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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Last Time Buy
Core Processor	ARM® Cortex®-M0
Core Size	32-Bit Single-Core
Speed	50MHz
Connectivity	I²C, IrDA, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, I²S, LVD, POR, PS2, PWM, WDT
Number of I/O	35
Program Memory Size	128KB (128K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	2.5V ~ 5.5V
Data Converters	A/D 8x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-LQFP
Supplier Device Package	48-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/nuvoton-technology-corporation-america/nuc100le3an

Figures

Tables

1   GENERAL DESCRIPTION

The NuMicro™ NUC100 Series is 32-bit microcontrollers with embedded ARM® Cortex™-M0 core for industrial control and applications which need rich communication interfaces. The Cortex™-M0 is the newest ARM® embedded processor with 32-bit performance and at a cost equivalent to traditional 8-bit microcontroller. NuMicro™ NUC100 Series includes NUC100, NUC120, NUC130 and NUC140 product line.

The NuMicro™ NUC100 Advanced Line embeds Cortex™-M0 core running up to 50 MHz with 32K/64K/128K-byte embedded flash, 4K/8K/16K-byte embedded SRAM, and 4K-byte loader ROM for the ISP. It also equips with plenty of peripheral devices, such as Timers, Watchdog Timer, RTC, PDMA, UART, SPI, I^{2}C, I^{2}S, PWM Timer, GPIO, PS/2, 12-bit ADC, Analog Comparator, Low Voltage Reset Controller and Brown-Out Detector.

Product Line	UART	SPI	I^{2}C	USB	LIN	CAN	PS/2	I^{2}S
NUC100	●	●	●				●	●
NUC120	●	●	●	●			●	●
NUC130	●	●	●		●	●	●	●
NUC140	●	●	●	●	●	●	●	●

Table 1-1 Connectivity Supported Table

- Analog Comparator

  - Up to two analog comparators
  - External input or internal bandgap voltage selectable at negative node
  - Interrupt when compare result change
  - Power down wake-up

- One built-in temperature sensor with 1℃ resolution

- Brown-Out detector

  - With 4 levels: 4.5 V/3.8 V/2.7 V/2.2 V
  - Support Brown-Out Interrupt and Reset option

- Low Voltage Reset

  - Threshold voltage levels: 2.0 V

- Operating Temperature: -40℃~85℃

- Packages:

  - All Green package (RoHS)
  - LQFP 100-pin / 64-pin / 48-pin (100-pin for NuMicro™ NUC100/NUC120 Medium Density Only)

3   PARTS INFORMATION LIST AND PIN CONFIGURATION

3.1   NuMicro™ NUC100 Products Selection Guide

3.1.1   NuMicro™ NUC100 Medium Density Advance Line Selection Guide

Part number	APROM	RAM	Data Flash	ISP Loader ROM	I/O	Timer	UART	SPI	I²C	USB	LIN	CAN	I²S	Comp.	PWM	ADC	RTC	EBI	ISP ICP	Package
NUC100LD3AN	64 KB	16 KB	4 KB	4 KB	up to 35	4x32-bit	2	1	2	-	-	-	1	1	6	8x12-bit	v	-	v	LQFP48
NUC100LE3AN	128 KB	16 KB	Definable	4 KB	up to 35	4x32-bit	2	1	2	-	-	-	1	1	6	8x12-bit	v	-	v	LQFP48
NUC100RD3AN	64 KB	16 KB	4 KB	4 KB	up to 49	4x32-bit	3	2	2	-	-	-	1	2	6	8x12-bit	v	-	v	LQFP64
NUC100RE3AN	128 KB	16 KB	Definable	4 KB	up to 49	4x32-bit	3	2	2	-	-	-	1	2	6	8x12-bit	v	-	v	LQFP64
NUC100VD2AN	64 KB	8 KB	4 KB	4 KB	up to 80	4x32-bit	3	4	2	-	-	-	1	2	8	8x12-bit	v	-	v	LQFP100
NUC100VD3AN	64 KB	16 KB	4 KB	4 KB	up to 80	4x32-bit	3	4	2	-	-	-	1	2	8	8x12-bit	v	-	v	LQFP100
NUC100VE3AN	128 KB	16 KB	Definable	4 KB	up to 80	4x32-bit	3	4	2	-	-	-	1	2	8	8x12-bit	v	-	v	LQFP100

