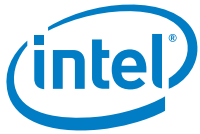


# Intel® Curie™ Module

Datasheet

*December 2016*

*Revision 1.21*



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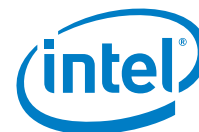
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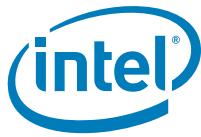
## Revision History

Revision	Description	Date
1.0	Initial release	August 2016
1.1	Reorganized the content into the existing chapters and renamed some chapters. Updated the list of reference documents. Added sections about manufacturing information, ordering information, package marking and ESD considerations. Updated Table 2-8 to remove external pull-up/pull-down recommendation for JTAG signals.	October 2016
1.2	Added reference to Curie Power Sequence Application Note in the power sequence section	November 2016
1.21	Minor fixes	December 2016

## Reference Documents

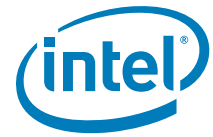
Title
Intel® Quark™ SE Microcontroller C1000 Datasheet
Intel® Curie™ Module Design Guide
Intel® Curie™ Power Sequence Considerations Application Note

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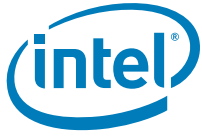
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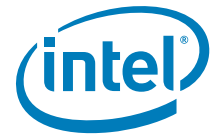


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# 1 Overview

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The Intel® Curie™ module is an advanced device built around the Intel® Quark™ SE microcontroller integrating compute, sense, awareness, connectivity and a programmable input/output controller within a common package.<sup>1</sup>

## 1.1 Naming convention

SoC is used for Intel® Quark™ SE microcontroller in some sections of the document.

## 1.2 Block diagram

Figure 1-1 depicts the main functional blocks and discrete devices within the Intel® Curie™ module.

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1. Note that this module is not a FCC-certified module. Emission testing has been performed and designs based on the Intel® Curie™ module that have FCC certification are available, but all new designs based on the module require regulatory approval prior to public availability



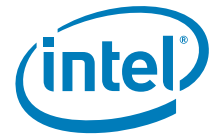
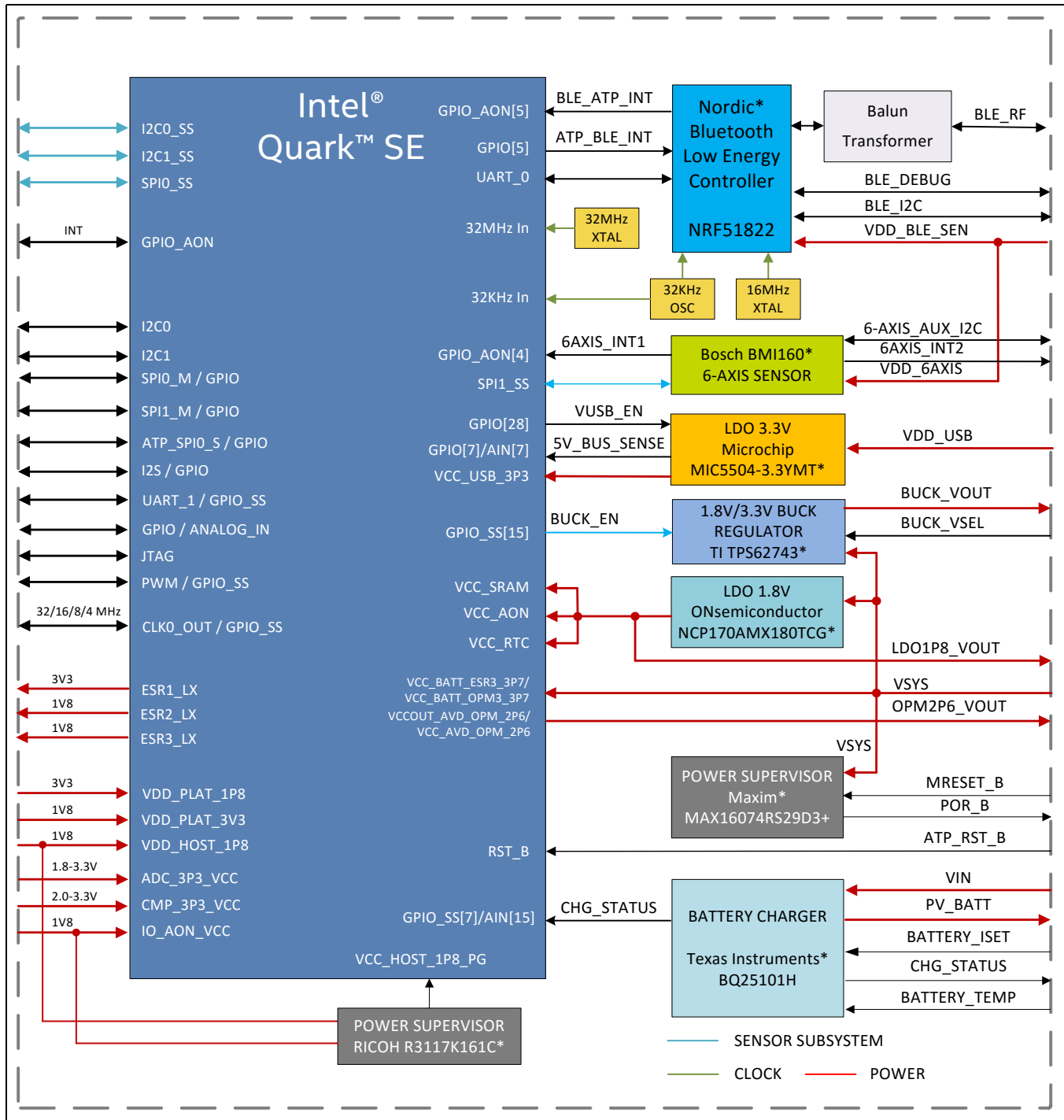


Figure 1-1. Intel® Curie™ module block diagram





## 1.3 Features

### 1.3.1 Intel® Quark™ SE microcontroller processor core

- 32-bit processor with 32-bit data bus
- 32 MHz clock frequency
- 32-bit address bus
- Pentium x86 ISA compatible without x87 floating point unit
- 8 kB L1 instruction cache
- Low-latency data tightly-coupled memory (TCM) interface to on-die SRAM
- Integrated local APIC and I/O APIC

The Intel® Quark™ SE microcontroller datasheet provides additional details for the core processor.

### 1.3.2 Memory subsystem

- 384 kB of on-die flash
- 80 kB of on-die SRAM

### 1.3.3 ARC EM4-based sensor subsystem

The Intel® Curie™ module contains an ARC EM4-based sensor subsystem and interrupt controller with the following features:

- 8 kB L1 instruction cache and 8 kB of closely coupled memory for data.
- Four counters that can be used in PWM or timer mode, timer mode supports 32-bit operation at 32 MHz granularity. These timers can be configured and used by both cores.
- Configuration watchdog timer with support to trigger an interrupt and/or a system reset upon timeout. This timer can be configured and used by both cores.

### 1.3.4 Six-axis accelerometer/gyroscope

The Intel® Curie™ module includes a Bosch\* BMI160 six-axis sensing device connected to the SPI1\_SS interface port; only the ARC can communicate with this logical block.

Key features of the Bosch BMI160 integrated device include:

- SPI interface from ARC core to the six-axis sensor to configure and read sensor data.
- GPIO\_AON[4] is used to receive interrupt from the six-axis sensor when data is available or when an error condition occurs. ARC core can be configured to receive this interrupt to process the information.
- Hardware synchronization of inertial sensor data.
- Available I2C from the Bosch BMI160 6-Axis device to interface with compatible, external geomagnetic / magnetometer devices.
- 16 bit digital, tri-axial accelerometer.



- 16 bit digital, tri-axial gyroscope.
- Ability to average sampled data for more accuracy and improve ARC core performance by reducing ARC core processing time.
- Sleep or standby mode to support low-power applications.
- Separate power supply for the sensor block, allowing the application to turn it off and on as needed to reduce the power consumption.

**Note:** Refer to Bosch\* BMI160 datasheet for more detailed information.

### 1.3.5 Bluetooth® low energy integration

The Intel® Curie™ module includes a Nordic\* nRF51822 that is interfaced to the Intel® Quark™ SE microcontroller via UART0.

All the low-level Bluetooth® low energy controller operations are handled by the Bluetooth low energy stack in the device. This makes the application implementation easier by treating the device as a modem and not worry about affecting all the Bluetooth® low energy low level activity because of the application code.

Features of this integrated device include:

- A 32-bit processor with AES Hardware Encryption.
- 2.4 GHz transceiver.
- Firmware update via DFU boot-loader, JTag interface and Over-the-Air (OTA) methods.
- Nordic S130 SoftDevice\* software that supports Bluetooth 4.1 services and the Gazell™ protocol stack at the same time.
- Low-power sleep mode when not transmitting nor receiving messages. The stack can be configured in this mode without application real time involvement saving processor real time cycles.
- Bluetooth low energy can receive or transmit messages while in sleep state, waking the SoC when done and also able to interrupt the core via GPIO\_AON[5].
- The Bluetooth low energy blocks are powered separately, allowing the application to turn it off and on as needed to reduce the power consumption. Ensure that there is no leakage or conflict between the blocks when one section is powered down with the others being powered up.

### 1.3.6 Pattern matching engine

- Parallel data recognition engine
- 128 parallel arithmetic units (Processing Element or PE) with 8-bit features per PE
- Two pattern matching algorithms:
  - K nearest neighbors (KNN)
  - Radial Basis Function (RBF)
- Two distance matching formulas:
  - Lsup
  - L1
- Constant recognition time



- Vector data: up to 128 bytes
- Classification status:
  - ID - identified, only one category matches
  - UNC - uncertain, more than one category matches
  - UNK- unknown, no match
- Support for up to 32,768 categories
- Supervised learning
- Save and restore network knowledge
- Three main operations supported:
  - Recognize a vector
  - Save the knowledge base from the network
  - Load the knowledge base to the network

### 1.3.7 USB device

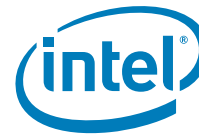
- Single USB 1.1 device port<sup>1</sup>.
- Supports full speed (12 Mbps) operation.
- UART mode profile support.
- Core detection of USB connected state via a comparator on GPIO7/AIN7 (USB supply VDD\_USB is connected to this interrupt).
  - AIN[7] is the interrupt line that will notify the Intel® Quark™ SE microcontroller that a USB voltage is present and thus enable the LDO via firmware. This feature only works with 5V USB sources, it will not detect a 3.3V USB source connection.
- The regulated USB 3.3V LDO supply is software controllable by setting (VUSB\_EN) GPIO28=0 to disable or =1 to enable.

### 1.3.8 I2C

- Four I2C Master interfaces: two on LMT and two on the sensor subsystem (ARC)
- Three I2C speeds supported:
  - Standard Mode (100 kbps)
  - Fast Mode (400 kbps)
  - Fast Mode Plus (1 Mbps) supported for the two I2C on the LMT or the main core only
  - These can also be configured as slave with Max data rate of 400 kbps for the ARC only I2C
- Support for both 7-bit and 10-bit addressing modes
- Support for 8-entry transmit and 8-entry receive FIFO
- Support for hardware DMA that allows data transfer without CPU involvement
- Support for FIFO threshold setting to generate an interrupt for applications to retrieve received data or when multiple bytes have completed transmission

---

1. Please note that not all USB 3.0 ports are backwards compatible with USB 1.1.



**Note:** Refer to the block diagram for I2C ports that are accessible by the main processor core and ARC.

### 1.3.9 I2S

- Two I2S Interfaces – 1 Transmit Interface and 1 Receive Interface. Each interface supports two channels for stereo left and right channels.
- Sample size from 12- to 32-bits.
- Support for Left Justified, Right Justified and DSP modes.
- Each interface can operate in Master or Slave Mode.
- FIFO mode supporting 4 words of selected data size transmit and receive for each channel.
- Support for hardware DMA that allows data transfer without CPU involvement.
- Audio sample rates up to 48kHz.
- Support for FIFO threshold setting to generate an interrupt for applications to retrieve received data or when multiple bytes have completed transmission.

### 1.3.10 UART

- One of two 16550-compliant UART interfaces available to user; UART0 dedicate to the Bluetooth® low energy controller
- Baud rates from 300 baud to 2 Mbaud
- Hardware and software flow control
- FIFO mode support (16 Bytes Tx and Rx FIFOs)
- Hardware DMA with configurable FIFO thresholds
- Hardware, software and no flow control

### 1.3.11 SPI

- The Intel® Curie™ module exposes three master SPI ports:
  - Two from the LMT and ARC and one from the sensor subsystem (only accessible through ARC)
  - One of the ARC SPI is used internally to communicate with built-in accelerometer (SPI1\_SS)
- Three SPI Master interfaces accessible from Intel® Quark™ SE microcontroller core and ARC
- Master SPI clock frequencies up from 488 hz to 16 MHz.
- One SPI Slave interface with support for SPI clock frequencies up to 3.2 MHz (accessible from ARC or Intel Quark processor core).
- 1-4 chip select lines per each master SPI interface and one for slave interface
- Five slave select pins per master interface
- Support for 4-bit up to 16-bit frame size
- 8 word (4-16 bits) entry for TX and RX FIFOs
- Hardware DMA with configurable FIFO thresholds



- Configurable clock phase and polarity

### 1.3.12 DMA controller

The DMA engine can be configured and can start performing data transfer without using the CPU in real time to perform the transfer, thus improving performance and reducing the power consumption.

- Eight unidirectional channels
- Support for 16 hardware handshake interfaces
- Dedicated hardware handshaking interfaces with peripherals plus software handshaking support
- Single and multi-block transfers
- Supported transfer modes<sup>1</sup>:
  - Memory to Memory
  - Peripheral to Memory
  - Memory to Peripheral
  - Peripheral to Peripheral

### 1.3.13 GPIO subsystem

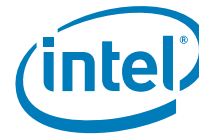
Two sets of GPIO signals are available; the ARC core can access its private group of GPIO lines and another set is accessible by both the ARC core and the main processor core.

#### 1.3.13.1 GPIO controller features

- All GPIOs are interrupt-capable supporting level-sensitive and edge-triggered modes.
- De-bounce logic for interrupt source.
- Four external and two internal awake-ON interrupts and wake-capable GPIOs.
- Up to four digital inputs and up to four analog inputs that can also be used as digital I/O; configuration dependent.
- Four Pulse Width Modulated outputs that can be configured as digital I/O lines.
- Separate data register bit and data direction control bit for each GPIO.
- GPIO registers retain their state during sleep and wake events.
- Software selectable drive strength via internal pull-up; unused lines must be configured inputs with internal pull up or GPIO with output set to low or set it input with external pull up.
- Interrupt mode supported for all GPIOs, with the following configuration:
  - Active High Level
  - Active Low Level
  - Rising Edge
  - Falling Edge.

---

1. Please note that peripherals for the sensor subsystem are not supported by the DMA controller.



— Both Edge

### 1.3.13.2 GPIO of Intel® Curie™ module

The Intel® Curie™ module provides up to 55 GPIO externally available GPIO lines that can be configured as:

- Four external AON/INT lines.
- Five lines used for analog input for the ADC mux.
- 34 GPIO / multifunction lines; these can be configured as GPIO if not consumed by other I/O signals. Refer to the Intel® Quark™ SE microcontroller datasheet for more information.
- 12 GPIO lines are used internally within the module.

The module internal GPIO signals are twelve in total: three dedicated to ARC, nine are shared and can be configured for either core. These are used internally for control or monitor / interrupt functions.

GPIO mapping tables are provided in section [Section 2.3.9](#)

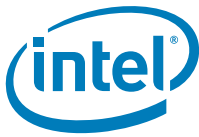
### 1.3.14 Timers and Pulse Width Modulator (PWM)

- Four counters capable of operating in PWM mode or timer mode.
- Configurable PWM high and low time with granularity of a single 32 MHz clock period per output.
- Timer mode supports 32-bit timer operating at 32 MHz.
- Two timers for ARC and two timers for LMT that can also be accessed by ARC core.
- ARC times can be configured as watchdog timers.

**Note:** PWM keep their state when going to sleep mode, allowing the application to set the wake configuration.

### 1.3.15 Analog comparators

- 19 analog comparators.
- Six high performance comparators.
- 13 low power comparators.
- Configurable polarity.
- Interrupt and wake event capable.
- Can be used with any of the AIN external pins or can be internally connected between the SoC and the resources on the Intel® Curie™ module.
- Wake events are supported by the low-power comparator interrupt.
- Comparator for Interrupt/wake event generation based on programmed match value.
- Each comparator can be powered down to achieve even lower power.



