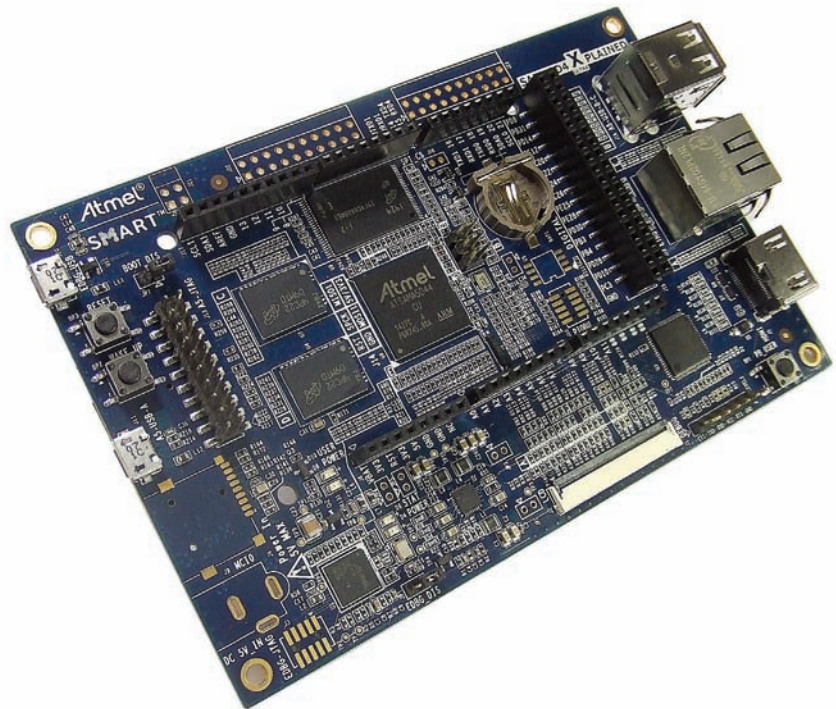




Introduction

This user guide introduces the Atmel® SAMA5D4 Xplained Ultra evaluation kit (SAMA5D4-XULT) and describes the development and debugging capabilities for applications running on the Atmel | SMART SAMA5D4 ARM® Cortex®-A5-based embedded microprocessor unit (eMPU).

Scope

This guide provides details on the SAMA5D4-XULT. It is made up of four main sections:

- [Section 1.](#) describes the evaluation kit content and its main features.
- [Section 2.](#) provides instructions to power up the SAMA5D4-XULT board.
- [Section 3.](#) provides an overview of the SAMA5D4-XULT board.
- [Section 4.](#) describes the SAMA5D4-XULT board components.

Kit Contents

The SAMA5D4-XULT includes:

- Board
 - One SAMA5D4-XULT board
- Cables
 - One Micro-AB type USB cable
- Welcome letter

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1. Evaluation Kit Specifications

Table 1-1. Evaluation Kit Specifications

Characteristic		Specifications
Board		SAMA5D4-XULT
Board supply voltage		USB powered 5VDC from optional jack connector or from “Arduino shield”
Temperature	Operating	0°C to +70°C
	Storage	-40°C to +85°C
Relative Humidity		0 to 90% (non-condensing)
Dimensions: Main board		135 × 88 × 20 mm
RoHS status		Compliant
Board Identification		SAMA5D4-XULT

1.1 Electrostatic Warning



ESD-Sensitive Electronic Equipment!

The evaluation kit is shipped in a protective anti-static package. The board system must not be subject to high electrostatic potentials.



We strongly recommend using a grounding strap or similar ESD protective device when handling the board in hostile ESD environments (offices with synthetic carpet, for example). Avoid touching the component pins or any other metallic element on the board.

1.2 Power Supply Warning



Hardware Power Supply Limitation

Using a power adapter greater than 5Vcc (e.g., the 12Vcc power adapters from other kits such as Arduino kits) may damage the board.



Hardware Power Budget

Using the USB as the main power source (max. 500 mA) is acceptable only with the use of the on-board peripherals and low-power LCD extension.

When external peripheral or add-on boards need to be powered, we recommend the use of an external power adapter connected to the J4 DC jack (can provide up to 1.2A on the 3.3V node).

2. Power Source

Several options are available to power up the SAMA5D4-XULT board.

The board can be:

- USB-powered through the USB Micro-AB connector (J11 - default configuration).
- Powered through an external AC-to-DC adapter connected via a 2.1 mm center-positive plug into the optional power jack of the board (J4). The recommended output voltage range of the power adapter is 5V at 2A.
- Powered through the Arduino shield.
- Powered through the USB Micro-AB connector on the Atmel Embedded Debugger (EDBG) interface (J20).



Unlike Arduino Uno boards, the SAMA5D4-XULT board runs at 3.3V. The maximum voltage that the I/O pins can tolerate is 3.3V. Providing higher voltages (e.g., 5V) to an I/O pin could damage the board.

2.1 Power up the Board

Unpack the board, taking care to avoid electrostatic discharge. Connect the USB Micro-AB cable to the connector (J11). Then connect the other end of the cable to a free USB port of your PC.

Table 2-1. Electrical Characteristics

Electrical Parameter	Values
Input voltage	5 VCC
Maximum Input voltage (limits)	6 VCC
Max DC 3v3 current available	1.2A
I/O Voltage	3.3V only

2.2 Sample Code and Technical Support

After boot up, you can run some sample code or your own application on the development kit. You can download sample code and get technical support from the [Atmel website](#).

Linux software and demos can be found on the website [Linux4SAM](#).

3. Hardware Overview

3.1 Introduction

The Atmel SAMA5D4-XULT is a fully-featured evaluation platform for the Atmel SAMA5D4 series ARM-based embedded microprocessor units (eMPU). It allows users to extensively evaluate, prototype and create application-specific designs.

3.2 Equipment List

The SAMA5D4-XULT board is based on the integration of an ARM Cortex-A5-based microprocessor with external memory, one Ethernet physical layer transceiver, two SD/MMC interfaces, two host USB ports and one device USB port, one 24-bit RGB LCD and HDMI interface and debug interfaces.

Seven headers, compatible with Arduino R3 (Uno, Due) and two Xplained headers are available for various shield connections.

3.3 Board Features

Table 3-1. Board Specifications

Characteristics	Specifications
Dimensions (L x W x H)	135 × 88 × 20 mm
Processor	SAMA5D44 (361-ball BGA package), 16x16 mm body, pitch 0.8 mm
Oscillators	MPU, EDBG: 12 MHz quartz RTC: 32.768 kHz PHY: 25 MHz
Main Memory	2 x DDR2 2 Gb 16 Meg x 16 x 8 banks (total 4 Gbit = 512 MB) 1 x SLC NAND Flash 4 Gb 8-bit data (total 4 Gbit = 512 MB)
Accessory memories	One optional Serial EEPROM SPI One EEPROM with Mac Address and Serial Number
SD/MMC	One 4-bit SD card connector One 4-bit Micro-SD card connector
USB	Two USB Hosts with power switch One Micro-AB USB device
Display	One LCD interface connector, LCD TFT Controller with overlay, alpha-blending, rotation, scaling and color space conversion
	One HDMI interface and connector
Ethernet	One Ethernet PHY (RMII 10/100MHz)
Debug port	One JTAG interface connector One EDBG interface One serial DBGU interface (3v3 level)
Expansion connector	Arduino R3 compatible set of connectors XPRO set of connectors
Board supply voltage	5V from USB, power jack, and Arduino shield On-board power regulation by PMIC
Battery	On-board battery socket
User interface	Reset, Wake-up and free user push button One red user/power LED One blue user LED

4. Board Components

4.1 Board Overview

The fully-featured SAMA5D4-XULT board integrates multiple peripherals and interface connectors, as shown in Figure 4-1.

Figure 4-1. SAMA5D4-XULT Board Overview

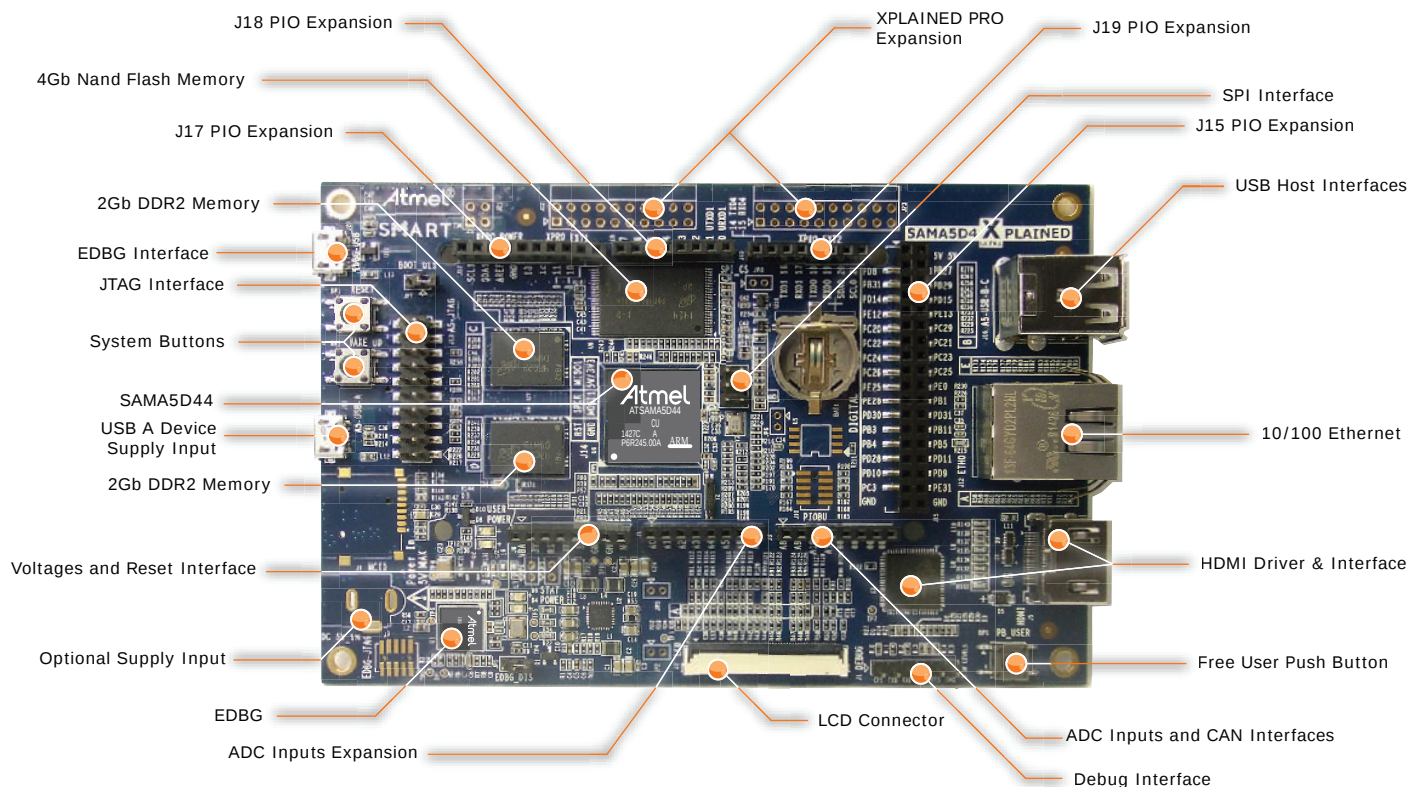


Table 4-1 describes the interface connectors on the SAMA5D4-XULT.

Table 4-1. SAMA5D4-XULT Board Interface Connectors

Connector	Interfaces to
J4	Main power supply
J11	USB A Device. Supports USB device using a type Micro-AB connector
J16	USB Host B and C. Supports USB host using a stacked type A connector
J1	Serial DBGU (3.3V level)
J13	JTAG, 20 pin IDC connector
J20	EDBG USB connector
J9	Micro-SD connector
J24	SD/MMC connector
J12	Ethernet ETH0
J2	Expansion connector with all LCD controller signals for display module connection (QTouch [®] , TFT LCD display with touchscreen and backlight)
J5	HDMI connector type A
BAT1	CR1225 Battery holder
J6, J7, J8, J14, J15, J17, J18, J19	Expansion connectors with Arduino R3 compatible PIO signals
J21, J22, J23	Expansion connectors Xplained
J3	JTAG EDBG (not populated)
J10	PIOBU extension (not populated)

4.2 Function Blocks

4.2.1 Processor

The Atmel® | SMART SAMA5D4 Series is a high-performance, power-efficient ARM® Cortex®-A5 processor MPU capable of running up to 600 MHz. It integrates the ARM NEON™ SIMD engine for accelerated signal processing, multimedia and graphics as well as a 128 KB L2-Cache for high system performance. The device features the ARM TrustZone® enabling a strong security perimeter for critical software, as well as several hardware security features. The device also features advanced user interface and connectivity peripherals.

The SAMA5D4 devices have three software-selectable low-power modes: Idle, Ultra Low-power, and Backup. In Idle mode, the processor is stopped while all other functions can be kept running at normal operating bus frequency. In Ultra Low-power mode, the processor is stopped while all other functions can be kept running at minimum operating bus frequency. In Backup mode, only the real-time clock, real-time timer, backup SRAM, backup registers, and wake-up logic are running.

The SAMA5D4 features an internal multi-layer bus architecture associated with 32 DMA channels to sustain the high bandwidth required by the processor and the high-speed peripherals. The device supports DDR2/LPDDR/LPDDR2 and SLC/MLC NAND Flash memory with 24-bit ECC.

The comprehensive peripheral set includes a 720p hardware video decoder, an LCD controller with overlays for hardware-accelerated image composition, a resistive touch screen function, and a CMOS sensor interface. Connectivity peripherals include a dual 10/100 Ethernet MAC with IEEE1588, three HS USB ports, UARTs, SPIs and I2Cs.

Security features includes an "on-the-fly" encryption-decryption process from the external DDR memory, tamper detection pins, secure storage of critical data, an integrity check monitor (ICM) to detect modification of the memory contents and a secure boot. The product also includes a dedicated coprocessor for public key cryptography such as RSA and elliptic curves algorithms (ECC), as well as AES, 3DES, SHA function and TRNG. These features permit to protect the system against counterfeiting, to safeguard sensitive data, authenticate safe program or secure external data transfers.

The SAMA5D4 series is optimized for control panel/HMI applications needing video playback and applications that require high levels of connectivity in the industrial and consumer market. Its security features make the SAMA5D4 well suited for secure gateways or for the IoT.

4.2.2 Power Supply Topology and Power Distribution

4.2.2.1 Power Lines

Refer to the Power Supplies and Power Supply Connections tables in the SAMA5D4 datasheet.

4.2.2.2 Power-up and Power-down Considerations

Power-up and power-down considerations are described in section "Power Considerations" of the SAMA5D4 Series datasheet.

4.2.2.3 SAMA5D44 Power Supplies Summary

Table 4-2. SAMA5D44 Power Supplies

Name	Voltage Range, Nominal	Associated Ground	Powers
VDDCORE	1.62–1.98V, 1.8V	GNDCORE	Regulator that generates core power supply on VDDCORE 10 μ F decoupling capacitor is to be connected to VDDCORE MUST BE ESTABLISHED AFTER VDDIOP OR AT THE SAME TIME
VDDCORE	1.1–1.32V, 1.2V	GNDCORE	Core
VDDIODDR	1.70–1.90V, 1.8V	GNDIODDR	DDR2 Interface I/O lines
	1.14–1.30V, 1.2V		LP-DDR2 Interface I/O lines
VDDIOM	1.65–1.95V, 1.8V 3.0–3.6V, 3.3V	GNDIOM	NAND and HSMC Interface I/O lines
VDDIOP ⁽¹⁾	3.0–3.6V, 3.3V	GNDIOP	Peripherals I/O lines MUST BE ESTABLISHED PRIOR TO VDDCORE
VDDBU	1.88–2.12V, 2V	GNDBU	Slow Clock oscillator, the internal 64 kHz RC and a part of the System Controller MUST BE ESTABLISHED FIRST
VDDUTMIC	1.1–1.32V, 1.2V	GNDUTMI	USB device and host UTMI+ core and the UTMI PLL MUST be connected to VDDCORE
VDDUTMII	3.0–3.6V, 3.3V	GNDUTMI	USB device and host UTMI+ interface
VDDPLLA	1.1–1.32V, 1.2V	GNDPLL	PLLA cell MUST be connected to VDDCORE
VDDOSC	3.0–3.6V	GNDOSC	Main Oscillator cell
VDDANA ⁽¹⁾	3.0–3.6V, 3.3V	GNDANA	Analog parts MUST be connected to VDDIOP with filtering
VDDFUSE	2.25–2.75V, 2.5V	GNDFUSE	Fuse box for programming VDDFUSE must be 2.5V or 0V and must not be left floating

Notes: 1. Both VDDIOP and VDDANA must rise at the same time due to internal constraints.

4.2.2.4 ACT8865 Power Management IC

The ACT8865 is a complete, cost-effective and highly-efficient ActivePMU™ power management solution, optimized to provide a single-chip power solution and voltage sequencing for Atmel SAMA5D3/SAMA5D4 and SAM9 series MPUs. It also meets the control requirements of these devices.

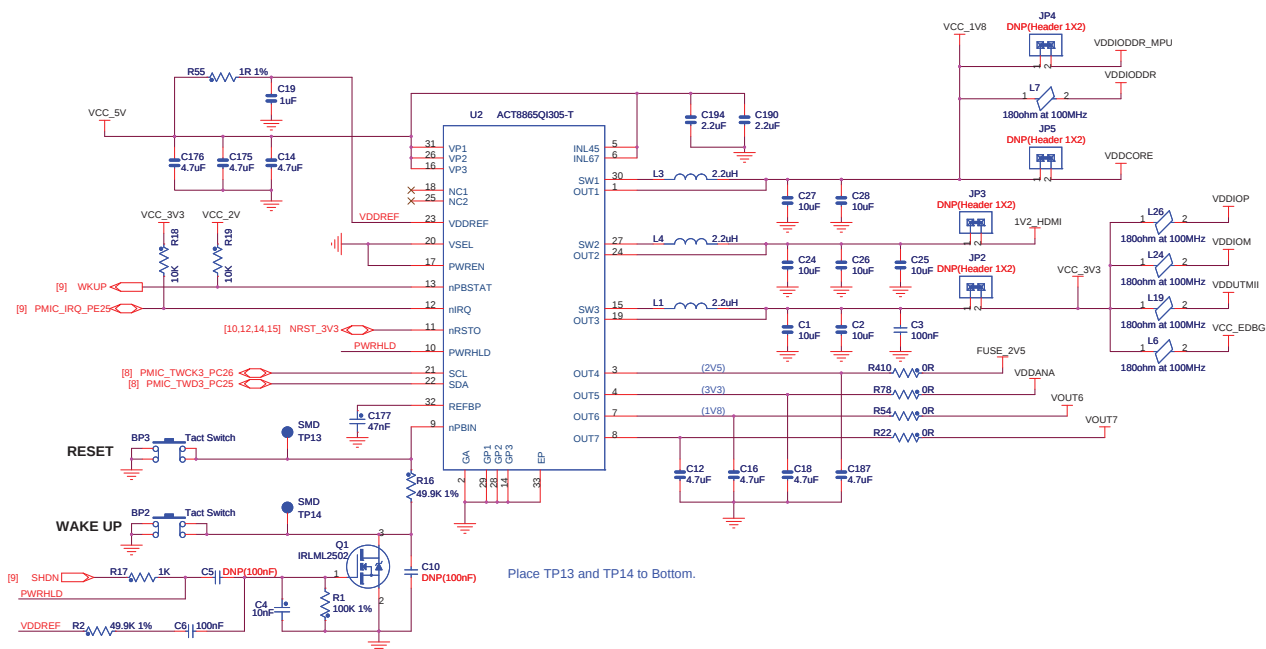
The ACT8865 features three step-down DC/DC converters and four low-noise, low-dropout linear regulators.



There is a known error on the ACT8865 I²C implementation. The port must be shut off after configuration or problems may occur with devices using the same I²C channel, e.g., TM43xx LCD display.

Refer to the ACT8865 datasheet at www.active-semi.com for more details.

Figure 4-2. Board Power Management



Supply Group Configuration

The ACT8865 provides:

- All power supplies required by the SAMA5D44 device:
 - 1.8V VDDCORE
 - 1.8V VDDIODDR
 - 2.0V VDDBU
 - 3.3V VDDIOP, VDDIOM, VDDANA, VDDUTMII
 - 2.5V VDDFUSE
- Power supplies to external chips on the main board:
 - 1.2V HDMI
 - 3.3V Ethernet PHY, HDMI, EDBG

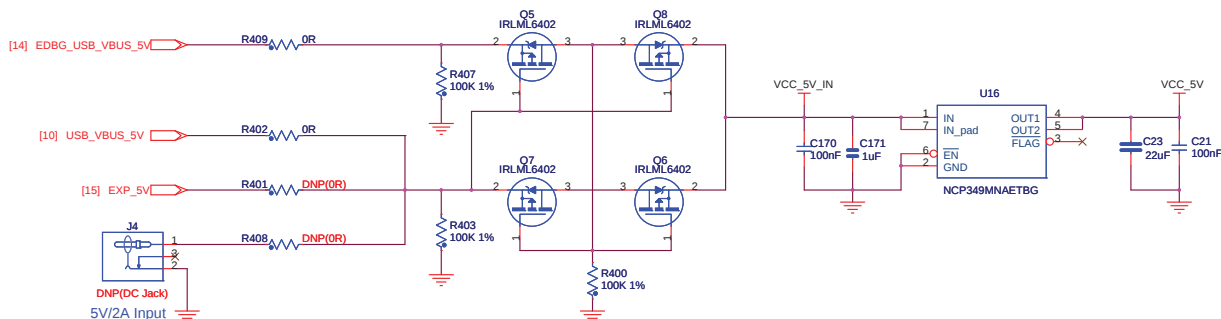
4.2.2.5 Power Options

There are several power options for the SAMA5D4-XULT board.

The power sources are selected by a set of 0R resistors. The USB-powered operation is the default configuration. It comes from the USB device port connected to a PC or a 5V DC supply. The USB supply is sufficient to power the board in most applications. It is important to note that when the USB supply is used, the USB Host ports do not function. If USB Host ports are required for the application, it is recommended that a DC supply be used.

Figure 4-3 provides the schematics of power options.

Figure 4-3. Input Powering Scheme Option



Note: USB-powered operation eliminates additional wires and batteries. It is the preferred mode of operation for any project that requires only a 5V source at up to 500 mA.

4.2.2.6 Wall Supply Source

A wall supply can be used to provide power to the board. A regulated 5V DC supply of at least 2A is required. If USB ports and expansion headers are used, a rating of 3A is preferred. A 2.1 mm plug with a center-hot configuration is required.

If the USB host ports or expansion board Arduino shields are used, additional current is necessary.

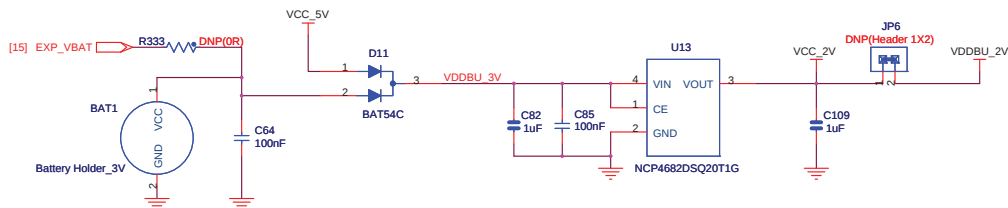
If the DC load required is greater than 500 mA per port, a higher current supply must be used.

4.2.2.7 Backup Power Supply

The SAMA5D4-XULT board requires a battery (3V lithium battery type CR1225 or equivalent) in order to permanently power the backup part of the SAMA5D4 device (refer to SAMA5D4 Series data sheet).

To avoid losing data and saved registers, the board must be powered on when replacing the battery.

