Atmel QTouch

QT3 Xplained Pro

USER GUIDE

Preface

The Atmel® QT3 Xplained Pro is an extension board, which enables the evaluation of a capacitive touch 12 key numpad in mutual capacitance configuration. The board is designed to use the Peripheral Touch Controller (PTC) in Atmel microcontrollers. The board shows how easy it is to design a capacitive touch solution for the PTC without the need for any external components. The kit includes one board with a 3 by 4 touch key matrix and a 4 by 4 LED matrix for a visual feedback of the touch.

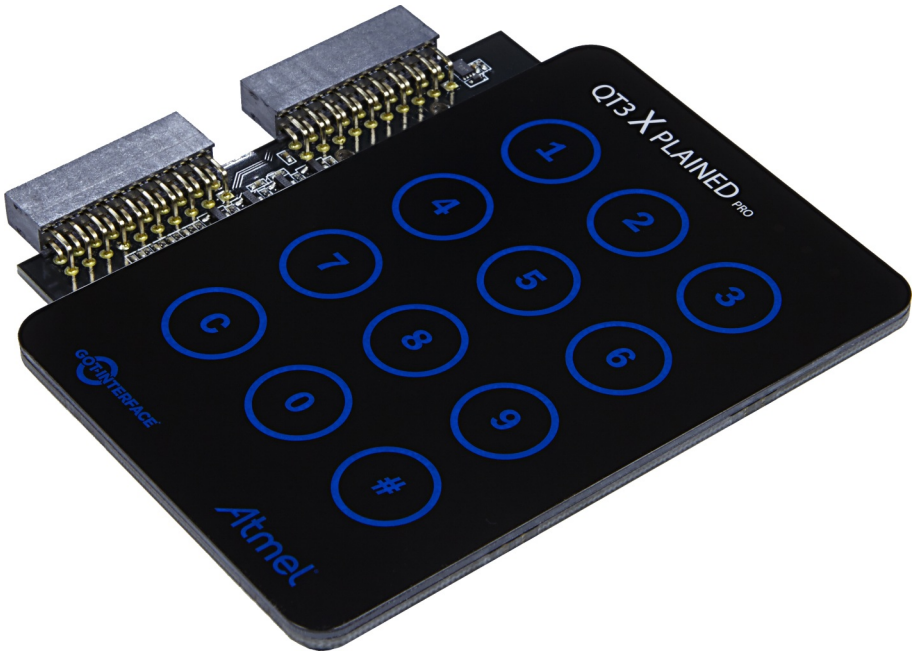


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1. Introduction

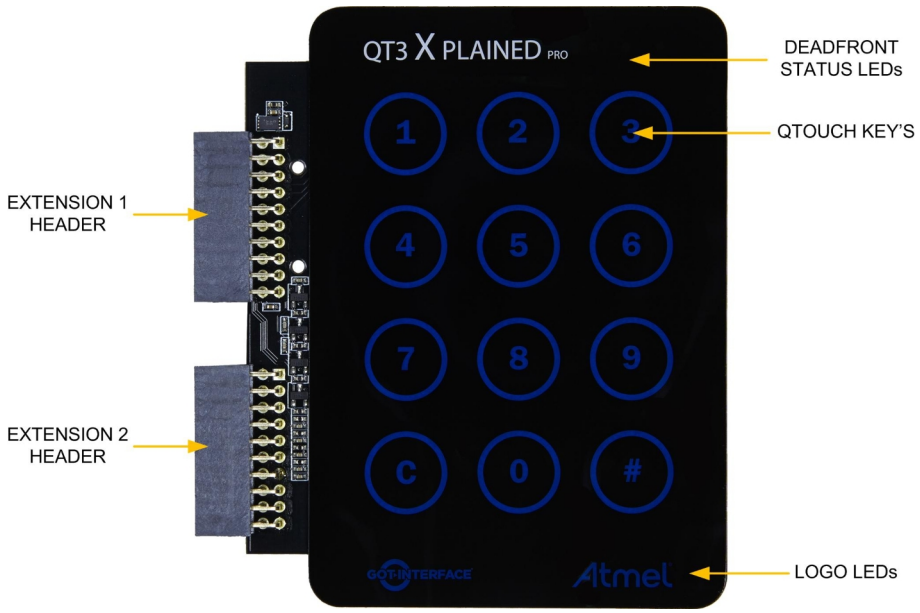
1.1. Features

- 3x4 Mutual Capacitance QTouch® keypad matrix
- 17 LEDs
  - One LED for each key
  - Two LEDs for logo
  - Three status LEDs
- Xplained Pro hardware identification system

1.2. Kit Overview

The Atmel QT3 Xplained Pro extension board is designed specifically for Xplained Pro MCU boards featuring a microcontroller with a built-in peripheral touch controller. The extension board can be used to explore the touch functions on the PTC module in mutual capacitance mode.

Figure 1-1 QT3 Xplained Pro Extension Board



2. Getting Started

2.1. Xplained Pro Quick Start

Three steps to start exploring the Atmel Xplained Pro platform:

1. Download Atmel Studio.
2. Launch Atmel Studio.
3. Connect QT3 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 Atmel QT3 Xplained Pro 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, and Windows 8.

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.

2.2. Design Documentation and Relevant Links

The following list contains links to the most relevant documents and software for QT3 Xplained Pro:

- **Xplained Pro products** - Atmel Xplained Pro is a series of small-sized and easy-to-use evaluation kits for Atmel microcontrollers and other Atmel products. It consists of a series of low cost MCU boards for evaluation and demonstration of features and capabilities of different MCU families.
- **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 QTouch Library** - QTouch Library for Atmel AVR® and ARM® - based microcontrollers.
