SMART ARM-based Microcontrollers

SAM R21 Xplained Pro

USER GUIDE

Preface

The Atmel® SAM R21 Xplained Pro evaluation kit is a hardware platform to evaluate the ATSAMR21G18A microcontroller.

Supported by the Atmel Studio integrated development platform, the kit provides easy access to the features of the Atmel ATSAMR21G18A and explains how to integrate the device in a custom design.

The Xplained Pro MCU series evaluation kits include an on-board Embedded Debugger, and no external tools are necessary to program or debug the ATSAMR21G18A.

The Xplained Pro extension kits offers additional peripherals to extend the features of the board and ease the development of custom designs.

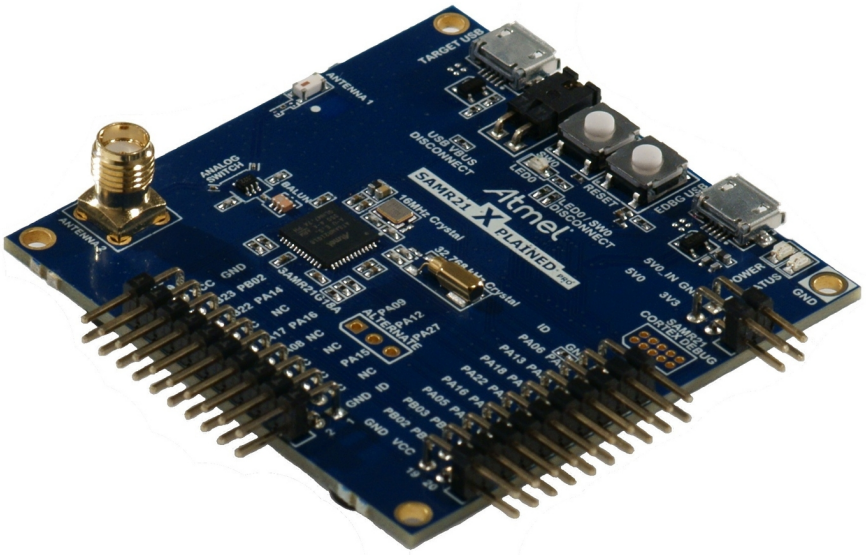


Table of Contents

Preface 1

1. Introduction 4
   - 1.1. Features 4
   - 1.2. Kit Overview 4

2. Getting Started 6
   - 2.1. Xplained Pro Quick Start 6
   - 2.2. Design Documentation and Relevant Links 6

3. Xplained Pro 8
   - 3.1. Embedded Debugger 8
   - 3.2. Hardware Identification System 9
   - 3.3. Power Sources 9
   - 3.4. Xplained Pro Headers and Connectors 10
     - 3.4.1. Xplained Pro Standard Extension Header 10
     - 3.4.2. Xplained Pro Power Header 11

4. Hardware User Guide 12
   - 4.1. Connectors 12
     - 4.1.1. Xplained Pro Extension Headers 12
     - 4.1.2. Alternate Signals Header 13
     - 4.1.3. Current Measurement Header 14
     - 4.1.4. Cortex Debug Connector 14
   - 4.2. Peripherals 14
     - 4.2.1. Crystal 14
     - 4.2.2. Mechanical Buttons 15
     - 4.2.3. LED 15
     - 4.2.4. USB 15
     - 4.2.5. RF 15
   - 4.3. 1.8V Operation 16
   - 4.4. Embedded Debugger Implementation 17
     - 4.4.1. Serial Wire Debug 17
     - 4.4.2. Virtual COM port 18
     - 4.4.3. Atmel Data Gateway Interface 18

5. Kit Specific Data 19

6. Agency Certification 20
   - 6.1. United States (FCC) 20
   - 6.2. European Union (ETSI) 20
   - 6.3. Canada (IC) 21
   - 6.4. List of Antennas Tested With This Product 21

7. Appendix 23

7.1. Getting Started with IAR....23
7.2. Connecting a SAM-ICE to an Xplained Pro Board....26
8. Hardware Revisions and Known Issues....28
8.1. Identifying Product ID and Revision....28
8.2. Revision 3....28
9. Document Revision History....29
10. Evaluation Board/Kit Important Notice....30

1. Introduction

1.1. Features

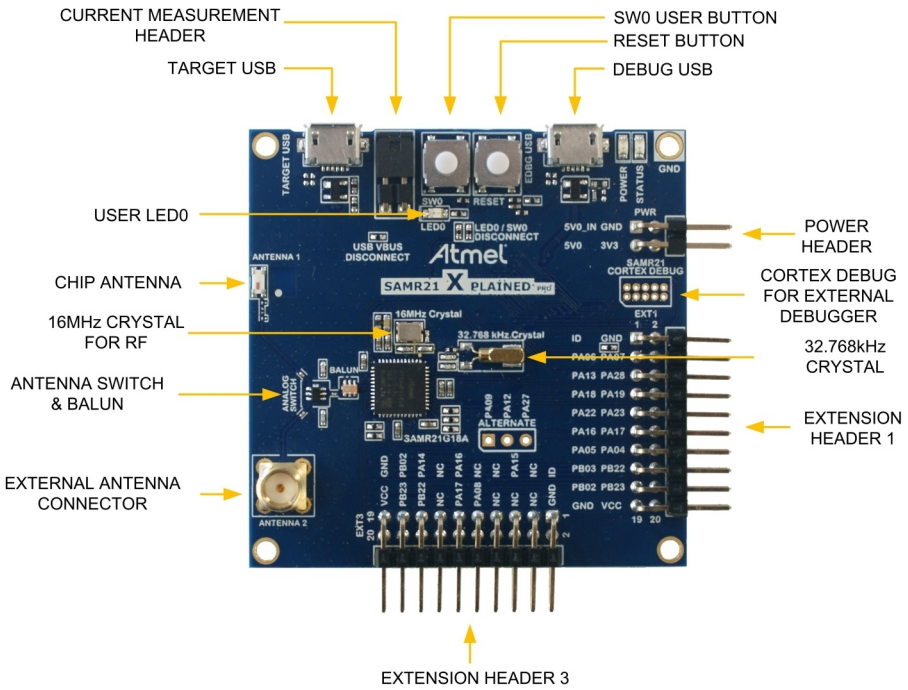
- Atmel ATSAMR21G18A microcontroller
- Embedded debugger (EDBG)
  - USB interface
  - Programming and debugging on board SAM R21 through Serial Wire Debug (SWD)
  - Virtual COM-port interface to target via UART
  - Atmel Data Gateway Interface (DGI) to target via SPI and TWI
  - Four GPIOs connected to target for code instrumentation
- Digital I/O
  - Two mechanical buttons (user and reset button)
  - One user LED
  - Two extension headers
- Antenna
  - One ceramic chip antenna (2450AT18D0100)
  - One SMA connector for external antenna
- Three possible power sources
  - External power
  - Embedded debugger USB
  - Target USB
- 32kHz crystal
- 16MHz crystal
- USB interface, device

1.2. Kit Overview

The Atmel SAM R21 Xplained Pro evaluation kit is a hardware platform to evaluate the Atmel ATSAMR21G18A.

