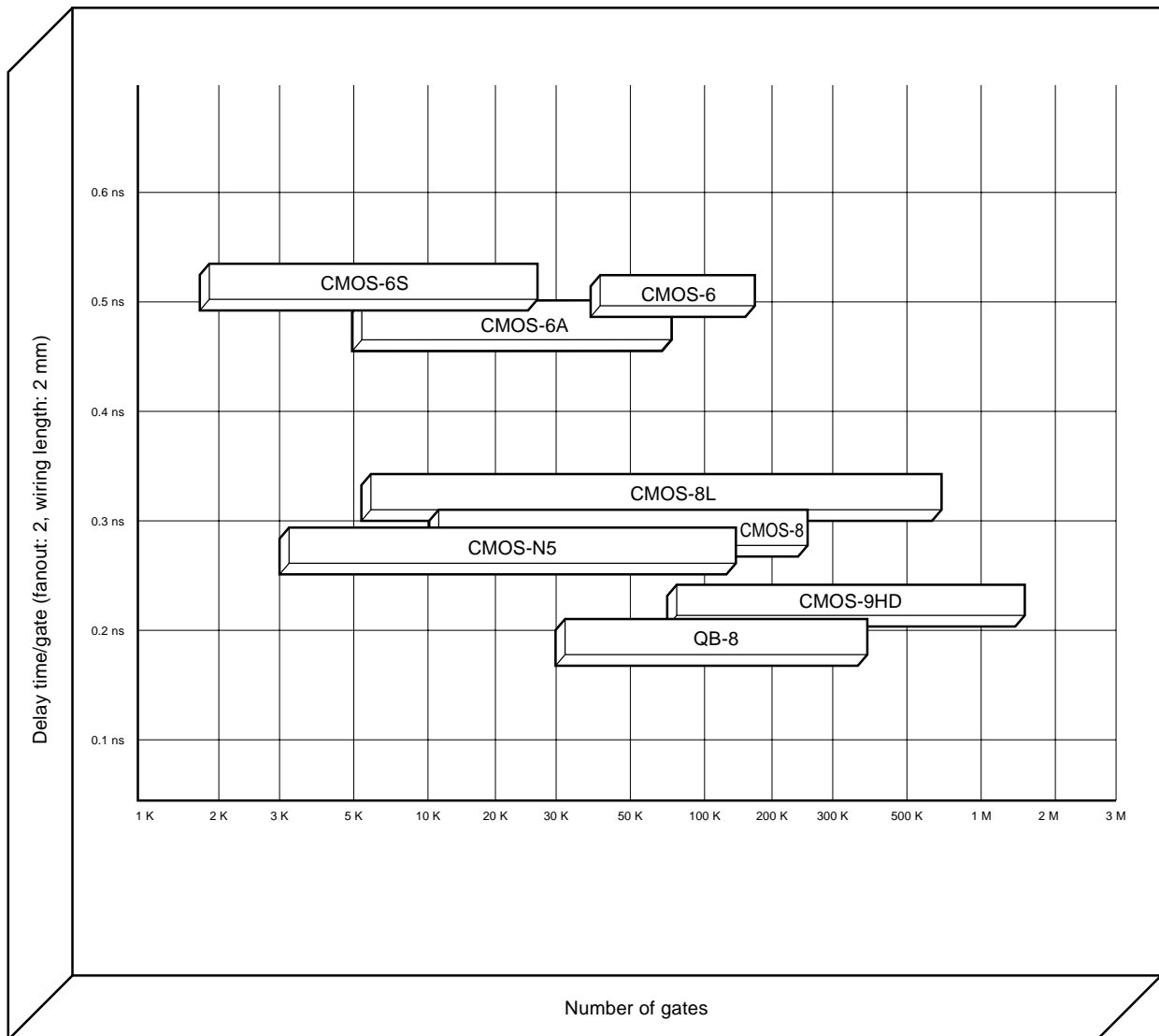


Gate Array

■ Product Line-Up

NEC offers 89 different gate array models (78 CMOS models, 11 BiCMOS models) with the world's highest performance and density, backed up by its leading-edge technology. These gate arrays are employed in a wide range of fields, such as electronic games, household appliances, optical communications equipment, and super computers.

Product Line-up



Channel-less CMOS : CMOS-N5, CMOS-9HD, CMOS-8, CMOS-8L, CMOS-6, CMOS-6A, CMOS-6S
 BiCMOS : QB-8

Gate Array**■ Features of NEC Gate Arrays****Wide variety of models**

Many different models are available, suitable for all kinds of systems.

CMOS gate arrays : 7 families, 78 models

BiCMOS gate arrays : 1 families, 11 models

High density and high speed thanks to leading edge technology

The CMOS-9HD family employs a 0.35- μm CMOS technology, 3-layer wiring technology, and channel-less structure. As a result, a density of up to 1.6M gates (1.1M usable gates) and a speed of 107ps have been achieved, enabling large-scale system integration on a single chip.

Drastic cost reduction

The CMOS-N5 family is a gate array that provides high-speed operation with a 5-V power supply voltage. Drastic cost reductions have been achieved thanks to higher integration by the adoption of 0.5 μm technology (2-layer wiring), and lowering the package assembly cost.

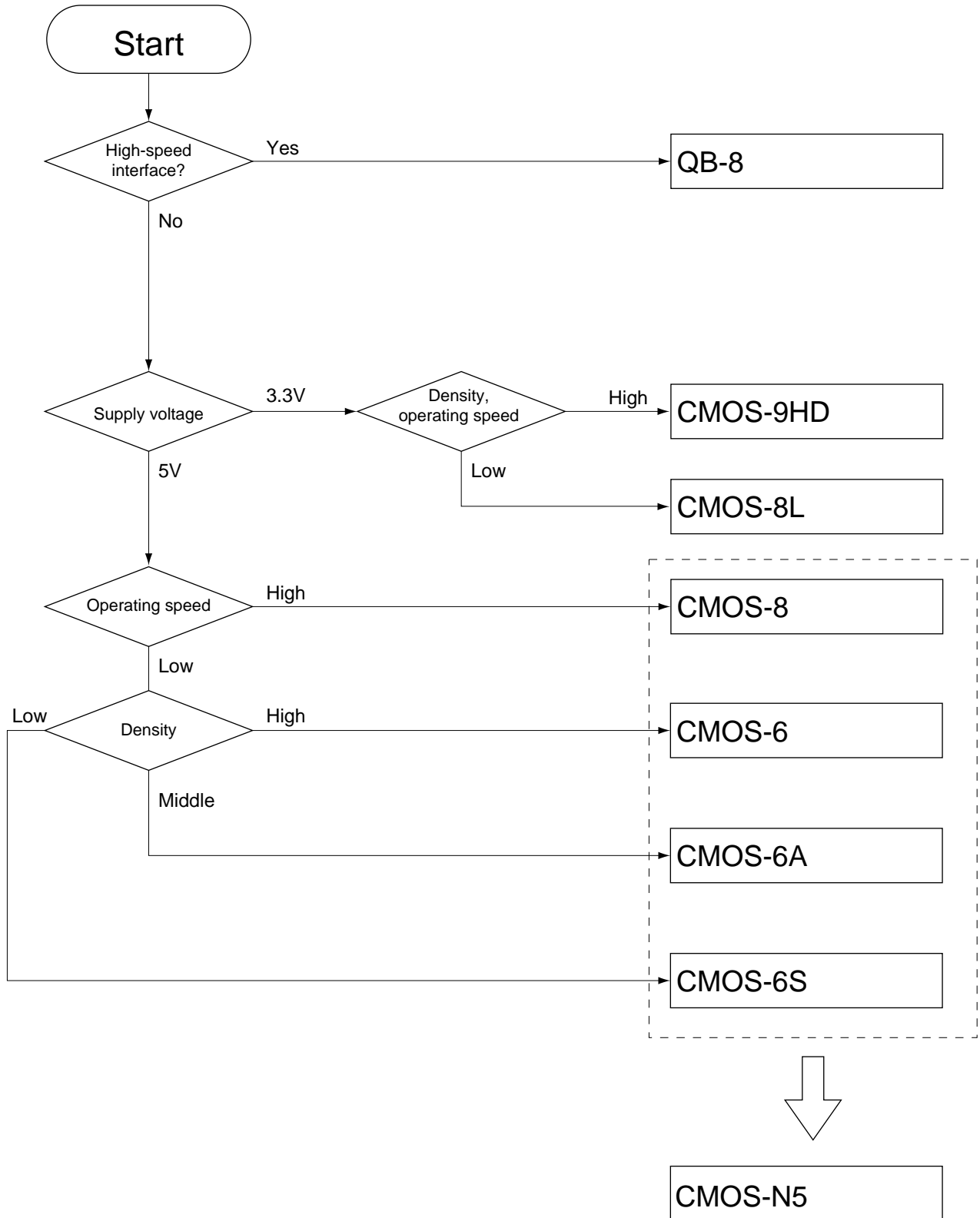
High-level gate arrays from many libraries

Because many library functions are available, it's easy to improve the functionality of your system. Moreover, every technology is standardized to facilitate design.

Macros of large-scale CPU peripheral circuits are available for CMOS gate arrays, shortening the designing period and improving the functionality of your systems.

Gate Array

■ Which Gate Arrays Is Best-Suited to Your System ?



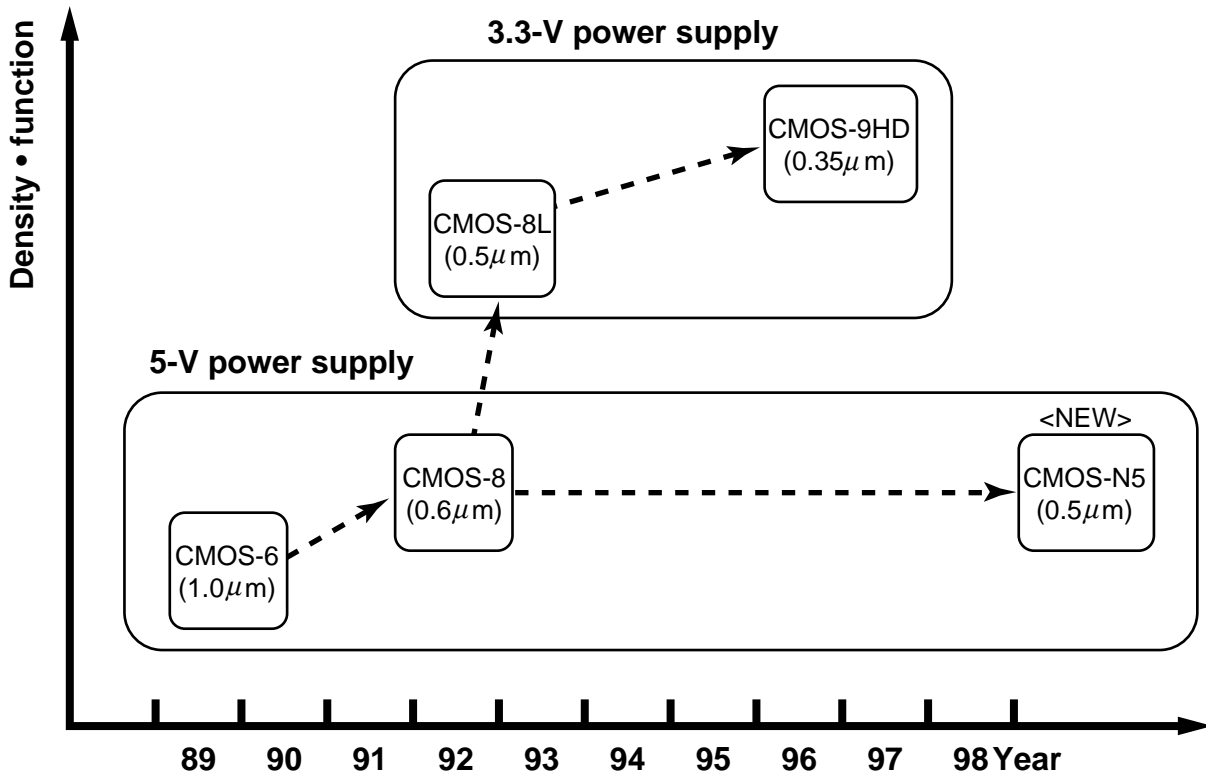
Gate Array

■ **CMOS Gate Arrays**

● **Product Line-Up**

NEC offer many types of CMOS gate arrays including the CMOS-6 family with a design rule of 1.0 μm and the CMOS-9HD family with a design rule of 0.35 μm .

These CMOS gate arrays have densities from 1.8K gates to 1.6M gates (78 models) and satisfy a wide range of user needs by providing compound functions with integrated memories and keeping the operating voltage low.



Gate Array

CMOS Gate Array

■ CMOS-6 Family

● Available Models

		μ PD65658	μ PD65664	μ PD65672	μ PD65676
Density	Number of integrated gates*	42240	72576	119232	177408
	Number of usable gates**	31680	54432	89424	133056
	Number of pads ^{Note}	236	304	384	464
Delay time	Internal gate	0.5 ns (fanout: 2, wiring length: 2 mm)			
	Power gate	0.4 ns (fanout: 2, wiring length: 2 mm)			
	Input buffer	1.0 ns (fanout: 2, wiring length: 2 mm)			
	Output buffer	2.0 ns ($C_L = 15$ pF)			
Output drive capability		$I_{OL} = 4.5, 9.0, 13.5, 18.0, 24.0$ mA			
Supply voltage		5 V			
Remark		* 2-input NAND conversion (1 cell = 1 gate) ** Cell utilization rate: 75 %			

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

■ CMOS-6A Family

● Available Models

		μ PD65630	μ PD65636	μ PD65640	μ PD65646	μ PD65650	μ PD65654	μ PD65656	μ PD65662
Density	Number of integrated gates*	5376	8000	11520	16240	21120	30720	40480	70272
	Number of usable gates**	3225	4800	6912	9744	12672	18432	24288	42163
	Number of pads ^{Note}	100	116	136	156	176	208	220	288
Delay time	Internal gate	0.5 ns (fanout: 2, wiring length: 2 mm)							
	Power gate	0.4 ns (fanout: 2, wiring length: 2 mm)							
	Input buffer	1.0 ns (fanout: 2, wiring length: 2 mm)							
	Output buffer	2.0 ns ($C_L = 15$ pF)							
Output drive capability		$I_{OL} = 4.5, 9.0, 13.5, 18.0, 24.0$ mA							
Supply voltage		5 V							
Remark		* 2-input NAND conversion (1 cell = 1 gate) ** Cell utilization rate: 60 %							

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

Gate Array

CMOS Gate Array

■ CMOS-6S Family

● Available Models

		μ PD65611	μ PD65621	μ PD65625	μ PD65643	μ PD65653
Density	Internal gates*	1836	3484	5312	13416	25488
	Number of usable gates**	1101	2090	3187	8049	15292
	Number of pads ^{Note}	80	100	120	176	236
Delay time	Internal gate	0.5 ns (fanout: 2, wiring length: 2 mm)				
	Power gate	0.4 ns (fanout: 2, wiring length: 2 mm)				
	Input buffer	1.0 ns (fanout: 2, wiring length: 2 mm)				
	Output buffer	2.0 ns ($C_L = 15$ pF)				
Output drive capability		$I_{OL} = 4.5, 9.0, 13.5, 18.0, 24.0$ mA				
Supply voltage		5 V				
Remark		* 2-input NAND conversion (1 cell = 1 gate) ** Cell utilization rate: 60 %				

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

Gate Array

CMOS Gate Array

■ CMOS-6/6A/6S Family

● Library

I/O buffer	Function block	Memory block	Mega macro
Function	Function	Function	Function
Input buffer Output buffer Bidirectional buffer Low-noise buffer Fail-safe buffer Oscillation circuit	Logic gate Buffer Inverter 3-state buffer Driver Delay Adder Decoder Multiplexer Latch Flip-flop Shift register Counter Others	High-speed single-port RAM High-speed dual-port RAM High-density single-port RAM Compiled RAM ROM	DMA controller Serial interface unit Parallel interface unit Timer/counter Interrupt controller

● Characteristics

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{DD}	-0.5 to +6.5	V
Input/output voltage	V_I/V_O	-0.5 to $V_{DD} + 0.5$	V
Output current	I_O	40 ^{Note1}	mA
Output current	I_O	30 ^{Note2}	mA
Output current	I_O	20 ^{Note3}	mA
Output current	I_O	10 ^{Note4}	mA
Operating temperature	T_A	-40 to +85	°C
Storage temperature	T_{stg}	-65 to +150	°C

- Notes**
1. I_{OL} (MIN.) = 18.0 mA type
 2. I_{OL} (MIN.) = 13.5 mA type
 3. I_{OL} (MIN.) = 9.0 mA type
 4. I_{OL} (MIN.) = 4.5 mA type

Caution If any of the parameters exceeds the absolute maximum ratings, even momentarily, the quality of the product may be impaired. The absolute maximum ratings are values that may physically damage the product(s). Be sure to use the product(s) within the ratings.

Recommended Operating Conditions

Parameter	Symbol	CMOS Level		TTL Level		Unit
		MIN.	MAX.	MIN.	MAX.	
Supply voltage	V_{DD}	4.5	5.5	4.75	5.25	V
High-level input voltage	V_{IH}	0.7 V_{DD}	V_{DD}	2.2	V_{DD}	V
Low-level input voltage	V_{IL}	0	0.3 V_{DD}	0	0.8	V
Input rise time	t_r	0	200	0	200	ns
Input fall time	t_f	0	200	0	200	ns
Positive trigger voltage	V_P	1.8	4.0	1.2	2.4	V
Negative trigger voltage	V_N	0.6	3.1	0.6	1.8	V
Hysteresis voltage	V_H	0.3	1.5	0.3	1.5	V

DC Characteristics

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Static current consumption	I_{DDs}	$V_I = V_{DD}$ or GND		0.1	280	μA
Off-state output leakage current	I_{Oz}	$V_O = V_{DD}$ or GND			± 10	μA
Output short-circuit current	I_{OS}	$V_O = 0V$			-250	mA
Input leakage current	Normal input	$V_I = V_{DD}$ or GND		$\pm 10^{-5}$	± 10	μA
	with pull-up (50 k Ω)	$V_I = GND$	-45	-131	-320	μA
	with pull-up (5 k Ω)	$V_I = GND$	-0.35	-1.0	-2.2	mA
	with pull-down (50 k Ω)	$V_I = V_{DD}$	45	131	320	μA
High-level output voltage (CMOS)	V_{OH}	$I_{OH} = 0mA$	$V_{DD} - 0.1$			V
High-level output voltage (TTL)	V_{OH}	$I_{OH} = 0mA$	2.6			V
Low-level output voltage	V_{OL}	$I_{OL} = 0mA$			0.1	V

Remark The above values are under the recommended operating conditions shown above.

For the details of the DC characteristics when other supply voltage (3.0 V \pm 10%) is used, refer to the **Design Manual**.

Gate Array

CMOS Gate Array

■ CMOS-8 Family

● Available Models (2-layer wiring)

		μ PD65800	μ PD65801	μ PD65802	μ PD65803
Density	Number of integrated gates*	11712	21504	32000	42688
	Number of usable gates**	7027	12902	19200	25612
	Number of pads ^{Note}	172	228	268	308
Delay time	Internal gate	0.29 ns (fanout: 2, wiring length: 2 mm)			
	Power gate	0.20 ns (fanout: 2, wiring length: 2 mm)			
	Input buffer	0.36 ns (fanout: 2, wiring length: 2 mm)			
	Output buffer	1.73 ns ($C_L = 15$ pF)			
Output drive capability		$I_{OL} = 3.0, 6.0, 9.0, 12.0, 18.0, 24.0$ mA			
Supply voltage		5 V \pm 10% (CMOS level), 5 V \pm 5% (TTL level)			
Remark		* 2-input NAND conversion ** Cell utilization rate: 60 %			

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

● Available Models (3-layer wiring)

		μ PD65804	μ PD65806	μ PD65808	μ PD65810	μ PD65811	μ PD65812	μ PD65813
Density	Number of integrated gates*	42688	58752	82432	103680	138776	176720	233280
	Number of usable gates**	32016	44064	61824	77760	104082	132540	174960
	Number of pads ^{Note}	308	356	420	468	524	588	676
Delay time	Internal gate	0.29 ns (fanout: 2, wiring length: 2 mm)						
	Power gate	0.20 ns (fanout: 2, wiring length: 2 mm)						
	Input buffer	0.36 ns (fanout: 2, wiring length: 2 mm)						
	Output buffer	1.73 ns ($C_L = 15$ pF)						
Output drive capability		$I_{OL} = 3.0, 6.0, 9.0, 12.0, 18.0, 24.0$ mA						
Supply voltage		5 V \pm 10% (CMOS level), 5 V \pm 5% (TTL level)						
Remark		* 2-input NAND conversion ** Cell utilization rate: 75 %						

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

Gate Array

CMOS Gate Array

■ CMOS-8 Family

● Library

I/O buffer	Function block	Memory block	Mega macro
Function	Function	Function	Function
Input buffer Output buffer Bidirectional buffer Low-noise buffer Fail-safe buffer PCI buffer GTL (under development) D-PLL (under development) Oscillation circuit	Logic gate Buffer Inverter 3-state buffer Clock driver Delay Adder Decoder Multiplexer Latch Flip-flop Shift register Counter Others	High-speed single-port RAM High-speed dual-port RAM High-density single-port RAM ROM	DMA controller Serial interface unit Parallel interface unit Timer/counter Interrupt controller

● Characteristics

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{DD}	-0.5 to +6.5	V
Input/output voltage	V_I/V_O	-0.5 to $V_{DD} + 0.5$	V
Output current	I_O	60 ^{Note1}	mA
Output current	I_O	40 ^{Note2}	mA
Output current	I_O	30 ^{Note3}	mA
Output current	I_O	20 ^{Note4}	mA
Output current	I_O	15 ^{Note5}	mA
Output current	I_O	10 ^{Note6}	mA
Operating temperature	T_A	-40 to +85	°C
Storage temperature	T_{stg}	-65 to +150	°C

Recommended Operating Conditions

Parameter	Symbol	CMOS Level		TTL Level		Unit
		MIN.	MAX.	MIN.	MAX.	
Supply voltage	V_{DD}	4.5	5.5	4.75	5.25	V
High-level input voltage	V_{IH}	0.7 V_{DD}	V_{DD}	2.2	V_{DD}	V
Low-level input voltage	V_{IL}	0	0.3 V_{DD}	0	0.8	V
Input rise time	t_r	0	200	0	200	ns
Input fall time	t_f	0	200	0	200	ns
Positive trigger voltage	V_P	1.8	4.0	1.2	2.4	V
Negative trigger voltage	V_N	0.6	3.1	0.6	1.8	V
Hysteresis voltage	V_H	0.3	1.5	0.3	1.5	V

Notes 1. I_{OL} (MIN.) = 24.0 mA type 4. I_{OL} (MIN.) = 9.0 mA type
 2. I_{OL} (MIN.) = 18.0 mA type 5. I_{OL} (MIN.) = 6.0 mA type
 3. I_{OL} (MIN.) = 12.0 mA type 6. I_{OL} (MIN.) = 3.0 mA type

Caution If any of the parameters exceeds the absolute maximum ratings, even momentarily, the quality of the product may be impaired. The absolute maximum ratings are values that may physically damage the product(s). Be sure to use the product(s) within the ratings.

DC Characteristics

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Static current consumption	I_{DDS}	$V_I = V_{DD}$ or GND		0.1	200	μA
Off-state output leakage current	I_{OZ}	$V_O = V_{DD}$ or GND			± 10	μA
Output short-circuit current	I_{OS}	$V_O = 0V$			-250	mA
Input leakage current	Normal input	$V_I = V_{DD}$ or GND		$\pm 10^{-5}$	± 10	μA
	with pull-up (50 k Ω)	$V_I = GND$	-45	-131	-320	μA
	with pull-up (5 k Ω)	$V_I = GND$	-0.35	-1.0	-2.2	mA
	with pull-down (50 k Ω)	$V_I = V_{DD}$	45	131	320	μA
High-level output voltage (CMOS)	V_{OH}	$I_{OH} = 0$ mA	$V_{DD} - 0.1$			V
High-level output voltage (TTL)	V_{OH}	$I_{OH} = 0$ mA	2.6			V
Low-level output voltage	V_{OL}	$I_{OL} = 0$ mA			0.1	V

Remark The above values are under the recommended operating conditions shown above. For the details refer to the **Design Manual**.

Gate Array

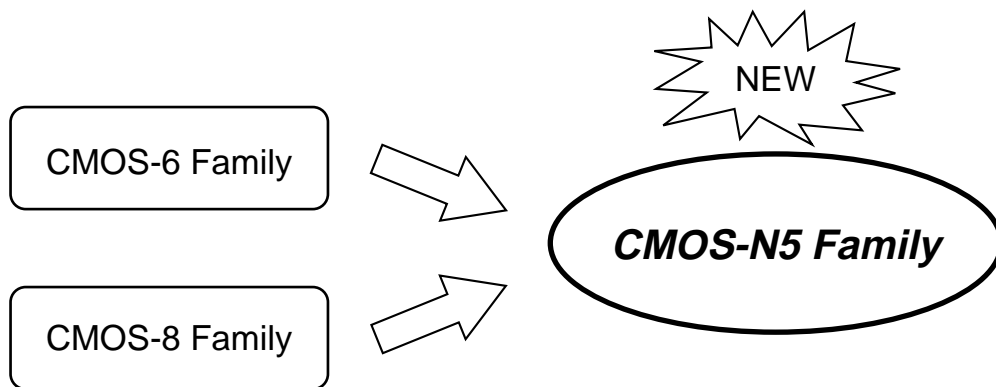
CMOS Gate Array

■ CMOS-N5 Family

● Features

The CMOS-N5 family is a channel-less type gate array that provides high speed operation with a 5-V power supply voltage.

Drastic cost reductions have been achieved compared with the conventional CMOS-6 and CMOS-8 families thanks to higher integration by the adoption of 0.5 μm technology (2-layer wiring), and lowering the package assembly cost.



Integration

- 3K to 120K gates (number of integrated gates)
- 2K to 74K gates (number of usable gates)

High-speed operation (preliminary)

- $t_{PD} = 0.2 \text{ ns}$ (2-input NAND (power gate), fanout = 2, standard wiring length)
- Operating frequency: 60 MHz max.

Function blocks

- RAM block (1 port/2 ports)
- Oscillation block
- CTS block

Gate Array

CMOS Gate Array

■ CMOS-N5 Family

● Available Models (Preliminary)

		μPD65880	μPD65881	μPD65882	μPD65883	μPD65884	μPD65885	μPD65887	μPD65889	μPD65890	μPD65893
Density	Number of integrated gates*	3456	5880	13952	25344	33864	40768	56496	76000	99528	123384
	Number of usable gates**	2073	3528	8371	15206	20318	24460	33897	45600	59716	74030
	Number of pads ^{Note}	72	88	120	160	184	244	284	324	372	412
Delay time	Internal gate	0.29 ns (fanout: 2, standard wiring length)									
	Power gate	0.20 ns (fanout: 2, standard wiring length)									
	Input buffer	0.36 ns (fanout: 2, standard wiring length)									
	Output buffer	1.73 ns (C _L = 15 pF)									
Output drive capability		I _{OL} = 3, 6, 9, 12, 18, 24 mA									
Supply voltage		5 V ± 10 % (CMOS level)									
Remark		* 2-input NAND conversion ** Cell utilization rate: 60 %									

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

Gate Array

CMOS Gate Array

■ CMOS-8L Family

● Available Models (2-layer wiring)

		μ PD65837	μ PD65839	μ PD65840	μ PD65841	μ PD65842	μ PD65843	μ PD65845	μ PD65846
Density	Number of integrated gates*	4480	7904	10912	20832	30192	40592	52528	61904
	Number of usable gates**	2912	5137	6547	12499	18115	24355	31516	37142
	Number of pads ^{Note}	80	104	164	204	212	244	276	300
Delay time	Internal gate	0.33 ns (fanout: 2, wiring length: 2 mm)							
	Power gate	0.21 ns (fanout: 2, wiring length: 2 mm)							
	Input buffer	0.71 ns (fanout: 2, wiring length: 2 mm)							
	Output buffer	1.44 ns ($C_L = 15$ pF)							
Output drive capability		$I_{OL} = 3, 6, 9, 12, 18, 24$ mA							
Supply voltage		3.3 V \pm 0.3 V							
Remark		* 2-input NAND conversion (1 cell = 1 gate) ** Cell utilization rate: 60 %							

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

		μ PD65848	μ PD65849	μ PD65850	μ PD65851	μ PD65852	μ PD65853	μ PD65855	μ PD65858
Density	Number of integrated gates*	81984	102272	120768	148256	202752	255744	342000	488720
	Number of usable gates**	49190	61363	72460	88953	121651	153446	205200	293232
	Number of pads ^{Note}	340	380	412	452	524	588	676	804
Delay time	Internal gate	0.33 ns (fanout: 2, wiring length: 2 mm)							
	Power gate	0.21 ns (fanout: 2, wiring length: 2 mm)							
	Input buffer	0.71 ns (fanout: 2, wiring length: 2 mm)							
	Output buffer	1.44 ns ($C_L = 15$ pF)							
Output drive capability		$I_{OL} = 3, 6, 9, 12, 18, 24$ mA							
Supply voltage		3.3 V \pm 0.3 V							
Remark		* 2-input NAND conversion (1 cell = 1 gate) ** Cell utilization rate: 60 %							

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

Gate Array

CMOS Gate Array

■ CMOS-8L Family

● Available Models (3-layer wiring)

		μ PD65860	μ PD65861	μ PD65862	μ PD65863	μ PD65865	μ PD65866	μ PD65868	μ PD65869
Density	Number of integrated gates*	10912	20832	30192	40592	52528	61904	81984	102272
	Number of usable gates**	8184	15624	22644	30444	39396	46428	61488	76704
	Number of pads ^{Note}	164	204	212	244	276	300	340	380
Delay time	Internal gate	0.33 ns (fanout: 2, wiring length: 2 mm)							
	Power gate	0.21 ns (fanout: 2, wiring length: 2 mm)							
	Input buffer	0.71 ns (fanout: 2, wiring length: 2 mm)							
	Output buffer	1.44 ns ($C_L = 15$ pF)							
Output drive capability		$I_{OL} = 3, 6, 9, 12, 18, 24$ mA							
Supply voltage		3.3 V \pm 0.3 V							
Remark		* 2-input NAND conversion (1 cell = 1 gate) ** Cell utilization rate: 75 %							

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

		μ PD65870	μ PD65871	μ PD65872	μ PD65873	μ PD65875	μ PD65878
Density	Number of integrated gates*	120768	148256	202752	255744	342000	488720
	Number of usable gates**	90576	111192	152064	191808	256500	366540
	Number of pads ^{Note}	412	452	524	588	676	804
Delay time	Internal gate	0.33 ns (fanout: 2, wiring length: 2 mm)					
	Power gate	0.21 ns (fanout: 2, wiring length: 2 mm)					
	Input buffer	0.71 ns (fanout: 2, wiring length: 2 mm)					
	Output buffer	1.44 ns ($C_L = 15$ pF)					
Output drive capability		$I_{OL} = 3, 6, 9, 12, 18, 24$ mA					
Supply voltage		3.3 V \pm 0.3 V					
Remark		* 2-input NAND conversion (1 cell = 1 gate) ** Cell utilization rate: 75 %					

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

Gate Array**CMOS Gate Array****■ CMOS-8L Family****● Library**

I/O buffer	Function block	Memory block	Mega macro
Function	Function	Function	Function
3 V Input buffer Output buffer Bidirectional buffer PCI buffer 5 V (level shifter) Input buffer Output buffer Bidirectional buffer GTL D-PLL	Logic gate Buffer Inverter 3-state buffer Clock driver Delay Adder Decoder Multiplexer Latch Flip-flop Shift register Counter Others	High-speed single-port RAM High-speed dual-port RAM High-density single-port RAM ROM	DMA controller Serial interface unit Parallel interface unit Timer/counter Interrupt controller

Gate Array

CMOS Gate Array

■ CMOS-8L Family

● Characteristics

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{DD}	-0.5 to +4.6	V
Input/output voltage (3-V interface block)	V_I/V_O	-0.5 to +4.6	V
Input/output voltage (5-V interface block)	V_I/V_O	-0.5 to +6.6	V
Output current	I_O	3 ^{Note1}	mA
Output current	I_O	7 ^{Note2}	mA
Output current	I_O	10 ^{Note3}	mA
Output current	I_O	20 ^{Note4}	mA
Output current	I_O	30 ^{Note5}	mA
Output current	I_O	40 ^{Note6}	mA
Output current	I_O	60 ^{Note7}	mA
Output current	I_O	80 ^{Note8}	mA
Operating temperature	T_A	-40 to +85	°C
Storage temperature	T_{stg}	-65 to +150	°C

- Notes**
- I_{OL} (MIN.) = 1.0 mA type
 - I_{OL} (MIN.) = 2.0 mA type
 - I_{OL} (MIN.) = 3.0 mA type
 - I_{OL} (MIN.) = 6.0 mA type
 - I_{OL} (MIN.) = 9.0 mA type
 - I_{OL} (MIN.) = 12.0 mA type
 - I_{OL} (MIN.) = 18.0 mA type
 - I_{OL} (MIN.) = 24.0 mA type

Recommended Operating Conditions

Parameter	Symbol	$V_{DD} = 3.3V \pm 0.3V$		Unit
		MIN.	MAX.	
Supply voltage	V_{DD}	3.0	3.6	V
High-level input voltage (3-V interface block)	V_{IH}	2.0	V_{DD}	V
High-level input voltage (5-V interface block)	V_{IH}	2.0	5.5	V
Low-level input voltage (3-V interface block)	V_{IL}	0	0.8	V
Low-level input voltage (5-V interface block)	V_{IL}	0	0.8	V
Input rise time	t_r	0	200	ns
Input fall time	t_f	0	200	ns
Positive trigger voltage (3-V interface block)	V_P	1.70	2.70	V
Positive trigger voltage (5-V interface block)	V_P	2.20	2.55	V
Negative trigger voltage (3-V interface block)	V_N	0.60	1.20	V
Negative trigger voltage (5-V interface block)	V_N	0.84	1.01	V
Hysteresis voltage (3-V interface block)	V_H	1.10	1.50	V
Hysteresis voltage (5-V interface block)	V_H	1.36	1.54	V

Caution If any of the parameters exceeds the absolute maximum ratings, even momentarily, the quality of the product may be impaired. The absolute maximum ratings are values that may physically damage the product(s). Be sure to use the product(s) within the ratings.

DC Characteristics

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Static current consumption	I_{DDs}				300	μA
Off-state output leakage current	I_{OZ}				± 18	μA
Output short-circuit current	I_{OS}				-250	mA
Input leakage current	Normal input	I_I $V_I = V_{DD}$ or GND		$\pm 10^{-5}$	± 10	μA
	with pull-up (50 k Ω)	I_I $V_I = GND$	-10	-40	-80	μA
	with pull-up (5 k Ω)	I_I $V_I = GND$	-130	-350	-640	μA
	with pull-down (50 k Ω)	I_I $V_I = V_{DD}$	30	65	130	μA
High-level output voltage (3-V interface block)	V_{OH}	$I_{OH} = 0$ mA	$V_{DD} - 0.1$			V
High-level output voltage (5-V interface block)	V_{OH}	$I_{OH} = 0$ mA	$V_{DD} - 0.2$			V
Low-level output voltage	V_{OL}	$I_{OL} = 0$ mA			0.1	V

- Remark 1.** The above values are under the recommended operating conditions shown above. For details, refer to the **Design Manual**.
2. Blank indicates value is under study.

Gate Array

CMOS Gate Array

■ **CMOS-9HD Family**

● **Features**

The CMOS-9HD family is a collection of channel-less gate arrays employing a 0.35- μm technology. This family consists of 10 masters with 75K to 1.6M gates.

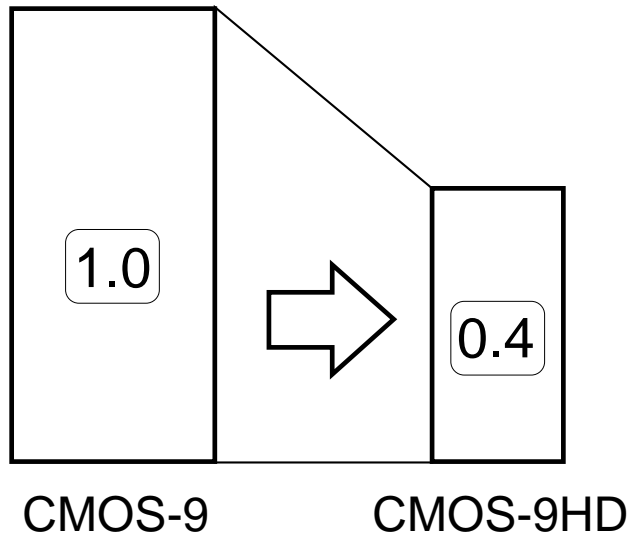
The most outstanding feature of this family is the scale of integration.

The gate density of this family is about 2.5 times higher than that of the existing CMOS-9 family 0.35- μm gate arrays, thanks to improvement of the cell structure.

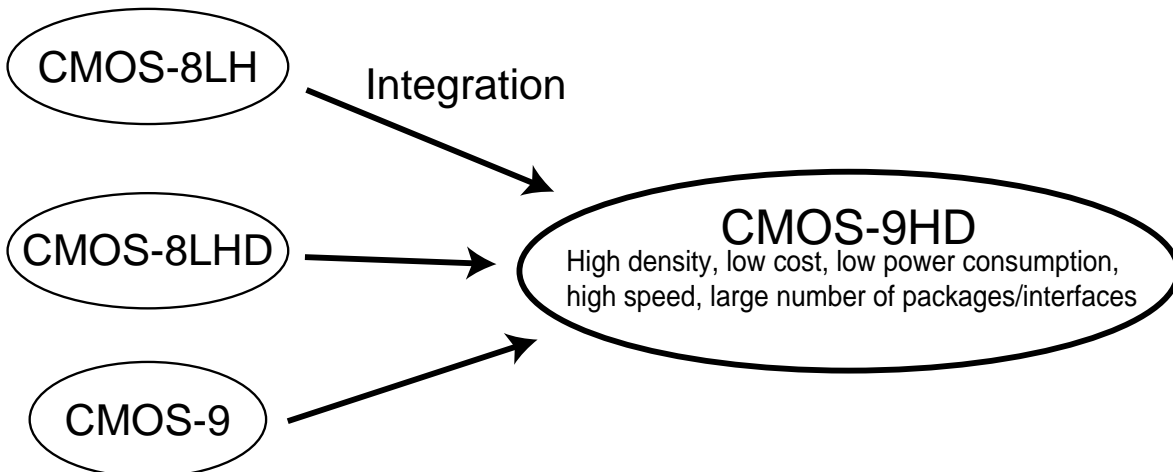
In addition, the power consumption is 30 % lower, and thanks to new I/O pad layout technology, this family offers a large number of pins in addition to the high density.

Conventional (CMOS-9)

Gate density: 2.5 times higher
Power consumption: 30% lower



Conventional



Gate Array

CMOS Gate Array

■ CMOS-9HD Family

● Available Models (3-layer wiring)

		μ PD65943	μ PD65944	μ PD65945	μ PD65946	μ PD65948	μ PD65949	μ PD65951	μ PD65954	μ PD65956	μ PD65958
Density	Internal gates*	75740	100602	128338	202630	312684	437136	585390	835664	1096452	1615646
	Number of usable gates**	53018	70421	89836	141841	218878	305995	351234	501398	657871	969387
	Number of pads ^{Note}	172	196	216	268	324	380	436	516	588	708
Delay time	Internal gate	131 ps (2-input NAND, fanout: 1, standard wiring length)									
	Power gate	107 ps (2-input NAND, fanout: 1, standard wiring length)									
	Input buffer	229 ps (fanout: 2, standard wiring length)									
	Output buffer	1396 ps ($C_L = 15$ pF, $I_{OL} = 9$ mA)									
Output drive capability		$I_{OL} = 1, 2, 3, 6, 9, 12, 18, 24$ mA									
Supply voltage		3.3 V \pm 0.3 V									
Remark		* 2-input NAND conversion ** Cell utilization rate: 70 % (60 % in the largest four masters)									

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

● Library

I/O buffer	Function block	Memory block	Mega macro (under development)
Function	Function	Function	Function
3 V Input buffer Output buffer Bidirectional buffer PCI buffer Low-noise buffer Fail-safe buffer 5 V (level shifter) Input buffer Output buffer Bidirectional buffer GTL (under development) D-PLL (under development)	Logic gate Buffer Inverter 3-state buffer Clock driver Delay Adder Decoder Multiplexer Latch Flip-flop Shift register Counter Others	High-speed single-port RAM High-speed dual-port RAM	DMA controller Serial interface unit Parallel interface unit Timer/counter Interrupt controller

Gate Array

CMOS Gate Array

■ CMOS-9HD Family

● Characteristics (1/5)

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V_{DD}		-0.5 to +4.6	V
Input voltage				
3-V input buffer	V_i	$V_i < V_{DD} + 0.5 \text{ V}$	-0.5 to +4.6	V
3-V input buffer with fail-safe function	V_i	$V_i < V_{DD} + 0.5 \text{ V}$	-0.5 to +4.6	V
5-V input buffer	V_i	$V_i < V_{DD} + 0.5 \text{ V}$	-0.5 to +6.6	V
Output voltage				
3-V output buffer	V_o	$V_o < V_{DD} + 0.5 \text{ V}$	-0.5 to +4.6	V
TTL 5-V output buffer	V_o	$V_o < V_{DD} + 3.0 \text{ V}$	-0.5 to +6.6	V
CMOS 5-V output buffer	V_o	$V_o < V_{DD} + 3.0 \text{ V}$	-0.5 to +6.6	V
Output current ^{Note}	I_o	$I_{OL} = 1 \text{ mA(FV0B)}$	3	mA
		$I_{OL} = 2 \text{ mA(FV0B)}$	7	mA
		$I_{OL} = 3 \text{ mA(FO09,FV09)}$	10	mA
		$I_{OL} = 6 \text{ mA(FO04,FV04)}$	20	mA
		$I_{OL} = 9 \text{ mA(FO01,FV01)}$	30	mA
		$I_{OL} = 12 \text{ mA(FO02)}$	40	mA
		$I_{OL} = 18 \text{ mA(FO03)}$	60	mA
		$I_{OL} = 24 \text{ mA(FO06)}$	75	mA
Operating temperature	T_A		-40 to +85	°C
Storage temperature	T_{stg}		-65 to +150	°C

Note Input current: Maximum value of current that can flow via input protection diode. Output current: Maximum DC current that can flow through output pin

Caution If any of the parameters exceeds the absolute maximum ratings, even momentarily, the quality of the product may be impaired. The absolute maximum ratings are values that may physically damage the product(s). Be sure to use the product(s) within the ratings.

Remark Apart from the buffer with the fail-safe function, apply 5 V or 3 V to the I/O pin after the supply voltage has been stabilized.

Gate Array

CMOS Gate Array

■ CMOS-9HD Family

● Characteristics (2/5)

Recommended Operating Conditions

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	
Supply voltage	V_{DD}		3.00	3.30	3.60	V	
High-level input voltage	V_{IH}	<ul style="list-style-type: none"> • LVTTL interface buffer • LVTTL interface buffer with fail-safe function 	2.00		V_{DD}	V	
Low-level input voltage	V_{IL}		0		0.80	V	
Positive trigger voltage	V_P		Schmitt input	1.50		2.70	V
Negative trigger voltage	V_N			0.60		1.40	V
Hysteresis voltage	V_H			1.10		1.50	V
High-level input voltage	V_{IH}		<ul style="list-style-type: none"> • TTL 5-V tolerant interface buffer • 5-V input buffer 	2.00		5.50	V
Low-level input voltage	V_{IL}	0			0.80	V	
Positive trigger voltage	V_P	Schmitt input		2.20		2.55	V
Negative trigger voltage	V_N			0.84		1.01	V
Hysteresis voltage	V_H			1.36		1.54	V
Input rise time	t_{ri}	Normal input		0		200	ns
Input fall time	t_{fi}		0		200	ns	
Input rise time	t_{ri}	Schmitt input ^{Note}	0		10	ms	
Input fall time	t_{fi}		0		10	ms	

Note Do not use this for the clock.

Remark If a signal with a long rise/fall time is input, use a Schmitt trigger input buffer to prevent malfunctioning due to noise superimposed on the signal line.

Fluctuation of power caused by simultaneous operation of output buffers lower the capability of the Schmitt trigger input buffer, and therefore, care must be exercised in laying out the pins.

Gate Array

CMOS Gate Array

■ CMOS-9HD Family

● Characteristics (3/5)

The following values are under the recommended operating conditions shown above. For details, refer to the **Design Manual**.

DC Characteristics (1/3)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Static current consumption ^{Note1}						
μ PD65943, 65944, 65945	I_{DD5}	$V_I = V_{DD}$ or GND		2.0	300	μA
μ PD65946, 65948, 65949	I_{DD5}	$V_O = V_{DD}$ or GND		0	400	μA
μ PD65951, 65954, 65956	I_{DD5}	$V_O = V_{DD}$ or GND		4.0	800	μA
Off-state output leakage current ^{Note2}						
3-V output	I_{OZ}	$V_O = V_{DD}$ or GND			± 10	μA
TTL 5-V output	I_{OZ}	$V_O = V_{DD}$ or GND			± 10	μA
CMOS 5-V output	I_{OZ}	$V_O = V_{DD}$ or GND			± 10	μA
Output sink current ^{Note3}						
CMOS 5-V output	I_R	$V_{PU} = 5.5 V$ $R_{PU} = 2 k\Omega$ $V_O = 3.0 V$			10	μA
Output short-circuit current ^{Note4}						
	I_{OS}	$V_O = GND$			-250	mA
Input leakage current						
Normal input	I_I	$V_I = V_{DD}$ or GND			± 1.0	μA
With pull-up resistor (50 k Ω)	I_I	$V_I = GND$	28	83	190	μA
With pull-up resistor (5 k Ω)	I_I	$V_I = GND$	280	700	1900	μA
With pull-down resistor (50 k Ω)	I_I	$V_I = V_{DD}$	28	83	190	μA
Pull-up resistor (50 k Ω) ^{Note5}	R_{PU}		18.9	39.8	107.1	k Ω
Pull-up resistor (5 k Ω) ^{Note5}	R_{PU}		1.9	4.7	10.7	k Ω
Pull-down resistor (50 k Ω) ^{Note5}	R_{PD}		18.9	39.8	107.1	k Ω

Notes 1. The static current consumption increases when an I/O block with pull-up/pull-down resistor is used.

2. The output off-state current of the TTL and CMOS 5-V 3-state buffer and I/O buffer slightly increases because of the bias of the 5-V protection circuit.

3. A sink current flows from the output pin to the internal circuit of the LSI if the TTL and CMOS 5-V output buffer are pulled up at a voltage higher than the supply voltage of the LSI.

4. The output short-circuit time is 1 second or less for only 1 pin of the LSI.

5. The pull-up resistance and pull-down resistance vary depending on the input and output voltages.

Remark The + and - symbols next to the current values in the above figure indicate the direction of the current. Current flowing into the device is indicated by + and current flowing out is indicated by -.

Note that the CMOS 5-V tolerant output buffer cannot output a DC high level because of its structure.

Gate Array

CMOS Gate Array

■ CMOS-9HD Family

● Characteristics (4/5)

DC Characteristics (2/3)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Low-level output current ^{Note1}						
3-V output type						
3.0-mA type FO09	I_{OL}	$V_{OL} = 0.4 \text{ V}$	3.00 ^{Note2}			mA
6.0-mA type FO04	I_{OL}	$V_{OL} = 0.4 \text{ V}$	6.00			mA
9.0-mA type FO01	I_{OL}	$V_{OL} = 0.4 \text{ V}$	9.00			mA
12.0-mA type FO02	I_{OL}	$V_{OL} = 0.4 \text{ V}$	12.00			mA
18.0-mA type FO03	I_{OL}	$V_{OL} = 0.4 \text{ V}$	18.00			mA
24.0-mA type FO06	I_{OL}	$V_{OL} = 0.4 \text{ V}$	24.00			mA
Low-level output current ^{Note1}						
TTL 5-V output						
1.0-mA type FV0A	I_{OL}	$V_{OL} = 0.4 \text{ V}$	1.00			mA
2.0-mA type FV0B	I_{OL}	$V_{OL} = 0.4 \text{ V}$	2.00			mA
3.0-mA type FV09	I_{OL}	$V_{OL} = 0.4 \text{ V}$	3.00			mA
6.0-mA type FV04	I_{OL}	$V_{OL} = 0.4 \text{ V}$	6.00			mA
9.0-mA type FV01	I_{OL}	$V_{OL} = 0.4 \text{ V}$	9.00			mA
12.0-mA type FV02	I_{OL}	$V_{OL} = 0.4 \text{ V}$	12.00			mA
18.0-mA type FV03	I_{OL}	$V_{OL} = 0.4 \text{ V}$	18.00			mA
24.0-mA type FV06	I_{OL}	$V_{OL} = 0.4 \text{ V}$	24.00			mA
Low-level output current ^{Note1}						
CMOS 5-V output						
3.0-mA type FY09	I_{OL}	$V_{OL} = 0.4 \text{ V}$	3.00			mA
6.0-mA type FY04	I_{OL}	$V_{OL} = 0.4 \text{ V}$	6.00			mA
9.0-mA type FY01	I_{OL}	$V_{OL} = 0.4 \text{ V}$	9.00			mA
12.0-mA type FY02	I_{OL}	$V_{OL} = 0.4 \text{ V}$	12.00			mA
18.0-mA type FY03	I_{OL}	$V_{OL} = 0.4 \text{ V}$	18.00			mA
24.0-mA type FY06	I_{OL}	$V_{OL} = 0.4 \text{ V}$	24.00			mA

Notes 1. The specifications of the buffers with the same driving capabilities are the same.

2. 2.00 mA for type with 5-k Ω pull-up resistor

Remark The + and – symbols next to the current values in the above figure indicate the direction of the current. Current flowing into the device is indicated by + and current flowing out is indicated by –.

Note that the CMOS 5-V tolerant output buffer cannot output a DC high level because of its structure.

Gate Array

CMOS Gate Array

■ CMOS-9HD Family

● Characteristics (5/5)

DC Characteristics (3/3)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
High-level output current ^{Note}						
3-V output type						
3.0-mA type FO09	I_{OH}	$V_{OH} = 2.4\text{ V}$	-3.00			mA
6.0-mA type FO04	I_{OH}	$V_{OH} = 2.4\text{ V}$	-6.00			mA
9.0-mA type FO01	I_{OH}	$V_{OH} = 2.4\text{ V}$	-9.00			mA
12.0-mA type FO02	I_{OH}	$V_{OH} = 2.4\text{ V}$	-12.00			mA
18.0-mA type FO03	I_{OH}	$V_{OH} = 2.4\text{ V}$	-18.00			mA
24.0-mA type FO06	I_{OH}	$V_{OH} = 2.4\text{ V}$	-24.00			mA
High-level output current ^{Note}						
TTL 5-V output						
1.0-mA type FV0A	I_{OH}	$V_{OH} = 2.4\text{ V}$	-1.00			mA
2.0-mA type FV0B	I_{OH}	$V_{OH} = 2.4\text{ V}$	-1.00			mA
3.0-mA type FV09	I_{OH}	$V_{OH} = 2.4\text{ V}$	-3.00			mA
6.0-mA type FV04	I_{OH}	$V_{OH} = 2.4\text{ V}$	-3.00			mA
9.0-mA type FV01	I_{OH}	$V_{OH} = 2.4\text{ V}$	-3.00			mA
12.0-mA type FV02	I_{OH}	$V_{OH} = 2.4\text{ V}$	-3.00			mA
18.0-mA type FV03	I_{OH}	$V_{OH} = 2.4\text{ V}$	-6.00			mA
24.0-mA type FV06	I_{OH}	$V_{OH} = 2.4\text{ V}$	-6.00			mA
Low-level output current ^{Note}						
3-V output type	V_{OL}	$I_{OL} = 0\text{ mA}$				
3-V output type (with 5-k Ω pull-up resistor)	V_{OL}	$I_{OL} = 0\text{ mA}$			0.1	V
TTL 5-V output	V_{OL}	$I_{OL} = 0\text{ mA}$			0.1	V
CMOS 5-V output	V_{OL}	$I_{OL} = 0\text{ mA}$			1	V
High-level output voltage						
3-V output type	V_{OH}	$I_{OH} = 0\text{ mA}$	$V_{DD} - 0.1$			V
TTL 5-V output	V_{OH}	$I_{OH} = 0\text{ mA}$	$V_{DD} - 0.2$			V

Note The specifications of the buffers with the same driving capabilities are the same.

Remark The + and – symbols next to the current values in the above figure indicate the direction of the current. Current flowing into the device is indicated by + and current flowing out is indicated by –.

Note that the CMOS 5-V tolerant output buffer can not output a DC high level because of its structure.

Gate Array

BiCMOS Gate Array

■ QB-8 Family

● Features

The QB-8 family is a collection of BiCMOS gate arrays that offer high speed, low power consumption, and high density, and a price comparable to CMOS devices through the use of an innovative cell structure and technology, radically changing the image of conventional BiCMOS gate arrays.

These gate arrays help increase the speed and decrease the power consumption of many electronic systems such as office machines and communications equipment.

High-speed operation

- Internal gate
 - $t_{PD} = 107$ ps (2-input NAND, fanout: 1, wiring length: 0 mm)
 - $t_{PD} = 191$ ps (2-input NAND, fanout: 2, wiring length: 2 mm)
- Power gate
 - $t_{PD} = 142$ ps (2-input NAND, fanout: 2, wiring length: 2 mm)

Super low power consumption

$1.09 \mu\text{W} =$ (per gate, $V_{DD} = 3.3$ V at 1 MHz)

Function block

Compatible with CMOS-8L family

Many high-speed interfaces

Maximum operating output frequency

- | | |
|----------|---------|
| • LVTTTL | 100 MHz |
| • GTL | 200 MHz |
| • PECL | 250 MHz |
| • PCI | 66 MHz |
| • HSTL | 250 MHz |
| • LVDS | 300 MHz |

Gate Array

BiCMOS Gate Array

■ QB-8 Family

● Available Models

		μ PD67821	μ PD67822	μ PD67823	μ PD67824	μ PD67825	μ PD67826
Density	Number of integrated gates*	32832	44352	56800	69520	93184	123808
	Number of usable gates**	22982	31046	39760	48664	65229	86666
	Number of pads ^{Note}	180	204	228	240	284	324
Delay time	Internal gate	107 ps (fanout: 1, wiring length: 0 mm), 191 ps (fanout: 2, wiring length: 2 mm)					
	Power gate	142 ps (fanout: 2, wiring length: 2 mm)					
	Input buffer	289 ps (fanout: 2, wiring length: 2 mm)					
	Output buffer	1.64 ns (load: 15 pF, $I_{OL} = 18$ mA)					
Supply voltage		3.3V \pm 0.3V					
Output drive capability		$I_{OL} = 1, 2, 3, 6, 9, 12, 18, 24$ mA					
I/O interface level		LVTTTL, TTL, GTL, HSTL, PECL, PCI					
Remark		* 2-input NAND conversion **Cell utilization rate: 70 %					

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

		μ PD67827	μ PD67828	μ PD67829	μ PD67830	μ PD67831
Density	Number of integrated gates*	136752	167280	234280	292896	381840
	Number of usable gates**	95726	117096	164024	205027	267288
	Number of pads ^{Note}	340	372	436	484	548
Delay time	Internal gate	107 ps (fanout: 1, wiring length: 0 mm), 191 ps (fanout: 2, wiring length: 2 mm)				
	Power gate	142 ps (fanout: 2, wiring length: 2 mm)				
	Input buffer	289 ps (fanout: 2, wiring length: 2 mm)				
	Output buffer	1.64 ns (load: 15 pF, $I_{OL} = 18$ mA)				
Supply voltage		3.3 V \pm 0.3 V				
Output drive capability		$I_{OL} = 1, 2, 3, 6, 9, 12, 18, 24$ mA				
I/O interface level		LVTTTL, TTL, GTL, HSTL, PECL, PCI				
Remark		* 2-input NAND conversion **Cell utilization rate: 70 %				

Note Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of the package.

Gate Array

BiCMOS Gate Array

■ QB-8 Family

● Library

I/O buffer	Function block	Memory block	Mega macro (under development)
Function	Function	Function	Function
3 V Input buffer Output buffer Bidirectional buffer PCI buffer HSTL buffer Low-noise buffer Fail-safe buffer 5 V (level shifter) Input buffer GTL PECL LVDS	Logic gate Buffer Inverter 3-state buffer Clock driver Delay Adder Decoder Multiplexer Latch Flip-flop Shift register Counter Others	High-speed single-port RAM High-speed dual-port RAM High-density single-port RAM High-density dual-port RAM	DMA controller Serial interface unit Parallel interface unit Timer/counter Interrupt controller

Gate Array

BiCMOS Gate Array

■ QB-8 Family

● Characteristics (1/2)

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V_{DD}		-0.5 to +4.6	V
Input voltage				
3-V input buffer	V_i	$V_i < V_{DD} + 0.5 \text{ V}$	-0.5 to +4.6	V
3-V input buffer with fail-safe function	V_i	$V_i < V_{DD} + 0.5 \text{ V}$	-0.5 to +4.6	V
5-V input buffer	V_i	$V_i < V_{DD} + 0.5 \text{ V}$	-0.5 to +6.6	V
Output voltage				
3-V output buffer	V_o	$V_o < V_{DD} + 0.5 \text{ V}$	-0.5 to +4.6	V
5-V output buffer	V_o	$V_o < V_{DD} + 3.0 \text{ V}$	-0.5 to +6.6	V
Output current ^{Note}	I_o	$I_{OL} = 1 \text{ mA (FV0A)}$	3	mA
		$I_{OL} = 2 \text{ mA (FV0B)}$	7	mA
		$I_{OL} = 3 \text{ mA (FO09, FV09, FW09)}$	10	mA
		$I_{OL} = 6 \text{ mA (FO04, FV04, FW04)}$	20	mA
		$I_{OL} = 9 \text{ mA (FO01)}$	30	mA
		$I_{OL} = 12 \text{ mA (FO02)}$	40	mA
		$I_{OL} = 18 \text{ mA (FO03)}$	60	mA
		$I_{OL} = 24 \text{ mA (FO06)}$	80	mA
Operating temperature	T_A		-40 to +85	°C
Storage temperature	T_{stg}		-65 to +150	°C

Note Output current: Maximum DC current that can flow through output pin

Caution If any of the parameters exceeds the absolute maximum ratings, even momentarily, the quality of the product may be impaired. The absolute maximum ratings are values that may physically damage the product(s). Be sure to use the product(s) within the ratings.

Remark Apart from the buffer with the fail-safe function, apply 5 V or 3 V to the I/O pin after the supply voltage has been stabilized.

Recommended Operating Conditions

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{DD}		3.00	3.30	3.60	V
High-level input voltage	V_{IH}	3-V interface	2.00		V_{DD}	V
Low-level input voltage	V_{IL}		0		0.80	V
Positive trigger voltage	V_P		1.50		2.70	V
Negative trigger voltage	V_N		0.60		1.40	V
Hysteresis voltage	V_H		1.10		1.50	V
High-level input voltage	V_{IH}		5-V interface	2.00		5.50
Low-level input voltage	V_{IL}	0			0.80	V
Positive trigger voltage	V_P	2.20			2.25	V
Negative trigger voltage	V_N	0.84			1.01	V
Hysteresis voltage	V_H	1.36			1.54	V
Input rise time	t_{ri}	Normal input		0		200
Input fall time	t_{fi}		0		200	ns
Input rise time	t_{ri}	Schmitt input ^{Note}	0		10	ms
Input fall time	t_{fi}		0		10	ms

Note Do not use this for the clock.

Gate Array

BiCMOS Gate Array

■ QB-8 Family

● Characteristics (2/2)

DC Characteristics

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Static current consumption						
μ PD67830,67831	I_{DDS}	$V_i = V_{DD}$ or GND		15	4800	μ A
μ PD67827,67828,67829				9	3000	μ A
μ PD67824,67825,67826				5	1500	μ A
μ PD67821,67822,67823				2	700	μ A
Off-state output current						
3-V output	I_{OZ}	$V_o = V_{DD}$ or GND			± 10	μ A
5-V output	I_{OZ}	$V_o = V_{DD}$ or GND			± 14	μ A
Output sink current 5-V output	I_R	$V_{PU} = 5.5$ V $R_{PU} = 2$ k Ω $V_o = 3.0$ V			14	μ A
Output short-circuit current	I_{OS}	$V_o =$ GND			-250	mA
Input leakage current						
Normal input	I_i	$V_i = V_{DD}$ or GND			± 10	μ A
with pull-up resistor (50 k Ω)	I_i	$V_i =$ GND	-30	-66	-144	μ A
with pull-up resistor (5 k Ω)	I_i	$V_i =$ GND	-300	-660	-1440	μ A
with pull-down resistor (50 k Ω)	I_i	$V_i = V_{DD}$	30	66	144	μ A
High-level output voltage						
3-V output	V_{OH}	$I_{OH} = 0$ mA	$V_{DD} - 0.1$			V
5-V output	V_{OH}	$I_{OH} = 0$ mA	$V_{DD} - 0.2$			V
Low-level output voltage						
3-V output	V_{OL}	$I_{OL} = 0$ mA			0.1	V
5-V output	V_{OL}	$I_{OL} = 0$ mA			0.1	V

Remarks 1. The above values are under the recommended operating conditions shown above.

For details, refer to the **Design Manual**.

2. Blank indicates values are under study.

Cell-Based IC

■ **Cell-Based IC Line-Up (1/2)**

A cell-based IC is an LSI that is designed combining large-scale macros such as existing CPU and memories, and user's own circuits. Because its internal logic cells are optimally designed according to their functions, a large scale of integration with low current consumption can be realized even if the circuit consists of only logic, as compared with gate arrays.

In addition, a system-on-chip that integrates a high-performance CPU core with analog macros such as A/D and D/A converters can be realized.

Many families available

Families are available for each technology.

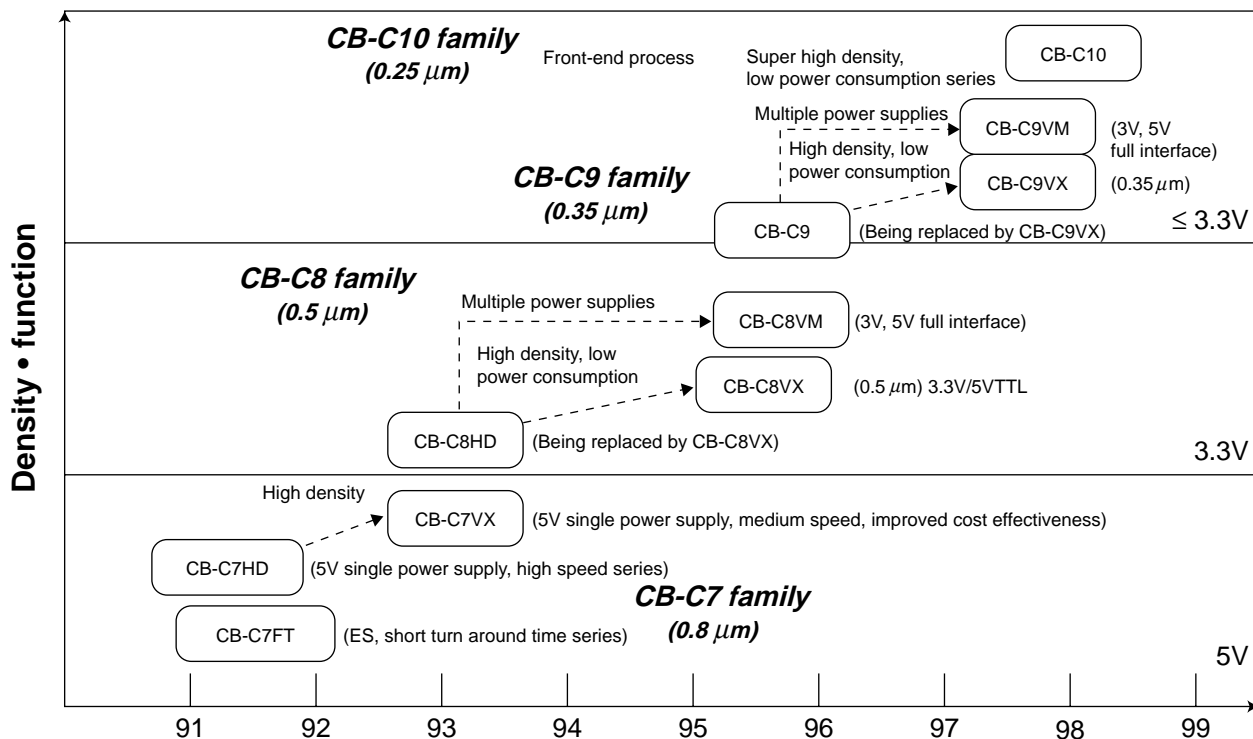
- 0.8 μ m CMOS family :CB-C7 family (HD/FT/VX type)
- 0.5 μ m CMOS family :CB-C8 family (VX/VM type)
- 0.35 μ m CMOS family :CB-C9 family (VX/VM type)
- 0.25 μ m CMOS family :CB-C10 family

The CB-C8 family VM type and CB-C9 family VM type can easily interface with 5-V and 3.3-V signals by using a buffer with level shifter in a system where 5 V and 3.3 V are used together.

The CB-C9 family VX type internally operates at 2.0 V and has a 3.3-V interface, and is ideal for portable systems where low power consumption is required, such as cellular telephones.

The CB-C10 family can internally operate at 2.5 V and have a 2.5 or 3.3 V interface to allow larger-scale systems with lower power consumption. (For details of the CB-C10 family, refer to the description in the section titled 0.25 μ m ASIC in this pamphlet.)

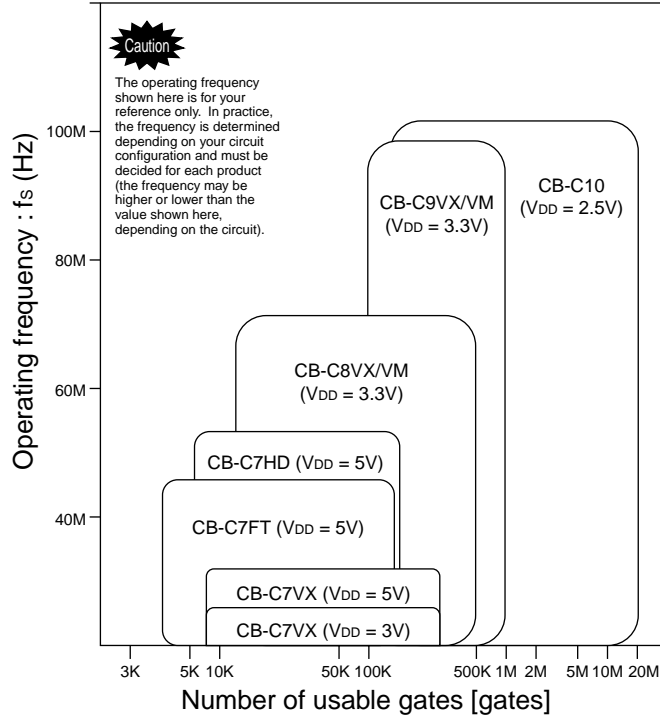
Series development of Cell-Based ICs



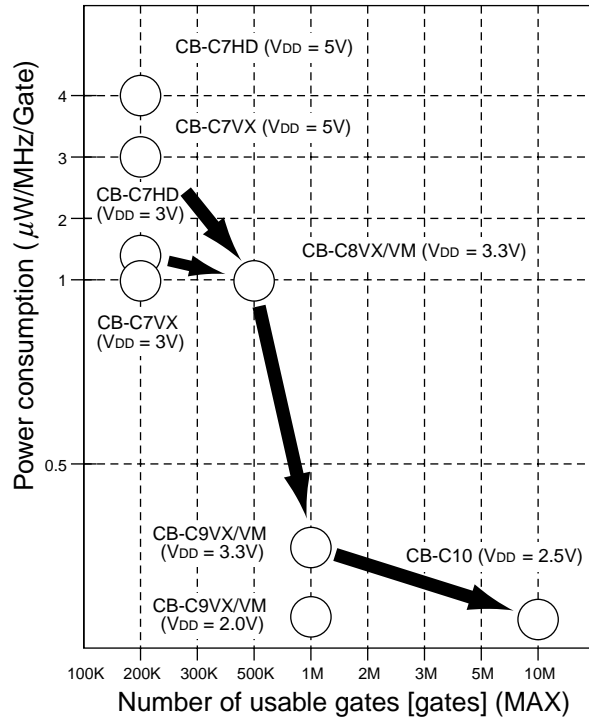
Cell-Based IC

■ Cell-Based IC Line-Up (2/2)

Comparison of performance of each series

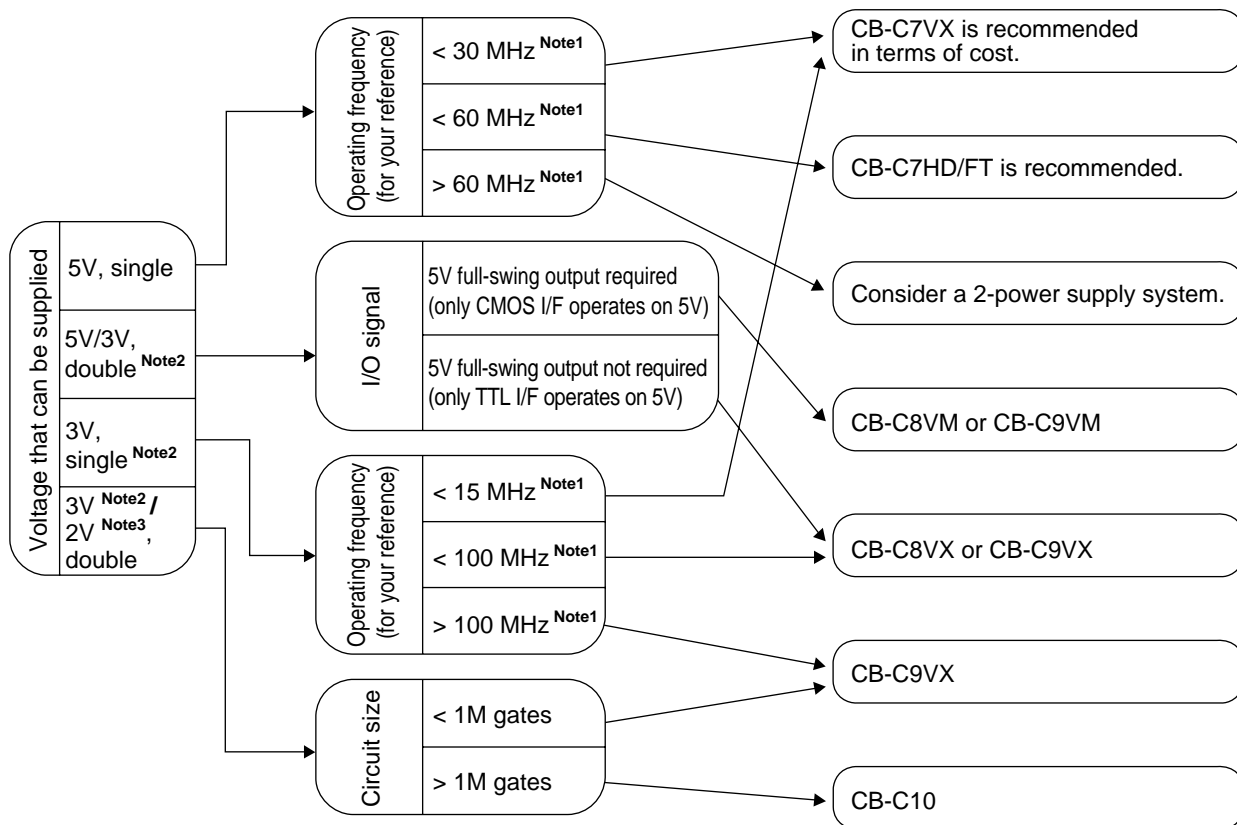


Transition of power consumption



Cell-Based IC

■ Guide to Selecting Cell-Based ICs



Notes 1. The values of the operating frequency shown above are for your reference only. In practice, the value of the operating frequency varies depending on your circuit configuration.

- 2.** CB-C7, 3V: $V_{DD} = 3.0\text{ V} \pm 0.3\text{ V}$
CB-C8VX/VM, CB-C9VX/VM, CB-C10: $V_{DD} = 3.3\text{ V} \pm 0.3\text{ V}$
- 3.** CB-C9VX, 2V: $V_{DD} = 2.0\text{ V} \pm 0.2\text{ V}$
CB-C10: $V_{DD} = 2.5\text{ V} \pm 0.2\text{ V}$

Many cores available

The need for system-on-chip is satisfied by CPU peripheral cores, memory macros, and analog masters such as A/D and D/A, as well as a high-performance CPU.

High-density memory macros, RAM and ROM, can be integrated by means of the memory compiled method.

Cell-Based IC

■ **CB-C7 Family**

● **Features**

Three types available

FT type : Short turn around time realized by gate array method (substrate is developed first)

HD type : High speed and high density by employing dedicated cells

VX type^{Note} : Super high density by employing dedicated cells and small transistors

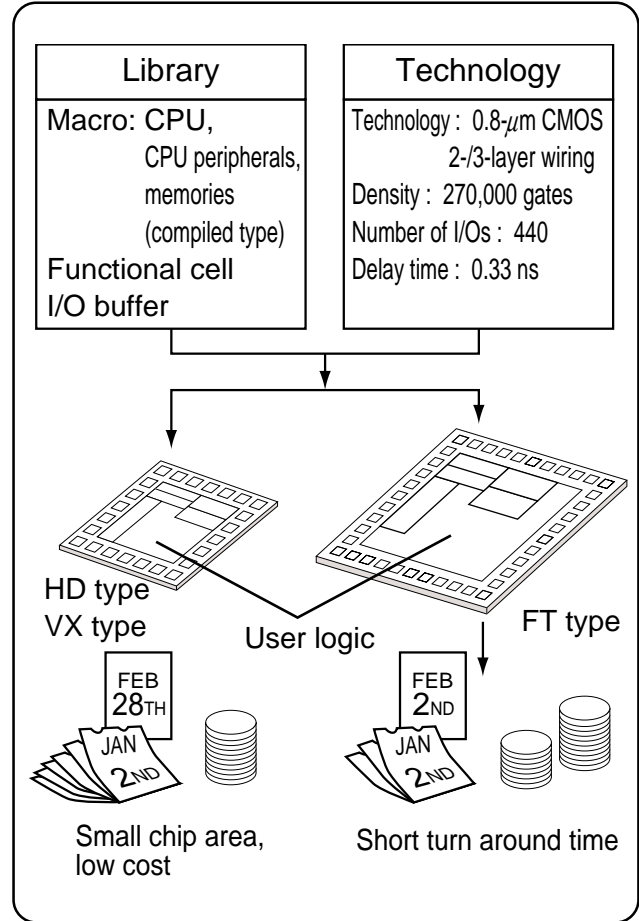
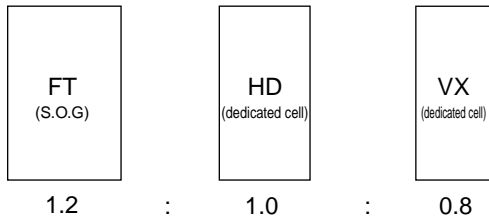
Note The applications of the VX type are limited.

