SAM L10/L11 Xplained Pro User Guide

Preface

The Microchip® SAM L10 and SAM L11 Xplained Pro evaluation kits are hardware platforms for evaluating the SAM L10/L11 microcontrollers (MCUs). Each kit is supported by the Atmel Studio integrated development platform, which provides an easy access to the features of the microcontroller. The Xplained Pro MCU series evaluation kits include an on-board embedded debugger, hence external tools are not required to program or debug the microcontroller. The Xplained Pro extension kit offers additional peripherals to extend the features of the board and ease the development of custom designs.

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1. Introduction

1.1 Features

The following are key features of the board:

- ATSAML10E16A-AU/ATSAML11E16A-AU microcontrollers
- One mechanical reset button
- One mechanical programmable button
- One QTouch® button
- One user LED (yellow)
- 32.768 kHz crystal
- ATECC508A CryptoAuthentication™ IC
- Two Xplained Pro extension headers
- mikroBUS™ header
- X32 header
- Embedded debugger
    - Auto ID for board identification in Atmel Studio
    - One status LED (yellow)
    - One board power LED (green)
    - Symbolic debug of complex data types, including scope information
    - Programming and debugging, including power measurements
    - Data Gateway Interface: SPI, I^{2}C, four GPIOs
    - Virtual COM port (CDC)
- Embedded current measurement circuitry with Atmel Data Visualizer support for data visualization
- USB powered

1.2 Kit Overview

The Microchip SAM L10 and SAM L11 Xplained Pro Evaluation kits are hardware platforms for the evaluation of the Microchip SAM L10/L11 devices.

The Evaluation kit part numbers are as follows:

- SAM L10 Xplained Pro: DM320204
- SAM L11 Xplained Pro: DM320205

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

Figure 1-1. SAM L10 Xplained Pro Evaluation Kit Overview

ATSAML10E16A
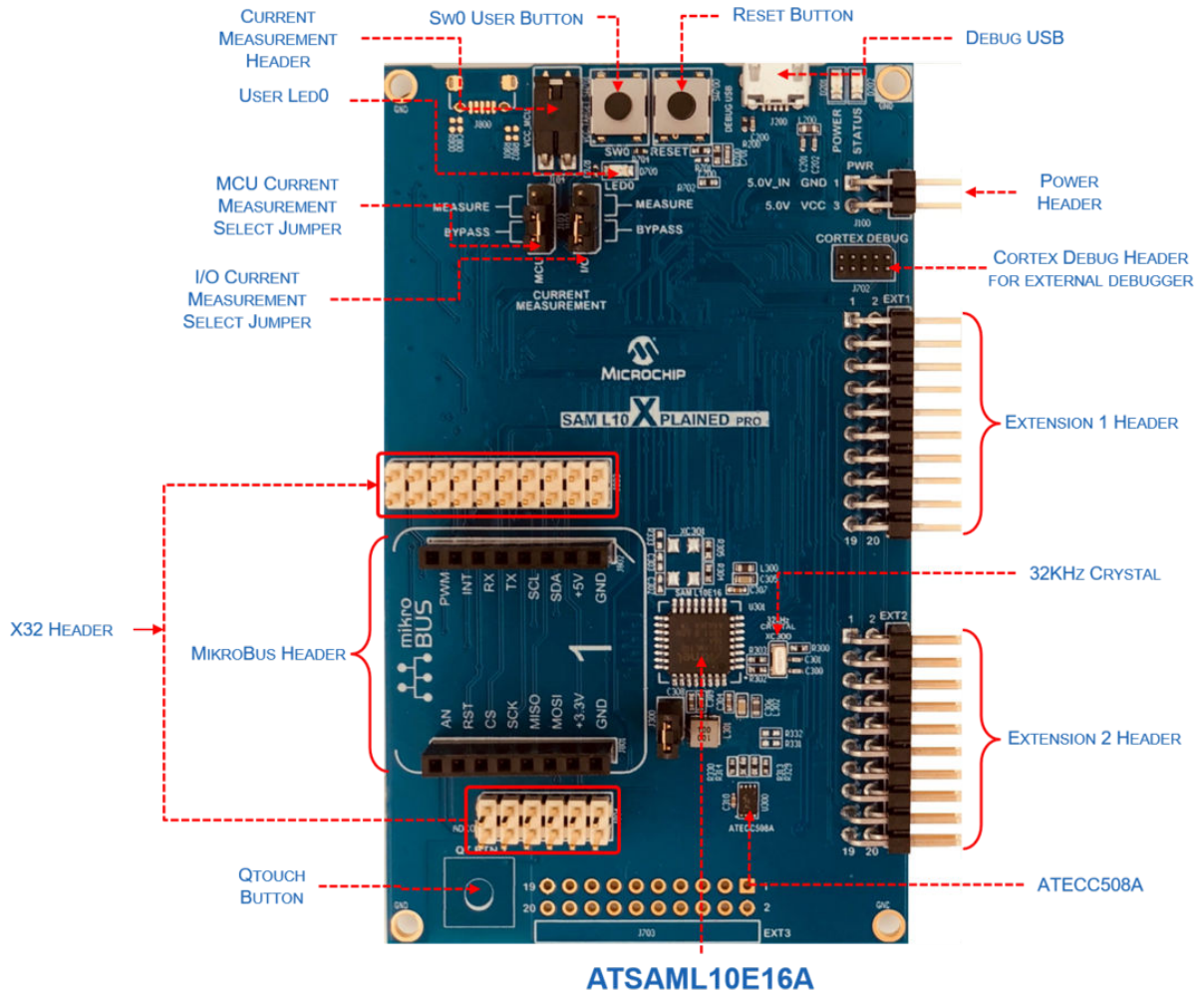
2.   Getting Started

Follow these steps to explore the Microchip Xplained Pro platform:

1. Download Atmel Studio.
2. Launch Atmel Studio.
3. Connect the debug USB port on the kit to the computer using a USB cable (Standard-A to Micro-B or Micro-AB).