Figure 4-4. VBAT Powering Scheme Option



4.2.2.8 Power Supply Control

In the ACT8865, three DCDCs (1.8V, 1.2V, 3.3V) and two LDO outputs are available.

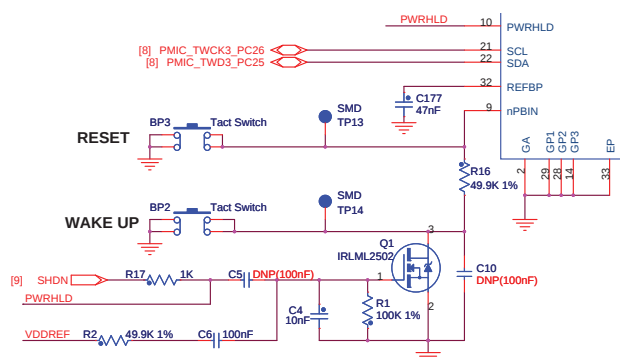
All ACT8865 outputs can be controlled by the TWI interface through software.

The three DCDCs outputs can be enabled or disabled by the SAMA5D44 SHDN output:

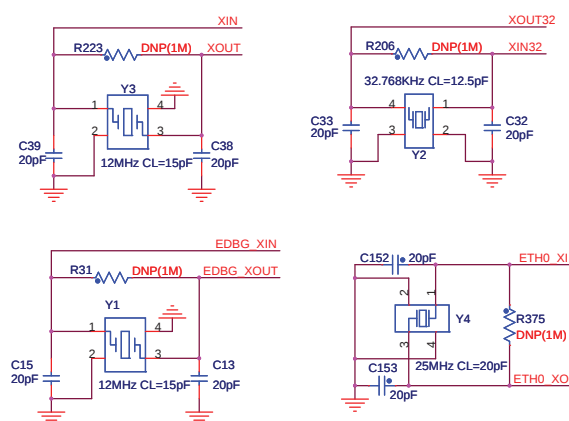
- SHDN = 0: The DCDCs output is disabled.
- SHDN = 1: The DCDCs output is enabled.

- Wakeup push button: When pressed, the ACT8865 power outputs are restarted if the ACT8865 is in shutdown mode.
- Reset push button: When pressed, the ACT8865 transfers the reset signal to NRST_3V3, and then to NRST_2V for the MPU by using a resistor divider.

- Power-on reset from the Power Management Unit (PMIC)
- Push button reset BP3
- External reset from Arduino connectors
- JTAG or EDBG reset from an in-circuit emulator



- Two clocks are alternatives for the SAMA5D44 processor (12 MHz, 32 kHz)
- One crystal oscillator used for the Ethernet RMII chip (25 MHz)
- One crystal oscillator used for the EDBG (12 MHz)



4.2.5 Memory

4.2.5.1 Memory Organization

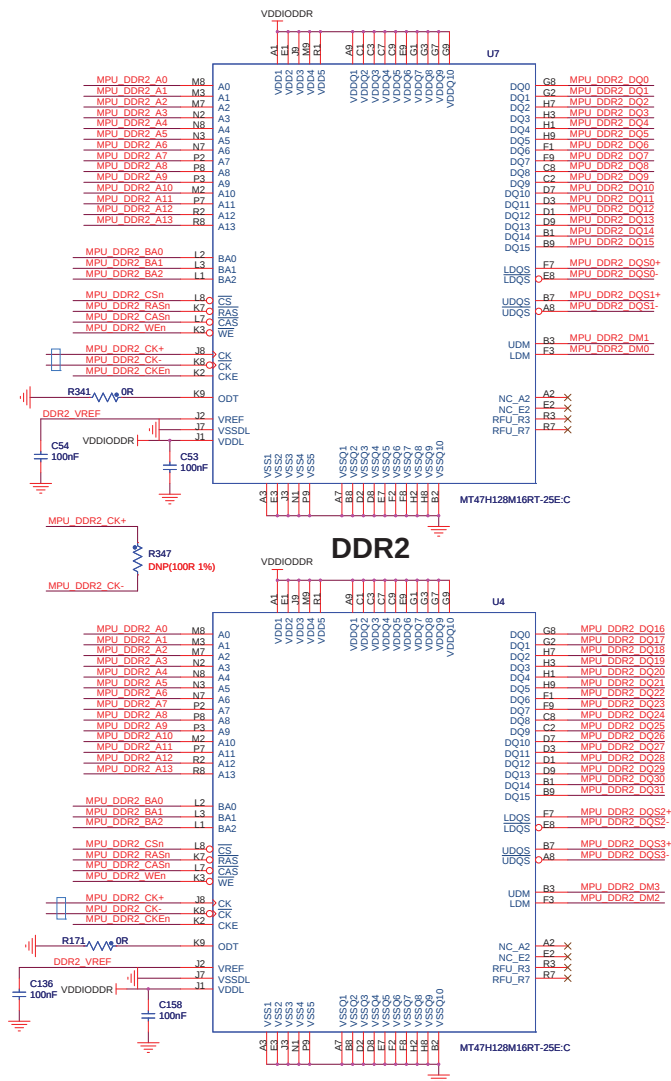
The SAMA5D4 features a DDR/SDR memory interface and an External Bus Interface (EBI) to permit interfacing to a wide range of external memories and to almost any kind of parallel peripheral.

This section describes the memory devices that equip the SAMA5D4-XULT board.

4.2.5.2 DDR2/SDRAM

- Two DDR2/SDRAM (MT47H128M16 - 2 Gb - 16 Meg x 16 x 8 banks) are used as main system memory. The board provides 4 Gb on-board, soldered DDR2 (double data rate) SDRAM. The memory bus is 32 bits wide and operates with a frequency of up to 176 MHz.

Figure 4-7. DDR2



4.2.5.3 DDR_CALP and DDR_CALN Analog Inputs

Two specific analog inputs, DDR_CALP and DDR_CALN, are used to calibrate all DDR I/Os.

Figure 4-8. DDR_CALP and DDR_CALN Analog Inputs

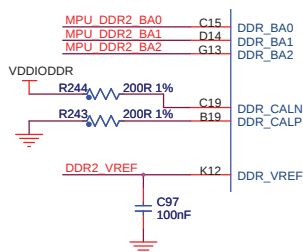


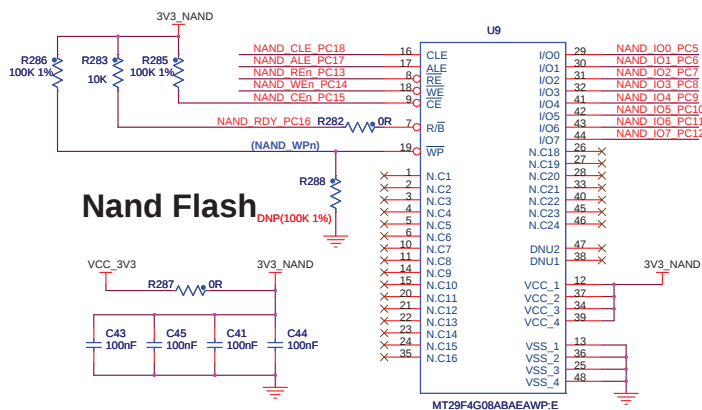
Table 4-3. DDR_CALN and DDR_CALP

Memory Type	CALP Pull-down	CALN Pull-up
DDR2	200 ohm	200 ohm
LPDDR2	240 ohm	240 ohm

4.2.5.4 NAND Flash

One 512 MB NAND Flash is connected to the processor.

Figure 4-9. NAND Flash



4.2.5.5 CS Disable

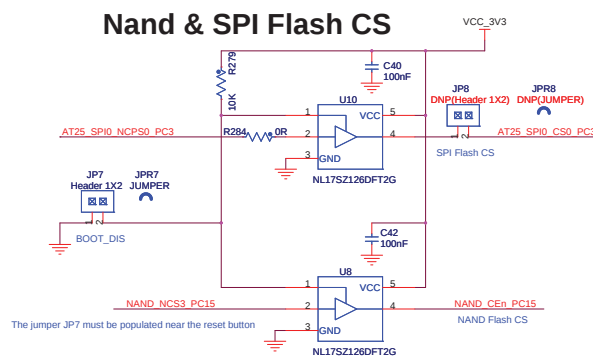
The SAMA5D44 device boots according to the following sequence:

1. D CARD connected on MCI1
2. Optional Dataflash connected on NPCS0 SPI0
3. 8-bit NAND Flash connected to D0–D7

In this sequence, the first device found with bootable contents is selected as the boot source. The others are disregarded.

On-board jumpers (JP7, JP8) control the selection (CS#) of the on-board bootable memory components (NAND Flash and Serial DataFlash) using a non-inverting 3-state buffer.

Figure 4-10. CS Disable



The rule of operation is:

- JP7 = OFF (default) → enable normal boot from NAND Flash (or serial DataFlash if mounted)
- JP7 = ON → booting from optional serial DataFlash or NAND Flash is disabled

JP8 (optional) also controls the serial DataFlash if mounted.

Refer to the SAMA5D4 Series datasheet for more information on standard boot strategies and sequencing.

4.2.6 Additional Memories

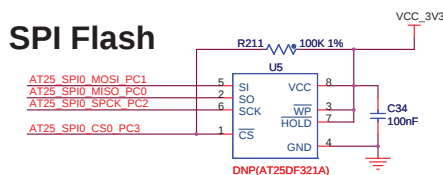
4.2.6.1 Serial Data Flash (optional)

The SAMA5D44 provides two high-speed Serial Peripheral Interface (SPI) controllers. One port is used to interface with the optional on-board serial DataFlash.

The four main signals used in the SPI are Clock, Data In, Data Out, and Chip Select. The SPI is a serial interface similar to the I²C bus interface but with three main differences:

- It operates at a higher speed.
- Transmit and receive data lines are separate.
- Device access is chip select-based instead of address-based.

Figure 4-11. Optional Serial DataFlash



4.2.6.2 Serial EEPROM with Unique MAC Address

The SAMA5D4-XULT board embeds one Atmel AT24MAC402/602 EEPROM using a TWI0 interface.

The AT24MAC402/602 provides 2048 bits of Serial Electrically-Erasable Programmable Read-Only Memory (EEPROM) organized as 256 words of eight bits each and is accessed via an I²C-compatible (2-wire) serial interface. In addition, the AT24MAC402/602 incorporates an easy and inexpensive method to obtain a globally unique MAC or EUI address (EUI-48 or EUI-64).

The EUI-48/64 addresses can be assigned as the actual physical address of a system hardware device or node, or it can be assigned to a software instance. These addresses are factory-programmed by Atmel and permanently write-protected in an extended memory block located outside of the standard 2-Kbit memory array.

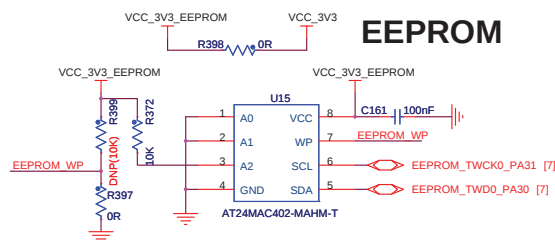
In addition, the AT24MAC402/602 provides the value-added feature of a factory-programmed, guaranteed unique 128-bit serial number located in the extended memory block (same area as the EUI address values).

The EEPROM device is used as a “soft label” to store board information such as chip type, manufacture name and production date, using the last two 16-byte blocks in memory.



The information contained in these blocks should not be modified.

Figure 4-12. EEPROM



4.2.7 High-Speed Multimedia Card Interface (HSMCI)

4.2.7.1 Multimedia Card Interface (MCI)

The SAMA5D4-XULT board has two high-speed Multimedia Card interfaces (MCIs) that support the multimedia card (MMC) Specification V4.3, the SD Memory Card Specification V2.0 and the SDIO V1.1 specification:

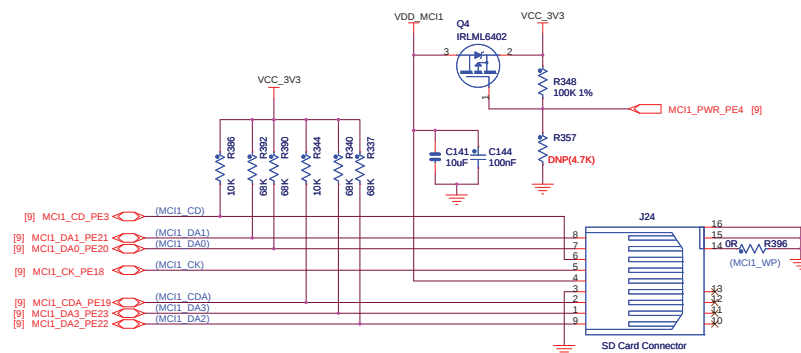
- **MCI0 interface** based on a 7-pin interface (clock, command, 4-bit data, power lines).
- **MCI1 Interface** based on a 7-pin interface (clock, command, 4-bit data, power lines).

4.2.7.2 HSMCI Card Connector

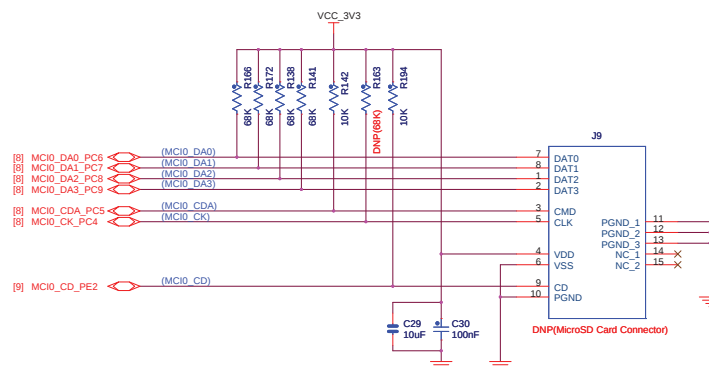
A standard MMC/SD card (push and click type) connector, connected to MCI1, is mounted on the top side of the board. It features a push-lock / push-eject mechanism and a card detection switch.

A micro SD card (push and click type) connector, connected to MCI0, is mountable as an option on the bottom side of the board.

Figure 4-13. HSMCI0 & HSMCI1



SD/MMCplus CARD INTERFACE - MCI1



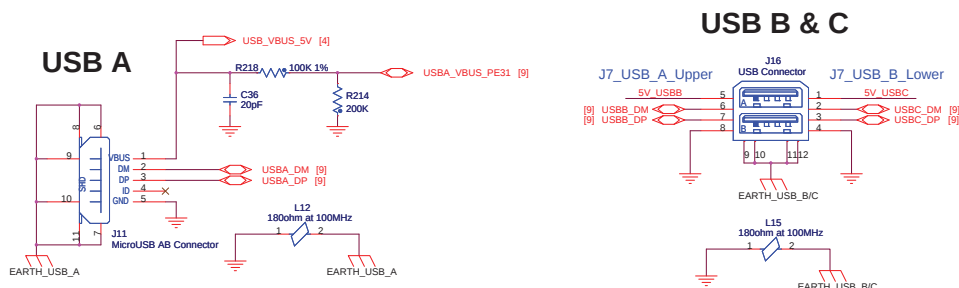
Micro SD CARD INTERFACE - MCI0

4.2.8.2 USB Host/Device A, B & C

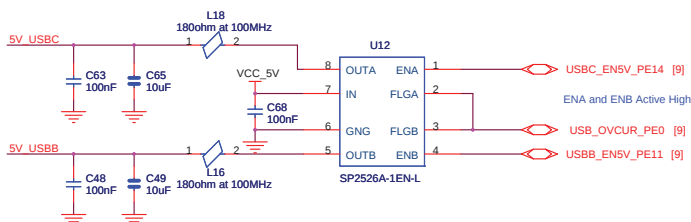
The SAMA5D4-XULT board features three USB communication ports:

- USB Host B/C High- and Full-speed Interface
 - Two USB host stacked type A connectors.
- USB Host/Device A Interface
 - One USB device standard micro-AB connector. This port has a VBUS detection function made through the resistor ladder R218 and R214.

Figure 4-15. USB Host & Device Interface



The two USB Host ports are equipped with 500 mA high-side power switch for self-powered and bus-powered applications.



4.2.9 LCD TFT Interface

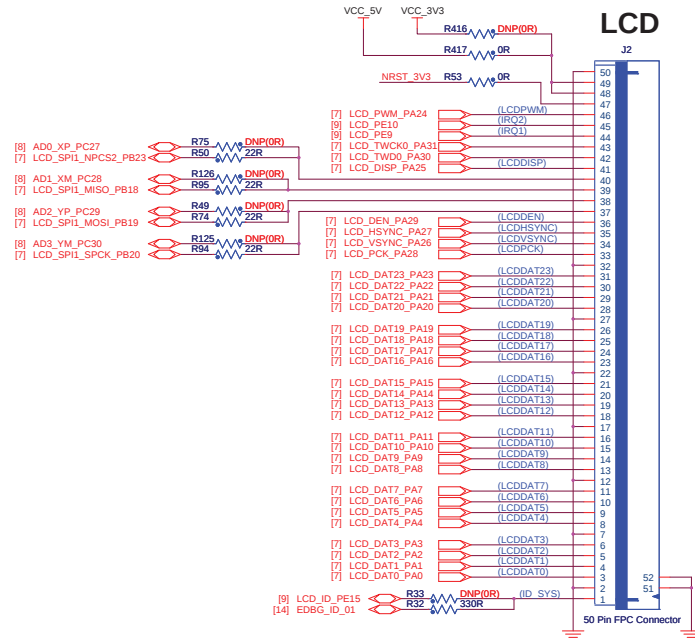
4.2.9.1 LCD

The SAMA5D4 provides 24 bits of data and control signals to the LCD interface. Other signals are used to control the LCD and are available on connector J2: TWI, SPI, 2 GPIOs for interrupt, 1-Wire and power supply lines.

4.2.9.2 LCD Expansion Header

J2 is a 1.27mm pitch 50-pin header; it gives access to the LCD signals.

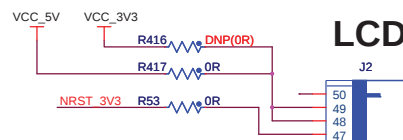
Figure 4-16. LCD Expansion Header Interface



4.2.9.3 LCD Power

In order to operate correctly out of the processor with various LCD modules, two voltage lines are available: 3.3V and 5 VCC (default), both selected by 0R resistors R416 and R417.

Figure 4-17. LCD Power



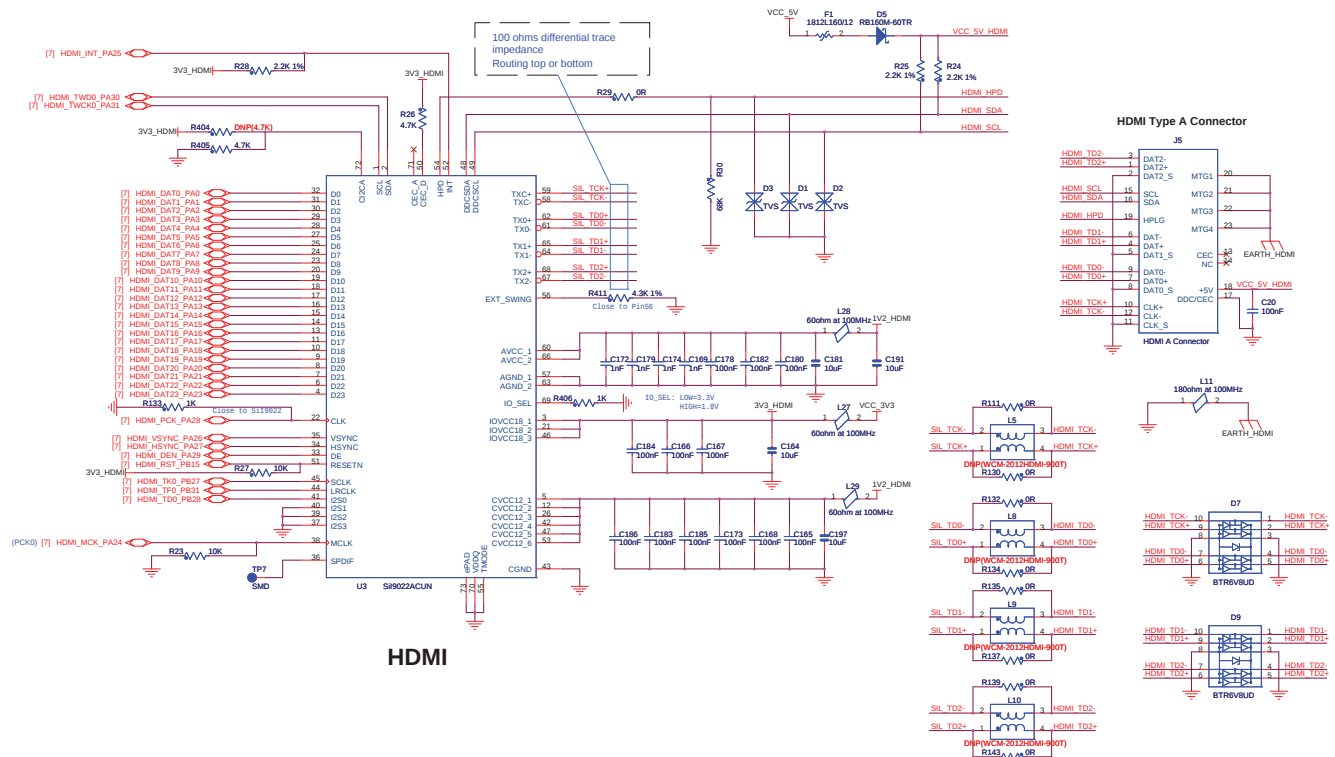
4.2.10 HDMI Transmitter Interface

The SAMA5D4-XULT board features the Silicon Image SiI9022ACUN device to convert video signals to the HDMI standard.

It features the following:

- Compliance
 - HDMI 1.2a, Simply HD, DVI 1.0
- Digital Video Output
 - Integrated TMDS core
 - DTV resolution support - 480i/576i/480p/576p/720p/1080i/1080p
 - PC resolution support - VGA/XGA/SXGA/WSXGA/UXGA
 - Flexible interface to HD MPEG decoders
 - Integrated YCbCr → RGB conversion
 - 4:2:2 → 4:4:4 up-converter
- Digital Audio Output
 - DVD-Audio support through 4 x I2S inputs
 - Supports 2-ch 192 kHz or 8-ch 96 kHz
 - Supports IEC60958 2-ch PCM or IEC61937 compressed audio (Dolby Digital, DTS, etc.)
 - Industry-standard S/PDIF input, Integrated MCLK generator
- Power Management
 - 1.2V and 1.8V cores provide low-power operation
 - Flexible power-down modes

Figure 4-18. HDMI Interface

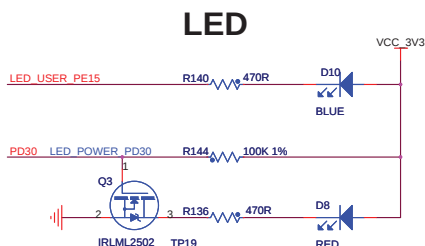


4.2.11 Indicators

There are two LEDs on the SAMA5D4-XULT board that can be controlled by the user:

- The red LED provides an indication that power is supplied to the board and is controlled via software.
- The blue LED is controlled via GPIO pins.

Figure 4-19. LED Indicators

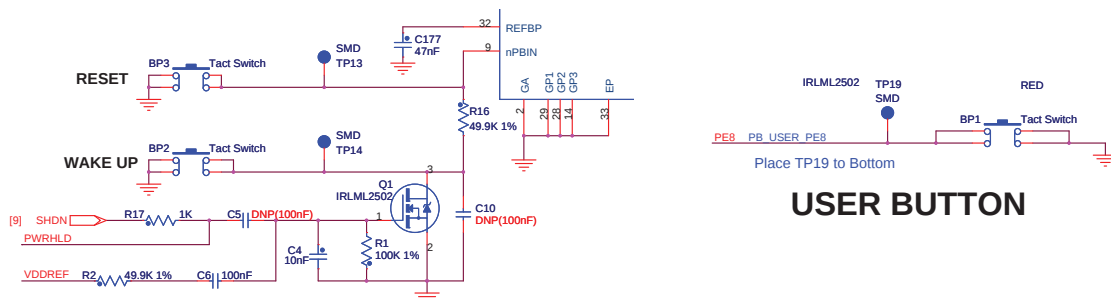


4.2.12 Push Button Switches

The SAMA5D4-XULT features three push buttons:

- One board Reset button (BP3). When pressed and released, it causes a power-on reset of the board.
- One Wakeup push button to exit the processor from low-power mode (BP2).
- One User momentary push button (BP1).

