EV96B94A

WBZ451 Curiosity Board User's Guide

Introduction

The WBZ451 Curiosity Board is an efficient and modular development platform that supports rapid prototyping and demonstrates the features, capabilities and interfaces of Microchip's Bluetooth® Low Energy and Zigbee RF Module (WBZ451PE).

The WBZ451 Curiosity Board:

- Offers integrated programming/debugging features using the PICkit™ On-board 4 (PKOB4) debugger interface
- Requires only a Micro USB cable to power-up and program the board
- Includes a mikroBUS™ Click™ header, which helps the users to expand the functionalities by connecting to various MikroElectronika mikroBUS Click adapter boards
- Performs rapid prototyping utilizing the Bluetooth Low Energy and Zigbee-enabled RF Module

The WBZ451 Curiosity Board supports a variety of applications:

- Wireless lighting
- Home automation or Internet of Things (IoT)
- Industrial automation
- Other Bluetooth Low Energy or Zigbee-related applications

Features

- WBZ451PE Bluetooth Low Energy and Zigbee RF Module
- USB or Li-Po Battery Powered
- On-board Programmer/Debug Circuit using PKoB4 based on Microchip SAME70 MCU
- Microchip MCP73871 Li-Ion/LiPo Battery Charger with Power Path Management
- On-board USB to UART Serial Converter with Hardware Flow Control based on Microchip MCP2200
- mikroBUS Socket to Expand Functionality using MikroElectronika Click Adapter Boards
- RGB LED Connected to Pulse Width Modulation (PWM)
- One Reset Switch
- One User Configurable Switch
- One User LED
- 32.768 kHz Crystal
- Microchip SST26VF064B, 64-Mbit External QSPI Flash Memory
- Microchip MCP9700A, Low Power Analog Voltage Temperature Sensor
- 10-pin ARM Serial Wire Debug (SWD) Header for External Programmer/Debugger

For more details, refer to 3. Hardware.

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1. Quick References

1.1 Reference Documentation

For further details, refer to the following:

- *MPLAB® XC32 C/C++ Compiler User's Guide* (DS50001686)
- *MPLAB® X IDE User's Guide* (DS50002027)
- *MPLAB® Snap In-Circuit Debugger Information Sheet* (DS50002787)
- *MCP1727 1.5A, Low Voltage, Low Quiescent Current LDO Regulator Data Sheet* (DS21999)
- *SST26VF064B/SST26VF064BA 2.5V/3.0V 64-Mbit Serial Quad I/O™ (SQI™) Flash Memory Data Sheet* (DS20005119J)
- *Stand-Alone System Load Sharing and Li-Ion/Li-Polymer Battery Charge Management Controller Data Sheet* (DS20002090)
- *MCP9700A, Low-Power Linear Active Thermistor IC Data Sheet* (DS20001942)
- *Universal Serial Bus Specification and Associated Documents* (www.usb.org)
- *mikroBUS™ Specification* (www.mikroe.com/mikrobus)
- *PIC32CX-BZ2 and WBZ45 Family Data Sheet* (DS70005504)

1.2 Hardware Prerequisites

- WBZ451 Curiosity Board
- Type-A male to Micro-B USB cable
- Li-Ion Polymer Battery - 4.2V for battery-powered application
- Bluetooth-enabled Smartphone:
  - Android™ device
  - iOS: iPhone® device

1.3 Software Prerequisites

- MPLAB® Integrated Development Environment (MPLAB X IDE) tool (version 5.50 or later)
- MPLAB XC32 Compiler (version 2.40 or later)
- PKOB4 Tool Pack version 1.7.738 or later
- Released Out of Box (OOB) demo

1.4 Acronyms and Abbreviations

Table 1-1. Acronyms/Abbreviations

Acronyms/Abbreviations	Description
ADC	Analog-to-Digital Converter
BOM	Bill of Material
GPIO	General Purpose Input Output
I^2C	Inter-Integrated Circuit
ICD	In-Circuit Debugger
IoT	Internet of Things

.....continued

Acronyms/Abbreviations	Description
LDO	Low-Dropout
LED	Light Emitting Diode
MCU	Microcontroller
NC	Not Connected
OOB	Out-of-Box
PCB	Printed Circuit Board
PKOB	PICKit On-Board
PPS	Peripheral Pin Select
PWM	Pulse Width Modulation
RTCC	Real Time Clock and Calendar
RX	Receiver
SCL	Serial Clock
SDA	Serial Data
SMD	Surface Mount Device
SoC	System-on-Chip
SPI	Serial Peripheral Interface
SWD	Serial Wire Debug
TX	Transmitter
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus

2. Kit Overview

The WBZ451 Curiosity Board contains a WBZ451PE module. All the signals from the WBZ451PE module are connected to on-board features of the Curiosity Board for flexibility and rapid prototyping.

Figure 2-1. WBZ451 Curiosity Board (EV96B94A) – Top View

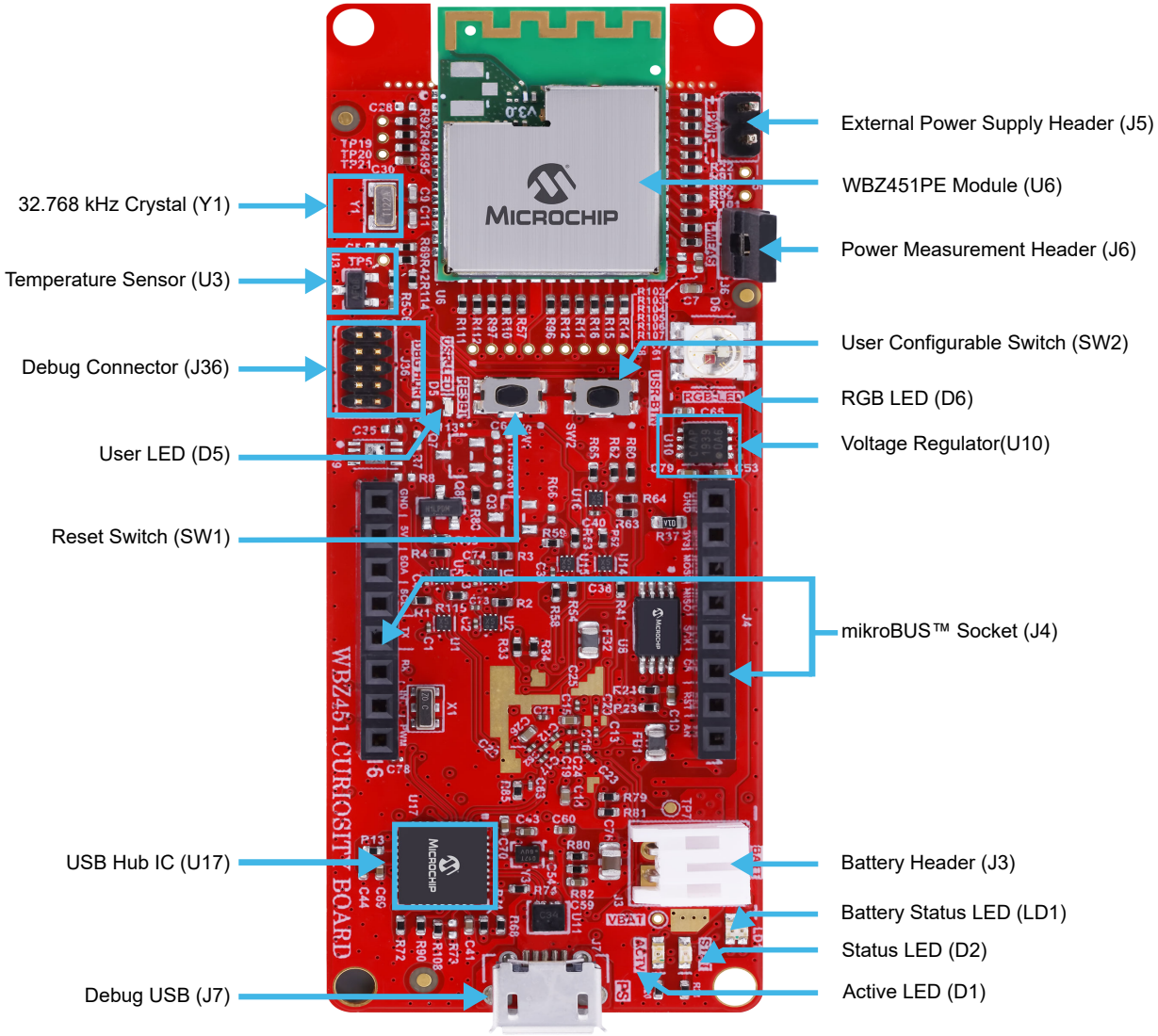
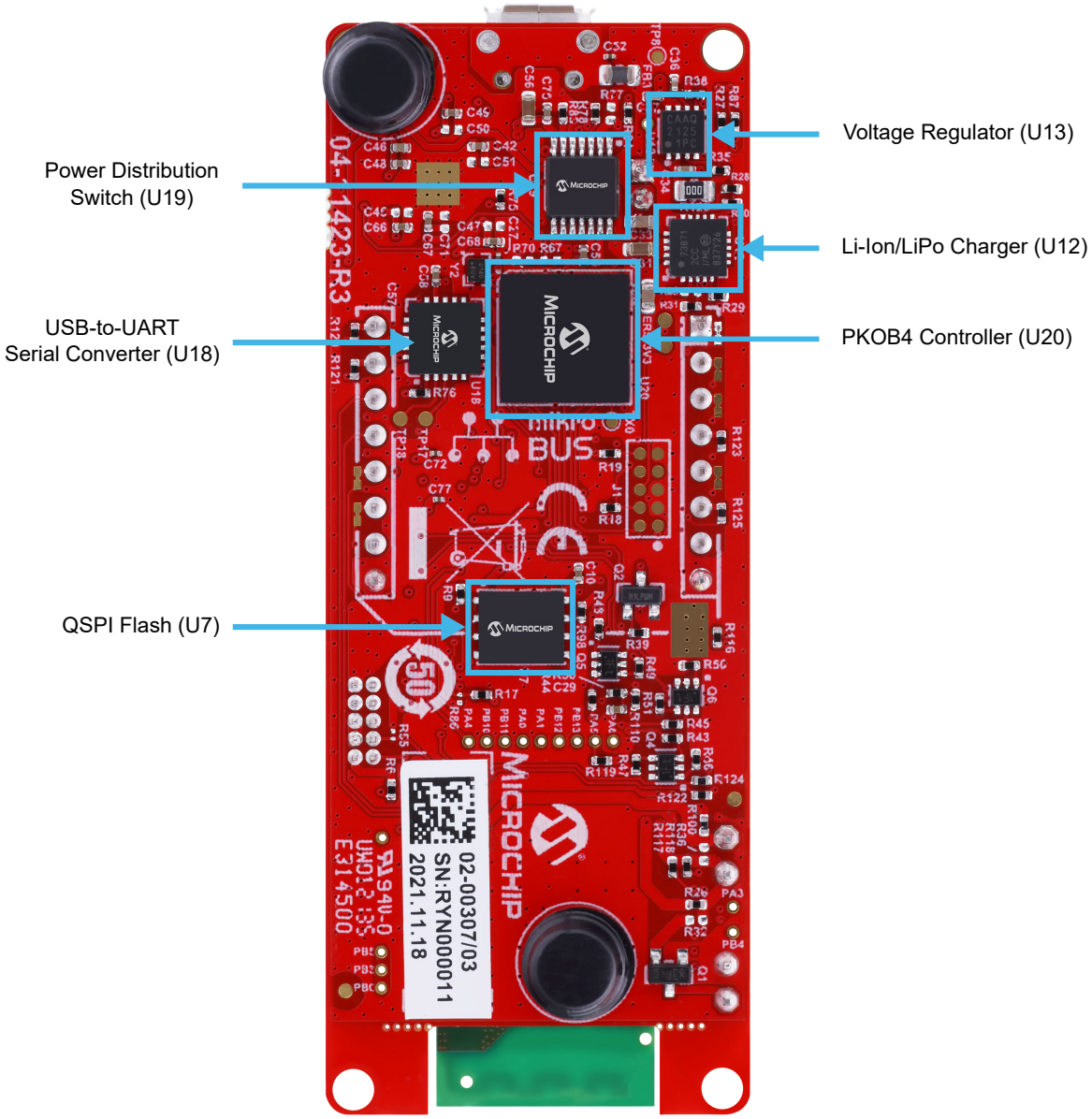


Figure 2-2. WBZ451 Curiosity Board (EV96B94A) – Bottom View



2.1 Kit Contents

The EV96B94A (WBZ451 Curiosity Board) kit contains the following:

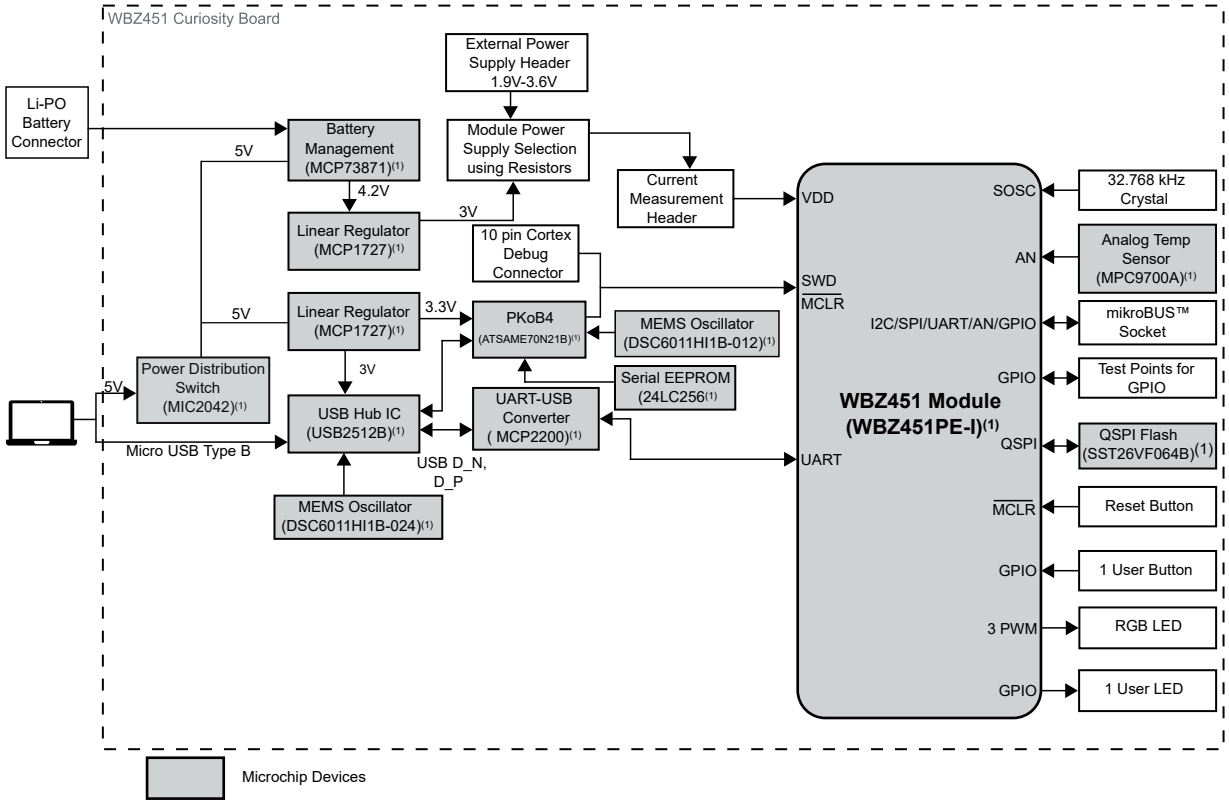
- A WBZ451PE module mounted on the WBZ451 Curiosity Board
- A Type-A male to Micro-B USB cable

Note: If any of the above items are missing in the kit, go to support.microchip.com or contact your local Microchip Sales office. In this user guide, there is a list of Microchip offices for sales and services provided on the last page.