### 1.3.16 Watchdog timer (WDT)

- Configurable watchdog timer able to issue an interrupt and/or a system reset upon timeout.
- Selectable timeout value can be set between ~2ms and ~60s (at 32 MHz).
- Interrupt generation on first timeout.
- If the interrupt has not been cleared by the second timeout, the WDT requests a microcontroller warm reset to recover for an application program error or unexpected condition.

### 1.3.17 Real Time Clock (RTC)

- 32-bit counter running from 1 Hz up to 32.768 kHz
- Interrupt and wake event generation upon match of programmed value
- Only requires 32.768 kHz clock to be running to generate interrupt and wake events
- Provides an additional 32-bit always-on counter
- Provides an additional 32-bit always-on counter as a match count value to generate interrupt

### 1.3.18 Analog to Digital Converter (ADC) Unit

- Five analog inputs AIN\_11 – AIN\_14, 11 other possible analog inputs using alternate functions.
- ADC controller is only accessible from ARC and DMA controller. All configuration and read access is via ARC software.
- Successive-Approximation engine with selectable resolution (6, 8, 10 or 12 bit).
- 2.24 MSPS conversion rate - See Intel® Quark™ SE microcontroller Datasheet for more details.
- Internal voltage regulator and digital calibration algorithm to improve accuracy.
- Only single-ended input options supported.
- Digital offset calibration block aids the measurement and correction of the offset voltage for the ADC. This needs to be done after selection of the input pin and temperature or supply voltage changes. Many application do not require this type of accuracy and in that case initial calibration should be acceptable and re-calibration may not be required.
- ADC resolution set via ADC\_RES[1:0] register; lower bit resolution can be sampled faster than the 12 bit maximum.
  - 11 = 12 bit
  - 10 = 10 bit
  - 01 = 8 bit
  - 00 = 6 bit. Lower number of bit can be sampled quicker in less clock cycle than the 12 bit maximum number of bits.

**Note:** ADC block is a complex analog circuit and is sensitive to any noise from digital IO, RF, Ground and VCC which affect the accuracy of sampling. Depending on your application design and layout, some of the samples vary in measurement compared to others





because of external noise. Averaging samples, adding filtering to the input and increasing the number of clock for the sample and hold circuit is recommended where applicable.

**Note:** ADC supply voltage needs to match the AIN supply voltage and COMP\_AREF to make sure to meet the voltage requirement.

**Table 1-1. Intel® Curie™ module ADC interface external pins**

Analog Input Signal Name	Intel® Curie™ Module Pin Number
AIN_10	Pin J2
AIN_11	Pin H21
AIN_12	Pin H2
AIN_13	Pin L2
AIN_14	Pin C24

**Table 1-2. Intel® Quark™ SE microcontroller ADC interface pins connected to Intel® Curie™ module external pins**

Analog Input Signal Name	Intel® Quark™ SE Microcontroller Pin Number
AIN_10	Pin K5
AIN_11	Pin G1
AIN_12	Pin J4
AIN_13	Pin G2
AIN_14	Pin F1

**Table 1-3. Intel® Quark™ SE microcontroller ADC interface multifunction pins connected to Intel® Curie™ module external pins**

Optional Functions	Intel® Curie™ Module Pin Number (Intel® Quark™ SE Microcontroller Pin Number)
GPIO_SS0/UART1_CTS/AIN_8	J22 (Intel® Quark™ SE microcontroller pin L5)
GPIO_SS1/UART1_RTS/AIN_9	K21 (Intel® Quark™ SE microcontroller pin M5)
GPPIO0/SPI_S_CS_B/AIN_0	F3
GPPIO1/SPI_S_MISO/AIN_1	G3
GPPIO2/SPI_S_SCK/AIN_2	E4
GPPIO3/SPI_S_MOSI/AIN_3	F4
GPIO4/SW_FG_VBATT/AIN4	P21 (Intel® Quark™ SE microcontroller pin K6)
GPIO6/Intel® Quark™ SE microcontroller_SWDIO/ AIN6	E24 (Intel® Quark™ SE microcontroller pin H4)
GPIO7/5V_BUS_SENSE/AIN7	K4 (Intel® Quark™ SE microcontroller pin G3)
CHG_STATUS/AIN_15	M22 (Intel® Quark™ SE microcontroller pin J5)

### 1.3.19 Interrupt

The interrupt consists of the following and is described in the Intel® Quark™ SE microcontroller datasheet.

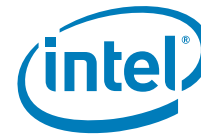
- Interrupt controller to either core or sensor subsystem provided in the system control subsystem
  - Interrupt controller
  - Configure interrupt priority
  - Level or pulse sensitivity
  - Fast interrupt support for the sensor subsystem second register bank for context switching without saving and restoring registers
  - Interrupt vector mapping showing the vector number and associated peripheral, core and co-processor
  - Interrupt wake event supported only by the AON signals identified by AON (Awake On / Always On) name

### 1.3.20 Power management

- Three SoC system states: Active, Sleep, and Off
- Intel Quark processor core states: C0 to C2
- Sensor subsystem states: Sensing Active, Sensing Wait, and Sensing Standby

The following helps reducing the total power consumption on the Intel® Curie™ module:

- Configuring the SoC IO voltages to 1.8 V instead of 3.3 V.
- Configuring any external resource to the SoC in Intel Curie module.
- If using Bluetooth® low energy, configure the software to set it in sleep mode when not used.
- If not using Bluetooth low energy nor the six-axis sensor for a long time, configure your design to turn off the power to both and turn it back on, initialize and use it when needed.
- Turn off/disable any of the internal power converters if not needed.
- To reduce any internal leakage, set to low any signal that goes to the powered off block so you don't leak current into that block. For example if you power off the Bluetooth low energy and six-axis sensor circuit externally, then set the enable signal and the GPIOs connected to these blocks including any interrupt pins.
- Enable internal pull-up on any of the unused inputs to the Intel Curie module and Intel® Quark™ SE microcontroller. You can turn the unused pins to output set to low condition instead if preferred instead of enabling internal pull-up. Just remember during any reset these internal pull-ups will not be enabled and the possibility of oscillation on these pins is increased. For this reason do not keep the module in reset for a long period of time. For example when the application board is not used, don't keep Intel Curie module in reset all the time.
- Any peripherals that are not used should be turned off to save power.
- When a peripheral is turned off, it is preferred to set any external signal connected to it to be in a logic low so it will not create any leakage increasing the power consumption of the application.



### 1.3.21 Power architecture

The power architecture is a power generation solution that provides both the internal – host and always on (AON) – and external (platform) supply rails. Some of these supply voltages can be internally or externally turned off to reduce power consumption for the application.

The Intel® Curie™ module internal power supply resources are limited and can only be used in some applications. Applications which require higher power can use the application power converter circuits to provide their power needs. If any of these voltage converters are not used, the application firmware and hardware need to disable the unused ones to reduce the leakage and improve the power consumption.

Also refer to third-party switching supplies and make sure their minimum output load is met otherwise their output voltage regulation may not be stable.

- A 3.3 V switching regulator (Intel Curie module internal 1.8 V/3.3 V) providing up to 300 mA current and able to handle a minimum load of 10 uA. It typically runs at 1.2 MHz switching frequency.
- A 3.3 V LDO regulator (Intel Curie module internal 3.3 V) providing up to 300 mA current. This is used to provide VUSB\_3p3 power to the SoC and can be turned on and off via GPIO. Auto discharge and enable pull down selected.
- A 3.3 V platform regulator (SoC PLAT\_3P3 Internal ESR1, Intel Curie module pin N1 - Switching Regulator). Provides up to 200 mA current. It requires an external inductor and a capacitor.

The following SoC internal power supply resources are limited and can only be used in some applications. The applications which require higher power can use Intel® Curie™ module power converters or additional application circuit to provide their power needs. If any of these voltage converters are not used, the application firmware and hardware need to disable the unused ones to reduce the leakage and improve the power consumption.

- A 1.8V platform regulator (SoC PLAT\_1P8 Internal ESR2, Intel® Curie™ module pin M4 - switching regulator). Provides up to 100 mA current. It requires external inductor and capacitor.
- A 1.8V host regulator (SoC HOST\_1P8 Internal ESR3, Intel® Curie™ module pin P4 - switching regulator) providing up to 100 mA current. It requires external inductor and capacitor.
- A 2.6V LDO regulator (SoC internal 2.6 V LDO, Intel® Curie™ module pin P4) providing up to 300 uA current used to enable Intel® Curie™ module internal LDO to supply VCC\_AON and comparator reference voltage.

### 1.3.22 Clock management

The system clock has the features listed hereafter. Specific properties are listed in [Table 1-4](#). The accuracy of the clock is maintained within the operating temperature range.

- Dynamic frequency scaling.
  - The clocks can be reduced for all blocks including core, ARC, pattern matching Engine, AHB bus, peripherals to reduce power consumption.
- Dynamic clock gating.



- For example SPI master clock can be gated off when not sending data to a peripheral and back on when it start using it.
- Autonomous state-based clock gating.
- Autonomous peripheral clock gating.

**Table 1-4. Intel® Curie™ module system clocks**

Clock	Use	Accuracy	Note
32 kHz	Always on timer	+/-5ppm	1
SoC Silicon Oscillator 4/8/16/32 MHz	Enabled at boot time	+/-20,000ppm	-
SoC XTAL Oscillator - 32 MHz	Can be enabled by software	+/-30ppm	Must be used to meet UART timing
16 MHz Bluetooth® low energy clock	Active during Bluetooth® low energy transmit/receive	+/-30ppm	-

**Notes:**

1. This is a MEMS-based temperature-compensated clock that feeds both the SoC and the Nordic\* Bluetooth® low energy controller. It is always running when power is applied. Primary use is for real time clock and software timer.

### 1.3.23 Test and debug

- Five-pin IEEE 1149.1 JTAG interface
- Boundary scan support
- ARC metaware debugger
- LMT minutia debugger
- Serial Boot Loader
- Bluetooth® low energy debug and program via J-Link / SWD emulator

### 1.3.24 Component references

- SoC: Intel® Quark™ SE microcontroller C1000
- Bluetooth® low energy: Nordic\* nRF51822--CEAAE0/PAN V3.0 (Stack S130)
- Balun, Transformer: BAL-NRF02D3
- Sensor: Bosch\* BMI160 (six-axis sensor)
- Battery charger: TI\* BQ25101H
- Power supervisor: Maxim\* MAX16074RS29D3+T
- Power supervisor: RICOH\* R3117K161C
- LDO 1.8 V: OnSemiconductor\* NCP170AMX180TCG
- LDO 3.3 V (USB): Microchip\* MIC5504-3.3YMT
- Buck regulator 1.8 V/3.3 V: TI\* TPS62743

**Note:** Refer to the respective third-party, and Intel® Quark™ SE microcontroller documents as required.



## 1.4 Bluetooth® low energy controller

### 1.4.1 Nordic\* nRF51822 overview

- 32-bit central processing unit
- Memory
  - 256 kB embedded flash
  - 16 KB RAM

### 1.4.2 Multi-protocol radio (2.4 GHz)

- +4 dBm to -20 dBm output power in 4 dBm steps; default TX power of 0 dbm
- -30 dBm output power in whisper mode
- Adjustable data rates and power levels at the application level, dependent upon driver and API

### 1.4.3 Connection method

The on-module Bluetooth® low energy controller device is interfaced to the processor via UART 0.

The processor software sends commands and receives status and messages from the Bluetooth low energy stack running in this block acting like a modem to simplify the software design.

### 1.4.4 Software stack support

The Nordic\* S130 Bluetooth® low energy protocol stack provides concurrent multi-link Central, Peripheral, Broadcaster, and Observer roles. The S130 is compliant with Bluetooth® 4.1 and the SoftDevice enables Bluetooth network topologies.

### 1.4.5 Clock

Intel® Curie™ module provides 16 MHz (run) and 32 kHz (standby) clocks to the Bluetooth® low energy controller; which contains additional oscillators

- 16 MHz XO
- 32 kHz clock oscillator shared between Bluetooth® low energy and the Intel® Quark™ SE microcontroller

### 1.4.6 Power system

The Nordic\* S130 Bluetooth® low energy protocol stack provides configuration parameters to allow the chip to go to sleep when idle. Alternately the controller can be powered by external sources for direct activation to create application specific states.

### 1.4.7 Programming and debug

Multiple methods are available to load a software image into the Bluetooth® low energy section:

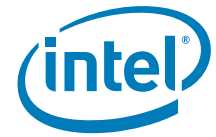
- If USB is implemented for the application, It can be used to load image using DFU utility.
- JTAG programmer (Flyswatter2\* or J-Link) supported by the Intel® Quark™ SE microcontroller can be used to load the image. For downloading to the Bluetooth low energy block, refer to the Nordic website.
- Software can implement other methods to receive the image from UART or Over-the-Air to program it.

## 1.5 Sensor device

The integrated 6-Axis sensing device offloads data management and averaging tasks from the system processor and provides accessory connection interface.

### 1.5.1 Feature summary

- Digital resolution
  - Accelerometer (A): 16 bit
  - Gyroscope (G): 16 bit
- Measurement ranges (programmable)
  - (A):  $\pm 2\text{ g}$ ,  $\pm 4\text{ g}$ ,  $\pm 8\text{ g}$ ,  $\pm 16\text{ g}$
  - (G):  $\pm 125^\circ/\text{s}$ ,  $\pm 250^\circ/\text{s}$ ,  $\pm 500^\circ/\text{s}$ ,  $\pm 1000^\circ/\text{s}$ ,  $\pm 2000^\circ/\text{s}$
- Sensitivity (calibrated)
  - (A):  $\pm 2\text{g}$ : 16384 LSB/g
  - $\pm 4\text{g}$ : 8192 LSB/g
  - $\pm 8\text{g}$ : 4096 LSB/g
  - $\pm 16\text{g}$ : 2048 LSB/g
  - (G):  $\pm 125^\circ/\text{s}$ : 262.4 LSB/ $^\circ/\text{s}$
  - $\pm 250^\circ/\text{s}$ : 131.2 LSB/ $^\circ/\text{s}$
  - $\pm 500^\circ/\text{s}$ : 65.6 LSB/ $^\circ/\text{s}$
  - $\pm 1000^\circ/\text{s}$ : 32.8 LSB/ $^\circ/\text{s}$
  - $\pm 2000^\circ/\text{s}$ : 16.4 LSB/ $^\circ/\text{s}$
- Zero-g offset (typ., over life-time)
  - (A):  $\pm 40\text{ mg}$
  - (G):  $\pm 10^\circ/\text{s}$
- Noise density (typ.)
  - (A): 180  $\mu\text{g}/\text{vHz}$
  - (G): 0.008  $^\circ/\text{s}/\text{vHz}$
- Bandwidths (programmable)
  - 1600 Hz ... 25/32 Hz
- Temperature range
  - -40 ... +85 $^\circ\text{C}$
- Current consumption



- full operation = 950  $\mu$ A
- low-power mode = 3  $\mu$ A
- FIFO data buffer
  - 1024 byte
- Shock resistance
  - 10,000 g x 200  $\mu$ s

## 1.5.2 Accessory sensor connections

The Intel® Curie™ module provides an I2C port for communication with an externally powered magnetometer to implement nine-axis (9AXIS) capability.

The sensor can interrupt the Intel® Quark™ SE microcontroller core when it needs priority attention.