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

When the Xplained Pro MCU board is powered, the power LED (green) will glow and Atmel Studio will autodetect the specific Xplained Pro MCU and extension boards that are connected to it. Atmel Studio will present relevant information, such as datasheets and kit documentation.

The SAM L10/L11 devices are programmed and debugged by the on-board embedded debugger, therefore, no external programmer or debugger tool is required.

3. Xplained Pro

The Xplained Pro is an evaluation platform that provides the full Microchip microcontroller experience.

The platform consists of a series of Microcontrollers (MCUs) and extension boards. These are integrated with Atmel Studio, which contains Advanced Software Framework (ASF) drivers, demo code, support data streaming, and so on.

The Xplained Pro MCU boards support a wide range of Xplained Pro extension boards, and 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 an Xplained Pro MCU board. This information is used to present relevant user guides, application notes, data sheets, and example code through Atmel Studio.

3.1 Embedded Debugger

The Xplained Pro contains the Microchip Embedded Debugger (EDBG) for on-board debugging. The EDBG is a complex USB device with three interfaces, such as a debugger, virtual COM port, and a data gateway interface (DGI). Together with Atmel Studio, the EDBG debugger interface can program and debug the microcontroller. On the SAM L10/SAM L11 Xplained Pro, the SWD interface is connected between the EDBG 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 terminal software. It offers variable baud rate, parity, and stop bit settings. Note that the settings on the microcontroller must match the settings given in the terminal software.

Note: The virtual COM port in the EDBG requires the terminal software to set the data terminal ready (DTR) signal to enable the UART pins connected to the microcontroller. If the DTR signal is not enabled, the UART pins on the EDBG is kept in high-z (tristate), rendering the COM port unusable. The DTR signal is set automatically by some terminal software, but it must be manually enabled in the terminal.

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 microcontroller or as a generic *printf*-style data channel. Traffic over the interfaces can be time stamped on the EDBG for accurate tracing of events. Timestamping imposes an overhead that reduces maximum throughput. The Atmel Data Visualizer Extension, installed with Atmel Studio, is used to send and receive data through DGI.

The EDBG controls two LEDs on the SAM L10/SAM L11 Xplained Pro: a power LED and a status LED. The following table provides how the LEDs are controlled in different operation modes.

Table 3-1. EDBG LED Control

Operation Mode	Power LED	Status LED
Normal Operation	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)	The power LED and the status LED blink simultaneously.	
Bootloader Mode (firmware upgrade)	The power LED and the status LED blink in an alternating pattern.	

For further documentation on the EDBG, refer to the Microchip EDBG User Guide.

3.2 Xplained Pro Analog Module

3.2.1 Overview

The Xplained Pro Analog Module (XAM) extends the embedded debugger with high dynamic range current measurement, and this enables the power profiling of the target system.

Figure 3-1. Xplained Pro Analog Module (XAM)

Xplained Pro Analog Module (XAM)
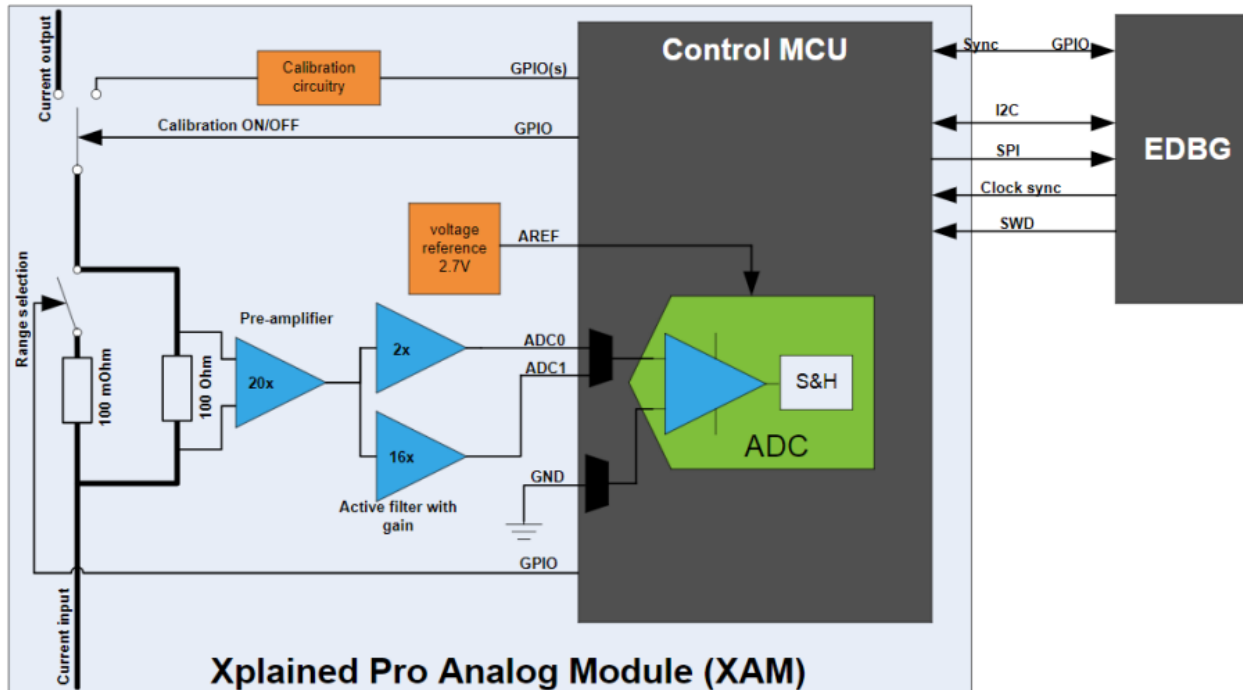
The XAM consists of these following key features:

- Calibration circuitry
- Voltage reference
- Analog frontend
    - Shunt resistors with a range selection switch
    - Pre-amplifier
    - Two active filters with gain
- Control MCU
    - Analog-to-Digital Converter (ADC)
    - Signal processing
    - Control/communication interface to the EDBG

The current measurement frontend is a high-side shunt measurement with a pre-amplifier, and a second active filter stage with gain. The wide dynamic range is achieved by four measurement ranges which are defined by two shunts, and the two parallel second stage active filters with gain.

