

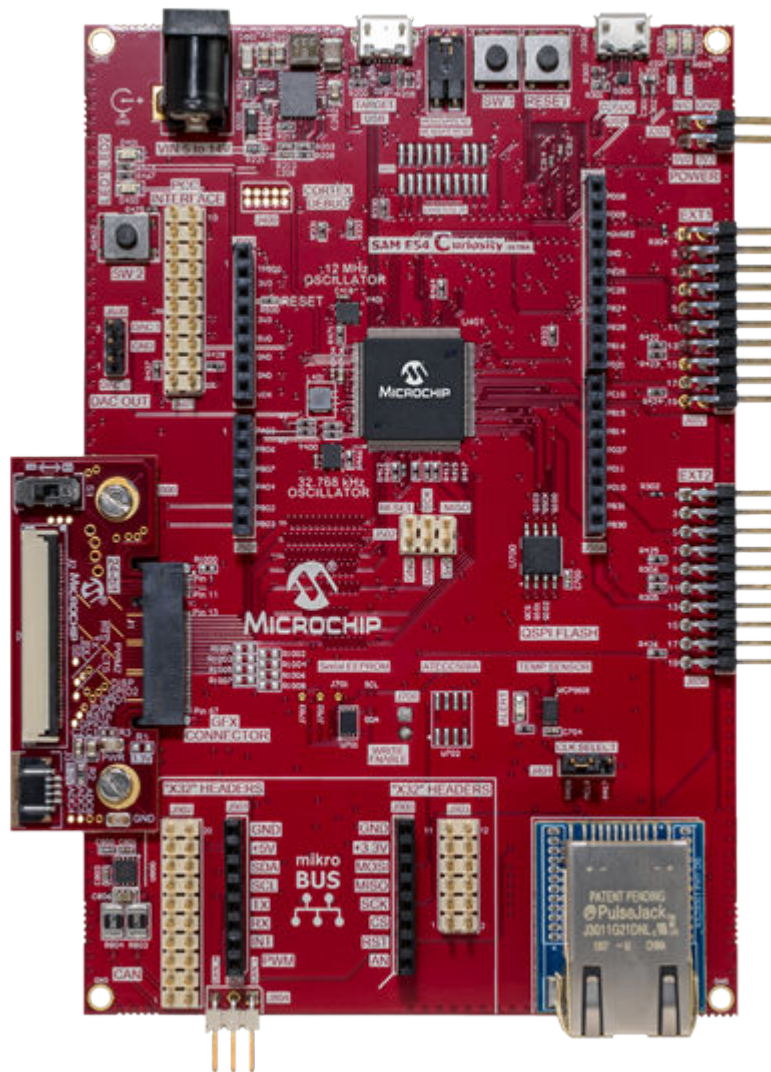
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**SAME54 Curiosity Ultra Users Guide DM320210**

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**Introduction**

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The SAM E54 Curiosity Ultra Development Board (DM320210) includes an integrated programmer and debugger, hence additional hardware is not required to get started. Users can add functionality through MikroElektronika mikroBUS™ Click™ adapter boards, add Ethernet connectivity with the Microchip PHY Daughter Board, add Wi-Fi™ connectivity capability using the Microchip expansion boards, and add audio input and output capability with Microchip audio daughter boards.

With or without expansion boards, the SAM E54 Curiosity Ultra Development Board provides the freedom to develop for a variety of applications, including Bluetooth® Audio, CAN, Graphics User Interface (GUI), Internet of Things (IoT), robotics development, and proof-of-concept (PoC) designs.

## Features

The following are features of the SAM E54 Curiosity Ultra development board

- ATSAME54P20A, 120 MHz, 1MB Flash, 256 KB RAM
- On-Board Debugger (EDBG)
  - Real time Programming and Debugging
  - Virtual COM port (VCOM)
  - Data Gateway Interface (DGI)
- One mikroBUS interfaces
- One X32 audio interfaces supporting Bluetooth and audio
- Ethernet interface
- Graphics interface
- Xplained Pro extension compatible interface
- CAN interface
- User buttons
- User LEDs
- 8-MB QSPI memory
- Arduino Uno R3 compatible interface

## Kit Contents

The development board kit contains one SAM E54 Curiosity Ultra development board (DM320210).

Note: If you are missing any part of the 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.

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## Table of Contents

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|  |    |
|--|----|
| Introduction.....  | 1  |
| 1. SAM E54 Curiosity Ultra Development Board Functionality and Features..... | 4  |
| 2. Hardware.....   | 19 |
| The Microchip Website.....   | 32 |
| Product Change Notification Service.....                                     | 32 |
| Customer Support.....  | 32 |
| Product Identification System.....   | 33 |
| Microchip Devices Code Protection Feature.....                               | 33 |
| Legal Notice.....  | 33 |
| Trademarks.....  | 34 |
| Quality Management System.....   | 34 |
| Worldwide Sales and Service.....   | 35 |

### 1. SAM E54 Curiosity Ultra Development Board Functionality and Features

The SAM E54 Curiosity Ultra development board features and functionalities are given in the following sections.

#### 1.1 SAM E54 Curiosity Ultra Development Board Features

Figure 1-1. SAM E54 Curiosity Ultra Development Board Layout (Top View)

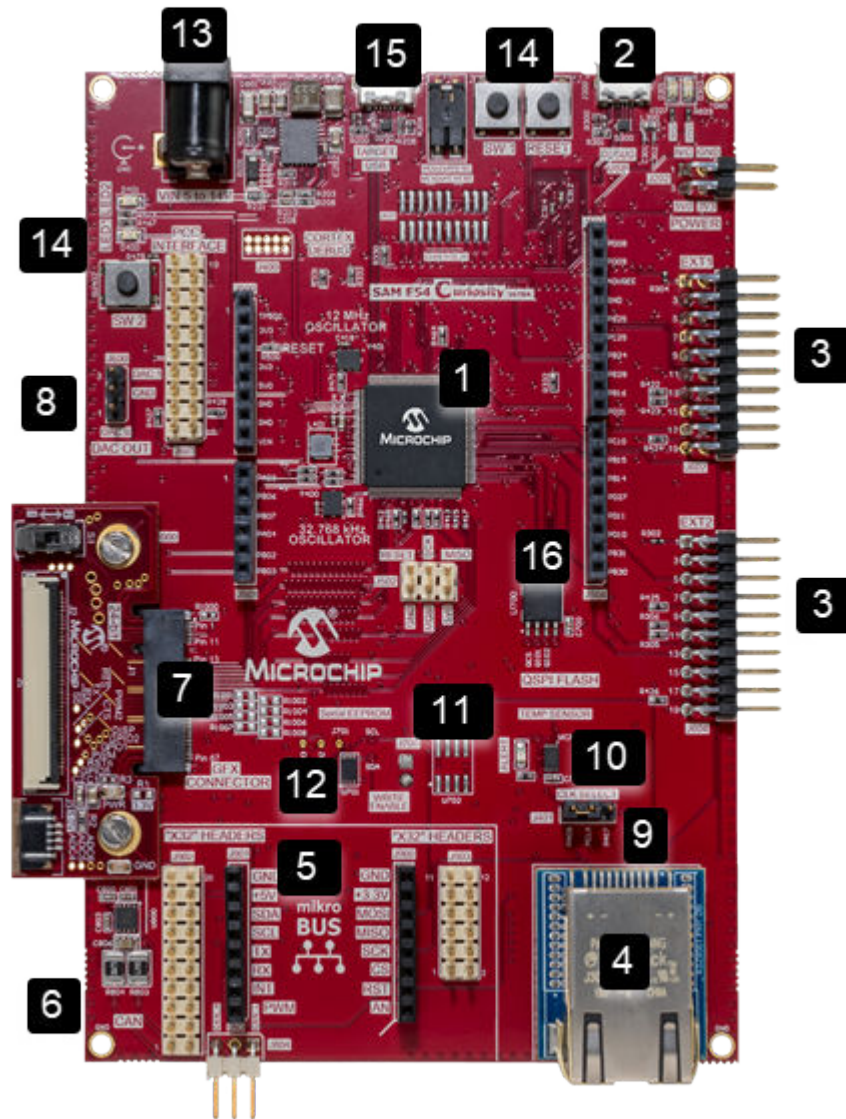


Table 1-1. SAM E54 Curiosity Ultra Development Board Feature Descriptions

| Number | Description of item                         |
|--------|---|
| 1      | ATSAME54P20A                                |
| 2      | USB debugger interface                      |
| 3      | Xplained Pro expansion compatible interface |

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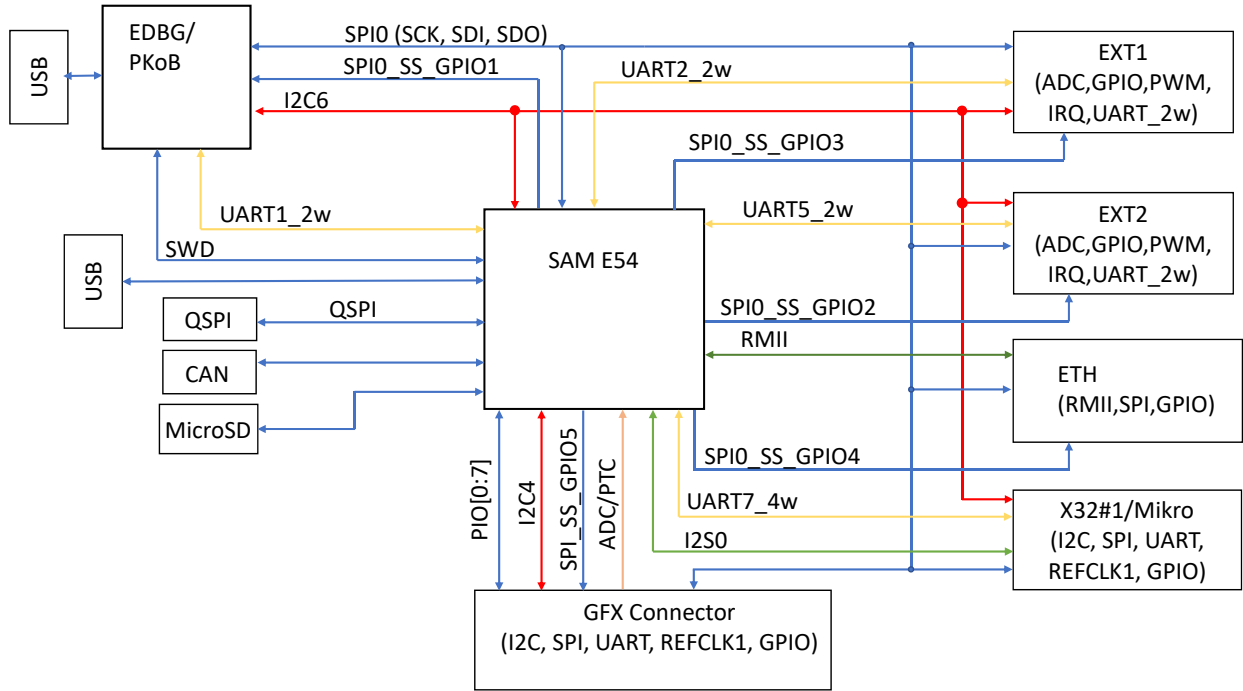
**.....continued**

| <b>Number</b> | <b>Description of item</b>   |
|---------------|--|
| 4             | Ethernet interface (RMII, SPI, GPIO).                                      |
| 5             | X32 audio interface. 2 per board. Bluetooth & audio codecs sold separately |
| 6             | CAN interface  |
| 7             | Graphics interface   |
| 8             | DAC output   |
| 9             | Audio reference clock select   |
| 10            | I <sup>2</sup> C temp sensor (MCP9808)                                     |
| 11            | ATECC508 (Not populated)   |
| 12            | I <sup>2</sup> C Serial EEPROM with MAC address                            |
| 13            | 2.1 mm barrel jack power input   |
| 14            | Programmable user buttons and LEDs   |
| 15            | USB to ATSAME54P20A  |
| 16            | Quad SPI memory 256 Mb (8 MB)  |

**1.2 System Block Diagram**

The following figure illustrates the system block diagram, which indicates the data bus routing.

