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Joy of innovation



NuMicro M451 Series Microcontrollers



NuMicro M4



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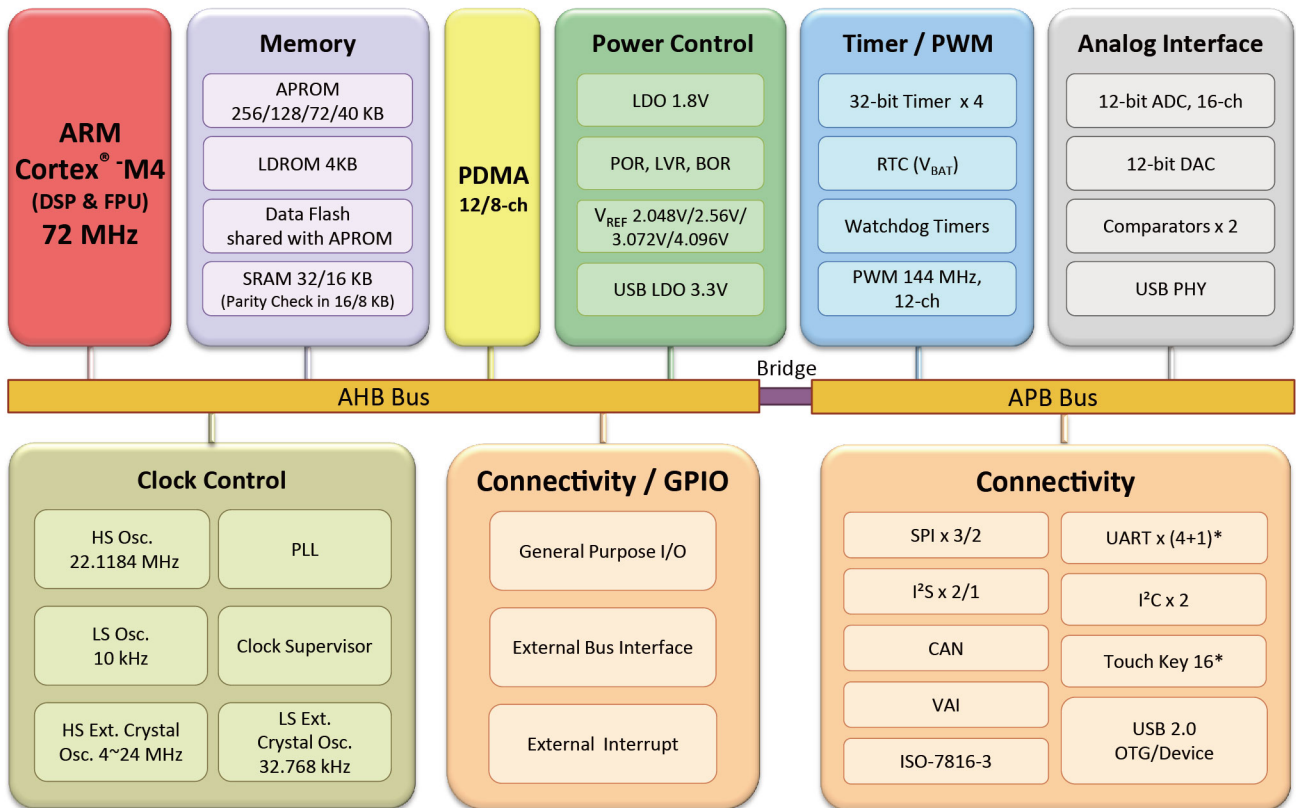
NuMicro M451 Series for High-performance, High-precision, High-flexibility Applications

The NuMicro M451 series comprises a total of 33 ARM® Cortex®-M4F based products, including the NuMicro M451 Base series, M452 USB and OTG series, M453 CAN series, and M451M series supporting pin compatible to the M051 Series MCUs. The NuMicro M451 series is embedded with the ARM® Cortex®-M4F core for use on DSP (digital signal processor) and FPU (float point unit), and is equipped with high performance computing capability running up to 72MHz, built-in 256/128/72/40 Kbytes Flash ROM and 32/16 Kbytes SRAM. The NuMicro M451 series is now in volume production; it offers the LQFP48 (7mm x 7mm), LQFP64 (7mm x 7mm), LQFP64 (10mm x 10mm) and LQFP100 (14mm x 14mm) package types for various applications.

Nuvoton's NuMicro M451 series provides the industrial operating temperature from -40°C to 105°C, 22.1184 MHz internal RC oscillator (variation < ±2%) and 32.768 kHz external crystal oscillator (variation < ±0.25%), by auto calibration adequately fulfill the high precision demand of communications. The wide operating voltage range (2.5V~5.5V) and 5V tolerance of I/O input design of the NuMicro M451 series can significantly enhance system integration capability and stability. The specially designed VAI (Voltage Adjustment Interface) system supports voltage level shift for individual I/O (1.8V~5.5V) to save additional cost on level shift components.



