# SAMHA1E16A Xplained-Pro

SAM HA1E16A

Product Overview

The SAM HA1E16A Xplained Pro evaluation kit is a hardware platform to evaluate the ATSAMHA1E16A microcontroller.

Supported by the Atmel Studio integrated development platform, the kit provides easy access to the features of the ATSAMHA1E16A 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 ATSAMHA1E16A.

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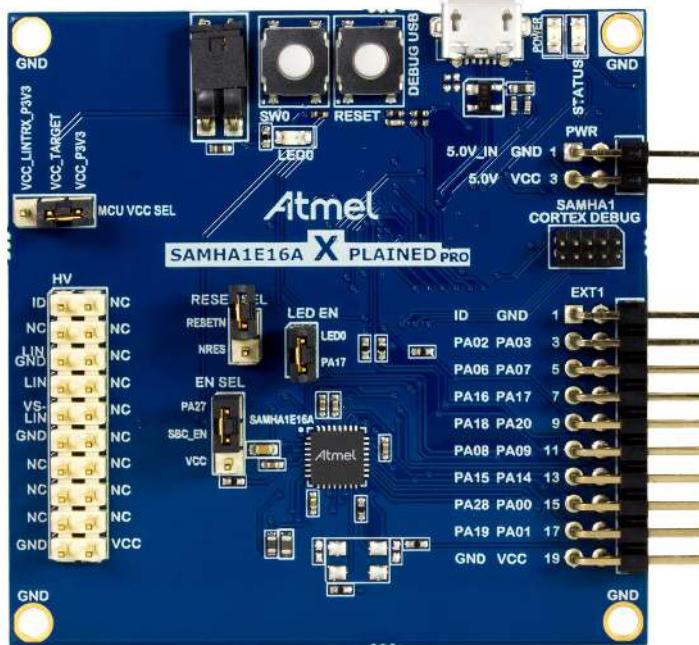
Features

- SAMHA1E16A System in Package
- One Mechanical Reset Button
- One Mechanical Programmable Button
- One Yellow User LED
- One Xplained Pro Extension Header

- One High Voltage Extension Header
- Embedded Debugger
    - Auto-ID for board identification in Atmel Studio
    - One yellow status LED
    - One green board power LED
    - Programming and debugging
    - Data Gateway Interface: I^2C and four GPIOs
    - Virtual COM port (CDC)
- USB Powered

What is the SAM HA1E16A Xplained Pro Evaluation Kit?

The SAM HA1E16A Xplained Pro evaluation kit is a hardware platform to evaluate the ATSAMHA1E16A.

The kit offers a set of features that enables the ATSAMHA1E16A user to get started with the SAM HA1 peripherals right away and to get an understanding of how to integrate the device in their own design.

Figure 1. SAM HA1E16A Xplained Pro Evaluation Kit Overview
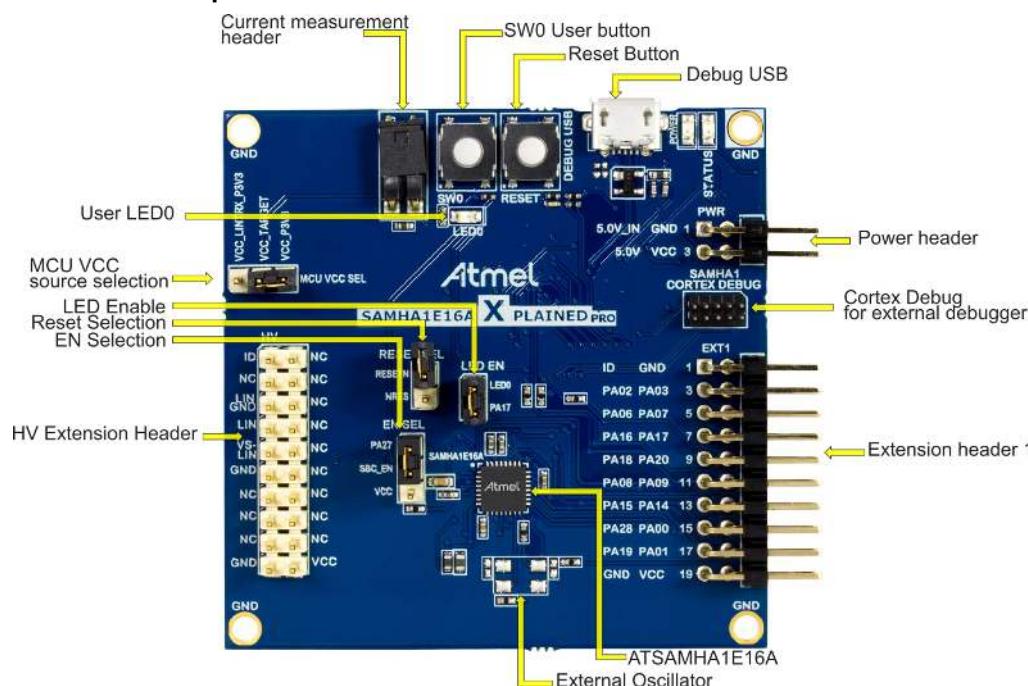
What Does the SAM HA1E16A Xplained Pro Evaluation Kit Contain?

This SAM HA1E16A Xplained ProEvaluation Kit includes:
- SAM HA1E16A XPlained Pro Evaluation Board
- Important Information Sheet

Table of Contents

1. Installation and Operation

1.1 Xplained Pro Quick Start

Steps to start exploring the Xplained Pro platform:

1. Download and install Atmel Studio.
2. Launch Atmel Studio.
3. Connect the Debug USB port on the evaluation kit to the computer using a USB cable (Standard-A to Micro-B or Micro-AB).

When the Xplained Pro MCU kit is connected to the computer for the first time, the operating system installs the driver software automatically. This driver supports 32-bit and 64-bit versions of Microsoft® Windows® XP, Windows Vista®, Windows 7, Windows 8, Windows 10, and Windows Server 2012.

When the Xplained Pro MCU board is powered, the power LED (green) glows and the Atmel Studio automatically detects the specific Xplained Pro MCU and extension board(s) that are connected. The landing page of the kit in the Atmel Studio has an option to launch the Atmel Software Framework (ASF) and the Atmel START example application codes for the kit. The SAM HA1 device is programmed and debugged by the on-board embedded debugger and therefore no external programmer or debugger tool is required.

1.2 SAM HA1E16A Design Documentation and Relevant Links

The following list contains links to the most relevant documents and software for the SAM HA1E16A Xplained Pro.

- **Xplained products** - Xplained evaluation kits are a series of easy-to-use evaluation kits for Microchip microcontrollers and other Microchip products.
  - Xplained Nano - used for low pin-count devices and provides a minimalistic solution with access to all I/O pins of the target microcontroller.
  - Xplained Mini - used for medium pin-count devices and adds Arduino Uno compatible header footprint and a prototyping area.
  - Xplained Pro - used for medium to high pin-count devices that features advanced debugging and standardized extensions for peripheral functions.

  Note: All the above kits have on-board programmers/debuggers, which creates a set of low-cost boards for evaluation and demonstration of features and capabilities of different Microchip products.
- **Atmel Studio** - Free IDE for the development of C/C++ and assembler code for microcontrollers.
- **Microchip sample store** - Microchip 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 16 KB for devices with M0, M0+, and M1 cores and 32 KB for devices with other cores.
- **QTouch® tools** - A collection of tools to design capacitive touch applications.

- **Data Visualizer** - Data Visualizer is a program used for processing and visualizing data. The 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 HA1E16A Xplained Pro available through microchipDIRECT** - microchipDIRECT link.

2.   Xplained Pro

Xplained Pro is an evaluation platform which contains a series of microcontroller boards (evaluation kits) and extension boards. Atmel Studio is used to program and debug the microcontrollers on these boards. Atmel Studio includes ASF and Atmel START, which has drivers and demo code, and Data Visualizer, which supports data streaming and advanced debugging. Xplained Pro evaluation kits can be connected to a wide range of Xplained Pro extension boards through standardized headers and connectors. Xplained Pro extension boards have identification (ID) chips to uniquely identify which boards are connected to the Xplained Pro evaluation kits.

2.1   Embedded Debugger

The SAM HA1E16A Xplained Pro contains an Embedded Debugger (EDBG) for on-board debugging. The EDBG is a USB composite device with the following interfaces:

- Debugger
- Virtual COM Port
- Data Gateway Interface (DGI)

The EDBG can program and debug the ATSAMHA1E16A with the help of Atmel Studio. The SWD interface is connected between the EDBG and the ATSAMHA1E16A on the SAM HA1E16A Xplained Pro.

The Virtual COM Port is connected to a UART on the ATSAMHA1E16A and provides an easy way to communicate with the target application through terminal software. It offers variable baud rate, parity, and stop bit settings. The settings on the ATSAMHA1E16A 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 ATSAMHA1E16A. If the DTR signal is not enabled, the UART pins on the EDBG are kept in tri-state (high-z) to render the COM Port not usable. The DTR signal is automatically set by some terminal software, but it may have to be manually enabled in your terminal.

The DGI consists of several physical interfaces for bidirectional communication with the host computer. Communication over the interfaces is bidirectional. It can be used to send event values and data from the ATSAMHA1E16A. Traffic over the interfaces can be timestamped by the EDBG for more accurate tracking of events, but timestamping reduces the maximal data throughput. The Data Visualizer is used to send and receive data through DGI.

The EDBG controls two LEDs on the SAM HA1E16A Xplained Pro, a power LED and a status LED. The following table provides details on how the LEDs are controlled in different operation modes.

Table 2-1. EDBG LED Control

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

For additional information on the EDBG, see the EDBG User Guide.

2.2 Hardware Identification System

All Xplained Pro extension boards come with an identification chip (ATSHA204A CryptoAuthentication™ chip) to uniquely identify the boards that are connected to the Xplained Pro evaluation kit. 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 evaluation kit, the information is read and sent to the Atmel Studio. The following table shows the data fields stored in the ID chip with example content.