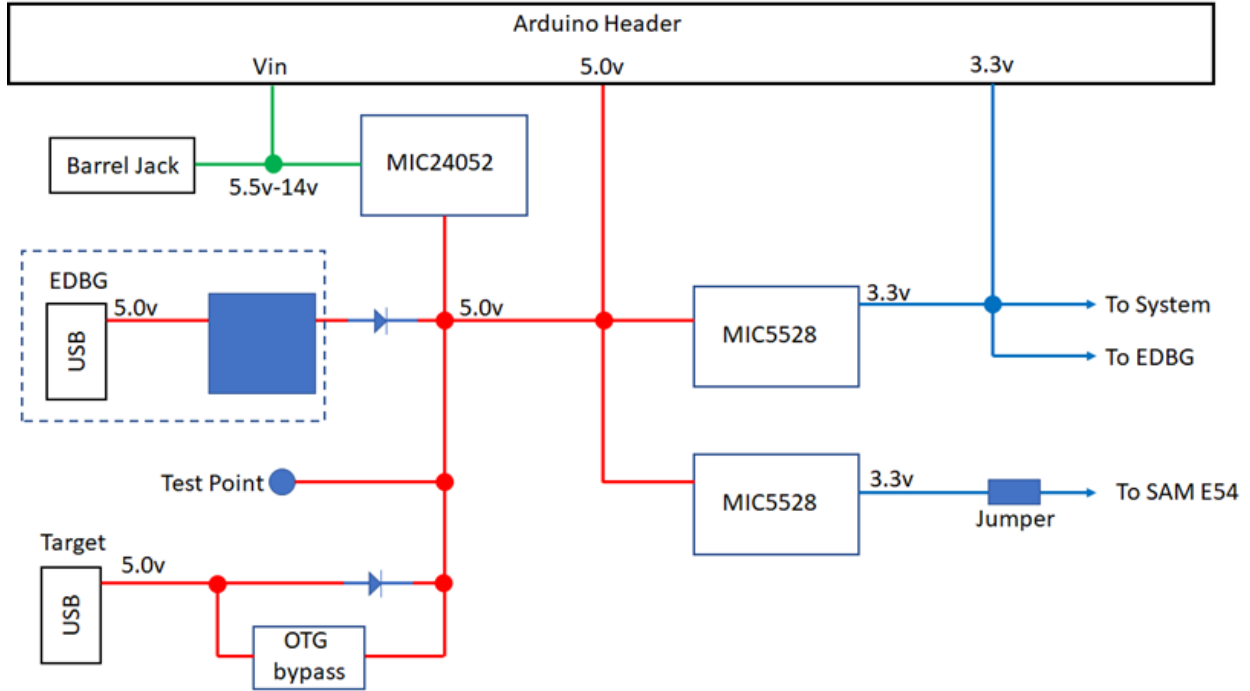
**Figure 1-2. System Block Diagram**



### 1.3 Power Block Diagram

The following diagram shows the power system on the SAM E54 Curiosity Ultra development board. The development board has many power sub systems that allow it to accept up to 16V. The barrel jack is a 2.1 mm center positive connector. The power in can also be connected through the Arduino header (Vin), and it supplies power before the reverse voltage protection.

Figure 1-3. Power Block Diagram



## 1.4 EDBG

The SAM E54 Curiosity Ultra development board implements several Curiosity Pro standards, such as extension headers and connectors. Curiosity Pro is an evaluation platform that provides a full Microchip microcontroller experience. The platform consists of a series of Microcontroller (MCU) boards and extension boards that are integrated with the Microchip MPLAB<sup>®</sup> X IDE that supports data streaming. The Curiosity Pro MCU boards support a wide range of Curiosity Pro extension boards, such as audio DACs and codecs, Ethernet PHYs, graphics cards, and mikroBUS that are connected through a set of standardized headers and connectors. Each extension board has an identification (ID) chip to uniquely identify which boards are connected to a Xplained Pro MCU board. This information is given in the relevant user guides, application notes, data sheets, and the example code examples through the MPLAB X IDE.

The development board contains a Microchip Embedded Debugger (EDBG) for on-board debugging. The EDBG is a complex USB device, which is based on the following interfaces:

- Debugger
- Virtual COM Port
- Data Gateway Interface (DGI)

Together with the Microchip MPLAB X IDE, the EDBG debugger interface can program and debug the ATSAME54P20A. On the development board, the SWD interface is connected between the EDBG and the ATSAME54P20A.

The Virtual COM Port is connected to a UART on the ATSAME54P20A and provides an easy way to communicate with the target application through the terminal software. It offers variable baud rate, parity, and Stop bit settings. The settings on the ATSAME54P20A must match with the settings given in the terminal software.

**Note:** If not set automatically, Data Terminal Ready (DTR) must be set in the terminal software.

The DGI consists of several physical interfaces for communication with the host computer. Communication over the interfaces is bidirectional. It can be used to send events and values from the ATSAME54P20A, or as a generic printf-style data channel. Traffic over the interfaces can be timestamped on the EDBG for accurate tracing of events. Note that timestamping imposes an overhead that reduces maximal throughput. The Data Visualizer is used to send and receive data through DGI.

The EDBG controls two LEDs on the development board: a power LED and a status LED. The table below provides how the LEDs are controlled in different operation modes.

**Table 1-2. EDBG LED Control**

| Operation Mode                     | Power LED  | Status LED  |
|------------------------------------|--|---|
| Normal operation                   | The power LED is lit when power is applied to the board.           | Activity indicator, LED flashes when any communication happens to the EDBG. |
| Bootloader mode (Idle mode)        | The power LED and the status LED blinks simultaneously.            | The power LED and the status LED blinks simultaneously.                     |
| Bootloader mode (firmware upgrade) | The power LED and the status LED blinks in an alternating pattern. | The power LED and the status LED blinks in an alternating pattern.          |

For additional information on EDBG, refer to the [EDBG User Guide](#).

### Hardware Identification System

All Curiosity Pro-compatible extension boards have an Microchip ATSHA204 CryptoAuthentication™ chip mounted. This chip contains information that identifies the extension with its name and data. When an Xplained Pro extension is connected to a Curiosity Pro MCU board, the information is read and sent to the MPLAB X IDE. The Microchip kits extension, installed with MPLAB X IDE, provides relevant information, such as code examples, and links to relevant documents. The following table provides the data fields stored in the ID chip with content examples.



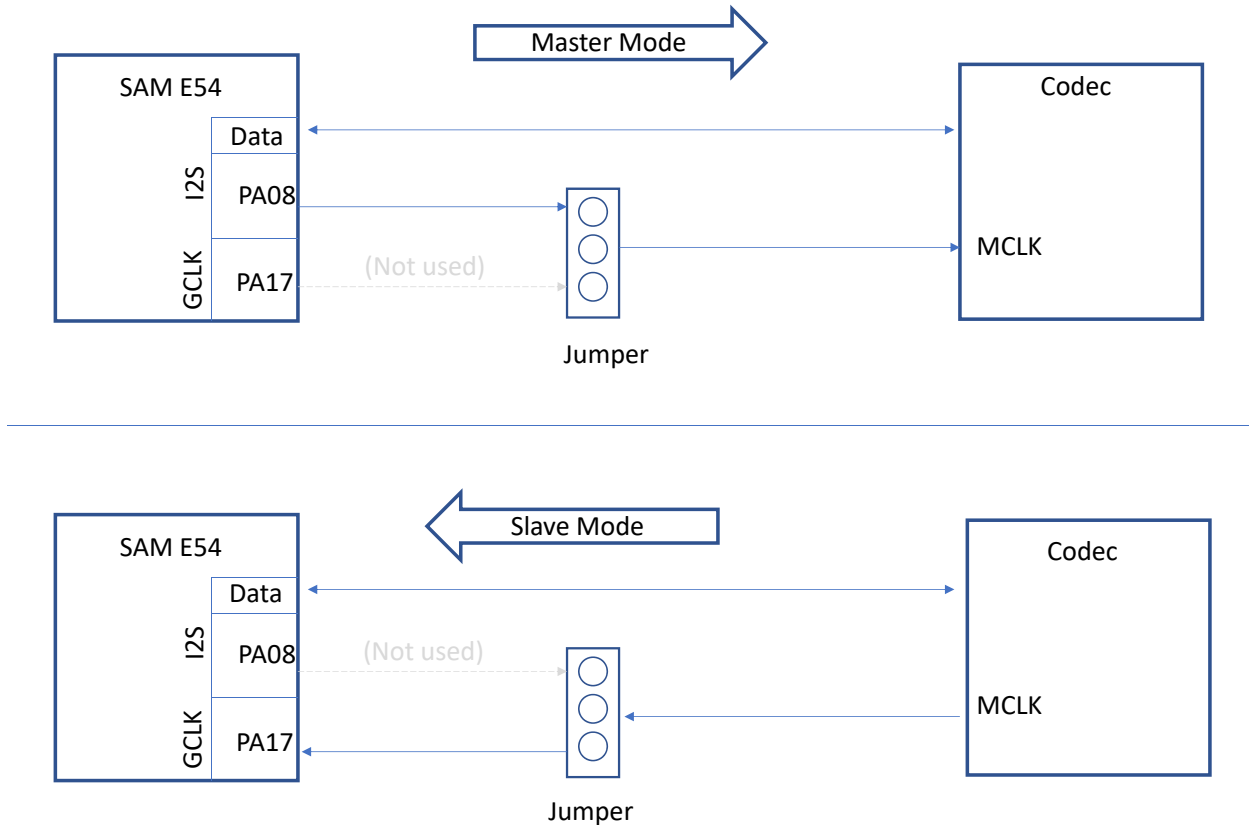
Table 1-3. Xplained Pro ID Chip Content Example

| Data Field            | Data Type    | Example             |
|-----------------------|--------------|---------------------|
| Manufacture           | ASCII string | Microchip\0'        |
| Product Name          | ASCII string | -                   |
| Product Revision      | ASCII string | 04\0'               |
| Product Serial number | ASCII string | 1774020200000010\0' |
| Minimum Voltage (mV)  | uint16_t     | 3000                |
| Maximum Voltage (mV)  | uint16_t     | 3600                |
| Maximum Current (mA)  | uint16_t     | 30                  |

## 1.5 Audio Clock Selection

The SAM E54 has two ways of supporting I<sup>2</sup>S audio applications: Host mode and Slave mode. This refers to which mode generates the I<sup>2</sup>S Master clock, and it also known as a reference clock. The following figure shows the relationship between the devices. On this board there is a jumper to select between the two modes, Master mode and Slave mode. The usable modes also depend on which codec it supports, as not all codecs can support both the modes.

