EV06X38A/EV09H35A

PIC32CX SG41/SG61 Curiosity Ultra User Guide

Preface

The Microchip® PIC32CX SG41 and PIC32CX SG61 Curiosity Ultra evaluation kits are hardware platforms for evaluating the PIC32CX SG41/SG60/SG61 microcontrollers (MCUs). Each evaluation kit is supported by the MPLAB® X Integrated Development Environment (IDE) and MPLAB Harmony v3 featuring application examples.

The Curiosity Ultra evaluation kits include an on-board embedded debugger to program or debug the target microcontroller. This enables an easy start to a project and provides application examples that can be used in the design of a custom application.

The Curiosity Ultra evaluation kits provide easy access to the features of the microcontroller, and are integrated with Arduino Uno, mikroBUS™, and extension headers to interface with Microchip extension boards for a rapid prototyping and expanded functionality. The PIC32CX SG41/PIC32CX SG61 Curiosity Ultra evaluation kit is shown below:
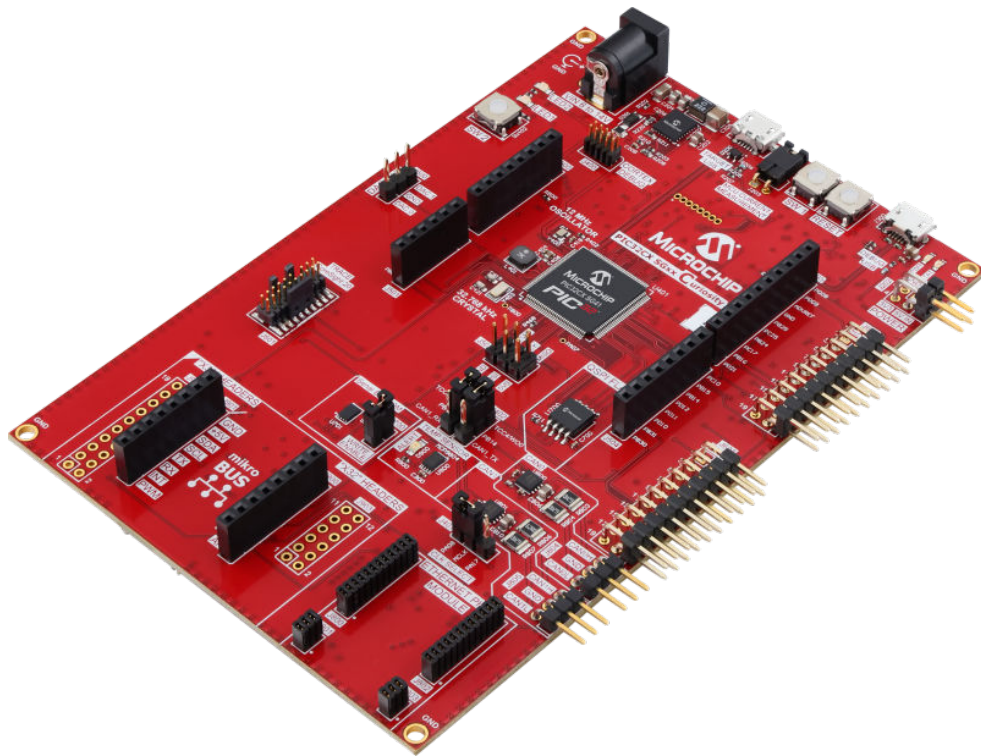
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1. Introduction

1.1 Features

The key features of the board are as follows:

- PIC32CX1025SG41128 or PIC32CX1025SG61128 microcontrollers
- One mechanical reset button
- Two mechanical programmable buttons
- Two user LEDs
- 32.768 kHz crystal
- 12 MHz oscillator
- USB interface, Host or Device
- 64 Mbit Quad SPI Flash
- AT24MAC402 Serial EEPROM with EUI-48™ MAC address
- Ethernet 10/100 Mbps
    - RMII Interface with modular PHY Header
- SD/SDIO card connector
- Two CAN interfaces with on-board transceivers
- I²C-based temperature sensor
- DAC Output Header
- mikroBUS header connector
- Two extension headers compatible with a wide range of Microchip extension boards
- Arduino Uno header connectors
- CoreSight 10 connector
    - 10-pin Cortex® Debug header (SWD)
- CoreSight 20 connector
    - 20-pin Cortex Debug + ETM Connector (SWD and 4-bit Trace)
- Embedded debugger (PKoB4)
    - Programming and debugging
    - Virtual COM port (CDC)
- USB powered
- Power Header and Barrel Jack connector for external power sources
- Supported in MPLAB Harmony v3

1.2   Overview of Available Kits

The part numbers of the two evaluation kits are as follows:

- PIC32CX SG41 Curiosity Ultra: EV06X38A
- PIC32CX SG61 Curiosity Ultra: EV09H35A

The evaluation kit offers a set of features that enables the user to start with the microcontroller peripherals immediately and to obtain an understanding of how to integrate the device in their design.