Table 2-2. Xplained Pro ID Chip Content

Data Field	Data Type	Example Content
Manufacturer	ASCII string	Microchip'\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

2.3 Power Sources

The SAM HA1E16A Xplained Pro kit can be powered by several power sources, as listed in the table below.

Table 2-3. Power Sources for SAM HA1E16A Xplained Pro

Power Source	Voltage Requirements	Current Requirements	Connector Marking
External Power	5V ±2% (±100 mV) for USB host operation. 4.3V to 5.5V if a USB	Maximum recommended current is 2A.	PWR

Power Source	Voltage Requirements	Current Requirements	Connector Marking
	host operation is not required.		
Embedded debugger USB	4.4V to 5.25V (according to USB spec.)	500 mA (according to USB spec.)	DEBUG USB
External HV input	6V to 28V	Voltage regulator in SBC is specified for up to 85 mA. This input also supplies the LIN Bus and all the other features of the SBC. It's recommended to use at least 500 mA.	VS and GND on Connector HV

The kit automatically detects which power sources are available and chooses which one to use according to the following priority:

1. External power.
2. Embedded Debugger USB.
3. External HV input

Note: The selection for the supply of the Target MCU has a separate connector. The above priority selects which supply is used to power the EDBG and the VCC_P3V3_CON.

> **Info:** External power is required when 500 mA from a USB connector is not enough to power the board with possible extension boards.

2.4 Xplained Pro Headers and Connectors

2.4.1 Xplained Pro Standard Extension Header

All Xplained Pro kits have many dual row, 20-pin, 100-mil extension headers. The Xplained Pro MCU boards have male headers, while the Xplained Pro extensions have their female counterparts. The following table provides the pin description of all the connected pins.

> **Info:** Not all pins are always connected on all extension headers.

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 microcontroller on the Xplained Pro boards.

Table 2-4. Xplained Pro Standard Extension Header

Pin Number	Pin Name	Description
1	ID	Pin to communicate with the ID chip on an extension board.
2	GND	Ground
3	ADC(+)	Analog-to-Digital Converter; alternatively, a pin for the positive terminal of a differential ADC.
4	ADC(-)	Analog-to-Digital Converter; alternatively, a pin for the negative terminal of a differential ADC.
5	GPIO1	General purpose I/O pin.
6	GPIO2	General purpose I/O pin.
7	PWM(+)	Pulse width modulation; alternatively, a pin for the positive part of a differential PWM.
8	PWM(-)	Pulse width modulation; alternatively, a pin for the negative part of a differential PWM.
9	IRQ/GPIO	Interrupt request pin and/or general purpose I/O pin.
10	SPI_SS_B/ GPIO	Slave select pin for Serial Peripheral Interface (SPI) and/or general purpose I/O pin.
11	I^2C_SDA	Data pin for I^2C interface. Always connected, bus type.
12	I^2C_SCL	Clock pin for I^2C interface. Always connected, bus type.
13	UART_RX	Receiver pin of target device UART.
14	UART_TX	Transmitter pin of target device UART.
15	SPI_SS_A	Slave select for SPI. This pin should preferably not be connected to anything else.
16	SPI_MOSI	SPI master out slave in pin. Always connected, bus type.
17	SPI_MISO	SPI master in slave out pin. Always connected, bus type.
18	SPI_SCK	SPI clock pin. Always connected, bus type.
19	GND	Ground pin for extension boards.
20	VCC	Power pin for extension boards.

2.4.2 Xplained Pro Power Header

The power header can be used to connect external power to the SAM HA1E16A Xplained Pro kit. The kit automatically detects and switches to any external power if supplied. The power header can also be used to supply power to external peripherals or extension boards. Ensure that the total current does not exceed the recommended current limit of the on-board regulator when using the 3.3V pin.

Table 2-5. Xplained Pro Power Header

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

2.4.3 Xplained Pro HV Header

This Xplained Pro kits has one, 20-pin, 100mil HV-extension header. Note that all pins are not always connected. All connected pins follow the defined pin-out description in the table below.

Table 2-6. Xplained Pro HV Extension Header

Pin Number	Name	Description
1	ID	Communication line to the ID chip on an extension board
2	GND	Ground
3	NC	
4	NC	
5	LIN_GND	GND of LIN SBC
6	NC	
7	LIN	LIN-Bus signal
8	NC	
9	VS	Battery voltage VS
10	NC	
11	GND	GND
12	NC	
13	NC	
14	NC	
15	NC	
16	NC	
17	NC	
18	NC	
19	GND	Ground
20	VCC	Power for extension board

3. Hardware Description

3.1 Power Distribution

SAM HA1E16A Xplained Pro has two power sources; EDBG USB and external 5.0V. The kit will automatically select the source to draw power from. The kit has two on board 3.3V voltage regulators, one for the EDBG and XAM, and one for the ATSAMHA1E16A and other peripherals.

Figure 3-1. Power Supply Block Diagram
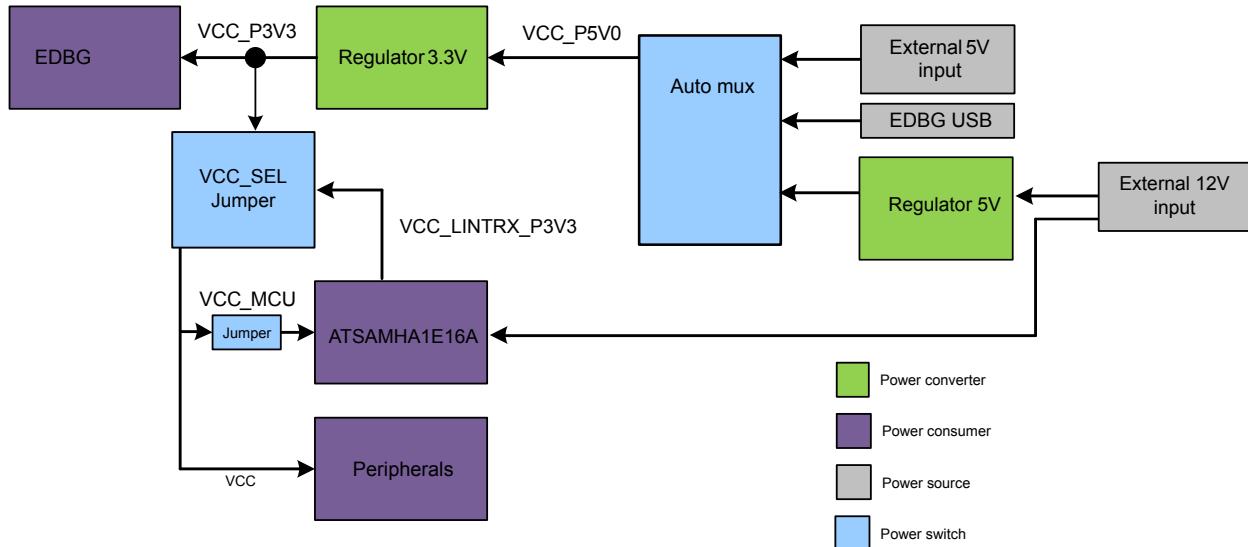
3.2 Connectors

This chapter describes the implementation of the relevant connectors and headers on SAM HA1E16A Xplained Pro and their connection to the ATSAMHA1E16A. The tables of connections in this chapter also describes which signals are shared between the headers and on-board functionality.

3.2.1 Xplained Pro Extension Headers

The SAM HA1E16A Xplained Pro header EXT1 offers access to the I/O of the microcontroller in order to expand the board e.g. by connecting extensions to the board. This header is based on the standard extension header specified in Table 2-4. The header has a pitch of 2.54 mm.

Table 3-1. Extension Header EXT1

EXT1 pin	SAM HA1 pin	Function	Shared functionality
1 [ID]	-	-	Communication line to the ID chip on an extension board
2 [GND]	-	-	Ground
3 [ADC(+)]	PA02	AIN[0]	
4 [ADC(-)]	PA03	AIN[1]	

EXT1 pin	SAM HA1 pin	Function	Shared functionality
5 [GPIO1]	PA06	GPIO	
6 [GPIO2]	PA07	GPIO	
7 [PWM(+)]	PA16	TCC2/WO[0]	
8 [PWM(-)]	PA17	TCC2/WO[1]	
9 [IRQ/GPIO]	PA18	IRQ2/GPIO	DGI_GPIO3
10 [SPI_SS_B/GPIO]	PA20	GPIO	DGI_GPIO1
11 [TWI_SDA]	PA08	SERCOM2 PAD[0] I²C SDA	EDBG I²C
12 [TWI_SCL]	PA09	SERCOM2 PAD[1] I²C SCL	EDBG I²C
13 [USART_RX]	PA15	SERCOM4 PAD[3] UART RX	CDC_UART_RX
14 [USART_TX]	PA14	SERCOM4 PAD[2] UART TX	CDC_UART_TX
15 [SPI_SS_A]	PA28	SPI Master SS	DGI_GPIO2
16 [SPI_MOSI]	PA00	SERCOM1 PAD[0] SPI MOSI	SW0/DGI_GPIO0
17 [SPI_MISO]	PA19	SERCOM1 PAD[3] SPI MISO	
18 [SPI_SCK]	PA01	SERCOM1 PAD[1] SPI SCK	
19 [GND]	-	-	Ground
20 [VCC]	-	-	Power for extension board

Table 3-2. Extension Header HV

HV pin	SAM HA1 pin	Function	Shared functionality
1 [ID]	-	-	Communication line to the ID chip on an extension board
2 [GND]	-	-	Ground
3 -	-	-	
4 -	-	-	
5 [LIN_GND]	GND	-	Ground
6 -	-	-	
7 [LIN]	LIN	LIN Bus	
8 -	-	-	
9 [VS_LIN]	VS	Supply Voltage	
10 -	-	-	
11 [GND]	GND	-	Ground

HV pin	SAM HA1 pin	Function	Shared functionality
12 -	-	-	
13 -	-	-	
14 -	-	-	
15 -	-	-	
16 -	-	-	
17 -	-	-	
18 -	-	-	
19 [GND]	-	-	Ground
20 [VCC]	-	-	Power for extension board

3.2.2 Current Measurement Header

An right-angled 1x2, 100-mil pin header marked with the MCU current measurement is located at the upper edge of the SAM HA1E16A Xplained Pro. All power to the ATSAMHA1E16A is exclusively routed through this header (excluding power to extension headers and peripherals). 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 ATSAMHA1E16A to be powered through its I/O pins. This may cause permanent damage to the device.