Figure 1-4. Audio Clock Selection



### 1.5.1 Pinout

The following table describes the pinout for the X32 Audio Interface. See the [2.1 Schematics](#) for more information.

Table 1-4. Pinout

| Pin Number | Name                 | Description                                | Interface        |
|------------|----------------------|--|------------------|
| 1          | GND                  | Ground                                     | Power            |
| 2          | GND                  | Ground                                     | Power            |
| 3          | UART RX              | UART RX, receive to MCU from DB            | UART             |
| 4          | UART CTS             | UART Clear to send                         | UART             |
| 5          | UART TX              | UART TX, transmit from MCU to DB           | UART             |
| 6          | UART RTS             | UART Ready to send                         | UART             |
| 7          | I <sup>2</sup> C SCL | Clock line for I <sup>2</sup> C interface. | I <sup>2</sup> C |
| 8          | STBY/RST             | Standby/Reset control                      | GPIO             |

.....continued

| Pin Number | Name                 | Description  | Interface        |
|------------|----------------------|--|------------------|
| 9          | I <sup>2</sup> C SDA | Data line for I <sup>2</sup> C interface.                        | I <sup>2</sup> C |
| 10         | Audio WS/LRCLK       | Audio Word Select/Left Right Clock                               | I <sup>2</sup> S |
| 11         | Audio In             | Audio into MCU, out from codac                                   | I <sup>2</sup> S |
| 12         | Audio CLK            | Audio clock  | I <sup>2</sup> S |
| 13         | Audio out            | Audio out of MCU, into codac/DAC                                 | I <sup>2</sup> S |
| 14         | REFCLK/MCK           | Reference clock #1   | REFCLK           |
| 15         | GND                  | Ground   | Power            |
| 16         | GND                  | Ground   | Power            |
| 17         | NC                   | Legacy hold over   | -                |
| 18         | +3.3v                | VDD  | Power            |
| 19         | NC                   | Legacy hold over   | -                |
| 20         | +5.0v                | VDD  | Power            |
| 21 (1)     | NC                   | NC   |                  |
| 22 (2)     | ADC/Card ID pin      | Analog-to-Digital Converter to read voltage on the daughter card | 1-wire           |
| 23 (3)     | NC                   | NC   |                  |
| 24 (4)     | NC                   | NC   |                  |
| 25 (5)     | NC                   | NC   |                  |
| 26 (6)     | NC                   | NC   |                  |
| 27 (7)     | NC                   | NC   |                  |
| 28 (8)     | NC                   | NC   |                  |
| 29 (9)     | NC                   | NC   |                  |
| 30 (10)    | NC                   | NC   |                  |
| 31 (11)    | GND                  | Ground   | Power            |
| 32 (12)    | GND                  | Ground   | Power            |

**1.5.2 X32 Port Connections**

The following table provides the port and connection details of the X32 audio interface. The I<sup>2</sup>S signals listed are the Main signals, and both the signals are available at each interface.

**Table 1-5. X32 Port Connections**

| Interface            | X32  |
|----------------------|------|
| UART RX              | PC13 |
| UART TX              | PC12 |
| UART RTS             | PC14 |
| UART CTS             | PC15 |
| I <sup>2</sup> C SDA | PD09 |
| I <sup>2</sup> C SCL | PD08 |

| .....continued                    |   |
|-----------------------------------|---|
| Interface                         | X32   |
| Reset                             | PC18  |
| REFCLK                            | PA08/PA17 (refer to Figure 1-4 Audio Clock Selection) |
| I <sup>2</sup> S Clock            | PA10  |
| I <sup>2</sup> S Audio Out (MOSI) | PA11  |
| I <sup>2</sup> S Audio In (MISO)  | PB10  |
| I <sup>2</sup> S LRCLK            | PA09  |

### 1.6 mikroBUS

The mikroBUS interface enables using additional click boards. For more information, and to see the boards that can be used with this development board follow the link: <https://www.mikroe.com/>.

**Note:** Some of these pins are shared with the X32 audio interface. Due to location, an X32 audio card cannot be used simultaneously as the click interface due to mechanical interference.

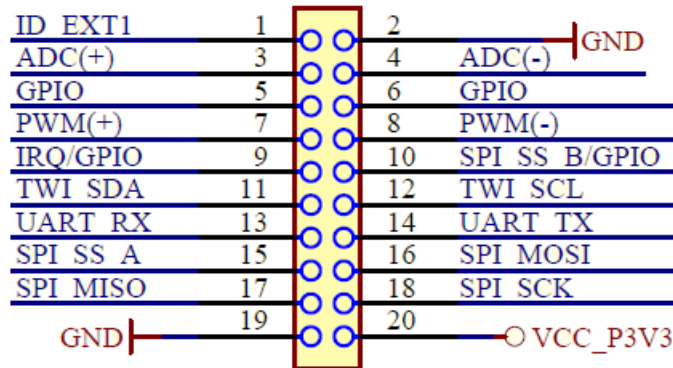
## 1.7 Xplained Pro Standard Extension Header

All Xplained Ultra and Curiosity Ultra Kits have many dual-row, 20-pin, and 100 mil extension headers. Xplained Ultra and Curiosity Ultra MCU boards have male headers, while Xplained Ultra extensions have their female counterparts as shown in the following figure.

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

The extension headers can be used to connect a variety of Xplained Pro extensions to Xplained Ultra and Curiosity Ultra MCU boards, or to access the pins of the target MCU on Xplained Ultra MCU or Curiosity Ultra boards directly.

**Figure 1-5. Extension Headers**



All connected pins follow the defined pinout description as shown in the following table.

**Table 1-6. Xplained Pro Standard Extension Header**

| Pin number | Name                 | Description   |
|------------|----------------------|---|
| 1          | ID                   | Communication line to the ID chip on an extension board                                       |
| 2          | GND                  | Ground  |
| 3          | ADC(+)               | Analog-to-Digital Converter (ADC), alternatively positive part of differential ADC            |
| 4          | ADC(-)               | Analog-to-Digital Converter (ADC), alternatively negative part of differential ADC            |
| 5          | GPIO1                | General purpose I/O   |
| 6          | GPIO2                | General purpose I/O   |
| 7          | PWM(+)               | Pulse-Width Modulation (PWM), alternatively positive part of differential PWM                 |
| 8          | PWM(-)               | Pulse-Width Modulation (PWM), alternatively negative part of differential PWM                 |
| 9          | IRQ/INT/GPIO         | Interrupt request line and general purpose I/O  |
| 10         | SPI SS B/GPIO        | SPI Slave Select or general purpose I/O   |
| 11         | I <sup>2</sup> C SDA | Data line for I <sup>2</sup> C interface. Always implemented, bus type                        |
| 12         | I <sup>2</sup> C SCL | Clock line for I <sup>2</sup> C interface. Always implemented, bus type                       |
| 13         | UART RX              | Receiver line of target device UART   |
| 14         | UART TX              | Transmitter line of target device UART  |
| 15         | SPI SS A/GPIO        | SPI Slave Select or general purpose I/O   |
| 16         | SPI MOSI             | <b>Master Out Slave In</b> line of serial peripheral interface. Always implemented, bus type. |
| 17         | SPI MISO             | <b>Master In Slave Out</b> line of serial peripheral interface. Always implemented, bus type. |

.....continued

| Pin number | Name            | Description  |
|------------|-----------------|--|
| 18         | SPI SCK         | Clock for serial peripheral interface. Always implemented, bus type. |
| 19         | GND             | Ground   |
| 20         | V <sub>CC</sub> | Power for extension boards (3.3V)                                    |

## 1.8 Graphics Connectors or GFX Card Interface

The SAM E54 Curiosity Ultra development kit is designed to have a modular graphics interface. This interface enables the use of several different graphics cards, which allows for expandability and different use cases. A 24-bit pass through card is included with the kit, this board passes parallel data through, and can be configured to an 8-bit 8080 MCU mode. This card also provides access to the ADC for resistive touch screen or self-drive PTC touch screens. Refer to the following table for the pin description.

**Table 1-7. Graphics Interface Pinout**

| Pin Number | Name                       | Description  |
|------------|----------------------------|--|
| 1          | GND                        | Ground   |
| 2          | GND                        | Ground   |
| 3          | $\overline{\text{MCLR}}$   | Master Clear Reset controlled by the debuggers. Allows for a complete system reboot. |
| 4          | IRQ1 (LCD Touch)           | Interrupt request line for cap touch device  |
| 5          | 5.0V V <sub>CC</sub>       | 5.0V   |
| 6          | IRQ2 (Q Touch)             | Interrupt request line for Q touch devices   |
| 7          | LCDEN                      | LCD Data Enable  |
| 8          | IRQ3 (Display Controllers) | Interrupt request line for external display controllers                              |
| 9          | LCDHSYNC/NCS3              | LCD Horizontal Sync or GPIO  |
| 10         | IRQ4 (Resistive touch)     | Interrupt request line for resistive touch controllers                               |
| 11         | LCDVSYNC/nWE               | LCD Vertical Sync, CS, or GPIO   |
| 12         | 5.0v V <sub>CC</sub>       | +5.0v  |
| 13         | LCDPCK/nRD                 | LCD pixel clock, Write Enable or GPIO  |
| 14         | I <sup>2</sup> C SDA       | Data line for I <sup>2</sup> C interface. Always implemented, bus type.              |
| 15         | LCD D0                     | LCD Data bit 0   |
| 16         | I <sup>2</sup> C SCL       | Clock line for I <sup>2</sup> C interface. Always implemented, bus type.             |
| 17         | LCD D1                     | LCD Data bit 1   |
| 18         | SPI SCK                    | Clock for serial peripheral interface. Always implemented, bus type.                 |
| 19         | LCD D2                     | LCD Data bit 2   |
| 20         | SPI MOSI                   | <b>Master Out Slave In</b> line of serial peripheral interface.                      |
| 21         | LCD D3                     | LCD Data bit 3   |
| 22         | SPI MISO                   | <b>Master In Slave Out</b> line of serial peripheral interface.                      |
| 23         | LCD D4                     | LCD Data bit 4   |