Figure 1-1. PIC32CX SG41/SG61Curiosity Ultra Evaluation Board Layout (Top View)
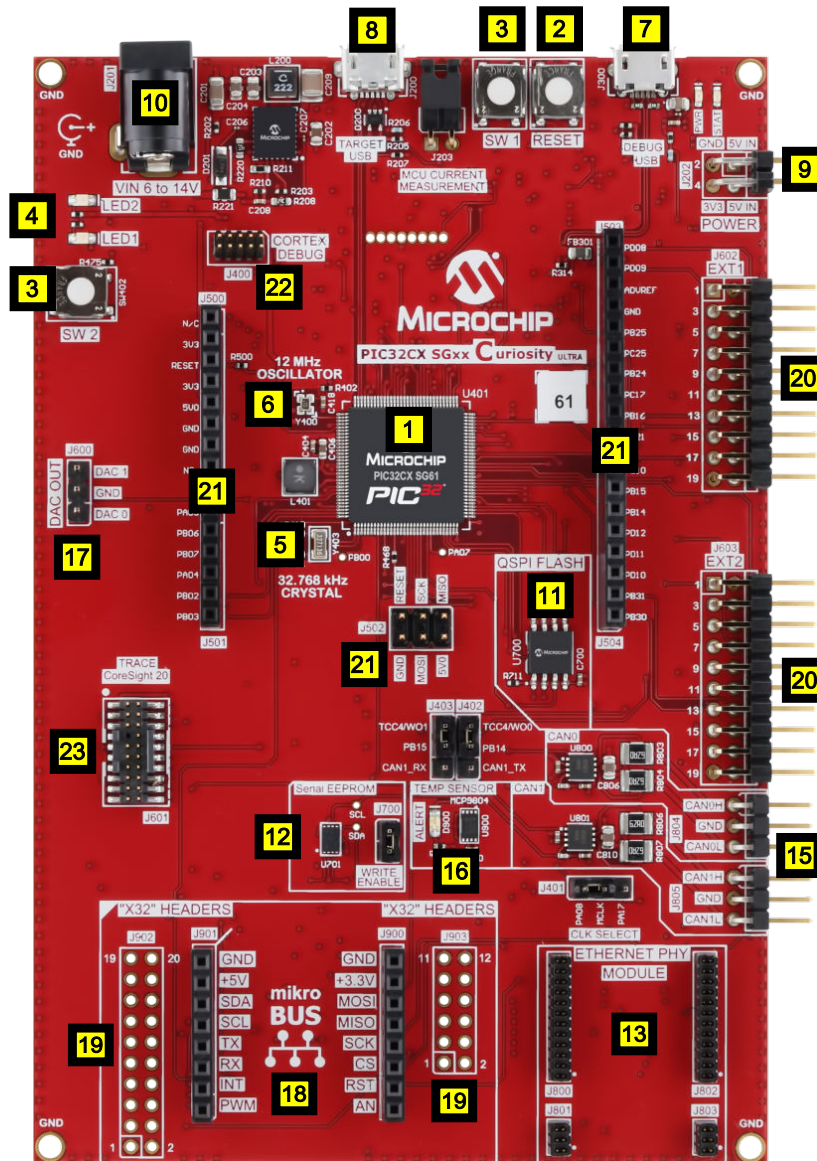
Figure 1-2. PIC32CX SG41/SG61Curiosity Ultra Evaluation Board Layout (Bottom View)
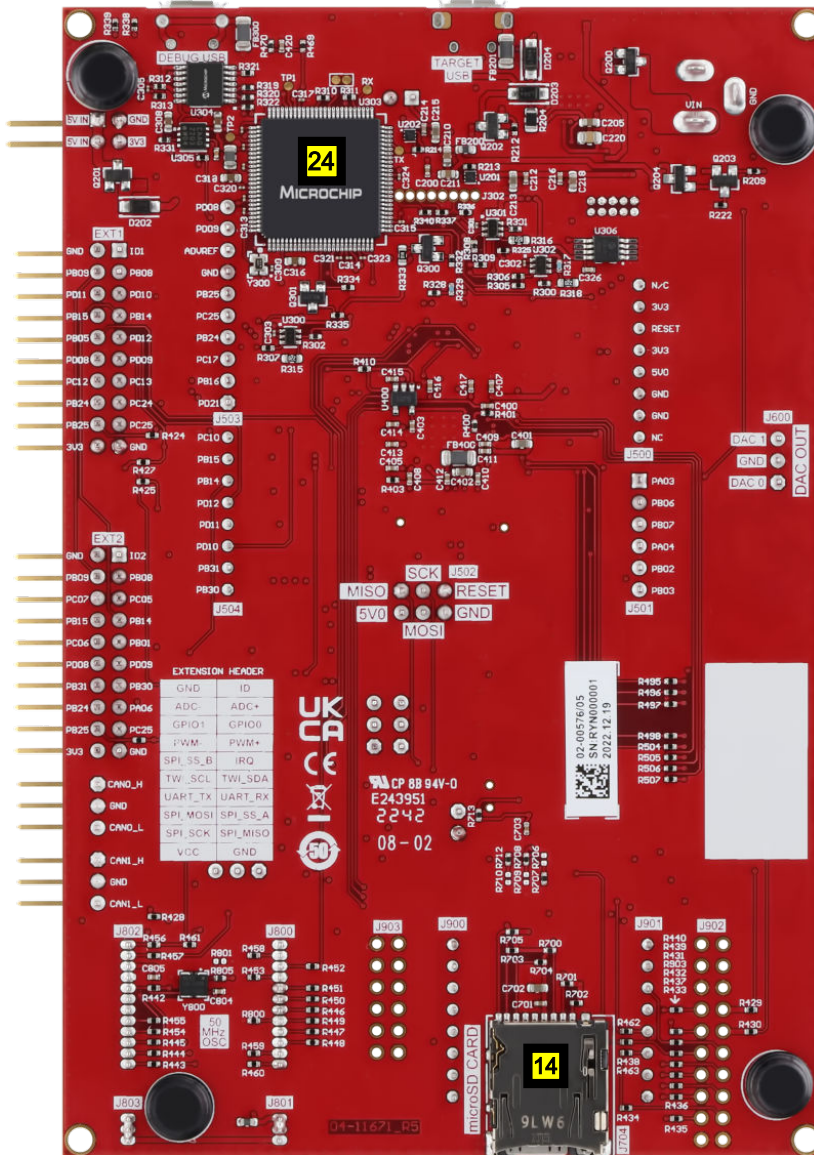
Table 1-1. PIC32CX SG41/SG61 Curiosity Ultra Board Features and Location

Number	Item Description
1	PIC32CX SG41 / PIC32X SG61 Target MCU
2	Reset button
3	Programmable buttons
4	User LEDs
5	32.768 kHz crystal
6	12 MHz oscillator
7	USB On-board Debugger Interface
8	USB Target Interface, Host and Device
9	Power Header (External power source)
10	Power Barrel Jack connector (External power source)
11	64 Mbit Quad SPI Flash
12	AT24MAC402 Serial EEPROM
13	Ethernet Interface
14	SD Card connector
15	CAN Interfaces
16	Temperature Sensor
17	DAC Output header
18	mikroBUS header connector
19	X32 Audio Interface Headers
20	Extension headers
21	Arduino Uno header connectors
22	10-pin Cortex Debug header (SWD)
23	20-pin Cortex Debug + ETM Connector
24	Embedded Debugger MCU (PKoB4)

