

## Preface

Atmel® QT4 Xplained Pro kit is an extension board that enables evaluation of self-capacitance mode proximity and touch using the peripheral touch controller (PTC) module. The kit shows how easy it is to design a capacitive touch board solution for the PTC without the need for any external components.

Figure 1. QT4 Xplained Pro



# 1. Introduction

## 1.1 Kit Contents

- 1 × ATQT4-XPRO

## 1.2 Features

- QTouch®
  - Two buttons
- Two proximity sensors
  - One unshielded sensor
  - One driven shield sensor with external op amp driver
- LEDs
  - One LED indicator for each self-capacitive button
  - One LED indicator for each proximity sensor
- Op amp supply jumper
  - Supply current monitoring of the driven shield op amp
- Xplained Pro hardware identification system<sup>(1)</sup>

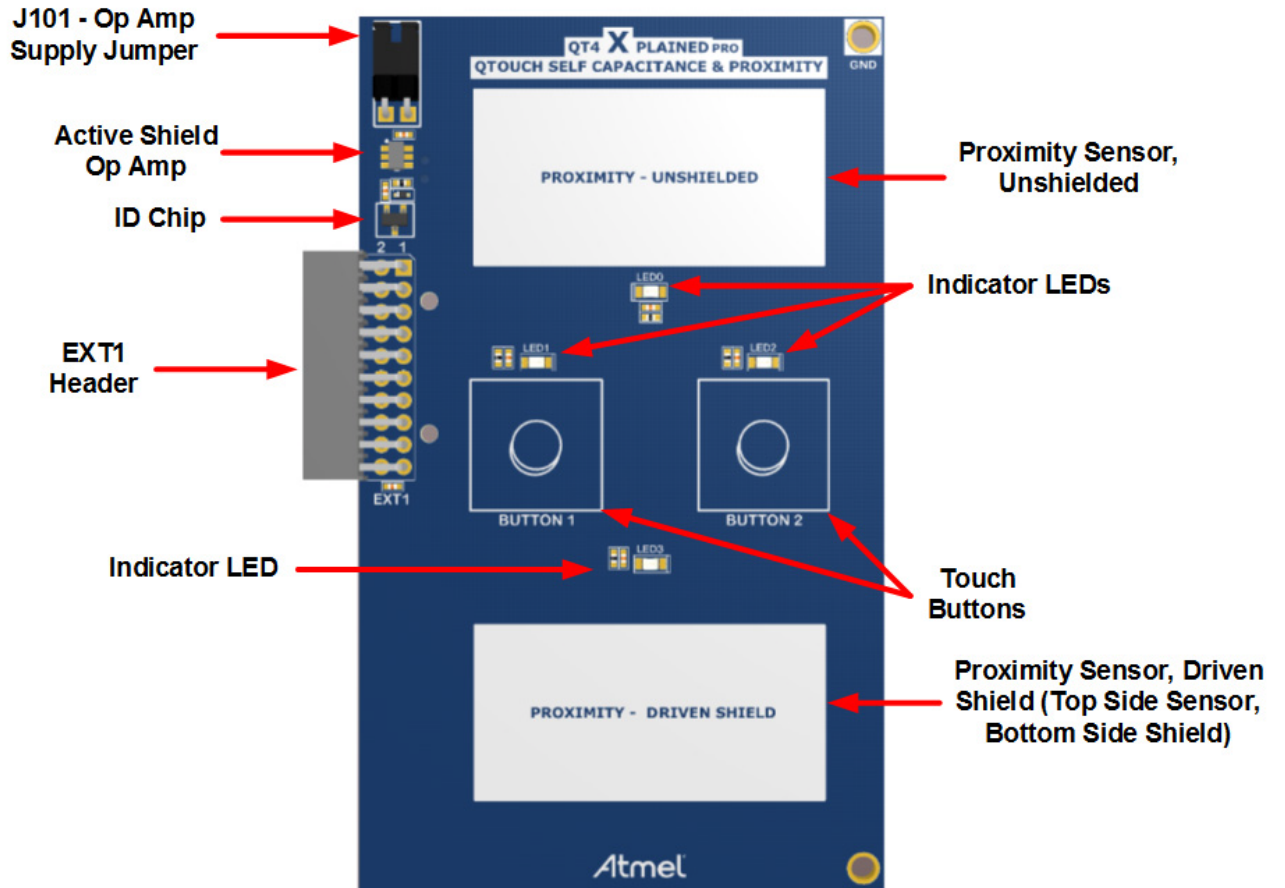
## 1.3 Kit Overview

Atmel® QT4 Xplained Pro is an extension board designed specifically for Xplained Pro MCU boards featuring an MCU with a built-in peripheral touch controller. The extension board can be used to explore the touch functions on the PTC module in self-capacitance (SC) mode only and includes both touch and proximity functionality.

Two of the extension board sensors provide proximity detection. The first sensor is unshielded. This sensor consists of a single electrode on the top layer of the PCB. All copper shielding has been removed beneath the sensor electrode. This sensor is response to touch/proximity from both sides of the PCB, top and bottom. The second proximity sensor employs an active or driven shield which consists of two electrodes – a top-side sensor and a bottom-side shield. The shield is driven by the MCU (located on the Xplained Pro controller board) through an external op amp (Texas Instruments OPA357) on the extension board.

The active shield provides two major benefits compared to the unshielded sensor. First, the active shield suppresses all touch and proximity detection from the bottom (shielded) side of the proximity sensor. Detection can only occur from the top side of the PCB (sensor side). Second, the active shield provides a modest increase in sensor detection range compared to the unshielded sensor of the same size.