FT vs. HD vs. VX selection

• **Comparison of features of each type**

	FT	HD	VX
Turn around time	◎	○	○
Speed	○	◎	△
Density	△	○	◎
Power consumption	○	○	◎

• **Comparison of cell area (average of all blocks)**



Cell-Based IC

■ CB-C7 Family

● Product Outline

Type name		FT type/HD type/VX type			
Part number		μ PD93000	μ PD94000	μ PD95100	μ PD96100
CPU, peripherals		—			O
Derivative models ^{Note 1}		—	O	—	O
Supply voltage		5 V \pm 10 %, 3 V \pm 10 %			
Interface level		CMOS, TTL compatible			
Number of usable gates ^{Note 2}		FT: 167K gates (MAX.)/HD: 223K gates (MAX.)/VX: 273K gates (MAX.)			
Delay time	Internal gate	FT,HD : 0.33ns ^{Note 3} /0.44ns(5V), 0.67ns ^{Note 3} /0.90ns(3V) [F/O=2,L=2mm] VX : 0.90ns ^{Note 3} /2.10ns(5V), 1.54ns ^{Note 3} /3.42ns(3V) [F/O=2,L=2mm]			
	Input buffer	FT,HD : 0.60 ns(5 V), 0.76 ns(3 V) [F/O = 2, L = 2 mm] VX : 1.25 ns(5 V), 2.18 ns(3 V) [F/O = 2, L = 2 mm]			
	Output buffer	FT,HD : 1.6 ns(5 V, _{loL} = 8 mA), 3.0 ns(3 V, _{loL} = 4.4 mA) [C _L = 15 pF] VX : 1.7 ns(5 V, _{loL} = 8 mA), 3.0 ns(3 V, _{loL} = 4.4 mA) [C _L = 15 pF]			
Power consumption (internal gate)		FT,HD : 3.90 μ W/MHz/gate(5 V), 1.41 μ W/MHz/gate(3 V) VX : 3.21 μ W/MHz/gate(5 V), 1.17 μ W/MHz/gate(3 V)			
Output drive capability		_{loL} = 4,8,12,24,48 mA(5 V) _{loL} = 2.2,4.4,6.6 mA(3 V)			

- Notes**
1. ROM code changeable. O: Derivative models available, —: No derivative models available
 2. Number of gates if hard macro is not integrated (2-input NAND gate conversion)
 3. Power gate

Cell-Based IC

■ CB-C8 Family VX/VM Type

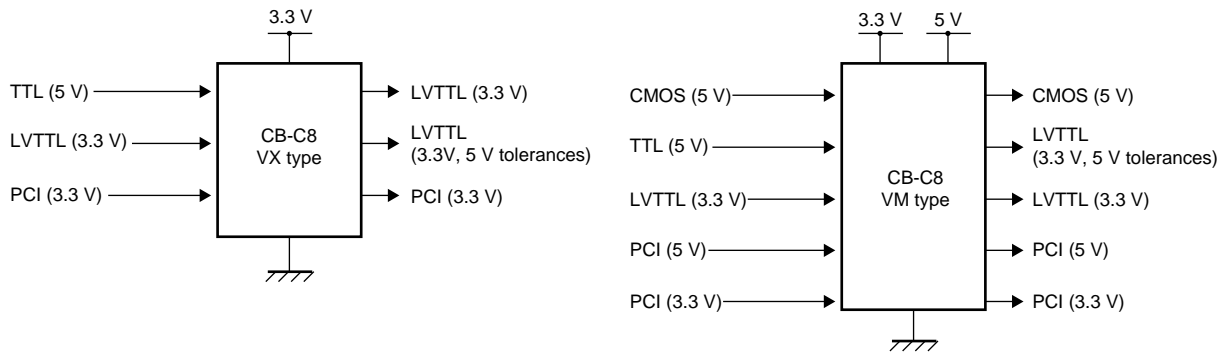
● Features

High-density, power-saving type and 2-power supply type available

VX type : Density 1.5 times (MAX.) higher and power consumption 20% lower than existing type

VM type : 2-power supply full-swing interface in system where 5-V and 3.3-V power sources are used together

Interface level



● Product Outline (VX/VM type)

Type name	VX type	VM type
Part number	μ PD97000	μ PD99000
Derivative models ^{Note 1}	O	O
Technology	0.5 μ m rule CMOS (Ti silicide), aluminum 2-layer/3-layer wiring	
Supply voltage	3.3V \pm 0.3V, single	Internal: 3.3 V \pm 0.3 V I/O block: 5 V \pm 10%, 3.3 V \pm 0.3 V
Interface level	LVTTTL (including 5 V tolerance)	5 V CMOS/TTL LVTTTL (including 5 V tolerance)
Number of usable gates ^{Note 2}	1000K gates (MAX.)	
Delay time	Internal gate	0.16 ns ^{Note 3} /0.34 ns [F/O = 2, L = 1mm]
	Input buffer	3.3-V LVTTTL: 0.26 ns [F/O = 2, L = 1 mm] 5-V tolerant LVTTTL: 0.33 ns [F/O = 2, L = 1 mm] 5-V full swing: 0.72 ns [F/O = 2, L = 1 mm]
	Output buffer	3.3-V LVTTTL: 1.24 ns (I _{OL} = 9 mA) [C _L = 15 pF] 5-V tolerant LVTTTL: 1.88 ns (I _{OL} = 9 mA) [C _L = 15 pF] 5-V full swing: 2.30 ns (I _{OL} = 9 mA) [C _L = 15 pF]
Power consumption (internal gate)	Standard block (F, L blocks): 1.04 μ W/MHz/gate (3.3 V) Low power consumption block (Y block): 0.75 μ W/MHz/gate (3.3 V)	
Output drive capability	I _{OL} = 3, 6, 9, 12, 18, 24 mA [for 3-V interface] I _{OL} = 1, 2, 3, 6, 9 mA [for 5-V interface (5 V tolerance)]	
	—	I _{OL} = 1, 2, 3, 6, 9, 12, 18 mA [for 5-V full swing]

Notes 1. ROM code changeable. O: Derivative models available

2. Number of gates if hard macro is not integrated [2-input NAND gate conversion]

3. 2 NAND power gate

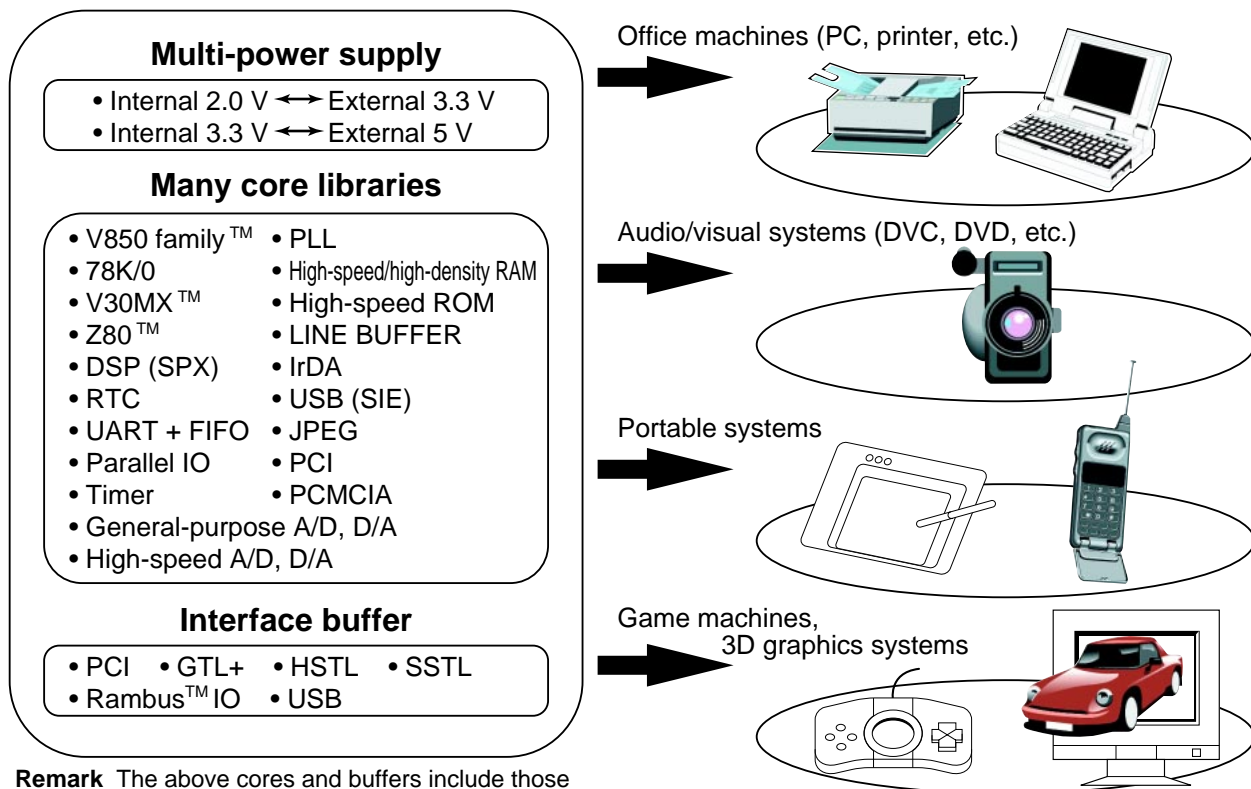
Cell-Based IC

■ CB-C9 Family VX/VM Type

● Features

The CB-C9 family VX/VM type is a collection of cell-based ICs employing a 0.35- μm technology. The VX type realizes an I/O voltage of 3.3 V and internal voltage of 2.0 V, and the VM type realizes an I/O voltage of 5 V and internal voltage of 3.3 V. These cell-based ICs are suitable for systems where low power consumption is required.

CB-C9 family VX/VM type



Remark The above cores and buffers include those still under development.

Cell-Based IC

■ CB-C9 Family VX/VM Type

● Product Outline (VX/VM type)

Type name		VX type		VM type	
Part Number		μ PD822XX		μ PD826XX	
Derivative models ^{Note1}		O			
Technology		0.35 μ m rule CMOS, aluminum 2-layer/3-layer wiring			
Supply voltage I/O block		3.3 V \pm 0.3 V		5.0 V \pm 10 %	3.3 V \pm 0.3 V
Supply voltage internal block		3.3 V \pm 0.3 V	2.0 V \pm 0.2 V	3.3 V \pm 0.3 V	
Interface level		LVTTTL, TTL, 5-V CMOS (VM Type only)			
Number of usable gates ^{Note2}		1.7-M usable gate		1.6-M usable gate	
Delay time	Internal gate ^{Note3}	114 ps	207 ps	114 ps	114 ps
	Input buffer ^{Note4}	169 ps	—	690 ps	169 ps
	Output buffer ^{Note5}	864 ps	—	2045 ps	864 ps
Power consumption (internal gate)		0.3 μ W/MHz/gate	0.12 μ W/MHz/gate	0.3 μ W/MHz/gate	

- Notes**
1. ROM code changeable. O: Derivative models available
 2. Number of gates if hard macro is not mounted (2-input NAND conversion)
 3. 2-input NAND power gate, fanout = 2, standard wiring length
 4. fanout = 2, standard wiring length
 5. Load capacitance: 15 pF, $I_{OL} = 18$ mA

Cell-Based IC

■ Library

● CPU core

	General-purpose model	CB-C7 (5 V)	CB-C7 (3 V)	CB-C8 (HD)	CB-C8 (VX/VM)	CB-C9 (VX/VM)
Z80	μ PD70008A	○	○	○	○	○
V20HL™	μ PD70108H	○	○	—	—	—
V30HL™	μ PD70116H	○	○	—	—	—
V30MX		○	—	○	○	○
V30MT		—	—	—	○	△
V30MZ		—	—	—	—	○
V30MZC™		—	—	—	—	○
78K/0		—	—	—	—	○
V851™		—	—	—	—	○
V853™		—	—	—	—	○
V850E		—	—	—	—	△
V830 family™		—	—	—	—	
V _R series™		—	—	—	—	

Remark ○ : can be supported, △ : under development, — : cannot be supported, blank : under study

● Features of V850E core

CPU performance (Dhrystone): 87 MIPS (at 66 MHz)

V850 RISC CPU adopting 5-stage pipeline method. The object coding efficiency of C compilation has been improved and the program size has been reduced using 2-byte length basic instructions and instructions compatible with high-level language.

Two kinds of bus interface, VSB and NPB

- VSB: Bus operates synchronously with the CPU clock. It is used for connecting high-speed peripheral macros such as peripheral I/O provided with a memory controller and FIFO interface.
- NPB: Bus operates asynchronously with the CPU clock. It is used for connecting low-speed peripheral macros such as a timer and serial interface.

Instruction set: Completely compatible with V850E series 32-bit single-chip microcontrollers.

Cell-Based IC

Library

● Functional Outline of V850E Core

Item	Function		
Register set	General-purpose registers 32 bits × 32 + dedicated registers 32 bits × 11		
Instruction set	Upward compatible with V850 CPU Signed multiplication (32 bits × 32 bits → 64 bits) Saturated operation instruction (with overflow/underflow detection function) 32-bit shift instruction: 1 clock Bit manipulation instruction Load/store instruction with long/short format Signed load instruction		
Memory space	Program area: 64M bytes linear Data area: 4G byte linear <table border="1" style="margin-left: 20px;"> <tr> <td style="padding: 2px;">Internal ROM size: 0 to 1M bytes</td> </tr> <tr> <td style="padding: 2px;">Internal RAM size: 4K/12K/28K/60K bytes</td> </tr> </table> Memory bank division function	Internal ROM size: 0 to 1M bytes	Internal RAM size: 4K/12K/28K/60K bytes
Internal ROM size: 0 to 1M bytes			
Internal RAM size: 4K/12K/28K/60K bytes			
External bus interface	VSB (V850E) system bus <ul style="list-style-type: none"> • Separate address/data bus (28-bit address/32-bit data bus) • 32/16/8-bit bus sizing function • Bus hold function • External wait function NPB (NEC peripheral I/O bus) <ul style="list-style-type: none"> • Separate address/data bus (14-bit address/16-bit data bus) • Programmable wait function • Retry function 		
Interrupt	Non-maskable	3	
	Maskable	64 (8 priority levels can be specified.)	
	Exception	1	
DMA control function	4-channel configuration Transfer unit: 8 bits, 16bits, 32bits Maximum number of transfer: 65536 (2 ¹⁶)times Transfer type: Fly-by (1 cycle) transfer, 2-cycle transfer Transfer mode: Single transfer, single-step transfer, line transfer, block transfer Terminal count output signal		
Power save function	HALT, software STOP, hardware STOP modes		

● NPB Peripheral Macro for V850E Core

Function	Macro name	CB-C9 (VX/VM)
Prescaler	PRS1	△
PWM	PWM	△
16-bit timer/counter	TMC	△
16-bit interval timer	TMD	△
UART	UART5	△
Serial I/O	SIO	△

Remark △: Under development

Cell-Based IC**Library****● Features of V851 and V853 core**

CPU performance (Dhrystone): 38 MIPS (at 33 MHz)

Executes almost all instructions in 1 clock under control of a 5-stage pipeline based on RISC architecture.

Linear address space of up to 4G bytes

Supports linear address space of up to 4G bytes as data area and up to 16M bytes as program area

Instruction set: Completely compatible with V85X series 32-bit single-chip microcontrollers

● Functional Outline of V851 Core

Item		Function
Internal memory	Mask ROM ^{Note}	48K, 64K, 96K, 128K, 256K
	RAM	4K, 8K, 16K, 24K
Register set		General-purpose register 32 bits X 32 + dedicated register 32 bits X 6
Minimum instruction execution time		30 ns (at 33 MHz)
Instruction set		Signed multiplication (16 bits X 16 bits → 32 bits): 1 to 2 clocks Saturated operation instruction (with overflow/underflow detection function) 32-bit shift instruction: 1 clock Bit manipulation instruction Load/store instruction with long/short format
External bus interface		16-bit data bus (DIN/DOOUT separated) 24-bit address bus
Interrupt	Non-maskable	1
	Maskable	14 (8 priority levels can be specified)
Real-time pulse unit		16-bit timer/event counter: 1 ch 16-bit interval timer: 1 ch
Serial interface		Asynchronous serial interface (UART): 1 ch Clock serial interface (CSI): 1 ch
Power save function		HALT, STOP, IDLE modes Clock output stop function

Note ROM may not be provided.

Cell-Based IC

■ **Library**

● **Functional Outline of V853 Core**

Item		Function
Internal memory	Mask ROM ^{Note}	48K, 64K, 96K, 128K, 256K
	RAM	4K, 8K, 16K, 24K
Register set		General-purpose register 32 bits X 32 + dedicated register 32 bits X 6
Minimum instruction execution time		30 ns (at 33 MHz)
Instruction set		Signed multiplication (16 bits X 16 bits → 32 bits): 1 to 2 clocks Saturated operation instruction (with overflow/underflow detection function) 32-bit shift instruction: 1 clock Bit manipulation instruction Load/store instruction with long/short format
External bus interface		16-bit data bus (DIN/DOUT separated) 24-bit address bus
Interrupt	Non-maskable	1
	Maskable	31 (8 priority levels can be specified)
Real-time pulse unit		16-bit timer/event counter: 4 ch 16-bit interval timer: 1 ch
Serial interface		Asynchronous serial interface (UART) Clocked serial interface (CSI) UART/CSI: 2 ch CSI: 2 ch
PWM output		8/9/10/12-bit resolution PWM: 2 ch
Power save function		HALT, STOP, IDLE modes Clock output stop function

Note ROM may not be provided.

Cell-Based IC

Library

● Features of 78K/0 core

- Instruction set: Completely compatible with 78K/0 series 8-bit single-chip microcontrollers
- Many peripheral units such as timer, serial interface, and interrupt controller
- Software development environments available

● Functional Outline of 78K/0 Core

Item		Function
General-purpose register		8 bits X 32
Minimum instruction execution time		238.4 ns (at 8.38 MHz)
Instruction set		Multiplication/division (8 bits X 8 bits, 16 bits ÷ 8 bits) Bit manipulation instruction (set, reset, test, Boolean operation)
External bus interface		8-bit data bus (DIN/DOUT separated) 16-bit address bus
Interrupt	Maskable	Internal : 17 External : 12
Port		128 bits MAX. Input : 64 bits (8 bits X 8) Output : 64 bits (8 bits X 8)
Timer		16-bit timer/event counter: 1 ch 8-bit timer (PWM output): 2 chs Watch timer: 1 ch Watchdog timer: 1 ch
Serial interface		Asynchronous serial interface (UART): 2 chs Clocked serial interface (CSI): 2 chs I ² C bus interface: 2 chs
Standby function		HALT, STOP modes

Cell-Based IC

Library

● V851, V853, and 78K/0 core dedicated peripheral macros

Function	Macro Name	CB-C9 (VX/VM)
UART	UART	○
Serial I/O	SIO	○
16-bit timer	TM4	○
8/16-bit timer	TM5	○

Remark ○: can be supported

	UART	SIO(CSI)	TM4	TM5
Features	7/8-bit character length 1/2-bit stop bit length Parity bit specification None/0/odd/even Baud rate generator IrDA mode	3-wire synchronous serial Transfer clock External clock fx/2 fx/8 fx/32	16-bit interval timer	8/16-bit timer/event counter 8-bit PWM output External pulse output

Dedicated external bus interface for V851, V853, or 78K/0 core is provided with each peripheral macro. Each peripheral macro can be directly connected to each CPU core.

Cell-Based IC

Library

Features of V30MX series

V30MX core

V30HL upward compatible

2-clock bus cycle realized by separating the address bus and data bus which are multiplexed in the V30HL.

V30MT core

Small and low-power model of V30MX

- Software compatible with V30HL and V30MX
- Low power consumption realized by deleting internal Hi-Z signal

V30MZ core

- Processing performance comparable to RISC thanks to internal pipeline processing
35 MIPS (66 MHz, 0 wait)
- 1-clock bus cycle
- ICE conforming to N-Wire
- Software compatible with V30HL and V30MX
- 2.0 V supported for CB-C9VX/VM ($f_{MAX} = 32$ MHz)

V30MZC core

V30MZ with cache memory

- Cache memory capacity: 4K bytes
- 20 MIPS (50 MHz)
- Burst transfer mode supported

CPU core	V30MX	V30MT	V30MZ	V30MZC
Operating frequency	33 MHz	16 MHz	66 MHz	50 MHz
Performance (0 wait)	4.3 MIPS	2.6 MIPS	35 MIPS	20 MIPS
Current consumption	1.0 mA/MHz	0.8 mA/MHz	1.2 mA/MHz	T.B.D.
Bus cycle	2 clocks	2 clocks	1 clock	4 clocks (external) 1 clock between cache and CPU

Remark Specification for CB-C9VX/VM. However, V30MT only is for CB-C8VX/VM

Cell-Based IC

Library

Peripheral macros

Function	General-purpose model	CB-C7 (5 V)	CB-C7 (3 V)	CB-C8 (VX/VM)	CB-C9 (VX/VM)
Serial I/O	μPD71051	○	○	○	○
Timer	μPD71054	○	○	○	○
Parallel I/O	μPD71055	○	○	○	—
Interrupt controller	μPD71059	○	○	○	○
DMAC (8 bits)	μPD71037	○	○	○	—
Watch	μPD4991AL	○	○	○	○
UART + FIFO	NS16550	○	—	○	○
FDC + DVFO	μPD72065B	△	—	△	△
IrDA1.1		—	—	○	○
SIE for USB1.1 full speed		—	—	—	○
USB function controller for printer		—	—	—	△
USB function controller for display				—	△
Line buffer for PPC (7.5 kW)		—	—	—	○

Remark ○ : can be supported, △ : under development, — : cannot be supported, blank : under study

Analog macros

Function	Performance	CB-C7	CB-C8 (VX/VM)	CB-C9 (VX/VM)
A/D	8 bits, 100 kHz	○	○	○
	10 bits, 100 kHz	—	—	○
	12 bits, 300 kHz	—	—	△
	8 bits, 50 MHz	—	—	△
	10 bits, 30 MHz	—	—	△
D/A	8 bits, 100 kHz (1 ch)	○	○	○
	10 bits, 100 kHz (1 ch)	—	—	○
	8 bits, 20 MHz (3 chs)	○	—	—
	8 bits, 30 MHz (3 chs)	—	○	○
	9 bits, 30 MHz (2 chs)	—	○	—
	10 bits, 30 MHz (3 chs)	—	—	○
	10 bits, 85 MHz (1 ch)	—	—	△
PLL	For multiplication	○	○	○
	For skew adjustment	—	—	○
Analog switch		○	○	○
Comparator		○		—

Remark ○ : can be supported, △ : under development, — : cannot be supported, blank : under study

Cell-Based IC

■ **Library**

● **Compiled macros**

Function	Performance	CB-C7 (5 V)	CB-C7 (3 V)	CB-C8 (VX/VM)	CB-C9 (VX/VM)
Multiplier	Signed (32 X 32 MAX.)	○	○	—	
Register file (2 ports)	8K bits MAX.	○	○	○	△
Register file (3 ports)	8K bits MAX.	○	○	○	△
Low-power synchronous 1-port RAM	128K bits MAX.	○	○	○	—
High-density synchronous 1-port RAM	64K bits MAX.	—	—	—	○
High-density synchronous 2-port (R + W) RAM	32K bits MAX.	—	—	—	○
High-speed synchronous 1-port RAM	64K bits MAX.	○	—	—	○
High-speed synchronous 2-port (R/W + R) RAM	64K bits MAX.	—	—	○	○
Super high-speed synchronous 1-port RAM	16K bits MAX.	—	—	—	○
Low-power asynchronous 1-port ROM	512K bits MAX.	○	○	○	—
High-speed synchronous 1-port ROM	512K bits MAX.	—	—	—	○

Remark ○: can be supported, △: under development, —: cannot be supported, blank : under study

Embedded Array**■ EA-C9HD Family****● Features (1/2)****High-density, super high-speed, and low-power consumption embedded array using the most advanced 0.35 μm technology**

- High-level function and high-performance LSI compatible to cell-based IC
- Easy development and modification of derivative models
- Short turn around time equivalent to gate array
- Macro maintenance common to cell-based IC (CB-C9/9VX)

The EA-C9HD family is a collection of embedded arrays employing a 0.35- μm technology.

This family consists of 10 masters with 76K to 1.6M gates.

The gate density of this family is about 2.5 times higher than that of the existing EA-C9 family 0.35- μm embedded arrays, thanks to improvement of the cell structure.

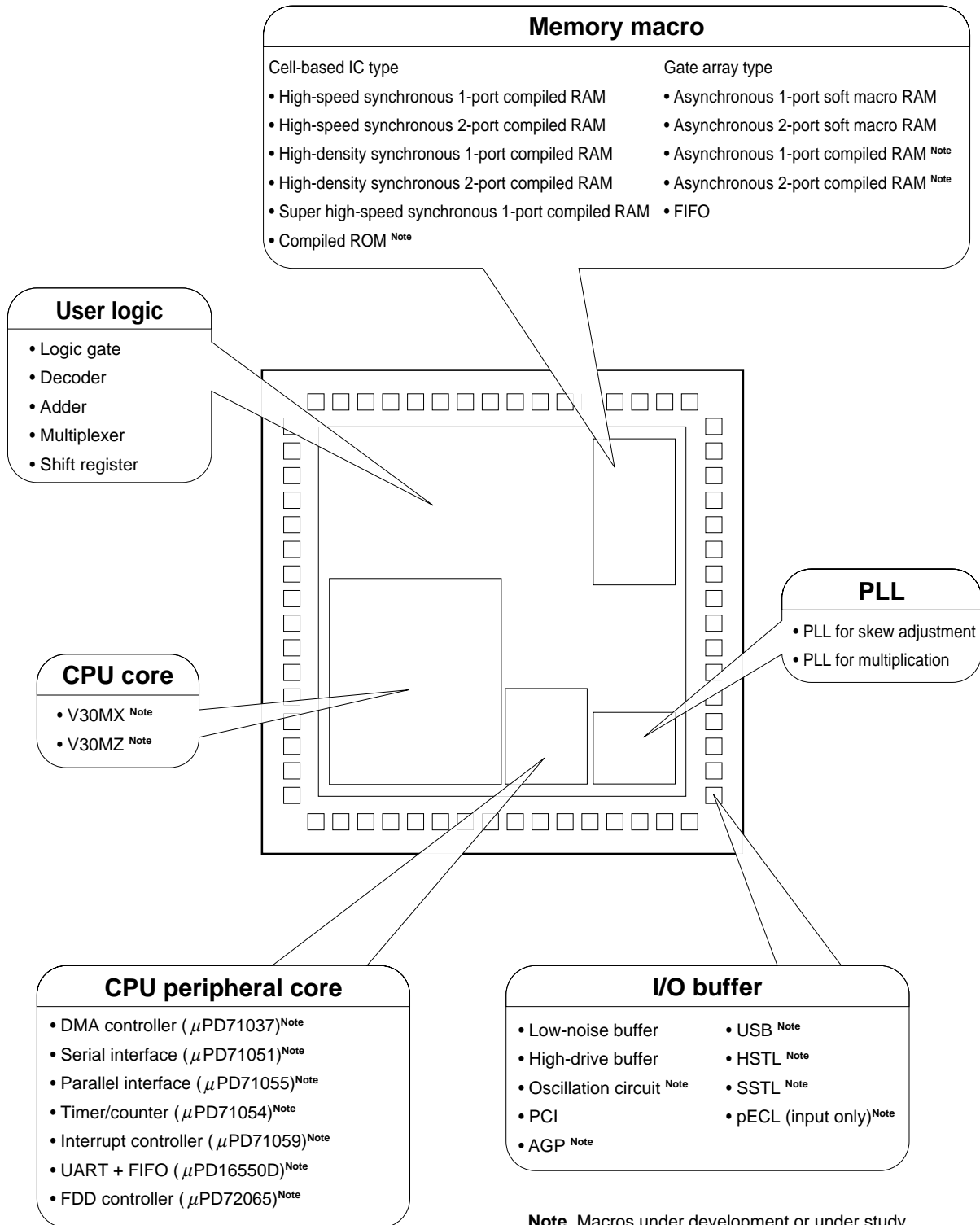
In addition, the power consumption is 40 % lower, and thanks to new I/O pad layout technology, this family offers a large number of pins in addition to the high density.

Embedded Array

■ EA-C9HD Family

● Features (2/2)

Wide variety of macro libraries



Embedded Array

■ EA-C9HD Family

● Available Models (3-layer wiring)

		μ PD65443	μ PD65444	μ PD65445	μ PD65446	μ PD65448	μ PD65449	μ PD65451	μ PD65454	μ PD65456	μ PD65458
Density	Internal gates*	76720	103032	128872	207000	314104	440832	592020	840768	1104432	1626628
	Number of usable gates**	38360	51516	64436	103500	157052	220416	296010	420384	552216	813314
	Number of pads ^{Note1}	172	196	216	268	324	380	436	516	588	708
Delay time	Internal gate	131 ps (2-input NAND, fanout: 1, standard wiring length)									
	Power gate	107 ps (2-input NAND, fanout: 1, standard wiring length)									
	Input buffer	229 ps (fanout: 2, standard wiring length)									
	Output buffer	1396 ps ($C_L = 15$ pF, $I_{OL} = 9$ mA)									
Output drive capability		$I_{OL} = 1, 2, 3, 6, 9, 12, 18, 24$ mA									
Supply voltage		$3.3V \pm 0.3V$									
Remark		*2-input NAND conversion, **Cell utilization rate: 50 to 70 % ^{Note2}									

Notes 1. Including the power supply and GND pins. The number of pins that can be actually used differs depending on the type of package.
2. Differs depending on the number of pin pairs and the occupation rate of the macro.

Analog Master

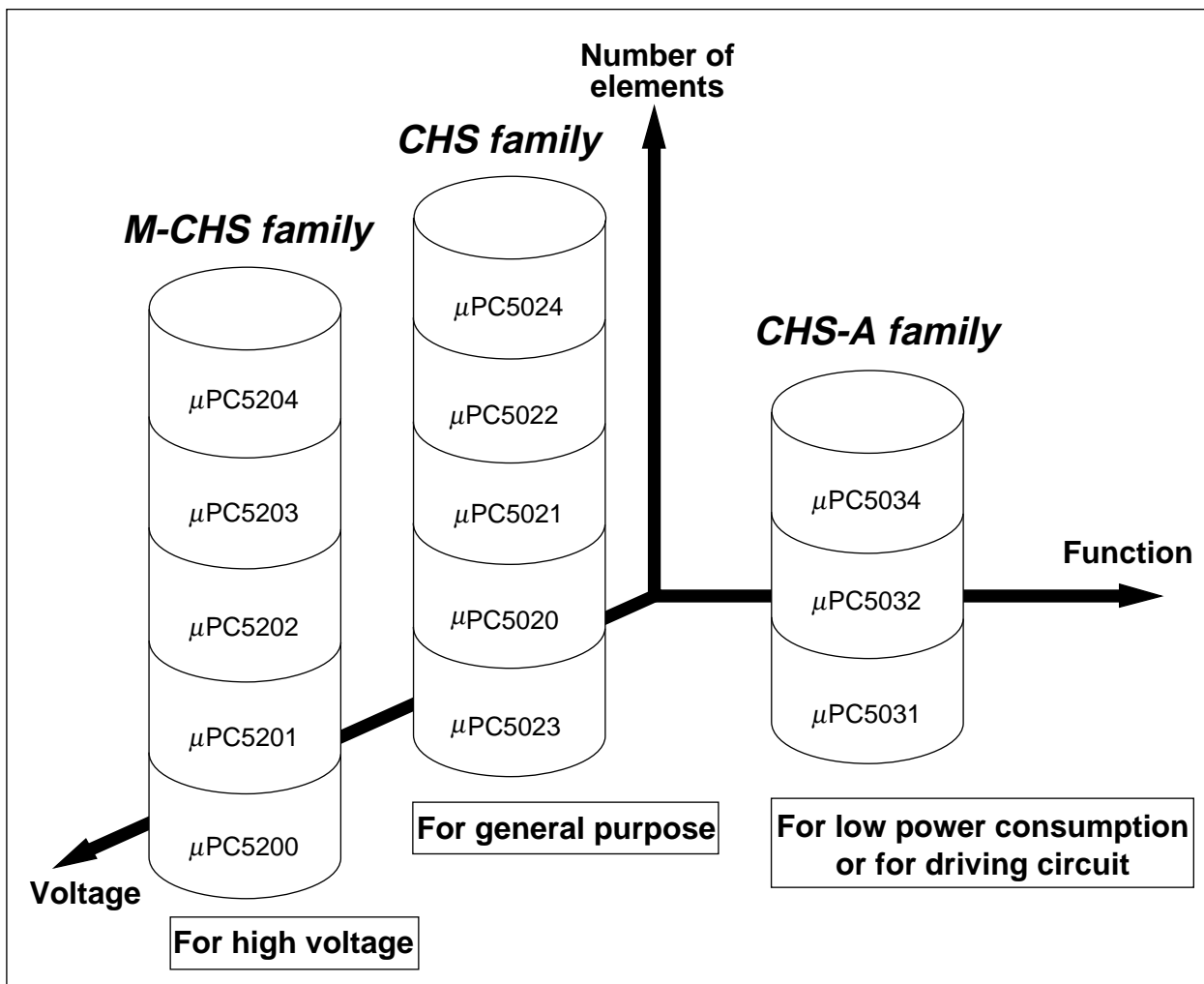
■ **Analog Master Line-Up**

NEC's analog master is classified into the following 3 families (refer to the figure below).

- CHS family and CHS-A family for wide application field
- M-CHS family for high voltage

From this wide line-up (3 families 13 masters), user can find the optimum one to realize the user-desired analog LSI.

Line-up and features

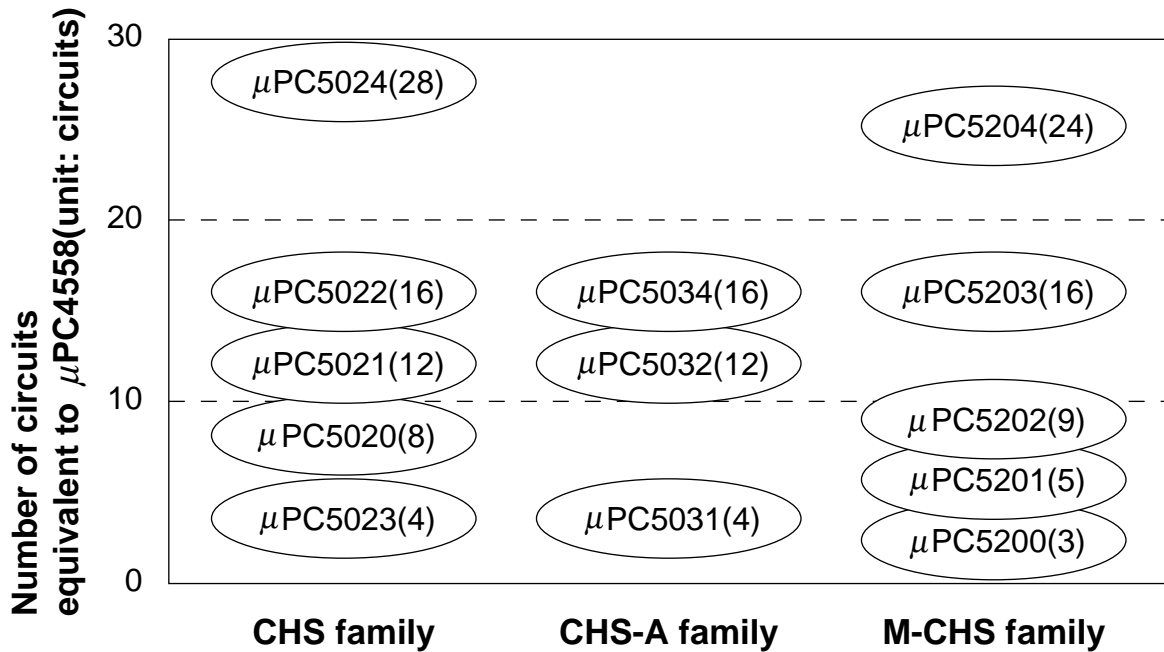


Analog Master

■ Circuit Scale of Each Family

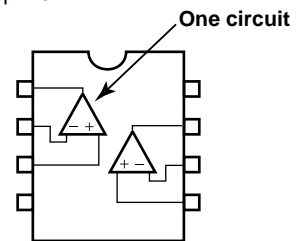
The scale of the circuit that can be integrated on the analog master differs depending on the model of each family.

The scale of the circuit that can be integrated shown below is roughly calculated in terms of the number of circuits where one circuit is equivalent to the general-purpose operational amplifier μPC4558 ^{Note 1}.



(Numbers in the parentheses indicate the number of circuits^{Notes 2} that can be integrated.)

Notes 1. One of the two operational amplifiers in the general-purpose operational amplifier μPC4558 package (8-pin DIP) is counted as one circuit.



- 2.** The number of circuits shown above is a guideline in which only operational amplifiers are integrated, and does not include operational amplifier peripheral circuits (such as feedback circuits). When selecting a model, estimate the circuit scale by taking these peripheral circuits into consideration.

Analog Master

■ Available Models

Item	CHS Family					CHS-A Family		
Technology	High-speed bipolar							
Absolute maximum ratings	14 V							
Features	<ul style="list-style-type: none"> High-speed analog signal processing circuit can be created. $f \leq$ several 10 MHz 					<ul style="list-style-type: none"> Many pins Internal driver High resistance 		
Part number	μ PC5020	μ PC5021	μ PC5022	μ PC5023	μ PC5024	μ PC5031	μ PC5032	μ PC5034
Total number of elements	1628	2328	3042	727	6152	576	1472	2252
NPN transistor ^{Note1}	260	368	476	129	836	118(13)	298(18)	446(26)
PNP transistor	224	320	416	116	672	105	280	450
Resistor	1116	1600	2098	468	4560	338	854	1266
Capacitor	28	40	52	14	84	15	40	90
Macro library	Operational amplifiers, comparators, regulators, switches, timers					Operational amplifiers, comparators, regulators, switches, super white TEG ^{Note2}		

Item	M-CHS Family				
Technology	High voltage bipolar				
Absolute maximum ratings	44 V				
Features	<ul style="list-style-type: none"> High voltage: $V_{CC(MAX)} = 44$ V $f \leq$ several MHz 				
Part number	μ PC5200	μ PC5201	μ PC5202	μ PC5203	μ PC5204
Total number of elements	654	1030	1787	3088	4562
NPN transistor	105	163	283	484	710
PNP transistor	84	140	252	448	672
Resistor	456	712	1225	2108	3108
Capacitor	9	15	27	48	72
Macro library	Operational amplifiers, comparators, regulators, switches				

Notes 1. (): Products with driver

2. Super white TEG: TEG (Test Element Group) containing analog function macros (operational amplifiers, comparators, regulators, switches, drivers, and reset circuits) used as peripherals of microcontroller in one package

Mixed Signal ASIC

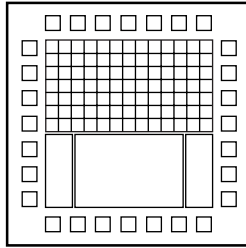
■ Mixed Signal ASIC Product Lines (1/2)

NEC offers mixed digital ASICs that employ the BiCMOS technology with a technology rule of 0.6 μm to 0.35 μm .

Furthermore, NEC supports the world's first analog IP cores through the use of a leading-edge 0.35- μm BiCMOS technology, applying its rich analog circuit design know-how.

An extensive line-up of products is available to answer the wide-ranging needs of users.

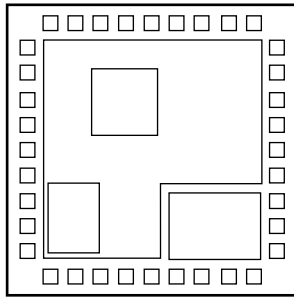
5-V power supply
for small-scale circuits



MA-8 family ($\mu\text{PD680XX}$)

0.6- μm BiCMOS technology
Gate array
+ Analog master slice form

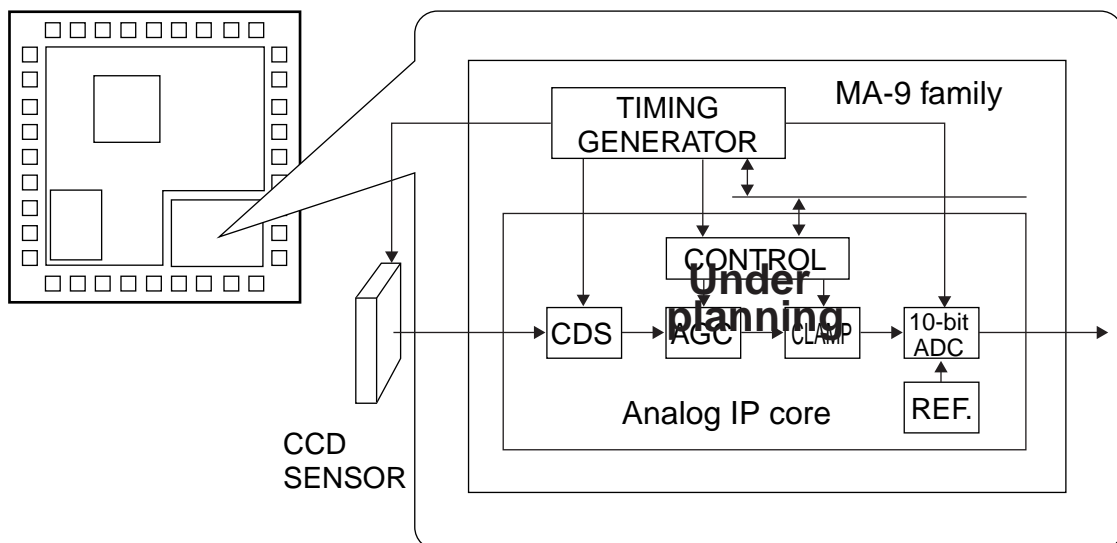
3.3-V power supply
for large-scale systems



MA-9 family ($\mu\text{PD681XXX}$)

0.35- μm BiCMOS technology
Cell-based form

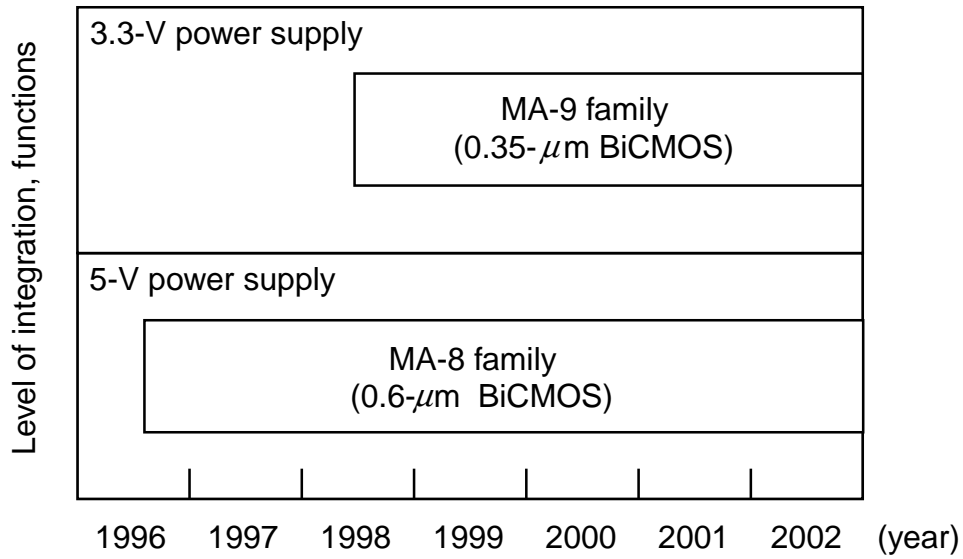
● MA-9 Family Analog IP Core



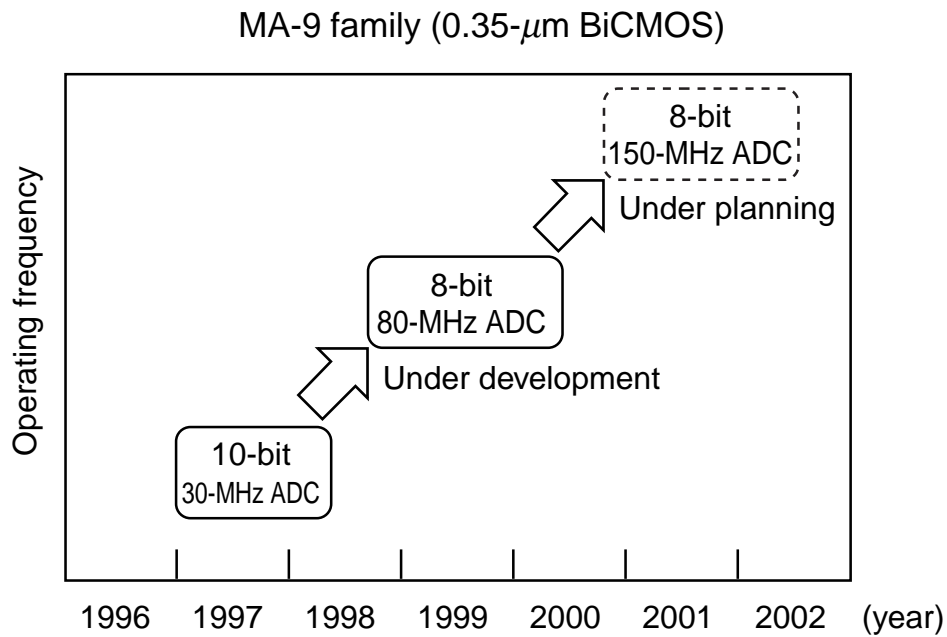
Mixed Signal ASIC

■ **Mixed Signal ASIC Product Lines (2/2)**

● **Mixed Signal ASIC Family Evolution**



● **Mixed Signal ASIC Analog Core Evolution**



Mixed Signal ASIC**■ MA-8 Family (0.6- μ m Mixed Signal ASIC)****● Features**

The MA-8 Family (μ PD680xx) consists of top-level mixed signal ASICs that employ the latest high-cost-performance BiCMOS technology.

This family achieves the integration of mixed digital/analog circuits on a single chip, which will be pivotal for the development of the multimedia market.

Support of digital/analog mixed circuits

By employing the latest BiCMOS technology, the MA-8 Family realizes the integration of 0.6- μ m CMOS gate array and analog ASIC (analog master) on a single chip.

Analog block element configuration prioritizing circuit functions

Analog circuits that mix bipolar transistors and CMOS transistors can be created through the use of the BiCMOS technology:

High input impedance operational amplifiers

Sample and hold circuits

Analog switches, etc.

Simple design and short development time

The logic block can be easily developed with OPENCAD (NEC' s original CAE tool).

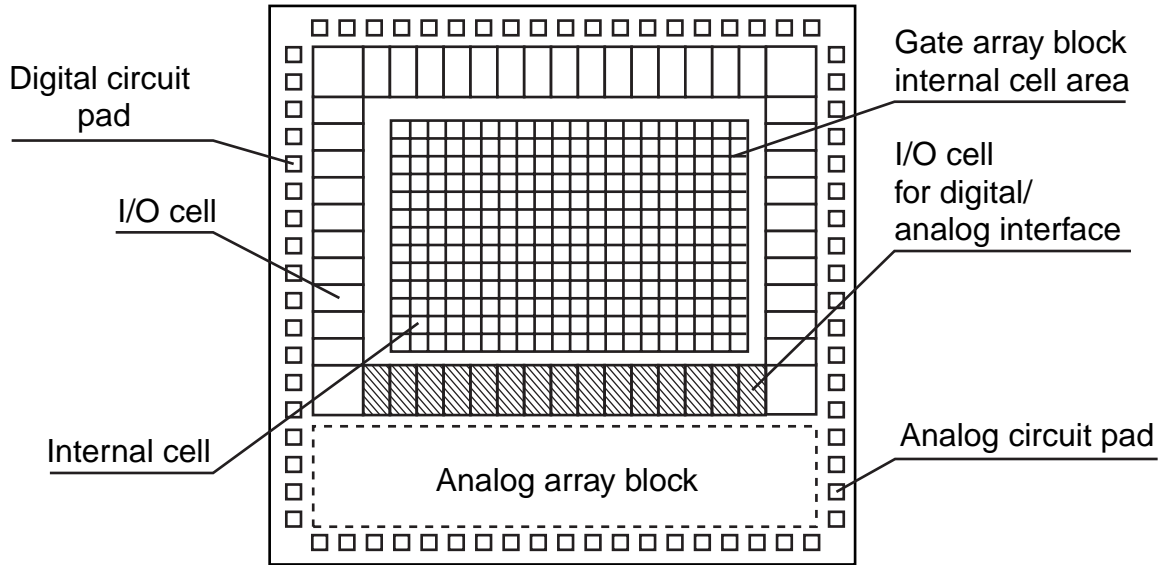
Furthermore, a short development time can be achieved, which is another advantage of ASICs.

Mixed Signal ASIC

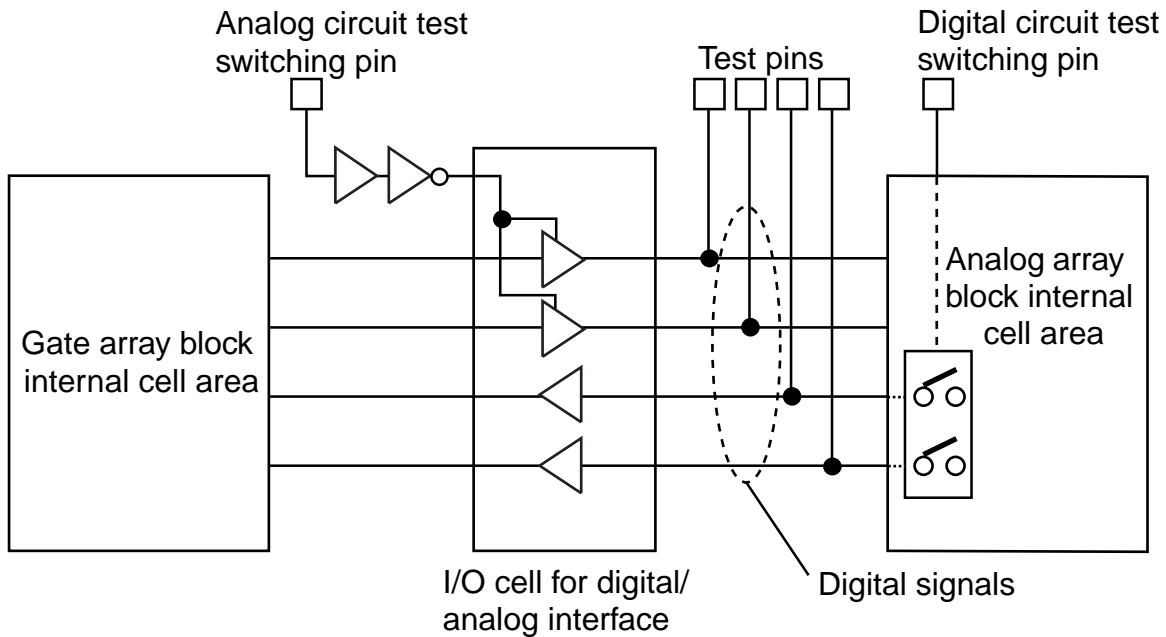
■ **MA-8 Family (0.6- μ m Mixed Signal ASIC)**

● **Chip Configuration**

The MA-8 Family is mainly composed of a gate array block and an analog array block. The I/O cells for the digital/analog interface perform input/output of digital signals between the gate array block and the analog array block.



I/O Cells for Digital/Analog Interface



Mixed Signal ASIC

■ MA-8 Family (0.6- μm Mixed Signal ASIC)

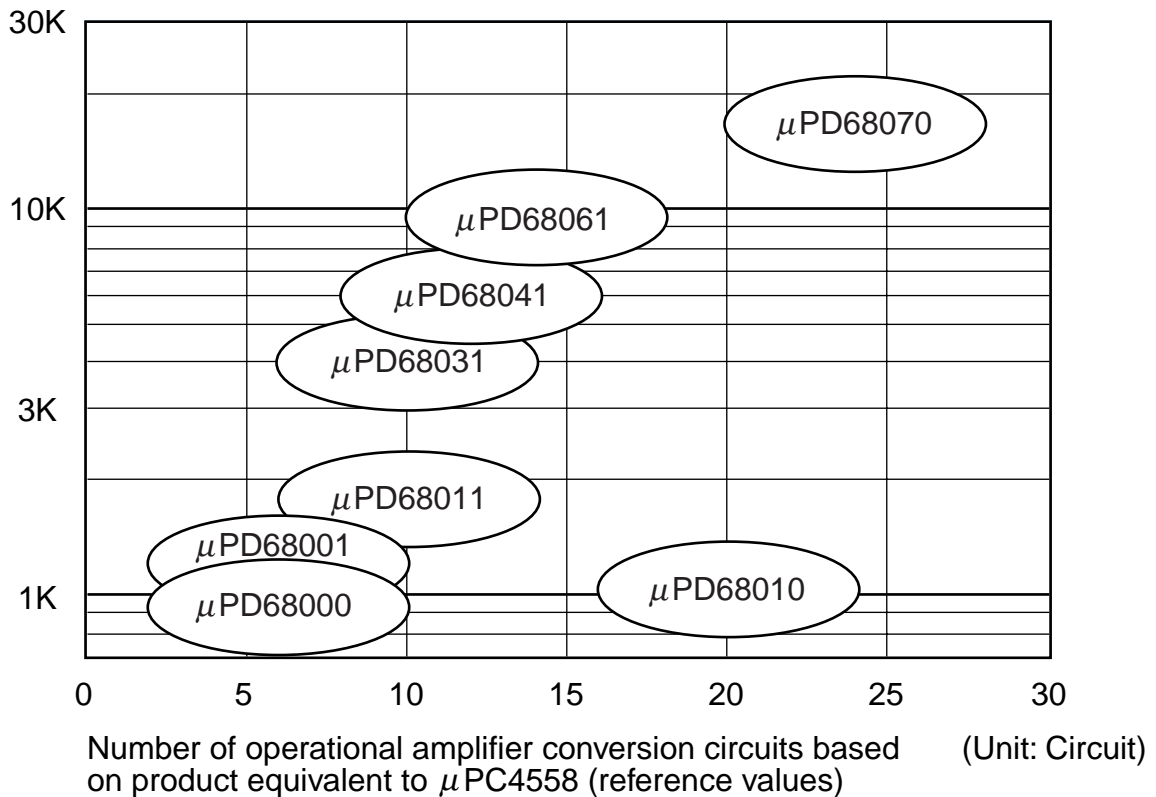
● Master Size

The MA-8 Family offers eight masters, based on the gate array block size, the analog array block size, and whether the analog array block has MOS transistors.

The figure below shows the master block size in terms of the number of usable gates and the number of circuits^{Note 1} calculated as general-purpose operational amplifier circuits corresponding to the μPC4558 .

MA-8 Family Master Sizes

Number of usable gates^{Note 2}
(Unit: Gates)

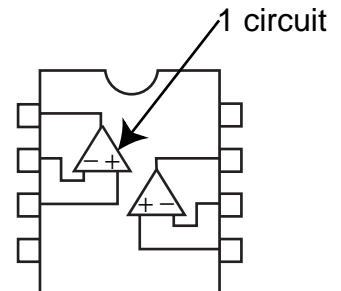


Notes 1. The two operational amplifiers mounted on the package (8-pin DIP) of the μPC4558 general-purpose amplifier are each treated as one circuit. Moreover, the numbers of conversion circuits indicated in the figure above are merely reference values for the case when only operational amplifiers are mounted on the analog array block, and operational amplifier peripheral circuits (such as feedback circuits) are not included. In particular when selecting products, estimate the circuit scale considering their peripheral circuits.

2. Gate utilization rate: 60%

Remark The presence of analog MOS transistors and analog switches on the analog array block.

- Mounted : $\mu\text{PD68000}$, 68010, 68070
- Not mounted : $\mu\text{PD68001}$, 68011, 68031, 68041, 68061



Mixed Signal ASIC

■ MA-8 Family (0.6- μm Mixed Signal ASIC)

● Element List

Part Number	$\mu\text{PD68000}$	$\mu\text{PD68001}$	$\mu\text{PD68010}$	$\mu\text{PD68011}$	$\mu\text{PD68031}$	$\mu\text{PD68041}$	$\mu\text{PD68061}$	$\mu\text{PD68070}$	
Technology	High-performance BiCMOS technology								
Maximum supply voltage	6.0 V (absolute maximum rating)								
Number of pads	68	68	108	84	96	108	128	168	
Logic block									
Number of gates	1520	1520	1680	2880	6720	9520	16512	28320	
Number of usable gates ^{Note}	912	912	1008	1728	4032	5712	9907	16992	
Number of logic I/Os	23	23	31	32	44	53	68	88	
Analog block									
Total number of elements	912	1264	4614	2016	2016	2304	2736	5017	
NPN transistor	(Standard)	150	210	756	336	336	384	456	816
	(Large type)	25	35	126	56	56	64	76	136
PNP transistor (Lateral)		200	280	1008	448	448	512	608	1088
Polysilicon resistor	(1 k Ω)	150	210	756	336	336	384	456	816
	(5 k Ω)	300	420	1512	672	672	768	912	1632
Capacitor (5 pF)		25	35	126	56	56	64	76	136
P-ch MOS transistor		50	70	252	112	112	128	152	272
Analog SW		4	0	24	0	0	0	0	15
P-ch MOS transistor for analog		4	2	28	0	0	0	0	58
N-ch MOS transistor for analog		4	2	26	0	0	0	0	48
Digital/analog junction block									
Digital/analog I/F (Maximum)		14	14	36	14	14	14	14	24

Note Gate utilization rate: 60%

Remark The last digit in the part number of MA-8 Family products indicates the presence/absence of analog MOS transistors and analog switches in the analog array block, as follows:

Last digit = 0 → Mounted

Last digit = 1 → Not mounted

Mixed Signal ASIC

■ MA-8 Family (0.6- μ m Mixed Signal ASIC)

● Basic Specifications

Logic Block

Product Name		μ PD680XX
Technology		0.6- μ m BiCMOS technology
Supply Voltage		5.0 V \pm 0.5 V (I/O block, internal gates)
Maximum integration (logic only)		17K gates (usable)
Interface level		CMOS, TTL
Delay time	Internal gates ^{Note 1}	190 ps (TYP.)
	Input buffer ^{Note 2}	340 ps (TYP.)
	Output buffer ^{Note 3}	2.13 ns (TYP.)

Notes 1. Value assuming 2-input NAND power gate, fanout: 1, and wiring length: 0.6 mm/1 pin pair.

2. Value assuming fanout: 2, wiring length: 0.6 mm/1 pin pair.

3. Value assuming load capacitance: 15 pF, block name: FO01.

Analog Block

Product Name		μ PD680XX
Technology		0.6- μ m BiCMOS technology
Supply Voltage		5.0 V \pm 0.5 V
Transistor	NPN type	$f_T = 10$ GHz, $h_{FE} = 80$ (all TYP.)
	PNP type (Lateral)	$f_T = 10$ MHz, $h_{FE} = 70$ (all TYP.)
	MOS	N-ch type, P-ch type for analog circuit
Polysilicon resistor^{Note}		Absolute precision: $\pm 20\%$, relative precision: $\pm 2\%$ (all MAX.)
Capacitor (MOS type)^{Note}		Absolute precision: $\pm 15\%$, relative precision: $\pm 2\%$ (all MAX.)

Note Values indicated are for reference only. The relative precision applies only to when the pin is positioned in an adjacent location.

Mixed Signal ASIC

■ MA-8 Family (0.6- μ m Mixed Signal ASIC)

● Electrical Characteristics

Absolute Maximum Ratings

Item	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{DD}, V_{CC}		-0.5 to +6.0	V
Input/output voltage (logic block)	V_i / V_o		-0.5 to $V_{DD} + 0.5$	V
Input current (logic block)	I_i		20	mA
Output current (logic block)	I_o	$I_{OL} = 3 \text{ mA}$	10	mA
		$I_{OL} = 6 \text{ mA}$	15	mA
		$I_{OL} = 9 \text{ mA}$	20	mA
		$I_{OL} = 12 \text{ mA}$	30	mA
		$I_{OL} = 18 \text{ mA}$	40	mA
		$I_{OL} = 24 \text{ mA}$	60	mA
Operating ambient temperature	T_A		-40 to +85	$^{\circ}\text{C}$
Storage temperature	T_{stg}		-65 to +150	$^{\circ}\text{C}$

Caution If any of the parameters exceeds the absolute maximum ratings, even momentarily, the quality of the product may be impaired. The absolute maximum ratings are values that may physically damage the product(s). Be sure to use the product(s) within the ratings.

Definition of absolute maximum rating terms

Item	Symbol	Meaning
Supply voltage	V_{DD}	The range of voltage that, even if applied to the V_{DD} pin, will not cause destruction or lower reliability.
Input voltage	V_i	The range of voltage that, even if applied to the input pin, will not cause destruction or lower reliability.
Output voltage	V_o	The range of voltage that, even if applied to the output pin, will not cause destruction or lower reliability.
Input current	I_i	The absolute value of current capacity that, even if applied to the input pin, will not cause latchup to occur.
Output current	I_o	The absolute value of DC current capacity that, even if output from or input to the output pin, will not cause destruction or lower reliability.
Operating ambient temperature	T_A	Range of ambient temperature in which normal logical operation will occur.
Storage temperature	T_{stg}	Range of pin temperature that will not cause destruction or lower reliability when voltage and current are not applied.

Mixed Signal ASIC

■ MA-9 Family (0.35- μ m Mixed Signal ASIC) New Products

● Features

The MA-9 Family (μ PD68155) consists of leading-edge mixed signal ASICs that aim for system-on-a-chip through the use of a leading-edge 0.35- μ m BiCMOS technology pioneered by NEC.

While aiming for ultra-high integration for large-scale digital/analog mixed systems in the field of multimedia, the MA-9 Family realizes high-speed, high-accuracy stable signal processing.

Support of world's first analog IP core

NEC supports the world's first analog IP core, using its rich analog circuit design resources.

Mixed signal ASICs aiming for system-on-a-chip

Large-scale mixed signal systems can now be created on a single chip using the cell-based form.

NEC supports mixed signal cores that include an analog IP core, high-speed ADC and DAC and other analog cores, digital/analog mixed circuits, etc.

Leading-edge BiCMOS technology

High-speed digital circuits and high-accuracy, sophisticated analog circuits can now be realized on a single chip by employing NEC's leading-edge 0.35- μ m BiCMOS technology.

Low power consumption

A low power consumption is achieved for LSIs by employing a low-voltage operation technology (3.3 V)

Flexible mixed signal development environment

NEC's development environment for cell-based ICs can be used for the internal logic.

For mixed signal cores, NEC supports a development environment using analog arrays that enables a short turn around time comparable to that of embedded arrays.

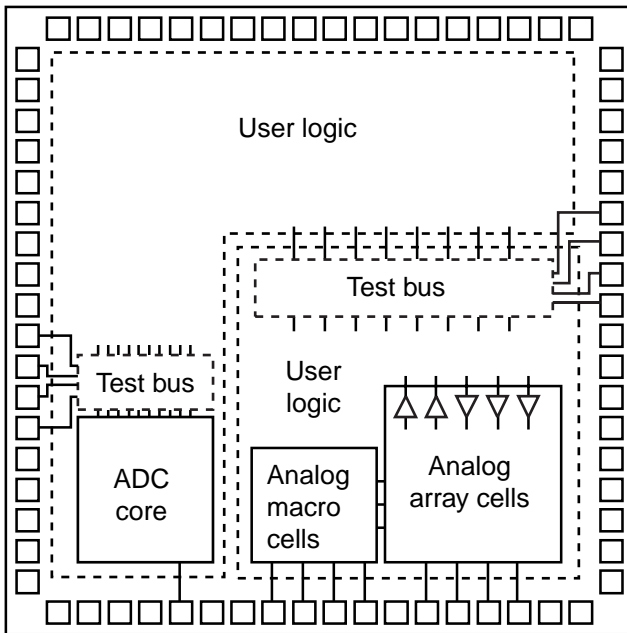
Moreover, for circuit blocks, for which analog characteristics particularly matter, NEC supports a development environment that enables the use of macro cells.

Mixed Signal ASIC

■ **MA-9 Family (0.35- μ m Mixed Signal ASIC) New Products**

● **Chip Configuration**

The MA-9 Family features a digital/analog mixed circuit configured as a core (mixed signal core) as its internal logic.



Internal Logic

- User logic
Logic gates, decoder, adder, multiplexer, counter, shift register, etc.
- I/O buffer
- Cores
Analog core
Mixed signal core

Mixed signal core

Analog array cells
(analog macro)

Operational amplifier, comparator, reference voltage source, analog switches, sample and hold, VCA, filters, etc.

+

User logic
(analog circuit operation and related logic circuits)

Logic gates, decoder, latches, shift registers, etc.

Mixed Signal ASIC

■ MA-9 Family (0.35- μm Mixed Signal ASIC) New Products

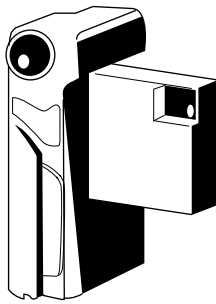
● Analog IP Cores (1/2)

The MA-9 Family combines NEC's rich analog circuit design technology and NEC's analog ASIC technology cultivated through its analog master products, supporting analog IP cores through the use of the world's first leading-edge BiCMOS technology.

In the area of digital/analog mixed circuits, NEC provides already custom designed analog circuits that require advanced circuit technology as IP cores, thereby reducing the development load of users and supporting the creation of high-quality mixed signal systems within a short time.

Analog Front-End Cores for CCD Signal Processing

Through the use of bipolar transistors, which have outstanding analog characteristics compared to CMOS transistors, NEC offers cores with superb low-noise characteristics made possible only by the use of the BiCMOS technology.

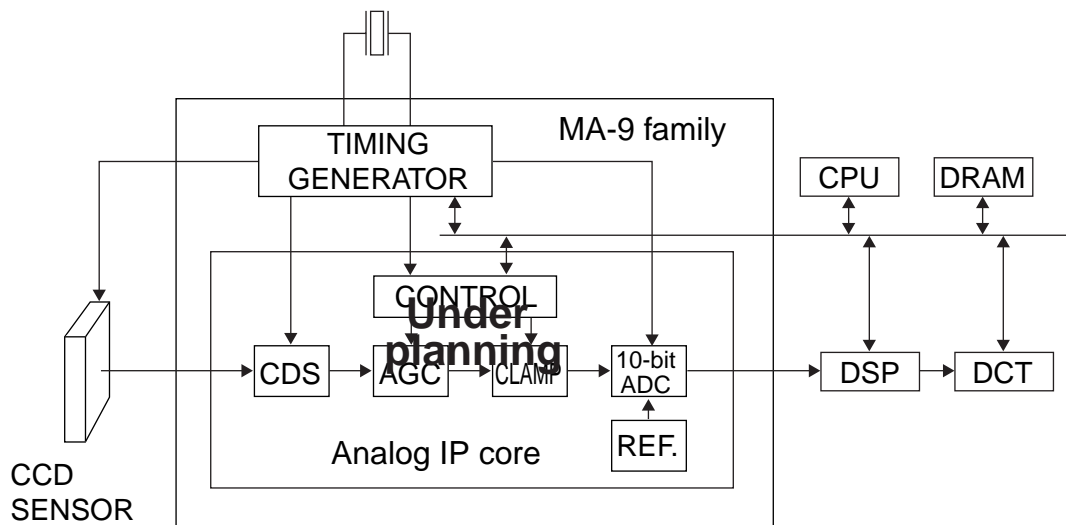


Features

- CDS optimum for digital still cameras (correlated double sampling)
- High-gain AGC for higher sensitivity
- Low-consumption-power-type 10-bit ADC and reference voltage
- Controller circuit inside DAC for analog circuit characteristics correction

Under planning

Application Example (Digital Still Camera)



Mixed Signal ASIC

■ **MA-9 Family (0.35- μ m Mixed Signal ASIC) New Products**

● **Analog IP Cores (2/2)**

High-Speed ADC Cores for Video

The MA-9 Family supports high-speed ADC cores as ASIC cores through the use of the world's most advanced 0.35- μ m BiCMOS technology.

NEC has realized high-speed ADC, which is difficult to realize with a CMOS technology, through optimum design using CMOS transistors and bipolar transistors that can be created only by employing the BiCMOS technology.

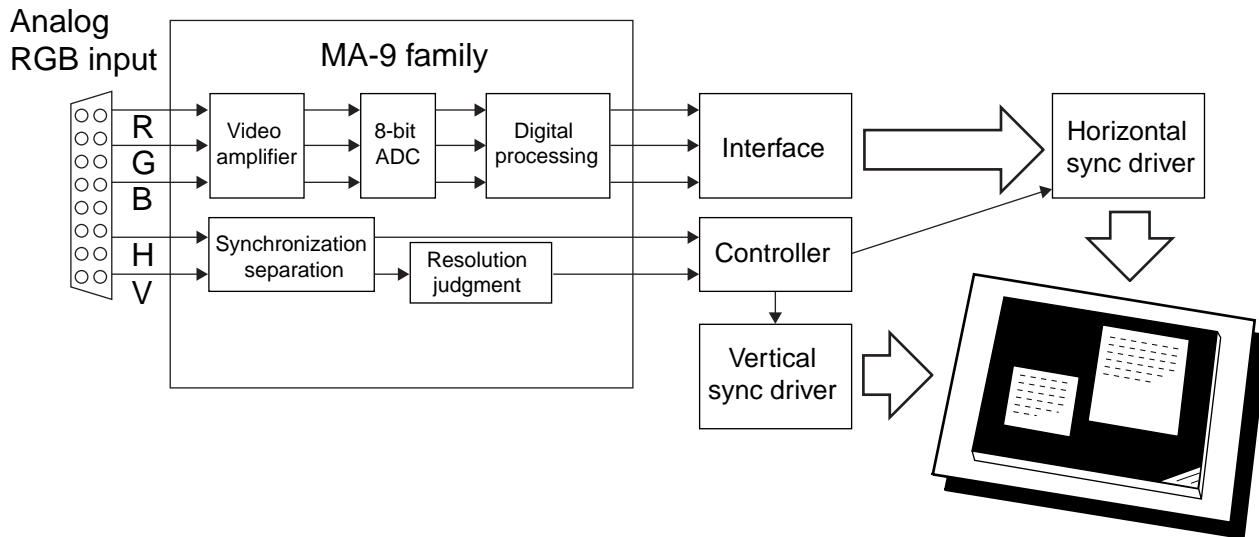
Moreover, by offering these ADCs as cores, NEC makes these products available for a wide range of applications.

For video	8-bit 80-MHz	Under development
------------------	--------------	--------------------------

Application Example (LDC Display Video Signal Input)

By combining an analog circuit and a high-speed ADC core on a single chip, it is possible to realize high-precision analog/digital conversion by avoiding the attenuation and degradation of high-speed analog signals caused by the capacitance load of the package I/O pins of analog LSIs and high-speed ADC LSIs externally connected to conventional LSIs and the capacitance load of the printed wiring board.

Moreover, the reduction of these load capacitances enables the simplification of the output stage of the analog circuit, thereby making it relatively easy to achieve high bandwidth analog circuits and enabling the reduction of the power consumption of the LSI.



Mixed Signal ASIC

<ul style="list-style-type: none"> ■ MA-9 Family (0.35-μm Mixed Signal ASIC) New Products
--

<ul style="list-style-type: none"> <ul style="list-style-type: none"> ● Analog Core
--

<ul style="list-style-type: none"> <ul style="list-style-type: none"> ADC Core

NEC provides both video and general-purpose ADC cores.

For video	10-bit 30 MHz	$V_{DD} = 3.3\text{ V (TYP)}$, $I_{DD} = 60\text{ mA (TYP)}$
		Differential linearity error : $\pm 1.0\text{ LSB (MAX)}$ Integral linearity error : $\pm 2.0\text{ LSB (MAX)}$ Analog input range : 0.8 to 1.8 V
	10-bit 15 MHz	$V_{DD} = 3.3\text{ V (TYP)}$, $I_{DD} = 30\text{ mA (TYP)}$
		Differential linearity error : $\pm 1.0\text{ LSB (MAX)}$ Integral linearity error : $\pm 2.0\text{ LSB (MAX)}$ Analog input range : 0.8 to 1.8 V
General-purpose	10-bit 100 kHz	$V_{DD} = 3.3\text{ V (TYP)}$, $I_{DD} = 1.5\text{ mA (TYP)}$
		Differential linearity error : $\pm 1.0\text{ LSB (MAX)}$ Integral linearity error : $\pm 2.0\text{ LSB (MAX)}$ Analog input range : 0.3 to 3.0 V
	8-bit 100 kHz	$V_{DD} = 3.3\text{ V (TYP)}$, $I_{DD} = 0.6\text{ mA (TYP)}$
		Differential linearity error : $\pm 1.0\text{ LSB (MAX)}$ Integral linearity error : $\pm 2.0\text{ LSB (MAX)}$ Analog input range : 0.3 to 3.0 V

<ul style="list-style-type: none"> <ul style="list-style-type: none"> DAC Core

NEC provides both video and general-purpose DAC cores.

For video	10-bit 30 MHz	$V_{DD} = 3.3\text{ V (TYP)}$, $I_{DD} = 7\text{ mA (TYP)}$
		Differential linearity error : $\pm 1.0\text{ LSB (MAX)}$ Integral linearity error : $\pm 2.0\text{ LSB (MAX)}$ Analog output voltage : 1.2 to 2.2 V
	8-bit 30 MHz	$V_{DD} = 3.3\text{ V (TYP)}$, $I_{DD} = 5\text{ mA (TYP)}$
		Differential linearity error : $\pm 0.5\text{ LSB (MAX)}$ Integral linearity error : $\pm 1.5\text{ LSB (MAX)}$ Analog output voltage : 1.4 to 2.4 V
General-purpose	10-bit 100 kHz	$V_{DD} = 3.3\text{ V (TYP)}$, $I_{DD} = 40\text{ }\mu\text{A (TYP)}$
		Differential linearity error : $\pm 1.0\text{ LSB (MAX)}$ Integral linearity error : $\pm 1.0\text{ LSB (MAX)}$ Analog output voltage : 0 to 3.2 V
	8-bit 100 kHz	$V_{DD} = 3.3\text{ V (TYP)}$, $I_{DD} = 20\text{ }\mu\text{A (TYP)}$
		Differential linearity error : $\pm 1.0\text{ LSB (MAX)}$ Integral linearity error : $\pm 1.0\text{ LSB (MAX)}$ Analog output voltage : 0 to 3.2 V

Mixed Signal ASIC

■ MA-9 Family (0.35- μ m Mixed Signal ASIC) New Products

● Basic Specifications

Logic Block

Product Name		μ PD681XX
Technology		0.35- μ m BiCMOS technology
Supply Voltage		3.3 V \pm 0.3 V (I/O block, internal gates)
Maximum integration (logic only)		1.7 million gates (usable)
Interface level		LVTTTL
Delay time	Internal gates ^{Note 1}	114 ps (TYP)
	Input buffer ^{Note 2}	169 ps (TYP)
	Output buffer ^{Note 3}	864 ps (TYP)

Notes 1. Value assuming 2-input NAND power gate, fanout 2, and standard wiring length.

2. Value assuming fanout 2 and standard wiring length.

3. Value assuming load capacitance 15 pF, $I_{OL} = 18$ mA.

Analog Block

Product Name		μ PD681XX
Technology		0.35- μ m BiCMOS technology
Supply Voltage		3.3 V \pm 0.3 V
Transistors	NPN type	$f_T = 10$ GHz, $h_{FE} = 70$ (all TYP)
	PNP type (Vertical type)	$f_T = 2$ GHz, $h_{FE} = 30$ (all TYP)
	MOS	N-ch type, P-ch type for analog circuit
Polysilicon resistor^{Note}		Absolute precision: $\pm 20\%$, relative precision: $\pm 2\%$
Capacitor (MIM type)^{Note}		Absolute precision: $\pm 20\%$, relative precision: $\pm 2\%$

Note Values indicated are for reference only. The relative precision applies only to when the pin is positioned in an adjacent location.

Mixed Signal ASIC

■ MA-9 Family (0.35- μ m Mixed Signal ASIC) New Products

● Electrical Characteristics

Absolute Maximum Ratings

Item	Symbol	Conditions	Rating	Unit
Supply voltage	V_{DD}			
3.3-V			-0.5 to +4.6	V
I/O voltage	V_i/V_o			
LVTTL buffer		$V_i/V_o < V_{DD} + 0.5$ V	-0.5 to +4.6	V
Output current	I_o	$I_{oL} = 1$ mA	3	mA
		$I_{oL} = 2$ mA	7	mA
		$I_{oL} = 3$ mA	10	mA
		$I_{oL} = 6$ mA	20	mA
		$I_{oL} = 9$ mA	30	mA
		$I_{oL} = 12$ mA	40	mA
		$I_{oL} = 18$ mA	60	mA
		$I_{oL} = 24$ mA	75	mA
Operating ambient temperature	T_A		-40 to +85	$^{\circ}$ C
Storage temperature	T_{stg}		-65 to +150	$^{\circ}$ C

Caution If any of the parameters exceeds the absolute maximum ratings, even momentarily, the quality of the product may be impaired. The absolute maximum ratings are values that may physically damage the product(s). Be sure to use the product(s) within the ratings.

Definition of absolute maximum rating terms

Item	Symbol	Meaning
Supply voltage	V_{DD}	The range of voltage that, even if applied to the V_{DD} pin, will not cause destruction or lower reliability.
Input voltage	V_i	The range of voltage that, even if applied to the input pin, will not cause destruction or lower reliability.
Output voltage	V_o	The range of voltage that, even if applied to the output pin, will not cause destruction or lower reliability.
Input current	I_i	The absolute value of current capacity that, even if applied to the input pin, will not cause latchup to occur.
Output current	I_o	The absolute value of DC current capacity that, even if output from or input to the output pin, will not cause destruction or lower reliability.
Operating ambient temperature	T_A	Range of ambient temperature in which normal logical operation will occur.
Storage temperature	T_{stg}	Range of pin temperature that will not cause destruction or lower reliability when voltage and current are not applied.

