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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	ARM® Cortex®-M0
Core Size	32-Bit Single-Core
Speed	50MHz
Connectivity	I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, LVR, POR, PWM, WDT
Number of I/O	55
Program Memory Size	32KB (32K x 8)
Program Memory Type	FLASH
EEPROM Size	4K x 8
RAM Size	4K 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	64-LQFP
Supplier Device Package	64-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/nuvoton-technology-corporation-america/m058ssan

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4 PARTS INFORMATION LIST AND PIN CONFIGURATION

4.1 NuMicro™ M058S Series Selection Guide

Part Number	APROM (KB)	RAM (KB)	Data Flash (KB)	ISP ROM (KB)	I/O	Timer (32-Bit)	Connectivity			PWM (16-bit)	ADC (12-bit)	WDT	WWDT	ISP/ICP/IAP	Package	Operating Temperature Range(℃)
							UART	SPI	I^2C							
M058SFAN	32	4	4	4	14	4	1	1	1	1	2	√	√	√	TSSOP20	-40 to +85
M058SZAN	32	4	4	4	26	4	1	1	1	2	5	√	√	√	QFN33	-40 to +85
M058SLAN	32	4	4	4	42	4	1	1	2	4	8	√	√	√	LQFP48	-40 to +85
M058SSAN	32	4	4	4	55	4	1	1	2	4	8	√	√	√	LQFP64	-40 to +85

