MICROCHIP

ATBTLC1000ZR-XPRO

ATBTLC1000ZR Xplained Pro User's Guide

Description

The ATBTLC1000ZR Xplained Pro is an extension board in the Xplained Pro evaluation platform. It is designed to demonstrate ultra-low power Bluetooth® Low Energy ATBTLC1000-ZR110CA module together with Xplained Pro MCU boards.
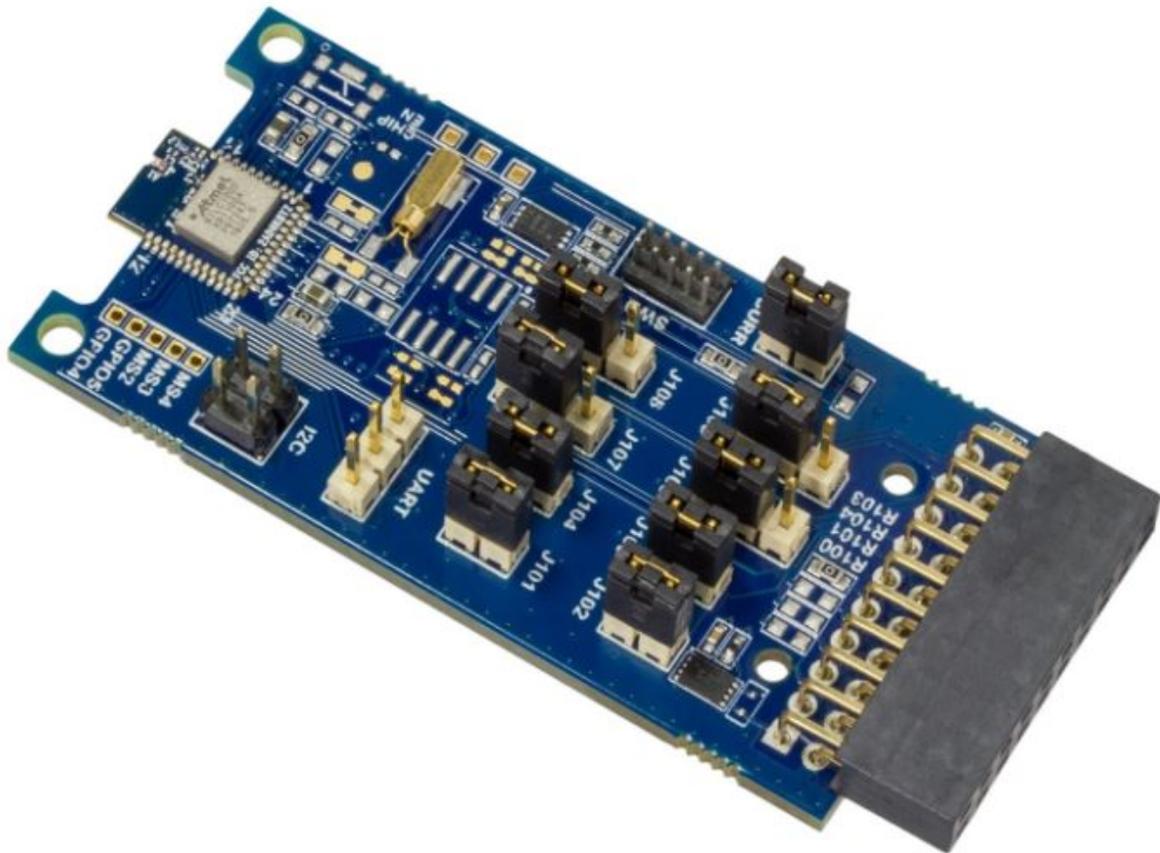
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1. Introduction

1.1 Features

- ATBTLC1000-ZR110CA BLE Module:
    - ARM® Cortex®-M0 32-bit processor
- AT30TSE758A Digital Temperature Sensor:
    - Integrated with temperature sensor, non-volatile registers and serial EEPROM
    - 2-Wire I^{2}C and SMBus compatible serial interface
- Xplained Pro hardware identification system using ATSHA204A
- Power debugger support using current measurement header
- Pin headers and jumpers to connect the board to various Xplained Pro MCU boards
- Serial Wire Debugger (SWD) header
- 32.768 kHz crystal

1.2 Kit Overview

The ATBTLC1000ZR Xplained Pro is an extension board containing the ultra-low power Bluetooth module ATBTLC1000-ZR110CA for the Xplained Pro platform. The kit can be connected to the EXT1 extension header on an Xplained Pro MCU Board.

