NuMicro® Family

Arm® 32-bit Cortex®-M0 Microcontroller

M031BT/M032BT BLE MCU Series Product Brief

For additional information or questions, please contact: Nuvoton Technology Corporation.

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1 GENERAL DESCRIPTION

The M031BT/M032BT BLE MCU series microcontroller (MCU) is based on Arm Cortex-M0 core with built-in Bluetooth Low Energy 5.0 (BLE 5.0) with rich peripherals and analog functions for applications that need wireless connectivity with multiple control functions. The M031BT/M032BT BLE MCU series is compliant with the BLE 5.0 standard supporting data rates up to 2 Mbps, offering 2.4 GHz proprietary stacks to achieve more possibility for wireless connectivity and Over-the-Air (OTA) for firmware upgrade. The M031BT/M032BT BLE MCU series solution allows those microcontroller applications to be the Internet of Things (IoT) devices with wireless connectivity.

The M031BT/M032BT BLE MCU series runs up to 72 MHz and features 64 Kbytes to 512 Kbytes Flash, 8 Kbytes to 96 Kbytes SRAM, 1.8V ~ 3.6V supply voltages, and supports 5V I/O tolerance within -40°C ~ 85°C operating temperature.

The M031BT/M032BT BLE MCU series provides a solution that need the connection with enhanced 2 MSPS fast conversion rate 12-bit ADC, 2 comparators and up to 24-ch 144 MHz PWM control. The M031BT/M032BT supports a fast and precise data conversion for the voltage, current, and sensor data, and fast response control to the external device. Additionally, the M031BT/M032BT BLE MCU series also provides plenty of peripherals including a Universal Serial Control Interface (USCI) that can be set as UART/SPI/I^2C flexibly, 2 sets of I^2C, up to 8 sets of UART, and 1-wire UART interface for data communication between master and slave devices. Moreover, part numbers with the M032BT series are all based on the M031BT series and enhanced with the crystal-less USB 2.0 full-speed device feature for USB related applications.

The M031BT BLE MCU series supports small form factor package QFN 48-pin (5 mm x 5 mm) that makes the PCB design to be compact size. The M032BT BLE MCU series offers QFN 68-pin (8 mm x 8 mm) for more functionality I/O control.

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

USCI*: supports UART, SPI or I^2C

Product Line	UART	I^2C	Timer	USCI*	PWM	PDMA	ADC	ACMP	Divider	USBD	RTC
M031BT	3	2	4	1	12	5	16	2	1	-	-
M032BT	8	2	4	2	24	9	16	2	1	1	1

Table 1-1 NuMicro M031BT/M032BT BLE MCU series Key Features Support Table

The M031BT/M032BT BLE MCU series is suitable for a wide range of applications such as:

- IoT edge device
- Personal healthcare device with wireless connectivity
- Smart home appliance with remote control
- Assess tracking device