- **Atmel QTouch Composer** - Tool for developing capacitive buttons, sliders, and wheels applications.
- **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.
- **Design Documentation** - Package containing CAD source, schematics, BOM, assembly drawings, 3D plots, layer plots etc.
- **Hardware Users Guide in PDF format** - PDF version of this User Guide.
- **QT3 Xplained Pro in the Atmel store** - Atmel Store link.

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 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.

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 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. Table 3-1 Xplained Pro ID Chip Content on page 5 shows the data fields stored in the ID chip with example content.

Table 3-1 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

3.2. Xplained Pro 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 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 Table 3-2 Xplained Pro Standard Extension Header on page 6.

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 3-2 Xplained Pro Standard Extension Header

Pin number	Name	Description
1	ID	Communication line to the ID chip on an extension board
2	GND	Ground
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^2C_SDA	Data line for I^2C interface. Always implemented, bus type.
12	I^2C_SCL	Clock line for I^2C 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

4. Hardware Users Guide

4.1. Headers and Connectors

4.1.1. QT3 Xplained Pro Extension Headers

QT3 Xplained Pro implements two Xplained Pro Standard Extension Header on page 5 marked with EXT1 and EXT2 in silkscreen. These headers make it possible to connect the board to an Xplained Pro MCU board with an MCU featuring a PTC module. The pin-out definition for the extension headers can be seen in Table 4-1 QT3 Xplained Pro Extension Header EXT1 on page 7 and Table 4-2 QT3 Xplained Pro Extension Header EXT2 on page 8.

The X-sensors of the touch pad are available on both EXT1 and EXT2 header on the kit for supporting Xplained Pro MCU kits with and without the EXT2 header. Driving the LEDs require both headers to be connected.

