

**NuMicro<sup>®</sup> Family**  
**Arm<sup>®</sup> Cortex<sup>®</sup>-M0-based Microcontroller**

# M0A21/M0A23 Series Datasheet

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## 1 GENERAL DESCRIPTION

The NuMicro® M0A21/M0A23 series is a 32-bit microcontroller based on Arm® Cortex®-M0 core. It provides compact package with highly flexible digital pin function assignment, rich analog peripherals, -40°C to 125°C operating temperature, 2.4V ~ 5.5V operating voltage, CAN 2.0B and LIN interface for robust communication. The NuMicro® M0A21/M0A23 series targets robust and high operating temperature applications, such as 24 GHz mmWave radar, Battery Management System (BMS), car lighting, electric window lifter, and power seat.

The NuMicro® M0A21/M0A23 series provide SSOP20 and TSSOP28 package with rich analog and digital functions, which are especially suitable for small form factor applications. SSOP20 provides up to 18 IO pins and TSSOP28 provides up to 26 IO pins. Each IO pin of the M0A21/M0A23 series can be arbitrarily assigned to digital peripherals, such as UART, SPI, and PWM. The M0A21/M0A23 series provides rich analog functions including 17-ch 12-bit 800 kSPS ADC, 1 set of 5-bit DAC and 2 sets of ACMP in both SSOP20 and TSSOP28 package. Moreover, it provides low voltage reset (LVR) and brown-out detector (BOD) to ensure the system safety.

The NuMicro® M0A21/M0A23 series runs up to 48 MHz and supports hardware divider. It provides 32 Kbytes Flash memory, 4 Kbytes SRAM and 2 Kbytes LDRAM for ISP (In-System Programming) feature for easily firmware update. It is equipped with plenty of peripherals including up to four 32-bit timers, 6-ch 16-bit PWM generators, 1 set of CAN 2.0B controller, 2 sets of LIN functions, 5-ch PDMA, 2 sets of UART with One-Wire mode, IrDA and RS485 functions. Besides, the M0A21/M0A23 series provides two sets of Universal Serial Control Interfaces (USCI) that can be configured as UART, SPI or I<sup>2</sup>C.

The package types of the M0A21/M0A23 series are included SSOP20 (5.3x7.2x1.75 mm) and TSSOP28 (4.4x9.7x1.0 mm).

| Product Line | CAN | UART | LIN | USCI | Timer | PWM | PDMA | ADC | ACMP | Divider |
|--------------|-----|------|-----|------|-------|-----|------|-----|------|---------|
| M0A21        | 0   | 2    | 2   | 2    | 4     | 6   | 5    | 17  | 2    | 1       |
| M0A23        | 1   | 2    | 2   | 2    | 4     | 6   | 5    | 17  | 2    | 1       |

Table 1-1 NuMicro® M0A21/M0A23 Series Key Features Table

The M0A21/M0A23 is targeted at applications such as:

- 24GHz mmWave radar
- BMS (Battery Management System)
- Industrial control
- Car lighting
- Car windows
- Power seat

## 2 FEATURES

| <b>Core and System</b>          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Arm® Cortex®-M0</b>          | <ul style="list-style-type: none"> <li>• Arm® Cortex®-M0 core, running up to 48 MHz</li> <li>• Built-in Nested Vectored Interrupt Controller (NVIC)</li> <li>• 24-bit system tick timer</li> <li>• Programmable and maskable interrupt</li> <li>• Low Power Sleep mode by WFI and WFE instructions</li> </ul>                                                                                                                                                                                                                                    |
| <b>Brown-out Detector (BOD)</b> | <ul style="list-style-type: none"> <li>• Four-level BOD with brown-out interrupt and reset option. (4.4V/3.7V/2.7V/2.3V)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Low Voltage Reset (LVR)</b>  | <ul style="list-style-type: none"> <li>• LVR with 2.22V threshold voltage level</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Security</b>                 | <ul style="list-style-type: none"> <li>• 96-bit Unique ID (UID).</li> <li>• 128-bit Unique Customer ID (UCID).</li> <li>• One built-in temperature sensor.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                            |
| <b>32-bit H/W Divider(HDIV)</b> | <ul style="list-style-type: none"> <li>• Signed (two's complement) integer calculation</li> <li>• 32-bit dividend with 16-bit divisor calculation capacity</li> <li>• 32-bit quotient and 32-bit remainder outputs (16-bit remainder with sign extends to 32-bit)</li> <li>• 6 HCLK clocks taken for one cycle calculation</li> </ul>                                                                                                                                                                                                            |
| <b>Memories</b>                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Boot Loader</b>              | <ul style="list-style-type: none"> <li>• Nuvoton ISP (In-System-Programming) tool for firmware upgrade via UART</li> <li>• ISP/IAP libraries</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Flash</b>                    | <ul style="list-style-type: none"> <li>• Up to 32 KB application ROM (APROM)</li> <li>• 2 KB on-chip Flash for user-defined loader (LDROM)</li> <li>• All on-chip Flash support 512 bytes page erase</li> <li>• Fast Flash programming verification with CRC</li> <li>• On-chip Flash programming with In-Chip Programming (ICP), In-System Programming (ISP) and In-Application Programming (IAP) capabilities</li> <li>• Configurable boot up sources including boot loader, user-defined loader (LDROM) or Application ROM (APROM)</li> </ul> |

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                     | <ul style="list-style-type: none"> <li>• Data Flash with configurable memory size</li> <li>• 2-wired ICP Flash updating through SWD interface</li> <li>• 32-bit and multi-word Flash programming function</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                         |
| SRAM                                | <ul style="list-style-type: none"> <li>• Up to 4 KB embedded SRAM</li> <li>• Supports byte-, half-word- and word-access</li> <li>• Supports PDMA mode</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Cyclic Redundancy Calculation (CRC) | <ul style="list-style-type: none"> <li>• Supports CRC-CCITT, CRC-8, CRC-16 and CRC-32 polynomials</li> <li>• Programmable initial value</li> <li>• Programmable order reverse setting and one's complement setting for input data and CRC checksum</li> <li>• 8-bit, 16-bit, and 32-bit data width</li> <li>• 8-bit write mode with 1-AHB clock cycle operation</li> <li>• 16-bit write mode with 2-AHB clock cycle operation</li> <li>• 32-bit write mode with 4-AHB clock cycle operation</li> <li>• Uses DMA to write data with performing CRC operation</li> </ul>                                                                       |
| Peripheral DMA (PDMA)               | <ul style="list-style-type: none"> <li>• Supports up to 5 independent configurable channels for automatic data transfer between memories and peripherals</li> <li>• Basic and Scatter-Gather transfer modes</li> <li>• Each channel supports circular buffer management using Scatter-Gather Transfer mode</li> <li>• Stride function for rectangle image data movement</li> <li>• Fixed-priority and Round-robin priorities modes</li> <li>• Single and burst transfer types</li> <li>• Byte-, half-word- and word transfer unit with count up to 65536</li> <li>• Request source can be from software, UART, ADC, PWM and Timer</li> </ul> |
| <b>Clocks</b>                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| External Clock Source               | <ul style="list-style-type: none"> <li>• 4~24 MHz High-speed eXternal crystal oscillator (HXT) for precise timing operation</li> <li>• 32.768 kHz Low-speed eXternal crystal oscillator (LXT) for low-power system operation</li> <li>• Supports clock failure detection for external crystal oscillators and exception generation (NMI)</li> </ul>                                                                                                                                                                                                                                                                                          |
| Internal Clock Source               | <ul style="list-style-type: none"> <li>• 48 MHz High-speed Internal RC oscillator (HIRC) trimmed to</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | <ul style="list-style-type: none"> <li>• <math>\pm 0.25\%</math> accuracy that can optionally be used as a system clock</li> <li>• 38.4 kHz Low-speed Internal RC oscillator (LIRC) for watchdog timer and wakeup operation</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Timers</b>       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>32-bit Timer</b> | <ul style="list-style-type: none"> <li>• Four sets of 32-bit timers with 24-bit up counter and one 8-bit pre-scale counter from independent clock source</li> <li>• One-shot, Periodic, Toggle and Continuous Counting operation modes</li> <li>• Supports event counting function to count the event from external pins</li> <li>• Supports external capture pin for enhanced interval measurement and resetting 24-bit up counter</li> <li>• Supports chip wake-up from Idle/Power-down mode if a timer interrupt signal is generated</li> <li>• Timer interrupt flag or external capture interrupt flag to trigger PWM, ADC and PDMA.</li> </ul>                                                                                                                                                          |
| <b>PWM</b>          | <ul style="list-style-type: none"> <li>• Three 16-bit counters with 12-bit prescale for six 48 MHz PWM output channels.</li> <li>• Supports independent mode for PWM output/Capture input channel</li> <li>• Supports complementary mode for 3 complementary paired PWM output channel</li> <li>• Dead-time insertion with 12-bit resolution</li> <li>• Two compared values during one period</li> <li>• Supports 16-bit resolution PWM counter</li> <li>• Up, down or up-down PWM counter type</li> <li>• Supports mask function and tri-state enable for each PWM pin</li> <li>• Supports brake function</li> <li>• Up to 6 independent input capture channels with 16-bit resolution counter</li> <li>• Counter synchronous start function</li> <li>• Able to trigger ADC to start conversion.</li> </ul> |
| <b>Watchdog</b>     | <ul style="list-style-type: none"> <li>• 20-bit free running up counter for WDT time-out interval.</li> <li>• Selectable time-out interval (24 ~ 220) and the time-out interval is 416us ~ 27.3 s if WDT_CLK = 38.4 kHz (LIRC).</li> <li>• System kept in reset state for a period of <math>(1 / \text{WDT\_CLK}) * 63</math>.</li> <li>• Able to wake up from Power-down or Idle mode</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                            |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <ul style="list-style-type: none"> <li>• Interrupt or reset selectable on watchdog time-out</li> <li>• Supports selectable WDT reset delay period, including 1026, 130, 18 or 3 WDT_CLK reset delay period.</li> <li>• Supports to force WDT enabled after chip powered on or reset by setting CWDTEN[2:0] in Config0 register.</li> <li>• Supports WDT time-out wake-up function only if WDT clock source is selected as LIRC or LXT.</li> </ul> |
| <b>Window Watchdog</b> | <ul style="list-style-type: none"> <li>• Clock sources from HCLK/2048 (default selection) or LIRC</li> <li>• Window set by 6-bit down counter with 11-bit prescale</li> <li>• WWDT counter suspends in Idle/Power-down mode</li> <li>• Supports Interrupt</li> </ul>                                                                                                                                                                              |

### Analog Interfaces

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Analog-to-Digital Converter (ADC)</b> | <ul style="list-style-type: none"> <li>• Analog input voltage range: 0 ~ AV<sub>DD</sub> (voltage of V<sub>DD</sub> pin).</li> <li>• 12-bit resolution and 10-bit accuracy is guaranteed.</li> <li>• Up to 17 single-end analog input channels or 8 differential analog input channels</li> <li>• Maximum ADC peripheral clock frequency is 16 MHz.</li> <li>• Up to 800 kSPS sampling rate.</li> <li>• Four operation modes: <ul style="list-style-type: none"> <li>- Single mode: A/D conversion is performed one time on a specified channel.</li> <li>- Burst mode: A/D converter samples and converts the specified single channel and sequentially stores the result in FIFO.</li> <li>- Single-cycle Scan mode: A/D conversion is performed only one cycle on all specified channels with the sequence from the smallest numbered channel to the largest numbered channel.</li> <li>- Continuous Scan mode: A/D converter continuously performs Single-cycle Scan mode until software stops A/D conversion.</li> </ul> </li> <li>• An A/D conversion can be started by: <ul style="list-style-type: none"> <li>• Software Write 1 to ADST bit.</li> <li>• External pin (STADC).</li> <li>• Timer 0~3 overflow pulse trigger.</li> <li>• PWM trigger.</li> </ul> </li> <li>• Each conversion result is held in data register of each channel with valid and overrun indicators.</li> </ul> |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                          | <ul style="list-style-type: none"> <li>• Conversion result can be compared with specified value and user can select whether to generate an interrupt when conversion result matches the compare register setting.</li> <li>• 4 internal channels band-gap voltage (VBG), temperature sensor (<math>V_{TEMP}</math>), internal reference voltage and DAC0 output</li> <li>• Supports PDMA transfer mode</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Digital to Analog Converter (DAC)</b> | <ul style="list-style-type: none"> <li>• Supports one 5-bit 100 kSPS voltage type DAC</li> <li>• Analog output voltage range: 0~<math>AV_{DD}</math> (voltage of <math>V_{DD}</math> pin)</li> <li>• Reference voltage from internal reference voltage <math>V_{REF}</math> pin or <math>AV_{DD}</math></li> <li>• DAC maximum conversion updating rate 100K sps</li> <li>• Rail to rail settle time 10us</li> <li>• Supports software and timer0~3 trigger to start DAC conversion</li> <li>• Supports PDMA mode</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Analog Comparator (ACMP)</b>          | <ul style="list-style-type: none"> <li>• Analog input voltage range: 0 ~ <math>AV_{DD}</math> (voltage of <math>V_{DD}</math> pin)</li> <li>• Up to two rail-to-rail analog comparators</li> <li>• Supports hysteresis function</li> <li>• Supports wake-up function</li> <li>• Selectable input sources of positive input and negative input</li> </ul> <p><b>ACMP0 supports:</b></p> <ul style="list-style-type: none"> <li>• 3 multiplexed I/O pins at positive sources: <ul style="list-style-type: none"> <li>- ACMP0_P0, Comparator Reference Voltage (CRV), and DAC0 output</li> </ul> </li> <li>• 5 negative sources: <ul style="list-style-type: none"> <li>- ACMP0_N0, ACMP0_N1, ACMP0_N2, ACMP0_N3</li> <li>- Comparator Reference Voltage (CRV)</li> </ul> </li> </ul> <p><b>ACMP1 supports:</b></p> <ul style="list-style-type: none"> <li>• 3 multiplexed I/O pins at positive sources: <ul style="list-style-type: none"> <li>- ACMP1_P0, Comparator Reference Voltage (CRV), and DAC0 output</li> </ul> </li> <li>• 5 negative sources:</li> </ul> <p><b>ACMP1_N</b></p> <ul style="list-style-type: none"> <li>• ACMP1_N0, ACMP1_N1, ACMP1_N2, ACMP1_N3</li> <li>• Comparator Reference Voltage (CRV)</li> <li>• Shares one ACMP interrupt vector for all comparators</li> <li>• Interrupts generated when compare results change (Interrupt event condition is programmable)</li> </ul> |

- Supports triggers for break events and cycle-by-cycle control for PWM
- Supports window compare mode and window latch mode

### Communication Interfaces

#### UART

- Supports up to 2 UARTs: UART0, UART1
- UART baud rate clock from LXT (32.768 kHz) with 9600bps can work normally in power down mode even system clock is stopped
- Full-duplex asynchronous communications
- Separates receive and transmit 16/16 bytes entry FIFO for data payloads
- Supports hardware auto-flow control (RX, TX, CTS and RTS) and programmable receiver buffer trigger level
- Supports programmable baud rate generator for each channel individually
- Supports 8-bit receiver buffer time-out detection function
- Programmable transmitting data delay time between the last stop and the next start bit  
by setting DLY (UART\_TOUT [15:8])
- Supports Auto-Baud Rate measurement and baud rate compensation function
- Supports break error, frame error, parity error and receive/transmit buffer overflow detection function
- Fully programmable serial-interface characteristics
- Programmable number of data bit, 5-, 6-, 7-, 8- bit character
- Programmable parity bit, even, odd, no parity or stick parity bit generation and detection
- Programmable stop bit, 1, 1.5, or 2 stop bit generation
- Supports LIN function mode
- Supports LIN master/slave mode
- Supports programmable break generation function for transmitter
- Supports break detection function for receiver
- Supports LIN slave header time-out detection function
- Supports LIN response time-out detection function
- Supports LIN wake-up function
- Supports IrDA SIR function mode
- Supports for 3/16 bit duration for normal mode

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                           | <ul style="list-style-type: none"> <li>• Supports RS-485 mode</li> <li>• Supports RS-485 9-bit mode</li> <li>• Supports hardware or software enables to program nRTS pin to control RS-485 transmission direction</li> <li>• Supports nCTS, incoming data, Received Data FIFO reached threshold and RS-485 Address Match (AAD mode) wake-up function</li> <li>• Supports PDMA mode</li> <li>• Supports Single-wire function mode.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| CAN                                       | <ul style="list-style-type: none"> <li>• Supports CAN protocol version 2.0 part A and B</li> <li>• Bit rates up to 1 MBit/s</li> <li>• 32 Message Objects</li> <li>• Supports wake-up function</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Universal Serial Control Interface (USCI) | <ul style="list-style-type: none"> <li>• Supports one set of USCI</li> <li>• USCI supports UART, SPI and I<sup>2</sup>C function</li> <li>• Single byte TX and RX buffer mode</li> </ul> <p><b>UART</b></p> <ul style="list-style-type: none"> <li>• One transmit buffer and two receive buffer for data payload</li> <li>• Hardware auto flow control function and programmable flow control trigger level</li> <li>• Programmable baud-rate generator</li> <li>• Supports 9-Bit Data Transfer</li> <li>• Baud rate detection by built-in capture event of baud rate generator</li> <li>• Supports Wake-up function (Data and nCTS Wakeup Only)</li> <li>• Supports PDMA transfer</li> </ul> <p><b>SPI</b></p> <ul style="list-style-type: none"> <li>• Master or Slave mode operation (maximum frequency: master = <math>f_{PCLK} / 2</math>, slave &lt; <math>f_{PCLK} / 5</math>)</li> <li>• Configurable bit length of a transfer word from 4 to 16-bit</li> <li>• One transmit buffer and two receive buffer for data payload</li> <li>• MSB first or LSB first transfer sequence</li> <li>• Word suspend function</li> <li>• Supports PDMA transfer</li> <li>• Supports 3-wire, no slave select signal, bi-direction interface</li> <li>• Wake-up function: input slave select transition</li> </ul> |



- Supports one data channel half-duplex transfer

#### I<sup>2</sup>C

- Full master and slave device capability
- 7-bit addressing mode (10-bit mode Not supported)
- Communication in standard mode (100 kbps) or in fast mode (up to 400 kbps)
- Multi-master bus
- One transmit buffer and two receive buffer for data payload
- Supports 10-bit bus time-out capability
- Supports Bus monitor mode
- Power down wake-up by data toggle or address match
- Multiple address recognition
- Device address flag
- Setup/hold time programmable

#### GPIO

- Four I/O modes:
  - Quasi-bidirectional mode
  - Push-Pull Output mode
  - Open-Drain Output mode
  - Input only with high impedance mode
- Schmitt trigger input
- I/O pin configured as interrupt source with edge/level trigger setting
- Supports high drive and high sink current I/O
- Supports independent pull-up control
- Maximum I/O Speed is 24 MHz when  $V_{DD} = 2.4 \sim 5.5V$ .
- Supports up to 18/26 GPIOs for SSOP20 TSSOP28 respectively
- Enabling the pin interrupt function will also enable the wake-up function

3 PARTS INFORMATION

3.1 Package Type

Package is Halogen-free, RoHS-compliant and TSCA-compliant.

| SSOP20     | TSSOP28    |
|------------|------------|
| M0A21OB1AC | M0A21EB1AC |
| M0A21OC1AC | M0A21EC1AC |
| M0A23OC1AC | M0A23EC1AC |

## 3.2 NuMicro® M0A21/M0A23 Series Selection Guide

### 3.2.1 NuMicro® M0A21 Series

| Part Number | Flash (KB) | SRAM (KB) | ISP ROM (KB) | I/O | Timer | PWM | PDMA | Connectivity |      |     |     | DAC | LXT | ACMP | ADC(12-Bit) | Package |
|-------------|------------|-----------|--------------|-----|-------|-----|------|--------------|------|-----|-----|-----|-----|------|-------------|---------|
|             |            |           |              |     |       |     |      | USCI*        | UART | LIN | CAN |     |     |      |             |         |
| M0A21OB1AC  | 16         | 4         | 2            | 18  | 4     | 6   | 5    | 2            | 2    | 2   | -   | 1   | 1   | 2    | 17-ch       | SSOP20  |
| M0A21OC1AC  | 32         | 4         | 2            | 18  | 4     | 6   | 5    | 2            | 2    | 2   | -   | 1   | 1   | 2    | 17-ch       | SSOP20  |
| M0A21EB1AC  | 16         | 4         | 2            | 26  | 4     | 6   | 5    | 2            | 2    | 2   | -   | 1   | 1   | 2    | 17-ch       | TSSOP28 |
| M0A21EC1AC  | 32         | 4         | 2            | 26  | 4     | 6   | 5    | 2            | 2    | 2   | -   | 1   | 1   | 2    | 17-ch       | TSSOP28 |

USCI\*: supports UART, SPI or I<sup>2</sup>C

### 3.2.2 NuMicro® M0A23 Series

| Part Number | Flash (KB) | SRAM (KB) | ISP ROM (KB) | I/O | Timer | PWM | PDMA | Connectivity |      |     |     | DAC | LXT | ACMP | ADC(12-Bit) | Package |
|-------------|------------|-----------|--------------|-----|-------|-----|------|--------------|------|-----|-----|-----|-----|------|-------------|---------|
|             |            |           |              |     |       |     |      | USCI*        | UART | LIN | CAN |     |     |      |             |         |
| M0A23OC1AC  | 32         | 4         | 2            | 18  | 4     | 6   | 5    | 2            | 2    | 2   | 1   | 1   | 1   | 2    | 17-ch       | SSOP20  |
| M0A23EC1AC  | 32         | 4         | 2            | 26  | 4     | 6   | 5    | 2            | 2    | 2   | 1   | 1   | 1   | 2    | 17-ch       | TSSOP28 |

USCI\*: supports UART, SPI or I<sup>2</sup>C

3.2.3 NuMicro® M0A21/M0A23 Selection Code

| Core       | Series                            | Package                                                | Flash Size           | SRAM Size | Revision | Temperature     |
|------------|-----------------------------------|--------------------------------------------------------|----------------------|-----------|----------|-----------------|
| M0         | A21                               | O                                                      | C                    | 1         | A        | C               |
| Cortex®-M0 | A21: without CAN<br>A23: with CAN | O: SSOP20<br>(5.3x7.2 mm)<br>E: SSOP28<br>(4.4x9.7 mm) | B: 16 KB<br>C: 32 KB | 1: 4 KB   |          | C:-40°C ~ 125°C |

4 PIN CONFIGURATION

The pin configuration information can be found in the M0A21/M0A23 Series Multi-function Summary Table section or by using [NuTool - PinConfigure](#). The NuTool - PinConfigure contains all Nuvoton NuMicro® Family chip series with all part number, and helps configure GPIO multi-function pins correctly and handily.

4.1 Pin Configuration

4.1.1 M0A21 Series Pin Diagram

4.1.1.1 SSOP20 Package

Corresponding Part Number: M0A21OB1AC, M0A21OC1AC

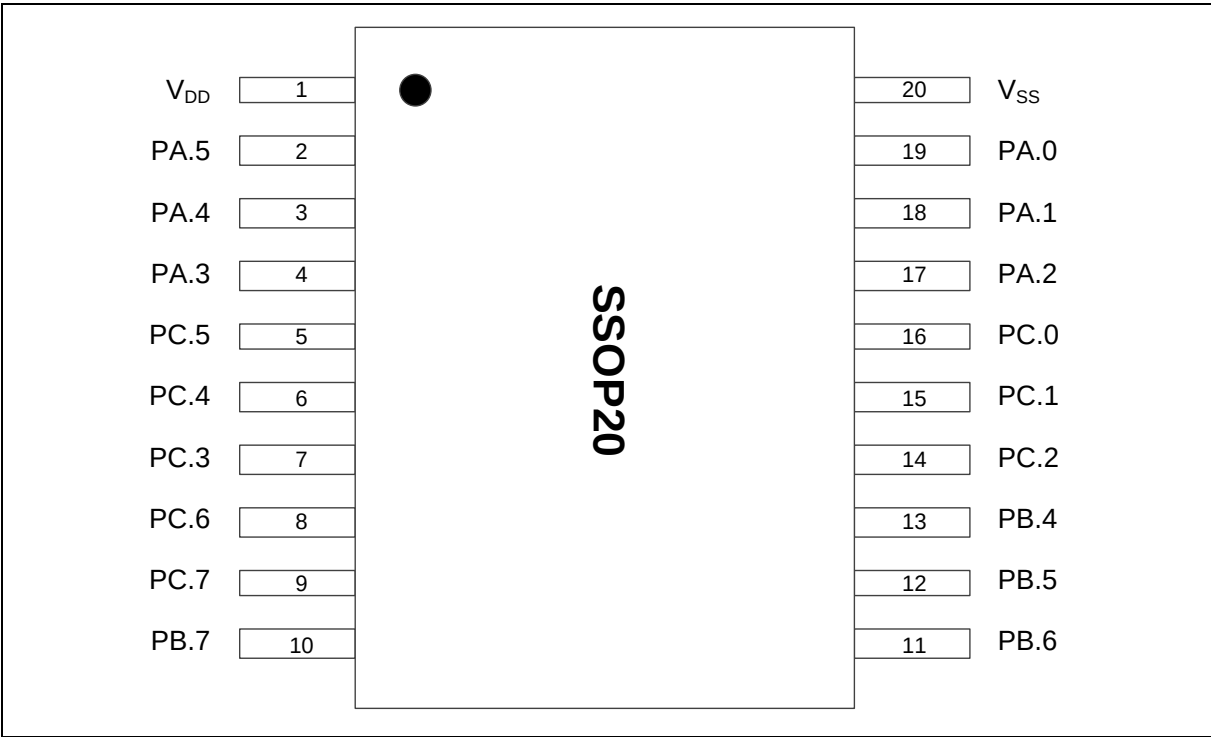


Figure 4.1-1 M0A21 Series SSOP 20-pin Diagram

4.1.1.2 TSSOP28 Package

Corresponding Part Number: M0A21EB1AC, M0A21EC1AC

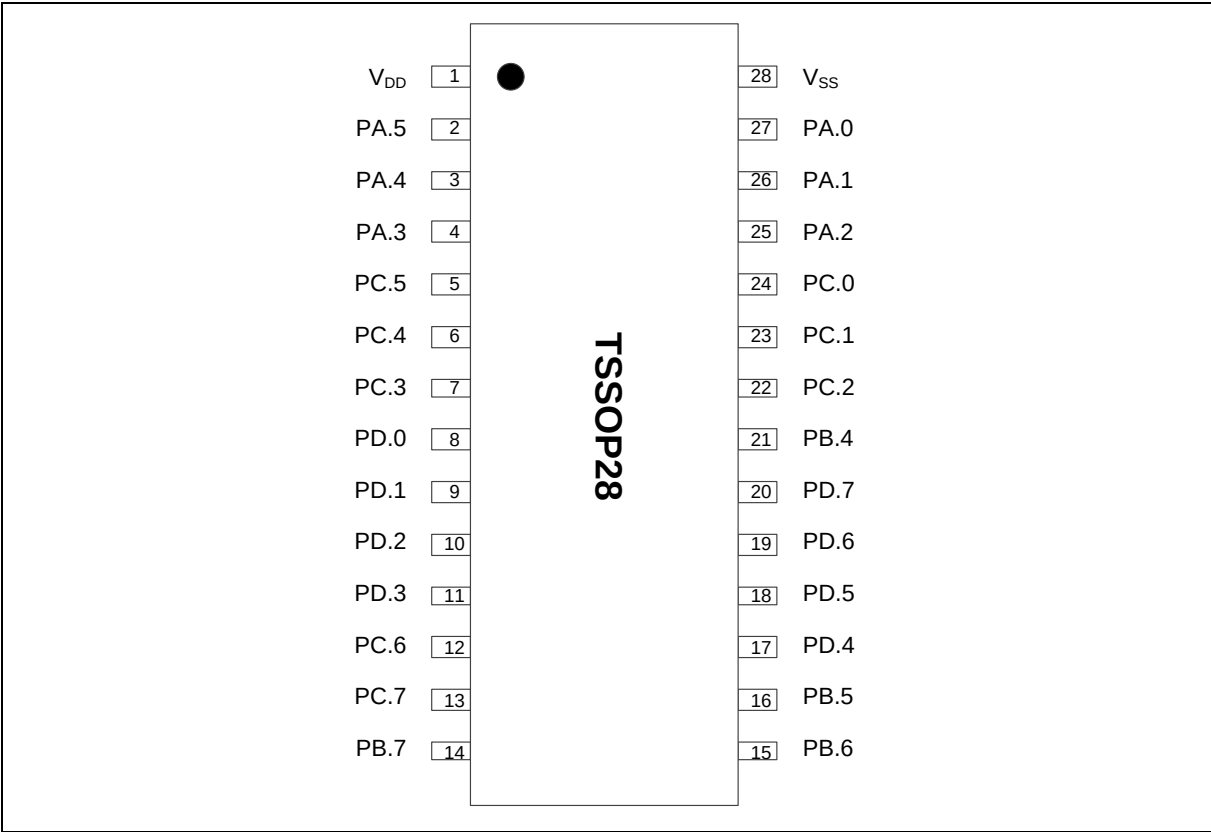


Figure 4.1-2 M0A21 Series TSSOP 28-pin Diagram

4.1.2 M0A21 Series Function Pin Table

4.1.2.1 SSOP20 Package

Corresponding Part Number: M0A21OB1AC, M0A21OC1AC

M0A21OB1AC Multi-function Pin Table

| Pin | M0A21OB1AC Pin Function                                                                                                                                                                                                                                                                                                           |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | V <sub>DD</sub>                                                                                                                                                                                                                                                                                                                   |
| 2   | PA.5 / ADC0_CH16 / UART0_nRTS / XT1_IN / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USCIO1_CLK / USCIO1_DAT0 / USCIO1_DAT1 / USCIO1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT  |
| 3   | PA.4 / ADC0_CH15 / UART0_nRTS / XT1_OUT / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USCIO1_CLK / USCIO1_DAT0 / USCIO1_DAT1 / USCIO1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT |
| 4   | PA.3 / nRESET / UART0_nCTS / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USCIO1_CLK / USCIO1_DAT0 / USCIO1_DAT1 / USCIO1_CTL0 / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_RXD / INT0                                                                       |
| 5   | PC.5 / ADC0_CH14 / X32_IN / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 /                                                                                                                                                          |

| Pin | M0A21OB1AC Pin Function                                                                                                                                                                                                                                                                                                                               |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT1                                                                                                                                                                                                         |
| 6   | PC.4 / ADC0_CH13 / X32_OUT / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT2                               |
| 7   | PC.3 / ADC0_CH12 / ACMP0_N3 / ACMP1_N3 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT3      |
| 8   | PC.6 / ADC0_CH11 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT4                            |
| 9   | PC.7 / ADC0_CH10 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT5                            |
| 10  | PB.7 / ADC0_CH9 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT                       |
| 11  | PB.6 / ADC0_CH8 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                       |
| 12  | PB.5 / ADC0_CH7 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT0                             |
| 13  | PB.4 / ADC0_CH6 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / UART1_nCTS                       |
| 14  | PC.2 / ADC0_CH5 / ACMP0_N2 / ACMP1_N2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / UART1_nRTS |
| 15  | PC.1 / ADC0_CH4 / ACMP0_N1 / ACMP1_N1 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD              |
| 16  | PC.0 / ADC0_CH3 / ACMP1_P0 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0           |
| 17  | PA.2 / ADC0_CH2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1                      |

| Pin | M0A21OB1AC Pin Function                                                                                                                                                                                                                                                                                                                                 |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18  | PA.1 / ADC0_CH1 / ACMP0_N0 / ACMP1_N0 / VREF+ / ICE_CLK / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0 |
| 19  | PA.0 / ADC0_CH0 / DAC0_OUT / ACMP0_P0 / ICE_DAT / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1         |
| 20  | V <sub>SS</sub>                                                                                                                                                                                                                                                                                                                                         |

M0A21OC1AC Multi-function Pin Table

| Pin | M0A21OC1AC Pin Function                                                                                                                                                                                                                                                                                                                      |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | V <sub>DD</sub>                                                                                                                                                                                                                                                                                                                              |
| 2   | PA.5 / ADC0_CH16 / UART0_nRTS / XT1_IN / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT                     |
| 3   | PA.4 / ADC0_CH15 / UART0_nRTS / XT1_OUT / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                    |
| 4   | PA.3 / nRESET / UART0_nCTS / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_RXD / INT0                                                                                          |
| 5   | PC.5 / ADC0_CH14 / X32_IN / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT1                           |
| 6   | PC.4 / ADC0_CH13 / X32_OUT / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT2                          |
| 7   | PC.3 / ADC0_CH12 / ACMP0_N3 / ACMP1_N3 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT3 |
| 8   | PC.6 / ADC0_CH11 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT4                       |
| 9   | PC.7 / ADC0_CH10 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT5                       |



| Pin | M0A21OC1AC Pin Function                                                                                                                                                                                                                                                                                                                                     |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | PB.7 / ADC0_CH9 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT                             |
| 11  | PB.6 / ADC0_CH8 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                             |
| 12  | PB.5 / ADC0_CH7 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INTO                                   |
| 13  | PB.4 / ADC0_CH6 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / UART1_nCTS                             |
| 14  | PC.2 / ADC0_CH5 / ACMP0_N2 / ACMP1_N2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / UART1_nRTS       |
| 15  | PC.1 / ADC0_CH4 / ACMP0_N1 / ACMP1_N1 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD                    |
| 16  | PC.0 / ADC0_CH3 / ACMP1_P0 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0                 |
| 17  | PA.2 / ADC0_CH2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1                            |
| 18  | PA.1 / ADC0_CH1 / ACMP0_N0 / ACMP1_N0 / VREF+ / ICE_CLK / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0 |
| 19  | PA.0 / ADC0_CH0 / DAC0_OUT / ACMP0_P0 / ICE_DAT / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1         |
| 20  | V <sub>SS</sub>                                                                                                                                                                                                                                                                                                                                             |

#### 4.1.2.2 TSSOP28 Package

Corresponding Part Number: M0A21EB1AC, M0A21EC1AC

M0A21EB1AC Multi-function Pin Table

| Pin | M0A21EB1AC Pin Function                                                                                                                                                                                                                                                                                                                      |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | V <sub>DD</sub>                                                                                                                                                                                                                                                                                                                              |
| 2   | PA.5 / ADC0_CH16 / UART0_nRTS / XT1_IN / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT                     |
| 3   | PA.4 / ADC0_CH15 / UART0_nRTS / XT1_OUT / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                    |
| 4   | PA.3 / nRESET / UART0_nCTS / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_RXD / INT0                                                                                          |
| 5   | PC.5 / ADC0_CH14 / X32_IN / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT1                           |
| 6   | PC.4 / ADC0_CH13 / X32_OUT / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT2                          |
| 7   | PC.3 / ADC0_CH12 / ACMP0_N3 / ACMP1_N3 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT3 |
| 8   | PD.0 / PWM0_CH4 / UART0_TXD / USC1_CLK / TM0                                                                                                                                                                                                                                                                                                 |
| 9   | PD.1 / PWM0_CH5 / UART0_RXD / USC1_DAT0 / TM1                                                                                                                                                                                                                                                                                                |
| 10  | PD.2 / PWM0_CH0 / USC1_DAT1 / TM2 / UART1_nCTS                                                                                                                                                                                                                                                                                               |
| 11  | PD.3 / PWM0_CH1 / USC1_CTL0 / TM3 / UART1_nRTS                                                                                                                                                                                                                                                                                               |
| 12  | PC.6 / ADC0_CH11 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT4                       |
| 13  | PC.7 / ADC0_CH10 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT5                       |
| 14  | PB.7 / ADC0_CH9 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT                  |
| 15  | PB.6 / ADC0_CH8 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                  |
| 16  | PB.5 / ADC0_CH7 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 /                                                                               |

| Pin | M0A21EB1AC Pin Function                                                                                                                                                                                                                                                                                                                                |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT0                                                                                                                                                                                                                                                                                                 |
| 17  | PD.4 / PWM0_CH0 / UART0_TXD / USCIO_CLK / TM0                                                                                                                                                                                                                                                                                                          |
| 18  | PD.5 / PWM0_CH1 / UART0_RXD / USCIO_DAT0 / TM1                                                                                                                                                                                                                                                                                                         |
| 19  | PD.6 / PWM0_CH2 / USCIO_DAT1 / TM2 / UART1_nCTS                                                                                                                                                                                                                                                                                                        |
| 20  | PD.7 / PWM0_CH3 / USCIO_CTL0 / TM3 / UART1_nRTS                                                                                                                                                                                                                                                                                                        |
| 21  | PB.4 / ADC0_CH6 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / UART1_nCTS                            |
| 22  | PC.2 / ADC0_CH5 / ACMP0_N2 / ACMP1_N2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USC1_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / UART1_nRTS       |
| 23  | PC.1 / ADC0_CH4 / ACMP0_N1 / ACMP1_N1 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD                   |
| 24  | PC.0 / ADC0_CH3 / ACMP1_P0 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USC1_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0                 |
| 25  | PA.2 / ADC0_CH2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1                           |
| 26  | PA.1 / ADC0_CH1 / ACMP0_N0 / ACMP1_N0 / VREF+ / ICE_CLK / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USC1_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0 |
| 27  | PA.0 / ADC0_CH0 / DAC0_OUT / ACMP0_P0 / ICE_DAT / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1        |
| 28  | V <sub>SS</sub>                                                                                                                                                                                                                                                                                                                                        |

M0A21EC1AC Multi-function Pin Table

| Pin | M0A21EC1AC Pin Function                                                                                                                                                                                                                                                                                                  |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | V <sub>DD</sub>                                                                                                                                                                                                                                                                                                          |
| 2   | PA.5 / ADC0_CH16 / UART0_nRTS / XT1_IN / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT |

| Pin | M0A21EC1AC Pin Function                                                                                                                                                                                                                                                                                                                      |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3   | PA.4 / ADC0_CH15 / UART0_nRTS / XT1_OUT / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USC1_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                     |
| 4   | PA.3 / nRESET / UART0_nCTS / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_RXD / INT0                                                                                          |
| 5   | PC.5 / ADC0_CH14 / X32_IN / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT1                           |
| 6   | PC.4 / ADC0_CH13 / X32_OUT / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USC1_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT2                           |
| 7   | PC.3 / ADC0_CH12 / ACMP0_N3 / ACMP1_N3 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT3 |
| 8   | PD.0 / PWM0_CH4 / UART0_TXD / USC1_CLK / TM0                                                                                                                                                                                                                                                                                                 |
| 9   | PD.1 / PWM0_CH5 / UART0_RXD / USC1_DAT0 / TM1                                                                                                                                                                                                                                                                                                |
| 10  | PD.2 / PWM0_CH0 / USC1_DAT1 / TM2 / UART1_nCTS                                                                                                                                                                                                                                                                                               |
| 11  | PD.3 / PWM0_CH1 / USC1_CTL0 / TM3 / UART1_nRTS                                                                                                                                                                                                                                                                                               |
| 12  | PC.6 / ADC0_CH11 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USC1_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT4                        |
| 13  | PC.7 / ADC0_CH10 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT5                       |
| 14  | PB.7 / ADC0_CH9 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USC1_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT                   |
| 15  | PB.6 / ADC0_CH8 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USCIO_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                  |
| 16  | PB.5 / ADC0_CH7 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCIO_CLK / USCIO_DAT0 / USCIO_DAT1 / USCIO_CTL0 / USC1_CTL1 / USC1_CLK / USC1_DAT0 / USC1_DAT1 / USC1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT0                         |
| 17  | PD.4 / PWM0_CH0 / UART0_TXD / USCIO_CLK / TM0                                                                                                                                                                                                                                                                                                |
| 18  | PD.5 / PWM0_CH1 / UART0_RXD / USCIO_DAT0 / TM1                                                                                                                                                                                                                                                                                               |
| 19  | PD.6 / PWM0_CH2 / USCIO_DAT1 / TM2 / UART1_nCTS                                                                                                                                                                                                                                                                                              |

| Pin | M0A21EC1AC Pin Function                                                                                                                                                                                                                                                                                                                                     |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20  | PD.7 / PWM0_CH3 / USCI0_CTL0 / TM3 / UART1_nRTS                                                                                                                                                                                                                                                                                                             |
| 21  | PB.4 / ADC0_CH6 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / UART1_nCTS                             |
| 22  | PC.2 / ADC0_CH5 / ACMP0_N2 / ACMP1_N2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / UART1_nRTS       |
| 23  | PC.1 / ADC0_CH4 / ACMP0_N1 / ACMP1_N1 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD                    |
| 24  | PC.0 / ADC0_CH3 / ACMP1_P0 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0                 |
| 25  | PA.2 / ADC0_CH2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1                            |
| 26  | PA.1 / ADC0_CH1 / ACMP0_N0 / ACMP1_N0 / VREF+ / ICE_CLK / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0 |
| 27  | PA.0 / ADC0_CH0 / DAC0_OUT / ACMP0_P0 / ICE_DAT / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1         |
| 28  | V <sub>SS</sub>                                                                                                                                                                                                                                                                                                                                             |

4.1.3 M0A23 Series Pin Diagram

4.1.3.1 SSOP20 Package

Corresponding Part Number: M0A23OC1AC

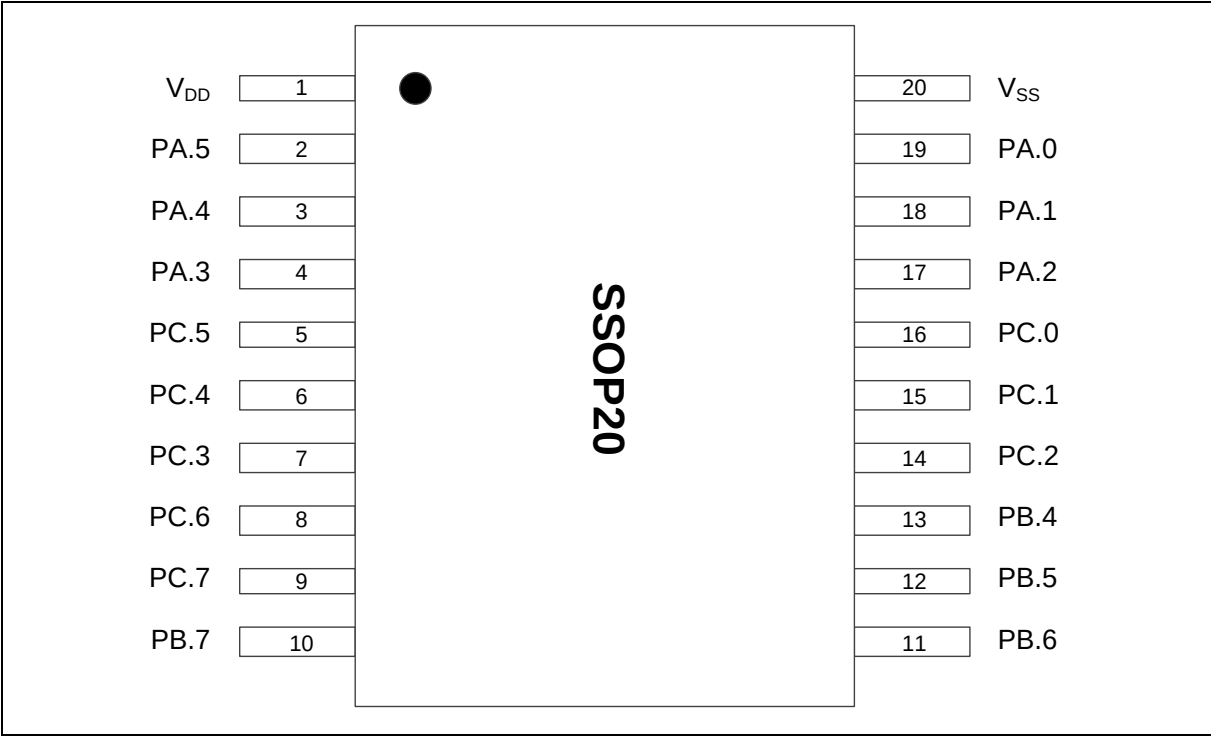


Figure 4.1-3 M0A23 Series SSOP 20-pin Diagram

4.1.3.2 TSSOP28 Package

Corresponding Part Number: M0A23EC1AC.

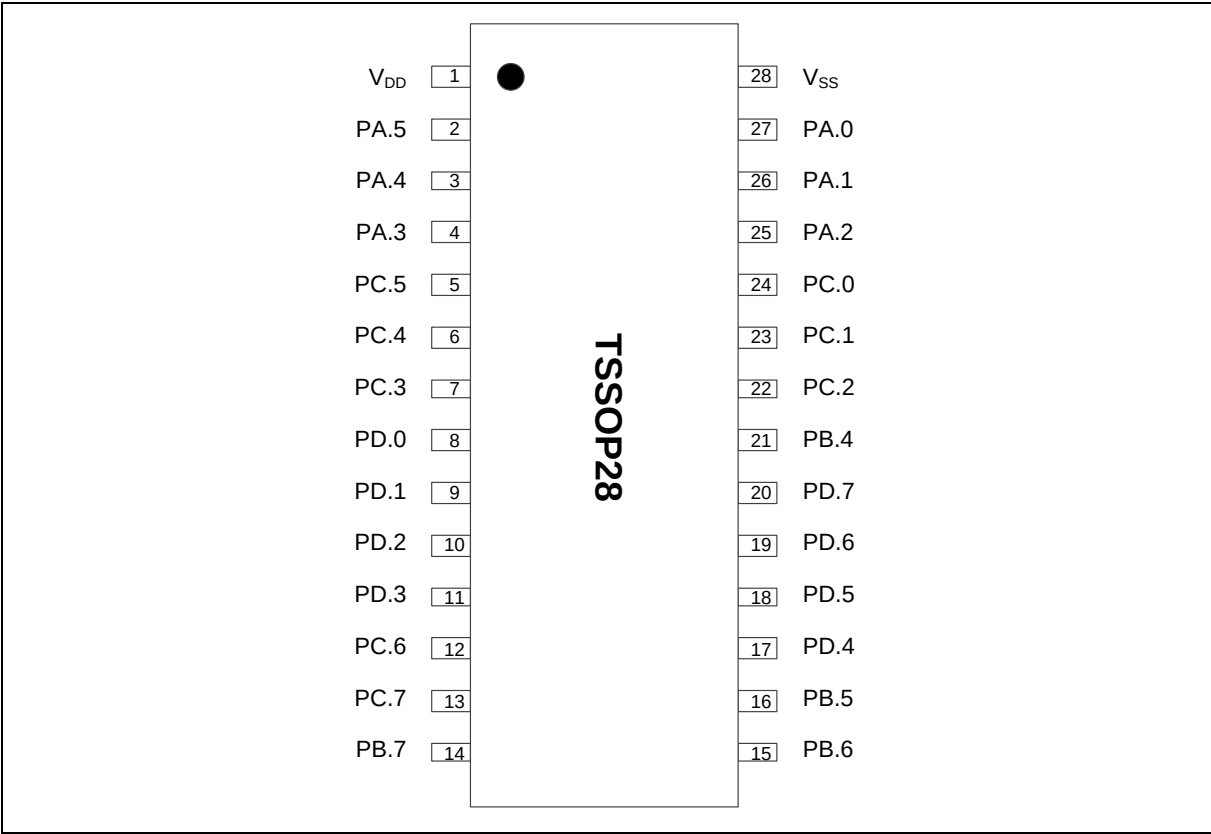


Figure 4.1-4 M0A23 Series TSSOP 28-pin Diagram

#### 4.1.4 M0A23 Series Function Pin Table

##### 4.1.4.1 SSOP20 Package

Corresponding Part Number: M0A23OC1AC.

M0A23OC1AC Multi-function Pin Table

| Pin | M0A23OC1AC Pin Function                                                                                                                                                                                                                                                                                                                                                |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | V <sub>DD</sub>                                                                                                                                                                                                                                                                                                                                                        |
| 2   | PA.5 / ADC0_CH16 / UART0_nRTS / XT1_IN / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT                     |
| 3   | PA.4 / ADC0_CH15 / UART0_nRTS / XT1_OUT / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                    |
| 4   | PA.3 / nRESET / UART0_nCTS / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_RXD / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_RXD / INT0                                                                                                     |
| 5   | PC.5 / ADC0_CH14 / X32_IN / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT1                           |
| 6   | PC.4 / ADC0_CH13 / X32_OUT / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT2                          |
| 7   | PC.3 / ADC0_CH12 / ACMP0_N3 / ACMP1_N3 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT3 |
| 8   | PC.6 / ADC0_CH11 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT4                       |
| 9   | PC.7 / ADC0_CH10 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT5                       |
| 10  | PB.7 / ADC0_CH9 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT                  |
| 11  | PB.6 / ADC0_CH8 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                  |
| 12  | PB.5 / ADC0_CH7 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O /                                                                                                         |



| Pin | M0A23OC1AC Pin Function                                                                                                                                                                                                                                                                                                                                                           |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INTO                                                                                                                                                                                                                                                                                                  |
| 13  | PB.4 / ADC0_CH6 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / UART1_nCTS                             |
| 14  | PC.2 / ADC0_CH5 / ACMP0_N2 / ACMP1_N2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / UART1_nRTS       |
| 15  | PC.1 / ADC0_CH4 / ACMP0_N1 / ACMP1_N1 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD                    |
| 16  | PC.0 / ADC0_CH3 / ACMP1_P0 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0                 |
| 17  | PA.2 / ADC0_CH2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1                            |
| 18  | PA.1 / ADC0_CH1 / ACMP0_N0 / ACMP1_N0 / VREF+ / ICE_CLK / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0 |
| 19  | PA.0 / ADC0_CH0 / DAC0_OUT / ACMP0_P0 / ICE_DAT / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1         |
| 20  | V <sub>SS</sub>                                                                                                                                                                                                                                                                                                                                                                   |

#### 4.1.4.2 TSSOP28 Package

Corresponding Part Number: M0A23EC1AC.

M0A23EC1AC Multi-function Pin Table

| Pin | M0A23EC1AC Pin Function                                                                                                                                                                                                                                                                                                                            |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | V <sub>DD</sub>                                                                                                                                                                                                                                                                                                                                    |
| 2   | PA.5 / ADC0_CH16 / UART0_nRTS / XT1_IN / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT |
| 3   | PA.4 / ADC0_CH15 / UART0_nRTS / XT1_OUT / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 /                                                                                                                                                                          |

| Pin | M0A23EC1AC Pin Function                                                                                                                                                                                                                                                                                                                                                |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                                                                                                                                                                                              |
| 4   | PA.3 / nRESET / UART0_nCTS / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_RXD / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_RXD / INT0                                                                                                     |
| 5   | PC.5 / ADC0_CH14 / X32_IN / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT1                           |
| 6   | PC.4 / ADC0_CH13 / X32_OUT / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT2                          |
| 7   | PC.3 / ADC0_CH12 / ACMP0_N3 / ACMP1_N3 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT3 |
| 8   | PD.0 / PWM0_CH4 / UART0_TXD / USCI1_CLK / TM0                                                                                                                                                                                                                                                                                                                          |
| 9   | PD.1 / PWM0_CH5 / UART0_RXD / USCI1_DAT0 / TM1                                                                                                                                                                                                                                                                                                                         |
| 10  | PD.2 / PWM0_CH0 / USCI1_DAT1 / TM2 / UART1_nCTS                                                                                                                                                                                                                                                                                                                        |
| 11  | PD.3 / PWM0_CH1 / USCI1_CTL0 / TM3 / UART1_nRTS                                                                                                                                                                                                                                                                                                                        |
| 12  | PC.6 / ADC0_CH11 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT4                       |
| 13  | PC.7 / ADC0_CH10 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / INT5                       |
| 14  | PB.7 / ADC0_CH9 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / ACMP0_WLAT                  |
| 15  | PB.6 / ADC0_CH8 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / ACMP1_WLAT                  |
| 16  | PB.5 / ADC0_CH7 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / INT0                        |
| 17  | PD.4 / PWM0_CH0 / UART0_TXD / USCI0_CLK / TM0                                                                                                                                                                                                                                                                                                                          |
| 18  | PD.5 / PWM0_CH1 / UART0_RXD / USCI0_DAT0 / TM1                                                                                                                                                                                                                                                                                                                         |
| 19  | PD.6 / PWM0_CH2 / USCI0_DAT1 / TM2 / UART1_nCTS                                                                                                                                                                                                                                                                                                                        |

| Pin | M0A23EC1AC Pin Function                                                                                                                                                                                                                                                                                                                                                           |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20  | PD.7 / PWM0_CH3 / USCI0_CTL0 / TM3 / UART1_nRTS                                                                                                                                                                                                                                                                                                                                   |
| 21  | PB.4 / ADC0_CH6 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / UART1_nCTS                             |
| 22  | PC.2 / ADC0_CH5 / ACMP0_N2 / ACMP1_N2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / UART1_nRTS       |
| 23  | PC.1 / ADC0_CH4 / ACMP0_N1 / ACMP1_N1 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD                    |
| 24  | PC.0 / ADC0_CH3 / ACMP1_P0 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0                 |
| 25  | PA.2 / ADC0_CH2 / UART0_nRTS / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1                            |
| 26  | PA.1 / ADC0_CH1 / ACMP0_N0 / ACMP1_N0 / VREF+ / ICE_CLK / UART0_nCTS / CLKO / PWM0_CH0 / PWM0_CH2 / PWM0_CH4 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI1_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM0 / TM2 / TM0_EXT / TM2_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE0 |
| 27  | PA.0 / ADC0_CH0 / DAC0_OUT / ACMP0_P0 / ICE_DAT / UART0_nCTS / CLKO / PWM0_CH1 / PWM0_CH3 / PWM0_CH5 / UART0_TXD / UART0_RXD / USCI0_CLK / USCI0_DAT0 / USCI0_DAT1 / USCI0_CTL0 / USCI0_CTL1 / USCI1_CLK / USCI1_DAT0 / USCI1_DAT1 / USCI1_CTL0 / CAN0_TXD / CAN0_RXD / ACMP0_O / ACMP1_O / ADC0_ST / TM1 / TM3 / TM1_EXT / TM3_EXT / UART1_TXD / UART1_RXD / PWM0_BRAKE1         |
| 28  | V <sub>SS</sub>                                                                                                                                                                                                                                                                                                                                                                   |

## 4.2 Pin Description

Different part number with same package might have different functions. Please refer to the selection guide in section 3.2.