2 FEATURES

- **Core**
  - Arm Cortex-M0 core running up to 72 MHz
- **Operating Characteristics**
  - Voltage range: 1.8 V to 3.6 V
  - Temperature range: -40°C to +85°C
- **Memories**
  - Up to 512 KB Flash
  - Up to 96 KB SRAM
  - Up to 8 KB Flash for user program loader (LDROM)
  - Up to 2 KB SPROM
  - ISP/ICP/IAP programming
- **Clocks**
  - 4 to 32 MHz HXT crystal oscillator or external input clock
  - 32.768 kHz LXT crystal oscillator or external input clock for low-power mode
  - Internal 48 MHz HIRC oscillator with variation ±2 % within all temperature range
  - Internal 38.4 kHz LIRC for low-power mode
  - One PLL up to 96/144 MHz for high speed module operation
- **Power management**
  - Integrated with Power-on Reset, Brown-out Reset and Low Voltage Reset
  - Supports wake up from Power-down mode by: ACMP, GPIO, WDT, TIMER, UART, USCI, I^2C, WWDT, ADC, PDMA, PWM, RTC
- **Timers**
  - Up to four 32-bit timers
  - Up to 144 MHz 16-bit PWM (Up to 24 channels)
  - One 24-bit SysTick timer
  - One Independent watchdog
  - One window watchdog
  - RTC with Calendar and Alarm
- **PDMA**
  - Up to 9 channels
  - Channel can be operated by – software trigger, USPI, UART, UUART, I^2C, ADC, PWM and Timer
- **Cryptography Accelerator**
  - Supports CRC accelerator: CRC-CCITT, CRC-8, CRC-16, and CRC-32 polynomials
- **Analog**
  - Up to 16 channels 12-bit 2 MSPS SAR ADC
  - Two comparators (ACMP)
- **Communication interfaces**
  - Up to 8 sets of 6 MHz UART interfaces with UART, RS-485 and IrDA mode
  - 2 sets of 400 kHz I^2C interfaces
  - 2 sets of USCI interfaces that support UART, SPI and I^2C mode
- **Bluetooth 5 low energy, 2.4 GHz transceiver**
  - Modem with Integrated RF Radio for 2.4 GHz Bluetooth communication link
  - Compliant with Bluetooth 5 Low Energy Specification
  - Supports proprietary 2.4 GHz protocols
  - Supports OTA (Over-the-Air) for firmware upgrage for BLE mode
  - Rx Sensitivity: −94 dBm for M031BT series / -93 dBm for M032BT series (1 Mbps BLE mode)
  - TX power supports -20 to +8 dBm for M031BT series or +6 dBm for M032BT series in BLE mode
  - Immune to interference (-25 dBm image rejection)
  - Data rate: 1 Mbps and 2 Mbps for BLE mode
  - Integrated security: CRC, AES-128, AES-CCM for real-time processing of the data stream
  - Dedicated 32 kHz oscillator (± 500 ppm)
  - RSSI read-out
  - Integrated DC-DC converter and LDO regulator
- **Up to 43 I/O with interrupt capability**
  - Schmitt trigger input
  - Four I/O modes
  - 5V tolerant I/O except analog pins
- **Serial Wire Debug (SWD)**
  - Nuvoton Nu-Link debugger support
- **32-bit H/W Divider (HDIV)**
  - 32-bit dividend with 16-bit divisor calculation capacity
- **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, I^2C, RS-485 peripheral interface
  - Pin Viewer for real time monitor the status of all IO pins
  - NuTool - PinConfigure for pin assignment, initial code generation and OrCAD/Protel part generation
  - NuTool - ClockConfigure for generating the initial source code of system clock
- **96-bit Unique ID (UID)**
- **128-bit Unique Customer ID (UCID)**
- **Package:**

Product Line	M031BT	M032BT
Type	QFN48	QFN68
I/O Pin	29	43
Lead Pitch	0.35	0.4
Dimensions (nm)	5x5x0.9	8x8x0.9