The kit offers a set of features that enables the ATSAMR21G18A user to get started using the ATSAMR21G18A peripherals right away and to get an understanding of how to integrate the device in their own design.

Figure 1-1. SAM R21 Xplained Pro Evaluation Kit Overview



2. Getting Started

2.1. Xplained Pro Quick Start

Steps to start exploring the Atmel Xplained Pro platform:

1. Download Atmel Studio.
2. Launch Atmel Studio.
3. Connect a USB cable (Standard-A to Micro-B or Micro-AB) between the PC and the DEBUG USB port on the kit.

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, Windows 8, Windows 10, and Windows Server 2012.

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 SAM R21 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 the SAM R21 Xplained Pro.

- **Xplained products** - Atmel Xplained evaluation kits are a series of easy-to-use evaluation kits for Atmel microcontrollers and other Atmel products. For low pin-count devices the Xplained Nano series provides a minimalistic solution with access to all I/O pins of the target microcontroller. Xplained Mini kits are for medium pin-count devices and adds Arduino Uno compatible header footprint and a prototyping area. Xplained Pro kits are for medium to high pin-count devices, they features advanced debugging and standardized extensions for peripheral functions. All these kits have on board programmers/debuggers which creates a set of low-cost boards for evaluation and demonstration of features and capabilities of different Atmel products.
- **Atmel Studio** - Free Atmel IDE for development of C/C++ and assembler code for Atmel microcontrollers.
- **Atmel sample store** - Atmel sample store where you can order samples of devices.
- **EDBG User Guide** - User guide containing more information about the on-board Embedded Debugger.
- **IAR Embedded Workbench® for ARM®** - This is a commercial C/C++ compiler that is available for ARM®. There is a 30 day evaluation version as well as a code size limited kick-start version available from their website. The code size limit is 16KB for devices with M0, M0+, and M1 cores and 32KB for devices with other cores.
- **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.
- **SAM R21 Xplained Pro at www.atmel.com** - www.atmel.com 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. Embedded Debugger

The SAM R21 Xplained Pro contains the Atmel Embedded Debugger (EDBG) for on-board debugging. The EDBG is a composite USB device of three interfaces; a debugger, Virtual COM Port, and a Data Gateway Interface (DGI).

Together with Atmel Studio, the EDBG debugger interface can program and debug the ATSAMR21G18A. On SAM R21 Xplained Pro, the SWD interface is connected between the EDBG and the ATSAMR21G18A.

The Virtual COM Port is connected to a UART on the ATSAMR21G18A and provides an easy way to communicate with the target application through terminal software. It offers variable baud rate, parity, and stop bit settings. Note that the settings on the ATSAMR21G18A must match the settings given in the terminal software.



Info: The virtual COM port in the EDBG requires the terminal software to set the data terminal ready (DTR) signal to enable the UART pins connected to the ATSAMR21G18A. If the DTR signal is not enabled the UART pins on the EDBG is kept in high-z (tristate) rendering the COM port unusable. The DTR signal is set automatically by some terminal software, but it may have to be manually enabled in your terminal.

The DGI consists of several physical interfaces for communication with the host computer. Communication over the interfaces is bidirectional. It can be used to send events and values from the ATSAMR21G18A or as a generic printf-style data channel. Traffic over the interfaces can be timestamped on the EDBG for more accurate tracing of events. Note that timestamping imposes an overhead that reduces maximal throughput. Atmel Data Visualizer is used to send and receive data through DGI.

The EDBG controls two LEDs on SAM R21 Xplained Pro; a power LED and a status LED. The table below shows how the LEDs are controlled in different operation modes.

Table 3-1. EDBG LED Control

Operation mode	Power LED	Status LED
Normal operation	Power LED is lit when power is applied to the board.	Activity indicator, LED flashes when any communication happens to the EDBG.
Bootloader mode (idle)	The power LED and the status LED blinks simultaneously.	
Bootloader mode (firmware upgrade)	The power LED and the status LED blinks in an alternating pattern.	

For further documentation on the EDBG, see the EDBG User Guide.

3.2. 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. The table below shows the data fields stored in the ID chip with example content.

Table 3-2. 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

3.3. Power Sources

The SAM R21 Xplained Pro kit can be powered by several power sources as listed in the table below.

Table 3-3. Power Sources for SAM R21 Xplained Pro

Power input	Voltage requirements	Current requirements	Connector marking
External power	5V ±2% (±100mV) for USB host operation. 4.3V to 5.5V if USB host operation is not required.	Recommended minimum is 1A to be able to provide enough current for connected USB devices and the board itself. Recommended maximum is 2A due to the input protection maximum current specification.	PWR
Embedded debugger USB	4.4V to 5.25V (according to USB spec.)	500mA (according to USB spec.)	DEBUG USB
Target USB	4.4V to 5.25V (according to USB spec.)	500mA (according to USB spec.)	TARGET USB

The kit will automatically detect which power sources are available and choose which one to use according to the following priority:

1. External power.
2. Embedded Debugger USB.
3. Target USB.

Info: External power is required when 500mA from a USB connector is not enough to power the board with possible extension boards. A connected USB device in a USB host application might easily exceed this limit.

3.4. Xplained Pro Headers and Connectors

3.4.1. 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 the table below.