### 4.2.1 M0A21/M0A23 Series Pin Description

| 20 Pin | 28 Pin | Pin Name        | Type | MFP   | Description                                                                     |
|--------|--------|-----------------|------|-------|---------------------------------------------------------------------------------|
| 1      | 1      | V <sub>DD</sub> | P    | MFP0  | Power supply for I/O ports and LDO source for internal PLL and digital circuit. |
| 2      | 2      | PA.5            | I/O  | MFP0  | General purpose digital I/O pin.                                                |
|        |        | ADC0_CH16       | A    | MFP1  | ADC0 channel 16 analog input.                                                   |
|        |        | UART0_nRTS      | O    | MFP2  | UART0 request to Send output pin.                                               |
|        |        | XT1_IN          | I    | MFP3  | External 4~24 MHz (high speed) crystal input pin.                               |
|        |        | CLKO            | O    | MFP4  | Clock Out                                                                       |
|        |        | PWM0_CH0        | I/O  | MFP5  | PWM0 channel 0 output/capture input.                                            |
|        |        | PWM0_CH2        | I/O  | MFP6  | PWM0 channel 2 output/capture input.                                            |
|        |        | PWM0_CH4        | I/O  | MFP7  | PWM0 channel 4 output/capture input.                                            |
|        |        | UART0_TXD       | O    | MFP8  | UART0 data transmitter output pin.                                              |
|        |        | UART0_RXD       | I    | MFP9  | UART0 data receiver input pin.                                                  |
|        |        | USCI0_CLK       | I/O  | MFP10 | USCI0 clock pin.                                                                |
|        |        | USCI0_DAT0      | I/O  | MFP11 | USCI0 data 0 pin.                                                               |
|        |        | USCI0_DAT1      | I/O  | MFP12 | USCI0 data 1 pin.                                                               |
|        |        | USCI0_CTL0      | I/O  | MFP13 | USCI0 control 0 pin.                                                            |
|        |        | USCI0_CTL1      | I/O  | MFP14 | USCI0 control 1 pin.                                                            |
|        |        | USCI1_CLK       | I/O  | MFP15 | USCI1 clock pin.                                                                |
|        |        | USCI1_DAT0      | I/O  | MFP16 | USCI1 data 0 pin.                                                               |
|        |        | USCI1_DAT1      | I/O  | MFP17 | USCI1 data 1 pin.                                                               |
|        |        | USCI1_CTL0      | I/O  | MFP18 | USCI1 control 0 pin.                                                            |
|        |        | CAN0_TXD        | O    | MFP19 | CAN0 bus transmitter output.                                                    |
|        |        | CAN0_RXD        | I    | MFP20 | CAN0 bus receiver input.                                                        |
|        |        | ACMP0_O         | O    | MFP21 | Analog comparator 0 output pin.                                                 |
|        |        | ACMP1_O         | O    | MFP22 | Analog comparator 1 output pin.                                                 |
|        |        | ADC0_ST         | I    | MFP23 | ADC0 external trigger input pin.                                                |
|        |        | TM0             | I/O  | MFP24 | Timer0 event counter input/toggle output pin.                                   |
|        |        | TM2             | I/O  | MFP25 | Timer2 event counter input/toggle output pin.                                   |
|        |        | TM0_EXT         | I/O  | MFP26 | Timer0 external capture input/toggle output pin.                                |
|        |        | TM2_EXT         | I/O  | MFP27 | Timer2 external capture input/toggle output pin.                                |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                        |
|--------|--------|------------|------|-------|----------------------------------------------------|
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.                 |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                     |
|        |        | ACMP0_WLAT | I    | MFP30 | Analog comparator 0 window latch input pin         |
| 3      | 3      | PA.4       | I/O  | MFP0  | General purpose digital I/O pin.                   |
|        |        | ADC0_CH15  | A    | MFP1  | ADC0 channel 15 analog input.                      |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                  |
|        |        | XT1_OUT    | O    | MFP3  | External 4~24 MHz (high speed) crystal output pin. |
|        |        | CLKO       | O    | MFP4  | Clock Out                                          |
|        |        | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.               |
|        |        | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.               |
|        |        | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.               |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.                 |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                     |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                   |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                  |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                  |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                               |
|        |        | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                               |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                   |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                  |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                  |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                               |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                       |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                           |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                    |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                    |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                   |
|        |        | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.      |
|        |        | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.      |
|        |        | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin.   |
|        |        | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin.   |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.                 |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                     |
|        |        | ACMP1_WLAT | I    | MFP30 | Analog comparator 1 window latch input pin         |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                                                                                                                                                                             |
|--------|--------|------------|------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4      | 4      | PA.3       | I    | MFP0  | General purpose digital input pin.                                                                                                                                                                      |
|        |        | nRESET     | I    | MFP2  | External reset input: active LOW, with an internal pull-up. Set this pin low reset to initial state.<br><b>Note:</b> It is recommended to use 10 kΩ pull-up resistor and 10 uF capacitor on nRESET pin. |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                                                                                                                                                                          |
|        |        | PWM0_CH0   | I    | MFP5  | PWM0 channel 0 capture input.                                                                                                                                                                           |
|        |        | PWM0_CH2   | I    | MFP6  | PWM0 channel 2 capture input.                                                                                                                                                                           |
|        |        | PWM0_CH4   | I    | MFP7  | PWM0 channel 4 capture input.                                                                                                                                                                           |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                                                                                                                                                                          |
|        |        | USC0_CLK   | I    | MFP10 | USC0 clock pin.                                                                                                                                                                                         |
|        |        | USC0_DAT0  | I    | MFP11 | USC0 data 0 pin.                                                                                                                                                                                        |
|        |        | USC0_DAT1  | I    | MFP12 | USC0 data 1 pin.                                                                                                                                                                                        |
|        |        | USC0_CTL0  | I    | MFP13 | USC0 control 0 pin.                                                                                                                                                                                     |
|        |        | USC0_CTL1  | I    | MFP14 | USC0 control 1 pin.                                                                                                                                                                                     |
|        |        | USC1_CLK   | I    | MFP15 | USC1 clock pin.                                                                                                                                                                                         |
|        |        | USC1_DAT0  | I    | MFP16 | USC1 data 0 pin.                                                                                                                                                                                        |
|        |        | USC1_DAT1  | I    | MFP17 | USC1 data 1 pin.                                                                                                                                                                                        |
|        |        | USC1_CTL0  | I    | MFP18 | USC1 control 0 pin.                                                                                                                                                                                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                                                                                                                                                                                |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                                                                                                                                                                        |
|        |        | TM0        | I    | MFP24 | Timer0 event counter input pin.                                                                                                                                                                         |
|        |        | TM2        | I    | MFP25 | Timer2 event counter input pin.                                                                                                                                                                         |
|        |        | TM0_EXT    | I    | MFP26 | Timer0 external capture input pin.                                                                                                                                                                      |
|        |        | TM2_EXT    | I    | MFP27 | Timer2 external capture input pin.                                                                                                                                                                      |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                                                                                                                                                                          |
|        |        | INT0       | I    | MFP30 | External interrupt 0 input pin.                                                                                                                                                                         |
| 5      | 5      | PC.5       | I/O  | MFP0  | General purpose digital I/O pin.                                                                                                                                                                        |
|        |        | ADC0_CH14  | A    | MFP1  | ADC0 channel 14 analog input.                                                                                                                                                                           |
|        |        | X32_IN     | I    | MFP2  | External 32.768 kHz crystal input pin.                                                                                                                                                                  |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                                                                                                                                                                          |
|        |        | CLKO       | O    | MFP4  | Clock Out                                                                                                                                                                                               |
|        |        | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.                                                                                                                                                                    |
|        |        | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.                                                                                                                                                                    |
|        |        | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.                                                                                                                                                                    |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|        |        | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|        |        | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|        |        | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | INT1       | I    | MFP30 | External interrupt 1 input pin.                  |
| 6      | 6      | PC.4       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH13  | A    | MFP1  | ADC0 channel 13 analog input.                    |
|        |        | X32_OUT    | O    | MFP2  | External 32.768 kHz crystal output pin.          |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|        |        | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|        |        | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|        |        | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|        |        | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|        |        | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | INT2       | I    | MFP30 | External interrupt 2 input pin.                  |
| 7      | 7      | PC.3       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH12  | A    | MFP1  | ADC0 channel 12 analog input.                    |
|        |        | ACMP0_N3   | A    | MFP1  | Analog comparator 0 negative input 3 pin.        |
|        |        | ACMP1_N3   | A    | MFP1  | Analog comparator 1 negative input 3 pin.        |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|        |        | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|        |        | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |



| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|        |        | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|        |        | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|        |        | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | INT3       | I    | MFP30 | External interrupt 3 input pin.                  |
|        | 8      | PD.0       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | PWM0_CH4   | I/O  | MFP2  | PWM0 channel 4 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP3  | UART0 data transmitter output pin.               |
|        |        | USCI1_CLK  | I/O  | MFP4  | USCI1 clock pin.                                 |
|        |        | TM0        | I/O  | MFP5  | Timer0 event counter input/toggle output pin.    |
|        | 9      | PD.1       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | PWM0_CH5   | I/O  | MFP2  | PWM0 channel 5 output/capture input.             |
|        |        | UART0_RXD  | I    | MFP3  | UART0 data receiver input pin.                   |
|        |        | USCI1_DAT0 | I/O  | MFP4  | USCI1 data 0 pin.                                |
|        |        | TM1        | I/O  | MFP5  | Timer1 event counter input/toggle output pin.    |
|        | 10     | PD.2       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | PWM0_CH0   | I/O  | MFP2  | PWM0 channel 0 output/capture input.             |
|        |        | CAN0_TXD   | O    | MFP3  | CAN0 bus transmitter output.                     |
|        |        | USCI1_DAT1 | I/O  | MFP4  | USCI1 data 1 pin.                                |
|        |        | TM2        | I/O  | MFP5  | Timer2 event counter input/toggle output pin.    |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | UART1_nCTS | I    | MFP6  | UART1 clear to Send input pin.                   |
|        | 11     | PD.3       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | PWM0_CH1   | I/O  | MFP2  | PWM0 channel 1 output/capture input.             |
|        |        | CAN0_RXD   | I    | MFP3  | CAN0 bus receiver input.                         |
|        |        | USCI1_CTL0 | I/O  | MFP4  | USCI1 control 0 pin.                             |
|        |        | TM3        | I/O  | MFP5  | Timer3 event counter input/toggle output pin.    |
|        |        | UART1_nRTS | O    | MFP6  | UART1 request to Send output pin.                |
| 8      | 12     | PC.6       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH11  | A    | MFP1  | ADC0 channel 11 analog input.                    |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|        |        | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|        |        | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|        |        | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|        |        | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | INT4       | I    | MFP30 | External interrupt 4 input pin.                  |
| 9      | 13     | PC.7       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH10  | A    | MFP1  | ADC0 channel 10 analog input.                    |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|        |        | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|        |        | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USC10_CLK  | I/O  | MFP10 | USC10 clock pin.                                 |
|        |        | USC10_DAT0 | I/O  | MFP11 | USC10 data 0 pin.                                |
|        |        | USC10_DAT1 | I/O  | MFP12 | USC10 data 1 pin.                                |
|        |        | USC10_CTL0 | I/O  | MFP13 | USC10 control 0 pin.                             |
|        |        | USC10_CTL1 | I/O  | MFP14 | USC10 control 1 pin.                             |
|        |        | USC11_CLK  | I/O  | MFP15 | USC11 clock pin.                                 |
|        |        | USC11_DAT0 | I/O  | MFP16 | USC11 data 0 pin.                                |
|        |        | USC11_DAT1 | I/O  | MFP17 | USC11 data 1 pin.                                |
|        |        | USC11_CTL0 | I/O  | MFP18 | USC11 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|        |        | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|        |        | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|        |        | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | INT5       | I    | MFP30 | External interrupt 5 input pin.                  |
| 10     | 14     | PB.7       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH9   | A    | MFP1  | ADC0 channel 9 analog input.                     |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|        |        | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|        |        | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|        |        | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|        |        | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|        |        | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | ACMP0_WLAT | I    | MFP30 | Analog comparator 0 window latch input pin       |
| 11     | 15     | PB.6       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH8   | A    | MFP1  | ADC0 channel 8 analog input.                     |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|        |        | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|        |        | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|        |        | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|        |        | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|        |        | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | ACMP1_WLAT | I    | MFP30 | Analog comparator 1 window latch input pin       |
| 12     | 16     | PB.5       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH7   | A    | MFP1  | ADC0 channel 7 analog input.                     |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|        |        | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|        |        | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|        |        | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|        |        | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|        |        | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | INT0       | I    | MFP30 | External interrupt 0 input pin.                  |
|        | 17     | PD.4       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | PWM0_CH0   | I/O  | MFP2  | PWM0 channel 0 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP3  | UART0 data transmitter output pin.               |
|        |        | USCI0_CLK  | I/O  | MFP4  | USCI0 clock pin.                                 |
|        |        | TM0        | I/O  | MFP5  | Timer0 event counter input/toggle output pin.    |
|        | 18     | PD.5       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | PWM0_CH1   | I/O  | MFP2  | PWM0 channel 1 output/capture input.             |
|        |        | UART0_RXD  | I    | MFP3  | UART0 data receiver input pin.                   |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                   |
|--------|--------|------------|------|-------|-----------------------------------------------|
|        |        | USCI0_DAT0 | I/O  | MFP4  | USCI0 data 0 pin.                             |
|        |        | TM1        | I/O  | MFP5  | Timer1 event counter input/toggle output pin. |
|        | 19     | PD.6       | I/O  | MFP0  | General purpose digital I/O pin.              |
|        |        | PWM0_CH2   | I/O  | MFP2  | PWM0 channel 2 output/capture input.          |
|        |        | CAN0_TXD   | O    | MFP3  | CAN0 bus transmitter output.                  |
|        |        | USCI0_DAT1 | I/O  | MFP4  | USCI0 data 1 pin.                             |
|        |        | TM2        | I/O  | MFP5  | Timer2 event counter input/toggle output pin. |
|        |        | UART1_nCTS | I    | MFP6  | UART1 clear to Send input pin.                |
|        | 20     | PD.7       | I/O  | MFP0  | General purpose digital I/O pin.              |
|        |        | PWM0_CH3   | I/O  | MFP2  | PWM0 channel 3 output/capture input.          |
|        |        | CAN0_RXD   | I    | MFP3  | CAN0 bus receiver input.                      |
|        |        | USCI0_CTL0 | I/O  | MFP4  | USCI0 control 0 pin.                          |
|        |        | TM3        | I/O  | MFP5  | Timer3 event counter input/toggle output pin. |
|        |        | UART1_nRTS | O    | MFP6  | UART1 request to Send output pin.             |
| 13     | 21     | PB.4       | I/O  | MFP0  | General purpose digital I/O pin.              |
|        |        | ADC0_CH6   | A    | MFP1  | ADC0 channel 6 analog input.                  |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.             |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                |
|        |        | CLKO       | O    | MFP4  | Clock Out                                     |
|        |        | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.          |
|        |        | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.          |
|        |        | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.          |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.            |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                              |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                             |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                             |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                          |
|        |        | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                          |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                              |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                             |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                             |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                          |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                  |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|        |        | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|        |        | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|        |        | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | UART1_nCTS | I    | MFP30 | UART1 clear to Send input pin.                   |
| 14     | 22     | PC.2       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH5   | A    | MFP1  | ADC0 channel 5 analog input.                     |
|        |        | ACMP0_N2   | A    | MFP1  | Analog comparator 0 negative input 2 pin.        |
|        |        | ACMP1_N2   | A    | MFP1  | Analog comparator 1 negative input 2 pin.        |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|        |        | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|        |        | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |



| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|        |        | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|        |        | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|        |        | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | UART1_nRTS | O    | MFP30 | UART1 request to Send output pin.                |
| 15     | 23     | PC.1       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH4   | A    | MFP1  | ADC0 channel 4 analog input.                     |
|        |        | ACMP0_N1   | A    | MFP1  | Analog comparator 0 negative input 1 pin.        |
|        |        | ACMP1_N1   | A    | MFP1  | Analog comparator 1 negative input 1 pin.        |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|        |        | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|        |        | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |

| 20 Pin | 28 Pin | Pin Name   | Type | MFP   | Description                                      |
|--------|--------|------------|------|-------|--------------------------------------------------|
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|        |        | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|        |        | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|        |        | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|        |        | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
| 16     | 24     | PC.0       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH3   | A    | MFP1  | ADC0 channel 3 analog input.                     |
|        |        | ACMP1_P0   | A    | MFP1  | Analog comparator 1 positive input 0 pin.        |
|        |        | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO       | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|        |        | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|        |        | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|        |        | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|        |        | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|        |        | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|        |        | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|        |        | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|        |        | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|        |        | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|        |        | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|        |        | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|        |        | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |

| 20 Pin | 28 Pin | Pin Name    | Type | MFP   | Description                                      |
|--------|--------|-------------|------|-------|--------------------------------------------------|
|        |        | TM2         | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|        |        | TM0_EXT     | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|        |        | TM2_EXT     | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|        |        | UART1_TXD   | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD   | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | PWM0_BRAKE0 | I    | MFP30 | PWM0 Brake 0 input pin.                          |
| 17     | 25     | PA.2        | I/O  | MFP0  | General purpose digital I/O pin.                 |
|        |        | ADC0_CH2    | A    | MFP1  | ADC0 channel 2 analog input.                     |
|        |        | UART0_nRTS  | O    | MFP2  | UART0 request to Send output pin.                |
|        |        | UART0_nCTS  | I    | MFP3  | UART0 clear to Send input pin.                   |
|        |        | CLKO        | O    | MFP4  | Clock Out                                        |
|        |        | PWM0_CH1    | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|        |        | PWM0_CH3    | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|        |        | PWM0_CH5    | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|        |        | UART0_TXD   | O    | MFP8  | UART0 data transmitter output pin.               |
|        |        | UART0_RXD   | I    | MFP9  | UART0 data receiver input pin.                   |
|        |        | USC0_CLK    | I/O  | MFP10 | USC0 clock pin.                                  |
|        |        | USC0_DAT0   | I/O  | MFP11 | USC0 data 0 pin.                                 |
|        |        | USC0_DAT1   | I/O  | MFP12 | USC0 data 1 pin.                                 |
|        |        | USC0_CTL0   | I/O  | MFP13 | USC0 control 0 pin.                              |
|        |        | USC0_CTL1   | I/O  | MFP14 | USC0 control 1 pin.                              |
|        |        | USC1_CLK    | I/O  | MFP15 | USC1 clock pin.                                  |
|        |        | USC1_DAT0   | I/O  | MFP16 | USC1 data 0 pin.                                 |
|        |        | USC1_DAT1   | I/O  | MFP17 | USC1 data 1 pin.                                 |
|        |        | USC1_CTL0   | I/O  | MFP18 | USC1 control 0 pin.                              |
|        |        | CAN0_TXD    | O    | MFP19 | CAN0 bus transmitter output.                     |
|        |        | CAN0_RXD    | I    | MFP20 | CAN0 bus receiver input.                         |
|        |        | ACMP0_O     | O    | MFP21 | Analog comparator 0 output pin.                  |
|        |        | ACMP1_O     | O    | MFP22 | Analog comparator 1 output pin.                  |
|        |        | ADC0_ST     | I    | MFP23 | ADC0 external trigger input pin.                 |
|        |        | TM1         | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|        |        | TM3         | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|        |        | TM1_EXT     | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|        |        | TM3_EXT     | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |

| 20 Pin | 28 Pin | Pin Name         | Type | MFP   | Description                                                                                                       |
|--------|--------|------------------|------|-------|-------------------------------------------------------------------------------------------------------------------|
|        |        | UART1_TXD        | O    | MFP28 | UART1 data transmitter output pin.                                                                                |
|        |        | UART1_RXD        | I    | MFP29 | UART1 data receiver input pin.                                                                                    |
|        |        | PWM0_BRAKE1      | I    | MFP30 | PWM0 Brake 1 input pin.                                                                                           |
| 18     | 26     | PA.1             | I/O  | MFP0  | General purpose digital I/O pin.                                                                                  |
|        |        | ADC0_CH1         | A    | MFP1  | ADC0 channel 1 analog input.                                                                                      |
|        |        | ACMP0_N0         | A    | MFP1  | Analog comparator 0 negative input 0 pin.                                                                         |
|        |        | ACMP1_N0         | A    | MFP1  | Analog comparator 1 negative input 0 pin.                                                                         |
|        |        | V <sub>REF</sub> | A    | MFP1  | ADC reference voltage input.<br><b>Note:</b> This pin needs to be connected with a 1uF capacitor.                 |
|        |        | ICE_CLK          | I    | MFP2  | Serial wired debugger clock pin.<br><b>Note:</b> It is recommended to use 100 kΩ pull-up resistor on ICE_CLK pin. |
|        |        | UART0_nCTS       | I    | MFP3  | UART0 clear to Send input pin.                                                                                    |
|        |        | CLKO             | O    | MFP4  | Clock Out                                                                                                         |
|        |        | PWM0_CH0         | I/O  | MFP5  | PWM0 channel 0 output/capture input.                                                                              |
|        |        | PWM0_CH2         | I/O  | MFP6  | PWM0 channel 2 output/capture input.                                                                              |
|        |        | PWM0_CH4         | I/O  | MFP7  | PWM0 channel 4 output/capture input.                                                                              |
|        |        | UART0_TXD        | O    | MFP8  | UART0 data transmitter output pin.                                                                                |
|        |        | UART0_RXD        | I    | MFP9  | UART0 data receiver input pin.                                                                                    |
|        |        | USCI0_CLK        | I/O  | MFP10 | USCI0 clock pin.                                                                                                  |
|        |        | USCI0_DAT0       | I/O  | MFP11 | USCI0 data 0 pin.                                                                                                 |
|        |        | USCI0_DAT1       | I/O  | MFP12 | USCI0 data 1 pin.                                                                                                 |
|        |        | USCI0_CTL0       | I/O  | MFP13 | USCI0 control 0 pin.                                                                                              |
|        |        | USCI1_CTL1       | I/O  | MFP14 | USCI1 control 1 pin.                                                                                              |
|        |        | USCI1_CLK        | I/O  | MFP15 | USCI1 clock pin.                                                                                                  |
|        |        | USCI1_DAT0       | I/O  | MFP16 | USCI1 data 0 pin.                                                                                                 |
|        |        | USCI1_DAT1       | I/O  | MFP17 | USCI1 data 1 pin.                                                                                                 |
|        |        | USCI1_CTL0       | I/O  | MFP18 | USCI1 control 0 pin.                                                                                              |
|        |        | CAN0_TXD         | O    | MFP19 | CAN0 bus transmitter output.                                                                                      |
|        |        | CAN0_RXD         | I    | MFP20 | CAN0 bus receiver input.                                                                                          |
|        |        | ACMP0_O          | O    | MFP21 | Analog comparator 0 output pin.                                                                                   |
|        |        | ACMP1_O          | O    | MFP22 | Analog comparator 1 output pin.                                                                                   |
|        |        | ADC0_ST          | I    | MFP23 | ADC0 external trigger input pin.                                                                                  |
|        |        | TM0              | I/O  | MFP24 | Timer0 event counter input/toggle output pin.                                                                     |
|        |        | TM2              | I/O  | MFP25 | Timer2 event counter input/toggle output pin.                                                                     |

| 20 Pin | 28 Pin | Pin Name    | Type | MFP   | Description                                                                                                      |
|--------|--------|-------------|------|-------|------------------------------------------------------------------------------------------------------------------|
|        |        | TM0_EXT     | I/O  | MFP26 | Timer0 external capture input/toggle output pin.                                                                 |
|        |        | TM2_EXT     | I/O  | MFP27 | Timer2 external capture input/toggle output pin.                                                                 |
|        |        | UART1_TXD   | O    | MFP28 | UART1 data transmitter output pin.                                                                               |
|        |        | UART1_RXD   | I    | MFP29 | UART1 data receiver input pin.                                                                                   |
|        |        | PWM0_BRAKE0 | I    | MFP30 | PWM0 Brake 0 input pin.                                                                                          |
| 19     | 27     | PA.0        | I/O  | MFP0  | General purpose digital I/O pin.                                                                                 |
|        |        | ADC0_CH0    | A    | MFP1  | ADC0 channel 0 analog input.                                                                                     |
|        |        | DAC0_OUT    | A    | MFP1  | DAC0 channel analog output.                                                                                      |
|        |        | ACMP0_P0    | A    | MFP1  | Analog comparator 0 positive input 0 pin.                                                                        |
|        |        | ICE_DAT     | I/O  | MFP2  | Serial wired debugger data pin.<br><b>Note:</b> It is recommended to use 100 kΩ pull-up resistor on ICE_DAT pin. |
|        |        | UART0_nCTS  | I    | MFP3  | UART0 clear to Send input pin.                                                                                   |
|        |        | CLKO        | O    | MFP4  | Clock Out                                                                                                        |
|        |        | PWM0_CH1    | I/O  | MFP5  | PWM0 channel 1 output/capture input.                                                                             |
|        |        | PWM0_CH3    | I/O  | MFP6  | PWM0 channel 3 output/capture input.                                                                             |
|        |        | PWM0_CH5    | I/O  | MFP7  | PWM0 channel 5 output/capture input.                                                                             |
|        |        | UART0_TXD   | O    | MFP8  | UART0 data transmitter output pin.                                                                               |
|        |        | UART0_RXD   | I    | MFP9  | UART0 data receiver input pin.                                                                                   |
|        |        | USCI0_CLK   | I/O  | MFP10 | USCI0 clock pin.                                                                                                 |
|        |        | USCI0_DAT0  | I/O  | MFP11 | USCI0 data 0 pin.                                                                                                |
|        |        | USCI0_DAT1  | I/O  | MFP12 | USCI0 data 1 pin.                                                                                                |
|        |        | USCI0_CTL0  | I/O  | MFP13 | USCI0 control 0 pin.                                                                                             |
|        |        | USCI0_CTL1  | I/O  | MFP14 | USCI0 control 1 pin.                                                                                             |
|        |        | USCI1_CLK   | I/O  | MFP15 | USCI1 clock pin.                                                                                                 |
|        |        | USCI1_DAT0  | I/O  | MFP16 | USCI1 data 0 pin.                                                                                                |
|        |        | USCI1_DAT1  | I/O  | MFP17 | USCI1 data 1 pin.                                                                                                |
|        |        | USCI1_CTL0  | I/O  | MFP18 | USCI1 control 0 pin.                                                                                             |
|        |        | CAN0_TXD    | O    | MFP19 | CAN0 bus transmitter output.                                                                                     |
|        |        | CAN0_RXD    | I    | MFP20 | CAN0 bus receiver input.                                                                                         |
|        |        | ACMP0_O     | O    | MFP21 | Analog comparator 0 output pin.                                                                                  |
|        |        | ACMP1_O     | O    | MFP22 | Analog comparator 1 output pin.                                                                                  |
|        |        | ADC0_ST     | I    | MFP23 | ADC0 external trigger input pin.                                                                                 |
|        |        | TM1         | I/O  | MFP24 | Timer1 event counter input/toggle output pin.                                                                    |
|        |        | TM3         | I/O  | MFP25 | Timer3 event counter input/toggle output pin.                                                                    |

| 20 Pin | 28 Pin | Pin Name        | Type | MFP   | Description                                      |
|--------|--------|-----------------|------|-------|--------------------------------------------------|
|        |        | TM1_EXT         | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|        |        | TM3_EXT         | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|        |        | UART1_TXD       | O    | MFP28 | UART1 data transmitter output pin.               |
|        |        | UART1_RXD       | I    | MFP29 | UART1 data receiver input pin.                   |
|        |        | PWM0_BRAKE1     | I    | MFP30 | PWM0 Brake 1 input pin.                          |
| 20     | 28     | V <sub>SS</sub> | P    | MFP0  | Ground pin for digital circuit.                  |

#### 4.2.2 M0A21/M0A23 Series Multi-function Summary Table

| Group | Pin Name | GPIO | MFP   | Type | Description                               |
|-------|----------|------|-------|------|-------------------------------------------|
| ACMP0 | ACMP0_N0 | PA.1 | MFP1  | A    | Analog comparator 0 negative input 0 pin. |
|       | ACMP0_N1 | PC.1 | MFP1  | A    | Analog comparator 0 negative input 1 pin. |
|       | ACMP0_N2 | PC.2 | MFP1  | A    | Analog comparator 0 negative input 2 pin. |
|       | ACMP0_N3 | PC.3 | MFP1  | A    | Analog comparator 0 negative input 3 pin. |
|       | ACMP0_O  | PA.5 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PA.4 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PC.5 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PC.4 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PC.3 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PC.6 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PC.7 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PB.7 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PB.6 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PB.5 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PB.4 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PC.2 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PC.1 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PC.0 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PA.2 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PA.1 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_O  | PA.0 | MFP21 | O    | Analog comparator 0 output pin.           |
|       | ACMP0_P0 | PA.0 | MFP1  | A    | Analog comparator 0 positive input 0 pin. |

| Group | Pin Name   | GPIO | MFP   | Type | Description                                |
|-------|------------|------|-------|------|--------------------------------------------|
|       | ACMP0_WLAT | PA.5 | MFP30 | I    | Analog comparator 0 window latch input pin |
|       | ACMP0_WLAT | PB.7 | MFP30 | I    | Analog comparator 0 window latch input pin |
| ACMP1 | ACMP1_N0   | PA.1 | MFP1  | A    | Analog comparator 1 negative input 0 pin.  |
|       | ACMP1_N1   | PC.1 | MFP1  | A    | Analog comparator 1 negative input 1 pin.  |
|       | ACMP1_N2   | PC.2 | MFP1  | A    | Analog comparator 1 negative input 2 pin.  |
|       | ACMP1_N3   | PC.3 | MFP1  | A    | Analog comparator 1 negative input 3 pin.  |
|       | ACMP1_O    | PA.5 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PA.4 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PC.5 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PC.4 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PC.3 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PC.6 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PC.7 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PB.7 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PB.6 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PB.5 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PB.4 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PC.2 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PC.1 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PC.0 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PA.2 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PA.1 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_O    | PA.0 | MFP22 | O    | Analog comparator 1 output pin.            |
|       | ACMP1_P0   | PC.0 | MFP1  | A    | Analog comparator 1 positive input 0 pin.  |
|       | ACMP1_WLAT | PA.4 | MFP30 | I    | Analog comparator 1 window latch input pin |
|       | ACMP1_WLAT | PB.6 | MFP30 | I    | Analog comparator 1 window latch input pin |
| ADC0  | ADC0_CH0   | PA.0 | MFP1  | A    | ADC0 channel 0 analog input.               |
|       | ADC0_CH1   | PA.1 | MFP1  | A    | ADC0 channel 1 analog input.               |
|       | ADC0_CH10  | PC.7 | MFP1  | A    | ADC0 channel 10 analog input.              |
|       | ADC0_CH11  | PC.6 | MFP1  | A    | ADC0 channel 11 analog input.              |
|       | ADC0_CH12  | PC.3 | MFP1  | A    | ADC0 channel 12 analog input.              |
|       | ADC0_CH13  | PC.4 | MFP1  | A    | ADC0 channel 13 analog input.              |
|       | ADC0_CH14  | PC.5 | MFP1  | A    | ADC0 channel 14 analog input.              |
|       | ADC0_CH15  | PA.4 | MFP1  | A    | ADC0 channel 15 analog input.              |

| Group | Pin Name  | GPIO | MFP   | Type | Description                      |
|-------|-----------|------|-------|------|----------------------------------|
|       | ADC0_CH16 | PA.5 | MFP1  | A    | ADC0 channel 16 analog input.    |
|       | ADC0_CH2  | PA.2 | MFP1  | A    | ADC0 channel 2 analog input.     |
|       | ADC0_CH3  | PC.0 | MFP1  | A    | ADC0 channel 3 analog input.     |
|       | ADC0_CH4  | PC.1 | MFP1  | A    | ADC0 channel 4 analog input.     |
|       | ADC0_CH5  | PC.2 | MFP1  | A    | ADC0 channel 5 analog input.     |
|       | ADC0_CH6  | PB.4 | MFP1  | A    | ADC0 channel 6 analog input.     |
|       | ADC0_CH7  | PB.5 | MFP1  | A    | ADC0 channel 7 analog input.     |
|       | ADC0_CH8  | PB.6 | MFP1  | A    | ADC0 channel 8 analog input.     |
|       | ADC0_CH9  | PB.7 | MFP1  | A    | ADC0 channel 9 analog input.     |
|       | ADC0_ST   | PA.5 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PA.4 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PA.3 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PC.5 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PC.4 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PC.3 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PC.6 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PC.7 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PB.7 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PB.6 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PB.5 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PB.4 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PC.2 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PC.1 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PC.0 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PA.2 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PA.1 | MFP23 | I    | ADC0 external trigger input pin. |
|       | ADC0_ST   | PA.0 | MFP23 | I    | ADC0 external trigger input pin. |
| CAN0  | CAN0_RXD  | PA.5 | MFP20 | I    | CAN0 bus receiver input.         |
|       | CAN0_RXD  | PA.4 | MFP20 | I    | CAN0 bus receiver input.         |
|       | CAN0_RXD  | PA.3 | MFP20 | I    | CAN0 bus receiver input.         |
|       | CAN0_RXD  | PC.5 | MFP20 | I    | CAN0 bus receiver input.         |
|       | CAN0_RXD  | PC.4 | MFP20 | I    | CAN0 bus receiver input.         |
|       | CAN0_RXD  | PC.3 | MFP20 | I    | CAN0 bus receiver input.         |
|       | CAN0_RXD  | PD.3 | MFP3  | I    | CAN0 bus receiver input.         |



| Group | Pin Name | GPIO | MFP   | Type | Description                  |
|-------|----------|------|-------|------|------------------------------|
|       | CAN0_RXD | PC.6 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PC.7 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PB.7 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PB.6 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PB.5 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PD.7 | MFP3  | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PB.4 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PC.2 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PC.1 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PC.0 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PA.2 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PA.1 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_RXD | PA.0 | MFP20 | I    | CAN0 bus receiver input.     |
|       | CAN0_TXD | PA.5 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PA.4 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PC.5 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PC.4 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PC.3 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PD.2 | MFP3  | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PC.6 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PC.7 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PB.7 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PB.6 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PB.5 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PD.6 | MFP3  | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PB.4 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PC.2 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PC.1 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PC.0 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PA.2 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PA.1 | MFP19 | O    | CAN0 bus transmitter output. |
|       | CAN0_TXD | PA.0 | MFP19 | O    | CAN0 bus transmitter output. |
| CLKO  | CLKO     | PA.5 | MFP4  | O    | Clock Out                    |
|       | CLKO     | PA.4 | MFP4  | O    | Clock Out                    |

| Group | Pin Name    | GPIO | MFP   | Type | Description                                                                                                       |
|-------|-------------|------|-------|------|-------------------------------------------------------------------------------------------------------------------|
|       | CLKO        | PC.5 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PC.4 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PC.3 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PC.6 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PC.7 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PB.7 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PB.6 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PB.5 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PB.4 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PC.2 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PC.1 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PC.0 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PA.2 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PA.1 | MFP4  | O    | Clock Out                                                                                                         |
|       | CLKO        | PA.0 | MFP4  | O    | Clock Out                                                                                                         |
| DAC0  | DAC0_OUT    | PA.0 | MFP1  | A    | DAC0 channel analog output.                                                                                       |
| ICE   | ICE_CLK     | PA.1 | MFP2  | I    | Serial wired debugger clock pin.<br><b>Note:</b> It is recommended to use 100 kΩ pull-up resistor on ICE_CLK pin. |
|       | ICE_DAT     | PA.0 | MFP2  | I/O  | Serial wired debugger data pin.<br><b>Note:</b> It is recommended to use 100 kΩ pull-up resistor on ICE_DAT pin.  |
| INT0  | INT0        | PA.3 | MFP30 | I    | External interrupt 0 input pin.                                                                                   |
|       | INT0        | PB.5 | MFP30 | I    | External interrupt 0 input pin.                                                                                   |
| INT1  | INT1        | PC.5 | MFP30 | I    | External interrupt 1 input pin.                                                                                   |
| INT2  | INT2        | PC.4 | MFP30 | I    | External interrupt 2 input pin.                                                                                   |
| INT3  | INT3        | PC.3 | MFP30 | I    | External interrupt 3 input pin.                                                                                   |
| INT4  | INT4        | PC.6 | MFP30 | I    | External interrupt 4 input pin.                                                                                   |
| INT5  | INT5        | PC.7 | MFP30 | I    | External interrupt 5 input pin.                                                                                   |
| PWM0  | PWM0_BRAKE0 | PC.0 | MFP30 | I    | PWM0 Brake 0 input pin.                                                                                           |
|       | PWM0_BRAKE0 | PA.1 | MFP30 | I    | PWM0 Brake 0 input pin.                                                                                           |
|       | PWM0_BRAKE1 | PA.2 | MFP30 | I    | PWM0 Brake 1 input pin.                                                                                           |
|       | PWM0_BRAKE1 | PA.0 | MFP30 | I    | PWM0 Brake 1 input pin.                                                                                           |
|       | PWM0_CH0    | PA.5 | MFP5  | I/O  | PWM0 channel 0 output/capture input.                                                                              |
|       | PWM0_CH0    | PA.3 | MFP5  | I    | PWM0 channel 0 capture input.                                                                                     |
|       | PWM0_CH0    | PC.4 | MFP5  | I/O  | PWM0 channel 0 output/capture input.                                                                              |

| Group | Pin Name | GPIO | MFP  | Type | Description                          |
|-------|----------|------|------|------|--------------------------------------|
|       | PWM0_CH0 | PD.2 | MFP2 | I/O  | PWM0 channel 0 output/capture input. |
|       | PWM0_CH0 | PC.6 | MFP5 | I/O  | PWM0 channel 0 output/capture input. |
|       | PWM0_CH0 | PB.7 | MFP5 | I/O  | PWM0 channel 0 output/capture input. |
|       | PWM0_CH0 | PB.5 | MFP5 | I/O  | PWM0 channel 0 output/capture input. |
|       | PWM0_CH0 | PD.4 | MFP2 | I/O  | PWM0 channel 0 output/capture input. |
|       | PWM0_CH0 | PC.2 | MFP5 | I/O  | PWM0 channel 0 output/capture input. |
|       | PWM0_CH0 | PC.0 | MFP5 | I/O  | PWM0 channel 0 output/capture input. |
|       | PWM0_CH0 | PA.1 | MFP5 | I/O  | PWM0 channel 0 output/capture input. |
|       | PWM0_CH1 | PA.4 | MFP5 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PC.5 | MFP5 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PC.3 | MFP5 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PD.3 | MFP2 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PC.7 | MFP5 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PB.6 | MFP5 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PD.5 | MFP2 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PB.4 | MFP5 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PC.1 | MFP5 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PA.2 | MFP5 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH1 | PA.0 | MFP5 | I/O  | PWM0 channel 1 output/capture input. |
|       | PWM0_CH2 | PA.5 | MFP6 | I/O  | PWM0 channel 2 output/capture input. |
|       | PWM0_CH2 | PA.3 | MFP6 | I    | PWM0 channel 2 capture input.        |
|       | PWM0_CH2 | PC.4 | MFP6 | I/O  | PWM0 channel 2 output/capture input. |
|       | PWM0_CH2 | PC.6 | MFP6 | I/O  | PWM0 channel 2 output/capture input. |
|       | PWM0_CH2 | PB.7 | MFP6 | I/O  | PWM0 channel 2 output/capture input. |
|       | PWM0_CH2 | PB.5 | MFP6 | I/O  | PWM0 channel 2 output/capture input. |
|       | PWM0_CH2 | PD.6 | MFP2 | I/O  | PWM0 channel 2 output/capture input. |
|       | PWM0_CH2 | PC.2 | MFP6 | I/O  | PWM0 channel 2 output/capture input. |
|       | PWM0_CH2 | PC.0 | MFP6 | I/O  | PWM0 channel 2 output/capture input. |
|       | PWM0_CH2 | PA.1 | MFP6 | I/O  | PWM0 channel 2 output/capture input. |
|       | PWM0_CH3 | PA.4 | MFP6 | I/O  | PWM0 channel 3 output/capture input. |
|       | PWM0_CH3 | PC.5 | MFP6 | I/O  | PWM0 channel 3 output/capture input. |
|       | PWM0_CH3 | PC.3 | MFP6 | I/O  | PWM0 channel 3 output/capture input. |
|       | PWM0_CH3 | PC.7 | MFP6 | I/O  | PWM0 channel 3 output/capture input. |
|       | PWM0_CH3 | PB.6 | MFP6 | I/O  | PWM0 channel 3 output/capture input. |

| Group | Pin Name | GPIO | MFP   | Type | Description                                   |
|-------|----------|------|-------|------|-----------------------------------------------|
|       | PWM0_CH3 | PD.7 | MFP2  | I/O  | PWM0 channel 3 output/capture input.          |
|       | PWM0_CH3 | PB.4 | MFP6  | I/O  | PWM0 channel 3 output/capture input.          |
|       | PWM0_CH3 | PC.1 | MFP6  | I/O  | PWM0 channel 3 output/capture input.          |
|       | PWM0_CH3 | PA.2 | MFP6  | I/O  | PWM0 channel 3 output/capture input.          |
|       | PWM0_CH3 | PA.0 | MFP6  | I/O  | PWM0 channel 3 output/capture input.          |
|       | PWM0_CH4 | PA.5 | MFP7  | I/O  | PWM0 channel 4 output/capture input.          |
|       | PWM0_CH4 | PA.3 | MFP7  | I    | PWM0 channel 4 capture input.                 |
|       | PWM0_CH4 | PC.4 | MFP7  | I/O  | PWM0 channel 4 output/capture input.          |
|       | PWM0_CH4 | PD.0 | MFP2  | I/O  | PWM0 channel 4 output/capture input.          |
|       | PWM0_CH4 | PC.6 | MFP7  | I/O  | PWM0 channel 4 output/capture input.          |
|       | PWM0_CH4 | PB.7 | MFP7  | I/O  | PWM0 channel 4 output/capture input.          |
|       | PWM0_CH4 | PB.5 | MFP7  | I/O  | PWM0 channel 4 output/capture input.          |
|       | PWM0_CH4 | PC.2 | MFP7  | I/O  | PWM0 channel 4 output/capture input.          |
|       | PWM0_CH4 | PC.0 | MFP7  | I/O  | PWM0 channel 4 output/capture input.          |
|       | PWM0_CH4 | PA.1 | MFP7  | I/O  | PWM0 channel 4 output/capture input.          |
|       | PWM0_CH5 | PA.4 | MFP7  | I/O  | PWM0 channel 5 output/capture input.          |
|       | PWM0_CH5 | PC.5 | MFP7  | I/O  | PWM0 channel 5 output/capture input.          |
|       | PWM0_CH5 | PC.3 | MFP7  | I/O  | PWM0 channel 5 output/capture input.          |
|       | PWM0_CH5 | PD.1 | MFP2  | I/O  | PWM0 channel 5 output/capture input.          |
|       | PWM0_CH5 | PC.7 | MFP7  | I/O  | PWM0 channel 5 output/capture input.          |
|       | PWM0_CH5 | PB.6 | MFP7  | I/O  | PWM0 channel 5 output/capture input.          |
|       | PWM0_CH5 | PB.4 | MFP7  | I/O  | PWM0 channel 5 output/capture input.          |
|       | PWM0_CH5 | PC.1 | MFP7  | I/O  | PWM0 channel 5 output/capture input.          |
|       | PWM0_CH5 | PA.2 | MFP7  | I/O  | PWM0 channel 5 output/capture input.          |
|       | PWM0_CH5 | PA.0 | MFP7  | I/O  | PWM0 channel 5 output/capture input.          |
| TM0   | TM0      | PA.5 | MFP24 | I/O  | Timer0 event counter input/toggle output pin. |
|       | TM0      | PA.3 | MFP24 | I    | Timer0 event counter input pin.               |
|       | TM0      | PC.4 | MFP24 | I/O  | Timer0 event counter input/toggle output pin. |
|       | TM0      | PD.0 | MFP5  | I/O  | Timer0 event counter input/toggle output pin. |
|       | TM0      | PC.6 | MFP24 | I/O  | Timer0 event counter input/toggle output pin. |
|       | TM0      | PB.7 | MFP24 | I/O  | Timer0 event counter input/toggle output pin. |
|       | TM0      | PB.5 | MFP24 | I/O  | Timer0 event counter input/toggle output pin. |
|       | TM0      | PD.4 | MFP5  | I/O  | Timer0 event counter input/toggle output pin. |
|       | TM0      | PC.2 | MFP24 | I/O  | Timer0 event counter input/toggle output pin. |

| Group | Pin Name | GPIO | MFP   | Type | Description                                   |
|-------|----------|------|-------|------|-----------------------------------------------|
|       | TM0      | PC.0 | MFP24 | I/O  | Timer0 event counter input/toggle output pin. |
|       | TM0      | PA.1 | MFP24 | I/O  | Timer0 event counter input/toggle output pin. |
| TM1   | TM1      | PA.4 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PC.5 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PC.3 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PD.1 | MFP5  | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PC.7 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PB.6 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PD.5 | MFP5  | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PB.4 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PC.1 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PA.2 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PA.0 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
|       | TM1      | PA.0 | MFP24 | I/O  | Timer1 event counter input/toggle output pin. |
| TM2   | TM2      | PA.5 | MFP25 | I/O  | Timer2 event counter input/toggle output pin. |
|       | TM2      | PA.3 | MFP25 | I    | Timer2 event counter input pin.               |
|       | TM2      | PC.4 | MFP25 | I/O  | Timer2 event counter input/toggle output pin. |
|       | TM2      | PD.2 | MFP5  | I/O  | Timer2 event counter input/toggle output pin. |
|       | TM2      | PC.6 | MFP25 | I/O  | Timer2 event counter input/toggle output pin. |
|       | TM2      | PB.7 | MFP25 | I/O  | Timer2 event counter input/toggle output pin. |
|       | TM2      | PB.5 | MFP25 | I/O  | Timer2 event counter input/toggle output pin. |
|       | TM2      | PD.6 | MFP5  | I/O  | Timer2 event counter input/toggle output pin. |
|       | TM2      | PC.2 | MFP25 | I/O  | Timer2 event counter input/toggle output pin. |
|       | TM2      | PC.0 | MFP25 | I/O  | Timer2 event counter input/toggle output pin. |
|       | TM2      | PA.1 | MFP25 | I/O  | Timer2 event counter input/toggle output pin. |
| TM3   | TM3      | PA.4 | MFP25 | I/O  | Timer3 event counter input/toggle output pin. |
|       | TM3      | PC.5 | MFP25 | I/O  | Timer3 event counter input/toggle output pin. |
|       | TM3      | PC.3 | MFP25 | I/O  | Timer3 event counter input/toggle output pin. |
|       | TM3      | PD.3 | MFP5  | I/O  | Timer3 event counter input/toggle output pin. |
|       | TM3      | PC.7 | MFP25 | I/O  | Timer3 event counter input/toggle output pin. |
|       | TM3      | PB.6 | MFP25 | I/O  | Timer3 event counter input/toggle output pin. |
|       | TM3      | PD.7 | MFP5  | I/O  | Timer3 event counter input/toggle output pin. |
|       | TM3      | PB.4 | MFP25 | I/O  | Timer3 event counter input/toggle output pin. |
|       | TM3      | PC.1 | MFP25 | I/O  | Timer3 event counter input/toggle output pin. |
|       | TM3      | PA.2 | MFP25 | I/O  | Timer3 event counter input/toggle output pin. |

| Group | Pin Name | GPIO | MFP   | Type | Description                                      |
|-------|----------|------|-------|------|--------------------------------------------------|
|       | TM3      | PA.0 | MFP25 | I/O  | Timer3 event counter input/toggle output pin.    |
| TM0   | TM0_EXT  | PA.5 | MFP26 | I/O  | Timer0 external capture input/toggle output pin. |
|       | TM0_EXT  | PA.3 | MFP26 | I    | Timer0 external capture input pin.               |
|       | TM0_EXT  | PC.4 | MFP26 | I/O  | Timer0 external capture input/toggle output pin. |
|       | TM0_EXT  | PC.6 | MFP26 | I/O  | Timer0 external capture input/toggle output pin. |
|       | TM0_EXT  | PB.7 | MFP26 | I/O  | Timer0 external capture input/toggle output pin. |
|       | TM0_EXT  | PB.5 | MFP26 | I/O  | Timer0 external capture input/toggle output pin. |
|       | TM0_EXT  | PC.2 | MFP26 | I/O  | Timer0 external capture input/toggle output pin. |
|       | TM0_EXT  | PC.0 | MFP26 | I/O  | Timer0 external capture input/toggle output pin. |
|       | TM0_EXT  | PA.1 | MFP26 | I/O  | Timer0 external capture input/toggle output pin. |
| TM1   | TM1_EXT  | PA.4 | MFP26 | I/O  | Timer1 external capture input/toggle output pin. |
|       | TM1_EXT  | PC.5 | MFP26 | I/O  | Timer1 external capture input/toggle output pin. |
|       | TM1_EXT  | PC.3 | MFP26 | I/O  | Timer1 external capture input/toggle output pin. |
|       | TM1_EXT  | PC.7 | MFP26 | I/O  | Timer1 external capture input/toggle output pin. |
|       | TM1_EXT  | PB.6 | MFP26 | I/O  | Timer1 external capture input/toggle output pin. |
|       | TM1_EXT  | PB.4 | MFP26 | I/O  | Timer1 external capture input/toggle output pin. |
|       | TM1_EXT  | PC.1 | MFP26 | I/O  | Timer1 external capture input/toggle output pin. |
|       | TM1_EXT  | PA.2 | MFP26 | I/O  | Timer1 external capture input/toggle output pin. |
|       | TM1_EXT  | PA.0 | MFP26 | I/O  | Timer1 external capture input/toggle output pin. |
| TM2   | TM2_EXT  | PA.5 | MFP27 | I/O  | Timer2 external capture input/toggle output pin. |
|       | TM2_EXT  | PA.3 | MFP27 | I    | Timer2 external capture input pin.               |
|       | TM2_EXT  | PC.4 | MFP27 | I/O  | Timer2 external capture input/toggle output pin. |
|       | TM2_EXT  | PC.6 | MFP27 | I/O  | Timer2 external capture input/toggle output pin. |
|       | TM2_EXT  | PB.7 | MFP27 | I/O  | Timer2 external capture input/toggle output pin. |
|       | TM2_EXT  | PB.5 | MFP27 | I/O  | Timer2 external capture input/toggle output pin. |
|       | TM2_EXT  | PC.2 | MFP27 | I/O  | Timer2 external capture input/toggle output pin. |
|       | TM2_EXT  | PC.0 | MFP27 | I/O  | Timer2 external capture input/toggle output pin. |
|       | TM2_EXT  | PA.1 | MFP27 | I/O  | Timer2 external capture input/toggle output pin. |
| TM3   | TM3_EXT  | PA.4 | MFP27 | I/O  | Timer3 external capture input/toggle output pin. |
|       | TM3_EXT  | PC.5 | MFP27 | I/O  | Timer3 external capture input/toggle output pin. |
|       | TM3_EXT  | PC.3 | MFP27 | I/O  | Timer3 external capture input/toggle output pin. |
|       | TM3_EXT  | PC.7 | MFP27 | I/O  | Timer3 external capture input/toggle output pin. |
|       | TM3_EXT  | PB.6 | MFP27 | I/O  | Timer3 external capture input/toggle output pin. |
|       | TM3_EXT  | PB.4 | MFP27 | I/O  | Timer3 external capture input/toggle output pin. |

| Group | Pin Name  | GPIO | MFP   | Type | Description                                      |
|-------|-----------|------|-------|------|--------------------------------------------------|
|       | TM3_EXT   | PC.1 | MFP27 | I/O  | Timer3 external capture input/toggle output pin. |
|       | TM3_EXT   | PA.2 | MFP27 | I/O  | Timer3 external capture input/toggle output pin. |
|       | TM3_EXT   | PA.0 | MFP27 | I/O  | Timer3 external capture input/toggle output pin. |
| UART0 | UART0_RXD | PA.5 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PA.4 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PA.3 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PC.5 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PC.4 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PC.3 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PD.1 | MFP3  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PC.6 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PC.7 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PB.7 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PB.6 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PB.5 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PD.5 | MFP3  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PB.4 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PC.2 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PC.1 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PC.0 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PA.2 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PA.1 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_RXD | PA.0 | MFP9  | I    | UART0 data receiver input pin.                   |
|       | UART0_TXD | PA.5 | MFP8  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PA.4 | MFP8  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PC.5 | MFP8  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PC.4 | MFP8  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PC.3 | MFP8  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PD.0 | MFP3  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PC.6 | MFP8  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PC.7 | MFP8  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PB.7 | MFP8  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PB.6 | MFP8  | O    | UART0 data transmitter output pin.               |
|       | UART0_TXD | PB.5 | MFP8  | O    | UART0 data transmitter output pin.               |

