## Empowered by Innovation





### NEW GENERAL-PURPOSE MICROCONTROLLER



# Smooth Migration New General-Purpose Mi

When developing microcontroller application products, flexibility of product development would be far greater if microcontrollers with the ideal performance for each application could be selected and used as desired, free from considerations of bit count and price. NEC Electronics' new general-purpose microcontroller K1 Family grew from an entirely new concept to realize such ideals. The K1 Family, consisting of the 32-bit V850ES/Kx1 Series and the 8-bit 78K0/Kx1 Series, implements smooth, seamless migration by standardizing operability with simple development tools and integrated debuggers, as well as supporting a wide range of applications. It also enables 32-bit products to be purchased at a reasonable price. A new era of microcontroller selection will begin with the K1 Family of NEC Electronics.



### **Positioning of K1 Family**



Commercial names of K1 Family





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### Extensive memory and package selection

We provide a wide selection of ROM sizes (4 KB<sup>\*</sup> to 256 KB<sup>\*</sup>) and packages (20 pins<sup>\*</sup> to 144 pins). You can make your selection from a rich lineup of products that best suit your needs. \*Partially under development

### Common peripheral functions incorporated

Common peripheral functions ranging from a small number of pins to a large number of pins are incorporated, enabling smooth migration.

### **Cost performance**

Upward expansion of the 78K0/Kx1 Series is supported by the V850ES/Kx1 Series, which has an excellent cost-performance ratio. In the K1 Family (excluding the V850ES/Kx1), peripheral IC functions are incorporated to realize a reduction in total system costs.

### Low noise design

Realization of even lower noise than the conventional 78K0 and V850 products reduces the costs required for noise countermeasures when designing a system.

### Assured future expansion

The Kx1+ Series to be developed next will have a single-power-supply flash memory and implement even higher functionality by using the same concepts as those of the Kx1 Series, as well as providing pin compatibility.

Consept and a large-capacity memory is also underway.



### Common peripheral functions incorporated



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## The K1 Family reinforces measures for preventing malfunction.



### Double the EMS noise immunity of conventional products

EMS measurement results [power supply coupling measurement (reference values)]

			Relative ratio	
78K0/KF1(Flash)	Existing 78K0 product	Relative ratio of noise 0	1.0	2.0 or mor
VDD = 5 V	VDD = 5 V			0 0 0 0
Oscillator: 10 MHz	Oscillator: 10 MHz	78K0/KF1		
Internal frequency: 10 MHz (PCC = 00H)	Internal frequency: 10 MHz (PCC = 00H)	Existing 78K0 product (product without filter)		
V850ES/KJ1(Elash)	Existing V850 product	■Relative ratio of noise	Relative ratio	2 0 or mor
VDD = 5 V	VDD = 5 V	immunity		2.0 01 1101
Oscillator: 4 MHz	Oscillator: 16 MHz	V850ES/KJ1		
Internal frequency: 16 MHz	Internal frequency: 16 MHz	Existing V850 product	:	
(PLL = UN)			:	:

78K0/Kx1

78K0/Kx1+ V850ES/Kx1

### Enhancement of detection function when malfunction occurs



• 78K0/Kx1+, V850ES/Kx1+: Under development

### A previously unavailable function to enhance the prevention of malfunction is also included in the watchdog timer

### Problems of the conventional watchdog timer

### Comparison of functions with the conventional watchdog timer

Problems of the conventiona	IWDT
<ol> <li>The CPU clock and the WDT If the CPU clock stops, a pro</li> <li>If a program loop occurs, the be inadvertently manipulate The WDT may not work even</li> </ol>	clock are identical. ogram loop cannot be detected. e WDT clear flag may d. i ff a program loop does occur.
Features of the new WDT	The above problems are now solved
①The WDT source clock is fix	ed to Ring-OSC

(if Ring-OSC stop disabled is selected by an option setting). The CPU clock and the WDT source clock are totally independent. The Ring-OSC cannot be stopped as long as power is being supplied. ②Counting is cleared by writing 8-bit data to the WDTE register.

Reset by unauthorized access to a WDT related register.

A WDT clear operation and a count frequency change by a program loop are now impossible.

