

Preface

Atmel® ATBTLC1000 Xplained Pro is an extension board in the Atmel Xplained Pro evaluation platform. It is designed to demonstrate ultra-low power Bluetooth® SMART (BLE 4.1) ATBTLC1000 together with Xplained Pro MCU boards.



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1. Introduction

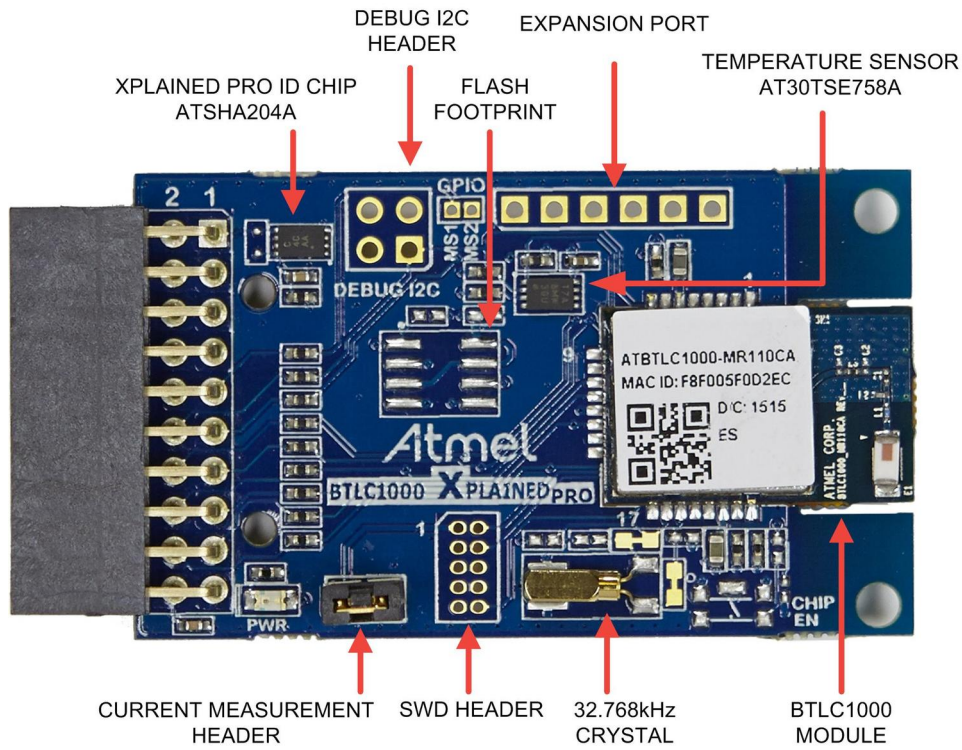
1.1. Features

- ATBTLC1000-MR110CA Bluetooth module
 - Complies with Bluetooth V4.1, ETSI EN 300 328 and EN 300 440 Class 2, FCC CFR47 Part 15, and ARIB STD-T66
 - ARM® Cortex®-M0 32-bit processor
- AT30TSE758A Digital Temperature Sensor
 - Integrated temperature sensor + nonvolatile registers + serial EEPROM
 - 2-Wire I²C and SMBus compatible serial interface
- Xplained Pro hardware identification system using ATSHA204A
- Power LED
- Power debugger support using current measurement header
- Provision for external flash (footprint only). Recommended MPN: IS25LD020-JNLE.
- Debug I²C header
- Debug UART/SPI extension port
- CHIP EN switch for ATBTLC1000 module (footprint only)
- SWD header
- 32kHz crystal

1.2. Kit Overview

The Atmel ATBTLC1000 Xplained Pro is an extension board containing the Atmel ultra-low power Bluetooth module *ATBTLC1000-MR110CA* for the Xplained Pro platform. The kit can be connected to any extension header on an Xplained Pro MCU Board.

