USER GUIDE

Atmel IO1 Xplained Pro

Preface

Atmel® IO1 Xplained Pro is an extension board to the Atmel Xplained Pro evaluation platform. IO1 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

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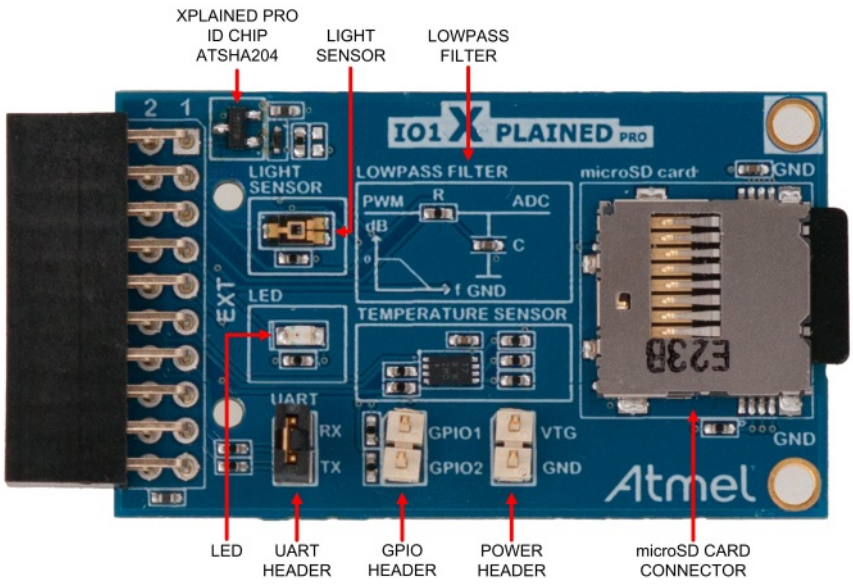
1.2 Kit overview

Atmel IO1 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. IO1 Xplained Pro extension board



2. Getting started

2.1 3 Steps to start exploring the Atmel Xplained Pro platform

1. Download and install Atmel Studio[1].
2. Launch Atmel Studio.
3. Connect IO1 Xplained Pro to an Xplained Pro MCU board and connect a USB cable to DEBUG USB port on the Xplained Pro MCU board.

2.2 Connecting IO1 Xplained Pro to the Xplained Pro MCU board.

Atmel IO1 Xplained Pro has been designed to be connected to the Xplained Pro header marked EXT1. However it is compatible with all Xplained Pro EXT headers. Please refer to the pin-out of your Xplained Pro evaluation kit to find out which Xplained Pro EXT headers that can be used.

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) that is connected. You will be presented with relevant information like datasheets and kit documentation. You also have the option to launch Atmel Software Framework (ASF) example applications. The target device is programmed and debugged by the on-board Embedded Debugger. No external programmer or debugger tool is needed.

2.3 Design documentation and related links

The following list contains links to the most relevant documents and software for IO1 Xplained Pro.

1. **Xplained Pro products** [2] - Atmel Xplained Pro is a series of small-sized and 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.
2. **IO1 Xplained Pro User Guide** [3] - PDF version of this User Guide.
3. **IO1 Xplained Pro Design Documentation** [4] - Package containing schematics, BOM, assembly drawings, 3D plots, layer plots etc.
4. **Atmel Studio** [5] - Free Atmel IDE for development of C/C++ and assembler code for Atmel microcontrollers.

[1] http://www.atmel.com/atmelstudio
[2] http://www.atmel.com/XplainedPro
[3] http://www.atmel.com/Images/Atmel-42078-IO1-Xplained-Pro_User-Guide.pdf
[4] http://www.atmel.com/Images/Atmel-42078-IO1-Xplained-Pro_User-Guide.zip
[5] 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, 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 a Xplained Pro MCU board. This information is used to present relevant user guides, application notes, datasheets and example code through Atmel Studio. Available Xplained Pro MCU and extension boards can be purchased in the Atmel Web Store[1].

3.1 Hardware identification system

All Xplained Pro compatible extension boards have an Atmel ATSHA204 crypto authentication chip mounted. This chip contains information that identifies the extension with its name and some extra 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, will give relevant information, code examples and links to relevant documents. Table 3.1, “Xplained Pro ID chip content” 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 Standard headers and connectors

3.2.1 Xplained Pro standard extension header

All Xplained Pro kits contains 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 the connected pins follow the defined pin-out described in Table 3.2, “Standard extension header”. 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. Standard extension header

Pin number	Name	Description
1	ID	Communication line to the ID chip on 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 IO
6	GPIO2	General purpose IO
7	PWM(+)	Pulse width modulation , alternatively positive part of differential PWM
8	PWM(-)	Pulse width modulation , alternatively positive part of differential PWM

[1] http://store.atmel.com/CBC.aspx?q=c:100113

Pin number	Name	Description
9	IRQ/GPIO	Interrupt request line and/or general purpose IO.
10	SPI_SS_B/GPIO	Slave select for SPI and/or general purpose IO.
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 Asynchro-nous 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 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 Headers and connectors

4.1.1 IO1 Xplained Pro extension header

IO1 Xplained Pro implements one Xplained Pro Standard 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 Table 4.1, “IO1 Xplained Pro extension header”.