Figure 4-20. Push Buttons



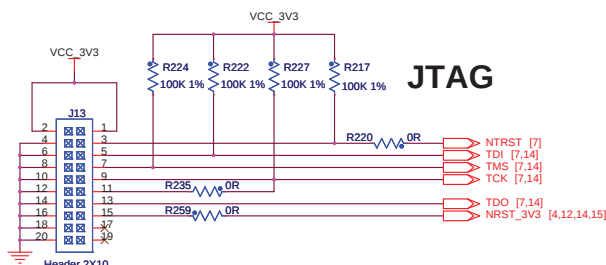
4.2.13 Debug Interfaces

The SAMA5D4-XULT board includes a JTAG, a Debug serial COM port and an EDBG interface port, to provide debug level access to the SAMA5D4.

4.2.13.1 Debug JTAG

A 2x10-pin JTAG header is provided on the SAMA5D4-XULT board to facilitate the software development and debugging by using various JTAG emulators. The interface signals have a voltage level of 3.3V.

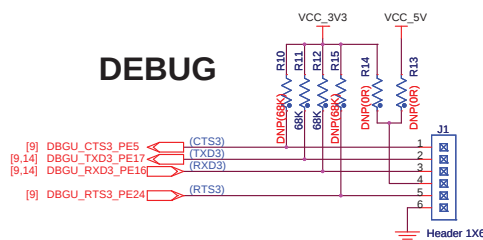
Figure 4-21. JTAG Interface



4.2.13.2 DBGU

The SAMA5D4-XULT board has a dedicated serial port for debugging, which is accessible through the 6-pin male header J1. Various interfaces can be used as USB/Serial DBGU port bridge, such as FTDI TTL-232R USB to TTL serial cable or basic breakout board for the RS232/USB converter.

Figure 4-22. DBGU Interface



R13 and R14 are optional (not implemented) resistors that can be used for power selection. Power can be delivered either by the SAMA5D4-XULT board or by the debug interface tool. To avoid malfunction between the debug interface (e.g., FTDI) and the on-board power system, ensure that the voltage level selected corresponds to application requirements.

4.2.14 Embedded Debugger (EDBG) Interface

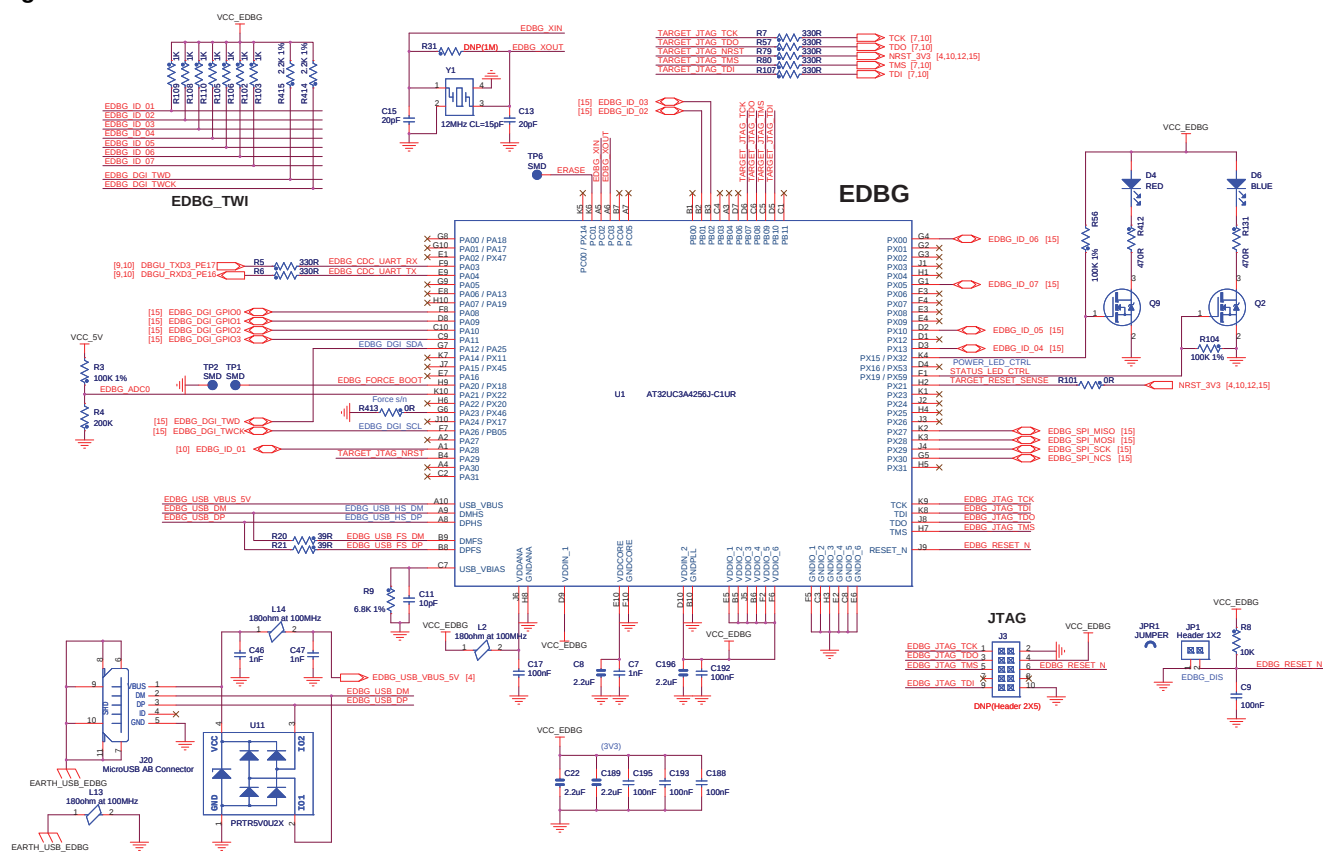
The Atmel Embedded Debugger (EDBG) ⁽¹⁾ is an intuitive plug-and-play solution which adds full programming and debugging support to embedded hardware kits containing Atmel microcontrollers. It enables seamless integration between the target hardware and the Atmel Studio front end.

In addition to the Virtual COM port which provides a UART bridge to the target device, the EDBG provides a Data Gateway Interface, through which the target device and host PC can communicate, facilitating high-level application debugging, monitoring, graphing and logging of system information in real-time.

The EDBG is based on the Atmel UC3A4 high-performance low-power 32-bit AVR microcontroller running at up to 60 MHz. The device includes an on-chip USB 2.0 high-speed hardware module with dedicated DMA channels, making it ideal for data communications.

By default, the EDBG is in Reset state and not usable. To use the EDBG interface, remove the jumper JP1. To avoid any conflict with the debug signals, do not use the JTAG and EDBG at the same time.

Figure 4-23. EDBG Interface

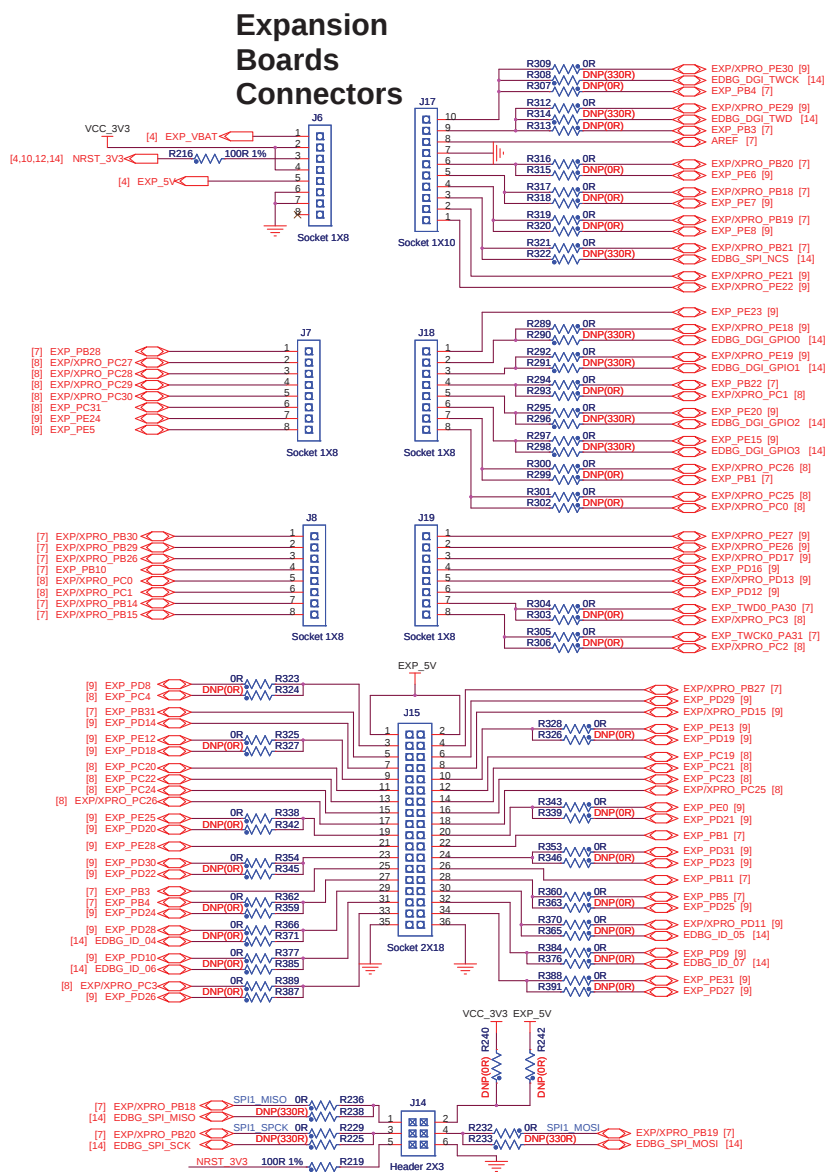


1. Device and Ordering Information—The EDBG is a factory-programmed AT32UC3A4256J-C1UR standard microcontroller with ordering code AT32UC3A4256HHB-C1UR. For further information please contact edbg@atmel.com.

4.2.15.1 Arduino

Due to multiplexing, different signals can be provided on each pin.

Figure 4-24. Expansion Boards Connectors



4.2.15.2 Functions Available Through the Arduino Headers

The multiplexing of the SAMA5D44 I/Os (standard parallel I/O and up to three peripheral functions per pin) makes it possible to route alternate signals via Arduino extension headers. To enable these signals, SAMA5D44 PIO multiplexing must be properly configured. For more details, refer to [Section 4.3.15](#) of this document and the section PIO Controller (PIO) in the SAMA5D4 Series datasheet.

In addition, on-board resistors may be unsoldered and moved to an alternate location to enable a different connection.

[Table 4-5](#) to [Table 4-11](#), together with the connector schematics, provide the alternate signals available for use with Arduino connectors.



How to read the tables

For the example [Figure 4-25](#) and [Table 4-4](#) below, the information provided on alternate signals is read as follows:

Pin 3 of Jxx is normally connected to SAMA5D44 PD8 which has PCK0 as an alternate function.

By unsoldering R323 and soldering it on R324 footprint, pin 3 of J15 will be connected to SAMA5D44 PC4 which has SPI0_NPCS1, MCIO_CK and PCK1 as alternate functions.

Figure 4-25. Jxx Connector

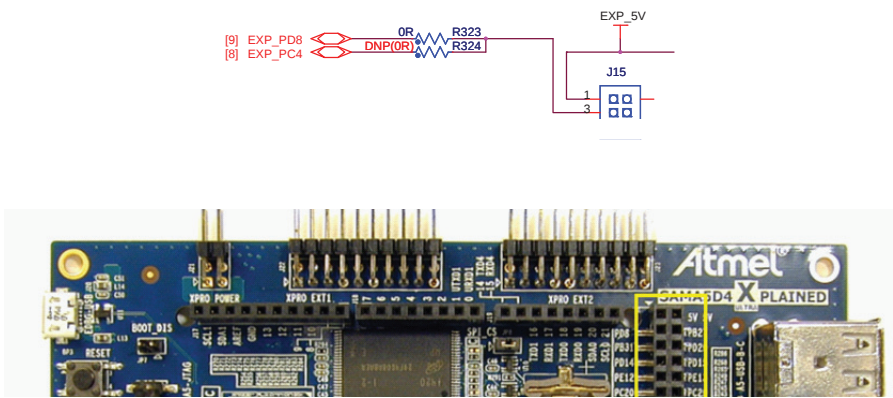


Table 4-4. Jxx Connector Signals

Pin No.	SAMA5D44 PIO Muxing Alternates				On-board Alternates			
	PD8	PCK0	—	—	PC4	SPI0_NPCS1	MCIO_CK	PCK1
3	PD8	PCK0	—	—	PC4	SPI0_NPCS1	MCIO_CK	PCK1

Figure 4-26. J6 Connector

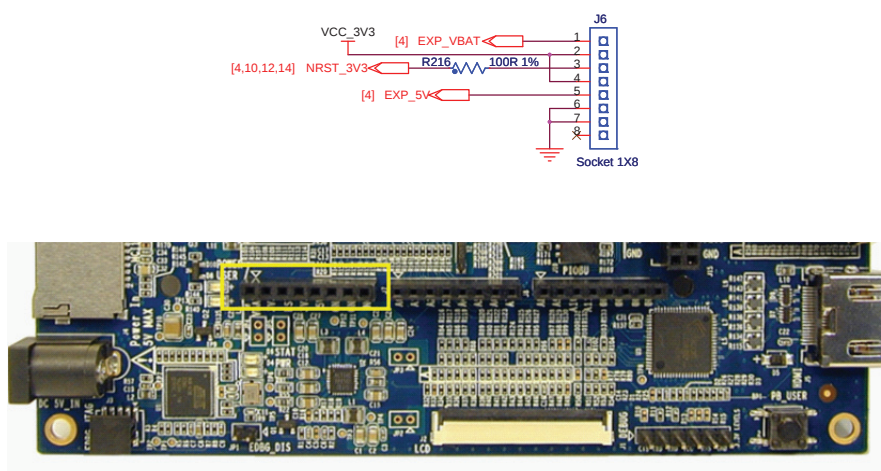


Table 4-5. J6 Connector Signals

Pin No.	Signal			On-board Alternates			
1	EXP_VBAT	—	—	—	—	—	—
2	VCC_3V3	—	—	—	—	—	—
3	NRST_3V3	—	—	—	—	—	—
4	VCC_3V3	—	—	—	—	—	—
5	EXP_5V	—	—	—	—	—	—
6	GND	—	—	—	—	—	—
7	GND	—	—	—	—	—	—
8	NC	—	—	—	—	—	—

Figure 4-27. J7 Connector

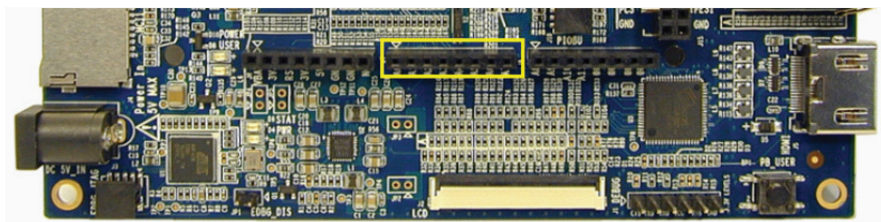
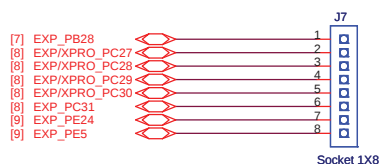


Table 4-6. J7 Connector Signals

Pin No.	SAMA5D44 PIO Muxing Alternates				On-board Alternates			
1	PB28	SPI2_NPCS3	TD0	PWMH1	—	—	—	—
2	PC27	AD0	SPI0_NPCS1	PWML0	—	—	—	—
3	PC28	AD1	SPI0_NPCS2	PWML1	—	—	—	—
4	PC29	AD2	SPI0_NPCS3	PWMFIO	—	—	—	—
5	PC30	AD3	—	PWMH0	—	—	—	—
6	PC31	AD4	—	PWMH1	—	—	—	—
7	PE24	NCS0	RTS3	—	—	—	—	—
8	PE5	A5	CTS3	—	—	—	—	—

Figure 4-28. J8 Connector

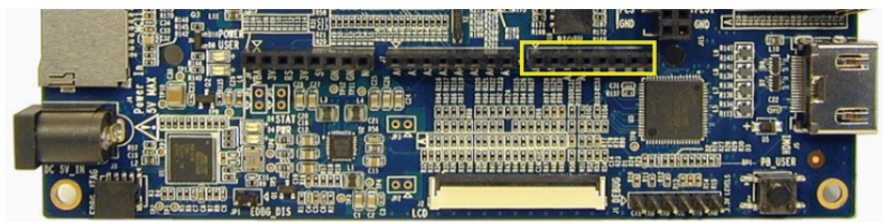
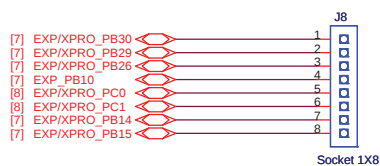


Table 4-7. J8 Connector Signals

Pin No.	SAMA5D44 PIO Muxing Alternates				On-board Alternates
1	PB30	TWCK2	RF0	–	–
2	PB29	TWD2	RD0	PWML1	–
3	PB26	PCK0	RK0	PWMH0	–
4	PB10	G0_RX2	PCK2	PWML1	–
5	PC0	SPI0_MISO	PWMH2	ISI_D8	No DAC available
6	PC1	SPI0_MOSI	PWML2	ISI_D9	No DAC available
7	PB14	G0_TX2	SPI2_NPCS1	PWMH0	No CAN available
8	PB15	G0_TX3	SPI2_NPCS2	PWML0	No CAN available

Figure 4-29. J14 Connector

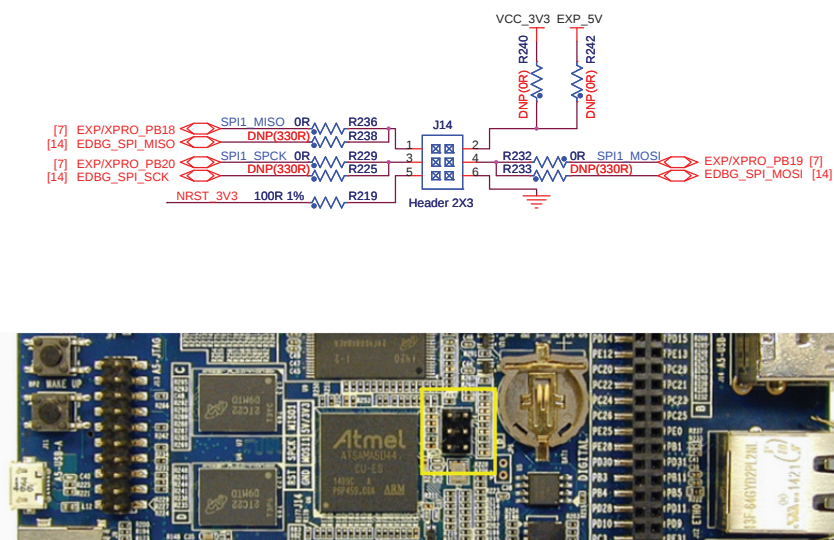


Table 4-8. J14 Connector Signals

Pin No.	SAMA5D4 PIO Muxing Alternates				On-board Alternates					EDBG Alternate
1	PB18	SPI1_MISO	D8	—	—	—	—	—	—	DGI_SPI
2	5V	—	—	—	—	—	—	—	—	—
3	PB20	SPI1_SPCK	D10	—	—	—	—	—	—	DGI_SPI
4	PB19	SPI1_MOSI	D9	—	—	—	—	—	—	DGI_SPI
5	nRST	—	—	—	—	—	—	—	—	—
6	GND	—	—	—	—	—	—	—	—	—

Figure 4-30. J15 Connector

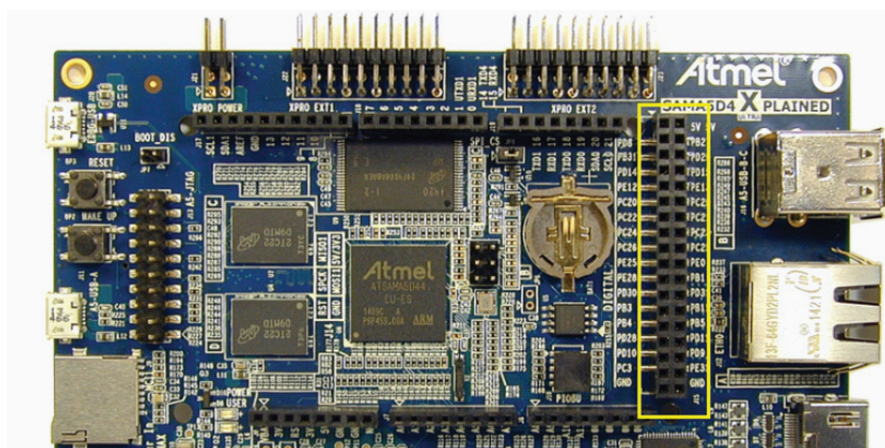
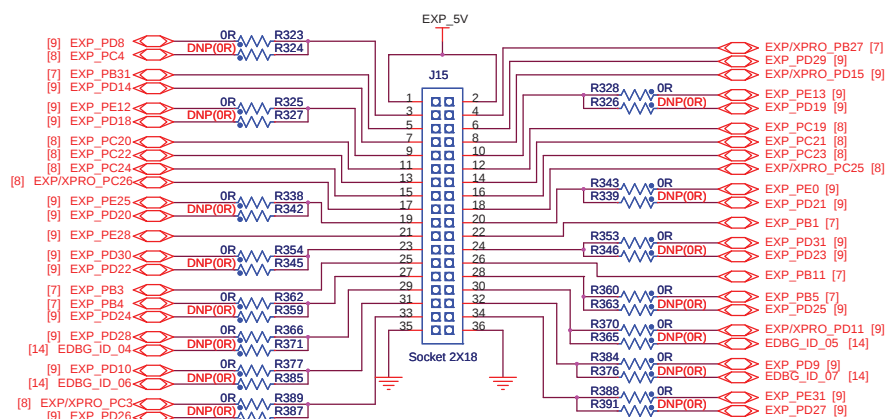


Table 4-9. J15 Connector Signals

Pin No.	SAMA5D44 PIO Muxing Alternates				On-board Alternates			
1	5V	—	—	—	5V	—	—	—
2	5V	—	—	—	5V	—	—	—
3	PD8	PCK0	—	—	PC4	SPI0_NPCS1	MCI0_CK	PCK1
4	PB27	SPI1_NPCS3	TK0	PWML0	—	—	—	—
5	PB31	—	TF0	—	—	—	—	—
6	PD29	SCK1	DIS	—	—	—	—	—
7	PD14	CTS1	CDETb	—	—	—	—	—
8	PD15	RTS1	SPI2_SPCK	—	—	—	—	—
9	PE12	A12	TIOA1	PWMH2	PD18	—	SENSE0	—
10	PE13	A13	TIOB1	PWML2	PD19	—	SENSE1	—
11	PC20	ISI_D1	TF1	—	—	—	—	—
12	PC19	ISI_D0	TK1	—	—	—	—	—

Table 4-9. J15 Connector Signals (Continued)

