



**DT100113**

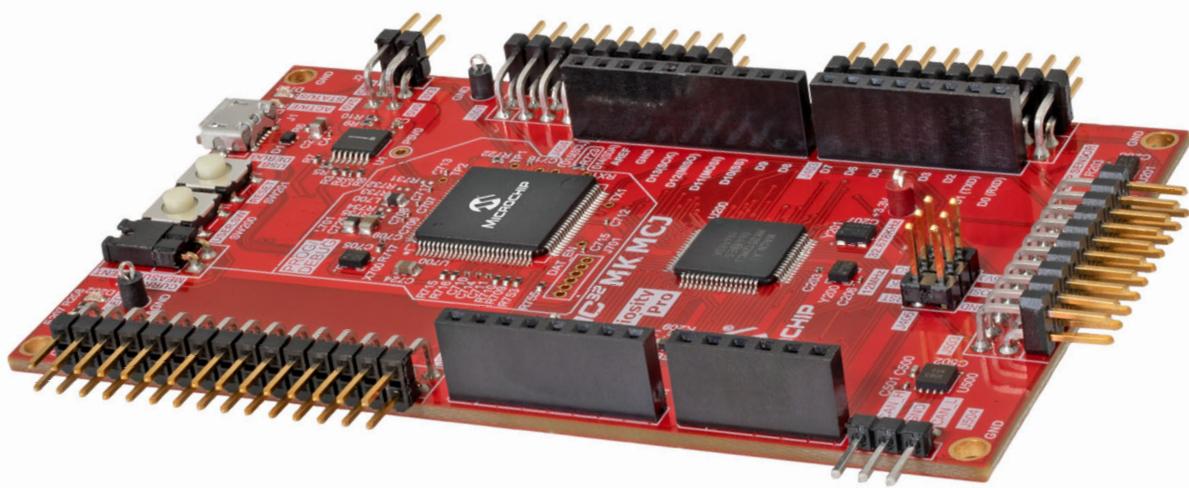
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## **PIC32MK MCJ Curiosity Pro Users Guide**

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**DT100113**

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## 1. Introduction

This document describes the Microchip PIC32MK MCJ Curiosity Pro Development board (DT100113) features, functionality, and schematics. The PIC32MK MCJ Curiosity Pro Development board includes an integrated programmer or debugger, and requires no additional hardware to get started. Users can expand functionality through Arduino Uno R3 or Xplained Pro compatible expansion boards, and control a 3-phase inverter to drive a 3-phase BLDC, PMSM, and ACIM motor.

With expansion boards, the PIC32MK MCJ Curiosity Pro Development board provides the freedom to develop for a variety of applications, including Bluetooth Audio, Internet of Things (IoT), robotics development, and proof-of-concept designs. This board has a dedicated header for interfacing a CAN transceiver. All requisite control input and output signals relevant for a 3-phase motor control application have been brought to a single header which can interface to a 3-Phase Inverter board.

### 1.1 PIC32MK MCJ Curiosity Pro Features

- PIC32MK0512MCJ064, 120 MHz, 512 KB Flash, 64 KB SRAM
- On-Board debugger (PKoB4)
  - Real time Programming and Debugging
  - Virtual COM port (VCOM)
  - Data Gateway Interface (DGI)
- Arduino Uno R3 compatible interface
- Xplained pro extension compatible interface
- Motor Control interface
- On-Board Temperature Sensor
- CAN interface
- User buttons
- User LEDs

### 1.2 Kit Contents

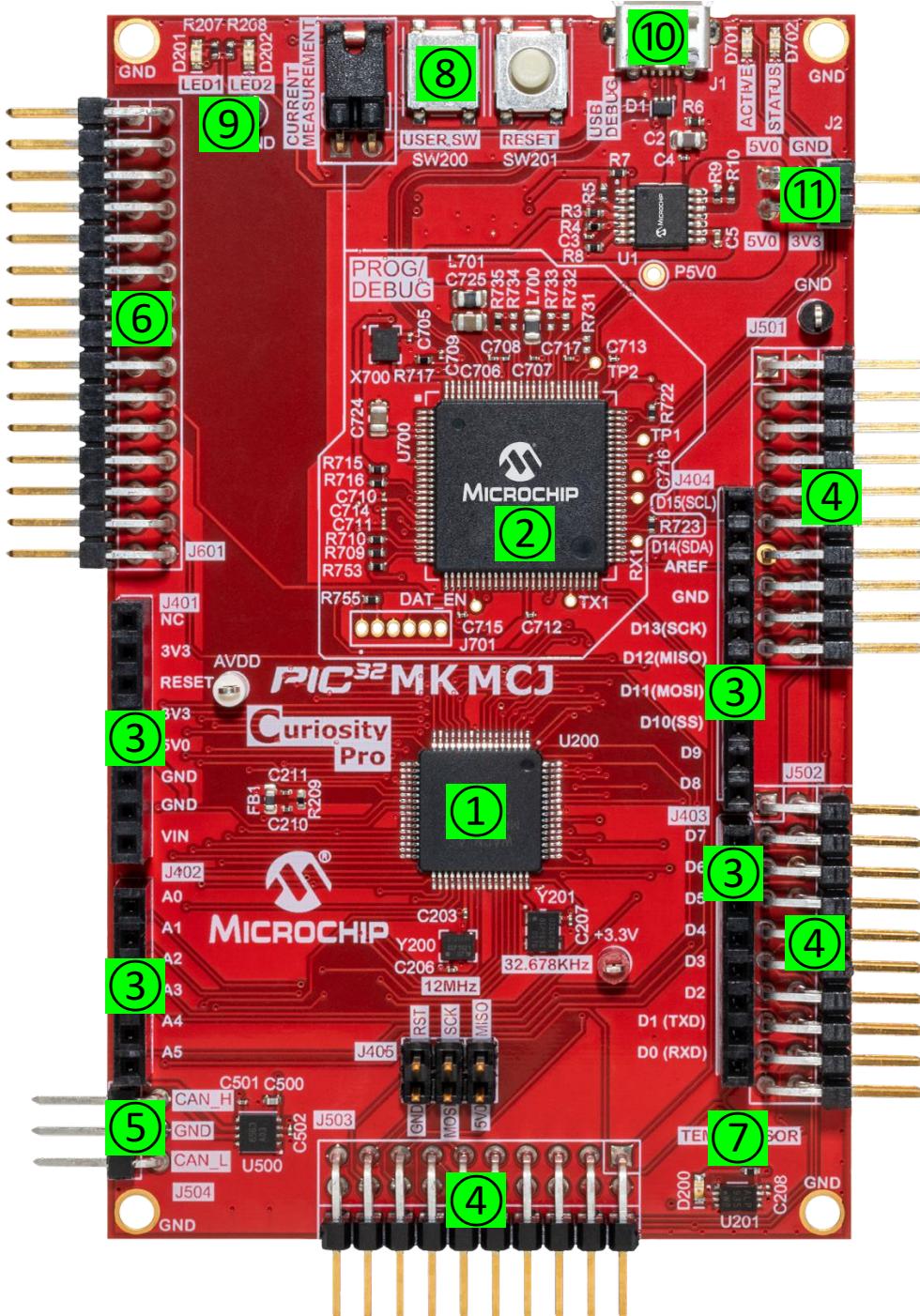
The kit contains one PIC32MK MCJ Curiosity Pro development board, DT100113.

