

# 78K0 CAN family

## Product Letter

# μPD78(F)0948/49

## 8-bit Microcontrollers

### Description

The μPD78(F)094x with an on-chip CAN interface is a member of a new branch of NEC's 78K0 8-bit microcomputer family. Based on 0.35 mm technology, the devices integrate powerful application-specific peripherals in combination with EEPROM and Flash memory technology. They offer outstanding perspectives and opportunities for system solutions at an excellent price/performance ratio. There are now over 120 different devices in NEC's established and powerful 78K0 8-bit microcomputer family. All new products will be offered as mask ROM and Flash EPROM.

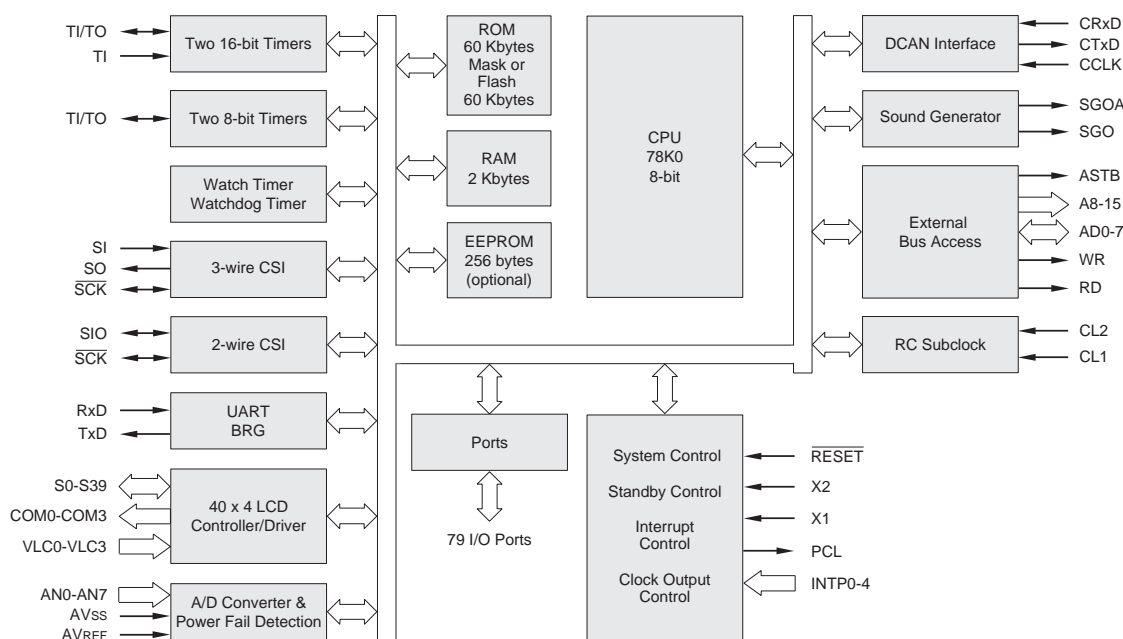
### Applications

The μPD78(F)094x is suited for dashboard, air conditioning and high-end body controller applications in the automotive sector. In addition, the device is ideal for applications where CAN functionality is combined with control-oriented peripherals. In particular, there is full support for systems connected to an LCD display. Since the LCD output is shared with a general-purpose pin, non-LCD applications are also covered.

### Features

- 60 Kbytes internal mask ROM or Flash EPROM
- 2 Kbytes internal RAM (high speed: 1024 bytes; LCD display: 40 bytes; expansion: 992 bytes)
- 256 bytes EEPROM optional
- Instructions execution time adjustable from 0.25 μs at 8 MHz down to RC subsystem clock
- Powerful instruction set
- Bit manipulation in entire address space
- Built-in multiply and divide instructions
- DCAN Interface (2 transmit buffers; up to 16 program receive buffers)
- 4 x 40 segments LCD controller/driver
- 8-channel 8-bit A/D converter, including power failure detector
- Serial interface (3-wire, 2-wire, UART)
- Timer channels (2 x 16-bit timer, 2 x 8-bit timer/ event counter, watch timer, watch dog timer)
- Sound generator
- External access
- Vectored interrupts (22 internal, 5 external)
- 79 I/O ports
- RC subsystem clock oscillator
- Built-in clock oscillator circuit
- Standby control (HALT, STOP mode)
- Operating supply voltage: 4.0 – 5.5 V
- 100-pin QFP package (14 mm x 20 mm)

## Block Diagram



## Functional Block Description

### CPU

The heart of the 78K0 family is a powerful 8-bit CPU. The 0.35 mm process technology ensures an excellent power/performance ratio. Four 8-bit register banks can be concatenated to a 16-bit register to support 16-bit operation, eg, 8-bit multiplication with a 16-bit result or 16-bit index addressing. The 64-Kbyte linear address space is accessed via 16-bit addresses. Bit manipulation operations are supported on all registers and the entire RAM address space. Subclock CPU operation to reduce system power consumption is also supported.