Pin No.	SAMA5D44 PIO Muxing Alternates				On-board Alternates			
13	PC22	ISI_D3	RF1	–	–	–	–	–
14	PC21	ISI_D2	TD1	–	–	–	–	–
15	PC24	ISI_D5	RK1	PCK1	–	–	–	–
16	PC23	ISI_D4	RD1	–	–	–	–	–
17	PC26	ISI_D7	TWCK3	UTXD1	–	–	–	–
18	PC25	ISI_D6	TWD3	URXD1	–	–	–	–
19	PE25	NCS1	SCK4	IRQ	PD20	–	SENSE2	–
20	PE0	A0/NBS0	MCIO_CDB	CTS4	PD21	–	SENSE3	–
21	PE28	NWAIT	RTS4	A19	–	–	–	–
22	PB1	G0_RXCK	SCK2	ISI_PCK	–	–	–	–
23	PD30	–	–	–	PD22	–	SENSE4	–
24	PD31	SPI0_NPCS2	PCK1	–	PD23	–	SENSE5	–
25	PB3	G0_TXER	CTS2	ISI_VSYNC	–	–	–	–
26	PB11	G0_RX3	RTS2	PWMH1	–	–	–	–
27	PB4	G0_CRS	RXD2	ISI_HSYNC	PD24	–	SENSE6	–
28	PB5	G0_COL	TXD2	PCK2	PD25	–	SENSE7	–
29	PD28	SCK0	–	–	–	–	–	–
30	PD11	RTS0	SPI2_MISO	–	–	–	–	–
31	PD10	CTS0	CDETA	–	–	–	–	–
32	PD9	FIQ	–	–	–	–	–	–
33	PC3	SPI0_NPCS0	PWML3	ISI_D11	PD26	–	SENSE8	–
34	PE31	ADTRG	–	–	PD27	–	SENSE9	–
35	GND	–	–	–	GND	–	–	–
36	GND	–	–	–	GND	–	–	–

Figure 4-31. J17 Connector

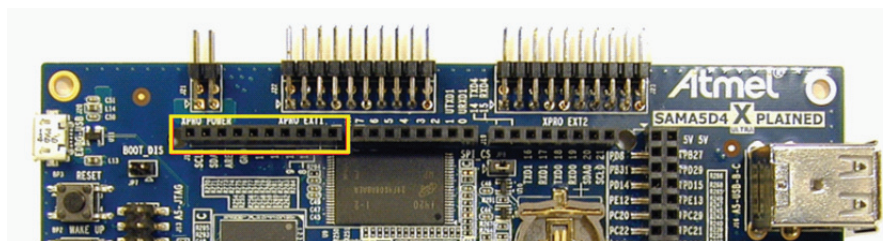
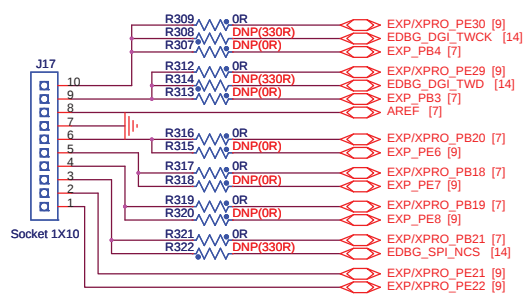


Table 4-10. J17 Connector Signals

Pin No.	SAMA5D4 PIO Muxing Alternates				On-board Alternates				EDBG Alternate
10	PE30	DIBN	UTXD0	TWCK1	PB4	G0_CRS	RXD2	ISI_HSYNC	DGI_TWI
9	PE29	DIBP	URXD0	TWD1	PB3	G0_TXER	CTS2	ISI_VSYNC	DGI_TWI
8	AREF	—	—	—	—	—	—	—	—
7	GND	—	—	—	—	—	—	—	—
6	PB20	SPI1_SPCK	D10	—	PE6	A6	TIOA3	—	—
5	PB18	SPI1_MISO	D8	—	PE7	A7	TIOB3	PWMF1	—
4	PB19	SPI1_MOSI	D9	—	PE8	A8	TCLK3	PWML3	—
3	PB21	SPI1_NPCS0	D11	—	—	—	—	—	DGI_SPI
2	PE21	A23	TIOA4	MC11_DA1	—	—	—	—	—
1	PE22	A24	TIOB4	MC11_DA2	—	—	—	—	—

Figure 4-32. J18 Connector

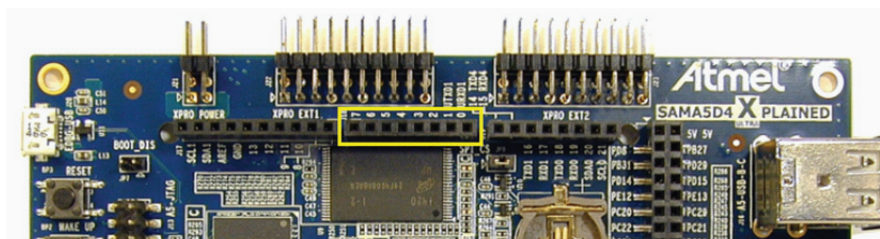
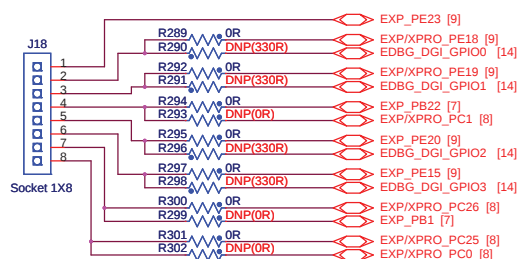


Table 4-11. J18 Connector Signals

Pin No.	SAMA5D44 PIO Muxing Alternates				On-board Alternates				EDBG Alternate
1	PE23	A25	TCLK4	MCI1_DA3	—	—	—	—	—
2	PE18	A18	TIOA5	MCI1_CK	—	—	—	—	DGI_GPIO0
3	PE19	A19	TIOB5	MCI1_CDA	—	—	—	—	DGI_GPIO1
4	PB22	SPI1_NPCS1	D12	—	PC1	SPI0_MOSI	PWML2	ISI_D9	—
5	PE20	A20	TCLK5	MCI1_DA0	—	—	—	—	DGI_GPIO2
6	PE15	A15	SCK3	TIOA0	—	—	—	—	DGI_GPIO3
7	PC26	ISI_D7	TWCK3	UTXD1	PB1	G0_RXCK	SCK2	ISI_PCK	—
8	PC25	ISI_D6	TWD3	URXD1	PC0	SPI0_MISO	PWMH2	ISI_D8	—

Figure 4-33. J19 Connector

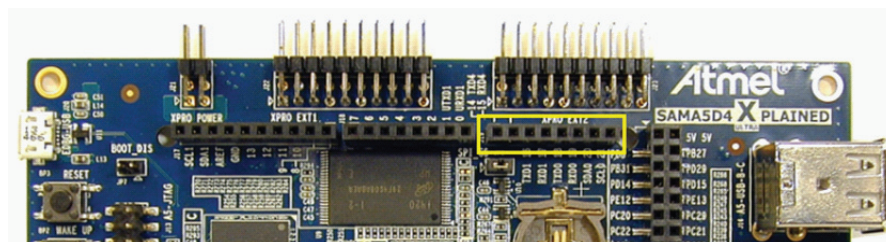
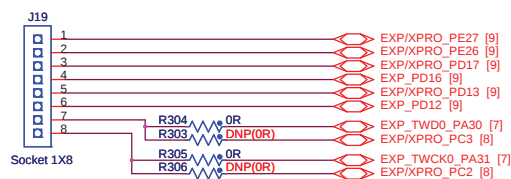


Table 4-12. J19 Connector Signals

Pin No.	SAMA5D44 PIO Muxing Alternates				On-board Alternates				
1	PE27	NWR1/NBS1	TXD4	—	—	—	—	—	—
2	PE26	NCS2	RXD4	A18	—	—	—	—	—
3	PD17	TXD1	SPI2_NPCS0	—	—	—	—	—	—
4	PD16	RXD1	DCENB	—	—	—	—	—	—
5	PD13	TXD0	SPI2_MOSI	—	—	—	—	—	—
6	PD12	RXD0	DCENA	—	—	—	—	—	—
7	PA30	TWD0	—	—	PC3	SPI0_NPCS0	PWML3	ISI_D11	—
8	PA31	TWCK0	—	—	PC2	SPI0_SPCK	PWMH3	ISI_D10	—

4.2.15.3 SAMA5D44 Peripheral Functions Available Through Arduino Headers

Table 4-13 provides details on access to the SAMA5D44 internal peripherals through the Arduino headers.

Note: Only one function at a time can be selected for each pin (refer to Section 4.3.15 in this document and the PIO controller section in SAMA5D4 Series datasheet).

Table 4-13. SAMA5D44 Peripheral Functions Available through the Arduino Headers

Connector	SAMA5D44 to Arduino	System Function	PCK	ISI	SSC	SPI	TWI	UART/ USART	ANALOG	MISC
J14	PB18	–	–	–	–	SPI1_MISO	–	–	–	–
	3v3/5v	3.3V/5V	–	–	–	–	–	–	–	–
	PB20	–	–	–	–	SPI1_SPCK	–	–	–	–
	PB19	–	–	–	–	SPI1_MOSI	–	–	–	–
	nRST	nRST	–	–	–	–	–	–	–	–
	GND	GND	–	–	–	–	–	–	–	–
J7	PB28	–	–	–	TD0	SPI2_NPCS3	–	–	–	PWMH1
	PC27	–	–	–	–	SPI0_NPCS2	–	–	AD0	PWML0
	PC28	–	–	–	–	SPI0_NPCS3	–	–	AD1	PWML1
	PC29	–	–	–	–	–	–	–	AD2	PWMFIO
	PC30	–	–	–	–	–	–	–	AD3	PWMH0
	PC31	–	–	–	–	–	–	–	AD4	PWMH1
	PE24	–	–	–	–	–	RTS3	–	–	–
	PE5	–	–	–	–	–	CTS3	–	–	–
J8	PB30	–	–	–	RF0	–	TWCK2	–	–	–
	PB29	–	–	–	RD0	–	TWD2	–	–	PWML1
	PB26	–	PCK0	–	RK0	–	–	–	–	PWMH0
	PB10	–	PCK2	–	–	–	–	–	–	PWML1
	PC0	–	–	ISI_D8	–	SPI0_MISO	–	–	–	PWMH2
	PC1	–	–	ISI_D9	–	SPI0_MOSI	–	–	–	PWML2
	PB14	–	–	ISI_D10	–	SPI0_SPCK	–	–	–	PWMH0
	PB15	–	–	–	–	–	–	–	–	PWML0
J17	PE30	–	–	ISI_HSYNC	–	–	TWCK1	RXD2	–	–
	PE29	–	–	ISI_VSYNC	–	–	TWD1	CTS2	–	–
	AREF	AREF	–	–	–	–	–	–	–	–
	GND	GND	–	–	–	–	–	–	–	–
	PB20	–	–	–	–	SPI1_SPCK	–	–	–	TIOA3
	PB18	–	–	–	–	SPI1_MISO	–	–	–	TIOB3
	PB19	–	–	–	–	SPI1_MOSI	–	–	–	TCLK3
	PB21	–	–	–	–	SPI1_NPCS0	–	–	–	–
	PE21	–	–	–	–	–	–	–	–	TIOA4
	PE22	–	–	–	–	–	–	–	–	TIOB4

Table 4-13. SAMA5D44 Peripheral Functions Available through the Arduino Headers (Continued)

Connector	SAMA5D44 to Arduino	System Function	PCK	ISI	SSC	SPI	TWI	UART/ USART	ANALOG	MISC
J18	PE23	–	–	–	–	–	–	–	–	TCLK4
	PE18	–	–	–	–	–	–	–	–	TIOA5
	PE19	–	–	–	–	–	–	–	–	TIOB5
	PB22	–	–	ISI_D9	–	SPI1_NPCS1	–	–	–	–
	PE20	–	–	–	–	SPI2_NPCS1	–	–	–	TCLK5
	PE15	–	–	–	–	SPI2_NPCS2	–	–	–	TIOA0
	PC26	–	–	ISI_D8	–	–	TWCK3	UTXD1	–	PWMH2
	PC25	–	–	ISI_PCK	–	–	TWD3	URXD1	–	–
J19	PE27	–	–	–	–	–	–	TXD4	–	–
	PE26	–	–	–	–	–	–	RXD4	–	–
	PD17	–	–	–	–	SPI2_NPCS0	–	TXD1	–	–
	PD16	–	–	–	–	–	–	RXD1	–	–
	PD13	–	–	–	–	SPI2_MOSI	–	TXD0	–	–
	PD12	–	–	–	–	–	–	RXD0	–	–
	PA30	–	–	ISI_D11	–	SPI0_NPCS0	TWD0	–	–	PWML3
	PA31	–	–	ISI_D10	–	SPI0_SPCK	TWCK0	–	–	PWMH3

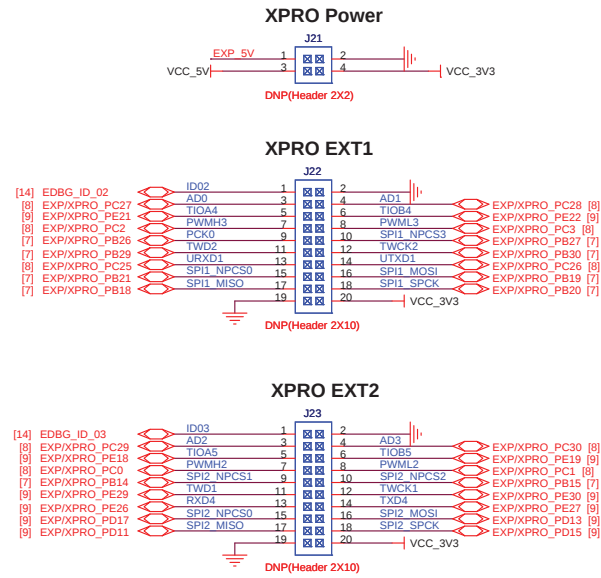
Table 4-13. SAMA5D44 Peripheral Functions Available through the Arduino Headers (Continued)

Connector	SAMA5D44 to Arduino	System Function	PCK	ISI	SSC	SPI	TWI	UART/ USART	ANALOG	MISC
J15	5V	5V	–	–	–	–	–	–	–	–
	5V	5V	–	–	–	–	–	–	–	–
	PD8	–	PCK0/PC K1	–	TK0	–	–	TXD2	–	–
	PB27	–	–	–	TF0	SPI1_NPCS3	–	–	–	PWML0
	PB31	–	–	–	–	–	–	–	–	–
	PD29	–	–	–	–	–	–	SCK1	–	–
	PD14	–	–	–	–	–	TWD0	CTS1	–	–
	PD15	–	–	–	–	SPI2_SPCK	TWCK0	RTS1	–	–
	PE12	–	–	–	–	–	–	–	–	PWMH2
	PE13	–	–	–	–	–	–	–	–	PWML2
	PC20	–	–	ISI_D1	TF1	–	–	–	–	–
	PC19	–	–	ISI_D0	TK1	–	–	–	–	–
	PC22	–	–	ISI_D3	RF1	–	–	–	–	–
	PC21	–	–	ISI_D2	TD1	–	–	–	–	–
	PC24	–	PCK1	ISI_D5	RK1	–	–	–	–	–
	PC23	–	–	ISI_D4	RD1	–	–	–	–	–
	PC26	–	–	ISI_D7	–	–	TWCK3	UTXD1	–	–
	PC25	–	–	ISI_D6	–	–	TWD3	URXD1	–	–
	PE25	–	–	–	–	SPI0_MOSI	–	SCK4	–	–
	PE0	–	–	–	–	SPI0_MISO	–	CTS4	–	–
	PE28	–	–	–	–	SPI0_NPCS0	–	RTS4	–	–
	PB1	–	–	–	–	SPI0_SPCK	–	SCK2	–	–
	PD30	–	–	–	–	–	–	–	–	–
	PD31	–	PCK1	–	–	SPI0_NPCS2	–	–	–	–
	PB3	–	–	–	–	–	–	CTS2	–	–
	PB11	–	–	–	–	–	–	RTS2	–	PWMH1
	PB4	–	–	–	–	–	–	RXD2	–	–
	PB5	–	PCK2	–	–	–	–	TXD2	–	–
	PD28	–	–	–	–	–	–	SCK0	–	–
	PD11	–	–	–	–	–	–	RTS0	–	–
	PD10	–	–	–	–	–	–	CTS0	–	–
	PD9	–	–	–	–	–	–	–	–	–
	PC3	–	–	ISI_D11	–	SPI0_NPCS0	–	–	–	PWML3
	PE31	–	–	–	–	–	–	–	–	–
	GND	GND	–	–	–	–	–	–	–	–
	GND	GND	–	–	–	–	–	–	–	–

4.2.15.4 XPRO

The SAMA5D4-XULT board embeds three connectors to interface Xplained PRO wings.

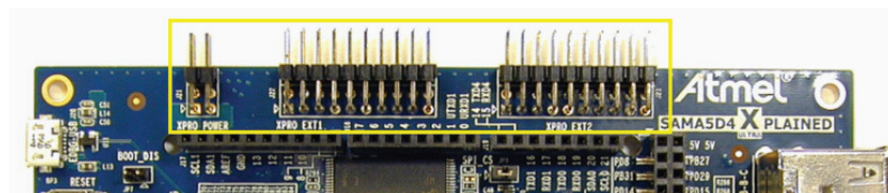
Figure 4-34. XPRO Connectors



XPRO Connectors

The standard extension headers include common signals. These are male 20-pin/100-mil/right-angled headers (extension boards feature a female 20-pin straight header).

Figure 4-35. XPRO Extension Headers



4.3 PIO Usage and Interface Connectors

4.3.1 Power Supply

Figure 4-36. Power Supply Connector J4

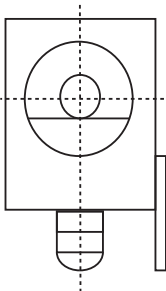


Table 4-14. Power Supply Connector J4 Signal Description

Pin	Mnemonic	Signal Description
1	Center pin	+5V
2	Spring blade	GND
3	Fixing pin	Floating

4.3.2 JTAG/ICE Connector

Figure 4-37. JTAG J13

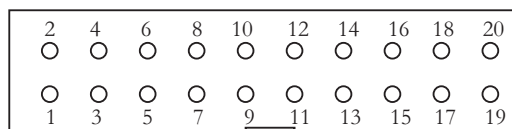


Table 4-15. JTAG/ICE Connector J13 Signal Descriptions

Pin	Mnemonic	Signal Description
1	VTref. 3.3V power	This is the target reference voltage (main 3.3V).
2	Vsupply. 3.3V power	This pin is not connected in SAM-ICE™ and reserved for compatibility with other equipment. Connected to main 3.3V.
3	nTRST TARGET RESET - Active-low output signal that resets the target	JTAG Reset. Output from SAM-ICE to control the Reset signal on the target system.
4	GND	Common ground
5	TDI TEST DATA INPUT - Serial data output line, sampled on the rising edge of the TCK signal	JTAG data input into target CPU
6	GND	Common ground
7	TMS TEST MODE SELECT	JTAG mode set input into target CPU
8	GND	Common ground
9	TCK TEST CLOCK - Output timing signal, for synchronizing test logic and control register access	JTAG clock signal into target CPU
10	GND	Common ground
11	RTCK - Input Return test clock signal from the target	Some targets having too slow system clock must synchronize the JTAG inputs to internal clocks. In present case such synchronization is unneeded and TCK merely looped back into RTCK.
12	GND	Common ground
13	TDO JTAG TEST DATA OUTPUT - Serial data input from the target	JTAG data output from target CPU
14	GND	Common ground
15	nSRST RESET	Active-low reset signal. Target CPU reset signal.
16	GND	Common ground
17	RFU	This pin is not connected in SAM-ICE.
18	GND	Common ground
19	RFU	This pin is not connected in SAM-ICE.
20	GND	Common ground

4.3.3 EDBG USB Type Micro-AB

Figure 4-38. EDBG USB Type Micro-AB Connector J20

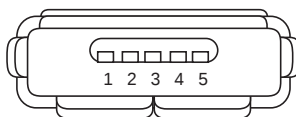


Table 4-16. EDBG USB Type Micro-AB Connector J20 Signal Descriptions

Pin	Mnemonic	Signal Description
1	Vbus	5V power
2	DM	Data minus
3	DP	Data plus
4	ID	On-the-go identification
5	GND	Common ground

4.3.4 USB Type A Dual Port

Figure 4-39. USB Type A Dual Port J16

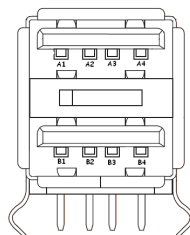


Table 4-17. USB Type A Dual Port J16 Signal Descriptions

Pin	Mnemonic	Signal Description
A1	Vbus - USB_A	5V power
A2	DM - USB_A	Data minus
A3	DP - USB_A	Data plus
A4	GND	Common ground
B1	Vbus - USB_A	5V power
B2	DM - USB_A	Data minus
B3	DP - USB_A	Data plus
B4	GND	Common ground
Mechanical pins	—	Shield

4.3.5 USB Micro-AB

Figure 4-40. USB Host/Device Micro-AB Connector J11

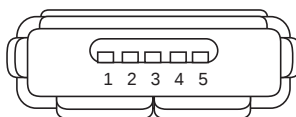


Table 4-18. USB Host/Device Micro-AB Connector J11 Signal Descriptions

Pin	Mnemonic	Signal Description
1	Vbus	5V power
2	DM	Data minus
3	DP	Data plus
4	ID	On-the-go identification
5	GND	Common ground

4.3.6 DEBUG Connector

Figure 4-41. DEBUG Connector J1

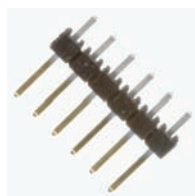


Table 4-19. DEBUG Connector J1 Signal Descriptions

Pin	Mnemonic	PIO	Signal Description
1	CTS3	PE5	Handshake input
2	TXD3 (Transmitted Data)	PE17	RS232 serial data input signal
3	RXD3 (Received Data)	PE16	RS232 serial data output signal
4	Power	–	5V/3.3V (selected by resistors)
5	RTS3	PE24	Handshake output
6	GND	–	Common ground

4.3.7 SD/MMC Plus MCI0

Figure 4-42. SD/MMC Socket J24

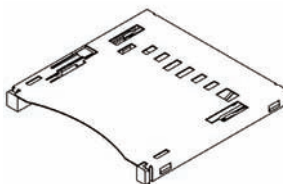


Table 4-20. SD/MMC Socket J24 Signal Descriptions

Pin	Mnemonic	PIO	Signal Description
1	DAT3	PE23	Data Bit
2	CMD	PE19	Command Line
3	VSS	–	Common ground
4	VCC	–	Supply Voltage 3.3V
5	CLK	PE18	Clock / Command Line
6	CD	PE3	Card Detect
7	DAT0	PE20	Data Bit
8	DAT1	PE21	Data Bit
9	DAT2	PE22	Data Bit
10	–	Not connected	Data Bit
11	–	Not connected	Data Bit
12	–	Not connected	Data Bit
13	–	Not connected	Data Bit
14	WP	GND	Write Protection (deactivated)
15	VSS	–	Common ground
16	VSS	–	Common ground

4.3.8 MicroSD MCI1

Figure 4-43. MicroSD Socket J9

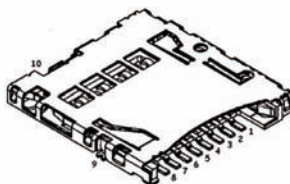


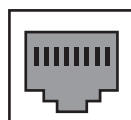
Table 4-21. MicroSD Socket J9 Signal Descriptions

Pin	Mnemonic	PIO	Signal Description
1	DAT2	PC8	Data Bit 2
2	CD/DAT3	PC9	Card Detect / Data Bit 3
3	CMD	PC5	Command Line
4	VCC	–	Supply Voltage 3.3V
5	CLK	PC4	Clock / Command Line
6	VSS	–	Common ground
7	DAT0	PC6	Data Bit 0
8	DAT1	PC7	Data Bit 1
9	CD	PE2	Card Detect
10	GND	–	Common ground