3.2.2 EDBG Interface

The Xplained Pro Analog Module (XAM) is connected to the EDBG with the following interfaces:

- I^2C: This is used to control and configure the XAM.
- SPI: Current measurement data is streamed to the EDBG through this interface. This is a one-way data transfer channel from the XAM to the EDBG.
- SWD: The MCU in the XAM is programmed through SWD from the EDBG.
- GPIO: At least one GPIO, that is connected to the EDBG from the target MCU, is also connected to the current measurement unit to enable the user to sync current measurements with their application.
- Clock sync: Synchronization signal to synchronize ADC measurements with EDBG.

3.2.3 Sample Rate

The raw sampling rate of the Xplained Pro analog module (XAM) is up to 250 kHz and with the default averaging configuration (average of 16 samples). The actual output of the XAM is 16.67 kSPS, and the XAM output sample rate is not an integer fraction of the raw sampling.

3.2.4 Measurement Ranges and Accuracy

The Xplained Pro analog module has four measurement ranges. These are defined by two shunt resistors and two gain stages.

Table 3-2. Xplained Pro Analog Module Measurement Ranges and Accuracy

Measurement Range	Hardware	Resolution	Accuracy	Comments
Range 1	Low-current shunt and high-gain stage	20 nA	1 LSB ±1%	Below 1 µA the error will increase. Typical error for 300 nA is 1 LSB ±10%
Range 2	Low-current shunt and low-gain stage	150 nA	1 LSB ±1%	-
Range 3	High-current shunt and high-gain stage	10 µA	1 LSB ±1%	-
Range 4	High current shunt and low gain stage	100 µA	1 LSB ±1%	Above 100 mA the error will increase to 1 LSB ±5% at 400 mA. Maximum current is 400 mA

The ranges are switched automatically by the XAM to achieve best measurement results and the current active range is visualized in the Microchip Data Visualizer frontend tool. The maximum voltage drop over the shunt resistor is 100 mV, and the XAM will switch the range automatically before this limit is reached.

3.3   Hardware Identification System

All Xplained Pro compatible extension boards have one Microchip ATSHA204 CryptoAuthentication™ chip. This chip contains information that identifies the extension with its name and some extra data.

When Xplained Pro extension is connected to the Xplained Pro MCU board, the information is read and sent to Atmel Studio.

The Microchip Kits extension, installed with Atmel Studio, will give relevant information, code examples, and links to relevant documents.

The following table provides the data fields stored in the ID chip with example content.

Table 3-3. Xplained Pro ID Chip Content

Data Field	Data Type	Example Content
Manufacturer	ASCII string	Atmel'\0'
Product Name	ASCII string	Segment LCD1 Xplained Pro'\0'
Product Revision	ASCII string	02'\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

3.4   Power Sources

The SAM L10/SAM L11 Xplained Pro kits can be powered by several power sources as listed in the following table.

Table 3-4. Power Sources for SAM L10/SAM L11 Xplained Pro

Power Input	Voltage Requirements	Current Requirements	Connector Marking
External Power	4.3V to 5.5V .	Recommended maximum is 2A due to the input protection maximum current specification.	PWR
Embedded Debugger	4.4V to 5.25V (according to USB specifications).	500 mA (according to USB specifications)	DEBUG USB

The kit will automatically detect the available power sources and choose which one to use according to the following priority:

• External power
• Embedded debugger USB

Note: External power is required when 500 mA from a USB connector is not sufficient to power the board with possible extension boards.

3.5 Xplained Pro Headers and Connectors

3.5.1 Xplained Pro Standard Extension Header

All Xplained Pro kits have many dual row, 20-pin, 100 mil extension headers. The Xplained Pro MCU boards have male headers, while Xplained Pro extensions 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.

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

Table 3-5. Xplained Pro Standard Extension Header

Pin Number	Name	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 (PWM) alternatively positive part of differential PWM
8	PWM(-)	PWM alternatively negative part of differential PWM
9	IRQ/GPIO	Interrupt Request Line and/or general purpose I/O
10	SPI_SS_B/GPIO	Slave Select for SPI and/or 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	Slave Select for SPI. Should preferably be unique.
16	SPI_MOSI	Master out slave in line of serial peripheral interface
17	SPI_MISO	Master in slave out line of serial peripheral interface
18	SPI_SCK	Clock for SPI. Always implemented, bus type.
19	GND	Ground
20	VCC	Power for extension board

3.5.2   Xplained Pro Power Header

The power header (PWR) can be used to connect external power to the SAM L10/SAM L11 Xplained Pro kit. The kit will automatically detect and switch to any external power if supplied. The power header can also be used as a 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 3-6. Xplained Pro Power Header (PWR)

Pin Number	Pin Name	Description	Connector Marking
1	VCC_EXT_P5V0	External 5V input	5.0V IN
2	GND	Ground	GND
3	VCC_MUX_P5V0	Unregulated 5V (output, derived from one of the input sources)	5.0V
4	VCC_TARGET_P3V3	Regulated 3.3V (output, used as main power supply for the kit)	VCC

4. Hardware Details

4.1 Connectors

The following sections describe the implementation of the different connectors and headers on the SAM L10/SAM L11 Xplained Pro and their connections to the SAM L10/L11.

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

The following figure shows available connectors and jumpers on the SAM L10/SAM L11 Xplained Pro.