**Note:** If you are missing any part of a kit, contact a Microchip sales office for assistance. A list of Microchip offices for sales and service is provided on the last page of this document.

## 2. Development Board Functionality and Features

### 2.1 Board Feature Location

Figure 2-1. PIC32MK MCJ Curiosity Pro Development Board Layout (Top View)

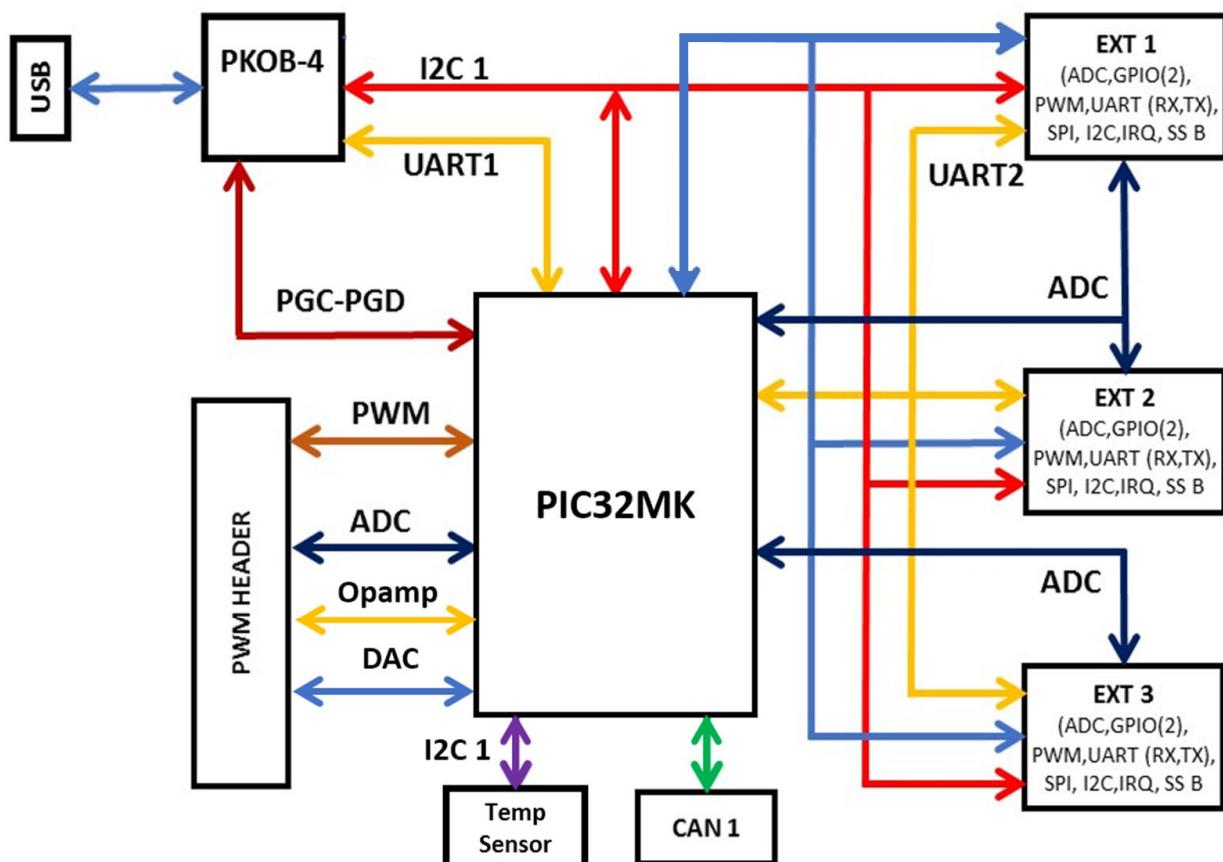


**Table 2-1. PIC32MK MCJ Curiosity Pro Board Features and Location**

Number	Description of item
1	PIC32MK0512MCJ064
2	PICKit on Board 4 (PKoB4)
3	Arduino Uno interface
4	Xplained Pro expansion compatible interface
5	CAN interface
6	Motor Control Interface.
7	On-board temperature sensor
8	Programmable user buttons
9	User LEDs
10	USB to PKoB4 for debugging, power, virtual COM port
11	External 5V supply header

## 2.2 System Block Diagram

The figure below illustrates a high-level block diagram of the PIC32MK MCJ Curiosity Pro development board.

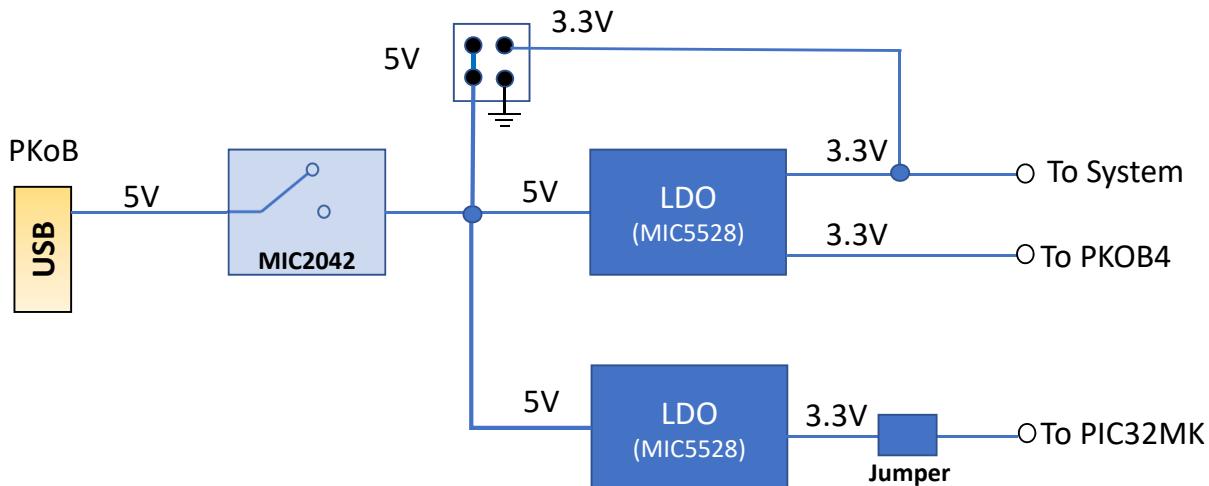
**Figure 2-2. PIC32MK MCJ Curiosity Pro Block Diagram**

## 2.3

### Power Block Diagram

The figure below shows a high-level block diagram of the power system on the PIC32MK MCJ Curiosity Pro development board. The development board can be powered through a 5V supply available from the USB connector for the PKoB4 debugger or through an external 5V or 3.3V supply which can be connected through a 2 x 2 header, J2.

**Figure 2-3. PIC32MK MCJ Curiosity Pro Power Block Diagram**



## 2.4

### Control Area Network (CAN) Bus Interface

The PIC32MK MCJ Curiosity Pro development board provides access to a CAN interface that is post transceiver. The on-board CAN transceiver is an ATA6563 allowing the application to be used with any CAN bus compliant interface.

**Table 2-2. Pins for Use With the CAN Interface**

Pin Number	Name	Description
1	CAN_H	CAN High Signal
2	GND	Ground
3	CAN_L	CAN Low Signal

## 2.5

### Xplained Pro Standard Extension Header

The PIC32MK MCJ Curiosity Pro development board has three Xplained Pro compatible interfaces that enables use of existing expansion boards. Each interface consists of a dual-row, 30-pin, 100 mil, 90 degree extension male headers, while Xplained Pro extensions have their female counterparts. The extension headers can be used to connect a variety of Xplained Pro extension boards or to access the pins of the target MCU directly.