Figure 1-1. QT4 Xplained Pro Extension Board



## 2. Getting Started

### 2.1 Three Steps to Start Exploring the Atmel Xplained Pro Platform

1. Download and install Atmel® Studio.
2. Launch Atmel Studio.
3. Connect QT4 Xplained Pro to an Xplained Pro MCU board and connect a USB cable to the DEBUG USB port on the Xplained Pro MCU board.

### 2.2 Connecting the QT4 Xplained Pro to the Xplained Pro MCU Board

Atmel QT4 Xplained Pro has been designed to be connected to the header marked EXT1 on the Xplained Pro MCU board. Before touch application development, download and install the Atmel QTouch Library and Atmel QTouch Composer from the extension gallery in Atmel Studio. Once the Xplained Pro MCU board is powered, the green power LED lights up and Atmel Studio auto-detects which Xplained Pro MCU or extension board is connected. Relevant information such as datasheets and kit documentation is displayed. You also have the option to launch sample Atmel Software Framework (ASF) applications. The target device is programmed and debugged by the on-board embedded debugger.

Note: No external programmer or debugger tool is needed.

### 2.3 Design Documentation and Related Links

The following list provides lists for the most relevant documents and software for QT4 Xplained Pro.

- Xplained Pro products<sup>(1)</sup> – Atmel Xplained Pro is a series of small, easy-to-use evaluation kits for 8- and 32-bit Atmel microcontrollers. It consists of a series of low cost MCU boards for evaluation and demonstration of features and capabilities of different MCU families.
- QT4 Xplained Pro User Guide<sup>(2)</sup> – PDF version of this User Guide.
- QT4 Xplained Pro Design Documentation<sup>(3)</sup> – Package containing schematics, BOM, assembly drawings, 3D plots, layer plots, etc.
- Atmel QTouch Library<sup>(4)</sup> – QTouch library to support Atmel AVR® and ARM®-based microcontrollers.
- Atmel QTouch Composer<sup>(5)</sup> – Tool for developing capacitive buttons, sliders and wheel applications.
- Atmel Studio<sup>(6)</sup> – Free Atmel IDE for development of C/C++ and assembler code for Atmel microcontrollers.