| .....continued |                |  |
|----------------|----------------|--|
| Pin Number     | Name           | Description  |
| 24             | SPI SS         | SPI Slave Select   |
| 25             | LCD D5         | LCD Data bit 5   |
| 26             | UART RX        | Receiver line of target device UART  |
| 27             | LCD D6         | LCD Data bit 6   |
| 28             | UART TX        | Transmitter line of target device UART. (from MCU to GFX card)                             |
| 29             | LCD D7         | LCD Data bit 7   |
| 30             | UART RTS       | UART Ready-To-Send (from MCU to GFX card)  |
| 31             | LCD D8         | No Connect   |
| 32             | UART CTS       | UART Clear-To-Send (from MCU to GFX card)  |
| 33             | LCD D9         | No Connect   |
| 34             | LCD PWM        | LCD PWM back light control   |
| 35             | LCD D10        | No Connect   |
| 36             | PWM2           | Pulse-Width Modulation (PWM)   |
| 37             | LCD D11        | No Connect   |
| 38             | GPIO1          | General purpose I/O  |
| 39             | LCD D12        | No Connect   |
| 40             | GPIO2          | General purpose I/O  |
| 41             | LCD D13        | No Connect   |
| 42             | GPIO3          | General purpose I/O  |
| 43             | LCD D14        | No Connect   |
| 44             | STBY/RST/GPIO4 | Standby/Reset or general purpose I/O. For resetting devices attached to the GFX connector. |
| 45             | LCD D15        | No Connect   |
| 46             | STBY/RST/GPIO5 | Standby2/Reset2 or general purpose I/O   |
| 47             | LCD D16        | No Connect   |
| 48             | ID pin         | Communication line to the ID chip on an extension board                                    |
| 49             | LCD D17        | No Connect   |
| 50             | ADC 0          | Analog-to-Digital Converter to MCU   |
| 51             | LCD D18        | No Connect   |
| 52             | ADC1           | Analog-to-Digital Converter to MCU   |
| 53             | LCD D19        | No Connect   |
| 54             | ADC2           | Analog-to-Digital Converter to MCU   |
| 55             | LCD D20        | No Connect   |
| 56             | ADC3           | Analog-to-Digital Converter to MCU   |
| 57             | LCD D21        | No Connect   |

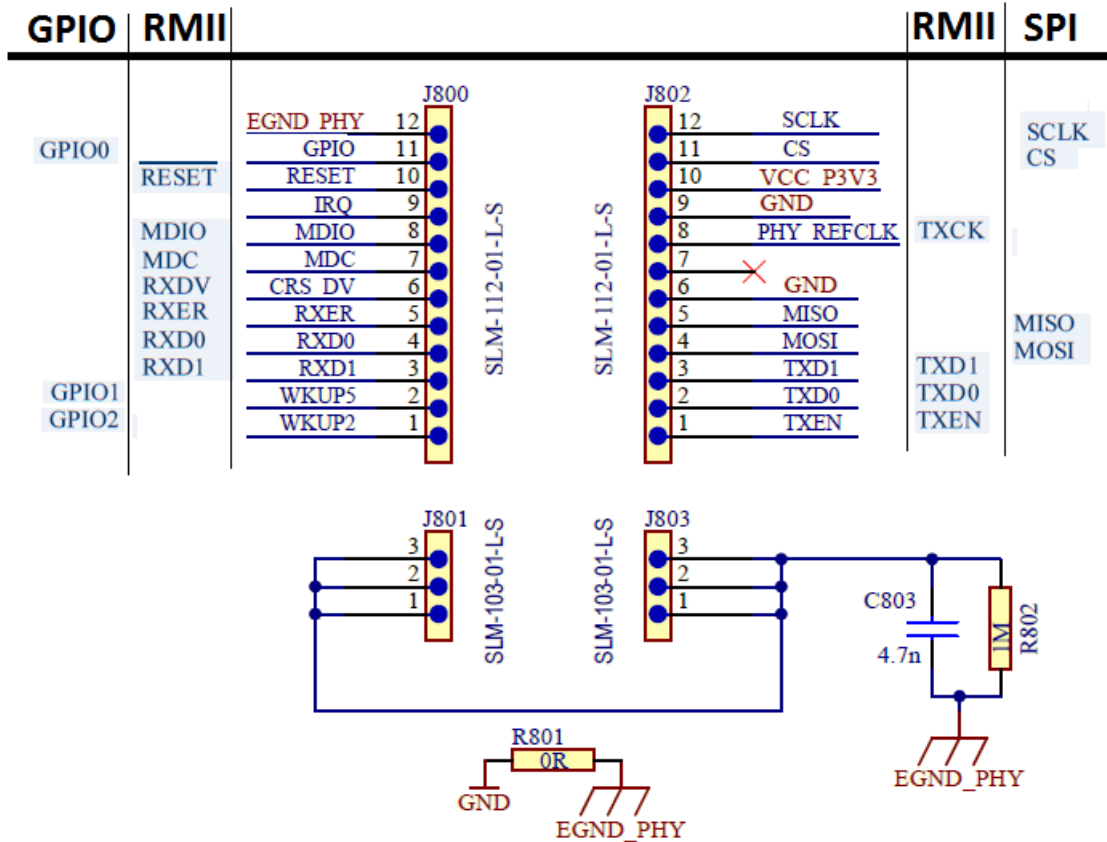
| .....continued |                      |                                    |
|----------------|----------------------|------------------------------------|
| Pin Number     | Name                 | Description                        |
| 58             | ADC4                 | Analog-to-Digital Converter to MCU |
| 59             | LCD D22              | No Connect                         |
| 60             | ADC5                 | Analog-to-Digital Converter to MCU |
| 61             | LCD D23              | No Connect                         |
| 62             | ADC6                 | Analog-to-Digital Converter to MCU |
| 63             | 3.3V V <sub>CC</sub> | +3.3V V <sub>CC</sub>              |
| 64             | ADC7                 | Analog-to-Digital Converter to MCU |
| 65             | GND                  | Ground                             |
| 66             | 3.3V V <sub>CC</sub> | +3.3V V <sub>CC</sub>              |
| 67             | GND                  | Ground                             |
| 68             | GND TAB              | Mounting Tab                       |
| 69             | GND TAB              | Mounting Tab                       |

### 1.9 Ethernet

The SAM E54 Curiosity Ultra development kit has a modular Ethernet PHY system that enables different PHYs to be plugged into the board. This interface is setup to use a Reduced Media-Independent Interface (RMII) and a SPI bus interface with GPIO. The following figure illustrates the Ethernet PHY header configuration.



Figure 1-6. Ethernet PHY Header Configuration



The following table provides the Ethernet PHY interface pinout descriptions.

Table 1-8. Ethernet Interface Pinout Description

| Pin Number | Name  | Description                       |
|------------|-------|-----------------------------------|
| 1          | GPIO  | General purpose I/O               |
| 2          | GPIO  | General purpose I/O               |
| 3          | RXD1  | Receive Data 1                    |
| 4          | RXD0  | Receive Data 0                    |
| 5          | RXER  | Receive Error                     |
| 6          | RXDV  | Receive Data Valid                |
| 7          | MDC   | -                                 |
| 8          | MDIO  | -                                 |
| 9          | IRQ   | Interrupt request line            |
| 10         | RESET | Reset control to the Ethernet PHY |
| 11         | GPIO  | General purpose I/O               |
| 12         | EGND  | Shield Ground                     |
| 13 (1)     | TXEN  | Transmit Enable                   |
| 14 (2)     | TXD0  | Transmit Data                     |

| .....continued |                       |   |
|----------------|-----------------------|---|
| Pin Number     | Name                  | Description   |
| 15 (3)         | TDX1                  | Transmit Data   |
| 16 (4)         | MOSI                  | Master Out Slave In line of serial peripheral interface |
| 17 (5)         | MISO                  | Master In Slave Out line of serial peripheral interface |
| 18 (6)         | GND                   | Ground  |
| 19 (7)         | NC                    | No Connect  |
| 20 (8)         | REFCLK (in)           | Reference Clock input (50 MHz)                          |
| 21 (9)         | GND                   | GND   |
| 22 (10)        | +3.3v V <sub>DD</sub> | +3.3V V <sub>DD</sub>                                   |
| 23 (11)        | CS                    | Chip Select for serial peripheral interface             |
| 24 (12)        | SCK                   | Clock for serial peripheral interface                   |
| 25 -30         | EGND                  | Shield Ground   |

### 1.10 AT24MAC402 Serial EEPROM

The development board has an on-board 2-Kbit I<sup>2</sup>C serial EEPROM which is available for user applications. This serial EEPROM has a unique EUI-48, and 128-bit serial number. The unique number can be seen in the Microchip MPLAB Kit window or Atmel Studio Xplained window after the kit has been plugged into the PC.

Users can change the device address using the solder pads on the board, but all address bits have been defaulted to one. Refer to [schematics](#) for additional information. For additional usage information of on this part, refer to the “AT24MAC402 and AT24MAC602 Data Sheet”, which is available for download from the Hardware Features, or from the following location: <http://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-8807-SEEPROM-AT24MAC402-602-Datasheet.pdf>.

The following are default address for the device:

AT24MAC\_I2C\_EEPROM\_ADDR 0b1010110 //0x56 (7 bit)

AT24MAC\_I2C\_EXTENDED\_ADDR 0b1011110 //0x5E (7 bit)

### 1.11 On-Board External Temperature Sensor

This development kit has an on-board external I<sup>2</sup>C-based temperature sensor for application use. The external sensor is a MCP8908. The temperature sensor has a user programmable temperature alert output and a user programmable temperature limits with a typical accuracy of +/-0.25°C.