3 BLOCK DIAGRAM

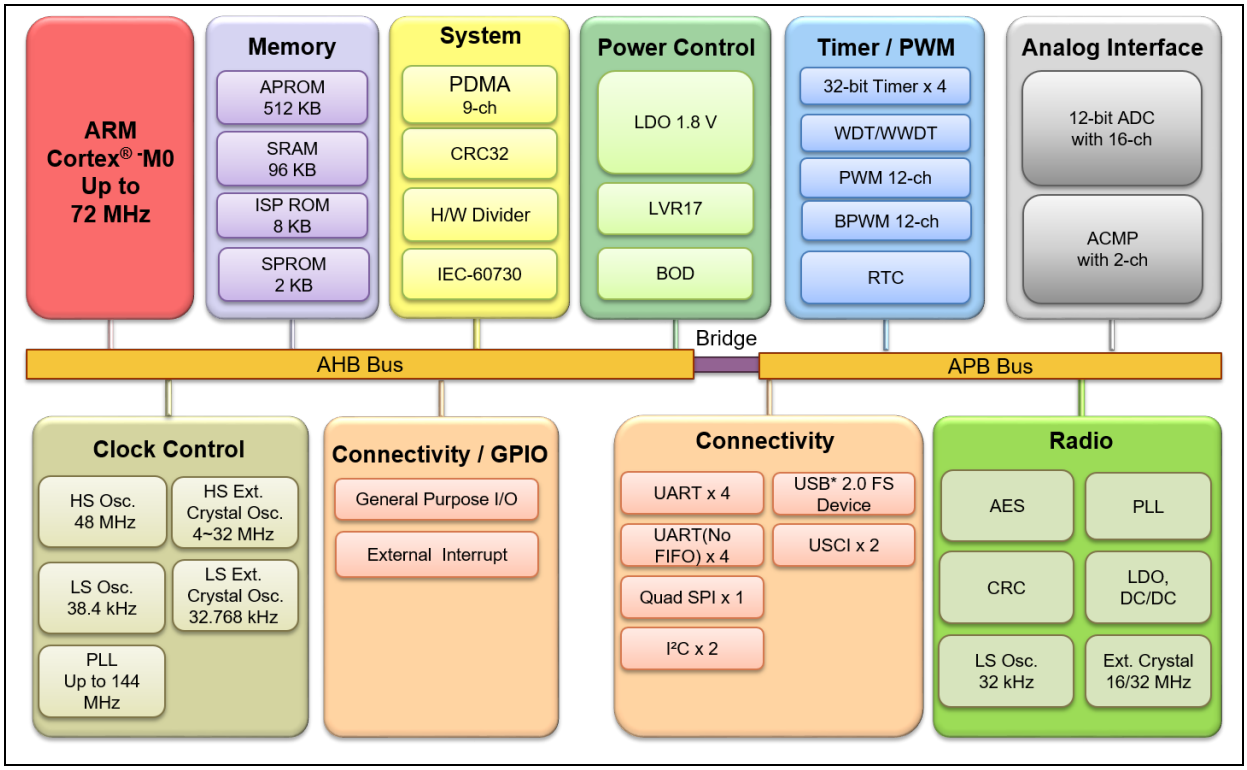

Figure 3-1 NuMicro M031BT/M032BT BLE MCU Series Block Diagram

4 PARTS INFORMATION

4.1 M031BT/M032BT BLE MCU series Naming Rule

M0	31BT	Y	E	3	A	N
Core	**Line**	**Package**	**Flash**	**SRAM**	**Reserve**	**Temperature**
Cortex-M0	31BT: Control with RF 32BT: USB with RF	A: QFN68 (8x8 mm) Y: QFN48 (5x5 mm)	D: 64 KB E: 128 KB G: 256 KB I: 512 KB	2: 8 KB 3: 16 KB 8: 64 KB A: 96 KB		N:-40°C ~ 85°C

4.2 M031BT/M032BT BLE MCU series Selection Guide

4.2.1 M031BT Control with RF series

Part Number		M031BT	
		YD2AN	YE3AN
Flash (KB)		64	128
SRAM (KB)		8	16
LDROM (KB)		2	4
SPROM(Bytes)		512	
System Frequency (MHz)		48	
PLL (MHz)		96	
I/O		29	
32-bit Timer		4	
Connectivity	USCI*	1	
	UART	3	
	I²C	2	
PWM		12	
PDMA		5	
CRC		√	
HDIV		√	
Analog Comparator		2	
12-bit SAR ADC		16	
Package		QFN48	

USCI*: supports UART, SPI or I^2C

4.2.2 M032BT USB with RF seires

Part Number		M032BT	
		AG8AN	AIAAN
Flash (KB)		256	512
SRAM (KB)		64	96
LDROM (KB)		4	8
SPROM(Bytes)		2048	
System Frequency (MHz)		72	
PLL (MHz)		96	
I/O		43	
32-bit Timer		4	
Connectivity	USCI*	2	
	UART	6	8
	QSPI	√	
	I²C/SMBus	2/1	
	USB FS	√	
PWM		12	
BPWM		12	
PDMA		7	9
CRC		√	
HDIV		√	
RTC		√	
Analog Comparator		2	
12-bit SAR ADC		16	
Package		QFN68	

USCI*: supports UART, SPI or I^2C

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 UART/USB
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-PinView, NuTool-ClockConfig, NuConsole

5.3 Development Board

EVB NuMaker	**Part Number**	**Feature**
NK-M031BTYE	M031BTYD2AN, M031BTYE3AN	Support Expand Connector, Arduino Uno Interface
NK-M032BTAI	M032BTAG8AN, M032BTAIAAN	

6 REVISION HISTORY

Date	Revision	Description
2021.06.08	1.00	Initial version
2021.06.11	2.00	Updated M032BT information
2021.06.25	2.01	Updated cover page and 5.2 section information and product series name

Important Notice

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