3.1.2   NuMicro™ NUC100 Low Density Advance Line Selection Guide

Part number	APROM	RAM	Data Flash	ISP Loader ROM	I/O	Timer	UART	SPI	I²C	USB	LIN	CAN	I²S	Comp.	PWM	ADC	RTC	EBI	ISP ICP	Package
NUC100LC1BN	32 KB	4 KB	4 KB	4 KB	up to 35	4x32-bit	2	1	2	-	-	-	1	1	4	8x12-bit	v	-	v	LQFP48
NUC100LD1BN	64 KB	4 KB	4 KB	4 KB	up to 35	4x32-bit	2	1	2	-	-	-	1	1	4	8x12-bit	v	-	v	LQFP48
NUC100LD2BN	64 KB	8 KB	4 KB	4 KB	up to 35	4x32-bit	2	1	2	-	-	-	1	1	4	8x12-bit	v	-	v	LQFP48
NUC100RC1BN	32 KB	4 KB	4 KB	4 KB	up to 49	4x32-bit	2	2	2	-	-	-	1	2	4	8x12-bit	v	v	v	LQFP64
NUC100RD1BN	64 KB	4 KB	4 KB	4 KB	up to 49	4x32-bit	2	2	2	-	-	-	1	2	4	8x12-bit	v	v	v	LQFP64
NUC100RD2BN	64 KB	8 KB	4 KB	4 KB	up to 49	4x32-bit	2	2	2	-	-	-	1	2	4	8x12-bit	v	v	v	LQFP64

3.2.2 NuMicro™ NUC100 Low Density Pin Diagram

3.2.2.1 NuMicro™ NUC100 Low Density LQFP 64 pin
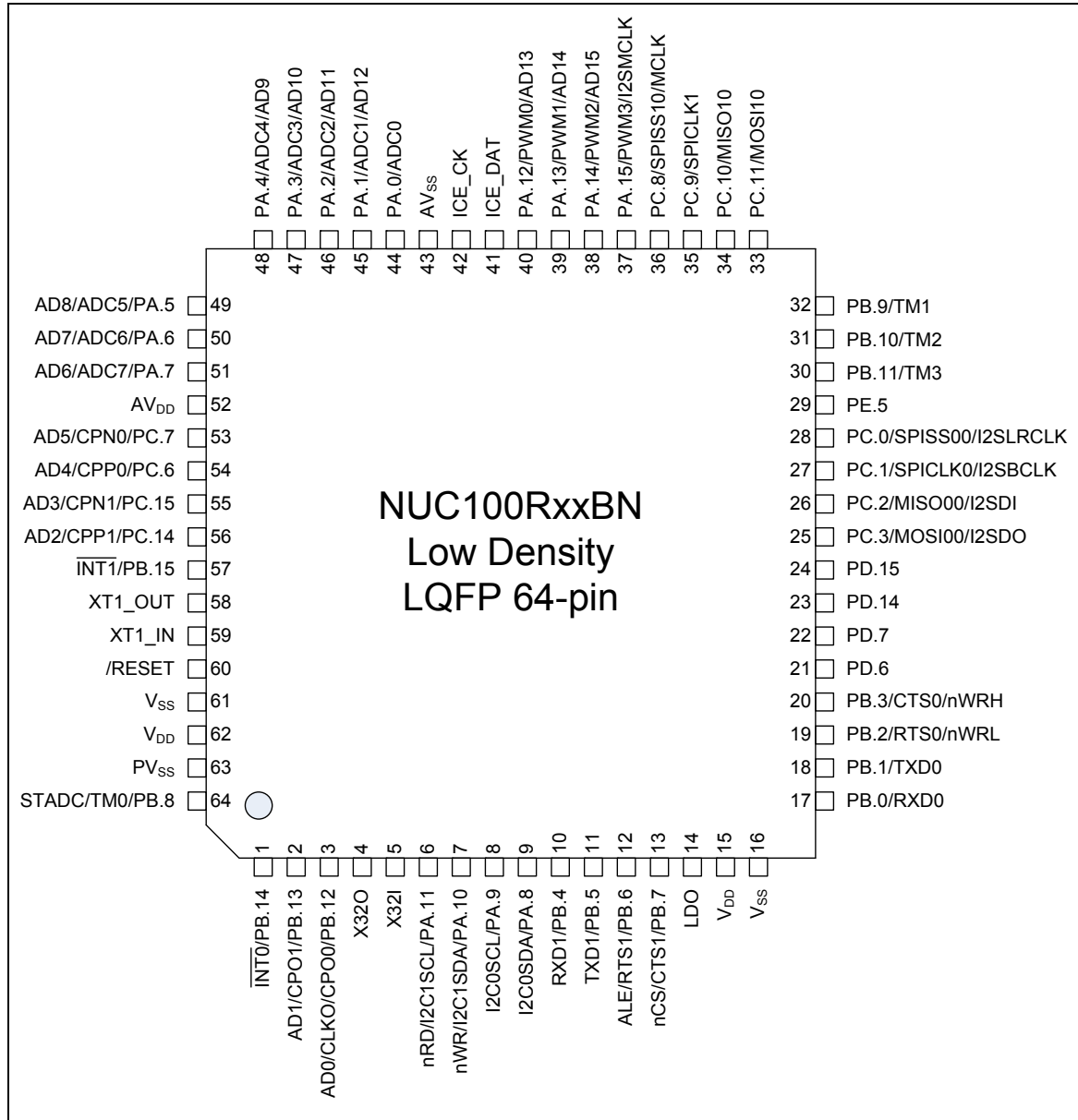
Figure 3-4 NuMicro™ NUC100 Low Density LQFP 64-pin Pin Diagram