Item	Conventional Watchdog Timer	New Watchdog Timer*1
WDT clock source	Main system clock	Ring OSC*2
Clock source stop	Stoppable by software	Not stoppable
Operation after reset	Operation start with the longest interval	Operation start with the longest interval
Timer clear method	1-bit flag setting	8-bit data write(ACH)*3
Operation mode	Interval/operation mode can be set only once	Interval can be set only once
Stop mode	WDT stop	Operation
Reset factor	Timer overflow	Timer overflow Writing twice to WDTM Writing anything other than ACH to WDTE Execution of 1-bit operation instruction to WDTE

\* 1:If Ring-OSC stop disabled is set by a mask option
 \* 2:The Ring-OSC never stops as long as power is being supplied.
 \* 3:Patent pending

WDTM:Watchdog timer mode register WDTE:Watchdog timer enable register



### The operation mode of WDT is changed by an option setting.

### Watchdog timer operation mode

### Operation mode

Option setting	Ring-OSC stop disabled	Ring-OSC cannot be stopped by software
WDT clock source	Ring-OSC fixed <sup>*</sup>	Selectable by software (main, Ring, or stop). Operation with Ring when reset is released
Operation after reset	Operation start with the longest interval	Operation start with the longest interval
Operation mode	Interval can be set only once	Clock selection/interval can be set only once
Features	Current in STOP mode when WDT can never be stopped: About $10\mu A$	Current in STOP mode when WDT can be stopped during standby: Almost $0\mu A$

\*The Ring-OSC never stops as long as power is being supplied.

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## The K1 Family reduces system costs.

### 78K0/Kx1 78K0/Kx1+

## The security functions are enhanced and all the peripheral functions required for the system are integrated on one chip



### **Elimination of external reset IC**

A POC circuit that can set a 2-step detection voltage is included. LVI can also be used as a reset circuit. The RESET signal can be output to an externally connected IC using an output dedicated port that outputs at low level during reset.



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## The K1 Family implements a low-noise design.



### Adoption of pin layout so that noise countermeasures can easily be implemented even on external boards







• 78K0/Kx1+, V850ES/Kx1+: Under development



8-bit CISC

0.40

0

0 0.2 0.4 0.6 0.8 1.0

V850ES-20MHz

Company A 16bits 20 MHz

Company A 16bits 16 MHz

Company B 32bits 50 MHz

2

\*Measurement results by NEC Electronics using sample programs

Code size comparison

3

4 5 (Relative ratio)

1.2 1.4 1.6 (Relative ratio)

## The K1 Family also provides single-power-supply flash memory products.

Flash memory         2kB         2kB	K0/Kx1+ V850ES/Kx1+ Single-power-supply flash memory Self-rewritable/erasable in units of 2 K	ry function B In units of 2 KB	Rewritable/erasable/verifiable in units of 2 KB
	Write/erase/verify	Flash memory 2kB 2kB 2kB 2kB 2kB 2kB 2kB 2kB	Flash-Programmer(PG-FP4, etc.) Write/erase/verify Serial communication

• 78K0/Kx1+, V850ES/Kx1+: Under development

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78K0/Kx1

78K0\*1

78K0S\*2

0.20

\*1: 12 MHz (0.168µs) is supported by some products.

\*2: 10 MHz (0.2µs) is supported by some products.

0.24

## The K1 Family supports LIN bus.



The low-cost single-line network LIN bus is taking the place of CANbus. LIN bus communication, which is now expanding not only in the automotive electrical field, but also in the industrial and household appliance fields, is made possible in the K1 Family using hardware.









Timer configuration for inverter motor control



• 78K0/Kx1+, V850ES/Kx1+: Under development

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Furthermore, the inclusion of an on-chip debug function makes it possible to perform development work simultaneously providing there is one in-circuit emulator (ICE) supporting full emulation—the conventional one board per developer is no longer required. On-chip debug function



Software auto-generation tools are also supported, reducing the load of software development and implementing smooth migration to the K1 Family.