Figure 1-1. ATBTLC1000 Xplained Pro Extension Board



2. Getting Started

2.1. Xplained Pro Quick Start

Steps to start exploring the Atmel Xplained Pro platform:

1. Download [Atmel Studio](#).
2. Launch Atmel Studio.
3. Connect a USB cable (Standard-A to Micro-B or Micro-AB) between the PC and the DEBUG USB port on the kit.
4. Connect ATBTLC1000 Xplained Pro to an Xplained Pro MCU board and connect a USB cable to the DEBUG USB port on the Xplained Pro MCU board.

When the Xplained Pro MCU kit is connected to your computer for the first time, the operating system will perform a driver software installation. The driver file supports both 32- and 64-bit versions of Microsoft® Windows® XP, Windows Vista®, Windows 7, Windows 8, Windows 10, and Windows Server 2012.

Once the Xplained Pro MCU board is powered the green power LED will be lit and Atmel Studio will auto detect which Xplained Pro MCU- and extension board(s) are connected. Atmel Studio will present relevant information like datasheets and kit documentation. The kit landing page in Atmel Studio also has the option to launch Atmel Software Framework (ASF) example applications for the kit. The target device is programmed and debugged by the on-board Embedded Debugger and therefore no external programmer or debugger tool is needed.

3. Design Documentation and Relevant Links

The following list contains links to the most relevant documents and software for ATBTLC1000 Xplained Pro:

- [Xplained products](#) - Atmel Xplained evaluation kits are a series of easy-to-use evaluation kits for Atmel microcontrollers and other Atmel products. For low pin-count devices the Xplained Nano series provides a minimalistic solution with access to all I/O pins of the target microcontroller. Xplained Mini kits are for medium pin-count devices and adds Arduino Uno compatible header footprint and a prototyping area. Xplained Pro kits are for medium to high pin-count devices, they features advanced debugging and standardized extensions for peripheral functions. All these kits have on board programmers/debuggers which creates a set of low-cost boards for evaluation and demonstration of features and capabilities of different Atmel products.
- [Atmel Studio](#) - Free Atmel IDE for development of C/C++ and assembler code for Atmel microcontrollers.
- [EDBG User Guide](#) - User guide containing more information about the on-board Embedded Debugger.
- [Atmel Data Visualizer](#) - Atmel Data Visualizer is a program used for processing and visualizing data. Data Visualizer can receive data from various sources such as the Embedded Debugger Data Gateway Interface found on Xplained Pro boards and COM ports.
- [Atmel Software Framework](#) - MCU software library providing a large collection of embedded software for Atmel flash MCUs.
- [Hardware Users Guide in PDF format](#) - PDF version of this User Guide.
- [Design Documentation](#) - Package containing CAD source, schematics, BOM, assembly drawings, 3D plots, layer plots etc.
- [ATBTLC1000 Xplained Pro on Atmel website](#) - Atmel website link.
- [ATBTLC1000 BluSDK](#) - Software, firmware, applications, and tools packages. Located in the software section of the page.

4. Xplained Pro

Xplained Pro is an evaluation platform that provides the full Atmel microcontroller experience. The platform consists of a series of Microcontroller (MCU) boards and extension boards, which are integrated with Atmel Studio, have Atmel Software Framework (ASF) drivers and demo code, support data streaming, and more. Xplained Pro MCU boards support a wide range of Xplained Pro extension boards, which 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, datasheets, and example code through Atmel Studio.

4.1. Hardware Identification System

All Xplained Pro compatible extension boards have an Atmel ATSHA204 CryptoAuthentication™ chip mounted. This chip contains information that identifies the extension with its name and some extra data. When an Xplained Pro extension is connected to an Xplained Pro MCU board the information is read and sent to Atmel Studio. The Atmel Kits extension, installed with Atmel Studio, will give relevant information, code examples, and links to relevant documents. The table below shows the data fields stored in the ID chip with example content.