3.2.3 VCC_SEL Header

A 1 x 3, 100 mil pin-header marked with MCU VCC SEL header is located at the upper left side of the SAM HA1E16A Xplained Pro. The power source for the ATSAMHA1E16A and extension boards is selected with this header.

Table 3-3. MCU VCC SEL header

Jumper position	Power source	Comment
VCC_LINTRX_P3V3 - VCC_TARGET	LIN SBC	The LIN SBC supplies the microcontroller and the extension boards. For this setting to work, the SBC must be supplied as described in chapter Power Sources. The voltage regulator inside the SBC is specified for max 85 mA. If extension boards with high current consumption are attached, this setting should not be used.
VCC_P3V3 - VCC_TARGET	500 mA voltage Regulator	The on board 500 mA voltage regulator supplies the microcontroller and extension boards.

3.2.4 Cortex Debug Connector

SAM HA1E16A Xplained Pro has a 10-pin 50-mil Cortex® Debug Connector that can be used to attach external debuggers to the ATSAMHA1E16A.

Table 3-4. Cortex Debug Connector

Cortex Debug Connector Pin	Pin / Net	Function
1	VCC_TARGET_P3V3	ATSAMHA1E16A voltage
2	SWDIO	SWD data signal
3	GND	Ground
4	SWCLK	SWD clock signal
5	GND	Ground
6	-	-
7	-	-
8	-	-
9	GND	Ground
10	RESETN	Target reset signal

3.3 Peripherals

3.3.1 Mechanical Buttons

SAM HA1E16A Xplained Pro contains two mechanical buttons. One button is the RESET button connected to the SAM HA1 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.

Note: There is no pull up resistor connected to the generic user button. Remember to enable the internal pull up in the SAM HA1 to use the button.

Table 3-5. Mechanical Buttons

SAM HA1 pin	Silkscreen text
RESET	RESET
PA18	SW0

3.3.2 LED

There is one yellow LED available on the SAM HA1E16A 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 3-6. LED Connection

SAM HA1 pin	Function	Comment
PA17	Yellow LED0	Please note that this is connected through a jumper since the Pin on the SAM HA1 is shared with EXT1

3.3.3 LIN SBC

The LIN SBC inside the SAM HA1 has external connections to headers and the microcontroller inside the SAM HA1. The LIN-SBC can be switched into different modes using the EN-Pin. The EN-Pin can be connected to a microcontroller port pin or fixed to VCC.

Table 3-7. EN SEL Header

Mode	Setting	Comment
Determined by Microcontroller	PA27 - SBC_EN	PA27 controls the mode of the SBC. During startup SBC stays in failsafe due to PA27 being in tri-state and EN pin having a pull down resistor.
Always normal mode	VCC - SBC_EN	SBC goes into normal mode after startup. Mode can't be controlled by the microcontroller.
Always fail-safe	Open	The internal pull down resistor keeps the SBC in fail-safe mode. Useful when no LIN-communication is needed but the SBC is used to supply the board.

Table 3-8. LIN-Transceiver connections

Microcontroller pin	LIN-TRX pin	MUX Setting
PA13	TXD	SERCOM[4]-PAD[2], MUX: **C**
PB11	RXD	SERCOM[4]-PAD[3], MUX: **D**

Table 3-9. RES SEL Header

Header pin	SAM HA1 pin	Comment
1 [NRES]	LIN-SBC NRES output	Connect to enable resetting of the microcontroller by the LIN SBC. Possible sources are VS undervoltage and others, listed in the ATSAMHA1E16A datasheet.
2 [RESETN]	Microcontroller Reset Input	

3.4 Embedded Debugger Implementation

SAM HA1E16A Xplained Pro contains an Embedded Debugger (EDBG) that can be used to program and debug the ATSAMHA1E16A using Serial Wire Debug (SWD). The Embedded Debugger also includes a Virtual Com port interface over UART, a Data Gateway Interface over I^{2}C and it includes four of the SAM HA1 GPIOs. Atmel Studio can be used as a front end for the Embedded Debugger.

3.4.1 Serial Wire Debug

The Serial Wire Debug (SWD) uses two pins to communicate with the target. For further information on how to use the programming and debugging capabilities of the EDBG, see Embedded Debugger.

Table 3-10. SWD Connections

SAM HA1 pin	Function
PA30	SWD clock
PA31	SWD data

3.4.2 Virtual COM Port

The Embedded Debugger acts as a Virtual Com Port gateway by using one of the ATSAMHA1E16A UARTs. For further information on how to use the Virtual COM port, see Embedded Debugger.

Table 3-11. Virtual COM Port Connections

SAM HA1 pin	Function
PA14	SERCOM4 PAD[2] UART TXD (SAM HA1 TX line)
PA15	SERCOM4 PAD[3] UART RXD (SAM HA1 RX line)

3.4.3 Data Gateway Interface

The Embedded Debugger features a Data Gateway Interface (DGI) by using an I²C interface. The DGI can be used to send a variety of data from the ATSAMHA1E16A to the host PC. For further information on how to use the DGI interface, see Data Visualizer and the EDBG User Guide.

Table 3-12. DGI Interface Connections when using I²C

SAM HA1 pin	Function
PA08	SERCOM2 PAD[0] SDA (Data line)
PA09	SERCOM2 PAD[1] 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 HA1 application code. For further information on how to configure and use the GPIO monitoring features, see Data Visualizer and the EDBG User Guide.

Table 3-13. GPIO Lines Connected to the EDBG

| SAM HA1 pin	Function
PA00	GPIO0
PA20	GPIO1
PA28	GPIO2
PA18	GPIO3

4. Appendix

4.1 Getting Started with IAR

The IAR Embedded Workbench® for ARM® is a proprietary, high-efficiency compiler not based on GCC. The 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 programming and debugging to work.

The following steps explain how to set up a project for programming and debugging:

1. Open the project that needs to be configured. Open the **OPTIONS** dialog for the project.
2. In the **General Options** category, click the **Target** tab. Select the "Device" for the project or the "Core" of the device.

   Figure 4-1. Select Target Device
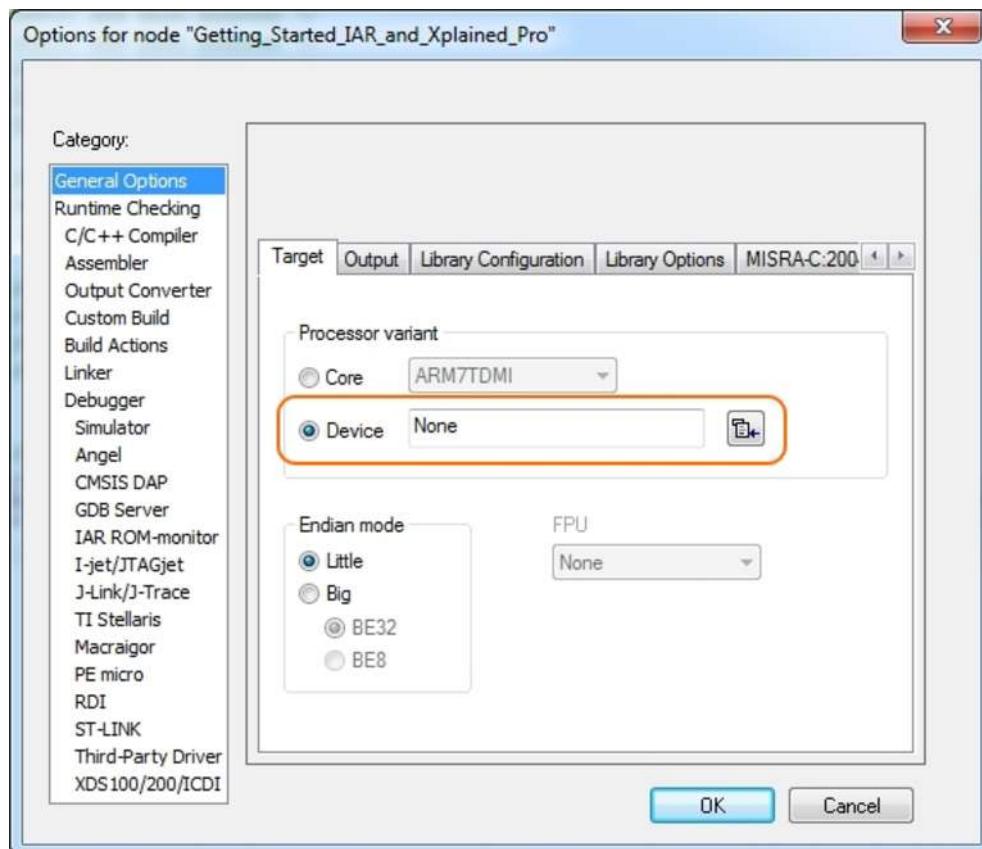
3. In the **Debugger** category, click the **Setup** tab. Select **CMSIS DAP** as the driver.