| Group | Pin Name   | GPIO | MFP  | Type | Description                        |
|-------|------------|------|------|------|------------------------------------|
|       | UART0_TXD  | PD.4 | MFP3 | O    | UART0 data transmitter output pin. |
|       | UART0_TXD  | PB.4 | MFP8 | O    | UART0 data transmitter output pin. |
|       | UART0_TXD  | PC.2 | MFP8 | O    | UART0 data transmitter output pin. |
|       | UART0_TXD  | PC.1 | MFP8 | O    | UART0 data transmitter output pin. |
|       | UART0_TXD  | PC.0 | MFP8 | O    | UART0 data transmitter output pin. |
|       | UART0_TXD  | PA.2 | MFP8 | O    | UART0 data transmitter output pin. |
|       | UART0_TXD  | PA.1 | MFP8 | O    | UART0 data transmitter output pin. |
|       | UART0_TXD  | PA.0 | MFP8 | O    | UART0 data transmitter output pin. |
|       | UART0_nCTS | PA.3 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PC.5 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PC.4 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PC.3 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PC.6 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PC.7 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PB.7 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PB.6 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PB.5 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PB.4 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PC.2 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PC.1 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PC.0 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PA.2 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PA.1 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nCTS | PA.0 | MFP3 | I    | UART0 clear to Send input pin.     |
|       | UART0_nRTS | PA.5 | MFP2 | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PA.4 | MFP2 | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PC.3 | MFP2 | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PC.6 | MFP2 | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PC.7 | MFP2 | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PB.7 | MFP2 | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PB.6 | MFP2 | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PB.5 | MFP2 | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PB.4 | MFP2 | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PC.2 | MFP2 | O    | UART0 request to Send output pin.  |



| Group | Pin Name   | GPIO | MFP   | Type | Description                        |
|-------|------------|------|-------|------|------------------------------------|
|       | UART0_nRTS | PC.1 | MFP2  | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PC.0 | MFP2  | O    | UART0 request to Send output pin.  |
|       | UART0_nRTS | PA.2 | MFP2  | O    | UART0 request to Send output pin.  |
| UART1 | UART1_RXD  | PA.5 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PA.4 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PA.3 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PC.5 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PC.4 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PC.3 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PC.6 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PC.7 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PB.7 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PB.6 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PB.5 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PB.4 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PC.2 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PC.1 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PC.0 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PA.2 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PA.1 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_RXD  | PA.0 | MFP29 | I    | UART1 data receiver input pin.     |
|       | UART1_TXD  | PA.5 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PA.4 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PC.5 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PC.4 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PC.3 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PC.6 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PC.7 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PB.7 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PB.6 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PB.5 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PB.4 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PC.2 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PC.1 | MFP28 | O    | UART1 data transmitter output pin. |

| Group | Pin Name   | GPIO | MFP   | Type | Description                        |
|-------|------------|------|-------|------|------------------------------------|
|       | UART1_TXD  | PC.0 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PA.2 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PA.1 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_TXD  | PA.0 | MFP28 | O    | UART1 data transmitter output pin. |
|       | UART1_nCTS | PD.2 | MFP6  | I    | UART1 clear to Send input pin.     |
|       | UART1_nCTS | PD.6 | MFP6  | I    | UART1 clear to Send input pin.     |
|       | UART1_nCTS | PB.4 | MFP30 | I    | UART1 clear to Send input pin.     |
|       | UART1_nRTS | PD.3 | MFP6  | O    | UART1 request to Send output pin.  |
|       | UART1_nRTS | PD.7 | MFP6  | O    | UART1 request to Send output pin.  |
|       | UART1_nRTS | PC.2 | MFP30 | O    | UART1 request to Send output pin.  |
| USC10 | USC10_CLK  | PA.5 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PA.4 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PA.3 | MFP10 | I    | USC10 clock pin.                   |
|       | USC10_CLK  | PC.5 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PC.4 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PC.3 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PC.6 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PC.7 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PB.7 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PB.6 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PB.5 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PD.4 | MFP4  | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PB.4 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PC.2 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PC.1 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PC.0 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PA.2 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PA.1 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CLK  | PA.0 | MFP10 | I/O  | USC10 clock pin.                   |
|       | USC10_CTL0 | PA.5 | MFP13 | I/O  | USC10 control 0 pin.               |
|       | USC10_CTL0 | PA.4 | MFP13 | I/O  | USC10 control 0 pin.               |
|       | USC10_CTL0 | PA.3 | MFP13 | I    | USC10 control 0 pin.               |
|       | USC10_CTL0 | PC.5 | MFP13 | I/O  | USC10 control 0 pin.               |
|       | USC10_CTL0 | PC.4 | MFP13 | I/O  | USC10 control 0 pin.               |

| Group | Pin Name   | GPIO | MFP   | Type | Description          |
|-------|------------|------|-------|------|----------------------|
|       | USCI0_CTL0 | PC.3 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PC.6 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PC.7 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PB.7 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PB.6 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PB.5 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PD.7 | MFP4  | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PB.4 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PC.2 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PC.1 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PC.0 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PA.2 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PA.1 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL0 | PA.0 | MFP13 | I/O  | USCI0 control 0 pin. |
|       | USCI0_CTL1 | PA.5 | MFP14 | I/O  | USCI0 control 1 pin. |
|       | USCI0_CTL1 | PA.3 | MFP14 | I    | USCI0 control 1 pin. |
|       | USCI0_CTL1 | PC.5 | MFP14 | I/O  | USCI0 control 1 pin. |
|       | USCI0_CTL1 | PC.3 | MFP14 | I/O  | USCI0 control 1 pin. |
|       | USCI0_CTL1 | PC.7 | MFP14 | I/O  | USCI0 control 1 pin. |
|       | USCI0_CTL1 | PB.6 | MFP14 | I/O  | USCI0 control 1 pin. |
|       | USCI0_CTL1 | PB.4 | MFP14 | I/O  | USCI0 control 1 pin. |
|       | USCI0_CTL1 | PC.1 | MFP14 | I/O  | USCI0 control 1 pin. |
|       | USCI0_CTL1 | PA.2 | MFP14 | I/O  | USCI0 control 1 pin. |
|       | USCI0_CTL1 | PA.0 | MFP14 | I/O  | USCI0 control 1 pin. |
|       | USCI0_DAT0 | PA.5 | MFP11 | I/O  | USCI0 data 0 pin.    |
|       | USCI0_DAT0 | PA.4 | MFP11 | I/O  | USCI0 data 0 pin.    |
|       | USCI0_DAT0 | PA.3 | MFP11 | I    | USCI0 data 0 pin.    |
|       | USCI0_DAT0 | PC.5 | MFP11 | I/O  | USCI0 data 0 pin.    |
|       | USCI0_DAT0 | PC.4 | MFP11 | I/O  | USCI0 data 0 pin.    |
|       | USCI0_DAT0 | PC.3 | MFP11 | I/O  | USCI0 data 0 pin.    |
|       | USCI0_DAT0 | PC.6 | MFP11 | I/O  | USCI0 data 0 pin.    |
|       | USCI0_DAT0 | PC.7 | MFP11 | I/O  | USCI0 data 0 pin.    |
|       | USCI0_DAT0 | PB.7 | MFP11 | I/O  | USCI0 data 0 pin.    |
|       | USCI0_DAT0 | PB.6 | MFP11 | I/O  | USCI0 data 0 pin.    |

| Group | Pin Name   | GPIO | MFP   | Type | Description       |
|-------|------------|------|-------|------|-------------------|
|       | USCI0_DAT0 | PB.5 | MFP11 | I/O  | USCI0 data 0 pin. |
|       | USCI0_DAT0 | PD.5 | MFP4  | I/O  | USCI0 data 0 pin. |
|       | USCI0_DAT0 | PB.4 | MFP11 | I/O  | USCI0 data 0 pin. |
|       | USCI0_DAT0 | PC.2 | MFP11 | I/O  | USCI0 data 0 pin. |
|       | USCI0_DAT0 | PC.1 | MFP11 | I/O  | USCI0 data 0 pin. |
|       | USCI0_DAT0 | PC.0 | MFP11 | I/O  | USCI0 data 0 pin. |
|       | USCI0_DAT0 | PA.2 | MFP11 | I/O  | USCI0 data 0 pin. |
|       | USCI0_DAT0 | PA.1 | MFP11 | I/O  | USCI0 data 0 pin. |
|       | USCI0_DAT0 | PA.0 | MFP11 | I/O  | USCI0 data 0 pin. |
|       | USCI0_DAT1 | PA.5 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PA.4 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PA.3 | MFP12 | I    | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PC.5 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PC.4 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PC.3 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PC.6 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PC.7 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PB.7 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PB.6 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PB.5 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PD.6 | MFP4  | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PB.4 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PC.2 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PC.1 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PC.0 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PA.2 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PA.1 | MFP12 | I/O  | USCI0 data 1 pin. |
|       | USCI0_DAT1 | PA.0 | MFP12 | I/O  | USCI0 data 1 pin. |
| USCI1 | USCI1_CLK  | PA.5 | MFP15 | I/O  | USCI1 clock pin.  |
|       | USCI1_CLK  | PA.4 | MFP15 | I/O  | USCI1 clock pin.  |
|       | USCI1_CLK  | PA.3 | MFP15 | I    | USCI1 clock pin.  |
|       | USCI1_CLK  | PC.5 | MFP15 | I/O  | USCI1 clock pin.  |
|       | USCI1_CLK  | PC.4 | MFP15 | I/O  | USCI1 clock pin.  |
|       | USCI1_CLK  | PC.3 | MFP15 | I/O  | USCI1 clock pin.  |

| Group | Pin Name   | GPIO | MFP   | Type | Description          |
|-------|------------|------|-------|------|----------------------|
|       | USCI1_CLK  | PD.0 | MFP4  | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PC.6 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PC.7 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PB.7 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PB.6 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PB.5 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PB.4 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PC.2 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PC.1 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PC.0 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PA.2 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PA.1 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CLK  | PA.0 | MFP15 | I/O  | USCI1 clock pin.     |
|       | USCI1_CTL0 | PA.5 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PA.4 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PA.3 | MFP18 | I    | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PC.5 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PC.4 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PC.3 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PD.3 | MFP4  | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PC.6 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PC.7 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PB.7 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PB.6 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PB.5 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PB.4 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PC.2 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PC.1 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PC.0 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PA.2 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PA.1 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL0 | PA.0 | MFP18 | I/O  | USCI1 control 0 pin. |
|       | USCI1_CTL1 | PA.4 | MFP14 | I/O  | USCI1 control 1 pin. |
|       | USCI1_CTL1 | PC.4 | MFP14 | I/O  | USCI1 control 1 pin. |

| Group | Pin Name   | GPIO | MFP   | Type | Description          |
|-------|------------|------|-------|------|----------------------|
|       | USCI1_CTL1 | PC.6 | MFP14 | I/O  | USCI1 control 1 pin. |
|       | USCI1_CTL1 | PB.7 | MFP14 | I/O  | USCI1 control 1 pin. |
|       | USCI1_CTL1 | PB.5 | MFP14 | I/O  | USCI1 control 1 pin. |
|       | USCI1_CTL1 | PC.2 | MFP14 | I/O  | USCI1 control 1 pin. |
|       | USCI1_CTL1 | PC.0 | MFP14 | I/O  | USCI1 control 1 pin. |
|       | USCI1_CTL1 | PA.1 | MFP14 | I/O  | USCI1 control 1 pin. |
|       | USCI1_DAT0 | PA.5 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PA.4 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PA.3 | MFP16 | I    | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PC.5 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PC.4 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PC.3 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PD.1 | MFP4  | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PC.6 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PC.7 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PB.7 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PB.6 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PB.5 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PB.4 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PC.2 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PC.1 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PC.0 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PA.2 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PA.1 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT0 | PA.0 | MFP16 | I/O  | USCI1 data 0 pin.    |
|       | USCI1_DAT1 | PA.5 | MFP17 | I/O  | USCI1 data 1 pin.    |
|       | USCI1_DAT1 | PA.4 | MFP17 | I/O  | USCI1 data 1 pin.    |
|       | USCI1_DAT1 | PA.3 | MFP17 | I    | USCI1 data 1 pin.    |
|       | USCI1_DAT1 | PC.5 | MFP17 | I/O  | USCI1 data 1 pin.    |
|       | USCI1_DAT1 | PC.4 | MFP17 | I/O  | USCI1 data 1 pin.    |
|       | USCI1_DAT1 | PC.3 | MFP17 | I/O  | USCI1 data 1 pin.    |
|       | USCI1_DAT1 | PD.2 | MFP4  | I/O  | USCI1 data 1 pin.    |
|       | USCI1_DAT1 | PC.6 | MFP17 | I/O  | USCI1 data 1 pin.    |
|       | USCI1_DAT1 | PC.7 | MFP17 | I/O  | USCI1 data 1 pin.    |

| Group            | Pin Name         | GPIO | MFP   | Type | Description                                                                                                                                                                                             |
|------------------|------------------|------|-------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | USCI1_DAT1       | PB.7 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
|                  | USCI1_DAT1       | PB.6 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
|                  | USCI1_DAT1       | PB.5 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
|                  | USCI1_DAT1       | PB.4 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
|                  | USCI1_DAT1       | PC.2 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
|                  | USCI1_DAT1       | PC.1 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
|                  | USCI1_DAT1       | PC.0 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
|                  | USCI1_DAT1       | PA.2 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
|                  | USCI1_DAT1       | PA.1 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
|                  | USCI1_DAT1       | PA.0 | MFP17 | I/O  | USCI1 data 1 pin.                                                                                                                                                                                       |
| V <sub>REF</sub> | V <sub>REF</sub> | PA.1 | MFP1  | A    | ADC reference voltage input.<br><b>Note:</b> This pin needs to be connected with a 1uF capacitor.                                                                                                       |
| X32              | X32_IN           | PC.5 | MFP2  | I    | External 32.768 kHz crystal input pin.                                                                                                                                                                  |
|                  | X32_OUT          | PC.4 | MFP2  | O    | External 32.768 kHz crystal output pin.                                                                                                                                                                 |
| XT1              | XT1_IN           | PA.5 | MFP3  | I    | External 4~24 MHz (high speed) crystal input pin.                                                                                                                                                       |
|                  | XT1_OUT          | PA.4 | MFP3  | O    | External 4~24 MHz (high speed) crystal output pin.                                                                                                                                                      |
| nRESET           | nRESET           | PA.3 | MFP2  | I    | External reset input: active LOW, with an internal pull-up. Set this pin low reset to initial state.<br><b>Note:</b> It is recommended to use 10 kΩ pull-up resistor and 10 uF capacitor on nRESET pin. |

### 4.2.3 M0A21/M0A23 Series Multi-function Summary Table Sorted by GPIO

|      | Pin Name   | Type | MFP   | Description                                                                                                      |
|------|------------|------|-------|------------------------------------------------------------------------------------------------------------------|
| PA.0 | PA.0       | I/O  | MFP0  | General purpose digital I/O pin.                                                                                 |
|      | ADC0_CH0   | A    | MFP1  | ADC0 channel 0 analog input.                                                                                     |
|      | DAC0_OUT   | A    | MFP1  | DAC0 channel analog output.                                                                                      |
|      | ACMP0_P0   | A    | MFP1  | Analog comparator 0 positive input 0 pin.                                                                        |
|      | ICE_DAT    | I/O  | MFP2  | Serial wired debugger data pin.<br><b>Note:</b> It is recommended to use 100 kΩ pull-up resistor on ICE_DAT pin. |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                                                                                   |
|      | CLKO       | O    | MFP4  | Clock Out                                                                                                        |
|      | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.                                                                             |
|      | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.                                                                             |
|      | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.                                                                             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.                                                                               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                                                                                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                                                                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                                                                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                                                                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                                                                                             |
|      | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                                                                                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                                                                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                                                                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                                                                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                                                                                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                                                                                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                                                                                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                                                                                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                                                                                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                                                                                 |
|      | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.                                                                    |
|      | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.                                                                    |
|      | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin.                                                                 |
|      | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin.                                                                 |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.                                                                               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                                                                                   |



|      | Pin Name         | Type | MFP   | Description                                                                                                       |
|------|------------------|------|-------|-------------------------------------------------------------------------------------------------------------------|
|      | PWM0_BRAKE1      | I    | MFP30 | PWM0 Brake 1 input pin.                                                                                           |
| PA.1 | PA.1             | I/O  | MFP0  | General purpose digital I/O pin.                                                                                  |
|      | ADC0_CH1         | A    | MFP1  | ADC0 channel 1 analog input.                                                                                      |
|      | ACMP0_N0         | A    | MFP1  | Analog comparator 0 negative input 0 pin.                                                                         |
|      | ACMP1_N0         | A    | MFP1  | Analog comparator 1 negative input 0 pin.                                                                         |
|      | V <sub>REF</sub> | A    | MFP1  | ADC reference voltage input.<br><b>Note:</b> This pin needs to be connected with a 1uF capacitor.                 |
|      | ICE_CLK          | I    | MFP2  | Serial wired debugger clock pin.<br><b>Note:</b> It is recommended to use 100 kΩ pull-up resistor on ICE_CLK pin. |
|      | UART0_nCTS       | I    | MFP3  | UART0 clear to Send input pin.                                                                                    |
|      | CLKO             | O    | MFP4  | Clock Out                                                                                                         |
|      | PWM0_CH0         | I/O  | MFP5  | PWM0 channel 0 output/capture input.                                                                              |
|      | PWM0_CH2         | I/O  | MFP6  | PWM0 channel 2 output/capture input.                                                                              |
|      | PWM0_CH4         | I/O  | MFP7  | PWM0 channel 4 output/capture input.                                                                              |
|      | UART0_TXD        | O    | MFP8  | UART0 data transmitter output pin.                                                                                |
|      | UART0_RXD        | I    | MFP9  | UART0 data receiver input pin.                                                                                    |
|      | USCI0_CLK        | I/O  | MFP10 | USCI0 clock pin.                                                                                                  |
|      | USCI0_DAT0       | I/O  | MFP11 | USCI0 data 0 pin.                                                                                                 |
|      | USCI0_DAT1       | I/O  | MFP12 | USCI0 data 1 pin.                                                                                                 |
|      | USCI0_CTL0       | I/O  | MFP13 | USCI0 control 0 pin.                                                                                              |
|      | USCI1_CTL1       | I/O  | MFP14 | USCI1 control 1 pin.                                                                                              |
|      | USCI1_CLK        | I/O  | MFP15 | USCI1 clock pin.                                                                                                  |
|      | USCI1_DAT0       | I/O  | MFP16 | USCI1 data 0 pin.                                                                                                 |
|      | USCI1_DAT1       | I/O  | MFP17 | USCI1 data 1 pin.                                                                                                 |
|      | USCI1_CTL0       | I/O  | MFP18 | USCI1 control 0 pin.                                                                                              |
|      | CAN0_TXD         | O    | MFP19 | CAN0 bus transmitter output.                                                                                      |
|      | CAN0_RXD         | I    | MFP20 | CAN0 bus receiver input.                                                                                          |
|      | ACMP0_O          | O    | MFP21 | Analog comparator 0 output pin.                                                                                   |
|      | ACMP1_O          | O    | MFP22 | Analog comparator 1 output pin.                                                                                   |
|      | ADC0_ST          | I    | MFP23 | ADC0 external trigger input pin.                                                                                  |
|      | TM0              | I/O  | MFP24 | Timer0 event counter input/toggle output pin.                                                                     |
|      | TM2              | I/O  | MFP25 | Timer2 event counter input/toggle output pin.                                                                     |
|      | TM0_EXT          | I/O  | MFP26 | Timer0 external capture input/toggle output pin.                                                                  |
|      | TM2_EXT          | I/O  | MFP27 | Timer2 external capture input/toggle output pin.                                                                  |

|      | Pin Name    | Type | MFP   | Description                                      |
|------|-------------|------|-------|--------------------------------------------------|
|      | UART1_TXD   | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD   | I    | MFP29 | UART1 data receiver input pin.                   |
|      | PWM0_BRAKE0 | I    | MFP30 | PWM0 Brake 0 input pin.                          |
| PA.2 | PA.2        | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH2    | A    | MFP1  | ADC0 channel 2 analog input.                     |
|      | UART0_nRTS  | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS  | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO        | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH1    | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|      | PWM0_CH3    | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|      | PWM0_CH5    | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|      | UART0_TXD   | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD   | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK   | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0  | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1  | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0  | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI0_CTL1  | I/O  | MFP14 | USCI0 control 1 pin.                             |
|      | USCI1_CLK   | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0  | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1  | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0  | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD    | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD    | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O     | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O     | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST     | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM1         | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|      | TM3         | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|      | TM1_EXT     | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|      | TM3_EXT     | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|      | UART1_TXD   | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD   | I    | MFP29 | UART1 data receiver input pin.                   |
|      | PWM0_BRAKE1 | I    | MFP30 | PWM0 Brake 1 input pin.                          |

|      | Pin Name   | Type | MFP   | Description                                                                                                                                                                                             |
|------|------------|------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PA.3 | PA.3       | I    | MFP0  | General purpose digital input pin.                                                                                                                                                                      |
|      | nRESET     | I    | MFP2  | External reset input: active LOW, with an internal pull-up. Set this pin low reset to initial state.<br><b>Note:</b> It is recommended to use 10 kΩ pull-up resistor and 10 uF capacitor on nRESET pin. |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                                                                                                                                                                          |
|      | PWM0_CH0   | I    | MFP5  | PWM0 channel 0 capture input.                                                                                                                                                                           |
|      | PWM0_CH2   | I    | MFP6  | PWM0 channel 2 capture input.                                                                                                                                                                           |
|      | PWM0_CH4   | I    | MFP7  | PWM0 channel 4 capture input.                                                                                                                                                                           |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                                                                                                                                                                          |
|      | USC10_CLK  | I    | MFP10 | USC10 clock pin.                                                                                                                                                                                        |
|      | USC10_DAT0 | I    | MFP11 | USC10 data 0 pin.                                                                                                                                                                                       |
|      | USC10_DAT1 | I    | MFP12 | USC10 data 1 pin.                                                                                                                                                                                       |
|      | USC10_CTL0 | I    | MFP13 | USC10 control 0 pin.                                                                                                                                                                                    |
|      | USC10_CTL1 | I    | MFP14 | USC10 control 1 pin.                                                                                                                                                                                    |
|      | USC11_CLK  | I    | MFP15 | USC11 clock pin.                                                                                                                                                                                        |
|      | USC11_DAT0 | I    | MFP16 | USC11 data 0 pin.                                                                                                                                                                                       |
|      | USC11_DAT1 | I    | MFP17 | USC11 data 1 pin.                                                                                                                                                                                       |
|      | USC11_CTL0 | I    | MFP18 | USC11 control 0 pin.                                                                                                                                                                                    |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                                                                                                                                                                                |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                                                                                                                                                                        |
|      | TM0        | I    | MFP24 | Timer0 event counter input pin.                                                                                                                                                                         |
|      | TM2        | I    | MFP25 | Timer2 event counter input pin.                                                                                                                                                                         |
|      | TM0_EXT    | I    | MFP26 | Timer0 external capture input pin.                                                                                                                                                                      |
|      | TM2_EXT    | I    | MFP27 | Timer2 external capture input pin.                                                                                                                                                                      |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                                                                                                                                                                          |
|      | INT0       | I    | MFP30 | External interrupt 0 input pin.                                                                                                                                                                         |
| PA.4 | PA.4       | I/O  | MFP0  | General purpose digital I/O pin.                                                                                                                                                                        |
|      | ADC0_CH15  | A    | MFP1  | ADC0 channel 15 analog input.                                                                                                                                                                           |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                                                                                                                                                                       |
|      | XT1_OUT    | O    | MFP3  | External 4~24 MHz (high speed) crystal output pin.                                                                                                                                                      |
|      | CLKO       | O    | MFP4  | Clock Out                                                                                                                                                                                               |
|      | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.                                                                                                                                                                    |
|      | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.                                                                                                                                                                    |
|      | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.                                                                                                                                                                    |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.                                                                                                                                                                      |

|      | Pin Name   | Type | MFP   | Description                                       |
|------|------------|------|-------|---------------------------------------------------|
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                    |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                  |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                 |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                 |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                              |
|      | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                              |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                  |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                 |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                 |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                              |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                      |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                          |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                   |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                   |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                  |
|      | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.     |
|      | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.     |
|      | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin.  |
|      | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin.  |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.                |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                    |
|      | ACMP1_WLAT | I    | MFP30 | Analog comparator 1 window latch input pin        |
| PA.5 | PA.5       | I/O  | MFP0  | General purpose digital I/O pin.                  |
|      | ADC0_CH16  | A    | MFP1  | ADC0 channel 16 analog input.                     |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                 |
|      | XT1_IN     | I    | MFP3  | External 4~24 MHz (high speed) crystal input pin. |
|      | CLKO       | O    | MFP4  | Clock Out                                         |
|      | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.              |
|      | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.              |
|      | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.              |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.                |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                    |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                  |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                 |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|      | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|      | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|      | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | ACMP0_WLAT | I    | MFP30 | Analog comparator 0 window latch input pin       |
| PB.4 | PB.4       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH6   | A    | MFP1  | ADC0 channel 6 analog input.                     |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|      | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|      | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|      | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|      | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|      | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | UART1_nCTS | I    | MFP30 | UART1 clear to Send input pin.                   |
| PB.5 | PB.5       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH7   | A    | MFP1  | ADC0 channel 7 analog input.                     |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|      | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|      | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|      | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|      | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|      | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | INT0       | I    | MFP30 | External interrupt 0 input pin.                  |
| PB.6 | PB.6       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH8   | A    | MFP1  | ADC0 channel 8 analog input.                     |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|      | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|      | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|      | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|      | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|      | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | ACMP1_WLAT | I    | MFP30 | Analog comparator 1 window latch input pin       |
| PB.7 | PB.7       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH9   | A    | MFP1  | ADC0 channel 9 analog input.                     |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|      | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|      | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |



|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|      | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|      | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|      | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | ACMP0_WLAT | I    | MFP30 | Analog comparator 0 window latch input pin       |
| PC.0 | PC.0       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH3   | A    | MFP1  | ADC0 channel 3 analog input.                     |
|      | ACMP1_P0   | A    | MFP1  | Analog comparator 1 positive input 0 pin.        |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|      | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|      | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|      | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |

|      | Pin Name    | Type | MFP   | Description                                      |
|------|-------------|------|-------|--------------------------------------------------|
|      | TM0_EXT     | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|      | TM2_EXT     | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|      | UART1_TXD   | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD   | I    | MFP29 | UART1 data receiver input pin.                   |
|      | PWM0_BRAKE0 | I    | MFP30 | PWM0 Brake 0 input pin.                          |
| PC.1 | PC.1        | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH4    | A    | MFP1  | ADC0 channel 4 analog input.                     |
|      | ACMP0_N1    | A    | MFP1  | Analog comparator 0 negative input 1 pin.        |
|      | ACMP1_N1    | A    | MFP1  | Analog comparator 1 negative input 1 pin.        |
|      | UART0_nRTS  | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS  | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO        | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH1    | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|      | PWM0_CH3    | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|      | PWM0_CH5    | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|      | UART0_TXD   | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD   | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK   | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0  | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1  | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0  | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI0_CTL1  | I/O  | MFP14 | USCI0 control 1 pin.                             |
|      | USCI1_CLK   | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0  | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1  | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0  | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD    | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD    | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O     | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O     | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST     | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM1         | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|      | TM3         | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|      | TM1_EXT     | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
| PC.2 | PC.2       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH5   | A    | MFP1  | ADC0 channel 5 analog input.                     |
|      | ACMP0_N2   | A    | MFP1  | Analog comparator 0 negative input 2 pin.        |
|      | ACMP1_N2   | A    | MFP1  | Analog comparator 1 negative input 2 pin.        |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|      | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|      | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|      | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|      | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|      | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | UART1_nRTS | O    | MFP30 | UART1 request to Send output pin.                |
| PC.3 | PC.3       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH12  | A    | MFP1  | ADC0 channel 12 analog input.                    |
|      | ACMP0_N3   | A    | MFP1  | Analog comparator 0 negative input 3 pin.        |
|      | ACMP1_N3   | A    | MFP1  | Analog comparator 1 negative input 3 pin.        |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|      | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|      | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|      | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|      | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|      | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | INT3       | I    | MFP30 | External interrupt 3 input pin.                  |
| PC.4 | PC.4       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH13  | A    | MFP1  | ADC0 channel 13 analog input.                    |
|      | X32_OUT    | O    | MFP2  | External 32.768 kHz crystal output pin.          |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|      | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|      | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|      | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|      | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|      | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | INT2       | I    | MFP30 | External interrupt 2 input pin.                  |
| PC.5 | PC.5       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH14  | A    | MFP1  | ADC0 channel 14 analog input.                    |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | X32_IN     | I    | MFP2  | External 32.768 kHz crystal input pin.           |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|      | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|      | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|      | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|      | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|      | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | INT1       | I    | MFP30 | External interrupt 1 input pin.                  |
| PC.6 | PC.6       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH11  | A    | MFP1  | ADC0 channel 11 analog input.                    |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | PWM0_CH0   | I/O  | MFP5  | PWM0 channel 0 output/capture input.             |
|      | PWM0_CH2   | I/O  | MFP6  | PWM0 channel 2 output/capture input.             |
|      | PWM0_CH4   | I/O  | MFP7  | PWM0 channel 4 output/capture input.             |
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI1_CTL1 | I/O  | MFP14 | USCI1 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM0        | I/O  | MFP24 | Timer0 event counter input/toggle output pin.    |
|      | TM2        | I/O  | MFP25 | Timer2 event counter input/toggle output pin.    |
|      | TM0_EXT    | I/O  | MFP26 | Timer0 external capture input/toggle output pin. |
|      | TM2_EXT    | I/O  | MFP27 | Timer2 external capture input/toggle output pin. |
|      | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | INT4       | I    | MFP30 | External interrupt 4 input pin.                  |
| PC.7 | PC.7       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | ADC0_CH10  | A    | MFP1  | ADC0 channel 10 analog input.                    |
|      | UART0_nRTS | O    | MFP2  | UART0 request to Send output pin.                |
|      | UART0_nCTS | I    | MFP3  | UART0 clear to Send input pin.                   |
|      | CLKO       | O    | MFP4  | Clock Out                                        |
|      | PWM0_CH1   | I/O  | MFP5  | PWM0 channel 1 output/capture input.             |
|      | PWM0_CH3   | I/O  | MFP6  | PWM0 channel 3 output/capture input.             |
|      | PWM0_CH5   | I/O  | MFP7  | PWM0 channel 5 output/capture input.             |

|      | Pin Name   | Type | MFP   | Description                                      |
|------|------------|------|-------|--------------------------------------------------|
|      | UART0_TXD  | O    | MFP8  | UART0 data transmitter output pin.               |
|      | UART0_RXD  | I    | MFP9  | UART0 data receiver input pin.                   |
|      | USCI0_CLK  | I/O  | MFP10 | USCI0 clock pin.                                 |
|      | USCI0_DAT0 | I/O  | MFP11 | USCI0 data 0 pin.                                |
|      | USCI0_DAT1 | I/O  | MFP12 | USCI0 data 1 pin.                                |
|      | USCI0_CTL0 | I/O  | MFP13 | USCI0 control 0 pin.                             |
|      | USCI0_CTL1 | I/O  | MFP14 | USCI0 control 1 pin.                             |
|      | USCI1_CLK  | I/O  | MFP15 | USCI1 clock pin.                                 |
|      | USCI1_DAT0 | I/O  | MFP16 | USCI1 data 0 pin.                                |
|      | USCI1_DAT1 | I/O  | MFP17 | USCI1 data 1 pin.                                |
|      | USCI1_CTL0 | I/O  | MFP18 | USCI1 control 0 pin.                             |
|      | CAN0_TXD   | O    | MFP19 | CAN0 bus transmitter output.                     |
|      | CAN0_RXD   | I    | MFP20 | CAN0 bus receiver input.                         |
|      | ACMP0_O    | O    | MFP21 | Analog comparator 0 output pin.                  |
|      | ACMP1_O    | O    | MFP22 | Analog comparator 1 output pin.                  |
|      | ADC0_ST    | I    | MFP23 | ADC0 external trigger input pin.                 |
|      | TM1        | I/O  | MFP24 | Timer1 event counter input/toggle output pin.    |
|      | TM3        | I/O  | MFP25 | Timer3 event counter input/toggle output pin.    |
|      | TM1_EXT    | I/O  | MFP26 | Timer1 external capture input/toggle output pin. |
|      | TM3_EXT    | I/O  | MFP27 | Timer3 external capture input/toggle output pin. |
| PD.0 | UART1_TXD  | O    | MFP28 | UART1 data transmitter output pin.               |
|      | UART1_RXD  | I    | MFP29 | UART1 data receiver input pin.                   |
|      | INT5       | I    | MFP30 | External interrupt 5 input pin.                  |
|      | PD.0       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | PWM0_CH4   | I/O  | MFP2  | PWM0 channel 4 output/capture input.             |
| PD.1 | UART0_TXD  | O    | MFP3  | UART0 data transmitter output pin.               |
|      | USCI1_CLK  | I/O  | MFP4  | USCI1 clock pin.                                 |
|      | TM0        | I/O  | MFP5  | Timer0 event counter input/toggle output pin.    |
|      | PD.1       | I/O  | MFP0  | General purpose digital I/O pin.                 |
|      | PWM0_CH5   | I/O  | MFP2  | PWM0 channel 5 output/capture input.             |
| PD.1 | UART0_RXD  | I    | MFP3  | UART0 data receiver input pin.                   |
|      | USCI1_DAT0 | I/O  | MFP4  | USCI1 data 0 pin.                                |
|      | TM1        | I/O  | MFP5  | Timer1 event counter input/toggle output pin.    |
|      | PD.2       | I/O  | MFP0  | General purpose digital I/O pin.                 |



|      | Pin Name   | Type | MFP  | Description                                   |
|------|------------|------|------|-----------------------------------------------|
|      | PWM0_CH0   | I/O  | MFP2 | PWM0 channel 0 output/capture input.          |
|      | CAN0_TXD   | O    | MFP3 | CAN0 bus transmitter output.                  |
|      | USCI1_DAT1 | I/O  | MFP4 | USCI1 data 1 pin.                             |
|      | TM2        | I/O  | MFP5 | Timer2 event counter input/toggle output pin. |
|      | UART1_nCTS | I    | MFP6 | UART1 clear to Send input pin.                |
| PD.3 | PD.3       | I/O  | MFP0 | General purpose digital I/O pin.              |
|      | PWM0_CH1   | I/O  | MFP2 | PWM0 channel 1 output/capture input.          |
|      | CAN0_RXD   | I    | MFP3 | CAN0 bus receiver input.                      |
|      | USCI1_CTL0 | I/O  | MFP4 | USCI1 control 0 pin.                          |
|      | TM3        | I/O  | MFP5 | Timer3 event counter input/toggle output pin. |
|      | UART1_nRTS | O    | MFP6 | UART1 request to Send output pin.             |
| PD.4 | PD.4       | I/O  | MFP0 | General purpose digital I/O pin.              |
|      | PWM0_CH0   | I/O  | MFP2 | PWM0 channel 0 output/capture input.          |
|      | UART0_TXD  | O    | MFP3 | UART0 data transmitter output pin.            |
|      | USCI0_CLK  | I/O  | MFP4 | USCI0 clock pin.                              |
|      | TM0        | I/O  | MFP5 | Timer0 event counter input/toggle output pin. |
| PD.5 | PD.5       | I/O  | MFP0 | General purpose digital I/O pin.              |
|      | PWM0_CH1   | I/O  | MFP2 | PWM0 channel 1 output/capture input.          |
|      | UART0_RXD  | I    | MFP3 | UART0 data receiver input pin.                |
|      | USCI0_DAT0 | I/O  | MFP4 | USCI0 data 0 pin.                             |
|      | TM1        | I/O  | MFP5 | Timer1 event counter input/toggle output pin. |
| PD.6 | PD.6       | I/O  | MFP0 | General purpose digital I/O pin.              |
|      | PWM0_CH2   | I/O  | MFP2 | PWM0 channel 2 output/capture input.          |
|      | CAN0_TXD   | O    | MFP3 | CAN0 bus transmitter output.                  |
|      | USCI0_DAT1 | I/O  | MFP4 | USCI0 data 1 pin.                             |
|      | TM2        | I/O  | MFP5 | Timer2 event counter input/toggle output pin. |
|      | UART1_nCTS | I    | MFP6 | UART1 clear to Send input pin.                |
| PD.7 | PD.7       | I/O  | MFP0 | General purpose digital I/O pin.              |
|      | PWM0_CH3   | I/O  | MFP2 | PWM0 channel 3 output/capture input.          |
|      | CAN0_RXD   | I    | MFP3 | CAN0 bus receiver input.                      |
|      | USCI0_CTL0 | I/O  | MFP4 | USCI0 control 0 pin.                          |
|      | TM3        | I/O  | MFP5 | Timer3 event counter input/toggle output pin. |
|      | UART1_nRTS | O    | MFP6 | UART1 request to Send output pin.             |

5 BLOCK DIAGRAM

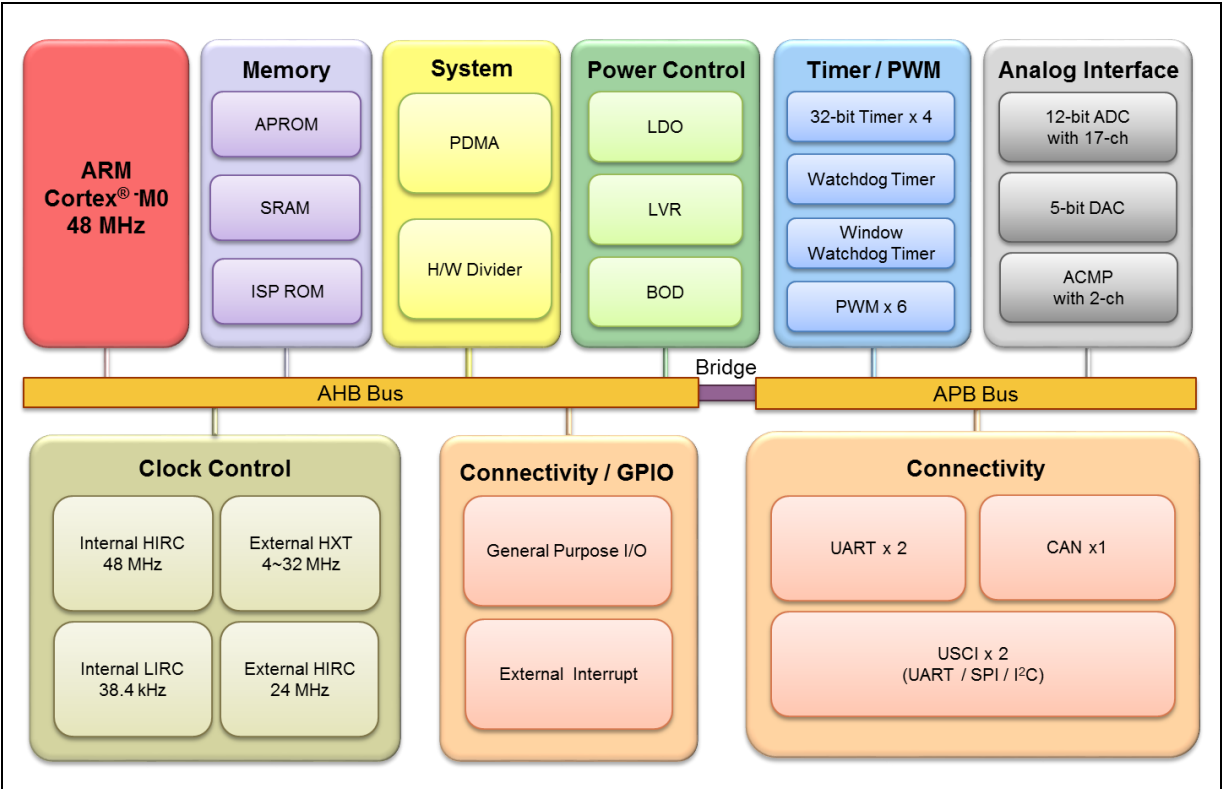


Figure 4.2-1 NuMicro® M0A21/M0A23 Block Diagram

## 6 FUNCTIONAL DESCRIPTION

### 6.1 Arm® Cortex®-M0 Core

The Cortex®-M0 core is a configurable, multistage, 32-bit RISC processor, which has an AMBA AHB-Lite interface and includes an NVIC component. It also has optional hardware debug functionality. The core 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 6.1-1 shows the functional block diagram of processor.

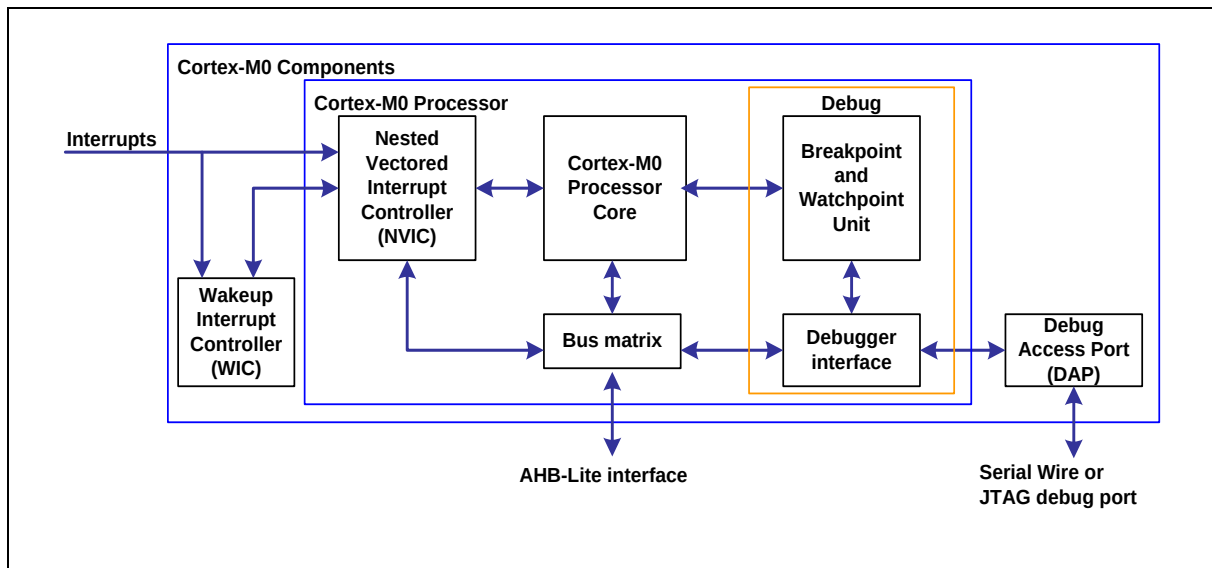


Figure 6.1-1 Functional Block Diagram

The implemented device provides:

- A low gate count processor:
  - Arm®6-M Thumb® instruction set
  - Thumb-2 technology
  - Arm®6-M compliant 24-bit SysTick timer
  - A 32-bit hardware multiplier
  - System interface supported with little-endian data accesses
  - 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 the Wait For Interrupt (WFI), Wait For Event (WFE) instructions, or return from interrupt sleep-on-exit feature
- NVIC:
  - 32 external interrupt inputs, each with four levels of priority

- Dedicated Non-maskable Interrupt (NMI) input
- Supports for both level-sensitive and pulse-sensitive interrupt lines
- Supports Wake-up Interrupt Controller (WIC) and, providing Ultra-low Power Sleep mode
- Debug support:
  - Four hardware breakpoints
  - Two watchpoints
  - Program Counter Sampling Register (PCSR) for non-intrusive code profiling
  - Single step and vector catch capabilities
- Bus interfaces:
  - Single 32-bit AMBA-3 AHB-Lite system interface that provides simple integration to all system peripherals and memory
  - Single 32-bit slave port that supports the DAP (Debug Access Port)

## 6.2 System Manager

### 6.2.1 Overview

System management includes the following sections:

- System Reset
- System Power Distribution
- SRAM Memory Organization
- System Timer (SysTick)
- Nested Vectored Interrupt Controller (NVIC)
- System Control register

### 6.2.2 System Reset

The system reset can be issued by one of the events listed below. These reset event flags can be read from SYS\_RSTSTS register to determine the reset source. Hardware reset sources are from peripheral signals. Software reset can trigger reset through setting control registers.

- Hardware Reset Sources
  - Power-on Reset
  - Low level on the nRESET pin
  - Watchdog Time-out Reset and Window Watchdog Reset (WDT/WWDT Reset)
  - Low Voltage Reset (LVR)
  - Brown-out Detector Reset (BOD Reset)
  - CPU Lockup Reset
- Software Reset Sources
  - CHIP Reset will reset whole chip by writing 1 to CHIPRST (SYS\_IPRST0[0])
  - MCU Reset to reboot but keeping the booting setting from APROM or LDROM by writing 1 to SYSRESETREQ (AIRC[2])
  - CPU Reset for Cortex®-M0 core Only by writing 1 to CPURST (SYS\_IPRST0[1])
  - nRESET glitch filter time 32us

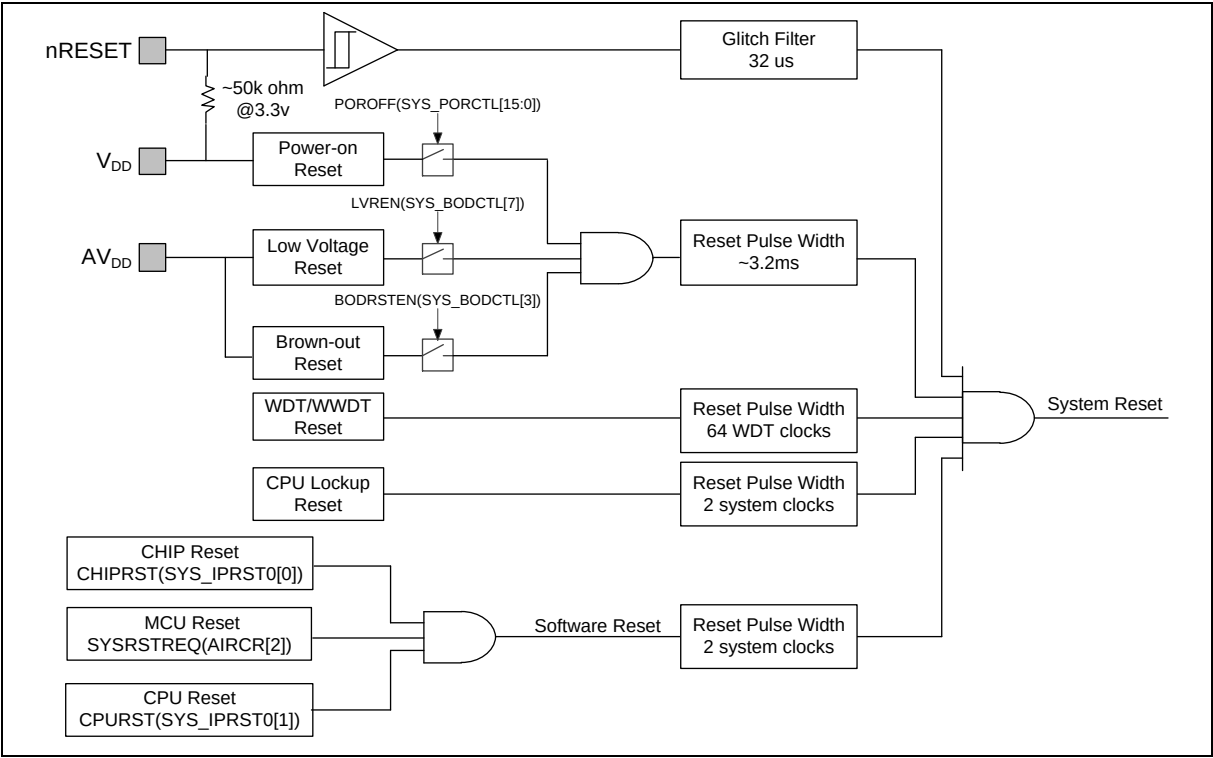


Figure 6.2-1 System Reset Sources

There are a total of 9 reset sources in the NuMicro® family. In general, CPU reset is used to reset Cortex®-M0 only; the other reset sources will reset Cortex®-M0 and all peripherals. However, there are small differences between each reset source and they are listed in Table 6.2-1.

| Reset Sources<br>Register   | POR                       | NRESET                    | WDT                       | LVR                       | BOD                       | Lockup                    | CHIP                      | MCU                       | CPU       |
|-----------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|-----------|
| SYS_RSTSTS                  | Bit 0 = 1                 | Bit 1 = 1                 | Bit 2 = 1                 | Bit 3 = 1                 | Bit 4 = 1                 | Bit 8 = 1                 | Bit 0 = 1                 | Bit 5 = 1                 | Bit 7 = 1 |
| CHIPRST<br>(SYS_IPRST0[0])  | 0x0                       | -                         | -                         | -                         | -                         | -                         | -                         | -                         | -         |
| BODEN<br>(SYS_BODCTL[0])    | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | -                         | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | -         |
| BODVL<br>(SYS_BODCTL[16])   |                           |                           |                           |                           |                           |                           |                           |                           |           |
| BODRSTEN<br>(SYS_BODCTL[3]) |                           |                           |                           |                           |                           |                           |                           |                           |           |
| HXTEN<br>(CLK_PWRCTL[0])    | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0 |           |
| LXTEN<br>(CLK_PWRCTL[1])    | 0x0                       | -                         | -                         | -                         | -                         | -                         | -                         | -                         | -         |
| WDTCKEN<br>(CLK_APBCLK0[0]) | 0x1                       | -                         | 0x1                       | -                         | -                         | -                         | 0x1                       | -                         | -         |

|                                                                    |                              |                              |                              |                              |                              |                           |                              |                           |   |
|--------------------------------------------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|---------------------------|------------------------------|---------------------------|---|
| HCLKSEL<br>(CLK_CLKSEL0[2:0])                                      | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0 | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0 | - |
| WDTSEL<br>(CLK_CLKSEL1[1:0])                                       | 0x3                          | 0x3                          | -                            | -                            | -                            | -                         | -                            | -                         | - |
| HXTSTB<br>(CLK_STATUS[0])                                          | 0x0                          | -                            | -                            | -                            | -                            | -                         | -                            | -                         | - |
| LXTSTB<br>(CLK_STATUS[1])                                          | 0x0                          | -                            | -                            | -                            | -                            | -                         | -                            | -                         | - |
| HIRCSTB<br>(CLK_STATUS[4])                                         | 0x0                          | -                            | -                            | -                            | -                            | -                         | -                            | -                         | - |
| CLKSFAIL<br>(CLK_STATUS[7])                                        | 0x0                          | 0x0                          | -                            | -                            | -                            | -                         | -                            | -                         | - |
| RSTEN<br>(WDT_CTL[1])                                              | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | -                         | Reload<br>from<br>CONFIG0    | -                         | - |
| WDTEN<br>(WDT_CTL[7])                                              |                              |                              |                              |                              |                              |                           |                              |                           |   |
| WDT_CTL<br>except bit 1 and bit 7.                                 | 0x0700                       | 0x0700                       | 0x0700                       | 0x0700                       | 0x0700                       | -                         | 0x0700                       | -                         | - |
| WDT_ALTCTL                                                         | 0x0000                       | 0x0000                       | 0x0000                       | 0x0000                       | 0x0000                       | -                         | 0x0000                       | -                         | - |
| WWDT_RLDCNT                                                        | 0x0000                       | 0x0000                       | 0x0000                       | 0x0000                       | 0x0000                       | -                         | 0x0000                       | -                         | - |
| WWDT_CTL                                                           | 0x3F0800                     | 0x3F0800                     | 0x3F0800                     | 0x3F0800                     | 0x3F0800                     | -                         | 0x3F0800                     | -                         | - |
| WWDT_STATUS                                                        | 0x0000                       | 0x0000                       | 0x0000                       | 0x0000                       | 0x0000                       | -                         | 0x0000                       | -                         | - |
| WWDT_CNT                                                           | 0x3F                         | 0x3F                         | 0x3F                         | 0x3F                         | 0x3F                         | -                         | 0x3F                         | -                         | - |
| BS<br>(FMC_ISPCTL[1])                                              | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | -                         | Reload<br>from<br>CONFIG0    | -                         | - |
| FMC_DFBA                                                           | Reload<br>from<br>CONFIG1    | Reload<br>from<br>CONFIG1    | Reload<br>from<br>CONFIG1    | Reload<br>from<br>CONFIG1    | Reload<br>from<br>CONFIG1    | -                         | Reload<br>from<br>CONFIG1    | -                         | - |
| CBS<br>(FMC_ISPSTS[2:1])                                           | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | Reload<br>from<br>CONFIG0    | -                         | Reload<br>from<br>CONFIG0    | -                         | - |
| VECMAP<br>(FMC_ISPSTS[23:9])                                       | Reload<br>base on<br>CONFIG0 | Reload<br>base on<br>CONFIG0 | Reload<br>base on<br>CONFIG0 | Reload<br>base on<br>CONFIG0 | Reload<br>base on<br>CONFIG0 | -                         | Reload<br>base on<br>CONFIG0 | -                         | - |
| Other Peripheral<br>Registers                                      | Reset Value                  |                              |                              |                              |                              |                           |                              |                           |   |
| FMC Registers                                                      | Reset Value                  |                              |                              |                              |                              |                           |                              |                           |   |
| Note: '-' means that the value of register keeps original setting. |                              |                              |                              |                              |                              |                           |                              |                           |   |

Table 6.2-1 Reset Value of Registers

### 6.2.2.1 nRESET Reset

The nRESET reset means to generate a reset signal by pulling low nRESET pin, which is an asynchronous reset input pin and can be used to reset system at any time. When the nRESET voltage is lower than  $0.2 V_{DD}$  and the state keeps longer than 32  $\mu s$  (glitch filter), chip will be reset. The nRESET reset will control the chip in reset state until the nRESET voltage rises above  $0.7 V_{DD}$  and the state keeps longer than 32  $\mu s$  (glitch filter). The PINRF(SYS\_RSTSTS[1]) will be set to 1 if the previous reset source is nRESET reset. Figure 6.2-2 shows the nRESET reset waveform.