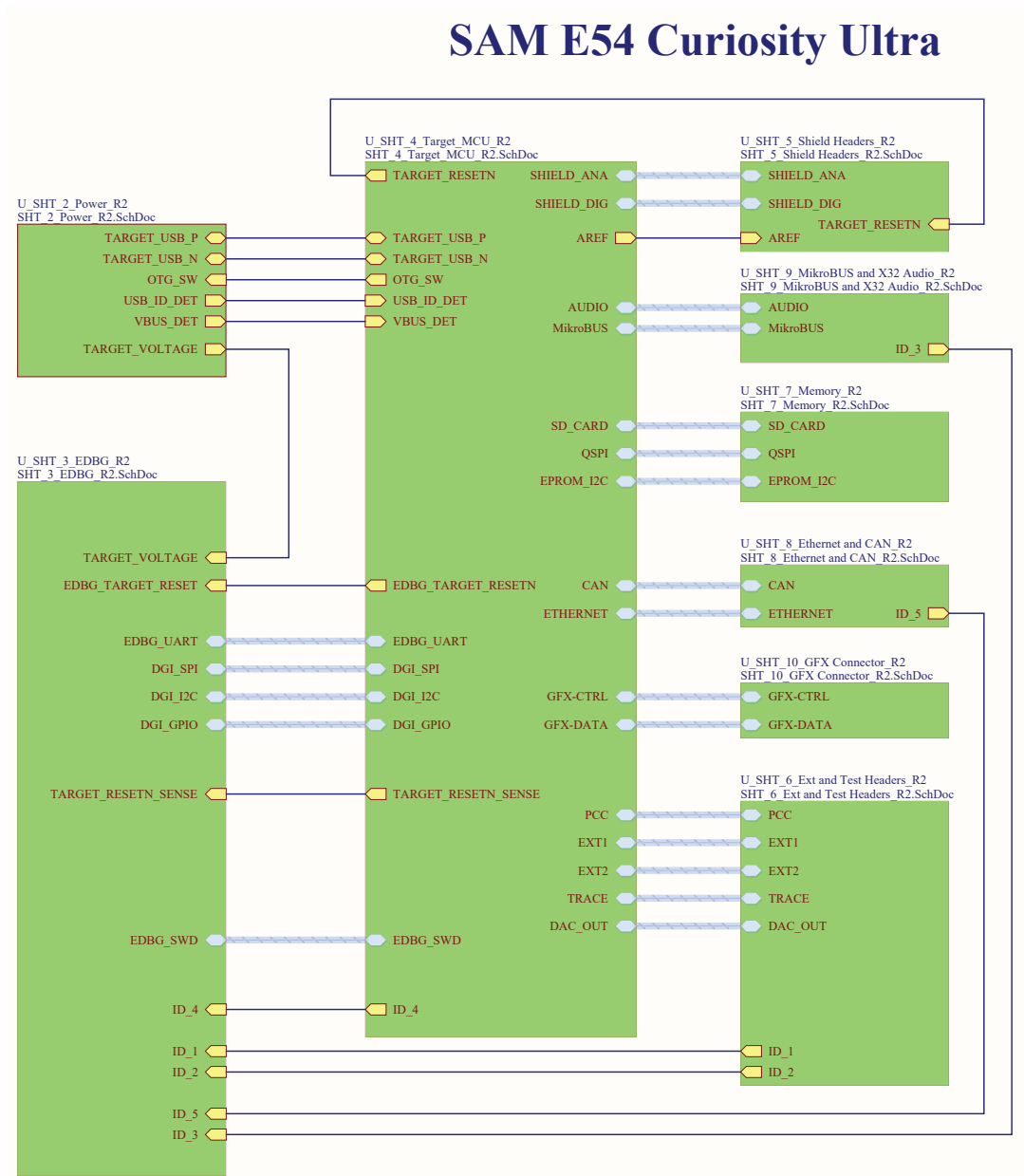
This part has an I<sup>2</sup>C address of 0x18h. For additional information, refer to the “±0.5°C Maximum Accuracy Digital Temperature Sensor” document, which is available for download from the following location: <http://ww1.microchip.com/downloads/en/DeviceDoc/25095A.pdf>.

### 1.12 Hardware Features

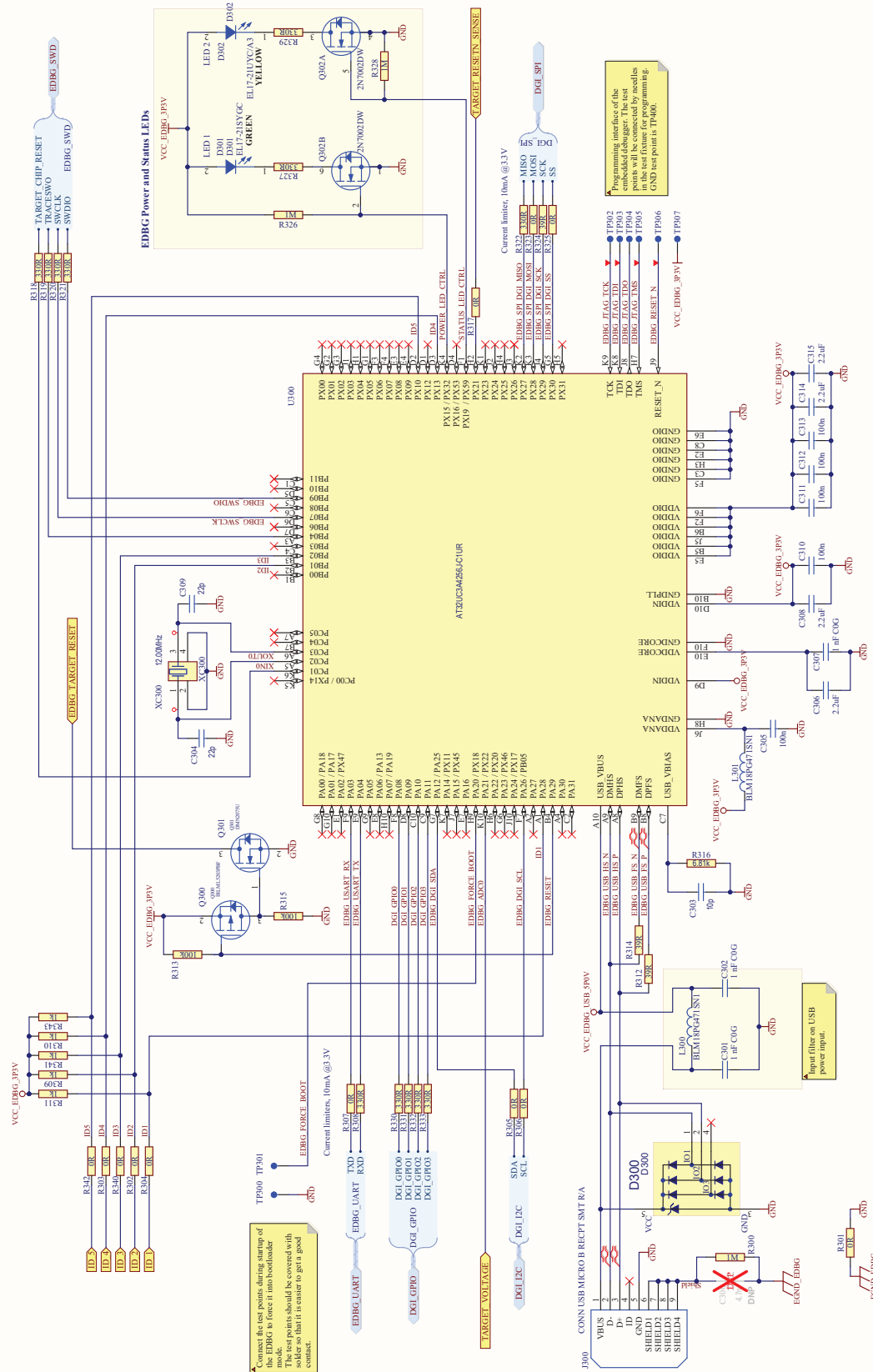
The starter kit provides the following two push button switches: User switch and Reset switch. The push button switches do not have any debounce circuitry and require the use of internal pull-up resistors. This enables the user to investigate the software debounce techniques. When Idle, the switches are pulled high (+3.3V,) and when pressed, they are grounded.

## 2. Hardware

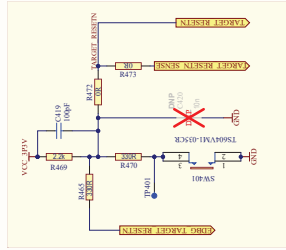
### 2.1 Schematics



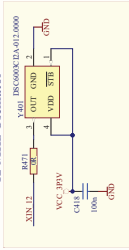




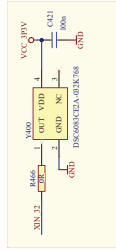
## RESET button with current limit and noise filter



## 12 MHz Oscillator



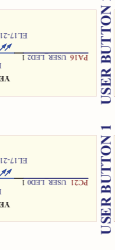
## 32.768 kHz Oscillator



## USER LED 1



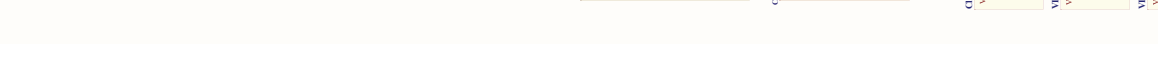
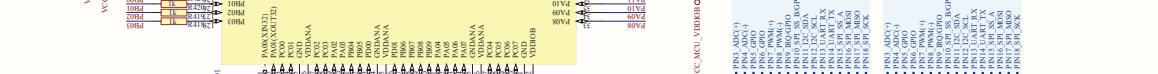
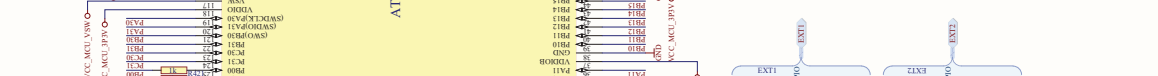
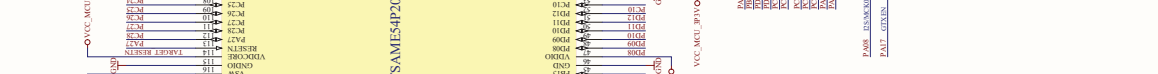
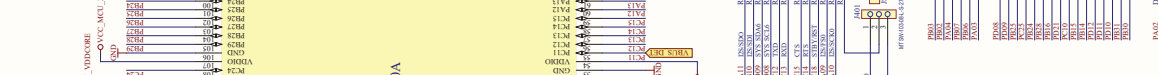
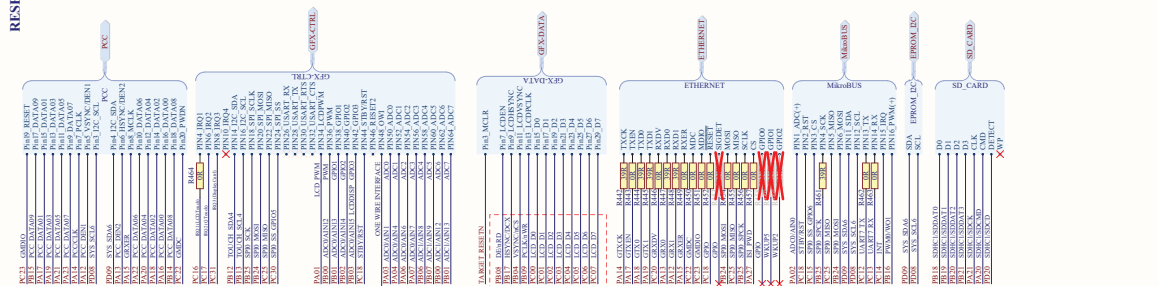
## USER LED 2