Table 4.1-1 NuMicro™ M058S Series Selection Guide

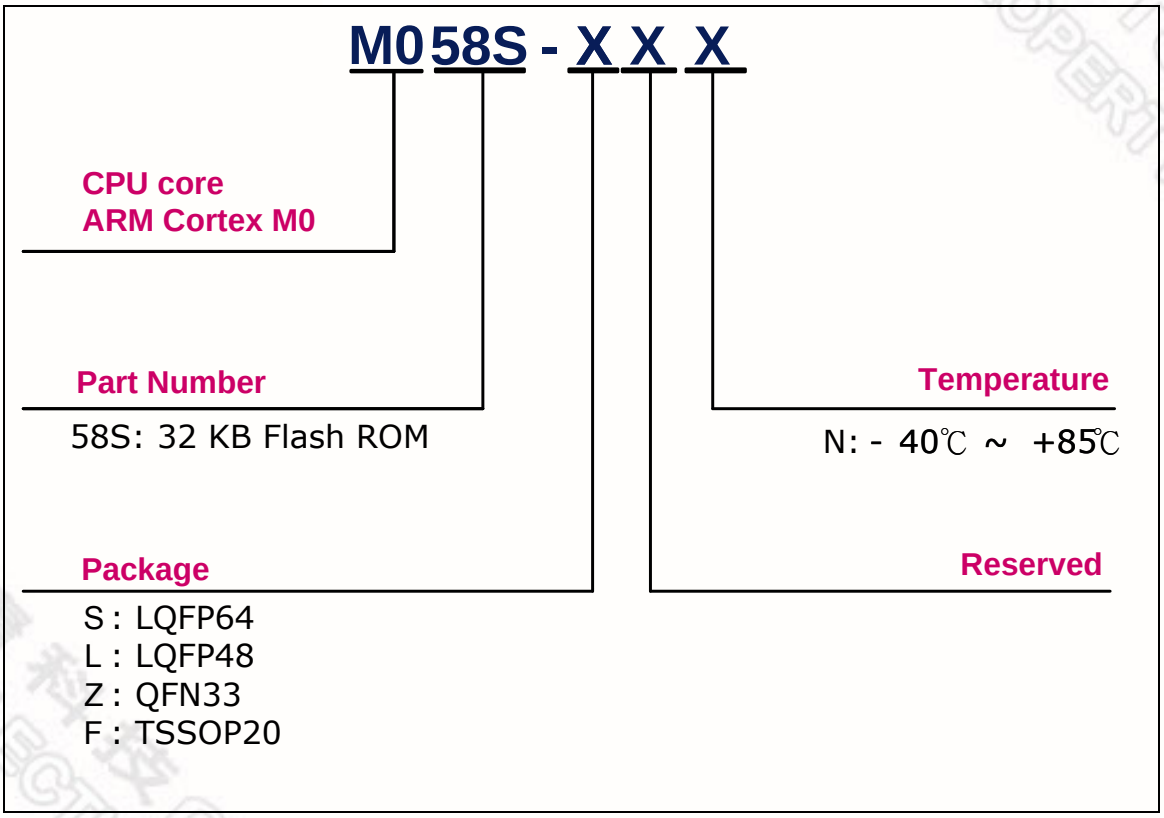


Figure 4.1-1 NuMicro™ M058S Series Selection Code

4.3 Pin Description

Pin Number				Symbol	Alternate Function			Type[1]	Description
TSSOP 20	QFN 33	LQFP 48	LQFP 64		1	2	3		
19	27	41	21 54	V_{DD}				P	Power supply to I/O ports and LDO source for internal PLL and digital circuit.
11	12 33	17	20 53	V_{SS}				P	Ground pin for digital circuit.
20	28	42	55	AV_{DD}				P	Power supply to internal analog circuit.
5	4	6	6	AV_{SS}				P	Analog Ground pin for analog circuit.
	NC	NC	56	V_{ref}				P	Voltage reference input for ADC
12	13	18	22	LDO _CAP				P	LDO output pin **Note:** This pin needs to be connected with a 1uF capacitor.
3	2	4	4	/RST				I (ST)	/RST pin is a Schmitt trigger input pin for hardware device reset. A "**Low"** on this pin for 768 clock counter of Internal RC 22M while the system clock is running will reset the device. /RST pin has an internal pull-up resistor allowing power-on reset by simply connecting an external capacitor to GND.
	26	40	52	P0.0				I/O	**PORT0:** General purpose I/O port, which can be configured by software in four modes. Its multifunction pins are for CTS1, RTS1, CTS0, RTS0, SPISS, MOSI, MISO, and SPICLK. The pins SPISS, MOSI, MISO, and SPICLK are for the SPI function use. CTS: Clear to Send input pin
	25	39	51	P0.1				I/O	
	NC	38	50	P0.2	CTS		TXD[2]	I/O	
	NC	37	49	P0.3	RTS		RXD[2]	I/O	
	24	35	47	P0.4	SPISS[2]			I/O	
18	23	34	46	P0.5	MOSI[2]			I/O	

Pin Number				Symbol	Alternate Function			Type[1]	Description
TSSOP 20	QFN 33	LQFP 48	LQFP 64		1	2	3		
17	22	33	45	P0.6	MISO[2]			I/O	for UART RTS: Request to Send output pin for UART The RXD/TXD pins are for UART function use.
16	21	32	44	P0.7	SPICLK[2]			I/O	
1	29	43	59	P1.0	T2	AIN0		I/O	**PORT1:** General purpose I/O port, which can be configured by software in four modes. Its multifunction pins are for T2, T3, SPISS0, MOSI, MISO, and SPICLK. The pins SPISS0, MOSI, MISO, and SCLK are for the SPI function use. The pins AIN0~AIN7 are for the 12 bits ADC function use. The T2/T3 pins are for Timer2/3 external event counter input.
	NC	44	60	P1.1	T3	AIN1		I/O	
	30	45	61	P1.2		AIN2		I/O	
	31	46	62	P1.3		AIN3		I/O	
2	32	47	63	P1.4	SPISS[2]	AIN4		I/O	
	1	1	1	P1.5	MOSI[2]	AIN5		I/O	
	NC	2	2	P1.6	MISO[2]	AIN6		I/O	
	NC	3	3	P1.7	SPICLK[2]	AIN7		I/O	
	NC	19	27	P2.0	PWM0[2]			I/O	**PORT2:** General purpose I/O port, which can be configured by software in four modes. It has an alternative function. The pins PWM0~PWM3 are for the PWM function use.
	NC	20	28	P2.1	PWM1[2]			I/O	
	14	21	29	P2.2	PWM2[2]			I/O	
13	15	22	30	P2.3	PWM3[2]			I/O	
	16	23	31	P2.4				I/O	
	17	25	33	P2.5				I/O	
	18	26	34	P2.6				I/O	
	NC	27	35	P2.7				I/O	
4	3	5	5	P3.0	RXD[2]			I/O	**PORT3:** General purpose I/O port, which can be configured by software in four modes. Its multifunction pins are for RXD, TXD, /INT0, /INT1, T0 and T1. The RXD/TXD pins are for
6	5	7	10	P3.1	TXD[2]			I/O	
	6	8	11	P3.2	/INT0	STADC	T0EX	I/O	
	NC	9	12	P3.3	/INT1		T1EX	I/O	