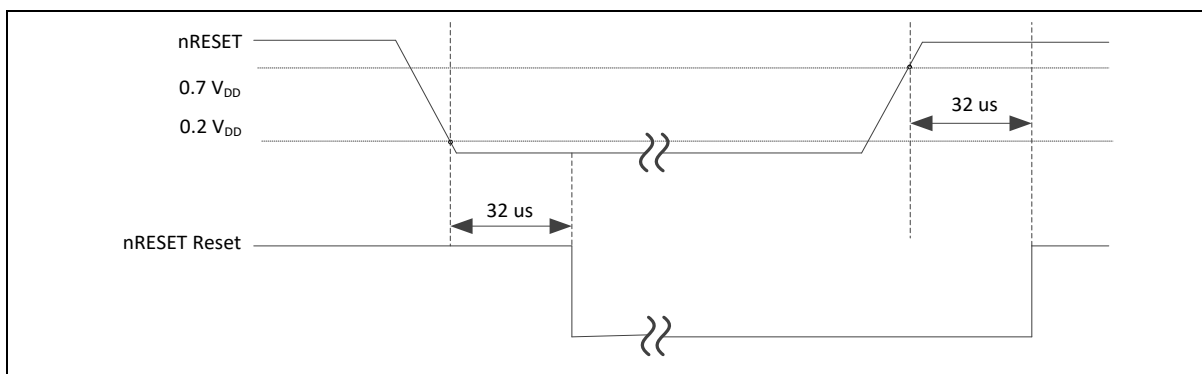


Figure 6.2-2 nRESET Reset Waveform

The special mode can enable nRESET pin function when system select other function for GPA.3, user can input special control signal for GPA.3 make system force enable nRESET pin.

Figure 6.2-3 shows the method of entry special mode.

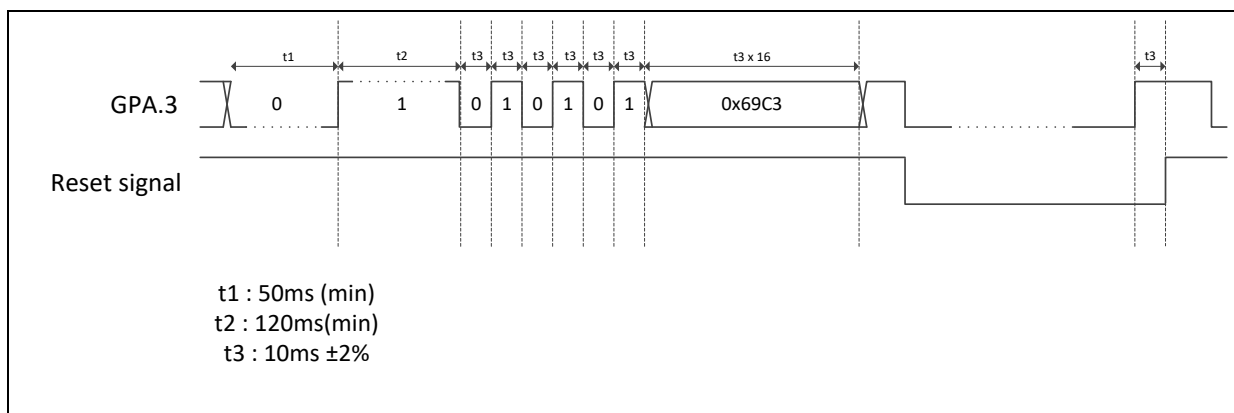


Figure 6.2-3 nRESET Reset Mode Enable Control Waveform

### 6.2.2.2 Power-on Reset (POR)

The Power-on reset (POR) is used to generate a stable system reset signal and forces the system to be reset when power-on to avoid unexpected behavior of MCU. When applying the power to MCU, the POR module will detect the rising voltage and generate reset signal to system until the voltage is ready for MCU operation. At POR reset, the PORF(SYS\_RSTSTS[0]) will be set to 1 to indicate there is a POR reset event. The PORF(SYS\_RSTSTS[0]) bit can be cleared by writing 1 to it. Figure 6.2-4 shows the power-on reset waveform.



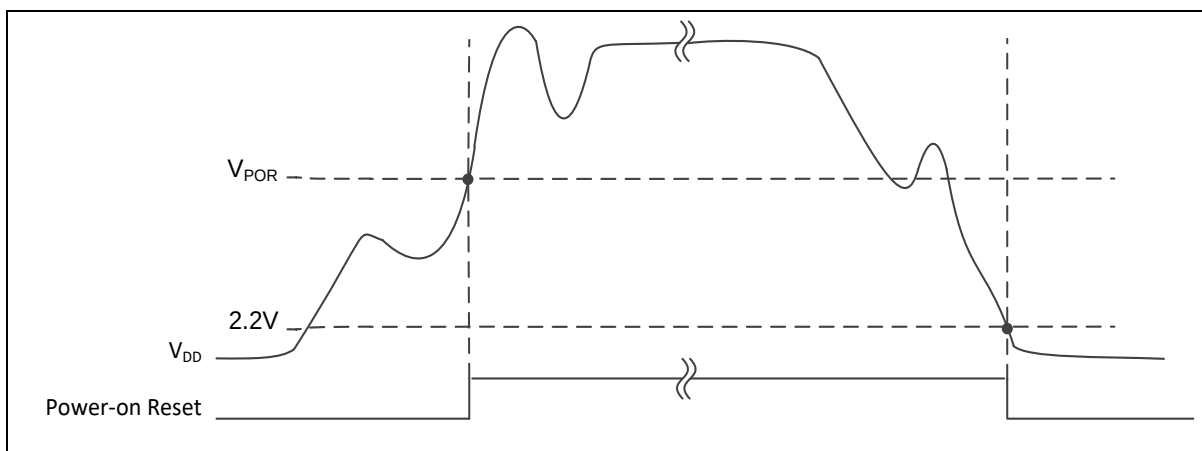


Figure 6.2-4 Power-on Reset (POR) Waveform

### 6.2.2.3 Low Voltage Reset (LVR)

If the Low Voltage Reset function is enabled by setting the Low Voltage Reset Enable Bit LVREN (SYS\_BODCTL[7]) to 1, after 200us delay, LVR detection circuit will be stable and the LVR function will be active. Then LVR function will detect  $AV_{DD}$  during system operation. When the  $AV_{DD}$  voltage is lower than  $V_{LVR}$  and the state keeps longer than De-glitch time set by LVRDGSEL (SYS\_BODCTL[14:12]), chip will be reset. The LVR reset will control the chip in reset state until the  $AV_{DD}$  voltage rises above  $V_{LVR}$  and the state keeps longer than De-glitch time set by LVRDGSEL (SYS\_BODCTL[14:12]). The default setting of Low Voltage Reset is enabled without De-glitch function. Figure 6.2-5 shows the Low Voltage Reset waveform.

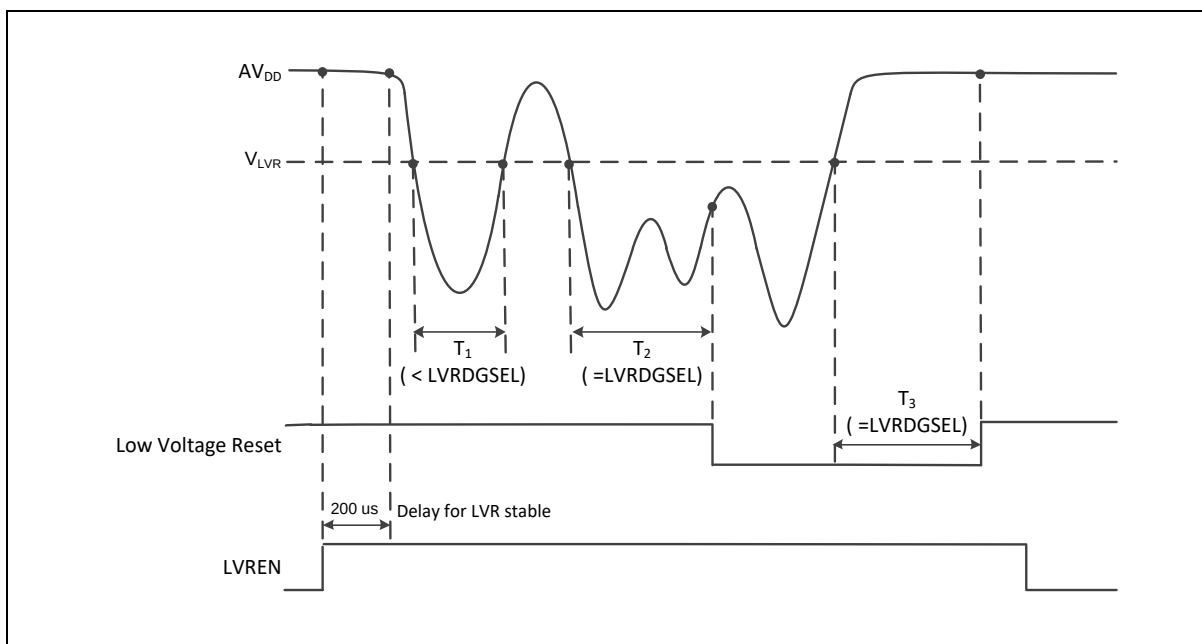


Figure 6.2-5 Low Voltage Reset (LVR) Waveform

### 6.2.2.4 Brown-out Detector Reset (BOD Reset)

If the Brown-out Detector (BOD) function is enabled by setting the Brown-out Detector Enable Bit BODEN (SYS\_BODCTL[0]), Brown-out Detector function will detect  $AV_{DD}$  during system operation. When the  $AV_{DD}$  voltage is lower than  $V_{BOD}$  which is decided by BODEN and BODVL (SYS\_BODCTL[17:16]) and the state keeps longer than De-glitch time set by BODDGSEL

(SYS\_BODCTL[10:8]), chip will be reset. The BOD reset will control the chip in reset state until the  $AV_{DD}$  voltage rises above  $V_{BOD}$  and the state keeps longer than De-glitch time set by BODDGESEL. The default value of BODEN, BODVL and BODRSTEN (SYS\_BODCTL[3]) is set by Flash controller user configuration register CBODEN (CONFIG0 [19]), CBOV (CONFIG0 [23:21]) and CBORST(CONFIG0[20]) respectively. User can determine the initial BOD setting by setting the CONFIG0 register. Figure 6.2-6 shows the Brown-out Detector waveform.

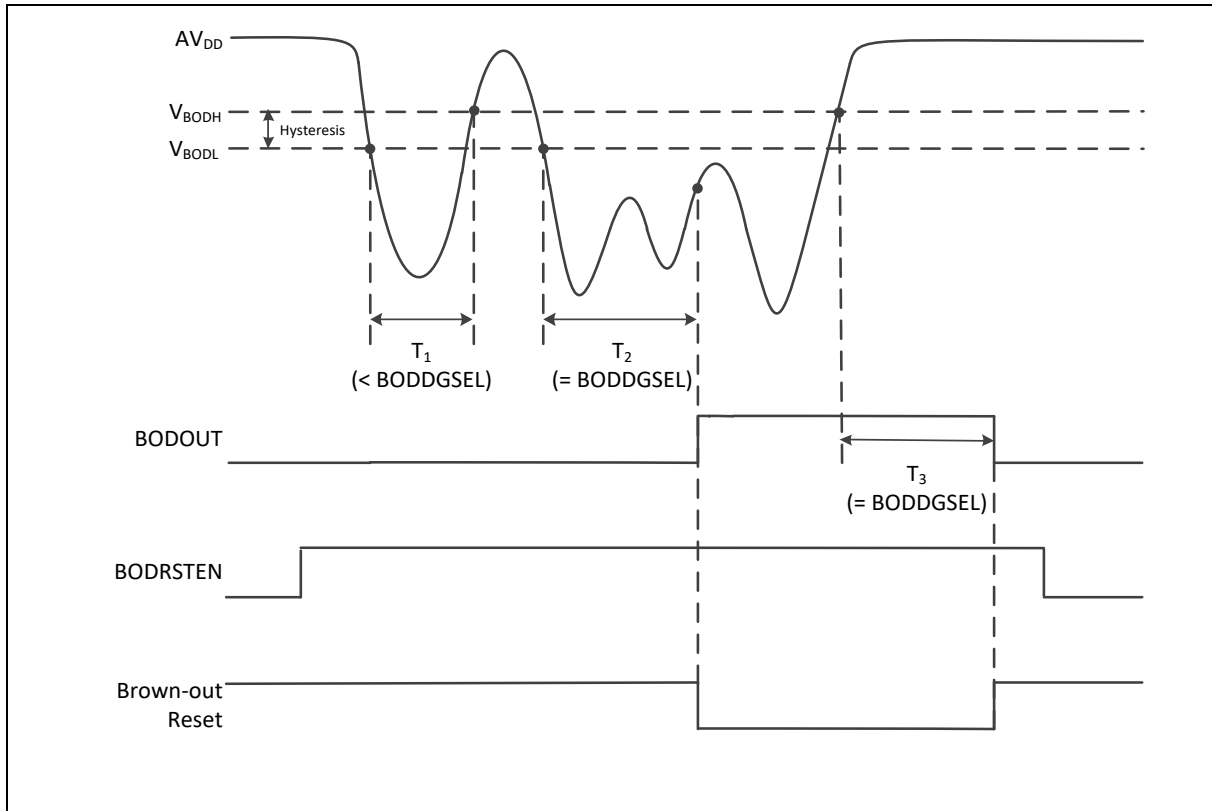


Figure 6.2-6 Brown-out Detector (BOD) Waveform

#### 6.2.2.5 Watchdog Timer Reset (WDT)

In most industrial applications, system reliability is very important. To automatically recover the MCU from failure status is one way to improve system reliability. The watchdog timer(WDT) is widely used to check if the system works fine. If the MCU is crashed or out of control, it may cause the watchdog time-out. User may decide to enable system reset during watchdog time-out to recover the system and take action for the system crash/out-of-control after reset.

Software can check if the reset is caused by watchdog time-out to indicate the previous reset is a watchdog reset and handle the failure of MCU after watchdog time-out reset by checking WDTRF(SYS\_RSTSTS[2]).

#### 6.2.2.6 CPU Lockup Reset

CPU enters lockup status after CPU produces hardfault at hardfault handler and chip gives immediate indication of seriously errant kernel software. This is the result of the CPU being locked because of an unrecoverable exception following the activation of the processor's built in system state protection hardware. When chip enters debug mode, the CPU lockup reset will be ignored.

#### 6.2.2.7 CPU Reset, CHIP Reset and MCU Reset

The CPU Reset means only Cortex®-M0 core is reset and all other peripherals remain the same status after CPU reset. User can set the CPURST(SYS\_IPRST0[1]) to 1 to assert the CPU Reset signal.

The CHIP Reset is same with Power-on Reset. The CPU and all peripherals are reset and BS(FMC\_ISPCTL[1]) bit is automatically reloaded from CONFIG0 setting. User can set the CHIPRST(SYS\_IPRST0[0]) to 1 to assert the CHIP Reset signal.

The MCU Reset is similar with CHIP Reset. The difference is that BS(FMC\_ISPCTL[1]) will not be reloaded from CONFIG0 setting and keep its original software setting for booting from APROM or LDROM. User can set the SYSRESETREQ(AIRCR[2]) to 1 to assert the MCU Reset.

### 6.2.3 System Power Distribution

In this chip, power distribution is divided into three segments:

- Analog power from  $V_{DD}$  and  $V_{SS}$  provides the power for analog components operation.
- Digital power from  $V_{DD}$  and  $V_{SS}$  supplies the power to the internal regulator which provides a fixed 1.8V power for digital operation and I/O pins.

The outputs of internal voltage regulators, LDO and  $V_{DD}$ , require an external capacitor which should be located close to the corresponding pin. Figure 6.2-7 shows the NuMicro® M0A21/M0A23 power distribution.

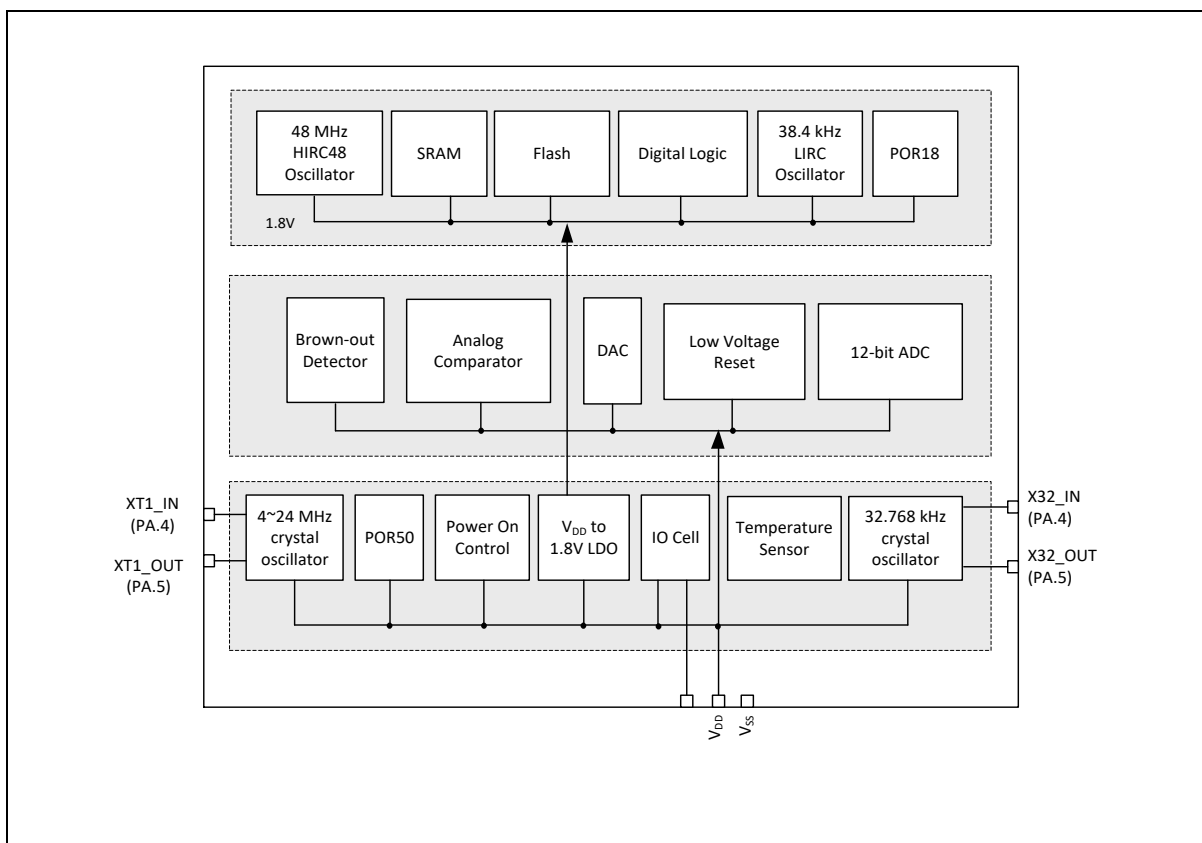


Figure 6.2-7 NuMicro® M0A21/M0A23 Power Distribution Diagram

### 6.2.4 Power Modes and Wake-up Sources

The M0A21/M0A23 series has power manager unit to support several operating modes for saving power. Table 6.2-2 lists all power mode in the M0A21/M0A23 series.

| Mode        | CPU Operating Maximum Speed( MHz) | Clock Disable                                |
|-------------|-----------------------------------|----------------------------------------------|
| Normal mode | 48                                | All clocks are disabled by control register. |

|                 |                            |                                                                                                                                                   |
|-----------------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Idle mode       | CPU enter Sleep mode       | Only CPU clock is disabled.                                                                                                                       |
| Power-down mode | CPU enters Power-down mode | Most clocks are disabled except LIRC/LXT, and only WDT/Timer/UART peripheral clocks still enable if their clock sources are selected as LIRC/LXT. |

Table 6.2-2 Power Mode Table

There are different power mode entry settings and leaving condition for each power mode. Table 6.2-3 shows the entry setting for each power mode. When chip power-on, chip is running in normal mode. User can enter each mode by setting SLEEPDEEP (SCR[2]), PDEN (CLK\_PWRCTL[7]) and execute WFI instruction.

| Register/Instruction Mode                       | SLEEPDEEP (SCR[2]) | PDEN (CLK_PWRCTL[7]) | CPU Run WFI Instruction |
|-------------------------------------------------|--------------------|----------------------|-------------------------|
| Normal mode                                     | 0                  | 0                    | NO                      |
| Idle mode<br>(CPU enter Sleep mode)             | 0                  | 0                    | YES                     |
| Power-down mode<br>(CPU enters Deep Sleep mode) | 1                  | 1                    | YES                     |

Table 6.2-3 Power Mode Difference Table

There are several wake-up sources in Idle mode and Power-down mode. Table 6.2-4 lists the available clocks for each power mode.

| Power Mode       | Normal Mode                                        | Idle Mode                     | Power-Down Mode                                                                       |
|------------------|----------------------------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Definition       | CPU is in active state                             | CPU is in sleep state         | CPU is in sleep state and all clocks stop except LXT and LIRC. SRAM content retended. |
| Entry Condition  | Chip is in normal mode after system reset released | CPU executes WFI instruction. | CPU sets sleep mode enable and power down enable and executes WFI instruction.        |
| Wake-up Sources  | N/A                                                | All interrupts                | WDT, Timer, UART, BOD, GPIO, EINT, USCI, CAN and ACMP                                 |
| Available Clocks | All                                                | All except CPU clock          | LXT and LIRC                                                                          |
| After Wake-up    | N/A                                                | CPU back to normal mode       | CPU back to normal mode                                                               |

Table 6.2-4 Power Mode Difference Table

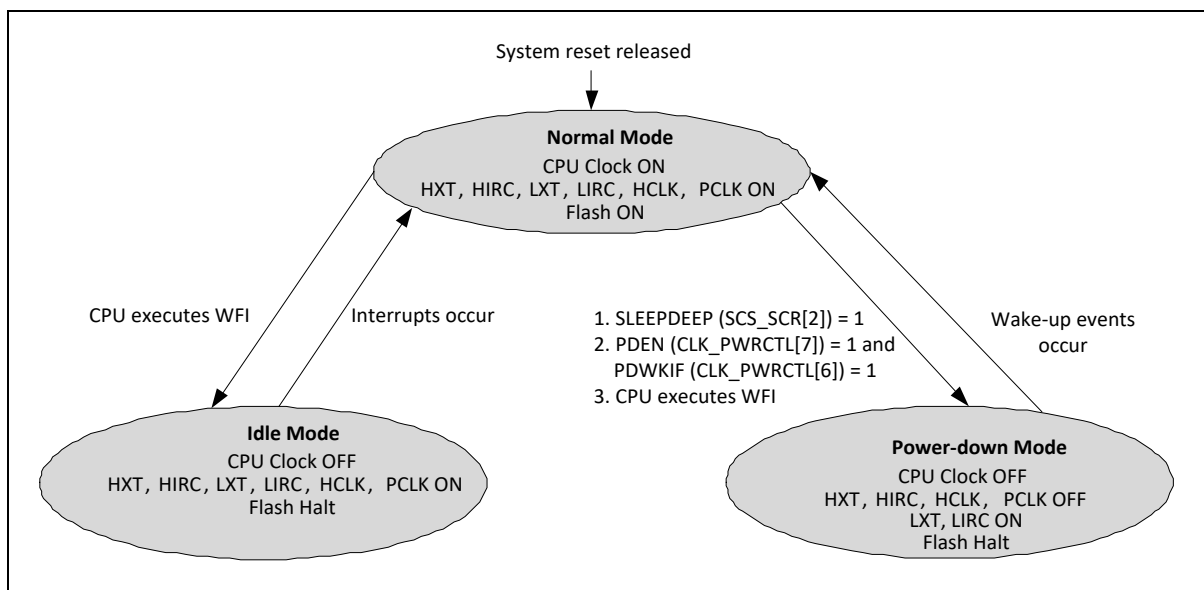


Figure 6.2-8 Power Mode State Machine

1. LXT (32768 Hz XTL) ON or OFF depends on SW setting in normal mode.
2. LIRC (38.4 kHz OSC) ON or OFF depends on S/W setting in normal mode.
3. If TIMER clock source is selected as LIRC/LXT and LIRC/LXT is on.
4. If WDT clock source is selected as LIRC and LIRC is on.
5. If UART clock source is selected as LXT and LXT is on.

|                     | Normal Mode | Idle Mode | Power-Down Mode     |
|---------------------|-------------|-----------|---------------------|
| HXT (4~24 MHz XTL)  | ON          | ON        | Halt                |
| HIRC48 (48 MHz OSC) | ON          | ON        | Halt                |
| LXT (32768 Hz XTL)  | ON          | ON        | ON/OFF <sup>1</sup> |
| LIRC (38.4 kHz OSC) | ON          | ON        | ON/OFF <sup>2</sup> |
| MLDO                | ON          | ON        | OFF                 |
| ULDO                | ON          | ON        | ON                  |
| CPU                 | ON          | Halt      | Halt                |
| HCLK/PCLK           | ON          | ON        | Halt                |
| SRAM retention      | ON          | ON        | ON                  |
| FLASH               | ON          | ON        | Halt                |
| GPIO                | ON          | ON        | Halt                |
| PDMA                | ON          | ON        | Halt                |
| TIMER               | ON          | ON        | ON/OFF <sup>3</sup> |
| PWM                 | ON          | ON        | Halt                |
| WDT                 | ON          | ON        | ON/OFF <sup>4</sup> |
| WWDT                | ON          | Halt      | Halt                |
| UART                | ON          | ON        | ON/OFF <sup>6</sup> |
| USCI                | ON          | ON        | Halt                |
| ADC                 | ON          | ON        | Halt                |
| ACMP                | ON          | ON        | Halt                |

Table 6.2-5 Clocks in Power Modes

**Wake-up sources in Power-down mode:**

WDT, Timer, UART, USCI, BOD, GPIO, CAN, and ACMP.

After chip enters power down, the following wake-up sources can wake chip up to normal mode. Table 6.2-5 lists the condition about how to enter Power-down mode again for each peripheral.

\*User needs to wait this condition before setting PDEN(CLK\_PWRCTL[7]) and execute WFI to enter Power-down mode.

| Wake-Up Source | Wake-Up Condition            | System Can Enter Power-Down Mode Again Condition*                                    |
|----------------|------------------------------|--------------------------------------------------------------------------------------|
| BOD            | Brown-Out Detector Interrupt | After software writes 1 to clear (SYS_BODCTL[4]).                                    |
| INT            | External Interrupt           | After software write 1 to clear the Px_INTSRC[n] bit.                                |
| GPIO           | GPIO Interrupt               | After software write 1 to clear the Px_INTSRC[n] bit.                                |
| TIMER          | Timer Interrupt              | After software writes 1 to clear TWKF (TIMERx_INTSTS[1]) and TIF (TIMERx_INTSTS[0]). |
| WDT            | WDT Interrupt                | After software writes 1 to clear WKF (WDT_CTL[5]) (Write Protect).                   |

|         |                                          |                                                                                     |
|---------|------------------------------------------|-------------------------------------------------------------------------------------|
| UART0/1 | nCTS wake-up                             | After software writes 1 to clear CTSWKF (UARTx_WKSTS[0]).                           |
|         | RX Data wake-up                          | After software writes 1 to clear DATWKF (UARTx_WKSTS[1]).                           |
|         | Received FIFO Threshold Wake-up          | After software writes 1 to clear RFRTWKF (UARTx_WKSTS[2]).                          |
|         | RS-485 AAD Mode Wake-up                  | After software writes 1 to clear RS485WKF (UARTx_WKSTS[3]).                         |
|         | Received FIFO Threshold Time-out Wake-up | After software writes 1 to clear TOUTWKF (UARTx_WKSTS[4]).                          |
| CAN     | RX Data wake-up                          | After software writes 1 to clear WAKUP_STS (CAN_WU_STATUS[0]).                      |
| ACMP    | Comparator Power-Down Wake-Up Interrupt  | After software writes 1 to clear WKIF0 (ACMP_STATUS[8]) and WKIF1 (ACMP_STATUS[9]). |

Table 6.2-6 Condition of Entering Power-down Mode Again

### 6.2.5 System Memory Map

The NuMicro® M0A21/M0A23 series provides 4G-byte addressing space. The memory locations assigned to each on-chip controllers are shown in Table 6.2-7. The detailed register definition, memory space, and programming will be described in the following sections for each on-chip peripheral. The M0A21/M0A23 series only supports little-endian data format.

| Address Space                                            | Token     | Controllers                                      |
|----------------------------------------------------------|-----------|--------------------------------------------------|
| Flash and SRAM Memory Space                              |           |                                                  |
| 0x0000_0000 – 0x0000_7FFF                                | FLASH_BA  | FLASH Memory Space (32 Kbytes)                   |
| 0x2000_0000 – 0x2000_0FFF                                | SRAM0_BA  | SRAM Memory Space (4 Kbytes)                     |
| Peripheral Controllers Space (0x4000_0000 – 0x400F_FFFF) |           |                                                  |
| 0x4000_0000 – 0x4000_01FF                                | SYS_BA    | System Control Registers                         |
| 0x4000_0200 – 0x4000_02FF                                | CLK_BA    | Clock Control Registers                          |
| 0x4000_0300 – 0x4000_03FF                                | NMI_BA    | NMI Control Registers                            |
| 0x4000_4000 – 0x4000_4FFF                                | GPIO_BA   | GPIO Control Registers                           |
| 0x4000_8000 – 0x4000_8FFF                                | PDMA_BA   | Peripheral DMA Control Registers                 |
| 0x4000_C000 – 0x4000_CFFF                                | FMC_BA    | Flash Memory Control Registers                   |
| 0x4001_4000 – 0x4001_7FFF                                | HDIV_BA   | Hardware Divider Register                        |
| 0x4003_1000 – 0x4003_1FFF                                | CRC_BA    | CRC Generator Registers                          |
| APB Controllers Space (0x4000_0000 ~ 0x400F_FFFF)        |           |                                                  |
| 0x4004_0000 – 0x4004_0FFF                                | WDT_BA    | Watchdog Timer Control Registers                 |
| 0x4004_3000 – 0x4004_3FFF                                | ADC_BA    | Analog-Digital-Converter (ADC) Control Registers |
| 0x4004_5000 – 0x4004_5FFF                                | ACMP01_BA | Analog Comparator 0/ 1 Control Registers         |
| 0x4004_7000 – 0x4004_7FFF                                | DAC0_BA   | DAC 0 Control Registers                          |
| 0x4005_0000 – 0x4005_0FFF                                | TMR01_BA  | Timer0/Timer1 Control Registers                  |
| 0x4005_1000 – 0x4005_1FFF                                | TMR23_BA  | Timer2/Timer3 Control Registers                  |
| 0x4005_8000 – 0x4005_8FFF                                | PWM0_BA   | PWM0 Control Registers                           |

|                                                      |          |                                                 |
|------------------------------------------------------|----------|-------------------------------------------------|
| 0x4007_0000 – 0x4007_0FFF                            | UART0_BA | UART0 Control Registers                         |
| 0x4007_1000 – 0x4007_1FFF                            | UART1_BA | UART1 Control Registers                         |
| 0x400A_0000 – 0x400A_0FFF                            | CAN0_BA  | CAN0 Control Registers                          |
| 0x400D_0000 – 0x400D_0FFF                            | USCI0_BA | USCI0 Control Registers                         |
| 0x400D_1000 – 0x400D_1FFF                            | USCI1_BA | USCI1 Control Registers                         |
| System Controllers Space (0xE000_E000 – 0xE000_EFFF) |          |                                                 |
| 0xE000_E010 – 0xE000_E0FF                            | SCS_BA   | System Timer Control Registers                  |
| 0xE000_E100 – 0xE000_ECFF                            | SCS_BA   | External Interrupt Controller Control Registers |
| 0xE000_ED00 – 0xE000_ED8F                            | SCS_BA   | System Control Registers                        |

Table 6.2-7 Address Space Assignments for On-Chip Controllers



### 6.2.6 SRAM Memory Organization

The M0A21/M0A23 supports embedded SRAM with total 4 Kbytes size

- Supports total 4 Kbytes SRAM
- Supports byte / half word / word write
- Supports oversize response error

Table 6.2-9 shows the SRAM organization of M0A21/M0A23. The address between 0x2000\_1000 to 0x3FFF\_FFFF is illegal memory space and chip will enter hardfault if CPU accesses these illegal memory addresses.

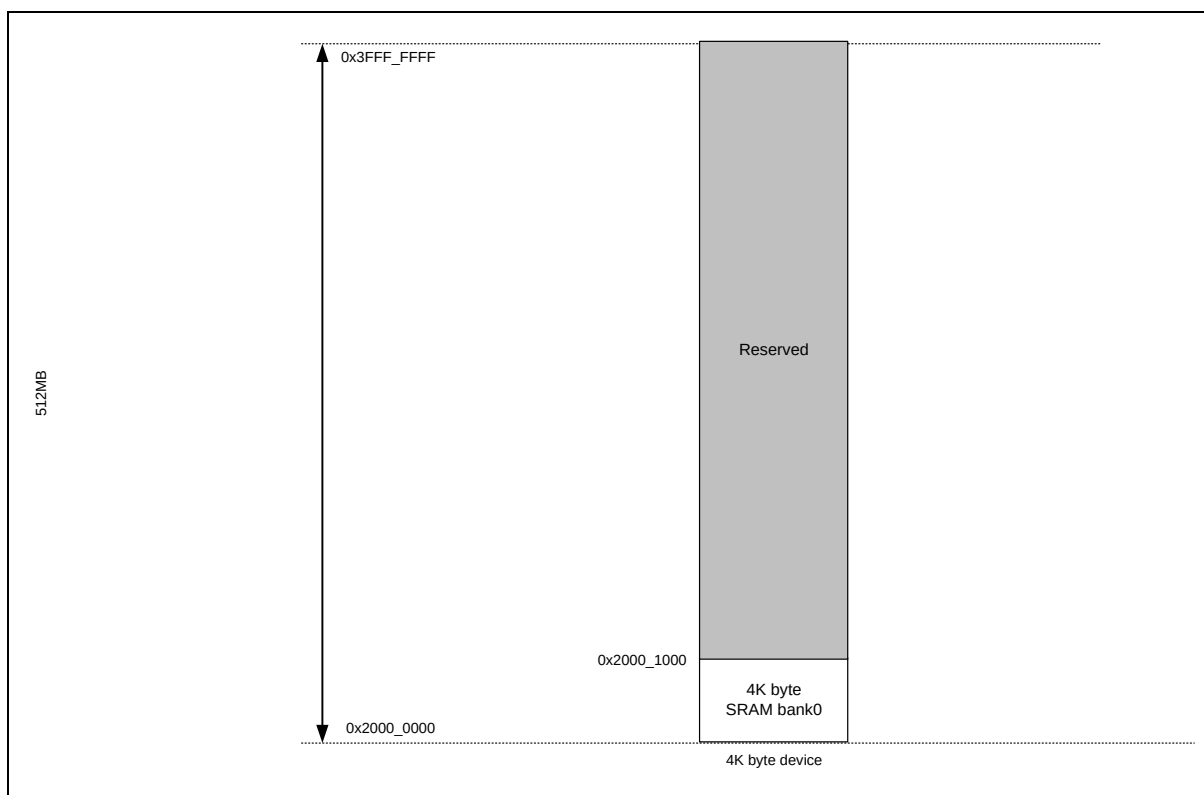


Figure 6.2-9 SRAM Memory Organization

### 6.2.7 Chip Bus Matrix

The M0A21/M0A23 series supports Bus Matrix to manage the access arbitration between masters. The access arbitration use round-robin algorithm as the bus priority.

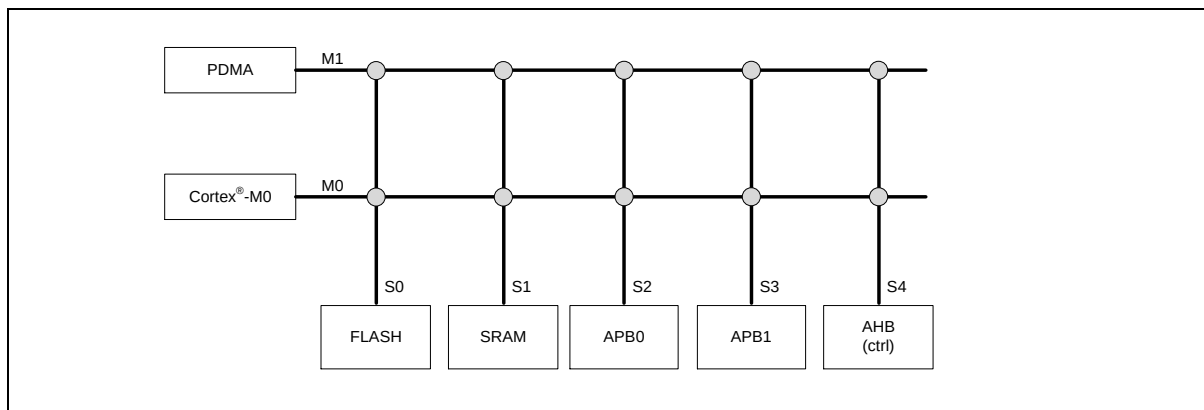


Figure 6.2-10 NuMicro® M0A21/M0A23 Bus Matrix Diagram

### 6.2.8 IRC Auto Trim

This chip supports auto-trim function: the HIRC trim (48 MHz RC oscillator), according to the accurate external 32.768 kHz crystal oscillator, automatically gets accurate output frequency, 0.25 % deviation within all temperature ranges.

In HIRC case, the system needs an accurate 48 MHz clock. In such case, if not soldering 32.768 kHz crystal or 12 MHz crystal in system, user has to set REFCKSEL (SYS\_HIRCTRIMCTL [10] reference clock selection) to "0", set FREQSEL (SYS\_HIRCTRIMCTL [1:0] trim frequency selection) to "01", and the auto-trim function will be enabled. Interrupt status bit FREQLOCK (SYS\_HIRCTRIMSTS[0] HIRC frequency lock status) "1" indicates the HIRC output frequency is accurate within 0.25% deviation.

## 6.2.9 Register Lock Control

Some of the system control registers need to be protected to avoid inadvertent write and disturb the chip operation. These system control registers are protected after the power-on reset till user to disable register protection. For user to program these protected registers, a register protection disable sequence needs to be followed by a special programming. The register protection disable sequence is writing the data “59h”, “16h” “88h” to the register SYS\_REGLCTL address at 0x4000\_0100 continuously. Any different data value, different sequence or any other write to other address during these three data writing will abort the whole sequence. All protected control registers are noted “(Write Protect)” and add an note “**Note:** This bit is write protected. Refer to the SYS\_REGLCTL register in register description field.

## 6.2.10 UART0\_TXD/USCI0\_DAT0 Modulation with PWM

This chip supports UART0\_TXD/USCI0\_DAT0 to modulate with PWM channel. User can set MODPWMSEL(SYS\_MODCTL[7:4]) to choose which PWM0 channel to modulate with UART0\_TXD/USCI0\_DAT0 and set MODEN(SYS\_MODCTL[0]) to enable modulation function. User can set TXDINV(UART\_LINE[8]) to inverse UART0\_TXD or DATOINV(UUART\_LINECTL[5]) to inverse USCI0\_DAT0 before modulating with PWM.

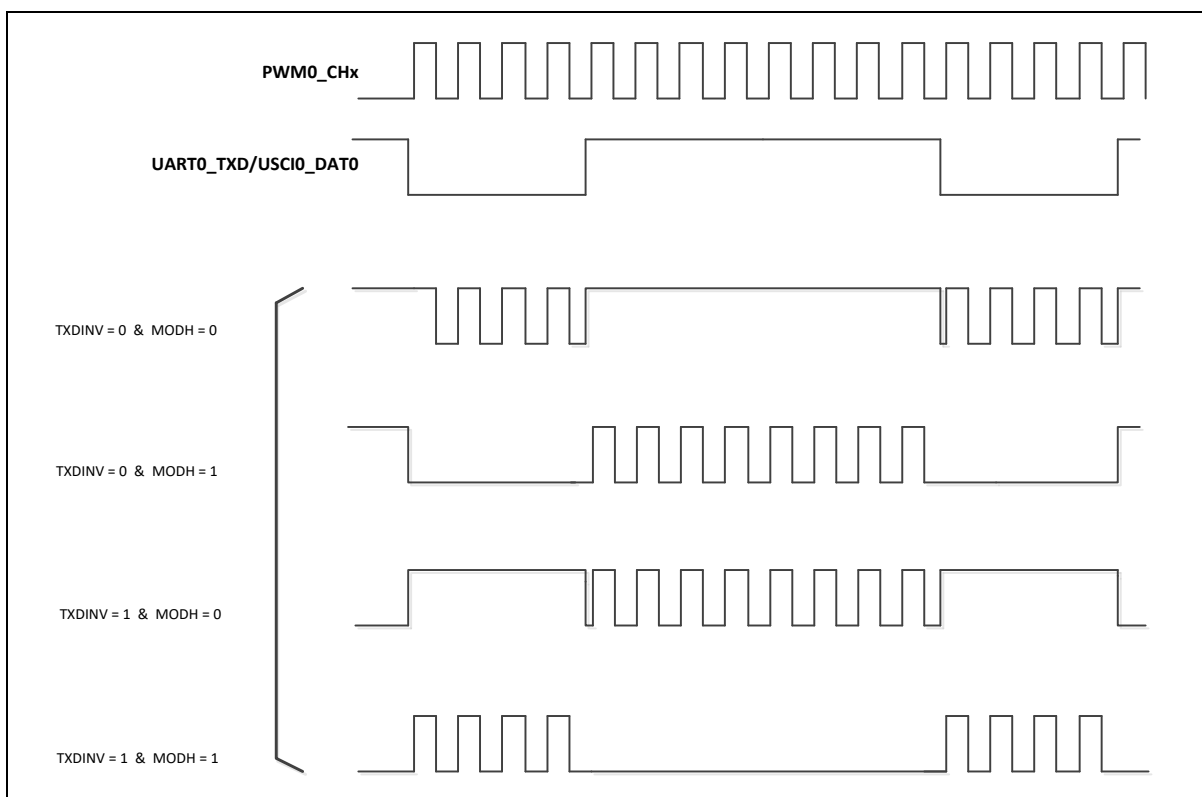


Figure 6.2-11 UART0\_TXD/USCI0\_DAT0 Modulated with PWM Channel

### 6.2.11 System Timer (SysTick)

The Cortex®-M0 includes an integrated system timer, SysTick, which provides a simple, 24-bit clear-on-write, decrementing, wrap-on-zero counter with a flexible control mechanism. The counter can be used as a Real Time Operating System (RTOS) tick timer or as a simple counter.

When system timer is enabled, it will count down from the value in the SysTick Current Value Register (SYST\_VAL) to zero, and reload (wrap) to the value in the SysTick Reload Value Register (SYST\_LOAD) on the next clock cycle, and then decrement on subsequent clocks. When the counter transitions to zero, the COUNTFLAG status bit is set. The COUNTFLAG bit clears on reads.

The SYST\_VAL value is UNKNOWN on reset. Software should write to the register to clear it to zero before enabling the feature. This ensures the timer will count from the SYST\_LOAD value rather than an arbitrary value when it is enabled.

If the SYST\_LOAD is zero, the timer will be maintained with a current value of zero after it is reloaded with this value. This mechanism can be used to disable the feature independently from the timer enable bit.

For more detailed information, please refer to the “Arm® Cortex®-M0 Technical Reference Manual” and “Arm® v6-M Architecture Reference Manual”.

### 6.2.11.1 System Timer Control Register Map

R: read only, W: write only, R/W: both read and write

| Register                                   | Offset      | R/W | Description                         | Reset Value |
|--------------------------------------------|-------------|-----|-------------------------------------|-------------|
| SYST Base Address:<br>SCS_BA = 0xE000_E000 |             |     |                                     |             |
| SYST_CTRL                                  | SCS_BA+0x10 | R/W | SysTick Control and Status Register | 0x0000_0000 |
| SYST_LOAD                                  | SCS_BA+0x14 | R/W | SysTick Reload Value Register       | 0xFFFF_FFFF |
| SYST_VAL                                   | SCS_BA+0x18 | R/W | SysTick Current Value Register      | 0xFFFF_FFFF |

### 6.2.11.2 System Timer Control Register Description

#### SysTick Control and Status Register (SYST\_CTRL)

| Register  | Offset      | R/W | Description                         | Reset Value |
|-----------|-------------|-----|-------------------------------------|-------------|
| SYST_CTRL | SCS_BA+0x10 | R/W | SysTick Control and Status Register | 0x0000_0000 |

|          |    |    |    |    |        |         |           |
|----------|----|----|----|----|--------|---------|-----------|
| 31       | 30 | 29 | 28 | 27 | 26     | 25      | 24        |
| Reserved |    |    |    |    |        |         |           |
| 23       | 22 | 21 | 20 | 19 | 18     | 17      | 16        |
| Reserved |    |    |    |    |        |         | COUNTFLAG |
| 15       | 14 | 13 | 12 | 11 | 10     | 9       | 8         |
| Reserved |    |    |    |    |        |         |           |
| 7        | 6  | 5  | 4  | 3  | 2      | 1       | 0         |
| Reserved |    |    |    |    | CLKSRC | TICKINT | ENABLE    |

| Bits    | Description                                                                                                                                                                                                                                                                                                                                                                                            |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:17] | <b>Reserved</b><br>Reserved.                                                                                                                                                                                                                                                                                                                                                                           |
| [16]    | <b>COUNTFLAG</b><br><b>System Tick Counter Flag</b><br>Returns 1 if timer counted to 0 since last time this register was read.<br>COUNTFLAG is set by a count transition from 1 to 0.<br>COUNTFLAG is cleared on read or by a write to the Current Value register.                                                                                                                                     |
| [15:3]  | <b>Reserved</b><br>Reserved.                                                                                                                                                                                                                                                                                                                                                                           |
| [2]     | <b>CLKSRC</b><br><b>System Tick Clock Source Selection</b><br>0 = Clock source is the (optional) external reference clock.<br>1 = Core clock used for SysTick.                                                                                                                                                                                                                                         |
| [1]     | <b>TICKINT</b><br><b>System Tick Interrupt Enabled</b><br>0 = Counting down to 0 does not cause the SysTick exception to be pended. Software can use COUNTFLAG to determine if a count to zero has occurred.<br>1 = Counting down to 0 will cause the SysTick exception to be pended. Clearing the SysTick current value register by a register write in software will not cause SysTick to be pended. |
| [0]     | <b>ENABLE</b><br><b>System Tick Counter Enabled</b><br>0 = Counter Disabled.<br>1 = Counter will operate in a multi-shot manner.                                                                                                                                                                                                                                                                       |

### SysTick Reload Value Register (SYST\_LOAD)

| Register  | Offset      | R/W | Description                   | Reset Value |
|-----------|-------------|-----|-------------------------------|-------------|
| SYST_LOAD | SCS_BA+0x14 | R/W | SysTick Reload Value Register | 0xFFFF_XXXX |

|          |    |    |    |    |    |    |    |
|----------|----|----|----|----|----|----|----|
| 31       | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
| Reserved |    |    |    |    |    |    |    |
| 23       | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| RELOAD   |    |    |    |    |    |    |    |
| 15       | 14 | 13 | 12 | 11 | 10 | 9  | 8  |
| RELOAD   |    |    |    |    |    |    |    |
| 7        | 6  | 5  | 4  | 3  | 2  | 1  | 0  |
| RELOAD   |    |    |    |    |    |    |    |

| Bits    | Description |                                                                                                           |
|---------|-------------|-----------------------------------------------------------------------------------------------------------|
| [31:24] | Reserved    | Reserved.                                                                                                 |
| [23:0]  | RELOAD      | System Tick Reload Value<br>The value to load into the Current Value register when the counter reaches 0. |

### SysTick Current Value Register (SYST\_VAL)

| Register | Offset      | R/W | Description                    | Reset Value |
|----------|-------------|-----|--------------------------------|-------------|
| SYST_VAL | SCS_BA+0x18 | R/W | SysTick Current Value Register | 0XXXXX_XXXX |

|          |    |    |    |    |    |    |    |
|----------|----|----|----|----|----|----|----|
| 31       | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
| Reserved |    |    |    |    |    |    |    |
| 23       | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| CURRENT  |    |    |    |    |    |    |    |
| 15       | 14 | 13 | 12 | 11 | 10 | 9  | 8  |
| CURRENT  |    |    |    |    |    |    |    |
| 7        | 6  | 5  | 4  | 3  | 2  | 1  | 0  |
| CURRENT  |    |    |    |    |    |    |    |

| Bits    | Description                                                                                                                                                                                                                                                                               |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:24] | <b>Reserved</b> Reserved.                                                                                                                                                                                                                                                                 |
| [23:0]  | <b>CURRENT</b> <b>System Tick Current Value</b><br>Current counter value. This is the value of the counter at the time it is sampled. The counter does not provide read-modify-write protection. The register is write-clear. A software write of any value will clear the register to 0. |



## 6.2.12 Nested Vectored Interrupt Controller (NVIC)

The Cortex®-M0 provides an interrupt controller as an integral part of the exception mode, named as “Nested Vectored Interrupt Controller (NVIC)”, which is closely coupled to the processor core 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 an interrupt 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 “Arm® Cortex®-M0 Technical Reference Manual” and “Arm® v6-M Architecture Reference Manual”.

### 6.2.12.1 Exception Model and System Interrupt Map

Table 6.2-8 lists the exception model supported by the M0A21/M0A23 series. Software can set four levels of priority on some of these exceptions as well as on all interrupts. The highest user-configurable priority is denoted as “0” and the lowest priority is denoted as “3”. The default priority of all the user-configurable interrupts is “0”. Note that priority “0” is treated as the fourth priority on the system, after three system exceptions “Reset”, “NMI” and “Hard Fault”.

| Exception Name | Vector Number | Priority     |
|----------------|---------------|--------------|
| Reset          | 1             | -3           |
| NMI            | 2             | -2           |
| Hard Fault     | 3             | -1           |
| Reserved       | 4 ~ 10        | Reserved     |
| SVCall         | 11            | Configurable |
| Reserved       | 12 ~ 13       | Reserved     |
| PendSV         | 14            | Configurable |

|                          |         |              |
|--------------------------|---------|--------------|
| SysTick                  | 15      | Configurable |
| Interrupt (IRQ0 ~ IRQ31) | 16 ~ 47 | Configurable |

Table 6.2-8 Exception Model

| Vector Number | Interrupt Number (Bit In Interrupt Registers) | Interrupt Name | Interrupt Description                    |
|---------------|-----------------------------------------------|----------------|------------------------------------------|
| 0 ~ 15        | -                                             | -              | System exceptions                        |
| 16            | 0                                             | BODOUT         | Brown-Out low voltage detected interrupt |
| 17            | 1                                             | WDT_INT        | Watchdog Timer interrupt                 |
| 18            | 2                                             | EINT024        | External interrupt from EINT0,2,4.       |
| 19            | 3                                             | EINT135        | External interrupt from EINT1.3.5        |
| 20            | 4                                             | GPAB_INT       | External interrupt from PA, PB pin       |
| 21            | 5                                             | GPCD_INT       | External interrupt from PC, PD pin       |
| 22            | 6                                             | PWM0_INT       | PWM0 interrupt                           |
| 23            | 7                                             | Reserved       | Reserved                                 |
| 24            | 8                                             | TMR0_INT       | Timer 0 interrupt                        |
| 25            | 9                                             | TMR1_INT       | Timer 1 interrupt                        |
| 26            | 10                                            | TMR2_INT       | Timer 2 interrupt                        |
| 27            | 11                                            | TMR3_INT       | Timer 3 interrupt                        |
| 28            | 12                                            | UART0_INT      | UART0 interrupt                          |
| 29            | 13                                            | UART1_INT      | UART1 interrupt                          |
| 30            | 14                                            | Reserved       | Reserved                                 |
| 31            | 15                                            | CAN0_INT       | CAN0 interrupt                           |
| 32            | 16                                            | Reserved       | Reserved                                 |
| 33            | 17                                            | Reserved       | Reserved                                 |
| 34            | 18                                            | Reserved       | Reserved                                 |
| 35            | 19                                            | Reserved       | Reserved                                 |
| 36            | 20                                            | Reserved       | Reserved                                 |
| 37            | 21                                            | Reserved       | Reserved                                 |
| 38            | 22                                            | USCI0          | USCI0 interrupt                          |
| 39            | 23                                            | Reserved       | Reserved                                 |
| 40            | 24                                            | DAC0_INT       | DAC0 interrupt                           |
| 41            | 25                                            | ACMP01_INT     | ACMP0 and ACMP1 interrupt                |
| 42            | 26                                            | PDMA_INT       | PDMA interrupt                           |

|    |    |           |                                                                   |
|----|----|-----------|-------------------------------------------------------------------|
| 43 | 27 | USC11     | USC11 interrupt                                                   |
| 44 | 28 | PWRWU_INT | Clock controller interrupt for chip wake-up from power-down state |
| 45 | 29 | ADC_INT   | ADC interrupt                                                     |
| 46 | 30 | CLKFAIL   | Clock fail detected or IRC Auto Trim interrupt                    |
| 47 | 31 | Reserved  | Reserved                                                          |

Table 6.2-9 Interrupt Number Table

### 6.2.12.2 Vector Table

When an interrupt is accepted, the processor will automatically fetch the starting address of the interrupt service routine (ISR) from a vector table in memory. For Armv6-M, the vector table base address is fixed at 0x00000000. The vector table contains the initialization value for the stack pointer on reset, and the entry point addresses for all exception handlers. The vector number on previous page defines the order of entries in the vector table associated with exception handler entry as illustrated in previous section.

| Vector Table Word Offset | Description                                      |
|--------------------------|--------------------------------------------------|
| 0                        | SP_main – The Main stack pointer                 |
| Vector Number            | Exception Entry Pointer using that Vector Number |

Table 7.2-10 Vector Figure Format

### 6.2.12.3 Operation Description

NVIC interrupts can be enabled and disabled by writing to their corresponding Interrupt Set-Enable or Interrupt Clear-Enable register bit-field. The registers use a write-1-to-enable and write-1-to-clear policy, both registers reading back the current enabled state of the corresponding interrupts. When an interrupt is disabled, interrupt assertion will cause the interrupt to become Pending, however, the interrupt will not be activated. If an interrupt is Active when it is disabled, it remains in its Active state until cleared by reset or an exception return. Clearing the enable bit prevents new activations of the associated interrupt.