4.2 NuMicro™ NUC100 Low Density Block Diagram

FLASH 64KB	Cortex-M0 50MHz	PDMA	P L L	10 kHz
				32.768 kHz
				22.1184 MHz
				4~24 MHz

ISP 4KB

SRAM 8KB

GPIO A,B,C,D,E

CLK_CTL

| LDO | 2.5V~ 5.5V |

RTC

WDT

SPI 0/1

12-bit ADC

I2C 1

Timer 0/1/

UART 0 -3M

Analog Comparator

UART 1 -115K

Timer 2/3

POR

Brown-out

PWM 0~3

LVR

I2S

I2C 0

‖ Peripherals with PDMA

Figure 4-2 NuMicro™ NUC100 Low Density Block Diagram

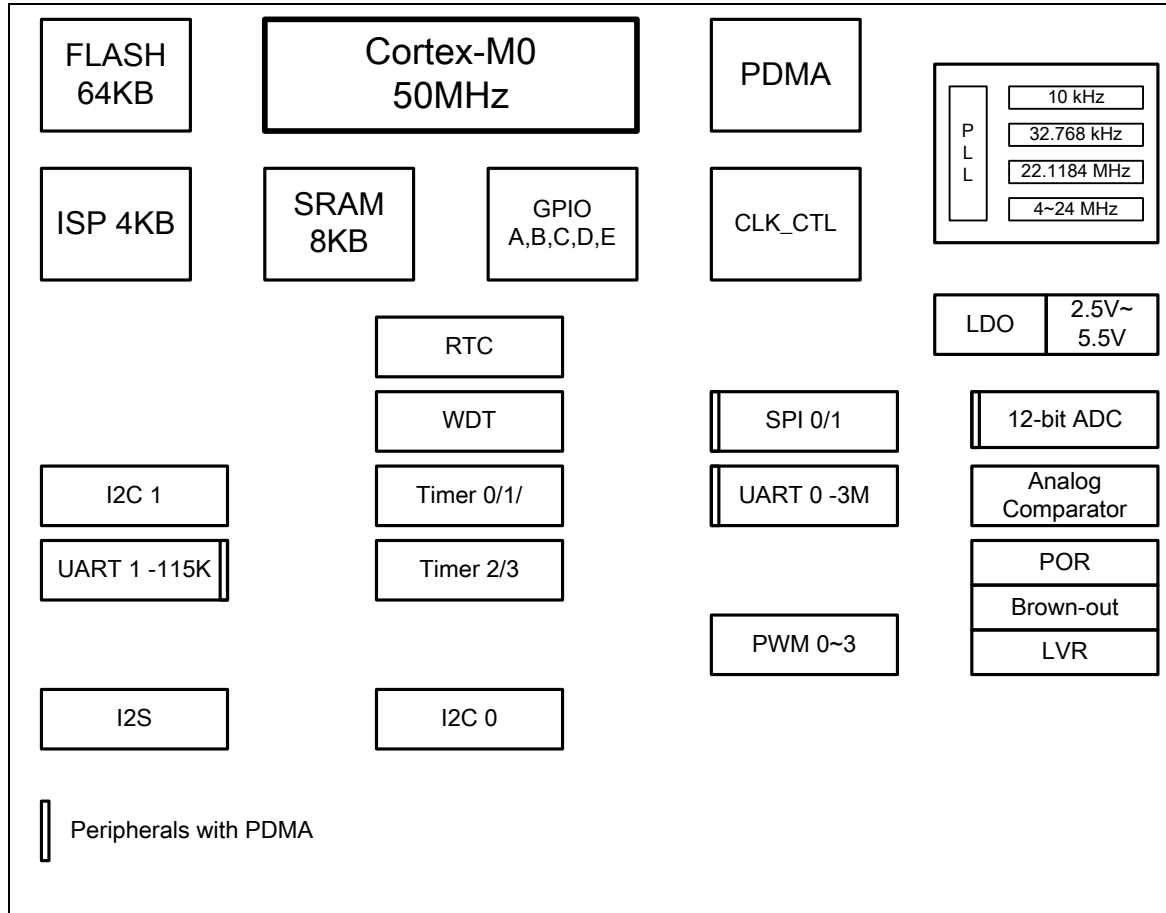## 5 FUNCTIONAL DESCRIPTION

5.1 ARM® Cortex™-M0 Core

The Cortex™-M0 processor is a configurable, multistage, 32-bit RISC processor. It has an AMBA AHB-Lite interface and includes an NVIC component. It also has optional hardware debug functionality. The processor can execute Thumb code and is compatible with other Cortex-M profile processor. The profile supports two modes -Thread mode and Handler mode. Handler mode is entered as a result of an exception. An exception return can only be issued in Handler mode. Thread mode is entered on Reset, and can be entered as a result of an exception return. Figure 5-1 shows the functional controller of processor.
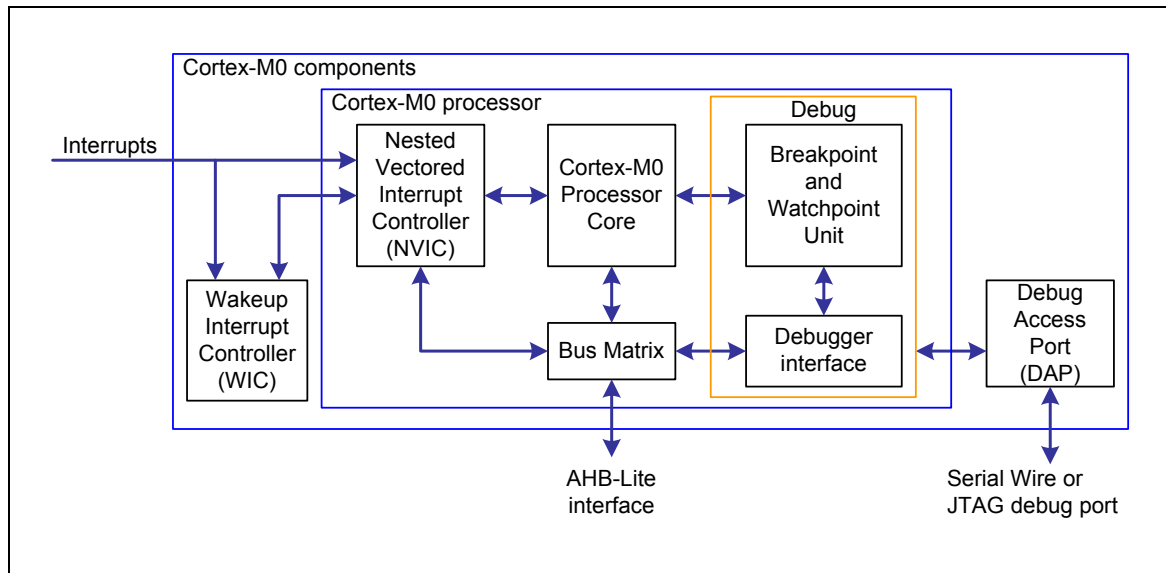

Figure 5-1 Functional Controller Diagram

The implemented device provides:

- A low gate count processor that features:
  - The ARMv6-M Thumb® instruction set
  - Thumb-2 technology
  - ARMv6-M compliant 24-bit SysTick timer
  - A 32-bit hardware multiplier
  - The system interface supports little-endian data accesses
  - The ability to have deterministic, fixed-latency, interrupt handling
  - Load/store-multiples and multicycle-multiplies that can be abandoned and restarted to facilitate rapid interrupt handling
  - C Application Binary Interface compliant exception model. This is the ARMv6-M, C Application Binary Interface (C-ABI) compliant exception model that enables the use of pure C functions as interrupt handlers
  - Low power sleep mode entry using Wait For Interrupt (WFI), Wait For Event (WFE) instructions, or the return from interrupt sleep-on-exit feature

5.2 System Manager

5.2.1 Overview

System management includes these following sections:

- System Resets
- System Memory Map
- System management registers for Part Number ID, chip reset and on-chip controllers reset , multi-functional pin control