5 BLOCK DIAGRAM

5.1 NuMicro™ M058S Block Diagram

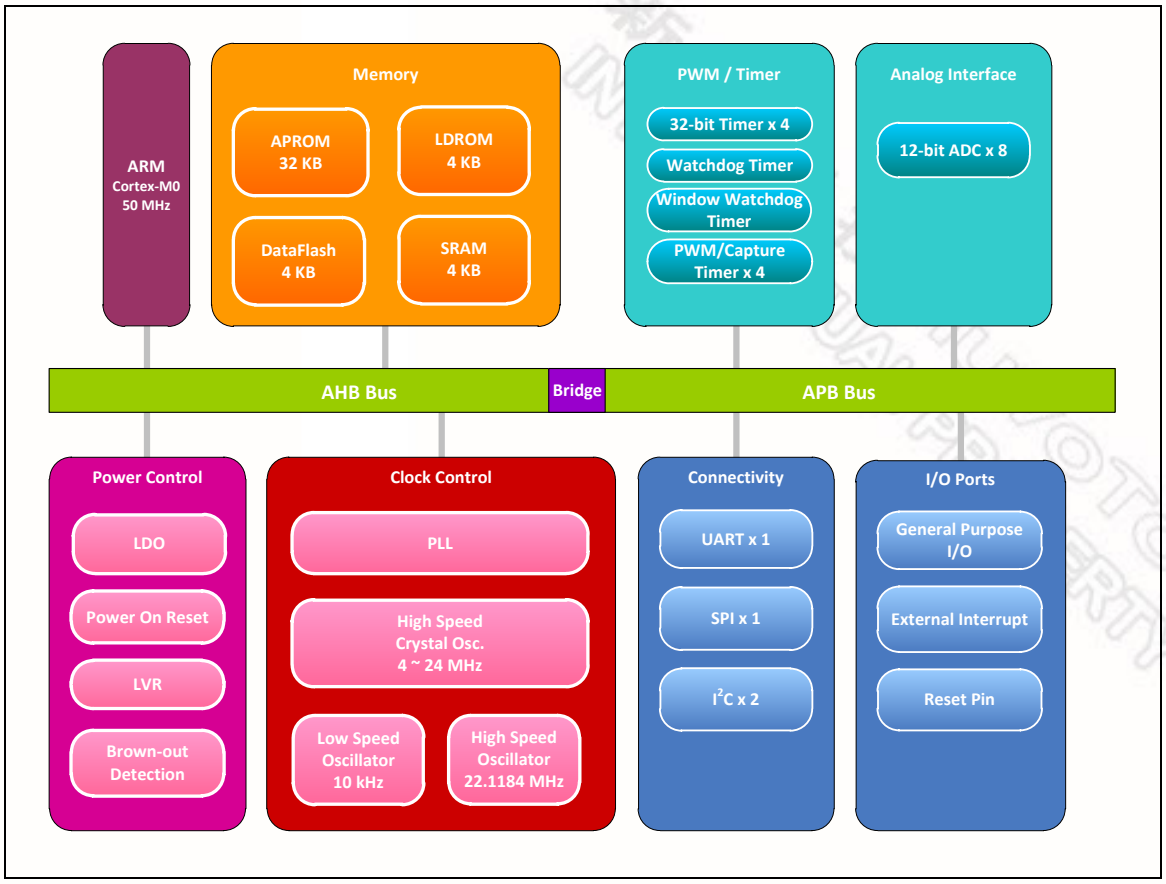


Figure 5.1-1 NuMicro™ M058S Block Diagram

6.2 System Manager

6.2.1 Overview

System management includes the following sections:

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

6.2.2 System Reset

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

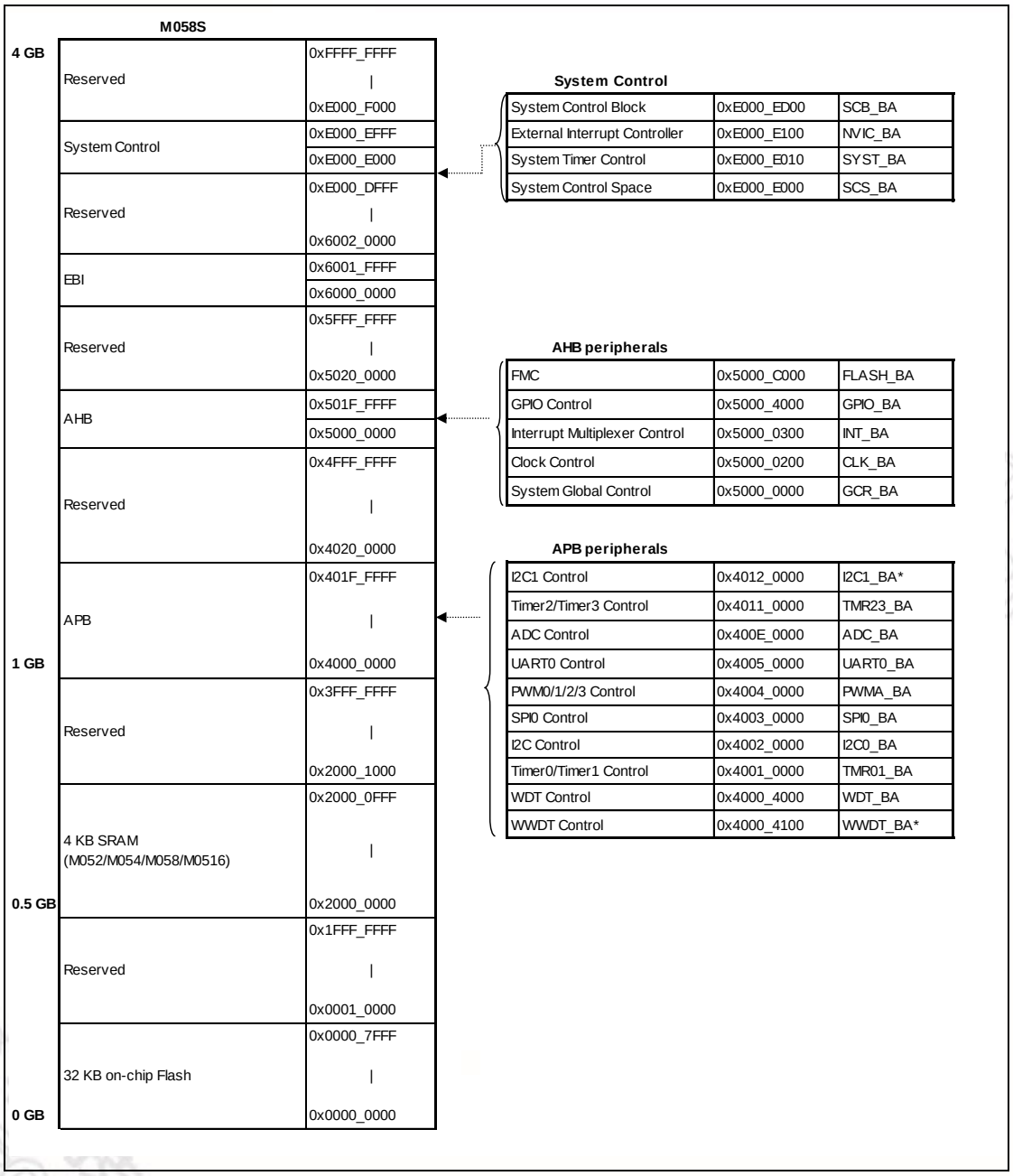
- Hardware Reset
  - Power-on Reset (POR)
  - Low level on the Reset Pin (nRST)
  - Watchdog Timer Time-out Reset (WDT)
  - Low Voltage Reset (LVR)
  - Brown-out Detector Reset (BOD)
- Software Reset
  - MCU Reset - SYSRESETREQ(AIRCR[2])
  - Cortex-M0 Core One-shot Reset - CPU_RST(IPRSTC1[1])
  - Chip One-shot Reset - CHIP_RST(IPRSTC1[0])

Note: ISPCON.BS keeps the original value after MCU Reset and CPU Reset.