NVIC interrupts can be pended/un-pended using a complementary pair of registers to those used to enable/disable the interrupts, named the Set-Pending Register and Clear-Pending Register respectively. The registers use a write-1-to-enable and write-1-to-clear policy, both registers reading back the current pended state of the corresponding interrupts. The Clear-Pending Register has no effect on the execution status of an Active interrupt.

NVIC interrupts are prioritized by updating an 8-bit field within a 32-bit register (each register supporting four interrupts).

The general registers associated with the NVIC are all accessible from a block of memory in the System Control Space and will be described in next section.

#### 6.2.12.4 NVIC Control Registers

**R:** read only, **W:** write only, **R/W:** both read and write

| Register                                                  | Offset               | R/W | Description                                 | Reset Value |
|-----------------------------------------------------------|----------------------|-----|---------------------------------------------|-------------|
| <b>NVIC Base Address:</b><br><b>NVIC_BA = 0xE000_E100</b> |                      |     |                                             |             |
| <b>NVIC_ISER0</b>                                         | NVIC_BA+0x000        | R/W | IRQ0 ~ IRQ31 Set-enable Control Register    | 0x0000_0000 |
| <b>NVIC_ICER0</b>                                         | NVIC_BA+0x080        | R/W | IRQ0 ~ IRQ31 Clear-enable Control Register  | 0x0000_0000 |
| <b>NVIC_ISPR0</b>                                         | NVIC_BA+0x100        | R/W | IRQ0 ~ IRQ31 Set-pending Control Register   | 0x0000_0000 |
| <b>NVIC_ICPR0</b>                                         | NVIC_BA+0x180        | R/W | IRQ0 ~ IRQ31 Clear-pending Control Register | 0x0000_0000 |
| <b>NVIC_IABR0</b>                                         | NVIC_BA+0x200        | R/W | IRQ0 ~ IRQ31 Active Bit Register            | 0x0000_0000 |
| <b>NVIC_IPRn</b><br><b>n=0,1..7</b>                       | 0xE000E400<br>+0x4*n | R/W | IRQ0 ~ IRQ31 Priority Control Register      | 0x0000_0000 |
| <b>STIR</b>                                               | 0xE000EF00           | R/W | Software Trigger Interrupt Registers        | 0x0000_0000 |

**IRQ0 ~ IRQ31 Set-enable Control Register (NVIC\_ISER0)**

| Register   | Offset        | R/W | Description                              | Reset Value |
|------------|---------------|-----|------------------------------------------|-------------|
| NVIC_ISER0 | NVIC_BA+0x000 | R/W | IRQ0 ~ IRQ31 Set-enable Control Register | 0x0000_0000 |

|        |    |    |    |    |    |    |    |
|--------|----|----|----|----|----|----|----|
| 31     | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
| SETENA |    |    |    |    |    |    |    |
| 23     | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| SETENA |    |    |    |    |    |    |    |
| 15     | 14 | 13 | 12 | 11 | 10 | 9  | 8  |
| SETENA |    |    |    |    |    |    |    |
| 7      | 6  | 5  | 4  | 3  | 2  | 1  | 0  |
| SETENA |    |    |    |    |    |    |    |

| Bits   | Description                                                                                                                                                                                                                                                                   |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:0] | <b>SETENA</b><br><b>Interrupt Set Enable Bit</b><br>The NVIC_ISER0 registers enable interrupts, and show which interrupts are enabled<br>Write Operation:<br>0 = No effect.<br>1 = Interrupt Enabled.<br>Read Operation:<br>0 = Interrupt Disabled.<br>1 = Interrupt Enabled. |

**IRQ0 ~ IRQ31 Clear-enable Control Register (NVIC\_ICER0)**

| Register   | Offset        | R/W | Description                                | Reset Value |
|------------|---------------|-----|--------------------------------------------|-------------|
| NVIC_ICER0 | NVIC_BA+0x080 | R/W | IRQ0 ~ IRQ31 Clear-enable Control Register | 0x0000_0000 |

|        |    |    |    |    |    |    |    |
|--------|----|----|----|----|----|----|----|
| 31     | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
| CALENA |    |    |    |    |    |    |    |
| 23     | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| CALENA |    |    |    |    |    |    |    |
| 15     | 14 | 13 | 12 | 11 | 10 | 9  | 8  |
| CALENA |    |    |    |    |    |    |    |
| 7      | 6  | 5  | 4  | 3  | 2  | 1  | 0  |
| CALENA |    |    |    |    |    |    |    |

| Bits   | Description                                                                                                                                                                                                                                                                        |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:0] | <b>CALENA</b><br><b>Interrupt Clear Enable Bit</b><br>The NVIC_ICER0 registers disable interrupts, and show which interrupts are enabled.<br>Write Operation:<br>0 = No effect.<br>1 = Interrupt Disabled.<br>Read Operation:<br>0 = Interrupt Disabled.<br>1 = Interrupt Enabled. |

**IRQ0 ~ IRQ31 Set-pending Control Register (NVIC\_ISPR0)**

| Register   | Offset        | R/W | Description                               | Reset Value |
|------------|---------------|-----|-------------------------------------------|-------------|
| NVIC_ISPR0 | NVIC_BA+0x100 | R/W | IRQ0 ~ IRQ31 Set-pending Control Register | 0x0000_0000 |

|         |    |    |    |    |    |    |    |
|---------|----|----|----|----|----|----|----|
| 31      | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
| SETPEND |    |    |    |    |    |    |    |
| 23      | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| SETPEND |    |    |    |    |    |    |    |
| 15      | 14 | 13 | 12 | 11 | 10 | 9  | 8  |
| SETPEND |    |    |    |    |    |    |    |
| 7       | 6  | 5  | 4  | 3  | 2  | 1  | 0  |
| SETPEND |    |    |    |    |    |    |    |

| Bits   | Description                                                                                                                                                                                                                                                                                                                                          |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:0] | <p><b>SETPEND</b></p> <p><b>Interrupt Set-pending</b><br/> The NVIC_ISPR0 registers force interrupts into the pending state, and show which interrupts are pending<br/> Write Operation:<br/> 0 = No effect.<br/> 1 = Changes interrupt state to pending.<br/> Read Operation:<br/> 0 = Interrupt is not pending.<br/> 1 = Interrupt is pending.</p> |

**IRQ0 ~ IRQ31 Clear-pending Control Register (NVIC\_ICPR0)**

| Register   | Offset        | R/W | Description                                 | Reset Value |
|------------|---------------|-----|---------------------------------------------|-------------|
| NVIC_ICPR0 | NVIC_BA+0x180 | R/W | IRQ0 ~ IRQ31 Clear-pending Control Register | 0x0000_0000 |

|         |    |    |    |    |    |    |    |
|---------|----|----|----|----|----|----|----|
| 31      | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
| CALPEND |    |    |    |    |    |    |    |
| 23      | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| CALPEND |    |    |    |    |    |    |    |
| 15      | 14 | 13 | 12 | 11 | 10 | 9  | 8  |
| CALPEND |    |    |    |    |    |    |    |
| 7       | 6  | 5  | 4  | 3  | 2  | 1  | 0  |
| CALPEND |    |    |    |    |    |    |    |

| Bits   | Description                                                                                                                                                                                                                                                                                                                                             |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:0] | <p><b>CALPEND</b></p> <p><b>Interrupt Clear-pending</b><br/> The NVIC_ICPR0 registers remove the pending state from interrupts, and show which interrupts are pending<br/> Write Operation:<br/> 0 = No effect.<br/> 1 = Removes pending state an interrupt.<br/> Read Operation:<br/> 0 = Interrupt is not pending.<br/> 1 = Interrupt is pending.</p> |



### IRQ0 ~ IRQ31 Active Bit Register (NVIC\_IABR0)

| Register   | Offset        | R/W | Description                      | Reset Value |
|------------|---------------|-----|----------------------------------|-------------|
| NVIC_IABR0 | NVIC_BA+0x200 | R/W | IRQ0 ~ IRQ31 Active Bit Register | 0x0000_0000 |

|        |    |    |    |    |    |    |    |
|--------|----|----|----|----|----|----|----|
| 31     | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
| ACTIVE |    |    |    |    |    |    |    |
| 23     | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| ACTIVE |    |    |    |    |    |    |    |
| 15     | 14 | 13 | 12 | 11 | 10 | 9  | 8  |
| ACTIVE |    |    |    |    |    |    |    |
| 7      | 6  | 5  | 4  | 3  | 2  | 1  | 0  |
| ACTIVE |    |    |    |    |    |    |    |

| Bits   | Description                                                                                                                                                              |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:0] | <p><b>Interrupt Active Flags</b></p> <p>The NVIC_IABR0 registers indicate which interrupts are active.</p> <p>0 = interrupt not active.</p> <p>1 = interrupt active.</p> |

### IRQ0 ~ IRQ31 Interrupt Priority Register (NVIC\_IPRn)

| Register              | Offset               | R/W | Description                            | Reset Value |
|-----------------------|----------------------|-----|----------------------------------------|-------------|
| NVIC_IPRn<br>n=0,1..7 | 0xE000E400<br>+0x4*n | R/W | IRQ0 ~ IRQ31 Priority Control Register | 0x0000_0000 |

|          |    |          |    |    |    |    |    |
|----------|----|----------|----|----|----|----|----|
| 31       | 30 | 29       | 28 | 27 | 26 | 25 | 24 |
| PRI_4n_3 |    | Reserved |    |    |    |    |    |
| 23       | 22 | 21       | 20 | 19 | 18 | 17 | 16 |
| PRI_4n_2 |    | Reserved |    |    |    |    |    |
| 15       | 14 | 13       | 12 | 11 | 10 | 9  | 8  |
| PRI_4n_1 |    | Reserved |    |    |    |    |    |
| 7        | 6  | 5        | 4  | 3  | 2  | 1  | 0  |
| PRI_4n_0 |    | Reserved |    |    |    |    |    |

| Bits    | Description                                                                                                            |
|---------|------------------------------------------------------------------------------------------------------------------------|
| [31:30] | <b>PRI_4n_3</b><br><b>Priority of IRQ_4n+3</b><br>"0" denotes the highest priority and "3" denotes the lowest priority |
| [29:24] | <b>Reserved</b><br>Reserved.                                                                                           |
| [23:22] | <b>PRI_4n_2</b><br><b>Priority of IRQ_4n+2</b><br>"0" denotes the highest priority and "3" denotes the lowest priority |
| [21:16] | <b>Reserved</b><br>Reserved.                                                                                           |
| [15:14] | <b>PRI_4n_1</b><br><b>Priority of IRQ_4n+1</b><br>"0" denotes the highest priority and "3" denotes the lowest priority |
| [13:8]  | <b>Reserved</b><br>Reserved.                                                                                           |
| [7:6]   | <b>PRI_4n_0</b><br><b>Priority of IRQ_4n+0</b><br>"0" denotes the highest priority and "3" denotes the lowest priority |
| [5:0]   | <b>Reserved</b><br>Reserved.                                                                                           |

Software Trigger Interrupt Register (STIR)

| Register | Offset     | R/W | Description                          | Reset Value |
|----------|------------|-----|--------------------------------------|-------------|
| STIR     | 0xE000EF00 | R/W | Software Trigger Interrupt Registers | 0x0000_0000 |

|          |    |    |    |    |    |    |       |
|----------|----|----|----|----|----|----|-------|
| 31       | 30 | 29 | 28 | 27 | 26 | 25 | 24    |
| Reserved |    |    |    |    |    |    |       |
| 23       | 22 | 21 | 20 | 19 | 18 | 17 | 16    |
| Reserved |    |    |    |    |    |    |       |
| 15       | 14 | 13 | 12 | 11 | 10 | 9  | 8     |
| Reserved |    |    |    |    |    |    | INTID |
| 7        | 6  | 5  | 4  | 3  | 2  | 1  | 0     |
| INTID    |    |    |    |    |    |    |       |

| Bits   | Description |                                                                                                                                                                                                                                                                                                       |
|--------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:9] | Reserved    | Reserved.                                                                                                                                                                                                                                                                                             |
| [8:0]  | INTID       | <b>Interrupt ID</b><br>Write to the STIR To Generate An Interrupt from Software<br>When the USERSETMPEND bit in the SCR is set to 1, unprivileged software can access the STIR<br>Interrupt ID of the interrupt to trigger, in the range 0-31. For example, a value of 0x03 specifies interrupt IRQ3. |

### 6.2.12.5 NMI Control Registers

**R:** read only, **W:** write only, **R/W:** both read and write

| Register                                                | Offset      | R/W | Description                          | Reset Value |
|---------------------------------------------------------|-------------|-----|--------------------------------------|-------------|
| <b>NMI Base Address:</b><br><b>NMI_BA = 0x4000_0300</b> |             |     |                                      |             |
| <b>NMIEN</b>                                            | NMI_BA+0x00 | R/W | NMI Source Interrupt Enable Register | 0x0000_0000 |
| <b>NMISTS</b>                                           | NMI_BA+0x04 | R   | NMI Source Interrupt Status Register | 0x0000_0000 |

### NMI Source Interrupt Enable Register (NMIEN)

| Register | Offset      | R/W | Description                          | Reset Value |
|----------|-------------|-----|--------------------------------------|-------------|
| NMIEN    | NMI_BA+0x00 | R/W | NMI Source Interrupt Enable Register | 0x0000_0000 |

|           |           |       |         |          |           |         |        |
|-----------|-----------|-------|---------|----------|-----------|---------|--------|
| 31        | 30        | 29    | 28      | 27       | 26        | 25      | 24     |
| Reserved  |           |       |         |          |           |         |        |
| 23        | 22        | 21    | 20      | 19       | 18        | 17      | 16     |
| Reserved  |           |       |         |          |           |         |        |
| 15        | 14        | 13    | 12      | 11       | 10        | 9       | 8      |
| UART1_INT | UART0_INT | EINT5 | EINT4   | EINT3    | EINT2     | EINT1   | EINT0  |
| 7         | 6         | 5     | 4       | 3        | 2         | 1       | 0      |
| Reserved  |           |       | CLKFAIL | Reserved | PWRWU_INT | IRC_INT | BODOUT |

| Bits    | Description                                                                                                                                                                                                                                                                                        |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:16] | <b>Reserved</b><br>Reserved.                                                                                                                                                                                                                                                                       |
| [15]    | <b>UART1_INT</b><br><b>UART1 NMI Source Enable (Write Protect)</b><br>0 = UART1 NMI source Disabled.<br>1 = UART1 NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register.                                                                              |
| [14]    | <b>UART0_INT</b><br><b>UART0 NMI Source Enable (Write Protect)</b><br>0 = UART0 NMI source Disabled.<br>1 = UART0 NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register.                                                                              |
| [13]    | <b>EINT5</b><br><b>External Interrupt From PC.7 Pin NMI Source Enable (Write Protect)</b><br>0 = External interrupt from PC.7 pin NMI source Disabled.<br>1 = External interrupt from PC.7 pin NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register. |
| [12]    | <b>EINT4</b><br><b>External Interrupt From PC.6 Pin NMI Source Enable (Write Protect)</b><br>0 = External interrupt from PC.6 pin NMI source Disabled.<br>1 = External interrupt from PC.6 pin NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register. |
| [11]    | <b>EINT3</b><br><b>External Interrupt From PC.3 Pin NMI Source Enable (Write Protect)</b><br>0 = External interrupt from PC.3 pin NMI source Disabled.<br>1 = External interrupt from PC.3 pin NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register. |
| [10]    | <b>EINT2</b><br><b>External Interrupt From PC.4 Pin NMI Source Enable (Write Protect)</b><br>0 = External interrupt from PC.4 pin NMI source Disabled.<br>1 = External interrupt from PC.4 pin NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register. |
| [9]     | <b>EINT1</b><br><b>External Interrupt From PC.5 Pin NMI Source Enable (Write Protect)</b>                                                                                                                                                                                                          |

|       |           |                                                                                                                                                                                                                                                                                                                                 |
|-------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       |           | 0 = External interrupt from PC.5 pin NMI source Disabled.<br>1 = External interrupt from PC.5 pin NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register.                                                                                                                           |
| [8]   | EINT0     | <b>External Interrupt From PA.3 or PB.5 Pin NMI Source Enable (Write Protect)</b><br>0 = External interrupt from PA.3 or PB.5 pin NMI source Disabled.<br>1 = External interrupt from PA.3 or PB.5 pin NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register.                      |
| [7:5] | Reserved  | Reserved.                                                                                                                                                                                                                                                                                                                       |
| [4]   | CLKFAIL   | <b>Clock Fail Detected and IRC Auto Trim Interrupt NMI Source Enable (Write Protect)</b><br>0 = Clock fail detected and IRC Auto Trim interrupt NMI source Disabled.<br>1 = Clock fail detected and IRC Auto Trim interrupt NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register. |
| [3]   | Reserved  | Reserved.                                                                                                                                                                                                                                                                                                                       |
| [2]   | PWRWU_INT | <b>Power-down Mode Wake-up NMI Source Enable (Write Protect)</b><br>0 = Power-down mode wake-up NMI source Disabled.<br>1 = Power-down mode wake-up NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register.                                                                         |
| [1]   | IRC_INT   | <b>IRC TRIM NMI Source Enable (Write Protect)</b><br>0 = IRC TRIM NMI source Disabled.<br>1 = IRC TRIM NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register.                                                                                                                      |
| [0]   | BODOUT    | <b>BOD NMI Source Enable (Write Protect)</b><br>0 = BOD NMI source Disabled.<br>1 = BOD NMI source Enabled.<br><b>Note:</b> This bit is write protected. Refer to the SYS_REGLCTL register.                                                                                                                                     |

### NMI Source Interrupt Status Register (NMISTS)

| Register | Offset      | R/W | Description                          | Reset Value |
|----------|-------------|-----|--------------------------------------|-------------|
| NMISTS   | NMI_BA+0x04 | R   | NMI Source Interrupt Status Register | 0x0000_0000 |

|           |           |       |         |          |           |         |        |
|-----------|-----------|-------|---------|----------|-----------|---------|--------|
| 31        | 30        | 29    | 28      | 27       | 26        | 25      | 24     |
| Reserved  |           |       |         |          |           |         |        |
| 23        | 22        | 21    | 20      | 19       | 18        | 17      | 16     |
| Reserved  |           |       |         |          |           |         |        |
| 15        | 14        | 13    | 12      | 11       | 10        | 9       | 8      |
| UART1_INT | UART0_INT | EINT5 | EINT4   | EINT3    | EINT2     | EINT1   | EINT0  |
| 7         | 6         | 5     | 4       | 3        | 2         | 1       | 0      |
| Reserved  |           |       | CLKFAIL | Reserved | PWRWU_INT | IRC_INT | BODOUT |

| Bits    | Description |                                                                                                                                                                                                                    |
|---------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:16] | Reserved    | Reserved.                                                                                                                                                                                                          |
| [15]    | UART1_INT   | <b>UART1 Interrupt Flag (Read Only)</b><br>0 = UART1 interrupt is deasserted.<br>1 = UART1 interrupt is asserted.                                                                                                  |
| [14]    | UART0_INT   | <b>UART0 Interrupt Flag (Read Only)</b><br>0 = UART1 interrupt is deasserted.<br>1 = UART1 interrupt is asserted.                                                                                                  |
| [13]    | EINT5       | <b>External Interrupt From PC.7 Pin Interrupt Flag (Read Only)</b><br>0 = External Interrupt from PC.7 interrupt is deasserted.<br>1 = External Interrupt from PC.7 interrupt is asserted.                         |
| [12]    | EINT4       | <b>External Interrupt From PC.6 Pin Interrupt Flag (Read Only)</b><br>0 = External Interrupt from PC.6 interrupt is deasserted.<br>1 = External Interrupt from PC.6 interrupt is asserted.                         |
| [11]    | EINT3       | <b>External Interrupt From PC.3 Pin Interrupt Flag (Read Only)</b><br>0 = External Interrupt from PC.3 interrupt is deasserted.<br>1 = External Interrupt from PC.3 interrupt is asserted.                         |
| [10]    | EINT2       | <b>External Interrupt From PC.4 Pin Interrupt Flag (Read Only)</b><br>0 = External Interrupt from PC.4 interrupt is deasserted.<br>1 = External Interrupt from PC.4 interrupt is asserted.                         |
| [9]     | EINT1       | <b>External Interrupt From PC.5 Pin Interrupt Flag (Read Only)</b><br>0 = External Interrupt from PC.5 interrupt is deasserted.<br>1 = External Interrupt from PC.5 interrupt is asserted.                         |
| [8]     | EINT0       | <b>External Interrupt From PA.3 or PB.5 Pin Interrupt Flag (Read Only)</b><br>0 = External Interrupt from PA.3 or PB.5 interrupt is deasserted.<br>1 = External Interrupt from PA.3 or PB.5 interrupt is asserted. |
| [7:5]   | Reserved    | Reserved.                                                                                                                                                                                                          |

|     |           |                                                                                                                                                                                                                |
|-----|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [4] | CLKFAIL   | <b>Clock Fail Detected or IRC Auto Trim Interrupt Flag (Read Only)</b><br>0 = Clock fail detected or IRC Auto Trim interrupt is deasserted.<br>1 = Clock fail detected or IRC Auto Trim interrupt is asserted. |
| [3] | Reserved  | Reserved.                                                                                                                                                                                                      |
| [2] | PWRWU_INT | <b>Power-down Mode Wake-up Interrupt Flag (Read Only)</b><br>0 = Power-down mode wake-up interrupt is deasserted.<br>1 = Power-down mode wake-up interrupt is asserted.                                        |
| [1] | IRC_INT   | <b>IRC TRIM Interrupt Flag (Read Only)</b><br>0 = HIRC TRIM interrupt is deasserted.<br>1 = HIRC TRIM interrupt is asserted.                                                                                   |
| [0] | BODOUT    | <b>BOD Interrupt Flag (Read Only)</b><br>0 = BOD interrupt is deasserted.<br>1 = BOD interrupt is asserted.                                                                                                    |



### 6.2.13 System Control Register

The Cortex®-M0 status and operation mode control are managed by System Control Registers. Including CPUID, Cortex®-M0 interrupt priority and Cortex®-M0 power management can be controlled through these system control registers.

For more detailed information, please refer to the “Arm® Cortex®-M0 Technical Reference Manual” and “Arm® v6-M Architecture Reference Manual”.

**R:** read only, **W:** write only, **R/W:** both read and write

| Register                                  | Offset       | R/W | Description                                      | Reset Value |
|-------------------------------------------|--------------|-----|--------------------------------------------------|-------------|
| SCR Base Address:<br>SCS_BA = 0xE000_E000 |              |     |                                                  |             |
| ICSR                                      | SCS_BA+0xD04 | R/W | Interrupt Control and State Register             | 0x0000_0000 |
| AIRCR                                     | SCS_BA+0xD0C | R/W | Application Interrupt and Reset Control Register | 0xFA05_0000 |
| SCR                                       | SCS_BA+0xD10 | R/W | System Control Register                          | 0x0000_0000 |
| SHPR2                                     | SCS_BA+0xD1C | R/W | System Handler Priority Register 2               | 0x0000_0000 |
| SHPR3                                     | SCS_BA+0xD20 | R/W | System Handler Priority Register 3               | 0x0000_0000 |

# Interrupt Control State Register (ICSR)

| Register | Offset       | R/W | Description                          | Reset Value |
|----------|--------------|-----|--------------------------------------|-------------|
| ICSR     | SCS_BA+0xD04 | R/W | Interrupt Control and State Register | 0x0000_0000 |

|             |             |            |           |           |           |             |          |
|-------------|-------------|------------|-----------|-----------|-----------|-------------|----------|
| 31          | 30          | 29         | 28        | 27        | 26        | 25          | 24       |
| NMIPENDSET  | Reserved    |            | PENDSVSET | PENDSVCLR | PENDSTSET | PENDSTCLR   | Reserved |
| 23          | 22          | 21         | 20        | 19        | 18        | 17          | 16       |
| ISRPREEMPT  | ISR_PENDING | Reserved   |           |           |           | VECTPENDING |          |
| 15          | 14          | 13         | 12        | 11        | 10        | 9           | 8        |
| VECTPENDING |             |            |           | RETTOBASE | Reserved  |             |          |
| 7           | 6           | 5          | 4         | 3         | 2         | 1           | 0        |
| Reserved    |             | VECTACTIVE |           |           |           |             |          |

| Bits    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31]    | <p><b>NMIPENDSET</b></p> <p><b>NMI Set-pending Bit</b><br/> Write Operation:<br/> 0 = No effect.<br/> 1 = Changes NMI exception state to pending.<br/> Read Operation:<br/> 0 = NMI exception is not pending.<br/> 1 = NMI exception is pending.<br/> <b>Note:</b> Because NMI is the highest-priority exception, normally the processor enters the NMI exception handler as soon as it detects a write of 1 to this bit. Entering the handler then clears this bit to 0. This means a read of this bit by the NMI exception handler returns 1 only if the NMI signal is reasserted while the processor is executing that handler.</p> |
| [30:29] | <p><b>Reserved</b></p> <p>Reserved.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| [28]    | <p><b>PENDSVSET</b></p> <p><b>PendSV Set-pending Bit</b><br/> Write Operation:<br/> 0 = No effect.<br/> 1 = Changes PendSV exception state to pending.<br/> Read Operation:<br/> 0 = PendSV exception is not pending.<br/> 1 = PendSV exception is pending.<br/> <b>Note:</b> Writing 1 to this bit is the only way to set the PendSV exception state to pending.</p>                                                                                                                                                                                                                                                                  |
| [27]    | <p><b>PENDSVCLR</b></p> <p><b>PendSV Clear-pending Bit</b><br/> Write Operation:<br/> 0 = No effect.<br/> 1 = Removes the pending state from the PendSV exception.<br/> <b>Note:</b> This is a write only bit. To clear the PENDSV bit, you must "write 0 to PENDSVSET and write 1 to PENDSVRTC_CAL" at the same time.</p>                                                                                                                                                                                                                                                                                                             |

|         |                    |                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [26]    | <b>PENDSTSET</b>   | <b>SysTick Exception Set-pending Bit</b><br>Write Operation:<br>0 = No effect.<br>1 = Changes SysTick exception state to pending.<br>Read Operation:<br>0 = SysTick exception is not pending.<br>1 = SysTick exception is pending.                                                                                                                                                               |
| [25]    | <b>PENDSTCLR</b>   | <b>SysTick Exception Clear-pending Bit</b><br>Write Operation:<br>0 = No effect.<br>1 = Removes the pending state from the SysTick exception.<br><b>Note:</b> This is a write only bit. To clear the PENDST bit, you must “write 0 to PENDSTSET and write 1 to PENDSTRTC_CAL” at the same time.                                                                                                  |
| [24]    | <b>Reserved</b>    | Reserved.                                                                                                                                                                                                                                                                                                                                                                                        |
| [23]    | <b>ISRPREEMPT</b>  | <b>Interrupt Preempt Bit (Read Only)</b><br>If set, a pending exception will be serviced on exit from the debug halt state.                                                                                                                                                                                                                                                                      |
| [22]    | <b>ISRPENDING</b>  | <b>Interrupt Pending Flag, Excluding NMI and Faults (Read Only)</b><br>0 = Interrupt not pending.<br>1 = Interrupt pending.                                                                                                                                                                                                                                                                      |
| [21:18] | <b>Reserved</b>    | Reserved.                                                                                                                                                                                                                                                                                                                                                                                        |
| [17:12] | <b>VECTPENDING</b> | <b>Number of the Highest Pended Exception</b><br>Indicate the Exception Number of the Highest Priority Pending Enabled Exception<br>0 = no pending exceptions.<br>Nonzero = the exception number of the highest priority pending enabled exception.<br>The value indicated by this field includes the effect of the BASEPRI and FAULTMASK registers, but not any effect of the PRIMASK register. |
| [11]    | <b>RETTOBASE</b>   | <b>Preempted Active Exceptions Indicator</b><br>Indicate whether There are Preempted Active Exceptions<br>0 = there are preempted active exceptions to execute.<br>1 = there are no active exceptions, or the currently-executing exception is the only active exception.                                                                                                                        |
| [10:6]  | <b>Reserved</b>    | Reserved.                                                                                                                                                                                                                                                                                                                                                                                        |
| [5:0]   | <b>VECTACTIVE</b>  | <b>Number of the Current Active Exception</b><br>0 = Thread mode.<br>Non-zero = The exception number of the currently active exception.                                                                                                                                                                                                                                                          |

### Application Interrupt and Reset Control Register (AIRCR)

| Register | Offset       | R/W | Description                                      | Reset Value |
|----------|--------------|-----|--------------------------------------------------|-------------|
| AIRCR    | SCS_BA+0xD0C | R/W | Application Interrupt and Reset Control Register | 0xFA05_0000 |

|            |          |    |    |    |             |               |           |
|------------|----------|----|----|----|-------------|---------------|-----------|
| 31         | 30       | 29 | 28 | 27 | 26          | 25            | 24        |
| VECTORKEY  |          |    |    |    |             |               |           |
| 23         | 22       | 21 | 20 | 19 | 18          | 17            | 16        |
| VECTORKEY  |          |    |    |    |             |               |           |
| 15         | 14       | 13 | 12 | 11 | 10          | 9             | 8         |
| ENDIANNESS | Reserved |    |    |    | PRIGROUP    |               |           |
| 7          | 6        | 5  | 4  | 3  | 2           | 1             | 0         |
| Reserved   |          |    |    |    | SYSRESETREQ | VECTCLRACTIVE | VECTRESET |

| Bits    | Description                                                                                                                                                                                                                                                                                                                         |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:16] | <b>VECTORKEY</b><br><b>Register Access Key</b><br>When writing this register, this field should be 0x05FA, otherwise the write action will be unpredictable.<br>The VECTORKEY field is used to prevent accidental write to this register from resetting the system or clearing of the exception status.                             |
| [15]    | <b>ENDIANNESS</b><br><b>Data Endianness</b><br>0 = Little-endian.<br>1 = Big-endian.                                                                                                                                                                                                                                                |
| [14:11] | <b>Reserved</b><br>Reserved.                                                                                                                                                                                                                                                                                                        |
| [10:8]  | <b>PRIGROUP</b><br><b>Interrupt Priority Grouping</b><br>This field determines the Split Of Group priority from subpriority,                                                                                                                                                                                                        |
| [7:3]   | <b>Reserved</b><br>Reserved.                                                                                                                                                                                                                                                                                                        |
| [2]     | <b>SYSRESETREQ</b><br><b>System Reset Request</b><br>Writing This Bit to 1 Will Cause A Reset Signal To Be Asserted To The Chip And Indicate A Reset Is Requested<br>This bit is write only and self-cleared as part of the reset sequence.                                                                                         |
| [1]     | <b>VECTCLRACTIVE</b><br><b>Exception Active Status Clear Bit</b><br>Setting This Bit To 1 Will Clears All Active State Information For Fixed And Configurable Exceptions<br>This bit is write only and can only be written when the core is halted.<br><b>Note:</b> It is the debugger's responsibility to re-initialize the stack. |
| [0]     | <b>VECTRESET</b><br>Reserved.                                                                                                                                                                                                                                                                                                       |

| PRIGROUP | Binary Point | Group<br>Priority Bits | Subpriority Bits | Number<br>Priorities | Of Group<br>Subpriorities |
|----------|--------------|------------------------|------------------|----------------------|---------------------------|
| 0b000    | bxxxxxx.y    | [7:1]                  | [0]              | 128                  | 2                         |
| 0b001    | bxxxxx.yy    | [7:2]                  | [1:0]            | 64                   | 4                         |
| 0b010    | bxxxxx.yyy   | [7:3]                  | [2:0]            | 32                   | 8                         |
| 0b011    | bxxxx.yyyy   | [7:4]                  | [3:0]            | 16                   | 16                        |
| 0b100    | bxxx.yyyyy   | [7:5]                  | [4:0]            | 8                    | 32                        |
| 0b101    | bxx.yyyyyy   | [7:6]                  | [5:0]            | 4                    | 64                        |
| 0b110    | bx.yyyyyyy   | [7]                    | [6:0]            | 2                    | 128                       |
| 0b111    | b.yyyyyyy    | None                   | [7:0]            | 1                    | 256                       |

Table 6.2-10 Priority Grouping

### System Control Register (SCR)

| Register | Offset       | R/W | Description             | Reset Value |
|----------|--------------|-----|-------------------------|-------------|
| SCR      | SCS_BA+0xD10 | R/W | System Control Register | 0x0000_0000 |

|          |    |    |           |          |           |             |          |
|----------|----|----|-----------|----------|-----------|-------------|----------|
| 31       | 30 | 29 | 28        | 27       | 26        | 25          | 24       |
| Reserved |    |    |           |          |           |             |          |
| 23       | 22 | 21 | 20        | 19       | 18        | 17          | 16       |
| Reserved |    |    |           |          |           |             |          |
| 15       | 14 | 13 | 12        | 11       | 10        | 9           | 8        |
| Reserved |    |    |           |          |           |             |          |
| 7        | 6  | 5  | 4         | 3        | 2         | 1           | 0        |
| Reserved |    |    | SEVONPEND | Reserved | SLEEPDEEP | SLEEPONEXIT | Reserved |

| Bits   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [31:5] | <b>Reserved</b><br>Reserved.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| [4]    | <b>SEVONPEND</b><br><b>Send Event on Pending</b><br>0 = Only enabled interrupts or events can wake up the processor, while disabled interrupts are excluded.<br>1 = Enabled events and all interrupts, including disabled interrupts, can wake up the processor.<br>When an event or interrupt enters pending state, the event signal wakes up the processor from WFE. If the processor is not waiting for an event, the event is registered and affects the next WFE.<br>The processor also wakes up on execution of an SEV instruction or an external event. |
| [3]    | <b>Reserved</b><br>Reserved.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| [2]    | <b>SLEEPDEEP</b><br><b>Processor Deep Sleep and Sleep Mode Selection</b><br>Control Whether the Processor Uses Sleep Or Deep Sleep as its Low Power Mode.<br>0 = Sleep.<br>1 = Deep sleep.                                                                                                                                                                                                                                                                                                                                                                     |
| [1]    | <b>SLEEPONEXIT</b><br><b>Sleep-on-exit Enable Control</b><br>This bit indicate Sleep-On-Exit when Returning from Handler Mode to Thread Mode.<br>0 = Do not sleep when returning to Thread mode.<br>1 = Enter sleep, or deep sleep, on return from an ISR to Thread mode.<br><b>Note:</b> Setting this bit to 1 enables an interrupt driven application to avoid returning to an empty main application.                                                                                                                                                       |
| [0]    | <b>Reserved</b><br>Reserved.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

### System Handler Priority Register 2 (SHPR2)

| Register | Offset       | R/W | Description                        | Reset Value |
|----------|--------------|-----|------------------------------------|-------------|
| SHPR2    | SCS_BA+0xD1C | R/W | System Handler Priority Register 2 | 0x0000_0000 |

|          |    |          |    |    |    |    |    |
|----------|----|----------|----|----|----|----|----|
| 31       | 30 | 29       | 28 | 27 | 26 | 25 | 24 |
| PRI_11   |    | Reserved |    |    |    |    |    |
| 23       | 22 | 21       | 20 | 19 | 18 | 17 | 16 |
| Reserved |    |          |    |    |    |    |    |
| 15       | 14 | 13       | 12 | 11 | 10 | 9  | 8  |
| Reserved |    |          |    |    |    |    |    |
| 7        | 6  | 5        | 4  | 3  | 2  | 1  | 0  |
| Reserved |    |          |    |    |    |    |    |

| Bits    | Description |                                                                                                                 |
|---------|-------------|-----------------------------------------------------------------------------------------------------------------|
| [31:30] | PRI_11      | Priority of System Handler 11 – SVCALL<br>“0” denotes the highest priority and “3” denotes the lowest priority. |
| [29:0]  | Reserved    | Reserved.                                                                                                       |

### System Handler Priority Register 3 (SHPR3)

| Register | Offset       | R/W | Description                        | Reset Value |
|----------|--------------|-----|------------------------------------|-------------|
| SHPR3    | SCS_BA+0xD20 | R/W | System Handler Priority Register 3 | 0x0000_0000 |

|          |    |          |    |    |    |    |    |
|----------|----|----------|----|----|----|----|----|
| 31       | 30 | 29       | 28 | 27 | 26 | 25 | 24 |
| PRI_15   |    | Reserved |    |    |    |    |    |
| 23       | 22 | 21       | 20 | 19 | 18 | 17 | 16 |
| PRI_14   |    | Reserved |    |    |    |    |    |
| 15       | 14 | 13       | 12 | 11 | 10 | 9  | 8  |
| Reserved |    |          |    |    |    |    |    |
| 7        | 6  | 5        | 4  | 3  | 2  | 1  | 0  |
| Reserved |    |          |    |    |    |    |    |

| Bits    | Description |                                                                                                                  |
|---------|-------------|------------------------------------------------------------------------------------------------------------------|
| [31:30] | PRI_15      | Priority of System Handler 15 – SysTick<br>“0” denotes the highest priority and “3” denotes the lowest priority. |
| [29:24] | Reserved    | Reserved.                                                                                                        |
| [23:22] | PRI_14      | Priority of System Handler 14 – PendSV<br>“0” denotes the highest priority and “3” denotes the lowest priority.  |



## 6.3 Clock Controller

### 6.3.1 Overview

The clock controller generates clocks for the whole chip, including system clocks and all peripheral clocks. The clock controller also implements the power control function with the individually clock ON/OFF control, clock source selection and a clock divider. The chip will not enter Power-down mode until CPU sets the Power-down enable bit PDEN(CLK\_PWRCTL[7]) and Cortex®-M0 core executes the WFI instruction. After that, chip enters Power-down mode and wait for wake-up interrupt source triggered to leave Power-down mode. In Power-down mode, the clock controller turns off the 4~24 MHz external high speed crystal (HXT) and 48 MHz internal high speed RC oscillator (HIRC) to reduce the overall system power consumption. Figure 6.3-1 shows the clock generator and the overview of the clock source control.

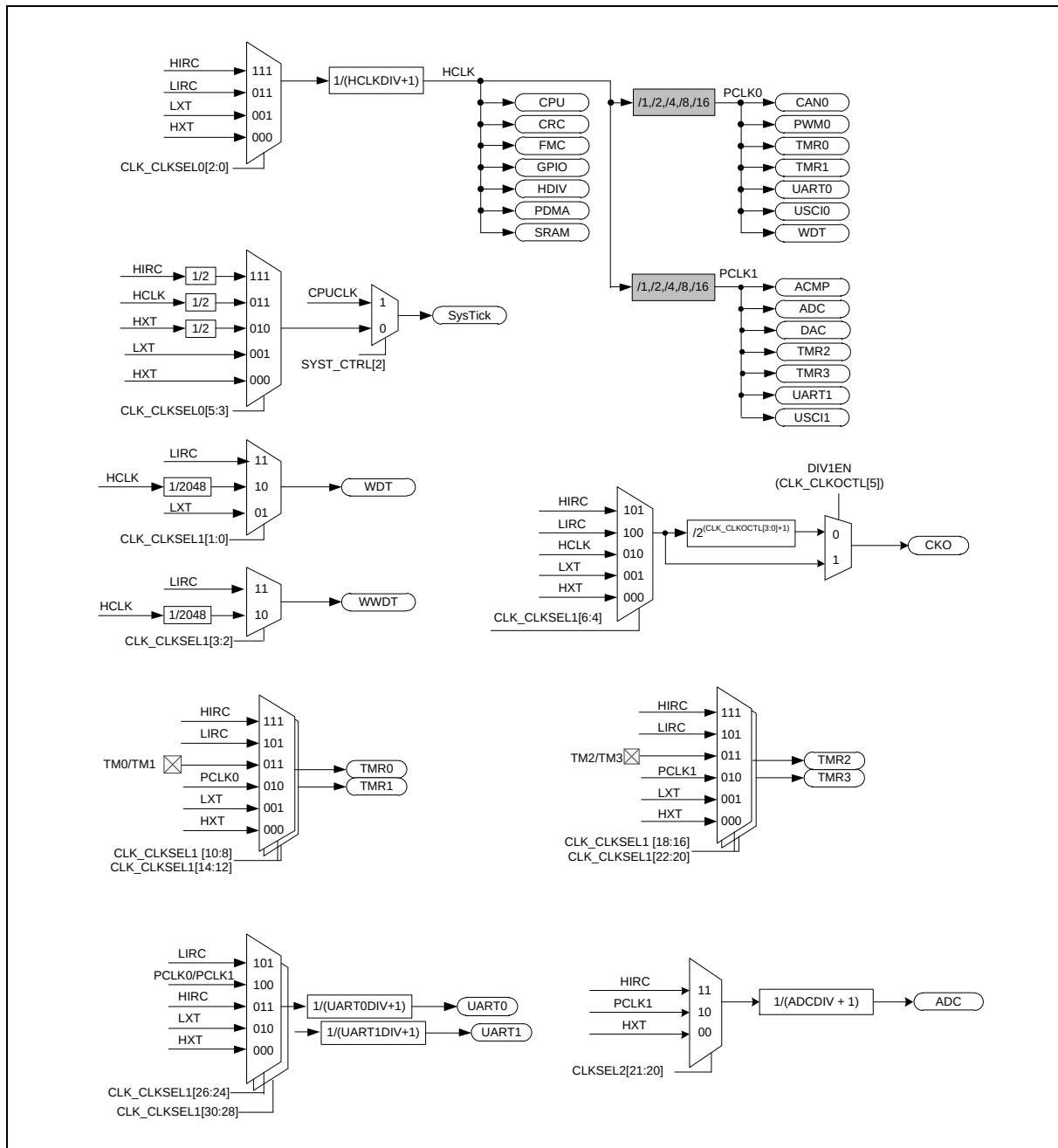


Figure 6.3-1 Clock Generator Global View Diagram

### 6.3.2 Clock Generator

The clock generator consists of 4 clock sources, which are listed below:

- 32.768 kHz external low speed crystal oscillator (LXT)
- 4~24 MHz external high speed crystal oscillator (HXT)
- 48 MHz internal high speed RC oscillator (HIRC)
- 38.4 kHz internal low speed RC oscillator (LIRC)

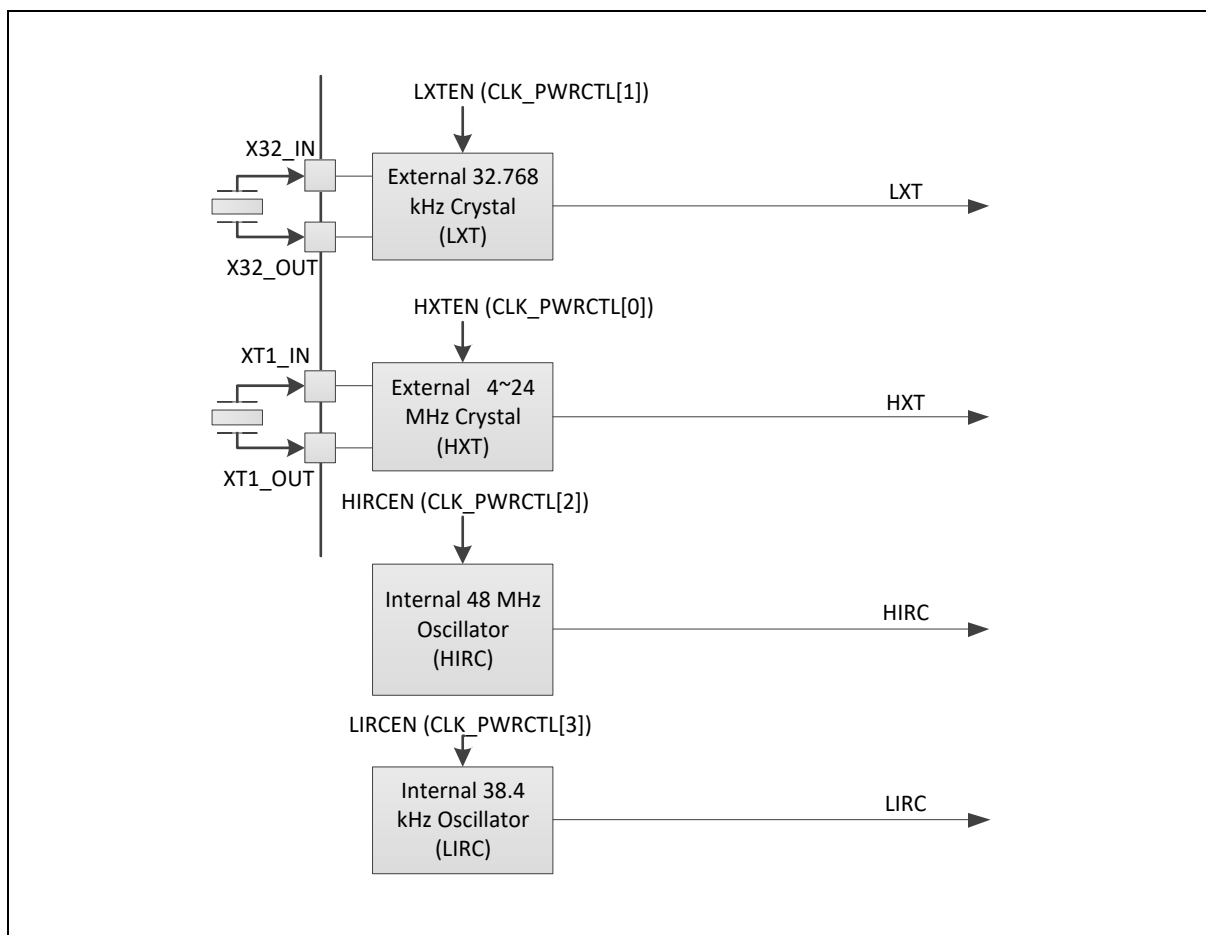


Figure 6.3-2 Clock Generator Block Diagram

### 6.3.3 System Clock and SysTick Clock

The system clock has 4 clock sources, which were generated from clock generator block. The clock source switch depends on the register HCLKSEL (CLK\_CLKSEL0[2:0]). The block diagram is shown in Figure 6.3-3

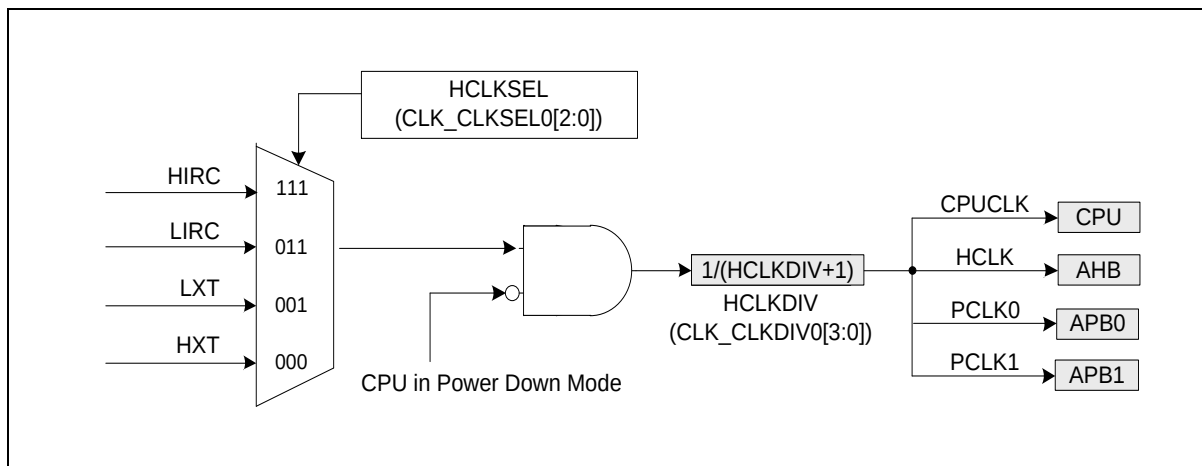


Figure 6.3-3 System Clock Block Diagram

There are two clock fail detectors to observe HXT and LXT clock source and they have individual enable and interrupt control. When HXT detector is enabled, the HIRC clock is enabled automatically. When LXT detector is enabled, the LIRC clock is enabled automatically.

When HXT clock detector is enabled, the system clock will auto switch to HIRC if HXT clock stop being detected on the following condition: system clock source comes from HXT. If HXT clock stop condition is detected, the HXTFIF (CLK\_CLKDSTS[0]) is set to 1 and chip will enter interrupt if HXTFIEN (CLK\_CLKDCTL[5]) is set to 1. User can try to recover HXT by disable HXT and enable HXT again to check if the clock stable bit is set to 1 or not. If HXT clock stable bit is set to 1, it means HXT is recover to oscillate after re-enable action and user can switch system clock to HXT again.

The HXT clock stop detect and system clock switch to HIRC procedure is shown in Figure 6.3-4.

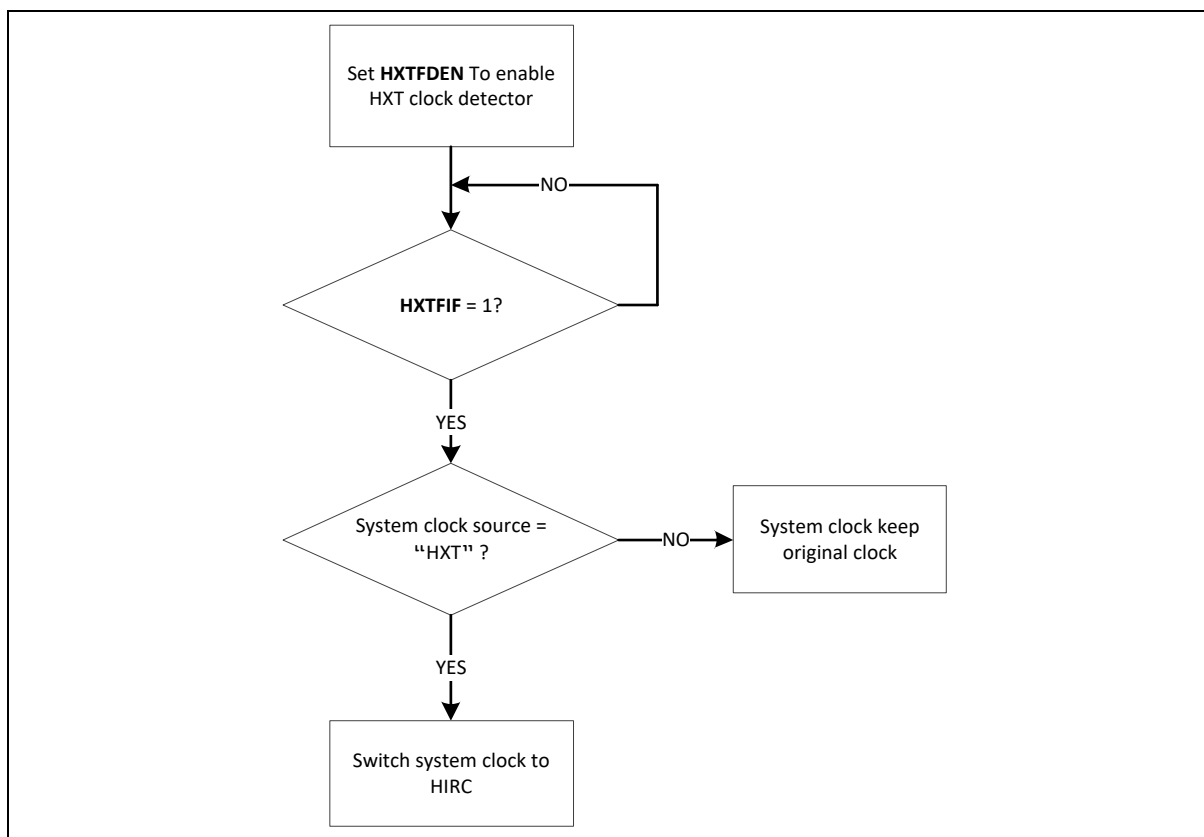


Figure 6.3-4 HXT Stop Protect Procedure

The clock source of SysTick in Cortex®-M0 core can use CPU clock or external clock (SYST\_CTRL[2]). If using external clock, the SysTick clock (STCLK) has 5 clock sources. The clock source switch depends on the setting of the register STCLKSEL (CLK\_CLKSEL0[5:3]). The block diagram is shown in Figure 6.3-5.

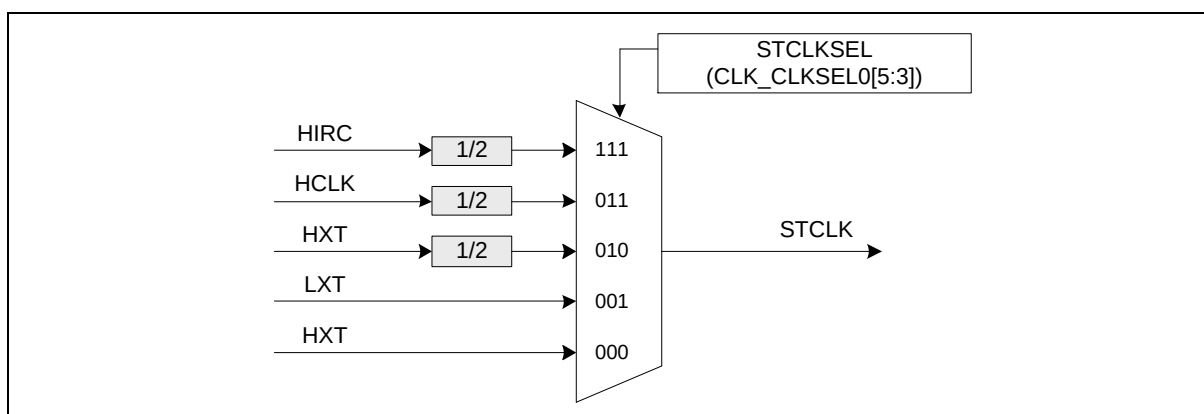


Figure 6.3-5 SysTick Clock Control Block Diagram

### 6.3.4 Peripherals Clock

The peripherals clock has different clock source switch setting, which depends on the different peripheral.