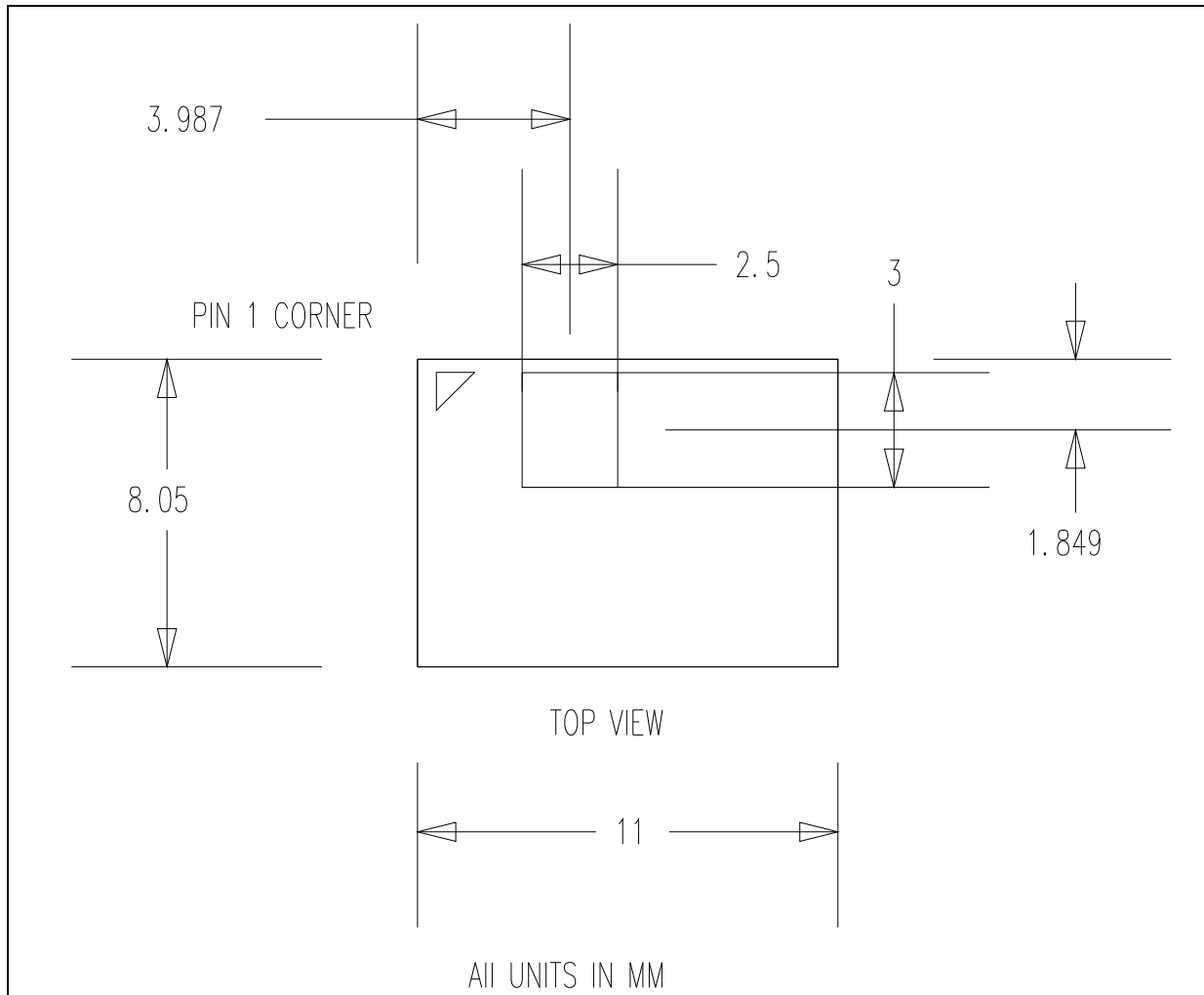
The sensor can interrupt the external magnetometer to coordinate the communication to it.

Refer to Bosch\* BMI160 datasheet and software library support.

### 1.5.3 Sensor position on Intel® Curie™ module

Figure 1-2 shows the approximate location of the sensor device within Intel® Curie™ module.

Figure 1-2. Intel® Curie™ module X-Y dimensions and position of the six-axis sensor







## 1.6 Memory

Intel® Quark™ SE microcontroller supports two address space mappings:

- Physical address space mappings
- Sensor subsystem auxiliary address space mappings

### 1.6.1 Memory map

#### 1.6.1.1 Physical address space mappings

There are 4 GB (32 bits) of physical address space that can be used as:

- Memory mapped I/O (MMIO – I/O fabric)
- Physical memory (system Flash/system SRAM/external SRAM)
- System Flash 0: 192 kilobytes (KB) (including system ROM)
- System ROM: 8 KB
- System Flash 1: 192 KB
- Internal System SRAM: 80 KB

**Note:** System ROM, Information memory. This is a flash memory write protected protect so it act as ROM but it can be updated with special sequence to enable the write.

In addition to this the Sensor Subsystem has an 8 KB DCCM (Data Closely Coupled Memory)

- The Intel Quark processor core and ARC core can access the full physical address space.

Other devices within Intel® Curie™ module can only access regions of physical address space presented to a given device via the multi-layer SoC fabric.

All Intel® Curie™ module peripherals except the ones on ARC, map their registers and memory to physical address space.

The ARC core maps peripherals directly attached to the sensor subsystem to an auxiliary address space that the ARC core has exclusive access to.

Refer to Intel® Quark™ SE microcontroller datasheet for the memory mapping information.

#### 1.6.1.2 Sensor subsystem auxiliary memory map

The ARC core has access to two physically separate memory spaces.

- The first memory space is the main memory space and is shared with the host processor and SoC peripherals.
- The other memory space is an auxiliary memory space that the ARC core uses to access peripherals that are directly connected to the sensor subsystem.

Only the ARC core can access the auxiliary memory space.



## 2 Ball Map and Pin Definitions

### 2.1 Module physical bump map

The module pin-out map is shown as a top view into the part.

Table 2-1. Module ball /pin map

	1	2	3	4						21	22	23	24
<b>A</b>	NO BALL	ATP_GND1	I2S_RXD	SPIO_M_CS1						6AXIS_SDA	6AXIS_SCL	6AXIS_INT2	ATP_GND1
<b>B</b>	I2S_RWS	I2S_RSCK	SPIO_M_CS0	ATP_RST_B						SPI1_M_CS2	SPI1_M_MISO	BLE_SDA	BT_GPIO
<b>C</b>	I2S_TWS	I2S_TSCK	SPIO_M_CS2	SPIO_M_SCK						SPI1_M_SCK	SPI1_M_CS3	ATP_GND1	GPIO/AIN_14
<b>D</b>	I2S_TXD	I2C1_SDA	SPIO_M_MOSI	SPIO_M_MISO						SPI1_M_CS1	SPI1_M_CS0	MRESET_B	BLE_SW_CLK
<b>E</b>	I2C1_SCL	I2C1_SS_SDA	PLT_CLK_0	ATP_SPI_S_SCK						AON_IO_VCC	SPI1_M_MOSI	POR_B	BLE_SWDIO
<b>F</b>	I2C1_SS_SCL	PWM3_OUT	ATP_SPI_S_CS	ATP_SPI_S_MOSI						ATP_INT3	ATP_INT0	BLE_SCL	BLE_RF
<b>G</b>	PWM2_OUT	PWM1_OUT	ATP_SPI_S_MISO	SPIO_SS_CS3						ATP_GND1	COMP_AREF	BLE_DEC2	ATP_GND1
<b>H</b>	PWM0_OUT	GPIO/AIN_12	SPIO_SS_CS1	SPIO_SS_CS0						GPIO/AIN_11	CMP_3P3_VCC	ADC_3P3_VCC	VDD_BLE_SEN
<b>J</b>	AVD_OPM_2P6	GPIO/AIN_10	SPIO_SS_MISO	SPIO_SS_SCK						UART1_TX	UART1_CTS	USB_DM	USB_DP
<b>K</b>	BUCK_VOUT	BUCK_VSEL	SPIO_SS_CS2	VDD_USB						UART1_RTS	UART1_RX	ATP_TRST_B	VIN[1]
<b>L</b>	LDO1P8_VOUT	GPIO/AIN_13	ATP_INT2	VSYS						ATP_ADC_AGND	BATT_ISET	ATP_TCK	ATP_TMS
<b>M</b>	PV_BATT	VDD_PLAT_1P8	SPIO_SS_MOSI	ESR2_LX						ATP_TDI	CHG_STATUS	ATP_TDO	I2C0_SCL
<b>N</b>	ESR1_LX	VDD_PLAT_3P3	ATP_INT1	ESR2_VBATT						VIN[2]	BATT_TEMP	I2C0_SS_SDA	I2C0_SS_SCL
<b>P</b>	ATP_GND1	ESR1_VBATT	VDD_HOST_1P8	ESR3_LX						SW_FG_VBATT	ATP_GND1	I2C0_SDA	ATP_GND1



## 2.2 Module to SoC mapping table

The Intel® Curie™ module is based on the Intel® Quark™ SE microcontroller, some of the microcontroller signals are used internally within the module to operate the integrated Bosch\* BMI160 six-axis sensor, the battery charger and the Nordic\* nRF51822 Bluetooth® low energy controller while other SoC signals are routed directly to the module interface.

The following table provides a high-level reference of signal mapping between the Intel® Quark™ SE microcontroller and the Intel® Curie™ module. It also includes, where available, alternate functions that interface pins can be configured as.

Consult the Intel® Quark™ SE microcontroller datasheet for additional information on specific microcontroller functions and registers.

**Table 2-2. Intel® Curie™ module to Intel® Quark™ SE microcontroller signal mapping**

Intel® Curie™ Module Ball Number	Ball Name	Primary Function	Alt Function1	Alt Function2	Intel® Quark™ SE Microcontroller/ Component Ball Name	Intel® Quark™ SE Microcontroller Ball Number
A1	No Ball	-	-	-	-	-
A2	ATP_GND1[3]	ATP_GND1[3]	VSS3	ATP_GND1	VSS	F03
A3	I2S_RXD	I2S_RXD	GPIO[15]	I2S_RXD	FST_EXTERNAL_PAD_49	B08
A4	SPI0_M_CS1	SPI0_M_CS_B[1]	GPIO[25]	SPI0_M_CS_B[1]	FST_EXTERNAL_PAD_59	A10
A21	6AXIS_SDA	6AXIS_SDA	ASDX (6AXIS / 2)	-	6AXIS I2C to external magnetometer to get 9AXIS	-
A22	6AXIS_SCL	6AXIS_SCL	ASCX (6AXIS / 3)	-		-
A23	6AXIS_INT2	6AXIS_INT2	INT2 (6AXIS / 9)	-		6AXIS Interrupt to external magnetometer to get 9AXIS
A24	ATP_GND1[9]	ATP_GND1[9]	VSS9	ATP_GND1	VSS	M01
B1	I2S_RWS	I2S_RWS	GPIO[17]	I2S_RWS	FST_EXTERNAL_PAD_51	B09
B2	I2S_RSCK	I2S_RSCK	GPIO[16]	I2S_RSCK	FST_EXTERNAL_PAD_50	A08
B3	SPI0_M_CS0	SPI0_M_CS_B[0]	GPIO[24]	SPI0_M_CS_B[0]	FST_EXTERNAL_PAD_58	E08
B4	ATP_RST_B	RST_B	RST_B		RST_N_PAD	F11
B21	SPI1_M_CS2	SPI1_M_CS_B[2]	GPIO[13]	SPI1_M_CS_B[2]	FST_EXTERNAL_PAD_47	B07
B22	SPI1_M_MISO	SPI1_M_MISO	GPIO[9]	SPI1_M_MISO	FST_EXTERNAL_PAD_43	D06
B23	Intel® Quark™ SE microcontroller_SDA	Intel® Quark™ SE microcontroller PO_31 / E8	-	-	BLE I2C to external device optional	-
B24	BT_GPIO	Intel® Quark™ SE microcontroller PO_18 / H1	-	-	BLE GPIO to external device optional	-



Table 2-2. Intel® Curie™ module to Intel® Quark™ SE microcontroller signal mapping

Intel® Curie™ Module Ball Number	Ball Name	Primary Function	Alt Function1	Alt Function2	Intel® Quark™ SE Microcontroller / Component Ball Name	Intel® Quark™ SE Microcontroller Ball Number
C1	I2S_TWS	I2S_TWS	GPIO[19]	I2S_TWS	FST_EXTERNAL_PAD_53	C09
C2	I2S_TSCK	I2S_TSCK	GPIO[18]	I2S_TSCK	FST_EXTERNAL_PAD_52	A09
C3	SPIO_M_CS2	SPIO_M_CS_B[2]	GPIO[26]	SPIO_M_CS_B[2]	FST_EXTERNAL_PAD_60	B10
C4	SPIO_M_SCK	SPIO_M_SCK	GPIO[21]	SPIO_M_SCK	FST_EXTERNAL_PAD_55	D08
C21	SPI1_M_SCK	SPI1_M_SCK	GPIO[8]	SPI1_M_SCK	FST_EXTERNAL_PAD_42	C06
C22	SPI1_M_CS3	SPI1_M_CS_B[3]	GPIO[14]	-	FST_EXTERNAL_PAD_48	A07
C23	ATP_GND1[5]	ATP_GND1[5]	VSS5	ATP_GND1	VSS	L12
C24	GPIO/AIN_14	GPIO_SS[6]	GPIO_SS[6]	AIN[14]	FST_EXTERNAL_PAD_14	F01
D1	I2S_TXD	I2S_TXD	GPIO[20]	I2S_TXD	FST_EXTERNAL_PAD_54	D09
D2	I2C1_SDA	I2C1_SDA	I2C1_SDA	-	FST_EXTERNAL_PAD_23	D02
D3	SPIO_M_MOSI	SPIO_M_MOSI	GPIO[23]	SPIO_M_MOSI	FST_EXTERNAL_PAD_57	E09
D4	SPIO_M_MISO	SPIO_M_MISO	GPIO[22]	SPIO_M_MISO	FST_EXTERNAL_PAD_56	E07
D21	SPI1_M_CS1	SPI1_M_CS_B[1]	GPIO[12]	SPI1_M_CS_B[1]	FST_EXTERNAL_PAD_46	C07
D22	SPI1_M_CS0	SPI1_M_CS_B[0]	GPIO[11]	SPI1_M_CS_B[0]	FST_EXTERNAL_PAD_45	D07
D23	MRESET_B	MR (MAX16074 / B2)	-	-	-	-
D24	Intel® Quark™ SE microcontroller_SW_CLK	SWDCLK (Intel® Quark™ SE microcontroller / H2)	GPIO[27]	SPIO_M_CS_B[3]	FST_EXTERNAL_PAD_61	C10
E1	I2C1_SCL	I2C1_SCL	-	-	FST_EXTERNAL_PAD_22	D01
E2	I2C1_SS_SDA	I2C1_SS_SDA	-	-	FST_EXTERNAL_PAD_26	B03
E3	PLT_CLK_0	PLT_CLK[0]	GPIO_SS[14]	PLT_CLK[0]	FST_EXTERNAL_PAD_67	D12
E4	ATP_SPI_S_SCK	SPI_S_SCK	GPIO[2]	AIN[2]/SPI_S_SCK	FST_EXTERNAL_PAD_02	H05
E21	AON_IO_VCC	AON_IO_VCC	VCC_IO_AON1	VCC_IO_AON1	VCC_IO_AON1	A11
			VCC_IO_AON2	VCC_IO_AON2	VCC_IO_AON2	G06
E22	SPI1_M_MOSI	SPI1_M_MOSI	GPIO[10]	SPI1_M_MOSI	FST_EXTERNAL_PAD_44	E06
E23	POR_B	RESETN (MAX16074 / B1)	-	-	Power supervisory Power On Reset output	-



Table 2-2. Intel® Curie™ module to Intel® Quark™ SE microcontroller signal mapping

Intel® Curie™ Module Ball Number	Ball Name	Primary Function	Alt Function1	Alt Function2	Intel® Quark™ SE Microcontroller/ Component Ball Name	Intel® Quark™ SE Microcontroller Ball Number
E24	BLE_SWDIO	SWDIO (BLE/J2)	(GPIO[6])	AIN[6]	FST_EXTERNAL_PAD_06	H04
F1	I2C1_SS_SCL	I2C1_SS_SCL	I2C1_SS_SCL	-	FST_EXTERNAL_PAD_27	A03
F2	PWM3_OUT	PWM[3]	GPIO_SS[13]	PWM[3]	FST_EXTERNAL_PAD_66	B11
F3	ATP_SPI_S_CS	SPI_S_CS_B	GPIO[0]	AIN[0] / SPI_S_CS_B	FST_EXTERNAL_PAD_00	F02
F4	ATP_SPI_S_MOSI	SPI_S_MOSI	GPIO[3]	AIN[3] / SPI_S_MOSI	FST_EXTERNAL_PAD_03	J06
F21	ATP_INT3	ATP_INT3	GPIO_AON[3]	-	AON_GPIO_PAD_3	F09
F22	ATP_INT0	ATP_INT0	GPIO_AON[0]	-	AON_GPIO_PAD_0	G09
F23	BLE_SCL	BLE P0_30 / D8		-	BLE I2C to external device optional	-
F24	BLE_RF	BALUN SE / A1	-	-	Antenna Micro Strip (50 ohms)	-
G1	PWM2_OUT	PWM[2]	GPIO_SS[12]	PWM[2]	FST_EXTERNAL_PAD_65	C11
G2	PWM1_OUT	PWM[1]	GPIO_SS[11]	PWM[1]	FST_EXTERNAL_PAD_64	D11
G3	ATP_SPI_S_MISO	SPI_S_MISO	GPIO[1]	AIN[1]	FST_EXTERNAL_PAD_01	G04
G4	SPI0_SS_CS3	SPI0_SS_CS_B[3]	GPIO[30]	SPI0_SS_CS_B[3]	FST_EXTERNAL_PAD_34	A04
G21	ATP_GND1[7]	ATP_GND1[7]	VSS7	ATP_GND1	VSS	M11
G22	COMP_AREF	COMP_AREF	COMP_AREF		COMP_AREF (or AREF_PAD)	F05
G23	BLE_DEC2	DEC2 (BLE / F1)	-	-	-	-
G24	ATP_GND1[6]	ATP_GND1[6]	VSS6	ATP_GND1	VSS	M12
H1	PWM0_OUT	PWM[0]	GPIO_SS[10]	PWM[0]	FST_EXTERNAL_PAD_63	E10
H2	GPIO/AIN_12	GPIO_SS[4]	GPIO_SS[4]	AIN[12]	FST_EXTERNAL_PAD_12	J04
H3	SPI0_SS_CS1	SPI0_SS_CS_B[1]	SPI0_SS_CS_B[1]	-	FST_EXTERNAL_PAD_32	C04
H4	SPI0_SS_CS0	SPI0_SS_CS_B[0]	SPI0_SS_CS_B[0]	-	FST_EXTERNAL_PAD_31	D04
H21	GPIO/AIN_11	GPIO_SS[3]	GPIO_SS[3]	AIN[11]	FST_EXTERNAL_PAD_11	G01
H22	CMP_3P3_VCC	CMP_3P3_VCC	VCC_CMP_3P3[2]	-	VCC_CMP_3P3[2]	J03
			VCC_CMP_3P3[1]	-	VCC_CMP_3P3[1]	M02
H23	ADC_3P3_VCC	-	-	-	-	-
H24	VDD_BLE_SEN	-	-	-	-	-