### DCAN Module

With its minimized circuit design, NEC's DCAN module is an ideal solution for providing full hardware support for most stand-alone CAN communication applications. Transmission is supported by two independent transmit buffers with easy priority control. With up to 16 mailboxes in the communication RAM, the receive path provides virtually "Full CAN" performance. The expansion RAM is used as CAN data RAM to the CPU. The number of mailboxes for transmission and CAN can be configured by setting the DCAN's SFR registers. Each message buffer allocates 16 bytes of expansion RAM, resulting in a RAM requirement of maximum 288 bytes for the DCAN module.

### A/D Converter

The converter has 8 channels with 8-bit resolution. One of the channels can be used as a failure detector that generates an internal interrupt on recognizing an analog input above/below a certain voltage. The 8-bit conversion time per channel is typically below 18  $\mu$ s at 8 MHz. The A/D resistor chain can be switched off to reduce power consumption.

### Serial Interface

The serial interface includes one UART (Universal Asynchronous Receiver Transmitter) that supports transfer rates up to 125 kbps. A dedicated baud rate generator sets the transfer rate. A 3-wire CSI (Clock Serial Interface) for transfer rates up to 1.25 Mbps is also provided. An I<sup>2</sup>C bus system can be configured using the 2-wire CSI.

### Timer

A flexible timer offers a total of 6 timer channels. Two-channel 16-bit timers can be used to generate a basic time interval, for PWM with compare registers and for precise measurements with up to three 16-bit capture registers. Two-channel 8-bit timers can be used as interval timers, for PWM output and as external event counters. The watch timer generates a watch time and can be used simultaneously as an interval timer. The on-chip watchdog timer monitors the CPU and generates either an internal reset or a non-maskable interrupt. It can also be used as an additional interval timer if the watchdog function is not required.

### RC Subclock

The subclock is driven by an external RC connected to the CL1/CL2 terminal pair. This is a very inexpensive method of generating a low frequency for much lower power consumption in subclock mode.

### LCD Driver

The LCD controller/driver can drive up to 160 LCD segments (40 segments, 4 commons). All LCD segments are shared with ports and can be selected bitwise to ensure maximum port pin availability if the application does not require all LCD segments.

### Sound Generator

The sound generator produces sounds composed of a frequency output and a PWM signal for volume control. The generated frequency is in the range of 256 Hz to 7.7 kHz. It can be used for simple alarm sounds, like buzzer, gong and beeper.

### External Access

External access can be used to expand memory capacity or to connect external circuits using a parallel interface.

### CAN Family Roadmap

At its European Technology Center (ETC), NEC has started work on a series of ASSPs (Application Specific Standard Products) targeted at the CAN market. The CAN product roadmap, based on the 78K0 8-bit CPU core, is shown in the table below. Located at NEC's European headquarters in Düsseldorf, the ETC enables NEC to respond faster and more flexibly to the demands of European customers. Further CAN products, based on different microcontroller cores like the 78K0 8-bit or V850 32-bit RISC family, are under development.

Part Number	Package	ROM	FLASH	RAM	EEPROM	Features	Miscellaneous
μPD780812	64 QFP	16 Kbytes	-	0.8 Kbytes	256 bytes	8.3 MHz/240 ns A/D converter + power-fail detector, UART, 6 timer channels, PWM, DCAN (2 transmit + 16 receive)	RC subclock, clock monitor, SIO
μPD780814	64 QFP	32 Kbytes	-	1.3 Kbytes	256 bytes		
μPD78F0818	64 QFP	-	60 Kbytes	2.0 Kbytes	256 bytes		
μPD780823	80 QFP	24 Kbytes	-	1.0 Kbytes	256 bytes		SIO, universal instrument
μPD780824	80 QFP	32 Kbytes	-	1.5 Kbytes	256 bytes		motor driver, sound generator, 4 x 28 LCD
μPD78F0828	80 QFP	-	60 Kbytes	2.0 Kbytes	256 bytes		
μPD780948(A)	100 QFP	60 Kbytes	-	2.0 Kbytes	-		RC subclock,
μPD78F0948	100 QFP	-	60 Kbytes	2.0 Kbytes	-		sound generator, 2 x SIO,
μPD780949(A)	100 QFP	60 Kbytes	-	2.0 Kbytes	256 bytes		4 x 40 LCD
μPD78F0949	100 QFP	-	60 Kbytes	2.0 Kbytes	256 bytes		external memory expansion