[MEMO]

Particular Purpose IC

DSP	240
CCD Linear Image Sensor.....	243
Communication IC.....	245
Mass Storage IC	250
Global Positioning System IC	251
Display IC	251
Intelligent Power MOS LSI	254
Power Switch for USB Application	255
Image IC	255
MPEG IC.....	256
Audio IC	257
TV IC	259
Multisync Monitor IC.....	262
Digital Image IC	263
On-Screen Character Display IC	265
Video Camera IC.....	265
Remote Control IC.....	266
Clock IC	266
Rotary Encoder IC	266
A/D Converter IC	267
D/A Converter IC.....	267
Line Driver Receiver IC	267

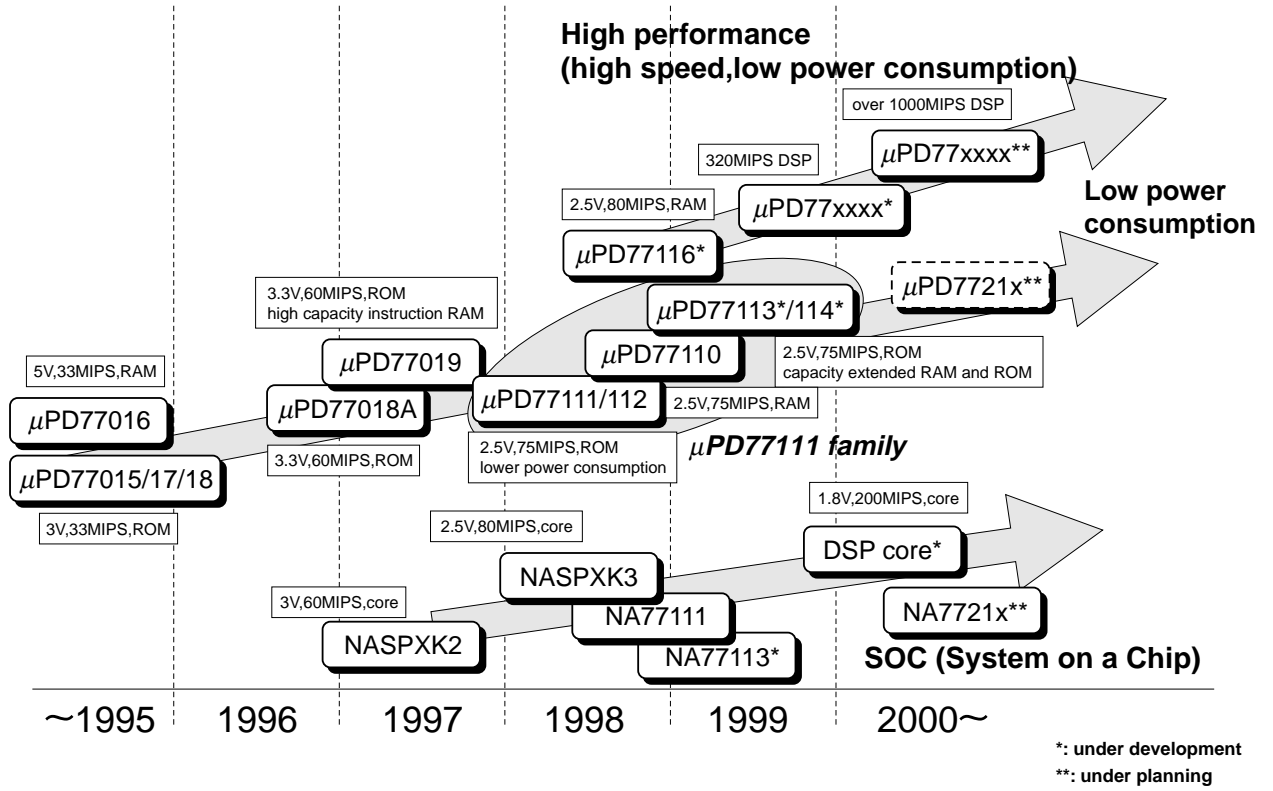
DSP

	μ PD77016	μ PD77018A	μ PD77019	μ PD77019-013
Instruction cycle (ns)	30	16.7	16.7	16.7
Data type	fixed point decimal	fixed point decimal	fixed point decimal	fixed point decimal
Multiplier precision (bits)	$40 + 16 \times 16 \rightarrow 40$	$40 + 16 \times 16 \rightarrow 40$	$40 + 16 \times 16 \rightarrow 40$	$40 + 16 \times 16 \rightarrow 40$
ALU precision (bits)	40	40	40	40
Internal memory (words \times bits)	Program ROM	24K \times 32	24K \times 32	–
	Program RAM	1.5K \times 32	256 \times 32	4K \times 32
	Data ROM	–	24K \times 16	24K \times 16
	Data RAM	4K \times 16	6K \times 16	6K \times 16
External memory (words \times bits)	48K \times 32 (program) 96K \times 16 (data)	32K \times 16 (data)	32K \times 16 (data)	32K \times 16 (data)
Power supply	5.0 V	3.0 V	3.0 V	3.0 V
Power consumption (TYP.)	4.2 mA/MHz (@5.0 V)	1.0 mA/MHz (@3.0 V)	1.1 mA/MHz (@3.0 V)	1.1 mA/MHz (@3.0 V)
Package	• 160-pin QFP	• 100-pin TQFP • 116-pin FBGA	• 100-pin TQFP	• 100-pin TQFP

	μ PD77110	μ PD77111	μ PD77112
Instruction cycle (ns)	13.3	13.3	13.3
Data type	fixed point decimal	fixed point decimal	fixed point decimal
Multiplier precision (bits)	$40 + 16 \times 16 \rightarrow 40$	$40 + 16 \times 16 \rightarrow 40$	$40 + 16 \times 16 \rightarrow 40$
ALU precision (bits)	40	40	40
Internal memory (words \times bits)	Program ROM	32K \times 32	32K \times 32
	Program RAM	35.5K \times 32	1K \times 32
	Data ROM	–	32K \times 16
	Data RAM	48K \times 16	6K \times 16
External memory (words \times bits)	64K \times 16 (data)	–	32K \times 16 (data)
Power supply	DSP core: 2.5 V I/O pins: 3.0 V	DSP core: 2.5 V I/O pins: 3.0 V	DSP core: 2.5 V I/O pins: 3.0 V
Power consumption (TYP.)	0.5 mA/MHz (@2.5 V)	0.4 mA/MHz (@2.0 V) 0.5 mA/MHz (@2.5 V)	0.4 mA/MHz (@2.0 V) 0.5 mA/MHz (@2.5 V)
Package	• 100-pin TQFP	• 80-pin TQFP • 80-pin FBGA	• 100-pin TQFP

DSP

■ DSP Development Plan



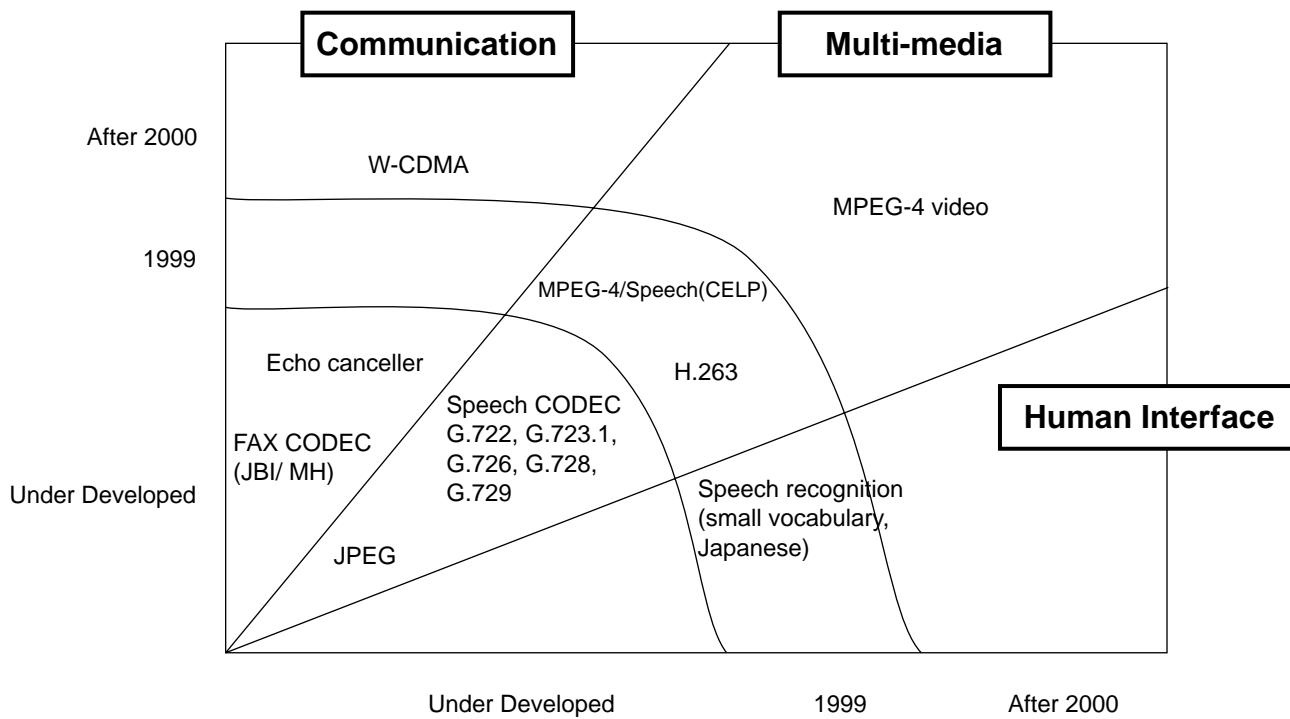
DSP

■ **DSP Middleware**

Field	Middleware	μPD77016 family
Image	JPEG	sample
	H.263	△
Speech	G.722	◎
	G.723.1	◎
	G.723.1 ANNEX A/C	◎
	G.726 (ADPCM)	◎
	G.728 (LDCELP)	◎
	G.729	◎
	G.729 ANNEX A/B	◎
	MPEG-4/Speech (CELP)	○
	Echo canceller (for hands-free operation)	◎
	Recognition	Speech recognition (Japanese)
		△ -

Remark ◎: Developed, ○: Under development, △: Under planning

■ **DSP Middleware Development Plan**



CCD Linear Image Sensor

■ Monochrome

Part number	μ PD3753	μ PD3734A	μ PD3739
Pixel number	2088	2660	5000
Resolution (dpi/sheet)	200/B4	300/A4	400/A3
Pixel size (μ m)	14 × 14	11 × 11	7 × 7
Sensitivity (TYP.) (V/lx*s)	90	70	9.0
Data rate (MAX.) (MHz)	2	5	40 (20 × 2)
Readout method	single-sided	dual-sided	
Output (ch)	1		2 (in or out of phase)
S/H circuit	—	○	—
Package	22-pin plastic DIP (400 mil)	22-pin plastic DIP (400 mil)	22-pin ceramic DIP (CERDIP) (400 mil)
Features	5 V power supply	Low image lag	μ PD35H71A pin compatible

Light source of the Sensitivity: Daylight color fluorescent lamp

■ Color

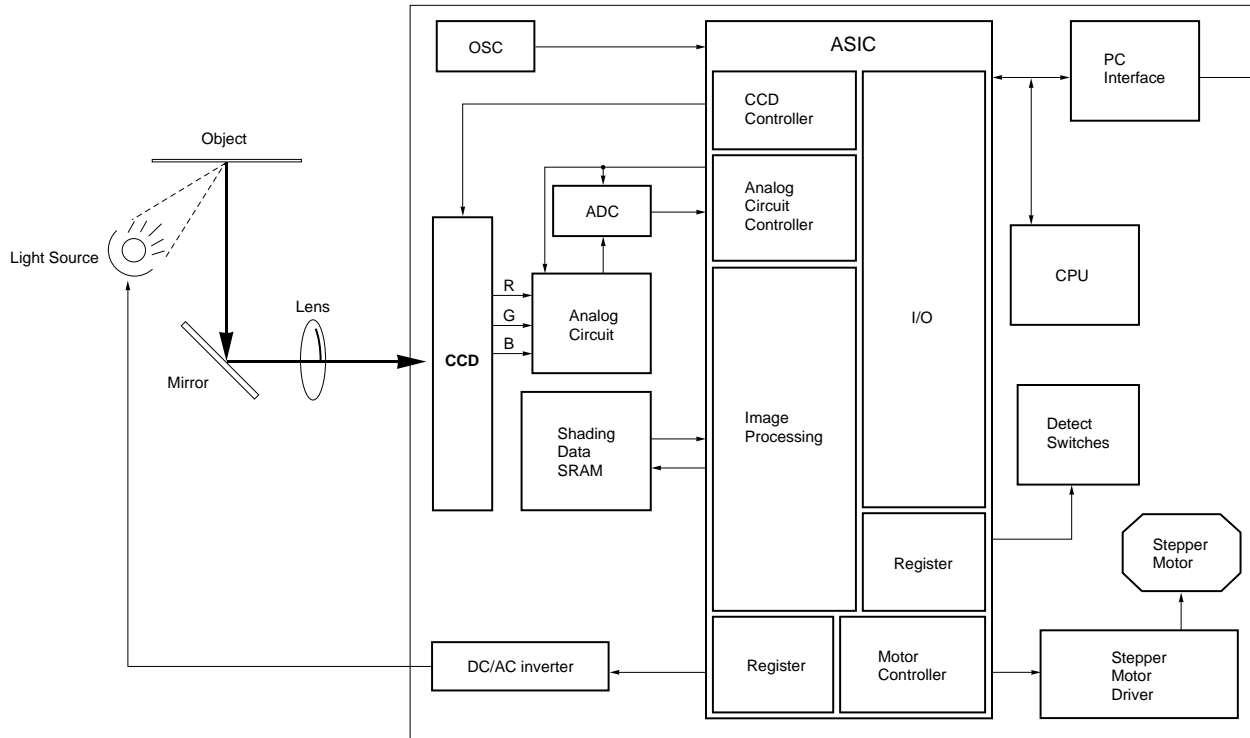
Part number	μ PD3794	μ PD3797	μ PD3799
Pixel number	2700 × 3	5300 × 3	
Resolution (dpi/sheet)	300/A4	600/A4	
Pixel size (μ m)	8 × 8	7 × 7	
Sensitivity (TYP.) (V/lx*s)	R	14.6	11.2
	G	13.3	10.2
	B	8.00	6.10
Line spacing	4 (32 μ m)	4 (28 μ m)	
Data rate (MAX.) (MHz)	4	3	4
Readout method	single-sided		
Output (ch)	1	3	
Clamp pulse generator	○	—	○
Package	22-pin plastic DIP (400 mil)	32-pin plastic DIP (glass cap) (400 mil)	32-pin plastic DIP (plastic cap) (400 mil)
Features	On-chip multiplexer	On-chip S/H circuit	upgraded from μ PD3797

Part number	μ PD3719	μ PD3729	μ PD3728
Pixel number	10600 × 3	5000 × 3	7300 × 3
Resolution (dpi/sheet)	1200/A4	400/A3	600/A3
Pixel size (μ m)	7 × 7	10 × 10	
Sensitivity (TYP.) (V/lx*s)	R	9.70	5.60
	G	8.80	5.10
	B	5.30	6.40
Line spacing	10 (70 μ m)	4 (40 μ m)	
Data rate (MAX.) (MHz)	2	30 (15 × 2)	40 (20 × 2)
Readout method	single-sided	dual-sided	
Output (ch)	3	6 (2-output/color (in phase))	
Clamp pulse generator	—		
Package	36-pin ceramic DIP (600 mil)	24-pin ceramic DIP (400 mil)	36-pin ceramic DIP (600 mil)
Features	V_{sat} : 4.0 V (MIN.), 15 V power supply, for professional color image scanners	High speed, for digital copiers	

Light source of the Sensitivity: 3200K halogen lamp + C-500S (infrared cut filter, t = 1 mm)

CCD Linear Image Sensor

■ CCD Linear Image Sensor System Block Diagram

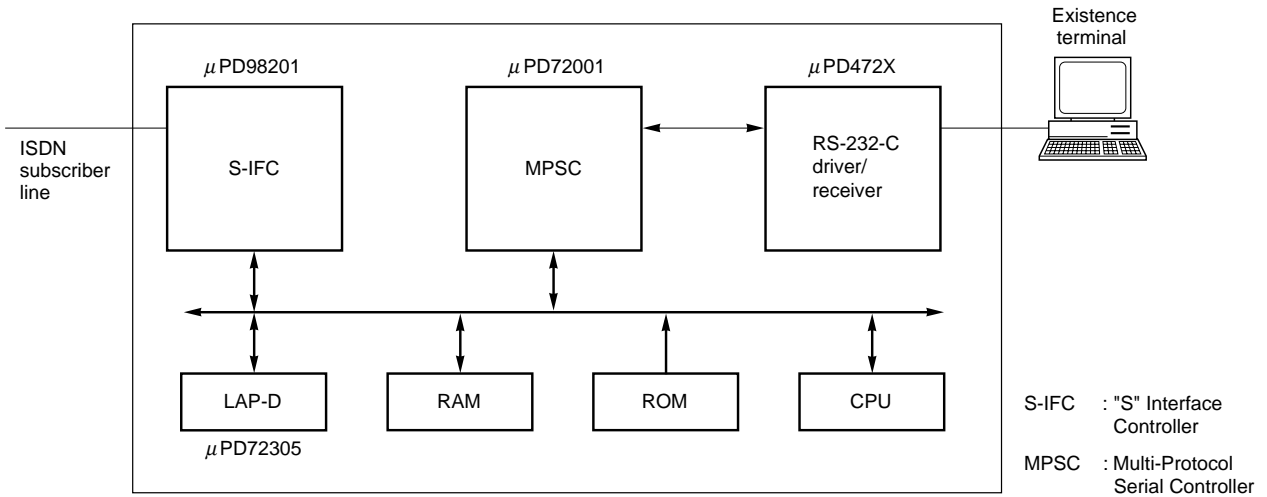


Communication IC

■ **Communication LSI**

Part number	Function	Features	Package
μ PD72001-11	Multi-protocol serial controller	Allows communication in ASYNC, COP, and BOP mode (2 ch) μ PD72001-11: 5 V Operation μ PD72001-A8: 3.3 V Operation	<ul style="list-style-type: none"> • 40-pin DIP • 52-pin QFP • 52-pin QFJ • 44-pin TQFP
μ PD72001-A8			<ul style="list-style-type: none"> • 40-pin DIP • 44-pin TQFP • 52-pin QFP
μ PD72002-11	Multi-protocol serial controller	Allows communication in ASYNC, COP, and BOP mode (1 ch)	<ul style="list-style-type: none"> • 40-pin DIP • 44-pin QFP • 44-pin QFJ • 44-pin TQFP
μ PD72103A	HDLC controller	HDLC frame control, link/separation are possible, internal DMA controller 8 Mbps operation	<ul style="list-style-type: none"> • 68-pin QFJ • 80-pin QFP
μ PD72107	Packet communication control LSI (X.25 communication control)	Conforms ITU-T recommendation X.25 (LAP-B '84 ver)	<ul style="list-style-type: none"> • 64-pin shrink DIP • 68-pin QFJ • 80-pin QFP
μ PD72305	LAP-D protocol processing LSI	Supports LAP-D protocol of ITU-T recommendation	<ul style="list-style-type: none"> • 64-pin shrink DIP • 68-pin QFJ • 80-pin QFP
μ PD98201	S interface transceiver for NT or TE	4-wire full duplexed communication (basic access) Conforms to ITU-T recommendation I430	• 64-pin QFP
μ PD98203	S interface transceiver for NT	Conforms to ITU-T recommendation I430	• 20-pin DIP
μ PD6708	IE Bus™ controller/driver	Transmit data buffer: 4 bytes Receive data buffer: 20 bytes	<ul style="list-style-type: none"> • 16-pin SOP • 16-pin DIP
μ PD72042A		Transmit data buffer: 33 bytes Receive data buffer: 40 bytes	• 16-pin SOP
μ PD72042B			

■ **ISDN Terminal Adapter**

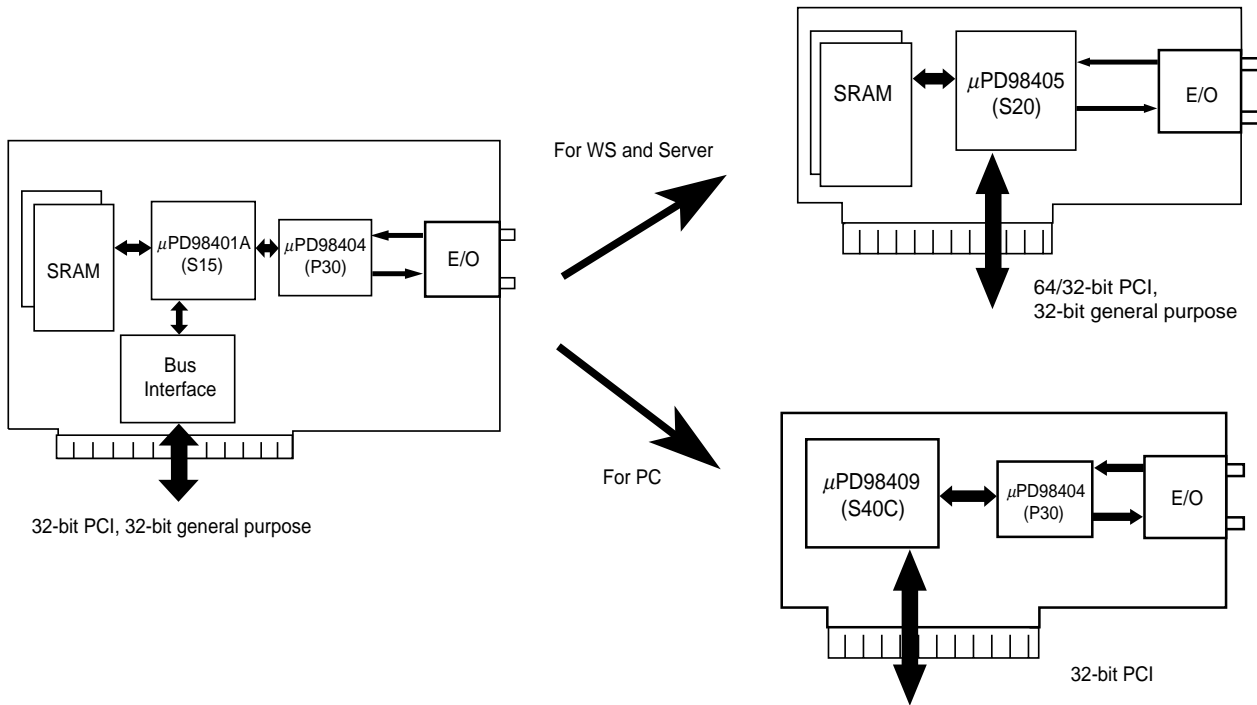


Communication IC

■ Chip Set for ATM

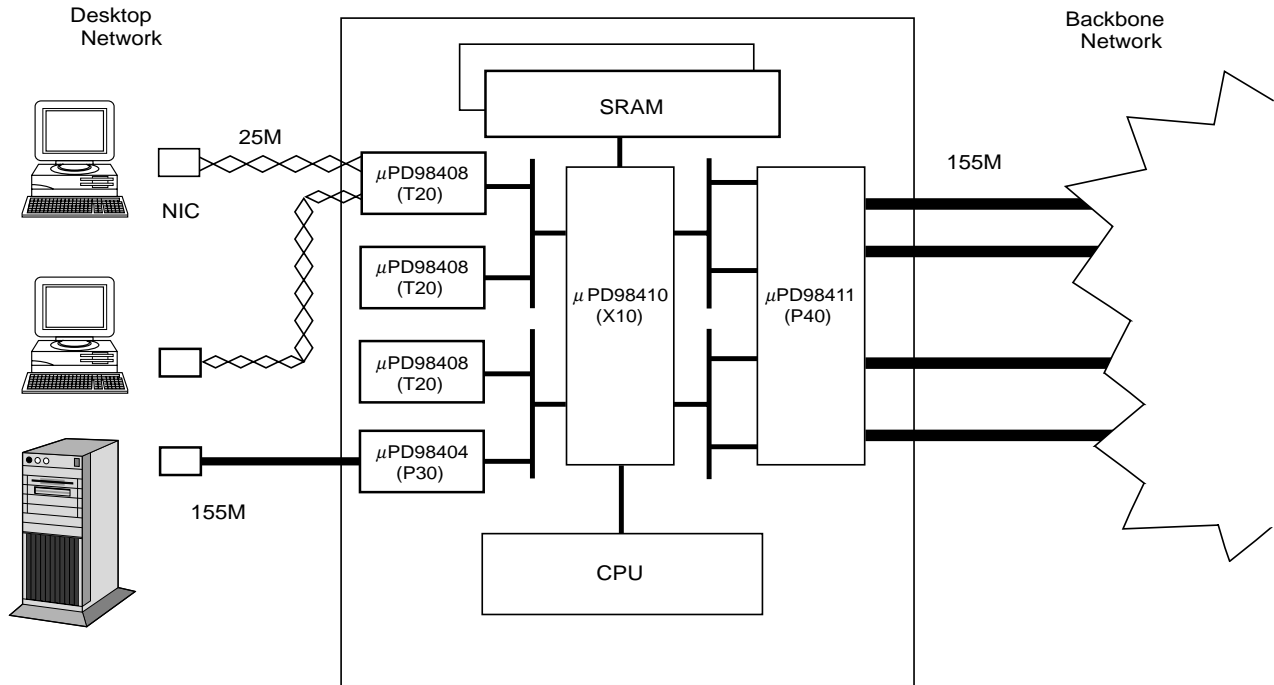
Part number	Function	Features	Package
μ PD98401A	ATM SAR Chip	<ul style="list-style-type: none"> Upward compatible with μPD98401 Conforms to ATM Forum recommendations Implements AAL-5 SAR sublayer and ATM layer functions 	<ul style="list-style-type: none"> 208-pin QFP (Fine Pitch)
μ PD98404	ATM Advanced SONET Framer	<ul style="list-style-type: none"> Supports TC sublayer in PHY layer Implements SONET STS-3c/SDH STM-1 (155 Mbps) framer function Integrated Clock recovery/Clock synthesis function UTOPIA Level 2 interface 	<ul style="list-style-type: none"> 144-pin QFP (Fine Pitch)
μ PD98405	ATM Integrated SAR controller	<ul style="list-style-type: none"> SONET STS-3c/SDH STM-1 (155M bps), Framer and SAR controller with ABR function in a single-chip Support both PCI bus and generic bus 	<ul style="list-style-type: none"> 304-pin QFP (Fine Pitch)
μ PD98408	6 port 25M ATM PHY	<ul style="list-style-type: none"> 25.6 Mbps ATM PHY (PMD & TC) function for 6 circuits UTOPIA Level 2 interface 	<ul style="list-style-type: none"> 208-pin QFP (Fine Pitch)
μ PD98409	ATM Light SAR Controller	<ul style="list-style-type: none"> Implements AAL-5 SAR sublayer and ATM layer function Supports PCI bus interface MPEG packet transfer engine 	<ul style="list-style-type: none"> 240-pin QFP (Fine Pitch)
μ PD98410	1.2 Gbps ATM Switch	<ul style="list-style-type: none"> ATM switching function in a single-chip 1.2 Gbps with non blocking ABR traffic control 	<ul style="list-style-type: none"> 580-pin BGA
μ PD98411	ATM QUAD SONET FRAMER	<ul style="list-style-type: none"> Implements 4 ports SONET STS-3c/SDH-1 (155M bps) framer function on chip 	<ul style="list-style-type: none"> 240-pin QFP (Fine Pitch)

■ PCI Bus Supporting ATM-NIC



Communication IC

■ ATM Switch



■ Ethernet LSI

Part number	Function	Features	Package
μPD98421	High Speed Address Search Engine	<ul style="list-style-type: none"> • CAM (64-bit × 8K Entry) • Implements three search modes 	<ul style="list-style-type: none"> • 240-pin QFP (Fine Pitch) • 240-pin FPBGA™
μPD98431	8-port 10/100 Mbps Ethernet Controller	<ul style="list-style-type: none"> • 8-port 10/100 Mbps Ethernet MAC • MII and 10 Mbps serial interface 	<ul style="list-style-type: none"> • 352-pin BGA

■ Standard USB

Part number	Function	Features	Package
μPD72011	USB Hub Controller	<ul style="list-style-type: none"> • All USB HUB function in a single-chip • Compliance with USB Specification 1.0 • Supports Self-powered and Bus-powered • 4 or 5 down-port selectable 	<ul style="list-style-type: none"> • 42-pin SDIP • 44-pin QFP
μPD72012		<ul style="list-style-type: none"> • Up-grade LSI of μPD72011 • Compliant with USB specification 1.1 • Built-in Mask-ROM for Generic HUB Descriptor Selectable to use Standard or User-Defined 	<ul style="list-style-type: none"> • 42-pin SDIP • 44-pin QFP

Communication IC

■ LSI for IEEE1394

Part number	Function	Features	Package
μPD72850	IEEE1394 400M PHY	<ul style="list-style-type: none"> Compliant with P1394a draft2.0 Selectable for 1-port, 2-port, 3-port Data Rate: 100/200/400 Mbps Compliant with MD8405 (FFM) 	<ul style="list-style-type: none"> 80-pin TQFP
μPD72861	IEEE1394 OHCI Host Controller	<ul style="list-style-type: none"> Compliant with Open HCI for IEEE1394-1995 1.0 Compliant with P1394a draft2.0 Data Rate: 100/200/400 Mbps Supports PCI-Bus/Cardbus 	<ul style="list-style-type: none"> 100-pin TQFP
μPD72870/71*	IEEE1394 1-chip OHCI Host Controller	<ul style="list-style-type: none"> Integrated OHCI LINK and .aPHY in a single chip 3-port: μPD72870, 1-port: μPD72871 	<ul style="list-style-type: none"> 160-pin LQFP 192-pin FPBGA

*: Under development

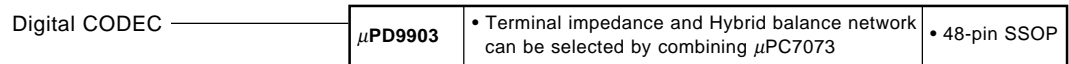
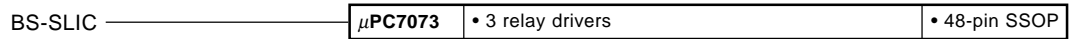
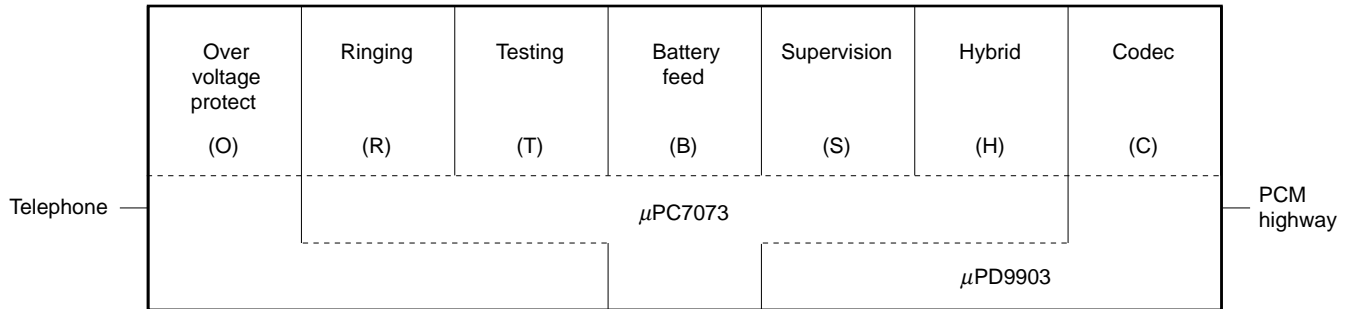
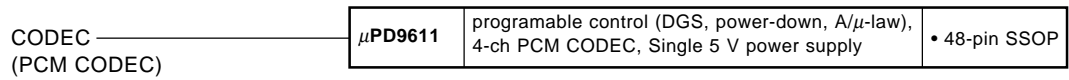
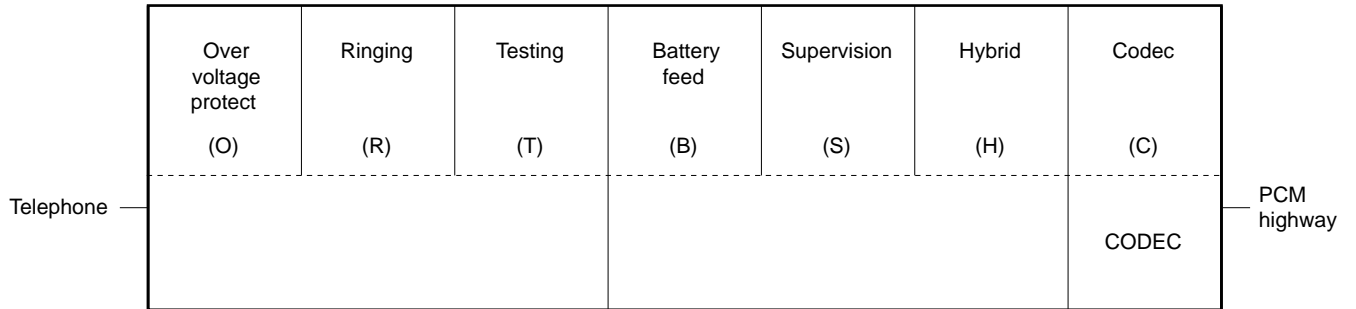
■ Power Switch for USB Application

Part number	Function	Internal circuit	Input voltage (V)	Circuit current (mA)	Output current (A)	Over current detect (A)	Package	Main application
μPD16855A	Pch High-side switch for USB (High active)	2	4.0 to 5.5	1.5	0.5	0.6 to 1.25	8-pin SOP (225 mil)	Note PC CRT monitor LCD monitor
μPD16855B	Pch High-side switch for USB (Low active)	2					8-pin DIP (300 mil) 8-pin SOP (225 mil)	
μPD16855C	Pch High-side switch for USB (High active, instant switch off)	2					8-pin SOP (225 mil)	
μPD16855D	Pch High-side switch for USB (Low active, instant switch off)	2					8-pin SOP (225 mil)	
μPD16874*	Pch High-side switch for USB (Low active)	4		2.5			16-pin DIP (300 mil) 16-pin SOP (300 mil)	CRT monitor LCD monitor
μPD16875*	Pch High-side switch for USB (Low active)	2		0.1			8-pin DiP (300 mil) 8-pin SOP (225 mil)	Key board HUB BOX

*: Under development

Communication IC

■ Analog Line Card LSI



Mass Storage IC

Part number	Function	Features	Package
μPC2575	RF amplifier for 24X speed CD-ROM	RF amplifier, error amplifier for 24X speed CD-ROM	• 36-pin SSOP
μPC2576	RF amplifier for 32X speed CD-ROM	RF amplifier, error amplifier for 32X speed CD-ROM Supports CD-RW Lens error amplifier Supports voltage output type pickup Power management	• 38-pin SSOP
μPD63724A	1 chip CD-ROM controller	Digital Servo, Data Processor, CD-ROM Decoder, Host I/F on 1 chip Supports 24X speed operation Automatic adjustment function Wide capture range High speed CAV audio playback Supports PIO mode 4, DMA mode 2 (Enhanced IDE/ATAPI) Power management Digital audio interface output	• 160-pin LQFP
μPD63725		Digital Servo, Data Processor, AudioDAC, CD-ROM Decoder, Host I/F, 1MbitSRAM on 1 chip Supports 32X speed operation Automatic adjustment function with μPC2576 Wide capture range by analog PLL High speed CAV audio playback Supports PIO mode 4, DMA mode 2 (Enhanced IDE/ATAPI) Supports UltraDMA mode 2 Supports CD TEXT Power management	• 176-pin QFP

Global Positioning System IC

RF IC for GPS receiver

Type	Part number	Function (frequency unit: MHz)	V _{cc} (V)	I _{cc} (mA)	CG (dB)	Package
General purpose wideband separate IC	μ PC2756	RF downconverter with osc. Tr	2.7 to 3.3	6	14	<ul style="list-style-type: none"> • 6-pin mini-mold • 6-pin super mini-mold
	μ PC2753	IF downconverter with gain control amplifier	2.7 to 3.3	6.5	60 to 79	<ul style="list-style-type: none"> • 20-pin plastic SSOP (225 mil)
Clock frequency specific 1 chip IC	μ PB1005	RF/IF downconverter + PLL synthesizer TCXO = 16.368/1stIF = 61.380/ 2ndIF = 4.092	2.7 to 3.3	45	72 to 92	<ul style="list-style-type: none"> • 36-pin plastic QFN

Typical performance. (T_A = +25°C, V_{cc} = 3.0 V)

Display IC

Fluorescent indicator panel (FIP) driver IC

Part number	Drives	Number of outputs	Withstand voltage (V)	Output current (mA)	Output type	Package	Main applications
μ PD6320	Static	39	18	1	CMOS	• 52-pin QFP	Car stereo
μ PD6321							
μ PD6323	Static	21	25	5	Pch-O.D	• 28-pin DIP	Automotive
μ PD6323B			40				
μ PD6340	Dynamic	20	80	25	NPN+Nch	• 52-pin QFP	ECR, PPC
μ PD6700	Static	47	18	1	CMOS	• 56-pin QFP	Car stereo
μ PD16304	Dynamic	40	200	20	CMOS	• 80-pin QFP*	Graphic FIP module
μ PD16306	Dynamic	64	80	50	CMOS	• 100-pin QFP	
μ PD16306A	Dynamic	64	80	25	CMOS	• 100-pin QFP	
μ PD16310	Dynamic	40	80	50	CMOS	• 80-pin QFP*	
μ PD16326	Dynamic	32	130	20	CMOS	• 44-pin QFP	
μ PD16326A	Dynamic	32	150	20	CMOS	• 44-pin QFP	

※: Three direction lead

Fluorescent indicator panel (FIP) controller/driver IC

Part number	Drives	Duty (Max.)	Number of outputs		Number of characters*	Logic voltage (V)/ Drive voltage (V)	Package	Main application	Remarks
			Segments	Grids					
μ PD16311	Segment	1/16	12	16	192 segments	5/35	• 52-pin QFP	VCR	Included key scan
μ PD16312	Segment	1/11	11	11	121 segments	5/35	• 44-pin QFP	VCR	
μ PD16313	Segment	1/11	11	11	121 segments	5/35	• 44-pin QFP	VCR	Included key scan (μ PD16312 mirror)
μ PD16314	DOT character	1/24	80	24	24 × 2 characters	5/50	• 144-pin QFP	OA, FA	
μ PD16315*	Segment	1/14	16	14	224 segments	5/35	• 44-pin QFP	VCR	Included key scan

※: At maximum duty

★: Under development

Display IC

■ Liquid crystal display (LCD) controller/driver IC

Part number	Drives	Duty (MAX.)	Number of outputs		Number of characters*1	Logic voltage (V)/ Drive voltage (V)	Package	Main application	Remarks
			Segments	Commons					
μPD7225	Segment	1/4	32	4	128 segments	2.7 to 5.5/ 2.7 to 5.5	• 52-pin QFP • 56-pin QFP	Car audio	Included key scan
μPD16430A			60	4	240 segments	3.5 to 6/ 3.5 to 14	• 80-pin QFP		
μPD16431A			56	4	224 segments	2.7 to 5.5/ 2.7 to 6.5	• 80-pin QFP		
μPD16432B	DOT character	1/15			12 × 2 characters + 60 pictographs	2.7 to 5.5/12	• 100-pin QFP		
μPD16434		1/16	42	16	8 × 2 characters	2.7 to 5.5/12	• 80-pin QFP		
μPD16435 μPD16435A	Graphic	1/73	119	73	119 × 71 dots + 119 × 2 pictographs	2.7 to 5.5/10*2	• TCP		
μPD16435B							• CHIP		
μPD16670	DOT character	1/36	60	33	12 × 4 characters + 60 pictographs	2.7 to 3.6/12*2	• CHIP	Mobile phone	Included DC/DC Converter
μPD16675A	Graphic		128	34	128 × 32 dots + 128 × 2 pictographs	2.7 to 5.5/10*2		Pager	
μPD16676			1/16 1/32	61	16	61 × 16 dots		2.7 to 5.5/12	
μPD16680	Graphic	1/53	100	53	100 × 51 dots + 100 × 2 pictographs	2.7 to 3.6/12*2	• CHIP	Mobile phone	Included DC/DC Converter
μPD16681		1/52	96	52	96 × 52 dots + 96 pictographs (8 × 4 Japanese Kanji character)	2.45 to 4.0/12*2			• Included DC/DC Converter • Included Japanese Kanji ROM
μPD16682		1/65	132	65	132 × 64 dots + 132 pictographs	2.4 to 5.5/12*2			• CHIP • TCP

*1: At maximum duty

*2: Internal DC/DC Converter

Display IC

■ Liquid crystal display (LCD) driver IC

Part number	Drives	Number of outputs	Withstand voltage (V)	Logic voltage (V)	Package	Main applications
μ PD6320	Static	39	18	5.0	• 52-pin QFP	Car stereo
μ PD6321						
μ PD16448A	TFT (source) Analog	240	5.0	3.3	• TCP	LCD-TV
μ PD16780*		288/300	5.0	3.3/5.0		LCD-TV
μ PD16633B		312	10.5	3.3		XGA
μ PD16634A		300	8.5	3.3		SVGA
μ PD16638A		300/309	8.5	3.3		SVGA/XGA
μ PD16640A		300/309	3.3/5.0	3.3		SVGA/XGA
μ PD16640B						
μ PD16640C						
μ PD16644						
μ PD16647*	TFT (source) 64 gray scale	384	5.0	3.3		XGA
μ PD16710		402	3.3/5.0	3.3		SVGA
μ PD16715		300/309	12.0	3.3		SVGA/XGA
μ PD16715A*		384	13.5	3.3		XGA/SXGA
μ PD16732		384	8.5	3.3		XGA/SXGA
μ PD16732A						
μ PD16732B						
μ PD16740	TFT (source) 256 gray scale	384	8.5	3.3		XGA/SXGA
μ PD16750		384	8.5	3.3		XGA
μ PD16650	TFT (gate)	120/128	40	3.3/5.0		–
μ PD16652*		192/200	31	3.3		–
μ PD16654		150/154	40	3.3	–	
μ PD16655		240	31	3.3	–	
μ PD16661A		STN (column) 4 gray scale	160	5	3.3	PDA (1/8 VGA to VGA)
μ PD16666A	STN (row)	240	36	5.0	PDA (1/8 VGA to VGA)	
μ PD16662	STN (column) 4 gray scale	240	5	3.3	PDA (1/8 VGA to 1/2 VGA)	
μ PD16667	STN (row)	160	36	5.0	PDA (1/8 VGA to 1/2 VGA)	
μ PD16663	STN (column) 16 gray scale	240	5	3.3	PDA (1/8 VGA to 1/2 VGA)	
μ PD16664*	STN (column) 4 gray scale	208	5	3.3	PDA (144 × 128 to 416 × 320 dots)	

*: Under development

■ Plasma display, EL display driver IC

Part number	Drives	Number of outputs	Withstand voltage (V)	Output current (mA)	Output type	Package
μ PD16305	AC-PDP row	40	200	400	CMOS	• 80-pin QFP*
μ PD16306B	AC-PDP/EL column	64	80	50		• 100-pin QFP
μ PD16306A		64	80	25		• 100-pin QFP • 100-pin QFP
μ PD16310	AC-PDP/EL	40	80	50		• 80-pin QFP*
μ PD16327	AC-PDP column	64	100	40		• 100-pin QFP • 100-pin QFP
μ PD16331		40	100	150		• 80-pin QFP • 80-pin QFP
μ PD16334		96	80	50		• For COB
μ PD16335		96	80	50		• For COB
μ PD16337		64	150	40		• 100-pin QFP
μ PD16364*		160	60	25		• TCP

*: Three direction lead

*: Under development

Display IC

■ Other driver IC

Part number	Number of outputs	Withstand voltage (V)	Output current (mA)	Output type	Package	Main applications
μPD6320 μPD6321	4 × 4	18	20	NPN+Nch	• 52-pin QFP	Car stereo (LED)
μPD6345	8	40	100	NPN-O.C	• 16-pin DIP • 16-pin SOP	Thermal head, LED, solenoid

NPN-O.C: NPN open-collector output (sink driver)

Intelligent Power MOS LSI

■ Motor Driver

Part number	Function	Recommended operation voltage range (V)		Output current (A)	Package	Main application	
		Control part	Output part				
μPD16804	DC motor driver	3 to 6	Up to 7.5	±0.5	• 16-pin SOP	Camera, DSC	
μPD16805		3 to 6	Up to 7.5	±1.0			
μPD16823		2.5 to 6	Up to 7.5	±0.5			
μPD16803	stepping motor driver	4 to 6	4 to 13.2	±0.38	• 20-pin SOP	FDD (2 aspects excitation)	
μPD16808		4 to 6	4 to 13.2	±0.45		FDD (1-2 aspects excitation)	
μPD16813		4 to 6		±0.31	• 16-pin SOP	FDD (2 aspects excitation)	
μPD16814		4 to 6		±0.415		FDD (1-2 aspects excitation)	
μPD16818		2.7 to 6		±0.38	• 20-pin SOP • 20-pin SSOP	FDD (2 aspects excitation)	
μPD16833		2.5 to 5.5	2.7 to 5.5	±0.3	• 30-pin SSOP	camcorder 4 ch-H bridge	
μPD16833A		2.5 to 5.5	2.7 to 5.5	±0.3	• 30-pin SSOP • 26-pin TSSOP	camcorder 4 ch-H bridge	
μPD16835		2.7 to 5.5	4.8 to 11	±0.15	• 38-pin SSOP	camcorder microstep drive	
μPD16836		3 aspects blush-less DC motor driver	4.5 to 5.5	10.8 to 13.2	±1.3 peak	• 24-pin SOP (375 mil)	CD-ROM PWM drive
μPD16837		stepping motor driver	4 to 6	10.8 to 13.2	±1.0 peak	• 30-pin SSOP (0.8 mm pitch)	CD-ROM/DVD actuator drive
μPD16853B	3 aspects blush-less DC motor driver	4.5 to 5.5		±1.9 peak	CD-ROM PWM drive		
μPD16856	3 aspects blush-less DC motor driver	4.5 to 5.5	10.8 to 13.2	±2.0 peak	CD-ROM PWM drive		
μPD16857	stepping motor driver	3.0 to 3.6	10.8 to 13.2	±1.0 peak	• 38-pin SSOP	DVD-RAM	
μPD16858B μPD16858C	3 aspects blush-less DC motor driver	4.5 to 5.5		±1.5 peak	• 30-pin SSOP	CD-ROM PWM drive	
μPD16877	stepping motor driver	2.5 to 5.5	2.7 to 5.5	±0.25	• 24-pin TSSOP	camcorder 4-ch-H bridge	

■ Power MOS IC for Voltage Regulator

Part number	Function	Input voltage (V)	Output voltage (V)	Output current (mA)	Package	Main application
μPD16901	Step-up type DC/DC converter for PCMCIA	4.5 to 5.5	11.72 to 12.28	140	• 14-pin SOP	Note PC

Power Switch for USB Application

Part number	Function	Internal circuit	Input voltage (V)	Circuit current (mA)	Output current (A)	Over current detect (A)	Package	Main application	
μ PD16855A	Pch High-side switch for USB (H-active)	2	4.0 to 5.5	1.5	0.5	0.6 to 1.25	• 8-pin SOP (225 mil)	Note PC CRT monitor LCD monitor	
μ PD16855B	Pch High-side switch for USB (L-active)	2					• 8-pin DIP (300 mil) • 8-pin SOP (225 mil)		
μ PD16855C	Pch High-side switch for USB (H-active, instant switch off)	2					• 8-pin SOP (225 mil)		
μ PD16855D	Pch High-side switch for USB (L-active, instant switch off)	2							
μ PD16874*	Pch High-side switch for USB (L-active)	4		2.5			• 16-pin DIP (300 mil) 16-pin SOP (300 mil)		CRT monitor LCD monitor
μ PD16875*	Pch High-side switch for USB (L-active)	2		0.1			• 8-pin DIP (225 mil) • 8-pin SOP (225 mil)		Key board HUB BOX

*: Under development

Image IC

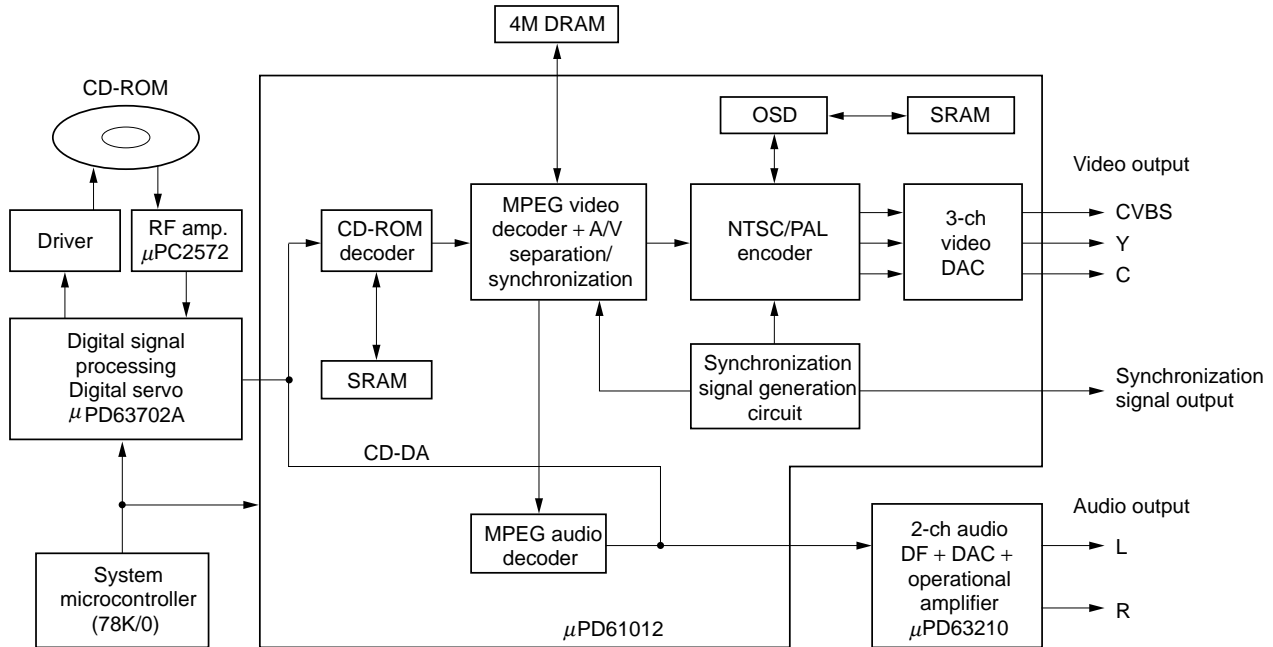
Part number	Function	Package
μ PD72254Y*	Graphics LSI	• 208-pin QFP

*: Under development

MPEG IC

Part number	Function	Package
μ PD61012	MPEG1 Audio/Video decoder for Video-CD	• 100-pin LQFP
μ PD61030	Signal processing for STB, includes MPEG2 Audio/Video decoder, TS demultiplexer, Graphics and Vr4110CPU	• 304-pin QFP

■ Video CD



Audio IC

■ Radio frequency amplification

Part number	Recommended operating voltage range (V)	Function					Recommended application Car radio	Package
		AM tuner	FM front end	FM IF amplification	FM detection	Other functions		
μ PC2533	7.5 to 8.5	●				Double super heterodyne DTS use	●	• 36-pin SOP

■ Pre-amplifier

Part number	Recommended operating voltage range (V)	Function				Recommended application		Package
		Play back amplifier	Recording amplifier	MIC amplifier	Other functions	Radio cassette recorder	Car radio	
μ PC1228	6 to 16	●			Dual	●	●	• 8-pin SIP

■ Power amplifier

Part number	Recommended operating voltage range (V)	Electrical characteristics (typical value)			Function	Recommended application			Package
		P _o (W)	V _{cc} (V)	R _L (Ω)		Home stereo	Radio cassette recorder	Car radio	
μ PC1316	3 to 16	1.2	9	8	Dual		●		• 14-pin DIPTAB
		0.5	6	8	Low pop noise				

■ D/A converter for audio system

Part number	Recommended operating voltage range (V)	Function	Recommended application			Package
			Home stereo	Portable	Car stereo	
μ PD6376	4.5 to 5.5	16-bit D/A converter	●	●	●	• 16-pin SOP
μ PD6379 μ PD6379A	4.5 to 5.5	16-bit D/A converter	●	●	●	• 8-pin SOP
μ PD6379L μ PD6379AL	3.0 to 5.5					
μ PD63200	4.5 to 5.5	18-bit D/A converter	●	●	●	• 16-pin SOP
μ PD63210 μ PD63210L	4.5 to 5.5 3.0 to 5.5	16-bit D/A converter with digital filter	●	●	●	• 28-pin SOP

■ Sound CODEC

Part number	Function	Features	Package
μ PD63310	Sound codec	<ul style="list-style-type: none"> • $\Delta\Sigma$ type ADCs and DACs are incorporated. • Mixers are incorporated into the analog input section and analog output section. • Low-noise microphone amplifiers are incorporated. • Sampling frequency: 2 to 48 kHz (master clock: 256 fs) • Single power source: +3 to 5.5 V • Operating temperature range: -20 to +80°C 	• 80-pin TQFP

Audio IC

■ **Device kit for CD**

Part number	Recommended operating voltage range (V)	Function	Recommended application			Package
			Home stereo	Portable	Car stereo	
μ PC2572	4.5 to 5.5	RF amp, error amp, APC for CD player	●		●	• 38-pin SOP
μ PD63702A	4.5 to 5.5	Digital servo, data processor, DAC for CD player	●		●	• 80-pin QFP
μ PD63710	4.5 to 5.5	RF amp, servo, data processor, ATT, DAC for CD player	●		●	• 100-pin LQFP

■ **Other functions**

Part number	Recommended operating voltage range (V)	Function	Recommended application			Package
			Home stereo	Tape deck	Radio cassette recorder	
μ PC1237	25 to 60	Stereo power amplifier protection circuit	●			• 8-pin SIP

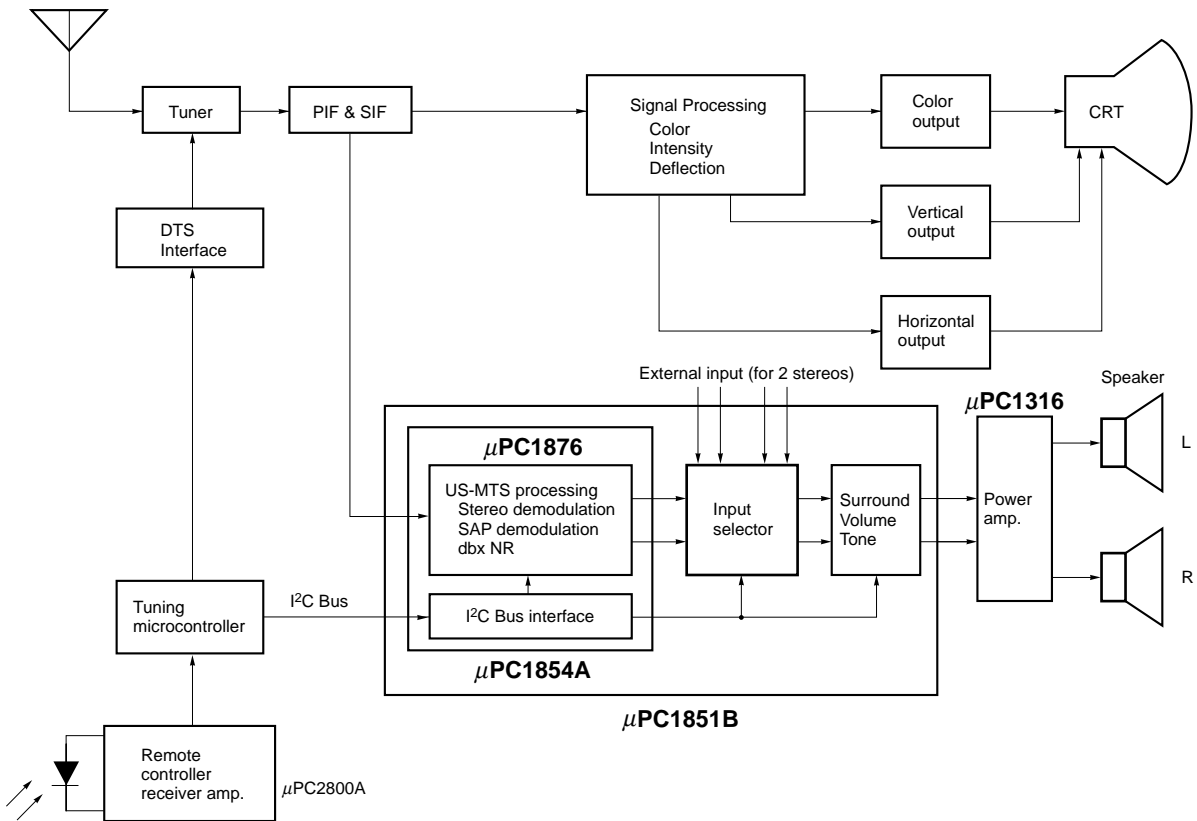
TV IC

■ US MTS Decoder

US MTS: Multi Television Sound for USA specifications

Part number	Function	Package
μ PC1851B	I ² C Bus, Input Selector (2 ch), dbx NR, SAP Decoder, Tone/Volume control	• 42-pin SDIP
μ PC1876	dbx NR, SAP Decoder	• 42-pin SSOP
μ PC1854A	I ² C Bus, dbx NR, SAP Decoder, Normal Output	• 28-pin SDIP • 28-pin SOP

■ US MTS (TV) System Block Diagram



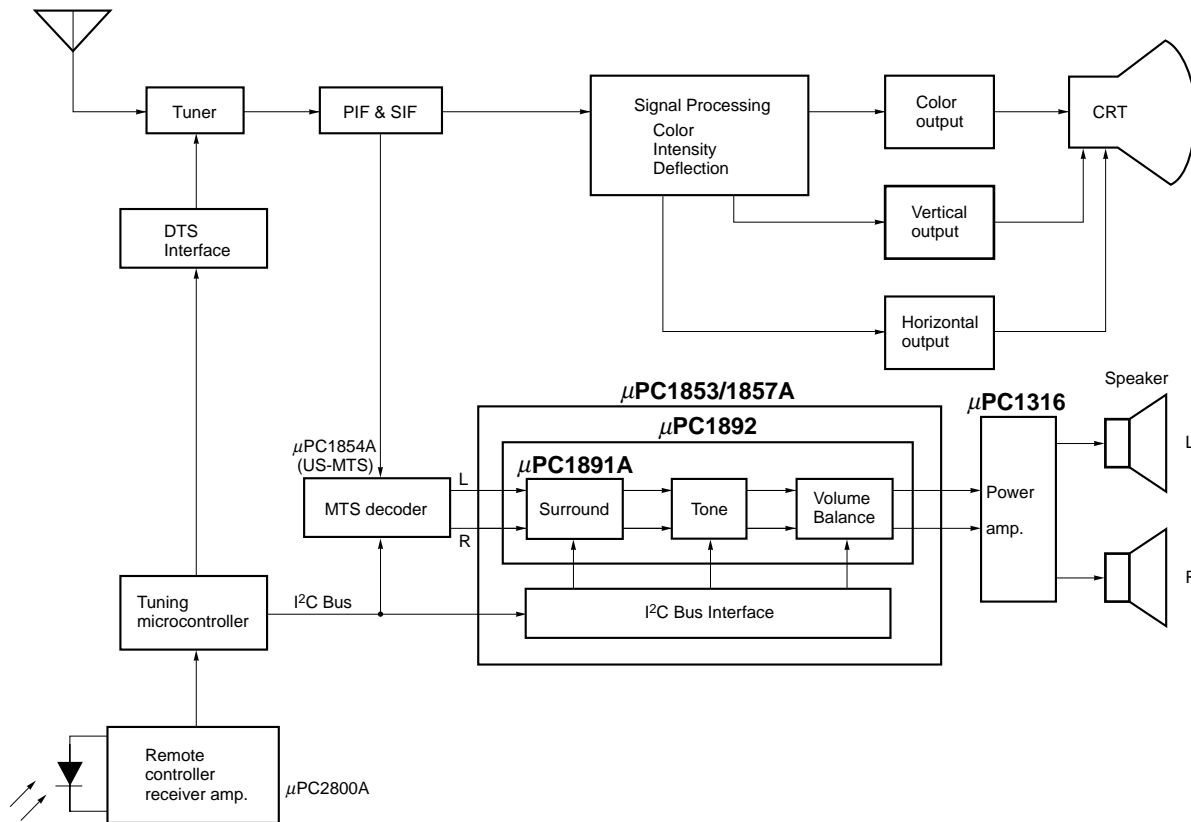
Remark DTS: Digital Tuning System
 MTS: Multichannel Television Sound
 PIF: Picture Intermediate Frequency
 SIF: Sound Intermediate Frequency

TV IC

■ **Matrix Surround**

Part number	Function	Package
μPC1891A	Matrix Surround (Phase Shift)	• 20-pin DIP
μPC1892	Matrix Surround (Phase Shift), Tone/Balance/Volume, L + R output	• 30-pin SDIP
μPC1853	I ² C bus, BASS boost, Matrix Surround, Tone/Balance/Volume, Audio output, L + R output	• 30-pin SDIP
μPC1857A	I ² C bus, Matrix Surround, Tone/Balance/Volume, Mixer input	• 30-pin SDIP

■ **Matrix Surround (TV) System Block Diagram**



Remark DTS: Digital Tuning System
 MTS: Multichannel Television Sound
 PIF: Picture Intermediate Frequency
 SIF: Sound Intermediate Frequency

TV IC

■ Digital Satellite Broadcasting

Part number	Function	Package
μ PD61511	A/D Converter, QPSK demodulation, Viterbi decoder, Reed-Solomon error correction	• 100-pin QFP
μ PC2781	AGC amplifier + Quadrature demodulator	• 20-pin SSOP
μ PC2782	L band frequency down converter + IF-AGC amplifier	• 20-pin SSOP
μ PC2795	L band frequency down converter	• 8-pin SSOP (175 mil)
μ PC3205	AGC amplifier + Quadrature demodulator	• 20-pin SSOP

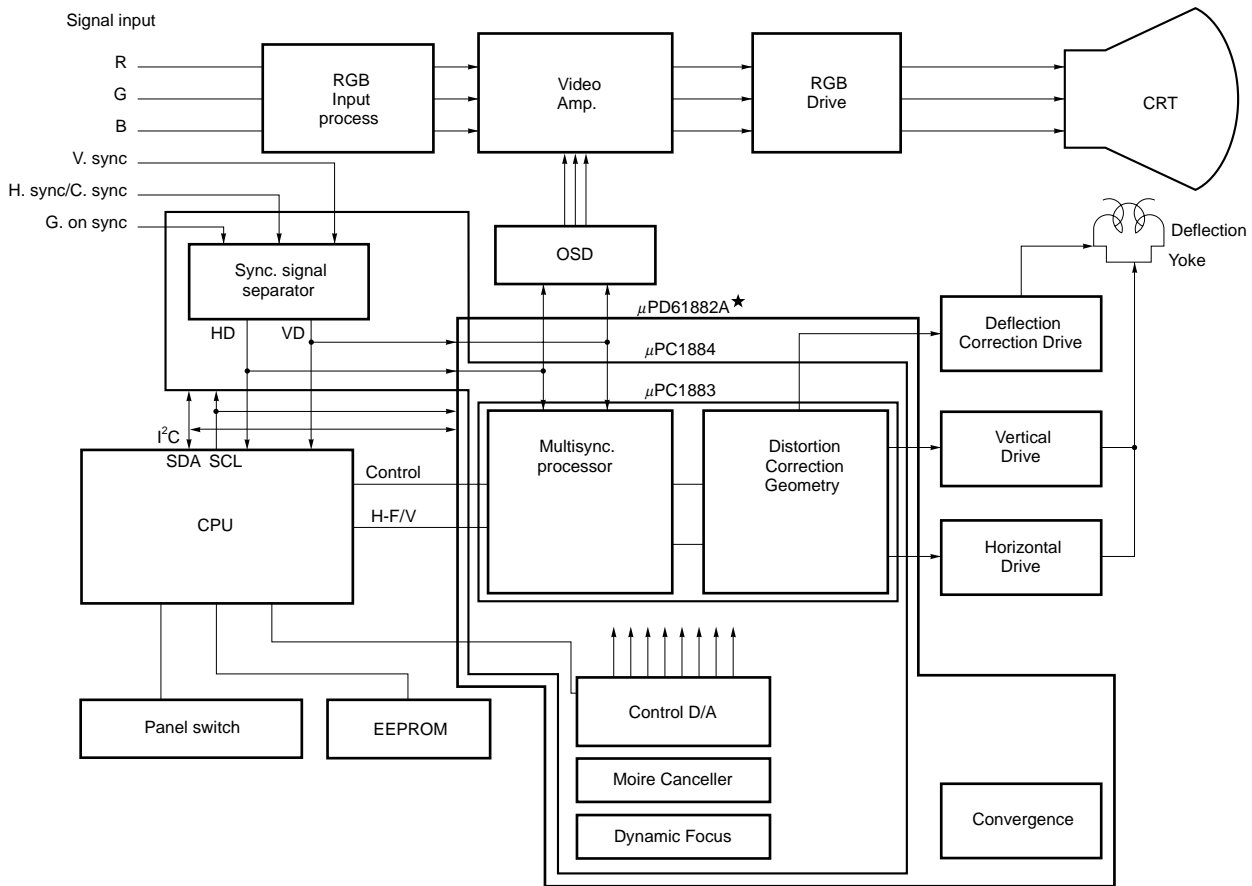
■ Digital CATV

Part number	Function	Package
μ PC2798GR	QAM IF down converter (AGC amplifier + MIX/OSC + Video amplifier)	• 20-pin SSOP
μ PC3206GR	50 dB AGC amplifier + Video amplifier	• 20-pin SSOP
μ PC3211GR	AGC amplifier for Return-pass	• 20-pin SSOP

Multisync Monitor IC

Part number	Function	Package
μ PC1883	Horizontal Vertical sync. processor, Picture geometry processor	• 30-pin SDIP
μ PC1884	Horizontal Vertical sync. processor, Picture geometry processor (I ² C bus)	• 30-pin SDIP
μ PD61882A*	Horizontal Vertical sync. processor, Picture geometry processor (I ² C bus)	• 64-pin QFP

*: Under development



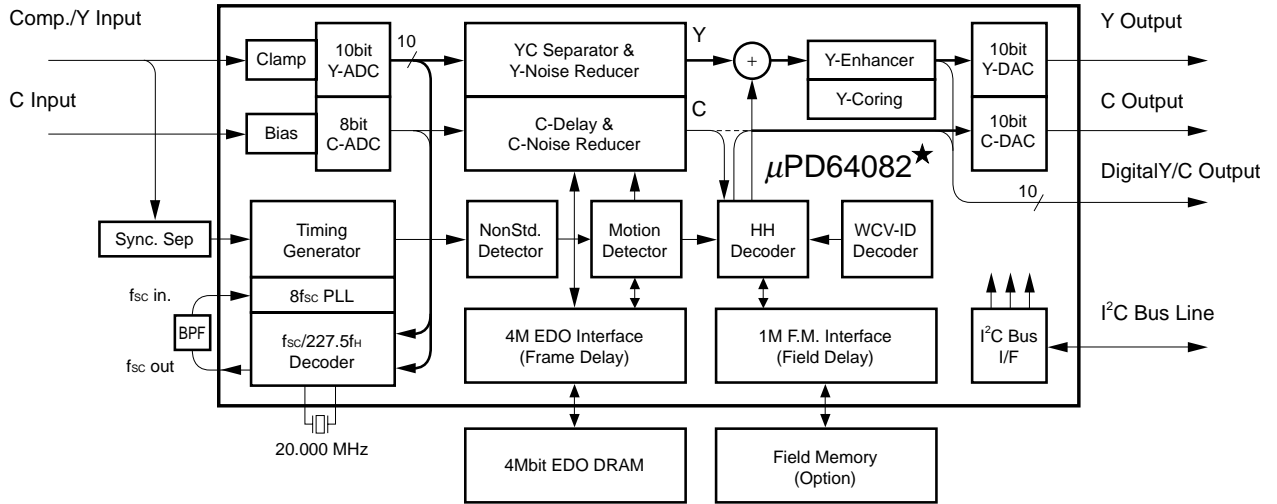
*: Under development

Digital Image IC

■ **3D Y/C Separator**

Part number	Function	Package
μ PD64082*	3D Y/C separator and noise reducer with 10 bit A/D converter	• 100-pin QFP

★: Under development



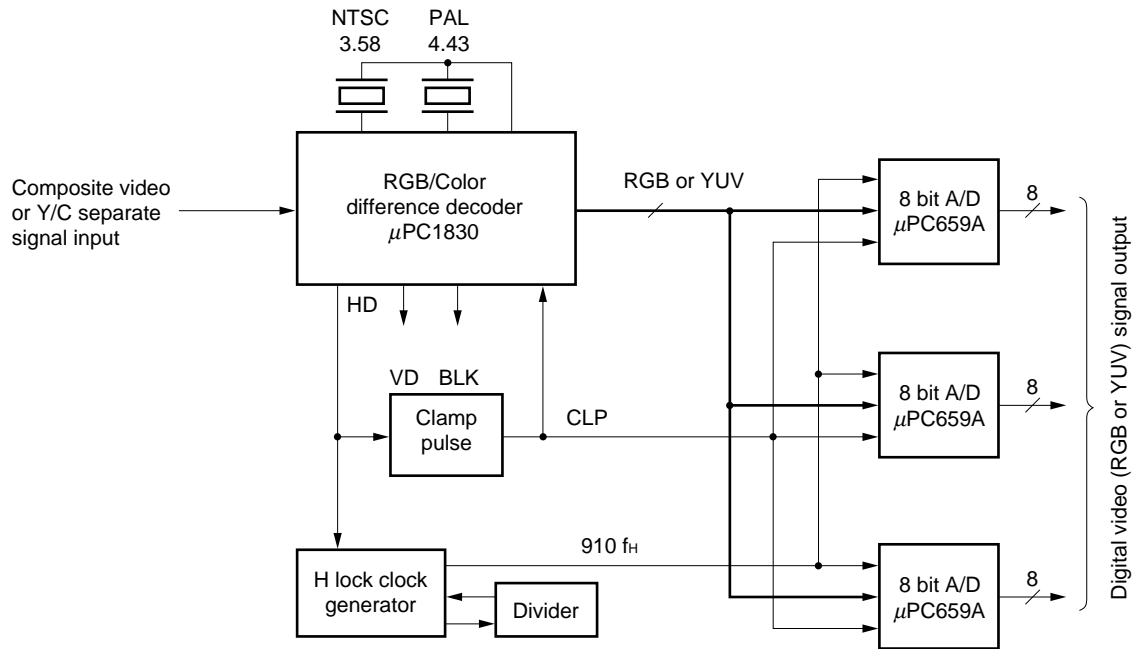
★: Under development

Digital Image IC

■ **Analog Frontend IC**

Part number	Function	Package
μ PC1830	5 V operation chroma decoder NTSC/PAL, 525/625 line, 50/60 Hz selectable, Matrix circuit	• 42-pin SOP

■ **Video capture system block diagram**



On-Screen Character Display IC

■ Video type

Function \ Part number	μ PD6464A	μ PD6465
Number of character types	128 (ROM)	256 (ROM)
Number of display characters	288 (12 lines \times 24 digits)	
Character configuration	12 \times 18	
Character color	Single (white, the luminance level of a character can be set in 2 stages.)	
Character size	1 dot/1H, 2H (per line)	
Internal video signal color	White/Black/Blue/Green	
Background	None/Fringed/Squared/Solid (per field)	
Applicable video signal mode	NTSC/PAL/PAL-M/SECAM	
Supply Voltage	4.5 to 5.5 V	
Package	<ul style="list-style-type: none"> • 24-pin SDIP (300 mil) • 24-pin SOP (375 mil) 	

- μ PD6464A adapts PAL-N.

■ RGB type

Function \ Part number	μ PD6461	μ PD6462	μ PD6466
Number of character types	256 (ROM)	128 (ROM)	512 (ROM)
Number of display characters	288 (12 lines \times 24 digits)		
Character configuration	12 \times 18		
Character color	8 colors		
Character size (per line)	1 dot/1H, 2H		1 dot/1H, 2H, 3H, 4H
Character color reverse (per character)	Black character/No fringed		Black character/No fringed White character/Fringed
Background (per frame)	None Square (8 colors) Solid (8 colors)		
Fringed (per frame)	Two colors (Black, White)		
Supply voltage	2.7 to 5.5 V		
Package	<ul style="list-style-type: none"> • 20-pin SSOP (300 mil) • 24-pin SOP (375 mil) 	<ul style="list-style-type: none"> • 20-pin SSOP (300 mil) 	<ul style="list-style-type: none"> • 20-pin SSOP (300 mil) • 24-pin SOP (375 mil)

- Making ideally suited for camcoders (μ PD6461, μ PD6462)
- μ PD6461 and μ PD6462 are commands convertible and pins convertible for 20-pin SSOP package.
- μ PD6466 has a blue background and character mirror reverse function.

Video Camera IC

■ CCD driver circuit

Part number	Function	Package
μ PD16501	Area sensor vertical drive interface	• 16-pin SOP (300 mil)
μ PD16502	Area sensor vertical drive interface	• 20-pin SOP (300 mil)
μ PD16510	Area sensor vertical, VOD shutter driver, for low voltage logic	• 22-pin SSOP (225 mil)
μ PD16520*	Area sensor vertical driver 10ch (3 state: 6, 2 state: 4), VOD shutter driver, for low voltage logic	• 38-pin SSOP (300 mil)

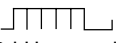
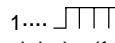
*: Under development

Remote Control IC

■ Infrared remote control preamplifiers IC

Part number	Supply voltage	Features	Package	Remarks
μ PC2800A	5 V \pm 10%	Internal high trap circuit	• 8-pin SOP	Active low type

■ Infrared remote control IC

Part number	μ PD6121G-001	μ PD6122G-001
Operating voltage range	2.0 to 3.3 V	
Operation clock (fosc)	400 to 500 kHz ceramic oscillator	
Transmission format	Leader	Custom code 16-bit
	Data code 8-bit	Data code 8-bit
Modulation mode	P.P.M. 0  1....  38 kHz • carrier modulation(fosc = 455 kHz)	
Custom code	16-bit set*	
Data code	32 \times 2	64 \times 2
Number of keys	32	64
Package	• 20-pin SOP	• 24-pin SOP

*: All codes except code "00FFH" are managed by NEC.