**Note:** All pins are not always connected.

The Pinout description for the Xplained Pro Standard Extension Header1, Header 2, and Header 3 are listed in the following tables.

**Table 2-3. Xplained Pro Header1 Pinout**

Pin number	Name	Description	Port
1	ID_EXT1	Communication line to the ID chip on an extension board	Connected to PKoB4

.....continued

Pin number	Name	Description	Port
2	GND	Ground	-
3	ADC0(+)	Analog-to-digital converter, alternatively positive part of differential ADC	RA0/AN0
4	ADC0(-)	Analog-to-digital converter, alternatively negative part of differential ADC	RC0
5	GPIO1	General purpose I/O	RA7
6	GPIO2	General purpose I/O	RG6
7	PWMH1	High-Side PWM	RB14
8	PWML1	Low-Side PWM	RB15
9	GPIO3	General purpose I/O	RG7
10	GPIO4	General purpose I/O	RA12
11	SDA2	Data line for I <sup>2</sup> C interface. Always implemented, bus type	RA8
12	SCL2	Clock line for I <sup>2</sup> C interface. Always implemented, bus type.	RB4
13	RX2	Receiver line of target device UART	RA14
14	TX2	Transmitter line of target device UART.	RG9
15	SS2	SPI Slave Select or General purpose I/O	RD8
16	MOSI	<b>Master Out Slave In</b> line of serial peripheral interface. Always implemented, bus type.	RC7
17	MISO	<b>Master In Slave Out</b> line of serial peripheral interface. Always implemented, bus type.	RD5
18	SCK2	Clock for serial peripheral interface. Always implemented, bus type	RF0
19	GND	Ground	-
20	VCC	Power for extension boards (3.3V)	-

Table 2-4. Xplained Pro Header2 Pinout

Pin number	Name	Description	Port
1	ID_EXT2	Communication line to the ID chip on an extension board	Connected to PKoB4
2	GND	Ground	-
3	ADC1(+)	Analog-to-digital converter, alternatively positive part of differential ADC	RA1
4	ADC1(-)	Analog-to-digital converter, alternatively negative part of differential ADC	RC1
5	GPIO5	General purpose I/O	RA11
6	GPIO6	General purpose I/O	RB1
7	PWMH2	High-Side PWM	RB12
8	PWML2	Low-Side PWM	RB13
9	GPIO7	General purpose I/O	RB2
10	GPIO8	General purpose I/O	RE12
11	SDA2	Data line for I <sup>2</sup> C interface. Always implemented, bus type	RA8
12	SCL2	Clock line for I <sup>2</sup> C interface. Always implemented, bus type.	RB4
13	RX2	Receiver line of target device UART	RA14

.....continued

Pin number	Name	Description	Port
14	TX2	Transmitter line of target device UART.	RG9
15	SS3	SPI Slave Select or General purpose I/O	RC6
16	MOSI	<b>Master Out Slave In</b> line of serial peripheral interface. Always implemented, bus type.	RC7
17	MISO	<b>Master In Slave Out</b> line of serial peripheral interface. Always implemented, bus type.	RD7
18	SCK2	Clock for serial peripheral interface. Always implemented, bus type	RF0
19	GND	Ground	-
20	VCC	Power for extension boards (3.3V)	-

Table 2-5. Xplained Pro Header3 Pinout

Pin number	Name	Description	Port
1	ID_EXT3	Communication line to the ID chip on an extension board	Connected to PKoB4
2	GND	Ground	-
3	ADC2(+)	Analog-to-digital converter, alternatively positive part of differential ADC	RB0
4	ADC2(-)	Analog-to-digital converter, alternatively negative part of differential ADC	RC2
5	GPIO9	General purpose I/O	RE13
6	GPIO10	General purpose I/O	RE14
7	PWMH3	High-Side PWM	RB10
8	PWML3	Low-Side PWM	RB11
9	GPIO11	General purpose I/O	RE15
10	GPIO12	General purpose I/O	RA4
11	SDA2	Data line for I <sup>2</sup> C interface. Always implemented, bus type	RA8
12	SCL2	Clock line for I <sup>2</sup> C interface. Always implemented, bus type.	RB4
13	RX2	Receiver line of target device UART	RA14
14	TX2	Transmitter line of target device UART.	RG9
15	SS4	SPI Slave Select or General purpose I/O	RD6
16	MOSI	<b>Master Out Slave In</b> line of serial peripheral interface. Always implemented, bus type.	RC7
17	MISO	<b>Master In Slave Out</b> line of serial peripheral interface. Always implemented, bus type.	RD5
18	SCK2	Clock for serial peripheral interface. Always implemented, bus type	RF0
19	GND	Ground	-
20	VCC	Power for extension boards (3.3V)	-

## 2.6 Motor Control Interface

The PIC32MK MCJ Curiosity Pro offers the ability to interface to a 3-Phase motor control driver board through a dual-row, 32-pin, 100 mil, 90 degree extension male header. The following table shows the function, description, and the port on the MCU for the motor control interface header.

**Table 2-6. Motor Control Extension Interface Pin Description**

Pin	Name	Motor Control Function	I/O Function	Port
1	IA	Motor Phase A Current	Analog Input	RA4
2	IB	Motor Phase B Current	Analog Input	RB7
3	ISUM	Inverter DC Bus Current	Analog Input	RA11
4	EXTRA	Extra ADC Input	Analog Input	RB9
5	VBUS	DC Bus measurement	Analog Input	RA12
6	POT	Potentiometer Measurement	Analog Input	RC11
7	OA1IN+	Non-inverting input of OPAMP1	Analog Input	RB2
8	OA1IN-	Inverting input of OPAMP1	Analog Input	RB3
9	OA1OUT	Output of OPAMP1	Analog Output	RB1
10	OA2IN+	Non-inverting input of OPAMP2	Analog Input	RA1
11	OA2IN-	Inverting input of OPAMP2	Analog Input	RB0
12	OA2OUT	Output of OPAMP2	Analog Output	RA0
13	OA3IN+	Non-inverting input of OPAMP3	Analog Input	RC2
14	OA3IN-	Inverting input of OPAMP3	Analog Input	RC1
15	OA3OUT	Output of OPAMP3	Analog Output	RC0
16	DAC1	Output of DAC1	Analog Output	RC10
17	AGND	Analog Ground	N/A	AVSS
18	AGND	Analog Ground	N/A	AVSS
19	PWMH1	High-Side PWM for Phase A	Digital Output	RB14
20	ID4	Identification pin connected to PKoB4	Digital Input	NC
21	PWML1	Low-Side PWM for Phase A	Digital Output	RB15
22	PWMH2	High-Side PWM for Phase B	Digital Output	RB12
23	PWML2	Low-Side PWM for Phase B	Digital Output	RB11
24	PWMH3	High-Side PWM for Phase C	Digital Output	RB10
25	PWML3	Low-Side PWM for Phase C	Digital Output	RB13
26	FLT5	Over-current Fault input	Digital Input	RE12
27	QEA1	Encoder Phase A signal	Digital Input	RG6
28	IDX1	Encoder Index signal	Digital Input	RA7
29	QEB1	Encoder Phase B signal	Digital Input	RG7
30	DGND	Digital Ground	N/A	VSS

## 2.7 Buttons and LEDs

The PIC32MK MCJ Curiosity Pro offers a user button and LEDs. The following table shows the function, description, and the port on the MCU.