0xE000_ED00 – 0xE000_ED8F	SCB_BA	System Control Block Registers

Table 6.2-1 Address Space Assignments for On-Chip Modules

6.2.5 Whole System Memory Mapping



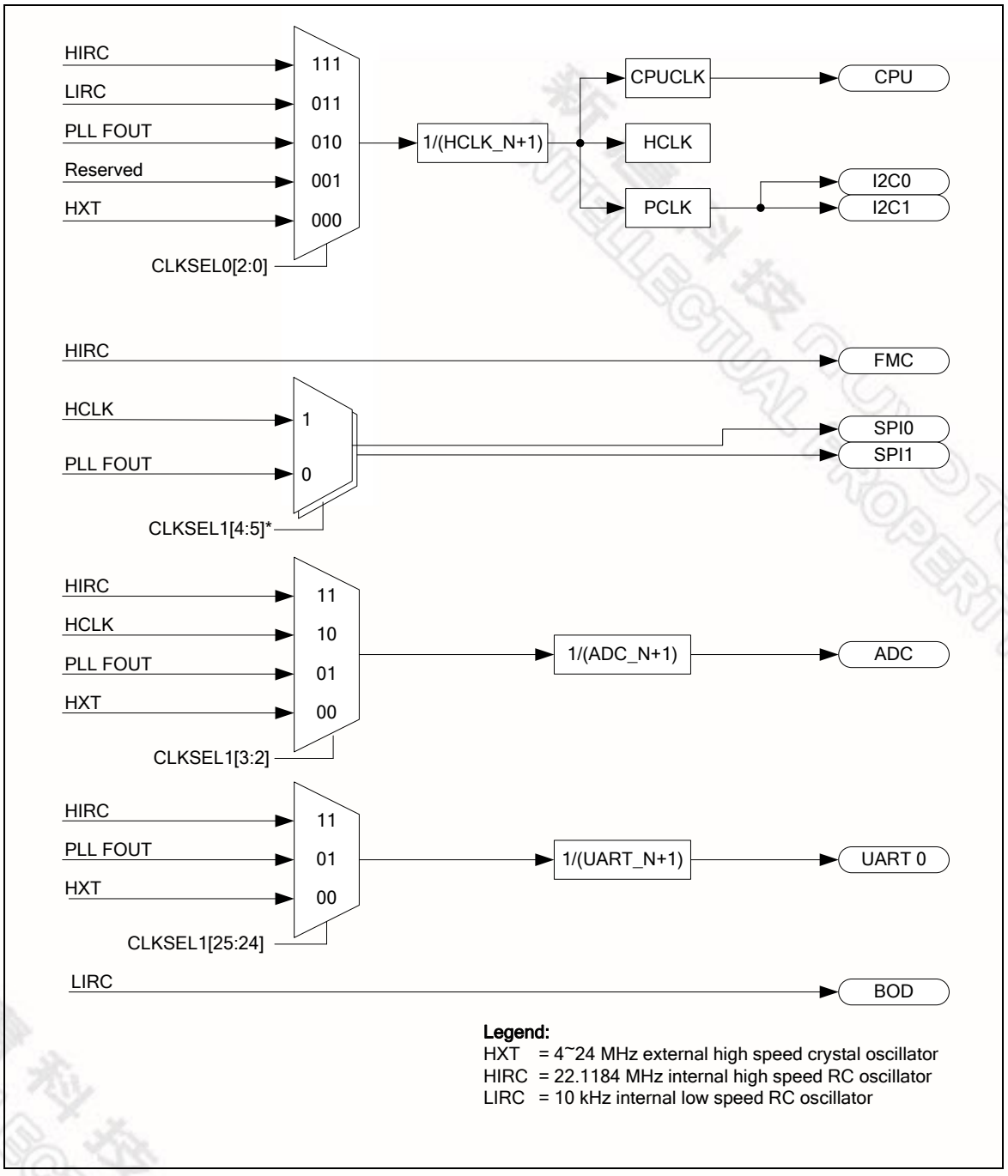
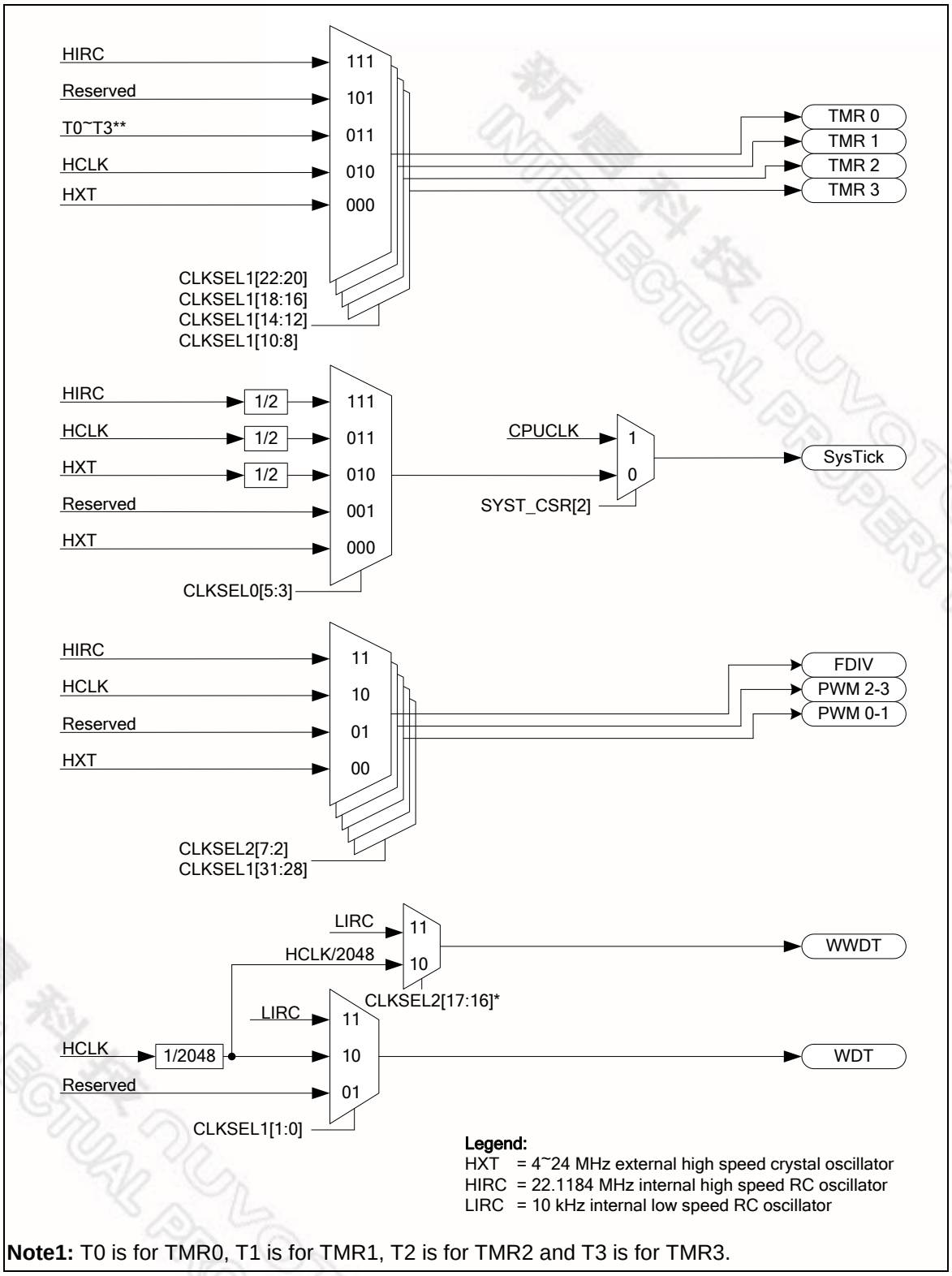