Table 4-1. 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

4.2. Xplained Pro Standard Extension Header

All Xplained Pro kits have one or more dual row, 20-pin, 100mil extension header. Xplained Pro MCU boards have male headers, while Xplained Pro extensions have their female counterparts. Note that all pins are not always connected. All connected pins follow the defined pin-out description in the table below.

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 4-2. Xplained Pro Standard Extension Header

Pin number	Name	Description
1	ID	Communication line to the ID chip on an extension board
2	GND	Ground

Pin number	Name	Description
3	ADC(+)	Analog to digital converter, alternatively positive part of differential ADC
4	ADC(-)	Analog to digital converter, alternatively negative part of differential ADC
5	GPIO1	General purpose I/O
6	GPIO2	General purpose I/O
7	PWM(+)	Pulse width modulation, alternatively positive part of differential PWM
8	PWM(-)	Pulse width modulation, 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	I ² C_SDA	Data line for I ² C interface. Always implemented, bus type.
12	I ² C_SCL	Clock line for I ² 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	Slave select for SPI. Should preferably be unique.
16	SPI_MOSI	Master out slave in line of serial peripheral interface. Always implemented, bus type.
17	SPI_MISO	Master in slave out line of serial peripheral interface. Always implemented, bus type.
18	SPI_SCK	Clock for serial peripheral interface. Always implemented, bus type.
19	GND	Ground
20	VCC	Power for extension board

5. Hardware Users Guide

5.1. Electrical Characteristics

ATBTLC1000 Xplained Pro can be connected to several Xplained Pro MCU boards and manually connected to other hardware. Xplained Pro MCU board(s) that does not have 3.3V as its primary target voltage will read all ID devices on connected extensions to check if they support the target voltage before enabling it to the extension headers. The table below shows the static content written in the ID chip.

Table 5-1. ATBTLC1000 Xplained Pro ID Chip Content

Data field	Content
Product name	ATBTLC1000-XPRO
Minimum operation voltage	1.8V
Maximum operation voltage	3.6V
Maximum current	10mA

Related Links

[Hardware Identification System](#) on page 7

5.2. Headers and Connectors

5.2.1. ATBTLC1000 Xplained Pro Extension Header

ATBTLC1000 Xplained Pro implements one Xplained Pro Standard Extension Header marked with EXT1 in silkscreen. This header makes it possible to connect the board to an Xplained Pro MCU board. The pin-out definition for the extension header can be seen in the table below.

Table 5-2. ATBTLC1000 Xplained Pro Extension Header EXT1

Pin on EXT1	Function	Description
1	ID	Communication line to the ID chip
2	GND	Ground
3	NC	Not Connected
4	NC	Not Connected
5	NC	Not Connected
6	GPIO/WAKE	Always-on External Wakeup
7	NC	Not Connected
8	PWM-/RTC_CLKP	32.768kHz RTC Clock (optional feature)
9	GPIO_MS1	Mixed signal/Analog interface pin
10	GPIO/CHIP_EN	Master Enable for chip
11	TWI_SDA	I ² C SDA

Pin on EXT1	Function	Description
12	TWI_SCL	I ² C SCL
13	UART_TX	UART TX
14	UART_RX	UART RX
15	SPI_SS_A	SPI SS
16	SPI_MOSI	SPI MOSI
17	SPI_MISO	SPI MISO
18	SPI_SCK	SPI Clock
19	GND	Ground
20	VCC	Target supply voltage

Related Links

[Xplained Pro Standard Extension Header](#) on page 7

5.2.2. Current Measurement Header

Current Measurement header *J101* can be used to measure the current consumed by the ATBTLC1000 module using an ammeter. The two 0Ω resistors *R112* and *R113* can be removed to measure the current consumed by individual power rails *VDDIO* and *VBAT* respectively by soldering in wires for an ammeter.