Clock IC

Part number	I/O	Alarm	Supply voltage (V)	Circuit Current (μ A)	Package
μ PD4990A	Serial	X	2.0 to 5.5	20	• 14-pin DIP • 16-pin SOP
μ PD4991A	4-bit • Parallel	○		14	• 18-pin DIP • 20-pin SOP
μ PD4992	8-bit • Parallel	X	2.4 to 5.5	6	• 20-pin DIP • 20-pin SOP

Rotary Encoder IC

Part number	Axis	Counter-bit	Supply voltage (V)	Package
μ PD4701A	2	12	5.0	• 24-pin DIP • 24-pin SOP
μ PD4702	1	8		• 20-pin DIP • 20-pin SOP
μ PD4704	1 (Expansion for μ PD4702)			

A/D Converter IC**■ A/D Converter for Video processing**

Part number	Resolution (bits)	Linearity (%FSR)	Sampling time (MSPS)	Supply voltage (V)	Data format	Output format	Package	Remarks
μ PC659A	8	0.2	20	+5	Binary	8-bit parallel	• 24-pin SOP	Parallel approximation Video processing

D/A Converter IC**■ D/A Converter**

Part number	Resolution (bits)	Linearity (%FSR)	Settling time (μ s)	Supply voltage (V)	Input format	Output format	Package	Remarks
μ PD6325	6 (4 circuits)	Monotonicity	200	+5 to +15 +5	Binary	Voltage output	• 16-pin DIP • 16-pin SOP	Serial input, CMOS
μ PD6335								
μ PD6326	6 (8 circuits)	Monotonicity	200	+5 to +15 +5	Binary	Voltage output	• 16-pin DIP	Serial input, CMOS
μ PD6336								
μ PD6221	8 (8 circuits)	0.31	100	+5	Binary	Voltage output	• 20-pin DIP • 20-pin SOP	I ² C-bus compatible Internal Output CMOS' Buffer
μ PD6222	8 (12 circuits)	0.31	100	+5	Binary	Voltage output	• 24-pin SDIP • 24-pin SOP	I ² C-bus compatible Internal Output CMOS' Buffer

■ D/A Converter for Video processing

Part number	Resolution (bits)	Linearity (%FSR)	Sampling rate (MSPS)	Supply voltage (V)	Input format	Output format	Package	Remarks
μ PC667	10	0.1	60	+5	Binary	Voltage output	• 30-pin SDIP	Parallel input Video processing

Line Driver Receiver IC

Part number	Driver	Receiver	Capacitor (μ F)	Supply voltage (V)	Package
μ PD4711B	2	2	1.0 to 4.7 (4 pcs)	5.0	• 20-pin DIP • 20-pin SOP
μ PD4712C	4	4	4.7 to 47 (4 pcs)		• 28-pin DIP • 28-pin SOP
μ PD4712D	4	4			• 24-pin DIP • 24-pin SOP
μ PD4713A	3	3			• 28-pin DIP • 28-pin SOP
μ PD4714A	3	5			• 20-pin SSOP
μ PD4715A	5	3	0.33 to 4.7 (4 or 5 pcs)	3.3/5.0	• 30-pin SSOP
μ PD4721	2	2	0.47 to 4.7 (4 or 5 pcs)		
μ PD4722	4	4	0.33 to 4.7 (4 or 5 pcs)		
μ PD4723	3	3			
μ PD4724	3	5	1.0 to 4.7 (4 pcs)		
μ PD4726	4	7			

[MEMO]

General Purpose Linear IC

Operational Amplifier	270
Comparator	271
Fixed Output Voltage, 3-Terminal Regulator	271
Variable Output Voltage Regulator	272
Regulator with System Reset	272
Regulator with ON/OFF Function.....	272
High Precision Reference Voltage	273
Switching Regulator Control Circuit	273
Functional Block	274

Operational Amplifier

Part number		Number of circuits*1	V _± (recommended value) (V)*2	V _{IO} (MAX.) (mV)	I _{CC} (MAX.) (mA)	SR (TYP.) (V/μs)	Features and Functions	Packages*3			Number of pins
Communication/industry use	General use							C	G2	HA	
μPC151	μPC741	1	±7.5 to ±16	±6	2.8	0.5	General purpose	○	○		8
μPC251	μPC1458	1	±7.5 to ±16	±6	5.6	0.5	General purpose	○	○		8
μPC258	μPC4558	2	±4 to ±16	±6	—	1.0	Low noise	○	○		8
μPC259	μPC4560	2	±4 to ±16	±6	—	2.8	Low noise, high output current	○	○		8
μPC451	μPC324	4	+3 to +30	±7	2.0	0.3	Single supply voltage	○	○		14
μPC452	μPC3403	4	+3 to +32	±7	7.0	0.8	Single supply voltage, high speed	○	○		14
μPC458	μPC4741	4	±4 to ±16	±5	7.0	1.0	Low noise	○	○		14
μPC801	μPC4081	1	±5 to ±16	±15	2.8	13	J-FET input	○	○		8
μPC802	μPC4250	1	±1 to ±16	±6	0.1	0 to 1.0	Micro-power	○	○		8
μPC803	μPC4082	2	±5 to ±16	±15	5.6	13	J-FET input	○	○		8
μPC804	μPC4084	4	±5 to ±16	±15	11.2	13	J-FET input	○			14
μPC811	μPC4091	1	±5 to ±16	±2.5	3.4	15	High accuracy, J-FET input	○	○		8
μPC812	μPC4092	2	±5 to ±16	±3	6.8	15	High accuracy, J-FET input	○	○		8
μPC813	μPC4093	1	±5 to ±16	±2.5	3.4	25	High accuracy, high speed, J-FET input	○	○		8
μPC814	μPC4094	2	±5 to ±16	±3	6.8	25	High accuracy, high speed, J-FET input	○	○		8
μPC815	—	1	±3 to ±20	±0.06	4.6	1.6	Super high accuracy	○			8
μPC816	—	1	±3 to ±20	±0.06	4.6	7.6	Super high accuracy	○			8
μPC821	μPC4071	1	±5 to ±16	±10	2.7	13	Low noise, J-FET input	○	○		8
μPC822	μPC4072	2	±5 to ±16	±10	5.0	13	Low noise, J-FET input	○	○	○	8*4
μPC824	μPC4074	4	±5 to ±16	±10	10.0	13	Low noise, J-FET input	○	○		14
μPC831	μPC4061	1	±2 to ±16	±10	0.25	3.0	Micro-power, J-FET input	○	○		8
μPC832	μPC4062	2	±2 to ±16	±10	0.5	3.0	Micro-power, J-FET input	○	○		8
μPC834	μPC4064	4	±2 to ±16	±10	1.0	3.0	Micro-power, J-FET input	○	○		14
μPC842	μPC4742	2	+3 to +32	±5	5.5	7.0	Single supply voltage, high speed, wide band	○	○		8
μPC844	μPC4744	4	+3 to +32	±5	11.0	7.0	Single supply voltage, high speed, wide band	○	○		14
μPC1251	μPC358	2	+3 to +30	±7	1.2	0.3	Single supply voltage	○	○	○	8*4
—	μPC4556	2	±4 to ±16	±6	—	5.0	Low noise, wide band	○	○		8
—	μPC4557	2	±4 to ±16	±6	—	1.0	Low noise, high output current	○			8
—	μPC4559	2	±4 to ±16	±6	—	2.0	Low noise, wide band	○			8
—	μPC4570	2	±4 to ±16	±5	8.0	7.0	Super low noise, wide band	○	○	○	8*4
—	μPC4572	2	±2 to ±7	±5	7.0	6.0	Super low noise, low voltage	○	○	○	8*4
—	μPC4574	4	±4 to ±16	±5	12.0	6.0	Super low noise, wide band	○	○		14

*1 : Single type has a offset adjust pin.

*2 : For product indicated by +/- voltage, single supply voltage operation is possible if the input/output voltage range is observed.

*3 : C, G2 or HA shows Package Type, as follows.

- C : Plastic DIP (300 mil)
- G2 : Plastic SOP (225 mil)
- HA : 9-pin plastic slim SIP

*4 : HA has 9 pins.

Comparator

Part number		Number of circuits	V _± (recommended value) (V)	V _{IO} (MAX.) (mV)	I* (MAX.) (mA)	t _d (TYP.) (μs)	Features and Functions	Packages*1			Number of pins
Communication/industry use	General use							C	G2	HA	
μPC177	μPC339	4	+2 to +32	±5.0	2.0	1.3	Single supply voltage	○	○		14
μPC271	μPC311	1	+5 to +32	±7.5	7.5	0.2	High speed	○	○		8
μPC272	μPC319	2	+5 to +32	±8.0	12.5	0.08	High speed	○	○		14
μPC277	μPC393	2	+2 to +32	±5.0	1.0	1.3	Single supply voltage	○	○	○	8*2

*1: C, G2 or HA shows Package Type, as follows.

C : Plastic DIP (300 mil)

G2 : Plastic SOP (225 mil)

HA : 9-pin plastic slim SIP

*2: HA has 9 pins.

Fixed Output Voltage, 3-Terminal Regulator

Type	Part number	Output current (A)	Output voltage (V)												Absolute maximum ratings		Package	Remarks		
			3	3.3	4	5	6	7	8	9	9.3	10	12	15	18	24			Input voltage (V)	Total power dissipation (W)*1
Positive voltage output	μPC78L00	0.1				○	○	○	○								30	0.7/2*3	• TO-92 • TO-243	
	μPC78N00	0.3				○			○								35	12.5	• TO-126	
	μPC78M00A	0.5				○	○	○	○	○							35	15	• MP-45*2	Improved version of μPC78M00
	μPC7800A	1.0				○			○		○		○	○	○		35	15	• MP-45*2	Improved version of μPC7800
	μPC29L00	0.1	○	○	○	○											16	0.7/2*3	• TO-92 • TO-243	Low dropout voltage type
μPC29M00	0.5	○	○		○	○	○	○	○			○	○			20	1.0/2.0*4 15	• TO-251 • TO-252 • MP-45*2	Low dropout voltage type	
μPC2900	1.0	○	○		○	○	○	○	○			○	○			20	1.0/2.0*4 15	• TO-251 • TO-252 • MP-45*2	Low dropout voltage type	
μPC24A00	2.0				○								○	○		36	20	• MP-45*2	Low dropout voltage type	
μPC24M00A	0.5				○	○	○	○	○			○	○	○	○	36	15	• MP-45*2	Low dropout voltage type	
μPC2400A	1.0				○	○	○	○	○			○	○	○	○	36	15	• MP-45*2	Low dropout voltage type	
Negative voltage output	μPC79L00	0.1				○			○							-30	0.7	• TO-92		
	μPC79N00	0.3				○			○								-35	12.5	• TO-126	
μPC79M00	0.5				○			○					○	○	○	-35	15	• MP-45*2		
																				-40
μPC7900A	1.0				○			○					○	○	○	-35	15	• MP-45*2	Improved version of μPC7900	
																				-40

*1 : Limited by internal circuit

*2 : TO-220 Plastic insulated package

*3 : With 16 cm² × 0.7 mm ceramic substrate

*4 : With 7.5 cm² × 0.7 mm ceramic substrate

Variable Output Voltage Regulator

Type	Part number	Output current (A)	Output voltage range (V)	Absolute maximum ratings		Package	Remarks
				Input voltage (V)	Total power dissipation (W)		
Positive voltage output	μ PC305	0.05	4.5 to 30	40	0.35, 0.44	• 8-pin DIP • 8-pin SOP	
	μ PC317	1.5	1.3 to 30	40	15*1	• MP-45*2	3-pin regulator
	μ PC1093	0.15	2.5 to 36	37	0.48, 0.7, 2*3, 0.2	• 8-pin SOP • TO-92 • TO-243 • 5-pin mini mold	Shunt regulator
	μ PC1943	0.05	1.26 to 24	25	1.6*3	• TO-243	Shunt regulator for Low Voltage
	μ PC1944	0.05	1.26 to 24	25	0.385, 0.56, 1.6*3	• 8-pin SOP • TO-92 • TO-243	Shunt regulator for Low Voltage
	μ PC1945*	0.015	0.4 to 9	12	0.41*4	• 5-pin mini mold	Shunt regulator for Low Voltage
Negative voltage output	μ PC337	1.5	-1.3 to -30	-40	15*1	• MP-45*2	3-pin regulator

*1 : Limited by internal circuit

*: Under development

*2 : TO-220 Plastic insulated package

*3 : When mounted on 16 cm² (0.7 mm thick) ceramic board

*4 : When mounted on 75 mm² (0.7 mm thick) ceramic board

Regulator with System Reset

Type	Part number	Output current (A)	Output voltage (V)	Reset start voltage (V)	Reset output logic		Absolute maximum ratings		Package	Remarks
					Active low	Active high	Input voltage (V)	Total power dissipation (W)		
Positive voltage output	μ PC2251	0.1	3	2.85	○		12	1.2*	• TO-126 (4-pin)	Low dropout type
	μ PC2253	0.1	5	2.85	○		12	1.2*	• TO-126 (4-pin)	Low dropout type
	μ PC2255	0.1	5	4.75	○		12	1.2*	• TO-126 (4-pin)	Low dropout type
	μ PC2260	0.5	5	4.85	○		35	20*	• TO-220 (5-pin)	Low dropout type

*: Limited by internal circuit

Regulator with ON/OFF Function

Part number	Output current (A)	Output voltage (V)	ON/OFF voltage (V)		Absolute maximum ratings		Package
			Output ON	Output OFF	Input voltage (V)	Total power dissipation (W)	
μ PC29S78	0.1	7.8	2.0	0.8	20	1.2*	• TO-126 (4-pin) • TO-126 Gullwing (4-pin)
μ PC29S10	0.1	10	2.0	0.8	20	0.48*	• 8-pin SOP

*: Limited by internal circuit

High Precision Reference Voltage

Part number	Input voltage range (V)	Output voltage (V)	Output current (mA)	Total power dissipation (mW)	Output voltage vs. temperature (ppm/°C)	Package
μ PC1060	4.5 to 40	2.5 \pm 0.025	10	350, 500	40	• 8-pin DIP

Switching Regulator Control Circuit

Part number	Input voltage range (V)	Absolute maximum ratings		Package	Output circuit operation mode	Applications
		Output current (mA)	Total power dissipation (W)			
μ PC494	7 to 40	250	1, 0.78*2, 0.65*2	• 16-pin DIP • 16-pin SOP*1 (375 mil/ 300 mil)	Push-pull/single selectable	General purpose
μ PC1094	11 to 24	1200 (peak)	0.57, 0.55	• 14-pin DIP • 14-pin SOP	Totem pole circuit configuration Single mode	Can operate up to 500 kHz General purpose
μ PC1099	11.5 to 24	1200 (peak)	1, 0.694	• 16-pin DIP • 16-pin SOP	Totem pole circuit configuration Single mode	Can operate up to 500 kHz General purpose
μ PC1905	12 to 30	1200 (peak)	1, 0.694	• 16-pin DIP • 16-pin SOP	Totem pole circuit configuration Single mode	Can operate up to 500 kHz General purpose
μ PC1909*	7 to 24	1200 (peak)	1, 0.694	• 16-pin DIP • 16-pin SOP	Totem pole circuit configuration Q, \bar{Q} output	Can operate up to 500 kHz ZCS, Half bridge
μ PC1100	3.6 to 40	25	1, 0.694	• 16-pin DIP • 16-pin SOP	2 outputs (synchronous control possible) If one output is shorted, both outputs will be turned OFF.	DC/DC converter
μ PC1150	3.6 to 40	25	1, 0.694	• 16-pin DIP • 16-pin SOP	2 outputs (synchronous control possible) If one output is shorted, only the output will be turned OFF.	DC/DC converter
μ PC1933	2.5 to 20	21	0.48	• 8-pin SOP	Open drain 1 output	DC/DC converter
μ PC1934	2.5 to 20	21	0.4, 0.417	• 16-pin SSOP • 16-pin T-SSOP	Open drain 2 outputs	DC/DC converter
μ PC1935	2.5 to 20	21	0.417	• 16-pin T-SSOP	Open drain 3 outputs	DC/DC converter
μ PC16902*	5.2 to 25	1000 (peak)	0.625	• 30-pin SSOP	High side: necessary drivers Low side: push-pull drivers	5 V, 3.3 V Synchronous rectifier controller

*1 : μ PC494G is 375 mil. μ PC494GS is 300 mil.

*2 : When mounted on 5×5 cm² (1.6 mm thick) glass epoxy board.

*: Under development

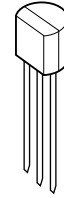
Functional Block

Function	Part number	Features	Package
Analog Multiplexer	μ PD5205	Single-pole 8 position mode/double-pole 4 position mode Supply Voltage: 44 V, ON Resistance: 270 Ω TYP.	<ul style="list-style-type: none"> • 24-pin shrink DIP • 24-pin SOP
Precision Timer	μ PC1555	CR Timer, Operating Temperature: $-20 \sim +80^{\circ}\text{C}$ Supply Voltage: 4.5 ~ 16 V, Free Running Frequency: 0.1 ~ 100 kHz	<ul style="list-style-type: none"> • 8-pin DIP • 8-pin SOP
	μ PD5555	CMOS CR Timer, CMOS Type of μ PC1555 Supply Voltage: 3 ~ 16 V, Free Running Frequency: 0.1 ~ 500 kHz	<ul style="list-style-type: none"> • 8-pin DIP • 8-pin SOP
	μ PD5556	CMOS CR Timer Dual Type of μ PD5555	<ul style="list-style-type: none"> • 14-pin DIP • 14-pin SOP

Transistor/Diode/Thyristor

Transistor	276
• Quick Reference by Package	276
• Quick Reference Table by Function/Application	286
Field Effect Transistor	292
• Small Signal FET	292
• Power MOS FET	295
Transistor with Internal Resistor	309
Transistor for Array	314
Transistor Array	315
Zener Diode	317
Noise Clipping Diode	319
Thyristor	321

Quick Reference by Package



TO-92

■ TO-92 Type Transistor

V_{CE0} (V) I_c (A)	~15	~30	~50	~70	~100	~150	~200	~250	~400
~20 m		2SC1674							
~50 m	2SA1206**					2SA988 2SA992 2SC1841 2SC1845			
~100 m			2SA733 2SA990 2SC945 2SC1842 2SC1843 AA1[] AN1[]		2SA675 ¹⁾		2SA1376 2SA1376A 2SC3478 2SC3478A	2SA1544	
~200 m	2SC2901**		2SC3622* (150 mA) 2SC3622A* (150 mA)						
~500 m			2SC3615* (300 mA)	2SA953 2SC2002	2SA954 2SC2003				2SA1625
~1.0		2SA952 2SC2001 2SC3616* (25 V/ 700 mA) AB1[] (25 V/ 700 mA) AP1[] (25 V/ 700 mA)	2SB1116 2SD1616	AD1[] AD2[]*** AR1[] 2SB1116A (60 V) 2SD1616A (60 V)*** 2SD1701 (60 V)	2SD1698 (80 V)				
~2.0		2SD1513 (16 V/2.0 A) 2SB1068 (16 V/2.0 A) AQ1[] (20 V/2.0 A)							
~3.0		2SB1300 (16 V/3 A)							

1) V_{CES} : Darlington transistor, *: High h_{FE} transistor, **: High speed switching, ***: Contains internal zener diode

Quick Reference by Package



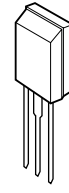
SST

■ SST Type Transistor

V_{CE0} (V) I_C (A)	~15	~20	~30	~50	~120
~20 m	2SC2786		2SC2787		
~50 m	2SA1459**				2SC2784
~100 m				2SA1175 2SC2785 2SC3623* BA1[] BN1[]	
~200 m	2SC3732**			2SA1458** (40 V) 2SC3623A* (150 mA) 2SC3731** (40 V)	
~700 m		2SB810 2SD1020	BB1[] (25 V) BP1[] (25 V)		

*: High hFE transistor, **: High speed switching

Quick Reference by Package



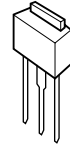
SP-8

■ SP-8 Type Transistor

V_{CE0} (V) / I_c (A)	~16	~25	~50	~80	~140	~160	~300	~400	~600
~50 m					2SA915 2SC1940	2SA916 2SC1941			
~200 m							2SC3209 2SC4000 (250 V/ 100 mA)		
~500 m					2SA1221 2SC2958	2SA1222 2SC2959			
~700 m			2SB605 2SD571 2SC2721						
~1.0		2SB564 2SD471	2SA1460** 2SB734 2SC3733** 2SD774 2SD1582*	2SB984 2SB1093 2SD1312 2SD1579 2SD1697 (800 mA) 2SD1700*** (60 V/ 800 mA) 2SD1843*** (60 V)					2SA1627
~2.0	2SB733 2SD773	2SD1581*	2SD2463	2SD1779* (60 V) 2SD1780* (60 V) CE1[]*** (60 V) CE2[]* (60 V)				2SA1626	
~3.0		2SB1117			2SB1318 (100 V)				
~5.0		2SA1897							

: Darlington transistor, *: High hFE transistor, **: High speed switching, ***: Internal zener diode

Quick Reference by Package



MP-3

■ **MP-3 Type Transistor**

V_{CE0} (V) $I_{C(DC)}$ (A)	~20	~40	~60	~100	~150	~300	~400	~600
-0.5							{ 2SA1400 2SC3588	
-1.0			{ 2SB963 2SD1286					{ 2SA1413 2SC3632
-2.0	2SD1583	2SD992	2SD1164		{ 2SB768 2SD1033	2SC2885 2SC2946	{ 2SA1412 2SC3631	
-3.0		2SB962 ⊙	2SD1584 { 2SB1261 ⊙ 2SD1899 ⊙					
-5.0			{ 2SA1385 ⊙ 2SC3518 ⊙ 2SA1648 ⊙	{ 2SA1647 ⊙ 2SC4331 ⊙			2SC4346	
-10	2SA1615 ⊙	2SA1649 ⊙						

□ : Darlingtton transistor, { : Complementary pair, ○ : Single High h_{FE} , ⊙ : Low $V_{CE(sat)}$



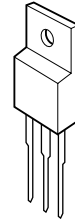
MP-5
(TO-126)

■ **MP-5 (TO-126) Type Transistor**

V_{CE0} (V) $I_{C(DC)}$ (A)	~45	~60	~80	~120	~160	~300	~400	~600
-1.0						{ 2SA1546 2SC4001		
-0.5						2SC2688	{ 2SA1156 2SC2752	
-1.0		2SD1630*		2SD415				{ 2SA1486 2SC3840
-2.0	2SD1695*	{ 2SB794 2SD985	{ 2SB795 2SD986	2SC2690	2SC2690A			
-3.0	2SD794 { 2SB772 ⊙ 2SD882 ⊙	2SD794A { 2SB1150* 2SD1693* 2SD1694 ○ 2SB1217 ⊙ 2SD1818 ⊙		{ 2SB1149 2SD1692 2SC4342				
-5.0		{ 2SB1151 ⊙ 2SD1691 ⊙						

□ : Darlingtton transistor, { : Complementary pair, *: Internal zener diode between C-B, ⊙ : Low $V_{CE(sat)}$, ○ : Single High h_{FE}

Quick Reference by Package

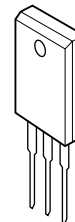


MP-25
(TO-220)

■ **MP-25 (TO-220) Type Transistor**

V_{CE0} (V) $I_{C(DC)}$ (A)	~40	~60	~80	~100	~150	~300	~400
~0.5						2SC1505	
~2.0				{ 2SA1008 2SC2331	{ 2SB546A 2SD401A	2SA1009	2SA1009A 2SC2333
~5.0		2SA1069	2SA1069A	{ 2SB601 2SD560 2SC2517			2SC2518
~7.0	2SA1129	2SB707	2SB708	{ 2SA1010 2SC2334 2SA1645 ☉			2SC2335
~7.0				2SA1646 ☉			

□ : Darlington transistor, { : Complementary pair, * : Internal zener diode between C-B, ☉ : Low $V_{CE(sat)}$



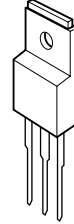
MP-40

■ **MP-40 Type Transistor**

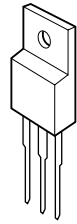
V_{CE0} (V) $I_{C(DC)}$ (A)	~60	~100	~400
~5.0	2SD1392*	2SD1308	
~7.0	2SC4305		2SC3158
~8.0		2SD1309	
~10		{ 2SA1261 2SC3157 2SC4350	2SC3159

□ : Darlington transistor, { : Complementary pair, * : Internal zener diode between C-B

Quick Reference by Package



MP-45
(MP-25 Insulated type)



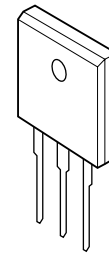
MP-45F
(MP-25 Insulated type)

■ MP-45, MP-45F (TO-220 Insulated Type) Transistor

V _{CE0} (V) I _{C(DC)} (A) Package	~60		~100		~300	~400
	MP-45	MP-45F	MP-45	MP-45F	MP-45	MP-45
~2.0			{ 2SA1395 2SC3567			2SC3569
~3.0	{ 2SB1094 2SD1585 2SD1593 ○	2SB1453 2SD2164 ○				
~5.0	{ 2SA1394 2SA1441 ◎ 2SC3691 ◎ 2SC4351*	{ 2SA1741 ◎ 2SC4549 ◎	{ 2SB1098 2SD1589 2SA1650 ◎	{ 2SB1430 2SD2161	2SD1592	2SC3570
~6.0			2SD1594 ○	2SD2165 ○		
~7.0	{ 2SB1097 2SD1588 2SA1442 ◎ 2SC3692 ◎	{ 2SA1742 ◎ 2SC4550 ◎	2SC4062 ○	2SC4553 ○		2SC3571
~8.0			{ 2SB1099 2SD1590	{ 2SB1431 2SD2162		
~10	{ 2SA1443 ◎ 2SC3693 ◎	{ 2SA1743 ◎ 2SC4551 ◎	{ 2SA1396 2SC3568 2SA1652 ◎ 2SC4336 ◎ 2SA1720 2SB1100 2SD1591	{ 2SB1432 2SD2163		2SC3572
~15	{ 2SA1444 ◎ 2SC3694	{ 2SA1744 ◎ 2SC4552 ◎	2SC4063 ○	2SC4554 ○		

□ : Darlington transistor, { : Complementary pair, * : Internal zener diode between C-B, ◎ : Low V_{CE(sat)},
○ : Single High h_{FE}

Quick Reference by Package

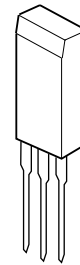


MP-80

■ MP-80 Type Transistor

V_{CE0} (V) / $I_{C(DC)}$ (A)	~100	~400
~5.0	2SC2908	
~1.0	<div style="border: 1px solid black; padding: 2px;">2SB897</div> <div style="border: 1px solid black; padding: 2px;">2SD1210</div>	2SC2749
~15	<div style="border: 1px solid black; padding: 2px;">2SC2750</div> <div style="border: 1px solid black; padding: 2px;">2SD1296</div>	2SC2751

 : Darlington transistor, *: MP-88



MP-10

■ MP-10 Type Transistor

V_{CE0} (V) / $I_{C(DC)}$ (A)	~60	~100
2.5		2SC4814 ○
~5	<div style="display: flex; align-items: center; gap: 10px;"> <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 5px;">2SA1843</div> <div style="font-size: 1.2em;">⊙</div> </div> <div style="display: flex; align-items: center; gap: 10px;"> <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 5px;">2SC4815</div> <div style="font-size: 1.2em;">⊙</div> </div>	<div style="display: flex; align-items: center; gap: 10px;"> <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 5px;">2SA1840</div> <div style="font-size: 1.2em;">⊙</div> </div> <div style="display: flex; align-items: center; gap: 10px;"> <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 5px;">2SC4810</div> <div style="font-size: 1.2em;">⊙</div> </div> <div style="display: flex; align-items: center; gap: 10px;"> <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 5px;">2SA1845</div> <div style="font-size: 1.2em;">⊙</div> </div>
~7		2SC4813 ○
~8		<div style="display: flex; align-items: center; gap: 10px;"> <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 5px;">2SA1841</div> <div style="font-size: 1.2em;">⊙</div> </div> <div style="display: flex; align-items: center; gap: 10px;"> <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 5px;">2SC4811</div> <div style="font-size: 1.2em;">⊙</div> </div>
~10		2SA1847 ⊙

 : Darlington transistor, { : Complementary pair, ○ : Low $V_{CE(sat)}$ High h_{FE} , ⊙ : Low $V_{CE(sat)}$

Quick Reference by Package



Mini mold
SC-59

■ Mini-Mold Transistor

V_{CE0} (V) I_c (mA)	~15	~20	~30	~40	~50	~60	~80	~120	~200	~300
~20		2SC2223								2SD2383
~30				2SA1226						
~50	2SA1462		2SC1009A					2SA811A 2SA1247 2SC1622A 2SC3115	2SC1653 (130 V) 2SC1654 (160 V)	
~100					2SA812 2SC1623 FA1[] FN1[]				2SA1330 2SC3360	
~150					2SC3624 2SC3624A					
~200	2SC3735	2SC1621		2SA1461 2SC3734						
~300						2SB736 2SD780	2SB736A 2SD780A			
~500				2SA1464 2SC3739						
~700			2SB624 (-25 V) 2SD596 (25 V) FB1[] (25 V) FP1[] (-25 V)							

Quick Reference by Package



Power mini mold
SC-62

■ Power Mini-Mold Transistor

V_{CE0} (V) I_C (A)	~20	~25	~50	~60	~80	~100	~120	~140	~300
~50 m								2SA1173 2SC2780	
~200 m									2SC3554
~300 m			2SC3617		2SB800 2SD1001				
~0.7		2SC3618	2SB799 2SD1000			2SB805 2SD1006	2SB806 2SD1007		
~1.0		2SB798 2SD999	2SA1463 2SB1115 2SC3736 2SD1615 2SD1702	2SB1115A 2SD1615A HD1[] HD2[] HR1[]	2SB804 2SD1005 2SD1699				
~2.0	2SB1114 2SD1614 HQ1[]	2SD1950							
~3.0	2SB1628			2SB1572 2SD2403					
~5.0			2SB1571 2SD2402						

 : Darlington connection

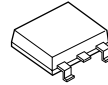


MP-2
SC-84

■ MP-2 Type Transistor

V_{CE0} (V) I_C (A)	~60	~600
~1.0		2SA1871 2SC4942
~5.0	2SB1578 2SD2425	

Quick Reference by Package



MP-3

■ **MP-3 Type (SC-63) Transistor**

V_{CE0} (V) \ I_c (A)	~20	~30	~45	~60	~200	~400	~600
~0.5						2SA1400-Z 2SC3588-Z	
~1.0				2SB963-Z 2SD1286-Z			2SA1413-Z 2SC3632-Z
~2.0	2SD1583-Z			2SD1164-Z (1.5 A)	2SB768 (150 V) 2SD1033 (150 V) 2SC2946(1)	2SA1412-Z 2SC3631-Z	
~3.0		2SB962-Z		2SB1261-Z 2SD1584-Z 2SD1899-Z			
~5.0				2SA1385-Z 2SC3518-Z			
~10	2SA1615-Z						

 : Darlington connection



Small mini mold
SC-70

■ **Small Mini-Mold Transistor**

V_{CE0} (V) \ I_c (mA)	~15	~20	~30	~40	~50	~120
~20		2SC4178				
~50	2SA1610		2SC4179			2SA1612 2SC4180
~100					2SA1611 2SC4177 GA1[] GN1[]	
~150					2SC4181	
~200	2SC4176	2SC4175				
~500			2SB1475 (-25 V) 2SD2228 (25 V)	2SA1608 2SC4173		

■ **Ultra Small Mini-Mold Transistor**

V_{CE0} (V) \ I_c (mA)	~50
~100	2SA1836 2SC4783



Ultra small mini mold

Quick Reference Table by Function/Application

Small Signal Transistor

■ **Small Signal Transistor (1/2)**

	TO-92	SP-8	SST	SMALL MINI MOLD	MINI MOLD	POWER MINI
FM/FM RF RF/MIX/CON	2SC1674		2SC2786	2SC4178	2SC2223	
FM AM/FM/AM MIX/OSC/IF			2SC2787	2SC4179	2SC1009A	
Audio Frequency Amplification	2SA733		2SA1175	2SA1611	2SA812	
					(2SA812)	
	2SA988			2SA1612	2SA811A	
	2SC945		2SC2785	2SC4177	2SC1623	
					(2SC1623)	
	2SC1841				2SC1622A	
	2SC3622/A		2SC3623/A	2SC4181	2SC3624/A	
Low Noise Amplification	2SA992		2SA1174		2SA1247	
	2SC1845		2SC2784		2SC3115	
Driver Output	2SA952		2SB810		2SB624	
	2SA953				2SB736	
	2SA954				2SB736A	2SB800
	2SA1376				2SA1330	
		2SB564	2SB811			2SB798
		2SB605				2SB799
	2SB1068					2SB1114
	2SB1116					2SB1115
	2SB1116A					2SB1115A
	2SC2001		2SD1020		2SD596	
	2SC2002				2SD780	
	2SC2003				2SD780A	2SD1001
	2SC3478				2SC3360	
		2SC1940			2SC1653	2SC2780
		2SC1941			2SC1654	
		2SC3209				2SC3554
	2SC3615					2SC3617
	2SC3616					2SC3618
		2SD471				2SD999
		2SD571				2SD1000
	2SD1513					2SD1614
	2SD1616					2SD1615
	2SD1616A					2SD1615A
	2SD1698	2SD1697				2SD1699
	2SD1701	2SD1700				2SD1702
		2SD1581				2SD1950

Quick Reference Table by Function/Application
--

Small Signal Transistor

■ Small Signal Transistor (2/2)

	TO-92	SP-8	SST	SMALL MINI MOLD	MINI MOLD	POWER MINI
Switching	2SA1206		2SA1459	2SA1610	2SA1462	
				2SA1608	2SA1464	
		2SA1460				2SA1463
			2SA1458		2SA1461	
				2SC4173	2SC3739	
	2SC2901		2SC3732	2SC4176	2SC3735	
		2SC3733				2SC3736
			2SC3731		2SC3734	

Quick Reference Table by Function/Application

Power Transistor

■ **Low $V_{CE(sat)}$ Transistor**

Charac- teristics V_{CEO} , $I_{C(DC)}$	SP-8	MP-2	MP-3	MP-5 (TO-126)	MP-25	MP-10	MP-45	MP-45F
16 V, 3 A		2SB1581						
20 V, 10 A	2SA1897 (5A)		2SA1615					
25 V, 3 A	2SB1117							
30 V, 3 A			2SB962	2SB772 2SD882				
30 V, 10 A			2SA1649					
60 V, 3 A			2SB1261 2SD1899	2SB1217 2SD1818				
60 V, 5 A		2SB1578 2SD2425	2SA1385 2SC3518	2SB1151 2SD1691		2SA1843 2SC4815		
			2SA1648				2SA1441 2SC3691	2SA1741 2SC4549
60 V, 7 A							2SA1442 2SC3692	2SA1742 2SC4550
60 V, 10 A							2SA1443 2SC3693	2SA1743 2SC4551
60 V, 15 A							2SA1444 2SC3694	2SA1744 2SC4552
100 V, 5 A			2SA1647 2SC4331			2SA1845	2SA1650	
100 V, 7 A					2SA1645			
100 V, 10 A						2SA1847	2SA1652 2SC4336	

■ **High h_{FE} Transistor**

Charac- teristics V_{CEO} , $I_{C(DC)}$	SP-8	MP-3	MP-5 (TO-126)	MP-10	MP-45	MP-45F
20 V, 2 A		2SD1583				
25 V, 2 A	2SD1581					
50 V, 1 A	2SD1582					
60 V, 3 A		2SD1584	2SD1694		2SD1593	2SD2164
100 V, 2.5 A				2SC4814*		
100 V, 6 A					2SD1594	2SD2165
100 V, 7.5 A				2SC4813*	2SC4062	2SC4553*
100 V, 15 A					2SC4063	2SC4554*

※: Low $V_{CE(sat)}$ & High h_{FE}

Quick Reference Table by Function/Application
--

Power Transistor

<ul style="list-style-type: none"> ■ Low Voltage, High Speed Switching Transistor
--

Characteristics V _{CEO} , I _C (DC)	SP-8	MP-25	MP-45	MP-80
45 V, 1 A	{ 2SA1460 2SC3733			
60 V, 5 A		2SA1069	2SA1394	
100 V, 2 A		{ 2SA1008 2SC2331	{ 2SA1395 2SC3567	
100 V, 5 A		2SC2517		
100 V, 7 A		{ 2SA1010 2SC2334		
100 V, 10			{ 2SA1396 2SC3568	
100 V, 15 A				2SC2750

<ul style="list-style-type: none"> ■ High Voltage, High Speed Switching Transistor

Characteristics V _{CEO} , I _C (DC)	MP-3	MP-5 (TO-126)	MP-25 (TO-220)	MP-40	MP-45	MP-80
200 V, 2 A	2SC2885 2SC2946 2SC2946(1)					
350 V, 2 A			2SA1009			
400 V, 0.5 A	{ 2SA1400 2SC3588	{ 2SA1156 2SC2752				
400 V, 2 A	2SC3631		2SA1009A 2SC2333		2SC3569	
400 V, 5 A	2SC4346		2SC2518		2SC3570	
400 V, 7 A				2SC3158	2SC3571	
400 V, 10 A				2SC3159	2SC3572	2SC2749
400 V, 15 A						2SC2751
600 V, 2 A	{ 2SA1413 2SC3632	{ 2SA1486 2SC3840				

Quick Reference Table by Function/Application

Power Transistor

■ **Audio Frequency Amplification Transistor**

Characteristics V _{CEO} , I _{C(DC)}	MP-3	MP-5 (TO-126)	MP-25 (TO-220)	MP-45
45 V, 3 A		2SD794		
60 V, 3 A		2SD794A		{ 2SB1094 2SD1585
60 V, 7 A			2SB707	{ 2SB1097 2SD1588
80 V, 0.8 A		2SD414		
80 V, 7 A			2SB708	
100 V, 0.8 A		2SD415		
150 V, 2 A	{ 2SB768 2SD1033		{ 2SB546A 2SD401A	

■ **High Frequency Amplification Transistor**

Characteristics V _{CEO} , I _{C(DC)}	SP-8	MP-5 (TO-126)	MP-25 (TO-220)
40 V, 7 A			2SA1129
120 V, 1.2 A		2SC2690	
160 V, 1.2 A		2SC2690A	
250 V, 0.1 A	2SC4000	{ 2SA1546 2SC4001	
300 V, 0.2 A	2SC2802	2SC2688	2SC1505

Quick Reference Table by Function/Application
--

Power Transistor■ **Darlington Transistor**

Charac- teristics V_{CE0} , $I_{C(DC)}$	SP-8	MP-3	MP-5 (TO-126)	MP-25 (TO-220)	MP-10	MP-40	MP-45	MP-45F	MP-80
31 V, 2 A	2SD2463*		2SD1695*						
60 V, 0.8 A	2SD1700*								
60 V, 1 A	2SD1843	{ 2SB963 2SD1286	2SD1630*						
60 V, 1.5 A		2SD1164	{ 2SB794 2SD985						
60 V, 3 A			{ 2SB1150* 2SD1693*						
60 V, 5 A						2SD1392*	2SC4351◎		
80 V, 0.8 A	2SD1697								
80 V, 1.5 A	{ 2SB1093 2SD1579		{ 2SB795 2SD986						
100 V, 3 A			{ 2SB1149 2SD1692 2SC4342◎						
100 V, 5 A			{ 2SB601 2SD560	{ 2SA1840 2SC4810	2SD1308	{ 2SB1098 ◎ 2SD1589 ◎	{ 2SB1430 2SD2161		
100 V, 8 A				{ 2SA1841 2SC4811	2SD1309	{ 2SB1099 2SD1590	{ 2SB1431 2SD2162		
100 V, 10 A						{ 2SA1720 ◎ 2SB1100 2SD1591	{ 2SB1432 2SD2163	{ 2SB897 2SD1210	
100 V, 15 A									2SD1296
100 V, 25 A									2SD1297
300 V, 5 A							2SD1592		

◎: High speed darlington transistor, *: Internal zener diode between C-B

Field Effect Transistor

Small Signal FET

■ **2SK type (MOS type) (1/2)**

Part number	Package	Absolute maximum rating (T _A = 25 °C)				Electrical characteristics (T _A = 25 °C)							Applications
		V _{DSS} (V)	I _D		P _T (W)	y _{fs} (S)			R _{DS(on)} (Ω)				
			DC (A)	Pulse (A)		V _{DS} (V)	I _D (A)	MIN.	V _{GS} (V)	I _D (A)	TYP.	MAX.	
2SK679A	TO-92	30	±0.5	±1.5	0.75	10	0.5	0.4	4	0.5	0.6	1.0	Switching
2SK680A	SC-62	30	±1.0	±2.0	1.0	10	0.5	0.4	4	0.5	0.6	1.0	
2SK681A	SP-8	30	±1.0	±2.0	1.0	10	0.5	0.4	4	0.5	0.6	1.0	
2SK1132	SST	50	0.1	0.2	0.25	5	0.02	0.03	4	0.02	30	50	
2SK1133	SC-59	50	0.1	0.2	0.2	5	0.02	0.03	4	0.02	30	50	
2SK1272	TO-92	60	±1.0	±2.0	0.75	10	0.5	0.4	4	0.5	—	1.0	
2SK1273	SC-62	60	±2.0	±4.0	2.0	10	0.5	0.4	4	0.5	—	1.0	
2SK1274	SP-8	60	±1.5	±3.0	1.0	10	0.5	0.4	4	0.5	—	1.0	
2SK1398	SST	50	0.1	0.2	0.25	3	0.01	0.02	2.5	0.005	20	40	
2SK1399	SC-59	50	0.1	0.2	0.2	3	0.01	0.02	2.5	0.005	20	40	
2SK1482	TO-92	30	±1.5	±3.0	0.75	10	0.5	0.4	4	0.5	0.19	0.8	
2SK1483	SC-62	30	±2.0	±4.0	2.0	10	0.5	0.4	4	0.5	0.19	0.8	
2SK1484	TO-92	100	±0.5	±1.0	0.75	10	0.5	0.4	4	0.5	0.62	1.2	
2SK1485	SC-62	100	±1.0	±2.0	2.0	10	0.5	0.4	4	0.5	0.62	1.2	
2SK1580	SC-70	16	0.1	0.2	0.15	3	0.01	0.02	2.5	0.001	9	15	
2SK1581	SC-59	16	0.2	0.4	0.2	3	0.01	0.02	2.5	0.001	3.2	5	
2SK1582	SC-59	30	0.2	0.4	0.2	5	0.01	0.02	4	0.01	2.2	5	
2SK1583	SC-62	16	±0.5	±1.0	2.0	5	0.3	0.4	2.5	0.3	1.2	2.0	
2SK1584	SC-62	30	±0.5	±1.0	2.0	5	0.3	0.4	2.5	0.3	1.2	2.0	
2SK1585	SC-62	16	±1.0	±2.0	2.0	5	0.5	0.4	2.5	0.5	0.8	1.2	
2SK1586	SC-62	30	±1.0	±2.0	2.0	5	0.5	0.4	4	0.5	—	1.0	
2SK1587	SC-62	16	±2.0	±4.0	2.0	5	1.0	0.4	2.5	1.0	0.55	0.8	
2SK1588	SC-62	16	±3.0	±6.0	2.0	3	1.0	0.4	2.5	1.0	0.34	0.5	
2SK1589	SC-59	100	0.1	0.2	0.2	5	0.01	0.02	4	0.01	19	30	
2SK1590	SC-59	60	0.2	0.4	0.2	5	0.01	0.02	4	0.01	3.2	6	
2SK1591	SC-59	100	0.2	0.4	0.2	5	0.01	0.02	4	0.01	5.8	8	
2SK1592	SC-62	60	±0.5	±1.0	2.0	10	0.5	0.4	4	0.5	1.6	2.5	
2SK1593	SC-62	100	±0.5	±1.0	2.0	10	0.5	0.4	4	0.5	4.0	6.0	
2SK1656	SST	30	0.1	0.2	0.25	3	0.01	0.02	2.5	0.01	25	45	
2SK1657	SC-59	30	0.1	0.2	0.2	3	0.01	0.02	2.5	0.01	25	45	
2SK1658	SC-70	30	0.1	0.2	0.15	3	0.01	0.02	2.5	0.01	25	45	
2SK1824	3-pin ultra super mini	30	0.1	0.2	0.2	3	0.01	0.02	2.5	0.001	7	13	
2SK1958	SC-70	16	0.1	0.2	0.15	3	0.01	0.02	1.5	0.001	30	50	
2SK1959	SC-62	16	±2.0	±4.0	2.0	3	1.0	1.0	1.5	0.05	0.08	0.8	
2SK1960	SC-62	16	±3.0	±6.0	2.0	3	1.5	2.0	1.5	0.1	0.35	0.8	

Field Effect Transistor

Small Signal FET

■ 2SK type (MOS type) (2/2)

Part number	Package	Absolute maximum rating (T _A = 25 °C)				Electrical characteristics (T _A = 25 °C)							Applications
		V _{DSS} (V)	I _D		P _T (W)	y _{fs} (S)			R _{DS(on)} (Ω)				
			DC (A)	Pulse (A)		V _{DS} (V)	I _D (A)	MIN.	V _{GS} (V)	I _D (A)	TYP.	MAX.	
2SK2053	MP-2	16	±5	±10	2.0	3	2.5	0.4	1.5	0.5	0.2	0.4	Switching
2SK2054	MP-2	60	±3	±6	2.0	10	1.5	2.0	4	1.5	0.18	0.25	
2SK2055	MP-2	100	±2	±4	2.0	10	1.0	2.0	4	1.0	0.28	0.45	
2SK2070	SP-8	100	±1	±2	2.0	10	1.0	2.0	4	1.0	0.28	0.45	
2SK2090	SC-70	50	±0.1	±0.2	0.15	3	0.01	0.02	2.5	0.01	20	40	
2SK2109	SC-62	60	±0.5	±1.0	2.0	10	0.3	0.4	4	0.3	0.55	1.5	
2SK2110	SC-62	100	±0.5	±1.0	2.0	10	0.3	0.4	4	0.3	0.90	2.0	
2SK2111	SC-62	60	±1.0	±2.0	2.0	10	0.5	0.4	4	0.5	0.35	1.0	
2SK2112	SC-62	100	±1.0	±2.0	2.0	10	0.5	0.4	4	0.5	0.67	1.5	
2SK2157	MP-2	30	±5	±10	2.0	10	2.5	2.0	4	2.5	0.08	0.15	
2SK2158	SC-59	50	0.1	0.2	0.2	3	0.01	0.02	1.5	0.001	21	50	
2SK2159	SC-62	60	±2	±4	2.0	10	1.0	0.4	1.5	0.1	0.26	0.7	
2SK2541	SST	50	±0.1	±0.2	0.2	3	0.01	0.02	1.5	0.001	21	50	
2SK2857*	SC-62	60	±4	±16	2.0	10	1	1	4	1.5	0.15	0.22	
2SK2858*	SC-70	30	±0.1	±0.4	0.15	3	0.01	0.02	2.5	0.001	10	15	

*: Under development

Field Effect Transistor

Small Signal FET

■ **2SJ type (MOS type)**

Part number	Package	Absolute maximum rating (T _A = 25 °C)				Electrical characteristics (T _A = 25 °C)							Applications
		V _{DSS} (V)	I _D		P _T T _C = 25 °C (W)	y _{fs} (S)			R _{DS(on)} (Ω)				
			DC (A)	Pulse (A)		V _{DS} (V)	I _D (A)	MIN.	V _{GS} (V)	I _D (A)	TYP.	MAX.	
2SJ165	SST	-50	±0.1	±0.2	0.25	-5	-0.02	0.03	-4	-0.02	22	50	Switching
2SJ166	SC-59	-50	±0.1	±0.2	0.2	-5	-0.02	0.03	-4	-0.02	22	50	
2SJ178	TO-92	-30	±1.0	±2.0	0.75	-10	-0.5	0.4	-4	-0.5	—	1.5	
2SJ179	SC-62	-30	±1.5	±3.0	2.0	-10	-0.5	0.4	-4	-0.5	—	1.5	
2SJ180	SP-8	-30	±1.0	±2.0	1.0	-10	-0.5	0.4	-4	-0.5	—	1.5	
2SJ184	SST	-50	±0.1	±0.2	0.25	-5	-0.02	0.02	-2.5	-0.05	25	40	
2SJ185	SC-59	-50	±0.1	±0.2	0.2	-5	-0.02	0.02	-2.5	-0.05	25	40	
2SJ196	TO-92	-60	±1.0	±2.0	0.75	-10	-0.5	0.4	-4	-0.5	0.89	1.5	
2SJ197	SC-62	-60	±1.5	±3.0	2.0	-10	-0.5	0.4	-4	-0.5	0.89	1.5	
2SJ198	TO-92	-100	±0.5	±1.0	0.75	-10	-0.5	0.4	-4	-0.5	1.7	2.0	
2SJ199	SC-62	-100	±1.0	±2.0	2.0	-10	-0.5	0.4	-4	-0.5	1.7	2.0	
2SJ202	SC-70	-16	±0.1	±0.2	0.15	-3	-0.01	0.02	-2.5	-0.001	—	60	
2SJ203	SC-59	-16	±0.2	±0.4	0.2	-3	-0.01	0.02	-2.5	-0.001	16	20	
2SJ204	SC-59	-30	±0.2	±0.4	0.2	-3	-0.01	0.02	-2.5	-0.001	8.8	15	
2SJ205	SC-62	-16	±0.5	±1.0	2.0	-5	-0.3	0.4	-2.5	-0.3	2.2	5.0	
2SJ206	SC-62	-30	±0.5	±1.0	2.0	-5	-0.3	0.4	-2.5	-0.3	2.8	3.0	
2SJ207	SC-62	-16	±1.0	±2.0	2.0	-5	-0.5	0.4	-2.5	-0.5	1.5	2.0	
2SJ208	SC-62	-16	±2.0	±4.0	2.0	-5	-1.0	0.4	-2.5	-1.0	0.6	1.5	
2SJ209	SC-59	-100	±0.1	±0.2	0.2	-5	-0.01	0.02	-4	-0.01	60	100	
2SJ210	SC-59	-60	±0.2	±0.4	0.2	-5	-0.01	0.02	-4	-0.01	10	15	
2SJ211	SC-59	-100	±0.2	±0.4	0.2	-5	-0.01	0.02	-4	-0.01	18	30	
2SJ212	SC-62	-60	±0.5	±1.0	2.0	-10	-0.5	0.4	-4	-0.5	1.8	4.0	
2SJ213	SC-62	-100	±0.5	±1.0	2.0	-10	-0.5	0.4	-4	-0.5	2.7	5.0	
2SJ243	3-pin ultra super mini	-30	±0.1	±0.2	0.2	-3	-0.01	0.02	-2.5	-0.0005	55	100	
2SJ353	SP-8	-60	±1.5	±3.0	1.0	-10	-1	1.0	-4	-0.8	0.58	0.68	
2SJ355	SC-62	30	2	4	2.0	-10	-1	1.0	4.0	1.0	0.50	0.60	
2SJ356	SC-62	60	2	4	2.0	-10	-1	1.0	4.0	1.0	0.65	0.95	
2SJ357	MP-2	30	3	6	2.0	-10	-1	1.8	4.0	1.5	0.23	0.35	
2SJ358	MP-2	60	3	6	2.0	-10	-1	1.8	4.0	1.5	0.29	0.40	
2SJ411	SP-8	-30	±5	±20	1.0	-10	-2.5	3.0	-4	-2.5	0.096	0.24	
2SJ460	SST	-50	±0.1	±0.2	0.25	-3	-0.01	0.01	-2.5	-0.003	75	100	
2SJ461	SC-59	-50	±0.1	±0.2	0.2	-3	-0.01	0.01	-2.5	-0.003	75	100	
2SJ462	MP-2	-12	±2.5	±5.0	2.0	-3	-1	1.5	-2.5	-0.5	0.23	0.3	
2SJ463A	SC-70	-30	±0.1	±0.4	0.15	-3	-0.01	0.02	-2.5	-0.001	23	60	

Field Effect Transistor

Power MOS FET

■ N6-L series Product Map

DC drain current I _{D(DC)} (A)	Drain to source voltage V _{DSS} (V)		Package
	30	60	
to 20	△ 2SK2981 (27 m/40 m)*		△ : TO-251 (MP-3) ● : Isolated TO-220 (MP-45F) ○ : TO-220AB (MP-25)
to 30	△ 2SK2982 (12.5 m/16.5 m)* ○ 2SK2983 (20 m/27 m)*	● 2SK3055 (34 m/50 m)	
to 40	○ 2SK2984 (10 m/13 m)*	○ 2SK3056 (34 m/50 m)	
to 50		● 2SK2057 (17 m/27 m) ● 2SK3059 (13 m/20 m)	
to 60		○ 2SK2058 (17 m/27 m)	
to 70		○ 2SK3060 (13 m/20 m) ● 2SK3061 (8.5 m/12 m)	
		○ 2SK3062 (8.5 m/12 m) ○ 2SK2826 (6.5 m/10.5 m)	

() : R_{DS(on)} MAX (Ω) (@V_{GS} = 10 V/V_{GS} = 4 V)

* : (@V_{GS} = 10 V/V_{GS} = 4.5 V)

■ N5-L series/P5-L series/N4-L series Product Map

DC drain current I _{D(DC)} (A)	Drain to source voltage V _{DSS} (V)			Package
	30	60	100	
8.0		△ 2SK2415 (0.1/0.15)		△ : TO-251 (MP-3) ● : Isolated TO-220 (MP-45F) ○ : TO-220AB (MP-25) ◎ : MP-10 □ : TO-3P (MP-88)
10		◎ 2SK2413 (70 m/95 m) △ 2SK2414 (70 m/95 m)		
15			● 2SK2462 (0.14/0.17)	
20		● 2SK2412 (70 m/95 m) ○ 2SJ492 (0.1/0.19)* ● 2SJ494 (50 m/88 m)*	● 2SK2461 (80 m/0.1)	
25		● 2SK2723 (40 m/60 m)*		
30		● 2SK2410 (40 m/60 m) ○ 2SK2411 (40 m/60 m) ● 2SJ495 (30 m/56m)*		
35	○ 2SK2941 (20 m/33 m)*	● 2SK2724 (27 m/40 m)*		
40		● 2SK2409 (27m/40 m) ● 2SK2510 (20 m/30 m)* □ 2SK2511 (27 m/40 m)*		
45		● 2SK2512 (15 m/23 m)* ○ 2SK2513 (15 m/23 m)*		
50		● 2SK2498 (9 m/14 m)* ○ 2SK2499 (9 m/14 m)* □ 2SK2514 (15 m/23 m)* □ 2SK2515 (9 m/14 m)*		

() : R_{DS(on)} MAX (Ω) (@V_{GS} = 10 V/V_{GS} = 4 V)

* : N5-L series

Field Effect Transistor

Power MOS FET

■ N3-L series/P3-L series Product Map

DC drain current I _{D(DC)} (A)	Drain to source voltage V _{DSS} (V)			Package
	30	60	100/[150]	
~ 4.0	△ 2SJ324 (0.25/0.52) △ 2SJ325 (0.11/0.24)	△ 2SK1282 (0.18/0.24) ◇ 2SK1283 (0.18/0.24) △ 2SJ326 (0.37/0.68) △ 2SJ327 (0.17/0.34)	△ 2SK1284 (0.32/0.40) ◇ 2SK1285 (0.32/0.40)	◇ : TO-126 (MP-5) △ : TO-251 (MP-3) ● : Isolated TO-220 (MP-45F) ○ : TO-220AB (MP-25) ◎ : MP-10 ▣ : TO-3P (MP-88)
~ 8.0		◎ 2SK1748 (0.11/0.16)		
~ 10		◎ 2SK1850 (70 m/95 m)	◎ 2SK1852 (0.15/0.20)	
~ 15		2SK1851 (45 m/60 m) ● 2SK1286 (70 m/95 m) ● 2SJ303 (0.1/0.24) ● 2SJ329 (60 m/0.11)	◎ 2SK1853 (80 m/0.10) ● 2SK1288 (0.15/0.20) [● 2SK2131 (0.12/0.20)]	
~ 20	● 2SK1594 (50 m/80 m)	○ 2SK1287 (70 m/95 m) ○ 2SJ302 (0.1/0.24) ○ 2SJ328 (60 m/0.11) ● 2SJ330 (50 m/90 m)	○ 2SK1289 (0.15/0.20) ● 2SK1292 (80 m/0.10)	
~ 25		● 2SK1290 (45 m/60 m)		
~ 30		▣ 2SJ331 (30 m/55 m)	○ 2SK1293 (80 m/0.10) ● 2SK1295 (50 m/70 m)	
~ 40	● 2SK1596 (20 m/30 m)	● 2SK1294 (27 m/50 m) ▣ 2SK1123 (27 m/50 m)	▣ 2SK1122 (50 m/70 m)	
~ 50		▣ 2SK1749 (18 m/25 m)		

() : R_{DS(on)} MAX (Ω) (@V_{GS} = 10 V/V_{GS} = 4 V)

Field Effect Transistor

Power MOS FET

■ N6-L Series (Low Voltage N channel 6th generation Series)

Part number	Package	Absolute maximum ratings			Electrical characteristics					
		V _{DSS} (V)	I _{D(DC)} (A)	P _T @T _C = 25 °C (W)	R _{DS(on)} @V _{GS} = 10 V		R _{DS(on)} @V _{GS} = 4 V		C _{iss} (pF)	C _{rss} (pF)
					TYP. (Ω)	MAX. (Ω)	TYP. (Ω)	MAX. (Ω)		
2SK2981	TO-251	30	20	20	20 m	27 m	30 m	40 m*	860	160
2SK2982	TO-251		30	20	9.8 m	12.5 m	13.2 m	16.5 m*	2290	440
2SK2983	TO-220AB		30	50	13 m	20 m	18 m	27 m*	1200	250
2SK2984	TO-220AB		40	60	6.5 m	10 m	8.5 m	13 m*	2600	500
2SK3053	Isolated TO-220	60	25	25	29 m	45 m	46 m	70 m	790	100
2SK3055	Isolated TO-220		30	25	28 m	34 m	42 m	50 m	990	90
2SK3056	TO-220AB		32	34	28 m	34 m	42 m	50 m	990	90
2SK3057	Isolated TO-220		45	30	14 m	17 m	21 m	27 m	2040	190
2SK3058	TO-220AB		55	58	14 m	17 m	21 m	27 m	2040	190
2SK3059	Isolated TO-220		50	30	11 m	13 m	16 m	20 m	2550	250
2SK3060	TO-220AB		70	70	11 m	13 m	16 m	20 m	2550	250
2SK3061	Isolated TO-220		70	35	6.3 m	8.5 m	9.8 m	12 m	5020	460
2SK3062	TO-220AB		70	100	6.3 m	8.5 m	9.8 m	12 m	5020	460
2SK2826	TO-220AB		70	100	5.5 m	6.5 m	7 m	10.5 m	7260	660

*: V_{GS} = 4.5 V

■ N5-L Series (Low Voltage N channel 5th generation Series)

Part number	Package	Absolute maximum ratings			Electrical characteristics					
		V _{DSS} (V)	I _{D(DC)} (A)	P _T @T _C = 25 °C (W)	R _{DS(on)} @V _{GS} = 10 V		R _{DS(on)} @V _{GS} = 4 V		C _{iss} (pF)	C _{rss} (pF)
					TYP. (Ω)	MAX. (Ω)	TYP. (Ω)	MAX. (Ω)		
2SK2941	TO-220AB	30	35	60	14 m	20 m	22 m	33 m	1250	460
2SK2723	Isolated TO-220	60	25	25	28 m	40 m	45 m	60 m	830	185
2SK2724	Isolated TO-220		35	30	20 m	27 m	33 m	40 m	1200	270
2SK2510	Isolated TO-220		40	35	16 m	20 m	24 m	30 m	1600	350
2SK2511	TO-3P		40	80	22 m	27 m	32 m	40 m	1210	270
2SK2512	Isolated TO-220		45	35	11 m	15 m	16 m	23 m	2100	500
2SK2513	TO-220AB		45	75	11 m	15 m	16 m	23 m	2100	500
2SK2498	Isolated TO-220		50	35	7.3 m	9 m	11 m	14 m	3400	770
2SK2499	TO-220AB		50	75	7.3 m	9 m	11 m	14 m	3400	770
2SK2514	TO-3P		50	150	11 m	15 m	16 m	23 m	2100	500
2SK2515	TO-3P		50	150	7.3 m	9 m	11 m	14 m	3400	770

Field Effect Transistor

Power MOS FET

■ **P5-L Series (Low Voltage P channel 5th generation Series)**

Part number	Package	Absolute maximum ratings			Electrical characteristics					
		V _{DSS} (V)	I _{D(DC)} (A)	P _T @T _C = 25 °C (W)	R _{Ds(on)} @V _{GS} = 10 V		R _{Ds(on)} @V _{GS} = 4 V		C _{iss} (pF)	C _{rss} (pF)
					TYP. (Ω)	MAX. (Ω)	TYP. (Ω)	MAX. (Ω)		
2SJ492	TO-220AB	-60	-20	70	70 m	0.10	0.12	0.185	1210	180
2SJ493	Isolated TO-220		-16	30	70 m	0.10	0.12	0.185	1210	180
2SJ494	Isolated TO-220		-20	35	39 m	50 m	61 m	88 m	2360	350
2SJ495	Isolated TO-220		-30	35	24 m	30 m	38 m	56 m	4120	580

■ **N4-L Series (Low Voltage N channel 4th generation Series)**

Part number	Package	Absolute maximum ratings			Electrical characteristics					
		V _{DSS} (V)	I _{D(DC)} (A)	P _T @T _C = 25 °C (W)	R _{Ds(on)} @V _{GS} = 10 V		R _{Ds(on)} @V _{GS} = 4 V		C _{iss} (pF)	C _{rss} (pF)
					TYP. (Ω)	MAX. (Ω)	TYP. (Ω)	MAX. (Ω)		
2SK2409	Isolated TO-220	60	40	35	21 m	27 m	30 m	40 m	1800	350
2SK2410	Isolated TO-220		30	35	28 m	40 m	40 m	60 m	1300	250
2SK2411	TO-220AB		30	75	28 m	40 m	40 m	60 m	1300	250
2SK2412	Isolated TO-220		15	30	53 m	70 m	70 m	0.10	700	150
2SK2413	MP-10		10	1.8*	53 m	70 m	70 m	0.10	700	150
2SK2414	TO-251		10	20	53 m	70 m	70 m	0.10	700	150
2SK2415	TO-251		8.0	20	70 m	0.10	0.11	0.15	440	85
2SK2461	Isolated TO-220	100	20	35	60 m	80 m	70 m	0.10	1510	140
2SK2462	Isolated TO-220		15	30	0.10	0.14	0.12	0.17	870	80

*: T_A = 25°C

■ **P3-L Series (Low Voltage P channel 3rd generation Series)**

Part number	Package	Absolute maximum ratings			Electrical characteristics					
		V _{DSS} (V)	I _{D(DC)} (A)	P _T @T _C = 25 °C (W)	R _{Ds(on)} @V _{GS} = 10 V		R _{Ds(on)} @V _{GS} = 4 V		C _{iss} (pF)	C _{rss} (pF)
					TYP. (Ω)	MAX. (Ω)	TYP. (Ω)	MAX. (Ω)		
2SJ324	TO-251	-30	-2.0	20	0.20	0.25	0.40	0.52	330	100
2SJ325	TO-251		-4.0	20	85 m	0.11	0.15	0.24	800	250
2SJ326	TO-251	-60	-2.0	20	0.28	0.37	0.50	0.68	320	75
2SJ327	TO-251		-4.0	20	0.13	0.17	0.22	0.34	750	165
2SJ303	Isolated TO-220		-14	35	75 m	0.1	0.17	0.24	1200	290
2SJ302	TO-220AB		-16	60	75 m	0.1	0.17	0.24	1200	290
2SJ328	TO-220AB		-20	75	48 m	60 m	85 m	0.11	2150	530
2SJ329	Isolated TO-220		-15	35	48 m	60 m	85 m	0.11	2150	530
2SJ330	Isolated TO-220		-20	35	38 m	50 m	65 m	90 m	2570	640
2SJ331	TO-3P	-30	150	25 m	30 m	40 m	55 m	4300	1110	

Field Effect Transistor

Power MOS FET

■ N3-L Series (Low Voltage 3rd generation Series)

Part number	Package	Absolute maximum ratings			Electrical characteristics						
		V _{DSS} (V)	I _{D(DC)} (A)	P _T @T _C = 25 °C (W)	R _{DS(on)} @V _{GS} = 10 V		R _{DS(on)} @V _{GS} = 4 V		C _{iss} (pF)	C _{rss} (pF)	
					TYP. (Ω)	MAX. (Ω)	TYP. (Ω)	MAX. (Ω)			
2SK1594	Isolated TO-220	30	20	30	37 m	50 m	50 m	80 m	1300	280	
2SK1596	Isolated TO-220		40	35	14 m	20 m	20 m	30 m	3400	960	
2SK1282	TO-251	60	3.0	20	0.15	0.18	0.18	0.24	500	40	
2SK1283	TO-126		3.0	20	0.15	0.18	0.18	0.24	500	40	
2SK1748	TO-251		8.0	20	80 m	0.11	0.11	0.16	850	350	
2SK1850	MP-10		10	1.8*	55 m	70 m	80 m	95 m	1400	130	
2SK1851	MP-10		15	1.8*	35 m	45 m	45 m	60 m	2200	180	
2SK1286	Isolated TO-220		15	30	55 m	70 m	80 m	95 m	1400	130	
2SK1287	TO-251		20	60	55 m	70 m	80 m	95 m	1400	130	
2SK1290	Isolated TO-220		25	35	35 m	45 m	45 m	60 m	2200	180	
2SK1294	Isolated TO-220		40	35	22 m	27 m	30 m	50 m	3250	380	
2SK1123	TO-3P		40	100	22 m	27 m	30 m	50 m	3250	380	
2SK1749	TO-3P		50	150	16 m	18 m	22 m	25 m	5400	620	
2SK1284	TO-251		100	3.0	20	0.26	0.32	0.32	0.40	500	20
2SK1285	TO-126			3.0	20	0.26	0.32	0.32	0.40	500	20
2SK1852	MP-10			10	1.8*	0.12	0.15	0.15	0.20	1400	50
2SK1853	MP-10	15		1.8*	70 m	80 m	80 m	0.10	2200	90	
2SK1288	Isolated TO-220	15		30	0.12	0.15	0.15	0.20	1400	50	
2SK1289	TO-220AB	20		60	0.12	0.15	0.15	0.20	1400	50	
2SK1292	Isolated TO-220	20		35	70 m	80 m	80 m	0.10	2200	90	
2SK1293	TO-220AB	30		75	70 m	80 m	80 m	0.10	2200	90	
2SK1295	Isolated TO-220	30		35	42 m	50 m	50 m	70 m	3300	200	
2SK1122	TO-3P	40		100	42 m	50 m	50 m	70 m	3300	200	
2SK2131	Isolated TO-220	150	15	35	0.10	0.12	0.13	0.20	2300	140	

*: T_A = 25°C

Field Effect Transistor

Power MOS FET

■ N5-H series Product Map

(): RDS(on) MAX (Ω) (@VGS = 10 V)

DC drain current ID(DC) (A)	Drain to source voltage VDS (V)				Package
	200/250 V	400/500 V	600 V	900 V	
2			△ 2SK3113 (4.4) ● 2SK3221 (4.4)		△ : TO-251 (MP-3) ● : Isolated TO-220 (MP-45F) ○ : TO-220AB (MP-25) □ : TO-3P (MP-88)
4			● 2SK3114 (2.2)		
5		● 2SK3306 (1.5)* ○ 2SK3305 (1.5)*	● 2SK3297 (1.6)*		
6			● 2SK3115 (1.2)	□ 2SK3304 (2.0)*	
7					
7.5			○ 2SK3116 (1.2) ● 2SK3298 (0.75)*		
8	● 2SK3108 (0.4)				
10	○ 2SK3109 (0.4)		○ 2SK3299 (0.75)*		
14	● 2SK3110 (0.18)				
20	○ 2SK3111 (0.18) ○ 2SK3294 (0.12)*1*		□ 2SK3300 (0.4)*		
25	○ 2SK3112 (0.11)*				

*1: 250 V *2: 450 V

*: Under development

■ N4-H series/P4-H series Product Map

DC drain current ID(DC) (A)	Drain to source voltage VDS (V)						Package
	[180]/200	250	450	500	600	[800]/900	
2.0					● 2SK1953 (5.0) △ 2SK2040 (5.0)	● 2SK2478 (7.5)	△ : TO-251 (MP-3) ● : Isolated TO-220 (MP-45F) ○ : TO-220AB (MP-25) ◎ : MP-10 □ : TO-3P (MP-88)
3.0						[● 2SK2476 (5.0)] ○ 2SK2479 (7.5) ● 2SK2480 (4.0)	
4.0	[△ 2SK1954 (0.65)] ◎ 2SK2132 (0.65)	● 2SJ448 (2.0)			● 2SK2137 (2.4)	○ 2SK2481 (4.0) ● 2SK2483 (2.8) (3.5 A)	
4.5			● 2SK2353 (1.4)	● 2SK2354 (1.5)			
5.0			○ 2SK2355 (1.4)	○ 2SK2356 (1.5)	○ 2SK2138 (2.4) ● 2SK2139 (1.5)	□ 2SK2482 (4.0) ○ 2SK2484 (2.8)	
6.0		● 2SJ449 (0.8)	● 2SK2357 (0.9)	● 2SK2358 (1.0)	● 2SK2141 (1.1)	□ 2SK2485 (2.8)	
7.0			○ 2SK2359 (0.9)	○ 2SK2360 (1.0)	○ 2SK2140 (1.5)	□ 2SK2486 (2.0)	
8.0			● 2SK2363 (0.5)	● 2SK2364 (0.6)		□ 2SK2487 (1.6)	
10			□ 2SK2361 (0.9) ○ 2SK2365 (0.5)	□ 2SK2362 (1.0) ○ 2SK2366 (0.6)		[□ 2SK2477 (1.0)] □ 2SK2488 (1.2)	
11		● 2SK2341 (0.26)					
13	○ 2SK2134 (0.4)						
14	● 2SK2135 (0.18)						
15			□ 2SK2367 (0.5)	□ 2SK2368 (0.6)			
16		○ 2SK2133 (0.26)					
20	○ 2SK2136 (0.18)		□ 2SK2369 (0.35)	□ 2SK2370 (0.4)			
25			□ 2SK2371 (0.25)	□ 2SK2372 (0.27)			

(): RDS(on) MAX (Ω) (@VGS = 10 V)

Field Effect Transistor

Power MOS FET

■ N3-H series Product Map

DC drain current $I_{D(DC)}$ (A)	Drain to source voltage V_{DSS} (V)					Package
	250	450	500	600	900	
2.0				● 2SK1758 (4.2)	● 2SK1994 (7.5)	△: TO-251 (MP-3) ●: Isolated TO-220 (MP-45F) ○: TO-220AB (MP-25) □: TO-3P (MP-88)
2.5		● 2SK1988 (2.8)	● 2SK1989 (3.0)			
3.0		○ 2SK1493 (2.8)	○ 2SK1494 (3.0)		○ 2SK1793 (7.5) ● 2SK1995 (4.0)	
3.5					● 2SK2275 (2.8)	
4.0					○ 2SK1501 (4.0)	
4.5		● 2SK1990 (1.4)	● 2SK1991 (1.5)			
5.0		○ 2SK1750 (1.4)	○ 2SK1751 (1.5)		□ 2SK1760 (4.0)	
6.0		● 2SK1992 (0.9)	● 2SK1993 (1.0)		□ 2SK1794 (2.8)	
7.0		○ 2SK1495 (0.9)	○ 2SK1496 (1.0)		□ 2SK1502 (2.0)	
8.0			● 2SK2234 (0.6)		□ 2SK1795 (1.6)	
10		□ 2SK1752 (0.9)	□ 2SK1753 (1.0)		□ 2SK1796 (1.2)	
12		□ 2SK1784 (0.6)	□ 2SK1785 (0.7)			
15		□ 2SK1756 (0.5)	□ 2SK1757 (0.6)			
20		□ 2SK1497 (0.35)	□ 2SK1498 (0.4)			
25	□ 2SK1491 (0.15)	□ 2SK1499 (0.25)	□ 2SK1500 (0.27)			
35	□ 2SK1492 (0.10)					

(): $R_{DS(on) MAX}$ (Ω) (@ $V_{GS} = 10$ V)

Field Effect Transistor

Power MOS FET

■ N5-H Series (High Voltage N channel 5th generation Series)

Part number	Package	Absolute maximum ratings			Electrical characteristics			
		V _{DSS} (V)	I _{D(DC)} (A)	P _T (W)	R _{DS(on)} @V _{GS} = 10 V		C _{iss} (pF)	Q _g (nC)
					TYP. (Ω)	MAX. (Ω)		
2SK3108	Isolated TO-220	200	8	25	0.33	0.4	400	15
2SK3109	TO-220AB	200	10	50	0.33	0.4	400	15
2SK3110	Isolated TO-220	200	14	35	0.13	0.18	1000	40
2SK3111	TO-220AB	200	20	65	0.13	0.18	1000	40
2SK3112	TO-220AB	200	25	70	0.08	0.11	1600	65
2SK3294*	TO-220AB	250	20	70	0.12	0.16	1600	65
2SK3305*	TO-220AB	500	5	50	1.35	1.5	570	20
2SK3306*	Isolated TO-220	500	5	30	1.35	1.5	570	20
2SK3113	TO-251	600	2	20	3.3	4.4	290	9
2SK3221	Isolated TO-220	600	2	25	3.3	4.4	290	9
2SK3114	Isolated TO-220	600	4	30	1.6	2.2	550	15
2SK3297*	Isolated TO-220	600	5	35	1.28	1.6	690	24
2SK3115	Isolated TO-220	600	6	35	0.9	1.2	1100	26
2SK3116	TO-220AB	600	7.5	70	0.9	1.2	1100	26
2SK3298*	TO-220AB	600	7.5	40	0.6	0.75	1500	51
2SK3299*	TO-220AB	600	10	70	0.6	0.75	1500	51
2SK3300*	TO-3P	600	20	150	0.32	0.4	3300	80
2SK3304*	TO-3P	900	7	120	1.6	2.0	1500	50

*: Under development

Field Effect Transistor

Power MOS FET

■ N4-H Series (High Voltage N channel 4th generation Series) (1/2)

Part number	Package	Absolute maximum ratings			Electrical characteristics			
		V _{DSS} (V)	I _{D(DC)} (A)	P _T (W)	R _{DS(on)} @V _{GS} = 10 V		C _{iss} (pF)	Q _g (nC)
					TYP. (Ω)	MAX. (Ω)		
2SK1954	TO-251	180	4.0	20	0.52	0.65	300	10
2SK2132	MP-10		4.0	1.8*	0.52	0.65	300	10
2SK2134	TO-220AB	200	13	70	0.32	0.40	540	15
2SK2135	Isolated TO-220		14	35	0.14	0.18	1100	30
2SK2136	TO-220AB		20	75	0.14	0.18	1100	30
2SK2341	Isolated TO-220	250	11	35	0.21	0.26	1090	33
2SK2133	TO-220AB		16	75	0.21	0.26	1090	25
2SK2353	Isolated TO-220	450	4.5	30	1.0	1.4	670	20
2SK2355	TO-220AB		5.0	50	1.0	1.4	670	20
2SK2357	Isolated TO-220		6.0	35	0.7	0.9	1050	27
2SK2359	TO-220AB		7.0	75	0.7	0.9	1050	27
2SK2361	TO-3P		10	100	0.7	0.9	1050	26
2SK2363	Isolated TO-220		8.0	35	0.4	0.5	1600	42
2SK2365	TO-220AB		10	75	0.4	0.5	1600	42
2SK2367	TO-3P		15	120	0.4	0.5	1600	43
2SK2369	TO-3P		20	120	0.28	0.40	2400	65
2SK2371	TO-3P		25	160	0.20	0.25	3600	95
2SK2354	Isolated TO-220		4.5	30	1.1	1.5	670	20
2SK2356	TO-220AB		5.0	50	1.1	1.5	670	20
2SK2358	Isolated TO-220		6.0	35	0.8	1.0	1050	27
2SK2360	TO-220AB		7.0	75	0.8	1.0	1050	27
2SK2362	TO-3P	10	100	0.8	1.0	1050	26	
2SK2364	Isolated TO-220	8.0	35	0.5	0.6	1600	42	
2SK2366	TO-220AB	10	75	0.5	0.6	1600	42	
2SK2368	TO-3P	15	120	0.5	0.6	1600	43	
2SK2370	TO-3P	20	120	0.32	0.40	2400	65	
2SK2372	TO-3P	25	160	0.22	0.27	3600	95	
2SK1953	Isolated TO-220	600	2.0	25	4.2	5.0	275	12
2SK2040	TO-251		2.0	20	4.2	5.0	275	12
2SK2137	Isolated TO-220		4.0	30	2.0	2.4	550	20
2SK2138	TO-220AB		5.0	70	2.0	2.4	550	20
2SK2139	Isolated TO-220		5.0	35	1.25	1.5	930	30
2SK2141	Isolated TO-220		6.0	40	0.9	1.1	1150	40
2SK2140	TO-220AB		7.0	75	1.25	1.5	930	30
2SK2476	Isolated TO-220		800	3.0	40	3.4	5.0	590
2SK2477	TO-3P	10	150	0.65	1.0	2950	90	
2SK2478	Isolated TO-220	900	2.0	30	5.0	7.5	485	17
2SK2479	TO-220AB		3.0	70	5.6	7.5	485	17
2SK2480	Isolated TO-220		3.0	35	3.2	4.0	900	30
2SK2481	TO-220AB		4.0	75	3.2	4.0	900	30

*: T_A = 25°C

Field Effect Transistor

Power MOS FET

■ **N4-H Series (High Voltage N channel 4th generation Series) (2/2)**

Part number	Package	Absolute maximum ratings			Electrical characteristics			
		V _{DSS} (V)	I _{D(DC)} (A)	P _T (W)	R _{DS(on)} @V _{GS} = 10 V		C _{iss} (pF)	Q _g (nC)
					TYP. (Ω)	MAX. (Ω)		
2SK2482	TO-3P	900	5.0	100	3.2	4.0	900	30
2SK2483	Isolated TO-220		3.5	40	2.2	2.8	1200	40
2SK2484	TO-220AB		5.0	75	2.2	2.8	1200	40
2SK2485	TO-3P		6.0	100	2.2	2.8	1200	40
2SK2486	TO-3P		7.0	120	1.4	2.0	1830	55
2SK2487	TO-3P		8.0	140	1.1	1.6	2100	65
2SK2488	TO-3P		10	160	1.0	1.2	2900	90

■ **P4-H Series (High Voltage P channel 4th generation Series)**

Part number	Package	Absolute maximum ratings			Electrical characteristics			
		V _{DSS} (V)	I _{D(DC)} (A)	P _T (W)	R _{DS(on)} @V _{GS} = 10 V		C _{iss} (pF)	Q _g (nC)
					TYP. (Ω)	MAX. (Ω)		
2SJ448	Isolated TO-220	-250	±4.0	30	1.5	2.0	470	15
2SJ449	Isolated TO-220	-250	±6.0	35	0.55	0.8	1040	23.4