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 3-4. 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

Pin number	Name	Description
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

3.4.2. Xplained Pro Power Header

The power header can be used to connect external power to the SAM R21 Xplained Pro kit. The kit will automatically detect and switch to any external power if supplied. The power header can also be used as supply for external peripherals or extension boards. Care must be taken not to exceed the total current limitation of the on-board regulator when using the 3.3V pin.

Table 3-5. Xplained Pro Power Header

Pin number	Pin name	Description
1	VEXT_P5V0	External 5V input
2	GND	Ground
3	VCC_P5V0	Unregulated 5V (output, derived from one of the input sources)
4	VCC_P3V3	Regulated 3.3V (output, used as main power supply for the kit)

4. Hardware User Guide

4.1. Connectors

This chapter describes the implementation of the relevant connectors and headers on SAM R21 Xplained Pro and their connection to the ATSAMR21G18A. The tables of connections in this chapter also describes which signals are shared between the headers and on-board functionality.

4.1.1. Xplained Pro Extension Headers

The SAM R21 Xplained Pro headers EXT1 and EXT3 offer access to the I/O of the microcontroller in order to expand the board e.g. by connecting extensions to the board. These headers all comply with the standard Xplained Pro extension header specification. All headers have a pitch of 2.54mm.

Table 4-1. Extension Header EXT1

Pin on EXT1	SAM R21 pin	Function	Shared functionality
1 [ID]	-	Communication line to ID chip on extension board	
2 [GND]	-	GND	
3 [ADC(+)]	PA06	AIN[6]	
4 [ADC(-)]	PA07	AIN[7]	
5 [GPIO1]	PA13	GPIO	
6 [GPIO2]	PA28	GPIO	
7 [PWM(+)]	PA18	TCC0 / WO[2]	
8 [PWM(-)]	PA19	TCC0 / WO[3]	
9 [IRQ/GPIO]	PA22	EXTINT[6]	
10 [SPI_SS_B/GPIO]	PA23	GPIO	
11 [TWI_SDA]	PA16	SERCOM1 PAD[0] I²C SDA	EXT3 and EDBG
12 [TWI_SCL]	PA17	SERCOM1 PAD[1] I²C SCL	EXT3 and EDBG
13 [USART_RX]	PA05	SERCOM0 PAD[1] UART RX	EDBG
14 [USART_TX]	PA04	SERCOM0 PAD[0] UART TX	EDBG
15 [SPI_SS_A]	PB03	SERCOM5 PAD[1] SPI SS	
16 [SPI_MOSI]	PB22	SERCOM5 PAD[2] SPI MOSI	EXT3 and EDBG
17 [SPI_MISO]	PB02	SERCOM5 PAD[0] SPI MISO	EXT3 and EDBG
18 [SPI_SCK]	PB23	SERCOM5 PAD[3] SPI SCK	EXT3 and EDBG
19 [GND]	-	GND	
20 [VCC]	-	VCC	

Table 4-2. Extension Header EXT3

Pin on EXT3	SAM R21 pin	Function	Shared functionality
1 [ID]	-	Communication line to ID chip on extension board	
2 [GND]	-	GND	
3 [ADC(+)]	-	-	
4 [ADC(-)]	-	-	
5 [GPIO1]	PA15	GPIO	
6 [GPIO2]	-		
7 [PWM(+)]	-		
8 [PWM(-)]	-		
9 [IRQ/GPIO]	-		
10 [SPI_SS_B/GPIO]	PA08	GPIO	EDBG
11 [TWI_SDA]	PA16	SERCOM1 PAD[0] I²C SDA	EXT1 and EDBG
12 [TWI_SCL]	PA17	SERCOM1 PAD[1] I²C SCL	EXT1 and EDBG
13 [USART_RX]	-	-	
14 [USART_TX]	-	-	
15 [SPI_SS_A]	PA14	GPIO	EDBG
16 [SPI_MOSI]	PB22	SERCOM5 PAD[2] SPI MOSI	EXT1 and EDBG
17 [SPI_MISO]	PB02	SERCOM5 PAD[0] SPI MISO	EXT1 and EDBG
18 [SPI_SCK]	PB23	SERCOM5 PAD[3] SPI SCK	EXT1 and EDBG
19 [GND]	-	GND	
20 [VCC]	-	VCC	

Related Links

Xplained Pro Standard Extension Header on page 10

4.1.2. Alternate Signals Header

The alternate signals header is marked with "Alternate" in silkscreen of the kit. The signals provided here are otherwise hard to do measurements on.

Table 4-3. Alternate Signals Header

Pin on header	Pin on SAM R21	Function
1	PA09	RFCTRL1, negative antenna switch control signal
2	PA12	RFCTRL2, positive antenna switch control signal
3	PA27	GPIO, chip select on the EDBG DGI SPI bus

4.1.3. Current Measurement Header

An angled 1x2, 100mil pin-header marked with MCU current measurement is located at the upper edge of the SAM R21 Xplained Pro. All power to the ATSAMR21G18A is routed through this header. To measure the power consumption of the device remove the jumper and replace it with an ammeter.

Caution: Removing the jumper from the pin-header while the kit is powered may cause the ATSAMR21G18A to be powered through its I/O pins. This may cause permanent damage to the device.

4.1.4. Cortex Debug Connector

The Cortex® debug connector is provided to enable external debuggers to be connected to the ATSAMR21G18A. The footprint is made for a 2x5 50mil connector and the pinout is shown in the table below. This header should only be used when the EDBG is disconnected from the target. For more information, see 1.8V Operation.

Table 4-4. Cortex Debug Connector

Pin on connector	Connected	Function
1	VCC Target	Voltage reference
2	PA31_SWDIO	Debug data
3	GND	GND
4	PA30_SWCLK	Debug clock
5	GND	GND
6	NC	-
7	NC	-
8	NC	-
9	GND	GND detect
10	RESETN	Target reset

4.2. Peripherals

4.2.1. Crystal

The SAM R21 Xplained Pro kit contains one crystal that can be used as clock source for the SAM R21 device. The crystal has a cut-strap next to it that can be used to measure the oscillator safety factor. This is done by cutting the strap and adding a resistor across the strap. More information about oscillator allowance and safety factor can be found in application note AVR4100.