- Notes:
1. <http://www.atmel.com/XplainedPro>
  2. [http://www.atmel.com/Images/Atmel-9386-QT4-Xplained-Pro\\_User-Guide.pdf](http://www.atmel.com/Images/Atmel-9386-QT4-Xplained-Pro_User-Guide.pdf)
  3. <http://www.atmel.com/Images/QT4-Xplained-Design-Documentation.zip>
  4. <http://www.atmel.com/tools/QTOUCHLIBRARY.aspx>
  5. [http://www.atmel.com/tools/atmel\\_qtouch.aspx](http://www.atmel.com/tools/atmel_qtouch.aspx)
  6. <http://www.atmel.com/atmelstudio>

## 3. 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 that are integrated with Atmel Studio, have Atmel software framework (ASF) drivers and demo code and support data streaming and more. Xplained Pro MCU boards support a wide range of Xplained Pro extension boards that are connected through a set of standardized headers and connectors. Each extension board has an identification (ID) chip to uniquely identify which boards are mounted on an Xplained Pro MCU board. This information is used to present relevant user guides, application notes, datasheets and sample code through Atmel Studio. Available Xplained Pro MCU and extension boards can be purchased from The Atmel Store<sup>(1)</sup>.

### 3.1 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 other additional data. When an Xplained Pro extension board 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, provide relevant information, sample code and links to relevant documents. [Table 3-1](#) shows the data fields stored in the ID chip with sample content.

Note: Actual data may differ.

**Table 3-1. Xplained Pro ID Chip Content**

Data Field	Data Type	Example Content
Manufacturer	ASCII string	Atmel\0'
Product name	ASCII string	QT4 Xplained Pro\0'
Product revision	ASCII string	03\0'
Product serial number	ASCII string	2414030000000000\0'
Minimum voltage [mV]	uint16_t	3000
Maximum voltage [mV]	uint16_t	3600
Maximum current [mA]	uint16_t	100

## 3.2 Standard Headers and Connectors

### 3.2.1 Xplained Pro Standard Extension Header

All Xplained Pro kits have one or more dual-row, 20-pin, 100mil extension headers. Xplained Pro MCU boards have male headers while Xplained Pro extensions have their female counterparts. Note that all pins are not always connected. However, all of the connected pins follow the defined pin-out described in [Table 3-2](#). The extension headers can be used to connect a wide variety of Xplained Pro extensions to Xplained Pro MCU boards and to access the pins of the target MCU on Xplained Pro MCU board directly.

**Table 3-2. Xplained Pro Extension Header**

Pin Number	Name	Description
1	ID	Communication line to the ID chip on the extension board
2	GND	Ground
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 positive 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 two-wire interface. Always implemented, bus type
12	TWI_SCL	Clock line for two-wire interface. Always implemented, bus type
13	USART_RX	Receiver line of universal synchronous and asynchronous serial receiver and transmitter
14	USART_TX	Transmitter line of universal synchronous and asynchronous serial receiver and transmitter
15	SPI_SS_A	Slave select for SPI. Should be unique if possible
16	SPI_MOSI	Master-out-slave-in line of serial peripheral interface. Always implemented, bus type
17	SPI_MISO	Master-out-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

### 3.2.2 J101 – Op Amp Supply

The driven shield op amp is powered by VCC\_TARGET (3.3V) from the Xplained Pro controller board. The jumper can be removed and replaced by a multimeter in order to monitor the op amp current consumption.

## 4. Hardware User Guide

### 4.1 Headers and Connectors

#### 4.1.1 QT4 Xplained Pro Extension Header

QT4 Xplained Pro uses 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 with a MCU that includes a PTC module. See [Table 4-1](#) for the pin-out definition of the extension header.