Table 2-2. Intel® Curie™ module to Intel® Quark™ SE microcontroller signal mapping

Intel® Curie™ Module Ball Number	Ball Name	Primary Function	Alt Function1	Alt Function2	Intel® Quark™ SE Microcontroller/ Component Ball Name	Intel® Quark™ SE Microcontroller Ball Number
J1	OPM2P6_VOUT	OPM2P6_VOUT	VCC_AVD_OPM_2P6	-	VCCOUT_AVD_OPM_2P6	K11
		AVD_OPM_2P6	VCCOUT_AVD_OPM_2P6	-		
		VCC_AVD_OPM_2P6	VCC_AVD_OPM_2P6	-	VCC_AVD_OPM_2P6	K12
		AVD_OPM_2P6	-			
J2	GPIO/AIN_10	GPIO_SS[2]	-	AIN[10]	FST_EXTERNAL_PAD_10	K05
J3	SPIO_SS_MISO	SPIO_SS_MISO	SPIO_SS_MISO	-	FST_EXTERNAL_PAD_28	C03
J4	SPIO_SS_SCK	SPIO_SS_SCK	SPIO_SS_SCK	-	FST_EXTERNAL_PAD_30	D03
J21	UART1_TX	UART1_TX	GPIO_SS[8]	AIN[16]/UART1_TXD	FST_EXTERNAL_PAD_16	L04
J22	UART1_CTS	UART1_CTS	GPIO_SS[0]	AIN[8]/UART1_CTS_B	FST_EXTERNAL_PAD_08	L05
J23	USB_DM	USB_DM	USB_DN	-	USB_PADN	H02
J24	USB_DP	USB_DP	USB_DP	-	USB_PADP	H01
K1	BUCK_VOUT	BUCK_VOUT	-	-	-	-
K2	BUCK_VSEL	VSEL1,3 (TPS62743)	-	-	-	-
K3	SPIO_SS_CS2	SPIO_SS_CS2	SPIO_SS_CS_B[2]	GPIO[29]	FST_EXTERNAL_PAD_3	B04
K4	VDD_USB	VDD_USB	-	-	-	G3
K21	UART1_RTS	UART1_RTS	GPIO_SS[1]	AIN[9]/UART1_RTS_B	FST_EXTERNAL_PAD_09	M05
K22	UART1_RX	UART1_RX	GPIO_SS[9]	AIN[17]/UART1_RXD	FST_EXTERNAL_PAD_17	M04
K23	ATP_TRST_B	ATP_TRST_B	TRST_B	-	TRST_PAD	G05
K24	VIN[1]	VIN (BQ25101 / A2)	-	-	-	-
L1	LDO1P8_VOUT	LDO1P8_VOUT	VCC_AON_1P8[2]	-	VCC_AON_1P8	A02
			VCC_SRAM_1P8	-	VCC_SRAM_1P8	C08
			VCC_RTC_1P8	-	VCC_RTC_1P8	G10
			VCC_AON_1P8[1]	-	VCC_AON_1P8	J07
L2	GPIO/AIN_13	GPIO/AIN_13	GPIO_SS[5]	AIN[13]	FST_EXTERNAL_PAD_13	G02
L3	ATP_INT2	ATP_INT2	GPIO_AON[2]	-	AON_GPIO_PAD_2	E12
L4	VSYS	VSYS	VCC_BATT_OPM_3P7	-	VCC_BATT_OPM_3P7	L10
			VCC_BATT_ESR3_3P7	-	VCC_BATT_ESR3_3P7	M09



Table 2-2. Intel® Curie™ module to Intel® Quark™ SE microcontroller signal mapping

Intel® Curie™ Module Ball Number	Ball Name	Primary Function	Alt Function1	Alt Function2	Intel® Quark™ SE Microcontroller/ Component Ball Name	Intel® Quark™ SE Microcontroller Ball Number
L21	ATP_ADC_AGND	ATP_ADC_AGND	VSS_ADC_AGND	-	VSS_ADC_AGND	L03
L22	BATT_ISET	BATT_ISET	-	-	-	-
L23	ATP_TCK	ATP_TCK	TCK	-	TCK_PAD	G07
L24	ATP_TMS	ATP_TMS	TMS	-	TMS_PAD	F06
M1	PV_BATT	OUT (BQ25101 / A1)	-	-	-	-
M2	VDD_PLAT_1P8	VDD_PLAT_1P8	VCCOUT_QLR2_1P8	-	VCCOUT_QLR2_1P8	J11
M3	SPI0_SS_MOSI	SPI0_SS_MOSI	SPI0_SS_MOSI	-	FST_EXTERNAL_PAD_29	E03
M4	ESR2_LX	ESR2_LX	VCCOUT_ESR2_1P8	-	EXTERNAL_PAD_17	J12
M21	ATP_TDI	ATP_TDI	TDI	-	TDI_PAD	F04
M22	CHG_STATUS	CHGN (BQ25101 / C1)	GPIO_SS[7]	AIN[15]	EXTERNAL_PAD_15	J05
M23	ATP_TDO	ATP_TDO	TDO	-	TDO_PAD	F08
M24	I2C0_SCL	I2C0_SCL	I2C0_SCL	-	EXTERNAL_PAD_20	C01
N1	ESR1_LX	ESR1_LX	VCCOUT_ESR1_3P3	-	VCCOUT_ESR1_3P3	J08
N2	VDD_PLAT_3P3	VDD_PLAT_3P3	VCC_VSENSE_ESR1	-	VCC_VSENSE_ESR1	H09
			VCCOUT_QLR1_3P3	-	VCCOUT_QLR1_3P3	J09
N3	ATP_INT1	ATP_INT1	GPIO_AON[1]	-	AON_GPIO_PAD_1	E11
N4	ESR2_VBATT	ESR2_VBATT	VCC_BATT_ESR2_3P7	-	VCC_BATT_ESR2_3P7	L11
N21	VIN[2]	VIN (BQ25101 / A2)	-	-	-	-
N22	BATT_TEMP	TSN (BQ25101 / B1)	-	-	-	-
N23	I2C0_SS_SDA	I2C0_SS_SDA	I2C0_SS_SDA	-	FST_EXTERNAL_PAD_24	E01
N24	I2C0_SS_SCL	I2C0_SS_SCL	I2C0_SS_SCL	-	FST_EXTERNAL_PAD_25	E02
P1	ATP_GND1[1]	ATP_GND1[1]	VSS1	ATP_GND1	VSS	A01
P2	ESR1_VBATT	ESR1_VBATT	VCC_BATT_ESR1_3P7	-	VCC_BATT_ESR1_3P7	M10
P3	VDD_HOST_1P8	VDD_HOST_1P8	VCC_HOST_1P8[2]	-	VCC_HOST_1P8[2]	A05
			VCC_HOST_1P8[1]	-	VCC_HOST_1P8[1]	H06
			VCC_PLL_1P8	-	VCC_PLL_1P8	K03
			VCCOUT_HOST_1P8	-	VCCOUT_HOST_1P8	K10

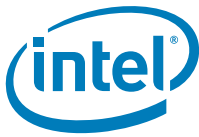


Table 2-2. Intel® Curie™ module to Intel® Quark™ SE microcontroller signal mapping

Intel® Curie™ Module Ball Number	Ball Name	Primary Function	Alt Function1	Alt Function2	Intel® Quark™ SE Microcontroller / Component Ball Name	Intel® Quark™ SE Microcontroller Ball Number
P4	ESR3_LX	ESR3_LX	VCCOUT_ESR3_1P8	-	VCCOUT_ESR3_1P8	K09
P21	SW_FG_VBATT	SW_FG_VBATT (AIN[4])	-	-	FST_EXTERNAL_PAD_04	K06
P22	ATP_GND1[4]	-	-	-	-	-
P23	I2C0_SDA	I2C0_SDA	I2C0_SDA	-	FST_EXTERNAL_PAD_21	C02
P24	ATP_GND1[10]	ATP_GND1[10]	VSS9	ATP_GND1	VSS	M01
-	Internal to 6AXIS	6AXIS_MISO	SDO (6AXIS / 1)	SPI1_SS_MISO	-	B05
-		6AXIS_MOSI	SDX (6AXIS / 14)	SPI1_SS_MOSI	EXTERNAL_PAD_36	C05
-		6AXIS_SCLK	SCX (6AXIS / 13)	SPI1_SS_SCK	EXTERNAL_PAD_37	D05
-		6AXIS_CS	CSB (6AXIS / 12)	SPI1_SS_CS_B[0]	EXTERNAL_PAD_38	E05
-		6AXIS_INT1	INT1 (6AXIS / 4)	GPIO_AON[4]	AON_GPIO_PAD_4	F10
-	Internal to BLE	Intel® Quark™ SE microcontroller_U ART_CTS	PO_12 (Intel® Quark™ SE microcontroller / J5)	SPI1_SS_CS_B[2]	UART0_CTS_B	A06
-		UART0_TXD	PO_09 (BLE / J7)	UART0_TXD	GPIO[31]	B02
-		Intel® Quark™ SE microcontroller_U ART_RTS	PO_10 (BLE / H6)	SPI1_SS_CS_B[3]	UART0_RTS_B	B06
-		UART0_RXD	PO_11 (BLE / J6)	UART0_RXD	AIN[18]	K04
-		ATP_BLE_INT	GPIO[5]	AIN[5]	EXTERNAL_PAD_05	L06
-	ATP_GND1	ATP_GND1[2]	VSS2	ATP_GND1	VSS	B01
-		ATP_GND1	VSS8			M06



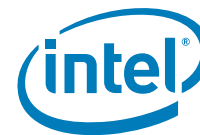


Table 2-2. Intel® Curie™ module to Intel® Quark™ SE microcontroller signal mapping

Intel® Curie™ Module Ball Number	Ball Name	Primary Function	Alt Function1	Alt Function2	Intel® Quark™ SE Microcontroller/ Component Ball Name	Intel® Quark™ SE Microcontroller Ball Number
-	GND	-	-	-	VSS_IO_AON1	B12
-		-	-	-	VSS_IO_AON2	F07
-		-	-	-	VSS_GNDSSENSE_OPM	K07
-		-	-	-	VSS_PLL	L02
-		-	-	-	VSS_RTC	H11
-		-	-	-	VSS_USB	J01
-		-	-	-	VSS_AVSS_ESR1	L07
-		-	-	-	VSS_GNDSSENSE_ESR1	L08
-		-	-	-	VSS_AVSS_ESR2	H07
-		-	-	-	VSS_GNDSSENSE_ESR2	H08
-		-	-	-	VSS_GNDSSENSE_ESR3	M07
-		-	-	-	VSS_AVSS_ESR3	M08
-		-	-	-	VSS_AVSS_CMP1	H03
-		-	-	-	VSS_AVSS_CMP2	L01
-		-	-	PLT_REG_EN	-	PLT_REG_EN
-	VSYS	VCC (MAX16074 / A2)	-	-	Power supervisory Power On Reset output	-

## 2.3 Pin definitions

### 2.3.1 Battery and power management pins

Table 2-3. Battery and power management pins (continued)

Ball	Ball Name	Function
P21	SW_FG_VBATT	Analog input for software fuel gauge (bat voltage measurement). Connected to SoC AIN4 and can be configured via software to use ADC to measure voltage or current.
K04	VDD_USB	DC power for USB interface (optional). This is supplied to the module by the USB cable or external 5 V supply. It is also connected to SoC AIN7 internally via voltage divider to be able to detect the voltage presence by software (22k pull down / 36k pull-up to VDD_USB). Then USB voltage converter can be enabled by VUSB_EN (GPIO28) to provide 3.3 V to the SoC for USB controller.
K24, N21	VIN[1], VIN[2]	Battery charger input voltage, These two pins are connected together internally in module to provide more current. Both pins externally need to be connected to the same voltage source.
L04	VSYS	Main DC input power. Provides input voltage to BUCK_VOUT (TPS62743) converter, VCC_BATT_OPM_3P7 (SoC), VCC_BATT_ESR3_3P7 (SoC), VCC_AON_PWR (NCP170AMX180TCG).
L22	BATT_ISET	Use a Pull-Down resistor value 0.54-13.5 Kohm to set charging current. Do not leave floating. Refer to (BQ2510H) datasheet for ISET.
M01	PV_BATT	Battery charger output (4.35 V max +/- 50 mV) to battery (positive) to charge it. External application circuit can be added for protection or / and fuel gauge circuit.
M22	CHG_STATUS	Open drain (15 mA max) pulls low when battery is being charged.



**Table 2-3. Battery and power management pins (continued)**

Ball	Ball Name	Function
N22	BATT_TEMP	Connect to battery thermistor. See TI BQ25101H* Datasheet for details. If battery does not have internal thermistor to measure temperature, then external thermistor can be used touching the battery to measure temperature for safety and meeting charging requirement of the battery manufacture for reliability.
J01	OPM2P6_VOUT	2.6 V reference voltage output. Can be used to power CMP_3P3_VCC. Otherwise leave disconnected.
L01	LDO1P8_VOUT	AON LDO power output. If used outside Intel® Curie™ module, maximum of 50 mA can be drawn externally. It is also connected internally to the SoC VCC_AON_1P8[1], VCC_AON_1P8[2], VCC_SRAM_1P8.

### 2.3.2 Platform buck converter pins

**Table 2-4. Platform buck converter pins**

Ball	Ball Name	Function
K01	BUCK_VOUT	Buck converter output of 1.8 V / 3.3 V. It can be connected and used for Awake ON (AON) IO supply voltage. Connect a 0.1uF decoupling capacitor. The input voltage requirement is minimum of 3.7 V and Maximum of 4.4 V. Internal signal BUCK_EN (GPIO_SS15) signal is used for software to disable or enable this converter. If software does not configure the BUCK_EN signal and leave it floating then AON_IO_VCC will enable it via a 10M pull-up resistor. It is highly recommended to enable and disable this via software. In some noisy application this pull-up may not be enough to keep this converter enabled all the time.
K02	BUCK_VSEL	0 (Ground) sets BUCK_VOUT to 1.8 V 1 (VSY) sets BUCK_VOUT to 3.3 V

### 2.3.3 Additional buck converter pins

**Table 2-5. Additional buck converter pins**

Ball	Ball Name	Function
M02	VDD_PLAT_1P8	Platform 1.8 V output
M04	ESR2_LX	External inductor and capacitor connection (for Platform 1V8)
N01	ESR1_LX	External inductor and capacitor connection (for Platform 3V3)
N02	VDD_PLAT_3P3	Platform 3.3 V output
N04	ESR2_VBATT	DC input for switching regulator 2
P02	ESR1_VBATT	DC input for switching regulator 1
P03	VDD_HOST_1P8	1.8 V input to host SoC
P04	ESR3_LX	External inductor and capacitor connection (for Host 1V8)

### 2.3.4 Reference voltage pins

**Table 2-6. Reference voltages on module (continued)**

Ball	Ball Name	Function
G22	COMP_AREF	Comparator reference voltage external input. Software selectable external 0-3.63 V or internal 1.09 V reference voltage



Table 2-6. Reference voltages on module (continued)

Ball	Ball Name	Function
E21	AON_IO_VCC	Always-on GPIO supply voltage
H22	CMP_3P3_VCC	Comparator supply voltage. See Table 3-5 for voltage specifications.
H23	ADC_3P3_VCC	ADC supply and reference voltage

### 2.3.5 Module ground pins

Table 2-7. Ground pins

Ball	Ball Name	Function
A02	ATP_GND1[3]	Module ground
A24	ATP_GND1[9]	Module ground
C23	ATP_GND1[5]	Module ground
G21	ATP_GND1[7]	Module ground
G24	ATP_GND1[6]	Module ground
L21	ATP_ADC_AGND	Analog ground. Can be connected directly to analog ground at a single point.
P01	ATP_GND1[1]	Module ground
P22	ATP_GND1[4]	Module ground
P24	ATP_GND1[10]	Module ground



### 2.3.6 Miscellaneous programming and debugging pins

Table 2-8. Miscellaneous pins

Ball	Ball Name	Function
B04	ATP_RST_B	SoC hardware reset. Active low. See <a href="#">Section 4.4</a> for information on reset wiring.
D23	MRESET_B	Manual reset. Connect POR_B to reset signal ATP_RST_B and pull low trigger a hardware reset. Refer Power supervisor chip (MAX16074) datasheet for more information.
E23	POR_B	Power on reset from power supervisor chip. Active low / open drain requires a pull-up on this signal. Refer Power supervisor chip (MAX16074) datasheet for more information.
L23	ATP_TCK	JTAG emulator debugger / programmer TCK signal.
M21	ATP_TDI	JTAG emulator debugger / programmer TDI signal.
M23	ATP_TDO	JTAG emulator debugger / programmer TDO signal.
L24	ATP_TMS	JTAG emulator debugger / programmer TMS signal.
K23	ATP_TRST_B	JTAG emulator debugger / programmer TRST signal.