- System Timer (SysTick)
- Nested Vectored Interrupt Controller (NVIC)
- System Control registers

5.2.2 System Reset

The system reset can be issued by one of the below listed events. For these reset event flags can be read by RSTSRC register.

- The Power-On Reset
- The low level on the /RESET pin
- Watchdog Time Out Reset
- Low Voltage Reset
- Brown-Out Detector Reset
- CPU Reset
- System Reset

System Reset and Power-On Reset all reset the whole chip including all peripherals. The difference between System Reset and Power-On Reset is external crystal circuit and ISPCON.BS bit. System Reset doesn't reset external crystal circuit and ISPCON.BS bit, but Power-On Reset does.

5.2.6 Nested Vectored Interrupt Controller (NVIC)

Cortex-M0 provides an interrupt controller as an integral part of the exception mode, named as "Nested Vectored Interrupt Controller (NVIC)". It is closely coupled to the processor kernel and provides following features:

- Nested and Vectored interrupt support
- Automatic processor state saving and restoration
- Reduced and deterministic interrupt latency

The NVIC prioritizes and handles all supported exceptions. All exceptions are handled in "Handler Mode". This NVIC architecture supports 32 (IRQ[31:0]) discrete interrupts with 4 levels of priority. All of the interrupts and most of the system exceptions can be configured to different priority levels. When an interrupt occurs, the NVIC will compare the priority of the new interrupt to the current running one's priority. If the priority of the new interrupt is higher than the current one, the new interrupt handler will override the current handler.

When any interrupts is accepted, the starting address of the interrupt service routine (ISR) is fetched from a vector table in memory. There is no need to determine which interrupt is accepted and branch to the starting address of the correlated ISR by software. While the starting address is fetched, NVIC will also automatically save processor state including the registers "PC, PSR, LR, R0~R3, R12" to the stack. At the end of the ISR, the NVIC will restore the mentioned registers from stack and resume the normal execution. Thus it will take less and deterministic time to process the interrupt request.