5.2.3. Debug Connectors

Debug I²C (J104) and Extension port (J105) are not mounted on the board. Extension port J105 can be configured as Debug UART or as SPI to connect to external sensors. Refer to the ATBTLC1000-MR110CA datasheet for reference.

Table 5-3. Debug I²C Connector

Pin on I ² C connector	Pin on ATBTLC1000 module	Function
1	8	I ² C SCL
2	1	Ground
3	7	I ² C SDA
4	-	Not Connected

Table 5-4. Extension Port

Pin on Extension Port	Pin on ATBTLC1000 module	Function
1	4	UART RX/ SPI SCK
2	5	UART TX/SPI MOSI
3	21	DBG_UART_RX/SPI SSN
4	23	DBG_UART_TX/SPI MISO
5	1	Ground
6	1	Ground

5.3. Peripherals

5.3.1. External Flash

ATBTLC1000 Xplained Pro provides a footprint for an external flash (U103), the design is tested with an ISSI *IS25LD020-JNLE* 2Mb flash. By default the flash is connected to the SPI Master/Slave interface of the ATBTLC1000 module, which is also connected to the Xplained Pro extension header.

The SPI Flash master interface of the ATBTLC1000 can also be used to control the external flash by reconfiguring the jumper straps (J109-J112) as below.

External flash Configuration 1: ATBTLC1000 SPI0 peripheral connected (default)
Short straps J109, J110, J111, and J112
Open straps J113, J114, J115, and J116

External flash Configuration 2: ATBTLC1000 SPI flash peripheral connected
Short straps J113, J114, J115, and J116
Open straps J109, J110, J111, and J112

Refer to [Design Documentation](#) and the ATBTLC1000-MR110CA datasheet for further reference.

Table 5-5. External Flash Pin Configuration

External flash		Configuration 1, ATBTLC1000 signals			Configuration 2, ATBTLC1000 signals		
Pin	Name	Pin	Name	Function	Pin	Name	Function
1	CE#	12	LP_GPIO_12	SPI0_SSN	21	LP_GPIO_16	SPI Flash SSN
2	SO	14	LP_GPIO_13	SPI0_MISO	23	LP_GPIO_18	SPI Flash RxD
5	SIO	11	LP_GPIO_11	SPI0_MOSI	5	LP_GPIO_3	SPI Flash TxD
6	SCK	10	LP_GPIO_10	SPI0_SCK	4	LP_GPIO_2	SPI Flash SCK

5.3.2. Temperature Sensor

The ATBTLC1000 Xplained Pro extension board features an Atmel AT30TSE758 temperature sensor with an 8kb serial EEPROM inside. The sensor includes programmable high and low temperature alarms, user-selectable temperature resolution up to 12 bits, and an I²C/SMBus™ compatible serial interface.

Table 5-6. Temperature Sensor Connections

Pin on EXT connector	Pin name	AT30TSE758 temperature sensor pin	Comment
11	SDA	1	Data line of serial interface
12	SCL	2	Clock line of serial interface
-	ALERT	3	Temperature alarm signaling pin
2, 19	GND	4	
-	A2	5	Address line for serial interface, shorted to GND
-	A1	6	Address line for serial interface, shorted to GND

Pin on EXT connector	Pin name	AT30TSE758 temperature sensor pin	Comment
-	A0	7	Address line for serial interface, shorted to GND
20	VCC	8	

The temperature sensor has two I²C addresses; one for the temperature sensor and one for the EEPROM. The addresses are "0b1001 A2 A1 A0" for the temperature sensor and "0b1010 A2 A1 A0" for the EEPROM. The address selection lines (A2, A1, and A0) of the temperature sensor are shorted to GND, which makes the default addresses 0b1001000 and 0b1010000. When communicating with the EEPROM parts of the TWI address is used as a page address. For more details, see the device (AT30TSE752A/754A/758A) [datasheet](#).

5.3.3. Power LED

Power LED (D101) is connected to the power rail from the extension header. Current measurement jumper has to be closed to enable power to the ATBTLC1000 module.