Figure 1-1. ATBTLC1000ZR Xplained Pro Extension board
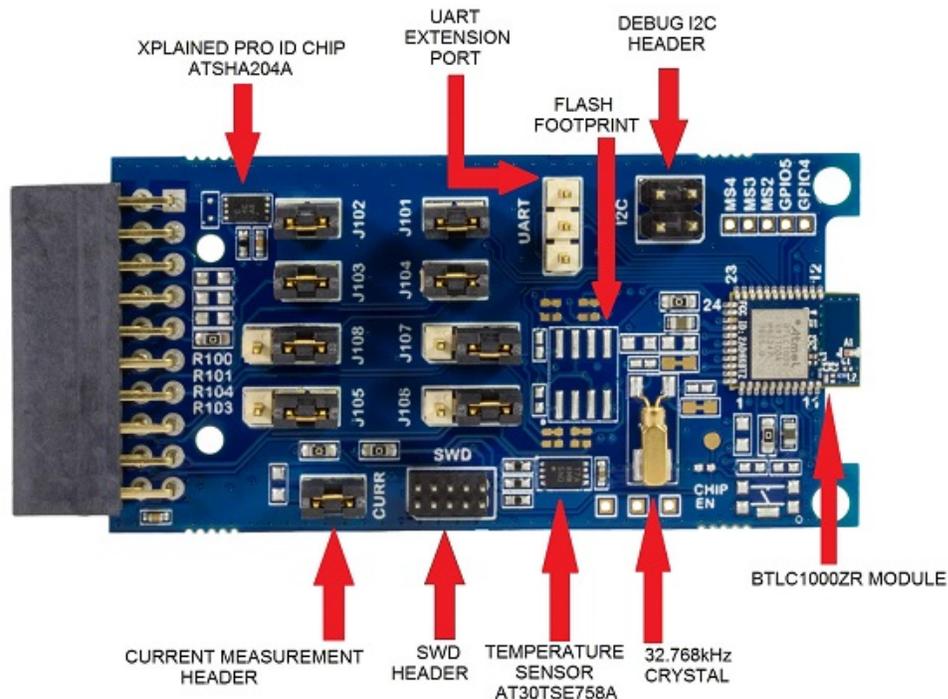
2. Getting Started

2.1 Xplained Pro Quick Start

Steps to start exploring the Xplained Pro platform:

1. Download Atmel Studio.
2. Launch Atmel Studio.
3. Connect ATBTLC1000ZR Xplained Pro extension board with 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 the computer for the first time, the operating system installs the software driver. The driver file supports 32-bit and 64-bit versions of Microsoft$^®$ Windows$^®$ XP, Windows Vista$^®$, Windows 7, Windows 8, Windows 10, and Windows Server 2012.

When the Xplained Pro MCU board is powered, the power LED (green color) glows and Atmel Studio automatically detects the specific Xplained Pro MCU and extension board(s) that are connected. The kit landing page in Atmel Studio comes with an option to launch the Advanced Software Framework (ASF) and Atmel START, example application codes 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 required.

3. Design Documentation and Relevant Links

The following list contains the links to the most relevant documents and software for ATBTLC1000ZR Xplained Pro:

- **Xplained Pro products** - Xplained Pro is a series of small-sized and easy-to-use evaluation kits for Microchip microcontrollers and other Microchip products. It consists of a series of low-cost MCU boards for evaluation and demonstration of features and capabilities of different Microchip products.
- **Atmel Studio** - Free IDE for development of C/C++ and assembler code for microcontrollers.
- **Data Visualizer** - Data Visualizer is a program used for processing and visualizing data. The Data Visualizer can receive data from various sources such as the Embedded Debugger Data Gateway Interface found on Xplained Pro boards and COM ports.
- **ATBTLC1000ZR Xplained Pro Design Documentation** - Package containing schematics, BOM, assembly drawings, 3D plots, layer plots, etc.
- **ATBTLC1000ZR Xplained Pro BluSDK** - Software, firmware, applications, and tools packages.