Note:
The 16MHz crystal is connected directly to the RF die inside the SAM R21. The clock signal generated by the crystal is routed from the CLKM pin on the RF die to a GCLK I/O pin on the microcontroller. For more information on how the RF die is connected to the microcontroller and how to configure the CLKM pin, see the SAM R21 datasheet.

Table 4-5. External 32.768kHz Crystal

Pin on SAM R21	Function
PA00	XIN32
PA01	XOUT32

Table 4-6. External 16MHz Crystal

Pin on SAM R21	Function
XTAL1	XIN
XTAL2	XOUT

4.2.2. Mechanical Buttons

SAM R21 Xplained Pro contains two mechanical buttons. One button is the RESET button connected to the SAM R21 reset line and the other is a generic user configurable button. When a button is pressed it will drive the I/O line to GND.

Table 4-7. Mechanical Buttons

Pin on SAM R21	Silkscreen text
RESETN	RESET
PA28	SW0

4.2.3. LED

There is one yellow LED available on the SAM R21 Xplained Pro board that can be turned on and off. The LED can be activated by driving the connected I/O line to GND.

Table 4-8. LED Connections

Pin on SAM R21	LED
PA19	Yellow LED0

4.2.4. USB

The SAM R21 Xplained Pro has a Micro-USB receptable for use with the SAM R21 USB module. To be able to detect when a USB cable is connected, a GPIO/ADC is used to detect the VBUS voltage on the connector.

Table 4-9. USB Connections

Pin on SAM R21	USB
PA07	VBUS Detection
PA24	USB D-
PA25	USB D+

4.2.5. RF

The main feature of SAM R21 Xplained Pro is to show the RF capability of the ATSAMR21G18A device. This device has bidirectional 100Ω differential antenna pins, which are fed through a balun (Johanson Technology, 2450BM15A0015) to create a single 50Ω unbalanced output/input. This kit has a passive analog RF switch (Skyworks Solutions Inc, AS222-92LF) connected to the unbalanced output of the

balun. The switch is driven by the RFCTRL1 and RFCTRL2 pins of the ATSAMR21G18A, which feature Antenna Diversity to enable the device to automatically select the best signal from two antennas (can also be selected manually). The output of the switch is connected to a ceramic chip antenna (Johanson Technology, 2540AT18D0100) and a SMA connector for external antennas.

Table 4-10. RF Connections

Pin on SAM R21	RF	Shared functionality
RFP	RF balanced output (positive)	
RFN	RF balanced output (negative)	
PA09 / RFCTRL1	RF switch control signal (negative)	EDBG
PA12 / RFCTRL2	RF switch control signal (positive)	EDBG

4.3. 1.8V Operation

The SAM R21 Xplained Pro board is operated at 3.3V by default, but it also has the possibility of running at lower voltages from an external supply. The EDBG is designed to run from a 3.3V supply and won't work on other voltages, therefore all connections from the EDBG and the on board 3.3V regulator to the ATSAMR21G18A have to be removed. Figure 4-1 1.8V Operation Modifications shows all components that have to be removed for 1.8V operation.

When the components are removed the kit can be supplied with a desired voltage through the pins marked 3V3 (pin four) and GND (pin two) on the power header described in Xplained Pro Power Header.

To program and debug the ATSAMR21G18A a 2x5 50mil header has to be mounted above EXT1 as shown in Figure 1-1 SAM R21 Xplained Pro Evaluation Kit Overview.

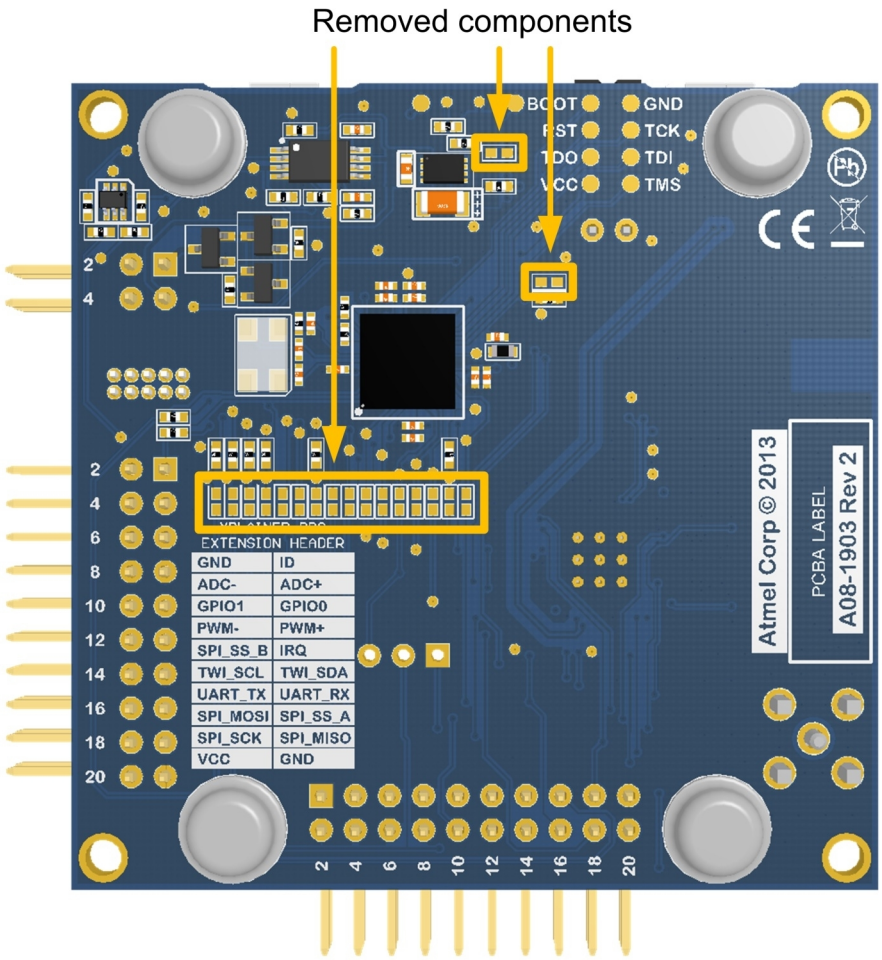
Note:
Operating the SAM R21 Xplained Pro on other voltages than 3.3V requires physical modifications on the kit using a soldering iron and an external debugger for programming the ATSAMR21G18A.