Device driver tool	
Software can be automatically generated just by setting the conditions for using the on-chip peripheral functions Selection of target device and peripheral functions	Setting of usage conditions

• 78K0/Kx1+, V850ES/Kx1+ : Under development • EM1 for 78K0/Kx1+ and EM1 for V850ES/Kx1+: Under development

Development

Features		<b>78K0/KB1</b> μPD780101/μPD780102 μPD780103/μPD78F0103		<b>78Κ0/KC1</b> μPD7801111/μPD780112 /μPD780113 μPD780114/μPD78F0114		<b>78K0/KD1</b> μPD780121/μPD780122 /μPD780123 μPD780124/μPD78F0124		μPD780131, μPD78F0134,		
Package			30-pir	SSOP	40-pir	n QFP	52-pi	n QFP		
Program memory	Mask ROM		8К	16/24K	8/16K	24/32K	8/16K	24/32K	8/16K	
(bytes)	Flash memory		_	24K	_	32K	-	32K	_	
RAM (bytes)	1		512	768	512	1K	512	1K	512	
Minimum instruction execution time				0.200µs@ 0.238µs@ 0.400µs@	04.0 to 5.5V 03.3 to 5.5V 02.7 to 5.5V			0.200µs@4.0 to 5.5V 0.238µs@4.0 to 5.5V 0.238µs@3.3 to 5.5V 0.400µs@2.7 to 5.5V	/(REGC pin=VDD) REGC pin=Capacity) /(REGC pin=VDD) /(REGC pin=VDD)	
	Main							2 to 10 MHz		
Frequency	Ring-OSC				_			240 kHz (typ)		
	Sub (32kHz)			-					32.768 kHz	
Supply voltage								2.7 to 5.5 V		
Regulator				-	-					
	Total		2	22	3	2	;	39		
	CMOS I/O		-	17	1	9	:	26		
I/O ports	CMOS input			4	8	3		8		
	CMOS output			1	-	1		1		
	N-ch O.D			_					4	
	16-bit TM (TM0p)	Number of channels	1							
		Function			Event counting/external event counter/PPG output/pulse width measurement/square war					
	8-bit TM (TMHn)	Number of channels		2						
Timers		Function	Event countir	g/PWM output	Event counting/PWM output/carrier generator outp					
	8-bit TM (TM5n)	Number of channels		1					2	
		Function				Even	t counting/external eve	ent counter/PWM outpu	t/square wave out pu	
	Watchdog timer				1			1		
	Clock timer			-					1	
	UART (supporting	LIN)		1				1		
	UART/CSI		_						1	
	UART							_		
Serial interface	UART/IIC			1				_		
	CSI		1				_			
	CSI with auto-transfer	function (32-byte buffer)					-			
	IIC				1			-		
A/D converter	10-bit A/D convert	er		4					8	
D/A converter	8-bit D/A converte	r						-		
	Address space						-			
	Address bus						-			
External bus	Mode						-			
	Wait function						-			
	Other						_			
Interrupt	External interrupt					5				
	ROM correction fu	Inction								
0.0	Multiplier/divider				-	-				
Other								yes		
						31 1/33 1/+0 15 1/	35 1/37 1/20 1/4 1		table by software	
						351+021	2 85 V+0 15 V No P		ask ontion	
Operating terms	100			To = -40 #	1.485°C Ta = -40 to +1	10°C (Linder developm	ent: Mask products on	$= -40 \text{ to } +125^{\circ}$	(Under development	
Operating temperatu	16		Ta = -40 to +85C Ta = -40 to +10C (Under development: Mask products only) Ta = -40 to +125C (Under development							

\* Only the following products contain IIC: V850E5/KF1 : µPD703208Y/µPD703209Y/µPD703210Y/µPD7053210Y V850E5/KG1 : µPD703212Y/µPD703213Y/µPD703214Y/µPD70F3214Y V850E5/KJ1 : µPD703216Y/µPD703217Y/µPD70F3217Y

Remark:Special grade products are also provided for both the 78K0/Kx1 and V850ES/Kx1.