**Note:** When JTAG emulator is used to connect here, the emulator options needs to be configured appropriately to ensure there are no conflicts with these.

### 2.3.7 Wake capable interrupt pins

Table 2-9. Intel® Quark™ SE microcontroller always-on wake capable interrupt pins

Ball	Ball Name	Function	Drive (Low / High)
F22	ATP_INT0	AON GPIO_AON0 / Always On Wake capable digital IO / Interrupt 0, can be configured for one of the two cores.	4mA / 8mA
N3	ATP_INT1	AON GPIO_AON1 / Always On Wake capable digital IO / Interrupt 1, can be configured for one of the two cores.	4mA / 8mA
L3	ATP_INT2	AON GPIO_AON2 / Always On Wake capable digital IO / Interrupt 2, can be configured for one of the two cores.	4mA / 8mA
F21	ATP_INT3	AON GPIO_AON3 / Always On Wake capable digital IO / Interrupt 3, can be configured for one of the two cores.	4mA / 8mA

**Note:** These signals can be programmed to be GPIO input or output. These are always powered and useful for bringing the SoC out of sleep mode

### 2.3.8 Clock out pin

Table 2-10. Clock pins

Ball	Ball Name	Primary Function	Alt Function1	Drive (Low / High)
E3	PLT_CLK_0	32/16/8/4MHz Clock output from module	GPIO_SS[14]	4/8mA

**Note:** Software can enable this pin to bring out the SoC core clock (32/16/8/4) and can be used for debugging or synchronizing application circuit. If application does not need it, you should not enable it to reduce power consumption.



## 2.3.9 GPIO pin mapping

### 2.3.9.1 Dedicated GPIO/analog input pins

These GPIO lines have a fixed configuration.

**Table 2-11. Dedicated GPIO/Analog input pins**

Ball	Ball Name	Primary Function	Alt Function1	Drive (Low / High)	Internal Pull Up / Down
J2	GPIO / AIN_10	GPIO_SS[2] (Should be used only for sensor devices)	AIN[10]	Selectable as 4/8	47 kohm
H21	GPIO / AIN_11	GPIO_SS[3] (Should be used only for sensor devices)	AIN[11]		
H2	GPIO / AIN_12	GPIO_SS[4] (Should be used only for sensor devices)	AIN[12]		
L2	GPIO / AIN_13	GPIO_SS[5] (Should be used only for sensor devices)	AIN[13]		
C24	GPIO / AIN_14	GPIO_SS[6] (Should be used only for sensor devices)	AIN[14]		
M22	GPIO / AIN_15	GPIO_SS[7] (Should be used only for sensor devices)	AIN[15]		
<p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>1. CHG_STATUS can be read via software at GPIO[7] / AIN[15]</li> <li>1. Charge Status: Open drain (LOW) means charging and open means complete first charging cycle is complete</li> <li>2. GPIO[7] / AIN[15] is connected to the external pin (M22) for the device hardware to read the state</li> <li>3. Internal or external pull up resistor should be used for this pin</li> <li>4. If Battery charger is not used then AIN[15] can be used as an external analog input or GPIO[7]. Disable battery charger by connecting BATT_TEMP to ground.</li> <li>5. CHG_STATUS or AIN15 is also connected to Nordic* chip port PO_00. Make sure you keep this pin floating and not define it as output.</li> </ol>					
<p><b>Note:</b> Internal Pull Up resistors are disabled at reset.</p>					

### 2.3.9.2 Dedicated GPIO/AON/INT mapping module to SoC

This table shows the GPIO pins that are directly connected from the module pin to the SoC.

**Table 2-12. Dedicated GPIO/AON/INT**

Intel® Curie™ Module Pin	Intel® Curie™ Module Signal	Intel® Quark™ SE Microcontroller Signal	Intel® Quark™ SE Microcontroller Pin
F22	ATP_INT0	GPIO_AON0	G9
N03	ATP_INT1	GPIO_AON1	E11
L3	ATP_INT2	GPIO_AON2	E12
F21	ATP_INT3	GPIO_AON3	F9
J02	AIN[10]	GPIO_SS[2]	K05
H21	AIN[11]	GPIO_SS[3]	G01
H02	AIN[12]	GPIO_SS[4]	J04
L02	AIN[13]	GPIO_SS[5]	G02
C24	AIN[14]	GPIO_SS[6]	F01



**Note:** Only AON pins and timers can wake the module from sleep.

### 2.3.9.3 GPIO multifunction mapping

These GPIO can be configured for primary or alternate function

**Table 2-13. GPIO / Multifunction lines (continued)**

Intel® Curie™ Module Pin	Primary Function	Alternate Function 1	Alternate Function 2
A03	I2S_RXD	GPIO[15]	-
A04	SPIO_M_CS1	GPIO[25]	-
B01	I2S_RWS	GPIO[17]	-
B02	I2S_RSCK	GPIO[16]	-
B03	SPIO_M_CS0	GPIO[24]	-
B21	SPI1_M_CS2	GPIO[13]	-
B22	SPI1_M_MISO	GPIO[9]	-
C01	I2S_TWS	GPIO[19]	-
C02	I2S_TSCK	GPIO[18]	-
C03	SPIO_M_CS2	GPIO[26]	-
C04	SPIO_M_SCK	GPIO[21]	-
C21	SPI1_M_SCK	GPIO[8]	-
C22	SPI1_M_CS3	GPIO[14]	-
D01	I2S_TXD	GPIO[20]	-
D03	SPIO_M_MOSI	GPIO[23]	-
D04	SPIO_M_MISO	GPIO[22]	-
D21	SPI1_M_CS1	GPIO[12]	-
D22	SPI1_M_CS0	GPIO[11]	-
E03	PLT_CLK[0]	GPIO_SS[14]	-
E04	SPI_S_CLK	GPIO[2]	AIN[2]
E22	SPI1_M_MOSI	GPIO[10]	-
F02	PWM3_out	GPIO_SS[13]	-
F03	SPI_S_CS_B	GPIO[0]	AIN[0]
F04	SPI_S_MOSI_B	GPIO[3]	AIN[3]
G01	PWM2_out	GPIO_SS[12]	-
G02	PWM1_out	GPIO_SS[11]	-
G03	SPI_S_MISO	GPIO[1]	AIN[1]
G04	SPIO_SS_CS3	GPIO[30]	-
H01	PWM0_out	GPIO_SS[10]	-
J21	UART1_TX	GPIO_SS[8]	AIN[16]
J22	UART1_CTS_B	GPIO_SS[0]	AIN[8]
K03	SPIO_SS_CS2	GPIO[29]	-
K21	UART1_RTS_B	GPIO_SS[1]	AIN[9]



Table 2-13. GPIO / Multifunction lines (continued)

Intel® Curie™ Module Pin	Primary Function	Alternate Function 1	Alternate Function 2
K22	UART1_RX	GPIO_SS[9]	AIN[17]

### 2.3.9.4 Internal GPIO mapping

Table 2-14. Internal GPIO signals

Intel® Curie™ Module Signal (Primary Function)	Intel® Curie™ Module Signal (Secondary Function)	Intel® Quark™ SE Microcontroller/Component Signal	Intel® Quark™ SE Microcontroller Pin
CHG_STATUS (Intel® Curie™ module Pin M22)	SPIO_SS[7]	AIN[15]	J5
UART0_TXD	GPIO[31]	BLE J6	-
UART0_RXD	AIN[18]	BLE J7	-
BUCK_EN	GPIO_SS[15]	BUCK CONVERTER Enable PIN B1	PLT_CLK[1]
ATP_BLE_INT	GPIO[5]	BLE H4	AIN[5]
5V_BUS_SENSE	GPIO[7]	AIN[7]	G3 VDD_USB (via resistor)
BLE_SW_CLK (Intel® Curie™ module PIN D24)	BLE_SW_CLK	GPIO[27]	C10
VUSB_EN	GPIO[28]	LDO VUSB PIN3 EN	D10
SW_FG_VBATT (Intel® Curie™ module PIN P21)	SW_FG_VBAT	GPIO[4]/AIN[4]	K6
BLE_SWDIO (Intel® Curie™ module PIN E24)	BLE_SWDIO (BLE PIN J2)	GPIO[6]/AIN[6]	H4

**Note:** Application software can be designed using SW\_FG\_VBAT to interrupt the SoC to control the application external battery charging / protection circuit in addition to the battery charger internal resources. SoC can monitor voltages and send signal to application circuit to turn on and off the supply voltage (VIN) to the charger circuit.

**Note:** BLE\_SW\_CLK signal has a 22 kohm internal pull down resistor to keep it from floating.

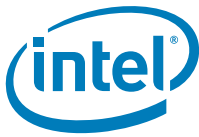
**Note:** BLE\_SW\_WDIO signal has a 22 kohm internal pull up resistor to keep it from floating.

**Note:** BLE\_SW\_CLK and BLE\_SWDIO is used with J-Link emulator to program or debug Bluetooth® low energy chip. It is also connected to the SoC so software can implement debug function and programming capability if required by the application.

### 2.3.10 6-Axis sensing device pins

Table 2-15. Six-Axis interface pins

Ball	Ball Name	Function
A21	6AXIS_SDA	I2C data interface to external sensor. Requires external pull up.
A22	6AXIS_SCL	I2C clock output to external sensor. Requires external pull up.
A23	6AXIS_INT2	Auxiliary output pin. Interrupt to external sensor
N/A	6AXIS_INT1	Internal interrupt signal from 6Axis to Intel® Quark™ SE microcontroller



**Note:** Refer Bosch\* BMI160 datasheet for more details.

### 2.3.11 Bluetooth® low energy controller pins

**Table 2-16. Bluetooth® interface pins**

Ball	Ball Name	Function	Drive (Low / High)
D24	BLE_SW_CLK	Two wire debug interface. For Jtag programming using J-Link. This is also connected to a GPIO[27] signal.	Refer to the Nordic* nRf51822 datasheet.
E24	BLE_SW_WDIO	Two wire debug interface. For Jtag programming using J-Link. This is also connected to a GPIO[6] signal.	
B24	BT_GPIO	GPIO from Bluetooth® low energy controller	
B23	BLE_DA	I2C data interface Bluetooth® low energy controller; Can be connected to external master. Requires external pullup.	
F23	BLE_CL	I2C clock interface for the Bluetooth® low energy controller chip. Requires external pull up. <sup>1</sup>	
F24	BLE_RF	Bluetooth® Antenna connection	
G23	BLE_DEC2	For 3.3V IO leave unconnected. For 1.8V IO connections to VD_BLE_SEN. Refer to nrf51822 datasheet for more information	
H24	VDD_BLE_SEN	Bluetooth® low energy controller power supply with internal 0.1uf capacitor. Refer to AVDD and VDD power rail in nRf51822 datasheet for more information.	

**Notes:**

1. Please note that this is not supported in software.

### 2.3.12 I2C interface pins

**Table 2-17. I2C interface pins**

Ball	Ball Name	Function	Drive (Low / High)	Internal Pull Up <sup>1</sup> / Pull Down
M24	I2CO_SCL	I2C0 clock	4/8mA	47 kohm  internal pull up configuration can be set in device Firmware for slower speed without external resistor  External pull-up resistor needed to operate at higher speed  Refer to I2C specification
P23	I2CO_SDA	I2C0 data		
N24	I2CO_SS_SCL	I2C0 sensor subsystem clock (Max 400KHz)	2/4mA	
N23	I2CO_SS_SDA	I2C0 sensor subsystem data		
E1	I2C1_SCL	I2C1 clock (Max 1MHz)		
D2	I2C1_SDA	I2C1 data		
F1	I2C1_SS_SCL	I2C1 sensor subsystem clock (Max 400KHz)		
E2	I2C1_SS_SDA	I2C1 sensor subsystem data		

**Notes:**

1. Internal Pull Up resistors are disabled at reset. These I/O's all have typical 47kohm optional internal pullup that can be enabled by the software.





## 2.3.13 I2S interface pins

Table 2-18. I2S interface pins

Ball	Ball Name	Function	Alternate Function	Drive (Low / High)	Internal Pull Up <sup>1</sup> / Pull Down
B2	I2S_RSCK	Receive clock input	GPIO[16]	2/4 mA	47 kohm  internal pullup configuration can be set in device Firmware for slower speed without external resistor
B1	I2S_RWS	Receive word select	GPIO[17]		
A3	I2S_RXD	Receive RX data	GPIO[15]		
C2	I2S_TSCK	Transmit clock output	GPIO[18]	4/8 mA	External pull-up resistor needed to operate at maximum speed
C1	I2S_TWS	Transmit word select	GPIO[19]		
D1	I2S_TXD	Transmit TX data	GPIO[20]		

**Notes:**

1. Internal Pull Up resistors are disabled at reset. These I/O's all have typical 47 kohm optional internal pullup that can be enabled by the software.

## 2.3.14 Pulse Width Modulator (PWM) pins

Table 2-19. PWM Output pins

Ball	Ball Name	Alternate Function	Function	Drive (Low / High)	Internal Pull Up <sup>1</sup> / Pull Down
H1	PWM0_OUT	PWM [0]	GPIO_SS[10]	4/8 mA	47 kohm
G2	PWM1_OUT	PWM [1]	GPIO_SS[11]		
G1	PWM2_OUT	PWM [2]	GPIO_SS[12]		
F2	PWM3_OUT	PWM [3]	GPIO_SS[13]		

**Notes:**

1. Internal Pull Up resistors are disabled at reset. These I/O's all have typical 47 kohm optional internal pullup that can be enabled by the software.



### 2.3.15 SPI Master pin out

Table 2-20. SPI Master pins

Ball	Ball Name	Source	Primary Function	Alt Function	Drive (Low / High)	Internal Pull Up <sup>1</sup> / Pull Down
B3	SPI0_M_CS0	SoC SPI0	chip select 0	GPIO[24]	2/4 mA	47 kohm
A4	SPI0_M_CS1		chip select 1	GPIO[25]		
C3	SPI0_M_CS2		chip select 2	GPIO[26]		
D4	SPI0_M_MISO		data in	GPIO[22]		
D3	SPI0_M_MOSI		data out	GPIO[23]		
C4	SPI0_M_SCK		clock	GPIO[21]		
H4	SPI0_SS_CS0	Sensor System	chip select 0		4/8 mA	
H3	SPI0_SS_CS1		chip select 1			
K3	SPI0_SS_CS2		chip select 2	GPIO[29]	2/4 mA	
G4	SPI0_SS_CS3		chip select 3	GPIO[30]		
J3	SPI0_SS_MISO		data in		4/8 mA	
M3	SPI0_SS_MOSI		data out			
J4	SPI0_SS_SCK		clock			
D22	SPI1_M_CS0	SoC SPI1	chip select 0	GPIO[11]	2/4 mA	
D21	SPI1_M_CS1		chip select 1	GPIO[12]		
B21	SPI1_M_CS2		chip select 2	GPIO[13]		
C22	SPI1_M_CS3		chip select 3	GPIO[14]		
B22	SPI1_M_MISO		data in	GPIO[9]	4/8 mA	
E22	SPI1_M_MOSI		data out	GPIO[10]	2/4 mA	
C21	SPI1_M_SCK		clock	GPIO[8]	4/8 mA	

**Notes:**

1. Internal Pull Up resistors are disabled at reset. These I/O's all have typical 47 kohm optional internal pullup that can be enabled by the software.

### 2.3.16 SPI Slave pin out

Table 2-21. SPI Slave pins

Ball	Ball Name	Primary Function	Alt Function 1	Alt Function 2	Drive (Low / High)	Internal Pull Up <sup>1</sup> / Pull Down
F3	ATP_SPI_S_CS	chip select	GPIO[0]	AIN[0]	4/8mA	47 kohm
G3	ATP_SPI_S_MISO	data out	GPIO[1]	AIN[1]		
F4	ATP_SPI_S_MOSI	data in	GPIO[3]	AIN[3]		
E4	ATP_SPI_S_SCK	clock	GPIO[2]	AIN[2]		

**Notes:**

1. Internal Pull Up resistors are disabled at reset. These I/O's all have typical 47 kohm optional internal pullup that can be enabled by the software.