The on board LED is selected for 3.3V operation, the light level at 1.8V operation is very low. To increase the emitted light level the value of the series resistor can be lowered.

The EDBG functionality can be restored by re-soldering the removed components, they are all 0Ω resistors.

Important:
The voltage supplied through the power header is applied directly to the ATSAMR21G18A and the extension headers. Applying a voltage greater than 3.3V may damage the board permanently.

Figure 4-1. 1.8V Operation Modifications



4.4. Embedded Debugger Implementation

SAM R21 Xplained Pro contains an Embedded Debugger (EDBG) that can be used to program and debug the ATSAMR21G18A using Serial Wire Debug (SWD). The Embedded Debugger also include a Virtual Com port interface over UART, an Atmel Data Gateway Interface over SPI and TWI and it monitors four of the SAM R21 GPIOs. Atmel Studio can be used as a front end for the Embedded Debugger.

4.4.1. Serial Wire Debug

The Serial Wire Debug (SWD) use two pins to communicate with the target.

Table 4-11. SWD Connections

Pin on SAM R21	Function
PA30	SWD clock
PA31	SWD data

Related Links

Embedded Debugger on page 8

4.4.2. Virtual COM port

The Embedded Debugger acts as a Virtual Com Port gateway by using one of the ATSAMR21G18A UARTs.

Table 4-12. Virtual COM Port Connections

Pin on SAM R21	Function
PA04	SERCOM0 PAD[0] UART TXD (SAM R21 TX line)
PA05	SERCOM1 PAD[1] UART RXD (SAM R21 RX line)

Related Links

Embedded Debugger on page 8

4.4.3. Atmel Data Gateway Interface

The Embedded Debugger features an Atmel Data Gateway Interface (DGI) by using either an SPI or I²C port. The DGI can be used to send a variety of data from the SAM R21 to the host PC.

Table 4-13. DGI Interface Connections When Using SPI

Pin on SAM R21	Function
PA27	GPIO SPI SS (Slave select) (SAM R21 is Master)
PB02	SERCOM5 PAD[0] SPI MISO (Master In, Slave Out)
PB22	SERCOM5 PAD[2] SPI MOSI (Master Out, Slave in)
PB23	SERCOM5 PAD[3] SPI SCK (Clock Out)

Table 4-14. DGI Interface Connections When Using I²C

Pin on SAM R21	Function
PA16	SERCOM1 PAD[0] I²C SDA (Data line)
PA17	SERCOM1 PAD[1] I²C SCL (Clock line)

Four GPIO lines are connected to the Embedded Debugger. The EDBG can monitor these lines and time stamp pin value changes. This makes it possible to accurately time stamp events in the SAM R21 application code.

Table 4-15. GPIO Lines Connected to the EDBG

Pin on SAM R21	Function
PA08	GPIO0
PA09	GPIO1
PA12	GPIO2
PA14	GPIO3

Related Links

Embedded Debugger on page 8

5. Kit Specific Data

One of the user pages in the EDBG is programmed with data specific to the SAM R21 Xplained Pro. The data can be read through the I^2C interface connected to the EDBG. For detailed information, see the **EDBG User Guide**. All data is stored as little endian.

Table 5-1. MAC64Register, Offset: 0x00

Name	Description	Size [bits]
MAC64	MAC64 Address (hex)	64

6. Agency Certification

6.1. United States (FCC)

This equipment complies with Part 15 of the FCC rules and regulations. To fulfill FCC Certification requirements, an OEM manufacturer must comply with the following regulations:

1. This equipment (SAM R21 Xplained Pro) is for use for evaluation purposes only and must not be incorporated into any other device or system.



Important:
This equipment complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation (FCC 15.19).

The internal / external antenna(s) used for this mobile transmitter must provide a separation distance of at least 20cm from all persons and must not be colocated or operating in conjunction with any other antenna or transmitter.

Installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance. This device is approved as a mobile device with respect to RF exposure compliance, and may only be marketed to OEM installers. Use in portable exposure conditions (FCC 2.1093) requires separate equipment authorization.



Important:
Modifications not expressly approved by this company could void the user's authority to operate this equipment (FCC section 15.21).



Important:
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense (FCC section 15.105).

6.2. European Union (ETSI)

The SAM R21 Xplained Pro Evaluation kits has been certified for use in European Union countries. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive.

Furthermore, the manufacturer must maintain a copy of the modules' documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation

requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

Important:
The 'CE' marking must be affixed to a visible location on the OEM product. The CE mark shall consist of the initials "CE" taking the following form:

- The CE marking must have a height of at least 5mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

More detailed information about CE marking requirements you can find at "DIRECTIVE 1999/5/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL" on 9 March 1999 at section 12.

6.3. Canada (IC)

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with radio frequency exposure limits set forth by Industry Canada for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the device and the user or bystanders.

Cet équipement est conforme aux limites d'exposition aux radiofréquences définies par Industrie Canada pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20cm de distance entre le dispositif et l'utilisateur ou des tiers

Important:
Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

6.4. List of Antennas Tested With This Product

Table 6-1. List of Tested Antennas

Antenna number	Make	Model/part #	Antenna gain [dBi]	Type of antenna
Antenna 1	Johanson Technology	2450AT18D0100	1.5dBi	Ceramic Antenna
Antenna 2	Techfun Co., Ltd	M01-SS2	0dBi	External Antenna

Important:
If professional users including, but not limited to Research and Development engineers wants to configure the power settings higher than those specified in page 7 of the FCC test report number 19660076 001, they are advised to use the antenna/device only in a shielded room.

7. Appendix

7.1. Getting Started with IAR

IAR Embedded Workbench® for ARM® is a proprietary high efficiency compiler not based on GCC. Programming and debugging of Xplained Pro kits are supported in IAR™ Embedded Workbench for ARM using the common CMSIS-DAP interface. Some initial settings have to be set up in the project to get the programming and debugging to work.

The following steps will explain how to get your project ready for programming and debugging:

1. Make sure you have opened the project you want to configure. Open the **OPTIONS** dialog for the project.
2. In the category **General Options**, select the **Target** tab. Select the device for the project or, if not listed, the core of the device.
3. In the category **Debugger**, select the **Setup** tab. Select **CMSIS DAP** as the driver.
4. In the category **Debugger**, select the **Download** tab. Check the check box for **Use flash loader(s)** option.
5. In the category **Debugger** > **CMSIS DAP**, select the **Setup** tab. Select **System (default)** as the reset method.
6. In the category **Debugger** > **CMSIS DAP**, select the **JTAG/SWD** tab. Select **SWD** as the interface and optionally select the **SWD speed**.