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78K0/KE1		78K0	/KE1	1/850	ES/KE1	V850E	S/KG1	V850ES/K 11	
	00 / DD700104	/ 0K0		DD700000 / DD7	20000V/ DD700000		0040V/ DD700040		
μPD/80132/μPD/801	33/µPD/80134	μPD/80143/μPD/8	30144/µPD/80146	μPD/03208/μPD/	032081/µPD703209	μPD/03212/μPD/0	3212Y/µPD/03213	µPD/03216/µPD/03216Y/µPD/03217	
μι Β/οσ130/μι Β/οσ1	507µ1 D701 0150	μι Β/ 66146/	1 07010140	μPD70F3210	/uPD70F3210Y	uPD70F3214/	PD70F3214Y		
64 pip OEP		80 pir	OEP	90 pi		100 pip OEP		144 pip OEP	
		80-pil		80-pi		100-pi			
24/32/4	18/60K	24/32K	48/60K	64/96K	128K	64/96K	128K	96/128K	
32K	60K	-	60K	-	128K	-	128K	128K	
1K	2K	1K	2K	4K	6К	4K	6K	6K	
						50 ns@4.5 to 5.5 V	(REGC pin = VDD)		
						62.5 ns@4.0 to 5.5 \	(REGC pin = VDD)		
						62.5 ns@4.0 to 5.5 V	REGC pin = Capacity)		
						100 ns@2.7 to 5.5 \	(REGC pin = VDD)		
						2 to 10	) MHz		
							=		
						32.76	8 kHz		
						2.7 to	5.5 V		
Yes						Y	es		
51		6	7		67	8	4	128	
38		5	4		59	7	6	112	
8		5			8	s	3	16	
1			,	8					
								(14)	
				(8) (10)				(14)	
2		1	2		2		•	6	
output				Ev	ent counting/external ev	vent counter/PPG outp	ut/pulse width measur	ement/square wave output	
						:	2		
					Eve	ent counting/PWM outp	ut/carrier generator ou	tput	
						2	2		
				Event	t counting/external ever	nt counter/PWM output	/square wave output/c	ascade connection operation	
						-			
						-	_		
						-	-		
						2		2	
					-	_		*	
								-	
		_	1			2		3	
					1			2	
						1 **		1 **	
					٤	3		16	
					-		:	2	
		60	КВ	12	8 KB	41	ИВ	16 MB	
		16	pits	16	bits	22	bits	24 bits	
		Multi	plex	Mul	tiplex	Multiplex/sepa	rate selectable	Multiplex/separate selectable	
		External wait function/programm	nable wait function (one state)	External wait function/orogrammable wait function (max_seven states)					
		_	-	Chin select function/8-bit or 18-bit data bus switching function					
	8	1					3		
	Yes					v	25		
	16 x 16 32/16	I					_		
	10 × 10, 32/10								
						-	_		
						-	-		
						-	-		
Mask products only)				1		Ta = -40	to +85°C		

### Differences between 78K0/Kx1 and 78K0/Kx1+

78K0/Kx1	78K0/Kx1+
30/44/52/64/80 pins	Addition of 20-pin product
8 KB/512 B (min.)	4KB/256B (min.)
Dual power supply	Single power supply and self programming
×	Supported (excluding some products)
×	Will be included in some products
Two points of 2.85/3.5 V	Only one point of 2.85 V $(\mbox{LVI}$ is used in the range above 2.85 V)
	78K0/Kx1         30/44/52/64/80 pins         8 KB/512 B (min.)         Dual power supply         ×         ×         Two points of 2.85/3.5 V

### Differences between V850ES/Kx1 and V850ES/Kx1+

	V850ES/Kx1	V850ES/Kx1+
Number of pins	80/100/144 pins	Addition of 64-pin product
Memory expansion (ROM/RAM)	64 KB/4 KB(min.) 128 KB/6 KB(max.)	128KB/6KB (min.) (KE1+:ROM 64KB) 256KB/12-16KB (max.) (KE1+:ROM 128KB)
Flash memory	Dual power supply	Single power supply and self programming
On-chip debug	×	Supported (excluding some products)
DMA	×	KE1+/KF1+:None KG1+/KJ1+:4ch
Inverter control	×	Controllable by TMQ + TMQOP, TMP
16-bit timer	-	Addition of TMQ and TMP
Watchdog timer	Both channels can be stopped	One channel can be connected to the Ring clock by an option setting.
UART	No UART6(LINbus support) (upward compatibility with UART5)	UART6: One channel is incorporated in all products KG1+ is incremented by one channel (KF1+ and KJ1+ have the same number)
A/D	Conversion time:14µs	Conversion time :<5µs
POC	×	Yes
LVI	×	Yes
Clock monitor	×	Yes
Ring oscillation	×	Yes (connected to CPU only for clock monitor reset source

Note:Because the 78K0/Kx1+ and V850ES/Kx1+ are currently under development, some of their specifications may be changed.