4.3.9 Ethernet ETH0 RJ45 Socket J12

Figure 4-44. Ethernet RJ45 Socket J12

1 2 3 4 5 6 7 8



RJ-45

4.3.10 LCD Connector J2

Figure 4-45. LCD Connector J2



Table 4-22. LCD Connector J2 Signal Descriptions

Pin	Signal	PIO	Signal	RGB Interface Function	Alternate
1	ID_SYS	PE15 / ID00	ID	Extension module identification	EDBG_ID_01
2	–	GND	GND	GND	–
3	LCDDAT0	PA0	D0	Data line	–
4	LCDDAT1	PA1	D1	Data line	–
5	LCDDAT2	PA2	D2	Data line	–
6	LCDDAT3	PA3	D3	Data line	–
7	–	GND	GND	GND	–
8	LCDDAT4	PA4	D4	Data line	–
9	LCDDAT5	PA5	D5	Data line	–
10	LCDDAT6	PA6	D6	Data line	–
11	LCDDAT7	PA7	D7	Data line	–
12	–	GND	GND	GND	–
13	LCDDAT8	PA8	D8	Data line	–
14	LCDDAT9	PA9	D9	Data line	–
15	LCDDAT10	PA10	D10	Data line	–
16	LCDDAT11	PA11	D11	Data line	–
17	–	GND	GND	GND	–
18	LCDDAT12	PA12	D12	Data line	–
19	LCDDAT13	PA13	D13	Data line	–
20	LCDDAT14	PA14	D14	Data line	–
21	LCDDAT15	PA15	D15	Data line	–
22	–	GND	GND	GND	–
23	LCDDAT16	PC14	D16	Data line	–
24	LCDDAT17	PC13	D17	Data line	–
25	LCDDAT18	PC12	D18	Data line	–
26	LCDDAT19	PC11	D19	Data line	–
27	–	GND	GND	GND	–
28	LCDDAT20	PC10	D20	Data line	–
29	LCDDAT21	PC15	D21	Data line	–
30	LCDDAT22	PE27	D22	Data line	–

Table 4-22. LCD Connector J2 Signal Descriptions (Continued)

Pin	Signal	PIO	Signal	RGB Interface Function	Alternate	
31	LCDDAT23	PE28	D23	Data line	–	
32	–	GND	GND	GND	–	
33	LCDPCK	PA28	PCLK	Pixel clock	–	
34	LCDVSYNC	PA26	VSYNC/CS	Vertical sync	–	
35	LCDHSYNC	PA27	HSYNC/WE	Horizontal sync	–	
36	LCDDEN	PA29	DATA_ENABLE/RE	Data enable	–	
37	SPI1_SPCK	PB20	SPI_SCK	–	AD3/YM	PC30
38	SPI1_MOSI	PB19	SPI_MOSI	–	AD2/YP	PC29
39	SPI1_MISO	PB18	SPI_MISO	–	AD1/XM	PC28
40	SPI1_NPCS2	PB23	SPI_CS	–	AD0/XP	PC27
41	LCDDISP	PA25	ENABLE	Display enable signal	–	
42	TWD0	PA30	TWI_SDA	I2C data line (maXTouch®)	–	
43	TWCK0	PA31	TWI_SCL	I2C clock line (maXTouch)	–	
44	GPIO	PE9	IRQ1	maXTouch interrupt line	–	
45	GPIO	PE10	IRQ2	Interrupt line for other I2C devices	–	
46	LCDPWM	PA26	PWM	Backlight control	–	
47	RESET	–	RESET	Reset for both display and maXTouch	–	
48	Main_5v/3v3	VCC	VCC	3.3V or 5V supply (0R)	–	
49	Main_5v/3v3	VCC	VCC	3.3V or 5V supply (0R)	–	
50	GND	GND	GND	GND	–	

4.3.11 HDMI Connector

Figure 4-46. HDMI Type A Female Connector J5

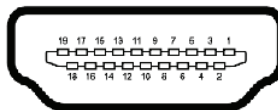


Table 4-23. HDMI Type A Female Connector J5 Signal Descriptions

Signal	Pin No.		Signal
TMDS Data 2+	1	2	TMDS Data 2 Shield
TMDS Data 2-	3	4	TMDS Data 1+
TMDS Data 1 Shield	5	6	TMDS Data 1-
TMDS Data 0+	7	8	TMDS Data 0 Shield
TMDS Data 0-	9	10	TMDS Clock +
TMDS Clock Shield	11	12	TMDS Clock -
CEC (not connected)	13	14	Not connected
SCL	15	16	SDA
GND	17	18	+5V
Hot Plug Detect	19	20	DDC/CEC (GND)

4.3.12 XPRO Power Connector

Figure 4-47. XPRO Power Connector J21

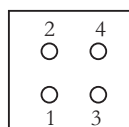


Table 4-24. XPRO Power Connector J21 Signal Descriptions

Signal	Pin No.		Signal
EXP_5V	1	2	GND
VCC_5V	3	4	VCC_3v3

4.3.13 XPRO Ext1 Connector

Figure 4-48. XPRO Ext1 Connector J22

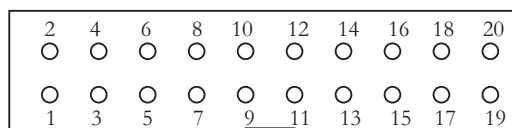


Table 4-25. XPRO Ext1 Connector J22 Signal Descriptions

SAMA5D44		XPRO Signal	Pin No.		XPRO Signal	SAMA5D44	
Function	Pin					Function	Pin
ID02 ⁽¹⁾	EDBG ⁽¹⁾	ID	1	2	GND	–	–
AD0	PC27	ADC(+)	3	4	ADC(-)	PC28	AD1
TIOA4	PE21	GPIO	5	6	GPIO	PE22	TIOBA4
PWMH3	PC2	PWM(+)	7	8	PWM(-)	PC3	PWML3
PCK0	PB26	IRQ/GPIO	9	10	SPI_SS_B/GPIO	PB27	SPI1_NPCS3
TWD2	PB29	TWI_SDA	11	12	TWI_SCL	PB30	TWCK2
URXD1	PC25	UART_RX	13	14	UART_TX	PC26	UTXD1
SPI1_NPCS0	PB21	SPI_SS_A	15	16	SPI_MOSI	PB19	SPI1_MOSI
SPI1_MISO	PB18	SPI_MISO	17	18	SPI_SCK	PB20	SPI1_SPCK
–	–	GND	19	20	VCC 3v3	–	–

Note: 1. Used by the EDBG interface.

4.3.14 XPRO Ext2 Connector

Figure 4-49. XPRO Ext2 Connector J23

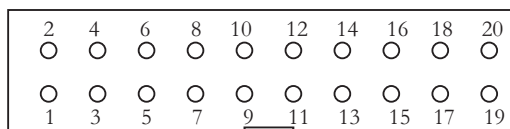


Table 4-26. XPRO Ext2 Connector J23 Signal Descriptions

SAMA5D44		XPRO Signal	Pin No.		XPRO Signal	SAMA5D44	
Function	Pin					Function	Pin
ID03 ⁽¹⁾	EDBG ⁽¹⁾	ID	1	2	GND	–	–
AD2	PC29	ADC(+)	3	4	ADC(-)	PC30	AD3
TIOA5	PE18	GPIO	5	6	GPIO	PE19	TIOB5
PWMH2	PC0	PWM(+)	7	8	PWM(-)	PC1	PWML2
SPI2_NPCS1	PB14	IRQ/GPIO	9	10	SPI_SS_B/GPIO	PB15	SPI2_NPCS2
TWD1	PE29	TWI_SDA	11	12	TWI_SCL	PE30	TWCK1
RXD4	PE26	UART_RX	13	14	UART_TX	PE27	TXD4
SPI2_NPCS0	PD17	SPI_SS_A	15	16	SPI_MOSI	PD13	SPI2_MOSI
SPI2_MISO	PD11	SPI_MISO	17	18	SPI_SCK	PD15	SPI2_SPCK
–	–	GND	19	20	VCC 3v3	–	–

Note: 1. Used by the EDBG interface.

4.3.15 PIO Usage

The following tables provide the use of different PIO lines on the SAMA5D4-XULT, sorted by PIO lines. Most of the signals can also be configured as either inputs or outputs from/to the processor.

Table 4-27. PIO A Pin Assignment and Signal Description

Power Rail	I/O Type	Primary Signal	Peripheral A Signal	Peripheral B Signal	Peripheral C Signal
VDDIOP	GPIO	PA0	LCDDAT0	–	TMS
VDDIOP	GPIO	PA1	LCDDAT1	–	–
VDDIOP	GPIO_CLK	PA2	LCDDAT2	G1_TXCK	–
VDDIOP	GPIO_CLK	PA3	LCDDAT3	G1_RXCK	–
VDDIOP	GPIO	PA4	LCDDAT4	G1_TXEN	–
VDDIOP	GPIO	PA5	LCDDAT5	G1_TXER	–
VDDIOP	GPIO	PA6	LCDDAT6	G1_CRS	–
VDDIOP	GPIO	PA7	LCDDAT7	–	–
VDDIOP	GPIO	PA8	LCDDAT8	–	TCK
VDDIOP	GPIO	PA9	LCDDAT9	–	–
VDDIOP	GPIO	PA10	LCDDAT10	G1_RXDV	–
VDDIOP	GPIO	PA11	LCDDAT11	G1_RXER	–
VDDIOP	GPIO	PA12	LCDDAT12	G1_RX0	–
VDDIOP	GPIO	PA13	LCDDAT13	G1_RX1	–
VDDIOP	GPIO	PA14	LCDDAT14	G1_TX0	–
VDDIOP	GPIO	PA15	LCDDAT15	G1_TX1	–
VDDIOP	GPIO	PA16	LCDDAT16	–	NTRST
VDDIOP	GPIO	PA17	LCDDAT17	–	–
VDDIOP	GPIO	PA18	LCDDAT18	G1_RX2	–
VDDIOP	GPIO	PA19	LCDDAT19	G1_RX3	–
VDDIOP	GPIO	PA20	LCDDAT20	G1_TX2	–
VDDIOP	GPIO	PA21	LCDDAT21	G1_TX3	–
VDDIOP	GPIO	PA22	LCDDAT22	G1_MDC	–
VDDIOP	GPIO	PA23	LCDDAT23	G1_MDIO	–
VDDIOP	GPIO_CLK	PA24	LCDPWM	PCK0	–
VDDIOP	GPIO	PA25	LCDDISP	TD0	–
VDDIOP	GPIO	PA26	LCDVSYNC	PWMH0	SPI1_NPCS1
VDDIOP	GPIO	PA27	LCDHSYNC	PWML0	SPI1_NPCS2
VDDIOP	GPIO_CLK2	PA28	LCDPCK	PWMH1	SPI1_NPCS3
VDDIOP	GPIO	PA29	LCDDEN	PWML1	–
VDDIOP	GPIO	PA30	TWD0	–	–
VDDIOP	GPIO	PA31	TWCK0	–	–

Table 4-28. PIO B Pin Assignment and Signal Description

Power Rail	I/O Type	Primary Signal	Peripheral A Signal	Peripheral B Signal	Peripheral C Signal
VDDIOP	GPIO_CLK	PB0	G0_TXCK	–	–
VDDIOP	GPIO_CLK	PB1	G0_RXCK	SCK2	ISI_PCK
VDDIOP	GPIO	PB2	G0_TXEN	–	–
VDDIOP	GPIO	PB3	G0_TXER	CTS2	ISI_VSYNC
VDDIOP	GPIO	PB4	G0_CRS	RXD2	ISI_HSYNC
VDDIOP	GPIO	PB5	G0_COL	TXD2	PCK2
VDDIOP	GPIO	PB6	G0_RXDV	–	–
VDDIOP	GPIO	PB7	G0_RXER	–	–
VDDIOP	GPIO	PB8	G0_RX0	–	–
VDDIOP	GPIO	PB9	G0_RX1	–	–
VDDIOP	GPIO_CLK	PB10	G0_RX2	PCK2	PWML1
VDDIOP	GPIO	PB11	G0_RX3	RTS2	PWMH1
VDDIOP	GPIO	PB12	G0_TX0	–	–
VDDIOP	GPIO	PB13	G0_TX1	–	–
VDDIOP	GPIO	PB14	G0_TX2	SPI2_NPCS1	PWMH0
VDDIOP	GPIO	PB15	G0_TX3	SPI2_NPCS2	PWML0
VDDIOP	GPIO	PB16	G0_MDC	–	–
VDDIOP	GPIO	PB17	G0_MDIO	–	–
VDDIOP	GPIO	PB18	SPI1_MISO	D8	–
VDDIOP	GPIO	PB19	SPI1_MOSI	D9	–
VDDIOP	GPIO_CLK	PB20	SPI1_SPCK	D10	–
VDDIOP	GPIO	PB21	SPI1_NPCS0	D11	–
VDDIOP	GPIO	PB22	SPI1_NPCS1	D12	–
VDDIOP	GPIO	PB23	SPI1_NPCS2	D13	–
VDDIOP	GPIO	PB24	DRXD	D14	TDI
VDDIOP	GPIO	PB25	DTXD	D15	TDO
VDDIOP	GPIO_CLK	PB26	PCK0	RK0	PWMH0
VDDIOP	GPIO	PB27	SPI1_NPCS3	TK0	PWML0
VDDIOP	GPIO	PB28	SPI2_NPCS3	TD0	PWMH1
VDDIOP	GPIO	PB29	TWD2	RD0	PWML1
VDDIOP	GPIO	PB30	TWCK2	RF0	–
VDDIOP	GPIO	PB31	–	TF0	–

Table 4-29. PIO C Pin Assignment and Signal Description

Power Rail	I/O Type	Primary Signal	Peripheral A Signal	Peripheral B Signal	Peripheral C Signal
VDDIOM	GPIO	PC0	SPI0_MISO	PWMH2	ISI_D8
VDDIOM	GPIO	PC1	SPI0_MOSI	PWML2	ISI_D9
VDDIOM	GPIO_CLK	PC2	SPI0_SPCK	PWMH3	ISI_D10
VDDIOM	GPIO	PC3	SPI0_NPCS0	PWML3	ISI_D11
VDDIOM	MCI_CLK	PC4	SPI0_NPCS1	MCI0_CK	PCK1
VDDIOM	GPIO	PC5	D0	MCI0_CDA	–
VDDIOM	GPIO	PC6	D1	MCI0_DA0	–
VDDIOM	GPIO	PC7	D2	MCI0_DA1	–
VDDIOM	GPIO	PC8	D3	MCI0_DA2	–
VDDIOM	GPIO	PC9	D4	MCI0_DA3	–
VDDIOM	GPIO	PC10	D5	MCI0_DA4	–
VDDIOM	GPIO	PC11	D6	MCI0_DA5	–
VDDIOM	GPIO	PC12	D7	MCI0_DA6	–
VDDIOM	GPIO	PC13	NRD/NANDOE	MCI0_DA7	–
VDDIOM	GPIO	PC14	NWE/NANDWE	–	–
VDDIOM	GPIO	PC15	NCS3	–	–
VDDIOM	GPIO	PC16	NANDRDY	–	–
VDDIOM	GPIO	PC17	A21/NANDALE	–	–
VDDIOM	GPIO	PC18	A22/NANDCLE	–	–
VDDIOM	GPIO	PC19	ISI_D0	TK1	–
VDDIOM	GPIO	PC20	ISI_D1	TF1	–
VDDIOM	GPIO	PC21	ISI_D2	TD1	–
VDDIOM	GPIO	PC22	ISI_D3	RF1	–
VDDIOM	GPIO	PC23	ISI_D4	RD1	–
VDDIOM	GPIO	PC24	ISI_D5	RK1	PCK1
VDDIOM	GPIO	PC25	ISI_D6	TWD3	URXD1
VDDIOM	GPIO	PC26	ISI_D7	TWCK3	UTXD1
VDDANA	GPIO_ANA	PC27	AD0	SPI0_NPCS1	PWML0
VDDANA	GPIO_ANA	PC28	AD1	SPI0_NPCS2	PWML1
VDDANA	GPIO_ANA	PC29	AD2	SPI0_NPCS3	PWMFIO
VDDANA	GPIO_ANA	PC30	AD3	–	PWMH0
VDDANA	GPIO_ANA	PC31	AD4	–	PWMH1

Table 4-30. PIO D Pin Assignment and Signal Description

PIOD Mode Secure		Primary Signal	Peripheral A Signal	Peripheral B Signal	Peripheral C Signal
Power Rail	I/O Type				
VDDIOP	GPIO_CLK	PD8	PCK0	–	–
VDDIOP	GPIO	PD9	FIQ	–	–
VDDIOP	GPIO	PD10	CTS0	CDETA	–
VDDIOP	GPIO	PD11	RTS0	SPI2_MISO	–
VDDIOP	GPIO	PD12	RXD0	DCENA	–
VDDIOP	GPIO	PD13	TXD0	SPI2_MOSI	–
VDDIOP	GPIO	PD14	CTS1	CDETB	–
VDDIOP	GPIO	PD15	RTS1	SPI2_SPCK	–
VDDIOP	GPIO	PD16	RXD1	DCENB	–
VDDIOP	GPIO	PD17	TXD1	SPI2_NPCS0	–
VDDANA	GPIO_ANA	PD18	–	SENSE0	–
VDDANA	GPIO_ANA	PD19	–	SENSE1	–
VDDANA	GPIO_ANA	PD20	–	SENSE2	–
VDDANA	GPIO_ANA	PD21	–	SENSE3	–
VDDANA	GPIO_ANA	PD22	–	SENSE4	–
VDDANA	GPIO_ANA	PD23	–	SENSE5	–
VDDANA	GPIO_ANA	PD24	–	SENSE6	–
VDDANA	GPIO_ANA	PD25	–	SENSE7	–
VDDANA	GPIO_ANA	PD26	–	SENSE8	–
VDDANA	GPIO_ANA	PD27	–	SENSE9	–
VDDIOP	GPIO_CLK	PD28	SCK0	–	–
VDDIOP	GPIO_CLK	PD29	SCK1	DIS	–
VDDIOP	GPIO	PD30	–	–	–
VDDIOP	GPIO_CLK	PD31	SPI0_NPCS2	PCK1	–

Table 4-31. PIO E Pin Assignment and Signal Description

Power Rail	I/O Type	Primary Signal	Peripheral A Signal	Peripheral B Signal	Peripheral C Signal
VDDIOM	MCI_CLK	PE0	A0/NBS0	MCI0_CDB	CTS4
VDDIOM	EBI	PE1	A1	MCI0_DB0	–
VDDIOM	EBI	PE2	A2	MCI0_DB1	–
VDDIOM	EBI	PE3	A3	MCI0_DB2	–
VDDIOM	EBI	PE4	A4	MCI0_DB3	–
VDDIOM	EBI	PE5	A5	CTS3	–
VDDIOM	EBI	PE6	A6	TIOA3	–
VDDIOM	EBI	PE7	A7	TIOB3	PWMF11
VDDIOM	EBI	PE8	A8	TCLK3	PWML3
VDDIOM	EBI	PE9	A9	TIOA2	–
VDDIOM	EBI	PE10	A10	TIOB2	–
VDDIOM	EBI	PE11	A11	TCLK2	–
VDDIOM	EBI	PE12	A12	TIOA1	PWMH2
VDDIOM	EBI	PE13	A13	TIOB1	PWML2
VDDIOM	EBI	PE14	A14	TCLK1	PWMH3
VDDIOM	EBI	PE15	A15	SCK3	TIOA0
VDDIOM	EBI	PE16	A16	RXD3	TIOB0
VDDIOM	EBI	PE17	A17	TXD3	TCLK0
VDDIOM	EBI	PE18	A18	TIOA5	MCI1_CK
VDDIOM	EBI	PE19	A19	TIOB5	MCI1_CDA
VDDIOM	EBI	PE20	A20	TCLK5	MCI1_DA0
VDDIOM	EBI	PE21	A23	TIOA4	MCI1_DA1
VDDIOM	EBI	PE22	A24	TIOB4	MCI1_DA2
VDDIOM	EBI	PE23	A25	TCLK4	MCI1_DA3
VDDIOM	EBI	PE24	NCS0	RTS3	–
VDDIOM	EBI	PE25	NCS1	SCK4	IRQ
VDDIOM	EBI	PE26	NCS2	RXD4	A18
VDDIOM	EBI	PE27	NWR1/NBS1	TXD4	–
VDDIOM	EBI	PE28	NWAIT	RTS4	A19
VDDIOP	DIB	PE29	DIBP	URXD0	TWD1
VDDIOP	DIB	PE30	DIBN	UTXD0	TWCK1
VDDIOP	GPIO	PE31	ADTRG	–	–

4.4 SAMA5D4-XULT Board Schematics

This section contains the following schematics:

- [Block diagram](#)
- [PIO Muxing Table](#)
- [Power Supply](#)
- [SAMA5D44 - Power](#)
- [SAMA5D44 - DDR2](#)
- [SAMA5D44 - PIOA and PIOB](#)
- [SAMA5D44 - PIOC and Flash](#)
- [SAMA5D44 - SYS, PIOD, and PIOE](#)
- [JTAG, USB, DEBUG, and LCD](#)
- [HDMI](#)
- [Ethernet_ETH0_10/100M](#)
- [HSMCI](#)
- [EDBG](#)
- [Expansion and XPRO Connectors](#)