5.3.4. Reset Switch

ATBTLC1000-XPRO contains footprint of switch (SW100) along with resistor R111 and capacitor C107 that can be mounted to reset the ATBTLC1000. The switch is connected to the CHIP_EN pin of the ATBTLC1000, which is pulled up by default.

5.3.5. 32kHz RTC Oscillator

The ATBTLC1000 has a 32.768kHz RTC oscillator that is used for BLE activities involving connection events. There is also provision to reconfigure the ATBTLC1000 Xplained Pro board to bypass external crystal oscillator with an external signal capable of driving 2pF on the RTC_CLK_P pin of the ATBTLC1000-MR110CA.

Table 5-7. Configuring the RTC Oscillator

Configuration option	Board configuration
32.768kHz RTC oscillator	Open R105, Close J107
External signal on RTC_CLK_P	Close R105, Open J107, J106

6. Hardware Revision History and Known Issues

6.1. 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 side 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:

```
"nnnnrrssssssss"  
n = product identifier  
r = revision  
s = serial number
```

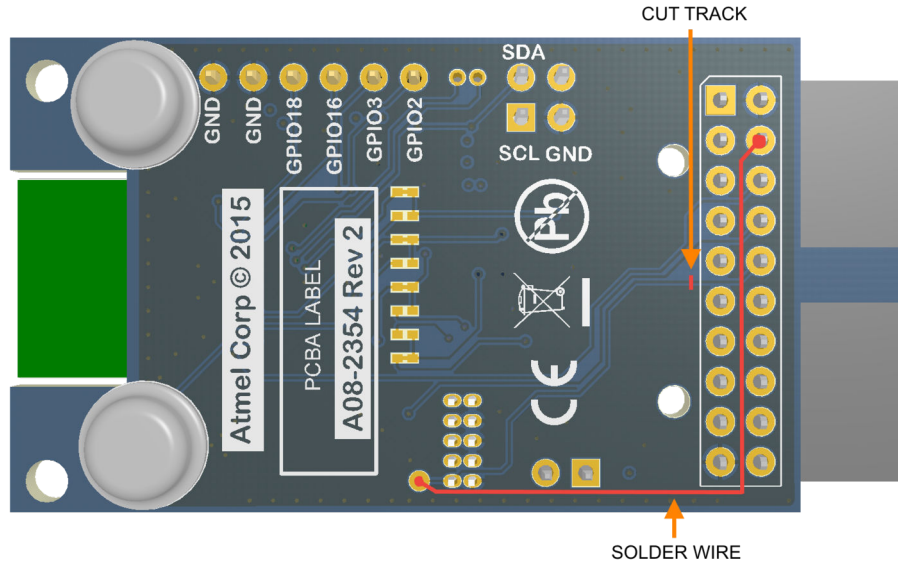
The product identifier for ATBTLC1000 Xplained Pro is A09-2528.

6.2. Revision 2

Revision 2 is the initially released revision.

ATBTLC1000 Xplained Pro revision 2 is partially incompatible with SAM L21 Xplained Pro extension header EXT1, pin 10 (Chip Enable) is shared with the user button SW0 on the SAM L21 Xplained Pro. A workaround for the incompatibility is to modify the kit by cutting a track in the PCB from pin 10, and soldering a wire from a test point to pin 4, of the Xplained Pro extension header as shown in the image below.