3. Hardware

This chapter describes the hardware features of the WBZ451 Curiosity Board.

Figure 3-1. WBZ451 Curiosity Board Block Diagram



Note:

1. Using Microchip's total system solution, which includes complementary devices, software drivers and reference designs, is highly recommended to ensure the proven performance of the WBZ451 Curiosity Boards. For more details, go to support.microchip.com or contact your local Microchip Sales office.

3.1 Power Supply

The WBZ451 Curiosity Board can be powered using any of the following sources:

1. The USB supplies power to the WBZ451 Curiosity Board using a Type-A male to Micro-B USB cable connected to the (J7) Micro B USB connector.
2. 4.2V Li-ion/Li-Po battery kit as follows:
   - Connected to J3, JST PH, 2-pin, 2 mm pitch and right-angle male battery header
   - Crimp style connector, battery polarity according to ± marking on the Curiosity Board
   - Battery is not part of the kit
   - Minimum recommended battery capacity is 400 mAh with a battery charge voltage of 4.2V

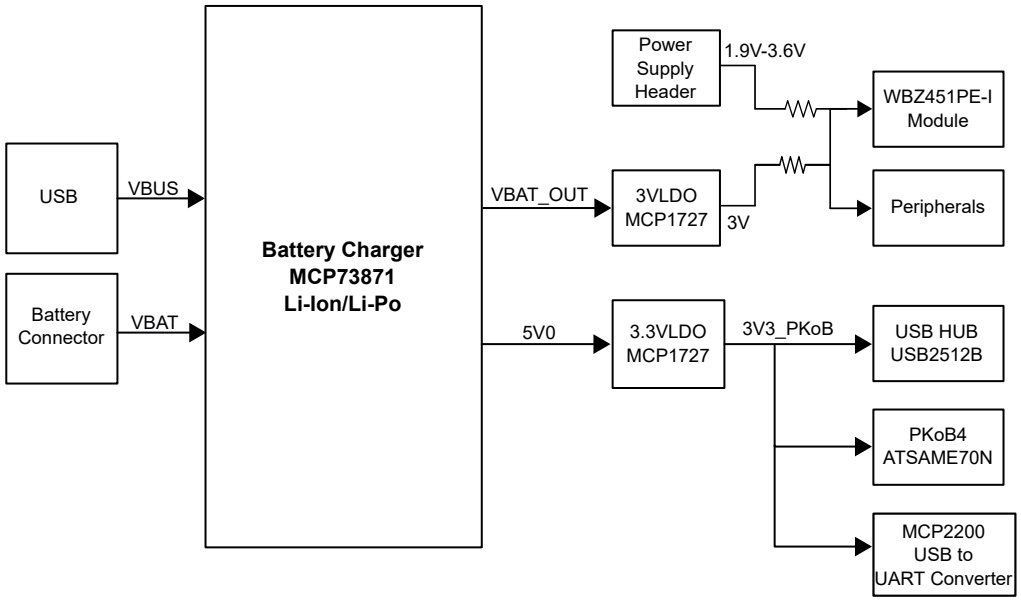
Battery management circuit automatically handles selection between USB power supply and battery supply.

The following are the two on-board MCP1727 voltage regulators on the WBZ451 Curiosity Board that power the circuitry on-board.

- U10 – Generates 3V that powers the WBZ451PE-I module along with the associated circuits
- U13 – Generates 3.3V that powers the USB hub IC (U201), PKOB4 main controller (U300), along with the associated circuits that connect the PKOB4 debugger to a host PC and MCP2200 USB to UART converter

For more details on the U10 and U13 voltage regulators, refer to the *MCP1727 1.5A, Low Voltage, Low Quiescent Current LDO Regulator Data Sheet* (DS21999).

Figure 3-2. WBZ451 Curiosity Board Power Supply Block Diagram



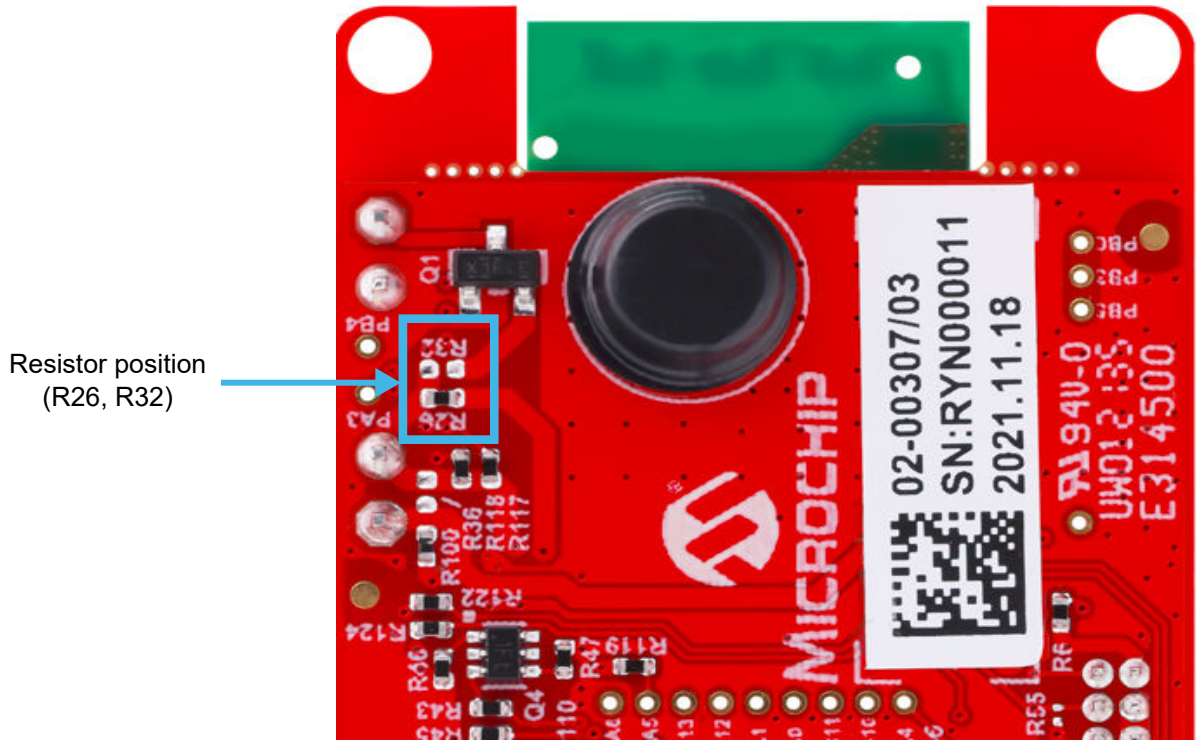
The WBZ451PE module and associated peripherals can also be powered from:

- External power supply header (J5) using external power supply (1.9V – 3.6V) for testing at different voltage levels apart from the default supply of 3V from on-board regulator. To use the external power supply header, disconnect the on-board 3V supply according to the following table:

Table 3-1. Resistor Option to Select the WBZ451PE Module Power Supply

On-board 3V Regulator	External Power Supply
Mount R26	Do not mount R26
Do not mount R32	Mount R32

Figure 3-3. Resistor Position to Select the WBZ451PE Module Power Supply



Note: The maximum available current from the PS USB (J7) is limited to 500 mA. The current is shared between charging the external battery (if connected) and the target application section.

3.2 Li-Po Battery Charger

A 4.2V, Li-Po battery connected to the 2-pin, 2 mm pitch right-angle male battery header can be charged using Battery Management IC MCP73871-2CC (U12) from the USB power supply at 100 mA fast charge current.

The battery management circuit automatically handles selection between the USB power supply and battery supply. The current is shared between charging the battery (if connected) and the target application section. For more details on the MCP73871 Li-ion/Li-Po battery charger, refer to the *Stand-Alone System Load Sharing and Li-Ion/Li-Polymer Battery Charge Management Controller Data Sheet* (DS20002090).

Table 3-2. LD1 Battery Charger Status LED

LED Color	Function
Red (charging)	The battery is charged by the USB when USB is plugged-in.
Red (discharging)	The battery voltage is low. Triggers, if the voltage is under 3.1V.
Green	Fully charged.

3.3 Power Measurement Header (J6)

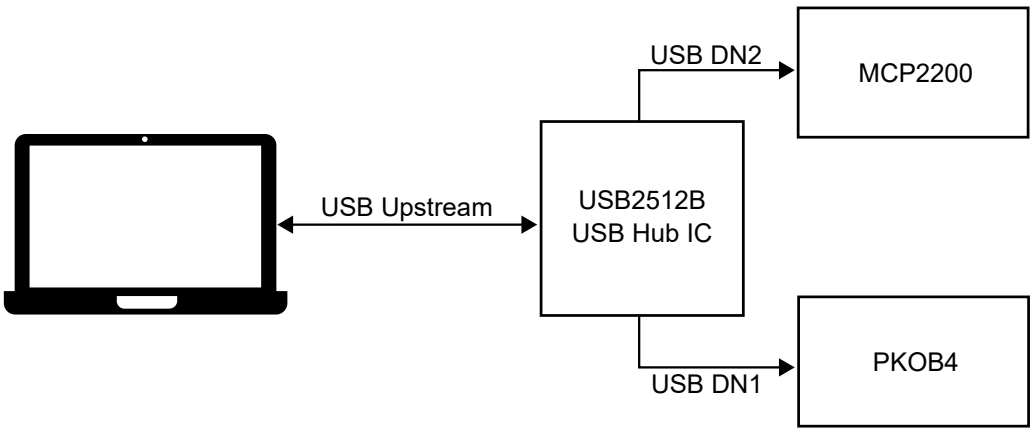
To measure the power going to the WBZ451PE module, 1x2, 2.54 mm male pin header with shunt connector (I-MEAS, J6) is provided. Remove the jumper (JP1) from J6 and connect an ammeter across its pins to measure the current. A shunt resistor (R36) option (DNP) across the jumper is also provided, which provides a relationship

between the voltage drop and current consumption. For current profiling in terms of voltage using a voltage probe, mount R36 and measure the voltage drop across the shunt resistor.

3.4 USB Connectivity using Microchip USB 2.0 Hub Controller

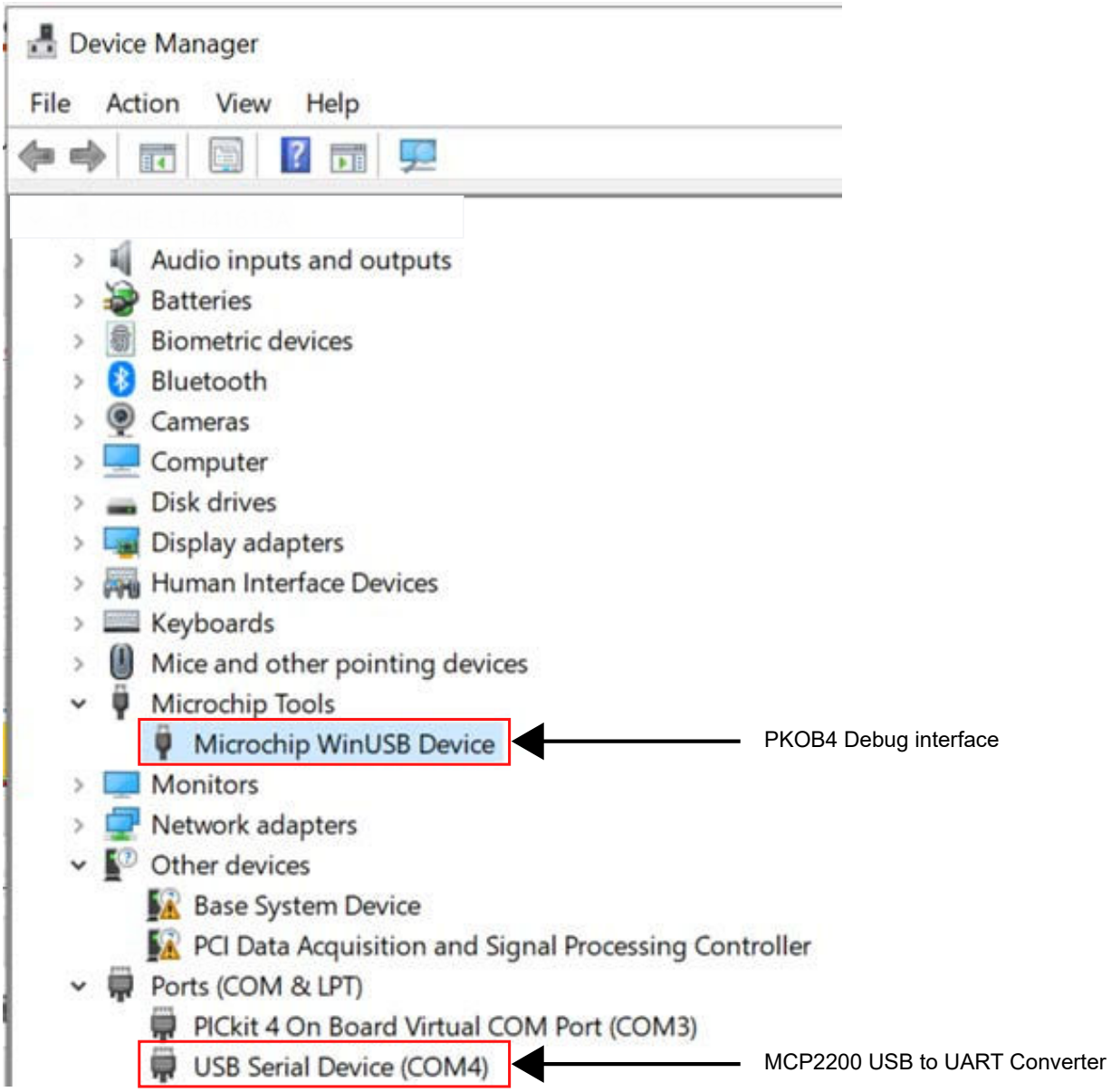
The WBZ451 Curiosity Board has two USB end device PKOB4 and MCP2200. Both these USB devices are accessible to the upstream PC via a common USB connector using Microchip USB 2.0 High Speed Hub Controller USB2512B providing the user with more ease of use.