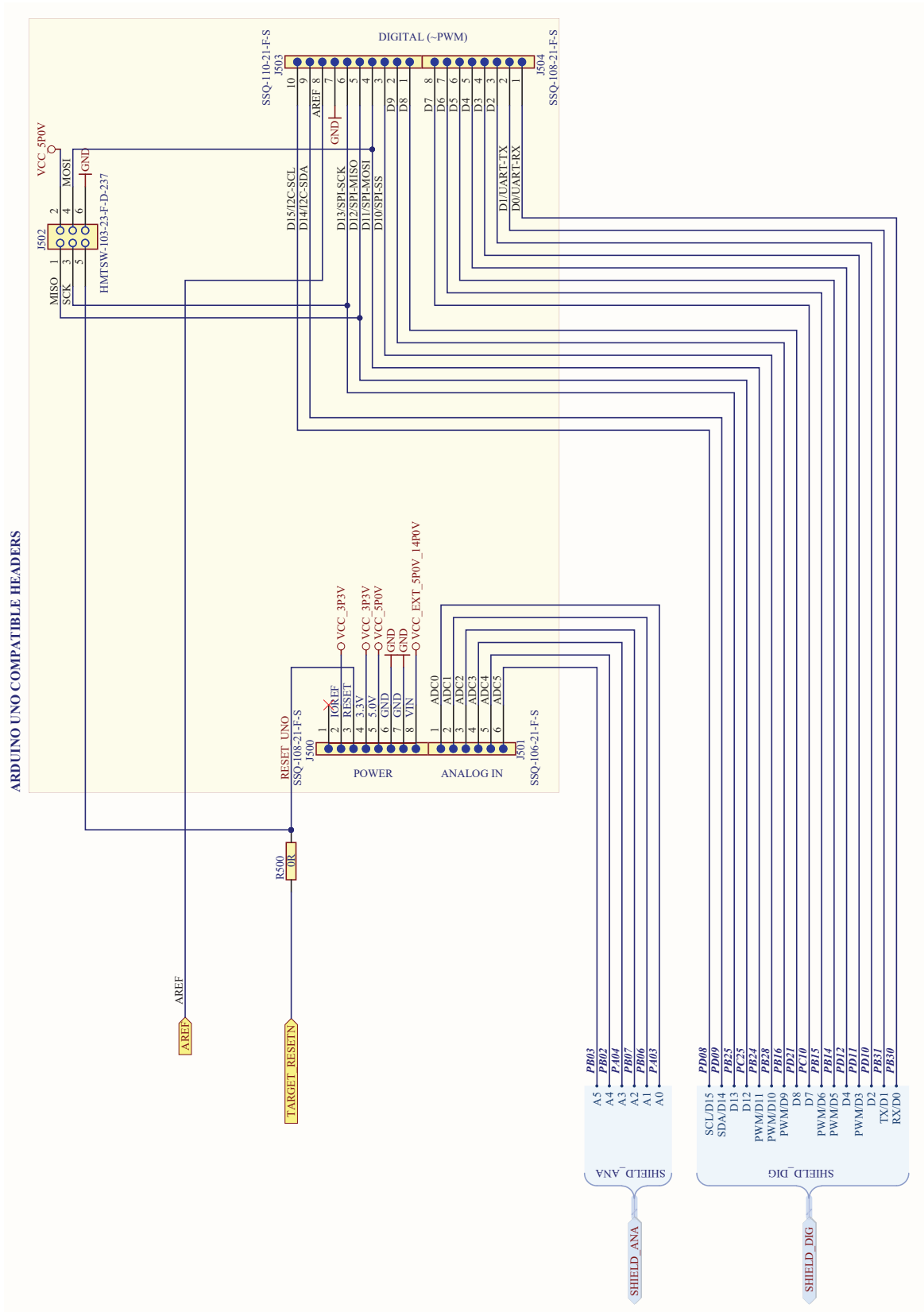


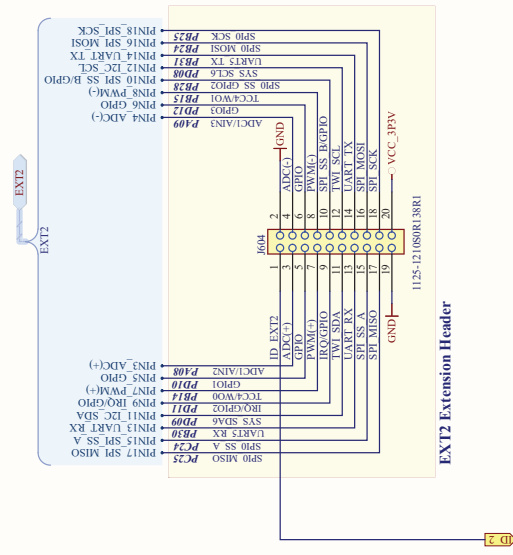
## USER BUTTON 1



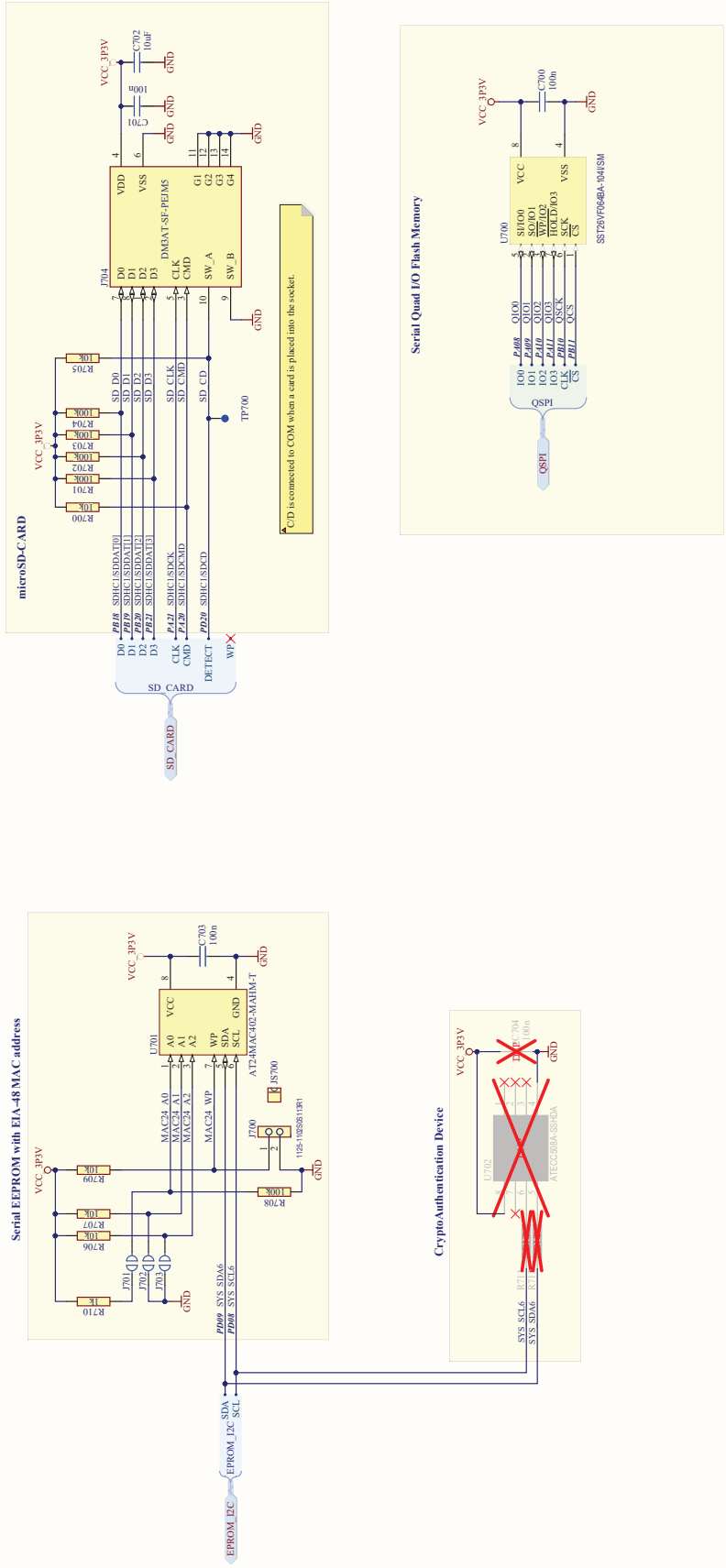
## USER BUTTON 2

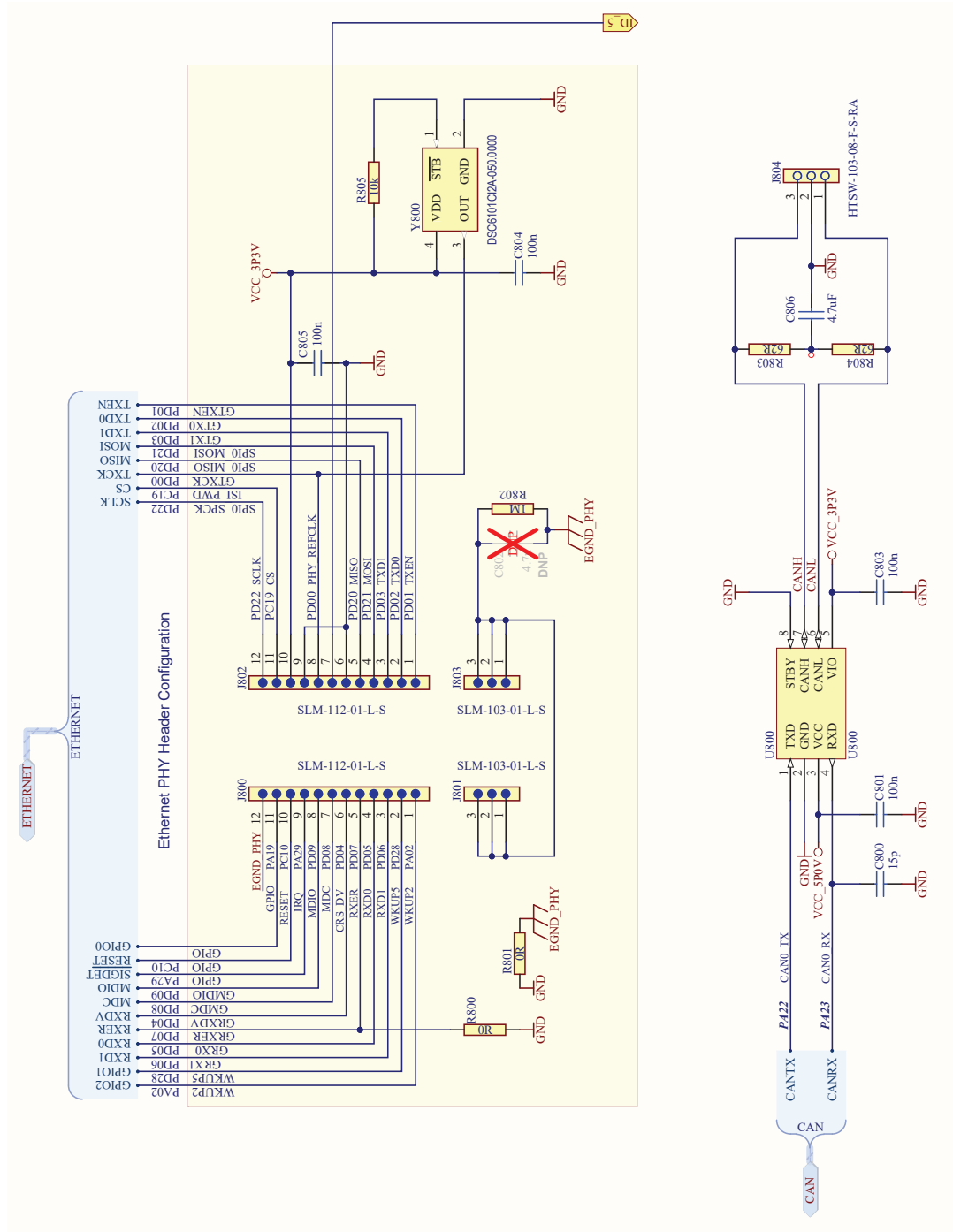


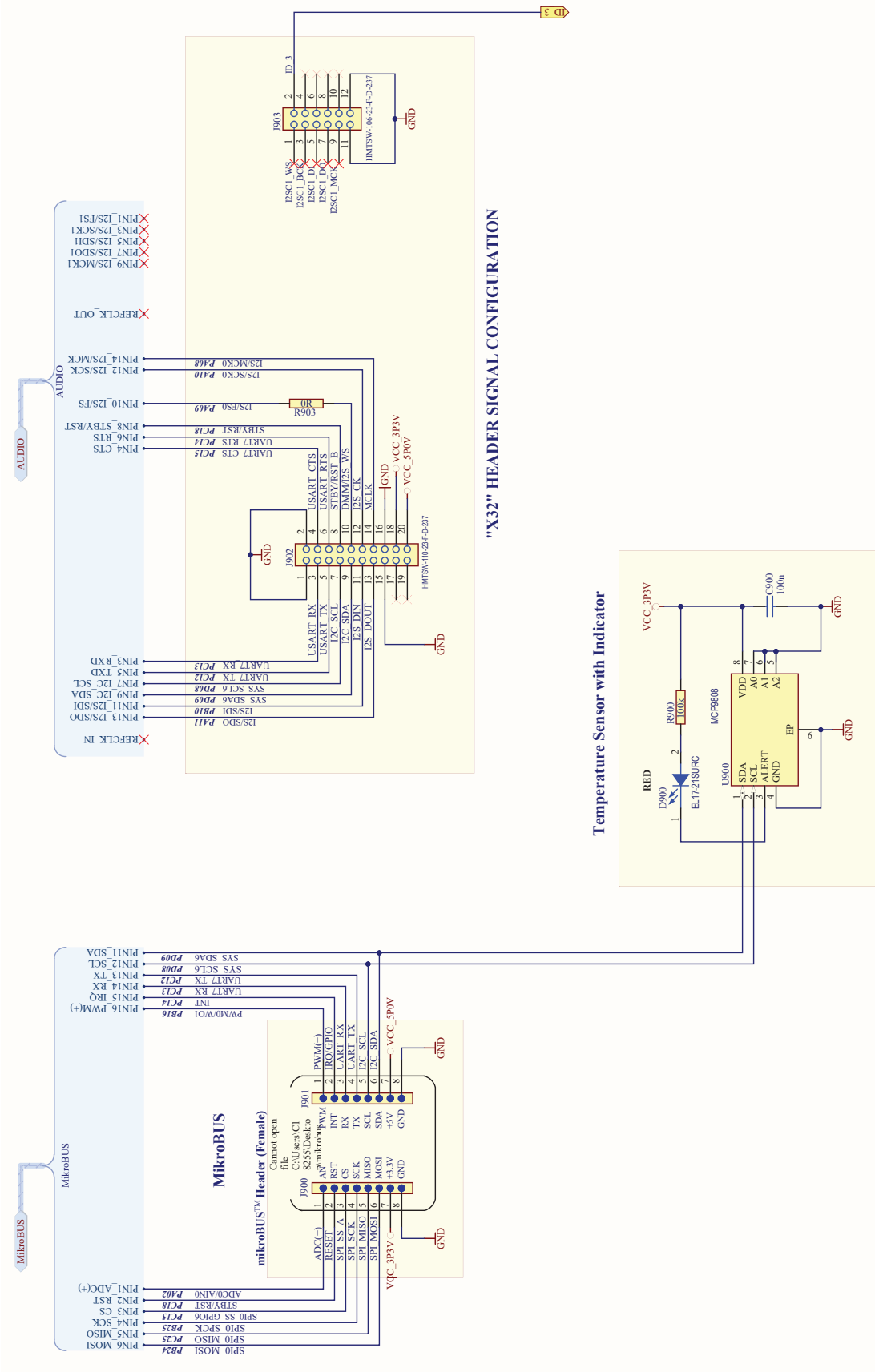


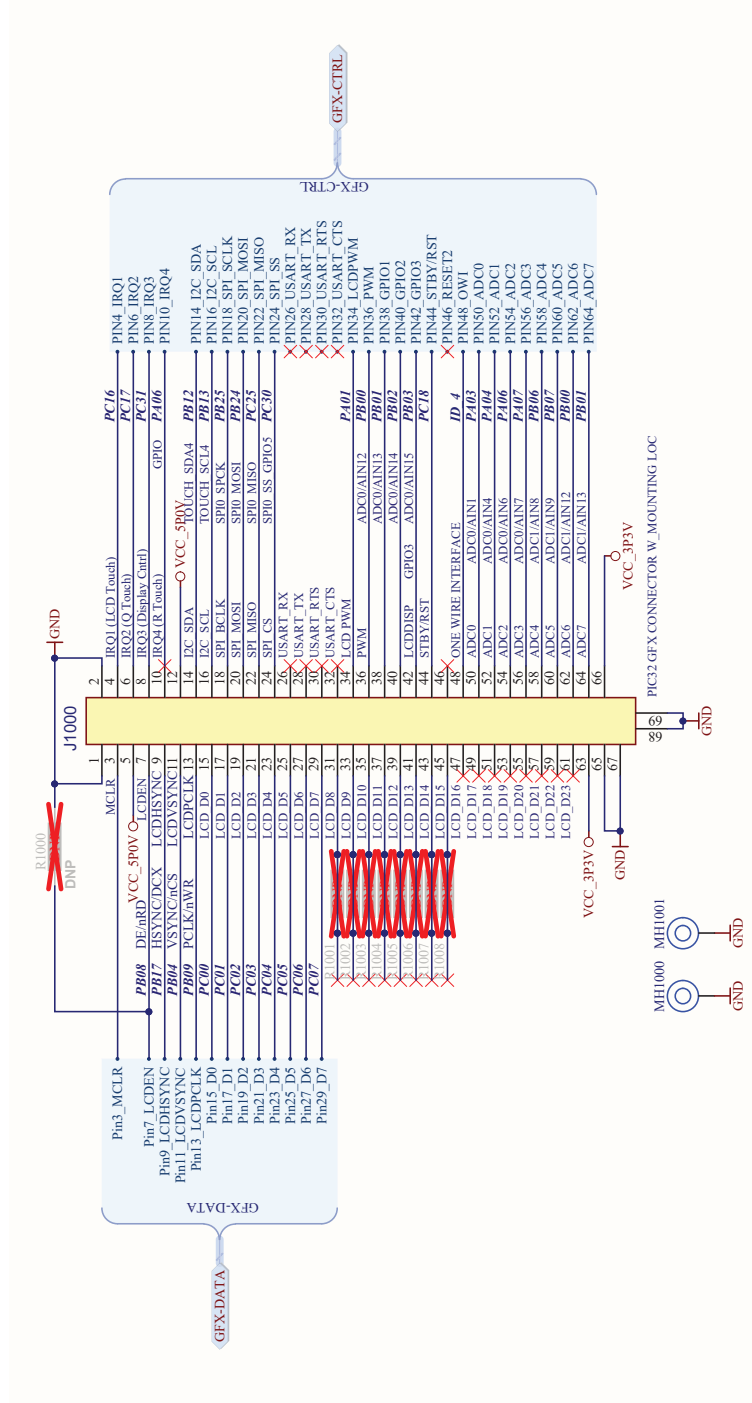












## 2.2 Bill of Materials

| Qty | Designator   | Value                          | Description  |
|-----|--|--------------------------------|--|
| 1   | C201   | 22uF                           | Ceramic capacitor, SMD 1206, X5R, 25V, 10%   |
| 1   | C202   | 2.2uF                          | Ceramic capacitor, SMD 0805, X5R, 25V, 10%   |
| 3   | C203, C204, C806   | 4.7uF                          | Ceramic capacitor, SMD 0805, X5R, 25V, ±10 %   |
| 5   | C205, C210, C211, C218, C219   | 1uF                            | CAP CER 1UF 16V 10% X5R 0603   |
| 7   | C206, C207, C212, C214, C216, C217, C220   | 0.1uF                          | CAP CER 0.1UF 50V 10% X7R 0402   |
| 1   | C208   | 4.7nF                          | Ceramic capacitor, SMD 0402, X7R, 25V, +/-10%  |
| 1   | C209   | 100uF/16V                      | Ceramic capacitor, SMD 1210, X5R, 16V, 20%   |
| 4   | C213, C215, C401, C402   | 10uF/10V                       | Ceramic capacitor, SMD 0603, X5R, 10V, 10UF ±20%   |
| 3   | C301, C302, C307   | 1 nF C0G                       | Ceramic capacitor, SMD 0402, C0G, 50V, +/-5%   |
| 1   | C303   | 10p                            | Ceramic capacitor, SMD 0402, NP0, 50V, +/-5%   |
| 2   | C304, C309   | 22p                            | Ceramic capacitor, SMD 0402, NP0, 50V, +/-5%   |
| 30  | C305, C310, C311, C312, C313, C400, C403, C404, C405, C407, C408, C409, C410, C411, C412, C413, C414, C415, C416, C417, C418, C421, C700, C701, C703, C801, C803, C804, C805, C900 | 100n                           | Ceramic capacitor, SMD 0402, X7R, 16V, +/-10%  |
| 4   | C306, C308, C314, C315   | 2.2uF                          | Ceramic capacitor, SMD 0402, X5R, 6.3V, +/-20%   |
| 1   | C406   | 4.7uF                          | Ceramic capacitor, SMD 0603, X5R, 10V, 10% (de31036)                                     |
| 1   | C419   | 100pF                          | Ceramic Capacitor, SMD 0402, COG, 50V, +/-5%   |