Figure 4-2. Select Debugger
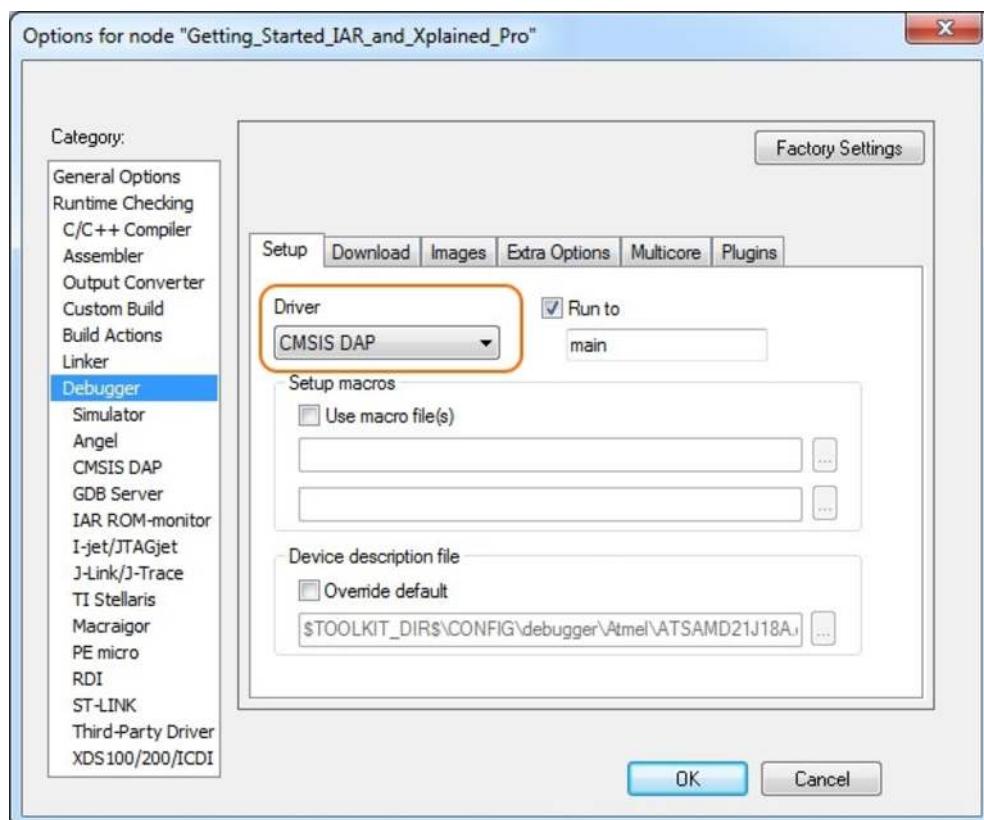
4. In the **Debugger** category, click the **Download** tab. Select the **Use flash loader(s)** option.

Figure 4-3. Configure Flash Loader
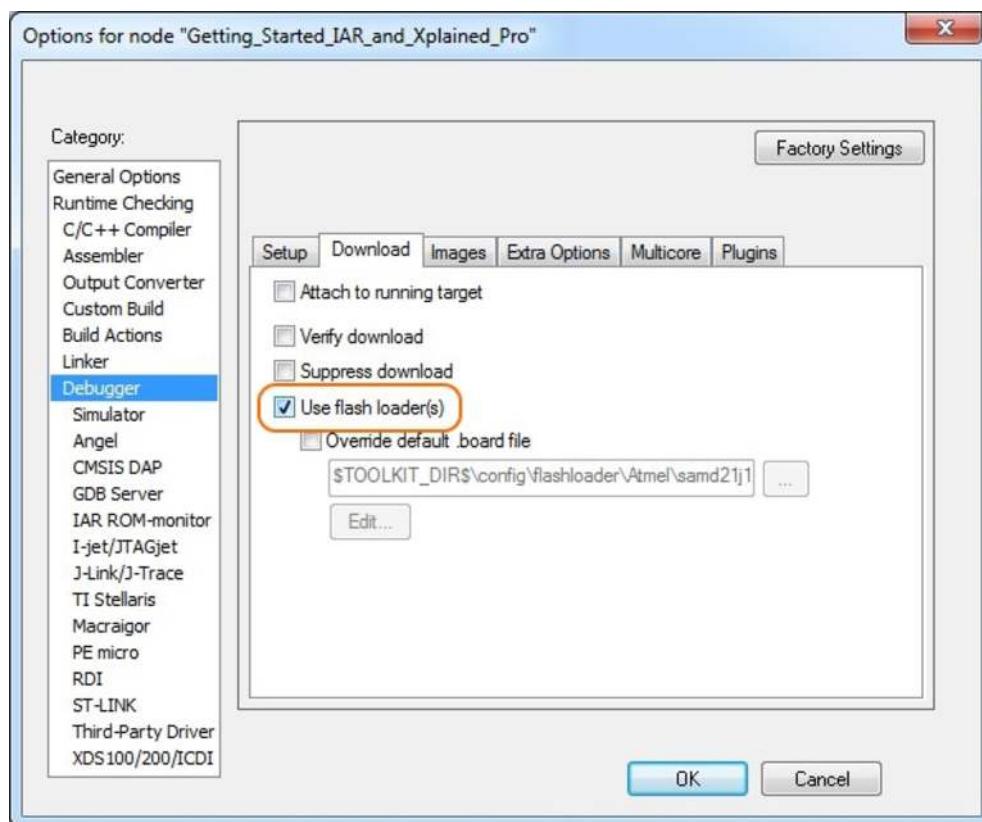
5. In the **Debugger** > **CMSIS DAP** category, select the **Setup** tab. Select **System (default)** as the reset method.

Figure 4-4. Configure Reset
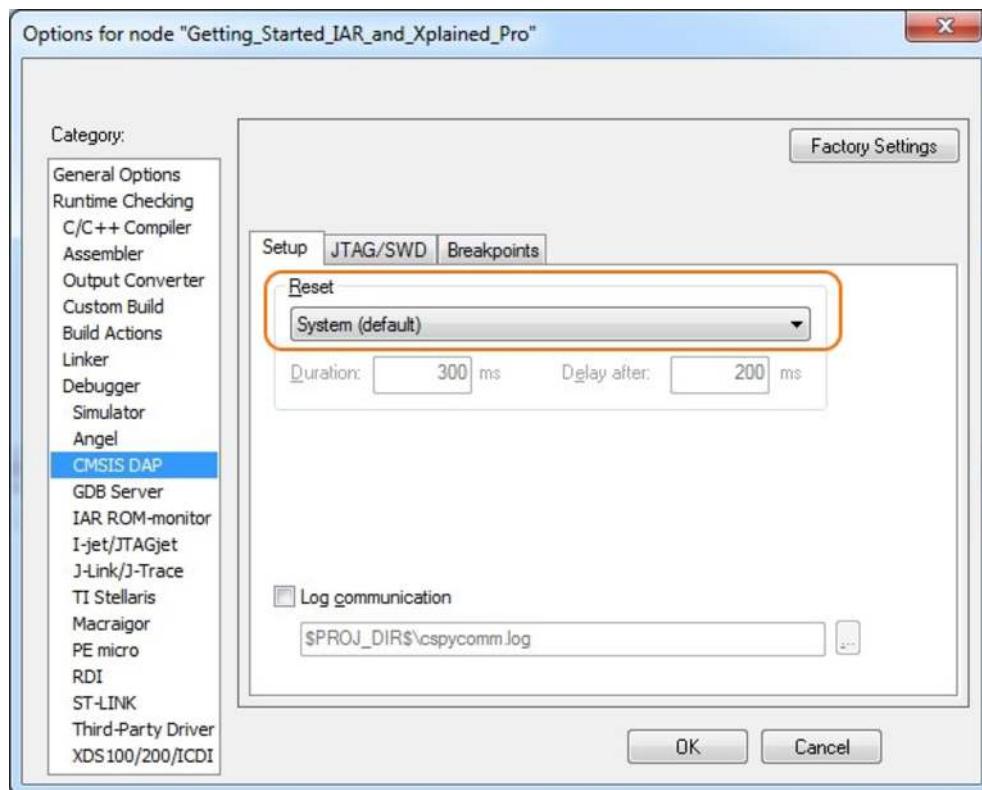
6. In the category **Debugger** > **CMSIS DAP**, click the **JTAG/SWD** tab. Select **SWD** as the interface and optionally select the **SWD speed**.

Figure 4-5. Configure Interface
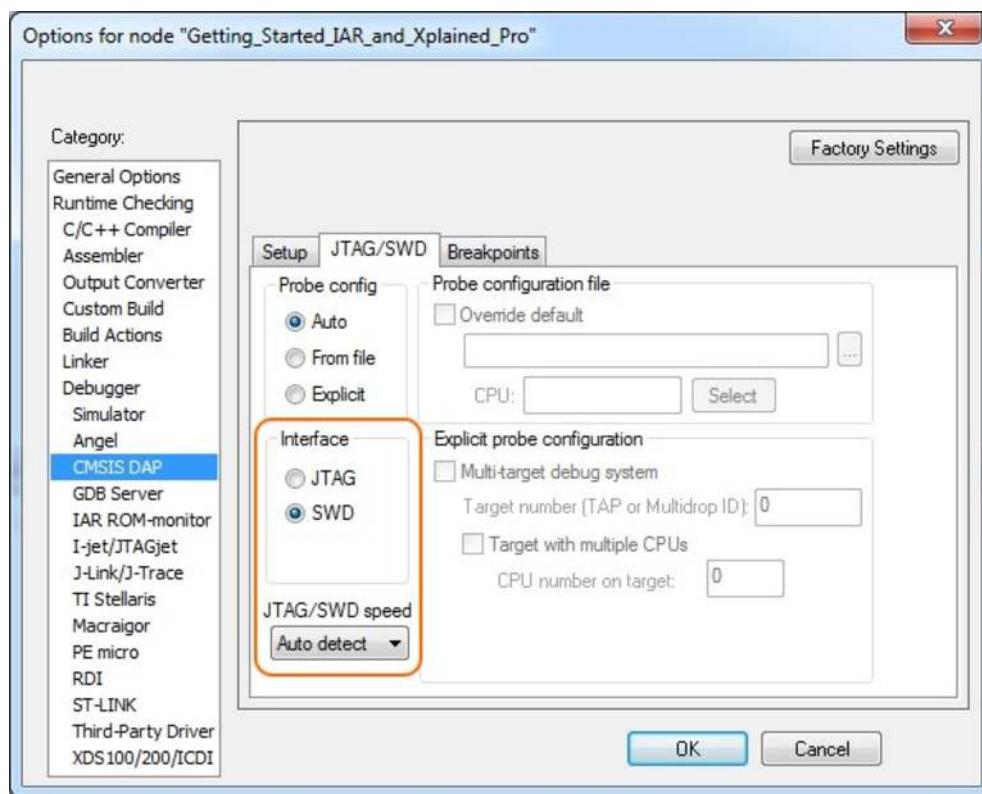
5. Schematics and Layout