Figure 3-4. USB Connectivity using Hub Controller



When the WBZ451 Curiosity Board is plugged into the upstream PC using a micro USB cable, device enumeration is as shown in the following figure for the PKOB4 and MCP2200.

Figure 3-5. Device Manager



3.5 PICkit On-Board 4 (PKOB4) and Debugger/Programmer Selection

The WBZ451 Curiosity Board includes an integrated programmer and debugger MPLAB PICkit On-Board 4 (PKOB4), a new generation of In-Circuit Debugger, which requires no additional programming/debugging tool to get started.

Features and capabilities of PKOB4:

- Connects to a computer through high-speed USB 2.0 (480 Mbits/s) cable
- Programs the devices using MPLAB X IDE or MPLAB IPE
- Supports multiple hardware and software breakpoints, stopwatch and source code file debugging
- Debugs the application in real time
- Sets breakpoints based on the internal events
- Monitors the internal file registers

- Debugs at full speed
- Configures the pin drivers
- Field-upgradeable through an MPLAB X IDE firmware download
- Indicates debugger status through on-board LED's development board functionality and features

The PKOB4 on the WBZ451 Curiosity Board is intended to support programming and debugging the target device (WBZ451PE module) through the micro-B USB connector (J7) from the Host PC. Other PKOB4 features, such as data gateway and PICKIT4 On-Board Virtual COM Port are not used in the WBZ451 Curiosity Board.

By default, the on-board debugger (PKOB4) is connected to the programming pins (SWDIO and SWDCLK) of the WBZ451PE module.

The voltage level translators are provided on signals between PKOB4 and WBZ451PE module for supporting target voltage from 1.9V – 3.6V.

Two PKOB4 LEDs indicate:

- Green (D1) – ACTIVE indicator
- Yellow (D2) – STATUS indicator

In addition, the Curiosity Board supports external debuggers, such as MPLAB ICD4 by connecting to the Debug Connector (J36).

The WBZ451PE programming/debugging through PKOB4 and external debugger is supported at the target voltage of 3V and at room temperature. Refer to the *PIC32CX-BZ2 Family Silicon Errata Sheet* for more details.

The Debug Connector (J36) follows the standard ARM SWD 10 pinout as shown in the following figure. MPLAB ICD4 can be connected to the DBG header using the Debugger Adapter Board (AC102015). For more details, refer to www.microchip.com/DevelopmentTools/ProductDetails/AC102015.

Table 3-3. SWD Debug Connector Details

Pin Number of DBG Header	Pin Name	Description
1	VCC	WBZ451, also for other instances of RF module power supply
2	SWDIO	PB9, SWD programming data
3	GND	Ground
4	SWCLK	PB8, SWD programming clock
5	GND	Ground
6	SWO	PB7, optional trace output
7	NC	No connection
8	NC	No connection
9	GND	Ground
10	RESET	RF module Reset NMCLR pin

3.6 USB-UART Virtual COM Port

The WBZ451 Curiosity Board has an on-board MCP2200 (U18) acts as a USB to the UART converter with hardware flow control support and enables the user through the micro-B USB connector (J7) from the Host PC. MCP2200 supports UART baud rates from 300-1000 kbps. Voltage level translators are provided on signals between MCP2200 and WBZ451PE module for supporting target voltage from 1.9V – 3.6V when powered externally.

Table 3-4. USB Serial Converter Pin Assignment

Pin on MCP2200	Pin on WBZ451PE Module	Description
TX	PA6, SERCOM0_PAD1	UART RX pin of the WBZ451PE module
RX	PA5, SERCOM0_PAD0	UART TX pin of the WBZ451PE module
RTS	PA4, SERCOM0_PAD3	UART CTS pin of the WBZ451PE module
CTS	PA3, SERCOM0_PAD2	UART RTS pin of the WBZ451PE module

3.7 mikroBUS Socket (J4)

A mikroBUS socket (J4) expands the functionality of the WBZ451 Curiosity Board using the MikroElectronika Click adapter boards.

The mikroBUS connector consists of:

- Two 1x8 female headers with Serial Peripheral Interface (SPI)
- Inter-Integrated Circuit (I^2C)
- Reset Pin (RST)
- Pulse Width Modulation
- Analog and interrupt lines
- 3.3V, 5V and ground power lines
  For a complete listing of the Click boards, refer to www.mikroe.com/click.

The GPIO pins for the mikroBUS sockets is assigned to route I^2C, and SPI peripherals and other GPIO pins as follows.

Note: Traditional Serial Communication Interface Documentation uses the terminology “Master” and “Slave” equivalent Microchip terminology used in this document is “Host” and “Client”, respectively.

Table 3-5. mikroBUS Socket Pinout Details

Pin Number	Pin Name	Pin on WBZ451PE Module	Description
1	AN	PB1, AN5	ADC analog input
2	$\overline{RST}$	PB2	General purpose I/O pin
3	$\overline{CS}$	PA9, SERCOM1_PAD2	Client select pin for SPI/ General purpose I/O pin
4	SCK	PA8, SERCOM1_PAD1	SPI clock
5	MISO	PA10, SERCOM1_PAD3	SPI host input client output
6	MOSI	PA7, SERCOM1_PAD0	SPI host output client input
7	+3.3V	+3V	3V power
8	GND	GND	Ground
9	GND	GND	Ground

.....continued			
Pin Number	**Pin Name**	**Pin on WBZ451PE Module**	**Description**
10	+5V	+5V	5V power
11	SDA	PA13, SERCOM2_PAD0	I2C data
12	SCL	PA14, SERCOM2_PAD1	I2C clock
13	TX	PA7, SERCOM1_PAD0	UART TX
14	RX	PA8, SERCOM1_PAD1	UART RX
15	INT	PA2	Interrupt pin/General purpose I/O pin. Shared with PWM pin
16	PWM	PA2	PWM pin/General purpose I/O pin. Shared with INT pin

Notes:

1. In the mikroBUS socket, both INT and PWM are connected to PA2. Using both INT and PWM simultaneously are not supported (for example, refer to www.mikroe.com/stepper-2-click).
2. In the mikroBUS socket, PA8 is shared between SPI SCK and UART RX and depopulates R123 to isolate SPI SCK and depopulates R122 to isolate UART RX.
3. In the mikroBUS socket, PA7 is shared between SPI MOSI and UART TX and depopulates R125 to isolate SPI MOSI and depopulates R124 to isolate UART TX.

3.8 Switches

The following switches are available on the WBZ451 Curiosity Board:

- Reset switch (SW1)
- User configurable switch (SW2)

In the Idle state, the level of the Reset switch is pulled high using the external pull up resistor and, when the switch is pressed, it drives the level of the switch to low and resets the WBZ451PE module.

The user-configurable switch is also pulled high using the external pull up resistor and, when the switch is pressed, it drives the level of the switch to low.

Table 3-6. Switches Description

Switch Name	Pin on WBZ451PE Module	Description
Reset (SW1)	NMCLR	Reset switch (SW1) connected to NMCLR pin
USR-BTN (SW2)	PB4	User configurable switch (SW2)

3.9 LEDs

3.9.1 User LED (D5)

One user-programmable blue indicator LED (D5) is available on the WBZ451 Curiosity Board, and this LED can be turned ON or OFF using the connected GPIO pin PB7. Drive the pin to a high level to turn OFF the LED and drive the pin to a low level to turn ON the LED.

Important: PB7 is also SWO pin on the WBZ451PE module. During a programming/debug session with MPLABx IDE, this pin is always driven low from the WBZ451PE module, thus making the user LED turned ON during the entire DEBUG session. When the DEBUG session is exited, this pin operates normally.

3.9.2 RGB LED (D6)

Three PWM signals from the WBZ451PE module are connected to RGB LED (D6) on the WBZ451 Curiosity Board.

Table 3-7. RGB LED Pin Description

Color	Pin on WBZ451
Red	PB0
Green	PB3
Blue	PB5

3.10 Temperature Sensor (U3)

Analog output from the temperature sensor (2.3V – 5.5V Microchip MCP9700A, U3) is connected to one of the analog pins (PB6, AN2) of the WBZ451PE module's ADC channel. For more details, refer to the *MCP9700A, Low-Power Linear Active Thermistor IC Data Sheet* (DS20001942).

3.11 QSPI Serial Flash

The WBZ451 Curiosity Board has an on-board 64-Mb, 2.3-3.6V Serial Quad I/O (SQI) Flash SST26VF064B (U6) memory for storage of data. A default SST26VF064B at power-up enables WP# and HOLD pins and disables SIO2 and SIO3 pins allowing for SPI protocol operations without register configuration. Register configuration is required to switch to Quad I/O operation with QSPI.

Table 3-8. QSPI Flash Pin Description

QSPI Flash	Pin on WBZ451PE Module	Description
CE	PB10, QSPI_CS	QSPI chip select
SO/SIO1	PB13, QSPI_DATA1	QSPI data channel 1
WP/SIO2	PA0, QSPI_DATA2	QSPI data channel 2
VSS	GND	Ground
SI/SIO0	PB12, QSPI_DATA0	QSPI data channel 0
SCK	PB11, QSPI_SCK	QSPI clock
Hold/SIO3	PA1, QSPI_DATA3	QSPI data channel 3
VDD	VDD	VDD

3.12 32.768 kHz Secondary Oscillator

The 32.768 kHz crystal connected to SOSC pins (PA11 and PA12) of the WBZ451PE module.

3.13 WBZ451PE Module

For more details on the WBZ451PE module pinout details, refer to the *PIC32CX-BZ2 and WBZ45 Family Data Sheet* (DS70005504).

Note: The user can configure the Peripheral Pin Select (PPS) pins for any of the supported peripheral functions based on the end user application.

3.14 Limitations of Using Battery and External Power Supply

Battery Power:

The battery management circuit is designed for a 4.2V battery going to a downstream 3V regulator. When the battery voltage is near to the required minimum input voltage of the regulator, it may affect the regulated output. It is advised to use a fully charged battery for evaluation and recharge the battery as soon as the low battery output indicator is turned ON at 3.1V.

External Power Supply Header:

The WBZ451 Curiosity Board is designed by default for evaluating the WBZ451PE module and associated peripherals with an on-board 3V regulator. The following limitations apply for the circuitry if the WBZ451PE module and associated circuitry is powered from external power supply header at other voltages:

- QSPI Serial Flash SST26VF064B (U6) – Standard operating voltage for the QSPI serial Flash is 2.3V – 3.6V operation
- Temperature Sensor MPC9700A (U3) – Standard operating voltage for the temperature sensor is 2.3V – 3.6V operation
- User LED (D5) – Designed for 3V operation; LED brightness at lower voltages will be dull or no glow. To increase the emitted light level, the value of the series resistor (R42) can be lowered.
- RGB Lighting LED (D6) – RGB lightning LED is powered from VBAT net. It requires either USB or battery power supply to be plugged in to be functional.

4. WBZ451 Curiosity Board Out of Box Demo

The **ble_zigbee_light_prov** demo application is pre-programmed on the Curiosity board.

This application brings several Bluetooth Low Energy, Zigbee and Multiprotocol (Bluetooth Low Energy and Zigbee) concepts to practice.

For more details for the Out-of-Box (OOB) demo source code and demo guide, refer to the following:

- Preprogrammed Demo Software

5. Appendix A: Reference Circuit

5.1 WBZ451 Curiosity Board Reference Schematics

Figure 5-1. Power Distribution Switch for PKoB4

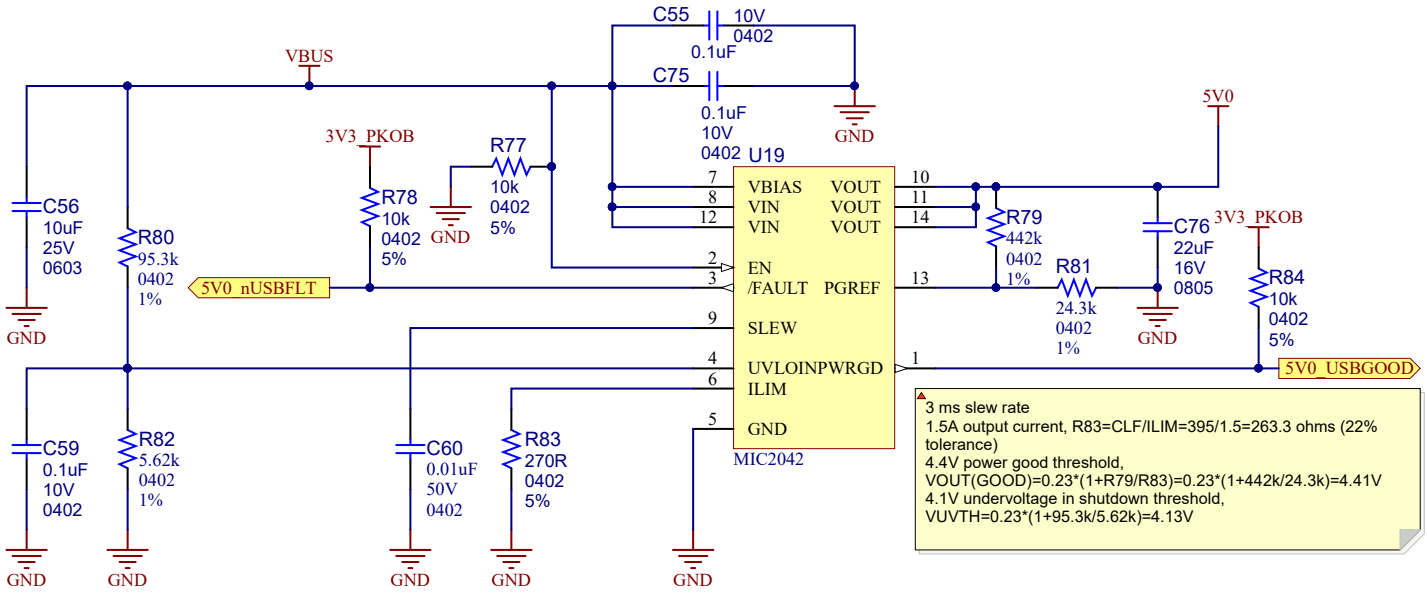


Figure 5-2. Li-Po Battery Connector/Charger

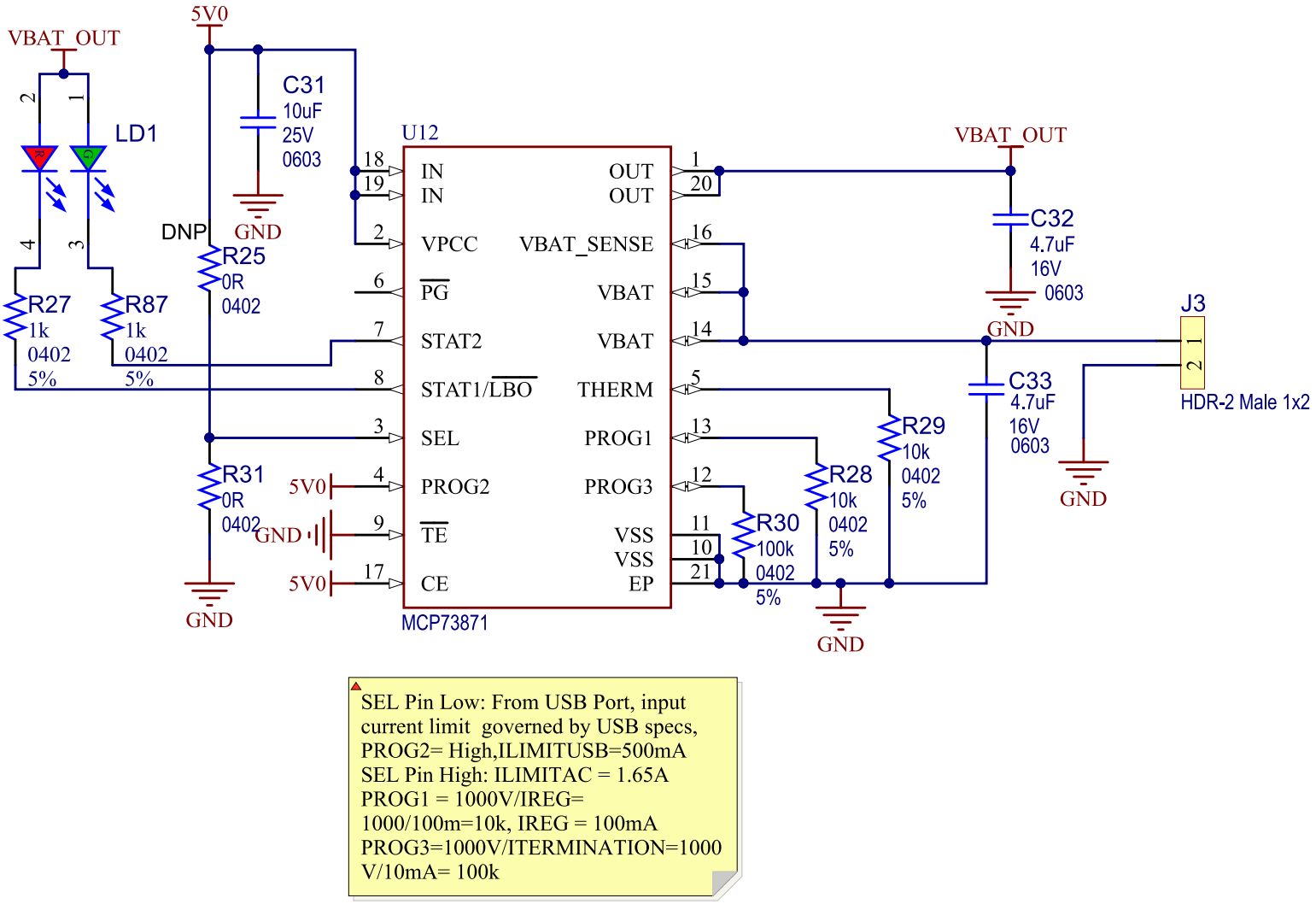


Figure 5-3. PKOB 3.3V Regulator

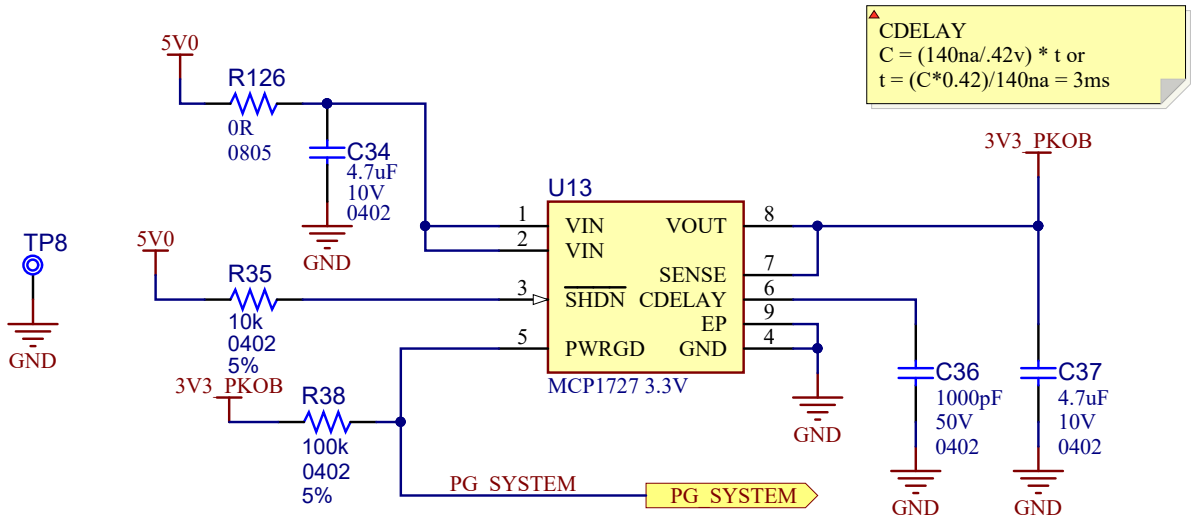


Figure 5-4. Target 3V Regulator

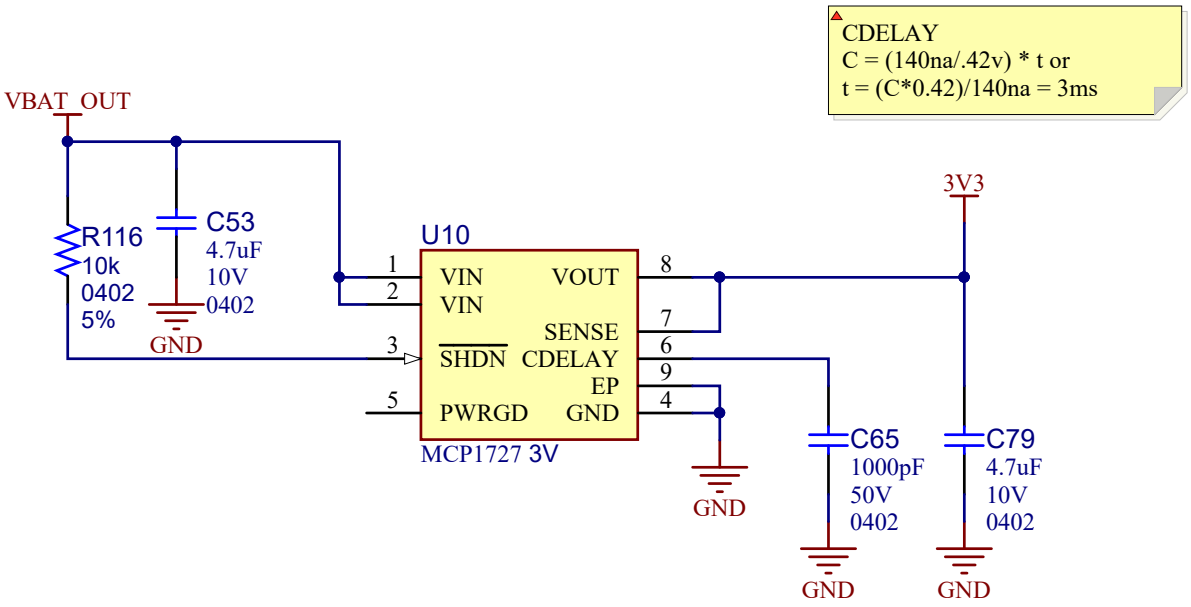


Figure 5-5. External Power Supply

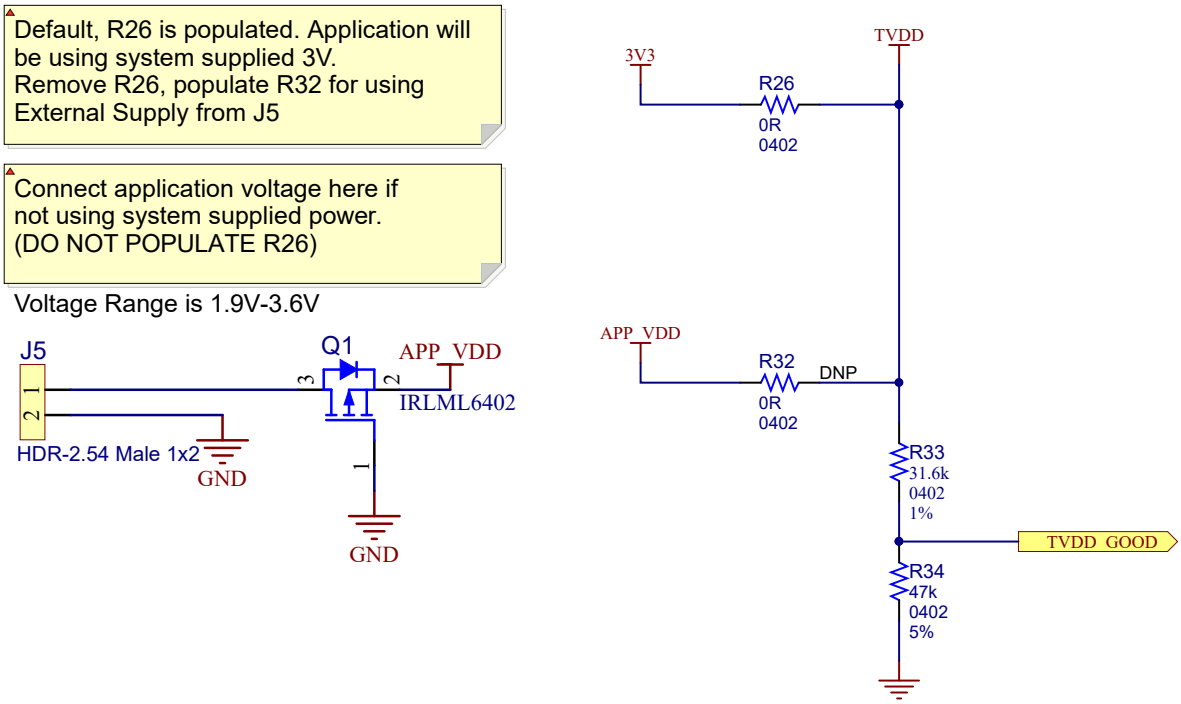


Figure 5-6. TGT Current Measurement Header

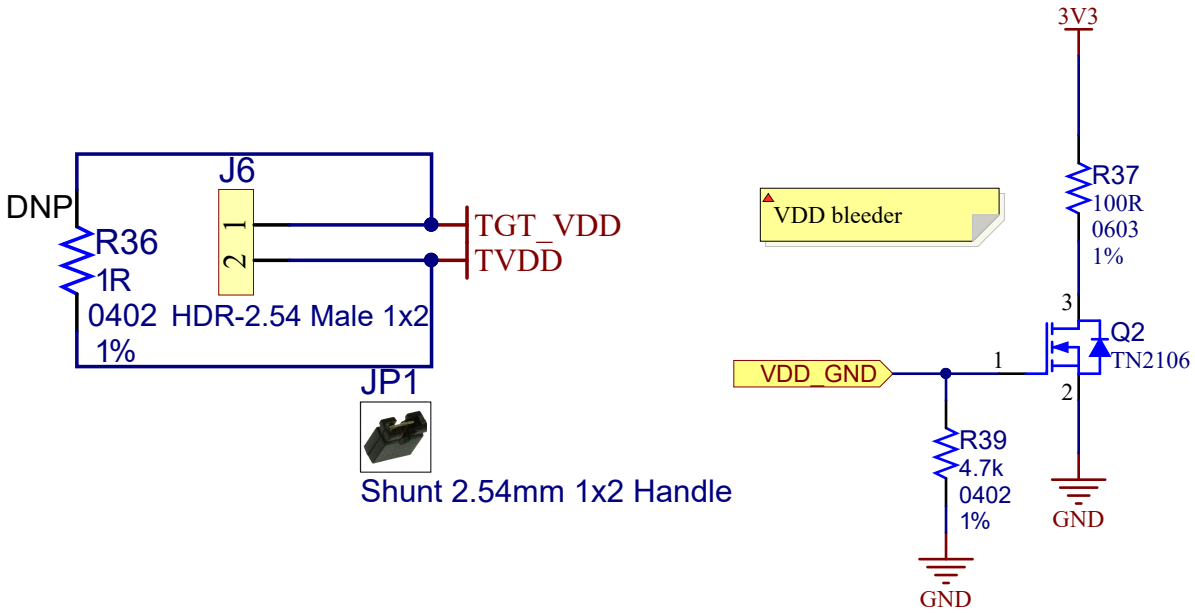


Figure 5-7. USB High Speed Hub

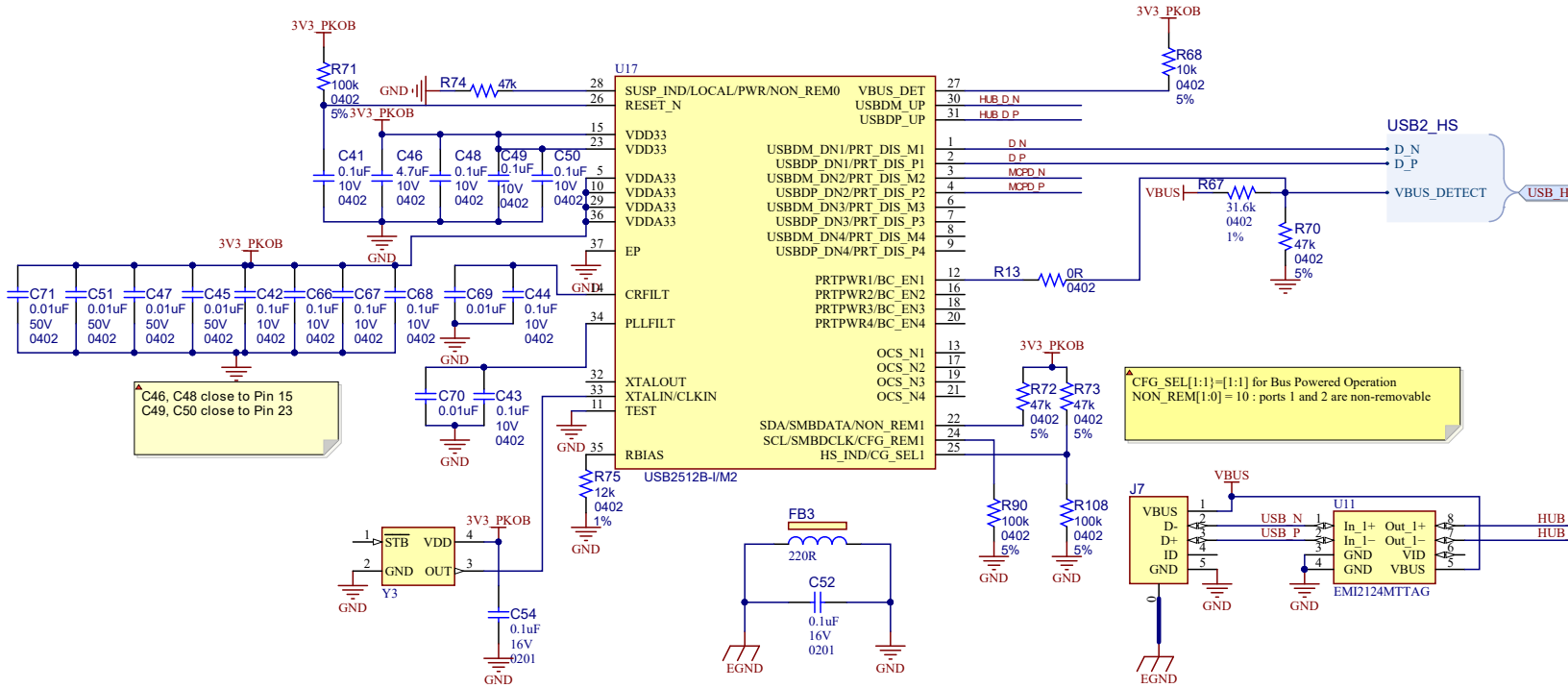


Figure 5-8. MCP2200 USB UART Converter

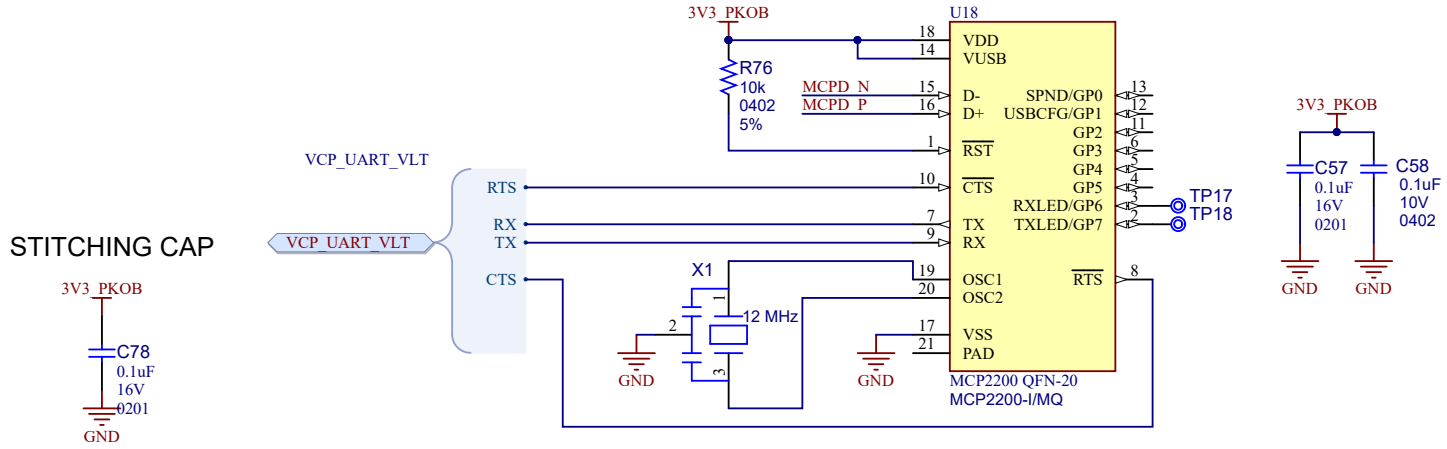


Figure 5-9. Application Virtual Comm Port

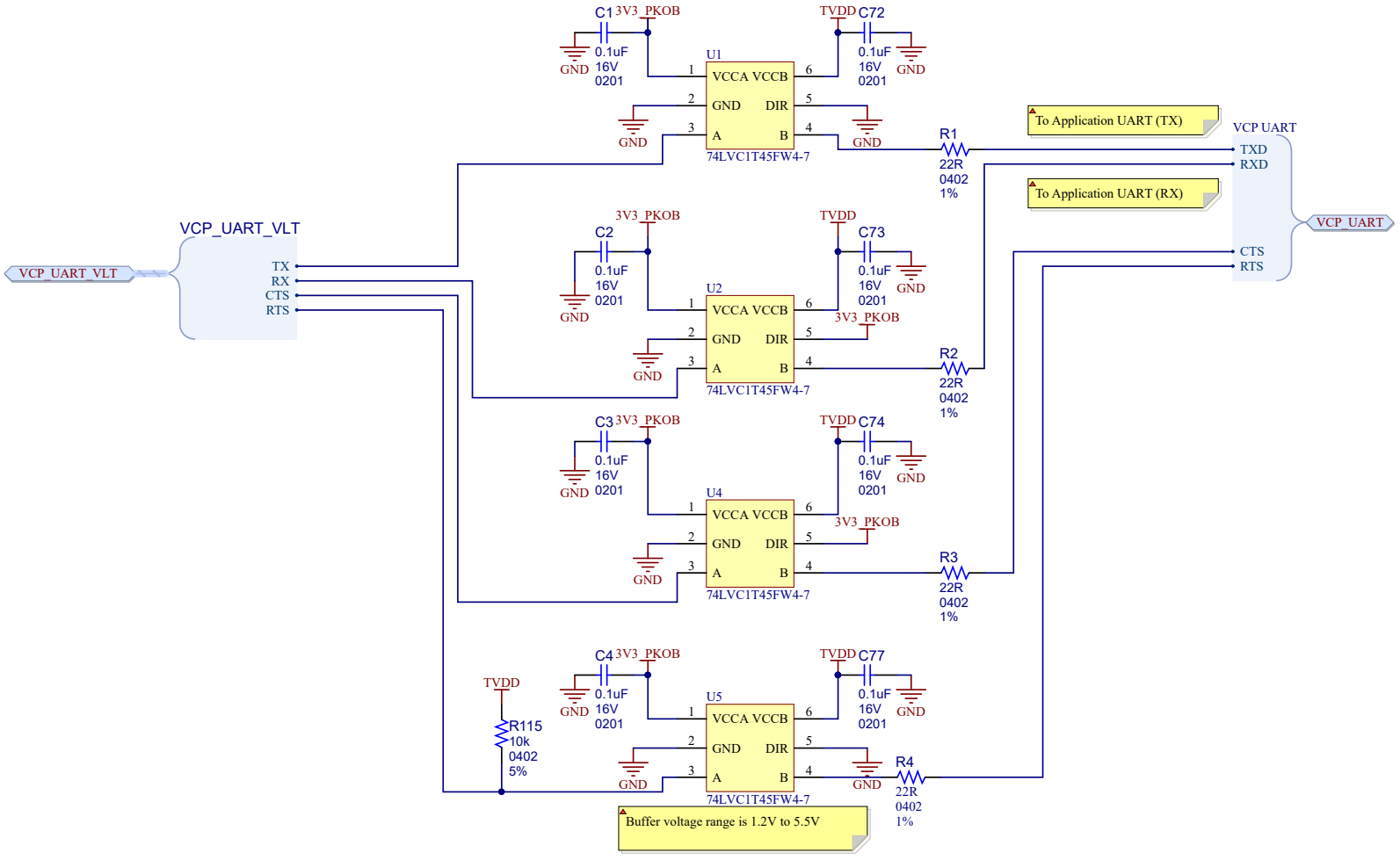


Figure 5-10. PKoB4 Main Micro 1 of 2

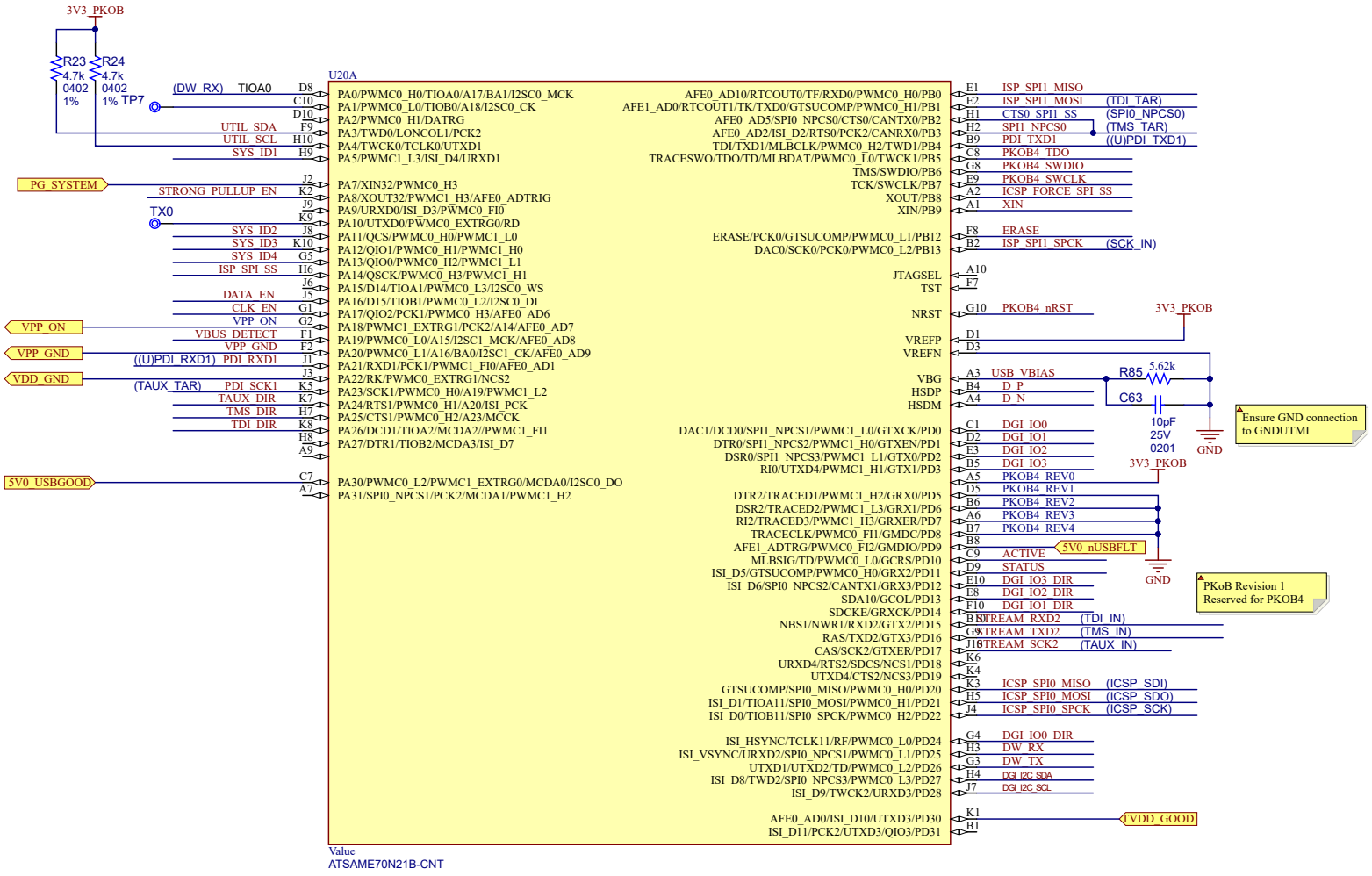


Figure 5-11. PKoB4 Main Micro 2 of 2

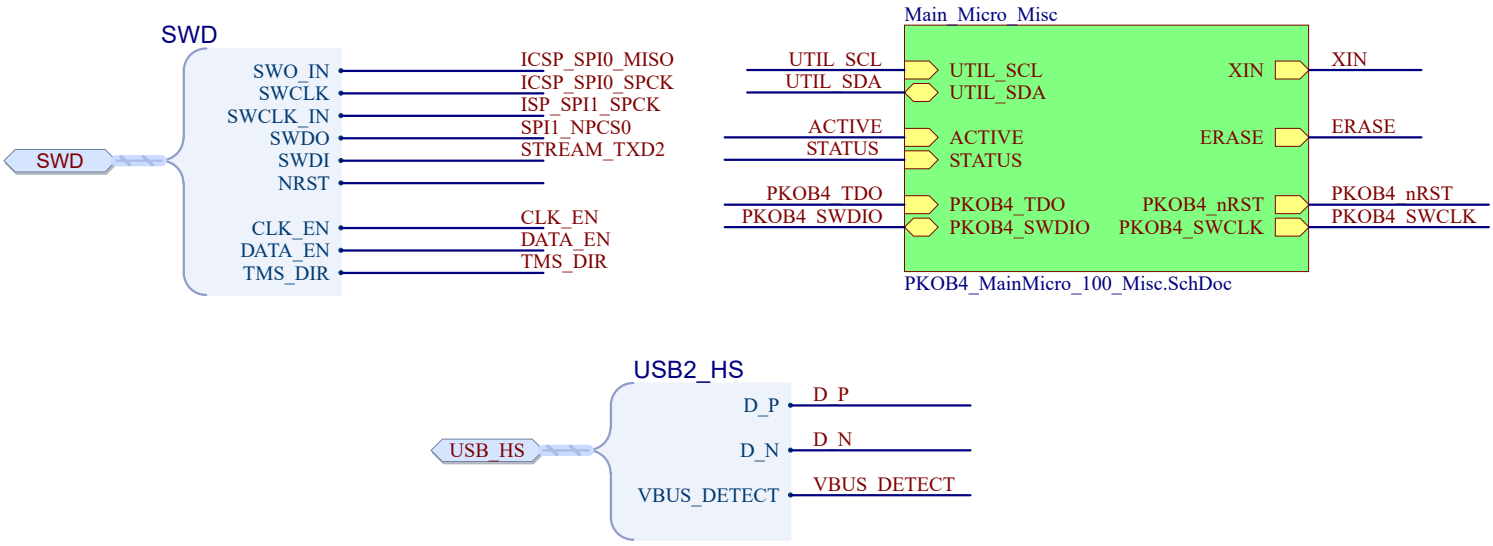


Figure 5-12. PKoB4 Debug Header Misc 1 of 2

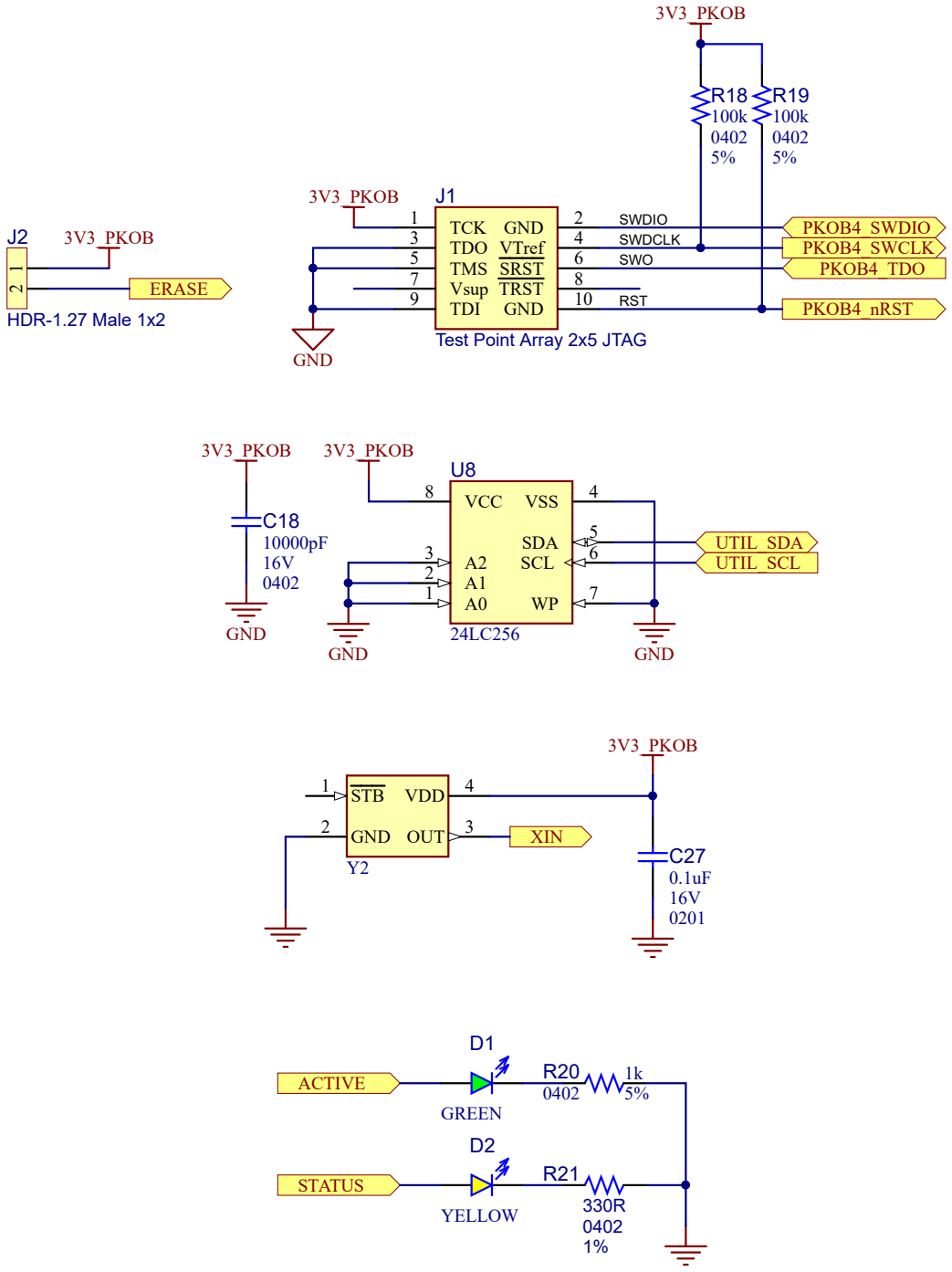


Figure 5-13. PKoB4 Debug Header Misc 2 of 2

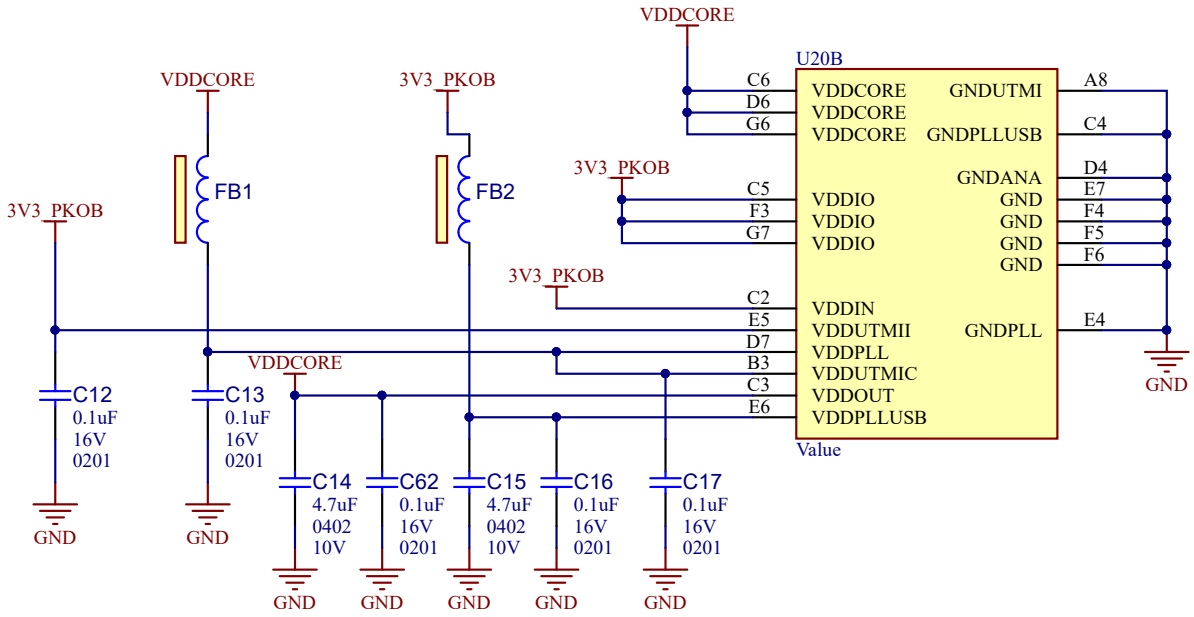


Figure 5-14. VDDCORE Bypass Caps

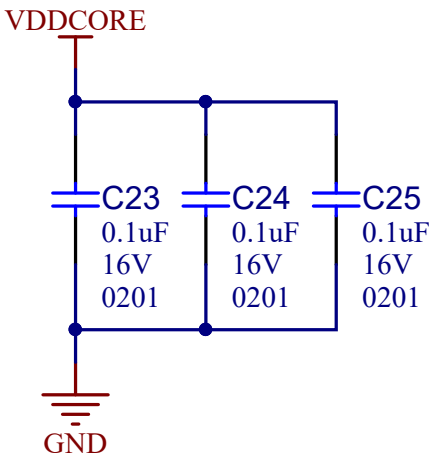


Figure 5-15. VDDIO Bypass Caps

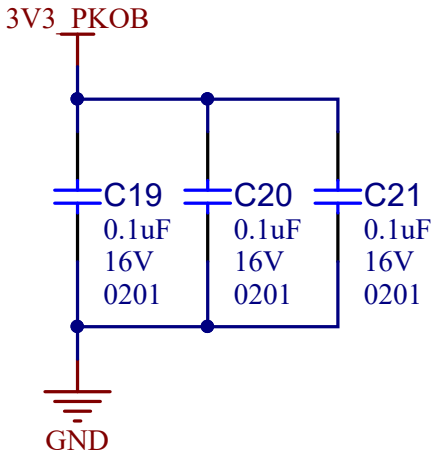