## 2.3.17 UART interface pins

Table 2-22. UART Interface pins

Ball	Ball Name	Primary Function	Alt Function 1	Alt Function 2	Drive (Low / High)	Internal Pull Up <sup>1</sup> / Pull Down
J22	UART1_CTS	flow control	GPIO_SS[0]	AIN[8]	4/8 mA	47 kohm Pull Up
K21	UART1_RTS	flow control	GPIO_SS[1]	AIN[9]		
K22	UART1_RX	Receive Data	GPIO_SS[9]	AIN[17]		
J21	UART1_TX	Transmit Data	GPIO_SS[8]	AIN[16]		

**Notes:**

1. Internal Pull Up resistors are disabled at reset. These I/O's all have typical 47 kohm optional internal pullup that can be enabled by the software.

## 2.3.18 USB interface pins

Table 2-23. USB Interface pins

Ball	Ball Name	Primary Function
K4	VDD_USB	5VDC from external USB source
J23	USB_DM	USB Data Minus (-) bidirectional signal
J24	USB_DP	USB Data Positive (+) bidirectional signal
J1	GROUND also known as VSS_USB and USB_VSS	Ground connection with external USB source

## 3 Electrical Characteristics

### 3.1 Absolute maximum and minimum specifications

The absolute maximum and minimum specifications are used to specify conditions allowable outside of the functional limits of the Intel® Curie™ module, but with possibly reduced life expectancy once returned to function limits. At conditions exceeding absolute specifications, neither functionality nor long term reliability can be expected. Parts may not function at all once returned to functional limits.

**Table 3-1. Min - Max specifications**

Ball	Function	Power I/O	Min	Typ	Max	Unit	Notes
VSYS	Main DC input power	-	1.9	-	4.4	V	VSYS should be greater than 3.3 if the module VDD_PLAT_3P3 regulator is used.
VDD_USB	USB power	-	3.5	5.0	5.25	V	-
VIN	Charging DC input	-	4.5	5.0	6.5	V	-
VDD_PLAT_1P8	-	-	1.62	-	1.98	V	-
VDD_PLAT_3P3	-	-	2.97	-	3.63	V	-
VDD_HOST_1P8	-	-	1.62	-	1.98	V	-

**Caution:** Although the module contains protective circuitry to resist damage from electrostatic discharge (ESD), always take precautions to avoid high static voltages or electric fields.

### 3.2 DC operating specifications

#### 3.2.1 DC specifications for I/O

**Table 3-2. AON\_IO\_VCC=3.3 VDC**

Symbol	Parameter	Min	Typ	Max	Unit	Notes
VIL	Input low voltage	-0.3		0.8	V	-
VIH	Input high voltage	2		3.6	V	-
VOL	Output low voltage			0.4	V	-
VOH	Output high voltage	2.4			V	-
IOL	2 mA @ VOL	2.4	3.8	5.3	mA	-
	4 mA @ VOL	4.7	7.6	10.6	mA	-
	8 mA @ VOL	9.4	15.3	21.2	mA	-
IOH	2 mA @ VOH	3.4	7.0	11.6	mA	-
	4 mA @ VOH	6.9	14.0	23.2	mA	-
	8 mA @ VOH	13.8	27.9	46.4	mA	-
RPU	Pullup resistor	34K	49K	74K	ohm	-
VT	Threshold point	1.33	1.4	1.47	V	-
VT+	L-> H threshold point	1.53	1.6	1.66	V	-
VT-	H-> L threshold point	1.13	1.2	1.27	V	-



Table 3-3. AON\_IO\_VCC=1.8V

Symbol	Parameter	Min	Typ	Max	Unit	Notes
VIL	Input low voltage	-0.3		0.63	V	-
VIH	Input high voltage	1.17		3.6	V	-
VOL	Output low voltage	-	-	0.45	V	-
VOH	Output high voltage	1.35	-	-	V	-
IOL	2 mA @ VOL	1.0	2.0	3.6	mA	-
	4 mA @ VOL	1.9	4.0	7.2	mA	-
	8 mA @ VOL	3.9	8.1	14.4	mA	-
IOH	2 mA @ VOH	0.8	2.0	4.1	mA	-
	4 mA @ VOH	1.6	4.0	8.1	mA	-
	8 mA @ VOH	3.2	8.0	16.2	mA	-
RPU	Pullup resistor	34K	49K	74K	ohm	-
VT	Threshold point	0.82	0.89	0.93	V	-
VT+	L-> H threshold point	0.99	1.07	1.12	V	-
VT-	H-> L threshold point	0.62	0.69	0.77	V	-

### 3.2.2 ADC - DC I/O specifications

Table 3-4. ADC - DC I/O specifications

Symbol	Parameter	Min	Typ	Max	Unit	Notes
Full-scale input range	AIN	0	-	<=ADC_3P3_VCC <=AON_IO_VCC	V	-
AGNDREF	Negative reference voltage	0	0	0.1	V	-
ADC_cap	Input sampling capacitance	-	5	-	pF	-

**Note:** Parasitic capacitance of the SoC and package are TBD. We recommend adding 10pF to the calculations for input capacitor charging.

### 3.2.3 Comparator voltage specification

Table 3-5. Comparator voltage range

Symbol	Parameter	Min	Typ	Max	Unit	Notes
COMP_AREF	External reference voltage	0.0	-	<= CMP_3P3_VCC	V	-
AIN	Full scale input voltage	0.0	-	<= CMP_3P3_VCC <= AON_IO_VCC	V	-
CMP_3P3_VCC	Comparator power	2.0	-	3.6	V	-

### 3.2.4 USB I/O - DC specifications

Table 3-6. USB I/O - DC specifications

Symbol	Parameter	Min	Typ	Max	Unit	Notes
VIL	Input low voltage	-	-	0.8	V	-
VIH	Input voltage high	2.0	-		V	-
VOL	Output low voltage	-	-	0.3	V	-
VOH	Output high voltage	2.8	-		V	-
VCRS	Differential output signal cross-point	1.3	-	2.0	V	-
VCM	Common mode range	0.8	-	2.5	V	-
RPU	External pull-up resistor	1.425	-	1.575	kohm	-
Vtrm	Termination voltage	3.0	-	3.6	V	-

**Note:** Refer to Intel® Quark™ SE microcontroller datasheet for complete SoC specification.

### 3.3 AC specifications

The follow diagram shows the USB IO AC characteristics.

Figure 3-1. USB IO AC characteristics

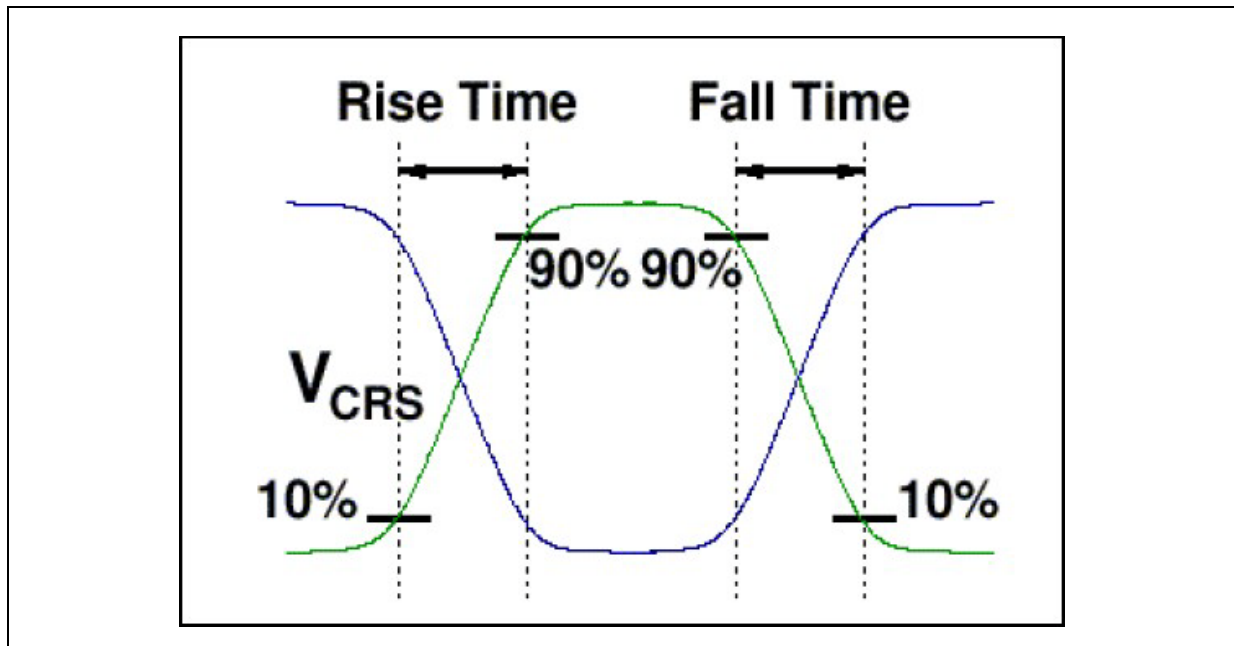


Table 3-7. USB IO AC specifications

Symbol	Parameter	Min	Typ	Max	Unit	Notes
TFR	Rise time 50 pF	4		20	ns	
TFF	Fall time 50 pF	4		20	ns	
TFRFF	Rise/fall matching	90		111.11	%	



### 3.4 Requested temperature ranges

Operating temperature range: -25°C to +70°C.

**Table 3-8. Package storage specifications**

Parameter	Description	Min	Max	Notes
T <sub>ABSOLUTE STORAGE</sub>	The non-operating device storage temperature. Damage (latent or otherwise) may occur when subjected to this temperature for any length of time.	-25°C	125°C	1, 2, 3
T <sub>SUSTAINED STORAGE</sub>	The ambient storage temperature limit (in shipping media) for a sustained period of time.	-5°C	40°C	1, 2, 3
R <sub>HSUSTAINED STORAGE</sub>	The maximum device storage relative humidity for a sustained period of time.	60% @ 24°C	-	1, 2, 3
T <sub>TIMESUSTAINED STORAGE</sub>	A prolonged or extended period of time: associated with customer shelf life in applicable Intel® boxes and bags	0 months	6 months	1, 2, 3

**Notes:**

1. TABSOLUTE STORAGE applies to the un-assembled component only and does not apply to the shipping media, moisture barrier bags or desiccant. Refers to a component device that is not assembled in a board or socket that is not to be electrically connected to a voltage reference or I/O signals.
2. Specified temperatures are based on data collected. Exceptions for surface mount re-flow are specified by applicable JEDEC J-STD-020 and MAS documents. The JEDEC, J-STD-020 moisture level rating and associated handling practices apply to all moisture sensitive devices removed from the moisture barrier bag.
3. Post board attach storage temperature limits are not specified. Consult your board manufacturer for storage specifications

### 3.5 ESD considerations

**Table 3-9. Intel® Curie™ module component ESD goal**

Symbol	Description	Stress Conditions	Test Results
HBM	ESD - Human Body Model - JS-001-2014	±1000 V	0(fail) / 2 pass
CDM	ESD - Charge Device Model - JESD22-C101	±500 V	0(fail) / 2 pass

**Note:** A reduction in either the HBM or CDM goal does not require additional design changes beyond the actual ESD guidance.



# 4 Power Considerations

## 4.1 Primary power

The Intel® Curie™ module is designed to operate under battery-operated systems, using 3.3 V or 1.8 V interfaces; and integrated power supervisor holds the system in reset when input voltage drops below 2.9 V. Optionally an external power supervisor can be used instead of the internal supervisor.

Intel® Curie™ module has 1.8 V and 3.3 V regulators meant for use by platform applications in addition to a 1.8 V regulator to power internal circuits. These internal LDO and converters are optional to use and application can provide their own converter or power source to meet their requirements.

- ESR1 provides platform 3.3 V, which can be used by external platform devices.
- ESR2 provides platform 1.8 V, which can be used by external platform devices.
- ESR3 provides host 1.8 V, which is fed back into Intel® Curie™ module to power the host.

Other core voltages includes,

- VDD\_BLE\_SEN: used to supply voltage to the internal Bluetooth® low energy system and the six-axis sensor.
- AON\_IO\_VCC decides the supply voltage to the IO level for peripheral interfaces. Choice is 1.8 V or 3.3 V level.

ESR requires an inductor and a bulk capacitor as a part of switching regulator function. [Table 4-1](#) provides the value of the inductor and the capacitor for the maximum power delivery.

**Table 4-1. ESR requirements**

Parameter	Description	Tolerance Min	Typical	Tolerance Max	Unit
<b>3.3V Platform rail requirements</b>					
C_ESR1	Decoupling Capacitor	-20%	8.2	+20%	μF
L_ESR1	Inductor	-30%	10	+30%	μH
<b>1.8V Platform rail requirements</b>					
C_ESR2	Decoupling Capacitor	-20%	4.7	+20%	μF
L_ESR2	Inductor	-30%	22	+30%	μH
<b>1.8V Host rail requirements</b>					
C_ESR3	Decoupling Capacitor	-20%	4.7	+20%	μF
L_ESR3 -	Inductor	-30%	22	+30%	μH





Table 4-2. Maximum current range

Power Rails from Intel® Curie™ Module	Description	Maximum Current (mA)
VDD_PLAT_3P3	ESR1 - 3.3V for platform devices (from Intel® Quark™ SE microcontroller SoC)	150
VDD_PLAT_1P8	ESR2 - 1.8V for platform device (from Intel® Quark™ SE microcontroller SoC)	100
VDD_HOST_1P8	ESR3 - 1.8V for Host Blocks (from Intel® Quark™ SE microcontroller SoC). Internal switching regulator 1.8v supply that can be used to power the cores. Additional inductor and capacitor is required.	100
BUCK_VOOUT*	1.8V/3.3V for platform devices. (from Internal Buck)	300

On-module regulators supply the integrated components while external devices need their own power system.

**Note:** Exceeding maximum input specifications or using non-compliant USB chargers damages the module input regulators.

## 4.2 Device power states

### 4.2.1 Off state

In the Off state, all voltage rails are disabled and no clocks are running.

The Off state is entered if the main power is removed or if the power is at an insufficient level to power the SoC.

When the power is applied, the SoC exits the Off state and transitions to Active.

### 4.2.2 Sleep state

Sleep is a suspend state in which:

- The core voltage rail and core clock are turned off, RTC clock is running.
- The always-on voltage rail remains powered in this state.
- The 3P3 and 1P8 voltage rails can be individually configured to power down for energy savings.
- A wake event via an enabled comparator, AON GPIO, AON Timers or RTC event is required to exit the Sleep state.
- The contents of SRAM can optionally be retained during the Sleep state
- Peripherals within the module can remain active when the SoC is in a sleep state.
- GPIOs can be configured to go in retention mode to hold their state while the core is in sleep mode.
- Refer to the diagram “SoC power states” in the Intel® Quark™ SE microcontroller Datasheet under power management.



### 4.2.3 Active state

- The Active state is the normal operating state of the SoC.
  - The core clock and RTC clock are running.
  - The Core (1P8) and AON voltage rails are enabled.
  - Applications can select if the 3P3 voltage rail is energized.
- Within the Active state:
  - The Host processor can transition into and out of various C-states.
  - The Sensor Subsystem can transition into and out of various sensing states.
  - SoC peripherals can be disabled or clock-gated for additional power savings.

## 4.3 Intel® Quark™ SE microcontroller power states

The Intel Quark processor and the ARC cores can run at a lower internal clock, if acceptable to application / design intent, for additional power savings that can be further enhanced with proper use of sleep states and wake events.

Refer to the Intel® Quark™ SE microcontroller Datasheet for detailed information.

## 4.4 Boot and reset sequences

### 4.4.1 Power Up - Off to Active

When VCC\_BATT\_V3P7 is applied by means of an external battery or other power source, the SoC can power up if software enabled any internal or external power converter used in the application design.

LDO 1.8V NCP170 is enabled by the VCC\_AON\_1P8 rail when it reaches the logic high threshold.

TPS62743 buck regulator (1.8V / 3.3V) is enabled by the AON\_IO\_VCC rail when it reaches the logic high threshold if the software disables BUCK\_EN by tri-stating GPIO\_SS[15]. Or the software can set GPIO\_SS[15] = 1 to enable or GPIO\_SS[15] = 0 to disable the bulk regulator.

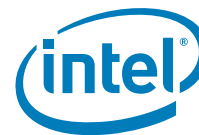
MIC5504-3.3YMT LDO (3.3v) is enabled by the VUSB\_EN signal that is 61% of the 5 V USB supply voltage when the USB cable is plugged. The software can then be configured to get an interrupt and the software can set GPIO[28] = 1 to enable the LDO for the USB interface. The software can disable the LDO by setting GPIO[28] = 0.

### 4.4.2 Power-up sequence timings and thresholds

The power sequence and timings given in this section are representative of typical values measured.

All rails except VSYS and AON\_IO\_VCC are outputs.