Figure 4-50. Block diagram

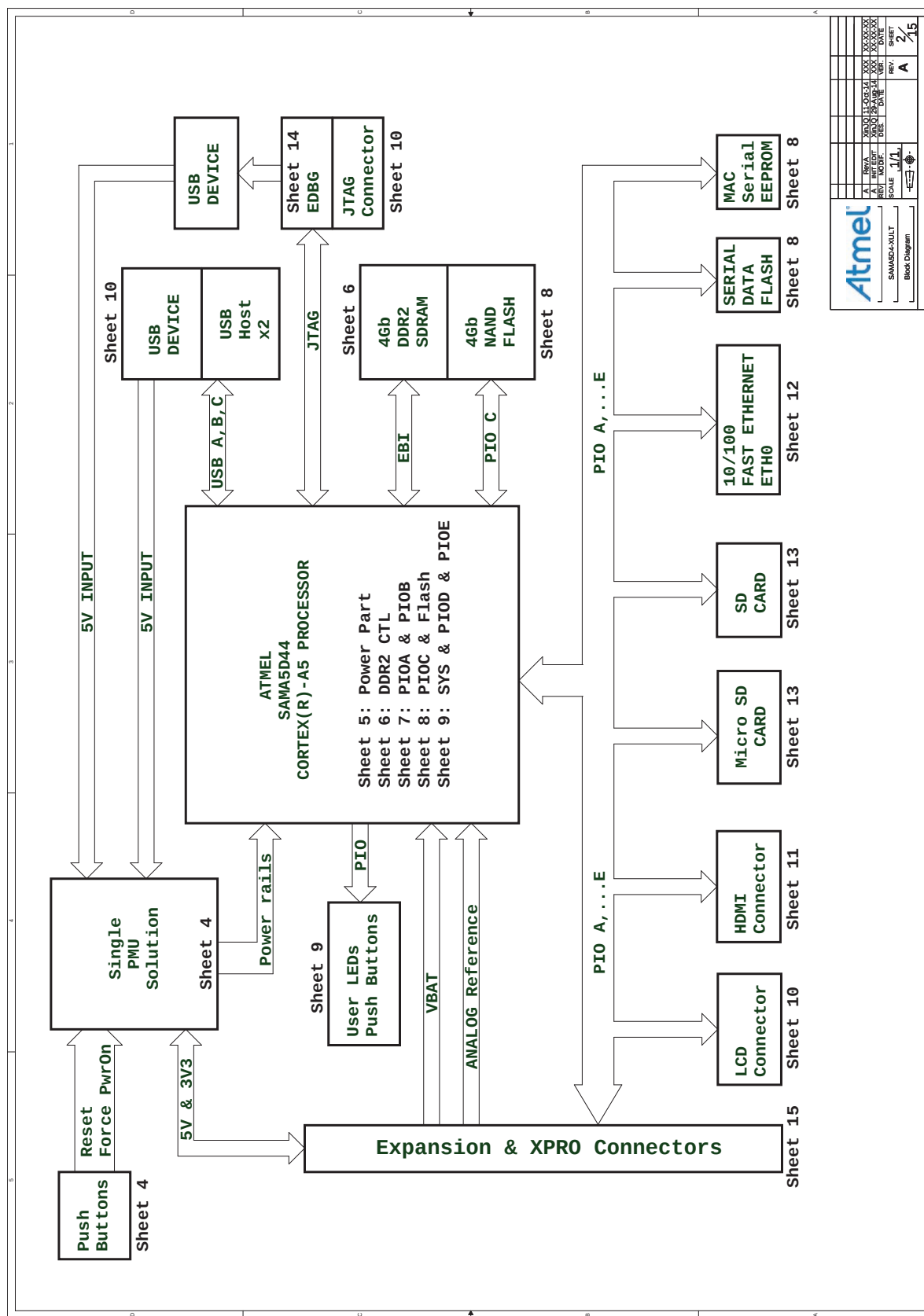


Figure 4-51. PIO Muxing Table

PIO Muxing & Jumper setting

PIO Muxing & Jumper setting														
LCD														
PIOA	USAGE	PIOA	USAGE	PIOB	USAGE	PIOB	USAGE	PIOC	USAGE	PIOC	USAGE	PIOD	USAGE	PIOD
PA0	LCDAT0/RTAG_TWS	PA16	LCDAT16/INTST	PB0	GO_TXCK	PB16	GO_MDC	PC0	SPI0_MISO/PWMH2/IS1_D6	PC16	NAND_RDY	PD0	SPI0_MISO/PWMH2/IS1_D6	PD16
PA1	LCDAT1	PA17	LCDAT17	PB1	SCK2/IS1_PCK	PB17	GO_MDC	PC1	SPI0_MISO/PWMH2/IS1_D9	PC17	NAND_ALE	PD1	SPI0_MISO/PWMH2/IS1_D9	PD17
PA2	LCDAT2	PA18	LCDAT18	PB2	GO_TXEN	PB18	GO_TXEN	PC2	SPI0_SPCK/PWMH3/IS1_D10	PC18	NAND_CLE	PD2	SPI0_SPCK/PWMH3/IS1_D10	PD18
PA3	LCDAT3	PA19	LCDAT19	PB3	CTS2/IS1_VSYNC	PB19	SPI1_MOSI	PC3	SPI0_NPCS0/PWMH3/IS1_D11	PC19	IS1_D0/TK1	PD3	SPI0_NPCS0/PWMH3/IS1_D11	PD19
PA4	LCDAT4	PA20	LCDAT20	PB4	RTX2/IS1_HS_VSYNC	PB20	SPI1_SPCK	PC4	MCIO_CK/PCK1	PC20	IS1_D7/TK1	PD4	MCIO_CK/PCK1	PD20
PA5	LCDAT5	PA21	LCDAT21	PB5	TXD2/PCK2	PB21	SPI1_NPCS0	PC5	MCIO_CDA/NAND_D0	PC21	IS1_D2/TK1	PD5	TXD2/PCK2	PD21
PA6	LCDAT6	PA22	LCDAT22	PB6	GO_RXDV	PB22	SPI1_NPCS1	PC6	MCIO_DAO/NAND_D1	PC22	IS1_D3/RF1	PD6	GO_RXDV	PD22
PA7	LCDAT7	PA23	LCDAT23	PB7	GO_RXER	PB23	SPI1_NPCS2	PC7	MCIO_DAJ/NAND_D2	PC23	IS1_D4/RF1	PD7	LCDAT7	PD23
PA8	LCDAT8/RTAG_TCK	PA24	LCDPWH/HDMI_MCK	PB8	GO_RXR	PB24	JTAG_TDI	PC8	MCIO_DAZ/NAND_D3	PC24	IS1_D5/RK3/PCK1	PD8	LCDAT8/RTAG_TCK	PD24
PA9	LCDAT9	PA25	LCDISP/HDMI_INT	PB9	GO_RX1	PB25	JTAG_TDO	PC9	MCIO_DAX/NAND_D4	PC25	IS1_D6/TWD3/UTXD1	PD9	LCDAT9	PD25
PA10	LCDAT10	PA26	LCDVSYNC	PB10	PCK2/PWMH1	PB26	PCK0/RK0/PWMH0	PC10	NAND_D5	PC26	IS1_D7/TWCK3/UTXD1	PD10	CT_S0	PD26
PA11	LCDAT11	PA27	LCDHSYNC	PB11	RTS2/PWMH1	PB27	SPI1_NPCS3/HDMI_TK0/PWMH0	PC11	NAND_D6	PC27	AD0_XP/PWMH0	PD11	RTS0/SPI2_MISO	PD27
PA12	LCDAT12	PA28	LCDPCK	PB12	GO_TX0	PB28	SPI2_NPCS3/HDMI_TD0/PWMH1	PC12	NAND_D7	PC28	AD1_XM/PWMH1	PD12	TXD0/SPI2_MOSI	PD28
PA13	LCDAT13	PA29	LCDDEN	PB13	GO_TX1	PB29	TWD2/RD0/PWMH1	PC13	NAND_RE	PC29	AD2_YP/PWMH1	PD13	CT_S1	PD29
PA14	LCDAT14	PA30	TW00	PB14	SPI2_NPCS1/PWMH0	PB30	TWCK2/RF0	PC14	NWE/NAND_WE	PC30	AD3_YM/PWMH0	PD14	LED_POWER	PD30
PA15	LCDAT15	PA31	TWCK0	PB15	SPI2_NPCS2/PWMH0/HDMI_RST	PB31	HDMI_TF0	PC15	NAND_NCS3	PC31	AD4_PWMH1	PD15	RTS1/SPI2_SPCK	PD31
PA16	LCDAT16	PA32	LCDAT16	PB16	GO_TXCK	PB32	GO_TXCK	PC16	NAND_RDY	PC32	NAND_ALE	PD16	GO_TXCK	PD32
PA17	LCDAT17	PA33	LCDAT17	PB17	SCK2/IS1_PCK	PB33	SCK2/IS1_PCK	PC17	NAND_CLE	PC33	NAND_CLE	PD17	SCK2/IS1_PCK	PD33
PA18	LCDAT18	PA34	LCDAT18	PB18	GO_TXEN	PB34	GO_TXEN	PC18	IS1_D0/TK1	PC34	IS1_D0/TK1	PD18	GO_TXEN	PD34
PA19	LCDAT19	PA35	LCDAT19	PB19	CTS2/IS1_VSYNC	PB35	CTS2/IS1_VSYNC	PC19	IS1_D7/TK1	PC35	IS1_D7/TK1	PD19	CTS2/IS1_VSYNC	PD35
PA20	LCDAT20	PA36	LCDAT20	PB20	SPI1_SPCK	PB36	SPI1_SPCK	PC20	IS1_D2/TK1	PC36	IS1_D2/TK1	PD20	SPI1_SPCK	PD36
PA21	LCDAT21	PA37	LCDAT21	PB21	SPI1_NPCS0	PB37	SPI1_NPCS0	PC21	IS1_D3/RF1	PC37	IS1_D3/RF1	PD21	SPI1_NPCS0	PD37
PA22	LCDAT22	PA38	LCDAT22	PB22	SPI1_NPCS1	PB38	SPI1_NPCS1	PC22	IS1_D4/RF1	PC38	IS1_D4/RF1	PD22	SPI1_NPCS1	PD38
PA23	LCDAT23	PA39	LCDAT23	PB23	SPI1_NPCS2	PB39	SPI1_NPCS2	PC23	IS1_D5/RK3/PCK1	PC39	IS1_D5/RK3/PCK1	PD23	SPI1_NPCS2	PD39
PA24	LCDAT24	PA40	LCDAT24	PB24	JTAG_TDI	PB40	JTAG_TDI	PC24	IS1_D6/TWD3/UTXD1	PC40	IS1_D6/TWD3/UTXD1	PD24	JTAG_TDI	PD40
PA25	LCDAT25	PA41	LCDAT25	PB25	JTAG_TDO	PB41	JTAG_TDO	PC25	IS1_D7/TWCK3/UTXD1	PC41	IS1_D7/TWCK3/UTXD1	PD25	JTAG_TDO	PD41
PA26	LCDAT26	PA42	LCDAT26	PB26	PCK0/RK0/PWMH0	PB42	PCK0/RK0/PWMH0	PC26	IS1_D7/TWCK3/UTXD1	PC42	IS1_D7/TWCK3/UTXD1	PD26	PCK0/RK0/PWMH0	PD42
PA27	LCDAT27	PA43	LCDAT27	PB27	SPI1_NPCS3/HDMI_TK0/PWMH0	PB43	SPI1_NPCS3/HDMI_TK0/PWMH0	PC27	AD0_XP/PWMH0	PC43	AD0_XP/PWMH0	PD27	SPI1_NPCS3/HDMI_TK0/PWMH0	PD43
PA28	LCDAT28	PA44	LCDAT28	PB28	SPI2_NPCS3/HDMI_TD0/PWMH1	PB44	SPI2_NPCS3/HDMI_TD0/PWMH1	PC28	AD1_XM/PWMH1	PC44	AD1_XM/PWMH1	PD28	SPI2_NPCS3/HDMI_TD0/PWMH1	PD44
PA29	LCDAT29	PA45	LCDAT29	PB29	TWD2/RD0/PWMH1	PB45	TWD2/RD0/PWMH1	PC29	AD2_YP/PWMH1	PC45	AD2_YP/PWMH1	PD29	TWD2/RD0/PWMH1	PD45
PA30	LCDAT30	PA46	LCDAT30	PB30	TWCK2/RF0	PB46	TWCK2/RF0	PC30	AD3_YM/PWMH0	PC46	AD3_YM/PWMH0	PD30	TWCK2/RF0	PD46
PA31	LCDAT31	PA47	LCDAT31	PB31	HDMI_TF0	PB47	HDMI_TF0	PC31	AD4_PWMH1	PC47	AD4_PWMH1	PD31	HDMI_TF0	PD47
PA32	LCDAT32	PA48	LCDAT32	PB32	GO_TXCK	PB48	GO_TXCK	PC32	NAND_RDY	PC48	NAND_RDY	PD32	GO_TXCK	PD48
PA33	LCDAT33	PA49	LCDAT33	PB33	SCK2/IS1_PCK	PB49	SCK2/IS1_PCK	PC33	NAND_CLE	PC49	NAND_CLE	PD33	SCK2/IS1_PCK	PD49
PA34	LCDAT34	PA50	LCDAT34	PB34	GO_TXEN	PB50	GO_TXEN	PC34	IS1_D0/TK1	PC50	IS1_D0/TK1	PD34	GO_TXEN	PD50
PA35	LCDAT35	PA51	LCDAT35	PB35	CTS2/IS1_VSYNC	PB51	CTS2/IS1_VSYNC	PC35	IS1_D7/TK1	PC51	IS1_D7/TK1	PD35	CTS2/IS1_VSYNC	PD51
PA36	LCDAT36	PA52	LCDAT36	PB36	SPI1_SPCK	PB52	SPI1_SPCK	PC36	IS1_D2/TK1	PC52	IS1_D2/TK1	PD36	SPI1_SPCK	PD52
PA37	LCDAT37	PA53	LCDAT37	PB37	SPI1_NPCS0	PB53	SPI1_NPCS0	PC37	IS1_D3/RF1	PC53	IS1_D3/RF1	PD37	SPI1_NPCS0	PD53
PA38	LCDAT38	PA54	LCDAT38	PB38	SPI1_NPCS1	PB54	SPI1_NPCS1	PC38	IS1_D4/RF1	PC54	IS1_D4/RF1	PD38	SPI1_NPCS1	PD54
PA39	LCDAT39	PA55	LCDAT39	PB39	SPI1_NPCS2	PB55	SPI1_NPCS2	PC39	IS1_D5/RK3/PCK1	PC55	IS1_D5/RK3/PCK1	PD39	SPI1_NPCS2	PD55
PA40	LCDAT40	PA56	LCDAT40	PB40	JTAG_TDI	PB56	JTAG_TDI	PC40	IS1_D6/TWD3/UTXD1	PC56	IS1_D6/TWD3/UTXD1	PD40	JTAG_TDI	PD56
PA41	LCDAT41	PA57	LCDAT41	PB41	JTAG_TDO	PB57	JTAG_TDO	PC41	IS1_D7/TWCK3/UTXD1	PC57	IS1_D7/TWCK3/UTXD1	PD41	JTAG_TDO	PD57
PA42	LCDAT42	PA58	LCDAT42	PB42	PCK0/RK0/PWMH0	PB58	PCK0/RK0/PWMH0	PC42	IS1_D7/TWCK3/UTXD1	PC58	IS1_D7/TWCK3/UTXD1	PD42	PCK0/RK0/PWMH0	PD58
PA43	LCDAT43	PA59	LCDAT43	PB43	SPI1_NPCS3/HDMI_TK0/PWMH0	PB59	SPI1_NPCS3/HDMI_TK0/PWMH0	PC43	AD0_XP/PWMH0	PC59	AD0_XP/PWMH0	PD43	SPI1_NPCS3/HDMI_TK0/PWMH0	PD59
PA44	LCDAT44	PA60	LCDAT44	PB44	SPI2_NPCS3/HDMI_TD0/PWMH1	PB60	SPI2_NPCS3/HDMI_TD0/PWMH1	PC44	AD1_XM/PWMH1	PC60	AD1_XM/PWMH1	PD44	SPI2_NPCS3/HDMI_TD0/PWMH1	PD60
PA45	LCDAT45	PA61	LCDAT45	PB45	TWD2/RD0/PWMH1	PB61	TWD2/RD0/PWMH1	PC45	AD2_YP/PWMH1	PC61	AD2_YP/PWMH1	PD45	TWD2/RD0/PWMH1	PD61
PA46	LCDAT46	PA62	LCDAT46	PB46	TWCK2/RF0	PB62	TWCK2/RF0	PC46	AD3_YM/PWMH0	PC62	AD3_YM/PWMH0	PD46	TWCK2/RF0	PD62
PA47	LCDAT47	PA63	LCDAT47	PB47	HDMI_TF0	PB63	HDMI_TF0	PC47	AD4_PWMH1	PC63	AD4_PWMH1	PD47	HDMI_TF0	PD63
PA48	LCDAT48	PA64	LCDAT48	PB48	GO_TXCK	PB64	GO_TXCK	PC48	NAND_RDY	PC64	NAND_RDY	PD48	GO_TXCK	PD64
PA49	LCDAT49	PA65	LCDAT49	PB49	SCK2/IS1_PCK	PB65	SCK2/IS1_PCK	PC49	NAND_CLE	PC65	NAND_CLE	PD49	SCK2/IS1_PCK	PD65
PA50	LCDAT50	PA66	LCDAT50	PB50	GO_TXEN	PB66	GO_TXEN	PC50	IS1_D0/TK1	PC66	IS1_D0/TK1	PD50	GO_TXEN	PD66
PA51	LCDAT51	PA67	LCDAT51	PB51	CTS2/IS1_VSYNC	PB67	CTS2/IS1_VSYNC	PC51	IS1_D7/TK1	PC67	IS1_D7/TK1	PD51	CTS2/IS1_VSYNC	PD67
PA52	LCDAT52	PA68	LCDAT52	PB52	SPI1_SPCK	PB68	SPI1_SPCK	PC52	IS1_D2/TK1	PC68	IS1_D2/TK1	PD52	SPI1_SPCK	PD68
PA53	LCDAT53	PA69	LCDAT53	PB53	SPI1_NPCS0	PB69	SPI1_NPCS0	PC53	IS1_D3/RF1	PC69	IS1_D3/RF1	PD53	SPI1_NPCS0	PD69
PA54	LCDAT54	PA70	LCDAT54	PB54	SPI1_NPCS1	PB70	SPI1_NPCS1	PC54	IS1_D4/RF1	PC70	IS1_D4/RF1	PD54	SPI1_NPCS1	PD70
PA55	LCDAT55	PA71	LCDAT55	PB55	SPI1_NPCS2	PB71	SPI1_NPCS2	PC55	IS1_D5/RK3/PCK1	PC71	IS1_D5/RK3/PCK1	PD55	SPI1_NPCS2	PD71
PA56	LCDAT56	PA72	LCDAT56	PB56	JTAG_TDI	PB72	JTAG_TDI	PC56	IS1_D6/TWD3/UTXD1	PC72	IS1_D6/TWD3/UTXD1	PD56	JTAG_TDI	PD72
PA57	LCDAT57	PA73	LCDAT57	PB57	JTAG_TDO	PB73	JTAG_TDO	PC57	IS1_D7/TWCK3/UTXD1	PC73	IS1_D7/TWCK3/UTXD1	PD57	JTAG_TDO	PD73
PA58	LCDAT58	PA74	LCDAT58	PB58	PCK0/RK0/PWMH0	PB74	PCK0/RK0/PWMH0	PC58	IS1_D7/TWCK3/UTXD1	PC74	IS1_D7/TWCK3/UTXD1	PD58	PCK0/RK0/PWMH0	PD74
PA59	LCDAT59	PA75	LCDAT59	PB59	SPI1_NPCS3/HDMI_TK0/PWMH0	PB75	SPI1_NPCS3/HDMI_TK0/PWMH0	PC59	AD0_XP/PWMH0	PC75	AD0_XP/PWMH0	PD59	SPI1_NPCS3/HDMI_TK0/PWMH0	PD75
PA60	LCDAT60	PA76	LCDAT60	PB60	SPI2_NPCS3/HDMI_TD0/PWMH1	PB76	SPI2_NPCS3/HDMI_TD0/PWMH1	PC60	AD1_XM/PWMH1	PC76	AD1_XM/PWMH1	PD60	SPI2_NPCS3/HDMI_TD0/PWMH1	PD76
PA61	LCDAT61	PA77	LCDAT61	PB61	TWD2/RD0/PWMH1	PB77	TWD2/RD0/PWMH1	PC61	AD2_YP/PWMH1	PC77	AD2_YP/PWMH1	PD61	TWD2/RD0/PWMH1	PD77
PA62	LCDAT62	PA78	LCDAT62	PB62	TWCK2/RF0	PB78	TWCK2/RF0	PC62	AD3_YM/PWMH0	PC78	AD3_YM/PWMH0	PD62	TWCK2/RF0	PD78
PA63	LCDAT63	PA79	LCDAT63	PB63	HDMI_TF0	PB79	HDMI_TF0	PC63	AD4_PWMH1	PC79	AD4_PWMH1	PD63	HDMI_TF0	PD79
PA64	LCDAT64	PA80	LCDAT64	PB64	GO_TXCK	PB80	GO_TXCK	PC64	NAND_RDY	PC80	NAND_RDY	PD64	GO_TXCK	PD80
PA65	LCDAT65	PA81	LCDAT65	PB65	SCK2/IS1_PCK	PB81	SCK2/IS1_PCK	PC65	NAND_CLE	PC81	NAND_CLE	PD65	SCK2/IS1_PCK	PD81
PA66	LCDAT66	PA82	LCDAT66	PB66	GO_TXEN	PB82	GO_TXEN	PC66	IS1_D0/TK1	PC82	IS1_D0/TK1	PD66	GO_TXEN	PD82
PA67	LCDAT67	PA83	LCDAT67	PB67	CTS2/IS1_VSYNC	PB83	CTS2/IS1_VSYNC	PC67	IS1_D7/TK1	PC83	IS1_D7/TK1	PD67	CTS2/IS1_VSYNC	PD83
PA68	LCDAT68	PA84	LCDAT68	PB68	SPI1_SPCK	PB84	SPI1_SPCK	PC68	IS1_D2/TK1	PC84	IS1_D2/TK1	PD68	SPI1_SPCK	PD84
PA69	LCDAT69	PA85	LCDAT69	PB69	SPI1_NPCS0	PB85	SPI1_NPCS0	PC69	IS1_D3/RF1	PC85	IS1_D3/RF1	PD69	SPI1_NPCS0	PD85
PA70	LCDAT70	PA86	LCDAT70	PB70	SPI1_NPCS1	PB86	SPI1_NPCS1	PC70	IS1_D4/RF1	PC86	IS1_D4/RF1	PD70	SPI1_NPCS1	PD86
PA71	LCDAT71	PA87	LCDAT71	PB71	SPI1_NPCS2	PB87	SPI1_NPCS2	PC71	IS1_D5/RK3/PCK1	PC87	IS1_D5/RK3/PCK1	PD71	SPI1_NPCS2	PD87
PA72	LCDAT72	PA88	LCDAT72	PB72	JTAG_TDI	PB88	JTAG_TDI	PC72	IS1_D6/TWD3/UTXD1	PC88	IS1_D6/TWD3/UTXD1	PD72	JTAG_TDI	PD88
PA73	LCDAT73	PA89	LCDAT73	PB73	JTAG_TDO	PB89	JTAG_TDO	PC73	IS1_D7/TWCK3/UTXD1	PC89	IS1_D7/TWCK3/UTXD1	PD73	JTAG_TDO	PD89
PA74	LCDAT74	PA90	LCDAT74	PB74	PCK0/RK0/PWMH0	PB90	PCK0/RK0/PWMH0	PC74	IS1_D7/TWCK3/UTXD1	PC90	IS1_D7/TWCK3/UTXD1	PD74	PCK0/RK0/PWMH0	PD90
PA75	LCDAT75	PA91	LCDAT75	PB75	SPI1_NPCS3/HDMI_TK0/PWMH0	PB91	SPI1_NPCS3/HDMI_TK0/PWMH0	PC75	AD0_XP/PWMH0	PC91	AD0_XP/PWMH0	PD75	SPI1_NPCS3/HDMI_TK0/PWMH0	PD91
PA76	LCDAT76	PA92	LCDAT76	PB76	SPI2_NPCS3/HDMI_TD0/PWMH1	PB92	SPI2_NPCS3/HDMI_TD0/PWMH1	PC76	AD1_XM/PWMH1	PC92	AD1_XM/PWMH1	PD76	SPI2_NPCS3/HDMI_TD0/PWMH1	PD92
PA77	LCDAT77	PA93	LCDAT77	PB77	TWD2/RD0/PWMH1	PB93	TWD2/RD0/PWMH1	PC77	AD2_YP/PWMH1	PC93	AD2_YP/PWMH1	PD77	TWD2/RD0/PWMH1	PD93
PA78	LCDAT78	PA94	LCDAT78	PB78	TWCK2/RF0	PB94	TWCK2/RF0	PC78	AD3_YM/PWMH0	PC94	AD3_YM/PWMH0	PD78	TWCK2/RF0	PD94
PA79	LCDAT79	PA95	LCDAT79	PB79	HDMI_TF0	PB95	HDMI_TF0	PC79	AD4_PWMH1	PC95	AD4_PWMH1	PD79	HDMI_TF0	PD95
PA80	LCDAT80	PA96	LCDAT80	PB80	GO_TXCK	PB96	GO_TXCK	PC80	NAND_RDY	PC96	NAND_RDY	PD80	GO_TXCK	PD96
PA81	LCDAT81	PA97	LCDAT81	PB81	SCK2/IS1_PCK	PB97	SCK2/IS1_PCK	PC81	NAND_CLE	PC97	NAND_CLE	PD81	SCK2/IS1_PCK	PD97
PA82	LCDAT82	PA98	LCDAT82	PB82	GO_TXEN	PB98	GO_TXEN	PC82	IS1_D0/TK1	PC98	IS1_D0/TK1	PD82	GO_TXEN	PD98
PA83	LCDAT83	PA99	LCDAT83	PB83	CTS2/IS1_VSYNC	PB99	CTS2/IS1_VSYNC	PC83	IS1_D7/TK1	PC99	IS1_D7/TK1	PD83	CTS2/IS1_VSYNC	PD99
PA84	LCDAT84	PA100	LCDAT84	PB84	SPI1_SPCK	PB100	SPI1_SPCK	PC84	IS1_D2/TK1	PC100	IS1_D2/TK1	PD84	S	

