

NuMicro[®] Family

Arm[®] Cortex[®]-M23-based Microcontroller

M2003 Series

Product Brief



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1 GENERAL DESCRIPTION

The NuMicro M2003 series 32-bit microcontroller is based on Arm Cortex-M23 core with 32-bit hardware multiplier/divider. It runs up to 24 MHz and features 32 Kbytes Flash, 4 Kbytes SRAM, 2.4V to 5.5V operating voltage, and -40°C to 105°C operating temperature.

The M2003 series provides plenty of peripherals including 4 sets of 32-bit Timers, Watchdog Timers, 3-channel enhanced input capture, up to 2 sets of UART, 1 set of I²C and 1 set of Universal Serial Control Interface (USCI) that can be set as UART/SPI/I²C flexibly. Furthermore, all these communication interfaces have the individual FIFO to ensure the integrity of high-speed communication data. The M2003 series also provides rich analog peripherals including 8 single-end analog input channels of 500 kSPS 12-bit ADC and 6 channels of 16-bit PWM. The peripherals integrated into the M2003 series offer enhanced functionality compared to the NuMicro 1T 8051 series products.

Pin Compatible with N76E003 Series, N76S003 Series, MS51 Series and MG51 Series

The M2003 series with multiple function pins is fully compatible and seamlessly aligned with the Nuvoton N76E003 series, N76S003 series, MS51 series, and MG51 series. This includes compatibility with specific part numbers such as N76E003AT20, N76E003AQ20, , N76S003AT20, N76S003AQ20, MS51FB9AE, MS51XB9AE, , MG51FB9AE, MG51FC9AE, MG51XB9AE, and MG51XC9AE. Supported small form factor packages including TSSOP 20-pin and QFN 20-pin with pin-compatible for different part numbers make the system design and parts change easily.

For the development system, Nuvoton provides the NuMaker evaluation board and Nuvoton Nu-Link debugger. The 3rd Party IDE such as Keil MDK, IAR EWARM, and NuEclipse IDE with GNU GCC compilers are also supported.

USCI*: supports UART, SPI or I²C

+1*: The additional 1 set is generated by USCI.

Product Line	UART	I ² C	SPI	USCI*	Timer	PWM	ADC
M2003	2+1*	1+1*	+1*	1	4	6	8

Table 3.1-1 NuMicro M2003 Series Key Features Support Table

2 FEATURES

- **Operating Characteristics**
 - Voltage range: 2.4V to 5.5V
 - Temperature range: -40°C to 105°C
 - EFT 4.4 KV
 - ESD HBM 7 KV
- **Core**
 - Arm Cortex-M23 core running up to 24 MHz
 - Single-cycle hardware multiplier and 32-bit 17-cycle hardware divider
- **Memories**
 - 32 KB Flash
 - 4 KB SRAM
 - 4 KB Flash for user program loader (LDRAM)
 - 1 KB security protection ROM (SPROM)
 - Supports all APROM Flash used as Data Flash memory
 - ISP/ICP/IAP programming
- **Clocks**
 - Internal 24 MHz HIRC oscillator $\pm 4\%$ within all temperature range, $\pm 2\%$ at 0°C~85°C, $\pm 1\%$ at 25°C)
 - Internal 10 kHz LIRC oscillator with variation $\pm 50\%$ within all temperature range
- **Power management**
 - Support Cap-less LDO
 - Supports NPD Mode
 - Supports BOD (4.4/3.7/2.7/2.2V falling edge)
 - Normal run: 130 uA/MHz
 - Idle: <40 uA/MHz
- **Timers**
 - Four 32-bit timers
 - One 24-bit count-down SysTick timer
 - One Independent watchdog
 - One window watchdog
 - One 3-channel Enhanced input capture (ECAP)
- **PWM**
 - 6 channels of PWM with one 16-bit timer
- **Analog Peripheral**
 - 8 channels of 12-bit 500 kSPS SAR ADC

- **Communication interfaces**
 - 2 sets of UART interfaces with UART, RS-485 and IrDA mode
 - 1 set of I²C interface
 - 1 set of USCI interface supporting UART, SPI and I²C mode
- **I/O Features**
 - Internal pull-up/pull-down resistor
 - 18 I/Os with interrupt capability
 - Supports INT0/INT1 external interrupt pins
 - Reset pin can be configured as GPIO
 - Supports I/O and wakeup timer wakeup in NPD mode
- **Serial Wire Debug (SWD)**
 - Nuvoton Nu-Link debugger support
- **96-bit Unique ID (UID)**
- **128-bit Unique Customer ID (UCID)**
- **Package**
 - Package is Halogen-free, RoHS-compliant and TSCA-compliant.

Pin Count	20	20
Type	TSSOP	QFN
I/O Pin	18	18
Lead Pitch	0.65	0.4
Dimensions (mm)	4.4x6.5x0.9	3x3x0.8

- **Development Platform Support**
 - Arm Keil RVMDK and IAR EWARM IDE support for debugging
 - Free GNU compiler with Eclipse IDE support
 - ICP (In Circuit Programmer) support for updating internal code via Nu-Link debugger
 - ISP (In System Programmer) support for updating internal code through UART, SPI, I²C peripheral interface
 - Pin Viewer for real time monitoring the status of all I/O pins
 - PinConfigure tool for pin assignment, initial code generation and OrCAD/Protel part generation
 - ClockConfigure tool for generating the initial source code of system clock
 - CodeGenetater tool for generating the project of peripheral.

