# 78K0 VAN family

**Product Letter**

# µPD16(F)15X/16X

**8-bit Microcontrollers**

## Description

The µPD16(F)15X/16X with an on-chip VAN (Vehicule Area Network) interface is a member of a new branch of NEC's 78K0 8-bit microcomputer family. Based on 0.35 µm technology, the devices integrate powerful application-specific peripherals in combination with Flash memory technology. They offer outstanding potential for automotive system solutions with an excellent price/performance ratio. They are now over 200 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.

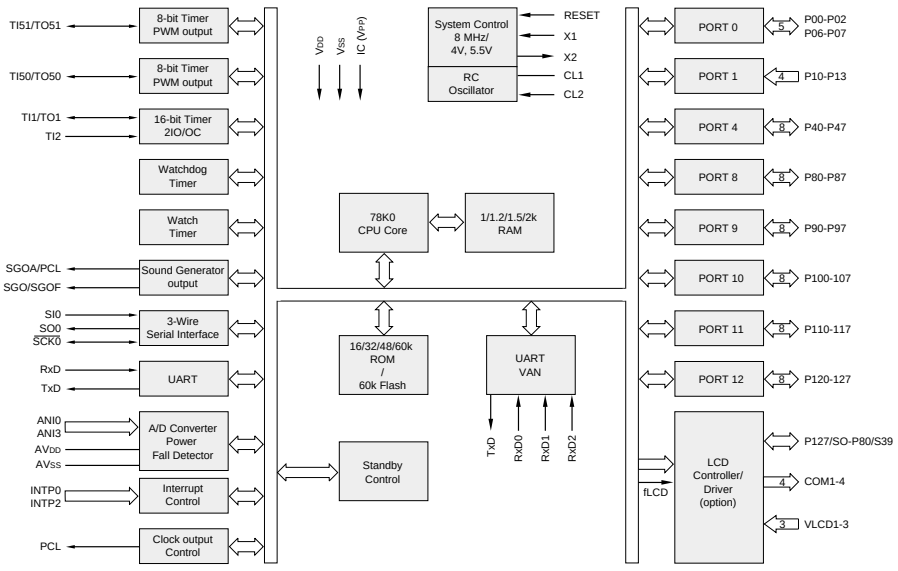
## Applications

The µPD16(F)15X/16X is ideal for all automotive body and comfort control applications that call for an effective serial communication bus like VAN. The µPD16(F)15X LCD version is designed for dash-board, multi function display, rain sensor, climate, alarm and car radio applications. The µPD1616X is a general-purpose version, perfectly suited for use in door modules, top head column and airbag control.

## Features

- 78K0 8-bit CPU core
- 60 Kbytes Flash EPROM or 16/32/48/60 Kbytes ROM
- 1/1.2/1.5/2 Kbyte(s) RAM
- Instruction execution time adjustable from 0.25 µs at 8MHz down to RC subsytem clock
- Powerful instruction set
- Bit manipulation in entire address space
- Built-in multiply and divide instructions
- Serial interfaces (3-Wire, UART)
- Timer channels (16-bit timer/event counter, 2 x 8-bit timer with PWM output, watch timer and watchdog timer)
- 4 x 40 segments LCD controller/driver
- UART VAN interface up to 500 kTS/s at 8 MHz
- 4-channel 8-bit A/D converter, including power failure detector
- Vectored interrupts (15 internals, 3 externals)
- 57 I/O ports (including segment signal output dual-pins)
- Sound generator
- Main clock monitor
- Built-in clock oscillator circuit
- Standby control (HALT, STOP modes)
- Operating supply voltage : 4.0 - 5.5 V
- 80-pin QFP package (14 x 14 mm)

## Block Diagram

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## Functional Block Description

**CPU**

The heart of the 78K0 family is a powerful 8/16 bit CPU. The 0.35 µm process technology ensures an excellent power/performance ratio. Four 8-bit register banks can be concatened 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-Kbytes linear address space is accessed via 16-bit addresses. Subclock CPU operation to reduce system power consumption is also supported.

**Memory**

The µPD16F15X Flash device has 60 Kbytes Flash EPROM and 2 Kbytes RAM. The µPD1615X Mask ROM device has 60/48/32 Kbytes ROM and 2/1.5/1.2 Kbytes RAM.
The µPD1616X Mask ROM device has 32/16 Kbytes ROM and 1.2/1 Kbyte(s) RAM.

**RC Subclock**

The subclock is driven by an external RC. This is a very inexpensive method of generating a low frequency clock for much lower power consumption in subclock mode.

**VAN Module**

With its minimized circuit design, EC's VAN module is an ideal solution for providing full hardware support for most stand-alone VAN communication applications. The interface is fully compliant to the ISO 11519 VAN standart, Part 3 revision 4.00. The module executes all VAN frame types and operates in automonous and synchronous mode. The UART VAN supports data transfert up to 500 kTS/s at 8MHz and has a collision detection mechanism.