Figure 5-16. VDDIN Cap

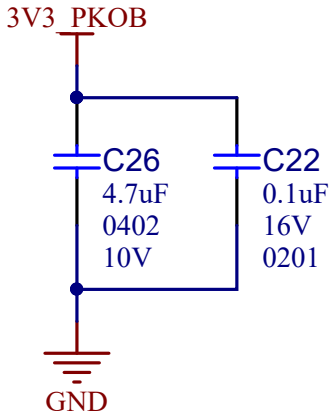


Figure 5-17. Serial Wire Debug

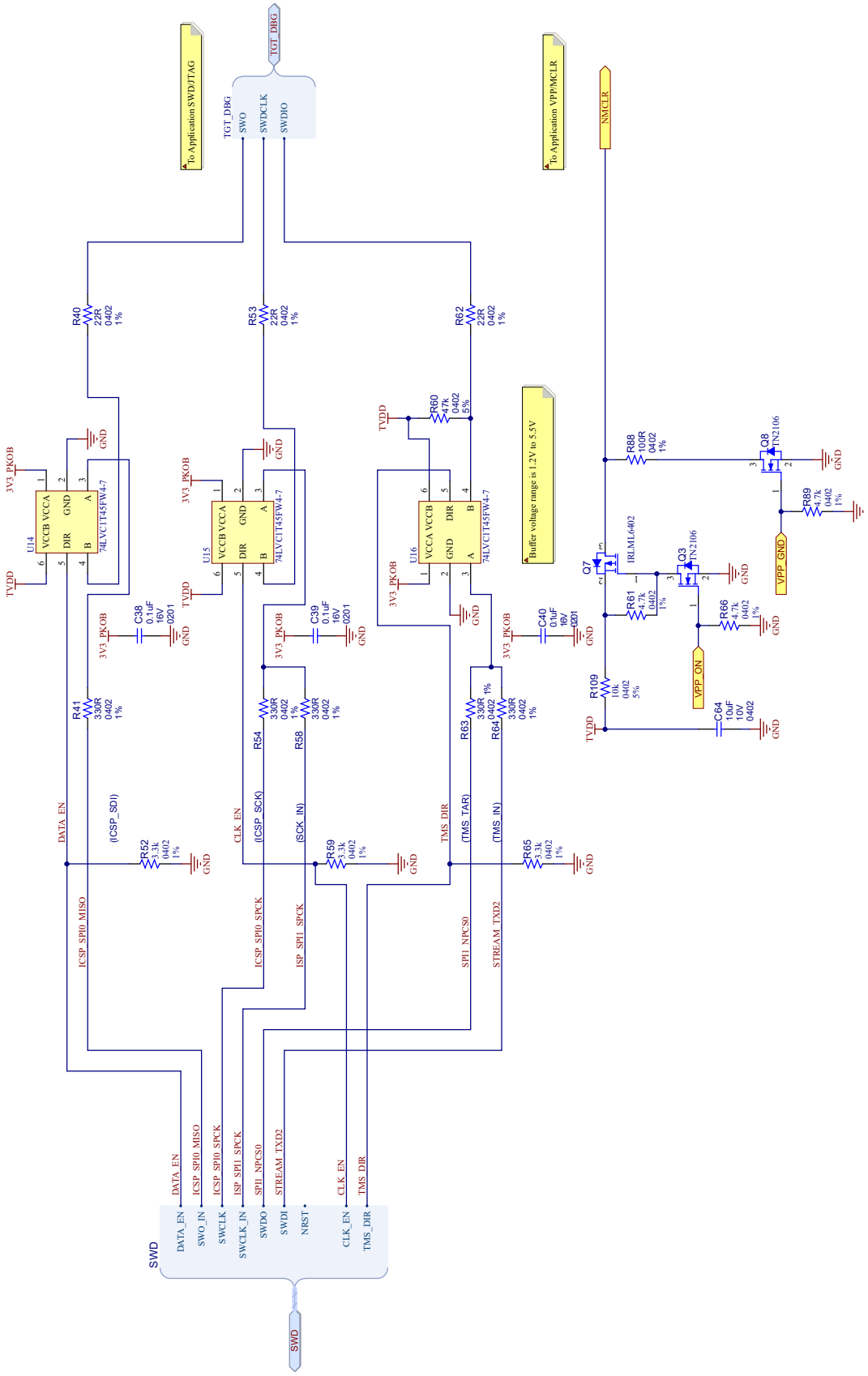


Figure 5-18. WBZ451 Curiosity Board

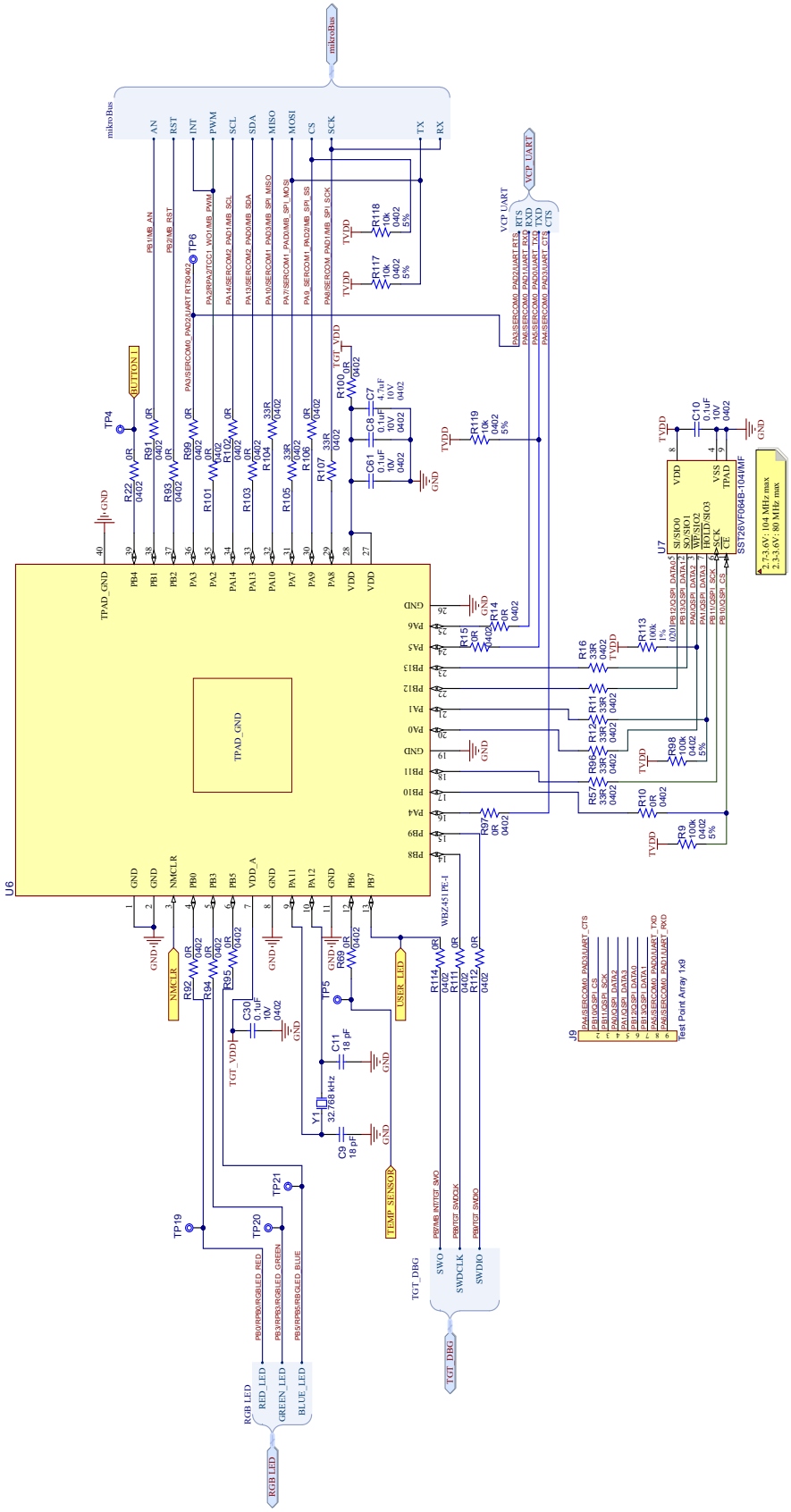


Figure 5-19. mikroBUS Click Host with Crypto IC

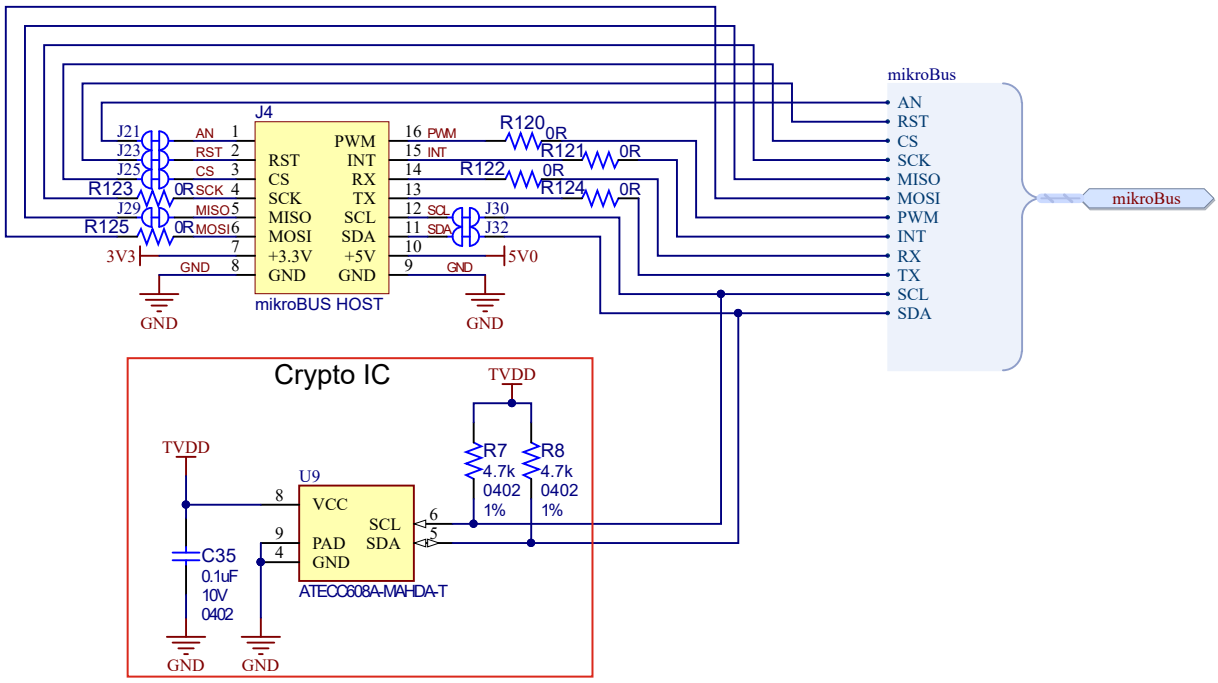


Figure 5-20. RGB LED

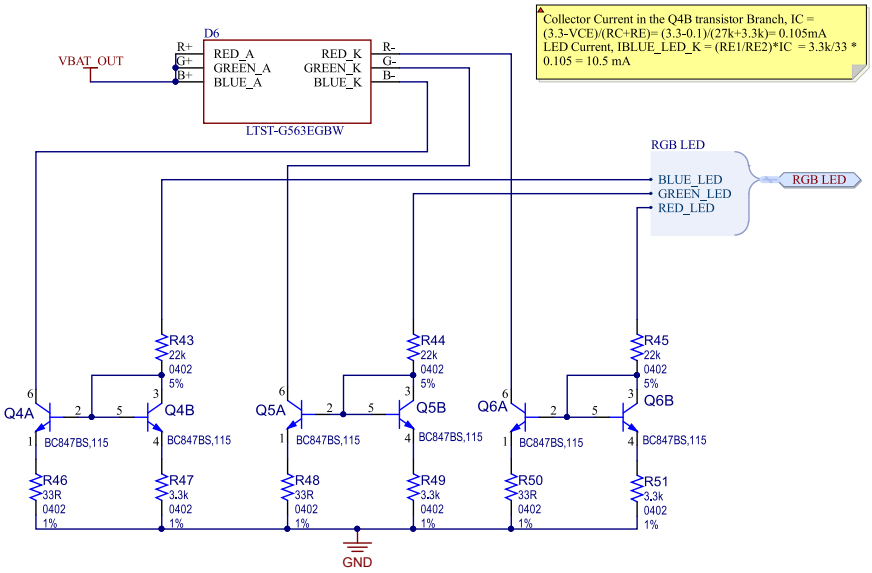


Figure 5-21. Temperature Sensor

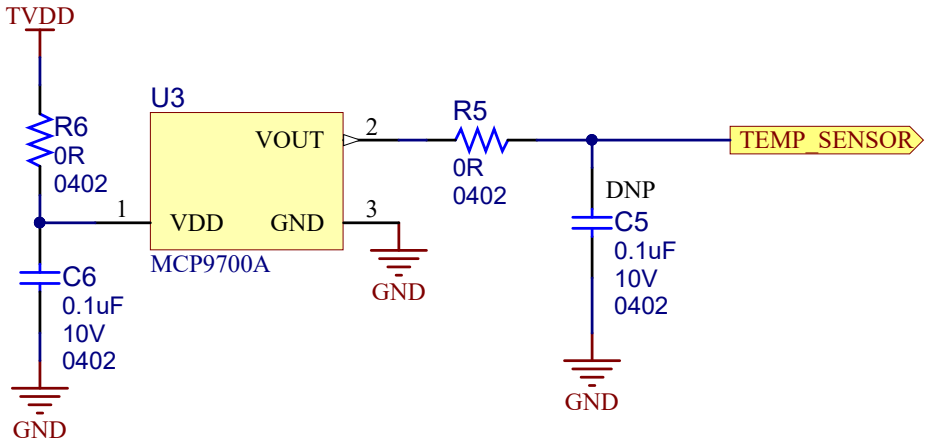


Figure 5-22. Debug Header with Reset Button and User Button

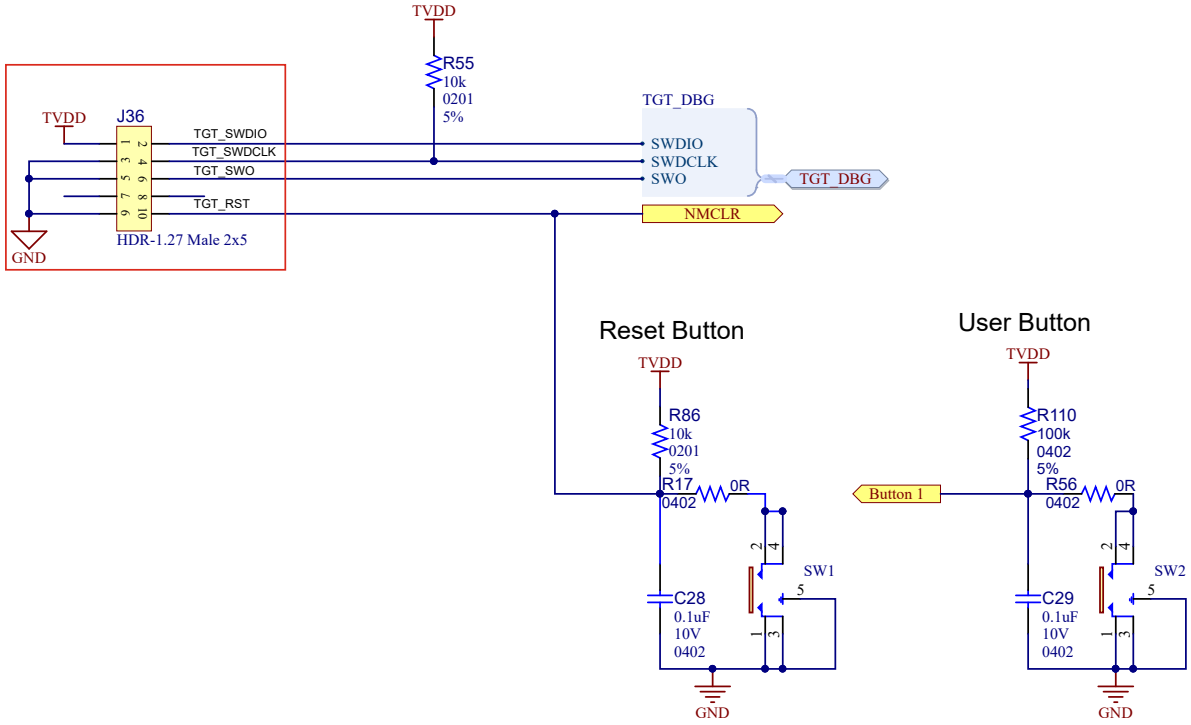
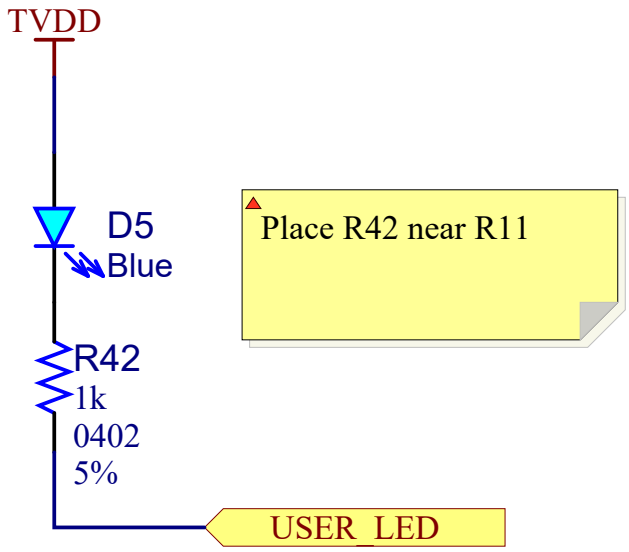


Figure 5-23. User LED



5.2 WBZ451 Curiosity Board Bill of Materials

The following table provides the Bill of Materials (BOM) for the WBZ451 carrier board.

Table 5-1. Bill of Materials

Reference	Description	Manufacturer	Part Number
C1, C2, C3, C4, C12, C13, C16, C17, C19, C20, C21, C22, C23, C24, C25, C27, C38, C39, C40, C52, C54, C57, C62, C72, C73, C74, C77	CAP CER 0.1 µF 16V 10% X5R SMD 0201	Murata Electronics North America	GRM033R61C104KE84D
C6, C10, C29, C30, C41, C42, C43, C44, C48, C49, C55, C58, C59, C61, C66, C67, C68, C75	CAP CER 0.1 µF 10V 10% X5R SMD 0402	KEMET	C0402C104K8PACTU
C7, C14, C15, C26, C34, C37, C46, C53, C79	CAP CER 4.7 µF 10V 10% X5R SMD 0402	TDK Corporation	C1005X5R1A475K050BC