Figure 7-1. Select Target Device

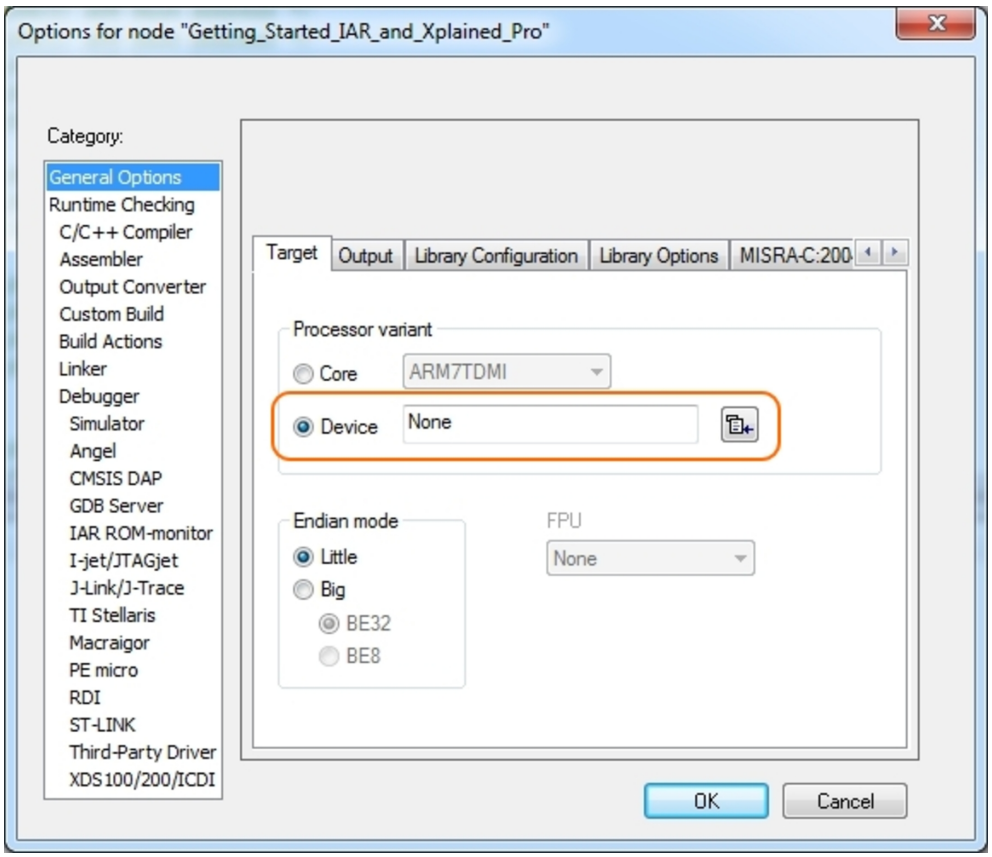


Figure 7-2. Select Debugger

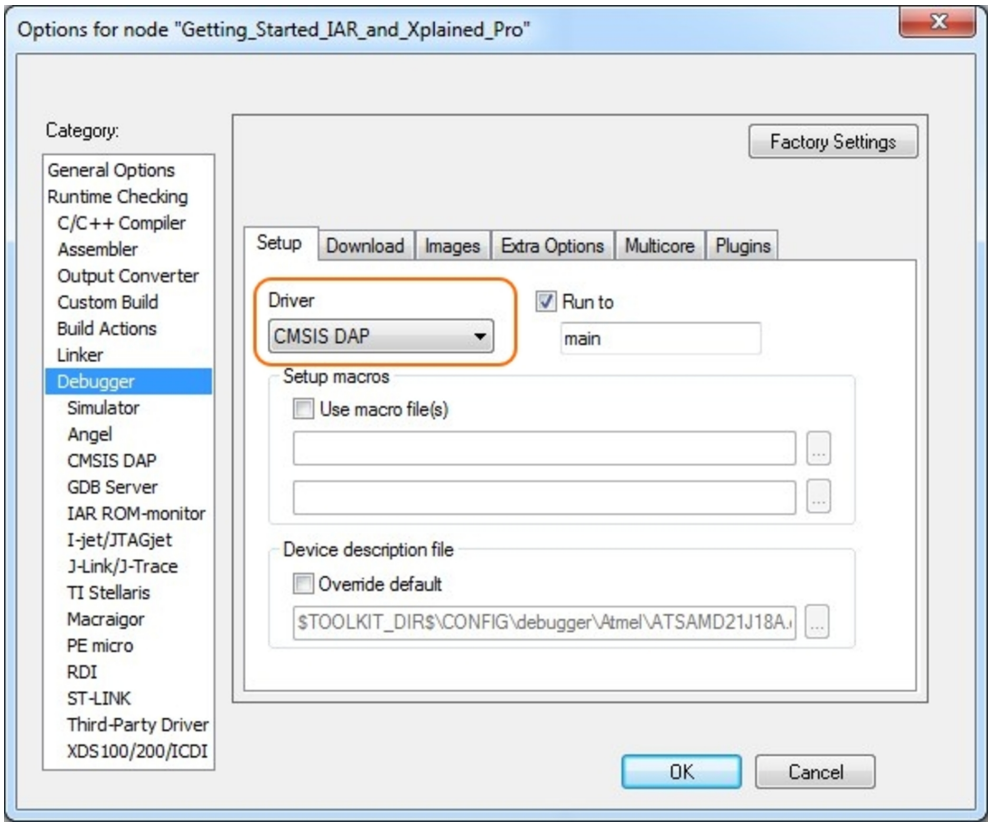


Figure 7-3. Configure Flash Loader