**Table 2-7. Button and LED Pin Description**

Function	Description	Type	Port
User SW	User Switch	Digital Input	RB8
User LED1	User LED	Digital Output	RE13
User LED2	User LED	Digital Output	RA10

## 2.8 PICKit™ On-Board 4

The MPLAB® PICkit On-Board 4 (PKoB4) is a new generation In-Circuit Debugger. The MPLAB PKoB4 programs faster than its predecessor and is designed to use a high-speed 2.0 USB interface, which provides a feature rich debugging experience through one USB cable. The PKoB4 is intended to support programming, debugging, and a Data Gateway interface.

The MPLAB PKoB4 In-Circuit Debugger is compatible with any one of these platforms:

- Microsoft Windows® 7 or later
- Linux®
- macOS™

The MPLAB PKoB4 In-Circuit Debugger system provides the following advantages:

Features/Capabilities:

- Connects to computer through high-speed USB 2.0 (480 Mbits/s) cable
- Programs devices using MPLAB X IDE or MPLAB IPE
- Supports multiple hardware and software breakpoints, stopwatch, and source code file debugging
- Debugs your application in real time
- Sets breakpoints based on internal events
- Monitors internal file registers
- Debugs at full speed
- Configures pin drivers
- Virtual COM Support which can establish UART communication between the host PC and the target device using the following UART Configuration:
  - Baud rate: 115,200 bps
  - Only 8-bit character format
  - No hardware flow control
  - One stop-bit
- Field-upgradeable through an MPLAB X IDE firmware download
- Adds new device support and features by installing the latest version of MPLAB X IDE (available as a free download at <https://www.microchip.com/mplabx/>)
- Indicates debugger status through on-board LEDs

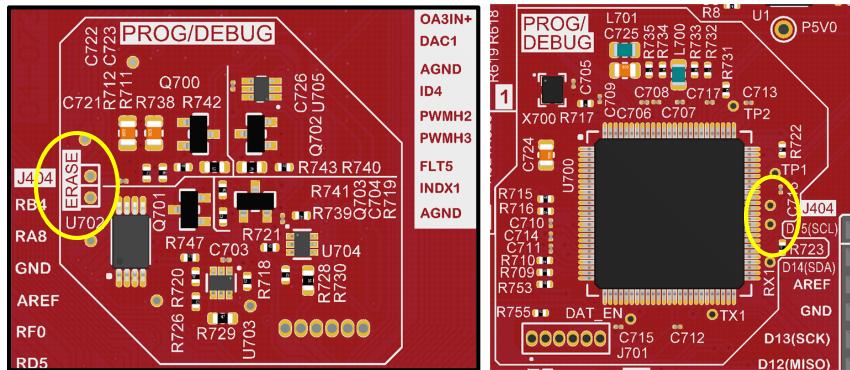
Performance/Speed:

- More and faster memory
- A Real-Time Operating System (RTOS)
- No firmware download delays incurred when switching devices
- A 32-bit MCU running at 300 MHz

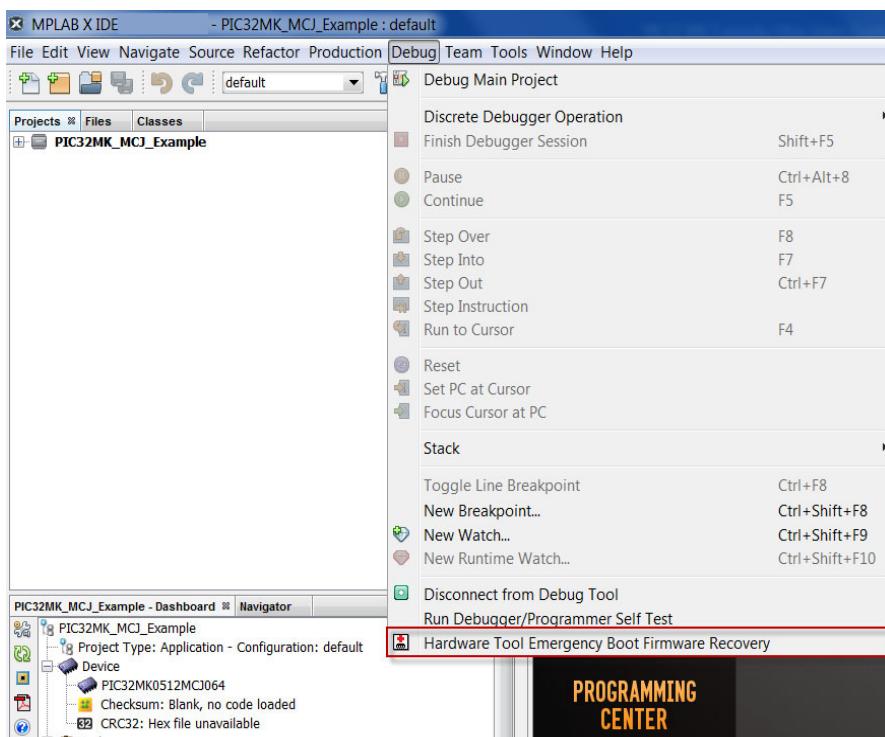
### 2.8.1 Recovery Method

If PKoB4 becomes unresponsive, users can recover the tool by following these steps:

1. With the PIC32MK MCJ Curiosity Pro development board still powered, short the 2 pads for approximately 10 seconds.



2. Open The latest version of MPLAB X IDE.
  3. From *Debug > Hardware Tool Emergency Boot Firmware Recovery*.



4. Follow the onscreen instructions to reset the tool to factory conditions.

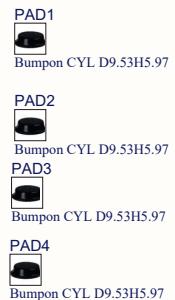
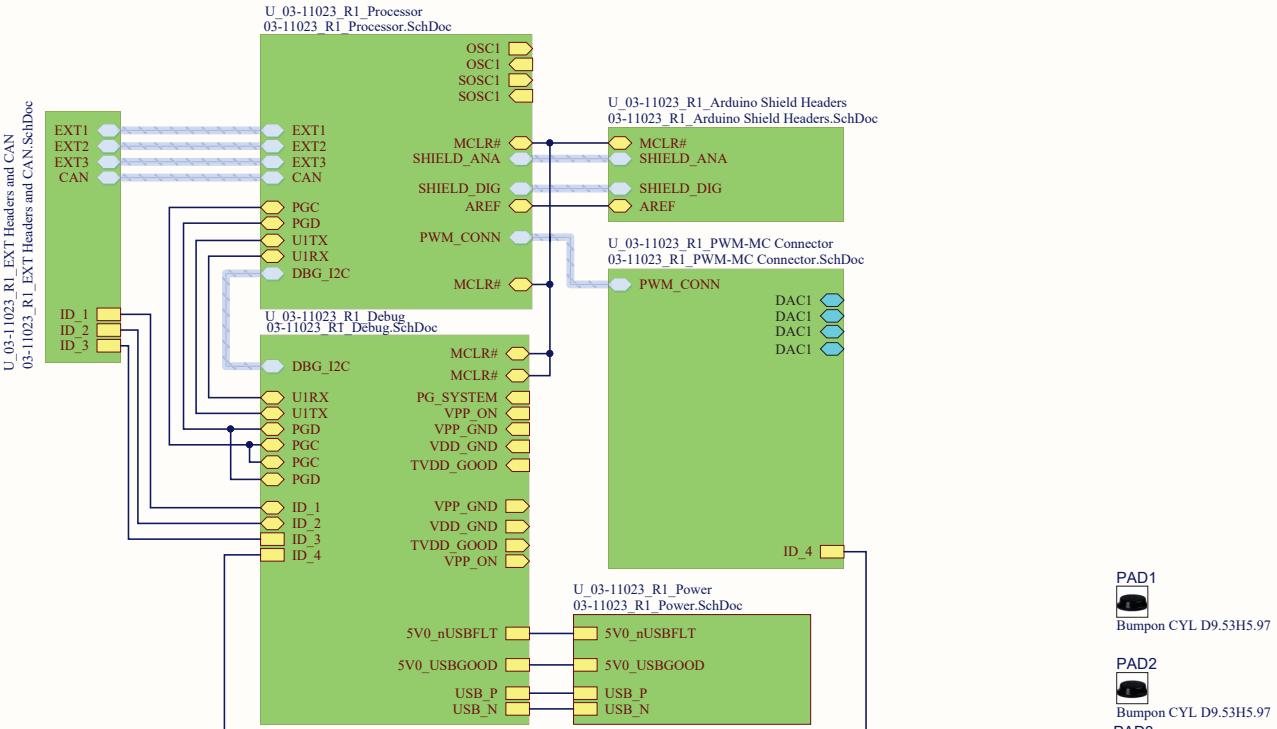
For additional information on the PKoB4, refer to the “MPLAB® PICkit™ 4 User’s Guide” (DS50002751), which is available for download at the following location:

<http://ww1.microchip.com/downloads/en/DeviceDoc/MPLAB%20PICkit%204%20ICD%20Users%20Guide%20DS50002751C.pdf>

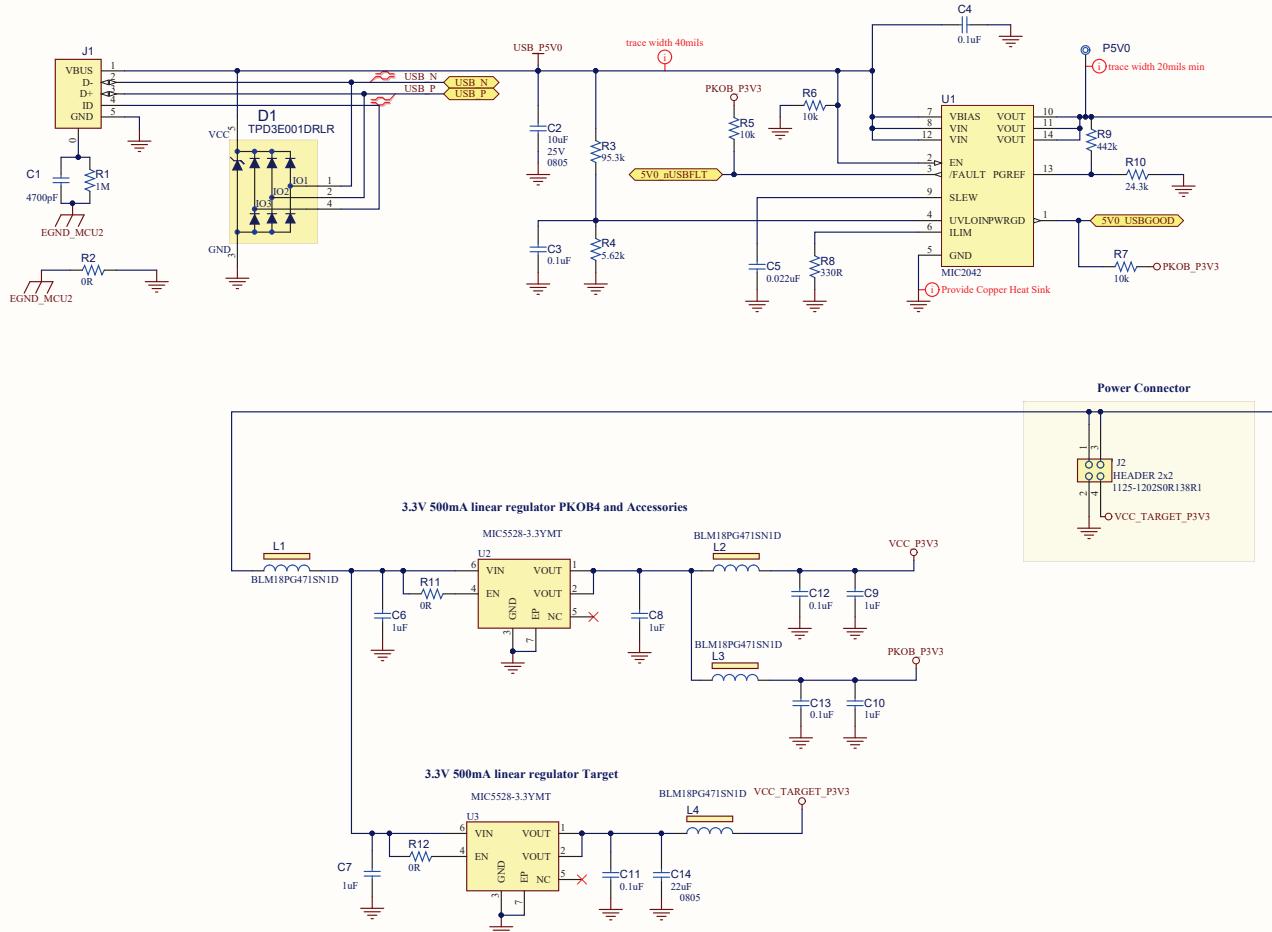
### 3. Hardware

This section covers the PIC32MK MCJ Curiosity Pro development board schematics.