This appendix contains the following schematics and layouts for SAM HA1E16A Xplained Pro:

- Board - Schematic Top Level
- Board - Schematic Power Supply
- Board - Schematic Target MCU
- Board - Schematic Connectors
- Board - Schematic EDBG
- Board - Top Layer
- Board - GND Layer
- Board - Power Layer
- Board - Bottom Layer
- Board - Top Silk Layer
- Board - Bottom Silk Layer

5.1 Board - Schematic Top Level
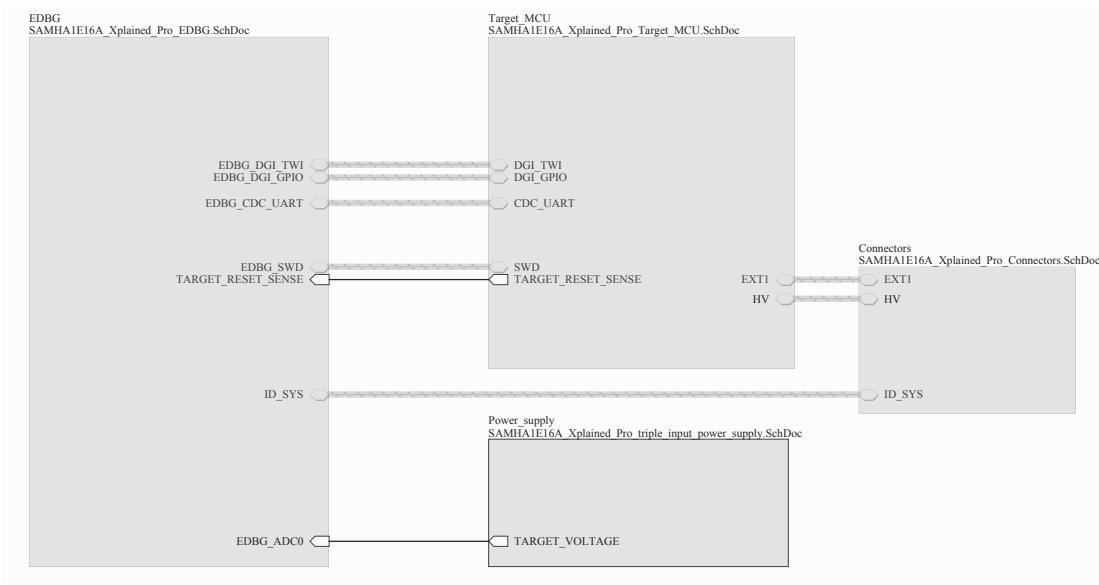
5.2 Board - Schematic Power Supply
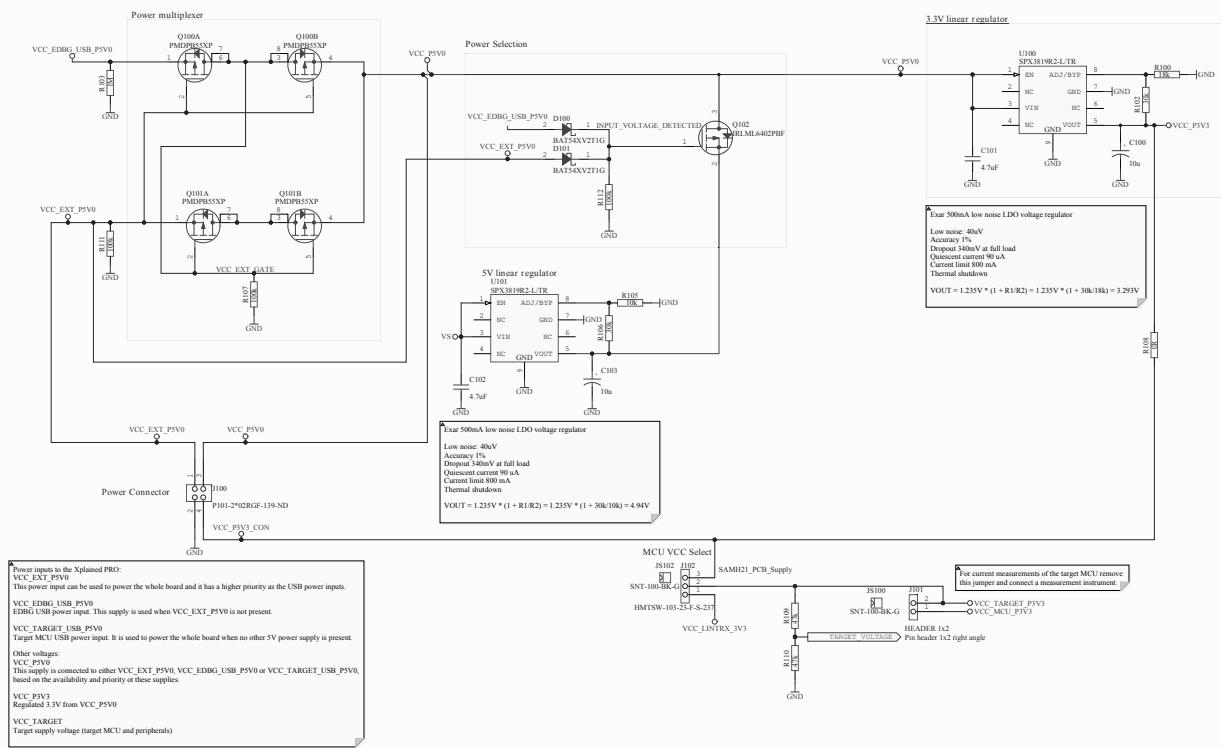
5.3   Board - Schematic Target MCU

