Intel® Quark™ Microcontroller D2000 Development Platform

Hardware Manual

September 2016

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Revision History

Date	Revision	Description
September 2016	005	Added note on internal oscillator trim codes and updates based on user feedback.
May 2016	004	Updated sections 1 and 2.
March 2016	003	Updated table 2 with booster pack pins.
February 2016	002	Updated for development platform.
December 2015	001	Initial release.

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1.0 Introduction

This document describes the Intel® Quark™ microcontroller D2000 SoC based development board that is contained in the Intel® Quark™ microcontroller Developer Kit D2000 (MM 948988) and the Intel® Quark™ microcontroller Evaluation Kit D2000 (MM 951244).

1.1 Terminology

Table 1. Terminology

Acronym	Definition
ADC	Analog-to-Digital Converter
AIN	Analog Input
AREF	Analogue Reference Voltage Input
BGA	Ball Grid Array
BSP	Board Support Package – Refers to OS + Device Drivers
COMP	Comparator
CLK	Clock
CRB	Customer Reference Board
CTS	Clear To Send
DC	Direct Current
DDR	Double Data Rate
DIO	Digital Input / Output
DOUT	Digital OUT
EFI	Extensible Firmware Interface
ESD	Electrostatic Discharge
GND	Ground
GPIO	General-Purpose Input / Output
HW	Hardware
I^2C	Inter-Integrated Circuit
IA	Intel Architecture
ICSP	In-Circuit Serial Programming
IOREF	Input/Output Reference Voltage Input
JTAG	Joint Test Action Group
MCU	Micro Controller Unit

Acronym	Definition
MISO	Master In Slave Out
MOSI	Master Out Slave In
NC	Not Connected
OTP	One-Time Programming
PCB	Printed Circuit Board
PWM	Pulse Width Modulation
RTC	Real Time Clock
RTS	Request To Sen
RXD	Receive Data
SCK	Serial Clock
SCS	Chip Select
SCLK	Serial Clock
SDA	Serial Data
SoC	System on Chip
SPI	Serial Peripheral Interface Bus
SS	Slave Select
SRAM	Static Random Access Memory
TCK	JTAG (Test) Clock
TDI	JTAG (Test) Chain In
TDO	JTAG (Test) Chain Data Out
TMS	JTAG (Test) Chain Mode Select
TRST	JTAG (Test) Chain Reset
TXD	Transmit Data
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus

2.0 Development Platform

2.1 Overview

The Intel® Quark™ Microcontroller D2000 Development Board is a versatile platform targeted towards Internet of Things developers.

Intel® Quark™ microcontroller D2000 features:

- Intel® Quark™ microcontroller D2000 SoC 32MHz
- 32KB flash memory (internal)
- 8KB OTP flash (internal)
- 4KB data flash (internal)
- 8KB SRAM (internal)
- 1x I^2C (Master/Slave)
- 1x SPI master supports up to 4 devices
- 1x SPI slave
- 2x UART – supports 9-bit addressing mode
- 19 ADC/Comparator inputs
- 2x PWM signals
- 25 GPIOs
- Real-time clock
- Watchdog timer

Intel® Quark™ microcontroller D2000 development platform main expansion options:

- "Arduino Uno" like SIL sockets (3.3V IO only) (see section 2.1.2)
- Booster pack like SIL headers (3.3V IO only)

On-board components:

- 6-axis Accelerometer / Magnetometer with temperature sensor
- UART/JTAG to USB convert for USB debug port

Other connectors include:

- 1x USB 2.0 Device Port – micro Type B
- On-board coin cell battery holder (type CR2032)
- 5V input a screw terminal/header (external power or Li-ion)

Power sources for this platform:

- External (2.5V - 5V) DC input
- USB power (5V) – via debug port
- Coin cell battery (type CR2032 not supplied)

2.1.1 Arduino Shield Sockets Note

The Intel® Quark™ Microcontroller D2000 Development Platform supports the familiar open standard Arduino Uno Rev 3.0 physical interface and is mechanically compatible with Uno Rev 3.0.

- Each functional I/O can be configured to provide the same function that is supported on the Arduino Uno Rev 3.0 with the exception of the PWM capability which can only be supported on IO6 and IO9.
- The developer platform supports 3.3V IO operation only and is not 5V tolerant.
- VIN Pin is not supported.
- The 6 pin ICSP Header is not supported.

The purpose of supporting the Arduino Uno Rev3.0 form factor is to enable rapid hardware prototyping through leveraging the existing ecosystem of 3.3v Arduino Shields or the Arduino compatible prototyping shields. Software compatibility of any Arduino shield is not assumed and would be the responsibility of the developer to produce the appropriate code.

