Atmel

I/O1 Xplained Pro

USER GUIDE

Preface

Atmel® I/O1 Xplained Pro is an extension board to the Atmel Xplained Pro evaluation platform. I/O1 Xplained Pro is designed to give a wide variety of functionality to Xplained Pro MCU boards including a microSD card, a temperature sensor, a light sensor, and more.

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1. Introduction

1.1. Features

- microSD card connector
  - 2GB microSD card included
  - Accessed with SPI interface
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- ADC
  - PWM → Low pass filter → ADC
  - Light sensor
- UART
  - Loopback interface via pin header
- TWI
  - AT30TSE758 temperature sensor with EEPROM
- Xplained Pro hardware identification system

1.2. Kit Overview

Atmel I/O1 Xplained Pro extension board is a generic extension board for the Xplained Pro platform. It connects to any Xplained Pro standard extension header on any Xplained Pro MCU board.

The extension board utilizes all functions on the standard Xplained Pro extension header to further enhance the feature set of Xplained Pro MCU boards.

Figure 1-1 I/O1 Xplained Pro Extension Board
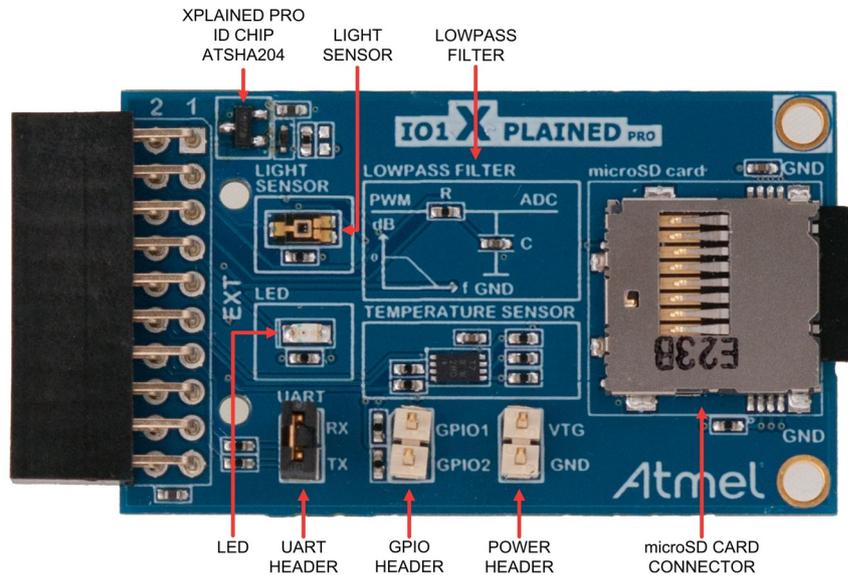
2. Getting Started

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 I/O1 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, 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 I/O1 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.
- **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.
- **I/O1 Xplained Pro on Atmel web page** - Atmel website 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^{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

4. Hardware User Guide

4.1. Electrical Characteristics

I/O1 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 it's 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 4-1 I/O1 Xplained Pro ID Chip Content

Data field	Content
Product name	I/O1 Xplained Pro
Minimum operation voltage	2.0V
Maximum operation voltage	3.6V
Maximum current	10mA

Related Links

Hardware Identification System on page 5

4.2. Headers and Connectors

4.2.1. I/O1 Xplained Pro Extension Header

I/O1 Xplained Pro implements one standard Xplained Pro extension header marked with EXT in silkscreen. This header makes it possible to connect the board to any Xplained Pro MCU board. The pin-out definition for the extension header can be seen in the table below.

Table 4-2 I/O1 Xplained Pro Extension Header

Pin on EXT	Function	Description
1	ID	Communication line to ID chip
2	GND	Ground
3	LIGHTSENSOR	Light sensor output (ADC)
4	LP_OUT	Low pass filter output (ADC)
5	GPIO1	General Purpose I/O pin (GPIO)
6	GPIO2	General Purpose I/O pin (GPIO)
7	LED	LED control (PWM)
8	LP_IN	Low pass filter input (PWM)
9	TEMP_ALERT	ALERT pin (Pin 3) of temperature sensor chip (IRQ)
10	microSD_DETECT	Detect pin on microSD card connector (GPIO)

Pin on EXT	Function	Description
11	TWI SDA	Data line of TWI interface, connected to SDA pin (Pin 1) of temperature sensor chip
12	TWI SCL	Clock line of TWI interface, connected to SCL pin (Pin 2) of temperature sensor chip
13	UART RX	Receive pin of target MCU UART interface
14	UART TX	Transmit pin of target MCU UART interface
15	microSD_SS	Chip select signal, connected to DAT3 pin on microSD card connector
16	SPI_MOSI	Master Out, Slave In signal of target MCU SPI interface. Connected to CMD pin on microSD card connector.
17	SPI_MISO	Master In, Slave Out signal of target MCU SPI interface. Connected to D0 pin on microSD card connector.
18	SPI_SCK	Clock line of SPI interface. Connected to CLK pin on microSD card connector.
19	GND	Ground
20	VCC	Target supply voltage

4.2.2. Power Header

The two pin power header on IO1 Xplained Pro can be used together with the GPIO pins to connect external circuitry or probe the voltage on the board. The pins of the header are marked in silk screen with VTG for target voltage and GND for ground.

> **Info:** The two pin power header should not be used to apply power to I/O1 Xplained Pro when connected to an Xplained Pro MCU board as it will get power from the Xplained Pro MCU board through the 20-pin extension connector.

