

Intel® Quark™ Microcontroller D2000 Jundenned underned under d underined underined underined underined underined underined underined under the day of the state of the sta

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Date	Revision	Description
September 2016	005	Added note on internal oscillator trim codes and updates based on
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

nur.	Acronym	Definition	
	ADC	Analog-to-Digital Converter	"iuge"
.0	AIN	Analog Input	
ed ui.	AREF	Analogue Reference Voltage Input	
indefined undefined	BGA	Ball Grid Array	
d uno	BSP	Board Support Package – Refers to OS + Device Drivers	
Hineu	СОМР	Comparator	
inde	CLK	Clock	ed ui
	CRB	Customer Reference Board	define
	CTS	Clear To Send	d nuco
11.	DC	Direct Current	
ined to	DDR	Double Data Rate	
defill	DIO	Digital Input / Output	
od une	DOUT	Digital OUT	
istines	EFI	Extensible Firmware Interface	
unde	ESD	Electrostatic Discharge	ned b
3	GND	Ground	defill
	GPIO	General-Purpose Input / Output	dune
	HW	Hardware	
ined.	I ² C	Inter-Integrated Circuit	
adeill	IA	Intel Architecture	
ed m.	ICSP	In-Circuit Serial Programming	
18fine	IOREF	Input/Output Reference Voltage Input	
, unos	JTAG	Joint Test Action Group	
,o	MCU CO	Micro Controller Unit	adefil.
	cillo	0	

September 2016



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	inec	ed un	
/intel®		define singo	
60		d unce	
defil		sin ^o	
d une	Acronym	Definition	
	MISO	Master In Slave Out	ind
	MOSI	Master Out Slave In	sed u.
	NC	Not Connected	defille
	ОТР	One-Time Programming	
ind	PCB	Printed Circuit Board	
ined undefined une	PWM	Pulse Width Modulation	
defill	RTC	Real Time Clock	
4 unc	RTS	Request To Sen	
	RXD	Receive Data	
	SCK	Serial Clock	ed un
	SCS	Chip Select	refine
	SCLK	Serial Clock	
	SDA	Serial Data	
ed un	SoC	System on Chip	
define	SPI	Serial Peripheral Interface Bus	
	SS	Slave Select	
	SRAM	Static Random Access Memory	
	TCK	JTAG (Test) Clock	ad ul
	TDI	JTAG (Test) Chain In	istine
	TDO	JTAG (Test) Chain Data Out	Inde
	TMS	JTAG (Test) Chain Mode Select	
ed ui	TDCT	461	
efine	TRST	JTAG (Test) Chain Reset	
VOC	TXD	Transmit Data	
	UART	Universal Asynchronous Receiver/Transmitter	
undefined ur	USB	Universal Serial Bus	40
	Inde	defill	
		dune	"uge,
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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 I²C (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

Document Number: 333582-005EN



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:

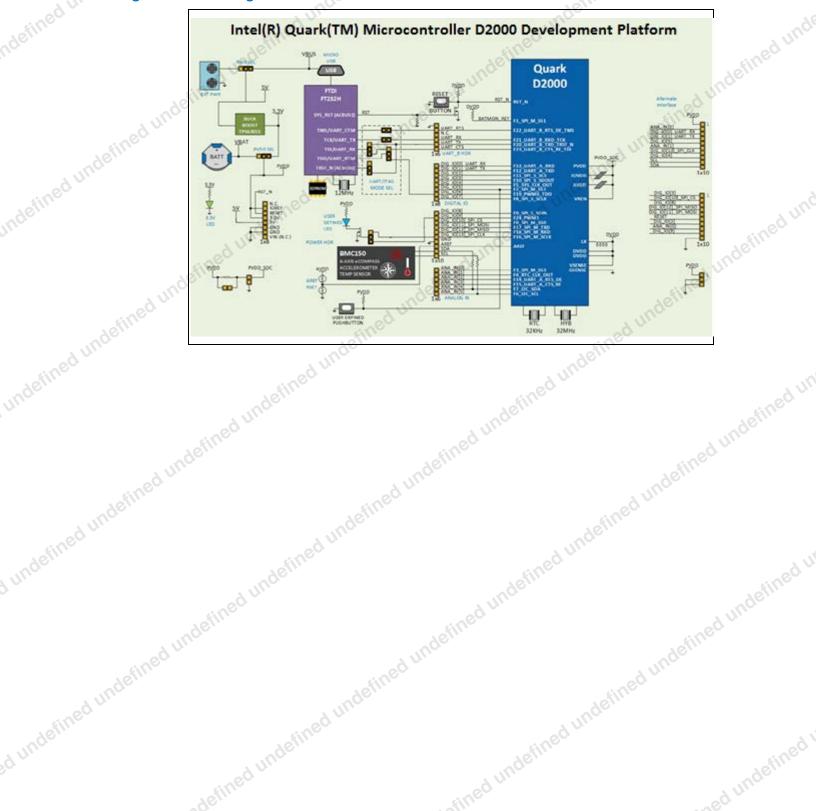
- Use a grounded wrist strap designed to prevent ESD.
- Touch a grounded metal object before removing boards from antistatic bags.
- Handle a board by its edges only; do not touch its components, peripheral chips, memory modules or gold contacts.
- When handling chips or modules, avoid touching their 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.