2.1.2 Internal Oscillator Trim Codes

Certain early build versions of the D2000 Development Platform used Intel® Quark™ Microcontroller D2000 devices that did not have the internal oscillator trim codes programmed into them. The effect of using an MCU with untrimmed silicon oscillators means the operating frequency of the oscillator is not precise. Effects can vary but are not limited to:

- System clock frequency may contain an offset.
- On Self clocked interfaces like UART, the issue can potentially cause unexpected characters on the terminal.
- On Interfaces with a clock the issue can potentially cause unexpected reduction or increase in bandwidth.

The D2000 Developer & Evaluation Kits affected by this issue have the following serial numbers:

Table 2 Kits Affected

Description	MM#	Batch Code	Serial Number Range
D2000 Developer Kit	948988	CNHT605001	160500001 - 160501000
D2000 Developer Kit	948988	CNHT615001 - CNHT615005	161501001 - 161505500
D2000 Evaluation Kit	951244	CNHT615006	161505501 - 161506000

There are 3 options to resolve the issue of un-programmed trim codes:

1. If the solution design is not sensitive to the problem then there is nothing to do.
2. Use the external platform crystal on the development platform.
3. From Intel® QMSI version 1.1 onwards, trim codes are automatically set through a function in 'rom_startup.c'.

2.2 Handling the Development Board

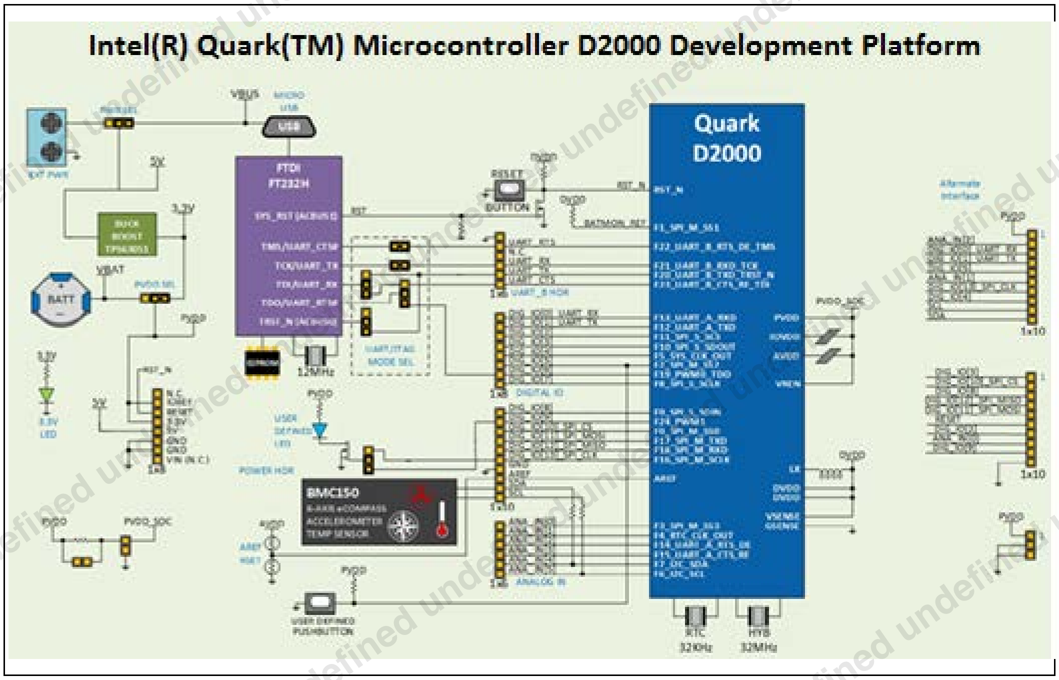
Electrostatic Discharge (ESD) can damage electronic components. To prevent damage to any printed circuit boards (PCBs), it is important to handle them very carefully. To prevent the development board from bending, keep one hand under the centre of the board to support it when handling. The following measures are generally sufficient to protect your equipment from electric static discharge:

- Use a grounded wrist strap designed to prevent ESD.
- Touch a grounded metal object before removing boards from antistatic bags.
- Handle a board by its edges only; do not touch its components, peripheral chips, memory modules or gold contacts.
- When handling chips or modules, avoid touching their pins.
- Put the board, add-on cards and any peripherals back into their antistatic bags when not in use.

2.3 General Assumptions

This section covers the general Intel® Quark™ microcontroller D2000 module and development board system topology and interface connectivity assumptions.