Field Effect Transistor

Power MOS FET

■ N3-H Series (High Voltage N channel 3rd generation Series)

Part number	Package	Absolute maximum ratings			Electrical characteristics			
		V _{DSS} (V)	I _{D(DC)} (A)	P _T (W)	R _{DS(on)} @V _{GS} = 10 V		C _{iss} (pF)	Q _G (nC)
					TYP. (Ω)	MAX. (Ω)		
2SK1491	TO-3P	250	25	120	0.12	0.15	1950	55
2SK1492	TO-3P	250	35	140	0.08	0.1	3000	80
2SK1988	Isolated TO-220	450	2.5	30	2.2	2.8	350	12
2SK1493	TO-220AB	450	3	50	2.2	2.8	350	12
2SK1990	Isolated TO-220	450	4.5	30	1.1	1.4	610	22
2SK1750	TO-220AB	450	5	50	1.1	1.4	610	22
2SK1992	Isolated TO-220	450	6	35	0.7	0.9	1060	36
2SK1495	TO-220AB	450	7	70	0.7	0.9	1060	36
2SK1752	TO-3P	450	10	100	0.7	0.9	1060	36
2SK1784	TO-3P	450	12	100	0.5	0.6	1330	46
2SK1756	TO-3P	450	15	120	0.4	0.5	1500	50
2SK1497	TO-3P	450	20	120	0.28	0.35	2460	85
2SK1499	TO-3P	450	25	160	0.2	0.25	3300	115
2SK1989	Isolated TO-220	500	2.5	30	2.4	3	350	12
2SK1494	TO-220AB	500	3	50	2.4	3	350	12
2SK1991	Isolated TO-220	500	4.5	30	1.2	1.5	610	22
2SK1751	TO-220AB	500	5	50	1.2	1.5	610	22
2SK1993	Isolated TO-220	500	6	35	0.8	1	1060	36
2SK1496	TO-220AB	500	7	70	0.8	1	1500	57
2SK2234	Isolated TO-220	500	8	40	0.5	0.6	1060	36
2SK1753	TO-3P	500	10	100	0.8	1	1060	36
2SK1785	TO-3P	500	12	100	0.6	0.7	1330	46
2SK1757	TO-3P	500	15	120	0.5	0.6	1500	50
2SK1498	TO-3P	500	20	120	0.32	0.4	2460	85
2SK1500	TO-3P	500	25	160	0.22	0.27	3300	115
2SK1758	Isolated TO-220	600	2	30	2.8	4.2	360	17
2SK1994	Isolated TO-220	900	2	30	5.5	7.5	430	15.5
2SK1793	TO-220AB	900	3	75	5.5	7.5	430	19
2SK1995	Isolated TO-220	900	3	35	3	4	790	28
2SK2275	Isolated TO-220	900	3.5	35	2.2	2.8	1000	42
2SK1501	TO-220AB	900	4	70	2.8	4	790	33
2SK1760	TO-3P	900	5	100	3.1	4	790	34
2SK1794	TO-3P	900	6	100	2.4	2.8	1000	42
2SK1502	TO-3P	900	7	120	1.7	2	1550	80
2SK1795	TO-3P	900	8	140	1.3	1.6	1740	66
2SK1796	TO-3P	900	10	150	1	1.2	2500	90
2SK1271*	TO-3P	1400	5	240	3.5	4	1800	125

*: 2nd Generation

Field Effect Transistor

Power MOS FET

■ 8-pin SOP Type Power MOS FET

On-Resistance R _{ds (on)} (mΩ) (TYP.) @V _{GS} = 10 V	Drain to source voltage V _{DSS} (V)		
	20	30	60
up to 600			μPA1790 (Nch + Pch)
up to 150			μPA1759 (Nch Dual)
up to 90		μPA1750 (P-ch Dual)	
up to 70		μPA1710 (P-ch Single) μPA1710A (P-ch Single) μPA1754 (N-ch Dual)	
up to 50		μPA1713 (P-ch Single)	
up to 40	μPA1752 (N-ch Dual)*1	μPA1711 (P-ch Single)	
up to 30	μPA1753 (N-ch Dual)*1 μPA1756 (N-ch Dual)*1	μPA1751 (N-ch Dual) μPA1714 (P-ch Single) μPA1755 (N-ch Dual) μPA1758 (N-ch Dual)*1	
up to 20	μPA1701 (N-ch Single)*1 μPA1701A (N-ch Single) μPA1757 (N-ch Dual)*1	μPA1700 (N-ch Single) μPA1700A (N-ch Single) μPA1712 (P-ch Single) μPA1716 (P-ch Single) μPA1705 (N-ch Single)*2	
up to 10		μPA1702 (N-ch Single) μPA1703 (N-ch Single) μPA1704 (N-ch Single) μPA1706 (N-ch Single) μPA1707 (N-ch Single) μPA1715 (P-ch Single)	

*1: 2.5 V drive is possible. Otherwise 4 V drive is possible. *2: 4.5 V drive

Field Effect Transistor

Power MOS FET

■ Power SOP8 series

Part number	Configuration	Absolute maximum rating (T _A = 25 °C)				Electrical characteristics (T _A = 25 °C)				Applications
		V _{DSS} (V)	I _D		P _T T _C = 25 °C (W)	R _{DS(on)} (Ω)				
			DC (A)	Pulse (A)		V _{GS} (V)	I _D (A)	TYP.	MAX.	
μPA1700	N-ch Single	30	±7	±28	2.0* ¹	4	3.5	0.040	0.050	Switching
μPA1700A	N-ch Single	30	±7	±28	2.0* ¹	4	3.5	0.028	0.05	
μPA1701	N-ch Single	20	±7	±28	2.0* ¹	2.5	3.5	0.03	0.04	
μPA1701A	N-ch Single	20	±7	±28	2.0* ¹	2.5	3.5	0.026	0.04	
μPA1702	N-ch Single	30	±8	±32	2.0* ¹	4	4	0.018	0.025	
μPA1703	N-ch Single	30	±10	±40	2.0* ¹	4	5.0	0.012	0.017	
μPA1704	N-ch Single	30	±10	±40	2.0* ¹	2.5	5.0	0.0125	0.016	
μPA1705	N-ch Single	30	±7	±28	2.0* ¹	4.5	3.5	0.031	0.04	
μPA1706	N-ch Single	30	±13	±52	2.0* ¹	4	7.0	0.008	0.012	
μPA1707	N-ch Single	30	±10	±40	2.0* ¹	4	5.0	0.014	0.021	
μPA1710	P-ch Single	-30	∓5	∓20	2.0* ¹	-4	-2.5	0.11	0.16	
μPA1710A	P-ch Single	-30	∓5	∓20	2.0* ¹	-4	-2.0	0.091	0.16	
μPA1711	P-ch Single	-30	∓7	∓28	2.0* ¹	-4	-3.5	0.049	0.07	
μPA1712	P-ch Single	-30	∓8	∓32	2.0* ¹	-4	-4.0	0.027	0.048	
μPA1713	P-ch Single	30	∓5	∓20	2.0* ¹	-4	2.5	0.10	0.16	
μPA1714	P-ch Single	-30	∓7	∓28	2.0* ¹	-4	3.5	0.049	0.07	
μPA1715	P-ch Single	-30	∓11	∓44	2.0* ¹	-4.5	-6.0	0.011	0.016	
μPA1716	P-ch Single	-30	∓8	∓32	2.0* ¹	-4.5	-4	0.017	0.023	
μPA1750	P-ch Dual	-30	∓3.5	∓14	2.0* ²	-4	-1.8	0.125	0.18	
μPA1751	N-ch Dual	30	±5	±20	2.0* ²	4	2.5	0.044	0.064	
μPA1752	N-ch Dual	20	±5	±20	2.0* ²	2.5	2.5	0.042	0.061	
μPA1753	N-ch Dual	20	±6	±24	2.0* ²	2.5	3.0	0.028	0.04	
μPA1754	N-ch Dual	30	±7	±28	2.0* ²	4	3.5	0.029	0.053	
μPA1755	N-ch Dual	-30	±7	±28	2.0* ²	4.5	3.5	0.028	0.045	
μPA1756	N-ch Dual	30	±6	±24	2.0* ²	2.5	3.0	0.028	0.04	
μPA1757	N-ch Dual	20	±7	±28	2.0* ²	2.5	3.5	0.022	0.032	
μPA1758	N-ch Dual	30	±6	±24	2.0* ²	2.5	3.0	0.026	0.04	
μPA1759	N-ch Dual	60	±5	±20	2.0* ²	10	2.5	0.11	0.15	
μPA1790	N-ch + P-ch	60/-60	±1.0/±0.7	±4.0/±2.8	1.0* ²	10	0.5/0.35	0.12/0.44	0.26/0.6	

*1: T_A = 25°C, Mounted on ceramic substrate of 1200 mm² × 0.7 mm*2: T_A = 25°C, 2 circuits, Mounted on ceramic substrate of 2000 mm² × 1.1 mm

Field Effect Transistor

Power MOS FET

■ 8-pin TSSOP Type Power MOS FET

On-Resistance R _{DS(on)} (mΩ) (MAX.) @V _{GS} = 4.5 V	Drain to source voltage V _{DSS} (V)		
	12	20	30
~210		μPA1851 (P-ch Dual)	
~190			μPA1853 (P-ch Dual)
~115	μPA1850 (P-ch Dual)		
~75		μPA1811 (P-ch Single)	μPA1812 (P-ch Single)
~60	μPA1854 (P-ch Dual) μPA1810 (P-ch Single)		
~40		μPA1852 (N-ch Dual)	μPA1800 (N-ch Single)
~30			μPA1814 (P-ch Single)*
~25	μPA1813 (P-ch Single)	μPA1801 (N-ch Single) μPA1855 (N-ch Dual)* μPA1802 (N-ch Single) μPA1815 (P-ch Single)*	μPA1803 (N-ch Single)*

*: Under development

■ 8-pin TSSOP Type Power MOS FET

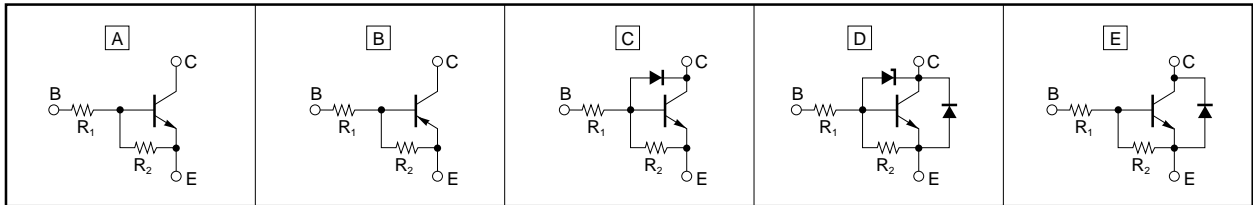
Part number	Configuration	Absolute maximum rating (T _A = 25 °C)				Electrical characteristics (T _A = 25 °C)				Applications
		V _{DSS} (V)	V _{GSS} (V)	I _{D(DC)} (A)	P _{Tr} * (W)	R _{DS(on)} (mΩ) MAX.				
						V _{GS} = 2.5 V	V _{GS} = 4 V	V _{GS} = 4.5 V	V _{GS} = 10 V	
μPA1800	N-ch Single	30	±20	±5	2	–	45	39	27	Switching
μPA1801	N-ch Single	20	±8	±6	2	34	25	24	–	
μPA1802	N-ch Single	20	±12	±7	2	32	25	23	–	
μPA1803*	N-ch Single	30	±20	±7	2	–	–	16	21	
μPA1810	P-ch Single	–12	–10/+5	±4	2	100	60	55	–	
μPA1811	P-ch Single	–20	–12/+5	±4	2	120	80	75	–	
μPA1812	P-ch Single	–30	–20/+5	±5	2	–	90	70	40	
μPA1813	P-ch Single	–12	–10/+5	±5	2	40	30	25	–	
μPA1814*	P-ch Single	–30	–20/+5	±7	2	–	–	30	19	
μPA1815*	P-ch Single	–20	–12/+3	±7	2	30	23	22	–	
μPA1850	P-ch Dual	–12	–10/+5	±2.5	2	200	130	115	–	
μPA1851	P-ch Dual	–20	–20/+5	±2.5	2	–	250	210	105	
μPA1852	N-ch Dual	20	±12	±5	2	60	45	40	–	
μPA1853	P-ch Dual	–30	–20/+5	±2.5	2	–	220	190	85	
μPA1854	P-ch Dual	–12	–10/+5	±2.5	2	105	70	60	–	
μPA1855*	N-ch Dual	20	±12	±6	2	29	24	23	–	

*: Mounted on ceramic substrate of 50 cm² × 1.1 mm

*: Under development

Transistor with Internal Resistor

■ Equivalent circuit



■ AA1[], AN1[], BA1[], BN1[] series (TO-92, SST)

Part number		Equivalent circuit and applications	Absolute maximum ratings (T _A = 25 °C)					Electrical characteristics (T _A = 25 °C)						
			V _{CB0} (V)	V _{CE0} (V)	V _{EB0} (V)	I _C (mA)	P _T (mW)	T _J (°C)	R ₁ (kΩ)	R ₂ (kΩ)	h _{FE}	V _{CE} (V)	I _C (mA)	Remarks
TO-92	SST	Refer to equivalent circuit A Switching	60	50	10	100	250	150	10	10	35 to 100	5.0	5.0	
AA1A4M	BA1A4M		60	50	5	100	250	150	10	47	35 to 340	5.0	5.0	
AA1A4P	BA1A4P		60	50	10	100	250	150	22	22	60 to 195	5.0	5.0	
AA1F4M	BA1F4M		60	50	5	100	250	150	22	47	85 to 340	5.0	5.0	
AA1F4N	BA1F4N		60	50	10	100	250	150	47	47	85 to 340	5.0	5.0	
AA1L4M	BA1L4M		60	50	15	100	250	150	47	22	60 to 195	5.0	5.0	
AA1L4L	BA1L4L		60	50	5	100	250	150	4.7	–	135 to 600	5.0	5.0	
AA1L3Z	BA1L3Z		60	50	5	100	250	150	10	–	135 to 600	5.0	5.0	
AA1A4Z	BA1A4Z		60	50	5	100	250	150	22	–	135 to 600	5.0	5.0	
AA1F4Z	BA1F4Z		60	50	5	100	250	150	47	–	135 to 600	5.0	5.0	
AA1L4Z	BA1L4Z		60	50	10	100	250	150	4.7	4.7	20 to 80	5.0	5.0	
AA1L3M	BA1L3M		60	50	5	100	250	150	4.7	10	35 to 100	5.0	5.0	
AA1L3N	BA1L3N		60	50	5	100	250	150	1.0	10	35 to 100	5.0	5.0	
AA1A3Q	BA1A3Q		60	50	5	100	250	150	1.0	10	35 to 100	5.0	5.0	
AN1A4M	BN1A4M		–60	–50	–10	–100	250	150	10	10	35 to 100	–5.0	–5.0	
AN1A4P	BN1A4P		–60	–50	–5	–100	250	150	10	47	85 to 340	–5.0	–5.0	
AN1F4M	BN1F4M		–60	–50	–10	–100	250	150	22	22	60 to 195	–5.0	–5.0	
AN1F4N	BN1F4N		–60	–50	–5	–100	250	150	22	47	85 to 340	–5.0	–5.0	
AN1L4M	BN1L4M		–60	–50	–10	–100	250	150	47	47	85 to 340	–5.0	–5.0	
AN1L4L	BN1L4L		–60	–50	–15	–100	250	150	47	22	60 to 195	–5.0	–5.0	
AN1L3Z	BN1L3Z	–60	–50	–5	–100	250	150	4.7	–	135 to 600	–5.0	–5.0		
AN1A4Z	BN1A4Z	–60	–50	–5	–100	250	150	10	–	135 to 600	–5.0	–5.0		
AN1F4Z	BN1F4Z	–60	–50	–5	–100	250	150	22	–	135 to 600	–5.0	–5.0		
AN1L4Z	BN1L4Z	–60	–50	–5	–100	250	150	47	–	135 to 600	–5.0	–5.0		
AN1L3M	BN1L3M	–60	–50	–10	–100	250	150	4.7	4.7	20 to 80	–5.0	–5.0		
AN1L3N	BN1L3N	–60	–50	–5	–100	250	150	4.7	10	35 to 100	–5.0	–5.0		
AN1A3Q	BN1A3Q	–60	–50	–5	–100	250	150	1.0	10	35 to 100	–5.0	–5.0		

Transistor with Internal Resistor

■ **AB1[], AP1[], BB1[], BP1[] series (TO-92, SST)**

Part number		Equivalent circuit and applications	Absolute maximum ratings (T _A = 25 °C)						Electrical characteristics (T _A = 25 °C)						
			V _{CB0} (V)	V _{CEO} (V)	V _{EBO} (V)	I _C (A)	P _T (mW)		T _J (°C)	R ₁ (kΩ)	R ₂ (kΩ)	h _{FE}	V _{CE} (V)	I _C (A)	Re- marks
TO-92	SST					TO-92	SST								
AB1A4A	BB1A4A	Refer to equivalent circuit [A]	30	25	10	0.7	750	250	150	–	10	300 ~	2.0	0.5	
AB1L2Q	BB1L2Q		30	25	10	0.7	750	250	150	0.47	4.7	300 ~	2.0	0.5	
AB1A3M	BB1A3M		30	25	10	0.7	750	250	150	1.0	1.0	100 ~	2.0	0.5	
AB1F3P	BB1F3P		30	25	10	0.7	750	250	150	2.2	10	300 ~	2.0	0.5	
AB1J3P	BB1J3P		30	25	10	0.7	750	250	150	3.3	10	300 ~	2.0	0.5	
AB1L3N	BB1L3N		30	25	10	0.7	750	250	150	4.7	10	300 ~	2.0	0.5	
AB1A4M	BB1A4M	Refer to equivalent circuit [B]	30	25	10	0.7	750	250	150	10	10	300 ~	2.0	0.5	
AP1A4A	BP1A4A		–25	–25	–10	–0.7	750	250	150	–	10	100 ~	–2.0	–0.5	
AP1L2Q	BP1L2Q		–25	–25	–10	–0.7	750	250	150	0.47	4.7	100 ~	–2.0	–0.5	
AP1A3M	BP1A3M		–25	–25	–10	–0.7	750	250	150	1.0	1.0	100 ~	–2.0	–0.5	
AP1F3P	BP1F3P		–25	–25	–10	–0.7	750	250	150	2.2	10	100 ~	–2.0	–0.5	
AP1J3P	BP1J3P		–25	–25	–10	–0.7	750	250	150	3.3	10	100 ~	–2.0	–0.5	
AP1L3N	BP1L3N		–25	–25	–10	–0.7	750	250	150	4.7	10	100 ~	–2.0	–0.5	
AP1A4M	BP1A4M		–25	–25	–10	–0.7	750	250	150	10	10	100 ~	–2.0	–0.5	

■ **AQ1[] series (TO-92)**

Part number		Equivalent circuit and applications	Absolute maximum ratings (T _A = 25 °C)						Electrical characteristics (T _A = 25 °C)					
			V _{CB0} (V)	V _{CEO} (V)	V _{EBO} (V)	I _C (A)	P _T (mW)	T _J (°C)	R ₁ (kΩ)	R ₂ (kΩ)	h _{FE}	V _{CE} (V)	I _C (A)	Remarks
TO-92														
AQ1A4A		Refer to equivalent circuit [B]	–20	–20	–10	–2.0	750	150	–	10	150 ~	–2.0	–1.0	
AQ1F2Q			–20	–20	–10	–2.0	750	150	0.22	2.2	150 ~	–2.0	–1.0	
AQ1L2N			–20	–20	–10	–2.0	750	150	0.47	1.0	150 ~	–2.0	–1.0	
AQ1L2Q			–20	–20	–20	–10	750	150	0.47	4.7	150 ~	–2.0	–1.0	
AQ1A3M			–20	–20	–10	–2.0	750	150	1.0	1.0	150 ~	–2.0	–1.0	
AQ1F3M			–20	–20	–10	–2.0	750	150	2.2	2.2	150 ~	–2.0	–1.0	
AQ1F3P		–20	–20	–10	–2.0	750	150	4.7	10	150 ~	–2.0	–1.0		

Transistor with Internal Resistor

■ **AD1[], AD2[], AR1[] series (TO-92)**

Part number	Equivalent circuit and applications	Absolute maximum ratings (T _A = 25 °C)						Electrical characteristics (T _A = 25 °C)					Remarks	
		V _{CB0} (V)	V _{CE0} (V)	V _{EB0} (V)	I _C (A)	P _T (mW)	T _J (°C)	R ₁ (kΩ)	R ₂ (kΩ)	h _{FE}	V _{CE} (V)	I _C (A)		
TO-92														
AD1A3M	Refer to equivalent circuit [A]	80	60	10	1.0	750	150	1.0	1.0	200 ~	2.0	0.5		
AD1F3P		80	60	10	1.0	750	150	2.2	10	300 ~	2.0	0.5		
AD1L3N		80	60	10	1.0	750	150	4.7	10	300 ~	2.0	0.5		
AD1A4M		80	60	10	1.0	750	150	10	10	300 ~	2.0	0.5		
AD1L2Q		Switching	80	60	10	1.0	750	150	0.47	4.7	300 ~	2.0	0.5	
AD1F2Q			80	60	10	1.0	750	150	0.22	2.2	300 ~	2.0	0.5	
AD1A4A			80	60	10	1.0	750	150	–	10	300 ~	2.0	0.5	
AD2A3M	Refer to equivalent circuit [C]	60 ±10	60 ±10	10	1.0	750	150	1.0	1.0	200 ~	2.0	0.5		
AD2F3P		60 ±10	60 ±10	10	1.0	750	150	2.2	10	300 ~	2.0	0.5		
AD2L3N		60 ±10	60 ±10	10	1.0	750	150	4.7	10	300 ~	2.0	0.5		
AD2A4M		60 ±10	60 ±10	10	1.0	750	150	10	10	300 ~	2.0	0.5		
AD2L2Q		Switching	60 ±10	60 ±10	10	1.0	750	150	0.47	4.7	300 ~	2.0	0.5	
AD2F2Q			60 ±10	60 ±10	10	1.0	750	150	0.22	2.2	300 ~	2.0	0.5	
AD2A4A			60 ±10	60 ±10	10	1.0	750	150	–	10	300 ~	2.0	0.5	
AR1A3M	Refer to equivalent circuit [B]	–60	–60	–10	–1.0	750	150	1.0	1.0	100 ~	–2.0	–0.5		
AR1F3P		–60	–60	–10	–1.0	750	150	2.2	10	100 ~	–2.0	–0.5		
AR1L3N		–60	–60	–10	–1.0	750	150	4.7	10	100 ~	–2.0	–0.5		
AR1A4M		–60	–60	–10	–1.0	750	150	10	10	100 ~	–2.0	–0.5		
AR1L2Q		Switching	–60	–60	–10	–1.0	750	150	0.47	4.7	100 ~	–2.0	–0.5	
AR1F2Q			–60	–60	–10	–1.0	750	150	0.22	2.2	100 ~	–2.0	–0.5	
AR1A4A			–60	–60	–10	–1.0	750	150	–	10	100 ~	–2.0	–0.5	

■ **CE1[], CE2[] series (SP-8)**

Part number	Equivalent circuit and applications	Absolute maximum ratings (T _A = 25 °C)						Electrical characteristics (T _A = 25 °C)				
		V _{CB0} (V)	V _{CE0} (V)	V _{EB0} (V)	I _C (A)	P _T (W)	T _J (°C)	R ₁ (kΩ)	R ₂ (kΩ)	h _{FE}	V _{CE} (V)	I _C (A)
SP-8												
CE1A3Q	Refer to [D]	60 ±10	60 ±10	15	±2.0	1.0	150	1.0	10	1000 to 3000	5.0	1.0
CE1F3P		60 ±10	60 ±10	15	±2.0	1.0	150	2.2	10	1000 to 3000	5.0	1.0
CE1N2R		60 ±10	60 ±10	15	±2.0	1.0	150	0.68	10	1000 to 3000	5.0	1.0
CE2A3Q	Refer to [E]	60	60	15	±2.0	1.0	150	1.0	10	1000 to 3000	5.0	1.0
CE2F3P		60	60	15	±2.0	1.0	150	1.0	10	1000 to 3000	5.0	1.0

Transistor with Internal Resistor

■ FA1[], FN1[], GA1[], GN1[] series (SC-59, SC-70)

Part number		Equivalent circuit and applications	Absolute maximum ratings (T _A = 25 °C)					Electrical characteristics (T _A = 25 °C)						
			V _{CB0} (V)	V _{CEO} (V)	V _{EB0} (V)	I _C (mA)	P _T (mW)	T _J (°C)	R ₁ (kΩ)	R ₂ (kΩ)	h _{FE}	V _{CE} (V)	I _C (mA)	Remarks
SC-59	SC-70													
FA1A4M	GA1A4M	Refer to equivalent circuit [A]	60	50	10	100	200 (SC-59)	150	10	10	35 to 100	5.0	5.0	
FA1A4P	GA1A4P		60	50	5	100		150	10	47	35 to 340	5.0	5.0	
FA1F4M	GA1F4M		60	50	10	100		150	22	22	60 to 195	5.0	5.0	
FA1F4N	GA1F4N		60	50	5	100		150	22	47	85 to 340	5.0	5.0	
FA1L4M	GA1L4M		60	50	10	100		150	47	47	85 to 340	5.0	5.0	
FA1L4L	GA1L4L		60	50	15	100		150	47	22	60 to 195	5.0	5.0	
FA1L3Z	GA1L3Z		60	50	5	100		150	4.7	–	135 to 600	5.0	5.0	
FA1A4Z	GA1A4Z		60	50	5	100	150 (SC-70)	150	10	–	135 to 600	5.0	5.0	
FA1F4Z	GA1F4Z		60	50	5	100		150	22	–	135 to 600	5.0	5.0	
FA1L4Z	GA1L4Z		60	50	5	100		150	47	–	135 to 600	5.0	5.0	
FA1L3M	GA1L3M		60	50	10	100		150	4.7	4.7	20 to 80	5.0	5.0	
FA1L3N	GA1L3N		60	50	5	100		150	4.7	10	35 to 100	5.0	5.0	
FA1A3Q	GA1A3Q		60	50	5	100		150	1.0	10	35 to 100	5.0	5.0	
FN1A4M	GN1A4M		Refer to equivalent circuit [B]	–60	–50	–10		–100	200 (SC-59)	150	10	10	35 to 100	–5.0
FN1A4P	GN1A4P	–60		–50	–5	–100	150	10		47	85 to 340	–5.0	–5.0	
FN1F4M	GN1F4M	–60		–50	–10	–100	150	22		22	60 to 195	–5.0	–5.0	
FN1F4N	GN1F4N	–60		–50	–5	–100	150	22		47	85 to 340	–5.0	–5.0	
FN1L4M	GN1L4M	–60		–50	–10	–100	150	47		47	85 to 340	–5.0	–5.0	
FN1L4L	GN1L4L	–60		–50	–15	–100	150	47		22	60 to 195	–5.0	–5.0	
FN1L3Z	GN1L3Z	–60		–50	–5	–100	150	4.7		–	135 to 600	–5.0	–5.0	
FN1A4Z	GN1A4Z	–60		–50	–5	–100	150 (SC-70)	150	10	–	135 to 600	–5.0	–5.0	
FN1F4Z	GN1F4Z	–60		–50	–5	–100		150	22	–	135 to 600	–5.0	–5.0	
FN1L4Z	GN1L4Z	–60		–50	–5	–100		150	47	–	135 to 600	–5.0	–5.0	
FN1L3M	GN1L3M	–60		–50	–10	–100		150	4.7	4.7	20 to 80	–5.0	–5.0	
FN1L3N	GN1L3N	–60		–50	–5	–100		150	4.7	10	35 to 100	–5.0	–5.0	
FN1A3Q	GN1A3Q	–60		–50	–5	–100		150	1.0	10	35 to 100	–5.0	–5.0	

■ FB1[] series (SC-59)

Part number		Equivalent circuit and applications	Absolute maximum ratings (T _A = 25 °C)					Electrical characteristics (T _A = 25 °C)						
			V _{CB0} (V)	V _{CEO} (V)	V _{EB0} (V)	I _C (A)	P _T (mW)	T _J (°C)	R ₁ (kΩ)	R ₂ (kΩ)	h _{FE}	V _{CE} (V)	I _C (A)	Remarks
FB1A4A		Refer to equivalent circuit [A]	30	25	10	0.7	200	150	–	10	300	2.0	0.5	
FB1L2Q			30	25	10	0.7		150	0.47	4.7	300	2.0	0.5	
FB1A3M			30	25	10	0.7		150	1.0	1.0	100	2.0	0.5	
FB1F3P			30	25	10	0.7		150	2.2	10	300	2.0	0.5	
FB1J3P			30	25	10	0.7		150	3.3	10	300	2.0	0.5	
FB1L3N	Switching		30	25	10	0.7		150	4.7	10	300	2.0	0.5	
FB1A4M			30	25	10	0.7		150	10	10	300	2.0	0.5	
FP1A4A		Refer to equivalent circuit [B]	–25	–25	–10	–0.7	200	150	–	10	100	–2.0	–0.5	
FP1L2Q			–25	–25	–10	–0.7		150	0.47	4.7	100	–2.0	–0.5	
FP1A3M			–25	–25	–10	–0.7		150	1.0	1.0	100	–2.0	–0.5	
FP1F3P			–25	–25	–10	–0.7		150	2.2	10	100	–2.0	–0.5	
FP1J3P			–25	–25	–10	–0.7		150	3.3	10	100	–2.0	–0.5	
FP1L3N	Switching		–25	–25	–10	–0.7		150	4.7	10	100	–2.0	–0.5	
FP1A4M			–25	–25	–10	–0.7		150	10	10	100	–2.0	–0.5	

Transistor with Internal Resistor

■ HD1[], HD2[], HR1[] series (SOT-89)

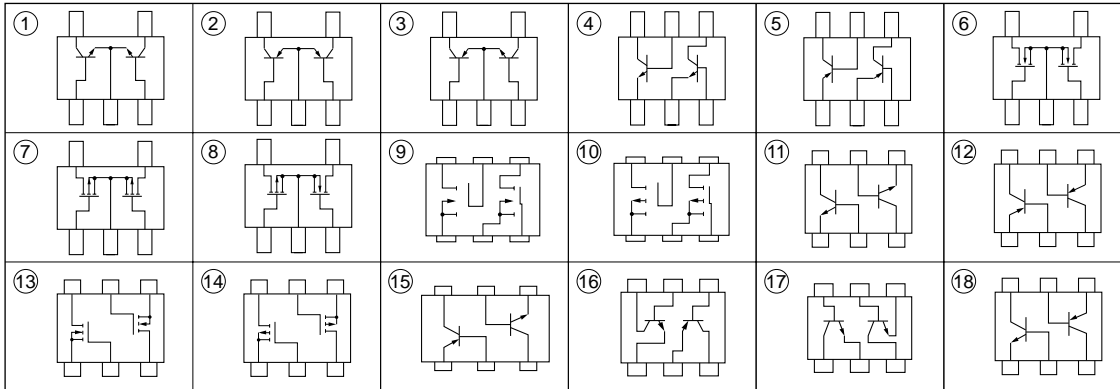
Part number	Equivalent circuit and applications	Absolute maximum ratings (T _A = 25 °C)					Electrical characteristics (T _A = 25 °C)						Remarks	
		V _{CB0} (V)	V _{CE0} (V)	V _{EB0} (V)	I _C (A)	P _T (mW)	T _J (°C)	R ₁ (kΩ)	R ₂ (kΩ)	h _{FE}	V _{CE} (V)	I _C (A)		
HD1A3M	Refer to equivalent circuit [A]	80	60	10	1.0	2.0	150	1.0	1.0	200	2.0	0.5		
HD1F3P		80	60	10	1.0		150	2.2	10	300	2.0	0.5		
HD1L3N		80	60	10	1.0		150	4.7	10	300	2.0	0.5		
HD1A4M		80	60	10	1.0		150	10	10	300	2.0	0.5		
HD1L2Q		Switching	80	60	10		1.0	150	0.47	4.7	300	2.0	0.5	
HD1F2Q			80	60	10		1.0	150	0.22	2.2	300	2.0	5.0	
HD1A4A			80	60	10		1.0	150	–	10	300	2.0	0.5	
HD2A3M	Refer to equivalent circuit [C]	60±10	60±10	10	1.0	2.0	150	1.0	1.0	200	2.0	0.5		
HD2F3P		60±10	60±10	10	1.0		150	2.2	10	300	2.0	0.5		
HD2L3N		60±10	60±10	10	1.0		150	4.7	10	300	2.0	0.5		
HD2A4M		60±10	60±10	10	1.0		150	10	10	300	2.0	0.5		
HD2L2Q		Switching	60±10	60±10	10		1.0	150	0.47	4.7	300	2.0	0.5	
HD2F2Q			60±10	60±10	10		1.0	150	0.2	2.2	300	2.0	0.5	
HD2A4A			60±10	60±10	10		1.0	150	–	10	300	2.0	0.5	
HR1A3M	Refer to equivalent circuit [B]	–60	–60	–10	–1.0	2.0	150	1.0	1.0	100	–2.0	–0.5		
HR1F3P		–60	–60	–10	–1.0		150	2.2	10	100	–2.0	–0.5		
HR1L3N		–60	–60	–10	–1.0		150	4.7	10	100	–2.0	–0.5		
HR1A4M		–60	–60	–10	–1.0		150	10	10	100	–2.0	–0.5		
HR1L2Q		Switching	–60	–60	–10		–1.0	150	0.47	4.7	100	–2.0	–0.5	
HR1F2Q			–60	–60	–10		–1.0	150	0.22	2.2	100	–2.0	–0.5	
HR1A4A			–60	–60	–10		–1.0	150	–	10	100	–2.0	–0.5	

■ HQ1[] series (SOT-89)

Part number	Equivalent circuit and applications	Absolute maximum ratings (T _A = 25 °C)					Electrical characteristics (T _A = 25 °C)						Remarks	
		V _{CB0} (V)	V _{CE0} (V)	V _{EB0} (V)	I _C (A)	P _T (mW)	T _J (°C)	R ₁ (kΩ)	R ₂ (kΩ)	h _{FE}	V _{CE} (V)	I _C (A)		
HQ1A4A	Refer to equivalent circuit [B]	–20	–20	–10	–2.0	2.0	150	–	10	150	–2.0	–1.0		
HQ1F2Q		–20	–20	–10	–2.0		150	0.22	2.2	150	–2.0	–1.0		
HQ1L2N		–20	–20	–10	–2.0		150	0.47	1.0	150	–2.0	–1.0		
HQ1L2Q		–20	–20	–20	–10		150	0.47	4.7	150	–2.0	–1.0		
HQ1A3M		Switching	–20	–20	–10		–2.0	150	1.0	1.0	150	–2.0	–1.0	
HQ1F3M			–20	–20	–10		–2.0	150	2.2	2.2	150	–2.0	–1.0	
HQ1F3P			–20	–20	–10		–2.0	150	4.7	10	150	–2.0	–1.0	

Transistor for Array

Equivalent Circuit



■ Bipolar Transistor

Part number	Equivalent circuit	V _{CEO} (V)	I _{C(DC)} (mA)	P _T * (mW)	h _{FE}	VCE (V)		I _C (mA)	Package
						6	1		
μPA570T	①	50	100	200	90 to 600	6	1	• 5-pin Super Mini-Mold SC-88A	
μPA571T	②	-50	-100	200		-6	-1		
μPA574T	③	50/-50	100/-100	300		6/-6	1/-1		
μPA670T	⑪	50	100	200		6	1	• 6-pin Super Mini-Mold SC-88	
μPA671T	⑫	-50	-100	200		-6	-1		
μPA500T	①	50	100	300		6	1	• 5-pin Mini-Mold SC-74A	
μPA501T	②	-50	-100	300		-6	-1		
μPA504T	③	50/-50	100/-100	300		6/-6	1/-1	• 6-pin Mini-Mold SC-74	
μPA600T	④	50	100	300		6	1		
μPA601T	⑤	-50	-100	300		-6	-1		
μPA604T	⑪	50	100	300		6	1		
μPA605T	⑫	-50	-100	300		-6	-1		
μPA608T	⑮	50 -16	100 -500	300		90 to 600 110 to 400	6 -1		1 -100
μPA609T	⑯	40 -40	500 -500	300		75 to 300 75 to 300	1 -1	150 -150	
μPA673T	⑰	15	200	200	82 to 180	6	1	• 6-pin Super Mini-Mold SC-88	
μPA674T	⑱	15 -15	200 -50	200	40 to 200 50 to 150	1 -1	10 -10		

*: Total

■ MOS FET

Part number	Equivalent circuit	V _{bss} (V)	I _{D(DC)} (mA)	P _T * (mW)	R _{DS(on)} (Ω) MAX	V _{GS} (V)		I _D (mA)	Package
						2.5	10		
μPA572T	⑥	30	100	200	13	2.5	10	• 5-pin Super Mini-Mold SC-88A	
μPA573T	⑦	-30	-100	200	60	-2.5	-10		
μPA502T	⑥	50	100	300	30	4	10		
μPA503T	⑦	-50	-100	300	100	-4	-10	• 5-pin Mini-Mold SC-74A	
μPA505T	⑧	50/-50	100/-100	300	30/100	4/-4	10/-10		
μPA602T	⑨	50	100	300	30	4	10	• 6-pin Mini-Mold SC-74	
μPA603T	⑩	-50	-100	300	100	-4	-10		
μPA606T	⑬	50	100	300	30	4	10		
μPA607T	⑭	-50	-100	300	100	-4	-10		
μPA610TA	⑩	-30	-100	300	60	-2.5	-1		
μPA611TA	⑨	30	100	300	15	2.5	1		
μPA672T	⑬	50	100	200	40	2.5	10	• 6-pin Super Mini-Mold SC-88	

*: Total

Transistor Array

■ **Signal transistor array Product Map (Monolithic)**

I_o (mA)	500
V_o (V)	
50	μ PA2981 μ PA2982 μ PA2987
60	μ PA2001 μ PA2002 μ PA2003 μ PA2004

■ **Signal transistor array (Monolithic)**

Part number	Number of circuits				Output voltage V_o (V)	Output current I_o (mA/Unit)	Surge absorber diode	Input impedance	Active level		Input/output relationship		Output current relationship		Remarks	Number of pins
	5	6	7	8					"H"	"L"	Inverter type	Non-inverter type	Source type	Sink type		
μ PA80C, GR			○		60	50	—	20 k Ω		○				○	Darlington	16
μ PA81C			○		45	400*2	—	20 k Ω	○					○	FIP driver	18
μ PA2001C, GR			○		60	500	○	—	○					○	Darlington	16
μ PA2002C, GR			○		60	500	○	7VZDi +10.5 k Ω	○					○	Darlington	16
μ PA2003C, GR			○		60	500	○	2.7 k Ω	○					○	Darlington	16
μ PA2004C, GR			○		60	500	○	10.5 k Ω	○					○	Darlington	16
μ PA2981C			○		50	500	○	3 k Ω	○				○		Darlington output stage	18
μ PA2982C			○		50	500	○	8.5 k Ω	○				○		Darlington output stage	18
μ PA2987C			○		50	500	○	3 k Ω	○				○		Darlington output stage	16

*1: PW \leq 30 ms, duty cycle \leq 10% (7 circuits operation)

*2: PW \leq 10 ms, duty cycle \leq 10% (7 circuits operation)

■ **Power transistor array Product Map (Multi-chip, 4 circuits)**

V_{CE0} (V)	I_C (DC) (A)		2.0	3.0	5.0
	Polarity				
30	NPN		μ PA1478H ○		
	PNP				
60	NPN		μ PA1428AH ○	μ PA1434H ●	μ PA1458H ○
	PNP				μ PA1453H ☆
100	NPN		μ PA1476H ○	μ PA1436AH	μ PA1454H ●
	PNP			μ PA1437H	μ PA1456H

○ : with Zenner Diode ☆ : Low $V_{CE(sat)}$ ● : Single High h_{FE}

■ **Power transistor array (Multi-chip, 4 circuits)**

Part number	Number of circuits	Collector-emitter voltage V_{CE} (V)	Collector current I_C (A)	Surge absorber diode	Input impedance	Output current relationship		Remarks	Number of pins
						Source type	Sink type		
μ PA1428AH	4	60 \pm 10	\pm 2.0	○	—		○	Darlington	10
μ PA1434H	4	60	3.0	—	—		○	High beta	10
μ PA1436AH	4	100	\pm 3.0	—	—		○	Darlington	10
μ PA1437H	4	—100	\mp 3.0	—	—	○		Darlington	10
μ PA1453H	4	—60	5.0	—	—	○		Low $V_{CE(sat)}$	10
μ PA1454H	4	100	5.0	—	—		○	High beta	10
μ PA1456H	4	100	\pm 5.0	—	—		○	Darlington	10
μ PA1458H	4	60 \pm 10	\pm 5.0	○	—		○	Darlington	10
μ PA1476H	4	100 \pm 15	\pm 2.0	○	—		○	Darlington	10
μ PA1478H	4	31 \pm 4	\pm 2.0	○	—		○	Darlington	10

Transistor Array

■ Power MOS FET array Product Map (Multi-chip, 4 circuits)

V _{DSS} (V)	I _D (DC) (A)		
	2.0	3.0	5.0
30	• <u>μPA1520BH</u> (0.25)		• μPA1550H (0.15)
60	• μPA1522H (0.35) • μPA1572BH (0.8) • <u>μPA1523BH</u> (1.3)	• μPA1500BH (0.24)	• μPA1552BH (0.24)
80	• <u>μPA1524H</u> (1.0)		
100	• μPA1526H (0.6) • μPA1576H (1.5) • <u>μPA1527H</u> (1.5)		• μPA1556AH (0.33)
120		• μPA1501H (0.53) • μPA1560H (0.165)	

(): R_{DS(on)} (@V_{GS} = 4 V) [Ω MAX.] Underlined: P-channel

■ Power MOS FET array (Multi-chip, 4 circuits)

Part number	Number of circuits			V _{DSS} (V)	I _D (A/Unit)	Surge absorber diode	4 V driving	Active level		Input/output relationship		Output current relationship		Number of pins
	4	7	8					"H"	"L"	Inverter type	Non-inverter type	Source type	Sink type	
μPA1500BH	○			60	±3	○	○	○		○			○	12
μPA1501H	○			120	±3	○	○	○		○			○	12
μPA1520BH	○			30	±2	–	○	○		○			○	10
μPA1522H	○			60	±2	–	○	○		○			○	10
μPA1523BH	○			–60	±2	–	○		○		○	○		10
μPA1524H	○			80	±2	–	○	○		○			○	10
μPA1526H	○			100	±2	–	○	○		○			○	10
μPA1527H	○			–100	±2	–	○		○		○	○		10
μPA1550H	○			30	±5	–	○	○		○			○	10
μPA1552BH	○			60	±5	–	○	○		○			○	10
μPA1556AH	○			100	±5	–	○	○		○			○	10
μPA1572BH	○			60	±2	–	○	○		○			○	10
μPA1576H	○			100	±2	–	○	○		○			○	10
μPA1560H	○			120	±3		○	○		○			○	10

■ Power MOS FET array Product Map (Monolithic)

V _{DSS} (V)	I _D (DC) (A)		
	0.43	0.5	0.87
30	• μPA1601 (5.3 Ω, 7 _{CH}) (DIP, SOP) • μPA1602 (5.3 Ω, 7 _{CH}) (DIP, SOP)	• μPA1600 (4.0 Ω, 8 _{CH}) (DIP, SOP)	• μPA1603 (1.3 Ω, 4 _{CH}) (DIP, SOP)

■ Power MOS FET array (Monolithic)

Part number	Number of circuits			V _{DSS} (V)	I _D (A/Unit)	Surge absorber diode	4 V driving	Active level		Input/output relationship		Output current relationship		Number of pins
	4	7	8					"H"	"L"	Inverter type	Non-inverter type	Source type	Sink type	
μPA1600CX/GS			○	30	0.5	–	○	○		○			○	20
μPA1601CX/GS		○		30	0.43	–	○	○		○			○	16
μPA1602CX/GS		○		30	0.43	–	○		○		○		○	16
μPA1603CX	○			30	0.87	○	○	○		○			○	16
μPA1604CX	○			30	0.87	○	○		○		○		○	16

Zener Diode

■ Zener Diode Quick Reference (1/2) (Surface-Mount Type)

Vz (V)	P (W)							
	0.15		0.2				1.0	
TYP.								
2.0		RD2.0UM	RD2.0M	RD2.0MW	RD2.0S		RD2.0P	RD2.0FM
2.2		RD2.2UM	RD2.2M	RD2.2MW	RD2.2S		RD2.2P	RD2.2FM
2.4		RD2.4UM	RD2.4M	RD2.4MW	RD2.4S		RD2.4P	RD2.4FM
2.7		RD2.7UM	RD2.7M	RD2.7MW	RD2.7S		RD2.7P	RD2.7FM
3.0		RD3.0UM	RD3.0M	RD3.0MW	RD3.0S		RD3.0P	RD3.0FM
3.3		RD3.3UM	RD3.3M	RD3.3MW	RD3.3S		RD3.3P	RD3.3FM
3.6		RD3.6UM	RD3.6M	RD3.6MW	RD3.6S		RD3.6P	RD3.9FM
3.9		RD3.9UM	RD3.9M	RD3.9MW	RD3.9S		RD3.9P	RD4.3FM
4.3		RD4.3UM	RD4.3M	RD4.3MW	RD4.3S		RD4.3P	RD4.7FM
4.7	RD4.7UJ	RD4.7UM	RD4.7M	RD4.7MW	RD4.7S	RD4.7SL	RD4.7P	RD4.7FM
5.1	RD5.1UJ	RD5.1UM	RD5.1M	RD5.1MW	RD5.1S	RD5.1SL	RD5.1P	RD5.1FM
5.6	RD5.6UJ	RD5.6UM	RD5.6M	RD5.6MW	RD5.6S	RD5.6SL	RD5.6P	RD5.6FM
6.2	RD6.2UJ	RD6.2UM	RD6.2M	RD6.2MW	RD6.2S	RD6.2SL	RD6.2P	RD6.2FM
6.8	RD6.8UJ	RD6.8UM	RD6.8M	RD6.8MW	RD6.8S	RD6.8SL	RD6.8P	RD6.8FM
7.5	RD7.5UJ	RD7.5UM	RD7.5M	RD7.5MW	RD7.5S	RD7.5SL	RD7.5P	RD7.5FM
8.2	RD8.2UJ	RD8.2UM	RD8.2M	RD8.2MW	RD8.2S	RD8.2SL	RD8.2P	RD8.2FM
9.1	RD9.1UJ	RD9.1UM	RD9.1M	RD9.1MW	RD9.1S	RD9.1SL	RD9.1P	RD9.1FM
10	RD10UJ	RD10UM	RD10M	RD10MW	RD10S	RD10SL	RD10P	RD10FM
11	RD11UJ	RD11UM	RD11M	RD11MW	RD11S	RD11SL	RD11P	RD11FM
12	RD12UJ	RD12UM	RD12M	RD12MW	RD12S	RD12SL	RD12P	RD12FM
13	RD13UJ	RD13UM	RD13M	RD13MW	RD13S	RD13SL	RD13P	RD13FM
15	RD15UJ	RD15UM	RD15M	RD15MW	RD15S	RD15SL	RD15P	RD15FM
16	RD16UJ	RD16UM	RD16M	RD16MW	RD16S	RD16SL	RD16P	RD16FM
18	RD18UJ	RD18UM	RD18M	RD18MW	RD18S	RD18SL	RD18P	RD18FM
20	RD20UJ	RD20UM	RD20M	RD20MW	RD20S	RD20SL	RD20P	RD20FM
22	RD22UJ	RD22UM	RD22M	RD22MW	RD22S	RD22SL	RD22P	RD22FM
24	RD24UJ	RD24UM	RD24M	RD24MW	RD24S	RD24SL	RD24P	RD24FM
27	RD27UJ	RD27UM	RD27M	RD27MW	RD27S	RD27SL	RD27P	RD27FM
30	RD30UJ	RD30UM	RD30M	RD30MW	RD30S	RD30SL	RD30P	RD30FM
33	RD33UJ	RD33UM	RD33M	RD33MW	RD33S	RD33SL	RD33P	RD33FM
36	RD36UJ	RD36UM	RD36M	RD36MW	RD36S	RD36SL	RD36P	RD36FM
39	RD39UJ	RD39UM	RD39M	RD39MW	RD39S	RD39SL	RD39P	RD39FM
43			RD43M		RD43S		RD43P	RD43FM
47			RD47M		RD47S		RD47P	RD47FM
51					RD51S		RD51P	RD51FM
56					RD56S		RD56P	RD56FM
62					RD62S		RD62P	RD62FM
68					RD68S		RD68P	RD68FM
75					RD75S		RD75P	RD75FM
82					RD82S		RD82P	RD82FM
91					RD91S		RD91P	RD91FM
100					RD100S		RD100P	RD100FM
110					RD110S		RD110P	RD110FM
120					RD120S		RD120P	RD120FM
Package	2-pin ultra mini-mold		Mini-mold (SC-59)		2-pin super mini-mold		Power mini-mold (SC-62)	2-pin power mini-mold
	Low noise	General Purpose			General Purpose	Low noise		

Zener Diode

■ Zener Diode Quick Reference (2/2) (Through-Hole Type)

Vz (V)	P (W)			
	0.4	0.4	0.5	1.0
TYP.				
2.0		RD2.0ES	RD2.0E	RD2.0F
2.2		RD2.2ES	RD2.2E	RD2.2F
2.4		RD2.4ES	RD2.4E	RD2.4F
2.7		RD2.7ES	RD2.7E	RD2.7F
3.0		RD3.0ES	RD3.0E	RD3.0F
3.3		RD3.3ES	RD3.3E	RD3.3F
3.6		RD3.6ES	RD3.6E	RD3.6F
3.9		RD3.9ES	RD3.9E	RD3.9F
4.3		RD4.3ES	RD4.3E	RD4.3F
4.7	RD4.7JS	RD4.7ES	RD4.7E	RD4.7F
5.1	RD5.1JS	RD5.1ES	RD5.1E	RD5.1F
5.6	RD5.6JS	RD5.6ES	RD5.6E	RD5.6F
6.2	RD6.2JS	RD6.2ES	RD6.2E	RD6.2F
6.8	RD6.8JS	RD6.8ES	RD6.8E	RD6.8F
7.5	RD7.5JS	RD7.5ES	RD7.5E	RD7.5F
8.2	RD8.2JS	RD8.2ES	RD8.2E	RD8.2F
9.1	RD9.1JS	RD9.1ES	RD9.1E	RD9.1F
10	RD10JS	RD10ES	RD10E	RD10F
11	RD11JS	RD11ES	RD11E	RD11F
12	RD12JS	RD12ES	RD12E	RD12F
13	RD13JS	RD13ES	RD13E	RD13F
15	RD15JS	RD15ES	RD15E	RD15F
16	RD16JS	RD16ES	RD16E	RD16F
18	RD18JS	RD18ES	RD18E	RD18F
20	RD20JS	RD20ES	RD20E	RD20F
22	RD22JS	RD22ES	RD22E	RD22F
24	RD24JS	RD24ES	RD24E	RD24F
27	RD27JS	RD27ES	RD27E	RD27F
30	RD30JS	RD30ES	RD30E	RD30F
33	RD33JS	RD33ES	RD33E	RD33F
36	RD36JS	RD36ES	RD36E	RD36F
39	RD39JS	RD39ES	RD39E	RD39F
43			RD43E	RD43F
47			RD47E	RD47F
51			RD51E	RD51F
56			RD56E	RD56F
62			RD62E	RD62F
68			RD68E	RD68F
75			RD75E	RD75F
82			RD82E	RD82F
91			RD91E	
100			RD100E	
110			RD110E	
120			RD120E	
Package	DO-34	DO-34	DO-35	DO-41

Noise Clipping Diode

■ Surface-Mount Type Quick Reference

V _{BR} (V)	P (W)					Application
TYP.	0.15	0.2				
3.3	NNCD3.3C	NNCD3.3D	NNCD3.3E	NNCD3.3F	NNCD3.3G	<ul style="list-style-type: none"> • E.S.D. absorber • Surge absorber
3.6	NNCD3.6C	NNCD3.6D	NNCD3.6E	NNCD3.6F	NNCD3.6G	
3.9	NNCD3.9C	NNCD3.9D	NNCD3.9E	NNCD3.9F	NNCD3.9G	
4.3	NNCD4.3C	NNCD4.3D	NNCD4.3E	NNCD4.3F	NNCD4.3G	
4.7	NNCD4.7C	NNCD4.7D	NNCD4.7E	NNCD4.7F	NNCD4.7G	
5.1	NNCD5.1C	NNCD5.1D	NNCD5.1E	NNCD5.1F	NNCD5.1G	
5.6	NNCD5.6C	NNCD5.6D	NNCD5.6E	NNCD5.6F	NNCD5.6G	
6.2	NNCD6.2C	NNCD6.2D	NNCD6.2E	NNCD6.2F	NNCD6.2G	
6.8	NNCD6.8C	NNCD6.8D	NNCD6.8E	NNCD6.8F	NNCD6.8G	
7.5	NNCD7.5C	NNCD7.5D	NNCD7.5E	NNCD7.5F	NNCD7.5G	
8.2	NNCD8.2C	NNCD8.2D	NNCD8.2E	NNCD8.2F		
9.1	NNCD9.1C	NNCD9.1D	NNCD9.1E	NNCD9.1F		
10	NNCD10C	NNCD10D	NNCD10E	NNCD10F		
11	NNCD11C	NNCD11D	NNCD11E	NNCD11F		
12	NNCD12C	NNCD12D	NNCD12E	NNCD12F		
27					NNCD27G	
Package	2-pin ultra mini-mold	2-pin super mini-mold	3-pin mini-mold (SC-59)		5-pin mini-mold (SC-74A quarto)	
			Single	Twin		

■ Surface-Mount Type (Low Capacitance) Quick Reference

V _{BR} (V)	P (W)		Application
TYP.	0.2		
5.6	NNCD5.6LG	NNCD5.6LH	<ul style="list-style-type: none"> • E.S.D. absorber
6.2	NNCD6.2LG	NNCD6.2LH	
6.8	NNCD6.8LG	NNCD6.8LH	
Package	5-pin mini-mold (SC-74A quad)		5-pin super mini-mold (SC-88A quad)

■ Surface-Mount Type (Low Capacitance and High ESD Endurance Type) Quick Reference

V _{BR} (V)	P (W)		Application
TYP.	0.2		
5.6		NNCD5.6MG	<ul style="list-style-type: none"> • E.S.D. absorber
6.2	NNCD6.2MF	NNCD6.2MG	
6.8		NNCD6.8MG	
Package	3-pin mini-mold (SC-59 twin)		5-pin mini-mold (SC-74A quad)

Noise Clipping Diode

■ Through Hole Type Quick Reference

V _{BR} (V) TYP.	P (W)		Application
	0.4	0.5	
3.3	NNCD3.3A	NNCD3.3B	<ul style="list-style-type: none"> • E.S.D. protection • Surge absorber
3.6	NNCD3.6A	NNCD3.6B	
3.9	NNCD3.9A	NNCD3.9B	
4.3	NNCD4.3A	NNCD4.3B	
4.7	NNCD4.7A	NNCD4.7B	
5.1	NNCD5.1A	NNCD5.1B	
5.6	NNCD5.6A	NNCD5.6B	
6.2	NNCD6.2A	NNCD6.2B	
6.8	NNCD6.8A	NNCD6.8B	
7.5	NNCD7.5A	NNCD7.5B	
8.2	NNCD8.2A	NNCD8.2B	
9.1	NNCD9.1A	NNCD9.1B	
10	NNCD10A	NNCD10B	
11	NNCD11A	NNCD11B	
12	NNCD12A	NNCD12B	
Package	DO-34	DO-35	

Thyristor

■ SCR

Package																		
	SOT-89	TO-92		MP-3			TO-202AA					TO-220AB		TO-220-like insulated type				
$I_{T(RMS)}$ (A)	0.47	0.47		4.7	8	12.6	4	4	4	4.7	4.7	8	12.6	8	12.6			
$I_{T(AV)}$ (A)	0.3	0.3		3	5	8	2	2	2.5	3	3	5	8	5	8			
I_{TSM} (A)	6	8		40	65	80	20	20	45	65	65	80	100	80	100			
T_j (°C)	125	125		125			125					125		125				
V_{DRM} V_{RRM} (V)	200	03P2J	03P2M	-	-	-	-	-	-	2S2M	-	-	-	-	8P2M	-	8P2SM	
	400	03P4J	03P4M	03P4MF*1	03P4MG	3P4J	5P4J	8P4J	2P4M	2S4M	2V5P4M	3P4MH	3S4M	5P4M	8P4M	5P4SM	8P4SM	
	500	03P5J	-	-	03P5MG	-	-	-	2P5M	-	-	3P5MH	-	5P5M	-	-	-	
	600	-	-	-	03P6MG	-	-	5P6J	5P6J-Z	2P6M	-	-	3P6MH	-	5P6M	-	5P6SM	-
I_{GT} (mA)	0.2	0.2	100 μ A	3-50 μ A	0.1	0.2	10	0.2	0.3	0.1	0.2	30	10	10	10	10		
t_q (TYP.) (μ s)	25	25	40	60	30	80	50	30	15*2	80	80	5*2	50	100	50	100		

*1: $V_{RRM} = 5$ V
 *2: indicates MAX.

■ TRIAC

Package																		
	SOT-89	TO-92		MP-3		TO-202AA	TO-220AB					TO-220AB-like insulated type						
$I_{T(RMS)}$ (A)	1.0	0.8	1.0	3	5	3	5	8	10	12	16	3	5	8	10	12	16	
$I_{TSM(50\text{ Hz})}$ (A)	7.0	7	9	30	50	30	50	80	80	100	150	30	50	80	80	100	150	
T_j (°C)	125	125		125		125	125					125						
V_{DRM} V_{RRM} (V)	400	AC01DJM	AC0V8DGM	AC01DGM	AC03DJM	AC05DJM	AC03DGM	AC05DGM	AC08DGM	AC10DGM	AC12DGM	AC16DGM	AC03DSM	AC05DSM	AC08DSM	AC10DSM	AC12DSM	AC16DSM
	500	-	-	-	-	-	AC03EGM	AC05EGM	AC08EGM	AC10EGM	AC12EGM	AC16EGM	-	AC05ESM	AC08ESM	AC10ESM	AC12ESM	-
	600	-	-	-	AC03FJM	AC05FJM	AC03FGM	AC05FGM	AC08FGM	AC10FGM	AC12FGM	AC16FGM	AC03FSM	AC05FSM	AC08FSM	AC10FSM	AC12FSM	AC16FSM
I_{GT} (mA)	I	5	5	3	12	10	12	10	20	20	20	30	12	10	20	20	20	30
	II	10	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III	5	5	3	12	10	12	10	20	20	20	30	12	10	20	20	20	30
	IV	10	10	3	12	10	12	10	20	20	20	30	12	10	20	20	20	30
$(dv/dt)_c$ (V/ μ s)	MIN.	0.5	1	0.5	5	5	5	5	10	10	10	10	5	5	10	10	10	10

[MEMO]

RF and Microwave Devices

IC	324
• AGC AMP. (μPCxxxx, μPGxxxx)	324
• IQ Modulator/Demodulator (μPCxxxx)	324
• Up Converter (μPCxxxx)	324
• Prescaler (μPBxxxx, μPGxxxx)	325
• Down Converter (μPCxxxx)	326
• PLL Synthesizer (μPBxxxx)	327
• Switch (μPGxxxx)	327
• Wide Band AMP. (μPCxxxx, μPGxxxx)	328
• Driver AMP. (μPGxxxx)	330
• Power AMP. (μPGxxxx, MC-xxxx)	330
• Transistor Array (μPAxxx)	330
• Typical Characteristics	331
Discrete	335
• Dual Gate MES/MOS FET	335
• Low Noise BIP. TR. (2SC, NE)	336
• Twin TR. (μPAxxx)	338
• Low Noise GaAs/HJ FET (NE)	339
• Power TR./FET (2SC, NE, NEL, NEM, NES, NEZ)	341
• Cross-reference Table	344
Application	351

IC

■ AGC AMP. (μ PCxxxx, μ PGxxxx)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PC8119T	Mobile Comm.	3	11	100–1920	G_P (MAX.)=12.5dB, GCR=50dB, $P_{o(1dB)}$ =3dBm@f=950MHz	6-pin minimold
μ PC8120T	Mobile Comm.	3	11	100–1920	G_P (MAX.)=13dB, GCR=50dB, $P_{o(1dB)}$ =3.5dBm@f=950MHz	
μ PC8130TA	Mobile Comm.	3	11	800–1500	G_P (MAX.)=12.5dB, GCR=50dB, $P_{o(1dB)}$ =5dBm@f=950MHz	
μ PC8131TA	Mobile Comm.	3	11	800–1500	G_P (MAX.)=12dB, GCR=45dB, $P_{o(1dB)}$ =5dBm@f=950MHz	
μ PG175TA	Mobile Comm.	3	20	925–960	G_P =30dB, GCR=35dB, P_o =8dBm	6-pin minimold
μ PC2723T	BS Tuner, Mobile Comm.	5	15	1100	G_P =13dB, NF=11dB, P_o =-2dBm@f=500MHz	20-pin SSOP
μ PC3206GR	CATV Tuner, Video Amp.	5	34.5	100 or less	GCR=50dB(MIN.), G_P (MAX.)=38.5dB(@AGC block)	
μ PC3211GR	CATV Tuner	9	38	5–100	GCR=55dB, IM_2 =44dBc, IM_3 =57dBc	

■ IQ Modulator/Demodulator (μ PCxxxx)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PC8101GR	Mobile Comm. IQ Modulator	3	15	150	LOL=-49dBc, ImR =37.5dBc, P_o =-11dBm	20-pin SSOP
μ PC8104GR	Mobile Comm. IQ Modulator	3	28	900–2000	LOL=-40dBc, ImR =-40dBc, P_o =-13.5dBm	
μ PC8105GR	Mobile Comm. IQ Modulator	3	16	400	LOL=-40dBc, ImR =-40dBc, P_o =-18.5dBm	16-pin SSOP
μ PC8110GR	Mobile Comm. IQ Modulator	3	24	900	LOL=-35dBc, ImR =-40dBc, P_o =-10dBm	20-pin SSOP
μ PC8125GR	Mobile Comm. IQ Modulator	3	36	1800–2000	LOL=-37dBc, ImR =-35dBc, P_{RFout} =-9dBm	
μ PC8126GR	Mobile Comm. IQ Modulator	3	35	915–960	LOL=-35dBc, ImR =-40dBc, P_{RFout} =-9dBm	
μ PC8126K	Mobile Comm. IQ Modulator	3	35	889–960	LOL=-35dBc, ImR =-40dBc, P_{RFout} =-9dBm	28-pin QFN
μ PC8129GR	Mobile Comm. IQ Modulator	3	28	800–1900	LOL=-40dBc, ImR =-30dBc, P_{RFout} =-5dBm	20-pin SSOP
μ PC8139GR-7JH	PHS Transceiver	3	32.5	1800–2000	LOL=-40dBc, ImR =-40dBc, $P_{TX-MIXout}$ =-13dBm	30-pin TSSOP
μ PC8158K	Mobile Comm. IQ Modulator	3	28	800–1500	LOL=-40dBc, ImR =-40dBc, P_{RFout} =-11.5dBm	28-pin QFN
μ PC2766GR/GS	BS Tuner IQ Demodulator	5	60	DC–1000	$\Delta\phi \leq \pm 1.5^\circ$, $\Delta V \leq \pm 0.5$ dB	20-pin SSOP/SOP
μ PC2781GR	BS Tuner IQ Demodulator	5	70	440–520	$\Delta\phi \leq \pm 2^\circ$, $\Delta V \leq \pm 0.5$ dB	20-pin SSOP
μ PC3205GR	BS Tuner IQ Demodulator	5	65	440–520	$\Delta\phi \leq \pm 2^\circ$, $\Delta V \leq \pm 0.5$ dB	

■ Up Converter (μ PCxxxx)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PC8100GR	Mobile Comm. Up/Down	3	15	800–900	CG(UP)=20.5dB, CG(DOWN)=18dB	20-pin SSOP
μ PC8106T	Mobile Comm.	3	9	400–2000	CG=7dB, $P_{o(sat)}$ =-4dBm@f _{RFOUT} =1900MHz	6-pin minimold
μ PC8106TB	Mobile Comm.	3	9	400–2000	CG=7dB, $P_{o(sat)}$ =-4dBm@f _{RFOUT} =1900MHz	6-pin super minimold
μ PC8109T	Mobile Comm.	3	5	400–2000	CG=5dB, $P_{o(sat)}$ =-7.5dBm@f _{RFOUT} =1900MHz	6-pin minimold
μ PC8109TB	Mobile Comm.	3	5	400–2000	CG=4dB, $P_{o(sat)}$ =-7.5dBm@f _{RFOUT} =1900MHz	6-pin super minimold
μ PC8163TB	Mobile Comm.	3	16.5	800–2000	CG=9dB, $P_{o(sat)}$ =0.5dBm OIP_3 =9.5dBm@f=830MHz	20-pin SSOP
μ PC2799GR	CATV Tuner	5	60	250–850	GCR=14.5dB, $P_{o(sat)}$ =6dBm (@V _{AGC} =5V)	

IC

■ Prescaler (μ PBxxxx, μ PGxxxx)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PB1502GR	Mobile Comm. 1.7GHz 64/65, 128/129	3	6.7	500–1700	64/65, 128/129, $V_o=0.8V_{p-p}$	8-pin SOP
μ PB1502GR(1)	Mobile Comm. 2.0GHz 64/65, 128/129	3	6.7	500–2000	64/65, 128/129, $V_o=0.8V_{p-p}$	
μ PB1504GR	Mobile Comm. 1.1GHz 64/65, 128/129	3	2.47@64/65 2.24@128/129	500–1100	64/65, 128/129, $V_o=0.9V_{p-p}$	
μ PB1509GV	Mobile Comm. 1GHz, +2, +4, +8	3	5	500–1000@1/8	1/2, 1/4, 1/8 $V_o=0.3V_{p-p}$	8-pin SSOP
μ PB1505GR	BS Tuner 3GHz, +64, +128, +256	5	14	500–3000	1/256, 1/128, 1/64, $V_o=1.6V_{p-p}$	8-pin SOP
μ PB1506GV	BS Tuner 3GHz, +64, +128, +256	5	19	500–3000	1/256, 1/128, 1/64, $V_o=1.6V_{p-p}$	8-pin SSOP
μ PB1507GV	BS Tuner 3GHz, +64, +128, +256	5	19	500–3000	1/256, 1/128, 1/64, $V_o=1.6V_{p-p}$	
μ PB1508GV	BS Tuner 3GHz, +2	5	12	500–3000	1/2, $P_o=-7dBm$	
μ PB1510GV	BS Tuner 3GHz, +4	5	14	500–3000	1/4, $P_o=-7dBm$	
μ PG501B	Microwave Comm. 5GHz, +4	10	70	1300–5000	1/4 Static, $P_{in}=10dBm$, $P_o=2dBm$	K-12, 8-pin ceramic
μ PG502B	Microwave Comm. 5GHz, +2	10	100	1000–5000	1/2 Static, $P_{in}=10dBm$, $P_o=2dBm$	
μ PG503B	Microwave Comm. 9GHz, +4	3.8, -2.2	80	4000–8000	1/2 Dynamic, $P_{in}=10dBm$, $P_o=2dBm$	
μ PG504B	Microwave Comm. 9GHz, +2	3.8, -2.2	55	2500–8000	1/2 Dynamic, $P_{in}=10dBm$, $P_o=-1dBm$	
μ PG506B	Microwave Comm. 14GHz, +8	3.8, -2.2	105	8200–13200	1/8 Dynamic, $P_{in}=6dBm$, $P_o=1dBm$	
μ PG508B	Microwave Comm. 13GHz, +4	3.8, -2.2	100	8500–12200	1/4 Dynamic, $P_{in}=6dBm$, $P_o=1dBm$	

IC

■ Down Converter (μ PCxxxx) (1/2)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PC2721GR/GV	General Purpose L-Band	5	38	900–2000	$G_P=21\text{dB}$, $N_F=9\text{--}11\text{dB}$, Emitter follower Output	8-pin SOP/SSOP
μ PC2722GR/GV	General Purpose L-Band	5	28	900–2000	$G_P=18\text{dB}$, $N_F=9\text{--}11\text{dB}$, Open Collector Output	
μ PC2795GV	General Purpose L-Band	5	35	950–2150	$CG=11\text{dB}$, $N_F=13.5\text{dB}@f=950\text{MHz}$	8-pin SSOP
μ PC1694GR	General Purpose 1GHz	5	40	55–1000	$CG=18\text{dB}$, $N_F=12.5\text{--}13.5\text{dB}$, $P_{o(\text{sat})}=10\text{dBm}$	14-pin SOP
μ PC2757T	Mobile Comm.	3	5.6	100–2000	$CG=15\text{dB}$, $N_F=10\text{dB}@f=800\text{MHz}$	6-pin minimold
μ PC2757TB	Mobile Comm.	3	5.6	100–2000	$CG=15\text{dB}$, $N_F=10\text{dB}@f=800\text{MHz}$	6-pin super minimold
μ PC2758T	Mobile Comm.	3	11	100–2000	$CG=19\text{dB}$, $N_F=9\text{dB}@f=800\text{MHz}$	6-pin minimold
μ PC2758TB	Mobile Comm.	3	11	100–2000	$CG=19\text{dB}$, $N_F=9\text{dB}@f=800\text{MHz}$	6-pin super minimold
μ PC8001	Mobile Comm.	3	2.1	470	$f_{\text{out}}=455\text{kHz}$, $RSS_{\text{out}}=0.79\text{--}2.75\text{V}$	14-pin SSOP
μ PC8002	Mobile Comm.	3	1.7	250	$f_{\text{out}}=10.7\text{MHz}$, $RSS_{\text{out}}=1.08\text{--}2.68\text{V}$	20-pin SSOP
μ PC8112T	Mobile Comm.	3	8.5	800–2000	$CG=13\text{dB}$, $N_F=11.2\text{dB}@f_{\text{RFin}}=1900\text{MHz}$	6-pin minimold
μ PC8112TB	Mobile Comm.	3	8.5	800–2000	$CG=13\text{dB}$, $P_{o(\text{sat})}=-3\text{dBm}@f_{\text{RFin}}=1900\text{MHz}$	6-pin super minimold
μ PC8100GR	Mobile Comm. Up/Down	3	15	800–900	$CG(\text{UP})=20.5\text{dB}$, $CG(\text{DOWN})=18\text{dB}$	20-pin SSOP
μ PC2743GS	TV/VCR Tuner UHF/VHF	9	47@VHF 49@UHF	55–890	$CG=20/23\text{dB}$, $N_F=13/12\text{dB}$, (VHF/UHF)	20-pin SOP
μ PC2744GS	TV/VCR Tuner UHF/VHF	9	47@VHF 49@UHF	55–890	$CG=25/31\text{dB}$, $N_F=11/10\text{dB}$, (VHF/UHF)	
μ PC2775GR/GS	TV/VCR Tuner UHF/VHF	9	35@VHF 36@UHF	55–890	$CG=22/28\text{dB}$, $N_F=10/10\text{dB}$, (VHF/UHF)	20-pin SSOP/SOP
μ PC2794GS	TV/VCR Tuner UHF/VHF	9	48@VHF 50@UHF	55–890	$CG=23/32\text{dB}$, $N_F=11/10\text{dB}$, (VHF/UHF)	20-pin SOP
μ PC2797GR	TV/VCR Tuner UHF/VHF	9	38	55–890	$CG=22/28\text{dB}$, $N_F=11/10\text{dB}$, (VHF/UHF)	20-pin SSOP
μ PC3200GS	TV/VCR Tuner UHF/VHF	9	38	55–890	$CG=22/28\text{dB}$, $N_F=11/10\text{dB}$, (VHF/UHF)	20-pin SOP
μ PC3202GR	TV/VCR Tuner UHF/VHF	5	41	55–800	$CG=25/29\text{dB}$, $N_F=10.5/10\text{dB}$, (VHF/UHF)	20-pin SSOP
μ PC3207GR	TV/VCR Tuner UHF/VHF	9	38	55–890	$CG=22/28\text{dB}$, $N_F=11/10\text{dB}$, (VHF/UHF)	
μ PC1686G	TV/VCR Tuner VHF	5	38	55–500	$CG=19.5\text{dB}$, $N_F=11\text{dB}$, $P_{o(\text{sat})}=10\text{dBm}@f=200\text{MHz}$	8-pin SOP
μ PC1686GV	TV/VCR Tuner VHF	5	38	55–500	$CG=19.5\text{dB}$, $N_F=11\text{dB}$, $P_{o(\text{sat})}=10\text{dBm}@f=200\text{MHz}$	8-pin SSOP
μ PC1687G	TV/VCR Tuner UHF	5	38	500–900	$CG=26\text{dB}$, $N_F=9\text{dB}$, $P_{o(\text{sat})}=10\text{dBm}@f=500\text{MHz}$	8-pin SOP
μ PC1687GV	TV/VCR Tuner UHF	5	38	500–900	$CG=26\text{dB}$, $N_F=9\text{dB}$, $P_{o(\text{sat})}=10\text{dBm}@f=500\text{MHz}$	8-pin SSOP
μ PC2731GS	BS Tuner AGC	5	69	900–2000	$CG=14.5\text{dB}$, $N_F=12\text{dB}@f=900\text{MHz}$	20-pin SOP
μ PC2734GR	BS Tuner	5	40	900–2100	$CG=12\text{dB}$, $N_F=10\text{dB}$, $f_{\text{in}}=480\text{MHz}@f=900\text{MHz}$	20-pin SSOP
μ PC2782GR	BS Tuner AGC	5	66	900–2100	$CG=10\text{dB}$, $N_F=11\text{dB}@f=900\text{MHz}$	
μ PC2798GR	CATV Tuner Video Amp.	5	35.5	30–250	$GCR=32\text{dB}$, $V_o=3V_{p-p}@R_L=1\text{k}\Omega$	
μ PC2753GR	GPS	3	6.9	DC–400	$CG=38\text{dB}$, $N_F=12\text{dB}$	6-pin minimold
μ PC2756T	GPS	3	6	100–2000	$CG=14\text{dB}$, $N_F=10\text{dB}$, $P_o=-8\text{dBm}@f=900\text{MHz}$	
μ PC2756TB	GPS	3	6	100–2000	$CG=14\text{dB}$, $N_F=10\text{dB}$, $P_o=-8\text{dBm}@f=900\text{MHz}$	

IC

■ Down Converter (μ PCxxxx) (2/2)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PC2768GR	Keyless Entry	3	6.8	DC-450	CG=36dB, NF=12dB@f=450MHz	20-pin SSOP
μ PC8116GR	Keyless Entry	3	4.1	100-500	G _{MIX} =11dB, RSSI _{sen} =-95dBm	
μ PC8103T	Pager	1.05	1	150-330	CG=15.5dB@f _{RFIn} =280MHz	6-pin minimold
μ PC8108T	Pager	1.05	1.5	150-930	CG=15dB@f _{RFIn} =930MHz	

■ PLL Synthesizer (μ PBxxxx)

Part Number	Functions	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PB1005K	PLL Synthesizer +Down Converters	GPS	3	45	1575.42	f _{2ndIF} =4.092MHz, f _{TCXOIn} =16.368MHz	36-pin QFN

■ Switch (μ PGxxxx)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PG132G	Mobile Comm. SPDT	0, +3	0.05	100-2500	L _{INS} =0.6dB, ISL=22dB, P _{In(1dB)} =30dBm	8-pin SSOP
μ PG133G	Mobile Comm. SPDT	0, -3	0.05	100-2500	L _{INS} =0.6dB, ISL=25dB, P _{In(1dB)} =25dBm	
μ PG137GV	Mobile Comm. SPDT	0, +3	0.005	100-2500	L _{INS} =0.55dB, ISL=25dB, P _{In(1dB)} =32dBm MIN.@f=1GHz	
μ PG138GV	Mobile Comm. SPDT	0, -3	0.005	100-2500	L _{INS} =0.55dB, ISL=30dB, P _{In(1dB)} =32dBm MIN.@f=1GHz	
μ PG139GV	Mobile Comm. DPDT	V _{CONT} = 3.6V/0V, V _{DD} =3V	0.015	100-2500	TXL _{INS} =0.7dB, TXISL=15.5dB, TXP _{In(1dB)} =34dBm@f=1GHz	8-pin SOP
μ PG152TA	Mobile Comm. SPDT	0, +3	0.005	100-2500	L _{INS} =0.6dB, ISL=22dB, P _{In(1dB)} =30dBm@f=2GHz	6-pin minimold
μ PG153TB	Mobile Comm. SPDT	V _{CONT} = 3.0V/0V	0.02	100-2500	L _{INS} =0.7dB, ISL=13dB, P _{In(1dB)} =33dBm@f=2GHz	6-pin super minimold
μ PG154TB	Mobile Comm. SPDT	V _{CONT} = 3.0V/0V, V _{DD} =3V	0.002	100-2500	L _{INS} =0.65dB, ISL=21dB, P _{In(1dB)} =30dBm@f=2GHz	
μ PG155TB	Mobile Comm. SPDT	V _{CONT} = 3.0V/0V	0.02	100-2500	L _{INS} =0.75dB, ISL=16dB, P _{In(1dB)} =34dBm@f=2GHz	