### 6.3.5 Power-down Mode Clock

When entering Power-down mode, system clocks, some clock sources and some peripheral clocks are disabled. Some clock sources and peripherals clock are still active in Power-down mode.

For these clocks, which still keep active, are listed below:

- Clock Generator
  - 38.4 kHz internal low speed RC oscillator (LIRC) clock
  - 32.768 kHz external low speed crystal oscillator (LXT) clock
- Peripherals Clock (When the modules adopt LXT or LIRC as clock source)

### 6.3.6 Clock Output

This device is equipped with a power-of-2 frequency divider which is composed by 16 chained divide-by-2 shift registers. One of the 16 shift register outputs selected by a sixteen to one multiplexer is reflected to CLKO function pin. Therefore there are 16 options of power-of-2 divided clocks with the frequency from  $F_{in}/2^1$  to  $F_{in}/2^{16}$  where  $F_{in}$  is input clock frequency to the clock divider.

The output formula is  $F_{out} = F_{in}/2^{(N+1)}$ , where  $F_{in}$  is the input clock frequency,  $F_{out}$  is the clock divider output frequency and N is the 4-bit value in FREQSEL (CLK\_CLKOCTL[3:0]).

When writing 1 to CLKOEN (CLK\_CLKOCTL[4]), the chained counter starts to count. When writing 0 to CLKOEN (CLK\_CLKOCTL[4]), the chained counter continuously runs till divided clock reaches low state and stays in low state.

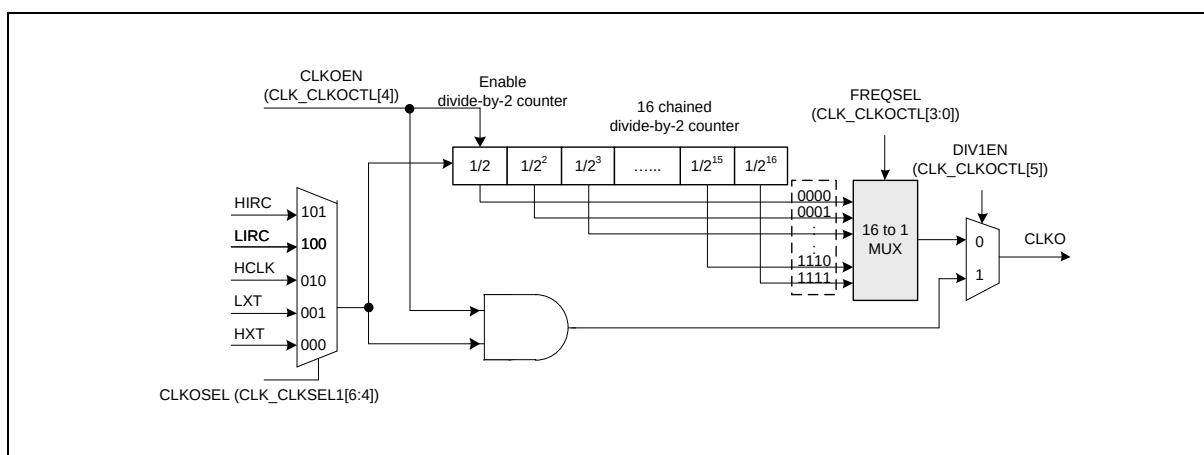


Figure 6.3-6 Clock Output Block Diagram

## 6.4 Flash Memory Controller (FMC)

### 6.4.1 Overview

This chip is equipped with 16/32 Kbytes on-chip embedded Flash. A User Configuration block is provided for system initialization. A loader ROM (LDROM) is used for In-System-Programming (ISP) function. This chip also supports In-Application-Programming (IAP) function. User switches the code executing without the chip reset after the embedded Flash is updated.

### 6.4.2 Features

- Supports 16/32 Kbytes application ROM (APROM).
- Supports 512 bytes page size for 16/32 Kbytes Flash.
- Supports 2 Kbytes loader ROM (LDROM).
- Supports configurable Data Flash size to share with APROM.
- Supports 12 bytes User Configuration block to control system initialization.
- Supports 512 bytes page erase for all embedded Flash.
- Supports CRC-32 checksum calculation function.
- Supports In-System-Programming (ISP) / In-Application-Programming (IAP) to update embedded Flash memory.

## 6.5 General Purpose I/O (GPIO)

### 6.5.1 Overview

This chip has up to 26 General Purpose I/O pins to be shared with other function pins depending on the chip configuration. These 26 pins are arranged in 4 ports named as PA, PB, PC, PD. PA has 6 pins on port, PB has 4 pins on port. PC and PD have 8 pins on port. Each 26 pins is independent and has the corresponding register bits to control the pin mode function and data, except GPA[3]. GPA[3] is a input pin.

The I/O type of each of I/O pins can be configured by software individually as Input, Push-pull output, Open-drain output or Quasi-bidirectional mode. After the chip is reset, the I/O mode of all pins are depending on CIOINI (CONFIG0[10]). Each I/O pin has a very weakly individual pull-up resistor which is about 50 k $\Omega$ . Please refer to the M0A21/M0A23 Datasheet for detailed pin operation voltage information about V<sub>DD</sub> electrical characteristics.

### 6.5.2 Features

- Four I/O modes:
  - Quasi-bidirectional mode
  - Push-Pull Output mode
  - Open-Drain Output mode
  - Input only with high impedance mode
- TTL/Schmitt trigger input selectable
- I/O pin can be configured as interrupt source with edge/level setting
- Configurable default I/O mode of all pins after reset by CIOINI (CONFIG0[10]) setting
  - CIOINI = 0, all GPIO pins in Quasi-bidirectional mode after chip reset
  - CIOINI = 1, all GPIO pins in input mode after chip reset
- Supports independent pull-up control
- Enabling the pin interrupt function will also enable the wake-up function



## 6.6 PDMA Controller (PDMA)

### 6.6.1 Overview

The peripheral direct memory access (PDMA) controller is used to provide high-speed data transfer. The PDMA controller can transfer data from one address to another without CPU intervention. This has the benefit of reducing the workload of CPU and keeps CPU resources free for other applications. The PDMA controller has a total of 5 channels and each channel can perform transfer between memory and peripherals or between memory and memory.

### 6.6.2 Features

- Supports 5 independently configurable channels
- Selectable 2 level of priority (fixed priority or round-robin priority)
- Supports transfer data width of 8, 16, and 32 bits
- Supports source and destination address increment size can be byte, half-word, word or no increment
- Supports software and UART, USCI, ADC, PWM, DAC and TIMER request
- Supports Scatter-Gather mode to perform sophisticated transfer through the use of the descriptor link list table
- Supports single and burst transfer type
- Supports time-out function on channel 0 and channel1

## 6.7 Timer Controller (TMR)

### 6.7.1 Overview

The timer controller includes four 32-bit timers, Timer0 ~ Timer3, allowing user to easily implement a timer control for applications. The timer can perform functions, such as frequency measurement, delay timing, clock generation, and event counting by external input pins, and interval measurement by external capture pins.

### 6.7.2 Features

#### 6.7.2.1 Timer Function Features

- Four sets of 32-bit timers, each timer having one 24-bit up counter and one 8-bit prescale counter
- Independent clock source for each timer
- Provides one-shot, periodic, toggle-output and continuous counting operation modes
- 24-bit up counter value is readable through CNT (TIMERx\_CNT[23:0])
- Supports event counting function
- 24-bit capture value is readable through CAPDAT (TIMERx\_CAP[23:0])
- Supports external capture pin event for interval measurement
- Supports external capture pin event to reset 24-bit up counter
- Supports internal capture triggered while internal ACMP output signal and LIRC transition
- Supports chip wake-up from Idle/Power-down mode if a timer interrupt signal is generated
- Support Timer0 ~ Timer3 time-out interrupt signal or capture interrupt signal to trigger PWM, ADC, PDMA function
- Supports Inter-Timer trigger mode

## 6.8 Watchdog Timer (WDT)

### 6.8.1 Overview

The Watchdog Timer (WDT) is used to perform a system reset when system runs into an unknown state. This prevents system from hanging for an infinite period of time. Besides, this Watchdog Timer supports the function to wake up system from Idle/Power-down mode.

### 6.8.2 Features

- 20-bit free running up counter for WDT time-out interval
- Selectable time-out interval ( $2^4 \sim 2^{20}$ ) and the time-out interval is 416us ~ 27.3 s if WDT\_CLK = 38.4 kHz (LIRC).
- System kept in reset state for a period of  $(1 / \text{WDT\_CLK}) * 63$
- Supports selectable WDT reset delay period, including 1026, 130, 18 or 3 WDT\_CLK reset delay period
- Supports to force WDT enabled after chip powered on or reset by setting CWDTEN[2:0] in Config0 register
- Supports WDT time-out wake-up function only if WDT clock source is selected as LIRC or LXT.

## 6.9 Window Watchdog Timer (WWDT)

### 6.9.1 Overview

The Window Watchdog Timer (WWDT) is used to perform a system reset within a specified window period to prevent software run to uncontrollable status by any unpredictable condition.

### 6.9.2 Features

- 6-bit down counter value (CNTDAT, WWDT\_CNT[5:0]) and 6-bit compare value (CMPDAT, WWDT\_CTL[21:16]) to make the WWDT time-out window period flexible
- Supports 4-bit value (PSCSEL, WWDT\_CTL[11:8]) to programmable maximum 11-bit prescale counter period of WWDT counter
- WWDT counter suspends in Idle/Power-down mode

## 6.10 PWM Generator and Capture Timer (PWM)

### 6.10.1 Overview

The chip provides one PWM generator. PWM supports 6 channels of PWM output or input capture. There is a 12-bit prescaler to support flexible clock to the 16-bit PWM counter with 16-bit comparator. The PWM counter supports up, down and up-down counter types. PWM uses comparator compared with counter to generate events. These events are used to generate PWM pulse, interrupt and trigger signal for ADC to start conversion.

The PWM generator supports two standard PWM output modes: Independent mode and Complementary mode. They have different architecture. In Complementary mode, there are two comparators to generate various PWM pulse with 12-bit dead-time generator. For PWM output control unit, it supports polarity output, independent pin mask and brake functions.

The PWM generator also supports input capture function to latch PWM counter value to the corresponding register when input channel has a rising transition, falling transition or both transition is happened. Capture function also support PDMA to transfer captured data to memory.

### 6.10.2 Features

#### 6.10.2.1 PWM Function Features

- Supports maximum clock frequency up to 48 MHz
- Supports up to one PWM module and provides 6 output channels
- Supports independent mode for PWM output/Capture input channel
- Supports complementary mode for 3 complementary paired PWM output channel
  - Dead-time insertion with 12-bit resolution
  - Two compared values during one period
- Supports 12-bit prescaler from 1 to 4096
- Supports 16-bit resolution PWM counter
  - Up, down and up-down counter operation type
- Supports mask function and tri-state enable for each PWM pin
- Supports brake function
  - Brake source from pin and system safety events (clock failed, Brown-out detection and CPU lockup)
  - Noise filter for brake source from pin
  - Edge detect brake source to control brake state until brake interrupt cleared
  - Level detect brake source to auto recover function after brake condition removed
- Supports interrupt on the following events:
  - PWM counter matches 0, period value or compared value
  - Brake condition happened
- Supports trigger ADC on the following events:
  - PWM counter matches 0, period value or compared value

#### 6.10.2.2 Capture Function Features

- Supports up to 6 capture input channels with 16-bit resolution
- Supports rising or falling capture condition

- Supports input rising/falling capture interrupt
- Supports rising/falling capture with counter reload option
- Supports PDMA transfer function for PWM all channels

## 6.11 UART Interface Controller (UART)

### 6.11.1 Overview

The chip provides two channels of Universal Asynchronous Receiver/Transmitters (UART). The UART controller performs serial-to-parallel conversion on data received from the peripheral and parallel-to-serial conversion on data transmitted from the CPU. Each UART controller channel supports eleven types of interrupts. The UART controller supports flow control function. The UART controller also supports LIN, IrDA SIR, RS-485, and Single-wire function modes and auto-baud rate measuring function.

### 6.11.2 Features

- Full-duplex asynchronous communications
- Separates receive and transmit 16/16 bytes entry FIFO for data payloads
- Supports hardware auto-flow control
- Programmable receiver buffer trigger level
- Supports programmable baud rate generator for each channel individually
- Supports nCTS, incoming data, Received Data FIFO reached threshold and RS-485 Address Match (AAD mode) wake-up function
- Supports 8-bit receiver buffer time-out detection function
- Programmable transmitting data delay time between the last stop and the next start bit by setting DLY (UART\_TOUT[15:8])
- Supports Auto-Baud Rate measurement and baud rate compensation function
  - Supports 9600 bps for UART\_CLK is selected LXT.
- Supports break error, frame error, parity error and receive/transmit buffer overflow detection function
- Fully programmable serial-interface characteristics
  - Programmable number of data bit, 5-, 6-, 7-, 8- bit character
  - Programmable parity bit, even, odd, no parity or stick parity bit generation and detection
  - Programmable stop bit, 1, 1.5, or 2 stop bit generation
- Supports IrDA SIR function mode
  - Supports for 3/16 bit duration for normal mode
- Supports LIN function mode
  - Supports LIN master/slave mode
  - Supports programmable break generation function for transmitter
  - Supports break detection function for receiver
  - Supports LIN slave header time-out detection function
  - Supports LIN response time-out detection function
  - Supports LIN wake-up function
- Supports RS-485 function mode
  - Supports RS-485 9-bit mode
  - Supports hardware or software enables to program nRTS pin to control RS-485

transmission direction

- Supports PDMA transfer function
- Supports Single-wire function mode.

| UART Feature                                 | UART0/ UART1    | USCI-UART                 |
|----------------------------------------------|-----------------|---------------------------|
| FIFO                                         | 16 Bytes        | TX: 1 Byte<br>RX: 2 Bytes |
| Auto Flow Control (CTS/RTS)                  | √               | √                         |
| IrDA                                         | √               | -                         |
| LIN                                          | √               | -                         |
| RS-485 Function Mode                         | √               | √                         |
| nCTS Wake-up                                 | √               | √                         |
| Imcoming Data Wake-up                        | √               | √                         |
| Received Data FIFO reached threshold Wake-up | √               | -                         |
| RS-485 Address Match (AAD mode) Wake-up      | √               | -                         |
| Auto-Baud Rate Measurement                   | √               | √                         |
| STOP Bit Length                              | 1, 1.5, 2 bit   | 1, 2 bit                  |
| Word Length                                  | 5, 6, 7, 8 bits | 6~13 bits                 |
| Even / Odd Parity                            | √               | √                         |
| Stick Bit                                    | √               | -                         |
| <b>Note:</b> √= Supported                    |                 |                           |

Table 6.11-1 NuMicro® M0A21/M0A23 Series UART Features



## 6.12 USCI - Universal Serial Control Interface Controller (USCI)

### 6.12.1 Overview

The Universal Serial Control Interface (USCI) is a flexible interface module covering several serial communication protocols. The user can configure this controller as UART, SPI, or I<sup>2</sup>C functional protocol.

### 6.12.2 Features

The controller can be individually configured to match the application needs. The following protocols are supported:

- UART
- SPI
- I<sup>2</sup>C

## 6.13 USCI – UART Mode

### 6.13.1 Overview

The asynchronous serial channel UART covers the reception and the transmission of asynchronous data frames. It performs a serial-to-parallel conversion on data received from the peripheral, and a parallel-to-serial conversion on data transmitted from the controller. The receiver and transmitter being independent, frames can start at different points in time for transmission and reception.

The UART controller also provides auto flow control. There are two conditions to wake-up the system.

### 6.13.2 Features

- Supports one transmit buffer and two receive buffer for data payload
- Supports hardware auto flow control function
- Supports programmable baud-rate generator
- Support 9-bit Data Transfer (Support 9-bit RS-485)
- Baud rate detection by built-in capture event of baud rate generator
- Supports PDMA capability
- Supports Wake-up function (Data and nCTS Wakeup Only)

## 6.14 USCI - SPI Mode

### 6.14.1 Overview

The SPI protocol of USCI controller applies to synchronous serial data communication and allows full duplex transfer. It supports both master and Slave operation mode with the 4-wire bi-direction interface. SPI mode of USCI controller performs a serial-to-parallel conversion on data received from a peripheral device, and a parallel-to-serial conversion on data transmitted to a peripheral device. The SPI mode is selected by FUNMODE (USPI\_CTL[2:0]) = 0x1

This SPI protocol can operate as Master or Slave mode by setting the SLAVE (USPI\_PROTCTL[0]) to communicate with the off-chip SPI Slave or master device. The application block diagrams in Master and Slave mode are shown below.

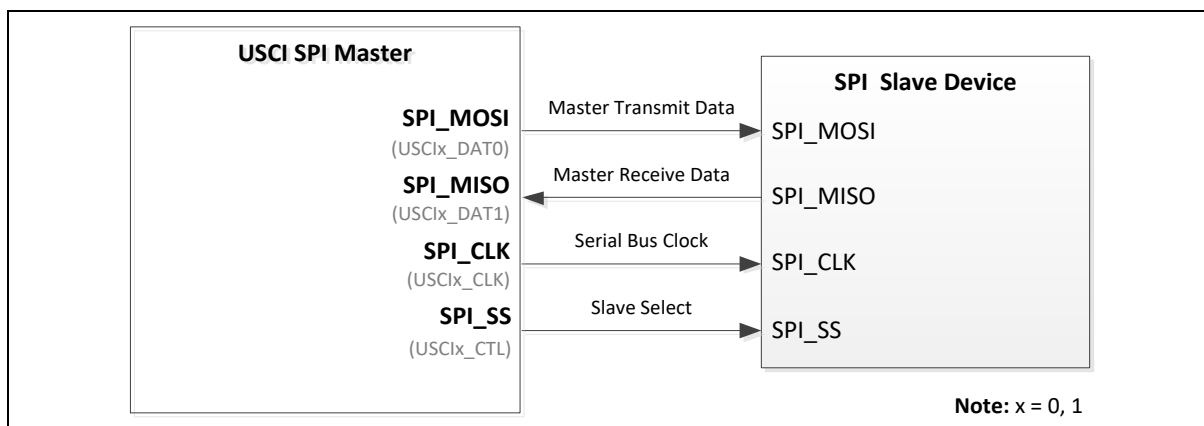


Figure 6.14-1 SPI Master Mode Application Block Diagram

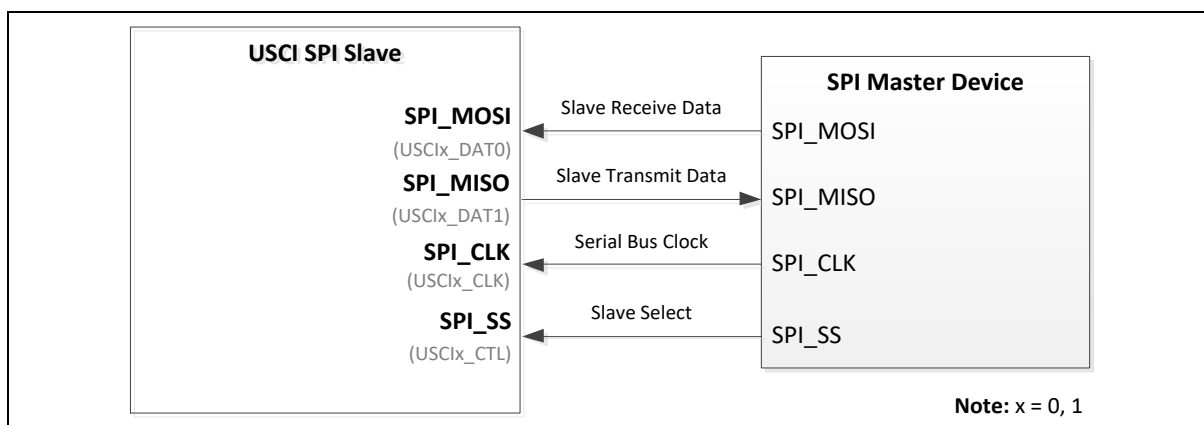


Figure 6.14-2 SPI Slave Mode Application Block Diagram

### 6.14.2 Features

- Supports Master or Slave mode operation (the maximum frequency -- Master =  $f_{CLK} / 2$ , Slave <  $f_{CLK} / 5$ )
- Configurable bit length of a transfer word from 4 to 16-bit
- Supports one transmit buffer and two receive buffers for data payload
- Supports MSB first or LSB first transfer sequence
- Supports Word Suspend function

- Supports PDMA transfer
- Supports 3-wire, no slave select signal, bi-direction interface
- Supports wake-up function by slave select signal in Slave mode
- Supports one data channel half-duplex transfer

## 6.15 USCI - I<sup>2</sup>C Mode

### 6.15.1 Overview

On I<sup>2</sup>C bus, data is transferred between a Master and a Slave. Data bits transfer on the SCL and SDA lines are synchronously on a byte-by-byte basis. Each data byte is 8-bit. There is one SCL clock pulse for each data bit with the MSB being transmitted first, and an acknowledge bit follows each transferred byte. Each bit is sampled during the high period of SCL; therefore, the SDA line may be changed only during the low period of SCL and must be held stable during the high period of SCL. A transition on the SDA line while SCL is high is interpreted as a command (START or STOP). Please refer to Figure 6.15-1 for more detailed I<sup>2</sup>C BUS Timing.

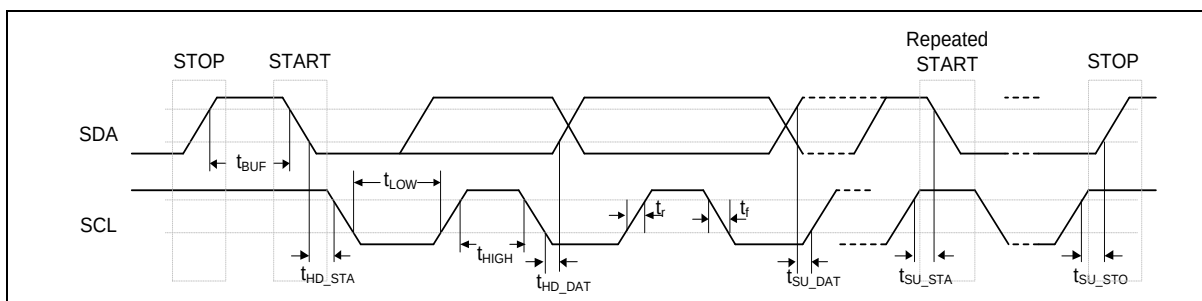


Figure 6.15-1 I<sup>2</sup>C Bus Timing

The device's on-chip I<sup>2</sup>C provides the serial interface that meets the I<sup>2</sup>C bus standard mode specification. The I<sup>2</sup>C port handles byte transfers autonomously. The I<sup>2</sup>C mode is selected by FUNMODE (UI2C\_CTL [2:0]) = 100B. When enabling this port, the USCI interfaces to the I<sup>2</sup>C bus via two pins: SDA and SCL. When I/O pins are used as I<sup>2</sup>C ports, user must set the pins function to I<sup>2</sup>C in advance.

**Note:** Pull-up resistor is needed for I<sup>2</sup>C operation because the SDA and SCL are set to open-drain pins when USCI is selected to I<sup>2</sup>C operation mode.

### 6.15.2 Features

- Full master and slave device capability
- Supports of 7-bit addressing, as well as 10-bit addressing
- Communication in standard mode (100 kBit/s) or in fast mode (up to 400 kBit/s)
- Supports multi-master bus
- Supports one transmit buffer and two receive buffer for data payload
- Supports 10-bit bus time-out capability
- Supports bus monitor mode.
- Supports Power down wake-up by data toggle or address match
- Supports setup/hold time programmable
- Supports multiple address recognition (two slave address with mask option)

## 6.16 Controller Area Network (CAN)

### 6.16.1 Overview

The Bosch CAN (is named as C\_CAN) consists of the CAN Core, Message RAM, Message Handler, Control Registers and Module Interface. The CAN Core performs communication according to the CAN protocol version 2.0 part A and B. The bit rate can be programmed to values up to 1 MBit/s. For the connection to the physical layer, additional transceiver hardware is required.

For communication on a CAN network, individual Message Objects are configured. The Message Objects and Identifier Masks for acceptance filtering of received messages are stored in the Message RAM. All functions concerning the handling of messages are implemented in the Message Handler. These functions include acceptance filtering, the transfer of messages between the CAN Core and the Message RAM, and the handling of transmission requests as well as the generation of the module interrupt.

The register set of the C\_CAN can be accessed directly by the software through the module interface. These registers are used to control/configure the CAN Core and the Message Handler and to access the Message RAM.

### 6.16.2 Features

- Supports CAN protocol version 2.0 part A and B
- Bit rates up to 1 MBit/s
- 32 Message Objects
- Each Message Object has its own identifier mask
- Programmable FIFO mode (concatenation of Message Objects)
- Maskable interrupt
- Disabled Automatic Re-transmission mode for Time Triggered CAN applications
- Programmable loop-back mode for self-test operation
- 16-bit module interfaces to the AMBA APB bus
- Supports wake-up function

## 6.17 CRC Controller (CRC)

### 6.17.1 Overview

The Cyclic Redundancy Check (CRC) generator can perform CRC calculation with four common polynomials CRC-CCITT, CRC-8, CRC-16, and CRC-32 settings.

### 6.17.2 Features

- Supports four common polynomials CRC-CCITT, CRC-8, CRC-16, and CRC-32
  - CRC-CCITT:  $X^{16} + X^{12} + X^5 + 1$
  - CRC-8:  $X^8 + X^2 + X + 1$
  - CRC-16:  $X^{16} + X^{15} + X^2 + 1$
  - CRC-32:  $X^{32} + X^{26} + X^{23} + X^{22} + X^{16} + X^{12} + X^{11} + X^{10} + X^8 + X^7 + X^5 + X^4 + X^2 + X + 1$
- Programmable seed value
- Supports programmable order reverse setting for input data and CRC checksum
- Supports programmable 1's complement setting for input data and CRC checksum
- Supports 8/16/32-bit of data width
  - 8-bit write mode: 1-AHB clock cycle operation
  - 16-bit write mode: 2-AHB clock cycle operation
  - 32-bit write mode: 4-AHB clock cycle operation
- Supports using PDMA to write data to perform CRC operation

## 6.18 Hardware Divider (HDIV)

### 6.18.1 Overview

The hardware divider (HDIV) is useful to the high performance application. The hardware divider is a signed, integer divider with both quotient and remainder outputs.

### 6.18.2 Features

- Signed (two's complement) integer calculation
- 32-bit dividend with 16-bit divisor calculation capacity
- 32-bit quotient and 32-bit remainder outputs (16-bit remainder with sign extends to 32-bit)
- Divided by zero warning flag
- Write divisor to trigger calculation



## 6.19 Analog-to-Digital Converter (ADC)

### 6.19.1 Overview

The chip contains one 12-bit successive approximation analog-to-digital converter (SAR A/D converter) with twenty one input channels. The A/D converter supports four operation modes: Single, Burst, Single-cycle Scan and Continuous Scan mode. The A/D converter can be started by software, external pin, timer0~3 overflow pulse trigger and PWM trigger.

### 6.19.2 Features

- Analog input voltage range: 0 ~ AV<sub>DD</sub> (voltage of V<sub>DD</sub> pin).
- 12-bit resolution and 10-bit accuracy is guaranteed
- Up to 17 single-end analog input channels or 8 differential analog input channels
- Maximum ADC peripheral clock frequency is 16 MHz
- Up to 800 kSPS sampling rate
- Configurable ADC internal sampling time
- Four operation modes:
  - Single mode: A/D conversion is performed one time on a specified channel.
  - Burst mode: A/D converter samples and converts the specified single channel and sequentially stores the result in FIFO.
  - Single-cycle Scan mode: A/D conversion is performed only one cycle on all specified channels with the sequence from the smallest numbered channel to the largest numbered channel.
  - Continuous Scan mode: A/D converter continuously performs Single-cycle Scan mode until software stops A/D conversion.
- An A/D conversion can be started by:
  - Software Write 1 to ADST bit
  - External pin (STADC)
  - Timer 0~3 overflow pulse trigger
  - PWM trigger with optional start delay period
- Each conversion result is held in data register of each channel with valid and overrun indicators.
- Conversion result can be compared with specified value and user can select whether to generate an interrupt when conversion result matches the compare register setting.
- 4 internal channels, they are band-gap voltage (V<sub>BG</sub>), temperature sensor (V<sub>TEMP</sub>), internal reference voltage and DAC0 output
- Support PDMA transfer mode.

**Note 1:** ADC sampling rate = (ADC peripheral clock frequency) / (total ADC conversion cycle)

**Note 2:** If the internal channel for temperature sensor is active, the minimum time of sample stage should be T<sub>TEMP\_ADC</sub>. Please refer to section 8.5.7 in the relative Datasheet for detailed information.

**Note 3:** If the internal channel for band-gap voltage is active, the minimum time of sample stage should be T<sub>VBG\_ADC</sub>. Please refer to section 8.2 in the relative Datasheet for detailed information.

## 6.20 Digital to Analog Converter (DAC)

### 6.20.1 Overview

The DAC module is a 5-bit, voltage output digital-to-analog converter. It can be used in conjunction with the PDMA controller. The DAC integrates a voltage output buffer that can be used to reduce output impedance and drive external loads directly without having to add an external operational amplifier.

### 6.20.2 Features

- Supports one 5-bit 100k SPS voltage type DAC
- Analog output voltage range: 0~AV<sub>DD</sub> (voltage of V<sub>DD</sub> pin)
- Reference voltage from internal reference voltage V<sub>REF</sub> pin or AV<sub>DD</sub>.
- DAC maximum conversion updating rate 100k SPS
- Rail to rail settle time 10us
- Supports software and timer0~3 trigger to start DAC conversion.
- Supports PDMA mode.

## 6.21 Analog Comparator Controller (ACMP)

### 6.21.1 Overview

The chip provides two comparators. The comparator output is logic 1 when positive input is greater than negative input; otherwise, the output is 0. Each comparator can be configured to generate an interrupt when the comparator output value changes.

### 6.21.2 Features

- Analog input voltage range: 0 ~ AV<sub>DD</sub> (voltage of V<sub>DD</sub> pin)
- Up to two rail-to-rail analog comparators
- Supports hysteresis function
  - ◆ Support programmable hysteresis window: 0mV and 30mV
- Supports wake-up function
- Selectable input sources of positive input and negative input
- ACMP0 supports:
  - 3 multiplexed I/O pins at positive sources:
    - ◆ ACMP0\_P0, Comparator Reference Voltage (CRV), and DAC0 output
  - 5 negative sources:
    - ◆ ACMP0\_N0, ACMP0\_N1, ACMP0\_N2, ACMP0\_N3
    - ◆ Comparator Reference Voltage (CRV)
- ACMP1 supports
  - 3 multiplexed I/O pins at positive sources:
    - ◆ ACMP1\_P0, Comparator Reference Voltage (CRV), and DAC0 output
  - 5 negative sources:
    - ◆ ACMP1\_N0, ACMP1\_N1, ACMP1\_N2, ACMP1\_N3
    - ◆ Comparator Reference Voltage (CRV)
- Shares one ACMP interrupt vector for all comparators
- Interrupts generated when compare results change (Interrupt event condition is programmable)
- Supports triggers for break events and cycle-by-cycle control for PWM
- Supports window compare mode and window latch mode

6.22 Peripherals Interconnection

6.22.1 Overview

Some peripherals have interconnections which allow autonomous communication or synchronous action between peripherals without needing to involve the CPU. Peripherals interact without CPU saves CPU resources, reduces power consumption, operates with no software latency and fast response.

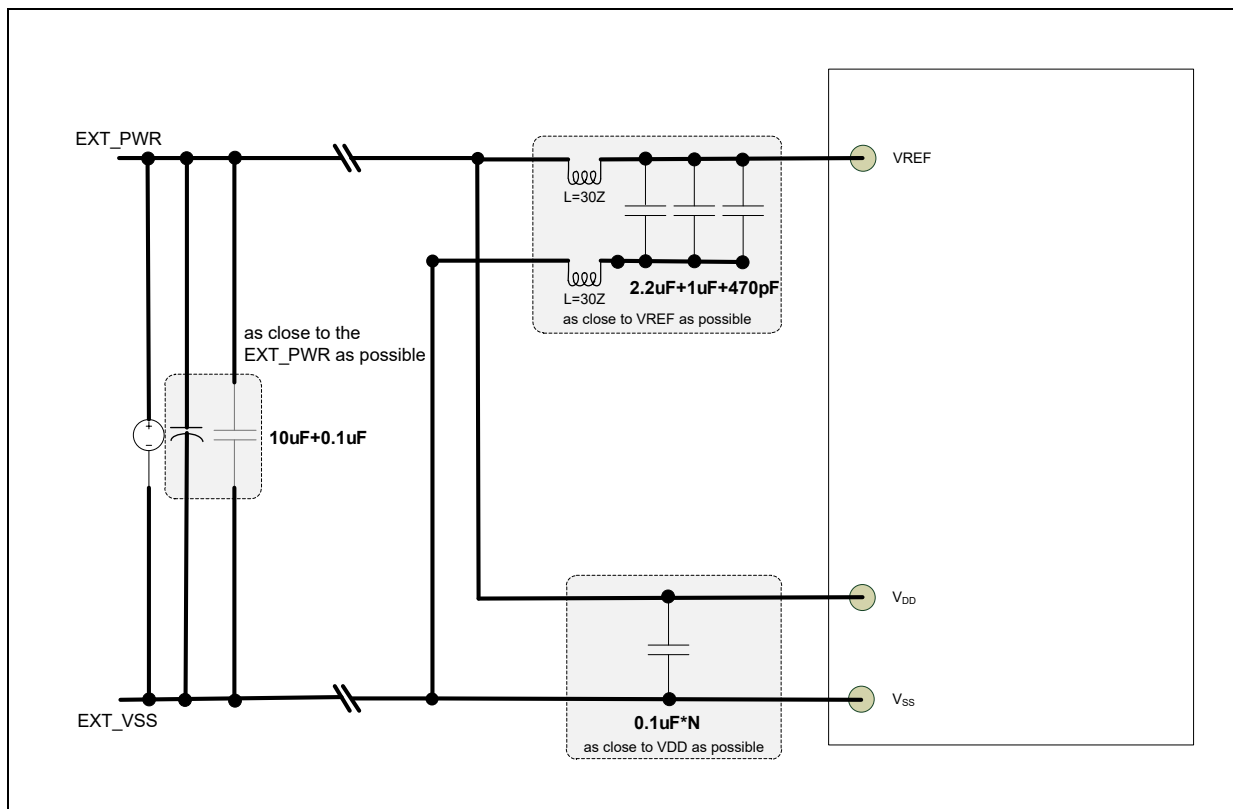
6.22.2 Peripherals Interconnect Matrix Table

| Source | Destination       |                   |                   |                   |
|--------|-------------------|-------------------|-------------------|-------------------|
|        | ADC               | DAC               | PWM               | Timer             |
| LIRC   | -                 | -                 | -                 | <a href="#">4</a> |
| PWM    | <a href="#">1</a> | -                 | -                 | -                 |
| Timer  | <a href="#">1</a> | <a href="#">2</a> | <a href="#">3</a> | <a href="#">5</a> |

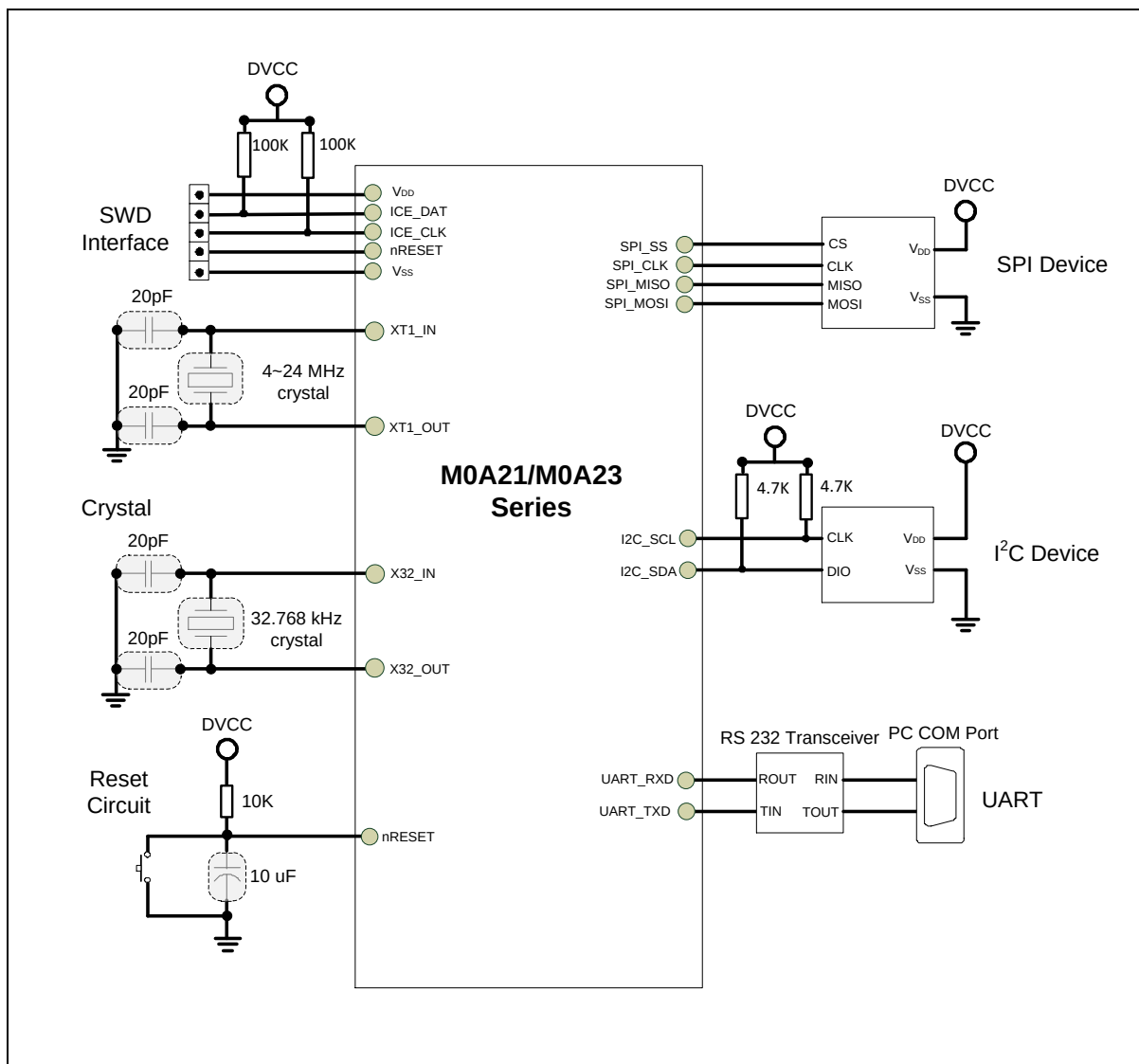
Table 6.22-1 Peripherals Interconnect Matrix Table

## 7 APPLICATION CIRCUIT

### 7.1 Power Supply Scheme



## 7.2 Peripheral Application Scheme



## 8 ELECTRICAL CHARACTERISTICS

### 8.1 Absolute Maximum Ratings

Stresses above the absolute maximum ratings may cause permanent damage to the device. The limiting values are stress ratings only and cannot be used to functional operation of the device. Exposure to the absolute maximum ratings may affect device reliability and proper operation is not guaranteed.

#### 8.1.1 Voltage Characteristics

| Symbol                                                                                                                                                                                                                                                                                | Description                                      | Min          | Max | Unit |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------|-----|------|
| $V_{DD}-V_{SS}^{[*1]}$                                                                                                                                                                                                                                                                | DC power supply                                  | -0.3         | 6.5 | V    |
| $\Delta V_{DD}$                                                                                                                                                                                                                                                                       | Variations between different $V_{DD}$ power pins | -            | 50  | mV   |
| $\Delta V_{SS}$                                                                                                                                                                                                                                                                       | Variations between different ground pins         | -            | 50  | mV   |
| $V_{IN}$                                                                                                                                                                                                                                                                              | Input voltage on any other pin <sup>[*2]</sup>   | $V_{SS}-0.3$ | 6.5 | V    |
| <b>Notes:</b> <ol style="list-style-type: none"> <li>1. All main power (<math>V_{DD}</math>) and ground (<math>V_{SS}</math>) pins must be connected to the external power supply.</li> <li>2. Refer to Table 8.1-2 for the values of the maximum allowed injected current</li> </ol> |                                                  |              |     |      |

Table 8.1-1 Voltage Characteristics

### 8.1.2 Current Characteristics

| Symbol                       | Description                                               | Min | Max | Unit |
|------------------------------|-----------------------------------------------------------|-----|-----|------|
| $\Sigma I_{DD}^{[*1]}$       | Maximum current into $V_{DD}$                             | -   | 200 | mA   |
| $\Sigma I_{SS}$              | Maximum current out of $V_{SS}$                           | -   | 100 |      |
| $I_{IO}$                     | Maximum current sunk by a I/O Pin                         | -   | 20  |      |
|                              | Maximum current sourced by a I/O Pin                      | -   | 20  |      |
|                              | Maximum current sunk by total I/O Pins <sup>[*2]</sup>    | -   | 100 |      |
|                              | Maximum current sourced by total I/O Pins <sup>[*2]</sup> | -   | 100 |      |
| $I_{INJ(PIN)}^{[*3]}$        | Maximum injected current by a I/O Pin                     | -   | ±5  |      |
| $\Sigma I_{INJ(PIN)}^{[*3]}$ | Maximum injected current by total I/O Pins                | -   | ±25 |      |

**Note:**

- Maximum allowable current is a function of device maximum power dissipation.
- This current consumption must be correctly distributed over all I/Os and control pins. The total output current must not be sunk/sourced between two consecutive power supply pins.
- A positive injection is caused by  $V_{IN}>V_{DD}$  and a negative injection is caused by  $V_{IN}<V_{SS}$ .  $I_{INJ(PIN)}$  must never be exceeded. It is recommended to connect an overvoltage protection diode between the analog input pin and the voltage supply pin.

Table 8.1-2 Current Characteristics



8.1.3 Thermal Characteristics

The average junction temperature can be calculated by using the following equation:

$T_J = T_A + (P_D \times \theta_{JA})$

- $T_A$  = ambient temperature (°C)
- $\theta_{JA}$  = thermal resistance junction-ambient (°C/Watt)
- $P_D$  = sum of internal and I/O power dissipation

| Symbol                                                                                                              | Description                                                     | Min | Typ | Max | Unit    |
|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-----|-----|-----|---------|
| $T_A$                                                                                                               | Operating ambient temperature                                   | -40 | -   | 125 | °C      |
| $T_J$                                                                                                               | Operating junction temperature                                  | -40 | -   | 135 |         |
| $T_{ST}$                                                                                                            | Storage temperature                                             | -65 | -   | 150 |         |
| $\theta_{JA} [^{\circ}1]$                                                                                           | Thermal resistance junction-ambient<br>20-pin SSOP(4.4x6.5 mm)  | -   | 38  | -   | °C/Watt |
|                                                                                                                     | Thermal resistance junction-ambient<br>28-pin TSSOP(4.4x9.7 mm) | -   | 30  | -   | °C/Watt |
| <b>Note:</b><br>1. Determined according to JEDEC51-2 Integrated Circuits Thermal Test Method Environment Conditions |                                                                 |     |     |     |         |

Table 8.1-3 Thermal Characteristics

### 8.1.4 EMC Characteristics

#### 8.1.4.1 Electrostatic Discharge (ESD)

For the Nuvoton MCU products, there are ESD protection circuits which built into chips to avoid any damage that can be caused by typical levels of ESD.

#### 8.1.4.2 Static Latchup

Two complementary static tests are required on six parts to assess the latchup performance:

- A supply overvoltage is applied to each power supply pin
- A current injection is applied to each input, output and configurable I/O pin

#### 8.1.4.3 Electrical Fast Transients (EFT)

In some application circuit compoment will produce fast and narrow high-frequency trasnients bursts of narrow high-frequency transients on the power distribution system..

- Inductive loads:
  - Relays, switch contactors
  - Heavy-duty motors when de-energized etc.

The fast transient immunity requirements for electronic products are defined in IEC 61000-4-4 by International ElectrotechnicalCommission (IEC).

| Symbol                | Description                                 | Min   | Typ | Max   | Unit |
|-----------------------|---------------------------------------------|-------|-----|-------|------|
| $V_{HBM}^{[*1]}$      | Electrostatic discharge,human body mode     | -6000 | -   | +6000 | V    |
| $V_{CDM}^{[*2]}$      | Electrostatic discharge,charge device model | -1000 | -   | +1000 |      |
| $LU^{[*3]}$           | Pin current for latch-up <sup>[*3]</sup>    | -150  | -   | +150  | mA   |
| $V_{EFT}^{[*4] [*5]}$ | Fast transient voltage burst                | -4.4  | -   | +4.4  | kV   |

**Notes:**

1. Determined according to ANSI/ESDA/JEDEC JS-001 Standard, Electrostatic Discharge Sensitivity Testing – Human Body Model (HBM) – Component Level
2. Determined according to ANSI/ESDA/JEDEC JS-002 standard for Electrostatic Discharge Sensitivity (ESD) Testing – Charged Device Model (CDM) – Component Level.
3. Determined according to JEDEC EIA/JESD78 standard.
4. Determined according to IEC 61000-4-4 Electrical fast transient/burst immunity test.
5. The performance cretia class is 4A.

Table 8.1-4 EMC Characteristics

### 8.1.5 Package Moisture Sensitivity(MSL)

The MSL rating of an IC determines its floor life before the board mounting once its dry bag has been opened. All Nuvoton surface mount chips have a moisture level classification. The information is also displayed on the bag packing.

| Pacakge                                                        | MSL   |
|----------------------------------------------------------------|-------|
| 20-pin SSOP(4.4x6.5 mm) <sup>[*1]</sup>                        | MSL 3 |
| 28-pin TSSOP(4.4x9.7 mm) <sup>[*1]</sup>                       | MSL 3 |
| <b>Note:</b><br>1. Determined according to IPC/JEDEC J-STD-020 |       |

Table 8.1-5 Package Moisture Sensitivity(MSL)

8.1.6 Soldering Profile

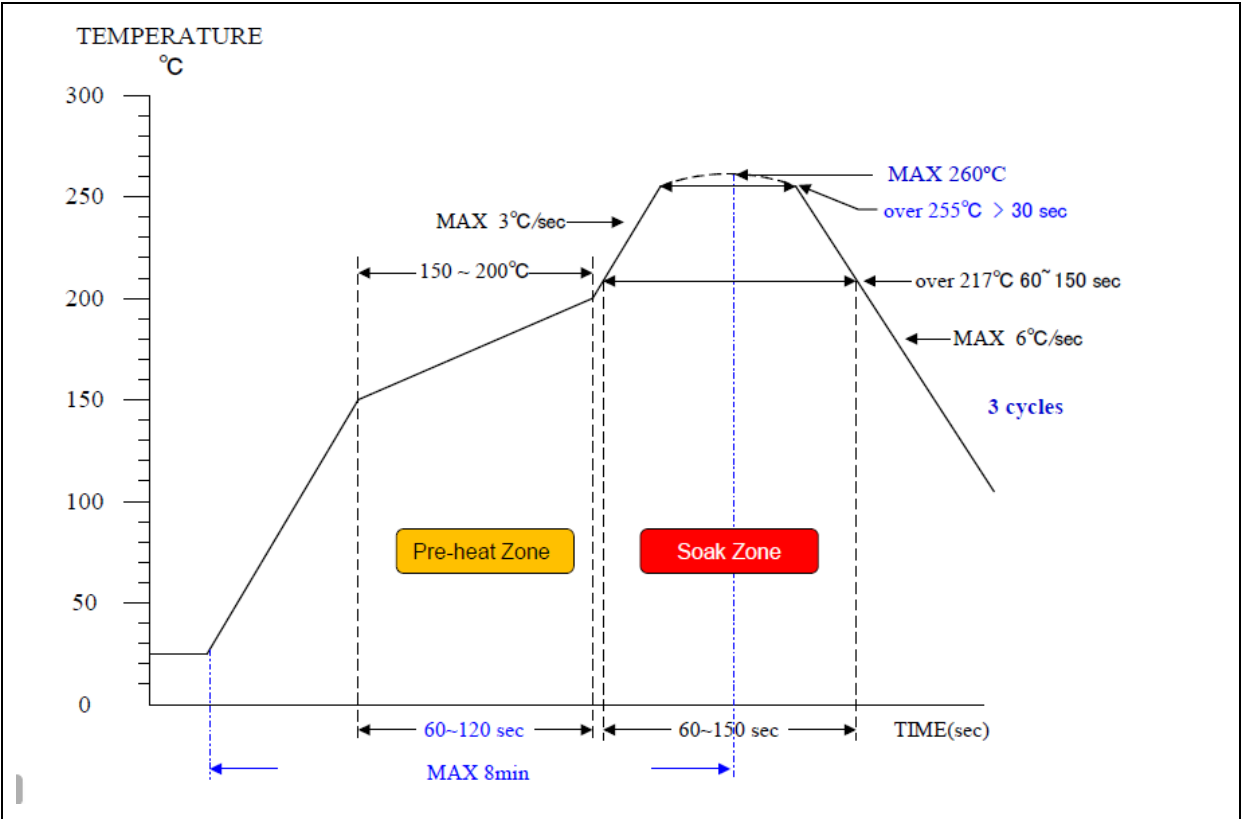


Figure 8.1-1 Soldering Profile from J-STD-020C

| Porfile Feature                                       | Pb Free Package     |
|-------------------------------------------------------|---------------------|
| Average ramp-up rate (217°C to peak)                  | 3°C/sec. max        |
| Preheat temperature 150°C ~200°C                      | 60 sec. to 120 sec. |
| Temperature maintained above 217°C                    | 60 sec. to 150 sec. |
| Time with 5°C of actual peak temperature              | > 30 sec.           |
| Peak temperature range                                | 260°C               |
| Ramp-down rate                                        | 6°C/sec ax.         |
| Time 25°C to peak temperature                         | 8 min. max          |
| <b>Note:</b><br>1. Determined according to J-STD-020C |                     |

Table 8.1-6 Soldering Profile

## 8.2 General Operating Conditions

( $V_{DD}-V_{SS} = 2.4 \sim 5.5V$ ,  $T_A = 25^\circ C$ , HCLK = 48 MHz unless otherwise specified.)

| Symbol                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Parameter                                                                 | Min   | Typ   | Max      | Unit       | Test Conditions                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|-------|-------|----------|------------|--------------------------------------------------------------------------------|
| $T_A$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Temperature                                                               | -40   | -     | 125      | $^\circ C$ |                                                                                |
| $f_{HCLK}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Internal AHB clock frequency                                              | -     | -     | 48       | MHz        |                                                                                |
| $V_{DD}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Operation voltage                                                         | 2.4   | -     | 5.5      | V          |                                                                                |
| $V_{REF}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Analog reference voltage                                                  | 2.4   | -     | $V_{DD}$ |            |                                                                                |
| $V_{LDO}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | LDO output voltage                                                        | -     | 1.8   | -        |            |                                                                                |
| $V_{BG}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Band-gap voltage                                                          | 1.174 | 1.210 | 1.246    | V          |                                                                                |
| $T_{VBG\_ADC}^{[*3]}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ADC sampling time when reading the band-gap voltage                       | 12    | -     | -        | $\mu S$    |                                                                                |
| $C_{LDO}^{[*2]}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | LDO output capacitor on each pin                                          | 1     |       |          | $\mu F$    |                                                                                |
| $R_{ESR}^{[*3]}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ESR of $C_{LDO}$ output capacitor                                         | -     | -     | 0.5      | $\Omega$   |                                                                                |
| $I_{RUSH}^{[*3]}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | InRush current on voltage regulator power-on (POR or wakeup from Standby) | -     | 150   | 200      | mA         |                                                                                |
| $E_{RUSH}^{[*3]}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | InRush energy on voltage regulator power-on (POR or wakeup from Standby)  | -     | 3     | -        | $\mu C$    | $V_{DD} = 2.4 V$ , $T_A = 125^\circ C$ ,<br>$I_{RUSH} = 150 mA$ for 15 $\mu s$ |
| <b>Note:</b> <ol style="list-style-type: none"> <li>1. It is recommended to power <math>V_{DD}</math> from the same source. A maximum difference of 0.3 V between <math>V_{DD}</math> can be tolerated during power-on and power-off operation .</li> <li>2. To ensure stability, an external 1 <math>\mu F</math> output capacitor, <math>C_{LDO}</math> must be connected between the LDO_CAP pin and the closest GND pin of the device. Solid tantalum and multilayer ceramic capacitors are suitable as output capacitor. Additional 100 nF bypass capacitor between LDO_CAP pin and the closest GND pin of the device helps decrease output noise and improves the load transient response.</li> <li>3. Guaranteed by design, not tested in production</li> </ol> |                                                                           |       |       |          |            |                                                                                |

Table 8.2-1 General Operating Conditions

## 8.3 DC Electrical Characteristics

### 8.3.1 Supply Current Characteristics

The current consumption is a combination of internal and external parameters and factors such as operating frequencies, device software configuration, I/O pin loading, I/O pin switching rate, program location in memory and so on. The current consumption is measured as described in below condition and table to inform test characterization result.