The NVIC supports "Tail Chaining" which handles back-to-back interrupts efficiently without the overhead of states saving and restoration and therefore reduces delay time in switching to pending ISR at the end of current ISR. The NVIC also supports "Late Arrival" which improves the efficiency of concurrent ISRs. When a higher priority interrupt request occurs before the current ISR starts to execute (at the stage of state saving and starting address fetching), the NVIC will give priority to the higher one without delay penalty. Thus it advances the real-time capability.

For more detailed information, please refer to the documents "ARM® Cortex™-M0 Technical Reference Manual" and "ARM® v6-M Architecture Reference Manual".

5.3.3　System Clock and SysTick Clock

The system clock has 5 clock sources which were generated from clock generator block. The clock source switch depends on the register HCLK_S (CLKSEL0[2:0]). The block diagram is showed in Figure 5-5.
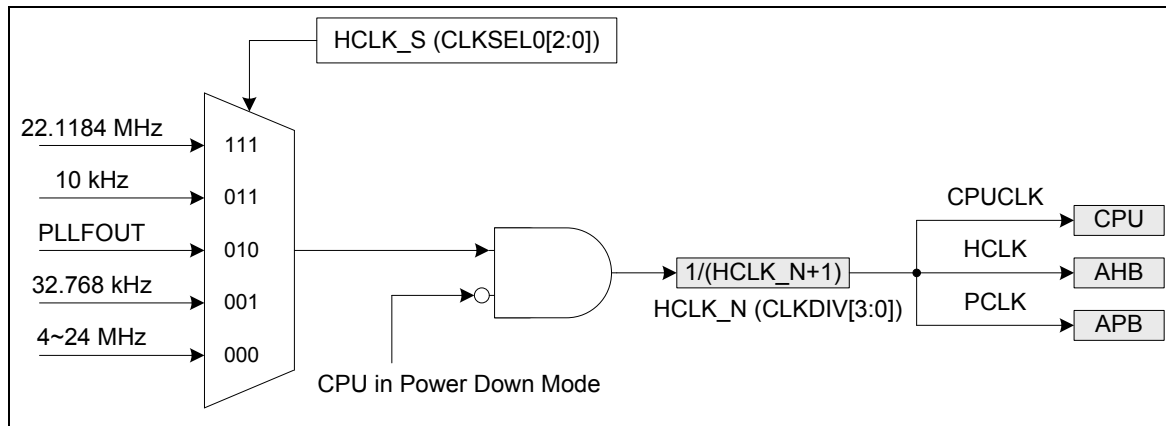

Figure 5-5 System Clock Block Diagram

The clock source of SysTick in Cortex-M0 core can use CPU clock or external clock (SYST_CSR[2]). If using external clock, the SysTick clock (STCLK) has 5 clock sources. The clock source switch depends on the setting of the register STCLK_S (CLKSEL0[5:3]). The block diagram is showed in Figure 5-6.
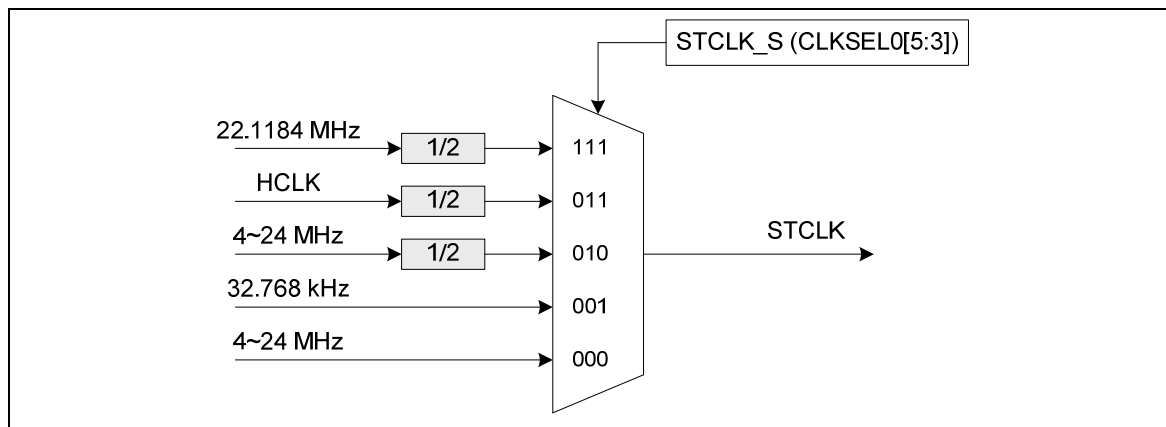

Figure 5-6 SysTick Clock Control Block Diagram

5.4 General Purpose I/O (GPIO)

5.4.1 Overview

NuMicro™ NUC100/NUC120 Medium Density has up to 80 General Purpose I/O pins can be shared with other function pins; it depends on the chip configuration. These 80 pins are arranged in 5 ports named with GPIOA, GPIOB, GPIOC, GPIOD and GPIOE. Each port equips maximum 16 pins. Each one of the 80 pins is independent and has the corresponding register bits to control the pin mode function and data.