4. Xplained Pro

Xplained Pro is an evaluation platform which contains a series of microcontroller boards (evaluation kits) and extension boards. Atmel Studio is used to program and debug the microcontrollers on these boards. Atmel Studio includes ASF and Atmel START, which has drivers and demo code, and Data Visualizer, which supports data streaming and advanced debugging. Xplained Pro evaluation kits can be connected to a wide range of Xplained Pro extension boards through standardized headers and connectors. Xplained Pro extension boards have identification (ID) chips to uniquely identify which boards are connected to the Xplained Pro evaluation kits.

4.1 Xplained Pro Standard Extension Header

All Xplained Pro kits have one or more dual row, 20-pin, 100-mil extension header. The Xplained Pro MCU boards have male headers, while the Xplained Pro extensions have their female counterparts. All connected pins follow the defined pin description in the table.

> **i** **Info:** All pins are not always connected on all extension headers.

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 microcontroller on Xplained Pro MCU boards directly.

Table 4-1. Xplained Pro Standard Extension Header

Pin Number	Pin Name	Description
1	ID	Pin to communicate with the ID chip on an extension board
2	GND	Ground
3	ADC(+)	Analog-to-Digital Converter; alternatively, a pin for the positive terminal of a differential ADC
4	ADC(-)	Analog-to-Digital Converter; alternatively, a pin for the negative terminal of a differential ADC
5	GPIO1	General purpose I/O pin
6	GPIO2	General purpose I/O pin
7	PWM(+)	Pulse width modulation; alternatively, a pin for the positive part of a differential PWM
8	PWM(-)	Pulse width modulation; alternatively, a pin for the negative part of a differential PWM
9	IRQ/GPIO	Interrupt request pin and/or general purpose I/O pin
10	SPI_SS_B/ GPIO	Slave select pin for Serial Peripheral Interface (SPI) and/or general purpose I/O pin
11	I^{2}C_SDA	Data pin for I^{2}C interface. Always connected, bus type

Pin Number	Pin Name	Description
12	I^{2}C_SCL	Clock pin for I^{2}C interface. Always connected, bus type
13	UART_RX	Receiver pin of target device UART
14	UART_TX	Transmitter pin of target device UART
15	SPI_SS_A	Slave select for SPI. This pin should preferably not be connected to anything else.
16	SPI_MOSI	SPI master out slave in pin. Always connected, bus type
17	SPI_MISO	SPI master in slave out pin. Always connected, bus type
18	SPI_SCK	SPI clock pin. Always connected, bus type
19	GND	Ground pin for extension boards
20	VCC	Power pin for extension boards

4.2   Hardware Identification System

All Xplained Pro extension boards come with an identification chip (ATSHA204A CryptoAuthentication™ chip) to uniquely identify the boards that are connected to the Xplained Pro evaluation kit. 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 evaluation kit, the information is read and sent to Atmel Studio. The following table shows the data fields stored in the ID chip with example content.

Table 4-2. 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

5. Hardware User's Guide

5.1 ID Chip Content

The ATBTLC1000ZR 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 reads all ID devices on connected extensions to check if they support the target voltage before enabling it to the extension headers. The table provides the static content written in the ID chip.

Table 5-1. ATBTLC1000ZR Xplained Pro ID Chip Content

Data field	Content
Product name	ATBTLC1000ZR-XPRO
Minimum operation voltage	1.8V
Maximum operation voltage	3.3V
Maximum current	10mA

Related Links

4.2 Hardware Identification System

5.2 Headers and Connectors

5.2.1 Extension Header

The ATBTLC1000ZR Xplained Pro implements one Xplained Pro Standard Extension Header (female) which makes it possible to connect the board to an Xplained Pro MCU board. The table provides pin description for the extension header.