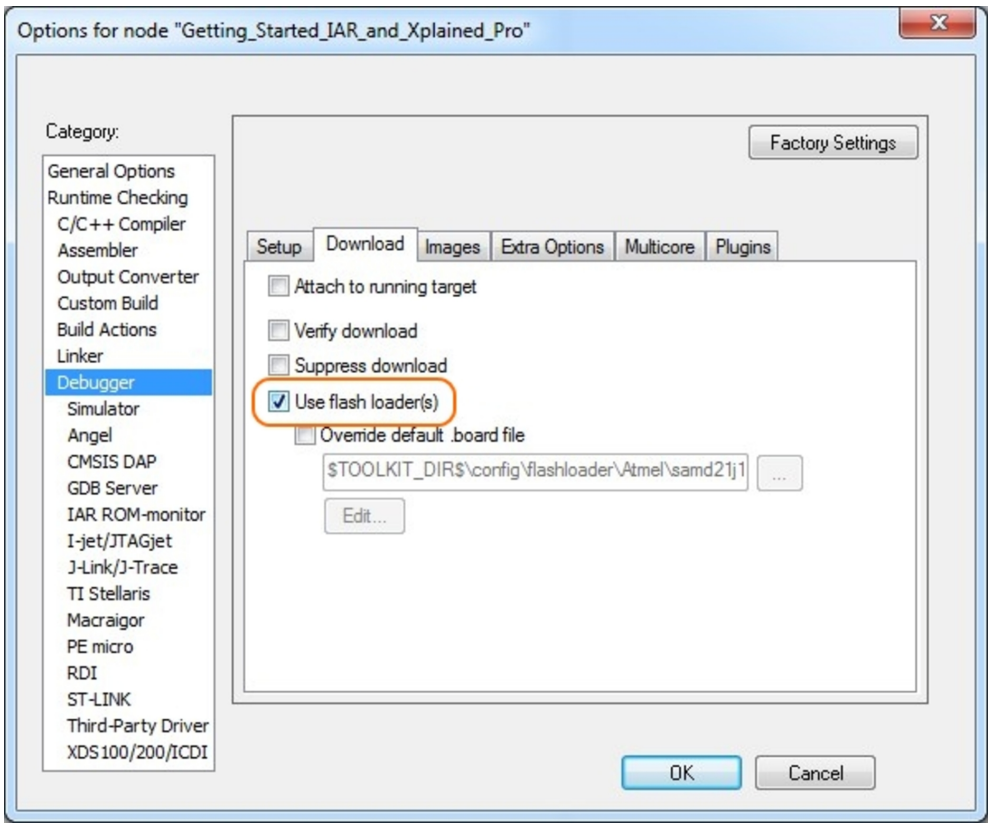


Figure 7-4. Configure Reset

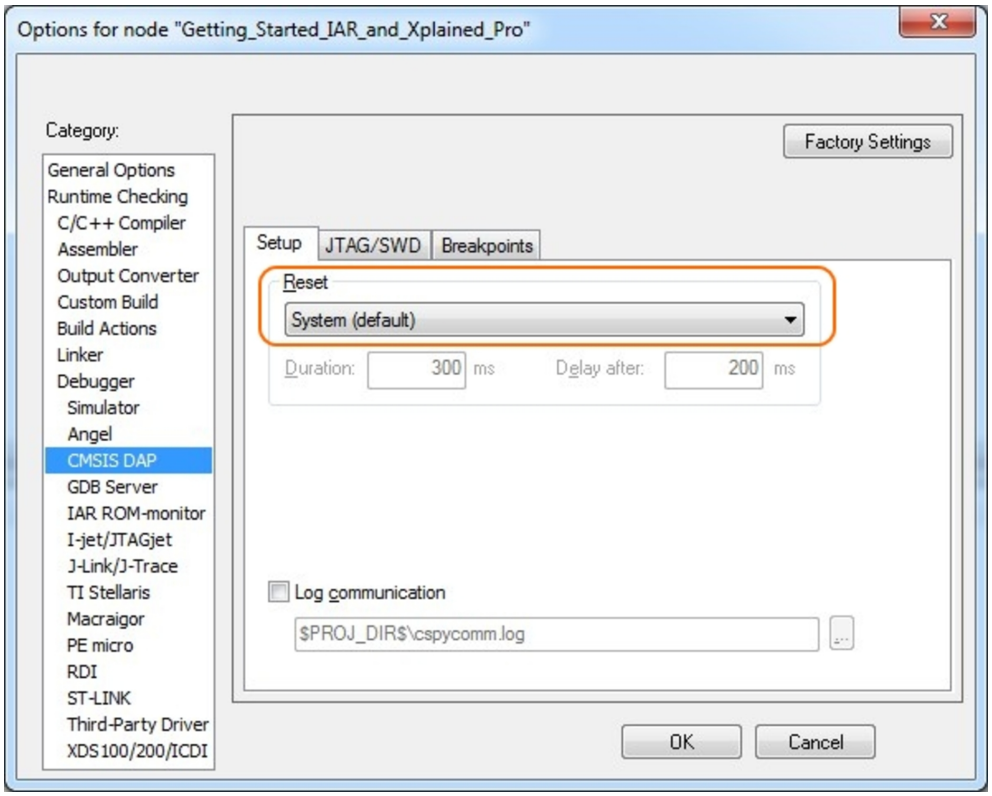
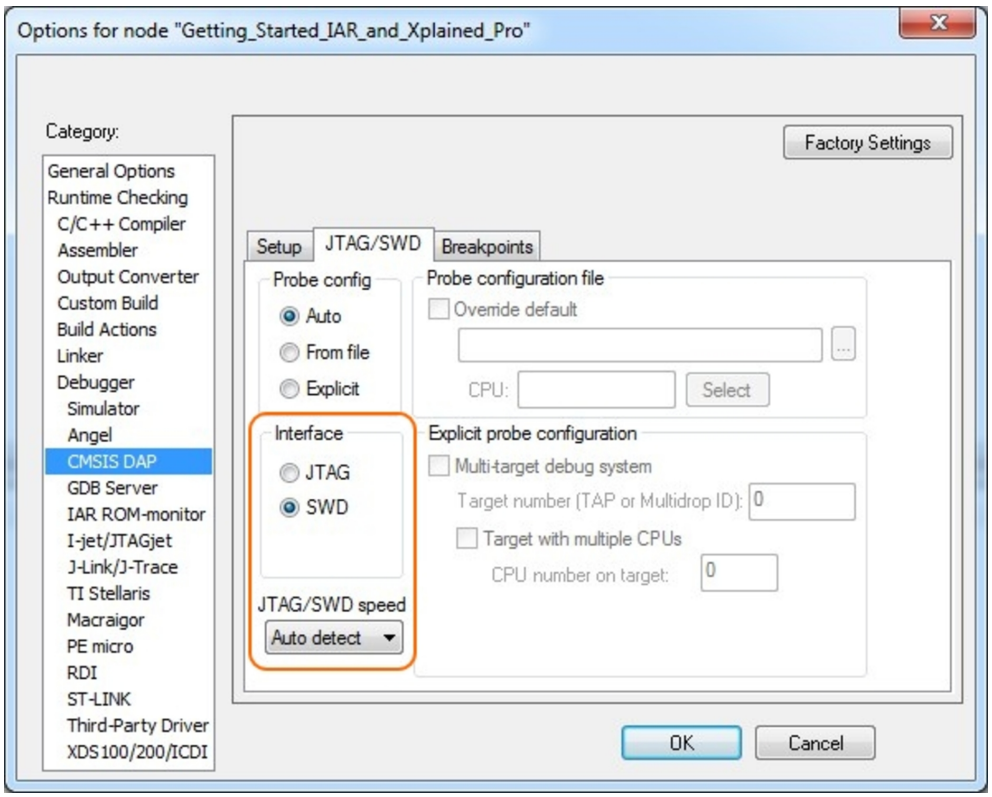