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## Standardization of operability of the integrated debugger $\rightarrow$ Development can be carried out independent of the CPU



\* Product of Application Corporation

### Development work can be performed with the same operability.



### **Hardware tools**

### High-performance in-circuit emulator

Commercial Name	Device Name	Package	In-Circuit Emulator	Emulation Board	Power Supply Unit	PC Interface Board	Emulation Probe	Conversion Socket / Conversion Adapter	Flash Programmer	Program Adapter
78K0/KB1	μPD780101	30-pin SSOP (7.62mm (300))					NP-30MC*1	NSPACK30BK *6	PG-FP4	FA-30MC *1
	μPD780102							YSPACK30BK *6	FL-PR4 *1	
	μPD780103							YQ-Guide *6		
	μPD78F0103							YSSOCKET30BKF*6		
78K0/KC1	μPD780111	44-pin LQFP (10×10mm)					NP-44GB*1	EV-9200G-44		FA-44GB-8ES *1
	μPD780112						NP-44GB-TQ*1	TGB-044SAP *6		
	μPD780113						NP-H44GB-TQ*1			
	μPD780114									
	μPD78F0114									
78K0/KD1	μPD780121	52-pin LQFP (10×10mm)					NP-H52GB-TQ*1	TGB-052SBP*6		FA-52GB-8ET *1
	μPD780122									
	μPD780123									
	μPD780124		IE-78K0-NS	IE-780148-NS-EM1	IE-70000-MC-PS-B	IE-70000-98-IF-C				
	μPD78F0124		IE-78K0-NS-A			IE-70000-PC-IF-C				
78K0/KE1	μPD780131	64-pin LQFP (10×10mm)				IE-70000-CD-IF-A	NP-H64GB-TQ*1	TGB-064SDP *6		FA-64GB-8EU-A *1
	μPD780132	64-pin TQFP (12×12mm)				IE-70000-PCI-IF-A	NP-64GK *1	TGK-064SBW *6		FA-64GK-9ET *1
	μPD780133						NP-H64GK-TQ*1			
	μPD780134	64-pin LQFP (14×14mm)					NP-64GC *1	EV-9200GC-64		FA-64GB-8BS-A *1
	μPD78F0134						NP-64GC-TQ*1	TGC-064SAP *6		
	μPD780136						NP-H64GC-TQ*1			
	μPD780138									
	μPD78F0138									
78K0/KF1	μPD780143	80-pin QFP (14×14mm)					NP-80GC *1	EV-9200GC-80		FA-80GC-8BT *1
	μPD780144						NP-80GC-TQ *1	TGC-080SBP *6		
	μPD780146						NP-H80GC-TQ *1			
	μPD780148	80-pin TQFP (12×12mm)					NP-80GK *1	TGK-080SDW *6		FA-80GK-9EU *1
	μPD78F0148						NP-H80GK-TQ *1			
		1			1					
V850ES/KF1	μPD703208	80-pin QFP (14×14mm)						EV-703210GC	PG-FP4	FA-80GC-8BT *1
	μPD703208Y								FL-PR4 *1	
	μPD703209									
	μPD703209Y									
	μPD703210	80-pin TQFP (12×12mm)						EV-703210GK		FA-80GK-9EU *1
	μPD703210Y									
	μPD70F3210									
	μPD70F3210Y									
V850ES/KG1	μPD703212	100-pin LQFP (14×14mm)						EV-703214GC		FA-100GC-8EU-A*1
	μPD703212Y									
	μPD703213		IE-V850ES-G1	IE-703217-G1-EM1	Included in	IE-70000-CD-IF-A	Supplied with			
	μPD703213Y				12-100020-01	IE-70000-PCI-IF-A	12-700217*011 EWI			
	μPD703214									
	μPD703214Y									
	μPD70F3214									
	μPD70F3214Y									
V850ES/KJ1	μPD703216	144-pin LQFP (20×20mm)						EV-703217GJ		FA-144GJ-UEN *1
	μPD703216Y									
	μPD703217									
	μPD703217Y									
	μPD70F3217									
	μPD70F3217Y									