Table 1-2. PIC32CX SG41/SG61 Microchip Total System Solutions (TSS)

TSS Components	Designator	Quantity(per board)	Function
PIC32CX1025SG41128-I/Z2X PIC32CX1025SG61128-E/XCB	U401	1[1]	Target MCU
SST26VF064BA-104I/SM	U700	1	Serial Quad I/O Flash Memory
AT24MAC402-MAHM-T	U701	1	Serial EEPROM with EIA-48 MAC Address
ATA6563-GBQW1	U800, U801	2	CAN Transceivers
MCP9804T-E/MC	U900	1	Temperature Sensor
DSC6011HI1B-012.0000	Y300, Y400	2	PKoB4 Oscillator and Target MCU Primary Oscillator (12 MHz)
VMK3-9001-32K7680000	Y403	1	Secondary Oscillator - 32.768 kHz
DSC1001CI2-050.0000T	Y800	1	Ethernet Oscillator
TN2106K1-G	Q300, Q301	2	PKoB4 - VDD and VPP Switching

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TSS Components	**Designator**	**Quantity(per board)**	**Function**
MIC24052YJL-TR	U200	1	6V to 14V Input, 5V Output Switching Regulator
MIC5528-3.3YMT-TR	U201, U202	2	3.3V LDO for Peripherals and MCU
ATSAME70N21B-ANT	U303	1	PKoB4 - MCU
MIC2042-1YTS	U304	1	PKoB4 - 5V Switching Regulator
MCP1727-3302E/MF	U305	1	PKoB4 - LDO 5V in, 3.3V out
24LC256T-I/MS	U306	1	PKoB4 - EEPROM
MCP6231T-E/OT	U400	1	OPAMP, AVREF Generator

Note:
1. Only one target MCU per kit.

2. Getting Started

Follow these steps to explore the Curiosity Ultra platform:

1. Download MPLABX IDE.
2. Launch MPLAB X IDE.
3. Connect the DEBUG USB port on the kit to the computer using a USB cable (Standard-A to Micro-B, or Micro-AB).

Note: When the Curiosity Ultra MCU kit is connected to the computer for the first time, the operating system will install the software driver. The software driver supports both 32-bit and 64-bit versions of Microsoft® Windows®XP, Windows Vista®, Windows 7, Windows 8, and Windows 10.

When the Curiosity Ultra MCU board is powered, the power LED (green) will glow and MPLAB X IDE will auto-detect the specific Curiosity Ultra MCU that is connected to it. MPLAB X IDE will present relevant information, such as data sheets and kit documentation.

The PIC32CX SG41/SG61 devices can be programmed and debugged by the on-board embedded debugger (PKoB4), therefore an external programmer or debugger tool is not required.

Note: Users can connect external debugger tools using the Cortex-M Debugger Interface header.

3. Curiosity Ultra

The Curiosity Ultra is a user-friendly rapid prototyping platform. It is supported with both MPLAB X IDE and the MPLAB Harmony v3 software development framework.

The Curiosity Ultra evaluation kits support a wide range of extension boards which are connected through a set of standardized headers and connectors.

3.1 Embedded Debugger (PKoB4)

The Curiosity Ultra contains an Embedded Debugger (PKoB4) for on-board debugging. The PKoB4 is a USB composite device with the following interfaces:

- Debugger (SWD)
- Virtual COM port (CDC)

Together with MPLAB X IDE, the PKoB4 debugger interface can program and debug the microcontroller. On the PIC32CX SG41/SG61 Curiosity Ultra, the SWD interface is connected between the PKoB4 and the microcontroller.

The virtual COM Port is connected to a UART on the microcontroller and provides a straightforward 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 microcontroller must match the settings given in the terminal software.

3.1.1 PKoB4 LEDs Status

The PKoB4 has two fixed color LEDs: the Power LED (PWD) is green, and the Status LED (STAT) is yellow. The expected start-up LED sequence for the PKoB4 debugger is steady on Green, and yellow is off.

The following tables describe the normal and error modes for the LEDs.

Table 3-1. Normal Mode LEDs Description

LED	Status	Description
Power (PWR)	ON	Power is connected
Status (STAT)	ON (or pulsing activity)	Debugger is busy (Activity during an operation)

Table 3-2. Error LEDs Description

LED	Status	Description
STAT	ON 3 seconds	Bootloader problem accessing the serial EEPROM
STAT	ON 10 seconds	API commands cannot be processed by the Bootloader
PWR and STAT	Fast blink (alternating)	A runtime exception occurred in the firmware update
PWR and STAT	Fast blink (in tandem)	A runtime exception occurred in the Bootloader

3.1.2 Serial Wire Debug (SWD)

The Serial Wire Debug uses two pins to communicate with the target.

Table 3-3. Serial Wire Debug (SWD) Connection

Schematics Text	MCU Pin	Function	Shared Functionality
TARGET_RESETn	$\overline{\text{RESET}}$	RESET	Cortex Debug, Trace, RESET button, Arduino
SWCLK	PA30	SWCLK	Cortex Debug, Trace
SWDIO	PA31	SWDIO	Cortex Debug, Trace

3.1.3 Virtual COM Port (CDC)

The Embedded Debugger acts as a virtual COM port gateway using one of the PIC32CX SG41/SG61 UARTs.

Table 3-4. Virtual COM Port Connection

Schematics Text	MCU Pin	Function	Shared Functionality
PKoB4_VCP_RXD4	PB12	SERCOM4/PAD[0] UART TX	-
PKoB4_VCP_TXD4	PB13	SERCOM4/PAD[1] UART RX	-

4. Hardware User Guide

4.1 Power Sources

The PIC32CX SG41/SG61 Curiosity Ultra evaluation kit can be powered by these power sources:

- Debug USB (PKoB4)
- Target USB
- External 5V power header
- External 6V to 14V barrel jack connector

The power input requirements are provided in the following table.