Table 4.1. IO1 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 IO pin (GPIO)
6	GPIO2	General Purpose IO 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)
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 data 3 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

4.1.2 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.

Note The two pin power header should not be used to apply power to IO1 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 4.2. Power header

Silk screen marking	Description
VTG	Target voltage, main voltage of the IO1 Xplained Pro extension board

Silk screen marking	Description
GND	Ground

4.1.3 GPIO header

IO1 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 4.3. GPIO header

Pin on EXT connector	Silk screen marking
5	GPIO1
6	GPIO2

4.1.4 UART header

IO1 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 4.4. UART header

Pin on EXT connector	Silk screen marking
14	TX
13	RX

4.2 Peripherals

4.2.1 LED

There is one yellow LED available on the IO1 Xplained Pro extension board that can be controlled by phase width modulation (PWM) or regular GPIO operation. The LED can be activated by driving the connected I/O line to GND.

Table 4.5. LED connection

Pin on EXT connector	Silk screen marking
7	LED

4.2.2 Low-pass filter

IO1 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 sampleed it with an ADC pin.

Table 4.6. Low-pass filter connections

Pin on EXT connector	Silk screen marking
8	PWM
4	ADC

4.2.3 Temperature sensor

IO1 Xplained Pro extension board features an Atmel AT30TSE758 temperature sensor chip with an 8kbit 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.

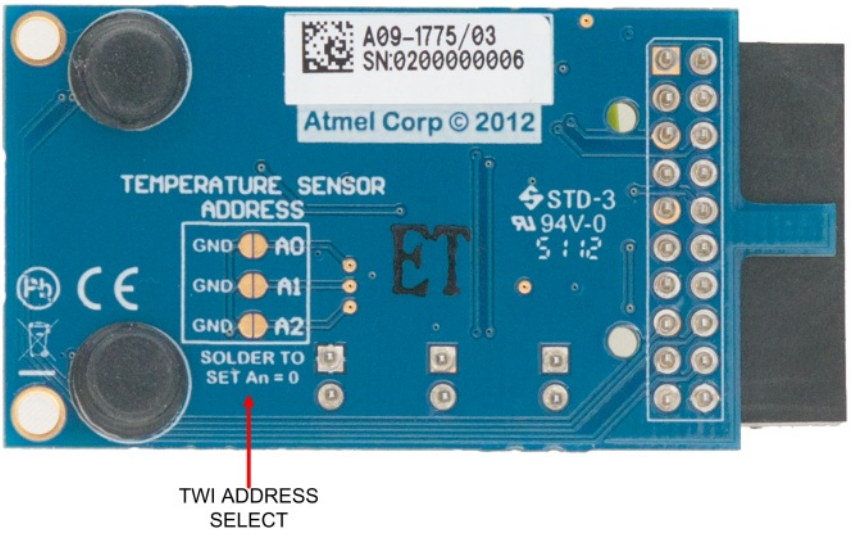
Table 4.7. Temperature sensor connections

Pin on EXT connector	Pin name	AT30TSE758 temperature sensor pin	Comment
11	SDA	1	Data line of serial interface

Pin on EXT connector	Pin name	AT30TSE758 temperature sensor pin	Comment
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 100 kΩ resistors, which makes the default addresses 0b1001111 and 0b1010111. Soldering the the straps on the back of the IO1 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 IO1 Xplained Pro extension board. When communicating with the EEPROM parts of the TWI address is used as a page address. for more details see the device datasheet[1].

Figure 4.1. Temperature sensor TWI address



4.2.4 microSD card connector

IO1 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[2]. The connections to the microSD card connector is shown in Table 4.8, “microSD connector connections”.

Table 4.8. 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 100 kΩ pullup resistor

[1] http://www.atmel.com/Images/doc8751.pdf
[2] https://www.sdcard.org/

Pin on EXT connector	Pin name	microSD card connector pin	Comment
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 is 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	

4.2.5 Light sensor

IO1 Xplained Pro features a TEMT6000[3] light sensor from Vishay. The sensor data can be read by an ADC pin on n Xplained Pro MCU board.

Table 4.9. Light sensor connections

Pin on EXT connector	Function
3	Light sensor signal

[3] http://www.vishay.com/docs/81579/temt6000.pdf

5. Hardware revision history and knonwn issues

5.1 Identifying product ID and revision

The revision and product identifier of Xplained Pro boards can be found in two ways, through Atmel Studio or by looking at the sticker on the bottom side of the PCB.

By connecting a Xplained Pro MCU board to a computer with Atmel Studio running, an information window will pop up. The first 6 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 Kits 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 kit identifier for IO1 Xplained Pro is 1775.

5.2 Revision 3

Revision 3 of IO1 Xplained Pro is the initial released version, there are no known issues.

6. Document revision history

Doc. Rev.	Date	Comment
A	25/02/2013	First release

7. Evaluation board/kit important notice

7.1 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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