3 BLOCK DIAGRAM

3.1 M2003 Series Block Diagram

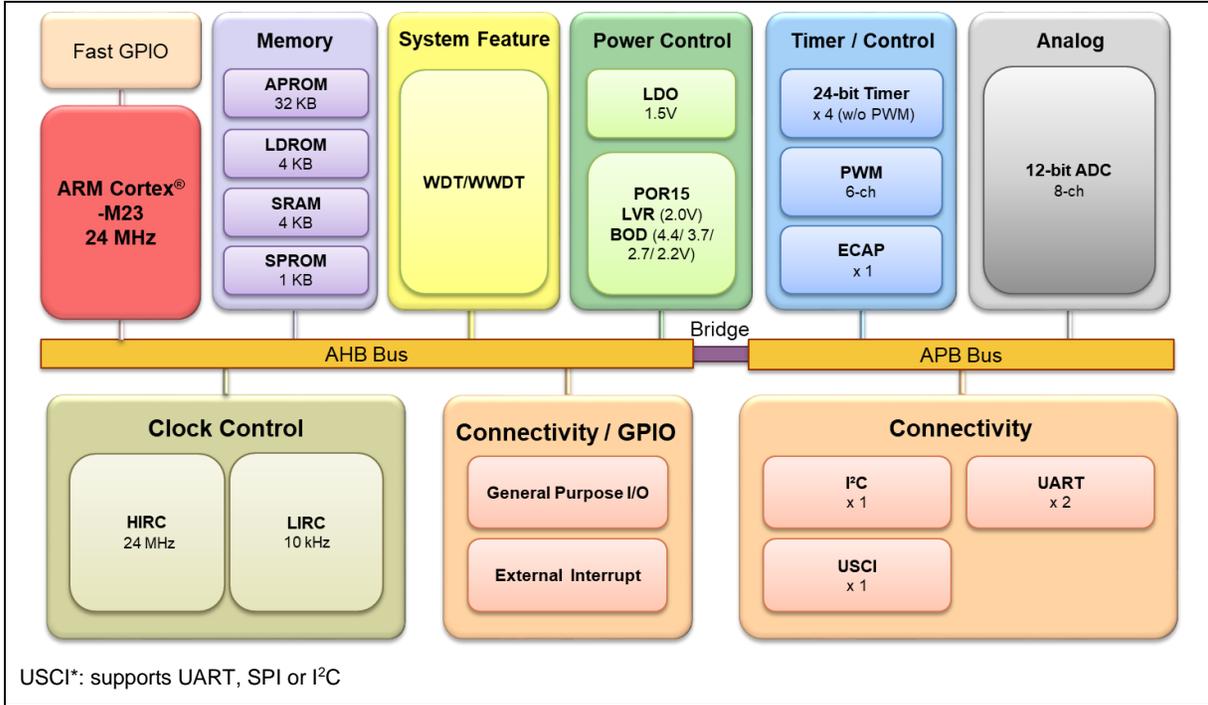


Figure 3-1 NuMicro M2003 Series Block Diagram

4 PARTS INFORMATION

4.1 M2003 Series Naming Rule

M2	003	F	C	1	A	E
Core	Line	Package	Flash	SRAM	Reserve	Temperature
Cortex-M23		F: TSSOP20 (4.4x6.5x0.9 mm) X: QFN20 (3x3x0.8 mm)	C: 32 KB	1: 4 KB		E: -40°C to 105°C

4.2 M2003 Series Selection Guide

Part Number		M2003	
		FC1AE	XC1AE
Flash (KB)		32	32
SRAM (KB)		4	4
LDROM (KB)		4	4
SPROM (KB)		1	1
System Frequency (MHz)		24	24
I/O		18	18
32-bit Timer		4	4
Connectivity	UART	2+1*	2+1*
	SPI	+1*	+1*
	I ² C	1+1*	1+1*
	USCI	1	1
PWM		6	6
12-bit SAR ADC		8	8
Package		TSSOP20	QFN20
Note: USCI*: supports UART, SPI or I ² C +1*: The additional 1 set is generated by USCI.			

5 DEVELOPMENT PLATFORM

5.1 Programmer and Debugger

Nu-Link	Basic full speed USB2.0 hardware debugger/programmer
Nu-Link-Pro	Advanced hardware debugger/programmer with programming counter
Nu-Link 2.0	Advanced high speed USB2.0 hardware debugger/programmer with multi-functions
Nu-Link-Gang	Off-line hardware programmer supporting up to four chips programming for mass-production
ISP	In System Programmer, a software programming tool supporting I ² C/UART
ICP	In Chip Programmer, a software programming tool supporting Nu-Link programmer

5.2 Development Environment

Programming IDE	Keil MDK, IAR, NuEclipse (GCC)
Software Package	Board Support Package (BSP), Sample Code
Development IDE	NuTool-PinConfigure, NuTool-PinView, NuTool-ClockConfig, NuConsole, NuTool-CodeGenerater
RTOS	Mbed, FreeRTOS, Amazon FreeRTOS, Ali-OS
HMI	Support emWin with font create tool and easy GUI builder
Programming IDE	Keil MDK, IAR, NuEclipse (GCC)

5.3 Development Board

EVB NuMaker	Part Number	Feature
NK-M2003FC	M2003FC1AE, M2003XC1AE	Supports Expand Connector, Arduino Uno Interface

6 REVISION HISTORY

Date	Revision	Description
2024.06.07	1.00	Initial version.



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