**Table 4-1. Power Sources for PIC32CX SG41/SG61 Curiosity Ultra**

Power Input	Voltage Requirements	Silkscreen Text
Debug USB	4.75V to 5.25V (according to USB specifications).	DEBUG USB
Target USB	4.75V to 5.25V (according to USB specifications).	TARGET USB
External Power Header	4.3V to 5.5V if a USB Host operation is not required. 5V ±2% (±100 mV) for USB Host operation.	POWER
External Jack Connector	6V to 14V if a USB Host operation is not required.	VIN 6 to 14V

Note: An external power source is required when 500 mA from a USB connector is not enough to power the board and its optional extension boards. The connected USB device in a USB Host application may exceed this limit.

The evaluation kit has the following on-board 3.3V voltage regulators:

- One for the MCU
- One for the on-board peripherals
- One for the Embedded Debugger (PKoB4)

Figure 4-1. Power Supply Block Diagram
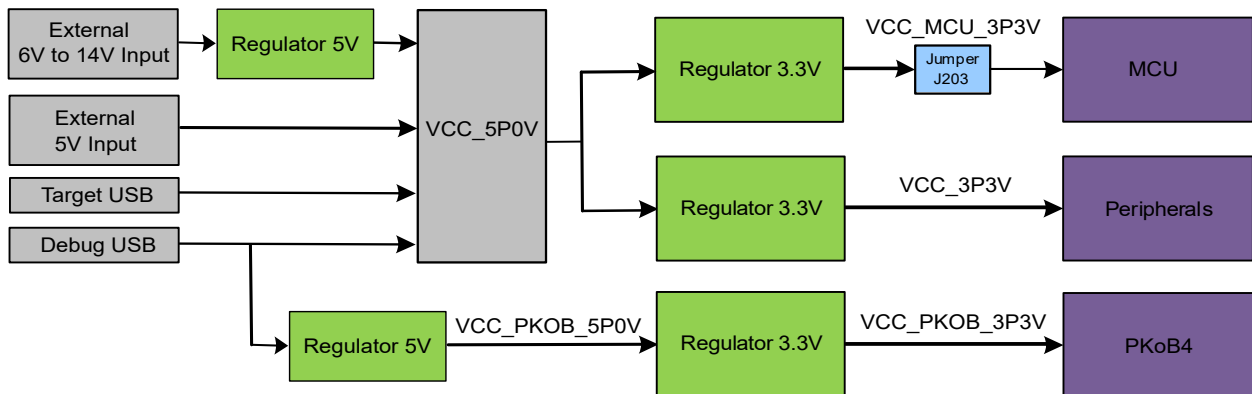
4.2 Headers and Connectors

The following sections describe the implementation of different headers and connectors on the PIC32CX SG41/SG61 Curiosity Ultra evaluation kit and their connections to the PIC32CX SG41/SG61 microcontroller.

The tables in the following sections describe which signals are shared between the headers and on-board functionality.

4.2.1 Curiosity Ultra Power Header

The power header (POWER) can be used to connect an external 5V power supply to the PIC32CX SG41/SG61 Curiosity Ultra evaluation kit.

The power header can also be used as a 3.3V supply for external peripherals or extension boards. Care must be taken not to exceed the total current limitation of the on-board regulator when using the 3.3V pin.

Table 4-2. Curiosity Ultra Power Header (J202)

Pin Number	Pin Name	Function	Pin Description
1	5VIN	VCC_5P0V_IN	External 5V input
2	GND	GND	Ground
3	5VIN	VCC_5P0V_IN	External 5V input
4	3V3	VCC_3P3V	Regulated 3.3V (output, used as main power supply for the kit)

4.2.2 Extension Headers

All Curiosity Ultra evaluation kits have several dual row, 20-pin, 100 mil extension headers (with a pitch of 2.54 mm), which can be used to connect to a variety of Microchip extension boards, or to access the pins of the target.

The Curiosity Ultra evaluation kits have male headers. The extension boards have their female counterparts. All pins are not always connected, and the connected pins follow the defined pin-out descriptions given in the following table.

Table 4-3. Extension Header

Pin Number	Pin Name	Pin Description
1	ID_EXTx	Communication line to the ID chip on an extension board EXTx
2	GND	Ground
3	ADC(+)	Analog-to-Digital Converter (ADC) alternatively positive part of differential ADC
4	ADC(-)	ADC alternatively negative part of differential ADC
5	GPIO	General purpose I/O
6	GPIO	General purpose I/O
7	PWM(+)	Pulse-Width Modulator (PWM) alternatively positive part of differential PWM
8	PWM(-)	PWM alternatively negative part of differential PWM
9	IRQ/GPIO	Interrupt Request Line and general purpose I/O
10	SPI_SS_B/GPIO	SPI Select and general purpose I/O
11	TWI_SDA	Data line for I²C interface
12	TWI_SCL	Clock line for I²C interface
13	UART_RX	Receiver line of target device UART
14	UART_TX	Transmitter line of target device UART
15	SPI_SS_A	SPI Select. Must preferably be unique.
16	SPI_MOSI	Host out Client in line of serial peripheral interface

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Pin Number	Pin Name	Pin Description
17	SPI_MISO	Host in Client out line of serial peripheral interface
18	SPI_SCK	Clock for SPI.
19	GND	Ground
20	VCC	Power for extension board

The PIC32CX SG41/SG61 extension headers, EXT1 and EXT2, offer access to the I/O of the microcontroller to expand the board by connecting extensions. These headers are based on the standard extension header and are specified in the following tables.