Figure 4-52. Power Supply

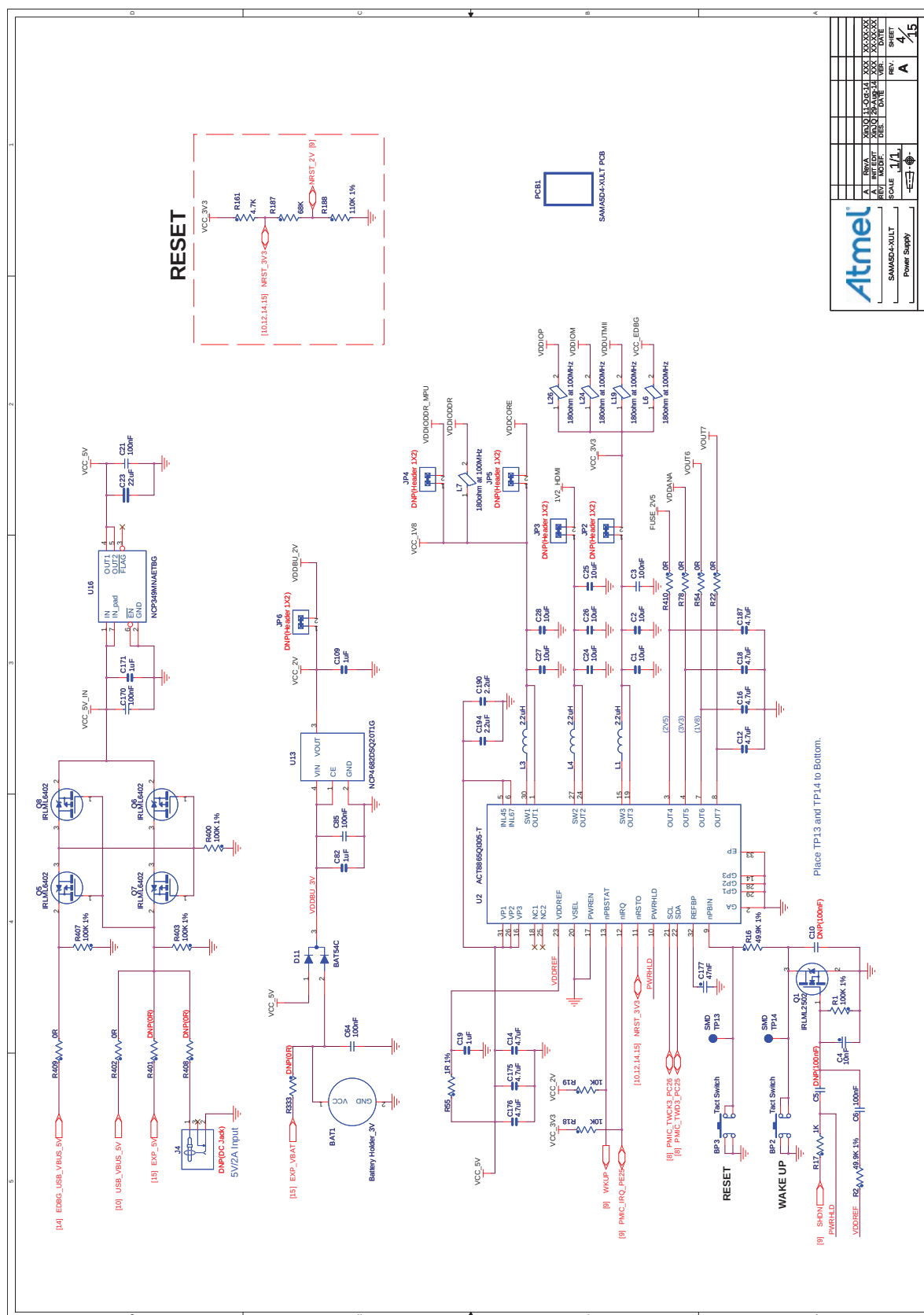


Figure 4-53. SAMA5D44 - Power

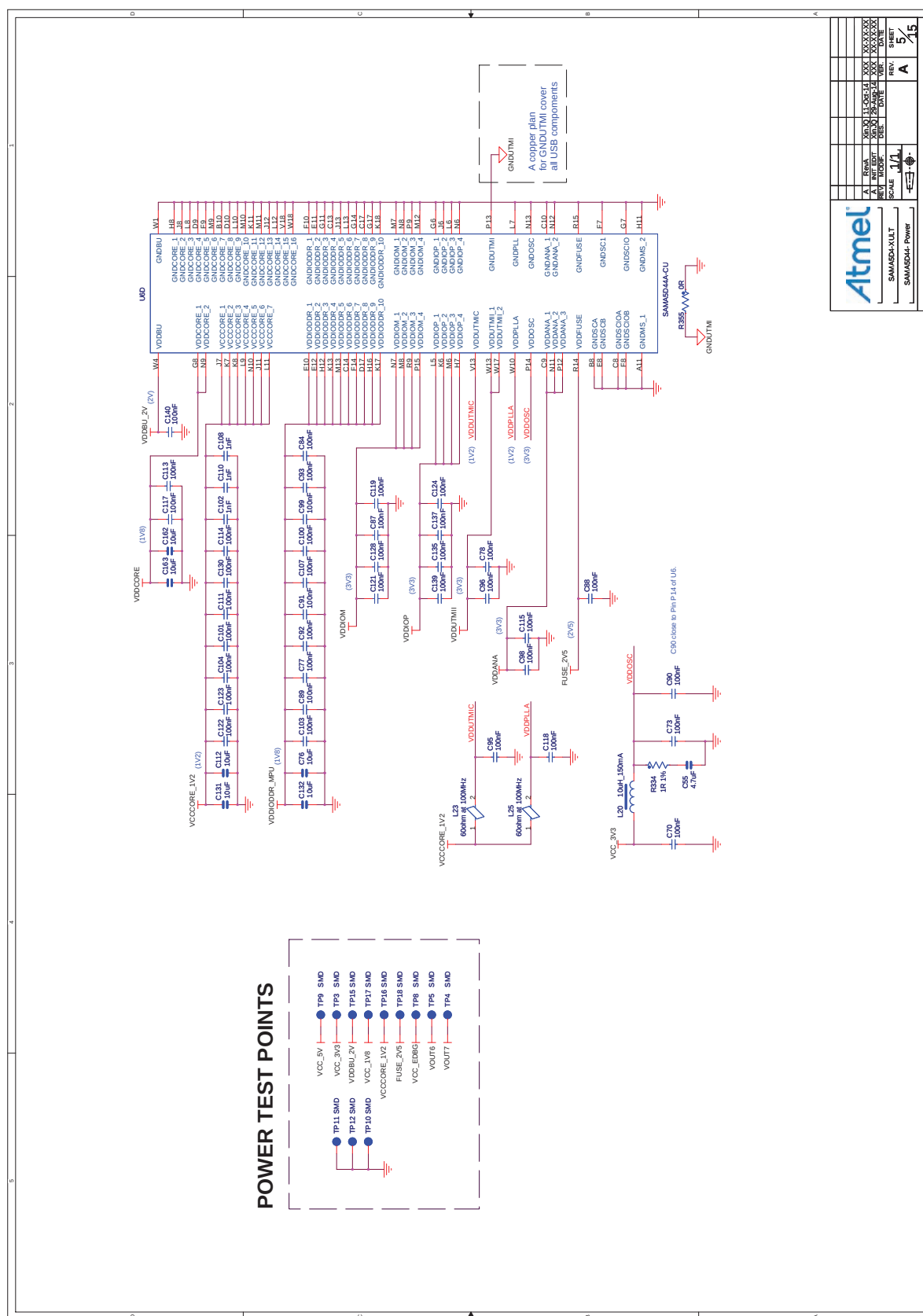
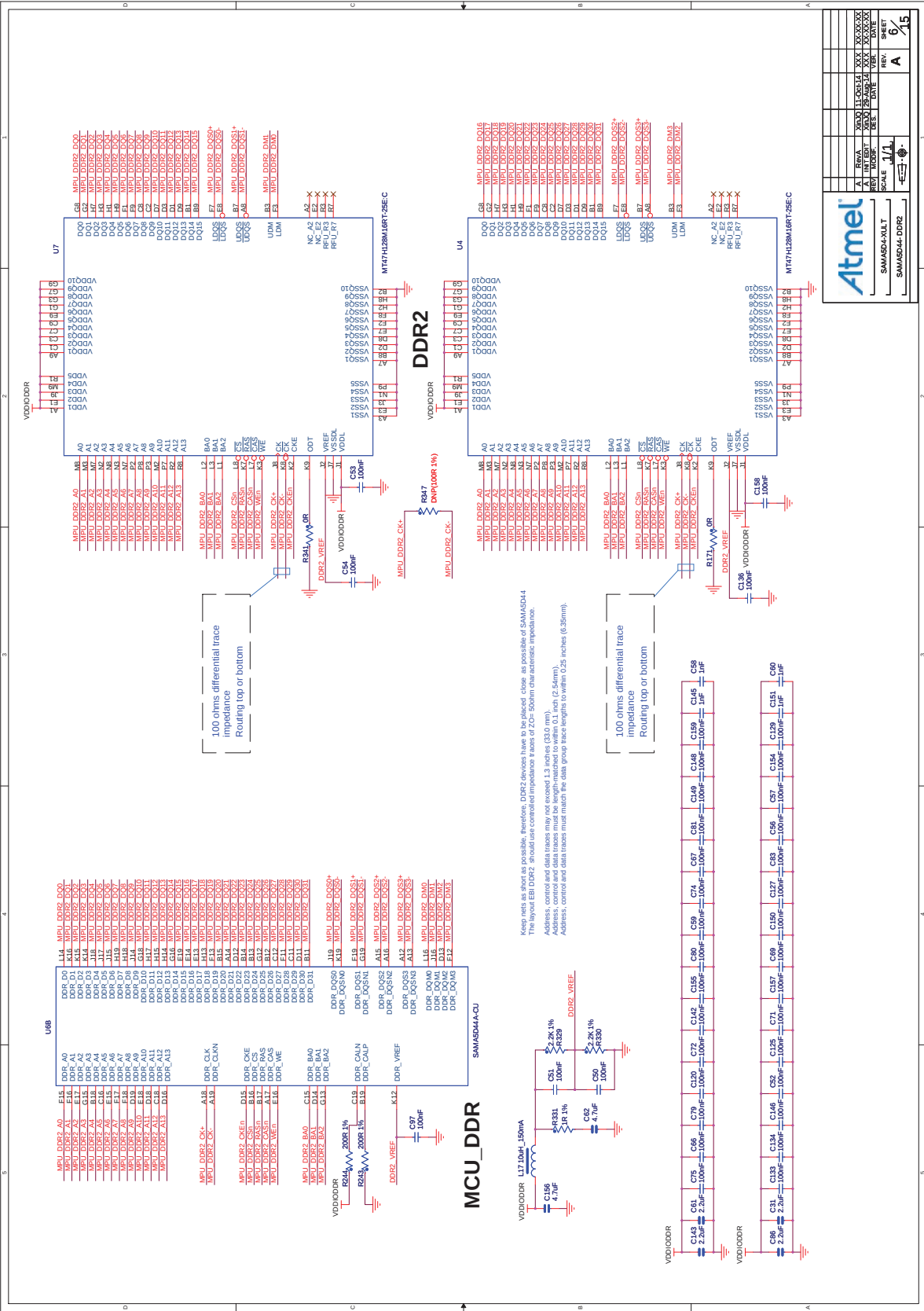


Figure 4-54. SAMA5D44 - DDR2



Atmel	SAMA5D44-ULLT	SAMA5D44-ULLT	REV. A	6/15
SCALE	1/1	1/1	REV. A	6/15
SHEET	1/1	1/1	REV. A	6/15

Figure 4-55. SAMA5D44 - PIOA and PIOB

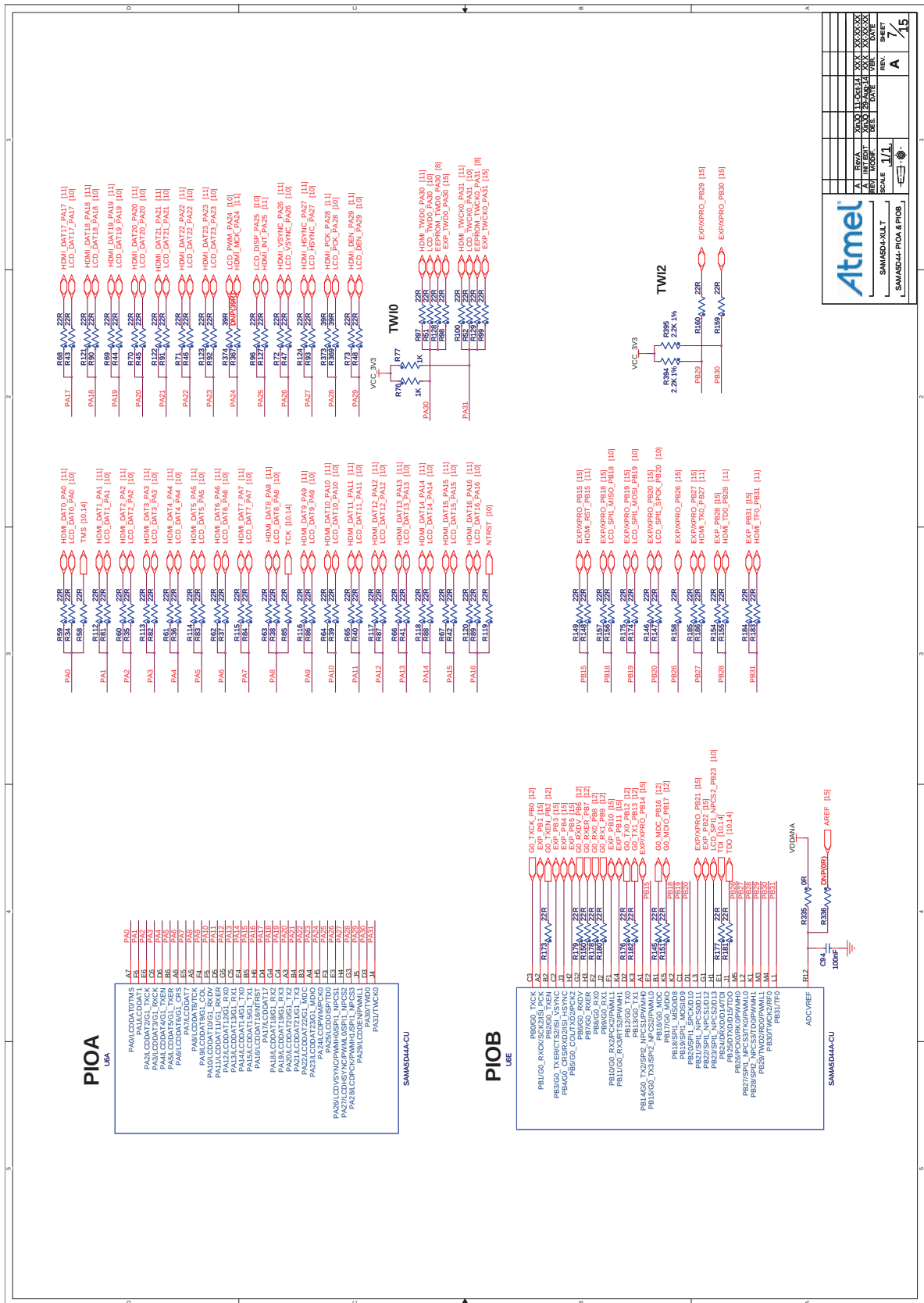


Figure 4-56. SAMA5D44 - PIOC and Flash

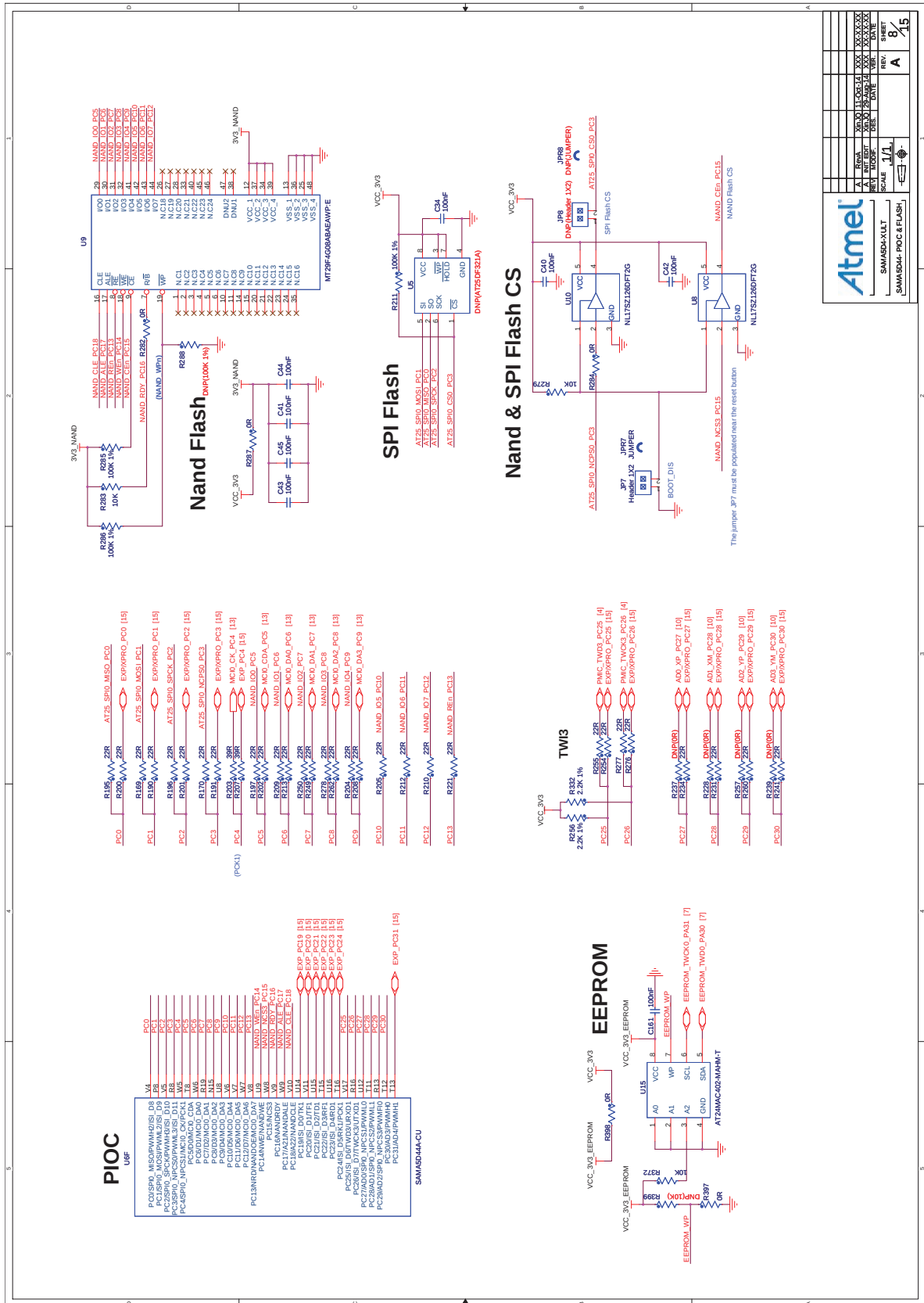


Figure 4-57. SAMA5D44 - SYS, PIOD, and PIOE

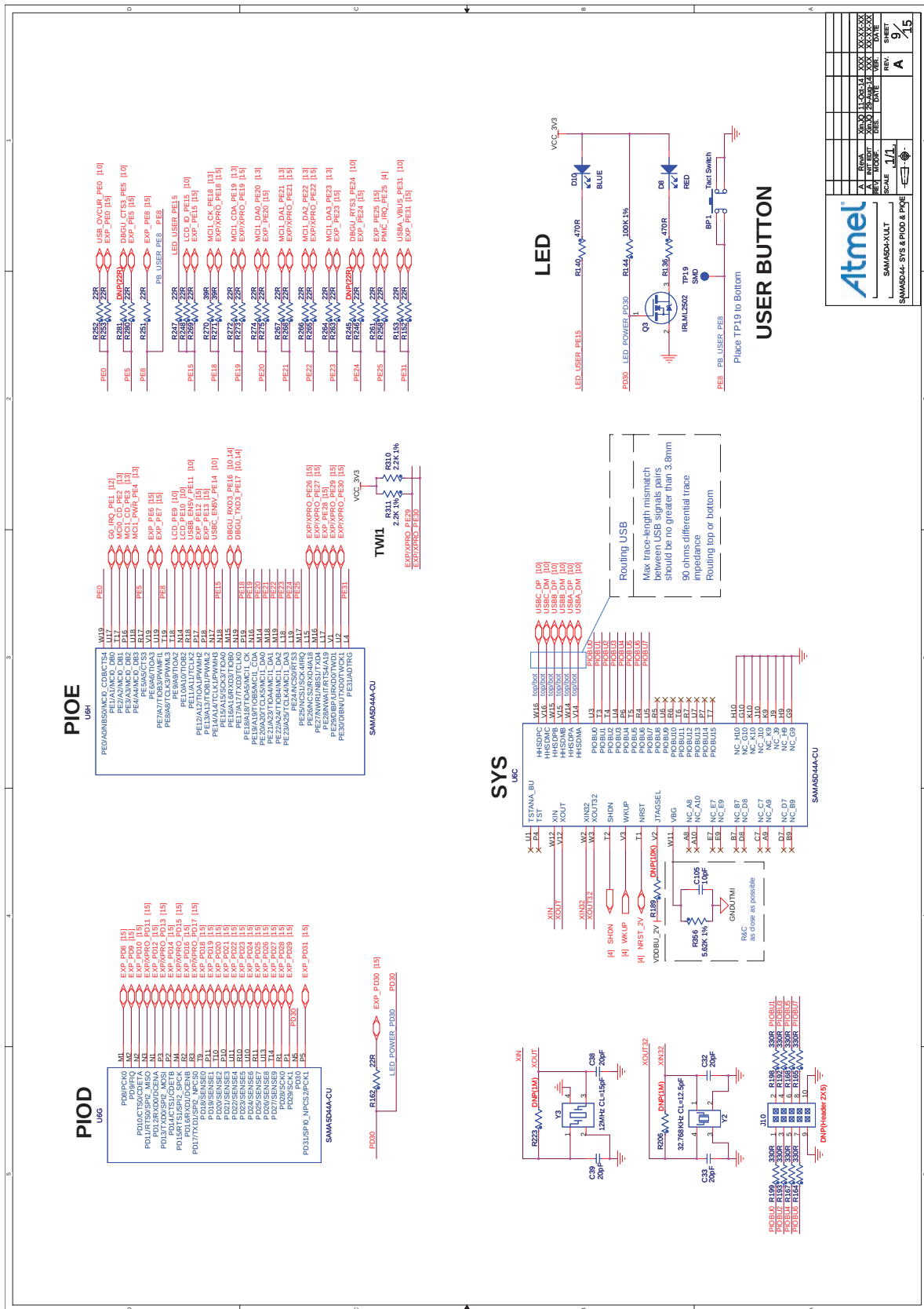
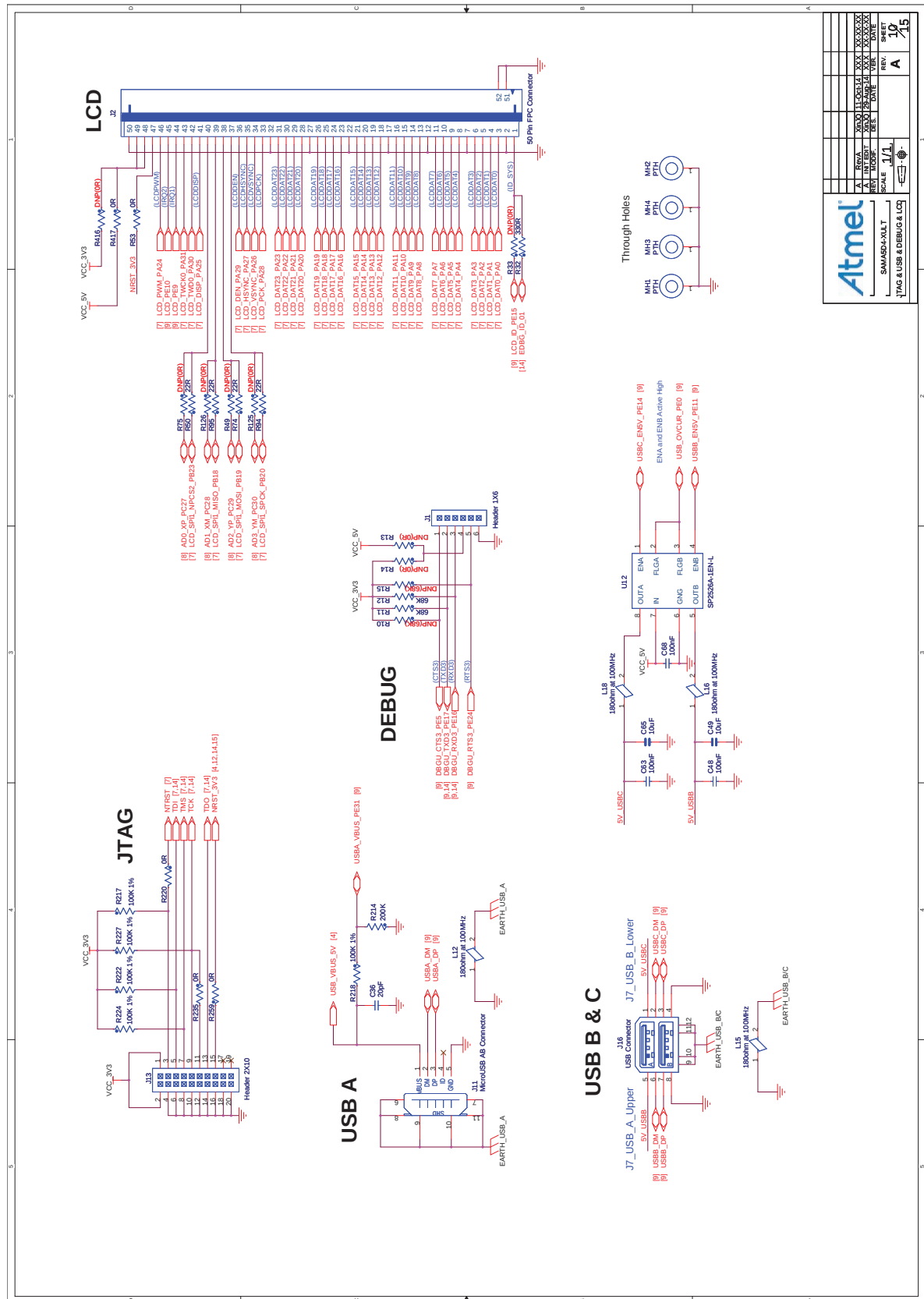