- All GPIO pins are in push pull mode and output high.
- The maximum values are obtained for  $V_{DD} = 5.5\text{ V}$  and maximum ambient temperature ( $T_A$ ), and the typical values for  $T_A = 25\text{ }^{\circ}\text{C}$  and  $V_{DD} = 2.4 \sim 5.5\text{ V}$  unless otherwise specified.
- $V_{DD}$
- When the peripherals are enabled HCLK is the system clock,  $f_{PCLK0,1} = f_{HCLK}$ .
- Program run CoreMark<sup>®</sup> code in Flash.

| Symbol              | Conditions                                                                                          | F <sub>HCLK</sub> | Typ <sup>[*1]</sup>    | Max <sup>[*1][*2]</sup> |                        |                         | Unit |
|---------------------|-----------------------------------------------------------------------------------------------------|-------------------|------------------------|-------------------------|------------------------|-------------------------|------|
|                     |                                                                                                     |                   | T <sub>A</sub> = 25 °C | T <sub>A</sub> = 25 °C  | T <sub>A</sub> = 85 °C | T <sub>A</sub> = 125 °C |      |
| I <sub>DD_RUN</sub> | Normal run mode,<br>executed from Flash,<br>all peripherals disable<br>HIRC, HXT, LIRC or LXT clock | 48 MHz(HIRC48M)   | 8.89                   | 9.79                    | 9.83                   | 10.36                   | mA   |
|                     |                                                                                                     | 24 MHz(HIRC48M/2) | 5.41                   | 5.71                    | 6.00                   | 6.80                    |      |
|                     |                                                                                                     | 24 MHz(HXT24M)    | 5.39                   | 5.90                    | 6.41                   | 7.40                    |      |
|                     |                                                                                                     | 12 MHz(HXT24M/2)  | 3.42                   | 3.80                    | 4.26                   | 5.20                    |      |
|                     |                                                                                                     | 4 MHz(HXT24M/6)   | 2.06                   | 2.37                    | 2.78                   | 3.67                    |      |
|                     |                                                                                                     | 38.4 KHz          | 0.12                   | 0.14                    | 0.33                   | 1.03                    |      |
|                     |                                                                                                     | 32.768 KHz        | 0.12                   | 0.14                    | 0.33                   | 1.03                    |      |
|                     | Normal run mode,<br>executed from Flash,<br>all peripherals enable<br>HIRC, HXT, LIRC or LXT clock  | 48 MHz(HIRC48M)   | 16.62                  | 18.04                   | 18.22                  | 18.97                   |      |
|                     |                                                                                                     | 24 MHz(HIRC48M/2) | 9.44                   | 9.99                    | 10.39                  | 11.28                   |      |
|                     |                                                                                                     | 24 MHz(HXT24M)    | 8.86                   | 9.58                    | 10.25                  | 11.37                   |      |
|                     |                                                                                                     | 12 MHz(HXT24M/2)  | 5.15                   | 5.65                    | 6.20                   | 7.19                    |      |
|                     |                                                                                                     | 4 MHz(HXT24M/6)   | 2.63                   | 2.98                    | 3.43                   | 4.34                    |      |
|                     |                                                                                                     | 38.4 KHz          | 0.13                   | 0.15                    | 0.35                   | 1.05                    |      |
|                     |                                                                                                     | 32.768 KHz        | 0.13                   | 0.15                    | 0.35                   | 1.05                    |      |

Notes:

1.

When analog peripheral blocks such as, DAC, ADC, ACMP, HIRC, LIRC, HXT and LXT are ON, an additional power consumption should be considered.

2.

Based on characterization, not tested in production unless otherwise specified.

Table 8.3-1 Current consumption in Normal Run mode

| Symbol | Conditions | F <sub>HCLK</sub> | Typ <sup>[*1]</sup>    | Max <sup>[*1][*2]</sup> |                        |                         | Unit |
|--------|------------|-------------------|------------------------|-------------------------|------------------------|-------------------------|------|
|        |            |                   | T <sub>A</sub> = 25 °C | T <sub>A</sub> = 25 °C  | T <sub>A</sub> = 85 °C | T <sub>A</sub> = 125 °C |      |

|                      |                                                                       |                   |       |       |       |       |    |
|----------------------|-----------------------------------------------------------------------|-------------------|-------|-------|-------|-------|----|
| I <sub>DD_IDLE</sub> | Idle mode,<br>all peripherals disable<br>HIRC, HXT, LIRC or LXT clock | 48 MHz(HIRC48M)   | 2.77  | 2.90  | 3.15  | 3..89 | mA |
|                      |                                                                       | 24 MHz(HIRC48M/2) | 2.10  | 2.20  | 2.45  | 3.17  |    |
|                      |                                                                       | 24 MHz(HXT24M)    | 2.10  | 2.41  | 2.83  | 3.71  |    |
|                      |                                                                       | 12 MHz(HXT24M/2)  | 1.76  | 2.07  | 2.47  | 3.34  |    |
|                      |                                                                       | 4 MHz(HXT24M/6)   | 1.50  | 1.80  | 2.19  | 3.06  |    |
|                      |                                                                       | 38.4 KHz          | 0.12  | 0.14  | 0.33  | 1.02  |    |
|                      |                                                                       | 32.768 KHz        | 0.12  | 0.14  | 0.33  | 1.02  |    |
|                      | Idle mode,<br>all peripherals enable<br>HIRC, HXT, LIRC or LXT clock  | 48 MHz(HIRC48M)   | 10.26 | 10.88 | 11.36 | 12.25 |    |
|                      |                                                                       | 24 MHz(HIRC48M/2) | 5.85  | 6.19  | 6.54  | 7.36  |    |
|                      |                                                                       | 24 MHz(HXT24M)    | 5.59  | 6.13  | 6.69  | 7.71  |    |
|                      |                                                                       | 12 MHz(HXT24M/2)  | 3.51  | 3.93  | 4.41  | 5.35  |    |
|                      |                                                                       | 4 MHz(HXT24M/6)   | 2.09  | 2.41  | 2.83  | 3.73  |    |
|                      |                                                                       | 38.4 KHz          | 0.13  | 0.15  | 0.34  | 1.04  |    |
|                      |                                                                       | 32.768 KHz        | 0.13  | 0.15  | 0.34  | 1.04  |    |

Notes:

1.

When analog peripheral blocks such as, DAC, ADC, ACMP, , HIRC, LIRC, HXT and LXT are ON, an additional power consumption should be considered.

2.

Based on characterization, not tested in production unless otherwise specified.

Table 8.3-2 Current consumption in Idle mode

| Symbol             | Test Conditions                                                                  | LXT <sup>[*1]</sup> | LIRC     | Typ <sup>[*2]</sup>    | Max <sup>[*3][*4]</sup> |                        |                         | Unit |
|--------------------|----------------------------------------------------------------------------------|---------------------|----------|------------------------|-------------------------|------------------------|-------------------------|------|
|                    |                                                                                  | 32.768 kHz          | 38.4 kHz | T <sub>A</sub> = 25 °C | T <sub>A</sub> = 25 °C  | T <sub>A</sub> = 85 °C | T <sub>A</sub> = 125 °C |      |
| I <sub>DD_PD</sub> | Power-down mode, all peripherals disable                                         | -                   | -        | 11                     | 19                      | 198                    | 847                     | μA   |
|                    | Power-down mode, WDT/Timer/UART enable and run                                   | V                   | -        | 13                     | 21                      | 201                    | 856                     |      |
|                    | Power-down mode, WDT/Timer enable and run                                        | -                   | V        | 13                     | 21                      | 202                    | 860                     |      |
|                    | Power-down mode, WDT/Timer/UART enable and run, WDT use LIRC, UART/Timer use LXT | V                   | V        | 14                     | 23                      | 204                    | 865                     |      |

Notes:

1.

Crystal used: AURUM XF66RU000032C0 with a C<sub>L</sub> of 20 pF for L1 gain level.

2.

V<sub>DD</sub> = 3.3V, LVR17 enabled, POR disabled and BOD disabled.

3.

Based on characterization, not tested in production unless otherwise specified.

4.

When analog peripheral blocks such as DAC, ADC and ACMP are ON, an additional power consumption should be considered.

5.

Based on characterization, tested in production.

Table 8.3-3 Chip Current Consumption in Power-down mode



### 8.3.2 On-Chip Peripheral Current Consumption

- The typical values for  $T_A = 25\text{ }^{\circ}\text{C}$  and  $V_{DD} = 3.3\text{ V}$  unless otherwise specified.
- All GPIO pins are set as output high of push pull mode without multi-function.
- HCLK is the system clock,  $f_{HCLK} = 48\text{ MHz}$ ,  $f_{PCLK0,1} = f_{HCLK}$ .
- The result value is calculated by measuring the difference of current consumption between all peripherals clocked off and only one peripheral clocked on

| Peripheral                                                                                       | I <sub>DD</sub> <sup>[*1]</sup> | Unit |
|--------------------------------------------------------------------------------------------------|---------------------------------|------|
| PDMA                                                                                             | 292                             | uA   |
| ISP                                                                                              | 0                               |      |
| HDIV                                                                                             | 53                              |      |
| CRC                                                                                              | 56                              |      |
| SRAM0                                                                                            | 65                              |      |
| WDT                                                                                              | 121                             |      |
| TMR0                                                                                             | 298                             |      |
| TMR1                                                                                             | 251                             |      |
| TMR2                                                                                             | 292                             |      |
| TMR3                                                                                             | 258                             |      |
| CLKO                                                                                             | 61                              |      |
| ACMP01                                                                                           | 358                             |      |
| UART0                                                                                            | 879                             |      |
| UART1                                                                                            | 935                             |      |
| ADC                                                                                              | 483                             |      |
| USCI0                                                                                            | 487                             |      |
| USCI1                                                                                            | 510                             |      |
| DAC                                                                                              | 47                              |      |
| PWM0                                                                                             | 1235                            |      |
| Notes:                                                                                           |                                 |      |
| 1. Guaranteed by characterization results, not tested in production.                             |                                 |      |
| 2. When the ADC is turned on, add an additional power consumption per ADC for the analog part.   |                                 |      |
| 3. When the ACMP is turned on, add an additional power consumption per ACMP for the analog part. |                                 |      |
| 4. When the DAC is turned on, add an additional power consumption per DAC for the analog part.   |                                 |      |

Table 8.3-4 Peripheral Current Consumption

### 8.3.3 Wakeup Time from Low-Power Modes

The wakeup times given in Table 8.3-5 is measured on a wakeup phase with a 48 MHz HIRC oscillator.

| Symbol | Parameter | Typ | Max | Unit |
|--------|-----------|-----|-----|------|
|--------|-----------|-----|-----|------|

|                                                                                                                                                                                                                                                      |                                          |       |   |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------|---|--------|
| $t_{WU\_IDLE}$                                                                                                                                                                                                                                       | Wakeup from IDLE mode                    | 5     | 6 | cycles |
| $t_{WU\_NPD}^{[*1][*2]}$                                                                                                                                                                                                                             | Wakeup from normal Power-down mode       | 65.77 | - |        |
| $t_{WU\_FWPD}^{[*1][*2]}$                                                                                                                                                                                                                            | Wakeup from fast wake up Power-down mode | 1.7   | - |        |
| $t_{ET\_IDLE}$                                                                                                                                                                                                                                       | Enter to IDLE mode                       | 2     | - | cycles |
| $t_{ET\_NPD}$                                                                                                                                                                                                                                        | Enter to normal Power-down mode          | 0.3   | - |        |
| <div>Notes:</div> <div><div>1. Based on test during characterization, not tested in production.</div><div>2. The wakeup times are measured from the wakeup event to the point in which the application code reads the first instruction.</div></div> |                                          |       |   |        |

Table 8.3-5 Low-power Mode Wakeup Timings

### 8.3.4 I/O Current Injection Characteristics

In general, I/O current injection due to external voltages below  $V_{SS}$  or above  $V_{DD}$  should be avoided during normal product operation. However, the analog component of the MCU is most likely to be affected by the injection current, but it is not easily clarified when abnormal injection accidentally happens. It is recommended to add a Schottky diode (pin to ground or pin to  $V_{DD}$ ) to pins that include analog function which may potentially injection currents.

| Symbol         | Parameter                     | Negative injection | Positive injection | Unit | Test Condition                                                                       |
|----------------|-------------------------------|--------------------|--------------------|------|--------------------------------------------------------------------------------------|
| $I_{INJ(PIN)}$ | Injected current by a I/O Pin | -0                 | 0                  | mA   | Injected current on nReset pins                                                      |
|                |                               | -0                 | 0                  |      | Injected current on PA0~PA2, PA4, PA5, PB4~PB7 and PC0~PC7 for analog input function |
|                |                               | -5                 | +5                 |      | Injected current on any other I/O except analog input pin                            |

Table 8.3-6 I/O Current Injection Characteristics

### 8.3.5 I/O DC Characteristics

#### 8.3.5.1 PIN Input Characteristics

| Symbol                                                                                                                                                                    | Parameter                            | Min                | Typ                | Max                | Unit          | Test Conditions                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------|--------------------|--------------------|---------------|-----------------------------------------------------------------------------------------------|
| $V_{IL}$                                                                                                                                                                  | Input low voltage (Schmitt trigger)  | 0                  | -                  | $0.3 \cdot V_{DD}$ | V             |                                                                                               |
|                                                                                                                                                                           | Input low voltage (TTL trigger)      | 0                  | -                  | 0.8                |               | $V_{DD} = 4.5\text{ V}$                                                                       |
|                                                                                                                                                                           |                                      | 0                  | -                  | 0.7                |               | $V_{DD} = 2.7\text{ V}$                                                                       |
|                                                                                                                                                                           |                                      | 0                  | -                  | 0.5                |               | $V_{DD} = 2.4\text{ V}$                                                                       |
| $V_{IH}$                                                                                                                                                                  | Input high voltage (Schmitt trigger) | $0.7 \cdot V_{DD}$ | -                  | $V_{DD}$           | V             |                                                                                               |
|                                                                                                                                                                           | Input high voltage (TTL trigger)     | 2                  | -                  | $V_{DD}$           |               | $V_{DD} = 5.5\text{ V}$                                                                       |
|                                                                                                                                                                           |                                      | 1.5                | -                  | $V_{DD}$           |               | $V_{DD} = 3.3\text{ V}$                                                                       |
|                                                                                                                                                                           |                                      | 0.8                | -                  | $V_{DD}$           |               | $V_{DD} = 2.4\text{ V}$                                                                       |
| $V_{HY}^{[1]}$                                                                                                                                                            | Hysteresis voltage of schmitt input  | -                  | $0.2 \cdot V_{DD}$ | -                  | V             |                                                                                               |
| $I_{LK}^{[2]}$                                                                                                                                                            | Input leakage current                | -1                 | -                  | 1                  | $\mu\text{A}$ | $V_{SS} < V_{IN} < V_{DD}$ ,<br>Open-drain or input only mode                                 |
|                                                                                                                                                                           |                                      | -1                 | -                  | 1                  |               | $V_{DD} < V_{IN} < 5\text{ V}$ , Open-drain or input only mode on any other 5v tolerance pins |
| $R_{PU}^{[1]}$                                                                                                                                                            | Pull up resistor                     | 84.12              | -                  | 87.26              | k $\Omega$    | $V_{DD} = 5.5\text{ V}$                                                                       |
| <b>Notes:</b><br>1. Guaranteed by characterization result, not tested in production.<br>2. Leakage could be higher than the maximum value, if abnormal injection happens. |                                      |                    |                    |                    |               |                                                                                               |

Table 8.3-7 I/O Input Characteristics

### 8.3.5.2 I/O Output Characteristics

| Symbol                                                                                                                                                                                                                                                                                                                                                       | Parameter                                                  | Min     | Typ | Max     | Unit    | Test Conditions                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|---------|-----|---------|---------|-------------------------------------------------|
| $I_{SR}^{[*1][*2]}$                                                                                                                                                                                                                                                                                                                                          | Source current for quasi-bidirectional mode and high level | -561.14 | -   | -606.28 | $\mu A$ | $V_{DD} = 4.5 V$<br>$V_{IN} = (V_{DD} - 0.4) V$ |
|                                                                                                                                                                                                                                                                                                                                                              |                                                            | -97.30  | -   | -108.50 | $\mu A$ | $V_{DD} = 3.0 V$<br>$V_{IN} = (V_{DD} - 0.4) V$ |
|                                                                                                                                                                                                                                                                                                                                                              | Source current for push-pull mode and high level           | -22.85  | -   | -28.14  | mA      | $V_{DD} = 4.5 V$<br>$V_{IN} = (V_{DD} - 0.4) V$ |
|                                                                                                                                                                                                                                                                                                                                                              |                                                            | -5.95   | -   | -7.64   | mA      | $V_{DD} = 3.0 V$<br>$V_{IN} = (V_{DD} - 0.4) V$ |
| $I_{SK}^{[*1][*2]}$                                                                                                                                                                                                                                                                                                                                          | Sink current for push-pull mode and low level              | 12.73   | -   | 15.26   | mA      | $V_{DD} = 4.5 V$<br>$V_{IN} = 0.45 V$           |
|                                                                                                                                                                                                                                                                                                                                                              |                                                            | 9.23    | -   | 10.79   | mA      | $V_{DD} = 3.0 V$<br>$V_{IN} = 0.45 V$           |
| $C_{IO}^{[*1]}$                                                                                                                                                                                                                                                                                                                                              | I/O pin capacitance                                        | -       | 5   | -       | pF      |                                                 |
| <b>Notes:</b> <ol style="list-style-type: none"> <li>Guaranteed by characterization result, not tested in production.</li> <li>The <math>I_{SR}</math> and <math>I_{SK}</math> must always respect the absolute maximum current and the sum of I/O, CPU and peripheral must not exceed <math>\Sigma I_{DD}</math> and <math>\Sigma I_{SS}</math>.</li> </ol> |                                                            |         |     |         |         |                                                 |

Table 8.3-8 I/O Output Characteristics

### 8.3.5.3 nRESET Input Characteristics

| Symbol                                                                                                                                                                                                              | Parameter                        | Min                 | Typ | Max                 | Unit | Test Conditions              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---------------------|-----|---------------------|------|------------------------------|
| V <sub>ILR</sub>                                                                                                                                                                                                    | Negative going threshold, nRESET | 0                   | -   | 0.3*V <sub>DD</sub> | V    |                              |
| V <sub>IHR</sub>                                                                                                                                                                                                    | Positive going threshold, nRESET | 0.7*V <sub>DD</sub> | -   | V <sub>DD</sub>     | V    |                              |
| R <sub>RST</sub> <sup>[*1]</sup>                                                                                                                                                                                    | Internal nRESET pull up resistor | 42.2                |     | 45.7                | kΩ   |                              |
| t <sub>FR</sub> <sup>[*1]</sup>                                                                                                                                                                                     | nRESET input filtered pulse time | -                   | 24  | -                   | μS   | Normal run and Idle mode     |
|                                                                                                                                                                                                                     |                                  | -                   | 24  | -                   |      | Fast wake up Power-down mode |
|                                                                                                                                                                                                                     |                                  | 75                  | -   | 155                 |      | Power-down mode              |
| <b>Notes:</b> <div><div>1. Guaranteed by characterization result, not tested in production.</div><div>2. It is recommended to add a 10 kΩ and 10uF capacitor at nRESET pin to keep reset signal stable.</div></div> |                                  |                     |     |                     |      |                              |

Table 8.3-9 nRESET Input Characteristics

## 8.4 AC Electrical Characteristics

### 8.4.1 48 MHz Internal High Speed RC Oscillator (HIRC)

The 48 MHz RC oscillator is calibrated in production.

| Symbol.                                                                                                                                                               | Parameter                                    | Min               | Typ | Max              | Unit          | Test Conditions                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------|-----|------------------|---------------|------------------------------------------------------------------------------------------------------------|
| $V_{DD}$                                                                                                                                                              | Operating voltage                            | 2.4               | -   | 5.5              | V             |                                                                                                            |
| $f_{HIRC}$                                                                                                                                                            | Oscillator frequency                         | 47.52             | 48  | 48.48            | MHz           | $T_A = 25\text{ }^{\circ}\text{C}$ ,<br>$V_{DD} = 3.3\text{V}$                                             |
|                                                                                                                                                                       | Frequency drift over temperature and voltage | -1                | -   | 1                | %             | $T_A = 25\text{ }^{\circ}\text{C}$ ,<br>$V_{DD} = 3.3\text{V}$                                             |
|                                                                                                                                                                       |                                              | -2 <sup>[1]</sup> | -   | 2 <sup>[1]</sup> | %             | $T_A = -40\text{ }^{\circ}\text{C} \sim +125\text{ }^{\circ}\text{C}$ ,<br>$V_{DD} = 2.4 \sim 5.5\text{V}$ |
| $I_{HIRC}$ <sup>[1]</sup>                                                                                                                                             | Operating current                            |                   | 471 |                  | $\mu\text{A}$ |                                                                                                            |
| $T_S$ <sup>[2]</sup>                                                                                                                                                  | Stable time                                  |                   | 5   |                  | $\mu\text{s}$ | $T_A = -40\text{ }^{\circ}\text{C} \sim +125\text{ }^{\circ}\text{C}$ ,<br>$V_{DD} = 2.4 \sim 5.5\text{V}$ |
| <b>Notes:</b> <ol style="list-style-type: none"> <li>1. Guaranteed by characterization result, not tested in production.</li> <li>2. Guaranteed by design.</li> </ol> |                                              |                   |     |                  |               |                                                                                                            |

Table 8.4-1 48 MHz Internal High Speed RC Oscillator(HIRC) Characteristics

8.4.3 38.4 kHz Internal Low Speed RC Oscillator (LIRC)

| Symbol                                                                                                                                                                          | Parameter                                    | Min <sup>[*1]</sup> | Typ  | Max <sup>[*1]</sup> | Unit | Test Conditions                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------|------|---------------------|------|-------------------------------------------------------------------------------------------|
| V <sub>DD</sub>                                                                                                                                                                 | Operating voltage                            | 2.4                 | -    | 5.5                 | V    |                                                                                           |
| F <sub>LRC</sub> <sup>[*2]</sup>                                                                                                                                                | Oscillator frequency                         | -                   | 38.4 | -                   | kHz  | T <sub>A</sub> = 25 °C,<br>V <sub>DD</sub> = 3.3V                                         |
|                                                                                                                                                                                 | Frequency drift over temperature and voltage | -2                  | -    | 2                   | %    | T <sub>A</sub> = 25 °C,<br>V <sub>DD</sub> = 3.3V                                         |
|                                                                                                                                                                                 |                                              | -15                 | -    | 15                  | %    | T <sub>A</sub> = -40~125°C<br>V <sub>DD</sub> = 2.4V~5.5V<br>Without software calibration |
| I <sub>LRC</sub>                                                                                                                                                                | Operating current                            |                     | 1.1  |                     | μA   | V <sub>DD</sub> = 3.3V                                                                    |
| T <sub>S</sub>                                                                                                                                                                  | Stable time                                  |                     | 500  |                     | μs   | T <sub>A</sub> = -40~125°C<br>V <sub>DD</sub> = 2.4V~5.5V                                 |
| <b>Notes:</b><br>1. Guaranteed by characterization, not tested in production.<br>2. The 38.4 kHz low speed RC oscillator can be calibrated by user.<br>3. Guaranteed by design. |                                              |                     |      |                     |      |                                                                                           |

Table 8.4-2 38.4 kHz Internal Low Speed RC Oscillator(LIRC) Characteristics

#### 8.4.4 External 4~24 MHz High Speed Crystal Resonator (HXT) characteristics

The high-speed external (HXT) clock can be supplied with a 4 to 24 MHz crystal oscillator. All the information given in this section are based on characterization results obtained with typical external components. In the application, the external components have to be placed as close as possible to the XT1\_IN and XT1\_Out pins and must not be connected to any other devices in order to minimize output distortion and startup stabilization time. Refer to the crystal resonator manufacturer for more details on the resonator characteristics (frequency, package, accuracy).

| Symbol                                                                        | Parameter                  | Min <sup>[*1]</sup> | Typ  | Max <sup>[*1]</sup> | Unit | Test Conditions                                                                                      |
|-------------------------------------------------------------------------------|----------------------------|---------------------|------|---------------------|------|------------------------------------------------------------------------------------------------------|
| V <sub>DD</sub>                                                               | Operating voltage          | 2.4                 | -    | 5.5                 | V    |                                                                                                      |
| R <sub>f</sub>                                                                | Internal feedback resistor | -                   | 1    | -                   | MΩ   |                                                                                                      |
| f <sub>HXT</sub>                                                              | Oscillator frequency       | 4                   | -    | 24                  | MHz  |                                                                                                      |
| I <sub>HXT</sub>                                                              | Current consumption        | -                   | 250  | 600                 | μA   | 4 MHz, Gain = L0, C <sub>L</sub> = 12.5 pF, DIP                                                      |
|                                                                               |                            | -                   | 380  | 980                 |      | 12 MHz, Gain = L1, C <sub>L</sub> = 12.5 pF, DIP                                                     |
|                                                                               |                            | -                   | 400  | 1050                |      | 16 MHz, Gain = L2, C <sub>L</sub> = 12.5 pF, DIP                                                     |
|                                                                               |                            | -                   | 750  | 2050                |      | 24 MHz, Gain = L3, C <sub>L</sub> = 12.5 pF, DIP<br>12 MHz, Gain = L3, C <sub>L</sub> = 12.5 pF, SMD |
|                                                                               |                            | -                   | 1400 | 3500                |      | 16 MHz, Gain = L4, C <sub>L</sub> = 12.5 pF, SMD                                                     |
|                                                                               |                            | -                   | 2100 | 5100                |      | 24 MHz, Gain = L7, C <sub>L</sub> = 12.5 pF, SMD                                                     |
| T <sub>S</sub>                                                                | Stable time                | -                   | 2400 | 2700                | μS   | 4 MHz, Gain = L0, C <sub>L</sub> = 12.5 pF, DIP                                                      |
|                                                                               |                            | -                   | 600  | 680                 |      | 12 MHz, Gain = L1, C <sub>L</sub> = 12.5 pF, DIP                                                     |
|                                                                               |                            | -                   | 400  | 500                 |      | 16 MHz, Gain = L2, C <sub>L</sub> = 12.5 pF, DIP                                                     |
|                                                                               |                            | -                   | 380  | 470                 |      | 24 MHz, Gain = L3, C <sub>L</sub> = 12.5 pF, DIP                                                     |
|                                                                               |                            | -                   | 2000 | 2200                |      | 12 MHz, Gain = L3, C <sub>L</sub> = 12.5 pF, SMD                                                     |
|                                                                               |                            | -                   | 1900 | 2500                |      | 16 MHz, Gain = L4, C <sub>L</sub> = 12.5 pF, SMD                                                     |
|                                                                               |                            | -                   | 1400 | 1900                |      | 24 MHz, Gain = L7, C <sub>L</sub> = 12.5 pF, SMD                                                     |
| D <sub>U<sub>HXT</sub></sub>                                                  | Duty cycle                 | 40                  | -    | 60                  | %    |                                                                                                      |
| V <sub>pp</sub>                                                               | Peak-to-peak amplitude     | 0.7                 | 1    | -                   | V    |                                                                                                      |
| <b>Notes:</b><br>1. Guaranteed by characterization, not tested in production. |                            |                     |      |                     |      |                                                                                                      |

Table 8.4-3 External 4~24 MHz High Speed Crystal (HXT) Oscillator

| Symbol | Parameter                       | Min <sup>[*1]</sup> | Typ | Max <sup>[*1]</sup> | Unit | Test Conditions                                           |
|--------|---------------------------------|---------------------|-----|---------------------|------|-----------------------------------------------------------|
| Rs     | Equivalent series resisotr(ESR) | -                   | -   | 120                 | Ω    | Crystal @4 MHz, C <sub>L</sub> = 12.5 pF, Gain = L0, DIP  |
|        |                                 | -                   | -   | 50                  |      | Crystal @12 MHz, C <sub>L</sub> = 12.5 pF, Gain = L1, DIP |
|        |                                 | -                   | -   | 30                  |      | Crystal @16 MHz, C <sub>L</sub> = 12.5 pF, Gain = L2, DIP |
|        |                                 | -                   | -   | 25                  |      | Crystal @24 MHz, C <sub>L</sub> = 12.5 pF, Gain = L3, DIP |
|        |                                 | -                   | -   | 120                 |      | Crystal @12 MHz, C <sub>L</sub> = 12.5 pF, Gain = L3, SMD |
|        |                                 | -                   | -   | 100                 |      | Crystal @16 MHz, C <sub>L</sub> = 12.5 pF, Gain = L4, SMD |
|        |                                 | -                   | -   | 50                  |      | Crystal @24 MHz, C <sub>L</sub> = 12.5 pF, Gain = L7, SMD |

Notes:

1. Guaranteed by characterization, not tested in production.
2. Safety factor (S<sub>f</sub>) must be higher than 5 for HXT to determine the oscillator safe operation during the application life. If Safety factor isn't enough, the HXT gain need be changed to higher driving level.

$$S_f = \frac{-R}{Crystal\ ESR} = \frac{R_{ADD} + R_S}{R_S}$$

R<sub>ADD</sub>: The value of smallest series resistance preventing the oscillator from starting up successfully. This resistance is only used to measure Safety factor (S<sub>f</sub>) of crystal in engineer stage, not for mass produciton.

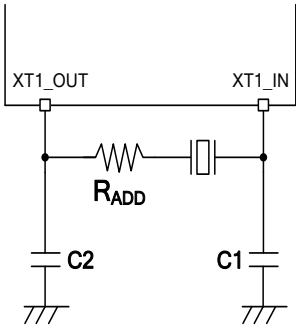


Table 8.4-4 External 4~24 MHz High Speed Crystal Characteristics

8.4.4.1 Typical Crystal Application Circuits

For C1 and C2, it is recommended to use high-quality external ceramic capacitors in 10 pF ~ 20 pF range, designed for high-frequency applications, and selected to match the requirements of the crystal or resonator. The crystal manufacturer typically specifies a load capacitance which is the series combination of C1 and C2. PCB and MCU pin capacitance must be included (8 pF can be used as a rough estimate of the combined pin and board capacitance) when sizing C1 and C2.

| CRYSTAL        | C1         | C2         | R1      |
|----------------|------------|------------|---------|
| 4 MHz ~ 24 MHz | 10 ~ 20 pF | 10 ~ 20 pF | without |



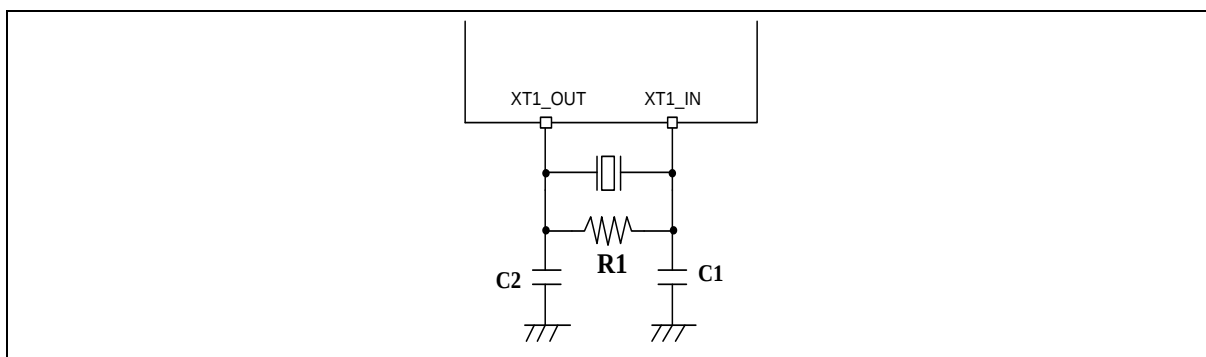


Figure 8.4-1 Typical Crystal Application Circuit

### 8.4.5 External 4~24 MHz High Speed Clock Input Signal Characteristics

For clock input mode the HXT oscillator is switched off and XT1\_IN is a standard input pin to receive external clock. The external clock signal has to respect the below Table. The characteristics result from tests performed using a waveform generator.

| Symbol                | Parameter                            | Min <sup>[*1]</sup>       | Typ | Max <sup>[*1]</sup>       | Unit | Test Conditions                         |
|-----------------------|--------------------------------------|---------------------------|-----|---------------------------|------|-----------------------------------------|
| $f_{\text{HXT\_ext}}$ | External user clock source frequency | 1                         | -   | 24                        | MHz  |                                         |
| $t_{\text{CHCX}}$     | Clock high time                      | 8                         | -   | -                         | nS   |                                         |
| $t_{\text{CLCX}}$     | Clock low time                       | 8                         | -   | -                         | nS   |                                         |
| $t_{\text{CLCH}}$     | Clock rise time                      | -                         | -   | 10                        | nS   | Low (10%) to high level (90%) rise time |
| $t_{\text{CHCL}}$     | Clock fall time                      | -                         | -   | 10                        | nS   | High (90%) to low level (10%) fall time |
| $Du_{\text{E\_HXT}}$  | Duty cycle                           | 40                        | -   | 60                        | %    |                                         |
| $V_{\text{IH}}$       | Input high voltage                   | $0.7 \cdot V_{\text{DD}}$ | -   | $V_{\text{DD}}$           | V    |                                         |
| $V_{\text{IL}}$       | Input low voltage                    | $V_{\text{SS}}$           | -   | $0.3 \cdot V_{\text{DD}}$ | V    |                                         |

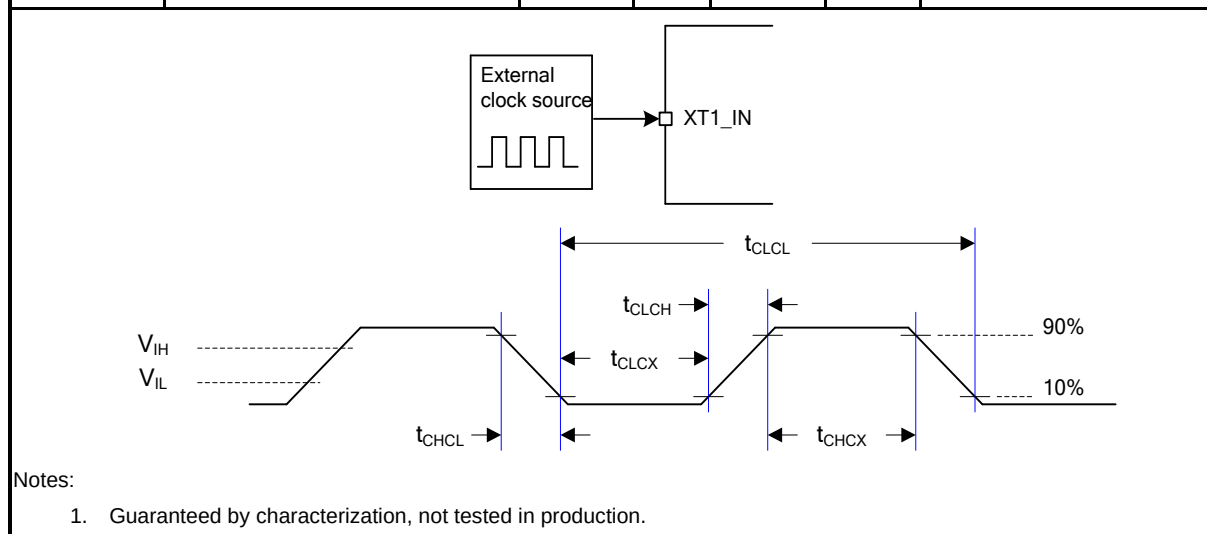


Table 8.4-5 External 4~24 MHz High Speed Clock Input Signal

### 8.4.6 External 32.768 kHz Low Speed Crystal (LXT) characteristics

The low-speed external (LXT) clock can be supplied with a 32.768 kHz crystal oscillator. All the information given in this section are based on characterization results obtained with typical external components. In the application, the external components have to be placed as close as possible to the X32\_OUT and X32\_IN pins and must not be connected to any other devices in order to minimize output distortion and startup stabilization time. Refer to the crystal resonator manufacturer for more details on the resonator characteristics (frequency, package, accuracy).

| Symbol                                                       | Parameter                  | Min <sup>[1]</sup> | Typ  | Max <sup>[1]</sup> | Unit | Test Conditions                                |
|--------------------------------------------------------------|----------------------------|--------------------|------|--------------------|------|------------------------------------------------|
| V <sub>DD</sub>                                              | Operation voltage          | 2.4                | -    | 5.5                | V    |                                                |
| T <sub>LXT</sub>                                             | Temperature range          | -40                | -    | 125                | °C   |                                                |
| R <sub>f</sub>                                               | Internal feedback resistor | -                  | 15   | -                  | MΩ   |                                                |
| F <sub>LXT</sub>                                             | Oscillator frequency       | 32.768             |      |                    | kHz  |                                                |
| I <sub>LXT</sub>                                             | Current consumption        | -                  | 0.55 | 4.4                | μA   | ESR=35 kΩ, C <sub>L</sub> = 12.5 pF, Gain = L0 |
|                                                              |                            | -                  | 0.65 | 4.6                |      | ESR=35 kΩ, C <sub>L</sub> = 12.5 pF, Gain = L1 |
|                                                              |                            | -                  | 0.72 | 4.8                |      | ESR=35 kΩ, C <sub>L</sub> = 12.5 pF, Gain = L2 |
|                                                              |                            | -                  | 0.9  | 5.2                |      | ESR=70 kΩ, C <sub>L</sub> = 12.5 pF, Gain = L3 |
|                                                              |                            | -                  | 1    | 5.4                |      | ESR=70 kΩ, C <sub>L</sub> = 12.5 pF, Gain = L4 |
|                                                              |                            | -                  | 1.1  | 5.6                |      | ESR=70 kΩ, C <sub>L</sub> = 12.5 pF, Gain = L5 |
|                                                              |                            | -                  | 1.3  | 6.0                |      | ESR=90 kΩ, C <sub>L</sub> = 12.5 pF, Gain = L6 |
|                                                              |                            | -                  | 1.6  | 6.6                |      | ESR=90 kΩ, C <sub>L</sub> = 12.5 pF, Gain = L7 |
| T <sub>S<sub>LXT</sub></sub>                                 | Stable time                | -                  | 1    | -                  | S    |                                                |
| D <sub>U<sub>LXT</sub></sub>                                 | Duty cycle                 | 30                 | -    | 70                 | %    |                                                |
| V <sub>pp</sub>                                              | Peak-to-peak amplitude     | -                  | 0.5  | -                  | V    |                                                |
| Notes:                                                       |                            |                    |      |                    |      |                                                |
| 1. Guaranteed by characterization, not tested in production. |                            |                    |      |                    |      |                                                |

Table 8.4-6 External 32.768 kHz Low Speed Crystal (LXT) Oscillator

| Symbol         | Parameter                        | Min | Typ | Max | Unit | Test Conditions     |
|----------------|----------------------------------|-----|-----|-----|------|---------------------|
| R <sub>s</sub> | Equivalent Series Resistor (ESR) | -   | 35  | 90  | kΩ   | Crystal @32.768 kHz |

Table 8.4-7 External 32.768 kHz Low Speed Crystal Characteristics

#### 8.4.6.1 Typical Crystal Application Circuits

| CRYSTAL                 | C1        | C2        | R1      |
|-------------------------|-----------|-----------|---------|
| 32.768 kHz, ESR < 70 KΩ | 5 ~ 20 pF | 5 ~ 20 pF | without |

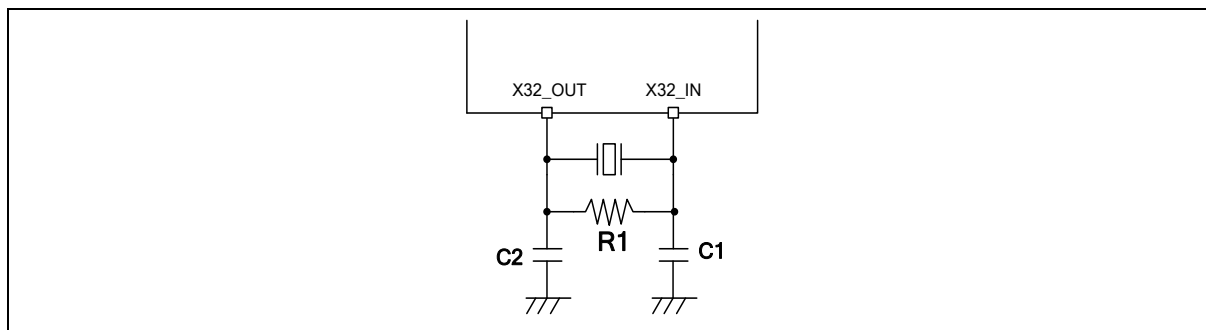


Figure 8.4-2 Typical 32.768 kHz Crystal Application Circuit

#### 8.4.7 External 32.768 kHz Low Speed Clock Input Signal Characteristics

For clock input mode the LXT oscillator is switched off and X32\_IN is a standard input pin to receive external clock. The external clock signal has to respect the below Table. The characteristics result from tests performed using a waveform generator.

| Symbol         | Parameter                        | Min <sup>[1]</sup> | Typ    | Max <sup>[1]</sup> | Unit | Test Conditions                         |
|----------------|----------------------------------|--------------------|--------|--------------------|------|-----------------------------------------|
| $f_{LXT\_ext}$ | External clock source frequency  | -                  | 32.768 | -                  | kHz  |                                         |
| $t_{CHCX}$     | Clock high time                  | 450                | -      | -                  | nS   |                                         |
| $t_{CLCX}$     | Clock low time                   | 450                | -      | -                  | nS   |                                         |
| $t_{CLCH}$     | Clock rise time                  | -                  | -      | 50                 | nS   | Low (10%) to high level (90%) rise time |
| $t_{CHCL}$     | Clock fall time                  | -                  | -      | 50                 | nS   | High (90%) to low level (10%) fall time |
| $Du_{E\_LXT}$  | Duty cycle                       | 30                 | -      | 70                 | %    |                                         |
| $Xin\_VIH$     | LXT input pin input high voltage | $0.7 \cdot V_{DD}$ | -      | $V_{DD}$           | V    |                                         |
| $Xin\_VIL$     | LXT input pin input low voltage  | $V_{SS}$           | -      | $0.3 \cdot V_{DD}$ | V    |                                         |

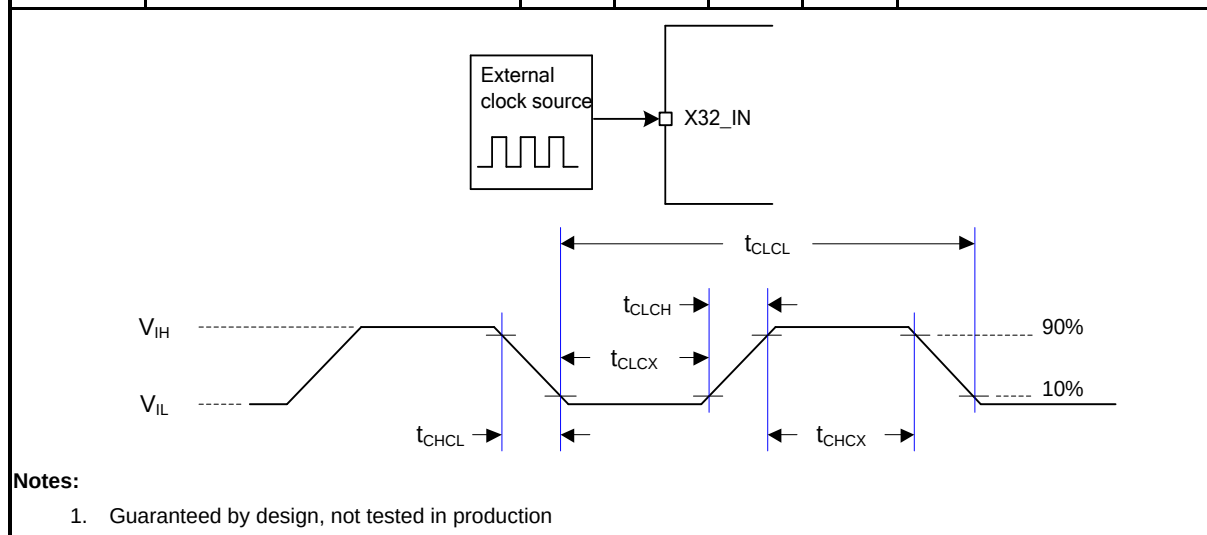


Table 8.4-8 External 32.768 kHz Low Speed Clock Input Signal

# 8.4.8 I/O AC Characteristics

| Symbol                    | Parameter                                                            | Typ. | Max <sup>[*1]</sup> | Unit | Test Conditions <sup>[*2]</sup>                                                   |
|---------------------------|----------------------------------------------------------------------|------|---------------------|------|-----------------------------------------------------------------------------------|
| $t_{f(I/O)out}$           | Output high (90%) to low level (10%) fall time<br>(Normal Slew Rate) | -    | 7.62                | nS   | $C_L = 30 \text{ pF}, V_{DD} \geq 4.5 \text{ V}$                                  |
|                           |                                                                      | -    | 5.32                |      | $C_L = 10 \text{ pF}, V_{DD} \geq 4.5 \text{ V}$                                  |
|                           |                                                                      | -    | 12.69               |      | $C_L = 30 \text{ pF}, V_{DD} \geq 2.7 \text{ V}$                                  |
|                           |                                                                      | -    | 9.33                |      | $C_L = 10 \text{ pF}, V_{DD} \geq 2.7 \text{ V}$                                  |
|                           |                                                                      | -    | 13.87               |      | $C_L = 30 \text{ pF}, V_{DD} \geq 2.4\text{V}$                                    |
|                           |                                                                      | -    | 10.10               |      | $C_L = 10 \text{ pF}, V_{DD} \geq 2.4 \text{ V}$                                  |
|                           | Output high (90%) to low level (10%) fall time<br>(High Slew Rate)   | -    | 6.89                |      | $C_L = 30 \text{ pF}, V_{DD} \geq 4.5 \text{ V}$                                  |
|                           |                                                                      | -    | 4.25                |      | $C_L = 10 \text{ pF}, V_{DD} \geq 4.5 \text{ V}$                                  |
|                           |                                                                      | -    | 11.90               |      | $C_L = 30 \text{ pF}, V_{DD} \geq 2.7 \text{ V}$                                  |
|                           |                                                                      | -    | 7.47                |      | $C_L = 10 \text{ pF}, V_{DD} \geq 2.7 \text{ V}$                                  |
| $f_{\max(I/O)out}^{[*3]}$ | I/O maximum frequency<br>(Normal Slew Rate)                          | -    | 45.95               | MHz  | $C_L = 30 \text{ pF}, V_{DD} \geq 4.5 \text{ V}$                                  |
|                           |                                                                      | -    | 69.66               |      | $C_L = 10 \text{ pF}, V_{DD} \geq 4.5 \text{ V}$                                  |
|                           |                                                                      | -    | 27.11               |      | $C_L = 30 \text{ pF}, V_{DD} \geq 2.7 \text{ V}$                                  |
|                           |                                                                      | -    | 39.68               |      | $C_L = 10 \text{ pF}, V_{DD} \geq 2.7 \text{ V}$                                  |
| $I_{DIO}^{[*4]}$          | I/O dynamic current consumption                                      | 2.77 | -                   | mA   | $C_L = 30 \text{ pF}, V_{DD} = 3.3 \text{ V},$<br>$f_{(I/O)out} = 24 \text{ MHz}$ |
|                           |                                                                      | 1.19 | -                   |      | $C_L = 10 \text{ pF}, V_{DD} = 3.3 \text{ V},$<br>$f_{(I/O)out} = 24 \text{ MHz}$ |
|                           |                                                                      | 0.69 | -                   |      | $C_L = 30 \text{ pF}, V_{DD} = 3.3 \text{ V},$<br>$f_{(I/O)out} = 6 \text{ MHz}$  |
|                           |                                                                      | 0.3  | -                   |      | $C_L = 10 \text{ pF}, V_{DD} = 3.3 \text{ V},$<br>$f_{(I/O)out} = 6 \text{ MHz}$  |

Notes:

1. Guaranteed by characterization result, not tested in production.

2.  $C_L$  is a external capacitive load to simulate PCB and device loading.