Figure 4-1. Xplain Pro Connectors
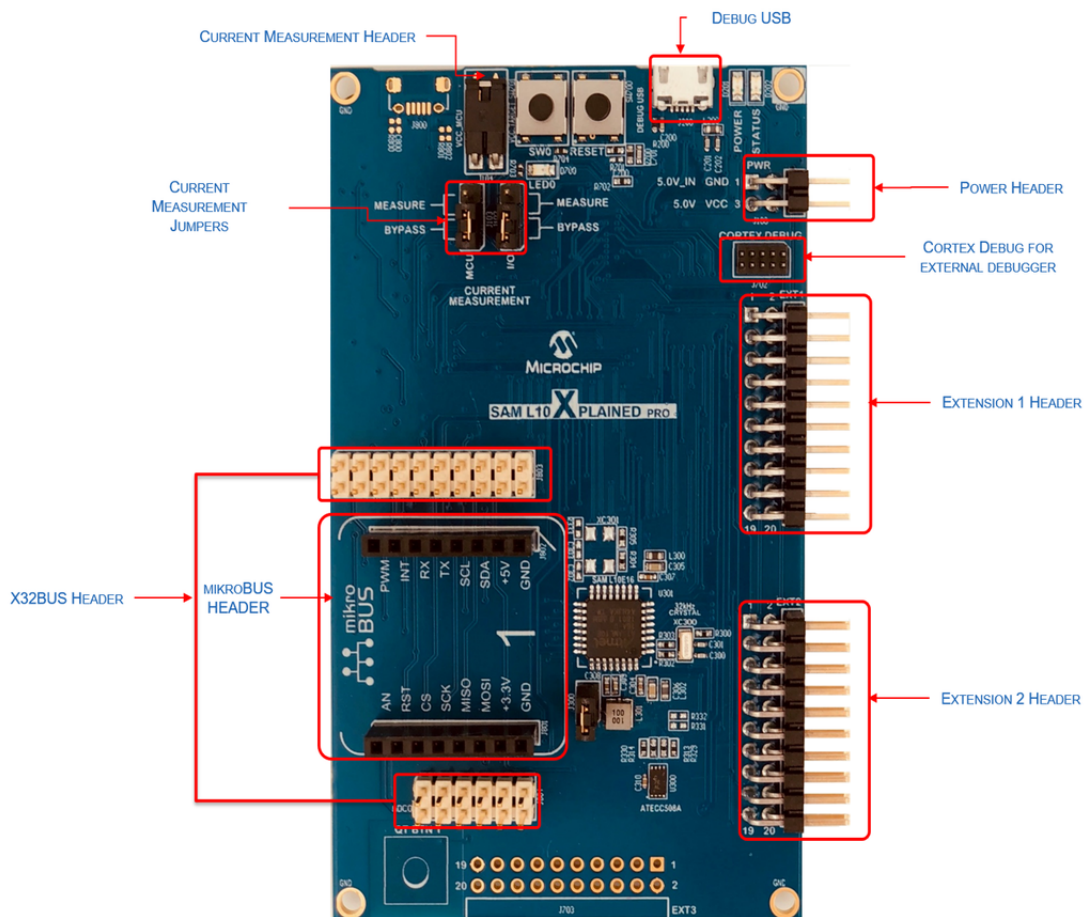
4.1.1 Xplained Pro Extension Headers

The SAM L10/SAM L11 Xplained Pro 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 specified in the following table. The headers have a pitch of 2.54 mm.

Table 4-1. Extension Header EXT1

EXT1 pin	SAM L10/SAM L11 pin	Functions	Schematics Net Name	Shared Functionality
1 [ID]	-	-	-	Communication line to the ID Chip on the extension board
2 [GND]	GND	-	GND	Ground
3 [ADC(+)]	PA02	AIN0	PA02_ADC0	mikroBUS, X32
4 [ADC(-)]	PA03	AIN1 / VREFA	PA03_ADC1_VREF	-
5 [GPIO]	PA10	SERCOM2/PAD[2]/USART RTS	PA10_GPIO1_S2_USART_RTS	DGI GPIO, X32
6 [GPIO]	PA11	SERCOM2/PAD[3]/USART CTS	PA11_GPIO2_S2_USART_CTS	DGI GPIO, X32
7 [PWM(+)]	PA18	TC2/WO[0]	PA18_PWM_TC2_0	mikroBUS
8 [PWM(-)]	PA19	TC2/WO[1]	PA19_PWM_TC2_1	-
9 [IRQ/GPIO]	PA22	EXTINT[1]	PA22_GPIO_IRQ_1	mikroBUS, X32
10 [SPI_SS_B/GPIO]	PA23	GPIO/SERCOM0/PAD[1]/SPI SS	PA23_GPIO_SS	DGI GPIO, mikroBUS
11 [TWI_SDA]	PA16	SERCOM1/PAD[0]/I²C SDA	PA16_S1_I2C_SDA	EXT2, DGI I²C, mikroBUS, X32, I²C Pull-up, ECC508
12 [TWI_SCL]	PA17	SERCOM1/PAD[1]/ I²C SCL	PA17_S1_I2C_SCL	EXT2, DGI I²C, mikroBUS, X32, I²C Pull-up, ECC508
13 [USART_RX]	PA09	PA09_S2_UART_RX	PA09_S2_UART_RX	mikroBUS, X32
14 [USART_TX]	PA08	PA08_S2_UART_TX	PA08_S2_UART_TX	mikroBUS, X32
15 [SPI_SS_A]	PA05	PA05_S0_SPI_SS	PA05_S0_SPI_SS	mikroBUS, X32
16 [SPI_MOSI]	PA14	PA14_S0_SPI_MOSI	PA14_S0_SPI_MOSI	EXT2, DGI SPI, mikroBUS, X32
17 [SPI_MISO]]	PA04	PA04_S0_SPI_MISO	PA04_S0_SPI_MISO	EXT2, DGI SPI, mikroBUS, X32
18 [SPI_SCK]	PA15	PA15_S0_SPI_SCK	PA15_S0_SPI_SCK	EXT2, DGI SPI, mikroBUS, X32
19 [GND]	GND	-	GND	Ground
20 [VCC]	-	-	VCC_TARGET_P3V3	Power for extension Board