C9, C11	CAP CER 18 pF 50V 2% NP0 SMD 0402	Murata	GRM1555C1H180GA01D
C18	CAP CER 10000 pF 16V 10% X7R SMD 0402	KEMET	C0402C103K4RACTU
C31, C56	CAP CER 10 µF 25V 20% X5R SMD 0603	TDK Corporation	C1608X5R1E106M080AC
C32, C33	CAP CER 4.7 µF 16V 10% X5R SMD 0603	TDK Corporation	C1608X5R1C475K080AC
C36, C65	CAP CER 1000 pF 50V 10% X7R SMD 0402	Murata	GRM155R71H102KA01D
C60, C69, C70	CAP CER 0.01 µF 50V 10% X7R SMD 0402 AEC-Q200, CAP CER 0.01 µF 50V 10% X7R SMD 0402	TDK Corporation	CGA2B3X7R1H103K050BB
C63	CAP CER 10 pF 25V 0.5 pF C0G SMD 0201	TDK Corporation	C0603C0G1E100D030BA
C76	CAP CER 22 µF 16V 10% X5R SMD 0805	TDK	C2012X5R1C226K125AC
D1	DIO LED GREEN 2V 30 mA 35 mcd Clear SMD 0603	Lite-On Inc	LTST-C191KGKT
D2	DIO LED YELLOW 2.1V 20 mA 6 mcd Clear SMD 0603	Lite-On	LTST-C190YKT
D5	DIO LED BLUE 2.85V 5 mA 49.5 mcd Diffuse SMD 470 nm	OSRAM Opto Semiconductors Inc.	LB QH9G-N1OO-35-1
D6	DIO LED TRI 2.2V Red, 3.3V Green, 3.3V Blue 6-SMD	Lite-On Inc.	LTST-G563EGBW
FB1, FB2	FERRITE 2A 600R SMD 0805	TDK Corporation	MPZ2012S601AT000

.....continued

Reference	Description	Manufacturer	Part Number
FB3	FERRITE 2A 220R SMD 0805	Murata Electronics North America	BLM21PG221SN1D
J3	CON HDR-2 Male 1x2 SHROUD 3.3 MH TH R/A	JST Sales America Inc	S2B-PH-K-S(LF)(SN)
J4	SOCKET mikroBUS HOST DIP 16 TH	Sullins Connector Solutions	PPTC081LFBN-RC