Figure 6-1. Chip Enable Workaround



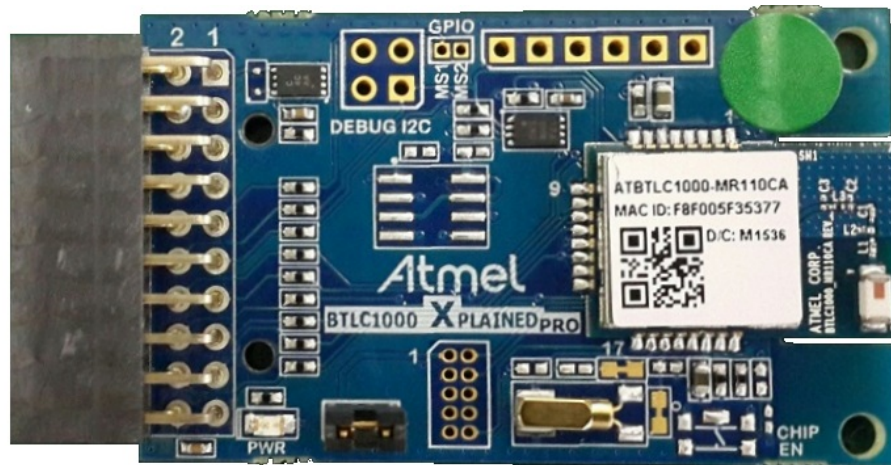
When the modification is done the pin-out table in [Table 5-2 ATBTLC1000 Xplained Pro Extension Header EXT1](#) is changed according to the table below.

Table 6-1. ATBTLC1000 Xplained Pro Extension Header EXT1 Modification

Pin on EXT1	Function	Description
4	GPIO/CHIP_EN	Master Enable for chip
10	NC	Not Connected

Some ATBTLC1000 Xplained Pro kits are already modified according to the instructions above, these kits are marked with a green, round, sticker in the upper right corner as shown in the picture below.

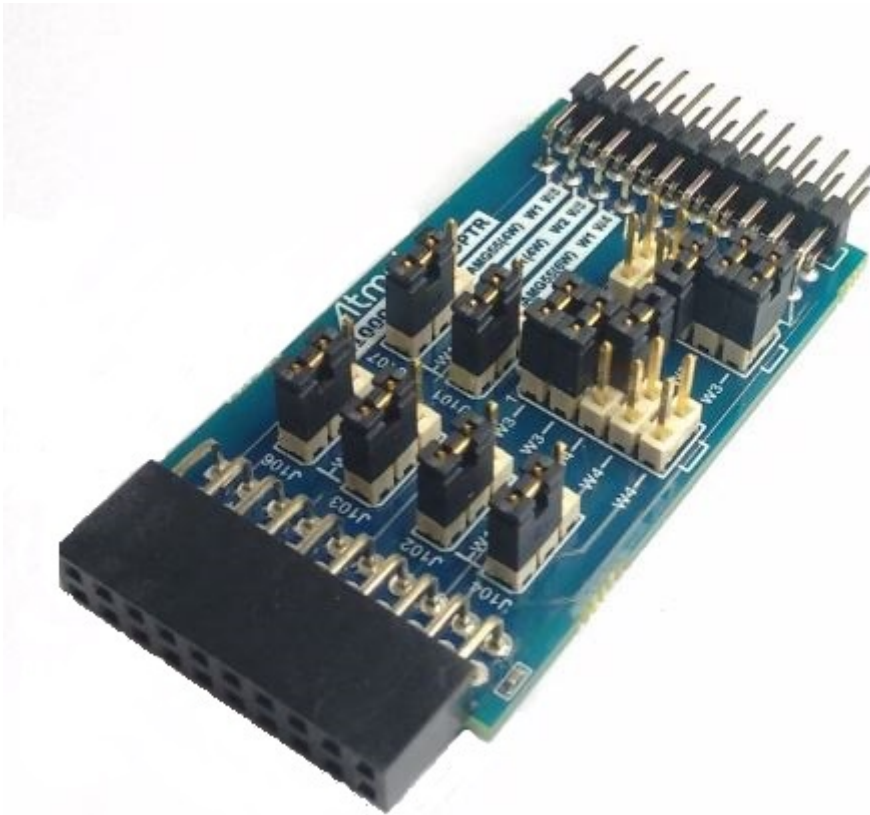
Figure 6-2. Modified ATBTLC1000 Xplained Pro Kits



7. ATBTLC1000XPRO-ADP Adapter Board

7.1. Kit Overview

The Atmel ATBTLC1000XPRO-ADP is an adapter board designed for ATBTLC1000 Xplained Pro with ATBTLC1000-MR110CA Bluetooth module. It is designed to allow direct connection of the ATBTLC1000 Xplained Pro with different Xplained Pro MCU boards for providing UART hardware flow control functionality.