Figure 4-58. JTAG, USB, DEBUG, and LCD



Atmel		SAMA5D4-XLT		JTAG & USB & DEBUG & LCD	
REV. A	REV. A	REV. A	REV. A	REV. A	REV. A
DATE	DATE	DATE	DATE	DATE	DATE
SCALE	SCALE	SCALE	SCALE	SCALE	SCALE
1/1	1/1	1/1	1/1	1/1	1/1
SHEET		SHEET		SHEET	
10		10		10	
15		15		15	

Figure 4-59. HDMI

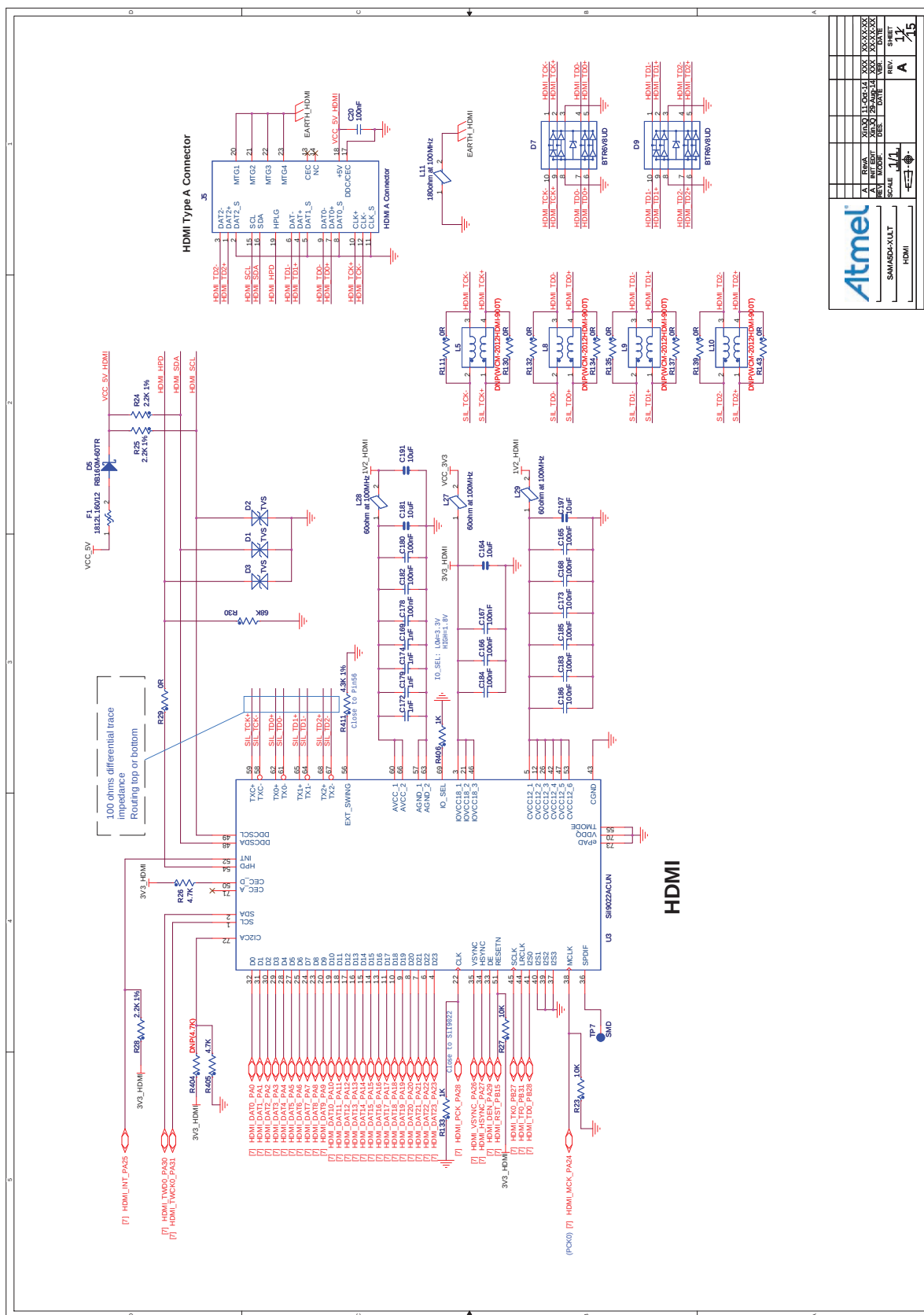


Figure 4-60. Ethernet_ETH0_10/100M

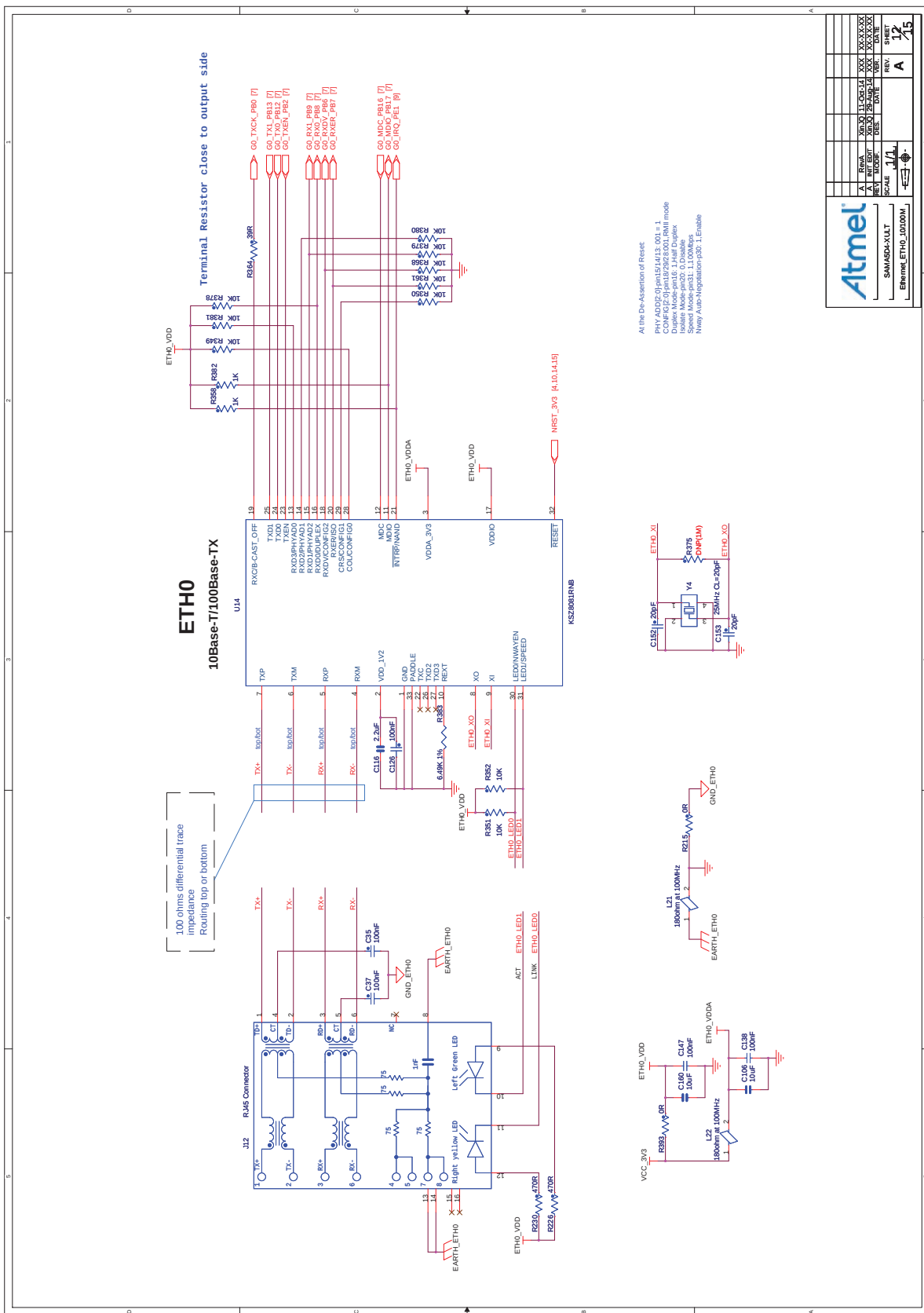


Figure 4-61. HSMCI

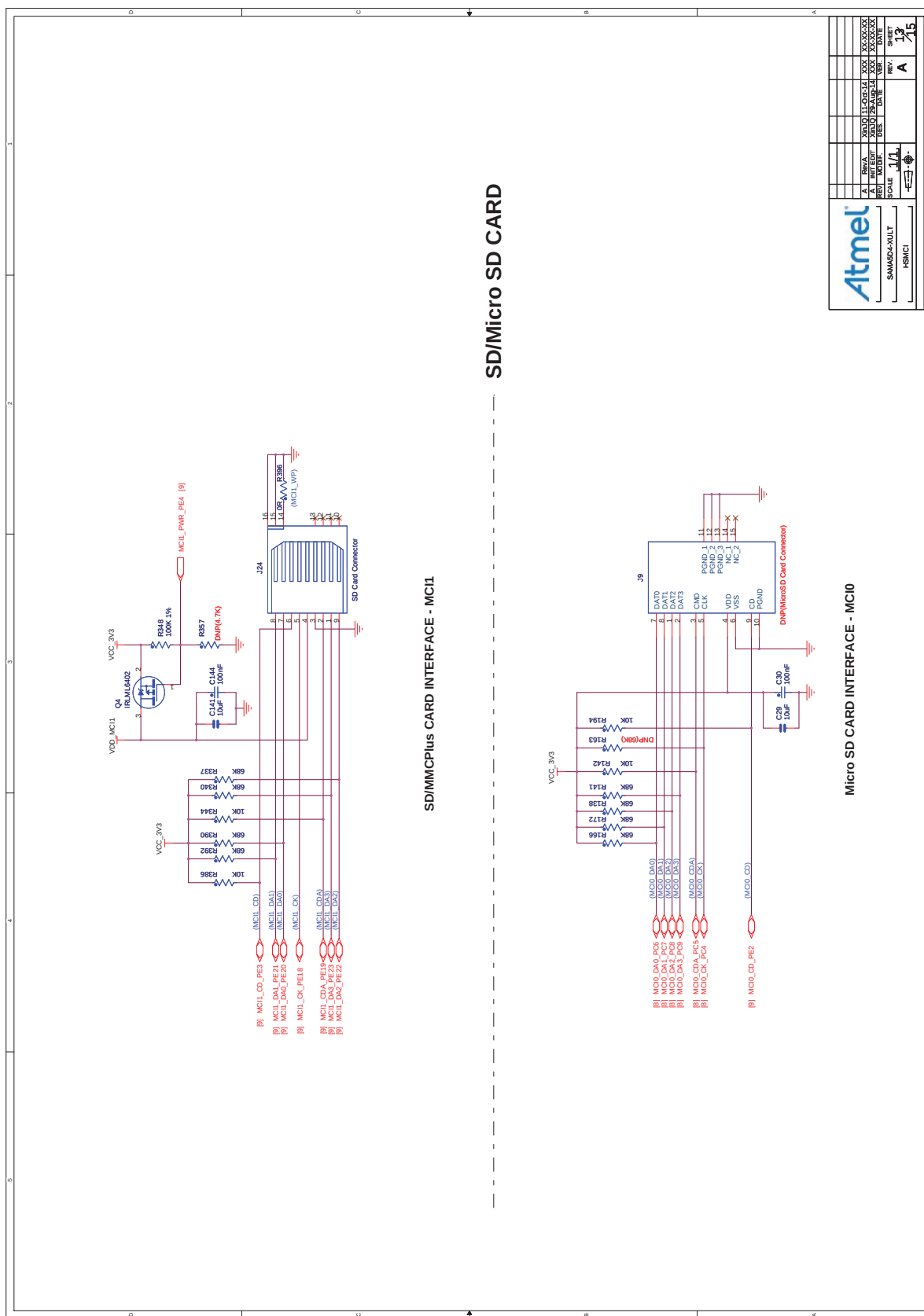


Figure 4-62. EDBG

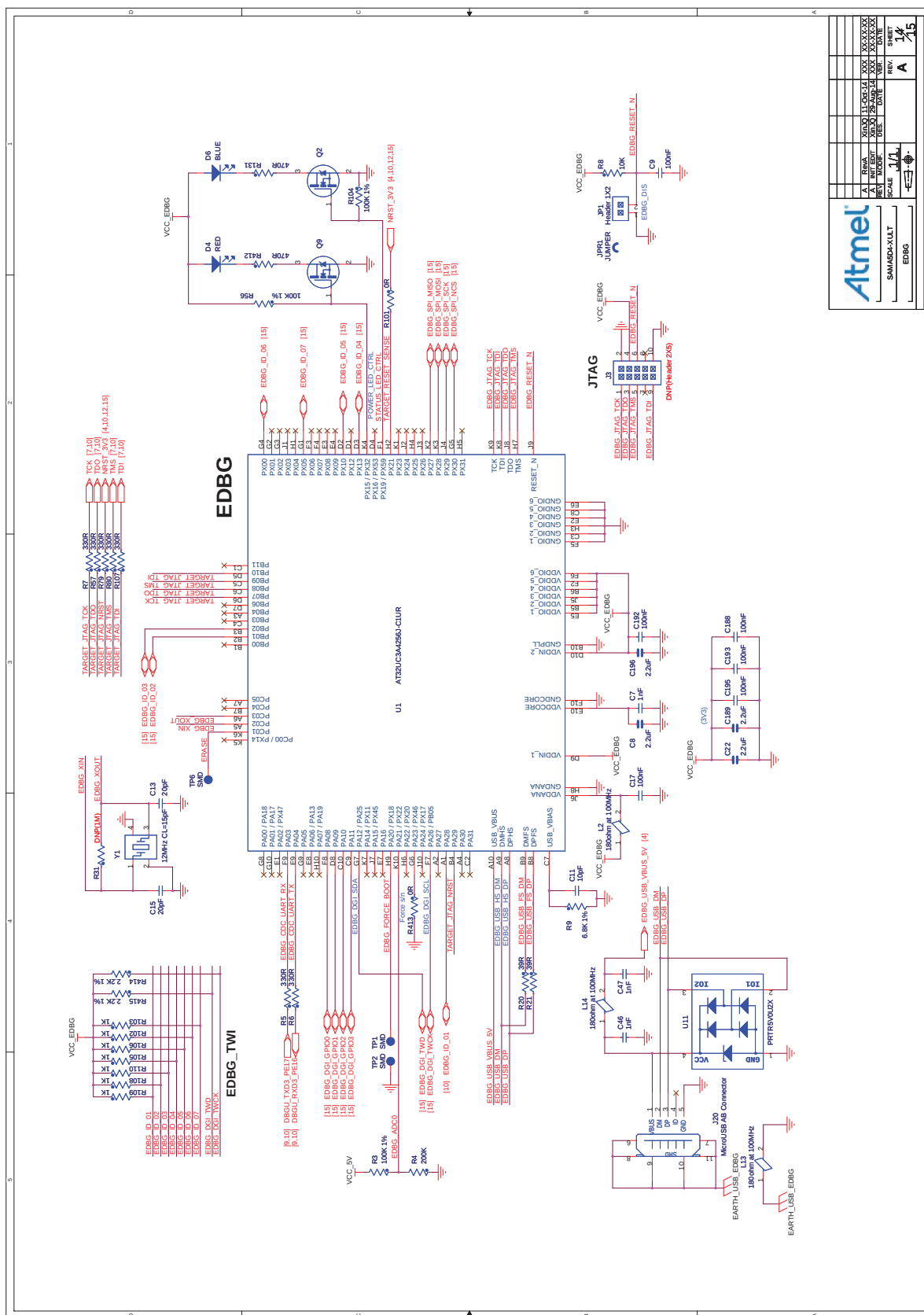
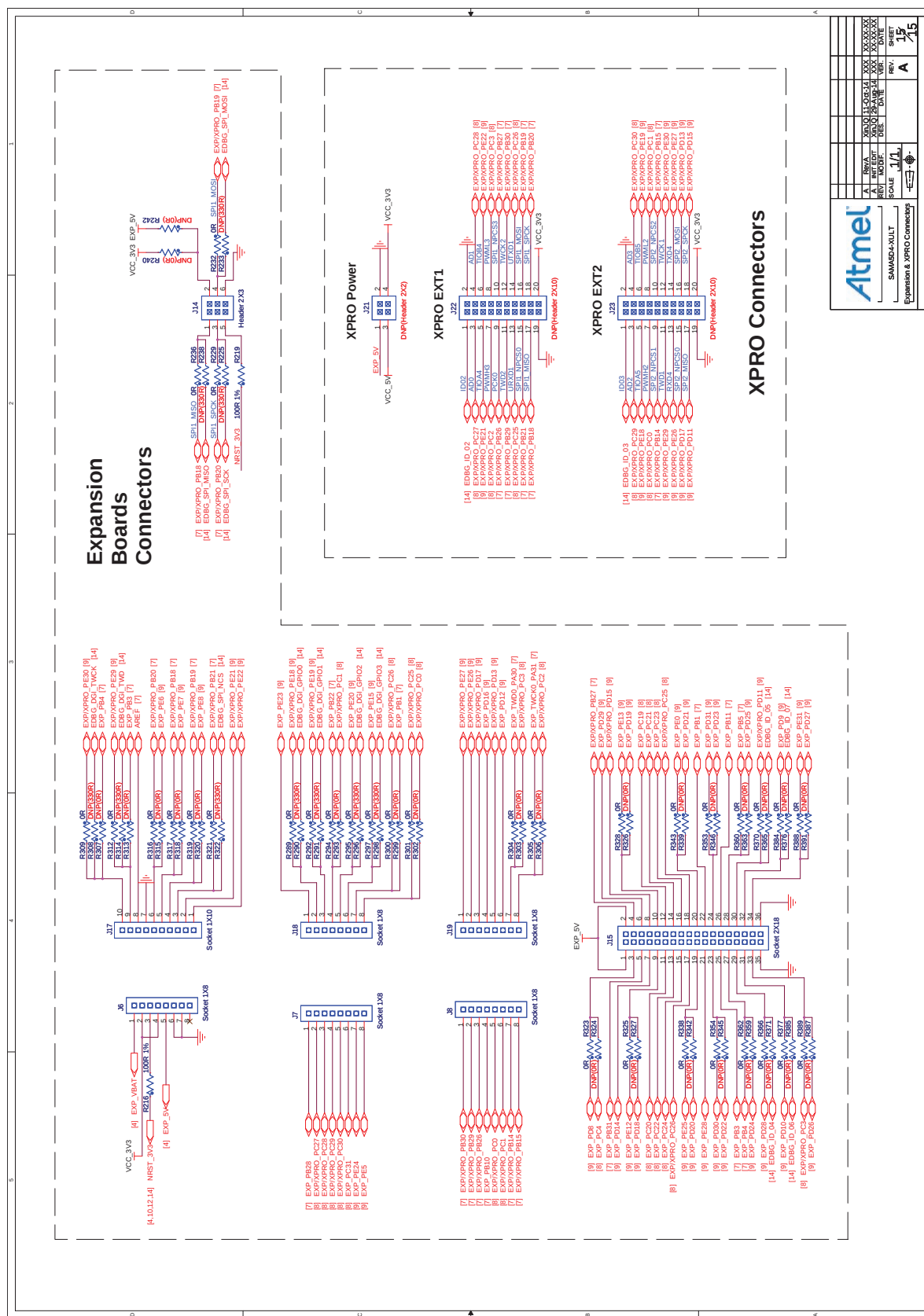


Figure 4-63. Expansion and XPRO Connectors



5. Revision History

In the tables that follow, the most recent version of the document appears first.

Table 5-1. SAMA5D4 Xplained Ultra User Guide Rev. 44005C Revision History

Doc. Date	Changes
11-Aug-15	Updated Section 4.2.1 “Processor” Modified Section 4.2.2.1 “Power Lines” Modified Section 4.2.2.2 “Power-up and Power-down Considerations” (title and content)

Table 5-2. SAMA5D4 Xplained Ultra User Guide Rev. 44005B Revision History

Doc. Date	Changes
28-Feb-15	Minor formatting and editorial changes throughout Table 4-3 “DDR_CALN and DDR_CALP” : added column header “Memory Type” Section 4.2.9.3 “LCD Power” : corrected “two voltage lines are available: 3.3V by default and 5 VCC” to read “two voltage lines are available: 3.3V and 5 VCC (default)” Table 4-13 “SAMA5D44 Peripheral Functions Available through the Arduino Headers” : changed column header “SAMA5D4 to Arduino” to “SAMA5D44 to Arduino”; added column header “System Function” Table 4-20 “SD/MMC Socket J24 Signal Descriptions” : defined mnemonic for pins 15 and 16 as “VSS” Table 4-21 “MicroSD Socket J9 Signal Descriptions” : for pin 9, changed mnemonic from “CARD DETECT” to “CD”; for pin 10, changed mnemonic from “PGND” to “GND”

Table 5-3. SAMA5D4 Xplained Ultra User Guide Rev. 44005 Revision History

Doc. Rev.	Changes
44005A	First issue.



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