J5, J6	CON HDR-2.54 Male 1x2 Gold 5.84 MH TH VERT	FCI	77311-118-02LF
J7	CON USB2.0 MICRO-B FEMALE TH/SMD R/A	FCI	10118194-0001LF
J36	CON HDR-1.27 Male 2x5 Gold 3.05 MH TH VERT	Amphenol FCI	20021111-00010T4LF
LABEL1	LABEL PCBA 18x6 mm Datamatrix Assy# / Rev / Serial / Date	ACT Logimark AS	505462
LD1	LED GREEN/RED BICOLOR 0606	Lite-On Inc	LTST-C195KGJRKT
Q1	TRANS FET P-CH IRLML6402 -20V -3.7A 1.3W SOT-23-3	International Rectifier	IRLML6402TRPBF
Q4, Q5, Q6	TRANS BJT NPN DUAL BC847BS,115 45V 100 mA 300 mW SOT-363	Nexperia USA Inc	BC847BS,115
R1, R2, R3, R4, R53, R62	RES TKF 22R 1% 1/20W SMD 0402	Panasonic Electronic Components	ERJ-2RKF22R0X
R5, R6, R10, R13, R14, R15, R17, R22, R26, R31, R56, R69, R91, R92, R93, R94, R95, R97, R99, R100, R101, R102, R103, R106, R111, R112, R114, R120, R121, R122, R123, R124, R125	RES TKF 0R 1/16W SMD 0402	Yageo	RC0402JR-070RL
R9, R18, R19, R30, R38, R71, R90, R98, R108, R110	RES TKF 100k 5% 1/16W SMD 0402	Yageo	RC0402JR-07100KL
R11, R12, R16, R46, R48, R50, R57, R96, R104, R105, R107	RES TKF 33R 1% 1/16W SMD 0402	Rohm Semiconductor	MCR01MRTF33R0
R20, R27, R42, R87	RES TKF 1k 5% 1/16W SMD 0402	Yageo	RC0402JR-071KL
R21, R41, R54, R58, R63, R64	RES TKF 330R 1% 1/16W SMD 0402	Yageo	RC0402FR-07330RL
R23, R24, R39, R89	RES TKF 4.7k 1% 1/16W SMD 0402	Yageo	RC0402FR-074K7L