### Entry-type in-circuit emulator

Tanat Cardin	DestNewber	Product Configuration						
l arget Family	Part Number	Emulator	Power Supply Unit	PC Interface Board	Emulation Probe	Integrated Debugger	Device File	
78K0/Kx1	IE-78K0K1-ET*2	0	0	0	-	0	0	
V850ES/Kx1	IE-V850ESK1-ET*3	0	0	0	0	0	0	

### Evaluation kit

Target Family	Part Number	Product Configuration					
		CPU Board	Power Supply Unit	Compiler (Restricted Version)	Integrated Debugger		
78K0/Kx1	TK-78K0 (provisional name/in planning) *4	0	0	0	0		
V850ES/Kx1	TK-850 * <sup>5</sup>	0	0	0	0		

\*1 Product of Naito Densei Machida Mfg. Co., Ltd. \*2 The emulation probe and conversion socket/conversion adapter are common to those of the high-performance in-circuit emulator.

\*1 Product of Natio Defised Machina Mig. Co., Ed. \*2 The emination proce and conversion social equiples are common to indee of the high-performance in-circuit emulator. There is no need to purchase an emulation board separately. \*4 The product onfiguration is subject to change. \*5 Product of Application Corporation \*6 Product of Tokyo Eletech Corporation

## **Software tools**

Commercial Name	Device Name	Package	Software Package	Real-Time OS	C Compiler Package	C Library Source File	Assembler Package	Integrated Debugger	System Emulator	System Performance Analyzer	Network Library	Device File
78K0/KB1	μPD780101	30-pin SSOP (7.62mm(300))										DF780103
	μPD780102											
	μPD780103											
	µPD78F0103											
78K0/KC1	μPD780111	44-pin LQFP(10×10mm)										DF780114
	μPD780112											
	μPD780113											
	μPD780114											
	μPD78F0114											
78K0/KD1	μPD780121	52-pin LQFP(10×10mm)										DF780124
	μPD780122											
	μPD780123											
	μPD780124											
	μPD78F0124		SP78K0*7	RX78K0	CC78K0	CC78K0-L	RA78K0	ID78K0-NS	SM78K0	-	-	
78K0/KE1	μPD780131	64-pin LQFP(10×10mm)										DF780138
	μPD780132	64-pin TQFP(12×12mm)										
	μPD780133											
	μPD780134	64-pin LQFP(14×14mm)										
	μPD78F0134											
	μPD780136											
	μPD780138											
	μPD78F0138											
78K0/KF1	μPD780143	80-pin QFP(14×14mm)										DF780148
	μPD780144											
	μPD780146											
	μPD780148	80-pin TQFP(12×12mm)										
	μPD78F0148											
1050504/51	PP70000											DETROCIO
V850ES/KF1	μΡD703208	80-pin QFP(14×14mm)										DF703210
	μΡD/03208Υ											
	μΡD703209											
	μΡD703209Υ											
	μΡD/03210	80-pin TQFP(12×12mm)										
	μΡD703210Υ										RX-NFT	
	μΡΟ/0F3210										(TPC/IP basic set)	
VICEOFORMO	μPD70F3210Y										DV NET/DDD)	DEZOCOLA
V850E5/KG1	μPD703212	100-pin LQFP(14×14mm)									DV NET/DNO	DF703214
	μFD703212Y		SD050 *8	DVOED	04950	_	*0		CMOED	47950		
	μPD703213		37050	DV050 Dro	UCANOU	-	*9	0690	UCOIVIC	A200U	DY.NET (ONTD/DOD)	
	μPD703213Y			DIA NCOVUL							DV NET/CTD	
	μFD703214										DV NET/TELNET	
	μPD703214Y										DV NET/WEDGEDWED	
	μPD/0F3214										nA-WEI(WEDDERVER)	
V950ES/KH	μFD70F32141	144-pip   OEP(20 × 20mm)										DE702217
VODUES/NJ1	uPD702210	י+י+י-µוו בערר(2ט∧2טוחש)										0F/0321/
	μFD7032101											
	μFD703217											
	uPD70E2217											
	μPD/0F321/											
	μΕυ/0Ε321/Υ									1		

\*7 The CC78K0, RA78K0, ID78K0-NS, and SM78K0 are packaged in the SP78K0. \*8 The CA850, ID850, SM850, and AZ850 are packaged in the SP850. \*9 Contained in the C compiler package.

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