NuMicro™ NUC100/NUC120 Low Density has up to 65 General Purpose I/O pins can be shared with other function pins; it depends on the chip configuration and package. These 65 pins are arranged in 4 ports named with GPIOA, GPIOB, GPIOC and GPIOD with each port equips maximum 16 pins and another port named GPIOE with 1 pins PE.5.

The I/O type of each of I/O pins can be configured by software individually as input, output, open-drain or quasi-bidirectional mode. After reset, the I/O type of all pins stay in quasi-bidirectional mode and port data register GPIOx_DOUT[15:0] resets to 0x0000_FFFF. Each I/O pin equips a very weakly individual pull-up resistor which is about 110KΩ~300KΩ for V$_{DD}$ is from 5.0 V to 2.5 V.

5.4.2 Features

- Four I/O modes:
  - ◆ Quasi bi-direction
  - ◆ Push-Pull output
  - ◆ Open-Drain output
  - ◆ Input only with high impendence
- TTL/Schmitt trigger input selectable
- I/O pin can be configured as interrupt source with edge/level setting
- High driver and high sink IO mode support

5.5.2 Features

The I²C bus uses two wires (SDA and SCL) to transfer information between devices connected to the bus. The main features of the bus are:

- Master/Slave mode

- Bidirectional data transfer between masters and slaves

- Multi-master bus (no central master)

- Arbitration between simultaneously transmitting masters without corruption of serial data on the bus

- Serial clock synchronization allows devices with different bit rates to communicate via one serial bus

- Serial clock synchronization can be used as a handshake mechanism to suspend and resume serial transfer

- Built-in a 14-bit time-out counter will request the I²C interrupt if the I²C bus hangs up and timer-out counter overflows.

- External pull-up are needed for high output

- Programmable clocks allow versatile rate control

- Supports 7-bit addressing mode

- I²C-bus controllers support multiple address recognition (Four slave address with mask option)

the PWM counter 0/1/2/3 will be reload at this moment.

The maximum captured frequency that PWM can capture is confined by the capture interrupt latency. When capture interrupt occurred, software will do at least three steps, they are: Read PIIR to get interrupt source and Read CRLRx/CFLRx(x=0~3) to get capture value and finally write 1 to clear PIIR to zero. If interrupt latency will take time T0 to finish, the capture signal mustn't transition during this interval (T0). In this case, the maximum capture frequency will be 1/T0. For example:

HCLK = 50 MHz, PWM_CLK = 25 MHz, Interrupt latency is 900 ns

So the maximum capture frequency will is 1/900ns ≈ 1000 kHz

5.6.2   Features

5.6.2.1   PWM function features:

- PWM group has two PWM generators. Each PWM generator supports one 8-bit prescaler, one clock divider, two PWM-timers (down counter), one dead-zone generator and two PWM outputs.

- Up to 16-bit resolution

- PWM Interrupt request synchronized with PWM period

- One-shot or Auto-reload mode PWM

- Up to 2 PWM group (PWMA/PWMB) to support 8 PWM channels or 4 PWM paired channels (only 1 PWM group support for NuMicro™ NUC100/NUC120 Low Density)

5.6.2.2   Capture Function Features:

- Timing control logic shared with PWM Generators

- Support 8 Capture input channels shared with 8 PWM output channels (NuMicro™ NUC100/NUC120 Low Density only support 4 Capture input channels shared with 4 PWM output channels)

- Each channel supports one rising latch register (CRLR), one falling latch register (CFLR) and Capture interrupt flag (CAPIFx)

5.10.2 Features

- 18-bit free running counter to avoid chip from Watchdog timer reset before the delay time expires.

- Selectable time-out interval ($2^4 \sim 2^{18}$) and the time out interval is 104 ms ~ 26.3168 s (if WDT_CLK = 10 kHz).

- Reset period = (1 / 10 kHz) * 63, if WDT_CLK = 10 kHz.

5.11 UART Interface Controller (UART)

NuMicro™ NUC100/NUC120 Medium Density provides up to three channels of Universal Asynchronous Receiver/Transmitters (UART). UART0 supports High Speed UART and UART1~2 perform Normal Speed UART, besides, only UART0 and UART1 support flow control function. NuMicro™ NUC100/NUC120 Low Density only supports UART0 and UART1.