.....continued

Reference	Description	Manufacturer	Part Number
R28, R29, R35, R68, R76, R78, R84, R115, R116, R117, R118, R119	RES TKF 10k 5% 1/16W SMD 0402	Vishay	CRCW040210K0JNED
R33	RES TKF 31.6k 1% 1/10W SMD 0402	Panasonic	ERJ-2RKF3162X
R34, R60, R72, R74	RES TKF 47k 5% 1/16W SMD 0402	Yageo	RC0402JR-0747KL
R37	RES TKF 100R 1% 1/10W SMD 0603	ROHM	MCR03EZPFX1000
R43, R44, R45	RES TKF 22k 5% 1/10W SMD 0402	Panasonic	ERJ-2GEJ223X
R47, R49, R51, R52, R59, R65	RES TKF 3.3k 1% 1/10W SMD 0402	Panasonic - ECG	ERJ-2RKF3301X
R75	RES TKF 12k 1% 1/16W SMD 0402	Rohm Semiconductor	MCR01MZPF1202
R79	RES TKF 442k 1% 1/16W SMD 0402	Samsung Electro-Mechanics America, Inc	RC1005F4423CS
R80	RES TKF 95.3k 1% 1/16W SMD 0402	Rohm Semiconductor	MCR01MRTF9532
R81	RES TKF 24.3k 1% 1/16W SMD 0402	Samsung	RC1005F2432CS
R82, R85	RES TKF 5.62k 1% 1/16W SMD 0402	Vishay Dale	CRCW04025K62FKED
R83	RES TKF 270R 5% 1/10W SMD 0402	Panasonic	ERJ-2GEJ271X
R88	RES TKF 100R 1% 1/16W SMD 0402	Yageo	RC0402FR-07100RL
R126	RES TKF 0R 1/8W SMD 0805	Panasonic	ERJ-6GEY0R00V
SW1, SW2	SWITCH TACTILE SPST-NO 32V 0.05A KMR221GLFS	C&K	KMR221GLFS
U1, U2, U4, U5, U14, U15, U16	IC VOLTAGE TRANSLATOR BI-DIR 1 CIRCUIT 74LVC1T45FW4-7 X2-DFN1010-6	Diodes Incorporated	74LVC1T45FW4-7
U11	IC FILTER EMI2124MTTAG COMMON MODE ESD WDFN-8	ON Semiconductor	EMI2124MTTAG
X1	RESONATOR 12 MHz 0.07% SMD CSTNE 3-SMD	Murata Electronics	CSTNE12M0GH5L000R0
Y1	CRYSTAL 32.768 kHz 12.5 pF SMD ABS07	Seiko	SC32S-12.5PF20PPM

.....continued

Reference	Description	Manufacturer	Part Number
Q2, Q8	MCHP ANALOG MOSFET N-CH TN2106 60V 28 0mA 360 mW 2.5R SOT23-3	Microchip Technology	TN2106K1-G
U3	MCHP ANALOG TEMPERATURE SENSOR -40℃ to +150℃ MCP9700AT-E/TT SOT-23-3	Microchip Technology	MCP9700AT-E/TT
U6	MOD BLE/ZIGBEE WBZ451PE-I	Microchip Technology	WBZ451PE-I
U7	MCHP SERIAL FLASH SST26VF064B-104I/MF WDFN-8	Microchip Technology	SST26VF064B-104I/MF
U8	MCHP MEMORY SERIAL EEPROM 256k I2C 24LC256T-E/ST TSSOP-8	Microchip Technology	24LC256T-E/ST
U10	MCHP ANALOG LDO 3V MCP1727-3002E/MF	Microchip Technology	MCP1727-3002E/MF
U13	MCHP ANALOG LDO 3.3V MCP1727-3302E/MF	Microchip Technology	MCP1727-3302E/MF
U12	MCHP ANALOG BATTERY CHARGER MCP73871-2CCI/ML QFN-20	Microchip Technology	MCP73871-2CCI/ML
U17	MCHP INTERFACE USB 2.0 HUB CTRLR USB2512B-I/M2 SQFN-36	Microchip Technology	USB2512B-I/M2
U18	MCHP INTERFACE USB UART MCP2200-I/MQ QFN-20	Microchip Technology	MCP2200-I/MQ
U19	MCHP ANALOG POWER SWITCH 5.5V 3A MIC2042-1YTS TSSOP-14	Microchip Technology	MIC2042-1YTS
U20	MCHP MCU 32-BIT 300 MHz 2 MB 384K x 8 ATSAME70N21B-CNT TFBGA-100	Microchip Technology	ATSAME70N21B-CNT
Y2	MCHP CMOS OSCILLATOR 12 MHz DSC6011HI1B-012.0000 SMD VFLGA-4	Microchip Technology	DSC6011HI1B-012.0000
Y3	MCHP CMOS OSCILLATOR 24 MHz DSC6011HI1B-024.0000 SMD VFLGA-4	Microchip Technology	DSC6011HI1B-024.0000
JP1	MECH HW JUMPER 2.54 mm 1x2 Handle Gold	TE Connectivity	881545-2
PAD1, PAD2	MECH HW RUBBER PAD Cylindrical flat top D8H2.8 Black	3M	SJ5076BLACK
C5, C8, C28, C35, C50	CAP CER 0.1 µF 10V 10% X5R SMD 0402	KEMET	C0402C104K8PACTU
C45, C47, C51, C71	CAP CER 0.01 µF 50V 10% X7R SMD 0402	TDK Corporation	CGA2B3X7R1H103K050BB

.....continued

Reference	Description	Manufacturer	Part Number
C64	CAP CER 10 µF 10V X5R SMD 0402	Samsung Electro-Mechanics	CL05A106MP8NUB8
C78	CAP CER 0.1 µF 16V 10% X5R SMD 0201	Murata Electronics North America	GRM033R61C104KE84D
J2	CON HDR-1.27 Male 1x2 Gold TH VERT	Digikey	952-3598-ND
J9	CON STRIP Stacker Male 1x9 TH VERT	Samtec	DWM-09-59-S-S-415
Q3	MCHP ANALOG MOSFET N-CH TN2106 60V 280 mA 360 mW 2.5R SOT23-3	Microchip Technology	TN2106K1-G
Q7	TRANS FET P-CH IRLML6402 -20V -3.7A 1.3W SOT-23-3	International Rectifier	IRLML6402TRPBF
R7, R8, R61, R66	RES TKF 4.7k 1% 1/16W SMD 0402	Yageo	RC0402FR-074K7L
R25, R32	RES TKF 0R 1/16W SMD 0402	Yageo	RC0402JR-070RL
R36	RES TKF 1R 1% 1/16W SMD 0402	Yageo	RC0402FR-071RL
R40	RES TKF 22R 1% 1/20W SMD 0402	Panasonic Electronic Components	ERJ-2RKF22R0X
R55, R86	RES TKF 10k 5% 1/20W SMD 0201	Yageo	RC0201JR-0710KL
R67	RES TKF 31.6k 1% 1/10W SMD 0402	Panasonic	ERJ-2RKF3162X
R70, R73	RES TKF 47k 5% 1/16W SMD 0402	Yageo	RC0402JR-0747KL
R77	RES TKF 10k 5% 1/16W SMD 0402	Vishay	CRCW040210K0JNED
R109	RES TKF 10k 5% 1/10W SMD 0402	Panasonic	ERJ-2GEJ103X
R113	RES TKF 100k 1% 1/20W SMD 0201	Panasonic Electronic Components	ERJ-1GEF1003C
U9	MCHP MEMORY SERIAL EEPROM CRYPTO AUTH I2C ATECC608A-MAHDA-T UDFN-8	Microchip Technology	ATECC608A-MAHDA-T

6. Appendix: B Regulatory Approval

This equipment (WBZ451 Curiosity Board/EV96B94A) is an evaluation kit and not a finished product. It is intended for laboratory evaluation purposes only. It is not directly marketed or sold to the general public through retail; it is only sold through authorized distributors or through Microchip. Using this requires a significant engineering expertise towards understanding of the tools and relevant technology, which can be expected only from a person who is professionally trained in the technology.

Regulatory compliance settings have to follow the WBZ451PE module certifications. The following regulatory notices are to cover the requirements under the regulatory approval.

6.1 United States

The WBZ451 Curiosity Board (EV96B94A) contains the WBZ451PE module, which has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” single-modular approval in accordance with Part 15.212 Modular Transmitter approval.

Contains FCC ID: 2ADHKWBZ451

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Important: FCC Radiation Exposure Statement
This equipment complies with FCC radiation exposure limits set forth for uncontrolled environment. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 8 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. This transmitter is restricted for use with the specific antenna(s) tested in this application for certification.

⚠ CAUTION Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

6.2 Canada

The WBZ451 Curiosity Board (EV96B94A) contains the WBZ451PE module, which has been certified for use in Canada under Innovation, Science and Economic Development Canada (ISED, formerly Industry Canada) Radio Standards Procedure (RSP) RSP-100, Radio Standards Specification (RSS) RSS-Gen and RSS-247.

Contains IC: 20266-WBZ451

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference;
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

⚠WARNING

This equipment complies with radio frequency exposure limits set forth by Innovation, Science and Economic Development Canada for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the device and the user or bystanders.

Cet équipement est conforme aux limites d'exposition aux radiofréquences définies par d'Innovation, Sciences et Développement économique Canada pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre le dispositif et l'utilisateur ou des tiers.

6.3 Europe

This equipment (EV96B94A) has been assessed under the Radio Equipment Directive (RED) for use in European Union countries. The product does not exceed the specified power ratings, antenna specifications and/or installation requirements as specified in the user manual. A Declaration of Conformity is issued for each of these standards and kept on file as described in Radio Equipment Directive (RED).

Simplified EU Declaration of Conformity

Hereby, Microchip Technology Inc. declares that the radio equipment type [EV96B94A] is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at www.microchip.com/en-us/development-tool/EV96B94A (See *Conformity Documents*).

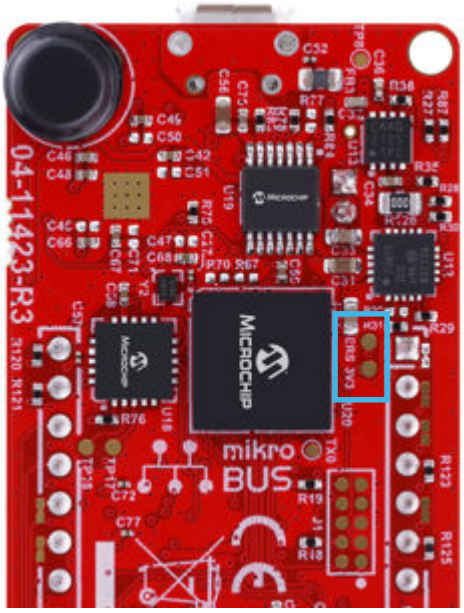
7. Appendix C: PKOB4 Recovery Method

When the MPLAB PICkit On-Board 4 is not responding, in rare cases, the user can recover its operation by following these steps:

WARNING Only use this utility to restore the hardware tool boot firmware to its factory state. Use only if the hardware tool no longer functions on any machine.

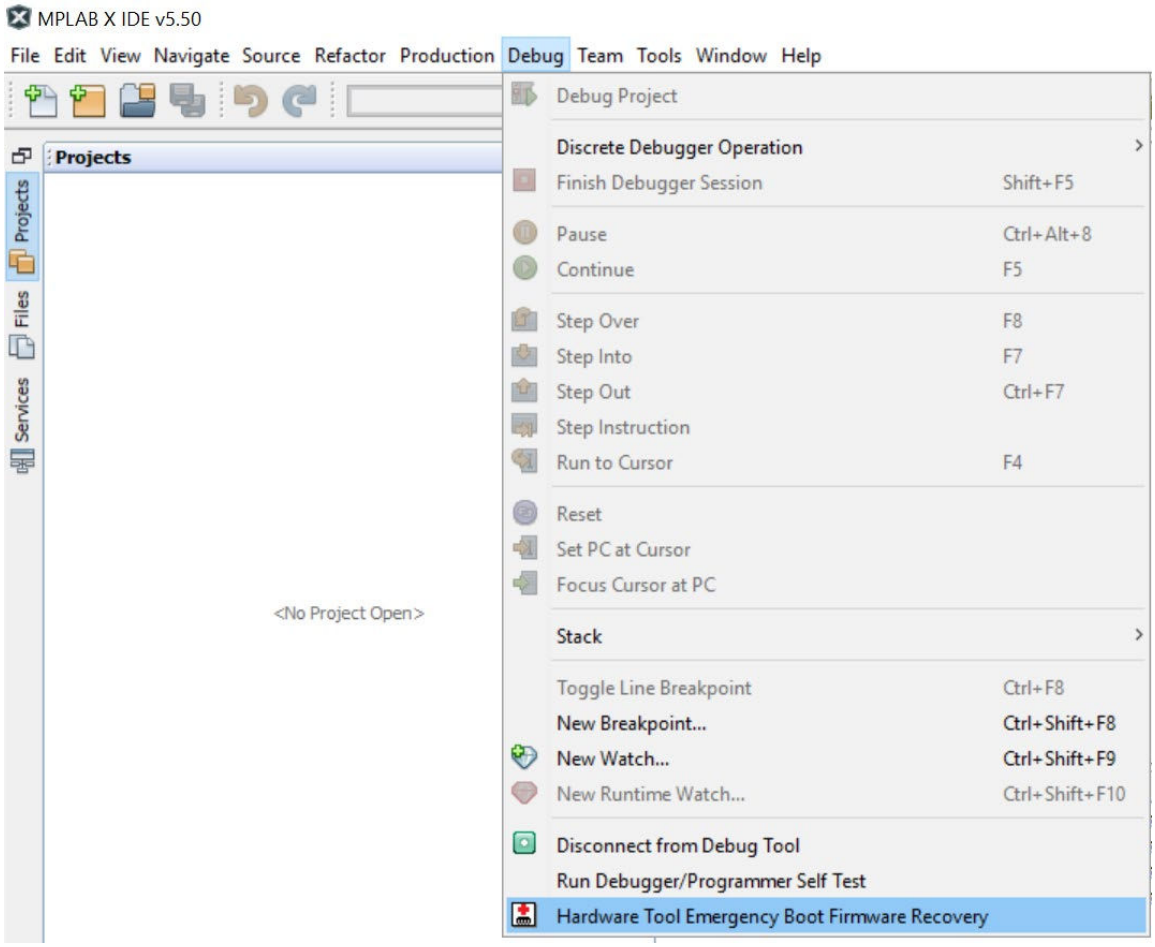
1. With the WBZ451 Curiosity Board still being powered, short the two pads for approximately ten seconds.

Figure 7-1. Location of Pads to Short



2. Open the latest version of MPLAB X. For more details, refer to 1.3. Software Prerequisites.
3. Click **Debug** > **Hardware Tool Emergency Boot Firmware Recovery**.

Figure 7-2. Hardware Tool Emergency Boot Firmware Recovery



4. Follow the directions on the screen. This resets the tool back to the factory conditions.
   Note: For additional information on the MPLAB PKOB4, refer to the *MPLAB® PICkit™ 4 In-Circuit Debugger User's Guide* (DS50002751) and *MPLAB® Snap In-Circuit Debugger User's Guide* (DS50002787).

8. Document Revision History

Revision	Date	Section	Description
A	10/2022	Document	Initial revision

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