**VAN Driver**

Drivers are coded as generic C sources files for integration in any application. Every application require a configuration file to be customized. The drivers manage the VAN protocol at frame level, making VAN easy to use and experiment with. An application note is available on request.

**A/D Converter**

The converter has 4 channels with 8-bit resolution. The conversion time is typically less than 15 ms at 8 MHz. 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.

**Serial Interface**

The serial interface includes one UART (Universal Asynchronous Receiver Transmitter) that supports transfer rates up to 125 kB/s. A 3-wire CSI (Clock Serial Interface) with configurable clock phase and polarity for transfer rates up to 1.0 MB/s is also provided.

**Sound Generator**

The sound generator produces sounds composed of a frequeny 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 or beeper.

**LCD Controller/Driver**

The LCD controller/driver can drive up to 160 LCD segments (40 segments, 4 channels).
All LCD segments are shared with general-purpose ports. LCD is available only on µPD1615x.

**Timer**

A flexible timer offers a total of 5 timer channels. A 1-channel 16-bit timer can be used to generate a basic time interval, for PWM (Pulse Width Modulation) with compare registers and for precise timing measurements with up to two 16-bit capture registers. 2-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.

## VAN Family Roadmap

NEC has designed a series of ASSPs (Application Specific Standart Products) for the VAN market. The VAN product roadmap, based on 78K0 8-bit and V850 32-bit RISC CPU cores, is shown in the table below. The AMAC (AutoMotive Application Center) at NEC's European headquarter in Düsseldorf and an application support facility in Paris enable NEC to respond faster and more flexibly to the demands of European customers. The established 8/16-bit 78K0 microcontroller family consists of more than 200 different products. All new products are offered as Mask ROM and Flash EPROM versions.

| Part Number | Package | ROM | Flash | RAM | Miscellaneous |
|---|---|---|---|---|---|
| μPD16F15A | 80 QFP<br>14 x 14 mm | - | 60 Kbytes | 2 Kbytes | 78K0 CPU core, 8.0 MHz/250 ns plus RC subclock, A/D converter, power-fail detector, 5 timers, PWM, sound generator, SIO, UART, VAN, 4 x 4 LCD |
| μPD1615A<br>μPD1615B<br>μPD1615F | 80 QFP | 60 Kbytes<br>48 Kbytes<br>32 Kbytes | -<br>-<br>- | 2 Kbytes<br>1.5 Kbytes<br>1.5 Kbytes | Same as 16F15A |
| μPD1616F<br>μPD1616H | 80 QFP | 32 Kbytes<br>16 Kbytes | -<br>- | 1.2 Kbytes<br>1 Kbytes | Same as 16F15A with LCD removed |
| VANSTORM<br>μPD76F0018A | 144 QFP<br>20 x 20 mm | - | 256 Kbytes | 8 Kbytes | V850 CPU core, 4-20MHz clock, 1FCAN, 2FVAN (comp. with TSS463/VANESSA2), 2 SCI, 2 UART, 5 timers, watchdog/watch timer, A/D converter 12 x 10-bit |
| VANSTORM<br>μPD760018A | 144 QFP<br>20 x 20 mm | 128 Kbytes | - | 4 Kbytes | Same as μPD76F0018A |
| VANESSA2<br>μPD790002 | 16 pin<br>SOP | - | - | 256 bytes | Full VAN controller/driver with serial MCU interface, hardware-and-software-compatible with standard commercial devices |

## Ordering Information

### Documentation

| Doc Number | Description | Type |
|---|---|---|
| | Device Introduction | Product Letter |
| U12326EJ3V0UM00 | 78K/0 Series Instructions | User's Manual |
| UxxxUM0 | Device User's Manual | Preliminary User's Manual |
| UxxxPPI00 | Functional description + Electrical Target Specification | Preliminary Product Information |
| UxxxDS00 | Electrical Specification | Data Sheet |
| UxxxAN00x | VAN Driver | Application note |
| UxxxAN00x | Sound generator | Application note |

### Tools

| Description | | Order Number | Type |
|---|---|---|---|
| Emulator<br>Interface card<br>Power Supply<br>Debugger<br>Compiler / Assembler / Linker | 78K0-Toolset<br>78K0-NS-PCI-SET/<br>78K0-NS-PCMCIA-SET | IE-78K0-NS-A<br>IE-70000-PCI/CD-IF-A<br>EB-PowerFW7301/5<br>DIWIN-I3HD-NS-780xx<br>CCIAR-CDR-78K0/K0S | HW/SW |
| I/O Emulation Board | | IE-78K0-NS-P04 | HW |
| Probe Board / Probe Extender Board | | IE-1615-NS-EM4 /<br>IE-78K0-R-EX1 | HW |
| Flash Programmer | | Flashmaster | HW |
| Programming Adapter | | FA-80GC | HW |
| Emulation Probe | | EP-78230GC-R | HW |

For further information on NEC's 78K0 family or other NEC products, visit our European website at **www.nec.de**

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## With compliments