5.11.1 Overview

The Universal Asynchronous Receiver/Transmitter (UART) performs a serial-to-parallel conversion on data received from the peripheral, and a parallel-to-serial conversion on data transmitted from the CPU. The UART controller also supports IrDA SIR Function and RS-485 mode functions. Each UART channel supports seven types of interrupts including transmitter FIFO empty interrupt (INT_THRE), receiver threshold level reaching interrupt (INT_RDA), line status interrupt (parity error or framing error or break interrupt) (INT_RLS), receiver buffer time out interrupt (INT_TOUT), MODEM/Wake-up status interrupt (INT_MODEM) and Buffer error interrupt (INT_BUF_ERR). Interrupts of UART0 and UART2 share the interrupt number 12 (vector number is 28); Interrupt number 13 (vector number is 29) only supports UART1 interrupt. Refer to Nested Vectored Interrupt Controller chapter for System Interrupt Map.

The UART0 is built-in with a 64-byte transmitter FIFO (TX_FIFO) and a 64-byte receiver FIFO (RX_FIFO) that reduces the number of interrupts presented to the CPU and the UART1~2 are equipped 16-byte transmitter FIFO (TX_FIFO) and 16-byte receiver FIFO (RX_FIFO). The CPU can read the status of the UART at any time during the operation. The reported status information includes the type and condition of the transfer operations being performed by the UART, as well as 4 error conditions (parity error, framing error, break interrupt and buffer error) probably occur while receiving data. The UART includes a programmable baud rate generator that is capable of dividing clock input by divisors to produce the serial clock that transmitter and receiver need. The baud rate equation is Baud Rate = UART_CLK / M * [BRD + 2], where M and BRD are defined in Baud Rate Divider Register (UA_BAUD). Table 5-6 lists the equations in the various conditions and Table 5-7 list the UART baud rate setting table.

Mode	DIV_X_EN	DIV_X_ONE	Divider X	BRD	Baud rate equation
0	0	0	B	A	UART_CLK / [16 * (A+2)]
1	1	0	B	A	UART_CLK / [(B+1) * (A+2)] , B must >= 8
2	1	1	Don't care	A	UART_CLK / (A+2), A must >=3

Table 5-6 UART Baud Rate Equation

System clock = Internal 22.1184 MHz high speed oscillator						
Baud rate	Mode0		Mode1		Mode2	
	Parameter	Register	Parameter	Register	Parameter	Register
921600	x	x	A=0,B=11	0x2B00_0000	A=22	0x3000_0016
460800	A=1	0x0000_0001	A=1,B=15 A=2,B=11	0x2F00_0001 0x2B00_0002	A=46	0x3000_002E
230400	A=4	0x0000_0004	A=4,B=15 A=6,B=11	0x2F00_0004 0x2B00_0006	A=94	0x3000_005E
115200	A=10	0x0000_000A	A=10,B=15 A=14,B=11	0x2F00_000A 0x2B00_000E	A=190	0x3000_00BE
57600	A=22	0x0000_0016	A=22,B=15 A=30,B=11	0x2F00_0016 0x2B00_001E	A=382	0x3000_017E
38400	A=34	0x0000_0022	A=62,B=8 A=46,B=11 A=34,B=15	0x2800_003E 0x2B00_002E 0x2F00_0022	A=574	0x3000_023E
19200	A=70	0x0000_0046	A=126,B=8 A=94,B=11 A=70,B=15	0x2800_007E 0x2B00_005E 0x2F00_0046	A=1150	0x3000_047E
9600	A=142	0x0000_008E	A=254,B=8 A=190,B=11 A=142,B=15	0x2800_00FE 0x2B00_00BE 0x2F00_008E	A=2302	0x3000_08FE
4800	A=286	0x0000_011E	A=510,B=8 A=382,B=11 A=286,B=15	0x2800_01FE 0x2B00_017E 0x2F00_011E	A=4606	0x3000_11FE

Table 5-7 UART Baud Rate Setting Table

The UART0 and UART1 controllers support auto-flow control function that uses two low-level signals, /CTS (clear-to-send) and /RTS (request-to-send), to control the flow of data transfer between the UART and external devices (ex: Modem). When auto-flow is enabled, the UART is not allowed to receive data until the UART asserts /RTS to external device. When the number of bytes in the RX FIFO equals the value of RTS_TRI_LEV (UA_FCR [19:16]), the /RTS is de-asserted. The UART sends data out when UART controller detects /CTS is asserted from external device. If a valid asserted /CTS is not detected the UART controller will not send data out.

The UART controllers also provides Serial IrDA (SIR, Serial Infrared) function (User must set IrDA_EN (UA_FUN_SEL [1]) to enable IrDA function). The SIR specification defines a short-range infrared asynchronous serial transmission mode with one start bit, 8 data bits, and 1 stop bit. The maximum data rate is 115.2 Kbps (half duplex). The IrDA SIR block contains an IrDA SIR Protocol encoder/decoder. The IrDA SIR protocol is half-duplex only. So it cannot transmit and receive data at the same time. The IrDA SIR physical layer specifies a minimum 10ms transfer delay between transmission and reception. This delay feature must be implemented by software.

For NuMicro™ NUC100/NUC120 Low Density, another alternate function of UART controllers is RS-485 9-bit mode function, and direction control provided by RTS pin or can program GPIO (PB.2 for RTS0 and PB.6 for RTS1) to implement the function by software. The RS-485 mode is selected by setting the UA_FUN_SEL register to select RS-485 function. The RS-485 driver control is implemented using the RTS control signal from an asynchronous serial port to enable the RS-485 driver. In RS-485 mode, many characteristics of the RX and TX are same as UART.