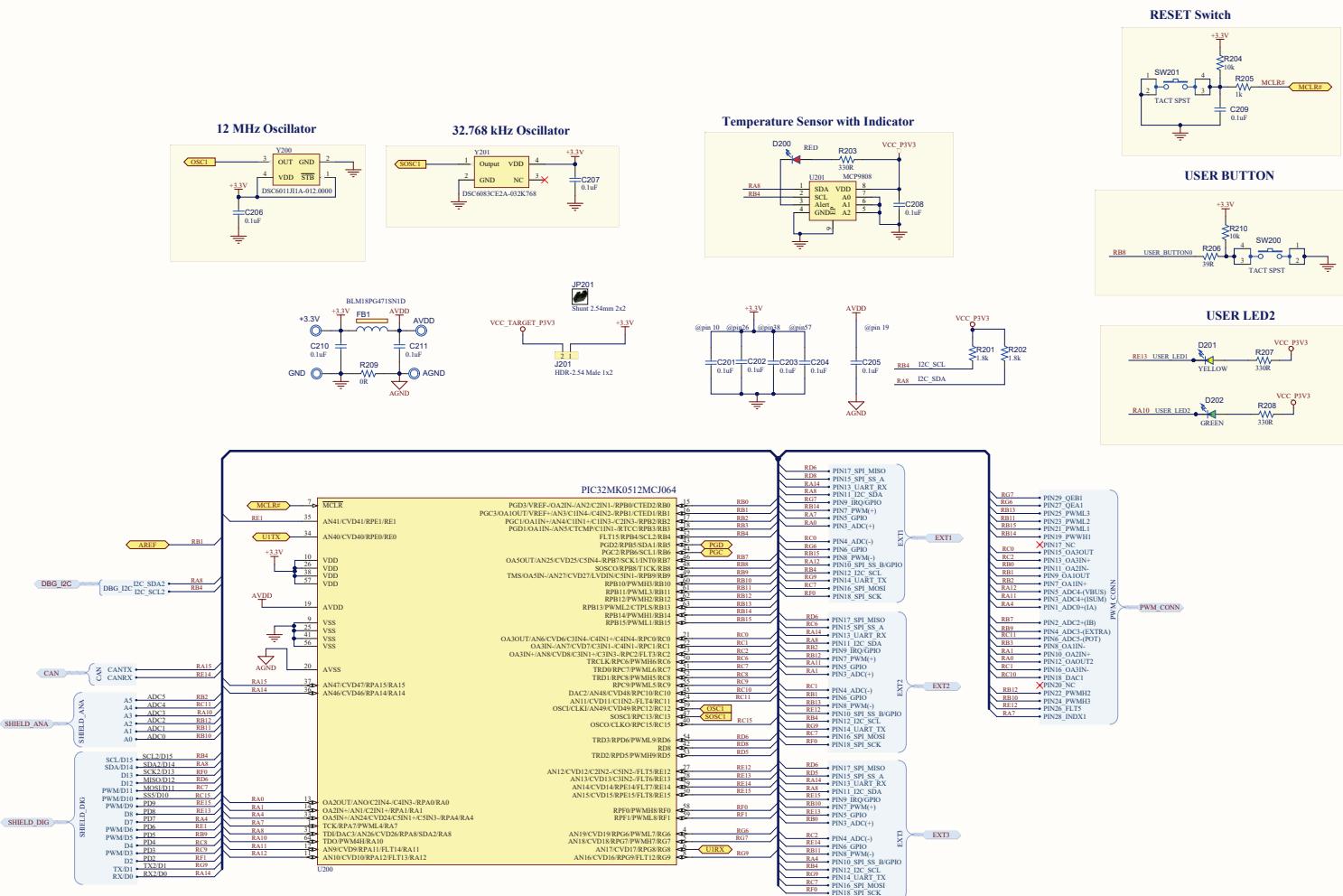
#### 3.1 Schematics



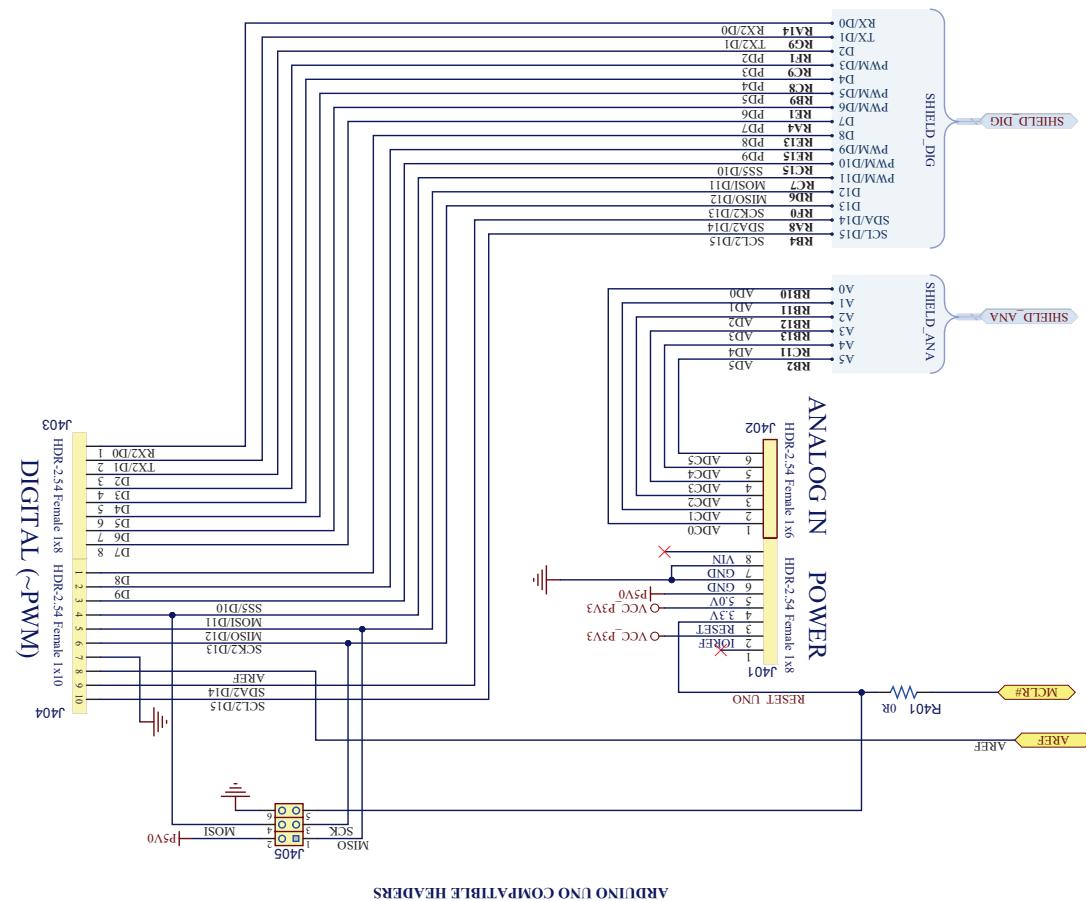
**Figure 3-2. PIC32MK MCJ Curiosity Pro Development Board Schematics (2 of 7)**