Table 4-4. Extension Header EXT1 (J602)

EXT1 Pin	MCU Pin	Function	Shared Functionality
1 [ID]	-	ID_EXT1	Communication line to the ID Chip on the extension board
2 [GND]	-	GND	Ground
3 [ADC(+)]	PB08	ADC0/AIN[2] , ADC1/AIN[0]	EXT2
4 [ADC(-)]	PB09	ADC0/AIN[3] , ADC1/AIN[1]	EXT2
5 [GPIO1]	PD10	GPIO	Arduino
6 [GPIO2]	PD11	GPIO	Arduino
7 [PWM(+)]	PB14	TCC4/WO[0], TCC0/WO[2], TC5/WO[0]	EXT2, Arduino, CAN1 TX (J402)
8 [PWM(-)]	PB15	TCC4/WO[1], TCC0/WO[3], TC5/WO[1]	EXT2, Arduino, CAN1 RX (J403)
9 [IRQ/GPIO]	PD12	EXTINT[7] / GPIO	Arduino
10 [SPI_SS_B/GPIO]	PB05	GPIO	-
11 [TWI_SDA]	PD09	SERCOM6/PAD[0]I²C SDA	EXT2, mikroBUS, Arduino, Audio, Temperature Sensor, Serial EEPROM
12 [TWI_SCL]	PD08	SERCOM6/PAD[1]I²C SCL	EXT2, mikroBUS, Arduino, Audio, Temperature Sensor, Serial EEPROM
13 [USART_RX]	PC13	SERCOM7/PAD[1]UART RX	mikroBUS, Audio
14 [USART_TX]	PC12	SERCOM7/PAD[0]UART TX	mikroBUS, Audio
15 [SPI_SS_A]	PC24	GPIO	Trace
16 [SPI_MOSI]	PB24	SERCOM0/PAD[0] MOSI	EXT2, mikroBUS, Ethernet, Arduino
17 [SPI_MISO]	PC25	SERCOM0/PAD[3] MISO	EXT2, mikroBUS, Ethernet, Arduino, Trace
18 [SPI_SCK]	PB25	SERCOM0/PAD[1] SCK	EXT2, mikroBUS, Ethernet, Arduino
19 [GND]	-	GND	Ground
20 [VCC]	-	VCC_3P3V	Power for extension Board

Table 4-5. Extension Header EXT2 (J603)

EXT2 Pin	MCU Pin	Function	Shared Functionality
1 [ID]	-	ID_EXT2	Communication line to the ID Chip on the extension board
2 [GND]	-	GND	Ground
3 [ADC(+)]	PB08	ADC0/AIN[2] or ADC1/AIN[0]	EXT1
4 [ADC(-)]	PB09	ADC0/AIN[3] or ADC1/AIN[1]	EXT1

EXT2 Pin	MCU Pin	Function	Shared Functionality
..........continued			
5 [GPIO1]	PC05	GPIO	-
6 [GPIO2]	PC07	GPIO	-
7 [PWM(+)]	PB14	TCC4/WO[0], TCC0/WO[2], TC5/WO[0]	EXT1, Arduino, CAN1 TX (J402)
8 [PWM(-)]	PB15	TCC4/WO[1], TCC0/WO[3], TC5/WO[1]	EXT1, Arduino, CAN1 RX (J403)
9 [IRQ/GPIO]	PB01	EIC/EXTINT[1] / GPIO	-
10 [SPI_SS_B/GPIO]	PC06	GPIO	-
11 [TWI_SDA]	PD09	SERCOM6/PAD[0]I²C SDA	EXT1, mikroBUS, Arduino, Audio, Temperature Sensor, Serial EEPROM
12 [TWI_SCL]	PD08	SERCOM6/PAD[1]I²C SCL	EXT1, mikroBUS, Arduino, Audio, Temperature Sensor, Serial EEPROM
13 [USART_RX]	PB30	SERCOM5/PAD[1]UART RX	Arduino, Cortex Debug, Trace
14 [USART_TX]	PB31	SERCOM5/PAD[0]UART TX	Arduino
15 [SPI_SS_A]	PA06	GPIO	-
16 [SPI_MOSI]	PB24	SERCOM0/PAD[0] MOSI	EXT1, mikroBUS, Ethernet, Arduino
17 [SPI_MISO]	PC25	SERCOM0/PAD[3] MISO	EXT1, mikroBUS, Ethernet, Arduino, Trace
18 [SPI_SCK]	PB25	SERCOM0/PAD[1] SCK	EXT1, mikroBUS, Ethernet, Arduino
19 [GND]	-	GND	Ground
20 [VCC]	-	VCC_3P3V	Power for extension Board

4.2.3 mikroBUS Header Connector

The mikroBUS socket is comprised of a pair of 1×8 female headers with a proprietary pin configuration and silkscreen markings.

The pinout (always laid out in the same order) consists of three groups of communication pins (SPI, UART and I^{2}C), five additional pins (PWM, interrupt, analog input, reset and chip select), and two power groups (+3.3V and 5V).

The following table provides the mikroBUS header details.

Table 4-6. mikroBUS Header Connector (J900/J901)

mikroBUS Pin	MCU Pin	Function	Shared Functionality
[AN]	PC03	ADC1/AIN[5]	-
[RST]	PC18	GPIO	Ethernet, Audio
[CS]	PC16	GPIO	-
[SCK]	PB25	SERCOM0/PAD[1] SCK	EXT1, EXT2, Ethernet, Arduino
[MISO]	PC25	SERCOM0/PAD[3] MISO	EXT1, EXT2, Ethernet, Arduino, Trace
[MOSI]	PB24	SERCOM0/PAD[0] MOSI	EXT1, EXT2, Ethernet, Arduino
[+3.3V]	-	VCC_3P3V	-
[GND]	-	GND	-
[PWM]	PB16	TC6/WO[0], TCC3/WO[0], TCC0/WO[4]	Arduino
[INT]	PC31	EIC/EXTINT[15]	-

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mikroBUS Pin	MCU Pin	Function	Shared Functionality
[RX]	PC13	SERCOM7/PAD[1]UART RX	EXT1, Audio
[TX]	PC12	SERCOM7/PAD[0]UART TX	EXT1, Audio
[SCL]	PD08	SERCOM6/PAD[1]I²C SCL	EXT1, EXT2, Arduino, Audio, Temperature Sensor, Serial EEPROM
[SDA]	PD09	SERCOM6/PAD[0]I²C SDA	EXT1, EXT2, Arduino, Audio, Temperature Sensor, Serial EEPROM
[+5V]	-	VCC_P5V0	-
[GND]	-	GND	Ground

4.2.4   Arduino Uno Header Connectors

The PIC32CX SG41/SG61 Curiosity Ultra evaluation kit implements the Arduino shield header connectors based on the Arduino Uno. All references to the Arduino pin names are considered from the official Arduino schematics of the Arduino Uno.