Figure 7-5. Configure Interface



7.2. Connecting a SAM-ICE to an Xplained Pro Board

Xplained Pro kits featuring a 10-pin 50mil debug connector can use external debug tools like SAM-ICE™ or Atmel-ICE instead of the built-in EDBG. Devices using SWD interface on-board will have a connector with the pinout compatible with the Cortex Debug Connector.

You can connect the SAM-ICE to the debug connector on an Xplained Pro using either an Atmel-ICE adapter, SAM-ICE adapter, or a 10-pin 50-mil header to squid cable. When using a squid cable, see the table and figures below for how to connect the SAM-ICE to the Xplained Pro board.

Table 7-1. Squid Cable Connections

Squid Cable pin	SAM-ICE pin
1 (VCC)	1 (VTref)
2 (SWDIO/TMS)	7 (TMS)
3 (GND)	4 (GND)
4 (SWCLK/TCK)	9 (TCK)
5 (GND)	6 (GND)
6 (SWO/TDO)	13 (TDO) (1)
7 (Not used)	
8 (Not used)	
9 (Not used)	
10 (RESET)	15 (RESET)

Note:

1. Optional, if the device has this functionality.

Figure 7-6. SAM-ICE using a Squid Cable



Figure 7-7. SAM-ICE using an Atmel-ICE Adapter



Important:
If contention with the on-board EDBG occur, power the Xplained Pro board from another input like the external power header or from the target USB. Physically removing the connection between the EDBG and the debug header by removing 0Ω resistors, where available, or cutting the tracks to the EDBG can also be done.

8. Hardware Revisions and Known Issues

8.1. 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:

"nnnnrrssssssssss"

n = product identifier

r = revision

s = serial number

The product identifier for SAM R21 Xplained Pro is A09-2127.

8.2. Revision 3

Revision 3 of SAM R21 Xplained Pro is the initial released version.

The VDDCORE capacitor C312 is mounted as 100nF on the SAM R21 Xplained Pro evaluation kit, while the ATSAMR21G18A datasheet recommends 1µF. Using 100nF for VDDCORE decoupling may create unwanted noise / ripple on the VDDCORE voltage.

Fix/Workaround: Use a 1µF capacitor for new designs.

9. Document Revision History

Doc. rev.	Date	Comment
42243D	04/2016	Added chapter about connecting SAM-ICE / external debuggers in the appendix.
42243C	08/2015	Added ERRATA in the known issues chapter, added IAR getting started chapter.
42243B	06/2014	Fixed RF switch control pin-mapping to be correct and updated the Agency Certification chapter.
42243A	02/2014	Initial document release.

10. 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.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER USER NOR ATMEL SHALL BE LIABLE TO EACH OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

No license is granted under any patent right or other intellectual property right of Atmel covering or relating to any machine, process, or combination in which such Atmel products or services might be or are used.

Mailing Address:

Atmel Corporation
1600 Technology Drive
San Jose, CA 95110
USA



Atmel | Enabling Unlimited Possibilities®



Atmel Corporation 1600 Technology Drive, San Jose, CA 95110 USA **T:** (+1)(408) 441.0311 **F:** (+1)(408) 436.4200 | **www.atmel.com**

© 2016 Atmel Corporation. / Rev.: Atmel-42243D-SAM-R21-Xplained-Pro_User Guide-04/2016

Atmel®, Atmel logo and combinations thereof, Enabling Unlimited Possibilities®, AVR® and others are registered trademarks or trademarks of Atmel Corporation in U.S. and other countries. Windows® is a registered trademark of Microsoft Corporation in U.S. and or other countries. ARM® and Cortex® are a registered trademarks of ARM Ltd. Other terms and product names may be trademarks of others.

DISCLAIMER: The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. EXCEPT AS SET FORTH IN THE ATMEL TERMS AND CONDITIONS OF SALES LOCATED ON THE ATMEL WEBSITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS AND PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and products descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Unless specifically provided otherwise, Atmel products are not suitable for, and shall not be used in, automotive applications. Atmel products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

SAFETY-CRITICAL, MILITARY, AND AUTOMOTIVE APPLICATIONS DISCLAIMER: Atmel products are not designed for and will not be used in connection with any applications where the failure of such products would reasonably be expected to result in significant personal injury or death (“Safety-Critical Applications”) without an Atmel officer's specific written consent. Safety-Critical Applications include, without limitation, life support devices and systems, equipment or systems for the operation of nuclear facilities and weapons systems. Atmel products are not designed nor intended for use in military or aerospace applications or environments unless specifically designated by Atmel as military-grade. Atmel products are not designed nor intended for use in automotive applications unless specifically designated by Atmel as automotive-grade.

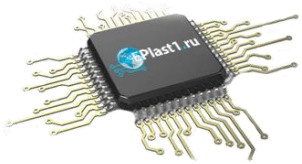
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.