5.4 Board - Schematic Connectors

EXT1 extension header

HV Extension Header
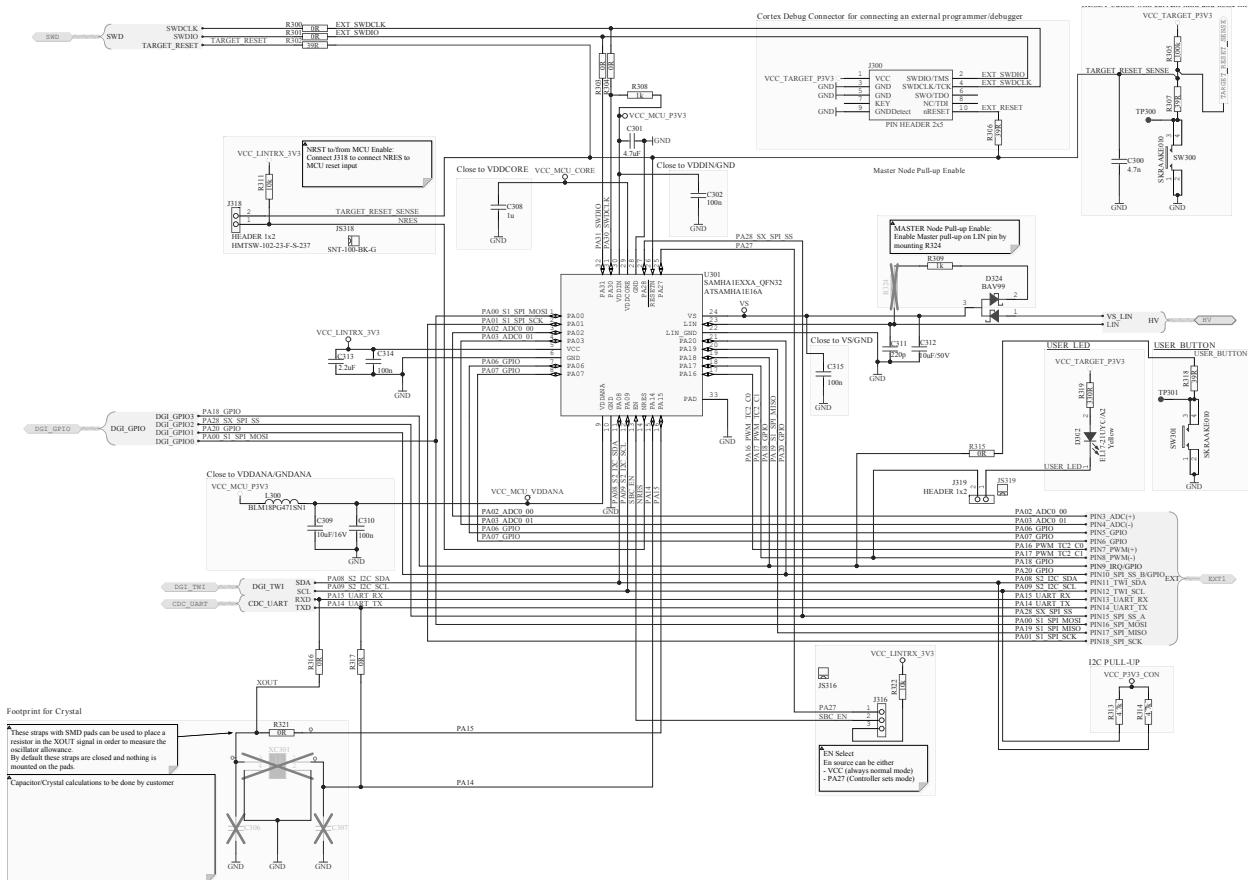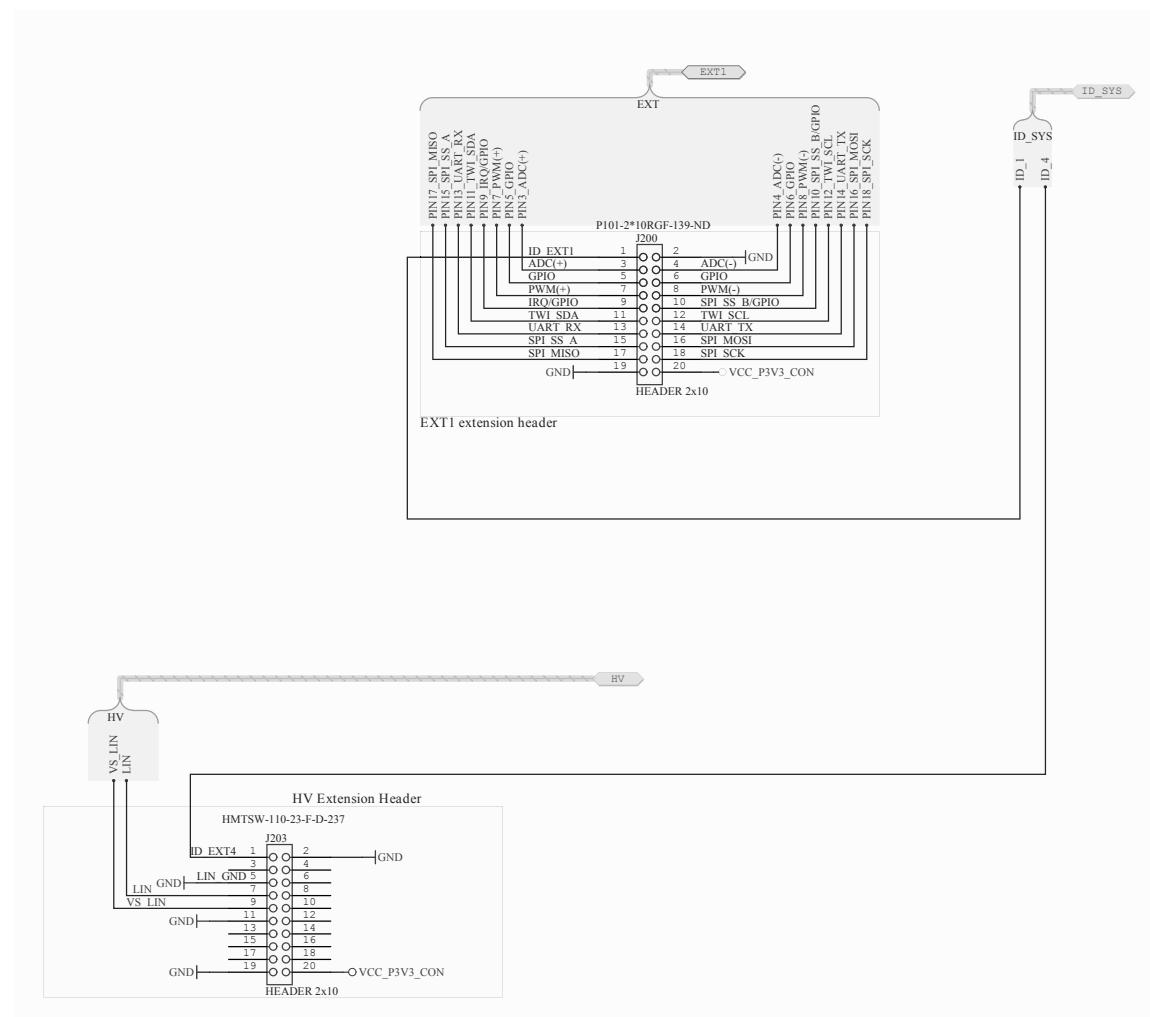
5.5   Board - Schematic EDBG
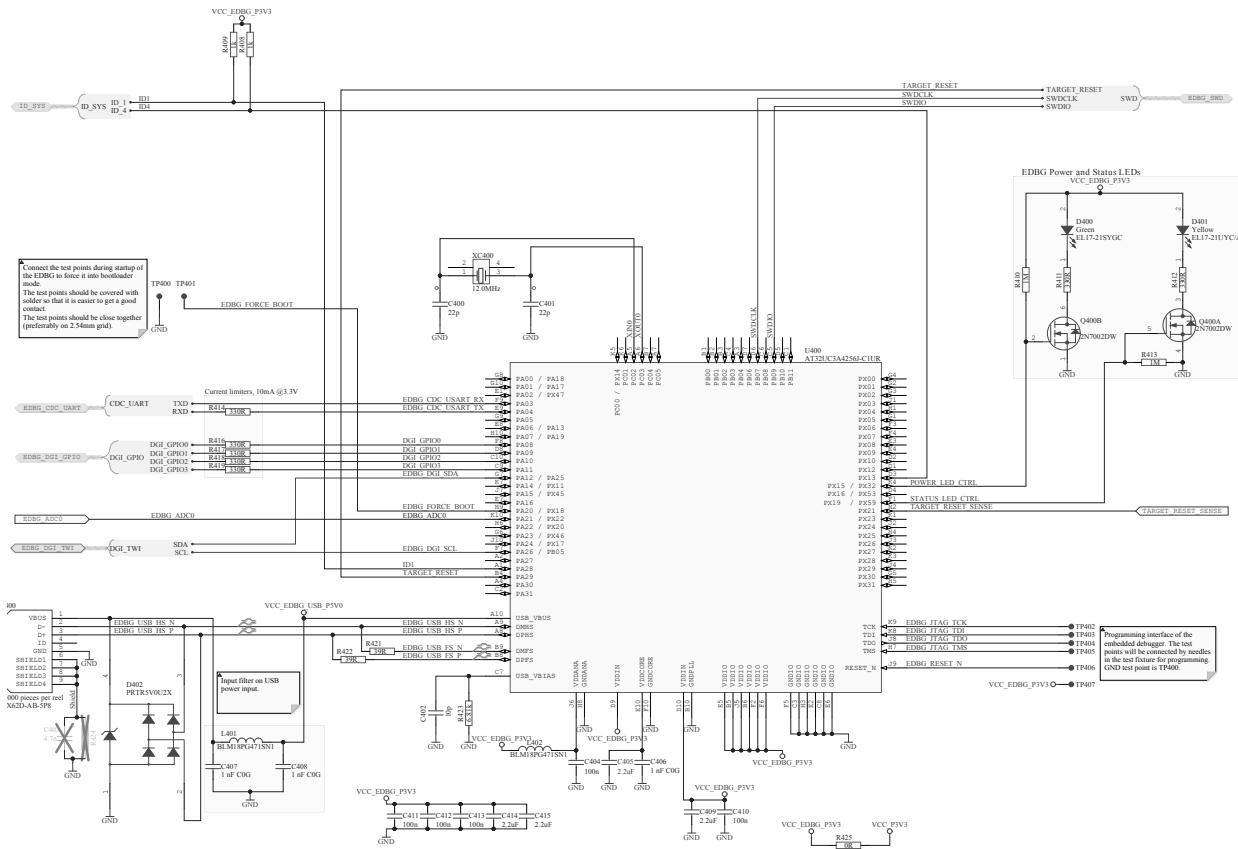
5.6　Board - Top Layer
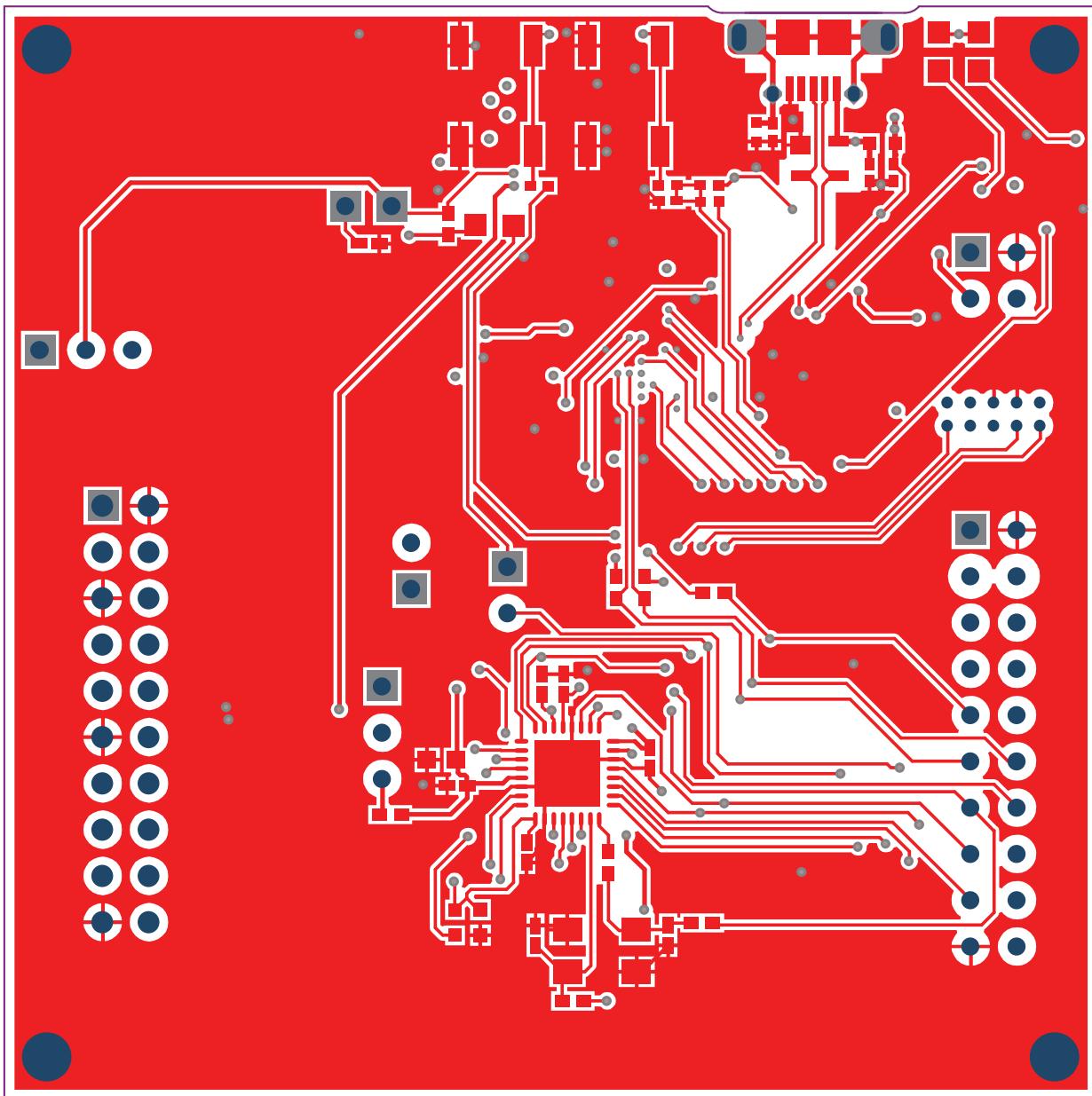
5.7 Board - GND Layer
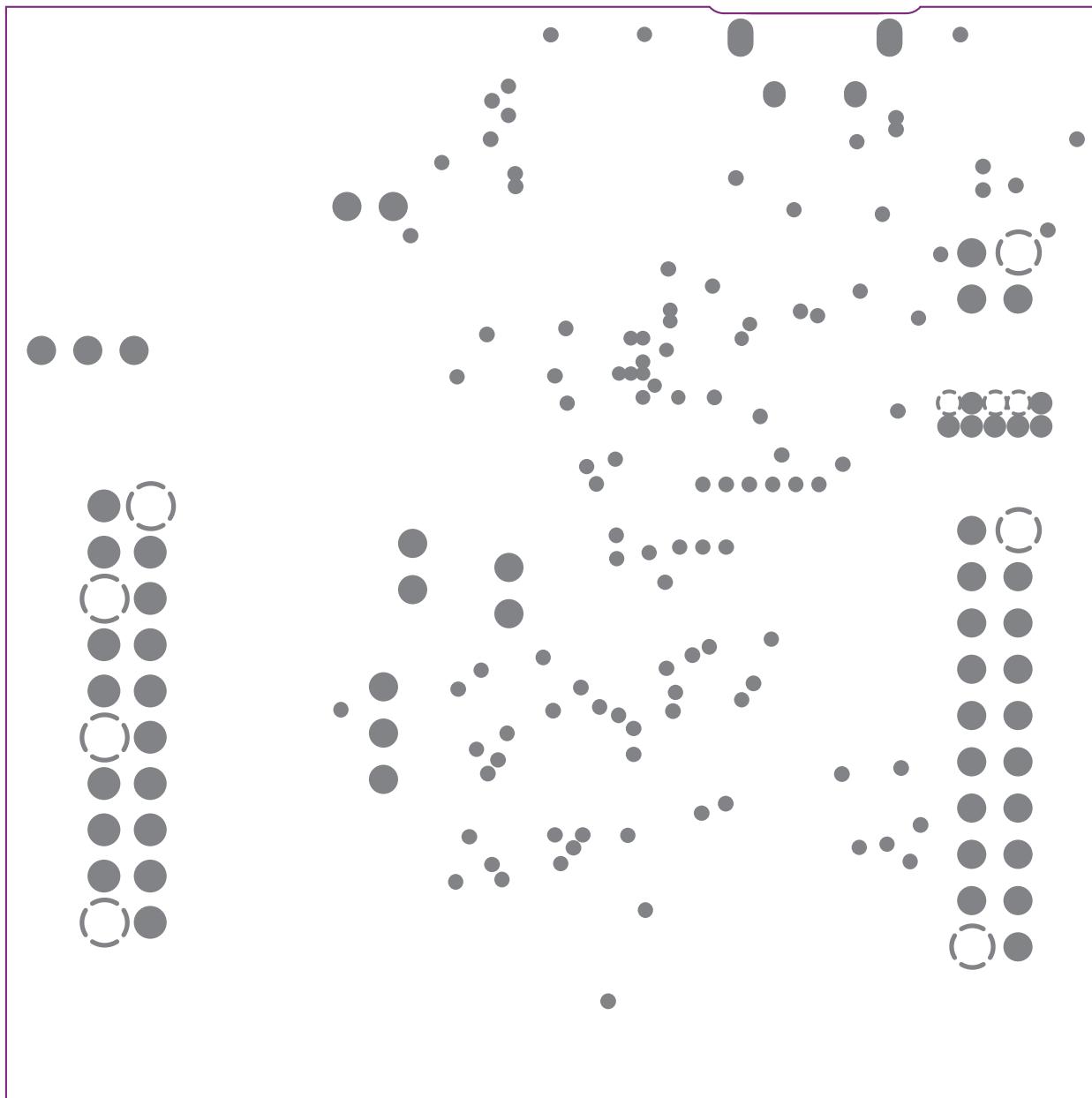
5.8 Board - Power Layer
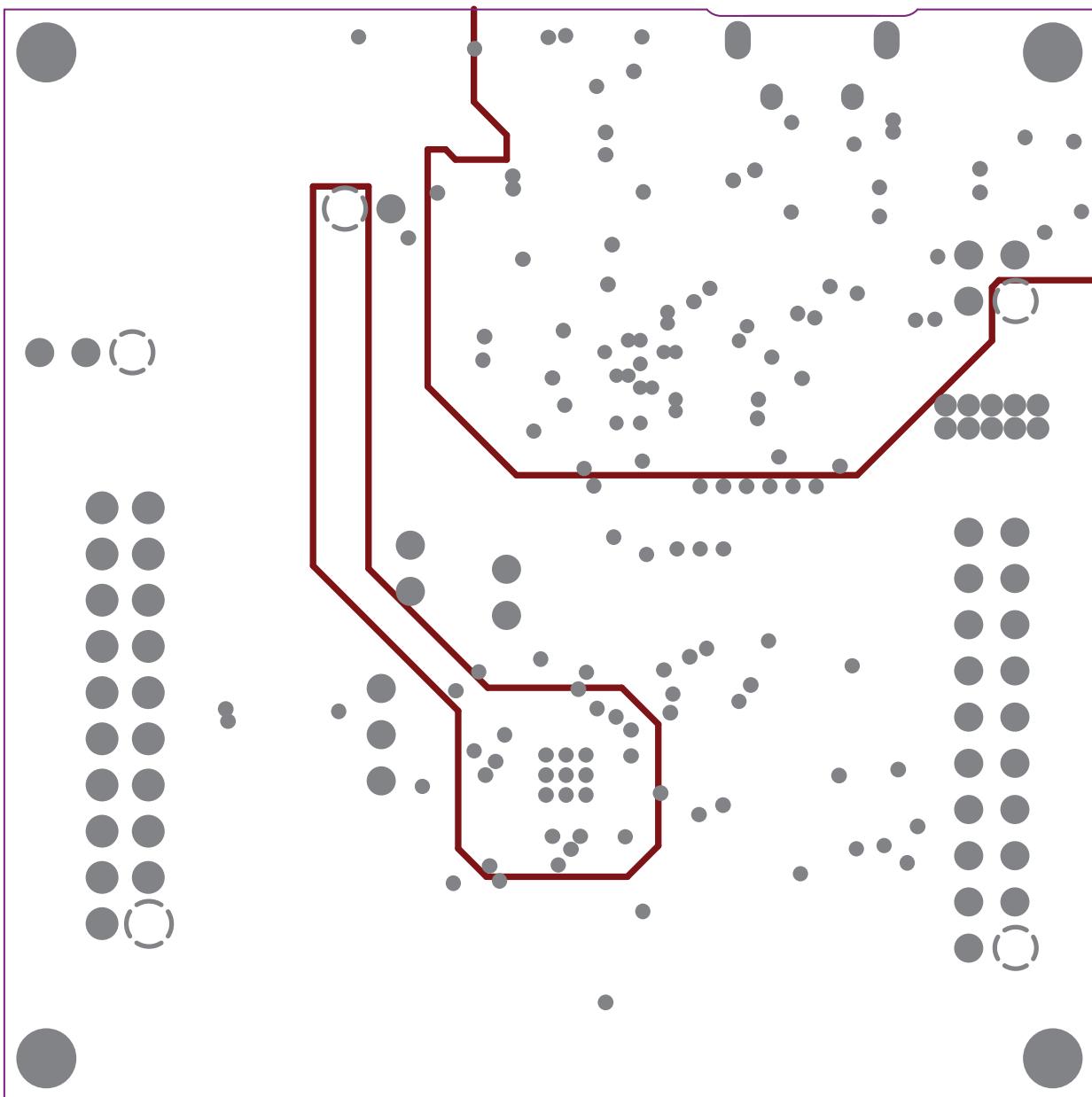
5.9   Board - Bottom Layer