Tip: The pins on the Arduino Uno do not have the same functionality as on the shield connectors. Each shield must be checked for compatibility before it is connected.

Table 4-7. Power (J500)

J500 Pin	MCU Pin	Function	Shared Functionality
1 [RFU]	-	N/C	-
2 [IOREF]	-	VCC_3P3V	-
3 [RESET]	$\overline{\text{RESET}}$	TARGET_RESETn	PKoB4 SWD, Cortex Debug,Trace, RESET button
4 [3.3V]	-	VCC_3P3V	-
5 [5V]	-	VCC_P5V0	-
6 [GND]	-	GND	-
7 [GND]	-	GND	-
8 [VIN]	-	N/C	-

Table 4-8. Analog (J501)

J501 Pin (SHIELD_ANA)	MCU Pin	Function	Shared Functionality
1 [A0]	PA03	ADC0/AIN[1]	-
2 [A1]	PB06	ADC1/AIN[8]	-
3 [A2]	PB07	ADC1/AIN[9]	-
4 [A3]	PA04	ADC0/AIN[4]	-
5 [A4]	PB02	ADC0/AIN[14]	-
6 [A5]	PB03	ADC0/AIN[15]	-

Table 4-9. Digital Low (J504)

J504 Pin (SHIELD_DIG)	MCU Pin	Function	Shared Functionality
1 [RX/D0]	PB30	SERCOM5/PAD[1]UART RX	EXT2, Cortex Debug, Trace
2 [TX/D1]	PB31	SERCOM5/PAD[0]UART TX	EXT2
3 [D2]	PD10	GPIO	EXT1
4 [PWM/D3]	PD11	GPIO	EXT1
5 [D4]	PD12	GPIO	EXT1
6 [PWM/D5]	PB14	GPIO	EXT1, EXT2, CAN1 TX (J402)
7 [PWM/D6]	PB15	GPIO	EXT1, EXT2, CAN1 RX (J403)
8 [D7]	PC10	GPIO	-

Table 4-10. Digital High (J503)

J503 Pin (SHIELD_DIG)	MCU Pin	Function	Shared Functionality
1 [D8]	PD21	GPIO	-
2 [PWM/D9]	PB16	GPIO	mikroBUS
3 [PWM/D10]	PC17	GPIO	-
4 [PWM/D11]	PB24	SERCOM0/PAD[0] MOSI	EXT1, EXT2, Ethernet, mikroBUS
5 [D12]	PC25	SERCOM0/PAD[3] MISO	EXT1, EXT2, Ethernet, mikroBUS, Trace
6 [D13]	PB25	SERCOM0/PAD[1] SCK	EXT1, EXT2, Ethernet, mikroBUS
7 [GND]	-	GND	-
8 [AREF]	-	AREF Generator	-
9 [SDA/D14]	PD09	SERCOM6/PAD[0]I²C SDA	EXT1, EXT2, mikroBUS, Audio, Temperature Sensor, Serial EEPROM
10 [SCL/D15]	PD08	SERCOM6/PAD[1]I²C SCL	EXT1, EXT2, mikroBUS, Audio, Temperature Sensor, Serial EEPROM

Table 4-11. SPI (J502)

J502 Pin (SHIELD_DIG)	MCU Pin	Function	Shared Functionality
1 [MISO]	PC25	SERCOM0/PAD[3] MISO	EXT1, EXT2, Ethernet, mikroBUS, Trace
2 [5V]	-	VCC_P5V0	-
3 [SCK]	PB25	SERCOM0/PAD[1] SCK	EXT1, EXT2, Ethernet, mikroBUS
4 [MOSI]	PB24	SERCOM0/PAD[0] MOSI	EXT1, EXT2, Ethernet, mikroBUS
5 [RESET]	$\overline{\text{RESET}}$	TARGET_RESETn	PKoB4 SWD, Cortex Debug,Trace, RESET button
6 [GND]	-	GND	-

4.2.5 MCU Current Measurement Header

An angled 1x2, 100 mil pin-header (J203) marked with CURRENT MEASUREMENT is located at the upper edge of the Curiosity Ultra. All power to the PIC32CX SG41/SG61 is routed through this header. To measure the power consumption of the device, remove the jumper and replace it with an ammeter.

⚠ CAUTION	Removing the jumper from the pin-header while the kit is powered may cause the PIC32CX SG41/SG61 to be powered through its I/O pins. This may cause permanent damage to the device.

4.2.6 Cortex Debug Connector

The Curiosity Ultra has a 10-pin, 50-mil Cortex Debug header that can be used to attach external debug probes to the PIC32CX SG41/SG61.

Table 4-12. CoreSight 10 Connector (J400)

J400 Pin	MCU Pin	Function	Shared Functionality
1 [VCC]	-	VCC_3P3V	-
2 [SWDIO/TMS]	PA31	SWDIO	PKoB4 SWD, Trace
3 [GND]	-	GND	-
4 [SWCLK/TCK]	PA30	SWCLK	PKoB4 SWD, Trace
5 [GND]	-	GND	-
6 [SWO/TDO]	PB30	SWO	Arduino, EXT2, Trace
7 [KEY]	N/C	-	-
8 [NC/TDI]	N/C	-	-
9 [GNDDetect]	GND	GND	-
10 [nRESET]	RESET	TARGET_RESETn	PKoB4 SWD, Trace,RESET button, Arduino

4.2.7 Cortex Debug Connector with Trace (ETM)

The PIC32CX SG41/SG61 Curiosity Ultra evaluation kit implements a 20-pin, 50-mil Cortex Debug + ETM Connector with SWD and 4-bit parallel trace. The connector is keyed (pin 7 is removed). To use the parallel trace functionality, an external debugger with trace support and 20-pin Cortex Debug + ETM Connector pin-out must be used. The following table shows the connections on the kit.