Table 4-1 QT3 Xplained Pro Extension Header EXT1

Pin on EXT1	Function	Description
1	ID	Communication line to the ID chip
2	GND	Ground
3	Y LINE 1	For keypad: "1", "2", and "3"
4	Y LINE 2	For keypad: "4", "5", and "6"
5	Y LINE 3	For keypad: "7", "8", and "9"
6	Y LINE 4	For keypad: "C", "0", and "#"
7	X LINE 1	X-line 1 (For use with MCU kits without EXT2 header)
8	X LINE 2	X-line 2 (For use with MCU kits without EXT2 header)
9	X LINE 3	X-line 3 (For use with MCU kits without EXT2 header)
10	Not Connected	
11	Not Connected	
12	Not Connected	
13	Not Connected	
14	Not Connected	
15	LED COL1	LED driver for column 1
16	LED COL2	LED driver for column 2
17	LED COL3	LED driver for column 3
18	LED COL4	LED driver for column 4
19	GND	Ground
20	VCC	Target supply voltage

Table 4-2 QT3 Xplained Pro Extension Header EXT2

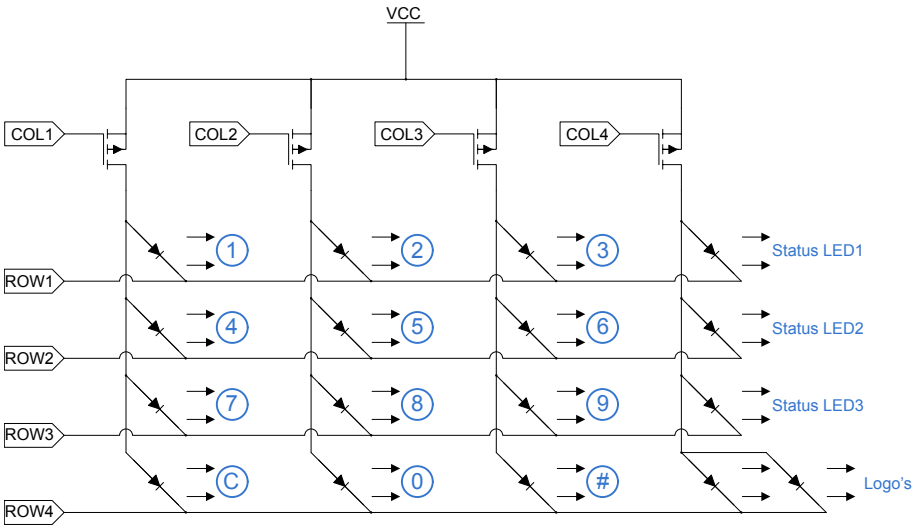
Pin on EXT1	Function	Description
1	ID	Communication line to the ID chip
2	GND	Ground
3	X LINE 1	For keypad: "1", "4", "7", and "C"
4	X LINE 2	For keypad: "2", "5", "8", and "0"
5	X LINE 3	For keypad: "3", "6"," 9", and "#"
6	Not Connected	
7	LED ROW1	
8	LED ROW2	
9	LED ROW3	
10	LED ROW4	
11	Not Connected	
12	Not Connected	
13	Not Connected	
14	Not Connected	
15	Not Connected	
16	Not Connected	
17	Not Connected	
18	Not Connected	
19	GND	Ground
20	Not Connected	

4.2. Peripherals

4.2.1. LEDs

There are 17 white LEDs arranged in a 4x4 matrix on the QT3 Xplained Pro extension board which can be used to visualize a touch in the QTouch sensor. All LEDs on the boards must be driven by the I/O of the target controller on an MCU board.

Figure 4-1 LED Connection Diagram



The LEDs must be driven with multiplexing techniques. Drive only one colum at the time by pulling the respective COL line low and keep the other COL lines high. The columns are driven with a FET gate and can therefore deliver current to all the LEDs in that column. The LED rows are connected directly to the MCU and can only sink one LED at the time. See Figure 4-2 LED Driving Waveform on page 9 for an illustration of the driving waveform.