Function Block Diagram



(4+1)* means 4 UART + ISO-7816 UART
Flash 256/128 KB with Touch key

| Robustness in Noisy Environments |

- High Immunity (8kV ESD, 4kV EFT)
- Wide Operating Voltage 2.5V~5.5V
- Wide Operating Temperature -40°C~+105°C

| High Performance |

- Cortex[®]-M4 core with FPU and DSP
- 72 MHz (90 DMIPS)
- CPU and peripherals can access SRAM blocks simultaneously
- FIFO-based PDMA accessible peripherals
- 12-bit ADC up to 1MSPS
- 12-bit DAC up to 1MSPS
- 16-bit PWM

| Industrial Safety |

- Dual Watchdogs
- SRAM Parity Check
- Clock Supervisor
- H/W CRC Engine

| Rich Peripherals |

- USB OTG, FS Device, CAN, UART, SPI, I²C, I²S, VAI, ADC, DAC, Comparator, RTC (V_{BAT}), Smart Card Interface

| High Security |

- UID, UCID, Security Lock
- Backup register with tamper detection

NuMicro M451 Future Innovation Series

Nuvoton expects to fulfill the demand for the ARM® Cortex®-M4F core with products at all levels, and fully commit to its customers by providing complete support to enhance long-term competitiveness. Nuvoton fulfills not only current product development demands, but also customers' imagination for future innovations.

The NuMicro M451 series, embedded with the ARM® Cortex®-M4F core, supports DSP (digital signal processor) and FPU (float point unit) complying with IEC60730, built-in boot ROM and independent 4 KB in-system programming Flash ROM.



The NuMicro M451 series provides the wide operating voltage (2.5V~5.5V) and 5V-tolerance input I/O to significantly enhance system stability. A trimmed HIRC (HIRC variation <math>< \pm 0.25\%</math>) working at

M451

The M451 Base series provides the most cost effective solution with high performance computing capability running up to 72 MHz, built-in 256/128/72/40 KB Flash ROM and 32/16 KB SRAM.

M452

The M452 USB series supports USB capabilities with Data Flash configurable to full-speed USB OTG or full-speed USB devices, and provides 8 programmable endpoints and 512 Bytes internal SRAM as USB buffer.

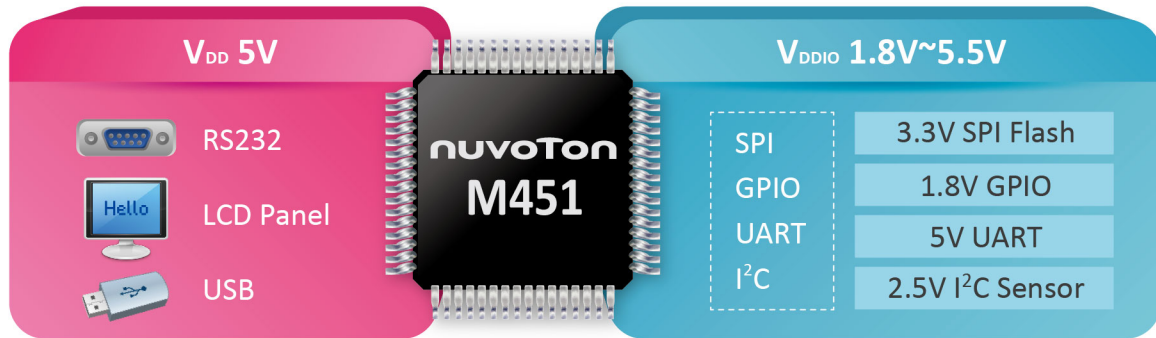
M453

The M453 CAN series supports CAN protocol version 2.0 part A and B with bit rates up to 1M-bit/s, and provides a robust control solution for a variety of industrial control, system automation and security surveillance.

The NuMicro M451 series provides two special designs. The first one is high-resolution 144 MHz PWM with high-speed electromechanical control timer and resolution <math>< 7\text{ns}</math>, making its industrial automation and motor control performance exceptionally outstanding. The other is VAI (Voltage Adjustment Interface) system which supports voltage level adjustment with individual I/O (1.8V~5.5V) to save additional cost on peripheral components used to adjust the interface voltage difference.

Voltage Adjustment Interface (VAI)