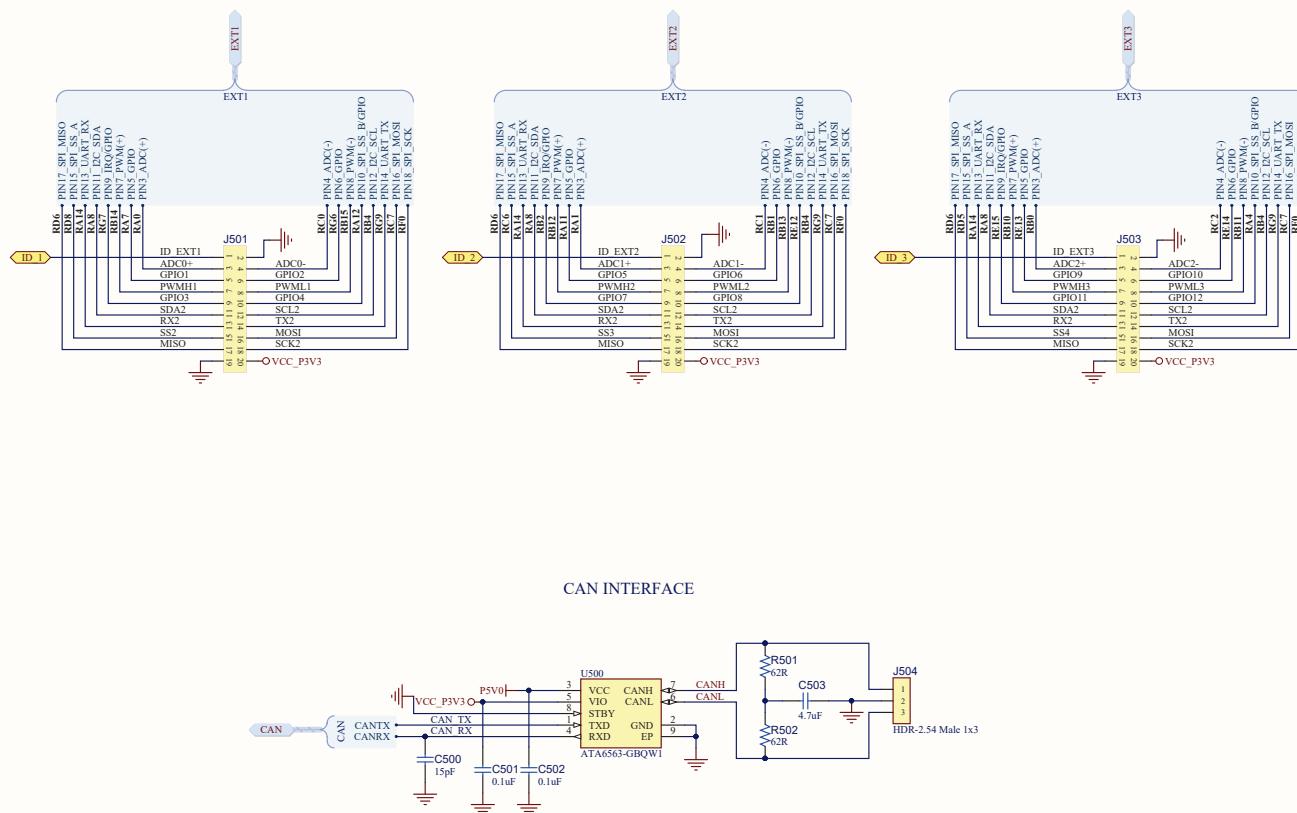
**Figure 3-3. PIC32MK MCJ Curiosity Pro Development Board Schematics (3 of 7)**



**Figure 3-4. PIC32MK MCJ Curiosity Pro Development Board Schematics (4 of 7)**



**Figure 3-5. PIC32MK MCJ Curiosity Pro Development Board Schematics (5 of 7)**



**Figure 3-6. PIC32MK MCJ Curiosity Pro Development Board Schematics (6 of 7)**

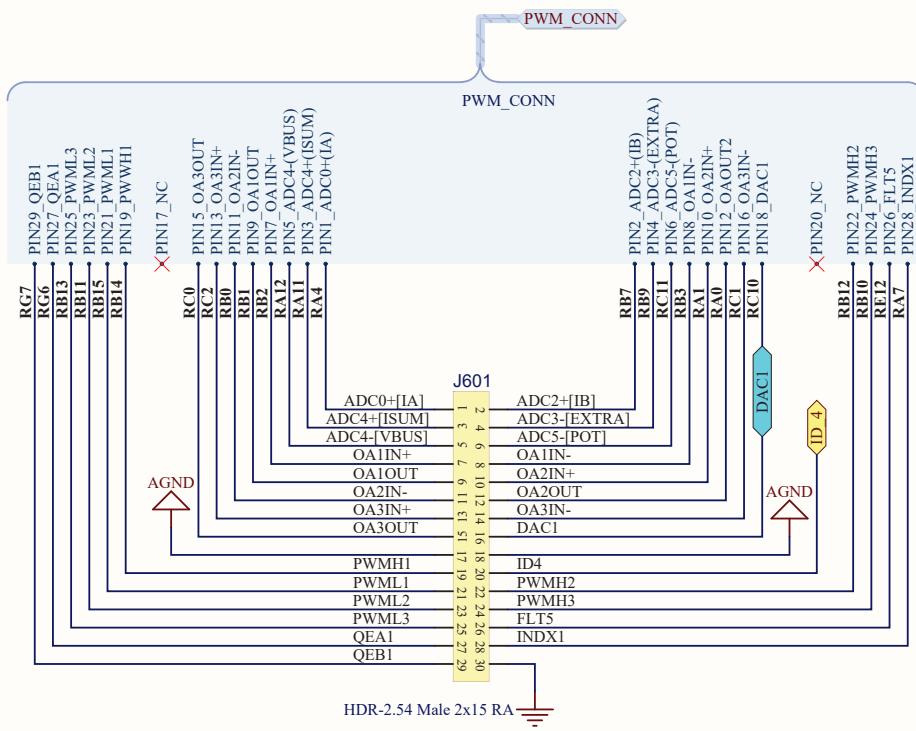
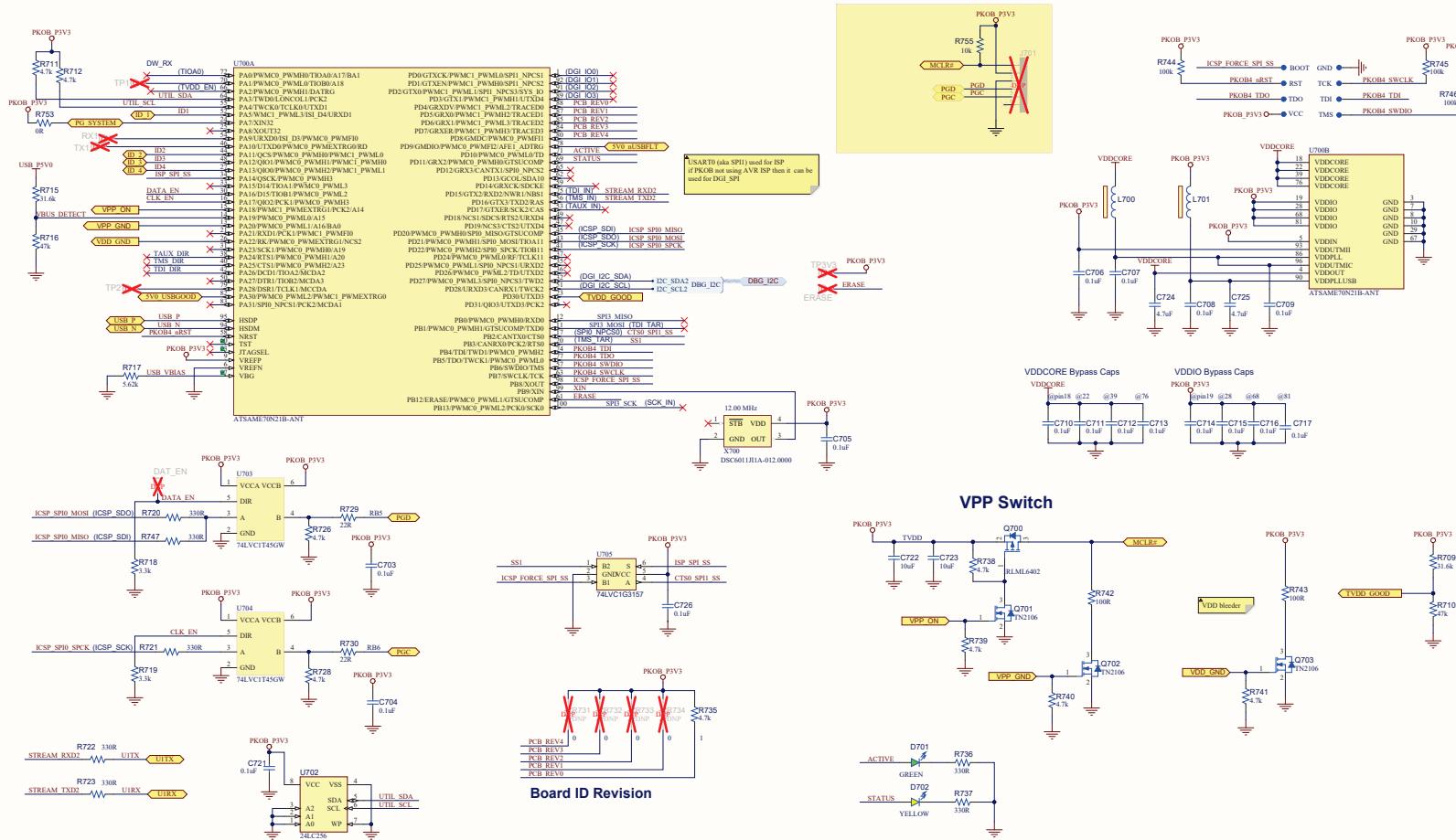