Table 4-13. CoreSight 20 Connector (J601)

J601 Pin	MCU Pin	Function	Shared Functionality
1 [VTREF]	-	VCC_3P3V	-
2 [TMS/SWDIO]	PA31	SWDIO	PKoB4 SWD, Cortex Debug
3 [GND]	-	GND	-
4 [TCK/SWCLK]	PA30	SWCLK	PKoB4 SWD, Cortex Debug
5 [GND]	-	GND	-
6 [TDO/SWO]	PB30	SWO	Arduino, EXT2, Cortex Debug
7 [KEY]	N/C	-	-
8 [TDI]	N/C	-	-
9 [GND]	-	GND	-
10 [nRST]	RESET	TARGET_RESETn	PKoB4 SWD, Cortex Debug,RESET button, Arduino
11 [NC]	-	-	-
12 [RTCK/TRACECLK]	PC27	TRACECLK	
13 [NC]	-	-	-

...........continued			
J601 Pin	**MCU Pin**	**Function**	**Shared Functionality**
14 [SWO/TraceD0]	PC28	TRACEDATA[0]	
15 [GND]	-	GND	-
16 [nTRST/TraceD1]	PC26	TRACEDATA[1]	-
17 [GND]	-	GND	-
18 [DBGRQ/TraceD2]	PC25	TRACEDATA[2]	EXT1, EXT2, Ethernet, mikroBUS
19 [GND]	-	GND	-
20 [DBGACK/TraceD3]	PC24	TRACEDATA[3]	-

4.3   Peripherals

4.3.1   Oscillators

The Curiosity Ultra evaluation kit contains one 32.768 kHz crystal, and one 12 MHz oscillator, which can be used as clock sources to the PIC32CX SG41/SG61 devices.

Table 4-14. External 32.768 kHz Crystal Connection (Y403)

Silkscreen Text	MCU Pin	Function	Shared Functionality
32.768 kHz Crystal	PA00	XOSC32K XIN32	-
	PA01	XOSC32K XOUT32	

Table 4-15. External 12 MHz Oscillator Connection (Y400)

Silkscreen Text	MCU Pin	Function	Shared Functionality
12 MHz Oscillator	PB22	XOSC1 XIN	-

Note: The external 12 MHz Oscillator, which feeds the XIN pin, is permanently powered. The oscillator current consumption must be considered, especially when measuring the current consumption of the MCU in Standby and Off modes. Users can desolder the 0-Ohm resistor (R402) to disable the oscillator and remove this extra current consumption.

4.3.2   Mechanical Buttons

The Curiosity Ultra board contains three mechanical buttons: one Reset button connected to the PIC32CX SG41/SG61 reset line, and two generic user configurable buttons. When a button is pressed, it will drive the I/O line to GND. The mechanical button details are provided in the following table.

Tip: The pull-up resistor is not connected to the generic user-configurable buttons. Ensure to enable the internal pull-up in the PIC32CX SG41/SG61 device to use these buttons.

Table 4-16. Mechanical Buttons Connection (SW400, SW402)

Silkscreen Text	MCU Pin	Function	Shared Functionality
RESET	RESET	TARGET_RESETn	PKoB4 SWD, Cortex Debug,Trace, Arduino
SW 1	PD00	GPIO	-
SW 2	PD01	GPIO	-

4.3.3   LEDs

One green LED and one red LED are available on the Curiosity Ultra evaluation board. These LEDs can be turned on and off, and activated by driving the connected I/O line to GND.

Table 4-17. LEDs Connection (D400, D401)

Silkscreen Text	MCU Pin	Function	Shared Functionality
LED1	PC21	GPIO	-
LED2	PA16	GPIO	-

4.3.4   Quad SPI Flash

The development board has an on-board 64-Mbit Serial Quad I/O Flash memory which is available for user applications.

The following table lists all I/O-lines connected to the QSPI Flash.

Table 4-18. Quad SPI Flash Connection (U700)

Schematics Text	MCU Pin	Function	Shared Functionality
QSPI_DATA0 / QIO0	PA08	QSPI/DATA[0]	Audio
QSPI_DATA1 / QIO1	PA09	QSPI/DATA[1]	Audio
QSPI_DATA2 / QIO2	PA10	QSPI/DATA[2]	Audio
QSPI_DATA3 / QIO3	PA11	QSPI/DATA[3]	Audio
QSPI_SCK / QSCK	PB10	QSPI/SCK	Audio
QSPI_CS / QCS	PB11	QSPI/CS	-

4.3.5 Serial EEPROM with EIA-48 MAC Address

The development board has an on-board 2 Kb I^2C serial EEPROM which is available for user applications.

This serial EEPROM has a unique EUI-48, and 128-bit serial number.

The following table lists all I/O-lines connected to the Serial EEPROM.

Table 4-19. Serial EEPROM Connection (U701)

Schematics Text	MCU Pin	Function	Shared Functionality
SYS_SCL6	PD08	SERCOM6/PAD[1]I²C SCL	EXT1, EXT2, mikroBUS, Audio, Temperature Sensor, Arduino
SYS_SDA6	PD09	SERCOM6/PAD[0]I²C SDA	EXT1, EXT2, mikroBUS, Audio, Temperature Sensor, Arduino

4.3.6 microSDCard Connector

The PIC32CX SG41/SG61 Curiosity Ultra has one standard microSD card connector which is connected to the SD/MMC Host Controller (SDHC).

The following table lists all I/O-lines connected to the microSD card connector.

Table 4-20. microSD Card Connection (J704)

Schematics Text	MCU Pin	Function	Shared Functionality
SD_D0	PB18	SDHC1 / SDDAT[0]	-
SD_D1	PB19	SDHC1 / SDDAT[1]	-
SD_D2	PB20	SDHC1 / SDDAT[2]	-
SD_D3	PB21	SDHC1 / SDDAT[3]	-
SD_CMD	PA20	SDHC1 / SDCMD	-
SD_CLK	PA21	SDHC1 / SDCK	-
SD_CD	PD20	SDHC1 / SDCD	-

4.3.7 USB

The PIC32CX SG41/SG61 Curiosity Ultra has a USB Micro-AB connector to use with the PIC32CX SG41/SG61 USB module, labeled TARGET USB on the kit.