5.10   Board - Top Silk Layer

GND

VCC_MCU
VCC_TARGET

VCC_LINTRX_P3V3
VCC_TARGET
VCC_P3V3

DEBUG USB

POWER

STATUS

GND

SW0   RESET

PWR

LED0

5.0V_IN   GND   1

5.0V   VCC   3

MCU VCC SEL

SAMHA1
CORTEX DEBUG

Atmel

SAMHA1E16A X PLAINED PRO

HV

ID   NC

NC   NC

LIN
GND   NC

LIN   NC

VS-
LIN   NC

GND   NC

NC   NC

NC   NC

NC   NC

GND   VCC

GND

RESET SEL

RESETN

NRES

EN SEL

PA27

SBC_EN

VCC

LED EN

LED0

PA17

SAMHA1E16A

EXT1

ID   GND   1

PA02   PA03   3

PA06   PA07   5

PA16   PA17   7

PA18   PA20   9

PA08   PA09   11

PA15   PA14   13

PA28   PA00   15

PA19   PA01   17

GND   VCC   19

GND

5.11 Board - Bottom Silk Layer

BOOT   GND

RST   TCK

TDO   TDI

VCC   TMS

5.0V_IN

GND

3.3V

5.0V

GND   ID

PA03   PA02

PA07   PA06   XPLAINED PRO
EXTENSION HEADER

GND	ID
ADC-	ADC+
GPIO1	GPIO0
PWM-	PWM+
SPI_SS_B	IRQ
TWI_SCL	TWI_SDA
UART_TX	UART_RX
SPI_MOSI	SPI_SS_A
SPI_SCK	SPI_MISO
VCC	GND