7.2. Need for the Kit

Due to the non-standard mapping of the UART flow control lines on the extension headers, the ATBTLC1000 Xplained Pro is incompatible for direct connection with some Xplained Pro platforms. Loose wire connections are required between the Xplained Pro boards and the ATBTLC1000 Xplained Pro extension board to support the UART flow control functionality.

The adapter board has been designed to avoid these loose wire connections. It has jumper configurations to support this functionality across different Xplained Pro MCU boards. The Xplained Pro boards and the corresponding UART flow control mode supported by the adapter board is shown in the table below.

Table 7-1. Xplained Pro Boards Support

XPLAINED PRO BOARD	UART FLOW CONTROL MODE
SAM L21 Xplained Pro	4-Wire Mode
SAM D21 Xplained Pro	4-Wire Mode
SAM 4S Xplained Pro	4-Wire Mode
SAM G55 Xplained Pro	4-Wire and 6-Wire Mode

7.3. Hardware

The ATBTLC1000XPRO-ADP adapter board has the following headers:

- Female Extension header (J100) - 1
- Male Extension header (J105) - 1
- 1x3 Pin headers (J101, J102, J103, J104, J106, J107) - 6
- 2x5 Pin headers (J108, J109) - 2

The adapter board can be connected to several Xplained Pro MCU boards using a female extension header. The male extension header is used to connect it to the ATBTLC1000 Xplained Pro.

The jumpers on the pin headers have to be placed, based on the Xplained Pro board used and the UART Flow Control mode of the ATBTLC1000 Xplained Pro (6-Wire mode or 4-Wire mode) as shown in the table below.

Table 7-2. Jumper Placement on Headers

JUMPERS	SAML21:4-Wire	SAMD21:4-Wire	SAM4S:4-Wire	SAMG55:4-Wire	SAMG55:6-Wire
J101	J2-3	J2-3	J1-2	J1-2	J1-2
J102	J2-3	J2-3	J1-2	J1-2	J1-2
J103	J2-3	J2-3	J1-2	J1-2	J1-2
J104	J2-3	J2-3	J1-2	J1-2	J1-2
J106	J2-3	J2-3	J1-2	J1-2	J1-2
J107	J2-3	J2-3	J1-2	J1-2	J1-2
J108	J1-2,J3-4	J1-2,J3-4	J1-2,J3-4	J1-2,J3-4	J5-6,J7-8,J9-10
J109	J1-2,J3-4	J1-2,J3-4	J1-2,J3-4	J1-2,J3-4	J5-6,J7-8,J9-10

8. Document Revision History

Doc. rev.	Date	Comment
42538C	05/2016	Added ATBTLC1000XPRO-ADP Adapter Board chapter.
42538B	11/2015	Added revision 2 ERRATA. Added temperature sensor, and electrical characteristics chapter. Updated the external flash chapter.
42538A	09/2015	Initial document release.

9. Evaluation Board/Kit Important Notice

This evaluation board/kit is intended for use for **FURTHER ENGINEERING, DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY**. It is not a finished product and may not (yet) comply with some or any technical or legal requirements that are applicable to finished products, including, without limitation, directives regarding electromagnetic compatibility, recycling (WEEE), FCC, CE or UL (except as may be otherwise noted on the board/kit). Atmel supplied this board/kit "AS IS", without any warranties, with all faults, at the buyer's and further users' sole risk. The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies Atmel from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge and any other technical or legal concerns.

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