IC

■ Wide Band AMP. (μ PC $\times\times\times\times$, μ PG $\times\times\times\times$) (1/2)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PC1652G	General Purpose	5	20	1200	$G_P=18\text{dB}$, $N_F=5.5\text{dB}$, $P_o=+5\text{dBm}$ @ $f=500\text{MHz}$	8-pin SOP
μ PC1658G	General Purpose	10	9–18	1000	$G_P=31\text{dB}$, $N_F=1.5\text{dB}$	
μ PC1663	General Purpose Video Amp.	6	13	200	$BW=700\text{MHz}$, $A_{vd}=320$ Gain determined by external resistor. Input noise $3\mu\text{V r.m.s.}$	8-pin SOP/SSOP
μ PC1675G	General Purpose	5	17	1900	$G_P=12\text{dB}$, $N_F=5.5\text{dB}$, $P_o=+4\text{dBm}$ @ $f=500\text{MHz}$	4-pin super small package
μ PC1676G	General Purpose	5	19	1200	$G_P=22\text{dB}$, $N_F=4.5\text{dB}$, $P_o=+5\text{dBm}$ @ $f=500\text{MHz}$	
μ PC1678G	General Purpose Medium Output	5	49	2000	$G_P=23\text{dB}$, $N_F=6\text{dB}$, $P_o=+17.5\text{dBm}$ @ $f=500\text{MHz}$	8-pin SOP
μ PC1678GV	General Purpose Medium Output	5	49	2000	$G_P=23\text{dB}$, $N_F=6\text{dB}$, $P_o=+17.5\text{dBm}$ @ $f=500\text{MHz}$	8-pin SSOP
μ PC1679G	General Purpose Medium Output	5	40	1800	$G_P=21.5\text{dB}$, $N_F=6\text{dB}$, $P_o=+15.5\text{dBm}$ @ $f=500\text{MHz}$	8-pin SOP
μ PC1688G	General Purpose	5	19	1100	$G_P=21\text{dB}$, $N_F=4\text{dB}$, $P_o=+4\text{dBm}$ @ $f=500\text{MHz}$	4-pin super small package
μ PC2708T	General Purpose Medium Output	5	26	2900	$G_P=15\text{dB}$, $N_F=6.5\text{dB}$, $P_o=+10\text{dBm}$ @ $f=1\text{GHz}$	6-pin minimold
μ PC2708TB	General Purpose Medium Output	5	26	2900	$G_P=15\text{dB}$, $N_F=6.5\text{dB}$, $P_o=+10\text{dBm}$ @ $f=1\text{GHz}$	6-pin super minimold
μ PC2709T	General Purpose Medium Output	5	25	2300	$G_P=23\text{dB}$, $N_F=5\text{dB}$, $P_o=+11.5\text{dBm}$ @ $f=1\text{GHz}$	6-pin minimold
μ PC2709TB	General Purpose Medium Output	5	25	2300	$G_P=23\text{dB}$, $N_F=5\text{dB}$, $P_o=+11.5\text{dBm}$ @ $f=1\text{GHz}$	6-pin super minimold
μ PC2710T	General Purpose Medium Output	5	22	1000	$G_P=33\text{dB}$, $N_F=3.5\text{dB}$, $P_o=+13.5\text{dBm}$ @ $f=500\text{MHz}$	6-pin minimold
μ PC2710TB	General Purpose	5	22	1000	$G_P=33\text{dB}$, $N_F=3.5\text{dB}$, $P_o=+13.5\text{dBm}$ @ $f=500\text{MHz}$	6-pin super minimold
μ PC2711T	General Purpose	5	12	2900	$G_P=13\text{dB}$, $N_F=5\text{dB}$, $P_o=+1\text{dBm}$ @ $f=1\text{GHz}$	6-pin minimold
μ PC2711TB	General Purpose	5	12	2900	$G_P=13\text{dB}$, $N_F=5\text{dB}$, $P_o=+1\text{dBm}$ @ $f=1\text{GHz}$	6-pin super minimold
μ PC2712T	General Purpose	5	12	2600	$G_P=20\text{dB}$, $N_F=4.5\text{dB}$, $P_o=+3\text{dBm}$ @ $f=1\text{GHz}$	6-pin minimold
μ PC2712TB	General Purpose	5	12	2600	$G_P=20\text{dB}$, $N_F=4.5\text{dB}$, $P_o=+3\text{dBm}$ @ $f=1\text{GHz}$	6-pin super minimold
μ PC2713T	General Purpose	5	12	1200	$G_P=29\text{dB}$, $N_F=3.2\text{dB}$, $P_o=+7\text{dBm}$ @ $f=500\text{MHz}$	6-pin minimold
μ PC2714T	General Purpose	3.4	4.5	1800	$G_P=11.5\text{dB}$, $N_F=5\text{dB}$, $P_o=-7\text{dBm}$ @ $f=500\text{MHz}$	
μ PC2715T	General Purpose	3.4	4.5	1200	$G_P=19\text{dB}$, $N_F=4.5\text{dB}$, $P_o=-6\text{dBm}$ @ $f=500\text{MHz}$	
μ PC2726T	General Purpose Differential Amp.	5	11.5	1600	$G_P=15\text{dB}$, $N_F=4.5\text{dB}$, $P_o=-2\text{dBm}$ @ $f=400\text{MHz}$	
μ PC3210TB	General Purpose	5	15	2300	$G_P=20\text{dB}$, $N_F=3.4\text{dB}$, $P_o=+3.5\text{dBm}$ @ $f=1.5\text{GHz}$	6-pin super minimold
μ PG100B	General Purpose	± 5	45	50–3000	$N_F=2.7\text{dB}$, $G_P=16\text{dB}$, $P_{o(1\text{dB})}=6\text{dBm}$	T-31, 8-pin ceramic
μ PG101B	General Purpose	8, -5	100	50–3000	$N_F=5\text{dB}$, $G_P=14\text{dB}$, $P_{o(1\text{dB})}=18\text{dBm}$	
μ PG103B	General Purpose	± 5	55	50–3000	$N_F=4.5\text{dB}$, $G_P=10\text{dB}$, $P_{o(1\text{dB})}=9\text{dBm}$	
μ PG110B	General Purpose	8	135	2000–8000	$G_P=15\text{dB}$, $P_{o(1\text{dB})}=14\text{dBm}$	4-pin ceramic

IC

■ Wide Band AMP. (μ PCxxxx, μ PGxxxx) (2/2)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PC2745T	Mobile Comm.	3	7.5	2700	$G_P=12\text{dB}$, $N_F=6\text{dB}$, $P_o=-1\text{dBm}@f=500\text{MHz}$	6-pin minimold
μ PC2745TB	Mobile Comm.	3	7.5	2700	$G_P=12\text{dB}$, $N_F=6\text{dB}$, $P_o=-1\text{dBm}@f=500\text{MHz}$	6-pin super minimold
μ PC2746T	Mobile Comm.	3	7.5	1500	$G_P=19\text{dB}$, $N_F=4\text{dB}$, $P_o=0\text{dBm}@f=500\text{MHz}$	6-pin minimold
μ PC2746TB	Mobile Comm.	3	7.5	1500	$G_P=19\text{dB}$, $N_F=4\text{dB}$, $P_o=0\text{dBm}@f=500\text{MHz}$	6-pin super minimold
μ PC2747T	Mobile Comm.	3	5	1800	$G_P=12\text{dB}$, $N_F=3.3\text{dB}$, $P_o=-7\text{dBm}@f=900\text{MHz}$	6-pin minimold
μ PC2747TB	Mobile Comm.	3	5	1800	$G_P=12\text{dB}$, $N_F=3.3\text{dB}$, $P_o=-7\text{dBm}@f=900\text{MHz}$	6-pin super minimold
μ PC2748T	Mobile Comm.	3	6	200–1500	$G_P=19\text{dB}$, $N_F=2.8\text{dB}$, $P_o=-3.5\text{dBm}@f=900\text{MHz}$	6-pin minimold
μ PC2748TB	Mobile Comm.	3	6	200–1500	$G_P=19\text{dB}$, $N_F=2.8\text{dB}$, $P_o=-3.5\text{dBm}@f=900\text{MHz}$	6-pin super minimold
μ PC2749T	Mobile Comm.	3	6	2900	$G_P=16\text{dB}$, $N_F=4\text{dB}$, $P_o=-6\text{dBm}@f=1900\text{MHz}$	6-pin minimold
μ PC2749TB	Mobile Comm.	3	6	2900	$G_P=16\text{dB}$, $N_F=4\text{dB}$, $P_o=-6\text{dBm}@f=1900\text{MHz}$	6-pin super minimold
μ PC2762T	Mobile Comm. Medium Output	3	26.5	2900	$G_P=13\text{dB}$, $N_F=6.5\text{dB}$, $P_o=+8\text{dBm}@f=900\text{MHz}$	6-pin minimold
μ PC2762TB	Mobile Comm. Medium Output	3	26.5	2900	$G_P=13\text{dB}$, $N_F=6.5\text{dB}$, $P_o=+8\text{dBm}@f=900\text{MHz}$	6-pin super minimold
μ PC2763T	Mobile Comm. Medium Output	3	27	2700	$G_P=20\text{dB}$, $N_F=5.5\text{dB}$, $P_o=+9.5\text{dBm}@f=900\text{MHz}$	6-pin minimold
μ PC2763TB	Mobile Comm. Medium Output	3	27	2700	$G_P=20\text{dB}$, $N_F=5.5\text{dB}$, $P_o=+9.5\text{dBm}@f=900\text{MHz}$	6-pin super minimold
μ PC2771T	Mobile Comm. Medium Output	3	36	2200	$G_P=21\text{dB}$, $N_F=6\text{dB}$, $P_o=+12.5\text{dBm}@f=900\text{MHz}$	6-pin minimold
μ PC2771TB	Mobile Comm. Medium Output	3	36	2200	$G_P=21\text{dB}$, $N_F=6\text{dB}$, $P_o=+12.5\text{dBm}@f=900\text{MHz}$	6-pin super minimold
μ PC8128TB	Mobile Comm. Buff Amp.	2.4–3.3	2.8	100–1900	$G_P=12.5\text{dB}$, $ISL=39\text{dB}$, $P_{o(1\text{dB})}=-4\text{dBm}$, $N_F=6.0\text{dB}$, $I_{CC}=2.8\text{mA}@f=1000\text{MHz}$	6-pin super minimold
μ PC8151TB	Mobile Comm. Buff Amp.	2.4–3.3	4.2	100–1900	$G_P=12.5\text{dB}$, $ISL=38\text{dB}$, $P_{o(1\text{dB})}=+2.5\text{dBm}$, $N_F=6.0\text{dB}$, $I_{CC}=4.2\text{mA}@f=1000\text{MHz}$	
μ PC8152TB	Mobile Comm. Buff Amp.	2.4–3.3	5.6	100–1900	$G_P=23\text{dB}$, $ISL=40\text{dB}$, $P_{o(1\text{dB})}=-4.5\text{dBm}$, $N_F=3.5\text{dB}$, $I_{CC}=5.6\text{mA}@f=1000\text{MHz}$	
μ PG170TB	Mobile Comm.	3.6	30	800–1500	$GL=11\text{dB}$, $P_{o(1\text{dB})}=14.5\text{dBm}$	
μ PC2776T	BS Converter Medium Output	5	25	2700	$G_P=23\text{dB}$, $N_F=6\text{dB}$, $P_o=+6.5\text{dBm}@f=1\text{GHz}$	6-pin minimold
μ PC2776TB	BS Converter Medium Output	5	25	2700	$G_P=23\text{dB}$, $N_F=6\text{dB}$, $P_o=+6.5\text{dBm}@f=1\text{GHz}$	6-pin super minimold
μ PC2791TB	BS Converter	5	17	1900	$G_P=12\text{dB}$, $N_F=5.5\text{dB}$, $P_o=+4\text{dBm}@f=500\text{MHz}$	6-pin super minimold
μ PC2792TB	BS Converter	5	19	1200	$G_P=20\text{dB}$, $N_F=3.5\text{dB}$, $P_o=+5\text{dBm}@f=500\text{MHz}$	
μ PC8102T	Pager	1	0.5	150–330	$G_P=14.7\text{dB}$, $N_F=4.0\text{dB}@f=280\text{MHz}$	6-pin minimold

IC

■ Driver AMP. (μ PG $\times\times\times\times$)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PG173TA	Mobile Comm.	2.8	25	800–1000	$P_o = 9\text{dBm}$, $G_P = 27\text{dB MIN.}$ $f = 889\text{--}960\text{MHz}$	6-pin minimold
μ PG174TA	Mobile Comm.	3	30	1400–2000	$P_o = 10\text{dBm}$, $G_P = 32\text{dB MIN.}$ $f = 1429\text{--}1453\text{MHz}$	
μ PG175TA	Mobile Comm.	3	20	925–960	$G_P = 30\text{dB}$, $G_{CR} = 35\text{dB}$, $P_o = 8\text{dBm}$	

■ Power AMP. (μ PG $\times\times\times\times$, MC- $\times\times\times\times$)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PG171GV	Mobile Comm.	3, -2	160	1895–1918	$G_P = 20\text{dB}$, $P_o = 21\text{dBm}$, $P_{adj} = -60\text{dBc}$	8-pin SSOP
MC-7712	CATV	24	240	50–750	$NF = 7.0\text{dB}$, $GL = 18.5\text{dB}$	7-pin special package
MC-7716	CATV	24	240	50–750	$NF = 6.5\text{dB}$, $GL = 22.0\text{dB}$	
MC-7722	CATV	24	395	50–750	$NF = 7.0\text{dB}$, $GL = 18.5\text{dB}$	
MC-7726	CATV	24	395	50–750	$NF = 6.5\text{dB}$, $GL = 22.0\text{dB}$	
MC-7852	CATV	24	240	50–860	$NF = 7.0\text{dB}$, $GL = 18.0\text{dB}$	
MC-7856	CATV	24	240	50–860	$NF = 7.0\text{dB}$, $GL = 21.5\text{dB}$	
MC-7862	CATV	24	395	50–860	$NF = 7.0\text{dB}$, $GL = 18.5\text{dB}$	
MC-7866	CATV	24	395	50–860	$NF = 6.5\text{dB}$, $GL = 21.5\text{dB}$	

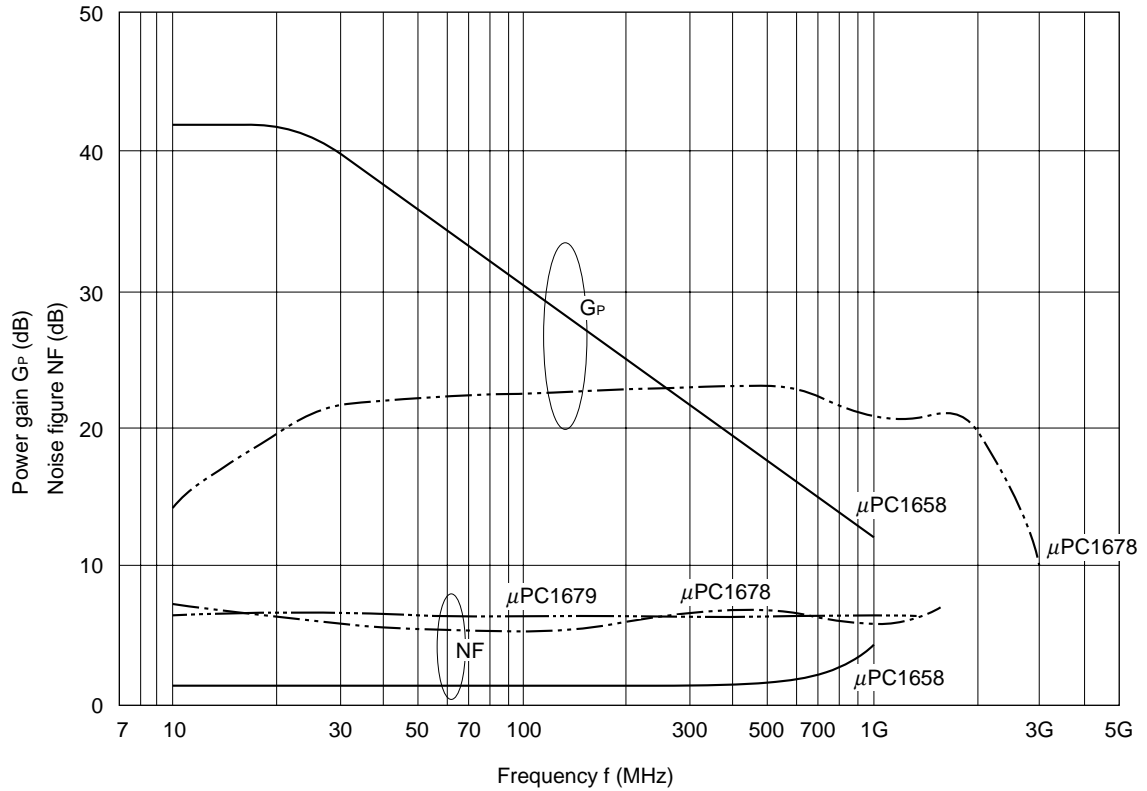
■ Transistor Array (μ PA $\times\times\times$)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PA101	General Purpose	3	0.001	9000	$f_r = 9\text{GHz}$	14-pin ceramic, 8-pin miniflat
μ PA102	General Purpose	3	0.001	9000	$f_r = 9\text{GHz}$	
μ PA103	General Purpose	3	0.001	9000	$f_r = 9\text{GHz}$	
μ PA104	General Purpose	3	0.001	9000	$f_r = 9\text{GHz}$	

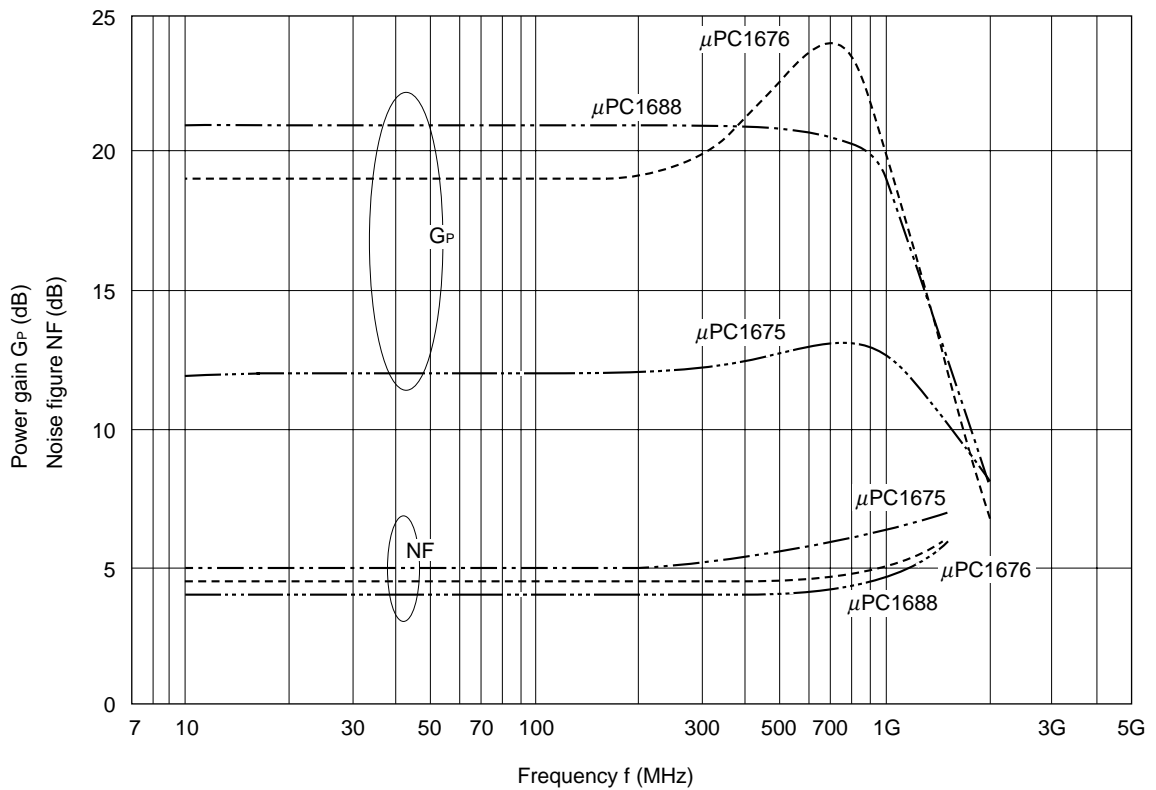
IC

■ Typical Characteristics

• POWER GAIN, NOISE FIGURE vs. FREQUENCY (1/4)



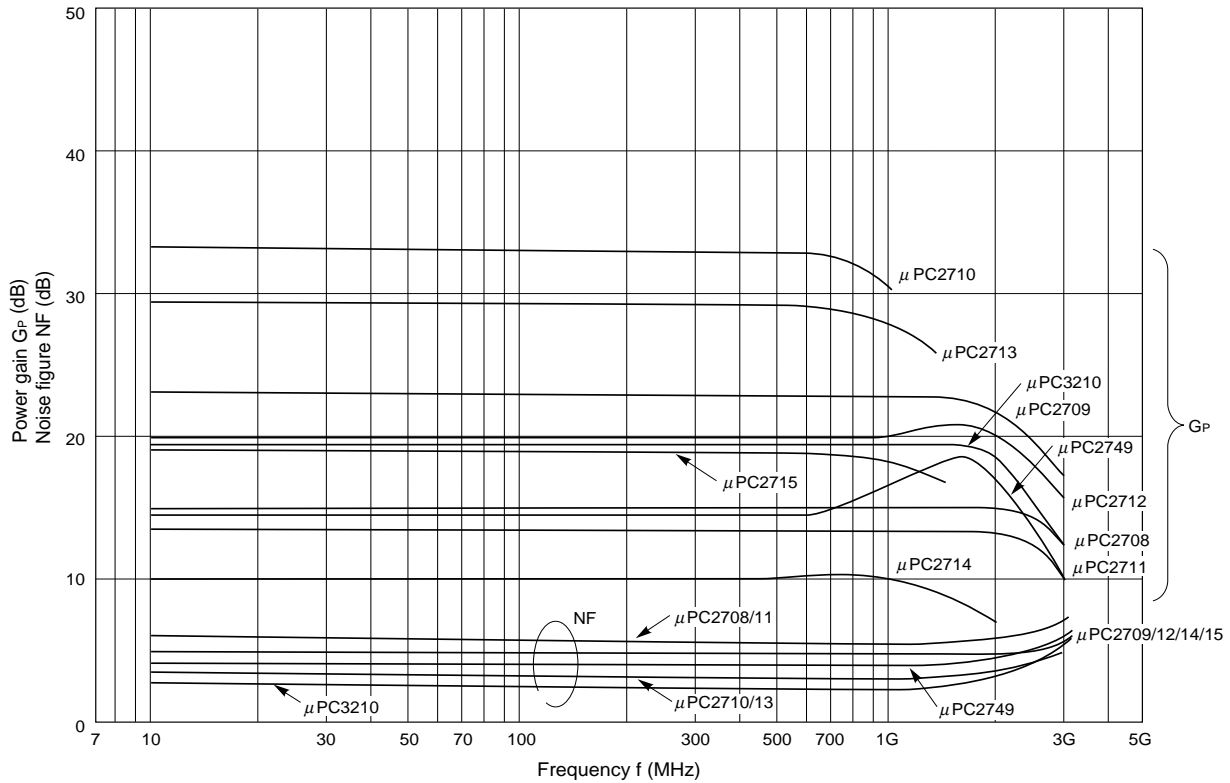
• POWER GAIN, NOISE FIGURE vs. FREQUENCY (2/4)



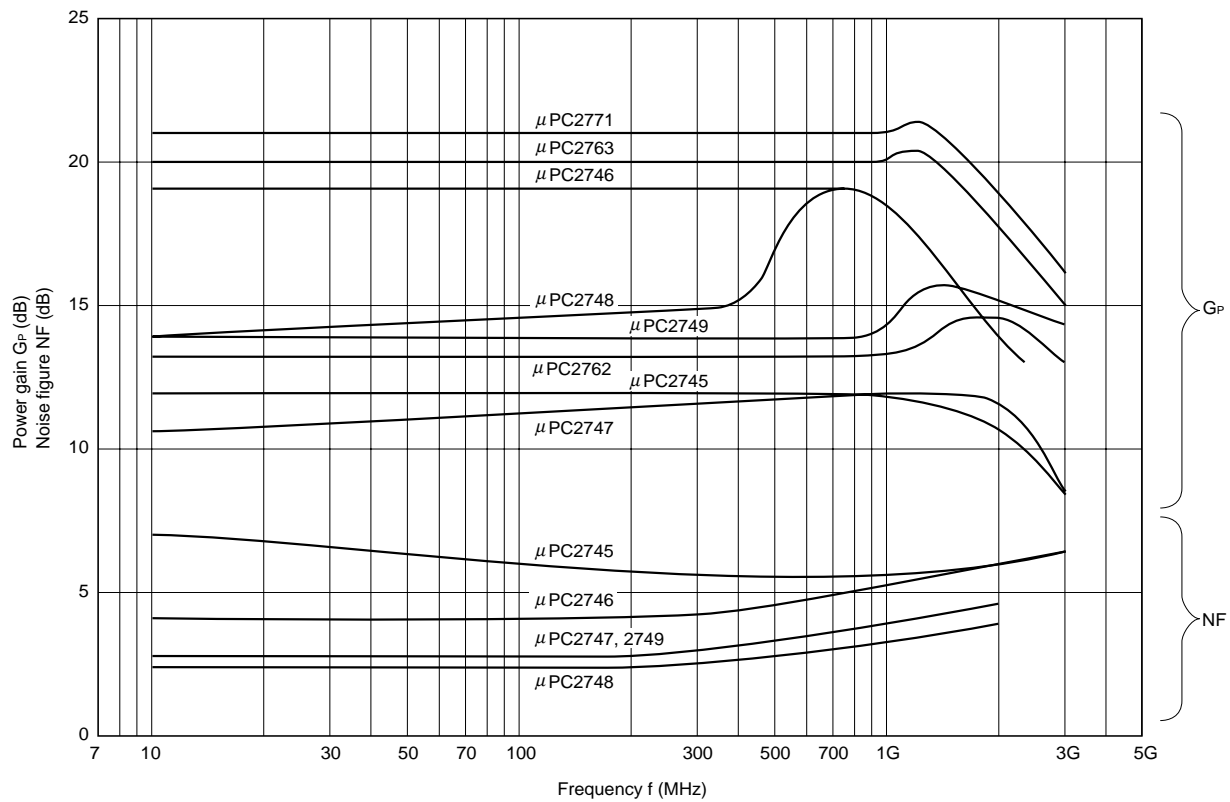
IC

Typical Characteristics

POWER GAIN, NOISE FIGURE vs. FREQUENCY (3/4)



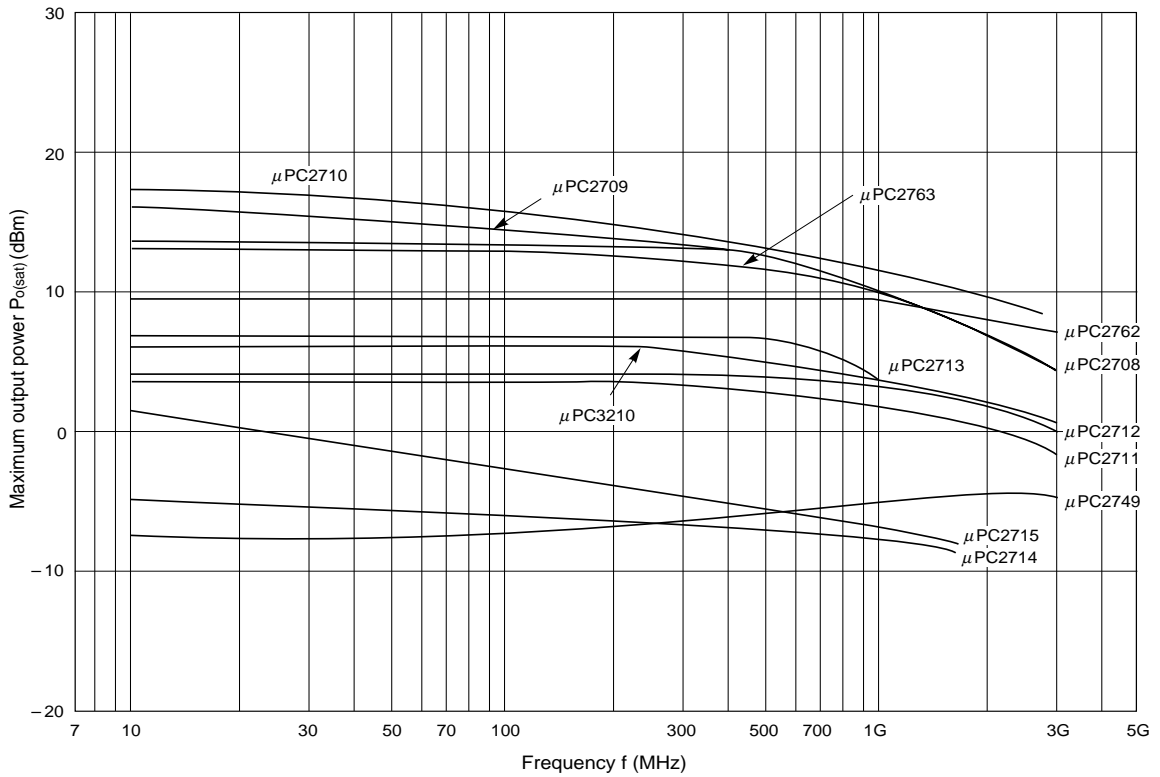
POWER GAIN, NOISE FIGURE vs. FREQUENCY (4/4)



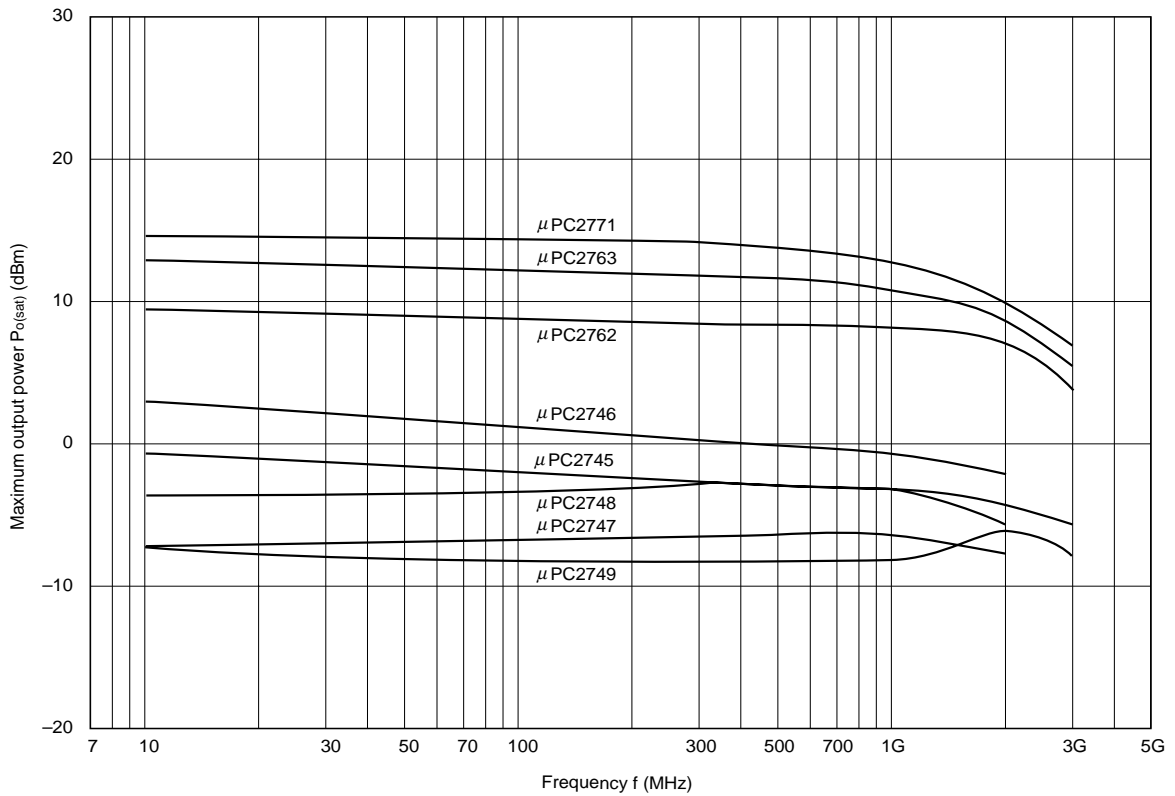
IC

■ Typical Characteristics

• MAXIMUM OUTPUT POWER vs. FREQUENCY (1/2)



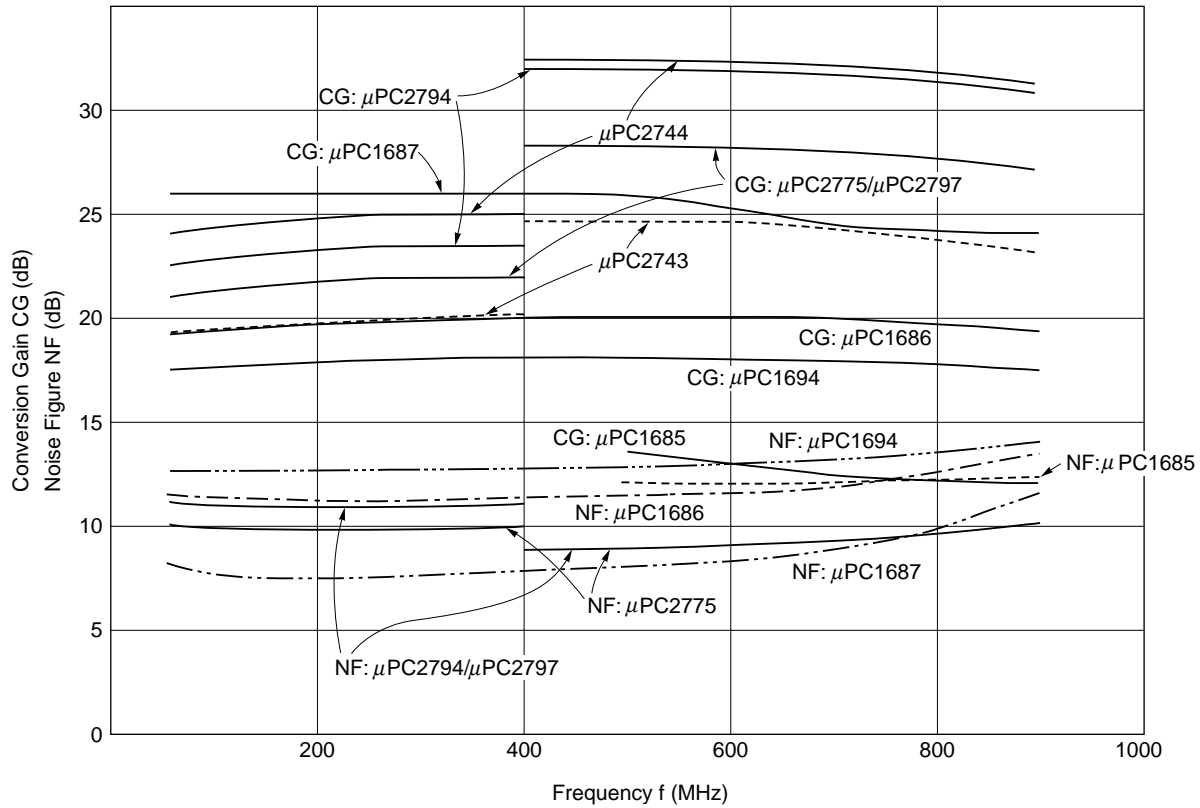
• MAXIMUM OUTPUT POWER vs. FREQUENCY (2/2)



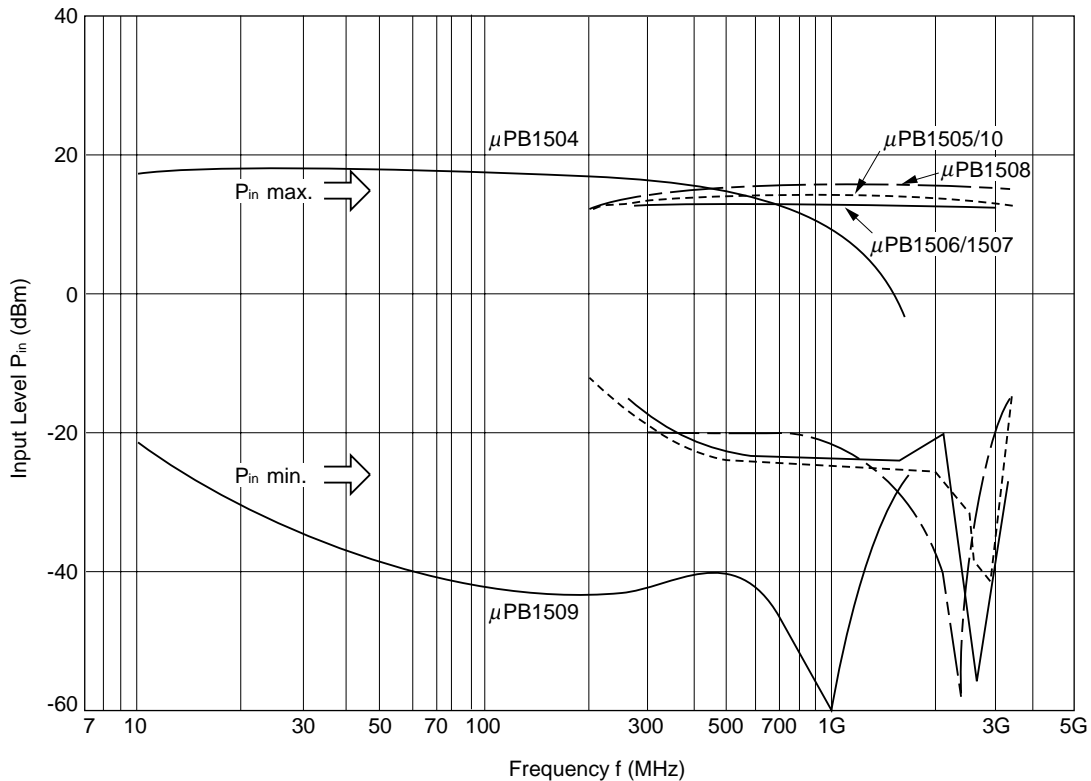
IC

■ Typical Characteristics

• CONVERSION GAIN, NOISE FIGURE vs. FREQUENCY



• INPUT LEVEL vs. FREQUENCY



Discrete

■ Dual Gate MES/MOS FET

• Dual Gate MES FET

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
3SK177 (NE25139)	TV/VCR Tuner	5	10	900	NF=1.1dB	4-pin minimold
3SK206 (NE25339)	TV/VCR Tuner	5	10	900	NF=1.1dB	
3SK299 (NE25118)	TV/VCR Tuner	5	10	900	NF=1.1dB	4-pin super minimold

• Dual Gate MOS FET

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
3SK131 (NE92939)	TV/VCR Tuner	10	10	200	NF=1.3dB	4-pin minimold
3SK134B (NE92739)	TV/VCR Tuner	10	10	900	NF=2.1dB	
3SK135A	TV/VCR Tuner	10	10	900	NF=2.7dB	
3SK176A	TV/VCR Tuner	6	3	470	NF=2.0dB	
3SK222 (NE92039)	TV/VCR Tuner	6	10	200	NF=1.2dB	
3SK223 (NE92239)	TV/VCR Tuner	6	10	470	NF=2.2dB	
3SK224 (NE92439)	TV/VCR Tuner	6	10	900	NF=1.8dB	
3SK230 (NE93039)	TV/VCR Tuner	6	10	470	NF=2.2dB	
3SK231 (NE93139)	TV/VCR Tuner	6	10	900	NF=2.0dB	
3SK252 (NE93239)	TV/VCR Tuner	3.5	7	470	NF=2.0dB	
3SK253 (NE93339)	TV/VCR Tuner	3.5	7	900	NF=1.8dB	
3SK254 (NE93218)	TV/VCR Tuner	3.5	7	470	NF=2.0dB	
3SK255 (NE93318)	TV/VCR Tuner	3.5	7	900	NF=1.8dB	

Discrete

■ Low Noise BIP. TR. (2SC, NE) (1/2)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
2SC1927 (NE73440B)	General Purpose	10	10	–	2 × 2SC1275	40(Ceramic)
2SC2148 (NE73435)	General Purpose	10	3	500	NF=2.1dB	μ-X
2SC2149 (NE02135)	General Purpose	10	20	2000	NF=2.6dB	
2SC2351 (NE02133)	General Purpose	10	5	1000	NF=1.5dB	3-pin minimold
2SC2954	General Purpose	10	30	500	NF=2.4dB	Power minimold
2SC3355 (NE85632)	General Purpose	10	7	1000	NF=1.1dB	TO-92
2SC3356 (NE85633)	General Purpose	10	7	1000	NF=1.1dB	3-pin minimold
2SC3357 (NE85634)	General Purpose	10	7	1000	NF=1.1dB	Power minimold
2SC3545 (NE94433)	General Purpose	10	–5	31.9	Cc-rbb'=4ps	3-pin minimold
2SC3582 (NE68132)	General Purpose	8	7	1000	NF=1.2dB	TO-92
2SC3583 (NE68133)	General Purpose	8	7	1000	NF=1.2dB	3-pin minimold
2SC3585 (NE68033)	General Purpose	6	5	2000	NF=1.8dB	μ-X
2SC3587 (NE68035)	General Purpose	6	5	2000	NF=1.7dB	
2SC3603 (NE85635)	General Purpose	10	7	2000	NF=2.1dB	3-pin minimold
2SC3604 (NE68135)	General Purpose	8	7	2000	NF=1.6dB	
2SC3663	General Purpose	1	0.25	1000	NF=3.0dB	3-pin minimold
2SC3809 (NE85641)	General Purpose	10	20	–	2 × 2SC3603	41(Ceramic)
2SC3810 (NE68141)	General Purpose	8	20	–	2 × 2SC3604	
2SC3841	General Purpose	10	–5	31.9	Cc-rbb'=4ps	3-pin minimold
2SC4092 (NE02139E)	General Purpose	10	5	1000	NF=1.5dB	4-pin minimold
2SC4093 (NE85639E)	General Purpose	10	7	1000	NF=1.1dB	
2SC4094 (NE68139E)	General Purpose	8	7	1000	NF=1.2dB	3-pin super minimold
2SC4095 (NE68039E)	General Purpose	6	5	2000	NF=1.8dB	
2SC4182	General Purpose	3	–5	31.9	Cc-rbb'=9ps	3-pin super minimold
2SC4183 (NE58030)	General Purpose	5	2	900	NF=3.0dB	
2SC4184	General Purpose	3	–5	31.9	Cc-rbb'=3.5ps	3-pin super minimold
2SC4185 (NE73430)	General Purpose	10	5	1000	f _T =2GHz	
2SC4186	General Purpose	10	–5	31.9	Cc-rbb'=5ps (MAX.)	3-pin super minimold
2SC4187 (NE68330)	General Purpose	1	0.25	1000	NF=3.0dB	
2SC4225	General Purpose	3	5	1000	NF=1.5dB	3-pin super minimold
2SC4226 (NE85630)	General Purpose	3	7	1000	NF=1.2dB	
2SC4227 (NE68130)	General Purpose	3	7	1000	NF=1.4dB	3-pin super minimold
2SC4228 (NE68030)	General Purpose	3	5	2000	NF=1.9dB	
2SC4536 (NE46134)	General Purpose	10	50	500	NF=2.5dB	Power minimold
2SC4568 (NE58133)	General Purpose	10	5	1000	S _{21e} ² =5.0dB (MIN.)	3-pin minimold
2SC4569 (NE58233)	General Purpose	5	5	1000	S _{21e} ² =5.0dB (MIN.)	
2SC4570 (NE58130)	General Purpose	5	5	1000	S _{21e} ² =5.0dB (MIN.)	4-pin minimold
2SC4571 (NE58230)	General Purpose	5	5	1000	S _{21e} ² =5.0dB (MIN.)	
2SC4703 (NE46234)	General Purpose	5	50	1000	NF=2.3dB	Power minimold
2SC4885 (NE61030)	General Purpose	5	5	1000	NF=3.0dB	4-pin minimold
2SC4954 (NE68433)	General Purpose	3	3	2000	NF=2.5dB	
2SC4955 (NE68533)	General Purpose	3	3	2000	NF=1.5dB	4-pin minimold
2SC4956 (NE68439E)	General Purpose	3	3	2000	NF=2.5dB	
2SC4957 (NE68539E)	General Purpose	3	3	2000	NF=1.5dB	4-pin minimold
2SC4958 (NE68430)	General Purpose	3	3	2000	NF=2.5dB	
2SC4959 (NE68530)	General Purpose	3	3	2000	NF=1.5dB	4-pin minimold
2SC5004 (NE58219)	General Purpose	5	5	1000	S _{21e} ² =5.0dB (MIN.)	
2SC5005 (NE58119)	General Purpose	5	5	1000	S _{21e} ² =5.0dB (MIN.)	3-pin ultra super minimold
2SC5006 (NE85619)	General Purpose	3	7	1000	NF=1.2dB	
2SC5007 (NE68119)	General Purpose	3	7	1000	NF=1.4dB	3-pin ultra super minimold
2SC5008 (NE68019)	General Purpose	3	5	2000	NF=1.9dB	
2SC5009 (NE68419)	General Purpose	3	3	2000	NF=2.5dB	3-pin ultra super minimold
2SC5010 (NE68519)	General Purpose	3	3	2000	NF=1.5dB	

Discrete

■ Low Noise BIP. TR. (2SC, NE) (2/2)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
2SC5011 (NE85618)	General Purpose	10	7	1000	NF=1.1dB	4-pin super minimold
2SC5012 (NE68118)	General Purpose	8	7	1000	NF=1.2dB	
2SC5013 (NE68018)	General Purpose	6	5	2000	NF=1.8dB	
2SC5014 (NE68418)	General Purpose	3	3	2000	NF=2.5dB	
2SC5015 (NE68518)	General Purpose	3	3	2000	NF=1.5dB	
2SC5177 (NE68633)	General Purpose	1	3	2000	NF=1.5dB	3-pin minimold
2SC5178 (NE68639)	General Purpose	1	3	2000	NF=1.5dB	4-pin minimold
2SC5179 (NE68630)	General Purpose	1	3	2000	NF=1.5dB	3-pin super minimold
2SC5180 (NE68618)	General Purpose	1	3	2000	NF=1.5dB	4-pin super minimold
2SC5181 (NE68619)	General Purpose	1	3	2000	NF=1.5dB	3-pin ultra super minimold
2SC5182 (NE68733)	General Purpose	1	3	2000	NF=1.3dB	3-pin minimold
2SC5183 (NE68739)	General Purpose	1	3	2000	NF=1.3dB	4-pin minimold
2SC5184 (NE68730)	General Purpose	1	3	2000	NF=1.3dB	3-pin super minimold
2SC5185 (NE68718)	General Purpose	1	3	2000	NF=1.3dB	4-pin super minimold
2SC5186 (NE68719)	General Purpose	1	3	2000	NF=1.3dB	3-pin ultra super minimold
2SC5191 (NE68833)	General Purpose	3	7	2000	NF=1.5dB	3-pin minimold
2SC5192 (NE68839)	General Purpose	3	7	2000	NF=1.5dB	4-pin minimold
2SC5193 (NE68830)	General Purpose	3	7	2000	NF=1.5dB	3-pin super minimold
2SC5194 (NE68818)	General Purpose	3	7	2000	NF=1.5dB	4-pin super minimold
2SC5195 (NE68819)	General Purpose	3	7	2000	NF=1.5dB	3-pin ultra super minimold
2SC5336	General Purpose	10	20	1000	$ S_{21e} ^2=12\text{dB}$ (TYP.)	4-pin power minimold
2SC5337	General Purpose	10	50	1000	$ S_{21e} ^2=7.0\text{dB}$ (MIN.)	
2SC5338	General Purpose	5	50	1000	$ S_{21e} ^2=8.5\text{dB}$ (MIN.)	
2SC5369 (NE696M01)	General Purpose	3	3	2000	NF=1.3dB	6-pin super minimold
2SC5408	Mobile Comm. LNA PA-Driver	2	1	2000	NF=1.1dB	
2SC5409	Mobile Comm. LNA PA-Driver	2	3	2000	NF=1.1dB	
2SC5431	Mobile Comm. VCO	5	5	1000	$ S_{21e} ^2=5.0\text{dB}$ (MIN.)	3-pin thin-type ultra super minimold
2SC5432	Mobile Comm. VCO	3	7	1000	NF=1.4dB	
2SC5433	Mobile Comm. VCO	3	7	1000	NF=1.4dB	
2SC5434	Mobile Comm. VCO	3	5	2000	NF=1.9dB	
2SC5435	Mobile Comm. VCO	3	3	2000	NF=1.5dB	
2SC5436	Mobile Comm. VCO	2	3	2000	NF=1.4dB	
2SC5437	Mobile Comm. VCO	1	3	2000	NF=1.9dB	
2SC5454	BS Tuner Buff Amp.	3	5	2000	NF=1.5dB	4-pin minimold
2SC5455	BS Tuner Buff Amp.	3	7	2000	NF=1.5dB	
2SC5507	LNA, VCO	2	2	2000	NF=1.2dB	4-pin thin-type super minimold
2SC5508	LNA, VCO	2	5	2000	NF=1.1dB	
2SC5509	Buff Amp.	2	10	2000	NF=1.2dB	

Discrete

■ Twin TR. (μ PA $\times\times\times$)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
μ PA800T	General Purpose	1	3	2000	NF=1.9dB	6-pin super minimold
μ PA801T	General Purpose	3	7	1000	NF=1.2dB	
μ PA801TC	General Purpose	3	7	1000	NF=1.2dB	6-pin thin-type ultra super minimold
μ PA802T	General Purpose	3	7	1000	NF=1.4dB	6-pin super minimold
μ PA803T	General Purpose	5	5	1000	S _{21e} ² =5.0dB (MIN.)	
μ PA804T	General Purpose	5	5	1000	S _{21e} ² =5.0dB (MIN.)	6-pin thin-type ultra super minimold
μ PA804TC	General Purpose	5	5	1000	S _{21e} ² =5.0dB (MIN.)	
μ PA805T	General Purpose	3	3	2000	NF=2.5dB	6-pin super minimold
μ PA806T	General Purpose	3	3	2000	NF=1.5dB	
μ PA807T	General Purpose	2	3	2000	NF=1.5dB	
μ PA808T	General Purpose	2	3	2000	NF=1.3dB	
μ PA809T	General Purpose	1	3	2000	NF=1.7dB	
μ PA810T	General Purpose	3	7	1000	NF=1.2dB	
μ PA810TC	General Purpose	3	7	1000	NF=1.2dB	
μ PA811T	General Purpose	3	5	2000	NF=1.9dB	6-pin super minimold
μ PA812T	General Purpose	3	7	1000	NF=1.4dB	
μ PA813T	General Purpose	5	5	1000	S _{21e} ² =5.0dB (MIN.)	
μ PA814T	General Purpose	3	7	2000	NF=1.5dB	
μ PA814TC	General Purpose	3	7	2000	NF=1.5dB	6-pin thin-type ultra super minimold
μ PA821TC	Mobile Comm. VCO	3	7	1000	NF=1.2dB	6-pin thin-type super minimold
μ PA821TF	Mobile Comm. VCO	3	7	1000	NF=1.2dB	
μ PA826TC	Mobile Comm. VCO	3	3	2000	NF=1.5dB	6-pin thin-type ultra super minimold
μ PA826TF	Mobile Comm. VCO	3	3	2000	NF=1.5dB	6-pin thin-type super minimold
μ PA827TF	Mobile Comm. VCO	2	3	2000	NF=1.5dB	
μ PA828TF	Mobile Comm. VCO	2	3	2000	NF=1.3dB	
μ PA831TC	Mobile Comm. VCO	Q1:3, Q2:3	Q1:7, Q2:7	Q1:1000, Q2:1000	Q1:NF=1.2dB Q2:NF=1.4dB	6-pin thin-type super minimold
μ PA831TF	Mobile Comm. VCO	Q1:3, Q2:3	Q1:7, Q2:7	Q1:1000, Q2:1000	Q1:NF=1.2dB Q2:NF=1.4dB	6-pin thin-type super minimold
μ PA832TF	Mobile Comm. VCO	Q1:3, Q2:3	Q1:7, Q2:3	Q1:1000, Q2:2000	Q1:NF=1.2dB Q2:NF=1.5dB	
μ PA833TF	Mobile Comm. VCO	Q1:1, Q2:3	Q1:3, Q2:3	Q1:2000, Q2:2000	Q1:NF=1.7dB Q2:NF=1.5dB	
μ PA834TF	Mobile Comm. VCO	Q1:3, Q2:3	Q1:7, Q2:7	Q1:1000, Q2:1000	Q1:NF=1.4dB Q2:NF=1.2dB	
μ PA835TC	Mobile Comm. VCO	Q1:3, Q2:3	Q1:3, Q2:7	Q1:2000, Q2:1000	Q1:NF=1.5dB Q2:NF=1.2dB	6-pin thin-type ultra super minimold
μ PA835TF	Mobile Comm. VCO	Q1:3, Q2:3	Q1:3, Q2:7	Q1:2000, Q2:1000	Q1:NF=1.5dB Q2:NF=1.2dB	6-pin thin-type super minimold
μ PA836TC	Mobile Comm. VCO	Q1:3, Q2:1	Q1:3, Q2:3	Q1:2000, Q2:2000	Q1:NF=1.5dB Q2:NF=1.7dB	6-pin thin-type ultra super minimold
μ PA836TF	Mobile Comm. VCO	Q1:3, Q2:1	Q1:3, Q2:3	Q1:2000, Q2:2000	Q1:NF=1.5dB Q2:NF=1.7dB	6-pin thin-type super minimold
μ PA840TC	Mobile Comm. VCO	Q1:3, Q2:3	Q1:3, Q2:7	Q1:2000, Q2:1000	Q1:NF=1.5dB Q2:NF=1.4dB	6-pin thin-type ultra super minimold

Discrete

■ Low Noise GaAs/HJ FET (NE) (1/2)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
NE674	General Purpose GaAs FET	3	10	4000–12000	NF=1.4dB, Ga=10dB@f=12GHz	Chip, 83B
NE71300	General Purpose GaAs FET	3	10	12000	NF=1.6dB	Chip
NE71383B	General Purpose GaAs FET	3	10	12000	NF=1.6dB	83B
NE76118	General Purpose GaAs FET	3	10	2000	NF=0.8dB	18
NE23383B	General Purpose HJ-FET	2	10	4000–12000	NF=0.35dB, Ga=15dB@f=4GHz	83B
NE24200	General Purpose HJ-FET	2	10	12000	NF=0.6dB	Chip
NE24283B	General Purpose HJ-FET	2	10	4000–18000	NF=0.6dB, Ga=11dB@f=12GHz	83B
NE27200	General Purpose HJ-FET	2	10	12000	NF=0.45dB	Chip
NE32500	General Purpose HJ-FET	2	10	12000	NF=0.45dB	
NE32900	General Purpose HJ-FET	2	10	4000–18000	NF=0.35dB, Ga=13dB@f=12GHz	
NE34018	Mobile Comm. HJ-FET	2	5	800–3000	NF=0.6dB, Ga=16dB, G _s =18dB@f=2GHz	18
NE38018	Mobile Comm. HJ-FET	2	5	800–3000	NF=0.55dB, Ga=14.5dB, G _s =16dB@f=2GHz	
NE72118	BS Converter OSC Stage GaAs FET	3	30	4000–12000	G _s =5.5dB, P _{o(1dB)} =13.5dBm@=12GHz	
NE721S01	BS Converter OSC Stage GaAs FET	3	30	12000	G _s =7dB	S01
NE72218	BS Converter OSC Stage GaAs FET	3	30	4000–12000	G _s =4.5dB, P _{o(1dB)} =15.0dBm@=12GHz	18
NE76000	BS Converter GaAs FET	3	10	12000	NF=1.6dB	Chip
NE76038	BS Converter GaAs FET	3	10	12000	NF=1.7dB	38
NE76083A	BS Converter GaAs FET	3	10	12000	NF=1.6dB	83A
NE76084	BS Converter GaAs FET	3	10	12000	NF=1.6dB	84
NE76184A	BS Converter GaAs FET	3	10	4000	NF=0.8dB, Ga=12dB	84A
NE32484A	BS Converter HJ-FET	2	10	12000	NF=0.6dB, Ga=11.0dB	
NE32584C	BS Converter HJ-FET	2	10	12000	NF=0.45dB, Ga=12.5dB	84C
NE325S01	BS Converter HJ-FET	2	10	12000	NF=0.45dB, Ga=12.5dB	S01
NE329S01	BS Converter HJ-FET	2	10	4000–18000	NF=0.35dB, Ga=13.0dB@f=12GHz	
NE3210S01	BS Converter HJ-FET	2	10	4000–18000	NF=0.35dB, Ga=13.5dB@f=12GHz	
NE33284A	BS Converter HJ-FET	2	10	4000	NF=0.35dB, Ga=15.0dB	84A
NE334S01	BS Converter HJ-FET	2	15	4000	NF=0.25dB, Ga=16.0dB	S01

Discrete

■ Low Noise GaAs/HJ FET (NE) (2/2)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
NE42484A	BS Converter HJ-FET	2	10	12000	NF=0.8dB, $G_a=10.5\text{dB}$	84A
NE42484C	BS Converter HJ-FET	2	10	12000	NF=0.7dB, $G_a=12.0\text{dB}$	84C
NE425S01	BS Converter HJ-FET	2	10	12000	NF=0.6dB, $G_a=12.0\text{dB}$	S01
NE428M01	BS Converter HJ-FET	2	10	4000–12000	NF=0.9dB, $G_a=8.5\text{dB}@f=12\text{GHz}$	M01
NE429M01	BS Converter HJ-FET	2	10	4000–12000	NF=0.9dB, $G_a=10\text{dB}@f=12\text{GHz}$	
NE4210M01	BS Converter HJ-FET	2	10	4000–12000	NF=0.8dB, $G_a=11\text{dB}@f=12\text{GHz}$	
NE434S01	BS Converter HJ-FET	2	15	4000	NF=0.35dB, $G_a=15.5\text{dB}$	S01

Discrete

■ Power TR./FET (2SC, NE, NEL, NEM, NES, NEZ) (1/3)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
2SC5288 (NE68939)	General Purpose Medium Po. Bip. Tr.	3.6	I _q =1	1900	P _{in(1dB)} =24dBm (class AB)	4-pin minimold
2SC5289 (NE69039)	General Purpose Medium Po. Bip. Tr.	3.6	I _q =1	1900	P _{in(1dB)} =27dBm (class AB)	
NE850R599A	C-Band Po. Amp. Power GaAs FET	10	100	2000–10000	P _{o(1dB)} =25.5dBm	99
NE8500199	C-Band Po. Amp. Power GaAs FET	10	200	2000–10000	P _{o(1dB)} =28.5dBm	
NE8500295-4	C-Band Po. Amp. Power GaAs FET	10	450	3500–5500	P _{o(1dB)} =33.8dBm	
NE8500295-6	C-Band Po. Amp. Power GaAs FET	10	450	5500–7500	P _{o(1dB)} =33.8dBm	95
NE8500295-8	C-Band Po. Amp. Power GaAs FET	10	450	7500–8500	P _{o(1dB)} =33.5dBm	
NEZ3642-15D	C-Band Po. Amp. Power GaAs FET	10	≤6000	3600–4200	P _{o(1dB)} =42.5dBm	
NEZ3642-15DD	C-Band Po. Amp. Power GaAs FET	10	≤6000	3600–4200	P _{o(1dB)} =42.5dBm	T-65
NEZ3642-4D	C-Band Po. Amp. Power GaAs FET	10	≤1500	3600–4200	P _{o(1dB)} =36.5dBm	T-61
NEZ3642-8D	C-Band Po. Amp. Power GaAs FET	10	≤3000	3600–4200	P _{o(1dB)} =39.5dBm	
NEZ3642-8DD	C-Band Po. Amp. Power GaAs FET	10	≤3000	3600–4200	P _{o(1dB)} =39.5dBm	
NEZ4450-15D	C-Band Po. Amp. Power GaAs FET	10	≤6000	4400–5000	P _{o(1dB)} =42.5dBm	T-65
NEZ4450-15DD	C-Band Po. Amp. Power GaAs FET	10	≤6000	4400–5000	P _{o(1dB)} =42.5dBm	
NEZ4450-4D	C-Band Po. Amp. Power GaAs FET	10	≤1500	4400–5000	P _{o(1dB)} =36.5dBm	T-61
NEZ4450-4DD	C-Band Po. Amp. Power GaAs FET	10	≤1500	4400–5000	P _{o(1dB)} =36.5dBm	
NEZ4450-8D	C-Band Po. Amp. Power GaAs FET	10	≤3000	4400–5000	P _{o(1dB)} =39.5dBm	
NEZ4450-8DD	C-Band Po. Amp. Power GaAs FET	10	≤3000	4400–5000	P _{o(1dB)} =39.5dBm	
NEZ5964-15D	C-Band Po. Amp. Power GaAs FET	10	≤6000	5900–6450	P _{o(1dB)} =42.5dBm	
NEZ5964-15DD	C-Band Po. Amp. Power GaAs FET	10	≤6000	5900–6450	P _{o(1dB)} =42.5dBm	T-65
NEZ5964-4D	C-Band Po. Amp. Power GaAs FET	10	≤1500	5900–6450	P _{o(1dB)} =36.5dBm	T-61
NEZ5964-4DD	C-Band Po. Amp. Power GaAs FET	10	≤1500	5900–6450	P _{o(1dB)} =36.5dBm	
NEZ5964-8D	C-Band Po. Amp. Power GaAs FET	10	≤3000	5900–6450	P _{o(1dB)} =39.5dBm	
NEZ5964-8DD	C-Band Po. Amp. Power GaAs FET	10	≤3000	5900–6450	P _{o(1dB)} =39.5dBm	
NEZ6472-15D	C-Band Po. Amp. Power GaAs FET	10	≤6000	6400–7200	P _{o(1dB)} =42.5dBm	
NEZ6472-15DD	C-Band Po. Amp. Power GaAs FET	10	≤6000	6400–7200	P _{o(1dB)} =42.5dBm	T-65

Discrete

■ Power TR./FET (2SC, NE, NEL, NEM, NES, NEZ) (2/3)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
NEZ6472-4D	C-Band Po. Amp. Power GaAs FET	10	≤1500	6400–7200	$P_{o(1dB)}=36.5dBm$	T-61
NEZ6472-4DD	C-Band Po. Amp. Power GaAs FET	10	≤1500	6400–7200	$P_{o(1dB)}=36.5dBm$	
NEZ6472-8D	C-Band Po. Amp. Power GaAs FET	10	≤3000	6400–7200	$P_{o(1dB)}=39.5dBm$	
NEZ6472-8DD	C-Band Po. Amp. Power GaAs FET	10	≤3000	6400–7200	$P_{o(1dB)}=39.5dBm$	
NEZ7177-4D	C-Band Po. Amp. Power GaAs FET	10	≤1500	7100–7700	$P_{o(1dB)}=36.5dBm$	
NEZ7177-4DD	C-Band Po. Amp. Power GaAs FET	10	≤1500	7100–7700	$P_{o(1dB)}=36.5dBm$	
NEZ7177-8D	C-Band Po. Amp. Power GaAs FET	10	≤3000	7100–7700	$P_{o(1dB)}=39.5dBm$	
NEZ7177-8DD	C-Band Po. Amp. Power GaAs FET	10	≤3000	7100–7700	$P_{o(1dB)}=39.5dBm$	
NEZ7785-15D	C-Band Po. Amp. Power GaAs FET	10	≤6000	7700–8500	$P_{o(1dB)}=42.5dBm$	T-65
NEZ7785-4D	C-Band Po. Amp. Power GaAs FET	10	≤1500	7700–8500	$P_{o(1dB)}=36.5dBm$	T-61
NEZ7785-4DD	C-Band Po. Amp. Power GaAs FET	10	≤1500	7700–8500	$P_{o(1dB)}=36.5dBm$	
NEZ7785-8D	C-Band Po. Amp. Power GaAs FET	10	≤3000	7700–8500	$P_{o(1dB)}=39.5dBm$	
NEZ7785-8DD	C-Band Po. Amp. Power GaAs FET	10	≤3000	7700–8500	$P_{o(1dB)}=39.5dBm$	
NE1280100	K-Band Medium Po. Amp. Power GaAs FET	5	60	18700	$P_{out}=21.5dBm$	Chip
NE1280200	K-Band Medium Po. Amp. Power GaAs FET	5	120	18700	$P_{out}=24.5dBm$	
NE1280400	K-Band Medium Po. Amp. Power GaAs FET	5	240	18700	$P_{out}=27.5dBm$	
NEZ1414-2E	Ku-Band Po. Amp. Power GaAs FET	9	700	14000–14500	$P_{o(1dB)}=34.0dBm$	T-78
NEZ1414-3E	Ku-Band Po. Amp. Power GaAs FET	10	700	14000–14500	$P_{o(1dB)}=34.0dBm$	
NEZ1414-4E	Ku-Band Po. Amp. Power GaAs FET	9	1000	14000–14500	$P_o=37.5dBm$	
NEZ1414-5E	Ku-Band Po. Amp. Power GaAs FET	10	1500	14000–14500	$P_{o(1dB)}=37.0dBm$	
NEZ1414-8E	Ku-Band Po. Amp. Power GaAs FET	9	2800	14000–14500	$P_o=39.5dBm$	T-61
2SC3817 (NEL150181-12)	L-Band Po. Amp. Power Bip. Tr.	13.5	$I_q=3$	1550	$P_{out}=30dBm$ (Class AB)	81 (Ceramic)
NEL2001	L-Band Po. Amp. Power Bip. Tr.	24	$I_q=20$	1970	$P_{in(1dB)}=2.5W$ (Class AB)	01
NEL2004	L-Band Po. Amp. Power Bip. Tr.	24	$I_q=40$	1970	$P_{in(1dB)}=7W$ (Class AB)	F02
NEL2012	L-Band Po. Amp. Power Bip. Tr.	24	$I_q=75$	1970	$P_{in(1dB)}=16W$ (Class AB)	
NEL2012F03-24	L-Band Po. Amp. Power Bip. Tr.	24	$I_q=75$	1970	$P_{in(1dB)}=16W$	F03
NEL2035	L-Band Po. Amp. Power Bip. Tr.	24	$I_q=100$	1970	$P_{in(1dB)}=33W$ (Class AB)	

Discrete

■ Power TR./FET (2SC, NE, NEL, NEM, NES, NEZ) (3/3)

Part Number	Applications	Supply Voltage (V)	Supply Current (mA)	Operating Frequency (MHz)	Performances	Package
NE650R279A	L, S-Band Po. Amp. Power GaAs FET	6	50	800–2500	$P_{o(1dB)}=23dBm$, $GL=16dB$, $\eta_{add}=45\%$ @ $f=1.9GHz$	79A
NE650R479A	L, S-Band Po. Amp. Power GaAs FET	6	100	800–2500	$P_{o(1dB)}=26dBm$, $GL=14dB$, $\eta_{add}=45\%$ @ $f=1.9GHz$	
NE6500379A	L, S-Band Po. Amp. Power GaAs FET	6	500	800–2500	$P_{o(1dB)}=35dBm$, $GL=10dB$, $\eta_{add}=50\%$ @ $f=1.9GHz$	
NE6500496	L, S-Band Po. Amp. Power GaAs FET	10	≤ 400	2300	$P_{o(1dB)}=36dBm$	96
NE6501077	L, S-Band Po. Amp. Power GaAs FET	10	≤ 1000	2300	$P_{o(1dB)}=39.5dBm$	77
NE651R479A	L-Band Po. Amp. Power GaAs HJ-FET	3.5	230	800–2500	$P_o=27dBm$, $GL=12dB$, $\eta_{add}=60\%$ @ $f=1.9GHz$	79A
NE6510179A	L-Band Po. Amp. Power GaAs HJ-FET	3.5	200	800–2500	$P_o=32.5dBm$, $GL=10dB$, $\eta_{add}=58\%$ @ $f=1.9GHz$	
NE6510379A	L-Band Po. Amp. Power GaAs HJ-FET	3.5	760	800–2500	$P_o=32.5dBm$, $GL=8dB$, $\eta_{add}=52\%$ @ $f=1.9GHz$	
NES1417B-30	L-Band Po. Amp. Power GaAs FET	10	1000	1500	$P_o=45dBm$	T-79
NES1821B-30	L-Band Po. Amp. Power GaAs FET	10	1000	1900	$P_o=45dBm$	
NES1821P-30	L, S-Band Po. Amp. Power GaAs FET	10	4000	1800-2300	$P_o=45dBm$, $GL=13dB$, $\eta_D=40\%$ @ $f=1.96GHz$	T-86
NES1821P-50	L, S-Band Po. Amp. Power GaAs FET	10	2000	1800-2200	$P_o=47dBm$, $GL=10.5dB$, $\eta_D=52\%$ @ $f=1.96GHz$	
NES1823P-100	L, S-Band Po. Amp. Power GaAs FET	10	6000	1800-2300	$P_o=50dBm$, $GL=11dB$, $\eta_D=50\%$ @ $f=2.2GHz$	T-92
NES2527B-30	S-Band Po. Amp. Power GaAs FET	10	6000	2500-2700	$P_{o(1dB)}=45.0dBm$	T-79
2SC2586 (NE050214E-12)	UHF Po. Amp. Power Bip. Tr.	12.6	–	500	$P_{out}=32dBm$ (Class C)	CAN
2SC2762 (NE050214-12)	UHF Po. Amp. Power Bip. Tr.	12.6	–	500	$P_{out}=31.5dBm$ (Class C)	
2SC3218-M (NEM085068-28)	UHF Po. Amp. Power Bip. Tr.	28	$I_q=2 \times 150$	860	$P_{out}=47.2dBm$ (Class AB)	68 (Ceramic)
2SC3286-M (NEM0214068-28)	VHF Po. Amp. Power Bip. Tr.	28	$I_q=2 \times 500$	230	$P_{out}=51.4dBm$ (Class AB)	Ceramic
NEM0899F06-30	UHF Po. Amp. Power Bip. Tr.	30	$I_q=2 \times 150$	860	$P_{out}=100W$	F06
NEM0995F06-30	UHF Po. Amp. Power Bip. Tr.	30	$I_q=2 \times 200$	960	$P_{out}=90W$	
2SK2597 (NEM0995F01-30)	UHF Po. Amp. Power MOS FET	30	$I_q=2 \times 200$	960	$P_o=90W$	F01
NEZ1011-2E	X-Band Po. Amp. Power GaAs FET	9	700	10700–11700	$P_{o(1dB)}=34.5dBm$	T-78
NEZ1011-3E	X-Band Po. Amp. Power GaAs FET	10	700	10700–11700	$P_{o(1dB)}=34.0dBm$	
NEZ1011-4E	X-Band Po. Amp. Power GaAs FET	9	1000	10700–11700	$P_o=36.5dBm$, $GL=8.0dB$ @ $f=10.7-11.7GHz$	
NEZ1011-5E	X-Band Po. Amp. Power GaAs FET	10	1500	10700–11700	$P_{o(1dB)}=37.0dBm$	
NEZ1011-8E	X-Band Po. Amp. Power GaAs FET	9	2000	10700–11700	$P_o=40.5dBm$	
NE960R275	X, Ku-Band Po. Amp. Power GaAs FET	9	90	8000–16000	$P_{o(1dB)}=25.0dBm$	75
NE960R575	X, Ku-Band Po. Amp. Power GaAs FET	9	180	8000–16000	$P_{o(1dB)}=27.5dBm$	

Discrete

■ Cross-reference Table

• Dual Gate MES FET

Remarks	4-pin minimold	4-pin super minimold
$W_g = 400 \mu\text{m}$	3SK177	3SK299
$W_g = 800 \mu\text{m}$	3SK206	

• Dual Gate MOS FET

Applications		4-pin minimold	4-pin super minimold
VHF Band (to 200 MHz)		3SK131	3SK242
		3SK222	3SK246
CATV Band (to 470 MHz)		3SK223	3SK243
		3SK230	
		3SK252	3SK254
UHF Band (to 900 MHz)	$\lambda/4$ matching	3SK135A	
		3SK224	3SK244
		3SK231	
		3SK253	3SK255
	$\lambda/2$ matching	3SK134B	3SK245

Remark: Devices listed in the same row are the same chip.