Table 4-2. Extension Header EXT2

EXT2 pin	SAM L10/SAM L11 pin	Functions	Schematics Net Name	Shared Functionality
1 [ID]	-	-	-	Communication line to the ID Chip on the extension board
2 [GND]	GND	-	GND	Ground
3 [ADC(+)]	-	-	Not Connected	-
4 [ADC(-)]	-	-	Not Connected	-
5 [GPIO1]	-	-	Not Connected	-
6 [GPIO2]	-	-	Not Connected	-
7 [PWM(+)]	-	-	Not Connected	-
8 [PWM(-)]	-	-	Not Connected	-
9 [IRQ/GPIO]	-	-	Not Connected	-

..........continued

EXT2 pin	SAM L10/SAM L11 pin	Functions	Schematics Net Name	Shared Functionality
10 [SPI_SS_B/GPIO]	PA27	GPIO/SPI SS	PA27_GPIO_SS	DGI GPIO, SW0
11 [TWI_SDA]	PA16	SERCOM1/PAD[0]/I²C SDA	PA16_S1_I2C_SDA	EXT1, DGI I²C, mikroBUS, X32, I²C Pull-up, ECC508
12 [TWI_SCL]	PA17	SERCOM1/PAD[1]/ I²C SCL	PA17_S1_I2C_SCL	EXT1, DGI I²C, mikroBUS, X32, I²C Pull-up, ECC508
13 [USART_RX]	PA25	SERCOM0/PAD[3]/UART RX	PA25_UART_RX	mikroBUS, X32
14 [USART_TX]	PA24	SERCOM0/PAD[2]/UART TX	PA24_UART_TX	mikroBUS, X32
15 [SPI_SS_A]	PA06	GPIO/SPI SS	PA06_SPI_SS	mikroBUS, X32, QT BTN1
16 [SPI_MOSI]	PA14	SERCOM0/PAD[2]/SPI MOSI	PA14_S0_SPI_MOSI	EXT1, DGI SPI, mikroBUS, X32
17 [SPI_MISO]	PA04	SERCOM0/PAD[0]/SPI MISO	PA04_S0_SPI_MISO	EXT1, DGI SPI, mikroBUS, X32
18 [SPI_SCK]	PA15	SERCOM0/PAD[3]/SPI SCK	PA15_S0_SPI_SCK	EXT1, DGI SPI, mikroBUS, X32
19 [GND]	GND	-	GND	Ground
20 [VCC]	-	-	VCC_TARGET_P3V3	Power for extension Board

4.1.2 mikroBUS Header

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 I²C), five additional pins (PWM, interrupt, analog input, reset and chip select), and two power groups (+3.3V and 5V). The figure below illustrates the mikroBUS socket.

Figure 4-2. mikroBUS Socket
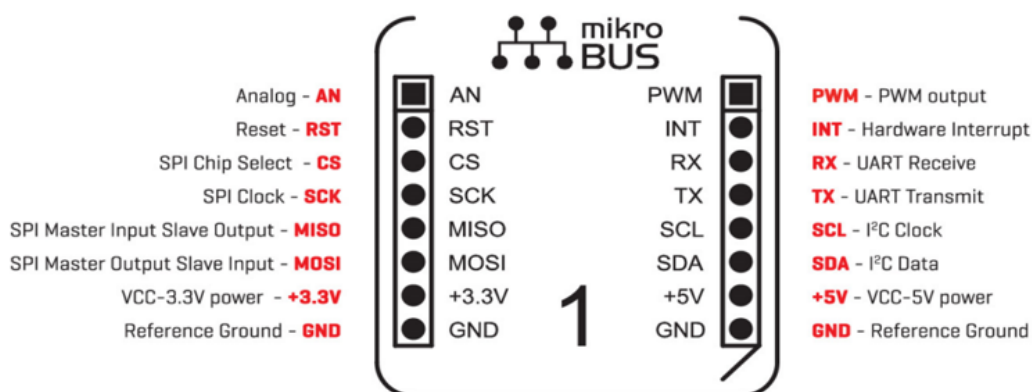
The table below provides the mikroBUS header details.

Table 4-3. mikroBUS Header

mikroBUS pin	SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
[AN]	PA02	AIN0	PA02_ADC0	EXT1, X32
[RST]	PA23	GPIO	PA23_GPIO_SS	EXT1, DGI GPIO
[CS]	PA05	SERCOM0/PAD[1]/SPI SS	PA05_S0_SPI_SS	EXT1, X32
[SCK]	PA15	SERCOM0/PAD[3] /SPI SCK	PA15_S0_SPI_SCK	EXT1, EXT2, DGI SPI, X32

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mikroBUS pin	SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
[MISO]	PA04	SERCOM0/PAD[0]/SPI MISO	PA04_S0_SPI_MISO	EXT1, EXT2, DGI SPI, X32
[MOSI]	PA14	SERCOM0/PAD[2]/SPI MOSI	PA14_S0_SPI_MOSI	EXT1, EXT2, DGI SPI, X32
[+3.3V]	-	-	VCC_TARGET_P3V3	-
[GND]	GND	-	GND	Ground
[PWM]	PA18	TC2/ WO[0]	PA18_PWM_TC2_0	EXT1
[INT]	PA22	EXTINT[1]	PA22_GPIO_IRQ_1	EXT1, X32
[RX]	PA09	SERCOM2/PAD[1]/ UART RX	PA09_S2_UART_RX	EXT1, X32
[TX]	PA08	SERCOM2/PAD[0]/ UART TX	PA08_S2_UART_TX	EXT1, X32
[SCL]	PA17	SERCOM1/PAD[1]/ I²C SCL	PA17_S1_I2C_SCL	EXT1, EXT2, DGI I²C, X32, I²C Pull-up, ECC508
[SDA]	PA16	SERCOM1/PAD[0]/I²C SDA	PA16_S1_I2C_SDA	EXT1, EXT2, DGI I²C, X32, I²C Pull-up, ECC508
[+5V]	-	-	VCC_P5V0	-
[GND]	GND	-	GND	Ground

4.1.3   X32 Header

The X32 header is populated on some of the PIC32 development kits, and it enables users to plug in an extension board, such as a Microchip Bluetooth or the AC320032-3 BM 64 Bluetooth Radio daughter board. The X32 header is available for download from the following location: http://www.microchip.com/Developmenttools/ProductDetails.aspx?PartNO=AC320032-3.