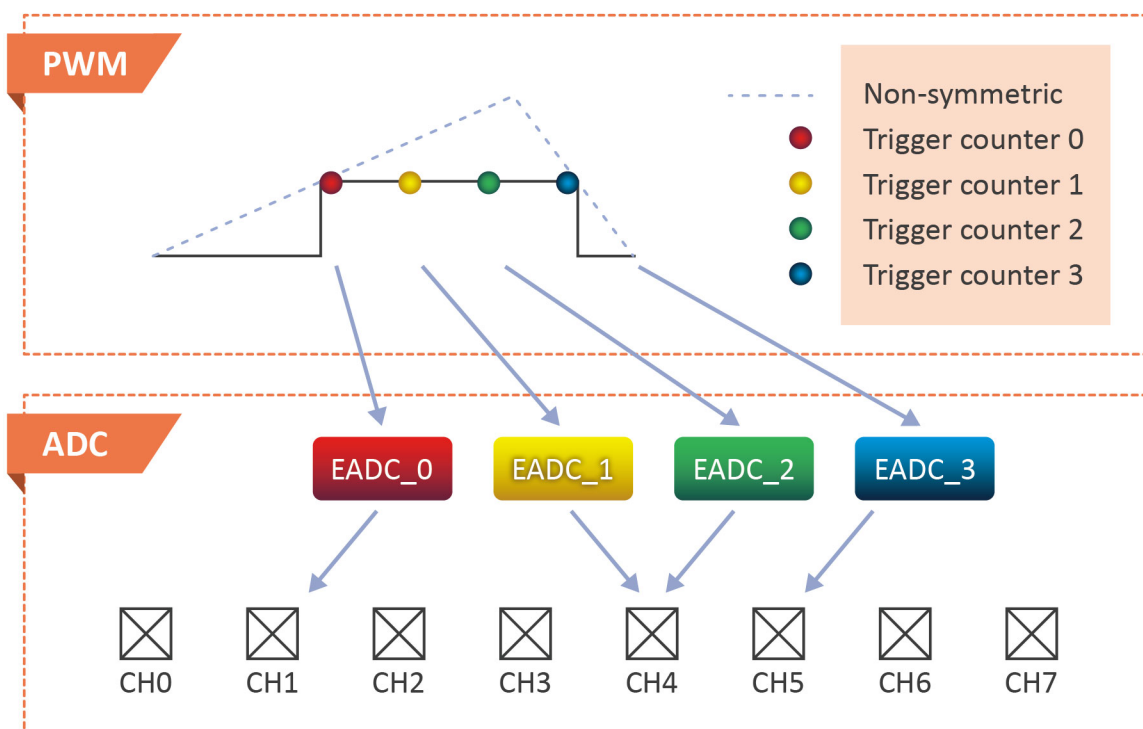
The VAI system supports voltage level adjustment for individual I/O (1.8V-5.5V) to save additional cost on level shift components. The VAI voltage is from V_{DDIO} which provides specific voltage for individual peripherals. The VAI voltage is the same with V_{DDIO} Pin. There are 8 kinds of VAI peripheral combinations available for different applications.



Flexible PWM configuration and ADC channel selection

The NuMicro M451 series supports non-symmetric PWM waveform and is able to trigger specific ADC in arbitrary waveform position by setting different trigger counters.

Each Enhanced ADC (EADC) has an independent trigger delay counter and sampling time for better sampling accuracy. Other than PWM, Enhanced ADC (EADC) trigger source can also come from timer, software, GPIO and interrupts. The highly flexible Enhanced ADC (EADC) outputs could be easily switched, which increases control efficiency.



Fully Supported Ecosystem for NuMicro M451 Series

Nuvoton provides powerful development tools to support customers in development, production and upgrades:

- Distinctive evaluation boards and a variety of debug tools help shorten development time
- Rich programming tools can satisfy various production types
- Open source tool can support product upgrades via multiple communication interfaces

Coding/Debug Tool

Evaluation/Development Boards

- The Nuvoton ICE debug circuit (Nu-Link-Me) is included in all boards
- No need to install additional debug hardware



Nu-Link

Debug, Emulate and Program

- USB debugger and programmer
- Based on SWD (Serial Wire Debug) interface
- Can be applied to the all microcontrollers in the Nuvoton NuMicro® Family
- Supports multiple development environments Keil RVMDK/IAR EWARM/CooCox



Library & Sample Code

www.nuvoton.com/NuSoftware

The software package (BSP) is based on CMSIS version 3.01.

- Enables easier coding
- Provides drivers and middleware API library for system and peripherals
- Supports sample code for board development

Nuvoton Tools

Development Has Never Been Easier

| Nu-Bridge |

- A portable handy testing dongle
- Supports multiple uses:
 - Single VCOM
 - I²C/SPI Master and Monitor
 - ADC Measurement
 - PWM Capture & Output



| PinConfigure |

- Provides GUI operation
- Supports to manage multi-function pins for target chip
- Generates pin configuring code
- Automatically creates library files for OrCAD

| PinView |

- A combination of monitoring and visualization tool
- Instantly shows the current status of I/O pins
- Supports stand-alone version application and plug-in version for IDE

Programming Tool

On-Line/Off-Line

In Circuit Programming (ICP)

- Supports on-line programming with Nu-Link
- Supports off-line programming after downloading BIN/HEX file to Nu-Link
- Supports encryption and certification in off-line programming
- Limits the number of programming times

On-Line Programming



Off-Line Programming



Chip Programming

- Nu-Gang Programmer supports 4-chip gang programming for on-line and off-line programming
- Takes only 10 seconds to complete 128 KB Flash size programming

Writer DIY

- Provides programming library and schematics
- Supports customers to develop their own program writer

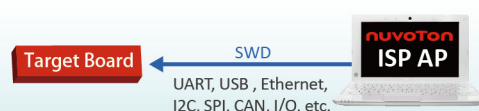
Third Party

- Worldwide third party support
- Provides programming solutions



Upgrading Tool

- Provides ISP (In-System Programming) tool
- Supports end user product upgrades via multiple interfaces
- All boot loader (Firmware) and GUI tool (Software) are open source



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