Example: 3SK131, 3SK242

• Dual Gate MES/MOS FET, Low Noise BIP. TR. (for TV tuner)

Applications		BIP. TR.		Dual Gate FET	
		Minimold (3-pin)	Small minimold (3-pin)	Minimold (4-pin)	Super minimold (4-pin)
VHF band	RF			3SK131 3SK222 3SK223 3SK230 3SK252	3SK254
	MIX	2SC3545	2SC4182 2SC4184	3SK131	3SK242
	OSC	2SC3545	2SC4182 2SC4184		
UHF band	RF ($\lambda/4$)		2SC4183	3SK135A 3SK224 3SK231 3SK253	3SK255
	RF ($\lambda/2$)			3SK134B	
	RF (GaAs FET)			3SK177 3SK206	
	MIX	2SC3545 2SC3841	2SC4183 2SC4185 2SC4184 2SC4186		
	OSC	2SC3545 2SC3841	2SC4182 2SC4184 2SC4185		

Discrete

■ **Cross-reference Table**

• **Low Noise BIP. TR. (1/2)**

Applications	Part Number						Electrical Characteristics	
	TO-92	Minimold		Super minimold		Ultra super minimold	f _T (GHz)	NF (dB)
		3-pin	4-pin	3-pin	4-pin	3-pin		
Pre Amp.	2SC3355	2SC3356	2SC4093	2SC4228	2SC5013	2SC5008	7 (20 mA)	1.1 (1 GHz)
	2SC2570A	2SC2351	2SC4092				5 (20 mA)	1.5 (1 GHz)
Buffer Amp.				2SC4185			2 (5 mA)	3 (0.5 GHz)
	2SC2570A	2SC2351	2SC4092				5 (20 mA)	1.5 (1 GHz)
1st IF Amp.	2SC3355	2SC3356	2SC4093	2SC4226	2SC5011	2SC5006	7 (20 mA)	1.1 (1 GHz)
	2SC2570A	2SC2351	2SC4092				5 (20 mA)	1.5 (1 GHz)
1st and 2nd OSC		2SC3545		2SC4184			1.8 (5 mA)	
				2SC4185			2 (5 mA)	
		2SC4568		2SC4570		2SC5005	5.5 (5 mA)	
		2SC4569		2SC4571		2SC5004	5 (5 mA)	
2nd IF Amp.			2SC4185			2 (5 mA)		

• **Low Noise BIP. TR. (2/2)**

Frequency (MHz)	NF (dB)		
	2.5	3.5	4.0
500	————	2SC2148	————
2000	2SC3604	2SC3603	2SC2149
4000	2SC3587	————	————

• **Twin TR.**

for pager		for VCO		for Mobile Communications		for VCO		
Same Chip				Different Chip				
Part Number	2SC No. (x2)	Part Number	2SC No. (x2)	Part Number	2SC No. (x2)	Part Number	2SC No. (x2)	
							Q1	Q2
μPA800T, TF	2SC5008	μPA811T	2SC5008					
μPA801T, TC, TF	2SC5006	μPA810T, TC, TF	2SC5006	μPA821TC, TF	2SC5006	μPA831TC, TF	2SC5006	2SC5007
μPA802T	2SC5007	μPA812T	2SC5007	μPA822TF	2SC5007	μPA832TF	2SC5006	2SC5010
μPA803T	2SC5005	μPA813T	2SC5005			μPA833TF	2SC5195	2SC5010
μPA804T, TC, TF	2SC5004					μPA834TF	2SC5007	2SC5006
μPA805T	2SC5009					μPA835TC, TF	2SC5010	2SC5006
μPA806T	2SC5010			μPA826TC, TF	2SC5010	μPA836TC, TF	2SC5010	2SC5195
μPA807T	2SC5181			μPA827TF	2SC5181	μPA837TF	2SC5181	2SC5195
μPA808T	2SC5186			μPA828TF	2SC5186	μPA838TF	2SC5195	2SC5186
μPA809T, TF	2SC5195	μPA814T, TC, TF	2SC5195	μPA829TF	2SC5195	μPA839TF	2SC5008	2SC5006
						μPA840TC	2SC5010	2SC5007

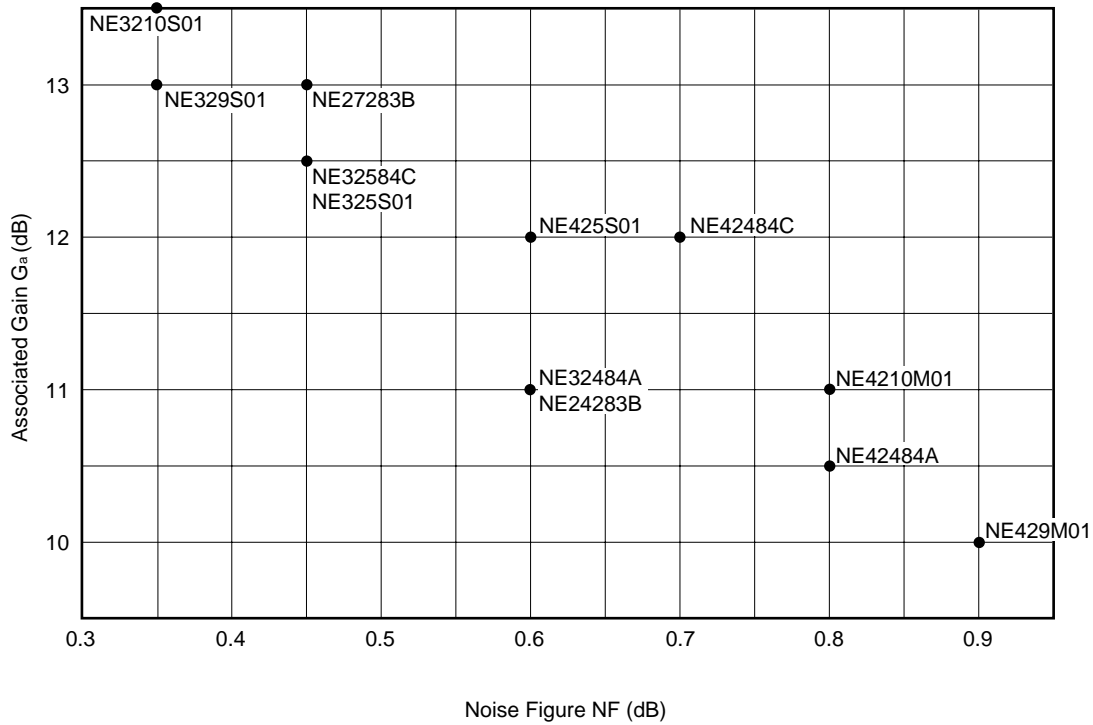
Package size T : 2.0 × 1.25 × 0.9 (mm)
 TC: 1.5 × 1.1 × 0.55 (mm)
 TF: 2.0 × 1.25 × 0.6 (mm)

Discrete

■ **Cross-reference Table**

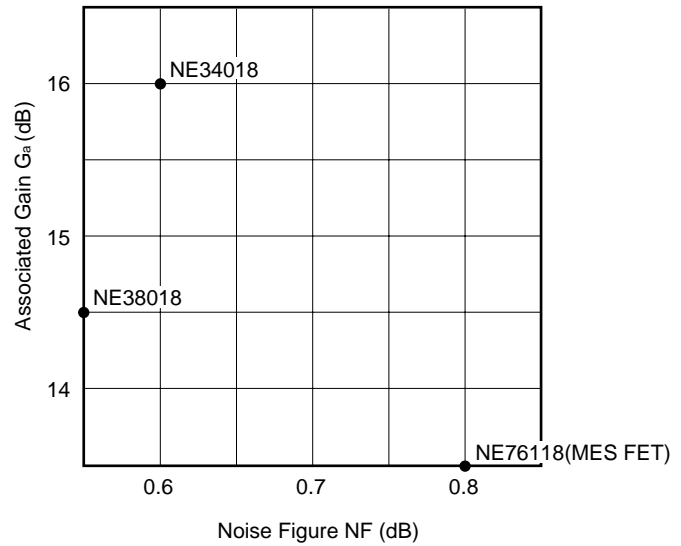
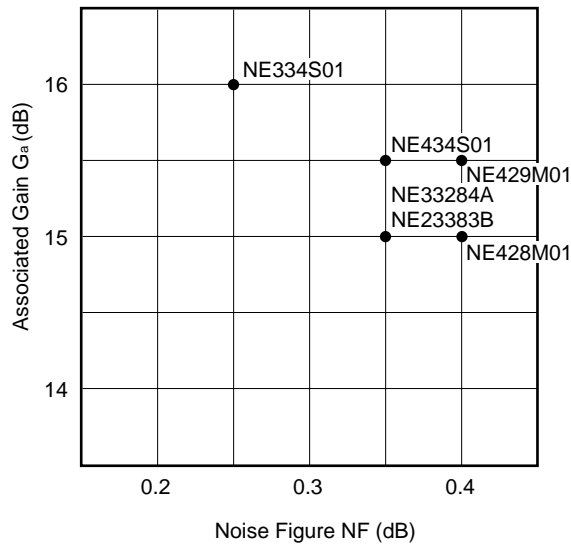
• **Low Noise GaAs/HJ FET**

ASSOCIATED GAIN vs. NOISE FIGURE @ f = 12 GHz



ASSOCIATED GAIN vs. NOISE FIGURE @ f = 4 GHz

ASSOCIATED GAIN vs. NOISE FIGURE @ f = 2 GHz

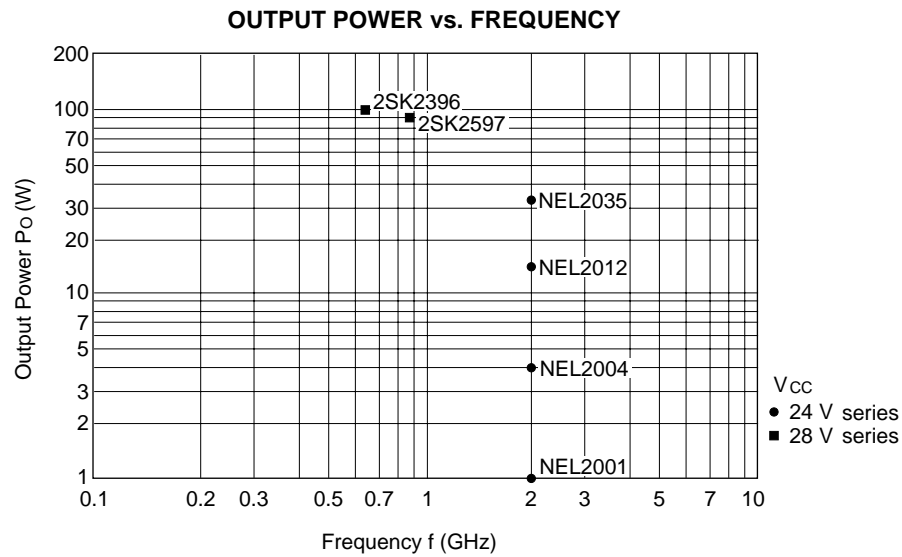


• : In mass production

Discrete

■ Cross-reference Table

• Power TR. (for mobile and portable radio station)



• Power TR. (for fixed radio station)

Frequency	Output Power	
	10 W or higher	
800 MHz or higher	2SK2396	
900 MHz or higher	2SK2597	
1900 MHz or higher	NEL2000 SERIES	

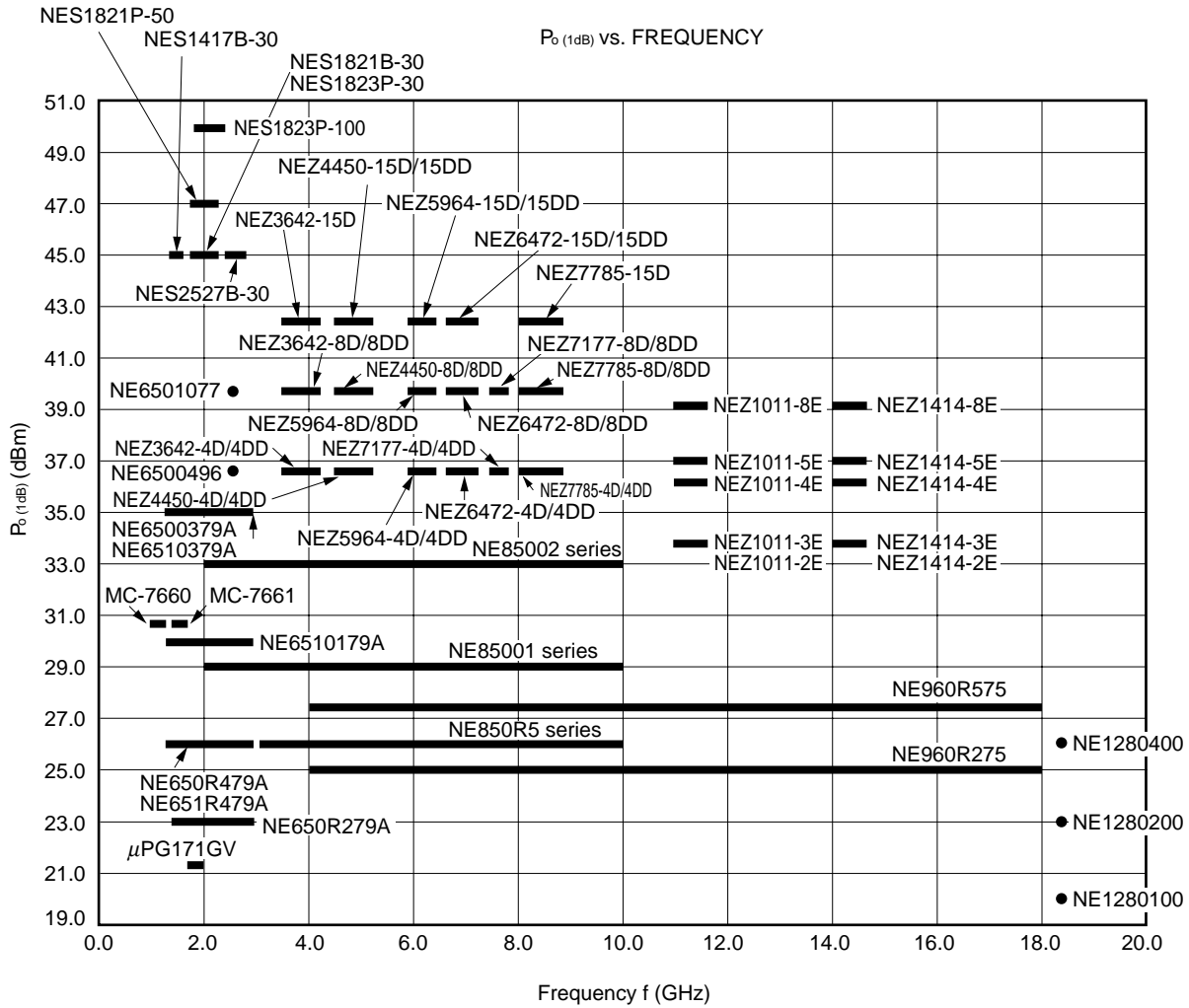
• Power TR. (for mobile and portable radio station)

Frequency	Output Power	
	0.1 W or higher	1 W or higher
1000 MHz or higher	2SC5288 2SC5289	—

Discrete

■ Cross-reference Table

• Power FET



Discrete

■ Cross-reference Table

• Silicon Microwave Single Transistor

Package fr (GHz)	μ -X	TO-92	Power MM (3-pin)	New Power MM (4-pin)	3-pin MM	3-pin SMM	4-pin MM	4-pin SMM	3-pin USMM (1608)	3-pin Thin USMM (1408)	6-pin SMM High Gain	4-pin SMM (R type)
1.0					2SC2758	2SC4183						
1.1					2SC2757	2SC4182						
2.0					2SC2759	2SC4185						
					2SC3545	2SC4184						
2.8	2SC2148											
4.0		2SC2408A	2SC2954									
					2SC3841	2SC4186						
					2SC3663	2SC4187	2SC4091					
4.5	2SC2149				2SC2351	2SC4225	2SC4092					
5.0		2SC2570A										
					2SC4569	2SC4571			2SC5004	2SC5431		
5.3			2SC4536	2SC5337								
5.5					2SC4568	2SC4570			2SC5005			
6.0			2SC4703	2SC5338								
7.0	2SC3603	2SC3355	2SC3357	2SC5336	2SC3356	2SC4226	2SC4093	2SC5011	2SC5006	2SC5432		
8.5	2SC3604	2SC3582			2SC3583	2SC4227	2SC4094	2SC5012	2SC5007	2SC5433		
10.0 ^{*1}	2SC3587				2SC3585	2SC4228	2SC4095	2SC5013	2SC5008	2SC5434		
					2SC5191	2SC5193	2SC5192	2SC5194	2SC5195	2SC5437		
11.0							2SC5455					
12.0 ^{*2}					2SC4954	2SC4958	2SC4956	2SC5014	2SC5009			
					2SC4955	2SC4959	2SC4957	2SC5015	2SC5010	2SC5435		
14.0 ^{*2}							2SC5454				2SC5369	
15.5 ^{*2}					2SC5177	2SC5179	2SC5178	2SC5180	2SC5181			
					2SC5182	2SC5184	2SC5183	2SC5185	2SC5186	2SC5436		
16.0											2SC5409 (2SC5533 ^{*3})	
17.0											2SC5408	2SC5509
25.0												2SC5507
												2SC5508

*1: Lower stage: Low operation voltage and low phase noise type.

*2: Upper stage: Low power dissipation type. Lower stage: Low noise figure type.

*3: 2SC5533 is a thin type of 2SC5409.

Discrete

■ Cross-reference Table

• NE Part No.-EIAJ No.

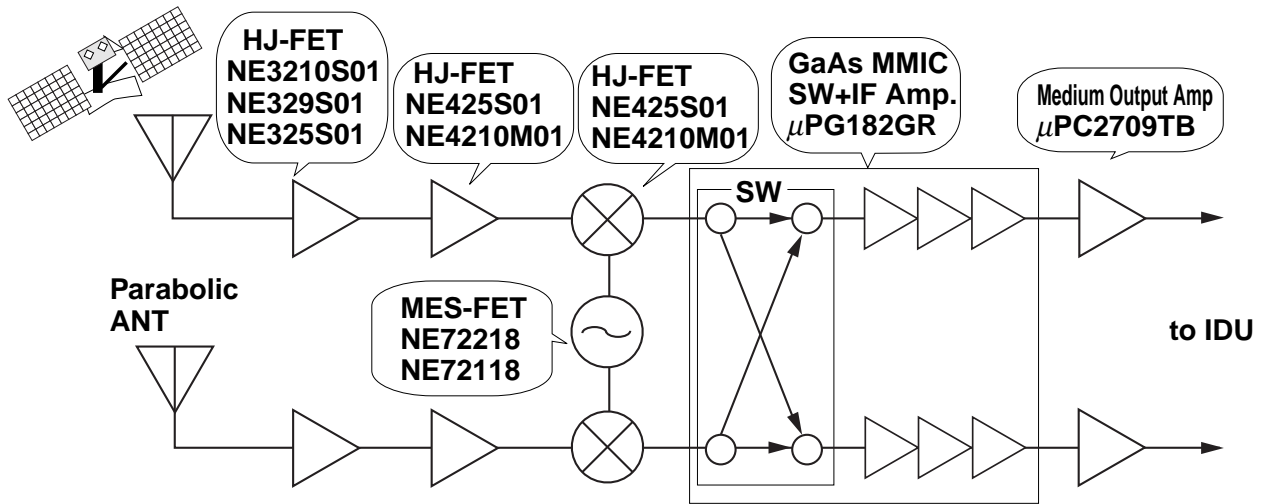
NE Part No.	EIAJ* No.
NE73416	2SC1733
NE73440A	2SC1926
NE73440B	2SC1927
NE73435	2SC2148
NE02135	2SC2149
NE02133	2SC2351
NE050214E-12	2SC2586
NE050214-12	2SC2762
NEM085068-28	2SC3218-M
NEM0214068-28	2SC3286-M
NE85632	2SC3355
NE85633	2SC3356
NE85634	2SC3357
NE94433	2SC3545
NE68132	2SC3582
NE68133	2SC3583
NE68033	2SC3585
NE68035	2SC3587
NE85635	2SC3603
NE68135	2SC3604
NE85641	2SC3809
NE68141	2SC3810
NEL150181-12	2SC3817
NE02139E	2SC4092
NE85639E	2SC4093
NE68139	2SC4094
NE68039	2SC4095
NE58030	2SC4183
NE73430	2SC4185
NE68330	2SC4187
NE85630	2SC4226
NE68130	2SC4227
NE68030	2SC4228
NE46134	2SC4536
NE58133	2SC4568
NE58233	2SC4569
NE58130	2SC4570
NE58230	2SC4571
NE46234	2SC4703
NE61030	2SC4885
NE68433	2SC4954
NE68533	2SC4955
NE68439E	2SC4956
NE68539E	2SC4957
NE68430	2SC4958
NE68530	2SC4959
NE58219	2SC5004
NE58119	2SC5005

NE Part No.	EIAJ* No.
NE85619	2SC5006
NE68119	2SC5007
NE68019	2SC5008
NE68419	2SC5009
NE68519	2SC5010
NE85618	2SC5011
NE68118	2SC5012
NE68018	2SC5013
NE68418	2SC5014
NE68518	2SC5015
NE68633	2SC5177
NE68639	2SC5178
NE68630	2SC5179
NE68618	2SC5180
NE68619	2SC5181
NE68733	2SC5182
NE68739	2SC5183
NE68730	2SC5184
NE68718	2SC5185
NE68719	2SC5186
NE68833	2SC5191
NE68839	2SC5192
NE68830	2SC5193
NE68818	2SC5194
NE68819	2SC5195
NE68939	2SC5288
NE69039	2SC5289
NE696M01	2SC5369
NEM0995F01-30	2SC2597
NE92939	3SK131
NE92739	3SK134B
NE25139	3SK177
NE25339	3SK206
NE92039	3SK222
NE92239	3SK223
NE92439	3SK224
NE93039	3SK230
NE93139	3SK231
NE92918	3SK242
NE92218	3SK243
NE92418	3SK244
NE92718	3SK245
NE92018	3SK246
NE93239	3SK252
NE93339	3SK253
NE93318	3SK255
NE25118	3SK299

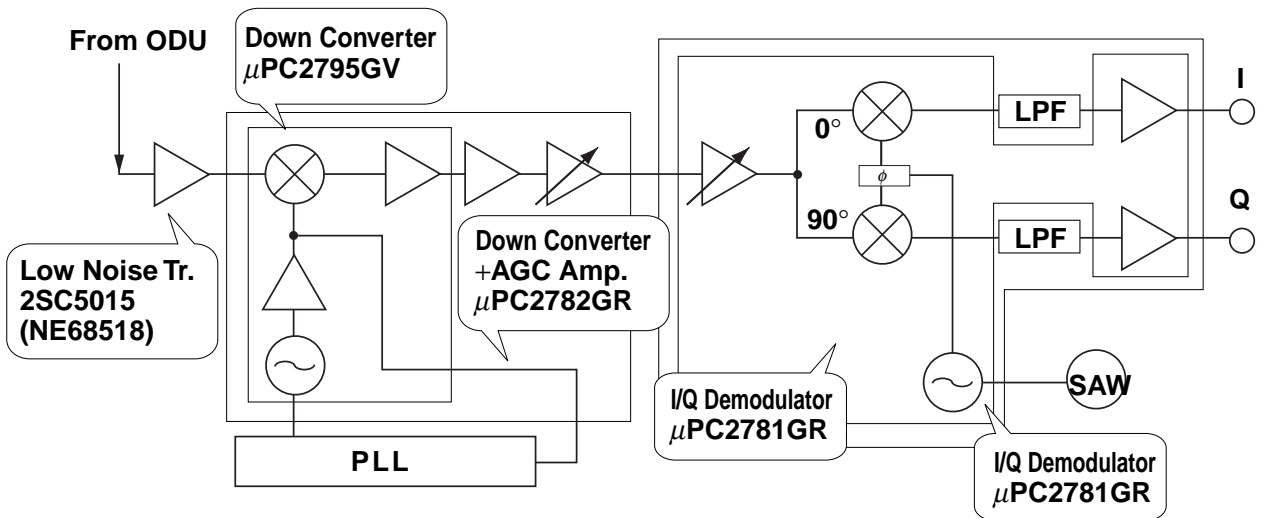
* : EIAJ = Electronics Industry Association Japan

Application

■ Digital DBS (1/2)

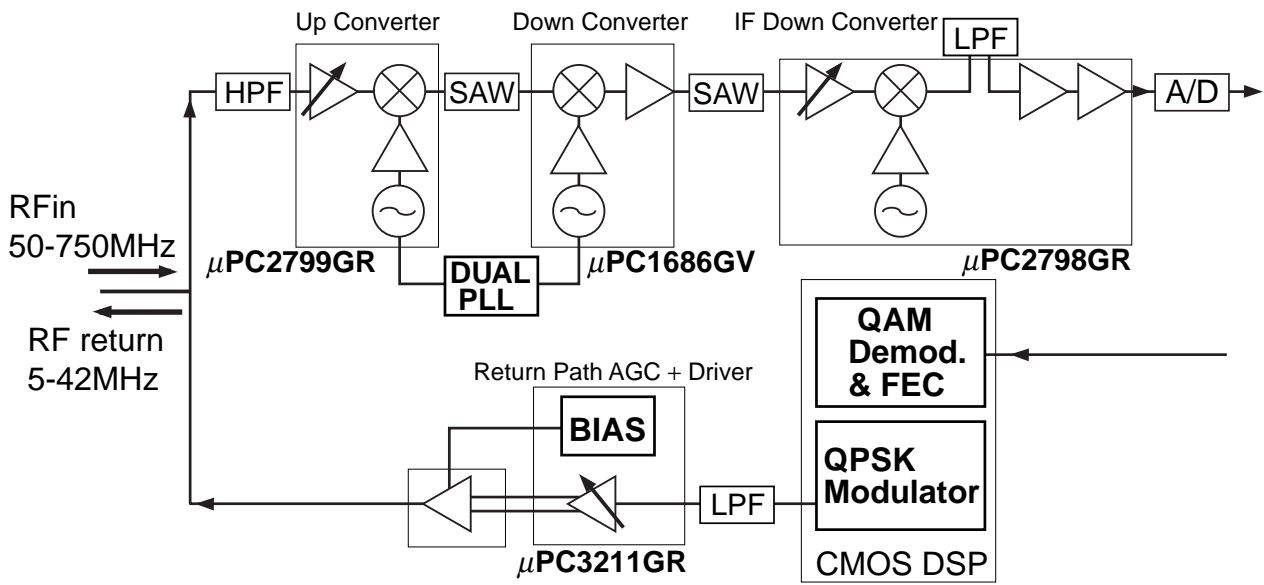


■ Digital DBS (2/2)



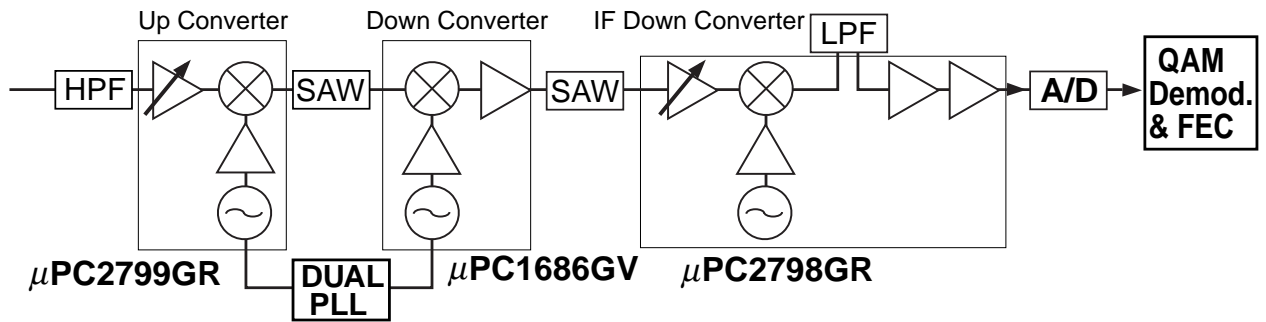
Application

■ **Transceiver Block for Digital Cable Modem/CATV Set-top-box**

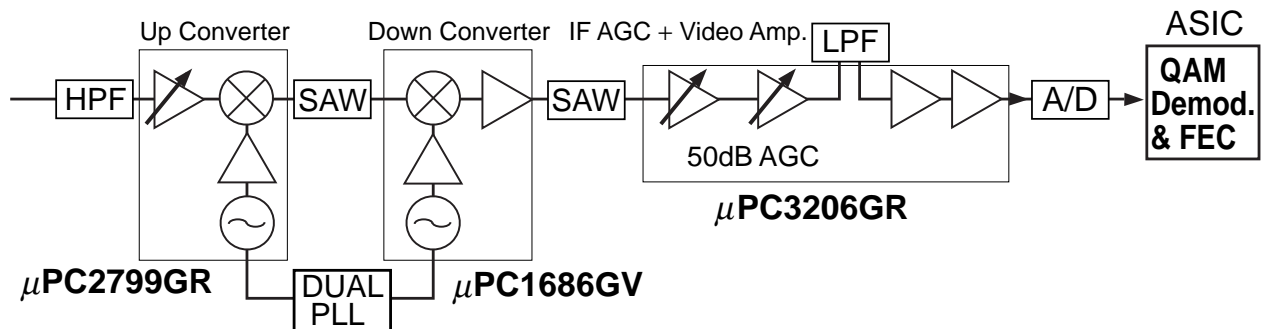


Application

Receiver Block for Digital Cable Modem/CATV Set-top-box (1/2)

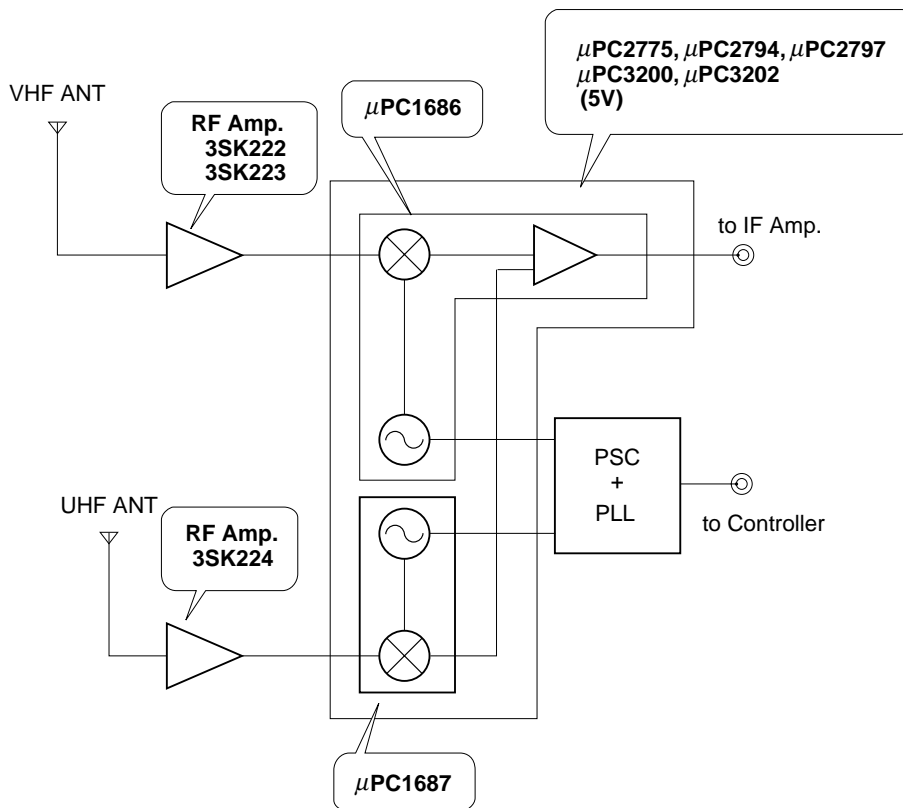


Receiver Block for Digital Cable Modem/CATV Set-top-box (2/2)

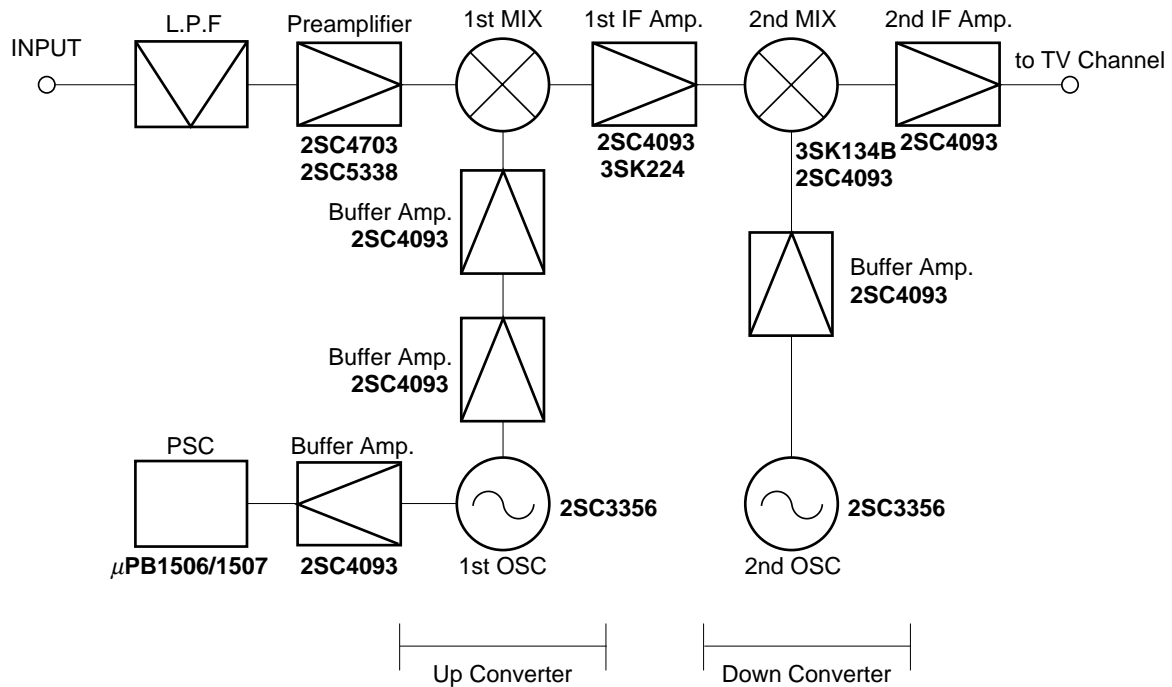


Application

■ **Terrestrial TV**



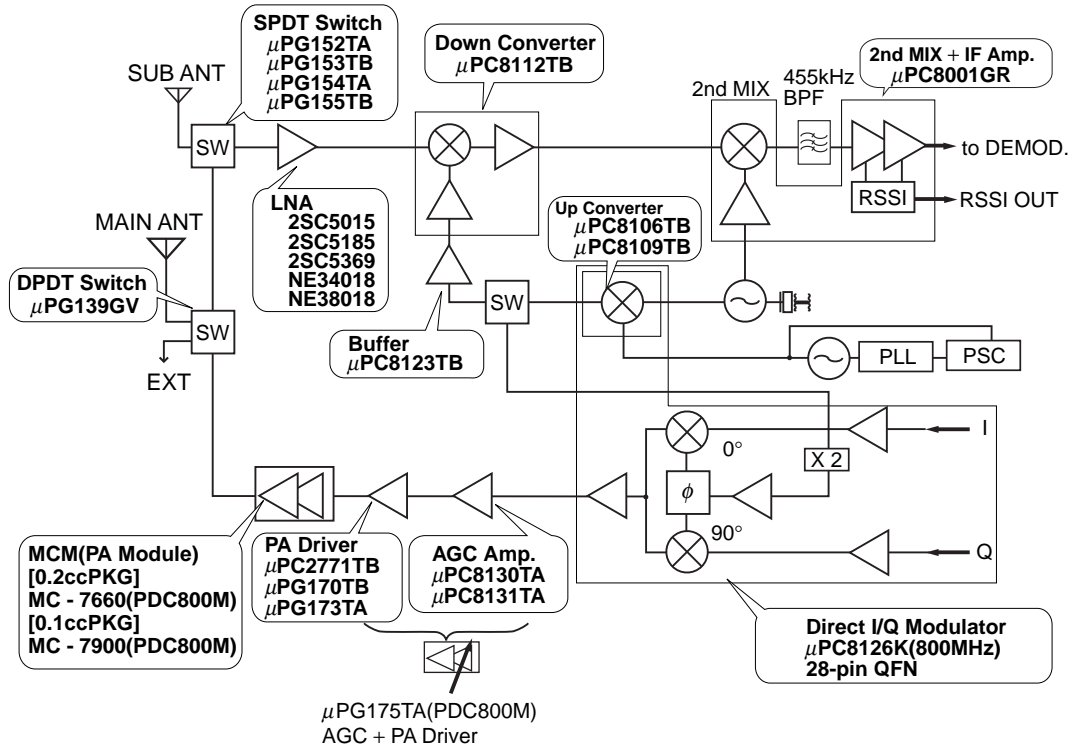
■ **Block for Digital Cable Modem/CATV Converter**



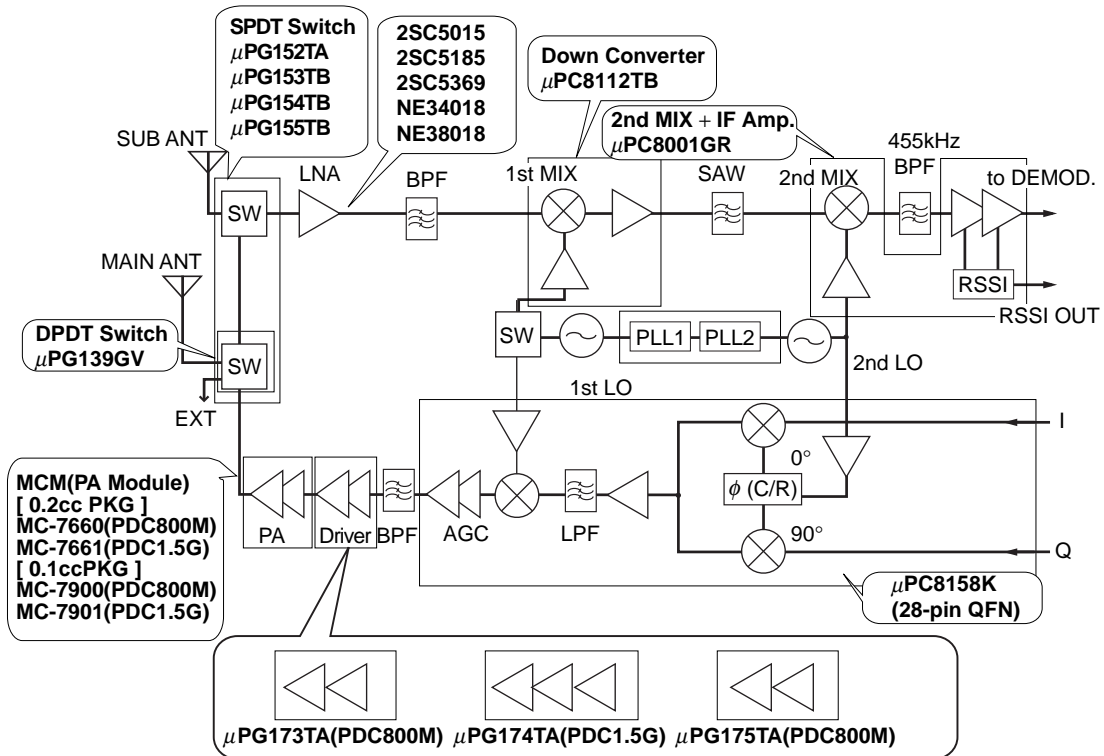
Application

■ PDC (RF Modulation System)

PDC 800M Direct Modulation System



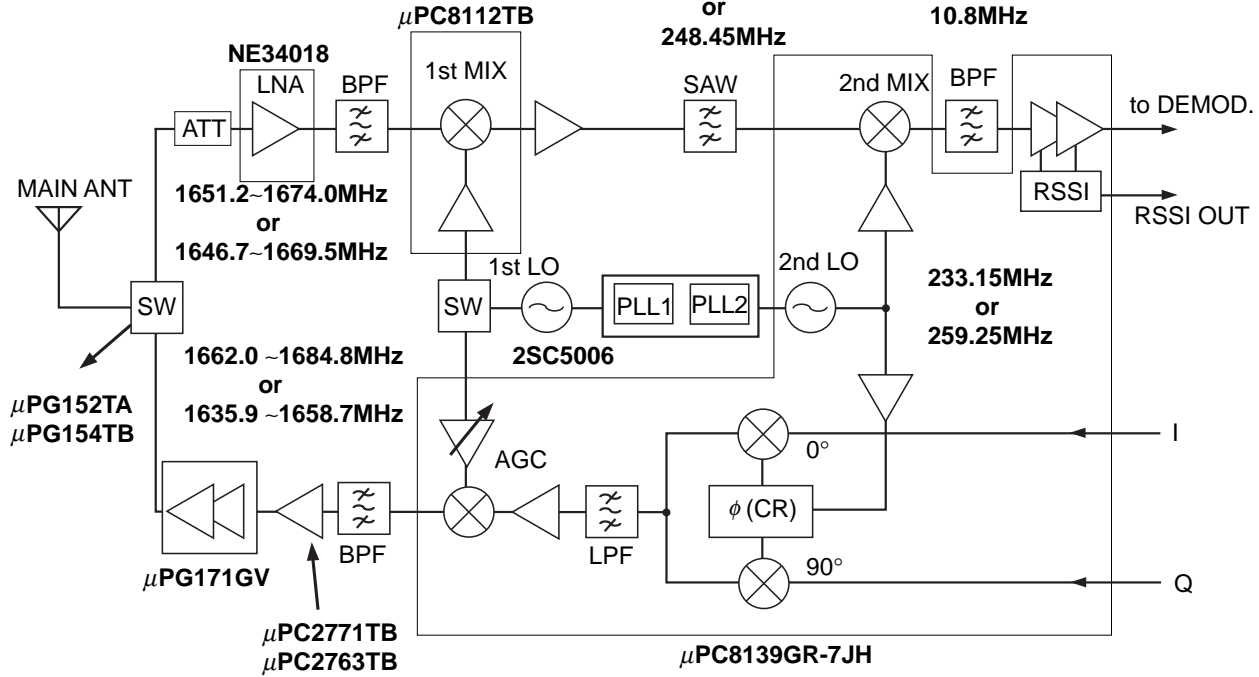
■ PDC (IF Modulation System)



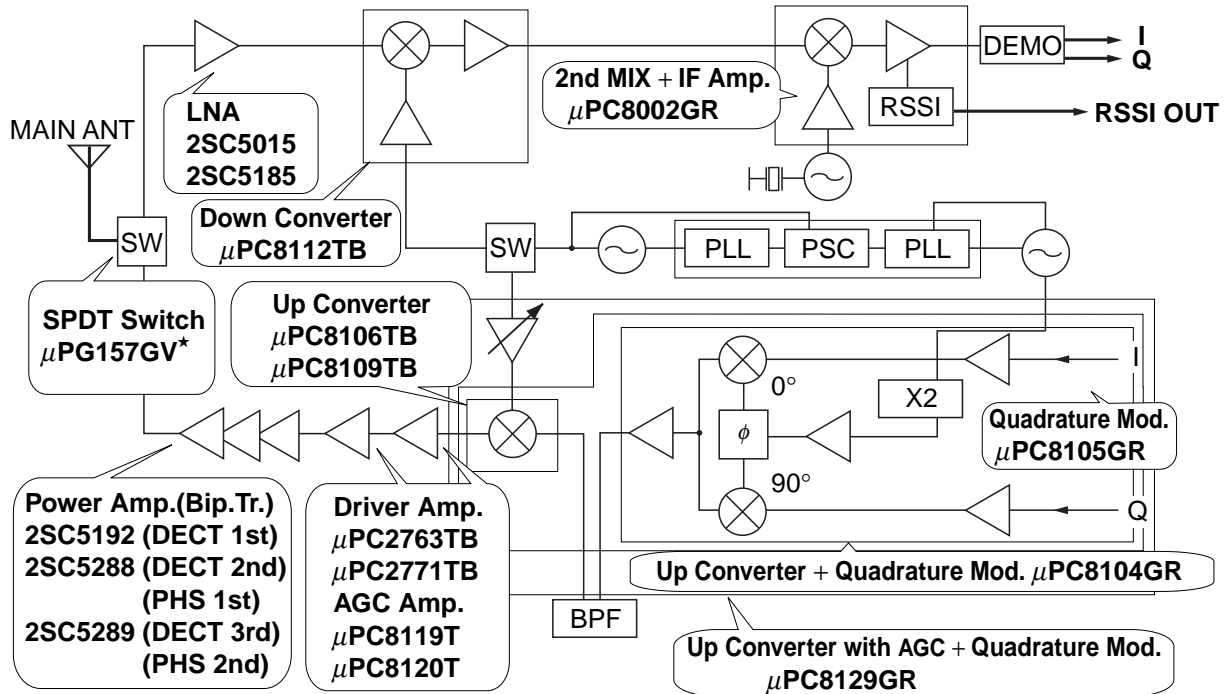
Application

■ PHS

1895.15~1917.95MHz
or
(1906.55±11.4MHz)



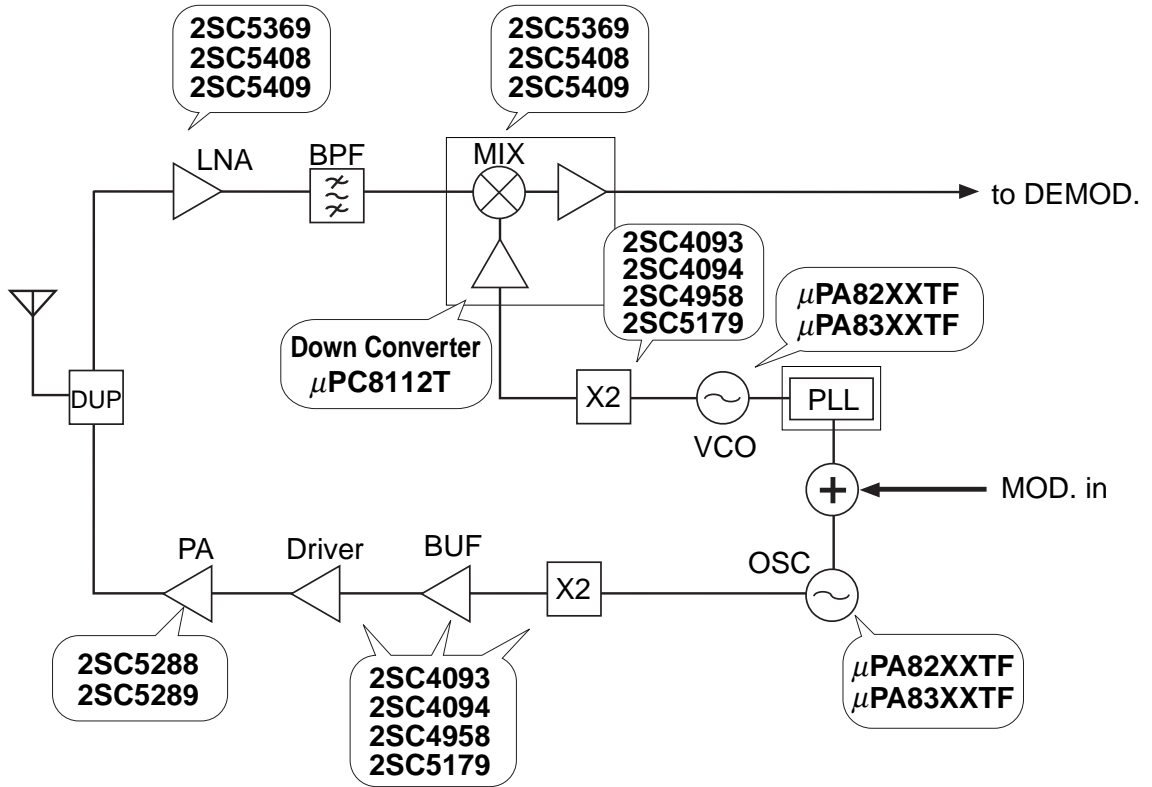
■ GSM (IF Modulation System)



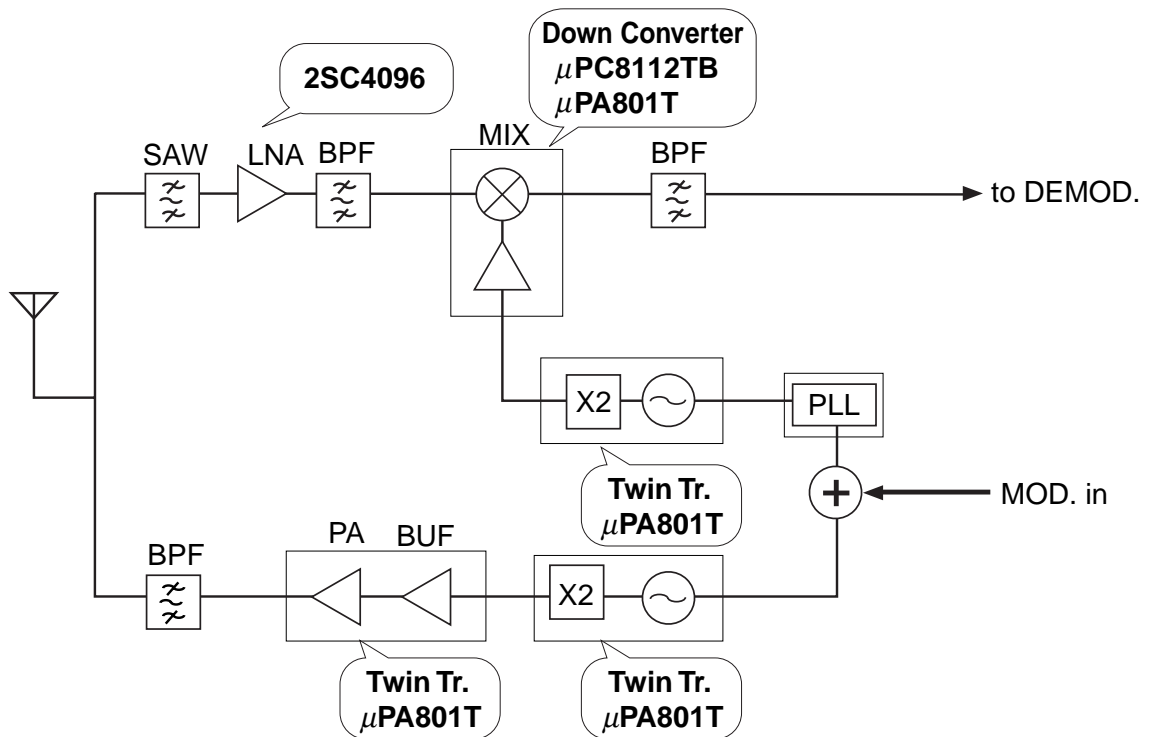
★ : Under development

Application

■ 900 MHz Cordless Phone (1/2)



■ 900 MHz Cordless Phone (2/2)



[MEMO]



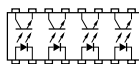


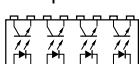



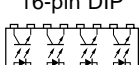

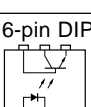
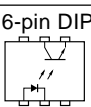
Optical Device

Photocoupler	360
• Tr. Output Type	360
• IC Output Type	369
• Safety Standards Approval List (Made in Japan, as of January 1999)	370
• Safety Standards Approval List (Made in Taiwan, as of January 1999)	372
OCMOS FET™ (Opto-Coupled MOS FET Relay)	373
• Safety Standards Approval List (as of January 1999)	377
Infrared Transceivers	378
Plastic Fiber Link	378
Visible Lasers	380
Fiberoptic Devices	380
• Lasers (Digital)	380
• Pump Laser	381
• Pulsed Lasers for OTDR	381
• Detectors	382

Photocoupler

Tr. Output Type








■ **Standard Type (Single Tr.) (1/2)**

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	IF (mA)	V _{CEO} (V)	I _C (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2501-1	High isolation voltage High V _{CEO} UL approved	5 k	80	80	50	80 to 600	3, 5 (R _L = 100 Ω)	4-pin DIP 
PS2501-2								8-pin DIP 
PS2501-4								16-pin DIP 
PS2511-1	High isolation voltage UL approved		50			100 to 300		4-pin DIP 
PS2511-2								8-pin DIP 
PS2511-4								16-pin DIP 
PS2561-1	High isolation voltage UL, VDE (Option), CSA, BSI, SEMKO, FIMKO, NEMKO, DEMKO approved		80					4-pin DIP 
PS2561-2								8-pin DIP 
PS2571-1	High isolation voltage UL, CSA, BSI, SEMKO, FIMKO, NEMKO, DEMKO approved		50			100 to 300		4-pin DIP 
PS2571-4								16-pin DIP 
PS2581L1 PS2581L2	High isolation voltage Outer creepage distance: 8 mm UL, VDE (Standard), CSA, BSI, SEMKO, FIMKO, NEMKO, DEMKO approved		80			80 to 400		4-pin DIP 
PS2601	High isolation voltage High V _{CEO} UL approved					80 to 600		6-pin DIP 
PS2602								6-pin DIP 

Photocoupler

Tr. Output Type














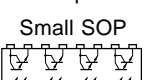
■ Standard Type (Single Tr.) (2/2)

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CEO} (V)	I _C (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2651	High isolation voltage UL, VDE (Option), CSA, BSI, SEMKO, FIMKO, NEMKO, DEMKO approved	5 k	80	80	50	50 to 400	3, 5 (R _L = 100 Ω)	6-pin DIP 
PS2652								6-pin DIP 
PS2701-1	UL, VDE (Option), BSI approved	3.75 k	50	40	80	50 to 300	3, 5 (R _L = 100 Ω)	4-pin SOP 
PS2701-2								8-pin SOP 
PS2701-4								16-pin SOP 
PS2801-1	Pin pitch: 1.27 mm UL, BSI approved	2.5 k	50	80	50	80 to 600	3, 5 (R _L = 100 Ω)	4-pin Small SOP 
PS2801-4	Pin pitch: 1.27 mm UL, VDE (Option), BSI approved							16-pin Small SOP 

Photocoupler

Tr. Output Type



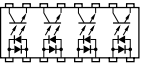






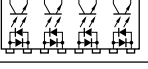

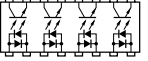
■ **Standard Type (Darlington Tr.)**

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CEO} (V)	I _C (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2502-1	High isolation voltage High CTR UL approved	5 k	80	40	200	200 or above	100, 100 (R _L = 100 Ω)	4-pin DIP 
PS2502-2					160			8-pin DIP 
PS2502-4					200			16-pin DIP 
PS2562-1	High isolation voltage UL, VDE (Option), CSA, BSI, SEMKO, FIMKO, NEMKO, DEMKO approved	5 k	80	40	200	200 or above	100, 100 (R _L = 100 Ω)	4-pin DIP 
PS2562-2					160			8-pin DIP 
PS2603	High isolation voltage High CTR UL approved	5 k	80	40	200	200 or above	100, 100 (R _L = 100 Ω)	6-pin DIP 
PS2604					160			6-pin DIP 
PS2653	High isolation voltage High CTR UL, VDE (Option), CSA, BSI, SEMKO, FIMKO, NEMKO, DEMKO approved	5 k	80	40	200	200 or above	100, 100 (R _L = 100 Ω)	6-pin DIP 
PS2654					160			6-pin DIP 
PS2702-1	High CTR UL, VDE (Option), BSI approved	3.75 k	50	40	200	200 or above	200, 200 (R _L = 100 Ω)	4-pin SOP 
PS2702-2					160			8-pin SOP 
PS2702-4					200			16-pin SOP 
PS2802-1	Pin pitch: 1.27 mm UL, BSI approved	2.5 k	50	40	90	200 or above	200, 200 (R _L = 100 Ω)	4-pin Small SOP 
PS2802-4	Pin pitch: 1.27 mm UL, VDE (Option), BSI approved				100			16-pin Small SOP 

Photocoupler

Tr. Output Type



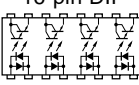






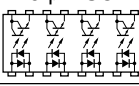

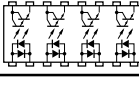
■ AC Input Type (Single Tr.)

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CEO} (V)	I _C (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2505-1	High isolation voltage AC input High V _{CEO}	5 k	±80	80	50	80 to 600	3, 5 (R _L = 100 Ω)	4-pin DIP 
PS2505-2	UL approved							8-pin DIP 
PS2505-4								16-pin DIP 
PS2565-1	High isolation voltage AC input					80 to 400		4-pin DIP 
PS2565-2	UL, VDE (Option), CSA, BSI, SEMKO, FIMKO, NEMKO, DEMKO approved							8-pin DIP 
PS2605	High isolation voltage AC input High V _{CEO}							6-pin DIP 
PS2606	UL approved					80 to 600		6-pin DIP 
PS2705-1	AC input UL, VDE (Option), BSI approved	3.75 k	±50	40	80	50 to 300	3, 5 (R _L = 100 Ω)	4-pin SOP 
PS2705-2								8-pin SOP 
PS2705-4								16-pin SOP 
PS2805-1	Pin pitch: 1.27 mm AC input UL, BSI approved	2.5 k	±50	80	50	80 to 600	3, 5 (R _L = 100 Ω)	4-pin Small SOP 
PS2805-4	Pin pitch: 1.27 mm AC input UL, VDE (Option), BSI approved							16-pin Small SOP 

Photocoupler

Tr. Output Type



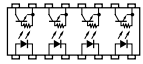






■ AC Input Type (Darlington Tr.)

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CEO} (V)	I _C (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2506-1	High isolation voltage AC input High CTR	5 k	±80	40	200	200 or above	100, 100 (R _L = 100 Ω)	4-pin DIP 
PS2506-2	UL approved				160			8-pin DIP 
PS2506-4								16-pin DIP 
PS2566-1	High isolation voltage AC input	3.75 k	±50	40	200	200 or above	200, 200 (R _L = 100 Ω)	4-pin DIP 
PS2566-2	UL, VDE (Option), CSA, BSI, SEMKO, FIMKO, NEMKO, DEMKO approved				160			8-pin DIP 
PS2607	High isolation voltage AC input High CTR				200			6-pin DIP 
PS2608	UL approved							6-pin DIP 
PS2706-1	High CTR AC input UL, VDE (Option),	2.5 k	±50	40	200	200 or above	200, 200 (R _L = 100 Ω)	4-pin SOP 
PS2706-2	BSI approved				160			8-pin SOP 
PS2706-4								16-pin SOP 
PS2806-1	Pin pitch: 1.27 mm AC input UL, BSI approved	100						4-pin Small SOP 
PS2806-4	Pin pitch: 1.27 mm AC input UL, VDE (Option), BSI approved							16-pin Small SOP 

Photocoupler

Tr. Output Type



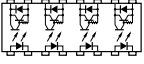


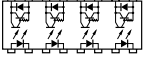




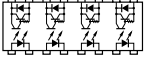


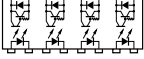
■ Low Input Current Type (Single Tr.)

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CEO} (V)	I _C (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2503-1	High isolation voltage High-speed UL approved	5 k	80	40	30	100 to 400	20, 30 (R _L = 10 kΩ)	4-pin DIP 
PS2503-2								8-pin DIP 
PS2503-4								16-pin DIP 
PS2703-1	High V _{CEO} (120 V) UL, VDE (Option), BSI approved	3.75 k	50	120	30	50 to 400	10, 10 (R _L = 1 kΩ)	4-pin SOP 
PS2703-2								8-pin SOP 
PS2703-4								16-pin SOP 
PS2707-1	AC input High V _{CEO} (120 V) UL, VDE (Option), BSI approved	3.75 k	±50	120	30	50 to 400	10, 10 (R _L = 1 kΩ)	4-pin SOP 
PS2707-2								8-pin SOP 
PS2707-4								16-pin SOP 

Photocoupler

Tr. Output Type


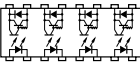
High Collector to Emitter Voltage Type (1/2)

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	IF (mA)	V _{CEO} (V)	I _c (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2532-1	High isolation voltage High V _{CEO} (300 V) Darlington Tr.	5 k	80	300	150	1500 to 6500	100, 100 (R _L = 100 Ω)	4-pin DIP 
PS2532-2	UL, VDE, (Option), BSI, SEMKO, FIMKO, NEMKO, DEMKO			8-pin DIP 				
PS2532-4	approved			16-pin DIP 				
PS2533-1	High isolation voltage High V _{CEO} (350 V) Darlington Tr.			350				4-pin DIP 
PS2533-2	UL, VDE (Option), BSI, SEMKO, FIMKO, NEMKO, DEMKO approved			8-pin DIP 				
PS2533-4				16-pin DIP 				
PS2633	High isolation voltage High V _{CEO} (300 V) High CTR			300		1000 to 15000		6-pin DIP 
PS2634	Darlington Tr. UL approved			6-pin DIP 				
PS2732-1	High isolation voltage Darlington Tr. High V _{CEO} (300 V)	2.5 k	50	300	150	1500 or above	100, 100 (R _L = 100 Ω)	4-pin SOP 
PS2732-2	UL, VDE (Option), BSI approved							8-pin SOP 
PS2732-4								16-pin SOP 
PS2733-1	High isolation voltage Darlington Tr. High V _{CEO} (350 V)			350				4-pin SOP 
PS2733-2	UL, VDE (Option), BSI approved			8-pin SOP 				
PS2733-4				16-pin SOP 				

Photocoupler

Tr. Output Type






■ High Collector to Emitter Voltage Type (2/2)

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CEO} (V)	I _C (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2832-1	Pin pitch: 1.27 mm Darlington Tr. High V _{CEO} (300 V) UL approved	2.5 k	50	300	120	400 or above	100, 100 (R _L = 100 Ω)	4-pin Small SOP 
PS2832-4	Pin pitch: 1.27 mm Darlington Tr. High V _{CEO} (300 V) UL, BSI approved							16-pin Small SOP 






Photocoupler

Tr. Output Type

■ **Large Input Current Type (DC Input, Single Tr.)**

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CEO} (V)	I _C (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2521-1	High isolation voltage Large input current UL approved	5 k	150	80	50	20 to 80	3, 5 (R _L = 100 Ω)	4-pin DIP 
PS2521-2								8-pin DIP 
PS2521-4								16-pin DIP 
PS2621	High isolation voltage Large input current UL approved	5 k	150	80	50	20 to 50	3, 5 (R _L = 100 Ω)	6-pin DIP 
PS2622								6-pin DIP 




■ **Large Input Current Type (AC Input, Single Tr.)**

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CEO} (V)	I _C (mA)	CTR (%)	t _r , t _f (μs) TYP.	
PS2525-1	High isolation voltage Large input current AC input UL approved	5 k	±150	80	50	20 to 80	3, 5 (R _L = 100 Ω)	4-pin DIP 
PS2525-2								8-pin DIP 
PS2525-4								16-pin DIP 
PS2625	High isolation voltage Large input current AC input UL approved	5 k	±150	80	50	20 to 50	3, 5 (R _L = 100 Ω)	6-pin DIP 
PS2626								6-pin DIP 





Photocoupler

IC Output Type

■ High-Speed Type 1Mbps (Analog Output)

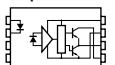
Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics			Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CC} (V)	I _O (mA)	CTR (%)	t _{PHL} (μs) MAX. (R _L = 1.9 kΩ)	t _{PLH} (μs) MAX. (R _L = 1.9 kΩ)	
PS8601	8-pin base connection UL, VDE (Option), BSI approved	5 k	25	35	8	15 or above	0.8 (R _L = 1.9 kΩ)	0.8 (R _L = 1.9 kΩ)	8-pin DIP 
PS8602	8 pins High CMR (2 kV/μs) UL, VDE (Option), BSI approved								8-pin DIP 
PS8701	5 pins High CMR (10 kV/μs) UL, VDE (Option) approved	2.5 k	25	35	8	15 to 35	0.8 (R _L = 2.2 kΩ)	1.2 (R _L = 2.2 kΩ)	5-pin SOP 

■ High-Speed Type 10Mbps (Digital Output)

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CC} (V)	I _O (mA)	I _{FLH} (mA) MAX.	t _{PLH} , t _{PHL} (ns) MAX.	
PS9601	Ultra high-speed type UL approved	5 k	30	7	50	5.0	75	8-pin DIP 
PS9701	Ultra high-speed type UL, VDE (option) approved	2.5 k	30	7	50	5.0	75	5-pin SOP 
PS9611★	Ultra high-speed type High CMR (10 kV/μs TYP.)	5 k	30	7	13	6.0	75	8-pin DIP 
PS9711★		2.5 k	30	7	13	6.0	75	5-pin SOP 

★ : Under development

■ High-Power Type (Inverter)

Part Number	Features	Absolute Maximum Ratings				Electrical Characteristics		Packages
		BV (Vr.m.s.)	I _F (mA)	V _{CC} (V)	I _{O1} /I _{O2} (A)	CM _H , CM _L (kV/μs)	t _{PLH} , t _{PHL} (μs) MAX.	
PS9634	Inverter circuit UL approved	5 k	30	18	0.5/ 0.8	1.0	5.0	8-pin DIP 

Photocoupler

■ Safety Standards Approval List (Made in Japan, as of January 1999) (1/2)

Part Number	Safety Standards								
	UL		VDE	CSA	BSI	SEMKO	FIMKO	NEMKO	DEMKO
	UL1577 E72422(S)		VDE0884	CL 9073 × 0030, CA 101391	EN 60065	EN 60065	EN 60065	EN 60065	EN 60065
	Single protection	Double protection			/IEC 65, EN 60950 /IEC 950	/IEC 60065, EN 60950 /IEC 60950	/IEC 65, EN 60950 /IEC 950	/IEC 65, EN 60950 /IEC 950	/IEC 60665, EN 60950 /IEC 950
PS2501-1, -2, -4	●	●							
PS2502-1, -2, -4	●	●							
PS2503-1, -2, -4	●								
PS2505-1, -2, -4	●	●							
PS2506-1, -2, -4	●	●							
PS2511-1, -2, -4	●								
PS2521-1, -2, -4	●								
PS2525-1, -2, -4	●								
PS2532-1, -2, -4	●		●		●	●	●	●	●
PS2533-1, -2, -4	●		●		●	●	●	●	●
PS2561-1, -2	●	●	●	●	●	●	●	●	●
PS2562-1, -2	●	●	●	●	●	●	●	●	●
PS2565-1, -2	●	●	●	●	●	●	●	●	●
PS2566-1, -2	●	●	●	●	●	●	●	●	●
PS2571-1, -4	●		△	●	●	●	●	●	●
PS2581L1, L2	●	●	●	●	●	●	●	●	●
PS2601	●								
PS2602	●								
PS2603	●								
PS2604	●								
PS2605	●								
PS2606	●								
PS2607	●								
PS2608	●								
PS2621	●								
PS2622	●								
PS2625	●								
PS2626	●								

Remark ●: Approved △: Awaiting approval

Photocoupler

■ Safety Standards Approval List (Made in Japan, as of January 1999) (2/2)

Part Number	Safety Standards								
	UL		VDE	CSA	BSI	SEMKO	FIMKO	NEMKO	DEMKO
	UL1577 E72422(S)		VDE0884	CL 9073 × 0030, CA 101391	EN 60065	EN 60065	EN 60065	EN 60065	EN 60065
	Single protection	Double protection			/IEC 65, EN 60950 /IEC 950	/IEC 60065, EN 60950 /IEC 60950	/IEC 65, EN 60950 /IEC 950	/IEC 65, EN 60950 /IEC 950	/IEC 60665, EN 60950 /IEC 950
PS2633	●								
PS2634	●								
PS2651	●		●	●	●	●	●	●	●
PS2652	●		●	●	●	●	●	●	●
PS2653	●		●	●	●	●	●	●	●
PS2654	●		●	●	●	●	●	●	●
PS2701-1, -2, -4	●		●		●				
PS2702-1, -2, -4	●		●		●				
PS2703-1, -2, -4	●		●		●				
PS2705-1, -2, -4	●		●		●				
PS2706-1, -2, -4	●		●		●				
PS2707-1, -2, -4	●		●		●				
PS2732-1, -2, -4	●		●		●				
PS2733-1, -2, -4	●		●		●				
PS2801-1	●				●				
PS2802-1	●				●				
PS2805-1	●				●				
PS2806-1	●				●				
PS2801-4	●		●		●				
PS2802-4	●		●		●				
PS2805-4	●		●		●				
PS2806-4	●		●		●				
PS2832-1	●								
PS2832-4	●				●				
PS8601	●		●		●				
PS8602	●		●		●				
PS8701	●		●						
PS9601	●								
PS9634	●								
PS9701	●		●						

Remark ●: Approved

Photocoupler

■ Safety Standards Approval List (Made in Taiwan, as of January 1999)

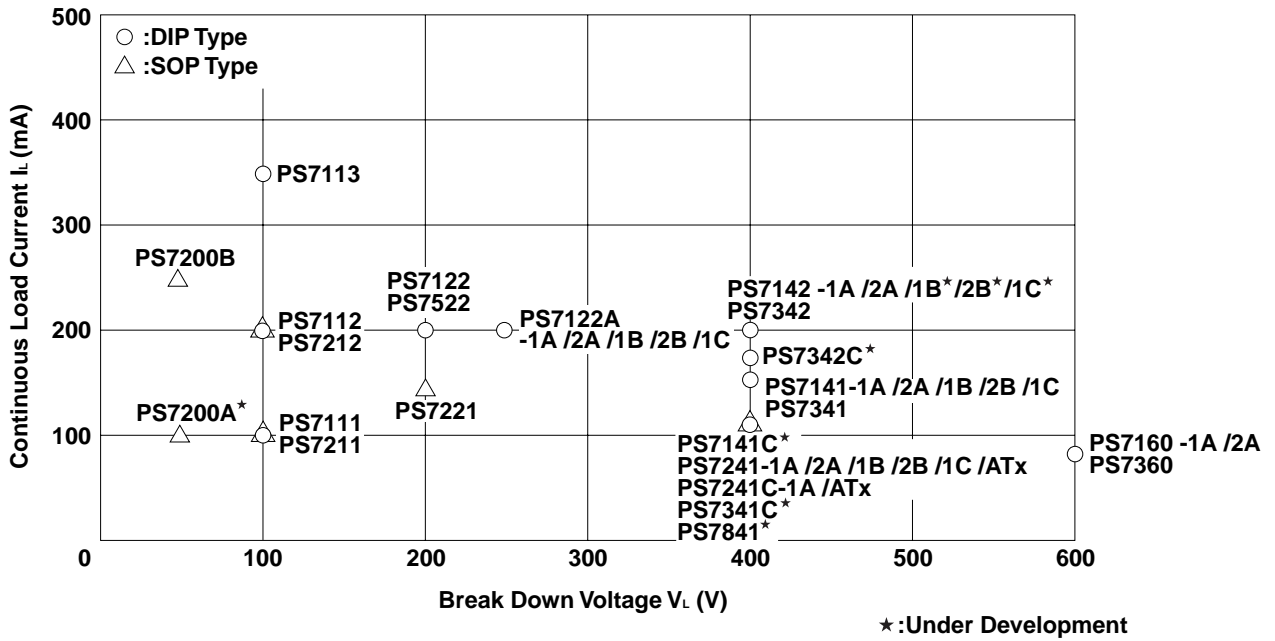
Part Number	Safety Standards								
	UL		VDE	CSA	BSI	SEMKO	FIMKO	NEMKO	DEMKO
	UL1577 E72422(S)		VDE0884	CL 9073 × 0030, CA 101391	EN 60065 /IEC 65, EN 60950 /IEC 950	EN 60065 /IEC 60065, EN 60950 /IEC 60950	EN 60065 /IEC 65, EN 60950 /IEC 950	EN 60065 /IEC 65, EN 60950 /IEC 950	EN 60065 /IEC 60665, EN 60950 /IEC 950
	Single protection	Double protection							
PS2501-1, -2, -4	●								
PS2502-1, -2, -4	●								
PS2503-1, -2, -4	●								
PS2505-1, -2, -4	●								
PS2506-1, -2, -4	●								
PS2521-1, -2, -4	●								
PS2525-1, -2, -4	●								
PS2532-1, -2, -4	●		●		●				
PS2533-1, -2, -4	●		●		●				
PS2561-1, -2	●	●	●			●	●	●	●
PS2562-1, -2	●	●	●			●	●	●	●
PS2565-1, -2	●	●	●			●	●	●	●
PS2566-1, -2	●	●	●			●	●	●	●

Remark ●: Approved

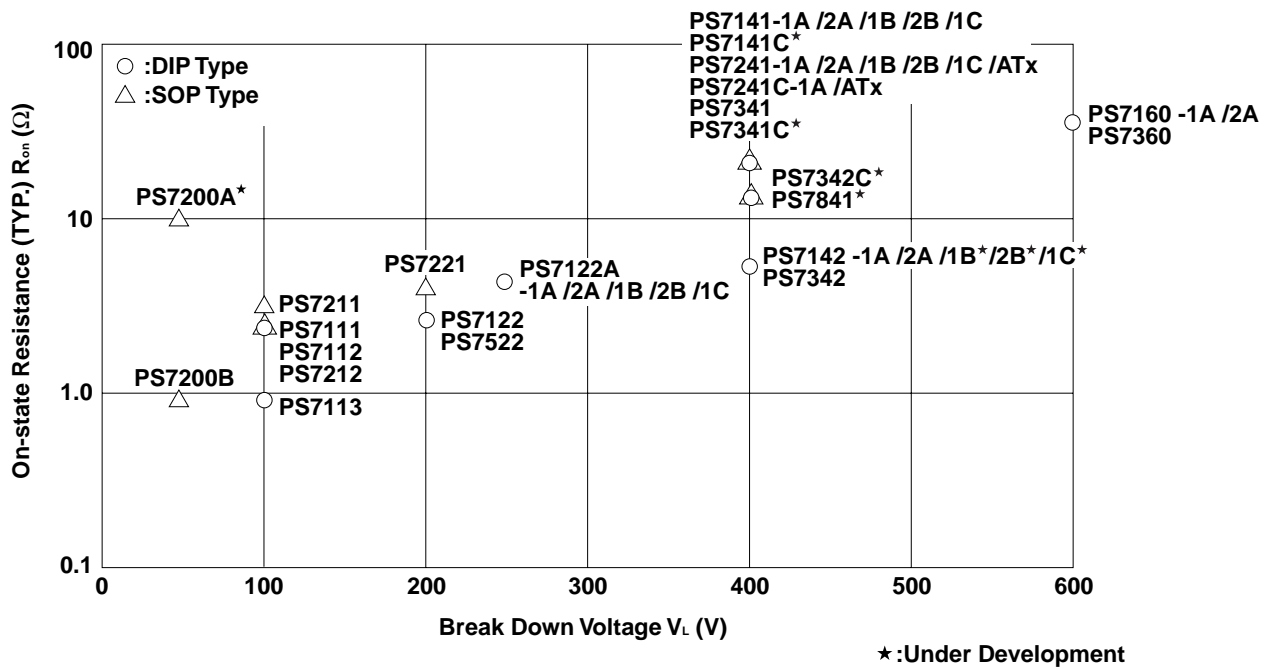
OCMOS FET™ (Opto-Coupled MOS FET Relay)

■ OCMOS FET Product Map

- Continuous Load Current vs. Break Down Voltage



- On-state Resistance vs. Break Down Voltage



OCMOS FET (Opto-Coupled MOS FET Relay)

■ **Standard Type**

Part Number	Features	Output Type	Absolute Maximum Ratings					Electrical Characteristics						Packages																					
			V _L (V)	I _L (mA)	BV (Vr.m.s.)	T _A (°C)	T _{stg} (°C)	Diode		MOSFET	Coupled																								
								V _F (V) MAX.	I _R (μA) MAX.	I _{off} (μA) MAX.	R _{on} (Ω) TYP.	t _{on} (ms) MAX.	t _{off} (ms) MAX.																						
PS7111-2A	Standard DIP, Normally open	2a	100	100	1.5 k	-40 to +80	-40 to +100	1.4	5	1	3.0	0.4	0.2	8-pin DIP																					
PS7112-1A		1a	100	200							3.0	0.4	0.2		6-pin DIP																				
PS7113-1A		1a	100	350							0.9	3.0	0.2			6-pin DIP																			
PS7113-2A		2a	100	350							0.9	3.0	0.2				8-pin DIP																		
PS7122-1A		1a	200	200							3.0	2.0	0.2					6-pin DIP																	
PS7122-2A		2a	200	200							3.0	2.0	0.2						8-pin DIP																
PS7122A-1A		1a	250	200							4.5	1.5	0.2							6-pin DIP															
PS7122A-2A		2a	250	200							4.5	1.5	0.2								8-pin DIP														
PS7141-1A		1a	400	150							20.0	1.0	0.2									6-pin DIP													
PS7141-2A		2a	400	150							20.0	1.0	0.2										8-pin DIP												
PS7142-1A		1a	400	200							6.0	5.0	0.2											6-pin DIP											
PS7142-2A		2a	400	200							7.5	2.0	0.2												8-pin DIP										
PS7160-1A		1a	600	90							42.0	1.5	0.2													6-pin DIP									
PS7160-2A		2a	600	90							42.0	1.5	0.2														8-pin DIP								
PS7211-2A		Standard SOP, Normally open	2a	100							100	1.5 k	-40 to +80															-40 to +100	1.4	5	1	3.4	1.0	0.2	8-pin SOP
PS7212-1A			1a	100							200																					3.0	1.0	0.2	
PS7221-2A	2a		200	150	4.0	1.5	0.2	8-pin SOP																											
PS7241-1A	1a		400	120	18.0	2.0	0.2		4-pin SOP																										
PS7241-2A	2a		400	120	21.0	1.0	0.2			8-pin SOP																									
PS7200A-1A★	Low CxR type	1a	40	100	1.5 k	-40 to +80	-40 to +100				1.4	5	0.1	9.3	0.5	0.2	4-pin SOP																		
PS7200B-1A		1a	40	250										0.8	1.0	0.2		4-pin SOP																	
PS7122A-1B	Standard, Normally close	1b	250	200	1.5 k	-40 to +80	-40 to +100	1.4			5	1	4.5	0.2	1.5	6-pin DIP																			
PS7122A-2B		2b	250	200					4.5				0.2	1.5	8-pin DIP																				
PS7141-1B		1b	400	150					24.0	0.2			1.0	6-pin DIP																					
PS7141-2B		2b	400	150					24.0	0.2			1.0				8-pin DIP																		
PS7142-1B★		1b	400	200					7.0	0.2			5.0					6-pin DIP																	
PS7142-2B★		2b	400	200					7.0	0.2			5.0						8-pin DIP																
PS7241-1B		1b	400	120					24.0	0.2			2.0							4-pin SOP															
PS7241-2B		2b	400	120					21.0	0.2			1.0								8-pin SOP														
PS7122A-1C		Standard, Transfer	1a+1b	250					200	1.5 k			-40 to +80									-40 to +100	1.4	5	1	4.5	1.5	0.2	8-pin DIP						
PS7141-1C	1a+1b		400	150	20.0	1.0	0.2	8-pin DIP																											
					(N.O.)	(N.O.)	(N.O.)																												
PS7142-1C★	1a+1b		400	200	8.0	2.0	0.2		8-pin DIP																										
		(N.O.)			(N.O.)	(N.O.)																													
PS7241-1C	1a+1b	400	120	21.0	1.0	0.2	8-pin SOP																												
				(N.O.)	(N.O.)	(N.O.)																													
PS7241-1C	1a+1b	400	120	21.0	1.0	0.2		8-pin SOP																											
				(N.O.)	(N.O.)	(N.O.)																													