The X32 header is composed of a 20-pin connector and a 12-pin connector. The following tables provide the details and functionalists of the 20-pin and 12-pin connectors:

Table 4-4. 20-pin Connector

X32BUS pin	SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
1 [GND]	Ground	Ground	-	-
2 [GND]	Ground	Ground	-	-
3 [USART_RX]	PA09	USART RX	PA09_S2_UART_RX	EXT1, mikroBUS
4 [USART_CTS]	PA11	USART CTS	PA11_GPIO2_S2_USART_CTS	EXT1, DGI GPIO
5 [USART_TX]	PA08	USART TX	PA08_S2_UART_TX	EXT1, mikroBUS
6 [USART_RTS]	PA10	USART RTS	PA10_GPIO1_S2_USART_RTS	EXT1, DGI GPIO
7 [I2C_SCL]	PA17	I²C SCL	PA17_S1_I2C_SCL	EXT1, EXT2, DGI I²C, mikroBUS, I²C Pull-up, ECC508
8 [STBY/RST_B]	RESET	RESET	TARGET_MCU_RESET	-
9 [I2C_SDA]	PA16	I²C SDA	PA16_S1_I2C_SDA	EXT1, EXT2, DGI I²C, mikroBUS, I²C Pull-up, ECC508
10 [DMM/I2S_WS]	PA05	DMM / I2S WS	PA05_S0_SPI_SS	EXT1, mikroBUS
11 [I2S_DIN]	PA14	I²S DIN	PA14_S0_SPI_MOSI	EXT1, EXT2, mikroBUS, DGI SPI, XIN
12 [I2S_CK]	PA15	I²S CK	PA15_S0_SPI_SCK	EXT1, EXT2, mikroBUS, DGI SPI, XOUT
13 [I2S_DOUT]	PA04	I²S DOUT	PA04_S0_SPI_MISO	EXT1, EXT2, mikroBUS, DGI SPI
14 [CLK_AUDIO]	PA22	CLK Audio	PA22_GPIO_IRQ_1	EXT1, mikroBUS
15 [GND]	GND	Ground	GND	-
16 [GND]	GND	Ground	GND	-
17 Not Connected	-	-	-	-

..........continued

X32BUS pin	SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
18 [+3.3V]	-	-	VCC_TARGET_P3V3	-
19 Not Connected	-	-	-	-
20 [+5V]	-	-	VCC_P5V0	-

Table 4-5. 12-pin Connector

X32BUS pin	SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
1 Not Connected	-	-	-	-
2 [ANALOG_POT]	PA02	Analog Pot	PA02_ADC0	EXT1, mikroBUS
3 Not Connected	-	-	-	-
4 Not Connected	-	-	-	-
5 Not Connected	-	-	-	-
6 Not Connected	-	-	-	-
7 Not Connected	-	-	-	-
8 Not Connected	-	-	-	-
9 Not Connected	-	-	-	-
10 Not Connected	-	-	-	-
11 [GND]	Ground	-	-	Ground
12 [GND]	Ground	-	-	Ground

4.1.4   Current Measurement Header

An angled 1x2, 100 mil pin-header marked with the MCU current measurement is located at the upper edge of the Xplained Pro. All power to the SAM L10/L11 is routed through this header. To measure the power consumption of the device, remove the jumper and replace it with an ammeter.

Table 4-6.

Current Measurement Header Pin	Function
1 [VCC_MCU]	VCC_MCU_P3V3
2 [VCC_TARGET]	VCC_TARGET_P3V3

⚠ **CAUTION** Removing the jumper from the pin-header while the kit is powered may cause the SAM L10/L11 to be powered through its I/O pins. This may cause permanent damage to the device.

4.1.5   Cortex Debug Connector

The Xplained Pro has a 10-pin, 50-mil Cortex® Debug Connector that can be used to attach external debuggers to the SAM L10/L11.

Table 4-7.

Cortex Debug Connector pin	SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
1 [VCC]	-	-	VCC_TARGET_P3V3	-
2 [SWDIO/TMS]	PA31	SW Data In/Out	SWDIO	Serial Wire debug

..........continued				
Cortex Debug Connector pin	**SAML10/SAML11 pin**	**Function**	**Schematics Net Name**	**Shared Functionality**
3 [GND]	GND	Ground	GND	-
4 [SWCLK/TCK]	PA30	SW Clock	SWCLK	Serial Wire debug
5 [GND]	GND	Ground	GND	-
6 [SWO/TDO]	Not connected	-	-	-
7 [KEY]	Not connected	-	-	-
8 [NC/TDI]	Not connected	-	-	-
9 [GNDDetect]	GND	Ground	GND	-
10 [nRESET]	/RESET	Reset	TARGET_MCU_RESET	Serial Wire debug, User reset

4.2 Peripherals

4.2.1 Crystals

The Xplained Pro kit contains one mounted 32.768 kHz crystal and a footprint for higher frequency crystals, which can be used as clock sources for SAM L10/L11. The footprint for the 32.768 kHz crystal is based on the Kyocera ST3215SB series.

- 32.768 kHz Crystal connection details are given in the following table.

Table 4-8. 32 KHz Crystal Connection

SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
PA00	XIN32	XIN32	-
PA01	XOUT32	XOUT32	-

- Higher Frequency crystal footprint details are provided in the following table.