Block Diagram Figure 1.

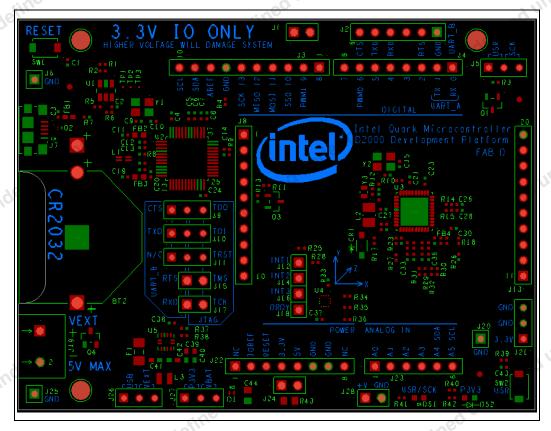




2.4 Floor Plan

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

Figure 2. PCB Floor Plan





Development Platform Pin Muxing 2.5

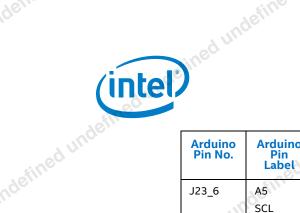
The Intel® Quark™ microcontroller D2000 provides flexibility for the platform design in configuring the functional I/Os to convey alternative functions or become GPIOs. The User Mode columns show the alternative microcontroller functions for each pin. Table 3 presents the Intel® Quark™ Microcontroller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

Table 3. **Development Board Pin Mapping**

ined undefine	Arduino Pin No.	Arduino Pin Label	CRB Pin Usage	User Mode0	User Mode1	User Mode2	Booster Pack Pin(s)	
live	J1_1	EINEO	3.3V		69	O.		
	J1_2	uger	Address Select Accel/Gyro		indefine			ed undefine
יוני)	J2_1	GND	GND	odefined	O.		J13_10, J21_2, J21_3	ed nur
defined	J2_2	RTS	USB port / Hdr	JTAG_TM S	GPIO_22	UART_B_RT S	Junge	
d nuo	J2_3		NC			181100		
efined undefined un	J2_4	RXD	USB port / Hdr	JTAG_TC K	GPIO_21	UART_B_RX D		
	J2_5	TCD	USB port / Hdr	JTAG_TR ST_N	GPIO_20	UART_B_TX D		ned undefine
	J2_6	CTS	USB port / Hdr	JTAG_TDI	GPIO_23	UART_B_CT S	.4.0	red nur
sined ur	J3_1	8	DIO_8	GPIO_9	ADC / COMP9	SPI_S_MOS I	J13_3	
Jefined undefined ur	J3_2	9 PWM1	DIO_9	GPIO_24	LPD_SIG_O UT	PWM1	J13_9	
efine	J3_3	10 SS0	SPI_M_SS0 / DIO_10	GPIO_0	ADC / COMPO	SPI_M_SS0	J13_2	
	J3_4	11 MOSI	SPI_M_MOSI / DIO_11	GPIO_17	ADC / COMP17	SPI_M_MO SI	J13_5	ined undefin
240	J3_5	12 MISO	SPI_M_MISO / DIO_12	GPIO_18	ADC / COMP18	SPI_M_MIS O	J13_4	
defined undefined v	J3_6	13 SCK	SPI_M_SCLK / DIO_13	GPIO_16	ADC / COMP16	SPI_M_SCL K	J8_7	
ed u.	J3_7	GND	GND			ndell.		
define	J3_8	ARF	AREF			eg m.		
	J3_9	SDA	SDA / AIN_04 / DIO_18	GPIO_7	ADC / COMP7	I2C_SDA	J8_10	Jef i
Intel® Quark™ M Hardware Mani		ler D2000 D	evelopment Platfo	orm ndefil	edu		September 2	fined undef