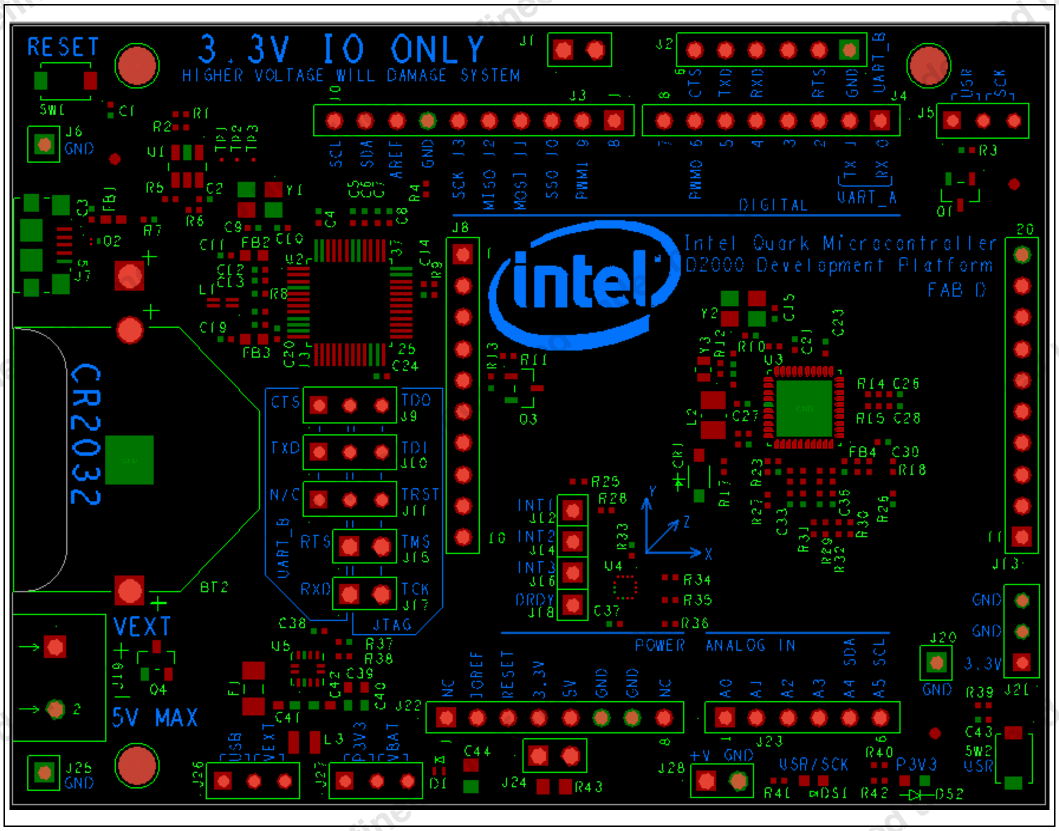
Figure 1. Block Diagram



2.4 Floor Plan

Figure 2 illustrates the development platform floor plan. The Development Platform PCB dimension is 3.3 x 2.25 inches.

Figure 2. PCB Floor Plan



2.5 Development Platform Pin Muxing

The Intel® Quark™ microcontroller D2000 provides flexibility for the platform design in configuring the functional I/Os to convey alternative functions or become GPIOs. The User Mode columns show the alternative microcontroller functions for each pin. Table 3 presents the Intel® Quark™ Microcontroller D2000 Development Board PIN to Function mapping for this platform.

Table 3. Development Board Pin Mapping

Arduino Pin No.	Arduino Pin Label	CRB Pin Usage	User Mode0	User Mode1	User Mode2	Booster Pack Pin(s)
J1_1		3.3V				
J1_2		Address Select Accel/Gyro				
J2_1	GND	GND				J13_10, J21_2, J21_3
J2_2	RTS	USB port / Hdr	JTAG_TMS	GPIO_22	UART_B_RTS	
J2_3		NC				
J2_4	RXD	USB port / Hdr	JTAG_TCK	GPIO_21	UART_B_RXD	
J2_5	TCD	USB port / Hdr	JTAG_TRST_N	GPIO_20	UART_B_TXD	
J2_6	CTS	USB port / Hdr	JTAG_TDI	GPIO_23	UART_B_CTS	
J3_1	8	DIO_8	GPIO_9	ADC / COMP9	SPI_S_MOSI	J13_3
J3_2	9 PWM1	DIO_9	GPIO_24	LPD_SIG_OUT	PWM1	J13_9
J3_3	10 SS0	SPI_M_SS0 / DIO_10	GPIO_0	ADC / COMP0	SPI_M_SS0	J13_2
J3_4	11 MOSI	SPI_M_MOSI / DIO_11	GPIO_17	ADC / COMP17	SPI_M_MOSI	J13_5
J3_5	12 MISO	SPI_M_MISO / DIO_12	GPIO_18	ADC / COMP18	SPI_M_MISO	J13_4
J3_6	13 SCK	SPI_M_SCLK / DIO_13	GPIO_16	ADC / COMP16	SPI_M_SCLK	J8_7
J3_7	GND	GND				
J3_8	ARF	AREF				
J3_9	SDA	SDA / AIN_04 / DIO_18	GPIO_7	ADC / COMP7	I2C_SDA	J8_10