Figure 3-7. PIC32MK MCJ Curiosity Pro Development Board Schematics (7 of 7)



### 3.2 Bill of Materials

Quantity	Designator	Description_
3	C2, C722, C723	CAP CER 10uF 25V 10% X5R SMD 0805
35	C3, C4, C11, C12, C13, C201, C202, C203, C204, C205, C206, C207, C208, C209, C210, C211, C501, C502, C703, C704, C705, C706, C707, C708, C709, C710, C711, C712, C713, C714, C715, C716, C717, C721, C726	CAP CER 0.1µF 16V 10% X5R SMD 0201
1	C5	CAP CER 0.022uF 16V 10% X7R SMD 0402
5	C6, C7, C8, C9, C10	CAP CER 1uF 16V 10% X7R SMD 0603
1	C14	CAP CER 22uF 25V 20% X5R SMD 0805
1	C500	CAP CER 15pF 50V 5% NP0 SMD 0402
3	C503, C724, C725	CAP CER 4.7uF 25V 10% X5R SMD 0805
1	D1	TVS DIODE ARRAY TPD3E001DRLR
1	D200	DIO LED RED 2V 30mA 2mcd Clear SMD 0603
2	D201, D702	DIO LED YELLOW 2.1V 20mA 6mcd Clear SMD 0603
2	D202, D701	DIO LED GREEN 2V 30mA 35mcd Clear SMD 0603
5	FB1, L1, L2, L3, L4	FERRITE 470R@100MHz 1A SMD 0603
1	J1	CONN RCPT USB2.0 MICRO AB SMD RA
1	J2	CON HDR-2.54 Male 2X2 Gold 6mm MH TH R/A
1	J201	CON HDR-2.54 Male 1X2 Gold 6mm MH TH R/A
2	J401, J403	CON HDR-2.54 Female 1x8 Tin TH VERT
1	J402	CON HDR-2.54 Female 1x6 Gold TH VERT
1	J404	CON HDR-2.54 Female 1x10 Gold TH VERT
1	J405	CON HDR-2.54 Male 2x3 Gold 5.84MH TH VERT
3	J501, J502, J503	CON HDR-2.54 Male 2x10 Gold TH RT ANGLE
1	J504	CON HDR-2.54 Male 1x3 Tin 6.2MH TH R/A
1	J601	CON HDR-2.54 Male 2x15 Gold 5.84MH TH R/A
1	JP201	MECH HW JUMPER 2.54mm 1x2
2	L700, L701	FERRITE 2A 600R SMD 0805
4	PAD1, PAD2, PAD3, PAD4	MECH HW RUBBER PAD CYLINDRICAL D9.53H5.97
1	Q700	TRANS FET P-CH IRLML6402 -20V -3.7A 1.3W SOT-23-3
3	Q701, Q702, Q703	MCHP ANALOG MOSFET N-CH TN2106 60V 280mA 360mW 2.5R SOT23-3
1	R1	RES TKF 1M 1% 1/10W SMD 0402
6	R2, R11, R12, R209, R401, R753	RES TKF 0R 1/16W SMD 0402
1	R3	RES TKF 95.3k 1% 1/16W SMD 0402

.....continued

Quantity	Designator	Description_
2	R4, R717	RES TKF 5.62k 1% 1/16W SMD 0402
6	R5, R6, R7, R204, R210, R755	RES TKF 10k 1% 1/10W SMD 0402
11	R8, R203, R207, R208, R720, R721, R722, R723, R736, R737, R747	RES TKF 330R 1% 1/16W SMD 0402
1	R9	RES TKF 442k 1% 1/16W SMD 0402
1	R10	RES TKF 24.3k 1% 1/16W SMD 0402
2	R201, R202	RES TKF 1.8k 1% 1/10W SMD 0402
1	R205	RES TKF 1k 1% 1/10W SMD 0603
1	R206	RES TKF 39R 1% 1/16W SMD 0402
2	R501, R502	RES TKF 62R 1% 1/2W SMD 1210
2	R709, R715	RES TKF 31.6k 1% 1/10W SMD 0402
2	R710, R716	RES TKF 47k 5% 1/10W SMD 0402
9	R711, R712, R726, R728, R735, R738, R739, R740, R741	RES TKF 4.7k 1% 1/16W SMD 0402
2	R718, R719	RES TKF 3.3k 5% 1/10W SMD 0402
2	R729, R730	RES TKF 22 OHM 1% 1/10W SMD 0603
2	R742, R743	RES TKF 100R 5% 1/10W SMD 0603
3	R744, R745, R746	RES TKF 100k 1% 1/10W SMD 0402
2	SW200, SW201	SWITCH TACT SPST 15V 20mA EVQ-Q2H03W SMD
1	U1	MCHP ANALOG POWER SWITCH 5.5V 3A MIC2042-1YTS TSSOP-14
2	U2, U3	MCHP ANALOG LDO 3.3V MIC5528-3.3YMT-TR 6-TDFN
1	U200	PIC32 300MHz 2MB 1000-LQFP ATSAME70N21B-ANT
1	U201	MCHP ANALOG TEMPERATURE SENSOR -40C to +125C MCP9808T-E/MC DFN-8
1	U500	MCHP INTERFACE CAN ATA6563-GBQW1 VDFN-8
1	U700	MCHP MCU 32-BIT 300MHz 2MB 384kB ATSAME70N21B-ANT LQFP-100
1	U702	MCHP MEMORY SERIAL EEPROM 256k I2C 24LC256-E/ST TSSOP-8
2	U703, U704	IC TRANSCEIVER 74LVC1T45GW Single Bit Voltage Translator SOT-363
1	U705	IC SWITCH SPDT 74LVC1G3157 SC-70-6
2	X700, Y200	MCHP CLOCK OSCILLATOR SINGLE 12.000MHZ DSC6011JI1A-012.0000 VLGA
1	Y201	MCHP CLOCK OSCILLATOR SINGLE 32.768Hz DSC6083CE2A-032K768 SMD DFN-4
1	+3.3V	MISC, TEST POINT MULTI PURPOSE MINI RED
2	AGND, GND	MISC, TEST POINT MULTI PURPOSE MINI BLACK
1	AVDD	MISC, TEST POINT MULTI PURPOSE MINI WHITE

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- Microchip is willing to work with the customer who is concerned about the integrity of their code.
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