Table 4-9. Main Crystal Connection

SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
PA14	XIN	XIN	EXT1, EXT2, DGI SPI, mikroBUS, X32
PA15	XOUT	XOUT	EXT1, EXT2, DGI SPI, mikroBUS, X32

4.2.2 Mechanical Buttons

The Xplained Pro contains two mechanical buttons. One button is the Reset button connected to the SAM L10/L11 reset line, and the other is a generic user configurable button. When a button is pressed it will drive the I/O line to GND.

Table 4-10. Mechanical Buttons Connections

SAML10/SAML11 pin	Function	Silkscreen Text	Schematics Net Name	Shared Functionality
/RESET	Reset	RESET	TARGET_MCU_RESET	-
PA27	GPIO	SW0	USER_BUTTON	DGI GPIO, EXT2

4.2.3 LED

There is one yellow LED available on the Xplained Pro board that can be turned on and off. The LED can be activated by driving the connected I/O line to GND.

Table 4-11. LED Connection

SAML10/SAML11 pin	Function	Silkscreen Text	Schematics Net Name	Shared Functionality
PA07	Yellow LED	LED0	USER_LED	DGI SPI

4.2.4 QTouch Button

One self-capacitance button is available on the Xplained Pro board that can be used as the I/O. The QTouch button is intended to be driven by the built-in Peripheral Touch Controller (PTC) of the device. A resistor is added on the board to easily disconnect the on-board touch buttons from the extension header as the I/O lines are shared between the two.

Note: To get started with QTouch refer to the Atmel QTouch® Library and Atmel QTouch® Composer.

Table 4-12. Qtouch Button Connection

SAML10/SAML11 pin	Function	Silkscreen Text	Schematics Net Name	Shared Functionality
PA06	Self-capacitance QTouch button	QT BTN1	USER_QTOUCH	EXT2

4.3 Embedded Debugger Implementation

The Xplained Pro contains an Embedded Debugger (EDBG) that can be used to program and debug the SAM L10/L11 using Serial Wire Debug (SWD). The Embedded Debugger also includes a virtual CPM port interface over UART, an Atmel Data Gateway Interface over SPI, TWI (I²C), and four of the SAM L10/L11 GPIOs.

Atmel Studio can be used as a front end for the Embedded Debugger.

4.3.1 Serial Wire Debug

The Serial Wire Debug (SWD) uses two pins to communicate with the target. For additional information on how to use the programming and debugging capabilities of the EDBG, refer to the Embedded Debugger User Guide.

Table 4-13. Serial Wire Debug Connection

SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
/RESET	Reset	TARGET_MCU_RESET	X32BUS, USER Reset (RESET)
PA30	Serial Wire Clock	SWCLK	Cortex debug Connector
PA31	Serial Wire Data IN/OUT	SWDIO	Cortex debug Connector

4.3.2 Virtual COM Port

The Embedded Debugger acts as a virtual COM port gateway by using one of the SAM L10/L11 UARTs. For further information on how to use the virtual COM port, refer to the Embedded Debugger User Guide.

Table 4-14. Virtual COM Port Connection

SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
PA25	SERCOM0/PAD[3]/ UART RX	PA25_UART_RX	EXT2
PA24	SERCOM0/PAD[2]/ UART TX	PA24_UART_TX	EXT2

4.3.3 Atmel Data Gateway Interface

The Embedded Debugger features a Microchip Data Gateway Interface (DGI) by using either a SPI or I²C. The DGI can be used to send many data from SAM L10/L11 to the host PC. For additional information on how to use the DGI interface, refer to the Data Gateway Interface User's Guide and EDBG User Guide.

4.3.3.1 DGI Interface Connections When Using SPI

SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
PA07	GPIO / SS	PA07_LED_PWM_TC0	LED0
PA14	SERCOM0/PAD[2]/ SPI MOSI	PA14_S0_SPI_MOSI	EXT1, EXT2, mikroBUS, X32

..........continued			
SAML10/SAML11 pin	**Function**	**Schematics Net Name**	**Shared Functionality**
PA04	SERCOM0/PAD[0]/ SPI MISO	PA04_S0_SPI_MISO	EXT1, EXT2, mikroBUS, X32
PA15	SERCOM0/PAD[3] /SPI SCK	PA15_S0_SPI_SCK	EXT1, EXT2, mikroBUS, X32

4.3.3.2 DGI Interface When Using I²C

SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
PA16	DGI TWI SDA	PA16_S1_I2C_SDA	EXT1, EXT2, mikroBUS, X32, I²C Pull-up, ECC508
PA17	DGI TWI SCL	PA17_S1_I2C_SCL	EXT1, EXT2, mikroBUS, X32, I²C Pull-up, ECC508

Four GPIO lines are connected to the Embedded Debugger. The EDBG can monitor these lines and time stamp the pin value changes. This makes it possible to accurately time stamp events in the application code.

4.3.3.3 GPIO Lines Connected to The EDBG

SAML10/SAML11 pin	Function	Schematics Net Name	Shared Functionality
PA10	DGI_GPIO0	PA10_GPIO1_S2_USART_RTS	EXT1, X32
PA11	DGI_GPIO1	PA11_GPIO2_S2_USART_CTS	EXT1, X32
PA23	DGI_GPIO2	PA23_GPIO_SS	EXT1, mikroBUS
PA27	DGI_GPIO3	PA27_GPIO_SS	EXT2, SW0 user button

4.3.4 Trusted and Secure Authentication Device: ATECC508A

ATECC508A is a secure element from the Microchip CryptoAuthentication portfolio with advanced Elliptic Curve Cryptography (ECC) capabilities.

With ECDH and ECDSA built in, this device is ideal for the rapidly growing IoT market by easily supplying the full range of security features, such as confidentiality, data integrity, and authentication to systems with MCU or MPUs running encryption and decryption algorithms (that is, AES). Similar to all Microchip CryptoAuthentication products, the new ATECC508A employs ultra-secure hardware-based cryptographic key storage and cryptographic counter measures which are robust than the software-based key storage.