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8	fined un			fined u	ndefined			· Indein
sfined undefined under			ined uni	ye.		-6-	intel	
fined und	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	d undefined i
	J4_1	0 RX [UART_A]	UART_RXD / DIO_0	GPIO_13	ADC / COMP13	UART_A_RX D	J8_3	d unde
aed une	J4_2	1 TX [UART_A]	UART_TXD / DIO_1	GPIO_12	ADC / COMP12	UART_A_TX D	J8_4	
indefine	J4_3	2	DIO_2	GPIO_11	ADC / COMP11	SPI_S_SCS	J13_7	
efined undefined und	J4_4	3	DIO_3	GPIO_10	ADC / COMP10	SPI_S_MIS O	J13_1	
© .	J4_5	481111	DIO_4	GPIO_5	ADC / COMP5	SYS_CLK_O UT	J8_8	ed undefined
	J4_6	5	DIO_5	GPIO_2	ADC / COMP2	SPI_M_SS2	J8_5	ed under
Jefined undefined un	J4_7	6 PWM0	USB port / DIO_6	JTAG_TD O	GPIO_19	PWM0	indefin	
I Under.	J4_8	7	DIO_7	GPIO_8	ADC / COMP8	SPI_S_SCLK	O	
	J22_1	NC	NC			MUOS		
le,	J22_2	IOREF	IOREF		eine	>		
	J22_3	RESET	RESET_N	RESET_N	"gell"		J13_6	istine
	J22_4	3.3V	3.3V	sine	3 011		J8_1, J21_1	ned undefiner
AV	J22_5	5V	5V	"uge,			4611	
	J22_6	GND	GND). ·			1 nug	
inder	J22_7	GND	GND			200	80	
red n.	J22_8	NC	NC			"uge		
defined undefined u	J23_1	AO FINS	AIN_0	GPIO_3	ADC / COMP3	SPI_M_SS3	J13_8	
	J23_2	A1	AIN_1	GPIO_4	ADC / COMP4	RTC_CLK_O UT	J8_6	indefine
.ned'	J23_3	A2	AIN_2	GPIO_14	ADC / COMP14	UART_A_RT S / UART_A_DE	J8_2	ined undefine
ndefined undefined	J23_4	A3	AIN_3	GPIO_15	ADC / COMP15	UART_A_CT S / UART_A_RE	ued a	
ndefine	J23_5	A4 SDA	AIN_4		10/11/1	eg nr.	J8_9	
	sine'	9 01.			ed unas	•		, undefil.



ger.	ad und	efine		, u	ndefined			ndefined un
int	el ined und		sed ur	User User			undefined	undefined un
ndefined undefined	Arduino Pin No.	Arduino Pin Label	CRB Pin Usage	User Mode0	User Mode1	User Mode2	Booster Pack Pin(s)	711.
noc	J23_6	A5 SCL	AIN_5	cd'	indefines		J8_10	, undefined c
4efined	unden		ined u	ndefine			d undefine	
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undefinec	A.	indefined			indefine	d und		defined i
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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 I²C address to be modified; by default the jumper is not connected and the I²C address is 0x10 & 0x12. When the jumper is connected the I²C address is 0x11 & 0x13.

Table 4. J1 Jumper

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

indefined un 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 0 V	Pin 1	Pin 2	Pin 3	Description
USR	✓	✓	indefil	By selecting pins 1 & 2 on jumper J5, DIO_9 is used to control the LED.
SCK		defin	ed 1	Selecting pins 2 & 3 on jumper J5 enables DIO_13 to control the LED.

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	ined in	√	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
d undefined u.	USB	· ndef	inedring		External power taken from connected USB host device 5V, this is the default.
Indefined	VSEXT	ilued pr	√	✓	External power from connected DC source 2.5V – 5V.

J27 Jumper 2.6.5

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

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.							_
Intel® Quark™ Microcontroller D2000 Development Platform Hardware Manual Maintain tseady flow of power from external power source (USB or external DC input).		J27	Pin 1	Pin 2	Pin 3	Description	huge.
BAT Connected when power is provided via the on board coin cell battery. Intel® Quark™ Microcontroller D2000 Development Platform Hardware Manual September 2016	undefined u	3V3	~	efined und	Chine	maintain steady flow of power from external power source (USB or external DC input).	
Hardware Manual September 2016		BAT	Stined un	✓	√	Connected when power is provided via the on board coin cell battery.	rined u
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