**Table 4-1. QT4 Xplained Pro Extension Header**

Pin Number	Name	Description
1	ID	Communication line to the ID chip on the extension board
2	GND	Ground
3	Y0	Unshielded proximity sensor
4	Y1	Driven shield proximity sensor
5	Y2	Self-cap sensor, B2
6	Y3	Self-cap sensor, B1
7	LED_0	LED indicator, unshielded proximity sensor
8	LED_1	LED indicator, B2 sensor
9	LED_2	LED indicator, B1 sensor
10	LED_3	LED indicator, driven shield proximity sensor
11	Unused	Not connected
12	Unused	Not connected
13	Unused	Not connected
14	Unused	Not connected
15	EN	Op amp enable
16	Unused	Not connected
17	Unused	Not connected
18	Unused	Not connected
19	GND	Ground
20	VCC	Power for extension board

## 4.1.2 Peripherals

### 4.1.2.1 LEDs

There are 4 LEDs available on the QT4 Xplained Pro extension board that can be used to visualize the behavior of the touch and proximity sensors. Each sensor has its own indicator LED. All LEDs on the boards are active low, which means that the microcontroller needs to sink the corresponding IO lines to activate the LEDs.

### 4.1.2.2 Sensors

The QT4 Xplained Pro has four sensors that can be used for touch/proximity demonstration: two touch buttons, one driven shield proximity sensor (using an op amp driver) and one unshielded proximity sensor. All four sensors are self-capacitive, copper PCB electrodes, each driven by a separate Y-line from the microcontroller. In this case, the self-capacitance of the sensor is measured to calculate touch.

This kit is only supported by Xplained Pro MCU boards that have a MCU with a built-in PTC and a matching pin-out that connects all extension sensors. MCU boards currently supported are the SAMD20/21 and the SAMDA1 series of Xplained Pro controller boards.

**Table 4-2. Sensors**

Sensor	Dimensions (mm)	Shield Type
Button 1	15x15	GND, internal plane, hatched
Button 2	15x15	GND, internal plane, hatched
Proximity – Unshielded	40x20	None
Proximity – Driven shield	40x20	Actively driven by external op amp (Texas Instruments, OPA357). Solid plane copper plane, 60x40mm.



## 5. Hardware Revision History and Known Issues

### 5.1 Identifying Product ID and Revision

The revision and product identifier of Xplained Pro boards can be accessed either through Atmel Studio or by looking at the sticker affixed to the bottom of the PCB. An information window pops up when connecting an Xplained Pro MCU board to a computer with Atmel® Studio running. The first six digits of the serial number listed under kit details contain the product identifier and revision. Information about connected Xplained Pro extension boards also appears in the Atmel kits window.

The same information can be found on the sticker on the bottom of the PCB. Most kits print the identifier and revision in plain text as *A09-nnnn\rr* with *nnnn* the identifier and *rr* the revision. Boards with limited space have a sticker with only a QR code containing a serial number string. The serial number string has the following format:

```
"nnnnrrssssssss"
```

```
n = product identifier
```

```
r = revision
```

```
s = serial number
```

The kit identifier for QT4 Xplained Pro is 2414.

### 5.2 Revision 3

Revision 3 of QT4 Xplained Pro is the initial released version; there are no known issues.

Please read the user guide for the supported kits or the datasheet of the devices for any known issues regarding the peripheral touch controller.

## 6. Important Notice and Disclaimer for the Atmel Evaluation Board/Kit

This evaluation board/kit is intended for user's internal development and evaluation purposes only. It is not a finished product and may not comply with technical or legal requirements that are applicable to finished products, including, without limitation, directives or regulations relating to electromagnetic compatibility, recycling (WEE), FCC, CE or UL. Atmel is providing this evaluation board/kit "AS IS" without any warranties or indemnities. The user assumes all responsibility and liability for handling and use of the evaluation board/kit including, without limitation, the responsibility to take any and all appropriate precautions with regard to electrostatic discharge and other technical issues. User indemnifies Atmel from any claim arising from user's handling or use of this evaluation board/kit. Except for the limited purpose of internal development and evaluation as specified above, no license, express or implied, by estoppel or otherwise, to any Atmel intellectual property right is granted hereunder. ATMEL SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RELATING TO USE OF THIS EVALUATION BOARD/KIT.

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