PA17   PA16

PA20   PA18

PA09   PA08

PA14   PA15

PA00   PA28

PA01   PA19

VCC   GND

NC   ID

NC   NC

NC   LIN
GND

Master
Operation NC   LIN

NC   VS-
LIN

NC   GND

NC   NC

NC   NC

NC   NC

VCC   GND

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PCBA LABEL

A08-2258 Rev 3

6. SAM HA1E16A Xplained Pro BOM

Table 6-1. BILL OF MATERIALS (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
2	C100, C103	SMD tantalum capacitor, 10u, ESR = 1.7, 3216-18 (EIA) 1206	Vishay	TR3A106K016C1700
2	C101, C102	Ceramic capacitor, 4.7 uF, SMD 0603, X5R, 10V, 10% (de31036)	TDK Corporation	C1608X5R1A475K
1	C300	Ceramic capacitor, 4.7n, SMD 0402, X7R, 25V, +/-10% (de35287)		
1	C301	Ceramic capacitor, 4.7 uF, SMD 0402, X5R, 6.3V, +/-10%	TDK Corporation	C1005X5R0J475K
4	C302, C310, C314, C315	Ceramic capacitor, 100n, SMD 0402, X7R, 16V, +/-10%	KEMET	C0402C104K4RACTU
0	C306, C307	DO NOT POPULATE		
1	C308	Ceramic capacitor, 1u, SMD 0402, X5R, 6.3V, +/-10% (de26942)	KEMET	C0402C105K9PAC
1	C309	Ceramic capacitor, 10 uF/16V SMD 0603, X5R, 16V, 10UF ± 20% (High Density)	Taiyo Yuden Co., Ltd.	EMK107BBJ106MA-T
1	C311	Ceramic capacitor, 220p, SMD 0603, X7R, 50V, ±10 %		
1	C312	Ceramic capacitor, 10 uF/50V, SMD 1210, X7S , 50V, Â±10%	TDK Corporation	CGA6P3X7S1H106K
1	C313	Ceramic capacitor,2.2 uF, SMD 0603, X7R, 50V, ±10 %	Murata	GRM1885C1H221JA01D
2	C400, C401	Ceramic capacitor, 22p, SMD 0402, NP0, 50V, +/-5%		
1	C402	Ceramic capacitor, 10p, SMD 0402, NP0, 50V, +/-5%		
0	C403	DO NOT POPULATE		
5	C404, C410, C411, C412, C413	Ceramic capacitor, 100n, SMD 0402, X7R, 16V, +/-10%	KEMET	C0402C104K4RACTU
4	C405, C409, C414, C415	Ceramic capacitor, 2.2 uF, SMD 0402, X5R, 6.3V, +/-20%	KEMET	C0402C225M9PAC
3	C406, C407, C408	Ceramic capacitor, 1 nF C0G, SMD 0402, C0G, 50V, +/-5%	Murata	GRM1555C1H102JA01D

Qty.	Reference	Description	Manufacturer	Part Number
2	D100, D101	Schottky diode, If:200 mA, Vf: 0.35V, Vrrm:30V, SOD-523	ON Semiconductor®	BAT54XV2T1G
2	D302, D401	LED, Yellow , Wave length=591nm, SMD 0805, ±70°	Everlight	17-21UYC/S530-A3/TR8
1	D324	High speed Double Diode	Philips	BAV99
1	D400	LED, Green, Wave length=575 nm, SMD 0805, ±70°	Everlight	EL17-21SYGC
1	D402	Double rail-to-rail USB ESD protection diode	Philips	PRTR5V0U2X
4	E1, E2, E3, E4	2.8 mm adhesive feet,diam 8.0 mm	3M	SJ-5076
1	FIXTURE1	Xplained PRO MCU board Jupiter Test Fixture	ESCATEC	Xplained PRO MCU board Jupiter Test Fixture
1	FW1	EDBG secured firmware	Microchip Technology Inc.	
1	J100	Pin header, 2 x 2, Right Angle, 2.54 mm, THT, Pin In Paste		P101-2*02RGF-139-ND
1	J101	1 x 2 pin header, right angle, 2.54 mm pitch, through-hole	Pro-Data	2213R-2G
1	J102	1 x 3 pin header, 2.54 mm pitch, Pin-in-Paste THM, 1 mm hole	Samtec, Inc.	HMTSW-103-23-F-S-237
1	J200	Pin header, 2 x 10, Right Angle, 2.54 mm, THM, Pin In Paste		P101-2*10RGF-139-ND
1	J203	2 x 10 pin header, 2.54 mm pitch, Pin-in-Paste THM	Samtec, Inc.	HMTSW-110-23-F-D-237
1	J300	2 x 5 pin header, 1.27 mm pitch, THM	Garry	STL21-0730 G TT-10U
1	J316	1 x 3 pin header, 2.54 mm pitch, Pin-in-Paste THM, 1 mm hole	Samtec, Inc.	HMTSW-103-23-F-S-237
2	J318, J319	1 x 2 pin header, 2.54 mm pitch, Pin-in-Paste THM	Samtec, Inc.	HMTSW-102-23-F-S-237
1	J400	ZX62D-AB-5P8, Micro USB AB Connector, Standard SMT + DIP		
5	JS100, JS102, JS316, JS318, JS319	Jumper cap for 2.54 mm pinheader	Samtec, Inc.	SNT-100-BK-G
3	L300, L401, L402	SMD RF inductor 0603. Z=470 Ohm (@100 MHz), Max	Murata	BLM18PG471SN1

Qty.	Reference	Description	Manufacturer	Part Number
		R(dc)=0.65 Ohm, Max current = 1A		
1	LABEL1	PCBA identification label PP Top White Gloss	ACT Logimark AS	505462
1	PCB1	SAMHA1E16A Xplained Pro Printed Circuit Board	Microchip Technology Inc.	
1	PCBADOC1	A09-2435 PCBA Files, SAM HA1E16A Xplained Pro PCBA documentation		
2	Q100, Q101	Dual P-Channel MOSFET, -20V, RDS(ON) < 55 mOhm @-3.4A@-4.5V	NXP Semiconductors	PMDPB55XP
1	Q102	P-ch. MOSFET. -30V, -3.7A continuous,RDS(ON)=0.05 Ohm@ VGS=-4,5V, RDS(ON)=0.08 Ohm@VGS=-2.5V	International Rectifier	IRLML6402PBF
1	Q400	Dual N-Channel MOSFET, 60V, 115 mA cont,RDS(ON) < 7.5 Ohm @50 mA@5V, SOT-363	Fairchild Semiconductor®	2N7002DW
1	R100	Thick film resistor, 18k, SMD 0402, 1/16W, 1%		
2	R102, R106	Thick film resistor, 30k, SMD 0402, 1/16W, 1%		
3	R103, R410, R413	Thick film resistor, 1M, SMD 0402, 1/16W, 1%		
3	R105, R311, R322	Thick film resistor, 10k, SMD 0402, 1/16W, 1%		
3	R107, R111, R112	Thick film resistor, 100k, SMD 0402, 1/16W, 1% Fitted R108,		
10	R108, R300, R301, R303, R304, R315, R316, R317, R321, R425	Thick film resistor, 0R, SMD 0402, 1/16W, 1%		
2	R109, R110	Thick film resistor, 47k, SMD 0402, 1/16W, 1%		
5	R302, R307, R318, R421, R422	Thick film resistor, 39R Thick, SMD 0402, 1/16W, 1%		

Qty.	Reference	Description	Manufacturer	Part Number
1	R305	Thick film resistor, 100k, SMD 0402, 1/16W, 1%		
1	R306	Thick film resistor, 39R, SMD 0402, 1/16W, 1%		
3	R308, R408, R409	Thick film resistor, 1k, SMD 0402, 1/16W, 1%		
1	R309	Thick film resistor, 1k, SMD 1210, 1/2W, 1%		
2	R313, R314	Thick film resistor, 4.7k, SMD 0402, 1/16W, 1%		
0	R324	DO NOT POPULATE		
8	R319, R411, R412, R414, R416, R417, R418, R419	Thick film resistor, 330R, SMD 0402, 1/16W, 1% Fitted		
1	R423	Thick film resistor, 6.81k, SMD 0402, 1/16W, 1%		
0	R424	DO NOT POPULATE		
2	SW300, SW301	6.2 x 6.2 mm SMD tact switch, same as A08-0091 but less force is needed	Exar Corporation	SKRAAKE010
1	TEST1	Fixture test for SAM HA1E16A Xplained Pro		
1	TESTDOC1	SAM HA1E16A Xplained Pro Test Instructions		
2	U100, U101	500 mA LDO, ADJ, low noise, 8-DFN package	Exar Corporation	SPX3819R2-L/TR
1	U301	Microchip SiP 32bit RISC MCU + LIN SBC 32 pin	Microchip Technology Inc.	ATSAMHA1E16A-MBT
1	U400	AVR 32-bit RISC MCU	Microchip Technology Inc.	AT32UC3A4256J-C1UR
0	XC301	DO NOT POPULATE		
1	XC400	Fox FQ5032B 12.0 MHz SMD crystal 738B-12	Fox Electronics	FQ5032B-12-C-C-C-200-1

Note: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

7.   Hardware Revision History and Known Issues

7.1   Identifying Product ID and Revision

The revision and product identifier of the 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.

When an Xplained Pro MCU board is connected to a computer with Atmel Studio running, an information window with the serial number is shown. The first six digits of the serial number contain the product identifier and revision. Information about connected Xplained Pro extension boards is also shown in the window.

The same information can be found on the sticker on the bottom side of the PCB. Most kits have stickers that have the identifier and revision printed 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 data matrix 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 the SAM HA1E16A Xplained Pro is A09-2435.

7.2   Revision 3

Revision 3 is the initially-released revision, there are no known issues.

8.   Document Revision History

Revision A (January 2018)

- Initial release of this document

9.   FCC Note

This device complies with Part 15 of the FCC rules. Operation is subject to the condition that this device does not cause harmful interference.

Note:

- Caution
    - This device must be installed by an authorized technician
- Attention
    - Cet appareil doit être installé par un technicien autorisé

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