Table 5-2. ATBTLC1000ZR Xplained Pro Extension Header EXT1

Pin on EXT1	Function	Description
1	ID	Communication line to the ID chip
2	GND	Ground
3	WAKE	Always-on External Wakeup
4	AO_GPIO_1	General purpose I/O pin
5	UART_CTS	UART CTS
6	UART_RTS	UART RTS
7	CHIP_EN	Master Enable for chip
8	EXT_CLK_ RTC	32.768 kHz RTC Clock (optional feature)
9	GPIO_MS1	Mixed signal/Analog interface pin
10	LP_GPIO_16	General purpose I/O pin
11	TWI_SDA	I^2C SDA of AT30TSE758A

Pin on EXT1	Function	Description
12	TWI_SCL	I^{2}C SCL of AT30TSE758A
13	UART_TXD	UART TX
14	UART_RXD	UART RX
15	SPI_SS_A/ UART_TXD	SPI SS or UART TX
16	SPI_MOSI/ UART_CTS	SPI MOSI or UART CTS
17	SPI_MISO/ UART_RXD	SPI MISO or UART RXD
18	SPI_SCK/ UART_RTS	SPI Clock or UART RTS
19	GND	Ground
20	VCC	Target supply voltage

Info: Pins 15,16,17,18 can be configured as either UART or SPI on the host MCU.

Related Links

4.1 Xplained Pro Standard Extension Header

5.2.2 Current Measurement Header

Current Measurement header *J109* can be used to measure the current consumed by the ATBTLC1000-ZR110CA module using an ammeter. The two 0Ω resistors *R111* and *R112* 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 Jumper Configuration on Pin headers

The ATBTLC1000 ZR Xplained Pro has few pin headers and jumpers to configure UART(with flow control) or SPI interface with different pins on the extension header of the Xplained Pro MCU board. The headers provided for this purpose are:

- 1x2 Pin headers (J101, J102, J103, J104) - 4
- 1x3 Pin headers (J105, J106, J107, J108) - 4

The pin headers and its functionality are mentioned in the table.

Table 5-3. Pin Headers and Functions

Pin on EXT1	Pin headers	Function
5	J101	UART_CTS
6	J102	UART_RTS
13	J104	UART_TXD

Pin on EXT1	Pin headers	Function
14	J103	UART_RXD
15	J108	SPI_SS/UART_TXD
16	J107	SPI_MOSI/UART_CTS
17	J105	SPI_MISO/UART_RXD
18	J106	SPI_SCK/UART_RTS

Note: The pins 15,16,17,18 can be configured as either UART or SPI.

These pin headers and jumpers makes it possible to connect the extension board to many Xplained Pro MCU boards. It can be configured in any one of the ways as mentioned in the table.

Table 5-4. Jumper Configuration on Pin headers

Functionality	Pins on EXT1	Pin headers	Jumper Placement
UART	5,6,13,14	J101,J102,J103,J104	J1-2
UART	15,16,17,18	J105,J106,J107,J108	J2-3
SPI	15,16,17,18	J105,J106,J107,J108	J1-2

5.2.4 Debug Connectors

Debug I^{2}C (J120) and Extension port (J118) are mounted on the board.

Table 5-5. Debug I^{2}C Connector

Pin on I^{2}C connector	Pin on ATBTLC1000ZR module	Function
1	5	DEBUG I^{2}C SCL
2	26	Ground
3	4	DEBUG I^{2}C SDA
4	-	Not Connected

Table 5-6. Extension Port

Pin on Extension Port	Pin on ATBTLC1000ZR module	Function
1	18	DEBUG_UART_RXD
2	19	DEBUG_UART_TXD
3	26	Ground

Note:

BluSDK does not support debug information through debug I^{2}C and debug UART. Debug I2C and debug UART headers are placeholders for future usage.

5.3 Peripherals

5.3.1 External Flash

The ATBTLC1000ZR Xplained Pro provides a footprint for an external Flash (U101). By default the Flash is connected to the SPI Master/Slave interface of the ATBTLC1000-ZR110CA module, which is also connected to the Xplained Pro extension header.