VIN is the system power supply. AON\_IO\_VCC has to be supplied externally. It is recommended to use VCC\_AON\_PWR to power the AON\_IO\_VCC. If it is fed by any other source, please make sure that the timings are met.



**Note:** Refer to the Intel Curie Power Sequence Considerations Application Note for some important information when designing your product.

Refer to Intel® Quark™ SE microcontroller datasheet for power up sequence timing parameters and power architecture section.

**Figure 4-1. Power state change diagram**

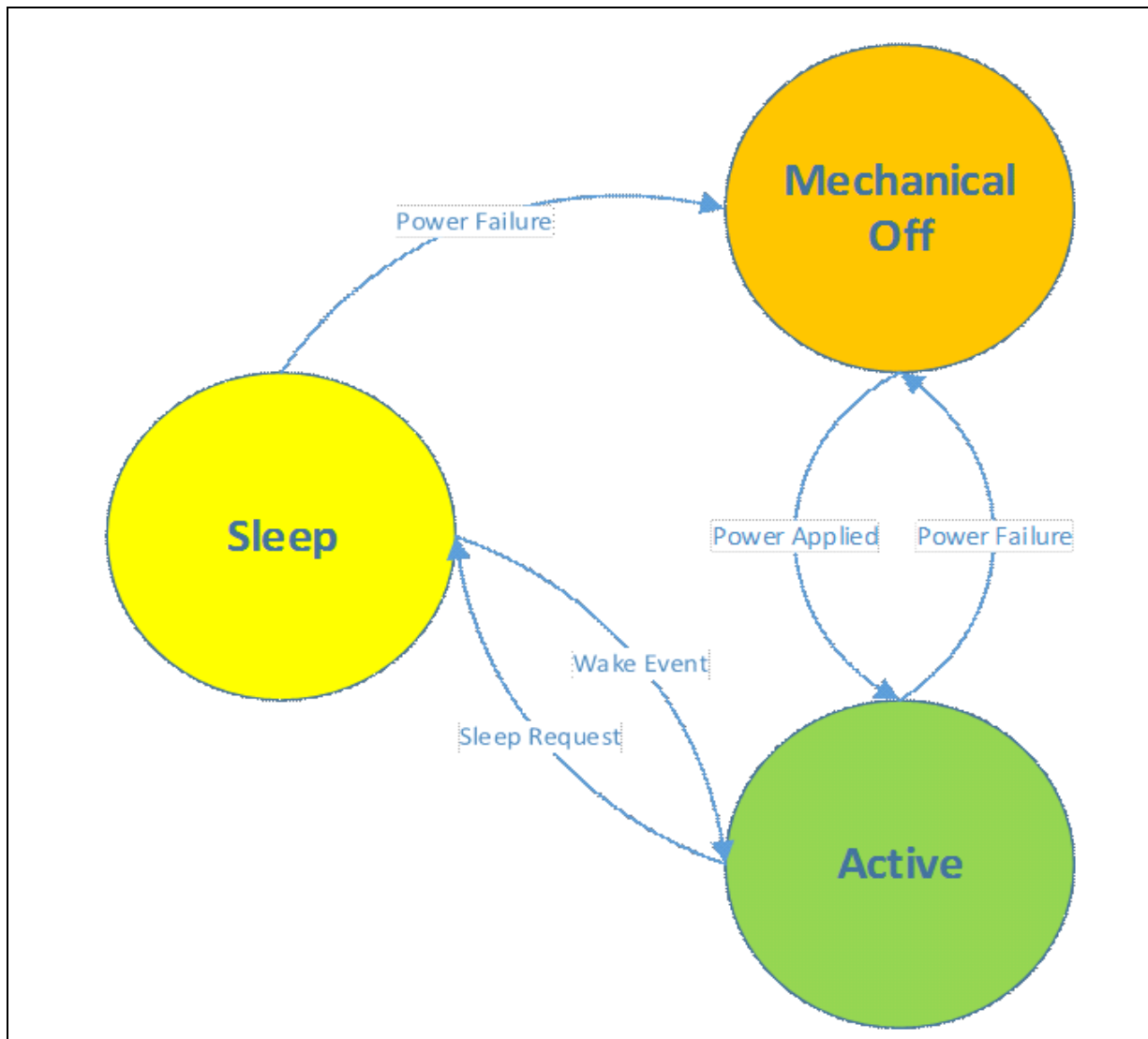
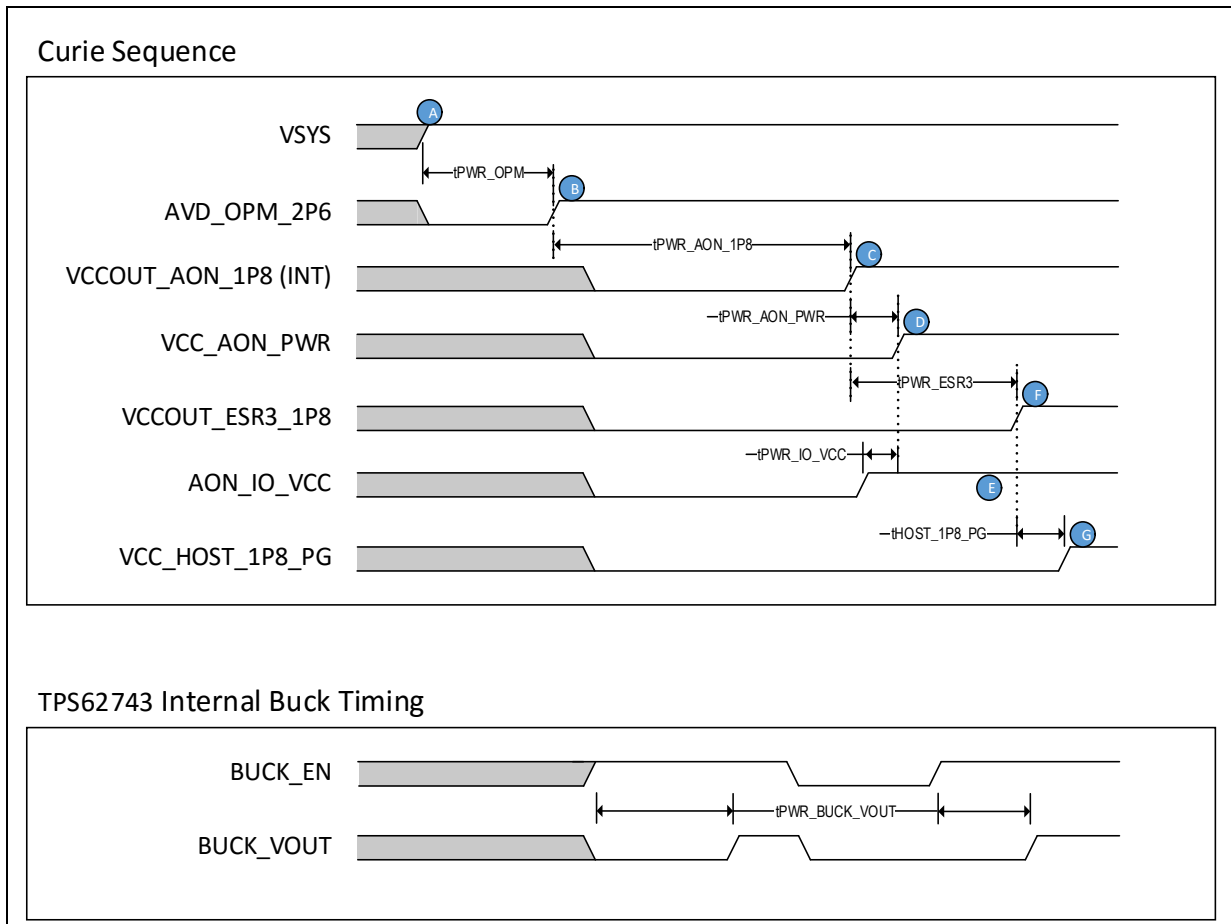


Figure 4-2. Power rail timing sequence



**Note:** VCCOUT\_AON\_1P8 is internal to the module.

Table 4-3. Power-up sequence parameters

Parameter	Description	Min	Typ	Max	Unit
tPWR_OPM	Time for OPM regulator properly regulate output when main power is applied.	-	20	-	µs
tPWR_AON_1P8	Time interval for Internal LDO regulator to properly regulate the output.	-	6	-	ms
tPWR_AON_PWR	Time interval for eSR to properly regulate the voltage.	-	200	-	µs
tPRW_ESR3	Time interval for eSR3 starts regulate the output voltage when VCCOUT_AON_1P8 reaches threshold (1.55V).	-	1.25	-	ms
tPWR_IO_VCC <sup>1</sup>	Time interval for LDO properly regulate output voltage when Enable asserted.	-		-	ms
tHOST_1P8_PG	Time interval for Buck regulator properly regulate output voltage when Enable asserted.	-	100	-	µs
tPWR_BUCK_VOUT	Time interval for Buck regulator (TPS62743) properly regulate output voltage when Enable (BUCK_EN) asserted.	-	10	25	ms

**Notes:**

1. When using a source other than VCC\_AON\_PWR to supply AON\_IO\_VCC, the source must be up and stable before VCCOUT\_AON\_1P8 (which is an internal node).



## 4.5 Platform power distribution

**Table 4-4. Power rail maximum current output**

Power Rail	Sources	Maximum Current
<b>1.9VDC to 4.4V RAIL</b>		
VCC_BATT_OPM_3P7	Battery	300ua
VCC_BATT_ESR1_3P7	Battery	250mA
VCC_BATT_ESR2_3P7	Battery	125mA
VCC_BATT_ESR3_3P7	Battery	125mA
<b>1.8VDC RAIL</b>		
VCC_AON_1P8	Internal LDO in Intel® Curie™ module	150mA
VCC_HOST_1P8	ESR3	50mA (Preliminary)
VCC_SRAM_1P8	Internal LDO within Intel® Curie™ module	4mA
VCC_PLL_1P8	ESR3	2.2mA
VCC_RTC_1P8	Internal LDO within Intel® Curie™ module	125nA
<b>3.3V RAIL</b>		
VCC_ADC_3P3	Dedicated ADC LDO	1mA
VCC_CMP_3P3	ESR1/OPM_2P6/Dedicated Comp LDO	60uA
VCC_USB_3P3	Dedicated LDO for USB	1mA
VDD_BLE_SEN	BUCK_OUT	26.75mA

## 4.6 Current draw (typical)

Data provided in this section was measured on a design-development platform and does not include components outside the Intel® Curie™ module. Results shown are averaged and are highly influenced by software configuration choices.

### 4.6.1 Module current consumption

**Table 4-5. Intel® Curie™ module Idle - Without motion sensing**

State	Value	Unit	Description
Intel® Curie™ module Idle - No motion sensing	20.02	uA	
<b>Peripherals breakdown</b>			No motion sensing and No Bluetooth® low energy activity SoC Idle (Deep Sleep + WDT wakeup every 5s) Nordic* Bluetooth® low energy Idle BMI160 Accelerometer and Gyrometer suspend
Intel® Quark™ SE microcontroller Deep Sleep (RTC ON/SRAM/IO retention)	9.1	uA	
Intel® Quark™ SE microcontroller watchdog wake every 33.5s	1		
Bluetooth® low energy Idle - Low power mode	2.55		
BMI160 (Accel / Gyro in suspend mode)	1.87		
Intel® Curie™ module hardware floor current	5.5		



**Table 4-6. Intel® Curie™ module Idle - Motion sensing without movement**

State	Value	Unit	Description
Intel® Curie™ module Idle - Motion sensing without any move	44.53	uA	
<b>Peripherals breakdown</b>			No motion sensing and No Bluetooth® low energy activity SoC Idle (Deep Sleep + WDT wakeup every 5s) Nordic* Bluetooth® low energy Idle BMI160 Accelerometer low power & Gyrometer suspend
Intel® Quark™ SE microcontroller Deep Sleep (RTC ON/SRAM/IO retention/External IRQ Wakeup)	9.1	uA	
Intel® Quark™ SE microcontroller watchdog wake every 33.5s	1		
Bluetooth® low energy Idle - Low power mode	2.36		
BMI160 (Accel ODR 100Hz@AVG1 / Gyro in suspend mode)	26.57		
Intel® Curie™ module hardware floor current	5.5		

**Table 4-7. Intel® Curie™ module Bluetooth® low energy fast advertising at 100ms - without motion sensing**

State	Value	Unit	Description
Intel® Curie™ module Bluetooth® low energy Fast Advertising @100ms - No motion sensing	144.07	uA	
<b>Peripherals breakdown</b>			No motion sensing - BMI160 Accelerometer & Gyrometer suspend SoC Idle (Deep Sleep + WDT wakeup every 5s) Nordic* Bluetooth® low energy advertising every 100ms; in Bluetooth® low energy Low power mode rest of the time
Intel® Quark™ SE microcontroller Deep Sleep (RTC ON/SRAM/IO retention/External IRQ Wakeup )	9.1	uA	
Intel® Quark™ SE microcontroller watchdog wake every 33.5s	1		
Bluetooth® low energy Fast Adv 100ms + Low power mode	126.6		
BMI160 (Accel / Gyro in suspend mode)	1.87		
Intel® Curie™ module hardware floor current	5.5		

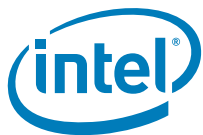


**Table 4-8. Intel® Curie™ module Bluetooth® low energy connection at 150ms - without motion sensing**

State	Value	Unit	Description
Intel® Curie™ module Bluetooth® low energy Connection @150ms - No motion sensing	48.17	uA	
<b>Peripherals breakdown</b>			No motion sensing - BMI160 Accelerometer & Gyrometer suspend SoC Idle (Deep Sleep + WDT wakeup every 5s) Nordic* Bluetooth® low energy advertising every 100ms; in Bluetooth® low energy Low power mode rest of the time
Intel® Quark™ SE microcontroller Deep Sleep (RTC ON/SRAM/IO retention/External IRQ Wakeup)	9.1	uA	
Intel® Quark™ SE microcontroller watchdog wake every 33.5s	1		
Bluetooth® low energy Fast Adv 100ms + Low power mode	30.7		
BMI160 (Accel / Gyro in suspend mode)	1.87		
Intel® Curie™ module hardware floor current	5.5		

**Table 4-9. Dhrystone 2.1 without motion sensing**

State	Value	Unit	Description
Intel® Curie™ module Bluetooth® low energy Connection @150ms - No motion sensing	36.01	mA	
<b>Peripherals breakdown</b>			No motion sensing - BMI160 Accelerometer & Gyrometer suspend SoC Idle (Deep Sleep + WDT wakeup every 5s) Nordic* Bluetooth® low energy advertising every 100ms; in Bluetooth® low energy Low power mode rest of the time
Intel® Quark™ SE microcontroller LTM C0 Dhrystone 2.1 ARC SSO Dhrystone 2.1 with all peripherals clock gated ON	36	mA	
Bluetooth® low energy Idle - Low power mode	2.36	uA	
BMI160 (Accel / Gyro in suspend mode)	1.87		
Intel® Curie™ module hardware floor current	5.5		



## 5 Package Information

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### 5.1 Packing geometry

Table 5-1. Module package details

Module Attribute	Value and Tolerance
Package size	11.00 x 8.05 mm +/- 0.05
Package height	1.95 mm +/- 0.09
Solder ball material	SAC 1205
Surface finish	CuOSP
Ball count	111
Ball pitch	0.57 x 0.45 mm
Solder reflow opening	0.240 mm
Ball diameter (pre-attach)	0.308 mm / 12.13 mil
Die thickness	0.240 mm
Substrate thickness	0.70 mm
Max Z-height (pre/post SMT)	1.86 mm to 1.95 mm +/- 0.09
NCFT corner balls	N/A
Overmold (mold cap showing device identification and marking)	Yes - 1 mm





## 5.2 Package marking

Figure 5-1 shows the marking for Intel® Curie™ module.