Figure 6.3-2 Clock Source Controller Overview (1/2)



Note1: T0 is for TMR0, T1 is for TMR1, T2 is for TMR2 and T3 is for TMR3.

Figure 6.3-3 Clock Source Controller Overview (2/2)

6.11 I²C Serial Interface Controller (I²C)

6.11.1 Overview

I²C is a two-wire, bi-directional serial bus that provides a simple and efficient method of data exchange between devices. The I²C standard is a true multi-master bus including collision detection and arbitration that prevents data corruption if two or more masters attempt to control the bus simultaneously. There are two sets of I²C which supports Power-down wake up function.

6.11.2 Features

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

- Supports up to two I²C ports
- Master/Slave mode
- Bidirectional data transfer between master and slave
- Multi-master bus (no central master)
- Arbitration between simultaneously transmitting masters without corruption of serial data on the bus
- Serial clock synchronization allowing devices with different bit rates to communicate via one serial bus
- Serial clock synchronization used as a handshake mechanism to suspend and resume serial transfer
- Built-in a 14-bit time-out counter requesting the I²C interrupt if the I²C bus hangs up and timer-out counter overflows.
- Programmable clocks allowing for versatile rate control
- Supports 7-bit addressing mode
- Supports multiple address recognition (four slave address with mask option)
- Supports Power-down Wake-up function

7 ELECTRICAL CHARACTERISTICS

7.1 Absolute Maximum Ratings

SYMBOL	PARAMETER	MIN	MAX	UNIT
DC Power Supply	V_{DD} –V_{SS}	-0.3	+7.0	V
Input Voltage	VIN	V_{SS}-0.3	V_{DD} +0.3	V
Oscillator Frequency	$1/t_{CLCL}$	4	24	MHz
Operating Temperature	TA	-40	+85	°C
Storage Temperature	TST	-55	+150	°C
Maximum Current into V_{DD}		-	120	mA
Maximum Current out of V_{SS}			120	mA
Maximum Current sunk by a I/O pin			35	mA
Maximum Current sourced by a I/O pin			35	mA
Maximum Current sunk by total I/O pins			100	mA
Maximum Current sourced by total I/O pins			100	mA

Note: Exposure to conditions beyond those listed under absolute maximum ratings may adversely affects the lift and reliability of the device.