For additional information, refer to the ATECC508A document which is available for download at https://www.microchip.com/wwwproducts/en/ATECC508A.

The connection between SAM L10/L11 and the ATECC508A requires only two I²C wires that are summarized in the following table:

Table 4-15. ATECC508A Connections

SAML10/L11 pin	Function	Schematics Net Name	Shared Functionality
PA16	I2C_SDA	PA16_S1_I2C_SDA	EXT1, EXT2, DGI I²C, mikroBUS, X32, I^{2}C pull-up
PA17	I2C_SCL	PA17_S1_I2C_SCL	EXT1, EXT2, DGI I²C, mikroBUS, X32, I^{2}C pull-up

5.   XAM Configuration

On the SAM L10/SAM L11 Xplained Pro, the MCU and the MCU peripherals (for example, extensions) are powered by its own regulator as shown in the following figure. All other parts of the board, specifically the embedded debugger and accompanying Xplained Pro Analog Module (XAM), are powered from a separate regulator. The current to the MCU and peripherals can be measured by connecting them to the XAM output through the jumper settings.

Figure 5-1. XAM
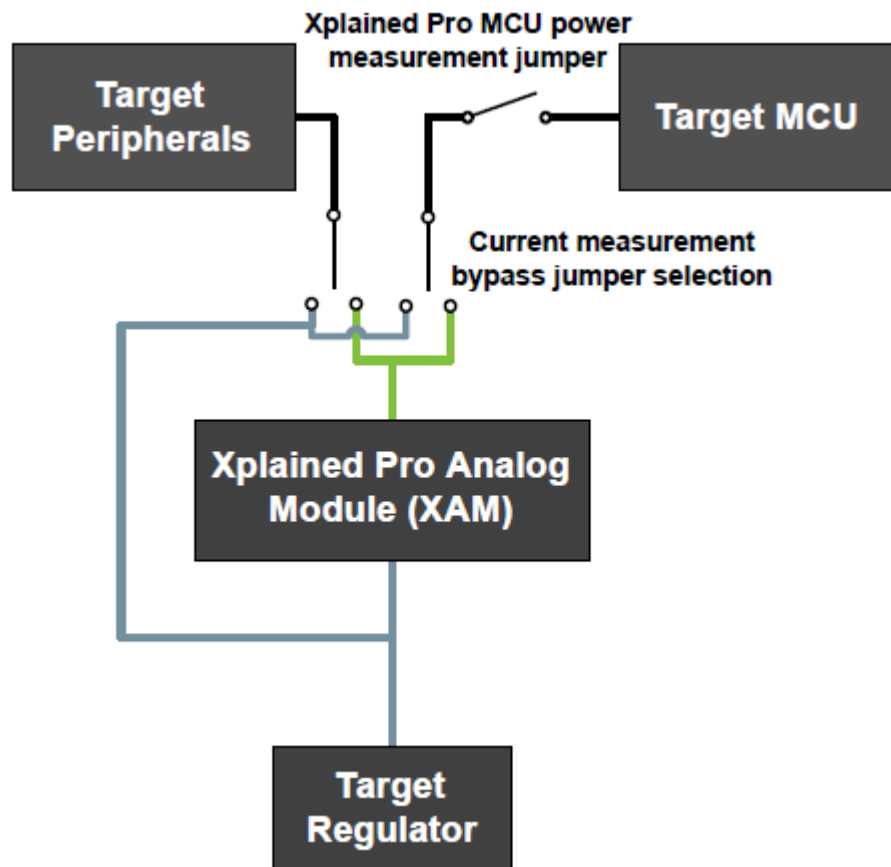
On the Xplained Pro, the XAM can be used in the following four configurations:

- **No current measurement or external MCU current measurement:** The XAM is bypassed and the MCU and peripherals are supplied by the regulator. Set both the jumpers in the BYPASS position. In this configuration, it is also possible to connect external measurement tools on the Xplained Pro MCU power measurement header to measure MCU current directly instead of using the XAM.
- **MCU current measurement:** The XAM measures only the MCU current while the peripherals are supplied by the regulator. For this configuration, place the jumper for the I/O (peripherals) into the BYPASS position and the MCU into the MEASURE position.
- **Peripherals measurement:** The XAM measures only the current of the peripherals while the MCU is supplied by the regulator. For this configuration place the jumper for MCU into the BYPASS position and the I/O jumper into the MEASURE position.
- **MCU and peripherals measurement:** In this configuration both the MCU and the peripherals are measured by the XAM. Place both the jumpers on I/O and MCU headers in the MEASURE position.

6. Identifying Product ID and Revision

The revision and product identifier of Xplained Pro boards can be found in two ways: either through Atmel Studio or by looking at the sticker on the bottom of the PCB. By connecting an Xplained Pro MCU board to a computer with Atmel Studio running, an information window will pop up. The first six digits of the serial number, which is listed under kit details, contain the product identifier and revision. Information about connected Xplained Pro extension boards will also appear in the Atmel Kit's window. The same information can be found on the sticker on the bottom side of the PCB. Most kits will print the identifier and revision in plain text as A09-nnnn\rr, where nnnn is the identifier and rr is the revision. Boards with limited space have a sticker with only a QR-code, which contains a serial number string. The serial number string has the following format:

"nnnnrrssssssssss"

n = product identifier

r = revision

s = serial number

7. Revision History

Revision C
April, 2019

Section	Updates
Xplained Pro Extension Headers	Updated Shared Functionality in row 10 of the Extension Header EXT1 Table.
mikroBUS Header	Updated mikroBUS Pin [RST] in the table mikroBUS Header.
Serial Wire Debug	Removed erroneous mikroBUS reference from the Serial Wire Debug Connection table.
GPIO Lines Connected to the EDGB	Updated the Shared Functionality for Pin PA23 in the table.

Revision B
June, 2018

Removed errata section.

Revision A
May, 2018

Initial version of the document.

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