★: Under development

OCMOS FET (Opto-Coupled MOS FET Relay)

■ High Isolation Voltage Type

Part Number	Features	Output Type	Absolute Maximum Ratings					Electrical Characteristics						Packages
			V _L (V)	I _L (mA)	BV (Vr.m.s.)	T _A (°C)	T _{stg} (°C)	Diode		MOSFET	Coupled			
								V _F (V)	I _R (μA)	I _{Loff} (μA)	R _{on} (Ω)	t _{on} (ms)	t _{off} (ms)	
								MAX.	MAX.	MAX.	TYP.	MAX.	MAX.	
PS7341-1A	High isolation voltage	1a	400	150	3.75 k	-40 to +85	-40 to +125	1.4	5	1	20.0	1.0	0.2	6-pin DIP
PS7342-1A			400	200							6.0	2.5	0.2	
PS7360-1A			600	90							41.0	2.0	0.2	

■ Slow Speed Type

Part Number	Features	Output Type	Absolute Maximum Ratings					Electrical Characteristics						Packages
			V _L (V)	I _L (mA)	BV (Vr.m.s.)	T _A (°C)	T _{stg} (°C)	Diode		MOSFET	Coupled			
								V _F (V)	I _R (μA)	I _{Loff} (μA)	R _{on} (Ω)	t _{on} (ms)	t _{off} (ms)	
								MAX.	MAX.	MAX.	TYP.	MAX.	MAX.	
PS7522-1A	Slow speed	1a	200	200	1.5 k	-40 to +80	-40 to +100	1.4	5	1	3.0	12.0	6.5	6-pin DIP
PS7522-2A		2a	200	200	1.5 k	-40 to +80	-40 to +100	1.4	5	1	3.0	12.0	6.5	8-pin DIP

■ Hybrid (Multi Function) Type

Part Number	Features	BV (Vr.m.s.)	OCMOS FET (1a type)			Photocoupler		Diode Bridge		Darlington Tr.			Packages
			V _L (V)	I _L (mA)	R _{on} (Ω) TYP.	V _{CEO} (V)	CTR (%)	V _R (V) MAX.	V _F (V) MAX.	V _{CEO} (V)	I _C (mA)	h _{FE}	
PS7241-AT1* ¹	DC Input	1.5 k	400	120	20.0	40	50 to 400	-	-	-	-	-	8-pin SOP
PS7241-AT5* ¹	AC Input												
PS7841-A15* ²	for DAA		400	120	16	40	50 to 400	100	1.2	40	120	10000 to 30000	16-pin SOP Lead pitch: 1.27 mm

★: Under development

*1: Solid state relays containing a GaAs LED on light emitting side (input side) and MOSFET's (+Photo transistor) on output side.

*2: The PS7841-A15 is a solid state relay for optical DAA (Data Access Arrangement) containing a diode bridge, MOS FET, photocoupler, Darlington transistor and LED.

OCMOS FET (Opto-Coupled MOS FET Relay)

■ **Current Limit Type**

• **Standard Type**

Part Number	Output Type	Absolute Maximum Ratings					Electrical Characteristics							Packages
		V _L (V)	I _L (mA)	BV (Vr.m.s.)	T _A (°C)	T _{stg} (°C)	Diode		MOSFET	Coupled				
							V _F (V)	I _R (μA)	I _{Loff} (μA)	R _{on} (Ω)	t _{on} (ms)	t _{off} (ms)	ILMT (mA)	
							MAX.	MAX.	MAX.	TYP.	MAX.	MAX.		
PS7141C-2A★	2a	400	120	1.5 k	-40 to +80	-40 to +100	1.4	5	1	26.0	1.0	1.0	170 to 250 mA/ch	8-pin DIP
PS7241C-1A	1a	400	120	1.5 k	-40 to +80	-40 to +100	1.4	5	1	28.0	2.0	0.2	125 to 180	4-pin SOP

★: Under development

• **High Isolation Voltage Type**

Part Number	Output Type	Absolute Maximum Ratings					Electrical Characteristics							Packages
		V _L (V)	I _L (mA)	BV (Vr.m.s.)	T _A (°C)	T _{stg} (°C)	Diode		MOSFET	Coupled				
							V _F (V)	I _R (μA)	I _{Loff} (μA)	R _{on} (Ω)	t _{on} (ms)	t _{off} (ms)	ILMT (mA)	
							MAX.	MAX.	MAX.	TYP.	MAX.	MAX.		
PS7341C-1A★	1a	400	120	3.75 k	-40 to +85	-40 to +125	1.4	5	1	27.0	1.0	1.0	125 to 250	6-pin DIP
PS7342C-1A★		400	170		12.0	5.0				1.0	175 to 370			

★: Under development

• **Hybrid (Multi Function) Type**

Part Number	Features	BV (Vr.m.s.)	OCMOS FET (1a type)				Photocoupler		Packages
			V _L (V)	I _L (mA)	R _{on} (Ω)	ILMT (mA)	V _{CEO} (V)	CTR (%)	
					TYP.				
PS7241C-AT1*	DC Input	1.5 k	400	120	28.0	125 to 180	40	50 to 400	8-pin SOP
PS7241C-AT5*	AC Input								

*: Solid state relays containing a GaAs LED on light emitting side (input side) and MOSFET's (+Photo transistor) on output side.

OCMOS FET (Opto-Coupled MOS FET Relay)

■ Safety Standards Approval List (as of January 1999)

Part Number	Safety Standards		
	UL	VDE	BSI
	UL1577	VDE0884	BS415 BS7002
PS7111-2A	●	△	●
PS7112-1A	●	△	●
PS7113-1A	●	△	●
PS7113-2A	●	△	●
PS7122-1A	●	△	●
PS7122-2A	●	△	●
PS7122A-1A	△	△	△
PS7122A-1B	△	△	△
PS7122A-1C	△	△	△
PS7122A-2A	△	△	△
PS7122A-2B	△	△	△
PS7141-1A	●	△	●
PS7141-1B	●	△	●
PS7141-1C	●	△	●
PS7141-2A	●	△	●
PS7141-2B	●	△	●
PS7141C-2A★	△	△	△
PS7142-1A	●	△	●
PS7142-2A	●	△	●
PS7142-1B★	△	△	△
PS7142-2B★	△	△	△
PS7142-1C★	△	△	△
PS7160-1A	●	△	●
PS7160-2A	●	△	●
PS7200A-1A★	△	△	●
PS7200B-1A	△	△	●
PS7211-2A	●	△	●
PS7212-1A	△	△	△
PS7221-2A	●	△	●
PS7241-1A	●	△	●
PS7241-1B	●	△	●
PS7241-1C	△	△	●
PS7241-2A	△	△	●
PS7241-2B	△	△	●
PS7241-AT1	●	△	●
PS7241-AT5	●	△	●
PS7241C-1A	●	△	△
PS7241C-AT1	△	△	△
PS7241C-AT5	△	△	△
PS7341-1A	●	△	●
PS7341C-1A★	●	△	△
PS7342-1A	●	△	●
PS7342C-1A★	●	△	△
PS7360-1A	●	△	●
PS7522-1A	●	△	●
PS7522-2A	●	△	●
PS7841-A15★	△	△	△

★: Under development

Remark ●: Approved △: Awaiting approval

Infrared Transceivers

■ **Infrared Transceivers**

Part Number	IrDA Ver.	Absolute Maximum Ratings (T _A = 25 °C)		Electro-Optical Characteristics (T _A = 25 °C)					Remarks
		T _A (°C)	T _{stg} (°C)	V _{CC} (V)	I _{LED} (mA) TYP.	I _{EH} (mW/Sr) TYP.	I _{CC} (A) TYP.	Data Rate (bps)	
NL1000★	1.0	0 to +70	-25 to +85	3.3	150	80	150 μ	2.4 k to 115.2 k	Standard: with Shield Case
NL1100	1.1	0 to +70	-25 to +85	5.0	300	160	4.0 m	A Port: 2.4 k to 115.2 k B Port: 0.576 M to 4.0 M	Option: Shield Case

★: Under development

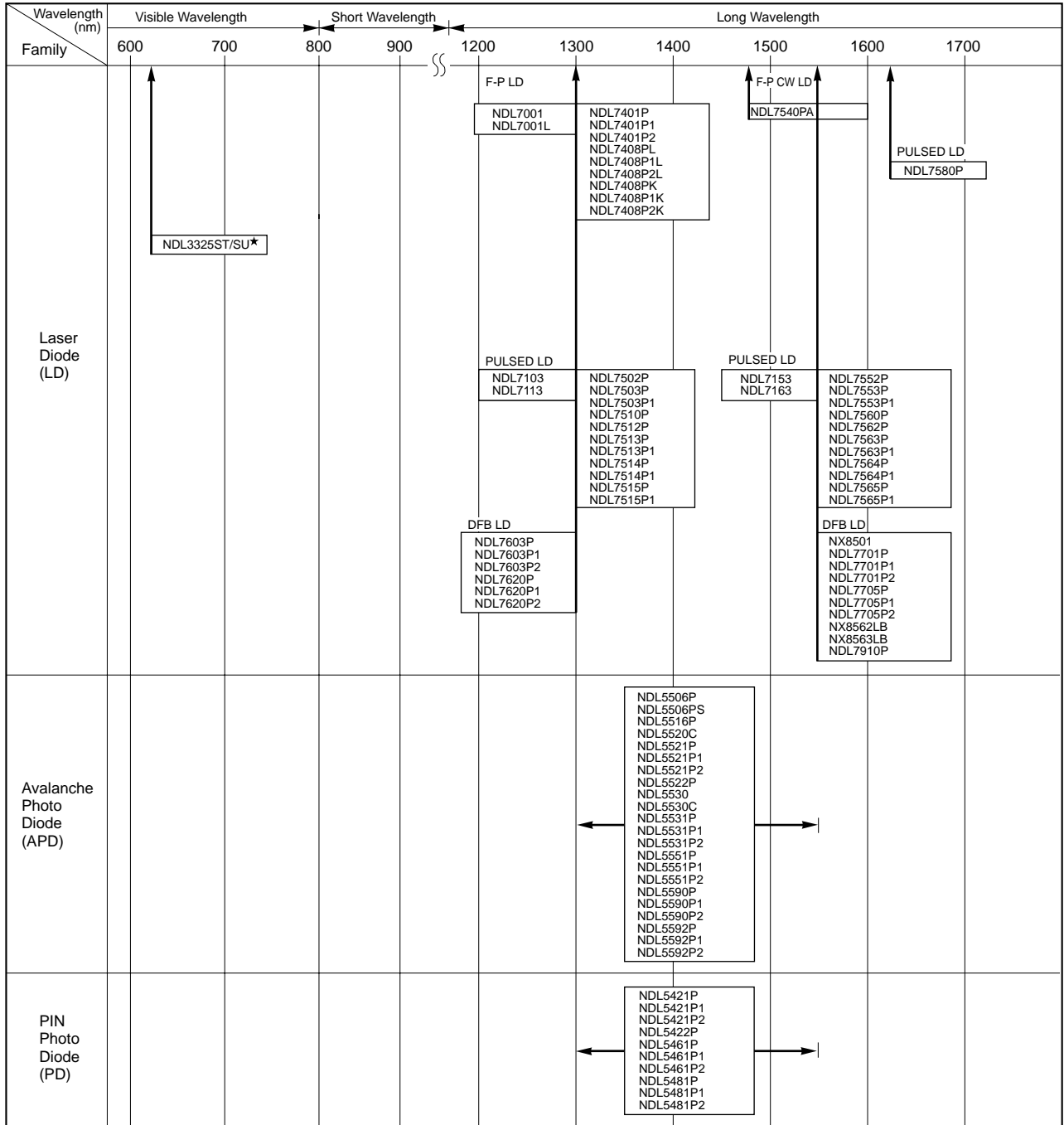
Plastic Fiber Link

■ **Plastic Fiber Link**

Part Number	Absolute Maximum Ratings (T _c = 25 °C)		Electro-Optical Characteristics (T _c = 25 °C)		
	V _{CC} (V)	T _c (°C)	Transmission Speed (Mbps)	Transmission Distance (m)	
				@ SI-POF	@ SI-HPCF
NL2100	-0.5 to +7.0	0 to +70	1 to 156	50	100
NL2110	-0.5 to +7.0	0 to +70	1 to 250	50	100

Visible Lasers/Fiberoptic Devices

Visible Lasers/Fiberoptic Devices Product Map



→ : Mark wavelength or operating range

★ : Under development

Modules are available with FC-PC or SC-PC connector.

Visible Lasers

Visible Lasers

Part Number	Peak Wavelength λ_p (nm)	Absolute Maximum Ratings ($T_c = 25^\circ\text{C}$)			Electro-Optical Characteristics ($T_c = 25^\circ\text{C}$)					Applications
		P_o (mW)	T_c ($^\circ\text{C}$)	T_{stg} ($^\circ\text{C}$)	I_{th} (mA)	I_{op} (mA)	P_o (mW)	θ_{\perp} (deg.)	θ_{\parallel} (deg.)	
NDL3325ST/SU★	650	8	-20 to +80	-40 to +85	30	40	5	30	8	for DVD

★: Under development

Fiberoptic Devices

Lasers (Digital)

Digital Optical Fiber Communications FP-LD

Part Number	Absolute Maximum Ratings			Electro-Optical Characteristics ($T_c = 25^\circ\text{C}$)						Package
	I_F (mA)	T_c ($^\circ\text{C}$)	T_{stg} ($^\circ\text{C}$)	I_{th} (mA)	I_{op} (mA)	P_o/P_r (mW)	λ_c (nm)	σ^* (nm)	t_r/t_f (ns)	
	TYP.	TYP.	MIN.	TYP.	TYP.	MAX.	TYP.	TYP.	MAX.	
NDL7001	–	-40 to +85	-55 to +125	10	$I_{th}+12$	5	1310	1.0	0.5/0.5	CAN
NDL7001L	–	-40 to +85	-55 to +125	10	$I_{th}+15$	5	1310	1.0	0.5/0.5	CAN with lens
NDL7401P Series	$I_{th}+50$	-40 to +85	-40 to +85	10	$I_{th}+15$	2.0	1310	1.3	0.5/0.5	Coaxial
NDL7408PL Series	$I_{th}+50$	-40 to +85	-40 to +85	10	$I_{th}+15$	0.2	1310	1.3	0.5/0.5	Coaxial
NDL7408PK Series	$I_{th}+50$	-40 to +85	-40 to +85	10	$I_{th}+20$	1.0	1310	1.3	0.5/0.5	Coaxial

*: RMS (-20 dB)

Digital Optical Fiber Communications DFB-LD

Part Number	Absolute Maximum Ratings			Electro-Optical Characteristics ($T_c = 25^\circ\text{C}$)				Package
	I_F (mA)	T_c ($^\circ\text{C}$)	T_{stg} ($^\circ\text{C}$)	I_{th} (mA)	P_o/P_r (mW)	λ_p (nm)	t_r/t_f (ns)	
	TYP.	MIN.	TYP.	MAX.	TYP.	MAX.		
NDL7603P Series	150	-40 to +85	-40 to +85	15	2	1310	0.5/0.5	Coaxial
NDL7620P Series	150	0 to +70	-40 to +85	45*1	2	1310	0.04/0.1*2	Coaxial
NX8501 Series	200	0 to +65	-40 to +85	20	2	1510	0.5/0.5	Coaxial
NDL7701P Series	150	-20 to +85	-40 to +85	15	2	1550	0.5/0.5	Coaxial
NDL7705P Series	$I_{th}+50$	-40 to +85	-40 to +85	15	2	1550	0.5/0.5	Coaxial
NX8562LB	300	-20 to +65	-40 to +85	20	20	1550*3	–	Butterfly
NX8563LB Series	300	-20 to +65	-40 to +85	20	10	ITU-T*4	–	Butterfly
NDL7910P (EA Modulator integrated type)	150	-20 to +70	-40 to +85	7	0.5	1550*3	0.125/0.125	Butterfly

*1: MAX.

*2: TYP.

*3: Wavelength selectable for ITU-T standards upon request.

*4: Wavelength selectable for ITU-T standards.

Fiber optic Devices

■ Pump Laser

• EDFA Pumping Applications FP-LD

Part Number	Absolute Maximum Ratings			Electro-Optical Characteristics (T _c = 25 °C)						Package
	I _F	T _c	T _{stg}	I _{th}	I _{op}	P _r	λ _c	σ*	t _r /t _f	
	(mA)	(°C)	(°C)	(mA)	(mA)	(mW)	(nm)	(nm)	(ns)	
NDL7540PA	600	-20 to +65	-40 to +85	40	500	110	1480	8	–	Butterfly

*: RMS (-20 dB)

■ Pulsed Lasers for OTDR

• OTDR Applications FP-LD

Part Number	Absolute Maximum Ratings			Electro-Optical Characteristics (T _c = 25 °C)						Package
	I _F *1	T _c	T _{stg}	I _{th}	I _{op} *1	P _o /P _r *1	λ _c *1	σ*2	t _r /t _f	
	(mA)	(°C)	(°C)	(mA)	(mA)	(mW)	(nm)	(nm)	(ns)	
NDL7103	1200	-40 to +70	-55 to +125	35	1000	320	1310	7	2/2	CAN
NDL7113	600	-40 to +70	-55 to +125	20	400	175	1310	10	1/1	CAN
NDL7153	1200	-40 to +70	-55 to +125	45	1000	240	1550	8	2/2	CAN
NDL7163	600	-40 to +70	-55 to +125	30	400	120	1550	10	1/1	CAN
NDL7502P	1200	-20 to +65	-40 to +70	35	1000	190	1310	10	2/2	DIP
NDL7503P Series	1200	-20 to +60	-40 to +85	35	1000	180	1310	10	2/2	Coaxial
NDL7510P	600	-20 to +65	-40 to +70	20	400	55	1310	10	1/1	DIP
NDL7512P	600	-20 to +65	-40 to +70	20	400	110	1310	10	1/1	DIP
NDL7513P Series	600	-20 to +60	-40 to +85	20	400	110	1310	10	1/1	Coaxial
NDL7514P Series	600	-20 to +60	-40 to +85	20	400	50	1310	10	1/1	Coaxial
NDL7515P Series	600	-20 to +60	-40 to +85	20	400	30	1310	10	1/1	Coaxial
NDL7552P	1200	-20 to +65	-40 to +70	40	1000	125	1550	10	2/2	DIP
NDL7553P Series	1200	-20 to +60	-40 to +85	45	1000	145	1550	10	2/2	Coaxial
NDL7560P	600	-20 to +65	-40 to +70	20	400	30	1550	10	1/1	DIP
NDL7562P	600	-20 to +65	-40 to +70	40	400	80	1550	10	1/1	DIP
NDL7563P Series	600	-20 to +60	-40 to +85	45	400	80	1550	10	1/1	Coaxial
NDL7564P Series	600	-20 to +60	-40 to +85	40	400	40	1550	10	1/1	Coaxial
NDL7565P Series	600	-20 to +60	-40 to +85	20	400	11	1550	10	1/1	Coaxial
NDL7580P	1200	-20 to +65	-40 to +70	30	1000	100*3	1625	15	2/2	DIP

*1: Pulse drive: Pulse width = 10 μs, duty = 1 % (Coaxial, DIP)

Pulse width = 1 μs, duty = 1 % (CAN)

*2: RMS (-20 dB)

*3: MIN.

Fiberoptic Devices

■ Detectors

• InGaAs PIN-PD

Part Number	Absolute Maximum Ratings			Electro-Optical Characteristics (T _c = 25 °C)								Package
	P _{in} (mW)	T _c (°C)	T _{stg} (°C)	Detecting area size (μm)	I _D (nA)		C _t (pF)		S (A/W)		f _c (GHz) MIN.	
					VR (V)	TYP.	VR (V)	TYP.	λ (nm)	TYP.		
NDL5421P Series	8	-40 to +85	-40 to +85	φ 50	5	0.1	5	0.7	1300	0.89	2.5	Coaxial
									1550	0.94		
NDL5422P	-	-40 to +70	-40 to +85	φ 50	5	0.1	-	-	1300	0.89	2.5	Butterfly with AMP
									1550	1.00		
NDL5461P Series	8	-40 to +85	-40 to +85	φ 80	5	0.1	5	1.0	1300	0.89	2.5	Coaxial
									1550	0.94		
NDL5481P Series	8	-40 to +85	-40 to +85	φ 80	10	0.1	10	0.7	1300	0.85	2.5	Coaxial

• InGaAs APD

Part Number	Absolute Maximum Ratings			Electro-Optical Characteristics (T _c = 25 °C)							Package
	I _R (mA)	T _c (°C)	T _{stg} (°C)	Detecting area size (μm)	V _{(BR)R} (V) TYP.	I _D (nA)* TYP.	S (A/W)		f _c (GHz) MIN.		
							λ (nm)	TYP.			
NDL5506P Series	0.5	-20 to +55	-40 to +85	φ 50	70	2	1300	0.89	1.0	DIP with internal cooler	
							1550	1.00			
NDL5516P	0.5	-20 to +55	-40 to +85	φ 80	75	2	1300	0.89	0.7	DIP with internal cooler	
							1550	1.00			
NDL5520C	0.5	-40 to +70	-55 to +100	φ 50	70	5	1300	0.89	2.5	Chip on carrier	
							1550	1.00			
NDL5521P Series	0.5	-40 to +85	-40 to +85	φ 50	55	5	1300	0.94	2.5	Coaxial	
							1550	0.96			
NDL5522P	0.5	-40 to +70	-40 to +85	φ 50	55	5	1310	0.89	2.5	Butterfly with AMP	
							1550	1.00			
NDL5530	0.5	-40 to +85	-55 to +100	φ 30	70	5	1300	0.94	2.5	CAN	
							1550	0.96			
NDL5530C	0.5	-40 to +85	-55 to +100	φ 30	70	5	1300	0.94	2.5	Chip on carrier	
							1550	0.96			
NDL5531P Series	0.5	-40 to +85	-40 to +85	φ 30	70	5	1300	0.94	2.5	Coaxial	
							1550	0.96			
NDL5551P Series	0.5	-40 to +85	-40 to +85	φ 50	70	5	1300	0.94	1.0	Coaxial	
							1550	0.96			
NDL5590P Series	0.5	-40 to +85	-40 to +85	φ 50	70	5	1310	0.94	1.0	Coaxial with AMP	
							1550	0.96			
NDL5592P Series	0.5	-40 to +85	-40 to +85	φ 30	70	5	1310	0.94	2.5	Coaxial with AMP	
							1550	0.96			

*: Conditions: V_{(BR)R} × 0.9

INDEX

Quick Reference Table by Part Number

Part number	Page	Part number	Page	Part number	Page	Part number	Page	Part number	Page
[Numerals]		2SA1625	276	2SB546A	280,290	2SC2762	343	2SC3732	277,287
03P2J	321	2SA1626	278	2SB564	278,286	2SC2780	284,286	2SC3733	278,287,289
03P2M	321	2SA1627	278	2SB601	280,291	2SC2784	277,286	2SC3734	283,287
03P4J	321	2SA1645	280,288	2SB605	278,286	2SC2785	277,286	2SC3735	283,287
03P4M	321	2SA1646	280	2SB624	283,286	2SC2786	277,286	2SC3736	284,287
03P4MF	321	2SA1647	279,288	2SB707	280,290	2SC2787	277,286	2SC3739	283,287
03P4MG	321	2SA1648	279,288	2SB708	280,290	2SC2802	290	2SC3809	336
03P5J	321	2SA1649	279,288	2SB733	278	2SC2885	279,289	2SC3810	336
03P5MG	321	2SA1650	281,288	2SB734	278	2SC2901	276,287	2SC3817	342
03P6MG	321	2SA1652	281,288	2SB736	283,286	2SC2908	282	2SC3840	279,289
2P4M	321	2SA1720	281,291	2SB736A	283,286	2SC2946	279,289	2SC3841	336
2P5M	321	2SA1741	281,288	2SB768	279,285,290	2SC2946(1)	285,289	2SC4000	278,290
2P6M	321	2SA1742	281,288	2SB772	279,288	2SC2954	336	2SC4001	279,290
2S2M	321	2SA1743	281,288	2SB794	279,291	2SC2958	278	2SC4062	281,288
2S4M	321	2SA1744	281,288	2SB795	279,291	2SC2959	278	2SC4063	281,288
2SA1008	280,289	2SA1836	285	2SB798	284,286	2SC3115	283,286	2SC4092	336
2SA1009	280,289	2SA1840	282,291	2SB799	284,286	2SC3157	280	2SC4093	336
2SA1009A	280,289	2SA1841	282,291	2SB800	284,286	2SC3158	280,289	2SC4094	336
2SA1010	280,289	2SA1843	282,288	2SB804	284	2SC3159	280,289	2SC4095	336
2SA1069	280,289	2SA1845	282,288	2SB805	284	2SC3209	278,286	2SC4173	285,287
2SA1069A	280	2SA1847	282,288	2SB806	284	2SC3218-M	343	2SC4175	285
2SA1129	280,290	2SA1871	284	2SB810	277,286	2SC3286-M	343	2SC4176	285,287
2SA1156	279,289	2SA1897	278,288	2SB811	286	2SC3355	336	2SC4177	285,286
2SA1173	284	2SA675	276	2SB897	282,291	2SC3356	336	2SC4178	285,286
2SA1174	286	2SA733	276,286	2SB962	279,288	2SC3357	336	2SC4179	285,286
2SA1175	277,286	2SA811A	283,286	2SB962-Z	285	2SC3360	283,286	2SC4180	285
2SA1206	276,287	2SA812	283,286	2SB963	279,291	2SC3478	276,286	2SC4181	285,286
2SA1221	278	2SA915	278	2SB963-Z	285	2SC3478A	276	2SC4182	336
2SA1222	278	2SA916	278	2SB984	278	2SC3518	279,288	2SC4183	336
2SA1226	283	2SA952	276,286	2SC1009A	283,286	2SC3518-Z	285	2SC4184	336
2SA1247	283,286	2SA953	276,286	2SC1505	280,290	2SC3545	336	2SC4185	336
2SA1261	280	2SA954	276,286	2SC1621	283	2SC3554	284,286	2SC4186	336
2SA1330	283,286	2SA988	276,286	2SC1622A	283,286	2SC3567	281,289	2SC4187	336
2SA1376	276,286	2SA990	276	2SC1623	283,286	2SC3568	281,289	2SC4225	336
2SA1376A	276	2SA992	276,286	2SC1653	283,286	2SC3569	281,289	2SC4226	336
2SA1385	279,288	2SB1068	276,286	2SC1654	283,286	2SC3570	281,289	2SC4227	336
2SA1385-Z	285	2SB1093	278,291	2SC1674	276,286	2SC3571	281,289	2SC4228	336
2SA1394	281,289	2SB1094	281,290	2SC1841	276,286	2SC3572	281,289	2SC4305	280
2SA1395	281,289	2SB1097	281,290	2SC1842	276	2SC3582	336	2SC4331	279,288
2SA1396	281,289	2SB1098	281,291	2SC1843	276	2SC3583	336	2SC4336	281,288
2SA1400	279,289	2SB1099	281,291	2SC1845	276,286	2SC3585	336	2SC4342	279,291
2SA1400-Z	285	2SB1100	281,291	2SC1927	336	2SC3587	336	2SC4346	279,289
2SA1412	279	2SB1114	284,286	2SC1940	278,286	2SC3588	279,289	2SC4350	280
2SA1412-Z	285	2SB1115	284,286	2SC1941	278,286	2SC3588-Z	285	2SC4351	281,291
2SA1413	279,289	2SB1115A	284,286	2SC2001	276,286	2SC3603	336	2SC4536	336
2SA1413-Z	285	2SB1116	276,286	2SC2002	276,286	2SC3604	336	2SC4549	281,288
2SA1441	281,288	2SB1116A	276,286	2SC2003	276,286	2SC3615	276,286	2SC4550	281,288
2SA1442	281,288	2SB1117	278,288	2SC2148	336	2SC3616	276,286	2SC4551	281,288
2SA1443	281,288	2SB1149	279,291	2SC2149	336	2SC3617	284,286	2SC4552	281,288
2SA1444	281,288	2SB1150	279,291	2SC2223	283,286	2SC3618	284,286	2SC4553	281,288
2SA1458	277,287	2SB1151	279,288	2SC2331	280,289	2SC3622	276,286	2SC4554	281,288
2SA1459	277,287	2SB1217	279,288	2SC2333	280,289	2SC3622A	276,286	2SC4568	336
2SA1460	278,287,289	2SB1261	279,288	2SC2334	280,289	2SC3623	277,286	2SC4569	336
2SA1461	283,287	2SB1261-Z	285	2SC2335	280	2SC3623A	277,286	2SC4570	336
2SA1462	283,287	2SB1300	276	2SC2351	336	2SC3624	283,286	2SC4571	336
2SA1463	284,287	2SB1318	278	2SC2517	280,289	2SC3624A	283,286	2SC4703	336
2SA1464	283,287	2SB1430	281,291	2SC2518	280,289	2SC3631	279,289	2SC4783	285
2SA1486	279,289	2SB1431	281,291	2SC2586	343	2SC3631-Z	285	2SC4810	282,291
2SA1544	276	2SB1432	281,291	2SC2688	279,290	2SC3632	279,289	2SC4811	282,291
2SA1546	279,290	2SB1453	281	2SC2690	279,290	2SC3632-Z	285	2SC4813	282,288
2SA1608	285,287	2SB1475	285	2SC2690A	279,290	2SC3663	336	2SC4814	282,288
2SA1610	285,287	2SB1571	284	2SC2721	278	2SC3691	281,288	2SC4815	282,288
2SA1611	285,286	2SB1572	284	2SC2749	282,289	2SC3692	281,288	2SC4885	336
2SA1612	285,286	2SB1578	284,288	2SC2750	282,289	2SC3693	281,288	2SC4942	284
2SA1615	279,288	2SB1581	288	2SC2751	282,289	2SC3694	281,288	2SC4954	336
2SA1615-Z	285	2SB1628	284	2SC2752	279,289	2SC3731	277,287	2SC4955	336

Part number	Page	Part number	Page	Part number	Page	Part number	Page	Part number	Page
2SC4956	336	2SD1308	280,291	2SD794	279,290	2SK1283	299	2SK1850	299
2SC4957	336	2SD1309	280,291	2SD794A	279,290	2SK1284	299	2SK1851	299
2SC4958	336	2SD1312	278	2SD882	279,288	2SK1285	299	2SK1852	299
2SC4959	336	2SD1392	280,291	2SD985	279,291	2SK1286	299	2SK1853	299
2SC5004	336	2SD1513	276,286	2SD986	279,291	2SK1287	299	2SK1953	303
2SC5005	336	2SD1579	278,291	2SD992	279	2SK1288	299	2SK1954	303
2SC5006	336	2SD1581	278,286,288	2SD999	284,286	2SK1289	299	2SK1958	292
2SC5007	336	2SD1582	278,288	2SJ165	294	2SK1290	299	2SK1959	292
2SC5008	336	2SD1583	279,288	2SJ166	294	2SK1292	299	2SK1960	292
2SC5009	336	2SD1583-Z	285	2SJ178	294	2SK1293	299	2SK1988	305
2SC5010	336	2SD1584	279,288	2SJ179	294	2SK1294	299	2SK1989	305
2SC5011	337	2SD1584-Z	285	2SJ180	294	2SK1295	299	2SK1990	305
2SC5012	337	2SD1585	281,290	2SJ184	294	2SK1398	292	2SK1991	305
2SC5013	337	2SD1588	281,290	2SJ185	294	2SK1399	292	2SK1992	305
2SC5014	337	2SD1589	281,291	2SJ196	294	2SK1482	292	2SK1993	305
2SC5015	337	2SD1590	281,291	2SJ197	294	2SK1483	292	2SK1994	305
2SC5177	337	2SD1591	281,291	2SJ198	294	2SK1484	292	2SK1995	305
2SC5178	337	2SD1592	281,291	2SJ199	294	2SK1485	292	2SK2040	303
2SC5179	337	2SD1593	281,288	2SJ202	294	2SK1491	305	2SK2053	293
2SC5180	337	2SD1594	281,288	2SJ203	294	2SK1492	305	2SK2054	293
2SC5181	337	2SD1614	284,286	2SJ204	294	2SK1493	305	2SK2055	293
2SC5182	337	2SD1615	284,286	2SJ205	294	2SK1494	305	2SK2070	293
2SC5183	337	2SD1615A	284,286	2SJ206	294	2SK1495	305	2SK2090	293
2SC5184	337	2SD1616	276,286	2SJ207	294	2SK1496	305	2SK2109	293
2SC5185	337	2SD1616A	276,286	2SJ208	294	2SK1497	305	2SK2110	293
2SC5186	337	2SD1630	279,291	2SJ209	294	2SK1498	305	2SK2111	293
2SC5191	337	2SD1691	279,288	2SJ210	294	2SK1499	305	2SK2112	293
2SC5192	337	2SD1692	279,291	2SJ211	294	2SK1500	305	2SK2131	299
2SC5193	337	2SD1693	279,291	2SJ212	294	2SK1501	305	2SK2132	303
2SC5194	337	2SD1694	279,288	2SJ213	294	2SK1502	305	2SK2133	303
2SC5195	337	2SD1695	279,291	2SJ243	294	2SK1580	292	2SK2134	303
2SC5288	341	2SD1697	278,286,291	2SJ302	298	2SK1581	292	2SK2135	303
2SC5289	341	2SD1698	276,286	2SJ303	298	2SK1582	292	2SK2136	303
2SC5336	337	2SD1699	284,286	2SJ324	298	2SK1583	292	2SK2137	303
2SC5337	337	2SD1700	278,286,291	2SJ325	298	2SK1584	292	2SK2138	303
2SC5338	337	2SD1701	276,286	2SJ326	298	2SK1585	292	2SK2139	303
2SC5369	337	2SD1702	284,286	2SJ327	298	2SK1586	292	2SK2140	303
2SC5408	337	2SD1779	278	2SJ328	298	2SK1587	292	2SK2141	303
2SC5409	337	2SD1780	278	2SJ329	298	2SK1588	292	2SK2157	293
2SC5431	337	2SD1818	279,288	2SJ330	298	2SK1589	292	2SK2158	293
2SC5432	337	2SD1843	278,291	2SJ331	298	2SK1590	292	2SK2159	293
2SC5433	337	2SD1899	279,288	2SJ353	294	2SK1591	292	2SK2234	305
2SC5434	337	2SD1899-Z	285	2SJ355	294	2SK1592	292	2SK2275	305
2SC5435	337	2SD1950	284,286	2SJ356	294	2SK1593	292	2SK2341	303
2SC5436	337	2SD2161	281,291	2SJ357	294	2SK1594	299	2SK2353	303
2SC5437	337	2SD2162	281,291	2SJ358	294	2SK1596	299	2SK2354	303
2SC5454	337	2SD2163	281,291	2SJ411	294	2SK1656	292	2SK2355	303
2SC5455	337	2SD2164	281,288	2SJ448	304	2SK1657	292	2SK2356	303
2SC5507	337	2SD2165	281,288	2SJ449	304	2SK1658	292	2SK2357	303
2SC5508	337	2SD2228	285	2SJ460	294	2SK1748	299	2SK2358	303
2SC5509	337	2SD2383	283	2SJ461	294	2SK1749	299	2SK2359	303
2SC945	276,286	2SD2402	284	2SJ462	294	2SK1750	305	2SK2360	303
2SD1000	284,286	2SD2403	284	2SJ463A	294	2SK1751	305	2SK2361	303
2SD1001	284,286	2SD2425	284,288	2SJ492	298	2SK1752	305	2SK2362	303
2SD1005	284	2SD2463	278,291	2SJ493	298	2SK1753	305	2SK2363	303
2SD1006	284	2SD401A	280,290	2SJ494	298	2SK1756	305	2SK2364	303
2SD1007	284	2SD414	290	2SJ495	298	2SK1757	305	2SK2365	303
2SD1020	277,286	2SD415	279,290	2SK1122	299	2SK1758	305	2SK2366	303
2SD1033	279,285,290	2SD471	278,286	2SK1123	299	2SK1760	305	2SK2367	303
2SD1164	279,291	2SD560	280,291	2SK1132	292	2SK1784	305	2SK2368	303
2SD1164-Z	285	2SD571	278,286	2SK1133	292	2SK1785	305	2SK2369	303
2SD1210	282,291	2SD596	283,286	2SK1271	305	2SK1793	305	2SK2370	303
2SD1286	279,291	2SD773	278	2SK1272	292	2SK1794	305	2SK2371	303
2SD1286-Z	285	2SD774	278	2SK1273	292	2SK1795	305	2SK2372	303
2SD1296	282,291	2SD780	283,286	2SK1274	292	2SK1796	305	2SK2409	298
2SD1297	291	2SD780A	283,286	2SK1282	299	2SK1824	292	2SK2410	298

Quick Reference Table by Part Number

Part number	Page	Part number	Page	Part number	Page	Part number	Page	Part number	Page
2SK2411	298	2SK3306	302	AC08ESM	321	MC-22103	153	μPA1520B	316
2SK2412	298	2SK679A	292	AC08FGM	321	MC-22104	153	μPA1522	316
2SK2413	298	2SK680A	292	AC08FSM	321	MC-22105	153	μPA1523B	316
2SK2414	298	2SK681A	292	AC0V8DGM	321	MC-22106	153	μPA1524	316
2SK2415	298	2V5P4M	321	AC10DGM	321	MC-22107	153	μPA1526	316
2SK2461	298	3P4J	321	AC10DSM	321	MC-4516CB64ES	144	μPA1527	316
2SK2462	298	3P4MH	321	AC10EGM	321	MC-4516CC725	142	μPA1550	316
2SK2476	303	3P5MH	321	AC10ESM	321	MC-4516CC726	142	μPA1552B	316
2SK2477	303	3P6MH	321	AC10FGM	321	MC-4516CD641ES	144	μPA1556A	316
2SK2478	303	3S4M	321	AC10FSM	321	MC-4516CD645	142	μPA1560	316
2SK2479	303	3SK131	335	AC12DGM	321	MC-4516CD646	142	μPA1572B	316
2SK2480	303	3SK134B	335	AC12DSM	321	MC-4516CD64ES	144	μPA1576	316
2SK2481	303	3SK135A	335	AC12EGM	321	MC-4516DA726	143	μPA1600	316
2SK2482	304	3SK176A	335	AC12ESM	321	MC-4516DA727	143	μPA1601	316
2SK2483	304	3SK177	335	AC12FGM	321	MC-4532CC726	142	μPA1602	316
2SK2484	304	3SK206	335	AC12FSM	321	MC-4532CD646	142	μPA1603	316
2SK2485	304	3SK222	335	AC16DGM	321	MC-4532DA726	143	μPA1604	316
2SK2486	304	3SK223	335	AC16DSM	321	MC-4532DA727	143	μPA1700	307
2SK2487	304	3SK224	335	AC16EGM	321	MC-454CA726	142	μPA1700A	307
2SK2488	304	3SK230	335	AC16FGM	321	MC-454CB641LS	144	μPA1701	307
2SK2498	297	3SK231	335	AC16FSM	321	MC-454CB645	142	μPA1701A	307
2SK2499	297	3SK252	335	AD1[]	276,311	MC-454CB646	142	μPA1702	307
2SK2510	297	3SK253	335	AD2[]	276,311	MC-454CB64LS	144	μPA1703	307
2SK2511	297	3SK254	335	AN1[]	276,309	MC-454DA726	143	μPA1704	307
2SK2512	297	3SK255	335	AP1[]	276,310	MC-4564DC726	143	μPA1705	307
2SK2513	297	3SK299	335	AQ1[]	276,310	MC-458CA725	142	μPA1706	307
2SK2514	297	5P4J	321	AR1[]	276,311	MC-458CA726	142	μPA1707	307
2SK2515	297	5P4M	321			MC-458CB641ES	144	μPA1710	307
2SK2541	293	5P4SM	321	[B]		MC-458CB645	142	μPA1710A	307
2SK2597	343	5P5M	321	BA1[]	277,309	MC-458CB646	142	μPA1711	307
2SK2723	297	5P6J	321	BB1[]	277,310	MC-458CB64LSA	144	μPA1712	307
2SK2724	297	5P6M	321	BN1[]	277,309	MC-458CD641LS	144	μPA1713	307
2SK2826	297	5P6SM	321	BP1[]	277,310	MC-458CD64LS	144	μPA1714	307
2SK2857	293	8P2M	321			MC-458DA726	143	μPA1715	307
2SK2858	293	8P2SM	321	[C]		MC-458DA727	143	μPA1716	307
2SK2941	297	8P4J	321	CE1[]	278,311	MC-45V16AD641	145	μPA1750	307
2SK2981	297	8P4M	321	CE2[]	278,311	MC-45V8AB641	145	μPA1751	307
2SK2982	297	8P4SM	321			MC-45V8AB641KS	145	μPA1752	307
2SK2983	297			[F]		MC-45V8AD641KS	145	μPA1753	307
2SK2984	297	[A]		FA1[]	283,312	MC-4R128BKD8J	145	μPA1754	307
2SK3053	297	AA1[]	276,309	FB1[]	283,312	MC-4R64BKD8J	145	μPA1755	307
2SK3055	297	AB1[]	276,310	FN1[]	283,312	MC-4RCNTYK	145	μPA1756	307
2SK3056	297	AC01DGM	321	FP1[]	283	MC-7712	330	μPA1757	307
2SK3057	297	AC01DJM	321			MC-7716	330	μPA1758	307
2SK3058	297	AC03DGM	321	[G]		MC-7722	330	μPA1759	307
2SK3059	297	AC03DJM	321	GA1[]	285,312	MC-7726	330	μPA1790	307
2SK3060	297	AC03DJM-Z	321	GN1[]	285,312	MC-7852	330	μPA1800	308
2SK3061	297	AC03DSM	321			MC-7856	330	μPA1801	308
2SK3062	297	AC03EGM	321	[H]		MC-7862	330	μPA1802	308
2SK3108	302	AC03FGM	321	HD1[]	284,313	MC-7866	330	μPA1803	308
2SK3109	302	AC03FJM	321	HD2[]	284,313	μPA101	330	μPA1810	308
2SK3110	302	AC03FJM-Z	321	HQ1[]	284,313	μPA102	330	μPA1811	308
2SK3111	302	AC03FSM	321	HR1[]	284,313	μPA103	330	μPA1812	308
2SK3112	302	AC05DGM	321			μPA104	330	μPA1813	308
2SK3113	302	AC05DJM	321	[M]		μPA1428A	315	μPA1814	308
2SK3114	302	AC05DJM-Z	321	MC-22000	153	μPA1434	315	μPA1815	308
2SK3115	302	AC05DSM	321	MC-22001	153	μPA1436A	315	μPA1850	308
2SK3116	302	AC05EGM	321	MC-22002	153	μPA1437	315	μPA1851	308
2SK3221	302	AC05ESM	321	MC-22003	153	μPA1453	315	μPA1852	308
2SK3294	302	AC05FGM	321	MC-22004	153	μPA1454	315	μPA1853	308
2SK3297	302	AC05FJM	321	MC-22005	153	μPA1456	315	μPA1854	308
2SK3298	302	AC05FJM-Z	321	MC-22006	153	μPA1458	315	μPA1855	308
2SK3299	302	AC05FSM	321	MC-22007	153	μPA1476	315	μPA2001	315
2SK3300	302	AC08DGM	321	MC-22100	153	μPA1478	315	μPA2002	315
2SK3304	302	AC08DSM	321	MC-22101	153	μPA1500B	316	μPA2003	315
2SK3305	302	AC08EGM	321	MC-22102	153	μPA1501	316	μPA2004	315

Part number	Page	Part number	Page	Part number	Page	Part number	Page	Part number	Page
μPA2981	315	μPB1509	325	μPC2713	328	μPC4074	270	μPC8112	326
μPA2982	315	μPB1510	325	μPC2714	328	μPC4081	270	μPC8116	327
μPA2987	315	μPC1060	273	μPC2715	328	μPC4082	270	μPC8119	324
μPA500	314	μPC1093	272	μPC272	271	μPC4084	270	μPC812	270
μPA501	314	μPC1094	273	μPC2721	326	μPC4091	270	μPC8120	324
μPA502	314	μPC1099	273	μPC2722	326	μPC4092	270	μPC8125	324
μPA503	314	μPC1100	273	μPC2723	324	μPC4093	270	μPC8126	324
μPA504	314	μPC1150	273	μPC2726	328	μPC4094	270	μPC8128	329
μPA505	314	μPC1228	257	μPC2731	326	μPC4250	270	μPC8129	324
μPA570	314	μPC1237	258	μPC2734	326	μPC451	270	μPC813	270
μPA571	314	μPC1251	270	μPC2743	326	μPC452	270	μPC8130	324
μPA572	314	μPC1316	257	μPC2744	326	μPC4556	270	μPC8131	324
μPA573	314	μPC1458	270	μPC2745	329	μPC4557	270	μPC8139	324
μPA574	314	μPC151	270	μPC2746	329	μPC4558	270	μPC814	270
μPA600	314	μPC1555	274	μPC2747	329	μPC4559	270	μPC815	270
μPA601	314	μPC1652	328	μPC2748	329	μPC4560	270	μPC8151	329
μPA602	314	μPC1658	328	μPC2749	329	μPC4570	270	μPC8152	329
μPA603	314	μPC1663	328	μPC2753	251,326	μPC4572	270	μPC8158	324
μPA604	314	μPC1675	328	μPC2756	251,326	μPC4574	270	μPC816	270
μPA605	314	μPC1676	328	μPC2757	326	μPC458	270	μPC8163	324
μPA606	314	μPC1678	328	μPC2758	326	μPC4741	270	μPC821	270
μPA607	314	μPC1679	328	μPC2762	329	μPC4742	270	μPC822	270
μPA608	314	μPC1686	326	μPC2763	329	μPC4744	270	μPC824	270
μPA609	314	μPC1687	326	μPC2766	324	μPC494	273	μPC831	270
μPA610	314	μPC1688	328	μPC2768	327	μPC5020	222	μPC832	270
μPA611	314	μPC16902	273	μPC277	271	μPC5021	222	μPC834	270
μPA670	314	μPC1694	326	μPC2771	329	μPC5022	222	μPC842	270
μPA671	314	μPC177	271	μPC2775	326	μPC5023	222	μPC844	270
μPA672	314	μPC1830	264	μPC2776	329	μPC5024	222	μPD16304	251
μPA673	314	μPC1851B	259	μPC2781	261,324	μPC5031	222	μPD16305	253
μPA674	314	μPC1853	260	μPC2782	261,326	μPC5032	222	μPD16306	251
μPA80	315	μPC1854A	259	μPC2791	329	μPC5034	222	μPD16306A	251,253
μPA800	338	μPC1857A	260	μPC2792	329	μPC5200	222	μPD16306B	253
μPA801	338	μPC1876	259	μPC2794	326	μPC5201	222	μPD16310	251,253
μPA802	338	μPC1883	262	μPC2795	261,326	μPC5202	222	μPD16311	251
μPA803	338	μPC1884	262	μPC2797	326	μPC5203	222	μPD16312	251
μPA804	338	μPC1891A	260	μPC2798	261,326	μPC5204	222	μPD16313	251
μPA805	338	μPC1892	260	μPC2799	324	μPC659A	267	μPD16314	251
μPA806	338	μPC1905	273	μPC2800A	266	μPC667	267	μPD16315	251
μPA807	338	μPC1909	273	μPC2900	271	μPC7073	249	μPD16326	251
μPA808	338	μPC1933	273	μPC29L00	271	μPC741	270	μPD16326A	251
μPA809	338	μPC1934	273	μPC29M00	271	μPC7800A	271	μPD16327	253
μPA81	315	μPC1935	273	μPC29S10	272	μPC78L00	271	μPD16331	253
μPA810	338	μPC1943	272	μPC29S78	272	μPC78M00A	271	μPD16334	253
μPA811	338	μPC1944	272	μPC305	272	μPC78N00	271	μPD16335	253
μPA812	338	μPC1945	272	μPC311	271	μPC7900A	271	μPD16337	253
μPA813	338	μPC2251	272	μPC317	272	μPC79L00	271	μPD16364	253
μPA814	338	μPC2253	272	μPC319	271	μPC79M00	271	μPD16430A	252
μPA821	338	μPC2255	272	μPC3200	326	μPC79N00	271	μPD16431A	252
μPA826	338	μPC2260	272	μPC3202	326	μPC8001	326	μPD16432B	252
μPA827	338	μPC2400A	271	μPC3205	261,324	μPC8002	326	μPD16434	252
μPA828	338	μPC24A00	271	μPC3206	261,324	μPC801	270	μPD16435	252
μPA831	338	μPC24M00A	271	μPC3207	326	μPC802	270	μPD16435A	252
μPA832	338	μPC251	270	μPC3210	328	μPC803	270	μPD16435B	252
μPA833	338	μPC2533	257	μPC3211	261,324	μPC804	270	μPD16448A	253
μPA834	338	μPC2572	258	μPC324	270	μPC8100	324,326	μPD16501	265
μPA835	338	μPC2575	250	μPC337	272	μPC8101	324	μPD16502	265
μPA836	338	μPC2576	250	μPC339	271	μPC8102	329	μPD16510	265
μPA840	338	μPC258	270	μPC3403	270	μPC8103	327	μPD16520	265
μPB1005	251,327	μPC259	270	μPC358	270	μPC8104	324	μPD16633B	253
μPB1502	325	μPC2708	328	μPC393	271	μPC8105	324	μPD16634A	253
μPB1504	325	μPC2709	328	μPC4061	270	μPC8106	324	μPD16638A	253
μPB1505	325	μPC271	271	μPC4062	270	μPC8108	327	μPD16640A	253
μPB1506	325	μPC2710	328	μPC4064	270	μPC8109	324	μPD16640B	253
μPB1507	325	μPC2711	328	μPC4071	270	μPC811	270	μPD16640C	253
μPB1508	325	μPC2712	328	μPC4072	270	μPC8110	324	μPD16644	253

Quick Reference Table by Part Number

Part number	Page	Part number	Page	Part number	Page	Part number	Page	Part number	Page
μPD16647	253	μPD17207	18	μPD30200	106	μPD4702	266	μPD6466	265
μPD16650	253	μPD17225	19	μPD30210	106	μPD4704	266	μPD65	21
μPD16652	253	μPD17226	19	μPD30500	106	μPD4711B	267	μPD65443	219
μPD16654	253	μPD17227	19	μPD30540	106	μPD4712C	267	μPD65444	219
μPD16655	253	μPD17228	19	μPD30541	106	μPD4712D	267	μPD65445	219
μPD16661A	253	μPD17235	19	μPD30700	106	μPD4713A	267	μPD65446	219
μPD16662	253	μPD17236	19	μPD30710	106	μPD4714A	267	μPD65448	219
μPD16663	253	μPD17704	15	μPD3719	243	μPD4715A	267	μPD65449	219
μPD16664	253	μPD17705	15	μPD3728	243	μPD4721	267	μPD65451	219
μPD16666A	253	μPD17707	15	μPD3729	243	μPD4722	267	μPD65454	219
μPD16667	253	μPD17708	15	μPD3734A	243	μPD4723	267	μPD65456	219
μPD16670	252	μPD17709	15	μPD3739	243	μPD4724	267	μPD65458	219
μPD16675A	252	μPD17717	16	μPD3753	243	μPD4726	267	μPD65611	178
μPD16676	252	μPD17718	16	μPD3794	243	μPD485505	153	μPD65621	178
μPD16680	252	μPD17719	16	μPD3797	243	μPD485506	153	μPD65625	178
μPD16681	252	μPD178002	23	μPD3799	243	μPD488385	141	μPD65630	177
μPD16682	252	μPD178003	23	μPD431000A	146	μPD488448	141	μPD65636	177
μPD16710	253	μPD178004A	23	μPD431000A-X	147	μPD488488	141	μPD65640	177
μPD16715	253	μPD178006A	23	μPD431231L	149	μPD4990A	266	μPD65643	178
μPD16715A	253	μPD178016A	23	μPD431532L	149	μPD4991A	266	μPD65646	177
μPD16732	253	μPD178018A	23	μPD431536L	149	μPD4992	266	μPD65650	177
μPD16732A	253	μPD178023	23	μPD431632L	149	μPD5205	274	μPD65653	178
μPD16732B	253	μPD178024	23	μPD431636L	149	μPD5555	274	μPD65654	177
μPD16740	253	μPD178046	25	μPD432232L	149	μPD5556	274	μPD65656	177
μPD16750	253	μPD178048	25	μPD43256B	146	μPD61012	256	μPD65658	177
μPD16780	253	μPD178076	24	μPD43256B-X	147	μPD61030	256	μPD65662	177
μPD16803	254	μPD178078	24	μPD43257B	146	μPD6121G-001	266	μPD65664	177
μPD16804	254	μPD178096	24	μPD432836AL	149	μPD6122G-001	266	μPD65672	177
μPD16805	254	μPD178098	24	μPD432836L	149	μPD6133	20	μPD65676	177
μPD16808	254	μPD178F048	25	μPD434001A	148	μPD6134	20	μPD65800	180
μPD16813	254	μPD178F098	24	μPD434001AL	148	μPD61511	261	μPD65801	180
μPD16814	254	μPD178P018A	23	μPD434004A	148	μPD61882A	262	μPD65802	180
μPD16818	254	μPD17933A	17	μPD434004AL	148	μPD61P34B	20	μPD65803	180
μPD16823	254	μPD17934A	17	μPD434008A	148	μPD62	21	μPD65804	180
μPD16833	254	μPD17P001	15	μPD434008AL	148	μPD6221	267	μPD65806	180
μPD16833A	254	μPD17P005	14	μPD434016A	148	μPD6222	267	μPD65808	180
μPD16835	254	μPD17P010	14	μPD434016AL	148	μPD6320	251,253,254	μPD65810	180
μPD16836	254	μPD17P012	14	μPD441000L-X	147	μPD63200	257	μPD65811	180
μPD16837	254	μPD17P073	17	μPD442000L-X	147	μPD6321	251,253,254	μPD65812	180
μPD16853B	254	μPD17P203A	18	μPD444010L-X	147	μPD63210	257	μPD65813	180
μPD16855A	248,255	μPD17P204	18	μPD444012L-X	147	μPD63210L	257	μPD65837	184
μPD16855B	248,255	μPD17P207	18	μPD45128163	139	μPD6323	251	μPD65839	184
μPD16855C	248,255	μPD17P228	19	μPD45128441	139	μPD6323B	251	μPD65840	184
μPD16855D	248,255	μPD17P236	19	μPD45128841	139	μPD6325	267	μPD65841	184
μPD16856	254	μPD17P709	15	μPD45256163	138	μPD6326	267	μPD65842	184
μPD16857	254	μPD17P719	16	μPD45256441	138	μPD63310	257	μPD65843	184
μPD16858B	254	μPD23C128000L	151	μPD45256841	138	μPD6335	267	μPD65845	184
μPD16858C	254	μPD23C128040L	151	μPD4564163	140	μPD6336	267	μPD65846	184
μPD16874	248,255	μPD23C16000AL	151	μPD4564323	140	μPD6340	251	μPD65848	184
μPD16875	248,255	μPD23C16040AL	151	μPD4564441	140	μPD6345	254	μPD65849	184
μPD16877	254	μPD23C24000	151	μPD4564841	140	μPD63702A	258	μPD65850	184
μPD16901	254	μPD23C24020	151	μPD4565161	141	μPD63710	258	μPD65851	184
μPD17001	15	μPD23C32000A	151	μPD4565421	141	μPD63724A	250	μPD65852	184
μPD17003A	14	μPD23C32000L	151	μPD4565821	141	μPD63725	250	μPD65853	184
μPD17005	14	μPD23C32020A	151	μPD45D128164	141	μPD6376	257	μPD65855	184
μPD17010	14	μPD23C32040L	151	μPD45D128442	141	μPD6379	257	μPD65858	184
μPD17012	14	μPD23C32082L	151	μPD45D128842	141	μPD6379A	257	μPD65860	185
μPD17015	17	μPD23C32202L	151	μPD464318AL	150	μPD6379AL	257	μPD65861	185
μPD17016	14	μPD23C64000AL	151	μPD464318L	150	μPD6379L	257	μPD65862	185
μPD17017	14	μPD23C64020	151	μPD464336AL	150	μPD63A	21	μPD65863	185
μPD17071	17	μPD23C64040AL	151	μPD464336L	150	μPD64	21	μPD65865	185
μPD17072	17	μPD26401	152	μPD464518AL	150	μPD64082	263	μPD65866	185
μPD17073	17	μPD26411	152	μPD464518L	150	μPD6461	265	μPD65868	185
μPD17201A	18	μPD29F008AL-X	152	μPD464536AL	150	μPD6462	265	μPD65869	185
μPD17203A	18	μPD29F800AL-X	152	μPD464536L	150	μPD6464A	265	μPD65870	185
μPD17204	18	μPD30121	106	μPD4701A	266	μPD6465	265	μPD65871	185

Part number	Page	Part number	Page	Part number	Page	Part number	Page	Part number	Page
μPD65872	185	μPD703101	99	μPD75P0116	4	μPD780206	66	μPD78098B	76
μPD65873	185	μPD703101-A	99	μPD75P3018A	8	μPD780208	66	μPD784031	82
μPD65875	185	μPD703102	99	μPD75P3036	12	μPD780232	67	μPD784031Y	83
μPD65878	185	μPD703102-A	99	μPD75P3116	9	μPD780306	70	μPD784035	82
μPD65880	183	μPD705101	98	μPD75P3216	10	μPD780306Y	70	μPD784035Y	83
μPD65881	183	μPD705102	98	μPD75P4308	6	μPD780308	70	μPD784036	82
μPD65882	183	μPD70741	98	μPD77016	240	μPD780308Y	70	μPD784036Y	83
μPD65883	183	μPD70F3003	103	μPD77018A	240	μPD78042F	64	μPD784037	82
μPD65884	183	μPD70F3003A	103	μPD77019	240	μPD78043F	64	μPD784037Y	83
μPD65885	183	μPD70F3008	102	μPD77019-013	240	μPD78044F	64	μPD784038	82
μPD65887	183	μPD70F3008Y	102	μPD77110	240	μPD78044H	65	μPD784038Y	83
μPD65889	183	μPD70F3017	100	μPD77111	240	μPD78045F	64	μPD784044	84
μPD65890	183	μPD70F3017Y	100	μPD77112	240	μPD78045H	65	μPD784046	84
μPD65893	183	μPD70F3025A	103	μPD780016AY	59	μPD78046H	65	μPD784054	84
μPD65943	189	μPD70F3033	101	μPD780018AY	59	μPD78052	53	μPD784214	85
μPD65944	189	μPD70F3033Y	101	μPD780021A	49	μPD78052Y	54	μPD784214Y	86
μPD65945	189	μPD70F3035	101	μPD780021AY	50	μPD78053	53	μPD784215	85
μPD65946	189	μPD70F3035Y	101	μPD780022A	49	μPD78053Y	54	μPD784215Y	86
μPD65948	189	μPD70F3102	99	μPD780022AY	50	μPD78054	53	μPD784216	85
μPD65949	189	μPD70F3102-A	99	μPD780023A	49	μPD78054Y	54	μPD784216Y	86
μPD65951	189	μPD70P3002	104	μPD780023AY	50	μPD78055	53	μPD784217	87
μPD65954	189	μPD72001-11	245	μPD780024A	49	μPD78055Y	54	μPD784217Y	88
μPD65956	189	μPD72001-A8	245	μPD780024AY	50	μPD78056	53	μPD784218	87
μPD65958	189	μPD72002-11	245	μPD780031A	49	μPD78056F	55	μPD784218Y	88
μPD6604	20	μPD72011	247	μPD780031AY	50	μPD78056FY	56	μPD784224	89
μPD66P04B	20	μPD72012	247	μPD780032A	49	μPD78056Y	54	μPD784224Y	90
μPD6700	251	μPD72042A	245	μPD780032AY	50	μPD78058	53	μPD784225	89
μPD6708	245	μPD72042B	245	μPD780033A	49	μPD78058F	55	μPD784225Y	90
μPD67821	196	μPD72103A	245	μPD780033AY	50	μPD78058FY	56	μPD784907	94
μPD67822	196	μPD72107	245	μPD780034A	49	μPD78058Y	54	μPD784908	94
μPD67823	196	μPD7225	252	μPD780034AY	50	μPD78062	68	μPD784915	91
μPD67824	196	μPD72254Y	255	μPD780053	57	μPD78062Y	69	μPD784915A	91
μPD67825	196	μPD72305	245	μPD780053Y	58	μPD78063	68	μPD784915B	91
μPD67826	196	μPD72850	248	μPD780054	57	μPD78063Y	69	μPD784916A	91
μPD67827	196	μPD72861	248	μPD780054Y	58	μPD78064	68	μPD784916B	91
μPD67828	196	μPD72870	248	μPD780055	57	μPD78064B	68	μPD784927	92
μPD67829	196	μPD72871	248	μPD780055Y	58	μPD78064Y	69	μPD784927Y	93
μPD67830	196	μPD750004	3	μPD780056	57	μPD780701Y	78	μPD784928	92
μPD67831	196	μPD750006	3	μPD780056Y	58	μPD780702Y	78	μPD784928Y	93
μPD680××	229	μPD750008	3	μPD780058	57	μPD78070A	62	μPD784935	95
μPD68000	228	μPD750064	5	μPD780058Y	58	μPD78070AY	62	μPD784936	95
μPD68001	228	μPD750066	5	μPD780065	52	μPD78074B	60	μPD784937	95
μPD68010	228	μPD750068	5	μPD780076	51	μPD78075B	60	μPD784938	95
μPD68011	228	μPD750104	4	μPD780076Y	51	μPD78076	60	μPD784953	96
μPD68031	228	μPD750106	4	μPD780078	51	μPD78076Y	61	μPD784955	96
μPD68041	228	μPD750108	4	μPD780078Y	51	μPD78078	60	μPD789011	28
μPD68061	228	μPD753012A	8	μPD78011F	46	μPD78078Y	61	μPD789012	28
μPD68070	228	μPD753016A	8	μPD78011FY	47	μPD78081	63	μPD789022	29
μPD681××	236	μPD753017A	8	μPD78011H	48	μPD78082	63	μPD789024	29
μPD6P4B	21	μPD753036	12	μPD78012F	46	μPD780831Y	79	μPD789025	29
μPD703002	104	μPD753104	9	μPD78012FY	47	μPD780833Y	79	μPD789026	29
μPD703003	103	μPD753106	9	μPD78012H	48	μPD780840	72	μPD789046	30
μPD703003A	103	μPD753108	9	μPD78013F	46	μPD780841	72	μPD789101A	31
μPD703004A	103	μPD753204	10	μPD78013FY	47	μPD780948	77	μPD789102A	31
μPD703006	102	μPD753206	10	μPD78013H	48	μPD780949	77	μPD789104A	31
μPD703008	102	μPD753208	10	μPD78014F	46	μPD780955	73	μPD789111A	31
μPD703008Y	102	μPD753304	11	μPD78014FY	47	μPD780957	74	μPD789112A	31
μPD703015	100	μPD754144	7	μPD78014H	48	μPD780958	74	μPD789114A	31
μPD703015Y	100	μPD754202	7	μPD78015F	46	μPD78095B	76	μPD789121A	32
μPD703017	100	μPD754244	7	μPD78015FY	47	μPD78096B	76	μPD789122A	32
μPD703017Y	100	μPD754264	7	μPD78016F	46	μPD780973	75	μPD789124A	32
μPD703025A	103	μPD754302	6	μPD78016FY	47	μPD780982	71	μPD789131A	32
μPD703033	101	μPD754304	6	μPD78018F	46	μPD780983	71	μPD789132A	32
μPD703033Y	101	μPD75F4264	7	μPD78018FY	47	μPD780984	71	μPD789134A	32
μPD703100	99	μPD75P0016	3	μPD780204	66	μPD780986	71	μPD789166	33
μPD703100-A	99	μPD75P0076	5	μPD780205	66	μPD780988	71	μPD789167	33

Quick Reference Table by Part Number

Part number	Page	Part number	Page	Part number	Page	Part number	Page	Part number	Page
μPD789176	33	μPD78P0308Y	70	NDL3325SU	380	NE329S01	339	NE68818	337
μPD789177	33	μPD78P048A	64	NDL5421P	382	NE33284A	339	NE68819	337
μPD789304	34	μPD78P054	53	NDL5422P	382	NE334S01	339	NE68830	337
μPD789306	34	μPD78P058	53	NDL5461P	382	NE34018	339	NE68833	337
μPD789314	34	μPD78P058F	55	NDL5481P	382	NE38018	339	NE68839	337
μPD789316	34	μPD78P058FY	56	NDL5506P	382	NE4210M01	340	NE68939	341
μPD789405A	35	μPD78P058Y	54	NDL5516P	382	NE42484A	340	NE69039	341
μPD789406A	35	μPD78P064	68	NDL5520C	382	NE42484C	340	NE696M01	337
μPD789407A	35	μPD78P064B	68	NDL5521P	382	NE425S01	340	NE71300	339
μPD789415A	35	μPD78P078	60	NDL5522P	382	NE428M01	340	NE71383B	339
μPD789416A	35	μPD78P078Y	61	NDL5530	382	NE429M01	340	NE72118	339
μPD789417A	35	μPD78P083	63	NDL5530C	382	NE434S01	340	NE721S01	339
μPD789426	36	μPD78P098B	76	NDL5531P	382	NE46134	336	NE72218	339
μPD789427	36	μPD78P4038	82	NDL5551P	382	NE46234	336	NE73430	336
μPD789436	36	μPD78P4038Y	83	NDL5590P	382	NE58030	336	NE73435	336
μPD789437	36	μPD78P4908	94	NDL5592P	382	NE58119	336	NE73440B	336
μPD789446	37	μPD78P4916	91	NDL7001	380	NE58130	336	NE76000	339
μPD789447	37	μPD78P9014	28	NDL7001L	380	NE58133	336	NE76038	339
μPD789456	37	μPD822XX	207	NDL7103	381	NE58219	336	NE76083A	339
μPD789457	37	μPD826XX	207	NDL7113	381	NE58230	336	NE76084	339
μPD789800	39	μPD93000	204	NDL7153	381	NE58233	336	NE76118	339
μPD789830	38	μPD94000	204	NDL7163	381	NE61030	336	NE76184A	339
μPD789841	40	μPD95100	204	NDL7401P	380	NE6500379A	343	NE8500199	341
μPD789842	40	μPD96100	204	NDL7408P	380	NE6500496	343	NE8500295	341
μPD78F0034A	49	μPD9611	249	NDL7502P	381	NE6501077	343	NE850R599A	341
μPD78F0034AY	50	μPD97000	205	NDL7503P	381	NE650R279A	343	NE85618	337
μPD78F0058	57	μPD98201	245	NDL7510P	381	NE650R479A	343	NE85619	336
μPD78F0058Y	58	μPD98203	245	NDL7512P	381	NE6510179A	343	NE85630	336
μPD78F0066	52	μPD98401A	246	NDL7513P	381	NE6510379A	343	NE85632	336
μPD78F0078	51	μPD98404	246	NDL7514P	381	NE651R479A	343	NE85633	336
μPD78F0078Y	51	μPD98405	246	NDL7515P	381	NE674	339	NE85634	336
μPD78F0233	67	μPD98408	246	NDL7540PA	381	NE68018	337	NE85635	336
μPD78F0701Y	78	μPD98409	246	NDL7552P	381	NE68019	336	NE85639E	336
μPD78F0833Y	79	μPD98410	246	NDL7553P	381	NE68030	336	NE85641	336
μPD78F0841	72	μPD98411	246	NDL7560P	381	NE68033	336	NE92039	335
μPD78F0948	77	μPD98421	247	NDL7562P	381	NE68035	336	NE92239	335
μPD78F0949	77	μPD98431	247	NDL7563P	381	NE68039E	336	NE92439	335
μPD78F0974	75	μPD99000	205	NDL7564P	381	NE68118	337	NE92739	335
μPD78F0988	71	μPD9903	249	NDL7565P	381	NE68119	336	NE92939	335
μPD78F4046	84	μPG100	328	NDL7580P	381	NE68130	336	NE93039	335
μPD78F4216	85	μPG101	328	NDL7603P	380	NE68132	336	NE93139	335
μPD78F4216Y	86	μPG103	328	NDL7620P	380	NE68133	336	NE93218	335
μPD78F4218	87	μPG110	328	NDL7701P	380	NE68135	336	NE93239	335
μPD78F4218Y	88	μPG132	327	NDL7705P	380	NE68139E	336	NE93318	335
μPD78F4225	89	μPG133	327	NDL7910P	380	NE68141	336	NE93339	335
μPD78F4225Y	90	μPG137	327	NE02133	336	NE68330	336	NE94433	336
μPD78F4928	92	μPG138	327	NE02135	336	NE68418	337	NE960R275	343
μPD78F4928Y	93	μPG139	327	NE02139E	336	NE68419	336	NE960R575	343
μPD78F4938	95	μPG152	327	NE050214-12	343	NE68430	336	NEL150181-12	342
μPD78F4956	96	μPG153	327	NE050214E-12	343	NE68433	336	NEL2001	342
μPD78F9026A	29	μPG154	327	NE1280100	342	NE68439E	336	NEL2004	342
μPD78F9046	30	μPG155	327	NE1280200	342	NE68518	337	NEL2012	342
μPD78F9116A	31	μPG170	329	NE1280400	342	NE68519	336	NEL2012F03-24	342
μPD78F9136A	32	μPG171	330	NE23383B	339	NE68530	336	NEL2035	342
μPD78F9177	33	μPG173	330	NE24200	339	NE68533	336	NEM0214068-28	343
μPD78F9418A	35	μPG174	330	NE24283B	339	NE68539E	336	NEM085068-28	343
μPD78F9437	36	μPG175	324,330	NE25118	335	NE68618	337	NEM0899F06-30	343
μPD78F9457	37	μPG501	325	NE25139	335	NE68619	337	NEM0995F01-30	343
μPD78F9801	39	μPG502	325	NE25339	335	NE68630	337	NEM0995F06-30	343
μPD78F9831	38	μPG503	325	NE27200	339	NE68633	337	NES1417B-30	343
μPD78F9842	40	μPG504	325	NE3210S01	339	NE68639	337	NES1821B-30	343
μPD78P0018AY	59	μPG506	325	NE32484A	339	NE68718	337	NES1821P-30	343
μPD78P018F	46	μPG508	325	NE32500	339	NE68719	337	NES1821P-50	343
μPD78P018FY	47			NE32584C	339	NE68730	337	NES1823P-100	343
μPD78P0208	66	[N]		NE325S01	339	NE68733	337	NES2527B-30	343
μPD78P0308	70	NDL3325ST	380	NE32900	339	NE68739	337	NEZ1011	343

Part number	Page	Part number	Page	Part number	Page	Part number	Page	Part number	Page
NEZ1414	342	PS2707	365	RD[]ES	318				
NEZ3642	341	PS2732	366	RD[]F	318				
NEZ4450	341	PS2733	366	RD[]FM	317				
NEZ5964	341	PS2801	361	RD[]JS	318				
NEZ6472	341,342	PS2802	362	RD[]JM	317				
NEZ7177	342	PS2805	363	RD[]MW	317				
NEZ7785	342	PS2806	364	RD[]P	317				
NL1000	378	PS2832	367	RD[]S	317				
NL1100	378	PS7111-2A	374	RD[]SL	317				
NL2100	378	PS7112-1A	374	RD[]UJ	317				
NL2110	378	PS7113-1A	374	RD[]JUM	317				
NNCD[]A	320	PS7113-2A	374						
NNCD[]B	320	PS7122-1A	374						
NNCD[]C	319	PS7122-2A	374						
NNCD[]D	319	PS7122A-1A	374						
NNCD[]E	319	PS7122A-1B	374						
NNCD[]F	319	PS7122A-1C	374						
NNCD[]G	319	PS7122A-2A	374						
NNCD[]LG	319	PS7122A-2B	374						
NNCD[]LH	319	PS7141-1A	374						
NNCD[]MF	319	PS7141-1B	374						
NNCD[]MG	319	PS7141-1C	374						
NX8501	380	PS7141-2A	374						
NX8562LB	380	PS7141-2B	374						
NX8563LB	380	PS7141C-2A	376						
		PS7142-1A	374						
		PS7142-1B	374						
[P]		PS7142-1C	374						
PS2501	360	PS7142-2A	374						
PS2502	362	PS7142-2B	374						
PS2503	365	PS7160-1A	374						
PS2505	363	PS7160-2A	374						
PS2506	364	PS7200A-1A	374						
PS2511	360	PS7200B-1A	374						
PS2521	368	PS7211-2A	374						
PS2525	368	PS7212-1A	374						
PS2532	366	PS7221-2A	374						
PS2533	366	PS7241-1A	374						
PS2561	360	PS7241-1B	374						
PS2562	362	PS7241-1C	374						
PS2565	363	PS7241-2A	374						
PS2566	364	PS7241-2B	374						
PS2571	360	PS7241-AT1	375						
PS2581	360	PS7241-AT5	375						
PS2601	360	PS7241C-1A	376						
PS2602	360	PS7241C-AT1	376						
PS2603	362	PS7241C-AT5	376						
PS2604	362	PS7341-1A	375						
PS2605	363	PS7341C-1A	376						
PS2606	363	PS7342-1A	375						
PS2607	364	PS7342C-1A	376						
PS2608	364	PS7360-1A	375						
PS2621	368	PS7522-1A	375						
PS2622	368	PS7522-2A	375						
PS2625	368	PS7841-A15	375						
PS2626	368	PS8601	369						
PS2633	366	PS8602	369						
PS2634	366	PS8701	369						
PS2651	361	PS9601	369						
PS2652	361	PS9611	369						
PS2653	362	PS9634	369						
PS2654	362	PS9701	369						
PS2701	361	PS9711	369						
PS2702	362								
PS2703	365								
PS2705	363	[R]							
PS2706	364	RD[]E	318						

NEC Semiconductor Data Book CD-ROM List (April 1999)

Following is the list of the Semiconductor Data Books NEC has published.

If you need a copy, please ask our sales representative.

Title / Items	Date Published
Memory (English / Japanese) Synchronous DRAM, Synchronous DRAM Module, Rambus DRAM, Rambus Module, ASM, Static RAM, Mask ROM, Flash Memory, Combo Chip	1999.4
Microcomputer (English / Japanese) 4-bit MCU (75XL, 17K, μ PD63), 8-bit MCU (178K, 78K/0S, 78K/0), 16-bit MCU (78K/IV), 32-bit MPU & MCU (V810, V830, V850), Development Tools	1999.4
Display Controller / Driver IC, General Purpose Digital IC (English)	1999.1
MOS FET (English) Power MOS FET, Signal MOS FET	1998.5
RF & Microwave Devices (English) Silicon Microwave Monolithic IC, High frequency Silicon Transister, GaAs Devices	1998.8
Optoelectronic Devices - NEPOC Series - (English) Photocoupler, OCMOS FET (Solid State Relay), Infrared Transceiver	1999.1

For further information, please contact:

NEC Corporation

NEC Building
7-1, Shiba 5-chome, Minato-ku
Tokyo 108-8001, Japan
Tel: 03-3454-1111
<http://www.ic.nec.co.jp/>

[North & South America]

NEC Electronics Inc.

2880 Scott Blvd.
Santa Clara, CA 95050-2554, U.S.A.
Tel: 408-588-6000
800-366-9782
Fax: 408-588-6130
800-729-9288
<http://www.necel.com/>

NEC do Brasil S.A.

Electron Devices Division
Rodovia Presidente Dutra, Km 214
07210-902-Guarulhos-SP Brasil
Tel: 55-11-6465-6810
Fax: 55-11-6465-6829

[Europe]

NEC Electronics (Germany) GmbH

Kanzlerstr. 2,
40472 Düsseldorf
Germany
Tel: 0211-650302
Fax: 0211-6503490

Munich Office

Arabellastr. 17
81925 München, Germany
Tel: 089-921003-0
Fax: 089-92100315

Stuttgart Office

Industriestr. 3
70507 Stuttgart, Germany
Tel: 0711-99010-0
Fax: 0711-99010-19

Hannover Office

Königstr. 12
30175 Hannover, Germany
Tel: 0511-33402-0
Fax: 0511-33402-34

Benelux Office

Boschdijk 187a
5612 HB Eindhoven,
The Netherlands
Tel: 040-2445845
Fax: 040-2444580

Scandinavia Office

P.O. Box 134
18322 Taebý, Sweden
Tel: 08-6380820
Fax: 08-6380388

NEC Electronics (UK) Limited

Cygnus House, Sunrise Park Way,
Milton Keynes, MK14 6NP, U.K.
Tel: 01908-691-133
Fax: 01908-670-290

NEC Electronics (France) S.A.

9, rue Paul Dautier-BP 187
78142 Velizy-Villacoublay Cédex
France
Tel: 01-30-67-58-00
Fax: 01-30675899

Madrid Office

Juan Esplandiú, 15
28007 Madrid, Spain
Tel: 91-504-2787
Fax: 91-504-2860

NEC Electronics Italiana s.r.l.

Via Fabio Filzi, 25/A,
20124 Milano, Italy
Tel: 02-667541
Fax: 02-66754299

[Asia & Oceania]

NEC Electronics Hong Kong Limited

12/F., Cityplaza 4,
12 Taikoo Wan Road, Hong Kong
Tel: 2886-9318
Fax: 2886-9022/9044

Seoul Branch

10F, ILSONG Bldg., 157-37,
Samsung-Dong, Kangnam-Ku
Seoul, the Republic of Korea
Tel: 02-528-0303
Fax: 02-528-4411

NEC Electronics Taiwan Ltd.

7F, No. 363 Fu Shing North Road
Taipei, Taiwan, R. O. C.
Tel: 02-2719-2377
Fax: 02-2719-5951

NEC Electronics Singapore Pte. Ltd.

101 Thomson Road #04-01/05
United Square, Singapore 307591
Tel: 65-253-8311
Fax: 65-250-3583