Figure 5-1. Package marking

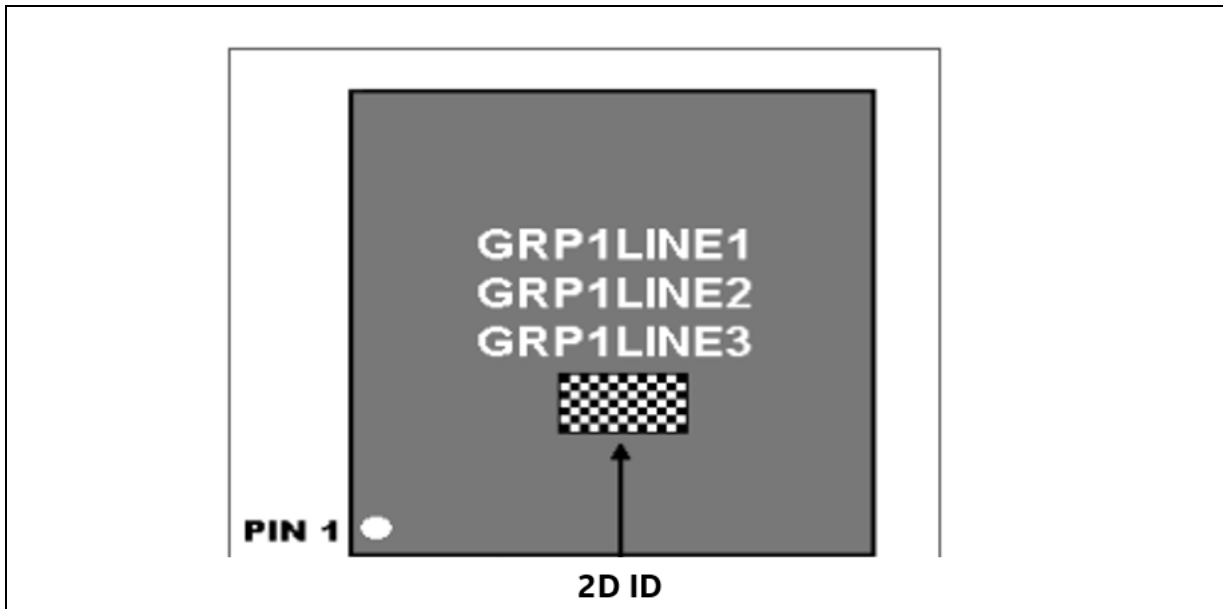


Table 5-2. Package marking

Line Number	Overview	Description
Line 1	-	Intel symbol
Line 2	{FPO}	FPO field number
Line 3	SR2NW {e1}	Product identification (engineering sample of HVM) and Pb-free compliance indicator {e1}

# 6 Manufacturing Information

## 6.1 Bootloader information

The Intel® Curie™ module comes with a manufacturing bootloader by default and customers can flash the bootloader of their choice through JTAG.

## 6.2 PCB pad design guidelines

To achieve the highest solder joint strength and reliability, we recommend the following:

- PCB pad size: 10 mil, MD pad
- No nCTF

Figure 6-1 illustrates the pad layout.

Figure 6-1. PCB pad layout

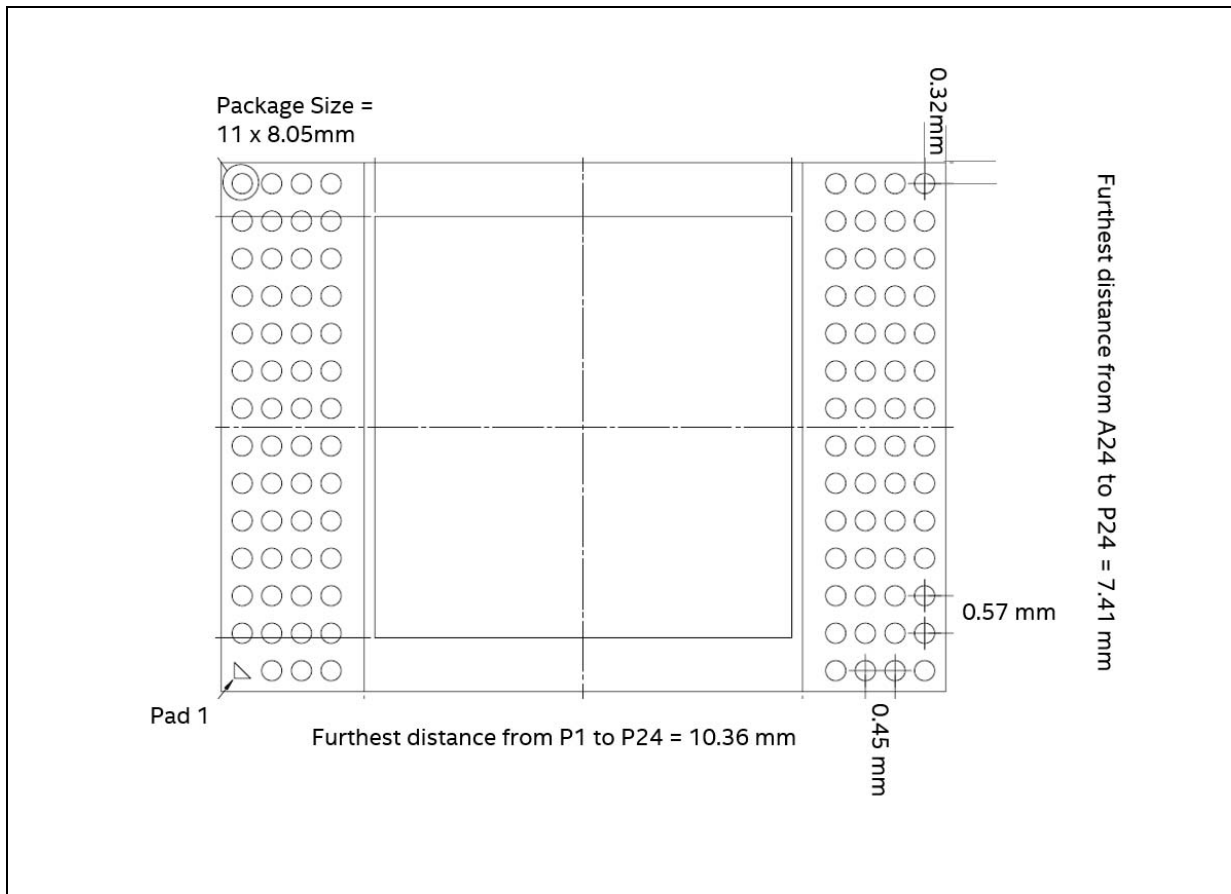
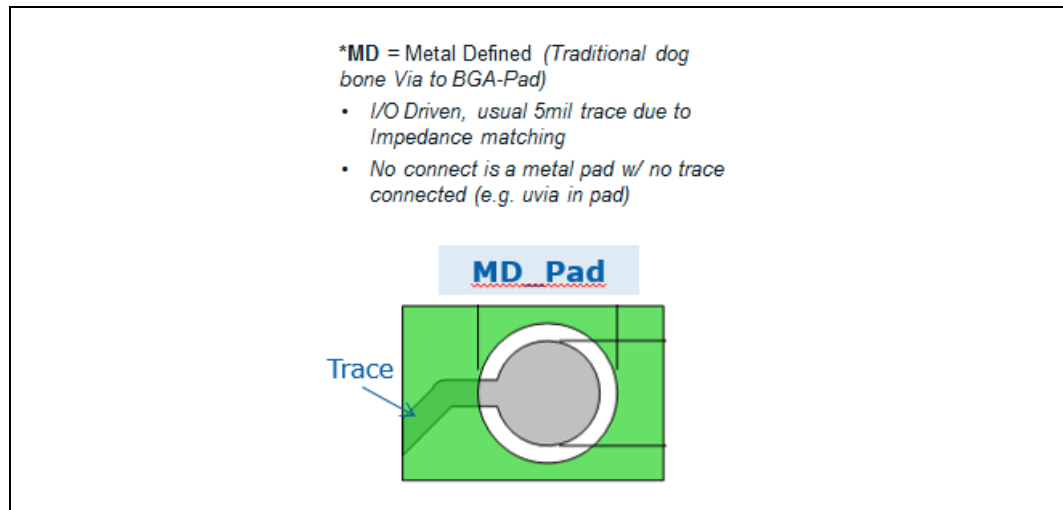


Figure 6-2 provides details about the metal defined pad.

Figure 6-2. Metal-defined pad





## 6.3 Manufacturing guidelines

### 6.3.1 SMT reflow parameters

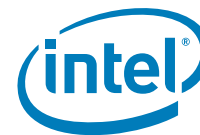
Table 6-1 lists the SMT reflow parameters.

Table 6-1. SMT reflow parameters<sup>1</sup>

Parameter	Description/Values	Notes
Intel evaluated solder paste	SAC305 Type 4	
Solder joint peak temperature	240°C ±5°C, should remain below 245°C	
Maximum body and substrate temperature	Never exceed 245°C	
Time above =<217°C (TAL)	60-90 sec	
Soak	Paste dependent. Consult paste manufacturer.	
Rising ramp rate	< 3°C per second	
Falling ramp rate	Maximum 3°C per second. Minimum 1°C per second from peak to 205°C	
Reflow ambient	N2 ambient (air is acceptable)	2
Reflow profile	Intel® Curie™ module is validated for 3 reflows	
Pallet Support for Board Warpage	Recommended	
SMT stencil information	Stencil thickness 3 mil aperture 10 mil round	
MSL level	<b>MSL Level 6.</b> Must be reflowed within the time limit specified on the label. Units should not be left on the floor as parts can absorb moisture and fail. If parts are not being used they should be put back into MBB and the bags should be vacuum packed or sealed with desiccant and HIC card. Floor exposure should be tracked.	
Other critical information	Please SMT the parts within 8 hours of opening the bag (typical 1 shift). If the cumulative time out of the bag (as measured from the 1 <sup>st</sup> open bag time) exceeds 8 hours but is below 48 hours, the parts should be baked at 125°C for 24 hours. <u>Please note that only 1 bake is allowed.</u> Please SMT the parts within 8 hours of bake. Partial lots after bake can be put back in MBB with desiccant to stop (but not reset) MET clock but cumulative moisture exposure should not exceed 8 hours after bake. If moisture exposure is beyond 48 hours then the units are irrecoverable.	

**Notes:**

1. **Disclaimer:** These results are provided for informational purposes only. Any sourcing decision is solely at the discretion of the Customer. Intel neither warrants, nor makes any representation whatsoever as to any supplier's products, including its availability, suitability, and reliability for the application for which this information is provided. Other pastes not listed above may perform better or worse based on customer SMT / board characteristics. The solder paste formulation above have passed Intel's SMT stress test and are recommended for customer evaluation with Intel® Curie™, to achieve acceptable SMT Yields.
2. Intel internal SMT development result indicated N2 is highly recommended to achieve the optimized SMT result. Intel internal SMT development used O2<1000 ppm concentration.



### 6.3.2 Board rework

The primary factors for board rework are the following:

- Flux formulation, solder paste formulation and volume
- A capable thermal reflow profile
- Proper PCB pad solder preparation/wicking (clean-up of the residual solder from the PCB pads)

The application design / board size, material and thickness will change the SMT profile. This section provides some guideline for building a board size.

**Caution:** Always remove the batteries before reworking the board.

Table 6-2 lists the rework recommendations for customer considerations.

**Table 6-2. Rework reflow parameter recommendations**

Parameter	FBGA and Chipset
Solder paste formulation	SAC305 type A, same stencil used in SMT
Flux formulation	TBD - Being evaluated
Solder paste volume	Over-print
Rework pallets	Case dependent. Follow customer practice.
Gap between nozzle and PCB surface (optimize air flow)	762 um (30mils)
Placement force	0 grams (paste application) 140 grams (flux application)
Rework ambient	Air (Nitrogen was not evaluated)
Solder joint peak reflow temperature	230 to 245°C
Time above ≥ 217°C	60 to 90 seconds
Maximum body temperature	Never exceed component temperature ≥ 245°C
Component delta T (ΔT)	≤ 10°C
Soak temperature and time	Paste dependent - Consult the paste manufacturer.
Rising ramp rate below 150°C (+)	0.5 to 2.5°C/sec
Rising ramp rate between 205°C and 215°C (+)	0.35 to 0.75°C/sec
Falling ramp rate (-)	0.50 to 2.0°C/sec

**Note:** Intel internal SMT development result indicated N2 is highly recommended to achieve the optimized SMT result. Intel internal SMT development used O2<1000 ppm concentration.

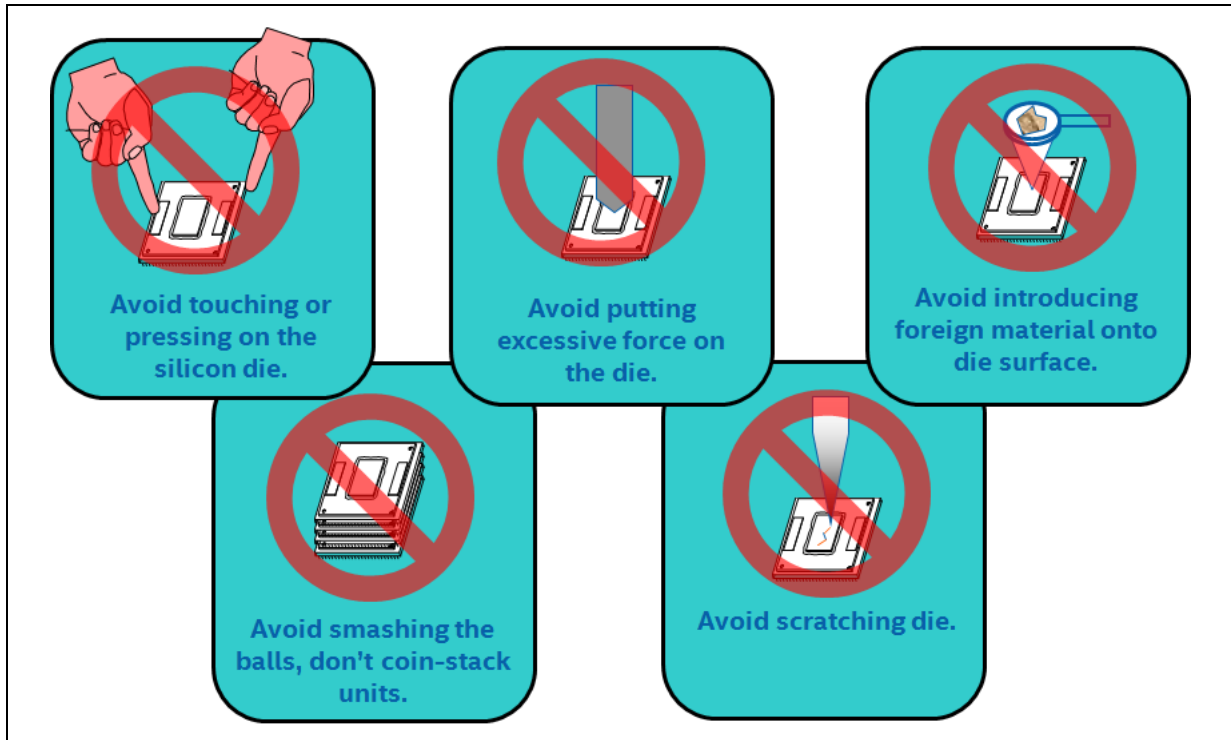
**Note:** Disclaimer: These results are provided for informational purposes only. Any sourcing decision is solely at the discretion of the Customer. Intel neither warrants, nor makes any representation whatsoever as to any supplier's products, including its availability, suitability, and reliability for the application for which this information is provided. Other pastes not listed above may perform better or worse based on customer SMT / board characteristics. The solder paste formulation above have passed Intel's SMT stress test and are recommended for customer evaluation with the Intel® Curie™ module, to achieve acceptable SMT Yields.

**Note:** Please share SMT yield summary (yield Pareto if possible) with Intel representative for revenue builds so we can track performance against our goals. In case of SMT failures, please secure the boards for timely failure analysis by Intel team to understand the defect mode.

## 6.4 General handling recommendations

The general handling recommendations are illustrated in Figure 6-3.

Figure 6-3. General handling recommendations





# 7 Ordering Information

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**Table 7-1. Ordering information for Intel® Curie™ module<sup>1</sup>**

Part Number (MM#)	Description	Packing
948119 - OBSOLETE <sup>2</sup>	Intel® Curie™ module integrated in Arduino 101* (Genuino 101* outside the U.S.)	N.A.
949350	Intel® Curie™ module with battery charger, in 11.00 mm x 8.05 mm package	Tray <sup>3</sup>
TBA <sup>4</sup>	Intel® Curie™ module without battery charger, in 11.00 mm x 8.05 mm package	Tray

**Notes:**

1. Contact your regional sales representative for pricing information.
2. These parts cannot be ordered.
3. No being shipped in tape and reel at this time.
4. Not yet available for ordering and shipping.



## 8 Terminology

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**Table 8-1. Terminology**

Term	Definition
ADC	Analog-to-digital converter
APIC	Advanced Programmable Interrupt Controller
ANT	Antenna
AON	Always-on (Wake Event)
Intel® Quark™ SE microcontroller	Intel® Quark™ SE microcontroller C1000 (WLCSP package used in Intel® Curie™ module)
BALUN	Balanced-unbalanced
BLE	Bluetooth® low energy (formerly Bluetooth® Smart)
CPU	Central processing unit
DCCM	Data Closely Coupled Memory
DSP	Digital signal processor
FAR	False acceptance rate
FIFO	First In First Out
FRR	False rejection rate
FW	Firmware
ISA	Instruction Set Architecture
MSL	Moisture sensitivity level
nCTF	Non critical to function
OS	Operating system
OTP	One-time programmable
PCB	Printed circuit board
POR	Power-on reset
PRU	Power receive unit
PTU	Power transmit unit
PWM	Pulse width modulation
RAM	Random access memory.
SMT	Surface mount technology
SoC	System on a Chip,
SW	Software
UART	Universal asynchronous receiver transmitter