| 1   | C702   | 10uF                           | Ceramic capacitor, SMD 0805, X5R, 10V, 10 %, (de19441)                                   |
| 1   | C800   | 15p                            | Ceramic capacitor, SMD 0402, NP0, 50V, +/-5%   |
| 2   | D200, D300   | TPD3E001DRLR                   | TVS DIODE LOW-CAP 3-CH ESD-Protection for HS Data Interfaces SOT553                      |
| 4   | D201, D202, D203, D204   | MBR230LSFT1                    | 2A, 30V,Vf=0.43V, Schottky diode ,SOD-123FL  |
| 1   | D301   | EL17-21SYGC                    | LED, Green, Wave length=575nm, SMD 0805, ±70°  |
| 3   | D302, D400, D401   | EL17-21UYC/A3                  | LED, Yellow, Wave length=591nm, SMD 0805, ±70°   |
| 1   | D900   | EL17-21SURC                    | LED, Red, Wave length=639nm, SMD 0805, ±70°  |
| 4   | E1, E2, E3, E4   | SJ-5076                        | 2.8mm adhesive feet,diam 8.0mm   |
| 1   | J200   | ZX62D-AB-5P8                   | Micro USB AB Connector, Standard SMT + DIP   |
| 1   | J201   | NEB 21 R                       | Through hole DC jack 2.1mm, 12V, 3A  |
| 1   | J202   | 1125-1202S0R138R1              | Pin header, 2x2, Right Angle, 2.54mm, THT  |
| 1   | J203   | Pin header 1x2 RA              | 1x2 pin header, right angle, 2.54 mm pitch, THT  |
| 1   | J300   | CONN USB MICRO B RECPT SMT R/A | micro B USB 2.0 Receptacle Connector 5 Position Surface Mount, Right Angle; Through Hole |
| 1   | J401   | MTSW-103-08-L-S-276            | 1x3 pin header, 2.54 mm pitch, THM   |
| 2   | J500, J504   | SSQ-108-21-F-S                 | 1x8 receptacle pin header, low insertion force, 2.54mm pitch THM, Pin in Paste           |
| 1   | J501   | SSQ-106-21-F-S                 | 1x6 receptacle pin header, 2.54mm pitch THM  |
| 1   | J502   | HMTSW-103-23-F-D-237           | 2x3 pin header, 2.54mm pitch, Pin-in-Paste THM   |
| 1   | J503   | SSQ-110-21-F-S                 | 1x10 receptacle pin header, low insertion force, 2.54mm pitch THM, Pin in Paste          |
| 1   | J600   | 1125-1103S0S113R1              | 1x3 pin Header, 2.54mm pitch, TH   |
| 2   | J601, J902   | HMTSW-110-23-F-D-237           | 2x10 pin header, 2.54mm pitch, Pin-in-Paste THM  |