Table 4-3 Power Header

Silk screen marking	Description
VTG	Target voltage, main voltage of the I/O1 Xplained Pro extension board
GND	Ground

4.2.3. GPIO Header

I/O1 Xplained Pro features a 2-pin header with access to the two generic GPIO lines on the 20-pin extension connector. These lines are routed from the 20-pin extension header through 39Ω series resistors to the 2-pin GPIO header.

Table 4-4 GPIO Header

Pin on EXT connector	Silk screen marking
5	GPIO1
6	GPIO2

4.2.4. UART Header

I/O1 Xplained Pro features a 2-pin header with access to the UART pins of the 20-pin extension connector. This two pin header comes with a jumper mounted to enable the UART to work in loopback mode. Both UART lines are terminated with 39Ω series resistors.

Table 4-5 UART Header

Pin on EXT connector	Silk screen marking
14	TX
13	RX

4.3. Peripherals

4.3.1. LED

There is one yellow LED available on the I/O1 Xplained Pro extension board that can be controlled by Pulse Width Modulation (PWM) or regular GPIO operation. The LED can be activated by driving the connected I/O line to GND.

Table 4-6 LED Connection

Pin on EXT connector	Silk screen marking
7	LED

4.3.2. Low Pass Filter

I/O1 Xplained Pro features a first order low-pass filter with a cutoff frequency of ~2340Hz. It is realized with a 680Ω resistor and a 100nF capacitor. This filter can be used to filter a PWM generated signal which can be sampled with an ADC pin.

Table 4-7 Low Pass Filter Connections

Pin on EXT connector	Silk screen marking
8	PWM
4	ADC

4.3.3. Temperature Sensor

I/O1 Xplained Pro extension board features an Atmel AT30TSE758 temperature sensor chip 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 I^{2}C/SMBus™ compatible serial interface.

Table 4-8 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
9	ALERT	3	Temperature alarm signalling pin
GND	GND	4	
-	A2	5	Address line for serial interface, by default pulled high
-	A1	6	Address line for serial interface, by default pulled high
-	A0	7	Address line for serial interface, by default pulled high
VCC	VCC	8	

The temperature sensor has two TWI 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 chip is by default pulled high through 100kΩ resistors, which makes the default addresses 0b1001111 and 0b1010111. Soldering the straps on the back of the I/O1 Xplained Pro board for *An* will alter that bit in the address to zero. Each strap is marked in silkscreen with A0, A1, and A2 as shown in the picture below. 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.

Figure 4-1 Temperature Sensor TWI Address

TWI ADDRESS SELECT
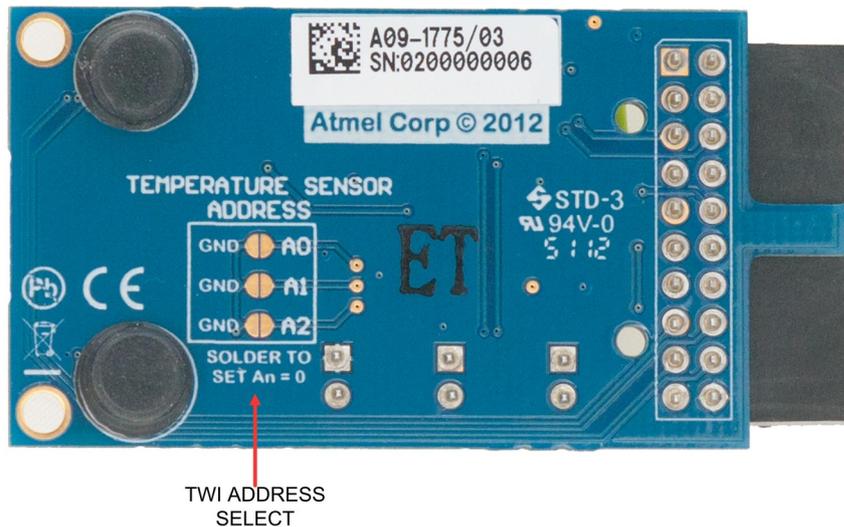
4.3.4. microSD Card Connector

I/O1 Xplained Pro features a microSD card connector that connects to cards via a SPI interface. Examples on how to use microSD cards and an example SD card stack can be found through ASF, for

the full SD card specification, see sdcard.org. The connections to the microSD card connector are shown in the table below.

Table 4-9 microSD Connector Connections

Pin on EXT connector	Pin name	microSD card connector pin	Comment
-	D2	1	Data line 2 on microSD card
15	D3	2	Data line 3 on microSD card. Active low chip select pin for microSD card, pulled high through 100kΩ pullup resistor.
16	CMD	3	Command line for microSD card. Connected to SPI_MOSI.
VCC	VDD	4	
18	CLK	5	Clock line on microSD card. Connected to SPI_SCK.
GND	GND	6	
17	D0	7	Data line 0 on microSD card. Connected to SPI_MISO.
-	D1	8	Data line 1 on microSD card
10	SW_A	9	When a microSD card is put into the connector, SW_A and SW_B are short-circuited. SW_A is connected to the microSD_DETECT signal. To use this as a card indicator remember to enable internal pullup in the target device.
GND	SW_B	10	

4.3.5. Light Sensor

I/O1 Xplained Pro features a TEMT6000 light sensor from Vishay. The sensor data can be read by an ADC pin on n Xplained Pro MCU board.

Table 4-10 Light Sensor Connections

Pin on EXT connector	Function
3	Light sensor signal

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 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:

"nnnnrrsssssssssss"

n = product identifier

r = revision

s = serial number

The product identifier for I/O1 Xplained Pro is A09-1775.

5.2. Revision 3

Revision 3 of I/O1 Xplained Pro is the initial released version. There are no known issues.

6. Document Revision History

Doc. rev.	Date	Comment
42078B	10/2015	Added electrical characteristics
42078A	02/2013	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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