In Device mode, for USB self-powered devices, a GPIO (VBUS_DET) is used to detect the VBUS voltage.

The USB ID signal is connected to another GPIO (USB_ID_DET) and can be used to check if a Host side cable is connected.

In Host mode, the VBUS voltage is enabled by setting the GPIO (VBUS_EN) to low.

Table 4-21. Target USB Connections (J200)

MCU Pin	Function	Shared Functionality
PA24	USB / DM	-
PA25	USB / DP	-
PC11	GPIO (VBUS_DET)	-
PB17	GPIO (USB_ID_DET)	-
PC19	GPIO ($\overline{\text{VBUS\_EN}}$)	-

4.3.8 CAN

The PIC32CX SG41/SG61 Curiosity Ultra has two CAN modules that perform communications according to ISO11898-1 (Bosch CAN specification 2.0 part A,B) and the Bosch ISO CAN FD specification.

Each CAN is connected to an on-board ATA6563 CAN physical-layer transceiver.

The following table shows the connections between the PIC32CX SG41/SG61 and the CAN headers, which are connected to the CAN transceivers.

Table 4-22. CAN0 Header (J804)

Header Pin	MCU Pin	Function	Shared Functionality
1 [CAN0H]	PA22	CAN0 / TX	-
2 [GND]	-	GND	-
3 [CAN0L]	PA23	CAN0 / RX	-

Table 4-23. CAN1 Header (J805)

Header Pin	MCU Pin	Function	Shared Functionality
1 [CAN1H]	PB14	CAN1 / TX	TCC4/WO0 (EXT1, EXT2, Arduino)
2 [GND]	-	GND	-
3 [CAN1L]	PB15	CAN1 / RX	TCC4/WO1 (EXT1, EXT2, Arduino)

CAN1/TX and CAN1/RX are shared with TCC4/WO0 and TCC4/WO1 using the J402 and J403 headers as provided in the following tables:

Table 4-24. CAN1 TX / TCC Jumper Selection (J402)

Pin Number	Function
1	CAN1 TX
2	PB14
3	TCC4/WO0

Table 4-25. CAN1 TX / TCC Jumper Selection (J403)

Pin Number	Function
1	CAN1 RX
2	PB15
3	TCC4/WO1

4.3.9 Ethernet

The PIC32CX SG41/SG61 Curiosity Ultra 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. The following tables illustrate the Ethernet PHY interface pinout descriptions.

Table 4-26. Ethernet Interface Pinout Description Connections (J800)

J800 Pin	MCU Pin	Function	Shared Functionality
1 [WKUP2]	-	NC	-
2 [WKUP5]	-	NC	-
3 [RXD1]	PA12	GMAC GRX[1]	-
4 [RXD0]	PA13	GMAC GRX[0]	-
5 [RXER]	PA15	GMAC GRXER	-
6 [RXDV]	PC20	GMAC GRXDV	-
7 [MDC]	PC22	GMAC GMDC	-
8 [MDIO]	PC23	GMAC GMDIO	-
9 [IRQ]	-	NC	-
10 [RESET]	PC18	$\overline{\text{RESET}}$	MikroBUS, Audio
11 [GPIO]	-	NC	-
12 [EGND]	-	GND	-

Table 4-27. Ethernet Interface Pinout Description Connections (J802)

J802 Pin	MCU Pin	Function	Shared Functionality
1 [TXEN]	PA17	GMAC GTXEN	Audio
2 [TXD0]	PA18	GMAC GTX[0]	-
3 [TXD1]	PA19	GMAC GTX[1]	-
4 [MOSI]	PB24	SERCOM0/PAD[0] MOSI	EXT1, EXT2, mikroBUS, Arduino
5 [MISO]	PC25	SERCOM0/PAD[3] MISO	EXT1, EXT2, mikroBUS, Arduino, Trace
6 [GND]	-	GND	-
7 [ID_3]	-	ID_3	-
8 [TXCK]	PA14	GMAC GTXCK	-
9 [GND]	-	GND	-
10 [VCC_3P3V]	-	VCC_3P3V	-
11 [CS]	PA27	GPIO	-
12 [SCLK]	PB25	SERCOM0/PAD[1] SCK	EXT1, EXT2, mikroBUS, Arduino

Note: To use GMAC GTXEN (PA17), place a J401 shunt on JS401 pins 2-3.

4.3.10 Temperature Sensor

This development board has an on-board external I^{2}C-based temperature sensor which is available for user applications.

The external sensor is a MCP9804 which has a user programmable temperature alert output and a user programmable temperature limit with a typical accuracy of +/-0.25°C.

The following table lists all I/O-lines connected to the Temperature sensor.

Table 4-28. Temperature Sensor Connection (U900)

Schematics Text	MCU Pin	Function	Shared Functionality
SYS_SCL	PD08	SERCOM6/PAD[1]I²C SCL	EXT1, EXT2, mikroBUS, Audio, Serial EEPROM, Arduino
SYS_SDA	PD09	SERCOM6/PAD[0]I²C SDA	EXT1, EXT2, mikroBUS, Audio, Serial EEPROM, Arduino

4.3.11 DAC Outputs

Table 4-29. DAC Outputs Header (J600)

Header Pin	MCU Pin	Function	Shared Functionality
1 [DAC0 PA02]	PA02	DAC VOUT[0]	-
2 [GND]	-	GND	-
3 [DAC1 PA05]	PA05	DAC VOUT[1]	-

4.3.12 Audio X32

An X32 audio interface is implemented to interface with the PIC32CX SG41/SG61 I²S peripheral. However, the X32 Port connections are not populated on the kit. Refer to the schematics for additional information.

5. Revision History

Rev. B - 01/2023

The following updates were performed in this revision:

- Added a figure to Preface
- Replaced the figures in Overview of Available Kits with updated images
- Corrected table formatting in Power Sources

Rev. A - 10/2022

This is the initial released version of this document.

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