| .....continued |  |                                    |   |
|----------------|--|------------------------------------|---|
| Qty            | Designator   | Value                              | Description   |
| 2              | J602, J604   | 1125-1210S0R138R1                  | Pin header, 2x10, Right Angle, 2.54mm, THM  |
| 1              | J700   | 1125-1102S0S113R1                  | 1x2 pin header, 2.54mm pitch, Pin-in-Paste THM  |
| 1              | J704   | DM3AT-SF-PEJM5                     | Micro SD Card Connector, (8 + 2) Position Push - Push, SMT, Right Angle Gold  |
| 2              | J800, J802   | SLM-112-01-L-S                     | 1x12 - THM - Female Receptacle - 0.05 pitch   |
| 2              | J801, J803   | SLM-103-01-L-S                     | 1x3 - THM - Female Receptacle - 0.05 pitch  |
| 1              | J804   | RT Pin Header 1X3                  | 1x3 pin header, 2.54 mm pitch, Right angle THM  |
| 2              | J900, J901   | 610-91-08GB00                      | PINREX, 2.54mm 1x8 Female Header Straight, THM, H=8.5mm, Gold Flash, Black Insulator  |
| 1              | J903   | HMTSW-106-23-F-D-237               | 2x6 pin header, 2.54mm pitch, Pin-in-Paste, 1mm hole  |
| 1              | J1000  | PIC32 GFX CONNECTOR W_MOUNTING LOC | PIC32 GFX CONNECTOR W_MOUNTING LOC_2199230-3  |
| 3              | JS203, JS401, JS700  | SNT-100-BK-G                       | Jumper cap for 2.54mm pinheader   |
| 1              | L200   | XAL4020-222ME                      | 2.2µH Shielded Power Inductor, 4x4x2mm, Isat=5.6A , Irms=4.0A , DCR=35.2mΩ  |
| 6              | L201, L202, L203, L300, L301, L400   | BLM18PG471SN1                      | SMD RF inductor 0603. Z=470Ohm (@100MHz), Max R(dc)=0.65Ohm, Max current=1A   |
| 1              | L401   | LQH3NPN100MJ0                      | 10uH power inductor, Isat = 560mA , Itemp = 710mA, Rdc = 0.360ohm   |
| 2              | MH1000, MH1001   | ROUND SMT STANDOFF M2.5 H2.5mm     | Round Standoff Threaded M2.5x0.45 Steel 0.098" (H2.50mm)  |
| 2              | Q200, Q300   | IRLML5203PBF                       | P-ch. MOSFET. -30V, -3.0A continuous, -24A Peak. RDS(ON)=0.098Ohm@VGS=-10V, RDS(ON)=0.165Ohm@VGS=-4.5V, -2.5V<VGS(th)<-1.0V |
| 1              | Q201   | AO3413                             | P-CH MOSFET, SOT-23, 20V, 3A, Rds(on)=0.097mOhm@3A, 4.5V  |
| 1              | Q202   | FDN304P                            | P-Channel Power MOSFET 20V 2.4A cont 10A peak   |
| 1              | Q203   | FDC6327C                           | Dual N/P-ch MOSFET, 20V, 2.7A/-1.9A cont, 8A/-8A pulse, RDS(ON)<0.08/0.170hm@VGS=4.5V, VGS(th)<1.5/-1.5V, SSOT6             |
| 59             | R200, R213, R214, R301, R302, R303, R304, R305, R306, R307, R317, R323, R325, R340, R342, R402, R403, R404, R405, R406, R407, R408, R409, R411, R422, R423, R425, R429, R430, R431, R432, R433, R434, R435, R436, R437, R438, R440, R443, R446, R449, R450, R451, R452, R454, R455, R456, R457, R462, R463, R464, R466, R471, R472, R473, R500, R800, R801, R903 | 0R                                 | RES 0.0 OHM 1/16W 0402 SMD  |
| 2              | R201, R802   | 1M                                 | Thick film resistor, SMD 0402, 1/16W, 1%  |
| 10             | R202, R203, R400, R401, R700, R705, R706, R707, R709, R805   | 10k                                | Thick film resistor, SMD 0402, 1/16W, 1%  |
| 2              | R204, R221   | 2.2R                               | Thick film resistor, SMD 0603, 1/10W, 1%  |
| 1              | R205   | 16k                                | Thick film resistor, SMD 0402, 1/16W, 1%  |
| 1              | R206   | 30k                                | Thick film resistor, SMD 0402, 1/16W, 1%  |
| 21             | R207, R309, R310, R311, R341, R343, R412, R413, R414, R415, R416, R417, R418, R419, R420, R421, R427, R428, R478, R479, R710   | 1k                                 | Thick film resistor, SMD 0402, 1/16W, 1%  |
| 1              | R208   | RES 19.6K OHM 1% 1/16W 0402        | RES 19.6K OHM 1% 1/16W 0402   |
| 11             | R209, R212, R222, R313, R315, R701, R702, R703, R704, R708, R900   | 100k                               | Thick film resistor, SMD 0402, 1/16W, 1%  |
| 1              | R210   | RES 2.49K OHM 1% 1/16W 0402        | RES 2.49K OHM 1% 1/16W 0402   |
| 1              | R211   | RES SMD 475 OHM 1% 1/16W 0402      | RES SMD 475 OHM 1% 1/16W 0402   |
| 2              | R215, R216   | 47k                                | Thick film resistor, SMD 0402, 1/16W, 1%  |

.....continued

| Qty | Designator   | Value                                      | Description   |
|-----|--|--|---|
| 1   | R220   | 4.7R                                       | Thick film resistor, SMD 0402, 1/16W, 1%                  |
| 3   | R300, R326, R328   | 1M   | Thick film resistor, SMD 0402, 1/16W, 1%                  |
| 17  | R308, R318, R319, R320, R321, R322, R327, R329, R330, R331, R332, R333, R439, R465, R467, R470, R474 | 330R                                       | Thick film resistor, SMD 0402, 1/16W, 1%                  |
| 13  | R312, R314, R324, R424, R426, R442, R444, R445, R447, R448, R461, R468, R475                         | 39R  | Thick film resistor, SMD 0402, 1/16W, 1%                  |
| 1   | R316   | 6.81k                                      | Thick film resistor, SMD 0402, 1/16W, 1%                  |
| 1   | R410   | 100R                                       | Thick film resistor, SMD 0402, 1/16W, 1%                  |
| 1   | R469   | 2.2k                                       | Thick film resistor, SMD 0402, 1/16W, 1%                  |
| 2   | R803, R804   | 62R  | Thick film resistor, SMD 1210, 0.5W, 1%                   |
| 2   | S1, S2   | M2.5x5mm Pan Phillip Screw                 | M2.5x5mm Pan Phillip Screw                                |
| 3   | SW400, SW401, SW402  | TS604VM1-035CR                             | SWITCH, SMD, 260gf, 6.4mm X 6.2mm                         |
| 1   | U200   | MCHP BUCK REGULATOR 12V 6A MIC24052 QFN-28 | MCHP BUCK REGULATOR 12V 6A MIC24052 QFN-28                |
| 2   | U201, U202   | MIC5528-3.3YMT                             | LDO 3.3V 0.5A 6TDFN                                       |
| 1   | U300   | AT32UC3A4256J-C1UR                         | EDBG controller   |
| 1   | U400   | MCP6001UT-I/OT                             | Single Op Amplifier, 1MHz, Low power, SOT-23-5            |
| 1   | U401   | ATSAME54P20A                               | Atmel 32-bit RISC MCU                                     |
| 1   | U700   | SST26VF064B-104ISM                         | 2.5V/3.0V 64 Mbit Serial Quad I/O (SQI) Flash Memory      |
| 1   | U701   | AT24MAC402-MAHM-T                          | 2kbit I2C EEPROM, single EU1-48 MAC, 1.7-5.5V, 2x3mm UDFN |
| 1   | U800   | ATA6563                                    | High-speed CAN Transceiver w Standby Mode CAN FD Ready    |
| 1   | U900   | MCP9808                                    | ±0.5°C Maximum Accuracy Digital Temp Sensor, I2C/SMBus    |
| 1   | XC300  | 12.00MHz                                   | Fox FQ5032B 12.0000MHz 20pF SMD crystal 738B-12           |
| 1   | Y400   | OSCILLATOR 32.768KHz DSC60xxL3.2xW2.5H0.90 | OSCILLATOR 32.768KHz 1.71-3.3V DSC60xxL3.2xW2.5H0.9       |
| 1   | Y401   | OSCILLATOR 12.000MHz DSC60xxL3.2xW2.5H0.90 | OSCILLATOR 12.000MHz 1.71-3.3V DSC60xxL3.2xW2.5H0.9       |
| 1   | Y800   | OSCILLATOR 50MHz DSC61xxL3.2xW2.5H0.90     | OSCILLATOR 50MHz 1.71-3.3V DSC60xxL3.2xW2.5H0.9           |

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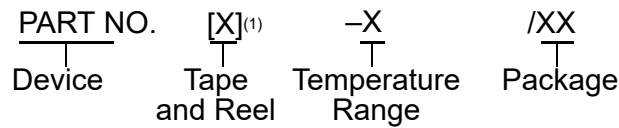
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|                     |   |                               |
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| Tape & Reel Option: | Blank   | = Tube                        |
|                     | T   | = Tape & Reel                 |
| Temperature Range:  | I   | = -40°C to +85°C (Industrial) |
|                     | E   | = -40°C to +125°C (Extended)  |
| Package:            | AA  | = Package AA                  |
|                     | BB  | = Package BB                  |

Examples:

- MCPXXXXXAT-E/AA: Tape and Reel, Extended temperature, XAA package
- MCPXXXXXBT-E/BB: Tape and Reel Extended temperature, XBB package

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