7.2 DC Electrical Characteristics

(V_{DD} -V_{SS}=2.5~5.5V, TA = 25°C, F_{OSC} = 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} =2.5V ~ 5.5V up to 50 MHz
LDO Output Voltage	V_{LDO}	1.7	1.8	1.9	V	V_{DD} ≥ 2.5V
Band Gap Analog Input	V_{BG}	-5%	1.20	+5%	V	V_{DD} =2.5V ~ 5.5V
Analog Operating Voltage	AV_{DD}	V_{DD}		V_{DD}	V	
Operating Current Normal Run Mode @ 50 MHz	IDD1		20.6		mA	V_{DD} = 5.5V@ 50 MHz, enable all peripherals and PLL, XTAL=12 MHz
	IDD2		14.4		mA	V_{DD} =5.5V@ 50 MHz, disable all peripherals and enable PLL, XTAL=12 MHz
	IDD3		18.9		mA	V_{DD} = 3.3V@ 50 MHz, enable all peripherals and PLL, XTAL=12 MHz
	IDD4		12.8		mA	V_{DD} = 3.3V@ 50 MHz, disable all peripherals and enable PLL, XTAL=12 MHz
Operating Current Normal Run Mode @ 22 MHz	IDD5		6.2		mA	V_{DD} = 5.5V@ 22 MHz, enable all peripherals and IRC 22 MHz, disable PLL
	IDD6		3.4		mA	V_{DD} =5.5V@ 22 MHz, disable all peripherals and enable IRC 22 MHz, disable PLL
	IDD7		6.1		mA	V_{DD} = 3.3V@ 22 MHz, enable all peripherals and IRC 22 MHz, disable PLL
	IDD8		3.4		mA	V_{DD} = 3.3V@ 22 MHz, disable all peripherals and enable IRC 22 MHz, disable PLL
Operating Current Normal Run Mode @ 12 MHz	IDD9		5.3		mA	V_{DD} = 5.5V@ 12 MHz, enable all peripherals and disable PLL, XTAL=12 MHz
	IDD10		3.7		mA	V_{DD} = 5.5V@ 12 MHz, disable all peripherals and disable PLL, XTAL=12 MHz
	IDD11		4.0		mA	V_{DD} = 3.3V@ 12 MHz, enable all peripherals and disable PLL, XTAL=12 MHz
	IDD12		2.3		mA	V_{DD} = 3.3V@ 12 MHz, disable all peripherals and disable PLL, XTAL=12 MHz

Positive going threshold (Schmitt input), /RST	VIHS	0.7 V_{DD}	-	V_{DD} +0.5	V	
Internal /RST pin pull up resistor	RRST	40		150	KΩ	
Negative going threshold (Schmitt input), P0/1/2/3/4	VILS	-0.5	-	0.3 V_{DD}	V	
Positive going threshold (Schmitt input), P0/1/2/3/4	VIHS	0.7 V_{DD}	-	V_{DD} +0.5	V	
Source Current P0/1/2/3/4 (Quasi-bidirectional Mode)	ISR11	-300	-370	-450	μA	V_{DD} = 4.5V, VS = 2.4V
	ISR12	-50	-70	-90	μA	V_{DD} = 2.7V, VS = 2.2V
	ISR13	-40	-60	-80	μA	V_{DD} = 2.5V, VS = 2.0V
Source Current P0/1/2/3/4 (Push-pull Mode)	ISR21	-20	-24	-28	mA	V_{DD} = 4.5V, VS = 2.4V
	ISR22	-4	-6	-8	mA	V_{DD} = 2.7V, VS = 2.2V
	ISR23	-3	-5	-7	mA	V_{DD} = 2.5V, VS = 2.0V
Sink Current P0/1/2/3/4 (Quasi-bidirectional and Push-pull Mode)	ISK11	10	16	20	mA	V_{DD} = 4.5V, VS = 0.45V
	ISK12	7	10	13	mA	V_{DD} = 2.7V, VS = 0.45V
	ISK13	6	9	12	mA	V_{DD} = 2.5V, VS = 0.45V
Brown-Out voltage with BOV_VL [1:0] =00b	VBO2.2	2.0	2.2	2.4	V	V_{DD} =5.5V
Brown-Out voltage with BOV_VL [1:0] =01b	VBO2.7	2.5	2.7	2.9	V	V_{DD} =5.5V
Brown-Out voltage with BOV_VL [1:0] =10b	VBO3.7	3.5	3.7	3.9	V	V_{DD} =5.5V
Brown-Out voltage with BOV_VL [1:0] =11b	VBO4.4	4.2	4.4	4.6	V	V_{DD} =5.5V
Hysteresis range of BOD voltage	VBH	30	-	150	mV	V_{DD} = 2.5V~5.5V

Notes:

1. /RST pin is a Schmitt trigger input.
2. XTAL1 is a CMOS input.
3. Pins of P0 - P7 can source a transition current when they are being externally driven from 1 to 0. In the condition of V_{DD}=5.5V, 5he transition current reaches its maximum value when Vin approximates to 2V.