Figure 4-2 LED Driving Waveform

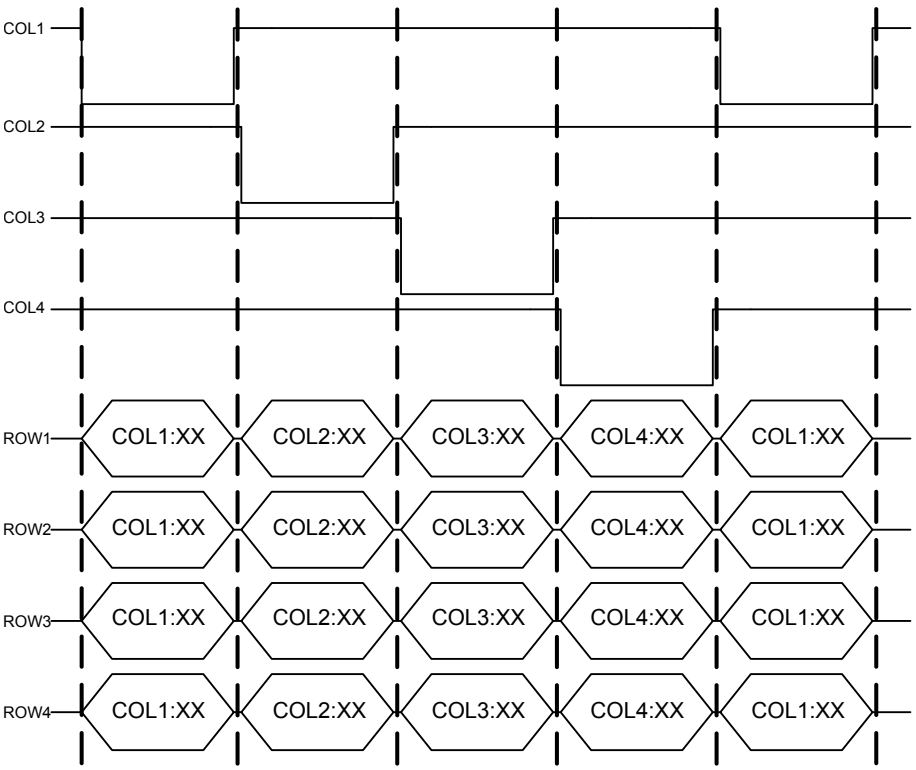


Table 4-3 LED Connection on EXT1

Pin on EXT1	Function	Description
15	LED COL1	Column 1, driving LEDs backlight for keypad: "1", "4", "7", and "C"
16	LED COL2	Column 2, driving LEDs backlight for keypad: "2", "5", "8", and "0"
17	LED COL3	Column 3, driving LEDs backlight for keypad: "3", "6", "9", and "#"
18	LED COL4	Column 4, driving status LED1, 2, and 3, and Logo's backlight

Table 4-4 LED Connection on EXT2

Pin on EXT2	Function	Description
7	LED ROW1	Row 1, driving LEDs backlight for keypad: "1", "2", "3", and one status LED1
8	LED ROW2	Row 2, driving LEDs backlight for keypad: "4", "5", "6", and one status LED2
9	LED ROW3	Row 3, driving LEDs backlight for keypad: "7", "8", "9", and one status LED3
10	LED ROW4	Row 4, driving LEDs backlight for keypad: "C", "0", "#", and Logo's

4.2.2. QTouch Buttons

QT3 Xplained Pro has one 3x4 mutual capacitance touch button sensor array, which requires seven touch lines for the 12 keys in the numberic keypad.

The Y-lines are only available on EXT1 on the kit, while the X-lines are available on both header. This makes the touch buttons compatible with MCU kits without the EXT2 header.

Info: To get started with QTouch, refer to Atmel QTouch Library and Atmel QTouch Composer.

5. Hardware Revision History and Known Issues

5.1. Identifying Product ID and Revision

The revision and product indentifier 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:

"nnnnrrssssssssss"

n = product identifier

r = revision

s = serial number

The product indentifier for QT3 Xplained Pro is A09-2329.

5.2. Revision 2

Revision 2 is the initially released revision, there are no known issues.

6. Document Revision History

Doc. rev.	Date	Comment
42404A	08/2015	Initial document release.

7. 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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