5.13 I²S Controller (I²S)

5.13.1 Overview

The I²S controller consists of IIS protocol to interface with external audio CODEC. Two 8 word deep FIFO for read path and write path respectively and is capable of handling 8 ~ 32 bit word sizes. DMA controller handles the data movement between FIFO and memory.

5.13.2 Features

- I²S can operate as either master or slave
- Capable of handling 8-, 16-, 24- and 32-bit word sizes
- Mono and stereo audio data supported
- I²S and MSB justified data format supported
- Two 8 word FIFO data buffers are provided, one for transmit and one for receive
- Generates interrupt requests when buffer levels cross a programmable boundary
- Two DMA requests, one for transmit and one for receive

7.2 DC Electrical Characteristics

7.2.1 NuMicro™ NUC100/NUC120 Medium Density DC Electrical Characteristics

(V_{DD}-V_{SS}=3.3 V, TA = 25°C, FOSC = 50 MHz unless otherwise specified.)

PARAMETER	SYM.	SPECIFICATION				TEST CONDITIONS
		MIN.	TYP.	MAX.	UNIT	
Operation voltage	V_{DD}	2.5		5.5	V	V_{DD} =2.5 V ~ 5.5 V up to 50 MHz
Power Ground	V_{SS} AV_{SS}	-0.3			V	
LDO Output Voltage	V_{LDO}	-10%	2.5	+10%	V	V_{DD} > 2.7 V
Analog Operating Voltage	AV_{DD}	0		V_{DD}	V	
Analog Reference Voltage	Vref	0		AV_{DD}	V	
Operating Current Normal Run Mode @ 50 MHz	I_{DD1}		54		mA	V_{DD} = 5.5 V@50 MHz, enable all IP and PLL, XTAL=12 MHz
	I_{DD2}		31		mA	V_{DD} = 5.5 V@ 50 MHz, disable all IP and enable PLL, XTAL=12 MHz
	I_{DD3}		51		mA	V_{DD} = 3 V@50 MHz, enable all IP and PLL, XTAL=12 MHz
	I_{DD4}		28		mA	V_{DD} = 3 V@50 MHz, disable all IP and enable PLL, XTAL=12 MHz
Operating Current Normal Run Mode @ 12 MHz	I_{DD5}		22		mA	V_{DD} = 5.5 V@12 MHz, enable all IP and disable PLL, XTAL=12 MHz
	I_{DD6}		14		mA	V_{DD} = 5.5 V@12 MHz, disable all IP and disable PLL, XTAL=12 MHz
	I_{DD7}		20		mA	V_{DD} = 3 V@12MHz, enable all IP and disable PLL, XTAL=12 MHz

PARAMETER	SYM.	SPECIFICATION				TEST CONDITIONS
		MIN.	TYP.	MAX.	UNIT	
	I_{DD8}		12		mA	V_{DD} = 3 V@12 MHz, disable all IP and disable PLL, XTAL=12 MHz
Operating Current Normal Run Mode @ 4 MHz	I_{DD9}		15		mA	V_{DD} = 5 V@4 MHz, enable all IP and disable PLL, XTAL=4 MHz
	I_{DD10}		11		mA	V_{DD} = 5 V@4 MHz, disable all IP and disable PLL, XTAL=4 MHz
	I_{DD11}		13		mA	V_{DD} = 3 V@4 MHz, enable all IP and disable PLL, XTAL=4 MHz
	I_{DD12}		9		mA	V_{DD} = 3 V@4 MHz, disable all IP and disable PLL, XTAL=4 MHz
Operating Current Idle Mode @ 50 MHz	I_{IDLE1}		38		mA	V_{DD}= 5.5 V@50 MHz, enable all IP and PLL, XTAL=12 MHz
	I_{IDLE2}		15		mA	VDD=5.5 V@50 MHz, disable all IP and enable PLL, XTAL=12 MHz
	I_{IDLE3}		35		mA	V_{DD} = 3 V@50 MHz, enable all IP and PLL, XTAL=12 MHz
	I_{IDLE4}		13		mA	V_{DD} = 3 V@50 MHz, disable all IP and enable PLL, XTAL=12 MHz
Operating Current Idle Mode @ 12 MHz	I_{IDLE5}		13		mA	V_{DD} = 5.5 V@12 MHz, enable all IP and disable PLL, XTAL=12 MHz
	I_{IDLE6}		5.5		mA	V_{DD} = 5.5 V@12 MHz, disable all IP and disable PLL, XTAL=12 MHz
	I_{IDLE7}		12		mA	V_{DD} = 3 V@12 MHz, enable all IP and disable PLL, XTAL=12 MHz

7.2.5 Power Down Current Curve

XTAL clock = 12 MHz, PLL Disable

Unit: mA