7.3.4 Internal 22.1184 MHz RC Oscillator

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Center Frequency	-	-	22.1184		MHz
Calibrated Internal Oscillator Frequency	+25°C; V_{DD} =5V	-3	-	+3	%
	-40°C~+85°C; V_{DD}=2.5V~5.5V	-5	-	+5	%
Operating current	V_{DD} =5V	-	500	-	uA

7.3.5 Internal 10 kHz RC Oscillator

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply voltage[1]	-	2.5	-	5.5	V
Center Frequency	-	-	10	-	kHz
Calibrated Internal Oscillator Frequency	+25°C; V_{DD} =5V	-30	-	+30	%
	-40°C~+85°C; V_{DD}=2.5V~5.5V	-50	-	+50	%
Operating current	V_{DD} =5V	-	5	-	uA

Notes:

1. Internal operation voltage comes from LDO.

7.4 Analog Characteristics

7.4.1 12-bit SARADC Specification

SYMBOL	PARAMETER		MIN.	TYP.	MAX.	UNIT
-	Resolution		-	-	12	Bit
DNL	Differential nonlinearity error		-	-1~2.0	-1~4.0	LSB
INL	Integral nonlinearity error		-	±2	±4	LSB
E_O	Offset error		-	3	-	LSB
E_G	Gain error (Transfer gain)		-	1	1.005	-
E_F	Full scale error			±2		LSB
E_A	Absolute error	AV_{DD} =5V		5		LSB
		AV_{DD} =3V		4		
-	Monotonic		Guaranteed			
F_{ADC}	ADC clock frequency	AV_{DD} =5V	-	-	16	MHz
		AV_{DD} =3V			8	
F_S	Sample rate		-	-	760	K SPS
T_S	Sampling time		7			ADC clock
V_{DDA}	Supply voltage		3	-	5.5	V
I_{DD}	Supply current (Avg.)		-	0.5	-	mA
I_{DDA}	Supply current (Avg.) @ AV_{DD} =3.0V		-	2.5	-	mA
V_{IN}	Analog Input voltage		0	-	V_{ref}[1]	V

Note[1]: V_{ref} is connected to AV_{DD} for LQFP48/QFN33 package.

7.4.2 LDO Specification

RAMETER	MIN	TYP	MAX	UNIT	NOTE
Input Voltage	2.5		5.5	V	V_{DD} input voltage
Output Voltage	-10%	1.8	+10%	V	LDO output voltage
Temperature	-40	25	85	℃	
C	-	1	-	uF	Resr=1ohm

Note:

1. It is recommended a 100nF bypass capacitor is connected between V_{DD} and the closest V_{SS} pin of the device.
2. For ensuring power stability, a 1uF or higher capacitor must be connected between LDO pin and the closest V_{SS} pin of the device.

7.4.3 Low Voltage Reset Specification

PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
Operation voltage	-	2.5	5	5.5	V
Temperature	-	-40	25	85	℃
Quiescent current	V_{DD} =5.5V	-	-	5	uA
Threshold voltage	Temperature=25°	1.7	2.0	2.3	V
	Temperature=-40°	-	2.3	-	V
	Temperature=85°	-	1.8	-	V
Hysteresis	-	0	0	0	V

7.4.4 Brown-Out Detector Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Operation voltage	-	2.5	-	5.5	V
Quiescent current	AV_{DD} =5.5V	-	-	140	μA
Temperature	-	-40	25	85	℃
Brown-Out voltage	BOV_VL[1:0]=11	4.2	4.4	4.6	V
	BOV_VL [1:0]=10	3.5	3.7	3.9	V
	BOV_VL [1:0]=01	2.6	2.7	2.8	V
	BOV_VL [1:0]=00	2.1	2.2	2.3	V
Hysteresis	-	30m	-	150m	V

7.4.5 Power-On Reset Specification (5V)

Parameter	Condition	Min.	Typ.	Max.	Unit
Temperature	-	-40	25	85	℃
Reset voltage	V+	-	2	-	V
Quiescent current	Vin>reset voltage	-	1	-	nA

7.4.6 Temperature Sensor Specification

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply voltage[1]		1.62	1.8	1.98	V
Temperature		-40	-	85	℃
Gain		-1.72	-1.76	-1.80	mV/℃

9 REVISION HISTORY

Revision	Date	Description
1.00	Jun. 12, 2014	First version
1.01	Jul. 24, 2014	Corrected 7.5 Flash DC Electrical Characteristics.
1.02	Sep. 12, 2014	1. Adjusted the format of Table 4.1-1 NuMicro™ M058S Series Selection Guide. 2. Updated Figure 4.1-1 NuMicro™ M058S Series Selection Code. 3. Added Chapter 3 ABBREVIATIONS. 4. Added 7.6 SPI Dynamic Characteristics. 5. Changed the order of Chapter 5 BLOCK DIAGRAM and Chapter 6 FUNCTIONAL DESCRIPTION. 6. Fixed typos and obscure descriptions.
1.03	Nov. 27, 2014	1. Fixed typos of Table 4.1-1 NuMicro™ M058S Series Selection Guide

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