### Ordering Information

#### Devices

Part Number	ROM	RAM	Flash ROM	EEPROM
μPD78F0948GF-3BA	-	2 Kbytes	60 Kbytes	-
μPD78F0949GF-3BA	-	2 Kbytes	60 Kbytes	256 bytes
μPD780948(A)GF-3BA	60 Kbytes	2 Kbytes	-	-
μPD780949(A)GF-3BA	60 Kbytes	2 Kbytes	-	256 bytes

#### Documentation

Doc Number	Devices	Description	Type
U12326EJ3V0UM00	μPD78094x(A), μPD78F094x	78K0 Series Instruction	User's Manual
U12670EE1V0UM00	μPD78094x(A), μPD78F094x	Device User Manual	Preliminary User's Manual
U12237EE1V0PM00	μPD780949(A), μPD78F0949	Functional Description & Target Specification	Preliminary Product Information
U12375EE1V0PM00	μPD780948(A), μPD78F0948		

#### Tools

Order Number	Description	Type
78K0-Toolset*	Tool Kit	Software/Hardware
IE-780948-SL-EM1	I/O Emulation Board	Hardware
IE-780948-SL-EM4	Probe Board	Hardware
EP-100GF-SL	Emulation Probe	Hardware
Flashmaster	Flash Programmer	Hardware
FA-100GF	Programming Adapter	Hardware
DSWIN-I3HD-780xx	Software Simulator	Software

\* Tool Kit includes Assembler, C Compiler, Debugger, In-circuit Emulator and PC Interface Board.

For further information on NEC's 78K0 family or other NEC products visit our European website at [www.nec.de](http://www.nec.de)

### NEC Offices

**NEC Electronics (Europe) GmbH**, Oberrather Str. 4, D-40472 Düsseldorf,  
Tel. (02 11) 65 03 01, Fax (02 11) 65 03-3 27

**NEC Electronics (Germany) GmbH**, Kanzlerstr. 2, D-40472 Düsseldorf,  
Tel. (02 11) 65 03 02, Fax (02 11) 65 03-4 90  
- Königstr. 12, D-30175 Hannover, Tel. (05 11) 3 34 02-0, Fax (05 11) 3 34 02-34  
- Arabellastr. 17, D-81925 München, Tel. (0 89) 92 10 03-0, Fax (0 89) 91 31 82  
- Industriestr. 3, D-70565 Stuttgart, Tel. (07 11) 9 90 10-0, Fax (07 11) 9 90 10-19

**NEC Electronics (BNL)** - Boschdijk 187a, NL-5612 HB Eindhoven,  
Tel. (0 40) 2 44 58 45, Fax (0 40) 2 44 45 80

**NEC Electronics (Scandinavia)** - Täby Centrum, Entrance S (7th floor),  
S-18322 Täby, Tel. (08) 6 38 08 20, Fax (08) 6 38 03 88

**NEC Electronics (France) S.A.**, 9, rue Paul Dautier, B.P. 187,  
F-78142 Velizy-Villacoublay Cédex, Tél. (01) 30 67 58 00, Fax (01) 30 67 58 99

**NEC Electronics (France) S.A., Representacion en Espana,**  
Juan Esplandiu 15, E-28007 Madrid, Tel. (01) 5 04 27 87, Fax (01) 5 04 28 60

**NEC Electronics Italiana S.R.L.**, Via Fabio Filzi, 25A, I-20124 Milano,  
Tel. (02) 66 75 41, Fax (02) 66 75 42 99  
- Rome Office, Via Monte Cervialto, 131, I-00139 Roma,  
Tel. (06) 8 86 22 91/2, Fax (06) 8 86 22 39

**NEC Electronics (UK) Ltd.**, Cygnus House, Sunrise Parkway, Milton Keynes,  
GB-MK14 6NP, Tel. (0 19 08) 69 11 33, Fax (0 19 08) 67 02 90  
- Scotland Office, Block 3, Carfin Industrial Estate, Motherwell GB-ML1 4UL,  
Tel. (0 16 98) 73 22 21, Fax (0 16 98) 83 38 68

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