Arduino Pin No.	Arduino Pin Label	CRB Pin Usage	User Mode0	User Mode1	User Mode2	Booster Pack Pin(s)
J3_10	SCL	SCL / AIN_05 / DIO_19	GPIO_6	ADC / COMP6	I2C_SCL	J8_9
J4_1	0 RX [UART_A]	UART_RXD / DIO_0	GPIO_13	ADC / COMP13	UART_A_RXD	J8_3
J4_2	1 TX [UART_A]	UART_TXD / DIO_1	GPIO_12	ADC / COMP12	UART_A_TXD	J8_4
J4_3	2	DIO_2	GPIO_11	ADC / COMP11	SPI_S_SCS	J13_7
J4_4	3	DIO_3	GPIO_10	ADC / COMP10	SPI_S_MISO	J13_1
J4_5	4	DIO_4	GPIO_5	ADC / COMP5	SYS_CLK_OUT	J8_8
J4_6	5	DIO_5	GPIO_2	ADC / COMP2	SPI_M_SS2	J8_5
J4_7	6 PWM0	USB port / DIO_6	JTAG_TDO	GPIO_19	PWM0	
J4_8	7	DIO_7	GPIO_8	ADC / COMP8	SPI_S_SCLK	
J22_1	NC	NC				
J22_2	IOREF	IOREF				
J22_3	RESET	RESET_N	RESET_N			J13_6
J22_4	3.3V	3.3V				J8_1, J21_1
J22_5	5V	5V				
J22_6	GND	GND				
J22_7	GND	GND				
J22_8	NC	NC				
J23_1	A0	AIN_0	GPIO_3	ADC / COMP3	SPI_M_SS3	J13_8
J23_2	A1	AIN_1	GPIO_4	ADC / COMP4	RTC_CLK_OUT	J8_6
J23_3	A2	AIN_2	GPIO_14	ADC / COMP14	UART_A_RTS / UART_A_DE	J8_2
J23_4	A3	AIN_3	GPIO_15	ADC / COMP15	UART_A_CTS / UART_A_RE	
J23_5	A4 SDA	AIN_4				J8_9

Arduino Pin No.	Arduino Pin Label	CRB Pin Usage	User Mode0	User Mode1	User Mode2	Booster Pack Pin(s)
J23_6	A5 SCL	AIN_5				J8_10

2.6 Development Platform Jumper Connections

This section describes the pin connection options for the various jumpers on the board.

2.6.1 J1 Jumper

Jumper J1 allows the I^2C address to be modified; by default the jumper is not connected and the I^2C address is 0x10 & 0x12. When the jumper is connected the I^2C address is 0x11 & 0x13.

Table 4. J1 Jumper

J1	Pin 1	Pin 2	Description
Not connected			This is the default, I^2C address is 0x10 & 0x12.
Connected	✓	✓	I^2C address is 0x11 & 0x13.

2.6.2 J5 Jumper

Jumper J5 allows the onboard LED to be controlled by either DIO_9 or DIO_13.

Table 5. J5 Jumper

J5	Pin 1	Pin 2	Pin 3	Description
USR	✓	✓		By selecting pins 1 & 2 on jumper J5, DIO_9 is used to control the LED.
SCK		✓	✓	Selecting pins 2 & 3 on jumper J5 enables DIO_13 to control the LED.

2.6.3 J24 Jumper

Jumper J24 is connected by default, and connects the SoC power supply. Removing this jumper connection allows external power supply to the SoC or access to measure the current being drawn by the SoC.

Table 6. J24 Jumper

J24	Pin 1	Pin 2	Description
Connected	✓	✓	SoC power supply connected, this is the default.
Not connected			SoC power supply disconnected.

2.6.4 J26 Jumper

Jumper J26 allows the external power source to be set to either USB or external DC input.

Table 7. J26 Jumper

J26	Pin 1	Pin 2	Pin 3	Description
USB	✓	✓		External power taken from connected USB host device 5V, this is the default.
VSEXT		✓	✓	External power from connected DC source 2.5V – 5V.

2.6.5 J27 Jumper

Jumper J27 allows the internal regulator to be activated when an external power source is used (J26 jumper). The regulator will maintain a steady flow of 3.3V to the platform. If an external power source is being used then pins 1 and 2 on this jumper should be connected, if on board coin cell battery source is being used then pins 2 and 3 on this jumper should be connected.

Table 8. J27 Jumper

J27	Pin 1	Pin 2	Pin 3	Description
3V3	✓	✓		Internal regulator activated to maintain steady flow of power from external power source (USB or external DC input).
BAT		✓	✓	Connected when power is provided via the on board coin cell battery.