3. The maximum frequency is defined by  $f_{max} = \frac{2}{3 \times (t_f + t_r)}$ .

4. The I/O dynamic current consumption is defined by  $I_{DIO} = V_{DD} \times f_{IO} \times (C_{IO} + C_L)$

Table 8.4-9 I/O AC Characteristics

## 8.5 Analog Characteristics

### 8.5.1 LDO

| Symbol                                                                                                                                                                                                                                                                                                                                                                                                                   | Parameter      | Min | Typ | Max | Unit | Test Condition |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----|-----|-----|------|----------------|
| V <sub>DD</sub>                                                                                                                                                                                                                                                                                                                                                                                                          | Power supply   | 2.4 | -   | 5.5 | V    |                |
| V <sub>LDO</sub>                                                                                                                                                                                                                                                                                                                                                                                                         | Output voltage | -   | 1.8 | -   | V    |                |
| T <sub>A</sub>                                                                                                                                                                                                                                                                                                                                                                                                           | Temperature    | -40 | -   | 125 | °C   |                |
| <b>Notes:</b> <ol style="list-style-type: none"> <li>1. It is recommended a 0.1μF bypass capacitor is connected between V<sub>DD</sub> and the closest V<sub>SS</sub> pin of the device.</li> <li>2. For ensuring power stability, a 1μF capacitor must be connected between LDO_CAP pin and the closest V<sub>SS</sub> pin of the device.</li> <li>3. V<sub>LDO</sub> is only used to supply internal power.</li> </ol> |                |     |     |     |      |                |

### 8.5.2 Reset and Power Control Block Characteristics

The parameters in below table are derived from tests performed under ambient temperature.

| Symbol                              | Parameter                                   | Min  | Typ   | Max  | Unit | Test Conditions                               |
|-------------------------------------|---------------------------------------------|------|-------|------|------|-----------------------------------------------|
| I <sub>POR</sub> <sup>[*1]</sup>    | POR operating current                       | -    | 10    | 20   | μA   | V <sub>DD</sub> = 3.3V                        |
| I <sub>LVR</sub> <sup>[*1]</sup>    | LVR operating current                       | -    | 0.7   | 1    |      | V <sub>DD</sub> = 3.3V                        |
| I <sub>BOD</sub> <sup>[*1]</sup>    | BOD operating current                       | -    | 10    |      |      | V <sub>DD</sub> = 3.3V, Normal mode           |
|                                     |                                             | -    | 1     |      |      | V <sub>DD</sub> = 3.3V, Enable Low Power mode |
| V <sub>POR</sub>                    | POR reset voltage                           | 2.10 | 2.20  | 2.30 | V    |                                               |
| V <sub>LVR</sub>                    | LVR reset voltage                           | 2.12 | 2.22  | 2.32 |      |                                               |
| V <sub>BOD</sub>                    | BOD brown-out detect voltage (Falling edge) | 2.15 | 2.30  | 2.45 |      | BODVL = 0                                     |
|                                     |                                             | 2.55 | 2.70  | 2.85 |      | BODVL = 1                                     |
|                                     |                                             | 3.45 | 3.70  | 3.95 |      | BODVL = 2                                     |
|                                     |                                             | 4.15 | 4.40  | 4.65 |      | BODVL = 3                                     |
|                                     | BOD brown-out detect voltage (Rising edge)  | 2.23 | 2.38  | 2.53 |      | BODVL = 0                                     |
|                                     |                                             | 2.63 | 2.78  | 2.93 |      | BODVL = 1                                     |
|                                     |                                             | 3.53 | 3.78  | 4.03 |      | BODVL = 2                                     |
|                                     |                                             | 4.23 | 4.48  | 4.73 |      | BODVL = 3                                     |
| T <sub>LVR_SU</sub> <sup>[*1]</sup> | LVR startup time                            | -    | 200   | TBD  | μS   | -                                             |
| T <sub>LVR_RE</sub> <sup>[*1]</sup> | LVR respond time                            | -    | 20    | 100  |      | -                                             |
| T <sub>BOD_SU</sub> <sup>[*1]</sup> | BOD startup time                            | -    | 1000  | TBD  |      | -                                             |
| T <sub>BOD_RE</sub> <sup>[*1]</sup> | BOD respond time                            | -    | 100   |      |      | Normal mode                                   |
|                                     |                                             | -    | 11200 | TBD  |      | Low Power mode                                |
| R <sub>VDDR</sub> <sup>[*1]</sup>   | V <sub>DD</sub> rise time rate              | 10   | -     | -    | μS/V | POR Enabled                                   |
| R <sub>VDDF</sub> <sup>[*1]</sup>   | V <sub>DD</sub> fall time rate              | 10   | -     | -    |      | POR Enabled                                   |

|                                                                                                                                      |  |         |   |   |  |                                  |
|--------------------------------------------------------------------------------------------------------------------------------------|--|---------|---|---|--|----------------------------------|
|                                                                                                                                      |  | 833.33  | - | - |  | LVR Enabled                      |
|                                                                                                                                      |  | 500     | - | - |  | BOD 2.3V Enabled, Normal mode    |
|                                                                                                                                      |  | 166.67  | - | - |  | BOD 2.7V Enabled, Normal mode    |
|                                                                                                                                      |  | 62.5    | - | - |  | BOD 3.7V Enabled, Normal mode    |
|                                                                                                                                      |  | 43.49   | - | - |  | BOD 4.4V Enabled, Normal mode    |
|                                                                                                                                      |  | 55600   | - | - |  | BOD 2.3V Enabled, Low Power mode |
|                                                                                                                                      |  | 18533   | - | - |  | BOD 2.7V Enabled, Low Power mode |
|                                                                                                                                      |  | 6950    | - | - |  | BOD 3.7V Enabled, Low Power mode |
|                                                                                                                                      |  | 4834.79 | - | - |  | BOD 4.4V Enabled, Low Power mode |
| <b>Notes:</b> <div>1. Guaranteed by characterization, not tested in production.</div> <div>2. Design for specified applcaiton.</div> |  |         |   |   |  |                                  |

Table 8.5-1 Reset and Power Control Unit

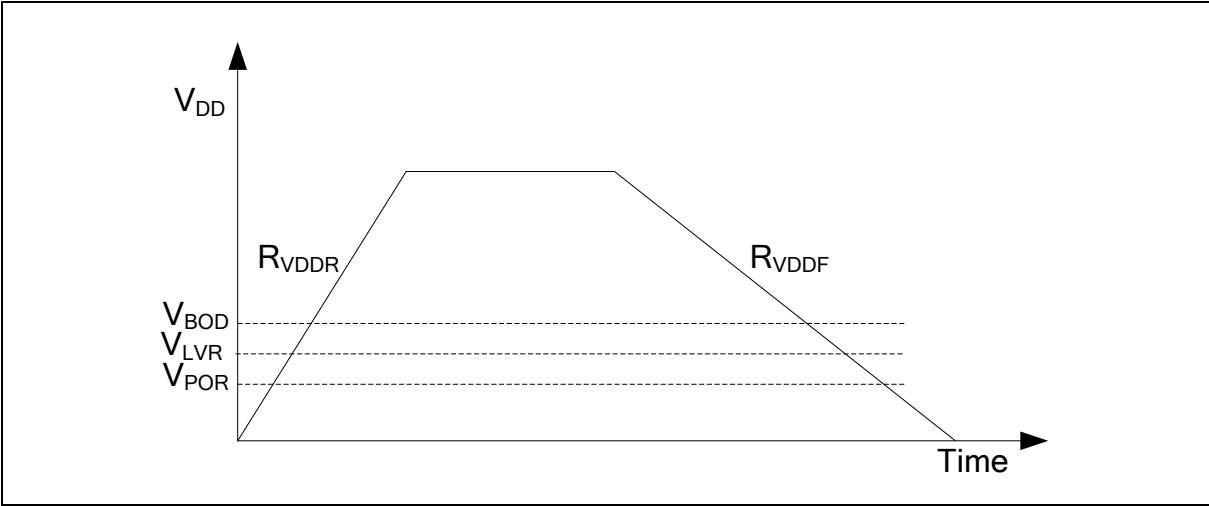


Figure 8.5-1 Power Ramp Up/Down Condition



**8.5.3 12-bit SAR Analog To Digital Converter (ADC)**

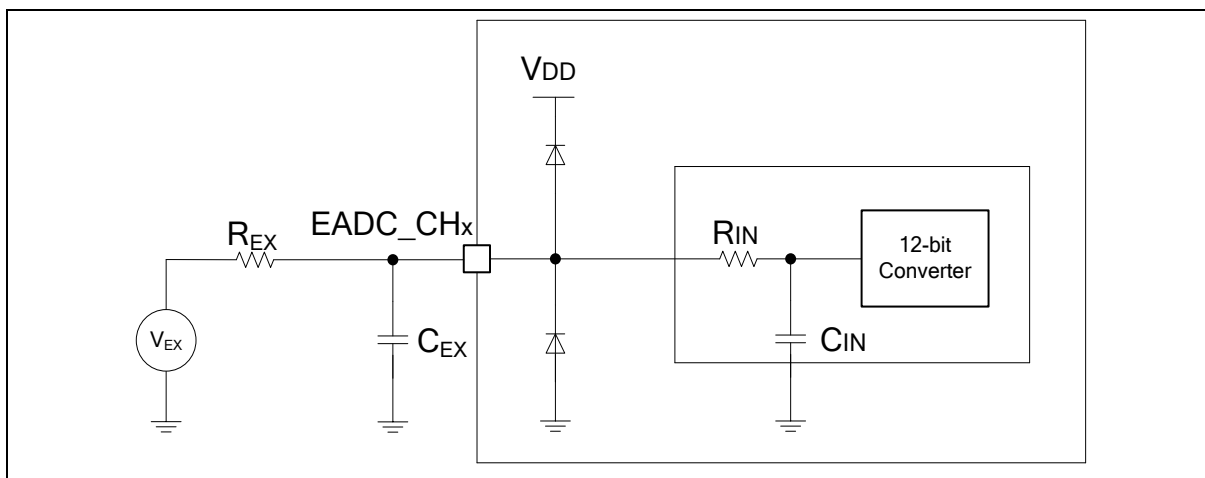
| Symbol                         | Parameter                                           | Min   | Typ | Max       | Unit        | Test Conditions                                                                             |
|--------------------------------|-----------------------------------------------------|-------|-----|-----------|-------------|---------------------------------------------------------------------------------------------|
| $T_A$                          | Temperature                                         | -40   | -   | 125       | °C          |                                                                                             |
| $V_{DD}$                       | Analog operating voltage                            | 2.4   | -   | 5.5       | V           | $V_{DD}$                                                                                    |
| $V_{REF}$                      | Reference voltage                                   | 2.4   | -   | $V_{DD}$  | V           |                                                                                             |
| $V_{IN}$                       | ADC channel input voltage                           | 0     | -   | $V_{REF}$ | V           |                                                                                             |
| $I_{ADC}^{[1]}$                | ADC Operating current ( $V_{DD} + V_{REF}$ current) | -     | -   | 4.5       | mA          | $V_{DD} = V_{REF} = 5.5\text{ V}$<br>$F_{ADC} = 16\text{ MHz}$<br>$T_{CONV} = 18 * T_{ADC}$ |
| $N_R$                          | Resolution                                          | 12    |     |           | Bit         |                                                                                             |
| $F_{ADC}^{[1]}$<br>$1/T_{ADC}$ | ADC Clock frequency                                 | -     | -   | 16        | MHz         |                                                                                             |
| $T_{SMP}$                      | Sampling Time                                       | 4     | -   | 259       | $1/F_{ADC}$ | $T_{SMP} = (EXTSMPT(EADC\_SCTLx[31:24]) + 4) * T_{ADC}$                                     |
| $T_{CONV}$                     | Conversion time                                     | 18    | -   | 273       | $1/F_{ADC}$ | $T_{CONV} = T_{SMP} + 14 * T_{ADC}$                                                         |
| $F_{SPS}^{[1]}$                | Sampling Rate                                       | -     | -   | 800       | kSPS        | $F_{SPS} = F_{ADC} / T_{CONV}$<br>$EXTSMPT(ADC\_ESMPCTL[7:0]) = 0$                          |
| $T_{EN}$                       | Enable to ready time                                | 1     | -   | -         | μs          |                                                                                             |
| $INL^{[1]}$                    | Integral Non-Linearity Error                        | -1.6  | -   | 1.83      | LSB         | $V_{REF} = V_{DD}$ ,<br>except SSOP20 and TSSOP28                                           |
|                                |                                                     | -1.68 | -   | 1.35      | LSB         | $V_{REF} = V_{DD}$<br>SSOP20 and TSSOP28                                                    |
| $DNL^{[1]}$                    | Differential Non-Linearity Error                    | -1    | -   | 2.44      | LSB         | $V_{REF} = V_{DD}$ ,<br>except SSOP20 and TSSOP28                                           |
|                                |                                                     | -1    | -   | 2.06      | LSB         | $V_{REF} = V_{DD}$<br>SSOP20 and TSSOP28                                                    |
| $E_G^{[1]}$                    | Gain error                                          | -2.44 | -   | -0.75     | LSB         | $V_{REF} = V_{DD}$ ,<br>except SSOP20 and TSSOP28                                           |
|                                |                                                     | -1.94 | -   | -0.5      | LSB         | $V_{REF} = V_{DD}$<br>SSOP20 and TSSOP28                                                    |
| $E_O^{[1]T}$                   | Offset error                                        | -0.25 | -   | 1.81      | LSB         | $V_{REF} = V_{DD}$ ,<br>except SSOP20 and TSSOP28                                           |
|                                |                                                     | 0.56  | -   | 1.5       | LSB         | $V_{REF} = V_{DD}$<br>SSOP20 and TSSOP28                                                    |
| $E_A^{[1]}$                    | Absolute Error                                      | -3.56 | -   | 2.69      | LSB         | $V_{REF} = V_{DD}$ ,<br>except SSOP20 and TSSOP28                                           |
|                                |                                                     | -2.94 | -   | 3         | LSB         | $V_{REF} = V_{DD}$<br>SSOP20 and TSSOP28                                                    |
| $ENOB^{[1]}$                   | Effective number of bits                            | -     | 10  | -         | bits        | $F_{ADC} = 16\text{ MHz}$                                                                   |

| Symbol                          | Parameter                            | Min | Typ | Max | Unit | Test Conditions                                                                                  |
|---------------------------------|--------------------------------------|-----|-----|-----|------|--------------------------------------------------------------------------------------------------|
| SINAD <sup>[*1]</sup>           | Signal-to-noise and distortion ratio | -   | 62  | -   | dB   | V <sub>DD</sub> = V <sub>REF</sub> = 3.3 V<br>Input Frequency = 20 kHz<br>T <sub>A</sub> = 25 °C |
| SNR <sup>[*1]</sup>             | Signal-to-noise ratio                | -   | 62  | -   |      |                                                                                                  |
| THD <sup>[*1]</sup>             | Total harmonic distortion            | -   | -80 | -   |      |                                                                                                  |
| C <sub>IN</sub> <sup>[*1]</sup> | Internal Capacitance                 | -   | TBD | -   | pF   |                                                                                                  |
| R <sub>IN</sub> <sup>[*1]</sup> | Internal Switch Resistance           | -   | -   | TBD | kΩ   |                                                                                                  |
| R <sub>EX</sub> <sup>[*1]</sup> | External input impedance             | -   | -   | TBD | kΩ   |                                                                                                  |

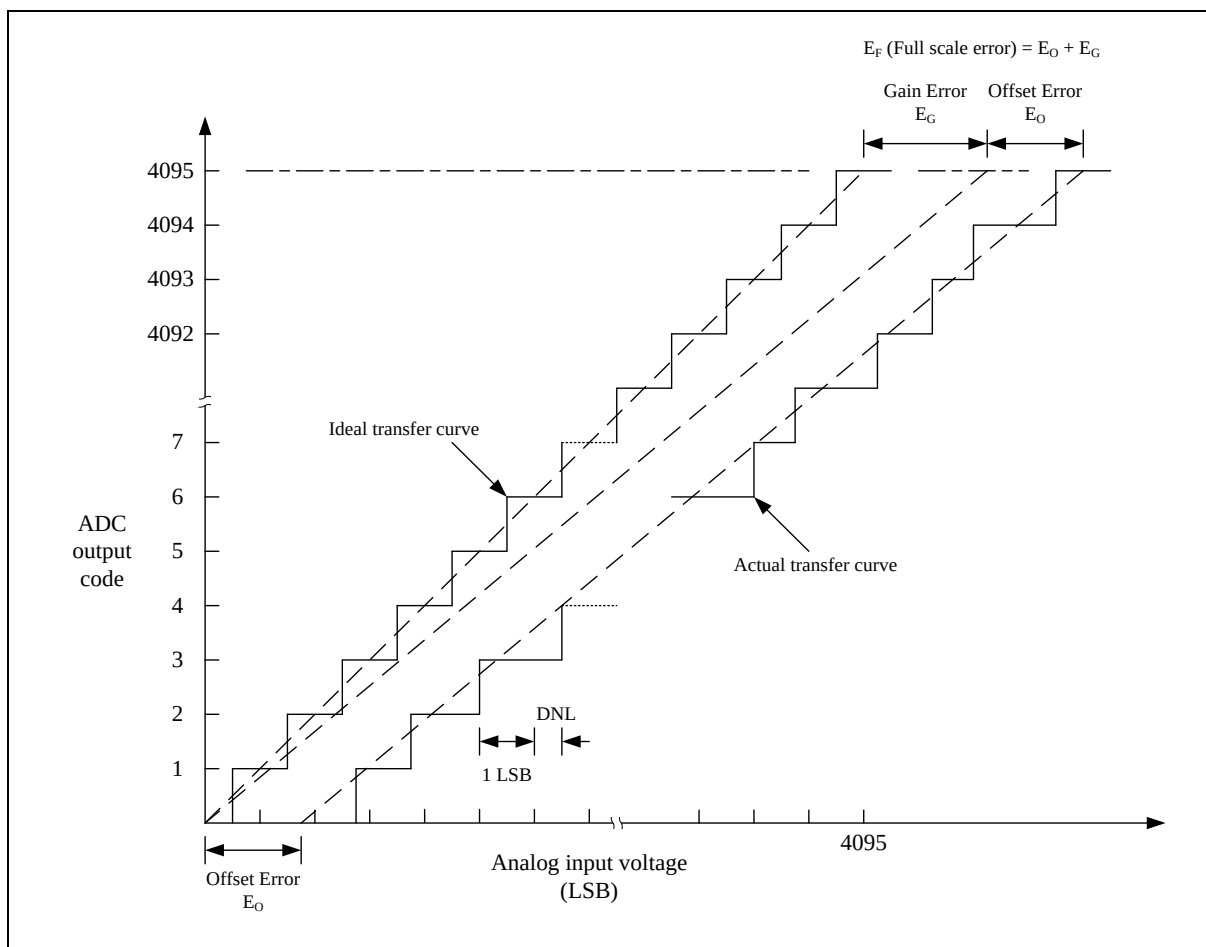
**Notes:**

1. Guaranteed by characterization result, not tested in production.
2. R<sub>EX</sub> max formula is used to determine the maximum external impedance allowed for 1/4 LSB error. N = 12 (based on 12-bit resolution) and k is the number of sampling clocks (T<sub>SMP</sub>). C<sub>EX</sub> represents the capacitance of PCB and pad and is combined with R<sub>EX</sub> into a low-pass filter. Once the R<sub>EX</sub> and C<sub>EX</sub> values are too large, it is possible to filter the real signal and reduce the ADC accuracy.

$$R_{EX} = \frac{k}{f_{ADC} \times C_{IN} \times \ln(2^{N+2})} - R_{IN}$$



**Note:** Injection current is an important topic of ADC accuracy. Injecting current on any analog input pins should be avoided to protect the conversion being performed on another analog input. It is recommended to add Schottky diodes (pin to ground and pin to power) to analog pins which may potentially inject currents.



**Note:** The INL is the peak difference between the transition point of the steps of the calibrated transfer curve and the ideal transfer curve. A calibrated transfer curve means it has calibrated the offset and gain error from the actual transfer curve.

### 8.5.4 Digital to Analog Converter (DAC)

The maximum values are obtained for  $V_{DD} = 5.5\text{ V}$  and maximum ambient temperature ( $T_A$ ), and the typical values for  $T_A = 25\text{ }^\circ\text{C}$  and  $V_{DD} = 3.3\text{ V}$  unless otherwise specified.

| Symbol                 | Parameter                                 | Min              | Typ | Max               | Unit          | Test Condition                                                                                                                                                          |
|------------------------|-------------------------------------------|------------------|-----|-------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{DD}$               | Analog supply voltage                     | 2.4              | -   | 5.5               | V             |                                                                                                                                                                         |
| $N_R$                  | Resolution                                | 5                |     |                   | bit           |                                                                                                                                                                         |
| $V_{REF}$              | Reference supply voltage                  | 2.4              | -   | $V_{DD}$          | V             | $V_{REF} \leq V_{DD}$                                                                                                                                                   |
| $DNL^{[*2]}$           | Differential non-linearity error          | -                | -   | $\pm 0.05$        | LSB           |                                                                                                                                                                         |
| $INL^{[*2]}$           | Integral non-linearity error              | -                | -   | $\pm 0.1$         | LSB           |                                                                                                                                                                         |
| $OE^{[*2]}$            | Offset Error                              | -                | -   | $\pm 0.1$         | LSB           |                                                                                                                                                                         |
| $GE^{[*2]}$            | Gain Error                                | -                | -   | $\pm 2$           | LSB           |                                                                                                                                                                         |
| $AE^{[*2]}$            | Absolute Error                            | -                | -   | $\pm 0.5$         | LSB           |                                                                                                                                                                         |
| -                      | Monotonic                                 | 5-bit guaranteed |     |                   | -             | -                                                                                                                                                                       |
| $V_O^{[*1]}$           | Output Voltage                            | 1*LSB            | -   | $V_{REF} - 1*LSB$ | V             |                                                                                                                                                                         |
| $R_O^{[*2]}$           | Output impedance                          | 4                | 5   | 6                 | k $\Omega$    |                                                                                                                                                                         |
| $C_{LOAD}^{[*2][*4]}$  | Capacitive load                           | -                | -   | 50                | pF            | -                                                                                                                                                                       |
| $I_{DAC\_VDD}^{[*2]}$  | DAC operating current on $V_{DD}$ supply  | -                | 38  | -                 | $\mu\text{A}$ |                                                                                                                                                                         |
| $I_{DAC\_VREF}^{[*2]}$ | DAC operating current on $V_{REF}$ supply | -                | 38  | -                 | $\mu\text{A}$ |                                                                                                                                                                         |
| $T_B^{[*2]}$           | Settling Time                             | -                | -   | 10                | $\mu\text{s}$ | Full scale: for a 5-bit input code transition between the lowest and the highest input codes when DAC_OUT reaches final value $\pm 1$ LSB, $C_{LOAD} \leq 50\text{ pF}$ |
| $PSRR^{[*1]}$          | Power Supply Rejection Ratio              | -                | -60 | -40               | dB            | No $R_{LOAD}$ , $C_{LOAD} = 50\text{ pF}$                                                                                                                               |

**Note:**

1. Guaranteed by design, not tested in production
2. Guaranteed by characteristic, not tested in production.
3. Resistive load between DACOUT and  $V_{SS}$ .
4. Capacitive load at DACOUT pin.

### 8.5.5 Analog Comparator Controller (ACMP)

The maximum values are obtained for  $V_{DD} = 5.5$  V and maximum ambient temperature ( $T_A$ ), and the typical values for  $T_A = 25$  °C and  $V_{DD} = 3.3$  V unless otherwise specified.

| Symbol                                                                                                                                                                         | Parameter                              | Min | Typ | Max      | Unit | Test Conditions                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-----|-----|----------|------|-----------------------------------|
| $V_{DD}$                                                                                                                                                                       | Analog supply voltage                  | 2.4 | -   | 5.5      | V    |                                   |
| $T_A$                                                                                                                                                                          | Temperature                            | -40 | -   | 125      | °C   |                                   |
| $I_{ACMP}^{[*2]}$                                                                                                                                                              | ACMP operating current                 | -   | 75  | 200      | μA   | MODESEL = 01                      |
| $V_{CM}^{[*2]}$                                                                                                                                                                | Input common mode voltage range        | 0   | -   | $V_{DD}$ |      |                                   |
| $V_{DI}^{[*2]}$                                                                                                                                                                | Differential input voltage sensitivity | 50  | -   | -        | mV   | Hysteresis disable (HYSSEL = 00)  |
| $V_{offset}^{[*2]}$                                                                                                                                                            | Input offset voltage                   | -   | -   | ±30      | mV   | Hysteresis disable (HYSSEL = 00)  |
| $V_{hys}^{[*2]}$                                                                                                                                                               | Hysteresis window                      | -   | 20  | -        | mV   | HYSSEL = 01                       |
|                                                                                                                                                                                |                                        | -   | 30  | 60       |      | HYSSEL = 10                       |
|                                                                                                                                                                                |                                        | -   | 40  | -        |      | HYSSEL = 11                       |
| $A_v^{[*1]}$                                                                                                                                                                   | DC voltage Gain                        | 43  | 70  | -        | dB   |                                   |
| $T_d^{[*2]}$                                                                                                                                                                   | Propagation delay                      | -   | 100 | 200      | nS   | MODESEL = 01                      |
| $T_{Setup}^{[*2]}$                                                                                                                                                             | Setup time                             | -   | -   | 5        | μS   |                                   |
| $A_{CRV}^{[*2]}$                                                                                                                                                               | CRV output voltage                     | -5  | -   | 5        | %    | $V_{DD} \times (1/6 + CRVCTL/24)$ |
| $R_{CRV}^{[*2]}$                                                                                                                                                               | Unit resistor value                    | -   | 5.8 | -        | kΩ   |                                   |
| $T_{SETUP\_CRV}^{[*1]}$                                                                                                                                                        | Setup time                             | -   | -   | 0.5      | μS   | CRV output voltage settle to ±5%  |
| $I_{DD\_CRV}^{[*2]}$                                                                                                                                                           | Operating current                      | -   | 30  | 60       | μA   |                                   |
| <b>Notes:</b> <ol style="list-style-type: none"> <li>Guaranteed by design, not tested in production</li> <li>Guaranteed by characteristic, not tested in production</li> </ol> |                                        |     |     |          |      |                                   |

Table 8.5-2 ACMP Characteristics

8.5.6 Internal Voltage Reference

The maximum values are obtained for  $V_{DD} = 5.5\text{ V}$  and maximum ambient temperature ( $T_A$ ), and the typical values for  $T_A = 25\text{ }^{\circ}\text{C}$  and  $V_{DD} = 3.3\text{ V}$  unless otherwise specified.

| Symbol                                                                      | Parameter                             | Min  | Typ   | Max  | Unit | Test Conditions                                                               |
|-----------------------------------------------------------------------------|---------------------------------------|------|-------|------|------|-------------------------------------------------------------------------------|
| $V_{REF\_INT}$                                                              | Internal reference voltage            | 1.49 | 1.536 | 1.59 | V    | $V_{DD} \geq 2.0\text{ V}$                                                    |
|                                                                             |                                       | 1.98 | 2.048 | 2.11 |      | $V_{DD} \geq 2.4\text{ V}$                                                    |
|                                                                             |                                       | 2.48 | 2.560 | 2.64 |      | $V_{DD} \geq 2.9\text{ V}$                                                    |
|                                                                             |                                       | 2.97 | 3.072 | 3.17 |      | $V_{DD} \geq 3.4\text{ V}$                                                    |
|                                                                             |                                       | 3.97 | 4.096 | 4.22 |      | $V_{DD} \geq 4.5\text{ V}$                                                    |
| $T_s^{[*1]}$                                                                | Stable time                           | -    | 0.5   | 0.8  | mS   | $C_L = 4.7\text{ }\mu\text{F}$ , $V_{REF}$ initial = 0, Preload is enabled.   |
|                                                                             |                                       | -    | 9.3   | 13   | mS   | $C_L = 4.7\text{ }\mu\text{F}$ , $V_{REF}$ initial = 5.5, Preload is enabled. |
|                                                                             |                                       | -    | 24    | 180  | mS   | $C_L = 1\text{ }\mu\text{F}$ , $V_{REF}$ initial = 0, Preload is enabled.     |
|                                                                             |                                       | -    | 2     | 2.6  | mS   | $C_L = 1\text{ }\mu\text{F}$ , $V_{REF}$ initial = 5.5, Preload is enabled.   |
| $I_{VREF\_INT}^{[*1]}$                                                      | $V_{REF\_INT}$ operating current      | -    | -     | 1    | mA   |                                                                               |
| $I_{VREF\_LOAD}^{[*1]}$                                                     | $V_{REF\_INT}$ output loading current | -    | -     | 1    | mA   |                                                                               |
| <b>Note:</b><br>1. Guaranteed by characterization, not tested in production |                                       |      |       |      |      |                                                                               |

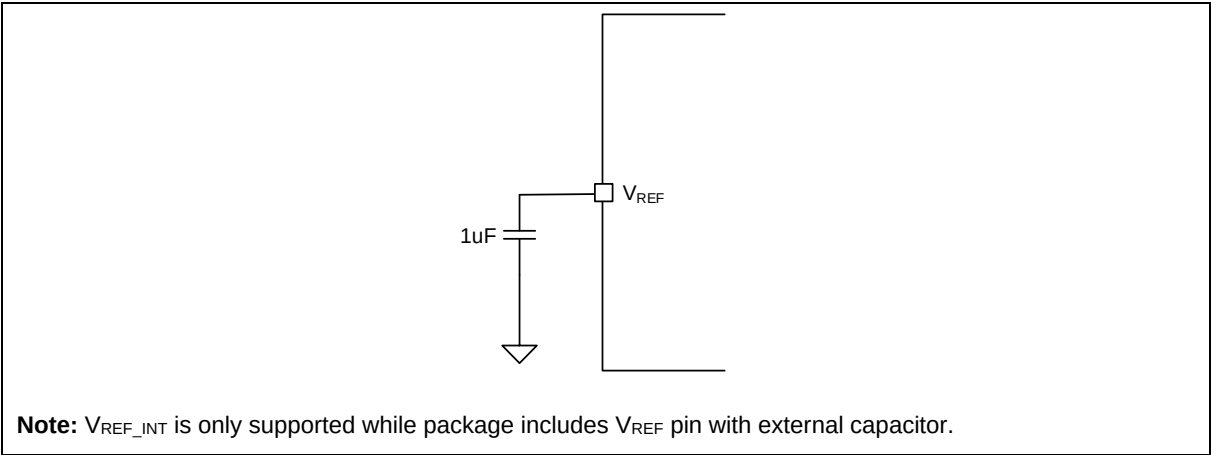


Figure 8.5-2 Typical Connection with Internal Voltage Reference

### 8.5.7 Temperature Sensor

The maximum values are obtained for  $V_{DD} = 5.5$  V and maximum ambient temperature ( $T_A$ ), and the typical values for  $T_A = 25$  °C and  $V_{DD} = 3.3$  V unless otherwise specified.

| Symbol                 | Parameter                                      | Min   | Typ   | Max   | Unit  | Test Conditions         |
|------------------------|------------------------------------------------|-------|-------|-------|-------|-------------------------|
| $V_{TEMP\_OS}^{[*1]}$  | Temperature sensor offset voltage              | 655   | 654   | 656   | mV    | $T_A = 0^\circ\text{C}$ |
| $T_C^{[*1]}$           | Temperature Coefficient                        | -1.99 | -2.00 | -2.01 | mV/°C |                         |
| $T_S^{[*2]}$           | Stable time                                    | -     | -     | 1     | μS    |                         |
| $T_{TEMP\_ADC}^{[*1]}$ | ADC sampling time when reading the temperature | -     | 15    | 20    | μS    |                         |
| $I_{TEMP}^{[*1]}$      | Temperature sensor operating current           | -     | 16    | 30    | μA    |                         |

**Note:**

1. Guaranteed by characterization, not tested in production
2. Guaranteed by design, not tested in production
3.  $V_{TEMP} \text{ (mV)} = T_C \text{ (mV/°C)} \times \text{Temperature } (^\circ\text{C}) + V_{TEMP\_OS} \text{ (mV)}$

| Symbol     | Parameter                            | Min | Typ    | Max | Unit | Test Conditions |
|------------|--------------------------------------|-----|--------|-----|------|-----------------|
| $V_{DD}$   | Analog supply voltage                | 2.5 | -      | 3.6 | V    |                 |
| $T_A$      | Temperature                          | -40 | -      | 125 | °C   |                 |
| $I_{TEMP}$ | Temperature Sensor operating current | -   | 200    | -   | μA   |                 |
| $T_{ACC}$  | Temperature Accuracy                 | -   | ±1     | ±2  | °C   |                 |
| $T_R$      | Temperature Resolution               | -   | 0.0625 | -   | °C   |                 |
| $T_{CONV}$ | Conversion Time                      | -   | 84     | 100 | mS   |                 |

**Note:**

1. Guaranteed by characterization, not tested in production

## 8.6 Communications Characteristics

### 8.6.1 USCI-SPI Dynamic Characteristics

| Symbol                                        | Parameter              | Min <sup>[*1]</sup>     | Typ | Max <sup>[*1]</sup> | Unit | Test Conditions                                         |
|-----------------------------------------------|------------------------|-------------------------|-----|---------------------|------|---------------------------------------------------------|
| F <sub>SPICLK</sub><br>1/ T <sub>SPICLK</sub> | SPI clock frequency    | -                       | -   | 24                  | MHz  | 4.5 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
|                                               |                        | -                       | -   | 24                  |      | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
| t <sub>CLKH</sub>                             | Clock output High time | T <sub>SPICLK</sub> / 2 |     |                     | nS   |                                                         |
| t <sub>CLKL</sub>                             | Clock output Low time  | T <sub>SPICLK</sub> / 2 |     |                     | nS   |                                                         |
| t <sub>DS</sub>                               | Data input setup time  | 2                       | -   | -                   | nS   |                                                         |
| t <sub>DH</sub>                               | Data input hold time   | 4                       | -   | -                   | nS   |                                                         |
| t <sub>v</sub>                                | Data output valid time | -                       | -   | 5                   | nS   | 4.5 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
|                                               |                        | -                       | -   | TBD                 | nS   | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
| Note:                                         |                        |                         |     |                     |      |                                                         |
| 1. Guaranteed by design.                      |                        |                         |     |                     |      |                                                         |

Table 8.6-1 USCI-SPI Master Mode Characteristics

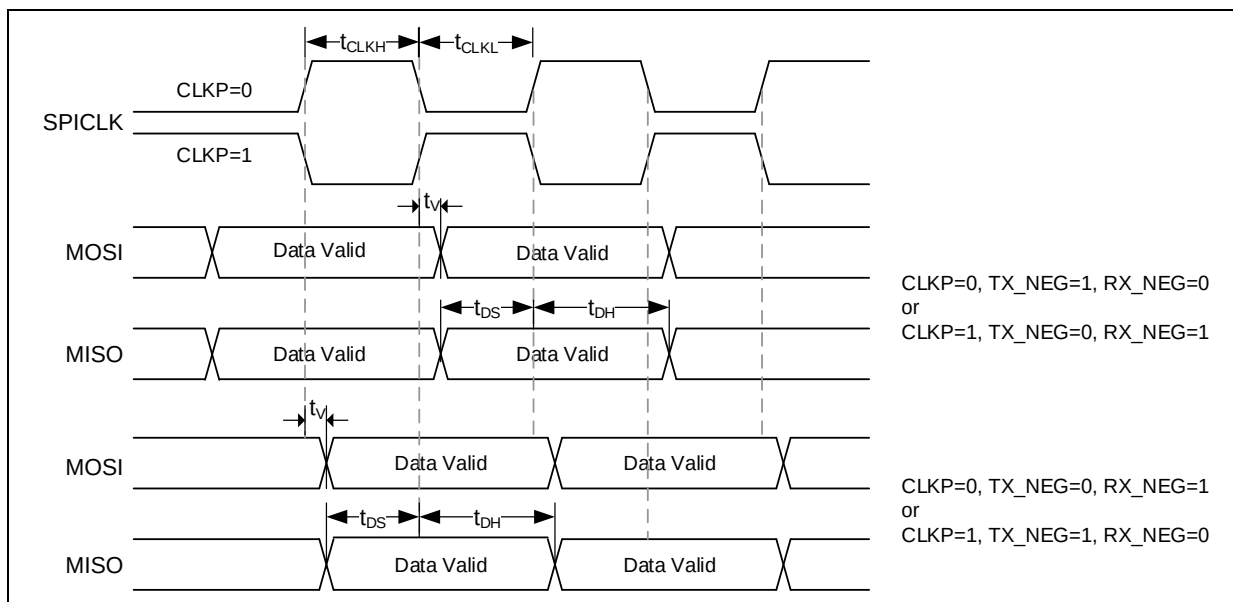


Figure 8.6-1 USCI-SPI Master Mode Timing Diagram



| Symbol                                        | Parameter               | Min <sup>[*1]</sup>               | Typ | Max <sup>[*1]</sup> | Unit | Test Conditions                                         |
|-----------------------------------------------|-------------------------|-----------------------------------|-----|---------------------|------|---------------------------------------------------------|
| F <sub>SPICLK</sub><br>1/ T <sub>SPICLK</sub> | SPI clock frequency     | -                                 | -   | 7                   | MHz  | 4.5 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
|                                               |                         | -                                 | -   | 7                   |      | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
| t <sub>CLKH</sub>                             | Clock output High time  | T <sub>SPICLK</sub> / 2           |     |                     | nS   |                                                         |
| t <sub>CLKL</sub>                             | Clock output Low time   | T <sub>SPICLK</sub> / 2           |     |                     | nS   |                                                         |
| t <sub>SS</sub>                               | Slave select setup time | 1<br>T <sub>SPICLK</sub><br>+ 2ns | -   | -                   | nS   | 4.5 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
|                                               |                         | TBD                               | -   | -                   |      | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
| t <sub>SH</sub>                               | Slave select hold time  | 1<br>T <sub>SPICLK</sub>          | -   | -                   | nS   |                                                         |
| t <sub>DS</sub>                               | Data input setup time   | 2                                 | -   | -                   | nS   |                                                         |
| t <sub>DH</sub>                               | Data input hold time    | 4                                 | -   | -                   | nS   |                                                         |
| t <sub>v</sub>                                | Data output valid time  | -                                 | -   | 65                  | nS   | 4.5 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
|                                               |                         | -                                 | -   | TBD                 |      | 2.7 V ≤ V <sub>DD</sub> ≤ 5.5 V, C <sub>L</sub> = 30 pF |
| Note:                                         |                         |                                   |     |                     |      |                                                         |
| 1. Guaranteed by design.                      |                         |                                   |     |                     |      |                                                         |

Table 8.6-2 USCI-SPI Slave Mode Characteristics

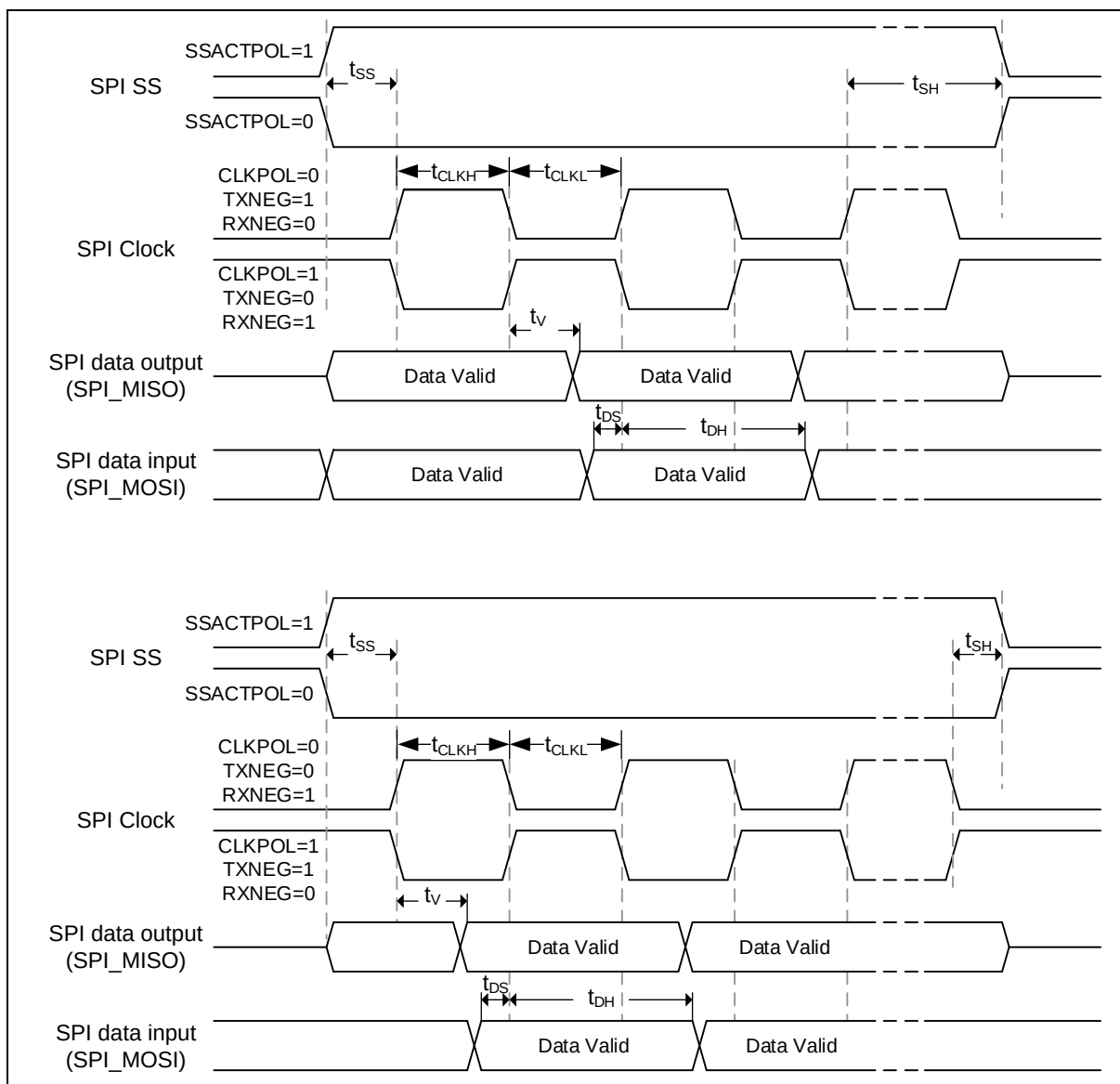


Figure 8.6-2 USCI-SPI Slave Mode Timing Diagram

## 8.6.2 USCI-I<sup>2</sup>C Dynamic Characteristics

| Symbol        | Parameter                           | Standard Mode <sup>[1][2]</sup> |                     | Fast Mode <sup>[1][2]</sup> |                    | Unit    |
|---------------|-------------------------------------|---------------------------------|---------------------|-----------------------------|--------------------|---------|
|               |                                     | Min                             | Max                 | Min                         | Max                |         |
| $t_{LOW}$     | SCL low period                      | 4.7                             | -                   | 1.3                         | -                  | $\mu$ S |
| $t_{HIGH}$    | SCL high period                     | 4                               | -                   | 0.6                         | -                  | $\mu$ S |
| $t_{SU, STA}$ | Repeated START condition setup time | 4.7                             | -                   | 0.6                         | -                  | $\mu$ S |
| $t_{HD, STA}$ | START condition hold time           | 4                               | -                   | 0.6                         | -                  | $\mu$ S |
| $t_{SU, STO}$ | STOP condition setup time           | 4                               | -                   | 0.6                         | -                  | $\mu$ S |
| $t_{BUF}$     | Bus free time                       | 4.7 <sup>[3]</sup>              | -                   | 1.2 <sup>[3]</sup>          | -                  | $\mu$ S |
| $t_{SU, DAT}$ | Data setup time                     | 250                             | -                   | 100                         | -                  | nS      |
| $t_{HD, DAT}$ | Data hold time                      | 0 <sup>[4]</sup>                | 3.45 <sup>[5]</sup> | 0 <sup>[4]</sup>            | 0.8 <sup>[5]</sup> | $\mu$ S |
| $t_r$         | SCL/SDA rise time                   | -                               | 1000                | $20+0.1C_b$                 | 300                | nS      |
| $t_f$         | SCL/SDA fall time                   | -                               | 300                 | -                           | 300                | nS      |
| $C_b$         | Capacitive load for each bus line   | -                               | 400                 | -                           | 400                | pF      |

**Notes:**

1. Guaranteed by characteristic, not tested in production
2. HCLK must be higher than 2 MHz to achieve the maximum standard mode I2C frequency. It must be higher than 8 MHz to achieve the maximum fast mode I2C frequency.
3. I2C controller must be retriggered immediately at slave mode after receiving STOP condition.
4. The device must internally provide a hold time of at least 300 ns for the SDA signal in order to bridge the undefined region of the falling edge of SCL.
5. The maximum hold time of the Start condition has only to be met if the interface does not stretch the low period of SCL signal.

Table 8.6-3 USCI-I<sup>2</sup>C Characteristics

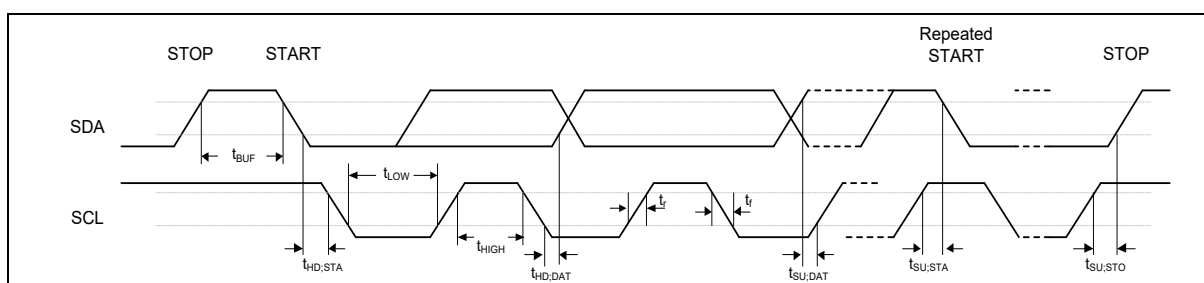


Figure 8.6-3 USCI-I<sup>2</sup>C Timing Diagram

## 8.7 Flash DC Electrical Characteristics

The devices are shipped to customers with the Flash memory erased.

| Symbol                          | Parameter         | Min <sup>[3]</sup> | Typ | Max | Unit                  | Test Condition                                   |
|---------------------------------|-------------------|--------------------|-----|-----|-----------------------|--------------------------------------------------|
| V <sub>FLA</sub> <sup>[1]</sup> | Supply voltage    | -                  | 1.5 | -   | V                     | T <sub>A</sub> = 25°C                            |
| T <sub>ERASE</sub>              | Page erase time   | -                  | 20  | -   | mS                    |                                                  |
| T <sub>PROG</sub>               | Program time      | -                  | 60  | -   | μS                    |                                                  |
| I <sub>DD1</sub>                | Read current      | -                  | 7   | -   | mA                    |                                                  |
| I <sub>DD2</sub>                | Program current   | -                  | 8   | -   | mA                    |                                                  |
| I <sub>DD3</sub>                | Erase current     | -                  | 12  | -   | mA                    |                                                  |
| N <sub>ENDUR</sub>              | Cycling Endurance | 20,000             | -   | -   | cycles <sup>[2]</sup> | T <sub>J</sub> = -40°C~125°C                     |
| T <sub>RET</sub>                | Data retention    | 10                 | -   | -   | year                  | 20 kcycle <sup>[2]</sup> , T <sub>J</sub> = 85°C |
|                                 |                   | 100                | -   | -   | year                  | 20 kcycle <sup>[2]</sup> , T <sub>J</sub> = 25°C |

Notes:

1.

V<sub>FLA</sub> is source from chip internal LDO output voltage.

2.

Number of program/erase cycles. The flash data can only be programmed once at the same address after flash erase.

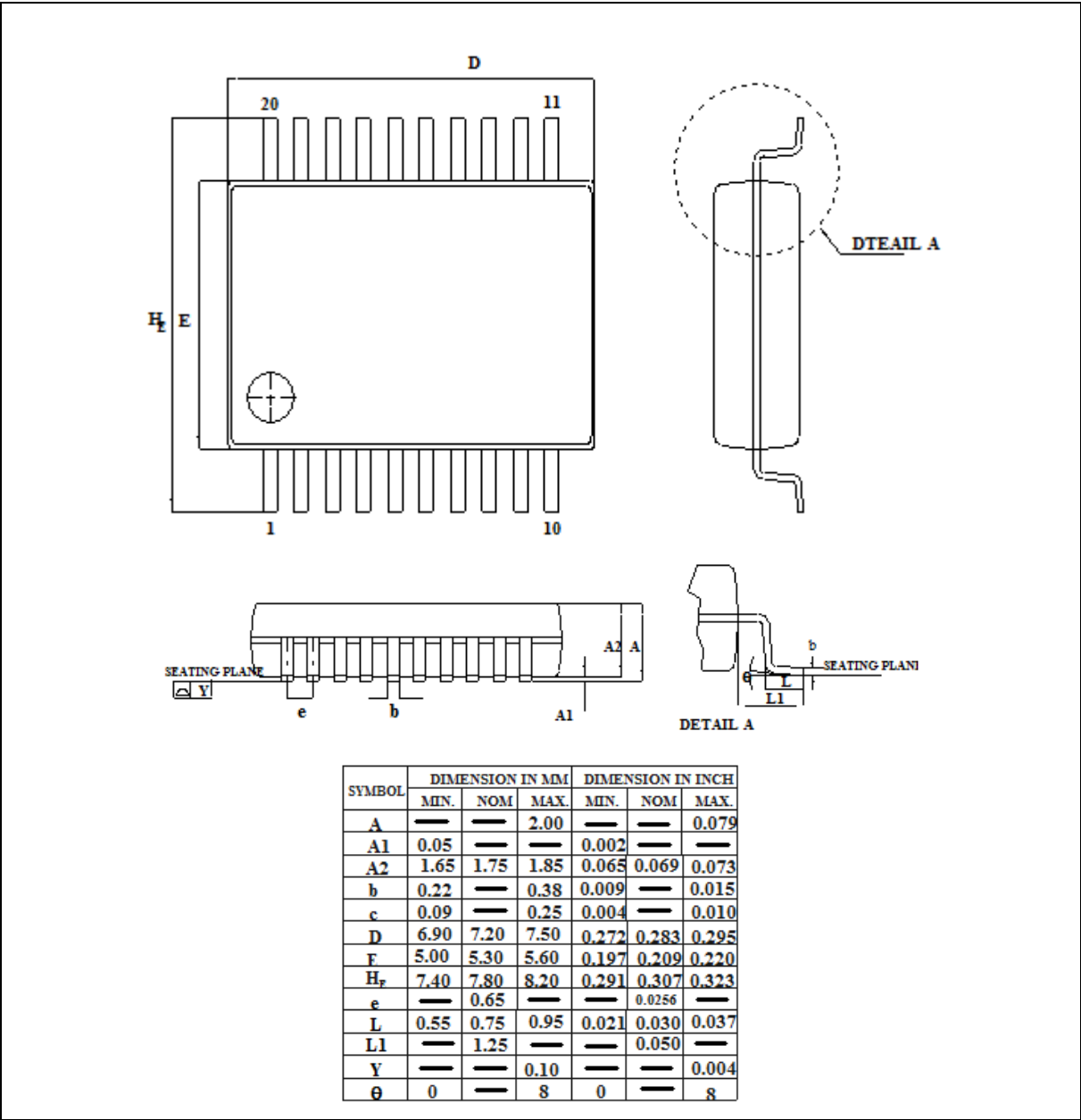
3.

Guaranteed by design.

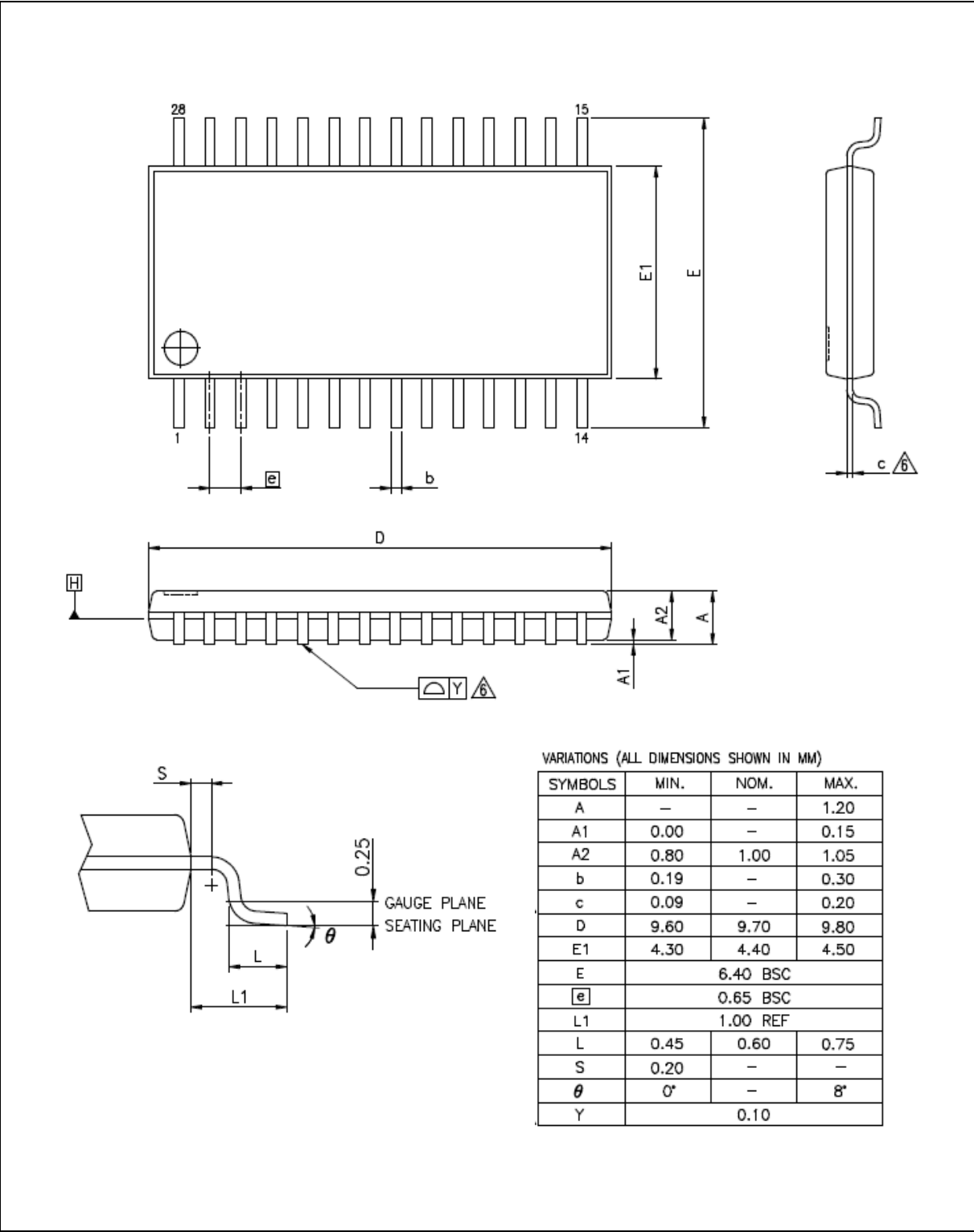
9 PACKAGE DIMENSIONS

Package is Halogen-free, RoHS-compliant and TSCA-compliant.

9.1 SSOP 20 (5.3x7.2x1.75 mm)



9.2 TSSOP 28 (4.4x9.7x1.0 mm)



## 10 ABBREVIATIONS

### 10.1 Abbreviations

| Acronym | Description                                     |
|---------|-------------------------------------------------|
| ACMP    | Analog Comparator Controller                    |
| ADC     | Analog-to-Digital Converter                     |
| AES     | Advanced Encryption Standard                    |
| APB     | Advanced Peripheral Bus                         |
| AHB     | Advanced High-Performance Bus                   |
| BOD     | Brown-out Detection                             |
| CAN     | Controller Area Network                         |
| DAP     | Debug Access Port                               |
| DES     | Data Encryption Standard                        |
| EADC    | Enhanced Analog-to-Digital Converter            |
| EBI     | External Bus Interface                          |
| EMAC    | Ethernet MAC Controller                         |
| EPWM    | Enhanced Pulse Width Modulation                 |
| FIFO    | First In, First Out                             |
| FMC     | Flash Memory Controller                         |
| FPU     | Floating-point Unit                             |
| GPIO    | General-Purpose Input/Output                    |
| HCLK    | The Clock of Advanced High-Performance Bus      |
| HIRC    | 12 MHz Internal High Speed RC Oscillator        |
| HXT     | 4~24 MHz External High Speed Crystal Oscillator |
| IAP     | In Application Programming                      |
| ICP     | In Circuit Programming                          |
| ISP     | In System Programming                           |
| LDO     | Low Dropout Regulator                           |
| LIN     | Local Interconnect Network                      |
| LIRC    | 10 kHz internal low speed RC oscillator (LIRC)  |
| MPU     | Memory Protection Unit                          |
| NVIC    | Nested Vectored Interrupt Controller            |
| PCLK    | The Clock of Advanced Peripheral Bus            |
| PDMA    | Peripheral Direct Memory Access                 |
| PLL     | Phase-Locked Loop                               |
| PWM     | Pulse Width Modulation                          |

|      |                                             |
|------|---------------------------------------------|
| QEI  | Quadrature Encoder Interface                |
| SD   | Secure Digital                              |
| SPI  | Serial Peripheral Interface                 |
| SPS  | Samples per Second                          |
| TDES | Triple Data Encryption Standard             |
| TK   | Touch Key                                   |
| TMR  | Timer Controller                            |
| UART | Universal Asynchronous Receiver/Transmitter |
| UCID | Unique Customer ID                          |
| USB  | Universal Serial Bus                        |
| WDT  | Watchdog Timer                              |
| WWDT | Window Watchdog Timer                       |

Table 10.1-1 List of Abbreviations



## 11 REVISION HISTORY

| Date       | Revision | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2020.12.15 | 1.00     | <ul style="list-style-type: none"> <li>Initial version.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2021.11.16 | 1.01     | <ul style="list-style-type: none"> <li>Updated current consumption value under test condition <math>T_A = 125^{\circ}\text{C}</math> in section 8.3.1.</li> <li>Updated BOD brown-out detect voltage value in section 8.5.2.</li> <li>Added temperature sensor specification in section 8.5.7.</li> </ul>                                                                                                                                                                                                                         |
| 2022.05.06 | 1.02     | <ul style="list-style-type: none"> <li>Updated temperature sensor specification in section 8.5.7.</li> <li>Fixed the max frequency of HXT from 32 MHz to 24 MHz.</li> </ul>                                                                                                                                                                                                                                                                                                                                                       |
| 2022.07.04 | 1.03     | <ul style="list-style-type: none"> <li>Updated band-gap voltage (<math>V_{BG}</math>) value in section 8.2.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                            |
| 2023.03.08 | 1.04     | <ul style="list-style-type: none"> <li>Fixed <math>T_J</math> value in section 8.1.3.</li> <li>Updated <math>T_{VBG\_ADC}</math> value in section 8.2.</li> <li>Fixed the description of max ADC sampling rate to 800 kSPS in chapter 1, 2 and section 6.19.2, 8.5.3.</li> <li>Changed the ADC note about using the internal channel for temperature sensor voltage and band-gap voltage in section 6.19.2.</li> <li>Added "Package is Halogen-free, RoHS-compliant and TSCA-compliant." in section 3.1 and chapter 9.</li> </ul> |
| 2024.01.23 | 1.05     | <ul style="list-style-type: none"> <li>Fixed PA.3 type to input only in section 4.2.1, 4.2.2 and 4.2.3.</li> <li>Removed non-supported register VTOR and SHPR1 in section 6.2.13.</li> </ul>                                                                                                                                                                                                                                                                                                                                      |

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