The SPI Flash master interface of the ATBTLC1000ZR XPRO can also be used to control the external Flash by reconfiguring the jumper straps (J110-J117) as provided in the following configurations.

External Flash Configuration 1:   Short straps J110, J112, J115, and J117

Open straps J111, J113, J114, and J116

External Flash Configuration 2:   Short straps J111, J113, J114, and J116

Open straps J110, J112, J115, and J117

Table 5-7. External Flash Pin Configuration

External Flash		Configuration 1, ATBTLC1000ZR-XPRO signals		Configuration 2, ATBTLC1000ZR-XPRO signals	
Pin	**Name**	**Pin**	**Function**	**Pin**	**Function**
1	CE#	24	SPI_SS	20	UART_CTS
2	SO	25	SPI_MISO	21	UART_RTS
5	SIO	23	SPI_MOSI	15	UART_TXD
6	SCK	22	SPI_SCK	14	UART_RXD

Note: The UART pins can be configured as SPI.

> **Info:**   Connecting BTLC1000ZR module to the external Flash is not supported now.

5.3.2 Temperature Sensor

The ATBTLC1000ZR Xplained Pro extension board features an AT30TSE758A temperature sensor with an 8 KB serial EEPROM inside. The sensor includes programmable high and low temperature alarms, user-selectable temperature resolution up to 12 bits, and an I^2C/SMBus™ compatible serial interface.

Table 5-8. Temperature Sensor Connections

Pin on EXT connector	Pin name	AT30TSE758A 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

Pin on EXT connector	Pin name	AT30TSE758A temperature sensor pin	Comment
2, 19	GND	4	
-	A2	5	Address line for serial interface, shorted to GND
-	A1	6	Address line for serial interface, shorted to GND
-	A0	7	Address line for serial interface, shorted to GND
20	VCC	8	

The temperature sensor has two I^{2}C 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, refer to Device (AT30TSE752A/754A/758A) Datasheet.

5.3.3 Reset Switch

The ATBTLC1000ZR Xplained Pro contains footprint of switch (SW100) along with resistors R108, R102 and capacitor C102 that can be mounted to reset the ATBTLC1000ZR module. The switch is connected to the CHIP_EN pin of the module.

> **Info:** When this switch is used to reset the device, the host MCU will lose the status of the ATBTLC1000ZR device. It is recommended not to reset the device using this switch when it is controlled by the host MCU.

5.3.4 Crystal

The ATBTLC1000ZR Xplained Pro has a 32.768 kHz RTC oscillator that is used for BLE activities involving connection events. There is also provision to reconfigure the ATBTLC1000ZR Xplained Pro board to bypass the external crystal oscillator with an external signal on the RTC_CLK_P pin of the ATBTLC1000-ZR110CA module.

Table 5-9. Configuring the RTC Oscillator

Configuration option	Board configuration
32.768 kHz RTC oscillator	Open R101, Close J121
External signal on RTC_CLK_P	Close R101,R116,R117 and Open J121,J122

6. Hardware Revision History

6.1 Identifying Product ID and Revision

The revision and product identifier of the 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.

When an Xplained Pro MCU board is connected to a computer with Atmel Studio running, an information window with the serial number is shown. The first six digits of the serial number contain the product identifier and revision. Information about connected Xplained Pro extension boards is also shown in the window.

The same information can be found on the sticker on the bottom side of the PCB. Most kits have stickers that have the identifier and revision printed 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 data matrix code, which contains a serial number string.

The serial number string has the following format:

```
"nnnnrrssssssssss"

n = product identifier

r = revision

s = serial number
```

The product identifier for the ATBTLC1000ZR Xplained Pro is A09-2689.

6.2 Revision

Revision 3 is the initially released revision.

7. Document Revision History

Rev B - 04/2018

Section	Changes
Document	Revised contents to match various Bluetooth Low Energy standard versions.

Rev A - 07/2017

Section	Changes
Document	Initial Release

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